Regulatory implications of the introduction of next generation networks and other new developments in electronic communications

Executive Summary

16th May 2003

Document Modification Log

Modifications

Release	Date	Modifications	Owner
Final v. 1.0	16th May 03	Final	SITICOM & Cullen Int.

Authors

Name	Position
Ms. Aurelie Dame	Consultant, Devoteam Siticom
Mr. Jan H. Guettler	Director, Cullen International
Dr. Ken Leeson	Managing Director, Cullen International
Mr. Morten Schultz	Project Director, Devoteam Siticom
Mr. Torben B Jensen	Senior Consultant, Devoteam Siticom

For any request regarding this document, please contact:

Name	Telephone	E-mail
Mr. Morten Schultz	Project Director Devoteam Siticom	Mschultz@devoteam-frontrunner.com
Mr. Jan H. Guettler	Director Cullen International	Jan.Guettler@cullen-international.com

Content

1. Introduction

This report presents the main findings and recommendations for the study entitled "Regulatory implications of the introduction of next generation networks and other new developments in electronic communications".

The report provides a plain-language market and technology tutorial to help readers understand where market developments will lead and what is technically feasible in the NGN marketplace. It also raises a number of regulatory issues that warrant public debate and the attention of policy makers and regulators in the European Commission and EU Member States who are working to shape a pan-European information society in coming years.

The term 'next generation networks' (NGN) refers here to the future competitive marketplace for communications and information services, a marketplace preceded in time by the generations-long monopoly era, ending circa 1990, and the current era of transition from monopoly to competition.

During the monopoly era the public switched telephone network exhibited natural monopoly characteristics, where unit costs of operations fall continuously as scale is increased.

Over time, technology and innovation undermined the rationale for monopoly provision of telephone service by pushing down unit costs, whetting the appetites of consumers for new services, and enabling smaller competitors to enter some segments of the market.

When the transition to competition began, the main "control points" over marketplace activity requiring regulatory attention with regard to competition were vestiges of the monopoly area, primarily residual market power and network "bottlenecks" controlled by the incumbent, such as local access.

To open markets for competition and to promote investment, regulators applied ex ante regulations to establish a level playing field. Ex ante tools include regulations to ensure cost-based, non-discriminatory access to the incumbent's bottleneck facilities by competitors, and the blocking of alliances seen as anti-competitive.

Decisions by regulators for the NGN marketplace will also have to address anti-competitive "control points," inherited or devised, that inhibit the normal functioning of a competitive marketplace.

However, unlike the monopoly era, in which control points resided primarily (though not exclusively) in the basic network, control points in NGN may reside in any layer of the network hierarchy, from basic assess to services and content. They will probably be difficult to identify, and they will have less predictable consequences for competitive activity if left unchecked, or indeed, if regulated.

The challenge for regulators will be to distinguish *anti-competitive* control points from *competitive* control points. Competitive control points are those developed or discovered in search of a commercial edge that actually promote the normal functioning of a competitive marketplace. These should be left untouched, to better serve consumers and to promote innovation and investment.

In their decision making, regulators will therefore have to:

- identify and assess marketplace control points for their potential impact on competition;
- strike the right balance between using ex-ante regulations and applying ex-post remedies;
- assess the effectiveness of self-correcting forces in a competitive marketplace;
- achieve optimum levels of concentration and vertical integration;
- consider the limits to jurisdiction over services whose components reside in different countries; and
- understand the role of trade agreements in shaping the regulatory landscape.

Throughout much of this study, potential control points in NGN are identified and discussed. The extent to which these will require regulatory attention or deserve specific ex ante regulatory action or ex post remedies will be the subject of a good deal of debate, and cannot be predicted at this point. Nevertheless, specific examples of the kinds of market imperfections likely to attract or deserve the attention of regulators are provided.

