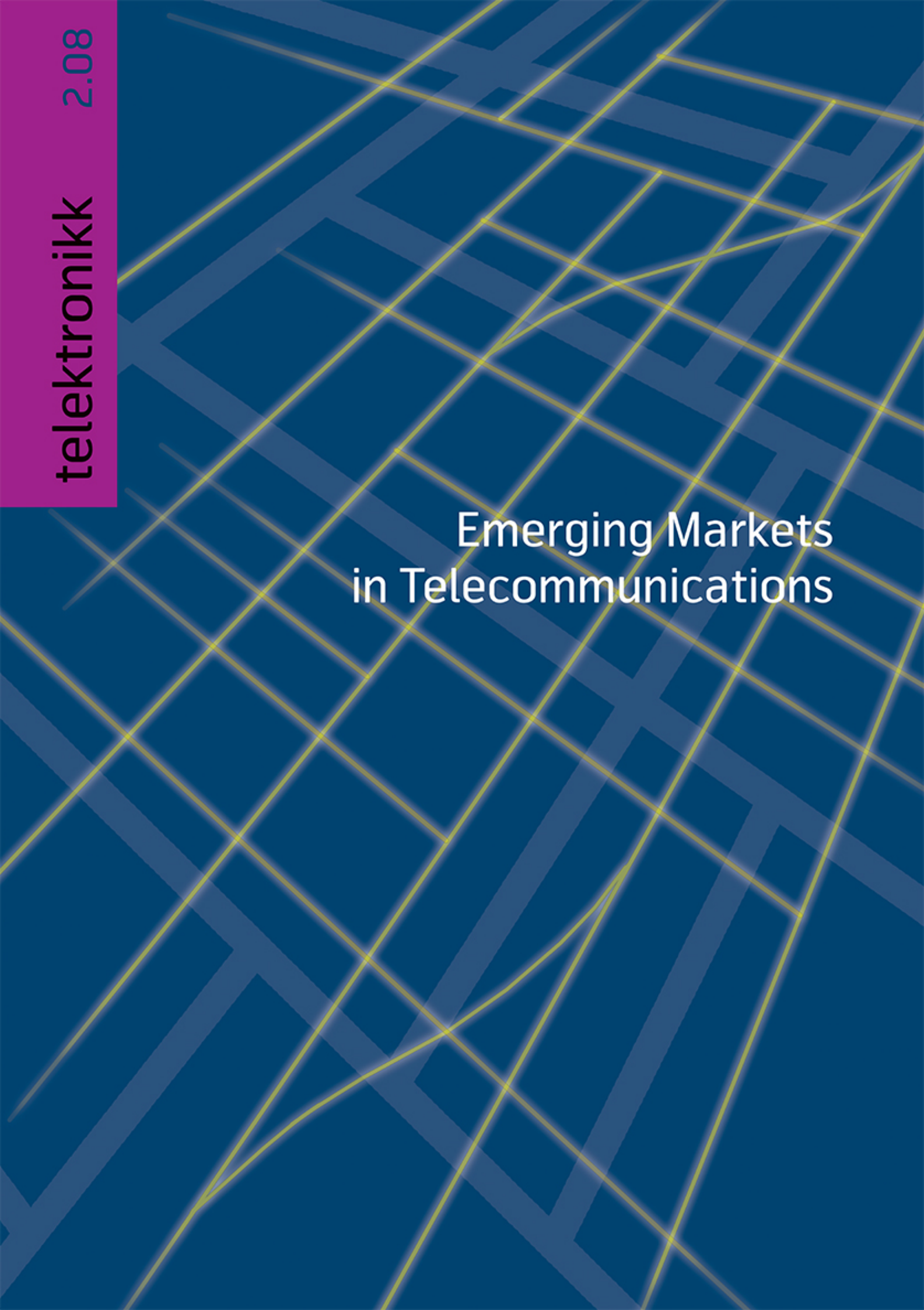
telektronikk 2.08

Emerging Markets in Telecommunications



Telektronikk
Volume 104 No. 2 – 2008
ISSN 0085-7130

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Graphic design:
Design Consult AS (Odd Andersen), Oslo

Layout and illustrations:
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Telenor R&I

Printing:
07 Gruppen as, Aurskog

Circulation:
4,000

Networks on networks

Connecting entities through networks – in technological, societal and personal terms – enables telecommunication. Networks occur on different levels, form parts of larger networks, and exist in numerous varieties. The artist Odd Andersen visualises the networks on networks by drawing interconnected lines with different widths. Curved connections disturb the order and show that networks are not regular but are adapted to the communication needs.

Per H. Lehne, Editor in Chief

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Guest Editorial

PER HELMERSEN, HANNE CECILIE GEIRBO

Per Helmersen is Senior Research Psychologist in Telenor R&I

Hanne C. Geirbo is Social Anthropologist in Telenor R&I

With local and well-established telecom markets rapidly becoming saturated, major players in the telecom industry are increasingly turning their attention to the so-called emerging or growth markets in Asia, Africa and Latin America. Their strategies for doing so were initially based on models developed and tested in more familiar surroundings, and were for that reason inadequate in markets lacking infrastructure, with unfamiliar (and often unfriendly) regulatory environments and where the majority of prospective customers have a disposable income of USD 5 a day or less. A natural first step into such markets is to target consumer segments that share the lifestyles and attributes (economic and aspirational) of Western consumers: the urban upper and middle classes and the upwardly mobile in lower classes. It was soon recognized that the real challenge and profits are to be found elsewhere, however. Operators such as Telenor are currently exploring the untapped market potential at the "base of the pyramid" – the four billion prospective customers who constitute the largest and fastest growing segment of the world's population. In doing so, we are forced to expose various tacit assumptions, re-examine conventional wisdom and to generate new understandings of who these four billion persons are and what they aspire to be. We are also required to ask ourselves if the standard services we are offering customers "back home" address genuine needs of rural and urban low income consumers in emerging markets, if they are affordable and inclusive. Recently, telecom operators such as Telenor have also been held accountable for the social and cultural impacts of their presence in these markets; issues related to corporate governance, ownership and working conditions for not only company employees, but also the employees of subcontractors have been in the media spotlight.

Criticizing "shallow thinkers" and articulating what could easily serve as a progressive telecom strategy for emerging markets – nearly three quarters of a century ahead of his time – President Franklin D. Roosevelt is usually credited with coining the term "bottom of the pyramid":

> "These unhappy times call for the building of plans that rest upon the forgotten, the unorganized but the indispensable units of economic power ... that build from the bottom up and not from the top down, that put their faith once more in the forgotten man at the bottom of the economic pyramid."[1)]

The men and women at the bottom of the economic pyramid are certainly not forgotten within our industry as witnessed by the burgeoning number of reports bearing titles such as "The Next Billion", "Ringing In the Next Billion Mobile Consumers", and "The Next 4 Billion"[2)]. It was the research community centered around C.K. Prahalad at The University of Michigan and Stuart L. Hart at Cornell University, however, that first called attention to the *business potential* of low income consumers. Prior to the process that led up to the publication of "The Fortune at the Bottom of the Pyramid"[3)] ICT initiatives targeting financially constrained segments and the so-called digital divide were generally classified under the headings "ICT4D", "livelihood creation", "poverty reduction" or simply "charity". Putting their faith in "the forgotten man" and suggesting that multinational corporations (MNCs), including telecom operators, should "build from the bottom up and not from the top down", these researchers presented convincing scenarios as well as a framework for thinking about profit generation in emerging markets. Their publications encouraged MNCs as well as international funding agencies to speak of poverty reduction/wealth creation, Millennium Development Goals and profit generation in the same sentence:

> "What is needed is a better approach to help the poor, an approach that involves partnering with them to innovate and achieve sustainable win-win scenarios where the poor are actively engaged and, at the same time, the companies providing products and services to them are profitable."[4)]

Prahalad recognizes that "old and tired solutions cannot create markets at the BOP" (op.cit., p. 6). A prerequisite for product as well as process innovation

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1) *From F.D.R.'s Radio Address, Albany, N.Y. April 7, 1932,* The Forgotten Man. *http://newdeal.feri.org/speeches/1932c.htm*

2) *"The Next Billion", Portio Research, 2007. "Ringing In the Next Billion Mobile Consumers", The Boston Consulting Group, 2007. "The Next 4 Billion", World Resources Institute, International Finance Corporation, 2007.*

3) *Prahalad, C K. 2005.* The Fortune at the Bottom of the Pyramid. *Upper Saddle River, NJ, Wharton School Publishing.*

4) *Op.cit. pp. 3-4.*

ISSN 0085-7130

is an intimate knowledge of consumers' lifestyles, habits, needs and aspirations as well as a basic understanding of their cultural and social setting. Simply repackaging technologies and solutions that address what we perceive to be "The Problem" based on our understanding and imbeddedness in our local culture will not do! There are no substitutes for fieldwork. Microsoft Research's Technology for Emerging Markets (TEM) group, certainly one of the most experienced and influential in this area, have summarized this "lesson learned" as follows:

> "Perhaps the most critical factor is to spend time with potential users in those circumstances in which the innovation might take hold. Spend time early, spend time frequently, and spend a lot of time … time spent with users 'in the field' is more valuable than just about anything else … the communities we hope to impact are so different from those we were raised in that our first instincts are of little help; to turn our 'subjects' into collaborators or empowered potential users, it's imperative that we establish rapport."[5)]

We think that this issue of *Telektronikk* reflects all of these themes from different perspectives. We hope the reader will come away with an appreciation of the complexity of providing telecom services in emerging markets. Successful service offerings must at one and the same time be financially sustainable in the long run, technically feasible, inclusive and affordable, meet local regulatory requirements and, most importantly, address the real rather than imagined needs of the intended user community.

In the first article Anne Welle-Strand (page 4) discusses the role and outcomes of business-oriented aid, using Grameenphone and Telenor's activities in Bangladesh as a case. The effects of business-oriented aid are indicated by discussing the findings of the study from technical, political and financial perspectives. Welle-Strand finds that foreign ownership, local knowledge and competent management have been the most crucial factors for Grameenphone's business success.

Sein, Ahmad and Harindranath (page 16) call for evaluations of ICT for development initiatives. They propose four conditions necessary for the sustainability of such initiatives, and evaluate the Grameenphone Community Information Centres (CIC) against these. They argue that while it may not always be possible to discover linear cause-effect relationships vis-à-vis sustainability, ICT for development initiatives such as Grameenphone CICs can build in mutually reinforcing elements of sustainability based on the four conditions proposed here.

De Silva and Zainuddin (page 25) use data from five Asian countries to discuss the issue of universal access. Although they find low levels of ownership in these countries, near universal access has been achieved. However, they find that ownership of mobile devices gives benefits that non-owners with access missed out on. They conclude that there is a great potential for expanding ownership at the bottom of the pyramid, but this requires efforts on the part of multiple stakeholders.

Grace Roldan and Andrew Wong (page 39) identify issues and challenges concerning micro-enterprises in developing countries, with a focus on Bangladesh. They discuss how the mobile phone and community information centres can be used as tools for enhancing their capability and sustainability.

Saeed, Chowdhury, Alam, Raihan and Warendorph (page 44) ask whether telco operators in developing countries fund their expansion by using earnings from high-end subscribers to cross-subsidise new subscribers. They explore this issue by applying a method for allocating both costs and revenues on every subscription. They show how subscription-wise income statements are able to prove that in the current expansion in the emerging markets the operators enable high-end customers and early adopters to effectively help in closing the digital divide.

Denis Cote (page 53) and Ruralfone Inc. have taken Prahalad's recommendations seriously and developed a truly unique distribution model, successfully piloted in one of the poorest cities in the world, Quixadá, in the northeastern state of Ceará in Brazil. Cote argues that adapting existing telephony models is an inferior alternative for both the customers' user experience and the operators' bottom line. Cote maintains that three fundamental shifts are required to achieve sustainability in remote areas that share Quixadá's characteristics: (1) decentralized build-up and allocation of resources, (2) demographic-specific sales and customer care processes, and (3) a willingness to enter, manage and innovate within local, rural economies.

Leopoldina Fortunati et al. (page 57) provide us with insights into the appropriation and domestication of mobile phones in China, with nearly a half a billion handsets, the largest market for mobile technology in the world. Their focus is on the impact of the mobile

5) *Donner, J., Gandhi, R., Javid, P., Medhi, I., Ratan, A., Toyama, R. & Veeraraghavan, R. (2008). "Stages of Design in Technology for Global Development". Computer, June 2008, pp. 34-41.*

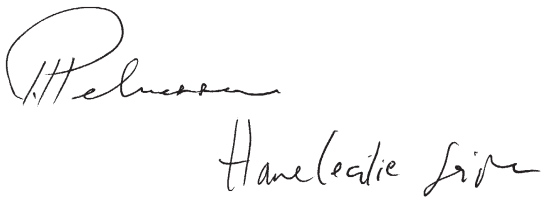
ISSN 0085-7130

phone on the social structure of interpersonal relationships, and what meaning users attribute to these devices as instruments of social mediation. Surprisingly, in spite of heavy migration within China, the authors document that the mobile is not primarily used to maintain relationships and stay connected with one's region of origin. Rather, it is a tool used to maintain social solidarity locally among peers. Furthermore, those who earn the least are most likely to stay in touch with friends and schoolmates via the mobile.

Shifting focus to a second Asian mobile hotspot, Raul Pertierra (page 68) invites us to examine the transformative effects of mobile communications on Philippine society. The author emphasizes the speed with which ICTs have been incorporated into Philippine life and the numerous unforeseen user services such as SMS have had. Gathering examples from kinship relations, romance and virtual intimacy, Pertierra predicts that new communication technologies will ultimately change personal identities, social relationships, political alliances and the global perspectives of Filipinos in the 21st century.

A second paper in this issue by Hanne Cecilie Geirbo and Per Helmersen (page 77) is also concerned with the unforeseen and highly complex behaviors that evolve through mobile communications in response to basic human needs. The practice of sending free-of-charge "missed calls" (a.k.a. beeping or flashing) is well documented in emerging telecom markets and generally considered to be associated with poverty and lack of funds. The authors present evidence from Bangladesh gathered in focus group discussions and based on analyses of several million charging data records (CDRs) indicating that missed calls are used for a variety of other purposes, ranging from social control and relationship maintenance to entertainment. Rather than focusing on countermeasures to eliminate missed calls, however, they contend that in-depth studies of missed calls may provide the telecom industry with a much needed window into the socio-cultural life space of customers, and suggest new service offerings that better match their needs and circumstances.

Finally, Einar Flydal (page 84) argues that information and communication technologies (ICT), market mechanisms, development theory, eco-design and economic growth all lack the mechanisms necessary to cope with the challenge of climate change. Efficient as they may be for their purposes, and although they are generally recognized as key elements in the great and global Modernization project, they simply do not address the problem of mitigating the detrimental aggregate effects that now set the climate at stake. Instead, the author contends, they all contribute to increasing the negative impact, as they open up for, or even actively contribute to, increased energy use. The author's mission is not to suggest simple, realistic and ready-made solutions, but to expose the problems and to shed some light on what needs to be done to harvest the gains in ways that can contribute to environmental sustainability and to sustainable social development in emerging markets. Alternative strategies will need to take less conventional directions that will have substantial implications for business models and business strategies – in emerging and developed markets alike.



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ISSN 0085-7130

Pride and Prejudice – Business, Aid and Charity

ANNE WELLE-STRAND

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This article is based on a study of Grameenphone and Telenor's activities in Bangladesh and the effects they have on local social and cultural development. The research was undertaken by MICRO, Centre for Development Studies and Microfinance of the Norwegian School of Management BI, as part of a broader research vision on the role and outcomes of business-oriented aid.

The article familiarizes the reader to the context and research design of the initial study. The motivation, research question and conceptual framework are briefly introduced. The effects of business-oriented aid are indicated by discussing the findings of the study from the technical, political and financial perspectives, and emphasizing the social aspects associated to Grameenphone's activities in Bangladesh. The combination of foreign ownership, local knowledge and competent management is found to have played an important role in the situation analyzed. Furthermore, competence alongside cultural awareness are critical success factors. Future research ought to focus on the area of private investment abroad and its impact on development.

I. Motivation, Research Question and Conceptual Framework

This article is based on a study[1)] of Grameenphone and Telenor's activities in Bangladesh, for which data collection was undertaken in July 2007. The purpose of the research was to bring more knowledge about the impact of private business on development in general and in particular to produce insights for a more balanced debate concerning the investments of Norwegian companies abroad.

Motivation

Two sources of inspiration triggered the study – one is theoretical and the other is practical. Firstly, the study is underpinned by the vision to research 'valid development aid'. 'Valid aid' is understood as development in a poor country, resulting in economic growth as well as independence in cultural, intellectual and political matters. The second source of inspiration was practical, but also political – the heated public debate in Norway about Telenor's ownership in Grameenphone, following the award of the Nobel Peace Prize in 2006 to Muhammad Yunus and Grameen Bank. A persistent feature of the debate was the rather strong criticism of Telenor's business success in Bangladesh. Making profits in a poor developing country has been seen as unethical, even as the opposite of development aid – exploitation. It has been claimed that Telenor should 'do the right thing' and hand over majority shareholding to the local partner. One of the leading Norwegian tabloid newspapers fuelled the criticism of Telenor by having a journalist reporting from Bangladesh. I was visiting Bangladesh at the same time, but had a different impression – indeed, Bangladeshi media, as well as key stakeholders, manifested relative satisfaction with regard to the role of Grameenphone and Telenor in the development of Bangladesh. This observation, together with the theoretical vision regarding valid development aid, prompted the research initiative.

Furthermore, the purpose of the study was to enhance knowledge about the impact of private business on development; in particular, the research aimed at providing insights for a more balanced debate on the topic of Norwegian investments abroad. The social impact, one of the dimensions explored in the analytical framework, is emphasized. This aspect is assumed to be the most relevant in understanding the 'cultural independence' dimension of development aid.

The Norwegian debate lacked focus on key economic and developmental issues, being mainly concerned about the ethical dimension of profits and aid. The debate was unaware of Grameenphone's already strong social role, of how the capabilities created by the company could be utilised in order to create the optimal contribution to overall development in Bangladesh. Moreover, Bangladesh itself is a case of particular interest. It is one of the poorest countries, with a very corrupt political system. Bangladesh has had an interim government supported by the military with a state of emergency declared since January 2007. The country is able to feed 145 million people on an area smaller than the county of Finnmark[2)].

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1) *The study* "Grameenphone and Telenor affecting Bangladeshi Socio-Cultural Development – Pride and Prejudice" *was published by Anne Welle-Strand and Lars Molden in* Studies in Development Management*, No 1, MICRO 2007, Oslo: Norwegian School of Management BI.*

2) *Finnmark is a county in the north of Norway.*

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Other peculiarities, more specifically related to the telecommunication sector, are that Bangladesh has one of the best network coverage and lowest mobile tariffs in the world.

Thinking in terms of making Norwegian development aid policies more effective, this study has had the ambition to increase the understanding of how the divides between public and private and between charity and State thinking and business economy can be overcome.

Research Question

Emerging from the motivation to study the role of Grameenphone in the development of Bangladesh, the obvious research question was: *How is Grameenphone contributing to the overall development of Bangladesh?* The assumption was that Grameenphone *seemed* to be contributing to the overall development of Bangladesh. The empirical information gathered comprised both about the society as context, and in particular about Grameenphone's action as an important organisational actor in Bangladeshi society.

Key Concepts

This section presents a brief discussion on the concepts important in this report: development, corporate social responsibility and human resource management.

Development

The concept of development has been extensively debated in the social sciences. One particular view is based on *cultural relativism*, where the ends and means of development are relative to numerous factors such as culture, social background, intelligence and education. A different perspective is based on a *universalistic logical positivism*, emphasising certain common 'truths' regardless of context and understanding. This tradition involves neo-classical economics and growth theory.

In this article, development is defined as the process of increasing availability of basic goods, raising the levels of living and expanding the range of choice. For the particular context of this study, the latter two are most relevant.

Corporate Social Responsibility (CSR)

In both proportion and political significance the concept of CSR has grown into common business practice. However, the rationale behind this concept and indeed its interpretation are subject to an extensive debate among academics and practitioners.

Milton Friedman (1970) claims that economic and social objectives are separate and distinct, so that corporate spending on social issues comes at the expense of the business activities. He also holds that companies engaging in philanthropic activities provide no greater value than any individual donor. Porter and Kramer (2002), however, argue that this rigid view of the company's role in society is based on two flawed assumptions. They argue that these assumptions are true, but only when "corporate contributions are unfocused and piecemeal" (Porter and Kramer 2002: 58). They suggest that a company can address social and economic goals simultaneously by improving the company's competitive context and by strategically focusing philanthropic efforts in a business manner, which is done by leveraging the company's unique capabilities. This article distinguishes between corporate philanthropy and CSR.

Human Resource Management

Human resource management (HRM) as a concept has evolved over the last decades. From traditionally being viewed as a mere administrative function, it now includes the strategic utilisation of human resources. The goal of HRM could be to help an organisation to meet strategic goals by attracting and maintaining employees as well as managing them effectively[3)].

One view of the strategic importance of HRM is held by Barney (1995). He claims that proper HRM will enhance the valuable resources of the company, leading to the creation of a sustainable competitive advantage. In this article, the HRM function includes a variety of activities. It will be investigated staffing needs, use of independent contractors or hire employees, recruiting and training the best employees, ensuring high performers, dealing with performance issues, and ensuring personnel and management practices conform to various regulations.

Norwegian Development Aid

The particular history and individual features of Norwegian development aid is a key point of the conceptual framework of this article. From the legacies of Lutheran missionaries and the State's socialist policies of solidarity, as well as an active human rights record and the Nobel Peace Prize, development aid has had an exceptionally strong standing within Norwegian society. Norway donates more money for development aid per capita than any other country in the world.

3) *Wikipedia/Britannica Online – "Human Resource Management" [Accessed August 2, 2007]*

The Context – Bangladesh

Bangladesh today makes a country case study of particular interest for private sector development for different reasons. It is among the poorest countries in the world with approximately 50 % of the people living in poverty with an average Gross National Income per capita of 470 USD. In 2007, it ranked as the 19th most corrupted country in a sample of 180 countries in Transparency International's Corruption Perceptions Index[4]. Nonetheless, Bangladesh is able to feed a population of more than 145 million people on less than 144,000 square kilometres signalling a highly efficient use of agri-production. Bangladesh thus stands out as a harsh environment, facing significant challenges in terms of various business risks.

Nonetheless, Bangladesh provides a promising context for private enterprise. The fastest growing industry with up to 100 % growth is the telecommunication sector. An interesting fact is that according to Transparency International's Bribe Payers Index 2002, the telecommunication industry is among the most likely to engage in corruption through bribes[5]. This, however, is not tested on Bangladesh in isolation. The telecommunication industry in Bangladesh is growing rapidly and represents a considerable impact on the growth of the country. It seems that what used to be obstacles for growth in the industry are now being removed, through both liberalisation and deregulation. Within this industry, one firm in particular is dominating: Grameenphone.

Grameenphone in Bangladesh

Grameenphone is the largest telecommunication service provider in Bangladesh with a market share of 50.3 % and almost 14 million subscribers as of August 2007; of these, 95 % are pre-paid users. It is owned by Telenor (62 %) and Grameen Telecom (38 %). Grameenphone employs over 5000 people on a regular basis with an estimated 100,000 in addition through vendors, retailers and other business partners. The total income of the company in 2006 was close to 45.7 billion BDT (665.8 million USD). Grameenphone is the single largest corporate tax-payer in Bangladesh. It has the largest distributional network in the country with 600 service desks, 8400 retail outlets and 70,000 outlets for 'recharge'. In addition, Grameenphone pioneers business solutions for the more sophisticated customer, as well as introduces innovations, such as bill payment services (Grameenphone 2007; Aas 2007). The company has significant autonomy, with a local management team consisting of 12 members (2 Norwegians and 10 Bangladeshi) and a strong Corporate Governance practice in place.

The next section of the paper reveals the findings of the study by addressing questions of: How has Grameenphone contributed to the technical, political and financial development of Bangladesh on the one hand, and to its social development on the other? How has the company affected the 'Great Synthesis' of economy and culture?

II. Findings of the Study

Technical, Political and Financial Aspects

The main findings provide evidence of two types of activities to Grameenphone's contribution in the Bangladeshi society. The first relates to the significant infrastructural investments, enhancement of local know-how, a very clear stand against corruption and an active role in lobbying. The second types of activities relate to the efforts of being the largest tax payer, employer and industry player in the country. A combination of both types of activities seems to be important in explaining the role of Grameenphone in the development of Bangladesh.

The Technical Impact

The key technical impact of Grameenphone is telecommunication infrastructure. Grameenphone has invested in developing a broad infrastructural base, now covering close to 98 % of the population. Industry estimates reveal that as many as 50 million customers is not an unrealistic ambition within 2009. It has recently launched EDGE and will soon establish a 3G network. It thus seems likely that the investments made by Grameenphone will have a growing effect on the overall development of Bangladesh in the future. One challenge will probably be to keep up the investment rates in accordance with the increasing demand for capacity. Other empirical studies have indicated that telecommunication infrastructure seems to affect development and economic growth (Islam and Bhaveshananda 2007; Das and Narayanan 2005). Das and Narayanan (2005) discuss Indian development, concluding that, in order for ICT to have a significant impact on the overall economic development of a country, the infrastructure must be aimed at covering the larger parts of the population. Others argue that telecommunication infrastructure is more likely to play a significant role in a nation's development when the penetration rate exceeds 40 % (Roller and Waverman 2001).

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4) *The rankings are available online from Transparency International's website http://www.transparency.org/policy_research /surveys_indices/cpi/2007 [Accessed January 7th, 2008]*

5) *Information available online at http://www.transparency.org/policy_research/surveys_indices/bpi [Accessed January 7, 2008]*

Grameenphone has played an important role in building local competence and know-how within the telecommunication industry. By contributing to local production of transmission towers, Grameenphone is reducing the costs of further infrastructural investments. Due to the investments in local competence, it is enhancing the skills level of local entrepreneurs and provides them with production facilities, as well as employment. Suppliers of transmitters are facing an increased and sophisticated demand from the highly competitive telecommunication industry to expand production, which will also lead to higher competence among producers. Over time this could lead to significant competitive advantages and perhaps export possibilities. Keeping up innovation is important, and knowledge transfer from abroad will be crucial until proper research and development (R&D) facilities are built. Being owned by a multinational telecommunication company, Grameenphone will have a role to play in both stages: transfer, as well as R&D capacity building. If such efforts are successful, this will, according to cluster theory (Porter 1998), strengthen the competitiveness of the telecommunication industry, all of its suppliers and the consumers, and hence play a crucial role in the overall development of Bangladesh.

It is also seen as crucial that production and local contractors mainly undertake maintenance. This is enhancing business opportunities locally and creating a bottom-up effect, possibly leading to a sustainable business environment. As the number and complexity of the transmitters are increasing the need for more skilled labour emerges.

The Political Impact

Grameenphone also affects the political sphere of the development of Bangladesh, being perceived as an important player with a low propensity to engage in corruption. This differs from standard industry practice, particularly in a country claimed to be among the worst bribe payers in the world. In addition to being sustainable and indeed profitable, the organisation follows the strict code of conduct and does not engage in corruption. Such behaviour sends strong signals to competitors, other industries and government. This means that incentives for rent-seeking behaviour are weakened due to fear of disclosure and therefore increased cost of corruption (Shleifer and Vishny 1993). With transparent procedures and extensive reporting, Grameenphone can be a catalyst for widespread reform within Bangladesh. This makes corruption harder and the rationale for engaging in bribing weaker.

Interviews with central administrators revealed that Grameenphone is often consulted in relation to regulatory and industry taxation issues. Seemingly Grameenphone employees are highly trusted by the authorities and other important players in the shaping the political outcomes in Bangladesh. The Chairman of the Bangladesh Telecommunication Regulatory Commission (BTRC) and a member of the National Revenue Board (NBR) emphasised the importance of close dialogue with Grameenphone. The impression was that the competence and advice coming from Grameenphone were reliable and valuable for the authorities.

Through direct actions and via the Association of Telecommunication Operators of Bangladesh (ATOB), Grameenphone works actively for reform. At present, monopoly structures prevail in parts of the telecommunication industry, such as for international calls. International calls result in a large unmet demand of approximately 8 million calls a week.[6)] By engaging in these activities, Grameenphone is pressing to remove competition fettering elements of this sort. Furthermore, the taxation of both telecommunication and complementary industries is seen as unnecessary by the industry. One could also argue that a rise in import tariffs for handsets would hurt the overall development of the market. By lobbying with the tax authorities Grameenphone seems, according to the NBR, to be succeeding in reducing some of these tariffs while building a stronger awareness of these issues in the government.

The Financial and Economic Impact

Contribution in financial and economic terms is presented using statistics from Grameenphone accounts, statistical agencies and banks. The financial impact is three-fold: Direct and indirect payments from taxes, VAT and licences. This amounts to 20.5 billion BDT (298.8 million USD) for 2006 – approximately 6.5 % of the national domestic revenue[7)] and a significant contribution to the domestic income. For Grameenphone, these payments amount to approximately 45 % of revenues. This amount is expected to grow with revenue in the years to come.

Grameenphone's investment in physical infrastructure amounted to 1.1 billion USD from 1997 to 2006, resulting in a population coverage of 98 % by its cellular network. In 2006 Grameenphone was behind 1.98 % of the total amount of fixed investments in Bangladesh[8)]. There are several development implications emerging from these investments: The broad

6) *Chairman of BTRC*

7) *Data from ADB and IMF in absolute measures and local currency*

8) *Data from World Bank and the Grameenphone Annual Report*

coverage is making mobile telephony available to a larger share of the population – indeed, when unmet demand meets a new source of supply, the overall consumer surplus increases. In principle, the marginal consumer added to the network will add value until all individuals are connected. Following this argument, the criticsm towards Grameenphone that the expansion in mobile telephony is damaging the market for the Village Ladies is flawed.

The expansion is fuelling development by connecting an increasing number of individuals and thus bridging the digital divide, faster than any village phone programme that resulting monopoly structures ever could. Investments in mobile technology parallel to fixed lines are breaking down the natural monopoly typically associated with physical infrastructure. This is mainly due to the declining costs of setting up transmitters. However, it is crucial to note that such investments are specific and as a result possess traits of propensity towards monopoly. It has been argued that the mobile telephony market is similar to a natural oligopoly and that a certain number of companies will survive independent of the market size because of the consumers' ability to move from one to another more easily than with fixed lines (Valletti 2003). A consequence of this is that the mobile telephony market is most likely to be highly competitive. The competitive parameter is most likely price, and because any rational actor will avoid pure price competition, product differentiation and innovation will be the outcome (Pepall, Richards, and Norman 2005). Grameenphone plays a crucial role in this situation by acting as the large incumbent with deep pockets and a credible commitment through increased capacity and coverage. This suggests that the market for mobile telephony would not have been as competitive today without such large investments made at an early stage by Grameenphone.

The direct payments from Grameenphone to its employees in the form of wages constitute a significant part of the aggregate purchasing power of the Bangladeshi consumer. In addition, the income coming from contractors, vendors, retailers and other partners is not taken into account but Grameenphone estimates suggest that close to 100,000 people receive income from Grameenphone.

Social Aspects

In addition to the impacts discussed above, the crucial question of how Grameenphone contributes to the social development of Bangladesh remains. An assumption has been made that Grameenphone affects this sphere of development in three ways. The main findings indicate that the Code of Conduct, Health, Safety and Environment (HSE) policy, Human Resource (HR) practices and extended business activities tend to play an important role within Grameenphone, and to produce effects beyond the company boundaries.

The Impact from Business Activities with Social Objectives

Grameenphone rolls out a series of activities with social impact. The Community Information Centre programme, the HealthLine service and the BillPay programme are assumed to have development implications in many respects. The common denominator of these seems to be that, owing to Grameenphone's services, people save time when performing everyday tasks.

According to Grameenphone's 2006 Annual Report, its *Community Information Centre programme* (CIC) is reaching 20 million people through 550 centres, employing approximately 945 people. This programme is reputable throughout the country. The function of an Internet connection point is a very important facet of development, bridging the digital divide. In addition, CIC offers services like community information and employment advertisements. The impression from interviews and newspapers is that CIC is successful in connecting poor people, despite minor challenges in terms of profitability[9)]. However, it could be argued that, because CIC is aligned with the core business of Grameenphone and utilises common capabilities, it stands a good chance of proving sustainable in the long run.

The *HealthLine* service is run in cooperation with the local Telemedicine Reference Centre (TRLC), giving access to medical advice to about 14 million people. It answers 6000 telephone calls per day, while the estimated demand is 20,000. In a country with one doctor for every 4000 people, the social impact of this programme is considerable: It saves people the time and cost of accessing a doctor and improves people's health. The World Health Organisation has stated that travelling a long distance to a doctor is a major health challenge in the developing world. Since only 30 % of the callers are transferred to a doctor, the presumption is that a significantly large amount of people are benefiting from this service. Estimations from Grameenphone suggest that 42 % of the callers saved approximately 4 USD and a day of work by using the Medical Call Centre. The quality of the service also seems to be high. TRLC is providing skilled staff and experienced management, while Grameenphone is the medium connecting these with

9) *Close to 50 % of the CICs are financially sustainable.*

the public. Employees in Grameenphone also use the HealthLine service in addition to their insurance programmes which cover regular medical consultations and visits. The main reason for this was the reduced waiting time and quality of the answers they got on their enquiries.

The *BillPay programme* is meant to reduce transaction costs attached to paying utility bills. Such digitalised payments are likely to become an important part of the future development of financial transaction systems. The programme is a step towards further utilisation of digital transfers in commerce[10]. Although BillPay is still in a pilot phase, it could, with the professional competence of Grameenphone, grow into a large concept with significant impact on the transaction costs of many people.

The Impact from Human Resource Management Practice

Through the Telenor Development Programme, Grameenphone offers employee training on several stages in the organisation. Close to 5000 people are subject to training and competence development customised for the individual and the organisational needs. Positive externalities are significant and it plays a key role in the development of Bangladesh through the strengthening of human capital.

Grameenphone offers educational grants to children of its employees. This effort is directly related to building human capital and could have long-term, less sector-specific spillovers. The main strength of this effort is that it benefits several levels of the school system, up to 21-year old students, bringing incentives for youths to continue their education beyond secondary school.

Furthermore, as Grameenphone is the largest company in Bangladesh, its universal Code of Conduct sets an important standard and precedent in one of the most corrupt countries in the world. Nevertheless, the challenge is to secure compliance in the whole organisation, especially when it is rapidly increasing in size. The Code of Conduct document has consequently taken this into consideration and introduces the possibility for 'whistle blowing' on employee malpractice.

The corporate governance structure and overall transparency practiced by Grameenphone is another area in which it is having an impact. Grameenphone has transparent financial reporting procedures and follows the International Financial Reporting Standards, the Bangladesh Accounting Standards and all other local laws and regulations. The fact that Grameenphone keeps complying with the Sarbanes-Oxley Act[11], even after Telenor delisted from the NASDAQ, could be seen as determination to preserve a high level of integrity.

Similarly, Grameenphone's HSE manual corresponds with Telenor's HSE policy and is subject to Telenor's internal audit. One could assume that Norwegian HSE standards, which Telenor follows, are of a high quality and standard. As a result Grameenphone, by introducing these standards in Bangladesh, could be regarded as pioneers. A core aspect of Grameenphone HSE policy is to provide a sound and proper framework for the company, but also be a role model for other companies in Bangladesh to follow. Recurrent inspections and follow-ups, as well as efforts such as the Fleet Management System, are all presumably important measures to ensure that the HSE policy is followed. This applies to all suppliers of Grameenphone as well.

Impact from CSR

Grameenphone has a wide range of CSR projects and a strategy which focuses on three target areas – health, education and empowerment, all related to the UN Millennium Development Goals. However, evidence suggests that Grameenphone's CSR activities resemble corporate philanthropy rather than corporate responsibility, because the initiatives are not aligned with the core business of the company. Therefore, it could be argued that the CSR efforts of Grameenphone have some unrealised potential. Although the CSR strategy emphasises three areas of focus, most of the current projects are related to health. This could suggest that the scope of the strategy may be too wide. The justification for this is based more on societal expectations than on "achieving commercial success in ways that honour ethical values and respect people, communities, and the natural environment"[12].

The CSR strategy explicitly states that the Grameenphone approach to CSR "shall be aligned with core

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10) *In Indonesia, for example, the use of mobile telephones for payments has increased rapidly over the last few years to include electronic wallets and payments over SMS (Sullivan 2007). The implication of this is that more of the economy can enter the formal sector.*

11) *Wide-ranging law signed in the aftermath of large corporate corruption scandals in the United States (US). It establishes new or enhanced standards for all US public company boards, management, and public accounting firms. All companies listed on American stock exchanges have to comply with this act.*

12) *Definition of corporate responsibility provided by Business for Social Responsibility, available online from the organisation's website http://www.bsr.org [Accessed January 7, 2008].*

business". However in reality, Grameenphone gives the impression that it operates mainly as a donor, through involvement in projects such as Safe Motherhood and Infant Care Programme, Dhaka Ahsania Mission Cancer & General Hospital and the 'eye-camps'. One could therefore argue that strategy and practice are not fully compatible. In the education sector, Grameenphone is mainly considering working in primary education despite that primary school enrolment and subsequent completion is higher in Bangladesh compared to the rest of the region (UNESCO 2005), while higher education is lagging behind the regional average and requires positive interventions.

In addition to ordinary CSR efforts, Grameenphone is sponsoring the national cricket team and a number of other socio-cultural activities like the National Book Fair, National Poetry Festival and children's art competitions. This is, according to the HR Director of Grameenphone, perceived as important by the employees, and was highlighted in numerous interviews.

Assuming that communications technology and management competence are equally important at all levels of an education system, one can challenge Grameenphone and question whether they are utilising the full potential of CSR – in relation to where they as a company can potentially contribute most.

Overall Impact

Grameenphone is continuously expanding in scale and scope. Alongside its corporate growth, which brings substantial technical, political and financial benefits to the country, Grameenphone contributes with social externalities to local community development. From the above empirical description, Grameenphone has contributed to development in Bangladesh in several ways:

- Building technical infrastructure with increasingly more advanced services, working towards a critical mass, where telecommunication impact on development will increase significantly;
- Through the transfer of technology and managerial expertise;
- Building production and maintenance capacity locally;
- Through strict codes of conduct possibly strengthening the norm against corruption;
- Individually, and through ATOB, working close with regulatory authorities against efficiency-hindering policies;
- Through high production and related high tax payments, as well as through continuous investments in competition and product differentiation. This results in a larger consumer surplus;
- Wages and payments paid out to close to 100,000 people, with considerable income effects;
- Through community services which help fund basic services for poor people;
- Through extended business activities such as the Village Phone, the CICs, the HealthLine, BillPay and extensive customer service undertakings;
- Through the comprehensive human relation policy and practice, including training and human resource development, employee benefits, the Code of Conduct, control of supply chain and a high-standard Health, Safety and Environment (HSE) policy;
- The corporate emphasis on social responsibility.

It seems that the impact of Grameenphone on the development of Bangladesh is significant, and also clearly beyond what is traditionally expected from a private company, such as investments, wages and taxes. The Code of Conduct, HSE policy, HR practices and extended business activities seem to play an important role in Grameenphone and also have effects beyond the company's own specific goals. A particularly interesting observation is the 'intellectual domestication' process going on, most likely implying increasing management independence.

III. The Power of Business-oriented Aid

This section argues that foreign ownership, local knowledge and competent management have been the most crucial factors in the business success of Grameenphone. Competition in the market and the rapid expansion of the telecommunication industry are two other factors which have been identified as beneficial to the development of Bangladesh.

Foreign Ownership

From Grameenphone's start-up phase in 1996 Telenor has been an active owner, making large investments and transferring competence and technology. Such actions seem prudent in the start-up phase. The continuous transfer of competence and technology from Telenor throughout the establishment and later during the daily operations of Grameenphone has also had a significant impact on the company's performance in the long run.

The role of foreign ownership in the building of Grameenphone is twofold. First, a high level of investment undertaken at an early stage seems to be crucial for rapid growth in the industry. The size of the network dictates the value created for the customer, and hence a larger network implies greater value. In this particular case, the investors faced significant political risk, according to Citibank. Telenor had the capital, and far more important, the know-how of establishing telecommunication companies. This seems to have remained an important factor for the success throughout the later years as well.

Second, business leaders have been appointed by Telenor to manage the company during different phases, all the way to becoming a market leader. The first chief executive officer (CEO) led the company in the start-up phase, and pushed to build a network within four months. This rapid expansion is suggested to be crucial in the telecommunication industry (Sullivan 2007). In the consolidation phase, two business leaders from Telenor organised the company and made it more stable. The real growth however, did not start until the fourth CEO arrived in December 2004. All these business leaders appointed by Telenor were professionals, partly with experience from other emerging markets. Consequently one could argue that Telenor has played and still plays an important role in human capital transfer.

These two arguments could, in principle, fit any professional business. The question then remains whether Telenor itself has played any key difference in creating and maintaining Grameenphone. Some facts could underpin an answer:

- Telenor is the only major European telecommunication company left in Asia.
- Telenor has actively put local management up to tasks and hence developed local competence, including technical knowledge.
- Telenor sets standards for reporting and HSE, exceeding local requirements.
- Telenor is expanding and building capacity in neighbouring countries.
- IFC demanded that Telenor kept majority share in relation to the issue of debt in 2005[13)].

Based on these observations it seems plausible to argue that Telenor has played an important role in building Grameenphone into the company it is today and will continue to do so in the future.

Grameenphone has been subject to some criticism for being owned by Telenor. In interviews with external stakeholders and Grameenphone staff, it became clear that some aspects of the media, some politicians and parts of the general public were sceptical to the foreign ownership. These feelings were particularly visible in Norwegian media, but less so in Bangladeshi media. The main question was whether Bangladeshi money was being exported out of the country and into the hands of foreign investors, in this case Telenor. The Executive Chairman stated that this was not the case. The dividend paid out was very modest in comparison with re-investments. The Chairman of BTRC stated that he did not know whether the dividend was too large, but noted that it was a very transparent process and hence easy to scrutinise.

Bangladeshi newspaper clippings from April to July 2007 showed that little concern for dividend export was raised. On the contrary, articles in Bangladeshi media presented Telenor as a professional owner with proper objectives, who wished to publically list Grameenphone as soon as possible. This intention was positively perceived by the media. Contrary to this position, the majority of the Norwegian media were sceptical to Telenor's ownership, claiming that it had a moral obligation to hand the company over to local owners.

Nearly all interviewees revealed a common perception that foreign ownership has been and will continue to be crucial for Grameenphone. The question of Telenor as owner in particular seems to be less obvious. However, based on their local presence, pioneering standards and good business practice, one could argue that Telenor is a significant partner for Grameenphone.

Professional Management with Local Knowledge

Currently 10 out of 12 people in the management team are local. This team has been running the company throughout the recent phases which have seen rapid growth. It seems as though the development of local competence has been crucial for the success. Furthermore, Telenor has been particularly important in facilitating much of the capacity building in Grameenphone.

Through the Telenor Development Programme, Telenor has set the standards for training and staff development in Grameenphone. The programme is

13) *According to an economist in the Asian Development Bank (ADB).*

developed by Telenor and customised by Grameenphone for local variations, such as culture. Hiring of a local, experienced HR manager could be seen to have strengthened the course and direction of the HR work including training and competence development. The synergies achieved with Telenor are significant, but the autonomy and the ability to make local adjustments are equally important. The consequence of this is a system where all employees are given the possibility to develop up to the highest level of management education and competence.

There is an impression that many managers were given new responsibilities. The goal of lowering the number of expatriates working in the company is a reality. The result has been a steep learning curve and rapid competence development, making the future outlook for Grameenphone a positive one, mainly as a result of its young, dynamic and competent local workforce.

Telenor has provided management expertise from the beginning, most notably all of the CEOs have been sourced through Telenor. One could argue that by placing key personnel in Grameenphone, Telenor was able to provide the company with autonomous decision-making competence. Several interviews suggested that this autonomy makes Grameenphone different from other telecommunication companies in Bangladesh. Based on this, one could suggest that Telenor has played an important role in fuelling the success.

Some criticism has been directed towards the local management regarding marketing. Public opinion in Bangladesh suggests that the resources being put into marketing could be better used in lowering tariffs. The marketing budget of Grameenphone is presently 4 % of the total revenue. However, observing the marketing situation in Bangladesh and advertising in particular, extensive marketing seems paramount to gain customers. Advertising on billboards, TV, radio and in newspapers takes a considerable part of the public sphere and in order to be noticed one has to be aggressive. Or as noted by a director in the marketing division: “Everyone is shouting so we have to shout louder. And we do”. In this reality one can argue that extensive marketing is necessary to be able to compete. The alternative would be to lose market share.

Increasing Competition

The telecommunication market in Bangladesh is competitive, with six operators of which five have strong, international partners. This has resulted in lower prices, a larger range of services and extensive marketing campaigns. Competition has played an important role in Grameenphone’s success.

High competition has led to decreasing prices and lowered entry barriers for new consumers. This, combined with the declining price of mobile hand-sets, led to a considerable growth of the potential market. The majority of new population segments reached by Grameenphone have been lower income consumers. This may have forced Grameenphone to roll out new services faster than it would have otherwise, in order to avoid devastating price competition. The expansion of services has seemingly been positive for the development of Bangladesh.

Summing up

Success factors in creating Grameenphone and affecting the overall development as discussed in this report can be summed up as follows:

- Foreign ownership in terms of knowledge and competence transfer, high level of investments at an early stage and regional know-how have been crucial.

- Telenor in particular has played a key role in providing sound policies, practices and experience from surrounding markets.

- Professional local management has been developed through extensive training programmes, hiring of local and foreign experts, and in pushing people up the organisational ladder.

- Competition in making Grameenphone roll out new services at an early stage.

It seems that the foreign ownership and Telenor in particular have been important success factors in building Grameenphone. This has been visible first and foremost through timely, large and risky investments in network infrastructure. But of significant importance is the transfer of know-how and competence in the form of practices, policies and key people.

The obvious successes of Grameenphone/Telenor in Bangladesh sticks out as a ‘business-oriented aid’ achievement for Norwegians to be proud of. The company’s transparency policies are a catalyst for wider industry reform and for the purposes of this study, made information very accessible. The strict stance against corruption is setting an important precedent and the consequences of this will have positive repercussions throughout Bangladesh and wider region, in terms of further development and attracting foreign investment. Valid information contained in this study about how this success has been achieved ought to make old prejudices about foreign business involvements in countries like Bangladesh fade.

IV. Concluding Remarks

Grameenphone's Impact on the Development of Bangladesh

This study has responded to the question "How is Grameenphone contributing to the overall development of Bangladesh?" by looking at four dimensions of the impact on development: technological, political, financial and social. Extensive data from written sources and interviews revealed the overall impression that Grameenphone has played a significant role in the development of Bangladesh. The scale of the impact is hard to assess, but this paper has highlighted several indicators pointing towards Grameenphone as a pioneer in many respects. However, in relation to the Norwegian debate surrounding Grameenphone in Bangladesh that fuelled the initial curiosity to conduct this investigation, some aspects are more significant than others.

The professional leadership and management of Grameenphone and its good corporate governance practices are setting a standard for others to follow in relation to business practice and corruption. Transparency is a paramount value. This professionalism is operationalized through an extensive health, safety and environment (HSE) policy and a compulsory code of conduct, seemingly followed by the whole organisation. The impact from such practices are influencing the norms within the wider society and setting precedents. Furthermore it provides the government with advice and consultations on issues regarding the telecommunication industry and the broader business environment as a whole.

Partly as a consequence of professional management, the human resource management (HRM) has been and still is successful in developing local competency. Through the Telenor Development Programme, all Grameenphone employees are subject to training and professional development. Furthermore the company is offering grants for the education of employees' children. In a developing country, competence with management and technology, as well as general education, is seen as a crucial component for the development of a society.

The large and continuous investments in infrastructure, in conjunction with enhancements in local competence on construction and maintenance, are also important. The ability of a nation to produce and maintain components of important infrastructure is vital and highlighted by theory. By taking risk and pressing for a rapid infrastructural development Grameenphone has been a significant contributor in this sense.

But some questions are still to be addressed. Although Grameenphone is partly seen as a consulting partner to the regulators, the professionalism of the company could be utilised even further. Other industries and companies would without doubt benefit from management and leadership training from Grameenphone. This could be adapted to fit into a broader CSR programme. Seeing that parts of the CSR efforts are not aligned with the core business of the company, it is tempting to ask if such efforts could become reality in the future. The same also goes for utilising more of the technology competence in community related programmes with social aims.

Grameenphone's Current Impact Capabilities

The question of *ownership* has been the major issue in the Norwegian debate, as well as being briefly highlighted in the Bangladeshi opinion. This question ought to rationally be related to what sort of ownership will be most productive in securing the highest possible positive impact for the development of Bangladesh. This study has argued that Telenor both by itself and as a foreign owner seems to be playing an important role in the building of Grameenphone. But the particular importance of Telenor's ownership in building the professional organisation that makes the impact discussed above possible needs some further comments.

Telenor has transferred technology and management know-how and placed top, competent individuals in central positions. From there, local competence has been developed up to the level of top management. The result is a management team where 10 out of 12 are local. Grameenphone, led by this professional management team, has been provided with sound policies on business practice and development, and human resource management.

The external stakeholders to Grameenphone who were interviewed agreed that Bangladesh, for now, does not have the competence level required to compete in the international arena of telecommunications. Hence, foreign ownership is seen as necessary; all but one claimed that this would remain the situation over the foreseeable future. The same interviewee stated that the professional ownership from Telenor was important mainly because of the competence transfer they provide.

Moreover, the combination of local knowledge, foreign competence and transparency seems to be a crucial success factor. However, this combination would perhaps not have been as impressive, had the organisation not had considerable independent autonomy. Telenor has provided Grameenphone with this autonomy.

The Vision of the Great Synthesis

MICRO's vision of research that makes a difference in fighting poverty, by identifying the impact of different economic and development factors, particularly business-oriented aid, have been reinforced by the study of Grameenphone/Telenor in Bangladesh. There are several indications of a business policy and strategy that have contributed considerably to increasing domestic, economic and cultural power. It is tempting to apply one of the catch phrases of traditional state and charity aid – *empowerment*. Telenor, via Grameenphone, has significantly empowered the Bangladeshi society.

This article has only been able to scratch the surface of this business-and-aid 'fairytale', it has without question stimulated the desire to undertake a series of follow-up studies, in Bangladesh and elsewhere. There is an obvious need to identify to what extent the business activity in Bangladesh has produced specific learning effects. What other learning effects are produced by the constructive synthesis of economic growth and increased learning for intellectual and cultural independence?

Future research: Business Lessons for Development Aid?

This article would not be considered complete without reflecting upon some broader policy implications. Such implications may provide links between the business-oriented aid approach and development aid approach in the developing countries. With this in mind, two factors may provide important lessons for the Development Aid industry.

The first factor is that *competence* matters. Previous research (e.g. Welle-Strand, 1998) indicates that the development aid administration lacks competence for a successful implementation and evaluation of its education program strategies. Similarly, a study reported in this article illustrates how competitive advantage is gained on a basis of gradually increasing investments in human capital. Nowadays, competence tends to be a key word in becoming and indeed remaining successful in business, regardless of what type of industry – including the development aid industry.

The second factor is that *cultural awareness* matters. Any foreign organization, profit or non-profit oriented, operating in any part of the world will acknowledge the importance of recognising and respecting local cultures and traditions. This rhetoric about cultural awareness became a global phenomenon, especially for development-aid agencies. However, there are numerous examples which identify how 'experts' from 'more developed parts of the world' are visiting 'less developed parts' and literally engaging in preaching 'best practice' with only a limited amount of knowledge of local culture and custom. This study illustrates how Grameenphone sustained its competitive advantage by being highly sensitive and adaptive to the local practices.

