Broadband 101

16 July 2025

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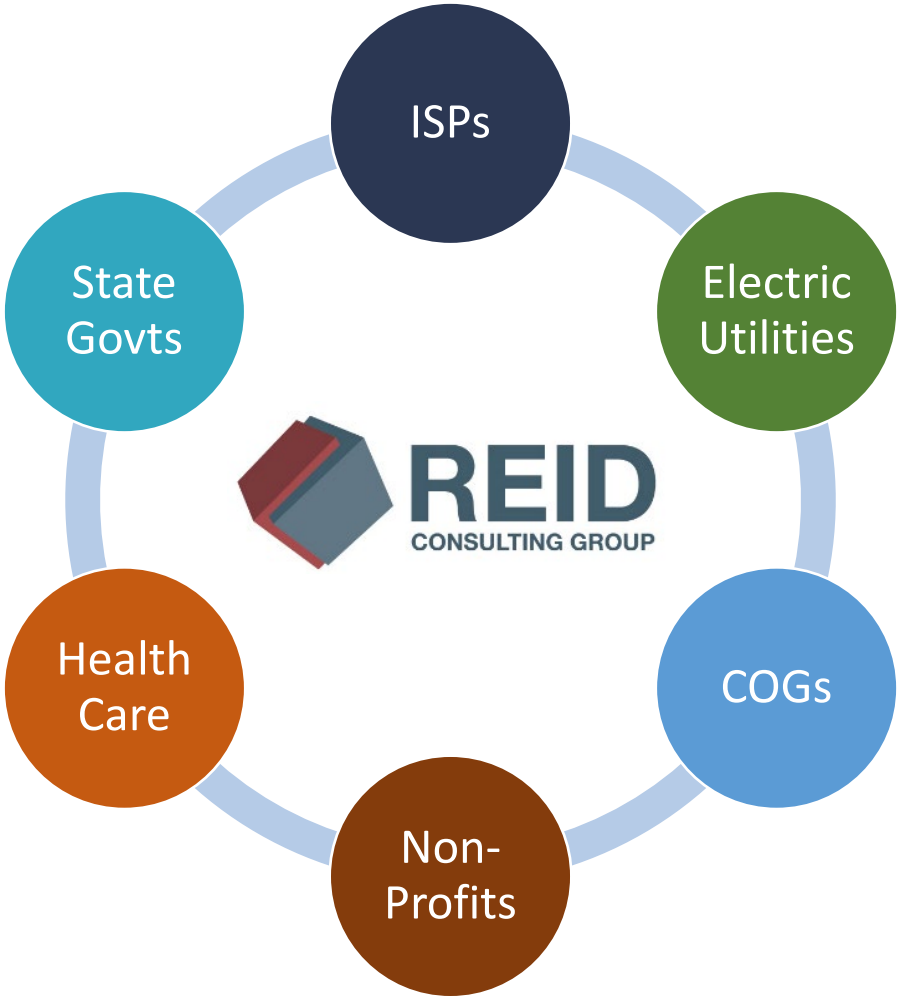
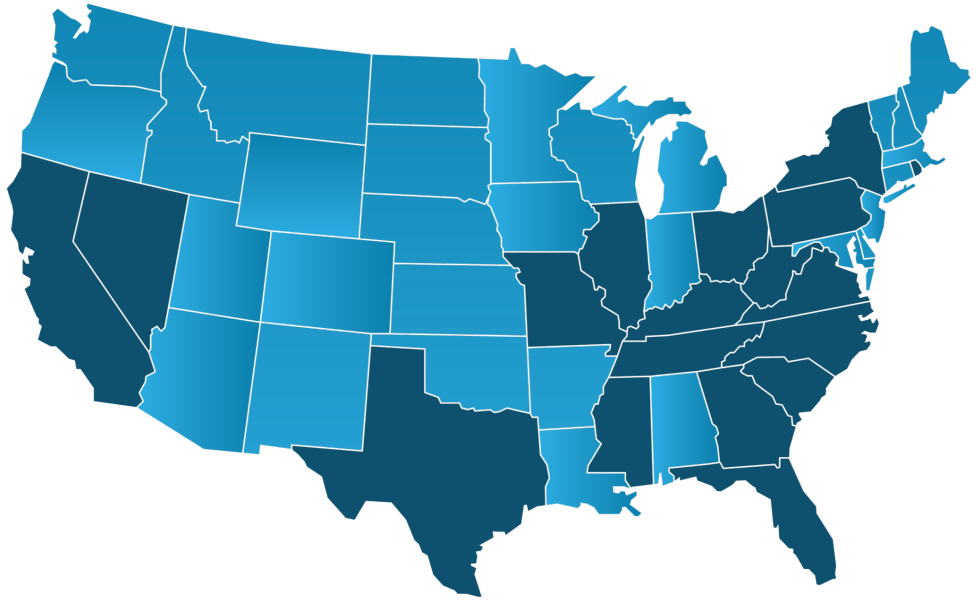
360 View of Broadband