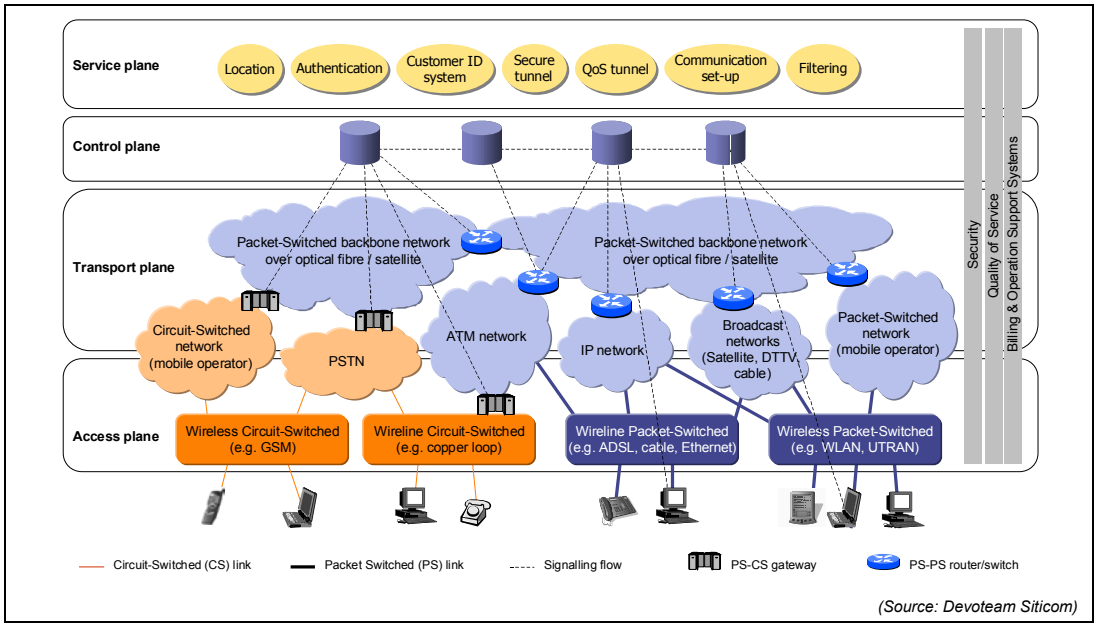
Prior to discussing a number of regulatory issues, this report has been structured to provide the reader with an insight into the technologies associated with NGN as well as an understanding of the market views on NGN related developments.

The report starts in chapters 2 and 3 by outlining the technology framework around which the following observations and analysis have been developed. These chapters allow the reader to achieve some fluency in the terminology and technical concepts under discussion now and in the near future. Chapter 4 summarises expected market developments based on the views expressed by representatives of 30 companies interviewed for this study. Chapter 5 provides an assessment of the regulatory implications of NGN and specifically discusses the general nature and implications of potential control points. The study is concluded in Chapter 6 offering a set of recommendations to supplement the main purpose of the study, which is to raise the awareness of regulators to NGN developments and to stimulate debate and discussion on policy issues and regulatory options that may make sense.

2. The NGN architecture

Next Generation Networks represent a vision and a market concept rather than a specific technology. From a high-level perspective however, it is generally acknowledged that the architecture of NGNs rely on a few general principles mentioned below.

- The NGN architecture is divided into functional planes (see Figure 1 below) providing flexibility and scalability to the network.
- The functional planes are separated by open interfaces facilitating interconnection and integration of new services, based on commercial agreements.
- NGNs are multi-service networks enabling operators to implement converged and new services utilising packet-based high-bandwidth technologies.



(Source: Devoteam Siticom)

Figure 1 Typical representation of NGN architecture

The NGN architecture allows for potential control points to appear in any of the four functional planes, that is not only in the access and transport planes, but also in the higher planes of control and services for the provisioning of access to the underlying resources. Figure 2 below provides examples of elementary service functions that could possibly trigger control points.

