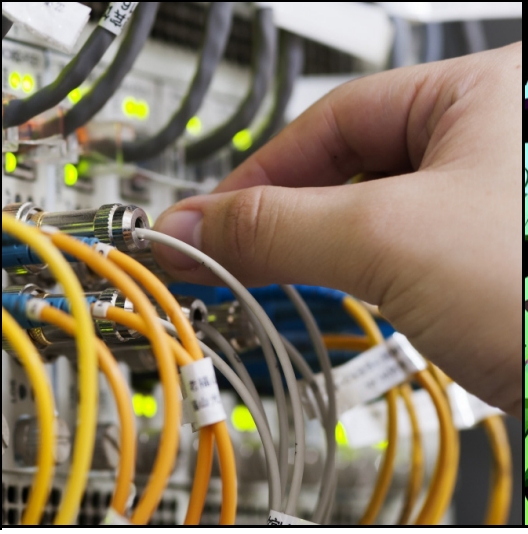
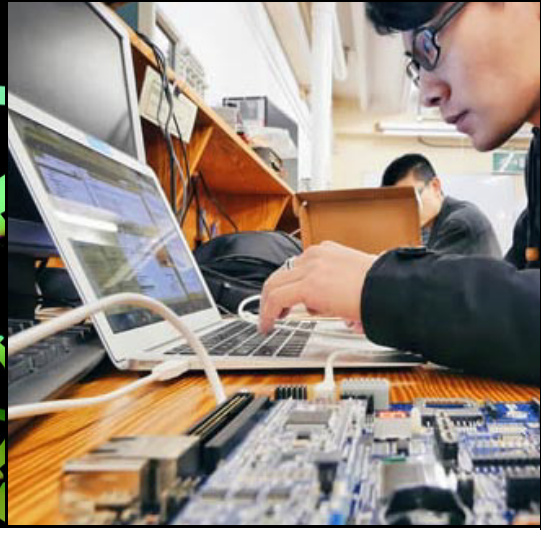




Sync.Lab (how it all works in telecom)

the Path to Excellence

Sync.Lab is based on an Ethernet / IP network with PTP synchronization that replicates accurately real architectures by means of Switches, Master/Slave clocks, WAN emulators and Field testers to simulate real traffic conditions. Sync.Lab has been designed for the industry and education centers willing to execute either proof of concept procedures, or running approval and acceptance test of new telecom appliances,or experiment new technologies.

Timing requirements in telecoms have moved from only frequency to frequency and phase. This change is important because time signals, traditionally provided by circuits, now is delivered by packet networks that can also provide phase information by means of PTP protocol. Sync.Lab is built with real Ethernet nodes, Master/Slave clocks, WAN emulators, Telecom testers and Packet capture appliances in order to generate anu kind of flows including PTP, SyncE and IP traffic that is routed across the lab. The result is a comprehensive network that can be configured with more than 65 scenarios to execute a large number of experiments, test suites and simulations.

Experiments while learning

LTE Operators, Power utilities, Airports, Railways and Finance Corporations are adopting PTP for time distribution across the existing networks. Sync.Lab is a reasonable solution for those experts willing to run trials, research programs or learning in a real platform.Every single resource, node or frame, can be spotted and manipulated by the users therefore reference clocks, traffic load, synchronization profiles, network conditions are under user's control that can run test suites or verify every single feature at transmission and timing layers.

"Smart PTP, SyncE, Ethernet, IP network to simulate and take the correct decisions"

Comprehensive Architecture

Sync.Lab has a sophisticated timing core to support both *PTP Grand-Master clock* to synchronize multiple clients and a *PTP Slave clock* to provide host synchronization through electrical / optical interfaces. It is able to simulate different network condition to check how tolerant the network is when quality or capacity degradations occur replicating impairments such as packet delay, errors, loss, bandwidth variations, traffic shaping and policing. Sync.Lab also includes a packet capture very useful for protocol analysis, and a field tester to verify that the Quality of the network follows the international standards.

