TLCSANNIO
TESTING LAB

xDSL lab

Ing. Michele Todino

TLCSANNIO
TESTING LAB

outline

- Lab Introduction
- Overview of equipment
- Certification
- Conclusions

TLCSANNIO
TESTING LAB

xDSL lab

The xDSL Lab contains equipments for xDSL testing and verification including instrumentation for TR-067 compliance verification.

Ing. Michele Todino

TLCSANNIO
TESTING LAB

mission

TLC Sannio Testing Lab has been created thanks to a joint collaboration between the **University of Sannio** in Benevento and the **Province of Benevento**, to provide testing services to companies involved in TLC equipment manufacturing.

TLCSANNIO
TESTING LAB

equipments:

- Spirent DLS5500 Noise Generator
- Spirent DLS5405 Noise Injection Unit
- Spirent DLS410 Line Simulator
- Tracespan DSL Xpert 2208A DSL Analyzer
- Agilent N2X Network Analysis Tool
- LeCroy SDA600 Serial data Analyzer
- Agilent E4404B Spectrum Analyzer

TLCSANNIO
TESTING LAB

Local Loop Simulation and Noise Generation:

Ing. Michele Todino

TLCSANNIO
TESTING LAB

Local Loop Simulation and Noise Generation:

This machine operating on the **physical layer**, or the first layer of the OSI model, need to deliver high quality data across the physical medium.

This Generator enables us **to simulate the properties of the copper lines** that your equipment needs to send and/or receive information over besides it is calibrate with an appropriate program and its firmware is always upgraded.

Real world noise such as crosstalk, RFI, impulse and white noise has a dramatic impact on the performance of modems and DSLAMs.

TLCSANNIO
TESTING LAB

Local Loop Simulation and Noise Generation (TESTING)

With this Generator is possible to test the CPE chipsets, modems and interoperability with DSLAM line cards requires wireline simulators and noise impairment generators to emulate the copper loop and various impairments:

- **crosstalk within a cable binder.**
- **radio frequency interference.**

Ing. Michele Todino

TLCSANNIO
TESTING LAB

Local Loop Simulation and Noise Generation (TESTING)

This instrument is designed for ADSL2+ and VDSL2 enable simulation of all loop and noise impairments specified by standards such as **TR-067**, G.992.5 and G.VDSL2. Testing conformance to these standards ensures that the equipment is able to support:

- data rates,
- functionality and interoperability

(required to deliver top quality IPTV and other services)

Ing. Michele Todino

TLCSANNIO
TESTING LAB

Local Loop Simulation and Noise Generation: (EXAMPLE)

DLS: Test Methodologies (IPTV Test Scenario): Testing IPTV at the Access Bottleneck

To deliver IPTV services, service providers need to deliver maximum bandwidth and near ubiquitous coverage over a converged network. The access infrastructure, specifically the local loop and CPE modems, must support sufficient bandwidth and functionality to enable IPTV services to be delivered successfully to the consumer.

TLCSANNIO
TESTING LAB

Local Loop Simulation and Noise Generation
(BENEFITS 1 OF 2)

With these test set-ups, we can be assured that the device under test will pass ITU-T or DSL Forum certification. These test solutions provide a high degree of accuracy and repeatability, allowing the us to obtain consistent and repeatable test results time after time, in any lab environment.

TLCSANNIO
TESTING LAB

Local Loop Simulation and Noise Generation
(BENEFITS 2 OF 2)

The use of these test solutions enables us to **simulate an Internet service provider**, minimizing costly issues and troubleshooting during deployment.

TLCSANNIO
TESTING LAB

DSL Xpert™ Multi-Layer ADSL AnalyzerFirst

(Non-intrusive analyzer for ADSL, ADSL2, and ADSL2+
DSL Xpert Advantages)

Ing. Michele Todino

DSL Xpert™ Multi-Layer ADSL AnalyzerFirst
(features)

This instrument is a pillar of our lab it permits us to:

- Testing of ADSL, ADSL2 and ADSL2+
- Comprehensive Performance Analysis
- Independent Testing tool – no ADSL chipset
- Non-Intrusive Monitoring
- Multi-Layer Probing
- User-Friendly PC-Controlled GUI
- Command Line for Automatic Testing
- Decision Making Tool for Managers

DSL Xpert™ Multi-Layer ADSL AnalyzerFirst
(Currently Supported Protocols and Features)

- ADSL (G.DMT /G.992.1)
- ADSL2 (G.992.3)
- ADSL2+ (G992.5)
- DSL Handshake (G.HS / G.994.1)
- ANSI (T1.413)
- Annexes: Annex A, Annex B, Annex L (Reach Extended), Annex M (Extended Upstream)
- Upper Layer Protocols (all layers from ATM to the IP layer and above)
- Real-Time Analysis for unlimited duration activity monitoring, analysis and statistics

