Incab

Webinar

FTTH 102

Tim Buffkin
National Sales Manager – Broadband, Incab America LLC

August 18, 2022

Registered Continuing Education Program

RCEP COMPLIANT

- Incab America has met the standards and requirements of the Registered Continuing Education Program.
- Credit earned on completion of this program will be reported to RCEP.net.
- Certificates of Completion will be issued to all participants via the RCEP.net online system.
- As such, it does not include content that may be deemed or construed to be an approval or endorsement by the RCEP.

Registered Continuing Education Program

PURPOSE STATEMENT / COURSE DESCRIPTION

- FTTH 102 will teach you the core differences between ADSS in power zone versus Strand and Lash in the Comm Space.
- We will discuss the cost and install/maintenance implications for underground fiber builds.

- We will discuss various fiber to the home architectures and how they differ from a cost and deployment standpoint
- Then you will learn about service drop options and how it affects speed of install and material costs

Registered Continuing Education Program

LEARNING OBJECTIVES

After this class, you will be able to:

1. Explain the core differences between ADSS in power zone versus Strand and Lash in the Comm Space:
   - Cost and install/maintenance implications
   - Pros and Cons of a pole mount splice enclosure and a cable mount splice enclosure
2. Evaluate your options with underground cable placement
   - Conduit vs direct bury: benefits, grounding needs
   - Install and maintenance implications and costs between direct burying and directional boring
3. Outline the main outside plant architecture used to deploy fiber to the home
   - Concepts of active ethernet, centralized split, distributed split, and distributed tap architectures
   - Pros and cons of each of these network designs

Incab University “School of Excellence in Fiber Optics” curriculum

Learning Hub

INCABAMERICA.COM

Webinar Rules

- Introduction and sound check
- Presentation: 45 min
- Use chat for questions during presentation
- Q&A (NB! Technical questions only)
- Let’s start!

Fiber cable systems deployment

Fiber cable systems: where they can be installed

ADSS in the Supply Region

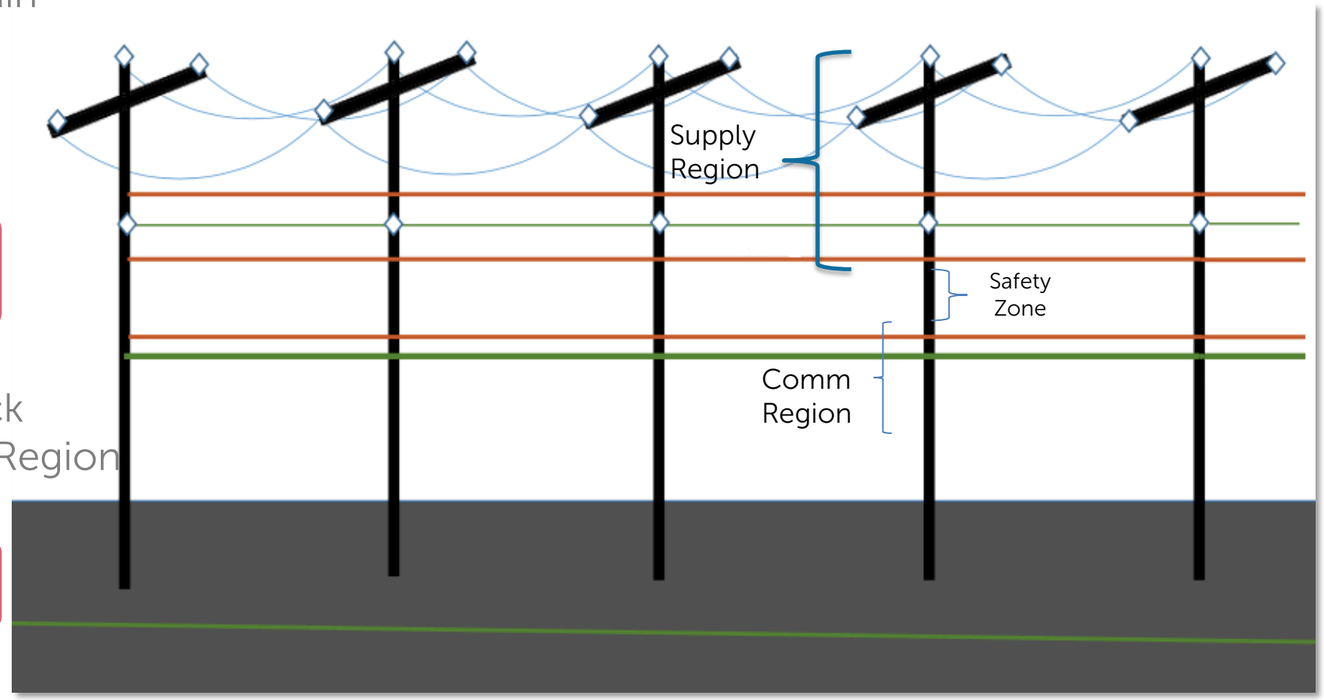
— Attachment must keep within ‘safe working practices’
— Minimum of 30” above top communication cable

ADSS or Lashed in Comm Region

— 12” between comm cables
— ADSS should be top of stack
— Must be 40” below Power Region

Underground

— Duct cable in conduit
— Armored cable, direct buried

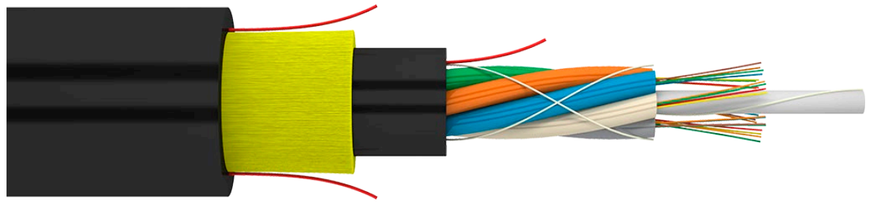


Incab products for each installation type

ADSS above the Neutral

InAir ADSS DJ TR (track-resistant)

InAir ADSS FiberGlass DJ TR (track-resistant)

