



# Outil de IP QoS et ADSL Qualification

Short introduction of a centralised monitoring and qualification system of copper lines operating with ADSL, ADSL2, and ADSL2+ and supporting multiplay applications such as Internet Acces, VoIP, and IPTV.

## 1. INTRODUCTION

ALBEDO Net.Audit is an on-line solution to prequalify and troubleshoot ADSL, ADSL2, ADSL2+ lines used to get access to IP services such Internet Acces, Critical Data transport, VoIP and IPTV that can also be monitored at IP layer to verify the QoS of the IP unified. Net.Udit read and represent those MIB contents relevant for the Telecom Operator including DSLAM, Routers and Switches.

Net.Audit proposal is a solution for broadband management and diagnostics including:

- Automatic or Manual operation
- Copper, xDSL, IP verification
- Web download speed test
- OSS integration using TCP/IP and SNMP
- Service qualification and troubleshooting

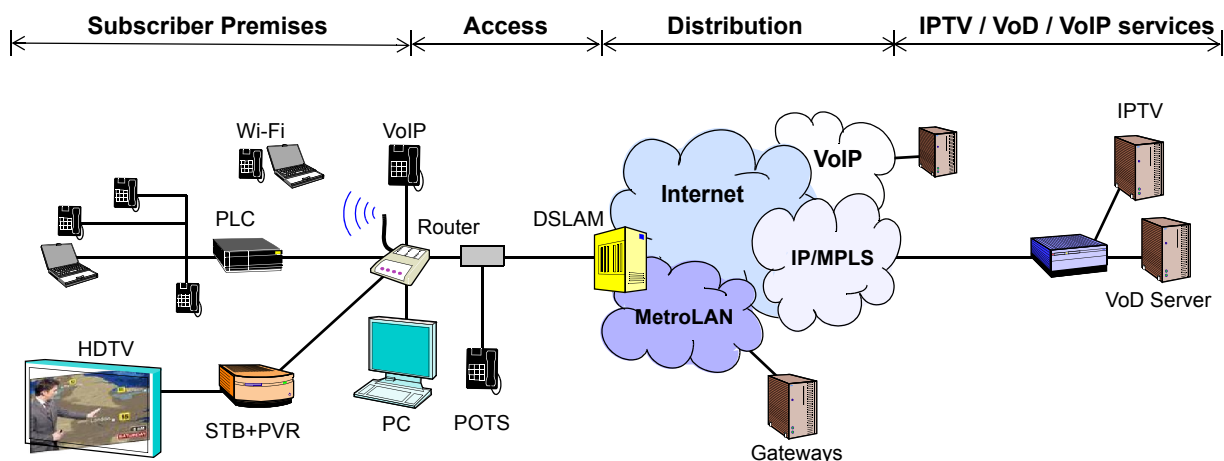


Figure 1. Typical Converged network based on xDSL access and capable to provide Multiplay Services based on IP

- Control access to CPE, DSLAM, and ISP
- ATU-C, ATU-R

ALBEDO Net.Audit xDSL is a system for the remote management of ADSL and SHDSL services. It reduces the need to dispatch engineers to carry out tests on suspected faults. This powerful test system can perform a complete range of single ended test functions in the customer and service provider directions including ISP connectivity and authentication.

Above all ALBEDO Net.Audit xDSL is extremely cost-effective and highly flexible and scalable, and can be integrated into an existing OSS

## Features and Benefits

ALBEDO Net.Audit xDSL provides a complete on-line analysis and diagnostic service from a remote site. It avoids the need for on-site fault diagnosis, reducing time and cost whilst increasing customer satisfaction. It consists of multiple test resources operated remotely from a central control site.

### Scalable and Open architecture

ALBEDO Net.Audit xDSL can be extended easily, just by adding new Test Heads and connecting them to TCP/IP network. It can also be integrated through SNMP into your existing OSS platform.

### Automatic or Manual test

Automatic mode or "one button testing" provides a simple PASS/FAIL result whilst Manual mode provides deeper analysis for experts. In both cases you can save results for further analysis. Predefined customized profiles are supported for every type of DSL service.

### Service Audit

The increased need for SLA verification requires a transparent and precise tool. ALBEDO Net.Audit xDSL offers an accurate, real-time solution.

## Applications

xDSL is a multilayer technology that relies on each individual layer operating both correctly and efficiently. ALBEDO Net.Audit xDSL provides an automatic incident solution for each layer.

Copper test. It is important that load coils and copper faults like split pairs, bridged taps, open circuits, grounds etc. that may be acceptable for the POTS service but not for the xDSL service, are identified and corrected.

### TDR and DMM.

Enables effective fault finding of the physical layer.

ADSL, SHDSL set up.

By means of ATU-R, ATU-C, STU-R or STU-C emulation. ALBEDO Net.Audit xDSL simplifies testing by synchronizing with the DSLAM or the customer modem. It provides comprehensive line statistics to identify faults and measure DSL performance.

### ATM verification.

To establish performance the BER measurement should be made at the ATM layer to get a complete picture of the DSL installation. It also verifies the ATM circuits with F5 OAM loop back cells, step-by-step up to the BRAS.

