**DESCRIPTION**

**FTTH Test lab automation:**
Towards the path of excellence

- **Current certification process has a high portion of “Waste”** (there are too many manual intervention and a lot of lab resources underused).
- **Manual execution of a Test Plan** takes a long time (usually several weeks) where 70% of committed time is devoted to tasks with less value added (i.e. resources set up and test plan execution). Due to time pressure, there is a high risk of lack of dedication to tasks of greater added value that lead to a growth in the likelihood of “diagnostic error”.

### Current testing drawbacks

<table>
<thead>
<tr>
<th>Inaccuracy</th>
<th>Subjective</th>
<th>Days/TCs</th>
<th>No TCs for stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Results not repeatable</td>
<td>Unstable Test Efficiency</td>
<td>Problems to meet deadlines</td>
<td>Poor Test Coverage</td>
</tr>
</tbody>
</table>

An **automated testing tool** is able to playback pre-recorded and pre-defined actions compare the results to the expected behavior and report the success or failure to a testing engineer. Automated tests can be easily be repeated and extended to perform tasks impossible with manual testing.

**FTTH Test Lab Automation:**
Moving from WASTE TO VALUE

The automation of all tasks related to resources set up, T-REX es FTTH GPON Test Lab Automation test plan execution and test report generation has a drastic impact on Test plan completion time. What it took weeks, now are hours (less than one day). These savings in time will lead to a continuous pursuit of perfection (better Test Plans) and staff recognised professional roles (Test Plan designers and Test results).

**GPONDoctor Test Automation solution, T-REX** is a powerful and affordable automated software-testing tool that is supported on all GPONDoctor products. It addresses the full range of CPE/ONU testing challenges that FTTH operators (QA engineers) have to deal with.
BENEFITS

To an Optimized Certification process

• Current certification process has a high portion of "Waste" (Excess manual intervention, very high resource waiting times).
• Risk of lack of dedication to tasks of greater added value and therefore increase the likelihood of "diagnostic error".
• LEAN methodology typical scenario (prioritize Action, continuous pursuit of perfection and staff new role).

With improvements thanks to automation in both ONU tests...

And OLTs interoperability...

<table>
<thead>
<tr>
<th>Task</th>
<th>Automation Degree</th>
<th>Time Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profiles &amp; Documentation</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>General Tests</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Boundaries</td>
<td>50%</td>
<td>65%</td>
</tr>
<tr>
<td>Protocols</td>
<td>80%</td>
<td>75%</td>
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</tr>
<tr>
<td>Security</td>
<td>50%</td>
<td>65%</td>
</tr>
<tr>
<td>IOT</td>
<td>100%</td>
<td>50%</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>40%</td>
</tr>
</tbody>
</table>

Foreseen benefits: ONTs’ Tests

- Test time is reduced due to a decrease in actions that demand human intervention.
- Total Testing time is reduced in a 40%.
- Productivity rise due to 60% Test Plan automation.
- Plus additional capacity as it is available 24×7.
- Very easy to run complex Test Cases -No need to be an expert.
- Productivity is increased in a factor of x2.

Additional improvements

- Test Equipment consolidation located in multiple places.
- Host multiple providers while keeping privacy (i.e. Alcatel-Lucent, Huawei, ZTE).
- Segregated access for each Test team (from the own company or external) so they can work in parallel.
- Resource reservation management mechanism with an approval scheme.
- Equipment usage test with the option to be invoicedper consumption.
- Report generation adapted to different profiles (management, technicians, DUT providers, etc.).
For those with needs to launch new devices, services and network features as well as to improve the Quality of Service and Quality of Experience. GPONDoctor T-REX, can "help" to define Test Plans, requirements, device acceptance process, policies and procedures as well as Test environments.

GPON ONUs’ Manufacturers

GPONDoctor T-REX will help them to demonstrate that their solution is 100% compatible with the standards and with the systems their customers already have. It is also a suitable tool for validation check during production.

GPON OLTs’ Manufacturers

GPONDoctor T-REX will help them to troubleshoot in Multi vendor environments, in order to verify other parties ONUs interoperability with manufacturer OLT products and Firmware releases.

