Supplementary Document to the ERG Common Statement on Regulatory Principles of IP-IC / NGN Core - A work program towards a Common Position

Part 1 Consultation report

Part 2 Country Study updates

Part 3 Technical Background Information

Part 4 Implications of Next Generation Networks on regulatory accounting (Input from RA PT)

This document ERG (08) 26b final constitutes a supplement to the **ERG Common Statement on Regulatory Principles of IP-IC / NGN Core - A work program towards a Common Position** (ERG (08) 26 final). It contains material that is referred to in the ERG Common Statement and consists of 4 parts:

The *Consultation Report* (Part 1) summarizes the main argument of the 21 comments (received to the "ERG Consultation Document on Regulatory Principles of IP-IC / NGN Core" (ERG (08) 26rev1) by topic and outlines how the ERG takes account of the arguments in the ERG Common Statement. *Note: One of the 21 comments was confidential and therefore not summarized in the Consultation Report.*

The following Parts (2-4) of the Supplementary Document constituted Annexes 2-4 of the Consultation Document but have been removed from the ERG Statement itself. Part 2 contains updates of country studies addressing IP interconnection issues. Part 3 provides further technical background information. Part 4 consists of the input delivered by the Regulatory Accounting Project Team on the implications of NGNs on regulatory accounting.

Supplementary Document to the ERG Common Statement on Regulatory Principles of IP-IC / NGN Core

Table of contents

List of figures

Part 1: Consultation Report

In the "ERG Consultation Document on Regulatory Principles of IP-IC / NGN Core" (ERG (08) 26rev1) interested parties were invited to comment on the 11 questions, each related to a particular chapter of the document. The Consultation Report is structured along these questions as raised in the Consultation Document:

1) ***A.4.1 Separation of transport and service***

Considering that according to the ITU definition of NGNs where service-related functions are independent from underlying transport-related technologies, how do you evaluate the concepts of transport interconnection and service interconnection as defined in the document?

2) A.6 Structure of the document

Do you see other issues regarding regulatory principles of IP-interconnection/NGN core that should be dealt with?

3) B.3.3.1 Number of network nodes and points of interconnection (PoI))

Can you make more precise statements on the number of network nodes and/or points of interconnection in NGNs?

4) ***B.3.3.2 Definition of local interconnection***

a) Is there an equivalent in NGNs to the concept of local interconnection as known from PSTNs?

b) What do you consider to be the locations for the lowest level of interconnection (physical and/or service), e.g. the broadband remote access servers (BRAS)?

c) Could the maximum number of PoI offered be considered equivalent to local interconnection?

5) C.1 Existing and proposed Framework

How do you assess the proposed Framework in the light of the migration process towards NGNs, their technical characteristics and economic implications? Are the proposals suited to address the specific challenges that these present?

6) C.3.1 Interoperability issues

What type of interoperability requirement do you consider necessary?

7) C.3.2 Impact of charging mechanism on transport bottlenecks

How do you assess different wholesale charging mechanisms in the light of the transport-related bottlenecks?

8) C.3 Bottlenecks and SMP positions

Do you see other areas (potential bottlenecks) for regulatory intervention?

9) C.4.2 Measures based on USO directive

a) Do you consider it sufficient to potentially regulate minimum quality (Art. 22 USD new para 3)?

b) Does this require additional regulation at the wholesale level?

c) What is your opinion on ERG's consideration that the power to set minimum quality of service requirements (both on end-user and network level) should be entrusted directly to NRAs?

10) C.5 Costing and Pricing

a) Do you agree with the description of the relevant change regarding the cost level, the cost drivers and the cost structure?

b) For a pricing regime under CPNP, which of the wholesale pricing regimes (EBC or CBC) do you consider more appropriate for IP interconnection?

11) C.6 Charging mechanisms

a) How do you assess the arguments with regard to the properties of the charging mechanisms CPNP and Bill & Keep raised in the sections C.6.2 – C.6.10?

b) How can the migration process towards all-IP infrastructures be alleviated for the following options: 1) long term goal CPNP, 2) long term goal Bill & Keep? How do you evaluate the measures and options discussed here? Please also consider problems of practical implementation.

c) Assuming that different charging mechanisms would apply in different Member States: would this imply specific problems (e.g. arbitrage)? If so, how could they be addressed?

d) Do you consider that the issues mentioned here are comprehensive with regard to the application of Bill & Keep for IP-interconnection?

In total 21 comments were received. One of these comments was confidential:

1) Arcor AG &Co. KG
2) AT&T
3) British Telecom
4) Bundesverband Breitbandkommunikation e.V. (BREKO)
5) Deutsche Telekom AG
6) European Cable Communications Association (Cable Europe)
7) European Competitive Telecommunication Association (ECTA)
8) European Telecommunications Network Operators' Association (ETNO)
9) European Telecommunications Platform (ETP)
10) France Telecom Group
11) Freiwillige Kontrolle Telefonmehrwertdienste e.V. (FST)
12) GSMA Europe
13) Hutchison 3G
14) Next ID GmbH
15) OTE S.A.
16) Portugal Telecom S.A.
17) QSC AG
18) Tele2 AB
19) Telecom Italia S.P.A.
20) Telefónica S.A.
21) The Number (*confidential)*

References in the text refer to the ERG CS on Regulatory Principles of IP-IC/NGN rather than the Consultation Document.

General claims made by respondents

Many respondents made some general remarks in addition their specific answers. These general comments are summarized briefly here. More specific arguments are presented in the Consultation Responses to each question.

In particular the incumbents referred to the early stage of NGN implementation (see also Consultation Reports question 11a). Thus, it is considered too early to derive concrete conclusions regarding the need for regulatory intervention and market outcomes should not be precluded **(DTAG, ETP, ETNO, FT, GSMA, OTE, Telefónica)**. According to an incumbent seeking detailed answers on a European level is premature. Instead, the emphasis should be on national consultations **(BT)**.

Other respondents reasoned that it is very important to lay out regulatory principles as soon as possible **(Tele2, and similarly Hutchison 3G**, who, at the same time state that NRAs should wait for the IP world to develop**)**. Two competitors consider a European regulatory strategy on Interconnection and NGN issues important **(QSC, Tele2)**. One of these added that NRAs must be able to diverge from a European approach, but only if required by national circumstances **(Tele2)**.

Generally, some respondents criticize the ERG's approach as simply adapting existing telco regulation to NGNs **(DTAG, BT, FT, Hutchison 3G)**. Regulatory action should only take

place if there is clear evidence of a problem **(e.g. AT&T, Hutchison 3G)**. More specifically an incumbent pointed out that the focus should not be limited to voice services but should be extended to other services provided over NGNs such as IPTV **(FT)**. Furthermore, one respondent stressed that many technological assumptions made did not reflect mobile networks **(GSMA)**.

1) Separation of transport and service (A.4.1)

Considering that according to the ITU definition of NGNs where service-related functions are independent from underlying transport-related technologies, how do you evaluate the concepts of transport interconnection and service interconnection as defined in the document?

Consultation Responses

General considerations

One competitor **(QSC)** supports the general notion of separate interconnections of service- and transport-related functions, especially in relation to new, as yet unidentified services, and, despite the uncertainty, asks that the opportunity for such separation be kept open. An association **(ECTA)** sees little evidence of realization of open interfaces between applications and transport, and foresees that competition based on separation of functions will have to use limited application programming interfaces allowed by the NGN provider. Another competitor **(Arcor)** identifies control as a third functional layer, and argues that, in order to allow network operators to manage their networks efficiently, service providers should not be granted access to this layer.

Feasibility of separation between service and transport

A number of respondents **(Arcor, BREKO, DTAG, FT, GSMA Europe, OTE, Telefónica, Tele2, TI)** argue that linkage between transport and service functions is necessary in NGN's in order to meet quality requirements of some services, particularly carrier-quality voice. They highlight that provision of such quality of service is a key distinction between NGN's and today's Internet, which is only capable of delivering "best effort" service quality. In a similar line of argument, an incumbent **(BT)** finds the definitions of transport and service in the consultation document to be unsatisfactory in the context of carrier-quality voice, whose transport requires some degree of session control. Another incumbent **(TI)** explains that access to emergency services, considered a basic feature of public telephony, is not provided by Internet-based VoIP service inter-working with carrier-quality voice services. An association **(GSMA)** questions whether separation of interconnection is efficient in mobile NGN's. The conclusions of these respondents are not favourable to a general separation of service and transport, some finding it undesirable, others saying it would be infeasible while still others say it would be counterproductive.

Some respondents **(BREKO, ECTA, FT, QSC)** point out that, for meeting privacy, security and other legal, regulatory and functional requirements, carrier-quality voice services carried by NGN's will need to interconnect using a set of functions which are currently available from manufacturers in a single item of equipment, namely session border controllers (SBC's). They go on to explain that, for voice services at least, this limits the feasibility of interconnecting service and transport separately. This argument is supported more generally by an incumbent and an association **(DTAG, ETNO)**, who see an inherent need not to separate transport from service functions stemming from security, privacy and other regulatory and legal requirements. A competitor **(QSC)** emphasizes, however, that these constraints only apply to voice services.

Need for regulatory intervention in separation of service and transport

In an incumbent's **(Telefónica)** view, it is premature to consider *ex-ante* regulation of new NGN services at transport or service levels. In the views of both an incumbent and an association **(ETP, Telefónica)** regulatory intervention to impose such separation at network borders is unnecessary. Another incumbent **(PT)** considers intervention in this area premature, pending more stable standards. An association **(GSMA)** believes that foreclosure of independent service providers is only likely in the presence of SMP and that, in the absence of SMP, there is no justification for enforced separation between the interconnections of service and transport. An incumbent and an association **(DTAG, ETNO)** argue that no regulatory intervention should be necessary because operators should have sufficient commercial incentives to provide wholesale service-specific transport to independent service providers in order to maximize the utilization of their networks. In a competitor's **(Arcor)** view, provision of transport services in NGN's will be competitive and will therefore not require regulation.

ERG Considerations

The ERG supports the separation as expressed in the NGN concept of the ITU-T. The ERG clarifies that this separation does not necessarily imply that transport and service layers should be completely independent of each other. Even with a logical separation between the layers, there could be co-ordination and interaction between them. What is key for competition, however, is that the separation should allow transport and service to be provided by different parties. If suitably open interfaces are made available, service provision independent of transport technology and type of network access could become possible by independent third parties.

If the industry develops in this direction separation of transport and service could potentially give rise to deregulatory opportunities. However, should the existing vertically integrated approach be favoured by the industry in its transition from PSTN to NGN – as corroborated by most respondents – then the current approach to regulation may also need to be transferred to the NGN world. In that case, where the underlying competition issues remain and/or potential new ones arise, regulation will continue to

be required, and the deregulatory potential that could flow from separation of transport and service may not materialize.

The ERG is convinced that separation between transport and service would contribute to and promote the development of new and innovative services.

2) Structure of the document (A.6)

Do you see other issues regarding regulatory principles of IP-interconnection/NGN core that should be dealt with?

Note: To avoid unnecessary duplication and to improve readability of the Consultation Report, the responses to this question are assigned to the other questions.

3) Number of network nodes and points of interconnection (B.3.3.1)

Can you make more precise statements on the number of network nodes and/or points of interconnection in NGNs?

Consultation Responses

Some incumbents (**FT, OTE, PT, TI)** consider that, presumably, the efficient number of PoI will be (substantially) lower than in current PSTN networks, due to a more centralized approach **(DTAG, ETNO, FT)** and the availability of new equipment with more capabilities and performance **(TI)**, although **(DTAG, ETNO, Telefónica)** reveal uncertainties about the factors which will influence the effective number of PoI.

According to an association **(ETNO)**, technical developments, QoS, traffic and service development will determine how the network structure will evolve and in the 5-15 years timeframe will be subject to change and evolution, depending on best practice in operations, etc.

More precisely, the optimal number of PoI will depend on specific network plans and factors such as:

- the number and distribution of customers; traffic mix; QoS - quality of IC; the location of content servers; potentially, the IC charging regime **(GSMA)**;
- capacity of PoI; structure of the network; resilience; costs of transport (including an adequate measurement of “distance”); type of services (bandwidth, real time requirements, required traffic levels); avoidance of “hot potato” routing **(Telefónica)**.

According to an incumbent **(Telefónica)**, the number of PoI to NGN services (within IMS networks, located at the control layer from the Access and peering SBCGs) will be low in the short term and will grow based on the market demand.

Several alternative operators and some associations **(ECTA, ETP)** also consider a probable reduction in the number of PoI, although its extension is not yet clear **(Arcor, BREKO).** One association, **(ECTA)** points to a reduction of about 2/3 while another association **(ETP)** holds that the current legacy PoI structure will be maintained in the short to medium term and an impact analysis is required on this matter.

For another competitor **(Arcor)**, a final statement is not possible as the portfolio of services and technical realisation in NGNs is still not clear. Also, the efficient number of PoI depend on the optimal number of *soft-switches*/SBCs of the incumbent, which is, on the other hand, a function of volume of traffic, e.g., if carrier selection is to be maintained, then more traffic will be carried and more PoI needed **(ECTA, QSC)**. For one respondent **(Tele2)** this optimal number, even if for efficiency reasons operators should use as few PoIs as possible, is also dependent on several other matters, such as costing and charging principles or set up costs. If disputes arise on the function and location, SLA of PoI, this would require a regulatory intervention.

ERG Considerations

As the Consultation has confirmed one may assume that the number of PoI and nodes in which routing of traffic will occur will be less than in current PSTN networks. Whether and to what extent this will be the case may depend on the specifics of each network and may therefore differ among countries. Although it is generally agreed by respondents that the number of PoI will decrease, it is not clear whether there is any one best number for any particular type of NGN implementation.

Transport and service interconnection might occur at different nodes and hierarchy levels. Considering the distinction between transport and service, transport interconnection could take place at a greater number of locations than service interconnection.

4) Definition of lowest level of IP interconnection (B.3.3.2)

a) Is there an equivalent in NGNs to the concept of local interconnection as known from PSTNs?

Consultation Responses

For one incumbent **(Telefónica)**, it is not clear if the local interconnection level will fit in the future in NGN. Others **(DTAG, TI)** consider that since its development is still at the beginning in nearly all Member States, the question concerning local interconnection and its possible evolution in the NGN context may not be currently fully answered. For another incumbent **(TI)**, in principle, in the short/medium term the current PoI used for legacy services will be maintained.

However, since NGNs will be more centralized and less influenced by the distance, the current distinction between local/regional/national level will probably be not applicable for the NGN **(DTAG, ETNO, FT, OTE)**. Several incumbents mentioned other rationale to defend the idea that local interconnection will not be meaningful concept in NGNs:

- the location of the customer has no relation to the location of the NGN platform **(ETNO, FT)**;
- distance is less relevant **(ETNO)**, specially regarding cost **(FT)**; reduction in cost of transmission **(Telefónica)**;
- wireless implementations making definition of local interconnection more difficult **(ETNO)** and voice services are more and more nomadic **(FT, Telefónica)**;
- certain functions cannot be located below certain levels of the network **(ETNO)**;
- in an IMS-NGN context, probably only one switching level will exist **(FT)**; optimal interconnection is done at a level above the current local level **(Telefónica)**;
- the current high number of local PoIs of the PSTN is not efficient. Regulatory requirement to maintain these local PoI could distort investment decisions of operators and make them incur non-efficient costs that would be passed to users **(Telefónica)**;
- due to security and network integrity reasons, interconnection should be done at the core level and not going “down” to what might be considered a local level **(PT)**;
- Demand for local interconnection for IMS based services not identified in countries where has a market presence. Percentage of local traffic in an integrated network (carrying voice, data and video) is much lower that in specialised networks **(Telefónica)**;

In contrast, even if assigning a “concentrator network” to an “access network” is wrong, an association **(BREKO)** considers that the concept of local interconnection should not be necessarily excluded, if MDFs are to be accessed. Moreover, according to a competitor **(Arcor)**, the concept of local interconnection is technology neutral, useful in both PSTN and NGN environments.

For the alternative operators **(ECTA, QSC)**, technically, in the context of interconnection at the SBC level, there is no equivalent of local PSTN interconnection. Not in a narrow sense, according to one competitor **(QSC)** reasoning that an equivalent to local interconnection is not feasible within NGNs as it would depend on a predictable relationship between E.164 numbers and IP-addresses and a specific physical location and existence of a switching unit. However, there is no geographic information related with an IP-address, either at the SBC level or for the end-user. In this context, as pointed out by two respondents **(ECTA, QSC)**, the maximum number of SBCs would define “local interconnection” as there is no hierarchy at the SBC level.

On the other hand, for one association **(ECTA)** the answer may be “yes, this remains relevant”, to the extent that local interconnection relates to the concept of differential

wholesale call termination charges according to where the call is delivered. In the context of minimising network utilisation, operators should be rewarded for handing over calls as near to the end user as possible, hence minimising cost. However, interconnect for voice at the (local) DSLAM/MSAN level actually increases cost, because the only way to handle the traffic is to trombone it to the nearest routing point, i.e. the metro node.

One competitor **(Tele2)**, moreover, considers it is very likely that exchange of traffic in an NGN network can take place at a local level, i.e. MDF/NRC locations, depending on the economic viability, which to a large extent will depend on the regulatory costing and charging regime.

b) What do you consider to be the locations for the lowest level of interconnection (physical and/or service), e.g. the broadband remote access servers (BRAS)?

Consultation Responses

According to some incumbents and an association **(DTAG, ETNO, OTE)** it would be inefficient to interconnect at the lowest level of the NGN network (e.g. MSAN). Some of them **(DTAG, ETNO)** argue, that the BRAS would not be the efficient PoI for a local level interconnection because it would imply a high(er) number of PoI. In principle, the efficient PoI number could be very small, particularly for voice, hence there is no comparable local interconnection for voice in a NGN scenario.