### PPPoE and PPPoATM.

Includes ISP authentication capabilities.

### IP testing.

Experience has demonstrated that in order to verify the application layers an IP ping test does not fully test the connections. It also provides IP trace route facilities with LAN/WAN statistics.

### Internet speed measurement.

Enables you to test the performance of end-to-end service at the http layer, from the Contents Provider application right to the Customer site.

The DSL industry is based on economies of scale, so good revenues can only be achieved with a significant number of customers.

### Call Centres

By using ALBEDO Net.Audit xDSL from the moment you receive a new customer order you can speed up the whole process of qualification and service provisioning. In a few minutes you will be able to tell the customer that the loop has been verified and when the broadband access will be available.

### Customer Support

Customer care for xDSL services can be now be located anywhere. Just a telephone and a PC with a TCP/IP connection is all that is required to provide an immediate answer to customers' queries.

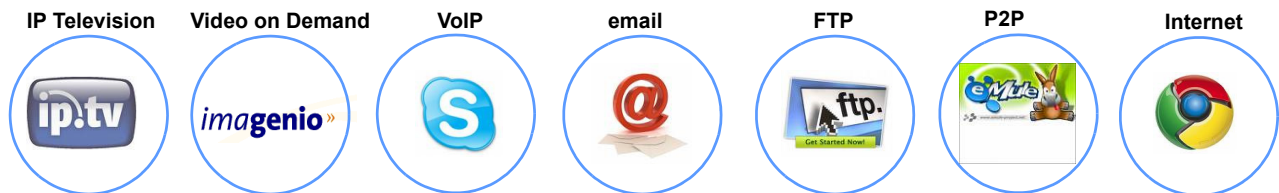


Figure 2. Services to verify.

### Help Desk

Once the broadband access is installed, your Help Desk can verify the service immediately after receiving a customer query. This will increase customer confidence, without the need to dispatch engineers to perform tests on the network —saving you costs.

## 2. APPLICATIONS

### Triple Play Feasibility

The large-scale deployment of converged services over IP is today the main stream in telecoms, and not only high speed Internet but also Voice, Video and Television. However, IP networks are not always able to transport every type of application. Each application has specific Quality and Bandwidth requirements.

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

### VoIP prequalification

The effectiveness of massive VoIP deployments not only depends on the terminals but also on the transport network. Resource management, serialization of traffic, congestion control and many other factors determine QoS parameters such as the delay and the jitter that are main factor of degradation of VoIP MOS.

Using the Net.Audit and the right methodology of analysis we can examine the parameters of capacity, quality and latency that affect the new VoIP network, therefore determining the success or failure. Through this analysis is possible to identify weaknesses in advance before the installation of servers, terminals and gateways.

### Quality of Service for VPNs

The Net.Audit probes permanently monitor the VPN links to verify that all services (including low latency ones) do not suffer any serious degradation. Service providers and customers may formalize their commitment on quality in SLAs that describe by means of parameters the level of QoS and Bandwidth.

### Quality of Service for VPNs

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### Internet Access Monitoring

Use IP for transporting voice and video, besides the traditional data, is increasingly prevalent in business networks and residential users.

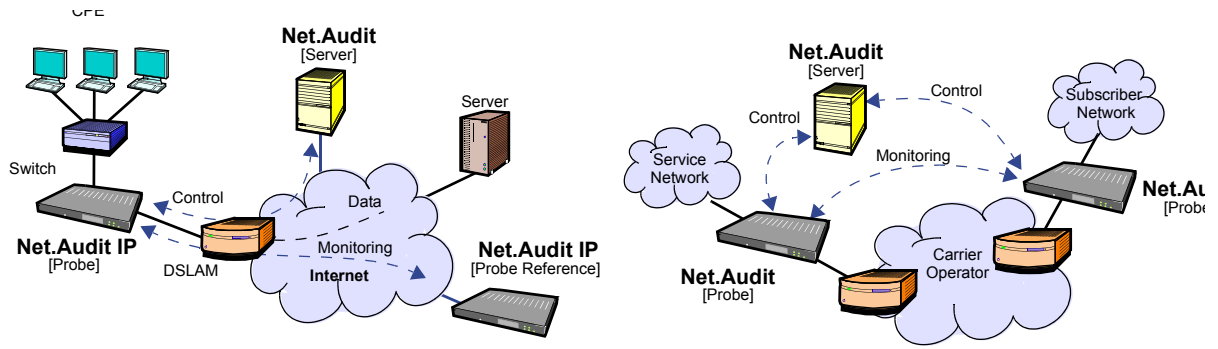


Figure 3. Quality monitoring in an Internet network with NAT address translation. Monitoring of the performance level provide by a carrier operator.