No matter whether you are system vendors, Customer devices manufacturers or Application/ Network Services providers, your Test Plans will be automated by one of our T-REX solution. Just focus on tasks that provide value to your company, T-REX will take care of the rest.

HOW IT WORKS

GPONDoctor T-REX is a Test automation platform that orchestrates a lab infrastructure topology where pre-defined Test plans are executed. Results are collected from all the testing elements involved and compared against validation criteria to determine a PASS/FAIL. Different level reports are also generated automatically.

Broadband Connectivity Services (Access Network Providers)

Their main concern is to guarantee the Quality of the connection pipes in terms of Bandwidth, Jitter and Delay as lack of compliance could lead them to serious problems with their customers – the Retailers. GPONDoctor T-REX will help them to achieve full interoperability and performance among all the devices involved in the communication in "hours instead of weeks".

Service Providers (IPTV, VoIP and HSI)

Their main concern is that their users enjoy the services always with the best quality (satisfying the Service Level Agreement). GPONDoctor T-REX will help them to check “Services” level of support of their Customer Premises Equipment (against "Emulated" or "Real" Services platforms). Their Test Plans usually involved “functional test cases”.

WholeSale Providers

They are the combination of a Network Service Provider (NSP) and an Application Service Provider (ASP) and thus providing Triple play services as well as connectivity pipes. GPONDoctor T-REX will provide them a combination Test lab for conformity, interoperability, and performance as well as functional for Service support.

GPONDoctor T-REX has two kind of users:

• Automation Producers: From a pre-defined set of testing resources stored in the block repository, they are in charge in the implementation of the Test Cases that are part of each Test Plan to be executed by T-REX.
• Automation Consumers: In charge to load Test plans into the system, schedule their execution and collecting the results and reports.
Physical Topology Orchestration

**GPONDoctor T-REX** will provide all the APIs needed to control all the devices involved in the Test Plan, including OLTs, Optical Matrix, Switches, Traffic Generators/Testers, GPON Testers, Variable Optical Attenuators, IP Power units, ONUs/ONTs, Home Gateway Units, CPEs, ACS and many others. All of them are controlled from a central server and will be provided with the proper configuration according to the specifics of each test case.

Test Execution Orchestration

Once the Test Plan is loaded in the system, **GPONDoctor T-REX** will get from the Configuration Repository the devices involved in each Test Case as well as the Validation Criteria. It communicates with the Topology orchestration module in order to setup all the devices involved accordingly while the Test Case is being executed. All the data generated during this process is tested and compared with the expected results and finally a report is generated and stored in the “Results Repository” together with the tested data. Once a Test Case is completed the next will be executed until all associated to the Test Plan are finalised.

Customized Report Generation

**GPONDoctor T-REX** is able to generate different types of Reports, from very intuitive where at a glance it is possible to see the Test plan/associated Test Cases/PASS-FAIL. To very detailed reports where it is possible to access to all data generated during the execution of the Test Case in order to find out the issues that have led the Test Case to FAIL.

Teams working in parallel

**GPONDoctor T-REX** allows several teams working in parallel, even combinations of Test automation producers and Test automation consumers. It is also possible to run the Test Plan and consult the results REMOTELY.

Absolute Providers’ Segregation

**GPONDoctor T-REX** guarantees Absolute Providers’ Segregation. Device manufacturers could access ONLY to the results of their device under test completely isolated from the other manufacturers.
T-REX 247 automation module. Advances, easy to use automation solution for testing GPON ONU standards conformance to a defined set of Broadband Forum TR-156 requirements and the related recommendations from appendix I & II of ITU-T G.988. Includes the test cases for GPON equipment functionality and implementation of OMCI protocol. Test Cases as defined in BBF.247.

