SLA verification + QoS control: the base for successful VoIP & IPTV deployments

White Paper.

by

ALBEDO Telecom - Barcelona

info.telecom@albedo.biz

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ALBEDO Telecom

Executive Summary

The integration of voice, data and television networks into a single architecture it is and old ambition of the telecommunications industry. In the 80's ISDN presented a unified interface for data packets and voice based on X.25 and PDH circuits and intended to support all the services. In the 90's the ambitious proposal of ATM tried to support all sorts of traffic through a packet network. This proposal did not reach the expected acceptance but facilitate that during this decade a new approach of convergence structured on Ethernet and IP tried again the Multiplay integration.

Network Convergence offers Multiple Services over many different Platforms.

Company Overview

ALBEDO Telecom is a Global Manufacturer of test, measurement and monitoring solutions. The founders of this company have been world pioneers in the design of hand-held testers for PDH, SDH/SONET, ATM and Jitter/Wander. Today ALBEDO Telecom is leader in a new generation of telecom testers and QoS / SLA tools, while providing integration services of VoIP and IPTV monitoring systems.

Overview

The fear of churn is a major motivator for telcos. Telecom services is something people expect to work without the necessity of a call to a support centre. For this reason a purely reactive approach to video quality problems is unlikely to be viable. Our goal is to provide with a solution for fault management that will improve service fulfillment, service assurance and service optimization.

Ethernet / IP has an extraordinary installed base and tremendous experience in communications. But as a universal network deployment is not free of difficulties. Everyone knows that packet networks are more efficient and cheaper than their predecessors PDH/SDH circuits. The problem is that the native architecture of Ethernet / IP is not able to guarantee either a capacity or a predetermined quality in a permanent way, at least as it has done so far by PDH-SDH circuits. This can be a serious drawback to carry audio and video signals, including transporting critical or time-sensitive data.

Ethernet was born as a best effort technology for LANs, it does not have mechanisms to provide Quality of Service (QoS), differentiated for each application. On the other hand IP was born as networking technology to manage datagrams of heterogeneous networks in a decentralized manner and with minimal human intervention. But does not have a native mode to transport voice and video in real time.

Whatever the TV technology is the goal is to identify when and where a problem is likely to occur. Monitoring equipment can be deployed at critical points in the network. Therefore a unified platform for all is required.

The late adoption of Ethernet in metropolitan networks (MAN) and wide (WAN) is achieved through the use of other technologies such as WDM, NG-SDH, PBB-TE or VPLS that improve the original limitations of Ethernet. While IP uses other level protocols such as MPLS, IntServ and DiffServ to support, with certain guarantees, quality of service requirements

Service Fulfillment

Accurate Monitoring and event management of all the channels can save a tremendous amount of time, money, and customer frustration in the future. This allows service providers to be ***strategic*** and ***proactive*** when planning and deploying advanced services.

Winning Architectures

One of the key factors moving fordward the convergence is because carriers are leaving those business models focused on telephony. After a decade of steady progress in access and transmission, telecom technologies allow operators to become multi-service providers of television, video on demand, internet, or private network services, as an extension of their traditional connectivity services.

Applications

Network-wide diagnostics for video/network operations centers and head-end operations teams responsible for video delivery through their Fiber, Cable, Telco, Terrestrial and Mobile video delivery networks required to maintain quality of service and ensure signal integrity, reducing subscriber dissatisfaction and protect subscriber and advertiser revenues

Can the new application achieve a reasonable quality?

Identify and resolve real-time video network errors with facility and network-wide views, and view thumbnails or backhaul video content from any probe within the network, while identifying the location and root cause of underlying systemic service delivery problems across a head-end network with statistical logging, report generation and trending analysis