ALBEDO Telecom

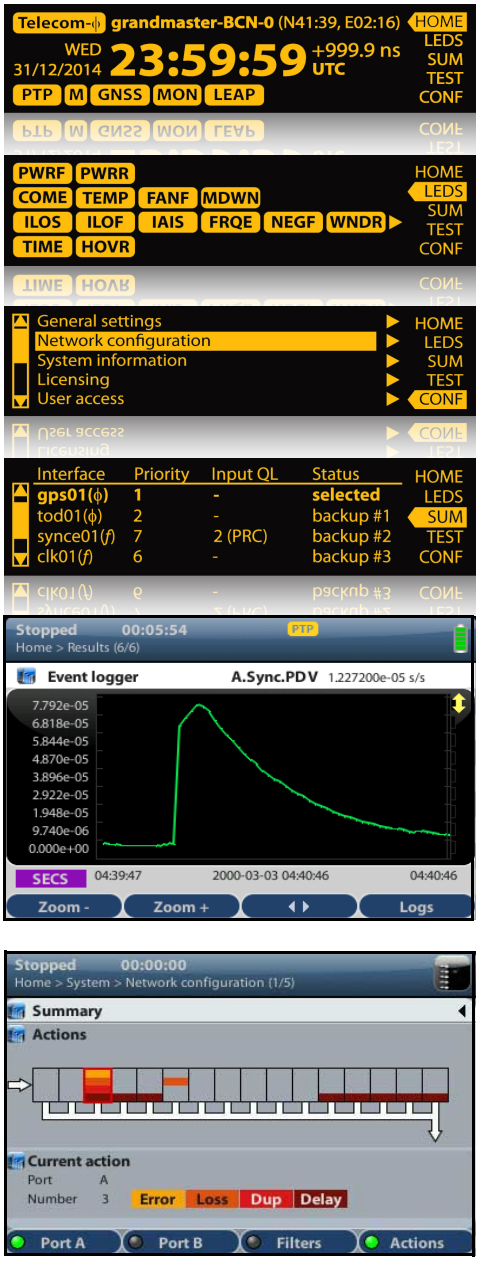
SYNC.LAB

Hands-on telecom

The core of Sync.Lab is made with the following products: **Net.Sync** (master and slave clocks), **Net.Storm** (WAN emulator), **Net.Hunter** (packet capute) and **Ether.Genius** (tester) then it allows the connection of a number of different nodes like switches, routers, base stations even CPEs to replicate customer' topologies.

TDM & PTP synchronization

New applications are demanding accurate time references. One Net.Sync equipped with OCXO or Rubidium can be configured as PTP master clock and to synchronize multiples PTP slave closck. User will be able control every single functionality or monitor the quality of the timing.



All you need in PTP

Ether.Genius and Net.Sync facilitate users to verify the connectivity, quality, and synchronization of networks controlled by means of PTP. Experts can now emulate 1588v2 slave/master clocks, and ensure network QoS by generating PTP messages and measure packet delay variation (PDV) stability over time which is a key parameter to maintain the quality.

Synchronous Ethernet

The Laboratory also manages SyncE, SSM, SSM protocols that can be captured with Net.Hunter for analysis or decoding.

Transport Layers

The Quality of the transport layer may determine the success of the syntonization. To pre-qualify those infrastructures distributing the PTP streams Ether.Genius has a powerful set of tools:

1. Deep analysis of the transmission sublayers executing quality and capacity test to find-out network KPIs.
2. Simulation a timing service with traffic profiles to know frame delay, jitter, loss ratio and availability that may modify protocols performance.
3. Cooperation with Net.Sync using it as reflector answering to BER or ICMP.

Improved performance

Ether.Genius and Net.Sync will cooperate to quickly identify protocol impairment that can be configured with the WAN emulator replicating in a controlled way what occurs in the real network. Perform the RFC 2544 test option, testing throughput, frame loss, latency, jitter and burst is straightforward that can be can execute in symmetric and asymmetric way and with the far-end device in loopback mode or peer-to-peer mode.

