

The Converged Telecom Market and Impact on Forecasting

THOR GUNNAR ESKEDAL



Thor Gunnar Eskedal is Researcher in Telenor R&I

Convergence in the Internet, telecommunications and broadcasting industry/market is becoming a reality today. Convergence enables the provisioning of services independent of the underlying networks. For instance, end-users will be able to access broadcasting services such as television on their mobile phones or personal computers (PCs). In other words, convergence offers an end user the possibility to access services anytime and anywhere irrespective of the access network or terminal used. For a network operator convergence may provide an opportunity to have better network management, reduce the operational expenditure, expand their market reach and retain their customers. However, this ultimate goal of seamless and ubiquitous service access would require major changes in the existing network architecture, market, services and terminals. Understanding these changes is crucial for telecom and broadcasting industries in order to make a successful migration and offer higher quality services to end-users.

1 Introduction

In the early days of tele-, data- and broadcast communication different services such as telephony, TV

broadcasting and data were transported on different networks. The services were rendered on different types of terminal devices and were delivered by different market

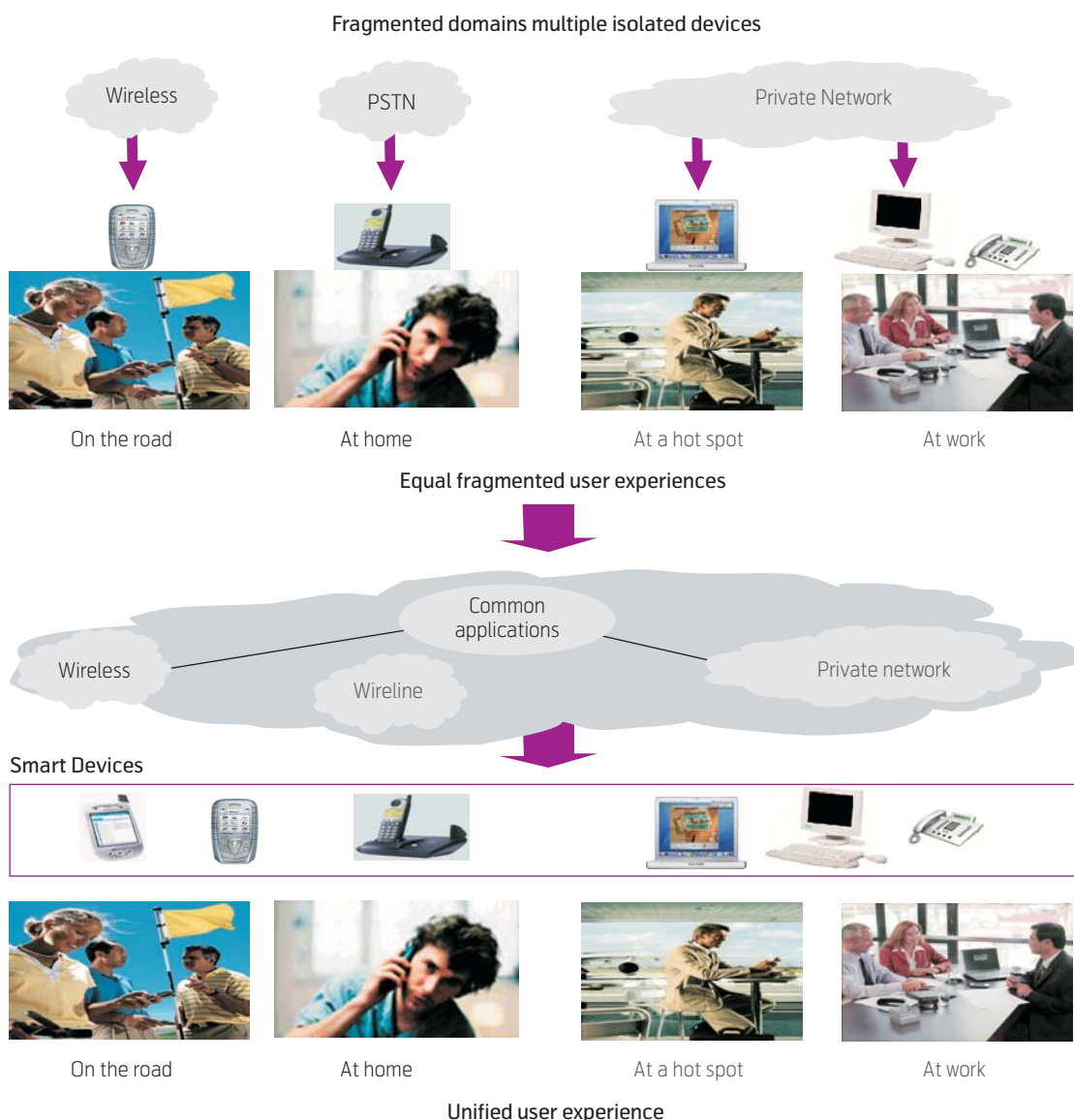


Figure 1 Unified user experience across networks, devices and locations

players. Today the situation has become quite different. The same network transports several kinds of telecom services, the same terminal device can receive several service categories and many market players are involved in delivering the same types of services. The telecommunication market in terms of number and types of stakeholders has thus grown enormously and the walls between various telecommunication and data communication services have diminished. New services, new transport technologies, new market structures and new business models have emerged. The term used to describe this development is *convergence* and it has and is continuously impacting the way the telecom industry is evolving. Convergence has brought forth changes not only in the way telecom stakeholders do business but also the way we live and the way we think. The selection of services and media is no longer a choice of either-or; it is rather a mix and match.

The main focus of this article is to describe the trends towards convergence as a new market situation in which the telecom analyst needs to conduct forecasting. Understanding this trend gives insight into the challenges forecasters meet when predicting usage of and demand for telecom services and thus demand for network build out. Precise and sound forecasting information is very important in all strategic planning for many stakeholders and thus represents a very important business skill. Thorough knowledge of the convergence trend within the telecommunication industry is thus a prerequisite to carry out this work.

