Tackling the Challenges of Next-Generation Fiber Deployments

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Agenda

- OTDR best practices for FTTx, data center and structured cabling applications
- The OTDRs of 2018: software assisted and network connected instruments
- Coffee Break
- VIAVI Fiber Optics portfolio overview
- Hands on session
- Q&A
Tech Trends

- 5G - IoT - Smart Home - Self drive cars – eHealth – 4K video - Gigabit to the Home…

- 100G reaching mainstream deployment phase
- Next Gen PON around the corner
- Next Gen access DOCSIS & G.Fast
- C-RAN deployment (DAS to C-RAN migration)
- 100G/400G in Data Center and MPO Enterprise
- FTTH densification – MPO fiber – higher split ratio
## Viavi OTDR Market Trend

<table>
<thead>
<tr>
<th>Market segment</th>
<th>Customer needs</th>
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</table>
| Enterprise / Data Center| - Workflow / data management (reporting)  
                          - MPO Testing (High-Res OTDR) especially in Data Centers  
                          - Simplified UI and result interpretation  
                          - PO-LAN                                                                                                    |
| Access/FTTH             | - Simplified UI and result interpretation  
                          - Measurement reliability through PON splitter  
                          - Price sensitive, fast time to market  
                          - Workflow / tablet / reporting (Vz, Orange, RJO, BT)  
                          - NGPON2 with up to 1x128 splitting ratio                                                                 |
| Wireless                | - xWDM upgrade: CWDM phase #1 and DWDM phase #2  
                          - CPRI tap / C-RAN  
                          - DAS Workflow                                                                                              |
| CATV                    | - DWDM upgrade of CWDM  
                          - EPON/GPON                                                                                                   |
| Metro/Long-haul         | - Coherent OTDR for submarine links                                                                                                                     |
| NEMs / FED              | - Very short link testing / jumper (High Res OTDR (SM & MM))  
                          - Tight wavelength specifications  
                          - Workflow with MAP switch                                                                                   |
| Aerospace / Avionic     | - Very short link testing / jumper (High Res OTDR (SM & MM))  
                          - Plastic fiber                                                                                             |
High Speed Broadband solutions

- **ADSL & ADSL2+**: 20Mb/s
- **VDSL2 (Bonded)**: 100 – 200 Mb/s Super Vectoring
- **VDSL (Vectorized)**: 250Mbps - 1Gb/s G.fast
- **G.FAST**
- **DSLAM**
- **FTTH**: 2.5Gb/s + FTTH

**RFCoG**
- **HFC – DOCSIS 3.1 – Fiber Deep**
Passive Optical Network (PON)

- Distributed system architecture (point to multi-points)
- Downstream data is transmitted to all ONTs
- Data is filtered based on port ID
- Upstream uses Time Division Multiple Access (TDMA)
- The OLT controls the upstream channel by assigning a different time slot to each ONT
High Speed Broadband solutions

- **ADSL & ADSL2+**
  - 20Mb/s

- **VDSL2** (Bonded)
  - 100 – 200 Mb/s Super Vectoring

- **VDSL2** (Vectored)
  - 250Mbps-1Gb/s G.fast

- **G.FAST**
  - 2.5Gb/s + FTTH

- **FTTH GPON**

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**RFoG**

**HFC – DOCSIS 3.1 – Fiber Deep**
Existing PON Architectures

ITU Standard Abstract

- The larger the split ratio, the more attractive for the service provider.
- Split ratio of up to 1x64 is realistic for the physical layer, with the current technology.

- Single Split

- Cascaded Split

Optimized speed per customer

Densification but limited bit rate per customer
Typical Fiber Values

- **Attenuation Loss (dB/km)**
  - 1550nm (singlemode) 0.2 dB/km
  - 1310nm (singlemode) 0.35 dB/km

- **Event Loss (dB)**
  - Fusion splice 0.05 dB
  - Mechanical splice 0.3 dB
  - Connector pair (FOTP-34) 0.5 dB

- **Reflectance (dB)**
  - PC connector -55 dB
  - APC connector up to -65 dB

- **Macro bend**
  - varies w/ degree of bend and wavelength

- **Fiber End or Break (Reflectance)**
  - PC to open air -14 dB
  - APC to open air -35 dB

- **Splitter Loss**

<table>
<thead>
<tr>
<th>Split</th>
<th>Typical Insertion Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 : 2</td>
<td>3-4 dB</td>
</tr>
<tr>
<td>1 : 4</td>
<td>8-9 dB</td>
</tr>
<tr>
<td>1 : 8</td>
<td>10-11 dB</td>
</tr>
<tr>
<td>1 : 16</td>
<td>12-13 dB</td>
</tr>
<tr>
<td>1 : 32</td>
<td>16-17 dB</td>
</tr>
</tbody>
</table>

**Tech Tips**

- Inspect before you connect – IBYC
- ORL
  - if in 20’s that’s bad
  - >30dB ok, often >40 to 45dB
- Macro bend
  - Loss higher with longer wavelength
- **Splitter loss estimate**
  - 3dB per 1:X splitter
  - Use “2 to the power of”
    - 1:2= 3dB
    - 1:8= 9dB (2 to 3rd power= 3dB*3=9dB)
    - 1:32= 15dB (2 to 5th power= 3dB*5=15dB)
Next Generation PON Standards

- Limitations with current G-PON/GE-PON standards
- Standards have been defined by ITU & IEEE:

<table>
<thead>
<tr>
<th></th>
<th>G-PON</th>
<th>XGS-PON (sym)</th>
<th>NG-PON2</th>
<th>GE-PON</th>
<th>10G-EPON</th>
<th>100G-EPON</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DS / US Data Rates</strong></td>
<td>2.4 / 1.2 GBps</td>
<td>10 / 10 GBps</td>
<td>40 / 10 GBps</td>
<td>1.25/1.25 GBps</td>
<td>10 / 10 GBps</td>
<td>Up to 100 /100</td>
</tr>
<tr>
<td><strong>Splitting Ratio</strong></td>
<td>up to 1:64 (128)</td>
<td>up to 1:128 (256)</td>
<td>up to 1:64</td>
<td>up to 1:128</td>
<td>Tbd</td>
<td></td>
</tr>
<tr>
<td><strong>Fiber Type</strong></td>
<td>G.652</td>
<td>G.652 / G.657 (for new inst.)</td>
<td>G.652</td>
<td>G.652 / G.657 (for new inst.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Max Loss</strong></td>
<td>32 dB</td>
<td>35 dB</td>
<td>35 dB</td>
<td>29 dB</td>
<td>29 dB</td>
<td>Tbd</td>
</tr>
<tr>
<td><strong>Co-existence</strong></td>
<td>N/A</td>
<td>YES with G-PON</td>
<td>N/A</td>
<td>Yes with GE-PON</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PON Wavelengths Allocation

- Today’s GPON systems utilize 2 wavelengths for communication
  - Downstream 2.5 Gbps at 1490 nm & upstream 1.2 Gbps at 1310 nm

- Overlay of 2 new λ for 10 Gbps services of XGS-PON
  - Downstream 10 Gbps at 1578 nm & upstream 10 Gbps at 1270 nm

- NG-PON2 supports multiple 10Gbps wavelengths
  - Downstream 40 (up to 80) GBps at 4 (up to 8) TWDM wavelengths between 1598 – 1603 nm
  - Upstream 10 (up to 20 GBps) at 4 (up to 8) TWDM wavelengths between 1524 – 1544 nm

- Additional window for high speed PtP WDM channels: 1603 – 1625 nm

- RF overlay at 1550 nm is not impacted by PON service

Source: FTTH EMEA D&O Committee FTTH Poland 2018
GPON Architecture

**GPON**

- **Downstream**: 1490nm
- **Upstream**: 1310nm

**Central Office**

- G-PON OLT
- RF Video
  - Video AMP

**WDM**

**Drop Terminal**

**Passive Splitter**

**Drop Terminal**

**Feeder fiber**

**Distribution fibers**

1490nm and 1550nm wavelengths for GPON.
Coexistence Architecture

**GPON**
- Downstream: 1490nm, 1550nm
- Upstream: 1310nm

**XGS-PON**
- Downstream: 1578nm
- Upstream: 1270nm

**NG-PON2**
- Downstream: 1596-1603 nm
- Upstream: 1528-1540 nm

CEx: coexistence element
WM: Wavelength Multiplexer
Best Practices and Lessons Learned
FTTx network deployment and maintenance
Service Provider Experiences shared with Viavi

- In “real life” fibres are installed in harsh environments
  (dirty cellars, next to water/gas pipes, …)
- Easy and robust installation required
  (fibres with reduced bend sensitivity, pre-assembled cables, …)
- Workflow efficiency is critical to achieve fast, profitable deployment. *No re-visits!*
- There are insufficient fibre experts available for a realistic FTTx roll out
  - Test instruments need to be super simple to use without special training
- Tight control and management of contractors required
Current and Next Generation PON Challenges

Challenges
1. Connector cleanliness
2. Transposed Fibers
3. Split ratio: up to 1:128 (1:256 max) - cascaded splitters
4. More complex network elements (CEx, WDM)
5. Signal wavelengths in L-Band (tighter bend constraints)

Constraints
1. Time - large amount of fiber optic connectors to be tested
2. Incorrect ONT allocation
3. Loss budget
4. Not enough fiber experts/Many different contractors
5. Fiber laying and handling

Impacts
1. Poor installation – Delay in rollout planning
2. Failing to turn up customer services
3. Service failures due to excess optic loss and network evolutions
4. Customer churn
Points of Vulnerability in an FTTH network

- **Low vulnerability**
  - But will affect many customers

- **Low to Medium vulnerability**

- **High vulnerability**
  - Many interactions

- **Central Office OLT**
- **Primary FCP**
  - **Splitter 1**
  - **Cross Connection**
  - **Faulty Splitter**
  - **Dirty Connector**

- **Secondary FCP**
  - **Drop Terminal**

- **Drop**
  - **ONT**

- **Customer Premise**

- **Access Node**
  - **Feeder**

- **Macro bend**
- **Micro bend**
- **Bad Splice**
- **Faulty Splice**
- **Fiber Break**
- **Alien/Rogue ONTs!**
- **Damaged / Dirty Connector**
- **Cross Connection**
In a study by NTT-Advanced Technology, 98% of installers (blue) and 80% of network owners (red) reported that issues with connector contamination was the greatest cause of network failure.
Fiber Management is Key

Looking for small changes – fiber management matters!

- [Image of fiber management examples]

- [Graphs showing fiber management improvements]

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Bending Constraints – Impact on Next Gen PON

- XGS-PON or NG-PON2 new construction is similar to G-PON with a special focus on loss induced by fiber bending

- Longer wavelengths -> higher sensitivity to macrobend (in house cabling !)

