Business Aspects Impacting Technical Architecture

TERJE JENSEN

Terje Jensen is Research Manager in Telenor Group Business Development and Research and Senior Researcher at Q2S/NTNU

There is a strong link between the business role(s) a market player wants to take on and the architecture guidelines that should be obeyed. Firstly, in order to swiftly interact with partners the proper interfaces have to be specified and made available. Secondly, functionality needed to carry out the roles has to be present. Thirdly, optional architecture modules should be defined according to the optional role features and corresponding risks.

This paper addresses a number of business aspects that should be examined in order to define a proper technical architecture.

1 Introduction

No technical solution exists in isolation; there are several considerations to be taken on which services to be sold and which customers and partners to engage. Governmental and public views would also make important inputs. On the task of defining a future roadmap, the present situation also has to be considered.

Elaborating a holistic technical architecture should evaluate different options in view of wanted requirements. Both *a reference* and *a target architecture* are relevant. The former devises relevant architecture components, their characteristics and how they are related. The target gives recommendations on how the reference architecture should be populated being more specific on what each component should be like. The target also provides a future-looking perspective.

One motivation for describing a reference architecture is to give a framework that existing (and future) systems and networks can be placed into. Then, one may analyse the resulting system and network 'maps' to identify overlaps, inefficient relations and holes. These aspects may not be deficiencies, however, as they could well be planned for.

In any case, *such maps give a common reference* for a systematic evaluation of the current situation and wanted future situation(s). A main objective driving these activities is to support decisions on how to organise the 'production means' in order to conduct business in an efficient manner. The inherent flexibility level sought must also be considered.

Note that from the outset, an architecture by itself does not define how the different systems should be obtained. One may still choose various sourcing options for different systems. For example, some areas could be out-sourced to vendors, others may be jointly operated with other providers, while still others are made in-house.

Business-related arguments for defining reference and target architectures are provided in Chapter 2. In order to take on the broader view, a number of perspectives are identified in Chapter 3. These cover a selection of viewpoints and key questions to be addressed as elaborated in Chapters 4 – 10. As part of evaluating options for future solutions, uncertainties have to be dealt with. For this purpose, scenario techniques could be applied as presented in Chapter 11.

2 Business Arguments for Defining Architecture(s)

Most business arguments are based on

i) Increasing efficiency in terms of lower costs;

ii) Improved service capabilities for potential service offerings and shorter time to revenue;

iii) Improved reputation, say from market, analysts and others; or,

iv) Increased managerial flexibility.

These are all to be considered when elaborating a technical architecture. However, they are also valid for most other activities conducted. Some further arguments related to organization and human factors, which *favour defining a common architecture include*:

- Improved communication between organizational units, as responsibilities and relationships can be depicted in an overall diagram. In theory, also formal methods could be introduced for automating interactions. Introducing any newcomers to a larger organization would also become swifter.

- Detecting communication needs between units (organisation and system) which require secure and compatible mechanisms.

ISSN 0085-7130

- Increased efficiency of communication between units as each defining mechanism should know its scope and area of responsibility.

- Predicting impact of introducing new units or changing configuration of current units. Being unaware of which relationships that are impacted when changing an interface could be quite dramatic.

- Providing a reference for sharing best-in-class practises between different organisations/operations. Comparing efficiency of solutions implemented in different ways and without a common mapping is commonly a tedious task.

Compared with the system development life cycle, defining an architecture would allow for a more *flexible plug-and-play component-wise implementation*. That is, components (or sets of components) could be replaced without widespread impacts on every other component. An alternative might follow an overall so-called waterfall development process. One major disadvantage of the latter may be the inherent complexity for the whole system portfolio. Thereby follows the time it would take from specification to full implementation. This likely implies that no (or few) requirements are allowed to change during this process. This would contradict any CxO who would not accept any change allowed for a duration of 2 – 3 years which typically is related to a transformation of larger operations.

Elaborating the architecture should provide answers, or at least insight into the following questions:

- What is the *optimal architecture* to ensure the key business requirements and activities? Is it at all realistic, appropriate, proactive and feasible? Which model should be applied to describe the applied architecture?

- Which *combinations of organization, technologies and processes* should be applied? And to what extent are these compatible with the target architecture?

- Which *heterogeneous components* will work together in an efficient manner? Which variants are applicable and how will these interact with the environment and related domains?

- How to manage the *portfolio of systems and units* in the rapidly *changing environment*? For example, how to ensure that the business is efficiently set up for the market purposes? How to track and manage any changes needed in an efficient manner?

- What *cascade of changes* is implied in case a modification or upgrade is required? That is, how are the inter-dependencies between different systems/units?

- How to make sure that relevant persons are *kept up to date on actual changes and emerging solutions*? Are there other efficient ways of segregating the systems and the competence areas?

On the farther horizon, a number of options will be looked into. This also includes investigating different trends regarding evolution of the relevant industries, competitors' behaviour, offerings that customers will ask for, solutions provided from vendors, and so forth. In fact, having a systematic description of these issues also allows for detecting new business opportunities. That is, opportunities are revealed, and triggers/factors for when to go for these opportunities are described.

Besides these aspects, other challenges can be prepared for, such as presence of a disruptive system reducing the entrance threshold to the service-offering arena. This ensures that responsiveness is maintained through the flexibility. In fact, a modular architecture should by itself provide shorter time for responding to any challenge. However, it also typically implies that strict architectural rules have to be obeyed.

Then, to arrive at a target architecture some exercise on future situations has to be made. This would include questions like:

- What usage patterns will be seen?
- Which services should be offered?
- How will the competitors act?
- Will any regulatory changes happen?
- Which technologies should be introduced – and which should be phased out?
- What personal competence is needed?
- What will the partner landscape look like?
- What are financial conditions expected to be?

There seems not to be any available full-fledged set of tools to elaborate technical architectures. The main resource is the human himself, drawing on the experience for balancing the use of the proper set of tools as well as the proper candidate descriptions.

Overall the technical architecture provides a:

–> *Reference for common understanding;* and
–> *Target for tactics/strategy and migration activities.*

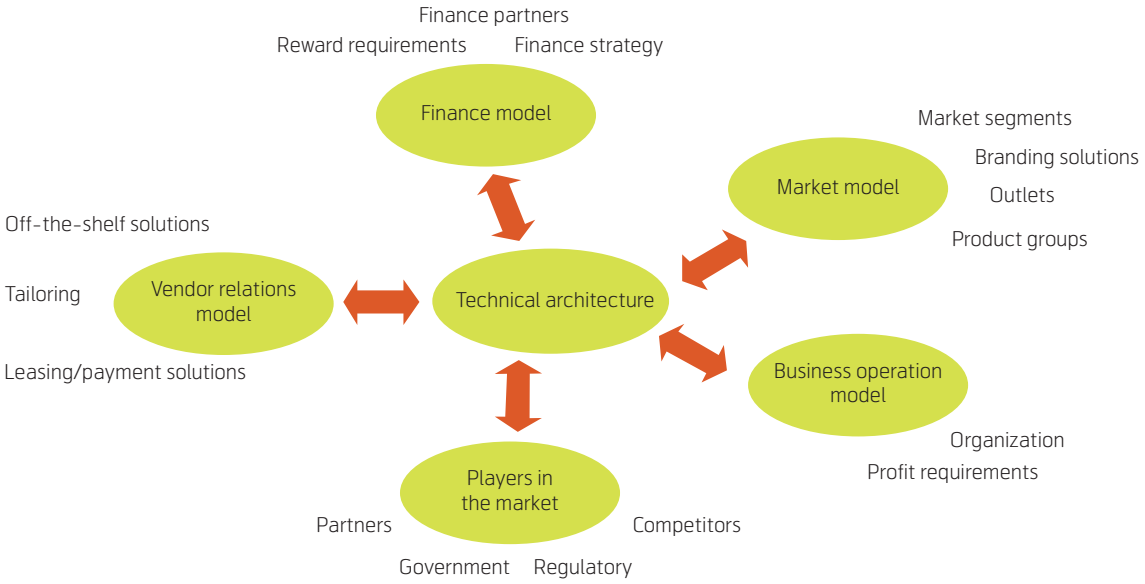

Figure 1 Business areas inter-relating with technical architecture

The architecture should not be too general to provide no guidance; neither should it be too detailed to miss the overview and the overall picture. It should also be clear on where well-known solutions are applied (commodity) and where differentiation is needed (tailoring).

