Next Generation Network structure and regulatory principles

ZHENG Yusheng, LIANG Xiongjian

School of Economics & Management
Beijing University of Posts & Telecommunications, Beijing 100876, P.R. China
e-mail:Jaschar@263.net, liangxj@bupt.edu.cn

Abstract: The imminent deployment of Next Generation Network (NGN) represents a new way of communications. This paper addresses the changes potentially in the NGN interconnection domain. We start from the structure of NGN, make comparisons with the case in legacy telecommunications network. Then we come up with a NGN interconnection layering model to analyze potential control points in NGN and give a foundation for interconnection framework establishment. At last, we discuss the Regulatory intervention on control points and the regulatory principles.

Keywords: network structure, layering model, control points, regulatory principles

1. INTRODUCTION

Numbers of operators are currently considering plans to deploy ‘Next Generation Networks’ (NGN). NGN essentially deliver convergence between the traditional world of public switched telephone networks, and the new world of data networks. From an operators perspective they provide a means of migrating from the old world to the new world, delivering substantial cost savings due to the economies of scope inherent in a single converged network. From a consumers perspective they can offer innovative new services, greater control and personalization, ease of migration between services as well as offering continuity for existing PSTN services. NGN are expected to run all kinds of service (including voice, data, multimedia) in a single IP-based network with Quality of Service (QoS) guarantees. And certainly, as a pre-requisite for any-to-any connectivity, the interconnection control points and the regulatory principles should be carefully studied.

In this paper, we first give some technical background knowledge about NGN. And then on the base of the above knowledge, we provide a NGN interconnection layering model to give an analysis of potential interconnection control points in NGN. Finally, we discuss the Regulatory intervention on control points and the regulatory principles.

2. Definition of NGN

The terms “Next Generation Network” and “NGN” are now in common use, but until recently there has not been a single widely accepted definition. At the broad level, many potential network arrangements are beyond the “current generation”, as indeed are networks now being introduced. There is, however, an emerging consensus in the telecommunications
industry about the standards that are required for future ubiquitous networks, able to support fixed, mobile and nomadic users and able to carry voice, data and multimedia services. These networks are being called “NGN”.

The Telecommunication Standardization area of the International Telecommunication Union (ITU-T) adopted the following working definition in March 2004 for the NGN(s) now being standardized:

A Next Generation Network (NGN) is a packet-based network able to provide services including Telecommunication Services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It offers unrestricted access by users to different service providers. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users.

![Diagram of NGN structure](image)

**Figure 1. Structure of NGN**

The NGN is characterized by the following fundamental aspects:

1. Packet-based transfer;
2. Separation of control functions among bearer capabilities, call/session, and application/service;
3. Decoupling of service provision from network, and provision of open interfaces;
4. Support for a wide range of services, applications and mechanisms based on service building blocks (including real time/ streaming/ non-real time services and multi-media);
5. Broadband capabilities with end-to-end QoS and transparency;
6. Inter working with legacy networks via open interfaces;
7. Generalized mobility;
8. Unrestricted access by users to different service providers;
9. A variety of identification schemes which can be resolved to IP addresses for the purposes of routing in IP networks;
10. Unified service characteristics for the same service as perceived by the user;
11. Converged services between Fixed/Mobile;
12. Independence of service-related functions from underlying transport technologies; and
13. Compliant with all regulatory requirements, for example concerning emergency communications and security/privacy, etc."

This definition was also endorsed by the Global Standards Collaboration Meeting (GSC-9) in May 2004 as the basis for NGN standards work across international, regional and national telecommunication standards development organizations.

3. **NGN interconnection layering model**

In NGN, relevant markets may arise in layers and hierarchical structure within a layer. In layering NGN, all different kinds of services access to a single backbone network through media gateways. Valid uses of NGN services across different core network involve interconnection among different layers from network-related interconnection service and service-specific interconnection.

