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**21st European Regional ITS Conference
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Hannu Enqvist, Thomas Casey

**Mobile Communications Industry Scenarios and
Strategic Implications for Network Equipment Vendors**

Mobile infrastructure markets have changed dramatically during the past years. The industry is experiencing a shift from traditional large-scale, hardware-driven system roll-outs to software and services –driven business models. Also, the telecommunications and internet worlds are colliding in both mobile infrastructure and services domains requiring established network equipment vendors and mobile operators to transform and adapt to the new business environment. This paper utilizes Schoemaker’s scenario planning process to reveal critical uncertain elements shaping the future of the industry. Four possible scenarios representing different value systems between industry’s key stakeholders are created. After this, five strategic options with differing risk and cost factors for established network equipment vendors are discussed in order to aid firm’s strategic planning process.

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1 Introduction

Telecommunications infrastructure markets have changed dramatically during the past years. Many direct and indirect factors are contributing to the dynamics of the market, including regulatory, business, technological and social forces. At the moment some of the most frequently discussed topics around mobile operators and their infrastructure vendors are outsourcing of business processes, the convergence of telecom and internet worlds, and the migration from traditional circuit-switched networks towards all-IP network environments and IP-based communications. The rapidly changing business environment is impacting intensively established network equipment vendors such as Nokia Siemens Networks and Ericsson who are facing potential threats and opportunities from many directions.

During the last decade the differentiating functionality of communications networks has shifted mostly to software components making hardware more or less a standardized platform and a shift from traditional large-scale, hardware-driven system roll-outs to software and services –driven business models is ongoing¹. The decreased overall network equipment market and increasing hardware price erosion have revealed the commoditized nature of pure equipment sales. Today's network equipment vendors acknowledge that the software and services business models offer far more attractive margins, differentiation leverage and competitive advantage.

At the same time increasing cost pressures due to substantial traffic growth and stagnant revenues force mobile operators to outsource non-core competence processes and operations such as consultation and systems integration, network planning and optimization, testing, operations-administration-maintenance, and hosting of applications and services to vendor partners. A recent study² indicates that reducing costs is one of the key targets of major mobile network operators at present. Furthermore, the professional service business is one of the few growth opportunities for many established infrastructure vendors making outsourcing through managed services one of the main drivers in today's mobile infrastructure industry.

Furthermore, the telecommunications and internet ecosystems are colliding on many levels. Substantial changes are being realized in both network and service domains of mobile communications industry. In the network domain mobile operators are modernizing their networks to IP-based solutions to cope with increasing operational expenditures and minimize the costs per megabyte. Increasingly more generic network elements and management systems have capabilities to provide the underlying networking infrastructure. Currently, most of the traffic in mobile operators' core and backhaul networks are carried over IP, and in next generation mobile and wireless technologies the air interface is expected to be mostly based on IP as well. Although the majority of mobile operators seem to be converging behind 3GPP LTE³, new local and metropolitan area operators are emerging that provide wireless access for end-users with internet based access technologies such as IEEE 802.11 based WLAN and IEEE 802.16 based WiMAX. These aspects decrease the barriers of IT and computer networking-oriented vendors, such as IBM and Cisco, to enter the telecom-specific infrastructure markets. It remains to be seen how long established network equipment vendors will maintain the role of primary suppliers of mobile infrastructure with strict carrier-grade requirements.

¹ Li and Whalley (2002), for example, have discussed the changing value creation logics in the industry.

² "Business needs study 2009: CSPs sharpen focus on customer satisfaction", Research by Nokia Siemens Networks, December 2009.

³ Announcements made by a number of largest operators such as Vodafone, China Mobile and Verizon Wireless to test LTE networks in 2009 (Vodafone, 2009), and by the major U.S. based operator AT&T to launch a commercial LTE network in 2011 (Ericsson, 2010) increase the LTE's domination globally.

Radical changes are occurring in the mobile applications and service domain as well. It is yet uncertain how traditional mobile operators will position themselves in the future mobile services ecosystem as major internet service providers, such as Google and Amazon, are challenging operators with disruptive service offerings. The internet service providers are providing holistic service mixtures based on communications over IP at the expense of mobile operators providing their customers with flat-rate data plans.

With this dynamic environment in mind, the goal of this paper is to improve the understanding of possible directions of industry evolution by constructing bounding future mobile communications industry scenarios for established network equipment vendors within the next five years. Another main purpose of the paper is to introduce and analyze strategic approaches for established network equipment vendors based on constructed scenarios. The research question of this paper is as follows:

1. What are the different possible value configurations between mobile operators and established network equipment vendors in the future (until 2015) and
2. What different strategic options exist for established network equipment vendors to best cope with them?

The structure of the paper is as follows. In Section 2 the research methods utilized in the paper are introduced. Section 3 covers the scenario construction process. In Section 4 we will formulate and discuss different strategic approaches for established network equipment vendors. Finally, in Section 5 we draw conclusions.

2 Methodology

In this section the research methods and theoretical frameworks utilized in the paper are presented briefly. The primary research method is the Schoemaker's version of scenario planning process (Schoemaker, 2000). Along with the Schoemaker's scenario planning process some complementary methods and theoretical frameworks are also utilized. This section also introduces these complementary methods and discusses how they relate to the scenario planning process during the study.

Essentially, scenario planning is a method for preparing for the future and it is mainly used as a strategic planning tool by organizations and institutions. Today there exist many variants of scenario planning and they all stem from the late 1960s and early 1970s when Royal Dutch/Shell developed a technique called 'Scenario planning' (Wack, 1985) to prepare for the 1973 oil crisis. As an ideal tool to study a rapidly evolving technology industry with many uncertain elements involved, we decided to choose the scenario planning process as the primary research method.

The structure of the analysis is based on Schoemaker's scenario planning process presented in (Table 1). The process begins with the definition of the chosen time-frame, scope and key stakeholders that have an interest in the related issues. Slightly diverting from the Schoemaker's process, between steps 2 and 3 the current industry structure around the established network equipment vendors is described utilizing a five-force framework by Michael Porter (Porter, 1980). During steps from 3 to 5 the market forces that may have an impact on the industry and stakeholders chosen are gathered and analyzed. Here, a PEST framework is utilized to categorize the gathered forces in four categories - political, economical, sociological and technological forces.

After this, the identified forces are assessed in terms of importance and uncertainty to find out the most important trends and uncertainties. A series of expert interviews was conducted in order to receive input for the assessment. In steps 6 and 7 two of the most important and uncertain forces are selected as key uncertainties. These key uncertainties are then used to form a matrix of four bounding scenarios. Elements of industry trends and other important uncertainties are then added to resulted scenarios in order to better describe and analyze the scenarios that describe possible value systems between stakeholders involved in mobile industry.

Table 1: The ten steps of Schoemaker's scenario planning process.

#	Step
1	Define the issues you wish to understand better in terms of time frame, scope, and decision variables.
2	Identify the major stakeholders or actors who would have an interest in these issues, and their current roles, interests, and power positions.
3	Identify and study the main forces that are shaping the future within the scope, covering the social, technological, economic, environmental, and political domains.
4	Identify trends or predetermined elements that will affect the issues of interest from the list of main forces.
5	Identify key uncertainties (forces deemed important whose outcomes are not very predictable) from the list of main forces. Examine how they interrelate.
6	Select the two most important key uncertainties, and cross their outcomes in a matrix. Add suitable outcomes from other key uncertainties, as well as trends and predetermined elements to all scenarios.
7	Assess the internal consistency and plausibility of the initial scenarios, revise.
8	Assess how the key stakeholders might behave in the revised scenarios.
9	See if certain interactions can be formalized in a quantitative model.
10	Reassess the uncertainty ranges of the main variables of interest, and express more quantitatively how each variable looks under different scenarios.