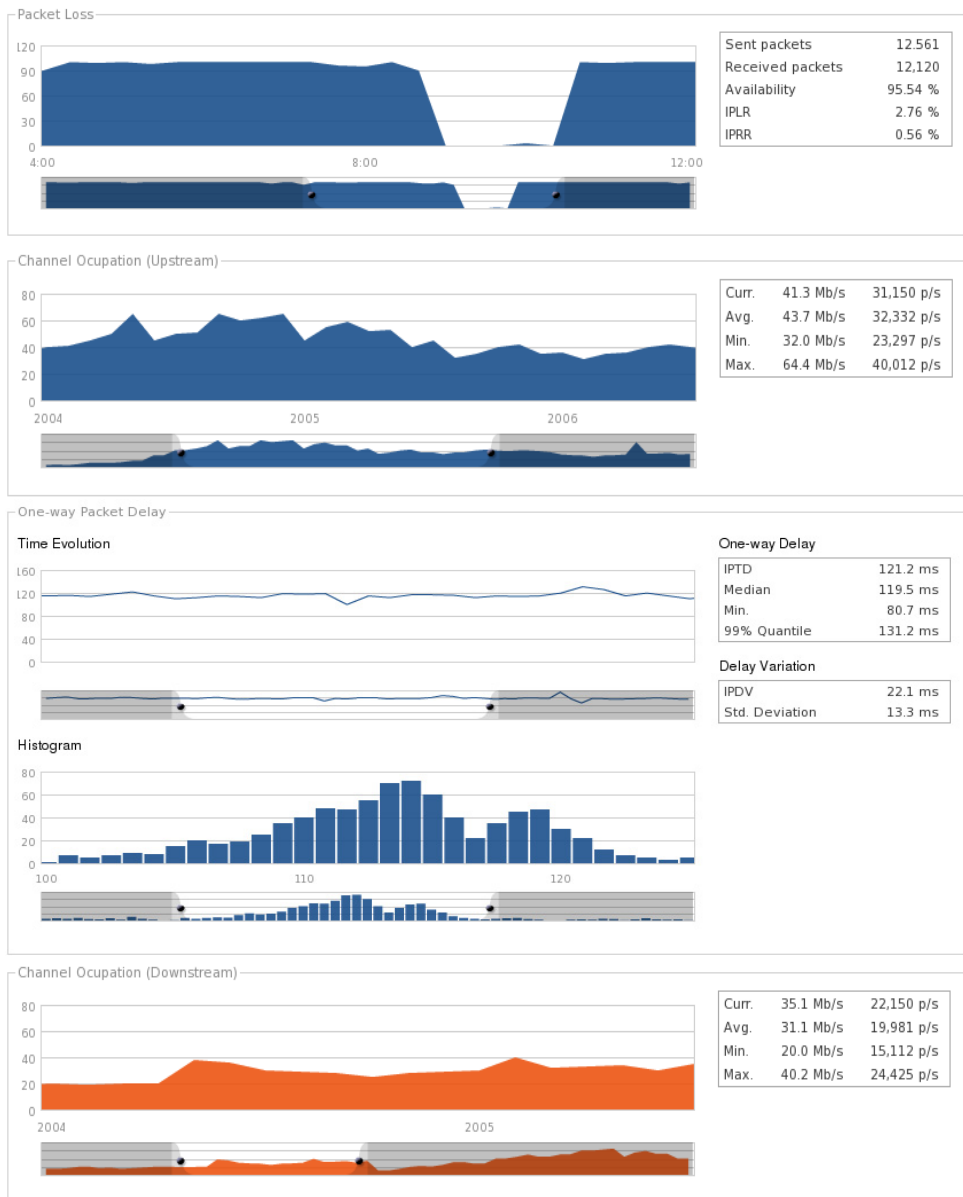
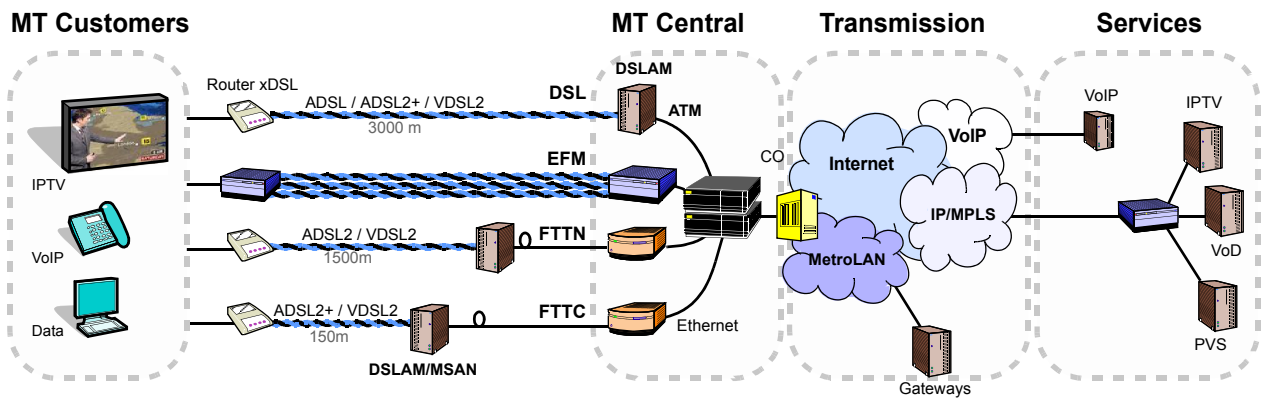


Figure 4. Net.Audit IP Quality Results obtained by Internet browser.