Here, we define service as a set of applications, such as Instant message (text and video), video telephony, video messaging, location-based services for mobile and nomadic users, audio, video and text conferencing etc. In NGN, there will be three kinds of generic actors: Access and Transport Layer, Control Layer and network Service Layer. The future interconnection arrangements are likely to occur between the network-related service providers and value-added service providers or among themselves.

![NGN interconnection layering model](image)

**Figure 2. NGN interconnection layering model**

<table>
<thead>
<tr>
<th>Layers</th>
<th>function architecture and influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service layer</td>
<td>● Voice/video Conferencing</td>
</tr>
<tr>
<td></td>
<td>● Directory/policy Services</td>
</tr>
<tr>
<td></td>
<td>● Centrex/VPN</td>
</tr>
<tr>
<td></td>
<td>● Enhanced UMS</td>
</tr>
<tr>
<td></td>
<td>● Personalized service</td>
</tr>
<tr>
<td>Control layer</td>
<td>● Call/connection Control</td>
</tr>
<tr>
<td></td>
<td>● Authentication (AAA)</td>
</tr>
<tr>
<td></td>
<td>● Resource Management</td>
</tr>
<tr>
<td>Access &amp; Transport layer</td>
<td>● Universal access</td>
</tr>
<tr>
<td></td>
<td>● Media routing and Switching</td>
</tr>
<tr>
<td></td>
<td>● QoS control</td>
</tr>
<tr>
<td></td>
<td>● High performance and Reliability</td>
</tr>
</tbody>
</table>

| Table 1. Layer function architecture and influence |
4. Interconnection Points

The network-related domain supplied not only basic transport service, but also Value added service. A multitude of interconnection points must be considered, the network element, user domain and the service domain:

**Figure 3. Interconnection Points**

- A multitude of Interconnection Points (RPIs)
- Location of interfaces: within the network, close to the user, within terminal devices
- New RPIs because Service Providers need specific access to and interconnection of control or management functions of the network
- Interconnection will be demanded by a far more differentiated number of entities
- Network related RPI components
- Service related

Provided a RPI-N has a real standardized interconnection interface associated with it carrying higher layer interface protocols for a RPI-S, the provider of the interface associated with the RPI-N is not necessarily responsible for the corresponding interface associated with the RPI-S.

5. Potential control points

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

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

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

Control points could relate to:

**Network capabilities**
NGN Potentially will enable dominant operators to limit access to certain infrastructure capabilities by competitors. Examples include:
- Network Address Translators and firewalls
- Routing tables
- Quality of service capabilities and interconnect
- Network coverage
- Termination capabilities

**Elementary services**
NGN potentially will enable dominant operators to limit competitive ability to create certain types of services. Examples include:
- Call set-up capabilities
- Proprietary standards
- Non-proprietary standards
- Interoperability
- Application Programming Interfaces

**User access capabilities**
NGN potentially will enable dominant operators to limit or restrain access to certain service providers. Examples include:
- Unnecessary software and service bundles
- Walled gardens
- Tunneling
- Filter mechanisms and digital rights
- End-user devices
- Content

**Individual user information**
NGN potentially will enable certain operators to decide who could construct services based on this information. Examples include:
- Authentication, single logon and profile management
- Customer billing information
- Access to customer information systems
- Resolution of names and numbers through customer identity systems
- Functions for determining location

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

1. Unnecessary software and service bundles
   Security and/or quality may be a pretext for requiring service bundles;

2. Walled gardens
   Content restrictions imposed by access providers, differentiating availability of information and services;

3. Tunneling
   Maintaining control over roaming users;

4. Filter mechanisms and Digital Rights
   Establishing access rights that depend on legal (and financial) status;

5. End-user devices
   Specific services linked to hand-set capabilities;

6. Content
   Certain types of content could become control points;

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

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

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

7. The regulatory principles

   Having analyzed NGN network structure, layering model and control points, we now consider the general application of each of the regulatory principles to NGN. The four principles are all relevant, and are considered in turn, since they tend to raise distinct issues.

