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Design and Implementation of Next Generation Networks: A Future Communication System over IP Platform

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ABSTRACT: Next-generation network (NGN) is a new concept and becoming important for future telecommunications networks. This paper illustrates five function layers of NGN architecture and discusses some end-to-end QOS (quality of service) for NGN (called NGNQOS) as: (1) One Application Layer that supports SIP protocol; (2)Network Control Layer that aims at overcoming the bottleneck problem at edge nodes or servers for end-to-end admission control; (3) Adaptation Layer that supports different network configurations and mobility; (4) Network Transmission Layer that provides end-to-end QOS controls for real-time communications through integrating DiffServ and MPLS and (5) Management Layer that provides Web-based client-server GUI browser and wireless information connection.

KEYWORDS: SIP protocol, NGN, QOS controls, DiffServ and MPLS.

I.INTRODUCTION

Next-generation network (NGN) is a new concept commonly used by network designers to depict their vision of future telecommunications networks. Various views on NGN have been expressed by operators, manufacturers and service providers. NGN seamlessly blends the end-to-end QOS into the public switched telephone network (PSTN) and the public switched data network (PSDN), creating a single multi-service network. Rather than large, centralized, proprietary switch infrastructures. Next-generation architecture pushes central core functionality to the edge of the network. The result is a distributed network infrastructure that leverages new, open technologies to reduce the cost of market entry dramatically, and to increase flexibility, and to accommodate both circuit-switched voice and packet switched data. The integrated services will bring communication market billions of incomes, however, the R&D for NGN still lack behind of the actual demands of the society [1]. On the other hand, the architecture of the Internet and IP-based networks is rapidly evolving towards one where service-enablement, reliability and scale become paramount.

Dynamic IP routing supported by routing protocols such as OSPF, IS-IS and BGP provides the basic internetworking function while confronting 1 The work is supported by Research Grant Council (RGC) Hong Kong, SAR China, under grant nos.: City U1055/00E and City U1039/02E and City U Strategic grant nos. 7001709. The dual challenges of greater scale and faster convergence. Many providers are looking to a converged packet switch network (PSN) future based on IP/MPLS and they seek a way to converge many networks into one to reduce costs and expand service reach. The transport layer protocols including TCP and SCTP continues to be an area of active research as developers seek optimal application throughput and resilience. IP QOS as defined by IntServ and DiffServ continues to evolve and interesting efforts are underway to enhance QOS signaling for wire line and wireless networks.

The challenges and opportunities associated with a fundamental transformation of current networks toward a multi-service ubiquitous infrastructure with a unified control and management architecture have been discussed in BellSouth Science & Technol., Atlanta, GA, USA [2], in which, the outline of the fundamental reasons why neither the control infrastructure of the PSTN nor that of the present-day Internet is adequate to support the myriad of new services in NGN. Although NGN will inherit heavily from both the Internet and the PSTN, its control and management

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architecture is likely to be radically different from both, and will be anchored on a clean separation between a QOS-enabled transport/network domain and an object-oriented service/application domain, with a distributed processing environment that glues things together and universally addresses issues of distribution, redundancy, and concurrency control for all applications.

This paper presents NGN architecture and discusses some end-to-end QOS for NGN. In Sec 2, a survey for NGN is given and the five layers architecture of NGN is illustrated in Sec 3. Some end-to-end QOS issues of NGN are described in Sec 4 and we conclude in the final section.

II. SURVEY OF NGN

Lucent proposed next-generation networks with various venues, expanding the boundaries [3]. The basis of this proposal is that the coordination of feature interactions in NGN can be served well with the use of semaphores. A feature semaphore is associated with each zone of a call session, and these semaphores become part of the user's per call data. Telcordia Technol in NJ, USA [4] proposed next generation networks (NGNs) that support a variety of communications services (data, video, and voice) seamlessly. Customers will demand that these networks be highly reliable as more and more traffic and services use them. Because of the historically exceptional reliability of wire-line voice telephony, the reliability of voice services supported by NGN voice over packet (VOP) necessitates special attention in order to achieve the customer satisfaction of the service.

