Nortel response to Ofcom consultation

Next Generation Networks
- Future arrangements for access and interconnection

Introduction

The imminent deployment of Next Generation Networks (NGNs) represents a tipping point in the way communications services are delivered. A defining characteristic of such networks is that they are based around cores that carry Internet Protocol (IP) packets and provide connectivity independent of service. Services are no longer inextricably linked with separate infrastructures. They are instead provided via computing servers linked to these common cores. NGNs also provide services that are independent of the access method that is used. Whether such access be fixed, mobile or via hot-spots, it is simply the means by which end users connect to core networks and thereby access the servers and communicate with each other. The major service providers will deploy their own distinct cores with carrier class capabilities and links to the Internet. Others will exploit the Internet itself to provide core functionality. As a result, similar services will be provided by NGNs with wildly differing qualities and grades of service.

NGNs offer the potential of substantial cost savings to operators. They enable the delivery of innovative new services, with the potential for far greater control and personalisation by end users. BT's 21st Century Network will almost certainly be the most significant carrier class NGN deployment in the next few years. However, BT is not alone in realising the potential of such networks. Other operators are at the planning stages of their own NGNs.

In what follows, we present the Nortel perspective of the regulatory implications of the deployment of NGNs. We have found it more straightforward to present our vision in the form of a discussion document rather than as set of answers to the questions posed. However, we have attempted to indicate via endnotes whenever our response directly touches upon key questions. The response is based on experience drawn from over a decade of pioneering R&D, during which we first defined and verified the architecture for NGNs and then developed a solution set to enable carrier class implementations of such networks. We concentrate on the opportunity that NGNs present to agree on a set of generic interfaces and 'open' protocols which have the potential to enable a service independent approach to regulation[1]. We argue that such an approach will lead to the withdrawal of the requirements for most of today's regulatory products[2]. We also note that the deployment of NGNs will lead to a number of regulatory issues of a transitional nature. Whilst we identify such issues, we leave further consideration of how they should be resolved to the service providers directly impacted by them.

The Transition to NGNs

The fundamental regulatory consideration relating to a newly deployed carrier class NGN is the extent to which it creates, perpetuates or removes economic bottlenecks. It is such bottlenecks, if they exist, that will determine where other operators will need regulated access to the network and the nature and service levels of the interconnections that will be required. If an NGN is being deployed as a replacement for an existing network, issues will arise with respect to

changes in the location and topology of such interconnection points, not least because NGNs have far less geographic dependence than legacy networks. Important though these geographical issues are, they are of a transitional nature. A careful balance has to be struck between too rapid a transition to new arrangements, given the significant investments made by service providers already accessing the network being replaced, and too slow a transition requiring the NGN operator to continue with arrangements that are uneconomic and therefore preventing a fair return on the NGN investment[3]. In this respect we fully support the guiding principles for the transition laid out in Section 4 of the consultation document. However, we believe that it is the definition of the ultimate form and location of such interconnections that is of prime importance, and which we therefore consider in greater detail in the remainder of this response.

Transport and Intelligence in an NGN World

Transport interconnection between Time Division Multiplexing (TDM) networks has historically been through Plesiochronous Digital Hierarchy (PDH) interfaces, with recent migration to higher data rate Synchronous Digital Hierarchy (SDH) interfaces. Whatever the nature and rate of such interfaces, they have always been well characterised in terms of security, guaranteed data rates and transfer delay. As well as enabling voice and data calls to be passed from one operator to another, they have been fundamental to the provision of leased connectivity services.

Such matters are nowhere near as straightforward with an NGN. Although it is possible for NGNs to continue to provide legacy connectivity services, for example by means of circuit emulation, the question arises as to the cost effectiveness of supporting the full range of such services. The alternative to emulating an unrealistically large number of services for too long a time is to transition to the more logical form of interconnection to an NGN, namely direct IP access. A generic means or format for such interconnection would obviously be highly desirable. For such a product to be able to support real-time multimedia services, it would need to meet stringently defined Quality of Service (QoS) parameters, at least in terms of packet loss and transfer delay. Such parameters would, however, be overkill for many of the elemental IP flows making up other services. Rather than agree several distinct IP interconnection services to address this issue, we believe that a preferable way forward is to define some form of generic IP access, ideally with third-party control over a range of QoS parameters, including the additional aspects of timing and synchronisation. This would necessitate one operator having access to another's intelligence functionality. NGN operators will need to implement such functionality to establish virtual connections with particular characteristics within their own networks. Access by operators to each other's QoS intelligence would have the added benefit of allowing dynamic control of parameters like data-rate, enabling, for example, the provision of 'on demand' bandwidth boosts for services such as streaming video. Such a generic format for IP access could obviate the need to continue to provide practically all other legacy services.

