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FTTP Outside Plant

Considerations and Case Study Analysis for the CATV Provider

FTTP OSP Considerations for the MSO:

1. FTTP Market Drivers
2. FTTP Technologies
3. PON-Based Architectures and Components
4. A MSO Case Study
5. Summary

But First, Some Terminology: FTTx and FTTP

- **Fiber-to-the-X. A generic industry term that is applied to:**
  - **Fiber-to-the-Home**
  - **Fiber-to-the-Business**
  - **Fiber-to-the-Curb**
  - **Fiber-to-the-Node**
  - **Fiber-to-the-MDU**
  - **Hybrid Fiber Coax**

- **Fiber-to-the-Premise. Applies to:**
  - **Fiber-to-the-Home**
  - **Fiber-to-the- (small) Business**
  - **Fiber-to-the-MDU / Fiber-in-the-MDU**

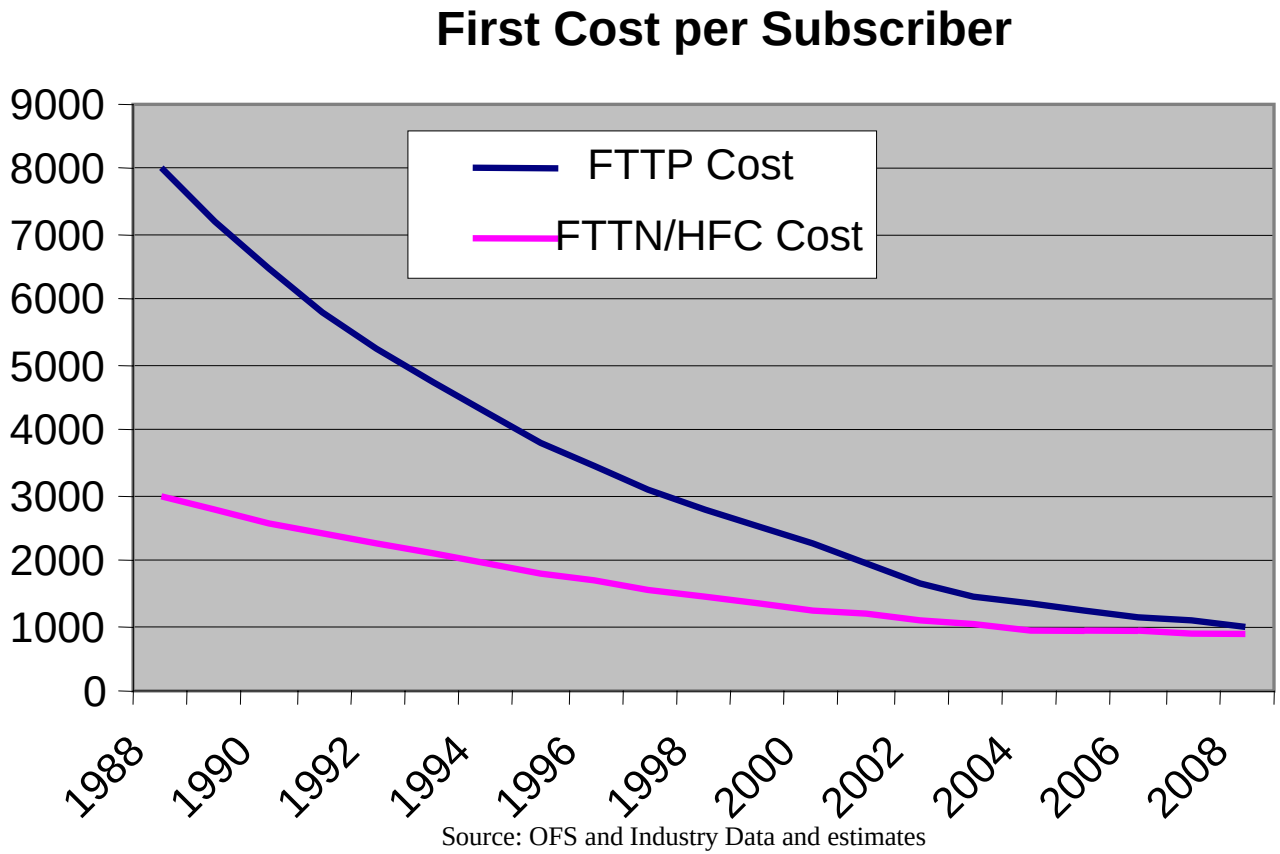
- **Today's topic is FTTP**

FTTP Market Drivers

What are the reasons for FTTP?

- First cost CapEx parity with other wireline solutions
- Reduced Operating expenditures
- Futureproofing
- Unbundling relief

FTTP Cost Convergence with Competing Technologies

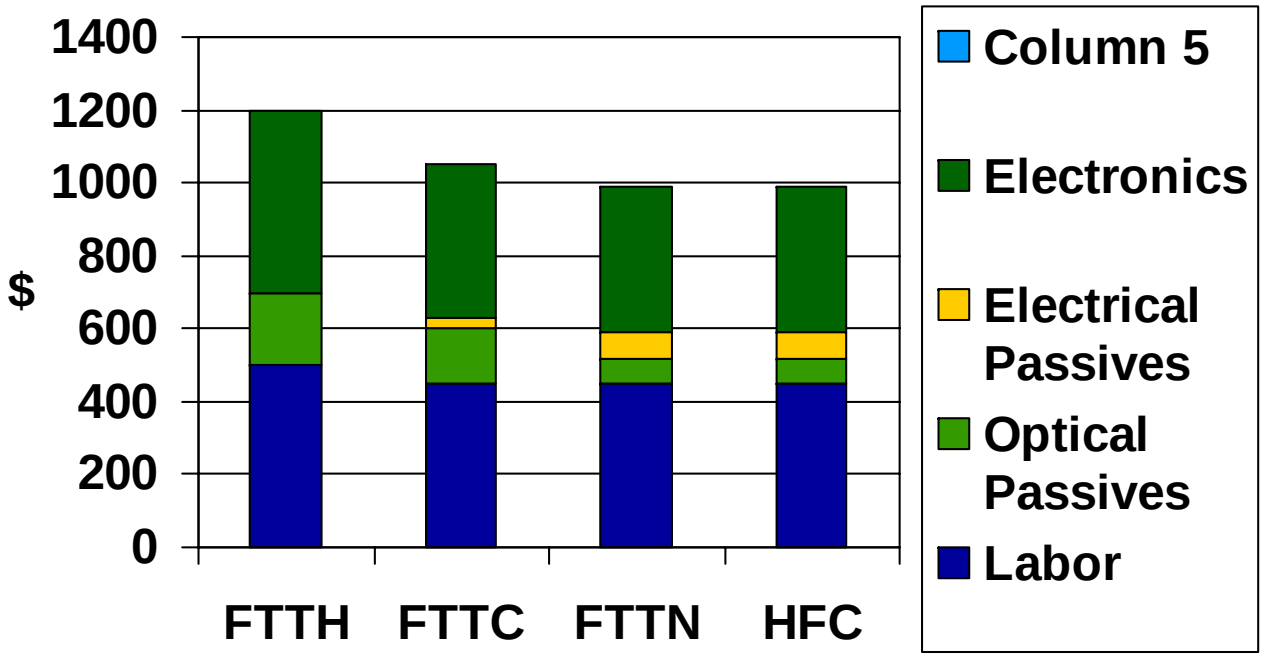


Source: OFS and Industry Data and estimates

1988 – 2000:	Equipment and fibre cabling infrastructure innovation and volume
2000 – 2003:	Cost innovation “dividend” resulting from R&D during the boom
2004 – 2008 +	Volume deployments drive cost to equal copper

FTTH First Cost

Cost per Subscriber



OFS Estimate

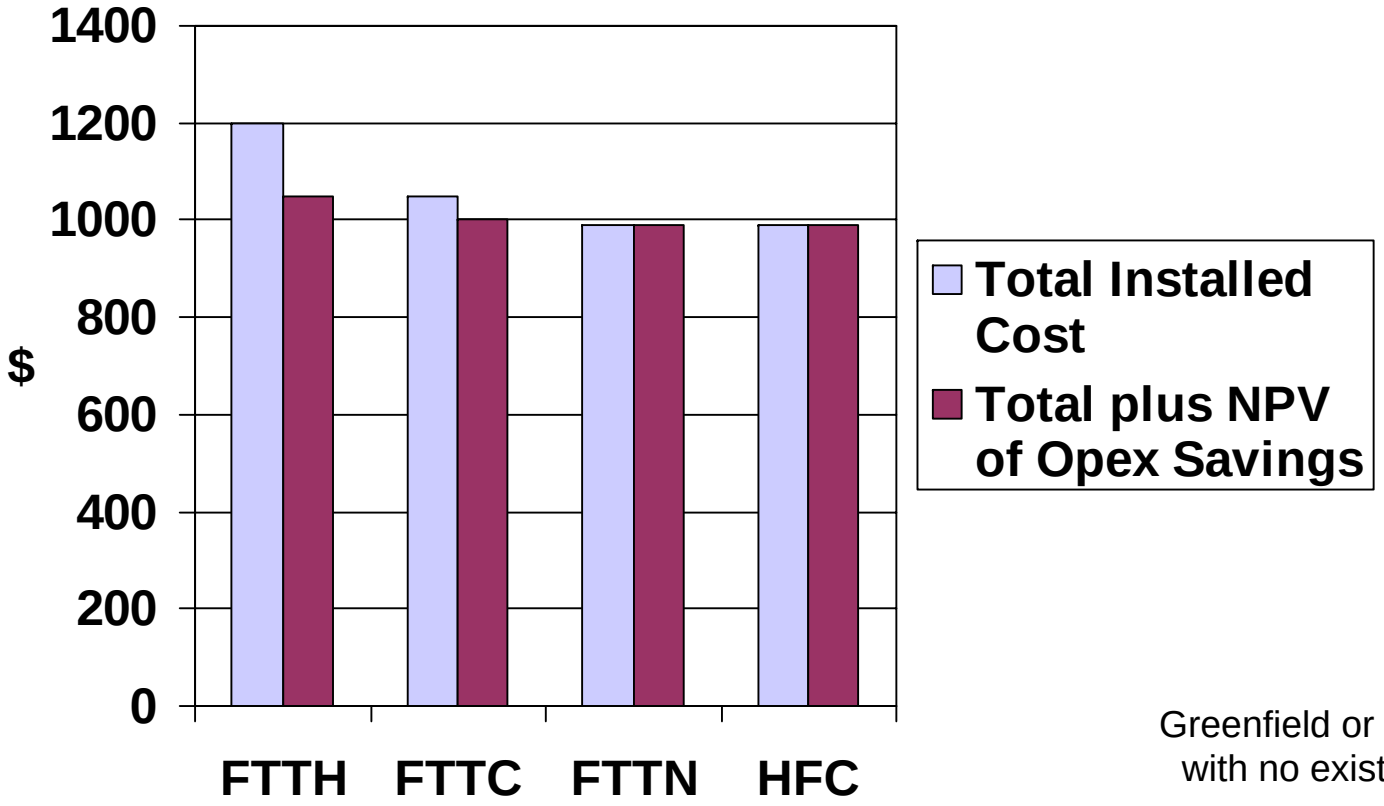
Aerial Greenfield or Brownfield with no existing cable

Buried about 50% higher cost vs. aerial, $delta between options about equal to that of aerial

FTTH Operating expense Savings

- **Why? Fewer truck rolls and no power**
  - Remote provisioning though software
  - Increased reliability
  - Fully Passive plant eliminates battery back-up in the field and powering of field electronics
- **Savings estimates vs. DSL/HFC**
  - FTTH Opex cost savings justifies $150 higher first cost
    - Source: RBOC Analysis
  - FTTH Opex saves $100 to $250 per subscriber vs. DSL or HFC
    - Source: Industry estimates

FTTH First Cost with OPEX Savings



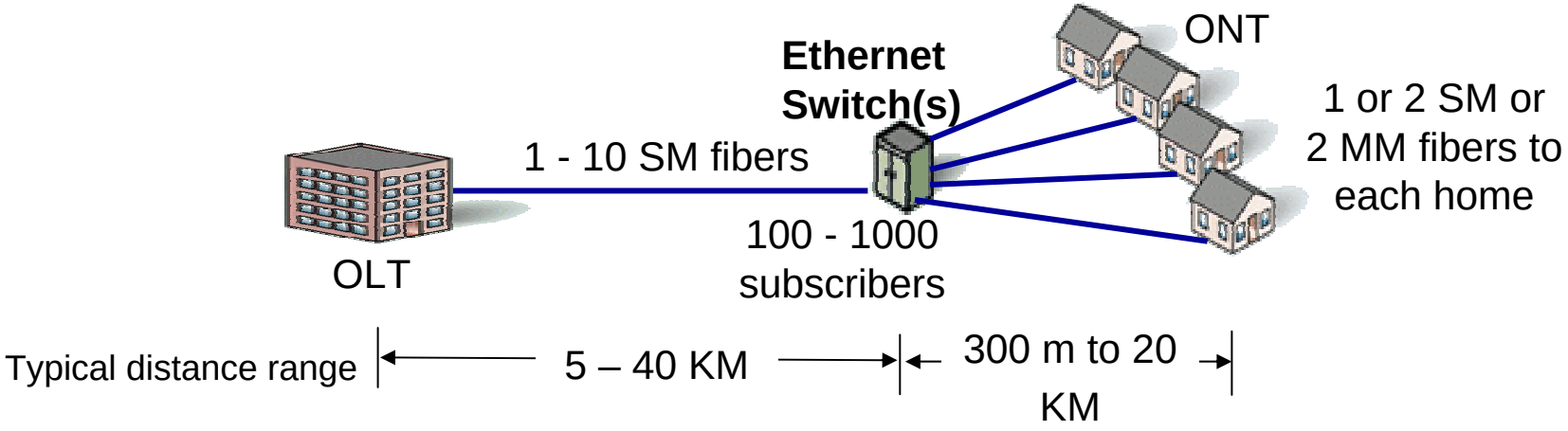
Greenfield or Brownfield with no existing cable

OFS Estimate

FTTP Technologies

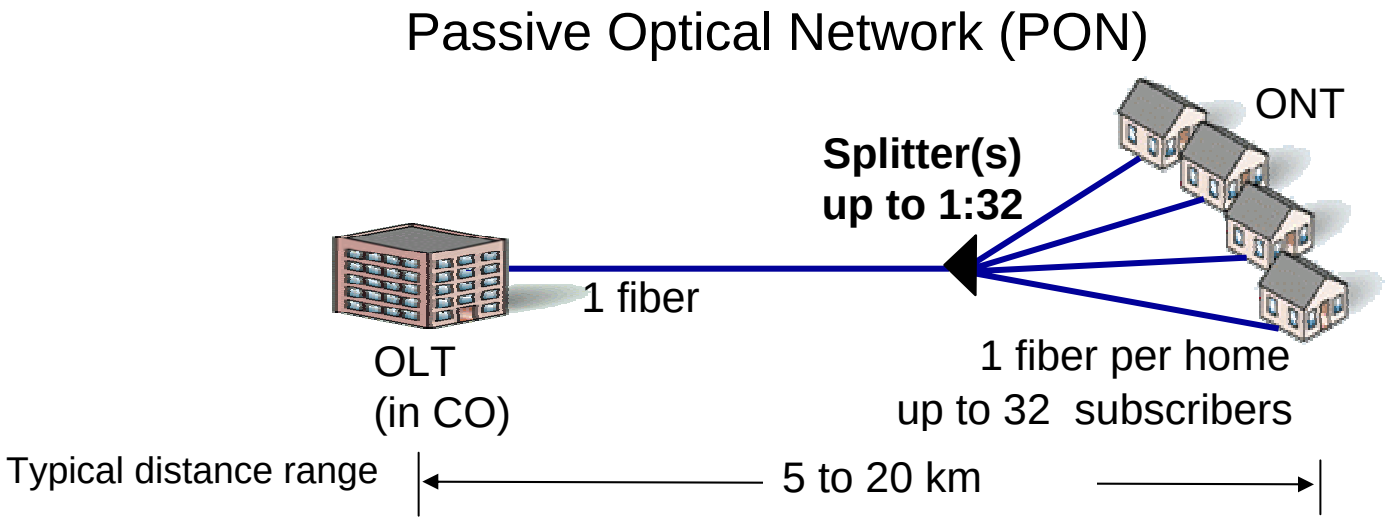
FTTP Technologies:

Ethernet Switched Optical Network (ESON)



