



**2025**

**WISPAMERICA™**

**BROADBAND WITHOUT BOUNDARIES**



# Fiber Economics – ROI – Take Rates – Business Models

# Panelists

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**ONE Network** is a  
diversity of solutions in a  
*Simple Unified Platform.*

## The Result?

- Improved Operational Efficiency
- Lower Operating Costs
- Better Customer Satisfaction



Fiber, Fixed Wireless,  
and Home Gateway



Point-to-Multipoint & Point-to-Point

### Services

Network Planning  
Network Design  
Quality of Experience  
24x7 Support

Security, Switching,  
& Enterprise Wi-Fi








Indoor & Outdoor Wi-Fi, Switching,  
Security & SD-WAN

# Fibersmith + VISION™

A FIBERSMITH SOFTWARE SOLUTION

Our engineering team specializes in grants and loan applications, fiber networks, video head ends, network modeling with GIS, labor and materials requirements, field staking and splicing schematics.

Vision is a Location Based, All-in-One ISP Software solution focusing on process management, network automation, billing, ticketing, marketing, and more.

 <p><b>Project Evaluation &amp; Discovery</b></p> <p>Determine what steps need to happen to get your project off the ground, including a project feasibility analysis and an exploration of financial opportunities.</p>	 <p><b>Fiber Network Design</b></p> <p>Turn your project idea into a blueprint for success with high level and low level design plans to expand your network.</p>	 <p><b>Field Collection</b></p> <p>Assess and compare the virtual design for your project to the ground truth requirements of the area, such as roads, rocks, trees and water.</p>	 <p><b>Construction Management</b></p> <p>When you're making a significant investment in growing your network, you want to make sure the job is done right.</p>	 <p><b>Plant Record Management</b></p> <p>As your business grows, it's critical to know your network. Accurate and up-to-date plant records help you unlock the full power to grow and scale your business.</p>
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# Discover The **WAV** SOLUTIONS

## WIRELESS BROADBAND & LTE



## FIBER SOLUTIONS



wavonline.com

**We've taken distribution to the next level.**

With 7 warehouses across US and Canada WAV, MBSI WAV and ISP Supplies have the **largest and most consistent stocking positions** of *Broadband, Switching and Wi-Fi* in the market.

Our combined teams are focused on **unrivaled customer support**, forecasting, planning, and have the combined purchasing capacity for even the largest of deployments.

Our customers have access to more solutions and brands for your fiber, fixed wireless, Wi-Fi and physical security deployments

Your dedicated sales representative is engaged by taking a **responsive, communicative, and pro-active** approach to your business, acting as a gateway to a wide breadth of supply chain, finance, engineering and logistical resources unrivaled by our peers.



# WHO IS ADTRAN?

Your trusted partner for the fiber-everywhere era

**\$1.15B**



FY23 revenue

**50**



Worldwide locations  
HQ = Huntsville, AL

**~3,200**



Employees  
worldwide

**A – Ω**



End-to-end  
solutions portfolio

**1,000+**



Global technology  
patents

**35+**



Years of  
experience

## Key differentiators

- Open, disaggregated platforms with vendor-neutral capability
- Extensive global design support and supply orchestration capabilities
- Full “core through the door” portfolio for the fiber-everywhere era
- Security solutions for mission-critical infrastructure
- Customers: communication service providers, internet content providers, SMBs, enterprises, tribal communities, governments and agencies: local, state, federal

“Adtran is focused on customer usability, service and support.”

Tom Stanton, CEO, Adtran

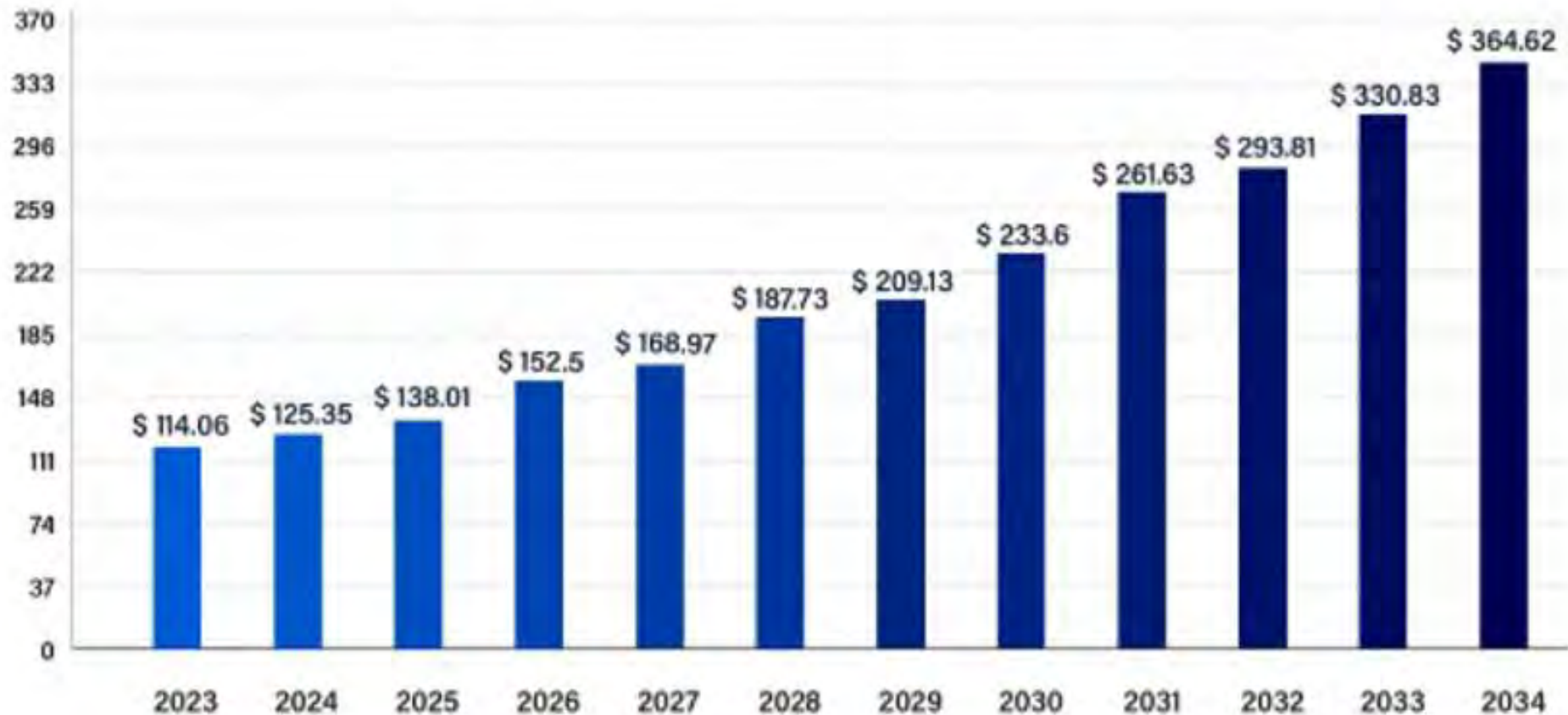
# Agenda

- Fiber Network Deployment Considerations for WISPs (Bayan)
- What to engineer for... (Nick)
- Infrastructure Monitoring (Zach)
- Fiber vs. Wireless vs. Hybrid Networks (Bruce)
- Open Q&A

# Fiber Network Deployment for WISPs: A Practical Guide

# The Fiber Imperative

## Data Center Market Size 2023 to 2034 (USD Billion)



Source: <https://www.precedenceresearch.com/data-center-market>

# Don't underestimate yourselves. You guys are WISPS!!!

What are some of the advantages that WISPS have over big carriers?

- **Strong Community Relationships**
  - Local Presence and Trust
  - Increased Customer Adoption
- **Existing Infrastructure**
  - Leveraging Assets
  - Faster Deployment
- **Agility and Flexibility**
  - Customized Solutions
  - Faster Response Time
  - Niche Expertise
- **Customer Focus**



# Infrastructure



# Aerial

## Cons

- Can be easily damaged by exposure to wind and trees. Can cause extensive outages in your network
- Can strain or sag or even break under the weight of ice buildups.
- Existing poles may need to be upgraded or strengthened to support a new carrier. Make ready fees, in some instances can make Aerial as expensive as underground.
- Permitting and engineering studies may delay deployment by years.
- Reoccurring monthly fees.
- Drunk Driver LOVE to aim for utility poles.

## Pros

- Faster deployments (after engineering studies)
- No excavation
- Well suited for areas without urban restrictions.
- Well suited for areas with Rocky terrain
- Well suited for remote areas with limited access to underground contractors.

### **Rough Contractor rates of Aerial**

\$2-\$5 per foot USD

Deployment: Roughly 1000'-5000' per day w/ Crew of 3



# Underground

## Pros

- Immune to wind and ice damage making them significantly more reliable than aerial
- No reoccurring fees
- More aesthetically pleasing.

## Cons

- Upfront cost can be higher than Aerial.
- Slower deployment.
- Customer installation is more difficult as Drop cables will also need to be buried.
- May have added cost for utility locates.
- Railroad crossings delay installation.

### **Rough Contractor rates of Underground**

Drilling \$6-\$30 per foot Deployment: 500-700' per day Crew of 3  
Plowing: \$2-\$4 per foot Deployment: 1000'-6000' per day. Crew of 3  
Includes Vault installation and excavating existing utilities.



# Getting started

## Step 1

### Pre-design Engineering

- Draw the area you wish to serve
- Decide on a split architecture that will best serve your needs
- Decide on a termination enclosure and how best to distribute the fiber to the homes.

#### Hardware needed

- Vaults or Pedestals
- Splice Enclosures
- Distribution/ Fiber Access Terminal
- Duct (optional but highly recommended)
- Aerial Hardware
- Fiber Armored, Dielectric, Microfiber.
- Splitters
- Drop Cables
- NIDs

# Step 2

Construction: who will build it?

**Contractors or build in house?**

- Manage additional crews
- Freezing temp. Down time
- Mechanical equipment failures
- Traffic control
- Maintain CDL and required documentation
- Ground restorations
- Waiting on Utility locates

**Scenario:**

**Deployment:** Underground

**Coverage:** Suburban area

**Coverage:** 10 miles (52,080')

**Passings:** 500 Homes

**Costs:**

**Materials:** \$163K

Duct, Fiber, Vaults, FOSC,  
Access Terminals, Tracer Wire,  
Splitters, Flower Pots etc.

