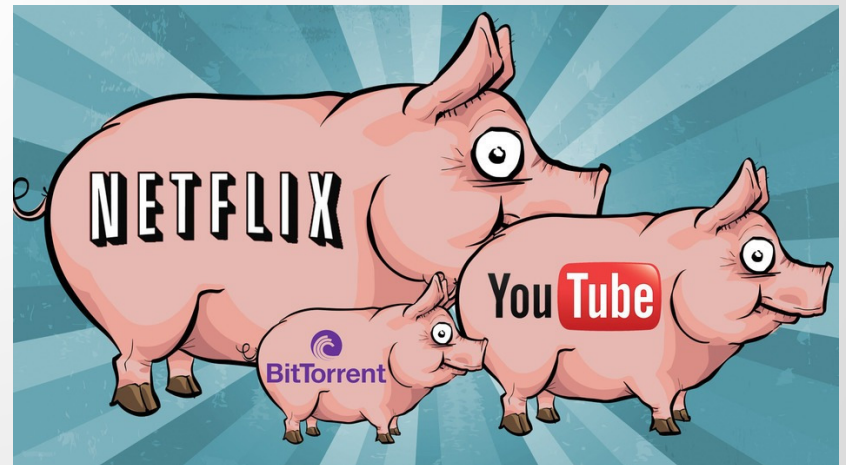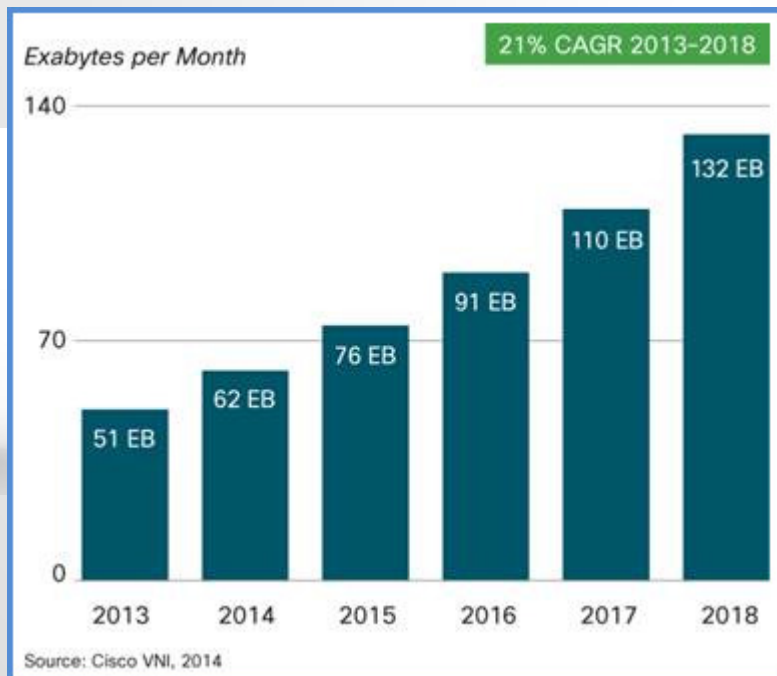# Měření v datacentrech

Presenter: **Vratislav Blažek dipl. Ing.**
RSM EE, Russia & CIS

October 23rd

EXFO
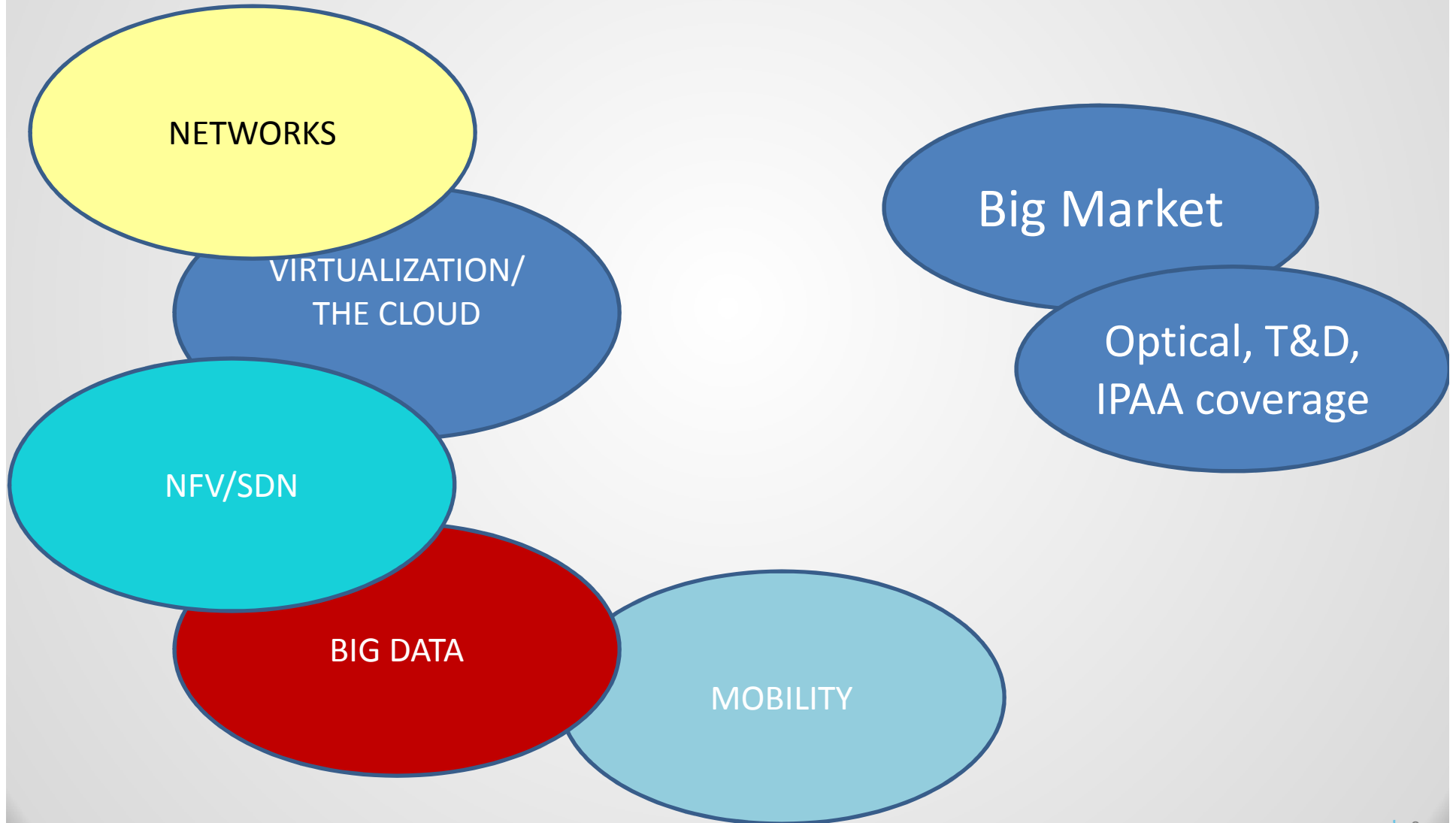
A few numbers…

- Datacenter Market is estimated at **15B USD** Market and growing rapidly!

