Gigabit PON Deployment Experience

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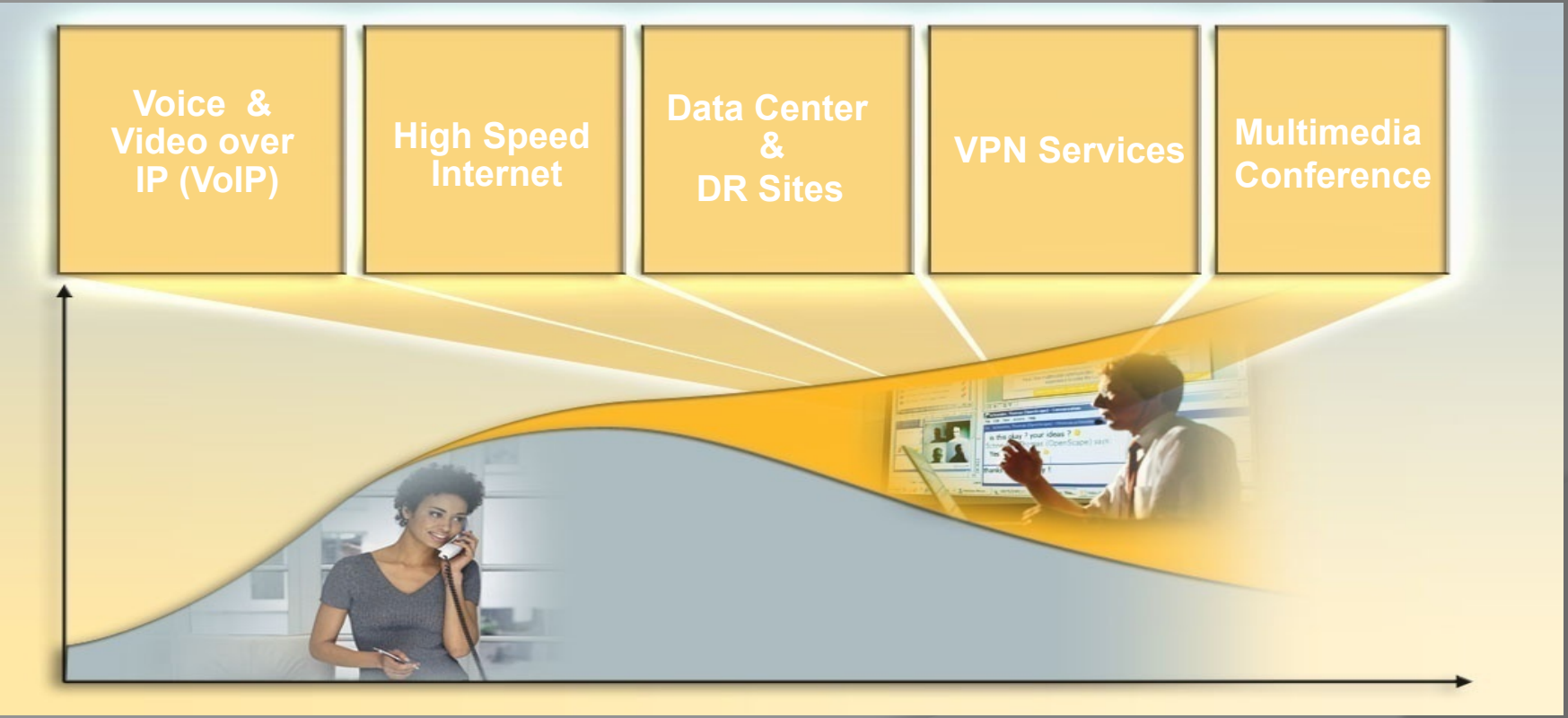
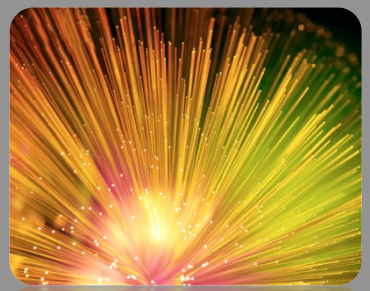
Why High Speed Connectivity?

Market Requirements

Reliable & Scalable network that address
Current & Future business and consumer needs




Intelligent Optical Network & its Benefits

Why?

Parameters	ISDN/Dial up	DSL	ION	Wireless		
				Licensed	Unlicensed	Satellite
Distance Limitation	High	High	**Low**	Medium	High	Low
Bandwidth Limitation	High	Medium	**Low**	High	High	High
Latency	High	High	**Low**	Medium	Medium	Medium
Interference	Low	High	**Low**	Medium	High	Medium
Security	Low	Low	**High**	Medium	Low	Medium
Geographical Limitations	High	Normal	**High**	Low	Low	Low
Onetime Cost	Low	Normal	**Medium**	Medium	High	Low
Reliability	Low	Low	**High**	Medium	Low	Medium
Scalability	Low	Low	**High**	Low	Low	Low



Active Vs Passive Optical Network

Access network bottleneck

local area networks

- use copper cable
- get high bandwidth over short distances

core networks

- use fiber optics
- get high bandwidth over long distances
- small number of active network elements