**Engineering/ permitting:** \$26K

**Headend:** \$16K

**CPE:** \$62K

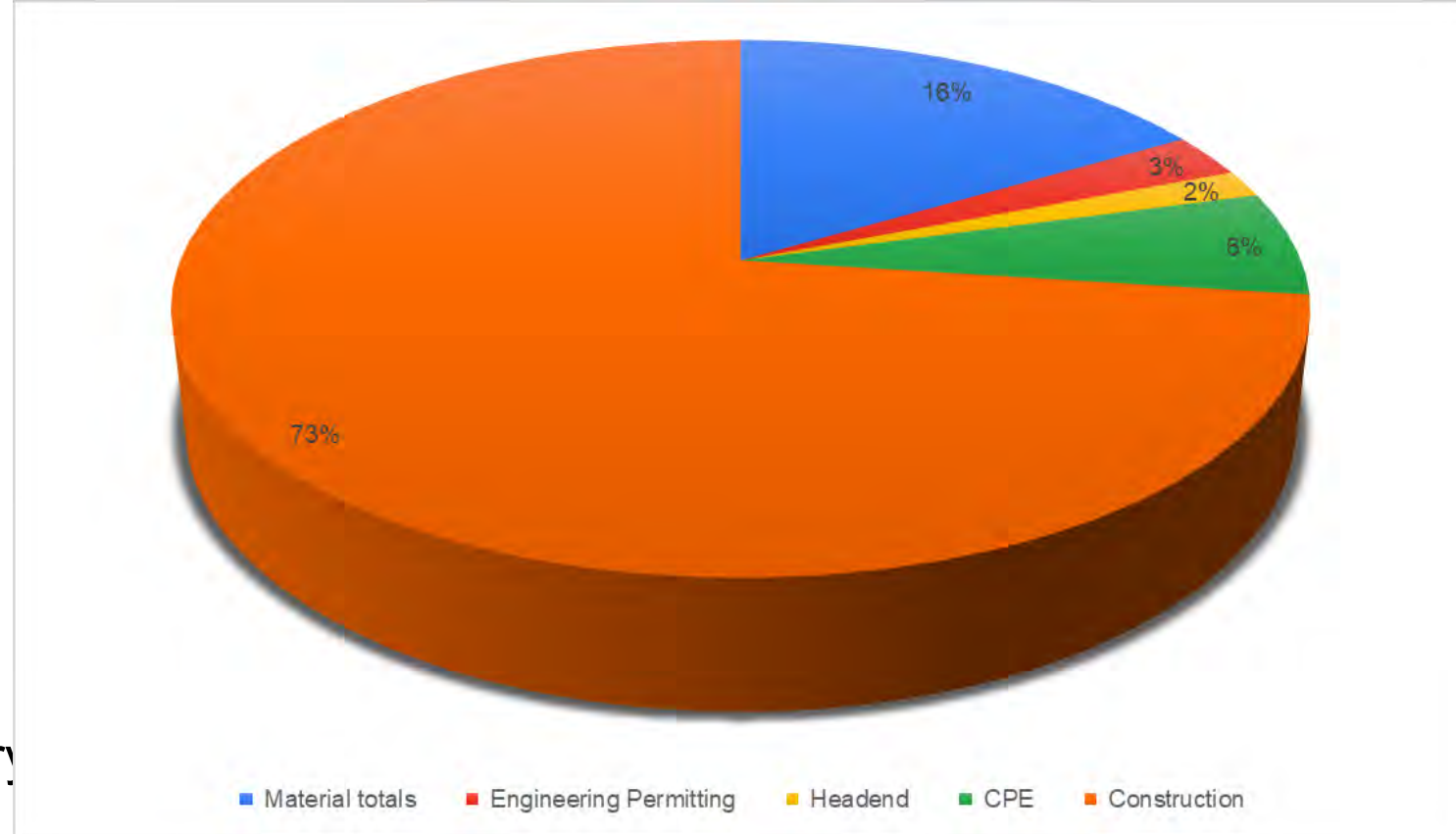
ONT, NID, Drop cables

**Construction:** \$720K

HDD, Vault installation, Splicing, drop bury

**Total:** \$987K

Cost per passing: **\$1974**



# Balancing Cost, Scalability, and Performance

## Cost Optimization Strategies:

- Leveraging existing infrastructure.
- In-house construction.
- Negotiating bulk discounts.
- Leveraging Middle Mile Providers
- Providing Managed WiFi Solutions
- Standardizing on materials and installation methods.

## Scalability for Future Growth:

- Future bandwidth demands.
- Becoming a Middle Mile.
- Consider multi-ducts and Micro Fiber solution.

## Performance Optimization:

- Distributed split architecture.
- Deskillifying Customer installations.
- Ecosystem with smart management capabilities.

# What am I engineering for?

**You are engineering for the most cost-effective network providing the most value to your clients.**

**Once you commit to building a network, every decision will *cost* you something. You need to understand what it's *buying* you!**

# Start with a model

- Begin to build a model built on variables.
- Remember the basic variables are labor and materials.
- Start by categorizing all of your assumptions into these fundamental categories.
- Just like politics, all builds are local. Your insight into local labor costs will make or break a project.

	Labor	Materials	Total
Outside Plant - Mainline			
Outside Plant - Drop			
ONT, CPE, Inside House			
Inside Plant - Switching Equipment			
Inside Plant - Routing			
Inside Plant - Access			
<b>Total</b>			

# Start simple. Iterate to accurate.

- Think of all your inputs as costs per unit, then discover what those units actually are.
- Construction units are either broken down to linear feet (boring, plowing, blowing) or discrete points (pole, hand hole, closure)
- Models are not where we sharpen pencils. Numbers should be defensible and reproduceable. It's harder to do one-offs based on salvage favors and eBay.
- The urge is to focus on materials costs, but remember labor makes up more than 80% of most builds.

Design Model Inputs						
Aerial Construction Inputs						
Fiber Construction costs/ Mile	12	24	48	72	144	288
Fiber Price per foot	\$ 0.42	\$ 0.53	\$ 0.74	\$ 0.89	\$ 1.42	\$ 2.00
Fiber Labor per Foot	\$ 1.50	\$ 1.50	\$ 1.50	\$ 1.50	\$ 1.50	\$ 1.50
Strand/Anchors per Foot	\$ 0.35	0.35	0.35	0.35	0.35	0.35
MST Per Mile	-	0	0	0	0	0
MST Cost	\$ 650.00	650	650	650	650	650
Splice Cases per Mile	4	4	4	4	4	4
Splice Cannister Cost (w/Labor)	\$ 550.00	550	550	550	550	550
ML Splices Per Mile	6	12	24	36	72	144
Customer Splices per Mile	16	16	16	16	16	16
Node Splicing	2	2	2	2	2	2
Splicing Overage	0%	0%	0%	0%	0%	0%
Splice Rate	\$ 30.00	30	30	30	30	30
Make Ready per Pole	\$ 150.00	150	150	150	150	150
Poles per Mile	26	26	26	26	26	26
Fiber Price	\$ 2,550.24	\$ 3,218.16	\$ 4,193.28	\$ 5,404.08	\$ 8,622.24	\$ 12,144.00
Labor						\$ 9,108.00
Strand and Anchors						\$ 2,125.20
MST						\$ -
Splice cases	12 Count		0%		25%	\$ 2,200.00
Splicing	24 Count		40%		30%	\$ 4,860.00
Fiber Dollars per Mile	48 Count		25%		15%	\$ 30,437.20
	72 Count		20%		10%	
	144 Count		15%		15%	
	288 Count		0%		5%	
	Total		100%			

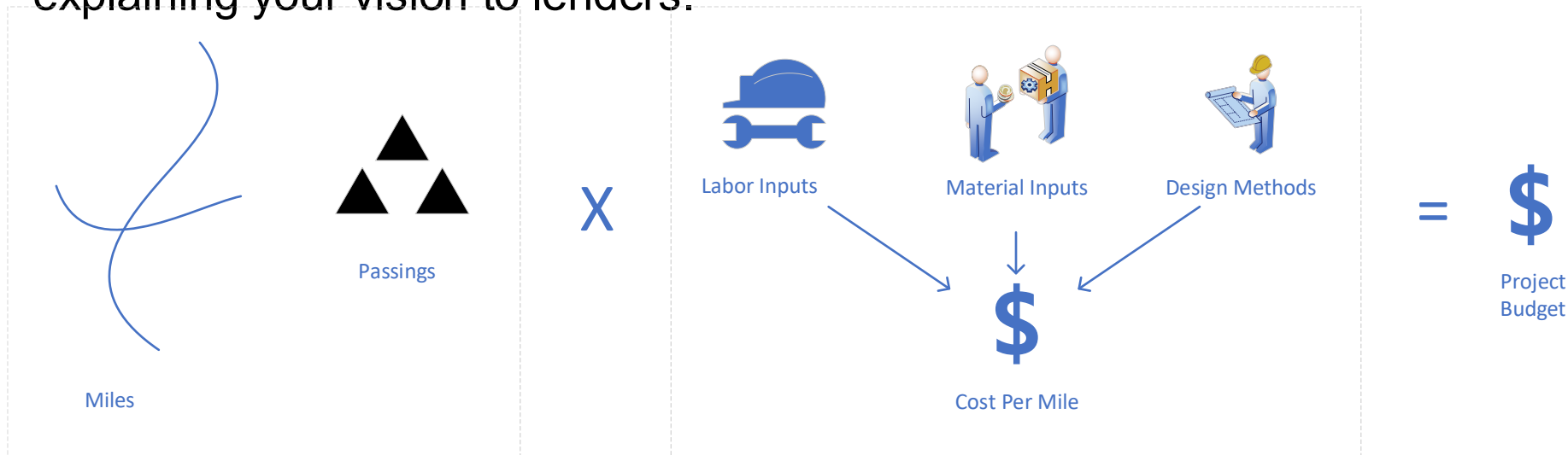
## Fiber Distribution Percentages

# Don't toss it.

- You model will become reusable and applicable to any project you'd like to chase, simply by changing the relevant inputs.
- This also give you a road map as you move from planning to funding and construction.
- Your model will also be **very** helpful in explaining your vision to lenders.

<b>CAPEX SUMMARY</b>	
<b>Category</b>	<b>Total</b>
Outside Plant - Mainline	\$ 30,574,302
Outside Plant - Drop	\$ 1,549,498
ONT, CPE, Inside House	\$ 1,629,432
Inside Plant - Access	\$ 270,270
Engineering	\$ 8,505,876
<b>Total</b>	<b>\$ 42,529,378</b>

<b>PROJECT STATISTICS</b>	
Project Cost per Passing	\$ 10,174.49
Project Cost per Mile	\$ 77,608.35
Project OSP Cost per Mile	\$ 55,792.52
Total Miles	548
Total Passings	4,180
Passings per Mile	7.63
Total Customers	2,928



# Engineer for Total Cost of Ownership – Tailored to your company

## Example: Aerial vs. Underground

- Constr. Labor (++)UG)
- Material Costs (+/-)
- Engineering Costs (+Aer)
- Pole Attachment Fees (+Aer)
- Make Ready (+Aer)

- Pole Rentals (+Aer)
- Maintenance (+Aer)
- Plant Access (+/-)

### CapEx

### OpEx

- These are region and company specific . The degree to which they can impact your specific build have to be specifically modeled.
- What type of company do you want to have? TCO can be reduced drastically by building internally IF you're interesting in building the capacity.
- If you're not the pole owner, results may vary, but it's going to be a lot slower than it should be.

