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An Overview on Quality of Services based Routers for NGN

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Abstract: 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. 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 good performance, QoS supported convey services, it is not adequate that only the traffic transport under a single domain or Autonomous System (AS) is under the thinking. Inter-domain QoS routing is also in a great need. As there has been empirically and hypothetically proved, the dominating Border Gateway Protocol (BGP) cannot address all the issues that in inter-domain QoS routing. Thus some protocol or system 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 appearance 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: Gateway, Router, QoS, NGN, MPLS.

I. INTRODUCTION

1. The networks of yesteryear physically separated voice, video, and data traffic. Literally, these traffic types flowed over separate media (for example, leased lines or fiber-optic cable plants). Today, however, network designers are leveraging the power of the data network to transmit voice and video, thus achieving significant cost savings by reducing equipment, maintenance, and even staffing costs.

2. The challenge, however, with today's converged networks is that multiple applications are contending for bandwidth, and some applications such as, voice can be more intolerant of delay (that is, latency) than other applications such as, an FTP file transfer. A lack of bandwidth is the overshadowing issue for most quality problems.

3. When a lack of bandwidth exists, packets can suffer from one or more of the following symptoms:

- **Delay—**Delay is the time that is required for a packet to travel from its source to its destination. You might witness delay on the evening news, when the news anchor is talking through satellite to a foreign news correspondent. Because of the satellite delay, the conversation begins to feel unnatural.
- **Jitter—**Jitter is the uneven arrival of packets. For example, consider that in a Voice over IP (VoIP) conversation, packet 1 arrives. Then, 20 ms later, packet 2 arrives. After another 70 ms, packet 3 arrives, and then packet 4 arrives 20 ms behind packet 3. This variation in arrival times (that is, variable delay) is not dropping packets, but this jitter can be interpreted by the listener as dropped packets.
- **Drops—**Packet drops occur when a link is congested and a buffer overflows. Some types of traffic, such as User Datagram Protocol (UDP) traffic (for example, voice), are not retransmitted if packets are dropped.

4. Fortunately, quality of service (QoS) features that are available on Proposed NGO routers and switches can recognize your "important" traffic and then treat that traffic in a special way. For example, you might want to allocate 128 kbps of bandwidth for your VoIP traffic and also give that traffic priority treatment.

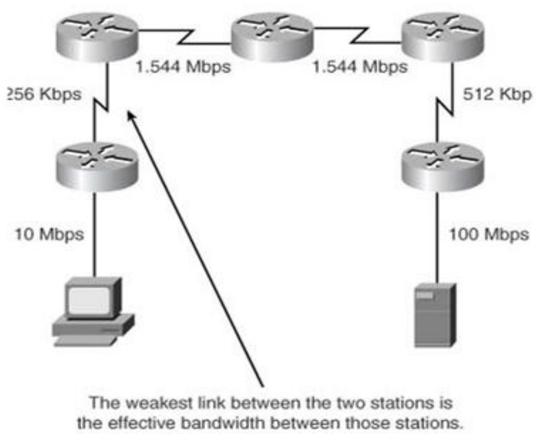

Fig 1: Effective Bandwidth

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5. Consider water that is flowing through a series of pipes with varying diameters. The water's flow rate through those pipes is limited to the water's flow rate through the pipe with the smallest diameter. Similarly, as a packet travels from its source to its destination, its effective bandwidth is the bandwidth of the slowest link along that path.

II. SURVEY OF QOS FOR NGN

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]. 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]. 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]. 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]. 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 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].

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III.OVERVIEW OF QOS

The mission statement of QoS could read something like "to categorize traffic and apply a policy to those traffic categories, in accordance with a QoS policy." Specifically, QoS configuration involves the following three basic steps:

Step 1 Determine network performance requirements for various traffic types. For example, consider the following design rules of thumb for voice, video, and data traffic:

Voice:

- No more than 150 ms of one-way delay
- No more than 30 ms of jitter
- No more than 1 percent packet loss

Video:

- No more than 150 ms of one-way delay for interactive voice applications (for example, video conferencing)
- No more than 30 ms of jitter

Data:

- Applications have varying delay and loss characteristics. Therefore, data applications should be categorized into predefined "classes" of traffic, where each class is configured with specific delay and loss characteristics.

Step 2 Categorize traffic into specific categories. For example, you can have a category named "Low Delay," and you decide to place voice and video packets in that category. You can also have a "Low Priority" class, where you place traffic such as music downloads from the Internet. As a rule of thumb, Proposed NGO router recommends that you create no more than ten classes of traffic.