3 Business Domains

There are several business areas that have a mutual dependency with the technical architecture, see Figure 1.

- *Market model* provides description of the overall market size. This is typically also related to macro characteristics such as Gross Domestic Product, average revenue, average spending on relevant products, and market penetration of relevant services.

  Key characteristics are the market potentials. In some cases these may be derived from the presence of number of enablers (or drivers). For example, when analysing future penetration of broadband access, the presence of terminals capable of making use of such access would provide a strong indication of the potential.

  The 'wealth' of the population is also a much used indicator. Commonly the correlation between 'wealth' and usage of telecom service is quite strong.

  Market models also include which product bundles to promote, which market segments to address and which channels or outlets to use. All these provide requirements on the technical solution such that services can be swiftly related to come up with the product bundle. Market outlets may be implemented by partnering or in other manners that must be supported by the Business and Operational Systems.

  For a running operation, there would also be requests for market statistics in order to estimate potentials for product areas and to identify relevant market segments.

- The *business operation model* includes description of responsibilities between different organisation units. In addition, operational objectives are stated, for example which profit goals that are to be pursued. Technical system areas and organisation units are commonly linked in the sense that each unit typically manages a number of systems to fulfil its objectives. Examples of organisation units are sales/distribution, marketing, product development, network/system operation, strategy and finance.

- *Players in the market* may be seen as, i) partners, ii) competitors, or iii) market regulators. All these set requirements to the technical architecture, for example in the sense that proper interfaces are open and readily available.

  The regulatory authority awards licenses and other rights. Depending on license characteristics, different technical solutions should follow. For example, a lower frequency (eg. in the 900 MHz band) may allow longer distances between base stations compared with higher frequencies (eg. in the 2400 MHz

ISSN 0085-7130

band). The license conditions may also imply certain coverage, capacity and quality requirements.

Inspection, interception and retention rights should comply with technical capabilities according to conditions on lawful intercept, data retention, etc. In some cases, tax and revenue/profit tracking may place additional requirements on systems' capabilities.

Sourcing configurations, such as network sharing, may imply that certain systems or network areas are out- or in-sourced or shared with other providers. Documentation of service levels, operational status, and so forth, may require dedicated functionality.

For mobile operators, roaming agreement requires a set of procedures and systems to follow up on any agreement status, credibility checks, accounting procedures, etc.

- *Vendor relations models* describe how different systems or equipment types are provided from different vendors. In some cases the solution is considered a commodity when commonly used by other providers. In other cases, however, the provider might require a tailored solution. Which approach to follow for which market segment and market region may differ, however. In order to arrive at an effective overall solution it becomes fundamental to have an architecture in place that relates the different areas.

  In some cases, vendors also engage in planning, deployment and operation. Corresponding systems need to be introduced to follow the responsibilities taken on.

- *Finance models* state how the operation is going to be financed and how the profits (or losses) are going to be shared. A range of different cases may occur such as direct loans, taking part in some product offerings, sharing ownership on some systems, providing market outlets, providing infrastructure, etc. Clear responsibilities, duties and reward schemes typically require procedures for tracking the status of the relevant areas.

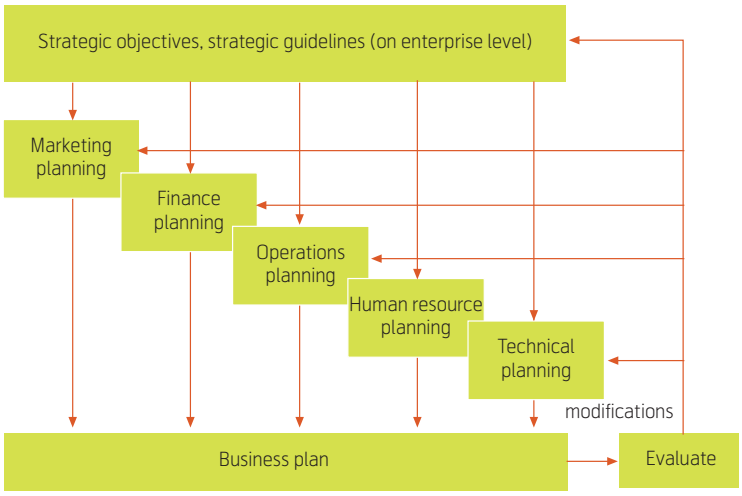

Figure 2 Relations between business plans, enterprise strategic objectives and area planning – improvements through iterations

4 Who are You – and Who do You want to Become?

Analyzing today and future: Please, mind the gap.

4.1 Business Plan

Any provider, as an instance of an enterprise, would have a business plan. The business plan includes the financial indicators enabling managers to evaluate the financial performance of the enterprise in order to make further decisions. In brief, a business plan summarizes the results of the activities involved, including:

- *Objectives* to achieve (future revenue, number of customers, etc.);
- *Effort* requested (human resources, equipment investments, etc.);
- *Influence on performance indicators*, in particular the financial indicators.

In a similar manner to different horizons of architecture work, business plans can be divided into, i) strategic business plans (decisions on farther horizon, affecting all enterprise), ii) tactical business plans (decisions for particular units/projects, affecting market segments, system choices, etc.), iii) short-term business plans for management control (assisting monitoring of performance, follow-up of budgets, etc.).

The relations between planning scopes and business plans can be illustrated as an iterative process, see Figure 2. Besides the outer iteration, there may also be interactions between the different groups. However, a fundamental message is that these have to be coherent in order to efficiently support the enterprise's objectives.

This is where the architecture comes into the picture. That is to *support the holistic and coherent perspective*. On the technical side, it collects information about technical system and network areas. In that respect it will directly support the technical planning. The technical architecture also composes the link between the technical systems and the other areas as described in Chapter 3.