### Quality between Operators

It is common for telecom operators have to use other operators to provide service to subscribers who are beyond the coverage of their own network. It is common that telecom operators rely on other operators to provide service to subscribers who are beyond the coverage of their own network.

The Albedo Telecom SL.Audit service identifies a carrier or service provider responsible for degradation. Thanks to this feature, it is possible to ensure that the end customers have sufficient guarantees of quality regardless of their service is delivered over homogeneous or heterogeneous network paths.



**Figure 4.** Actual and possible evolution of the Network of MT regarding advanced services over IP combining DSLAM and MSAN in the same network to provide Multiplay services including VoIP, IPTV, Data, and High Speed Internet.

### 3. THE SOLUTION

ALBEDO Telecom can provide a complete broadband test solution including:

1. Access Matrix, necessary to drop the line under test to the test head.
2. Physical copper module
3. The IP layer module

At the moment of writing this document are separate solutions therefore it will be necessary to integrate while adding specific functionalities required by MT.

#### Test Head

"ALBEDO Net.Audit xDSL shelf. Built in an ETSI rack which has capacity for two Multilayer test modules. Each module can be populated with different cards. ATU-R, ATU-C, Copper test card: Includes advanced features for DMM, TDR and analogue measurements.

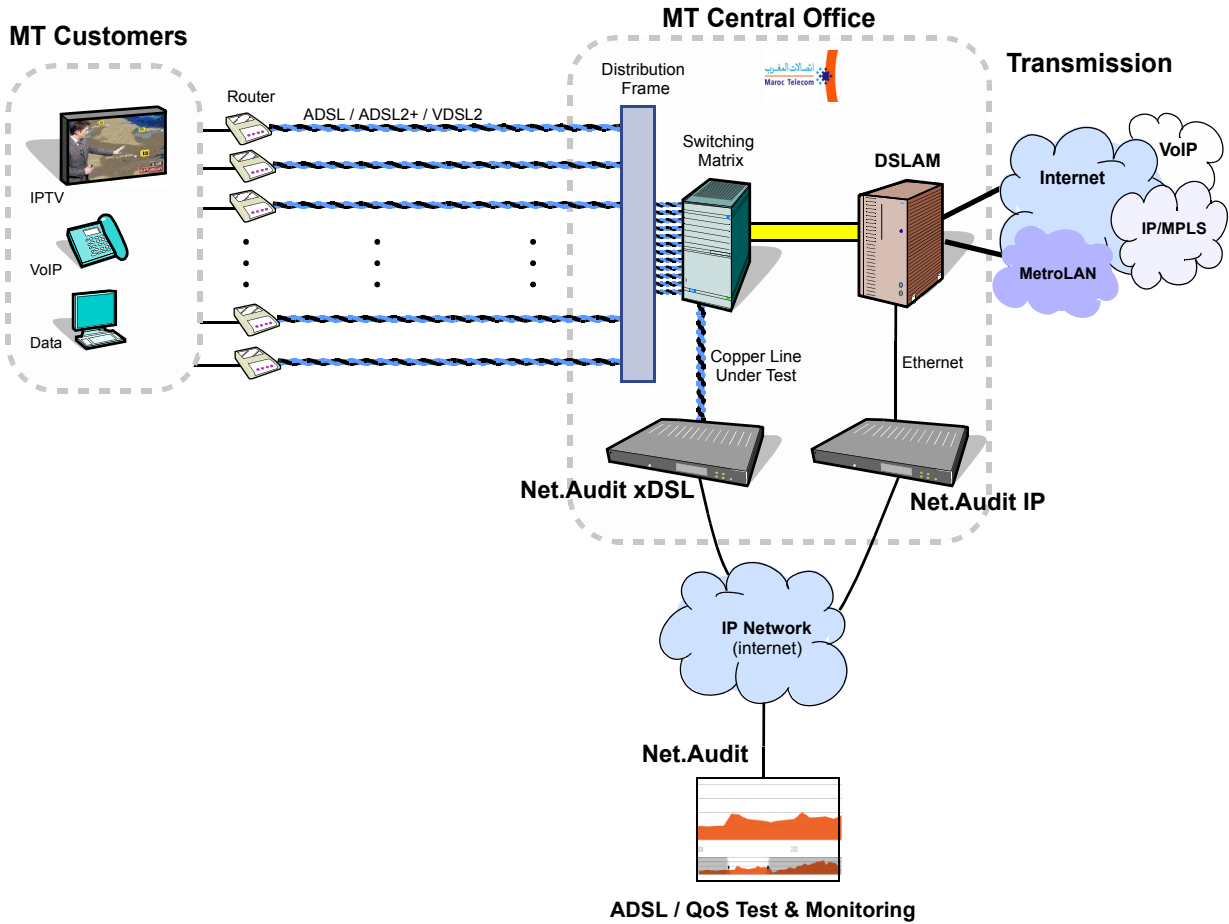


Figure 5. Net.Audit xDSL and Net.Audit IP.