Transport- and traffic-related elementary functions	**Content- and service-related elementary functions**	**AAA- & billing-related elementary functions**
• Create tunnels in or across networks • Secure network traffic • Guarantee a certain QoS • Restrict communication with other network and nodes • Redirect traffic	• Set-up and manage a voice or multimedia communication • Provide a Virtual Home Environment • Resolve name and numbers • Determine a user's location • Determine a user's status • Restrict access to certain types of content and services	• Authenticate a user • Authorise a user • Collect information on the user's use of (network) resources • Produce a bill

Figure 2 Examples of elementary service functions

3. Technology and Systems

The main technology trends relating to NGN are described below. In addition to these more specific trends, the "Technology and Systems" chapter describes general technologies for routing, Quality of Service and signalling.

3.1.1. Migration to NGNs

The migration of existing networks to NGNs depends on the background and actual assets of network operators.

The migration path taken by telecom operators will need to take account of the large investments made so far to build the telephony network. It will also require that the technology implemented does not reduce the quality provided.

Data network operators will try and simplify their current network and implement further features so that real-time and converged services can be implemented. Data network migration could also include a migration toward IPv6.

The migration milestones of mobile operators towards the third generation mobile network (in Europe) involve the implementation of a packet-switched core network for data communications, the upgrade of the radio access network and eventually a move to an all-IP network.

Broadcasting networks are also evolving, with legacy broadcasting networks still being upgraded to provide one-to-one communications.

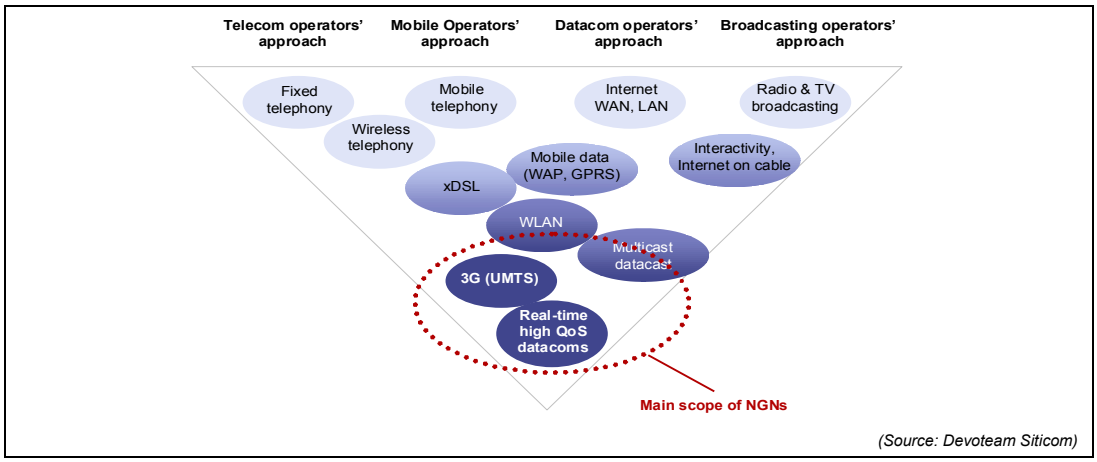


Figure 3 NGN perspectives and technologies

3.1.2. Development in access technologies to support broadband services and content

Developments in access technologies include lower-range technologies such as Bluetooth and Ultra-Wide Band, local area technologies such as Wireless LAN, local loop technologies such as ADSL, and greater-range technologies such as satellite technologies. The massive development of access technologies reflects the strategic importance of the access market to keep or gain control over the customer.

Access networks will increasingly be based on broadband, packet-based and "always-on" technologies.

Mobility and wireless connectivity is becoming increasingly important and is supported by Wireless Ethernet (WLAN), 3G networks, Bluetooth, etc.

Technologies are developed to enhance the capabilities of existing wireline infrastructures and to optimise the usage of existing assets providing wide or even ubiquitous coverage, e.g. DSL technologies, Cable TV technologies, etc.

Dedicated networks such as electricity networks or broadcasting networks are perceived as potentially suitable means for providing data and/or voice services, with technologies such as Powerline communications.

