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BROADBAND WITHOUT BOUNDARIES

# Rules To Know - Broadband

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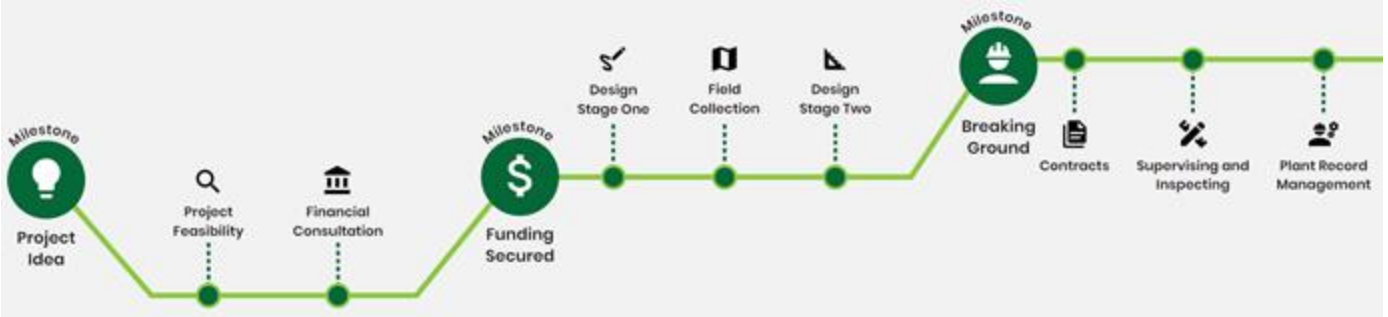
# Design to the Milestone



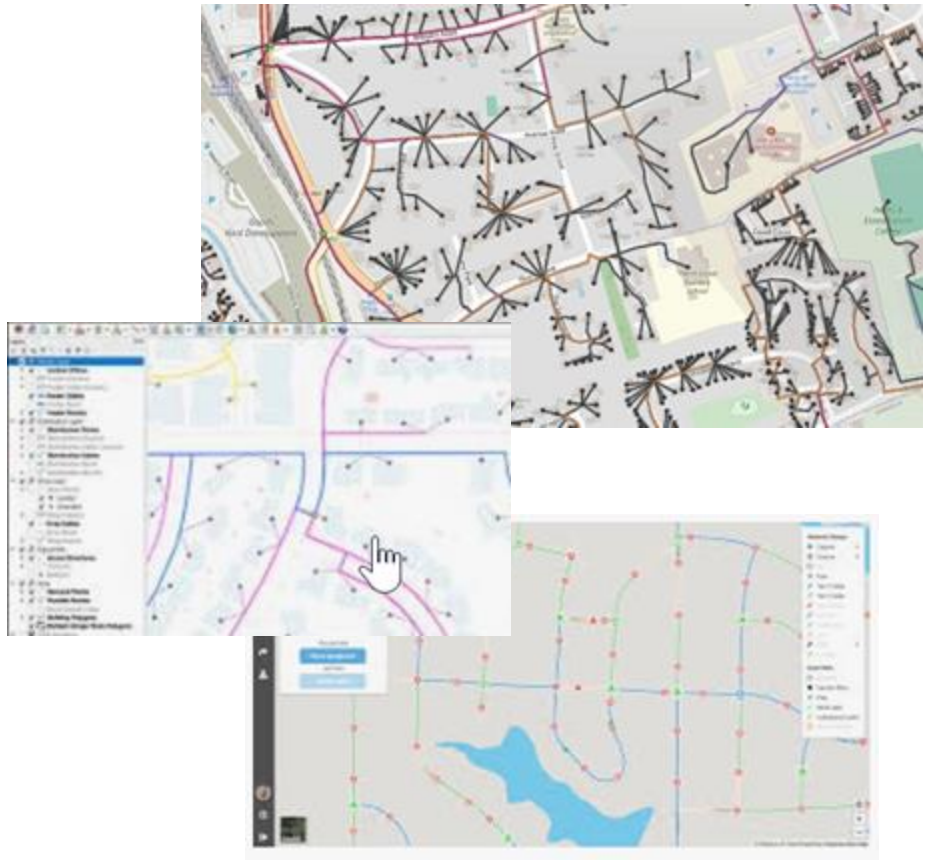

- Network Engineering needed before funding is secured can vary drastically from that needed after.
- Focus on fidelity only to the degree needed.
- For pre-funding, the type of design we're focused is modeling.  Stay out of the weeds!

# Identify your area!

- Review competitive environment and evaluate opportunities for growth
- Explore the availability of competent construction services and identify required resources
- Evaluate construction methods (like aerial, underground or microtrenching) and their merits for your particular project.