TLCSANNIO
TESTING LAB

DSL Xpert™ Multi-Layer ADSL AnalyzerFirst
(Configuration)

TLCSANNIO
TESTING LAB

DSL Xpert™ Multi-Layer ADSL AnalyzerFirst

(Continuous Real Time Analysis (CRTA))

Some events in the ADSL link may occur long time after the DSLAM and CPE modem have initiated and established their connection. Examples of such events are:

- Reset of the ADSL layer
- Disconnection of the IP layer
- A message repeated multiple times in a specific protocol
- Crossing a threshold of a specific parameter, like rate of an ATM channel
- External trigger using the DSL Xpert system's Command Line Interface

With CRTA we can better understand and simulate what happen.

TLCSANNIO
TESTING LAB

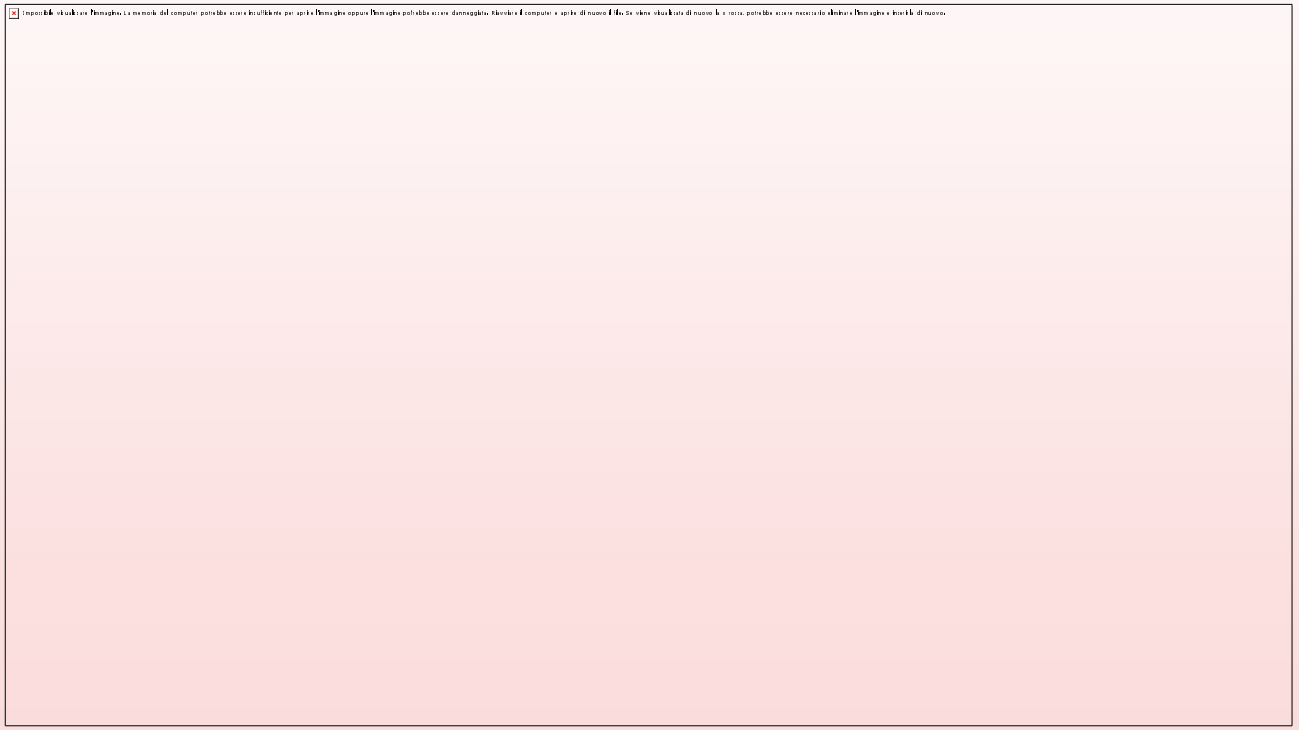
DSL Xpert™ Multi-Layer ADSL AnalyzerFirst

(Continuous Real Time Analysis (CRTA))

The captured data and analysis are saved to a cyclic file. we define the file's size (in seconds), which becomes the captured “time-window” duration. Besides we define the trigger for stopping the capture. When the specified pre-defined event occurs and the capturing stops, we may explore the recording and view the analysis with the usual DSL Xpert views for the events that occurred during the predefined time-window. Then we can also define that the capture will continue for a specific length of time after the event occurred. In addition to the Showtime captured data just before the event, the Real Time Analysis provides the parameters associated with the initialization sequences for any Showtime phase that occurs in the time window.

