
# SCTE New England Chapter

***Member Appreciation Event and Technical Session***

## *A Go!Foton Perspective on Passive Optical Network (PON) Deployment*

Michael Zammit, VP & GM Connectivity Solutions

December 13, 2022

# Roadmap

- Who the heck is Go!Foton anyway?
- What is PON?
- ODN Architecture
  - Centralized vs Distributed Splits
  - Distributed Splits with Tapping
- Deployment Challenges
- Q&A

# Who the heck is GoFoton?

- Privately held, US based company, HQ in in Somerset, NJ
- Historically Focused on Tier 1 Service Providers, System Vendors and the Data Center market
  - Pivoting to support broader Independent Telco, MSOs, Muni's, WISPS, Electric CO-OPs
- Global presence: USA, Netherlands, Japan, Philippines, and China
- Products & Solutions:
  - Fiber Connectivity
  - Active
  - Optical Device solutions
- Own manufacturing facility in Philippines
- 44 approved Patents
- Our culture:
  - Frictionless engagement
  - Innovation driven
  - Bring Light to Life
- Experienced team with extensive Tier 1 service provider expertise

# Go!Foton's Coming Out…

Nippon Sheet Glass Co. Ltd. (a.k.a. NSG Group) established — 1918

SELFOC® Technology developed by NSG — 1968

NSG Fiber Optics Division established — 1971

NSG America established in California; later moved to NJ — 1983

2000

FiOS PON Filter for Video Overlay — 2005

NSG dominated global Gradient Index (GRIN) lens market with SELFOC lenses as a sole source for passive devices for optical networks

**2009** GoFoton established through a management buyout of NSG Telecom Division

Acquired Zenko Technologies to strengthen its module business — 2010

2013

Passives, Actives and Connectivity Streamlined to be three Business Lines

PEACOC products started to be deployed in field — 2015

2016

Sole source for Cisco, Ciena and Nokia MPO jumpers and loop backs

Verizon AVL Jumper, cable & HD Fiber Panels — 2017

2018

Successfully delivered solutions for MSE Core Routers, VHOs and VCP applications

Volume PEACOC Shipments supporting Tier-1 MSO Remote-PHY — 2020

2021

Launch PEACOC OSP Solutions for FTTx

# Volume Manufacturing Capabilities

- **Factory floor space: ~130,000 sq. ft**
- **Location: Biñan, Philippines**
- **Workforce of ~1,200**
- **Design and manufacture of high-quality materials, components and devices in the field of:**
  - Fiber optics telecommunications
  - Datacenters
  - Imaging
  - Medical applications
- **Established track record to deliver custom solutions in 2-6 weeks**
- **Telcordia & Customer audited & certified facility**
- **Certified manufacturing processes ensuring the highest quality:**
  - TL9000, ISO 9001
  - ISO 14001, RoHS, REACH
- **Committed to protecting the environment**

# Product Portfolio: 90,000-ft View

## Connectivity Solutions

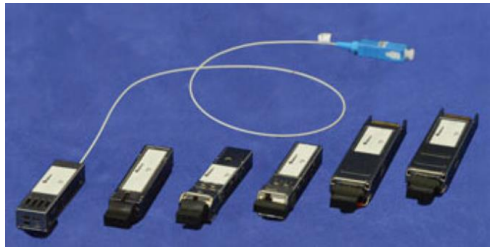
- Optical Fiber/Cable Assemblies
- PEACOC® High-Density Fiber Panel & Frame Solutions
- OSP Solutions: Fiber Terminals, Hubs, Splitters, and Indoor Living Unit Solutions, FTTA/Drop Cables
- EKO™ Intelligent Fiber Monitoring

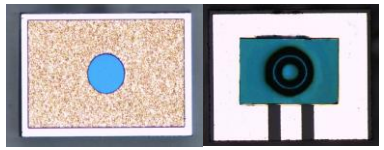

## Passive Optical Devices

- xWDM modules
- Fiber Tapping devices
- PLC Splitters / Couplers
- SELFOC® GRIN Lenses
- Collimators
- PD/APD Power Monitors and Taps
- Tap Photodetector Arrays
- Medical probe assemblies

## Active Optics

- XGS-PON Transceivers
- NG-PON2 Transceivers
- PON Reach Extenders
- PON Line Combiners
- Datacom 10G-100G Transceivers
- InP/GaAs Photodiode Wafers & Chips