For another incumbent **(OTE)**, it would be both inefficient in economic and technical terms, while it could even be technically impossible to interconnect at that level. Several incumbents **(FT, Telefónica)** specify that certain interconnection functions (e.g. codecs translation) cannot be located at that low level and the lowest interconnection level will not be the BRAS, but the typical PoI will be at a higher level that the BRAS of an area, possibly at regional aggregation points (SBCs).

Demand (or traffic) aggregation will determine the adequate PoI (e.g. metropolitan for cities or regional in a higher level), one incumbent says, **(Telefónica)** and according to another incumbent **(PT)** their location will be influenced by the location of NGN/IMS nodes and types of required interconnection, operators or 3rd party service providers.

In a similar way, an association **(BREKO)** objects to the idea of the BRAS being the lowest interconnection level, as this element is not at the border to the switched network. More specifically, another association **(ECTA)** states that transport interconnection should be carried at the lowest point of interconnection, which is the lowest point where IP routeing takes place, which in practical terms is the metro node containing an SBC. On the other hand, application interconnection (i.e. service interconnection) will inherently be application-specific.

However, a competitor **(QSC)** mentions that for transport interconnection the BRAS might be sensible. More specifically, as pointed out by another competitor **(Arcor)**,

since all hierarchy levels (router) are technically applicable if the functionality of a SBC and a BRAS are at the same (lower) level equivalence may exist. One respondent **(Tele2)** concurs in general terms by referring that this is not a predefined concept and the lowest level of interconnection is the level where exchange of traffic can take place.

c) *Could the maximum number of PoI offered be considered equivalent to local interconnection?*

Consultation Responses

For some incumbents and an association **(FT, GSMA, PT, Telefónica)**, there is no equivalence between those terms, it is not possible to establish an equivalence between the number of PoI in current PSTN and NGN interconnection. For one respondent **(PT)**, there is a difficulty to consider different interconnection levels and, with just one level (core), there is no need to establish a maximum number of PoI. In any case, as the number of NGN PoI – for signalling and media flows – is reduced with the more centralised approach, this number will be the maximum number of PoI and these points are not equivalent to local interconnection, another incumbent states **(FT)**.

One association **(GSMA)** refers to the fact that interconnection for mobile networks already occurs at a relatively high level in the network through gateway call servers and never at a local level. These questions focus on fixed networks, where the reduction of the number of PoI is a key source of cost savings.

Also some competitors argue that there is no equivalence in the sense of "same number as in PSTN" **(ECTA, QSC)**. However, the maximum number of PoI offered should result in the lowest interconnection rate, in the same way that local interconnection (for legacy technologies) yields the lowest wholesale interconnect charges **(ECTA, similar Arcor, QSC, Tele2)**.

ERG Considerations

Generally, the lowest level of the core network constitutes the lowest level for routing. In an all-IP network the broadband remote access server (BRAS) defines the border between access concentration and routing, but does not usually have routing functionality itself.

The currently used hierarchy concept of three physical levels, "local, regional, national", may not be applicable in an IP network. The ERG considers this view supported by the respondents.

The lowest interconnection level possible will be the metro node level in most countries, but this will depend on the design of the network in question. Interconnection will be driven towards higher levels of the core networks.

ERG considers that the maximum efficient number of PoI offered in NGNs should be used for applying the lowest interconnection rate accordingly , even in case where not all of these points are physically offered for interconnection. Note: This principle laid out in question 4c is to be distinguished question 3. Some respondents referred to differences in the number of PoIs between PSTN and NGNs to decline question 4c.

5) Existing and proposed Framework (C.1)

How do you assess the proposed Framework in the light of the migration process towards NGNs, their technical characteristics and economic implications? Are the proposals suited to address the specific challenges that these present?

Consultation Responses

This ERG document should not be the first place for discussions about the ongoing Review of the regulatory Framework. Nevertheless some changes with relevance to IP-IC/NGN-Core have been proposed and are therefore worth being considered in the consultation and its results.

Most respondents argue that the existing framework is adequate to address NGN and related topics (**ECTA, BT, OTE, TELE2**).

Others believe that there is a need or at least an opportunity to further adapt the framework to allow the development of NGN services and infrastructures (**BREKO, ETP, Telecom Italia, Telefónica**). One commentator (**GSMA**) proposes a more general review of existing regulatory obligations and their adaption to the IP world (lawful intercept, emergency calling…)

One respondent (**OTE**) is of the opinion that the analyses of the document are not in line with the current and proposed framework and that the approach of dealing with NGN seems to be a spill-over of existing regulation of PSTN services.

Some respondents (**BT, OTE, Telecom Italia**) point to the fact that both the current and the proposed framework require SMP for a regulatory intervention. Markets have been removed from the Recommendation list; other markets might need to be redefined. In one statement (**GSMA**) a desire by NRAs to be able to intervene more generally rather than only in SMP cases is identified.

Some respondents suggest that the development of NGN should be left to the market forces under competition rules (**GSMA, OTE, Telefónica**). In a competitive environment and in the absence of SMP it would be highly unlikely that an operator would be able to limit interoperability or interconnection QoS for anti-competitive reasons as such an action would mainly end up harming the operator itself (**Arcor, GSMA**).

Some respondents address concrete modification proposals from the review. One undertaking (**Orange-FT-Group**) considers Art. 5 par 1 FD as proposed to be prob-

lematic because that kind of information would most likely contain confidential information. Others argue that even stronger information requirements are necessary, especially for long-term outlook (**ECTA, QSC**) and that NRAs share relevant technical and operational information (**TELE2**).

The new section on security and integrity of networks and services (Art. 13/13a FD) is considered to be dangerous and inefficient by a respondent (**Orange-FT-Group**) because operators ensure security and integrity of their networks and services and must remain in charge of the decision to communicate or not on security breaches. These responsibilities should not be shared with NRAs. Respondents (**Deutsche Telekom**, **ETNO, Telecom Italia**) take the view that the new section could only be fulfilled by a managed NGN. In contrast to that it would have to be emphasised that the public Internet could not assure security and integrity of networks and services.

One undertaking (**QSC**) argues for an ongoing requirement for carrier selection.

Another undertaking (**Arcor**) thinks that the remedies must be completed with an obligation to interconnect on the service-level, especially an interconnection between sip servers should be mandatory. One commentator (**OTE**) believes that access to services should be analysed but should be regulated only if there is a well defined market failure.

Providers of directory enquiry services (**FST, Next ID**) claim that the existing regulatory framework needs to be adapted and reinforced in order to ensure effective universal access to DQ services.

ERG Considerations

The ERG holds the view that the power of NRAs to act on their own initiative to ensure end-to-end connectivity / interoperability should be maintained in Art. 5 para 4 AD.

ERG welcomes the proposed new para 3 in Art. 22 UD allowing the Commission to adopt technical implementing measures concerning minimum quality of service requirements to be set by the NRA on undertakings providing public communications networks. However, the ERG considers that the power to set minimum quality of service requirements should be entrusted directly upon NRAs. As minimum quality of service requires measures on both the end-user and the network level, it should be clarified that NRAs can require minimum quality of service on the network level as well.

In case it is not possible to do so in the UD, a second best option would be to empower NRAs in Art. 5 AD to set on their own initiative minimum quality of service requirements on operators of public communications networks.

6) Interoperability issues (C.3.1)

What type of interoperability requirement do you consider necessary?

Consultation Responses

General Comments

One provider and an association both commented regarding the issue of vendor interoperability that SMP operators must not be allowed to use vendor specific solutions as this could prevent interconnection, lead to degradation in QoS of inter-network traffic, or raise rivals' costs **(QSC, ECTA)**. The same association added that it is of high importance to ensure QoS across network boundaries. Therefore end-to-end connectivity and interoperability of networks would need to be maintained in a future NGN scenario. According to the statement made, specific consideration should be given to voice, which requires assurance of a minimum QoS across network boundaries according to that association **(ECTA)**. Another company demanded the necessity of assuring any-to-any communication by regulatory means from a value-added-services provider's point of view. It is pointed out that the migration of value added services to NGNs would require "pro-active" steps before implementing NGNs, as every change in numbers, locations or costs of interconnection products would have significant impact on related business cases and bears the risk of stranded investments (Next ID p5). Especially the issues of billing and collection are seen as necessary prerequisites for introducing value added services in an NGN context. In this respect it is referred to Art 12 (1) UD and Art.12 FD, where the principle of today's unified billing with regard to value-added services is mandated **(Next ID)**.

Interoperability as a market issue

A larger group of (mainly incumbent) operators and some associations address the question of interoperability being largely a market issue.

Two associations strongly argue for this argument **(ETP)** and that the standardisation of interfaces – although agreed as an important issue – would be no task for NRAs **(BREKO)**. One operator argues that vendor interoperability is a business matter and that there would simply be no need for regulatory intervention. Both interoperability of functional elements within the own network and interoperability between functional elements on inter-operator borders would be in the interest of the operators involved and should not be an object of regulatory intervention. Furthermore, some degree of incompatibility between functional elements is always possible due to a degree of freedom in the application of standards **(PT)**. A further operator underlines that interoperability issues are strictly related to service interconnection between different operators to provide common end-to-end services requiring common service profiles definition, service-dependent control information and user data coding and exchange, and that interoperability is not an issue related to the choice of specific equipment or

vendor **(TI)**. Another position taken up is vendor interoperability being seen as a pre-requisite for operator interoperability and overall concepts needed to be laid out as soon as possible **(Tele2)**.

One operator suggests that NRAs should encourage interoperability. However, mandatory regulation as a general rule could be detrimental for industry and users due to higher costs and lack of flexibility **(Telefónica)**. Another operator states that regulation should identify and focus on enduring bottlenecks, ensuring equivalence in provision of bottleneck services and deregulating downstream. Connection to the bottlenecks should be open and not unduly controlled by the firm controlling the bottleneck, therefore designed to use international standards from the start. NRAs should seek commitments from incumbents to consult on interconnection topology and participate in independent national standards setting **(BT)**. A similar point of view is taken by another operator suggesting to encourage participation to relevant standardisation bodies in order to develop fully interoperable solutions **(OTE)**. Furthermore, the application of ITU and ETSI standards, for architecture, functionalities and protocols, are seen by one operator as the only solution for securing service interconnection and interoperability **(TI)**. Another operator is sceptical whether full interoperability for all services from the initial launch in the market is achievable, and whether that would be commercially attractive to operators **(Telefónica)**. One other aspect raised amongst the consultation responses is the need for harmonization and consistent implementation of regulatory approaches of pan-European business services **(FT)**.

Incentives to provide interoperability

One association points out that network operators would have strong incentives to ensure connectivity between networks and interoperability of services **(ETNO)**. According to their and another operator's opinion, no operator would be in a position to deny interconnection and therefore even has an incentive to provide interconnection by open and standardised interfaces **(DTAG, ETNO)**. Both clarify that regulatory intervention is neither needed regarding vendor nor operator interoperability. In the case of vendor interoperability operators would have incentives to choose standardized network equipment specified by standardization bodies; regarding operator interoperability due to competition operators would have incentives to interconnect with other networks to enable any-to-any communication, and to provide open and standardized interfaces to independent service providers to generate traffic and optimise network utilisation usage **(DTAG, ETNO)**. Thus, migration to NGNs is even seen by one operator as fostering service competition implying that regulatory intervention would not be needed **(DTAG)**. Accordingly, one association takes up the position that due to network operators' own incentives to interconnect, powers to ensure end-to-end connectivity under Art 5 AD should generally not be applied in NGNs **(ETNO)**.

One association argues that operators would generally support interoperability and especially the mobile industry would have promoted the adoption of open standards

(IPX architecture) to support the cause. Regulatory intervention should be proportionate and limited to SMP operators and where demonstrated problems exist **(GSMA,)**.

One operator focuses on the transport level, where (at least for non-SMP operators) it would be rather unlikely that operators limit interoperability or interconnection **(Arcor)**.

ERG Considerations

The ERG clarifies that, in line with Recital 30 FD, standardisation should remain primarily a market-driven process. Nevertheless NRAs need to monitor carefully whether lack of interoperability causes competitive problems. In order to ensure interoperability NRAs should ensure that the reference offer can contain a provision regarding a "minimum set of standards" applicable or refers to a set of specific standards.

7) Impact of charging mechanism on transport bottlenecks (C.3.2)

How do you assess different wholesale charging mechanisms in the light of the transport-related bottlenecks?

Consultation Responses

Two incumbents disagree with the assumption that CPNP is a mechanism allowing the abuse of physical bottleneck or even doubt that Bill & Keep automatically avoids this problem **(FT, similar TI)**. One of the competitors does not see SMP in transport networks **(Arcor)**. More specifically, an incumbent reasons that termination bottlenecks tend to disappear with competition developing in access markets and the development of NGN with services provided by different service providers **(Telefónica)**. Also, the bottleneck associated with control over the E.164 number would diminish due other mechanisms (e.g. ENUM, IPv6) becoming popular. Generally, one respondent claims that bottlenecks that would warrant regulatory intervention cannot be determined in abstract, but require an examination of the specific market evidence. As regards Internet backbone competition, the regulator should continue to monitor whether SMP emerges **(GSMA)**. In contrast to these views a competitor reasons that the main problem with transport interconnection, if carried out in a peering and transit style, might be the reversal of the termination monopoly (the bigger operator may charge both for termination provided for others and termination services demanded), enhancing SMP **(QSC)**.

ERG Considerations

In the light of the responses the ERG upholds its analysis that the termination bottleneck and the possibility to exploit SMP results from the interplay of three factors: a) physical bottleneck for termination; b) control of the E-164 number; c) charging mechanisms. As regards to the bottleneck character of access networks it was al-

ready pointed out in the "ERG Opinion on Regulatory Principles of NGA" (ERG (07) 16rev2) that NGA networks may be more likely reinforce rather than fundamentally change the economics of local access networks.

Contrary to what is claimed in some responses, the ERG considers that NGNs are in themselves unlikely to change market power in the market for termination of voice services as long as CPNP is the charging mechanism used. Application of the CPNP regimes therefore ultimately perpetuates the need for regulation to obtain cost-oriented termination rates. Moreover, even if customers have different access options available to them, the calling party still encounters a physical terminating bottleneck.

Therefore, where Bill & Keep applies it is unlikely that SMP will be the outcome of a market analysis of the termination market. Bill & Keep significantly reduces the need for regulatory intervention as long as the transit market on IP-backbones and the broadband access market are sufficiently competitive.

Furthermore, contrary to some responses, at present the ERG does not see that other addressing mechanisms such as ENUM will alleviate the problem resulting from control over the E-164 number or any other private addressing mechanism.

8) Bottlenecks and SMP positions (C.3)

Do you see other areas (potential bottlenecks) for regulatory intervention?

Consultation Responses

Some responses hold the view that there are no new bottlenecks and that those existing in the PSTN are largely absent **(DTAG, ETNO, similar BT, GSMA, PT)**. One incumbent recommends NRAs to consider replicability and end-to-end connectivity on an ongoing basis **(BT)**. More specifically, an association reasons that call severs, core IMS and application servers are replicable and vertical interfaces between layers do not constitute bottlenecks **(GSMA)**. In two responses it is argued that due to strong competition network operators would have no incentive to worsen QoS or to discriminate between customers as regards QoS **(DTAG, similar ETNO)**. Also, network operators would have incentives to open up their network for service providers, to utilize standardized interfaces and to offer adequate wholesale products.

In contrast to from these views other respondents see scope for the emergence of new bottlenecks **(Arcor, ECTA, QSC, Tele2)** either stating that the list of service related bottlenecks is quite concise **(QSC)** or mentioning new bottlenecks such as authentication and presence services **(ECTA)**. Another respondent mentions access to the SIP server **(Arcor)**. Only the Voice over Internet provider could address the customer as it knows the linkage between the E-164 number and the associated IP-address. On the other hand, another respondent argues that with Bill & Keep not

much market power could be derived from knowing this linkage **(QSC)**. Finally, one incumbent sees scope for new bottlenecks by Internet service providers, contents aggregators, DRM providers, etc **(Telefónica)**.

Two responses stress that it would be naïve to believe that a player in NGN would cooperate in the manner another operator might in the context of internet-based services **(ECTA)**. Rather, NGN platform operators are expected to restrict the functionality open to third parties to provide themselves competitive gain **(Tele2)**.

ERG Considerations

The ERG does not agree with the general claim raised by some respondents that there will be no new bottlenecks in NGNs. From the ERG's point of view it is important to observe the ongoing migration towards IP-based networks and to monitor carefully whether new bottlenecks leading to SMP positions will emerge or whether certain bottlenecks will disappear.

9) Measures based on USO directive (C.4.2)

a) Do you consider it sufficient to potentially regulate minimum quality (Art. 22 USD new para 3)?

Consultation Responses

Most respondents claim that any minimum quality of services should be proposed by the industry and the well established standardization bodies and not by NRAs or the Commission (**Arcor, BREKO, BT, Deutsche Telekom, ECTA, ETNO, GSMA, Orange-FT-Group, Telefónica**). Regulatory intervention in the context of technical implementation of minimum quality of service would not be needed and could even harm the industry as inefficient quality specifications could also lead to higher prices to the detriment of customers (**Deutsche Telekom, ETNO, GSMA, Orange-FT-Group, Telecom Italia, Telefónica**).

One undertaking (**QSC**) is of other opinion. Due to their comment minimum quality should only be the first step. Especially if the SMP operator ensures higher quality within own networks, regulators must ensure non-discrimination. An incumbent (**Portugal Telecom**) supports that NRAs may specify QoS requirements, if judged necessary, after consultations, to be followed by all operators.