Strategic analysis is generally considered to be a natural extension to a scenario planning process. Similarly, in this paper the scenarios are accompanied with a strategy discussion. During step 8 the possible behavior of the chosen key stakeholder group is assessed. In the paper this step concentrates on discussing strategic implications for established network equipment vendors based on Michael Porter's (Porter, 1985) strategy frameworks under industry uncertainty. Porter introduces five basic approaches to prepare a strategy when industry development involves uncertain elements. The basic approaches are discussed more in detail in Section 4. Additionally, a few expert interviews were conducted in order to get feedback on scenario probabilities and feasibilities for operators and established network equipment vendors.

The last two steps of the Schoemaker's process involve quantitative analysis which is left out from the scope of the paper.

3 Scenario construction

In this Section a set of scenarios are constructed following the steps from 1 to 7 of the Schoemaker's scenario planning process introduced in the previous section. The process begins with a discussion of the current structure of mobile infrastructure industry. After that market forces impacting the business ecosystem are gathered and categorized according to the PEST model. Then, the importance and uncertainty of the forces are assessed utilizing data from a series of open interviews

with industry experts. Finally, possible future scenarios representing different value configurations of mobile communications industry are constructed based on key industry uncertainties.

3.1 Industry structure today

The key stakeholders involved in scenarios are selected to be the telecom vendors representing the established network equipment vendors, mobile network operators (MNO), wireless internet access providers (WIAP), service providers, end-users, platform vendors and IP-networking vendors. MNOs are traditional mobile network operators operating mobile infrastructure while WIAPs are wireless internet access providers operating more internet-based technology infrastructure such as Wi-Fi and WiMAX. Service providers are stakeholders providing end-users with content and services. Platform vendors are major IT-oriented organizations benefitting from substantial economies of scale advantages. They provide generic, cross-industrial hardware and software platform solutions. IP-networking vendors provide their customers (usually enterprises and institutions) with equipment, such as routers, switches and network management systems, software and services related to IP-based communication networks. The mobile communications value system, key stakeholders involved and their relationships are presented in Figure 1.

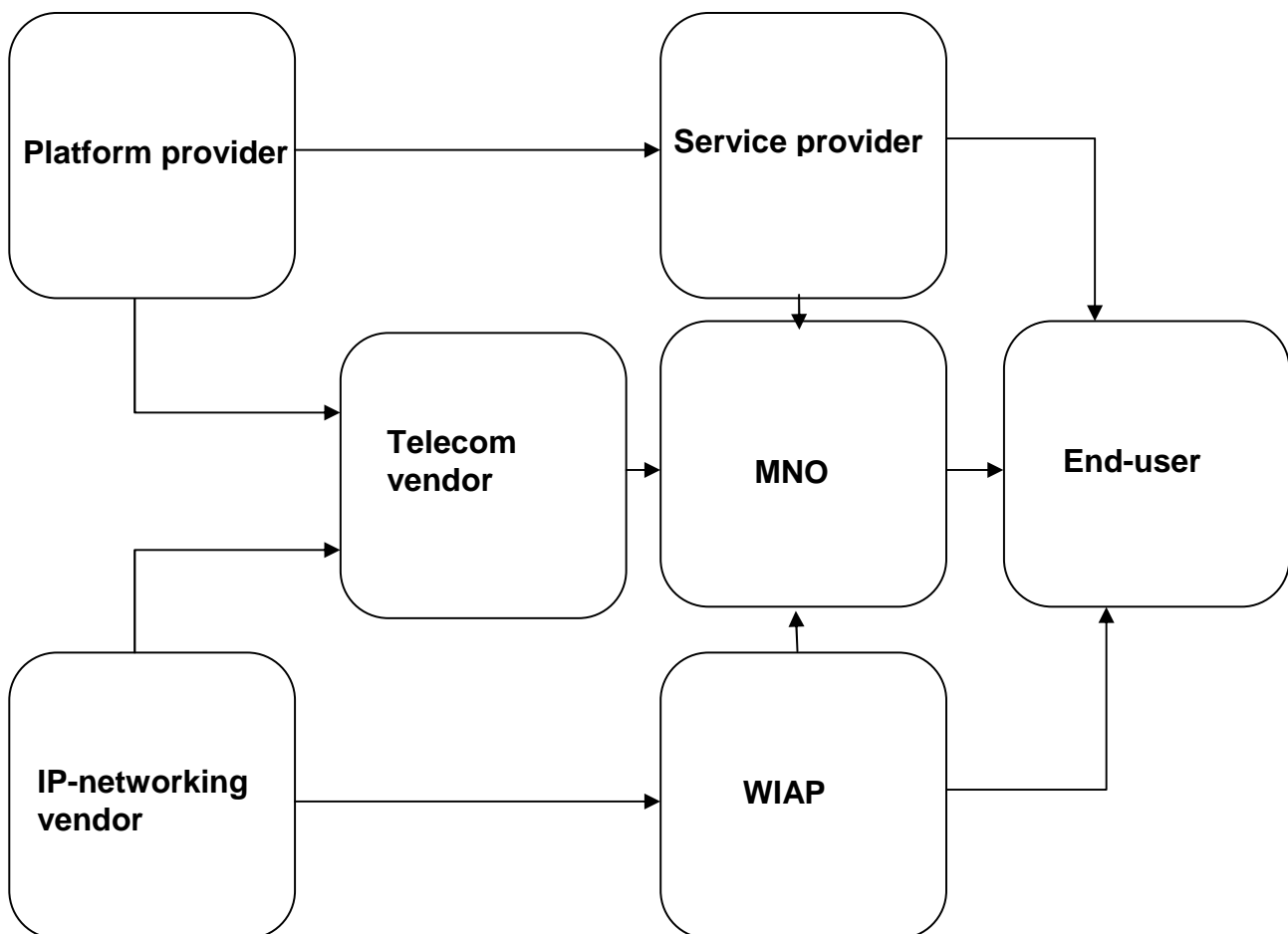


Figure 1: Mobile communications industry value system and key stakeholder groups.

The current industry structure and power positions of actors are described below utilizing the framework of Porter's five competitive forces. Figure 2 illustrates the main determinants of each force impacting the mobile infrastructure industry.

