Měření a kvalifikace sítí FTTa/DAS

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Obecné schema mobilní sítě
Úvod do fiber-based DAS

Cell tower site (RRH)

Outdoor distributed Antenna (DAS)

Indoor distributed Antenna (DAS)

DAS refereční architektura

Third Floor

Second Floor

First Floor

Ground Level

Equipment Room

Basement Level

Remote Head Unit
RF opt. to RF elec.
Antenna
Coax
Fiber
Conduit
Service room

Link with CO or cellsite

144 SMF

2x 12 SMF

96 SMF

3x 12 SMF

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Úvod do fiber-based DAS

Technology

<table>
<thead>
<tr>
<th>PHYSICAL LAYER CHARACTERISTICS</th>
<th>DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber Types</td>
<td>SM (new DAS) &amp; MM (older DAS)</td>
</tr>
<tr>
<td>Connector Types</td>
<td>SC/APC (90% of the time)</td>
</tr>
<tr>
<td>Splice</td>
<td>Yes</td>
</tr>
<tr>
<td>IL Budget</td>
<td>Tight (less than 5 dB)</td>
</tr>
<tr>
<td>ORL</td>
<td>Systems requirements between 36 to 40 dB</td>
</tr>
<tr>
<td>Test equipment currently used</td>
<td>Microscope, OPM, OLS and OTDR</td>
</tr>
</tbody>
</table>

Today’s Mobile Network Reality

Expanding coverage and capacity through various architectures
Testing from the optical network terminal (ONT) provides an OTDR trace that is easier to interpret. Testing from the optical line terminal (OLT) will present an OTDR trace with up to 32 or 64 branches combined after the splitter.

FTTH Network Testing Methods: Distribution Fibers

› OLTS Test Method

IL/ORL bidirectional

One technician stays at the FDH, while another goes to the terminal with a second OLTS.
Technological progress stops for no one. Mobile operators are always racing to be first-to-market. Field technicians must be, or even become, all-around technical experts, with abilities to efficiently address any situation they face, regardless of technology or network architecture. They can not afford to wait for external help, or come back later to complete the job.

**CONSTRUCTION**
- Network Connectivity
  - Testing the Optical Physical Layer
  - Connectors (dirt, damaged)
  - Link Characterization
  - Network Documentation

**TURN-UP & TROUBLESHOOTING**
- Service Validation
  - Services & SLAs
  - Ethernet Services
  - CPRI/SPS/I Protocol
  - Packet Transport network (signaling)

**OPERATIONAL EFFICIENCY**
- Performance Optimization
  - Cloud-Based Solution
  - Automated Test Configuration
  - Automated Test Data Management
  - Asset Management

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**Které parametry sledovat během výstavby?**

- **IL Splice and Connector**
- **Link ORL**

- **Macrobends**
- **Connector cleanliness**

**Loss Budget**
**Recommended Testing Tools**

- **Link ORL**
- **OTDR**
- **IL Splice & Connector**
- **Macroburnd**
- **iOLM**

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**Key deployment challenges...**

**OPEX CONCERNS**

- Copper technicians migrate to fiber-optic testing
- No time or budget for training
Key deployment challenges...

OPEX CONCERNS

TRUCK ROLLS

- Repeated truck rolls caused by wrong pass/fail criteria, wrong equipment usage, false diagnosis, wrong OTDR trace interpretation, etc.

iOLM

Get multiple acquisitions

Analyze traces

Combine results

Display optical link view
Do you know what these results mean?
How many of people could setup and interpret these results?
How long for a new optical technician to learn OLTS and OTDR language?
How many mistakes are made in references, settings and interpretation?
How to fix?
How much does it cost?
### iOLM jak pracuje?

- Do you know what these results mean?
- How many of people could setup and interpret these results?
- How long for a new optical technician to learn iOLM language?
- How many mistakes are made in references, settings and interpretation?
- How to fix?
- How much does it cost?

### iOLM jak pracuje?

Don’t change what you do

- OTDR-based
- DAS/Access/metro
- iOLM file results and report
- OTDR file in .SOR format
3 Connect Launch and Receive cables to DUT and Press START

4 In less than 1 minute
   1- Get IL and ORL with Pass/Fail
   2- Continuity
   3- Locate all faults
   4- Provides a diagnosis to fix
Let's compare... iOLM accuracy single-ended measurements with OLTS

<table>
<thead>
<tr>
<th>Specifications</th>
<th>iOLM</th>
<th>OLTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link IL uncertainty</td>
<td>0.08 dB</td>
<td>0.15 dB side-by-side</td>
</tr>
<tr>
<td>Reflectance uncertainty</td>
<td>0.75 dB</td>
<td>N/A</td>
</tr>
<tr>
<td>Short link ORL uncertainty</td>
<td>1 dB</td>
<td>0.5 dB</td>
</tr>
</tbody>
</table>
What to look for during the construction?