Another commentator (**Cable Europe**) connects the subject with ongoing net neutrality discussions but finds the situation in Europe totally different from that in the United States. They believe that it is essential that regulation of quality of service must be flexible enough to promote network management if traffic flows are to be optimized.

b) Does this require additional regulation at the wholesale level?

Consultation Responses

Most respondents do not see any need for additional regulation at the wholesale level. They state that there are no current problems in this area that would justify additional wholesale regulation (**Arcor, Cable Europe, GSMA, Telefónica**). Some respondents (**Orange-FT-Group, ETNO**) claim that service level agreements between operators already exist and that the best answer would be to let the market forces conclude commercial agreements which allow a provider to make commitments on a level of quality of service when delivering offers to its end-users.

One undertaking (**QSC**) asks for additional regulation at the wholesale level, for instance a minimum set of codecs.

c) What is your opinion on ERG's consideration that the power to set minimum quality of service requirements (both on end-user and network level) should be entrusted directly to NRAs?

Consultation Responses

As stated above most respondents claim that any minimum quality of services should be proposed by the industry and the well established standardization bodies and not by NRAs or the Commission (**Arcor, Cable Europe, Deutsche Telekom, GSMA, Orange-FT-Group**).

Others view (**ECTA, QSC)** see a certain necessity to centralize the setting of quality parameters because different NRAs setting different quality requirements may reduce competitiveness for European businesses. An incumbent (**OTE**) states that NRAs should monitor quality and provide end users with the tools to be able to select between providers based on prices and quality. A competitor (**TELE2**) sees a need for a set of quality metrics, and if this cannot be done by industry then some form of regulatory intervention may be necessary. Although one undertaking (**Telecom Italia**) is against additional regulation they state that it should be considered that quality measures should be harmonized on EU basis. Another commentator (**GSMA**), like the previous one against additional regulation, holds an opposed view whereby many communications markets will remain national for the foreseeable future and therefore it would seem appropriate for powers of this type to remain with NRAs. Also one incumbent (**Portugal Telecom**) favours a national approach and believes that NRAs are the best place to know the concrete situation in each country for a plausible set of common SLAs.

ERG Considerations

Considering the responses the ERG acknowledges that QoS issues are to be dealt with by the industry and standardization bodies in the first instance. Nevertheless,

NRAs need to monitor carefully whether market mechanism lead to a level playing field among operators. Thus, regulators could require operators to provide public information about QoS, based on articles 20 and 22 UD. ERG therefore welcomes the proposed provision in Art. 22 para 3 UD, but considers that the power to set minimum quality of service requirements should be entrusted directly to NRAs.

10) Costing and Pricing (C.5)

a) Do you agree with the description of the relevant change regarding the cost level, the cost drivers and the cost structure?

Consultation Responses

Several competitors agree to the description as it concerns the relevant changes **(Arcor, QSC, Tele2),** and also an incumbent states that a move away from "price per minute" might be a necessary step as that concept would not properly take into account the differences among traffic types **(Telecom Italia)**. One association, whilst agreeing, points out that this step has to be carefully considered. Furthermore termination rates have to be based on costs whereas differences must be justified by differences in relative costs **(ECTA)**.

However, due to the fact that there will be a period of a parallel running, which in the opinion of several respondents causes additional costs, several incumbents, one competitor and some associations do not agree with the ERG's description that NGN might become the modern equivalent asset **(Arcor, BREKO, BT, DTAG, ETNO, ETP, FT, OTE)**. In particular some incumbents stress there would not only be a period of parallel running but, as it was not proven that a pure NGN will be able to fully replace and offer the same functionalities as the legacy networks, PSTN would still be necessary for commercial, operational and regulatory reasons resulting in additional costs that would have to be taken into consideration **(DTAG, FT)**. One association and one incumbent recommend a review of the proposal to strictly apply the costs of "the alleged low-cost IP based technology" **(DTAG, ETNO)**. Furthermore four incumbents and one association are of the opinion that there are some uncertainties about the cost structure and cost drivers of NGN in comparison to PSTN: It is not obvious that there might be lower costs due to fewer physical layers; high investment costs, former investment and stranded assets would have to be considered as well **(DTAG, ETNO, FT, OTE, Telefónica)**. In the beginning NGNs would have to deal with equipment that is not yet mature, life cycles would be shorter and upgrades more costly than in the PSTN world, states one incumbent **(BT)**. Three incumbents point out that possible reduced costs might be cancelled out if accompanying new services are not accepted by the market resulting in falling volumes **(BT, FT, Telefónica)**. Higher fixed costs, one association says, also resulted from investments in the mobile networks whereas per call cost savings were rather limited **(GSMA)**.

Some emphasis is placed on the relevance of distance. Whereas one incumbent thinks that distance might still be a relevant factor **(PT)**, two incumbents and one association see little influence on costs as this was a factor of centralisation **(ETNO, FT, DTAG)**.

Apart from fixed costs some incumbents and competitors also focused on variable costs. If they were only based on efficient technology start-up costs would be ignored **(BT)**, and due to the variety of services provided they could be even higher than they are at the moment (e.g. different QoS even for voice) **(Telefónica)**. They could also increase as not all platforms were designed to provide IP routing capability **(Tele2)**. One incumbent asks for a pricing regime during the migration period in which there is no arbitrage between NGN IC and PSTN IC **(OTE)**.

One incumbent explicitly stresses the significant investment risks and suggest to postpone the migration to IP IC if these are not accounted for **(PT)**. As a solution one incumbent asks for the risks to be shared by all stakeholders that would benefit from the investments made by another party **(TI)**. Thus other incumbents and an association ask for new cost models to be developed in order to promote competition in NGN or support the bottom up approach albeit not a Greenfield bottom-up approach **(ETP, FT, Telefónica, TI)**. According to one incumbent there could even be different regimes, e.g. depending on the network layer or QoS **(PT)**.

b) For a pricing regime under CPNP, which of the wholesale pricing regimes (EBC or CBC) do you consider more appropriate for IP interconnection?

Consultation Responses

Concerning the wholesale pricing regime there is no uniform opinion within the market. Some responses prefer both EBC – as being more appropriate for access seekers with uncertainty over demand – and CBC – as being able to guarantee bandwidth at a lower cost – or a combination of both regimes on which the market should decide **(Arcor, ECTA, FT, GSMA, PT, Telefónica)**. On the other hand some incumbents and competitors prefer EBC whereas CBC is said to be more complicated and only presented questions and limitations if used in NGNs **(BT, QSC, Tele2, Telefónica)**. However, one incumbent preferring EBC also sees an opportunity for CBC in an NGN world but suggests NRAs might be involved depending on how mature the commercial relationship in each country is **(BT)**.

Independently from the preferred pricing regime especially the incumbents and some associations are of the opinion that the decision regarding which regime should be chosen is a market issue and that NRAs should avoid the imposition of one model. Otherwise there was a risk of inefficiency, and market players could be hindered to chose the model that fits their needs best (**DTAG, ETP, GSMA, PT, Telefónica)**.

ERG Considerations

Common and fixed costs of NGNs will represent a high percentage of total costs with a relatively low percentage of costs incremental to individual products or services.

In general, the cost of efficient service provision should be used as the cost standard for approval of interconnection rates. The pricing should be valid irrespective of whether interconnection is realized via circuit-switched or packet-switched networks, since strict application of the cost standard of long-run incremental costs requires the efficient technology used by the market players to be taken as a basis.

Based on the hypothesis that the economic rationale for NGNs is partly based on the expectation that the costs of delivering voice services in the long run will be no higher (and probably significantly lower) than using legacy PSTN technologies, then it is reasonable for NRAs, in modelling and evaluating NGN costs and/or associated pricing decisions, to assume that the cost of voice services will be no higher than currently calculated.

11) Charging mechanisms (C.6)

a) *How do you assess the arguments with regard to the properties of the charging mechanisms CPNP and Bill & Keep raised in the sections C.6.2 – C.6.10?*

Consultation Responses

General Remarks on Charging

In particular, some incumbents point out that deciding upon the appropriate charging model should be market-driven (**DTAG, FT, OTE, Telefónica, TI, similar also GSMA, ETP**). There is no IP interconnection model that can be defined as being superior under all circumstances and different services may require different charging models. In a multi-service NGN context the most likely model is characterized by co-existence of different charging mechanism and not a “one size fits all” model. More specifically, one incumbent rejects the argument that Bill & Keep relies more on market forces; this is only the case if Bill & Keep is a market-driven outcome **(DTAG)**.

Therefore, NRAs should refrain from imposing a single interconnection model **(GSMA, ETP)**. Some incumbents see a case for regulatory intervention only when market failures are clearly defined and after a market analysis **(OTE, TI)**.

More generally, some respondents point out that deciding on the future charging mechanism is premature given demand uncertainties and business model instability **(DTAG, TI)**. They refer to the risks of changing from a proven and well established regulatory regime **(PT)**. Bill & Keep could hinder the development of innovative services **(GSMA)**. Contrary to that view, one response argues that it is timely for the

ERG to address the practical steps towards IP charging mechanisms **(Hutchison 3G)**. This respondent refers to the incentive and ability of operators to delay the move to IP charging mechanisms.

An association considers that Bill & Keep might be suited as a wholesale charging mechanism without being a panacea for all issues therefore recommending deeper study before taking any conclusions **(ETCA)**.

Cost Recovery

Two responses consider CPNP to be superior as it allows network operators to recoup their costs **(DTAG, ETNO)**. One of these claims that the argument of cost recovery via the end-users would not hold due to strong retail competition **(DTAG)**. On the other hand an association argues that Bill & Keep is a more efficient way to cover costs in the presence of call externalities. According to this view costs are recovered mostly via increased fixed fees, thus implying a shift from usage to access revenues **(ECTA)**.

Focus of analysis

Next to the criticism of the properties of Bill & Keep, one association considers the discussion very voice-driven, neglecting that, depending on the service, different charging mechanisms could be optimal **(ETNO)**. Other responses argue that the analysis is focussed only on the termination monopoly and the reduction of transaction costs of NRAs **(DTAG, ETP)**. The analysis of issues such as companies transaction costs, sustainable competition, efficient investment, induced arbitrage or migration is insufficient **(DTAG)**. Also, the impact of different network technologies (fixed, mobile) needs to be analysed **(DTAG)**.

Legal / possibility for implementation

Some of the incumbents express doubts as regards the possibility to implement Bill & Keep. In this perspective Bill & Keep violates Art 8 (2) FD **(DTAG)** and the Framework does not support the mandatory adoption of Bill & Keep **(Telefónica).** Article 5 of the Framework Directive only concerns the obligation to facilitate the interconnection, not to impose a new business model such as Bill & Keep **(Telefónica, similar TI)**. Moreover, Bill & Keep is not a measure of price control as defined in Article 13 of Access Directive and can only be voluntarily adopted by operators **(Telefónica)**.

Supporting Bill & Keep

Two responses point out the “anti-club effect properties” of Bill & Keep **(QSC, ECTA)** which is considered even more relevant in the context of NGNs and flat rates. The club-effect favours larger operators with a higher percentage of on-net traffic than smaller operators. For on-net traffic the operator incurs incremental costs only but average costs for off-net traffic. Bill & Keep would strongly limit the competitive distor-

tions caused by on-net traffic. In particular operators with a large customer base have an incentive to over-recover the cost of terminating off-net traffic from the end-user in order to subsidies on-net traffic **(ECTA)**. Competition law would be too slow to tackle such issues.

Furthermore, referring to the complexities of determining termination rates, an association reasons that Bill & Keep could ensure non discrimination and a level playing field for all operators" **(ECTA)**.

A respondent favouring a move towards Internet charging principles refers to the ability of operators to the incentive and ability to delay such a move **(Hutchison 3G)**.

Bill & Keep requirements

Some responses argue that symmetry of traffic – or even of networks, costs, customer structures – is a requirement for Bill & Keep **(BREKO, DTAG, FT, ETNO, FST)**. Therefore Bill & Keep can only be a voluntarily negotiated result. A mandatory implementation would lead to market distortions putting larger network at a disadvantage (due to higher network costs) **(DTAG, ETNO)**. In the Internet multiple schemes emerged (e.g. paid transit, Internet exchanges) without regulation with Bill & Keep only being one of them **(DTAG, ETNO)**. One association particularly stressed that the assumptions (for Bill & Keep) clearly do not apply for the mobile access network where a large element of costs are traffic sensitive **(GSMA)**.

Efficient network usage

Some responses doubt whether Bill & Keep leads to efficient network usage. If the price is too low or even zero as with Bill & Keep free-riding problems and routing inefficiencies would occur **(DTAG, ETNO)**. One association points out that If Bill & Keep is applied universally, it will require significant analysis and considerable regulatory rule making and monitoring effort to avoid the risk of free-rider problems **(GSMA)**.

Effects on prices & usage

In an association's response the comparison of CPP countries with RPP/Bill & Keep countries is criticized **(GSMA)**. It is argued that in particular due to double-counts of on-net minutes usage in Bill & Keep countries is overstated by 30 % and that the mobile penetration is below the European figure. Simple international comparisons based on a single metric, such as minutes of usage or price per minute should not be used as the basis for major policy recommendations. The OECD pricing comparisons do not provide support for the ERG's argument that Bill & Keep systems with no (or low) mobile termination charges contributes to low mobile retail prices. Mobile retail prices are not noticeably cheaper in North America than in Europe. CPP also gives operators an incentive to maintain low value subscribers on their network in the expectation of revenues from inbound calls, whereas Bill & Keep threatens the sustainability of pre-paid tariffs.

Transaction costs

In some responses it is doubted whether Bill & Keep implies a reduction of transaction costs **(BREKO, DTAG, ETNO, FST, GSMA)**. CPNP would imply low transaction costs of implementation because it is well-known and because billing systems already exist. Different from this, the regulatory process under Bill & Keep involves high transaction costs because the number of PoI and their location needs to be determined **(DTAG, ETNO, GSMA)**. Savings in transaction costs did not materialize because existing billing system continue to be necessary for example for the billing of value added services **(BREKO, DTAG, ETNO, FST)**. Also, traffic volumes need to be monitored **(DTAG)**. Two responses see a need for classifying traffic according to whether the Bill & Keep requirements are met or not **(DTAG, ETNO)** and for separating traffic which is only terminated on another network and traffic transported via transit networks **(DTAG, similar PT)**.

Utility

As regards the utility of a call for the calling and the called party, two comments deem CPP more efficient as it reflects that the caller has a greater utility **(DTAG, ETNO)**. Nevertheless is very hard to determine utility of the called party.

Investment incentives

According to some responses Bill & Keep does not provide incentives to invest in infrastructure and QoS **(BREKO, BT, DTAG, ETP, FST, OTE, TI)**. Some of them claim that the incentives to invest in QoS under Bill & Keep need to be further analysed. Lack of investment incentives is due to adverse selection and the hot-potato problem under Bill & Keep **(BT, DTAG, ECTA)**.

A different view is taken by an association which also mentions risks for service quality due to the hot-potato problem. Nevertheless, it concludes that Bill & Keep could have a positive effect on investment incentives **(ECTA)**. According to this response a reciprocal Bill & Keep regime provides higher rather than lower investment incentives. The risk of degradation of QoS would depend rather on the choices made by operators than the charging regime. Furthermore, it is considered reasonable to stipulate minimum number of PoI to protect investment incentives.

Charging in the context of different transport classes

Some responses point out that the implementation of separate transport classes requires billing of different rates. Only identical qualities cause identical costs to be covered by identical charges **(Arcor, BREKO)**. Bill & Keep would not allow service differentiation **(TI)**.

Customer acceptance

Several comments emphasize that users are used to CPP at the retail level and would not accept RPP **(DTAG, ETNO, FST, GSMA, BREKO, PT)**. They implicitly assume that Bill & Keep at the wholesale level implies RPP at the retail level.

SPIT

Some responses expect that Bill & Keep would lead to a "dramatic increase" in unwanted calls (SPIT) **(BT, DTAG, ETNO, FST, PT)**. One comments refutes the ERG argument that the labour costs are a decisive factor for the occurrence of SPIT. Instead, the crucial factor is the prospect of a resulting contractual relationship with the called party **(FST)**. Also, as pointed out in other responses, in contrast with SPAM a SPIT-call cannot be filtered out in advance by some key words **(DTAG)**. For the customer the problem of SPIT is not only the content but also the ringing of the phone, which is why simply hanging up is not a solution for the customer **(DTAG, ETNO)**.

Other business models

Some respondents call for an analysis of the effects of Bill & Keep on other business models **(e.g. DTAG, ETNO, FST, Next ID, OTE, Telefónica, TI).** Different issues such as effects on carrier selection/preselection, different customer segments or premium rate and directory enquire services are mentioned. The latter could not be billed with Bill & Keep **(FST, Next ID)**. Respondents have different views whether carrier selection/preselection is still needed in an NGN context or not **(ETP, FT vs. QSC, implicitly also FST, Next ID)**. More generally, one respondent points out that current business cases implemented under CPNP conditions and that Bill & Keep could only easily be implemented in a greenfield situation **(Tele2)**.

b) How can the migration process towards all-IP infrastructures be alleviated for the following options: 1) long term goal CPNP, 2) long term goal Bill & Keep? How do you evaluate the measures and options discussed here? Please also consider problems of practical implementation.