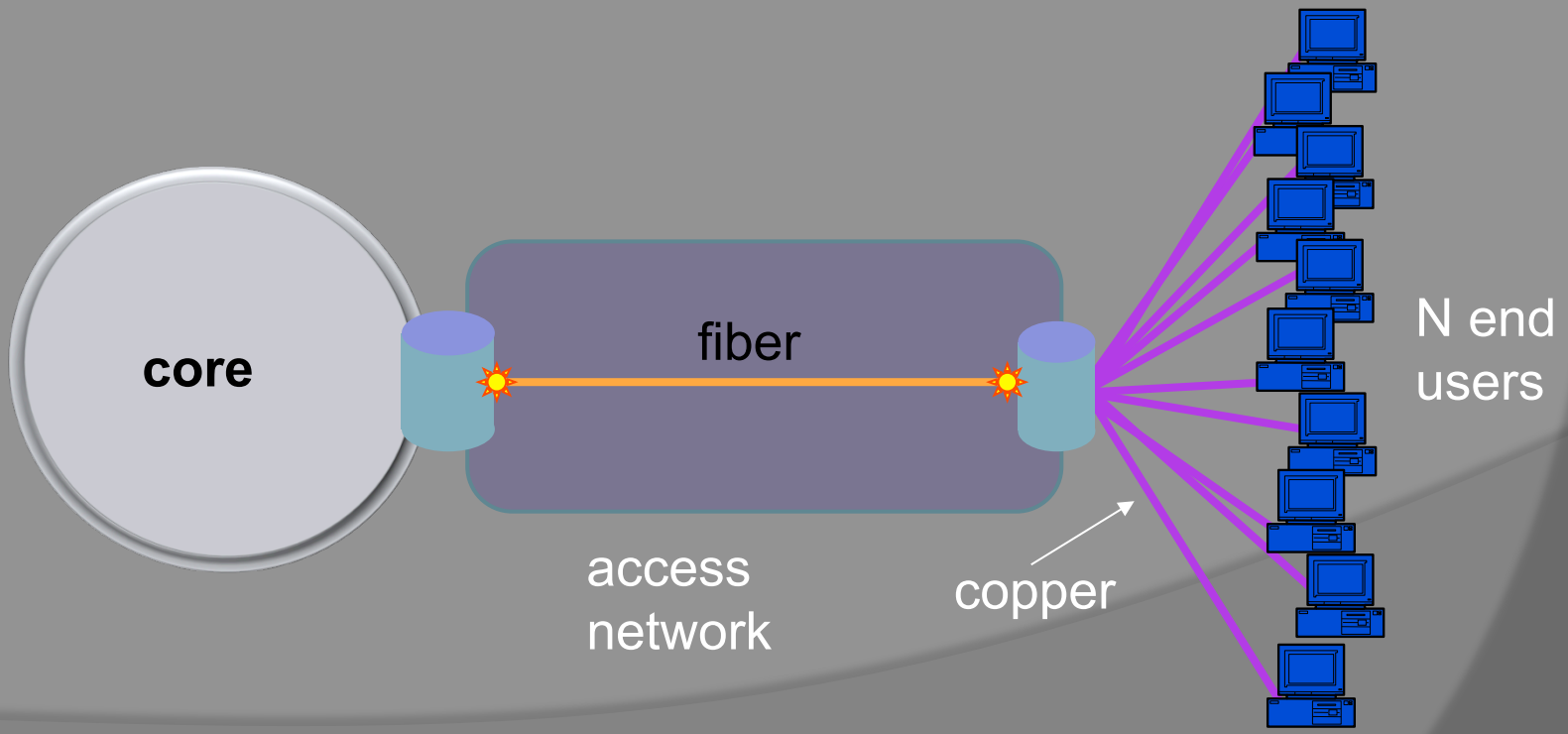
access networks (first/last mile)

- long distances
  - so fiber would be the best choice
- many network elements and large number of endpoints
  - if fiber is used then need multiple optical transceivers
  - so copper is the best choice
  - this severely limits the bandwidth

Fiber To The Curb

Hybrid Fiber Coax and VDSL

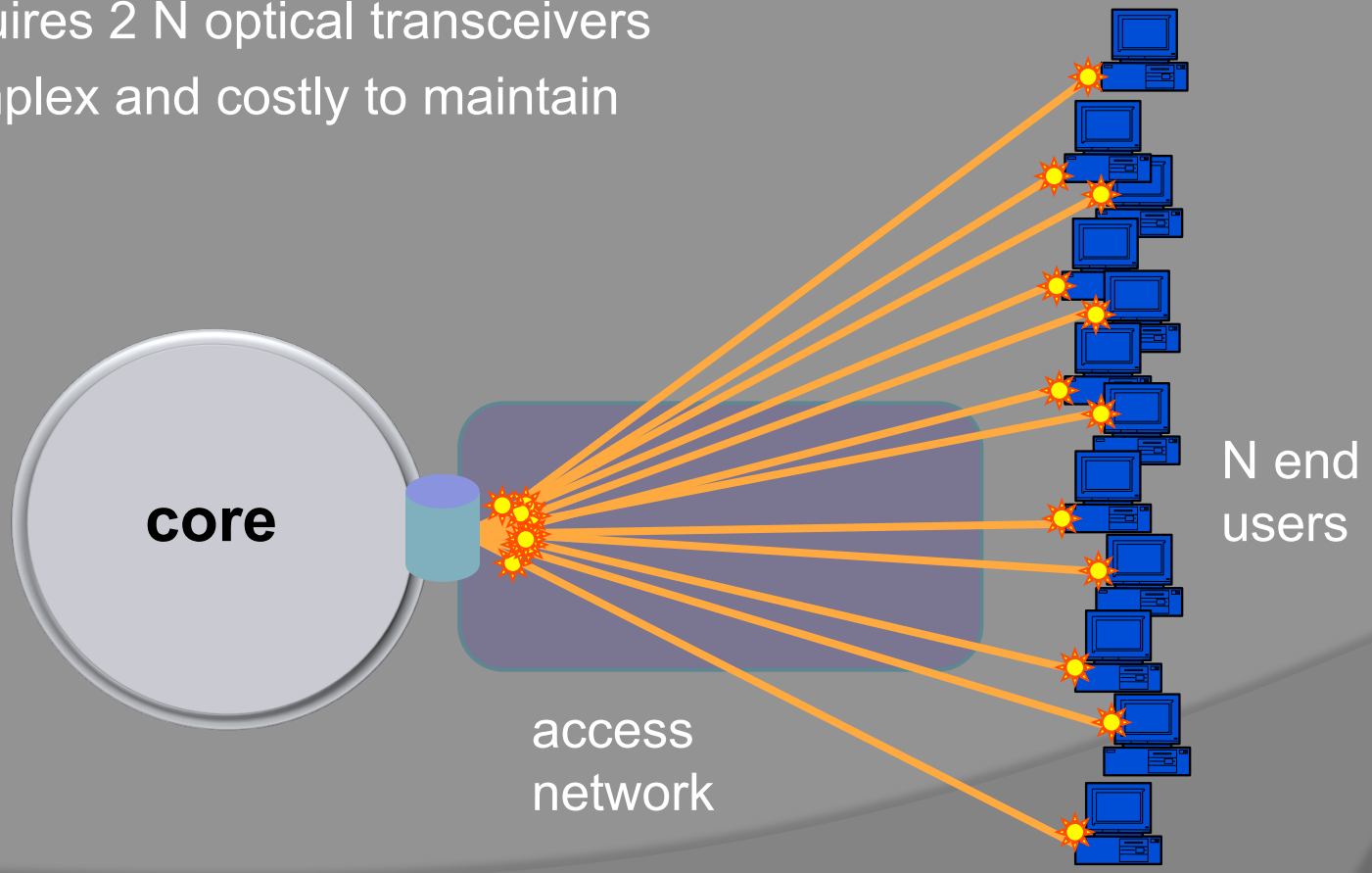
- switch/transceiver/miniDSLAM located at curb or in basement
- need only 2 optical transceivers (but ***not*** pure optical solution)
- lower BW from transceiver to end users
- need complex converter in constrained environment