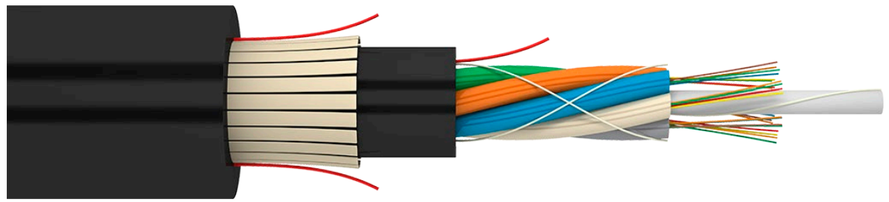


Discover more

Neutral / ADSS below the Neutral

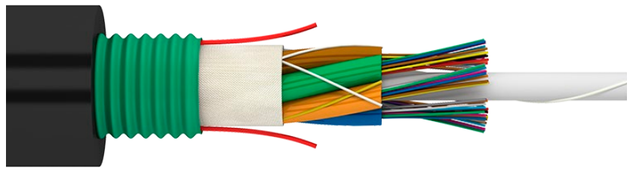
InAir ADSS DJ

InAir ADSS FiberGlass DJ



Strand / Lash / Below Grade

InArmor cables (InArmor CST)



Discover more

InDuct cables (InDuct)

Discover more

ADSS in Distribution Supply Region

Pros

— Greatly reduced make-ready costs

— No Grounding

— No competing against other companies for space (Not in Comm Zone)

— Very low maintenance after installation

— In most cases, additional guys not needed

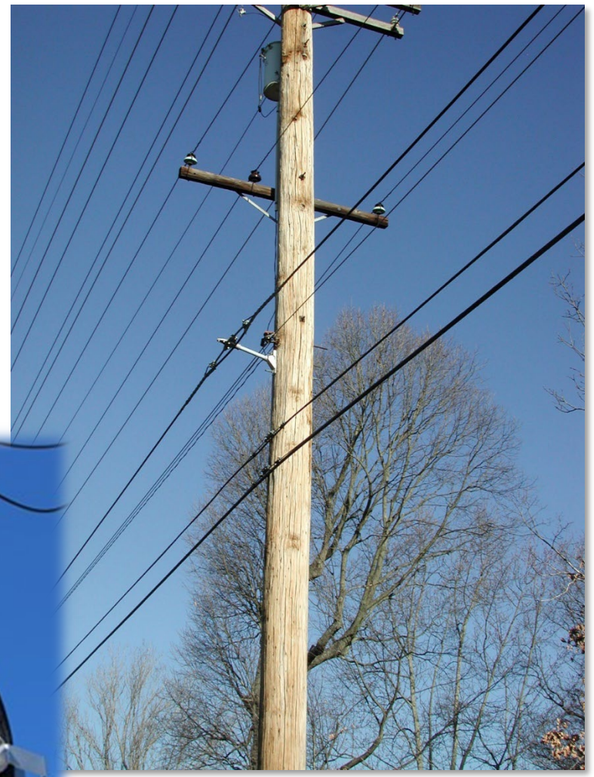
— Similar installation to a conductor

Cons

— Power utility crews are required

— Vulnerable to shotgun damage and squirrels (Incab does offer rodent-resistant fiber)

— Sag due to ice and wind



Aerial Systems: Lashed

Standard Hardware : Messenger Cable + Lashing Wire

Pros

— Ability to use armored cable to help with shotgun and squirrel damage

— Can over-lash when additional cable is needed

— Use of Telco installation crews instead of power crews

Cons

— Potentially very high make-ready costs, could be $50,000/mile

— Higher install cost and maintenance cost

— Two step installation: messenger, then cable

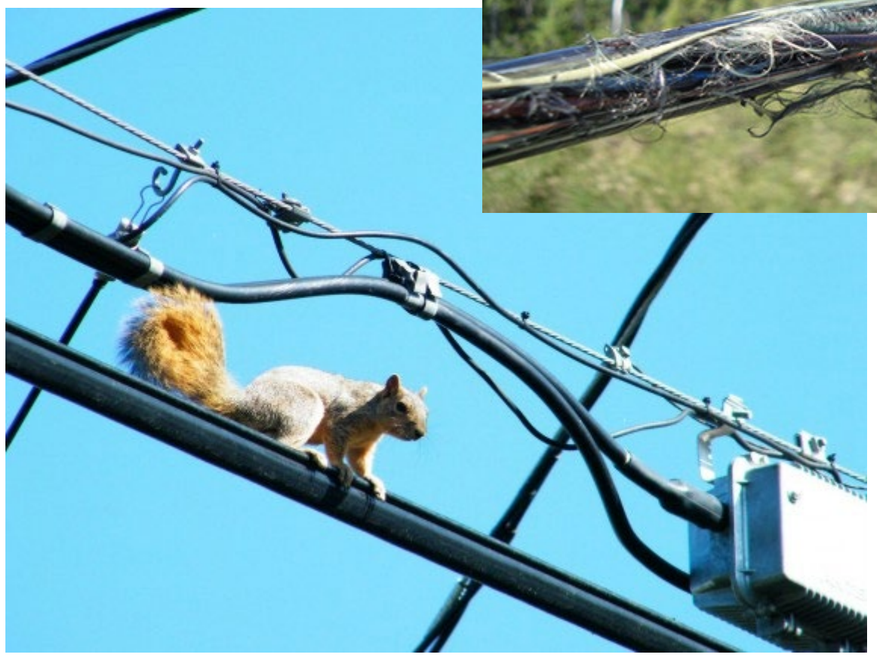
— Messenger needs to be bonded to ground

— Competition for space with other Telcos

— Broken lashing, constant maintenance

Aerial Cables
Damage

- Squirrels and gunshot damage lead the way! Lightning and fire not far behind.

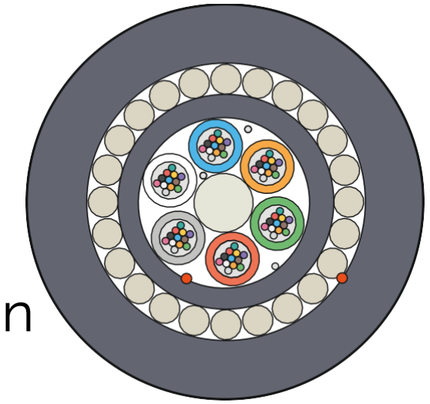


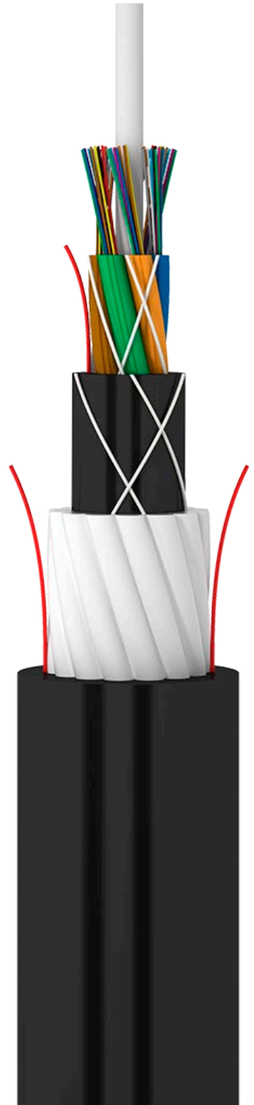
InAir ADSS FRP Defender

FiberGlass Rods (FRP) Defender

Discover more

- Anti-rodent additive in the outer jacket for first-line protection
- Superior protection from mechanical damage - FRP rods provide strength and second-line protection
- Completely protected from water ingress
- Designed for aerial applications of 138 kV or less where damage from squirrels/rodents is apparent