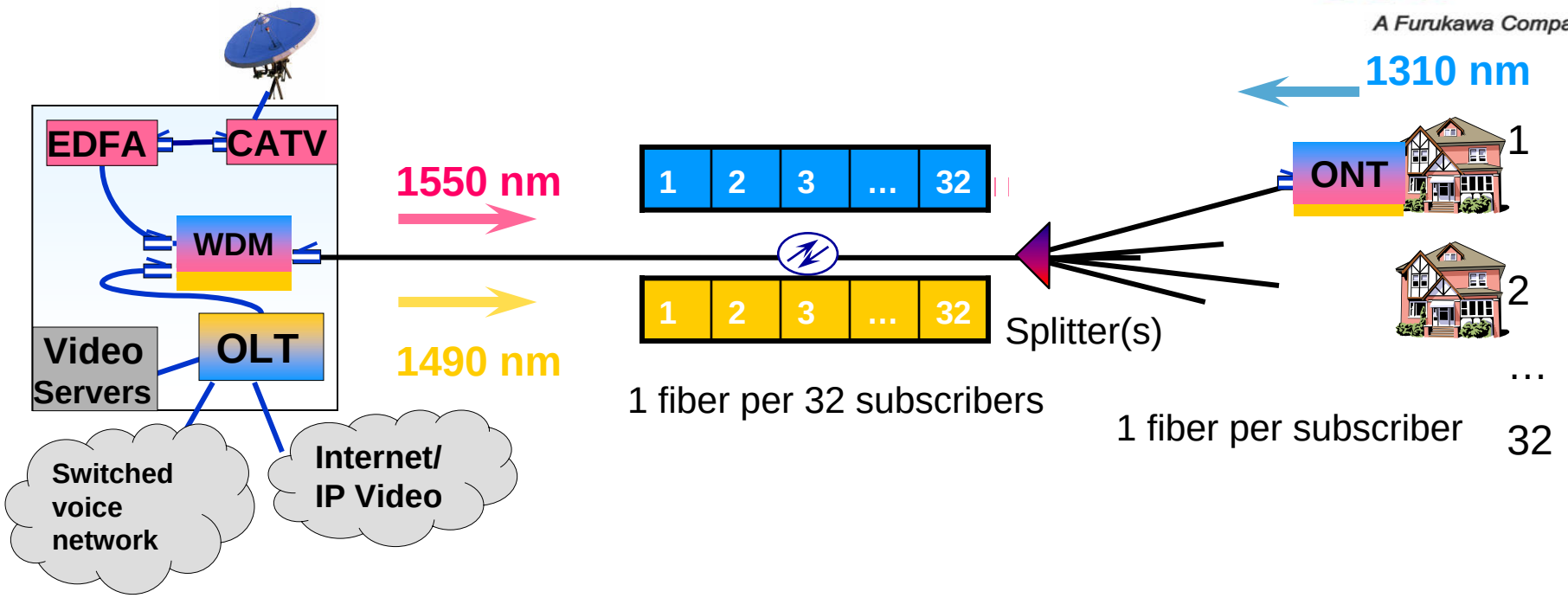
- **Low cost ports but twice the number of ports as PON**
- **Voice, video, and data all over IP**
- **10 to100 Mb/s per subscriber today**

FTTP Technologies:



- **No remote actives - enables low life cycle cost**
- **Voice over TDM or IP**
- **Data over IP or ATM**
- **Video – CATV type Broadcast and/or IP Video**
- **20 – 100 Mb/s per subscriber today**
- **Verizon, AT&T, many non-RBOC**
- **DOCSIS-based FTTP solutions are usually a variation on PON.**

FTTP Technologies: Telco-Style PON



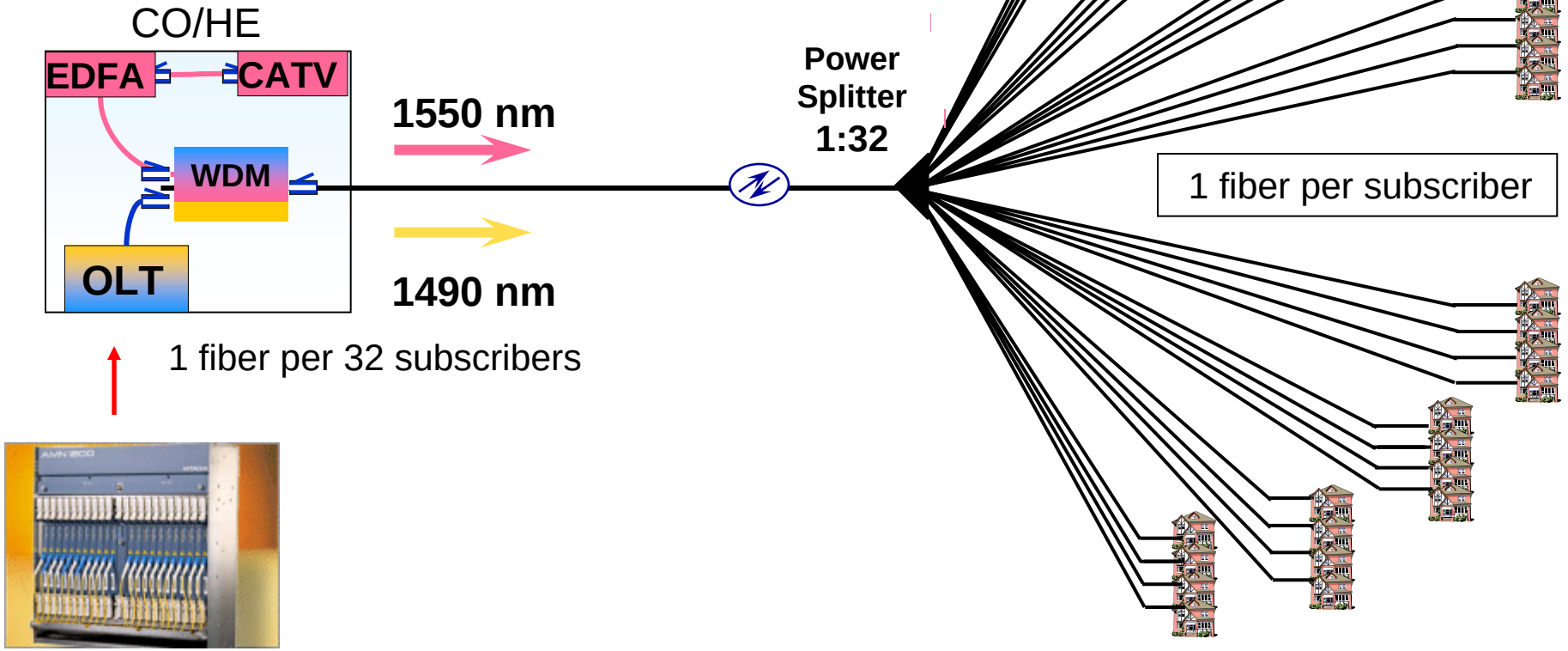
Voice, Data, IP Video
- **TO subscriber - 1490 nm**
- **FROM subscriber – 1310 nm**

Optional Broadcast Video CATV service to subscriber – 1550 nm
- **Analog + Digital**

FTTP Technologies: PON Standards

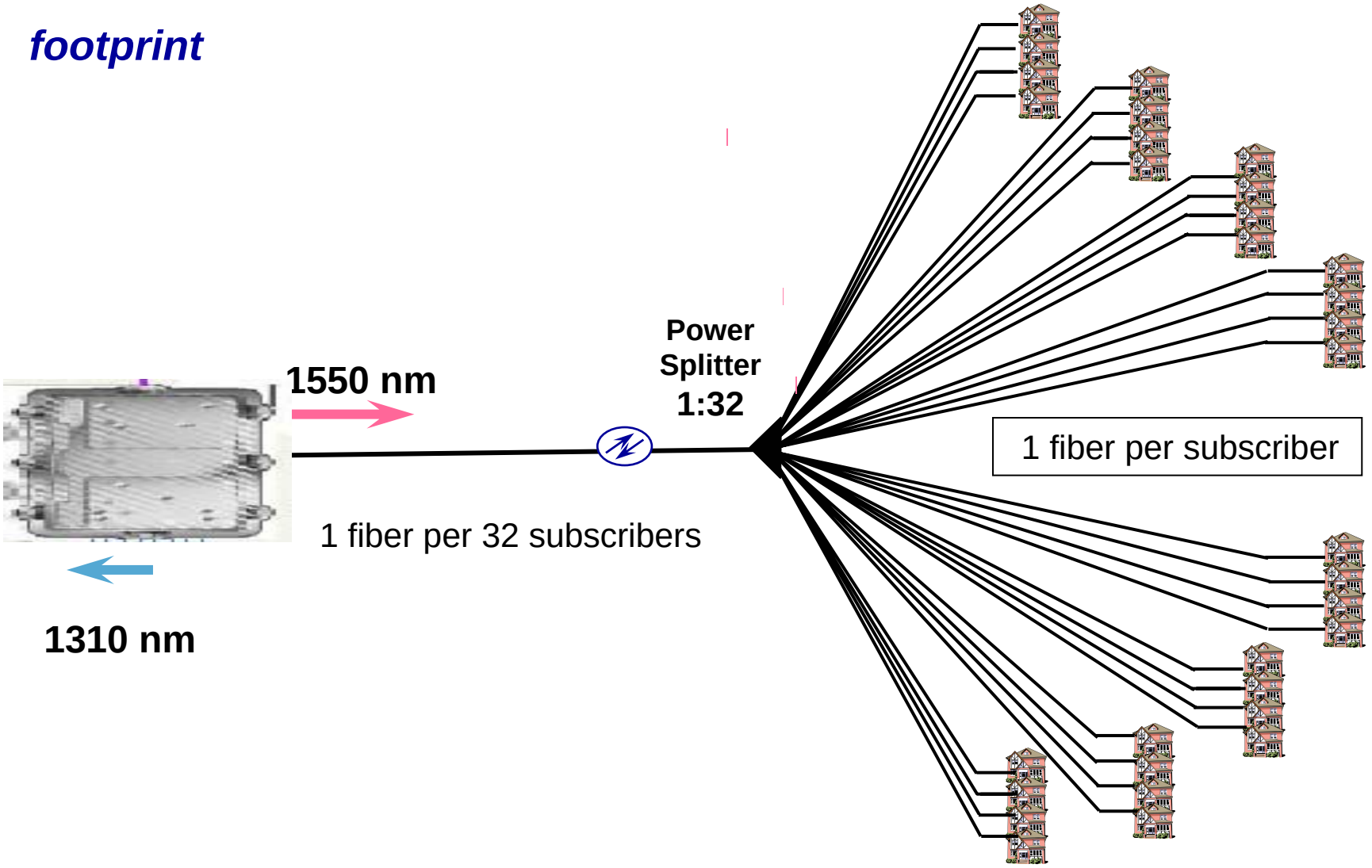
All Share the same basic OSP footprint and wavelength plan.

- **BPON**
- **EPON**
- **GPON**

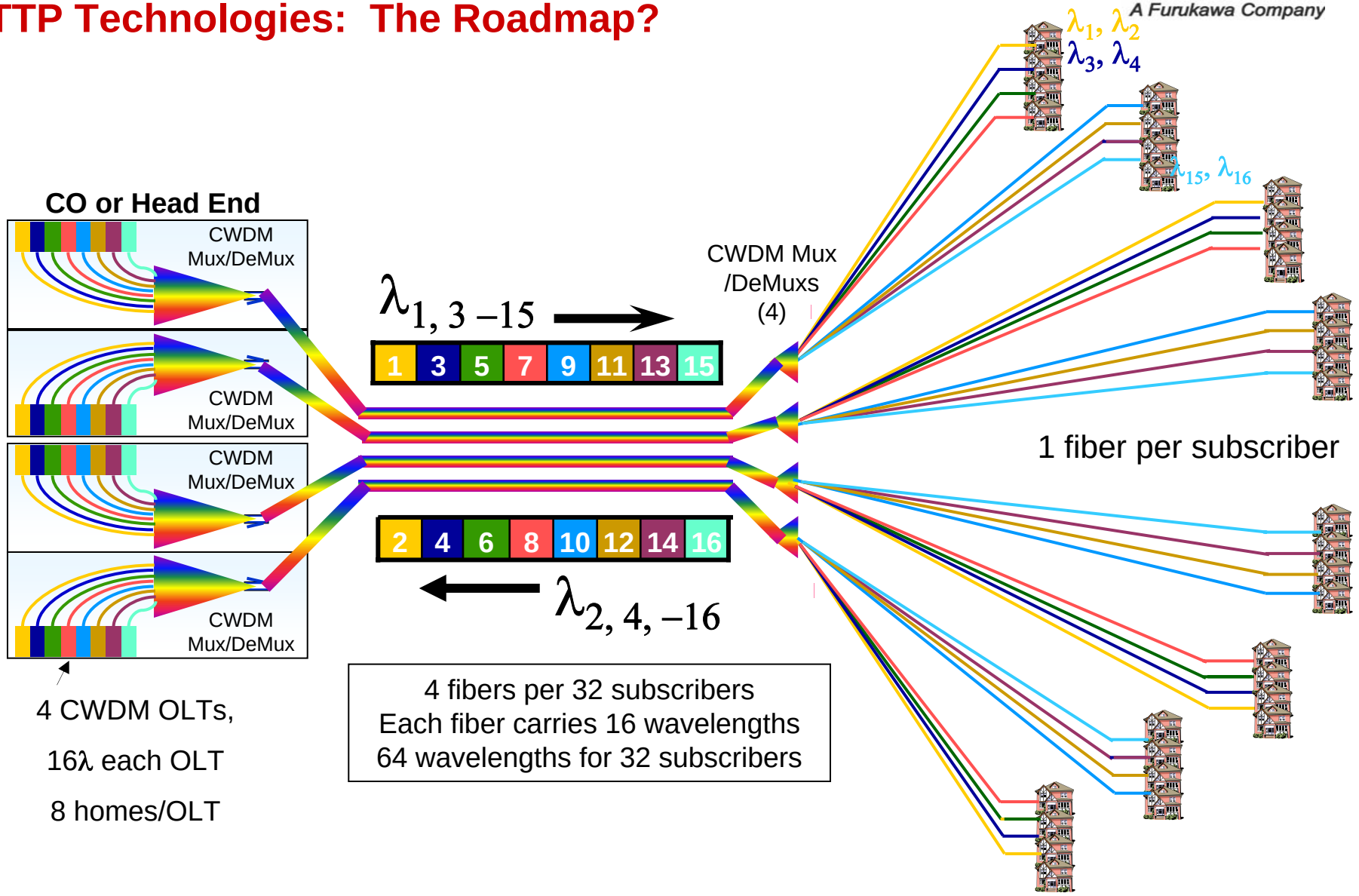


DOCSIS-Based Solutions:

Can adhere to the standards-based OSP footprint



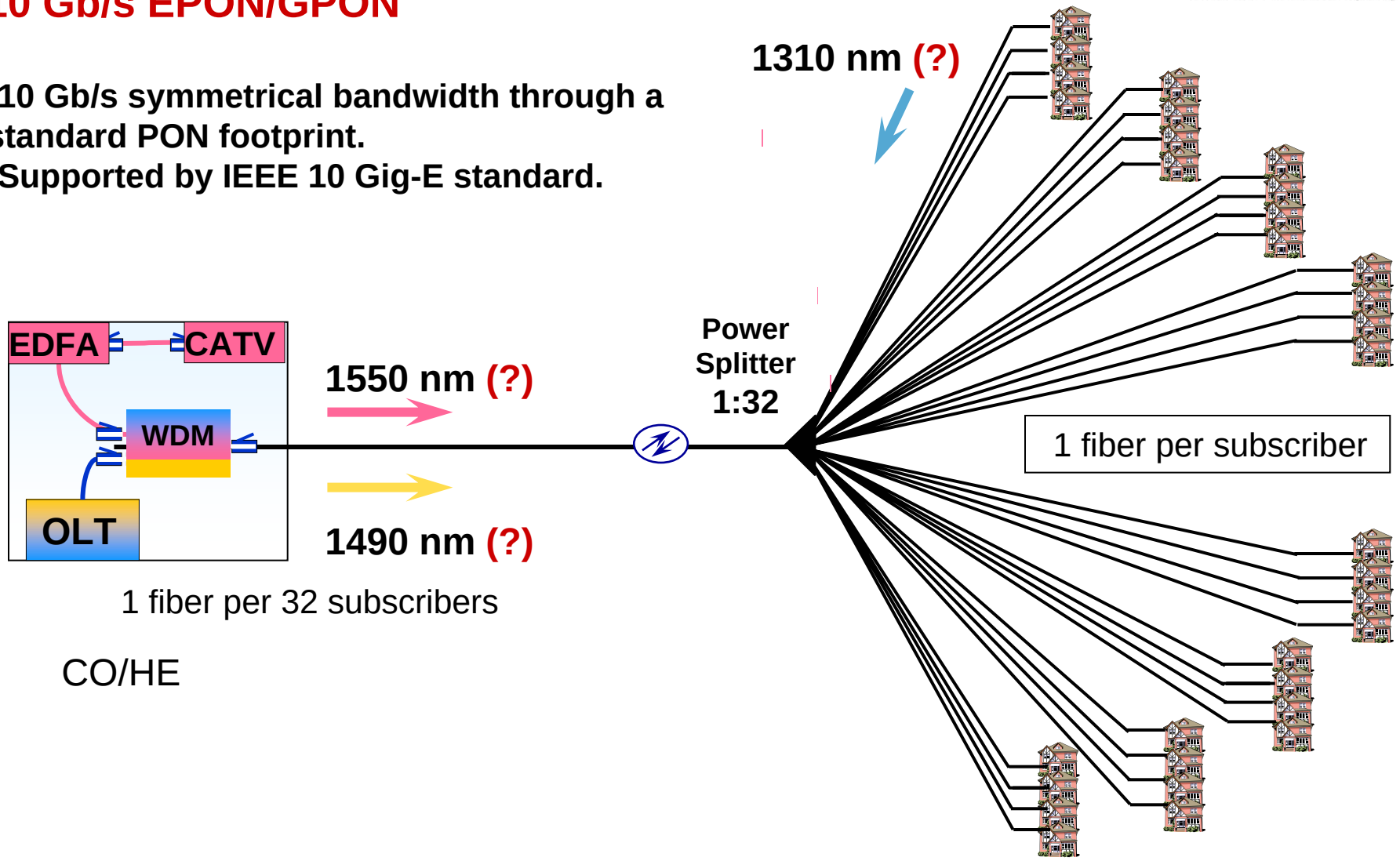
FTTP Technologies: The Roadmap?



