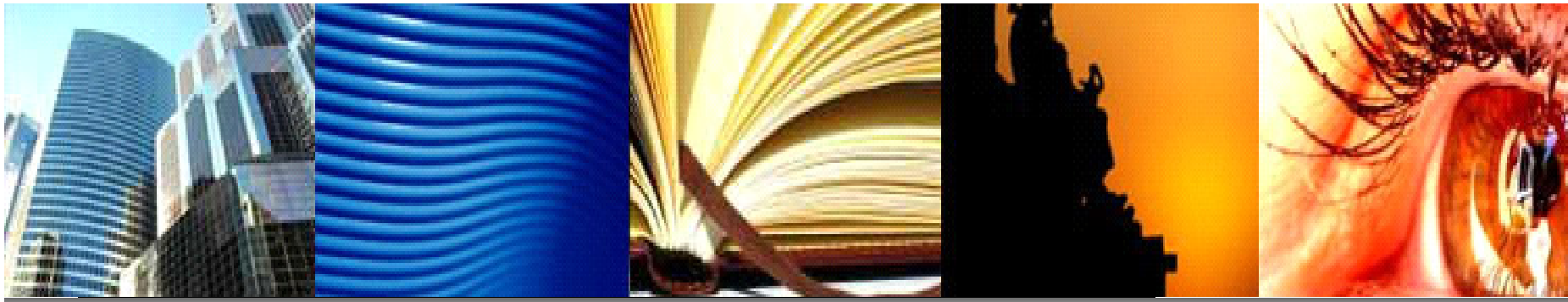
Net.Audit distributed Test System

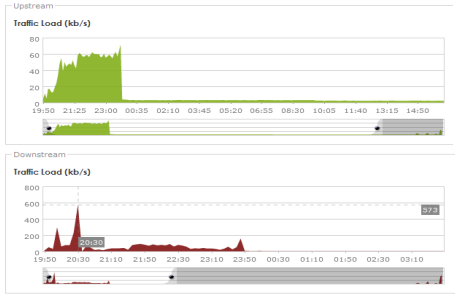


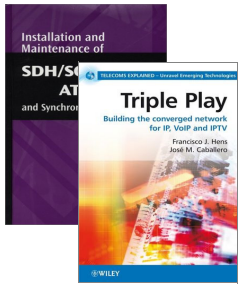
SLA & QoS in-service Measurements in Ethernet / IP networks

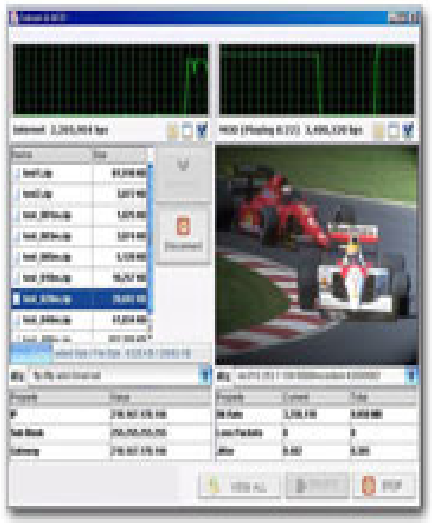
ALBEDO Telecom

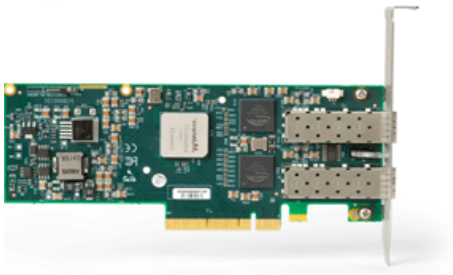
the Path to Excellence

About ALBEDO Telecom







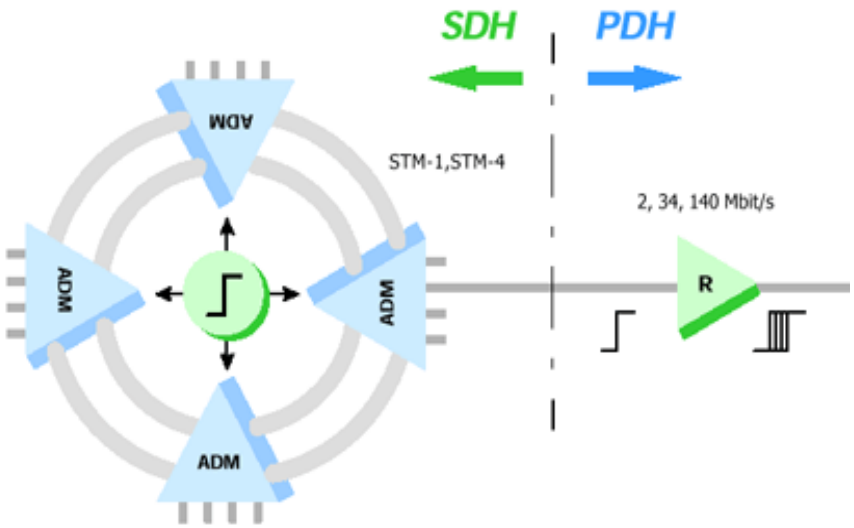


ALBEDO Telecom offers a full range of telecommunication products and services that help your organization make the most of your investment in telecoms.

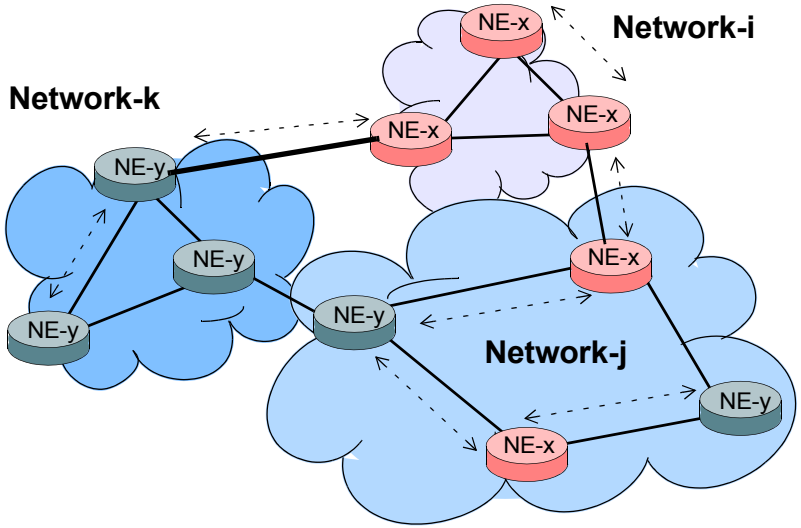
- **Hand-held testers**: E1, SDH, GbE, SyncE, IP, IPTV, VoIP, Datacom, Jitter, Wander
- **Impairment Generator**: Carrier Ethernet and IP
- **Acceptance Labs**: IPTV, VoIP, ISDN, POTS
- **Distributed Test System**: SLA, QoS, Bandwidth profile
- **Professional Training**: xDSL, PON, Carrier Ethernet, MPLS, SDH, Synchronization, IPTV, VoIP
- **Consultancy** / **Integration**: IPTV, VoIP