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>OTDR</th>
<th>iOLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of technician</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Technical expertise</td>
<td>Medium to high</td>
<td>Low</td>
</tr>
<tr>
<td>Number of acquisition/test per fiber</td>
<td>An average of 2 to 3 depending on the link complexity to fully characterize all the elements. For each acquisition, we can estimate an average of 15 sec/wavelength</td>
<td>1 (average of 45 sec, include all wavelengths)</td>
</tr>
<tr>
<td>Average test time per fiber including results analysis</td>
<td>Typically 2 to 10 minutes depending on the link complexity and technician’s skills</td>
<td>45 seconds to 1 minute</td>
</tr>
<tr>
<td>Graphical representation of the link</td>
<td>Traditional graphical representation</td>
<td>Link view</td>
</tr>
<tr>
<td>Provide Insertion Loss</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Optical Return Loss</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Provide Length of the fiber</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Automatic-Diagnostics</td>
<td>Macrobend detection and pass/fail status</td>
<td>Yes, global and individual pass/fail status plus diagnosis information for each failure</td>
</tr>
<tr>
<td>Allow troubleshooting</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Live testing</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Offer easy transpose fiber detection</td>
<td>No</td>
<td>Yes with receive box</td>
</tr>
</tbody>
</table>

IL Splice and Connector

Link ORL

Macrobends

Connector cleanliness

Loss Budget
The chart above is a summary of a study from NTT-Advanced Technology that polled network owner and cable installers on the sources of network failures. 98% of cable installers and 80% of network owners answered Yes to having contamination be the root cause of a network failure.

Videomikroskopy v portfoliu...

NEW FIP-400B

FTB-Ecosystem MaxTester 700B OTDR series Standalone MAX-FIP Display PC and Laptops

3 models
1. FIP-410B: Manual
2. FIP-420B: Analysis & Auto center
3. FIP-430B: Auto focus & Analysis & Auto center

DIGITAL USB PORT
- ConnectorMax IEC analysis embedded in the 420/430 models
- Use the 420/430 on any device and perform P/F analysis
Field Testing Process Improvement

Ethernet Service Activation Example – ‘Connecting’ the test set

Service Turn-Up Solution
- Simultaneous install of multiple circuits – no queues

- Verify installation, provisioning, and performance of backhaul connection with line-rate test traffic
- Centralized Turn-up tests performed by executing Multi-instance EtherSAM Service tests or RFC2544 through BrixWorx
  - NOC initiated tests to Access Provider
- Test results can be stored in BrixWorx for “Birth Certificate” creation
  - Results archived for historical trouble-shooting comparison/baselining

Benefits:
- Single or multi-user personnel operation for turn-up concurrent EtherSAM Service tests, multi-site tests & improve speed of testing
- Provide documentation to inspire customer confidence and traceability
- Provide a consistent procedure to get the service running quickly and efficiently
How does it all work?

Centralized correlation and analysis engine for provisioning and managing network performance data

Multiply verifier with turn-up, monitoring and troubleshooting capabilities

Leveraging standards-based responder capability

Portable platform for advanced on-site testing, turn-up and troubleshooting

Performance endpoint unit for remote testing and monitoring

One Field-Optimized Testing Solution

FTB-700G Series

As fiber and Ethernet become the leading technologies of choice for MNOs, it makes perfect sense for field technicians to be equipped with a solution that lets them characterize fiber links as well as the services that run over it, be it Ethernet, CPRI/OBSAI, SyncE, etc.

EXFO’s FTB-700G Series is the only handheld, user-friendly and automated testing solution on the market that integrates all the required testing functionalities needed to effectively activate, validate and troubleshoot mobile services into a SINGLE module.

The FTB-700G Series is the ONE testing solution that is specifically designed to address the needs of today’s mobile network field technicians.