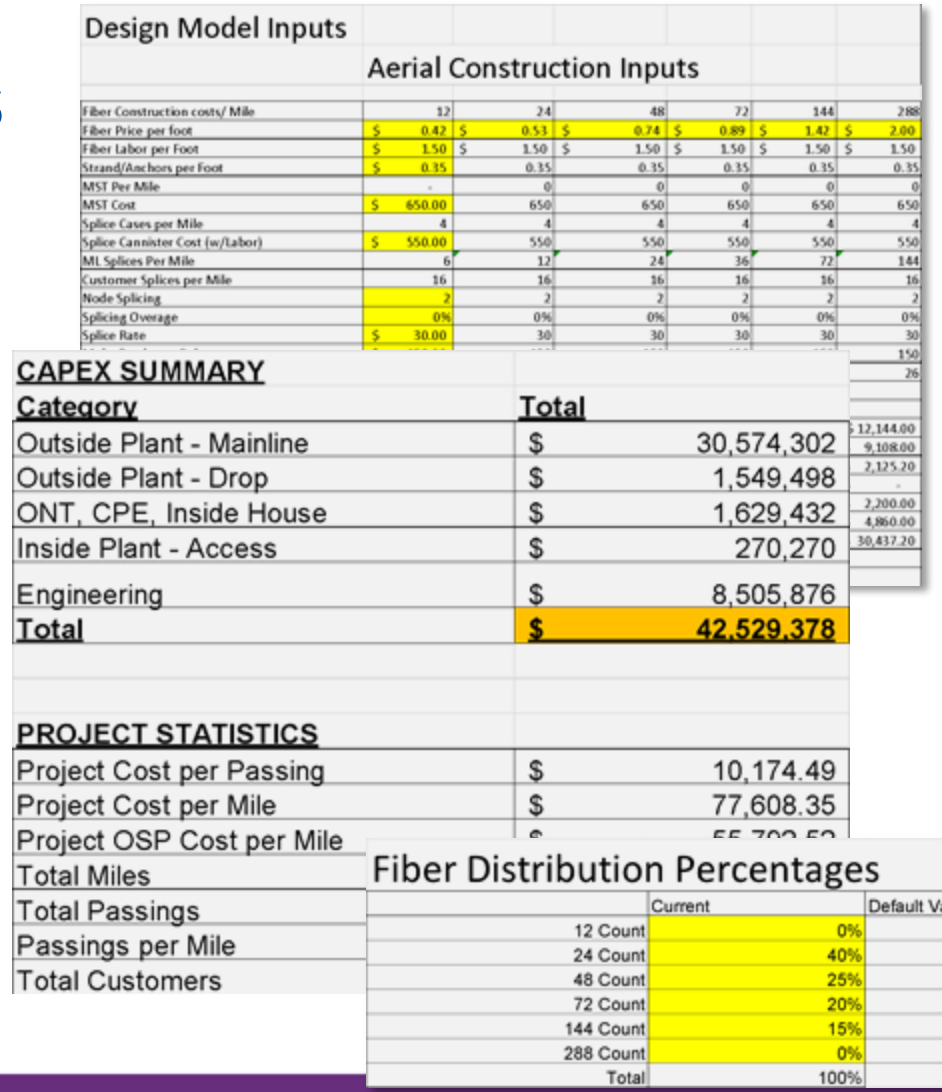
# Get Routing!

- Create reasonable routes likely to be built.
- Use center lines of road and try not to worry about sides of road, crossings, and the like.
- Wrong answers faster are better than slightly less wrong answers slower.
- Find routing/auto design tools you can use (IQGeo Comsof, Biarri FOND, Setics Sttar). The routes are more important than the bill of materials



# Build a Model that Works

- With your miles and served locations as your multiplier, create design models that will work as your per mile/passing multiplicand.
- Work in concert with regional providers to sanity check conclusions (work hard not to be too optimistic)
- Use defensible materials estimates that contemplate inflation for the length of your project.
- Think in costs per mile/passing per type of construction, and try to stay there until you have a good project.
- When seeking funding, a viable model is what RUS/NTIA want to see.