In South Koera, KT is considering the installation of NGN backbone network with IP Router. KT is now testing packet delay, loss and jitter in their test bed. QOS discussions on whether the IP router satisfies the forthcoming NGN customers who use basic application of NGN still remain. QOS values as packet delay, packet loss and jitter are measured and analyzed at the KT-NGN test bed, and are compared with the ITU-T QOS recommendation values [5, 6]. In Slovenia, Iskratel Ltd. is a company with of telecommunications with the latest product SI2000 with the basic functions, data and interfaces included in the management node software, which manages various network elements of the SI2000 product line [7] in which data and voice will share a common packet-switched network. The major drawbacks of the current NGN implementations that are based on those services are investigated. A new element in the NGN architecture is proposed, called multi-service mediator (MSM) and an interworking scenario with other currently defined NGN elements is described, especially with the soft switch [8]. Some German companies discuss QOS from a somewhat unconventional point of view and argue that high availability is a key ingredient in QOS perceived by the user. High availability with extremely short interruptions in case of failure is needed for acceptable QOS in real-time dialog services such as telephony or video conferencing and an even distribution of the traffic load over the network is essential to ensure the efficient network utilization given that some kind of admission control for QOS traffic has to be in place for overload avoidance [9].

Alcatel (France) proposes the NGN multimedia network structure and its business model with four players involved in charging: access provider, connection provider, telecommunication service provider, and value-added service provider. Often charging components must be correlated to create a clear postpaid bill and ensure correct treatment of prepaid accounts, as well as settlement between the providers involved. If charging is to remain a prime competitive tool in next-generation networks, it must be functionally intelligent and flexible, and able to optimize operator and service provider revenues while providing a fair policy toward the end users [10]. A prototype for a service platform for the next-generation network is also described, targeted at offering services in fixed and mobile networks using NGN principles, and focused primarily on the architecture of the core IP-UMTS network based on current 3GPP specifications [11].

France Telecom R&D presented a generic functional architecture to help people to identify functions needed to deliver different type of services, with different QOS levels and constraints using a NGN DSL network [12]. IP Differentiated Services have been discussed in Alcatel Network Strategy Group, Antwerp, Belgium and is widely seen as the framework to provide quality of service in the Internet in a scalable fashion. However many issues have still not been fully addressed, such as the way per-hop behaviors can be combined to provide endto-end services; the specification of admission control and resource reservation mechanisms; and the role of management plane functionality and its integration with the control and data planes.

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A team group at NTT, Tokyo, Japan has considered connectionless network is more suitable than connection-oriented network where voice over IP (VoIP) technologies are becoming practical. Call agents are being developed for the next generation network, called NGN-CA. NGN-CA provides Open API, which is standardized application programmer interface to control various network elements. Although various applications using Open API are written, ordinary call agent supports only one Open API because there is difference among call models of Open APIs. A call model has been proposed combining multiple Open APIs. Various applications written in different Open APIs can be installed on the implementation and these applications can provide services on a call simultaneously [14].

Centre for Telecommunication in South Africa, University of Witwatersrand proposed the use of the TINA retailer and accounting management architecture as the basis for usage accounting in the NGN [15]. Three computational objects, namely the accountable object, the metering manager and the accounting policy manager, are used. A CORBA-based distributed processing environment (DPE) enables the TINA components to be deployed in a non-TINA NGN environment. Service components and computational objects used in the TINA accounting management are described.

In UK, next generation IP-based networks that offering QOS guarantees by deploying technologies such as DiffServ and MPLS for traffic engineering and network-wide resource management have been proposed. The discussion includes the following aspects: emerging service level agreements (SLAs) and service level specifications (SLSs) for the subscription to QOS-based services; management protocols for off-line service negotiation and signaling mechanisms for the dynamic invocation of service instances; approaches for the derivation of a traffic matrix based on subscribed SLAs/SLSs and monitoring data; algorithms for off-line traffic engineering and provisioning through MPLS or through plain IP routing with QOS extensions; algorithms for dynamic resource management to deal with traffic fluctuations outside the predicted envelope; a policy-based overall framework for traffic engineering and service management. Finally, ongoing work towards inter domain QOS provisioning is presented [16]. The base issue of NGN trials on Russian public networks is interoperability testing of foreign equipment and adapted to the specific of Russian networks, domestic NGN system SAPFIR. Results of these NGN trials will be used for the development of the “NGN Evolution Concept” for the Russian public networks [17]. Beijing Univ. of Posts & Telecom., China, discussed that the NGN should provide end-to-end QOS solutions to users and analyzed QOS problems of wireless broadband applications in next generation mobile communications system, sets up a QOS index evaluation model, and presents an adaptive QOS paradigm for wireless broadband applications on NGN. A media negotiation mechanism in soft-switch based NGN is presented. The central point of this solution is to dynamically adjust the bandwidth occupation property of media connection belonging to certain sessions, reserve resource for the sessions, thus guarantee QOS. A variety of solutions are stated considering different soft-switch architecture and different types of sessions [18-20].

III. NGN ARCHITECTURE

NGN is a layered architecture consisting of transport, access, control and application layer. It is important to note that all the layers are independent from each other. Change in one layer should not affect other layers.