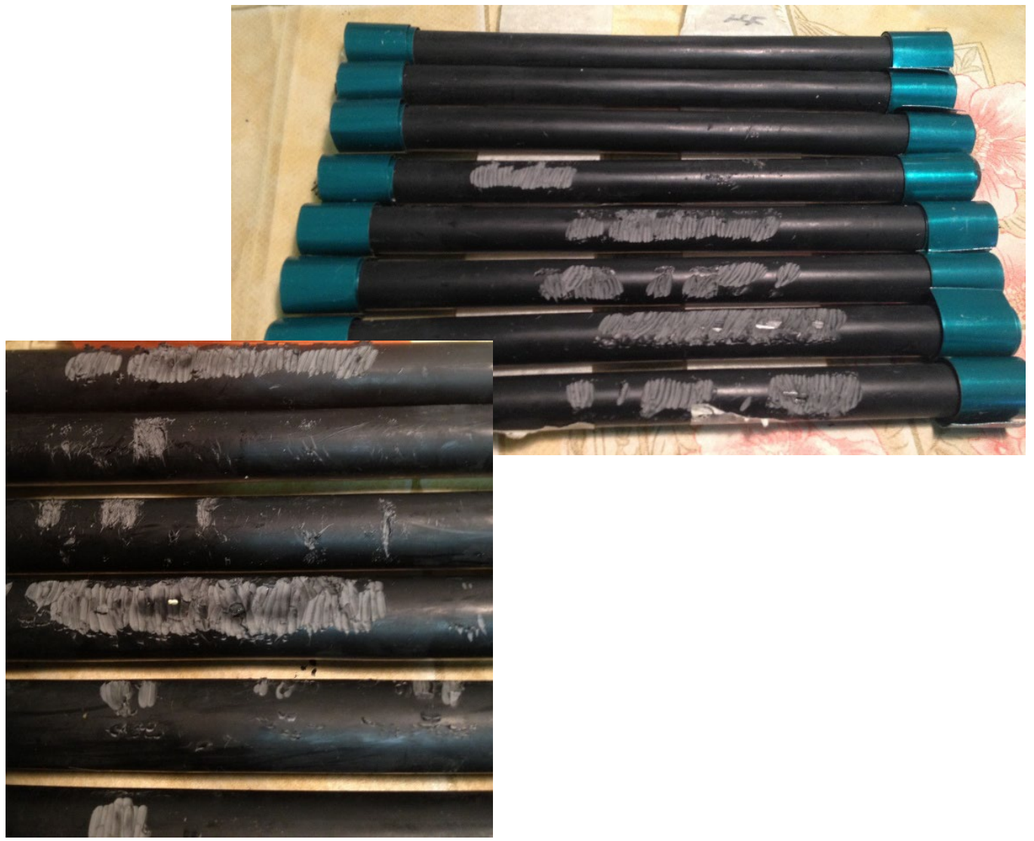




InAir ADSS MT FRP Defender

FRP rods are the best option: 👍

Incab laboratory tests:



Underground cables

Underground Cables

Pros

— Protected from harsh weather

— Can joint trench in new construction

— Cleaner aesthetics

— Lower chance for rodent damage

Cons

— Shorter cut lengths, typically less than 3,000 ft (more splicing = more money) — ROW easement concerns

— There are more backhoes than tornados!

— Underground damage can take longer to repair

— Vaults can fill with water, giving the potential for flooded splice enclosures

— Rocky terrain can greatly increase costs

Direct Bury vs Conduit

Direct Bury

- Lower overall cost
- Multiple options for armor to protect cable
- Will need to ground/potential to carry voltage back to electronics
- Armor can used to locate cable after install

Conduit

- Higher overall costs
- Conduit provides protection for cable
- No grounding necessary
- Can use ADSS cable in duct
- Can install multiple ducts for later expansion or leasing opportunities
- Ability to utilize micro-duct to run multiple micro-cables in same conduit (more opportunity to make $$$)

InArmor cables

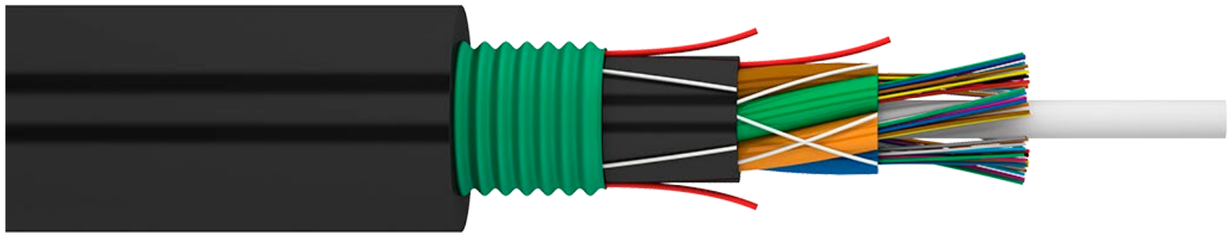
Discover more

InArmor CST

Corrugated Steel Tape

InArmor CST DJ

Corrugated Steel Tape Double Jacket

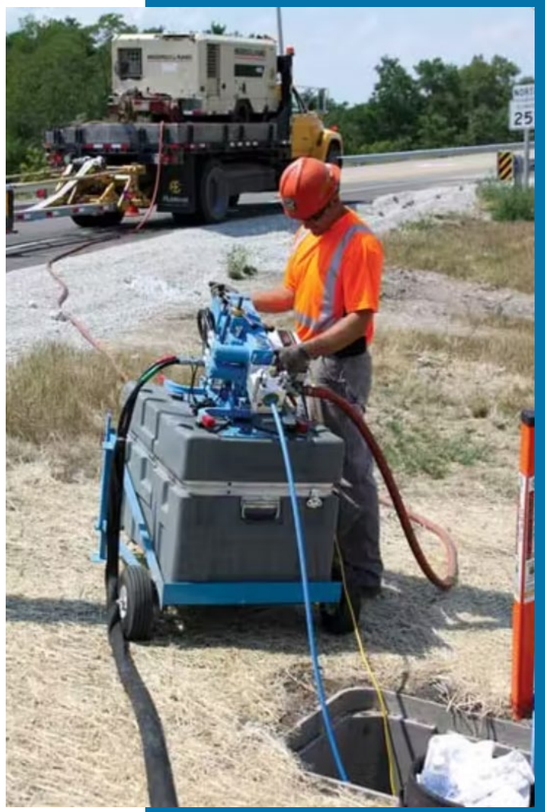


Blowing Infrastructure

Fast deployment with blown fiber cables up to 196 feet / min (60 meters / min)