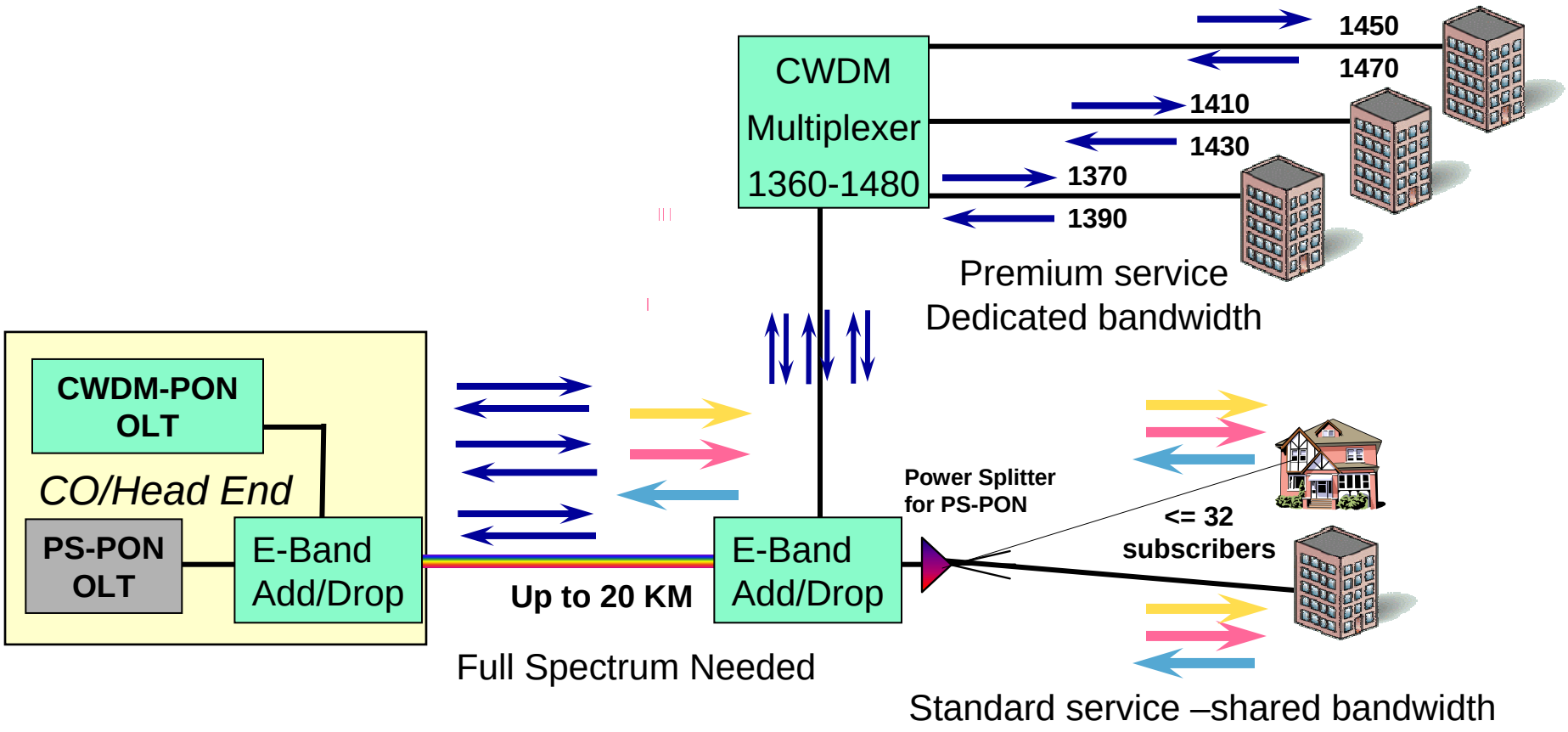
The PON Technology Roadmap:

10 Gb/s EPON/GPON

-**10 Gb/s symmetrical bandwidth through a standard PON footprint.**
-**Supported by IEEE 10 Gig-E standard.**

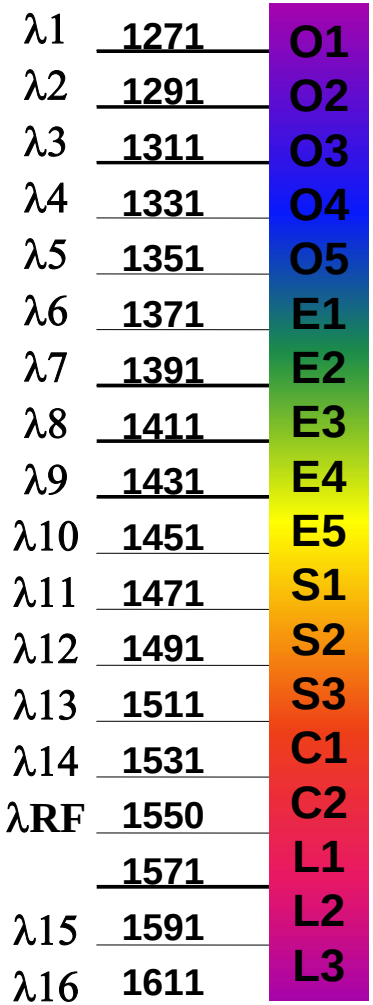


PON With Premium Business Services:



Technology Roadmap: Full Spectrum-CWDM

Wavelength Legend for Upgrade Options

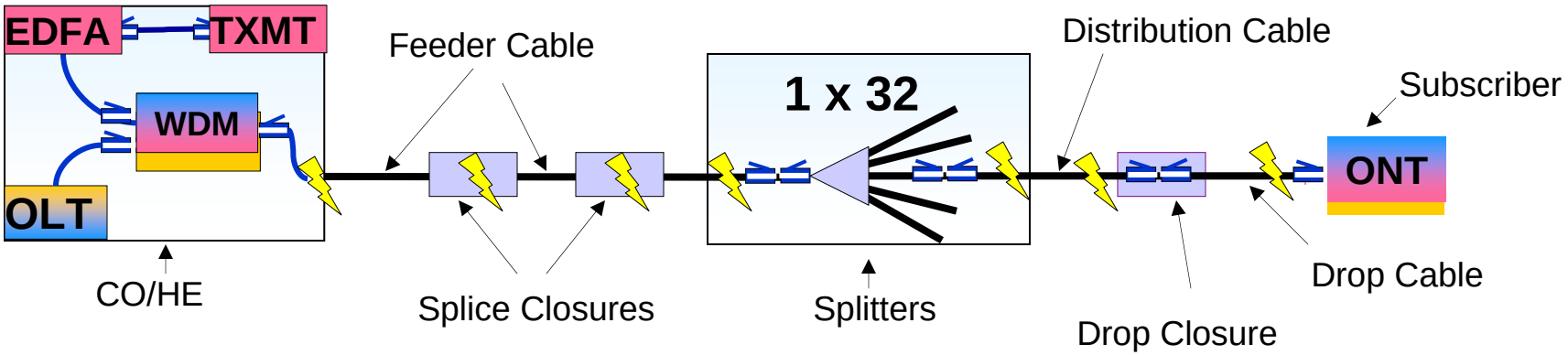


CWDM Full Spectrum Wavelength grid

- ITU G.694.2 (1271 – 1611 nm)
- 18 wavelengths
- 20 nm spacing between wavelengths

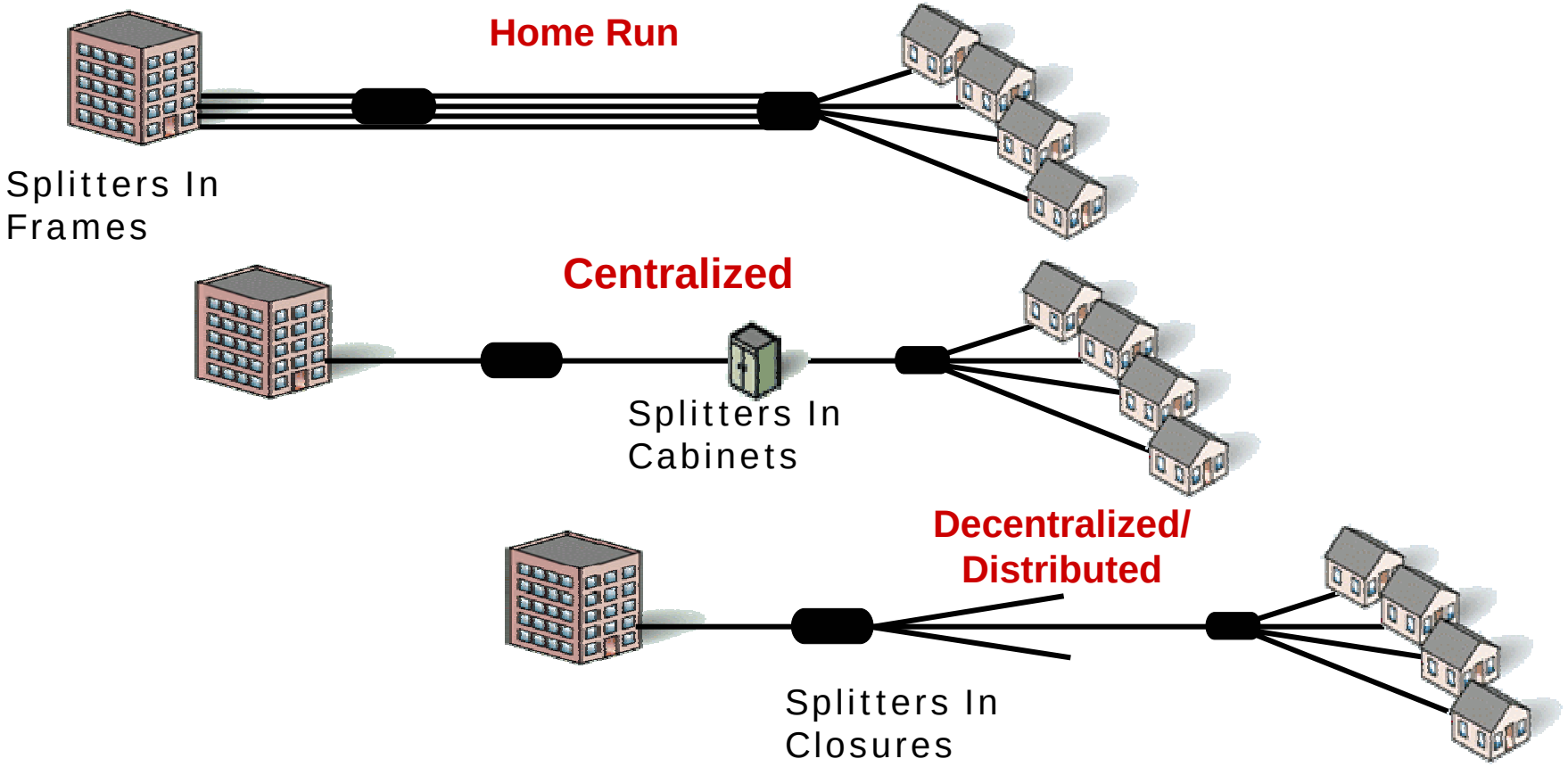
PON-Based Architectures and Components

PON Components:

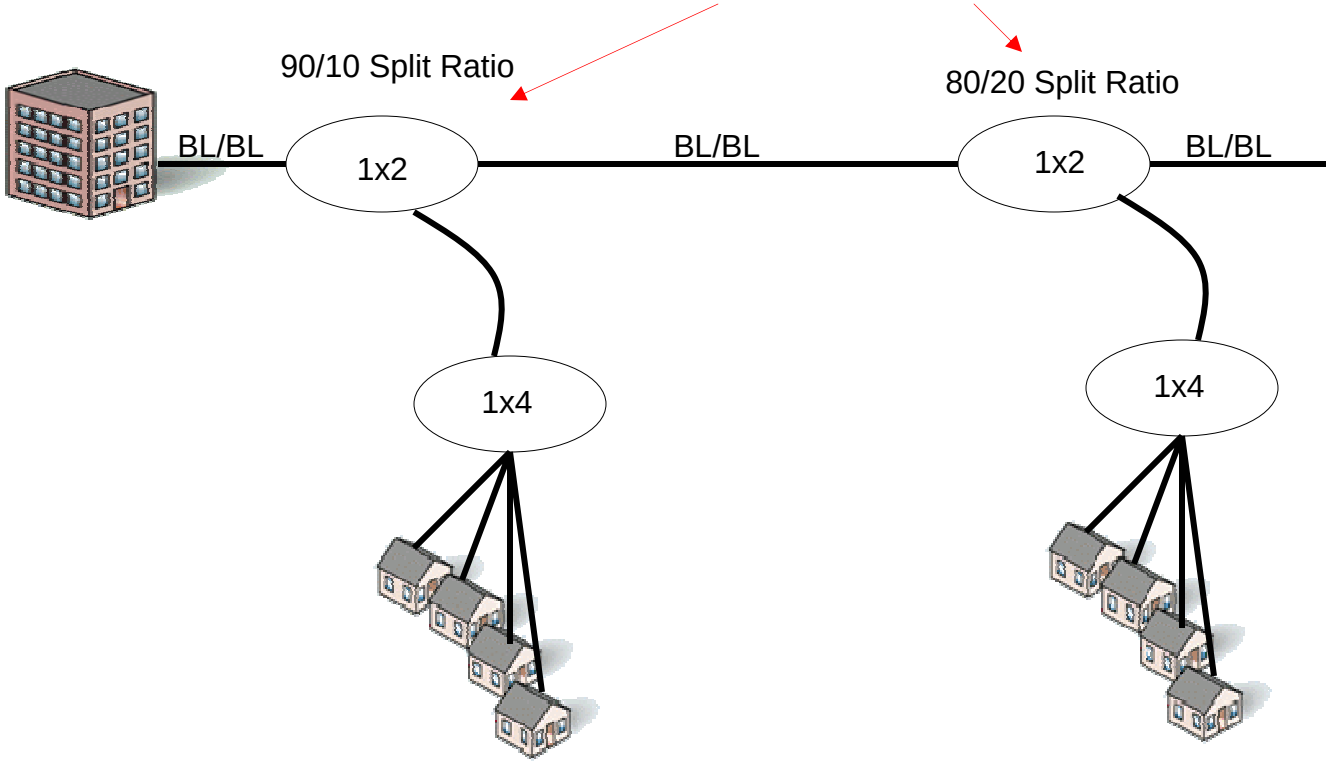


= Fusion Splice

PON Architectures: Splitter Placement



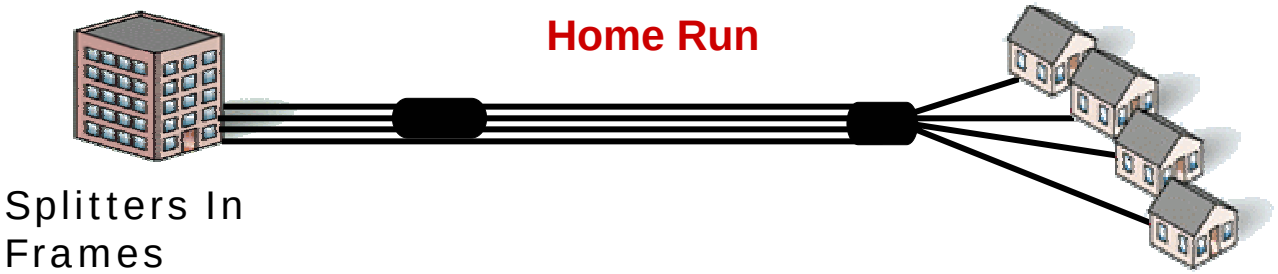
PON Architectures: The TAP

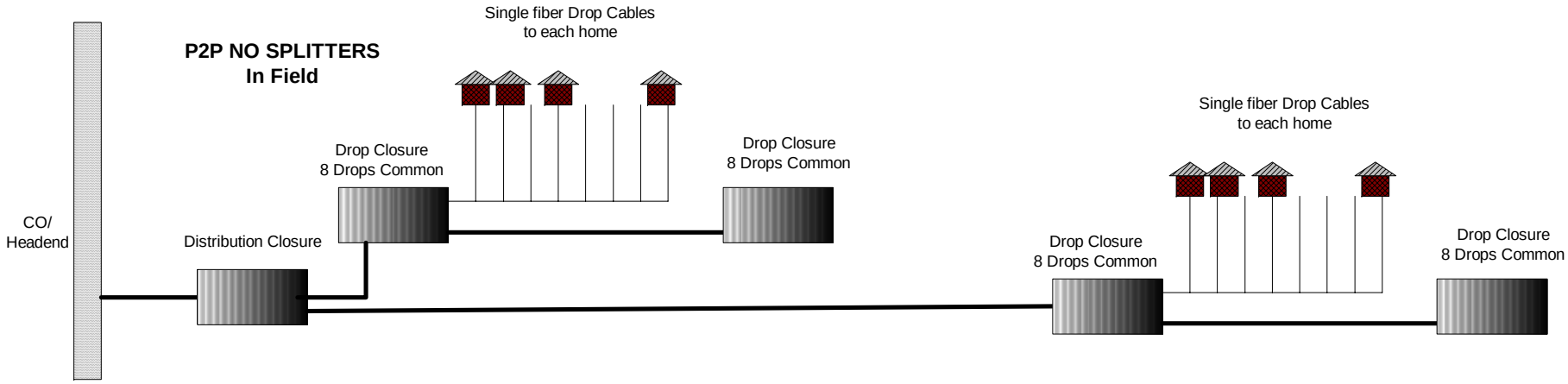


Splitter Efficiency: TAP Architectures

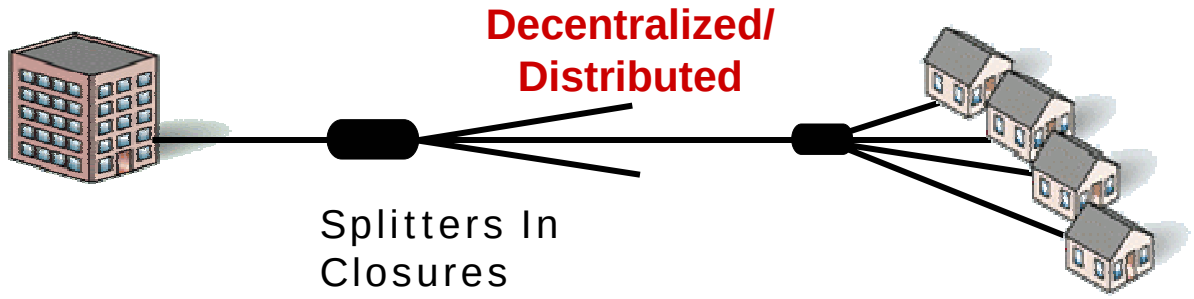
- Uses low-cost, uneven split-ratio wideband FBT couplers/splitters.
- Typically employed where a limited amount of fiber is already installed.
- Some potential downtime issues associated with adding new customers.
- FBT technology does not typically operate over the full CWDM optical spectrum.
- For the purposes of this presentation, the tap solution will be considered a variation of distributed architecture.