Based on the arguments above, further research related to competence production and local culture awareness is needed. It is assumed that the intriguing case of Grameenphone may provide a significant step forward in shedding light upon foreign owned business successes in the developing world. Moreover, knowledge about such business successes may provide a valuable contribution to research, in a field that used to be monopolized by the development aid agencies. The 'aid effect' of business success within developing countries may indicate a paradigm shift in understanding of what effective development aid is. Would anybody fear such a shift? The researcher of this paper certainly not, since the core business is to challenge existing paradigms and identify new ways of understanding social realities. The business companies probably would not either, since the aid effect is twined with profitable enterprise. Indeed, Grameenphone's *transparency* in providing access to information for this study suggests that businesses are motivated and very positive to this idea. And then the final, and perhaps most controversial question: are the State and NGO world of development aid ready to explore new aid strategies? The answer to this question remains to be seen. One may presume that no one would argue against engagement by the private sector in developing sustainable futures for the world's poorest.

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Sustaining ICT for Development Projects: The Case of Grameenphone CIC

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Information and communications technology is increasingly being used to enable social and economic development of underdeveloped economies. In this paper we draw on the literature on ICT for development to propose four conditions necessary for the sustainability of such initiatives: appropriate positioning of the project for finance flow, appropriate content, the need for a local catalyst, and an appropriate view of ICT within the project. We then present an evaluation of the Grameenphone CIC initiative against these four conditions. We argue that while it may not always be possible to discover linear cause-effect relationships vis-à-vis sustainability, ICT for development initiatives such as Grameenphone CIC can build in mutually reinforcing elements of sustainability based on the four conditions proposed here.

1 Introduction

ICT initiatives in underdeveloped countries (ICT4D) financed in some form or other by western countries need to be evaluated and assessed to determine whether they are successful or not. This is especially true of community telecenters such as Grameenphone Community Information Center (GPCIC) in Bangladesh, which are specifically aimed at bringing the benefits of new technologies to the rural poor.

However, before we come to the thorny question of defining *success* in this context, a more basic issue needs to be addressed first. For any ICT initiative to have a chance of success, it has to first survive. In other words, it has to be sustainable. While there are several dimensions of sustainability in this context as elaborated later in this paper (Ali and Bailur, 2007), the vital one is financial or economic sustainability. In simple terms, it must be a going concern where income must be at least equal to expenditure.

The challenge therefore is this: how can initiatives such as GPCIC become sustainable? In this paper,we will draw upon the growing body of literature in the area of ICT4D, especially on sustainability to propose four conditions for sustainability. We will use examples from around the world to illustrate our points. Then we will examine GPCIC against these four conditions and list some specific issues that GPCIC need to address in order to achieve sustainability. We will comment on some specific aspects that link these issues to success, based on theoretical and conceptual work done by researchers and practitioners in ICT4D including ourselves. Hopefully, the ideas expressed in this paper will help GPCIC and Telenor to plan similar projects. We will also reflect on implications these ideas can have on research in ICT4D.

2 Sustainability

2.1 Dimensions of Sustainability

As indicated in the Introduction section, there are various dimensions of sustainability. Table 1 summarizes these dimensions.

While all these dimensions of sustainability are important in their own right, and provide us with a

Type of sustainability	Description
Economic or financial	The long-term ability of ICT projects to generate adequate income to meet their operational and maintenance costs
Social	ICT4D projects to address social concerns, involve local actors, impact social structures (for example through empowerment of marginalized groups)
Technological	The long term availability and durability of the technology without recourse to major changes in hardware or software
Institutional	Linked to social sustainability but mainly focuses on political stakeholders that might affect the project and its viability
Environmental	The use of environmentally friendly equipment and the use of recycling and safe disposal of PCs etc.

Table 1 Dimensions of sustainability (based on Ali & Bailur, 2007)

ISSN 0085-7130 ©Telenor ASA 2008

deeper understanding of the term, they all contribute, in some form or other, either to financial sustainability or are dependent on it. For example, social sustainability focuses on whether the project can survive in a specific social context. This is important because any project that is not socially acceptable will not survive in the long run. However, a socially accepted project still has to be run and expenses have to be met. The question then is how an initiative such as GPCIC (or telecenters in general) generate revenues? Below we explore factors that influence sustainability.

2.2 Factors Influencing Sustainability

There are essentially two ways of generating revenues for CICs: either users have to be charged for usage or it has to be funded by some agency. Thus positioning for steady funding is a crucial factor. We then come to the crux of the matter: irrespective of the type of approach or category of source that will ensure sustainability, the fundamental question is why should users (customers) or sponsors pay? In other words, what is in it for the CIC's customers or sponsors? The answer to this is essentially quite simple: the service provided by the CIC should be useful to them. Thus the type of content and service provided by the CIC are vital. However, providing the right content and the right service requires that those who provide these services and develop the content are the appropriate people. We call such persons "champions or catalysts". Further, these catalysts must view ICT in a manner that will enable them to develop the right services. Below we further elaborate these issues.

Positioning for Revenue Flow

The revenue flow necessary to sustain CICs can come from the public or the private sector or an external agency such as an NGO or foreign aid agency. Aid agencies or NGOs cannot be expected to fund such initiatives over a long period. The solution then lies in the first two alternatives, namely public or private funding. There can also be a combination of these, the most prominent being public-private partnership (so-called PPP).

The public sector can fund CICs in a number of ways. They can be seen as investments in infrastructure building and thus platforms to achieve some governmental objectives such as providing employment or motivating the youth to become social entrepreneurs (Choudhury, 2007). Alternatively, CICs can be part of a bigger project so funds will continue to be allocated. There are examples of such initiatives from around the world; for example such centres could be part of a library (seen in many countries including Norway, USA, South Africa), they could be undertaken within publicly funded municipal projects (Sao Paolo in Brazil) or as part of e-Government initiatives (e.g. Tanzanian Ministry of Industry).

A good example of a public-private partnership is the e-Seva initiative in the south Indian state of Andhra Pradesh. It offers a range of government-to-citizen services (G2C) at a single location, such as payment of utility bills and taxes and issuance of permits and licenses (Prashanth, 2004), as well as business-to-customer services such as payment of credit card bills. E-Seva began as a government-funded pilot project in two urban locations, and was then extended to cover much of the state through privately run centers.

The most obvious example of a privately funded information centres would be the numerous cybercafés or Internet cafés seen in Bangladesh or elsewhere. We will not discuss such cybercafés in this paper as these are often set up by private individuals and therefore not relevant to our discussion on GPCIC, which we classify as being part of a private organization's strategic initiative. An example will illustrate this category. E-Choupal is a CIC project initiated by the Indian Tobacco Company explicitly to tighten its link to the tobacco growers who are their main suppliers (Kumar, 2004). While checking prices and being generally informed about the tobacco market are the main drivers for e-Choupals (Choupal means market in Hindi), they also serve as a general purpose CIC.

In a similar vein, GPCIC is a strategic initiative of Grameenphone and tied to its fiber optic network expansion strategy. The fact that it can at the same time bridge the digital divide and has thus the potential to achieve development objectives highlights the interplay of different stakeholder objectives that can achieve a mutually desirable end, no matter what these objectives are.

Content and Service Provided

It is almost axiomatic that unless the service provided by a CIC is useful, no one will use it. The literature abounds in examples of such useful services – crop prices, weather, government forms etc. There have been attempts to determine best practices in terms of contents and to replicate successful content from one site of CICs to another. The results have been mixed. The reason is rather obvious; the focus on 'Best Practice' content misses a vital point – that useful content is context specific and therefore highly localized. What is relevant in one context is not necessarily relevant in another. Take for example, prices of 'shutki' (a certain type of dried preserved fish) in Chittagong in Grameen's CIC. This information is extremely important in the context of Chittagong, where 'shutki' is produced and traded. It does not necessar-

ily mean that it would be considered equally important in say, Munshiganj where the original Village Computing kiosk of Grameen Communications (a sister organization of Grameen Bank but unrelated to Grameenphone) was set up. The success of the Munshiganj venture was attributed to a great extent on the importance of pineapple farming in that area. Apart from the fact that "shutki" is hardly a favourite food item for the people from Munshiganj, "shutki" and pineapple differ in other aspects as well. Pineapple is seasonal and the need for information is important during the monsoon when it is harvested, but irrelevant at any other time of the year. Commodities such as "shutki" are not affected by seasonal fluctuation.

Thus, an external consultant may not be the right person to determine content. This has to be undertaken locally. In other words, the driver and the catalyst for the content has to be a local champion or activist or catalyst.

Catalysts – the Appropriate Developers of Content and Services

The concept of an activist or catalyst was explored by Sein (2005) who proposed four different paradigms of ICT in development: functionalism, social relativism, radical structuralism and neo-humanism depending on how the actors involved view the ICT application and development. We briefly describe these paradigms below.

In *Functionalism*, arguably the most common paradigm, the main actors are foreign experts from donor agencies with the host government taking a relatively passive role. Here, a real understanding of the local context is often missing as ICT is seen as neutral and development is taken to imply modernisation with no reference to the local context. In *Social relativism*, while the main actors are still external experts, they are seen to play the role of facilitators, and the host country is represented by a local agent such as an NGO who is viewed as a partner. Here a more enlightened approach is often taken to ICT as it is now viewed within its context but development is still seen as some form of modernisation. Both *Radical structuralism* and *Neo-humanism* assume alternative paths to development that are context-relevant but while the main actors of the former view see ICT as neutral and act as partisans for the "exploited" class, the actors of the latter view are often activists whose aim is emancipation of the local population.

The key objective of the paradigms approach is to force the ICT4D actors to question their view of development and ICT so as to contextualise the intervention. Clealry, this is relevant to development of content and services in a CIC. As we explained above, these contents and services have to be contextual. The paradigm needs to be at least social relativism but most ideally, neo-humanism. The vital requirement though is that the content developer should be local.

Appropriate View of ICT – Ensemble and Enabler

In the context of ICT4D, we have found that ICT is all too often viewed as a tool. Sein and Harindranath (2004) present four views of ICT based on the work of Orlikowski and Iacono (2001): tool view, computational view, ensemble view, and enabler view. Here we present a brief summary.

According to the tool view, ICT is conceptualised as merely a technical artefact that is used to achieve something. The computational view conceptualises ICT as the technology and the algorithms and codes that make up the system. The tool and computational views, while essential for understanding the ICT artefact, do not have much developmental impact. On the other hand, the enabler and ensemble views do have developmental implications as under the former, ICT is conceptualised as a knowledge enabler, while the latter ensemble view conceptualises ICT as part of a bigger 'package' going beyond the technology "to activities and interactions performed in specific social and cultural contexts" (Sein and Harindranath, 2004, p.19). Here, ICT is part of an ensemble with social and contextual factors helping to determine how it is conceived within a given project. Simply providing access to information does not ensure that the user will be able to benefit from it. To illustrate, just because a farmer can check the price of their products in distant markets does not help them if they have no way of selling their products in those markets.

The significance of context means that ICT4D interventions must conceptualise ICT as an ensemble when implemented. Eventually, in its use and impact, ICT becomes an enabler. Since CICs are a general purpose manifestation of ICT, they need to be viewed as an enabler, i.e., an ICT intervention designed to enable the flow of information and knowledge to the rural poor. Indeed, information and knowledge flows have been shown to play a critical role in poverty reduction (see for instance, Marker et al., 2002).

2.3 Summarizing Sustainability

The arguments we presented above can be encapsulated in four theses about sustainability of CICs:

First, CICs must have a steady flow of financing – either through revenues generated by charging users or through the public sector in the form of entitlements from governments, or through a private sector's strategic initiative or partnership between public

and private sectors. Therefore, positioning for steady financing flow is vital. We call it *the appropriate positioning for finance flow condition*.

Second, such steady funding will only come if the content and service provided by the CICs are useful and fill the needs of the potential users. We call it *the appropriate content condition*.

Third, such content and service are highly localized and contextual which requires that only local catalysts and activists can determine the right content. We call it *the local catalyst condition*.

Fourth, these perspectives will not be taken by the stakeholders until ICT is viewed as an ensemble when planning and implementing it and then as an enabler when in use. We call it *the appropriate view condition*.

Only when all four conditions are met will a CIC be sustainable and survive.

3 Examining Grameenphone CIC

In order to evaluate the GPCIC projects, one should take into consideration their vision, motivation and objectives. As expressed by Sultanur Reza, Project Manager, Grameen CIC, "Grameen CIC's vision is to bring Internet and information based services to the unserved rural community." (Mahmud 2008)

In the rest of this section, we examine GPCIC against the four conditions of sustainability we proposed above.

3.1 Evaluating against the four Conditions

Evaluating against the Appropriate Positioning for Finance Flow Condition

GPCIC is initially funded by Grameenphone, a private consortium of which Norway's Telenor is the majority owner (the other owner being Bangladesh's Grameen Telecom). Grameenphone is a successful business enterprise. The company is the largest mobile phone operator in Bangladesh with over 10 million subscribers and its revenues for 2006 are estimated to surpass USD 600 million. The company's total revenues increased by 57 per cent in the third quarter compared with the same period last year (Telenor 2007).

Thus GPCIC is positioned in the 'private sector led initiative' category and it started with a sound financial backing. Whether this backing would continue, or needs to be continued, depend on several factors. Important among these factors are the objectives (both financial and social, as well as short-term versus long-term) of the parent company, support from the government for national development by improving and developing infrastructure, and the long-term financial ability of the GPCIC project itself to generate adequate income in order to meet its operational and maintenance costs.

The CICs are designed to be commercially viable and sustainable, so that local entrepreneurs could buy a 'Business in a Box' with a low-cost loan from Grameen Bank. A CIC is equipped with a computer, a printer, a scanner, a web and an EDGE modem (GP has established a nationwide EDGE – enhanced data rates for global evolution – network coverage, an advanced mobile technology that enables high-speed mobile internet and data services). The initial investment in a typical CIC ranges between BDT 70,000 to BDT 100,000 (USD 1,000 to USD 1,425). Grameen Telecom Corporation and the Society for Economic and Basic Advancement (SEBA), the two partners of the CIC initiative, are involved in the selection and training of entrepreneurs, and the distribution of kit and marketing materials. Users pay a small fee to use the CIC's services. The entrepreneurs are expected to become self-sufficient and sustainable through this business model.

Essentially, Grameen CIC's are franchise telecentres that offer marketable services and are expected to meet break even point in 12 months. Whether or not the expected one-year gestation period is working well for most of the CICs, we do not know yet. More time and data are needed to see if the CICs are reaching their break-even point successfully within the expected timeframe (Liyanage 2007).

We came across an example of one Mr. Rezaul Karim that perhaps can be considered as typical. Mr. Karim began his GPCIC franchise on March 23, 2007 in Salimpur, Chittagong. Grameen kickstarted his business with free Internet connection for a period of six months and a two-day training program. His revenue, after about two months in existence, was about BDT 2,000 per month but his monthly expenditure was BDT 4,000 (made up of BDT 1000 for the Grameen subscription and rent, and the cost of utilities at BDT 3,000). Mr. Karim was confident that his earnings would rapidly increase to around BDT 10,000 in the near future. He also hoped that Grameen would provide him with all the promised services (telemedicine or healthline education linkage, video chatting with experts and government service facilitation). He was also hopeful that Grameen would extend their free Internet access to a further six month period (Shaddy 2007).

In sum, GPCIC began with appropriate objectives with the backing of a sound business model. The model is based, in part, on recruiting, encouraging and nurturing local partners (entrepreneurs). We conclude that it is well positioned to generate a steady income flow.

Evaluating against the Appropriate Content Condition

Currently, the content and service provided by CICs are what can be best described as "contextualized best practice". The GPCIC brochure lists several services that are general in nature (for example, Internet surfing and e-mailing, chatting, video conferencing, computer composing, scanning and printing etc). Also offered are e-Government services (such as access to government forms, access to government web sites), job searches and market information. Actual content development for the local context is not stressed beyond tailoring of some of these services. An example of "contextualized content" could be early warning of cyclones and inclement weather in coastal regions.

Expanding services in areas that are important from social and humanitarian perspectives is important in helping attain social sustainability. Exploring new services that reflect the distinct needs of the people is the key to success. Grameenphone seems to be aware of this as adding health and medical information services in the CICs is encouraged. Recently Grameenphone launched HealthLine, a 24-hour call centre manned by registered physicians who provide basic health information. This can greatly enhance the services provided by the CICs.

GPCIC has also initiated a move to enter into partnership with important government and non-government organisations so that important content can be made available in local language. Providing good, consistent and reliable service is somewhat dependent on basic infrastructure such as electricity. Alternative arrangements may be necessary for handling occasional power outage, which is not uncommon in Bangladesh. One promising avenue could be partnership with Grameen Shakti, a sister organization of Grameen Bank that provides solar powered electricity to its clients in villages.

In summary, we find that the GPCIC still has some way to go in fulfilling the appropriate content condition.

Evaluating against the Local Catalyst Condition

CICs are run by local entrepreneurs (activists), who are supported at the outset with training, loans and technology. GPCIC encourages entrepreneurship. It has developed sound criteria for selecting CIC project owners from among local entrepreneurs. This helps in achieving social sustainability. Whether this also impacts institutional sustainability, depends on the political "clout" of these entrepreneurs.

Currently, the main criteria in selecting these entrepreneurs seem to be financial solvency and educational background. These are vital characteristics to look for in CIC operators. However, it will be fruitful to also include 'activist' individuals who are influential, energetic and motivated, in addition to having a good financial and educational background. They should have the ability to influence people, and to earn their respect and trust. In addition, an activist entrepreneur should have the knack for engaging people in social issues, such as education, healthcare, empowerment of women and other marginalized groups in the society. Our conclusion is that GPCIC has done well in engaging local entrepreneurs but could expand the criteria to seek activists.

Evaluating against the Appropriate View Condition

GPCIC selects the entrepreneurs for CICs, trains them and provides them support. This indicates that they view CICs as more than mere tools, and recognize the need to see CICs as part of a "package". This is in keeping with the ensemble view.

GPCIC also appears to take an enabler view of CICs. As an example it focuses its CSRD (Caring Society for Rural Distressed) involvement in three main areas – Health, Education and Empowerment. As a responsible corporate citizen Grameenphone believes that for sustainable development, it is important to ensure primary healthcare for the economically disadvantaged people, both in terms of service and access. (CSRD is a Non-Government Organization that conducts free Friday clinics providing primary healthcare to the economically disadvantaged community. The CIC established by Grameenphone will make CSRD self-sufficient by serving as an alternative source of income.)

Despite the fact that GPCIC has adopted the right perspective, and there are examples to support this, it is still too early to claim success of the GPCIC projects as enablers and as ensembles.

3.2 Success of GPCIC

GPCIC has been in existence only since February 2006. It is too early to evaluate whether it has been successful or not in a setting as enormous and complex as Bangladesh. We can simply point out that its growth to 560 centers in two years is impressive. It indicates that GPCIC services are being rapidly

adopted. However, as pointed out by *The Economist* (2008), adoption does not necessarily predict diffusion and actual use. Whether the number of centers can reach a level where they can meet the needs of a reasonable fraction of a country of 140 million people remains to be seen. In any case, the growth is simply a measure of what Sein and Harindranath (2004) call the "first order" or "primary" and possibly "second order" or "secondary" effect. It is necessary to eventually reach tertiary effect to achieve a developmental impact. Below, we discuss these three types of effects and indicate the key issues that GPCIC needs to address to ensure a successful impact.

The three Levels of Impact

Sein and Harindranath's (2004) model posits that ICT impacts society through three effects. The *first order or primary effect* is simple substitution of old technology by the new. Primary effect is observed when people use the ICT to do things that they would otherwise do without computers. For example, they would use the word processing capability in a GPCIC to write letters instead of by hand. Another example could be checking market prices of commodities through the Internet in a GPCIC instead of say, asking travellers, or reading newspapers or using a telephone. So far, there are indications that GPCIC has had primary effect although no statistics exist. We rely only on anecdotal evidence. We argue that while the primary effect does not necessarily indicate development, it is essential for higher order effects to take place.

The *second order or secondary effect* is an increase in the phenomenon enabled by the new ICT. In case of GPCIC, a secondary effect is observed when people seek more information about markets, or write more letters. Another indication of secondary effect is more people seeking useful information than before. There is no statistical evidence about secondary effect of GPCIC either. However, a surrogate measure could be the growth in the number of centers, the logic being that more centers would lead to more users and thus more use. There is however no evidence for this yet.

The *third order or tertiary effect* refers to societal and economic changes resulting from the introduction of new ICT and their use. It is here that GPCIC has the potential to have the greatest impact on development. For instance, they could become centres of new entrepreneurial initiatives such as ICT training, as happened in the Akshaya programme in Kerala, India (see Pal et al., 2005) or provide opportunities to empower women and unemployed youth as in the case of the Amader Gram Learning Centres (AGLCs) in Bangladesh (Raihan and Roy, 2007). The secondary impact of GPCICs in terms of increased communication and knowledge flows may also result in further tertiary impacts such as a more open society or changes in societal norms. There is some anecdotal evidence of it happening. In a conversation with one of the authors, Sultanur Reza recounted the story of an incident where a village market was being cleaned through tearing down of several buildings. When the building housing GPCIC came under threat of demolition, it was the power elite in the village that opposed it and eventually the building was saved. This indicates that the elite have come to realize the enabling potential of ICT.

There is also precedence in Bangladesh that tertiary effect can be achieved. Real structural change resulted from the Grameen village phone program, through the empowerment of women (Welle-Strand, and Molden, 2007). One way to achieve this is for GPCIC to target women – just as Akshaya did in Kerala and the Grameenphone did in Bangladesh.

3.3 Summarizing Assessment of GPCIC

Grameen CIC's objectives are (Reza, 2006)

- To develop a Business Model which is suitable and sustainable;
- To identify various content relevant to villagers' lives which will help ensure financial stability of the centres;
- To find suitable partners to spread it at grass root levels.

The number of Internet users at the CICs is going up and the number of CICs is also on the rise. According to Sultanur Reza, "We hope that 80 per cent of the present 560 CICs will become sustainable (economically viable) by June and 90 per cent by the end of this year (2008)" (Esther 2008). It is a good sign that Grameen CIC's proponents are aware of the importance of developing a sustainable business model. Considering all four conditions, GPCIC has the potential to become a sustainable project. Its performance and promise, however, are varied when evaluated with respect to individual conditions as we have described above.

There are additional issues that we would like to mention. One question is identifying the intended audience of GPCICs. At present it is mainly the educated middle class – the slick advertising films show a country cousin telling his visiting relative from the city that "we may not have this and that, but we have Internet". This is also reflected in some of the content. For example, one of the health tips on GPCIC sites CIC tells people to have parsley everyday, which is good for health. To the overwhelming

majority of the people in Bangladesh, parsley is an unknown word. This is an example of context-neutral application of ICT, i.e. the absence of an ensemble view.

It is however important to keep in mind that the audience discussed above is mainly the direct users of the GPCIC. There is a vast audience who do not use the CICs directly but nevertheless gain from it. The prime example is the farmer from Bhanga, a remote town who was facing problems when virus infected his chilli plants. A CIC operator who became aware of his problem collected information from a web site and advised the farmer accordingly leading to a resolution of the problem. Giving the fishermen the latest weather forecast from the Internet over a loudspeaker in Andhra Pradesh in India is another example. Such "chauffer driven" use of the computer is nothing new. In fact the first such users were top level managers in business organizations who neither had the ability nor the motivation to learn to use the computer.

This of course leads to the possibility of manipulation of information. Is the farmer getting all the information he needs or is any information deleted that would be useful but that runs counter to the interests of the operators or controllers of the CIC? This is especially a concern with centers that are part of a private organization's strategic plan. For example, e-Choupal's centers are located in the houses of prominent villagers who are not immune to vested interests – either their own or a powerful group's. It is even more critical to view ICT in its context, as an ensemble, in such cases.

4 Discussion

In this paper, we have argued that the vital issue of sustainability needs to be addressed satisfactorily before impacts of ICT4D initiatives can be examined. We proposed four conditions that must be met to attain sustainability. The discerning reader can readily point out an omission in our conditions – that is reliable technology and uninterrupted service. We deliberately did not go into this aspect because we feel that it is a given – without reliable technology and service, no ICT initiative can survive. Besides, it is captured in the ensemble view of ICT. There is another aspect of service provision that needs to be pointed out. Regrettably, the concept of good service is not widely shared in a typical Bangladeshi business environment. The principle that consumers/subscribers have a right to good service is often ignored, or not appreciated by most businesses in the service sector of Bangladesh. In most cases it is an issue of cultural mind-set and can be improved by setting examples.

We stress that we mainly relied on secondary sources and anecdotal evidence, augmented by some conversations with some key informants, such as Sultanur Reza, in our analysis in this paper. Our conclusions should be interpreted in that light. We recognize that a more accurate evaluation requires data based on rigorous field research. An "on the ground" field study is highly recommended either to confirm our evaluations or refute them.

In ICT4D projects such as GPCIC, there is no linear relationship between clearly causal and clearly effectual factors. Rather, they are intricately tied in a mutually influencing relationship where factors continuously and cyclically affect and are in turn caused by other factors. This is especially true about the mutually dependent relationship between sustainability and success – the more a project is sustainable, the more its chance to become successful, which in turn makes it more sustainable. The key is to make this a "virtuous cycle" where each element mutually reinforces the other in the "right" direction. The danger is of course that it can also become a "vicious cycle" – unsuccessful projects do not sustain, and projects that do not sustain have little chance to achieve success.

While we argue that only sustainable projects can lead to development, there is evidence that resolving the inherent tension between the stated (macro) objective of development and the essential requirement for financial sustainability at the micro level – through, for instance, entrepreneurial activities – can be a major challenge (see for instance, Kuriyan et al., 2006). Addressing such inherent tensions would require us to understand the social, economic, and political context of ICT at the local and national levels; i.e. viewing ICT as an ensemble.

World Bank figures (The Economist, 2008) indicate that underdeveloped countries are quick to adopt new ICT, but they do not diffuse or use them in any meaningful manner. This implies that while we have been good at introducing new technology in these countries, we have failed in spreading their use. Clearly, this is a key problem with sustaining the use of such technologies. Our arguments in this paper shed some light into the reasons for such lack of diffusion or use.

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Teleuse at the Bottom of the Pyramid:

Beyond Universal Access

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This paper looks at the question of universal access to telecommunications in emerging Asia. It looks at how universal access is defined, and compares this to access levels as found in a recent five-country study of the use of telecommunication services at the 'Bottom of the Pyramid' in India, Pakistan, Philippines, Sri Lanka and Thailand. Very high levels of access, but low levels of ownership are found. The paper then looks at the potential benefits that these non-owner users are missing out on, and then goes on to look at the key barriers to ownership that are faced by them. The paper estimates that there could be close to 150 million new subscribers at the BOP in these five countries by mid-2008. However, a distinct affordability gap is found. Possible ways to deal with this affordability gap are proposed in the final section with emphasis on multiple stakeholder efforts.

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1 Introduction

The enormous potential at the 'Bottom of the Pyramid' (or BOP; Prahalad, 2004) has been much talked about. In the telecommunications sector, companies are beginning to understand this burgeoning market, adapting products and business models to better serve its needs. As such, many predict that the low income, developing markets will be where much of the future growth in telecom will come from. While many of the developed country markets are nearing, if not already reached universal service, universal access is the more practical policy objective for these countries with low per capita incomes.

But where does emerging Asia stand today in terms of universal access? Have we achieved it? What issues do we need to address in striving to reach this target? What are the next steps that we need to take to ensure that the BOP, the most marginalised citizens in developing countries, avail from the many benefits of direct access to telecommunication? These are some of the questions that this paper tries to answer, based on a large sample study of telecom use at the BOP in Pakistan, India, Sri Lanka, the Philippines and Thailand.

The rest of this paper is organised as follows: Section 2 sets the overall context, looking at some of the relevant literature. Section 3 explains the study design and methodology. Section 4 looks at the findings of the current study in the five countries and tries to answer some of the questions posed. Section 5 concludes with recommendations for policy makers and industry.

2 Universal Access: Where are we now?

The Independent Commission for World Wide Telecommunications Development, led by Sir Donald Maitland in 1985, drew attention to the stark inequalities in the distribution of telephones between the 'developed' and 'developing' world at the time. The report of the Commission (Independent Commission for World Wide Telecommunications Development, 1985) claimed that of the 600 million telephone lines

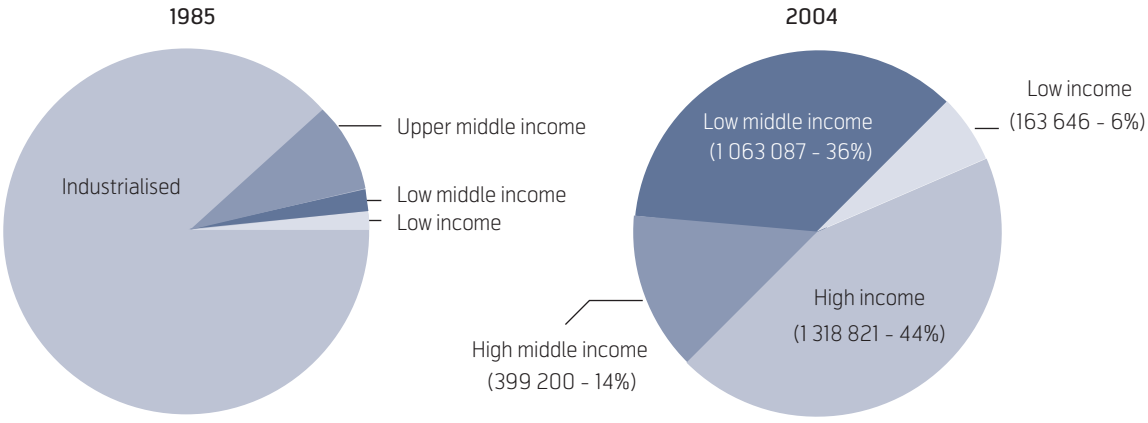

Figure 1 Distribution of telephones by economic grouping, 1985 versus 2004

ISSN 0085-7130

in existence, over three quarters of them were at the time located in nine 'advanced industrialised' countries. Much has changed since 1985. As Figure 1 illustrates in 1985, 'industrialised'[1] countries had more than three quarters of all the telephones in existence, while in 2004, almost two decades later, the distribution was somewhat more equitable. However, as Kelly (2005) shows, in comparison to the distribution of population across the countries, a considerable 'digital divide' exists. Kelly looks at measures of the digital divide (namely the Lorenz curve in conjunction with the Gini coefficient), and further illustrates that the digital divide is narrowing, however, he goes on to state that this is mainly due to middle-income countries 'catching up,' while some of the least developed countries are in fact falling behind.

According to ITU data by the end of 2004, there were a total of 2.94 billion telephone lines in existence, or 46.40 telephones per 100 inhabitants (ITU, 2006). Figure 2 illustrates that much of the 'catching up,' particularly in the Asia Pacific, has been achieved through the proliferation of mobile telephones between 1984 and 2003. While the fixed segment continues to grow, the mobile segment is clearly outpacing it. Unlike the developed world, new mobile connections often serve as the first connection in a household in the developing world, rather than additional connections, especially at the BOP. Waverman et al. (2005) show this phenomenon occurring in developing countries; Waverman et al. show that mobiles are playing the role that fixed phones played in developed countries, substituting fixed growth, rather than complementing it.

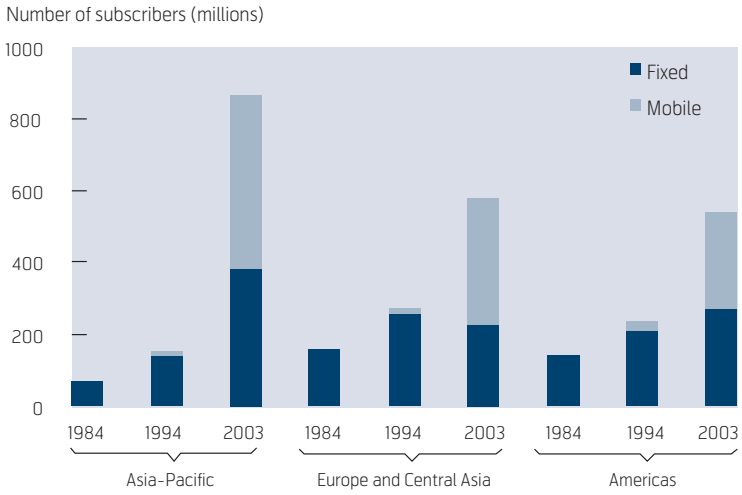

Figure 2 Fixed and mobile subscribers (millions) in Asia Pacific, Europe and Central Asia and the Americas (1984–2003)

Much of the growth that has taken place all around the world since 1984 from the time the Maitland Commission produced its seminal report, has been through mobile telecommunication; the number of fixed phones in Europe and Central Asia in fact decreased over the period.

As such, the Asia Pacific is one of the world's fastest growing telecom markets. While the GSM Association claims that the 'next billion subscribers' will come from developing countries, a 2006 study by Informa Telecoms & Media claimed that 45 percent of the global growth by the end of 2006 would come from the Asia Pacific; of this, 25 percent was estimated to come from India, Pakistan, Philippines and Thailand – four of the five countries considered in this study (DigiTimes, 2006). Similarly a recent research report by Pyramid Research has estimated that globally, between 2006 and 2010 the number of subscriptions will grow by 1.4 billion raising the total base of mobile subscribers from 2.8 to 4.2 billion; of this, it is estimated that 87 percent will come from Emerging Asian countries, India contributing the largest share, of 294 million new connections (Arathoon, 2007).

Growth in the mobile sector has been propelled by the relatively lower cost and speed of network deployment, as compared to traditional fixed networks. According to NOKIA (2006) the number of mobile users increases every day by one million, of which 80 percent are in developing countries. By the end of 2006, the number of mobiles surpassed 2.5 billion.

Universal access generally refers to a situation where every citizen has a 'reasonable means of access to a public telephone' (Intven, 2000; p. 6.1); the Maitland Commission set a goal that by the turn of the twenty-first century, almost every human being should be within 'easy reach' of a telephone. In both these cases, this could include public payphones, community telecenters, etc. There are many definitions of universal access; different countries have used different definitions.[2] Most include some dimension of population (e.g. a phone for every permanent settlement of 'x' population), distance (a phone within 'x' kilometres) and/or time (a phone within 'x' minutes) (ITU, 1998). Other definitions of universal access even include access to more than just 'plain old telephone service,' or POTS.[3] However, given that Internet access in the countries considered in this study is low, especially at the BOP, we will consider access to telecommunications as a starting point for this paper.

1) *The equivalent of what is now termed 'high income' by the ITU.*

2) *The ITU (1998) provides a list of the definitions used by selected countries in 1997.*

The question that arises is, how do we define a 'reasonable means of access'? With regard to the Maitland Commission 'definition,' or goal, 'easy reach' came to be understood as the presence of at least one telephone within two hours walking distance of every person in rural areas.[4] At a later point, taking into account the expansion of telecom access with time, this definition was revised to 30 minutes.

This means that universal access, unlike *universal service*[5] allows for shared use of phones; affordability barriers prevent people from owning their own phone, thus forcing them to use other people's phones or public phones. This is commonplace at the BOP, as many studies have shown. A ten country study by Research ICTs Africa! found heavy dependence on public payphones even among the wealthier countries included in the study (Gillwald, 2005. p 24). A pilot version of this study conducted in 11 localities among 3,199 respondents in India and Sri Lanka in 2005 showed that 57 percent in the Indian samples and 61 percent in the Sri Lankan samples did not own a phone; 73 percent in the Indian samples and 52 in the Sri Lankan samples used some form of public phones. This indicates that even those who own their own phone use public phones too. The VillagePhone program in Bangladesh provides another example where entire villages have been served by a single mobile phone connection (at least initially), which effectively functions as a mobile public phone (Knight-John, Zainudeen and Khan, 2005; Bayes, von Braun, and Akhter, 1999; Richardson, Ramirez and Haq, 2000). Grameenphone claims that this program has brought telecom access to 50,000 of the 64,000 villages in the country to telecom services (Grameenphone, 2006); in this context, one could argue that Bangladesh is near universal access to telecommunication.

Given such levels of shared use at the BOP, it is amply clear that looking solely at penetration or 'teledensity' rates (derived from industry subscriber numbers) is not sufficient as an indication of the progress toward universal access.[6] Similarly, looking at the proportion of the population 'covered' is also inadequate as an indicator of universal access. The GSMA states that mobile coverage has in fact already reached 90 percent of the population in some developing countries, and it expects that globally by 2010, coverage will reach 90 percent (GSMA, 2006). However, mobile coverage alone will not bridge the digital divide. In a report in 2005, the GSMA acknowledges that while 'between 75 % and 80 % of the world's population live in areas already covered by mobile communications systems … only 25 % use the services' (2005; p 3). Technology is not the problem; other issues of affordability, policy, regulation, etc, have to be tackled to enable that 90 percent to avail of the full benefits of mobile coverage, specifically through ownership of their own phone.

3 Research Methodology

3.1 Research Considerations: Defining the *Bottom of the Pyramid* for Country-wise Comparisons

The study was conducted in five emerging Asian countries, namely Pakistan, India, Sri Lanka, Philippines and Thailand. Given the necessity for cross country comparisons among the less privileged strata of society, the target groups had to be defined as close as possible in a universal manner. While income levels appeared to be relevant, the practicality of using it as an indicator was limited by its reliability and comparability across countries; the problems generated by spatial and temporal cost of living adjustments would have made comparisons difficult. In addition, past studies have revealed that Asians tend to overstate or understate their income. Given the study was to be among the lower income groups, the tendency would have been to overstate their income. Thus this parameter while indicative would not have been conclusive or reflective of the respondents' status. In this background, Socio Economic Classification (SEC) was used instead of Income to define the BOP.

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3) *For example, NOKIA (2006) defines universal access as the 'ability of every individual to connect to people, information and services regardless of their location or income'; the Millennium Development Goals set out access to ICT tools and services by 50 percent of the world's population by the year 2015; the UN uses the level of Internet users as an indicator of the progress being made on this front (see: http://unstats.un.org/unsd/mdg/Resources /Static/Products/Progress2006/MDGProgressChart2006.pdf)*

4) *http://www.itu.int/wsis/tunis/newsroom/background /missing-link.html*

5) *Universal service refers to a situation where telecom services are provided to all households in a country. Some developed countries have already achieved universal service, or are close to achieving it; however, while some urban markets in developing countries are said to be close to universal service (GSMA, 2006), for most developing countries as wholes, this is not a feasible or practical policy objective. Universal access is more relevant where developing countries are concerned. See Intven (2000, Module 6) for more details.*

6) *While noting that teledensity is an 'imperfect measure of universal service' (ITU, 1998; p.20), it is probably currently the most readily available indicator which can be compared across countries.*

SEC categorizes people into groups A to E based on the education and occupational status of the Chief Wage Earner of the household. For the purposes of this study, the top and middle of the pyramid was defined as SEC A, B & C, while the BOP was defined as SEC D and E. Focus was on the lower end (SEC DE) while a small middle and upper end sample (SEC ABC) was covered for comparison purposes.

3.2 Target Group

Target respondents of the study were telecom users, defined as those who had used a phone (own or someone else's; paid for or free-of-charge) during the preceding three months. Respondents were males and females between the ages of 18 and 60, from rural and urban locations.

3.3 Research Design

Both quantitative and qualitative research modules were undertaken. The quantitative module consisted of face to face interviews conducted with the target respondent using a structured questionnaire. Interviews were conducted at home. Both households and respondents were randomly selected. The sample was designed to represent the BOP in each country so that the findings could be projected back to this segment.

	Population (millions)	Sample Size			Error margin at 95 % CI
		Urban	Rural	Total	
Pakistan	166	900	912	1812	3 %
India	1,000	1645	2355	4000	1.5 %
Sri Lanka	16 million (excl. 2 provinces)	200	850	1050	3 %
Philippines	87	594	506	1100	3 %
Thailand	65	350	350	700	7 %
Total sample size: 8662					

Table 1 Quantitative sample overview

Having designed the sample the next issue was the accuracy of usage data; accurately capturing the calling patterns and behavior at the BOP is a difficult task.[7)] While much telecom use research in the developed world is based on billing records, in developing countries where the majority share phones and almost the entirety use pre-paid mobiles, it is not possible to obtain bill details, and thus alternative methods have to be relied on, such as the respondent's recall, mobile call logs or other more sophisticated and costly real-time measures.

As a result, the current study takes an innovative approach, recording phone use and behavior through the placement of a diary among respondents.[8)] Diaries were placed among 50 percent of randomly selected respondents for a period of two weeks.[9)] Number of calls made or received, whose phone or where the phone was used; who the call was to or from; purpose of the call; time of the call; type of phone used; whether voice or Short Message Service (SMS) etc. were recorded. An incentive was provided for diary completion while random checks were conducted to ensure that recordings were being made. Across the five countries about 90 percent of diary panelists completed calling information, but responses on SMS (text message) details were low.

A multi-stage stratified cluster sampling by probability proportionate to size (PPS) technique was used to select the target number of urban and rural centers. After determining the number of centers to be selected from each cell (strata in respective provinces), urban and rural areas were selected again using PPS on a constant population interval on geographically ordered centers within each cell.[10)] In each selected centre, a common place such as a road, park, hospital etc. was designated the starting point for contacting households.[11)] Only one respondent was selected from each household. In households with more than one valid respondent, the Kish grid[12)] (random num-

7) *Previous studies (Zainudeen et al., 2005) have cited the difficulties in recall data. See also Cohen and Lemish (2003) for discussion.*

8) *One of the very few examples of use of this approach is a British Telecom study examined in Mckenzie (1983). Interestingly, the authors were not able to locate any comprehensive studies using this approach in the literature for developing countries.*

9) *Given the low literacy level of some of these countries, a literate person in the household was selected and trained to record the necessary information.*

10) *For this purpose, the cumulative population of all geographically ordered centers was calculated within urban and rural areas of each province. To find out the sampling interval the total population of these centers was divided by the required number of cities to be sampled from that cell. To select the first center, a random number was generated. The center where that random number fell was the first selected center. By adding the sampling interval to that random number, the next center was selected, and so on.*

11) *Around each starting point, a maximum of ten interviews were conducted. The number of starting points was determined in accordance with the total number of interviews to be conducted in each center.*

12) *The Kish grid stems from the Hungarian born American statistician and survey methodologist Leslie Kish (1910–2000). When creating the grid Kish intended to select persons within the household with equal probability. On the other hand, the use of the grid can be checked easily contrary to e.g. a decision depending on the toss of a coin. His main work is the book* Survey Sampling *(1965), where he summarized and developed the current theory of sampling and survey design.*

ber chart) was used to randomly select the respondent. Within each country, data was weighted by gender, province group/zone and SEC group (ABC vs. DE) to correct over- or under-sampling in certain areas and socio economic groups.[13)]

An overview of the sample size and composition is given in Table 1. Table 2 provides the qualitative sample overview. Respondents included telecom users as well as non-users.[14)] Extended group discussions (EGDs) were conducted in the local language(s).[15)]

4 Findings

4.1 Universal Access?

The Asia Pacific is one of the world's fastest growing telecom markets. While the GSM Association claims that the 'next billion subscribers' will come from developing countries, a 2006 study by Informa Telecoms & Media claimed that 45 percent of the global growth by the end of 2006 would come from the Asia Pacific; of this, 25 percent was estimated to come from India, Pakistan, Philippines and Thailand – four of the five countries considered in this study (DigiTimes, 2006). Similarly a recent research report by Pyramid Research has estimated that globally, between 2006 and 2010 the number of subscriptions will grow by 1.4 billion raising the total base of mobile subscribers from 2.8 to 4.2 billion; of this, it is estimated that 87 percent will come from Emerging Asian countries, India contributing the largest share, of 294 million new connections (Arathoon, 2007). However, as seen in Table 3, the number of telephones per 100 population, or teledensities in each country as at end 2005 in Thailand and end 2006 in Pakistan, India, Sri Lanka and the Philippines suggest significant access inequalities with the number of fixed subscribers per 100 population ranging from less than 4 up to about 10 and the number of mobile SIMs[16)] per 100 population ranging from 13 to 50.

	SEC DE only				Centres
	Users		Non-users		
	Males	Females	Males	Females	
Pakistan	2	2	1	1	Peshawar, Karachi, Lahore
India	2	2	1	1	Lucknow, Teravalure
Sri Lanka	2	2	1	1	Kurunegala, Moneragala
Philippines	2	2	1	1	Metro Manila, Batangas
Thailand	2	2	1	1	Chiang Mai
Total sample size: 30 EGDs					

Table 2 Sample country composition for Qualitative component

As noted in Section 2, teledensity is not a good measure of the progress toward universal access, given that it does not take into account shared use of phones; one connection may serve an entire neighborhood or even an entire village. Thus in countries where shared use is prevalent, we should expect to see far higher levels of actual access, especially at the BOP.[17)]

	Pakistan	India	Sri Lanka	Philippines	Thailand
Fixed subscribers per 100 population[18)]	4.33	3.64	9.55	4.29	10.25[19)]
Mobile SIMs per 100 population[20)]	31.07	13.52	27.26	50.68	46.45

Sources: PTA (Pakistan); TRAI (India); CBSL (Sri Lanka); Manila Times (telephone subscriber numbers – Philippines); NTC (Thailand); World Bank

Table 3 Telephones per 100 population

13) *As a result of weighting by SEC it should be noted that in reporting the results, in some countries the SEC ABC weighted sample size becomes larger than the SEC DE weighted sample size where the former group forms a higher proportion of the country's population.*

14) *Someone who has not used any form of telecommunication during the preceding three months.*

15) *EGDs are longer than an average focus group – three hours or so as opposed to one and a half to two hours. The advantage is that respondents are not rushed an EGD.*

16) *Distinction is made here, between the number of mobile subscribers and the number of SIMs, as nothing can be said about the actual number of mobile subscribers based on the data reported, which more closely represents the number of SIMs.*

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18) *Fixed subscribers per 100 population: Q4 2005 for Thailand; Q4 2006 for all other countries. Calculated for the Philippines using subscriber figures and World Bank population figures.*

19) *Lines in use (different from installed capacity).*

20) *Mobile SIMs per 100 subscribers: Q4 2005 for Thailand; Q4 2006 for all other countries. Calculated for Sri Lanka using population figures used to calculate fixed subscribers per 100 population; calculated for the Philippines using subscriber figures and World Bank population figures.*

	South Asia			Southeast Asia	
	Pakistan	India	Sri Lanka	Philippines	Thailand
Accessibility (used a phone in the preceding 3 months)	98 %	94 %	92 %	93 %	95 %

Source: Outer sample

Table 4 Access to a phone at the BOP

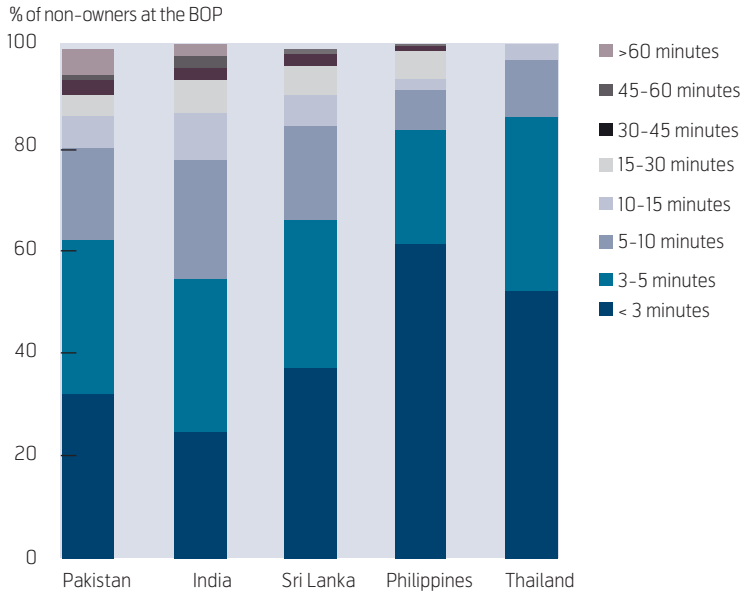

Figure 3 The time it takes non-owners to reach the nearest phone

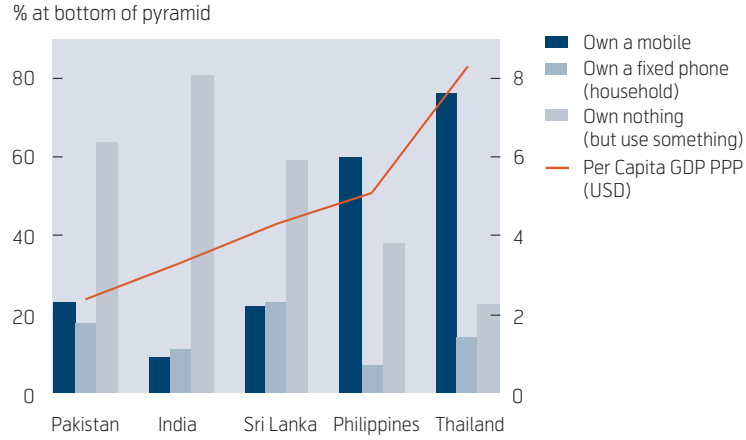

Figure 4 Ownership patterns at the BOP and national Gross Domestic Product

In contrast to the figures presented in Table 3, this study finds that access to a phone is extremely high in the countries studied; of all those contacted (through the random selection process), more than 90 percent in all countries had used a phone at least once during the preceding three months (Table 4). That is, made or received a call, from any phone in the last three months.

This is in sharp contrast to the much quoted claim that 'half the world's population have never made a phone call'[21] which Kelly rightly states seems to be a claim that has been 'frozen in time' (2005, p 26). This is, however, more in line with ITU estimates that about one fifth of the world's population do not have access to telecommunication (Kelly, 2005).

Among non-owners at the BOP in the five countries, the majority were able to get to a phone in less than 5 minutes (Figure 3). In the two Southeast Asian countries, of those who did not own a phone, most tended to use mobiles of other household members, or those of their friends and relatives as their main method of communication indicating the wider penetration of mobile phones. Of the non-owner South Asians, most relied on some kind of public phone (public call office, telecommunication centre or public phone booth), something that was seen in India and Sri Lanka in an earlier version of this study (Zainudeen et al. 2005).[22]

Putting these two sets of findings together with the earlier discussed 'definitions' of universal service (that is, more than 90 percent have used a phone in the preceding three months and most being able to access a phone within 5 minutes) one could conclude that near-universal access has been achieved in these countries. While this is a significant achievement, this is not the end of the game. While users at the BOP seem to have access to many different modes of telecommunication (personal mobile phones, household fixed phones, public phones, neighbors' phones, relatives' and friends' phones, etc.) ownership patterns vary significantly across the region as seen in Figure 4. Ownership at the BOP is high in the richer Southeast Asian countries, with relatively higher levels of mobile ownership (with some instances of people owning more than one mobile connection) and lower levels of fixed ownership.[23] Among the South Asian countries, overall phone ownership at the BOP was much lower, particularly in India.

21) *See for example, http://www.unrisd.org/unrisd/website/newsview.nsf/0/34329FCA3B21925D80256B7B003DCF2A?OpenDocument*

22) *In fact, public phone use was not limited to the BOP in India, Pakistan and Sri Lanka; those surveyed in SEC groups A, B and C were also public phone users.*

23) *Ownership of a fixed phone was defined at the household level, whereas that of a mobile phone was at an individual level.*

	South Asia			Southeast Asia	
	Pakistan	India	Sri Lanka	Philippines	Thailand
Efficiency of daily activities	4.17	3.90	3.98	4.40	4.37
Ability to earn or save	3.80	3.97	3.19	4.07	3.56
Family and Social relations	4.30	4.14	4.35	4.45	4.66
Ability to act in an emergency	4.48	4.28	4.58	4.63	4.83

1 = worsened; 2= slightly worsened; 3 = no change; 4 = somewhat improved; 5 = improved

Table 5 Mean responses on the perceived impact of direct telecom access

Some respondents had more than one mobile available in their household (as many as 43 percent in the Philippines and 23 percent in Pakistan), and some owned more than one SIM card (12 percent each in Pakistan and the Philippines); but on the whole ownership of a telephone – even within the household – was relatively low in South Asia, in contrast to access.