Fiber To The Premises

we ***can*** implement point-to-multipoint topology purely in optics

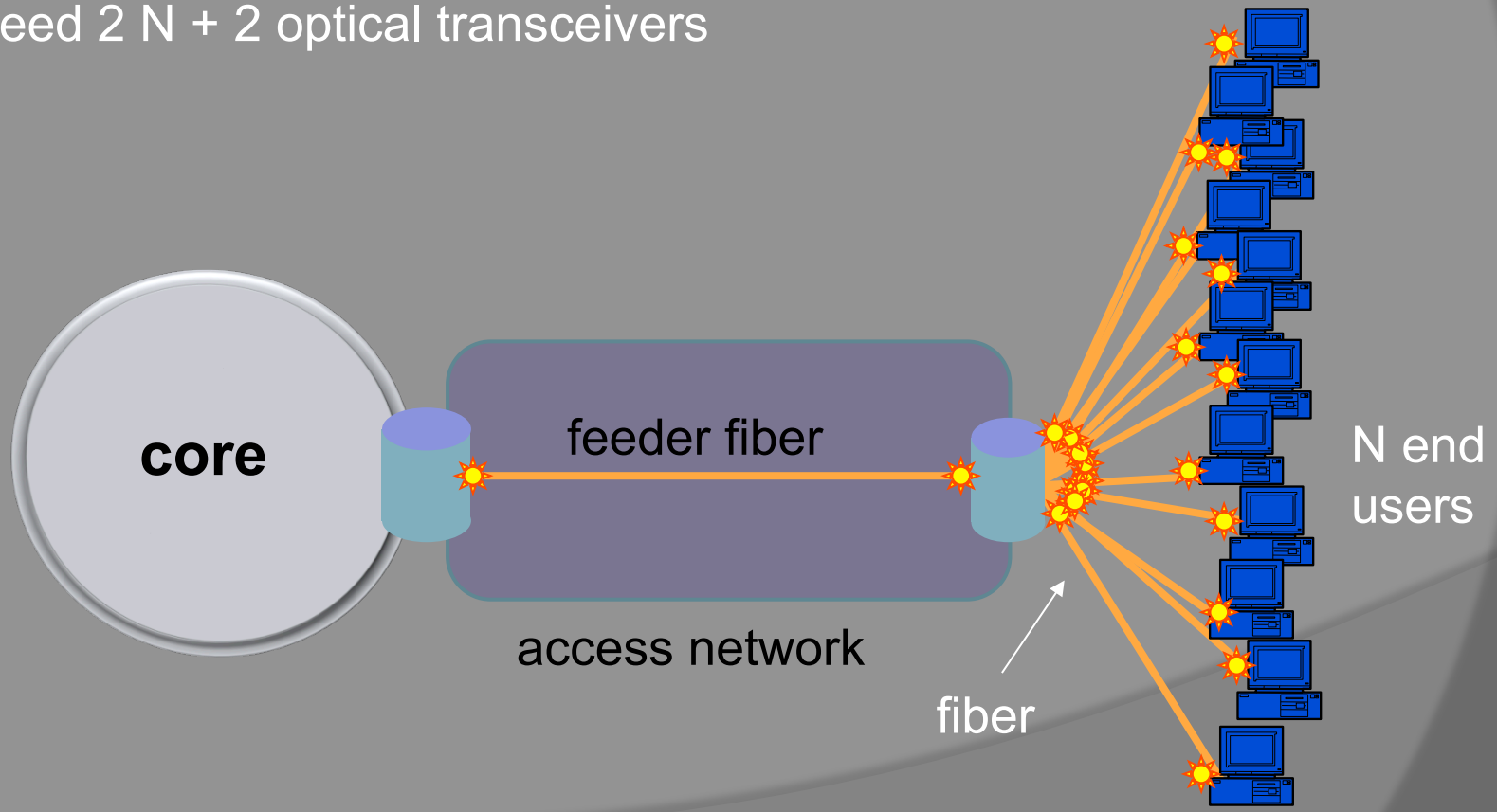
- but we need a fiber (pair) to each end user
- requires 2 N optical transceivers
- complex and costly to maintain