Explore the possibilities!
One Field-Optimized Testing Solution
FTB-700G Series

FIP-400B
Next-Generation Fiber Inspection Probe
- Automatic fiber image centering
- On-board connector and loss analysis
- Optimized digital image quality with three levels of magnification
- Re-engineered, rugged casing with ergonomic access to all controls

ConnectorMax2
Analysis Software
- Automatic passive connector analysis in seconds
- No risk of misinterpretation
- Achieves repeatability for consistency of results
- Available as an on-screen option with the FIP-400B Fiber Inspection Probe

iOLM
Intelligent Optical Link Mapper
- The best of OTDR-based technologies
  - PROBO is integrated with the best solution, by using multiwavelength and multiple wavelengths.
  - Turning complexity into simplicity
    - A single task is performed and mapped into a single link view, connecting complex data into simple results.
  - Optimized fiber deployments
    - A single testing option and live assessment
    - Misinterpretation costs can be minimized
    - Results across all test teams

EtherSAM
- SLA validation in a single test
- Simultaneous bidirectional testing
- Standards based (ITU-T, ITU-Y, ITU-P)
- 100% test time right result
- For fast deployment

EXFO Connect
- Automation and business intelligence
- Cloud-based equipment and test data management

FTB Anywhere™
Floating Test License
- Budget flexibility
- Available anywhere, any time and to anyone
- Eliminating barriers to field testing efficiency
- Feature-rich solution

ONE Solution

ONE TECH
EXFO's FTB-1 solution makes any field technician an expert. The unique combination of innovative and intuitive functionalities found in the FTB-1 gives technicians access to the latest technology to accurately diagnose and troubleshoot any type of fiber network connection without requiring external intervention. A true end-to-end testing solution!

ONE TOOL
No other solution in the industry matches the FTB-1 when it comes to deploying or upgrading a large number of fiber network connections. With this game-changing solution, technicians can perform multiple classes of Ethernet services with unprecedented speed and accuracy. The ultimate testing tool!

ONE TIME
EXFO's innovative, all-in-one testing solution empowers field technicians with easy-to-use yet powerful automated testing and analysis capabilities that eliminate guesswork and deliver 100% accuracy throughout the different test phases. Enhanced productivity while eliminating unnecessary back-to-back testing!

ONE Ecosystem
A comprehensive, cloud-based, field test management solution that is specifically designed for the needs of installation and maintenance teams. These teams require both significant operational cost reductions in their test equipment management and maximum value from their test results.
Combining Ethernet and Optical in **ONE Testing Solution**

**TACKLING TODAY’S MOBILE NETWORK CHALLENGES**

- Activate and maintain a high number of towers and small cells.
- Overcome limited technical resources and knowledge.
- Work with tight schedules and budget constraints (OPEX pressure).
- Maintain accuracy standards across the various deployed technologies.
- Validate numerous service classes.
- Optimize network performance.
- Eliminate unnecessary truck rolls.

Find out more at EXFO.com/ONESOLUTION

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## Un-surpassed Capabilities Day one!

<table>
<thead>
<tr>
<th>CAPABILITIES</th>
<th>FTB-720G</th>
<th>FTB-720G+</th>
<th>FTB-730G</th>
<th>FTB-730G+</th>
</tr>
</thead>
<tbody>
<tr>
<td>23B (1310/1550)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>12CD-23B (1310/1350) (850/1300)</td>
<td>February</td>
<td>February</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>OTDR</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>iOLM</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>GigE</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>10 GigE</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Sonet/SDH (Up to 10G)</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>OTN (Up to 11.3G)</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Fibre Channel 1X/2X/4X</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Fibre Channel 8X/10X</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CPRI/ OBSAI (2.4/3.1G)</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
What’s in the 700G series release?

Optical features
1310/1490/1550/1625/1650/Quad OTDR 12CD-23B (850/1300 & 1310/1550) iOLM

Multi-Service features
One Way Delay Ethersam/RFC 2544
EtherSAM EBS/CBS/EMIX
New Report Generation
Carrier Ethernet OAM
Tgen with 16 streams
Visual Frame Display
Test Configurator
TCP Throughput

General features
Both modules running simultaneously (may 2014)

Reference Architecture

Max. 250Mbps data rate required for all flatfile transfers!
Typical 10-20Mbps

EXFO KPI Server

EXFO PowerHawk Pro Probe

EXFO PowerHawk Pro Probe

Max 4000 calls /sessions per second

Max 10 000 flows per second

User Plane analysis data as flatfile

Control Plane analysis data as flatfile

IP data

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