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 |

CAPEX SUMMARY

| Category | Total | |
|---|---|---|
| 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 |
| **Total** | **$** | **42,529,378** |

PROJECT STATISTICS

| | | |
|---|---|---|
| Project Cost per Passing | $ | 10,174.49 |
| Project Cost per Mile | $ | 77,608.35 |
| Project OSP Cost per Mile | $ | [illegible] |
| Total Miles | | |
| Total Passings | | |
| Passings per Mile | | |
| Total Customers | | |

Fiber Distribution Percentages

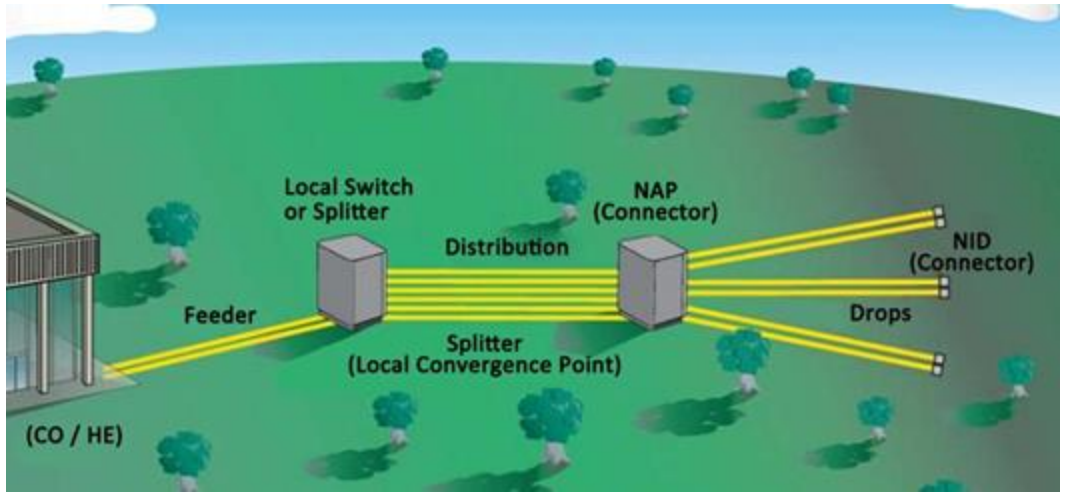
| | Current | Default Values |
|---|---|---|
| 12 Count | 0% | 25% |
| 24 Count | 40% | 30% |
| 48 Count | 25% | 15% |
| 72 Count | 20% | 10% |
| 144 Count | 15% | 15% |
| 288 Count | 0% | 5% |
| Total | 100% | |

# Determine the most efficient Architecture for YOUR project

Considerations

- Middle Mile - Feeder
  - Connectivity of own network
  - Leasing dark to other parties
- Last Mile
  - Urban Neighborhood builds
  - Planned Community/ Subdivisions
  - Campus type environments
- Future proofing:  Method/Cost for upgrading capacity
- Maintenance and Repair considerations

# Centralized Split vs. Distributed Split




Centralized

Pros:

- Efficient use of OLT cards
- Centralized splitting provides flexibility in limited take rate builds

Cons:

- More Fiber needed, More splicing needed = higher upfront CAPEX

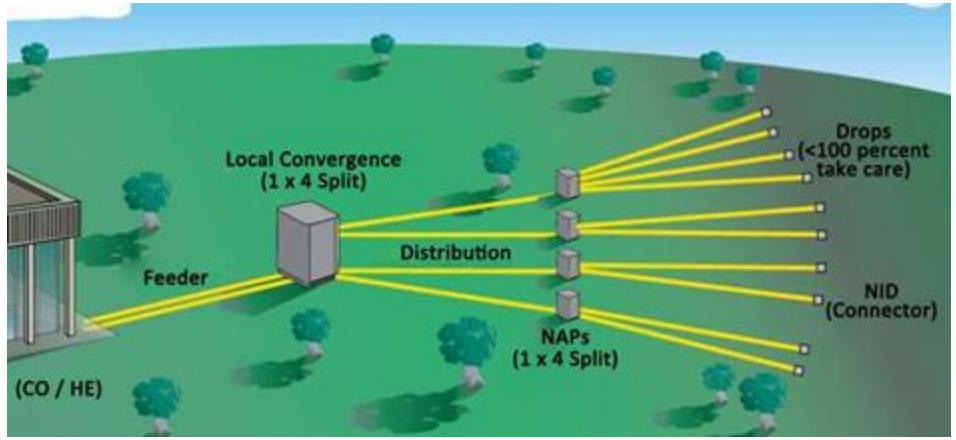
Distributed Split

Pros:

- Less Fiber and Splicing needed
- Faster to Deploy

Cons:

- More OLTs at outset
- Less Flexible



# Architecture Snapshot – Last Mile

| | Home Run | Centralized Split | Distributed Split | Distributed Tap | Air Blown Fiber | Financial Consideration |
|---|---|---|---|---|---|---|
| Amount of Fiber Required | | | | | | CAPEX |
| OLT Port Utilization | | | | | | CAPEX |
| Engineering Complexity | | | | | | CAPEX |
| Flexibility/Upgradeability | | | | | | CAPEX/OPEX |
| Testing/Monitoring | | | | | | OPEX |
| Amount of Splicing Required | | | | | | CAPEX/OPEX |
| CAPEX | | | | | | |
| Time to Build | | | | | | Time to Revenue |
| Time for Customer Turn Up | | | | | | Time to Revenue |
| | | | | | | |
| | | | | | | |
| | ← | Worse | | Better | → | |