TLCSANNIO
TESTING LAB

Agilent N2X Multi-services test solution



Ing. Michele Todino

Agilent N2X Multi-services test solution (overview 1 of 2)

The Agilent N2X provides a solution **for validating the performance and scalability characteristics** of next-generation network equipment for voice, video and data (triple-play) services. N2X is an equipment by providing a single test environment to simultaneously validate leading edge services over the latest infrastructures.

Ing. Michele Todino

TLCSANNIO
TESTING LAB

Agilent N2X Multi-services test solution (overview 2 of 2)

Network equipment manufacturers and service providers can gain unique insight into quality of experience (QoE) of each individual subscriber service under real-world conditions. N2X addresses the test challenges triple-play services impose across the IP/MPLS core, carrier edge and broadband-access networks, enabling a more complete characterization of service quality and the networking mechanisms required to deliver it.

N2X uniquely validates QoS mechanisms and high availability implementations. Using a emulation software, we can test a broader range of test cases.

Agilent N2X Multi-services test solution (features)

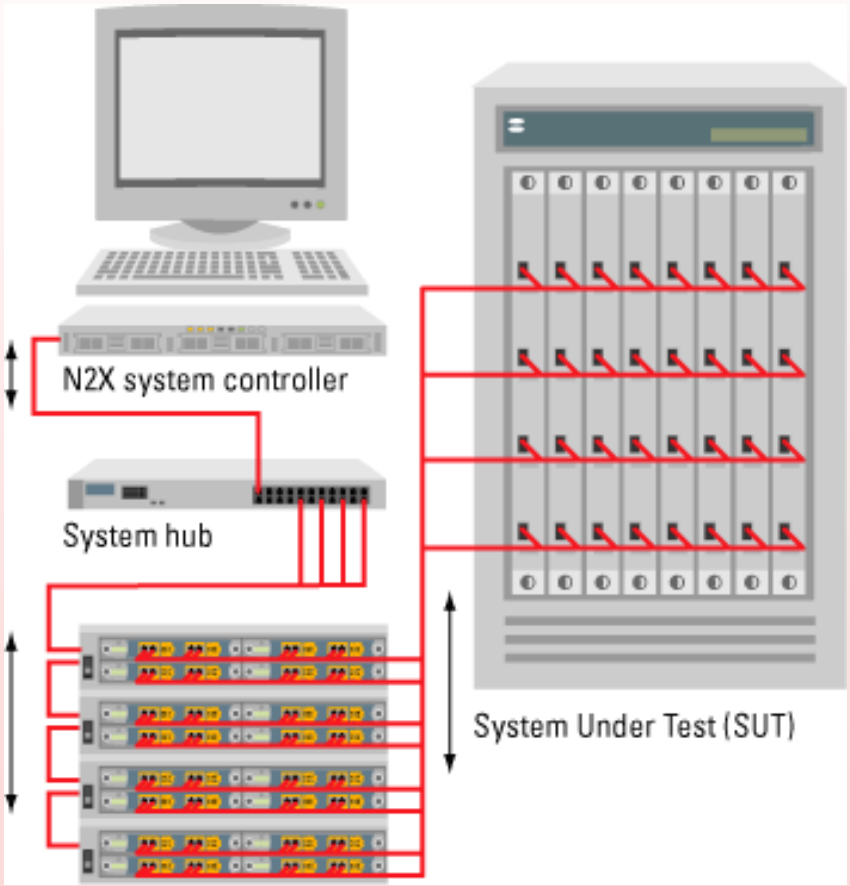
Realism: Simultaneously test a wide variety of services across broadband access, carrier edge and IP/MPLS core.

Scalability: Comprehensive protocol coverage to emulate the scale and complexity of network services.

Rapid Time to Insight: is possible to isolate problems anywhere in the network using the tools united to this machine.

TLCSANNIO
TESTING LAB

Agilent N2X Multi-services test solution (configuration)



TLCSANNIO
TESTING LAB

Agilent N2X Multi-services test solution (configuration)

The Agilent N2X system consists of a system controller and multiple chassis containing purpose-built Test Cards for specific test requirements. The system controller provides a graphical interface to drive applications running on the Test Cards.

Each controller provides an easy-to-use Windows environment. An Ethernet Switch is required for System Controllers that will connect to more than one N2X chassis; we will choose either an 8-port or a 24-port Ethernet system switch.

Agilent N2X Multi-services test solution (IPv6 1 of 3)

The gradual migration of IPv4 to IPv6 means that network equipment must support both traffic types and protocol flavors simultaneously, as well as mechanisms to transition seamlessly between the two infrastructures, while meeting QoS guarantees. **Testing whether a device or network can manage and scale both technologies at once is critical prior to deployment**. This challenging task for both Network Equipment Manufacturers and Service Providers means that they require test equipment to validate new network topologies prior to deployment.

Agilent N2X Multi-services test solution (IPv6 2 of 3)

N2X Solution provides comprehensive and accurate testing of IPv6 devices.