Founded in 2006
Clients in 18 states
$1.6 billion in project value
$330 million in grant funding
6,000 miles of fiber expansion

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Speeds

"Asymmetric"

Download Speed / Upload Speed

- 200/40 = 200 Mbps down/40 Mbps up
- 1000/200 = 1 Gbps down/200 Mbps up
- 5000/1000 = 5 Gbps down/1 Gbps up

"Symmetric"

Download Speed / Upload Speed

- 200/200 = 200 Mbps down/200 Mbps up
- 1000/1000 = 1 Gbps down/1 Gbps up
- 5000/5000 = 5 Gbps down/5 Gbps up

1 Mbps = 1 million bits per second

1 Gbps = 1 billion bits per second

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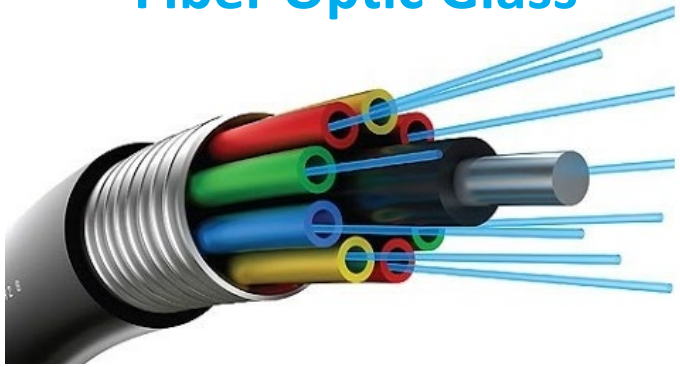
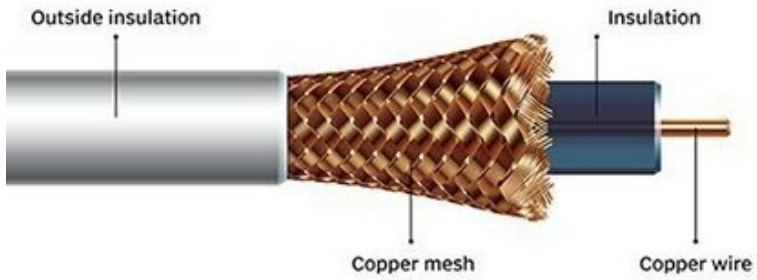
Underlying Infrastructure

“Fiber Optic Glass”



“Coaxial Cable Copper”



“Twisted Pair Copper”