# Rules To Know - Broadband

## Route Verification and Selection

The first step you want to do is contact the pole owner, for example the local power company, find out what their permitting requirements and costs are and the time frame for approvals, what are the attachment fees, have they replaced poles in this area recently. If UG areas are involved what are the trenching restrictions, is there joint trenching in the area or will you do new trenching, who takes care of traffic management and what documents are required for that process.

# Rules To Know - Broadband

## Route Verification and Selection

Then do a preliminary route ride out, look for route continuance from one line and area to the other, is there gaps that will need UG construction, how many other lines are on the poles now that may require make ready work, what shape are the poles in, how many may need replaced. The reason for doing these steps are:

- **Make Ready work** has an average cost of $500 per pole with an estimated figure of 15% of poles used will require make ready work.
- **Pole Replacement**, if a pole fails the “Load Analysis” you could have to pay the cost of replacing that pole, that cost can be anywhere from $500 to $3,000. This usually occurs in older build areas.
- **Pole Attachment fees** can be as low as $2 per pole up to $14 per pole depending on where the build is, rural or city for example.

# Rules To Know - Broadband

Route Verification and Selection

- **Underground Areas**, is there existing trench and conduit that you can lease, is it a joint trench area and you are on a time frame for placing conduit? Will you be doing the trenching and what are the restrictions for where you can trench, the width and depth and traffic control?

- **Directional Boring Required**, this can run anywhere from $6 per foot up to $20 per foot depending on bore diameter and if it is rural or urban locations. If you are talking rock then it can jump as high as $270 per foot.

- **Where is the build at**, this refers to what part of the country are you building, is it an area that experiences hurricanes or tornadoes on a regular basis or has heavy snow and ice in the winter. These play into the decision for aerial vs UG.

# Rules To Know - Broadband

## Route Verification and Selection

**When trenching is required, which technique will work best for the area and for you, Traditional or Micro? Below is a chart with some informational points for each type;**

| Traditional Trenching | Micro Trenching |
|---|---|
| digging a trench 10-12"w x 12-24' deep | trench is only 1-2" w x 6-10'"deep |
| laying conduit process | conduit is laid right behind the trencher |
| bringing in backfill of Rock and sand | trench is filled with a grout or Epoxy compound, can use asphalt or concrete on top couple of inches to match enviroment |
| removal of excess materials dirt, asphalt, etc | excess dirt is minimal and can be removed as you trench |
| rerouting or blocking off of Auto and Pedestrian traffic | minimal, if any, rerouting or blocking of auto and pedestrian traffic |
| asphalt, concrete, landscaping restore costs | since trench is only 1-2" w restoral is mininmal |
| a 300' trench is a 2 to 5 day process | a 300' trench is done in a day |
| average cost of $210,000 per mile | average cost of $130,000 per mile |
| | |

# Best Practices and Lessons Learned

Stephanie Herron

Director, Technical Operations

Sigma Technologies

# Initial High-Level Planning

Implement desktop planning to understand financial feasibility

- Households Passed (HHP)
- Aerial/Buried infrastructure
- Major obstructions (Waterways, RR, BLM, etc.)
- High level route
- Competition, pricing and take rates
- Talk with the communities being built
  - Funding support
  - Permitting leniency
  - Insider information on construction

# Planning for Field Verification

## Conduct Field Verification of Route

- Conduct Authority Having Jurisdiction (AHJ) and pole owner research
- Review aerial options
  - Joint use agreements
  - Pole owner Make Ready (MR) costs, rules, timelines
  - Implement cap on MR cost per pole
  - Overlash
- Consider buried plant
  - Rock
  - Existing utilities
  - ROW vs. easement
- Drop feed routing
- Concurrent fielding for both Communications and Power

# Best Practices/Lessons Learned

## Design

- Boundary to be served
- Fiber count to termination point
- Future expansions
- Spare capacity
- Existing routes/fibers
- Establish design rules
- Splice color to color
- Cabinet locations
- Material forecast

## Construction

- Material availability
- Secure crews
- Power and Telecom approved
- Manage permitting
- One Touch Make Ready (OTMR)
- Jurisdictional requirements

## Quality Assurance

- Specification and Standards
- Process Documents
  - WRITE IT!
  - AUDIT IT!
  - UPDATE IT!
- Establish objective metrics

# THANK YOU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