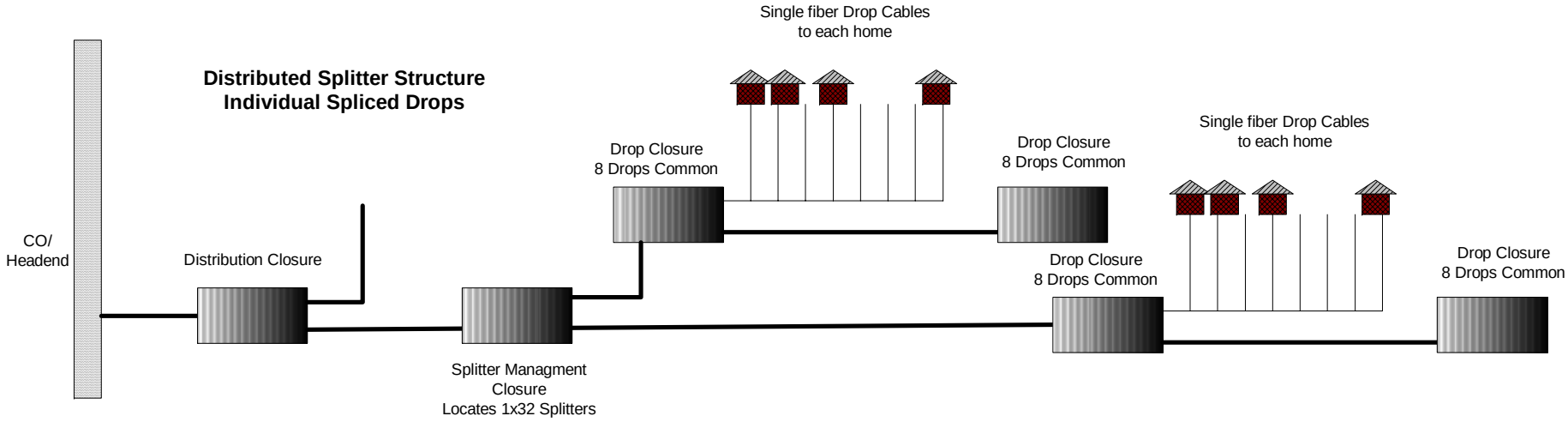
Point to Point (P2P) OSP:
All Fibers Feed From CO Splitters to Living Units



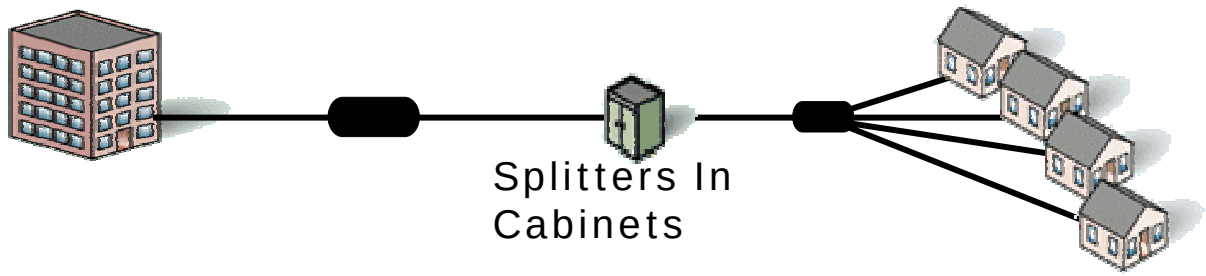


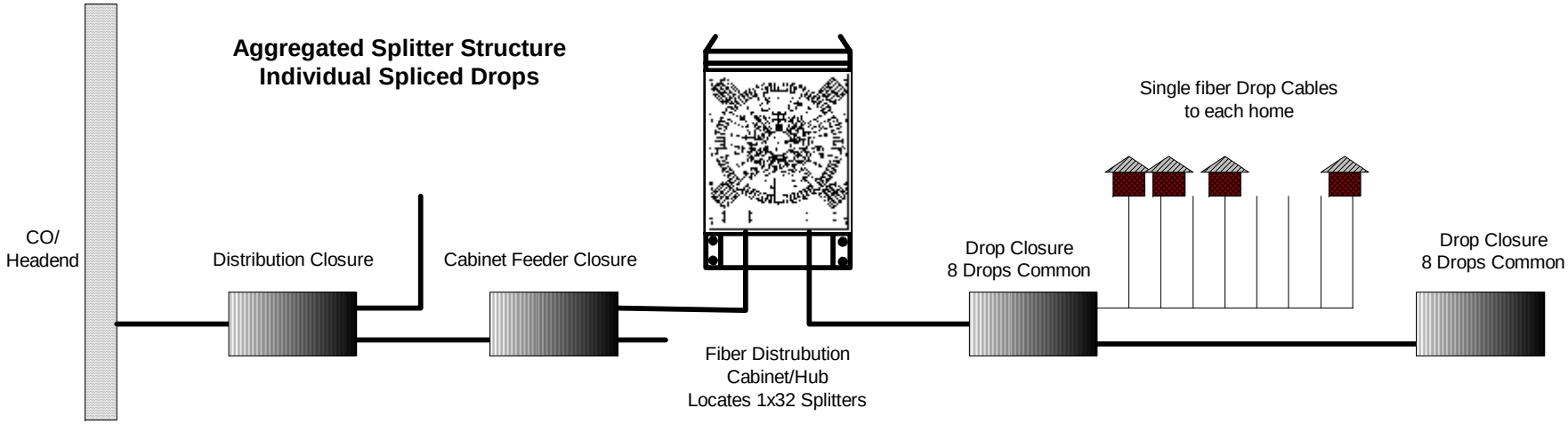
Distributed Splitter Application:





Centralized Splitter Application:



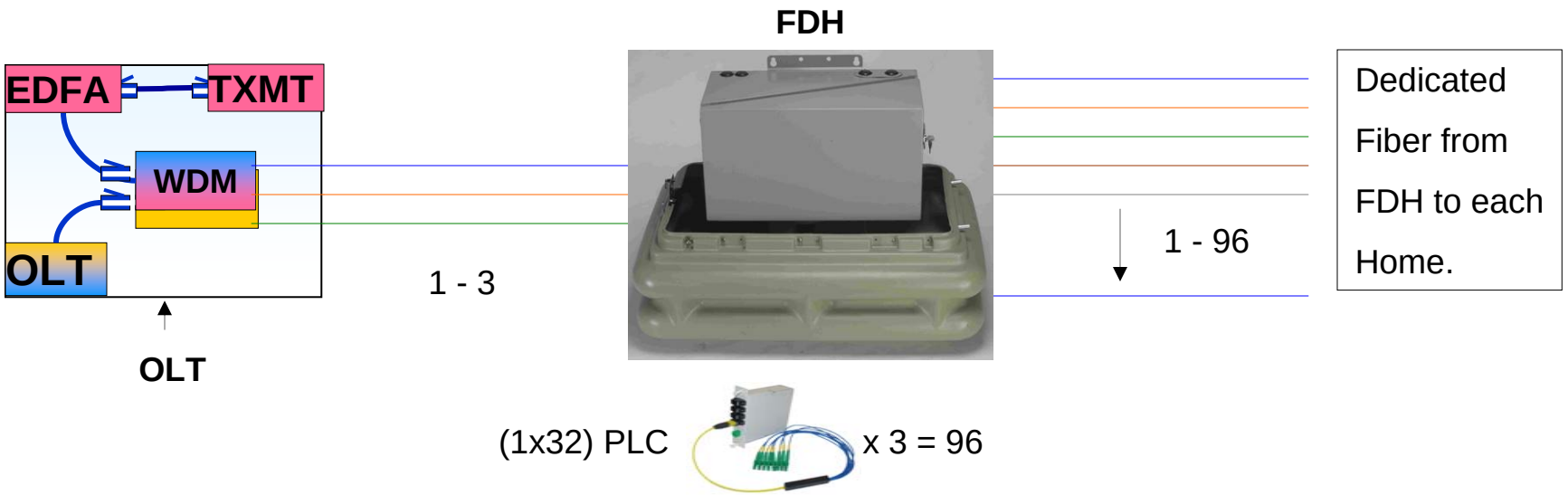


PON Centralized Architecture: Common Telco Solution

The FDH – Fiber Distribution Hub

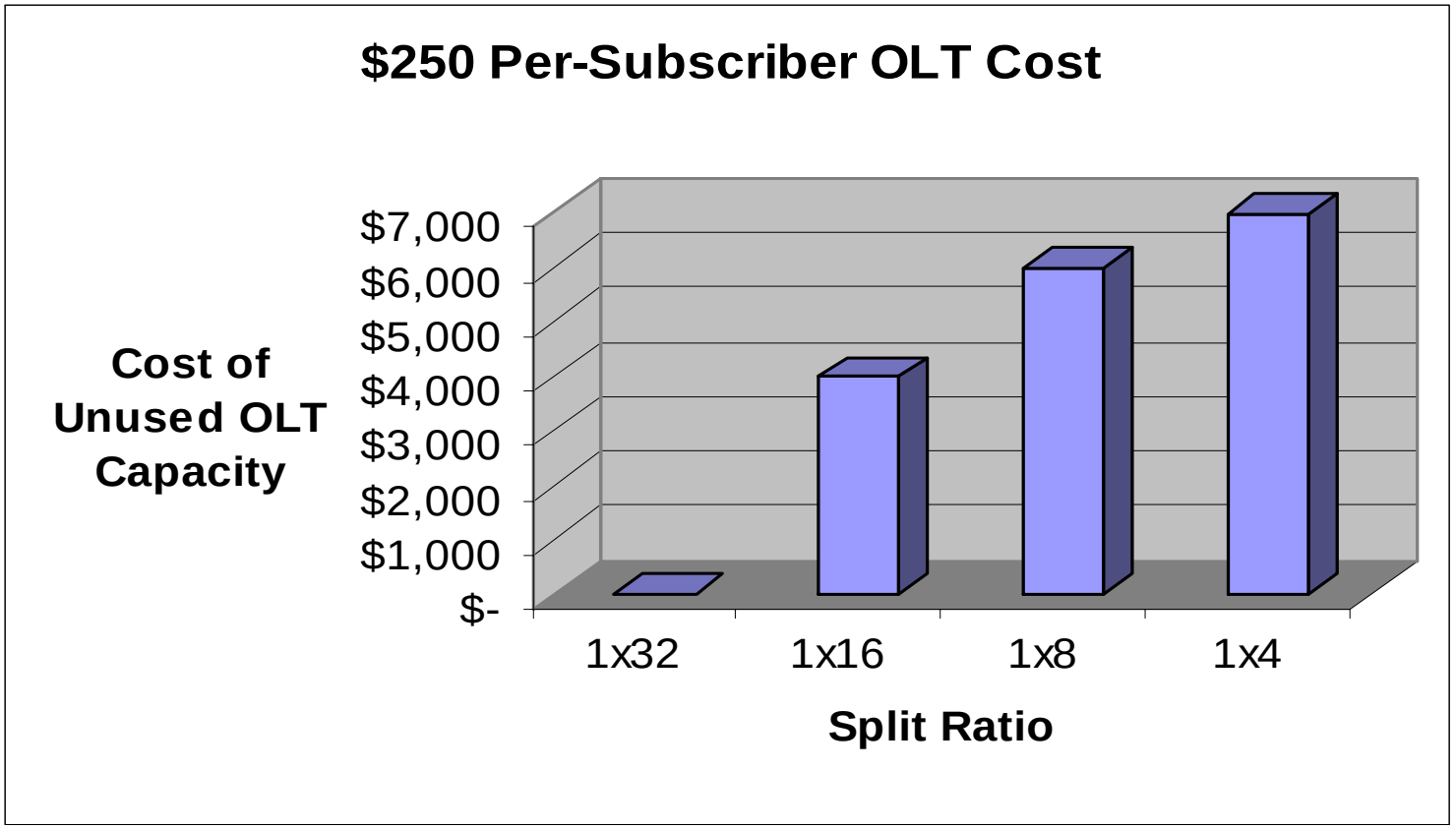
- **Very efficient use of OLT capacity and splitter capacity in an overbuild with unpredictable take-rates. Can achieve 100% efficiency.**

- **More fiber + more connectors + fiber management + real estate requirements = greater expense.**

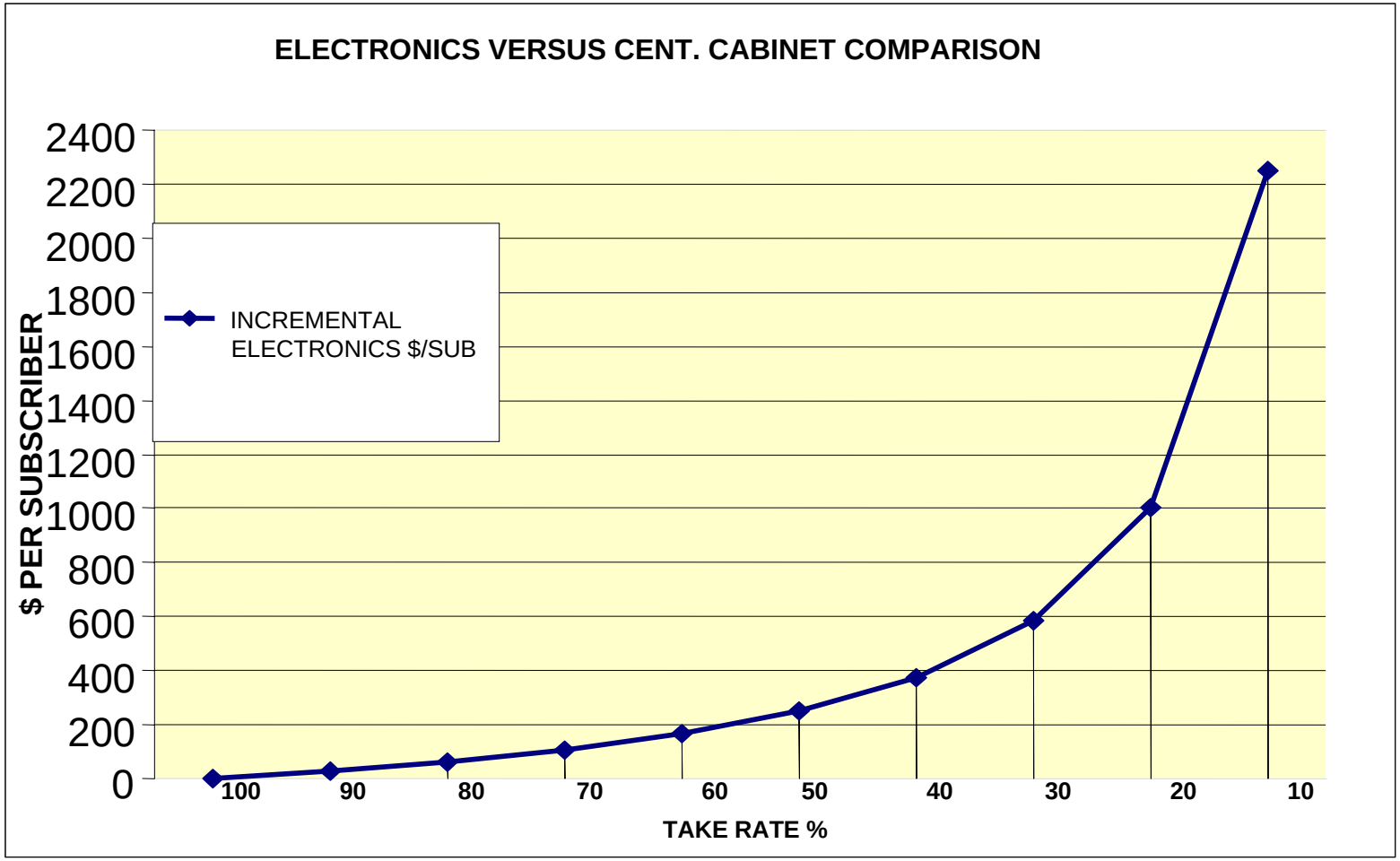


OLT Cost-Per-Subscriber:

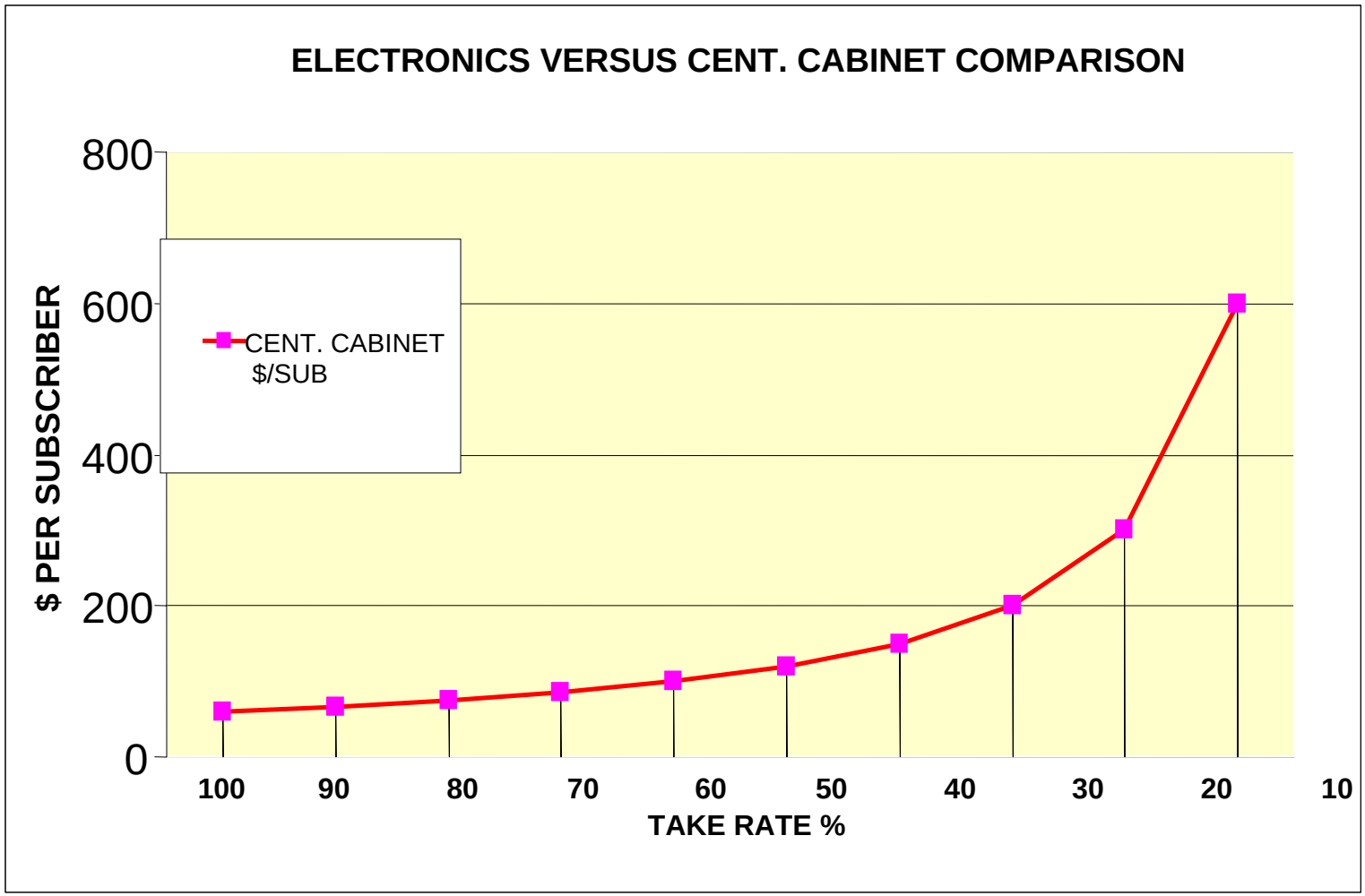
- **If the OLT cost-per-sub is $250, what is the cost of inefficiency?**



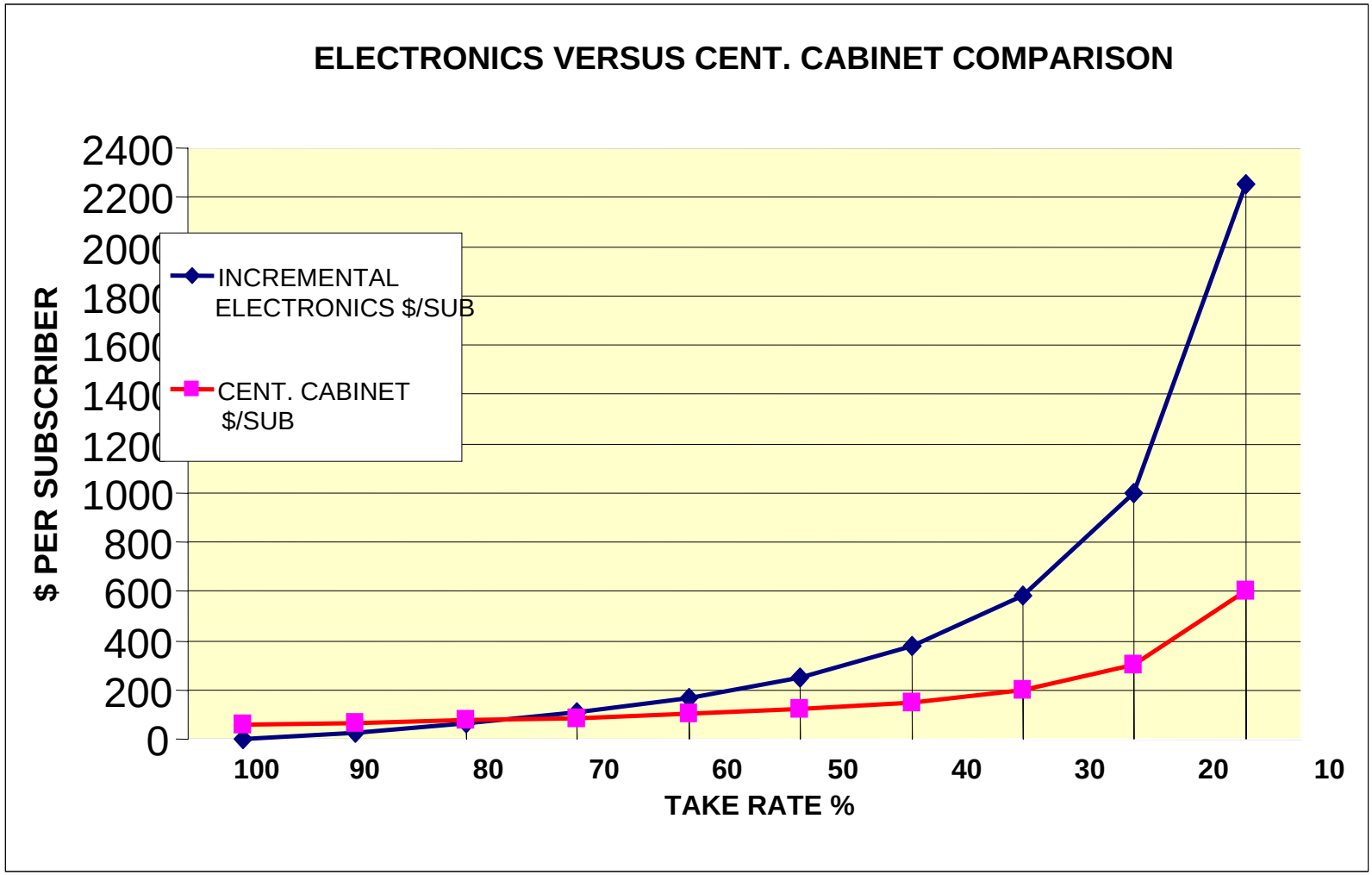
Why Do Telco's Deploy Cabinets?
$250/Sub OLT



Why Do Telco's Deploy Cabinets?
$60/Sub Cabinet



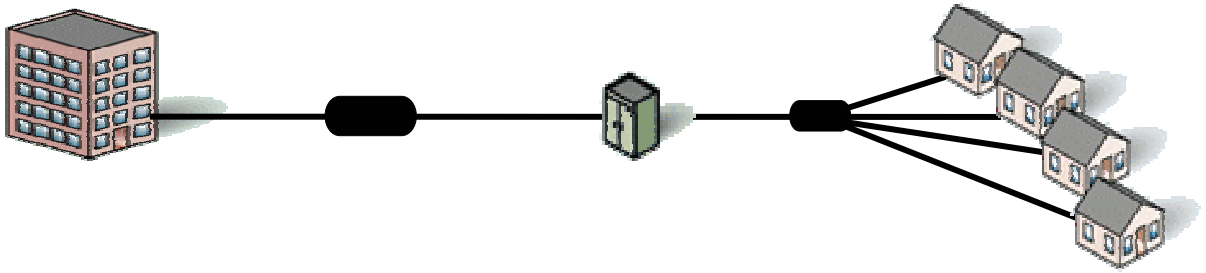
Why Do Telco's Deploy Cabinets?
$250/Sub OLT and $60/Sub Cabinet



Take-Rates, OLT Costs, and OSP Design:

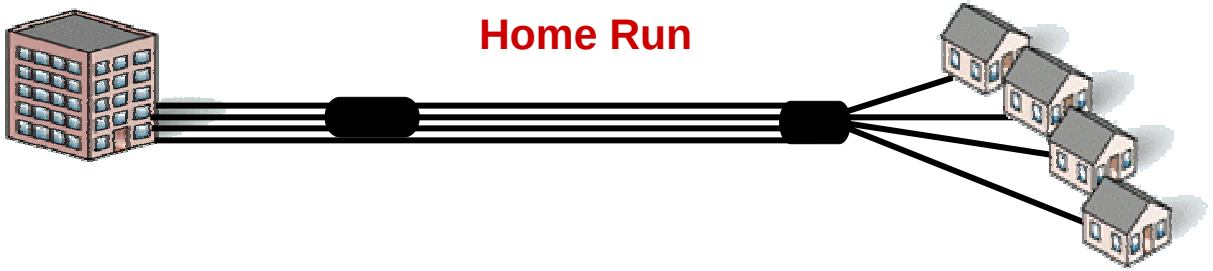
Centralized

- Efficient Take-Rate Management
- High OSP Material Costs



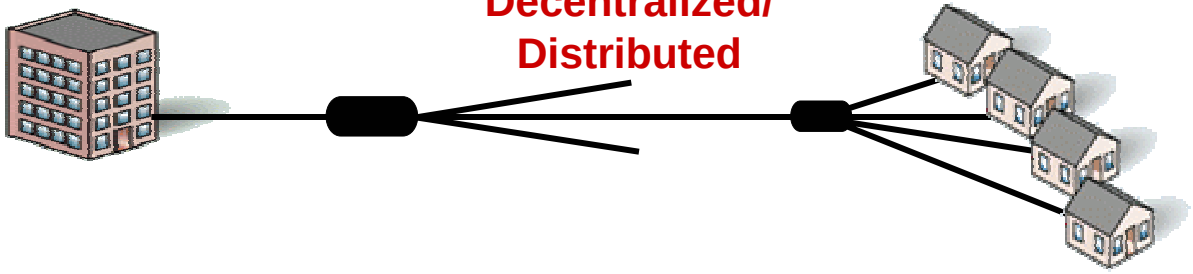
Home Run

- Efficient Take-Rate Management
- Moderate to High OSP Material Costs



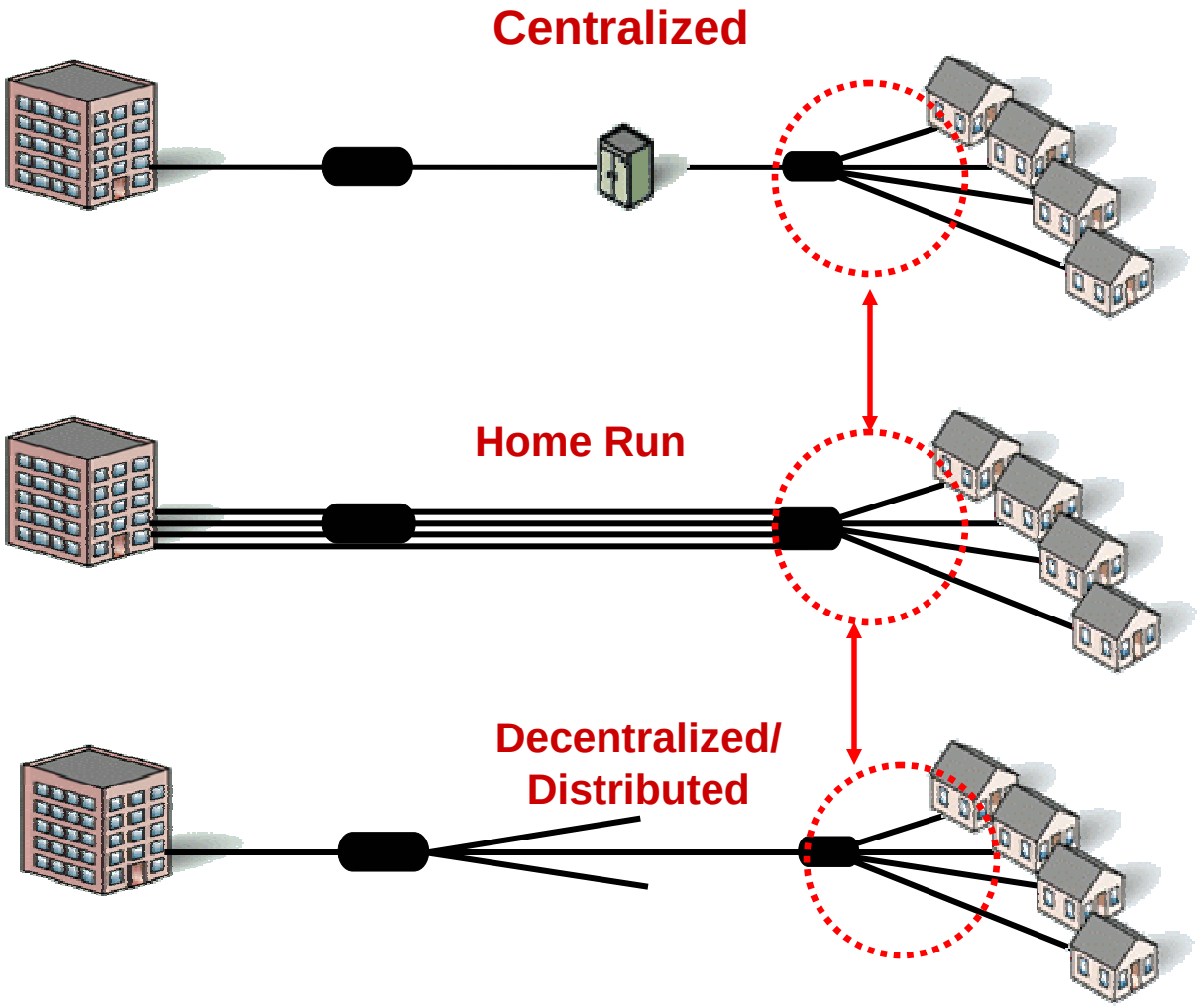
Decentralized/ Distributed

- Inefficient Take-Rate Management
- Low OSP Material Costs



The Drop Options:

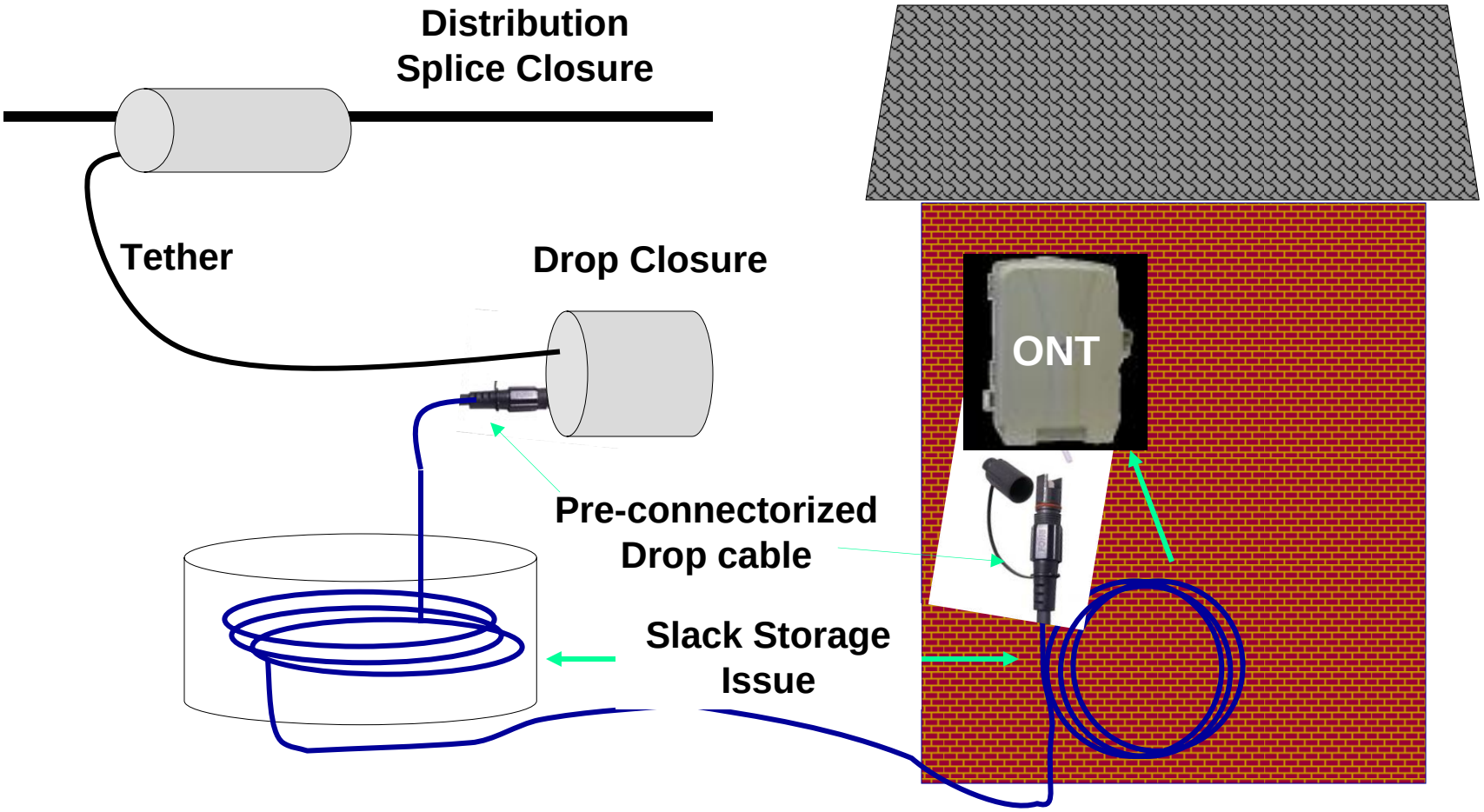
Drop Issues are common to all architectures