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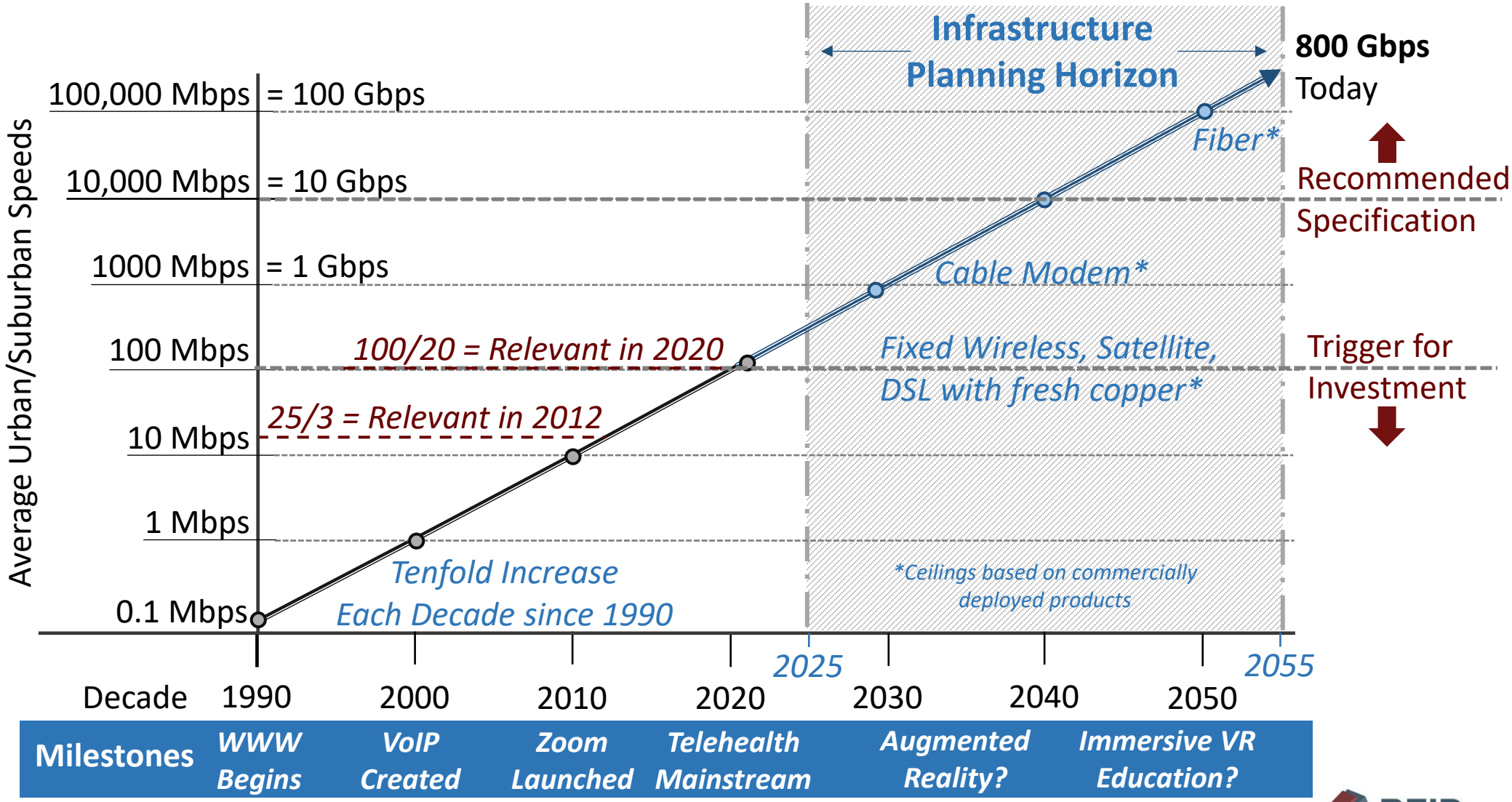
Long-Term Perspective

"Technology neutral" but must meet the speed requirements of 2055



Fixed Wireless Limitations from Terrain and Foliage

Wireless signals travel unobstructed across flat farmland, a feasible solution in these types of areas

In areas with rugged terrain and heavy foliage cover both coverage and capacity severely limited