A. Access Layer:

Access Layers is responsible for direct subscriber attachment function. NGN can support all kind of existing access as well as upcoming access. In fact NGN does not matter about type of access. NGN is capable of processing traffic originated from PSTN, GSM, CDMA, XDSL, WI-MAX or any other access system. Depending upon the type of access, protocol conversion and/or media conversion may be required at the NGN Gateways. Access Layer consists of Gateways. Example of getaways are media Gateway, Access gateway. Signaling gateway.

Media gateway terminates media, coming from PSTN/PLMN in E1 / STM. Here it is responsible for packetization of media under the instruction of control layer. After packetisation of information it throws packets to the transport Network.

Access gateway is nearer to subscriber. Subscriber can directly be terminated in Access Gateway. All the required configuration of such subscribers should be done at control layer. Access Gateway and Media Gateways are

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responsible for carriage of Media whereas Signaling gateway is carrying signaling generated by PSTN and informs Control Layer about the signaling in required format.

B. Transport Layer:

Transport Layer of NGN is based on IP. It can utilize the advantage of MPLS. Transport Layer forms the core of the Network. It basically consists of Routers, which are responsible for carrying traffic originated by access layer. As the same core network is going to be used for all kinds of subscribers enjoying different kind of real time and non real time services, it should be able to make use of band width policies and QOS policies. Operator has to think of managed Network for its subscribers.

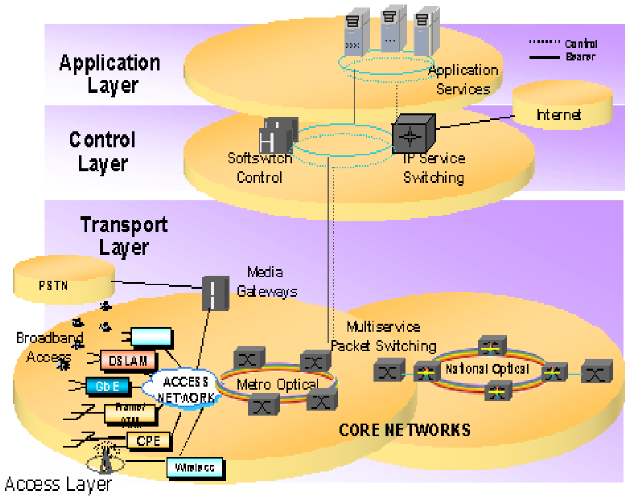
C. Control Layer:

It is responsible of call setup, routing and charging policies and other controls in NGN environment. It consists of call servers where all information of the network resides. These call servers are responsible for setting up, modifying, charging and tear down of the calls.

NGN may work on soft switch principle. It consists of MGC (Media Gateway Controller) as an overall controller and MGs(Media Gateway) for termination of traffic. MGC is basically a server and it is having all the necessary information of network MGC instructs MGs for establishing the call. Under the control of MGC, MG performs different call related tasks such as connection, modification and termination of media streams, packetisation of media etc.

D. Application Layer:

It is responsible for OSS/BSS. Enhanced services to the subscribers will be provided with the help of application servers. It may include prepaid servers, announcement servers, Service servers etc. Hence NGN is making service separation from Network. Any service can be introduced with the help of server at any time without any modifications in the control, transport or access.



IV.CONCLUSION

It is very much clear that NGN is a network, which can help operators for their needs and also very use full for end users since they are getting any device scenario. So NGN is a win-win salutation. NGN treated as an approach towards complete But at the same time operators have to invest in NGN wisely because of the fact that some past technologies like ISDN made so many promises but could not meet them properly. Same should not happen to NGN. Instead of

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depending upon any specific model (like Soft switch or IMS), NGN should be treated as an approach towards complete IP communication. Operators should have flexibility for implementing any kind of model on need basis.

IP communication and so it is called as future telecom network. It is understood that in near future operators will migrate to complete IP communication. But it is to be ensured that the migration process should be smooth. At present there should not be any hurry to implement NGN immediately. Operators will have to first work out for building reliable IP backbone and then process of migration can be started.

V. FUTURE SCOPE

The Next Generation Networking Symposium will focus on some of the important trends and evolutions in next generation Internet architectures and services. Modern Internet networking infrastructures embody a wide range of technologies-wireless and wired-and support a diverse spectrum of user services. However, as overall demands continue to grow, there is a continual need to develop improved "next-generation" architecture designs and services. In particular, some of the key challenges relate to multi-technology integration, future Internet designs, Internet security and privacy, routing scalability, Content Delivery Networks, impact of the rise of Cloud computing on networks, data center networking, and energy consumption (green networks). Furthermore, the increasing prevalence of wireless and mobile user devices is creating new challenges relative to mobility management. New paradigms such as software defined networking and network virtualization will influence next-generation network designs.

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