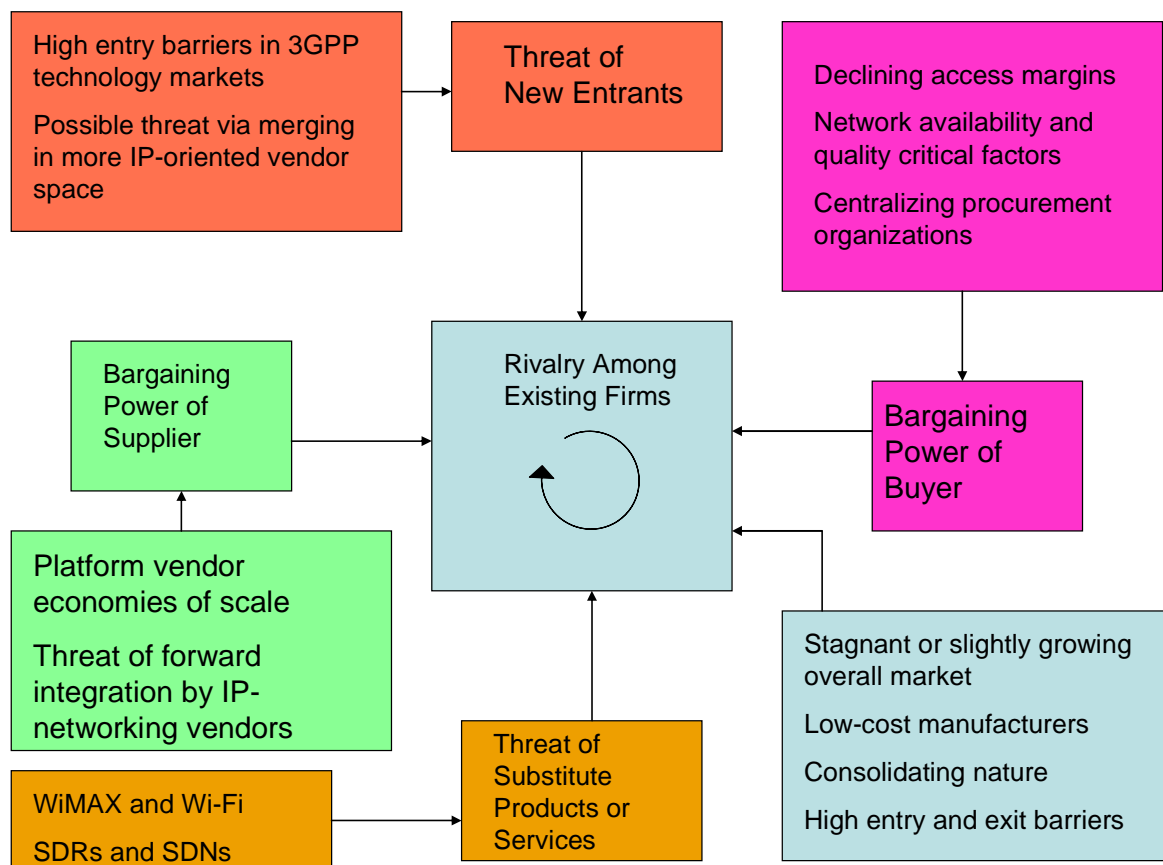


Figure 2: Five competitive forces impacting the current telecom equipment industry structure.

Bargaining power of buyers

In today's mobile infrastructure market the use of bargaining power of buyers (mainly MNOs) to lower equipment prices is not a chosen option, but rather a sanction driven by buyers' decreasing profits. The growing wireless data traffic, declining voice revenues and diffusion of mobile data flat-rate pricing are some of the main factors behind the general telecommunications equipment price erosion⁴. One of the main factors decreasing the bargaining power of buyers is the strict requirements for carrier grade networks. Operators are willing to pay for solutions offering good network availability and service quality as they remain to be critical factors for operators. Operators still hold a strong position as network equipment buyers and thus possess strong bargaining power due to large and valuable purchase volumes. Furthermore, the market is experiencing a trend that operators are concentrating their procurement organizations leveraging their bargaining power by choosing suppliers in a more centralized and professional manner being able to bargain the prices to the lowest possible levels.

Rivalry among existing firms

Large mergers of Alcatel and Lucent, and Nokia networks and Siemens communications have indicated the fierce competition and consolidating nature of mobile infrastructure market during the past years as operators have been decreasing their capital investments. Also, the filing of

⁴ As one of the main challenges faced by mobile operators in developed markets Mölleryd et al. (2009) introduce the *revenue gap* arguing that mobile data may generate 80% of the traffic while only contributing with 2% to the revenues.

bankruptcy by Nortel Networks in January 2009 indicates declining overall market and its profitability. Furthermore, great disturbance to industry structure and intensive competition is brought by low cost vendors from China. Few years ago Chinese telecom vendors mainly supplied operators in their own and neighboring countries but today the global presence of these vendors is acknowledged by the entire industry.

Threat of new entrants

Entry barriers for entering the mobile infrastructure industry are rather high as the established vendors have strong experience of mobile network technologies and complex, multi-vendor environments. Adding to this the long relationships with major incumbent operators and the present managed services contracts, it is very difficult for new entrants to gain market share. However, established network equipment vendor mergers and joint ventures with more IP-oriented vendors bring new players into the existing market.

Bargaining power of supplier

Major IT and software platform vendors usually serve many companies in multiple industries reducing the meaning of a single industry's buyers thus increasing the bargaining power of the supplier. On the other hand, small and medium sized suppliers may be heavily dependent on few large buyers contributing large proportion of supplier's revenues. However, as networks are turning to all-IP, IP and data-networking oriented vendors' opportunity to supply operators directly is increasing.

Threat of substitute products or services

MNOs and other operators may have to explore new ways other than traditional macro 3GPP technologies to support the traffic explosion, especially in densely populated areas and indoor locations. IEEE technologies such as WiMAX and Wi-Fi offer solutions to enhance macro cell coverage and capacity. Vendors such as Cisco and Motorola promoting these technologies could become a serious threat for the existing major telecom vendors currently holding strong positions in the market. MNOs and established network equipment vendors should also remember that the majority of enterprises and consumers utilize WLAN technologies and to some degree VoIP solutions for communications. Adding to this the fact that the majority of wireless traffic is generated in indoor locations⁵, the current substituting technologies with no real mobility support (e.g. WLAN) are already able to provide a variety of services to end-users. Considering the service and technology providers of these solutions (internet service providers, IP infrastructure operators and IP-networking vendors) it can be seen that there is an increasing threat of substitution to some parts of the traditional basic telecom services value chain. Additionally, the shift from hardware to software in terms of profitability and differentiation supports the development of software defined radios (SRD) and even networks (SDN) which may accelerate the substitution.

⁵ For example, Smura and Sorri (2009) state that the majority of wireless data and thus revenues will be generated in indoor locations.

3.2 Key trends and uncertainties

The next step is to study key forces impacting industry evolution. The gathering and assessment of these forces included literature study and industry expert interviews. Literature study consisted of various company publications, press releases, industry white papers and academic articles. Industry news from different portals and channels were also followed during the research and information cross-checked for better consistency of the present industry status and forces driving the change. After initial market forces were gathered data from expert interviews were utilized to stress the validity and relevance of the forces. The most relevant industry forces are discussed below according to PEST categorization beginning with political/regulatory forces and concluding with technological forces. The discussed forces are listed in Table 2. More detailed discussion of the forces and their selection process is presented in Enqvist (2010).

Table 2: Final trends and uncertainties.