➢ Use of G.657B bend insensitive fiber (works down to 10 mm radius)

➢ ODN characterization at 1625 nm will become a strong requirement
Patching Customers Correctly

- If continuity is not checked during installation phase:
  - Incorrect connections will not be found until ONT is turned-up -> dispatch
  - A customer who has been patched incorrectly might be brought down-> customer dissatisfaction
- Continuity tests reduce OPEX and customer dissatisfaction

Implement a continuity test during installation phase
FTTx Mass Roll Out

- Not enough qualified fiber optic work force for
  - Installation
  - Turn Up
  - Troubleshooting

- Enormous demand for training

- Challenge for field efficiency
  - Fully automatic super simple to use testers ("instrument adapts to user‘s skill set")
  - Shortest test set up and test time
  - Pass/fail analysis vs. subjective analysis
  - Advanced test documentation including data for the experts
  - Instruments/Tools need to adapt to the real workflow – starts with IBYC
Requirements:
- Test from ONT to the CO
- Filtered OTDR if live network
- Splitter identification
- Short deadzones
- High dynamic range to power through splitters, distance

1625 vs. 1650nm
- 1625nm OTDR good for GPON but not future proof
- 1650nm mandatory for NG-PON2
Challenges and Mitigations Summary

• Harsh environment
  • Reliability and environmental testing on all network components during production/assembly
    e.g. IL/ORL over temperature /over time

• Fiber Link Parameters required by Network-Elements (OLTs/ONUs)
  • Max Loss Budget → IL measurement of entire link (fiber, connectors, splices, splitters)
  • High ORL crucial with RF overlay
  • Fiber bends, bad connectors/splices → detection with OTDRs

• Network continuity
  • Proper Network documentation
  • Proper Fiber routing

• Quality of Service – Customer Experience
  • Shortest Repair Time demanded
  • In-Service test tools
  • Optical Monitoring Systems to identify class of failure and location
Test Solutions
### Current and Next Gen PON Test Solutions

#### Challenges
- Connector cleanliness
- Transposed Fibers
- Split ratio: up to 1:128 (1:256 max)/cascaded splitters
- More complex network elements (Cex, WDM)
- Signal wavelengths in L-Band (tighter bend constraints)

#### Constraints
- Large amount of fiber optic connectors to be tested
- Incorrect ONT allocation
- Loss budget
- Not enough fiber experts/Many different contractors
- Fiber laying and handling

#### Impacts
- Poor installation – Delay in rollout planning
- Failing to turn up customer services
- Service failures due to excess loss and network evolutions
- Customer churn

#### Solutions
- Inspect before you connect™
- Proper qualification and documentation of the optical distribution network (ODN)
- Ensure multi-wavelength power levels meet specification
- Appropriate in-service troubleshooting tools
- Centralized monitoring
- Documentation readiness (cloud-based)
Inspect Before You Connect!

Fiber inspection/cleaning of the patch cord and bulkhead sides are SIMPLE steps with immense benefits. Connectors behind the bulkhead are frequently dirty and problematic.

1. Inspect  
2. Clean  
3. Re-inspect  
4. Connect

Dirt, oil, pits, scratches not seen  
SUBJECTIVE INSPECTION

IEC 61300-3-35 Sets Requirements for Connector Quality
FTTH Construction - IL/ORL + OTDR Qualification
Feeder Testing: Unidir OTDR, Bidir IL/ORL

Two Man Team

One Man Team
Construction Acceptance Testing – End-to-end FiberComplete

Perform all fundamental fiber qualification tests required tests…

- Continuity Check
- Bi-Dir Insertion Loss (IL) 1310/1550nm
- Bi-Dir Optical Return Loss (ORL) 1310/1550nm
- OTDR event qualification: splices, connectors and splitters
- Distance to fault
FTTH Installation – Cascaded splitters

- Test through splitters with the OTDR to provide:
  - Insertion loss measurement (use of launch and receive cables of 20m)
  - Splitter characterization
  - Overall link length

- Construction is done by contractors, requires a simple OTDR test mode
- Solution set: FTTH-SLM with PON OTDR module
Managing in High-Count Fiber Testing

- Lots of potential setting errors in the field
- Missing test data – skipped fibers/retrieving files
- Misunderstanding of required methods and procedures
  - Difficult to ensure field techs running test as per expectations

- Management of a multi-fiber testing and cable commissioning project (e.g. FTTH drops)
- Manage testing against pre-defined procedures
- Permanent track of progress
- Reduce manipulation errors with automated test sequences
PON Service Activation Testing

- Wavelength selective power measurements
  - PON-OPM
- Upstream channel only activated by downstream signal
  - Through mode testing

Central Office

- RF Video
- GPON OLT
- XGS-PON OLT
- NGPON2 OLT (TWDM)

CE: coexistence element

G-OLT

通过模式测试

通过模式 OPM

通过模式测试

通过模式 OPM
OLP-88 TruePON Analyzer

- PON power level (1310, 1490, 1550nm) measurements with auto pass/fail analysis
- Verification of ONU/ONT activation process & serial number Identification
- Detection of Rogue ONUs/ONTs and Alien devices
- PON-ID Frame Analyzer (ODN class, TOL, ..)
FTTx/PON Power Meter Portfolio