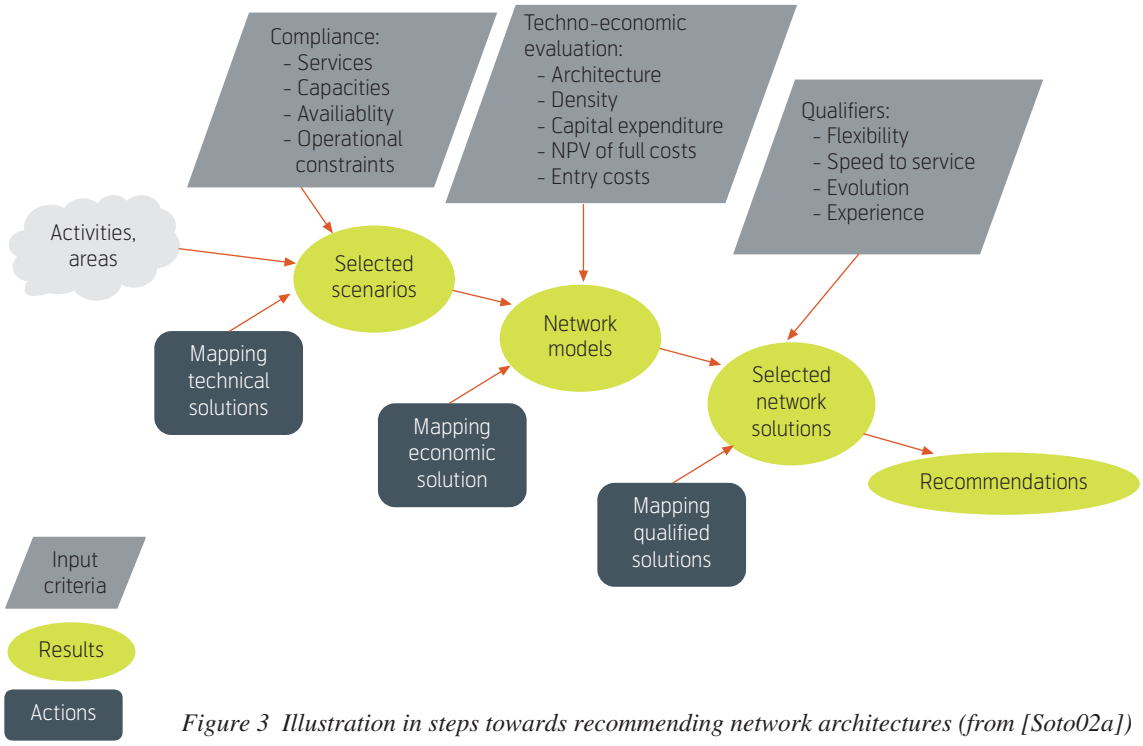

Figure 3 Illustration in steps towards recommending network architectures (from [Soto02a])

The elements in the business plan contain financial indicators, models for costs and revenues as well as sensitivity studies. These may be updated during refinements of different types. As shown in the figure, iterations allow for steady improvements.

4.2 Architecture as Basis for Recommendations

As an ultimate goal, all components of an architecture should be considered as a whole. However, this may not be realistic for any but the most simple system portfolio. Relations between current state, financial aspects, product forecasts and technical solutions must be considered. A set of procedures and corresponding tools might be requested. These assist when conducting the various activities. One variation of a procedure for making architectural recommendations is depicted in Figure 3.

A number of information elements are required as inputs. The results flow between the different steps and scopes involved. It is also important to consider the total life-cycle of systems. Hence, the process must also cover time estimates for phasing out systems.

4.3 Billing and Payment Models

Different payment schemes can be looked upon as balancing the risks between the parties involved. Which schemes to apply typically impacts the technical architecture in several ways. For example, appropriate mechanisms for monitoring, collecting information and conducting invoicing have to be covered.

Some payment configurations are:

- Subscription
- Volume (eg. number of bytes)
- Bandwidth requested/reserved
- Time
- Number of accesses/sessions
- Quality of service class
- Contents
- Events

Requirements on capabilities are found in the network areas, in operational systems and in business systems. Corresponding processes for billing/invoicing must also be implemented.

4.4 Go-to-Market – Through which Channels?

Market channels play important roles in connecting producers and consumers. This goes across all the

Fast Moving Consumer Good (FMCG)

Examples of traditional Fast Moving Consumer Goods are soft drinks, cigarettes, candies.

Features such as high sales volume, repeated consumption and fast churn rate, are typical characteristics of the FMCG category. Recharging pre-paid cards would commonly fall into this category.

As seen by FMCG consumers it is an essential factor that the goods are readily available at the moment of purchase decision. Increasingly it is also seen that Internet channels are used for marketing and sale of FMCG goods. This also changes the characteristics of the traditional FMCG goods to include digital media and services.

ISSN 0085-7130 ©Telenor ASA 2009

Factor	Own customer service centre	Common store/outlet
Investment	Large investment wholly born by operator	Exclusive agents invest much, while operators invest little
Construction period	Long	Short (initiated in different regions simultaneously)
Management	Powerful management and quick response	Relies on the channel management by operators
Marketing	Intensive marketing	Achieves intensive marketing by connecting sales volume to profits
Service	All-round service and customer care	Limited services
Brand	Good brand presentation	Relies on operator's promotions to enhance brand equity
Profit	Profits solely belong to the operators	Shares profits with operators

Table 1 Comparing operator's own centre versus common store (adapted from [Huaw08b])

traditional marketing channels, but also includes the word-of-mouth approach. The latter seems to take a growing position.

Market outlets may be built for exclusive selling or as common stores. Table 1 summarises some factors for these options. By placing telecom products in a common store, one sees a resemblance with other fast-moving consumer goods (FMCG). Typically this is observed for products such as pre-paid re-charging cards. Commonly several variants are used in the same market.

Note that the 'common store' could also be a virtual market outlet, such as an Internet page. Internet-based channels are increasingly utilized for marketing and sales of different goods and services. The technical architecture needs to comply with specific requirements to capture the capabilities of these channels. In theory, which channels are utilized for which product segment should have a minor impact on the overall technical architecture. Channel-specific requirements could be managed by the corresponding modules dealing with market outlets.

5 Know Your Customer

There is a great difference in mind-set between 'owning your customer' and 'knowing your customer'. Several Internet-based companies continue to leverage on the *'know your customer' philosophy*. In order to improve one's knowledge, social networking information is typically addressed. To carry out such investigations, the following items are commonly covered:

- Provide incentives to the customer to share more personal information about himself/herself. There are, however, several privacy and confidentiality concerns to adhere to.

- An open system is required. Facebook and Google Android are two examples where third parties interact and provide information. And the amount of readily available information grows. With the proper tools the value of this work will grow significantly even without monetary rewards.

- Touch points where the provider can interact with the customer to engage in a two-way communication. Utilizing social networking can make advertisements personal, intuitive and relevant.

As Web 2.0 is coming mobile, it will provide an opportunity whereby persons can push selected information and ideas. Some claim that Customer Relation Management systems version 2.0 should evolve in a similar manner. Then, customers can utilize data and analyse procedures for their own purposes. For example, customers know their own social network and manage their own connections. It would then become a way to motivate individuals to share data as they will see the benefit of doing this.

This is also related to the *word-of-mouth marketing*. The effect is two-fold as influential persons have direct impact on purchasing decisions (through recommendations) as well as indirectly by inspiring for imitation by their friends. For example, for individuals who were in the market to buy a car it was shown that 71% of the buyers were influenced by what their friends said, whereas only 17% were influenced by TV ads.

All these trends create additional requirements on the technical architecture. It is simply not sufficient to think along the traditional telecom provider's mind set. Systems for interactions and co-operation across different user types may allow additional business opportunities and could also be incorporated into the more traditional provider's processes.

6 Common Systems In-house or Out-sourcing?

There is a number of reasons why a provider will invest in telecom equipment. Firstly, new equipment could be installed providing the new services that cannot be provided by the current systems. Secondly, an existing system could be replaced in order to produce the services more efficiently. Naturally, the first and the second will also be combined in several cases. A third reason is to expand an existing system

in order to cover more traffic load or customers. This is also likely to provide the new versions (and hence a combination of the first and second arguments as well).

The cost components come in various flavours, including:

- Equipment costs – both hardware and software as well as other vendor costs. In several cases recurrent license and maintenance costs are given, or a cost level depending on the amount of traffic/carried load;

- Operation Systems' costs, as a consequence of introducing new equipment – this can be either completely new systems, or adaptations and integration related to existing systems;

- Installation costs;

- Operational costs, such as
  - Cost of human resources
  - Other necessary infrastructure (eg. transport layer support, fibre, copper line etc.)
  - Necessary vendor support and licenses
  - Training
  - Equipment footprint, reflecting building rental fees
  - Power and cooling requirements
  - Recurring way of right costs.

When replacing/modernising an existing system, there is also the potential to re-use or sell redundant equipment. The revenue/income side may also be included in the overall profit calculations.