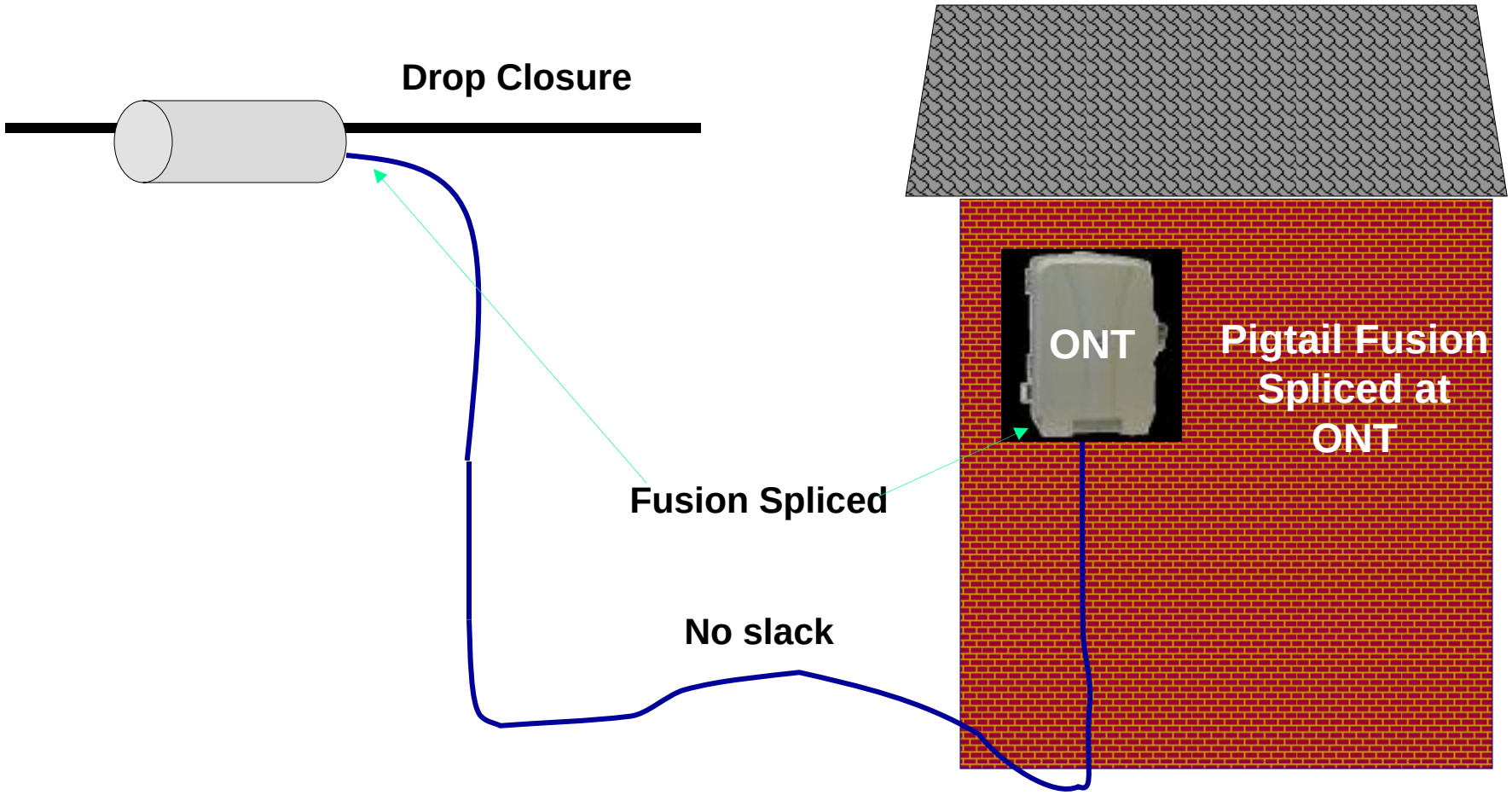
The Drop:

- A significant portion of the overall cost to deploy FTTP is in making the connection (or “drop”) to the subscriber.
- The challenge is to strike the optimum balance between addressing material costs and labor costs.
- A variety of options exist:
  - Fully-Spliced
  - Pre-connectorized on one end of the drop cable
  - Pre-connectorized on both ends of the drop cable
- Pre-connectorized solutions can decrease installation time and labor hours. They can also dramatically increase the material costs.

The Drop – Pre-Connectorized



The Drop - Spliced



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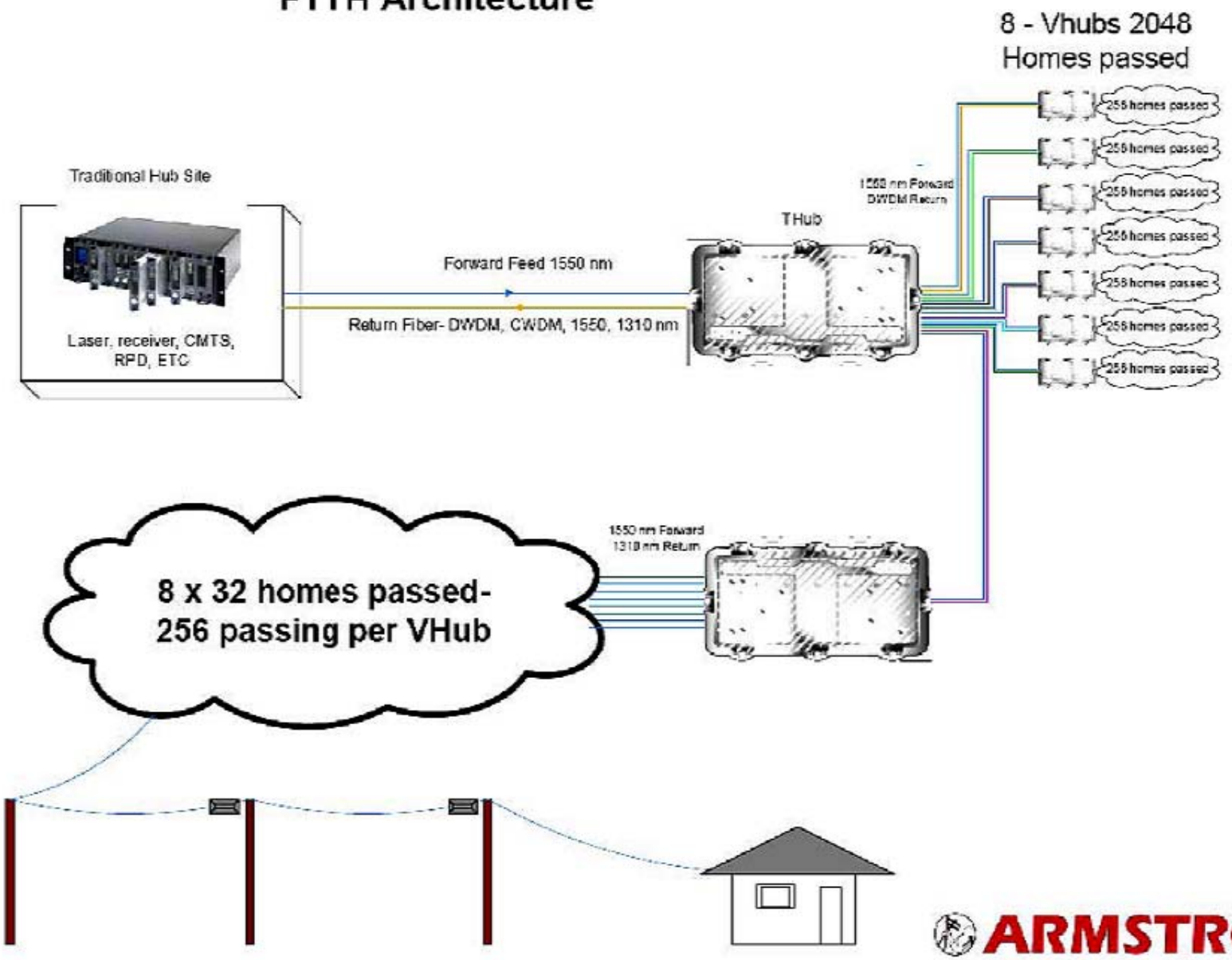
ARMSTRONG®

A CATV Provider Deploys FTTH

Armstrong
FTTH Architecture



ARMSTRONG®

From Armstrong, Why FTTH:

- Less active components
- Better picture quality
- Lower Cost to construct
- Lower operating expenses
  - No CLI
  - Fewer standby Power Supplies
  - No RF amplifiers to sweep
  - Customers powers his receiver
  - Less environmental plant issues
- Competitive edge
  - Long plant life

Armstrong Details:

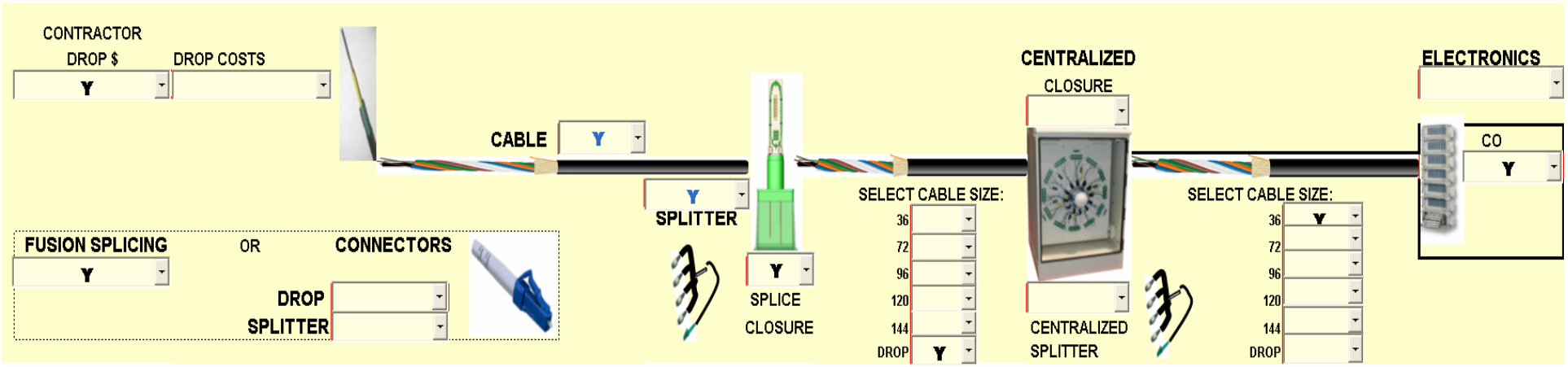
- Armstrong acquired plant which required significant rebuilding.

- Most FTTH is deployed in rural or semi-rural areas: Determined to be at cost-parity or less in rural environments.
  - High cost of coax vs fiber media
  - Reduced electronics
  - Reduced plant

- Take-rate is in excess of 50% and inefficiency costs are low relative to telco equivalent PON systems.
  - Distributed architecture selected based on cost-modeling.

SINGLE FAMILY RESIDENTIAL COST MODEL

NOTE: THESE COSTS ARE NOT ALL THE COSTS USE THEM TO COMPARE PLANS ONLY!



MODEL ASSUMPTIONS

MATERIAL PRICES

CONNECTOR PRICES PER CONNECTION:	
CONNECTORIZED PIGTAIL	7.00
DROP CONNECTORIZED	9.20
PER PORT ADAPTER	2.00
TOTAL	18.20

SPLITTERS	PRICES
1:32	675
1:8	325
1:4	187

FIBER CABLE SIZE AND PRICES:

DROP	4	6	12	24	30
0.146	0.154	0.166	0.207	0.284	0.312

36	72	96	120	144
0.35	0.62	0.76	1	1.12

				ELECTRONICS	
CENTRALIZD CLOSURE PRICE=	3200	CO FRAME=	32	CO	8000
CLOSURE PRICE = $	300	CO TERMIN.=	500	CUSTOMER	17600

AREA GEOGRAPHY

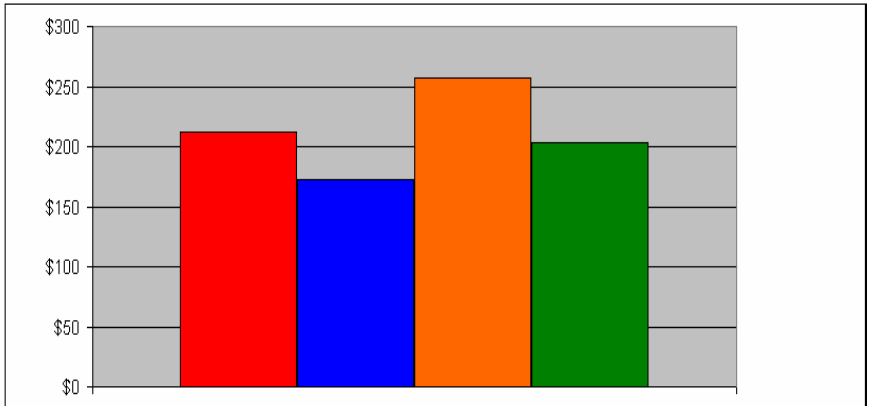
CABLE LENGTH BETWEEN CLOSURES =	200	4 DROPS/CLOS	
CABLE LENGTH BETWEEN CLOSURES =	400	8 DROPS/CLOS	
AVG DROP LENGTH=	50	4 DROPS/CLOSURE	
AVG DROP LENGTH=	100	8 DROPS/CLOSURE	
CENT CAB. LENGTH=	2000	CO CAB. LENGTH=	1000

LABOR AND CONTRACT PRICES

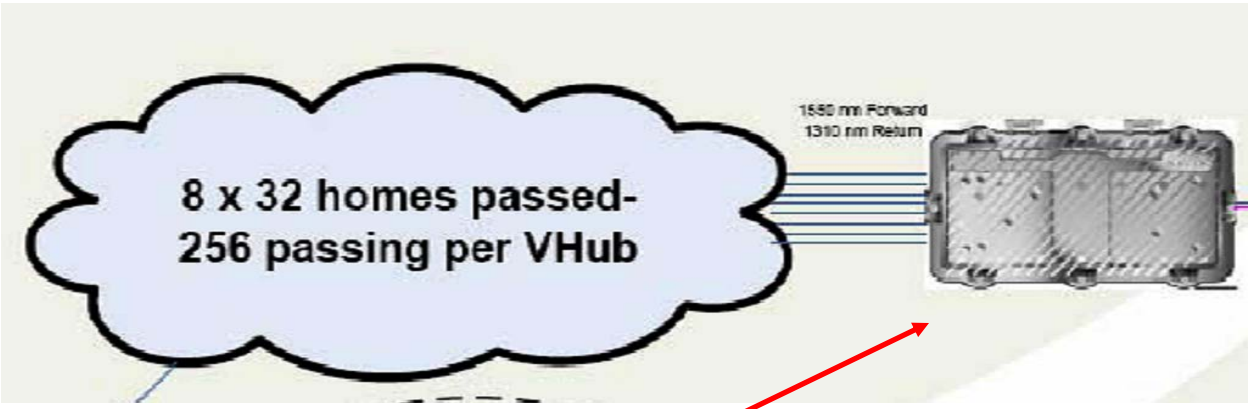
SPLICING LABOR =$	50	PER HOUR	
SPLICING TIME:			
1x32 HRS=	3	SPLICING HRS FOR	
1x8 HRS=	1.5	I DROP=	0.50
1X4 HRS=	1		
PLACE ONE EXTRA DROP IN TRENCH PER FOOT=			0.10
PLACE LONGER DROP IN TRENCH PER FOOT=			0.20
TAKE RATE % =	85%		
MAIN TRENCH FEET=	1600	PRICE/FT=	0

COST TO PLACE AVG. DROP EXCLUDED

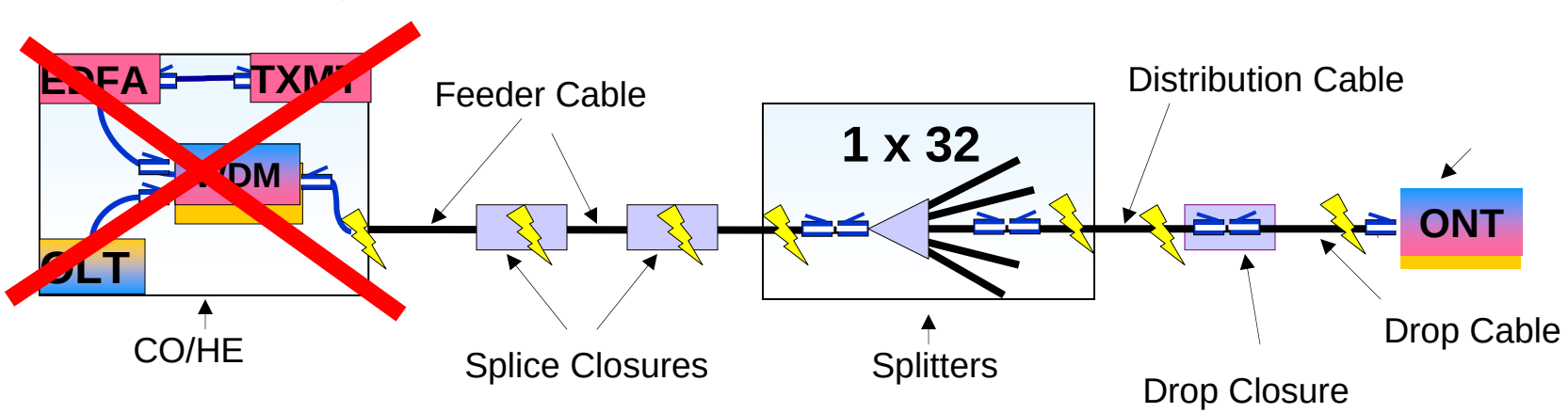
	32 SPLIT 4 DROPS/ PED	32 SPLIT 8 DROPS/PED	8-4 SPLIT	4-8 SPLIT	
CABLE COST	560	454	331	266	
DROP COST	0	0	0	0	
SPLITTER	675	675	1821	1487	
CONTRACTOR	0	240	0	240	
SPLICING LAB $	950	950	1275	1150	
CLOSURE COST	2400	1200	2400	1200	
CENT SPLIC COST	0	0	0	0	
CENT CLOS COST	0	0	0	0	
FEEDER CAB COST	1174	1174	1174	1174	
MAIN TRENCH	0	0	0	0	
ELECTRONICS	0	0	0	0	
	5759	4693	7001	5517	TOTAL
	$212	$173	$257	$203	$/SUBSCRIBER



