The Importance of Fiber

67%

Rural Migration Study: 67% of people chose where to live based on access to a reliable high-speed internet connection

1.5%

10% increase in high-speed broadband access can result in ~1.5% increase in annual per capita growth

The Time is Now to Close the Digital Divide

Did you know?
24 million Americans do not have internet service at home. Many of these households are located in rural and remote areas.*

To connect underserved and unserved areas, the government has allocated billions of dollars for the development of critical broadband infrastructure and services.

This is a once in a generation opportunity for digital leaders to transform their communities and change lives.

Simplify. Excite. Grow.

Over $80B Future Public Funding for Rural US

ARPA Projects
$15B

NTIA Tribal
$2B

NTIA Tribal
$1B

Re-Connect 3
~$1.2B

Re-Connect 4
~$1.2B

Re-Connect 5
~$2B

IIJA Broadband, Equity, Access & Deployment (BEAD)
$42.5B

FCC USF started in 2016

Future FCC USF: CAF and RDOF $30B

2022

2023

2024 to 2028

Simplify. Excite. Grow.

Why Broadband Is an Essential Service

- Economic development

- Education

- Telemedicine

- Social/ Civic engagement

- Public Safety

- Vols Football

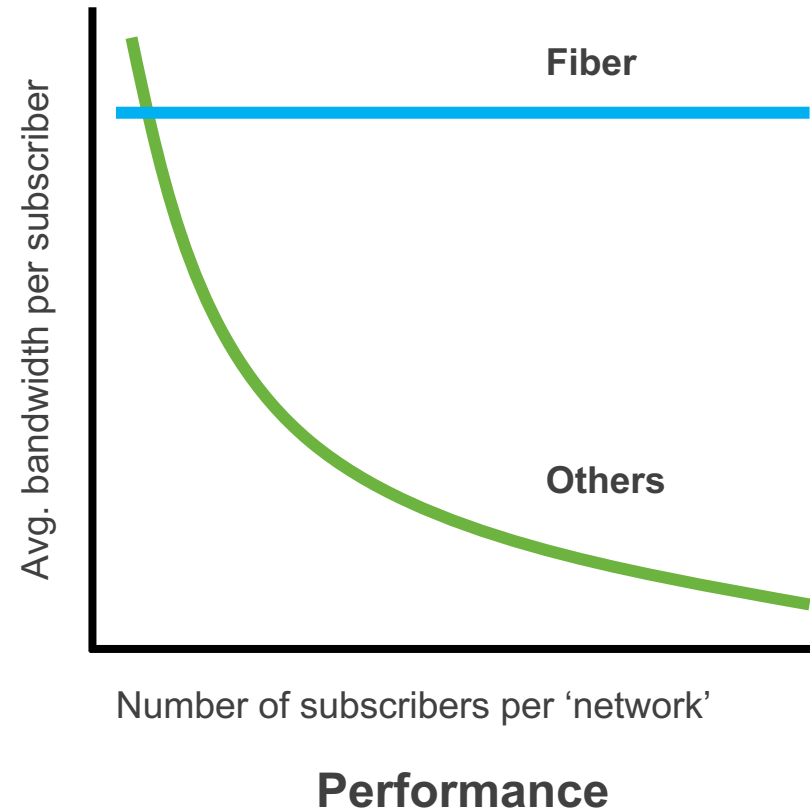# Factors Driving Fiber Deployment

Why Fiber?

It's just better

- **Unmatched capacity**

- **Extended reach**

- **Flexible deployment**

- **Longevity**

- **Upgradability**

- **Low maintenance cost**

The Case for Fiber

- Performance (by any measure)

- Extended reach without performance impact

- Large number of subscribers without performance impact

- Gig+ speed everywhere!

What about the future?

Fiber

Others

Avg. bandwidth per subscriber

Number of subscribers per 'network'

Performance

Simplify. Excite. Grow.

Fiber from the Operator Perspective

- **Serve multiple customer segments**

- **Smart Grid modernization – 43% reduction in power outages***

- **Low OPEX, allowing you to focus on customer experience**

- **Improved service, innovation, and job creation**

*Source: Chattanooga Economic Impact Study

– Professor   Bento Lobo UT-Chattanooga

NOTE: Each fiber is the size of human hair

The Case for Fiber

- Light travels faster than electrical pulses, so fiber can transmit more bits of data per second and offer higher bandwidth.