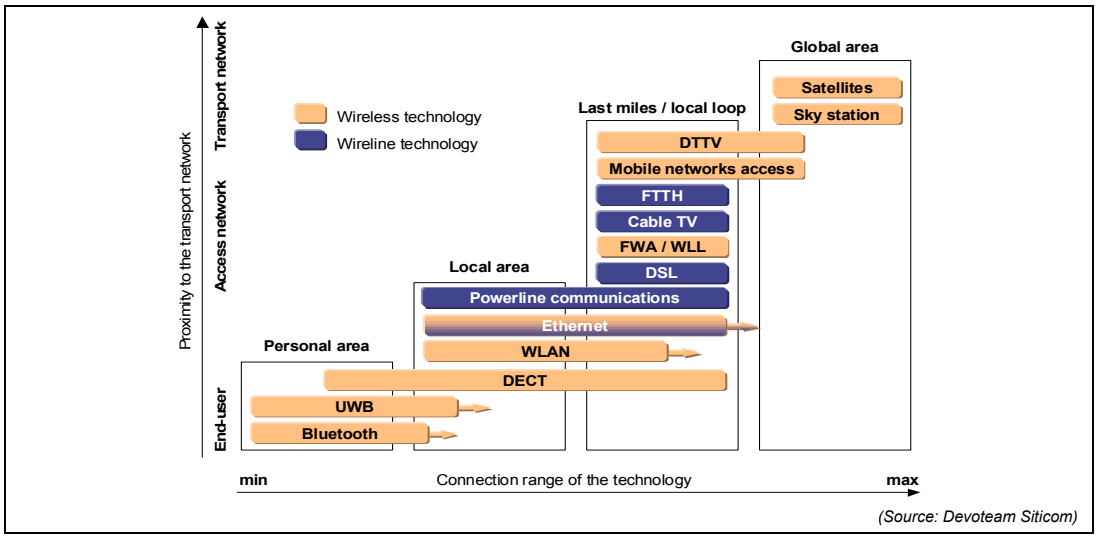


Figure 4 Positioning of access technologies

3.1.3. Service provisioning

Application Programming Interfaces (APIs) make it possible for third-party programmers to develop new services on top of existing networks, while still hiding much of the network complexity. APIs are therefore a key element for providing access to the network infrastructure capabilities and could therefore represent a key control point for network operators and/or service providers.

The Parlay and Jain APIs are the most significant standard APIs for next generation services creation on telecommunications networks.

Recently, XML-based APIs, known as Web Services, have been specified bringing a number of benefits related to NGN as for instance:

- XML-based APIs are capable of using standard Internet protocols and can thus be used seamlessly across servers and clients on the Internet. They can therefore be published on the net and utilised by other software applications.
- End-users can use Web Services to customise the services received.

3.1.4. Interworking of addressing systems

The convergence towards NGNs requires the interworking of the different naming, addressing and numbering systems. This includes the traditional public telephony E.164 numbers, Internet names (email addresses or website addresses), IP addresses and Instant Messaging identifiers. Several solutions are being proposed for the mapping and interworking of these names and addresses.

The ENUM (tElephone NUmber Mapping) specified by the IETF provides a mapping between public telephony numbers and other resources. The implementation of ENUM raises a number of issues, including the role that the different market players will have to play in the implementation and the maintenance of the system, as it could lead to the emergence of control points in the system.

TIPHON has proposed another solution which focuses only on public telephony services involving legacy telephony networks and Internet networks. This solution requires that all parties are assigned a public telephony number. The control of the public telephony service provided, including the mapping of the public telephony number into an Internet telephony name, remains within the control of the telephony service operator.

3.1.4.1. Roaming and mobility

The emergence of NGNs broadens the scope of roaming and mobility and raises new challenges. This section of the report describes different roaming scenarios and shows how, depending on the type of roaming technology implemented, the home operator can retain control over its customers.

The migration towards third generation mobile networks introduces the challenge of data services roaming on the top of voice services roaming. Guidelines related to the business and technical aspects of roaming between mobile operators have been published by the GSM association and involve a new type of operators, providing the connectivity between the home and the visited mobile networks.