Throughout this article the term telecommunication industry is used in quite a broad sense. The term will include the telephony, broadcast and Internet market, the service and media industry, the terminal and computer developments and the information and entertainment industry. Stakeholders within all these areas will be impacted by the trends towards convergence.

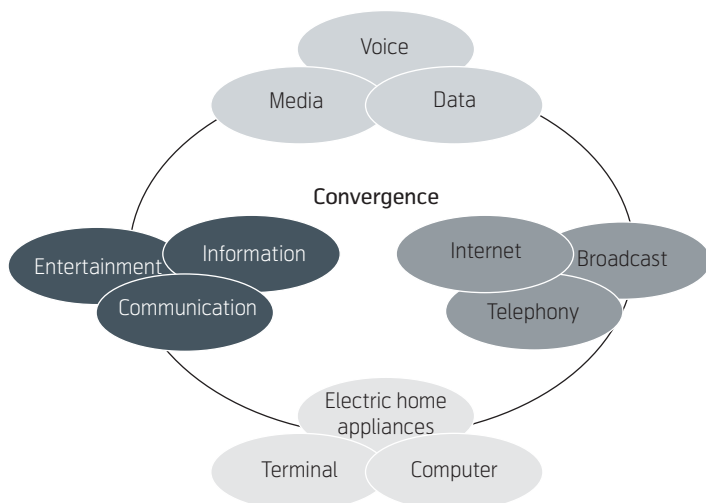


Figure 2 Several flavours of convergence

The term telecommunication industry will therefore be used to embrace all the stakeholders actively involved in all these areas.

The article starts out by giving a brief overview of the trends within the telecom industry as we see it today. Then convergence is described as a phenomenon embracing several aspects such as network technology, terminal development, the service market and various stakeholders. Each of these fields will be separately described in terms of their development towards convergence. These developments towards convergence are then described in terms of how they impact regulatory legislation, pricing aspects and uncertainty & risk. The last part of the article takes a little look into how this convergence picture impacts the way forecasting is conducted based on the usage of some typical forecasting models.

2 Trends within the Telecom Industry

Convergence has blurred the traditional boundaries between the core business of the telephony, internet and broadcast markets. The *Internet market's* core business has been to enable users to access Internet services such as email, web browsing and video-on-demand. Internet access has been enabled over fixed wireline (dialup over ISDN and broadband such as ADSL) as well as across wireless broadband access networks such as 3G, WLAN and WiMAX. Some of the industry players in this market are Google, Microsoft and AOL.

The *telephony market* has consisted of users accessing voice services over the fixed public-switched telephone network (PSTN/ISDN) and mobile networks. The main industry players in this market are traditional fixed and mobile telecom operators such as British Telecom, Telenor and Vodafone. A *broadcasting market* consists of viewers of traditional TV and radio programs over terrestrial/satellite broadcast networks. Some of the industry players in this market are BBC, NRK and CANAL+.

These convergence trends within the whole telecommunication industry are not distinct. They are highly inter-related and correlated. Network innovation enables creation and support of new services and new services define new requirements on networks. This spiral effect drives innovation and steadily impacts more market players and business sectors in the way they work and how they carry out their business. This ranges from the business of network operation and support through service and content development to the everyday business carried out by governmental and public authorities. All the sectors are seeking new ways of using telecommu-

nication in their business, eg. as a way to reduce operational cost, expanding the field of influence and information sharing and increase the business profitability overall. The latest development of the Subscriber Identity Module (SIM) card is a typical example of how several businesses seek to use a traditional telecom module for their own business purposes [1]. This telephony identity module is now being requested for use in businesses such as banking and ticketing.

In many firms access to various kinds of telecommunication services today stand out as one of the most important assets needed to run the business profitably. Even if large portions of the annual budget are used on telecom services and telecom infrastructure, the cost savings of using telecom services far exceed the cost and inconvenience of alternative communication and delivery solutions. Usage of telecom services, especially access to web, remote access to corporate networks and mobile services such as voice and messaging has thus become a prerequisite to carry out national and global business. Steadily more people today access their corporate email accounts from both their mobile phones and laptops when out of office.

Another trend the last years is the increased participation of the end user in the telecommunication industry. The user is no longer only a passive receiver of content with a locked device to one operator or service provider. The user has become an active participant who can create content, distribute it and compose personalized service bundles. Most of this is due to convergence based on the internet protocol which is enabling a homogeneous technology foundation with easy and flexible access to telecom and Internet service platforms such as the web.

The converged telecommunication network model is often referred to as the Telco 2.0 [2] model embracing the principles from the Web 2.0 [3] interactive internet business model. When deploying the Telco 2.0 model operators will be able to offer hundreds of services that bring together numerous applications and types of content from a variety of sources to form composite services. However, to form composite services it is essential to have an efficient and cost-effective user centric multi service platform to create, compose and bill new service packages. This paves the way for the implementation of *Service Oriented Architectures* (SOA) and cost effective *Service Delivery Platforms* (SDPs).

The Internet protocol (IP) has become the dominating technology basis for the development of all layers of a telecommunication service platform. The IP technology has become the basic technology in devices, network equipment and service control and creation platforms. The *walled garden* approach, where opera-

tors try to lock in customers to using specific handset brands, specific service portfolios and third party access is abandoned in favor of a more *open garden* approach offering the customer a much freer role of choice. From fiercely trying to fight competitors on the telecom market most actors now see the benefit of cooperating while still keeping a competitive edge. This is often denoted the co-opetition [4] era where promoting mutual benefits for competing stakeholders are regarded the most favorable business model, thus making use of each market player's specific assets and strengths. This trend is seen in the way service platforms are constructed with open interfaces, eg. based on web services, parlay X, .net and others. Instead of competing, many companies have seen the business potential in merging or establishing partnerships with other companies fulfilling a service or product demand. This we see in cooperations like BT/Vodafone, Nokia/Siemens and Ericsson/Sony. These new company constructions together with innovative new business models emerge from a new market landscape moving towards convergence which resulted from and leads to fierce competition.