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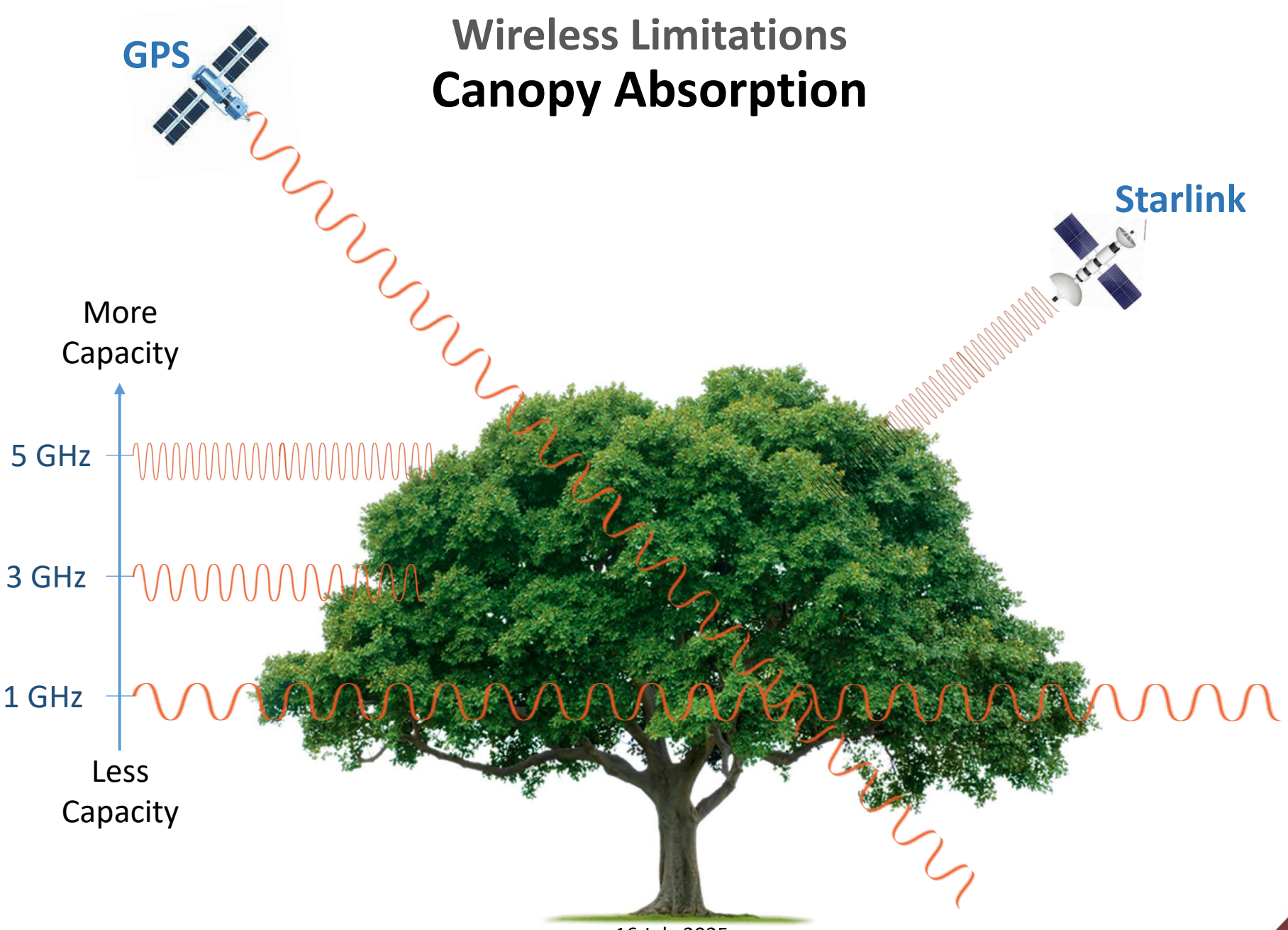