The deployment of public and private Wireless LANs (WLANs) has raised the issue of roaming between the independent WLAN spots. Inter-technology roaming, e.g. between WLAN spots and mobile networks, has also started to emerge. The solutions provided so far are however proprietary.

True mobility support, that is the ability to maintain a session while roaming between two networks and technologies, has been discussed for a while but is still far from being provided. Moreover, depending on whether it is implemented on IPv4 or IPv6 networks changes the way communications are handled by the home operator.

4. Market developments

Interviews with 30 organisations and individuals have identified some of the significant market developments and potential control points predicted for the next 5-7 years.

A gradual transition will take place from circuit switched to packet based environments supporting voice, data and multi-media services. The potential of new revenue channels and increased access capacity are seen as the main drivers for this transition.

A move away from a monolithic standards structure has been taking place for some time, and NGNs will be multi-standard environments with several standards solving the same issues. In NGN, new standardisation and interoperability requirements emerge in relation to interfaces between networks and services. Industry driven standardisation will become more significant with government driven standards expected to play a lesser role. The study has shown that there is some concern that proprietary standards succeeding as de facto standards could become potential control points requiring regulatory attention.

The study has shown that NGN could potentially lead to a consolidation of traditional roles into new partnerships which could become powerful entities in controlling both the NGN infrastructure and the services offered over NGN (see Figure 5).