Access to other forms of intelligence, such as those providing the 'location', 'presence status' and 'connection characteristics' of end users, will also increasingly become central to service provision. Whether or not one operator should have regulated access to another's knowledge in these areas is, of course, down to whether or not there is an economic bottleneck or technical barrier to entry. In this technical context we note that a service provider whose only access to a

customer is via another operator's network may well find knowledge of say, 'location', difficult to replicate[4,5].

The issue then arises as to how deep the 'hooks' into such intelligence capabilities need to be. True equivalence will almost certainly dictate that such hooks be as deep as the deepest 'open' Application Programming Interface (API)[6]. Any greater depth would have the potential of compromising an NGN operator's ability to maintain absolute control of fundamental aspects of the network, such as security. Any less depth would compromise the ability of the service provider accessing a customer through another's network to provide equivalent services without additional complexity and consequential cost.

Signalling in an NGN World[7]

Signalling between the switches in TDM networks has, in recent times, been based on variants of Common Channel Signalling System Number 7 (SS7). Equivalent inter-server signalling in Next Generation Networks will almost certainly be based on the Session Initiation Protocol (SIP). TDM networks have exploited Dual Tone Multi Frequency (DTMF) access signalling from analogue terminals, and Integrated Services Digital Network (ISDN) access signalling from digital terminals.

Where a customer receiving service from an NGN has an IP based terminal and IP connectivity, SIP will almost certainly be the preferred basis for access signalling. Indeed, the standards bodies are in the midst of defining an end-to-end SIP architecture for session based multimedia services delivered through NGNs. It is based on the IP Multimedia Subsystem (IMS) that has been defined for the General Packet Radio Service (GPRS) and 3rd Generation (3G) mobile networks by the 3G Partnership Project (3GPP).

Where a customer continues to use a legacy terminal, some form of Line Media Gateway will be required, with a device control protocol such as H.248 providing the link between that Gateway and an appropriate NGN server. Whilst we believe that it is a 'given' that SIP signalling between NGNs must be agreed and supported, it is debateable whether H.248 has the potential to become an inter-operator interface. Appropriately controlled IP access to the NGN incorporating the Media Gateway will enable third-party operator interconnection of multimedia call streams and direct SIP connections to the NGN operator's servers. Although this will not provide as granular control of services as an H.248 interface, it will satisfy the NGN multimedia generalisation of today's Carrier Pre-select (CPS).

The interconnection between NGNs and the remaining legacy TDM networks will almost certainly employ SS7 signalling and TDM transport via an appropriate Trunk Media Gateway. Whilst this is unavoidable, it would be undesirable if this emerged as 'the interconnection of choice' between NGNs for voice services, as every conversion between the IP and TDM domain introduces delay and distortion, which result in poorer call quality.

The Required Access and Interconnection Interfaces in an NGN World[8,9]

Based on the above considerations, we view the agreement on a generic format for IP access, with appropriate API hooks into the NGN's intelligence functionality, as fundamental to the establishment of a new regulatory regime. As we have seen, such an interface can ultimately replace today's requirements for a myriad of connectivity services and enable multimedia calls to be passed from one operator to another. Provided such an interface also enables direct QoS controlled IP connectivity to end users through the NGN's access network, it could also ultimately obviate the need for today's access products, such as Local Loop Unbundling (LLU)[10]. By exploiting the creation of 'tunnels' such connectivity to end users can be provided from any convenient geographic node in the network[11]. In NGNs the nature of an IP connection, and its ultimate destination, are entirely separable from its geographic origination.

It is likely that a key enabler of QoS in the core of NGNs will be the technology of Multi Protocol Label Switching (MPLS). However, such technology is not yet fully mature, and many NGNs will, for some time, use other means to help ensure QoS. As QoS is an end-to-end issue, the need for a corresponding mechanism in NGN access networks is a 'given', but the jury is still out on how this will be achieved. However, if an appropriate API is provided into the intelligence controlling it, the detail of its implementation, and indeed that of QoS in the core, need not be a concern of the regulator, instead being left to an individual NGN operator[12,13].