Trends	Uncertainties
<ul style="list-style-type: none"> • Mobile data traffic growth (Soc) • Capacity upgrades in RAN (more APs and BSs) and backhaul (Ethernet or MPLS over microwave or fiber) (Tech) • Coverage upgrades in developed (LTE/WiMAX migration) and emerging markets (3G coverage) (Tech) • Spectrum re-farming, e.g. UMTS900 (Reg/Tech) • More licensed spectrum released by regulators (Reg) • Applications drive the entire mobile communications industry (Soc) • Increasing adoption of cloud services (Tech/Econ) • M2M communications increases (Soc/Tech) 	<ul style="list-style-type: none"> • U1: Industry structure: Horizontal (access & services separated) vs. vertical (access & services tied together) (Econ) • U2: Mobile broadband access characteristics: Integrated vs. Fragmented access (Tech/Pol) • U3: Telecom and Web convergence: value of operator assets and substitution power of IP-based communications (Econ/Tech) • U4: LTE/WiMAX deployments: mass deployment time-scale and specification distribution (Tech/Econ) • U5: Active network infrastructure sharing: operator willingness (Econ/Reg) • U6: managed services market: operator interest to outsource (Econ) • U7: Telecom software markets: which players dominate the software markets (Tech/Econ)

Political and regulatory forces (Pol/Reg)

Political and regulatory industry forces are mostly related to the radio spectrum regulations and allocations that impact the operator business and technological evolution of communications networks, but also other important areas such as network sharing and spectrum re-farming policies and regulations. Frequently mentioned industry topic is spectrum re-farming to update older technology on a specific frequency band. Many operators are replacing 2G technology with 3G and nowadays even “pre-4G” technologies in order to increase capacity and coverage while decreasing costs. Additionally, network sharing is an increasing industry trend in the market driven by the operators’ increasing need to concentrate on the quality of user experience (QoE) and decrease both OPEX and CAPEX. While passive network sharing (sharing of physical elements such as antennas, masts, feeders, real estate sites, shelters and cabinets) is allowed and adopted by many operators

widely, active network sharing (sharing of active components such as radio base stations, allocated frequency spectrum and transmission systems) restrictions are still applied in variety of ways and differing from each other nationally. Furthermore, regulators and governments are under a growing pressure to release more licensed spectrum for next generation networks in order to accommodate the wireless traffic growth. It is yet uncertain how governments will tackle the spectrum shortage if wireless traffic continues its exponential growth.

Economical and business forces (Econ)

In today's industry operators are considering utilization of their network assets more efficiently. One of the key assets is the operator owned subscriber data (U3). This data consisting of subscriber profile, location, services being used, preferences, and state of billing (e.g. prepaid, charging level, etc.) may become important as operators are searching for new revenue streams. Combining this data with network management information more targeted and customer centric services can be provided to end-users. This trend is expected to accelerate the real-time subscriber data management (SDM) and billing platform and applications market. Furthermore, operators can leverage their assets by partnering with third parties and sharing these valuable assets which may open many opportunities in business areas such as application stores, mobile advertising and mobile banking. These factors have a substantial influence on the future MNO positioning in the mobile service ecosystem. It remains to be seen whether the industry evolves to more vertical or horizontal direction in terms of mobile services and access bundling⁶, and which industry stakeholders dominate the mobile services market (U1).

The traditional roles within the mobile industry, such as mobile network operations and service provisioning, and their borders are changing. One of the biggest industry trends is the operations, administration and maintenance outsourcing by operators to vendor partners. The main reasons for these managed services contracts for operators are to reduce operational expenditures and to concentrate on core business. The professional service business is a great win-win opportunity for both operators and their vendors as services market is one of the few opportunities for mobile infrastructure vendors to increase profitability in flat or slow-growth markets. However, operators may have to balance between the degree of control over their assets and cost pressures when considering outsourcing (U6) and network infrastructure sharing (U5).

Sociological forces (Soc)

Today's entire mobile service industry is driven by mobile applications. One of the major industry topics are the application stores spear-headed by Apple's App store, which was reported to have over 3 billion mobile application downloads in only 18 months⁷. The increasing use of smartphones, PDA's, e-readers and laptops with USB dongles that create, transfer and utilize bandwidth-hungry applications and services is one of the main contributors to the exponential wireless traffic growth. Also, frequently discussed topic in the industry is the growing trend of machine-to-machine (M2M) communications bringing new opportunities for operators and also infrastructure vendors in terms of new revenue streams. It will be interesting to see which stakeholders and how the mobile applications business is turned profitable as the majority of mobile applications downloaded today are free of charge or generate only a small portion of total revenues. At least one of the key factors of competitive edge that operators possess is the role of being end-

⁶ Smura and Sorri (2009) found the verticality of industry structure to be one of the most critical uncertainties in the industry.

⁷ "Apple's App Store Downloads Top Three Billion", Apple press release, January 5th 2010

users' trusted voice and messaging providers for many years which can be utilized in the growing application and content driven mobile services industry.

Technological forces (Tech)

From the technology point of view many operators, especially in the developed markets, are migrating towards all-IP networks. The main drivers behind the migration are the ever increasing operational costs due to the wireless traffic growth and the need for more network capacity and coverage. The major trends in the industry are the flat network architecture upgrades in RAN with HSPA+ and LTE technologies in 3GPP networks and mobile WiMAX deployments in IEEE-based networks, mobile backhaul upgrades from TDM to Ethernet, and the centralization of network management. Although many industry signs suggest that 3GPP's LTE will be the dominant "pre-4G" mobile technology there are industry stakeholders, such as Clearwire and WiMAX Forum promoting WiMAX technologies intensively (U4). It is yet to be seen how the defendants WiMAX and Wi-Fi bear up against the dominant LTE and whether mobile broadband access will evolve towards an integrated landscape with only few competing operators and one dominant technology family (3GPP) or towards a fragmented landscape with many competing operators and substituting technologies (U2)⁸.

The OPEX and CAPEX reduction need is promoting operators to leverage the value of their existing sites. Today's operators, especially in developed markets, already own a lot of network infrastructure and the adverse results of expensive spectrum license and infrastructure investments in 3G technology have made them more careful and price-sensitive when it comes to technology investments. This trend drives the development of flexible systems where functionality can be added in a modular way. Software defined radios (SDR), self-organizing networks (SON) and the increasing adoption of IP-based solutions promotes the software and services -business in the industry while decreasing the barriers of more IT and IP-oriented equipment and software vendors entering the telecom-specific market. At present the telecom-specificity of telecom software solutions - especially in mobile infrastructure and infrastructure management solutions - still remains rather high. However, due to the increased horizontalization of software market in telecom industry vendors have increased opportunity to sell the same system for many customers, across technologies and industries (Luoma et al, 2008). This development indicates that there may be a possibility in the future for more IT oriented vendors with economies of scale advantages to become direct suppliers of software solutions for MNO's and WIAP's (U7). Furthermore, one of the biggest hypes in the industry is the cloud services phenomenon where customers are offered computing power and storage as a service. At the moment operators are exploring the possible benefits of cloud services and it remains to be seen whether the established network equipment vendors are able to challenge the IT vendors and internet service providers currently dominating the market.

3.3 Scenarios

In this section four bounding industry scenarios are formed by crossing the two most critical industry uncertainties. The two most critical uncertainties were selected to be the industry structure (U1) describing two extremes: the provision of access and services in a bundled package (vertical) or the provision of access and services separately by different players (horizontal). The other key uncertainty was chosen to represent the degree of fragmentation of mobile broadband access for

⁸ Smura and Sorri (2009) have initially acknowledged the degree of access fragmentation being one of the most important uncertain factors in the industry.

both wide and local area access (U2) in terms of the amount of operators and technologies. By selecting these scenario dimensions the scenarios partly correspond to the work of Smura and Sorri (2009) who reached similar results regarding the possible industry structure and technical architecture around wireless local area access provisioning.