Active Solution

deploy intermediate switches

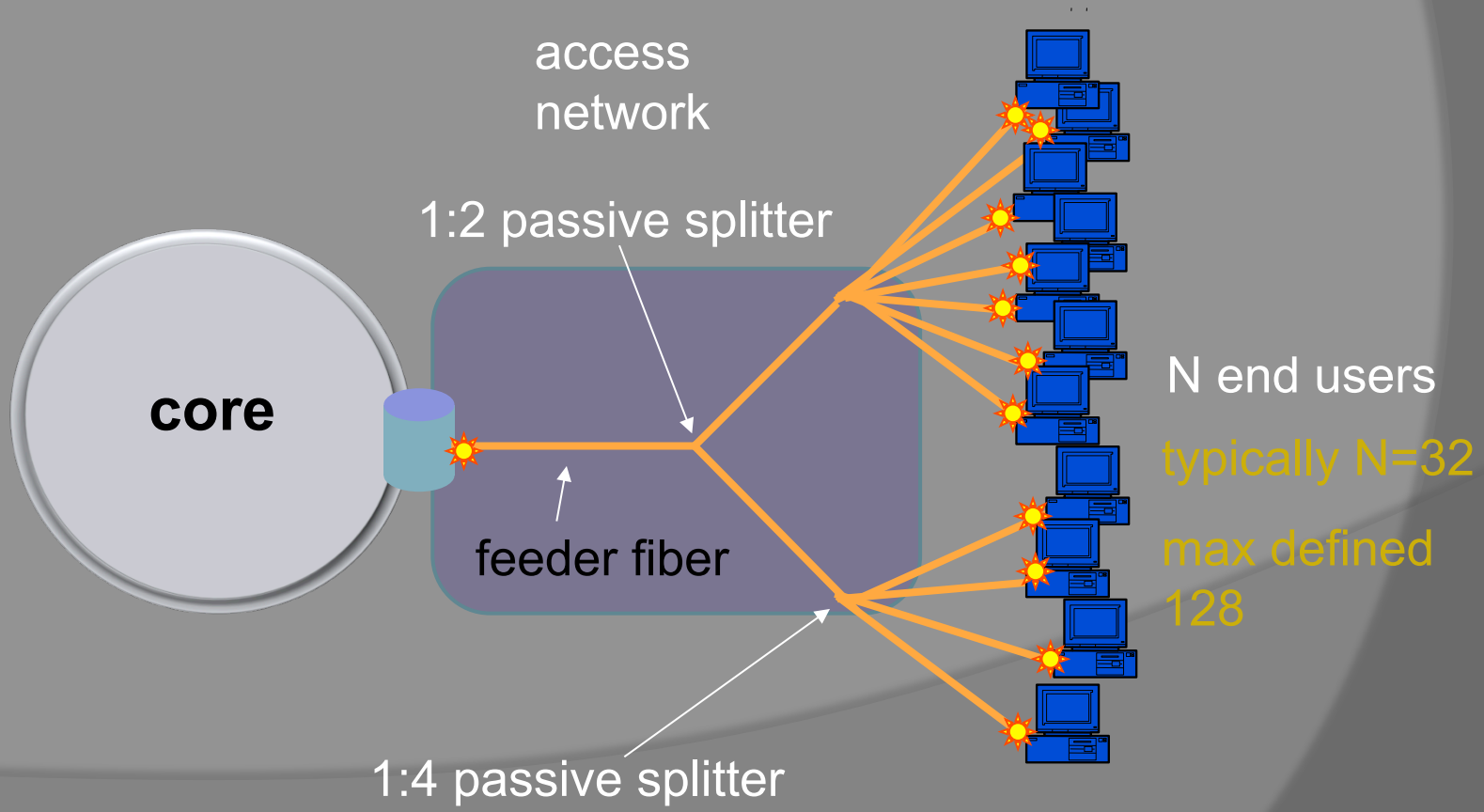
- (active) switch located at curb or in basement
- saves space at central office
- need 2 N + 2 optical transceivers