Optimized infrastructure footprint – higher fiber count in a reduced diameter

Economic benefits – reduced costs on logistics, manpower and time

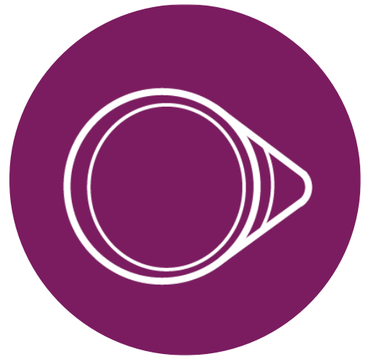


BlownIn cables

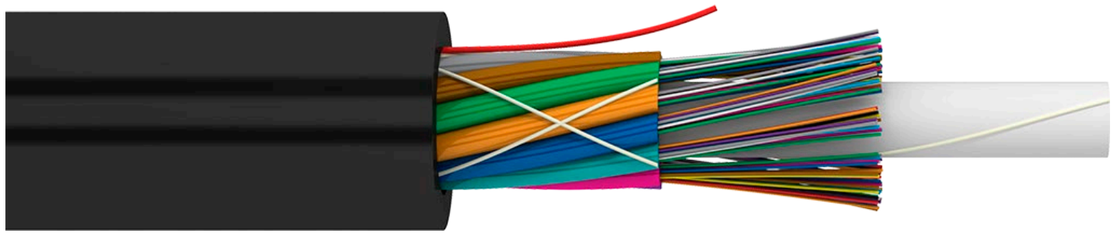
Discover more

BlownIn CT

Central Tube



BlownIn



Direct Bury vs Directional Boring Cost

Service/ Product	Price – Low	Price – High	Unit	Assumptions
Fiber Plowing	$1.25	$1.75	Foot	Assume standard installation method will be plowing. Route mileage for the corridor is from FHWA Route Log
Directional Boring – Rural	$6.00	$7.00	Foot	Assume rural bores average 150’ each
Directional Boring - Urban	$8.00	$10.00	Foot	Assume 10% of total bores as urban bores, average 200’ each
Directional Boring - Rock	$42.50	$271.00	Foot	Assume 5% of total bores as rock bores, average 150’ each
Conduit (2” HDPE)	$0.75	$0.80	Foot	Per foot cost. Assuming installation of two conduits.

Underground Cables

Use of Above Grade Level Enclosure vs Underground

- Above ground level enclosures (pedestals) allow for easy visual location in rural settings
- Easy access for technicians, and eliminates possibility of getting water inside enclosure
- More susceptible to damage from machinery (or bored kids with a baseball bat)
- Can be a cost saver depending on pedestal setup and design

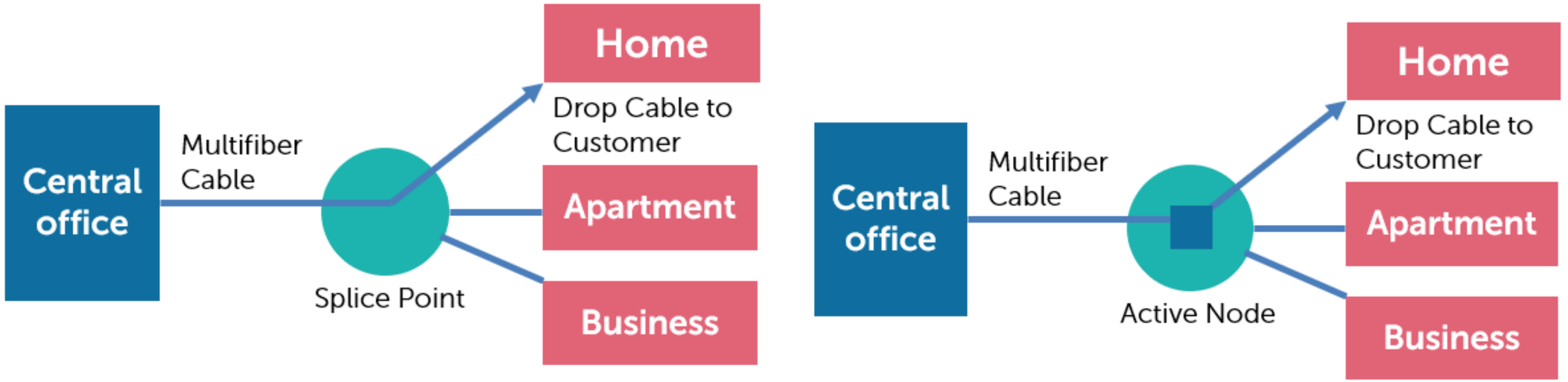
FTTH Architectures

FTTH Architectures

- Multiple FTTH architectures available that all affect cost, difficulty of design and maintenance, and speed of deployment
- Active/Home Run
- GPON (Gigabit Passive Optical Network)
  - -Centralized Split GPON
  - -Distributed Split GPON
  - -Distributed Tap GPON

Active Ethernet Network

- An Active network designates a single fiber that runs from the CO or a local switch directly to the customer with no splitters involved
- This architecture allows for the highest maximum bandwidth and flexibility but comes at a higher cost. Higher fiber counts are needed, as well as more expensive equipment
  Not very common in rural broadband deployments