How different Circuit & Packets networks are

Circuit Networks



Packet Networks



Dedicated Service

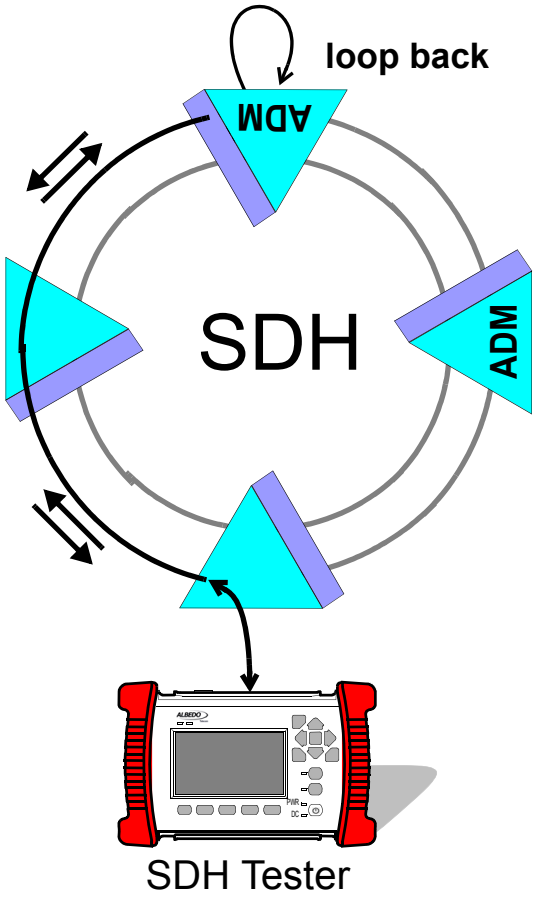
- Permanent Performance
- Delay constant
- Jitter/Wander predictable
- BER follow known patterns

Shared Service

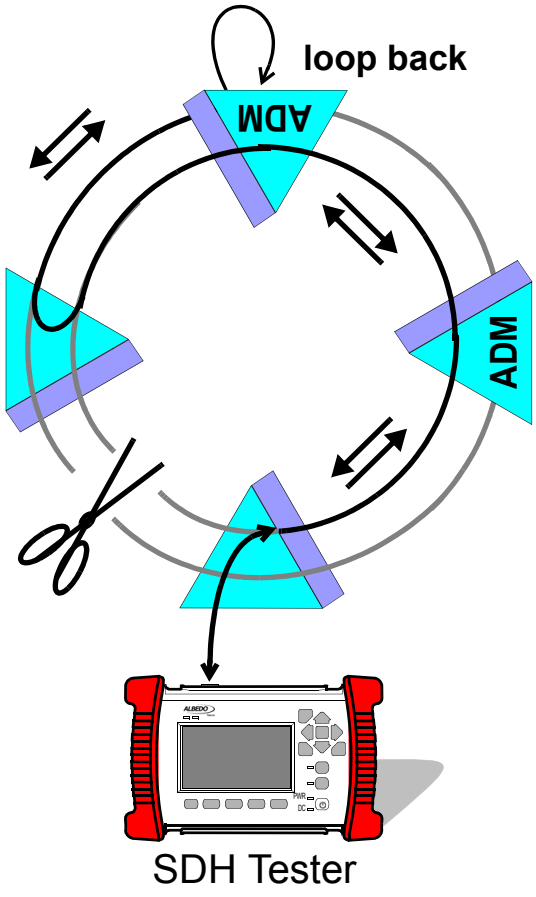
- Performance is function of the traffic
- QoS depends on traffic, routing, service, time
- Packet Jitter is unpredictable
- Error may follow multiple patterns

Test & Measurement in TDM networks

BERT test

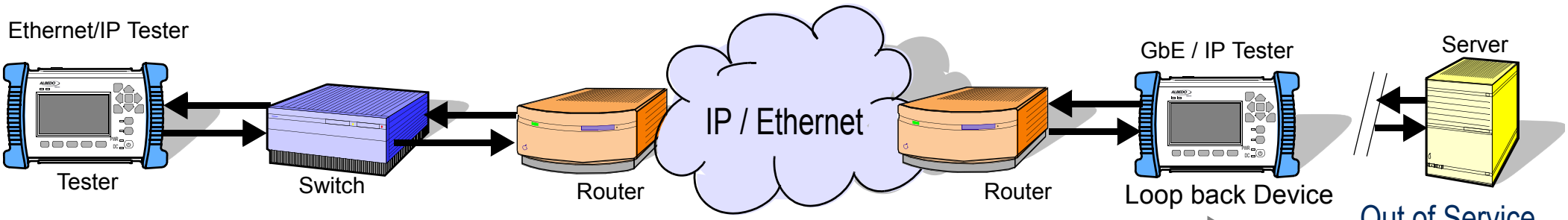


APS test



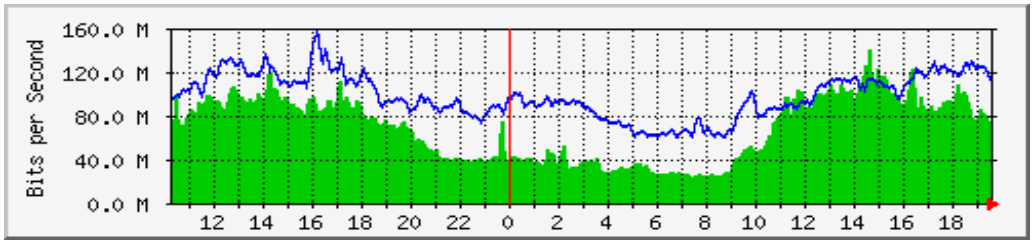
- In TDM measurements (Quality, Round-Trip-Delay, BER) are **executed out-of-service** (OOS)
- A physical loop-back is generally used
- Results **are also valid** when the network is in-service (IS)

Measurements in IP / Ethernet



RFC-2544 test

Jan 23th at 10:45am



BUT Network Traffic Conditions <u>are changing permanently</u> !!

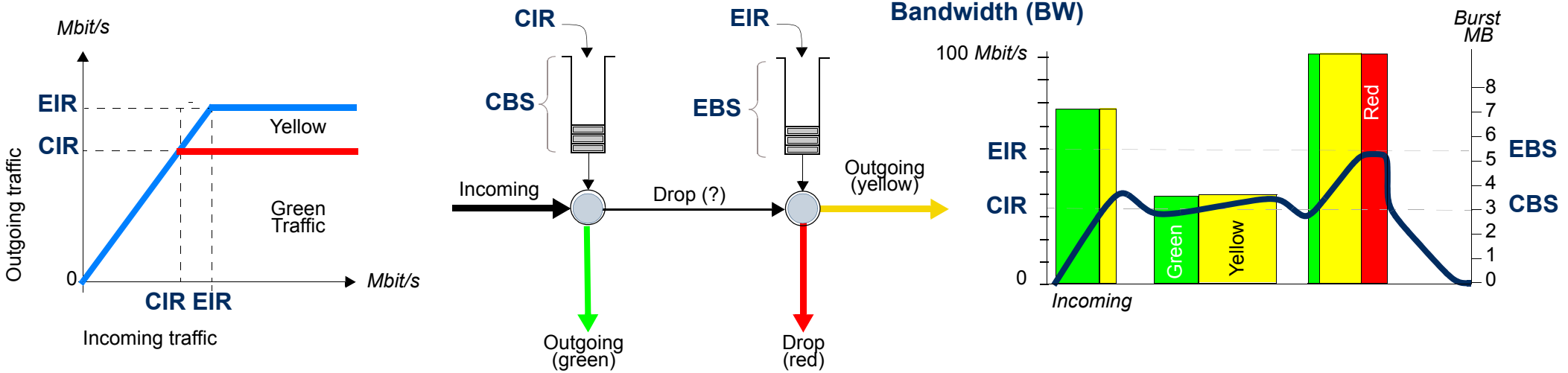
- QoS and Performance measurements <u>are just a snapshot</u> of the network when test is executed
- However, traffic is changing continuously then networks conditions too
- Measurements must be executed IN-SERVICE and permanently