4.2 Access is not enough: Why Ownership Matters

Many studies over time have concluded that access to telecom has a fairly strong impact on growth and economic development. At a macro-level, Hardy (1980), Cronin et al. (1991), Parker and Hudson (1995), Cronin et al. (1993) as well as Roeller and Waverman (2001) provide evidence for links between telecommunications and economic growth and development in the developed world. More recently, Waverman, Meschi and Fuss (2005) provide evidence for such links; demonstrating that in developing countries, for every additional 10 percentage point increase in mobile penetration, annual GDP growth increases by 0.6 percent. However, while a wealth of 'anecdotal' evidence is available to demonstrate income benefits on an individual level (e.g. rural farmers checking produce prices via a mobile phone), few of these findings have been empirically reinforced.[24)]

This study looked at the benefits of having direct access (i.e. owning a phone) as perceived by the owners themselves. The benefits were assessed on a five-point scale, in terms of the extent that direct access has had on the following aspects of their life:

i. efficiency of daily activities;

ii. financial (the ability to earn more using the phone – besides reselling minutes – or save a certain expense that would have been incurred without the phone);

iii. family and social relations;

iv. ability to act in emergencies.

The mean responses are provided in Table 5.

Across the five countries, the BOP felt that the efficiency of their daily activities had 'somewhat improved' due to access to telephones. This is very much an intuitive finding, given the time and effort being saved when calls are made in places of physical travel. The data supports this with a high level of confidence.

People value highly the contactability at any time, as well as at any location in the case of mobile phones. In fact, the contactability brought about through phones is one of the key reasons that are seen to be driving people to obtain their own connections. The ability to obtain information in an instant is also valued. Some findings that emerged from the Pakistani qualitative studies were that the male participants supported the notion that mobiles have reduced the dependence of females on them in running general home errands and contacting loved ones.

When it came to financial benefits (perceived, that is), there were mixed feelings at the BOP. The mean response ranged from 3.19 in Sri Lanka to 4.07 in the Philippines. The highest negative responses were seen in Sri Lanka (the only country of the five with a receiving party pays regime in place), where a quarter of respondents felt that direct access has in fact worsened their ability to earn or save. In all the countries except India, the mean responses on the first two aspects at the BOP (i.e., efficiency of daily activities vs. ability to earn or save) were significantly different at a 95 percent confidence interval. In these countries, many respondents at the BOP did not see as much economic benefit arising from access to telecom as they did efficiency gains, with the cluster around

24) *Souter et al. (2005) provide one such example.*

'somewhat improved' for efficiency gains being spread out and towards 'no change' in terms of ability to earn or save. There appeared to be a 'disconnect,' in people's perceptions between efficiency gains (for e.g. saving travel time and cost) and financial gains, which at the outset seems fairly counter-intuitive. There are a number of possible reasons for this, which will not be delved into in depth in this paper.[25)]

However, this is not to discount the body of research which demonstrates links between income improvements and access telecom services, or the reports of farmers and fishermen checking prices before they sell their goods. In India, Pakistan and the Philippines, for example, more than 60 percent of those engaged in agriculture felt that access to telecom improves both the efficiency of their daily activities and improves their ability to earn or save more. This goes to show that not only the cost, but also the availability of relevant content (for instance agricultural prices via phone and SMS etc.) plays an important role in allowing people at the BOP to financially benefit from access to telephones. Furthermore, the qualitative component of the study revealed that some see improvements citing the reduction in travel expenses resulting from using telecom, as well as the potential for businessmen to generate more business using the phone.

Phone owners by and large testified that access to a phone can enhance their family and social relations; this is also seen in the actual purposes of the calls made by diary respondents, with more than 60 percent of calls in all countries being for the purpose of 'keeping in touch.' The qualitative findings reinforced this sentiment, with many citing the importance of phones in maintaining relationships, building up new ones, and feeling connected to loved ones, as well as the outside world. This finding concurs with much of the existing research in the developing worlds (Souter et al, 2005; Vodafone, 2005; Zainudeen, Samarajiva and Abeysuriya, 2005), as well as the developed ones (Keller, 1977; Noble, 1987[26)]).

The biggest and most widespread impact of access to telephones at the BOP was in creating a sense of security; the ability to act in an emergency. The ability to contact someone or even get help in the event of illness or death or even a broken bicycle (cited by participants in the qualitative studies), for example,

	South Asia			South-east Asia	
	Pakistan	India	Sri Lanka	Philippines	Thailand
Plan to buy a phone in next 2 years (% of BOP)	53 %	38 %	53 %	42 %	38 %
Projected horizontal growth (non-owners joining market), millions	26.0	79.7	1.3	6.5	1.3
Projected vertical growth (current owners getting additional connections), millions	7.3	3.6	0.3	11.9	2.8
Projected new connections at BOP, millions	33.3	83.4	1.7	18.4	4.0
Projected total new connections at the BOP across all five countries, millions					140.7

Table 6 Projected growth at the BOP

25) *This issue is dealt with in an entirely separate paper, available at http://www.personal.umich.edu/~parkyo/site/paper%20abstracts/LIRNEasia_ICApc_Benefits_at_BOP_v2_1.pdf. Some of the possible reasons are as follow:*

- *The phone is rarely used for business purposes at the BOP (seen in the current, as well as other studies in Asia and Africa).*
- *A significant barter economy which exists at the BOP leads to the lines between economic transactions and social communications becoming blurred.*
- *There is a limited group within society who make direct earnings by using a phone, i.e., those that sell minutes and those that use the phone to sell their product or service; these are the kinds that are most likely to see a connection between the telephone and their earnings, if any.*

The high cost of service outweighs the perceived benefits, if at all.

26) *Cited in Wei and Lo, 2006; p. 56.*

is an important benefit of access. Souter et al. (2005) similarly found the most important use of phones in a study of the impact of telecom on rural livelihoods in India, Mozambique and Tanzania. The benefits of telecom, especially mobiles can also be seen in disaster management, from warning through response and recovery stages (Samarajiva, Knight-John, Anderson and Zainudeen, 2005).

It emerged strongly from the qualitative studies that in Pakistan, the only predominantly Muslim country in the group where women are less independent and more home-oriented, access to a telephone helped women at home contact men in times of emergency making them feel much more secure.

4.3 Connecting the Next Billion Subscribers

While access alone can be beneficial, ownership (which allows for use of the phone at any time – a key concern which was evident in this study) can bring a host of other benefits. The previous subsection discussed the benefits of direct access to a phone, or ownership, as perceived by the owner him- or herself. Many studies have shown positive relationships between telephones and economic growth and development as well. The question then remains, how do we convert non-owners into owners, to allow them to avail of the benefits of access? This subsection looks at the potential of new subscribers and the barriers to ownership, as given by current non-owners at the BOP in the five countries.

Potential Subscribers at the BOP

The study finds that there are close to 150 million people at the BOP in the five countries covered by this study who could theoretically become new telephone owners by mid-2008.[27)] This estimate is not inconsistent with the estimates of the GSM Association and others who believe a large component of new growth to occur in these five countries. Although these prospective customers may be already contributing to the revenues of operators (through the use of other people's phones); the usage data collected suggests, e.g. in Sri Lanka, that the number of calls made will almost double if a mobile is obtained, and more than double if a fixed telephone is obtained. However, several issues pertaining to making phone instruments affordable at the BOP will need to be addressed in order to capture this potential. As depicted in Table 6, the expected volume in South Asia will be far greater than that of Southeast Asia.[28)]

The bulk of prospective owners in the region will invest in mobile connections as seen in Table 7. Given that more than 90 percent of current mobile owners at the BOP in all five countries are prepaid subscribers, it is likely that a large proportion of these new mobile connections will also be prepaid.

The only exception to the mobile led growth is Sri Lanka, where more than half of the prospective owners plan to invest in a fixed phone. This is most likely a result of the entry of CDMA fixed phones, just prior to the survey, which provide limited mobility from a 'fixed' unit for approximately half the price of a conventional PSTN fixed phone connection. Another important policy issue is that even though there might

	South Asia			South-east Asia[29)]
	Pakistan	India	Sri Lanka	Philippines
Fixed Line phone	23 %	29 %	52 %	8 %
Mobile Phone	68 %	67 %	40 %	91 %
Have not decided yet	9 %	4 %	7 %	1 %

Table 7 Type of phone prospective owner would buy

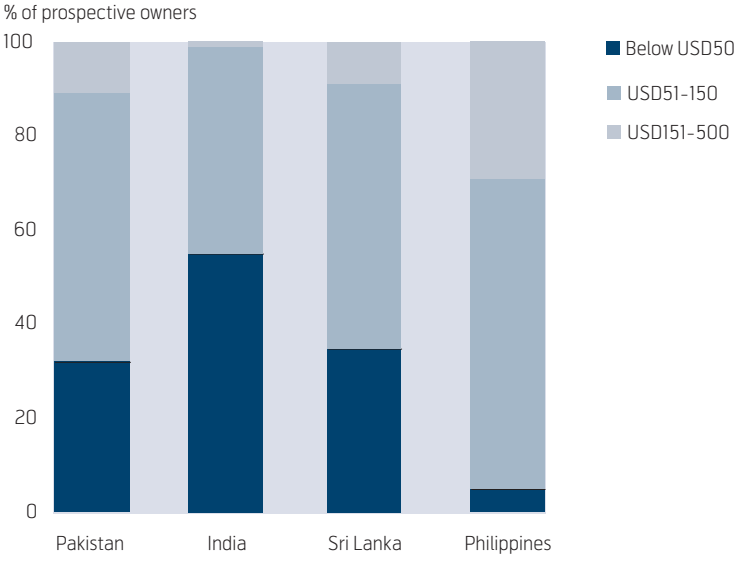

Figure 5 Income distribution of prospective owners[30)]

27) *That is, belonging to SEC D and E and between the ages of 18 and 60.*

28) *Based on the projection of the segment of non-owners who plan to but a phone in the next two years, plus the share of owners that are likely to obtain another connection, onto the following target populations (SEC groups D and E, aged 18-60) – Pakistan: 77.1million (excluding FANA/FATA – Tribal Areas); India: 260 million; Sri Lanka: 4.3 million (excluding the North and East Provinces); Philippines: 40.5million; Thailand: 14.7million.*

29) *Thailand was dropped from this analysis because the base was too small to be analyzed at a disaggregated level.*

30) *Thailand was dropped from this analysis because the base was too small to be analyzed at a disaggregated level.*

	South Asia						Southeast Asia			
	Pakistan		India		Sri Lanka		Philippines		Thailand	
	ABC	DE	ABC	DE	ABC	DE	ABC	DE	ABC	DE
I cannot afford it	56 %	75 %	47 %	82 %	60 %	72 %	68 %	77 %	68 %	77 %
I don't need one	26 %	17 %	38 %	15 %	20 %	18 %	25 %	14 %	25 %	14 %
Poor network	7 %	1 %	5 %	1 %	6 %	3 %	0 %	3 %	0 %	3 %
None of my contacts have a phone	1 %	1 %	3 %	1 %	0 %	1 %	0 %	1 %	0 %	1 %

Table 8 Primary reason for not owning a phone

be no real difference in the investment between a CDMA fixed phone and a mobile phone, the former does not attract a charge on incoming calls while the latter does, given Sri Lanka's receiving party pays regime. This finding highlights the issue of affordability.

New customers in the coming two years at the BOP will by and large have monthly household incomes of less than USD 5 per day, as seen in Figure 5. In India, a considerable number of new customers will be those with less than USD 2 per day.

	South Asia			South-east Asia[32]
	Pakistan	India	Sri Lanka	Philippines
Amount that prospective owner expects a new phone connection to cost				
Below USD 25	79 %	78 %	10 %	10 %
USD 26 – 55	18 %	18 %	21 %	39 %
USD 56 – 85	2 %	3 %	29 %	28 %
USD 86 – 115	1 %	0 %	22 %	18 %
Over USD 116	0 %	0 %	19 %	7 %
Amount that prospective owner can afford to pay to obtain a new phone connection				
Below USD 5	94 %	97 %	69 %	70 %
USD 5 – 10	5 %	2 %	26 %	29 %
USD 11 – 15	0 %	0 %	3 %	0 %
USD 16 – 20	1 %	0 %	1 %	0 %

Table 9 Initial cost of obtaining a phone: Expectations vs. affordability

The Affordability Barrier

Among non-owners, the key barrier to ownership is affordability (Table 8). Although overall the BOP (owners plus non-owners) can afford to use a phone[31] the majority cannot afford to own one; they have to be content with using someone else's.

In terms of getting connected, there appears to be a significant gap between the expected cost, and what the BOP can afford. While those at the BOP expect a telephone to cost a certain amount, their affordability does not necessarily reflect the ability to purchase a unit at the expected price point as seen in Table 9. This is true in the case of all four countries examined in the Table. In the case of Pakistan and India, BOP prospective-owners expect the cost to be somewhere from USD 0–25, but most can only afford to pay up to USD 5 to get connected. In Sri Lanka and the Philippines, while the expected cost is much higher, it is not matched by affordability.

Perhaps this cost barrier is a significant reason why about one third of the current BOP mobile owners are using second-hand handsets, seen in Figure 6. The average price paid for such recycled phones is about half that of brand new ones. Even though the study did not consider the smuggled phone phenomena (where import duty and sometimes even government taxes are avoided) the industry believes a significant component of particularly mobile instruments are brought into countries through such illegal means; thus making them cheaper than official selling prices.

It seems that the expected monthly expenditure and the affordable monthly expenditure, as stated by non-owners at the BOP are better aligned, than are

31) *The BOP (owners plus non-owners) rate the cost of using telecom services (on a five-point scale) as 'somewhat affordable' to 'affordable.'*

32) *Thailand was dropped from this analysis because the base was too small to be analyzed at a disaggregated level.*

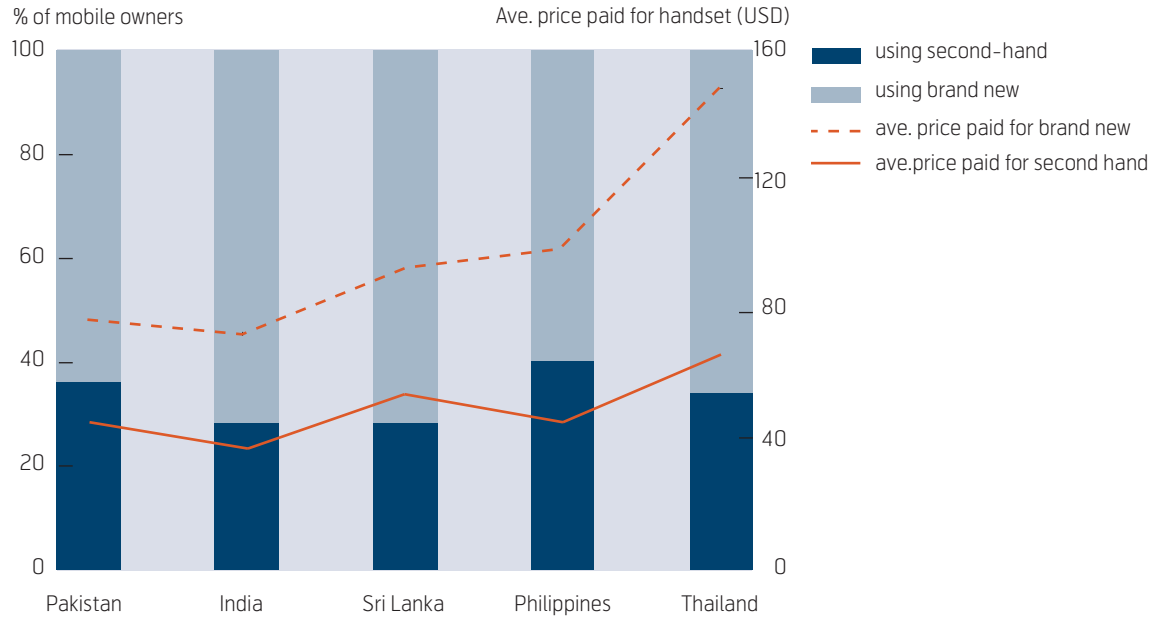

Figure 6 Use of brand new and second-hand handsets and price paid for same

expected versus affordable initial costs, seen earlier. The study finds that around 90 percent of non-owners in India and Pakistan expect monthly expenditure on telecom usage to be less than USD 5; around 30 percent in Sri Lanka and 40 percent in the Philippines expect their monthly expenditure to be USD 5–10. Non-owners at the BOP can afford to pay less than USD 5 per month in Pakistan and India and less than USD 10 in Sri Lanka and the Philippines. These numbers are broadly comparable to monthly ARPU (average revenue per user) numbers on prepaid (which form the majority of mobile connections), of around USD 5.[33)]

Preliminary estimates of the price elasticity of demand at the BOP e.g. in Sri Lanka based on the data from this study indicate that changing prices by small amounts will not have significant impacts on increasing demand; as Milne (2006) argues, when phones become available for the first time in low income settings and usage charges or tariffs are relatively high (in terms of income), people will make limited numbers of essential calls. In such settings, even if the prices fall by a small amount the number of such calls, for instance in an emergency or substituting a telephone call for a bus ride to a city, will not increase by much. This can be seen in the relatively low price elasticity of demand that has been found in the Sri Lankan case. But, as prices fall and in a much cheaper service environment, Milne argues that people will start to use the phone for many non-essential purposes; ranging from relationship maintenance to simple conveniences. Thus in the current context it seems that unless significant price changes are made, noteworthy impacts on demand may not be seen; however such changes are usually possible through policy changes which can affect pricing structures (e.g. abolishing RPP regimes). Thus, operators could aim to increase affordability through innovations in the marketplace that enable poorer people to make 'cheaper feeling' calls; for instance enabling very small denomination pre-paid reloading that can enable the user to make just the one or two phone calls that he needs by spending a few extra units of currency, rather than having to buy a high denomination prepaid card; this innovation has been introduced in many developing markets. The objective is for the person to move, albeit slowly, from making only 'essential' calls to making 'non-essential' calls.

5 Concluding Remarks

This study finds that almost everyone at the Bottom of the Pyramid in Pakistan, India, Sri Lanka, the Philippines and Thailand have access to telecommunication services without having to spend any significant amount of time in getting to a telephone. One might conclude that near universal access has been achieved at the BOP in these countries. In which case, where do we go from here?

While access seems to be high, the gap between those who *use* telecom services and those who actually *own* a telecom device is significant. Many at the BOP,

33) *For example, as at June 2006, the prepaid ARPU for India was USD 6.34 per month (INR286) (TRAI, 2006; p.24); that for the largest mobile operator in Sri Lanka as at end 2005 was USD 4.43 (LKR452) per month (Dialog Telekom, 2006).*

especially in South Asia, are missing out on the benefits that can be availed of through ownership of a phone.

There is a vast potential for telephone uptake in the region, especially South Asia. The combined potential in the five countries under study could be close to 150 million new connections by mid-2008; this market will be largely a mobile market, able to spend less than USD 5 on monthly charges. However, the biggest barrier to greater ownership seems to be affordability; while most at the BOP can afford to *use* a telephone, many cannot afford to *own* one. The question is how do we push out the affordability frontier and convert these non-owners into owners? How can we make a phone affordable for those on incomes of USD 2 a day in India?

The answer lies in part with policy makers, in part with industry and in part with the market itself. The challenge for policy makers and the industry is to facilitate the ownership of phones at such a low disposable income, until recently not considered by conventional wisdom. While some in industry argue government taxes on telephone instruments (in some countries) should be removed to make this possible, such action would not be considered too favorably by governments in developing Asia who depend on such taxes to fund numerous other social programs. There is a clear case for the removal of the RPP regime in Sri Lanka, which has had much influence on decisions and perceptions on telecom at the BOP, possibly even negating any positive perceptions of the impact of direct telecom access on earnings and savings. The key is the creation of an enabling environment on the part of the government, for the private sector to act in.

Industry operators can help bridge the expectation vs. affordability gap (in terms of getting connected) by providing solutions such as easy-payment plans to spread the cost of getting connected over a period of time. The expectations vs. affordability gap can also be bridged through low-cost mobile handsets. The industry is already making efforts to bring the cost of a brand new handset down to around USD 15 in the future. The efficacy of such efforts can be increased through the development of local language capabilities for SMS on affordable handsets. Much of the high mobile use in the Philippines – arguably driven by the high use of SMS (seen in the current study) – has been enabled by the ability to use SMS in the local language (which uses the Latin script).[34)]

Operators can help widen the set of potential income benefits of ownership perhaps through the provision of useful 'content' through telephones, such as agricultural prices, etc.; or even promote reseller models, similar to the Grameen model,[35)] which can also stimulate demand for minutes as well as further improve access.

Given the right conditions, the market will adapt and innovate to find its own solutions to the problems of affordability – the popularity of the 'missed call' or 'beeping' phenomenon (used among more than one third of users at the BOP in Pakistan, India, Sri Lanka and Thailand, and about two thirds of those in the Philippines) is testament to this.

In conclusion, there is great potential for expanding ownership, and thus benefits of direct telecom access at the bottom of the pyramid; however, efforts on the part of multiple stakeholders are required.

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Building Micro-Enterprises through Information and Communication Technologies (ICT) in Bangladesh

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The article seeks to identify issues and challenges concerning micro-enterprises in a developing country, specifically Bangladesh. It suggests that ICT can help address the concerns of small businesses such as access to information about production techniques and potential buyers, communication requirements for negotiating price, terms of payment, and delivery logistics, among others. The article hopes to shed light on how the mobile phone and the telecenter or Community Information Center (CIC) can be used as tools for enhancing capability and sustainability of these micro-enterprises.

Background

The bulk of the economies in developing countries thrive on small, medium and micro-enterprises. The role small-scale enterprises play in the development process cannot be underestimated as they help create employment, generate income, relieve poverty and redistribute economic opportunities throughout communities.

Bangladesh is a country where small-scale enterprise is significant. While there is an absence of accurate numbers of these small businesses, estimates suggest they range from about 55,916 small industries to 511,612 cottage industries. Based on the Bangladesh Planning Commission estimates, various categories of small and medium enterprises (SMEs) are reported to contribute between 80 % and 85 % of industrial employment and 23 % of total civilian employment. Moreover, SMEs contributed BDT 741 ($12.5) billion or nearly 25 % of the gross domestic product (BDT 2,996 billion) in 2003 (Mintoo, 2006).

This paper focuses on small businesses referred to here as "micro-enterprises" which may be defined as small enterprises that are often unregistered, operating "informally", and usually run by the poor. Micro-enterprises may also be a family-based enterprise with family members and relatives helping out in operations. Some micro-enterprises are in the form of cooperatives with ten people or less. Micro-enterprises generally have limited or no access to micro-credit or any type of banking services. With no clear-cut definition, public call offices, barbershops, machine shop owners, village phone ladies, farmers, fishermen, tailors, seamstresses, farmers, and fishermen, among others, can be considered as micro-entrepreneurs. In Bangladesh they proliferate in both urban and rural areas. Micro-enterprises cannot be viewed as marginal since they comprise the backbone of the economy.

Information and communication are crucial for micro-enterprises to survive on a day-to-day basis. It is common to resort to traditional modes like word-of-mouth and other established indigenous information mechanisms for obtaining information.

Communication is integral for the micro-entrepreneur when it comes to getting in touch with suppliers, customers, traders, and middlemen in some cases. Accurate and speedy communication is also important for negotiating prices, terms of payment, securing stocks of commodities, and coordinating deliveries. Micro-entrepreneurs go through intermediaries or middlemen just to get their agricultural produce or handicrafts sold to buyers. Fishermen at Cox's Bazaar, for instance, rely on middlemen to have their catch sold in the market (see Roldan, Wong, and Helmersen, 2007). Village women in some communities in Jessore sell their embroidery through non-governmental organizations which make these available to the market and to traders.

Drivers and Constraints on Micro-Enterprises

One would note that the need for survival and livelihood for individuals and families propel people to set up small businesses. In Bangladesh, SMEs and micro-enterprises are entities that cater more to a local market, mostly offering a single product or service.

The demand in the local economy capitalizing on existing skill and local resource can be a driver for these small businesses. Within communities, for example, there may be a need for agricultural produce such as fish, grains, spices, vegetables, and fruits which may not be easily obtained through one's backyard farming or barter with neighbors. The demand for clothing, jewelry, books, phone services, and other things may also be areas where micro-entrepreneurs see opportunities for livelihood. They

 ISSN 0085-7130

put up a small capital (by borrowing or by means of their own savings) and use existing or available skills to earn from these identified opportunities.

Community networks that are built around these small businesses also serve as drivers. They can be considered as a valuable resource for small businesses as they form part of their supply and demand chain. Customers are generated from these networks. Word-of-mouth and buzz are key elements in making services and products known around the community.

Insofar as constraints are concerned, the readiness of these small enterprises to respond to social, economic and technological changes may vary and can be unique according to these enterprises' structure and size. The ability of micro-enterprises to capitalize on opportunity and wrestle with challenges depends also on these factors.

SMEs are usually considered to be more agile in their form, structure and processes. Therefore, it generates a greater willingness to rise to the challenges of innovation and change (Department of Trade and Industry (DTI), 2000).

In the context of ICT adoption, Ritchie and Brindley (2005) argue that the barriers to ICT adoption faced by small enterprises are within strategic framework (business strategies, capital investment and networks), technological framework (complexity and professional support), and organizational and behavioral elements (human capacity and risk perceptions).

Looking at micro-enterprises / SMEs in a developing nation like Bangladesh, they appear to be no different from those in the developed world. However, we are able to point out significantly unique constraints such as lack of access to the right financing, information, and innovation necessary for their business development.

According to Donaghue (2004) the use of financial services as a development tool has evolved over the past 25 years. This involves rural credit schemes for subsidizing loans to poor farmers, micro-financing to provide working capital loans to predominately female micro-entrepreneurs, and a variety of organizations offering a range of financial services to help low-income households increase incomes and reduce their vulnerability to income fluctuations.

Although there are many channels to access to financing sources, small enterprises face multiple bottlenecks when they deal with financial institutions. They lack access to financing support due to the need for collateral or guarantee and steady flow of income to fulfill banking institutions' requirement. They have low financial maturity in terms of exposure to different financing options, and more importantly, they lack understanding or preparedness for future 'shocks' such as bad harvest seasons or flooding for those in the agriculture sector.

For example, farmers in Bangladesh have a low risk tolerance with the volatility of harvests. From the banks' perspective, they will try to limit their exposure by turning off farmers and rejecting their loan or other financing application. Without proper access to the formal banking system, most of them resolve to informal financing such as obtaining loans from usurers or lenders who charge high interest on a daily or weekly basis. Sometimes, farmers use their land title as collateral and risk their land being taken away if unable to pay.

Information flow in a developing country like Bangladesh may not be fluid compared to other developing countries. This can be ascribed to the lack of infrastructure (e.g. Internet-connected PC, public source etc.) and information sources (e.g. lack of transparent information sources, persons with the right information access). This is further amplified by the low literacy among micro-entrepreneurs, preventing them from finding necessary information sources to use for their own benefit.

In the Bangladesh context, a typical case would be that of a rice trader who wishes to get the latest pricing or type of rice but will have to depend mostly on middlemen for information. This may be the most efficient way of accessing information given the current condition. However, there is so much more information or transparent knowledge if there is a good information infrastructure (e.g. information dissemination from a governing body or a public information resource center).

According to Ghobadian & Gallear (1996) and Rothwell (1989), small enterprises have limited access to resources. Due to the scarcity of resources, most SMEs in the developing countries have the tendency to fulfill what is necessary to ensure their business survival.

This is of course a main concern; however; there are still a selected few who are willing to innovate to expand their businesses. There are plenty of innovations to go around, be it in agricultural, trading or small-scale manufacturing. It is just that it is not evenly distributed, especially in the rural areas. Romano (1990) revealed that the SME new product and product improvement growth is related to research and development, innovation, and the ability

to gain advantage over competitors in the product market. Acs and Yeung (1999) further elaborated that the ability to innovate and adopt new technology to make product modifications is likely because of the greater creativity and innovativeness of small-firm employees.

Based on our observations in Bangladesh, most of the micro-entrepreneurs or small business entities have limited innovation and visibility. It is difficult accessing the most recent or most efficient technique or most cost-effective way of doing business. This ties back to the earlier point on small enterprises lacking information access and infrastructure. This inhibits innovation. To illustrate, without knowing the best technique to ensure water irrigation, a farmer-entrepreneur may miss out on innovation that could increase his productivity.

Telecenters and Mobile Phones as Tools. CICs as Resource Centers

Community Information Centers (CICs) or telecenters are considered among the tools used to allow a freer flow of communication and information to reach villages and rural areas in Bangladesh, and which could in turn help even small business people or micro-entrepreneurs to increase their client base and address information needs.

The CIC provides communication, data access and other services that help cater to the learning, livelihood, and communication needs of people living in these remote areas. Grameenphone set up CICs in 2006 and is now providing Internet access to over 500 rural communities throughout Bangladesh. Grameenphone is targeting to make CICs available to some 1,500 communities in the next few years.

A Grameenphone CIC is a center equipped with a computer which can access the internet using an EDGE modem. A variety of services are made available via this telecommunication link – voice, email, web and other information based services.

Through GP CICs, online marketing, trading, and business transactions can take place through the CellBazaar. CellBazaar is a Grameenphone service that makes buying or selling goods and services possible through the Internet and over the mobile phone. One can post information on goods to buy or sell on CellBazaar (via its website, or for Internet/EDGE activated mobile handsets, one can go to wap.cellbazaar.com with the phone's internet browser). Sellers can be contacted directly. When buyers see an item they like, they can call the seller, get additional information, and meet the seller to complete the transaction.

CellBazaar is an example of a platform which micro-entrepreneurs can use. It can give them a wider reach and allows them to sell to regions all around Bangladesh. There is still, however, low awareness and usage of the Internet through CICs in remote villages. Grameenphone seeks to beef up awareness of CellBazaar through their local CIC entrepreneurs. There may also be other internet-based solutions that may provide assistance to micro-enterprises insofar as their information and communication needs are concerned.

The Mobile Phone as an Enabling Tool

Based on cases from our fieldwork in Bangladesh, we argue that there is a role to be played by mobile phones in empowering micro-enterprises. Constraints faced by micro-enterprises could be reduced in some way with the mobile phone as a business-enabling tool.

In this section, we explore this apparent conundrum on the expected responsiveness in the adoption of the mobile phone as an enabling tool, against the belief that the mobile phone only contributes little to business building for the small business enterprises. It also demonstrates three parameters that set off the mobile phone as a catalyst for productivity, networking and information gathering.

The mobile phone as a productive tool implies that the small business owners use the mobile phone to conduct business either to complete an order or bid for a stock. In one sense, the mobile phone acts as the compressor of time and distance, minimizing the need for travel or to have face-to-face meeting to complete a business deal.

The mobile phone can act as the 'gatherer and disseminator' of information for micro-entrepreneurs. There are examples of this, especially the well-known stories of the fisherman or farmer checking prices, finding suppliers or bidder customers through his mobile phone (King, 2004; Ross, 2004). Through the socio-economic lens, mobile phones resemble an engine that pulls forward the socio-economic status of the owner – owning a mobile phone is liberating the economic boundary of the small business owner, therefore, he or she can now be in touch with other business partners or customers.

Moreover, the mobile phone also serves as a tool to create networking opportunities – one chance encounter or chat through the mobile phone leads to another business opportunity scenario.

The widespread use of mobile phones among the small entrepreneurs leads to new practices in their business transaction, and these changes have significant implications for mobile operators who wish to capture these small entrepreneurs' unmet needs. Because of the adoption of these new modes of space-time coordination and increasing mobility of the small business owners by owning mobile phones, the spatial formation and processes of interaction between buyers and sellers have apparently become much more complicated in this age of mobile communication.

Internet-Based and Mobile-Based Platforms for Micro-Enterprises

While there are challenges faced by micro-enterprises in Bangladesh, there are possible tools made available through ICTs for their empowerment and growth.

Internet- and mobile-based applications can be used to help micro-enterprises handle concerns regarding information and communication. CICs can provide venues for bringing micro-entrepreneurs and traders/buyers to meet online through the CellBazaar initiative as an example. CICs can serve as "digital brokers" for small businessmen like farmers and fishermen who could transact business with the help of CIC operators in accessing the Internet. This, however, would entail significant work insofar as consciousness-raising on the benefits of the Internet is concerned. At present, there seems to be little awareness and interest among farmers, fishermen, and other small entrepreneurs in availing of CIC services, much less in visiting them. This is where much effort from Grameenphone, its CIC operators, and other stakeholders, such as community leaders and influencers, need to be consolidated to make the CIC a valuable resource center for the local community. In setting up an Internet-based system, it is essential to build upon and integrate already existing indigenous information mechanisms to make it more viable. This may still include participation of middlemen but in a different level or degree. Making them part of a new digital trading system may entail re-training or re-tooling. However, their knowledge on the local ecosystem could be helpful, however, and including them as a player in an ICT-based platform can make transparency more possible.

At present, since Internet connectivity in Bangladesh is low (only 0.3 %), it may be that mobile phones offer a good option because of the high mobile network coverage (98 %). The mobile phone can facilitate faster, direct communication between micro-entrepreneurs, their suppliers, and clientele. Even low-income people can have access now to handsets with the decreasing prices of simple low-end handsets. This augurs well for small enterprises to ride on the benefits that ICT tools can offer to improve the cost of doing business even in extremely challenging and competitive local settings.

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 ISSN 0085-7130 ©Telenor ASA 2008

Implementing Subscription Wise Profit and Loss Statement in Investigating the Emerging Markets

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The telco industry is seeing a rapid growth in users in developing countries due to price erosions on equipment and end-user prices expanding their footprint into low-income groups. The global optical backbone boom in the 1990s was mainly fueled by exuberant investors ploughing in capital, but is this the case for the mobile last-mile / access network for the bottom of the pyramid? Or are we seeing signs that the operators fund the expansion using earnings from high-end subscribers to cross-subsidize these new consumers? In this article we have tried to answer this question by applying a method for allocating both costs and revenues on each and every subscription. We used first hand data for Grameenphone while deploying several allocations methods to estimate the same figures for the other operators in the Bangladeshi mobile industry based on secondary financial and market information sources. The results show that there is a significant cross-subsidy from older and high-end users to new and low-end subscribers, but the industrial investors also contribute to the growth into these BoP customers (reflected in the low-return, long term yields). Hence the subscription-wise income statements were able to prove that the current expansion in the emerging markets is not entirely like the IT-bubble in late 1990s – in this new boom the operators enable high-end customers / early adopters to effectively help in closing the digital divide.

1 Introduction

With a prepaid ARPU of USD 21[1)] for Telenor Norway or USD 18[2)] for Vodafone UK, there are signs that the western world telecom market still earns oligopoly profits. But in developing countries like Bangladesh, it is different and with a declining ARPU of USD 5 for prepaid[3)] Grameenphone (with approximate 60 % revenue and subscription market share) faces certain challenges to maintain the desired EBITDA margin. This paper explores whether smarter ways to look at already available information can help in optimizing strategic decisions

The objective of this paper is to introduce a model that allocates revenues and costs directly on the individual customers in contrast to the much used cost-center or activity based modeling. The model described in this paper is a down-stream costing allocation method in contrast to the conventional accounting on the company's internal functions or processes. The model makes the customer or a group of customers accountable for the costs, enabling a segment-wise profit and loss statement. This allows in fact a true customer-wise, bottom-up financial income statement if implemented fully.

The capability of the model is shown by applying the down-stream costing on the total Bangladeshi mobile industry to see to what extent the operators cross subsidize new and low RPU[4)] customers using margins from older subscriptions and high RPU consumers. Defining the lower RPU-limit that the industry can absorb while maintaining a reasonable payoff will be the main take-away from the study. The study is limited to investigating a single case by applying the model in two dimensions/views (cross subsidy occurring over network AGE and RPU). We will not speculate whether the fiscal policy and the number of competitors/networks in Bangladesh are maximizing the social welfare or not. This is an interesting, and much needed study in itself, though it is believed that such research could be based on the modeling introduced in this paper[5)].

In the following section the downstream costing model will be explained and definitions will be listed. In section three we elaborate on how the total industry figures are generated. Section four deals with the theory and explains how we have applied the model on a real situation: in this section we outline the reasoning for the chosen cost accounts as well as the

1) *End of Quarter 3 2007, wireless intelligence, https://www.wirelessintelligence.com*

2) *Ibid*

3) *End of Quarter 3 2007, wireless intelligence, https://www.wirelessintelligence.com*

4) *Revenue Per User (henceforth RPU)*

5) *Such a study must also include models for market development, handset prices (together with culture the major consumer barrier for entry) and a wide set of macro economic assumptions.*

ISSN 0085-7130

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assumptions behind the allocations for both revenue and cost. In section five the results are represented. In the last section we conclude.

We have converted all figures to USD with a conversion from BDT of 1:70. Note also the difference between a 'subscriber' and a 'subscription' – we do not claim to measure profitability of a consumer, but the cost and revenues associated with a particular SIM card / subscription.

2 Deriving the Subscription-wise Profit and Loss Model

The model is not an accounting model nor does it involve any changes of the charts of accounts, it is simply a report principle. This model shows what a given subscriber is incurring in loss or profit based on that particular customer's behavior, contrary to classical accounting systems that measure financial performance of the company as a whole. The model derives 100 % data from cost accounting and revenue reporting. The model can thus generate profit and loss statement on individual subscription level (which, for big operators can be substantial).

This model has the flexibility to give views from any angle that is important for the management to take in strategic decision-making by giving a new dimension to the available financial information. A few examples of output are; individual subscription's profit or loss statement, subscriptions grouped into segments to attain segment wise profitability, certain products' profitability in a certain location, break-even churn rate for new subs, RPU bucket wise profit to observe the break-even RPU, base station-wise profitability, campaign analyses to check whether a given promotion was profitable or not, subscription life-cycle or age wise profitability analysis, etc.

In telecom industry with different types of billing system and data storage and reporting models it is not possible to fetch all the required data from a single source. The major challenges for data sourcing are; data on cost are mostly available on consolidated statements (in accounting / ERP[6)] systems made for traditional accounting), not on individual subscribers wise as required, different cost and revenue information is collected from different sources like ERP, DWH[7)], mediation / billing gateway system, matching the data collected in different time cycles and reconciliation of data with financials, as available. Our implementation of the model fetches required data, mainly revenue information from DWH and costs from ERP. DWH collects data from pre and post billing systems in the form of CDRs[8)] and groups them into subscriber-wise and hour-wise data. Whereas ERP provides ledger-wise cost and revenue figures on an aggregate or cost center level.

Subscription wise profit and loss statement is derived in four phases; i) data collection; ii) allocation of income, capital (henceforth denoted CAPEX) and operational expenses (henceforth denoted OPEX); iii) report generation, e.g. on-the-fly profit and loss statement generated on a weekly basis; and iv) adjustments with financial statements from the accounting system on monthly basis. It was observed in our systems that it takes at least seven days' time for individual subscriber data to take a stable form, for which the cycle to calculate profitability has been set to seven days.

Data collection and allocation of revenue are two different processes. Most of the revenue is delivered subscriber-wise as well as hour-wise by DWH. Subscription wise usage pattern is taken from DWH to allocate consolidated CAPEX and OPEX cost on to individual subscriber level. In addition to that, the existing model has the option to split revenue into outgoing and incoming minutes. This means the revenue is sub-divided into 50-50 on both 'Caller'[9)] and 'Receiver'[10)] in case of on-net outgoing minutes. This also gives us the flexibility to split the network costs into the two parties (Caller & Receiver). This ensures that the model is consistent over charging regimes and makes sure the value of a call terminated is correctly priced (it takes two to make a call).[11)] For off-net calls 'Caller' gets the whole share of revenue generated.

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6) *Enterprise Resource Planning (ERP) systems integrate (or attempt to integrate) all data and processes of an organization into a unified system. A typical ERP system will use multiple components of computer software and hardware to achieve the integration. Ideally, ERP delivers a single database that contains all data for the software modules.*

7) *Data Warehouse. According to Wikipedia, a data warehouse is the main repository of an organization's historical data, its corporate memory. It contains the raw material for management's decision support system. The critical factor leading to the use of a data warehouse is that a data analyst can perform complex queries and analyses, such as data mining, A data warehouse might be used to find the day of the week on which a company sold the highest prepaid product in May 2006, or how the change in tariff for a particular hour in May 2005 has changed the usage behavior of subscribers.*

8) *Call Detail Record.*

9) *A party, outgoing and caller are used here interchangeably.*

10) *B party, incoming and receiver are used here interchangeably.*

ISSN 0085-7130

Data collection and allocation of Cost is a complex process as subscriber-wise cost is not available from any system sources, the consolidated cost is allocated on individual subscriber based on certain logics. Three smaller methods have been developed to allocate costs onto individual subscribers; Direct (or Averaging), Linear/Unit-wise cost allocation and something we have termed "Profit measure". A brief overview of these methods is reviewed in the following paragraphs.

Direct or Averaging Method allocates costs on to the applicable number of subscribers, i.e. instead of projecting the cost roughly on every active subscriber it will be allocated on relevant group of subscribers. For example, Bill printing cost will be equally distributed among the active postpaid subscribers. The linear cost allocation model is applied to those costs that depend on every unit sold or intake; for example, SIM card cost. Direct allocation may raise some confusion for which only the activated SIM counts have been considered. What if the SIMs are in distributors'/ retailers' inventory? So all SIMs delivered within a time frame may not be activated within that period. Moreover some previous stocks may get diluted in that period's total activation. In such instances the accounting system's total cost will not match with the total cost allocated on each subscriber using unit-wise costing method. The remedy is to adjust the figures with a multiplier for each and every subscriber that will 'force' the accumulated Subscription wise Profit and Loss statements to be equal to the monthly Financial Income statement.

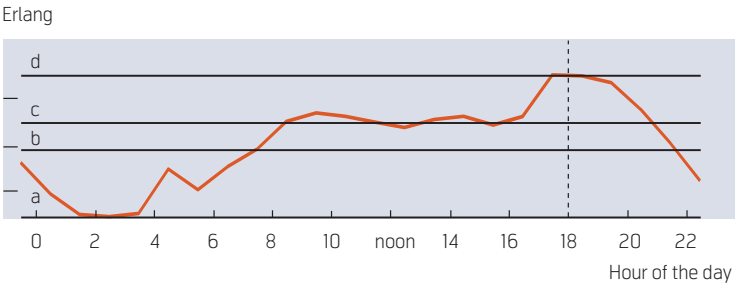

Figure 1 Allocation of Network CAPEX on different subscribers based on their usage behavior

Marginal Costing Method:
Following the figure above, if we consider point a *then we see that the cost incurred for handling this level of capacity should be allocated over all the day's 24 hours as it is the minimum capacity needed throughout the day. Then the hourly cost portion will be further allocated on to individual subscription according to their usage in that hour. At the other extreme, point* d *(from 6-7 PM) is the busy hour traffic, the subscriptions calling in that hour will bear this hour's additional cost (the investment needed to build capacity to handle the difference between busy hour and the second most trafficked hour) and thereafter share the cost portion of the remaining 23 hours.*

Following the same methodology point users calling in an hour demanding capacity b *(let's say this is the 16th less busy hour during the day) will be allocated the proportionate cost of that hour along with the cost portion of the 15 less trafficked hours as well, and for point* c *capacity users will be allocated the proportionate cost of that hour and also share the cost portion of 11 other hours.*

Profit Measure Method is the base for allocation of capital expenditures such as Network elements and billing system related costs. This method needs input from three sub models; i) Actual outgoing Minutes of Usage (henceforth denoted MoU); ii) Actual incoming MoU; and iii) Marginal Costing Method. Logic for allocating Actual Outgoing MoU has been essential in determining on-net- vs. off-net-wise and peak vs. off-peak-wise costs. For example, a subscriber calling to POTS[12)] will have to bear the expenses of a point of interconnection[13)] as for them the equipment needs to be installed. Cost for Actual incoming MoU is allocated by giving less cost on the on-net call receivers compared to off-net. Although for off-net Receiving Minutes opoerator receives interconnection charges of USD 0.006, the total network usage cost is greater than the interconnect revenue, hence in this Profit Measure allocation method a higher cost is allocated for receiving off-net incoming calls compared to on-net calls. Both actual outgoing MoU and incoming MoU have been derived from Marginal Costing method.

Marginal Costing Method allocates network costs according to usage pattern of different subscribers (outgoing and incoming minutes of usage). In this method the network cost that operators incur in order to build extra network capacity for a specific user is considered. A subscriber calling at an odd hour would bear the appropriate portion of cost based on his/her usage as the operator needs to build extra network capacity to support the calling pattern during that specific time. Figure 1 explains. Note that this method is most relevant for operators with almost full coverage as in effect, it says that only increased capacity should be allocated, and not additional coverage. This can be changed but for simplicity we have assumed that for Bangladesh the cost of cover is already sunk.

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11) *"T-Mobile hypothesized that if there were no inbound calls available, there would not be the current level of subscribers on the network and many subscribers would not be interested in the service. It added that people subscribe to mobile networks because of the ability to receive calls. T-Mobile argued strongly that in reality it was both inbound and outbound calling that drives subscriber costs and that the levels of such expenditures would never be incurred without both being available. (http://www.competition-commission.gov.uk/rep_pub/reports/2003/fulltext/475a7.9.pdf)"*

12) *Plain Old Telephone Service*

13) *For example, PCM expenses*

Missed calls and erroneous call setups resemble the non revenue generating calls occupying significant network capacity. In Bangladesh there are more Missed Calls than established ones. There are some eight different types of Miss Call / Error setup, and to identify subscriber-wise costs for this section, all sorts of missed call related data are being captured for one specific day. Subscribers are grouped into different RPU bucket based on their usage pattern, and cost is allocated for missed calls and error generation ratio into different bucket based on their usage pattern.

The last step to derive the profit and loss statement is 'Adjustments' with the published financials. Different assumptions are being used for allocation methods and the period of cost occurrence may differ from realization period (same classic example: SIMs delivered to distributor out will trigger taxation thus realized in a period different from when it will be activated – the latter 'cost when activated' is considered in this model as all revenues and costs are pushed down-stream to an end-customer). Usually official financial data becomes available in different periods, like on a quarterly or monthly basis. To ensure that both the forecasted cost and revenue of different operators match, revenue/cost item wise individual subscriber's figures are adjusted with different financials as they get available.

3 Data Collection on the Industry

The described model was fully implemented on Grameenphone, but to get 'Profit and Loss Statement' of the subscribers of the whole mobile telecom industry it was necessary to collect data from all the operators. None other than the regulatory body have access to all necessary financial information (and sometimes not even them), hence we were forced to make estimates for the free variables. Explaining the available data, methods used for estimation and accuracy of the aggregation (from a single company to the whole industry) is the aim of this section.

The bottom-up (or 'Base Company' as denoted henceforth) method includes several market share calculations such as subscription, capacity and revenue, taking a given base company as the standard for approximations of the others. These methods are complex in themselves, but are tested and tuned with public data for years and are taken as exogenous input to the model. Base company is the most used method to find details like inter-bucket caller/receiver ratios as well as interconnect minutes.

The top-down method is used when one knows the total but not details for all companies. In this study we had access to 100 % of the information for 60 % of the market (Grameenphone) and for certain parameters cost information is also available through reporting from other players, but not from the total industry. Having the total (and 60 %) it is possible to allocate reasonable ratios for the rest of the players using for example market share ratios or most resembling / equal known player.

There are three main types of data sources, apart from the subscription-wise income statements, with different levels of accuracy. The most reliable are the reported financials which can be drawn from the local reporting or from the consolidated reporting of the mother company. Government data are still considered reliable, though some of the reporting on subscriptions is inaccurate as there is no consistent definition of an active subscription. Further, there are third parties, research and news agencies, providing information such as spending on advertisement and promotions (A&P).

Check and balance is done in mainly two ways; if data is available one can do a top-down, bottom-up or vice-versa depending on the available information. But this is rather the exception so the most deployed control is to see if the four views yield the same bottom line results. The costs and revenues are allocated differently, but the total (such as total industry EBIT) must be exactly the same in all dimensions. Thus, if there is something wrong in the allocations the bottom line will not match if not by freak coincidence. The unfortunate aspect of this control method is that it cannot give you a clue as to where the error is, as the top-bottom-top method will.

Due to the unstable reporting of customer base by the regulator and with inconsistent churn definition we have chosen to rely on the 90-days-active definition for subscription count; total customers from all operators are estimated using unique MSISDN[14)] from call records (with a likelihood estimation of hidden subscribers who only call on-net).

4 Implementation

Quarter 2 of 2007 is used as the base year for the model as that was the latest complete data set when we implemented the model. The industry had in quarter 2 2007 a penetration of 18.7 %, an ARPU of USD 3.51[15)] and an EBITDA per user of USD 0.94.

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14) *Mobile Station International Subscriber Directory Number*

15) *The exchange rate used throughout the model is USD 1.00 = BDT 69.00 (as per rounded figures from Q2 financials of base company.*

Cost heading	Cost estimation method	Check & balance	Source
Manpower	Top Down Approach: salaries & benefit expenses for employees under the payroll of the company (regular, contractual and part-timers)	Bucket-wise figures are cross matched with the total figures in reported financials	Financial statements & Manpower records
SAC	Bottom-up (or Base Company) Approach: Cost of the SIM card and taxes paid for each new subscription	Adjusted with the multiplier for each and every subscriber that will normalize the deviation between unit wise costing total and accounting cost total figure	Financial statements
A&P	Top Down Approach: All kinds of promotion (media commercials, press and billboard advertisements) and trade-marketing (events, merchandizing and channel partner development) costs	Third party reports are cross matched with figures provided in available financials	Financial statements & 3rd party A&P cost reports
Interconnection	Bottom-up (or Base Company) Approach	Crossed matched with the total inter-connection charge figures provided in available financial statements	Financial statements & Call records
Commission	Top Down Approach: Commission paid on start-up of the subscription, the commission on flexiload (e-top-up) and scratch card top up and loyalty commission. Both postpaid and prepaid can be paid by e-load and the industry follows a set standard (4 %)	Cross checking with EBITDA figures after all other costs have been subtracted	Financial statements
Other operating costs	Top Down Approach: Rest of the operating costs grouped into one		Financial statements & Published financial figures
CAPEX	Bottom-up (or Base Company) Approach: Total asset value has been converted to depreciation cost (calculated by dividing the total investment by the lifetime) applied to the period considered (Q2 of 2007)	Allocation is crossed matched with the financial figures and EBIT	Financial statements & Call records

Table 1 Costing groups based on overall available Financial and 3rd party information

It is worth noting that we are mostly referring to subscriptions rather than subscriber/consumer/customer as this is a more accurate definition since the revenue is attached to a subscription account rather than a person. In the same manner, the costs are allocated based on certain attributes or state-changes with a subscription. The study assumes a 'one-to-many' relationship between consumer and subscription.

It is clear that studying income statements of millions and millions of subscriptions will not reveal any clear results. The reason for using the costing on subscriptions is to enable us to group them in buckets upon need. If a campaign-effect is to be studied it is useful to extract and group those subscriptions that availed the offer. In this case we will investigate the phenomena of cross subsidy over network AGE (old subscriptions subsidize new) and usage (high RPU subsidize low). Hence we have grouped the subscriptions in buckets along the time line and the RPU scale.

We have chosen ten buckets for the revenues and five AGE groups. The reasoning for the borders and break-up in the revenue allocation view is focused around current industry break-even. To explore some future predictions we have the finest dispersion and the majority of buckets on the lower side of the break-even. In the timeline view we have considered the exponential growth of the Bangladeshi market and therefore to make a fairly even distribution of customers in different age groups we have shorter intervals closer to date.