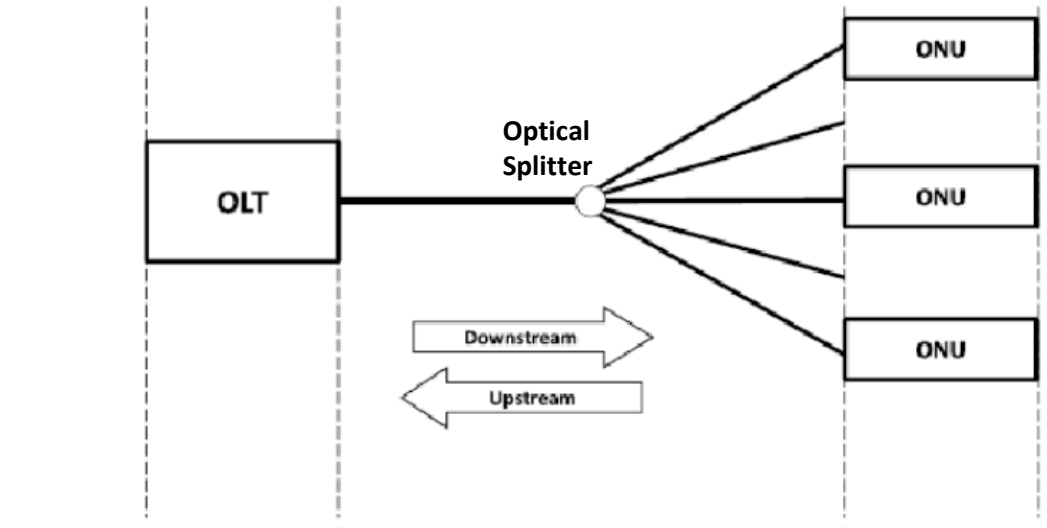




# What is PON?

# Passive Optical Networking (PON)

- Last mile fiber technology developed in the early 1990's (various ITU & IEEE standards)
- Designed to deliver POTS, RF video, & data to residential customers
- The network topology is characterized by being a shared, point-to-multipoint network using passive optical splitters
- Utilizes both WDM and TDM as underlying technology



# Main components: OLT

**Optical Line Terminal**

- The Network Element between the service providers core network and the PON
- Uses bi-directional optics to send/receive signals from the PON over a single fiber
- Performs wavelength and time diving multiplexing, bandwidth allocation & QoS management
- Typically, each OLT port will support up to 32/64/128 ONTs at a distance of 20km from the OLT

# Main components: ONT or ONU

**Optical Networking Unit or Terminal**

- Terminates the single fiber at the customers premises
- De-multiplexes the signal for each service (Voice, Video, Data)
- Presents native format: RJ11, RJ45, COAX
- Provide power for POTS (if used)
- May include an Integrated WiFi router
- May include battery backup

# Main component: ODN

**Optical Distribution Network**

- The “plumbing” required to deliver the optical signals back and forth between the OLT and ONTs
- CO/HE ODF, Splitters/MUXs
- OSP Distribution & Feeder Cable
- Fiber Splice Closures
- Fiber Distribution Hub or Terminal
- Optical Splitters
- Multi-port Service Terminal for Drops
- Drop Cables & Network Interface Device



7-ft Frame 9-ft Frame

Full HD Frame Deployments
3456/4320/6912 LC Ports

HD Cassette for
Optical Modules
Monitor Taps, CPRI, xWDM,
GPON Filters & Splitters