- Global IP traffic volume is expected to grow to **132 Exabytes** a month by 2018, a 21% cumulative annual growth rate

- Video will reach **69%** of global consumer Internet traffic by 2017

Exabytes per Month — 21% CAGR 2013-2018

51 EB (2013), 62 EB (2014), 76 EB (2015), 91 EB (2016), 110 EB (2017), 132 EB (2018)

Source: Cisco VNI, 2014

The Top 5 Data Center Trends

NETWORKS

VIRTUALIZATION/
THE CLOUD

NFV/SDN

BIG DATA

MOBILITY

Big Market

Optical, T&D,
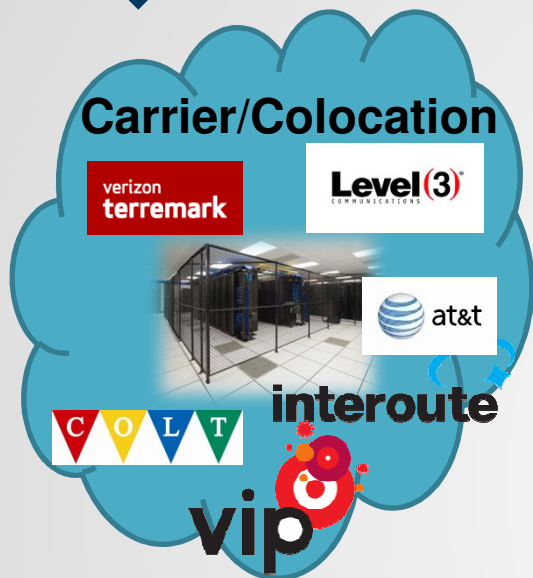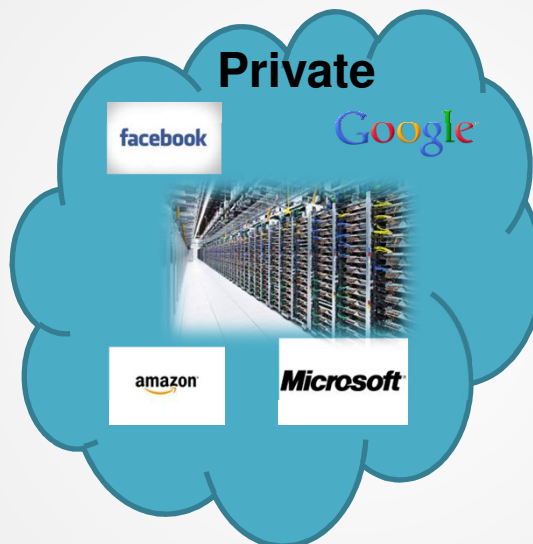IPAA coverage

DataCenter Anatomy

Carrier/Colocation

Space for rack installation with connectivity to carrier's fibre and bandwidth network and incumbent providers. May offer interconnectivity to other carriers.

Private

Generally server space for providing their own web/cloud services and data storage
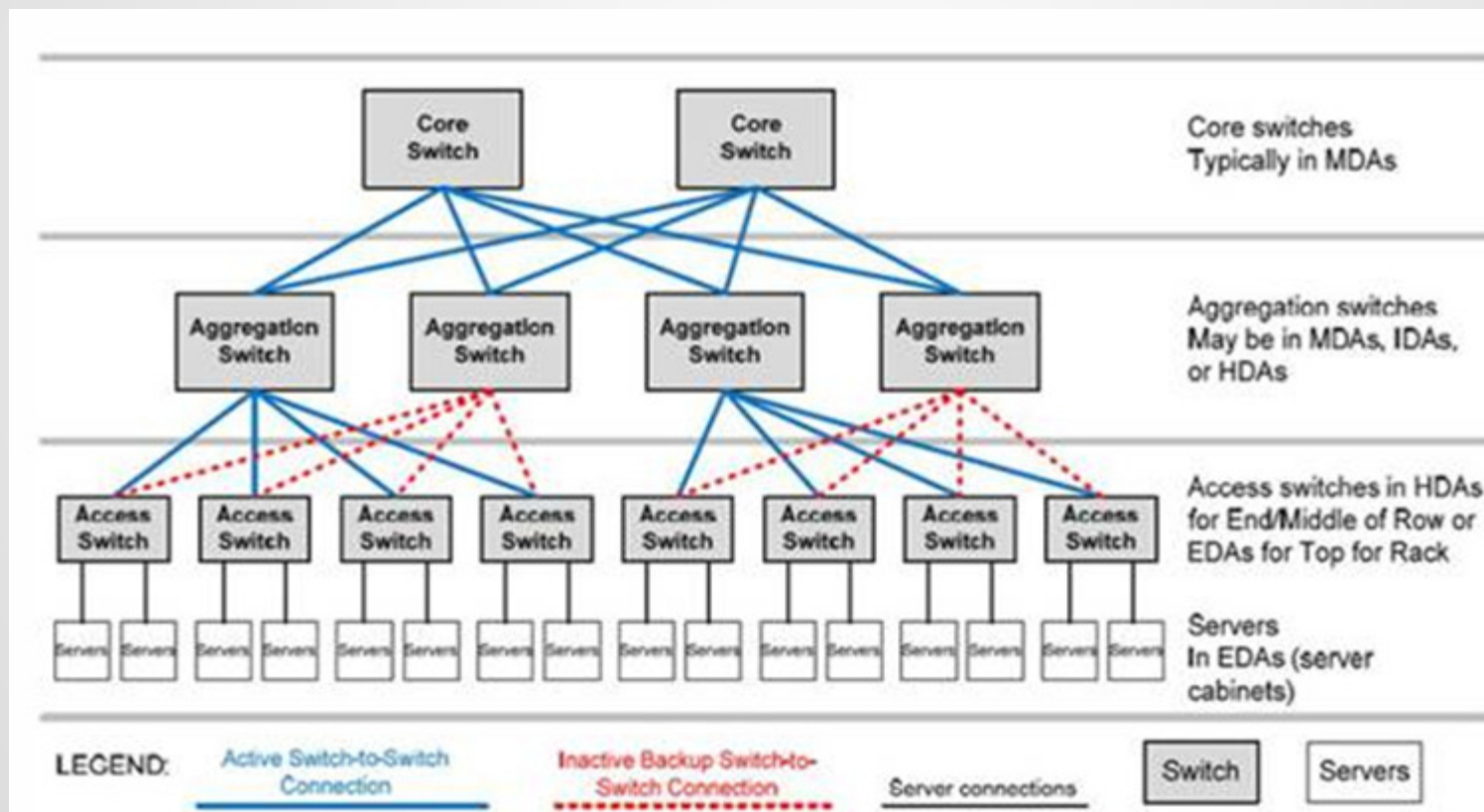
Carrier Neutral

Rental of racks, cages or suites with multiple interconnectivity options with other tenants or network providers. Facilities management

TIA-942 layaout/zones/cabling/procedures/enviromental
TIA-568/569 permanent cabling/SM/MM/Laser optimized/CAT

Traditional Data Center Architecture

Optical Challenger

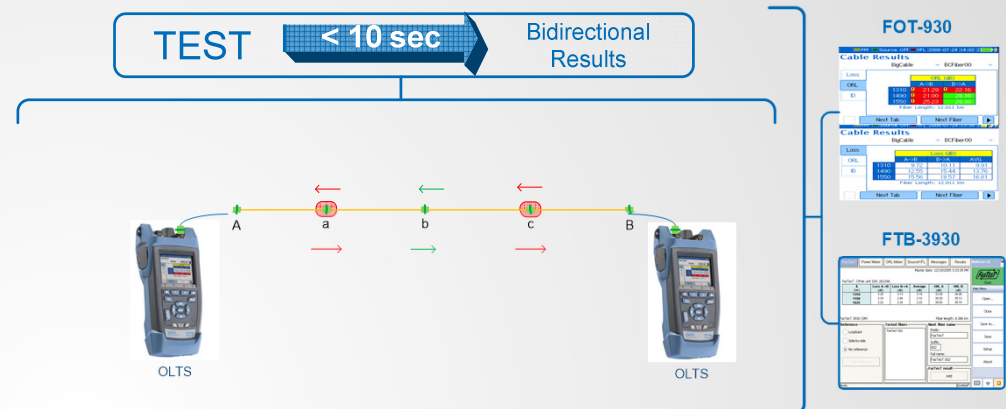# Colocation Installation Works Todays Workflow

Construction

- ALWAYS Loss Test (Tier-1)
- ALWAYS do OTDR testing or better alternative
- ALWAYS do connector inspection

Maintenance

- ALWAYS do OTDR testing or better alternative
- ALWAYS do connector inspection
- Same crew as above...