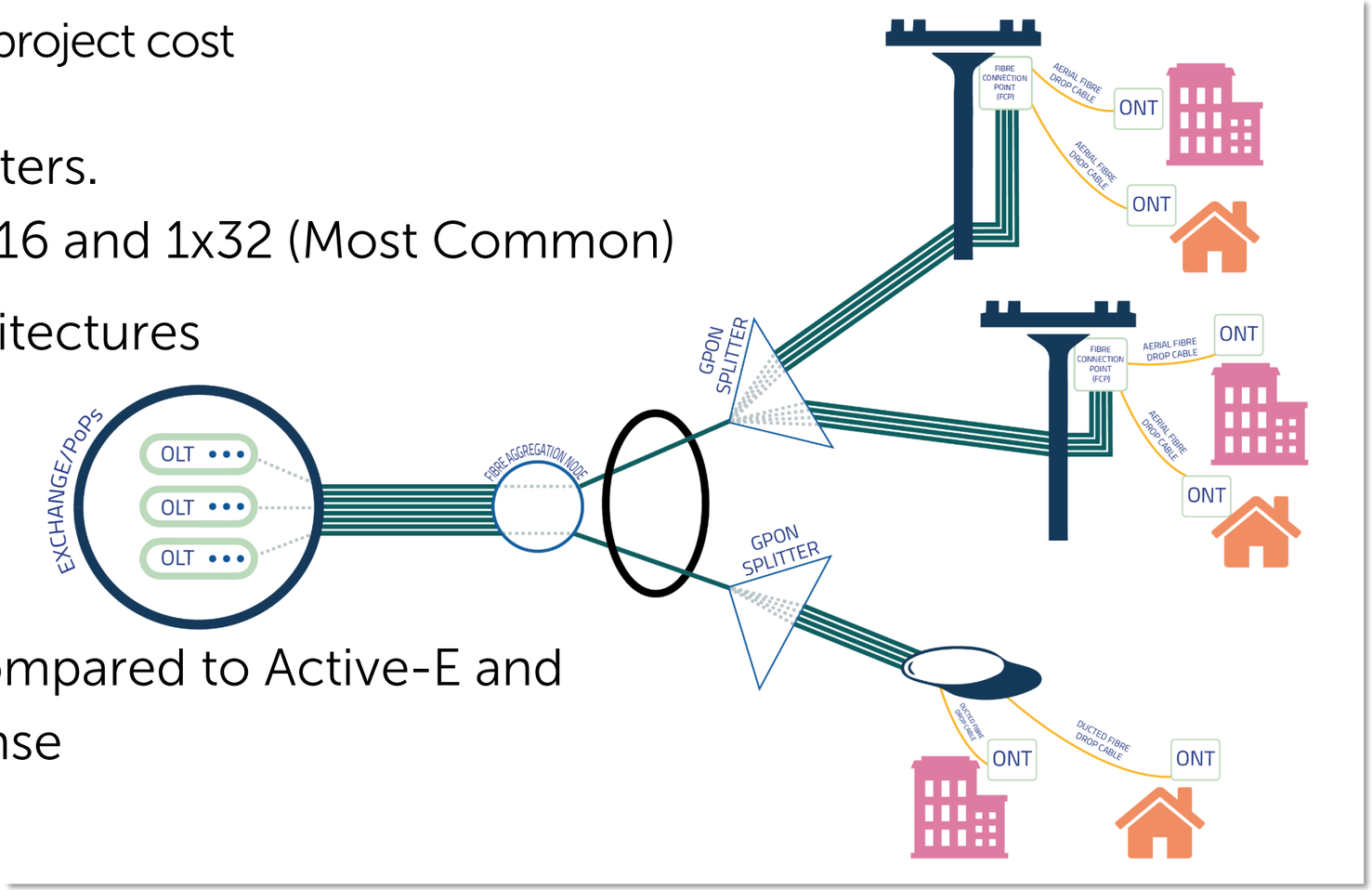


GPON Architecture Selection

GPON: Gigabit Passive Optical Network

Its affect on cable selection and project cost

- Utilizes passive optical splitters.
  Common split ratios are 1x16 and 1x32 (Most Common)
- Most common GPON architectures include Centralized Split, Distributed Split, and Distributed Tap
- Up to 50% lower cap-ex compared to Active-E and 80% lower operating expense