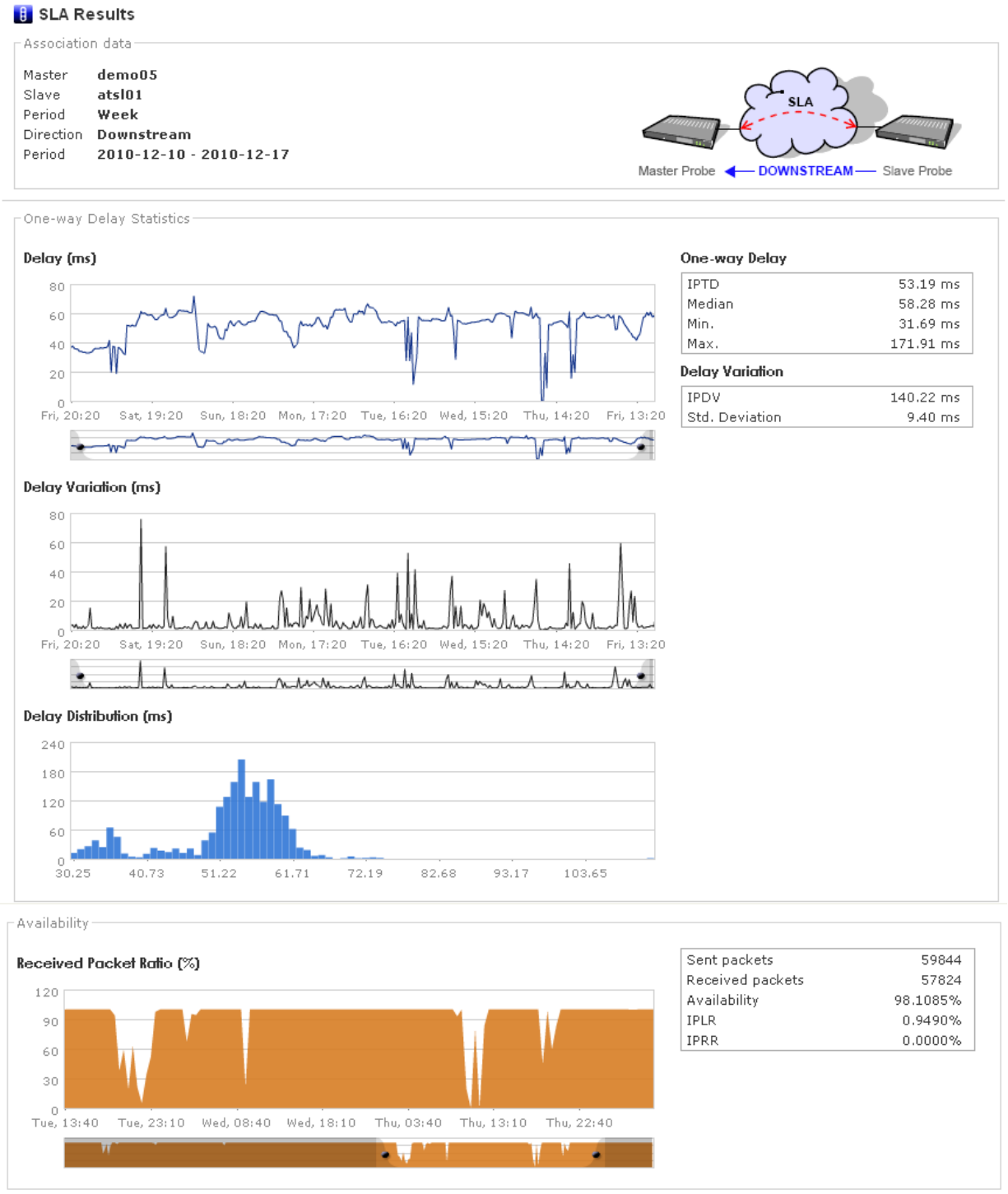
TV, video on demand, telephony, high speed internet, etc. are already offering unified services

The success of large-scale deployment of new applications depends heavily on the unified network ability to guarantee both: capacity and quality of the connections it provides. To achieve this, it is important features such as configuration, resource management and congestion control. Take some examples of new applications:

- Tele-education may include interactive video sessions, telephone with the teacher, teaching material downloads, instant messaging and web browsing.
- Tele-medicine may include video and telephone sessions with a doctor, access to database information, patient monitoring devices, remote check and emergency messages.

- Entertainment, downloads could include video clips in real time or delayed access to images, text, files and web pages.

That is, to certify the viability of one of these applications must ensure the individual of all components included.



Results of IP Packet Delay, Jitter, Loss, etc with ALBEDO Net.Audit Monitoring System

NetStorm generates those perturbances typical of IP and Ethernet to test applications, devices and protocols that should be tolerant with packet delay, jitter, loss, duplication, reordering, error and bandwidth variations.

Path to Excellence

There are several references to follow issued by the Metro Ethernet Forum (MEF), ITU-T, IETF and the IEEE. The MEF suggest that levels of service in Carrier-Ethernet networks are described on the basis of access parameters. While the ITU-T rec. Y.1541 defines up to eight QoS classes to define quality objectives of the IP network. Being faithful these organisms can be described accurately telecom service through two sets of parameters:

1. **Bandwidth Profile (WB)** defines the features that can transmit packets in terms of speed and quantity.
2. **Quality of Service Profile (QoS)** defines the quality characteristics in terms of packet delays and errors in its transit through the network.