Consultation Responses

One competitor, generally considering the document quite concise, sees a need for symmetrical termination rates **(QSC)** and an association reasons that termination rates close to costs would be a good solution for both long term goals **(ECTA)**. An incumbent reasons that in both cases the answer is evolution rather than revolution **(BT)** and determining the appropriate charging mechanisms would ultimately depend for example on the success of substitutes to Qos-assured voice. Two incumbents call for a deeper analysis of a glide path during the migration period **(DTAG, PT)**. Another respondent states that a glide-path towards a particular target should not be introduced at this time. According to an association the migration is working in a satisfactory manner driven by market forces accompanied by the PSTN interconnection

model and unregulated models of the IP world **(ETNO)**. Two responses state that a predictable migration period with parallel running of PSTN & NGN should take 5 years minimum **(FST, Next ID)**. More specifically, some respondents address arbitrage issues resulting from applying different regimes for the same service in different networks **(DTAG, ETNO, GSMA, Hutchison 3G)** or arbitrage opportunities for operators providing Voice over Internet without an own network **(Arcor)**.

c) *Assuming that different charging mechanisms would apply in different Member States: would this imply specific problems (e.g. arbitrage)? If so, how could they be addressed?*

Consultation Responses

On the one hand there are respondents who expect potential or even great arbitrage problems if Bill & Keep was implemented in Europe and CPNP elsewhere **(BT, DTAG, GSMA, Telefónica)**. If B&K was introduced in a region, operators outside would develop arrangements to route traffic via service providers within the region to also avoid paying termination charges. European operators will lose their current termination revenues earned from non-European operators, but consumers continue to pay termination charges on calls to other regions.

On the other hand there are those respondents who do not consider this a problem **(ECTA, QSC)**. Otherwise, US mobile operators would have had massive problems with international arbitrage already. Moreover, if one would want to differentiate now between national/European and international traffic, the termination problem might re-emerge", limited by bargaining power of international counterpart **(ECTA)**. Nevertheless call-back services from "non Bill & Keep countries" might endanger revenues from international calls.

d) *Do you consider that the issues mentioned here are comprehensive with regard to the application of Bill & Keep for IP-interconnection?*

Whereas a competitor expresses support by stating that there is no need for enlargement **(QSC)**, in particular incumbents and their associations mainly reiterate their claims that certain issues (such as investment incentives, recovery and allocation of common costs) are not sufficiently addressed **(e.g. BT, DTAG, ETNO)**. And from the mobile operators' perspective the way in which mobile markets operate is insufficiently considered **(GSMA)**. One respondent claims that changing to Bill & Keep would require lengthy study, nevertheless, the ERG's statement that termination fees may work as a collusion device allowing access providers to keep retail prices high may be correct in some instances **(Tele2)**.

ERG Considerations

It contrast to what is argued mainly by incumbents, that it is premature to address charging issues, the ERG considers it timely to address IP interconnection issues, including a discussion on charging mechanism. This is supported by some competitors.

Bill & Keep for the last segment of termination of the broadband access provider requires no regulatory intervention as long as the transit market on IP-backbones and the broadband access market are sufficiently competitive. Application of the CPNP regimes ultimately perpetuates the need for regulation of the termination rates (see also ERG Considerations on question 7).

The ERG is not convinced by the argument that due to retail competition Bill & Keep would not allow the same degree of cost recovery as CPNP. Competitive forces drive down retail prices only to the competitive level which allows recovery of efficiently incurred costs including a reasonable rate of return.

Since termination costs for the last segment are by definition not accounted for at the wholesale level symmetry (e.g. of traffic flows) cannot be considered a requirement for the applicability of Bill & Keep as claimed in some responses.

Given that Bill & Keep applies for the terminating segment up to the first router or switch and associated service control functions after the access/concentration network, hot potato routing applies on those parts of the network, that are excluded from the application of Bill & Keep, but where transit and peering agreements apply.

Both, CPNP and Bill & Keep provide flexibility at the retail level. The implicit assumption made by some respondents that Bill & Keep automatically implies RPP is not shared by the ERG.

With regard to the effects of Bill & Keep on usage the empirical data used indeed include a double counting effect. While acknowledging these effects to possibly weaken the quantitative strength of the argument, however, ERG holds that they do not change the conclusion that higher termination rates translate into high retail prices for originating calls and finally into lower usage.

The claim made in several responses to analyse the effects of Bill & Keep on other business models is taken up by the ERG in its work plan (note: the discussion on the need for carrier selection/preselection is rather a remedies than an interconnection issue). It is acknowledged that an introduction of Bill & Keep including the change of the cost recovery mechanism may imply that a transition from the current regime is a drastic and disruptive change for PSTN voice operators. Also the claim for a more comprehensive analysis of the transition process is reflected in the ERG's work plan mentioning migration as an issue meriting further study.

Some NRAs consider Bill & Keep a promising concept that should be aimed at in the medium to longer term. They focus on further studying how to best achieve this goal including finding answers that arise in a transition phase to a new system. Some NRA's, while recognising the merits of Bill & Keep, rather emphasize the risks implied by a change from the well-established regulatory regime of mainstream PSTN and mobile services and therefore see the need for further study.

Part 2: Country Studies

Questions:

a) Relevance of IP-interconnection

b) Complaints from competitors/disputes

c) Actions taken or planned by NRA with regard to NGN core and or IP-interconnection

d) Number of network nodes

e) Number of interconnection points

f) Definition of local interconnection

g) Migration scenario

Previous answers to questions a-c are to be found in Chapter 2 of the “Report on IP Interconnection” (ERG (07) 09) and answers to questions d-f in Chapter 3.2

Countries:

1) Austria
2) Cyprus
3) Denmark
4) France
5) Germany
6) Greece
7) Ireland
8) Italy
9) The Netherlands
10) Norway
11) Poland
12) Portugal
13) Romania
14) Slovenia
15) Spain
16) Switzerland
17) UK

2.1 Austria

The regulatory discussion with regard to NGN has significantly advanced in 2007 mainly caused by two developments. In 2007, the incumbent started rolling out a TV service in ur-

ban areas in order to improve its ability to compete with CATV triple play offers (voice/BB/TV). The NRA itself has started a discussion process in June 2007 by launching 3 papers for public consultation which covers topics like “Separation”, “Next Generation Regulation” and “NGN accounting”. The Paper “Next Generation Regulation” discusses the consequences of the deployment of Next Generation Networks for regulatory access obligations, investment incentives for communication service providers in next generation networks, future interconnection billing models, migration issues with regard to points of interconnection etc. The responses to this consultation paper have been subject to a public discussion during a regulatory workshop for operators and other stakeholders in October 2007 leading to the establishment of an industry working group on NGA/NGN matters starting work in early 2008. That industry working group initiated and moderated by the Austrian NRA addresses crucial questions regarding the (possible) migration to NGA and NGN in Austria. That process is accompanied by expert workshops on related issues also organised by the Austrian NRA. Another dialogue which has been initiated covers the future billing method to be used when settling interconnection costs between next generation networks and the question whether “Bill and keep” might be a preferable billing method within an NGN environment compared to the existing system of “Receiving Party’ s Network Pays”.

a) Relevance of IP-interconnection

IP interconnection has not been subject to proceedings before the NRA up to now.

b) Complaints from competitors/disputes

Several operators have initiated complaints before the NRA concerning a deterioration of their broadband services caused by deployment of DSLAMs in some of the incumbent’s Greenfield distribution frames. The issue has been discussed within the above mentioned industry working group on NGA/NGN matters leading to a work-around solution by means of applying specific deployment rules. However, proceedings of some cases brought forward to the NRA are still ongoing.

c) Actions taken or planned by NRA with regard to NGN core and/or IP-interconnection

According to the NRA’s working programme, the discussion on billing systems on wholesale level has been continued in 2008. In addition, the above mentioned NGA/NGN industry working group has been established in February 2008 to further discuss aspects of migrating incumbent’s public switched telephone network to a Next Generation Network. In a first step the group concentrates on Next Generation Access issues. The three major topics discussed so far regard the issue of spectrum management on the local loop, aspects of access to street cabinets and associated facilities as well as the topic of enhanced bitstream access products.

d-g) Number of network nodes/Number of interconnection points/Definition of local interconnection/Migration scenario

There are no specific plans to change the existing number of network nodes or number of interconnection points. Also, the definition of local interconnection will remain as it is for the time being. This might change in case proceedings before the NRA are initiated with regard to one of these topics.

2.2 Cyprus

Currently in Cyprus, the issue of IP interconnection is in a relatively early stage of assessment by OCECPR as well as by the incumbent operator and OLOs.

OCECPR, in order to be able to evaluate the evolving status of IP interconnection has conducted in May 2007 a workshop with market players based on NGN. During this workshop issues like infrastructure changes and architectural principles, regulatory intervention, migration procedures and costing models were examined.

Moreover, several discussions took place in late 2007 with the incumbent operator, about future plans for NGN interconnection, which were focused in issues like:

- Definition of interconnection points
- New retail products
- Presentation of IP-MPLS and IMS system architecture
- Charging principles
- Convergence services
- Migration Procedures

OCECPR is in the process of developing guiding principles in order to clearly identify the regulatory challenges and evaluate regulatory options on IP-IC.

2.3 Denmark

a) Relevance of IP-interconnection

In regards to the question concerning the current relevance of IP-interconnection in Denmark NITA has not yet outlined the actual use, deployment and extension of IP- interconnection in the incumbent’s backbone infrastructure.

b) Complaints from competitors/disputes

Furthermore, as of yet, there has been no complaints or disputes which have caused NITA to investigate further into this topic.

c) Actions taken or planned by NRA with regard to NGN core and/or IP-interconnection

NITA has however taken some initiatives to build knowledge on the NGN development – a NGN hearing has been carried out in 2006. NGN related issues have been dealt with on a conference arranged 2007 by NITA. Besides that NGN was also raised as a subject in connection with the strategic review when mapping the competitive situation on the Danish telecom market.

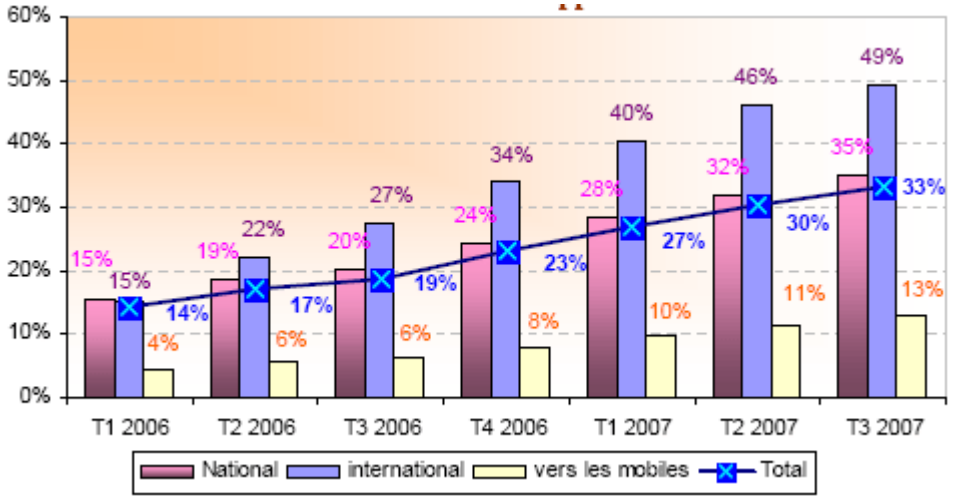
The conclusion drawn by NITA based on hearing statements from the market players and the observations made by NITA was that IP-interconnection still is an emerging market. It is expected that IP-interconnection will play a major role in the coming years in connection with the anticipated increasing development on a.o. VOIP services and the use of IP in the backbone networks. Consequently IP-based services will be considered by NITA in connection with the upcoming second round of market analyses.

NITA has already taken initiative to make a renewed assessment of the current use, deployment and extension of IP-interconnection. NITA will be sure to circulate any information's that will arise from this analysis.

2.4 France

At the end of 2007, 5 million local loops were unbundled in France (from 32 millions local loops) and the volume of VoIP communications represents one third of the volume of communications from fixed lines. Triple play services are widespread within residential customers whereas VoIP remains limited within the business market.

Figure 1: Percentage of IP traffic from fixed lines to different destinations



Source : http://www.art-telecom.fr/index.php?id=36

Before launching major plans to roll out higher-bandwidth access in France (described in the dedicated NGN Access document), most operators have migrated their core networks towards NGN, based on Gigabit Ethernet or a mixture with ATM/SDH technology. Nevertheless, Gigabit Ethernet seems the main transport technology to be used in the future, dimensioned as best effort or using in addition MPLS to provide extra QoS benefits.

At present, interconnection between operators is managed through SS7, requiring internal SS7/IP conversions within the networks when using IP internally. Full IP interconnection is at early stage but many operators consider SIP-T as being a signalling protocol adapted to handle voice over IP between interconnected networks in the short term.

The French incumbent (France Télécom) has started rolling out a pre-IMS network, based on an overlay strategy: equipments are progressively removed from the PSTN and new customers are connected primarily to the voice over broadband network. Consequently, France Télécom has reduced its number of TDM switches, below 500 local switches and is expecting in the long term to keep reduced number of customers on its PSTN network, studying the possible emulation of PSTN devices on the VoB network. Nonetheless, no date of the “PSTN switch over” has been announced so far.

Currently, France Télécom offers triple play services (VoIP, Internet and TV) at 1000 MDFs from 13000 MDFs total. Within its NGN network, IP routing is centralized in the core of the network for any kind of service. Interconnection with France Télécom NGN network is available at 9 points of presence, belonging to the 18 global points of presence available for its PSTN interconnection at the regional level: both interconnections are using SS7 signaling. Currently, SS7 interconnection is available at two levels: regional level on 18 tandem switches or at local level on 500 local switches.

2.5 Germany

a-c) Relevance / complaints / actions taken

The issue of IP interconnection increasingly gains relevance. One reason for this is the migration towards all IP networks which Deutsche Telekom intends to accomplish by 2012. According to a competitors’s association (Bundesverband Breitbandkommunikation – BREKO) 51% of its affiliated companies want to have implemented IP in the backbone networks in 2009.[1] Another contributing factor is the diffusion of VoIP services. Official complaints have not yet been filed with BNetzA.

BNetzA picked up the debate at an early stage in August 2005, when it established the advisory project group “Framework Conditions for the Interconnection of IP-based Networks”. This group - composed of high level experts from the market and led by BNetzA – had no power to make legally binding decisions. Its target was to analyse the framework conditions

1 BREKO, press conference, May 7 2007, available at: www.brekoverband.de.

for interconnection of IP-based networks and to develop possible scenarios and migration paths from the current narrowband interconnection regime to a new IP interconnection regime. In order to support the working group BNetzA had commissioned expert studies[2] focussing inter alia on the challenges arising from the coexistence of different accounting and interconnection regimes in the PSTN world and the Internet world.

On 15 December 2006 the project group published its Final Report. In January 2007, BNetzA conducted a public consultation to which 26 comments were received from companies, associations and other institutions. Following an analysis of these studies BNetzA published (11 February 2008) "Key Elements of IP Interconnection" as well as a synopsis of the comments.[3]

Although it is deemed too early for definite decisions BNetzA considers it crucial to early address the issue of IP interconnection in order to be prepared for any regulatory decisions possibly to be made in the future. BNetzA's "Key Elements" reflect the current state of the debate in Germany acknowledging that many issues are still open due to lacking practical experiences with interconnection of IP-based networks and in particular voice services.

Therefore, transparency on the further development of networks is a crucial requirement to assure planning reliability for companies making investment decisions. Transparency on the incumbent's migration plans was demanded in many comments.

Quality differentiation

A group of market players that contributed to the Final Report suggested a differentiation between Voice over NGN (VoNGN) and Voice over Internet (VoI). Accordingly, they requested that PSTN and NGN termination should have the same price level whereas a lower level should be applied for VoI. Such a differentiation would require a flagging of different service categories.

In the consultation it turned out that there is no consensus among market player on this suggested differentiation. On the one hand comments from e.g. incumbents and mobile operators stressed that VoNGN delivers a "predictable" quality which was not the case with VoI due to its best effort character. Moreover, they considered over-dimensioning an inefficient approach. On the other hand Internet companies as well as some network operators stated that in general there is no quality difference between VoNGN and VoI and that over-dimensioning is "efficient and applied in backbones". Whereas the first group advocated differentiated separate termination prices (PSTN/NGN vs. Internet) the latter rejected this idea.

---

2 Prof. Vogelsang (Boston University) „Abrechnungssysteme und Zusammenschaltungsregime aus ökonomischer Sicht"); Scott Marcus (WIK -Consult GmbH) „Framework for Interconnection of IP-based Networks – Accounting Systems and Interconnection Regimes in the USA and the USA"; Prof. Klaus Hackbarth, Dr. Gabriele Kulenkampff (Univ. de Cantabria / WIK -Consult GmbH) „Technische Aspekte der Zusammenschaltung in IP-basierten Netzen unter besonderer Berücksichtigung von VoIP".

3 All documents (Final Report, studies, „Key elements of IP Interconnections", synopsis) are available at www.bnetza.de.

In its “Key Elements of IP Interconnection” BNetzA concludes that, for the time being, there are no sufficiently reliable criteria based on quality guarantees for distinguishing retail voice services. Although being based on a best-effort approach, VoIP products are assumed to currently provide a similar end-to-end quality like VoNGN. Thus, there is no basis for service differentiated interconnection products (for VoNGN or VoI respectively). Consequently, price differentiation for interconnection services does not seem to be justified at this stage.

Technical issues of interconnection are dealt with in a NGN working group of the AKNN[4]. The document „Konzept für die Zusammenschaltung von Next Generation Networks“ (Version 1.0.0, as of: 08.05.2007) was finalized in May 2007.[5] The concept includes definitions for the interconnection of „NGN networks“ for transmitting several services over Internet Protocol (IP). Voice services (VoIP) are given priority in the initial phase. A mandate has since been given to the UAK NGN to consider additional services.

The AKNN has developed methods for measuring quality without having made determinations on voice or termination quality yet.

Wholesale billing regime

No final decision was made in the Final Report with regard to the wholesale billing regime. Some experts considered a dual regime with bill & keep in the concentrator network conceivable, other rejected this concept. In the consultation, a majority of comments disagreed with bill & keep.