Centralized Split Architecture

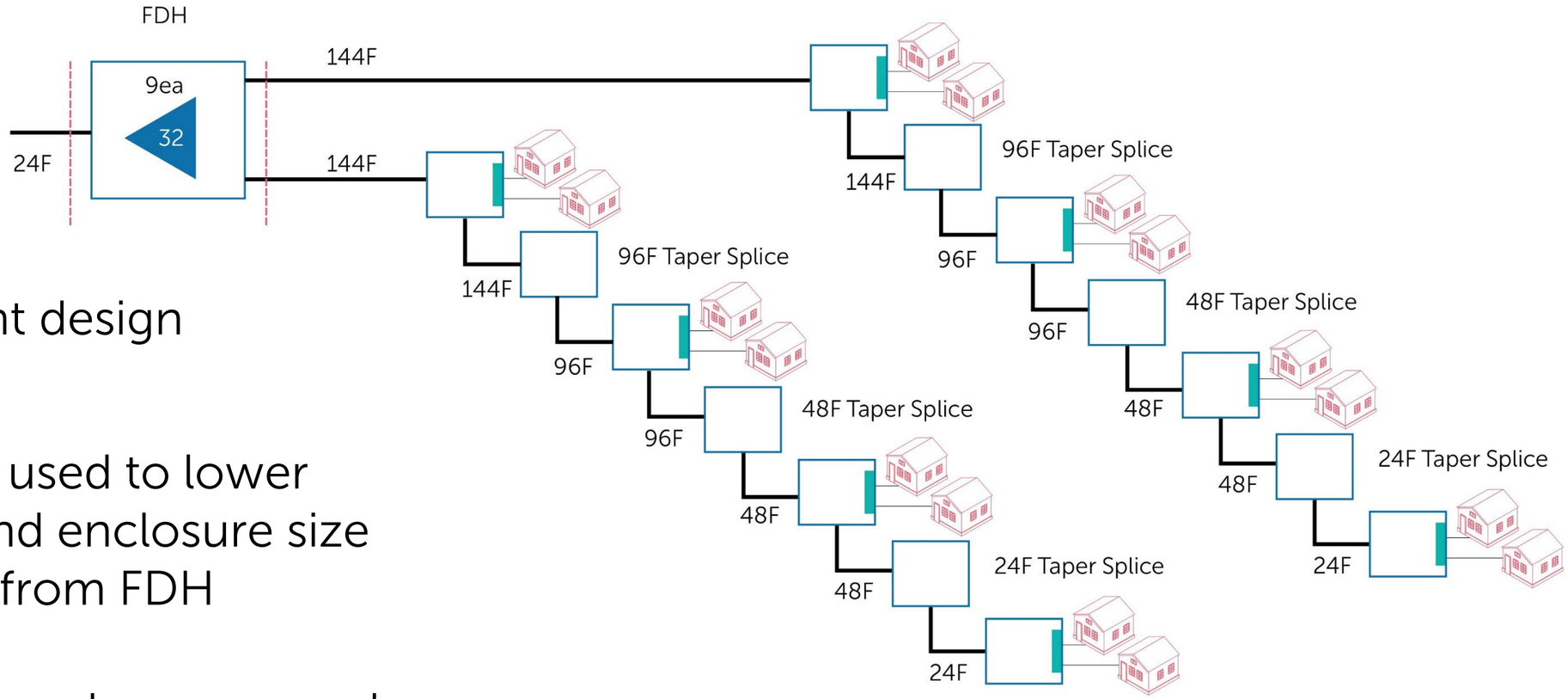
The Basics

- Multiple splitters placed in a single location, typically in a fiber distribution hub, and then fibers run “point to point” from hub to house
- FDH is typically fed with a 24F (or higher if spares needed), dependent on FDH size. The number for FDH cabinet designates how many customers can be served via GPON
- Typical FDH sizes include 96, 144, 288, 432, 576
- Splitters are installed and connected as customer base grows
- High cost associated with use of FDH in both material and splicing $20k or more in a single FDH location

288 – FDH Cabinet

Centralized Split Architecture
The Design

- 288 FDH
- 24F Feeder.
  (2) 144F Tails
- Point-to-point design from FDH
- Taper splices used to lower fiber count and enclosure size further away from FDH
- 3.25~ splices per home passed



Distributed Split Architecture

The Basics

- Moves splitters away from a centralized location and into splice cases throughout the field in different combinations (1x4 and 1x8, or 1x32, etc).
- Multiple splitter combinations can be used to achieve 1x32 or 1x16 split ratio (1x4 to 1x8, 1x2 to 1x16, or even just 1x32)
- “Feeder cable” in centralized split now becomes distribution cable, bypassing FDH
- Splitters are purchased and installed during initial construction
- Can reduce splicing by as much as 3 splices per home passed

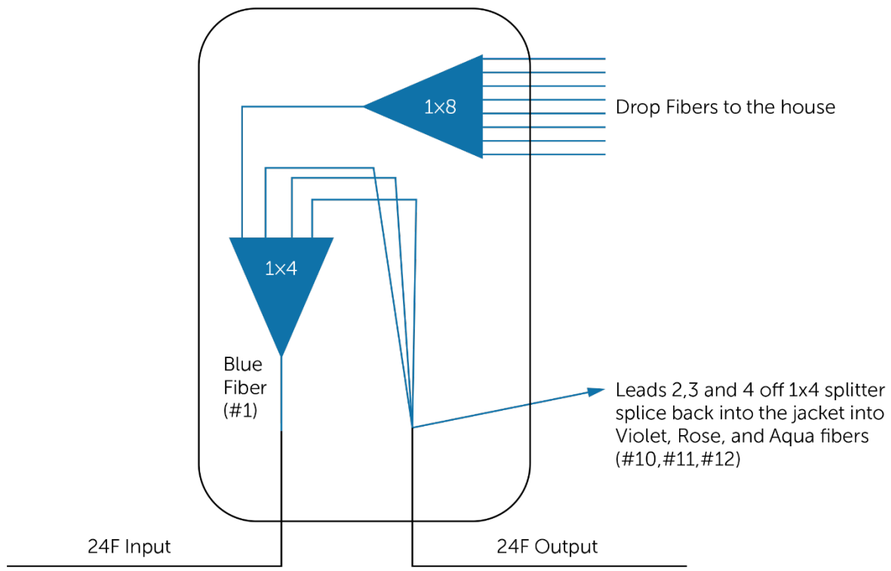
Strand Mount Enclosure With Splitter

Distributed Split Architecture

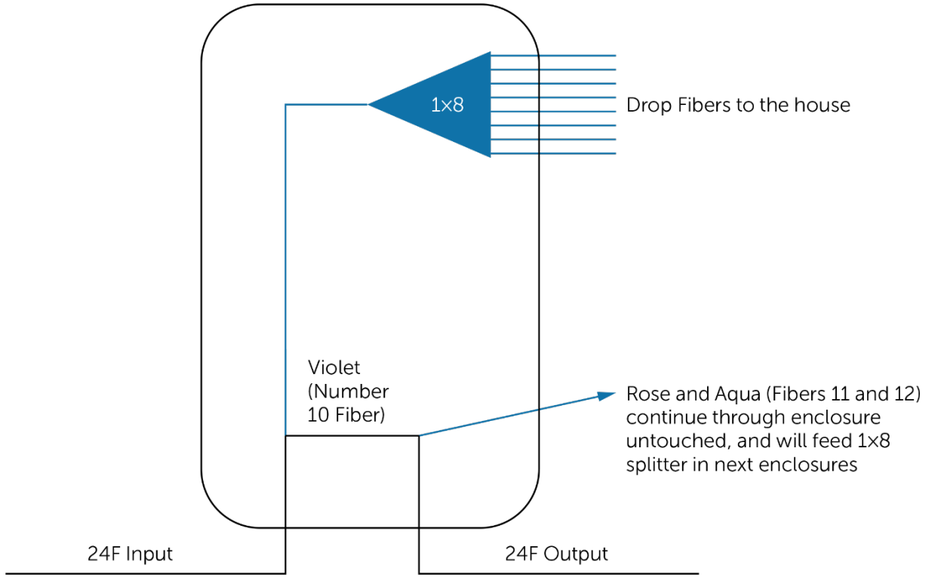
Fiber Re-Use for Distributed Split

- Reusing “dead” fibers to continue already split fibers to next enclosure allows us to reduce fiber count while still allowing for growth
- Each series of enclosures (In this case, a 1x4 to 1x8 split) features a primary enclosure with a 1x4 and 1x8 splitter, and then subsequent enclosures with a single 1x8 splitter, fed by 1x4 in previous enclosure