CONCLUSIONS

1. **Out-Of-Service** performance tests (i.e. RFC-2544) are **NOT VALID** in IP / Ethernet
2. **QoS results** on *Jan 23th at 10:45am* are **ONLY CORRECT** for *Jan 23th at 10:45am*

IP Bandwidth is based on complex algorithms

CIR, CBS, EIR, and EBS



Admission control for Ethernet/IP may use four parameters defined by the MEF

- **Committed Information Rate (CIR)** — average rate up to which service frames are delivered as per the service performance objectives
- **Committed Burst Size (CBS)** — maximum number of bytes up to which service frames may be sent as per the service performance objectives without considering the CIR
- **Excess Information Rate (EIR)** — average rate, greater than or equal to the CIR, up to which service frames do not have any performance objectives
- **Excess Burst Size (EBS)** — the number of bytes up to which service frames are sent (without performance objectives), even if they are out of the EIR threshold

QoS rec. ITU-T Y.1541

Network **Class** (ITU-T rec. Y.1541)	0	1	2	3	4	5	6	7
IPTD	100 ms	400 ms	100 ms	400 ms	1 s	U	100 ms	400 ms
IPDV	50 ms	50 ms	U	U	U	U	50 ms	
IPLR	1x10E-3					U	1x10E-5	
IPER	1x10E-4					U	1x10E-6	
IPRR	Undefined						1x10E-6	

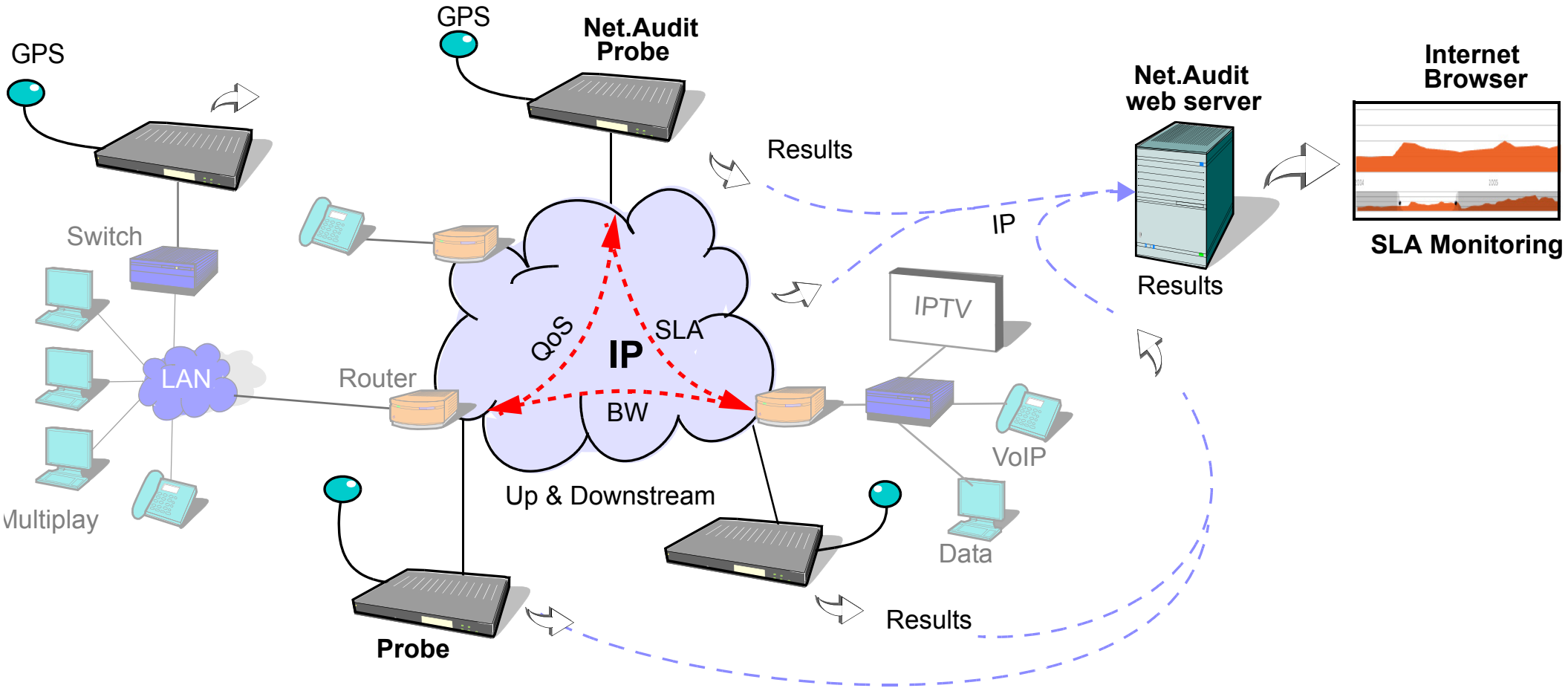
IPTD: IP Packet Transfer Delay,
IPDV: IP Packet Delay Variation,
IPLR: IP Packet Loss Ratio,
IPER: IP Packet Error Ratio
IPRR: IP Packet Reordering Ratio

Class	Applications (examples)	Node Mechanisms	Network Techniques
0	Real-time, Jitter sensitive, high interaction (VoIP, VTC)	Separate queue with preferential servicing, traffic grooming	Constrained routing and distance
1	Real-time, jitter sensitive, interactive (VoIP, VTC)		Less constrained routing and distances
2	Transaction data, highly interactive (Signalling)	Separate queue, drop priority	Constrained routing and distance
3	Transaction data, interactive		Less constrained routing and distances
4	Low loss only(short transactions, bulk data, video streaming)	Long queue, drop priority	Any route/path
5	Traditional applications of default IP networks	Separate queue (lowest priority)	Any route/path
6	Real-time, Jitter sensitive, high interaction, high quality (IPTV)		Constrained routing and distance
7	Real-time, jitter sensitive, interactive , high quality (IPTV)		Less constrained routing and distances

Class 0: i.e. PSTN-quality VoIP
Class 1: i.e. ISDN-quality VoIP
Class 2: i.e. Signalling
Class 3: i.e. Business Data, Internet access
Class 4: i.e. Internet access
Class 5: i.e. file transfer, back-up, P2P applications
Class 6: i.e. IPTV conference
Class 7: i.e. Video on Demand.