Arguments used for grouping the subscriptions to explain the cross-subsidy phenomena are also applicable for the grouping of the costs into headers.[16] As we are only looking at the bottom lines in this study (and not how a certain subscription segment is affecting any given cost driver)[17] – to what level is this cross-subsidy sustainable for the industry? We need not consider the practical grouping; rather, in theory,

16) *Fixed cost of Capex has been opex-ized; if we don't trace back the total cost (Capex & Opex) we cannot identify the bucket-wise profitability.*

17) *For example, if number of subscriptions in RPU bucket USD 1–1.5 is doubled, how much must network capacity increase? Or; if a min-RPU of USD 2 is implemented using validity – what will happen to SAC?*

it would be most accurate if all the costs with the same allocation method were grouped together, even if these were from totally different function or process.[18] With 100 % information this principle could be easily implemented, but with limited information available when studying the whole industry, we were forced to group the costs as per the most prevalent public available information.

The rest of the section will elucidate how we modeled the whole market based on 100 % information of only 60 % of the industry while limited for the remaining 40 %. To summarize, the cost heads applied in the practical example is limited by Occam's razor[19] while the incomplete information is 'forcing' more function-oriented cost headings.

As stated earlier, revenue has been split into a Caller and Receiver part. For the Base Company, most of the revenue is available subscription-wise as well as hour-wise. For the rest of the industry / other operators we have used both the bottom-up (Base Company) and top-down approaches, assuming the Base Company receives 60 % of the off-net minutes outgoing of the rest of the industry.[20] Similarly, outgoing calls to and from other operators within themselves are identified accordingly. Adjustment to the duration of on-net and off-net calls is made according to market promotions and events (on off-net & on-net offers) and with official financials at the end of each period. The process is implemented on each RPU and AGE bucket. The APPM multiplied by duration gives respective revenue figures for each bucket. Further adjustments are made periodically with Value Added Tax (VAT) figures obtained for all the operators (top-down)[21] from available market information.

Manpower Cost portions have been allocated on each bucket according to proportion of network usage for that specific bucket. The relation with network is due to significant utilization of manpower in network and system build up/maintenance for talk-time provision. The bucket-wise figures are clubbed to check with the total financial figures (bottom-up-bottom). Subscriber Acquisition Cost has been allocated by averaging the total cost on new subscriptions (0–3 month old subscriptions), based on top-down approach. The 0–3 month time frame has been chosen as all SIMs delivered within a time frame may not be activated within that period or some previous stock may be included. In such instances the accounting system's total cost will not match the total cost allocated on each subscriber using a unit-wise costing method.

Buckets of RPU (USD/month)	Buckets of Subscription Age	Cost Headings
0 – 0.5	< 3 months	Manpower
0.5 – 1.0	3 – 6 months	SAC
1.0 – 1.5	6 months – 1 year	A&P
1.5 – 2.0	1.0 – 1.5 year	Interconnection
2.0 – 2.5	1.5 year +	Commission
2.5 – 3.0		Other operating costs
3.0 – 4.0		CAPEX
4.0 – 5.0		
5.0 – 10.0		
10.0 +		

Table 2 Overview of i) grouping of subscriptions in monthly RPU, ii) network age, and iii) the cost headers

Advertisement & promotion costs have been equally allocated (top-down) into acquisition A&P expenses and retention A&P expenses by averaging on each group of subscriptions -50 % on new subscriptions (0–3 month old) and 50 % on old ones. Interconnection costs have directly allocated on off-net calls based on MoU outgoing. 60 % of the industry figures have been converted to 100 % on proportionate basis.[22] Commission costs have been allocated proportionate to usage – the more the usage, the more the recharging pattern with proportionate commission being paid to the retailer. Other operating costs have been allocated by averaging on all subscriptions. This cost could not be sub-divided as no figures were available for further breakdown.

CAPEX allocation has been done by allocating cost for actual outgoing Minutes of Usage on subscriptions depending on on-net – off-net and peak – off-peak patterns.[23] As the mentioned example in the model description (Section 2), a subscriber calling to

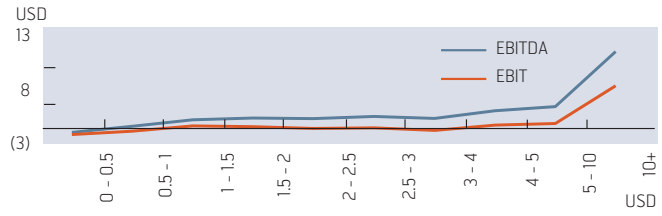
18) *Group the costs that have the same dynamics; they follow the same behavior with respect to the variables (age and RPU).*

19) *The sufficient, necessary principle – "entities should not be multiplied beyond necessity" (law of parsimony).*

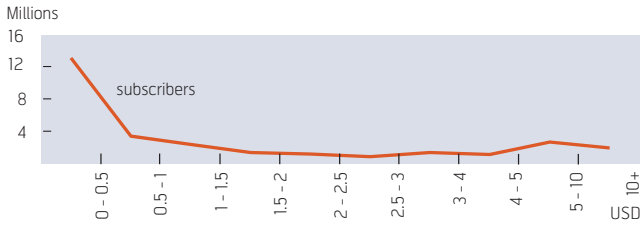
20) *Having 60 % subscriber base.*

21) *The total VAT figures (15 % of voice and SMS revenue) enable us to estimate the total revenue for each operator.*

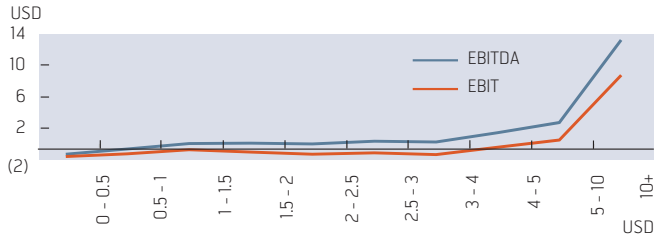
22) *This also gives us the flexibility to split the network costs into the two parties (A & B), unless off-net where A-party takes the whole cost (as the switching out is not based on the BTS cost, but rather a fixed fee of 40 paisa or USD 0.006).*



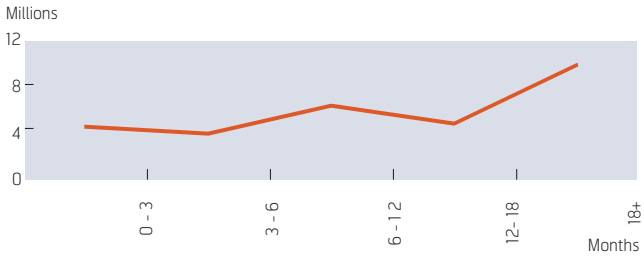
RPU50-50



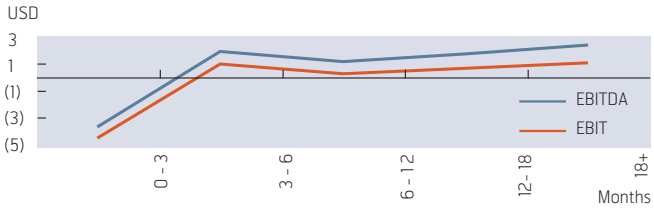
RPU (subs)



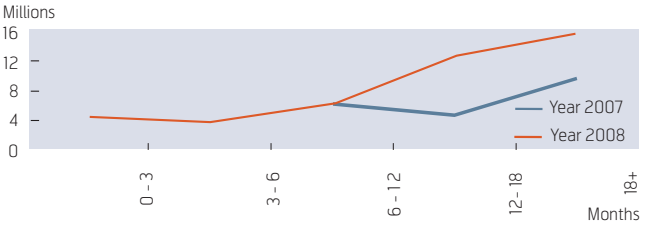
RPU100



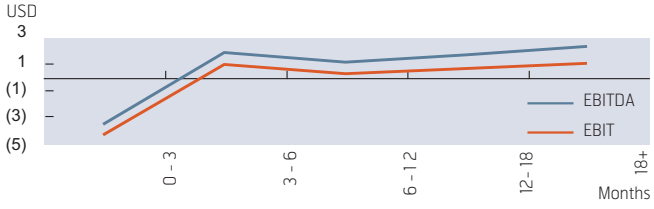
AGE (subs)



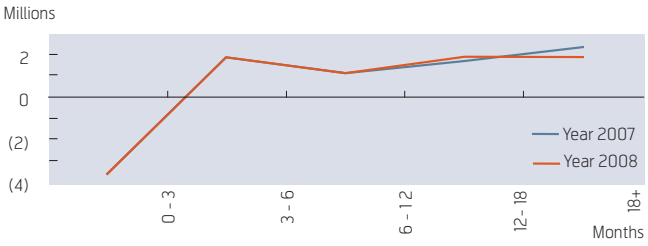
AGE50-50



2008AGE (subs)



AGE100



2008AGE50-50

RPU50-50 denotes the profit or loss on different RPU buckets of subscriptions if revenues are allocated 50 % on caller and 50 % on receiver. For RPU100 the same buckets are used, but the revenue is 100 % allocated on the caller. The RPU (subs) and AGE (subs) plots show the distribution of subscriptions over RPU or AGE bucket. The '2008' prefix indicates the forecasts described in Section 5

fixed lines will have to bear the expenses of PCM and the PoI operational costs. Cost for missed call + error setup is found by ratio of ARPU to missed calls / erroneous calls and used to allocate the respective cost difference on ARPU and AGE buckets.

5 Model Output on the Industry

The previous sections of the paper have described how a subscription-wise income statement can be produced and how useful it can be to test a given hypothesis regarding customer profitability. Further, we have shown one way of implementing the model

23) *A subscriber calling at an odd hour would bear the appropriate portion of cost based on his/her usage as the operator needs to build extra network capacity to support the calling pattern during that specific time.*

on the total industry to investigate certain characteristic, namely whether the operators cross subsidize low-RPU and new subscription with high-end and old subscriptions respectively. In this section we will produce the results and briefly discuss the implications.

We have predicted that the total per month revenues for the mobile operators in Bangladesh were slightly more than MUSD 100 in Q02 of 2007, while the operational expenses as defined in this paper were around MUSD 73.4 yielding close to 27 % industry margin. When depreciation and amortization of MUSD 30 is considered the industry is at a loss of 3 %. This negative EBIT margin means the industry, with the current pricing and taxation, is unable to maintain/operate the asset level which mostly consists of network. Hence, the residual profit from high-end RPU and old subscriptions that covers the operational expenses (including direct taxations such as the SIM-tax) will not cover the subsidies of new and low-RPU subscriptions.

If we now set network depreciations aside,[24] and look at how the industry operates considering only the EBITDA margins we can consider two models for cross-subsidy; top extreme subscriptions paying for low extreme when it comes to the RPU dimension and old subscriptions covering up for newest in the time-view. We denote this 'the tail view'. The second is stacking EBITDA from low (or new) and see how far up the scale one has to go before the losses are zeroed out. We term this 'stacking from below'. First we will focus on the RPU dimensions.

With a 50-50 allocation and stacking EBITDA from below we see that the lower 82 % or the lower 23.5 million yielding subscriptions cancel each other out. This leaves some 5.0 million subscriptions to cover 'ITDA'[25] and yield profits to the shareholders. If we are not applying the 50-50 allocation of revenues, but simply consider all revenues on the calling party, the ratio is 25.3 to 2.2 million.

If we rather use the tail view we see that the operators spend the margins from some 0.9 million of the high yielding subscriptions to cover the cost of handling around 12.8 million subscriptions that incur losses. This ratio is fairly irrespective of revenue allocation.

If the industry were able to set min-RPU levels through for example tacit collusion on top-up validity effectively blocking less than USD 0.5 RPU subscriptions, the industry EBITDA will increase by some 8.9 %. In the same case, if one chooses to look at a 100 % A-party revenue allocation one then considers all subscriptions of less than USD 1.3 as loss incurring. Blocking these 17.4 million subscriptions will theoretically increase the industry margin by 12.4 %.

Now looking at the new vs. the old subscription dimension in the 50-50 view and stacking from below one can deduce that the 12.5 million oldest still active subscriptions are left to pay non-operational expenses – the rest cancel each other out. Looking at the 100 % allocation the same extraction indicates that half a million fewer subscriptions will fuel the EBITDA. If we want to see how many of the oldest subscriptions are necessary to weigh up for the new intake, the 'tail view', the model indicates that between 68 % and 73 % of the total 9.6 million subscriptions activated before January 1, 2006 (more than 1.5 years old) must subsidize some 4.3 million brand new SIMs.

With the time-line dimension of the subscription-wise income statement it is also possible to estimate future profits to some degree by multiplying the type of subscriptions one expects to fill the network in the future. Of course this is a risky method as guessing on how new users will behave is not straightforward, but at least it can give some kind of indication. In this paper we have investigated a simplified forecast: how will the industry look if you double the subscriptions that are less than one year old? This will somewhat replicate what can happen by next year in Bangladesh. We have not doubled-up the subscription acquisition cost, while the A&P for new subs have been doubled. Apart from these heads all other costs are following the same allocation. We are a bit optimistic thinking that we can gain all these subscriptions without lowering the prices, but on the other hand it will then give us a secure upper limit on how the industry can do at best – a good old 'best case scenario'. Note also that as we have allocated the SAC on the first three months of a subscription it is not needed to consider any 'cost of churn' – in the way we have implemented the income statement model it is already included when the SIM is activated. Further, it is worth noting that the study from Wireless Intelligence, *Opex: a bubble or squeeze,*[26] shows that there does not exist any economies of scale in the mobile telco industry, hence one cannot predict major increase in efficiency in Bangladesh due to growth in subscriptions.

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24) *Effectively saying no more investment in the network will take place, which seems highly unlikely as AMPU levels have been fairly stable over time and there is an increasing market demand for data services.*

25) *Interests, profit taxes, depreciation and amortization.*

26) *Garner, M. Opex : A bubble or a squeeze. Wireless Intelligence, 3 February 2006. https://www.wirelessintelligence.com/print/035823.pdf*

Hence in the 'best case' one year down the line the model yields an approximate 51 % increase in revenue from some 14.3 million subscriptions. The EBITDA is estimated to increase from 26.7 % to 30.3 %. Still, in this theoretical best case it is clear that the industry will struggle to retain any earnings. The positive sign is that in a year, and stacking from below, almost twice as many old subscriptions are 'free' to deliver positive return to the operators – the cross subsidy over age will be reduced.

6 Conclusion

In this study we have explained how an operator can implement a reporting on top of the existing information systems that outputs the income statement subscription-wise. There can be multiple uses and the strength of the model is clear when income statements are grouped to study a specific phenomenon. The study further explained briefly how this model was implemented in Grameenphone and what practical challenges the company was faced with. A special case of cross subsidy in the rapidly growing Bangladeshi mobile market was dissected segmenting along the RPU scale and subscription age. Certain challenges were faced moving from an internal company with 100 % information to the whole industry with limited data. Methods for modeling the unknowns were devised and explained.

The results show that looking at ARPU and EBITDA will rather hide facts than yield useful insight. The outcome supports the hypothesis that the industry cross-subsidizes to attract new users. This transfer of margin from old and high-RPU subscriptions (urban, rich) to new and low using (rural, poor) is so massive that the industry in total was left with losses in the second quarter of 2007. At the end was presented a best case scenario for how the industry will look after a year. Although the EBITDA was estimated to increase some 3.6 % and the number of cross subsidizing subscriptions is halved it is questionable whether the industry will generate enough margin to pay for the depreciation of the heavy network investments.

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Ruralfone Inc. – The Need for a New Methodology in Providing Telecommunications to Bottom of the Pyramid Markets

DENIS COTE

Denis Cote is the Founder, President and CEO of Ruralfone Inc.

It is widely recognized that the majority of the next billion telephony subscribers will come from rural emerging markets. We, at Ruralfone Inc. argue that the dominant methodology for servicing this BOP (Bottom of the Economic Pyramid) market by telecoms operators – which is, to adapt *existing* telephony models – is an inferior alternative for both the population serviced and the operators' bottom line. Rather, we are convinced that the challenges presented by this market niche demands *exclusive* concentration on that particular segment.

In May 2005, we launched our service through our subsidiary "Local Serviços de Telecomunicações" (LOCAL) in one of the poorest cities in the world: Quixadá, in the northeastern state of Ceará in Brazil. LOCAL now has four cities in operation in that state.

We approached our market with a Business Model completely different from a traditional operator emphasizing:

- Maximization of local resources (decentralization)
- A completely different distribution system
- High personalized customer services

After almost three years of operation, we have proved that:

- Even in the low-income market segment (GDP being around 1/15 of the USA GDP), it is possible to be profitable.
- The social impact created by our "new approach" in telephony on the local population ensures the Business Model is highly sustainable.
- The solution to address the low-income markets resides more in a completely non-traditional approach as opposed to a new "technical solution".

LOCAL
TELEFONIA SEM COMPLICAÇÃO

Telephony without complication

The majority of the next billion telephony subscribers will come from poorer backgrounds in rural emerging markets. We argue that adapting existing telecom models to service this BOP (Bottom of the Economic Pyramid) market will provide sub-optimal results for both the populations serviced and the operators. In other words, these new populations present such differences in demographics, income, and acquaintance with telephony that they necessitate an independent business model.

Ruralfone Inc. and its Brazilian subsidiary, Local Serviços de Telecomunicações (LOCAL), believe they have proven the necessity – and gains to be had – of this exclusive focus. In particular, we believe that the cost-constraints involved in servicing this newly reachable market require three fundamental shifts:

1 Decentralized build-up and allocation of resources;

2 Demographic-specific sales & customer care processes;

3 A willingness to enter, manage and innovate within local, rural economies.

The results speak for themselves. Two years after we launched service in rural Ceará (a poor state in Brazil's rural Northeast where income per capita is 1/6 the national average), we had doubled the teledensity of our pilot village, boosted our subscribers average monthly MOU (minute of use) to one of the highest rates in the world (7 times the Brazilian average), and earned the highest customer satisfaction ratings in the Brazilian telecom market (96 % satisfaction rating). At the same time, we marched to a 50 % fixed-line market share and sustained an EBITDA margin twice that of most of our competitors.

ISSN 0085-7130

Some of the most industrious subscribers, who live outside of the main area of coverage, wire their handsets to an external antenna thereby ensuring proper coverage

To begin, the difference between the markets in which we operate and those of nearby metropolitan areas is striking. We provide service solely to economically underdeveloped, non-metropolitan areas with populations of less than 50,000. Currently, the average population of villages in service is 35,000, with a range between 30,000 and 45,000. (Efforts are being made to optimize the business model to support villages with populations as small as 3,000 – 4,000 inhabitants.) These villages are strikingly poor, with an average annual GDP per capita of R$ 2900 ($ 1660 or ⇔1135) – roughly 1/15 that of the US, or 1/20 that of Norway. This dearth of wealth is reflected through to their uptake of technology: the average, fixed-line teledensity of each village prior to operation is 9 %, around 1/8 the level of the US.

The LOCAL team for the city of Quixada, friendly face-to-face sales and customer service

As becomes readily obvious upon viewing traffic in the streets (the vast majority of which is on motorcycle or donkey-drawn), adapting existing telephony models and distribution strategies to service this market can only bring mediocre results. The market is strongly differentiated from its urban-affluent counterpart, and demands a totally distinct set of strategies. It is helpful to think about the difference as Toyota does in marketing its cars: Toyota employs a very distinct sales organization, retail distribution, and marketing campaign to sell its more luxurious, Lexus branded cars. The strategies differ so strongly that the two brands are often not found on the same lot.

The differences between metropolitan and rural markets are more pronounced in developing markets, and thus the need for an alternative approach for each segment an even greater necessity. Telecom value for customers is an entirely different calculation, requiring market-tailored product, sales and customer service strategies. Importing a one-size-fits-all model (i.e. adapting the same as those used in local metropolitan areas) will neglect customer demands and accordingly, leave business objectives unmet.

By focusing solely on this demographic, we have eschewed differences between wealthier, metropolitan markets and more rural ones. This permits an organizational build-up and structure better suited to its environment than that of a typical operator.

Free to concentrate our resources in the cities and villages we serve, over 85 % of our workforce are sourced from – and continue to live in – villages where we offer service. This alternative is not only less costly (operation expenditures are approximately 1/3 of our closest competitor), the resources' omnipresence within the city can be better employed to serve our customer base. From the sales side, this benefit has been realized with improved sales performance and 24-hour, 7-days a week customer service (most of which is face-to-face); from a technical side, it has enabled a nearly instantaneous response to any customer-affecting issues.

To better deliver value to this customer segment, all aspects of the sale are kept as simple and unburdensome as possible. Only two, easy to understand prepaid calling plans are commercialized. 80 % of the subscriber base have opted for a single, monthly "all-you-can-call" local fixed-line plan. The other twenty percent have signed up for a more traditional pay-per-minute, with the lowest and easiest to understand tariffs in the business. This focus on a customer's preferred experience extends through to the recharge process as well. Subscribers are dialed once a month

by their account executive (a local employee who manages a customer's product account during their lifecycle with the company), to schedule a recharge. On the date of credit expiration, a "moto-boy" is dispatched to collect the funds and deliver the credits – all free of charge to the user. These account executives also manage problems that develop specific to the user, answering simple questions, replacing lost SIM cards, providing 15-day loaner handsets, and performing home coverage tests. Given that we actually talk to the vast majority of our subscribers at least once a month, we benefit from a relationship with our customer base that is unlike any other operator. This focus on the "experience" of telephony for our customers engenders a fierce loyalty.

From a business standpoint, being the only telephony service provider with resources in these areas has translated to a more rapid sales cycle, less billing hassles, a reduction in customer assistance calls and the best customer retention figures in the industry. Our unique distribution model eliminates the need for widespread point-of-sales recharge terminals and/or retail distribution partners, and allows for more inventory flexibility. From both a customer and operator standpoint, the returns from our sales model proves the dominant place that must be allocated to the specificity of rural, emerging market consumers.

Also, our success has been in large part due to our ability to innovate with the participation of the local community, rather than trying to import solutions from abroad. For example, we have been actively involved in using telephony to improve governance, increasing City Hall line density on average 7-fold in the cities in which we operate.

Beyond facilitating communication between population and government, it has provided a platform for various initiatives, including direct report hot-lines for abuse and violence against women and children and other job-creating public services. We also source our marketing activities from the communities in which we are present, stimulating local small businesses that run the gambit from radio advertisers to flier-runners.

Furthermore, each year in every village where we are present, we team up with some of our subscriber base and partners to provide numerous services that are inadequately available in these areas. With the help of local doctors, lawyers, professors, other public servants and members of the community, we arrange for vaccinations for the youngest members of the population, seminars on health-related issues, issuance of new identification cards for the elderly, etc.

Instead of relying on 3rd party retail distribution for pre-paid recharges, LOCAL accepts payments and delivers pre-paid credits via a "moto-boy" wherever its subscriber may ask

Aside from its downstream effects for the community at large, this local engagement has given us better traction to enter largely informal markets, where the endorsement of a mayor, small business owner or long-time friends matter more to consumption decisions than celebrity or other more expensive endorsements, sourced and distributed from a distant media center.

Nowhere have the benefits of incorporating the local community been felt more strongly than in the ingenuity harvested from a base of previously-neglected employees. Providing performance-based salaries and promotion opportunities to our workforce – usually women between the ages of 20-30 – we have provided local populations with prospects for responsibility and decision-making generally unavailable with other employers. In turn, our average employee makes double the market wage with full benefits. This local investment in managers has paid off handsomely for the business: nearly every idea, from "all-you-can-talk" plans to City Hall involvement to

Vaccination of a young child during one of LOCAL's yearly "Local Action" days

ISSN 0085-7130 ©Telenor ASA 2008

"moto-boy" recharges, stem from our interaction with our employees. We are most proud that our regional revenue streams are now fully managed by local employees, who have spent years raised in our villages to earn promotions and privileges unimaginable to their peers.

Most operators and suppliers talk about "new technologies" and "future infrastructure products" which, in their opinion, would solve the fundamental issues in addressing the BOP markets. We are convinced that technology related solutions, although helpful, are certainly not the main success contributors. We furthermore believe that existing technologies are suited to address these markets, providing that there is an all-encompassing "focus".

In addition, we claim that although operators' "geographical market segmentation" could help to focus overall strategy, the BOP market segmentation approach should be much more attentive to population categories and income-levels as opposed to geographical areas. Rural developing markets of similar income levels have a lot of commonality between themselves regardless of geographical location. BOP populations have similar preoccupations and priorities independently of their nationalities, as their local political and socio-economic environments are similar. They rely more on local governments and solutions rather than central or national administrations for answers because they have different needs than those of their metropolitan counterparts.

In conclusion, servicing rural BOP telecom customers will come down to creating value for all of its stakeholders: the customer, investors and the community. By focusing exclusively on this market, we have been able to construct a business exceptional to this market:

- Customers are more satisfied and talk for longer at a fraction of the price;
- A low OPEX/sub enables an EBITDA twice that of its competitors; and
- BOP communities and employees are invested in, developed and given opportunities previously out of reach.

Ultimately, while many businesses have spotted the future importance of rural emerging markets, few have ventured to adopt a truly differentiated and exclusive approach the market demands. We have, and done so at great profit to all involved.

Denis Cote is CEO and Chairman of the Board of Ruralfone Inc., a telephone service provider that aims to be the most affordable supplier of basic telephone service to the BOP market segment outside metropolitan areas in developing countries. An American and Canadian national living in Brazil since 2004, Mr. Cote has over 35 years of international telecoms experience. Prior to founding and overseeing Ruralfone, he held executive positions at interWAVE Communications and at the microwave transmission division of the Harris Corporation.

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The 'Mobile' Face of Contemporary China

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The adoption and diffusion of the mobile phone has been exceptionally rapid in Mainland China, especially in its capital Beijing and the coastal industrialized towns. With almost half a billion mobile phones, China has rapidly become the biggest market for this technology and one of the world's leading nations in the production of information and communication technologies. In the last years also the amount of qualitative research devoted to ICTs in China is increased, while that of quantitative studies is still limited. This paper describes a quantitative research study, specifically focused on the appropriation and domestication of the mobile phone in China. On the basis of questionnaires that were personally administered to a convenient sample of 487 respondents, the design of this research attempts to answer the following research question: How the relational sphere in China is reshaped by the massive use of the mobile phone? And then are there striking differences between the attitudes, behaviours and practices associated with mobile phone use in China and in the West?

This is a very broad research topic, but in this paper we confine our examination to the social implications of the mobile phone use on some aspects of the relational sphere. A convenience sample of 487 respondents can hardly provide a basis for generalizations about the Chinese population as a whole. However, the results of this study will serve to indicate the most important patterns of mobile phone use, which would be a fruitful subject for future research. Thus the data presented here will provide the direction for further inquiries into various aspects of mobile phone use in China.

China's Position at the Crossroads of Industrialization, Technology, and Modernity

Sombart (1911) argued that each culture adapts technology to the context of its daily life. But what does this mean in the case of China, a country with a culture that differs strikingly from its Western counterpart? How is new technology such as the mobile phone appropriated and domesticated in China? The effects of technological advances are widely studied in the West, but this research is not necessarily applicable to China. Why did the mobile phone, in particular, become so immediately and widely popular among the Chinese? Why is a mobile phone so attractive that Chinese men and women are willing to spend one to three months' wages to own one?

With almost half a billion mobile phones, China is now the biggest market for this technology and has become one of the world's leading ICT nations in the production of information and communication technologies. China is a recently industrialized country; its rate of development is very high in comparison to countries where industrialization is well established. It is a country where the diffusion, use, and appropriation of technology, especially information and communication technology, play a strategic role in the development of production systems (Weber, 2003). Industrialization and technology are inextricably bound with another element: modernity (Ferrarotti, 1970; Giddens, 1991a, 1991b). By "modernity" we refer to the radical changes these new developments effect in social structures, the configuration of social relationships, and the perception of self, which result in the reshaping of the material and immaterial organization of the domestic sphere and civil society. Generally, the success of a technological device depends on its ability to make people believe that it will help them to deal with these changes. Technology and modernity are therefore closely interconnected (Law & Du, forthcoming).

In the last years the amount of qualitative research devoted to ICTs in China is increased (Law & Peng, 2004a, 2004b, 2006, 2007; Fortunati & Yang, forthcoming; Yang, 2005), while that of quantitative studies is still limited. Here we present a quantitative research study, specifically focused on the phenomenon of the mobile phone.[1)]

In this paper we address research questions related to the relational sphere of the mobile phone and to users' attitudes towards the device. We will pay particular attention to the investigation of how the

1) *We have already used the data collected during the research to analyse the importance of this device for the Chinese people, particularly its roles in increasing social connectivity, enhancing the sphere of communication, and reshaping emotional distance (Fortunati, Manganelli, Law, & Yang, 2008) and also to examine common characteristics of mobile phone use, such as familiarity, motivation, communicative means (calling and sending SMS), SMS content, and mobile functions (Fortunati, Manganelli, Law, & Yang, 2007).*

 ISSN 0085-7130

mobile is now shaping the social structure of interpersonal relationships in China and how gender differences are articulated. Doing so, we will probably be able to reach a deeper understanding of how Chinese read and interpret this device and which meaning they attribute to the mobile phone as an instrument of social mediation. Furthermore, we will be able to understand some particular features of the digital divide in China as well as the complex role of the mobile phone in immigrants' everyday life.

On the basis of questionnaires personally administered to a convenient sample of 487 respondents, this study investigates the following areas: the identity of the main recipient of calls, the frequency of mobile communicative exchanges, the type of contact (calls or SMS), the nature of SMS content, the respondents' attitudes towards the increasing complexity of the mobile phone, the respondents' passive or active approach to mobile communication, the advantages and disadvantages of the mobile phone, and possible substitutions for the device. Of course, a convenience sample of 487 respondents can hardly provide a basis for generalizations about the Chinese population as a whole. However, the results of the research suggest the most important patterns of the mobile phone use, which should be examined in further research. Thus the data presented here is intended to provide a starting point for a more in-depth inquiry into various aspects of the mobile phone use in China.

Aim and Method

The purpose of the study is broad, and covers a number of aspects of the appropriation and domestication of the mobile phone in China. In this paper, however, we will confine ourselves to the specific issues identified in the previous section. The data were collected during personally administered surveys conducted in March 2006 in Beijing. The demographic variables included in the research were gender, age, education, income, and place of origin (rural or urban). The participants were Beijing inhabitants: 280 males (57.5 %) and 207 females (42.5 %). The respondents' ages varied from 15 to 60, but the large majority of the sample (86 %) were under 30. Almost half were born in rural areas. Nearly a quarter had only basic education (secondary school); one-fifth had mid-level education (high school or some years of college); and more than half had at least one university degree. With respect to income, 21.6 % had no income; 30.6 % earned 1000 RMB or more per month; 34.3 %, from 1001 to 4000 RMB; and 13.1 %, 4000 RMB.[2)]

Results

People who use the mobile phone as a means of conducting their interpersonal relationships end up reshaping their social sphere. Since the phone allows users to be highly selective, they are able to shape the relational sphere in a rigid and self-determined way. Therefore, the first question of the survey was as follows: "Which interpersonal relationships are included in the social sphere maintained by your mobile phone?" We know that not all interpersonal relationships involve the same degree of mobile phone use. There are relationships that encourage only sporadic mobile phone use, and others that rely on it heavily. Table 1 illustrates this situation.

The table provides several insights into the structure of relational spheres in Beijing today. First, the mobile phone mediates in a different measure the different relationships. Almost half of our respondents use the mobile phone to sustain friendship and keep in touch with schoolmates. This type of relationship is the most "mobile" because it is the most fluid, flexible, and equal. In particular, the schoolmate represents a very important relationship in Chinese culture and is like an old friend that one knows since many years. Second, the mobile is not primarily used in the sphere of family relationships. Within families, it is more often used as a means of communication between husbands and wives than between parents and children (21.8 % and 15 %, respectively). It acts more horizontally than vertically. Colleagues (12.3 %) are in fourth place as recipients of mobile calls. Mobile phones are very seldom used to contact people from one's hometown (though a relationship

Recipient	Frequency	Percentage
Your friends or schoolmates	199	40.9
Your partner	106	21.8
Parents, children, or other relatives	73	15.0
Your colleagues or other working partners	60	12.3
Persons from your hometown	2	0.4
Others	11	2.2
N.A.	36	7.4
Total	**487**	**100.0**

Table 1 Most frequent recipients of mobile phone calls

2) *One euro is about 10 RMB.*

Interlocutors	Frequency of contacts					
	Many times a day	Once a day	Many times a week	Once a week	Not often	N.A.
Partner	155 **31.8 %**	54 11.1 %	46 9.4 %	16 3.3 %	36 7.4 %	180 37.0 %
Parents, children or other relatives	39 8.0 %	49 10.1 %	160 **32.9 %**	143 29.4 %	69 14.2 %	27 5.5 %
Friends and schoolmates	118 24.2 %	26 5.3 %	155 **31.8 %**	53 10.9 %	104 21.4 %	31 6.4 %
Persons from your hometown	13 2.7 %	9 1.8 %	49 10.1 %	39 8.0 %	241 **49.5 %**	136 27.9%
Colleagues	113 23.2 %	30 6.2 %	128 **26.3 %**	32 6.6 %	100 20.5 %	84 17.2 %

This table is built with the results of several frequency tables. Here we do not report the answers to the item "others".

Table 2 Frequency of mobile contact with different typologies of interlocutors

with one's birthplace has been historically very important for Chinese people). Only two respondents indicated that they called inhabitants of their hometown on their mobile phone. Probably the costs due to distance, in addition to technological annoyances and other psychological and communicative factors discourage the use of the mobile phone with hometown acquaintances.

In the organization of their mobile communicative sphere, men and women differ only insofar as the men are more inclined than women to contact a colleague by means of a mobile phone (18.4 % and 6.6 %, respectively).[3)] Age also plays a part in mobile phone use: those who are between 26 and 30 with a mid-level education are more apt to contact their colleagues by means of this device, while those under 25 are the most likely to use it to contact their friends or schoolmates. This suggests that the former group is obliged to devote more time to work problems and relationships with colleagues. For this group in particular, the mobile phone is a crucial work tool. Well-educated respondents follow another pattern; they are more inclined to use the mobile to work out their interpersonal relationships. In fact, these respondents make half of their mobile calls to friends and a third to their partners. Other patterns are created by income level: 68.8 % of those with no income contact friends, while people with an income above 1000 RMB are more likely to call their colleagues. Finally, with respect to geographical origin, it appears that urbanites are more likely to nurture sentimental relationships by means of the mobile phone than those with a rural background. The majority of respondents who contact their partner via the mobile phone came from the city. The relational spheres of the respondents, as shown by the frequency of their contacts with friends and schoolmates, partners, relatives, colleagues, and persons from own hometown are illustrated in Table 2.

It is worth noting that our respondents use the mobile with varying frequency depending on the nature of their relationship with the recipient. Our question was "How often do you contact these people below with the mobile phone?" Respondents had to answer on a five point scale which was as follows: 1 = not often, 2 = once a week, 3 = many times a week, 4 = once a day, 5 = several times a day. Partners are the people that our respondents contact most intensively: almost a third of the respondents declare that they call them many times a day. The number of no answers, however, is very high; 37.0 %, probably because many of the respondents do not have a partner. We recall that only a quarter of our sample is married, while 73.5 % have never been married. There are many things that couples need to regulate and co-ordinate; more importantly, the calls give them an opportunity to express their feelings and experiences. The lower frequency of calls is evident in the relationship between parents and children; 62.3 % of respondents indicate an obligatory call once or more times in a week. This is the relationship where the mobile phone plays the least critical role, because when parents and children

3) *Gender:* $\chi^2_{(4)} = 16.24$, $p < 0.01$; *age:* $\chi^2_{(12)} = 83.64$, $p < 0.0001$; *education:* $\chi^2_{(8)} = 59.08$, $p < 0.0001$; *income:* $\chi^2_{(12)} = 77.47$, $p < 0.0001$; *geographical origin:* $\chi^2_{(4)} = 10.36$, $p < 0.05$.

Means	Partner	Parents, children or other relatives	Friends and schoolmates	Colleagues
Calling	126 25.9 %	368 75.6 %	80 16.4 %	163 33.5 %
Sending an SMS	131 26.9 %	41 8.4 %	300 61.6 %	109 22.4 %
Varies according to context and situations	55 11.3 %	46 9.4 %	73 15.0 %	134 27.5 %
N.A.	175 35.9 %	32 6.5 %	34 6.9 %	81 16.6 %

This table is built with the results of several contingency tables.

Table 3 The means of contact

no longer live together, they need to have a regular, but not too frequent, contact to reassure one another that they are doing well. Contact with friends or schoolmates and contact with colleagues are equally frequent, since the modal class of answers in both cases is many times a week. However, there is friendship and friendship. Our respondents in fact use the mobile phone to mediate this kind of relationship in an articulate way; nearly a quarter of them say that they contact their friends and/or schoolmates many times a day, while almost a fifth declare that they do not call them often. The same trend is shown also by work relationship with the difference that in this case no answers are higher, probably because not all the respondents have work relationship. The survey indicated that the mobile phone acts as an important means of conducting work relationships. In the end, the modal class in the frequency with which respondents use the mobile phone to contact persons from their hometown is "not often" and with a high percentage of no answers. This result reconfirms the evanescence of this type of relationship in mobile communication.

Not surprisingly, we found differences based on gender: women are more frequent callers of partners, parents/children, and friends/ schoolmates, while men show a greater tendency to call colleagues.[4)] In China, as in many societies in the West, there is a gender division of labour regarding the maintenance of social relationships. Maintaining social bonds is a woman's task, part of the domestic sphere, while cultivating work relationships is more likely to be undertaken by men. There are slight differences based on geographical origin: those with urban backgrounds made more calls to partners, parents/children, and friends/schoolmates, but they called colleagues at the same rate as respondents with a rural background.[5)] It seems that it is especially the domestic sphere to be more solicited on a communication level by the urban culture. The only significant differences related to age were in the frequency with which our respondents call friends/schoolmates and colleagues.[6)] Not surprisingly, young respondents (25 and under) have more frequent communications with friends and schoolmates, while more mature respondents are more likely to call their colleagues. Education influences only the frequencies with which respondents contact partners and friends/schoolmates: the higher the educational level, the more likely it is that there are frequent calls to partners and friends.[7)] Income plays a role too: people with higher incomes tend to have a wider variety of recipients.[8)] These results mean that the possibility to keep alive personal networks does not pass only through a personal, psycho-

4) *All the comparisons reported in the text have been executed on average scores which have been calculated by considering a five point scale from 1 = not often to 5 = many times a day. For partners:* $t_{(305)} = -3.09$, $p < 0.01$; *parents/children:* $t_{(458)} = -3.47$, $p < 0.01$; *friends/schoolmates:* $t_{(454)} = -2.38$, $p < 0.05$; *colleagues:* $t_{(401)} = 2.56$, $p < 0.05$.

5) *For partners:* $t_{(303)} = 3.64$, $p < 0.0001$; *parents/children:* $t_{(455)} = 4.67$, $p < 0.0001$; *friends/schoolmates:* $t_{(451)} = 3.49$, $p < 0.01$.

6) *Univariate Anova with factor between frequency of contact with friends/schoolmates:* $F_{(3,451)} = 25.87$, $p < 0.0001$; *with colleagues:* $F_{(3,398)} = 3.73$, $p < 0.05$.

7) *Univariate Anova with factor between frequency of contact with partner:* $F_{(2,303)} = 10.54$, $p < 0.0001$; *with friends/schoolmates:* $F_{(2,452)} = 14.65$, $p < 0.0001$.

8) *Univariate Anova with factor between frequency of contact with partner:* $F_{(3,301)} = 7.67$, $p < 0.0001$; *with parents/children* $F_{(3,454)} = 4.02$, $p < 0.01$; *with friends/schoolmates:* $F_{(3,450)} = 16.71$, $p < 0.0001$; *with colleagues:* $F_{(3,397)} = 5.89$, $p < 0.01$.

logical ability, but it is connected also to these socio-demographic variables.

Another significant finding, which sheds light on the relational spheres of the respondents, is the number of people who our respondents contact by means of the mobile phone. The average for the sample is 17.32 (s.d. 31.81) per person. The men had more contacts than the women (M = 20.36 and 13.32, respectively).[9] There were no differences between respondents born outside Beijing and those born in the city. Among the other socio-demographic variables, only education and income are significant factors:[10] people with a mid-level education contact more people (M = 27.46) than those with other levels of education, and people with high or middle incomes have the largest number of mobile phone contacts (M = 21.40 and 22.23, respectively).

Let us look now at the means of the contact, since the form of communication (calling or sending an SMS) provides insight into the content of various social relationships (see Table 3).

The table shows that each type of relationship is associated with a certain means of mobile contact. With parents or children, it is almost always a phone call. Parents and children communicate by means of the voice, even when relying on technology. Recourse to SMS is very limited, and in less than 10 % of cases the decision to use one means or the other depends on the context or situation. Friends and schoolmates communicate mainly through SMS and only sometimes by calling. The choice of means in these relationships is more sensitive to different contexts and situations (15 %). The relationship with partners inhabits an area between those with parents/children and those with friends. In the case of partners, both means of communication – calling and sending SMS – are used in equal measure. Also the effect of context and situation on the means of communication is not as limited as it is for parents/children and not as significant as it is for friends. Finally, contact with colleagues is more likely to be a call than an SMS, and the effect of context and situation is much more crucial (27.5 %). Vertical relationships, that is, relationships based on a difference of power, such as those between parents and children and between different levels of personnel, seem to require the spoken word, while horizontal relationships, such as those between friends and partners, encourage uninhibited writing.

We will examine each type of social relationship, in turn, to determine the weight of each socio-demographic variable in each framework. In relationships with partners, the means of contact by mobile phone varies, revealing different styles of communication.[11] While men's behaviour is not different from women's, age is relevant. More than a third of the respondents under 20 use SMS to communicate with their partners, whereas 59.7 % of those between 31 and 60 years make calls. Also education shapes the means of communicating with a partner: 38.4 % of respondents with a low level of education rely on calls, while most well-educated respondents (72.7 %) exercise the prerogative to make a call or send an SMS according to different contexts and situations.

Income also affects the likelihood of calling: respondents who earn between 1000 and 3000 RMB significantly more than the others do so. In relationships with parents/children, men are more likely than women to call their parents or children rather than sending an SMS (83.7 % and 75.0 %, respectively).[12] Those who earn less than 1000 RMB are more likely to call parents/children (87 %). Respondents who were raised in the city are more likely to send an SMS than those with a rural background (12.6 % and 5.3 %, respectively), which leads to the corollary that those with rural backgrounds are more likely to call than urbanites (84.5 % and 75.8 %, respectively). In relationships with friends/schoolmates, men are more likely than women to call (24.6 % and 7.6 %, respectively); women are more apt to send SMS and to adapt the means of communication to circumstances and events.[13] One-third of respondents between 31 and 60 years of age call their friends, while more than 70 % of respondents under 25 rely on SMS. Almost one-third of the respondents who earn over 1000 RMB make calls, while 82.2 % of those with no income use SMS. Finally, in relationships with colleagues, men are much more likely than women to make a call.[14] Age introduces a dichotomy between young (under 25) and more mature (26 to 60) respondents: the former group is likely to send an SMS, the

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9) *Gender:* $t_{(457)} = 2.36$, $p < 0.05$.

10) *Univariate Anova with factor between education:* $F(2,455) = 6.16$, $p < 0.01$ *and income:* $F(3,453) = 3.18$, $p < 0.05$.

11) *Age:* $\chi^2_{(6)} = 36.50$, $p < 0.0001$; *education:* $\chi^2_{(4)} = 15.20$, $p < 0.01$; *income:* $\chi^2_{(6)} = 14.45$, $p < 0.05$.

12) *Gender:* $\chi^2_{(2)} = 7.61$, $p < 0.05$; *income:* $\chi^2_{(6)} = 14.48$, $p < 0.05$; *geographical origin:* $\chi^2_{(2)} = 8.25$, $p < 0.05$.

13) *Gender:* $\chi^2_{(2)} = 25.79$, $p < 0.0001$; *age:* $\chi^2_{(6)} = 39.35$, $p < 0.0001$; *income:* $\chi^2_{(6)} = 39.34$, $p < 0.0001$.

14) *Gender:* $\chi^2_{(2)} = 16.19$, $p < 0.001$; *age:* $\chi^2_{(6)} = 51.96$, $p < 0.0001$; *education:* $\chi^2_{(4)} = 19.18$, $p < 0.001$; *income:* $\chi^2_{(6)} = 45.63$, $p < 0.000$; *geographical origin:* $\chi^2_{(2)} = 8.09$, $p < 0.05$.

Type of use	Gender		Total
	Males	Females	
Giving a call	93	85	178
	35.4 %	**42.7 %**	38.5 %
Receiving a call	70	31	101
	26.6 %	15.6 %	21.9 %
Nearly half and half	100	83	183
	38.0 %	41.7 %	39.6 %
Total	**263**	**199**	**462**

In this table, 25 N.A. are not reported.

Table 4 Giving or receiving calls: prevalent use of the mobile phone by gender

latter to make calls. More than half the respondents with a mid-level education are likely to use their mobile phone to call their colleagues, while more than a third of interviewees with a low level of education prefer to send an SMS. Among those who vary their means of contact on the basis of context and situation, 61.9 % are people with higher levels of education. Income also played a significant role in the responses. At least half of those with an income over 1000 RMB prefer to call, while a third of the respondents with no income adapt the means according to the circumstances. Respondents with urban backgrounds are more likely than those with rural backgrounds to vary the means according to the circumstances (32.9 % and 26.3 %, respectively). Respondents born outside the city prefer to send an SMS in 30.4 % of cases, but this is true of only 18.2 % of urbanites.

Another very important element to consider when determining the communication profile of a country and its organization of interpersonal relationships is people's attitude towards the two aspects of mobile communication: giving and receiving calls. If compared to body-to-body communication, mediated communication requires more cooperation between these two elements of the process, since the agents are separated by space and, in some instances, time as well. Of course, there are people who prefer to call and people who prefer to be called. These attitudes may be described as active or passive approaches to communication. However, the analysis of the passive/active attitude towards communication cannot simply be understood in a psychological or socio-demographic framework. Understanding the reasons for these patterns (in calling and being called) is complicated by the fact that communication is subjected to the social organization of power. In some situations, those with greater power assume the initiative to call and talk, and in others, they prefer to receive communications initiated by others. Furthermore, the organization of power leads to different patterns and rituality depending on the specific culture. In Beijing, we found that the percentage of respondents who claim that they usually give calls is higher compared to that of respondents who say that they usually receive calls (see Table 4).

So it appears our Chinese respondents see themselves as more active than passive in mobile communication. Considering this aspect from the perspective of gender allows us to understand how important ritual aspects of communication are organized in a country.[15] In this survey, for example, there is a significant difference between men and women: women are more likely to take the initiative and make a call, opening up the communicative process. Men are more frequently the recipients of calls. This result may lead us to hypothesize that in Chinese culture power is identified with the capacity to attract communications from others, almost as a form of homage. But this hypothesis is weakened when we consider the effects of education. Respondents with a mid and high level education give more calls than they receive. Also respondents with urban backgrounds are more inclined to initiate a call than those with rural backgrounds (46.8 % and 30.1 %, respectively). These findings suggest that Chinese are proactive in communication and, on the whole, are more likely to take the communicative initiative than to await incoming calls that are perceived as a form of homage. The fact that women's calls are mainly related to interpersonal relationships in the domestic sphere provides additional support to the theory that social communication is part of their domestic role.

But what are the most crucial variables when it comes to accounting for the varying frequency of mobile calls to family, friends, and colleagues? To answer this question we ran a series of linear regression analyses: the dependent variable was the frequency of mobile contacts with specific typologies of interpersonal relationships. We used some socio-demographic variables as predictors, including gender (dummy variable 0 = M, 1 = F), urban/rural origin (dummy variable 0 = city, 1 = rural), age (measured in years), education, and income. We also included variables related to mobile phone practice, such as familiarity with the mobile phone (in years), quantity of calls made and messages sent with the mobile

15) *Gender:* $\chi^2_{(2)} = 8.39$, $p < 0.05$; *education:* $\chi^2_{(4)} = 10.35$, $p < 0.05$; *geographical origin:* $\chi^2_{(2)} = 14.05$, $p < 0.0001$.

16) *We illustrated the results related to these variables in Fortunati, L, Manganelli, A, Law, P, Yang, S (2007).*

	B	β	t	p <
Constant	3.53		6.09	.0001
Education	.09	.12	2.00	.05
Average number of SMS sent per day	.01	.17	3.02	.01
Income	.16	.26	3.92	.0001
Age	-.04	-.19	-3.00	.01
Gender	.36	.13	2.28	.05
Adjusted R^2	.14*			
N	285			
* p < .0001				

Table 5 Results of multiple regression analysis for frequency of mobile contacts with partners (stepwise method)

phone, and the range of social contacts maintained by this device.[16] The results for mobile calls to a partner are shown in Table 5, to parents/children and other relatives in Table 6, to friends/schoolmates in Table 7, to colleagues in Table 8.

The regression analysis for the frequency of mobile contacts with partners revealed five significant predictors: four were socio-demographic and one was related to mobile phone practices (see Table 5). The main predictor was income. The number of contacts with partners increases with higher incomes. This is not surprising; affluent respondents can afford a higher frequency of communication because they can easily pay mobile fees. The frequency of contact increases as age decreases. This inverse relationship is also easily understandable: young people are at the stage of life when long-term relationships are established, so they dedicate more effort to communication. Furthermore, frequency of contacts is positively influenced by the practice of sending SMS. The more respondents are inclined to send an SMS, the more likely they are to call their partner regularly. Gender also plays a role: women are more likely to contact their partner than men. In China, as in the West, the responsibility to nurture sentimental relationships, to co-ordinate daily activities, and to establish a domestic framework is shouldered primarily by women (Yuen, Law, & Ho, 2004). Finally, respondents with a high level of education are more likely to use the mobile phone to contact their partner. The cultivation of sentimental relationships through conversation is one of the consequences of a high level of education.

In the regression analysis for mobile contacts with parents/children or other relatives, the significant predictors were found to be geographical origin, gender, age, and the average number of SMS sent (see Table 6). Respondents born in rural areas were less inclined to contact parents/children than those born in city. Internal migration makes it more difficult to sustain family relationships due to the cost and to the fact that vertical communication tends to become more strained and, therefore, less frequent. In addition, as Law and Yang (2007) have observed, there have been changes in lifestyle among recent generations of immigrants, who are more likely to be consumers and less likely to send their money home to take care of their parents and children. The number of contacts increases with age. Youths wait for parents to initiate contact; they are eager to cut the umbilical cord that keeps them united to their families and,

	B	β	t	p <
Constant	1.95	7.28	.0001	
Geographical origin	-.36	-.16	-3.30	.01
Average number of SMS sent per day	.01	.13	2.68	.01
Age	.03	.14	2.86	.01
Gender	.28	.12	2.54	.05
Adjusted R^2	.07*			
N	426			
* p < .0001				

Table 6 Results of multiple regression analysis for frequency of mobile contacts with parents/children and other relatives (stepwise method)

	B	β	t	p <
Constant	3.69	9.41	.0001	
Age	-.05	-.21	-3.72	.0001
Education	.15	.18	4.05	.0001
Average number of SMS sent per day	.01	.16	3.47	.01
Income	-.11	-.17	-3.17	.01
Adjusted R^2	.17*			
N	422			
* p < .0001				

Table 7 Results of multiple regression analysis for frequency of mobile contacts with friends/schoolmates (stepwise method)

for this reason, they tend to call their parents less frequently. In contrast, parents try to sustain their relationship with their children and exert some control over their behaviour. The frequency of parent/child contacts is increased if the parties use SMS. The more inclined the respondents are to send an SMS, the more likely they are to contact their parents/children regularly. The SMS is, in this context, the ideal means to maintain a relationship: it provides communication but at a distance. Women are more frequent communicators than men, both as daughters and as mothers. However, we must underline that the effects of the independent variables that we have considered in this regression analysis, although they are significant, are weak, as is demonstrated by the low amount of variance of the dependent variable explained by the predictors.