3 The Move Towards Convergence

Convergence is thus changing the telecommunication industry as described above. The main driver towards this development has been the increasing impact of telecommunication as one of the most important assets in modern society. It has become an asset which the whole society is being built around, very similar to electricity and automobiles. The importance of telecom services drives willingness to pay for the goods, which again drives new stakeholders to enter the business. Fiercer competition drives prices down and innovation and cost effective systems and technologies are used to keep margins. This has paved the way for a major adoption of the IP protocol suite across a multitude of networks and services. This spiral effect of competition driving down prices leading to new innovation in usage of cost efficient systems and technology has not yet come to a standstill.

Looking more detailed into the specific trends driving convergence within the telecom business we can list;

- Fixed operators lose traffic to mobile
- Mobile networks run out of capacity and need continuous upgrades and new systems such as femtocells
- Wi-Fi has entered public and private domain
- Hybrid Wi-Fi-2G/3G terminals have entered the market

- Telco business becomes heavily impacted by software systems with increased competition leading to more actors that can participate in service creation and delivery
- Industry consolidation/merging and acquisitions
- Increased amount of capacity demanding applications on the market
- High expectations/demands from customers
- Migration towards an All-IP network
- Increased broadband and laptop penetration
- Aggressive VoIP actors entering the telecom segment
- Demanded cost reduction to ensure margins
- Strict price pressure on services leads to flat rate pricing on mobile
- Increased battle for the customer
- Formation of new roles in the communication industry, eg. brokers and aggregators
- Software companies go into telco business (Microsoft, ...)
- Internet companies offer telco services (Google, MSN, ...)
- The turnaround time of service creation and delivery gets stricter to be able to stay in business

All these aspects are reasons behind the drive towards convergence. Since there is a spiral effect many of the aspects listed are results of other aspects again driving new requirements and developments. Convergence is also driven by a push in many industries to be able to reach people and interact with people as often as possible independent of physical network coverage and terminal connectivity. Technology innovation is also needed to be able to track the movements of the people to streamline the service offerings and advertisements to a variety of situations and locations. Advertisements, tracking of buddies and marketing campaigns are now being introduced on mobile phones specifically targeted to an area based on location information of the person, eg. outside a shop. The earlier vertical silos of service development and delivery cannot handle the new users' service demands and they are not cost optimal for producing and delivering these services.

The strong growth of Wi-Fi and multi radio terminals has driven the developments of mobility technologies such as Unlicensed Mobile Access, IP multimedia subsystem (IMS) and Voice Call Continuity. It has also enabled more stakeholders to enter the voice business with Voice over IP and thus entered the telecom business arena competing with low cost telephony services. Lack of radio resources on mobile networks due to increased mobile data usage also trigger mobile operators to cooperate with fixed operators to utilize the fixed broadband access as backhaul for mobile services. Femtocells are a typical example of such a development where mobile operators enter the private household and indoor market with a small home 3G base stations. Finally software actors such as Microsoft, Goggle, Yahoo and others are entering the telecom business due to the shift towards an increased usage of software based telecom systems.

4 Convergence Types

The word convergence refers to something emerging from different directions or origination points but over time moving closer to each other and finally coming together. Another way to put it is that it refers to the blurring of dividing lines among traditionally distinct products and services, technologies, markets, industries, and regulatory structures.

Figure 3 illustrates this development within the telecom operator industry. From the old silo way of creating, distributing and rendering services such as voice, the convergence trends are moving towards a horizontal service creation, delivery and consumer model where the IP technology is the primary converging technology. Various services may be packed in service packages and sent across various access networks to various device types. There is no one-to-one relation anymore, rather a many-to-many relation between services, networks and devices.

The trend shown in Figure 3 is quite illustrative of the various levels of convergence ranging from the user's terminal to the application layer. As seen in the figure convergence impacts most layers in the telecommunication value network. Besides illustrating that the vertical silos are replaced with horizontal layers it also illustrates that in some layers there is a merging of functionality. The convergence is to create flexibility both for the operator and the end user.

Table 1 sums up some of the most typical characteristics of the shift in the telecom industry from the situation today to the next generation telecommunication network.

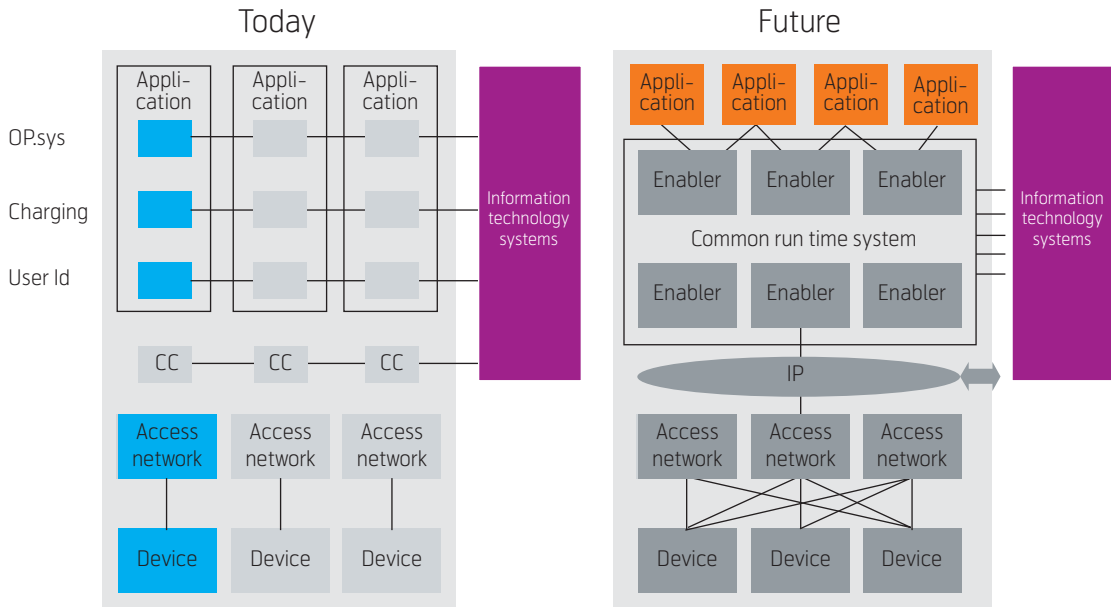


Figure 3 From a silo based network paradigm to the convergence era

In the following, five convergence aspects are described in more detail. These are:

- Device convergence
- Network convergence
- Control and management platform convergence
- Services and media convergence
- Industry convergence

4.1 Device Convergence

From the users' perspective the following requirements have been brought forward:

- Services are reachable any place, any time and on any device type
- The device shall be ease to configure and use
- Personalization of the user interaction to the device
- Always best connected, network selection
- Lowest price, high capacity
- Global mobility
- Single bill
- Multi purpose device
- Context awareness
- Adapt service to terminal in use

Below are pointed out some major developments that can be seen as enablers for or solutions to most of these requirements.

The devices have become *multi service enabled*. This means that the same device may be used to render many different services which were earlier dedicated to one device. For example, TV programs were received and watched on a television set, voice was received and sent on a dedicated telephone and data was received and transmitted on a PC. Each of these

devices was connected to distinct networks. Today all these services may be received on one multi-service terminal, often with several external interfaces both wireless and wireline. The modern mobile phones are such multi service devices as well as a wide range of laptops. The mobile device is used for voice, data, radio and TV services, and contains game consoles, camera functionality, web clients, GPS satellite receiver for positioning etc. Laptops are equipped with various wireless technologies such as Wi-Fi and 2G/3G so they can be used to render services while stationary and on the move. The television set is used for television programs, it runs text TV, the screen may be used as a large laptop screen and with the rights cables it's a nice photo and video console.

Characteristics	Traditional	Next generation
Convergence	Absent	Inherent
Services	Single	Multiple
Network	Multiple	Single
Network access mechanisms	Single	Multiple
Network access speed	Primarily narrowband	Broadband capabilities
Network building blocks	Dedicated	Reusable
Network management	Less centralized	Centralized
Product development	Slower	Faster
Interfaces	Closed	Open
Customer experience	Complex to adjust & less personal	Less complex to adjust
Regulatory compliance	Rules clear	Rules work in progress
Service delivery & assurance	Slower	Faster

Table 1 Characteristics for the future telecom market

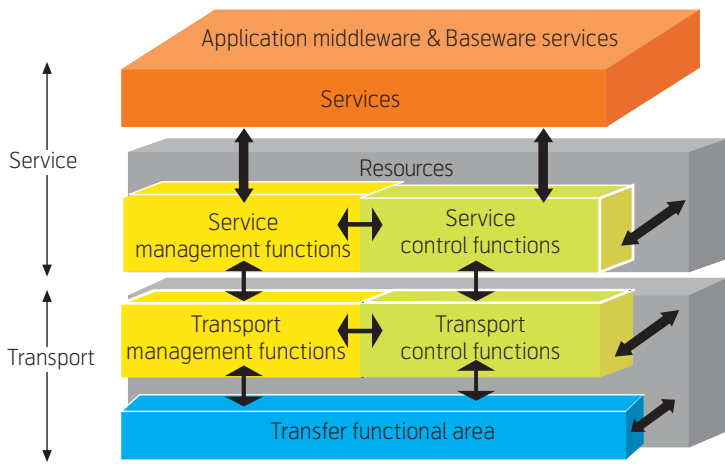


Figure 4 NGN's general functional model according to ITU-T Y.2011

Even the GPS used in cars has installed SMS receivers with voice reading for safe driving. One of the reasons for this is that the digital chip technology is getting very cheap and compact. Integrating various technologies into one device does not impact the price level so much and it just turns the device into a multi tasking mini computer.

With Internet Protocol stacks in the devices all types of IP services may be supported. Since all service types are IP based it is also easy to make up compound multimedia services consisting of several service components from various industries. This may be a multimedia service made up of traditional telecom (voice), internet (data), and broadcast (video) components in addition to value added information such as location, context information and multiparty possibilities. Constructing service compositions from various telecommunication industries is often denoted rich communication and is primarily enabled by the convergence across all these service areas.

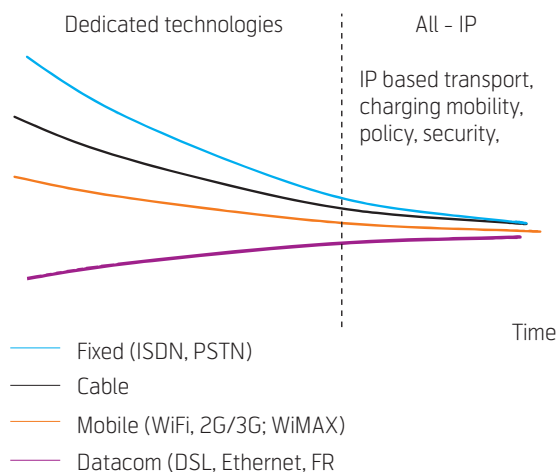


Figure 5 Network convergence, where dedicated technologies merge into a common IP based transport network

4.2 Network Convergence

Network convergence denotes the merging of telephony, datacom and broadcast networks in the way they transport and handle various types of communication traffic. This is seen especially in the convergence between the Internet world and the telecom world and between the fixed and mobile segments of the telecom industry. It is also seen in the way the TV cable networks are also used for broadband internet access with the introduction of the DOCSIS 3.0 bearer technology [5]. A typical example of the merging of fixed and mobile is the work of ETSI TISPAN in connection with the development of the IMS [6]. TISPAN has here added network functionality to the IMS specification to support fixed network installation. The 3GPP IMS architecture [7] is predominantly specified to support the mobile industry.