- Fiber only loses 3% of the signal over distances greater than 100 meters, compared to copper's 94% loss of signal

- With no electric current fiber optic bundles are fully resistant to fire, electromagnetic interference, lightning, or radio signals.

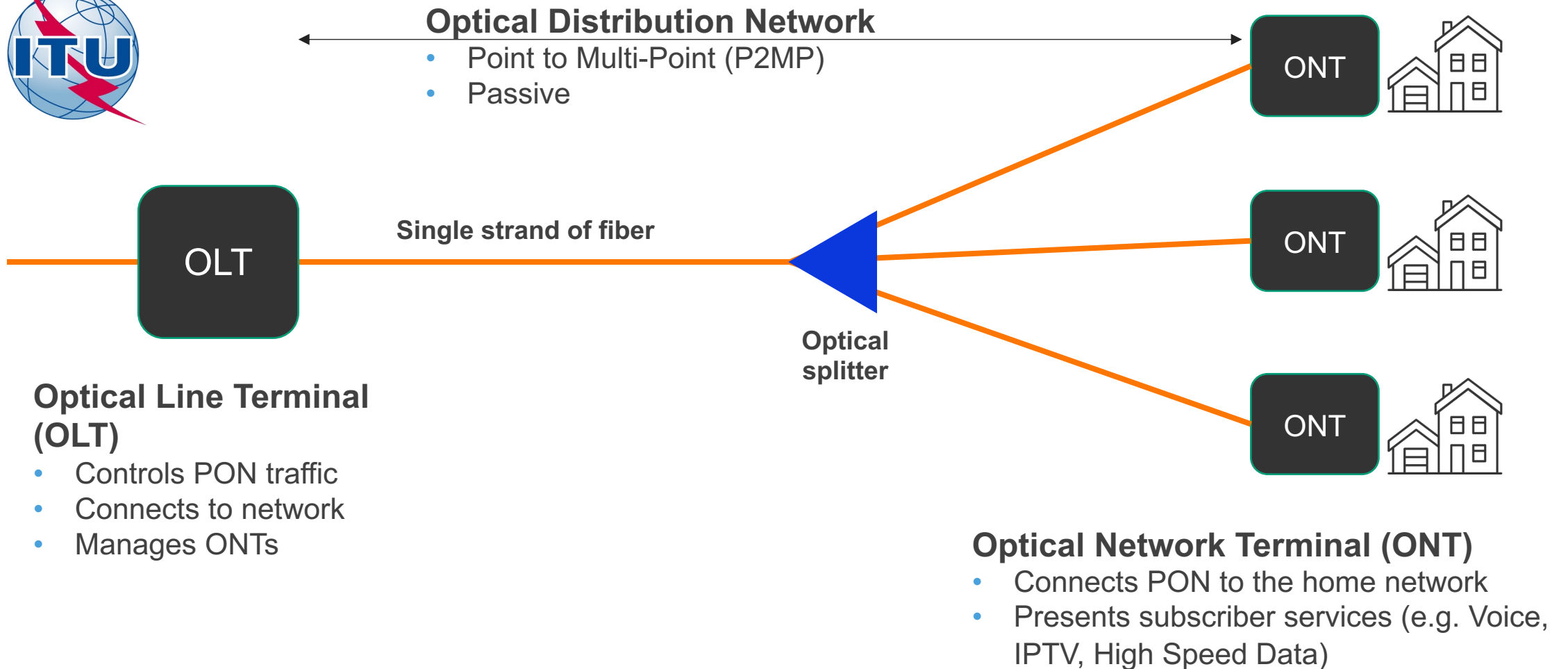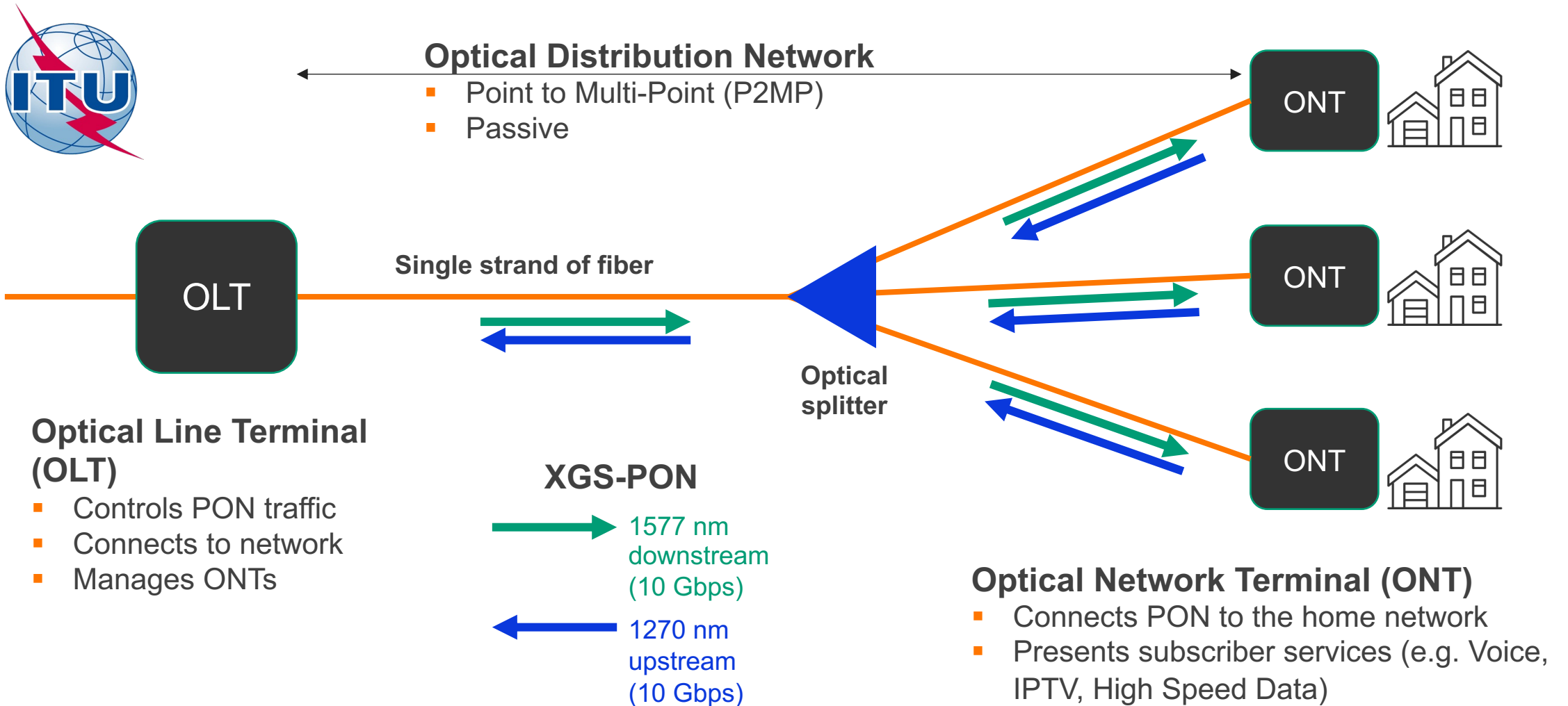- Fiber is smaller, lighter, and more durable than copper cabling