- The ITU-T Y.1541 is equivalent to TDM (G.821, G.826, M.2100) applied in IP network
- The rules for TDM based quality objectives defined in a single event: BER
- The latency Y.1541 incorporates the objectives through new parameters: IPTD, IPDV, IPRR

Net.Audit: a real-time test system

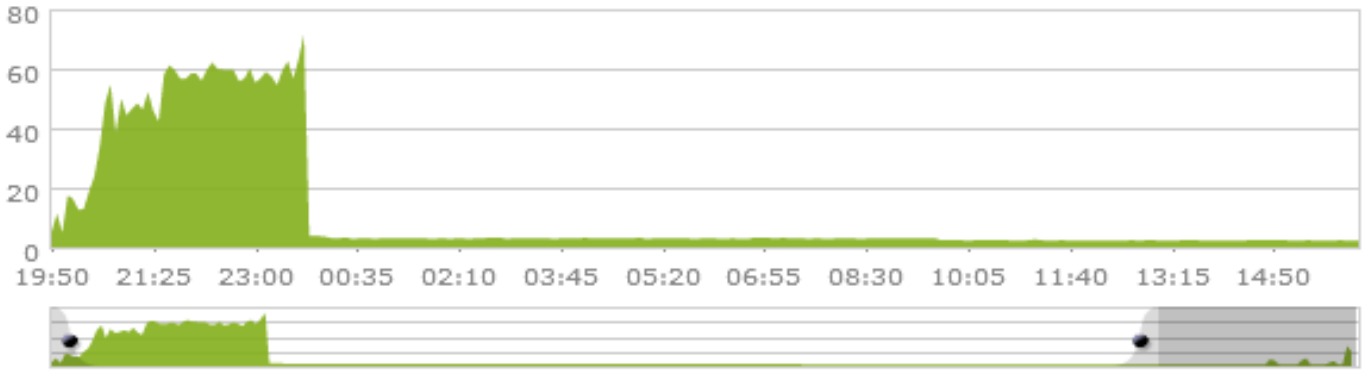


- Active and Independent In-Service measurements of IP QoS + Bandwidth
- Net.Audit does not compete but complements router based applications (i.e. CISCO SLA)
- Net.Audit competitors ARE testers that execute unappropiate out-of-service measurements

SLA Reports: Traffic Load (UP/DOWN)

Upstream

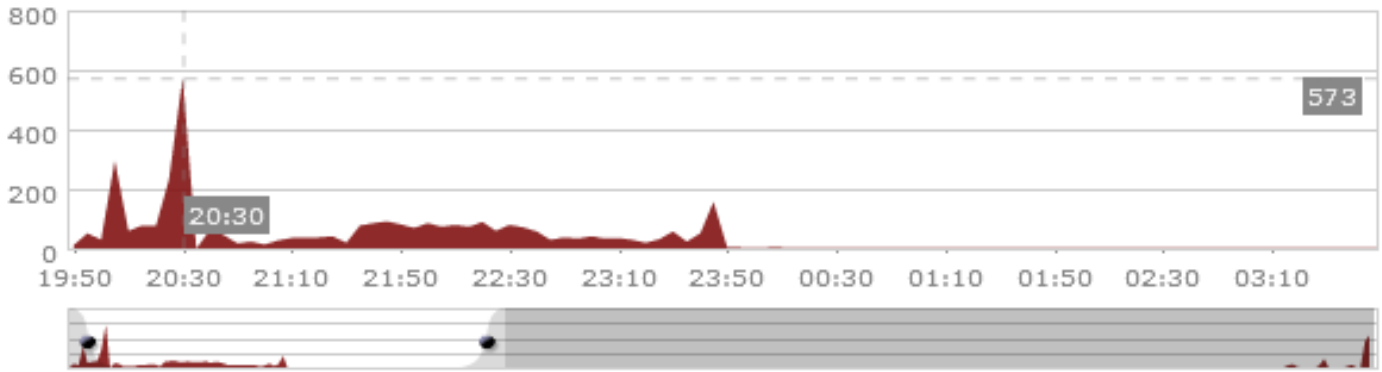
Traffic Load (kb/s)



Last	19.64 kb/s	0.00 p/s
Avg.	10.42 kb/s	0.00 p/s
Min.	2.09 kb/s	0.00 p/s
Max.	71.57 kb/s	0.00 p/s

Downstream

Traffic Load (kb/s)



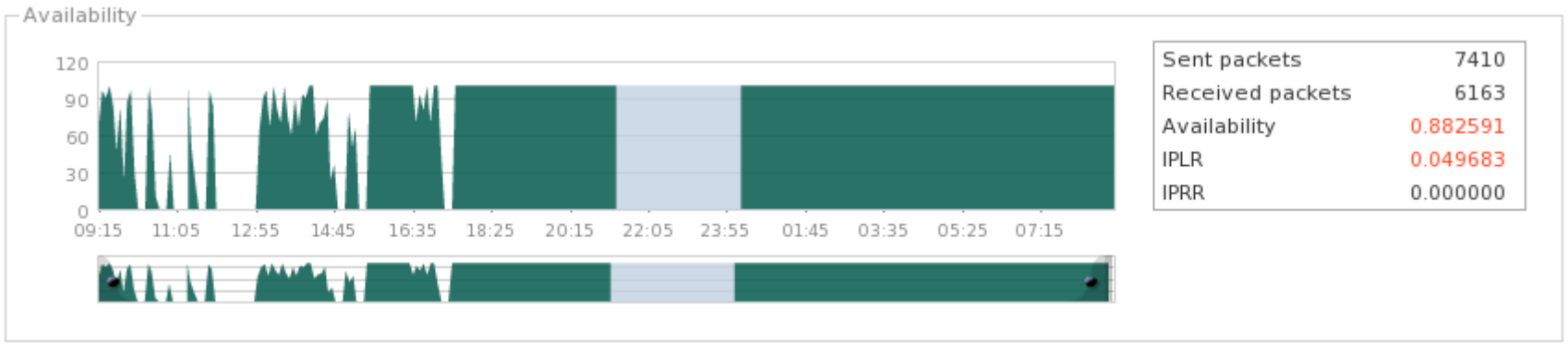
Last	431.80 kb/s	0.00 p/s
Avg.	17.54 kb/s	0.00 p/s
Min.	1.60 kb/s	0.00 p/s
Max.	572.92 kb/s	0.00 p/s

In IP Networks bandwidth demands are generally Asymmetric!