As a provider increases the number of systems, the set of customers to support is also likely to diversify in terms of characteristics. However, there is a steady trend towards integrating more systems onto common solutions. This would theoretically allow single systems within a provider. The common system would support a range of customer segments and product types. This is likely to require co-ordination between units within the provider in order to successfully deliver services to their respective customers.

A number of factors influence the co-ordination between units. The main ones discussed in the following place emphasis on 'trading' between units:

- *Centralisation vs. distribution*. Centralised solutions are better for relatively simple, common tasks with small requirements for individual changes and adaptation. For other cases, distributing the solutions might be the better choice.

  Centralised solutions imply a risk of becoming 'least common denominator', ie. not fully compliant with individual needs. A potential outcome may be (too) late introduction of new functionality that applies to some application areas only. This could come from the fact that flexibility and cost of implementation drive the evolution, on behalf of speed and agility.

  The downside of distributed solutions, obviously, is the risk that functions or tasks are duplicated. These are functions that otherwise could have been combined. On the other hand, distributed solutions allow for different time frames when introducing changes and upgrades, taking into account varying 'local needs'. That is, needs reflecting individual business units.

  As long as the size of the task/area is above a minimum, a distributed solution will be best suited to adapt to variation in requirements and changes in environment. The scale/scope effect, however, would influence the minimum level, including equipment cost/utilisation, human resources, etc.

- *Internal trading*. A 'demander' of a certain service within a provider has fundamentally three alternatives; i) buy from an external unit, ii) buy from another internal unit, iii) build it yourself. Whenever constraints are imposed on internal trading (ie. internal trading has to be applied), the challenges in defining the relationship are particularly great. A healthy climate for internal trading requires freedom and openness for all parties, ie. any agreement must be commercially viable for supplier and customer. This requires flexibility and incentives for the units involved.

- *Outsourcing*. Outsourcing a particular task implies that one becomes a buyer (ie. centralisation). This may imply some additional challenges:
  - A well-defined and professional supplier/customer relation must be defined.

  - The buyer's possibilities of having problems solved rapidly are reduced.

  - The buyer's possibilities of prioritising and controlling error corrections and upgrades are limited.

- *Scale and scope issues*. The following factors may be considered for the scale effect ('the bigger, the better'):
  - Co-location of equipment may be easier, including common power supply, housing, etc.

- Operation/maintenance staff and gathering of competence.

- Planning expertise.

- Vendor contacts – prices on equipment and support.

- Operator System-related – number of systems and need for interconnecting the systems.

- Common arrangements for interconnection with other providers.

The scope effect, advocating centralizing functions, may allow for easier introduction of new products and transfer of products between (currently) different networks. Hence, this would affect the service bundling challenge, in particular across (currently) different business units' responsibilities.

The co-ordination effects also address a generic challenge for a system design, sketched in Figure 4; the effort spent during the initial design and set-up of a system commonly lowers the effort needed when introducing changes to a system. This also goes for the procedures and schemes to follow between units – both within a provider and between the provider and others; an efficiently designed procedure commonly pays back in the longer run.

The chosen technical architecture must support the sourcing solution preferred, on both short and long term. In case 'trading' is involved, corresponding systems must be present. These should also provide the proper set of incentives to make the sourcing model run in an efficient manner.

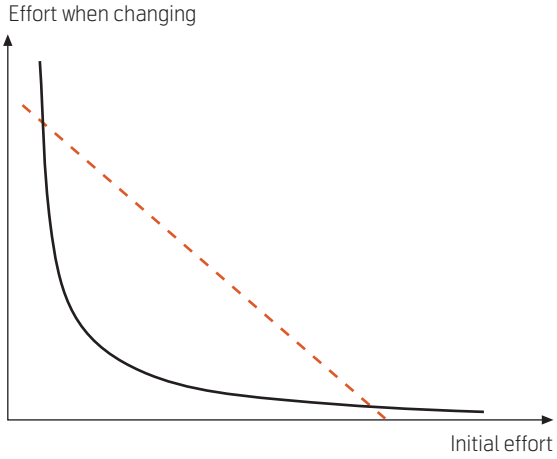

Figure 4 Trade-off effort during initial phase and modification/upgrading/operational phase

7 Regulatory and Political Issues

Providing public telecommunications services and use of radio frequency spectrum are fairly strictly regulated. There are also constraints on termination and roaming costs (eg. in Europe). In some markets a few providers are categorized to have so-called Significant Market Power (SMP). If so, they have to obey additional constraints, such as open and announced conditions for interconnection.

Examples of areas subject to regulation are:

- Provision of public mobile services (NMT, GSM, UMTS)
- Provision of public telephony service
- Provision of leased line services
- Unbundling of local access lines (LLUB)

In addition, an operator may have to obey the Universal Service Obligation (USO) with respect to public telephony, leased line services up to 2 Mbit/s and access to digital telecommunication network (the latter refers to interconnection as opposed to leased line).

Following additional rules due to holding SMP implies that more issues have to be taken care of:

- Transparency
- Non-discriminating
- Cost-based pricing
- Separate accounting for different services

SMP regulation is valid both for fixed network and mobile network services. Reporting to the regulating authority has to be taken care of.

Price caps on terminating traffic and roaming service usages can also be introduced.

Typically, a provider should document to some extent that regulatory directives have been complied with. This may imply mechanisms for monitoring, collecting information and presenting the results. To a large extent the basic operations could be utilizing the same mechanisms used for network and service measurements. This requires that those mechanisms have been defined to support multiple purposes and that the proper interfaces have been introduced. Both concerns advocate for having the technical architecture in place to guide the implementation.

Regulation may take place in *ex ante* or *ex post* mode. One of the typical differences between telecom (sector-specific) and general competition-oriented regulation is that the former uses *ex ante*, while the latter uses *ex post* mode. *Ex post* implies that regulatory

means are evaluated from case to case after an incident. For example, in case misuse of market power is detected, the authority for fair competition could take action. It is generally not illegal to possess dominating market power, but to misuse one's position would be illegal.

Ex ante implies that the authority wants to adjust behaviour in advance of any misuse. This implies that a set of regulations has to be defined. One example is the right to use certain frequency spectrum bands.

8 Mergers and Acquisitions

In the dynamics of the telecom business, mergers and acquisitions have been seen all the time since the inception of this business. For example, in Norway today's national operator was formed by consolidating a number of local/regional operators.

Some claim that an industry's state of evolution can be assessed by *consolidation activities*, ref. Figure 5. Four stages are illustrated (proposed by A.T. Kearney) claiming that most industries experience a period of relatively predictable consolidation during these four stages. These stages span a time period of 20 – 25 years on average. The following stage description is based on [Huaw08a]:

- First stage is characterised by *start-up and inception*. It can also be described by new or former monopolistic companies that have been de-controlled or privatized. New start-ups enter the market to gain their share. Subsequently, the consolidation is reduced.
- Second stage is characterised by *scale effect*. This leads to accumulation, which basically reverses the first stage, leading to market diversification intensifying the importance of size. This is driven by cost savings and larger scale organisation and systems. It will also be a natural reaction for some providers to avoid aggressive take-overs.
- Third stage makes a shift towards *exclusive operation and concentration* whereby core business expansion gets on the agenda of providers, competing with others. Theoretically, it is stated that the top three providers would likely control about 60% of the markets (given the same starting point, which is rarely the case).
- Fourth stage is described by *balance and alliances* and is a time when the major operators in the industry reinforce their market shares. Industry concentration then becomes relatively stable after rising to a given level and regulation (eg. anti-trust laws) inhibits further mergers and acquisitions. Moreover, the industry hierarchy's nascent maturity effectively controls future acquisitions.

It is claimed in [Huaw08a] that the telecom industry has reached the latter part of the second stage and is moving into the third stage. Note that this may well differ across the different regions of the world. In some markets telecom has been around for more than a century. On the other hand, it has not always consisted of the same set of services and ways of conducting business. In that respect one may consider PSTN, mobile and Internet as different areas, which could each go through the different phases.