In the short run, BNetzA does not expect bill & keep to be implemented on a broad scale in the market. Nevertheless, bill & keep might be reasonable option (at least) for the transport layer in the long run.

d)-e) Number of network nodes and points of interconnection

In the Final Report a number of not more than 100 IP core network nodes was expected in the long. Thus, these 100 network nodes are considered the upper limit for the number of IP points of interconnection. Comments from the “PSTN world” by and large agreed to this figure whereas comments not only from the “Internet world” but also some city carriers considered this figure “highly inefficient” because IP networks operators used to exchange traffic at 1-3 points.

---

4 Arbeitskreis für technische und betriebliche Fragen der Nummerierung und Netzzusammenschaltung (Study group on technical and operatinal questions of numbering and network interconnection). The AKNN is a self-organising working group of the telecommunications operators and manufacturers in Germany. BNetzA is a nonvoting member of the AKNN.

5 The quoted document (page 5 et seq.) is based upon the ITU-T’s NGN definition (see footnote 1) but considers it to be adequate if certain criteria („Minimum Criteria“) are met. Any criteria exceeding this are not required features for an NGN, however.

BNetzA expects the number of points of interconnection to decline in packet-based networks compared to switch-based networks. Moreover, it is assumed that the existing tariff structure (local, transit, double-transit) is likely to become obsolete in future networks.

f) Definition of local interconnection

This term is not yet defined.

g) Migration scenario

It is assumed that costs of packet-switched networks are lower than those of circuit-switched networks. To attenuate the disruptions of immediately basing interconnection fees on the lower costs of packet-based networks a migration path with gradual lowering of EBC fees towards the level of NGN costs is considered in BNetzA's "Key Elements of IP Interconnection". This concept was also suggested in the Final Report although it was not considered possible to make a determination on the length of this migration path. Several comments agreed to the idea of such a migration path.

2.6 Greece

The issues of IP interconnection and NGNs are on a very early stage of development in Greece. There is also limited demand for this type of interconnection from the operators. Thus, there is not currently any regulation governing IP interconnection and there are no complains or dispute resolutions that have been raised.

The only formal IP interconnection point in Greece is the Athens Internet Exchange (AIX) which interconnects 15 ISPs contracted with zero settlement peering agreements. Despite the above mentioned stage of NGN and IP-IC in Greece, some OLOs are already providing VoIP services (both managed and unmanaged) and a number of them offer IP-TV products over wireline broadband access.

Currently, the main effort for both the electronic communications providers and the public sector is taken on the development of broadband access and local loop unbundling. A result of this effort is the rapid development of the broadband market in Greece during the last year. Today, the collocation sites offered by the former incumbent operator (Hellenic Telecommunications Organization - OTE) are 134 (compared to 71 at the end of 2006), the unbundled local loops in Greece are above 300,000 (an increase of 1400% during 2007) and the total broadband wireline connections, including the broadband lines provided by OTE are above 1,000,000 (an increase of 108% during 2007).

It should be mentioned that these high rates were equally achieved by OTE and the OLOs, since from a total of 529,296 new broadband connections during last year, 280,000 were developed by the SMP operator and the remaining 249,000 by the OLOs. The main broadband access technologies used in the above mentioned connections are ADSL and ADSL2+ with line rates up to 24Mbps at the downstream direction.

Recently, OTE announced a project with a dominant telecom industry, for the upgrade and expansion of its transport infrastructure. Under the terms of the contract worth over 12 million euros, the telecom industry is implementing its optical services to support OTE's strategy of expanding the distribution of high-speed services in major urban and regional areas. The project is related to the upgrade of the existing optical backbone routes, which are based on synchronous digital hierarchy and dense wavelength division multiplexing technologies, the submarine link between Bari – Italy and Corfu – Greece, as well as create new optical rings throughout Greece.

From the regulatory point of view, during last year, EETT has taken several actions in order to support the development of NGN. Recently, EETT has updated the authorization regulation with several rules regarding the VoIP services. In addition EETT has proposed, according to its obligation by the Greek electronic communications law, to the ministry of Communications and Transportation a regulation regarding the rights of way for the development of wireline networks. The aim of the regulation is to provide a clear set of rules for the operations that are required in order to build ducts to support the development of electronic communication networks on public properties in the Greek territory and it is expected to clarify the rules and make it easier for the network operators to acquire the relevant licenses.

At July of 2007, EETT hosted a workshop on NGN Access, in order to inform the market players and begin a discussion with them regarding the development of NGN (specifically the FTTx technology) in Greece. The outcome of the event was that there is not a specific issue for the NGN and IP interconnection for both the OLOs and OTE in Greece. Specifically, the OLOs mentioned as a major problem the stranded investments as the result of an early NGN development while the (SMP operator) OTE states that NGN should not be regulated, in order for OTE to accelerate its evolution. In addition, EETT is in the process to review markets 2 and 3 according to the new recommendation on relevant markets issued by the EC in November of 2007. According to the schedule, the above mentioned review will be finished by November of 2008.

Recently, the Greek minister of Communications and Transportations announced a new major development program which includes several actions. As announced, the actions of the program, with a total budget (covered by both public and private funds) up to 3,000,000,000 euros, will be at the field of FTTx (FTTH and FFTB) development. According to the announced schedule, by the end of Q2 of this year the ministry will give more information regarding the specific actions and steps of the program.

In addition to the above mentioned actions, there are several active public funding projects, co-funded by the European Fund for Regional Development (EFRD), to support information technology and telecommunication investments. These projects mainly focus on the development of telecommunication networks for the public sector to support e-government and e-health operations. Several projects are in the field of municipal fiber optic networks to be used by the public sector. The major project for broadband development in regional areas of Greece is a project entitled: “Funding of private-sector companies for the development of broadband access in the Regional Areas of Greece” which is part of the Operational Program

"Information Society". The project involves the development of broadband infrastructure and the provision of broadband services outside the urban areas of Athens and Thessaloniki. The total budget of the project amounts to 210,000,000 euros, of which 50% is public spending and 50% private participation. The project has been included in the Operational Program Information Society of the 3rd Community Support Framework and is co-funded at 70% by the European Fund for Regional Development (EFRD) and at 30% by national funds. Until now all the Operators that are involved into this program have developed the main parts of their core network, which is based on fiber optic rings in urban areas and wireless point to point connections at the rural areas, and they have installed their access nodes (MSANs) at the collocation sites offered by (OTE).

2.7 Ireland

a) Relevance of IP-interconnection

There are currently no regulations governing IP interconnection in Ireland, although several parties have completed peering agreements. They have been achieved solely through commercial negotiation.

b) Complaints from competitors/disputes

There have been no complaints from competitors or formal disputes raised in relation to this matter.

c) Actions taken or planned by NRA with regard to NGN core and/or IP-interconnection

ComReg are currently hosting an industry forum to deal with the introduction of NGN (in general), the terms of reference of which include:

- What is the Network Topology Moving Forward?
- How will the Physical Network Architecture evolve to arrive at the target NGN architecture?
- What new functionality will be added and when?
- When will existing functionality no longer exist?
- What are the Technical Impacts of the move to NGN?
- How will the technical (both H/W and S/W) impacts of the move to NGN be communicated and operators kept informed of same?
- What is the Product Roadmap?

- What will the impact be of the transition on existing network products and what new products will be available and when?

d) Number of network nodes / e) Number of interconnection points

As these are commercially negotiated agreements, there is no clear information on the number of nodes that are involved in IP interconnection. However, anecdotal evidence would indicate that this is no more than 5 or 6. Most peering occurs at the INEX.

f) Definition of local interconnection

To the best of ComReg's knowledge there are no local IP interconnection arrangements in place at this time.

g) Migration scenario

Not relevant as there are no local IP interconnection arrangements in place.

2.8 Italy

a) Relevance of IP-interconnection

Several parties are using peering agreements both direct or using NAP. They have been achieved solely through commercial negotiation.

AGCOM has introduced an IP interconnection obligation to SMP Operator in MK 8,9 10 according to the principle of technological neutrality, temporarily adopting the same PSTN economical conditions, as far as an agreement is reached on the technical specifications to allow direct IP-IC. Up to now a specific proceeding is open for the definition of such technical interfaces.

In addition, using Article 5.1 and 5.2 AGCOM has set a symmetrical obligation to adopt the most efficient way to interconnect networks to allow the interoperability of VoIP services (this means that whenever IP interconnection is more efficient than CSS7 interconnection, IP interconnection should be adopted). In addition AGCOM has introduced the obligation for Operators to give access to their technical interface/protocols and to all the technologies necessary to allow interoperability of VoIP services. Standard protocols should be adopted whenever possible.

b) Complaints from competitors/disputes

There have been no complaints from big OLOs or formal disputes raised in relation to this matter. However small nomadic VoIP providers are asking for the definition of technical interfaces for direct IP interconnection.

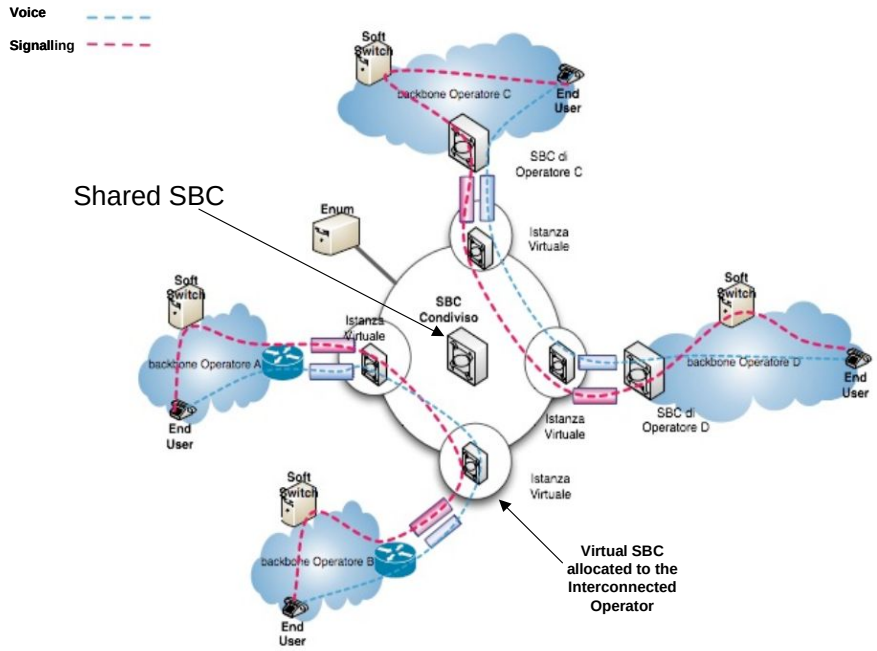
c) Actions taken or planned by NRA with regard to NGN core and/or IP-interconnection

AGCOM is currently carrying out a proceeding for the definition of technical interfaces for IP interconnection. A first working paper on IP interconnection by AGCOM has gone though a public consultation process. The main comments from stakeholders can be summarised as follows:

- Incumbent and infrustructured operators position on IP-IC reference standards and pricing
  - Adoption of a standard that allows both “carrier grade” voice (current PATS) and “best effort” VoIP (e.g. nomadic services);
  - Adoption of a single NGN SoIX-IC approach as defined by ETSI (ITU) which allows a control of QoS provided and the resource management;
  - Current NAP IP-IC model for best effort Internet is not applicable for VoIP Interconnection;
  - Neutral Access Point (NAP) model may become compatible with ETSI approach as long as such standard is adopted;
  - Mapping between E.164 and IP, based both on ENUM and on proprietary Data Base (ENUM may be the final target).
  - Application of current origination, transit and termination wholesale pricing models.
  - Adoption of SIP protocol as defined by ETSI/3GPP (standard ETSI ES 283 003/TS 124 229).
  - Adoption of ITU-T la Racc. Q.3401, which defines IC interface NNI for VoIP in the NGNs;
  - Adoption of ETSI/3GPP EN 383 001/3GPP TS 29.163 for the interworking with PSTN/ISDN-ISUP,
  - Adoption of IWF allows interworking with H.323 signalling (ETSI TS 101 883)
- Internet Service Provider reference models
  - Use of the Session Border Controller to provide:
    1. Logical and physical separation between operators’ VoIP domains
    2. Possible signaling protocol translation and voice transcoding
    3. Security
    4. Recording of traffic volume and data for billing
    5. Supported standards: SIP, SIP-T, H.323

- Use of NAP model for interconnection (see example)

Figure 2: Use of NAP model for interconnection



- Definition of protocol requirements that each Operator has to be compliant with at the IC-IP point to be interoperable as follows:
  - Signalling: at least on between
    - ITU H.323 v4
    - SIPv2 (RFC2543)
    - SIP-T (RFC3372 e RFC3204
    - SIP over TCP (RFC3261)
    - SIP IMS
  - DTMF management: at least one between
    - G.711 in band
    - RFC 2833
    - H.245 signal / alphanumeric
    - G.711 to RFC 2833
  - Codecs: G.711, PCM at 80kbps, MOS 4.0 plus at least one between

- o G.729
- o G.729B
- o G.726
- o G.723.1
- o iLBC

- Use of infrustructure ENUM (also Carrier ENUM) based on Tier1 (managed by all Operators) and Tier2 (managed by each single Operator)

d) Number of network nodes / e) Number of interconnection points

There are 12 interconnection points to SMP NGN for future IP interconnection. In addition most NAP (commercially agreed) IP peering occur in Rome and Milan.

f) Definition of local interconnection

To the best of AGCOM knowledge there are no local IP interconnection arrangements in place at this time.

g) Migration scenario

Not relevant as there are no local IP interconnection arrangements in place. Telecom Italia has migrated its core network to IP in 2004.

2.9 The Netherlands

a) Relevance of IP-interconnection

Yes. Voip is being used more and more in the Netherlands. Several parties (most notably cable operators) are in the process of setting up direct IP-based interconnects. Many of these parties are also connected to/through old TDM networks. It can be expected that these market parties will eventually put pressure on availability of IP interconnect with the incumbent and other operators to lower business costs (for conversion and maintenance of two types of infrastructure/switches). The incumbent is now partially on voip and offers connectivity to this network through a TDM transit and termination service (the transit part is not charged to competitors). See picture as in earlier answer and text earlier answers on that subject.

b) Complaints from competitors/disputes

OPTA has, in recent years, seen one or two complaints from smaller market parties regarding IP interconnection with the incumbent. Still no formal disputes pending, however.

Operators have, amongst themselves, developed an industry standard for IP-inteconnection based on SIP. OPTA has no overview of bilateral negotiations on the basis of that standard (see earlier answers too).

c) Actions taken or planned by NRA with regard to NGN core and/or IP-interconnection

Hearing regarding IP interconnection and related wholesale issues in late 2005. OPTA is monitoring development of IP strategy of the incumbent. No new developments all actions taken since, are related to access services such as unbundling, backhaul and WBA. There are no new developments on interconnection services.

d) Number of network nodes

4 / 14/ 137 / 24.000 – 25.000 (street cabinets/MSAN level)

e) Number of interconnection points

For data: 4 / 0 / 0 / 0. For telephony: 4 / 0 / 0 / 0.

f) Definition of local interconnection

A dispute has been settled in the end of 2007 for local interconnection in the PSTN network of KPN. Local interconnection has been defined in the PSTN network on the level of the MDF's. KPN has to offer local interconnection on these points for a time frame when inter-connection points get phased out due to the All-IP plans of KPN. It's unclear if the party who filed the dispute will actually take up on the offer. In the All-IP plans of KPN there doesn't seem to be plans for local interconnection points. Local interconnection on the level of the streetcabinets (MSAN's) seems totally not economical viable due to the amount of such points in such a small country.

2.10 Norway

a) Relevance of IP-interconnection

This topic is becoming more relevant since the NPT has become aware that the incumbent has started working on an offer of IP-interconnection. IP-interconnection is not yet available in the Norwegian market, and we will leave it to the incumbent to publish information about the time horizon for this work. However, the NPT has a good dialogue with the incumbent in this field and will continue to exchange information/views with regard to future IP-interconnection.

b) Complaints from competitors/disputes

No complaints have been registered with the NPT so far.

c) Actions taken or planned by NRA with regard to NGN core and/or IP-interconnection

Continued dialogue with stakeholders.

d) Number of network nodes

In a NGN: Core level: 4-5 (core routers) Distribution level: approx. 500 nodes (distribution routers) Access level: approx. 2500 nodes (DSLAM/Ethernet switch)

e) Number of interconnection points

Today, there are 13 POI (12 interconnection areas) for telephony (PSTN-platform) in Norway. Access/interconnection on the IP/MPLS-network will be available on the Distribution nodes (approx. 500).

f) Definition of local interconnection

In a NGN, local interconnection is understood to be exchange of traffic at the lowest level in the network hierarchy. The interconnection or access point are likely to vary for different types of services.

g) Migration scenario

NPT has not drafted any scenarios and the information received from the incumbent is business sensitive. However, the IP-based NGN in Norway is introduced in parallel to the existing PSTN/ISDN which was already modernised in 2005 with a new packet based architecture (ATM) at the transit level.

2.11 Poland

a) Relevance of IP-interconnection

Our incumbent operator has not announced any official plans for migration process into NGN, we do not have any information about that. Therefore NGN is not in the scope of regulation or planned regulation at the moment.

b) Complaints from competitors/disputes

We had one dispute concerning prioritization of IP traffic, but it was not in the context of IP Interconnection or NGN.

c) Actions taken or planned by NRA with regard to NGN core and/or IP-interconnection

There are no planned actions with regard to NGN at the moment. Thus, it is not possible to provide answers to questions e-g.