# Alphabet Soup Anyone?


**Not all PON is created equal!**

**Legacy ATM Based**
- APON
- BPON
- GPON
- NG-PON
- NG-PON2
- XG-PON
- XGS-PON

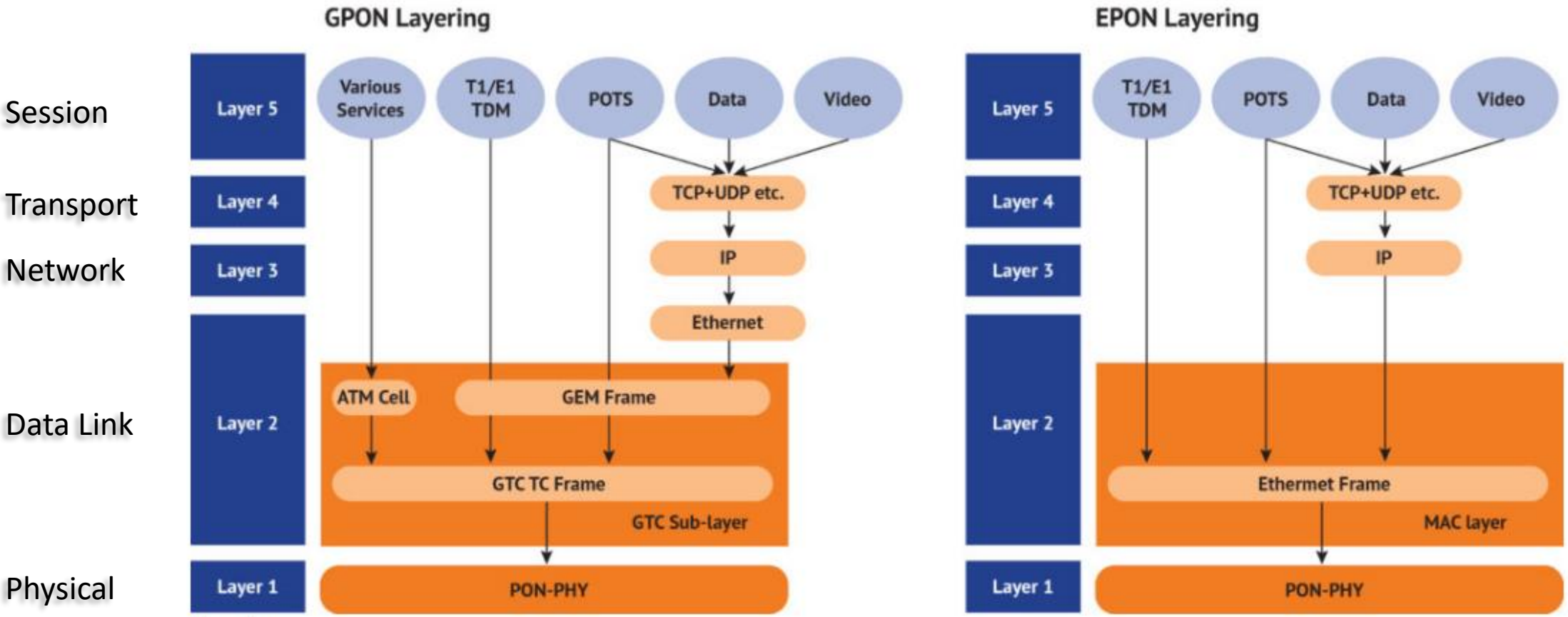
**Ethernet Based**
- EPON
- 10G/1G-EPON
- 10G-EPON

**Other PON Variants**
- RFoG
- WDM-PON
- 25G/50G-PON

All are Point-2-Multipoint Architectures
All use totally passive ODN
TWDM is the underlying technology

The main difference is in the treatment of the packets!

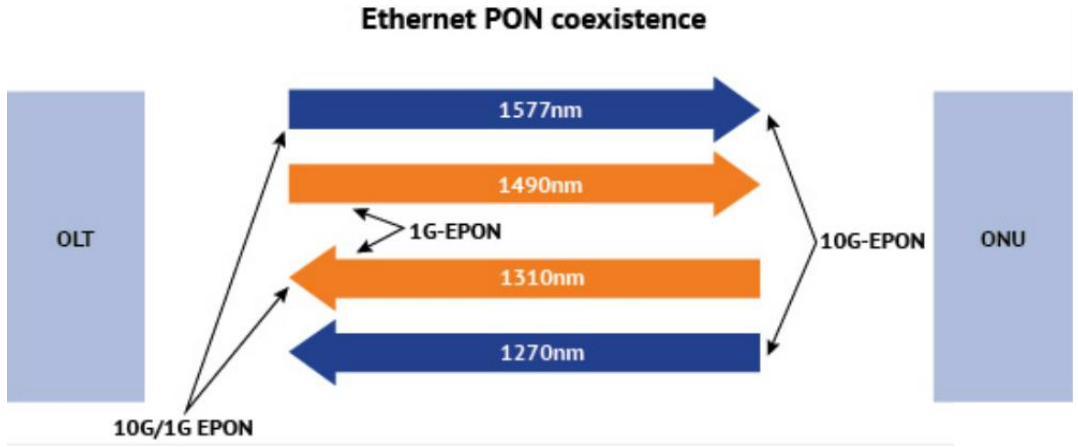
# What's the real difference?