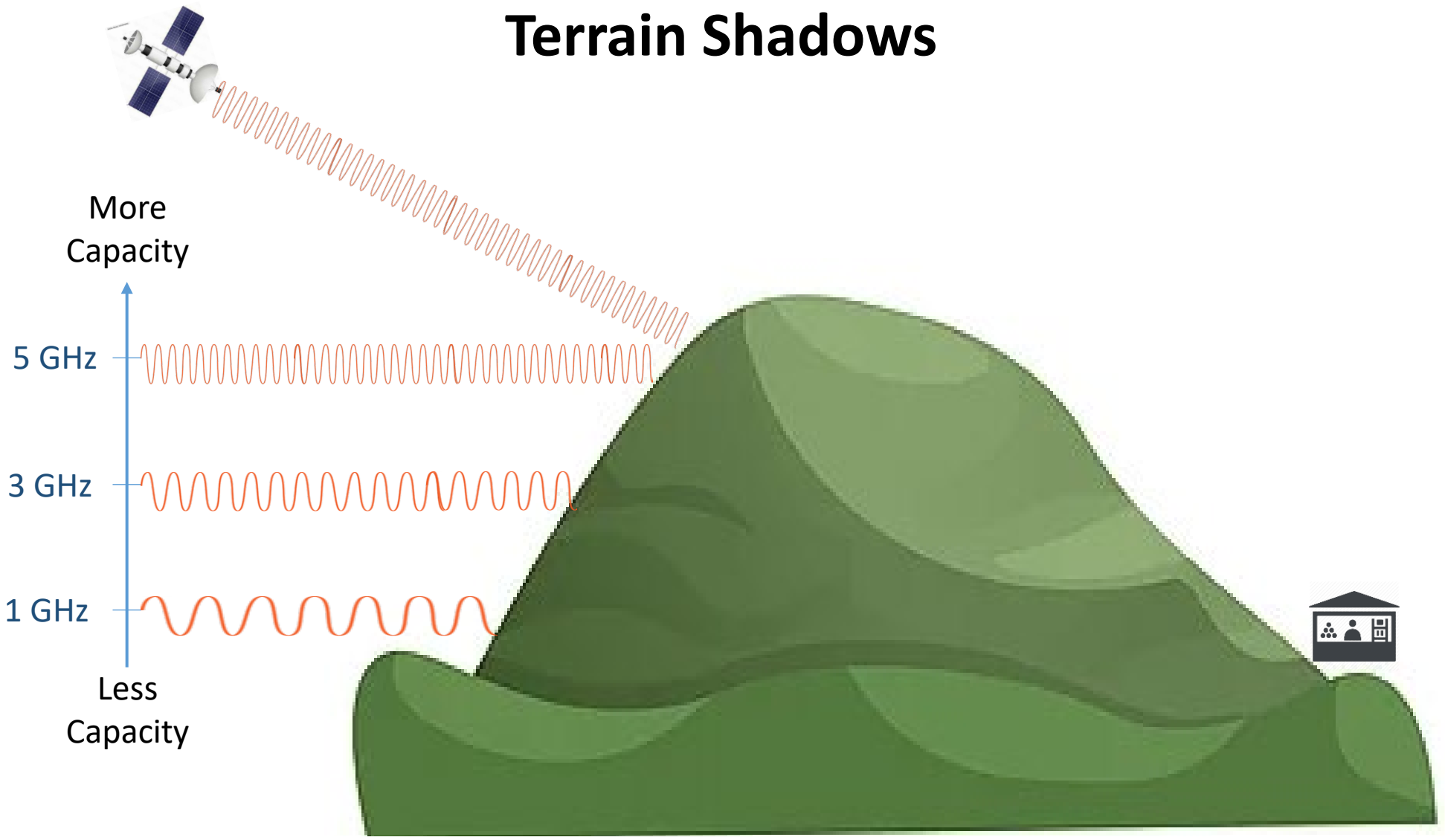
Wireless Limitations