OLP-37 Terminated PON-PM
- E/G-PON: λ-selective PM
  DS: 1490/1550nm (1610nm RFOG)

OLP-87 PON-PM
- E/G-PON: λ-selective /through mode PM
  DS: 1490/1550nm + US: 1310nm
- E/G-PON / XG-PON: λ-sel/through mode PM
  DS: 1490/1550/1578nm + US: 1270/1310nm
- E/G-PON / NG-PON2: λ-sel/thr-mode PM
  DS: 1490/1550/1596-1603nm
  US: 1310/1524-1544nm
- Fiber Inspection

OLP-88 TruePON Analyzer
- E/GP-ON: λ-sel. / through mode PM
  DS: 1490/1550nm + US: 1310nmwower
- ONT- and OLT-identification
- Verification of service activation status
- Alien/Rogue-ONU detection
- In-service loss testing
- Fiber Inspection

SmartOTDR 118FA65PPM
Terminated PON PM
- E/G-PON / XG-PON: λ-sel. PM
  DS: 1490/1550/1578nm
PON OTDR for Troubleshooting

- Out-of-band fault finding without disturbing the traffic with the use of filtered 1625nm or 1650nm wavelength
- Detect all events before and after the splitter(s)
- Pass/Fail thresholds per PON standards
## Tool Sets

### Construction Phase

<table>
<thead>
<tr>
<th>Inspection Scope</th>
<th>Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector end face certification</td>
<td>Fiber characterization</td>
</tr>
<tr>
<td></td>
<td>fiber, splices, connectors, splitters</td>
</tr>
<tr>
<td>Qualification of installed equipment</td>
<td>OLTS, ORL (Bi-dir)</td>
</tr>
<tr>
<td></td>
<td>– optical loss test, optical return loss test including 1625nm</td>
</tr>
<tr>
<td></td>
<td>wavelength</td>
</tr>
<tr>
<td>Documentation and reporting</td>
<td>Instrument / Cloud</td>
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### Service Activation Phase

<table>
<thead>
<tr>
<th>Inspection Scope</th>
<th>Scope</th>
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<tbody>
<tr>
<td>Connector end face verification</td>
<td>Downstream &amp; upstream power measurements with multi-wavelength</td>
</tr>
<tr>
<td></td>
<td>selective power meter</td>
</tr>
<tr>
<td></td>
<td>• GPON</td>
</tr>
<tr>
<td></td>
<td>• XGS-PON</td>
</tr>
<tr>
<td></td>
<td>• NG-PON2</td>
</tr>
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<td>Documentation and reporting</td>
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### Troubleshooting Phase

<table>
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<th>Inspection Scope</th>
<th>Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector end face verification</td>
<td>In-Service 1650nm PON OTDR</td>
</tr>
<tr>
<td>In-Service 1650nm PON OTDR</td>
<td>PON OTDR &amp; OPM</td>
</tr>
</tbody>
</table>
Guidelines Summary

• Proper care of fiber cabling
  - Dressing of cables
    • Avoid bends, crushing, etc
  - Capping unconnected fibers
  - Inspect Before You Connect

• Having, and following established procedures – consistency of contract and internal work force

• Cable layout – documentation of as-built with “birth certificate”

• Correct routing of fibers – from splitter and hub (PON-ID)

• Technical skills/training – pre-defined test procedures, including pass/fail criteria and set-up parameters.
OTDR Portfolio by Network Application

- **Last Mile**
  - E126A
  - E4126LA
  - E4123MM
  - E4146QUAD
  - E81xxA

- **LAN/WAN**
  - E81xxB

- **Data Center**
  - E138FA
  - E118FA65
  - E126B
  - E136FB

- **Short Access**
  - E138FA
  - E118FA65
  - E126B
  - E136FB

- **PON**
  - E41xxMA2
  - E41xxMA3
  - E41xxMP2

- **Metro**
  - E41xxMP2

- **Long-Haul**
  - E41xxMP2

- **Ultra Long-Haul**
  - E41xWDM

- **xWDM**
Viavi SmartOTDR Portfolio

Last Mile/Access PON

126A
138FA65
118FA65

Installation
Installation Maintenance

Maintenance

Metro PON

126B
136FB

SLM, FTTH-SLM and Cable-SLM Ready
Modular Handheld Platforms: MTS-2000/4000

MTS-2000 Platform

- Hands-free modular test set for the installation, turn-up and maintenance of fiber optic networks
- Built for simplicity - Smarter and faster field testing with simple setup and instantaneous pass/fail results
- Widest range of FiberTest Apps:
  - OTDR
  - FiberComplete™ IL/ORL
  - CWDM analyzer
  - PON Selective power meter
  - Connector inspection with IEC pass/fail analysis

MTS-4000 Platform

- Modular handheld test set for all-in-one Access/FTTx network and triple-play services installation and maintenance
- Dual slot capability enables to lowers cost by combining multiple test sets in one single box (ex: OTDR + PON selective power meter)
- Large 7inch display for better results viewing
What is the new 4100-Series Family