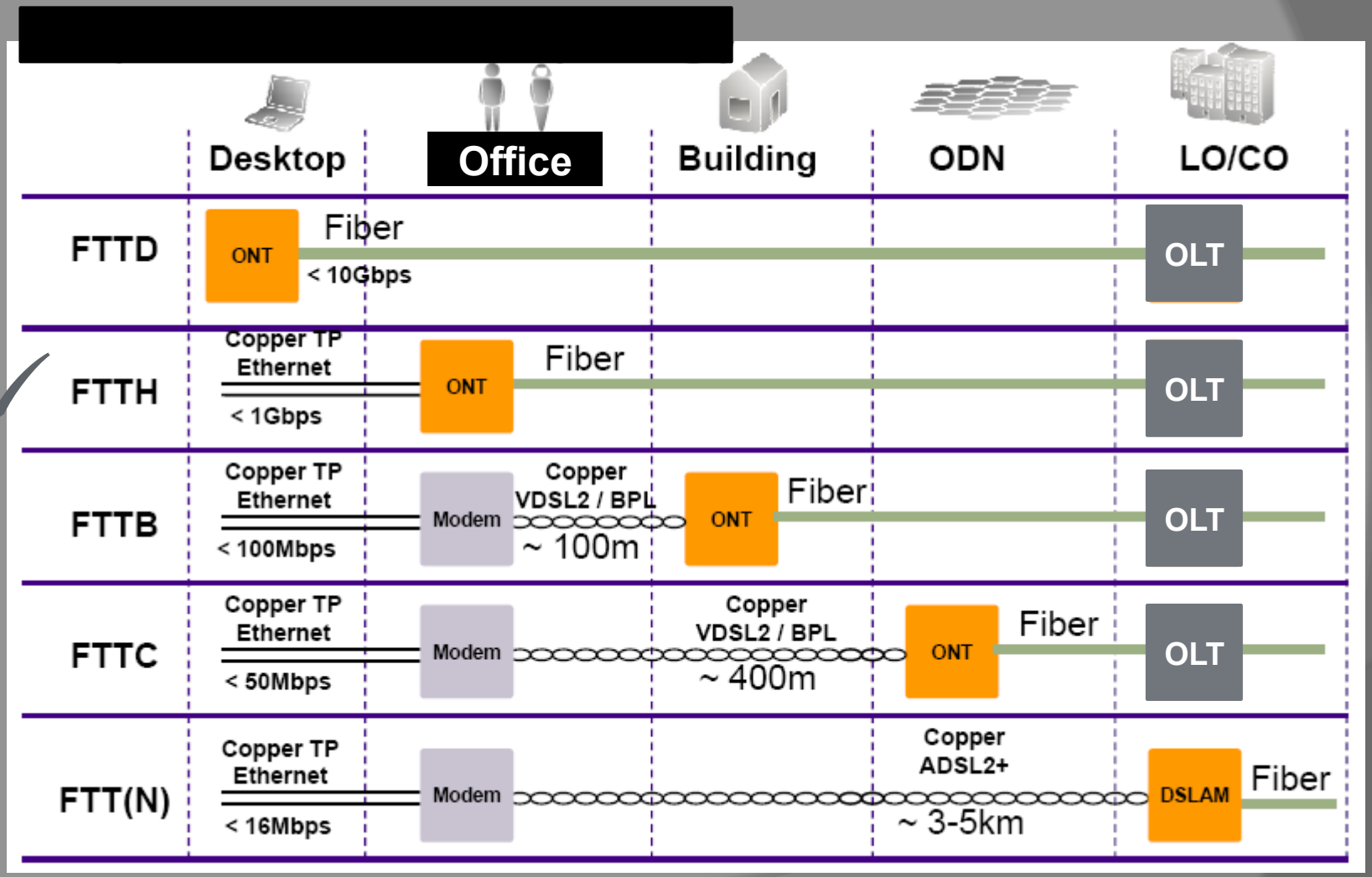
The PON solution

another alternative - implement point-to-multipoint topology purely in optics

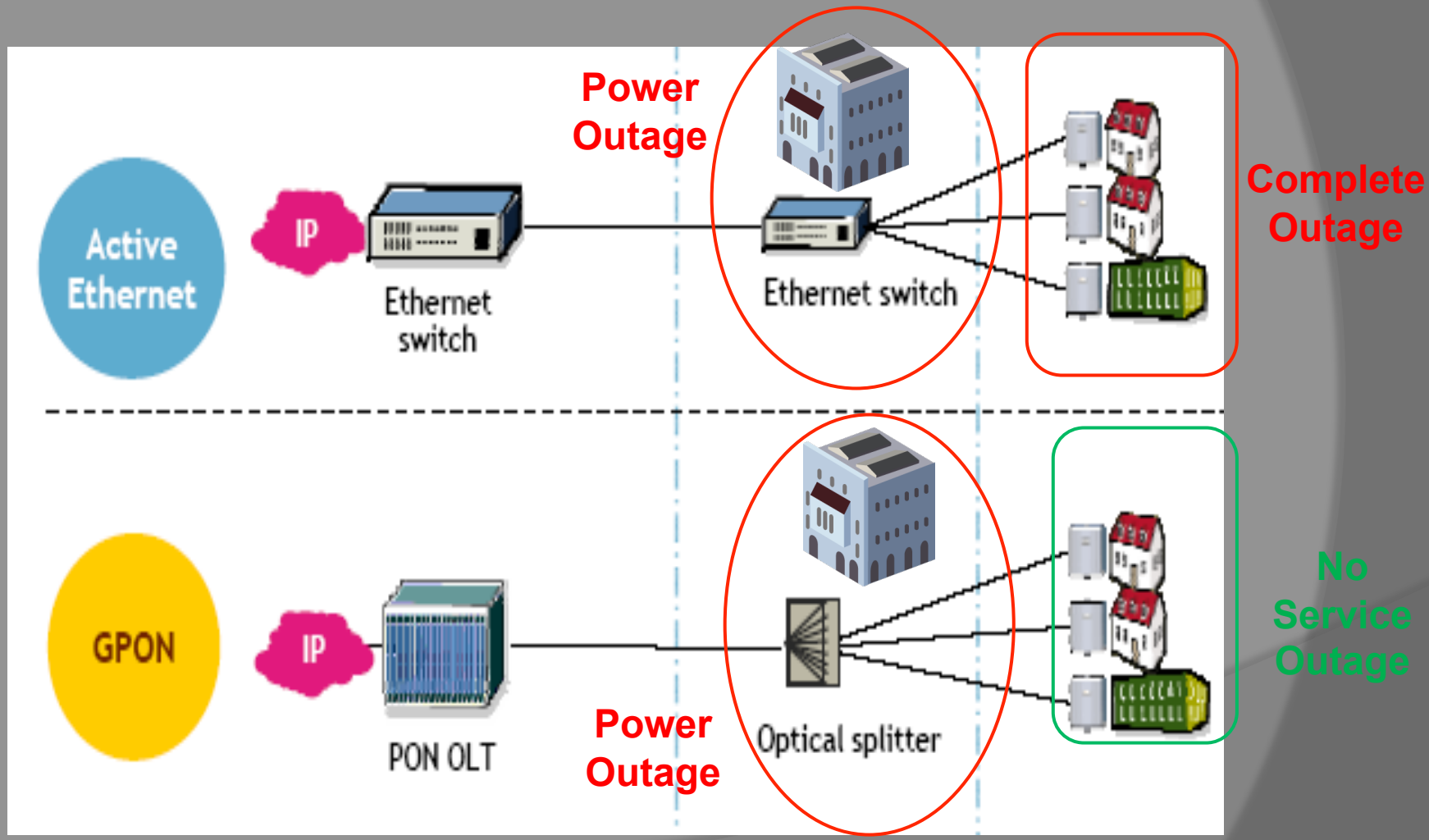
- avoid costly optic-electronic conversions
- use *passive splitters* – no power needed, unlimited MTBF
- only N+1 optical transceivers (minimum possible) !