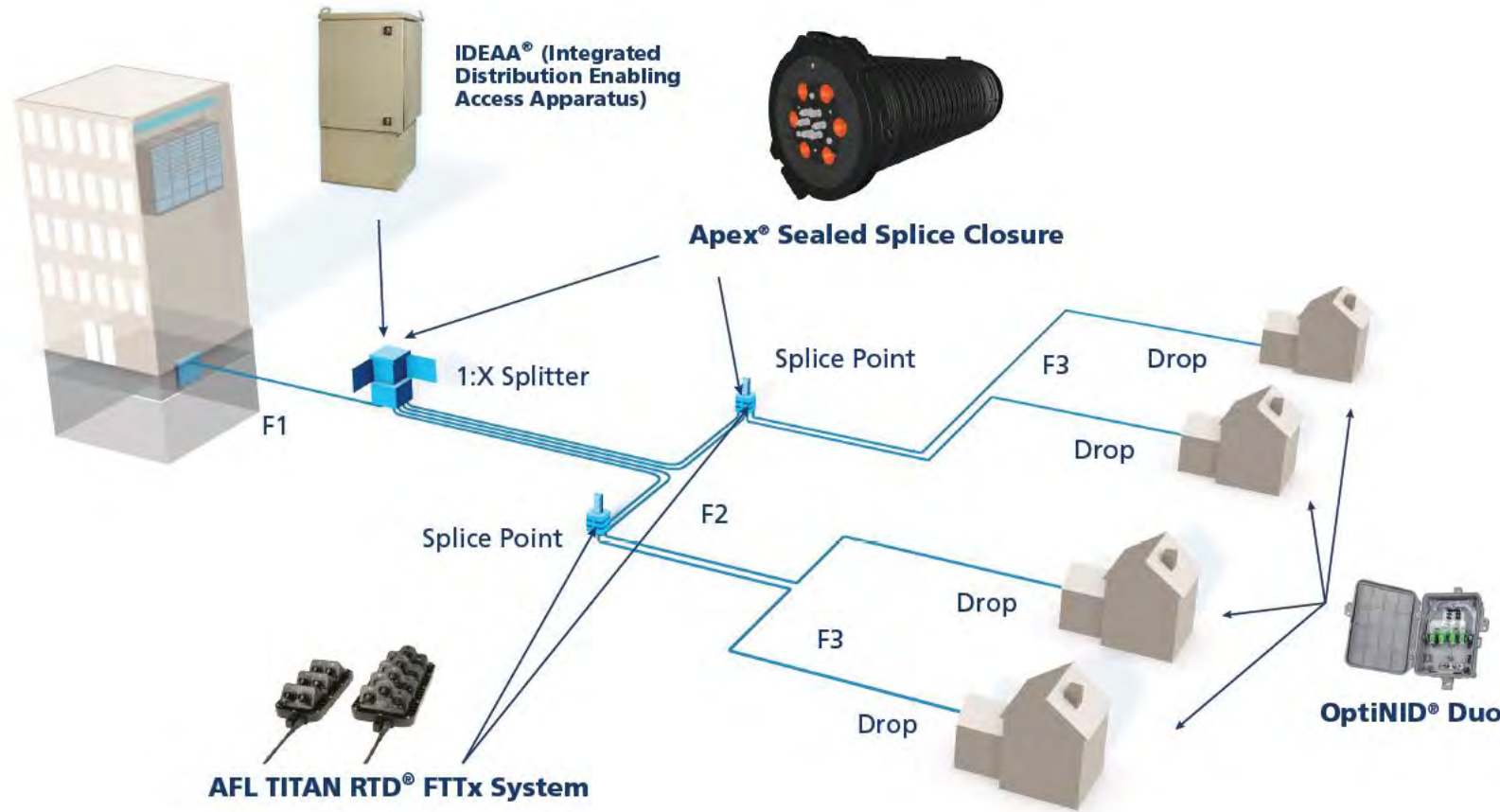
# Split architecture

## Centralized Split



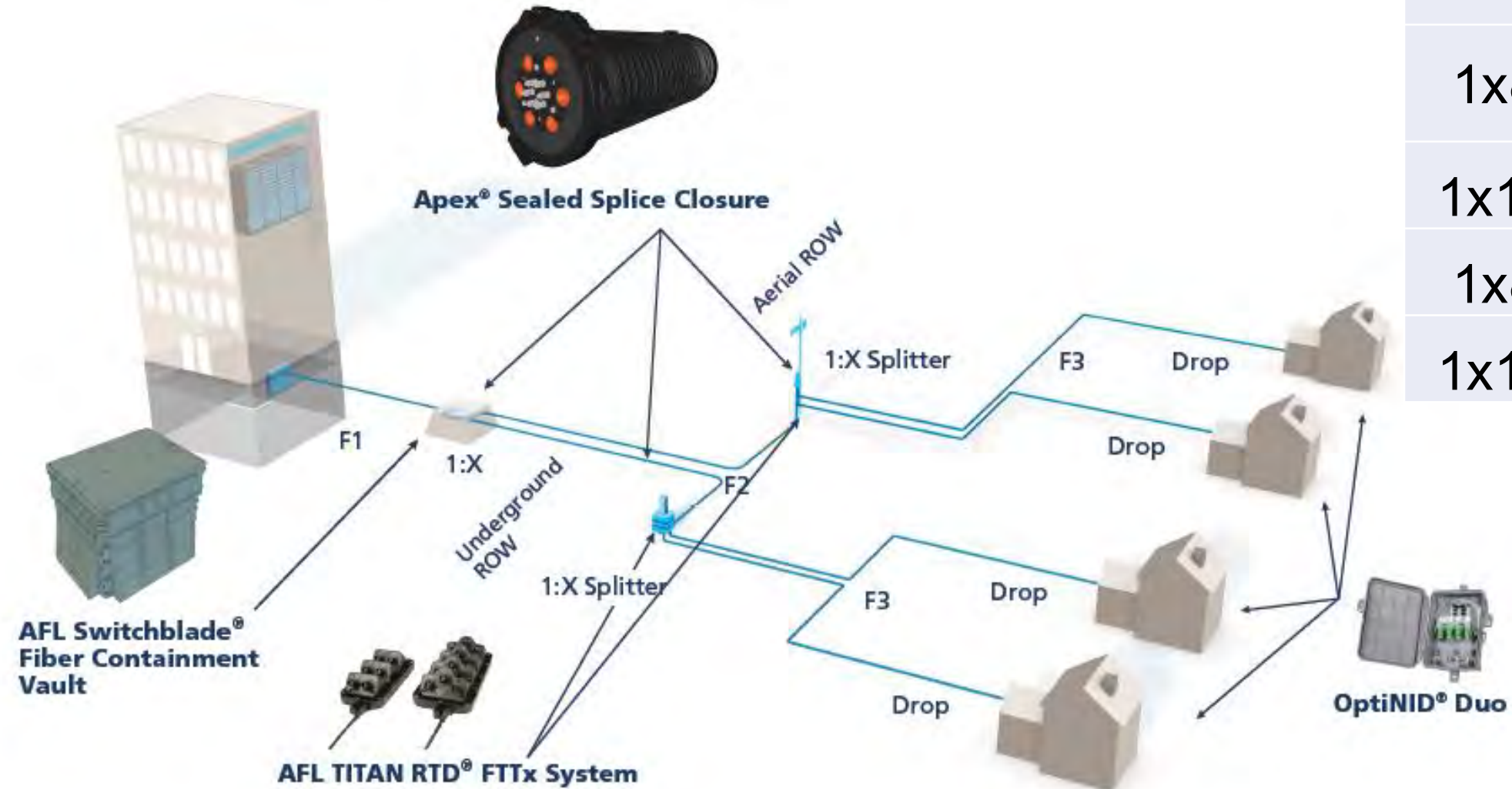
Hub box or cabinet that holds all splitters (one level, big ratio)

Box with only patching



# Split architecture

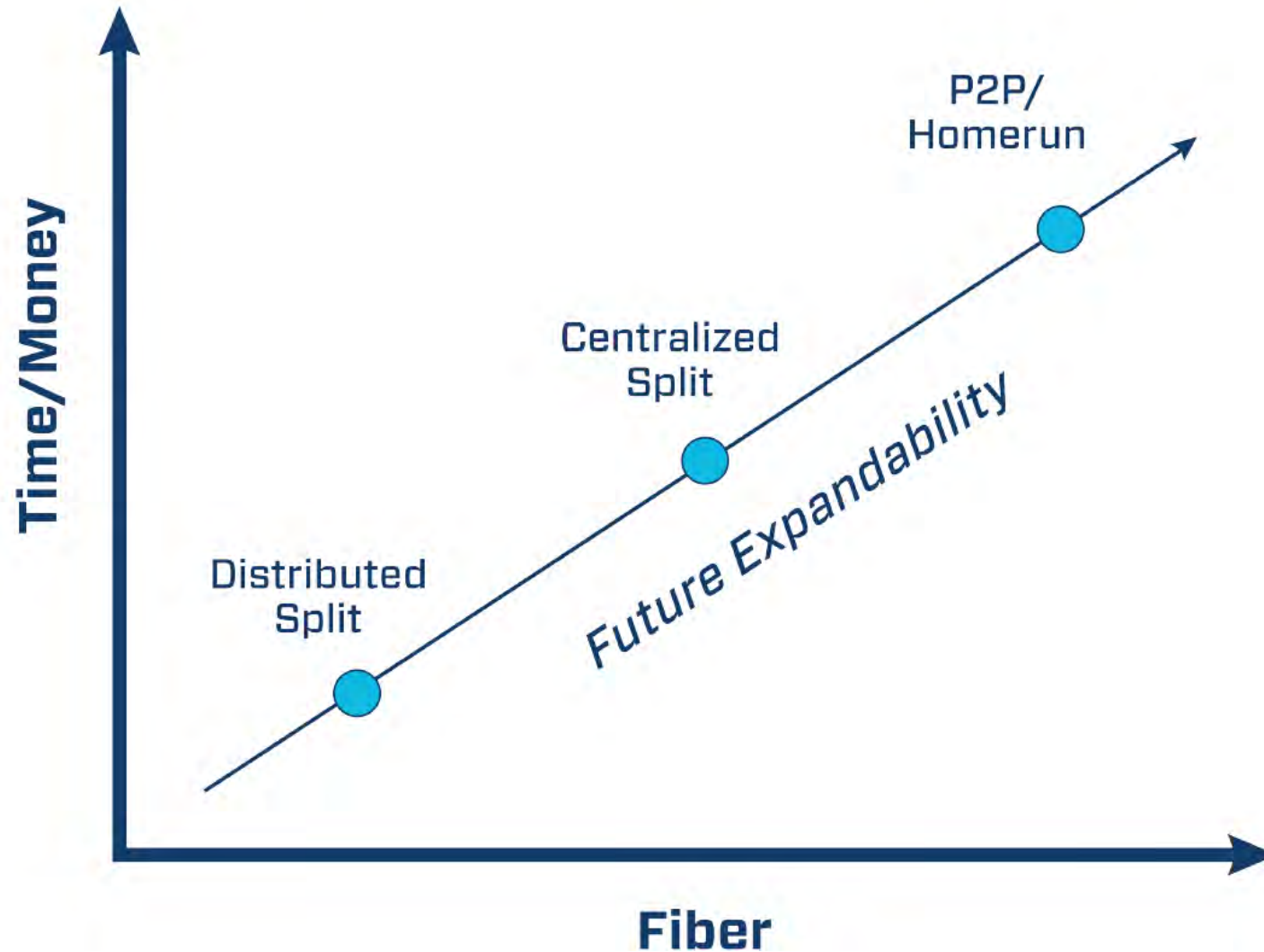
## Distributed/ Cascade Split







































Split 1	Split 2	Total split
1x8	1x4	1x32
1x16	1x2	1x32
1x8	1x8	1x64
1x16	1x4	1x64