<table>
<thead>
<tr>
<th>Previous OTDR Family</th>
<th>New OTDR Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>6K EVO C - 45/45 dB</td>
<td>MP2 FCO – 46/45 dB</td>
</tr>
<tr>
<td>MP2 – 45/43 dB (STD)</td>
<td>MP2 – 45/43 dB (+PON)</td>
</tr>
<tr>
<td>MP/MPFCO – 43 dB</td>
<td>MA3/MA3FCO – 43/42 dB</td>
</tr>
<tr>
<td>QUAD – 37 dB</td>
<td>QUAD – 37 dB</td>
</tr>
<tr>
<td>MA/MAFCO – 40 dB</td>
<td>MA2 – 40/40 dB</td>
</tr>
<tr>
<td>LA - 35 dB</td>
<td>LA - 35 dB</td>
</tr>
</tbody>
</table>

**MP2 OTDR (Metro/Long-Haul)**
- P2P & P2MP Applications
- CW Source standard
- Power Meter optional
- P2P: Best Dead Zones (65cm EDZ, 2.5m ADZ)
- P2MP: Test splitter up to 1x128
- P2MP: Best SADZ <35m on 16 dB loss (1x32)
- Filtered version with 2 ports / APC only

**MA3 OTDR (FTTH)**
- P2PM Applications
- CW Source standard
- Power Meter optional
- Best Dead Zones (65cm EDZ, 2.5m ADZ)
- Test splitter up to 1x64
- Filtered version with 2 ports / APC only

**MA2 OTDR (Metro/Access)**
- P2P Applications
- CW Source standard
- Power Meter optional
- Best Dead Zones (65cm EDZ, 2.5m ADZ)

**MA3/ MP2 FiberComplete**
- Bi-dir IL/ORL and OTDR combined in a single module
- 2x faster than previous one (<30 s)
- Not compatible with previous 4100-series
Modular Compact Platforms: MTS-6000/8000

MTS-6000A Platform

- Compact modular test set supporting physical and services layer testing
- Protect your investment with more than 50 application modules:
  - OTDR
  - FiberComplete™ IL/ORL
  - Dispersion
  - OSA
  - Multiple Services (Ethernet, Triple Play, SONET/SDH)
- Large 8 inch display for better results viewing

MTS-8000 Platform

- Scalable test set with practically unlimited field modularity. Can handle fiber and transport modules:
  - OTDR
  - FiberComplete™ IL/ORL
  - Dispersion, In-Service PMD and ROADM OSA
  - Ethernet, SONET/SDH, PDH, and T-carrier networks
- Highest levels of integration and productivity for a Fiber Characterization test set (up to 7 fiber test sets integrated)
- Best productivity with Fiber Characterization script saving 10 times over previous methods
A New Range of High Performance Test Modules

- More functionalities: LS, PM, FComp, FCharac, Macrobend, Traffic detection, Bidir-OTDR (Opt.), SLM (Opt.)
- Better performances (<65cm EDZ, <2.5m ADZ)
Global OTDR Portfolio

![Global OTDR Portfolio Diagram]

- **SmartOTDR**
- **Nano-OTDR**
- **2k/4k/5.8k OTDR**
- **6k/8k OTDR**

Performance vs. Price

- Price: 30 dB, 35 dB, 40 dB, 45 dB, 50 dB
- Performance: 30 dB, 35 dB, 40 dB, 45 dB, 50 dB
FiberComplete™ EVO Test Principle

Perform all fundamental fiber qualification tests…
… in one fiber connection, with one key press.

- 1 Fiber Connection
- 1 Key Press
- 1 Fully Automated Process
- Automatic Continuity Check
- Bi-dir. Insertion Loss (IL) with Pass/Fail
- Bi-dir. Optical Return Loss (ORL) with Pass/Fail
- Bi-dir. OTDR or FaultFinder
- Distance

Acquire
Measure Bidir IL & ORL and OTDR

Analyze
Locate failures with Fault Finder

Report
Save all the results Automatically
FiberComplete

- Measurement time: 30s for 2 wavelengths, bidirectional IL/ORL and distance

- Full setup exchange (OTDR + FCOMP) using the fiber datalink (talkset port) or M2M (internet cloud or local LAN)

- Comes with + Light Source (cw & mod.) + Power Meter

Up to 40 dB loss and 55 dB ORL
Viavi Solutions OTDR – Flexible operation based on skill level

**Expert** = Manual Settings
OTDR view

**Auto or SmartTest** = Automatic settings
OTDR or Fault Locator View

**SLM - Schematic View** = Simplified network view
Direct info on problems

**Other common features**

- **Real Time Mode** *(push start/stop – hold 2 sec)*
  automatic “zoom to end” button + live measurement functions

- **Front end connector analysis**
  loss and reflectance measurement indication
SmartConfig™ Concept = Setup made easy

Viavi / Managers / Network Engineers

1. Create a SmartConfig
2. Save it

Technicians/Field Users

1. Select a SmartConfig
2. Load it
3. Test

Note: Built-in Viavi predefined SmartConfigs per network application
OTDR Made Easy!