The formed bounding scenarios present different value systems between key industry stakeholder groups. After the critical uncertainties were chosen other industry uncertainties were weighed utilizing a five-point scale in each of the four scenarios. Figure 3 (appendix A) presents the uncertainty weights in each scenario. After this the data of weighed uncertainties and final industry trends were added to the scenarios as an input. Figure 4 presents the four scenarios, their descriptive names and some key characteristics in terms of overall feasibility for different stakeholder groups⁹¹⁰. Figure 5 presents the scenario value systems¹¹.

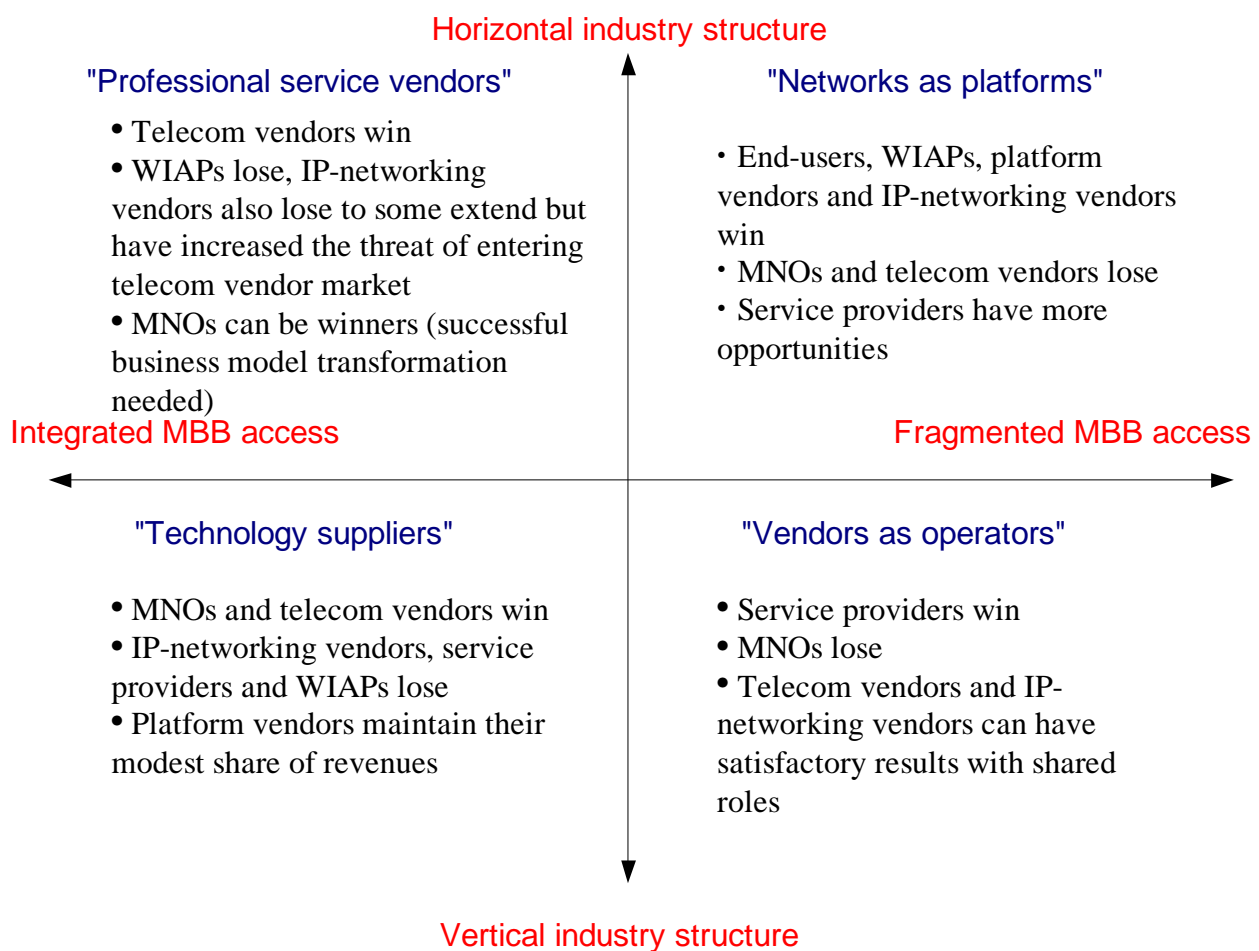


Figure 4: Scenario matrix.

⁹ It should be highlighted that the scenarios are meant to bound the future and that reality is likely to be a combination of them.

¹⁰ The scenarios reflect also the work of Charles Fine (2000) who argued that the structure of an industry typically circulates around a double helix cycle - that is between a vertical and horizontal industry structure and integrated and modularized technical architecture. The four scenarios can be seen as representing different possible phases of a full cycle of a reconfiguring mobile communications industry.

¹¹ Figure 5 utilizes a theoretical framework for examining business models in terms of shifts in power between a set of abstracted entities of roles and actors (Ballon, 2007).

A. Technology suppliers

In the first scenario MNOs have increased their power position significantly and are utilizing walled garden -type business models where end-users are able to purchase the connectivity and all the needed content and services in a bundled package from a few dominant operators. MNOs have been successful in leveraging the subscriber data they own by collaborating with selected development partners from media and internet worlds and creating innovative applications, content, services and business models. For example, operators are successfully implementing chargeable APIs to share subscriber data with third party developers and establishing their own application stores utilizing revenue sharing business models with development partners. Operators mainly create their own service portals relying on their own expertise in technology-wise and business-wise. Strong in-house mentality decreases vendor opportunities for managed services contracts.

The mobile broadband access provisioning is integrated to 3GPP specifications both technology and spectrum-wise. Only few incumbent operators hold the license to use the spectrum to provide access. The network technology (hardware and software) and interfaces have remained closed in nature and highly telecom-specific benefitting the established mobile operators and their traditional infrastructure vendors. Operators value and are willing to pay rather high margins for tailored, highly specified infrastructure management and business management software provided mainly by established network equipment vendors. Entry barriers to infrastructure markets remain high keeping platform and IP-networking vendors in the sub supplier space of the value system.

B. Professional service vendors

In the second scenario mobile content, applications and services are mostly provided by different players than mobile broadband access. There have been some consolidation in the operator domain and only a few major fixed-mobile operators own spectrum licenses. These incumbent MNOs have become sole bit carriers who simply connect the end-users and value added services are provided separately by many “over-the-top” internet service providers.

MNOs’ main concern is to provide extremely fast, high-quality bit-pipe for end-users with minimal costs making it very difficult for new entrants to enter the “bit-pipe market” profitably. MNOs are doing everything they can to leverage their existing infrastructure and they rely on their legacy vendor partners to plan, optimize and modernize their networks. In this scenario the professional services market has grown substantially and thus offers a rather feasible environment for established network equipment vendors. Vendors and operators have a close co-operation with each other and vendors are considered to be operators’ services and consultant partners rather than simple technology suppliers.

C. Networks as platforms

In the third scenario the mobile infrastructure has become extremely commoditized, and mobile broadband access is considered to be utility just as running water and electricity are today. Wireless networks are seen as platforms on top of which the real business value is added and the interoperability between 3GPP and IEEE networks is flawless. Most of the mobile network element interfaces to network management systems are open and have been standardized. Entry barriers to the mobile infrastructure market have thus decreased making it possible for vendors outside the traditional telecom equipment industry to gain market share. This has benefitted platform vendors who are able to provide standardized platforms for many industry stakeholders with only slight modifications.