FIBER OPTIC

TWISTED PAIR

COAXIAL

Passive Optical Network (PON) System

Optical Distribution Network
- Point to Multi-Point (P2MP)
- Passive

Single strand of fiber

OLT

Optical splitter

ONT

ONT

ONT

Optical Line Terminal (OLT)
- Controls PON traffic
- Connects to network
- Manages ONTs

Optical Network Terminal (ONT)
- Connects PON to the home network
- Presents subscriber services (e.g. Voice, IPTV, High Speed Data)

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XGS-PON

1577 nm downstream (10 Gbps)

1270 nm upstream (10 Gbps)

Optical Network Terminal (ONT)
- Connects PON to the home network
- Presents subscriber services (e.g. Voice, IPTV, High Speed Data)

Outside Plant Architectures

Centralized Split 1x32
(Urban)

Distributed Split 1x32
(Suburban)
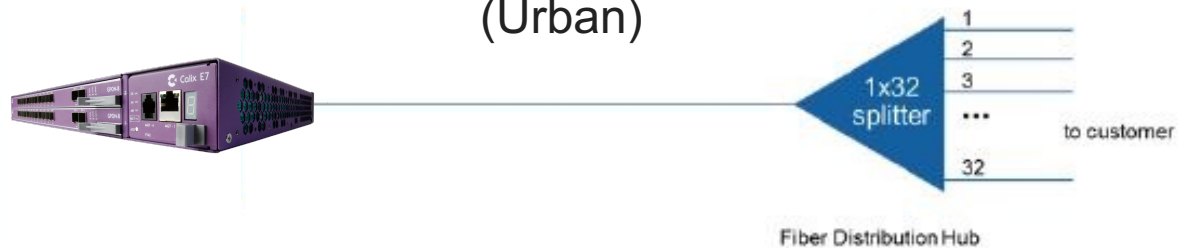
Active Ethernet 1x1
(SLA Large Business)
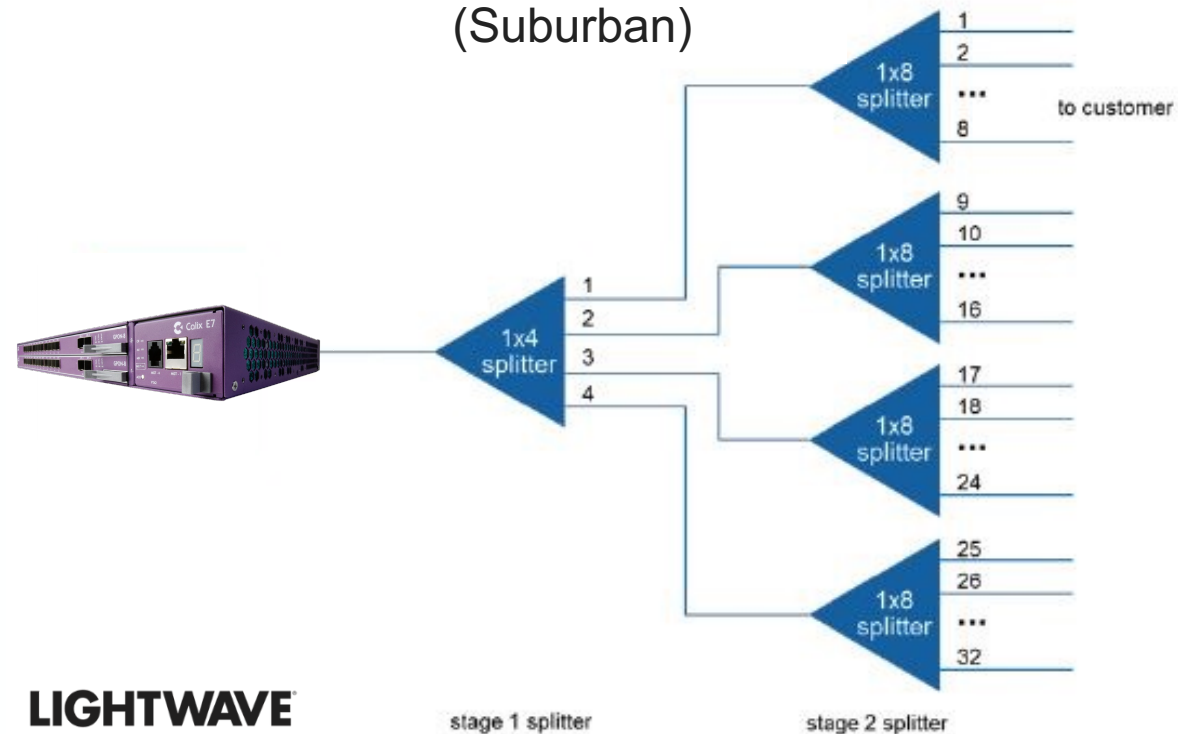
Distributed Tap 1x32
(Rural)