OLTS

TEST | < 10 sec | Bidirectional Results

FOT-930

FTB-3930

OTDR
Next slide

Fiber inspection

No.1 IN OTDRs WORLDWIDE

28 YEARS OF EXPERIENCE

MULTI-ACQUISITION

MULTIPULSE

MULTIWAVELENGTH
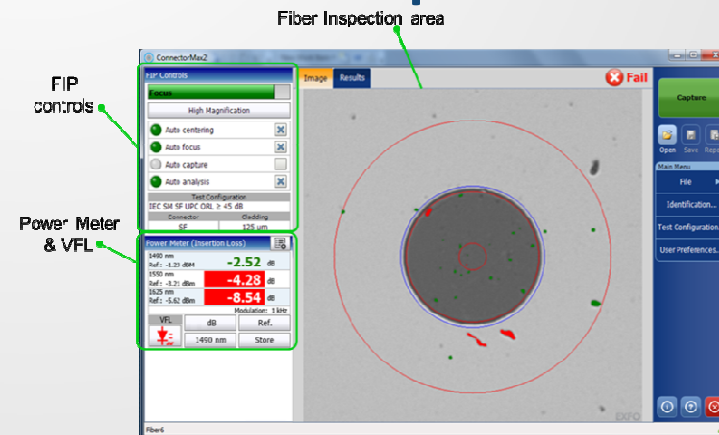
DIAGNOSIS AND GUIDANCE
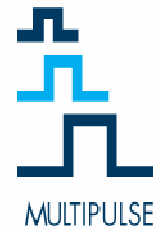
FULLY AUTOMATED, ONE-TOUCH OPERATION

iOLM

T&D Challenger

Where are all those YouTube videos stored!

T&D's Perspective Helping our customers build these Data Centers!

①

User-to-Data Center (DC) Connectivity

Data Center Access Network

Data Center Inter-Connect Network

②

DC-to-DC Connectivity

③

Intra DC Connectivity

- 1- User-to-DC Connectivity
  - Carrier Ethernet
  - Fiber Channel
- 2- DC-to-DC
  - SONET/SDH/OTN/λ
  - Carrier Ethernet
- 3- Intra DC
  - Ethernet
  - Fiber Channel

11
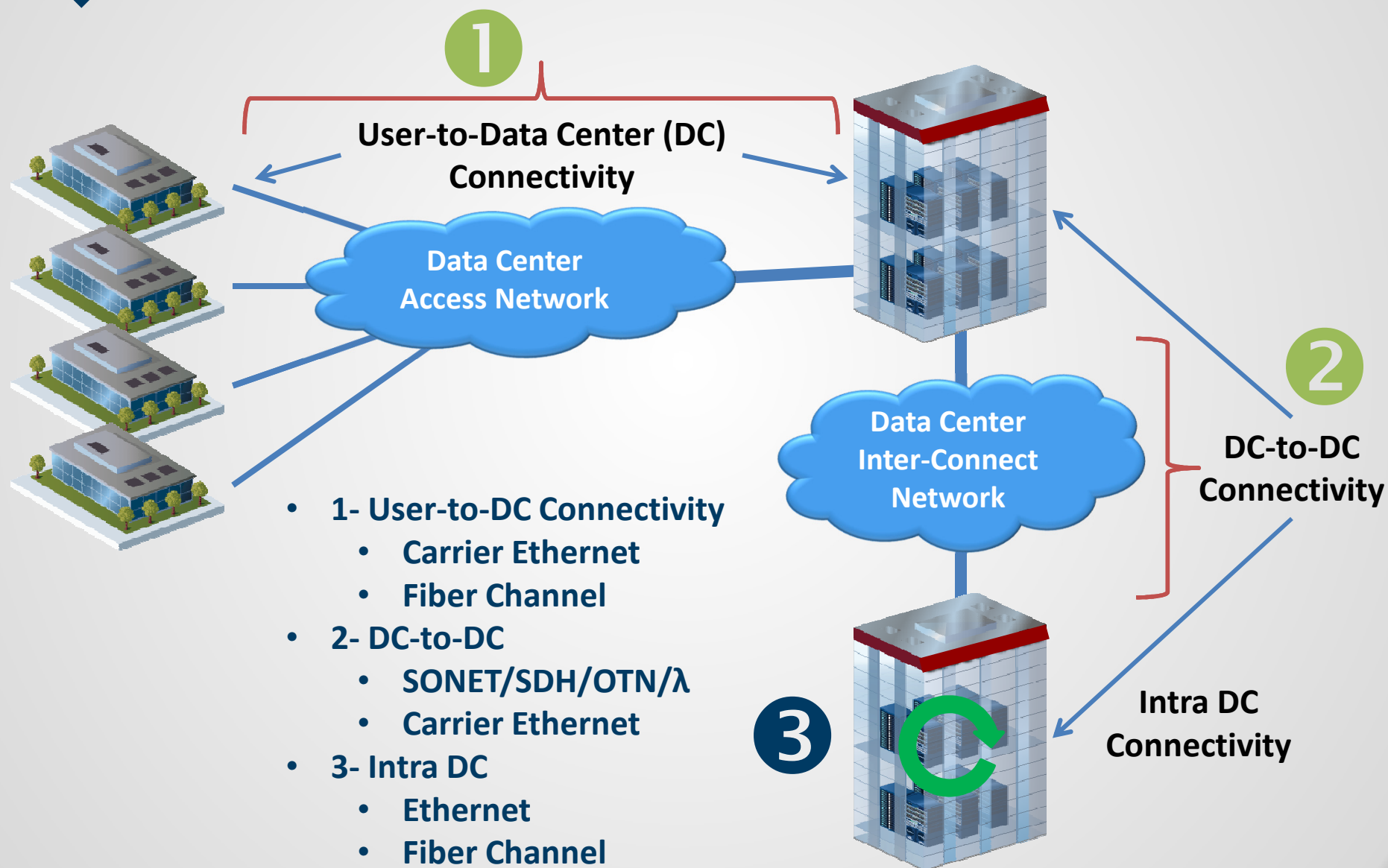
- **Turn-up and Troubleshooting of Data Center Access Services:**
  - Carrier Ethernet : SLA with Multiple CoS with different KPIs
    - EtherSAM (Y.1564) perfectly adapted to validate SLA
  - Fibre Channel: Test for Fibre Channel business services validation

Multi-Service EtherSAM (Y.1564) test
Or Fiber Channel test

User to Data Center (DC) Connectivity

Telepresence

Data Center Access Network

Non real-time content

Mission critical data

Cloud Service Users

Cloud Service Provider(s)

Data Center Access Services
What can we use to validate these services?

1
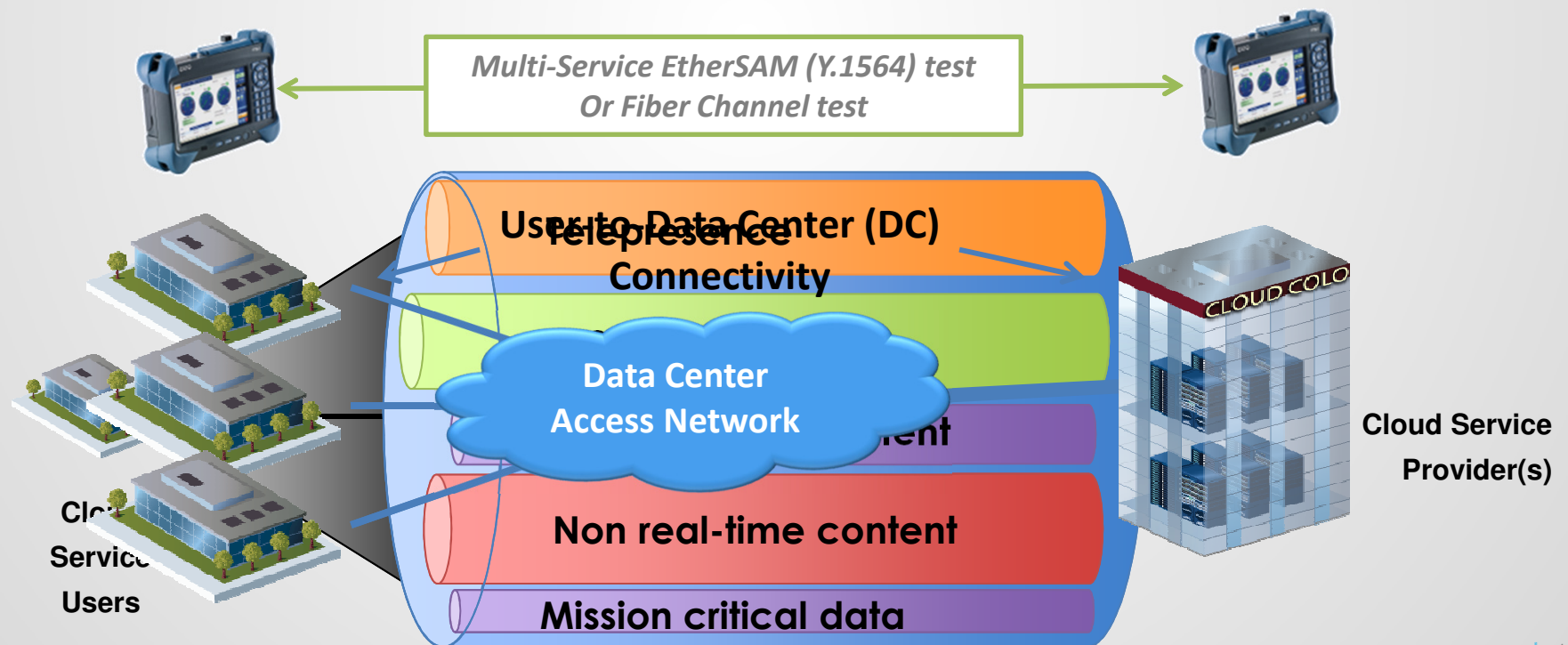
- ## For up to 10G Ethernet Testing and Fibre Channel **FC16x**
  - ### FTB-8830NGE in the FTB-2 Platform