Traditional wide area operators utilizing 3GPP technologies have struggled to provide feasible capacity for the growing mobile broadband subscriber base. New entrants and disruptive technologies have emerged to serve the densely populated areas including metropolitan area and local area operators utilizing IEEE wireless access technologies. Institutions, enterprises, households and other venue owners utilize their existing Wi-Fi infrastructure to offer access for mobile users in many new locations by extending their infrastructure in collaboration with Wi-Fi communities, commercial aggregators and IP-networking vendors. Competence in IP data networking and management systems will give competitive edge to IP-oriented vendors, such as Cisco, when it comes to planning and deploying highly complex operations and management networks due to the growing number of new access points and base stations.

Traditional MNOs are struggling as the fierce competition in the access market has driven down access margins. MNOs are trying to transform their businesses in order to compete with new agile entrants who utilize new innovative and growth oriented business models. Established network equipment vendors are partnering strategically with MNOs in order to find new revenue streams. MNOs are outsourcing their non-core operations, such as network operations and maintenance, to vendor partners more willingly. The business ecosystem is extremely dynamic and both MNOs and their established vendors are experiencing declining profitability.

D. Vendors as operators

In the fourth scenario major internet service providers such as Google, Microsoft and Amazon have extended their power position over the mobile access market purchasing access from operators on a wholesale basis. These service providers offer end-users bundled service packages including mobile broadband access, services and devices. One good example is the Amazon Kindle; a software and device platform with in-built cellular access capability for downloading and reading electronic material. Both operators and established network equipment vendors have shifted one tier away from the end-user decreasing the industry attractiveness and overall profitability of both access and infrastructure markets. The evolution of mobile infrastructure from the technology point of view has essentially developed to the same direction as in the previous scenario. However, the dominant position of internet service providers is decreasing the profitability of all other stakeholder groups (except for the end-users).

Incumbent MNOs are under heavy cost pressures as they are mainly selling connectivity to organizations with professional and centralized buying organizations. MNOs have also lost a large amount of subscribers to internet service providers. Revenues per megabyte have dropped to the minimum and operators' main goal is to minimize operational costs. Operators concentrate on selling their bit-pipes to service operators and let established network equipment vendors to handle the operations and maintenance. The cost pressures force MNOs to adopt active network sharing agreements with each other in order to minimize operational costs and capital investments.

Horizontal industry structure

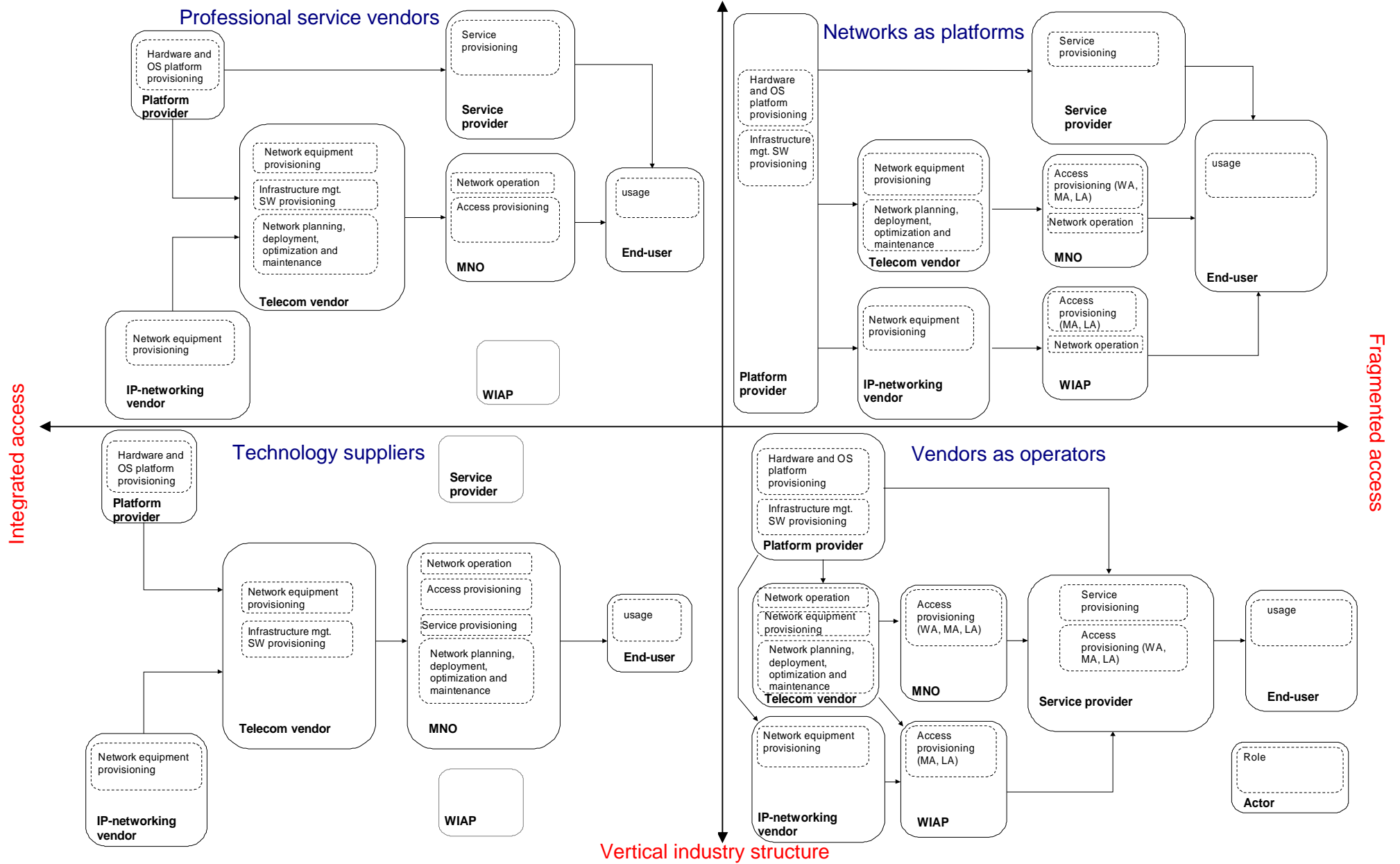


Figure 5: Scenario value systems.

4 Strategic implications

In this section strategic approaches for established network equipment vendors are discussed based on the constructed scenarios. The analysis is based on Porter's five strategic approaches under industry uncertainty (Porter, 1985). The strategic implications of each approach are discussed individually below.

4.1 *Bet on the most probable scenario*

The fundamental idea of *bet on the most probable scenario* strategy is to choose a scenario or a range of scenarios which are expected to occur with higher probability than other scenarios. According to Porter formulating strategy based on this approach an organization must consider aspects of scenario probability, the width of the resource gap between the present and future scenario industry structures, and the consequences of adversity.