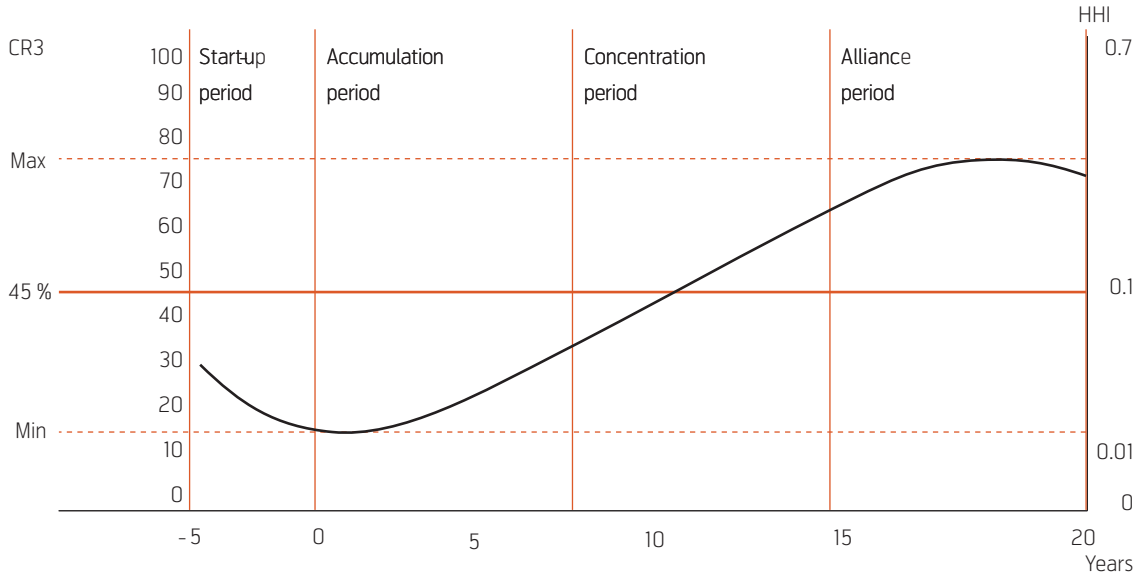

Figure 5 Illustration of industry consolidation stage (adapted from [Huaw08a])

ISSN 0085-7130 ©Telenor ASA 2009

Entering the third stage, consolidation is reflected by the objective of large-scale acquisitions. The model is motivated by the fact that only providers capable of acquiring major competitors in key markets would continue to the third stage. In effect, the telecom industry is currently seeing the emergence of industry giants.

The model also advices the providers, during the third stage, to focus on their core competences and profit mechanisms. Mergers during this stage are more likely to involve selective business units rather than whole providers' organization. Then, providers may strengthen their core competitive abilities and refine or simplify asset portfolios.

A provider that has secured its footing must remain highly attentive to its rising competitors and decide whether to imitate their advantages, implement an acquisition strategy, or employ restraints that inhibit their development. Small providers who focus upon regional or local markets have to deeply penetrate market segments in order to garner long-term survival, and in turn aggressively seek to promote brand equity and sustainable pricing strategies.

According to [Huaw08a] short term telecom industry mergers and acquisitions are driven by three major factors:

- *Capital will*; desire of the shareholders/owners. Typically, free cash flow providers would look for future growth opportunities. This would also go across different industry sectors, such as power production/distribution and telecom. A common owner behind multiple telecom providers may also push for mergers.

- *Technical innovation*. Evolution promotes multi-sector integration across mobile, fixed, broadband, media and internet areas, to name just a few. Hence, this spans platforms, organization units and users. Common technical solutions fuel merging different units to gain from scope and scale.

- *Strategy model*. There are several models promoting different actions. One model states that profits from mature market operations should be balanced between extending new product lines targeting existing customer groups and exploring opportunities in new markets addressing new customer groups. Another model advocates achieving diversification to capture some of the emerging business positions that are revealed. Basically, it boils down to not defining one's place too narrowly and always look for opportunities with a flexible mind-set.

In essence, new technologies and financial capital are the major catalyst that both promote mergers and acquisitions and create growth potential. Value chain perspectives have also to be taken on. For example, vertical integration could be beneficial in some markets to boost volume of certain core products.

All in all, these concerns must be brought into the *technical architecture*. That is the *dynamics* should be supported by the chosen architecture. That architecture must also enable the timely *business actions*.

The concepts of *horizontal* and *vertical actor models* have also been proposed. A horizontal model can be seen when a set of interconnected networks are involved between the communicating partners. One challenge with this is that, when new services are to be introduced that require specific support by the networks, all networks have to be upgraded.

For a horizontal model, common infrastructure (at a certain layer) is used for different applications. This implies that the common layers have been prepared to carry different applications. New application types should then be incorporated without change for other applications. All networks along the path still need to be prepared, though. Some also refer to this as *network virtualization* as the same physical resources can be shared by multiple independent logical networks.

9 Operations, Life Cycle Concerns

Management of services and formulation of adequate Service Level Agreements (SLAs) are related to applications and customer demands. What is needed for efficient service management? It is essential that the service management system works well with the network and element management systems, supporting the following tasks:

- *Dynamic network representation* – to handle new and out-of-service managed resources;

- *Proactive data and event monitoring* – to integrate data from a set of diverse vendor and protocol sources and identify potential problems;

- *Automate topological and model-based reasoning* – to understand the impacts of events based on connectivity and configuration;

- *Cause-effect inference* – to map between the effects of anomalies and their service impacts;

- *Root cause analysis* – to differentiate between symptoms of a problem and the true problem;

- *Operator guidance* – to assist in prioritising operator actions;

- *Automated testing* – to verify diagnoses while minimizing network impacts;

- *Automated fault correction* – to implement network reconfiguration to optimise service delivery.

These capabilities are essential for truly effective service level management. Not meeting the requirements, most of the event management responsibilities add to the already loaded human operators.

Mapping network events onto services and related SLAs allows for real time management of the business. Key performance indicators can be polled periodically, and trend analysis of the historical values can be used for proactive SLA management. These can also be used to predict SLA threshold violations. As a consequence of violating an SLA condition, any actions – not just reports – can be performed, allowing corrective measures to be automated.

The service management system should include integrated models of the network devices and their connection, the services, agreements and customers. It should be able to perform what-if analysis for possible customers affected by a potential failure and be able to generate a list of all devices used by a customer or group.

The elaborated technical architecture has to incorporate mechanisms that provide these functions. As similar mechanisms are used for measurements in general, common solutions can be utilized.

10 Financial Aspects and Risks – Transition or Steady?

When detailing future architecture candidates, a number of options are revealed. These will be compared in order to choose which set of candidates to spend money on. Hence, there is a need for defining a set of criteria to use when selecting which options are the better ones.

It is important to consider that, typically, the capital expenses are higher in the beginning, while operational expenses may make up the largest part in the long run. So, even though minimizing the level of initial investments, the eventual operational costs should also be considered. It is therefore fundamental that the technical architecture supports an efficient operation. This likely implies automated processes and simple management tasks.

A basic criterion is the *profit levels* expected as return after taking certain steps. Requirements on the expected profit are given considering the *accompanying risk level*. Hence, higher risk would likely ask for a higher profit level compared with a lower risk action. A profit can be estimated in different ways. For example, assuming that the income level is indifferent with respect to the solutions found, the cost of the solution is to be minimised. In general, however, various solutions may support different levels of services and product types. The income side must therefore also be considered in the equation.

A fundamental challenge with the income side is that the price level is influenced by quite a number of factors, such as competitors and regulators (see Chapter 3).