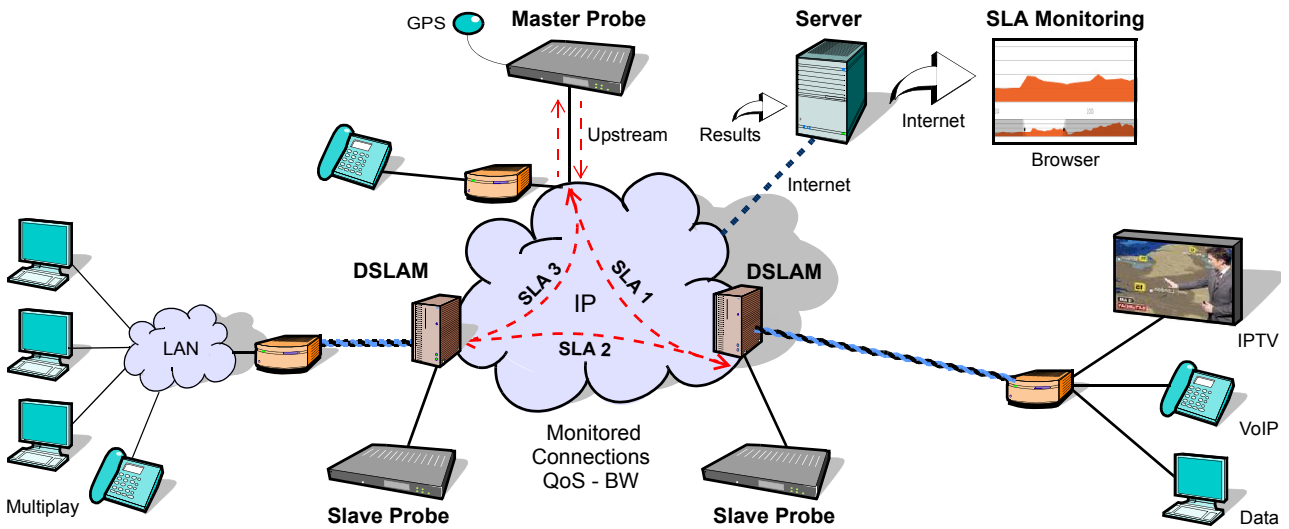
#### 4. ALBEDO NET.AUDIT XDSL

This is the Test Head to integrate on centralised system for testing of subscriber lines switched from CO main frame by matrix box or multi-connectors. ALBEDO Net.Audit. xDSL Test Head allows a series of automatic single or collection tests for local loop provisioning, maintenance and troubleshooting.

The ALBEDO Net.Audit. xDSL Test Head core is the same of the ALT2000 portable model. ALBEDO Net.Audit. xDSL Test Head is the definitive solution to provide Net.Audit. xDSL services quickly

#### Single End & Insertion Loss

The method used by the ALBEDO Net.Audit. xDSL Test Head for the Single-End Insertion Loss measurement (based on the FDR technology) is absolutely revolutionary, because it does not need to know the cable type under test (gauge and dielectric).



**Figure 6.** Net.Audit IP designed to test scenarios for media quantity verification: (a) Setup E, checks the network end of the Gm interface with custom network impairments. (b) Setup F, is similar to setup E but it is adapted to check the user-Gm interface.

In fact it does not use the old indirect test method (cable length by TDR and/or the capacitance) and the associated guesswork to elicit the attenuation based on knowledge of the electric characteristics of the cable.

**Specifications for xDSL band**

- FDR measurement on 100 - 1000 kHz band
- range: 0 to -50 dB;
- readout: spectral 0 to -80 dB,
- extension from 20 up to 2200 KHz,
- accuracy: .2dB @ -40dB / 300 kHz / 120 Ohm with open line;
- minimum line length limit: 400 m.

**Noise**

ALBEDO Net.Audit. xDSL Test Head perform the Noise in sample & hold mode (about 30 seconds) and by post-processing, the Far-End Noise prediction (green graph). High Noise Level on a line can be due to:

- Cross Talk from near lines used for digital service
- Industrial or radio interferences

Above causes produce more noise in the following Conditions:

- Low insulation between wires
- Split pairs
- Longitudinal unbalance.

**Specifications for xDSL band:**

- Spectral measurement on 20 - 2200 kHz band;
- readout: dBm; range: -30 to-120 dBm;
- resolution: 0.1 dB; accuracy: .0.2 dB @ -60dBm
- / 300 kHz / 100 Ohm.

**Return Loss**

ALBEDO Net.Audit. xDSL Test Head perform the Return-Loss Measurement by internal active hybrid circuit. High return-loss can be due to:

- Mismatching of line end impedance
- Improper line impedance
- Bridged taps and laterals
- Parasitic capacitances
- Impedance changing on joints due to wire gauge changing.