COMMSCOPE®

LIGHTWAVE®
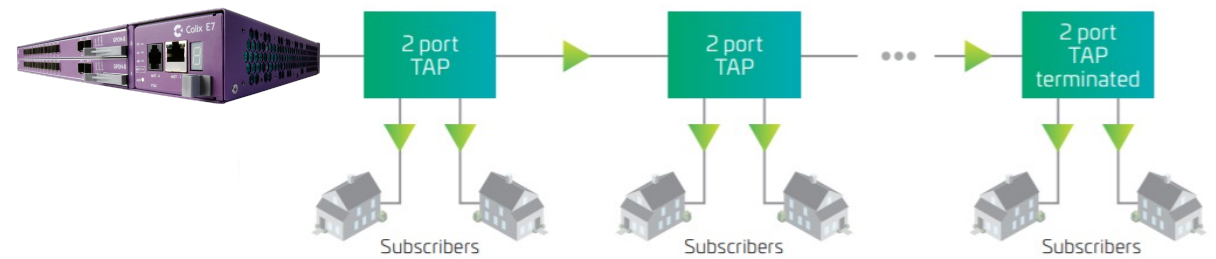
Calix OLT Systems

E9-2

High density OLT and subscriber services edge router
(256 GPON ports per system)

E7-2

1RU hardened 2-slot OLT and Ethernet aggregation system for CO and cabinet
(16 GPON ports per system)

E3-2

Field-serviceable sealed remote OLT and Ethernet aggregation system
(8 GPON ports per system)

Simplify. Excite. Grow.

Calix ONT Systems

ONT Functions

- Media converter: PON to Ethernet

- Service demarcation point… but that's evolving with single units

- Upstream traffic manager

- Configured by the OLT and/or remote management system

ONT/Gateway all in single unit

Form factors

- Indoor / outdoor

- Simple media converter or integrated multiservice gateways

Wi-Fi 6 gateway router with POTS, Ethernet, USB

Media converter ONT (PON to Ethernet)

With additional mesh units
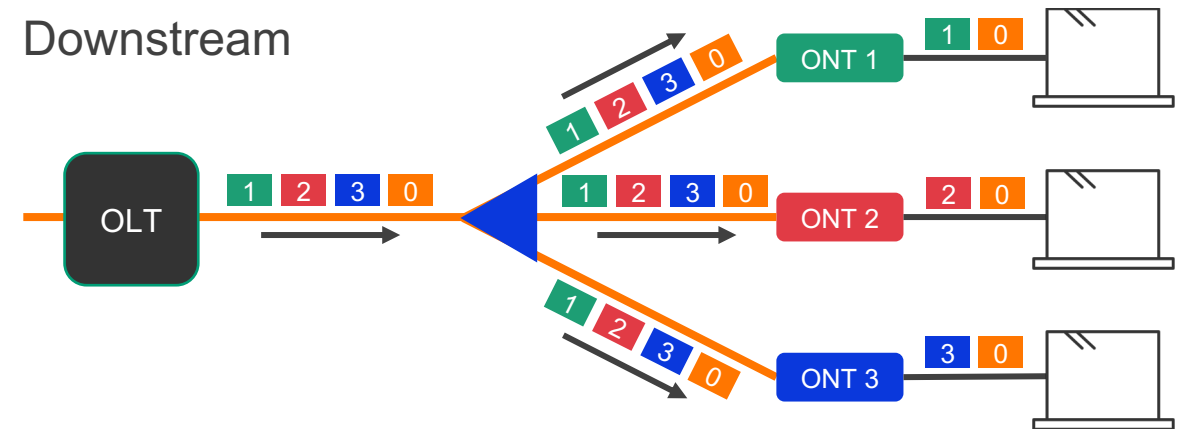
What Make PON So Efficient?