In addition to an agreement on a generic IP interface with API control of intelligence, the need for Layer 2 data link services and even Layer 1 transmission services will persist with NGNs. An operator seeking to exploit another's NGN network may find its ability to offer services compromised by the latter's IP architecture. Stringent delay requirements, for example, could dictate data link or transmission layer connectivity. Even when mature QoS controlled IP connectivity becomes available, with tightly controlled delay and loss characteristics, data link layer connectivity will remain as a pre-requisite for the most secure of services. Unlike the generic IP connectivity discussed above, considerations of the nature of such interconnect are not easily separable from considerations of its geographic origination.

Agreement needs to be reached on the presentation of all of the above interfaces. A shift is already underway from SDH to Gigabit Ethernet as the interface of choice for IP[14,15]. The latter will almost certainly become such for the largest pipes, but SDH seems destined to remain for lower data rate interconnection. Even final agreement on Gigabit Ethernet as the way forward for the largest pipes is contingent on the development of appropriate QoS, timing and synchronisation mechanisms.

The ability to use such generic interfaces to provide point-to-point and any-to-any connections across another operator's NGN network will ultimately replace the need for a myriad of today's access and interconnection products. Such connections will enable the implementation of voice, IP and Ethernet Virtual Private Networks (VPNs). Legacy Asynchronous Transfer Mode (ATM), ISDN and Frame Relay connectivity can continue to be provided using circuit emulation techniques or Pseudo-Wires. The key transitional issue to be resolved is that of the timescale over which responsibility for such circuit emulation passes from the operator of the newly deployed NGN to the service provider exploiting the connectivity.

Multimedia Calls in an NGN World[16]

With the ability to connect to customers via another operator's NGN, a third party service provider will be able to provide voice and more generalised multimedia IP services with a range of qualities and grades of service without ubiquitous points-of-presence. In particular, voice services will be enabled with characteristics stretching all the way from a very basic Public Electronic Communications Service (PECS) to the more rigorously defined Publicly Available Telephone Service (PATS). With API access to the NGN's intelligence, details of the location of the end customer will be available to assist with handling calls to the emergency services as well as providing more advance 'location' and 'presence' based services. Such an approach will increasingly become the preferred choice for a service provider wishing to offer voice services to customers. It is the logical end point of today's embryonic 'voice over broadband' services. As the transition to NGNs progresses, the need to regulate a complex set of PSTN access products and unbundle the base-band traffic of local loops will diminish[17]. There will no longer be a need for products such as Wholesale Line Rental (WLR)[18] and Flat Rate Internet Access Call Origination (FRIACO)[19].

Other Regulatory Issues

One other principal factor that must be borne in mind in developing regulatory policy in respect of NGNs is that such networks enable end users to connect to servers located geographically anywhere. Such servers can also be in portions of a network owned by either a carrier or an enterprise. Indeed, the distinction between carrier and enterprise solutions will become less of an issue of role, and more a question of who owns what network component and where it is located. Regardless of who provides a service, the server hosting it can be located in the same or another country. It is imperative that any new regulatory policies fully recognise such freedoms in 'who does what' and 'where' inherent in NGN architectures.

Conclusions

The imminent deployment of Next Generation Networks (NGNs) provides an excellent opportunity to agree and regulate improved interfaces to enable operators to interconnect and co-operate in the delivery of services. In particular, such deployment opens up the possibility of defining a much reduced set of generic data interfaces which, when coupled with access to 'open' inter-module and signalling protocols and to appropriate APIs to control the intelligence of NGNs, will enable a service independent approach to regulation to be developed. Such an approach is not simply desirable but is a necessity, since the architecture of NGNs not only allows the provision of today's voice and data services and their obvious multimedia generalisations, but also an unlimited range of new services limited only by human imagination. A service specific approach to the regulation of such networks would therefore eventually become unwieldy. As we have seen in this submission, the 'devil is in the detail' of the agreements on the required set of generic interfaces. However, given that the deployment of NGNs is imminent, it is imperative that such agreements are reached with the utmost urgency. Such agreements will, in any case, be fundamental to operators co-operating in the delivery of services regardless of what aspects of such co-operation need to be regulated because of economic bottlenecks or technical barriers to entry.