Multi-port Traffic Generation and Analysis - The flexible PDU Builder feature configures IPv4, IPv6 and tunneled traffic streams and N2X's multi-encapsulation autodetection feature enables simultaneous performance measurement of mixed traffic types such as IPv6, IPv4, and IPv6 over IPv4 on each port by automatically detecting each packet's test payload. These features enables us to make comparative QoS measurements:

- Throughput.
- Latency.
- Packet loss of IPv6 and IPv4 streams simultaneously.

TLCSANNIO
TESTING LAB

Agilent N2X Multi-services test solution (IPv6 3 of 3)

Comprehensive IPv6 Protocol Emulation - the IPv6 Routing Emulation software integrates the most scalable **BGP4+, OSPFv3, IS-ISv6, and RIPng routing protocol emulation** to deliver unparalleled protocol verification, interoperability and stress testing of IPv6-capables devices and networks. IPv4 and IPv6 routing protocols can be emulated individually or concurrently on the same port to simulate extremely large and dynamic networks, and measure how well the router, switch or network manages unstable, multi-protocol network topologies inherent in the Internet today.

Dynamic IPv6 Network Simulation - N2X supports the widest range of protocols and interfaces to simulate and test emerging IPv6 based services on routing devices.

TLCSANNIO
TESTING LAB

Agilent N2X Multi-services test solution (mpls 1 of 3)

The complexity of MPLS/GMPLS technology makes testing the devices and networks challenged with delivering this evolving technology an extremely demanding task, to say the least. Test considerations range from basic MPLS forwarding measurements, to functional and stress testing of newly extended protocols, to verifying whether the MPLS network is capable of delivering differentiating services and applications such as MPLS Virtual Private Networks (VPNs).

TLCSANNIO
TESTING LAB

Agilent N2X Multi-services test solution (mpls 2 of 3)

Agilent N2X generates multiple streams of IP and MPLS label-prefixed packets at wire-speed into every interface on your device, at speeds up to 40 Gb/s.

Traffic loads and label parameters, such as label values and experimental bits, **can be manipulated while N2X makes real-time MPLS forwarding measurements that determine how different test configurations affect the MPLS forwarding performance of your device.**

TLCSANNIO
TESTING LAB

Agilent N2X Multi-services test solution (mpls 3 of 3)

MPLS is comprised of a large family of protocols, including OSPF-TE, ISIS-TE, RSVP-TE, MP-iBGP, and LDP/CR-LDP, and thus by composition alone, is a relatively complicated technology.

N2X can accurately simulate huge, multi-protocol MPLS network topologies, carrying hundreds of thousands of dynamically changing label-switched paths (LSPs), around your routing device. We can then generate wire-speed MPLS traffic across this dynamic and complex topology to determine whether our device is capable of simultaneously managing MPLS protocol engines, forwarding MPLS traffic and delivering MPLS-based services.

Agilent N2X Multi-services test solution (multicast 1 of 3)

Multicast technology offers a bandwidth and resource-preserving alternative to broadcast and unicast packet transmission. IP Multicast transmission conserves bandwidth by forcing networks to do packet replication only when necessary, and is ideal for one-to-many and many-to-many applications such as the delivery of network ticker tapes, live stock quotes, multiparty video-conferencing, and shared white board applications.

Multicast traffic and control protocols place a different burden on router resources than unicast or broadcast traffic. It is therefore very important to carefully test how multicast implementations affect both router and network performance.

Agilent N2X Multi-services test solution (multicast 2 of 3)

N2X provides real-time multicast forwarding measurements over ATM, Ethernet, and POS interfaces. We can manipulate:

- the ratio
- load of multicast and IP traffic

while N2X makes real-time forwarding measurements, allowing us to determine how different test configurations and the uderlaying unicast network volatility affect the ultimate traffic forwarding performance and QoS delivery.

TLCSANNIO
TESTING LAB

Agilent N2X Multi-services test solution (multicast 3 of 3)

N2X delivers powerful IGMPv2/v3, PIM-SM/SSM (including IPv6 support), MSDP and routing protocol emulations to simulate multicast hosts and networks around your device and achieve multicast protocol conformance, interoperability, scalability and functional measurements.

order to determine whether your router or network is truly capable of concurrently and effectively managing network resources and delivering multicast services, requires that it be tested in an environment that accurately reflects the potential scale and dynamic nature of multicast-enabled networks. N2X uses dynamic IGMP, PIM-SM/SSM, MSDP and routing protocol emulations to manipulate multicast group memberships, distribution trees, and traffic configurations on-the-fly, and achieve complex multicast performance measurements.