Concerning financial aspects a number of topics should be looked at, such as:

- Financing needs, eg. peak funding;
- Value and profitability evaluations, eg. net present value, internal return rate, payback time;
- Sensitivity analyses regarding major factors.

Regarding risks, a number of non-technical areas could also be treated (ref. Chapter 3):

- Political and market economic risk;
- Market and commercial risk (including regulatory);
- Partner risk (also including vendors);
- Financial risk;
- Organisational risk (to follow the activities and realise profits).

Some of these could be transferred onto the technical architecture, such as flexible scaling, ability to decouple business areas, flexibility in sourcing schemes, and so forth.

A certain *profit level* may be related to certain *target architecture*. In order to realise the profits, appropriate steps have to be prepared for in a timely manner. These could include organisational efficiency, increased revenue, reduced cost, etc. For most steps, *exit strategies* have to be elaborated to cover alternative steps/paths to follow in case some of the planned steps turn out to be unwanted later on in the process. Which exit strategies that are possible should also be discussed. Allowing flexible exit strategies is also one type of concern when defining the road towards the target architecture.

The interplay with vendors and customers must also be obeyed. That is, trends among the users have to be observed and possibly matched in order to increase the service demands. Likewise, choices and prioriti-

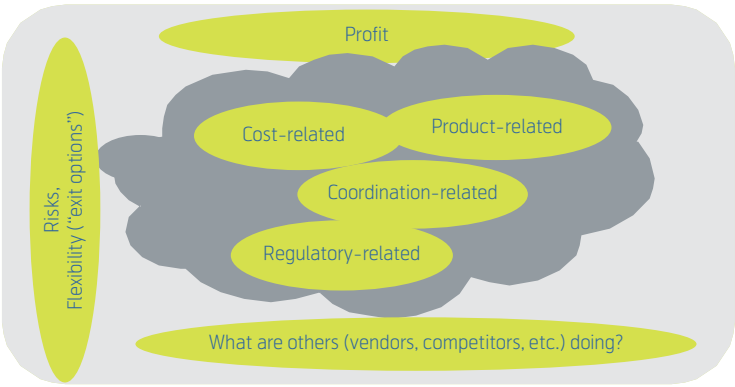

Figure 6 Selected criteria classes

sation made by the vendors have to be followed, as, for example, it could well turn out very costly to install and maintain a system from a vendor that is leaving the market or decides not to support that system in the future.

Keeping in mind the broader set of criteria, a few criteria groups may be (Figure 6):

- Product-related: Capabilities of supporting relevant products;
- Cost-related: The investment and operational costs associated with the network solution (and migration);
- Regulatory-related: Would there be any regulatory restrictions or exposure involved;
- Co-ordination-related: Are there any effects from the network solutions onto business matters (internal trading, etc.).

The actual criteria weights to use when evaluating a target architecture might also depend on the market situation/position. This includes concerns like whether an established provider's situation or a 'green field' region is considered. Hence, a somewhat wider scope may be applied where there is no 'history'/legacy system. To some extent this would also be valid when the overall service portfolio and operation of an actor is looked at – deciding upon which products to offer and which market segments to approach. When a set of legacy systems is involved, more emphasis might be placed on managing the systems efficiently and relating the products and systems (production means). This also includes decisions regarding the operations support systems.

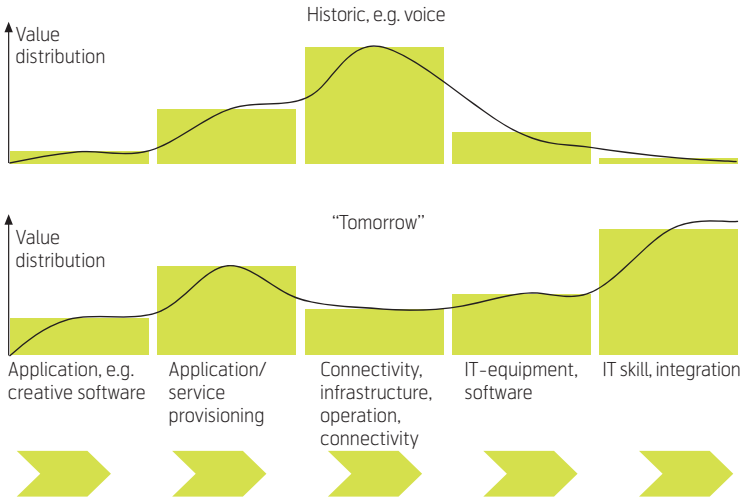

Figure 7 Shift in value chain (although depending on market/ competition situation)

11 Addressing Uncertainties – Scenarios

A core point of scenario analysis is to focus on the topics attached with *highest uncertainty* and the *greatest impact* upon the questions being studied. The topics that are likely to occur but require little attention are relatively easy to cater for. Likewise, topics that have little impact could be of interest to discuss but may not influence the architecture in either way.

It is fundamental to understand that the architecture work is not carried out for its own purposes *per se*. For the reference architecture, it needs to relate to the current situation in order to be of practical use. By bridging today's situation to a target architecture, it is natural to consider a number of migration steps. Each step is assumed some time ahead. This implies that each step should take the relevant systems closer to the target. But, what should the target look like? A scenario-based approach is intended to assist during these analyses.

One basic factor to examine is *where in the value chain most values are expected*. This reflects the discussion on potential shifts of power as illustrated in Figure 7. The architecture has to consider such potential cases. For example, this could be done by allowing for commodity solutions where all-standards are expected (no differentiation), and tailoring where fewer standards are expected (to allow for differentiation). For this argument it is believed that differentiation allows for higher value (and profit), which by itself should be further justified for the actual cases.

11.1 Elaborating Scenarios

Working with a horizon for a given number of years, it is natural to start by gaining insight into trends and key drivers for the evolution. However, quite a lot of optional solutions are expected. A set of evaluation criteria has to be defined enabling the selection of an appropriate migration towards a target architecture. To some extent, these criteria can be quantified,

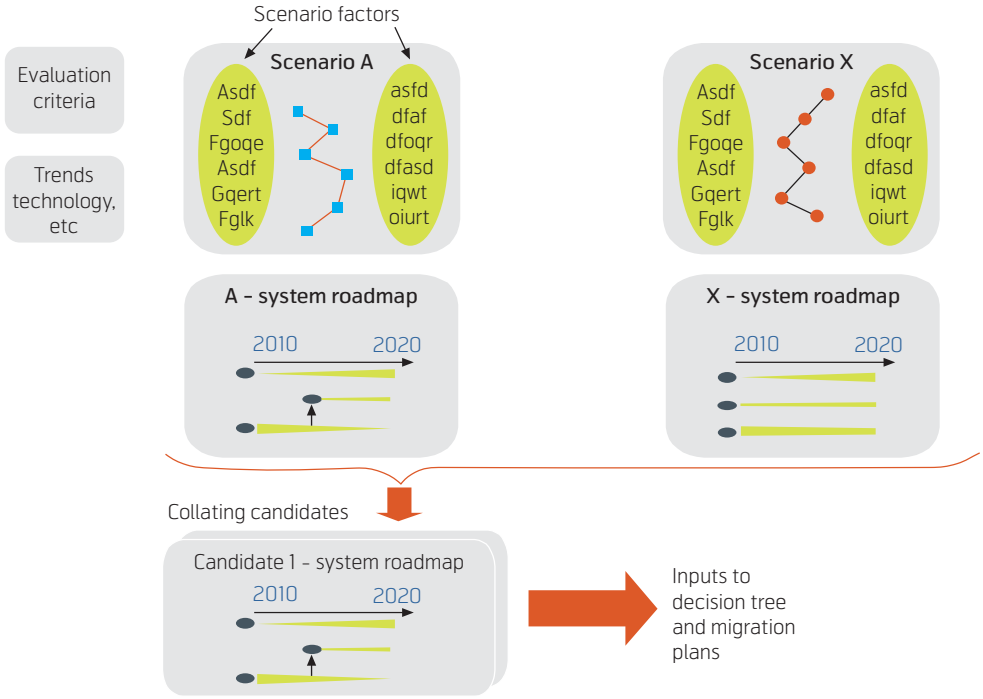

Figure 8 Overall approach followed for deriving candidates for system roadmaps and mapping of product categories (could be iterative)

although some qualitative assessments will also be necessary.