PON Point-to-Multipoint Traffic flow

Asymmetric traffic flow

Downstream

- OLT continuously transmitting
- All packets are addressed with a destination ONT/Service ID
- Every ONT receives all traffic – discards unwanted packets
- Packets encrypted for security on shared PON
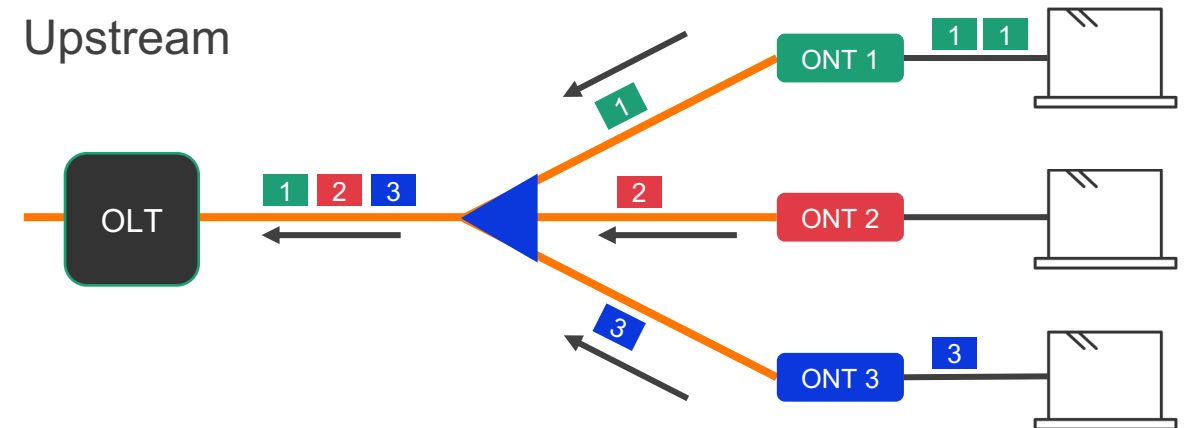- IPTV traffic is multicast for all ONTs to use

Downstream

PON Point-to-Multipoint Traffic flow

Asymmetric traffic flow

Upstream

- Time Division Multiplexing (TDM)
- ONTs transmit only during assigned time slots
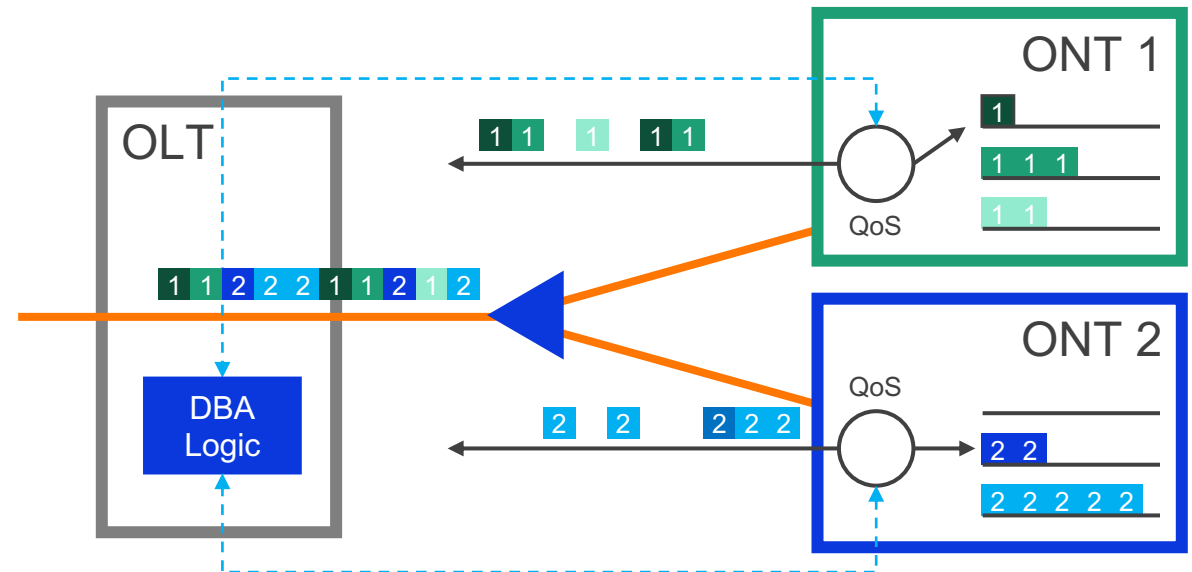- No collisions, extremely efficient!

Upstream

PON Efficiency – Nothing is Constant

Q: How can 64 subscribers on an XGS-PON network all get a 1 or 2 Gig service?