SLA Reports: Delay and Jitter

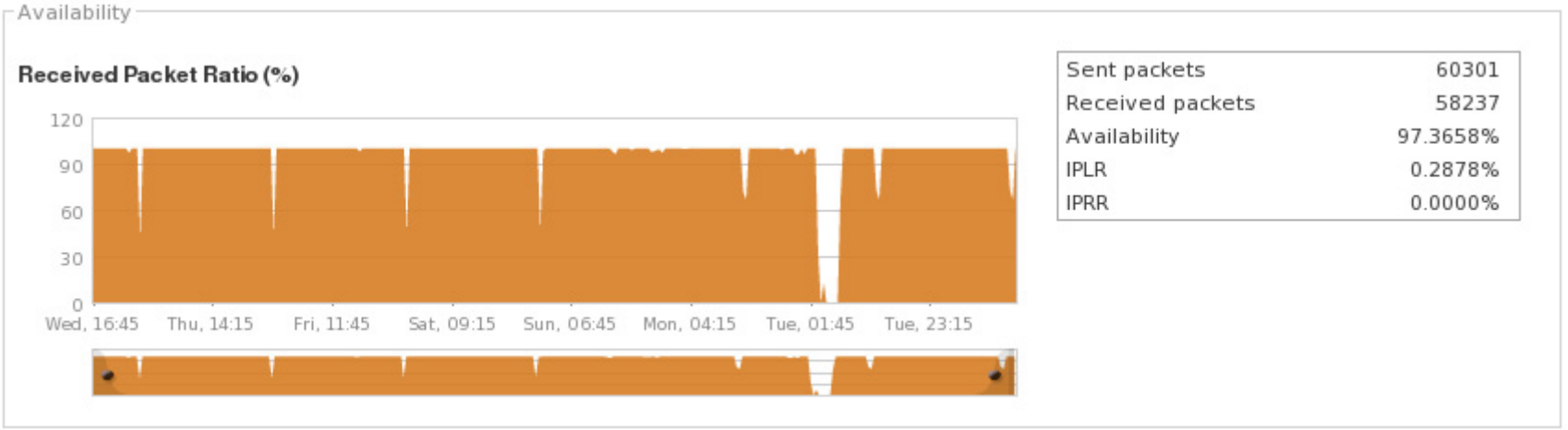
IP Networks require ONE-WAY-DELAY measurements because UP/DOWN delay is often different

SLA Reports: Network Availability



Upstream

Downstream



Availability is not five-nines any more (99,999%) but when failure occurs?

SLA settings - PASS/FAIL results

Traffic Description

Law	**Poisson**
Separation	**10 s**
Packet Size	**500 bytes**
DSCP (hex)	**0**

Apply

Performance Objectives

☐ IPTD	0	ms
☐ IPDV	0	ms
☐ IPLR	0	%
☐ IPRR	0	%
☐ Availability	0	%

Customer **SLA Settings**

Probes in the System

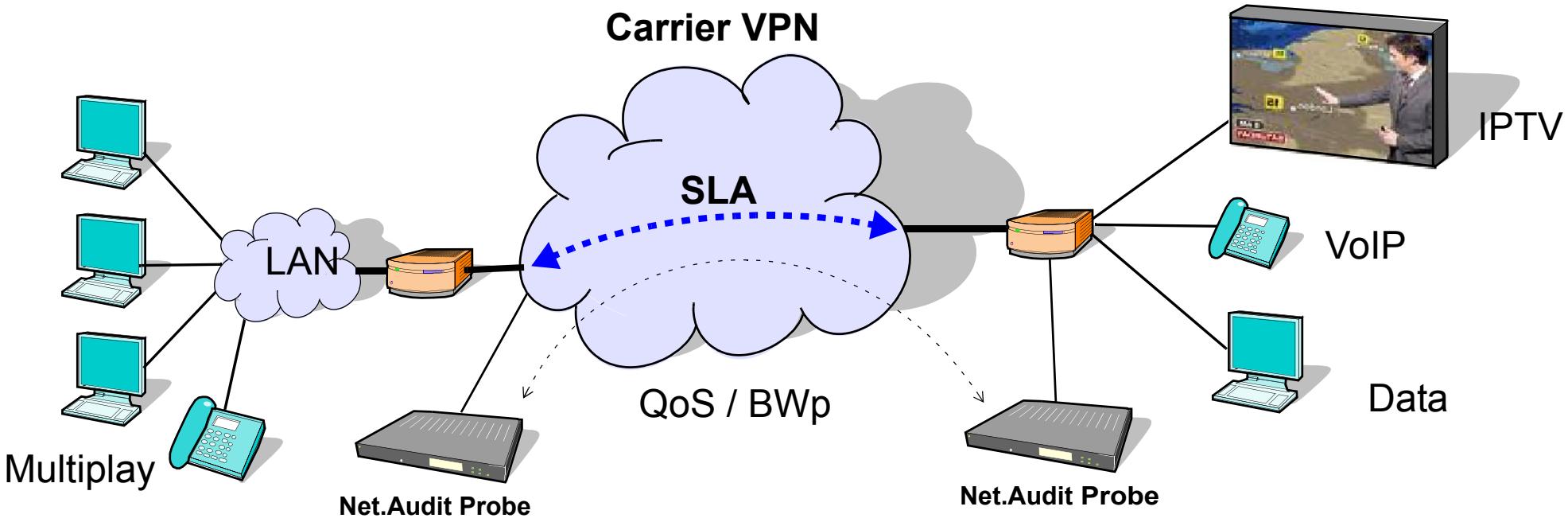
Probe	Enabled	Tests	Status	Sync Source	User	SLA	Results
atsl01	Yes	8	Sync	-	jcolomer	✗	Details
demo01	Yes	4	Sync	-	dpatil	✓	Details
demo03	No	1	-	-	gsanchez		
demo04	Yes	1	-	-			Details
mumbai01	Yes	1	Sync	-	dpatil	✗	Details
demo08	Yes	1	Sync	-	gdavis		Details

Customer **SLA PASS/FAIL**

Why Net.Audit is UNIQUE - ten reasons ten

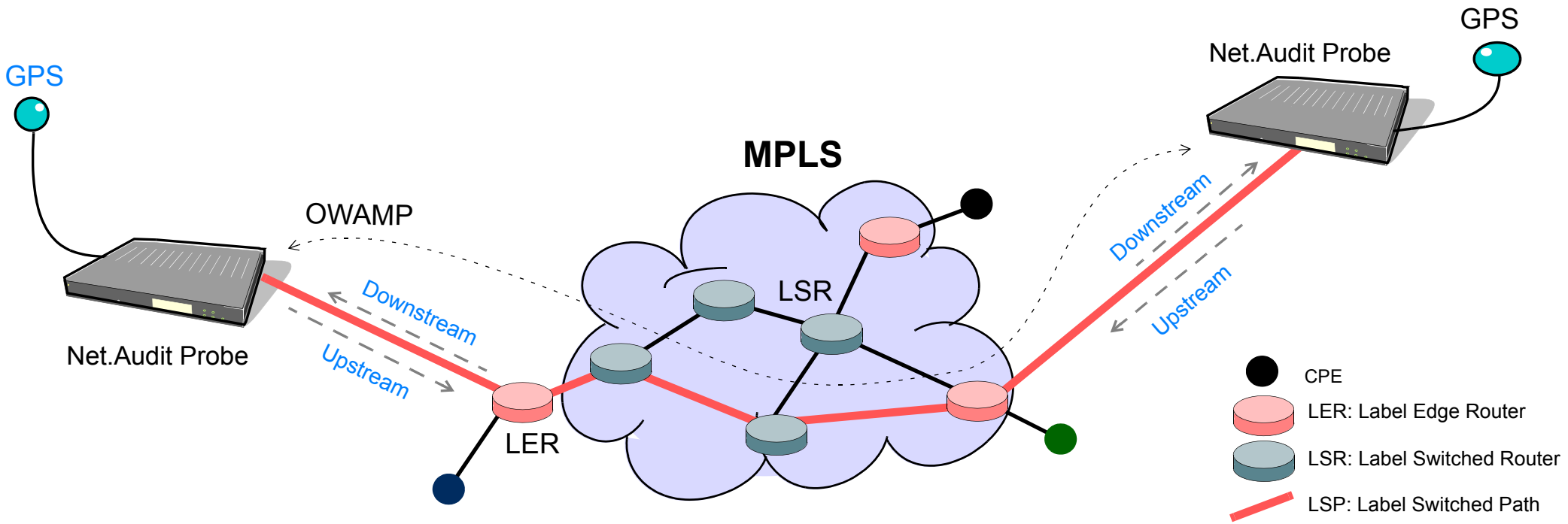
1. Net.Audit is a system based on **Active Probes** and distributed Measurements
2. It's *NOT based on Routers or Switches MIBs* but oriented to **Connectivity Services**
3. All the measurements are performed **In-Service** then it matches packet network nature
4. Net.Audit is able to measure **ONE WAY DELAY**
5. Probes does not NOT rely on NTP but can be **GPS synchronized** to get accuracy < 1ms
6. Support of **DSCP Classes of Service** to check how the network manage each type
7. Net.Audit probes can be connected at **ANY Ethernet interface** with IP connectivity
8. Measurements architectures: Serial, Parallel, Point-to-Point, and **Multipoint-to-Multipoint**
9. Full Net.Audit solution includes Net.Storm an **In-Service Internet Simulator**
10. **Automatic Report Generation** (Executive, CSV, HTML) to disk or to e-mail