In the regression analysis for mobile contacts with friends/schoolmates, the significant predictors were age, education, income, and the average number of SMS sent (see Table 7). With an increase in age, the likelihood of mobile contact decreased. This finding is not unexpected; as we age, we acquire more commitments and family/work responsibilities. This means we have less time to dedicate to friendships. The use of the mobile phone offers a good picture of this phenomenon. Education is a powerful ally of friendship: it offers reasons, motivations, and means to continue to stay in touch with friends. Education teaches the value of friendship, and the time we spend in school allows us to build friendships that may last for a lifetime. The higher the level of education, the more mobile contacts with friends and schoolmates. There are also correlations with income. But here we had an unexpected result. Research conducted in several Western societies shows that, in order to maintain friendships, it is necessary to invest money in means to stay in touch and meet (Allan, 1979). Money is required to access, maintain, and use mobile phones, computers, the Internet, and even the fixed telephone; it is also required for evenings at restaurants or cinemas, etc. However, our research suggested the opposite. The less the respondents earn, the more likely they were to stay in contact with their friends and schoolmates. One reason may be that the mobile phone serves a very important function for the poorest respondents – it is a generator of employment information. Also, the frequency of friends/schoolmate contacts is positively influenced by SMS use. The more respondents use SMS, the more they stay in contact with their friends/schoolmates. The SMS seems in this context the ideal means to maintain a relationship without spending too much.

Finally, in the regression analysis for mobile contacts with colleagues, the significant predictors are the number of mobile calls made, familiarity with the mobile phone, and the largeness of the relational sphere maintained by this device (see Table 8). The predictors that explain the frequency of contact with colleagues are completely different from the predictors in other spheres. Here it is the number of calls that matters, not the frequency of SMS. Work requires a level of discretion that often makes written communication inadvisable. Such communication must be transitory in order not to leave traces; it needs a voice to express all the nuances necessary to deal with various power relationships. Furthermore, familiarity with the device is important, as people cannot risk embarrassing themselves with colleagues due to an inadequate knowledge of mobile phone use. The longer respondents had owned the device, the more intensively they used it to contact their colleagues. People who are familiar with the device demonstrate to their colleagues that they can manage technology efficiently. Finally, the largeness of the relational sphere plays a significant role. This variable acts as an index of empowerment: people who have a large number of contacts seem well connected.

At the end of this series of regression analyses, however, we have to note that in general the effects of the independent variables that we have considered are

	B	β	t	p <
Constant	2.19	14.24	.0001	
Average number of calls made per day	.04	.25	4.84	.0001
Familiarity with the device	.10	.18	3.63	.0001
Largeness of the relational sphere	.01	.10	2.06	.05
Adjusted R^2	.15*			
N	373			
* p < .0001				

Table 8 Results of multiple regression analysis for frequency of mobile contacts with colleagues (stepwise method)

significant but rather weak, as it is demonstrated by the more or less low amount of variance of the dependent variable explained by the predictors. This is a good reason to share with caution the interpretation of these effects, as other variables, different from those we considered here, concur to determine the frequency of mobile contacts with the various typologies of interpersonal interlocutors.

Conclusion

In this paper we examined the structure and the characteristics of mobile phone behaviour among our Beijing respondents. Several patterns are similar to those found in many Western societies (Fortunati, Manganelli, 1998). But in at least two respects, the Chinese experience seems to be different. Our respondents in Beijing claim more contact with colleagues, which suggests that, for the Chinese, the mobile phone is perceived as a work tool as well as a social device. This result refers to a reading of the social meaning of the mobile phone which reveals a double identity – working and domestic. The mobile phone is a technology that in China seems to function as a communicative bridge between the place of work and the everyday life setting. Also, in China, the respondents who earned the least were the most likely to stay in contact with their friends and schoolmates via the mobile phone; this suggests that the device operates as a generator of social solidarity among peers and is, consequently, of particular value to the poorest respondents. This is in contrast to the situation in some Western countries, where the digital divide tends to affect people with low income and where moreover friendships generally are a "rare good" among people with low incomes (Allan, 1979; Fortunati, 1995). But this means also that it is probably from friendships, that is from strong ties, that the individuals received the precious information regarding employment. This result seems to be confirmed also by other research (Law & Peng, 2007). As for Chinese, no matter which levels of social strata they are from, social ties are mainly polarized into either "insiders" or "outsiders." Obviously, the ties among insiders are strong. Insiders are those they can lay their trust on, while outsiders are measured instrumentally (Metzger, 1998). And this again is different from many Western experiences, where, as Granovetter (1973, 1974) argues, the weakest ties are the most involved in helping to get a job.

There were not very significant differences found between men and women in this study, except that women's social contacts are more likely to relate to the domestic environment and the men's to the work world. And this lack of differences between men and women was unexpected in a country where power differences between men and women are still strong as the social structure is still patrilineal and hierarchical (Yuen, Law, Ho, 2004).

Finally, modernity in China has been achieved by the urbanization of millions of peasants. The development of the coastal cities has been achieved at high personal and social costs, which have been borne primarily by those with rural backgrounds (Chu & Yang, 2006). In addition to being uprooted from their home region, they encounter serious difficulties in the attempt to enter their new social sphere. Other research (Yang, forthcoming) have shown that, for instance, most of the migrant workers in Beijing working in the service industry do not have labour contracts, and it is very common for them to work overtime, have limited freedom, and have working and life spaces which overlap. The dwellings and the lives of the migrant workers Yang studied fill the crevices in the metropolis' modern veneer. In some respects, the mobile phone supports their efforts to overcome these social, economic, and cultural difficulties. For example, again according to Yang (forthcoming), migrants use mobiles to avoid the boredom and restrictions of work; they use mobiles to keep connected to their friends, mitigating conflicts between economic and emotional necessities and

gathering more important job market information; through the use of mobile phones, they can increase the scope of their romantic choices. But the mobile phone does not serve to them to maintain the relationship with their place of origin by contacting persons from their hometown. Probably other technologies such as the internet are more useful to sustain the relationship with the region of origin, as Peng (2007) shows in her research.

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Computer-Mediated-Interactive-Communication-Technology (CMICT) & the Anthropology of Communication: A Philippine Example

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Recently a Philippine tourism official claimed that a mobile saved his life. A bystander took pictures on a mobile while the official was being menaced by kidnappers – seeing this, the kidnappers fled. Another triumph for the mobile.

To some, the microchip was a wondrous invention – a high-tech helper that could increase security at nuclear plants and military bases, help authorities identify wandering Alzheimer's patients, allow consumers to buy their groceries, literally, with the wave of a chipped hand. To others, the notion of tagging people was Orwellian, a departure from centuries of history and tradition in which people had the right to go and do as they pleased, without being tracked, unless they were harming someone else. Chipping, these critics said, might start with Alzheimer's patients or Army Rangers, but would eventually be suggested for convicts, then parolees, then sex offenders, then illegal aliens – until one day, a majority of Americans, falling into one category or another, would find themselves electronically tagged.

Li Yijiang, 25, killed and mutilated six Beijing men between late 2002 and early last year, the Beijing Today newspaper reported. Police linked the murders by discovering all six victims had regularly used a pornographic website called Purple Boy. They then followed the trail to Li, who was arrested in August last year. Li confessed to the killings, saying he had logged on to the website after moving to Beijing from remote Xinjiang region to attend university. Li told police he was gang-raped after meeting the six men at a disco used by Purple Boy regulars. He later lured each man separately to his death.

With the development of the Internet, and with the increasing pervasiveness of communications between networked computers, we are in the middle of the most transforming technological event since the capture of fire. I used to think that it was just the biggest thing since Gutenberg, but now I think you have to go back further. (Barlow, 1995:36)

We're going to be Gods, we might as well get good at it. In another thousand years, we'll be machines or gods (Gray, 2002:9).

This paper examines some of the claims about the transformative consequences of the new communications media, especially as they apply to the Philippines. Modern technologies were introduced into the country soon after their discovery abroad but despite their transformative potential there was very little change in the basic structures of society. Why was this so? The transformative capacity of technology has been the driving force for social change in modern times. Why has the Philippines basically remained a conservative society unable to harness the potentials of technology despite its rapid introduction into the country? Will the mobile revolution finally transform the Philippines into a technologically driven economy and society? The mobile phone and to a lesser extent the Internet have been rapidly incorporated into everyday Philippine life. No other technology has received these rates of diffusion. What major transformations may be expected as a result of mobiles and the Internet?

Technologies often have unexpected uses. The use of SMS (texting) is an instance of this unforeseen usage. The mobile has become as much a writing as a speaking tool. But it has also transformed the relationship between writing and speech. Texting tries to convey the saying rather than the said (Ricoeur, 1971). A consequence of this is the explosion of banality, where texters exchange banal messages to reassure one another of their continuing relationship. Moreover, in texting, the formal rules of writing have been replaced with the informality of speech. Texting has taken over many of the ritual functions of talk in constituting and reproducing relationships. It expresses new forms of sociality.

Texts are also often used for religious messages, reinforcing traditional notions of spirituality, including exchanges with the dead (Pertierra, 2006). These unusual and heterotopic uses connect hitherto distinct elements into new hybridities. They also make possible an absent presence, allowing overseas workers to stay in close contact with their village kin. New forms of socialities such as online affairs, cybersex and postcorporeal relationships are some of the consequences of the new technology. The paper

ISSN 0085-7130 ©Telenor ASA 2008

concludes by examining how the new communication technologies may be expected to change personal identities, social relationships, political alliances and global perspectives of Filipinos in the 21st century.

Transformative Capacities of Technology

Despite having many features commonly associated with western modernity, such as a vigorous democracy, an accessible education system, a relatively free media and an obsession with western pop culture, the Philippines is not known for its technological development. The lack of resources is often blamed for the failure of the Philippine state to support science and technology but the opposite view is just as valid. The country's lack of resources is also due to its inability to harness the gains of technology for economic development. When the local legislature took over funding from the American colonial authorities in 1933, one of its first decisions was to drastically cut funds for the Bureau of Science, until then well known for its original research on tropical medicine and agriculture (Caoili, 1991). Local legislators saw the Bureau of Science as engaged in non-relevant research. This simple utilitarianism, seen from the view point of the layman, still characterizes much of Philippine life. A research orientation is lacking even in the leading universities for a variety of reasons such as poor facilities and heavy teaching loads but also because of the lack of a culture of critical discourse. Only what is seen as immediately practical and relevant is the subject of research. But relevance and the practical should themselves be open to a critical anthropological discourse and not assumed as givens. Anthropology should also interrogate notions of the practical and the relevant in order to expose their often unstated assumptions.

The main reason why technology has not so far had a major transformative role is that it mainly benefited metropolitan areas and was controlled by elite interests. These technologies did not enter into the everyday life of most Filipinos. In Luhmann's (1998) terms, technology lacked system-integration. It affected external but not internal system functionality. While the mass media is more accessible, these are under the control of special interests whose main concern is entertainment rather than conscientization. Communicative practices retained their traditional orientation and under these conditions, the new technologies were unable to produce significant social change. Some technologies such as the railway and the motor car principally affect our relationship to space. But these experiences of speed and linearity also altered our notions of spatial perspective. Distant horizons are now perceived as easily attainable. Other technologies like the telegraph and the cinema alter our sense of time, merging the present with the past and the future. Together these technologies change our understandings of nature as well as of ourselves. These are as much technologies of the soul as of the body. They reconstruct our identities and our understanding of the conditions of possibility. For technology to become the engine of social change, it must affect our relationship to ourselves as well as to the material world. Technology allows societal structures to simplify their internal relationships and their external effects on the environment. They expand system feedback. It seems that the government is now investing more in science and technology but the underlying structure has to undergo significant changes before significant results can be achieved.

Mass Media, Mobiles and National Consciousness

While television was introduced initially as a means for political advertising, its role is presently seen as entertainment. But according to David (2004), television converted the Filipino masses from an inchoate, local patrimony into an organized mass audience. This medium politicized its audience in unexpected ways. This television generated mass audience elected Estrada into the presidency in 1998 and it remains the largest political force in the country. Estrada's election indicated that the mass vote was up for grabs and that traditional politicians no longer dominated the political landscape as they had done. In the last elections (2007), access to television was seen as the most crucial determinant of success (Teodoro, 2007). Although media exposure is important its effects are not always predictable. The public can assess paid ads and celebrity news for their political relevance as indicated by the electoral victory of Trillanes (who got elected to the senate in May 2007 with almost no resources while in jail on charges of mutiny and who since then – November 2007 – has attempted another unsuccessful coup). While radio has remained local and vernacular, television has always been national. This signified a shift from an aural to a visual medium. Television's importance is not primarily related to the dissemination of information but rather to its capacity for mobilization via entertainment. To succeed politicians have to transform themselves into media stars, while the latter can often convert their popularity into political success. But even media stars such as Manny Pacquiao (boxing world title holder), prominent screen actors such as Cesar Montano and Nora Aunor have failed to transform their screen popularity into electoral success. The masa (mass audience) obviously distinguishes popularity from electoriality. Presently, candidates can also extend and individualize their visibility by using mobiles and the

Internet. Some commentators (Magno, 2007 PDI 9 March) have pointed out that political constituencies now include virtual as well as actual ones. The ontology of the real now includes the virtual as well as the actual. The major telcos handled over a billion text messages daily for the 2007 election campaign (Philippine Daily Inquirer, 6 March 07).

The new media is now routinely linked to the old media and often transforms its character. Now that the mobile has penetrated television, making it more participative (e.g. program ratings, posting messages) and interactive, what effects might this produce? Is this combination of mass/personal media likely to individualize a hitherto impersonal mass audience and transform it into more coherent and specific segments? Can it transform ordinary and even talentless people into media stars, bypassing former structures of competence? Reality television and the Internet present evidence that this may be happening. Pinoytube (a local version of Youtube) provides ordinary users with the opportunity to become global stars. CMICT gives global access to all its users, a possibility hitherto limited to a privileged few.

Rafael is an 18 year old bisexual who frequently participates in TV channels that post text messages. Using this service Rafael has been able to meet groups of friends with similar interests. When asked how he felt about texting, Rafael replied – *My attitude changed because of texting. I wasn't like this before … He feels that his social network has expanded* (Pertierra, et al, 2002:72). People sharing special interests or orientations like Rafael can now more easily coalesce. Similar examples can be readily found about the coalescing potentials of the Internet.

Political organizing is also facilitated by the new media. Bautista, a party list coordinator explains:

> *With cellphones we can coordinate our schedules effectively. Moreover, supporters can quickly inform us regarding 'black' propaganda thrown against us – we reacted by contacting local radio stations. Cellphones 'secure' our coordinators in a game of psywar. Our political opponents with bad intentions are less likely to harm our members knowing how quickly we can react. In San Remigio, where our coordinators were threatened, using our cellphones other members quickly responded and came to the rescue.* (Pertierra, 2006:54)

Mobiles become protective devices. They achieve this by acting as information beacons for colleagues and the general public. Examples such as the one concerning its salvational role against kidnapping are common.

If television created a national audience as David argues, the mobile individualized its members, converting large collectivities into micro-political units or smart mobs (Rheingold, 2002). By 2001, mobile phones had entered the communications landscape and sweeping claims have been made of its consequences (Pertierra, et al., 2002). The role of texting in EDSA 2, although exaggerated, is nevertheless significant. The Internet has extended these micro-political units onto the global stage combining them into new and larger collectivities. The Filipino Diaspora now actively participates in local everyday life while also giving it a global sensibility. At last, it seems that these new technologies will transform the structures of consciousness of most Filipino hitherto unaffected by earlier inventions.

The Internet (10 % of households) has not yet achieved the penetration rates of the mobile and remains limited to areas with landlines. Nevertheless, the presence of Internet Cafés has become a standard feature of most cities and large towns. For example, Tuguegarao with a population (2004) of 120,645 has 105 Internet Cafés offering nearly 1500 broadband connections (de Leon, 2007). People use them in favor of home connections for speed and privacy. This usage is mainly among young people, their purposes range from school research, games, job searches, emailing relatives and friends, accessing pornographic or religious sites and exploring online relationships. The global condition has reached Tuguegarao, bringing with it new expectations and understandings of the world.

Kinship

Philippine kinship is composed of bilateral descent groups. Bilateral kinship prevents the formation of stable lineages since each generation has competing claims. Affinity as much as consanguinity is the basis for kin group formation. Enduring group structures or coalitions are rare. Instead ego-focused kin groups coalesce around common temporary alliances. Kinship and local associations appear to be the main building block of Philippine society (David, 2001; Dumont, 1992; Zialcita, 2005). Beyond kin and the local, most Filipinos feel little solidarity. Social institutions eliciting wider loyalties exist but are not very developed. Since the Philippine state cannot provide adequate essential services – e.g. education, health, employment and security – it is unable to demand the corresponding loyalty from its citizens. Perhaps, more accurately, state services are allocated on the basis of kinship, locality or patronage rather than on the abstract rights of citizens. Hence its beneficiaries feel obliged to their patrons rather than to the corresponding state institutions.

The most obvious advantage of the new media for kinship is their ability to maintain synchronic ties with overseas relatives. The latter enjoy an absent presence in their village communities, and are able to participate in the routine decisions of family affairs. Most text messages and a frequent use of the Internet involve these kinship links. Personal confessions, intimate thoughts and anxieties generally avoided in direct talk are the favorite subjects of texts and the Internet. These exchanges generate a textual intimacy absent in ordinary discourse.

The phenomenon of an absent presence sometimes leads to unexpected consequences. Sarah worked in Hong Kong for several years and sent money to her husband regularly. He was supposed to use the money to build house extensions but instead used it for personal pleasures. Suspecting that something was wrong, Sarah spoke to her sister to confirm what was happening. She returned to the village but separated from her husband. Similar cases of close surveillance are now a common consequence of having mobiles (Pertierra, 2006).

Nagasaka (2003) describes how mobiles have changed the communicative practices in an Ilocano village, many of whose members work overseas. Prior to acquiring mobiles, rural villagers seldom communicated with their overseas kin except for emergency telephone calls or the exchange of gifts *(paw-it)* by returning and departing migrants. A developed system of sharing gifts and information assured that villagers and their overseas kin remained in contact. But the mobile significantly changed this system of communication, making it much easier. Apart from contemporeinity, the messages themselves become more private and emotive. Nagasaka argues that Ilocano kinship is processual and contingent, dependent on regular exchanges and reassurances.

> *It is in this context that everyday conversations associated with paw-it should be considered. To share their mutual experiences or incidents through everyday conversations is particularly significant for overseas migrants who cannot be physically present to engage in daily interactions in the village* (Nagasaka, 2003:49).

Nagasaka gives an example of a typical conversation between a husband in the village and his overseas spouse:

> *My wife asked how much money was withdrawn from the bank, how much is left and what are the details of the expenses, particularly those asked by the children – those they bought and those paid in school. She also asked their school performances and health status of Remy (one of his two children) who was then recovering from a fractured arm (her right arm was broken after falling from a tree). Aside from these, she also asked about the news from the neighborhood. What was new and what was happening. And she talked about the news from friends and their living conditions in Hong Kong* (Nagasaka, 2003:51).

Another conversation:

> *The same with the first call. 'How are the children?' Like that. We talked of their activities in school. About the expenses, this includes everything bought like school supplies, books, home appliances, grocery items, everything. Their health problems, who got sick and how much is spent. For some other news, she asked how were her parents, her relatives, her aunt, the neighbours, her in-laws, their children and so on. There are so many topics to discuss* (Nagasaka, 2003:51).

The processual nature of local kinship depends on access to information *(damag)* and particularly to gossip *(tsismis)*. Most social interactions concern this exchange of information. But gossip is always about other people and never consists of personal confessions or admissions. It is a system of surveillance that deals with exterior behaviour rather than interior feelings. Fault rather than sin becomes the crucial determinant of moral behaviour (Pertierra, 1988). Public shame through gossip rather than contrition supports the normative world.

The facility to communicate intimate feelings via texts or voice calls has added a new dimension to family relationships. Exchanges between parents and children and between spouses indicate an emotional familiarity and closeness generally lacking in traditional families. Paradoxically, this closeness to absent parents occurs as children are looked after by extended kin, either grandparents or aunts. While the village households of overseas parents include extended family, the discursive closeness of mobile communications only includes absent kin. Discursive intimacy and spatial propinquity are disengaged. This intimacy of virtual communications may lead to the nucleation of Filipino kinship hitherto a composite of Hawaiian generational and Eskimo nuclear family. While extended family relationships are still strong, factors such as the urban drift, overseas work and contemporary culture may be favoring closer ties within the nuclear family.

Texting Romances

Texting has now become a routine way of establishing new relationships, including romantic ones (Solis, 2005). While people still consider textmates a superficial mode of relating, Solis argues that these virtual friendships are as authentic as conventional ones. In the case of romance, texting can take the form of technological foreplay leading eventually to more corporeal contacts. Contemporary life is often based on mediated relationships drawn from the media or conducted through the mobile and the Internet. Most of these relationships simply extend and reinforce already existing ones but others are generated exclusively through the new communication technologies as argued by Miller (2007). These latter relationships are a product of the new media and increasingly characterize contemporary life. A popular example is online marriages discussed below.

As Pertierra, et al. (2003) have shown, both men and women use the new media to explore aspects of their inner selves. Women use the Internet more extensively than men in this exploration, particularly to find marriage partners. Most of our informants admitted having established firm friendships through texting or the Internet. Some of these relationships resulted in face-to-face interactions while others remained virtual or online. Overseas workers often exchange and pass on mobile numbers to their friends and relatives in the hope of encouraging courtships. Nagasaka (2007:219) writes:

> *Young villagers told me that there are many cases where textmates become one's boyfriends or girlfriends. There is also a case in Salpad where a female domestic worker in Italy got married to her textmate in the Philippines. She got his cellphone number from his mother who is also working in Italy.*

The large number of female overseas workers is also shaping the use of the new media. Their interest in keeping in close touch with their village families has been mentioned. Given that these women have become the major income providers has given them an added status and importance. Pingol (2006) has shown how their financial independence has extended into areas of personal freedom, including a more assertive sexual agency. The case of Sarah (Pertierra, 2006:110) is typical of these independent women. While waiting for her return to Hong Kong Sarah exercises her new self confidence through texting.

> *Interviewer: So, what do you think the cellphone has done to you? Do you feel different without the cellphone?*
>
> *Sarah: Yes, if there's no cellphone, I also don't think of him (her boyfriend). My daughter borrowed my cellphone for a month; I did not look for him. 'Never mind', I said. But if I have the cellphone with me and no load, I feel that I must load.*

In this case the cellphone clearly gives Sarah a new sense of agency. It is not only a mnemonic device but in itself generates social practices. The mobile is not simply a medium of communication but an object to which one relates in a new way. The mobile is part of a relationship *sui generis* (Miller, 2007). This self confidence also results from her experience of financial independence. The mobile complements the new economic role played by women working overseas.

Virtual but Real Intimacy

The liberational and emancipatory role of the new media has often been noted. Partly motivated by the anonymity of interlocutors but also because of the intrinsically democratic and unconstrained element of interactions, intimate exchanges are a marked feature of these media. This intimacy often involves participants known to one another but also arises between unknown interlocutors.

> *Carol: Hi, I saw your name in Abante Tonite. So, you want to have a friend? I am Carol De Guzman, 24 years old. Is it okay to text you so that we can exchange sweet messages?*
>
> *Linda: You know Carol, since I advertised my name on that tabloid, I have been receiving a lot of text messages so that I have to load my cellphone twice a month. In fact, others would even insist on seeing me but I just tell them that I live far away.*
>
> *Carol: I am just contented with texting because it is quite boring here in our workplace.*
>
> *Linda: Why? What type of job are you doing? Where are you from?*
>
> *Carol: I live in Cubao, Q.C. When my boss is not around I have nothing to do, that's why I get bored. So when I was reading a tabloid I saw your name and I decided to text you.*
>
> *Linda: Really? Thanks, I'm just lucky to have a textmate who is from Quezon City. How's your work there?*
>
> *Carol: Its fine, my employers are already old and they are always out of the country. Most of their relatives are living abroad, that's why they are*

always not here. So I just end up watching tv and texting.

Linda: And that's really boring. But you can always go out during your day-off. Have fun with friends, go to disco houses.

Carol: I don't know how to dance. I just love listening to music. Maybe you're a good dancer.

Linda: I know some steps. I'm a big Sexbomb Dancers fan. When I'm not doing anything I go with my friends to Padi's Point, they got such good musicians that you can't really keep from dancing.

Carol: My body is not really that graceful for me to go dancing.

Linda: I'm sorry. I'll just text you again because I have to do something. I'll forward a nice message to you.

Carol: Ok.

Later that day.

Linda: True friends are gifts not easily gained. It roots stem from one's heart and involves memories that stay, not for a moment, not for a day but forever. God Bless.

Carol: A friend like you is a gift that paints a smile in my heart. It gives memories that will stay in me, not for a while but for a lifetime.

Linda: That's a sweet message, it is very heartening. Maybe, you also have a lot of other textmates.

Carol: Of course, the maids from the next subdivision. I have many woman friends that give me nice text messages.

Linda: I had a girlfriend once. She went to work in Japan. She had this Japanese boyfriend who hurt her when the guy was high on drugs. I feel sorry for her because when we were together she did not experience that. I love her very much. But she learned how to use drugs and that was when I decided to break up with her.

Carol: So you're a lesbian. I have a nurse girlfriend, she's a jealous type of person but she's not checking my cellphone. We used to quarrel every time because of the messages in my cellphone. So I told her not to look into my messages and to mind her own business, that's why I only got to text with other people now.

Linda: How long have you been together?

Carol: Around two years. She always took me to this bar called Clowns, and we would watch comedians. It's very entertaining.

Linda: I saw these comedians on tv and they're really funny. When do you usually go to Clowns?

Carol: Every Saturday, the place is always full. But it is really nice, I enjoyed a lot going there, we usually go home at 2am.

Linda: You have a very nice girlfriend. She really loves you.

Carol: She's a good lover. I also have some male suitors but I am afraid of getting involved with them because I have this sister who got married to a guy. They have many children and her husband would beat her sometimes.

Linda: Maybe that's why you do not like to have boyfriends.

Carol: I am not yet totally closing my heart to men. I also want to have children some day. But I only want children, not a husband.

Linda: If you only want children, why not get one from the nursing homes?

Carol: I want one that is made of my own blood. You can't be sure with adopted children, they might grow up bad.

Linda: But you will teach them good values. They can even help you when you grow up.

Carol: Well, you have a reason but I am not planning to do it in the near future. It might take some time. Sorry, I have to go now.

Linda: Okay, Thanks for texting. Take care.

The exchange above illustrates the rapid transition from stranger to intimate made possible by mobiles. While such exchanges also took place before the mobile, e.g. during long bus trips, in certain life rituals, this technology greatly expands the capacity for discursive intimacy among strangers. This creates new social networks hitherto difficult to establish and thus generates new forms of sociality.

Internet Cafés

While household access to the Internet is still relatively low, Internet Cafés have become a common feature of most Philippine cities. Even people with household access often go to these Cafés for privacy and camaraderie. They are sites for both virtual and corporeal sociality. Internet Cafés are new sites for exploring novel relationships, virtual and actual, often resembling what anthropologists call liminal stuations, where new identities are explored. People in Tuguegarao use these cafés to remain in contact with friends and family abroad, to supplement the meager resources of local libraries, play games, search for porn, access useful information and as a place to meet friends. Janna is a young married woman (de Leon, 2007: 49):

> *I still go to the Internet café to download software, music videos, games and also to play with other gamers who I now consider friends. Actually I feel more 'free' in Internet cafés since I could open and browse any site I wish to visit. Although my personal computer is protected with several anti-viruses, I am still very cautious, especially that all important files are stored in it. My husband and I love online or network gaming and we do it in the Internet shop. Battle Realms, DOTA, and Need for Speed Underground are a few of our favorites. We like to compete with each other and since we have only one computer at home, we go to net cafés to play. I tried playing alone, but I get bored easy. With someone to compete with (not the computer), I can really be motivated to do well and win. One time I beat my husband, he got all boos, and hurrahs for me, he suddenly turned red because of embarrassment. I pitied him, but I was too overwhelmed by the other gamers' applauses.*
>
> *From then on, everybody wanted to play with me but I never beat my husband again … it's a matter of choice. I am actually withdrawn around people but in my constant visit to Internet cafés I eventually gained friends, especially those I played with. Most of them are males and in their late teens. Considering my personality I didn't imagine I could be friends with them. Our interest in computer/online games creased out unfriendly encounters.*

For Janna, the Internet Café is a new domain for exploring new relationships as well as for asserting new aspects of herself. She feels more confident in the Café and meets new friends. Her relationship with her husband takes on a more egalitarian aspect even as she continues to defer to him in important ways. But it is the capacity to form new friendships both online and on site that the Café provides that makes it significant. Married Filipinas are very circumspect about relationships with young men unrelated to them. The fact that Janna feels comfortable in befriending her Internet buddies indicates a new sense of individual confidence. The important thing is to contain these relationships within their appropriate sites, in this case the Internet Café. In this sense we can say that Janna's relationships are virtual in two senses – because they occur in cyberspace and because they are limited to the Internet Café.

Cyber-Cosmopolitanism

Online marriage sites are a common example of this new mobilizing potential. Constable (2005) has explored some of these sites and points out the opportunities it opens for both men and women for experiencing new bodily pleasures. While the Internet is often associated with disembodied experiences, it actually encourages particular corporealities. Combining virtual and bodily experiences with cultural values, the Internet reconstitutes the lived body, resulting in new possibilities. Filipina mail order brides were a common, if controversial, issue during the 80s and 90s. Much of the controversy eventually died down as these contracted marriages generally fared no worse than more conventional ones. However, this issue has been resurrected in association with female trafficking. The Internet greatly facilitates transnational marriages and includes the possibility of exploiting unwary users. Nevertheless, online marriages have become increasingly common and are now part of the wide repertoire of conventional courtship. Chen (2004) has studied Taiwanese online marriage sites. They combine traditional features such as marriage brokers with new technologies like the Internet. Clients are able to meet their possible brides online and arrange quick visits to Vietnam to meet their families. These sites are a response to shifts in marriage practices among Taiwanese women who are no longer willing to accept the traditional burdens of marriage. On the other hand, Vietnamese women are keen to improve their economic prospects and are willing to marry Taiwanese men. These marriages are arranged according to traditional rural custom except that the brides are recruited overseas. Chen argues that while these marriages conform to previous practices, their increasing commercialization poses new problems. In this case the Internet opens itself not only to new marital possibilities but also to new forms of economic exploitation.

Imee is another frequent user of Internet Cafés. She had a bad marriage and uses the Internet to make new friends online. She claims that the Internet made her less lonely and opened possibilities for new relationships.

I met Roger, a black American affiliated with NBC, on a certain website. After a few emails and night chats, he came to the Philippines, twice, and we had a great time. But after a year, the flame just died down. And then I met Brian (from Victoria, Canada) from the same website, but we chat only as friends. Realizing I could be happy with someone else, I filed for annulment/presumptive death. (Her husband had disappeared years earlier)

It was December 2005 when I met my second (soon-to-be) husband, Marc (Australian-based French chef), at match.com.au. We started exchanging messages, pictures, even sharing our experiences and life stories. We came to know each other mainly through the Internet. After three months of exchanging emails, talking on the net and chatting, Marc came to the Philippines and professed his love. That was then I knew this isn't a dream. Then, I brought him with me to Cagayan where he met my family, friends and relatives. Next thing I knew, I was flying with him to Australia (de Leon, 2007:56)

Conclusion

The mobile phone and the Internet have been accepted into Philippine society with unprecedented speed. Their transformational effects have yet to be fully assessed but early signs indicate that, unlike previous technologies, the new media are inducing basic socio-cultural changes. Older technologies, while readily assimilated, rarely entered into the lives of most Filipinos or only did so under constrained circumstances. Mobiles have penetrated all aspects of the private and public spheres, including religion, politics and economy. They affect not only relationships with the outside world but also transform orientations in the inner world. Functional capacity is enhanced both within and without the system. The new media not only enable their users to link more effectively with the environment but also interiorize these linkages to reconstitute the self. The environment is itself changing rapidly. Overseas work, tourism, virtual organizations, electronic transactions and transnational migration are transforming the social, political and cultural landscapes.

If the old media such as television constituted a national audience, the new media have both globalized and individualized their members into autonomous but linked units or smart mobs. Their political and social consequences are now being felt. Politics has to deal with both virtual and traditional constituencies. A hitherto hierarchical cultural order is quickly being subverted by popular choices. The results are unpredictable but certain to shake former structures. Traditional politicians, media stars and gay activists, each drawing on their respective constituencies (virtual and actual), compete in the new order.

The Filipino family has undoubtedly benefited from the new technology, at least in its capacity to enable closer relationships. Diasporic ties and overseas work have become normal aspects of family life. But the new media also deepens communicative exchanges, allowing hitherto unexpressed aspects to express themselves. Spouses frankly discuss their sexual needs and children more readily express their affections within the family. These exchanges tend to encourage a condensation of ties within the nuclear family. The democratization of feelings becomes a feature of family life.

The new media has been described as a technology of the soul as much as that of the body. They reconstitute our inner as well as our corporeal self, enabling new spiritual and bodily pleasures. Notions of authenticity are redefined. Traditional institutions such as marriage are readapted to respond to new possibilities. Space-time compression creates new landscapes within which to live old and new identities. Virtual, actual and liminal spaces characterize contemporary life, combining the old with the new. Electronic communication ushered in new realities combining elements of the natural and the spiritual worlds. No wonder these technologies often evoke supernatural expectations. Gray (2002:9) exclaims: *We're going to be Gods, we might as well get good at it*. Most of us, remembering earlier promises, may choose to remain more skeptical.

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Turning Threats into Opportunities – the Social Dynamics of Missed Calls

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The practice of sending intentional "missed calls" (calls that are terminated by the caller before the receiving party answers) is a familiar phenomenon in emerging mobile markets across Africa and Asia. Although generally considered to be a free-of-charge messaging service used primarily by the financially constrained, the authors document its use by a far wider range of mobile users and for a variety of other purposes, ranging from social control and relationship maintenance to entertainment. Mobile operators have long sought effective measures to eliminate or reduce the volume of missed calls since they are a major cause of network congestion and do not generate revenue. The authors argue, however, that in-depth studies of missed calls may provide the telecom industry with a much needed window into the sociocultural life space of customers, and suggest new service offerings that better match their needs and circumstances.

Introduction

In the course of two or three years the term "missed calls" has taken the leap from the vocabulary and practices of mobile users in various emerging markets to discussions among telecom network planners as well as scholarly debate among researchers of ICT behavior (Chakraborty, 2004; Fjuk, Furberg, Geirbo, Helmersen, 2007; Donner, 2007; Zainuddin, Samarajiva, Abeysuria, 2006). Intentional "missed" calls (or "beeping" and "flashing" as they are referred to in some countries (Donner, 2007) are calls placed to a number where the caller intentionally terminates the call before the receiving party answers. Under current price regimes most mobile operators do not charge for calls that are not terminated (answered). Customers are, naturally, aware of this and have put the "service" to good use as a signalling system. Since handsets display the number of missed calls the subscriber has received and which number(s) that generated them, a signalling system has gradually evolved among mobile users in which a vast variety of messages may be transmitted free of charge.

The discussions about the use of missed calls have mainly stressed that this is a form of messaging that is free as well as convenient. We will in the following investigate a wider specter of motivations that lie behind this practice, and see that missed calling is not only about transmitting instrumental messages – expressive communication is an important motivation as well. In conclusion, we will also discuss how missed calls as well as other forms of mobile use that telecom operators consider to be "untoward" and unwanted may be utilized as a source of inspiration for developing new services and new technologies that more closely reflect the current practices and needs of the users.

Methods

This paper is based on qualitative and quantitative data gathered in Bangladesh in 2007. Bangladesh has an estimated population 153 million (CIA Factbook). Although mobile penetration is roughly 23 %, what sets Bangladesh apart from most developing nations is the extremely high network coverage of 98 % (CIA Factbook, Paul Budde Communication 2008, Grameenphone Homepage). Thus, although most of the country's inhabitants have access to one or more mobile networks, their financial circumstances may not allow the majority to make extended use of it.

A series of eight focus group discussions were carried out in Dhaka, Bangladesh in April 2007. These groups each consisted of eight respondents ranging in age from 18 to 55 and covered high, middle and lower levels in the socio-economic hierarchy. Each group consisted of either males or females. Participants were screened to ensure that they had been active mobile users for at least one year and possessed more than one SIM from more than one mobile network operator. Since sharing of handsets is widespread in Bangladesh and because the focus of the current study was on use rather than ownership, a handset ownership requirement was not included. The focus groups were conducted in Bangla by qualified moderators, and English transcripts were provided for the purposes of analysis. In addition to the focus groups, conclusions are based on the analysis of observations and semi-structured conversations with respondents recruited in local markets, at tea stalls, public call offices, cyber cafes and among craftsmen, small traders and retailers. In February 2008 we included questions about missed calls to an in-depth interview study of 44 young Bangladeshis in rural and urban areas.

 ISSN 0085-7130

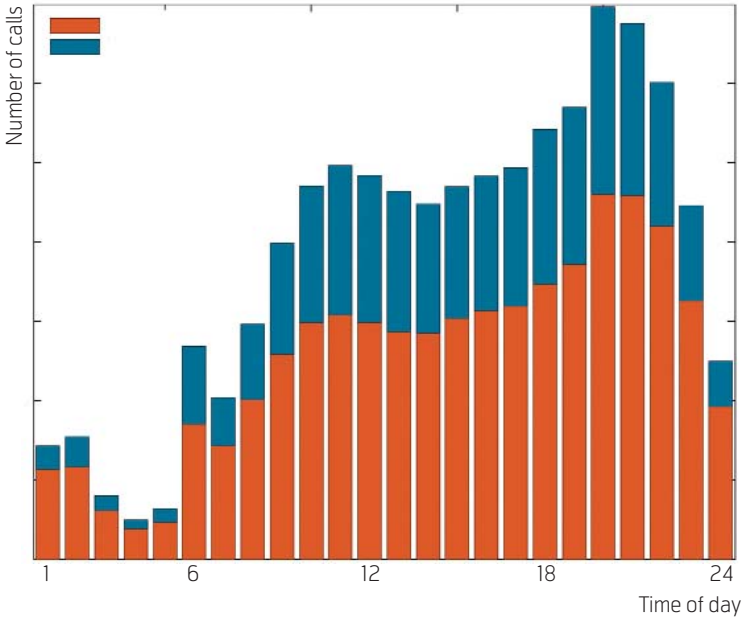

Figure 1 The distribution of missed and terminated calls across a twenty-four hour time span on Grameenphone's mobile network (statistics based on traffic data collected during a single day in June 2007)

The quantitative data on which our analysis is based derives from detailed analysis of 310 million Charging Data Records[1)] (CDR) from Grameenphone. The records are from a single day in June 2007[2)]. It provides a quantitative verification of some of our qualitative findings and may subsequently serve as a source of new hypotheses relating to patterns of mobile use

Why Missed Calling is Viewed as a Problem for the Telecom Operators

The obvious reason why a free-of-cost and easy to use messaging system is viewed as a problem for telecom operators, is that it implies a use of the facilities of the operator that does not generate revenue. It also reduces the revenue one could have expected from charged traffic, as there exists a free alternative to some of the communication needs that may be catered for by charged services. An argument that from time to time comes up in the discussions about missed calls is that missed calls in some cases generate charged traffic, and that this to some extent may outweigh the negative consequences of missed calls. Our data indicate that this is not the case. In Bangladesh, the charged traffic generated from an initial missed call is minimal compared to the missed call activity.

However, the are other serious consequences of widespread use of missed calls as well. One is that the convenience of using missed calls inhibits the uptake of other charged forms of messaging, like SMS, which is not much used in Bangladesh. Finding a number in your contact list, hitting the "call"-button and then, once you hear the call signal, pushing the "end call"-button is far easier than composing an SMS, especially if you are illiterate or not familiar with the alphabet on your phone's keypad. It is also more convenient than using various forms of messaging that do not include typing, like voice-messages or symbol messages.

The most serious consequence for the telecom operators is not, however, that missed calls reduce revenue generated by "legitimate" messaging services such as SMS and MMS, or that it inhibits the general uptake of such services, but that it is the major cause of network congestion in peak periods. In Bangladesh, missed calls constitute upwards of 70 % of total network traffic at any hour (see Figure 1). This congestion causes charged calls to be disconnected, or not connected in the first place. This reduces the quality of service, and leads to customer dissatisfaction. Since networks are scaled according to traffic volume and anticipated growth, it may also lead to over-dimensioning of the network based on false prognoses, leading to vast sums of money being wasted.

The main culprits are not customers who send one, two or three missed calls in a row to say "Call me back", "I am on my way home now, please start cooking the rice", or "father just went out, you can safely call me now". Those who make the most significant contribution to network congestion are the ones who send a large number of consecutive missed calls; fifty, one hundred or even several hundred missed calls in a short period of time have been documented in the present study.

The intuitive solution to the above-mentioned problems is either to charge call *attempts* so that missed calls will no longer be free, or to inhibit the use of missed calls by means of technical measures, e.g. filtering out caller information (the A-number) transmitted to the recipient (B-number) of a missed call. Not knowing who called will greatly reduce the information value of a missed call. This is likely to reduce missed calls significantly, but these approaches are problematic because subscribers have come to regard missed calls as a service in the same way that SMS

1) *Every call made on a mobile network (terminated as well as unterminated) generates a unique record in a database specifying – among other things – the caller's number, the receiving party's number, time, duration, location, etc. Several million CDRs generated during a 24-hour period were analyzed by the authors.*

2) *Analysis of CDRs was carried about by Kenth Engø-Monsen, Telenor R&I.*

and MMS are services. It is anticipated that removing or significantly reducing the possibility of using unlimited missed calls will not be received favorably by subscribers unless they receive some form of compensation, perhaps in the form of a free but limited use or an inexpensive alternative messaging service.

Finding a sustainable remedy for the missed call problem is hence dependent on gaining a thorough understanding of how and for which purposes missed calls are used, which needs it caters to, and which it does not fill satisfactorily, and the various motivations for choosing this form of messaging over other forms.

The Motivations behind Missed Calls

When we first started exploring the missed call phenomenon, we found that two assumptions were commonly made by people in telecom business. In the course of our research we found that, although not entirely misconceived, these understandings do not cover the complex reality of the missed calls practice.

Myth 1: Giving missed calls is motivated by economy.
Saving money is indeed a strong motivation behind sending missed calls. However, there are many other strong motivations. Sending missed calls is not only an economic strategy, it also fills practical needs, social needs and entertainment needs. We will discuss this in detail in the following.

Myth 2: Giving missed calls is a practice primarily among the financially disadvantaged.
Poor people do use missed calls, but all the other socio-economic classes are also familiar with and regularly use them. However, they may have different motivations for doing so and the way they use them may differ. We will come back to this as well in the following.

For operators, failing to regocnize the complexity in the practice of missed calls means that one will not be able to take the actions that are required to limit the practice. At a less measurable level, it means failing to take advantage of the insight the missed call practice gives us about our customers and their communication behavior. This insight is valuable for the development of new services as well as new technology. Hence, we will dig deeper into the phenomenon in the following.

We have categorized the motives that came out in the focus groups in four categories:

- Economic motives
- Practical motives
- Entertainment needs
- Social and relational motives

The category social and relational motives is by far the most complex, covering several sub-categories.

Economic Motives

"My husband gets mad at me if I finish my monthly phone budget of taka 300 in 15 days."
Woman, 40

As long as the subscriber is not charged for unterminated calls, missed calls is a way of sending mobile messages free of cost. This allows the financially constrained to avail mobile communication even when they do not have money to spare. For those with more disposable income, it means that economy is not a barrier for extensive use of the mobile. Economic motivations were stressed by most of our respondents as important for their use of missed calls.

Practical Motives

"After my husband comes back from office at 5:30 pm he gives me a missed call because we live on the 5th floor and when he reaches the ground floor he gives a missed call to signal me to throw the gate keys down …"
Woman, 34

Sending missed calls is an easy and fast way of communicating. Compared to voice, no time needs to be spent on small talk before getting to the point and before hanging up. Compared to SMS, only a little typing is needed. Moreover, literacy is not needed[3)]. 57 % of the Bangladeshi population are illiterate, and an even larger proportion do not read Roman letters (CIA Factbook). Imagination is the main limitation to what you can communicate with missed calls. The number of consecutive missed calls, who has sent them and what day and hour they were sent, as well as individual pre-negotiated agreements, are factors that are taken into consideration when interpreting the meaning. One missed call from the husband at 6 o'clock in the afternoon may mean "I just left work". Two missed calls may mean that "I am running late". During the day, a missed call from the husband may simply mean "I am thinking of you right now".

Another practical motivation for missed calling is that it is a discrete way of communicating. A missed call may be sent from within one's bag or even from within one's pocket. This is in particular a motivation

3) *The minimum requirement is that the recipient is capable of identifying the originator of the missed call, either recognizing the number or the associated name which is linked to specific numbers on the handset.*

for youth who in various situations want to keep their communication hidden from their friends or guardians. We will get back to such situations below.

Entertainment Needs

"It's fun to disturb people. Sometimes people call me back if I give missed calls continuously and sometimes it turns into a quarrel."
Woman, 19

Using missed calls is also a source of entertainment. Friends have missed call competitions; one person sends a missed call and the other tries to receive it before it is hung up. If she manages to receive the phone call, the calling person loses credit. If this game goes on for a while, a large number of consecutive missed calls may be the result, adding to the congestion of the network.

Missed calls are also a source of entertainment for youth (see Figure 2) or bored homemakers, especially during the frequent loadshedding when the lack of electricity makes housework difficult because the lamps and the fans stop working, and it is not possible to watch TV. Waiting in the damp and warm darkness for electricity to return, one can pass time by sending missed calls to friends and family, or even to random numbers to see whether one gets a reply.

Listening to ring back tones is another form of getting free entertainment through the mobile. A person who has a popular song as his ring back tone may have an agreement with his friends that if they give him two missed calls, it means "Don't pick up, I want to listen to your ring back tone".

Social and Relational Motives

In the category "social needs" we have included the motives that are related to establishing and maintaining relationships of various kinds.

Contact Seeking and Romantic Motives

Flirting and the desire for contact with the opposite sex is an important driver for the practice of missed calls. In Bangladesh, as in many other societies, missed calls constitute a private space where forbidden behavior such as flirting can be practiced without public exposure and ridicule. People send missed calls to random numbers hoping for a reply from a person who may eventually turn into a boyfriend/girlfriend or even a spouse. This is done by women as well as men. Below a young woman tells about how she first came into contact with her boyfriend:

"I gave him a missed call. It was an unknown number. He called me and asked me who I am. Then I told him that 'I don't know you, please don't call me anymore'. After that I gave him another missed call. He told me that I am preventing him from calling me, but am [still] giving him missed calls. Then I told him that he can talk to me."
Woman, 22

Photo: Per Helmersen

Figure 2 A group of young people in a Dhaka park entertaining themselves by listening to ring back tones and by sending missed calls to random numbers

ISSN 0085-7130 ©Telenor ASA 2008

After six months they were still only communicating through phone.

Most attempts to locate a companion by means of a missed call are certainly not this successful, but the stories about people finding love through a random missed call were told in most of our focus groups. Some of them may be urban myths or wishful thinking, but regardless of the truthfulness, the assumption that missed calls may, if one is lucky, result in a romantic relationship is a driver of the practice in itself.

Arranged marriages are still the norm for the majority of the Bangladeshi population, but self-arranged marriages (or "love marriages" as they tend to be called, where the partners choose each other independently of their parents' wishes) are not uncommon (Rashid 2005, Geirbo & Imam 2006). It may be that an increase in self-arranged marriages has a positive influence on the contact seeking missed call activity. But looking for love is not the only motivation behind sending missed calls to random numbers. Seeking acquaintances and friendships is also a reason why this is done. Both forms of contact seeking through missed calls can be compared to chat relationships found in online chat rooms. The same phenomena found there (misrepresentations of self, assumed identities, etc.) were also reported in relationships established by missed calls:

Photo: Syeda Shamema Sultana

Figure 3 Sending 'I'm thinking about (missing) you' calls was reported to be a frequently used missed call activity. Social grooming is clearly a need fulfilled by this type of calling

"I gave miss-calls to a number thinking that it might be a girl. One day that person sent me an SMS asking to meet. When I went to meet her, I found that it was a guy! We became good friends afterwards, even though he is senior to me."
(Man, 23)

Once romantic contact is established, it needs to be maintained. This generates voice calls and text messages, but also often additional large numbers of missed calls (see Figure 3). Sending a missed call may, given the context of interpretation, mean that the sender is thinking of you or missing you. Sending several missed calls intensifies this message, and it is not uncommon to send several hundred missed calls to the chosen one, like this quote tells:

"It is becoming a symbol of love. You can express your affection by giving hundreds of miss-calls."
(Man, 44)

Executing and Countering Social Control

At the same time as missed calling may be a way to bypass norms for proper conduct without getting caught, missed calls are also used as a tool for social control. Young couples send missed calls to each other both to check if the line is free (if not, the other might be having an affair with someone else) and to keep the line busy so he/she has less possibility to start a phone affair. Husbands expect missed calls from their wife at fixed hours as a signal that the household is running smoothly. Parents request missed calls from their children as a signal that they are safe when they are out with friends or have arrived safely at their destination. As sending missed calls does not require that the sender has credit on her prepaid card, there are also no valid excuses for refusing signaling with parents. Despite this being a disadvantage in situations where privacy is preferred by the youth, it is in other situations used by the youth to sidestep the parental control, as this story illustrates:

"Once I attended a friend's birthday party and came home late. I told my friend I would give her one missed call if I needed her to come to my place and help me if my father was angry. My father was very angry with me so I gave my friend a missed call. She came over with her mother to appease my father."
(Woman, 18)

Missed calls also have the advantage that it is not easy for others to know who initiated the contact. A newly married woman is expected to yield to the control of her mother-in-law, and being frequently in touch with her childhood home may be frowned upon by her in-laws. By sending a missed call to her mother, a young wife can tell her mother that she wants to talk to her. Her mother replies with a voice call, and the young wife thereby avoids her mother-in-law's fury for calling her mother.

Social Positioning

Bangladeshi society is characterized by complex social hierarchies. The signs that communicate a person's positions in the hierarchy are in many cases subtle, like whether or not an employee has an air freshener in her office. In some companies this is a sign of a high position in the hierarchy. On the lower rungs of the hierarchy access to a lift is a sign of one's position (a less subtle one than whether one has an air freshener or not). In a building block of some standard there will be a number of household employees, caretakers and occasionally craftsmen, some of whom may use the lift and some who may not. Knowing one's place in the hierarchy and behaving according to the norms that apply to this position is necessary if one wants to avoid sanctions from one's surroundings. This also goes for the use of missed calls. Depending on the position one holds in a hierarchy, there are people one may and may not give missed calls. As a general rule, one should not send missed calls to people below oneself in a hierarchy. Older brothers should not give missed calls to younger siblings, but rather be the one who bears the expenses of the call. Also, a man of means giving a missed call to a service provider will show disregard for his own position in the hierarchy:

> *"Who can you not send missed calls to?"*
> *"Drivers and electricians … it's a matter of prestige."*
> Man, 45

Communicating to people above you in the hierarchy also requires skillful assessment of relations. Giving missed calls to people with a better financial situation or a higher social standing than you is often approved of, but not always. Giving a missed call to a teacher or your boss is considered disrespectful.