- Guided steps (sequence of button press)
- Removed OTDR setup errors with easy configuration
- Systematic process for repeatable measurement process whatever the technician’s skills

1. Load a test config
2. Set basic parameters
3. START SmartLink acquisition
4. Read measurement pass/fail verdict
5. Save results
SMART TEST ASSISTANT
Smart Link Mapper Family

SLM
Displays OTDR results in a simple, icon-based map view (SmartLink), providing a clear diagnostic of detected issues

Cable-SLM
Provides a high-level view when commissioning optical fiber cables

FTTA-SLM
- Dedicated & simple setup menus
- Specific acquisition and OTDR analysis
- Detection and identification of FTTA network elements along the fiber link

FTTH-SLM
- Dedicated & simple setup menus
- Automatic identification of PON splitter types
- Special acquisition at multiple pulses to detect all events before and after the splitter(s)
- Pass/fail thresholds per PON standards

Enterprise- SLM
- Dedicated & simple setup menus
- Identification of specific elements (ex: cassette) along the fiber link
- Pass/fail thresholds and labeling schemes per DataCenter/Enterprise standards
Tier 2 Certification Report Example

- General Report & Job Information w/ Pass/Fail indication
- Endface Inspection (pass/fail to IEC std)
- General OTDR Settings
- OTDR Alarm Thresholds (per TIA/IEC std)
- OTDR Link Performance Summary
- OTDR Schematic Link View
- OTDR Detailed Trace(s)
- OTDR Detailed Event Table
# Tier-2 Project Summary Report Example

## Setup

- **OTDR** Laser: 1310nm
- **PW10ns** Range: 0.5km Time: 20.0s IOR: 1.46750 Backscat: -79.0 dB
- **OTDR** Laser: 1550nm PW2ns Range: 0.5km Time: 26.0s IOR: 1.46800 Backscat: -81.0 dB

## Alarms

<table>
<thead>
<tr>
<th>Thresholds</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector Loss (dB)</td>
<td>&gt;0.50</td>
</tr>
<tr>
<td>Splice Loss (dB)</td>
<td>&gt;0.20</td>
</tr>
<tr>
<td>Slope (dB/Km)</td>
<td>&gt;1.00</td>
</tr>
<tr>
<td>Reflectance (dB)</td>
<td>&gt;-35</td>
</tr>
<tr>
<td>ORL (dB)</td>
<td>&lt;27</td>
</tr>
</tbody>
</table>

## Summary Results

<table>
<thead>
<tr>
<th>Cable Id</th>
<th>Port #</th>
<th>Laser nm</th>
<th>Link Loss dB</th>
<th>Link ORL dB</th>
<th>Length m</th>
<th>Nb Evts</th>
<th>Alarms</th>
</tr>
</thead>
<tbody>
<tr>
<td>A01-PP01_01</td>
<td>3</td>
<td>1310</td>
<td>2.837</td>
<td>50.90</td>
<td>41.7</td>
<td>4</td>
<td>Fail</td>
</tr>
<tr>
<td>A01-PP01_01</td>
<td>3</td>
<td>1550</td>
<td>2.083</td>
<td>56.47</td>
<td>41.6</td>
<td>6</td>
<td>Fail</td>
</tr>
<tr>
<td>A01-PP01_01</td>
<td>4</td>
<td>1310</td>
<td>2.596</td>
<td>57.19</td>
<td>38.8</td>
<td>4</td>
<td>Fail</td>
</tr>
<tr>
<td>A01-PP01_01</td>
<td>4</td>
<td>1550</td>
<td>1.767</td>
<td>55.07</td>
<td>38.0</td>
<td>5</td>
<td>Fail</td>
</tr>
<tr>
<td>A01-PP01_01</td>
<td>9</td>
<td>1310</td>
<td>2.250</td>
<td>52.26</td>
<td>38.3</td>
<td>3</td>
<td>Fail</td>
</tr>
<tr>
<td>A01-PP01_01</td>
<td>9</td>
<td>1550</td>
<td>1.815</td>
<td>61.12</td>
<td>38.0</td>
<td>6</td>
<td>Fail</td>
</tr>
<tr>
<td>A01-PP01_01</td>
<td>10</td>
<td>1310</td>
<td>2.464</td>
<td>53.68</td>
<td>38.0</td>
<td>2</td>
<td>Fail</td>
</tr>
<tr>
<td>A01-PP01_01</td>
<td>10</td>
<td>1550</td>
<td>1.905</td>
<td>61.19</td>
<td>38.3</td>
<td>6</td>
<td>Fail</td>
</tr>
<tr>
<td>A01-PP01_01</td>
<td>11</td>
<td>1310</td>
<td>3.165</td>
<td>53.81</td>
<td>41.8</td>
<td>4</td>
<td>Fail</td>
</tr>
<tr>
<td>A01-PP01_01</td>
<td>11</td>
<td>1550</td>
<td>2.669</td>
<td>57.08</td>
<td>41.7</td>
<td>6</td>
<td>Fail</td>
</tr>
<tr>
<td>A01-PP01_01</td>
<td>12</td>
<td>1310</td>
<td>3.212</td>
<td>57.48</td>
<td>41.8</td>
<td>4</td>
<td>Fail</td>
</tr>
<tr>
<td>A01-PP01_01</td>
<td>12</td>
<td>1550</td>
<td>2.857</td>
<td>53.35</td>
<td>41.7</td>
<td>8</td>
<td>Fail</td>
</tr>
</tbody>
</table>
The connected OTDR
Networked Test Instrument

**Cloud storage**: compatible with a wide range of cloud servers (WebDAV service providers). It allows instant sharing of measurement reports.

**SmartAccess Anywhere (SAA)**: quickly resolves field issues in real time. It connects to the cloud and opens a tunnel, so that a technical assistant can virtually access and operate the unit from anywhere.

**StrataSync**: cloud-based solution that provides asset, configuration, and test data management and, ensures all instruments have the latest software and options installed.
Manage test data efficiently with wireless connectivity

In the field, connect a Smartphone or Tablet to SmartOTDR (using WiFi, Bluetooth or USB) and access 3G/4G network.