In-Service Measurements



- QoS & Performance measurements in IP networks must be in-service and long duration tests
- This requirement guarantees real traffic conditions and identifies traffic correlations
- Gigabit Ethernet testers can give snapshots only of some traffic conditions in permanent change
- Out-of-Services measurements are only valid in TDM (SDH-PDH-WDM) networks

ONE-WAY measurements & GPS synchronized



- As routers are not Synchronized measurements CANNOT BE ACCURATED
- Routers only measure TWO-WAY
- Vendor Router Applications do not separate Up / Downstream do not support ONE-WAY-DELAY
- Accuracy and one-way measurements matter: i.e. 15ms jitter causes video degradation
- Net.Audit probes are synchronized via GPS that provide traceable **results better than 1ms**

Automatic Reports Generation

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Net.Audit
Report

Report Type	**SLA summary**
Report Identifier	**rpt-trfsum-7aa10b5f**
User	**admin**
Local Interface	**mumbai01**
Remote Interface	**atsl01**
Period	**2011-05-05 - 2011-05-12**

Downstream Delay Statistics

IPTD	**216.71 ms**
Maximum delay	**867.06 ms**
Median delay	**250.52 ms**
Minimum delay	**128.11 ms**
IPDV	**738.95 ms**
One way delay standard deviation	**156.88 ms**

Upstream Delay Statistics

IPTD	**90.28 ms**
Maximum delay	**150.37 ms**
Median delay	**89.76 ms**
Minimum delay	**87.63 ms**
IPDV	**62.74 ms**
One way delay standard deviation	**4.94 ms**

Downstream Availability Statistics

Sample number	**4,490**
Received packets	
Availability	
IPLR	
IPRR	

Upstream Availability Statistics

Sample number	**4,581**

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Net.Audit
Report

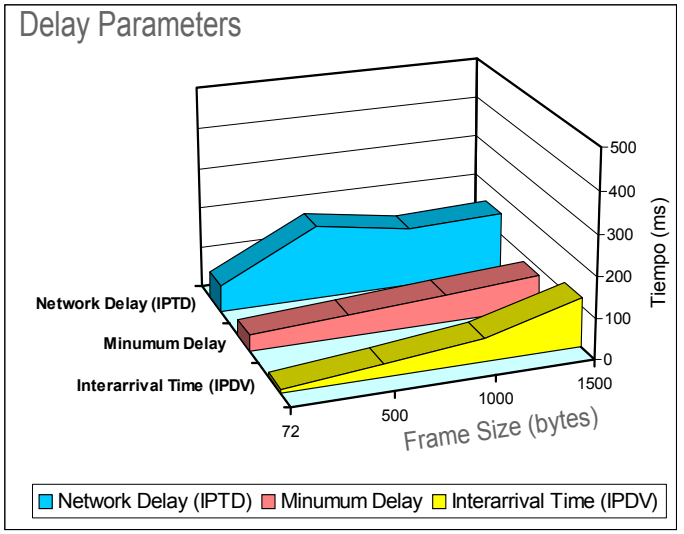
Report Type	**SLA summary**
Report Identifier	**rpt-trfsum-4535fa23**
User	**admin**
Interface	**mumbai01**
Period	**2011-04-25 - 2011-04-26**

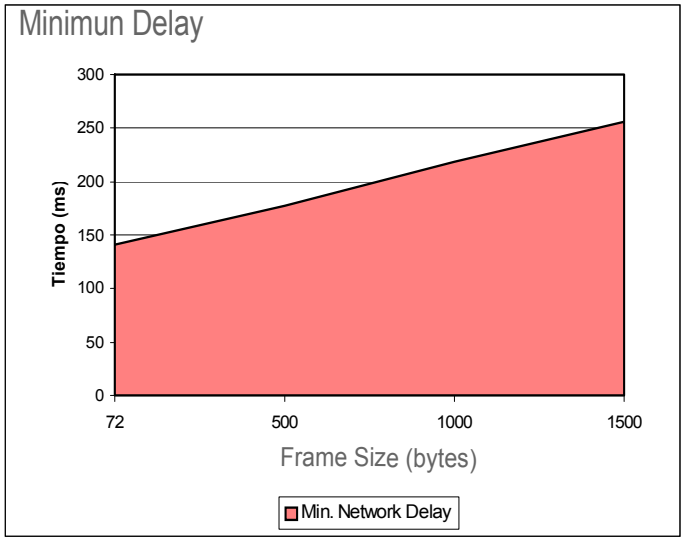
Upstream Traffic

Maximum transmitted traffic	**245.77 kb/s / 31.67 p/s**
Minimum transmitted traffic	**1.45 kb/s / 0.77 p/s**
Average transmitted traffic	**14.02 kb/s / 6.67 p/s**
Last transmitted traffic	**1.79 kb/s / 0.90 p/s**

Downstream Traffic

Maximum received traffic	**241.41 kb/s / 29.69 p/s**
Minimum received traffic	**1.16 kb/s / 0.66 p/s**
Average received traffic	**68.98 kb/s / 8.47 p/s**
Last received traffic	**1.63 kb/s / 0.78 p/s**





- Reports and Results CSV and HTML graphical formats
- Executive Summary Report export to email addresses