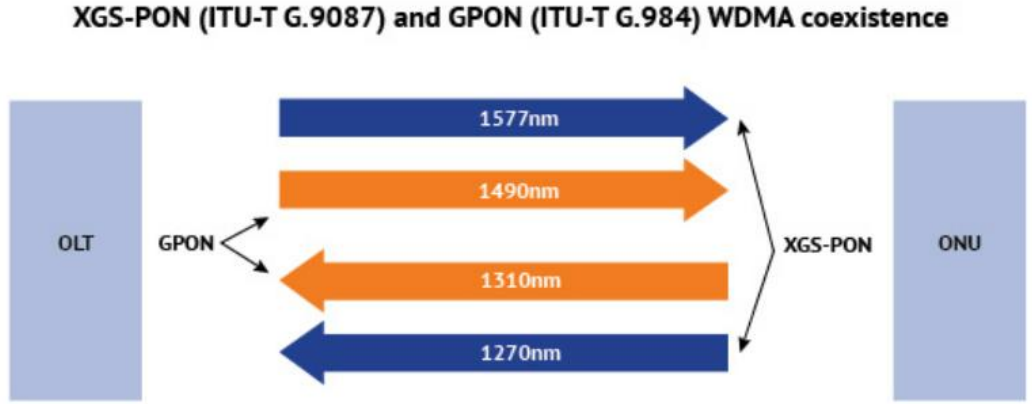


# Seriously, what's the real difference?

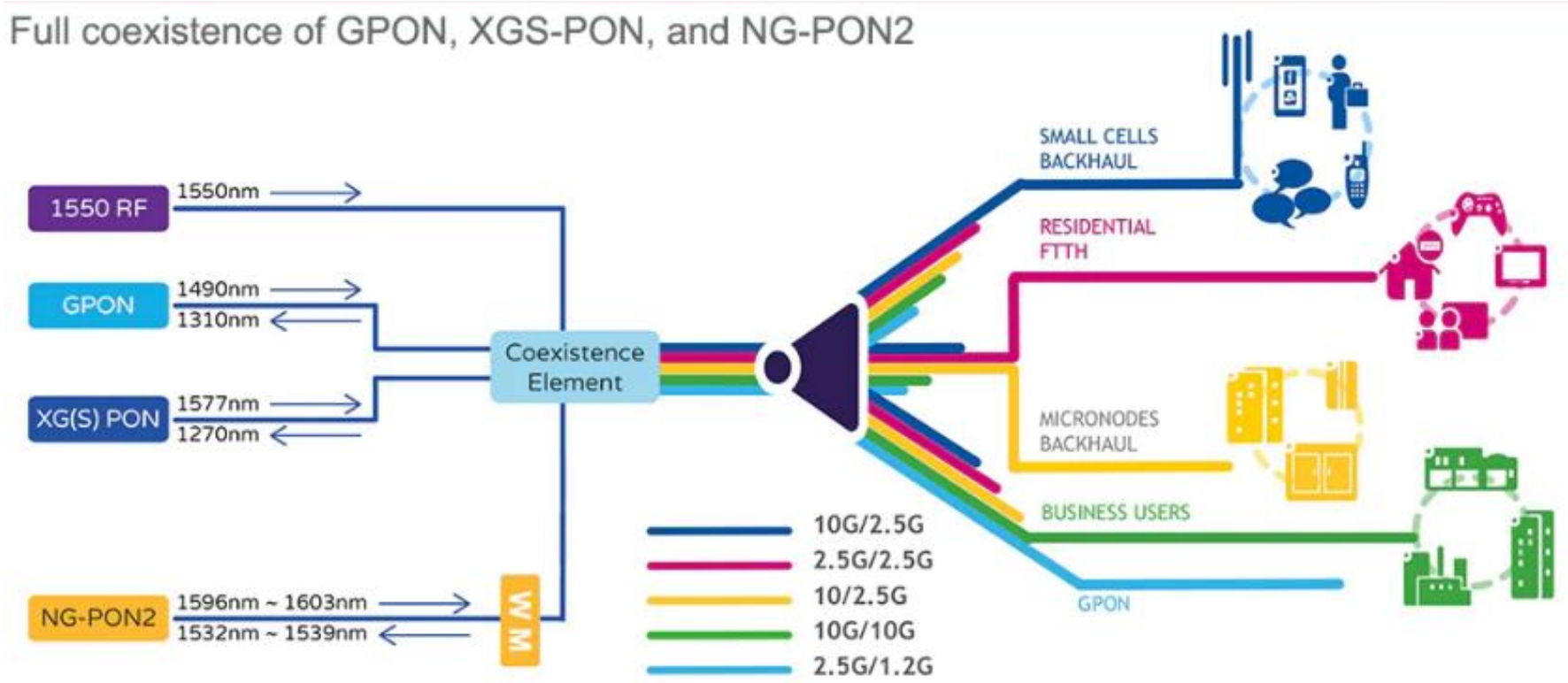
| Name | Standard | Data Rates | | Comment |
|---|---|---|---|---|
| | | Upstream | Downstream | |
| BPON | ITU-T G983.x | 622 Mbit/s | 155 Mbit/s | based on ATM |
| GPON | ITU-T G984.x | 2.5 Gbit/s | 1.25 Gbit/s | based on ATM |
| EPON | IEEE 802.3ah | 1 Gbit/s | 1 Gbit/s | based on Ethernet |
| 10G-EPON | IEEE 802.3av | 10 Gbit/s | 10 Gbit/s | based on Ethernet |
| XG-PON | ITU-T G987.x | 10 Gbit/s | 2.5 Gbit/s | based on ATM |
| NG-PON2 | ITU-T G989.x | 10 Gbit/s<br>10 Gbit/s | 10 Gbit/s<br>2.5 Gbit/s | TWDM, 4 λ<br>p-t-p WDM, 8 λ |
| XGS-PON | ITU-T G9807.1 | 10 Gbit/s | 10 Gbit/s | Symmetric GPON |
| NG-PON2 Amd1 | ITU-T G989.x | 10 Gbit/s | 10 Gbit/s | TWDM, 8 λ<br>p-t-p WDM, 16 λ |
| NG-EPON | IEEE 802.3ca | 25 Gbit/s<br>50 Gbit/s | 25 Gbit/s<br>50 Gbit/s | future standard |
| G.hsp.x | ITU-T SG15 | 50 Gbit/s | 50 Gbit/s | future standard |

Passive optical network (PON) standards.