Experience with CBC

In the first place the service was introduced by the Regulator's decision in 2007. As till now 12 operators have the possibility of using the CBC, that was mostly regulated by decisions and in one case – by the agreement. Unfortunately, because the service is quite new UKE does not have reliable information on its usage. It is assumed that this charging is used quite efficiently. The conditions of CBC provide that the average traffic of 125 000 minutes and maximum traffic of 371 000 minutes can be pushed through the IC link used for CBC. There are some exceptions to the traffic from being charged with the CBC, these are: transit, termination to intelligent network services, VAS and international termination.

2.12 Portugal

a) Relevance of IP-interconnection

IP Interconnection is not a relevant problem today, first and foremost because there is no interconnection between VoIP providers and PSTN providers using IP connections.

In any case, direct IP peering for VoIP services is not a practice. I.e., interconnection between two VoIP providers it is done by "double conversion" from IP to PSTN and from PSTN to IP.

On the other hand, Internet access providers, in general, already interconnect their IP networks, either directly or using PIX – Portuguese Internet Exchange6, without any regulatory intervention to date by ANACOM.

b) Complaints from competitors/disputes

No complaints / disputes brought up to ANACOM.

c) Actions taken or planned by NRA with regard to NGN core and/or IP-interconnection

The regulatory approach to VoIP was approved in February 20067. It includes, among other aspects, a chapter devoted to interconnection (including IP). Most of the small service providers fill the necessity of peering in IP to decrease cost (Gateways with SS7 are expensive) and from the technical point of view the best solution will be IP peering.

ANACOM's promoted in October 2006 a NGN workshop where issues like interconnection and migration to NGN were briefly discussed by service providers, suppliers and the regulator, but without specific conclusions

d) Number of network nodes

No information is available

---

6 See http://www.fccn.pt/index.php?module=pagemaster&PAGE_user_op=view_page&PAGE_id= 8&MMN_position=3:3.

7 See http://www.anacom.pt/template12.jsp?categoryId=184902.

e) Number of interconnection points

No information is available

g) Migration scenario

No information is available

2.13 Romania

a) Relevance of IP-interconnection

Although the incumbent announced its migration plans to NGN (see answer to migration scenario), IP interconnection is not yet a relevant subject.

b) Complaints from competitors/disputes

There have been no complaints from competitors or formal disputes raised in relation to IP-interconnection.

c) Actions taken or planned by NRA with regard to NGN core and/or IP-interconnection

The regulator is monitoring the evolution of NGN networks and IP interconnection.

d) Number of network nodes / e) Number of interconnection points

So far there is no clear information on the number of nodes that will be involved in IP interconnection.

f) Definition of local interconnection

To the best of our knowledge, the concept of local interconnection is not used in practice.

g) Migration scenario

As in most of the EU countries, the incumbent's traditional TDM network is gradually migrating towards IP-based Next Generation Networks (NGN). Apart from the usual cost saving reasons, its actions are also driven both by the fast development of broadband Internet access and TV services and the competition from other operators (mainly cable and mobile).

In 2005, Romtelecom made public for the first time its investment plans to migrate to a packet switched network, but did not disclose detailed information on the planned migration. According to incumbent's public statements, it might invest half a billion euros for the migration to NGN (with no details on the investment allocation between NGN core and access).

As a part of transition to NGN, the incumbent publicly stated that it plans to extend core network closer to the subscriber by introducing national and main city IP-MPLS backbones and

fibre optic local rings connecting remote concentrator units (RCUs) and optical network units (ONUs, also known as multi-service access nodes) to the local exchanges Lx.

In 2008, aiming an aggressive deployment and further development of its broadband services the incumbent operator announced the implementation of an IP NGN network which allows the provision of a multitude of services and applications and high security levels.

Recently, incumbent also started provision of VoIP origination services (calls and SMS) to other national and international networks, and bi-directional VoIP services to and from other users of its network, both VoIP and PSTN.

2.14 Slovenia

As a result of the first market analysis of market 9 in 2005, Telekom Slovenija was found to have SMP for call termination on its PSTN network. At the time of this analysis, the IP business, including VoIP, was only performed by the Telekom Slovenije's subsidiary SiOL to whom the SMP decision did not apply. SiOL, however, used per minute charging for termination to VoIP users, whereas alternative operators were only able to access its network by means of TDM-based transit over Telekom Slovenije's network.

In 2007, Telekom Slovenije integrated SiOL by means of corporate restructuring. As APEK's SMP decision was written in a technology neutral way, this resulted in SMP remedies also becoming applicable to Telekom Slovenije's VoIP termination. However, Telekom Slovenije disputed this, claiming that VoIP as technology should not be regulated.

In the second market 9 analysis in late 2007, it has been expressly stated by APEK that, as far as call termination is concerned, termination to both PSTN users and users with managed VoIP connections must be included in the market. The reason is sufficient functional substitution between these services for a particular user who is unlikely to possess both a PSTN and a managed VoIP connection at the same time. Accordingly, in 2008, Telekom Slovenije and alternative operators using managed VoIP connections were designated SMP on former market 9.

APEK recently had to intervene in disputes in relation to VoIP termination to Telekom Slovenije' s subscribers launched by two alternative operators. In mediation proceedings, APEK helped the operators to find a solution themselves, reiterating its position as to technological neutrality, transparency, and non-discrimination for alternative operators. As the result of mediation, Telekom Slovenije has agreed with the operators to ban the extra charge for TDM transit and not to charge VoIP termination any higher than the price of PSTN termination at the same PoI level. Telekom Slovenije has further undertaken to seek solutions for the introduction of direct IP-to-IP interconnection.

In April 2008, APEK has published for consultation an extensive document on VoIP and IP interconnection regulation. The document inter alia proposed the following principles for IP interconnection:

a) transparency and non-discrimination for alternative operators as to the incumbent's switch to NGN,

b) encouraging fast transition to IP-to-IP interconnection, entirely bypassing PSTN PoIs,

c) any decrease in the number of Telekom Slovenije's PoIs must be conducted in a transparent manner, by means of dialogue with alternative operators,

d) in future arrangements, APEK will promote step-by-step transition to Billl and Keep. In the mean time, it shall seek to develop a LRIC costing model to reflect the costs of VoIP termination.

2.15 Spain

CMT imposed Telefónica, as a result of the analysis of markets 8, 9 and 10, the obligation to publish a reference offer for interconnection or RIO (called OIR, Oferta de Interconexión de Referencia), whereby prices must be cost oriented. Other operators only have the obligation to give access to specific network resources, with prices for call termination that must be reasonable (an asymmetry of up to 30% at local level is allowed).

The defined levels of interconnection in the OIR follow the architecture of the switching network, where users are attached to a local exchange (possibly via remote nodes or concentrators), which are then connected to a transit exchange and, in some cases, also to a metropolitan exchange. The OIR defines interconnection at the following switching levels: local, metropolitan, single transit, and double transit. A local interconnection is given when the called user is directly attached to the interconnected exchange, be it local, metropolitan or transit. Telefónica’s circuit switched network includes over 609 local exchanges, 83 metropolitan exchanges and 84 transit exchanges (in 23 transit areas), for about 16 million lines in service.

The OIR specifies an interconnection based on SS7 ISUP signalling, with two charging schemes, metered (or time-based) and capacity-based. The former defines a scheme with prices per minute, so that the payment is dependent on the metered usage of the circuits. The capacity-based offer, available since 2001, defines a scheme with monthly prices per purchased capacity (in n×64 Kbit/s and n×2Mbit/s), so that the monthly payment is fixed irrespective of the actual traffic carried out. The charging scheme can be selected per PoI. Eligible traffic for capacity-based interconnection includes access (call origination) and call termination traffic, and does not distinguish between types of traffic (voice and/or data). Transit services, international call termination and special services (such as premium IN-services) are not included. Although only Telefónica has the obligation through the OIR to provide a

capacity-based charging, it has reached an agreement with a cable operator to terminate its traffic through capacity-based PoIs.

CMT opened a public consultation on NGAs in May 2007 and the conclusions are available in the CMT web page:

(http://www.cmt.es/en/actividades_en_curso/consulta_publica/anexos/Anexo_NGA_ingles2.pdf).

Though focused on access, it posed the question whether a second consultation, for core interconnection (NGN), were needed. The stakeholders presented different views, whereby an urge for such a debate could not be inferred. Some preferred NGN interconnection not to be regulated, or at most to regulate the PoI structure to maximise usage of the investment in the current interconnection scheme, but were not supporting a priori regulation of the underlying services. For this reason, CMT did not open a public consultation on NGN interconnection afterwards. However, Telefónica has recently communicated his interest in adapting the Reference Interconnection Offer (RIO) because of the foreseen commercial availability of services based on NGN architecture. In consequence, CMT is currently in a process with operators to analyze the implications and study the convenience of establishing a new NGN interconnection regime. All the aspects should be taken into account, with an special attention to the possibility of market distortion due to IP-interconnection not being offered to other operators, in particular under the potential scenario where Telefónica would provide for itself IP-based services with internal IP/MPLS interfaces while, at the same time, the OIR would continue offering to alternative operators only TDM SS7 ISUP interfaces.

Experience with CBC

In Spain, CBC was introduced in the fixed incumbent's Reference Interconnection Offer (RIO), for voice and Internet traffic and Internet traffic only, and allows operators to request interconnection through three different models: (i) on a capacity basis; (ii) a time-based model; or (iii) or a mix of both. Capacity-based interconnection may be requested in two capacity units (64kbps and 320kbps) and the RIO allows for the reselling of excess capacity.

For every Point of Interconnection (PoI), the operator has to choose between Capacity or Time Based Interconnection. Typically only for the smallest PoIs it is better to contract time based capacity.

The introduction of CBC in Spain has been a success that enabled alternative operators to compete in retail level with Telefónica offering flat rates. Furthermore, in 2006 aprox. 75% of the origination and termination traffic in fixed networks (excluding traffic originating from mobile networks) was exchanged under the capacity based regime.

In addition, the average occupation per 2 Mbit/s is of around 450.000 minutes per month. That occupation leads to a price reduction between 40-45% compared to time based services.

Even if the Capacity Based Charging has been applied only in PSTN networks, based on the peak-hour dimensioning of the network, this charging regime could be also valid for IP interconnection, adapting the methodology to the new requirements of dealing with packet based networks.

The experience in Spain has resulted very positive in the fixed market, where the regulation of interconnection capacity based services in 2001 fuelled the introduction of voice retail flat rate tariffs by the alternative operators, often bundled with broadband services.

The main concern about CBC relates to adapting the cost accounting based on usage (minutes) towards the capacity concept. However, the principles of CBC could, generally speaking, be adopted for IP networks, assuming that IP transport networks interconnection is much related to the reservation of a determined bandwidth in the PoI.

CBC incentivizes operators to an efficient usage of the networks, providing a higher flexibility in the innovation of retail pricing offers, compared to time-based charging. Further, differentiated charging levels could be implemented in CBC depending on the required level of quality of service, offering operators a reliable regime, where predefined Service Level Agreements (SLA) would be associated with the pricing levels.

2.16 Switzerland

a-b) Relevance of IP-interconnection / Complaints from competitors/disputes

There is also not really a need for IP interconnection, BAKOM did not receive demands from other operators and there are no complaints. The interconnection regime has not changed and it's not foreseen to change it. It should be considered that local loop unbundling started in Switzerland in April 2007 and BAKOM has received a lot of complaints on this issue (due to high prices). Thus, operators seem to be very much occupied with the issue of LLU at the moment.

c) Actions taken or planned by NRA with regard to NGN core and/or IP-interconnection

BAKOM plans to make new investigations by the operators in order to know the importance for them of IP interconnection.

d) Number of network nodes

The number of network nodes in an NGN context is not yet defined.

e) Number of interconnection points

The number of PoI is always 36 (2 per regions) for TDM interconnection (SS7) and there are no migrations scenario defined at the moment. The subloop unbundling is also possible and there are 10.000 street cabinets in Switzerland.

f) Definition of local interconnection

There are no definition of local interconnection, but local interconnection can apply in the context of LLU (local exchanges level, concentrators level, street cabinet level). But LLU only apply for copper and not for optical fiber.

g) Migration scenario

Concerning NGN and migration in Switzerland, the situation is still the same, no changes are made for the time being. Swisscom plans eventually to introduce IMS in his network, but is waiting at the moment. There are no new services in relation with NGN offered from Swisscom in comparison with 2 years ago.

2.17 United Kingdom

A number of UK network operators have deployed IP and MPLS technology in multi-service core networks. Examples include Thus and Carphone Warehouse. Some of these operators are also deploying multi-service access nodes (MSAN's) in local exchanges using unbundled local access products from BT, although to date only about one third of the volume of unbundled local loops are used to provide combined voice and broadband services.

BT has committed to replace its entire UK network infrastructure with a next-generation network, 21CN. The scope of this programme includes equipment in the core and backhaul as well as the replacement of all voice concentrators and DSLAM's with MSAN's in every local exchange. Trials have started on a limited scale and commercial deployment of the broadband service has started. BT forecasts completion of the programme by 2013.

The UK regulator, Ofcom, has not received any formal complaints or disputes relating to NGN's and their interconnection.

BT has been conducting consultations with other providers of communication services on its plans, products and network in the Consult21 programme. In addition, the UK industry agrees technical standards in a forum know as NICC[8]. Ofcom has also sponsored the formation of the NGN[uk] industry forum, a facilitation scheme whose overall goal is to develop an agreed industry-led vision of interconnected NGN's delivering a wide range of services.

BT's 21CN fundamental design consists of three main levels of network hierarchy: an MPLS core of 20 nodes; a set of 106 Metro-nodes, which are a super-set of the core; and approximately 5,800 local exchanges, which are also a superset of the Metro-nodes.

---

8 Participating member companies, have recently re-constituted the NICC as an industry-owned independent body, rather than maintaining its previous status as a committee reporting to Ofcom. This step was taken to put the NICC in a better position to address the challenges of agreeing a new suite of technical interconnection standards as networks change to NGN architectures.

Following consultation and discussion in Consult21 and NGNuk, BT has concluded that it will provide 29 points of voice service interconnection, and 20 broadband remote access server (BRAS) locations for aggregated interconnection with its wholesale broadband origination products.

Physical hand-over of interconnected traffic by competing operators is planned to occur at any of the Metro-nodes using a new IP multi-service interconnect link (MSIL) product. Hand-over of Ethernet traffic is planned to be possible in any of approximately 1,100 local exchanges designated as Tier-1 MSAN sites.

Part 3: Technical background information

3.1 Operation of IP Networks and Service Delivery

Like all telecommunication networks IP networks must be designed and management correctly in order to fulfill the anticipated telecommunication demand. An IP network is an all-purpose network that provides a platform for the delivery of multimedia services. In principle, any service can be realised, and with specific quality, if the performance objectives of the service can be met by the network.

This chapter gives a brief overview on the basic planning and management strategies that are used to control the traffic flow in IP network and thus form the basis for providing end-to-end services. The concept of QoS and its relationship to network performance[9].

Note: The aspects discussed here are focused on the transport performance of the networks and its ability to support end-to-end services. Protocol aspects for the support of specific network features or supplementary service elements are not considered.

3.1.1 Network Planning and Traffic Organisation

Current networks are evolving to carry a multitude of voice services and packet data services on Internet protocol. A network operator has to plan his network carefully in order to provide sufficient transmission performance and be able to handle the traffic demand.

Once the network topology is set a transmission plan that sets limits and objectives for fundamental transmission parameters and specifies the interfaces between networks and to the terminal equipment is elaborated[10]. Based on this transmission plan the actual network is build up and configured.

In operational networks the traffic needs to be handled and organised. This is activity is called traffic engineering and encompasses

d) the measurement, modeling, characterization and control of traffic,

e) the application of techniques to achieve specific performance objectives, including the reliable and expeditious movement of traffic through the network,

f) efficient utilization of network resources, and the planning of network capacity.

---

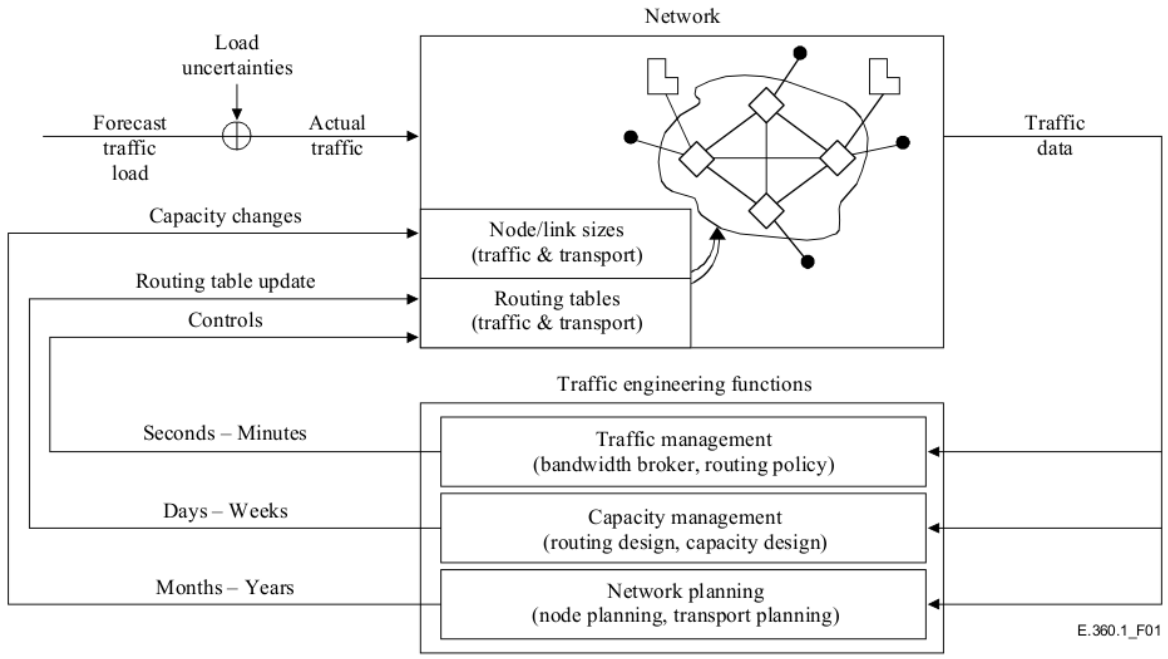
9 Note: The aspects discussed here are focused on the transport performance of the networks and its ability to support end-to-end services. Protocol aspects for the support of specific network features or supplementary service elements are not considered.