**Specifications for xDSL band:**

- Spectral measurement on 20 - 2200 kHz band;
- readout: dB, range: 0 to-90 dB; resolution: 0.1 dB;
- accuracy: .0.2 dB @ -10 dB / 300 kHz / 100 Ohm

**Longitudinal Balance**

High Longitudinal Unbalance between the two wire of a line referring to ground can be due to:

- -Low insulation of one of two wires toward the ground.
- -Parasitic capacitance of one of two wires toward the ground.
- -Split pairs.
- -Water infiltration into the junctions.

**Specifications for xDSL band:**

- Spectral measurement on 20 - 2200 kHz band;
- readout: dB, range: 0 to90 dB; resolution: 0.1 dB;
- accuracy: .0.2 dB @ -40 dB / 300 kHz /100 Ohm.

**TDR echogram**

A positive echo pulse (that is above the mean value of horizontal trace) shows an increase of the line impedance up to its total opening, which produce the maximum positive echo pulse.

A negative echo pulse (that is below the mean value of horizontal trace) shows an decreasing of the line impedance up to its short circuit, which produce the maximum negative echo pulse Modest echo pulse along the line ca be due to its normal junctions.

**Specifications of standard set-up**

- TDR echograms on linear scales: 0 to 250 m, or
- 0 to 2,500 m, or
- 0 to 6,000 m;
- Optimisation of pulse parameters for positive and negative end line echoes.

**Metallic and special data results**

**Line length (auto-interpretation with open line):**

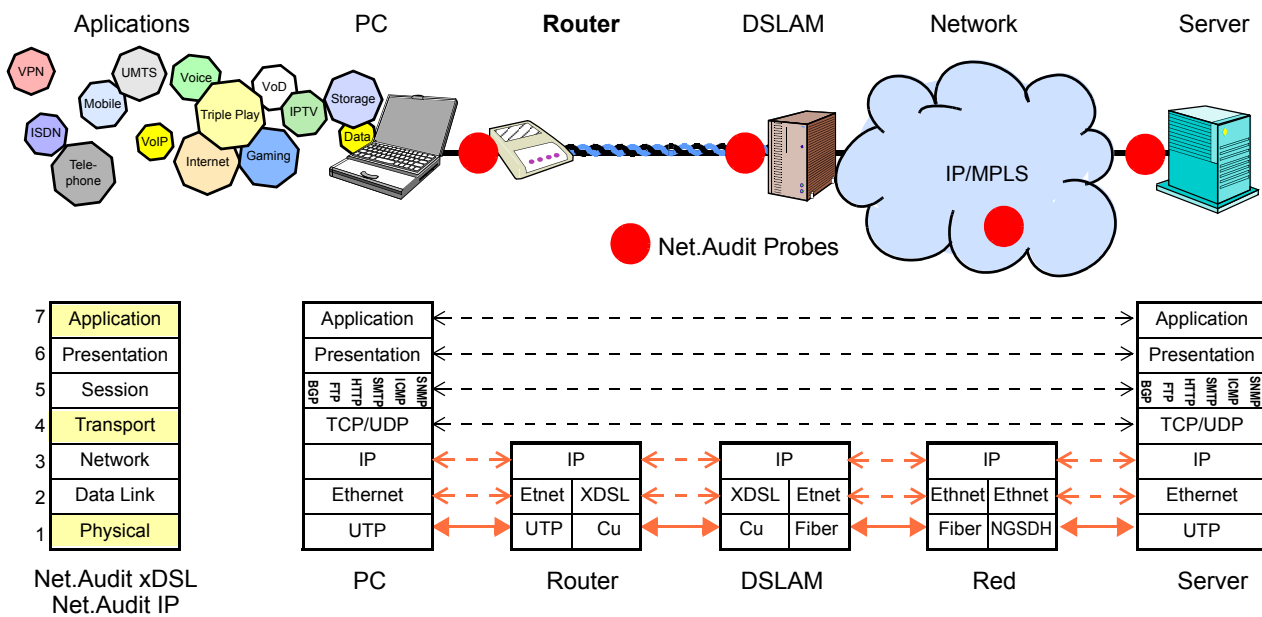
- range: 250 m to 5 km;
- accuracy: .5%
- PVF 0.580 (medium value for mix cable gauge)

**Maximum ADSL and ADSL2+ Up / Down Stream prediction:**

compute executed on S/N ratio, full rate 8 or 15 bit/symb and 11 dB Noise Margin.

**DC & AC voltage value**

- conductors: DC A-B, A-Gnd, B-Gnd; AC A-B
- readout: V, range: 0 to 140 Vdc / Vac (rms);
- resolution: 0.1 Volt;
- accuracy: 2% of reading . digit.



**Figure 7.** Net.Audit is focused on remote monitoring of the QoS at IP layer-3 while Net.Audit xDSL is focused on remote test a prequalification of the copper layer 1 used for ADSL, ADSL2 and ADSL2+ and VDSL2 access.

**Insulation / resistance value:**

- conductors: A-B, B-A, A-Gnd, B-Gnd;
- test voltage: 15 or 90 Vdc; readout: MOhm; range: 5 Ohm to 500 or 1000 MOhm;
- resolution: 0.01 MOhm; accuracy: 2% of reading . digit.