Primary Splice Enclosure

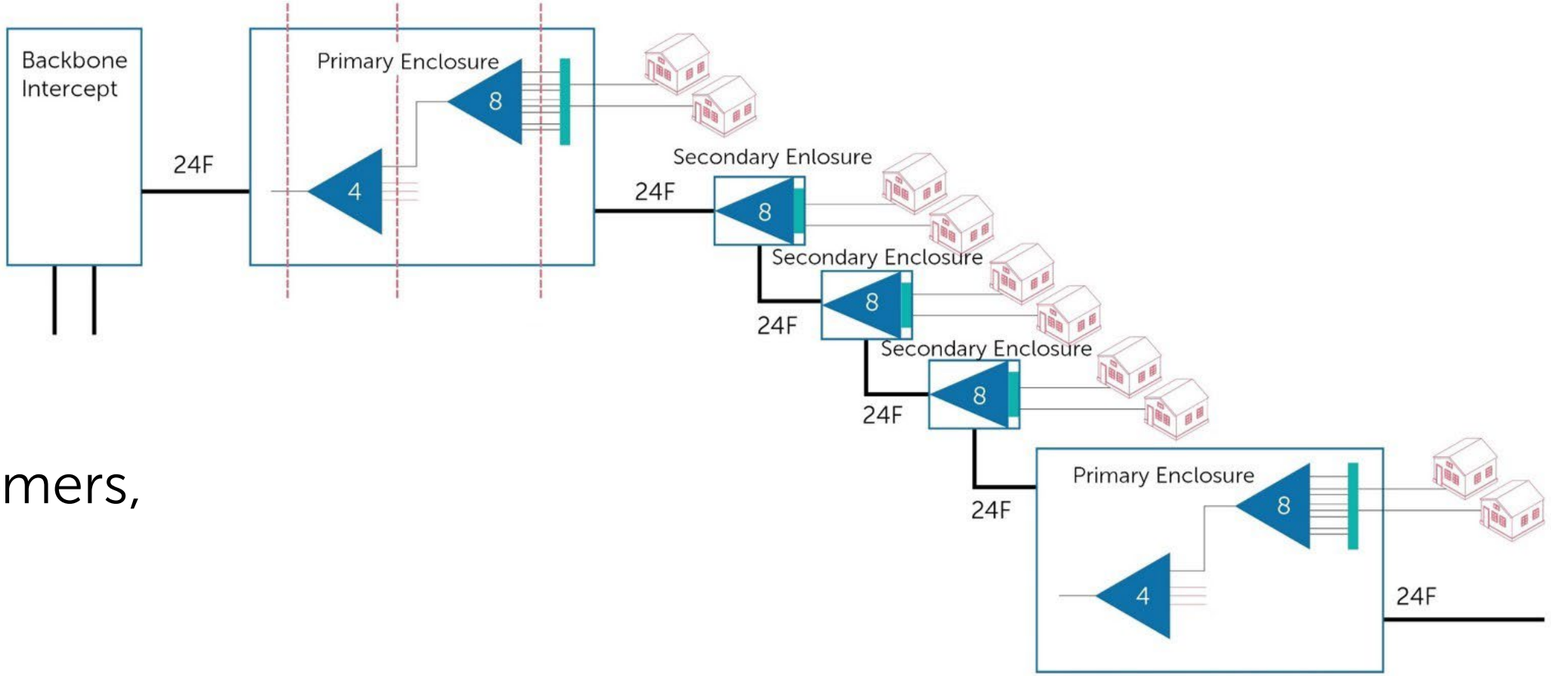


Secondary Split Enclosure



Distributed Split Architecture

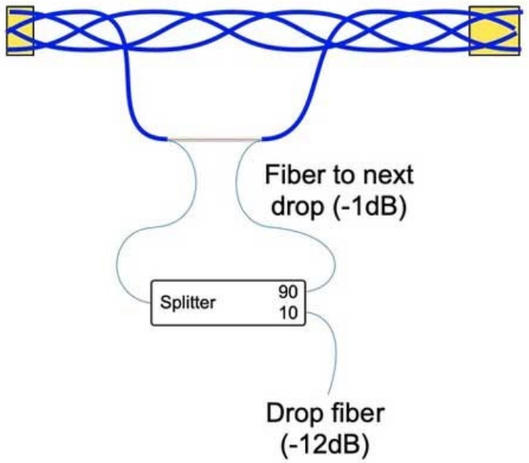
- 288 Customers served
- Same fiber count and same enclosures used throughout distribution portion of network
- In model shown, 1x4 to 1x8 split ratio used, ending in same 1x32 ratio used for Centralized Split design

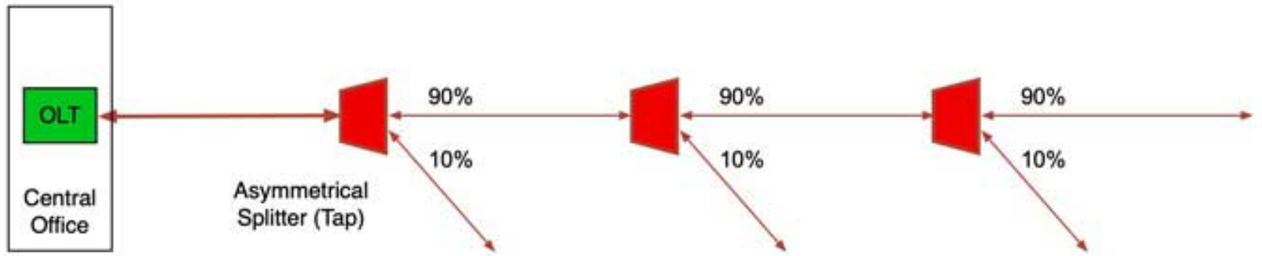


- After feeding 288 customers, (12) F1 fibers remain for expansion
- .3~ Splices per home passed

Distributed Tap Architecture

- Distributed tap has become more popular in rural broadband deployments, especially with use in rural electric cooperatives due to its low up-front cost.
- Instead of using symmetrical splitters, Tap architecture uses asymmetrical “taps” that bleed off a percentage of light at each tap





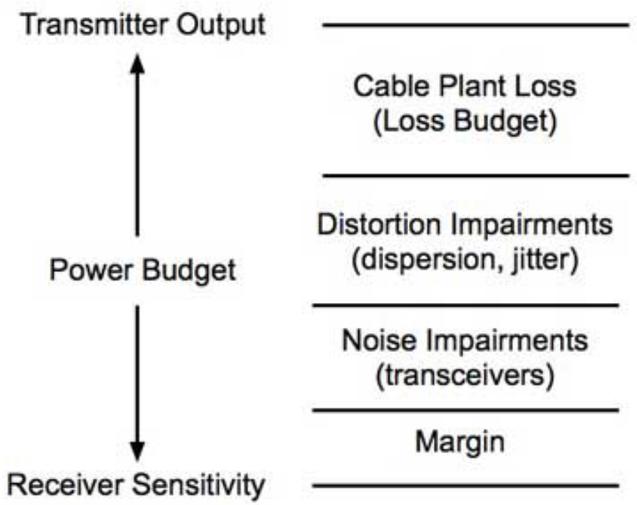
- The benefit to this design is it allows for smaller fiber counts, as each tap allows you to drop off fibers to customers and then continue down line on that same fiber, utilizing different tap percentages until you run out of light budget.