10 Detailed information can be found in ITU-T Rec. G.101 (The transmission plan).

Since the traffic demand varies, new services need to be supported, the network topology need to be adopted etc. traffic engineering is not a static but a dynamic process. A network operator has to monitor the traffic flow constantly and take measures when and where needed. The aim is to optimize the traffic flow and adopt the network such that a reliable and expedient traffic flow is maintained.

The whole process is illustrated in the following figure:

Figure 3: Traffic engineering model[11]



The central box represents the network which can have various architectures and configurations, and the routing tables used within the network. Network configurations could include metropolitan area networks national intercity networks, and global international networks which support both hierarchical and non-hierarchical structures, and combinations of the two.

Routing tables describe the path choices from an originating node to a terminating node, for a connection request for a particular service. Hierarchical and nonhierarchical traffic routing tables are possible, as are fixed routing tables and dynamic routing tables. Routing tables are used for a multiplicity of traffic and transport services on the telecommunications network.

Traffic management ensures that network performance is maximized under all conditions, including load shifts and failures.

11 Source ITU-T Rec. E.360.1

Traffic management includes control of routing functions, which include call routing (number/name translation to routing address), connection routing, QoS resource management, routing table management, and dynamic transport routing. Commonly used methods for Traffic management in IP networks are Resource Reservation Protocol, Differentiated Service and Label switching (see 3.1.3 for more details).

Capacity management plans, schedules, and provision of needed capacity, correspond to a time horizon of several months to one year or more. Capacity management ensures that the network is designed and provisioned to meet performance objectives for network demands at minimum cost.

Network planning ensures that node and transport capacity is planned and deployed in advance of forecasted traffic growth.

The load variation components have different time constants ranging from instantaneous variations, hour-to-hour variations, day-to-day variations, and week-to-week or seasonal variations. Accordingly, the time constants of the feedback controls are matched to the load variations, and function to regulate the service provided by the network through capacity and routing adjustments.

Network design embedded in capacity management encompasses both routing design and capacity design. Routing design takes account of the capacity provided by capacity management, and on a weekly, or possibly real-time, basis adjusts routing tables as necessary to correct service problems. The updated routing tables are provisioned (configured) in the switching systems either directly or via an automated routing update system. Network planning includes node planning and transport planning, operates over a multi-year forecast interval, and drives network capacity expansion over a multi-year period based on network forecasts.

An in-depth discussion of various practical solutions for traffic engineering can be found in the ITU-T Rec. E.360.x series. The strategies given there can be applied to any technology (IP, ATM, ISDN etc.)

3.1.2 Service Delivery

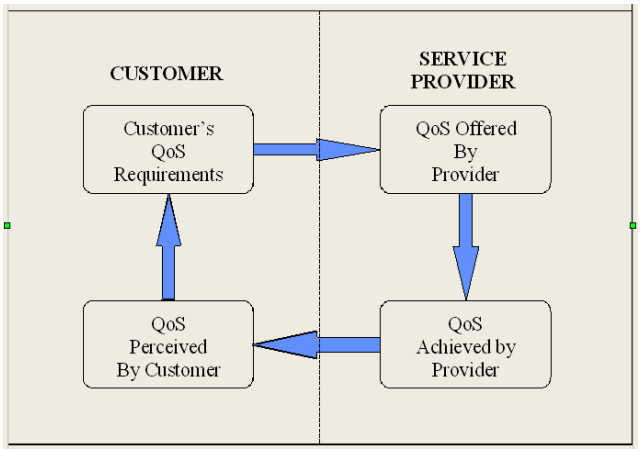
Once the network is set-up and is operated according to the methodology described above services can be implemented and offered to the users. A service provider will rely on the network performance provided by the network operator.

Additional service elements like a call server for voice calls will have to be maintained by the service provider.

The service quality will have to be monitored constantly by the service provider in order to be aware of faults and take actions in due time. There are specific measures for monitoring and measuring QoS and performance of equipment and networks.

Depending on the service under consideration different parameters (so-called QoS criteria[12]) can be identified and subsequently measured. Without going into details of the technical measures and methodologies that can be used for this purpose, the important thing for a service provider is to be aware of the four viewpoints of QoS[13] in order to establish a measurement concept and to interpret the measurement results.

Figure 4: The four viewpoints of QoS



The QoS criteria can be viewed from different perspectives:

- Customer's QoS requirements;
- Service provider's offerings of QoS (or planned/targeted QoS);
- QoS achieved or delivered;
- Customer survey ratings of QoS.

For any framework of QoS to be truly useful and practical enough to be, it must be meaningful from these four viewpoints and defined thereafter.

The service provider will have to develop a QoS measurement and monitoring framework and use the results to ensure stable service provision to the user and to cross-check whether the network operator offers the negotiated transmission performance.

12 See ITU-T Rec. E.802
13 See ITU-T Rec. G.1000

3.1.3 Commonly used methods for traffic management

Resource Reservation Protocol

IETF has defined the Resource Reservation Protocol (RSVP), inspired by telecoms and ATM networks.

A signalling phase takes place to reserve the necessary resources along the path from the sender to the receiver(s) before the communication is set-up. RSVP is a signalling protocol only and does not carry information packets: the Real-time Transport Protocol (RTP) undertakes the transport of information. The reservation message contains information about QoS parameters and the description of the packets involved in the communication. The routers along the path of the communication are responsible for allocating the necessary bandwidth to the traffic flow and need to remember the QoS parameters of the traffic flow as long as the communication lasts.

RSVP enables Integrated Services (IntServ), that is the provisioning of two types of Class of Service (CoS): the Guaranteed Service CoS, which provides strict guarantees on parameters such as bandwidth or delay, and the Controlled Load CoS, which provides a CoS similar to a best effort service under unloaded conditions whatever the condition of the network.

This protocol provides high QoS guarantees but also increases significantly the complexity of routers.

Differentiated Service

Differentiated Service (DiffServ) is a simpler and more scalable protocol also defined by the IETF.

Instead of reserving resources, DiffServ consists in classifying packets depending on their priority in the network and mark them with an index defining its Class of Service. The marking (and unmarking) of packets occurs at edge ingress points (and edge egress points) while core routers process the packets according to their priority. The priority is given in the ToS (Type of Service) field of the IPv4 header or in the Traffic class field of the IPv6 header depending on the IP protocol implemented.

The two main CoS used in DiffServ are Expedited Forwarding (EF), which minimises delay and jitter, and Assured Forwarding (AF), which minimises packet loss.

As opposed to the RSVP protocol, no signalling is required and the routers involved in a communication using DiffServ are stateless while the intelligence remains at the edge of the network. DiffServ however only provides statistical guarantees.

Label switching

In label switching protocols, the process of packets depends on how the ingress edge device has labelled them. MPLS (Multi-Protocol Label Switching) is the label switching protocol de-

fined by the IETF following the definition of other label switching protocols by Cisco and other manufacturers.

It is similar to DiffServ in the sense packets are processed depending on how they have been marked at the ingress point. MPLS is primarily a traffic engineering protocol used to define fixed bandwidth pipes within IP networks or other types of networks such as ATM. This traffic engineering mechanism results in increased performance. On the contrary of DiffServ, the label is not used to establish the priority of packets but to determine the next router hop. The router therefore forwards the packet to a known destination depending on the label (switching), instead of having to compute a route depending on a destination address (routing).

Routing is done once at the ingress point where the label is allocated. A further protocol has to be implemented between routers in order to enable the exchange of label information between routers.

3.1.4 Mapping of Classes of Service

When trying to guarantee end-to-end QoS of a session involving multiple and heterogeneous interconnected networks, one has to ensure that transmission performance objectives are met by all networks involved. For doing so, a variety of transport classes can to be specified and implemented by all networks or fixed performance allocation can be allocated for the networks (see ITU-T Rec. Y.1542).

This might involve agreement upon a mapping of the different QoS protocols and mechanisms of their respective networks. This section shows how the mapping of Classes of Service (CoS) can be achieved at a technical level.

For interconnection purposes then mapping needs to be done between the different Classes of Service (CoS) defined within the different QoS supporting protocols in order to enable interoperability between e.g. DiffServ enabled or RSVP enabled IP networks, ATM networks and MPLS-enabled networks.

Such mapping requires interconnected networks to agree on a way of exchanging and presenting information at interconnection points. Each network would therefore be required to shape its traffic and provide signalling information as agreed at the egress point before handling it over for transit or delivery.

Consequently different fora and standardisation bodies are working on defining a mapping between the CoS of different types of networks. The setting-up of SLAs between networks is also a commercial issue to be solved between interconnected networks. Some examples of this mapping between certain types of networks are given below:

a) Interoperability between DiffServ-enabled networks was included in the definition of the DiffServ architecture. DiffServ assumes the existence of SLAs between interconnected

networks detailing traffic profiles and policy criteria used.

b) In UMTS networks, 3GPP has defined four Classes of Service to be applied depending on applications used by end-user, and which mainly describe how delay sensitive the traffic is and represent a trade-off between delay requirements and error rate requirements. These classes are conversational class, streaming class, interactive class and background class. UMTS operators are responsible for determining the appropriate mapping between the UMTS CoS defined above and the DiffServ CoS used in their networks.

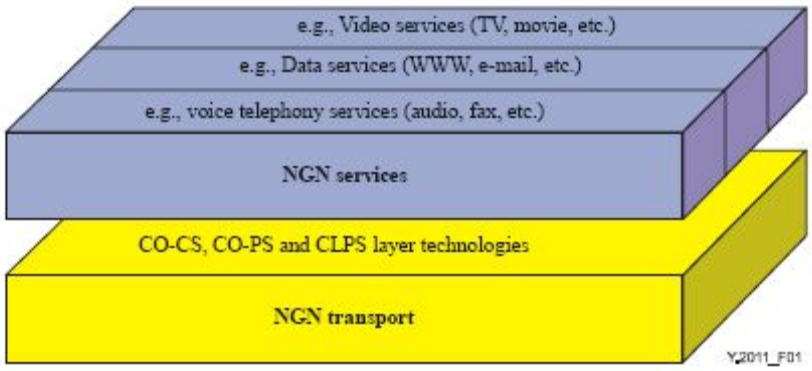
c) The IETF is working on interoperability between RSVP and DiffServ networks. RSVP is mainly implemented in the edge networks and DiffServ in the core network.

d) The ITU-T has published ITU-T Rec. Y.1541 that defines transport classes and Rec. Y.1542 with a framework for ensuring en-to-end performance.

3.2 NGN-Standard

Pursuing this view, the ITU-T produced two Recommendations, Y.2001[14] and Y. 2011[15] describing a NGN functional architecture comprising basically the separation of services from transport, allowing them to be offered separately and to evolve independently, the key cornerstone of NGN characteristics:

Figure 5: NGN Basic Reference Model



Source: ITU-T Rec. Y2011, 2004

The NGN architecture is intended to offer convergent multimedia services using a single shared core network for all types of access and services and packet mode transport. Another key point is the adoption of open and standardised interfaces between each layer, and in

14 General overview of NGN.
15 General principles and general reference model for next generation networks

particular for the Control and Services layers in order to allow third parties to develop and create services independent of the network. But now there are many services and applications to interconnect and this raises some issues such as interoperability issues due to a wide variety of protocol variants, network topologies and media codecs.

Moreover, the evolution of today's telecommunication networks, a shift from circuit-switched networks that are traditionally used for voice service to packet-based NGN must allow the continuation of, and interoperability with, existing networks while in parallel enabling the implementation of new capabilities, involving a broad series of protocols (including various profiles) at both service and network levels.

The standardisation of NGN architecture is an ongoing process within several standardisation bodies to address the telecommunication service capabilities that the NGN should provide: on one hand, maintaining separation between services and the networks they run on, develop a suitable service architecture focused on the interfaces to support different business models and seamless communication in different environments, and on the other hand, guaranty backward compatibility with existing services and systems, in order to meet the needs of end-users and service providers.

A detailed review cannot yet be provided but it is possible that there will be no single (or "harmonized") architecture for NGN architecture[16].

However, according to ITU-T (Y.2021) and ETSI, the 3GPP core IP Multimedia Subsystem - IMS is expected to be a key building block for NGN specifications, also using Internet (SIP) protocols to allow a variety of services and features (e.g. Presence, IPTV, Messaging or Conferencing) to be delivered irrespective of the network in use[17], i.e., at the core of that harmonized all-IP NGN network is the IMS which provides an (access independent) platform[18].

The Figure 11 (below) shows a more detailed diagram of the transport and service configuration of the NGN[19] including the interfaces between customer premises equipment and NGN access networks (UNI), between networks[20] (NNI) and third-party application provider equipment and NGNs[21].

---

16 Nonetheless, possible architectures are shown in Annex 1 for the sole purpose of illustrating the complexity that regulators need to take into account in their work. The ERG recognizes that these architectures may not be the only subjects of future regulation and that other implementations may be appropriate.

17 ETSI technical committee TISPAN, building upon the work already done (by the 3GPP) in creating the SIP-based IMS, is now working together with 3GPP to define a harmonized core for both wireless and wireline networks.

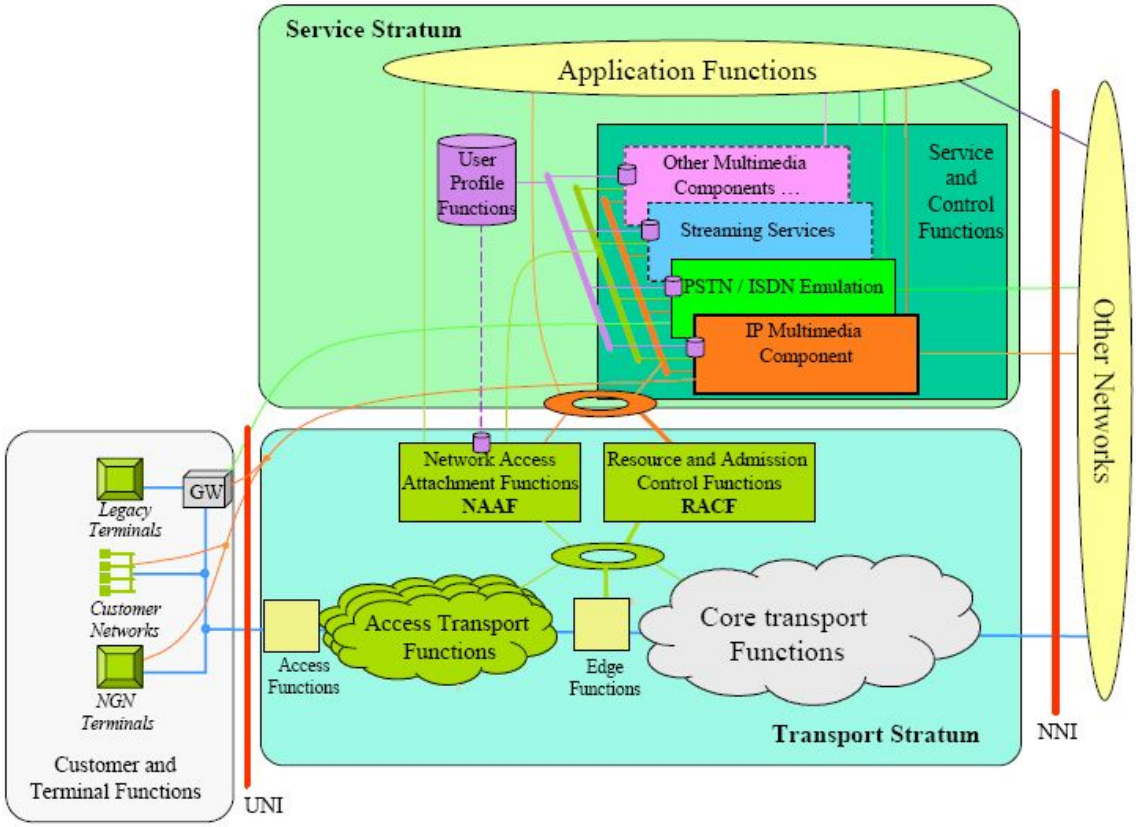
18 However, IMS is not intended to standardise applications itself but to aid the access of multimedia and voice applications across wireless and wireline terminals, i.e. aid a form of fixed mobile convergence.

19 In the diagram, the customer and access networks are only representative and not all inclusive.

20 NGNs and other networks, e.g. PSTN/ISDN, Internet.

21 Out of scope of NGN Release 1 of ITU-T. See ITU-T NGN FG Proceedings in http://www.itu.int/ITU-T/ngn/release1.html.

Figure 6: Transport and service configuration



Source: ITU-T "Security Requirements for NGN – Release 1"[22]

Interconnection of transport and service layers between different core networks is necessary for end-to-end global services[23], a similar situation as in legacy circuit switched networks[24]. But now there are many services and applications to interconnect and this raises some issues such as interoperability issues due to a wide variety of protocol variants, network topologies and media codecs.