**DC - AC Capacitance value**

- DC: conductors: A-B, Test Voltage: 95 Vdc; readout: uF, range: 0.01 uF to 10 uF, resolution: 0.01 uF;
- AC: conductors: A-B, A-Gnd, B-Gnd; readout .nF., range: 0.01 to 3000 nF, resolution: 1 pF;
- accuracy: - 1% of reading .1nF (@ C < 500 nF; - 5% of reading .1nF (@ C > 500 nF.

**Signal to Noise Ratio. Histogram**

New colour representation of the amplitude and spread of each DMT channel, based on the S/N ratio estimation (by Insertion-Loss and Noise)

**Specifications for ADSL and ADSL2+ band:**

- S/N measurement on 20 . 1100 or 2200 kHz band;
- Horizontal readout: 256 or 512 DM channel;
- Vertical readout: 0 . 90 dB and 0 . 15 bit;

**Power Spectrum Density on active xDSL lines**

Spectral measurement by Spectrum Analyzer setted on High Impedance for display of power xDSL signal energy;

**Specifications of standard set-up (ADSL2+ band)**

- Peak mode configuration (time 10 seconds);
- readout: dBm/Hz;
- band limits: 20 . 2200 kHz;
- Vo Ref: -40dBm; dB/Div: 10; Fc: 1100 kHz; kHz/Div: 182;
- Res BW: 5kHz; Zo: Zi-High; Zo Ref: 100 Ohm.

**NEXT. Spectrum of Next Cross-Talk (4 wire mode) xDSL lines.****Specifications of standard set-up (ADSL2+ band)**

- Bandwidth 20 . 2200 kHz; readout: spectral dB
- range: 0 . -80 dB, resolution: 0.1 dB; accuracy: ±0.2 dB @ -40 dB / 100 Ohm