GPON Architecture Selection

	Centralized Split	Distributed Split	Distributed Tap
Cost to Deploy	High	Lower	Lowest
Fiber Density	High	Low	Lowest
Design	Simple	More Complex	Most Complex
Speed to Deploy	Moderate	Fast	Fast
Troubleshooting	Straightforward	Moderately Complex	Most Complex
Expansion	Basic	Complex	Complex
Material Management	Low amount of SKUs	Moderate SKUs	Most SKUs
OLT Port Usage	Efficient	Less Efficient	Least efficient

Power Budget/Loss Budget

- Power Budget refers to the amount of fiber cable plant loss that can be tolerated between transmitter and receiver and still operate properly.
- There is a minimum and maximum power budget. Too much light can overpower the receiver, and not enough light will fail to provide enough bandwidth
- Loss Budget refers to how much loss there should be in the OSP plant given the amount of splicing, connectors, or taps that are in the field. During the design stage, this number is calculated and then compared to results after installation to ensure quality of installation.



Calculating Loss Budget

- Here are the expected losses for each of the following occurrences:
  Distance: 1db loss for every 1km of fiber
  Connector: .3db loss per connector
  Splice: .05db loss per splice
  Tap: 1db loss per tap

Typical Splitter Loss By Ratio

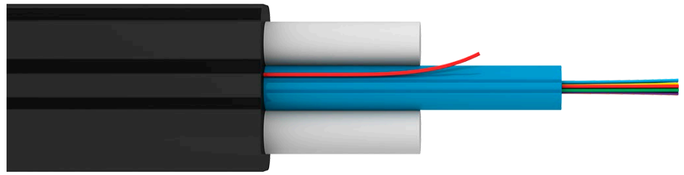
Splitter Ratio	1:2	1:4	1:8	1:16	1:32	1:64	1:128
Loss (dB)	4	7	11	15	18	21	24

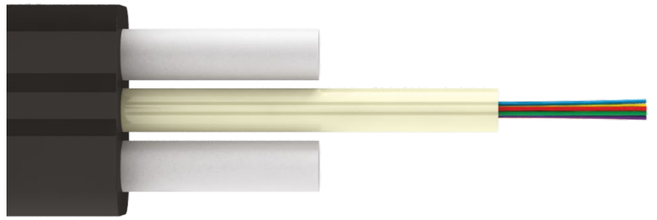
Upgrade PON System Specification Summary

	NG-PON2	XG-PON	XGS-PON
Standard	ITU-T G.989	ITU-T G.987	ITU-T G.9807
Downstream/Upstream Bitrate	10/2.5, 10/10, 2.5/2.5 Gb/s	10/2.5, 10/10 Gb/s	10/10 Gb/s
Downstream Wavelength	~1596-1603 nm	~1575-1580	Either same as GPON if no current GPON or XG-PON for overlay
Upstream Wavelength	~1524-1544	~1260-1280	Either same as GPON if no current GPON or XG-PON for overlay
Max PON Splits	64,128, 256	64,128, 256	64, 128, 256+
Power Budget*	14-29 dB (min - max) up to 20-35 dB (min - max) in 4 versions with up to 15 dB differential optical path loss	14-29 dB (min - max) up to 20-35 dB (min - max) in 4 versions with up to 20 dB differential optical path loss	13-28 dB (min - max) up to 20-35 dB (min - max) in 6 versions with up to 20 or 40 dB differential optical path loss in 2 versions
Coverage	20 and 40 km versions	60 km	60 km
Downstream/Upstream Bitrate	10/2.5, 10/10, 2.5/2.5 Gb/s	10/2.5, 10/10 Gb/s	10/10 Gb/s

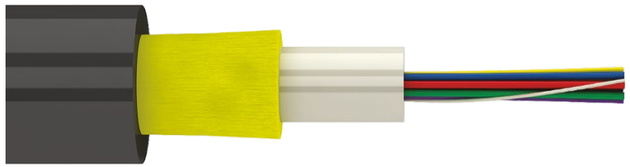
Service Drop Cables Options

- **Flat or “butterfly” drop cables** — newer design. Popular because of high strength. Aerial or UG (If aerial, what loading conditions, and how much sag?)

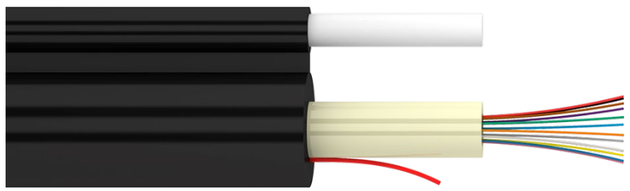




- **Round drop cables.** Can be armored for added protection



- **Figure 8 cables.** Great for long aerial spans. Much more rugged than a standard flat drop, and can cover up to 400ft more spans while remaining dielectric



Connectorized or Spliced Drops?

- **Spliced on drop:**
  - Better Connection/less light loss
  - Reduces risk of dirty connector
  - Makes reconfiguration of drop cables more difficult by needing to re-enter cable, break and resplice
  - Easier material management

- **Connectorized drop:**
  - Faster drop connection
  - No need for a splicer on install
  - Pre-connectorized drop terminals and pre-terminated drop cables much more expensive
  - Many more SKUs to manage, as drop cables come in pre-determined lengths (25ft, 50ft, 75ft,100ft, 200ft, etc)
  - Material cost add approximately $75/home passed

Fiber Cable for FTTH. Final Thoughts

- There is no “one size fits all” approach to building fiber to the home
- Do everything you can to educate yourself on your network make sure your consultant can explain “why”
- Don’t let a consulting firm push you to a solution that you may regret in 4 years after the project is completed
- Stay away from proprietary, outside plant material
- Reach out to other utilities that have deployed fiber to the home. Many are willing to share their experiences and advice

Feel free to use us as a resource! We’re happy to help and make introductions!

Incab

Thank you!

Tim Buffkin
tim.buffkin@incabamerica.com

INCABAMERICA.COM

Come visit our factory!
+1 833-34INCAB
+1 833-344-6222