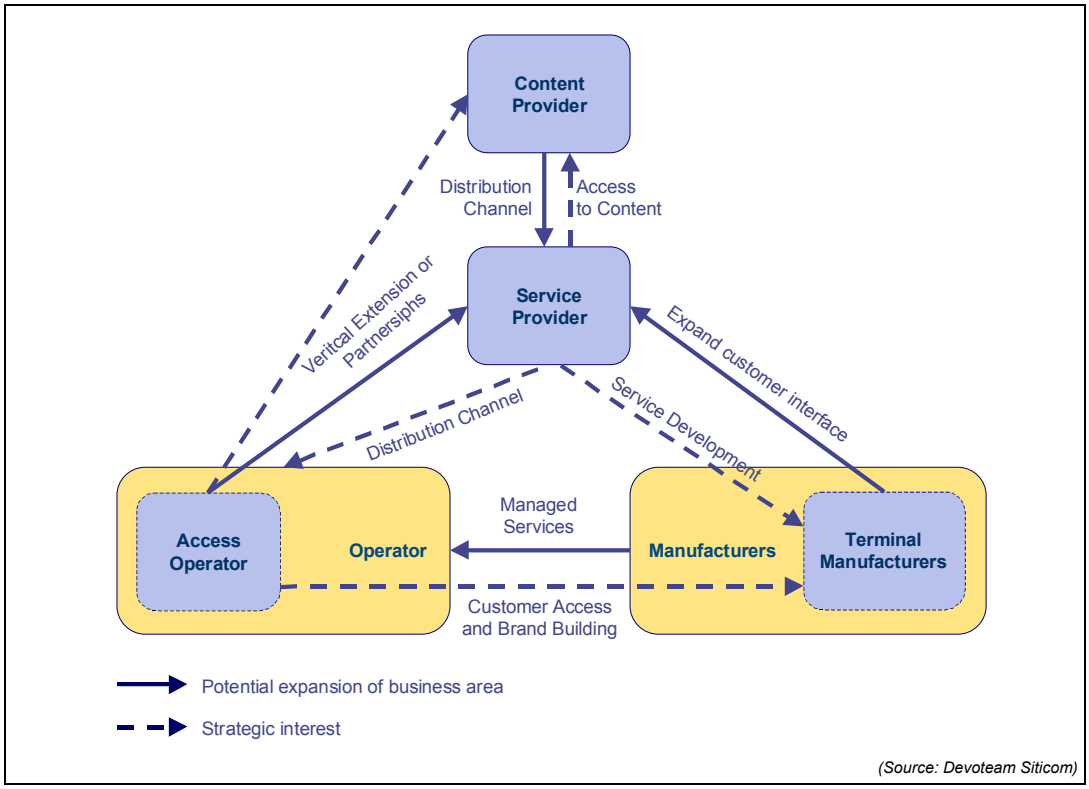


Figure 5 Examples of potential industry integration and bundling

Interconnection issues will move away from simple traffic exchange to higher-level interconnection of services. Commercial mechanisms seem to have been successful in resolving past IP interconnection issues and the Internet has become much less hierarchical over the last 5-6 years. In NGN, issues of market power and dominant position are more likely to appear at the level of services interconnection. However, the study has also found that global and large backbone providers still have an advantage

when negotiating charges and quality for interconnect and that this issue must be dealt with at a trans-national level.

NGN will support a new service environment where mobile and fixed terminals will share the same services over a common network. This raises new interoperability requirements in particular in relation to elementary service functions such as basic call functionality, Quality of Service, customer identification and filtering. Many of these functions could become potential control points and it is foreseen that network operators and players in the service layers (e.g. ASPs) will compete for such control.

In the NGN marketplace, the billing relationship and access to customer information is viewed by some as a control point which could potentially require regulatory attention. Access operators control huge repositories of customer data, they are closest to the subscriber and they are more experienced than most service providers in managing the customer relationship.

Interviews carried out as part of this study suggests that regulators must be cautious when putting in place ex-ante measures, and that ex post tools are seen by a large part of the industry as sufficient in a mature market. Many claim that NGN developments and an increasingly mature and competitive marketplace call for regulatory objectives to recognise the fading power of previous monopolies, a need to encourage further investments, and the expectation that services will converge into completely new service propositions. Players should thus be allowed a certain level of freedom when building services and gaining market.

5. Regulatory implications

5.1. Introduction

NGN represents a paradigm shift where electronic communications becomes heavily integrated with information society services. As a consequence, regulatory concerns will shift upwards to the higher layers of the network hierarchy and there can be many new interoperability and access issues. Control over interoperability could provide sources of market power and ability to dominate competition and in that sense constitute control points.

The study has a clear focus on the main competitive aspects of NGN. There are many other regulatory concerns that also could be discussed which relate to areas of price transparency, data protection, privacy, universal service and consumer protection. These, together with the relationship between the regulatory frameworks for electronic communications services and information society services, provide substantial scope for further study.

5.2. Control points

In this environment, market power can be derived from controlling fairly limited sets of functions and capabilities that are necessary for the provision of services to end users. For example, the root name server represents a control point upon which all domain name translations depend.

A real challenge posed by NGN is to understand where control points can appear in a new and fairly unknown environment. They could be related to any of the network layers and need not be owned by the operator of an electronic communications network or service, but could equally well be a critical software platform controlled by a software vendor.

There is no consensus in the market today that such control points will emerge with NGN nor a common understanding of what the potentially harmful control points would be. On the other hand, all players in the market try legitimately to achieve competitive advantage that can build or sustain market power and provide some degree of customer control. Given the complexity of the environment in which technology can provide a seemingly infinite range of possibilities, it is possible to construct a number of theoretical scenarios under which important NGN function(s) can come under control by a single commercial organisation.

Control points could relate to:

Network capabilities
- potentially enabling dominant operators to limit access to certain infrastructure capabilities by competitors. Examples include:

- Network Address Translators and firewalls
- Routing tables
- Quality of service capabilities and interconnect
- Network coverage

- Termination capabilities

Elementary services
- potentially enabling dominant operators to limit competitive ability to create certain types of services. Examples include:

- Call set-up capabilities
- Proprietary standards
- Non-proprietary standards
- Interoperability
- Application Programming Interfaces

User access capabilities
- potentially enabling dominant operators to limit or restrain access to certain service providers. Examples include:

- Unnecessary software and service bundles
- Walled gardens
- Tunnelling
- Filter mechanisms and digital rights
- End-user devices
- Content

Individual user information
- potentially enabling e certain operators to decide who could construct services based on this information. Examples include:

- Authentication, single logon and profile management
- Customer billing information
- Access to customer information systems
- Resolution of names and numbers through customer identity systems
- Functions for determining location

5.3. Regulatory intervention on control points

Having discovered dominance over a given control point, a next step for a regulator would be to consider whether some type of ex ante regulatory action would be necessary. This is the basic and very difficult challenge for regulation in the NGN environment where there are risks associated with any course of regulatory action as well as non-action. The complexity of the NGN environment makes it difficult to predict the consequences of any regulatory decision.