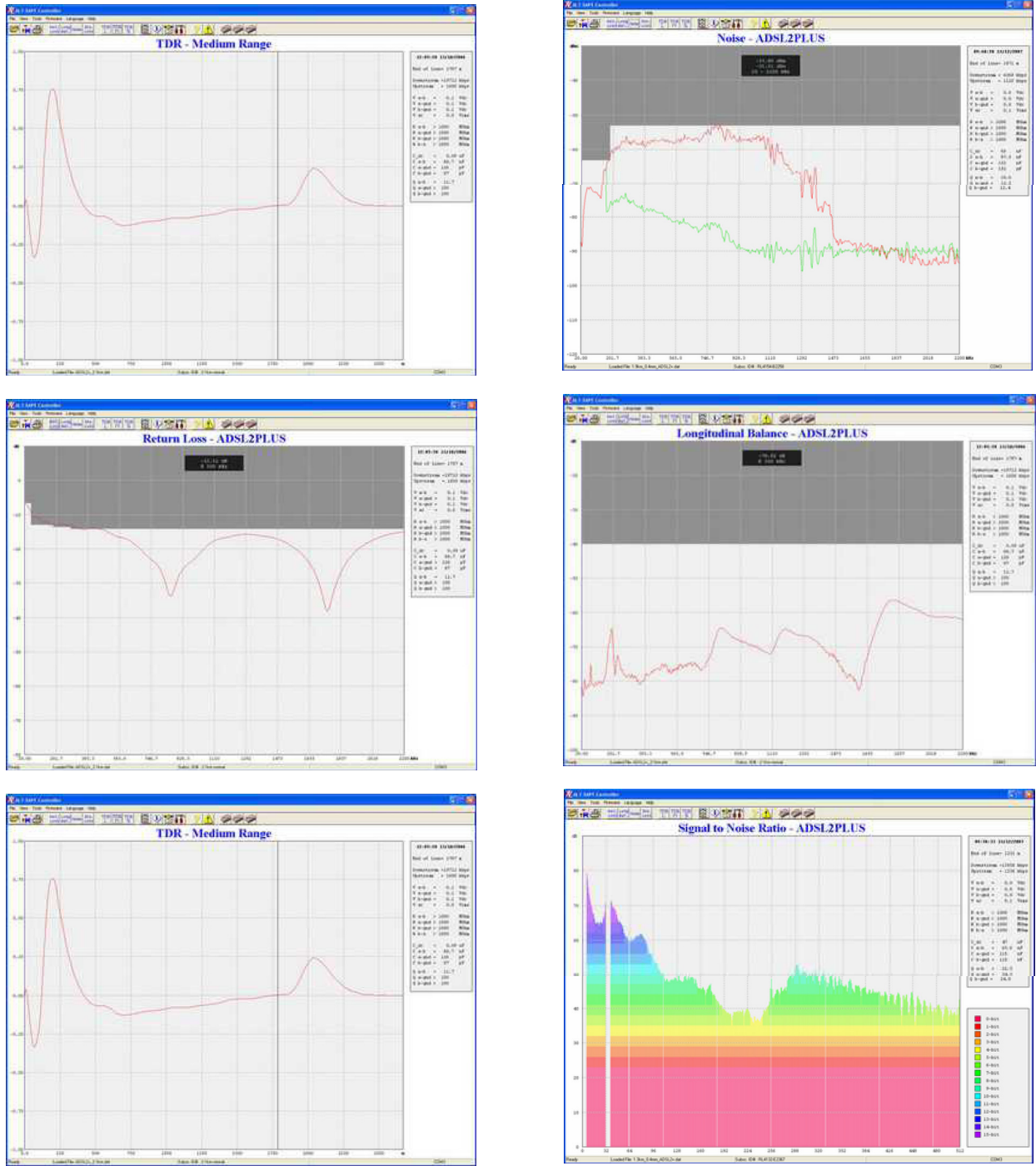


Figure 8. ADSL physical layer test results.

IP Layer specification	
Synchronization	<ul style="list-style-type: none"> <li>Using the Network Time Protocol (NTP)</li> <li>Using the Global Positioning System (GPS)</li> <li>Using external synchronization signal</li> </ul>
General	<ul style="list-style-type: none"> <li>Mode of operation: open, approved, encrypted</li> <li>Alerts/programed events sent by system e-mail and GSM</li> <li>Measuring cycle: 10s, 60s, 300s</li> </ul>
Traffic Test	<ul style="list-style-type: none"> <li>Number of test packets during a measurement cycle</li> <li>DSCP configuration</li> <li>Statistical distribution of test traffic: deterministic, and poisson</li> </ul>
Quality Objectives	<ul style="list-style-type: none"> <li>IPTD (ITU-T Y.1540)</li> <li>IPDV (ITU-T Y.1540)</li> <li>IPLR (ITU-T Y.1540)</li> <li>IPER (ITU-T Y.1540)</li> <li>IPRR (ITU-T Y.1540)</li> <li>Availability (ITU-T Y.1540)</li> </ul>

Measurements	
Delay	<ul style="list-style-type: none"> <li>Delay histogram time line and end to end IP (RFC 2678 One way delay)</li> <li>IPTD (average delay) with pass / fail indication</li> <li>IPDV (99.9% quantile - quantile 0%) with pass / fail indication</li> <li>Standard deviation of delay</li> <li>Quantile 1%, 50% (median) and 99%</li> <li>Graphs and statistics separate upstream and downstream channel</li> </ul>
Packet loss	<ul style="list-style-type: none"> <li>Schedule packet losses</li> <li>IPER indications IPLR and PASS / FAIL</li> <li>Parameters of statistical distribution of errors: "loss period" and "loss distance" (RFC 3357)</li> <li>IPRR (ITU-T 1540)</li> <li>Availability (ITU-T 1540))</li> </ul>
Bandwidth	<ul style="list-style-type: none"> <li>Schedule upstream and downstream occupancy (kbit/s)</li> <li>Occupations ascending and descending high, low and middle (kbit/s)</li> </ul>
Other	<ul style="list-style-type: none"> <li>Synchronization error estimation</li> <li>Traffic classes ITU-T Y.1541 target computer and wait</li> <li>Availability (ITU-T 1540)</li> </ul>

Design	
GUI	<ul style="list-style-type: none"> <li>GUI based secure web server installed on your computer</li> <li>Configuration and remote measurement using SNMP protocol</li> <li>Management console port (RS-232)</li> </ul>
Ergonomics	<ul style="list-style-type: none"> <li>Status information through built-in LCD screen to your computer</li> <li>2 x Ethernet 10/100BASE-T (RJ-45), RS-232 (console)</li> </ul>
Models and Options	<ul style="list-style-type: none"> <li>10/100 Mbit/s, 10/100/1000 Mbit/s, 1/10 Gbit/s Interface</li> <li>Internal / Externat bandwidth traffic taps</li> </ul>

## 5. TRAINING AND DOCUMENTATION

ALBEDO Telecom will carry out the complete installation in Morocco.

ALBEDO Telecom will carry out the training to MT staff on the technology and in the use of the laboratory and the system itself.

ALBEDO Telecom will support during one year, free of charge, all the queries regarding the system once delivered.



## ALBEDO Telecom

ALBEDO Telecom delivers solutions that enable Telecom organizations of all sizes to measure, troubleshoot, monitor, and migrate mission critical applications.

On local segments and across distributed networks, ALBEDO enable Organizations, Installers, Operators, Service Providers and Suppliers to quickly check the health of your architecture, verify SLA, or find and fix problems.

## Your Business Partner

**Results.** The ALBEDO Telecom to help industry to make the most of the investment on infrastructure.

**Expertise.** ALBEDO Telecom trainers, auditors, engineers and consultants provide industry-leading knowledge to address the unique needs of customers.

**Integration.** ALBEDO Telecom integrates disparate telecom resources and applications, realizing new business efficiencies.

**Agility.** ALBEDO Telecom increases the ability of customers to respond quickly to new market opportunities and requirements.

**Coverage.** ALBEDO Telecom offers solutions that facilitates the migration and the roll-out to new architectures.



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