# Split Architecture

## Comparison of Fiber Architectures



# PON Topologies Trade-Offs

	Home Run	Centralized Split	Distributed Split	Distributed Tap
Amount of Fiber Required	MORE 			 LESS
OLT Port Utilization	BETTER 			 WORSE
Engineering Complexity	LESS 			 MORE
Flexibility/Upgradability	BETTER 			 WORSE
Testing/Monitoring	BETTER 			 WORSE
Amount of Splicing Required	MORE 			 LESS
CAPEX	MORE 			 LESS
Time to Build	MORE 			 LESS
Time for Customer Turn-Up	MORE 			 LESS



# Engineer for Total Cost of Ownership – Tailored to your company

## Where do costs creep into construction?

- Uncertainty! When engaging contractors, risk increases cost.
  - Remember: Contractors pay for time. You pay for results.
- Changes! Reduce by creating a structure for these before you need them.
- Unplanned splices. Anticipate these and ensure your contracts prohibits payment for unallowed splicing. Defined splicing and reel ends are a must have.
- Material variance. You can save by standardizing on types, reel lengths, etc. A smaller menu makes it easier for distributors to work with you.

### Ex. Risks

- Weather
- Shut-downs due to X
- Materials issues
- Bad or non-existent design

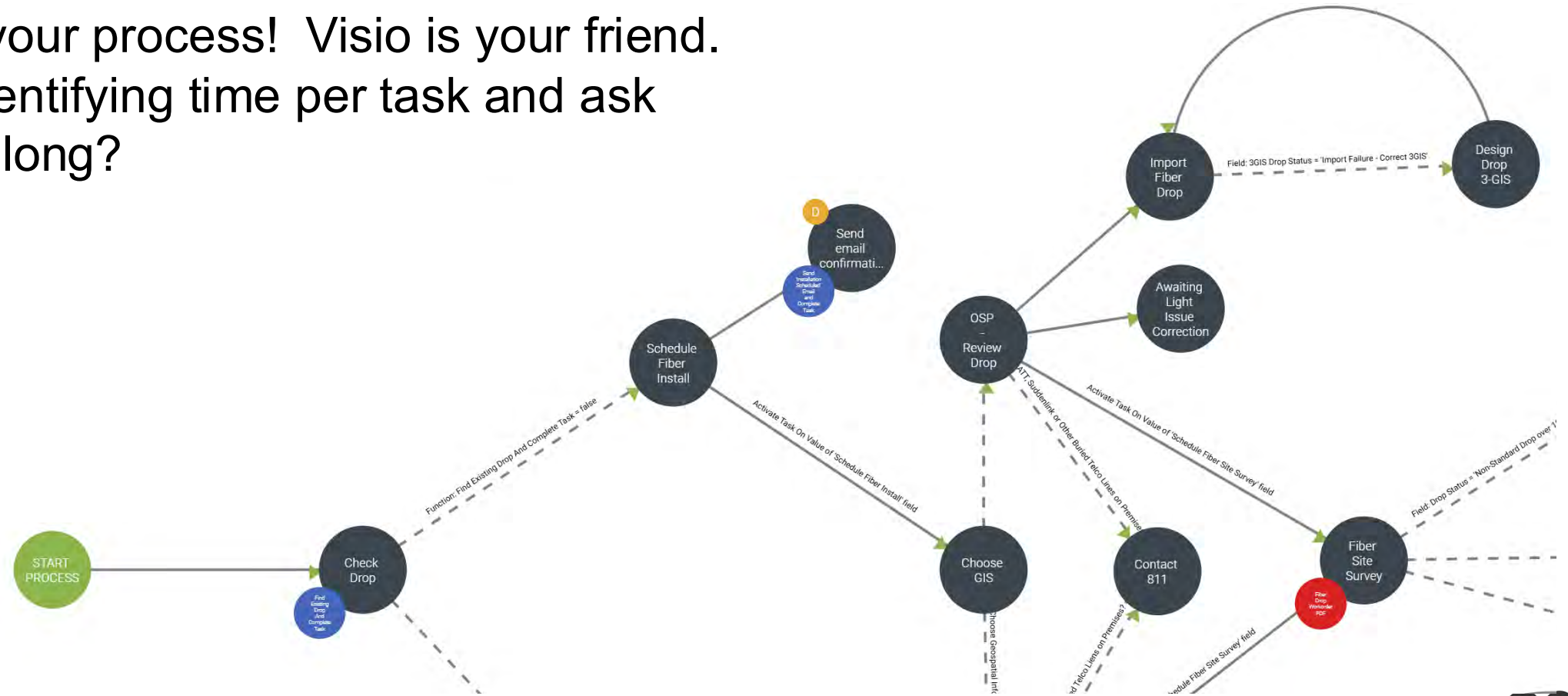
## Engineer process for speed – Remove friction from process

### Where do costs creep into operations?

- Delayed launch of service due to incomplete work. (Test & Inspect!)
- **Time!**
- Truck rolls. Devise a round number value you can use easily for cost/benefit analysis.
- Time per drop install. Don't sleep on locates.
- Time per customer install. Think in person hours.
- Lack of light, leading to return trips.
- You need a plan that optimizes for the least time from service request to turn-up.

# Engineer process for speed – Remove friction from process

- Model your process! Visio is your friend.
- Start identifying time per task and ask why so long?



## Engineer process for speed – Remove friction from process

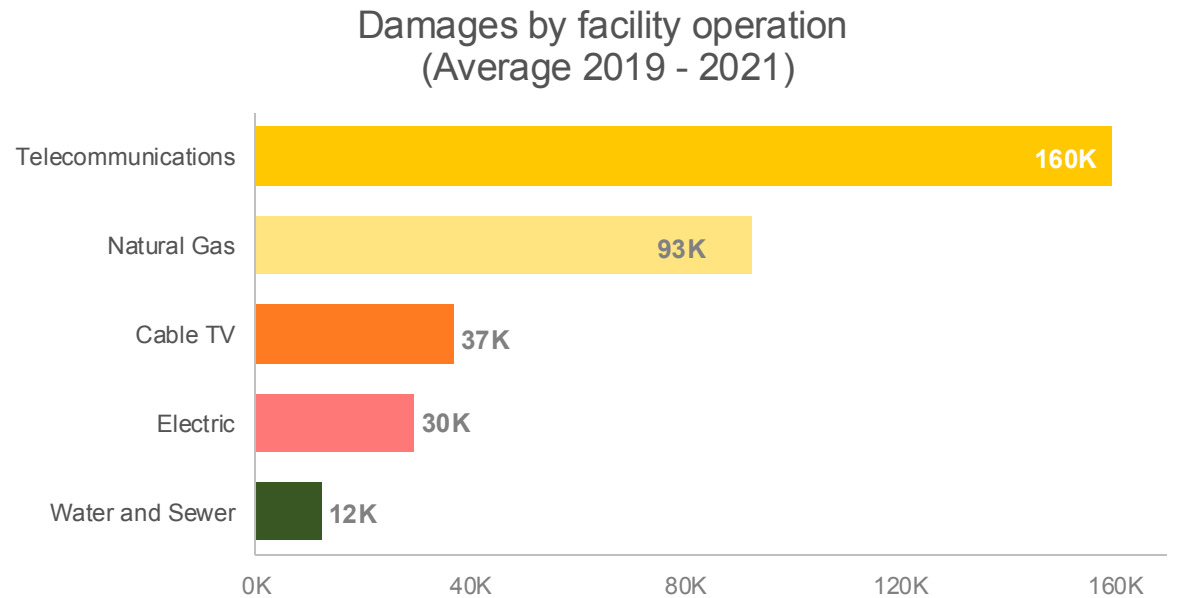
### Tips for streamlining turn-ups:

- Start with a persistent plant record you design with and build to.
- Systemize pre-qualification with your plant records to avoid sales you can't serve (BUT CAPTURE INTEREST!)
- Don't lose track of where you've already served (plant records).
- Don't reclaim ONTs. It's almost never worth it. Instead, use default profiles and walled gardens to accept new clients off of old hardware.
- Schedule everything when you take the sale. This is hard, but so is getting ahold of people who think they already bought your service.

# Infrastructure Monitoring

## Infrastructure Monitoring to Minimize OPEX

- 24/7 in-service fiber link monitoring
- Independent of any transport speed, protocol, or system vendor equipment
- Based on well-established OTDR technology
- Automated real-time fiber fault detection localization and notification
- Identifies fiber faults vs. electronics as source of network outages
- **Minimize operational costs to manage fiber assets.**



## Know Your Fiber

Know the **real** quality of your fiber.

In case of a fiber break, **how long** would it take you to find out where it happened exactly?

**Track** fiber link performance over time.

Track fiber splicing quality from a **central location** after repairs.

Get **notified** of potential physical infrastructure malicious attacks or eavesdropping.