# Coexistence



# Why is PON better?

***Best performing network hands down***

***Eliminate power from the ODN*** *– no power, no batteries, etc..*

***Speed and Ease of Implementation –*** *especially inside wire for MDU*

***Multi-Service Network:*** *One network supporting residential, business, Mobile front/back-haul, GPS timing for DAS, etc.*

***Lower Maintenance:*** Relatively easy to trouble shoot and fix failures in the PON network

***Future Proof Network:*** *Mux new wavelengths or u*pgrade the OLT & ONT. No need to rebuild the ODN.

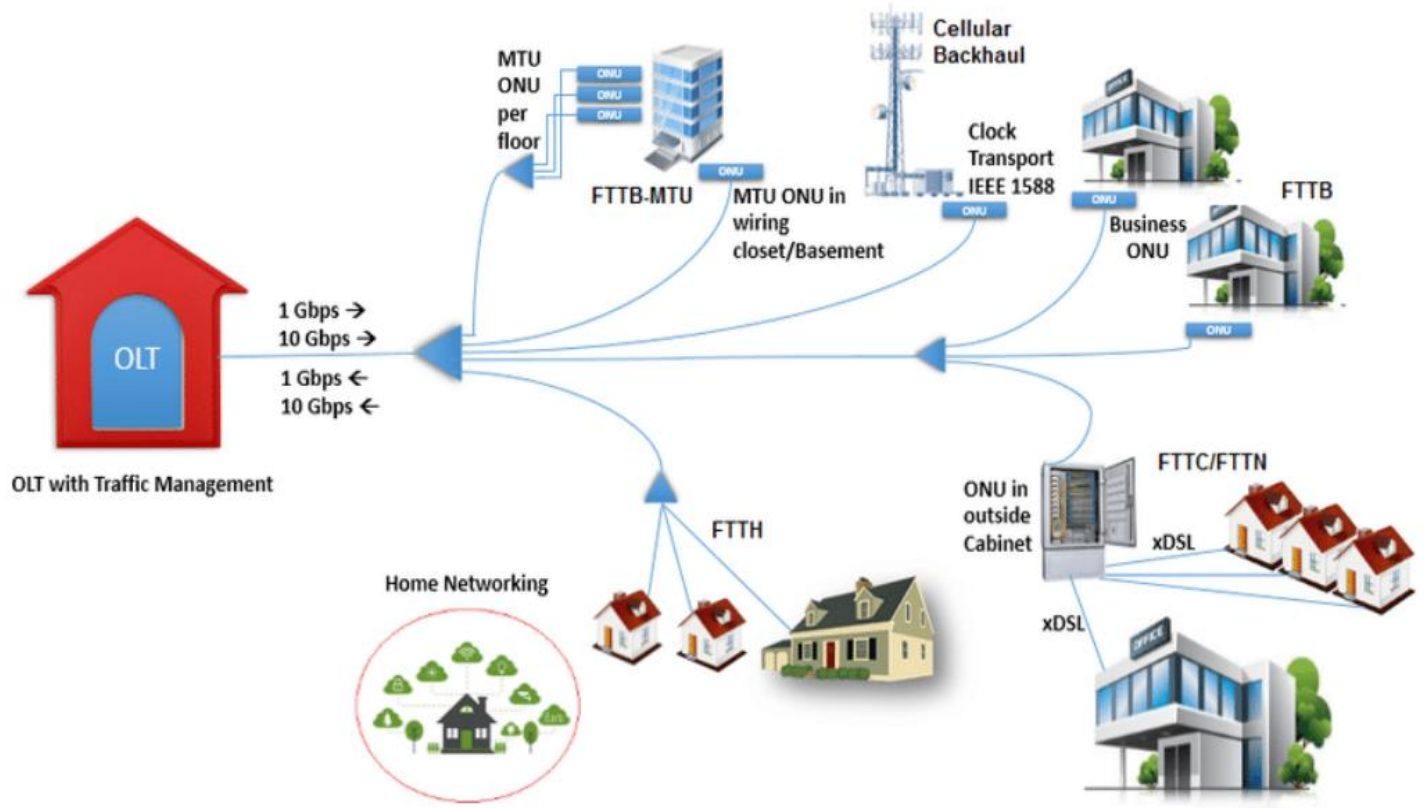
# Why are service providers switching to PON?