One of the pre-requisites for network convergence is a clear separation of network and service functionalities. Service should ideally be able to run on any network, and control and management should be homogeneous across services. These have earlier been tightly linked in the telecom (mobile as well as fixed) architecture. Figure 4 shows the ITU reference model for the Next Generation Networks (NGN) architecture [8] which illustrates this separation between transport and services.

Access to Internet is presumably one of the most important services a telecom network must be able to offer to the public. The main convergence enabler here, as for the separation of network and service layer, is the extensive usage of IP technology represented in the term All-IP.

All-IP is a term used for the whole telecommunication industry's strife towards a homogeneous IP technology basis. The networks are thus made up of IP based network equipment and functions/features such as QoS, mobility, policy handling, charging and addressing. An All IP network increases convenience, saves cost and increases flexibility and optimal utilization of the transport media compared to distinct communication media per service.

Since different access networks have different strengths and weaknesses we will still see several access networks also in the future. They will complement each other to fulfill coverage, performance and capacity requirements. These access networks may however all be based on IP transport but deviate in the aspects mentioned above.

4.3 Service Control and Management Platform Convergence

For the service control and management platforms the trends towards convergence have greatly emphasized efficient and flexible session routing and handling to support the use of multiple terminal devices and multiple transport and access networks. IP equipment has been introduced as a single technology everything should be based around to achieve this efficiency and flexibility. The session control and management platforms use information from various application servers. These may be user identity databases, charging, security and authorization systems, operation and business support systems, etc. In addition the service platforms manage network functions like quality of service and mobility functionality. Information from all these sources uses IP based protocols and is handled by functions in the network that can act upon the IP streams. This may be the charging system that can count IP packets and use IP network based service classes as input to the charging algorithms. It may also be the understanding of IP based mobility models such as the Mobile IP family which is slowly increasing its uptake in the telecom market. Convergence has thus led to developments of platforms that can handle all service types. This may greatly reduce cost and simplifies the operator's network from the earlier vertical silo system where each type of media needed to be routed and handled by its own operation and business support system to one homogeneous system taking care of all types of media.

The IMS is such a platform comprising both a session control and a service control platform. SIP/SDP is used as the session control and description protocol. SIP/SDP is IP based and was specified by the Internet engineering task force (IETF) [9] [10]. SIP/SDP has with some minor additions and modifications been adopted by 3GPP in the IMS system. IMS is constructed by 3GPP and most operators agree to adopt it as the service control and management platform architecture for their next generation network. The IMS is built to be access network agnostic and thus follows the trend of convergence. ETSI TISPAN has adopted the IMS system also for their fixed network solutions and some cable network providers have done the same, ref Figure 6.

Some of the main aspects of the 3GPP IMS are:

- Rapid and flexible service creation and packing possibilities
- Homogeneous session and service control across multiple access networks
- Purely IP based session and services handling

- Common charging and QoS/policy framework for all access types and service types
- Standardized IP based interfaces to third party service providers
- Lower time to market for new services
- Reduced investment and runtime cost

This flexible way of handling multiple service types into bundles and packages and routing them to various access networks, opens up for a new way of predicting usage and demand for each media type. The use of several services simultaneously composing one multimedia application is quite different from earlier when one would mostly forecast one service demand at a time. How the different services impact each other and correlate in usage is thus a more intricate problem in the convergence era.

4.4 Service and Media Convergence

Convergence on the service and media level is first and foremost linked to the strong focus on Service Delivery Platforms (SDP). The services as such are specific and cannot be said to converge. It is how they are created, transported and packed that has merged together into what we define as the service delivery platform. By creating a common SDP based on the Service Oriented Architecture (SOA), a major step has been taken to orchestrate service packages according to the choice of the user. The user may then easily compose new services from a multitude of service components and media.

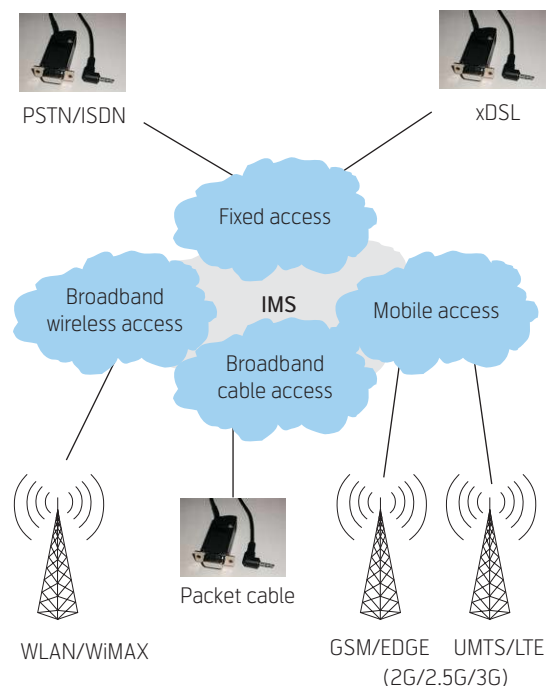


Figure 6 IMS as common session control for multiple accesses

All service and media streams use the internet protocol as a common network protocol technology. This makes service composition easier than mixing services based on different transport protocols. With the introduction of an efficient SDP operators are seeking a service platform that shortens time to market for services and reduces overall long term cost of investment and operation. The developments towards a common SDP also opens up for much greater flexibility to interface and integrate services developed by third party service providers over standardized IP based interfaces such as web services and Parlay X. This convergence of service delivery platforms has been implemented by several operators already to varying degrees.