Multi-Service EtherSAM (Y.1564) test
Or Fiber Channel test

FTB-8830NGE

FTB-8830NGE

Telepresence

VOIP calls

Streamed live content

Non real-time content

Mission critical data

Cloud
Service
Users

Cloud Service
Provider(s)

Data Center Access Services
What can we use to validate these services?

1

- For up to **100G** Ethernet Testing and Fibre Channel FC10x
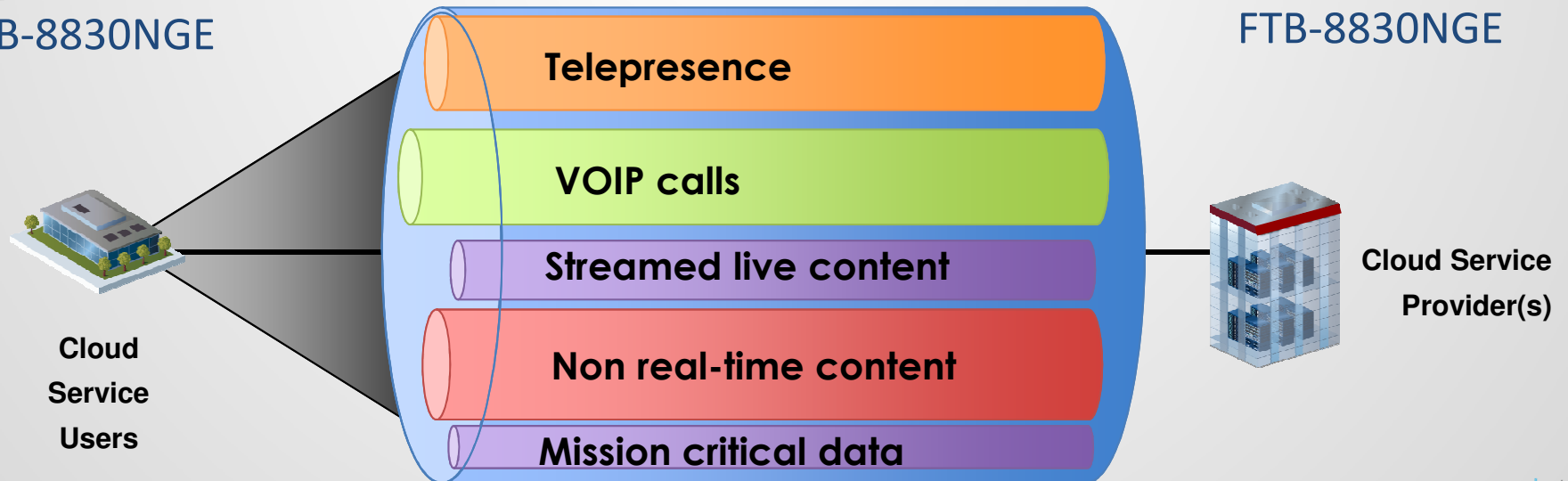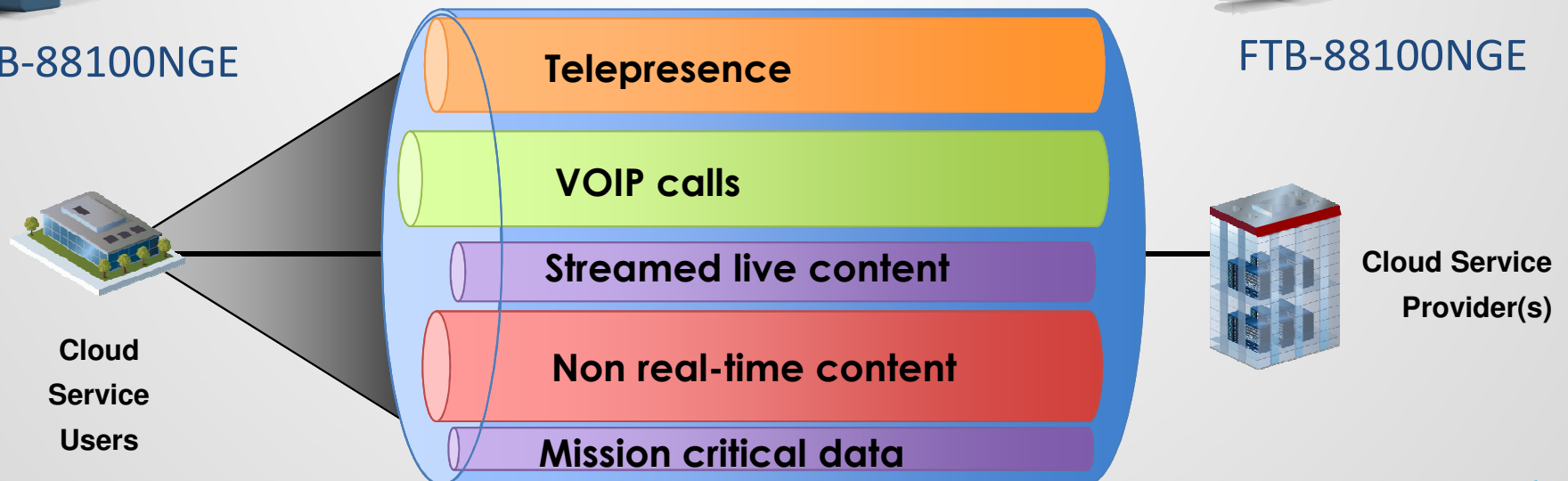 - FTB-88100NGE in the FTB-2 Platform