• Converge residential, business broadband and mobile “anyhaul” on one common infrastructure

• Accelerate 5G & small cell deployments

• Generate new revenue streams and improve ROI on new infrastructure
  - •25-40% take rates for profitability
  - •Depends on density, SFU vs MDU

• Delight customers with premium Gigabit and multi-Gigabit services




Next-generation EPON. ONU, optical network unit; OLT, optical line terminal.

# ODN Architecture

# PON Topologies

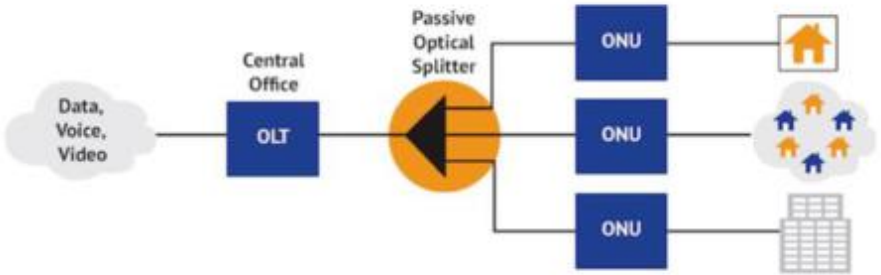
1. Centralized Split

2. Cascaded or Distributed Split

3. Distributed Split
   with Engineered Taps

# ODN Design Considerations

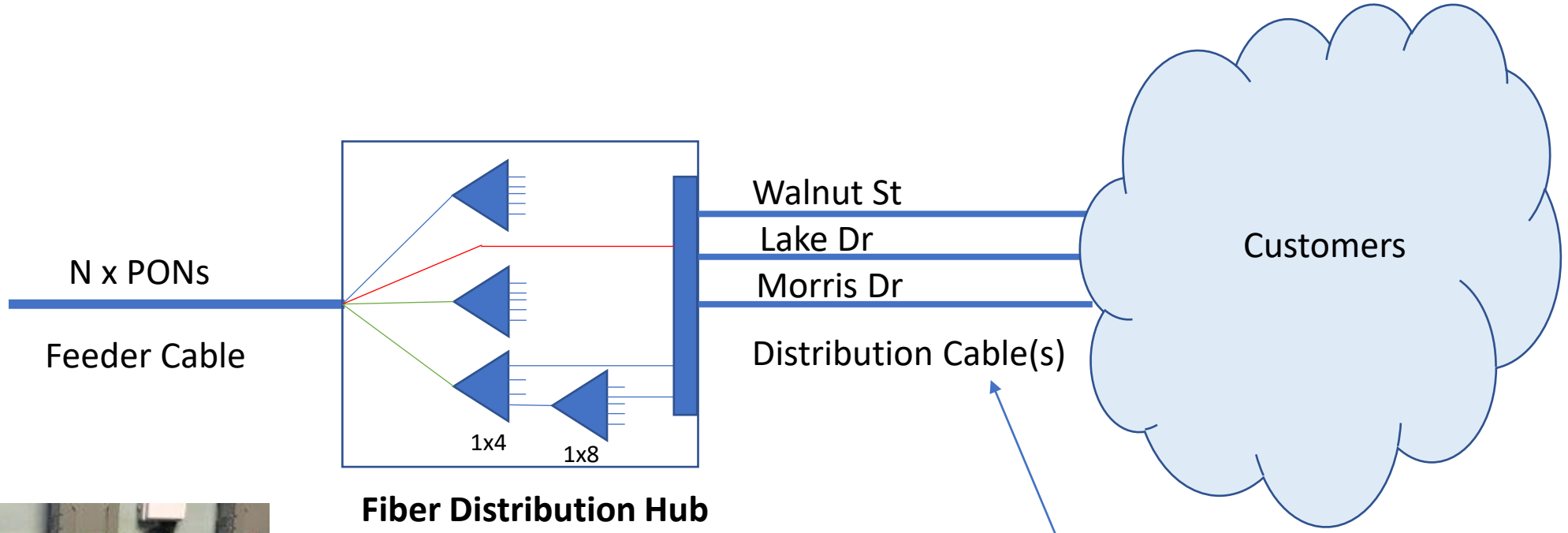
- Subscriber Density – urban or rural
- Subscriber Mix
  - SFU, MDU, Business, Other (e.g. cellular, small cell, IoT)
- Aerial or underground plant
- RoW or aesthetics
- Future Growth Needs




**Designers must ensure adequate optical power going both directions**

| Component | Typical loss values @ 1550 nm |
|---|---|
| Fiber | 0.2 dB/km |
| Splices | 0.05 dB |
| Connectors | 0.2 dB |
| Splitters (1x32) | 17-18 dB |