Service and media convergence is also seen concerning the market player's interest in tele- and datacom services. The strong usage growth of various flavors of voice, messaging and video drives the convergence of these applications across the telecom and Internet arena. Most of these services are supported on both telecom and internet actors' platforms, such as MSN, Google, and AOL. Web 2.0 and the interactivity it brings represent the internet service model where the user himself is the content creator and service composer. The IP technology has made this possible together with a network infrastructure with high capacity. From the user's perception many of the services offered on the internet have similar quality to the complement on the telecom network infrastructures. Services may thus very well become complementarities across these two markets. When this kind of complementarity occurs we say we have a product or service convergence between markets.

The service convergence is also evident between other branches of the industry. Newspapers were earlier distributed solely on paper. With the large uptake of internet the newspaper companies also distribute the news on the internet as well as on text TV. Telecom actors distribute special content of the newspaper on the mobile phone, eg. through the wireless application protocol (WAP). The same information is thus distributed on several platforms and the reader may pick and choose the media of choice to consume the content.

4.5 Industry Convergence

Finally convergence is also seen between different industries. In this context, the term industry convergence is defined as the converging of two or several hitherto separate industries. With this we do not only consider technological convergence based on the digital computer era. Technology is however one of the most important drivers of industry convergence. Factors such as regulation, standards, business model

innovation, changing customer requirements and industry channel structures are also included when talking about industry convergence. The most typical example is the convergence of the information technology (IT), telecommunication, and media and entertainment industry, all relying on digital media and telecom distribution.

Industries become technologically convergent if their products or processes start to rely on the same sets of technological assets. The telecommunication network is such an asset that very many industries are now completely dependent upon to carry out everyday business. TV and advertisement distribution and newspaper and magazine distribution are all industries where the telecom, broadcast and Internet are the distribution channels for the same type of information.

We also see telecom business actors converging with IT business actors by the evolution of software based telecom systems. This opens up for many new actors to enter the telecom business arena offering services such as voice and messaging. More actors are manufacturing and selling the same goods resulting in an industry convergence around the same basic end user product. An example may be mobile payment substituting the traditional payment industry based on banking. VoIP and traditional voice is another typical example, and IP TV can become a low priced substitute for traditional TV. In all these cases the services were earlier constructed and delivered by separate industries. There has been some overlap before but nothing like we expect to see in the future.

5 Convergence Impacts

Convergence has in the previous sections briefly described some of the most pronounced developments within the telecom industry in the last years and how it has impacted various stakeholders. In the following we will take a closer look at three other aspects that are closely related to convergence. This is how convergence has impacted pricing, regulations, and risk of operation for a network operator.

5.1 Pricing and Pricing Regimes

During the last years the price of voice, both fixed and mobile, and data services has gradually fallen. On fixed broadband the capacity increases yearly but the prices stay fairly constant. The charge for fixed voice calls has also decreased, often with free usage during evenings and weekends. Increased competition is the overall main reasons behind this. The competition is ranging from substitutes especially VoIP and various messaging services to cannibalization of fixed voice to mobile.

For mobile voice many operators now give away hundreds of minutes for free and some operators have launched subscriptions based on monthly flat rate with no upper limit on voice usage. For messaging (SMS) we see the same trends, where we find subscriptions with up to several hundred free messages each month. Some operators have also introduced monthly flat rate pricing of mobile data thus leading to a very rapid increase in mobile data traffic.

This development has been especially evident the last years as the convergence trends have developed. Lower price levels drive innovation to seek new more efficient ways to run the telecom business and keep the customers. Fixed mobile substitution has led to a fiercer price war between fixed and mobile actors. Falling prices drive convergence further, often with service bundling offers across industries. This again opens up for more actors taking part in the race which again drives price levels down even lower.

5.2 Regulations

Regulatory and competition legislation is also strongly impacted by convergence. Current regulations are particularly linked to service provisioning and interconnection.

Regulations evolve in response to market and technological developments. One of the aims of regulations is to protect against abuse of market power and support user access to telecom services at a reasonable price. This mainly concerns the rights/obligations of the stakeholder who has dominating market power. Aspects such as bundling, price levels and interconnection charging arrangements need to be regulated to prevent abuse of market dominance. With increasing impact of convergence market boundaries will be blurred, which again impacts regulations. Regulations will probably impact steadily more actors and the term dominating market power may also be blurred since the same basic service may come in several flavours and may be rendered on various platforms and by various actors. How the future regulatory regime will work and how it will impact the various stakeholders is thus very difficult to predict.

Knowledge of basic legal and regulatory rules within the telecom sector is thus of great importance to be aware of. Since regulations may impact the way technology is used to handle service delivery to the customers it is directly relevant for the forecasting of service usage and infrastructure demand.

5.3 Uncertainty and Risk

All forecasting introduces uncertainty and probability of things happening that may impact the business operation and results. The new converged era intro-

duces more challenges in predicting demands and usage. Risk is defined as consequences of an action or event times the probability of it occurring. The picture drawn up above on the converging market certainly puts new dimensions to the uncertainty of the usage of each of the technologies and the usage of the various device types and services.

This converging market increases uncertainty when trying to pinpoint the usage of each access technology, what terminal is used for the various service types and the usage of each type of device. Forecasting the needs for new network build out and capacity increase from an operator perspective will thus be more challenging.

On the other hand, several network types may support the same service portfolio. The increased usage of inter operator roaming and interworking between operators makes it less risky to invest in one network technology since the different operators can rely on other carriers to support coverage where one of them is not present. Shared usage of networks and obligations to support other actors' needs, eg. LLU (Local Loop Unbundling) policies, opens up for greater flexibility of usage between operators.

However, the risk of making large investments in one network infrastructure to support some telecom services may suddenly be altered by the introduction of a new less costly network technology. Since rolling out a new network technology, eg. GSM and UMTS has been a very costly investment with long Return on Investment time, it is crucial to make investments as flexible in use as possible due to the rapidly changing way of usage.