There is significant danger that regulatory intervention could be counter-productive in the sense that the regulator would be micro-managing the market instead of letting the market find its own solutions. At the same time, the potential negative consequences of non-action could be overtaken by other types of market developments. These factors suggest that regulators should demonstrate great reluctance against any temptation to over-regulate.

On the other hand, it cannot be ruled out that dominance of certain control points could represent irreversible barriers to market entry in a way that would justify ex ante regulation and that in extreme cases, lack of regulation could hamper development of the information society and the benefits that it is expected to bring.

5.4. Differences between CS and IP networks

There are many differences between traditional circuit switched (CS) networks and IP based networks that have regulatory implications. For example:

- IP networks may have in-band signalling which facilitates wider participation and more competition in advanced services. In addition, IP routing functions are normally separate from service functions. An important regulatory implication from these factors is that service creation may be geographically independent. It may be difficult to pinpoint a geographic location from where a service is provided and thus to determine the country of origin for the service;
- IP networks have fuzzy boundaries. Network server functions move to the “edge of the network” and in some cases it may be difficult to distinguish between network components and user terminal equipment. There is no difference between network components and terminal equipment in terms of addressing or transmission protocols;
- IP does not operate with fixed routing tables. Not only can routings vary over time, but multiple routings may be used for the same message. One of the implications is that time based tariffs become meaningless where cost orientation is a regulatory requirement;
- In contrast to CS where dedicated resources are allocated on a per call basis, IP packets are normally transmitted on a best effort basis over common resources. Various techniques, including over-engineering, may be applied to ensure sufficient capacity for various categories of services. One regulatory implication is that Quality of Service (QoS) may become a criteria to determine how different types of services will be regulated (or not regulated).

5.5. Interoperability in information society services

NGN and IP based networks are production platforms and distribution mechanisms for information society services. As communications migrate toward person-to-machine and machine-to-machine communications, regulators may have to turn their attention to higher protocol layers in order to ensure interoperability in the layers above the transmission layer. The complexity of the interoperability requirements is further augmented by the fact that IP enables many alternative strategies and options for deployment of technologies and creation of services. The NGN concept, based on IP, provides tremendous flexibility in terms of options, where intelligence and functionality can be distributed in many different ways among many different operators. Intelligence may be anywhere in the network as well as in the user equipment.

The feasibility of potential implementation strategies will depend largely on the degree of openness with regard to necessary interfaces. Not surprisingly, there are conflicting views on which interfaces should be open and which may remain closed. In one absolutist view, interfaces between all functional layers and across all server functions including the control plane would be open to enable competition for a maximum number of separate

service elements. In a more traditional view, many interfaces will remain closed at least for some years. In the beginning this may be a necessity because only proprietary standards may be available and solutions for interoperability are yet to be implemented. Over time, when standards or solutions for interoperability have been developed, network operators, who own the control plane, may seek to carefully select which interfaces in addition to transmission they will choose to open and under which terms and conditions.

Ability to control the degree of interoperability could create numerous control points within the NGN networks.

5.6. Interconnection

Regulators will also face new challenges with regard to interconnection. The vision of NGN reflects a unified backbone network which can encompass PSTN, Mobile, Internet and CableTV type of traffic. This means that services from networks that previously have been under different regulations, will share the same physical network.