# Centralized Splits




**Fiber Distribution Hub**

144/288/432-Ports

- Allows for Splitter Bypass
- Multiple Split Combinations
- Highest OLT Port Utilization

# Cascaded or De-Centralized Splits

1x8

8x Customers

Distribution Splice/Terminal
Branch Splice/Terminal
***With Integrated Splitter***

1x2

N x PONs

1x4

4x Customers

1x4

FAT
MST
Drop Terminal
***With Integrated Splitter***

16-port MST/FAT
16-port Drop Terminal
***With Integrated Splitter***

Dual
1x8

16x Customers

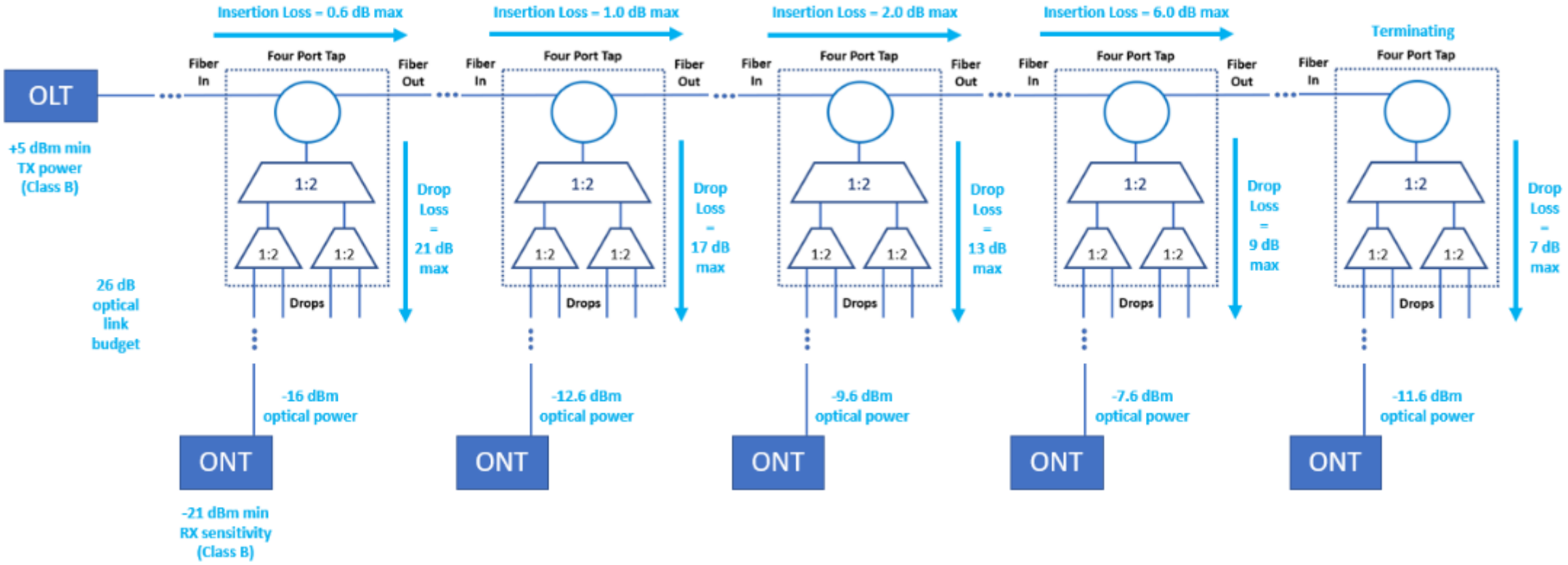
1x4

4x Customers

- **Less Distribution Fiber $$$**
- **Less efficient OLT Port Utilization**
- **No Splitter Bypass**

