Impact Factor (NJIF) : 2.126
Scientific Journal Impact Factor (SJIF): 1.711
International Journal of Modern Trends in Engineering and Research
ISSN (ONLINE) : 2349 - 9745
ISSN (PRINT) : 2393 - 8161

A survey on QoS based Routers for Next Generation Network (NGN)

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Abstract— In non-stationary environment, dynamic resource reservation schemes Operating in harmony with the variability in demand patterns may provide efficient mechanisms for resource utilization and guarantee QoS compliance. In this proposed work we identify the challenges that need to be addressed in designing a three level core which consists of policy making, packet queuing and forwarding and resource utilization itself concerning the high performance, QoS supported transport services, it is not sufficient that only the traffic transport under a single domain or Autonomous System (AS) is under the consideration. Inter-domain QoS routing is also in a great need. As there has been empirically and theoretically proved, the dominating Border Gateway Protocol (BGP) cannot address all the issues that in inter-domain QoS routing. Thus a new protocol or network architecture has to be developed to be able to carry the inter-domain traffic with the QoS and TE consideration. Moreover, the current network control also lacks the ability to cooperate between different domains and operators. The emergence of label switching transport technology such as of Multi-Protocol Label Switching (MPLS) or Generalized MPLS (GMPLS) supports the traffic transport in a finer granularity and more dedicated end-to-end Quality of Service classes.

Keywords- QoS, Router, NGN, WRED, RACF, MPLS, GMPLS

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 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 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.

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 end-to-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. 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 OpenAPI, which is standardized application programmer interface to control various network elements. Although various applications using OpenAPI are written, ordinary call agent supports only one OpenAPI because there is difference among call models of OpenAPIs. A call model has been proposed combining multiple OpenAPIs. Various applications written in different OpenAPIs 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 managementare 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.

III. OVERALL NGN ARCHITECTURE

NGN-QoS can be described from five layers: (1) Application layer that contains the typical middleware for authorization, accounting, directory, browser, search and navigation of the information for millions of users where we focus on SIP protocol; (2) Network control layer aims at overcoming the bottleneck problem at edge nodes or servers and it composes a series of control agents for admission control, call setup, end-to-end QoS control and application flows through available bandwidth detection and distributed incomplete local information control, class priority and intelligent scheduling. Multicast and anycast group managements will be implemented to leverage the load for the admission control or service/message distributions; (3) Adaptation layer that supports different network configurations and mobility. It provides soft switching between different network on different level such as IPv4, IPv6, ATM, Ethernet, WLAN, WMAN and 3G networks, the layer supports both packet and circuit switching and provides interconnection between the two switching

Volume 02, Issue 09, [September – 2015] ISSN (Online):2349–9745 ; ISSN (Print):2393-8161

networks protocols; (4) Network Transmission Layer that provides the effective end-to-end QoS controls for the real-time requests and flows through integration of parameterized QoS control and QoS class priority control, i.e., the DiffServ application to guarantee end-to-end delay with efficient routing algorithms for any cast and multicast etc..

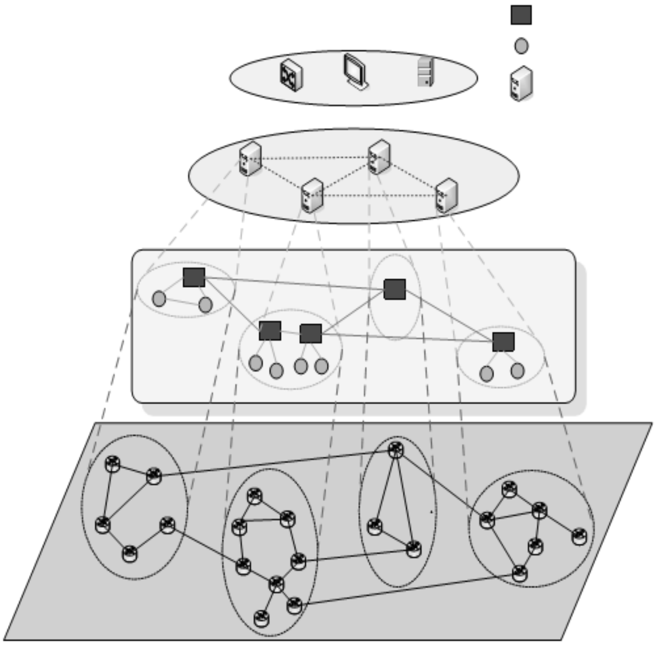


Fig. 1. NGN Network Architectures

This is particularly important to resolve the bottleneck problems as multipath routing enables the multiple choices for the path and any cast routing enables the selection to different (replicated) server thus reducing the bottleneck problems and (5) Management layer that provides Web-based client-server GUI browser and wireless information connection such as the access to the data using XML and Web-based visualization for data presentation, monitoring, modification and decision making on NGN. The IP telecommunication network architecture and software layer architecture are shown in Fig. 1 in which Bearer Control Layer and Logical Bearer Network together perform network control.