Catering to Phatic Communication Needs

Above we have seen some examples of how fairly complex messages can be transmitted and understood through a combination of number of calls sent, timing and knowledge of the sending party. Missed calls are, however, not only a medium for instrumental messaging. Much missed call practice originates in a need for phatic communication. Phatic communication refers to forms of communication where the interaction between the communicating parties is the motivation, not the content of the messages in itself. In phatic communication, the very act of communicating has a value in itself, separate from the value of exchanging information that is of practical use to the parties. The creation of bonds and the maintenance of community is the motivation behind this kind of communication. Much of the missed call activity reported by our respondents is phatic communication, like giving missed calls to say "I miss you" or "I am thinking of you right now".

In Bangladesh, phatic communication is acknowledged as an important part of the daily interaction between family and friends. That conversation is considered to have value in itself, separate from the content of the conversation, can be clearly seen in the importance Bangladeshis give to the communication form adda that exists in Bangladesh as well as Indian Bengal. An *adda* is an informal conversation among a group of people that goes on for a shorter or a longer period, often for hours on end. It may fluctuate between serious topics like politics and history to mundane topics like gossip and jokes (Chakraborty 2001: 124). However, it is not the content of the discussions that defines this as an *adda*, but the form: being together in a group engaging in communication about random issues. Without further comparison, the inherent emphasis on form rather than content gives missed calls a functionality that other forms of mobile messaging, like SMS or voice messages does not have. The inherent vagueness of a missed call makes it especially suitable for phatic communication. Services that open for more complex messages, like SMS, require the user to think up a specific message and formulate this. Using missed calls instead liberates the user from this requirement. As we have seen above, missed calls may well be used for instrumental communication (like asking someone to call you back), but it is equally, if not more, suited to the situations when you want to share affections and experience community with someone without having anything specific to say. Family members, couples and friends send missed calls back and forth throughout the day to reconfirm togetherness across space. A young man expresses it like this:

> *"Suppose a group of my friends have met up without me – they will give me missed calls to let me know they are missing me."*
> (Man, 22)

The inherent vagueness of missed calls also opens for the interpretation of the recipient, and this is likely to be an important reason for its popularity

as a medium for phatic communication. Receiving a missed call from a lover or a good friend can bring the receiver a lot of enjoyment thinking about the possible thoughts and feelings that motivated the sender.

Turning Threats into Opportunities

We have seen that missed calls cater to both instrumental communication needs and to phatic communication needs while being easy to use as well as free of charge. Hence, the volume of missed calls is not likely to decline unless the telecom industry comes up with attractive alternative service offerings or other countermeasures. As it is today, mobile operators in many parts of the world view the phenomenon solely from the perspective of lost revenue and unnecessary infrastructure investments. While we are in the process of coming up with solutions to this problem – technical, regulatory and other – we should view missed calls as a unique learning oportunity. The immense popularity of missed calls tells us that this practice contains valuable information about the communication needs and preferences of our customers.

To sum up, we have found that although financial considerations are important when deciding which communication service to use, there are other strong drivers as well. Ease of use and convenience is another strong driver, especially for illiterates or people who cannot use the Roman alphabet. Unexpectedly, we also found entertainment needs to be strong drivers, especially for young people and adult female homemakers. Establishing and maintaining of relationships turned out to be a key application area for missed calls.

Contrary to commonly held beliefs about the missed calls phenomenon, it is not the lack of resources that is the most prominent factor behind the practice; on the contrary, it is the abundance of creative social resources which makes the collective development and diffusion of this multifaceted messaging form possible. Tapping into this source of creativity through studies of unexpected and often disregarded ICT usage will provide the telecom industry with a much needed window into the socio-cultural life space of our customers, and suggest new service offerings that better match their needs and circumstances.

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ICT for Development and Climate Preservation? On the Need for more Realism and more Courageous Business Models

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The ICT business is now busy adapting to the message from the The Intergovernmental Panel on Climate Change (IPCC). Hence, consultancy companies are now re-launching energy saving applications invented in the ICT research labs and taken to market a decade or two ago: distance work, distance education, Intelligent Transportation Systems (ITS), video conferencing, software for logistics support, virtual project rooms, smart homes, etc. (e.g. Mellon et al. 2008 for Telstra; McKinsey 2008 for The Climate Group on behalf of the Global eSustainability Initiative (GeSI)[1)]). Also, the ICT business and politicians alike have for a decade or two argued for ICT to be an essential tool in lifting the world's poor out of poverty by cutting costs, freeing capacity, and creating work. Its effect as to spurring economic growth has even created revival-like enthusiasm, and forms a platform in its own right for forwarding the ICT business as being socially responsible, important, and wishable (e.g. Vodafone 2005; Entner & Lewin 2005; Deloitte & Touche LLP 2008).

There is no doubt that ICT applications can help us save on resources and (fossil[2)]) energy, and make us much more efficient in our tasks. It is also next to self-evident that rolling out such large and new infrastructures as mobile telephony spur economic growth. It even seems clear that we are nowhere near harvesting the full potential from applications like the ones now re-launched as being particularly "green". So far, so good. But worse, it seems that those same ICT efficiency gains make energy and resource consumption increase substantially. If so, there are some problems here that should be brought to the table and discussed to help shape the initiatives needed so that there will actually be gains harvested, not just an increase in non-sustainable consumption.

The purpose of this article is not to suggest simple, realistic and ready made solutions, but to expose the problems and to shed some light on what needs to be done to harvest the gains in ways that can contribute to environmental sustainability and to sustainable social development. To this author, such alternative strategies will need to take less conventional directions that will have substantial implications for business models and business strategies. It seems a good start simply to draw the picture as it emerges when listening to those who have been studying the topics of environment and development for some decades. Unrealistic and impractical? Yes, but no. Realism is a next step.

1 The Challenge: Ecologic Sustainability at Odds with Economic Growth and Development Theory

"The world can in effect get along without natural resources, so exhaustion is just an event, not a catastrophe."

This 1970s quote from the renowned economist Solow (quoted in Smukkestad 2005) demonstrates that a theoretical discipline can get pretty far away from real life. Commonplace as such attitudes were, they provided the intellectual basis for the ideas of "de-materialization", i.e. the "de-coupling" of economic development spirals from natural resources. ICT became a growth engine that should create sustainable economic growth, create jobs, and eradicate poverty in a world facing depleted resources. Such visions got reflected in numerous initiatives and plans for ICT for Development, ICT for sustainability, *e*Government, the EU "Bangemann report" (European Union 1994), etc.

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1) *The Climate Group and The Global e-Sustainability Initiative (www.gesi.org) are two cases in point: GeSI is an organisation supported by UNEP and ITU to contribute to the realisation of the Millennium Development Goals. It supports the view that ICT is a powerful instrument, increasing productivity, generating economic growth, and improving the quality of life of all, and states that "GeSI considers this a crucial principle to extend the influence of ICT into all aspects of socio-economic development, applying these technologies to both rich and poor countries to achieve sustainable development across the globe." The Climate Group consists of 30+ corporations, 80+ governmental bodies and various supporters working to "promote the development and sharing of expertise on how business and government can lead the way towards a low carbon economy whilst boosting profitability and competitiveness." (www.theclimategroup.org)*

2) *For practical purposes energy is used here as synonymous to fossil energy, and all energy efficiency gains mean fossil energy efficiency gains: Within the timespan relevant and for most geographic areas, all energy use, even hydropower based, has alternative use as replacement of fossil fuel.*

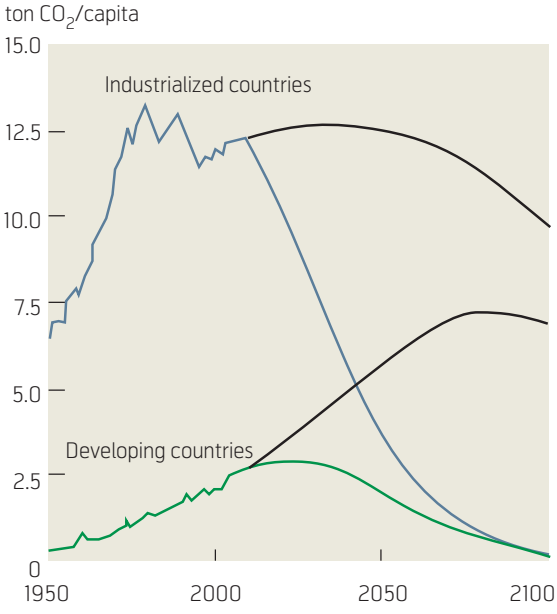
ISSN 0085-7130 ©Telenor ASA 2008

However, while years of large investments in various e-initiatives have gone by and many have no doubt harvested large gains from making services or indeed entire sectors more efficient, economists have also come to understand that ecology imposes limits on all economic development as to material welfare, and that – although complicated – there is a connection between economic growth and the use of energy and other resources, subjecting growth to limits as to the increase in resource use that might result from it, or be used to achieve it.

It took the ex-NASA scientist James Lovelock 30 years to get acceptance for his "Gaia theory", the theory that the earth (i.e. "Mother Earth" or "Gaia") is a homeostatic system, or indeed a system of systems, with certain thresholds that should not be exceeded if humans are to live on this planet (Lovelock 2006). The Gaia theory is now generally embraced, also by the IPCC (International Panel on Climate Change), after 30 years of being ridiculed and being declared unscientific. The IPCC reports state that within a generation or two resource use has to be reduced substantially not to surpass these thresholds. Calculations based on the IPCC data and a reckoned target of ≤ 2 °C temperature rise show that fossil energy emission reductions must be in the range of 90 % in the industrialized countries and 98 % even in the non-industrialized countries where per capita resource use is already low, to reach such a goal (Magnus 2008; Holtsmark 2008). Accordingly, the great vision of lifting the poor South out of material under-consumption, eventually by reducing material over-consumption in the rich North, is relegated to the status of a once sweet dream, if there shall be such a "moderate" temperature rise, and is now to be replaced by more realistic ambitions.

The two positions taken by Solow and Lovelock demonstrate two fundamentally different mindsets:

Normative economics is about how to create relentless economic growth, reflected in GNP or in a company's value creation, with growth as a proxy measuring stick – though a dubious one – for increase in welfare for the stakeholders, whether owners or society as a whole. Impact on the environment is either not part of the model, or can be represented by a cost (e.g. in the form of the present value of a future cost), which may be considered acceptable or not. Growth is success and spurred by incentive systems, status quo is backwardish and no fun, and "negative growth" is failure. The models are conscientiously simplistic, leaving out by purpose the many factors that the agent is not responsible for by convention, and forcing real life to conform to the model.



Source: Holtmark 2008, based on IPCC's A1-MESSAGE scenario

Figure 1 The content of development needs a revision: Historical and needed paths of fossil energy emissions to keep temperature within 2° C (coloured), versus predicted emissions by business-as-usual (black)

In the ecologist mindset, however, homeostasis (i.e. balance in a feedback based system) is the very foundation and criterion of success: Normative ecological theory is about how to keep the resource metabolism – whether caused by humans or others – within acceptable thresholds, so as to *avoid* setting off the spiralling or accelerating developments that follow from breaking homeostasis. Ecological systems are intricate and intertwined natural systems with floors and ceilings that metabolism cannot trespass without bringing the system out of balance. While self-enforcing growth spirals are the Mother of all development in economics thinking, and an attractive goal, self-enforcing growth spirals create collapses and havocs in ecology when the carrying capacity of their resource base is exceeded, and the system – be it technological, political, social – might return to higher entropy (more chaos, more even distribution) as it dissolves. From an ecologist mindset, ideas of eternal advances of mankind and relentless growth appear as mindless, dangerous, and backwardish. The models are complex, and seek to include the many factors that man cannot control, but has to adapt to.

Are the two – economic growth and maintaining an ecological balance – reconcilable? That is, may economic growth and ecological balance happen simultaneously? The Rio Declaration on Environment and Development states in 1992 that such reconciliation is indeed feasible and coins the term "sustainable development" for it. Still, the going rhetoric sounds as if it were. However, it seems that the whole idea of "sus-

tainable growth" was a legacy from Solow and mates, a political necessity of the time, and a contradiction in terms that would later be de-masked: Beyond exploiting nature's yield, economic growth forcibly leans on extracting natural resources. At some point, economic growth creates material consumption levels that surpass the thresholds of ecological sustainability. In the message from Lovelock and IPCC and their precursors that energy and resource consumption is since long surpassing those thresholds, lies the message that sustainable ecosystems and sustained economic growth are compatible within some limits only, and not with the present levels of energy and resource consumption, resulting in resource depletion, distructed eco-systems, and greenhouse effects.

Hence, what the IPCC tells us between the lines is that "modern society" is a social configuration variety about to fail in its project, as societal varieties mostly do when they surpass the thresholds for their ecosystems (Diamond 2006). There is an evident case for Luddites[3)] here: Any traditionalist – be he from the countryside of Texas, Afghanistan or the Caucasian plains – is in his rights to set up a defence against "modernisation", which from his angle most naturally emerges as a project to destroy social configurations which have kept on with relatively stable ecological adaptations for hundreds of years. Most traditional societies may claim a longer and more successful track record as to being compatible with their resource base, than modern mass consumer society.

What then about 'development'? What has development theory to offer? The very idea of 'development' is a brainchild of the Western Enlightenment (18th century), i.e. the large project of bringing the people of Europe out of impoverishment, a laborious life with fear, plagues and superstition, as well as the subjection to the brutal forces of nature and tyrants (Smukkestad 2005).[4)] The remedies were what today are the characteristics of the Western idealized image of "modern society": *reason*, *education* and *science*, law and *justice*, *virtues* and *industriousness*, the *free individual* as the central unit of society (contrary to clans, kinship, and guilds, or being subjected to serfdom etc), *roles achieved* in society instead of inherited, as well as *standardisation* and formal law to regulate transactions and benefit from scale, *technology* to extract resources as well as improve efficiency in production and bring new knowledge, *economic reasoning and regulation* to organize society's dispositions of wealth, and efficient and impartial *political and financial institutions* as the organisational framework of it all. The success stories of this historical mission, e.g. in the form of welfare and social security, are evident to all. These lines could not have been written without them. Europe in the late medieval ages was not an attractive place.

The idea that change would and should be to the better, and that the meaning of life was to strife for it, got deeply embedded in professional as well as conventional understandings of 'evolution' in all areas of life and academic disciplines – be it politics or culture, religion, biology, history, social sciences, polytechnics or linguistics: 'Development' and 'evolution' meant not just changes over time, but change from the simple to the more complex, from the inferior to the superior, from the primitive to the modern, from the darkness of ignorance to Enlightenment by "true knowledge and science", from scarcity and subjection to nature to abundance and liberation from nature. To spur and guide such a development among people "backwardish" or "primitive" or "uncivilized" was understood as a mission that the more advanced had to undertake – if not for other reasons, then for purely altruistic and moral ones – to bring welfare and prosperity to the lower classes, to the countryside, and to the global South and East.[5)]

Hence, the European explanatory as well as normative models as to the roots of backwardness and how to create progress were based on the evolution that took place in England in the 18th century and later, and they became the basics of development theory from the 1950s and onwards, "economic growth" being a key: The roots of the "initial state of backwardness" from which society should depart, were found in traditional inefficient production methods, in lack of practical know how, in lack of practical skills, in limiting traditions, and in lack of impetus (or triggers by today's lingo), all of which considered to be deficits which were to be mended to bring about development.

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3) *Term for opponents of technological change, named after Ned Ludd, an English worker who is supposed to have destroyed weaving machinery around 1779 (www.thefreedictionary.com).*

4) *The main points and some details in the description here of the evolvement and state of development theory lean on the eminently simplified overview given by Smukkestad.*

5) *It seems to the author, having the Germanic Norwegian as his mother tongue, that the extensive use of Latin in educated English makes it harder to see how deeply the Western historical perspective connects the passing of time with positive and wishful change, leaving other combinations to be impossible, unimaginable or unwished. "Advanced" means "having come further forward", as in German "fortgeschritten", or the Norwegian "fremskreden". It is closely paralelled to "progress, -ive", from "pro-" (forward) and "gredi" (to step forward in a proud or esteemed manner). Accordingly, evolving without improving, or development without progression, appear as being contradictions in terms.*

Typically the thinking was that some new sector, e.g. mechanical industry, would induce change that would "trickle down" to the rest of society. The manpower to this industry would come from the supposedly underemployed people in the countryside (mainly in agriculture), who would then constitute a new urban working force. In the next run, new and more efficient production methods and more efficient distribution systems, market information systems, and other mechanisms that reduce "friction" in economy, would then create increased production, increased wealth, increased demand, increased supply, hence increased welfare, and – through taxation – income to government. Hence, government would become able to provide infrastructure and other government services spurring new growth, and so on.

The idea of "developing countries" was firmly based in this development mindset, with a practical political and commercial twist: In 1949, as the colonial regime went towards its end, US president Harry Truman launched the idea of "developing countries", i.e. countries on the way to an economy, a society and a culture similar to, i.e. "as advanced as", the ones in the West. Hence, by implication, "developing the underdeveloped" would contribute to the advance of humanity.

Since then various "development schools" have fought regarding the definitions of the concept of development, goals, strategies, interests, measurements (indicators/indexes), and over the measuring of failures and successes. However crucial the differences might have seemed and still seem, and however important they have been in shaping history, they have still mostly operated within the cosmology of growth economics – without being concerned by global carrying capacity limitations.

Wolfgang Sachs, one of the leading critics of traditional development theory and a forerunner in transforming it to include the ecological perspective, sums up the status of development theory as it stands confronted with the global environmental threats with the following words:

> *"The idea of development stands to-day like a ruin in the intellectual landscape. Its shadow obscures our vision."* (Sachs 1992, quoted in Smukkestad 2007)

Gilbert Rist, a development scholar and theorist of French academic tradition, takes this warning even further (Rist 1997 & 2006): To him, the world view of economics is incapable of relating to the needs for ecological homeostasis. Why? Rist shows how basic assumptions are heavily inspired by European 17th century cosmology and religion and lead us astray by false assumptions that provide their own proofs by changing the world into their image: The norms, ethics and behaviour it leads us to adopt and impose, are destructive to traditional exchange patterns which carry important social values and in the same token impose limitations as to the exploitation of nature. Hence, the kind of development that economics imposes on the rest of the world ultimately embeds a European belief system that expands and "invades" other social systems, reshaping them to conform to the model behaviours of economists' thought – fostering behaviours which are non-sustainable from an environment perspective.[6)]

If Sachs and Rist were alone, we could write them off as eccentric. But they are not. They are voices from a huge and multifaceted, loosely tied global alliance of persons and movements. The common message of this organisational swarm, as its common features emerge once one starts to look for them, may be summed up as follows:

"Modernisation" is an instrument for *weakened* ecological sustainability – at a global, regional, national, or local level – imposing a growth based economy, population increase, and a culture with ambitions of material consumption beyond the carrying capacity of the ecosystem. Corporations, governments, and local (urban) elites seem caught in thought patterns that are instrumental to this destructive system, and their *raison d'être* is at odds with sustainable life. Development towards more sustainable ways of life would therefore often mean "de-development" into more locally based economic systems, reverting to traditions and local knowledge that is adapted to nature's carrying capacity.

Such views are easily found as ingredients in the ideologies or motivations behind many causes fought for on the world scene and come in all kinds of wrappings: religious revivals, regionalists, anarchists, Islamists, clan upheavals, New Age adherents, green movements, left, right, and third world rhetoric. The views might not form coherent and all-encompassing belief systems like the great ideologies of the 19th and 20th century, and they often lead to standpoints that seem bewildering or even reactionary as well as leftist through the lenses of conventional left-to-right political thinking.[7)] In our context here, what unites them, is first and fore-

6) *(Fukuyama 1992) even argues that we have passed a "year zero", as all cultures of importance have accepted the modernisation model. Hence it would be too late to revert to such more traditional cultural values. Economists have through the last decennials tried to bring the limitations of nature into theory. Herman Daily and Gretchen C. Daily are among the outstanding ones.*

most that they claim – with the support from many of the world's foremost minds within economics, politics, technology, relief organisations, and social sciences – that the concepts of growth and development must be re-defined to mean something else: They offer a "third road to development", under slogans like "Another world is possible!". Some meet in Quran schools[8], some meet in conventions like The World Social Forum, some in local community groups or on their thousands of web sites on the Internet.

In a world where globalization and universal principles as well as practical solutions to eradicate miseries have been the order of the day for several decades, such counter-forces are weak and fragmented. But their views are bound to gain ground: They make the world understandable – in ways combinable with any religion, any local culture. They provide a counter-current to "the world system"[9] and an alternative to the feeling of just being a puppet in a string on the world scene. Such views also provide an enemy, a target, a platform for action. They even provide Utopian goals and an understanding of oneself combinable with traditions, self-esteem and involvement, as an alternative to strive for a new and foreign identity provided by Westernized mass society.

To the ICT industry and its adherents, like the proponents of ICT for Development and ICT for Environment (ICT4D and ICT4E), these movements pose two challenges of very different order:

1. How to relate to such movements and views?
2. What has ICT to offer to such perspectives?

As to the first of these challenges, society at large – traditional as well as modern – offers a multitude of mechanisms as to reconciliation of opposing views and interests (clan and neighbourhood meetings, consumer and environmental protection laws, consultative organs, freedom to speak, to organize, etc). *Stakeholder theory*[10], the precautionary principle, *LCAs* (Life Cycle Assessments), ecological design principles (e.g. the *Hannover principles*, see later), and the forthcoming *ISO 26000 standard on Social Responsibility* (planned to be finalized in 2010) are some examples of new tools designed particularly to reconcile project planning, government and industry with nature as well as other interested parties within its surroundings. Such tools shift the focus from end-of-pipe evaluation of effects to the planning or pre-planning phases and to design methodology and management and process systems. Hence, any development project or business initiative should expect to be subject to early-in-the-process evaluations as to environmental as well as social sustainability at levels ranging from local to global.

As to the second of these challenges – what ICT has to offer – this will be the topic in the second half of this paper.

2 ICT and Sustainable Development – Is ICT Here to Help?

The potentials of ICT as a welfare instrument are evident. It is still a technology – or a family of such – characterized by continued innovation as to its applications, where huge efficiency gains can be harvested. Plans and policy declarations for social development abound accompanied with ambitions such as to close the gap between the West and the Rest, alleviate poverty, make public services more efficient, improve market information and the like. Accordingly, a large number of academic and non-academic studies analyze the use of ICT and dissect the various causes, corollaries, effects, conditions, etc. that contribute to social change through the use of computers, software, mobile phones, telco products and services, and so on (Donner 2008).

The validity of these studies and the social beneficial effects of such projects are not discussed below, neither is any doubt cast on them. This is however not contradictory to the main point made below: The power of ICT applications lends them to turning local economies into growth spirals – a most wanted good, but problematic at a higher level of analysis, as growth

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7) *An interesting example is the blend of arguments about ethics, terrorism, technology, ecology, psychology, economics, sociology and politics put together in "The Unabomber's Manifesto" or "Industrial Society and Its Future" by "the Unabomber", Theodore John "Ted" Kaczynski, the American mathematician who from the late 1970s into the 1990s mailed bombs to people at universities and airline companies he found were hubs in driving technological and social change (Kaczynski 1995).*

8) *(Hobsbawm 2007) shows in detail how religious revival, terrorism, banditism and the Modernization project are intimately connected.*

9) *"The world system" is a term coined by the world system theorists of the dependency school within development theory (Wallerstein 1974, as well as later works where the theory is expanded to present times). A main point is that poverty is explained as a result of "de-development" in the peripheries resulting from unequal exchange through power and trade relations with centers, i.e. through exploitative relations built mostly over long time spans.*

10) *A normative theory originally by R. Edward Freeman (1984) as to whom and what should be considered interested parties to a corporation. See e.g. http://en.wikipedia.org/wiki/Stakeholder_theory. Stakeholder theory expands the list of interested parties in e.g. an enterprise from owners and employees to include i.a. local inhabitants, future generations, and could in principle even comprise an ecosystem or a way of life.*

also triggers energy increase and extraction economics. These effects need to be addressed at a strategic and business model level. They therefore lead us in the next run to sketch up some elements for business models that could become part of the solutions.

3 Potent, Pervasive – and Perilous?

Investments in ICT globally amounted in 2005 to somewhere around 3 trillion USD, which makes ICT among the strongest shaping forces on the globe – economically, culturally, as well as politically (www.nepalit.com/Feb2006.htm)[11]. Of the main and most spectacular shapers of the globalized, "flat world", the lion's share has to do with ICT – in the restricted sense of PCs, World Wide Web and the Internet, software for cooperative work, open sourcing, outsourcing of the Y2K measures, offshoring, insourcing, in-forming, as well as individual, fast terminals (like laptops, software game equipment, mobile phones and PDAs) (Friedman 2005). If we also take into account that ICT is now present in almost everything else, like aircraft, cash registers, automatic door openers, echo sounders as well as puppets and dog neclaces, the shaping force of ICT becomes overwhelming.

This extreme pervasiveness and influence makes ICT the realm for business development *ad infinitum*. ICT components now embedded in practically all production based on the former technological revolutions such as the mechanical, chemical and biological – enforce this picture even more so, and bring about tremendous and rapid improvements as to capacities, energy efficiencies and cost in production.

Simply put, ICT is a bundle of technologies for realizing ideas developed in the 19th century and before: mathematical and logical operations to be performed by technological devices, speech and other information streams that are carried, stored and forwarded by mechanics or electricity. Seen as such, ICT is just a particular group of the many technologies all serving the purpose of helping mankind in its value creation activities. All technologies that prove viable, do so in terms of offering some kind of efficiency gain. Such gains are created and harvested, i.e. used somehow by someone for some purpose, when the technology is applied. At some point in time the technology might be "absorbed", i.e. the efficiency gain has become the norm, and the advantages it offers are regularly disposed of for some purpose. Hence, the room for twisting the way the gains are harvested is larger when a specific technology is new. Business models and organisational forms connected have similar attributes and opportunity windows.

In the general enthusiasm over what extraordinary gains mankind can have from ICT, we may – as we did with e.g. PCB – underestimate negative impacts, particularly indirect effects, not instantaneously observable: If it is right that ICT is a driver for increased energy consumption and weakened sustainability, it would mean that the energy efficiency improvements marketed by the ICT business as "green", may, paradoxically, add to the climate problems, and that measures should be taken to amend it, instead of adding to the problem by believing – or worse, pretending – to solve it by increasing the use of ICT.

To drill further into this view, we have to establish a basic distinction that seems frequently overlooked, causing development strategies to emerge that most probably have detrimental effects on the aggregate level.

4 Efficiency Improvements by Factor 10, 5, 4 – and 1

In the early 1990s, the Wuppertal Institute for Climate, Environment and Energy developed the idea of a "Factor 10" improvement, i.e. that utilizing the same amounts of energy and resources ten times more efficiently *for any unit of production*, would be an appropriate ambition for the industrial world to cope with environmental problems and resource scarcity. Among environmentalists, the idea caught on. Later, the environmental movement settled for the less ambitious "Factor 4" in an attempt to gain acceptance from politicians and industry, i.e. getting resource spending down by 75 %, in other words a 400 % improvement in resource efficiency. (Indeed, the Telenor headquarter at Fornebu near Oslo is a Factor 4 building as to the reduction of energy consumption per man/year compared to total energy use in the company's many previous facilities in the Oslo area (Høyer 2003).)

Various rough figures have been around as to the *reduction in total consumption* of energy needed in the *industrialised* world by 2050 if there were to be room for a rise in welfare in the *developing* world. 80 % reduction has been a commonly mentioned figure. 80 % reduction means "Factor 5", and equals a

[11] *The origin of this source is unknown. OECD figures are of similar orders, though split such that this author has not found any global aggregate figures. Of much more importance, however, is that although high, one might expect the figure to be far too low as an indication of the importance of ICT as shaper of society and ecology, as it probably only comprises products where ICT is considered the main feature, e.g. not cars, watches, kitchen apparel, lawn mowers, radios, sun panels, air conditioners, welding machines and other equipment where ICT significantly enhances functionality and/or efficiency.*

500 % improvement in all energy efficiency, i.e. getting five times more production volume or welfare out of the same amount of resources.

For comparison, the European Union's perspective on energy efficiency in its "Renewable Energy and Climate Plan Package" is that energy consumption all along the supply chain should be reduced by an amount permitting a 20 % reduction in import of fossil fuel by 2020. If benevolently interpreted as a 20 % energy efficiency increase, it would mean a modest Factor 1.25 as goal for 2020[12]. Such figures tell that industry cannot wait for the politicians to come up with reduction schemes: Stimulating consumption increases in parts of the world without corresponding decreases in others, means unsustainable growth. Industry has a role here to provide politicians with the needed legitimacy to make braver decisions, and help with solutions.

4.1 Efficiency Gains with ICT: a Piece of Cake, as with Consumption Increase

"Factor 5" might seem harsh. As to efficiency gains from ICT, however, it might seem to be a piece of cake: Efficiency gains from ICT are frequently much larger, as was documented in 2000, when then environmental manager of Telenor, Ellen-Birgitte Strømø and the author commissioned a literature study as to what research could at that time tell us on the topic (Evjemo & Paulsen 2000): Already in the 1990s, the CO_2 emissions throughout the lifecycle of voicemail, mobile phones and video conferences had been calculated, and estimates had also been made on energy savings from using e-mail. The resource efficiencies were found to be miles above the ambitions of the Wuppertal Institute. For example, the life long, i.e. from cradle to recycling, CO_2 emissions from a mobile telephony hand set – network use included – was estimated to equal one single 1.8 km car drive. In such a case, Factor 1000+ seems more appropriate as to the effect of using mobiles instead of car driving, and Factor 10 a pale ambition!

There is a vast pool of similar examples that were brought to the fore in the 1990s: ICT enabled traffic control systems result in higher throughput and less cars running on idle. Route planners (logistics software) were developed to provide more efficient distribution of merchandise. Video conferencing and telephone meetings and a number of other ICT-based services were developed to provide business expansion for telcos as well as opportunities for replacing CO_2-generating transport of molecules with next to "CO_2-free" transport of bits. Also, since the mid 1990s, "virtual project rooms" have triggered net-based cooperation and "flat" organisational forms, "materialized" so to speak in a host of virtual fora.

The gains from creating platforms for "remote cooperation" replacing transport of flesh, blood and documents with transportation of text, sound and images, are obvious. We are thus in possession of a fantastic arsenal of environmentally sound solutions, by and large the arsenal of "green solutions" that are now launched by the ICT business as a means to de-materialize transportation. Hence, we could start anew to calculate the number of meetings that can be replaced by meetings over the net, while freeing road capacity and time, and reducing CO_2 emissions. – Yes, we did calculate such things a long time ago. See for example (Aardal 1982). (McKinsey 2008) and other consultants now address a new generation, pointing at business opportunities as well as positive climate effects.

So, the findings were – and are – that ICT certainly has the potential to contribute considerably to more energy efficient and hence sustainable welfare creation.

This potential adds to the potential of what is normally called "eco-design" or "sustainable design", applicable to ICT as well as non-ICT items. Such design principles are described in a rich body of literature (see e.g. Wikipedia: "Sustainable design").[13] With ICT having become almost ubiquitous in parts of the world and in all kinds of products and tools, such design principles will increasingly become a demand. Such "greening" of the business has been demanded since long, and has finally become mainstream through regulations regarding pollution, as well as "Green ICT" and Climate Challenge Programmes.

4.2 But it's the Total that counts!

Most environmental policy issues, most "greening" of private or public enterprise, as well as most ICT for sustainable development initiatives, are about *energy or resource efficiency improvements*, at the level of production costs, per units of transactions, and the like. However, what counts in the context of climate change, is the level of *aggregate resource use or emissions*. The two are not directly related: Efficiency

12) *It is not a simple task to figure out how this "Renewable Energy and Climate Plan Package" has been put together and what it actually does consist of. One might use the following as a starting point: http://www.euractiv.com/en/energy/energy-efficiency-eu-action-plan/article-143199.*

13) *While eco-design initially addressed waste and pollution in manufacturing, and continued through establishing environmental requirements into the design process of things to minimize impact on nature, this tradition now also addresses replacing things with services, as well as the development of services that reduce environmental effects.*

gains at the individual equipment level may be achieved without resulting in reductions in aggregate levels. Lack of distinction blurs the view and the seeking for solutions.

So, even this coin has a flip side: As ICT develops and takes efficiency gains to new levels as per unit processed (e.g. bit/km) it also creates opportunity spaces for increased energy consumption and makes us consume more of them, a challenge not yet properly addressed.

5 A Flip Side Called "Rebound": Efficiency Gains Lost to Increased Volume

While efficiency gains might come easily with ICT, it is on the other hand highly possible that the gains obtained will be used for new resource consumption. It might even happen that the gains achieved become the driver as such for far more consumption. Hence, the ever more pervasive use of ICT may then trigger resource demands to such an extent that it might zero out the gains, and – worse even – cause a net increase. This downside effect is known as "the rebound effect", and was – together with the upsides – reported in (Evjemo & Paulsen 2000).

Examples abound:

Replace the old POTS phone with an ISDN phone or a PC with a "softphone" (e.g. Skype) and energy consumption will increase substantially. How much? A very rough and sketchy estimate, not even including the added energy needed to make the network run at higher bandwidths, is achieved by multiplying the number of broadband (XDSL and ISDN) subscribers in a country by the electricity consumption per day of a PC (e.g. 150 W always on). As to Telenor's fixed broadband customers (mainly located in Norway) this added consumption would amount to somewhere in the order of 1800 GWh per year. Even with ample tolerance for lack of precision we see that substantial power consumption is involved, and that at least a substantial share, is taking place at the edge of the networks. (In a climate sustainability context such consumption of energy as well as resources are intimately connected to the network and must be part of the same strategic plans to be addressed properly, as the edge is where the customer value is located.)

Good ICT-based flow regulating transport systems, e.g. "green waves", in conjunction with low energy prices cause increased traffic volumes.[14] Just-in-time based logistics is often mentioned to lead to increase in the number of deliveries, such as to sushi restaurants and car factories, which base their business on high-frequency deliveries and minimal warehousing. Hence, total traffic volumes go up. Web based consumer markets might save on warehousing, but also increase energy demands, as far more small packages are sent individually across long distances instead of whole pallets being sent the first legs, and than repacked before delivered to their close-vicinity final destinations. Also, the higher product availability due to the virtual markets on the World Wide Web, i.e. lower information cost, should be expected to lead to increased consumption.

In the early 1980s an often referred example of rebound within "office automation" was the case of two regional bank offices in the cities of Bergen and Oslo, 400 mountainous kilometres apart, integrating their IT systems for efficiency purposes and to reduce travel expenses[15]. However, the staff travels between the two cities increased – caused from getting more projects in common between the two branches, and therefore more reasons to meet to get to know each other and coordinate activities face to face in addition to doing so by email, fax and telephone calls. So also, e-mails seem to lead – as do phones, mobile phones and faxes – not only to reductions by substitution, but also to massive increases in communication, to more cooperation at a distance, and, as a result, more reasons to meet, and more involvement at locations we would otherwise only have dreamed of visiting. As percentage of transactions physical travel might well decrease, but in absolute volumes it might well increase. Overall figures show it does, and that is where the climate sustainability problem lies.

So, from an efficiency point of view, ICT often means more efficient value creation, higher rationality, and higher welfare. However, from a climate policy or sustainability point of view, we have – whether we are business, government or consumers – a problem here.

Is this anecdotal evidence of any practical importance? That is, are we talking losses to rebound that really matter? Are ICT induced efficiency gains not at least helping us in the right direction by substitu-

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14) *Such effects on traffic were calculated and reported in the early 1990s by the Fraunhofer Institute. My reference is a report on telecom and transportation from then, too well archived somewhere in my bookshelves for me to find! The fact that better roads create total traffic increase, not just cars to move from other roads to the new ones, is also well known to the roads and transportation professionals.*

15) *Also here, the source is lost in history. The two local banks that merged, were, according to the author's memory, Kreditkassen (Oslo) and Bergen Bank (Bergen).*

tion larger than rebound? We are talking volumes that matter, and at least sometimes, substitution of less importance:

Take "World of Warcraft" – played by millions of youngsters scattered around the globe – as an extreme, though clear, example: At the specific activity level, the energy saved from "de-materializing" long distance connections between hundreds of thousands of players should mean increased sustainability account of ICT. However, "World of Warcraft" can hardly be said to substitute other transportation, but is bit-transportation added, mostly substituting playing in the nearest park with wooden swords. Even the air conditioners to get rid of the heat from the players' scores of always-on-PCs might be considered part of the communication system, adding to the environmental footprint of ICT.

Similar cases might be made of broadband and mp3 players: They substitute music distribution on disc by music distribution over the net, but with a simultaneous massive increase in the number of players, batteries and melodies copied. World energy consumption will probably not decrease from this, but more likely increase. Databases take over paper archives, and word processors and email replace typewriters and mail. But we profit on the occasion to increase the information flow, e.g. by adding millions of new web-pages per day. Global paper consumption goes up, not down.

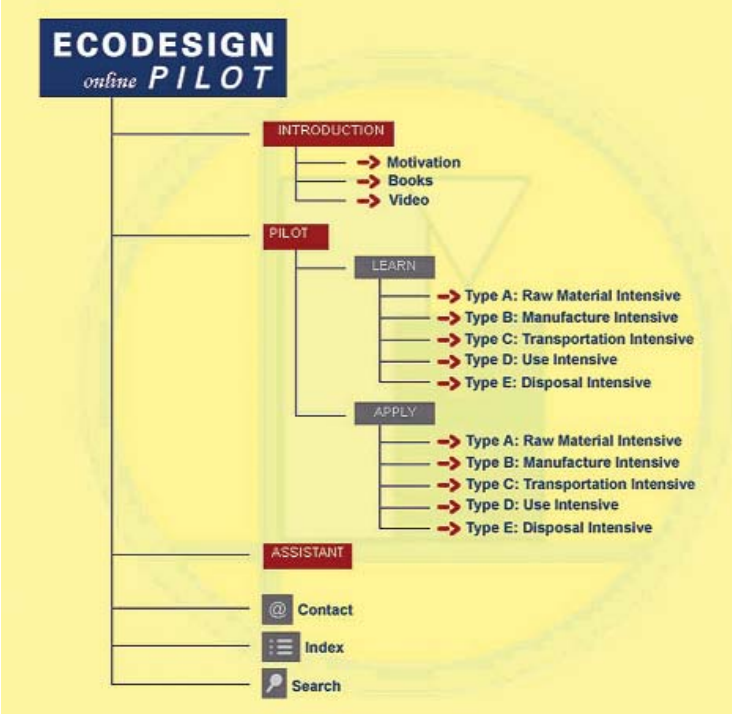

Figure 2 Overview of an interactive online tool for product eco-design, developed by Institut für Konstruktionswissenschaften, Technische Universität, Vienna (source: www.ecodesign.at)

The most shocking news might be that this knowledge about rebound effects from ICT is not new at all. But it has not been listened to: It has been a source of concern for a long time, with seminars, hearings and warnings. For example, we find a flood of papers focusing on e-trade and energy consumption (see e.g. Behrendt et al. 2003), and many authors have since long described the internet as a Trojan horse for increased electricity consumption (see e.g. Barthel, Öechtenböhmer & Thomas 2001).

In fact, experience based suspicions have been on their way to be given theoretical support since William Stanley Jevons in 1865 published his warnings that the demand for coal did rise after the breakthrough of James Watt's far more efficient steam engine. – The demand for coal did not fall as would then be expected[16]. The "Jevons' paradox" has in more recent research on energy use been labelled "the Khazzoom-Brookes postulate". In 1992 the economist Harry Saunders showed that this postulate – "that improvements in energy efficiency work to increase, rather than decrease energy consumption – was consistent with neo-classical growth theory under a wide range of assumptions" (http://en.wikipedia.org/wiki/Jevons_paradox, 8/25/2008), both by making the use of energy relatively cheaper, and by leading to increased economic growth, which in turn leads to a general increase in energy use, even if energy use within the specific market originally considered might fall.

More generally, the Khazzoom-Brookes postulate challenges the belief deeply embedded in modern man that technology and growth are synonymous to progress, not to decay. Hence, as to the longer term effects of ICT for development (ICT4D) and for environment (ICT4E), the analogy of using petrol to extinguish a fire comes to mind. Paradoxical though as it might seem, and as it also was to William Stanley Jevons as to his coal, ICT efficiency measures seem at odds with the need for development to contribute to ecological sustainability. The efficiency gains will, as follows from the Khazzom-Brookes postulate, in general be outpaced by the demand they cause themselves: 10 Gb drives in mp3 players cause more network traffic than 10 Mb drives, and, in the next run, more downloads stimulate the spread of mp3 players with even cheaper and larger memory.

The European Information & Communications Technology Industry Association, EICTA, reckons this

16) *Jevons, William Stanley: The coal question : An inquiry concerning the progress of the Nation, and the probable exhaustion of our coal-mines, (Reprints of economic classics), A.M. Kelley; 3rd rev. ed. edition (1965).*

state of the matter and states in exceptionally clear terms how crucial it has become to include rebound and aggregate climate effects in the analysis as well as in ICT business strategy (EICTA 2008):

> The boom in technology is likely to grow [for] three underlying reasons: Moore's Law (computer technology continues to get faster, smaller, cheaper and better), Metcalfe's Law (which states that the value of a network is proportional to the square of the numbers using it and explains the popularity of the web and social networking technologies), and the autocatalytic nature of ICT (computers and associated technology actively contribute to the development of new improved components and products). This is both a benefit and a challenge for the digital technology industry – whilst we, like any sector, want to grow and sell more products and services, energy efficiency measures that we implement will have to be robust enough to outweigh the kind of rapid growth and increasing proliferation that we have seen over the last decade and which look set to continue.

Grasping the essential dilemma in a single paragraph, the EICTA though prescribes a pact with the Devil: to fight the galloping proliferation of ICT equipment and applications and the resulting increase in resource use by new efficiency increases! Such a strategy, though understandable from a short sighted business perspective, seems not just to be a draconian challenge, but worse still: a strategy for spurring an ever *growing* net energy and resource demand from ICT.

The dubiousness of such a strategy might as well be demonstrated with the proliferation of mobile phones: A global increase from 3 to 4.5 billion in the next four years (Portio Research 2007), mainly from new subscribers living in low income rural communities, will more likely than not spur increased (fossil) energy demand, although some physical transportation will be substituted. Anything else would be at odds with trends, expectations, and with how mobile phones are marketed.[17)]

5.1 Time for Better Tools as to Environment as well as Development – and for Using the ones already there

Resolving the problem requires other tools than those that created them. Which ones? At least we know where to look, as environmentalists, economists, development thinkers, as well as designers have searched for – and developed – a score of tools that we find as soon as we start searching for them:

1. Does energy use decrease?
2. Do we use renewable energy sources?
3. Do we increase nature's resource building capacity?
4. Do we increase biological diversity?
5. Do we create closed circuits for the material involved?
6. Do we keep within the limits for nature's and humans' sustainability?
7. Do we solve several problems together without creating new ones?
8. As everything cannot be calculated beforehand, do we adapt the precautionary principle in a reasonable way?

Figure 3 Simple tool to use in development projects to get the big picture: "Directional analysis"

Within *climate and environment*, researchers, activists, bureaucrats and politicians have for more than three decades developed

- *principles* (e.g. precautionary principle, the Hannover principles, The Bellagio principles, etc., see an overview at www.nextstep.state.mn.us /res_detail.cfm?id=217);
- *guidelines for eco-design* (design rules, hints, and evaluation software, see example in Figure 2);
- *standards* for reducing environmental impact (e.g. ISO 14000-series);
- various *measuring tools* for ecological impact (e.g. "Life Cycle Analysis" (LCA) and analysis of "ecological footprints");
- as well as simple *rules of thumb for project evaluation*.

A simple such tool for the latter is the "Directional analysis" launched in 1991 by the Swedish Association of Local Authorities. The eight questions that form its base constitute a simple check list to evaluate whether new products or services contribute positively or negatively as to sustainable development (Figure 3, Månson 1992).

17) *Not to spur energy consumption increase would mean 1) that new handsets with similar functionalities use just a fraction of the energy of the old, 2) that the buyers would not go for more functionalities when buying new handsets, 3) that a very high percentage of the first 3 billion get themselves new and less energy demanding handsets, 4) that the handsets are not successful as catalysts of economic growth, and that they will not generate their own growth in physical transportation and other energy use in addition to what they might substitute, or 5) that the energy needed for handsets and networks would be emission free. None of these points seem likely.*

- Basic for all development is to satisfy human material and immaterial needs, and a reasonably egalitarian society. Redrawing from market economy is an option when free market induced economic growth happens at the expense of the poor.
- Development shall be endogenous in the sense that local societies shall decide themselves on their visions and values for own development. They shall dispose of local resources themselves and shall be self-sufficient at the local or regional level. They shall not be subjected to the development logic of external forces, like the state or the international "world system".
- The "territorial principle" should be reinforced, implying that areas should to a larger degree become self-sufficient, and not just fill a role in a system of division-of-labour or specialization between regions, which is a basic principle on which Modernization is based.
- Development shall be based on self-reliance, not dependency on external resources (aid or trade).
- Development of the local society shall aim at ecological balance, i.e. sustainability, at the premises of the local ecology (within the limits set by the global). Hence, "development" must always be understood in terms of the local environment and its resources, and has no universal meaning. (The industrialized West is no natural frame of reference.)

Figure 4 "Alternative road for development" guidelines

Such tools constitute frameworks based in ecology and homeostasis thinking, i.e. resource consumption within thresholds given by nature. A different current has tried to construct economic models for attributing Net Present Values to ecological features, i.e. prices one might decide to pay or not to maintain nature – a perspective far to "economistic" to be acceptable by many ecologists. Other economists, like Herman Daily, have since long worked for the introduction of absolute ecological limitations on economics, and have developed the topics theoretically (Daily 1999). In such models, there is room for economic growth, but only if there is ecological capacity.

As to *social development*, we find that frameworks have been developed for an equally long period within the loosely organized *"Another development movement"*[18], as response to the failed theories of modernisation. The frameworks envision a better match between needs, environment and people, and may be summed up as a set of *guiding principles for social development*[19], see Figure 4.

For societies to be re-shaped according to principles such as those outlined in Figure 4, structural changes quite different from the ones implied in modernization would be needed. Such changes would go much in the same direction as the principle of "subsidiarity", i.e. pushing responsibility down to the local level and out of central government, but not necessarily into the marketplace. The ideas seem related to the Utopias constructed by earlier European visionaries (de Geus 1999): Central is the principle that all essential functions of society, production, consumption, government, culture, etc. shall take place within the lowest/most local level found practical. Society shall be "self reliant", i.e. not isolated or closed, but able to make it on its own if necessary, and shall function without destructing its ecological base. To achieve this, the tools are, i.a., *consciousness rising*, *self-organizing*, *de-centralizing*, and *change agents*. These ideas are both ideologically and tactically based.

Utopian though, many aid and development organisations, like the GrameenBank in Bangladesh, have followed these ideas in the field for a long time. Some have succeded in combining them with large business projects, like the world-wide known "village phone ladies" project within Grameenphone (Singal, Svenkerud & Flydal 2001), a kind of "social business", later to grow beyond that model by it own success. Grameenphone has grown beyond all expectations to become an extremely successful new national infrastructure in its own right, and thereby a new service platform. By the same token it has set free the forces of modernization and economic growth by easing communication. A more recent example is Danone and Grameen Bank's enterprise in nutritional yogurts, also based on small distribution units financed from microcredit.

Such successes in social development are exactly the kind of successes that are the problem in the wider context of this paper.

We may therefore note that the principles of the *alternative road for development* contain ideas that might be *compatible* with combating climate change, but also with the opposite: Locally based social development is not necessarily good for energy preservation.

The works of the designer John Thackara and the network he has built around himself bring us one step further, trying to combine eco-design and social development. When many would equal "sustainable life" and "low carbon future" to a de-volution towards traditional society, John Thackara has taken on the task to generate

18) *(Smukkestad 2005) mentions some important contributors from several continents to "another development" thinking. Different in their approaches though, they share roughly the ideas summed up here. To mention a few: Marc Nerfin, Ignacy Sachs, Johan Galtung, Paul Ekins, Manfred Max-Neef, Paul Ehrlich, Bade Onimode, Fante Cheru, Vandana Shiva. The list of contributors could easily be expanded with names from all continents.*

19) *The list in Figure 4 as well as the next paragraphs on consequences as to development strategy draw on the summaries given by (Smukkestad 2005), but are here colored by this author's translation, additions and abridgements.*

and proliferate design goals for high tech based sustainable life, as well as triggering self-governed local innovation processes for sustainable ICT and non-ICT sustainable applications in his numerous activities around the globe – putting social issues at the center of technology innovation. His cannonade of ideas, visions and practical suggestions – wild as they might seem – comprise things as well as services, "bottom-up", "top-down" as well as participatory strategies, and address high tech and rich populations as well as low tech and poor ones, urban or not. His general rules of thumb are summed up in (Thackara 2005) and fit well with what we have seen from both the ecologists as well as the developmentalists – with a slight touch of New Age or Eastern focus on the inner self (Figure 5).

However, Thackara's suggestions, though rich and stimulating, fail in the same way as we have seen eco-design and development theory fail: They do not comprise mechanisms as to how to harvest efficiency gains at the level of the individual transactions in order to avoid it getting lost in increased total consumption: His wake up call for more efficient design might – unintended though – in our framework be understood as a call for increased total energy and resource use.

"Sensitivity to context, to relationships, and to consequences are key aspects of the transition from mindless development to design mindfulness. At the heart [...] is a belief that ethics and responsibility can inform design decisions without constraining the social and technical innovation we all need to do. Design mindfulness involves a determination to

- think about the consequences of design actions before we take them and pay close attention to the natural, industrial, and cultural systems that are the context of our design actions;
- consider material and energy flows in all the systems we design;
- give priority to human agency and not treat humans as a "factor" in some bigger picture;
- deliver value to people – not deliver people to systems;
- treat "content" as something we do, not something we are sold;
- treat place time, and cultural difference as positive values, not as obstacles;
- focus on services, not on things, and refrain from flooding the world with pointless devices."

Figure 5 Eco-design principles – Thackara style (Thackara 2005)

6 Business Environments and Models Made Tools for Confiscating Efficiency Gains

We have seen above that the tremendous efficiency gains from ICT stimulate more energy and resource consumption in an already overburdened global ecosystem – even when wrapped as ICT4D and ICT4E. This happens in ways that closely parallel the mechanisms behind the Khazzoom-Brookes postulate regarding energy efficiency gains (mentioned earlier). Economic growth, modernization and development in the standard sense are blueprints for such increased resource consumption – intended tools for welfare as they are.

Since The Club of Rome more than 30 years ago (Meadows et al. 1972), and more recently from the numerous analyses carried out by IPCC, we know that modernization's demand for energy and other resources – and a population increase that devours all efficiency gains achieved, itself being a result of modernization – cannot continue. So, how do we go about to ensure that the new and more energy efficient ICT solutions do not just result in energy and resource consumption added?[20)]

Eco-design and other tools to enhance resource efficiency provide only partial solutions: They do not comprise mechanisms against rebound. On the contrary, they even add to the problem by reducing the costs of further growth – just like more energy efficient cars make total traffic, steel and petrol consumption grow. To make them instrumental, some mechanism against rebound must be introduced, which means confiscating the benefits, for ICT as for other efficency increasing means:

> *... for a world facing the twin challenges of oil depletion and global climate change, there has never been a more urgent need for both (energy efficiency and conservation, EF). But in order for total efficiency to actually curb total energy usage, as opposed to energy intensity, consumers must be kept from reaping the benefits of those initiatives in ever-greater energy consumption. Otherwise, energy usage will be the beneficiary of our best efforts towards greater energy efficiency.*
> Jeff Rubin, Chief Economist at CIBC World Markets (Rubin 2007)

Is it possible to shape some mechanisms that stimulate ICT investments for applications with high efficiency gains, and – at the same token – confiscate the efficiency gains that have been created before spent on more energy or other resource consumption?