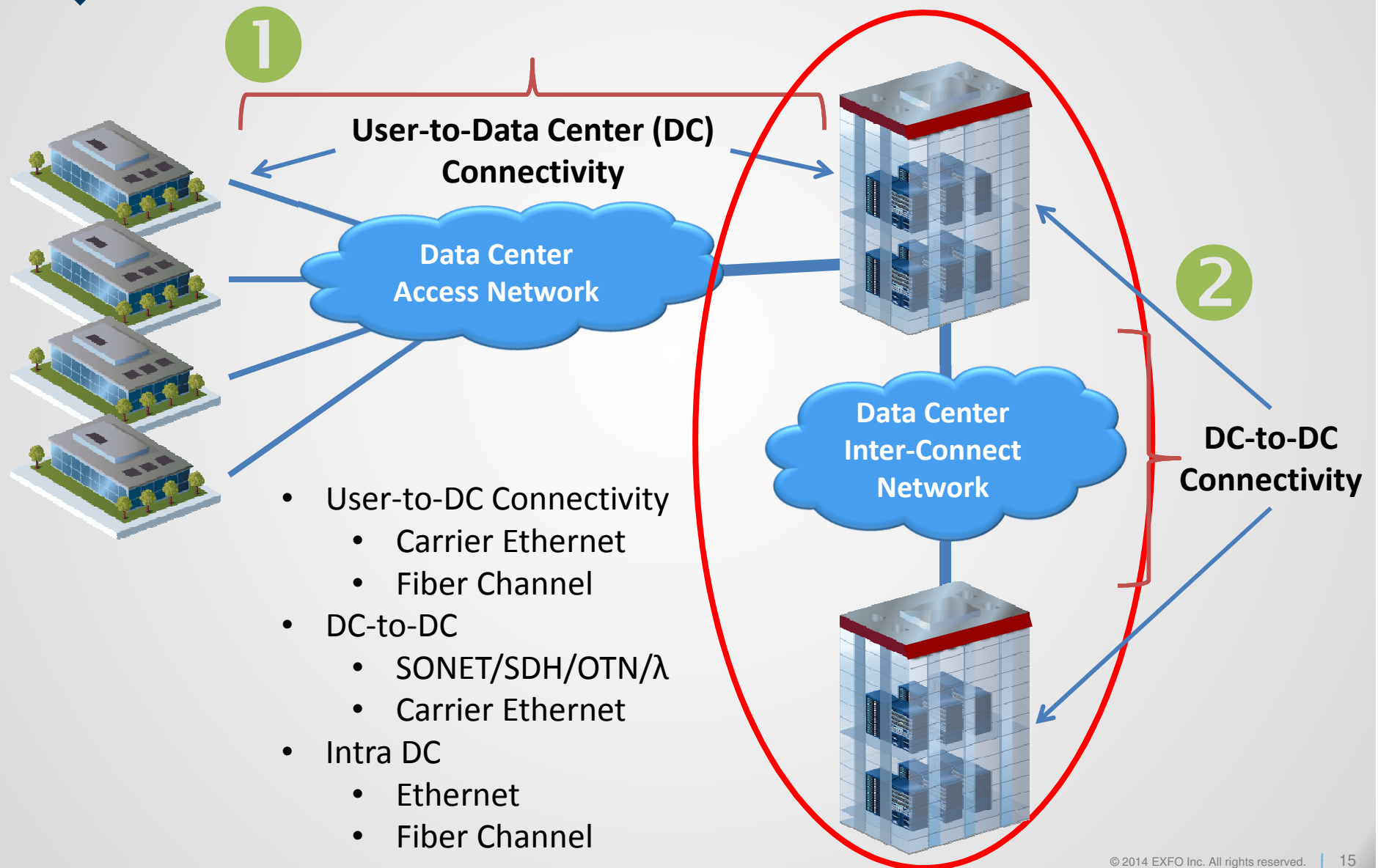## ACCESS NOT AT 100G TODAY BUT FUTURE PROOF!

FTB-88100NGE

FTB-88100NGE

Telepresence

VOIP calls

Streamed live content

Non real-time content

Mission critical data

Cloud
Service
Users

Cloud Service
Provider(s)

Data Center Inter-Connect Testing
Turn-Up & Troubleshooting

User-to-Data Center (DC) Connectivity

Data Center Access Network

Data Center Inter-Connect Network

DC-to-DC Connectivity

- User-to-DC Connectivity
  - Carrier Ethernet
  - Fiber Channel
- DC-to-DC
  - SONET/SDH/OTN/λ
  - Carrier Ethernet
- Intra DC
  - Ethernet
  - Fiber Channel

Data Center Inter-Connect Testing
Turn-Up & Troubleshooting ②

Data Center Inter-Connect Network

DC-to-DC Connectivity

②

FTB-88100NGE

FTB-88100NGE

- **Data Center Inter-Connect links are mostly 10G / 40G with some 100G rates today.**
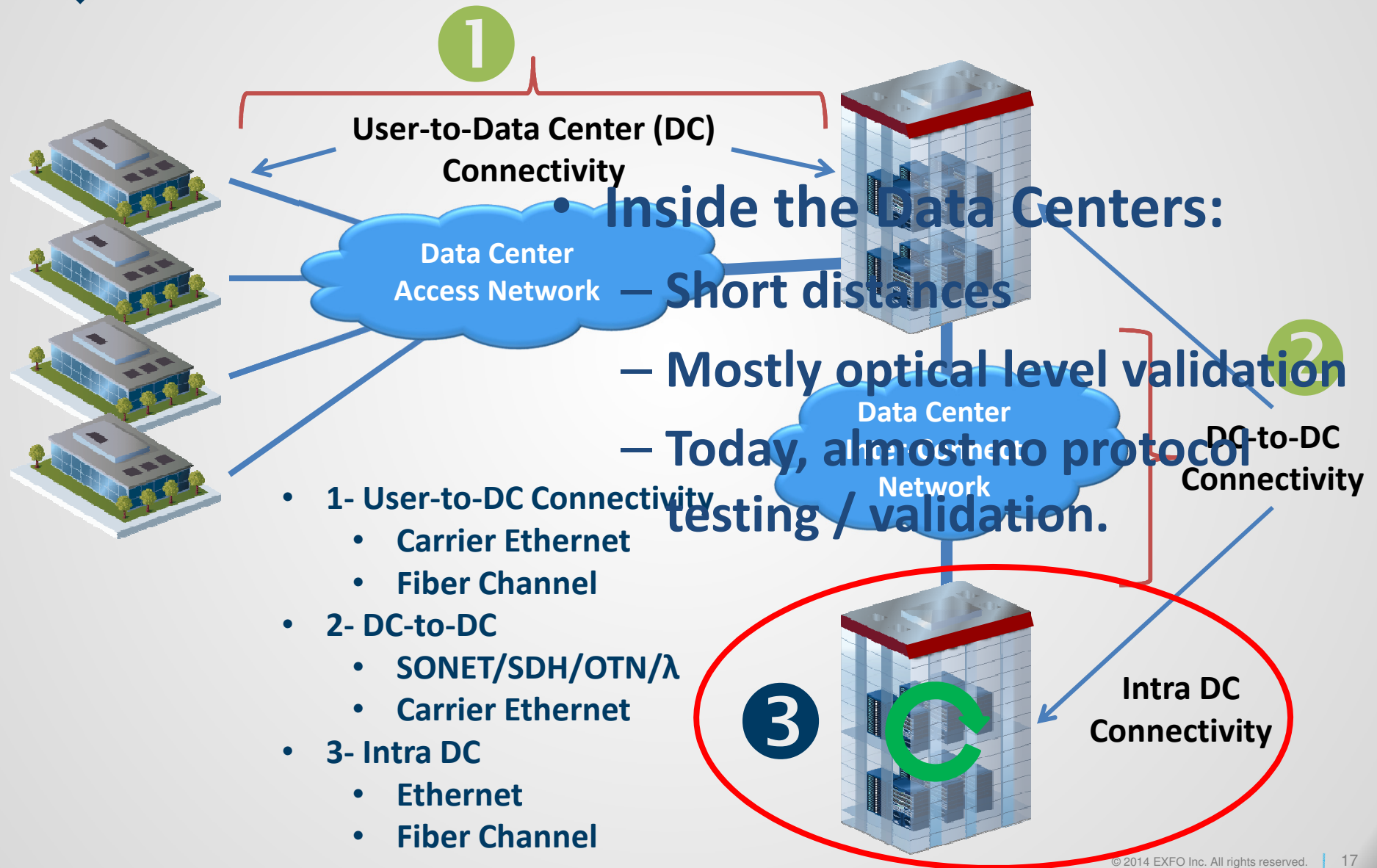
- **Quickly moving to 100G**

Multi-Service EtherSAM (Y.1564) test up to 100GE!

