OTDR field solution

Testing and maintain FTTx, CATV, LAN Access and Metro Networks

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Agenda

- Topology FTTx in wireless networks
  - Changed test requirements
- I&M Testing
  - Where to connect?
  - Endface quality, Macrobending, On-Site report
FTTx Acronyms
- FTTH - fiber to the home
- FTTP - fiber to the premise
- FTU - fiber to the user
- FTTC - fiber to the curb/cabinet
- FTTB - fiber to the business
- FTTN - fiber to the node

Operation System

Service Node
- Internet
- Leased Line
- Frame/Cell Relay
- Telephone
- Interactive Video
Mobile data Traffic

Figure 2. Global Mobile Data Traffic Forecast by Region

Exabytes per Month

66% CAGR 2012-2017

Source: Cisco VNI Mobile Forecast, 2013

Figure 11. 4G will be 10% of Connections and 45% of Traffic in 2017

Sources: Cisco VNI Mobile Forecast, 2013
Additional approach for FTTX in wireless networks

New opportunity is growing up

Mobile Operator’s territory
Why migration from copper to fiber?

- Increasing data traffic and data speed
- Reducing the power consumption of Booster Amplifier
- Lighten the cable weight itself and low cost deployment
- Easy upgrade for Higher bandwidth and expand areas

Figure 3: Comparison of conventional mobile communication systems with FTTH systems.

RRH placed next to antenna

Digital radio over fiber (D-RoF) from antenna to cell site cabinet
Quality and reliability is needed due to increasing the data traffic and speed.

Additional maintenance cost is generated by non-reliable fiber deployment.

Due to increase of fiber deployment to Mobile Network, Mobile Engineer need to use the OTDR for optical fiber installation/maintenance.
Reasons for fiber loss

- Absorption
- Coupling
- Fresnel-reflection
- Rayleigh-scattering
- Squeezing/Micro-bending
- Connector loss
- Loss due to Macro-bending
OTDR Terminology

- **Rayleigh scattering (Backscatter)**
  - Occurs along the optical fiber

- **Fresnel Reflexion**
  - Reflected part of the light at a single event
OTDR Terminology

- Distance / length measurement
  - km, m, ft
- Fiber loss/coefficient measurement
  - dB, dB/km
- Connector- / splice loss measurement
  - Insertion loss
  - Return loss
OTDR Blockdiagram

Temperature control

Optical switch or directional coupler

LD

Pulse generator

APD

Amplifier

Signal processing

Distance: 1.246 km
Loss: 4.72 dB
Fiber Loss: xx.x dB/km

MW9070B
λ: 1.31µm (SM)
IOR: 1.465500
DR: 5km
Average: 30
PW: 20ns
Full Trace

Distance: 1.246 km
Loss: 4.72 dB
Fiber Loss: xx.x dB/km

X: 0.004 km

"TELECOM INFRA EVENT 2013"
FTTA; I&M Testing

- Important to Mobile Engineers; optical I&M and optical fiber handlings
  → Simple Operation and easy understanding of the test result
- Connector endface quality
  → VIP Pass/Fail
- Impact of Macro bending; increased insertion loss reduces attenuation budget
  → Macro bending check
- On-Site report
  → PDF Report generation
- Need to evaluate MMF and SMF
  → Quad OTDR(0.85/1.3um MMF & 1.31/1.55um SMF)
- Bulky testers are not suitable at Antenna
  → Small & Light weight, Quick boot
FTTA; where to connect?
OTDR measurements have limitations for fibers <40m

Alternative methods:
- Power Meter & Light Source (Loss Test Set)
- VFL
FTTA; where to connect?

Loopback needed

OR

OR

OR
Fault location with comprehensive graphical summary

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Test Mode: Auto
Real Time: Off
Wavelength: 1310 / 1650 (Macro Bend)
Test Parameters: 1640 ft / 3 ns [HR]
Display From Origin

Toggle between summary and trace with one button

PDF report generation
When a connector endface is **dirty**, it produces a larger reflection. A good connection can be maintained by cleaning connector endfaces.
Connector endface quality

When a connector endface is damaged, in addition to having a greater amount of reflection, it also tends to exhibit greater splice loss. When the amount of reflection or loss caused by the damage is high, the connector needs to be replaced.
Where to connect?
Connector endface quality

Identification and tabulation of “defects” or “scratches”

(1) Defects in each area.
(2) Scratches in each area.
(3) Overall determination for each area merging (1) and (2)

Automatic pass/fail according to IEC61300-3-35 standard.
Impact of Macro bending; increased insertion loss reduces attenuation budget
Macrobending

Macrobending (60 mm)

Attenuation (dB)

Wavelength (nm)

0.005 0.0615 0.124 0.489 2.284

0 0.5 1 1.5 2 2.5

1250 1350 1450 1550 1650

0.124 0.489

2.284
On-site report

Company logo

Report Header

Test Result Summary

Graphical Events

OTDR Trace

Event table list
Measurement 1650nm (filtered)

Measurement sample of PON(1 x 64:1x16+1x4)
WL=1650nm, DR:10km, Ave:60s, Pw:100/500ns
Long distance measurement

- 1310nm, PW: 20us
- 1550nm, PW: 20us
- 1650nm, PW: 20us
Meaning/Importance of Dynamic Range

The smaller the distance (dynamic range) to the noise, the more overlay of noise on the OTDR trace.
Thank you!