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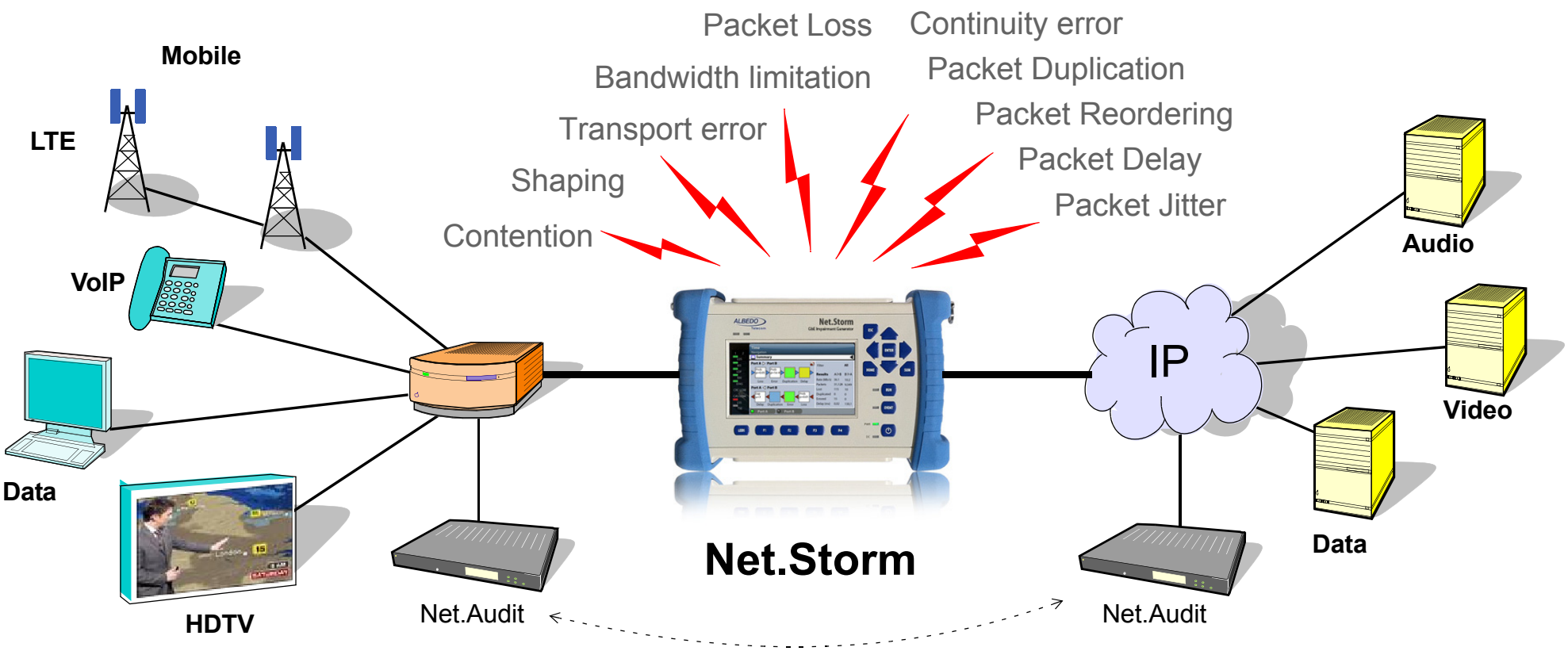
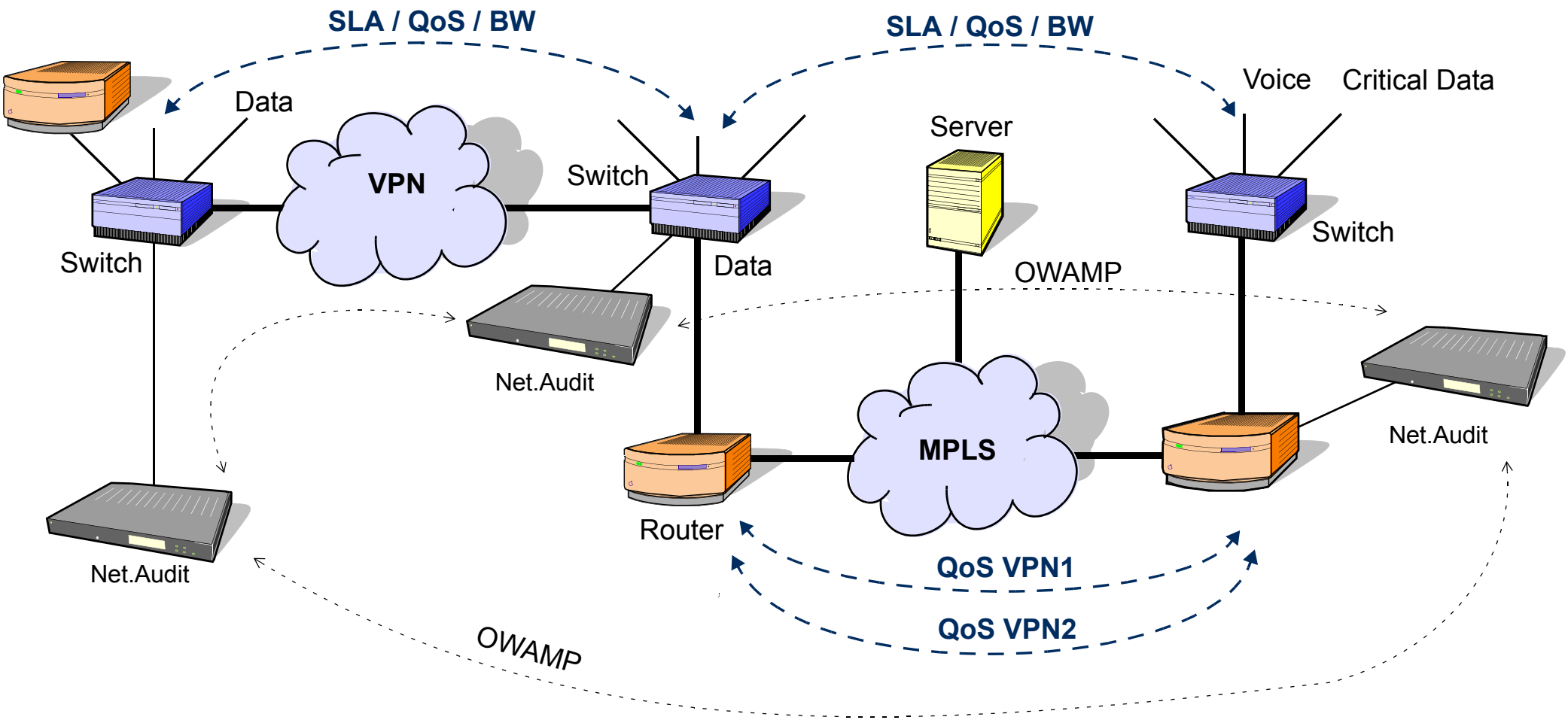
Net.Storm: in-service Internet simulator



- Emulate network conditions (IPTD, IPDV, IPLR, IPER, IPRR) by hardware (accuracy < 1 µs)
- Simulates link bandwidth with microseconds resolution
- Whole Bandwidth calculations with absolute precision
- 15 programmable filters based on VPN, VLAN / MPLS tags, MAC / IP address, and many more.