An overall objective of an actor is to even out the profit level, both on the short and long term. Bearing this in mind, the objectives of the strategic evaluations are to:

- Describe a target architecture;
- Identify smart timing of new investments and migration of existing systems;
- Establish a basis for decisions on investment and operational aspects to keep a low cost level:
  - Obtain lower overall investment levels, balanced between different system areas with corresponding timing (eg. access/transport/service networks, support systems);
  - Ensure complete solutions; consider running costs as well as investments;
- Ensure that a leading position is maintained for relevant segments by introducing innovative solutions adapted to the market requests.

The priority placed on the different initiatives has to be future-proof, meaning that the steps taken have to fit into a longer-term 'journey' approaching the target architecture.

It should be kept in mind that an approach based on scenario is commonly considered as subjective. Hence, several of the steps and choices made may not be uniquely inferred from the previous steps. Still, the scenario approach can be applied to capture the possible future in order to identify the choices that one should prepare for.

An overall illustration of an approach is given in Figure 8. As shown, the goal is to arrive at *system roadmaps*. Here the roadmap shows how the systems in the portfolio should be developed in the time period considered. Hence, for each scenario, a roadmap is derived. Deriving the roadmaps, the evaluation criteria and technology time lines have to be taken into account.

Using the sample of roadmaps corresponding to each scenario, the roadmaps are revisited to find the main candidates. A fewer set of candidates are seen than there are scenarios. Hence, these candidates form the basis for elaborating *a decision tree and the migration plans*.

In deriving a set of scenarios, one will face the trade-off between finding as few scenarios as possible while covering the complete feasibility space. Here, the feasibility space refers to all possible situations which may arise in the future. Naturally, a rather limited number of situations have to be selected in order to define a tractable task. Still, these situations should include most of the foreseeable challenges.

ISSN 0085-7130 ©Telenor ASA 2009

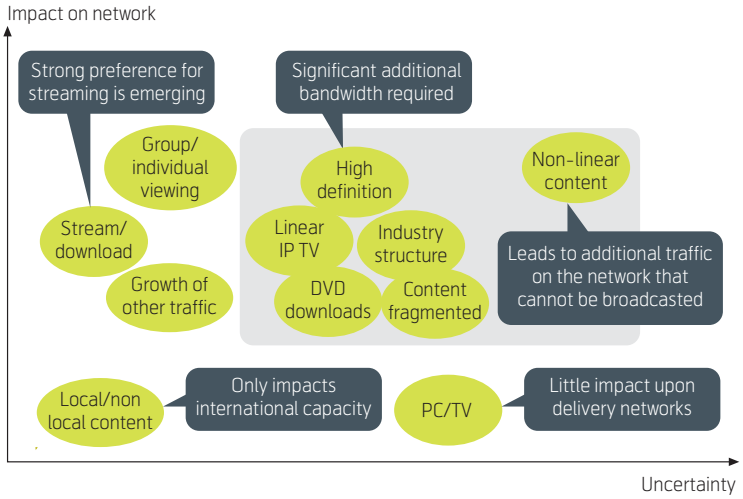

Figure 9 Illustration of topics included in a traffic demand scenario related to delivery of high-quality video services online (from [Anal08])

Deriving an adequate set of scenarios may be seen as an art as several subjectively determined conditions have to be included. However, during iterations, more insight is gained for each round. The overall learning will also be utilized for following scenario activities.

In order to describe a scenario, a number of scenario factors have to be defined. These factors will also to some extent assist when exploring whether or not the set of scenarios cover the feasibility space.

A high level of subjective judgement is involved when expressing the scenarios by the scenario factors. A brief scenario description would then contain:

- List of key characteristics;
- Short story of what happened/is happening;
- Short description of provider's situation;
- Categorization of the scenario according to the scenario factors.

Even though one would start with a set of scenarios and carry on by deriving roadmaps, it is likely that the scenarios would be adjusted based on the lessons learned. Hence, a few iterations might take place until the scenarios seem to address the most likely and central issues. An alternative would be to derive the scenarios from the scenario factors. Although these factors may not be independent, quite a few combinations will appear, leading to an intractable number of scenarios. On the other hand, these could still be used as a starting point for identifying the scenarios.

When devising the roadmaps, information from the expected trends/time lines as well as criteria are used. For example, the technology trends express views on when certain functions will be available including statements on when the solutions will be applied.

These inputs compose a natural starting point for describing the migration. When considering the scenario characteristics, issues from the technology time lines can be selected accordingly.

For each of the scenarios, a potential roadmap (and product mapping) has to be derived. A 'reverse processing' could then be applied; meaning that the resulting roadmaps are put together. Given that these have the same starting point, they will differ by taking certain (different) steps at certain instances of time. In principle, this can be thought of as a decision tree; facing an instance when two scenarios differ expresses that a decision has to be made. The decisions may also be more related to certain events and less strictly to time instances.

To speed up this process, it may be more efficient to start by raising the main questions relating to migration; that is, devising these questions and then adapt the scenarios correspondingly. One example is shown in Figure 9, where the question is to what extent high-quality video will be present. It would then be necessary to see what services, user behaviour and impacts could be involved.

The scenario factors express the uncertainty attached to a future evolution. Hence, assigning values/grades to a factor 'fixes' how that aspect evolves. The factors selected have been formulated as questions; like *A* versus *B*, where *A* and *B* are 'opposite' choices on a scale. It is also implied that the scenario description refers to the 'environment' as observed by the provider. This is related to the different perspectives as described in Chapter 3.

In some of the cases the different factors may not be orthogonal (or independent). In those cases, further work might be done to revise the set of factors based on the knowledge gained and the results one wants to look more closely into. However, the scenarios themselves are not considered to be the main results. Rather, these results are the potential and possibly recommended roadmap and argue for the proper target architecture.

11.2 Relating Scenarios to System Roadmaps

The overall process depicted in Figure 10 shows how a roadmap could be elaborated for today's system areas. The main objective, however, is to *decide upon the first step(s)*. A number of general phases can be identified:

i) The *'scope' of the task* is described by the elements: a) Current portfolio, b) Forecasts and trends, c) Set of (optional) target states. Naturally,

these are interrelated as a potential target state is influenced by where one is in the existing situation and the scenario for a further development. That is, a scenario-based approach will likely apply for this step. Included in the current portfolio is also an assessment of short-term development, eg. given through a 'historic' description in the traffic/user development in a system.

ii) The *'gap' between the current situation and the target architecture* is explained with a set of possible paths. That is, a path will tell a story of how the current portfolio will migrate in order to reach a target state. During a migration, a number of decisions have to be made and solutions implemented. A decision is indicated by a diamond in Figure 10. For each decision other choices could in principle have been made, possibly resulting in branches to the path. A decision point should be estimated in time (ie. when should the decision be made), in addition the relevant question has to be described as well as consequences of each of the relevant outcomes of the choices made (consequences in terms of technical, economic, product, etc. issues).

iii) Considering the set of optional (migration) paths and set of decision points, a *decision map can be drawn*. This contains the set of candidate paths than can be followed towards the target. Commonly, quite a few of the theoretical paths are not likely for practical reasons, including financial measures. Hence, a number of real candidates can be described, of which fewer can possibly be recommended migration tracks. These candidates may further be compared according to measures agreed upon, such as net present value, internal rate of return, financial needs, etc.