TLCSANNIO
TESTING LAB

Agilent N2X Multi-services test solution (vpn 1 of 2)

The adoption of Layer 2/3 VPNs by service providers is set to rise due to the attraction of increasing the utilization of existing IP/MPLS backbone infrastructures to create new revenue streams. VPN is a sophisticated technology incorporating various tunneling, signaling and routing protocols and security features, including MP-iBGP, RSVP-TE, LDP/CR-LDP, L2oMPLS (Martini) OSPF and IS-IS.

The sheer complexity of VPN technology makes testing the devices and networks that deliver VPN services an essential yet demanding task. A VPN service must provide reliable, secure and private connections between remote customer sites, and transmit business-critical services and applications with carrier-class reliability and predictability.

TLCSANNIO
TESTING LAB

Agilent N2X Multi-services test solution (vpn 2 of 2)

N2X can verify the scalability, reliability and revenue generating capacity of Layer 2/3 VPN implementations.

Validate point-to-point services delivered via the IP/MPLS infrastructure by simulating legacy services such as ATM/FR.

Ensure service reliability the multi-encapsulation autodetection feature enables simultaneous QoS measurement of mixed traffic types and/or varying encapsulations on the same port.

Revenue generating capacity of VPN implementations through comprehensive VPN test coverage

TLCSANNIO
TESTING LAB

Le Croy Oscilloscope and Protocol Analyzer

Ing. Michele Todino

TLCSANNIO
TESTING LAB

Le Croy Oscilloscope and Protocol Analyzer

The SDA 18000 serial data analyzer delivers an analog bandwidth—18 GHz—as well as a combined highest sampling rate of 60 GS/s and memory of up to 150 million points available in a real-time test instrument.

the SDA 18000 is a 4-channel real-time serial data analyzer that offers outstanding analysis capabilities.

Ing. Michele Todino

TLCSANNIO
TESTING LAB

Le Croy Oscilloscope and Protocol Analyzer

benefits:

- Pristine signal integrity measurements
- Accurate jitter analysis
- Powerful advanced waveform analysis
- Stable, repeatable results

TLCSANNIO
TESTING LAB

E4404B ESA-E Series Spectrum Analyzer, 100 Hz to 6.7 GHz

Ing. Michele Todino

TLCSANNIO
TESTING LAB

E4404B ESA-E Series Spectrum Analyzer, 100 Hz to 6.7 GHz

Speed

- 0.4 dB overall amplitude accuracy
- +16 dBm TOI
- -167 dBm DANL, with internal preamp
- 1 Hz narrow resolution bandwidth (optional)

Measurement Applications

Phase Noise, Noise Figure, GSM/EDGE, cdmaOne Includes Power Suite one-button RF power measurements

TLCSANNIO
TESTING LAB

E4404B ESA-E Series Spectrum Analyzer, 100 Hz to 6.7 GHz

Features

- 10 MHz analysis bandwidth
- Segmented sweep for up to 32 discontinuous spans in one sweep
- Rugged and portable for lab grade performance in the field
- 5 minute warm-up to guaranteed measurement accuracy

TLCSANNIO
TESTING LAB

Certification:

The TLC Sannio testing lab provides testing services to verify the compliance to TR-067 and TR-100 specifications.

TLCSANNIO
TESTING LAB

Interoperability:

“A CPE modem and a DSLAM are dynamically interoperable if they implement a

common and compatible set of features, functions and options and can demonstrate

satisfactory mutual communication in a real network architecture environment as

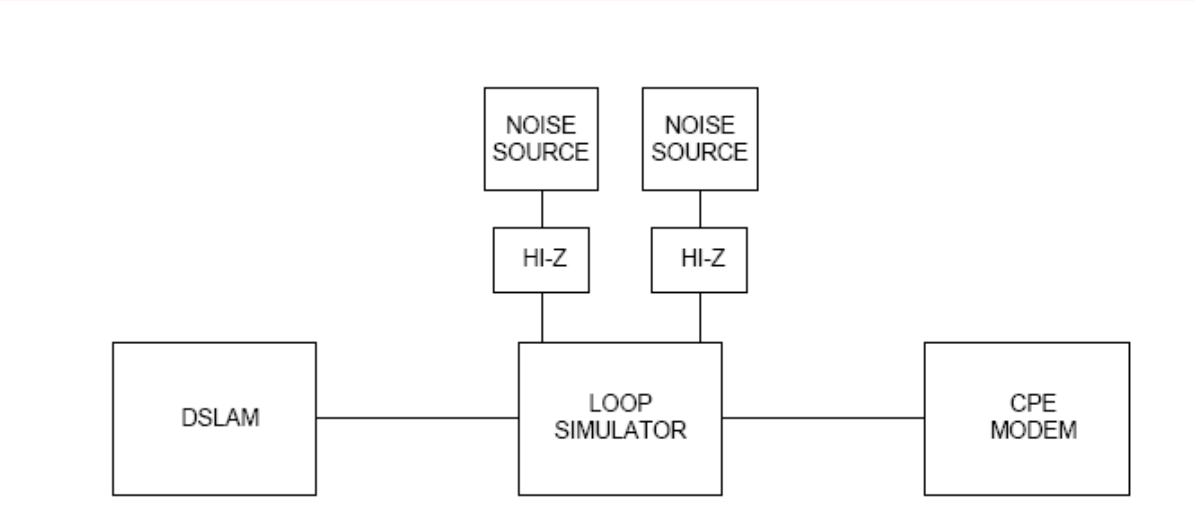
performance test conditions are varied and exercised. The term "compatible" is used to