- **Best solution for Data Center Operators / Service Providers to validate Data Center Inter-Connect links: FTB-88100NGE**

①

User-to-Data Center (DC) Connectivity

Data Center Access Network

• **Inside the Data Centers:**

— **Short distances**

— **Mostly optical level validation**

②

Data Center Interconnect Network

DC-to-DC Connectivity

— **Today, almost no protocol testing / validation.**

- • 1- User-to-DC Connectivity
  - • Carrier Ethernet
  - • Fiber Channel
- • 2- DC-to-DC
  - • SONET/SDH/OTN/λ
  - • Carrier Ethernet
- • 3- Intra DC
  - • Ethernet
  - • Fiber Channel

③

Intra DC Connectivity

INCREASING LINE RATES

Client interfaces are all a maximum of 100Gb/s

100G Within The Network

› SFP, XFP, SFP+ used to dominate pluggables market

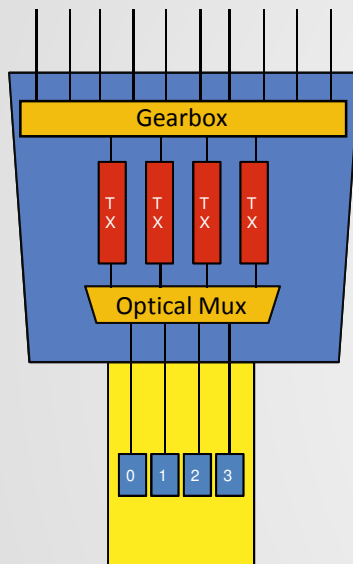› Faster 40G/100G lead to CFP use

SFP, XFP, SFP+

› Single wavelength

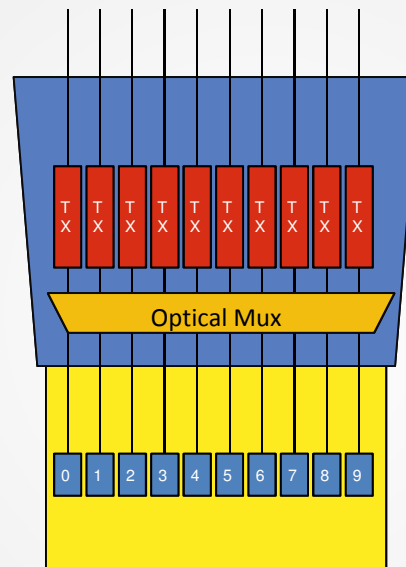**CFP**

› Multiple wavelengths

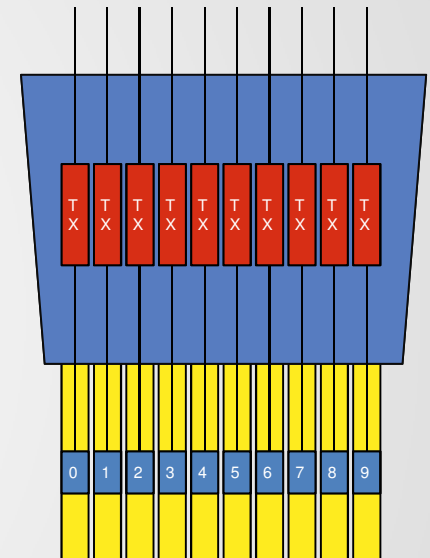# 4 X 25G & 10X10G CFP COMPARISON

LR4/ER4: 4λ

- › 25 / 28 Gbit/s per optical channel
- › Utilises Gearbox
- › High power requirements
- › LR4 – 10Km
- › ER4 – 40Km
- › 1300nm window - SM

LR10: 10λ

- › 10/12 Gbit/s per optical channel
- › No Gearbox – reduced complexity & cost
- › 1550nm window - SM

SR10: 10 fibre

- › 10/12 Gbit/s per optical channel
- › No Gearbox or optical mux
- › MPO connector
- › 850nm - MM

WHY THE DISPERSION REQUIREMENT NOW?

› Core network deployments intra-site only

  › Dispersion effect over 20m?

› Metro deployments over longer range

› CPE deployments can push reach limit

WHY THE DISPERSION REQUIREMENT NOW?

› Dispersion limits defined within IEEE 802.3ba

› LR4 / ER4 only (LR10 only defined in MSA)

Table 88–14—Fiber optic cabling (channel) characteristics

Description	100GBASE–LR4	100GBASE–ER4		Unit
Operating distance (max)	10	30	40	km
Channel insertion loss[a, b] (max)	6.3	18	18	dB
Channel insertion loss (min)	0	0		dB
Positive dispersion[b] (max)	9.5	28	36	ps/nm
Negative dispersion[b] (min)	−28.5	−85	−114	ps/nm
DGD_max[c]	8	10.3	10.3	ps
Optical return loss (min)	21	21	21	dB

[a]These channel insertion loss values include cable, connectors, and splices.
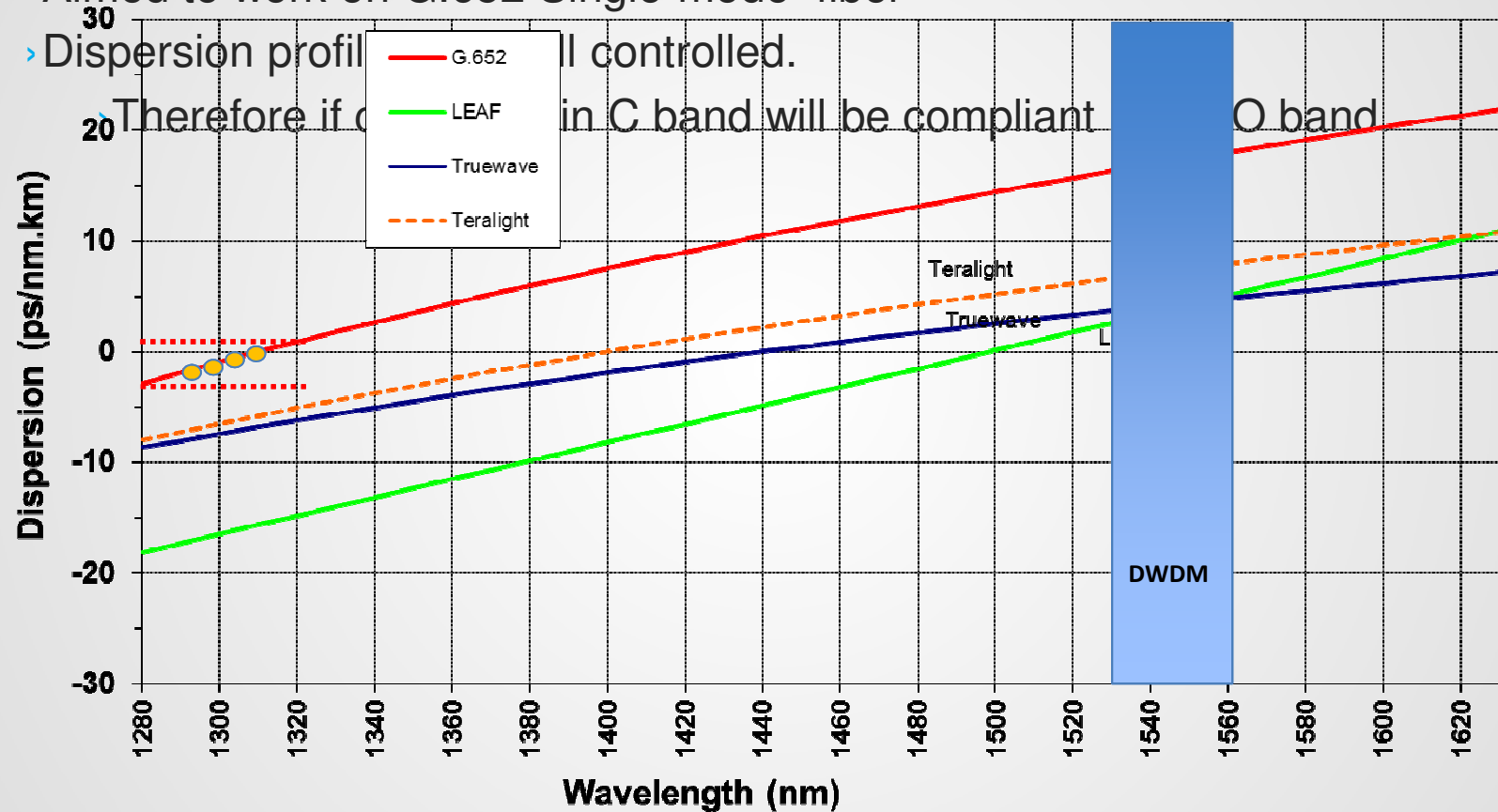[b]Over the wavelength range 1294.53 nm to 1310.19 nm
[c]Differential Group Delay (DGD) is the time difference at reception between the fractions of a pulse that were transmitted in the two principal states of polarization of an optical signal. DGD_max is the maximum differential group delay that the system must tolerate.

WHY THE DISPERSION REQUIREMENT NOW?

› Aimed to work on G.652 Single-mode fiber

› Dispersion profil[...]ll controlled.

○ Therefore if c[...] in C band will be compliant [...] O band

Dispersion Profiles of Various Fibre Types

Legend:
- G.652 (red)
- LEAF (green)
- Truewave (blue)
- Teralight (orange dashed)

Y-axis: Dispersion (ps/nm.km), range −30 to 30

X-axis: Wavelength (nm), range 1280 to 1620

Labels on chart: Teralight, Truewave, DWDM

WHY THE DISPERSION REQUIREMENT NOW?