Service activation (Y.1564)

This new methodology executes multiple traffic streams in two phases:

- *Service Configuration,* confirms the end-to-end set-up while quickly checking the Information Rate (IR), Frame Delay Variation (FDV), Frame Loss Ratio (FLR), Frame Loss Ratio at the Service Acceptance Criteria (FLRSAC).
- *Service Performance,* transmits all configured traffic streams at the CIR confirming all traffic is able to transverse the network under full load while checking IR, FDV, FLR and availability.

Q-in-Q

You can learn how to verify QoS by means of the VLAN CoS bits used for VLAN stacking by carriers and operators.

IP Services test

Often it is required to test IP features to verify end-to-end connectivity by means of Ping and Trace Route with ICMP echo request and analysis fully supported.

WAN emulation

Sync.Lab is able to generates those protuberances typical of IP and Carrier Ethernet to test IP applications and PTP too. Devices and protocols should be tolerant with packet delay, jitter, loss, duplication, reordering, error and bandwidth variations.

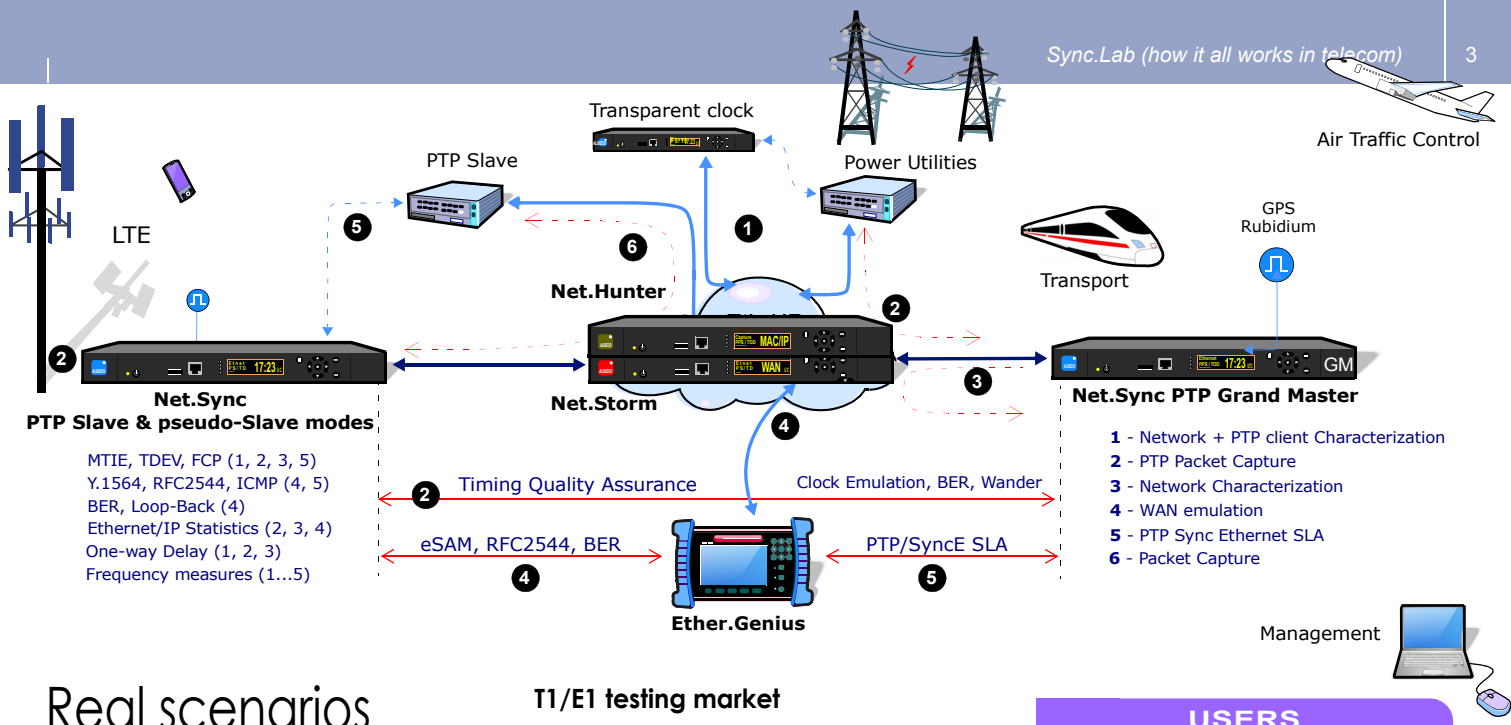
The emulation facilitates the verification of new applications, services and nodes through emulation of the real nature of IP networks. Sync.Lab enables engineers to model and modify arbitrary performance dynamics including packet delay, jitter, bandwidth limitations, congestion, packet loss, errors and duplication on live IP packets.