Types of Optical Fiber Network



Active Vs Passive (esp. in Pakistan)



GPON Edge

Feature	Active Ethernet	GPON
Maximum Download Bandwidth	100/1000Mbps	2.5Gbps
Maximum Upload bandwidth	100/1000Mbps	1.25Gbps
Access Interfaces	10/100/1000 Ethernet	10/100/1000 Ethernet, E1, POTS
Power Consumption	High	Low
Availability (Power Outages)	Medium	High
Reliability/Redundancies	Only Core Ring, No Access	Core Ring & Access both



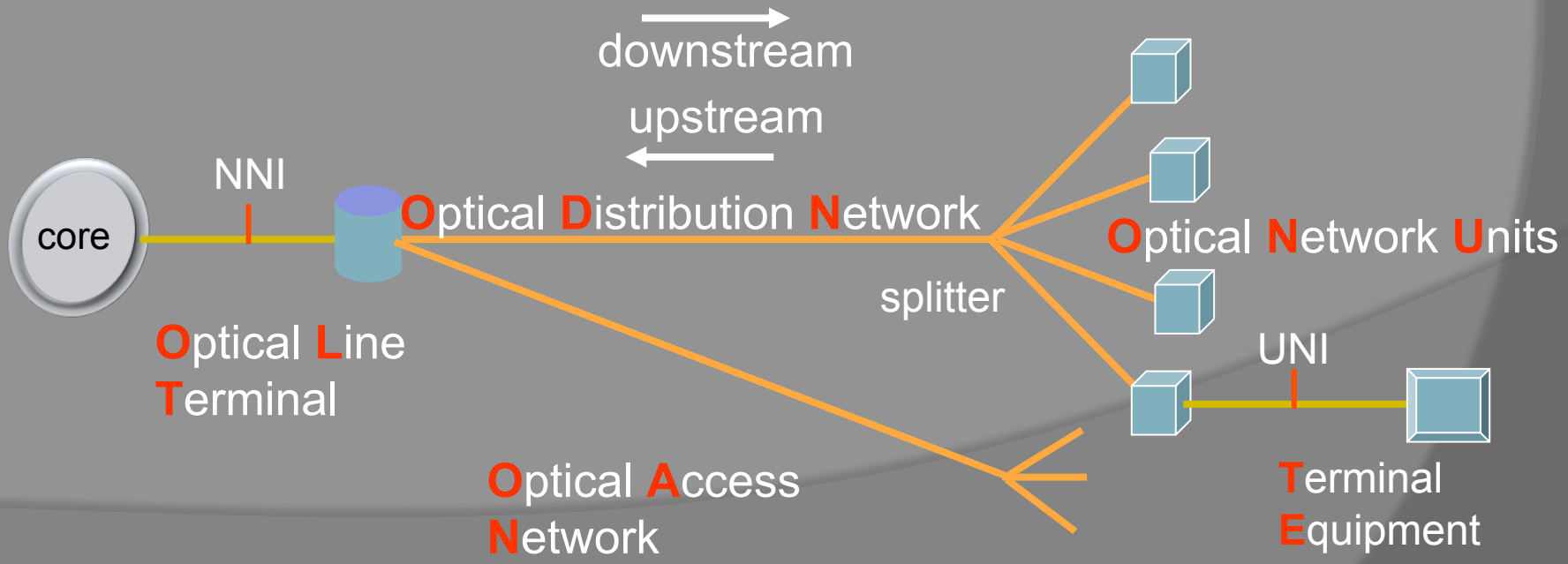
GPON – Technology Basics

PON Architecture

Terminology

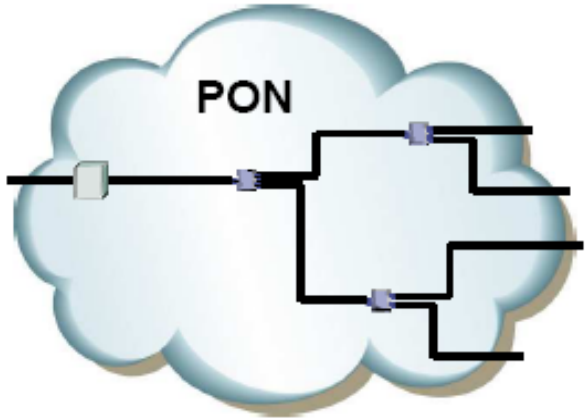
like every other field, PON technology has its own terminology

- the CO head-end is called an OLT
- ONUs are the CPE devices (sometimes called ONTs in ITU)
- the entire fiber tree (incl. feeder, splitters, distribution fibers) is an ODN
- all trees emanating from the same OLT form an OAN
- downstream is from OLT to ONU (upstream is the opposite direction)