iv) Looking at the candidate tracks, a number of *risk factors can be attached to each track* – describing technical, business-related, strategic, regulatory,

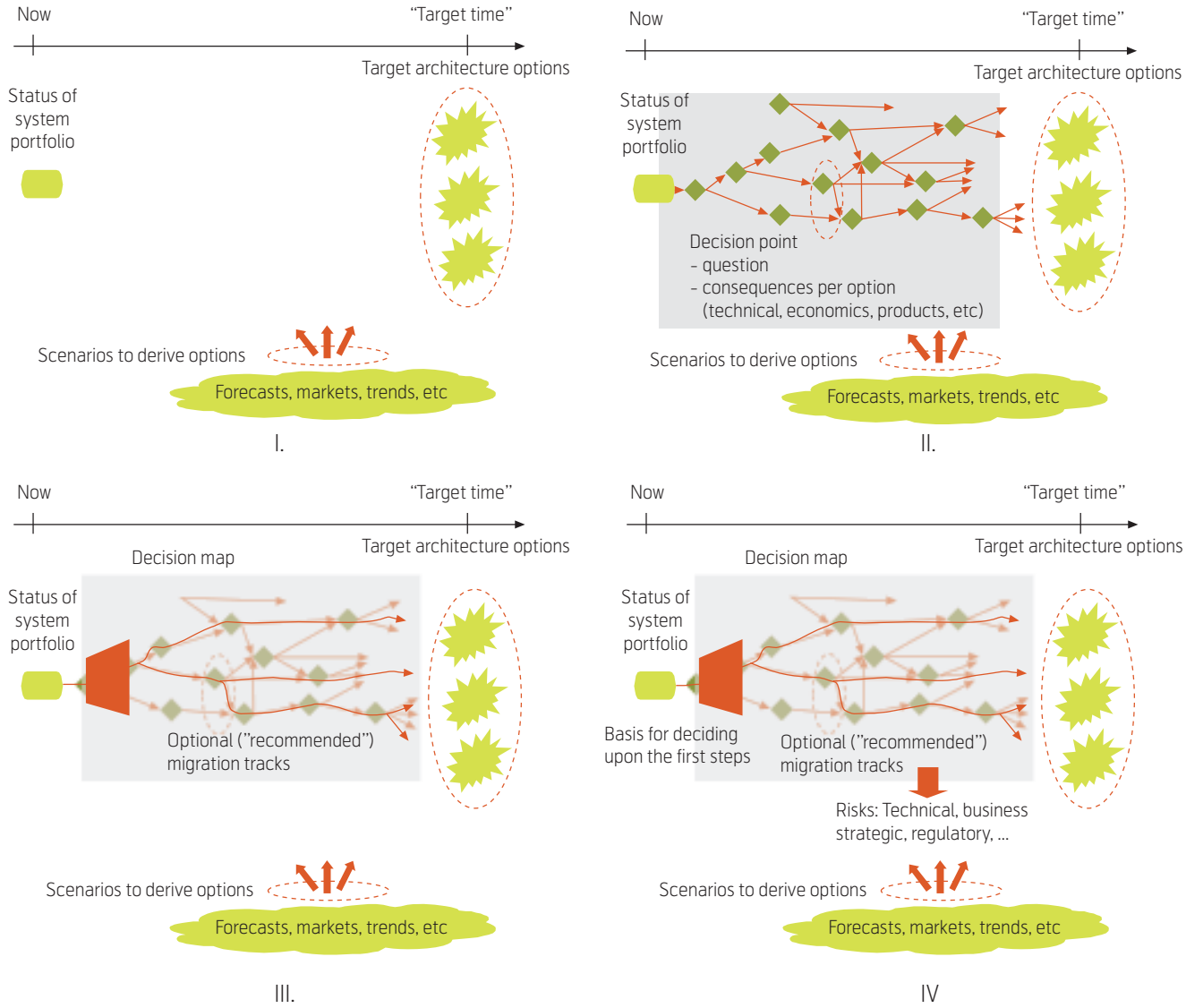

Figure 10 Illustration of step-wise approach using the target options for deriving recommended next steps for today's networks

ISSN 0085-7130 ©Telenor ASA 2009

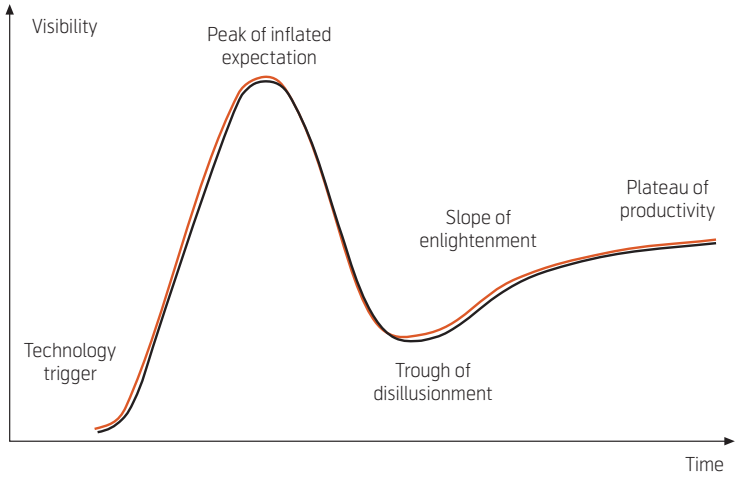

Figure 11 Gartner Group's Hype Cycle

etc risk phenomena. As described later, these risk factors can be described qualitatively or included in a quantitative way. So, by carrying out this exercise it is essential to relate the observations made to how to make the first step for the current portfolio. That is, the results are used when making the choice of how to proceed with today's systems. It is also important that the information is revisited and revised as needed on a regular basis; including the target options, the decision map and the risk evaluations.

To conduct the evaluation in a systematic manner it is essential to have a *reference architecture* in place. This is to ensure that *equal-for-equal options are compared*. Otherwise, it could be that different solutions are actually compared. This may often result in quite tedious discussions.

As part of the roadmaps, maturity of solutions becomes an issue. To assist in this evaluation the so-called Hype Cycle of Gartner Group could be applied. This is frequently used to indicate trends and shows how different phenomena could appear, see Figure 11. Some refer to this as elaborating on communities' beliefs and disbeliefs on trends. Often, there would be a degree of over-enthusiasms in the initial phases as steadily more persons adopt key phrases, perhaps without fully being aware of all practicalities. As things take time, impatience will lead to a drastic decrease of support. For a successful solution, this phase will carry over to insight into how it can practically be utilised. There will likely also be several market reports on deployment.

On the principle view, two phases of over-reactions could be identified; i) the over-expectation, and ii) the disappointment. Both are typical phenomena when a crowd of people have to form an opinion as there are some delays and steps between the leading opinion makers and the major groups.

12 Concluding Remarks

This paper elaborates on relations between a number of business aspects and the technical architecture. There are strong links between the business role(s) one pursuits and the architecture to apply.

During the evaluation of target technical architectures, different options are examined in view of the expected requirements. To ensure that the different options are compared fairly, a reference architecture is needed. The target architecture then provides guidelines regarding the population of the reference architecture. That is, it recommends which systems should be present and how these should be related.

The paper is by no means exhaustive on these topics.

References

[Anal08] Analysys Mason. *Delivering high-quality video services online*. Final report for Ofcom. 10 November 2008.

[Huaw08a] Feifei, W. Turn left or right – mergers and acquisitions : a strategy crossroads is reached. *Huawei Technologies Communicate*, 37, 31-34, Jan. 2008.

[Huaw08b] Junting, Z, Liuqui, Z. Smooth channels for mobile operations. *Huawei Technologies Communicate*, 37, 45-48, Jan. 2008.

For a presentation of Terje Jensen, please turn to page 3.