Description	100GBase-LR4	100GBase-ER4	Unit
DGD_max	8	10.3	ps

› DGD in most normal fibres varies statistically according to Maxwellian distribution

› Average DGD (what we commonly call PMD) value will be several orders lower than the DGDmax.

› To ensure that the average DGD (PMD) will remain below DGDmax for 99.999% we need to divide the DGDmax value by 3.19.

Maxwell distribution

DCD/Avg	Outage probability
3.19	1E-5
3.47	1E-6
3.73	1E-7
3.97	1E-8
4.19	1E-9
4.11	1E-10
4.61	1E-11
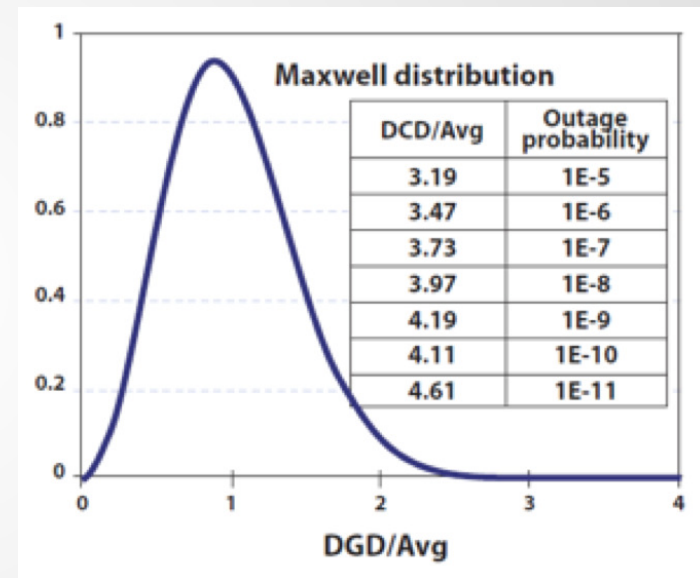
In this case this gives a PMD limit of ~2.5ps & 3.2ps for the LR4 & ER4 interfaces respectively.

Dispersion Product Portfolio

› Single Ended Solution : FTB-5700
- › CD & PMD Single button press
- › Distances up to 150km

› Dual Ended solution: FTB-5500b & FTB-5800
- › All application spaces
- › Greater dynamic range
- › Advanced Features

Now ultra low PMD

› Distributed PMD: FTB-5600
- › Find bad section of link
- › Extend network life

CFP Spectral Analysis Portfolio

›C

›C
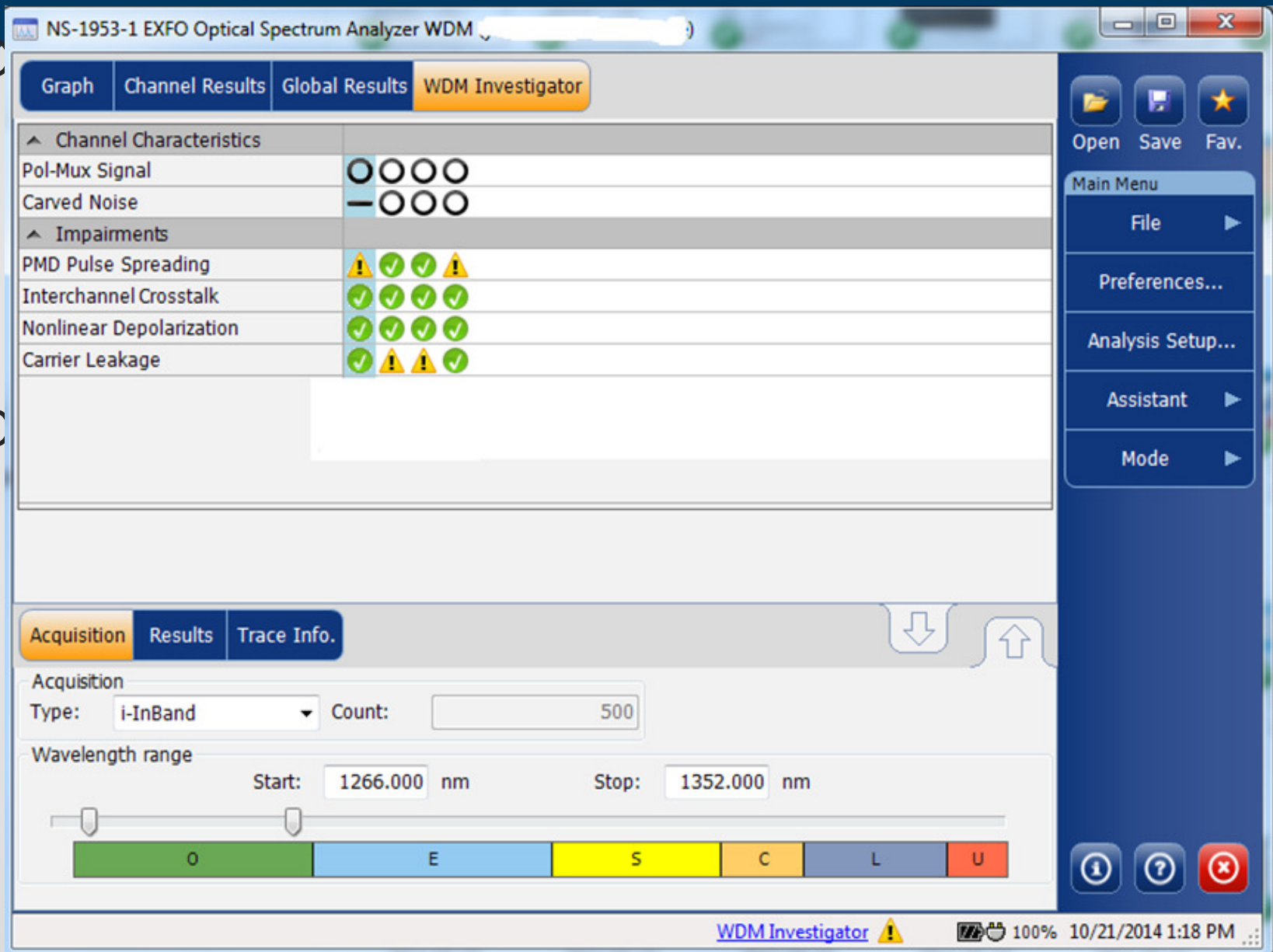
Detailed IP application analysis Challenger

Data Center Focus: IP Application Analysis

› Automatic IP flow and application analysis for 1000+ OTT applications with QoS over 1GbE or 10GbE links
› GTP-U, GRE and L2TP tunneling support
› Application classification, metadata and QoS
› Up to 30k+ IP Application sessions per sec
› Up to 1M pkts analyzed per sec in realtime (6Gbps+ of typical internet data)
› Analysis also by postprocessing from capture files to improve performance
› Flow record storing to fDR database

Sample statistics:
- Top WWW sites visited
- Worst DNS response time
- Top applications

Sample flow view:
- Customer usage by application
- TCP window size
- Re-sent TCP packets
- Average throughput for FTP sessions and amount of data downloaded

What applications are used in the network?
How much data does Skype use in the network?
Who is using most of the data?
What is the MOS value of SIP calls?
How do my customers experience FTP downloads

| SUPERIOR CAPTURE AND RECORDING-TO-DISK PERFORMANCE | REALTIME IP APPLICATION ANALYSIS | EASY-TO-UNDERSTAND REPORTS FOR QUICK PROBLEM SOLVING |

TravelHawk Pro

› **Multiple 1 and 10 GigE** interfaces supported simultaneously
  › IPv4 and IPv6 support
› **Wireless analysis** capable of handling and storing **millions of calls per hour**
  › Wireless network statistics (e.g., rates/failures/counts)
  › Full LTE and packet core support (e.g., S1-MME, S11, S6a, Gn, SGi, Gi, IMS)
› **Detailed IP application analysis** (e.g., Skype/Google/YouTube/e-mail)
  › IP network and application statistics (e.g., top WWW servers, DNS queries, throughputs)
  › **Correlated control- and user-plane analysis**
› Protocol-level drill down with full details for root-cause analysis
› VoLTE voice-quality MOS analysis, SIP support, RTP Voice playback