Fiber eavesdropping



Fiber or splice degradation



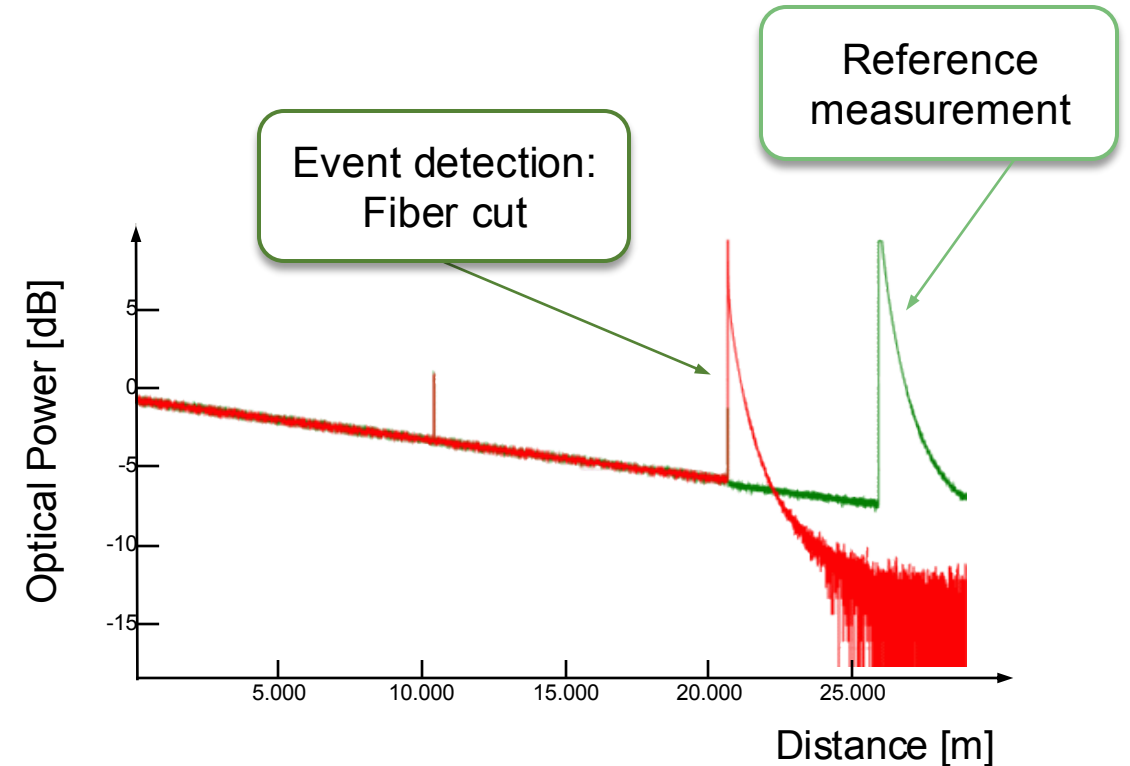
Fiber break

## FAULT ANALYSIS BASED ON INITIAL REFERENCE MEASUREMENT – FINGERPRINT

How does it work?

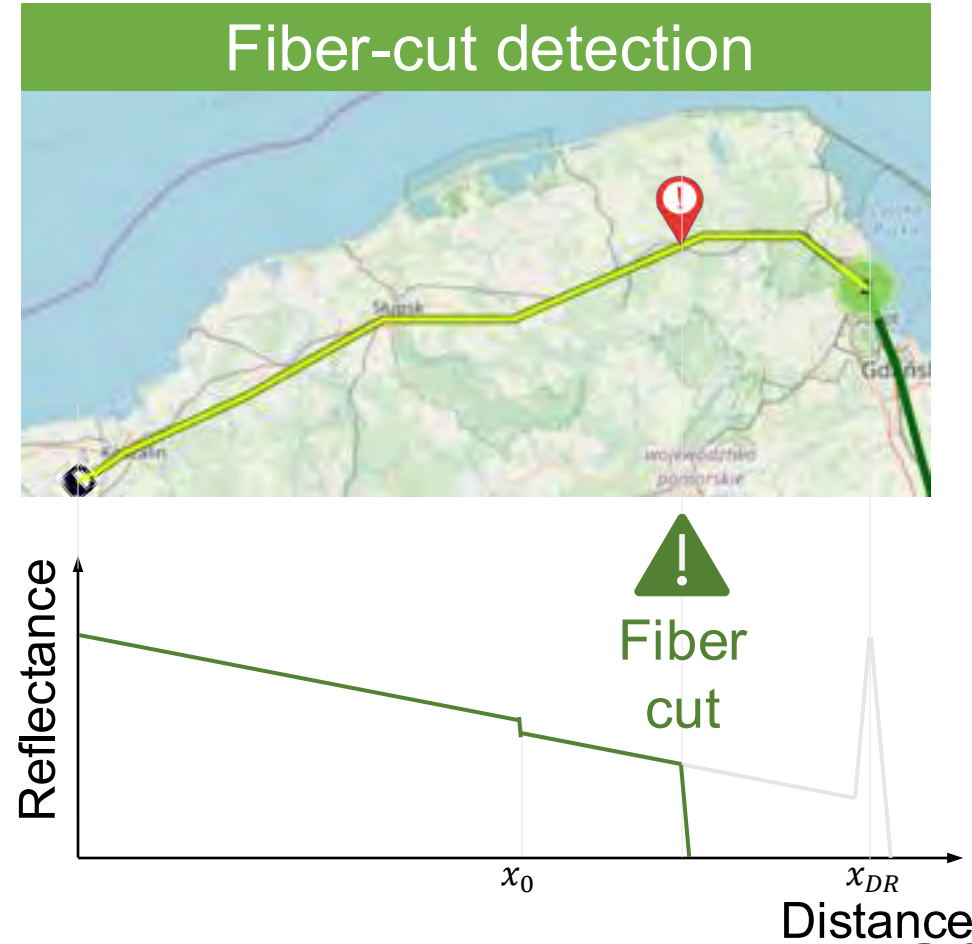
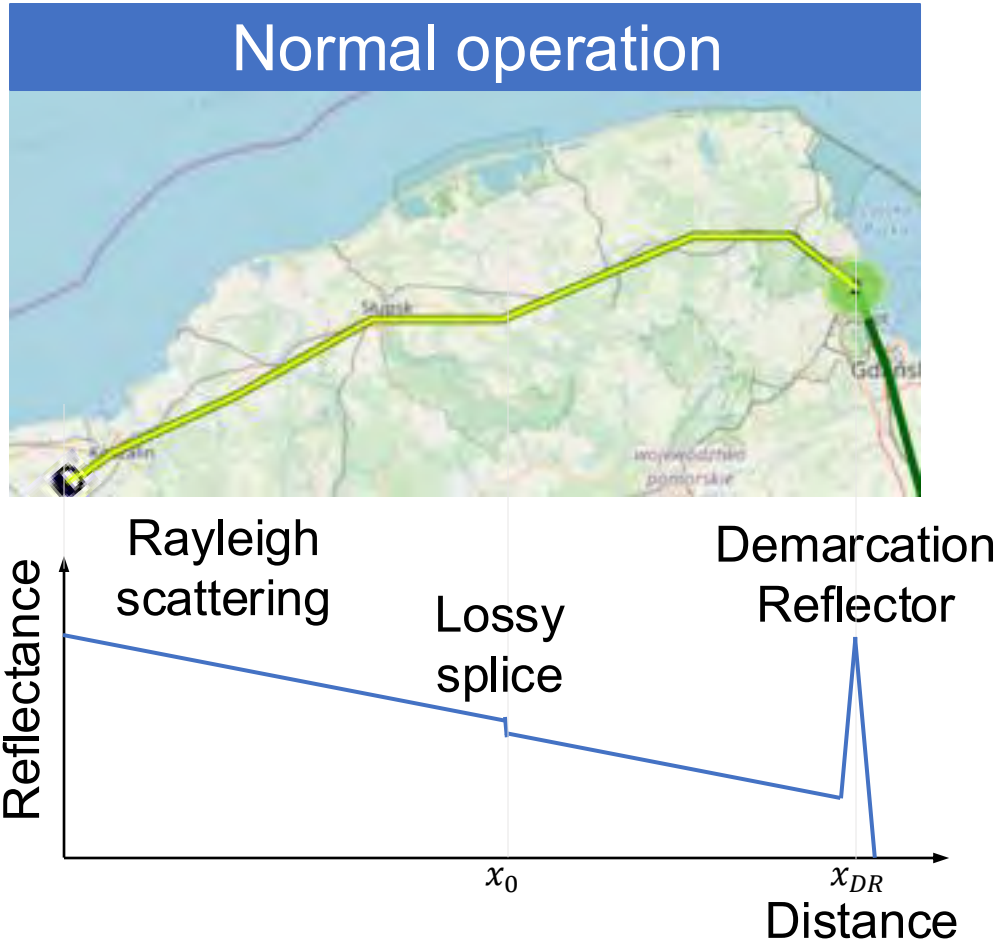
### Automatic alarm generation based on events

- The reference measurement is used for comparison (fingerprint)
- A list of reflective optical events with associated distance per fiber link is created
- Measure compared to baseline and cuts and/or alarm thresholds crossed creates event and notification



# REAL-TIME GEOGRAPHICAL INFORMATION WITH MULTIPLE NOTIFICATION OPTIONS

Exact real-world fault location within seconds

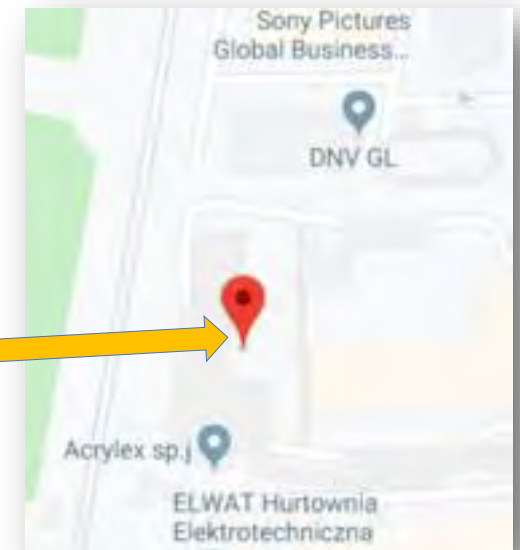
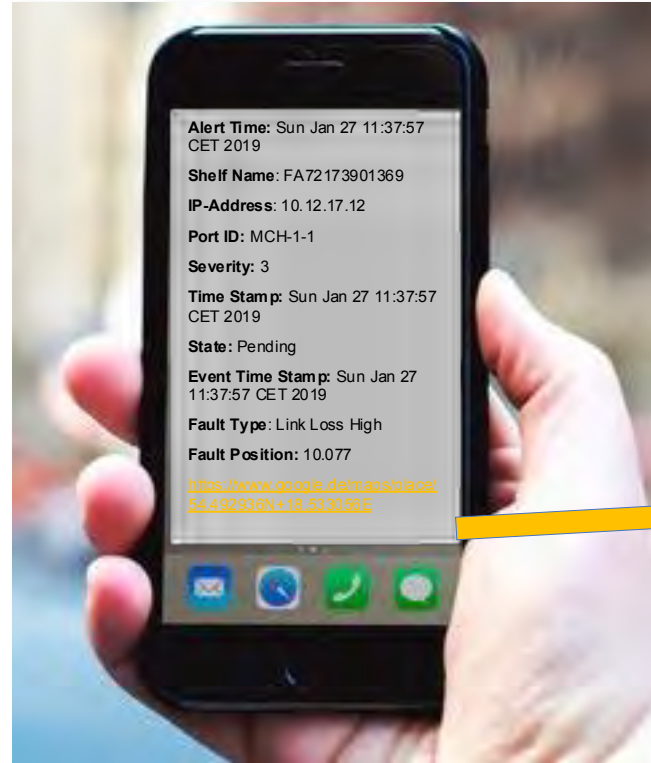


## EMAIL NOTIFICATIONS

### Alarm notifications

#### Notification options

- SNMP Traps
- NETCONF
- Email messages
  - Integration with Google Maps, OpenStreet Maps
  - Multi user support