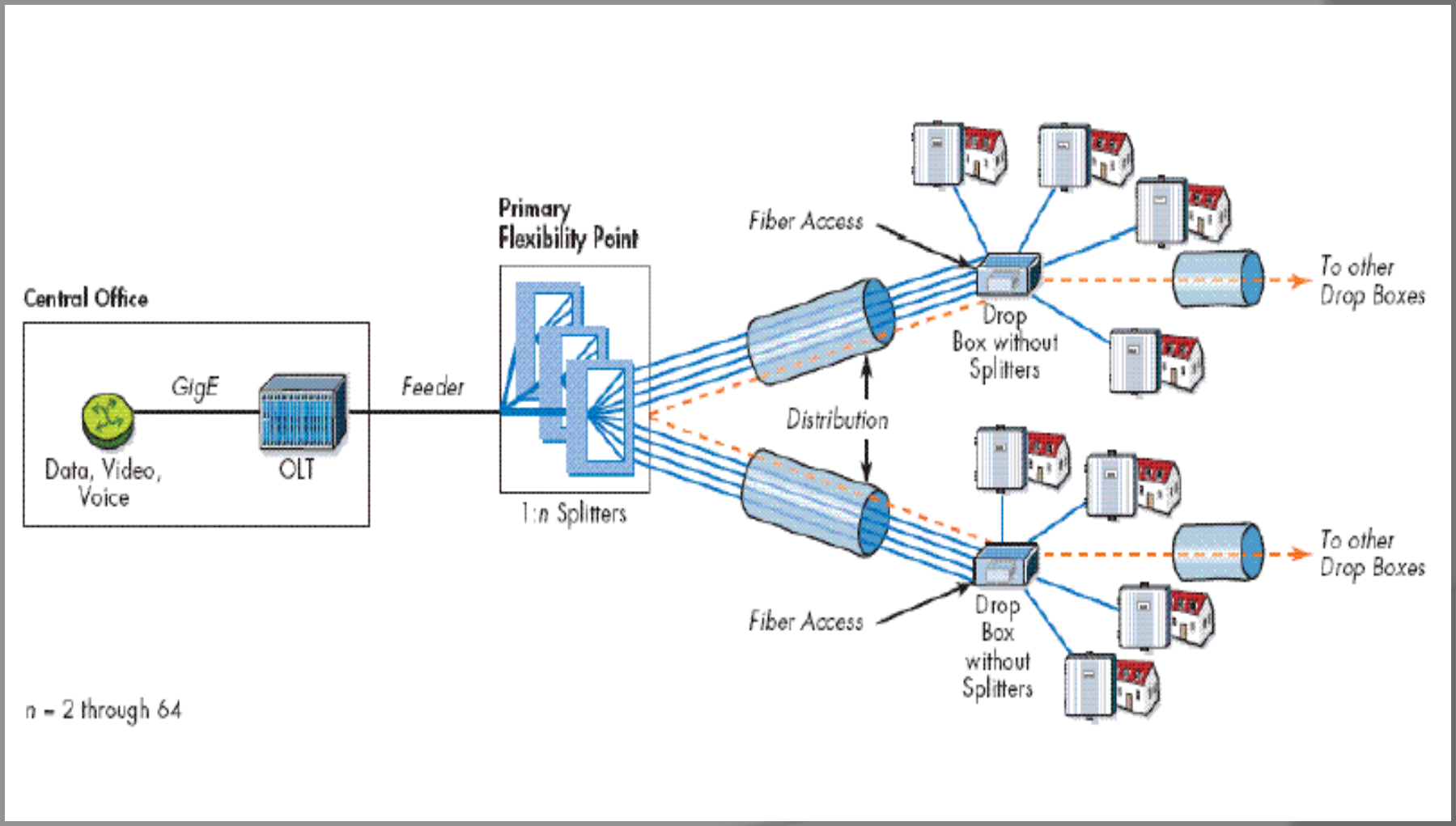
PON Properties

- PON – Passive Optical Network
  - passive components
    splitters + WDM-device
  - star topology
    p2mp – point to multipoint
- lambdas
  - 1490nm – downstream data
  - 1310nm – upstream data
  - 1550nm – downstream (optional)
- ranging distance
  - 60 km logical reach
  - 20 km physical reach
    differential distance
- split-ratio
  - 64 subscribers (or even more)