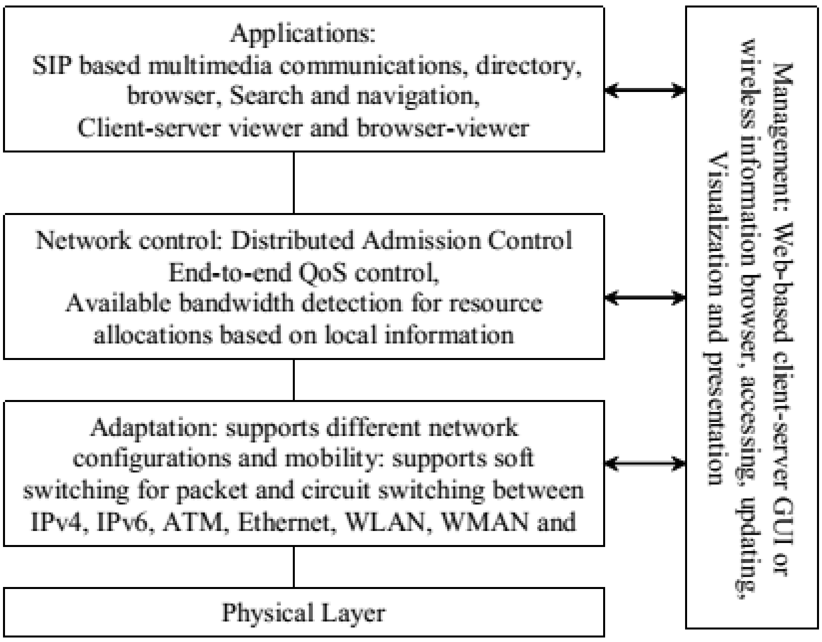


Fig. 2. Layered functions of NGN-QoS

IV. MODELING TRAFFIC ON QOS BASED ROUTER FOR NGN

Following two basic approaches for QoS deployment in your NGN

Command line Interface (CLI)- The CLI is the standard IOS interface that configures routers. CLI QoS features such as Priority Queuing (PQ) which is configured through the CLI.

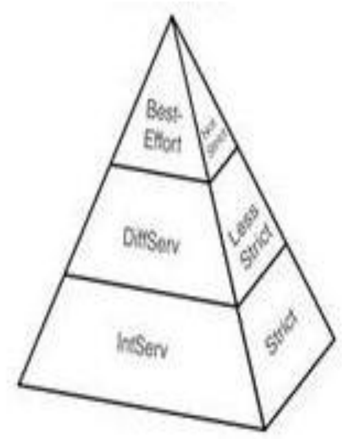
Modular QoS CLI (MQC)- Three step MQC process allows you to 1) place packets into different classes, 2) assign policy for those classes and 3) apply the policy to an interface. QoS mechanisms can not only provide for the allocation of a minimum amount of bandwidth for specific traffic but also limit the amount of bandwidth made available to that traffic. This section discusses how policing and shaping mechanisms limit traffic rates.

Policing Versus Shaping- Instead of allocating bandwidth for applications, in some instances, you might want to restrict the amount of bandwidth that is available for specific traffic.

Policing- However, policing also can remark traffic that exceeds the specified rate and attempt to send the traffic anyway. Because policing drop behavior causes TCP retransmits, it is recommended for use on higher-speed interfaces. Also, note that policing can be applied inbound or outbound on an interface.

Shaping- Shaping limits excess traffic, not by dropping it but by buffering it. This buffering of excess traffic can lead to delay. Because of this delay, shaping is recommended for slower-speed interfaces. Unlike policing, shaping cannot remark traffic. As a final contrast, shaping can be applied only in the outbound direction on an interface. It is impossible for an interface to send at a rate that is slower than the line rate.

QoS Categories- The category of QoS resources used most often in production, however, is the Differentiated Services category, which offers greater scalability and flexibility than the resources, found in the Best-Effort or Integrated Services categories.



Best-Effort- Best-Effort does not truly provide QoS, because there is no reordering of packets. Best-Effort uses the first-in first-out (FIFO) queuing strategy, where packets are emptied from a queue in the same order in which they entered it.

Integrated Services (IntServ)- IntServ is often referred to as "Hard QoS," because it can make strict bandwidth reservations. IntServ uses signaling among network devices to provide bandwidth reservations. Resource Reservation Protocol (RSVP) is an example of an IntServ approach to QoS. Because IntServ must be configured on every QoS based router along a packet's path, the main drawback of IntServ is its lack of scalability.

Differentiated Services (DiffServ)- DiffServ, as the name suggests, differentiates between multiple traffic flows. Specifically, packets are "marked," and QoS based routers and switches can then make decisions (for example, dropping or forwarding decisions) based on those markings. Because DiffServ does not make an explicit reservation, it is often called "Soft QoS." DiffServ, as opposed to IntServ or Best-Effort. To maintain relative levels of priority among devices, the Internet Engineering Task Force (IETF) selected a subset of those 64 values for use. These values are called per-hop behaviors (PHBs), because they indicate how packets should be treated by each QoS based router hop along the path from the source to the destination.

Following are some of the QoS tools that are addressed later in these

Classification—Classification is the process of placing traffic into different categories. Multiple characteristics can be used for classification. For example, POP3, IMAP, SMTP, and Exchange traffic could all be placed in an "EMAIL" class.

Marking—marking alters bits within a frame, cell, or packet to indicate how the network should treat that traffic. Marking alone does not change how the network treats a packet.

Congestion management—When an interface's output software queue contains packets, the interface's queuing strategy determines how the packets are emptied from the queue.

Congestion avoidance—If an interface's output queue fills to capacity, newly arriving packets are discarded, regardless of the priority that is assigned to the discarded packet.

V. CONCLUSION

We have discussed some important issues for the next generation router and various layers of end to end Qos services implemented by some researchers. Here in survey the issues discussed are not comprehensive, however the further work is required with quality of service parameters for next generation networks. We are curently working on the implementations of such a parameters for the next generation networks (NGN). Our work on implementing QoS based router offers a wealth of QoS resources on its router platforms in NGN.

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