Capture & protocol analysis

Users will be able to monitor traffic at wire-speed lines and capture complete flows of selected traffic thanks to the Net.Hunter appliance included on Sync.Lab. The whole content is analysed including headers and payloads then, if compliant with any of the programmable conditions, they can either be tapped to a LAN or recorded into the internal hard disk. Recorded flows from different sources can be correlated thanks to PCAP time stamp synchronized by NTP.

Sync.Lab takes advantages of both open source software and other analysis suites to reconstruct sessions that will allow you to discover what occurred. Experts may then analyse the protocols, reassemble a conversation or identify malware in order to get a clear picture of what occurred with the traffic. Saved packets with PCAP can be correlated and reconstruct traffic. For this use, capturing data at high rates and indexing to speed access are critical.

Net.Hunter can be synchronized therefore the captures of PTP packets with time-stamps can be very useful to study transparent clock performance, compensation timing, timing accuracies.



Real scenarios

Sync.Lab is configured as a real Ethernet/IP/PTP network with optical and electrical interfaces that can even generate frequency and phase impairments identical to those that may occur in actual networks to challenge experts in installation and maintenance. Therefore Sync.Lab is ideal to model, experiment, test and learn in a true network but 100% controlled architecture.

Remote GUI: Wi-Fi and VNC

The Remote Control by means of VNC standards is a very special feature of all ALBEDO instruments to grant full, but password controlled access, to configure, execute, and get results directly using an ad-hoc wi-fi or a LAN and using a public/private IP address. Therefore you will be able to control the unit from a remote PC, or a local iPhone or iPad.

Design, set-up & maintenance

Sync.Lab provides valuable insight to design Ethernet and PTP networks. Everything is possible. From verify QoS, find tolerances for testing new equipment or learn new technologies management. Experts will be able to rapidly characterize the resources found in the network effectively and with minimal intervention.

Demarcation

Telecom providers have to face the maintenance of unhappy customers that often do not differentiate between their internal issues and service provider problems. Experts wil learn how to demarcate customers and operator networks. Test can be executed addressing both capacity and quality parameters simultaneously to prove where the issue is.

T1/E1 testing market

This market has plenty of new opportunities including traditional applications such as voice, data, synchronization and leased lines, plus the new challenging architectures that combine T1, E1 circuit with Carrier-Ethernet and IP.

Telecom timing

Several test are possible to verify Boundary Clock (BC), Transparent Clock (TC) and Ordinary Clock (OC).

- Grandmaster and time distribution network can be verified with two modes: Net.Sync in slave mode (not time reference) and also in pseudo slave.
- Ether.Genius can play the role of a Grand Master or Slave to substitute a clock under test.
- It si also possible to know the quality of 1 pps output (or any other output signal) from PTP slave.
- There are also schemes that apply to BCs and TCs. For these tests two Net.Sync and Ether.Genius can be synchronized through a cable at 1 pps interface or bay means of a GPS if they are in different locations.
- It is also possible to test the PTP compliance to G. 8261.1 and G.8271.1 that define the operating limits for distribution profiles for PTP frequency and phase using Ether.Genius.
- Another interesting experiment is the verification of MTIE, max |TE| or FPP.
- Net.Sync can be configured in emulation mode as PTP Grandmaster and slave PTP as well.