**ONU conformance test cases:**

### Classification and Tagging

- Single untagged U-interface
- Single U-interface with symmetric VLAN tag translation
- Deriving p-bits as a function of received P-bits (single user port)
- Addition of an S-Tag in the Upstream Direction in a VBES Architecture
- Validation of an S-Tag in the Upstream Direction in a VBES Architecture
- Translation of an S-Tag in the Upstream Direction in a VBES Architecture
- Removal of an S-Tag in the Downstream Direction in a VBES Architecture
- Translation of an S-Tag in the Downstream Direction in a VBES Architecture
- Deriving p-bits as a function of received VID (single user port)
- Deriving p-bits as a function of received Ethertype (single user port)
- VID Support for Untagged Frames. N:1 or 1:1 VLAN Architecture Single-Tagged at the V Interface
- VID Support for Untagged Frames. 1:1 VLAN Architecture Double-Tagged at the V Interface
- VID Support for Priority Tagged Frames with Priority Preservation. N:1 VLAN Architecture Double-Tagged at the V Interface
- VID Support for Priority Tagged Frames without Priority Preservation. N:1 VLAN Architecture Double-Tagged at the V Interface
- ONU addition and removal of C-Tag for 1:1 VLANS
- ONU addition and removal of S-Tag for 1:1 VLANS
- ONU translation between Q-Tag and C-Tag for 1:1 VLANS
- ONU translation between Q-Tag and S-Tag for 1:1 VLANS
- Deriving P-bits as a function of received P-bits for a VBES architecture (single user port)
- Deriving P-bits as a function of received VID for a 1:1 or N:1 architecture (single user port)

### Frame Mapping and QoS

- Single U-interface with multiple downstream GEM ports
- User Isolation on ONU Devices with Multiple U-interfaces
- Mapping Traffic from GEM Ports to U Interface in the Downstream Direction in a VBES Architecture
- Mapping traffic into GEM Ports based on P-bit values in the upstream direction (single user port)
- Mapping traffic into GEM Ports based on VID values in the upstream direction (single user port)
- Mapping traffic into GEM Ports based on VID & p-bit values in the upstream direction (single user port)
- Mapping traffic into GEM Ports based on VID values in the upstream direction (multiple user port)
- Mapping traffic into GEM Ports based on VID & p-bit values in the upstream direction (multiple user port)
- Mapping multiple p-bit values to the same GEM port (single user port)
- Mapping Traffic from GEM Ports to Multiple U Interfaces in the Downstream Direction (VBES)
- Mapping Traffic from GEM Ports to Multiple U Interfaces in the Downstream Direction (1:1 VLAN Architecture)

### IGMP Controlled Multicast

- ONU passing of downstream IGMP messages
- ONU silent discarding of IGMPv1 messages
T-Rex ONT Conformance

Marking Upstream IGMP Messages with Ethernet P-Bits
- IGMP controlled Multicast
- Multicast White List
- IGMP rate limit
- IGMP immediate leave
- Maximum number of multicast flows
- IGMP transparent Snooping
- Multicast VLAN membership based on user ports (Multiple User ports)
- IGMP transparent Snooping (Multiple User ports)
- IGMP transparent Forwarding

Failed Software Image Download, incorrect software
- Activate uncommitted software image
- Commit software image

Performance - QoS
- Strict priority downstream scheduling among 4 queues on ONU
- Indicating drop precedence using p-bits upstream
- Indicating drop precedence using DEI bit upstream
- Indicating drop precedence using p-bits downstream
- Indicating drop precedence using DEI bit downstream

Non-IGMP Controlled Multicast and Broadcast
- Downstream Broadcast Handling, Single U-interface
- Downstream Broadcast Handling, Multiple U-interfaces

TR-156 Other
- 2000-Byte Frames Supported by the ONU

Initial Provisioning of ONU
- Local setting of a registration ID at the ONU (ONU retains the Registration ID indefinitely)

ONU Bring-Up
- New ONU Bring-up method on new ONU
- New ONU Bring-up method for old ONU
- Old ONU Bring-up method for ONU
- New ONU Bring-up method for new ONU with encrypted OMCC

MIB and Alarm Synchronization
- Alarm synchronization
- MIB synchronization : Correct Data Sync
- MIB synchronization : MIB Upload

Software Image Download
- Software Image Download, multiple window sizes, padded final window
- Software Image Download, shortened final window
- Failed Software Image Download, missing section

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