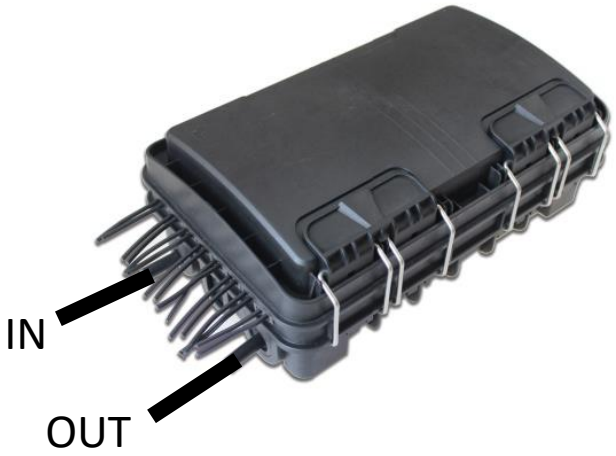
GoFoton

# Distributed Split with Taps

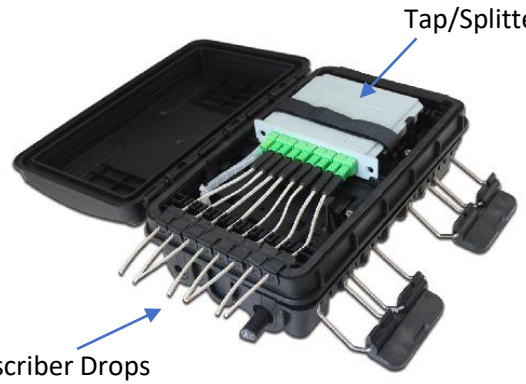



https://www.exfo.com/en/resources/blog/rural-fiber-distribution-solutions/

# OSP Terminal with Integrated Tap-Splitter




Mid-Span Splice Terminal
Up to 144F Feeder Cable
+ 2x Branch Cables




- Flat or Round Cable
- Precon or Field Install

Tap In/Out Splice
+ 48F Branch Splicing

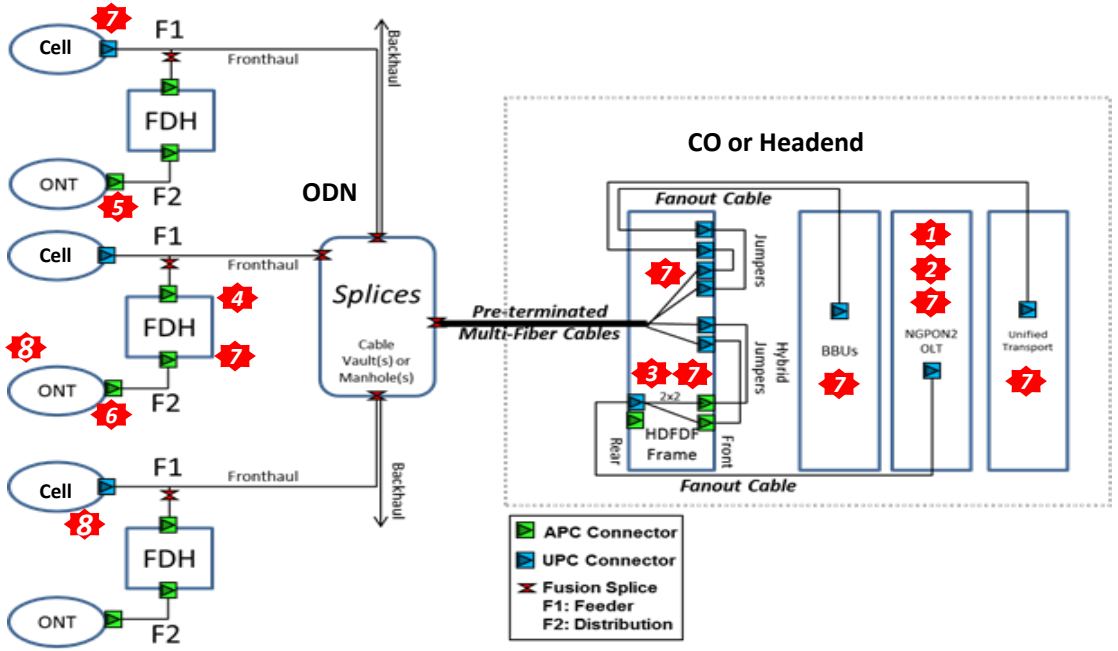
8ft Buffer Tube Storage

Separate chambers for feeder cable entry & splice and subscriber drop connections

# PON Deployment Challenges

- Densification of Fiber
  - More fiber, more ports, less space
  - ROW challenges.  How do you do more with less?
- New Technology
  - Bend Optimized Fiber – G652.D, G657.A1/A2/B3?
  - Smaller Form Factor Jumpers 2.0mm, 1.6mm, 1.2mm?
- Supply Chain
  - Beware of highly proprietary solutions
- Labor

# Go!Foton Solutions for Successful PON Deployment




## Go!Foton Fully Integrated ODN Solutions for PON

1. NG-PON2 OLT N2 Transceiver
2. High quality WM1 for US/DS
3. CEx-1/2, 2x2, 4x4
4. 1xn, PLC based splitters
5. NG-PON2 ONT Transceiver
6. RF-Video overlay
7. PEACOC HD Packaging & Cable Terminations (CO & OSP)
8. OSP Terminals & Drops

### Active Optical Components

- Low Dark Current PD/APD
- High Speed Burst Mode Receiver for OLT Transceiver
- Tunable ONT Transceiver

### Passive Optical Components

- TFF based filters – WM1 & CEx
- PLC Splitters for FDH/Terminals
- TFF Monitor Taps

### Fiber Connectivity

- PEACOC Panel, OSP FDH
- Fiber Patch Cords & Drops
- MST Drop Terminals
- Next Gen Cable & Connector Technology

**Go!Foton Integrated Solutions Transforming Fiber Networks**

Thank you!