Such a new approach to regulation will ultimately lead to the withdrawal of the requirements for most of today's regulatory products. The continued imposition of such legacy requirements on a NGN operator might entail costly emulations. Too long a period of such imposition would compromise the operator's ability to realise an adequate return on the investment in the NGN network, and would likely slow down the introduction of such networks to the economic and social disadvantage of the UK. However, to drop such requirements too soon would be unfair to those operators who have made significant investments on the assumption of a continuation in the deployment of today's network technologies and architectures. However, as such issues are of a transitional nature, it is essential that they are addressed independently of the definition of a new regulatory approach, with the latter optimised for a time when NGNs will be the norm rather than the exception.

Nortel has for many years been developing solution sets to enable the implementation of NGNs, based on the initial R&D into such networks undertaken in the mid 1990s. Other vendors and service providers are also developing products. We are therefore confident that the industry is well placed to implement a phased transition to NGNs at a rate appropriate to the business and market environment in the UK.

Philip Hargrave
13 January 2005

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[1] Question 3 - What opportunities are there for generic access products to enable withdrawal of regulation from existing service specific products?

[2] Question 2 - In what areas might regulatory withdrawal be feasible if 21CN enabled the delivery of improved equivalence, including 'equivalence of inputs'?

[3] Question 5 - What principles should Ofcom adopt in order to promote a favourable climate for efficient and timely investment by all operators in Next Generation Networks?

[4] Question 23 - Under what circumstances should access to intelligence capabilities be regulated on a reciprocal basis and what specific examples are there?

[5] Question 24 - To what extent might commercially negotiated access to intelligence capabilities remove the need for regulation?

[6] Question 25 - Is it important to consider the provision of deeper hooks to directly access intelligence capabilities and is this access likely to be practical?

[7] Question 40 - What issues need to be considered relating to signalling used for PSTN interconnection with 21CN? (for example the SIP specification to be adopted, the availability of SS7 as well as SIP interconnection, the availability of IUP as well as ISUP, the availability to interconnecting operators of H248, support for a UK specific feature set)).

[8] Question 15 - If MSAN interconnection were appropriate, what level of access (eg layer 2 v layer 3 v voice interconnect) is likely to be suitable?

[9] Question 58 - Is it reasonable to consider replacing the two existing forms of broadband interconnection (IPStream and DataStream) with a single converged IP interconnection service, incorporating the option of MPLS-based QoS management, in addition to a basic 'best-efforts' service?

[10] Question 7 - What is the potential impact on LLU operators and competition in broadband access of the widespread availability of broadband dialtone?

[11] Question 1 - What are your views on the potential for competition based on access at different geographic levels (local/metro/core) and the way this may vary depending on geography?

[12] Question 56 - Is it likely that consumer broadband services will in the future require some form of managed QoS, or some other specialised capability, due to the introduction of new multimedia services such as real-time video?

[13] Question 57 - If so, might this be best delivered through changes to the underlying generic access and interconnection services associated with 21CN, or by the introduction of new forms of access and interconnection specifically designed to support such requirements as real-time video?

[14] Question 64 - Would it be appropriate for next generation leased line services provided over 21CN to focus on new transmission technologies such as Gigabit Ethernet?

[15] Question 66 - Are there certain types of business services that will continue to need PDH/SDH-based transmission, or will PDH and SDH increasingly become legacy services?

[16] Question 44 - Would broadband access and interconnection need to evolve to allow derived voice services to be provided in an efficient manner over an entry-level broadband connection, and still provide similar quality of service to PSTN voice?

[17] Question 35 - Is it likely that take-up of 'Voice over Broadband' will eventually allow the withdrawal of voice-specific regulation, and if so, under what conditions and over what timescale might this occur?

[18] Question 34 - Given that 21CN will result in narrowband and broadband access being supported using almost identical platforms, is it sensible to continue to make a distinction between wholesale narrowband access (WLR) and wholesale broadband access (Broadband EUA), or should consideration be given to a single wholesale access transport service supporting narrowband and broadband?

[19] Question 51 - Once broadband is available to most UK consumers would it be appropriate to agree a process and timetable for the withdrawal of FRIACO?