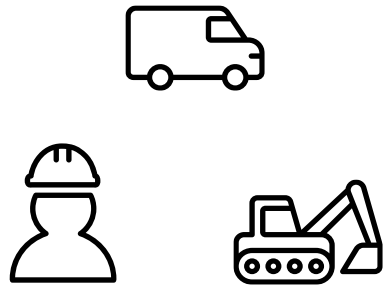


## REAL AND COSTLY PROBLEM WITH RAPID GROWTH

False and unplanned truck rolls

25%

Faults in fresh installs

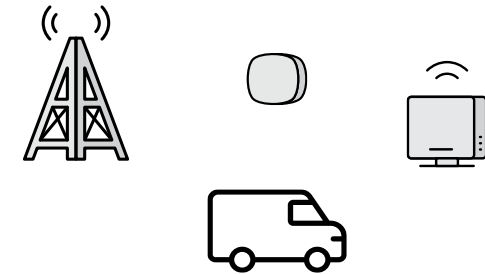


- Poor installation quality
- Incorrect documentation
- Substandard components
- Improper network design



70%

No fiber fault found

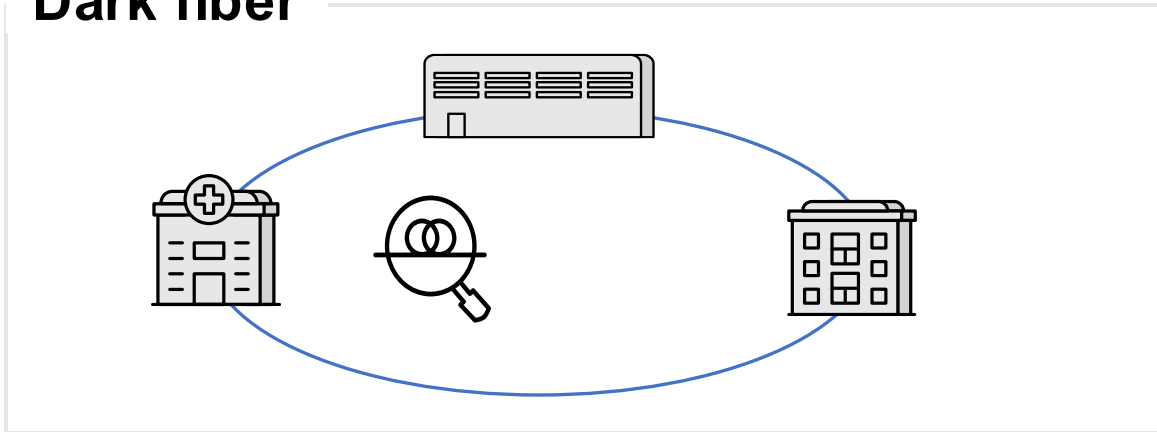


- Electronic failures
- Upper layer network protocols
- Improper access rights/configuration
- Intermittent failures (flapping)