USERS

- Mobile Operators (3G, LTE)
- Universities, R+D centers
- Power Utilities labs
- PTP clocks vendors
- Telecom Integrators

KEY FEATURES

- 100% controlled by users
- Real Traffic conditions
- Real Ethernet / IP / E1 /T1
- Real PTP / Sync clocks
- Real Field testers
- Real Protocol Analysis
- Realistic telecom architecture
- Multiple test scenarios
- TDM and Packets included
- SyncE / PTP wander analysis and Generation
- FDP, TIE, TDEV, |TE|, max |TE|
- RFC2544, eSAM, 1-way delay
- Flow capture protocol check
- VLAN, MPLS SNMP support

BENEFITS

- Modular and customizable
- Hands-on Boundary, Transparent and Ordinary Clocks
- All fields are editable
- Veryfy, learn before install

Ethernet / IP / E1 / T1 / Datacom	
Interfaces	• 2 x SFP / SFP+ ports: 1000BASE-T, 1000BASE-SX, 1000BASE-LX, 1000BASE-ZX, 1000BASE-BX, 100BASE-FX, 100BASE-TX, 10BASE-T • 2 x RJ-45 port for electrical connection 10/100/1000BASE-T; PoE detection and PoE transparency • SMA-F: GNSS (GPS, GLONASS) • RJ45 and BNC: PPT, SyncE, PPS, ToD, E1, 2MHz, T1, 1.5MHz, 10MHz
Ethernet / IP Tests	• RFC 2544: Throughput, Frame-loss, Latency, Back-to-back, Recovery, Asymmetric RFC based on Ethernet and IP RMP • Y.1564: Ethernet service activation, Eight / four services (color / not) CIR, EIR, max, throughput, FTD, FDV, FLR, availability objectives • Loopback: Layer 1-4 loopback with Filtering conditions
ICMP	• RFC 792: IP ping / Traceroute, Generation of ICMP echo request: Dest. IP address, Packet length, Generation interval • Analysis of ICMP echo reply: Round trip time, Lost packets, Time-To-Live Exceeded, Port unreachable
E1 / T1	• BERT (G.826, G.821, and M.2100), Jitter & Wander (Overpass O.172, TIE, MTIE, TDEV), Pulse Mask
Datacom	• V.11/X.24, V.24/V.28, V.24/V.35, V.24/V.11 (V.36/RS449), EIA530 and EIA-530A
Statistics	• Top 16 talkers: Sour/Dest MAC / IPv4 / IPv6 addresses, VID (VLAN), C-VID (Q_in_Q), S-VID (MPLS) • Ethernet Frame Counts (RFC 2819): VLAN, Q-in-Q, Priority, Control, Pause, BPDUs • Tx/Rx Uni-Multi-Broadcast, Errors, Undersized, Oversized, Fragments, Jabbers, Runts, (Late) Collisions, Sizes, MPLS stack length • Bandwidth Statistics: (in bit/s, frame/s,%) Rate, Max, Min, Aver, Occupancy, Unicast, Multicast, Broadcast • IPv4 & IPv6 counts: (in bit/s, frame/s,%) Unicast, Multicast, Broadcast, Errors, TCP, UDP, ICMP