Based on the combined input from industry expert interviews and industry announcements, it was seen that scenarios with integrated mobile broadband access landscape were more probable. Furthermore, the *Professional service vendors* scenario was seen more probable than the *Technology vendors* scenario as holistic service packages offered by MNOs were considered improbable. The reasoning was the substantial investments made by major operators in 3GPP mobile network infrastructure and frequency licenses. It was argued that these investments would be protected to some extent also by regulators implying that spectrum management would remain rather centralized and the spectrum licenses would still bring their owners substantial competitive edge. Although the technological development is seen very rapid, the time frame of five years was considered to be slightly too short to incorporate such substantial shifts as was described in fragmented mobile broadband access scenarios.

The industry structure in *Professional service vendors* scenario is somewhat similar than of today's implying that no major resource or strategic positioning gaps exist between the present and the future. *Professional service vendors* scenario implies that services business in the equipment market will increase in size and importance supporting the expectations of established network equipment vendors' views.

Fully betting on integrated access landscape promoting only 3GPP wide area technologies would mean dropping out completely IEEE-based technologies in order to gain competitive advantage over competitors. However, existing relationships with WiMAX and Wi-Fi operators should be maintained in order to support possible operator migration from IEEE to 3GPP. The risk is that by completely abandoning the IEEE technology support a huge portion of addressable market is lost if scenarios with more fragmented access landscape occurs. If expecting the *Professional service vendors* scenario to occur an established network equipment vendor should invest in femtocell technologies and develop self-organizing network (SON) capabilities in order to enable highly automated femtocell base station deployments and network configuration as the local area access is mainly provided by 3GPP femtocells in locations where wide area cells are congested. In the content and application domain established network equipment vendors should reconsider the resource allocation to service delivery platform (SDP) development as operators are mainly "bit-pipes".

4.2 Bet on the best scenario

The fundamental idea of *bet on the best scenario* strategy is to commit resources early to a strategy for a scenario or a range of scenarios that is expected to be the “best” or in other words where a firm can *establish the most sustainable long-run competitive advantage given its initial resources*. When choosing this strategic approach important aspects to be considered are the scenario feasibility, scenario probabilities and the degree of inconsistency of strategies for different scenarios.

Based on the expert interviews it was unanimously seen that the most feasible scenarios for established network equipment vendors were the integrated access scenarios with 3GPP-led mobile infrastructure and a few incumbent MNOs providing access. The most feasible scenario for both MNOs and their infrastructure vendors was seen to be *technology suppliers* scenario mainly because of the assumption that in this scenario operators probably have the least cost pressures. However, it should be taken into consideration that although *technology suppliers* scenario was seen to be the most feasible scenario it was also ranked as the most improbable one. Another critical point to consider is that betting for the best approach is quite inconsistent with strategies having other scenarios as targets as *technology suppliers* scenario is the only one where MNOs have a substantial role in mobile content, application and service delivery.

In order to gain competitive edge in *technology suppliers* scenario an established network equipment vendor should be able to offer MNOs systems and services for managing every aspect of the service delivery environment. Incumbent MNOs would value solutions that support the business models of MNO being the sole provider of access, content and services. These solutions should constitute secure asset exposure capabilities, service creation environments and tools for fast roll-out of new innovative content, applications and services. Also, platforms for MNOs to set up their own application stores would give an established network equipment vendor competitive edge compare to rivals.

4.3 Hedge

Hedge is a robust strategic approach to aim for satisfactory results in every scenario thus resulting in suboptimal strategies. Although resources are committed early this approach delivers no substantial competitive edge compared to competitors in any of the scenarios. The main benefit of this approach is the mitigated risks encompassed in industry uncertainties. When *hedge* approach is chosen critical aspects to consider are scenario probabilities, ability to hedge, costs required to change the strategy and common factors present in each scenario. Also, the irreversibility and the degree of locking-in of chosen actions should be taken into consideration.

In general, hedging strategy promotes focusing on acknowledged industry trends in order to secure a rather safe position in the market. Established network equipment vendor should concentrate on maintaining or only slightly increasing market share rather than aiming for increased profitability. This approach suggests that vendors would begin negotiations early for managed service contract renewals as many present deals expire around year 2015. A notable industry trend is the expected growth of mobile data traffic and possible constraints with indoor coverage implying that established network equipment vendors should prepare themselves for macro cell capacity constraints by developing femtocell technologies for both 3GPP and IEEE standard families.

For an established network equipment vendor hedging promotes keeping broad technology and service portfolios, supporting both 3GPP and IEEE mobile infrastructure technology lines. By

supporting both standardization families a vendor could address substantially wider market if more heterogeneous access landscape emerges. However, the scenario probabilities must be taken into consideration implying that slightly more weight should be put on 3GPP technology development.

To mitigate the risk of major platform and IP-networking vendors entering the more telecom-oriented market, established network equipment vendors should break away from traditional network-centric and especially hardware-centric mentality. In order to hedge against this threat, vendors should be precocious and collaborate strategically with more IP-centric vendor partners. Today's 2G and 3G mobile infrastructure management system market can only be addressed by the established network equipment vendor stakeholder group. In the future, however, the increasing amount of IP technology in mobile networks indicates that future, next generation mobile networks could be managed with more generic data-networking management systems provided by large platform and IP-networking vendors. This is why established network equipment vendors should seriously consider developing IP-network management solutions possibly in partnerships with existing IP vendors to strengthen their position in this particular market.

4.4 Preserve flexibility

Preserve flexibility is another robust strategic approach. Essentially, resource commitments are postponed until it gets clearer in which direction the industry is evolving. By delaying resource commitments a firm can mitigate risks involved in uncertainty but with a cost of weakened first-mover advantages. When preparing a *preserve flexibility* strategy a firm should define important "checkpoints" that give more concrete indications of the industry's evolutionary path. It should also be considered which resource commitments are irreversible and tend to lock vendors into a chosen strategy path.

As a general guideline for a firm choosing *preserve flexibility* strategy it is advised to closely observe competitor movements, especially strategic betting. Competitors' moves usually embody invaluable information about their views of industry evolution.

An important "checkpoint" to observe in terms of mobile broadband access landscape is the migration choices of major WiMAX proponents in both operator and vendor markets. Mobile WiMAX is still rather unaccomplished compared to LTE in terms of trial and commercial deployments. However, new WiMAX spectrum licenses are auctioned and networks deployed. Thus, established network equipment vendors should wait and see how the WiMAX markets will evolve within the next few years. It remains to be seen will WiMAX operators choose to continue supporting the technology or will they initiate migration projects towards 3GPP's LTE. Until clearer industry signals it could be a good practice for vendors to mainly source WiMAX (and possibly Wi-Fi) from third parties.

Operator and internet service provider strategic movements related to service bundles and related strategic partnerships should be observed in order to understand the evolution of industry structure. Major internet service providers such as Google and Amazon should be observed in case of increased service bundling and their overall ability to offer the same basic communications services provided by MNOs today. Another important aspect to follow is the operator "self-cannibalization" actions of moving towards more bit-pipe-oriented business models. For example, a MNO offering

its subscribers flat-rate data plans and devices with integrated VoIP applications such as Skype¹² clearly indicates a strategy aiming at more bit-pipe-oriented business models.

4.5 Influence

In the previous approaches a firm chooses its approach and waits for the outcome of the industry evolution. However, when choosing *influence* strategy a firm takes actions to be involved in shaping the causal factors behind uncertain elements thus shaping the industry evolution, e.g. technological change and governmental policy and regulation. If *influence* approach is chosen a firm need to weigh costs of influence and gained benefits. A firm should also carefully consider its chances to influence the causal factors behind scenarios and scenario probabilities.