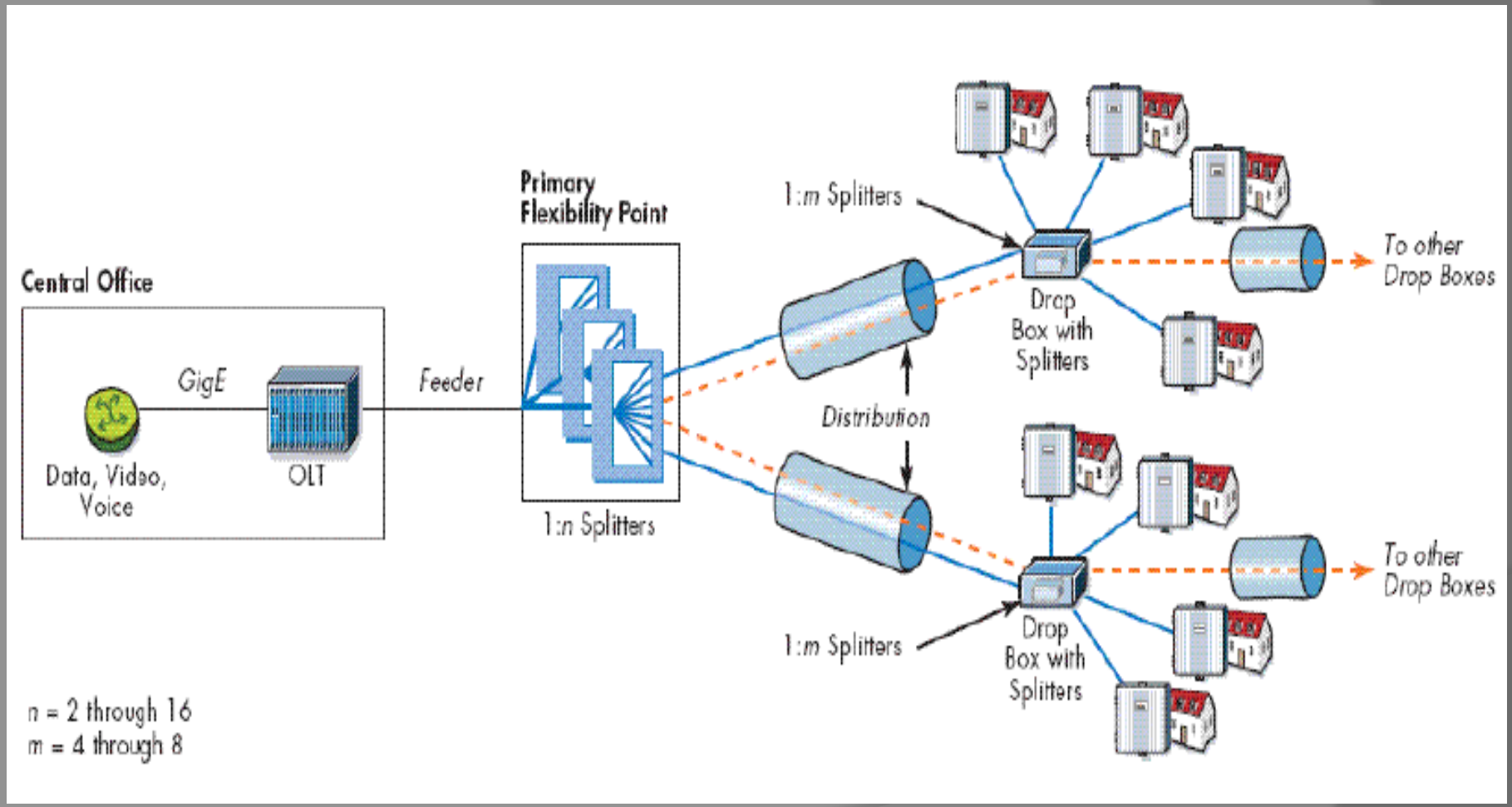


- line rate
  - downstream: 2.488 Gb/s
  - upstream: 1.244 Gb/s

Centralized Splitters

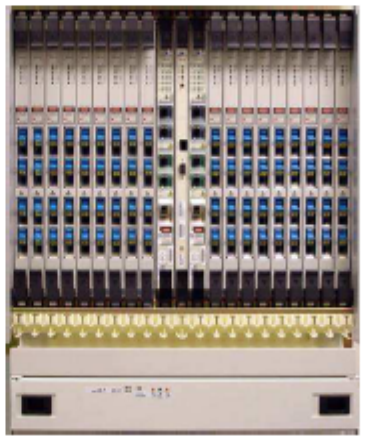


Distributed Splitters (CYBERNET approach)



Alcatel 7342 FTTx solution

- GPON standards based optical broadband - part of the ISAM family with shared technology, management
- 2.5 Gb/s downstream and 1.2 Gb/s upstream over a single fiber.
- GPON encapsulation mode (GEM) for most efficient transfer of IP/Ethernet service traffic
- Up to 64 subscribers per PON (a single fiber), 4 PONs per line card
- Variety of ONT options to match the needs of residential or business customers



Optical Line Terminal

High density: 4,608 customers in one shelf

I-Series ONT

O-Series ONT

B-Series ONT

MDU ONT

Alcatel ONTs

Indoor ONT (I-Series ONT)

- Designed for indoor use and aesthetics for home applications
- Small size, light weight
- Three versions
  - 2 POTS, 2 Ethernet, 1 RF
  - Data only: 2 FE or 2 GE
  - 2 POTS, 4 GEs, optional RF

Outdoor ONT (O-Series ONT) Single Family Unit

- Designed for outdoor use for home applications
- 2/4 POTS, 1/2 Ethernet, 1 RF

Business/SOHO ONT (B-Series ONT)

- Designed for outdoor use for business applications
- 8 POTS, 1 GE, 2 DS1 or E1, 1 RF

MDU ONTs (O-Series Low-Profile)

- Designed for apartment buildings
- 24 POTS and 12 VDSL2 or 12 GE
- Most compact GPON MDU in market!

PON Feeder redundancy

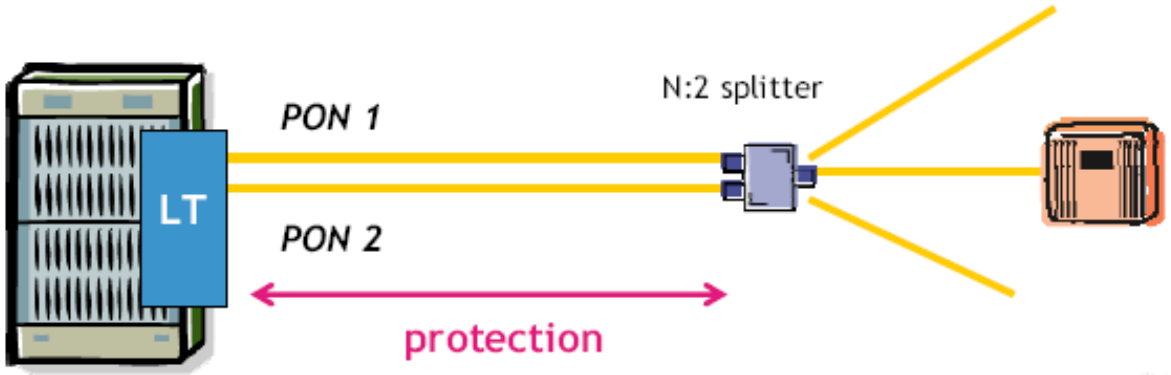
- ITU-T G.984.1 specifies 3 types of redundancy between OLT and ONT
  - ***Type A*** *: spare fiber, no additional LTs or ONTs*
  - ***Type B*** *: redundancy to the splitter : redundant LTs and feeder fibers to the first splitter*
  - ***Type C****: redundancy through the entire path: redundant LTs, fibers, splitters, ONTs*

*** Separate geographical paths required for two feeders to avoid simultaneous fiber cuts ***

Redundancy supported in Alcatel?

- Alcatel-Lucent chose partial Type B redundancy (Type B-)
  - 1+1 redundant feeder fibers from the LT PON to the optical splitter
  - Fiber-only protection: redundant fiber can be used in case the other one fails

    *** Separate geographical paths required for two feeders to avoid simultaneous fiber cuts*
  - No redundant LTs - no protection against HW & SW failures on the LT
  - Reduces LT capacity by 50%





Installation Procedure

Installation

The MP1800 series integrated services router is a medium network access router.

Maipu 1800

MP801E incorporates the multi-service integration technology, which integrates routing, security, VoIP, transmission and network management. It supports IPv6, Routing Protocols (OSPF, BGP), VPN, VoIP applications, backup and QoS features. It applies to data, video and VoIP access solutions.

Supports IP-SLA features

Interfaces: 2 Fast Ethernet, 8 port Switch Module, 2 WIC slot for E1 / Serial / ISDN, 1 WIC for VoIP & IPSec Module

for

vices.

ONT Installation

CYBER ION