Benefits:

- Run tests, generate reports, upload them to the Cloud or e-mail/text them immediately
Save test data and reports directly in the Cloud!

1. Select a Cloud with WebDAV services

<table>
<thead>
<tr>
<th>Example of free providers</th>
<th>Server URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>4shared</td>
<td>webdav.4shared.com</td>
</tr>
<tr>
<td>Box</td>
<td>dav.box.com/dav</td>
</tr>
<tr>
<td>CloudMe</td>
<td>webdav.cloudme.com</td>
</tr>
<tr>
<td>CloudSafe</td>
<td>webdav.cloudsafe.com</td>
</tr>
</tbody>
</table>

2. In SmartOTDR, Setup Cloud Storage

   ![Cloud Storage](image)

   - Enter URL
   - Enter user name / login id
   - Enter password

3. In SmartOTDR, Connect Cloud Storage

   ![Connect Cloud Storage](image)
Simplified Access in Confined Environments

In confined or challenging environment, connect a Smart phone or tablet to SmartOTDR (using Peer-to-Peer/Ad Hoc WiFi) and utilize mobile device features for intuitive operation

Benefits:

- Easily operate, run tests and access test reports from a smartphone/ tablet
SmartAccessAnywhere Mobile App

- A free Windows and Android App

http://smartaccess.updatemyunit.net/

SmartAccessAnywhere App enables
- workforce support in real time
- remote control of SmartOTDR
- SmartOTDR test files and reports transfer
- SmartOTDR firmware upgrade
FiberTrace 2 & FiberCable 2 Reporting Software


- One Powerful Tool – Two Versions:
  
  ✓ FiberTrace:
    - View, edit, analyze and print in a professional format Viavi IL, ORL, FiberComplete, OTDR, CD, PMD, AP, OSA, I-PMD optical test results

  ✓ FiberCable:
    - Provides in addition the capability to generate high fiber counts cable OTDR acceptance reports and Fiber Characterization reports combining various test results in a single document.
StrataSync® Enables Asset & Test Result Management

### Asset Visibility & Tracking
- Asset information automatically sent to StrataSync™
- Supervisor has centralized access to track and manage their assets

### Configuration Updates
- Customer (Supervisor) selects Firmware, Options, or Configurations to deploy
- Updates deployed to instruments

### Centralized Test Results
- Test results automatically sent to StrataSync™
- Supervisor has centralized access to all test results

- **Multiple use cases across multiple instruments** from the functionality provided by StrataSync™
- StrataSync will enable customers to **increase operational efficiency** by significantly reducing time to track and configure devices, get access to test data, and train their work force
Enables Service Providers & Contractors – Data Exchange

Service Provider Benefits:
✓ Centralized access to all test results - service provider’s techs and contractors
✓ Immediate visibility of all test results
✓ Ability to drill down based on specific contractor

Contractor Benefits:
✓ Elimination of manual activities to produce and upload test reports
✓ Faster job completion due to elimination of test report preparation
✓ Quicker payment due to immediate upload of test results to service provider
OTDR Portfolio by Network Application

- **Last Mile**
  - E126A
  - E4126LA
  - E4123MM
  - E4146QUAD
  - E81xxA

- **LAN/WAN**
  - E4126LA
  - E4146QUAD
  - E81xxA

- **Short Access**
  - E41xxMA2
  - E41xxMA3
  - E41xxMP2
  - E41xxMP2

- **Metro**
  - E138FA
  - E118FA65
  - 126B
  - 136FB

- **Long-Haul**
  - E41xxMP2
  - E41xxMP2

- **Ultra Long-Haul**
  - E41xWDM

- **xWDM**
Enterprise-SLM Software Application for Tier 2 Certification
Viavi Portfolio for Tier 2 testing and certification of SM and MM networks

Test, troubleshoot and document LANs/WANs, Enterprise networks and Data Centers

- **T-BERD/MTS-2000**
  with QUAD or MM OTDR Module

- **T-BERD/MTS-4000**
  with QUAD or MM OTDR Module

- **T-BERD/MTS-6000A**
  with EVO A OTDR Module
Viavi Tier 2 Solutions Key Features & Benefits

➢ Viavi Solutions provides the best performance/price ratio OTDR on the market for complete Tier-2 certification of premises fiber-optic networks

• Enterprise-SLM Apps
  - Automatically sets the configuration for quick and error-free datacenter & enterprise fibers tests
  - Eliminates OTDR interpretation errors with Smart Link view that displays results in an icon based map view (no longer requires OTDR trace analysis)
  - Lets you certify compliance to industry standards with TIA/IEC or customer specifications pass/fail thresholds

• Ultra-short event and attenuation dead-zones enable to precisely locate events and faults on short fiber links (EVO A)

• Easily generates All-in-one PDF certification reports on site (OTDR and fiber inspection)
Enterprise-SLM
Enterprise-SLM at A Glance

- SM & MM icons on Home Page
- Dedicated & simple setup menus
- Pass/fail thresholds and labeling schemes per DataCenter / Enterprise standards (IEC/TIA)
- Certifies simplex, duplex (Tx/Rx) and MPO cables
- Compatible with future Enterprise mobile/cloud apps
Auto-setting of Acquisition Parameters

- **No test configuration is required** like on traditional OTDR devices: range, pulsewidth, acquisition time ….
- Enterprise-SLM automatically selects the optimum acquisition parameters