A1: Statistical multiplexing of "bursty" traffic
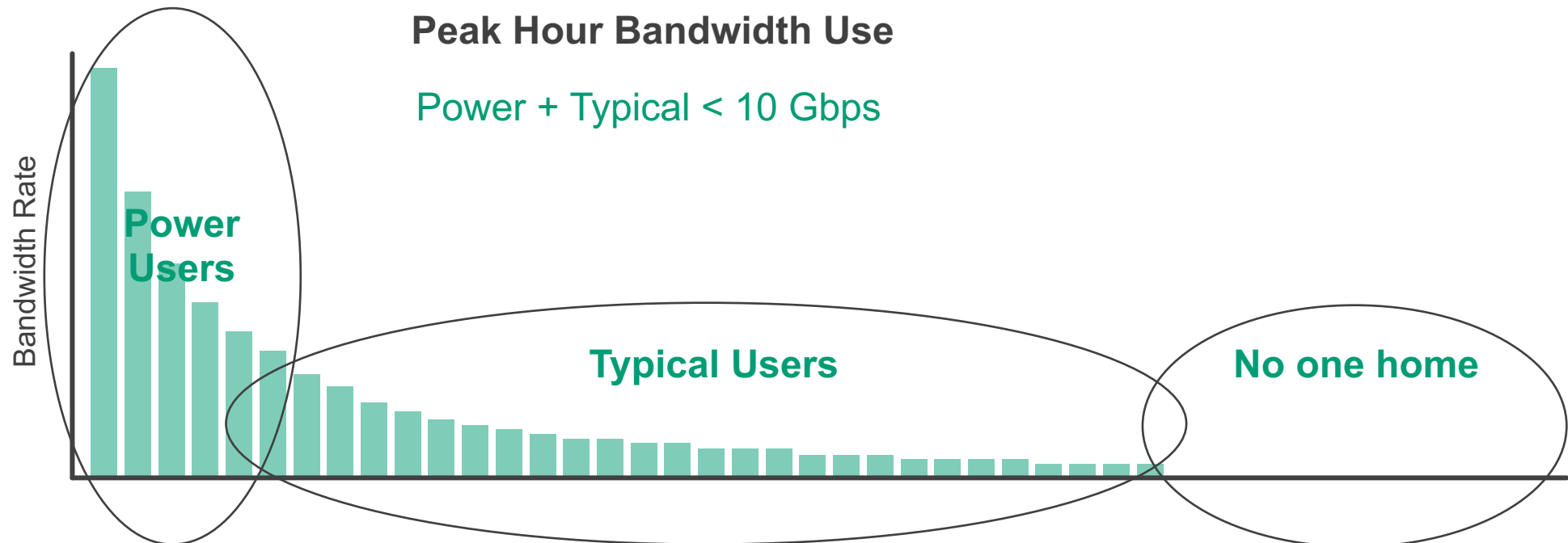
Dynamic Bandwidth Allocation (DBA)

- Capacity only for ONTs that need it
- Four traffic classes
- ONTs buffer and report status
- OLT schedules transmit time slots

PON Efficiency – Law of Large Numbers

Q: How can 64 subscribers on an XGS-PON network all get a 1 or 2 Gig service?

A2: Not all broadband users are the same

Peak Hour Bandwidth Use

Power + Typical < 10 Gbps

Bandwidth Rate

Power Users

Typical Users

No one home

Want to know more?

Broadband Academy's 5 Pillars

Five steps to becoming a Broadband Service Provider

FUND

- Introduction to Funding
- Government Funding
- Private Funding
- Securing Private Funding
- Dos and Don'ts of Government Funding

DESIGN

- Start with the Subscriber
- Getting to Know Your Service Area
- Designing the Access Network
- The Middle Mile
- Subscriber Home Network

BUILD

- Partnering with the Right Contractors
- Constructing the Outside Plant
- Monitoring the Build
- Mitigating Risks
- Keeping the Community Informed

OPERATE

- Before You Deploy:Hiring the Right Staff
- Understanding Network Management
- Operating a Broadband Network
- Key Customer Services
- Peer Success Stories

MARKET

- Digital Marketing
- Email Marketing
- Social Media Marketing
- Mobile App Marketing
- CSR Best-Practices Training
- Product Marketing

Discover What It Takes to Become a
Broadband Service Provider

The journey to coming a Broadband Service Provider can feel overwhelming.
That's why Calix created Broadband Academy, an online curriculum that guides you through the five stages of building and managing a successful broadband business.

Complimentary access

Expert-designed courses

Self-paced lessons

Knowledge checks and quizzes

Badges and Certificates

Training and upskilling

Simplify. Excite. Grow.

#BroadbandAcademy

Calix | Broadband Academy

Gain complimentary access at
www.calix.com/bba

Simplify. Excite. Grow.

THANK YOU!