Synchronization surveillance	
Operation Modes	• PTP Clock: PTP Grandmaster (IEEE 1588v2), PTP Slave (IEEE 1588v2), GNSS Receiver, Synchronization input to timing output • Service Activation Methodology (ITU-T Y.1544), PTP / Ethernet appliance: Performance test (IEEE RFC2544), L1/L2/L3/L4 loop-back
PTP profiles	• Default (IEEE 1588v2), Frequency Delivery (ITU-T G.8265.1), Power Profile (IEEE C37.238-2011)
Timing Inputs (time references)	• Built-in GNSS receiver over SMA-F connector (GPS and GLONASS support) • Built-in Rubidium clock, OCXO; 1xPPS, 1xToD with NMEA format over RJ45 and BNC connectors • SyncE: ESMC and SSM decoding, double Port 1000BASE-T and 1000BASE-X • PTP (IEEE 1588v2): double Port 1000BASE-T and 1000BASE-X, E1/T1, 1544/2048 kbit/s, 1.544/2.048/10 MHz
Timing Outputs	• PTP Clock IEEE 1588v2, Synchronous Ethernet, E1, 2048 kbit/s, 2048 kHz, T1, 1544 kbit/s, 1544 kHz, 1 x PPS (over RJ45 and BNC)
Timing Accuracy	• Locked to GPS: timestamp ± 100 ns • Holdover: PPS to OCXO: Phase<±1.5ms then 1h; Freq.<16 ppb 1month, to Rubidium: Phase<±1.5ms then 24h; Freq.<16 ppb 5year
Timing Quality and Assurance	• Operation: Generation / Decoding of PTP, PTP Master / Slave operation, Transparent in pass-through mode • Protocol state: Port state, best master, identity, BMC priorities, clock class, accuracy, clock variance, time source • PTP Counts & statistics: Sync, Delay req, Delay resp, Peer delay req, Peer delay res, Follow up, Peer delay res. follow up, Announce • PTP Sync Floor Delay Population: FPC, FPR, FPP min and current; Configurable Pass / Fail threshold • PTP Wander analysis: TIE, MTIE, TDEV according to ITU-T G.8260, SyncE Analysis: Line frequency, offset, drift • Wander TIE / MTIE / TDEV (ITU-T O.172), Wander generation, QL in SSM decoding (G.781) • Asymmetric Delay Analysis: Two-way delay measurement, One-way delay measurement (Assisted by GNSS)

WAN emulation	
Filters	• Allows to select which is the traffic flow to be modified depending on several custom parameters • 16 blocks are arranged for filtering per each port (32 filters in total) • Filters based on IP address, MAC, Ethertype, VLAN, UDP port address and many others
Packet Impairments	• Delay: Single delay insertion [0ms - 60s], Uniform min /max. delay [0ms - 60s], Random exponential Mean and Mini delay (ms) • Jitter: Deterministic or random jitter using uniform and exponential distribution • Loss: Deterministic, Single loss, Burst Loss, Periodic Burst Loss, Random loss by a probability or two-state model of Gilbert-Elliot • Duplication: Traffic duplication defined by deterministic and random events • Error: Single error insertion, Constant error insertion defined by a probability
Traffic Shaping & Policing	• Shaping filter for bandwidth control. Not conforming frames are delayed. • Policing filter for bandwidth control. Not conforming frames are dropped

Packet Capture	
Filters (16+16)	• Generic Filters defined by 16-bit masks and user defined offset on Ethernet, IP, PTP, UDP, TCP, FTP and more • Pattern filter (one per port) to match alphanumeric words or expressions. Length filters to match frames by their length • Ethernet: MAC address, Ethertype value, VLAN-VID, VLAN-CoS, S-VLAN / C-VLAN, S-VLAN / C-VLAN CoS value with selection mask, DEI • IPv4: Address, Protocol in IP (TCP, UDP, Telnet, FTP, etc.), DSCP field, single value and range • IPv6: Address, IPv6 flow label and Next header field value, TCP/UDP port, single value or ranges, DSCP field, single value and range
Operation	• Tap & Filter: Packets are forwarded between line ports • Packets are selectively copied to the mirror ports • Packets are stored in an SD card or stored the internal high speed storage device SSD

Platform Racks and hand-helds	
Rack mounted (Net.Sync, Net.Hunter, Net.Storm)	• Management: SNMP, SSH, VNCSNMP, MIB and VNC remote control • Front Panel: Display: OLED, LEDs, Keypad, Console: RJ45, USB. Back Panel: Network and Time interfaces, Redundant Power Supply • Mechanical: Fanless, Size: 1¾"x10"x19" (ETSI 1U rack mount)
Hand-held (Ether.Genius)	• Touchscreen 480 x 272 TFT, Mouse, USB & Ethernet ports, • 1.0 kg, 223 x 144 x 65mm; Rechargeable Batteries, AC Power Adapter Input: 100 ~ 240 V AC, 50/60 Hz

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