In summary in ETSI/TISPAN, there will be two types of NGN interconnections[25]:

- Service oriented Interconnection[26]: Physical and logical linking of NGN domains that allows operators and service providers to offer services over NGN (i.e. IMS and PES[27])

---

22 See "ITU-T NGN FG Proceedings Part II" – NGN GSI (Global Standards Initiative), ITU-T 2005

23 The global NGN architecture consists of interconnected core networks belonging to different carriers, with endpoints connected through attached access networks, and gateways (border gateways control access into and out of each core network, monitoring and regulating the data flows on each interface) to non-NGN networks.

24 With SS7 (MTP and ISUP), ISDN, etc

25 An NGN interconnection mode can be direct or indirect. Direct interconnection refers to the interconnection between two network domains without any intermediate network domain. Indirect interconnection at one layer refers to the interconnection between two network domains with one or more intermediate network domain(s) acting as transit networks. The intermediate network domain(s) provide(s) transit functionality to the two other network domains. Different interconnection modes may be used for carrying service layer signalling and media traffic.

26 Sometimes referred to as SoIx.

platforms with control signalling (i.e. session based), which provides defined levels of interoperability/QoS, depending upon the service or the QoS or the Security, etc. This type of interconnection is typically characterised by the presence of two types of information exchanged between the two interconnected domains: service-related signalling[28] and transport information[29].[30] For higher efficiency, the transport layer must allow IP interconnection for all services at least if one party want to do it. It imposes transparency of transport and open interfaces.

- Connectivity oriented Interconnection (as in the figure below)[31]: The physical and logical linking of operators based on simple IP connectivity irrespective of the levels of interoperability. This interconnection is then characterised by the absence of the service-related signalling, implying that there is no end-to-end service awareness. As a consequence, service specific QoS and security requirements are not necessarily assured. This definition does not exclude that some services may provide a defined level of interoperability. However only “Service oriented Interconnection” fully satisfies NGN interoperability requirements.

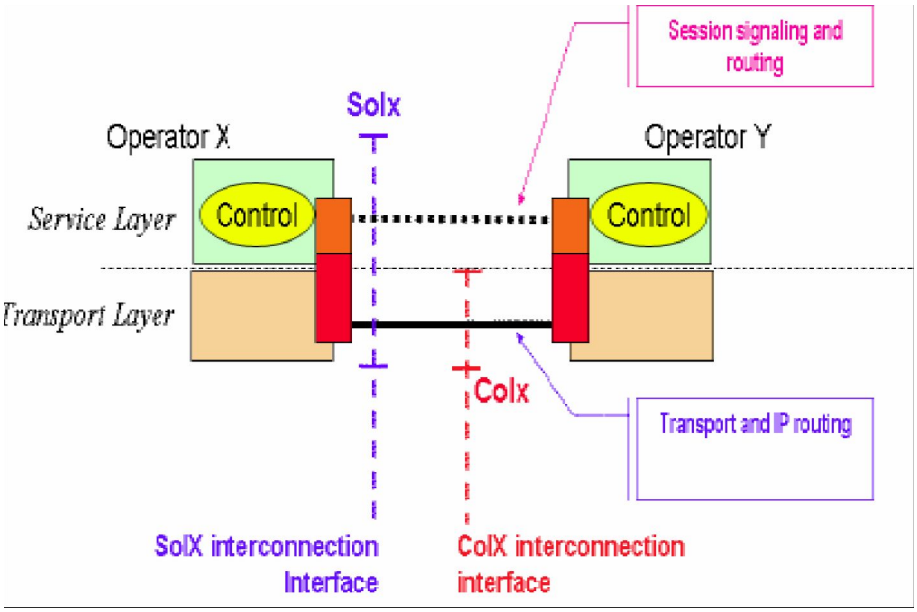
According to this view, service oriented interconnection combines service-related signalling and transport information thus implying a bundling of transport interconnection and service interconnection (as defined in Section A.4.1) leading to a vertically integrated service provision. This differs from the understanding in this paper where service interconnection is viewed as including service specific parameters only and excluding any transport related information.

Connectivity oriented interconnection is identical to the definition of transport interconnection (in Section A. 4.1)

---

27 PES - PSTN/ISDN Emulation Subsystem, which supports the voice services in a NGN.
28 Information that allows identification of the end-to-end service that has been requested.
29 That carries the bearer traffic.
30 See section A.3.1.
31 Sometimes referred to as CoIx.

Figure 7: Simplified model of SoIx and CoIx interconnections

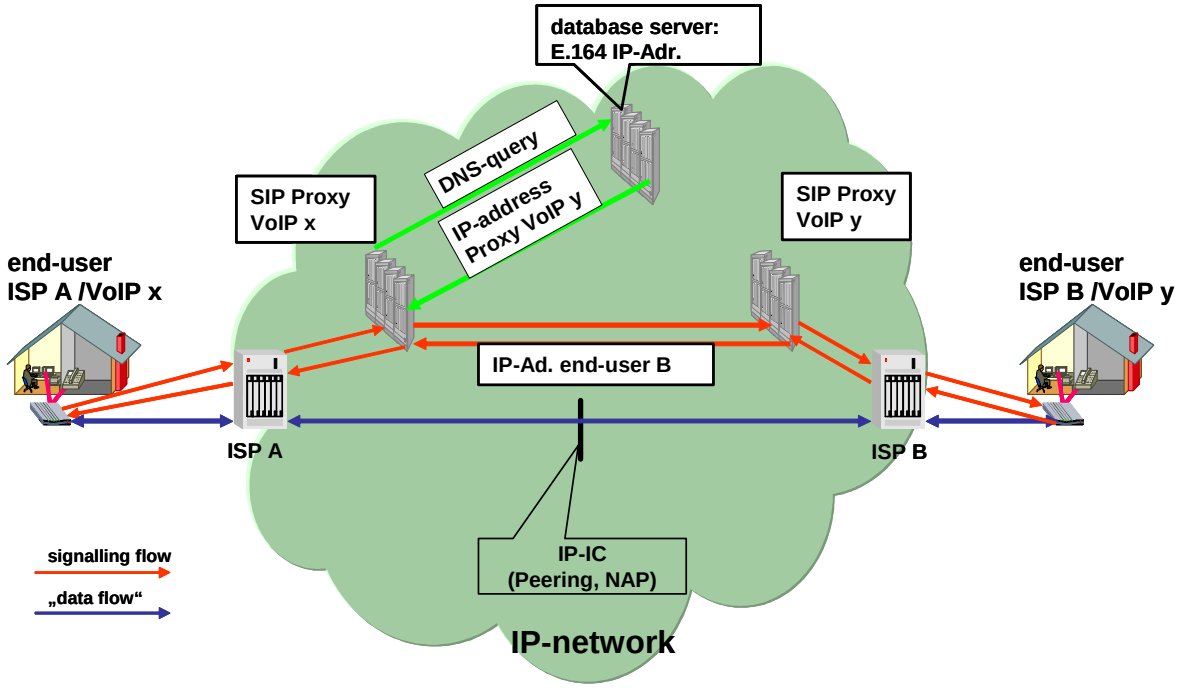


Source: TISPAN WG4

3.3 Technical implementations of IP interconnection

In the following, different technical implementations of IP interconnection reflecting the separation of layers are explained:

Figure 8: IP Interconnection of application providers using others' infrastructure



Source: Eickers (2005)

The figure above illustrates the interconnection of two application providers who interconnect their services while making use of an IP infrastructure provided by other operators. An example of this could be some current VoIP operators, who provide best-effort voice services to customers of ISPs, making use of the public Internet for traffic transport. This figure clearly depicts the separation of transport and service as different operators provide these functions.

The functions required at the IP interconnection may in addition include the protection of the integrity of each network by logical and physical separation between operators' IP domains, translation of signalling protocols to allow the control functions to interoperate, voice transcoding to allow voice transport to interoperate, the enforcement of network security policies to avoid attack, and the recording of traffic volumes and other data for billing purposes.

If end-user A wants to make phone call to end-user B, A sends B's E.164 number to the SIP server of his VoIP providers (*VoIP x*), which makes a database query to receive the IP-address or domain of *VoIP y*.[32] Then, an interconnection on the service layers takes place

---

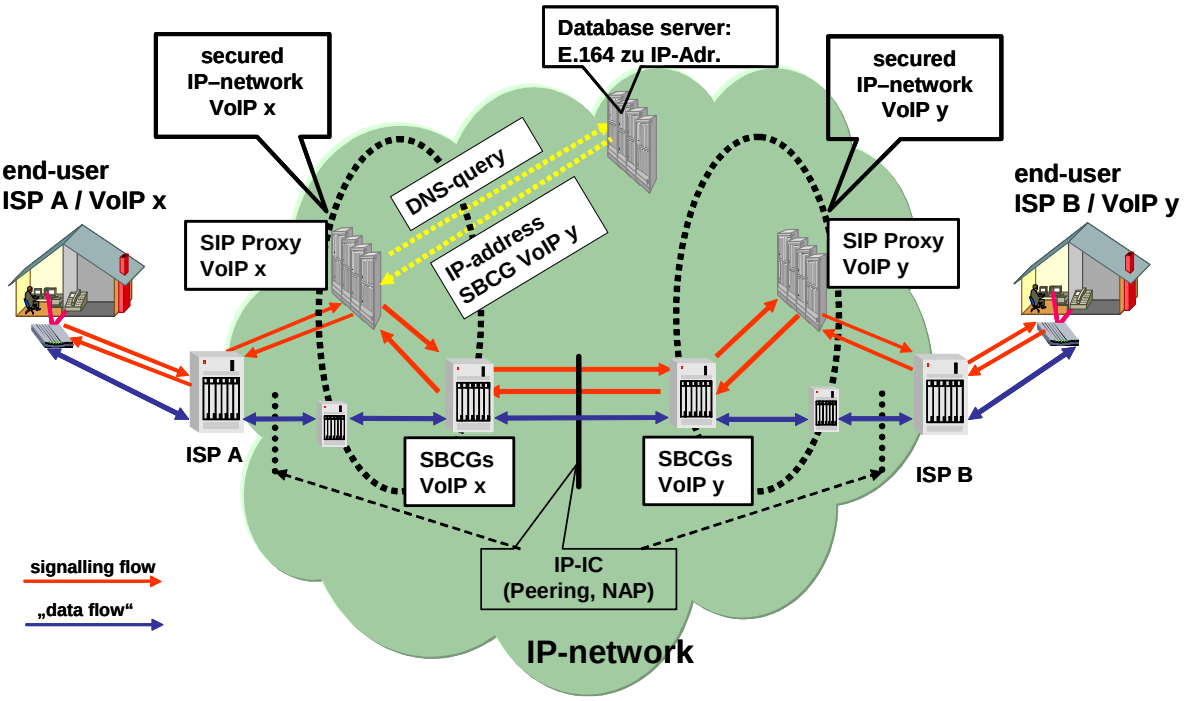
32 The E.164 database server enables call routing between two interconnected networks. It operates according to the ENUM protocol which converts the E.164 telephone number of the called party into appropriate routing information. This can be the IP address of the VoIP SIP server or the IP address of the Session Border Controller of the called party's network, i.e. the network terminating the call. The functionality principle behind ENUM is the transformation of the E.164 telephone number into a domain name. A Domain Name Server (DNS) can then be used to covert the domain name to an IP address for routing the call, in much the same way that DNS is used in the world-wide web to convert a domain name such as www.erg.eu.int to an IP addresses.

between VoIP x and VoIP y, where the former receives the IP-address of end-user B. With this address, A's end-user equipment can establish the media stream to B.

It is to assumed that VoIP x and VoIP y interconnect their SIP servers on the service level without payment flows at the wholesale level.[33] Considering that VoIP services between co-operating networks are provided at a prize of zero on the retail level (similar to an on-net call), the end-user is not separately billed for the service layer interconnection.

Moreover, it is assumed that the DNS query (VoIP x to database server) is not separately billed, neither at the wholesale nor the retail level.

Figure 9: Example of IP interconnection using Session Border Controllers



Source: Eickers (2005)

In this figure, service and transport are provided by one single operator. In order to combine these functionalities - signalling and data flow - the operator uses Session Border Controllers (SBC). It can be assumed that in particular telco network operators are prone to follow this approach because it enables them to continue a vertically integrated provision of transport and service as it was the case in legacy networks. Operators favouring this "bundling" of transport and service often consider to implement interconnection only service-specifically - for voice services at least – during the transitional period towards NGN whereas other market participants do not consider such a combination necessary.

---

33 See WIK-Consult (2008), ch. 5.1.4.1.

Interconnection in this example can either take place on a bilateral peering basis, by using an Internet exchange (both without inducing payment flows at the wholesale level) or on a transit basis.

In this case only these SBC communicate with each other. The VoIP providers only exchange the IP-addresses or domains of the Session Border Control Gateways in the database server. The costs of the SBCs contribute to the fact that this realisation of VoIP is more expensive than the one in figure 13 above.

Part 4: Implications of Next Generation Networks on regulatory accounting (Input from RA PT)

The purpose of this paper is to provide a summary of work carried out by the ERG regulatory accounting PT. The scope of this paper is limited to identifying issues raised in implementing cost accounting and accounting separation systems and discusses how NRA's can seek to take account of these issues when setting guidance for preparing and reporting regulatory financial information. This information could be used to help NRA's analyse the regulatory and commercial implications of NGN's, assist investigations into alleged anti-competitive behaviour or monitor non-discrimination and price controls (including cost orientation).

Summary

Preparing meaningful and robust regulatory cost information is often central to the regulatory decision making and compliance monitoring process. However, the costing of next generation networks and services raises some new and challenging questions about the assumptions, concepts, methodologies, and practices that form the current established ways of preparing and viewing regulatory accounting information.

The communication sector is used to fast changing technologies and regulatory accounting guidance is based on a set of well established principles rather than fixed rules. These principles have served NRA's well when looking at cost data to inform regulatory decisions or to guide the preparation of regulatory financial statements. Our findings so far point to the costing principles remaining relevant but their application to NGN costs requiring more careful interpretation.

There are various forms of guidance on cost accounting/accounting separation issued to assist NRA's, operators and other stakeholders. As part of its initial analysis the PT looked at this guidance and found that:

1. Extant regulatory accounting guidance remains relevant and valid

    i) The technology neutral guidance published by the EC and ERG on the implementation of regulatory accounting obligations should also be applied to NGN's.

    ii) The key regulatory accounting principles of cost causality and objectivity (fairness) remain central to the costing of NGN's.

    iii) The use of current cost accounting as the basis of costing and asset valuation continues to be preferred rather than an historic cost base.

    iv) Both "long run incremental cost" and "efficiently incurred fully attributed/distributed cost" methodologies are suitable and appropriate methods that can be applied to determine the costs of services provided by a NGN.

2. The cost structures of NGN when compared to legacy networks will probably differ in the following ways

   v) The Opex and Capex of a NGN are forecast to be significantly lower in the long term than current legacy technologies.

   vi) Common and fixed costs of NGN's will represent a high percentage of total costs with a relatively low percentage of costs incremental to individual products or services.

   vii) The cost/volume relationship of a NGN seems to be shallower at current volumes than legacy networks suggesting that increases in volumes will have a relatively lower incremental cost impact.

3. NRA's will need to consider revising modelling and cost accounting approaches in SMP markets

   viii) A key feature of a robust NGN cost model is likely to be the way in which it deals with the capabilities of the technology to deliver multiple services across a network with high common costs. This suggests that NRA's will need to understand the cost and cost recovery (pricing) implications of all services (both SMP and non-SMP) running across the NGN platform characterised by a relatively high proportion of common costs.

   ix) The use of traditional costing methodologies such as LRIC and efficiently incurred FAC/FDC will need to be reworked to recognise the different cost characteristics of NGN's. For example, new cost drivers will need to be identified that reflect the cost causality principle and possibly new methods assessed for the recovery of common costs.

   x) The costing boundary between access and core network services will need to be reviewed taking account of NGN technologies. Initial analysis suggests that the costs relating to the parts of a NGN providing access (often shown as elements of MSAN's) are dedicated to a line and therefore mainly caused by the number of customers connected to it and, following the cost causality principle, these costs would more appropriately form part of the access services cost base.

   xi) NGN's will become the accepted "modern equivalent asset" for core networks soon and the results of cost models based on legacy network valuations irrelevant.

4. In the short term, the transition from traditional or legacy networks to one common NGN platform is likely to raise some temporary costing issues for NRA's, such as:

   xii) The use of top-down (actual) financial data will be distorted as operators run down legacy networks and deploy NGN's.

xiii) There is a possibility that an operator may be left with stranded assets as NGN's replace legacy technologies. Regulatory costing methodologies imply that residual costs of stranded assets should not play a role in the calculation of cost-orientated tariffs either because only relevant efficiently incurred costs should be taken into account or they are irrelevant on a forward looking basis. However, there may be situations where NRA's may need to look at the causation of residual costs of stranded assets to assess whether, in whole or part, they are relevant.

xiv) An operator has a number of roll-out options (timing, implementation period, use of overlay NGN, etc) and NRA's may have to consider the most optimal implementation approach in considering how efficiently incurred costs specifically for roll-out purposes are identified and treated.

xv) Based on the hypothesis that the economic rationale for NGN's is partly based on the expectation that the costs of delivering voice services in the long run will be no higher (and probably significantly lower) than using legacy PSTN technologies then it is reasonable for NRA's, in modelling/evaluating NGN costs and/or associated pricing decisions, to assume that the cost of voice services will be no higher than currently calculated.

The PT considered a number of other issues where it was considered too early to reach any firm view, including

- Cost of capital: The PT is not aware of any evidence to suggest that implementing an NGN will significantly increase or decrease the risk element.

- Quality of Service: Further analysis is necessary to fully understand the cost implications delivering services with different levels of service over NGN's.

- Depreciation: the premise that depreciation should reflect the consumption of economic value of an asset remains but for NGN assets it is less clear what the economic lives will be. Early indications suggest that this equipment will be depreciated over lives similar to IT equipment which tends to be relatively short reflecting technological progress.