Although interconnection is defined as the “linking of public communications networks”, it would be inappropriate to think in terms of NGN networks as relevant markets for interconnection without further qualification in terms of the services in question. It would be counter-productive to lump all services together even if it could be argued that the transmission of an IP packet is independent of the service it belongs to. It would also be against the spirit of the new framework to consider that any new and innovative service could be regulated with ex ante conditions for interconnection just because it was carried over the network of a dominant operator.

It makes more sense to accept different types of network interconnection agreements for different market categories defined by their service characteristics rather than by network technology. Some, but not all of these agreements may be subject to significant market power conditions, depending on whether there is dominance in the corresponding market for interconnection.

Network interconnection arrangements for telephony services in an NGN environment could if necessary retain many of the principles upon which the present reference interconnection offerings are based. Quality of service represents a potential problem when interconnecting telephony services over IP based networks and raises certain regulatory questions whether there is a need for interconnection agreements to include service level agreements in combination with non-discrimination clauses.

Following the service market approach, there would be no particular need to start regulation of Internet interconnection. But if ever that would become necessary, there could be interesting challenges in setting out criteria for non-discriminatory arrangements based, for example, on peering.

An argument against regulation is that the Internet business model is probably not yet stable in the sense of providing sustainable and fair payments to all participants in the value chain, including content providers. Many business models are likely to be tried out in the market, with different dependency on termination charges. Dissuasive termination conditions may prevent certain business models from being tested. In this context, premature interconnection regulations could have the effect of regulating one part of the value chain and prevent the market from finding a workable solution. This argument is also valid for many of the new information society type of services that are expected to be developed with NGN.

6. Concluding recommendations

Essentially, NGN has the potential of providing a more open and competitive service environment. Paradoxically, this potential may also lead to additional sources of market power. The potential control points that have been identified in this report indicate that the battle for market power will be fought on many different fronts. For regulators seeking to ensure a fair and well functioning market, it is of obvious interest to understand these mechanisms.

The regulatory framework for electronic communications and its (prospective) application will play a significant role in the development of the information society. To this end, the Framework Directive[1], warns against applying ex ante regulation in newly emerging markets, such as new service markets within the NGN environment. Regulators must avoid creating the impression that success will be "punished" by regulation. At the same time, the new framework does not preclude the possibility of applying ex ante regulation to potential "control points" identified in NGN if they were to meet certain criteria. These criteria are set out in the Commission Recommendation on relevant product and service markets[2]:

It is important for the European Commission as well as for national regulatory authorities to understand where new sources of market power can be found. This will require an understanding of new technologies and how they interrelate. The technical sections in this report have been developed with this objective in mind. A long list of potential control points or sources of market power has been identified, but it is premature to assume that they will emerge with NGN in a sense that would require regulatory action.

With the shift of competition from the lower transport and network layers to the higher layers of services and applications, the European Commission should carefully consider the role played by customer information in NGN, including location data, and whether access to and use of this information should be controlled by the entity compiling it or the customer to whom it pertains. Further study on Customer Identity Systems (CIS) is recommended to better understand the extent to which the development of information society services will depend on non-discriminatory access to customer information gathered by entities with significant market power and to what extent CIS could be used as a control point.

In addition, further study into the behavioural patterns in the marketplace is recommended with a view to creating awareness among authorities and to analyse the risks of leveraging a position of dominance into control over the delivery of future multimedia services.

The complexity of dealing with control points in a regulatory perspective suggests that there is a need to develop a special type of expertise for analysis and risk assessment of regulatory actions and inaction. Since the European Commission has a primary role in the procedures leading to the definition of a control point as a relevant market for ex ante

[1] 2002/21/EC - Framework Directive – Recital 27

[2] See COMMISSION RECOMMENDATION of 11/02/2003 On Relevant Product and Service Markets within the electronic communications sector susceptible to ex ante regulation in accordance with Directive 2002/21/EC of the European Parliament and of the Council on a common regulatory framework for electronic communication networks and services – Recital 9

conditions, it must also ensure that the required expertise is available. This is likely to involve several EU authorities, including competition authorities and suggests a particular development programme, perhaps to pool expert resources and to build new circles of competence.