Armstrongs “OLT” = The V-Hub



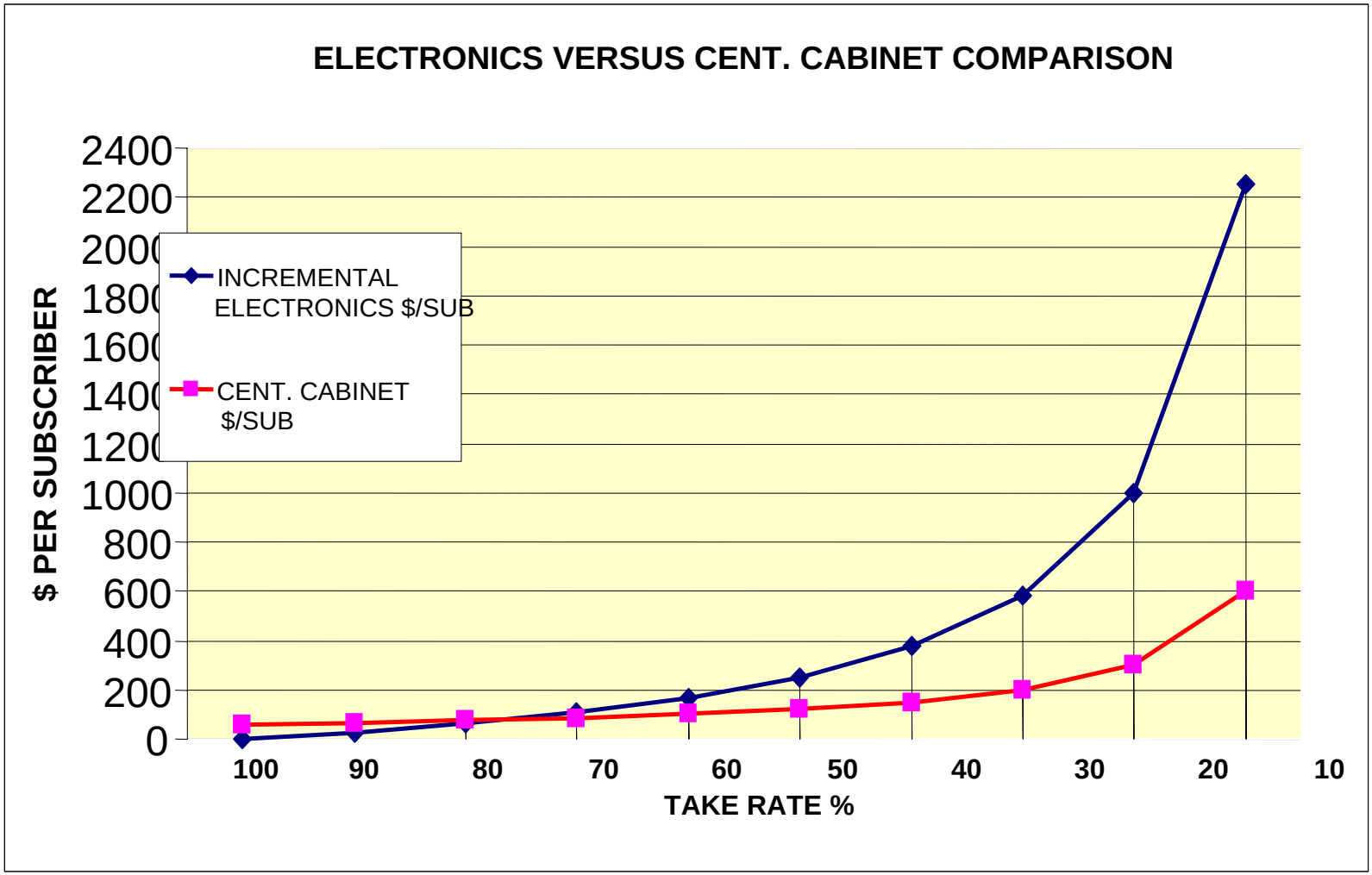
Subscriber



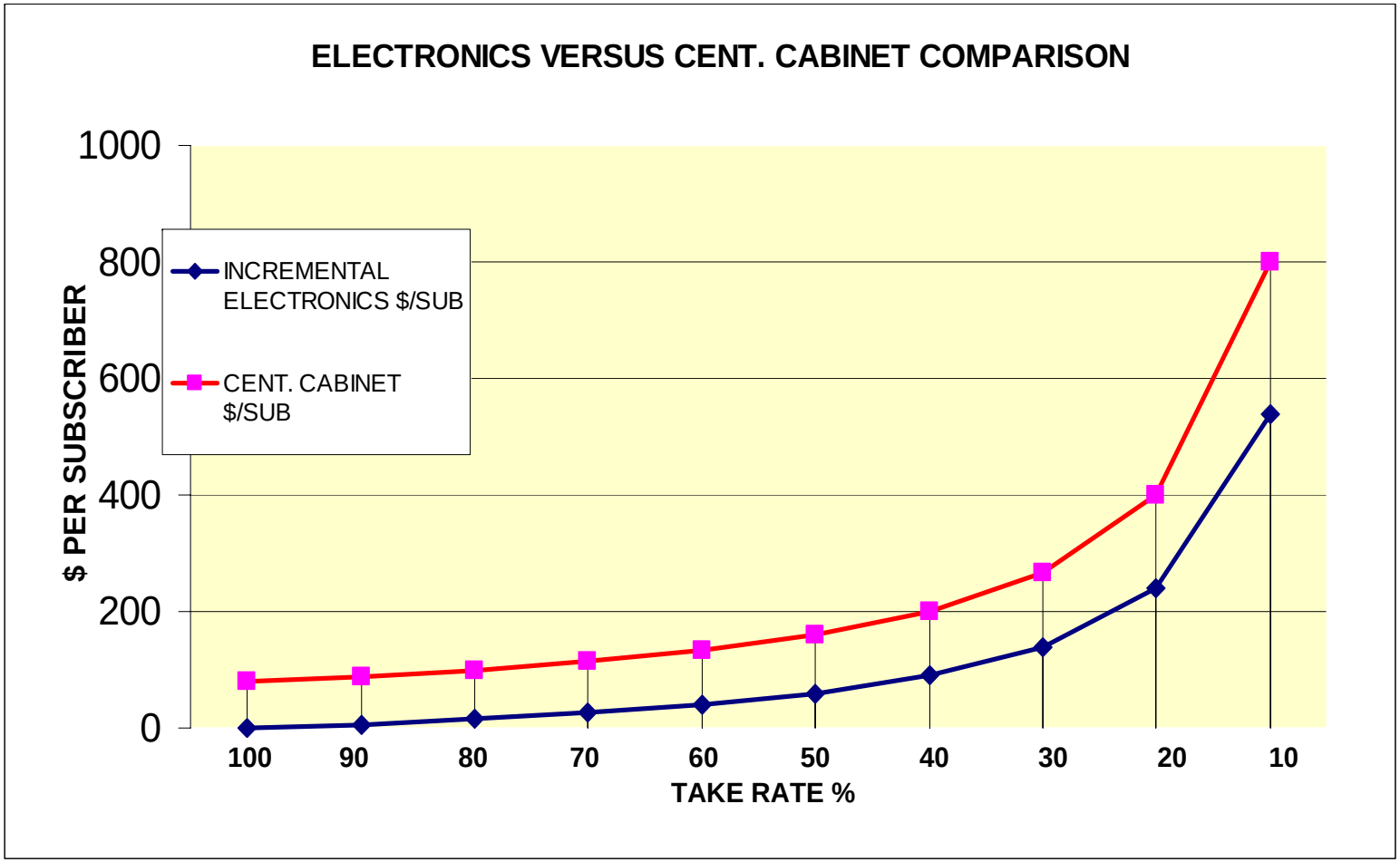
The V-Hub:

- 1 V-Hub Serves up to 256 Homes
- V-Hub “per subscriber” cost is approx. $60.
- V-Hub = OLT. Therefore, OLT per-sub cost is $60
- Cabinet deployment in semi-rural area costs $80 to $100 per-sub.

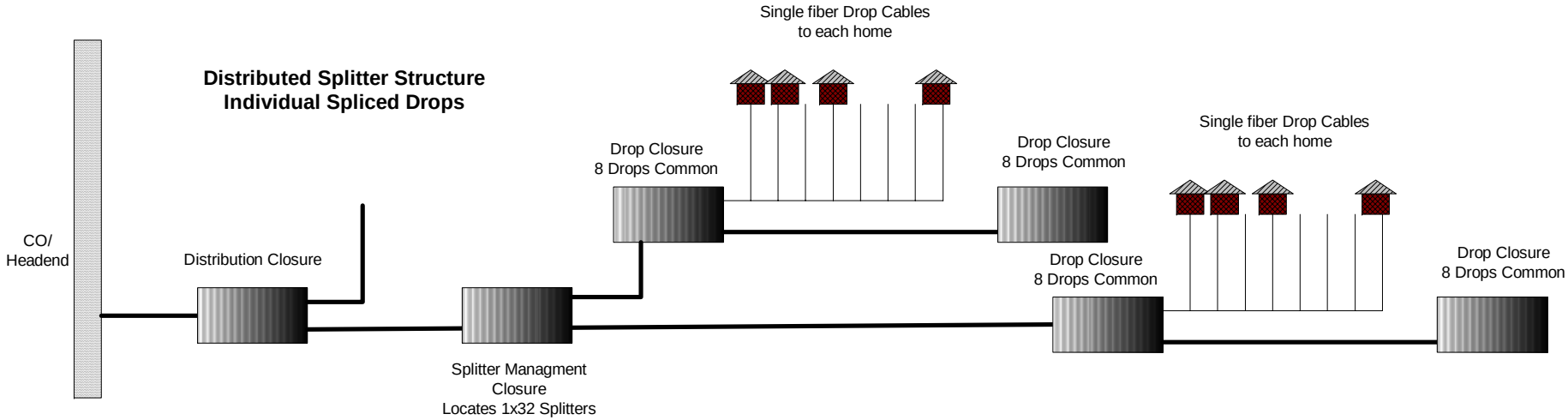
We go from this . . . . .



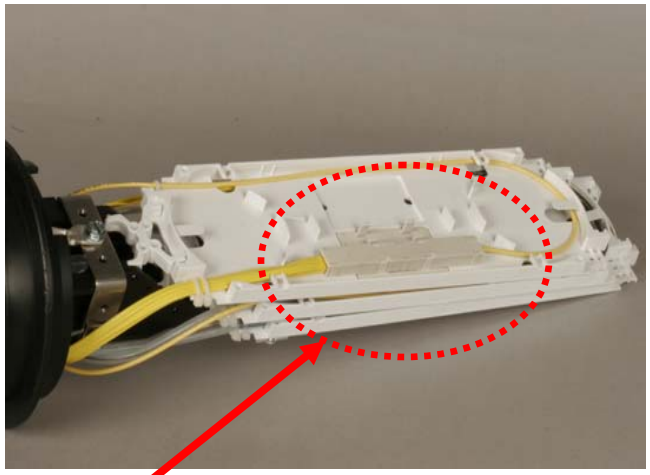
To this . . . . .

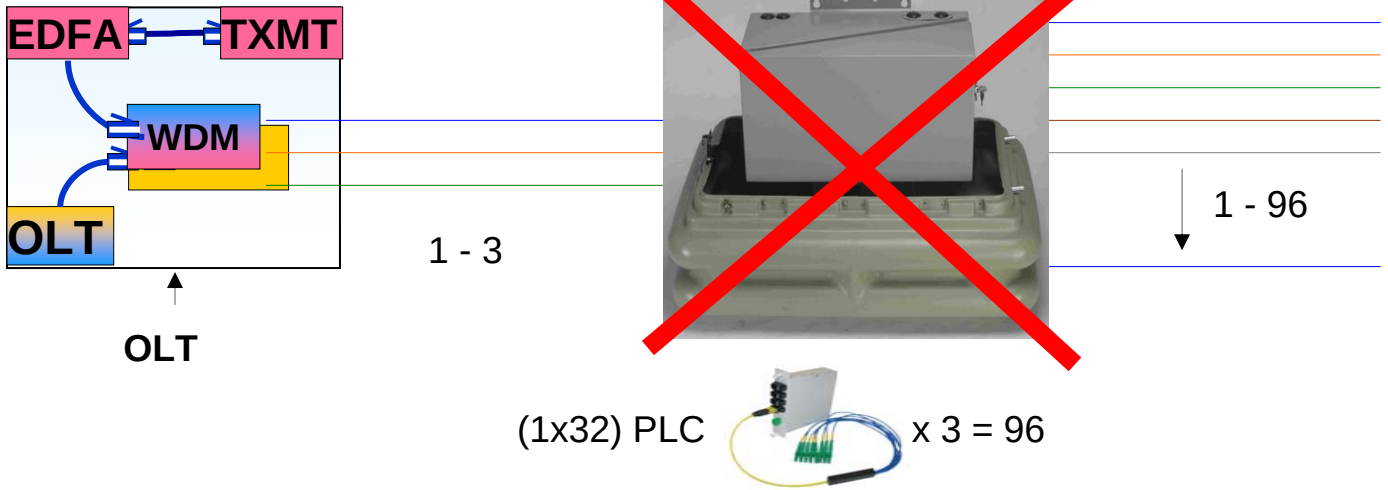


Distributed Splitter Application:



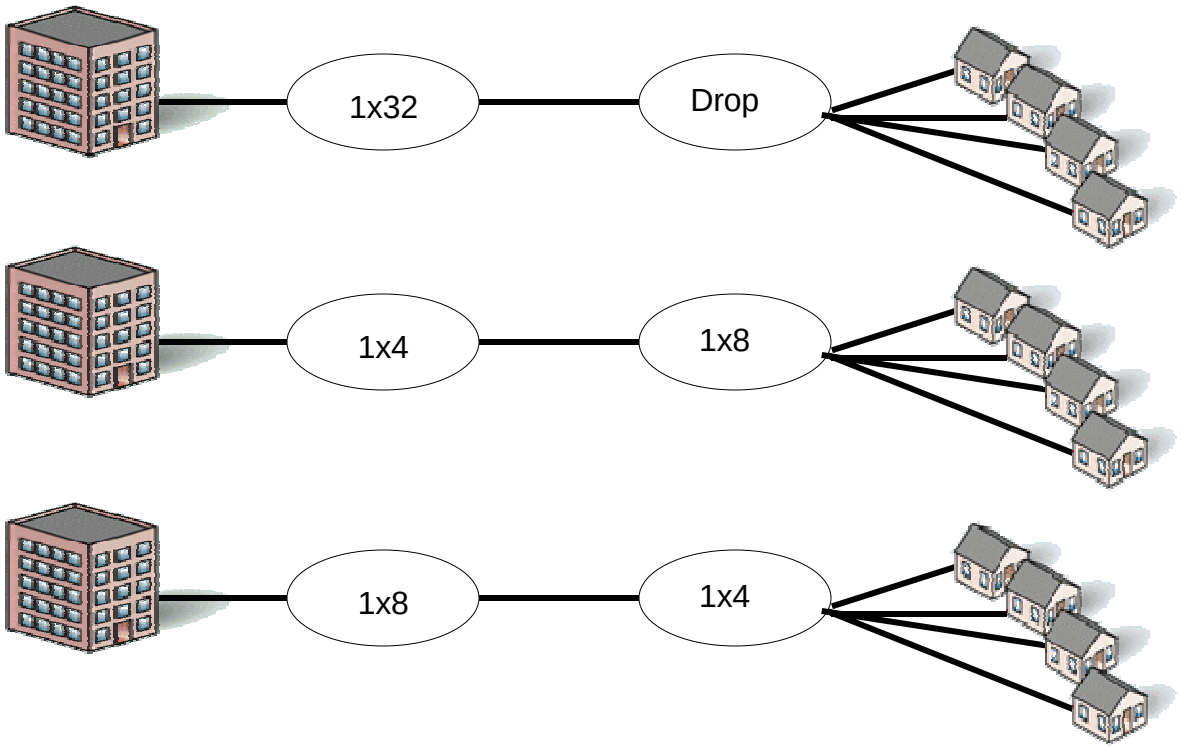
Armstrong's Splitter Solution:





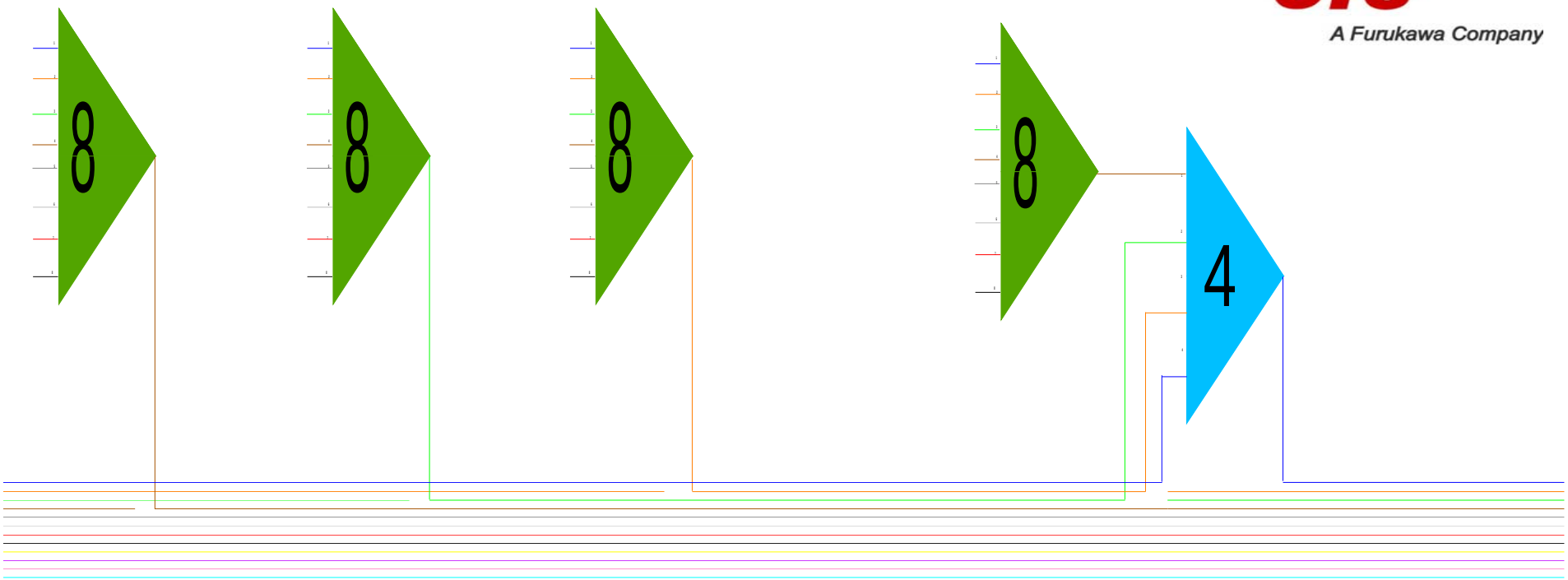
Distributed PON Design Options:

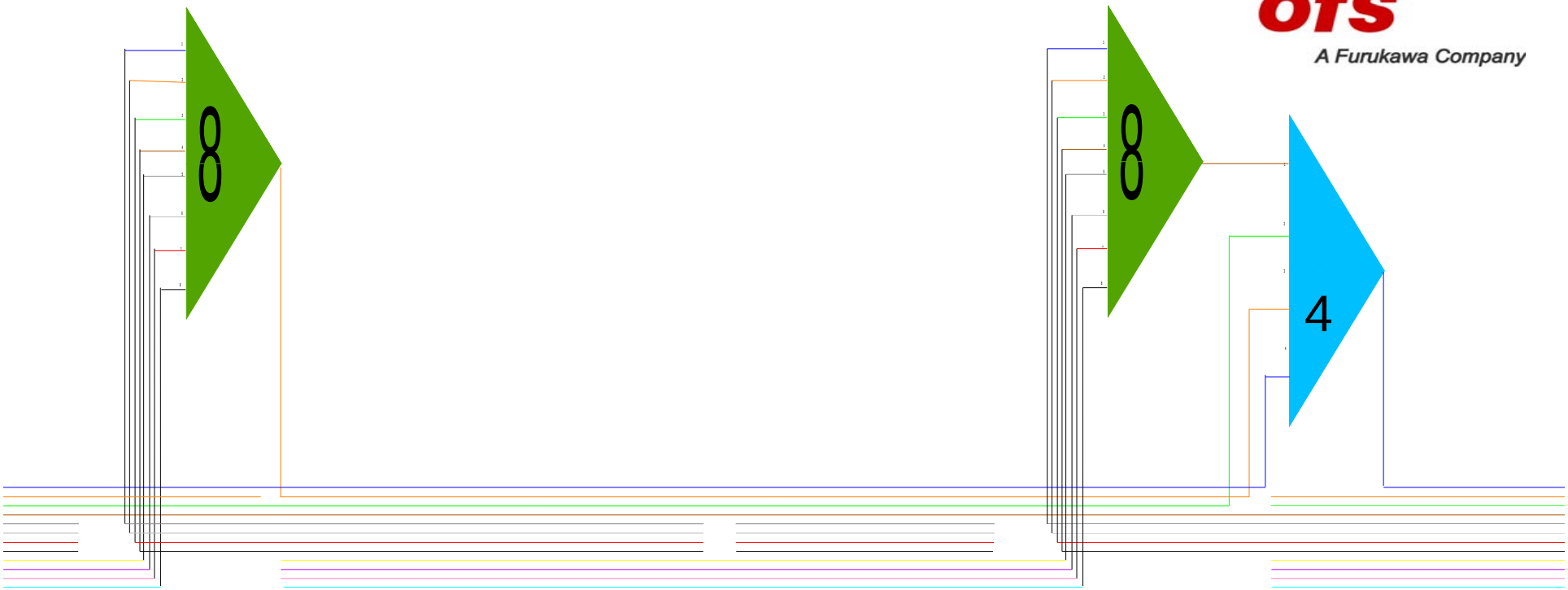
- **1x32 is a “cumulative” number in PON design.**



Distributed PON: Material Costs

- The primary material costs trade-off when choosing a distribution architecture is splitter cost versus distribution cable costs.
- A single 1x32 splitter is typically less expensive than one 1x4 and four 1x8's or one 1x8 and eight 1x4's.
- However, more distributed architectures keep distribution fiber counts lower than placing a single 1x32 in a closure. Thus, lower potential distribution cable costs.
- As a general rule, deployments with lot sizes less than 100' are more cost-effectively served by a single 1x32 architecture. Larger lot sizes may derive a cost benefit from more distributed splitting. *Armstrong is a rural deployment.





Armstrong's Distributed Architecture:

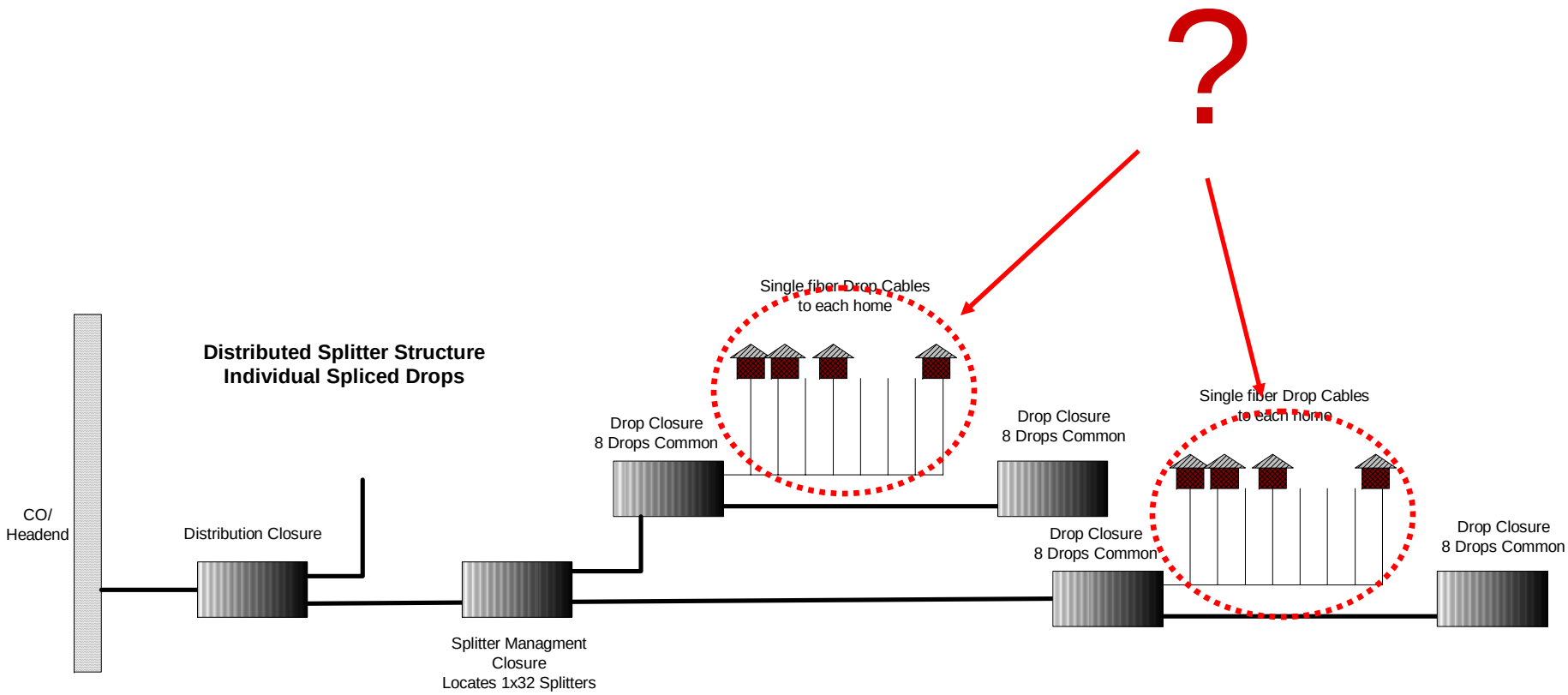
- **Armstrong adheres to the 1x32 split ratio associated with common PON standards. Upgradeability is a key concern.**

- **Armstrong deploys a single 1x32 splitter in closures where they have suburban population density. More distributed splitting (1x4's to 1x8's) is deployed in rural areas.**

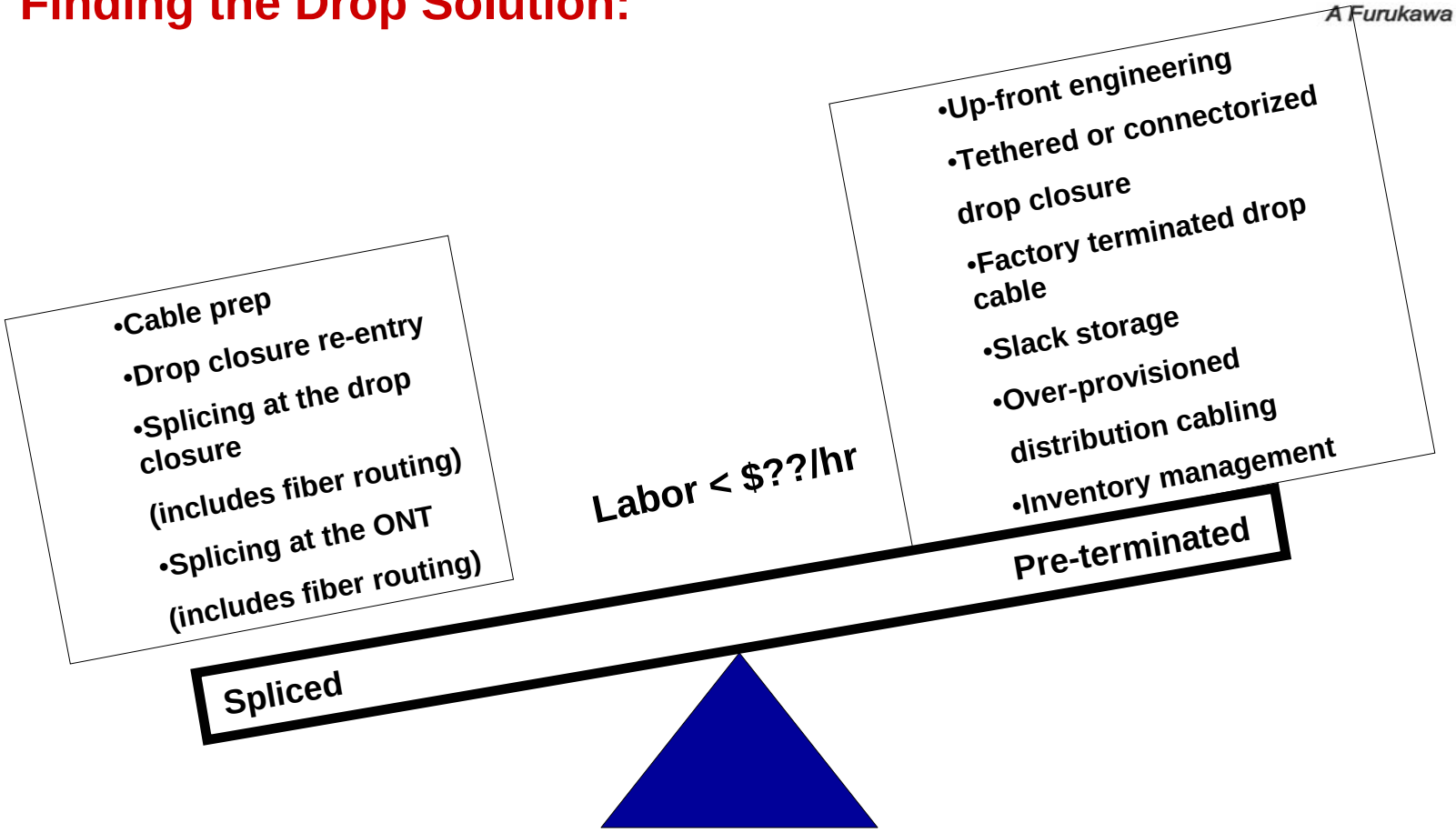
- **The standard distribution cable size is 24 fiber.**

- **The more distributed architecture would make splitter replacement difficult if needed for an upgrade. Armstrong uses full optical spectrum splitters.**

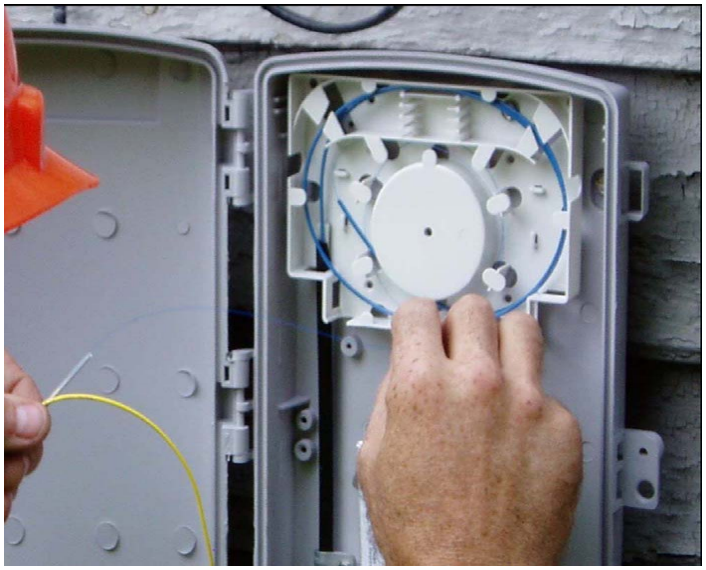
Armstrong: The Drop and the Home



Finding the Drop Solution:



Armstrong: Fully-Spliced



Armstrong's Drop Solution:

- Armstrong's track record with fiber connectors in the field is not very positive. One objective was to eliminate as many connectors as possible.
- The lot sizes in a rural application made inventory of pre-terminated drops a major issue.
- Pre-term tethers or pre-term drop closures are an additional up-front cost. Splice labor for drops occurs when customers sign up for service – better cost distribution.
- No slack loops for drops.
- Found splice closure solutions that offered easy re-entry.

Armstrong's Drop Solution:

Fiber Drop

•Use traditional Telephone Drop Materials

•Very tough and damage resistant

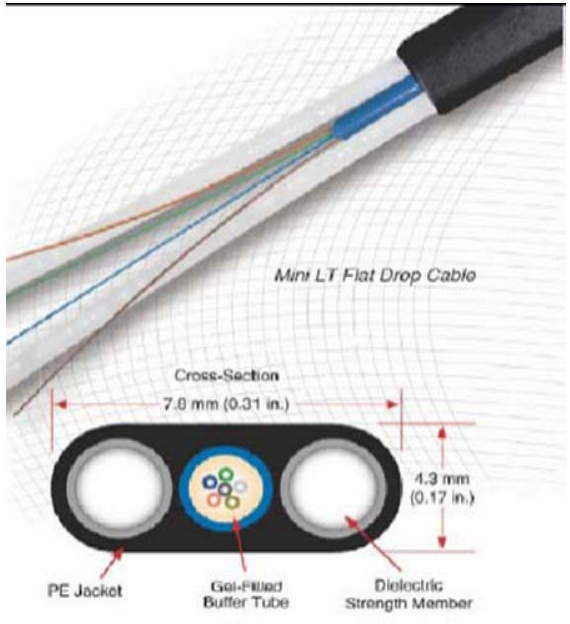
•Very water resistant

•Very light weight compared to RG-6 or telephone drop

•Totally non-conductive

•Underground with Toner Wire

•1 and 12 Fiber drop stocked



At The Home: MicroNode

- Deploying Alloptic
- Commscope BrightPath in trial
- PCT trial 1st qtr ’08
- Scientific Atlanta trial forthcoming

- Power from AC outlet at the customer premise.
- RG cable from power outlet.

At The Home: MicroNode

•Battery back-up for telephony and commercial customers

Armstrong's Latest Design:

- 4,000 subscribers passed using 150 miles of fiber.
- Estimate 250 miles of fiber necessary to deploy using HFC.
  - Number of laterals required in a rural environment.
  - Loss associated in coax drop cable (optical loss in fiber is consistent for feeder, distribution and drop cable).
- 21 V-Hubs deployed. Estimate requirement for 55 Nodes in an HFC deployment.

Summary Points:

- **Telephony PON deployments and DOCSIS-based FTTH deployments share similar standards and outside-plant design parameters.**
- **CATV provider take-rates, population densities, inefficiency costs, material costs, and labor costs may differ significantly from most telephony deployments.**
- **FTTH and HFC cost issues may drive first CATV FTTH deployments toward less densely populated areas.**
- **Indications from early adopters are that distributed architectures may be a rational choice for CATV FTTH deployments.**
- **Drop solutions will be evaluated on a case-by-case basis.**

Questions?

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