Main Features
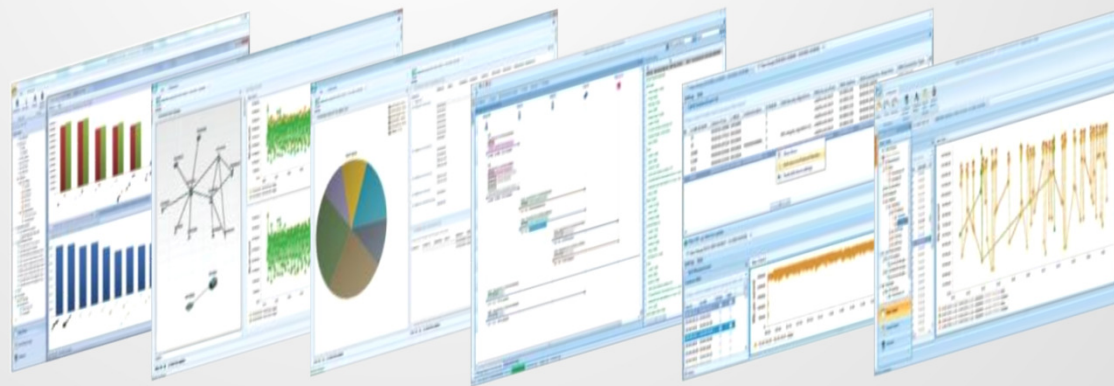
Levels of Analysis
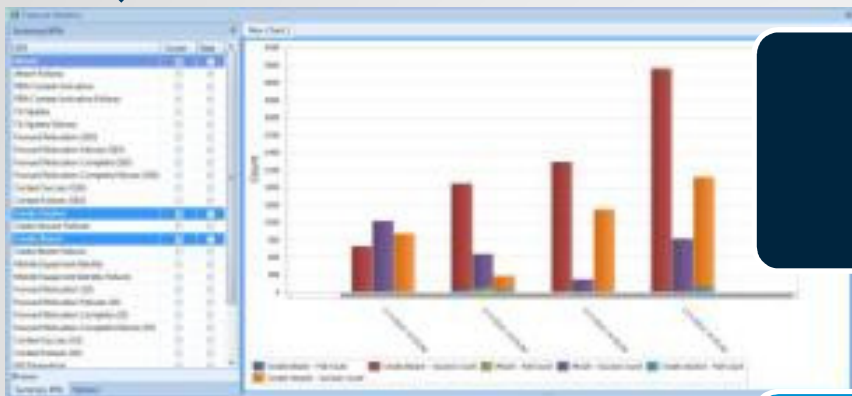
Statistics

High-altitude view
(e.g., amount of dropped
calls in an area)

Session and Flows

Correlated signaling and
flow data

Details

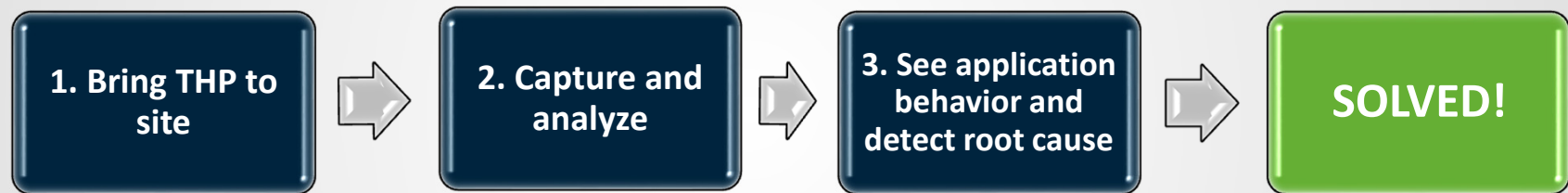Every message or details of
the message from the
sessions and flows

Integrated DPI

› **Deep packet technology (DPI) utilized for maximum application level accuracy**

  › Application classification—identification of network applications (over 1000 protocols)

  › Key parameters (metadata) provided for each application (thousands of parameters)

  › All information stored to database for easy searching and analysis of sessions
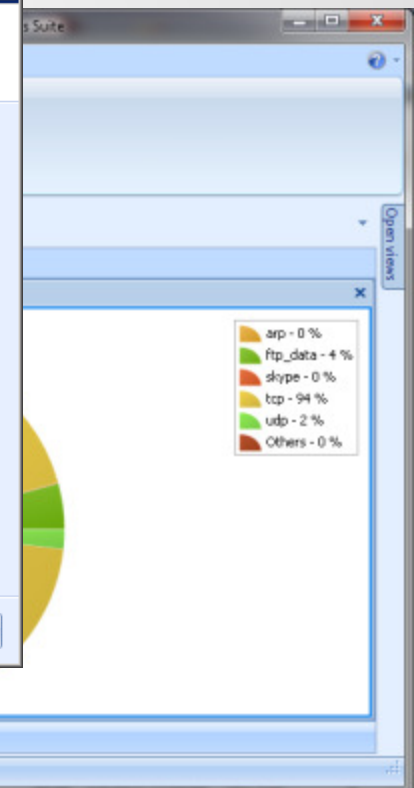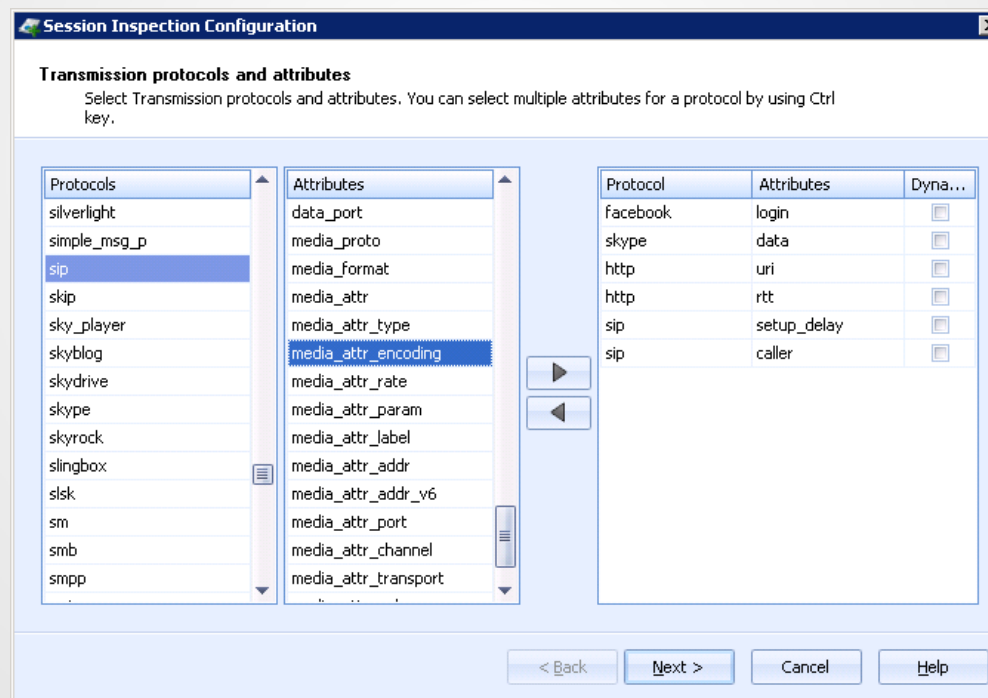
Usecase: Application Troubleshooting

Poor application connection/stability/QoS
(e.g., YouTube throughput, facebook connection time, Skype throughput, VoLTE MOS score)

1. Bring THP to site → **2. Capture and analyze** → **3. See application behavior and detect root cause** → **SOLVED!**

› **Benefits of our solution**

- Analyze data from wireless interfaces and Internet

- Speed up application analysis through application detection

- UNIQUE TO THP: Deepest IP application analysis in the portable market (95% of apps detected and analyzed)

› Automatically sees the application and its behavior (e.g., throughput/error in the connections). Sees transmission issues, i.e., the quality classes when correct DNS servers are used,. Checks different servers (e.g., YouTube/FB have different service levels)

› Detects if the root cause is in the network configurations, in the application server or in transmission network

Thank you!