mean that there are no conflicting requirements that will prevent the ADSL system from

achieving interoperability.” **www.dslforum.org**

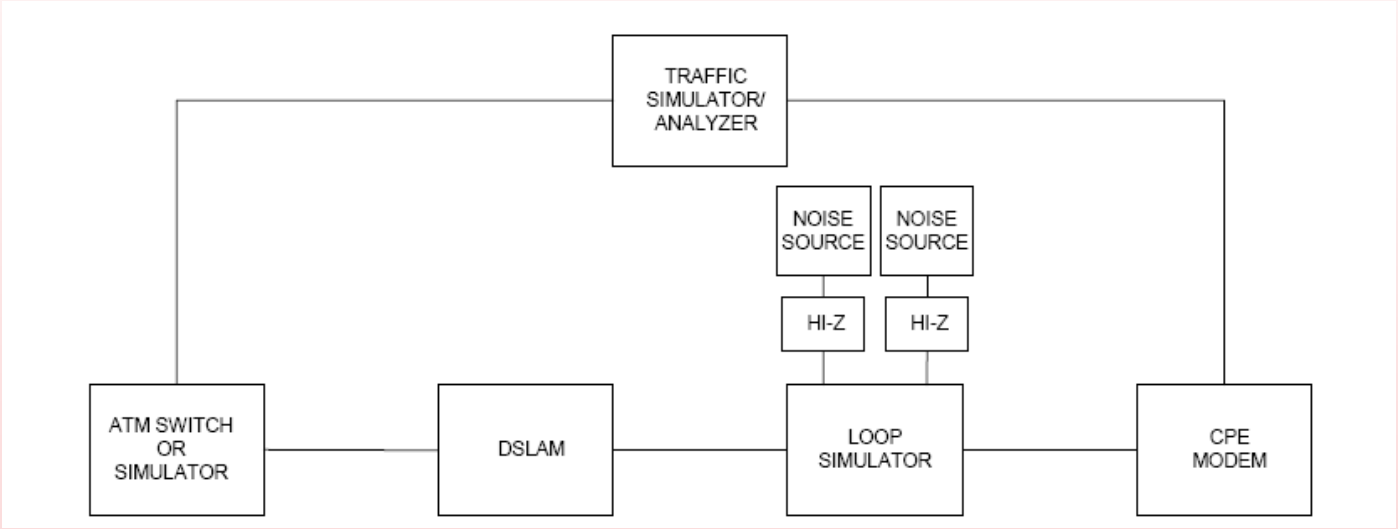
TLCSANNIO
TESTING LAB

Configuration:



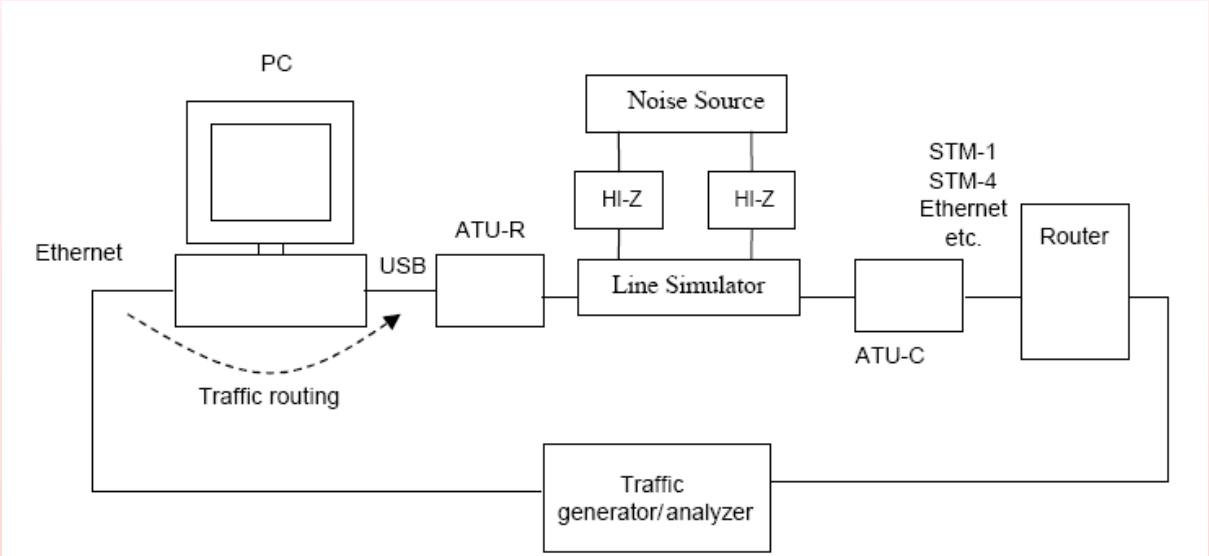
TLCSANNIO
TESTING LAB

Configuration
(with Ethernet interface):



