**FTTH-GPON OLT Emulator with integrated Network Analyser**

### Features

**OLT Emulation**
Emulates OLT functionality, allowing to build specific provisioning models and configure OMCi entities individually and sequentially. It supports the injection of real traffic at 10Gbps/s at its “V” interface. Other OLT emulation features:
- Editable GTC header, including Bandwidth maps.
- CRC Errors insertion in GTC header fields, including PLOAM messages and Bandwidth maps.
- Controlled fragmentation and interleaving of GEM payload (GTCi and Ethernet).
- HEC/CRC Errors insertion in GEM headers and payload (OMC messages and ethernet frames).
- FEC errors insertion.

**Capture+Analyze+Evaluate in 1 click**
GPONDoctor™ 8000 gathers all control and management information from the PON and by using an smart analysis engine it is capable of inferring the network topology and verifying the ITU-T G.984.x recommendation level of compliance. Its automatic adaptive synchronization, automatic calibration and easy interface makes it ready to be used from the first day.

**Troubleshooting a GPON network**
Evaluates and detects problems in a GPON, identifying the origin of the malfunction and its source.

**Real time user traffic extraction**
GPON Doctor™ 8000 extracts, decrypts and reassembles user traffic at Ethernet layer, in real time. This traffic is made available at the 10/100/1000BaseT interface. Possible applications are: QoS/QoE monitoring, network performance and upper layer analysis. Its hardware decoder fully supports AES automatic decryption combined with FEC encoding.

**Service regeneration and QoS/QoE Evaluation**
GPON Doctor™ can regenerate services established over a PON network. Multicast video can be sniffed & reassembled in real time and played as in Customers’ premises. This feature is perfect to identify services optimum performance deviation over a PON.

**Real time GPON Capture**
GPON Doctor™ 8000 captures GTC and OMCi messages within the PON in Real Time. Highlighting negotiation processes and configurations, while showing the current status of ONTs, GEM and TCONT.

**Detailed diagrams of OMCi entities and BW allocation**
Easy to understand and complete entity-relation OMCi diagram, including alarms and errors. Bandwidth allocation per ONT and TCONT and its evolution in time. Real time Upstream bandwidth consumption per GEM port.

### Description

**GPON Doctor™ 8000** is an FTTH GPON OLT emulator, integrating a passive, chipset-less GPON protocol sniffer and analyzer. Connected to any location within your PON distribution network (ODN), will capture downstream and upstream bit-level information. Provides comprehensive analysis of the GTC layer: OAM, PLOAM, and OMCI.

GPON Doctor™ 8000 is mainly oriented for **ONT/ONU conformance and network interoperability tests**, being a perfect tool for lab application engineers engaged in GPON pre-deployment phase as well as for GPON network elements vendors.

GPON Doctor™ is a complete and autonomous solution: Composed by a GPON OLT emulation hardware, a capture and evaluator card, an “state of art” chassis and an smart processing software capable of analysing and evaluating the captured data.

As an OLT emulator, it is completely flexible, allowing to configure as many different provisioning models as desired. OMCI messages can be sent individually or grouping several of them in scripts.

The capture hardware includes last generation optical modules and powerful processing engine. Capable of synchronizing with the Downstream and Upstream data flow within the GPON and performing automatic calibration and long length captures. It also extracts and decrypts in real time Ethernet traffic that can be further used to regenerate services like video or VoIP.

The Analysis engine interprets the captured data and presents the results in an format understandable by the user, while allowing to find deviations from standard is a very easy and fast way. It also analyzes the content of the control information inferring the topology and state of a GPON network: ONTs detected, data channels established, configuration exchanged, OMCI E/R diagram, bandwidth analysis and graphics per every ONT and by TCONT.

Based in Windows XP Embedded, GPON Doctor™ can include (according to customer needs) other office and analyze tools for other service protocols used over GPON. Very intuitive and usable, with a very low learning curve that lets you start using it right from the start.
OLT Emulation

GPON-Doctor™ 8000 provides the same functionality as a GPON OLT. It is completely configurable and, by using different templates, any commercial OLTS behaviour can be emulated.

Highlights of the OLT emulation module:

- **Reception and report of events**, messages and alarms linked to the responses to each of the OMCI messages sent to the ONT,
- **OMCI master.** At OMCI level, the emulator behaviour can be programmed using **scripts or one by one. Messages for configuring OMCI entities in each ONT: Creation, Destruction, Reading, Writing, Test, etc.**
- **Generation of PLOAM message to perform different functions at GTC level:** Enable and Configure the GEM OMCC port, password authentication tests, etc.
- **Error injection**, to check the resiliency of a GPON under network malfunctioning circumstances: CRC errors in GTC header fields, including PLOAM, HEC/CRC errors in GEM headers and payload, FEC error insertion. Fragmentation manipulation, etc.

GPON Doctor™ 8000 supports the reception and transmission of traffic encapsulated in GEM frames, **carrying real Ethernet traffic through a 10Gbps transport interface.** Through this port, a traffic generator can be connected, and together with the capture and analysis module and its ability of real-time traffic extraction and analysis, enables the detection of traffic deviations within the data transmission among the ONTs and the OLT (Point of network with packet loss, error sources). This interface also supports various configurations for filtering and VLAN tagging both at ONT and OLT levels.