20) *There is no such solution as finding alternative sources that permit energy use to continue or raise at habitual levels. See e.g. (MacKay 2008). Mechanisms to restrict the supply of energy and resources are a speciality not considered here. We limit ourselves to a relatively simple field within what the ICT business can initiate: business models.*

It seems that such mechanisms would be simplest and easiest to create not at the end of pipe but at the start of pipe, and that they would have to be shaped in close co-operation between business and the local powers (government or others) that could impose general measures. Hence, it seems that confiscating energy gains should be part of business models, as should the partnerships necessary for them to work. Using business models for such purposes is a far cry from the present attitude, where business insists on marketing just efficiency gains, leaving to governments' or users' neglect or descretion if saved time, costs and energy would be saved or spent to rebound on the total emissions.

Why business models and not other means? Business models are mostly stronger tools than ethics and regulations. They are adhered to even when ethics and regulations are not. Tony White, of the British venture fund Climate Change Capital, provides us with a case in point when he airs his frustration as to the energy business having incentives contrary to the political aims of energy saving and investing in new capacity (White 2008): As investment is high and inflexible, production costs fairly fixed, and margins mostly low, profit depends highly on volume. Selling electricity by the watt to the customers makes you want the customers to consume as much as you can deliver. Thomas A. Edison had a different model after having invented the light bulb: He sold home lighting, which urged him to get as much light (measured in lumen) out of the watts as possible. That business model made watts an input factor, not the end product, and urged him to save on the input factor per lumen. Similarly, "Gaia", or the global system of climate systems needs the ICT business to change from isolated and individual efficiency gains as the basic value proposition offered to the customer, into net accumulated efficiency gains turned into a production goal. Somehow this would imply confiscation of efficiency gains or regulation of some of the other few parameters of the equation: population size and culture, product and services availability, availability of purposes for spending efficiency gains.

Below are some unfinished lines of thought on the way towards identifying some such mechanisms. Rephrasing them into some measures that can be put into practice, eventually testing the realism of them, is beyond the ambition here. However, the reader will easily see that some lines of thought are simpler and more realistic to convert to business models than others. Some would need forms that do not trigger large ethical and political controversies, and some might depend on finding ethically and politically more palatable methods for change unless some bright new ideas come up.[21] One might fear that the range of options will narrow as time passes.

- Energy efficiency gains may be thought of as *"value added"* (positive or negative) to the ICT product or service in question. Value added is conventionally stimulated or reduced by tax incentives and/or confiscated by VAT (value added tax). Hence, in principle,

  - taxation might be used to reduce investments in ICT, or to set a price on ICT to reflect (at least) the expected costs of sequestering from the biosphere extra emissions of CO_2 caused by the ICT investment.[22]

  - subsidies or similar incentives on ICT investments might be used to stimulate investments in ICT when measures are taken that effectively confiscate the efficiency gains from being spent on more energy and resource consumption. The level of incentives should reflect less than the costs saved.[23]

- ICT induced energy efficiency gains are *opportunities for reducing capacity on energy and resource consumption*. Hence, confiscation of energy efficiency gains might take the form of capacity reductions in a bundling operation that involve co-operation between business, local and central government, or other relevant partners, e.g. NGOs, each responsible for its part of such operations.

  - The larger the expected energy efficiency gains from ICT, the more capacity reduction in the most carbon consuming activities of society. Accordingly, road widths should be narrowed proportionally to the number of mobile phone handsets. Cost of fuel should increase with the spread of "de-materialised" products. Tax on newspapers should increase with the availability of TV sets, information panels, and broadband – or even the other way round if paper production and distribution were proven the more efficient

21) *The lines of thought presented below are not contrary to mainstream marketing of "green products", nor to the search for new energy solutions, etc. They are just derivations from the basic argument of this paper that such mainstream strategies seem by far insufficient or even counterproductive, as long as they are marketed without informing that their positive effect is highly conditional, and not reinforced with measures such as outlined here.*

22) *Carbon quotas trading and CO_2 deposits are a range of solutions addressing the end-of-pipe problems. As the gains are hard to specify when accounting for direct as well as indirect effects from ICT, such taxation would be similar to general taxes on luxurious items. Frequent upgrading of equipment would be an evident target.*

ways! Mobile telephony subscribers should be offered price schemes for public transport that would stimulate them not to keep private cars, to reduce their travelling, and to go by public transport if necessary.

- ICT could be a strong means to *decrease world population*. Without such a decrease in population increase as well as absolute size, even strong energy efficiency measures are quickly neutralized from population growth.[24] The causes behind population growth in poor countries are mixed, being among other things improved health and less disease, poverty, lack of family planning and birth control, lack of other social security systems for the elderly, culture, and need for work force in the individual family. Aid activities (and businesses) have largely failed to stop population growth, apart from in China, and world population has multiplied since the Modernization era started with industrialization.

  - There is a vast opportunity space for all kinds of innovative applications that will stimulate population reduction: Conventional measures would be family planning campaigns, better social security systems, law enforcement, and enlightenment. Innovative initiatives with much stronger and faster effects than before are now needed. Such initiatives carried out in ethically acceptable ways are hardly thinkable without massive use of ICT in combination with some kind of large-scale public services and regulations – e.g. in the form of TVs and village information systems, sterilization surgery assisted at a distance, family planning shows, efficient social security services, re-distribution and compensation schemes, etc.

7 Conclusion

Information and communication technologies (ICT), market mechanisms, development theory, eco-design and economic growth do all lack the mechanisms necessary to cope with the challenge of climate change: Efficient as they may be for their purposes, and although being key elements in the great and global Modernization project, they do simply not address the problem of confiscating the detrimental aggregate effects that now set the climate at stake. Instead, they all contribute to increasing the negative impact, as they open for, or even urge for, increased energy use.

This is not sustainable, and changes are needed. A rich variety of tools are available for the design of products and services more compatible to such demands, but even new and stronger tools are needed. This seems to make necessary a fresh look at business models, to find mechanisms to confiscate the tremendous efficiency gains from ICT before they are spent on activities that trigger aggregate energy consumption increase. Some lines of thought, preliminary indeed, have been put forward as to how such business models might look.

Such a transformation is not simple – to say the least. But climate challenge seems to force the ICT business, as most other businesses, to take on more responsibility along its value chains – as well as beyond. This is fully in line with strong international currents since the Rio declaration on sustainability, and should astonish nobody.

To search for what ICT can contribute, might in a way be to search for ICT's role in helping industrial society to learn from traditional societies as to how to live without triggering metabolism growth spirals.

The ICT business – along with its stakeholders in government, NGOs and consumers – serves its proper long run interests by exploring this further, and to formulate its practical consequences as to business models and partnerships. Neither business nor consumers or government can justify – nor should wish – to leave the responsibility for such thinking or practical measures to the other parties alone.

So, where does it take us? Can the complex ICT business adapt, or will only the simpler low-energy value creation forms that do not need such complex organisations and partnerships do?

Or can we imagine equally trajectory disruptive but still ICT based responses? What would make us switch off the electricity based infrastructures of daily life, or not spend the time saved on more consumption? Poverty? Massive and frequent Internet fall-outs, like the one that we saw February 2008 in the Middle East and India? Politically motivated or fraud-investigation related close downs of the net of entire countries, like it happened earlier in Iraq, Afghanistan and Kazakhstan? Can we for example imagine a new variety of the virtual Second Life not based on electricity? Or would it more energy-efficiently be substituted by some hallucinogen? Can we imagine a "Facebook" alike not seducing the user to always stay

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[23] *Heat pumps would be a case in point. But how do you avoid savings from using a heat pump being spent on e.g. an air flight?*

[24] *Lovelock suggests about half a billion humans (500 million) to be a suitable number to permit for some flexibility in life forms (Lovelock 2006). That would imply a reduction to 1/18 of prognosticated world population in a few years from now.*

on-line? Or could it then be replaced more energy-efficiently by local friends? Eventually, could we return to more robust and low-technology solutions, like the Fido Net?[25)]

The simple answer is that we do not know. We are striving with the concequences of Modernity, and are on board the Jagannath wagon, as Anthony Giddens since long coined it (Giddens 1990). But we do know that – borrowing a metaphor from Herman Daly, quoted by Lovelock – "now that we have no choice but to move from acknowledgement of the problem to throwing ourselves into the foggy space of finding practical solutions that really do help, where even the most rudimentary parachutes are better than exact altimeters."

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25) *FidoNet was a "rarely-on" network for e-mail. It was e.g. used by development aid organizations in regions with poor and unstable tele-networks, particularly in sub-Sahara Africa. Emails jumped stepwise closer towards the reciever as connections were established. Another kind of low tech network would be cooperation groups for low-technology heat pumps.*

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Terms and Acronyms in *Telecom in Emerging Markets*

Acronym	Definition	Explanation	Web
3G	Third Generation mobile technology	The generic term for the next generation of wireless mobile communications networks supporting enhanced services like multimedia and video. Most commonly, 3G networks are discussed as graceful enhancements of 2G cellular standards, like e.g. GSM. The enhancements include larger bandwidth, more sophisticated compression techniques, and the inclusion of in-building systems. 3G networks will carry data at 144 kb/s, or up to 2 Mb/s from fixed locations. 3G comprises mutually incompatible standards: UMTS FDD and TDD, CDMA2000, TD-CDMA.	
AGE	Adjusted Gross Estate	The value of an estate after payment of administrative expenses, debts of the decedent and losses, but before estate taxes are paid.	
ARPU	Average Revenue Per User	It is a measure of the revenue generated by one customer phone, pager, etc., per month. The term is used by companies that offer subscription services to clients, for example, telephone carriers, Internet Service Providers, and Hosters etc. In mobile telephony, ARPU includes not only the revenues billed to the customer each month for usage, but also the revenue generated from incoming calls, payable within the regulatory interconnection regime.	
ATOB	Association of Telecommunication Operators of Bangladesh		
BDT	Bangladesh Taka	The Bangladesh currency, I BDT = 0.01480 USD (13.8.08)	
BOP	Bottom of the (Economic) Pyramid	In economics, the bottom of the pyramid is the largest, but poorest socio-economic group. In global terms, this is the four billion people who live on less than 2 USD per day, typically in developing countries. The phrase "bottom of the pyramid" is used in particular by people developing new models of doing business that deliberately target that demographic, often using new technology. This field is also often referred to as the "Base of the Pyramid" or just the "BoP".	
BTRC	Bangladesh Telecommunication Regulatory Commission	Bangladesh Telecommunication Regulatory Commission (BTRC) is an independent Commission established under the Bangladesh Telecommunication Act, 2001 (Act no. 18 of 2001) published by the Parliament in the Bangladesh Gazette, extraordinary issue of April 16, 2001. BTRC started functioning from January 31, 2002.	http://www.btrc.gov.bd/
CAPEX	Capital expenditure	Expenditures used by a company to acquire or upgrade physical assets such as equipment, property, industrial buildings. In accounting, a capital expenditure is added to an asset account (i.e. capitalized), thus increasing the asset's basis.	
CDR	Charging Data Record	The computer record produced by a telephone exchange containing details of a call that passed through it. It is the automated equivalent of the paper toll tickets that were written and timed by operators for long distance calls in a manual telephone exchange. Also referred to as Call Data Record or Call Detail Record.	
CIC	Community Information Centre	A community based shared access facility where users can access communication and information resources such as Internet services, telephony, printed material, and a variety of other sources of information. Also referred to as Community Multimedia Centres, such facilities are generally operated by local entrepreneurs, government agencies, NGO's or telcos. See also GP CIC.	
CMICT	Computer-Mediated-Interactive-Communication-Technology	Term often used about the "new media", i.e. mobile telephones and Internet. CMICT produce new communication structures, like novel and unpredictable imaginary spaces, re-narrating lived space.	

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Acronym	Definition	Explanation	Web
CSR	Corporate Social Responsibility	A concept whereby organizations consider the interests of society by taking responsibility for the impact of their activities on customers, suppliers, employees, shareholders, communities and other stakeholders, as well as the environment. This obligation is seen to extend beyond the statutory obligation to comply with legislation and sees organizations voluntarily taking further steps to improve the quality of life for employees and their families as well as for the local community and society at large.	
Direct or Averaging Method		Method to allocate cost onto individual subscribers when subscriber-wise cost is not available from any system sources. The Direct or Averaging Method allocates costs onto the applicable number of customers, i.e. it is allocated on relevant groups of subscribers instead of just projecting the cost roughly on every active subscriber.	
DWH	Data Warehouse	A repository of an organization's electronically stored data. Data warehouses are designed to facilitate reporting and analysis. This classic definition of the data warehouse focuses on data storage. However, the means to retrieve and analyze data, to extract, transform and load data, and to manage the dictionary data are also considered essential components of a data warehousing system. Many references to data warehousing use this broader context. Thus, an expanded definition for data warehousing includes business intelligence tools, tools to extract, transform, and load data into the repository, and tools to manage and retrieve metadata.	
EBIT	Earnings before interest and taxes	A measure of a firm's profitability that excludes interest and income tax expenses. EBIT = Operating Revenue – Operating Expenses (OPEX) + Non-operating Income.	
EBITDA	Earnings before interest, taxes, depreciation and amortization	A metric that can be used to evaluate a company's profitability. EBITDA = Operating Revenue – Operating Expenses + Other Revenue. EBITDA is not a defined measure according to Generally Accepted Accounting Principles (GAAP), and thus can be calculated however a company wishes.	
EDGE	Enhanced Data for GSM Evolution	A modulation method for GSM and IS-136 TDMA networks, standardized by ETSI, that allows for wireless data transfer up to 384 kb/s.	http://www.etsi.org, http://www.3gpp.org
EICTA	European Information, Communications and Consumer Electronics Technology Industry Associations	A Brussels-based European trade association of electronics and telecommunications companies. EICTA (European Information & Communications Technology Industry Association) was founded in November 1999. EICTA finds its origins in two former European federations of industries associations: ECTEL and eurobit. In October 2001, the European Information & Communications Technology Industry Association merged with the EACEM, the European Association of Consumer Electronics Manufacturers, but kept its original acronymic name.	http://www.eicta.org/
EOY	End of Year		
ERP	Enterprise Resource Planning	An ERP system is a business support system that maintains in a single database the data needed for a variety of business functions such as Manufacturing, Supply Chain Management, Financials, Projects, Human Resources and Customer Relationship Management.	
GDP	Gross Domestic Product	GDP is defined as the total market value of all final goods and services produced within the country in a given period of time (usually a calendar year). GDP is one of the measures of national income and output for a given country's economy. It is also considered the sum of value added at every stage of production (the intermediate stages) of all final goods and services produced within a country in a given period of time, and it is given a money value.	
GeSI	Global e-Sustainability Initiative	GeSI is a global partnership of ICT companies that promotes technologies for sustainable development. In 2000, 189 countries signed up to the Millennium Development Goals. These goals outlined action on matters as diverse as climate change and poverty elevation. The rapidly converging Information and Communications Technology Sector (ICT) recognized that addressing these issues would need an effective, industry-wide response. As part of this response GeSI was born in 2001 to further sustainable development in the ICT sector.	http://www.gesi.org

ISSN 0085-7130

Acronym	Definition	Explanation	Web
GNP	Gross National Product	GNP is defined as the "value of all (final) goods and services produced in a country in one year, plus income earned by its citizens abroad, minus income earned by foreigners in the country". It is a measure of national income used in economics to estimate the welfare of an economy through totalling the value of goods and services produced in an economy. GNP is part of a system of national accounting first developed in the 1940s.	
GP	Grameenphone	A GSM-based cellular operator in Bangladesh. Grameenphone started operations on March 26, 1997. It is partly owned by Telenor (62 %) and Grameen Telecom (38 %). Grameenphone is the largest mobile phone company in Bangladesh with 19.58 million customers as of May, 2008. It is also one of the fastest growing cellular telephone networks in Bangladesh.	http://www.grameenphone.com/
GPCIC		Grameenphone Community Information Centre is a shared access facility where rural and urban users can access a wide range of state of art services such as Internet, voice communications, video conferencing and other information services. Set up with technical assistance from the GSM Association, the Grameenphone Community Information Centres (GPCICs) are usually equipped with at least one PC, printer, scanner, web cam and modem to access the Internet using the GSM/EDGE connectivity. See also CIC.	http://www.gpcic.org/
GSM	Global System for Mobile communications	A digital cellular phone technology system that is the predominant system in Europe, but is also used around the world. Development started in 1982 by CEPT and was transferred to the new organisation ETSI in 1988. Originally, the acronym was the group in charge, "Group Special Mobile" but later the group changed name to SMG. GSM was first deployed in seven countries in Europe in 1992. It operates in the 900 MHz and 1.8 GHz band in Europe and 1.9 GHz band in North America. GSM defines the entire cellular system, from the air interface to the network nodes and protocols. As of October 2006, there were more than 2.1 billion GSM users in more than 200 countries worldwide. The ubiquity of the GSM standard makes international roaming very common between mobile phone operators which enables phone users to access their services in many other parts of the world as well as their own country. GSM differs significantly from its predecessors in that both signalling and speech channels are digital, which means that it is seen as a second generation (2G) mobile phone system. This fact has also meant that data communication was built into the system from very early on. GSM is an open standard which is currently developed by the 3GPP.	http://www.gsmworld.com/, http://www.etsi.org, http://www.3gpp.org
GSMA	GSM Association	World's leading wireless industry representative body, consisting of more than 660 second- and third-generation wireless network operators and key manufacturers and suppliers to the wireless industry.	http://www.gsmworld.com/
HRM	Human Resource Management	The strategic and coherent approach to the management of an organization's most valued assets – the people working there who individually and collectively contribute to the achievement of the objectives of the business. The terms "human resource management" and "human resources" (HR) have largely replaced the term "personnel management" as a description of the processes involved in managing people in organizations. HRM is evolving rapidly. Human resource management is both an academic theory and a business practice that addresses the theoretical and practical techniques of managing a workforce.	
HSE	Health, Safety & Environment	A cross-disciplinary area concerned with protecting the safety, health and welfare of people engaged in work or employment. As a secondary effect, it may also protect co-workers, family members, employers, customers, suppliers, nearby communities, and other members of the public who are impacted by the workplace environment. Also called Occupational safety and health. Since 1950, the International Labour Organization (ILO) and the World Health Organization (WHO) have shared a common definition of occupational health. It was adopted by the Joint ILO/WHO Committee on Occupational Health at its first session in 1950 and revised at its twelfth session in 1995. The definition reads: "Occupational health should aim at: the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities; and, to summarize, the adaptation of work to man and of each man to his job."	http://www.ilo.org/public/english/protection/safework/cis/

Acronym	Definition	Explanation	Web
ICT	Information and Communication Technology	The technology required for information processing. In particular the use of electronic computers and computer software to convert, store, protect, process, transmit, and retrieve information from anywhere, anytime.	
ICT4D	Information and Communication Technologies for Development	A general term referring to the application of Information and Communication Technologies (ICTs) within the field of socio-economic development.	
IFC	The International Finance Corporation	IFC is a member of the World Bank Group and is headquartered in Washington, DC. The IFC promotes sustainable private sector investment in developing countries as a way to reduce poverty and improve people's lives. It was established in 1956 and has 179 member countries , which collectively determine its policies and approve investments. To join IFC, a country must first be a member of the International Bank for Reconstruction and Development (IBRD). IFC's corporate powers are vested in its Board of Governors, to which member countries appoint representatives. IFC's share capital, which is paid in, is provided by its member countries, and voting is in proportion to the number of shares held. IFC's authorized capital (the sums contributed by its members over the years) is $2.45 billion; IFC's net worth (which includes authorized capital and retained earnings) was $9.8 billion as of June 2005.	http://www.ifc.org/
IPCC	Intergovernmental Panel on Climate Change	A scientific body tasked to evaluate the risk of climate change caused by human activity. The panel was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), two organizations of the United Nations. The IPCC shared the 2007 Nobel Peace Prize with former Vice President of the United States, Al Gore. The IPCC does not carry out research, nor does it monitor climate or related phenomena. A main activity of the IPCC is publishing special reports on topics relevant to the implementation of the UN Framework Convention on Climate Change (UNFCCC), an international treaty that acknowledges the possibility of harmful climate change; implementation of the UNFCCC led eventually to the Kyoto Protocol. The IPCC bases its assessment mainly on peer reviewed and published scientific literature. The IPCC is only open to member states of the WMO and UNEP. IPCC reports are widely cited in almost any debate related to climate change. National and international responses to climate change generally regard the UN climate panel as authoritative.	http://www.ipcc.ch/
ISDN	Integrated Services Digital Network	A digital telecommunications network that provides end-to-end digital connectivity to support a wide range of services, including voice and non-voice services, to which users have access by a limited set of standard multipurpose user-network interfaces. The user is offered one or more 64 kb/s channels.	http://www.itu.int
ISO	International Organization of Standardization	ISO is a worldwide federation of national standards bodies from more than 140 countries, one from each country. ISO is a non-governmental organization established in 1947. The mission of ISO is to promote the development of standardization and related activities in the world with a view to facilitating the international exchange of goods and services, and to developing cooperation in the spheres of intellectual, scientific, technological and economic activity.	http://www.iso.org
ISO 14000		The ISO 14000 series are environmental management standards which exist to help organizations minimize how their operations negatively affect the environment (cause adverse changes to air, water, or land) and comply with applicable laws and regulations.	http://www.14000.org/
ITU	International Telecommunication Union	On May 17, 1865, the first International Telegraph Convention was signed in Paris by the 20 founding members, and the International Telegraph Union (ITU) was established to facilitate subsequent amendments to this initial agreement. It changed name to the International Telecommunications Union in 1934. From 1948 a UN body with approx. 200 member countries. It is the top forum for discussion and management of technical and administrative aspects of international telecommunications.	http://www.itu.int
Kish grid		A widely used technique in survey research, by which interviewers who have been issued with a sample of household addresses can then sample individuals on the doorstep, by following simple and rigorous rules for selecting one person to interview from among household residents. The technique involves constructing a list of eligible individuals at a particular address, ordered by age, and then selecting according to the serial number of the address itself. The system is devised so that all individuals in a household have an equal chance of selection. First described by Leslie Kish (1910 – 2000) in 'A Procedure for Objective Respondent Selection Within the Household', *Journal of the American Statistical Association*, 1949.	

Acronym	Definition	Explanation	Web
LCA	Life Cycle Assessment	LCA is also known as life cycle analysis, ecobalance, and cradle-to-grave analysis. It is the investigation and valuation of the environmental impacts of a given product or service caused or necessitated by its existence.	
Marginal Costing Method		Method to allocate cost onto individual subscribers when subscriber-wise cost is not available from any system sources. The Marginal Costing Method allocates network costs according to usage patterns of different subscribers. E.g. a subscriber calling at an odd hour would bear the appropriate portion of cost based on his/her usage.	
Missed call		The deliberate termination of an outgoing telephone call by the caller, before the called party answers it. Missed calls can be used to notify another person of the caller's presence or to conveniently exchange cellphone numbers. Although commonly used by one who has low credit balance or simply wishes to limit telcom expenditures, missed calls are frequently used to convey messages by means of predefined agreements or "codes". Thus, a predefined number of successive missed calls or one or more missed calls at a certain time of day will have a specific meaning. The number of the caller is usually flashed on the screen of the callee who is using caller ID, and/or can be viewed from the missed calls list of the cellphone. This phenomenon is common in developing countries, particularly India, Pakistan, the Philippines and large parts of Africa, where cell phone use is increasing, but people still have to cope with the costs of calling on a regular basis. The missed call serves as a cheap way of communication for those who cannot maintain a high credit balance such as teenagers and people with low income.	
MoU	Minutes of Usage		
NASDAQ	National Association of Securities Dealers Automated Quotation System	An American stock exchange. It is the largest electronic screen-based equity securities trading market in the United States. With approximately 3,200 companies, it lists more companies and has more trading volume per day than any other stock exchange in the world. It was founded in 1971 by the National Association of Securities Dealers (NASD), who divested themselves of it in a series of sales in 2000 and 2001. It is owned and operated by the NASDAQ OMX Group, the stock of which was listed on its own stock exchange in 2002, and is monitored by the Securities and Exchange Commission (SEC).	http://www.nasdaqomx.com/
NBR	National Revenue Board	The National Board of Revenue (NBR) is the central authority for tax administration in Bangladesh. Administratively, it is under the Internal Resources Division (IRD) of the Ministry of Finance (MoF). MoF has 3 Divisions; namely, the Finance Division, the Internal Resources Division (IRD), and the Economic Relations Division (ERD). Each division is headed by a Secretary to the Government. Secretary, IRD is the ex-office Chairman of NBR. NBR is responsible for formulation and continuous re-appraisal of tax-policies and tax-laws in Bangladesh.	http://www.nbr-bd.org/
NGO	Non-Governmental Organisation	A legally constituted organization created by private persons or organizations with no participation or representation of any government. In the cases in which NGOs are funded totally or partially by governments, the NGO maintains its non-governmental status insofar as it excludes government representatives from membership in the organization. The number of internationally operating NGOs is estimated at 40,000.	
OPEX	Operations Expenditure	A company's operational cost in contrast to CAPEX – Capital Expenditure, which is the company's investment cost.	
PCM	Pulse Code Modulation	The speech coding algorithm used in most circuit-switched fixed networks. PCM is a wave form coding method which is neutral to the actual content of the signal.	
POTS	Plain Old Telephone Service	A very general term used to describe an ordinary voice telephone service. See also PSTN.	
PPS	Probability Proportionate to Size		
Profit Measure Method		Method to allocate cost onto individual subscribers when subscriber-wise cost is not available from any system sources. The Profit Measure Method is used in allocation of CAPEX such as network element and billing system related costs which feeds information to itself from three more sub-models; Actual outgoing Minutes of Usage (MoU), Actual incoming MoU and Marginal Costing Method.	

Acronym	Definition	Explanation	Web
RPU	Revenue Per User	See ARPU	
SAC	Subscriber Acquisition Cost		
SOX	Sarbanes-Oxley Act	Corporate governance rules, regulations and standards for specified public companies including SEC registrants (SEC: security – in this case a particular subcategory of companies certified for information security (revision, provision, consulting etc.)).	
SEBA	Society for Economic and Basic Advancement	SEBA was established as a Non-Government Organization (NGO), by a number of social workers in 1984 to improve the social and economic condition of the poor and depressed people of South East and northern parts of Bangladesh. SEBA is registered with the Bangladesh department of social service, Ministry of Social Welfare.	http://www.seba-bd.org/
SEC	Socio Economic Classification	Basically the same as "social class", which refers to the hierarchical distinctions (or stratification) between individuals or groups in societies or cultures. Usually individuals are grouped into classes based on their economic positions and similar political and economic interests within the stratification system.	
SIM	Subscriber Identity Module	The SIM is a subscriber identity module for GSM/GPRS subscriptions. In 2G systems the term SIM is used for a dedicated smartcard with subscriber identity information (including security credentials and algorithms). In the 3G system a SIM is an application running on the UICC (smartcard). Although the terms UICC and SIM are often interchanged, UICC refers to the physical card, whereas SIM (in 3G) refers to a single application residing in the UICC that collects GSM/GPRS user subscription information. The corresponding UMTS subscriber application is the USIM (which is always present on a UICC). The SIM provides secure storing of the key identifying a mobile phone service subscriber but also subscription information, preferences and storage of text messages. The equivalence of a SIM in UMTS is a Universal Subscriber Identity Module (USIM). Defined in 3GPP specification series 31.	http://www.3gpp.org/ftp/Specs/html-info/31-series.htm
SME	Small and Medium Enterprises	Micro, small and medium-sized enterprises represent 99 % of all enterprises in the European Union. The European Commission published in 2003 a revised definition of SMEs. According to this definition, micro-sized enterprises have less than 10 employees and a turnover less than € 2 mill. A small enterprise has less than 50 employees and a turnover of less than € 10 mill. Medium-sized enterprises have less than 250 employees and a turnover of less than € 50 mill.	http://europa.eu.int/comm/enterprise/enterprise_policy/sme_definition/index_en.htm
SMS	Short Message Service	A means by which short messages can be sent to and from digital cellular phones, pagers and other handheld devices. Alphanumeric messages of up to 160 characters can be supported.	
TRCL	Telemedicine Reference Centre Ltd.	TRCL provides low-cost technological and medical solutions to healthcare organizations in developing countries and has pioneered development of international teleconsultation services in Bangladesh. TRCL is implementing a rural telehealthcare system in Bangladesh, where rural doctors will be provided with expert medical consultative services from Dhaka. It is a privately funded project, but the Ministry of Health and Family Welfare of the Government of People's Republic of Bangladesh is playing a significant role in TRCL's rural telehealthcare program implementation. It was founded in 1996.	http://www.trclcare.com/
UN	United Nations	The United Nations (UN) is an international organization whose stated aims are to facilitate cooperation in international law, international security, economic development, social progress, human rights, and achieving world peace. The UN was founded in 1945 after World War II to replace the League of Nations, to stop wars between countries and to provide a platform for dialogue. There are currently 192 member states, including nearly every recognized independent state in the world. The headquarter is on international territory in Manhattan, New York City, USA.	http://www.un.org/

ISSN 0085-7130

Acronym	Definition	Explanation	Web
UNEP	United Nations Environment Programme	UNEP coordinates United Nations environmental activities, assisting developing countries in implementing environmentally sound policies and encourages sustainable development through sound environmental practices. It was founded as a result of the United Nations Conference on the Human Environment in June 1972 and is headquartered in Nairobi, Kenya. UNEP also has six regional offices and various country offices. Its activities cover a wide range of issues regarding the atmosphere, marine and terrestrial ecosystems. UNEP is the designated authority of the United Nations system in environmental issues at the global and regional level. Its mandate is to coordinate the development of environmental policy consensus by keeping the global environment under review and bringing emerging issues to the attention of governments and the international community for action.	http://www.unep.org/
UNESCO	United Nations Educational, Scientific and Cultural Organization	A specialized agency of the United Nations established in 1945. Its stated purpose is to contribute to peace and security by promoting international collaboration through education, science, and culture in order to further universal respect for justice, the rule of law, and the human rights and fundamental freedoms proclaimed in the UN Charter.	http://portal.unesco.org/en/
USD	U.S. Dollar ($)	The U.S. Currency	
VAT	Value Added Tax	VAT is tax on exchanges. It is levied on the added value that results from each exchange. It differs from a sales tax because a sales tax is levied on the total value of the exchange. For this reason, a VAT is neutral with respect to the number of passages that there are between the producer and the final consumer. A VAT is an indirect tax, in that the tax is collected from someone who does not bear the entire cost of the tax. To avoid double taxation on final consumption, exports (which by definition, are consumed abroad) are usually not subject to VAT and VAT charged under such circumstances is usually refundable. VAT was invented by a French economist in 1954 as "taxe sur la valeur ajoutée" (TVA in French). Maurice Lauré, joint director of the French tax authority, the Direction générale des impôts, was first to introduce VAT with effect from 10 April 1954 for large businesses, and it was extended over time to all business sectors.	http://ec.europa.eu/taxation_customs/taxation/vat/how_vat_works/index_en.htm
XDSL	(Any) Digital Subscriber Line	Various configurations of digital subscriber line: X = ADSL – asymmetric, VDSL – very high speed, SHDSL – single pair high speed, SDSL – symmetric, HDSL – high speed.	

Status

Connecting Objects in the Internet of Things

INGE GRØNBÆK

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The architecture includes a secure Application Programming Interface (API), a backbone and separate device networks with standard interface to the backbone. The API decouples innovation of services and service logic from protocols and network elements. It also enables service portability between systems, i.e. a service may be allocated to end-systems or servers, with possible relocation and replication throughout its lifecycle. Machine-to-machine services for Connected Objects (CO) could benefit the society in many areas, including environmental, health care, trade, transportation, alarms and surveillance. However, such development depends on powerful communications features with global interoperability for service ubiquity. Interoperability is required not only for a standard Quality of Service (QoS) controlled Internet Protocol (IP) bearer, but also for cross domain security, mobility, multicast, location, routing and management, including fair compensation for utility provisioning. The proposed architecture with its API not only includes these critical elements but also caters for multi-homing, mobile networks with dynamic membership and third party persistent storage based on indirection. The API supports end-to-end service control and offers capability features as a vehicle for service development and ubiquitous deployment. The architecture is more generic than traditional hierarchical sensor and actuator networks as it supports grids and autonomous neural type of networks.

Introduction

This article describes the core of a service oriented architecture offering generic functionality for Connecting Objects in the Internet of Things (IoT). The architecture supports network and/or end system based services and service features.

The evolving IoT may potentially cause an explosion in the number of communicating Connected Objects (CO). Even when most of these objects contribute with limited traffic, the sum may well become the major source on the Internet. CO services could benefit the society in many areas, including environmental, health care, trade, transportation, alarms and surveillance. However, such development depends on the availability of global interoperability and powerful communications features.

There are urgent actions to be taken to pave the way for this development to take place, in order to benefit individuals, interested parties and the community as a whole. The pivotal point is establishment of a global market through service ubiquity. This requires new attitudes with respect to cooperation, coordination and standardisation in order to ensure inter-carrier interoperability. The architecture is therefore introduced in ETSI in order to contribute to this process [1].

The functionality offered to objects via an API is either peer-to-peer (P2P) or enabled by a minor set of new generic functional entities. These include a gateway and an anchor point entity class. The gateway can be instantiated for interconnect of a rich variety of COs, including layer two proprietary COs. It can also be designed to support interoperability for native General Packet Radio Service (GPRS) devices on GPRS networks. The anchor point entity handles global mobility management and mobile M:N multicast. Additionally, these new entities support presence and location based services. Locations of COs can be identified, and the set of COs at a specified location may be found. Privacy is also handled by the same entities.

The architecture is functionally layered, with protocols and components identified for each layer of the well known Open Systems Interconnect (OSI) model. Diverse protocol stacks are supported by relating the stack profile and the CO identity. Deployed Internet protocols and protocols under development by the Internet Engineering Taskforce (IETF) are adopted.

The two critical elements for the support of ubiquitous services are interoperability for services and bearers. Bearer interoperability requires both interoperability for the IP bearer (user plane) and for the bearer control (control plane).

The background for the strong interoperability demand is described by Metcalfe's Law, stating that the usefulness of a network increases by the square of the number of nodes (users or devices) connected to the network. Furthermore, Reed's Law states that the utility of large networks, particularly social networks, can scale exponentially with the size of the network.

 ISSN 0085-7130

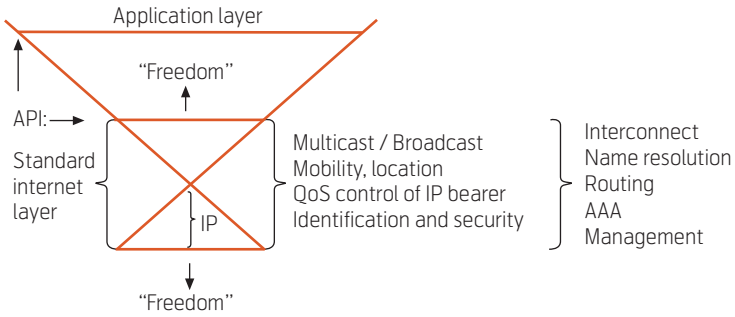

Figure 1 Internet layer with API

Formation of such groups is gradually happening, e.g. the social utility Facebook which connects people with friends and others who work, study and live around them. These strong positive network externalities, where the benefits are an increasing function of the number of other users, represent a huge commercial potential which may be severely reduced by the lack of interconnect [2] and missing ubiquity in service support and provisioning.

The major area in demand for harmonization belongs to what is here termed the Internet layer (Figure 1). The Internet layer is the IP network layer, extended to include the inter-domain functionality required for end-to-end maintenance of QoS, Security, Mobility, Location, Multicast, Name resolution, Routing, Authentication Authorisation and Accounting (AAA), and Management. This functionality is required to interoperate across interconnected domains, i.e. administrative and technology domains, for the IoT to support ubiquitous multifunctional services. In order for higher layer functionality and applications to get access to this functionality, there is a need for Application Programming Interfaces (API) at selected layers of the protocol stack (e.g. as depicted for the application and the Internet layer of Figure 1).

The architecture is more generic than traditional hierarchical sensor and actuator networks, as it supports grids and autonomous neural types of communications. The following description of the architecture is centred on the API and the functionality required for its support. This is starting with object identification in chapter 1. Layering with functional aggregation, and primitive (method) design principles in chapter 2. Chapter 3 describes an example API service element and provides an overview of the service functionality (Appendix A goes into more detail). Network elements and functional components required for support of the API are described in chapter 4.

1 Object Identification

Applications benefit from objects being identifiable and/or locatable through different mechanisms. The most important ones are:

- By identifiers
- By the location (e.g. geographical confinement)
- By an object's profile or element(s) thereof, e.g. in combination with location.

The major challenge is to define and standardise a globally unique namespace supporting ubiquitous services. A solution is proposed by [3] and [4], introducing a new flat namespace based on public and private key pairs. This namespace is called the Host Identity namespace. It fills the gap between the IP and Domain Name Service (DNS) namespaces. The Host Identity namespace consists of Host Identifiers (HIs), the public key of an asymmetric key-pair. Each host will have at least one Host Identity. Each Host Identity uniquely identifies a single host.

For efficiency purposes a Host Identity Tag (HIT) is defined as a 128-bit representation of a Host Identity. It is created by taking a cryptographic hash over the corresponding Host Identifier. A HIT presents the identity in a consistent format to a protocol, independent of the cryptographic algorithms used.

2 API and Layering Principles

The API describes capabilities and services between objects. Capabilities and services may freely be allocated to end systems (COs) or to servers. This enables functional allocations at the discretion of the developer. The same API may be used for network centric services and for P2P services. This enables services and service components to move, i.e. the architecture is agnostic to functional allocation and location.

Generic service elements may serve as building blocks for the full class of event oriented (i.e. data centric) and streaming oriented CO services.

The actual CO protocol (e.g. monitoring or remote control) is carried as payload by the user plane service elements of the API. These protocols may be proprietary, related to actual sensors or controllers, or adhere to standards. The architecture allows multiple application specific protocols to coexist, and it allows new applications and protocols to be defined without changing the basic API or its primitives (i.e. methods).

The service logically provided between COs, via the service API (Figure 2), shall be flexible in also offering subsets of the functionality. The idea, in particu-

lar applicable to device networks, is for the implementation to apply the simplest and most efficient protocol stack meeting the service requirements, with no or minimum processing and transmission overhead. It shall further be possible to increase the level of functionality by adding or including functional (sub) layers as required. Figure 2 shows aggregation of functionality from the set of service layers and protocol entities in the protocol stack. Any of the layers shown may be functionally transparent, depending on the protocol stack profile in use. Flexibility is enabled by resolution of the CO characteristics from the CO identifier.

The aggregated IP bearer service is logically provided at the top of the enhanced Network layer (i.e. to the Transport layer as shown in Figure 2). However, in an operational configuration, any of the layers may apply no protocol for communication with its protocol peer(s), i.e. the layer is empty except possibly from an inter layer service mapping (Figure 5).

A standardised API and protocols at the Internet layer (Figure 2) is key for support of inter operator ubiquitous services.

2.1 Service Aggregation

The functionality of the API service offered to COs is aggregated from the services offered by the sub-layers shown in Figure 2. The description adheres to the well known ISO OSI model, and the approach relies on the same principles as the Platform-Based Design Methodology explained in [5]. The aggregated API functionality represents the Platform Design-Space Export.

The aggregated network service, i.e. the Aggregated IP bearer at Layer 3+, enhances the basic IP bearer service, which may be limited to offering a best effort service (IPv4 or IPv6).

2.2 Service Primitive Design Principles

According to the Representational State Transfer (REST) [6] principle, all basic service primitives shall offer a container for carrying data of a separately defined type. This creates an environment where clients and servers (i.e. objects) that encode their information the same way work together (i.e. share a common data definition). The uniform API interface can evolve over time. That is why it is built from three different parts, serving different and independent purposes:

- Identifiers (e.g. HITs),
- Methods (i.e. service primitives),
- (Document/data) types.

Each part is designed to change independently of the other parts. For example, new methods do not require the addition of new (data) types, and new (data) types

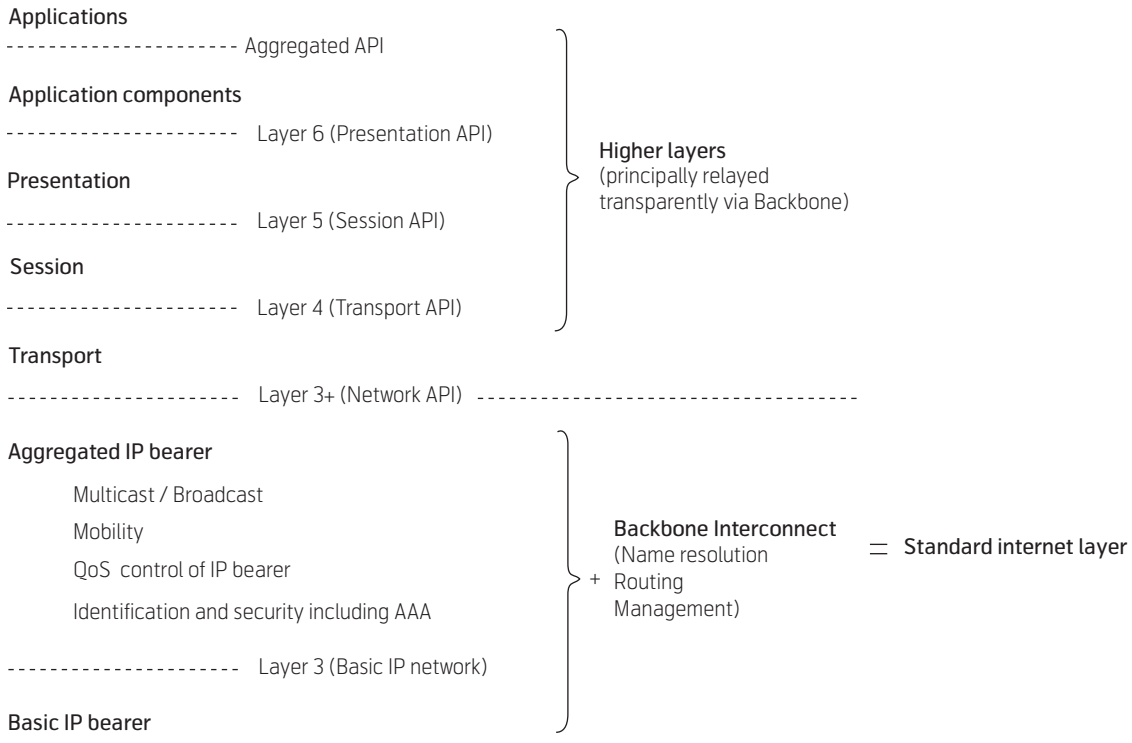

Figure 2 API and service aggregation
The layers above the Layer 3+ are the Transport, Session, Presentation and the applications. The service primitives offered by these layers are termed higher layer service primitives

do not require the addition of new methods. In object-oriented terms there is a single base class that defines the methods, but most methods have an "insert data here" slot. The information you want to transfer is added to this slot, along with the name of its (data) type. This avoids multiplying the number of standard methods by the number of (data) types.

3 API Service Elements

This chapter describes an example API service element (Micro-payment), and gives a brief overview of the complete service (Table 1). Appendix A describes selected service primitives, and an in-depth presentation is given in [7].

3.1 Micro-Payment Management Service

Settlement and compensation is allocated to the Management domain, as the functionality may be applicable to all layers of the protocol stack.

Fair and flexible compensation schemes between cooperating and competing parties are required to correlate resource consumption and cost, in order to avoid anomalous resource consumption and blocking of incentives for investing in infrastructure.

The proposed functionality is based on micro-payments as defined in [8] and is based on hash-chain trees, and involves minimal computational costs for packet authentication. The use of hash chain trees allows efficient generation and storage of hash values within a simple object with limited storage capacity. The number of cryptographic keys required is minimised, still allowing for fast verification of authentication data.

An object generates a hash chain of length N by applying a hash function N times to a random secret value PN, the root of the hash chain, to obtain a final hash P0, the anchor of the hash chain. The object commits to the chain by digitally signing the anchor with the private key. For each payment, the object releases a pre-image of the last hash value. For example, the object releases the hash value P1 for the first payment. The receiver of the payment can apply the same hash function to the value P1 to obtain the anchor P0. Since the hash function is one-way, only the object could have generated the hash value.

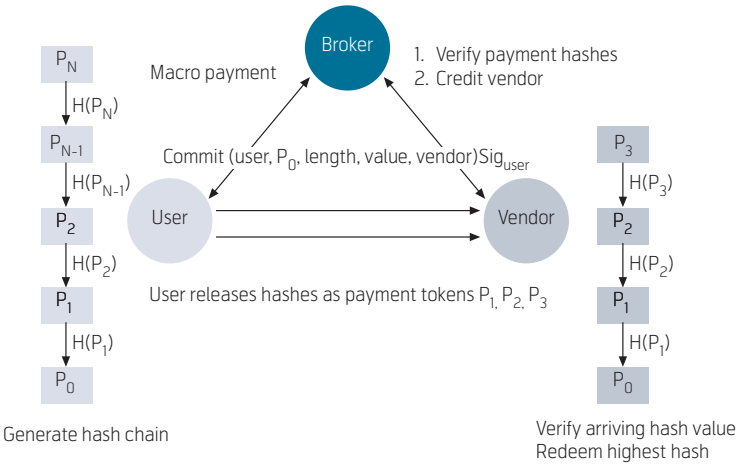

Figure 3 Micro-payments using hash chains

Figure 3 shows the overall payment process, where an object generates a hash chain of length N. The object commits to the anchor of the chain P0, the length of the chain, the value of each hash, and the vendor at which he/she wishes to spend the chain. Prior to payment, the object forwards the commitment to the vendor, who can verify its authenticity offline. For each micro-payment, the object releases the next (number of) payment hash(es) in the chain. The vendor can redeem the hashes at the Broker with whom the object has an account at a later date, by presenting the highest payment hash along with the signed commitment.

For additional efficiency it is proposed in [8] to apply an Unbalanced One-Way Binary Tree (UOBT) scheme, where the root of each chain is derived from another hash chain. The scheme is ideal when a large number of hashes are needed and the device has limited storage capabilities. Only the single value of the tree root has to be stored on the device to be able to reconstruct the entire tree.

A service provider generates revenue by charging for usage of network resources e.g. from objects, and may also provide other value-added services.

The employed micro-payment technology allows services to be charged for, and also allows the routers within the (access) network to authenticate packets by including a new hash value in each packet. This eliminates the need for any long-lived contracts between an object and a service provider.

3.1.1 Micro-Payment Primitives

The following service primitive initiates the acquirement of Length number of tokens (returned in Tokens), each valued Value and honoured by Vendor (e.g. via a macro transaction):

- Buy-Tokens (Broker-ID, Length, Value, Vendor-ID, P0)

The Commit-Token is used to initiate payment, and it allows the Vendor to verify the validity of the tokens via the Broker:

- Commit-Token (Vendor-ID, Broker-ID, Length, Value, P0)

Explicit micro-payment is made by invoking the primitive:

- Submit-Tokens (Vendor-ID, Length, Tokens)

Length number of tokens is transferred to the Vendor.

The Submit-Tokens functionality may be integrated in other primitives, e.g. in the Data transmission primitives for real-time payment of utilized transmission resources.

The Vendor applies the following primitive for redeeming the tokens (e.g. macro-payment):

- Redeem-Token (Broker-ID, Tokens)

3.2 Service overview

Table 1 summarises the service functionality at each layer. Detailed examples are included in Appendix A.

4 The Topology and Network Elements

The IoT comprises two logically distinct, but closely coupled, network domains (Figure 4), i.e. the backbone and the device network domains. Both domains may be serving COs directly.

The backbone network offers ubiquitous interconnect for services at the Internet layer (Figure 2), while connected objects interconnect at the Application layer, i.e. the higher layer protocols are transparent to the Internet layer.

Device networks connecting clusters of objects must be flexible in technology and topology. A limited set of interfaces need to be standardised for interconnect with and via the backbone network (Figure 4, Figure 5). Device networks and their devices are expected to develop continuously for a longer period, and their technology basis is an important topic for continued research. There is a need to integrate simple low-end devices, e.g. with limitations in functionality and

Description	Service
Application component sub-layer The application component sub-layer functionality may be offered as either complete services or as additional building blocks for in-house or third party services. The following represent example services.	**Storage, retrieval** **Event reporting** **Presence** **Application routing** **Etc.**
• **Presentation service.** Defines the vocabulary for (control of) CO service applications; i.e. the data structures and commands required for COs to interoperate, e.g. for an advanced control and surveillance application. The actual monitoring or control protocol may be proprietary, related to actual sensors or controllers, or standards may be applied.	Application dependent. (Pending standardisation)
• **Session service.** In this context a session shall be understood to represent the state of active communication between connected objects; i.e. it is not required to be established by e.g. the Session Initiation Protocol (SIP).	**Invite (Destination, Profile)**
• **Transport service.** The abstract service for explicit transport protocol selection (TCP, UDP, MQTT, NIL)	**Transport-Selection (Destination-CO, Protocol)**
• **Network service at the Internet layer** The Internet layer in Figure 2 is the IP network layer, extended to include the inter-domain functionality required for end-to-end maintenance of QoS control, Security, Mobility, Location, Multicast, Name resolution, Routing and Management. This functionality is required to be maintained across interconnected domains of the IoT, to support ubiquitous multifunctional services. This functionality is therefore critical for end-to-end service provisioning, since network elements in interconnected domains need to contribute to the functionality on a hop-by-hop basis.	**Data transmission** **Multicast** **Mobility** **QoS control** **ID and Security** **Location & status** **Basic IP bearer** (This equates to the IP sockets interface)
Management The management comprises functionality of generic nature that cannot logically be confined to a specific layer of the OSI stack.	**Compensation** **Software upgrades** **Functional configuration** **Provisioning/fulfilment** **Assurance/fault handling**

Table 1 Services at each layer

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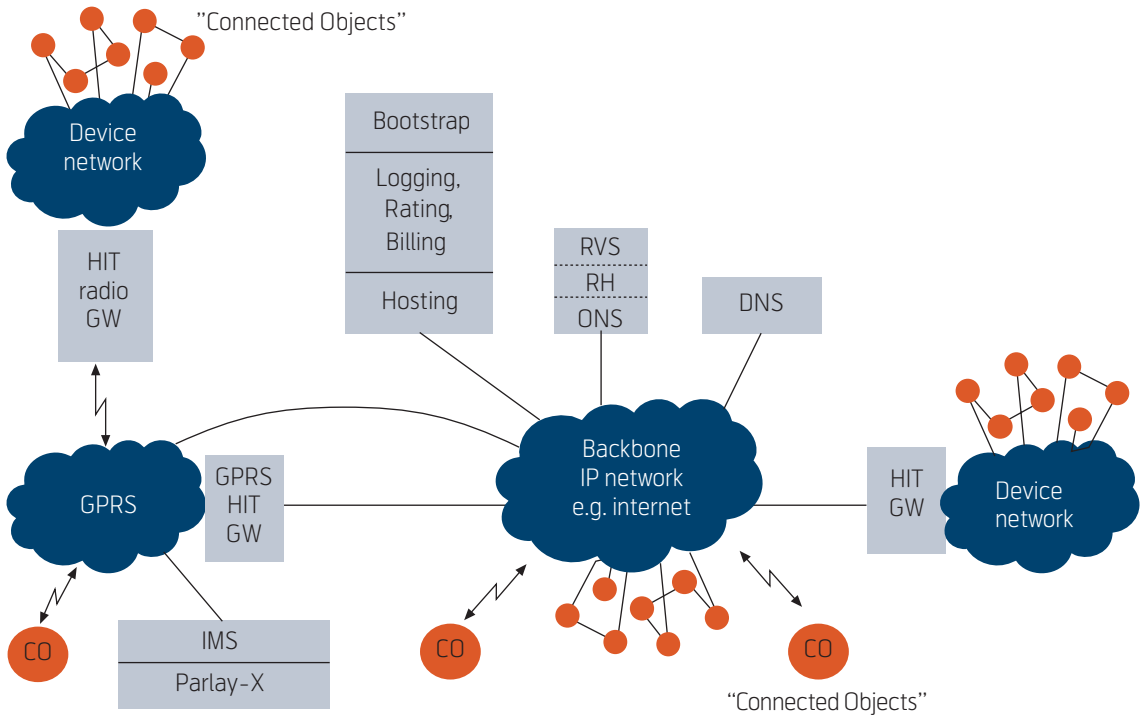

Figure 4 Components and their relation
The naming reflects the use of the Host Identity Protocol (HIP) protocol for e.g. obtaining name/address separation, security and mobility for objects

power supply. Such elements are interfaced efficiently through a flexible gateway architecture proposed in [9] and depicted in Figure 5. The naming reflects the use of the HIP protocol for e.g. obtaining name/address separation, security and mobility for objects.