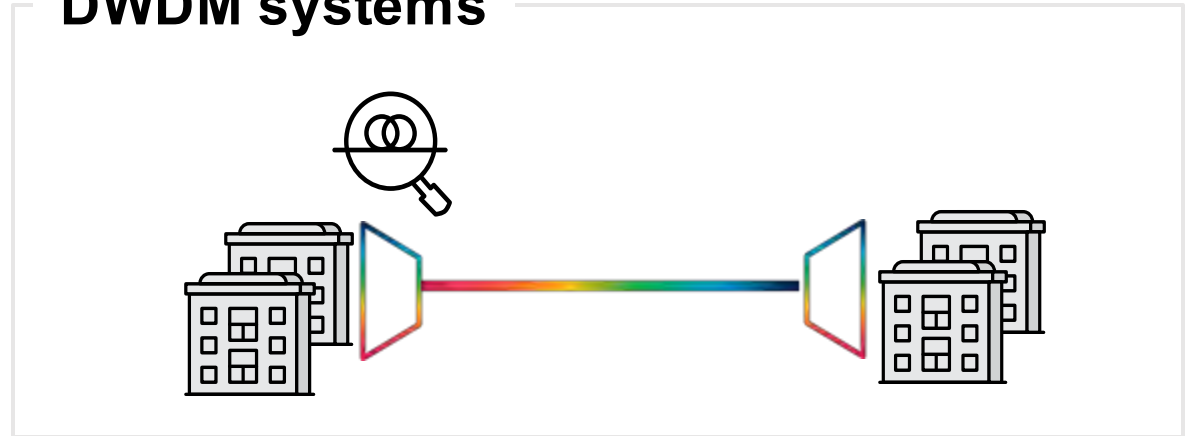
# VENDOR, SPEED AND TECHNOLOGY AGNOSTIC

## Use Cases

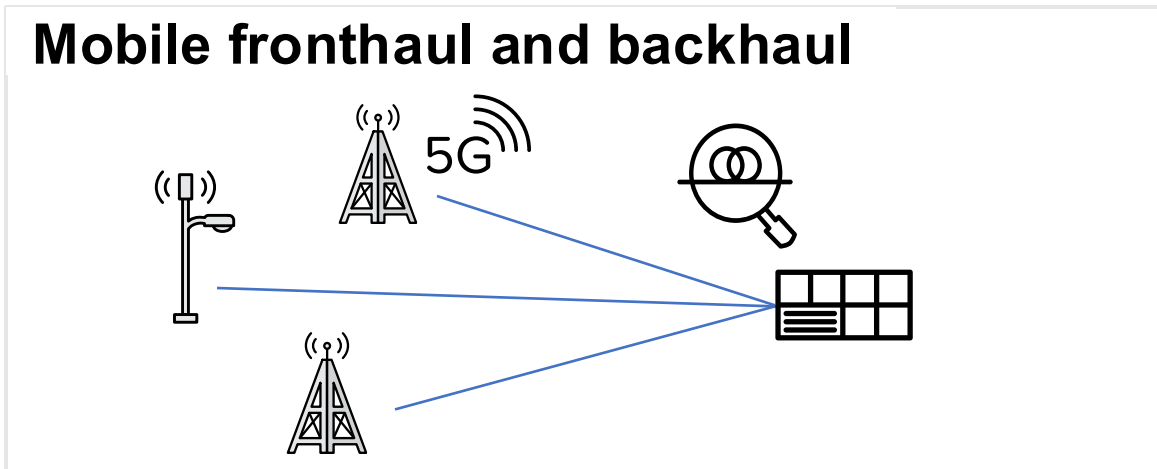
### Dark fiber



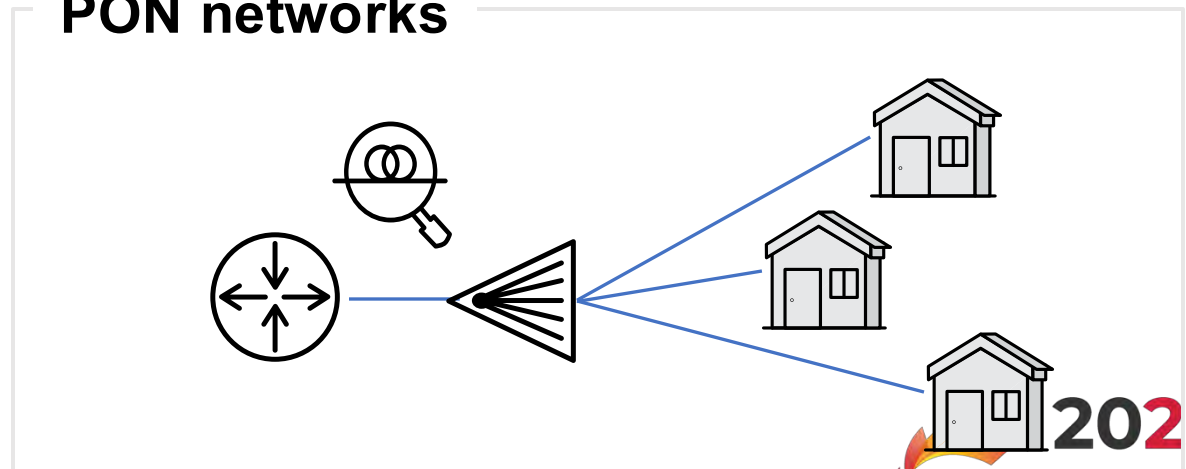
### DWDM systems



### Mobile fronthaul and backhaul



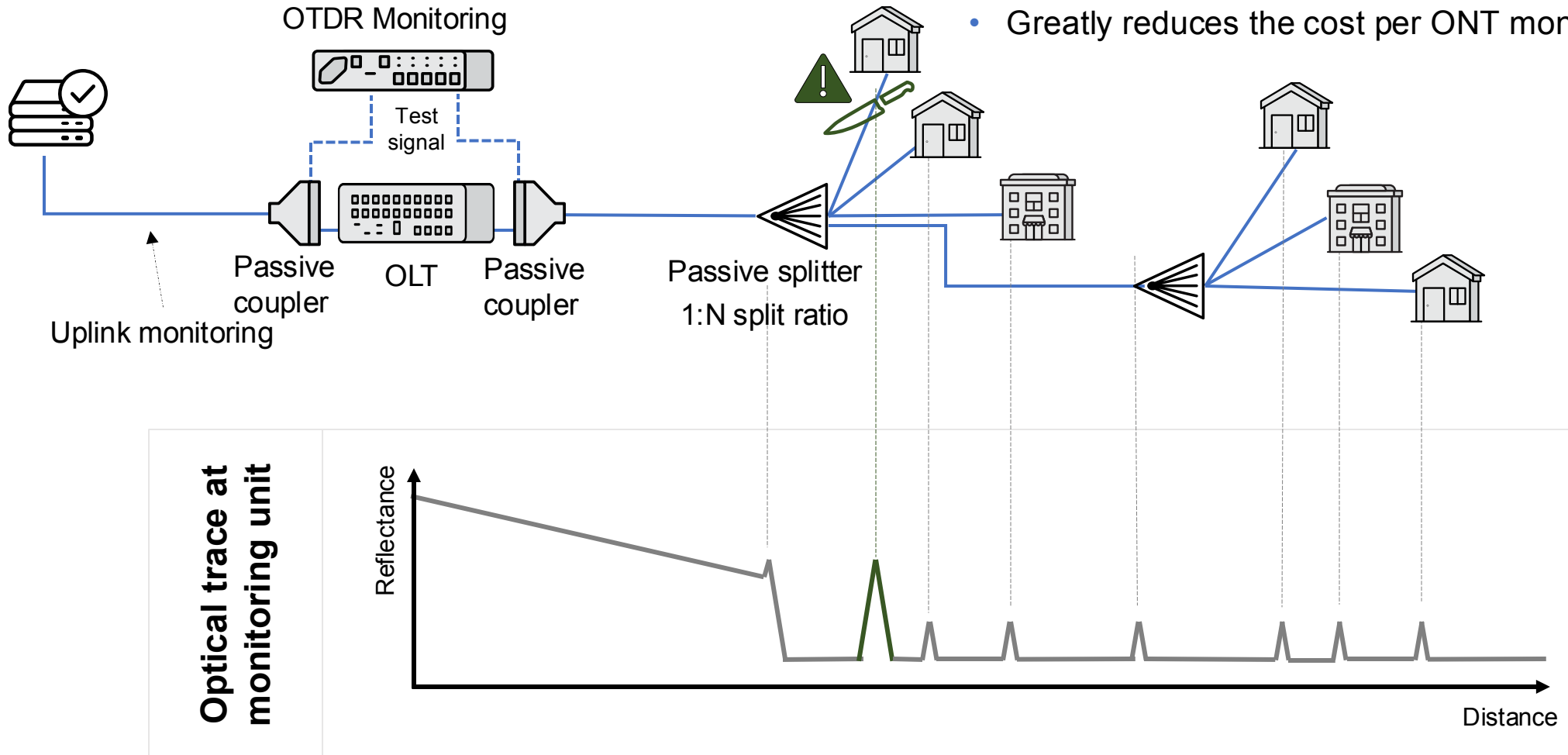
### PON networks



# “SEE” BEYOND THE SPLITTER

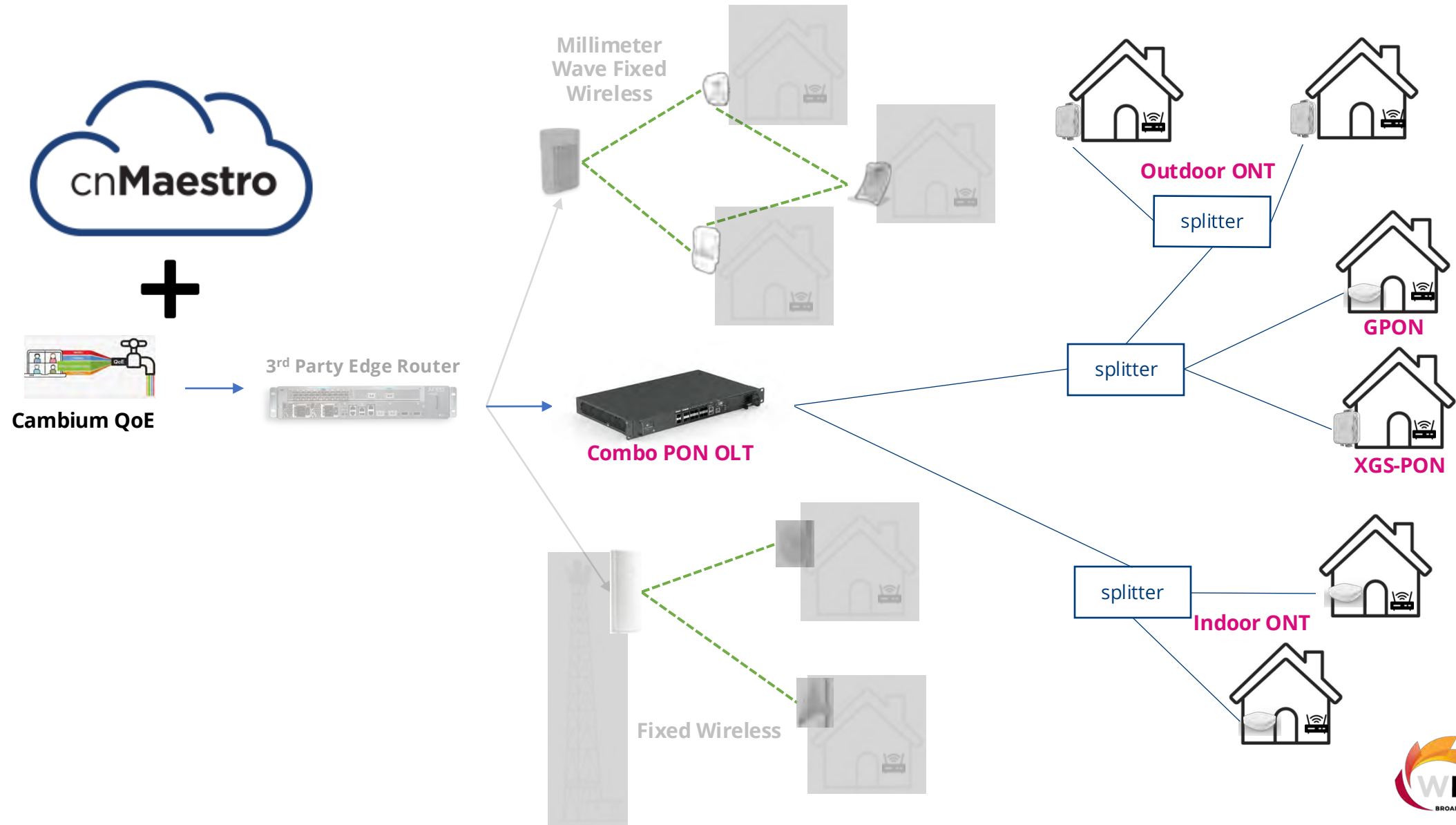
## PON Assurance

- 24/7 in-service, non-intrusive PON monitoring even beyond splitters
- Greatly reduces the cost per ONT monitored



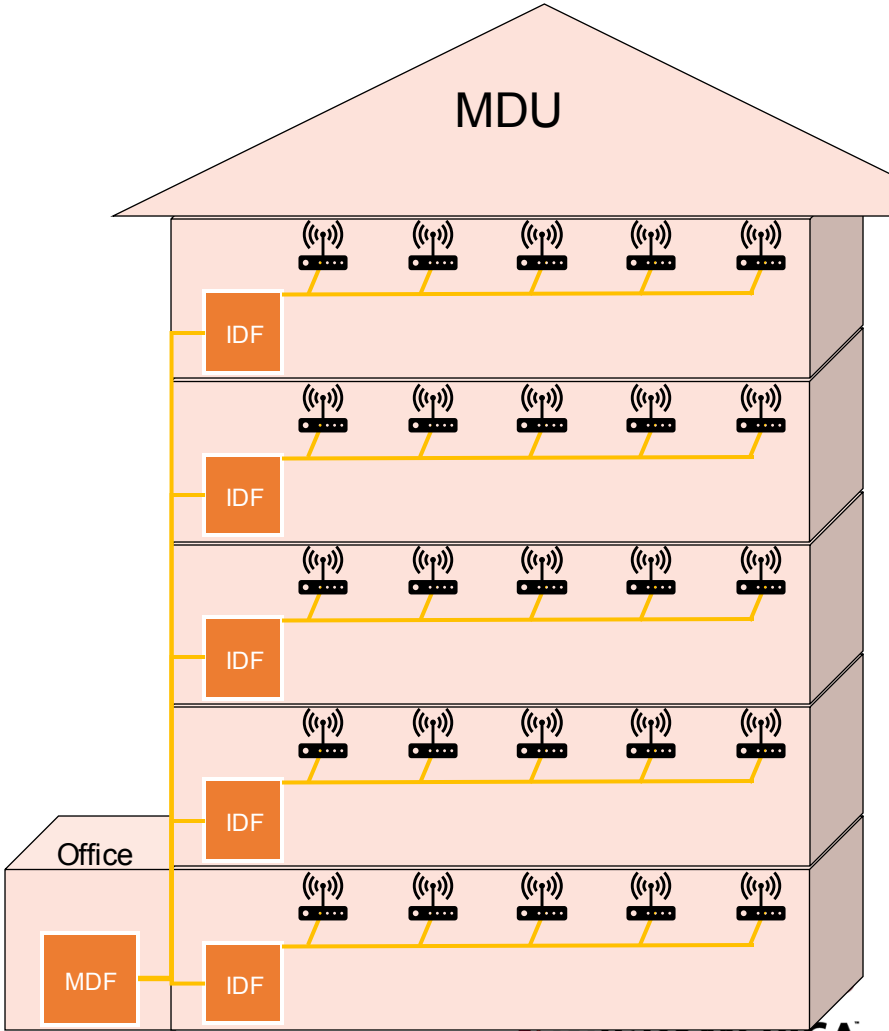
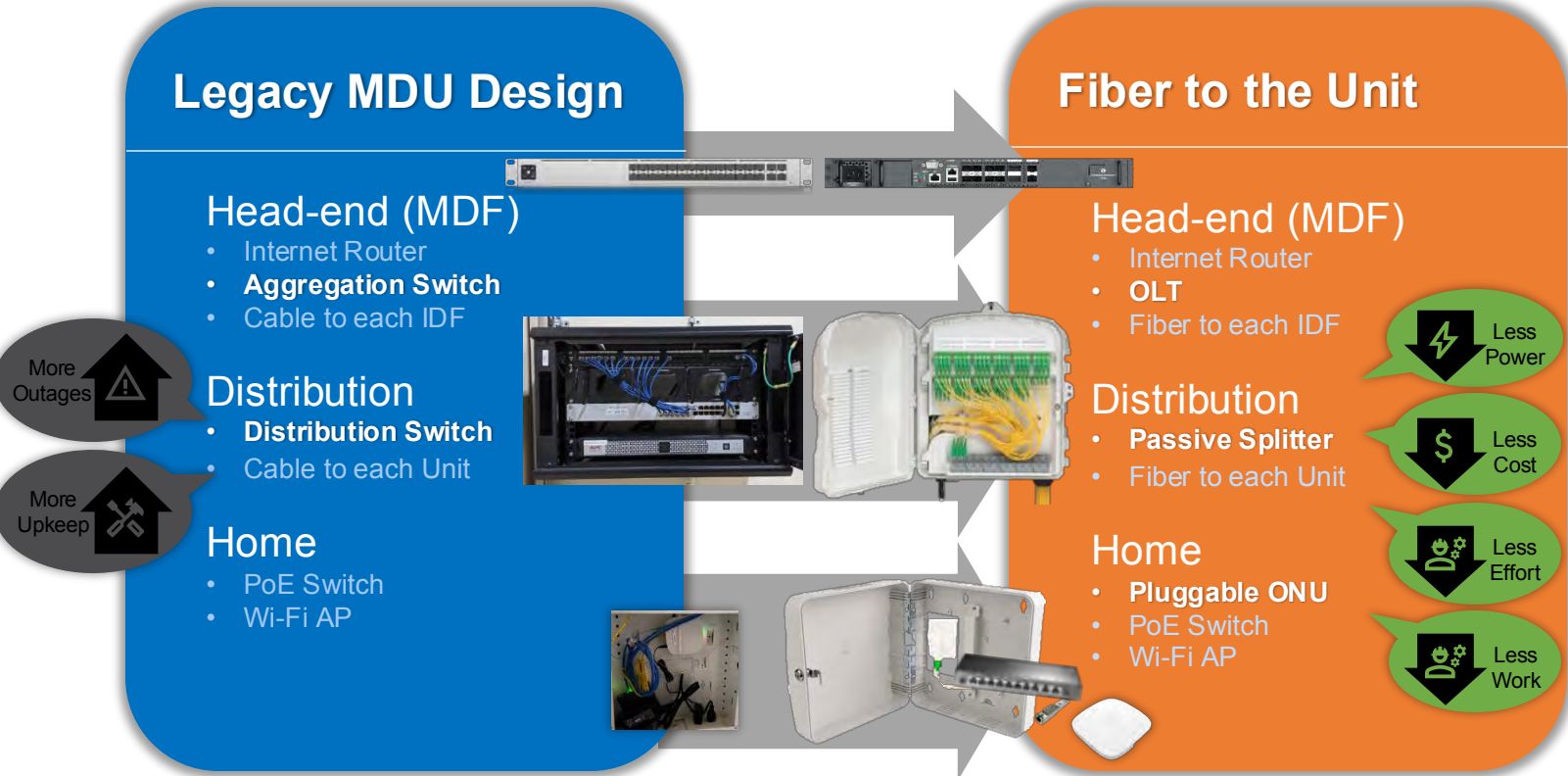
# Hybrid Fiber/Wireless