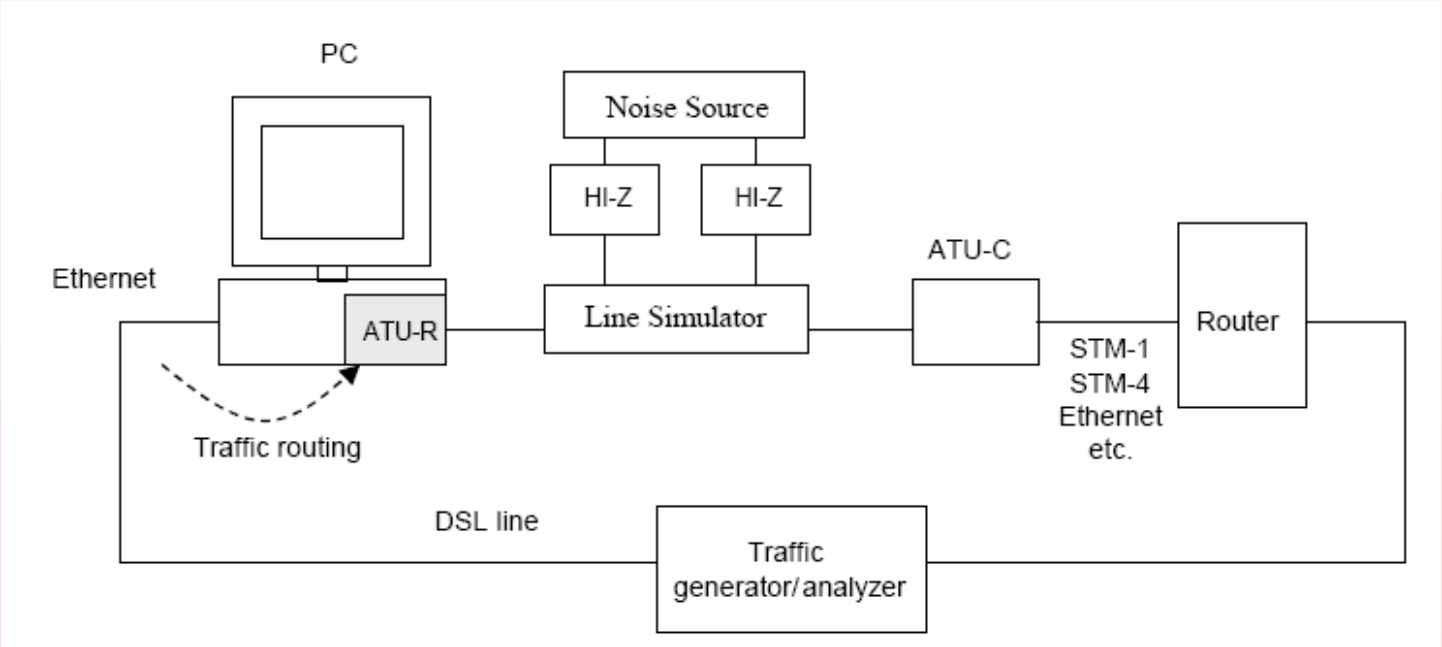
TLCSANNIO
TESTING LAB

Test setup for USB modem:

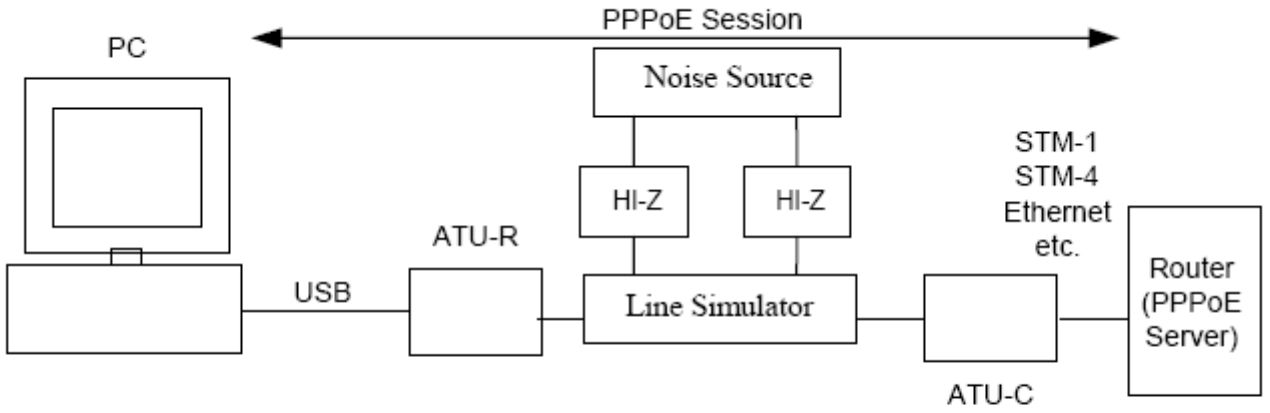


TLCSANNIO
TESTING LAB

Test setup for internal modem:

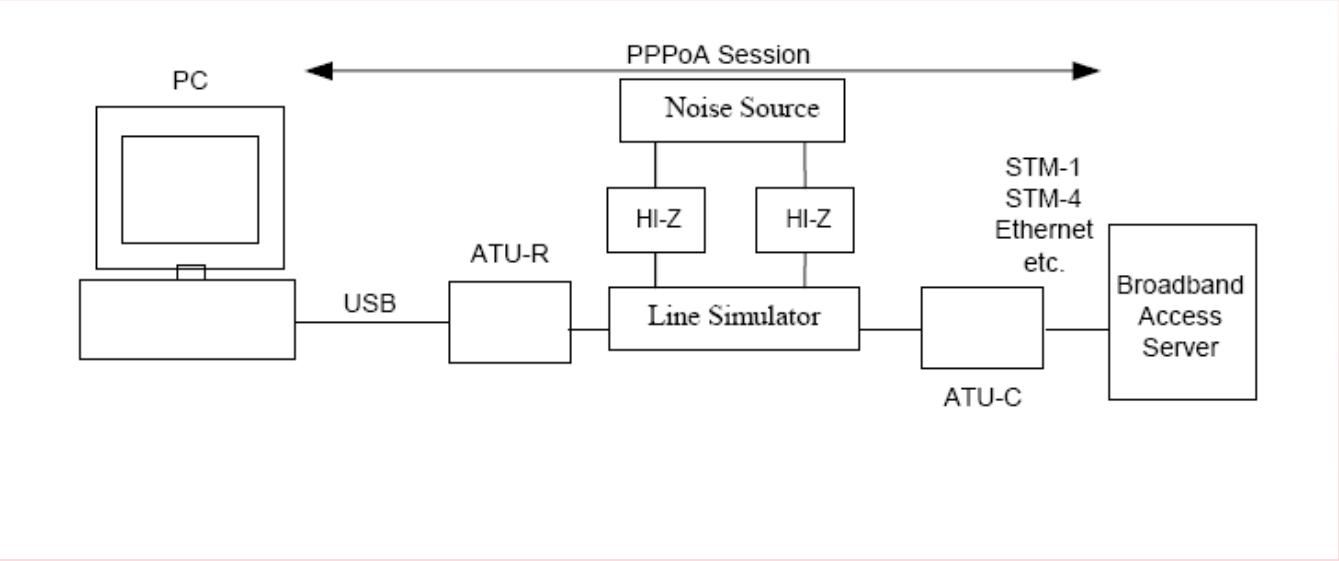


Test setup for PPOE modem (with Ethernet interface):



TLCSANNIO
TESTING LAB

Test setup for PPOA modem (with Ethernet interface):



TLCSANNIO
TESTING LAB

Certification :

Instead tests indicated in the TR-067 and TR-100 document can be carried out.

- **Physical layer**
- **Higher layers**

TLCSANNIO
TESTING LAB

Physical layer:

- ADSL functionality tests
- Sudden application of RFI
- DSL noise spikes/Surges tests
- Stress test
- Electrical compatibility tests

TLCSANNIO
TESTING LAB

Higher layers:

- ATM connectivity tests
- RFC 2684 bridged mode (Eth or USB)
- RFC 2516 PPPoE
- RFC 2364 PPPoA

TLCSANNIO
TESTING LAB

Higher layers:

- Usability test PC Re-boot Power Cycle Test Link Cycle Test Verify 10/100 Ethernet Auto-negotiation (802.3u)

TLCSANNIO
TESTING LAB

Conclusions:

As we have seed in this presentation our lab is possible to simulate a real telecommunication world:

- We can test CPE over a simulated network.
- We can test multiple scenario (MPLS, VPN)
- We can test many kind of data time (data, voice, tv)

TLCSANNIO
TESTING LAB

Links:

Province of Benevento

LESIM
Laboratory of Measurement and Signal Processing

RCOST
Research Centre on Software Technology