Risk assessment is thus important before strategic decisions are made. Since there may be so many alternatives for service delivery and consummation one of the big challenges is to be able to choose the most flexible and future proof technical solution to avoid costly consequence if the decision should be wrong.

6 Delphi Survey

To examine opinions about the future converged market a Delphi survey [11] was performed in the autumn 2006. It was an on-site Delphi survey conducted at CTTE 2006 [12] in Greece. 56 participants participated, including experienced telecom experts and graduate students. The Delphi survey was organized by the ECOSYS project [13] consortium. ECOSYS was a three year CELTIC/EUREKA project aimed at developing techno-economic methodologies in the area of telecommunications and con-

duct business case modelling/analysis of different scenarios in the fixed, mobile and convergence communications industry/market.

6.1 Delphi Method

A Delphi survey is a forecasting method to calculate opinions about a topic. To improve on some earlier used forecasting methods, the Rand Corporation [14] developed the 'Delphi Procedure' in which a panel of experts arrive at a consensus but eliminate the regulating of committee bias by employing a series of individual questionnaires. The first phase asks for the panel's forecasts. The replies are compounded. The second phase requests comments on the Phase 1 compound forecast. This means that all participants get to see a compound result from Phase 1. Phase 2 then gets answers that are based on information from all other participants' views in Phase 1. Phase 3 is a derivative of Phase 1 based on the results of Phase 2 again, and so on.

A typical process includes two or three interactions or phases. The goal of this multi-phase process is a forecast convergence between the participants where misunderstandings are sought eliminated.

6.2 Results from the Delphi Survey

The results from the Delphi survey showed how the experts saw the telecom market development up until 2013. 2013 is several years into the future and much may have changed within the telecom area by then. The evolution within terminal technology, network and radio technology, IP applications etc will all impact the usage of services and the pricing. However, the Delphi survey gave an overview of the opinions of many experts who had a profession closely linked to telecommunication.

The main conclusions from the Delphi survey were:

- 1 50 % of voice calls will still be circuit switched in 2013, the rest may be VoIP or push to talk over cellular.
- 2 There will still be 15 % traditional fixed telephony service in 2013.
- 3 Usage of the mobile network for voice traffic will not increase much while usage of fixed and broadband wireless (eg. WiMAX, HSPA) will increase much.
- 4 80 % think that there will be a price difference running a voice call dependent on the access network used, while 55 % believe that there should be a price difference for messaging services.
- 5 Presence and location information is highly valued: people would pay additionally 5-8 Euro a month for these services.

6 SMS traffic will decline in favour of e-mail, instant messaging and multimedia messaging. E-mail will increase the most.

7 Web browsing will increase slightly on mobile networks but decrease on fixed broadband.

Several of these results may be discussed as to whether they still follow the experienced trends in the telecommunication market. The Delphi survey is now two years old and the telecom market is changing very fast.

What we do see today is that data access from web browsing and downloads of movies, music and files on wireless networks have gained enormous momentum the last years. Wireless broadband has to a certain degree become a substitute for the fixed broadband networks in some markets with low broadband penetration. For example in the Philippines mobile data access for the operator Smart has now surpassed voice traffic and accounts for 53.9 % of the total service revenue [15]. O2 in the UK follows with 34.9 % of the revenue resulting from mobile data applications.

The reason for the rapid uptake of mobile data applications has primarily been the lowering of data tariffs of wireless network usage together with increased capacity of the networks. Some operators have offered an unlimited data access subscription which has led to an explosion of wireless internet access usage. Due to this subscription some subscribers have abandoned, or not acquired fixed broadband and only used the wireless broadband access skyrocketing the wireless capacity demands. This development is an indication that pricing of services together with the right timing of data enabled devices and network access possibilities have given a turn in network usage. 3G data cards and 3G dongles have boosted uptake of mobile broadband usage and turned the mobile network into a major transport infrastructure for internet and data access. Convergence and fixed mobile substitution have altered the way pricing of services is carried out and the way networks are used.

7 Forecasting Models

In the following we will give some considerations of forecasting modelling in a convergence view. Traditional forecasting methodologies are widely used and have been an established scientific area since the 1930s. Numerous papers have been published especially on quantitative forecasting methods. Earlier the telecommunication market was much less complicated. There were few services, no complicated technology, and the incumbents controlled the market. Therefore, advanced quantitative forecasting models

could be developed and used for forecasting telecommunication demand. Now, the situation is different. The market is more complex with intensive competition, lost market share, service substitutions and technology convergence. Due to the small margins and the fierce competition it is important that the market players do sound forecasting work when high investments are needed.

In the future converged market, where the services change characteristics or new services emerge that will impact the existing services, historic data may not be so relevant. New services emerge at a rapid pace and many of them may be regarded as substitutes to earlier, more established services. Push to talk over cellular, VoIP and internet telephony may to a certain degree substitute circuit switched voice. New messaging services such as instant messaging and chatting services may also to a certain degree substitute the use of circuit switched telephony. Again 3G cards for PC usage and seamless mobility across networks may also open up for new ways of using telephony and impact the usage of traditional telephony. These new aspects will impact the way forecasting should be conducted. The following two sections briefly describe two main categories of forecasting models that are well established today. To do sound forecasting in the future it will be even more important than earlier to combine the strengths from both these main groups.

Judgmental or Opinion Driven Forecasting

These methods are not based on mathematical calculations or extrapolation and are thus prone to uncertainties caused by human opinions and evaluations. Within this group there are several methods ranging from taking individual opinions from experts (intuitive forecasting), to consensus forecasting where experts carry out group discussions to reach a common opinion. The Delphi survey described earlier may be characterized as a judgmental and opinion driven forecasting where the model is claimed to improve the intuitive and consensus forecasting method by directing the forecasting results through a series of questionnaires. The Delphi model thus limits the possibility of misunderstanding and takes into account aspects that each single person may have forgotten or regarded as irrelevant. Opinion driven forecasting also has the strength of taking into account many soft values such as intangible assets, general market trends, culture, communities, regulation forecasting, business developments. It is a more user centric approach compared to the quantitative methods. In the converged future market these aspects are very relevant and must be taken into account since these aspects may impact the usage and demand to a large degree.