Step 3 Document your QoS policy, and make it available to your users. Then, for example, if a user complains that his network gaming applications are running slowly, you can point him to your corporate QoS policy, which describes how applications such as network gaming have "best-effort" treatment.

• QoS Deployment

Proposed NGO routeroffers the following four basic approaches for QoS deployment in your network:

• Command-Line Interface (CLI)

The CLI is the standard IOS (or Cat OS) interface that configures routers or switches. CLI QoS features such as Priority Queuing (PQ) or Custom Queuing (CQ), which are configured through the CLI, have been available for many years.

• Modular QoS CLI (MQC)

Instead of using the CLI to configure QoS parameters for one interface at a time, the three-step MQC process allows you to (1) place packets into different classes, (2) assign a policy for those classes, and (3) apply the policy to an interface. Because the approach is modular, you can apply a single policy to multiple interfaces.

• AutoQoS

AutoQoS is a script that is executed on routers or switches that automates the process of QoS configuration. Specifically, this automatic configuration helps optimize QoS performance for VoIP traffic.

• QoS Policy Manager (QPM)

QPM, in conjunction with Cisco Works, centralizes QoS configuration. Policies that are created with QPM can be pushed out to routers throughout an enterprise, thus reducing the potential for misconfiguration.

QoS Components

Proposed NGO router offers a wealth of QoS resources on its switch and router platforms. These resources are classified into one of three categories, which are discussed in this section. 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.

QoS Categories

All of the Proposed NGO router's QoS features are categorized into one of the following three 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 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 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." Effort.

QoS Tools

Now that you understand how markings can be performed with the DiffServ QoS model, realize that marking alone does not alter the behavior of packets. You must have a QoS tool that references those marking and alters the packets' treatment based on those markings. Following are some of the QoS tools that are addressed later in these Quick Reference Sheets:

• 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. Classification does not, however, alter bits in the frame or packet.

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• **Marking**— Marking alters bits (for example, bits in the ToS byte) 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. Other tools (for example, queuing tools) can, however, reference those markings and make decisions based on them.

• **Congestion management**—When you hear the term congestion management, think queuing. These concepts are the same. When an interface's output software queue contains packets, the interface's queuing strategy determines how the packets are emptied from the queue. For example, some traffic types can be given priority treatment, and bandwidth amounts can be made available for specific classes of traffic.

• **Congestion avoidance**—If an interface's output queue fills to capacity, newly arriving packets are discarded (that is, "tail-dropped"), regardless of the priority that is assigned to the discarded packet. To prevent this behavior, Proposed NGO router uses a congestion avoidance technique called Weighted Random Early Detection (WRED). After the queue depth reaches a configurable level (that is, the minimum threshold) for a particular priority marking (for example, IP Precedence or DSCP), WRED introduces the possibility of discard for packets with those markings. As the queue depth continues to increase, the possibility of discard increases until a configurable maximum threshold is reached. After the queue depth has exceeded the maximum threshold for traffic with a specific priority, there is a 100 percent chance of discard for those traffic types.

• **Policing and shaping**—Sometimes, instead of making a minimum amount of bandwidth available for specific traffic types, you might want to limit the available bandwidth. Both policing and shaping tools can accomplish this objective. Collectively, these tools are called traffic conditioners.

Fig 2: QoS Categories

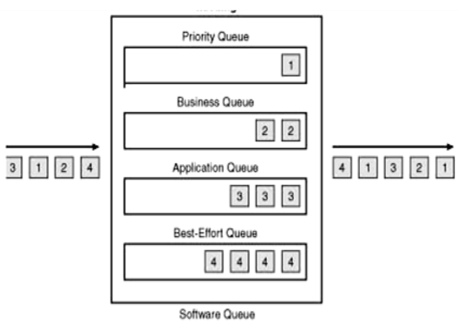

Fig 3: Queuing mechanism

Policing can be used in either the inbound or outbound direction, and it typically discards packets that exceed the configured rate limit, which you can think of as a "speed limit" for particular traffic types. Because policing drops packets, resulting in retransmissions, it is recommended for use on higher-speed interfaces. Policing mechanisms also allow you to rewrite packet markings (for example, IP Precedence markings).

Shaping can be applied only in the outbound direction. Instead of discarding traffic that exceeds the configured rate limit, shaping delays the exceeding traffic by buffering it until bandwidth becomes available. That is why shaping preserves bandwidth, as compared to policing, at the expense of increased delay. Therefore, shaping is recommended for use on slower-speed interfaces. Also, shaping does not have policing ability to rewrite packet markings.