### Technical features of OLT emulation module

- Meets the requirements of ITU-T G.984.3
- GPON B+ SFP optical interface according to ITU-T G.984.2 standard. Supports Up to 60 Km range and 1:64 splitting ratio.
- Support for managing entities defined in ITU-T G. 988.
- 10Gbps XFP Ethernet transport Interface.
- OMCI creation messages using programmable templates
- Individual OMCI messages sending . TCL scripts for multiple OMCI messages and OLT configuration.
- OMCI master behaviour.
- Generation and forwarding of Real Ethernet traffic encapsulated in GEM frames
- Reception of asynchronous events and alarms from the ONTs
- PLOAM messages generation to activate and configure a detected ONT.
- Simultaneous management and monitoring of multiple ONTs
- Error injection and GEM encapsulation manipulation
- Supports 802.1ad, 802.1Q and 802.1p
Troubleshooting in PON and GPON networks
With the aim of widening ONTs offer, it is important that any OLT interoperates with all available ONUs in the market. However, GPON has a number of intrinsic characteristics that is currently making difficult to achieve the desired level of the interoperability:

- Coexistence of products with different standard versions.
- Problems during the activation process.
- Different ways of implementing the standards
- OMGI, a very broad and with "vendor specific" options.
- Heterogeneity among operators.

Furthermore, the structure of a PON network is a fibre that is further divided using optical power splitters. The "degree of splitting", defined as the number of divisions that the fibre goes through before reaching an ONT, determines the percentage of optical power arriving to that ONT. Attenuation in a GPON circuit can be very high due to the sum of fibre splitting, connectorization (Insertion loss), fusion splice, and distance in the fibre, and thus, some of the network active elements may be operating under stress conditions.

In order to reach the optimum performance state of a GPON network, during the deployment and maintenance, all causes of interference need to be debugged by tools like GPONDoctor 8000.

Non-invasive Capture
Once a Network is deployed, it is required that the usage of a test tool does not impact in its behaviour. Therefore, GPON-Doctor™ 8000 transparently sniffs traffic within a FTTH network. Moreover, its automatic calibration and stand alone configuration enables full capture of GPON network traffic without disturbing the communication between the OLT and ONTs.

The capture can be very long (e.g. 30 minutes) and allows captured data export to XML format for later analysis in desktop computers.

Smart Network analysis and evaluation
The smart analysis software interprets the captured data and translates it into a graphical and categorized format that can be easily used for in-depth analysis of GPON protocol conformance, interoperability evaluation, bandwidth assignments and field deployment troubleshooting.

The results from the GPON Doctor™ analysis enable the view of:

- GPON network topology: ONTs detected, ONTs and OLT operational status, data channels established,
- Entities created and the relationship among them,
- Bandwidth assignment graphics per ONT and TCONT,
- Degree of standard conformance, by applying an evaluation system for the ITU-T G.984.x protocol based on contextualized dynamic rules.

Real-time upper layer Ethernet traffic extraction
GPON-Doctor™ 8000 allows clear-text user traffic extraction in real-time for both upstream and downstream. The traffic is extracted at Ethernet layer.

This traffic can be further analysed by upper layer protocol analyzers, either external or by a software network protocol analyser installed within the GPON Doctor™.

The combination of the GPON Doctor™ 8000 with a traffic generator and an upper layers protocol analyser, is a powerful setup to verify the correct transmission of any data over the network.

This feature can be also used to regenerate services inside GPON Doctor™ 8000: Play Multicast Video flows, hear sound of voice services in realtime, analyze QoS & QoE.
Highlights

Start screen

Control traffic analysis GPON 984.3 y 984.4

ONTs GPON state (GTC and OMCI)

Entity-relation diagram of OMCI entities

Real Time Extraction using Industry standard application

Analysis of bandwidth per ONT and TCONT
Technical Specifications

**Application examples**

- Fundamental tool for GPON new network deployment, equipment development and certification
- Diagnosis and Analysis of events and deviations for already deployed GPON networks.
- Interoperability troubleshooting among different vendors equipment coexisting in a Telco access network.
- Evaluation of protocol compliance during the development of GPON OLTs and ONTs.
- Analysis of user traffic within the GPON Networks through its Ethernet interface.
- GPON 984.x interoperability test.
- GPON problems delimiting within an FTTH network.
- Knowledge of the Network state and all its active elements (ONTs).

**Technical features**

- GPON OLT Emulator (fully configurable)
- Capture OAM + PLOAM control data and OMCI messages (full support)
- Real Time PLOAM + OMCI + Negotiation messages capture
- Low attenuation (<1.5 dB) internal fibre tap module, perfect for field environment or optical lab analysis.
- Infers the GTC machines in ONTs state and the ONTs OMCI entitles state/value
- Infers network topology: ONU/ONTs, OLT
- Evaluation of the compliance degree with the ITU-G.984.x standard, generating a list of standard inconsistencies and violations
- Bandwidth allocation distribution analysis and Bandwidth real consumption in upstream
- Real Time Service regeneration and monitoring: Multicast Video, Voice
- Long duration captures (~30 minutes).
- Automatic calibration.
- Real time upper layer Ethernet traffic extraction
- Windows XP Embedded Operating System
- Automatic behaviour: capture, analyse and evaluate in one click
- Captures storage for further analysis by the GPON-Doctor™
- Hardware/software customization upon request

**Interfaces**

- Touch screen (High definition colour TFT, 12”, 1280x800)
- 2xGigabit Ethernet Capture/Management modules: QinQ Transparent/Stripping configurable
- Gigabit Ethernet over GPON Real Time Extraction port: External network protocol analyser plug in
- 6x USB 2.0 to easy transfer data, traces and reports export

**GPON capture interfaces:**

- Downstream: SFP Single Mode 1490nm (2.5Gbps) module. SM 1310nm optional
- Upstream: Single Mode 1310nm (1.25Gbps)