1. Load a config. file or project
2. Complete additional information
3. Test

Additional information that may be required:
- Fiber types (IOR)
- Launch / receive cables
- Alarm thresholds (standards or users)
- Site properties
- Report format
- File naming convention

<table>
<thead>
<tr>
<th>7 Files - 0 Directories</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENTERPRISE_Class2_RdCable_3ns.MM-OTDR</td>
<td>28/01/16 08:57</td>
</tr>
<tr>
<td>ENTERPRISE_Class2_Hlink_3ns.MM-OTDR</td>
<td>28/01/16 08:57</td>
</tr>
<tr>
<td>ENTERPRISE_Class3_RdCable_3ns.MM-OTDR</td>
<td>28/01/16 08:57</td>
</tr>
<tr>
<td>ENTERPRISE_Cable_3ns.MM-OTDR</td>
<td>28/01/16 08:57</td>
</tr>
<tr>
<td>ENTERPRISE_Custom_3ns.MM-OTDR</td>
<td>28/01/16 08:57</td>
</tr>
<tr>
<td>ENTERPRISE_Simple_3ns.MM-OTDR</td>
<td>28/01/16 08:57</td>
</tr>
<tr>
<td>ENTERPRISE_VariMM-OTDR</td>
<td>29/01/16 11:19</td>
</tr>
</tbody>
</table>

Pre-defined configurations with set of labels or blank label scheme
Compliant with IEC / TIA Standards

- Select pre-configured TIA-606 label schemes
- Document and create IEC/TIA standards compliant acceptance reports

Note: EVO A OTDR is the only Enterprise/Data Center OTDR on the market compliant with the Encircled Flux standard for accurate and repeatable loss measurement
MPO Cable OTDR Testing (via MPO Switch)

MPO Switch
Automatic switching driven by the OTDR via USB
### Enterprise-SLM (Label List View)

<table>
<thead>
<tr>
<th>Project name</th>
<th>Tested Cable: 2/4</th>
<th>Pass: 1/2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2A.AJ09-27:01</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>2A.AJ09-27:02</td>
<td>✗</td>
<td></td>
</tr>
<tr>
<td>2A.AJ09-27:03</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>2A.AJ09-27:04</td>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

- 1 label per cable (simplex, duplex or MPO)
- If MPO switch plugged via USB and label selected, press START to launch the auto-test of the active fibers
- For 1 label, n ports can be defined (usually 12 for MPO)
- If switch plugged via USB and one port is selected, press START to launch the auto-test of 1 fiber
- **Green** = pass, **Red** = failed, **Grey** = not tested, **Black** = not to be tested

Press “View Traces” to see OTDR/SLM results

Summary results of selected fiber

<table>
<thead>
<tr>
<th>Laser (dB)</th>
<th>Bilan (dB)</th>
<th>ORL (dB)</th>
<th>Length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1310</td>
<td>8.202</td>
<td>31.21</td>
<td>25.337</td>
</tr>
<tr>
<td>1550</td>
<td>4.696</td>
<td>30.83</td>
<td>25.347</td>
</tr>
</tbody>
</table>
Main Advantages of Enterprise-SLM

*Acquires and displays key test information at the press of a button*

“Event diagnostic” key suggests corrective actions for resolving fiber problems when a fault is detected.
Identifies quickly front and back connectors’ cassettes

- Conventional OTDRs can’t distinguish between front and back connectors of a cassette
  - If ribbon connector (back) is damaged/dirty, maintenance of the connector/replacement can affect multiple fibers/services (up to 10 channels)
  - If front connector (single) is damaged/dirty, maintenance of the connector/replacement will affect only one fiber/channel.

- Viavi EVO A OTDR
  - Identifies quickly front and back connectors’ cassettes avoiding unnecessary service/traffic disruption
Viavi Tier 2 Test Solutions  
*Applications and Specifications*

Enterprise-SLM Part Number:  
- ENTERPRISE-2K  
- ENTERPRISE-6KV2  

For existing unit:  
- ENTERPRISE2KUPG  
- ENTERPRISE6KV2UP

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dead Zones (EDZ/ADZ)</th>
<th>SM: 0.9 / 4 m</th>
<th>MM: 0.8 / 4 m</th>
<th>SM: 0.6 / 2 m</th>
<th>MM: 0.2 / 1.5 m</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SM</td>
<td>MM</td>
<td>SM: 40/38 dB</td>
<td>MM: 26/24 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other applications</th>
<th>FTTA/DAS</th>
<th>Metro/FTTH</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Encircled Flux Source</th>
<th>x</th>
<th>✓</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>MPO Cassettes Front/Back Connector Measurement</th>
<th>x</th>
<th>✓</th>
</tr>
</thead>
</table>
Viavi Solutions in the Enterprise

Forms part of the MPO solution set
- MTS-4000 V2
  - Regular MA, MP, MA2, MP2, etc. OTDR modules
  - QUAD OTDR
  - CWDM & DWDM OTDR modules
  - Cable-SLM & Enterprise-SLM license
- MPOIx
- FIT
  - P5000i or FiberChek with MPO tip
  - FiberChek Sidewinder
- CERTiFi / StrataSync
Enterprise-SLM Workflow Integration

- Design projects with online UI
- Assign tasks directly to team members
- Upload tasks directly to test devices
- Deploy tasks to instruments with the CERTiFi Mobile App
- Test to configured design requirements
- Analyze real time metrics
- Generate certification reports