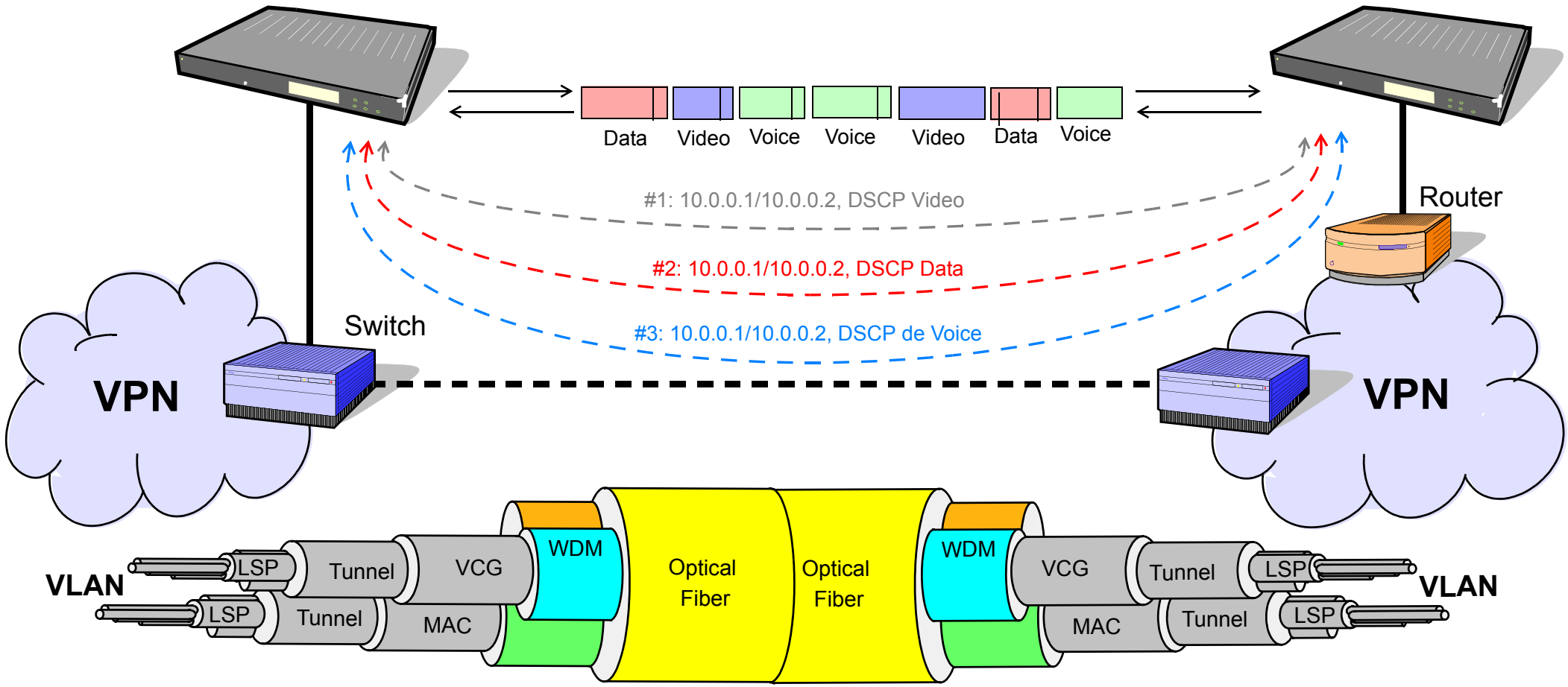
Point-to-Point & Multipoint-to-Multipoint



Multiple configurations and architectures are possible:

- Point-to-point, point-to-multipoint, multipoint-to-multipoint
- Serial and parallel configurations

Support of DSCP Classes of Service



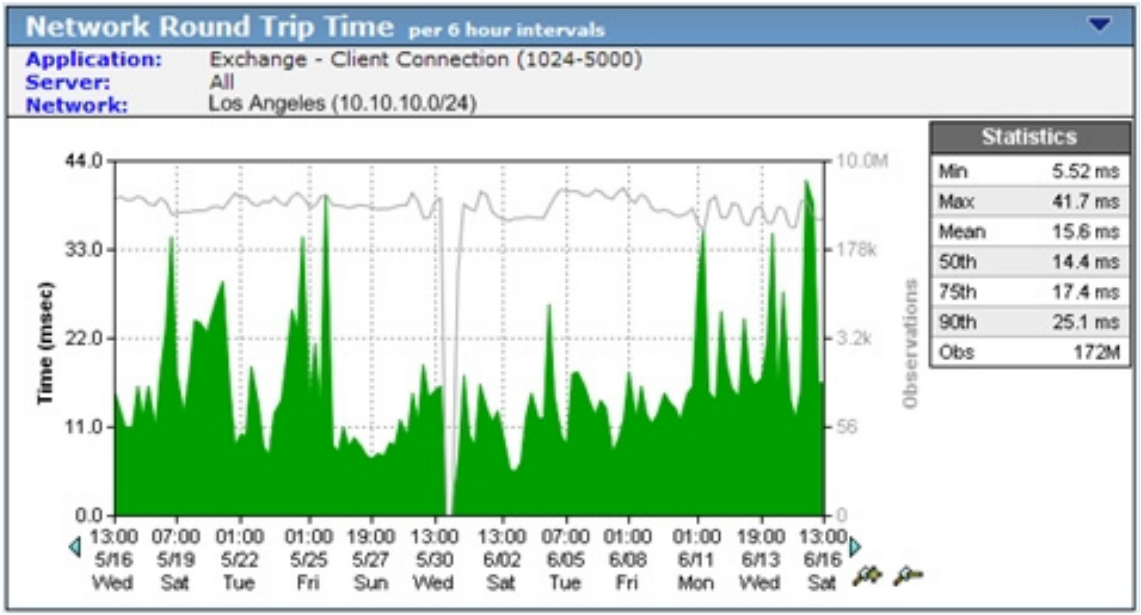
- The DSCPs can be enabled to define high-quality services for applications and selected users.
- Net.Audit probes considers DSCP to confirm SLAs are met for both regular and exclusive services
- Net.Audit can measure the effect of different Classes of Service in terms of QoS

ALBEDO Net. Audit Benefits

Net.Audit is an in-service test system to verify critical communication services:

- Real END-TO-END measurements even behind NAT
- Based on OWAMP One-way Active Measurement Protocol [RFC4656] for one-way metric
- Synchronized probes for High accuracy QoE measurements of Bandwidth, QoS and SLA
- Automatic results by e-mail, web browser, and csv file
- Self installation system, no screen, no keyboard, no expertise required, only remote access
- Multiprotocol IPTV, VoIP, and Critical Data enabler
- Allows the customer to define QoS objectives or SLA
- Centralised management, remote configuration with no field engineer required
- Automatic results by e-mail, html / java, and csv file

What Routers CAN'T do



Routers have not been designed to measure:

1. NO ONE-WAY measurements only two-way (or round trip)
2. NO MEASUREMENTS through NAT
3. NO END-to-END measurements
4. POOR ACCURACY since routers are no synchronized
5. NO MULTIVENDOR, only proprietary solutions (all routers must be of the same vendor)
6. Measurements based on PING which are low priority and can be dropped easily
7. NOT ABLE to SIMULATE network traffic conditions

What GbE testers CAN'T do

GbE / IP testers have been designed like the old PDH / SDH testers:

1. NOT ONE-WAY measurement enabled
2. NOT designed for IN_SERVICE measurements
3. NOT designed for LONG TERM measurement (at least one week)
4. POOR ACCURACY, -since hand-held testers are not synchronized
5. NO MULTIPOINT-TO-MULTIPOINT measurements
6. NO CENTRALISED measurements (requires field engineer)
7. NOT ABLE to SIMULATE network traffic conditions

That's all