7.1. Principle 1: Competition at greatest depth Two aspects to ‘depth’ are considered:
   Geographic depth within the topology of NGN, how close to the customer is access provided. There are three geographic levels within network at which it might be possible to
provide access: the local loop (MDF/MSAN sites), the metro node and the core node. It is likely that a combination of access remedies will be required, focusing on access at MDF/MSAN sites in those geographies where this is likely to result in sustainable competition, and providing metro node access elsewhere.

There is likely to be a choice between end-to-end services (e.g. wholesale calls), service-specific interconnection services (e.g. voice call origination), a generic interconnection service (e.g. bit stream interconnection) or physical unbundling (e.g. LLU). Consistent with its regulatory principles, we believe regulation should be focused as deep in this service stack as possible, recognizing that this might vary with different geographies. If, for example, some form of access is made available at the MSAN, then there would be a preference for this to be at the physical or bit stream level rather than service specific.


The design of key regulated access and interconnection products must support equality of access. In particular, new regulated NGN access and interconnect products will need to support ‘equivalence of inputs’, so that operator uses the same products, at the same price, managed using the same systems and processes as alternative providers. Reduced time to market is expected to be one of the key benefits of NGN, so an effective process for the introduction of new regulated products will also be important. Even where existing regulated products currently support equivalence of access, they may have to evolve in light of new capabilities introduced by NGN. For example, the requirement to support equivalence of access to the local access network might require changes to the existing LLU service, and may require consideration of some form of bit stream access at the MSAN.


NGN might allow for regulatory withdrawal because:

- NGN may be the vehicle for the delivery of improved equivalence in relation to wholesale services. This should allow other providers to compete in downstream markets and create the conditions where downstream services, particularly at the retail level, could be deregulated.
- Next Generation Network – Future arrangements for access and interconnection. At the wholesale or network level a key theme of NGN is convergence. If convergence is effective, this should allow a reduction in service specific wholesale regulation, and a greater focus on generic access and interconnection remedies (LLU, bit stream interconnection).


An important general principle is that regulation of NGN should not simply be seen as a ‘zero-sum’ game, where we primary concern is to decide how the benefits of investment in NGN should be divided between operator and the rest of industry. Instead, the aim should be to promote a favorable investment climate for industry as a whole, in order to deliver the greatest possible benefit to consumers of an industry wide migration to NGN. There are a number of ways in which we can influence the investment climate:

- Providing regulatory clarity and predictability
- Ensuring alternative providers have confidence in regulated operator’s products
- Setting appropriate regulated returns for operator’s regulated products, that take account of the commercial and technical risks associated with its investment in NGN
• Ensuring the migration to NGN minimizes the impact on existing investments (and thereby also minimizes the perceived risk associated with new investments) whilst enabling operator to close its existing networks as soon as reasonable

The introduction of Next Generation Networks (NGN) presents an excellent opportunity to develop a new approach to regulation. We believe that real ‘equality of access’ to an NGN entails access to a set of data interfaces, the inter-module and signaling protocols used by the network, and the interfaces that control its intelligence. Such access will enable a service independent approach to regulation to be developed, and will lead to the withdrawal of the requirements for many of today’s regulatory products. Given that the deployment of NGN is imminent, it is imperative that the nature and regulation of such interfaces are agreed without delay.

8. Conclusion

The introduction of Next Generation Network (NGN) presents an excellent opportunity to develop a new approach to regulation. We believe that real ‘equality of access’ to an NGN entails access to a set of data interfaces, the inter-module and signaling protocols used by the network, and the interfaces that control its intelligence. Such access will enable a service independent approach to regulation to be developed, and will lead to the withdrawal of the requirements for many of today’s regulatory products. Given that the deployment of NGN is imminent, it is imperative that the nature and regulation of such interfaces are agreed without delay.

REFERENCES
7. MICHAEL K. POWELL, Federal Communications Commission on Voice over Internet Protocol (VoIP), 2004