On the other hand, a strategic decision must be backed up with quantitative calculation of demand and usage. The opinions must be quantified and be input in a demand modelling calculation model. Succeeding in taking all relevant aspects into account to estimate usage is a difficult task. Very many aspects may impact the results. Risk estimates and sensitivity calculations can be conducted to show the impact of each impacting component.

Quantitative Forecasting Methods

Quantitative forecasting models have benefits since they are independent of judgmental information and opinions and thus create an 'objective truth' of the future usage and demand. The problem is the values of the input variables, which must be based on eg. time series of historical data or judgmental or opinion based data. The result of a quantitative model is thus sensitive to the accuracy of the input values. How to construct the quantitative model is also a challenge. What parameters shall be included and what is the impact of the various parameters. In general quantitative models may not sufficiently take into account market trends, changes in regulation, market dynamics of business aspects, social networking aspects at the same time. These are very difficult to link specific numbers to, and they are often highly correlated.

To aid quantitative methods option theory may be used to calculate several different options for market development. Based on a probability factor for each of the various options a certain development will be pointed out as the most plausible one.

8 Summary

This article has summed up various convergence trends in the telecommunication market. Convergence has been evident within several segments of the telecommunication value network covering the user device, the network, the control platforms, the service and media and the industry stakeholders. The convergence trends have been related to the challenge of forecasting service usage and network operator demand for infrastructure development. The convergence trends have and will continue to impact several areas of our society from the end users' perception of telecom services and usage through developments with regulations and pricing aspects to calculations of risk and business positioning.

The development and challenge of forecasting has included areas such as service and terminal development, transport and access network infrastructures, market player developments and competition and regulations and social dynamics. It has been pointed out that the new converged market will impose new chal-

lenges to conduct forecasting in all these areas and thus result in it being even more important to use several forecasting models to be able to predict the development of usage and demand. The uncertainty of the prediction will increase and the risk of losing out on business will increase, especially due to lower margins and fiercer competition both on network access and delivery and service development level.

The converged market will however increase flexibility in what network to use to transport services to the user, open up for a much richer variety of what kind of customer equipment that can be used to render services and increase flexibility to share network infrastructure with other operators. The risk is moved from being worried about not supporting coverage and the right services to the customer to being able to support these issues in a cost optimal way. Intangible assets are getting more important since the earlier distinguishing factors, eg. on area coverage and capacity decrease.

9 References

- 1 *WIMA 2008: Mobey Forum 2. The 2nd European NFC Developers Summit.* 29 April 2008. [online], visited 21.10.2008. URL: http://www.wima-nfc.com/content/mobey_forum_2UK.php?menu=smenu2
- 2 *Telco 2.0 Initiative.* [online], visited 08.10.08. URL: <http://www.stlpartners.com/telco2.php>
- 3 *Web 2.0 description on Wikipedia.* [online], visited 08.10.08, URL: http://en.wikipedia.org/wiki/Web_2.0
- 4 Brandenburger, A, Nalebuff, B. *Co-Opetition: A Revolution Mindset That Combines Competition and Cooperation.* New York, Doubleday, 1996. (ISBN 0-385-47950-6)
- 5 CableLabs. *DOCSIS Specifications – DOCSIS 3.0 Interface.* [online], visited 21.10.2008. URL: <http://www.cablemodem.com/specifications/specifications30.html>
- 6 *ETSI TISPAN.* [online], visited 21.10.2008. URL: <http://www.etsi.org/tispan>,
- 7 *3rd Generation Partnership Project. IP Multimedia Subsystem (IMS) – Stage 2.* 3GPP TS 23.228 V8.6.0, September 2008.
- 8 *Next Generation Networks Global Standards Initiative (NGN-GSI).* [online], visited 21.10.2008. URL: <http://www.itu.int/ITU-T/ngn/>
- 9 Internet Engineering Task Force (IETF). *SIP: Session Initiation Protocol.* [online], visited 21.10.2008. URL: <http://www.ietf.org/rfc3261.txt>
- 10 Internet Engineering Task Force (IETF). *SDP: Session Description Protocol.* [online], visited 21.10.2008. URL: <http://www.ietf.org/rfc/rfc4566.txt>
- 11 *What is a Delphi Survey?* [online], visited 21.10.2008. URL: <http://www.ibiblio.org/fosphost/IFHOSP/ExplainDelphi/whatdelphi.htm>
- 12 *5th Conference on Telecommunication Techno-Economics – CTTE 2006.* Athens, Greece, 8-9 June 2006.
- 13 *ECOSYS Project Home Page.* [online], visited 21.10.2008. URL: <http://centurion.di.uoa.gr/ecosys/>
- 14 *RAND Pardee Center Publications: Futures Methodologies.* [online], visited 21.10.2008. URL: http://www.rand.org/international_programs/pardee/pubs/methodologies
- 15 *Wireless Intelligence, Q4:2007.* [online], visited 21.10.2008. URL: <https://www.wirelessintelligence.com/index.aspx> (Restricted Access)

Thor Gunnar Eskedal received his MSc degree in physics from the University of Oslo in 1990. After graduating he started working as research assistant at the Norwegian Institute of Technology (NTH) in Trondheim. In 1991 he received his business economist degree from BI Norwegian School of Management and joined Telenor R&I. At Telenor he started working with system architecture, broadband technologies and IP network performance. Since 1998 he has been following the standardisation and uptake of various wireless networks such as 2G/3G and Wi-Fi. From 2000 his main focus has been on business modelling, techno-economic analysis and network development.

thor-gunnar.eskedal@telenor.com