The backbone architecture must include a limited set of interfaces for device network access and interconnect. A baseline proposal is defined in [9].

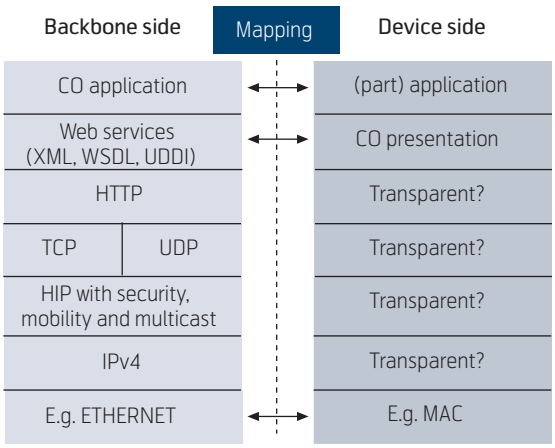

Figure 5 HIT gateway architecture
The communication scheme on the device network side of the gateway can be based on local lightweight protocols, e.g. at the link layer. The layers denoted "Transparent?" may or may not be instantiated at the device side of the gateway

All interconnect with non backbone compliant architectures is carried out at the rim of the backbone, and this effectively eliminates the need for the N square interconnect arrangements and gateways for N different technologies (e.g. service specific networks). The common backbone architecture will also reduce the number of different and variant network elements.

4.1 Gateways

The Host Identity Tag (HIT) gateway (Figure 5) is based on the Host Identity Protocol [3] and allows global addressing of COs while maintaining the use of IPv4 addresses. This is achieved by allocating a single public IP-address to a potentially large group of COs under control of a single HIT gateway. This is the address of the HIT gateway. This is similar to a care-of address in mobile IPv4. The gateway applies the HIT for addressing and/or identifying the actual CO. The HIT gateway also supports localized mobility management, as the IP-address of a CO would only change when the CO moves outside the control of its current gateway. The HIT gateway shall keep track of the location of all COs under its control. Each gateway shall be allocated a coverage area, allowing identification of objects within that area. The same HIT gateway may serve more areas in parallel in order to increase the granularity of CO identification.

Each gateway shall furthermore keep track of all its physical gateway neighbours, to allow extended area

search for COs. The HIT gateway may be multi-homed, e.g. via interfaces applying different network technologies.

The architecture of the gateway is depicted in Figure 5. A cluster of objects (i.e. a mobile network) may share mobility management through common gateway objects representing the cluster members towards the surroundings. The HIT gateway represents the members of the device network. In its basic version, the members of the mobile network are static. This may well meet the requirement of most device networks. However, there are situations where dynamic and hierarchical formation of such networks is highly desirable and efficient.

The mechanisms required for such dynamic mobility management is multi level registrations and indirection in the resolution handling at the Resolution Handler (RH). In addition to the basic name-to-address resolution, there is a need for a name-to-name resolution. That is, when an object (or objects) joins a mobile network it registers the name (HIT) of the caring gateway at its Rendezvous Server (RVS) at the RH.

The HIT Radio gateway is functionally equivalent to the HIT gateway, except for applying a radio interface (e.g. GSM, EDGE, UTRAN) for access to the GPRS network from single COs or CO clusters.

The GPRS HIT gateway offers interconnect of HIT based COs, e.g. on the Internet with Universal Mobile Telecommunications Service (UMTS)/GPRS native (non HIT) devices. The gateway handles both control and data/user-plane mapping. The control plane mapping is carried out for mobility management. The local mobility within the GPRS network will be transparent to the HIP based mobility management. A special requirement is that a CO attached to GPRS needs its local IP address to be registered at the gateway and at the mobility anchor point RVS (i.e. the Rendezvous server) in Figure 4. This registration must be carried out when the GPRS Attach / Packet Data Protocol (PDP) context creation takes place.

The user-plane mapping requires relaying of the IP user-plane between the GPRS Tunnelling Protocol user plane (GTP-U) and the HIP/IP protocol. This implies that the CO security association and the HIP protocol will terminate at the gateway.

4.2 Servers (RVS, RH, ONS)

The basic functionality of the Rendezvous Server (RVS) is to offer mobility anchoring, i.e. maintenance of the HIT to address bindings. It may also be engaged in traffic forwarding in cases where privacy is required. Event reporting shall also be handled by the RVS serving the target CO, i.e. the CO at which events are monitored for reporting. This implies that the registrar and notification functionality shall be implemented at the RVS as well.

The Resolution Handler (RH) is an RVS extension offering generic name resolution from a flat name-space (e.g. HIT to address resolution). Retrieval of CO characteristics is part of the functionality (e.g. identification of protocol stack and other capabilities):

> URI -> (HI -> HIT) -> IP address or HIT for indirection -> CO characteristics (e.g. protocol stack support)

This resolution is carried out by the following method:

- Resolve (HIT, Address)

In case of indirection, the HIT of an object will first resolve to the HIT of the caring gateway (GW). The RH recognises that this is not an address, so it repeatedly resolves all HITs until an address is finally encountered.

When a gateway receives a packet with a HIT that cannot be found in the local HIT to address binding table (i.e. routing table), it has to check if the HIT is inside a subordinate gateway. This is done by resolving the HIT relative to the current gateway by applying the following method:

- Resolve-Relative (HIT, Current-GW, Next-GW)

The resolution process stops when the resolution reaches current gateway and returns its predecessor as the Next-GW. The address of the Next-GW is subsequently locked up in the local routing table, and the packet may be forwarded.

For multi-homed objects, and potentially also for replicated “service or data objects”, the HIT resolves to an IP address and a CO characteristic for each individual interface or instance. Each of these interfaces is identified by a locally scoped identifier (i.e. relative to the HIT).

The RH may be implemented as a self contained unit or integrated with the RVS. The RH is based on the Data-Oriented Network Architecture [4], introduced to obtain e.g. persistence in naming of data and services together with strong authentication. This functionality is not implemented in the legacy DNS based name resolution. In [4] RHs are networked and tiered, and the architecture is claimed to scale to serve the complete Internet.

The Object Naming Service (ONS) is part of the EPC Global Network [10]. The ONS may be integrated with the RVS entity, or can be implemented as a self-contained entity. The ONS offers name resolution for Electronic Product Codes (EPC):

EPC -> EPC-IS (i.e. the URL of the interface to the owner of the EPC manager code).

4.3 IMS/Parlay-X

NGN/IMS may implement the functionality of the CO service-primitives. NGN/IMS supports high volume streaming well, but small amounts of real-time data are not handled efficiently within the session oriented framework of IMS. The use of the SIP MESSAGE method for such data exchange may be proposed. However, the solution would require mechanisms like QoS differentiation, charging, multicast, flow- and congestion-control to be implemented for that purpose, and at the IMS signalling/control plane.

The solution is therefore a general, QoS controlled, connectionless service at the network layer, i.e. the Network API in Figure 2. This could be realized within the framework of NGN by adding a new connectionless subsystem to IMS. This is perceived equivalent to basing the CO service on a general QoS controlled IP network, except for the integration of OSS and BSS.

IMS/Parlay-X functionality is offered via the CO API for access to information supplied via IMS. This is described in more detail in [7].

4.4 Support Features

Bootstrap functionality shall be available to cover functionality like Dynamic Host Configuration, Identity management, Service discovery, Network and neighbour discovery.

Logging Rating and Billing are not further described in this presentation. The required functionality described in [7] covers logging of statistics, e.g. for planning purposes, and the information shall be sufficient as the basis for non-repudiation, rating and billing. Real-time rating is required to support Advice of Charge (AoC) and Prepaid.

Hosting, e.g. for third parties, shall be based on evolving technologies for virtualization. Persistent storage may be supported by the indirection as described for the RH.

5 Conclusion and Recommendations

The architecture urgently needs standardisation to take place in order to create a global (i.e. cross operator and service provider) market for end-to-end CO services. Since the architecture with the API shields applications from the underlying technology, it reduces efforts involved in service development, and at the same time allows services and technology platforms to evolve independently. Adoption of the architecture will allow the effect of economic network externalities to increase the total value of the market by supporting ubiquitous services on an end-to-end basis. This will provide efficiency in scale and scope in service infrastructures, service production and service development.

The Next Generation Network (NGN) and IP Multimedia Subsystem (IMS) initially only support the class of session oriented applications for use by COs. It is therefore important to implement the non-session (data) related part with interconnect to GPRS based networks. The architecture allows ubiquitous services also via GPRS/UMTS, and for native GPRS devices.

The architecture may serve as a vehicle for migration to the true all-IP IoT. However, this presupposes avoiding the mistakes made by Internet Service Providers (ISPs) for the Internet [2], i.e. by not co-operating and coordinating between operators in order to allow service and transport level interoperability at the Internet layer. This is required for service ubiquity, in order to enlarge the total global market, thereby benefiting the whole Information and Communications Technology (ICT) industry.

The IoT may evolve through a holistic approach to integration of COs, stimulating fair competition, economic growth and innovation. The value of the IoT market will grow due to new service offerings related to COs, but maybe more by the increase in value caused by positive network externalities resulting from general Internet service ubiquity.

Acknowledgement

The author is grateful for enlightening discussions, comments and contributions from Jan Audestad, Terje Jensen, and Anne-Grethe Kåråsen, all with Telenor.

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Appendix A
Example Service Primitives

A description of how the IMS/Parlay-X service can be offered as a part of the API can be found in [7].

Application Component Sub-layer

The application component sub-layer functionality may be offered as either complete services or as additional building blocks for in-house or third party services. The following represent example services.

Storage and Retrieval

An object may not only be a node in the Internet of things. It may also be a data object, e.g. stored in a node (i.e. in an end-system or in a network element). By assigning a Host Identity Tag (HIT) to a data object, it may be stored and retrieved in a location independent manner by applying indirection. The name resolution from the HIT to address is carried out by Resolve method:

- Resolve (HIT, Address)

In case of indirection, the HIT of an object will first resolve to the HIT of the caring (HIT) database server. The resolver recognises that this is not an address, so it repeatedly resolves all HITs until an address is finally encountered.

This functionality is similar to applying Distributed Hash Tables (DHTs) for data management, except for giving the network full control of the allocation and location of database resources. Data may be replicated by applying the same resolution mechanisms as for multi-homing, i.e. the HIT would resolve to multiple addresses. This mechanism can support data resilience as well as load distribution for multiple retrievals.

The following primitives are used to store, retrieve and delete data-objects:

- Store-Object (OID, Data-Object, Scheme, Result)

Scheme indicates time to live, need for replication and any access restrictions and key(s).

The Result parameter returns the status of the operation.

- Retrieve-Object (OID, Data-Object, Scheme, Result)
- Delete-Object (OID, Scheme, Result)

In the Retrieve and Delete primitives the Scheme parameter mainly conveys the required access rights for the operations.

Event Reporting

The following primitive is used for event subscription at the event server (Registrar-CO-ID), for events at the Target-CO-ID (both could be the same CO):

- Event-Subscription-Send (Registrar-CO-ID, Target-CO-ID, Parameters)

An event subscription shall be confirmed by an event notification from the Registrar. The event notification indicates an event at the Target-CO-ID, or a subscription for events.

- Event-Notification-Send (Subscriber-CO-ID, Target-CO-ID, Parameters)

The Event-Report primitive is used for carrying reports from a CO (e.g. a simple censor) to the recipient (e.g. the Registrar event server).

- Event-Report-Send (Registrar-CO-ID, Parameters)

The Parameters may specify a distinct value or a set of values (e.g. representing upper and lower limits). Events may also be complex in that more COs and parameters may be involved.

CO Presence

The following primitive is used for dynamic CO presence registration:

- Register-Send (Registrar-CO-ID, Parameters)

A registration shall be confirmed by an event notification to the registering party, and to all parties having subscribed on this registration event.

Presentation Service

This layer defines the vocabulary for (control of) CO service applications; i.e. the data structures and commands required for COs to interoperate, e.g. for an advanced control and surveillance application.

The actual monitoring or control protocol may be proprietary, related to actual sensors or controllers, or standards may be applied. The identification or standardization of such protocols is for further study, but architecturally the vocabulary of such protocols is allocated to the Presentation layer.

Session Service

In this context a session shall be understood to represent the state of active communication between connected objects; i.e. it is not required to be established by e.g. the Session Initiation Protocol (SIP). A session may thus even be represented by a link layer association.

Transport Service

The abstract service for explicit transport protocol selection is composed of the following primitive:

- Transport-Selection (Destination-CO-ID, Protocol).

The initial protocol offerings will be UDP, TCP, MQTT(s) or NIL.

Primitives from subordinate layers will be applied, e.g. for sending and receiving data.

Network Service at the Internet Layer

The Internet layer in Figure 2 is the IP network layer, extended to include the inter-domain functionality required for end-to-end maintenance of QoS control, Security, Mobility, Location, Multicast, Name resolution, Routing and Management. This functionality is required to be maintained across interconnected domains of the IoT, to support ubiquitous multifunctional services. This functionality is therefore critical for end-to-end service provisioning, since network elements in interconnected domains need to contribute to the functionality on a hop-by-hop basis.

The network service aggregates the functionality from each of its subordinate layers into the service provided to the transport, or directly to COs.

Data Transmission

The following primitives are defined for sending and receiving unsecured and secured data:

- Send-ID (CO-ID, Data)
  % sends to the identified CO (CO-ID)
- Receive-ID (CO-ID, Data)
- Send-SA (SA, Data)
  % sends to the specified Security Association (SA)
- Receive-SA (SA, Data)

A combined mechanism for sending data and paying for its transfer is defined as follows:

- Send-ID-Token (CO-ID, Data, Length, Token)
- Send-SA-Token (SA, Data, Length, Token)

The Length parameter specifies the token rate to be submitted.

Tokens are acquired and redeemed by the primitives for Settlement and compensation defined previously.

Multicast

The service for managing multicast for COs is composed of the following primitives:

- MC-Group-Open (Group-ID, Profile)

Profile specifies the characteristics, e.g. security level.

- MC-Group-Close (Group-ID)

The basic Send and Receive primitives are used to send and receive secured or unsecured data.

The joining and leaving of a multicast group is achieved by the following primitives:

- MC-Group-Join (Group-ID)
- MC-Group-Leave (Group-ID)

Mobility

The API for specifying mobility management to be applied for a CO is composed of the following primitives:

- MM-Register (CO-ID)
- MM-End (CO-ID)

QoS Control

The API for specifying a default QoS to be applied is composed of the following primitives:

- QoS-Set-Default (Profile)
- QoS-Set-Default-Confirm (Profile, AoC)

Advice of Charge (AoC), as returned from the network, provides the information required for estimation of the charging rate.

The API for explicit QoS control is composed of the following primitives:
- QoS-Set-Path (Destination-CO-ID, Profile)
- QoS-Set-Path-Confirm (Destination-CO-ID, Profile, AoC)

ID and Security

The API for security association creation is composed of the following set of control primitives:
- SA-Create (CO-ID, Profile, SA)

The Profile shall indicate both the security requirement and the involved algorithms.

Location & Status

The service for network assisted reporting of status and location of user terminals includes the following set of control primitives:
- Location-Request (CO-ID-Set, Scheme)
  % The CO-ID-Set identifies one or more COs
- Location-Response (CO-ID-Set, Scheme, Status, Coordinates)

The Scheme defines the desired coordinate system. Status indicates the validity of the returned coordinates.

The following primitives are used to request the network to identify object(s) known to be at a specific location:
- ID-Location-Request (Scheme, Coordinates)
- ID-Location-Response (Scheme, Coordinates, Status, CO-ID-Set)

The CO-ID-Set identifies zero or more COs.

Reporting of end-system supplied location and status is done by applying the following primitives (e.g. to Geographic Information Systems (GIS) central information portal):
- End-Location-Report (CO-ID, Scheme, Status, Coordinates)
- End-Location-Report-Indication (GIS-ID, Scheme, Status, Coordinates)

Basic IP Bearer

The network service of the basic IP bearer is simply composed of the following primitives for sending and receiving data:
- Send-IP (To-IP-address, Data)
- Receive-IP (From-IP-address, Data)

This equates to the IP sockets interface.
A more complete overview is given in [7].

Abbreviations

AAA	Authentication Authorisation and Accounting
AoC	Advice of Charge
API	Application Programming Interface
BSS	Business Support System
CO	Connected Objects
DHT	Distributed Hash Table
DNS	Domain Name Service
EDGE	Enhanced Data rates for Global Evolution
EPC	Electronic Product Code
GIS	Geographic Information System
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
GTP-U	GPRS Tunnelling Protocol user plane
GW	Gateway
HIP	Host Identity Protocol
HIT	Host Identity Tag
ICT	Information and Communications Technology
ID	Identifier
IETF	Internet Engineering Taskforce
IMS	IP Multimedia Subsystem
IoT	Internet of Things
IP	Internet Protocol
ISP	Internet Service Provider
M2M	Machine to Machine
MQTT	MQ Telemetry Transport
NGN	Next Generation Network
NIL	Nothing; zero
OID	Object ID
ONS	Object Naming Service
OSI	Open Systems Interconnect
OSS	Operations Support System
P2P	Peer-to-peer
PDP	Packet Data Protocol
QoS	Quality of Service
REST	Representational State Transfer
RH	Resolution Handler
RVS	Rendezvous Server
SA	Security Association
SIP	Session Initiation Protocol
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
UMTS	Universal Mobile Telecommunications Service
UOBT	One-Way Binary Tree
URI	Universal Resource Identifier
URL	Uniform Resource Locator
UTRAN	UMTS Terrestrial Radio Access Network

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The Telenor Research Prize 2007

TERJE ORMHAUG

Terje Ormhaug is Senior Research Scientist in Telenor R&I and Secretary for the Research Prize

"Developments of business models, roles and competitive regimes in the converging media, communication and mobile industries"

The background for choosing this as theme for the Telenor Research Prize 2007 is the rapid changes in the communication marketplace since the abolishment of the telecom monopolies in the 1990s. Competition then became a driving force for bringing new communications and media services, at low prices, to the public. In the beginning, competition among the traditional, big actors transformed telephony from being a business and household service, to becoming personalized by making mobile phones and services affordable for everyone, children and grannies alike. The development then expanded to encompass both new players and a diversity of advanced new services and changes in what was considered to be the core business of established companies. The advent of internet not only introduced a new technology, but also raised the question whether we are now, as some claim, facing an establishment of new business paradigms. Others, however, maintain that the traditional rules of economics still are sustainable. As an example, there is today an ongoing controversy between those who insist that networked content and services should be for free, and producers and owners of content who want to get paid for their efforts.

The nominations revealed great interest in the 2007 theme and showed that it has many aspects. Several of the candidates could have been worthy of the prize, but the Jury made a unanimous choice to give it to two economists who have followed and studied the evolution of the communication marketplace since the mid 1990s. One of their achievements is that they managed to interpret in a correct way what was the real substance of the "internet economy" and could stand by their findings when the "bubble" burst around year 2000. The decision to give the prize to Senior Research Scientist, Dr. Bjørn Hansen at Telenor R&I, and Professor, Dr. Øystein Foros at the Norwegian School of Economics and Business Administration, were made on the following grounds:

- The winners have done interesting and high quality research that covers all the aspects of the theme for 2007, encompassing both business models, competition regimes, and convergence of services, as well as regulatory aspects.
- They have published a long list of papers in highly ranked journals.
- The have presented both qualitative and quantitative results that in an excellent way combine experiences from running business with academic methods and analysis.
- The results of their research have been well received and have had an impact on strategic and operational decisions.

The winners have been pioneers, in both practical and theoretical ways, to build new activities on business modelling in Telenor, that is relevant for network companies. It must be pointed out, however, that the Jury has as a very clear mandate to make their decisions totally independent of any commercial or other interests of Telenor, and has done so also this time.

The members of the Jury are:

- CEO *Berit Svendsen* (leader), Conax, Norway
- Professor *Erik Bohlin*, Chalmers University of Technology, Sweden
- Associate Professor *Mads Christoffersen*, The Technical University of Denmark
- Professor *Peter T. Kirstein*, University College London
- Professor *Olli Martikainen*, The University of Oulu, Finland
- Professor *Gunnar Stette*, The Norwegian University of Science and Technology

Themes and winners of previous years have been:

1997	*Video Coding* (main prize)	Dr. Gisle Bjøntegård (N)
	SW tools and languages (additional prize)	Birger Møller-Pedersen, Dag Belsnes and Øistein Haugen (N/DK)
1998	*Development of internet technology*	Professor Stephen Pink (S)
1999	*Advanced applications of communications and information services*	The Telepathology group (N)
2000	*Enabling technologies for advanced ICT systems and services*	Professor Peter Andreksson (S)
2001	*Research in socio-economic impact of ICT*	Professor Jon Bing (N)
2002	*Mobility and wireless access to Internet Technologies, new services and applications*	Professor Christian S. Jensen (DK)
2003	*Technologies and systems enabling new communication services*	Dr. Haakon Bryhni (N)
2004	*SW of importance for the creation or improvement of communication services*	Professor Claes Wohlin (S)
2005	*Enabling technologies and communication based value added services for the home, leisure and professional environments*	Professor Ramjee Prasad (DK)
2006	*Innovative solutions for emergency communications*	Professor Petri Mähönen (SF)

ISSN 0085-7130

The Interplay between Competition and Co-operation: Market Players' Incentives to Create Seamless Networks[1)]

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Bjørn Hansen is Senior Research Scientist, Telenor R&I

Competing network providers typically have to co-operate in different types of interconnection and infrastructure sharing arrangements (e.g. roaming) in order to provide seamless communication to customers. Thus, firms being active in the same market have to compete in some dimensions and co-operate in other dimensions. We discuss the interplay between competition and co-operation, and show some potential trade-offs between co-operation and competition. The trade-offs have implications for both business strategy and regulation policy. In some cases (but not all) firms can arrange their co-operation such that they are able to soften competition and increase prices. Whether such effects are present or not depends on technology and market characteristics. It is accordingly necessary to carry out case by case analyses in order to assess these issues

1 Introduction

Technological developments enable network convergence, and what used to be diverse communication networks can be merged into common platforms designed for the integration of the basic communication channels voice, video and data into a streamlined high-bandwidth communication environment supporting new technologies and new integrated applications. This makes it possible for users to communicate with each other and access information across networks in a seamless manner. Interactive media will increase customers' ability to select content, format, as well as time and place of consumption. However, seamless communications depends on the interplay between technological, economic, and cultural features. Even though seamless networks are technically feasible, it is not obvious that this will be neither the market outcome nor the optimal outcome. Economic incentives and business models will be of crucial importance in determining the degree of seamlessness.

Network providers are often both competitors and complementors. On the one hand, they compete for the same clientele in their attempt to attract customers. On the other hand, they are complementors to the extent that a quality enhancing investment by one provider may benefit customers connected to the rival's platform. An internet backbone provider who improves its platform functionality will also increase the quality of the rivals' backbones due to peering agreements (interconnection) between the backbone providers. Analogously, mobile phone operators share their networks through roaming agreements. Such platform sharing agreements (interconnection, peering and roaming) refer to the degree of compatibility chosen by network providers. All these examples emphasize the close interplay between technological features and the market players' abilities and incentives to create seamless networks.

In communication networks the utility of being a member of a particular network typically increases with the network size. This relationship is by some called Metcalfe's law (see Figure 1).[2)]

In economic theory, the phenomenon is called network effects and was first analyzed by Rohlfs (1974). Similarly to Metcalfe, Rohlfs focuses on the problem of starting up a new communications service, or more generally the existence of multiple equilibria. In contrast to Metcalfe, Rohlfs does not postulate a squared relationship. Rohlfs' work does however not take into account that there may be competing firms offering the network service. This is in contrast to Katz and Shapiro (1985) who analyze the implications of network externalities within a competitive environment. Katz and Shapiro pay particular attention to the choice of compatibility. They find that a large (dominant) firm may prefer too little compatibility, a small firm prefers too much compatibility, and the industry would jointly prefer too little compatibility.[3)] This last result is in contrast to Farrell and Saloner (1992) and Foros and Hansen (2001). This difference is

1) *Øystein Foros thanks SNF project no 1304 "Seamless Infrastructures, Business Models and Cultural Diversity", funded by The Research Council of Norway, for financial support. Bjørn Hansen thanks Telenor R&I for financial support. The article is written as an invited contribution to* Telektronikk *after the authors were awarded "Telenor Research and Innovation Prize 2007".*

2) *According to Simeonov (2006), in the early 1980s, Bob Metcalfe, the inventor of Ethernet, wanted to convince firms that it would be of large value to install a (Ethernet based) local network. The illustration of the value of the network being proportional to the square of the number of nodes (N^2) was used to motivate potential buyers. Later George Gilder coined this relationship Metcalfe's law.*

3) *The seminal analysis by Katz and Shapiro has been extended in a number of ways in the literature. A literature overview can e.g. be found in Liebowitz and Margolis (2002).*

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explained by different assumptions regarding downstream competition. In this article we consider different cases and we demonstrate that the firms' incentives to provide seamless interfaces between their networks indeed depend upon technology and market characteristics.

The rest of the article is organized as follows. In section 2 we discuss co-operation in order to achieve economies of scale and scope. In section 3 we discuss market experience and firms' incentive to create seamless networks. Finally, in section 4 we provide some concluding remarks.

2 Co-operation to Achieve Economies of Scale and Scope

Deregulation and fast technological change have resulted in a rapid transformation of the telecommunications industry. The initial steps of the deregulatory process were, in most countries, designed so that newcomers would invest in some parts of the production chain and then rely on getting access to other parts of the production chain from a regulated incumbent. The terms and conditions for such access have typically been regulated. The rationale for regulating access is that the regulated segments are considered as bottlenecks, i.e. it is prohibitively costly to duplicate already installed capacity. The local loop in the fixed network is a classical example. The copper cable connecting residential customers to the network will typically have sufficient capacity to carry all telephony and internet related traffic. Thus it would be socially wasteful if newcomers had to install new cables to reach the household. This kind of access problems is one-way in the sense that newcomers need access but incumbents do not.

One-way access problems have been discussed in the literature, at least since the US Supreme Court's 1912 Terminal Railroad decision (considered as the origination of the essential facilities doctrine). Two-way access problems relates to situations where each network controls an asset, customers and/or capacity, which is valuable to the other party. Introductions and overviews of this literature and its applications to telecommunications can e.g. be found in Laffont and Tirole (2002) and Armstrong (2002).

In economic theory it is common to distinguish between increasing returns on the supply side and on the demand side, as illustrated in Figure 2. There are increasing returns on the supply side if it is cost efficient to produce several different products within one and the same firm (economies of scope) or if the average costs fall when each single product is produced in large series (economies of scale). Due to the fact that it has been difficult to separate services from

The systemic value of compatibly communicating devices grows as the square of their number:

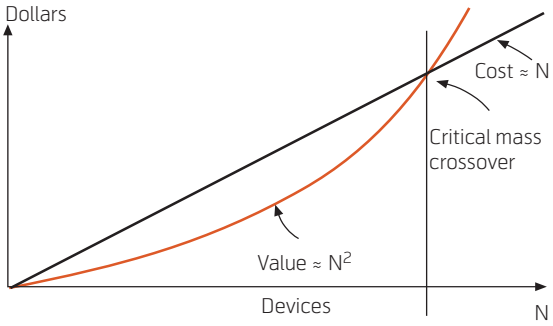

Figure 1 Metcalfe's law as illustrated by http://vcmike.wordpress.com/2006/08/18/metcalfe-social-networks/

the underlying infrastructure, economies of scope have historically been important in telecommunications. This kind of economies of scope is presumably smaller within the internet, due to the properties of the layered internet structure. In contrast, there is little doubt that the supply side economies of scale are significant. This is true both with respect to investments in infrastructure and in development of new services. Technologies like 3G mobile telephony and fiber-optics are characterized by considerable supply side economies of scale, and thus there are potential gains from making networks co-operate on the supply side.

Economies of scope on the demand side, which are placed in the lower right hand corner of Figure 2, are commonly described by the term complementarity. For our purpose we can say that two goods are complements if a price reduction or a quality improvement on one of them increases the demand for both goods. A lower price on internet browsers, for instance, is likely to stimulate sales of operating systems, and vice versa. This is an insight that Microsoft has taken advantage of. Economies of scale on the demand side are commonly named *network effects* and take place when the unit value of a product or a system increases with the number of users as illustrated in Figure 1.[4)] Willingness to pay for network membership typically increases with the number of communication partners. Thus there are potential social gains from making sure that networks interconnect in order to facilitate communication across networks.

Since there are gains from co-operation, one would expect that networks, being free to negotiate con-

	Scale	Scope
Supply side	Decreasing average costs	Gains from joint production
Demand side	Network effects	Complementarity

Figure 2 Increasing returns on the supply and demand side

ISSN 0085-7130

tracts, would be able to design efficient contracts. However, networks are, at the same time, supposed to compete for customers. Thus there is a danger that networks design their access agreements in a way that softens competition. Furthermore, due to the network effects, if networks do not interconnect, one may experience "network tipping", i.e. that all consumers join one of the two networks and thus that one of the networks succeeds in gaining a monopoly position. Thus a firm may deny two-way access in an attempt to foreclose the market. At the outset we can accordingly expect that unregulated two-way access will in some cases yield efficient outcomes, in other cases there is too much access, and in yet other cases too little. It is accordingly not evident that regulatory intervention is required, and furthermore, if such intervention is required, it is likely that the regulatory design should depend upon characteristics of the market under consideration.

3 Market Experience: Network Providers' Incentives to Create Seamless Networks

In this section we will discuss some relevant two-way access problems for electronic communication services. We will comment on technological characteristics as well as market outcomes with respect to two-way access. Finally we will also briefly discuss the degree of regulatory intervention behind the outcomes.

In the literature on two-way access the focus is typically on shared market equilibrium. Parameter-restrictions are imposed in order to make sure that this outcome is achieved. Given these restrictions firms will typically gain from providing access. If, however, the parameter restrictions are violated, or some firms expect them to be violated, then the market will tend to tip in one or the other direction. Thus there will be competition *for* the market instead of competition *in* the market. Firms competing *for* the market will not necessarily enter voluntarily into two-way access agreements. Below we will argue that market observations indeed lend support to this assertion.

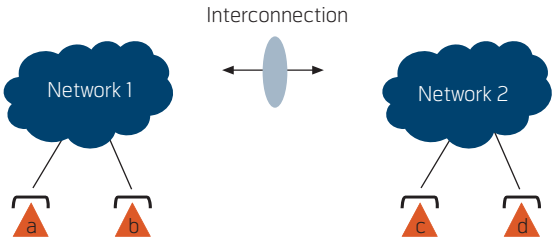

Figure 3 Interconnection

3.1 Interconnection in Voice Telephony

Without interconnection consumers on different networks can only make calls to other consumers on the same network; on-net calls. Due to interconnection consumers on a network can call consumers on another network; off-net calls. An off-net call from say consumer *a* to consumer *d* in Figure 3 can be divided into two parts. The first part is origination, i.e. to convey the call from the caller, consumer *a*, to the interconnection interface. The second part is termination, to carry the call from the interconnection interface to the receiver, consumer *d*.

Interfaces for interconnecting line-switched fixed and mobile telephony are well established and all firms providing fixed and mobile telephony are typically directly or indirectly interconnected to all other networks. This ubiquitous interconnection is the result of a long historical process. Currently it is common to make ubiquitous interconnection a requirement in the license for telephone companies.

There are some examples of non-interconnected phone companies from the early days of telephony history. In the period 1881 to 1886 there were two competing phone companies in the capital of Norway, Kristiania.[5)] The two companies rolled out parallel access networks and they competed head to head. It was not possible to make calls from one network to the other. The period characterized by access competition ended in 1886 because the local authorities forced the two companies to merge by denying the companies licenses to install new cables until they merged. According to Rinde (2005), p. 146, it was in particular the merchant community of the city that wanted the two firms to merge. The arguments were twofold; they wanted all phones to be interconnected and they wanted to avoid duplication of civil works from network roll out. Similarly, in the period between the end of the Bell patents in 1893 and the Kingsbury commitment in 1913, a number of phone companies independent of the Bell system were denied interconnection (Brock, 2002). During this period, phone companies competed head to head in the US and network effects were used strategically.

4) *It is common to distinguish between direct and indirect network effects. For instance, we have direct network effects between owners of telephones; the more people that have installed a telephone, the greater its value (this is also labeled a* real *network). An example of indirect network effects is that between users of PCs; a large number of PC users imply that there will be a large demand for PC compatible software. This in turn tends to generate a large variety of PC software, which increases the user value of the PCs (this is an illustration of a* virtual *network).*

5) *The name of the city was changed to Oslo in 1924.*

During this early period there was a notable difference in the speed of telephony adoption in areas with local competition as compared to areas characterized by local monopolies. As an example, according to Rinde (2005), the rate of telephony adoption in Kristiania was twice as high as the rate of adoption in Copenhagen, which had a local monopoly. This example emphasizes a potential tradeoff between competition and co-operation. Without an interconnection agreement market shares matter, and this may certainly increase the degree of competition between the firms. They may reduce the end-user prices and/or invest into higher coverage (and other quality dimensions) in order to gain a competitive advantage. Due to network effects, the customers will prefer to connect to the firm with the largest market share, all other things equal. With seamless interfaces, customers do not care about the firms' market share when they decide where to subscribe.

As mentioned above, interfaces for interconnecting line-switched fixed and mobile telephony are now well established and all firms providing telephony are typically directly or indirectly interconnected to all other networks. While the quality level for off-net communication equals the quality level for on-net communication, termination charges are probably the most hotly debated issue related to interconnection for voice telephony. At present, the termination rates of incumbent fixed operators are subject to regulation in both Europe and the US. In the US, the Telecommunications Act of 1996 requires reciprocity of termination rates (see e.g. DeGraba 2003). Thus, fixed-line entrants are required to charge the same termination rate as the incumbent. In Europe reciprocity is not currently embedded in the regulatory framework, and the national regulators have to decide whether termination rates should be reciprocal or not. Recently, the European Commission view is that we should have a development towards reciprocity of termination rates also in Europe.

There are in particular two features of the termination markets which raise the concern of excessive pricing in an unregulated market. First, when termination rates are determined unilaterally, each provider has a monopoly with respect to offering termination to their own subscribers (see e.g. Armstrong, 2002, Laffont, Rey and Tirole, 1998a, 1998b, and Vogelsang, 2003). Second, when prices differ between networks, consumers are often ignorant about the price they actually have to pay – labeled consumer ignorance (Gans and King, 2000). Consumers may then be likely to base their demand on average prices. All other things equal, this will induce the firms to increase their termination prices to an inefficiently high level. The reason is that an increase in the termination price from network A will only affect the demand for network A through the average price. In an unregulated environment, providers will then have incentives to set high termination prices.

As a consequence, the theoretical literature based on these assumptions show that there is a need to regulate termination tariffs for all providers, and the majority of this literature suggests that this should be done through symmetric termination prices. Armstrong (1998), Laffont, Rey and Tirole (1998a, 1998b) consider models where termination tariffs are set at stage 1, and at stage 2 the firms compete in retail prices. A major insight from the work by Laffont Rey and Tirole (1998a,b) and Gans and King (2001) is that the incentives with respect to setting the price of termination depends upon the contracts in the downstream market. When there is uniform pricing in the downstream market, the mobile firms can use the termination rate as an instrument to soften competition. By raising each other's marginal cost they reduce the competitive pressure. In Laffont Rey and Tirole (1998b) it is demonstrated that this effect changes if one considers two-part tariffs in the downstream market. Then the profits of the mobile firms are independent of the termination rate. Finally Gans and King (2001) consider network based discrimination, i.e. the price for on- and off-net traffic being allowed to differ, and find that a low termination rate may be used as an instrument for increasing profits. Observed mobile networks typically offer a menu of contracts where they simultaneously offer uniform prices and two-part tariffs both with and without network based discrimination. Thus the theoretical literature hardly provides any guidance as to the incentives of mobile firms in setting symmetric termination rates. An empirical investigation of the relationship between termination rates and profits in the European mobile industry by Andersson and Hansen (2007) lends support to the profit neutrality result by Laffont Rey and Tirole (1998b).

Extensions to a framework where firms are asymmetric are provided by Carter and Wright (2003), Peitz (2005a, 2005b) and Dewenter and Haucap (2005). Dessein (2003) considers consumer heterogeneity and Jeon, Laffont and Tirole (2004) analyze the implications of willingness to pay for receiving calls. Gans, King and Wright (2006) provide a recent comprehensive overview of this theoretical literature.

3.2 Interconnection in the Internet

Interconnection in the internet is arranged quite differently from telephony. It is a hierarchy, and the hierarchy and its associated interconnection contracts have evolved as a result of market forces and not as the result of regulatory intervention. The internet is accordingly an interesting case for comparison.

The internet is a set of interconnected data networks all using the same system of addresses and protocols enabling communication between users on the different networks. Interconnection is evidently a key element in this architecture. There are two main types of interconnection arrangements in the internet, peering and transit (see e.g. Kende 2002). The internet hierarchy is often divided into three levels or tiers. Each level is characterized by the types of interconnection agreements they are engaged in.

Peering is a barter arrangement where two networks mutually agree to exchange traffic free of charge. The traffic being exchanged is between customers (of customers) on the two peering networks. Peering networks do not accept traffic to third parties (traffic from one peer to other peers). The other type of contract is transit where one network is paid for accepting any traffic to and from its contract partner, i.e. also to third parties. With the terminology introduced earlier in this chapter peering can be characterized as two-way access, and transit is one-way access.

At tier 1 of the hierarchy we find the global internet backbones; such networks are only engaged in peering arrangements. At tier 2 we find networks with a mix of contracts, both peering (typically regionally) and buying transit from one or more of the tier 1 networks. Finally a tier 3 network is not engaged in peering. An overview of the peering arrangements various networks are engaged in can be found at http://www.peeringdb.com/. There is unregulated, seemingly well functioning competition at each level in this hierarchy. Local access is however an exception. Local loop unbundling as well as other measures are used by regulators to facilitate competition at this level too.

In Norway we have recently had a hot debate due to Telenor's decision not to participate in the NIX[6)] for a period in 2006. In the late 1990s the topic of major providers' incentives to degrade the interconnection quality towards smaller ISPs was also hotly debated. A common view among policy makers was that big firms usually would have the abilities and incentives to degrade interconnection quality towards smaller ISPs. In 1998 two tier 1 networks, MCI and WorldCom merged. The merger would result in a significant increase in market concentration among tier 1 networks, and both European and US anti-trust authorities approved the merger under the condition that the Internet business of MCI was divested. The concern was that the merged firm would degrade interconnection quality towards smaller rivals (see FCC, 1998, Cremer et al., 2000, and Economides, 2006).

Motivated by the Norwegian market structure, Hansen and Foros (2001) provide an explanation for voluntary peering agreements between ISPs by showing that the ISPs can reduce the competitive pressure by increasing interconnection capacity.

Foros and Hansen (2001) consider a two-stage game between two ISPs. In the first stage the two ISPs choose the level of compatibility (i.e. quality of a direct interconnect link between the two networks). In the second stage the two ISPs compete in prices à la Hotelling. Foros and Hansen then show that ISPs can reduce the stage 2 competitive pressure by increasing compatibility due to the network externality. The firms will thus agree upon a high compatibility at stage 1. When it is costly to invest in compatibility, Foros and Hansen find that the firms overinvest, as compared to the welfare maximising investment level (see also Farrell and Saloner, 1992).[7)]

In contrast to Foros and Hansen (2001) and Farrell and Saloner (1992) Cremer, Rey and Tirole (2000) find that dominant firms may have incentives to degrade interconnection. There are a number of differences with regard to assumptions between the results. By its very nature, it is difficult to make general predictions, and case by case analyses are needed to evaluate whether the providers have incentives to achieve seamless interfaces between their networks. We should also emphasize that the above-mentioned results show that seamless interfaces need not benefit customers.[8)]

3.3 Infrastructure Sharing in Mobile Telecommunications

In most industrialized countries, mobile firms are upgrading their networks to 3G.[9)] The cost of obtaining a given geographical coverage is much higher on 3G as compared to 2G. Thus the cost of introducing 3G is significant. Competing networks are rolling out networks in parallel. There are accordingly evident potential gains from co-operation at the investment stage.

Internationally there is considerable variation with respect to whether mobile firms co-operate in this dimension. Sweden is a particularly interesting

6) *Norwegian Internet Exchange, see http://www.uio.no/nix/*

7) *There are some notable differences between Foros and Hansen (2001) and the Farrell Saloner (1992) model. In contrast to Farrell and Saloner, Foros and Hansen consider vertical differentiation; the suppliers share the cost of compatibility and this functionality is bundled into the product.*

8) *Roson (2002) compares Foros and Hansen (2001) and Cremer et al. (2000).*

case.[10] In December 2000 four 3G licenses were issued in Sweden based on a beauty contest. All the firms being awarded a license promised very aggressive network investments. The dominating firm, Telia, was not that aggressive in the beauty contest and was accordingly not granted a license. Soon after the licenses were issued, Telia formed a joint venture with the second largest mobile firm, Tele2. The joint venture, called Svensk UMTS nät AB, rolled out a 3G network based on the license awarded to Tele2. Both Telia and Tele2 offer 3G services to end-users based on capacity from the joint network. The Swedish Competition Authority (2002) approved the co-operation under a set of conditions. The Swedish case implies a high degree of co-operation at the investment stage. Less extreme examples of co-operation are Germany and the UK. Taking Germany as an example, the European Commission[11] has approved the sharing of sites, and they have approved national roaming for a limited time period.

Both the Commission, in its decision on roaming in Germany, and the competition authorities in Sweden[12] try to balance gains from co-operation against the possible adverse effects on competition in the end-user market. In both cases the approval of co-operation is time limited. From the decisions in UK and Germany it is quite explicit that the firms will not be allowed to co-operate on roaming after the approval expires. This is in contrast to Sweden.

Foros, Hansen and Sand (2002) analyze infrastructure sharing (national roaming) in the market for mobile telecommunications. Firms undertake quality improving investments in network infrastructure in order to increase geographical coverage, capacity in a given area, or functionality (e.g. 3G). Prior to investments, roaming policy is determined. Foros, Hansen and Sand show that under collusion at the investment stage, firms' and a benevolent welfare maximizing regulator's interests coincide, and no regulatory intervention is needed. When investments are undertaken non-cooperatively, firms' and the regulator's interests do not coincide. Contrary to what seems to be the regulator's concern, firms would decide on a higher roaming quality than the regulator. The effects of allowing a virtual operator to enter are also examined.[13]

The quality improvements from investments in mobile networks can take the form of improved capacity and/or improved coverage. Foros et al. (2002) are focusing on capacity. This is in contrast to Valletti (2003) where the emphasis is on coverage as a means to vertical differentiation. The duopoly equilibrium in the Valletti model is characterized by maximum differentiation. One firm chooses maximum coverage, the other chooses minimum coverage (minimum coverage is typically specified in the license). In Valletti (2003) national roaming is unprofitable for the firms. Thus roaming is only profitable if the firms collude. This result is in contrast to Foros et al. In their review article Gans et al. (2006) argue that the Valletti result is due to simplifying assumptions.[14] Furthermore, observed market behavior indicates that mobile firms tend to set similar coverage.

The market experience reviewed above revealed that mobile firms in several countries indeed co-operate over roaming and investments. Furthermore, the regulating authorities, given a set of conditions, have approved the co-operation. Given the approach taken by the regulating authorities an interesting issue to analyze would be to look into the implications of allowing co-operation only in a limited time period.

3.4 Internet-based Applications

The internet enables ubiquitous data connectivity. Thus any pair of users can in principle communicate, but they need interoperable applications to facilitate this communication. E-mail is an example of an application (or service) running over the internet such that any e-mail user can communicate with any other e-mail user. This is in contrast to other communications services provided over the internet where interconnection is an issue.

The necessary architecture for providing messenger[15] services and voice over the internet (VoIP) has some important similarities. In both cases *servers*[16] contain databases linking user names (or phone numbers) to IP addresses such that a user, being logged on, can be reached irrespective of physical location. When a communication session is initiated the servers feed address information to the necessary

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9) *The standard for 3G mobile networks being deployed in Europe is called UMTS; Universal Mobile Telecommunications System, whereas GSM (Global System for Mobile Communications) is the 2G standard.*

10) *See Hultén et al. (2001) for a description of the 3G license process in Sweden.*

11) *See European Commission (2003).*

12) *See Swedish Competition Authority (2002).*

13) *Gans et al. (2006) based their discussion of the implications of national roaming on results from Foros et al. (2002).*

14) *Gans et al. (2006) argue that the Valletti result is due to the assumed pure vertical differentiation. If there is horizontal differentiation in addition to the vertical differentiation, then firms may set identical coverage and instead compete in other dimensions.*

15) *A messenger platform enables users to engage in text based real-time dialogues over the internet.*

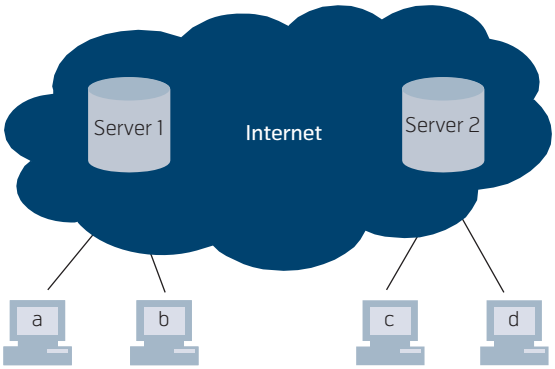

Figure 4 Real time communication on the internet

systems such that the actual media stream (e.g. the voice call) is not passing through the server.

Technically, direct interconnect between networks requires that servers are able to "talk to each other" in order to exchange address information, and that end-systems are sufficiently compatible (e.g. that the technology for transferring voice to IP packets and back are interoperable).

In Figure 4 we have illustrated two telephony networks on the internet. User *a* and user *b* as well as server 1 belong to network 1. When user *a* makes a call to user *b*, the software on the originating computer will communicate with the call-server in order to obtain the necessary address information. Provided with this information, the software on computer *a* establishes direct contact with the software on computer *b* and the actual call takes place. The call itself does not pass through the server. If user *a* wants to communicate with user *d* in Figure 4, the two servers must exchange address information in order to facilitate a communication session.

As compared to traditional telephony, the entry barriers for providing services over the internet are relatively low. An entrant wanting to offer e.g. VoIP must establish a call-server, and distribute necessary software to end-users. Thus local access is no longer a bottleneck. Referring to Figure 4, users on network 1 and 2 can already communicate, e.g. by e-mail. The problem is, however, to find the address of the one you want to communicate with. Thus the servers must exchange information in order to facilitate interconnection. With the introduction of VoIP a possible new bottleneck is accordingly access to these databases. In addition technical compatibility can be used strategically to gain competitive advantage. The examples provided below demonstrate that denying interconnection of databases as well as incompatible technical solutions indeed are important issues in these markets.

There is a number of large global messenger networks, notably MSN Messenger, Yahoo! Messenger, AIM/ICQ, GTalk and QQ. In 1999 Microsoft tried to establish interconnection between MSN messenger and AIM, but the attempts were blocked by AOL, the owner of AIM/ICQ (which still has a dominant position in the US market). In the seven year period 1999 – 2006 none of the large IM networks were interconnected. However, in July 2006 MSN and Yahoo! became interconnected, and recently it has been announced that GTalk and Yahoo are going to be interconnected. Interconnection is evidently a strategic issue for these firms.

Telephony networks based on VoIP are rapidly gaining market shares. The situation within the VoIP market has similarities to the messenger market. Most VoIP-networks are accordingly not directly interconnected.[17] Some VoIP-networks like Skype have managed to enter the telephony market without interconnecting with other networks. Other VoIP-networks are taking a more traditional route by installing a gateway to the established circuit-switched telephony networks.[18] By doing so the entire installed base of telephony users on both fixed and mobile becomes available from VoIP. Since many VoIP-networks have a gateway to the traditional telephony network, they are also indirectly interconnected. Thus, instead of routing a call between VoIP customers on different networks directly over the internet, the call is routed via gateways and through the traditional telephony networks. This is illustrated by the dotted line in Figure 5.

This way of facilitating interconnection between different VoIP-networks seems inefficient. By interconnecting call-servers and making software sufficiently compatible the call could instead be routed directly over the internet. As the proportion of customers on VoIP increases, and thus the proportion of VoIP to VoIP calls increases, the significance of the inefficiency will increase.

There are accordingly likely to be gains from direct interconnection. A possible future development is that some firms will deny all kinds of direct inter-

16) *For instant messaging and telephony the servers are called IM-servers and call-servers, respectively. The server functionality may be physically distributed, but logically it works as a database.*

17) *There are some notable exceptions, in particular the US-based network Free world dial up. According to their web site, their customers can use FWD to talk with people who use other networks to make calls over the internet.*

18) *In addition to the components illustrated in Figure 4, interconnection with the circuit switched network also requires a gateway.*

connection; others will want to interconnect with all others, while a third group of networks will choose targeted degradation. It is not unlikely therefore that interconnection will continue to be an issue for regulators. The focus will, however, shift from local access towards access to address information (i.e. interconnection of servers) as well as compatibility and standardization.

4 Concluding Remarks

Seamlessness and standardization yield obvious benefits since they typically result in gains from economies of scale and scope on both the demand and supply side. At the same time seamlessness and standardization may soften competition resulting in higher prices, slower network roll out and less innovation. Thus there is a tradeoff. Similarly, firms typically try to strategically exploit economies of scale and scope on both the demand and the supply side. The result may be a welfare maximizing market equilibrium, but it may also be too much or too little seamlessness and compatibility in equilibrium. Furthermore, a particular network or technology may be characterized by a low degree of seamlessness in some periods and high degree of seamlessness in other periods as demonstrated by the instant messaging example above. There is accordingly no "one size fits all solutions" with respect to the choice of business model and strategy in such markets. One has to carry out case by case analysis. One consequence is that regulatory policy also has to be determined on a case by case basis. In some cases regulators have to try to induce the market to choose a higher degree of seamlessness, in other cases a welfare improving regulatory policy should push in the opposite direction.

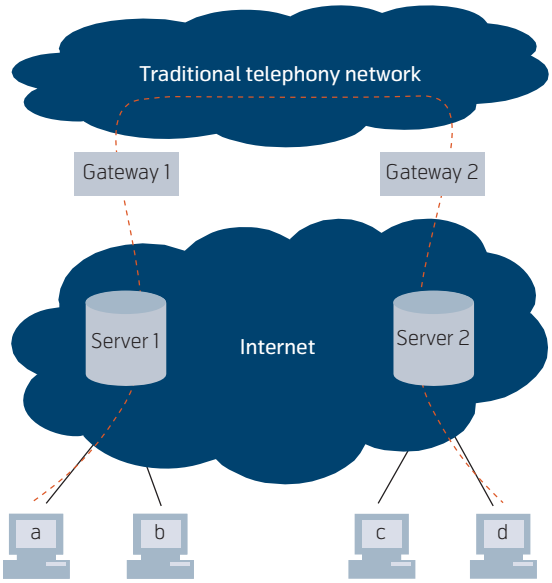

Figure 5 A call routed via the traditional telephony network

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