Class	IPTD	IPDV	IPLR	IPER	IPRR	Samples
0	100 ms	50 ms	1×10^{-3}	1×10^{-4}	-	Real-time, jitter sensitive, low delay, very interactive, ie VoIP
1	400 ms	50 ms	1×10^{-3}	1×10^{-4}	-	Real time, jitter sensitive, average delay, interactive
2	100 ms	U	1×10^{-3}	1×10^{-4}	-	Transactions, low delay, very interactive, ie Internet...
3	400 ms	U	1×10^{-3}	1×10^{-4}	-	Transactions, average delay, interactive
4	1 s	U	1×10^{-3}	1×10^{-4}	-	Few missed, i.e. downloads
5	U	U	U	U	-	Best effort, i.e. email
6	100ms	50 ms	1×10^{-5}	1×10^{-6}	1×10^{-6}	High speed, low loss, low delay, interactive, ie IPTV
7	400ms	50 ms	1×10^{-5}	1×10^{-6}	1×10^{-6}	High speed, low loss, average delay, interactive

ITU-T Rec. Y-1541: Quality of Service Requirements for IP level

Bandwidth Profile

Access is described in terms of capacity at the point of demarcation between carrier and client:

- Committed Flow (CIR) and bandwidth offered by the network (bit / s)
- Committed Burst (CBS) or maximum size of an admitted burst (bytes)
- Excess Flow (EIR) or traffic on the network tolerance without compromising on quality (bit / s)
- Excess Burst (EBS) or maximum burst size tolerated without compromising on quality (bytes)

There are many methodologies for assessing these parameters between the RFC-2544 notes.

Quality metrics

According to the ITU-T the set of parameters that define the QoS at IP-level are:

- Frame Delay (IPTD), end to end latency (ms)
- Delay variation (IPDV), packet jitter (ms)
- Packet Loss (IPLR), ratio of frames compliant and not delivered to the destination
- Packages Error (IPER), bit error ratio observed at reception
- Disordered Packages (IPRR), ratio of packets that arrive out of order

Verification and certification of a L2 VPN service, or L3 VPN is to measure end to end and compare the results with the provisions of Y.1541. These results should be made permanently, not just in certain circumstances.

Application	Sample	ITU-T Class							
		5	4	3	2	1	0	7	6
Live TV streaming	IPTV, Pay per View, Multi-					YES		YES	YES
Video streaming	VoD, PVS, time-shift TV					YES		YES	
Audio streaming	Music on demand					YES			
Control Protocols	Zapping, Stop/Start/Bwd/Fwd				YES				
Video downloads	VoD		YES						
Video uploads	Closed group of video user		YES						
Downloading	Images, books, etc.	YES							
Web access	Portals	YES							
Telephony	VoIP						YES		
Interactive / low	Videoconferences						YES		
Interactive	Instant Messages			YES					
Mainling	email	YES							
e-business	e-commerce			YES					

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Service Level Agreements

The inherent difficulty of the packet networks to provide a quality and a precise bandwidth has changed the content and structure of the service provider agreement (SLA). In networks PDH / SDH verification of an SLA was something about checking the bit error rate (BER), the availability and timing of back-ups and protections. The adoption of unified networking based on Carrier-Ethernet / IP has made SLA more complex to describe and check the service. While PDH / SDH service level is checked at installation time (commissioning), unified network monitoring is a more appropriate manner because network conditions are constantly changing because the nature of statistical multiplexing. That is why today they are more common auditing and certification of SLA agreements, and that is the way to meet the service closely and define responsibilities.

SLA	**Service**			**Comentarios**
	Connectivity	**Mobile**	**PDH / SDH**	
Latency	5 to 30ms	5 to 10ms	50-60ms	Depends on application
Packet Jitter	2 ms		-	Depends on application
Losst of packet	< 10E-6		-	Depends on the service
BER	< 10E-8	10E-6 < BER < 10E-11	< 10E-11	
Protection (backup)	50 ms			Physical layer
Availability	99,9% to 99,999%			From 8h 45' to 5' / year
Repair time	2 h	4 h		

Critical telecom service delimited by a SLA

Telecom service level agreements (SLA) benefit both parties. For customers because they are most interested in signing and monitor the goodness of the service they pay for, but Operator also get benefits because will increase customer satisfaction, will extract more from the network and will end up being more competitive.

Centralized Control

Set-top solutions have limited value because when a problem is identified then a technician has to solve it – a costly business. It is better to have a network operations centre with information coming back rather than have to send someone out. Remote analysis is less expensive. It makes more sense to invest in integrating the network probes with the operator's back-end systems to provide manageable and useful data. One key area of development is to tie monitoring and testing in with the operator's OSS systems, enabling reports to be compiled for a range of uses.