Established network equipment vendors have a good position in the market to choose *influence* approach. As the fundamental idea is to choose the most beneficial future scenario and try to impact the course of industry evolution to that particular direction, vendors have probability on their side. As was discussed earlier the most feasible scenarios for established network equipment vendors were deemed to be the integrated access scenarios, especially the *professional service vendors* scenario. Furthermore, this particular scenario was considered to be rather probable.

From the view point of a firms technology portfolio an established network equipment vendor should develop one that promotes operators to adapt a role of a sole connectivity provider or a “bit-pipe”. To support operators’ bit-pipe business vendors should promote network operations outsourcing, optimization and revenue assurance services to leverage operators’ existing infrastructure.

One area where established network equipment vendors have a substantial opportunity of influence is the future mobile network technologies. The network technology development today determines the future technology landscape making it a critical causal factor behind the evolution of mobile broadband access landscape. Vendors should aggressively promote 3GPP over IEEE technologies to maintain the access landscape as integrated as possible. Another important aspect is to ensure that governments are not forced to promote competition and localize spectrum management which is more likely to happen if MNOs struggle to provide efficient wireless capacity, especially to indoor locations. Influencing spectrum regulation thus implies that vendors should prepare themselves with solutions for indoor capacity constraints. The 3GPP femtocell technology development is one possibility to tackle this issue simultaneously promoting the usage of licensed spectrum.

5 Discussion and Conclusions

As a remainder the intention of the paper was to address the following two-fold research question: (1) What are the different possible value configurations between mobile operators and established networks equipment vendors in the future (until 2015) and (2) what different strategic options exist for established network equipment vendors to best cope with them? The first part of the question is addressed in section 3 where Schoemaker’s scenario planning process is used to present a new approach for analyzing uncertain elements present in the mobile communications industry. As a result four bounding future scenarios were developed two of which were considered to be more

¹² For example, 3 UK – a British operator offers end-users a bundle including a flat-rate data subscription and a mobile device with integrated Skype application. “3 UK announces X-Series pricing”, Press release, 01 December 2006

conservative (integrated access) and two of which have more progressive characteristics (fragmented access). Resulted scenarios partly reflect the work of Smura and Sorri (2009) who developed similar scenarios for wireless local area access. The second part of the question is addressed in section 4 where different strategic approaches for established networks equipment vendors were discussed utilizing Porter's strategic frameworks.

One of the key findings was the significant change in the nature of network equipment business during the past years and how it may shape the future. The technological evolution towards more computer-oriented solutions has accelerated the change from hardware-centric to software and services-driven business models. The constructed industry scenarios highlight the importance of established network vendors' ability to adapt to the new rules of business by transforming internally to better support software and services business models and customer needs flexibly. Another key finding is that established network equipment vendors have several options to prepare for the future. These approaches embody differing amounts of risks involved, resources needed and important aspects to be considered as firms are conducting strategic planning¹³.

Future scenarios bring new perspective to the traditional strategic planning process. Scenario descriptions and the discussion of strategic options may assist managers to make informed decisions based on explicit views about the future and be aware of the set from which the selected approach or a set of approaches is chosen. It should be kept in mind that the scenarios represent bounding future outcomes and that the realized future business ecosystem will likely be a combination of different scenarios. Still, the scenarios should offer valuable information aiding strategic planners to avoid common mistakes, such as underestimating radical changes in the entire business ecosystem brought along with technology evolution.

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References

Ballon P. (2007). "Business Modelling Revisited: The Configuration of Control and Value", *The Journal of Policy, Regulation and Strategy for Telecommunications, Information and Media*, Vol. 9, No. 5, pp. 6-19.

Enqvist, H. (2010). "Mobile Communications Industry Scenarios and Strategic Implications for Network Equipment Vendors", M.Sc. Thesis, Aalto University School of Science and Technology, 2010.

Ericsson (2010). "LTE ROLLOUT FOR AT&T IN THE US", Press release, February 10th 2010, Ericsson.

¹³ It should be noted that in addition to these pure strategic approaches, combined and sequenced strategies are also possible. For example, according to Porter, betting on the most probable or best scenario can be combined with attempting to influence which scenario occurs. This could be a natural option for the established vendors. Also, the preserving flexibility approach can be a part of a sequential strategy that ultimately involves a bet on the most probable scenario (Porter, 1985).

- Fine, C. (2000). Clock speed-based strategies for supply chain design, *Production and Operations Management*, Volume 9, Issue 3, pp. 213-221.
- Li, F. and Whalley, J. (2002), "Deconstruction of the telecommunications industry: from value chains to value networks", *Telecommunications Policy*, Vol. 26, No. 9-10, pp. 451-472.
- Luoma, E., Frank, L. and Tyrväinen, P. (2008). "Analyzing the Mergers and Acquisitions in the Telecommunications Software Markets", In *Proceedings of the Eight Conference of Telecommunications Techno-Economics*, Vol. 1, 18 June 2009.
- Mölleryd, B. G., Markendahl, J. & Mäkitalo, Ö. (2009). "Analysis of operator options to reduce the impact of the revenue gap caused by flat rate mobile broadband subscriptions", In *Proceedings of the 8th Conference of Telecommunication, Media and Internet Techno-Economics (CTTE 2009)*, Stockholm, Sweden, June 2009.
- Porter M. (1980). *Competitive Strategy: Techniques for Analyzing Industries and Competitors*, New York : Free Press, cop. 1980.
- Porter M. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*, London: Collier, 1985.
- Schoemaker, P. and Mavaddat, V. (2000). Scenario Planning for Disruptive Technologies, in G.S. Day and P.J.H. Schoemaker (eds.): *Wharton on Managing Emerging Technologies*, New York: John Wiley & Sons, pp. 206-241.
- Smura, T. and Sorri, A. (2009). "Future Scenarios for Local Area Access: Industry Structure and Access Fragmentation". In *Proceedings of the Eight International Conference on Mobile Business*, IEEE, pp. 57-63.
- Vodafone (2009): "China Mobile, Verizon Wireless and Vodafone Trials Confirm LTE as a Next Generation Candidate for Seamless Global Mobile Services", press release, 18th February 2009.
- Wack, P. (1985): "Scenarios: Uncharted Waters Ahead", *Harvard Business Review*, vol. 63, pp. 73-89.

Appendix A - Figure 3: Uncertainty weights in each scenario.


1 = Technology suppliers
 2 = Professional service vendors
 3 = Networks as platforms
 4 = Vendors as operator

U3: Telecom and Web convergence

1. The importance of operators' subscriber data assets

No clear advantage  Gives clear competitive edge

2. The role of IP-based communications


Complementary  Replacing

U4: Migration to "pre-4G" mobile networks


1. LTE and/or WiMAX mass migration time-frame

2011  2015 or later

2. In terms of global mobile broadband data what proportion is realized in 3GPP specified networks (air interface)?

30%  100%

U5: Operator interest to share active network infrastructure / Operator cost pressures

Low interest / cost pressures  High interest / cost pressures

U6: Managed services markets: Operator interest to outsource...


(a) Network related operations

Low interest  High interest

(b) Service related operations

Low interest  High interest

U7: Telecom software markets: From whom will the operators mostly purchase the telecom software?

Telecom vendors  Platform vendors and/or ISVs