• **Link efficiency**—To make the most of the limited bandwidth that is available on slower-speed links, you can choose to implement compression or Link Fragmentation and Interleaving (LFI). Using header compression on smaller packets can dramatically increase a link's available bandwidth.

LFI addresses the issue of "serialization delay," which is the amount of time required for a packet to exit an interface. A large data packet, for example, on a slower-speed link could create excessive delay for a voice packet because of the time required for the data packet to exit the interface. LFI fragments the large packets and interleaves the smaller packets among the fragments, reducing the serialization delay that the smaller packets experience.

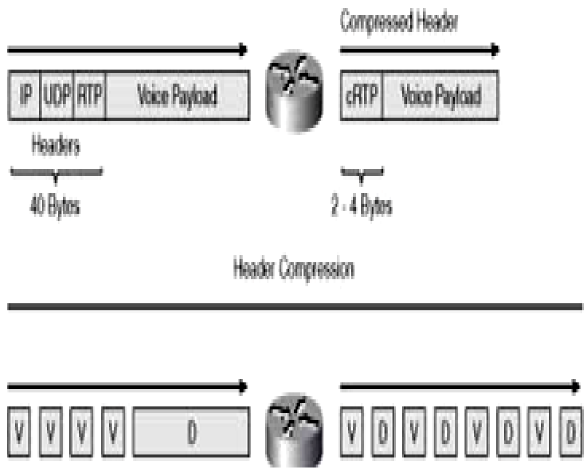

Fig 4: Link efficiency Management

IV. OVERALL NGN ARCHITECTURE

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

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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 any cast 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 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..

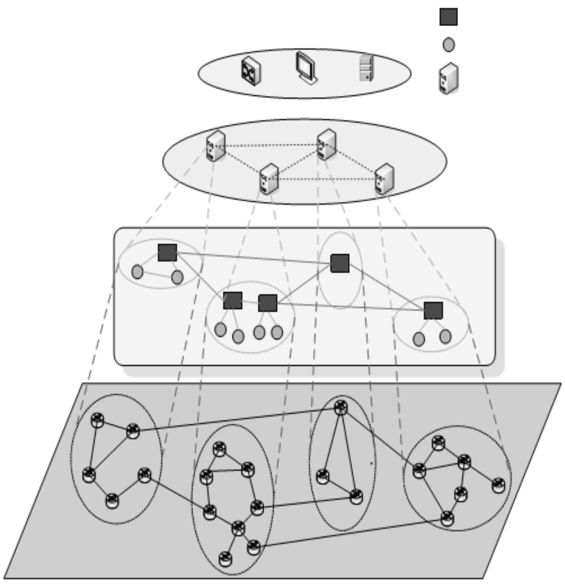
Fig. 5. NGN Network Architectures

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. 5 in which Bearer Control Layer and Logical Bearer Network together perform network control.

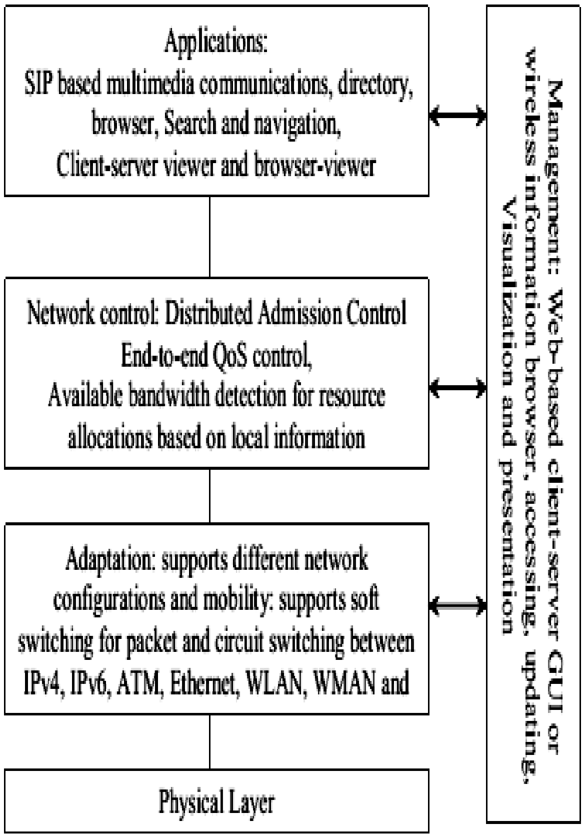

Fig. 6. Layered functions of NGN-QoS

V. CONCLUSION

We are currently 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. 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.

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