# Hybrid Fiber/Wireless



# Hybrid Fiber/Wireless: MDU Use Case

- ✓ OLT instead of Aggregation Switch
- ✓ Passive distribution instead of IDF Switches
- ✓ Pluggable ONU instead of Copper to the Unit



# Hybrid Fiber/Wireless Model – FTTP (Fiber to the Pole)

## Hybrid for Faster Market Capture

- ✓ Jump Over right-of-way Issues
- ✓ Launch Gigabit Wireless Today
- ✓ Capture Subscriptions Now
- ✓ Convert to Fiber Tomorrow



\*AP Powered by Solar + Battery, Street Light Tapping, Direct Tap, or Utility Meter

# Building the Business Case:

Panel Discussion

# Fiber XGS-PON CAPEX

CAPEX Components	Description	Typical Cost
<b>Outside Plant Construction</b>	Fiber cable deployment (trenching, boring for underground or pole attachments for aerial), plus splitters and splice enclosures.	~\$700–\$2,700 per home passed (aerial vs underground, urban vs rural). Rural buried builds can reach \$7k+ per passing.
<b>Central Office (OLT)</b>	OLT chassis & PON line cards/ports; aggregation switches; facility buildout.	\$1000 per XGS-PON port (splitter ratios of 1:32, 1:64, 1:128): \$10 to \$60 per connected home
<b>Drops &amp; ONT (Subscriber)</b>	Drop cable from curb to home, ONT device and installation and customer activation.	~\$1,500–\$2,000 per home connected in rural; can be <\$500 in dense neighborhoods. ONT device ~\$80 - \$160 (indoor or outdoor / GPON or XGS-PON options).
<b>Engineering &amp; Permitting</b>	Network design, make-ready surveys, permits for ROW and pole access.	~10%–15% of project cost
<b>Other Capital Costs</b>	Project management, splicing gear, test equipment, buildings/POP huts, contingency.	Budget 5–15% of total CAPEX (varies by project complexity).

# Example PON Hardware Pricing Scenarios

## GPON

### Scenario 1 – \$80/sub

- 16-Port OLT (fully populated)
- 2048 Indoor GPON (1:128)

### Scenario 2 – \$94/sub

- 8-Port OLT (fully populated)
- 512 Indoor GPON (1:64)

### Scenario 3 – \$153/sub

- 8-Port OLT (half populated)
- 128 Indoor GPON (1:32)

## XGS-PON

### Scenario 4 – \$156/sub

- 16-Port OLT (fully populated)
- 2048 Indoor XGS-PON (1:128)

### Scenario 5 – \$171/sub

- 8-Port OLT (fully populated)
- 512 Indoor XGS-PON (1:64)

### Scenario 6 – \$234/sub

- 8-Port OLT (half populated)
- 128 Indoor XGS-PON (1:32)

# Fiber XGS-PON OPEX

OPEX Component	Description	Typical Cost
<b>Network Maintenance</b>	Regular maintenance of fiber plant (inspections, repairs, splicing).	Costs ~1% of CAPEX per year. Example: \$40M network budgets ~\$400k/year. Average cost: ~\$53 per home passed per year.
<b>Network Operations &amp; Backhaul</b>	Includes Network Operations Center (NOC), IP transit, backhaul leases, and power.	Bandwidth costs: \$1–\$3 per Mbps-month. Power accounts for ~2% of total broadband OPEX.
<b>Customer Operations</b>	Covers customer support, billing, marketing, and administrative expenses. Include truck rolls. Included churn.	Estimated at ~\$10–\$15 per subscriber per month. Churn and truck rolls are ~85% of access network OPEX.
<b>Recurring Subscriptions and Support costs of hardware and software support</b>	Some equipment manufacturers require subscriptions for hardware support.	Assumes no recurring costs.
<b>Overall OPEX</b>		Total OPEX: ~\$50–\$100 per home passed per year. Example: 5,000 homes passed = ~\$250k annual OPEX. On a per-subscriber basis, ~\$100 per year or <\$10 per month per subscriber.

# Fiber ARPU

ARPU Considerations	Description	Typical Cost
<b>Tiered Services</b>	Basic Tier: 40% (100 Mbps symmetrical at \$50) High Tier: 40% (200-500 Mbps symmetrical at \$65) Top Tier: 20% (1Gbps symmetrical at \$90)	Typical ARPU in U.S. : \$60 - \$75 (Use \$64 in our model) Adjust for inflation only.
<b>Charge for Installation?</b>	Installation of drop cable, ONT, wi-fi router	\$100 to \$300 for installation but often waived as a promotion. Model assumes \$0.
<b>Voice</b>	VoIP services \$20	Model assumes \$0
<b>Wi-Fi Router Rental</b>	\$5-\$10 per month for managed wi-fi router	Model assumes \$0

# Fiber Take Rates

- Most business cases require 30-40% take rate to break-even
- Is area already served by cable or other? (slower ramp)
- Suburban vs. Rural
- Ramp Rate:
  - Year 1: 20%
  - Year 2: 30%
  - Years 3-5: max out around 40-50%

# Simplified Business Case

	Suburban	Rural	Subsidized Rural	Assumptions
Deployment Scenario	5,000 homes	750 Homes spread over 25 sq. miles	750 Homes spread over 25 sq. miles	
CAPEX per home passed	\$2,000	\$9,000	\$9,000	
CAPEX per home connected	\$500	\$1,500	\$1,500	
Up-front investment	\$10M up-front \$11M at full 40% deployment	\$6.75M up-front \$7.3M at full 50% take-rate deployment	Assume 75% BEAD subsidy \$1.82M at full deployment	
OPEX	\$150K/year	\$80K/year	\$80K/year	
Revenue	\$65 monthly Y1: \$156K Y2/3: \$1.3M Y4+: \$1.6M	\$65 monthly Y1: \$120K Y2/3: \$175K Y4+: \$300K	\$65 monthly Y1: \$120K Y2/3: \$175K Y4+: \$300K	Assume take rate of 20% Y1, 30% Y2-3, 50% by Y4+
Straight Payback	9 years	32 years	10 years	

# Fixed Wireless CAPEX

Category	Description	Typical Cost
<b>Tower Infrastructure</b>	Includes tower construction, leasing existing structures, power supply, and shelter for equipment.	Costs range from \$50K - \$250k per tower or leasing at \$5K to \$18K per year
<b>Base Station Equipment</b>	Base station radios, antennas, and supporting RF equipment.	Typical 4-sector tower equipment cost: \$10K - \$30K
<b>Customer Premises Equipment (CPE)</b>	Outdoor or indoor subscriber module radios at customer locations.	Unit cost: \$150 to \$500 per subscriber.
<b>Installation &amp; Labor</b>	Truck rolls and labor for customer installs.	Typically \$200 to \$400 per installation.

# Fixed Wireless OPEX

Category	Description	Typical Cost
<b>Spectrum Licensing &amp; Fees</b>	Free or in case of Licensed spectrum costs vary,	Assume 5 GHz or 6 GHz so no cost.
<b>Backhaul Connectivity</b>	Leased fiber or microwave backhaul to connect towers.	Can range from \$500 - \$5,000 per month per site.
<b>Network Operations &amp; Monitoring</b>	Network Operations Center (NOC), remote monitoring software, and cloud-based management. Costs scale with network size.	Unit cost: \$5/year/subscriber
<b>Maintenance &amp; Repairs</b>	Periodic equipment replacements, firmware updates, and field repairs.	Estimated at 2% of network CAPEX per year.
<b>Customer Support &amp; Billing</b>	Call center, billing systems, marketing, and administrative costs including churn.	Typically \$8-\$12 per subscriber per month.

# Comparing Fixed Wireless to Fiber

	Suburban	Rural	Subsidized Rural	Fixed Wireless
Deployment Scenario	5,000 homes	750 Homes spread over 25 sq. miles	750 Homes spread over 25 sq. miles	750 Homes spread over 25 sq. miles using single tower. 50% take rate.
CAPEX per home passed	\$2,000	\$9,000	\$9,000	\$33 (\$25K tower equipment and install)
CAPEX per home connected	\$500	\$1,500	\$1,500	\$600 (CPE + Truck-roll)
Up-front investment	\$10M up-front \$11M at full 40% deployment	\$6.75M up-front \$7.3M at full 50% take-rate deployment	Assume 75% BEAD subsidy \$1.82M at full deployment	\$295K
OPEX	\$150K/year	\$80K/year	\$80K/year	\$100K
Revenue	\$65 monthly Y1: \$156K Y2/3: \$1.3M Y4+: \$1.6M	\$65 monthly Y1: \$120K Y2/3: \$175K Y4+: \$300K	\$65 monthly Y1: \$120K Y2/3: \$175K Y4+: \$300K	\$65 monthly Y1: \$120K Y2/3: \$175K Y4+: \$300K
Straight Payback	9 years	32 years	10 years	3.5 years

# Summary of Fiber PON / Fixed Wireless and Hybrid Networks

	Fiber PON	Fixed Wireless	Hybrid (Fiber + Wireless)
<b>CAPEX Investment</b>	Highest upfront cost (\$1,500–\$10,000 per home passed)	Lower upfront cost (\$500–\$2,000 per home passed)	Blended CAPEX for high and low-density areas
<b>OPEX &amp; Maintenance Costs</b>	Lower OPEX	Higher OPEX	Middle Ground
<b>Scalability &amp; Future-Proofing</b>	Grow to future multi-gigabit speeds, long lifespan	Limited by spectrum congestion and distance constraints	Balance fiber scalability and longevity with wireless flexibility
<b>Revenue Potential &amp; ARPU</b>	Supports premium gigabit services, ARPU (\$60–\$100/month)	Competitive but lower ARPU (\$40–\$70/month)	Combines fiber’s high ARPU with wireless cost efficiencies
<b>ROI &amp; Breakeven Period</b>	Longest breakeven (7-12+ years), high long-term ROI	Fastest ROI (2-5 years), but requires ongoing reinvestment	Mid-range ROI (5-7 years), blending fiber longevity and wireless speed to market
<b>Deployment Speed &amp; Coverage</b>	Slow to deploy due to permitting and trenching	Fastest to deploy with minimal infrastructure requirements	Rapid initial service with wireless while expanding / over-building fiber gradually
<b>Government Subsidy &amp; Funding</b>	Favored for BEAD/RDOF (up to 75-100% subsidy in rural areas)	Eligible for some subsidies, but less favored for long-term funding	Can leverage fiber grants while using wireless for interim broadband



**THANK YOU**

# Backup Slides