It is likely the integration of monitoring probes the operator's reporting systems. Monitoring is less than half the issue. You need to be able to analyze and find out the issues providing simple integration to provide reports to experts and customer care Departments. SNMP is key for setting alarm thresholds and so on but can be of limited use in providing more detailed real-time information about access and aggregation network.

In order to provide information that can be used, for example by customer relations staff who may be less technically sophisticated than staff in the engineering department, it is necessary to provide a simple user interface. Some people need something simple but an engineer needs a lot more to understand how far along it is in fulfilling its SLA obligations.

Master	Slave	Period	Connect	Upstream	Downstream	SLA
atsl01	demo1	Week	Yes	Class 2	Class 2	✗
demo1	demo5	Day	No	Class 2	Class 6	✓
demo5	atsl01	Day	Yes	Class 2	Class 2	✓

SLA Results of IP with ALBEDO Net.Audit Monitoring System

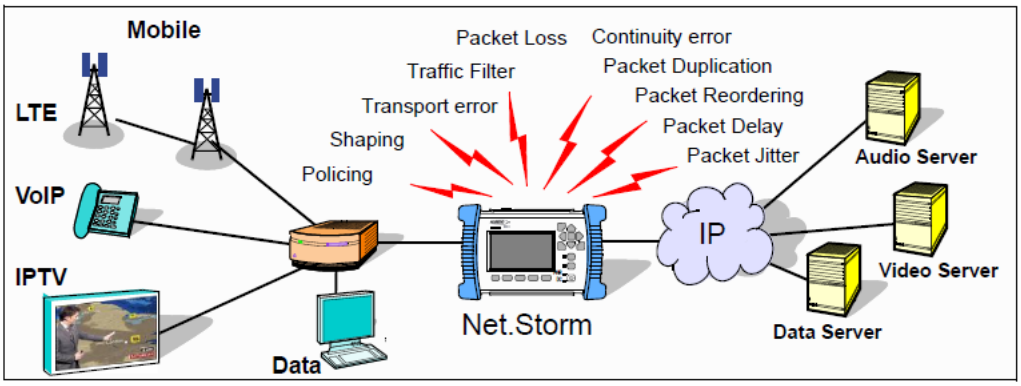
Net.Audit Benefits

Network Auditing provides operators with the simplest information necessary to identify and resolve a large percentage of real-time issues on IP networks:

- Facility and network-wide views across a video network with visual centric paradigm
- Ability to direct/tune the probe from a centralized control system
- Allows engineers to rapidly identify the location and root cause of underlying problems
- Statistical logging and report generation
- Trending analysis for tracking of management performance metrics and service-level agreements
- Users can easily install, configure and maintain their own monitoring system
- Automatic discovery of probe availability, configuration and diagnostic capabilities

ALBEDO Net.Storm

NetStorm generates those perturbances typical of IP and Carrier Ethernet to test applications, devices and protocols that should be tolerant with delay, jitter, loss, duplication, reordering, error and bandwidth variations.



Net.Storm is able to emulate the network in a realistic way

- Network Design. Verification and debugging of Ethernet and IP networks, in both telecom and enterprise.
- IP Applications access, VoIP, Gaming, Streaming audio and video, IPTV, VoD, and real/time services.
- Approval and Acceptance Tests
- Application Troubleshooting. Audio and video streaming, IPTV, VoIP, network gaming, and many more.
- QoS level verification in Intranet or Internet environment to configure terminals, gateways and routers.
- Laboratories. Generation of controlled QoS on different flows defined by the user to
- Emulation network conditions latency, jitter, packet loss, reordering, bandwidth limitations.
- Protocol testing used by Multiplay Application such as H.323, SIP, MPEG2, MPEG4, and VC1.

+ Info (Net.Audit)

Net.Audit is a system to measure accurately those parameters that determine the IP layer Quality of Service required by applications such as VoIP, IPTV and Internet access. Net.Audit is also a tool to verify the SLA signed between Carrier & Operator, or Between Operators & Enterprises, checking connectivity services according International standards from ITU-T and MEF, assisting the identification of the causes of quality degradation, or poor performance.

+ Info (Net.Storm)

Net.Storm is a simple, fast, hardware based Ethernet/IP network emulator that provides the ability to generate common network effects such as packet loss, duplication, delay, congestion, packet errors and bandwidth limitations. It is designed to offer sufficient capabilities and performance to reproduce a wide range of network behaviours up to 1 Gbps rates with accuracy always better that 1 ms. By operating at the Ethernet layer Net.Storm can emulate the critical end-to-end performance characteristics imposed by various wide area network situations and by underlying subnetwork technologies.