Canopy Absorption



Starlink

Wireless Limitations
Terrain Shadows



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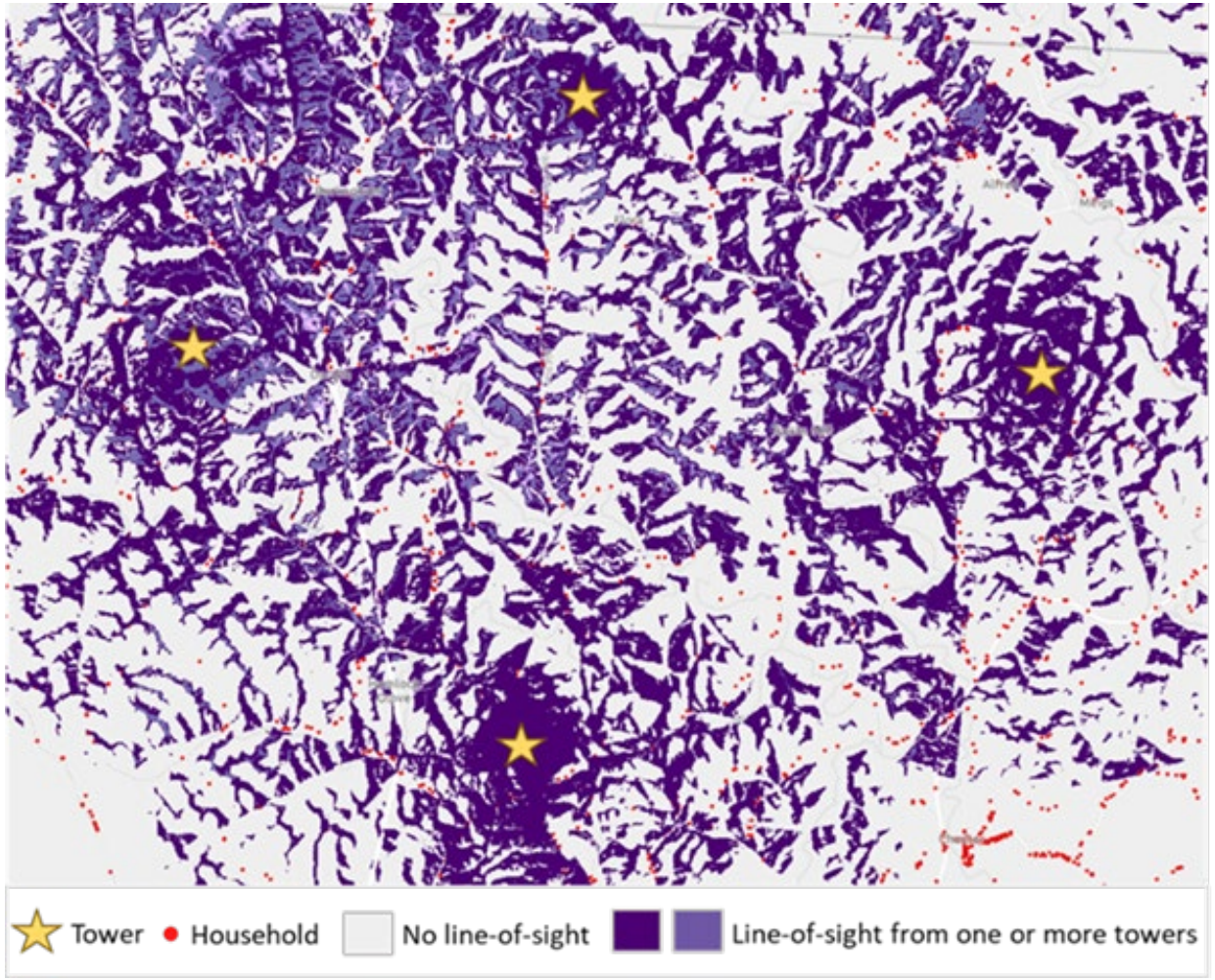
Terrain Shadows

- 4 towers on high points, each 300’ tall, 3-5 miles apart to serve 50 square miles
- Many locations remain unreachable due to terrain shadows, without considering other obstructions or foliage
- Remaining households offer even a more difficult investment equation
- Low-orbit satellites such as Starlink require unobstructed view of the sky



Fixed Wireless and Satellite Capacity Limitations

- **If** the service area was flat and devoid of trees
- The fixed wireless and satellite networks could not support the load

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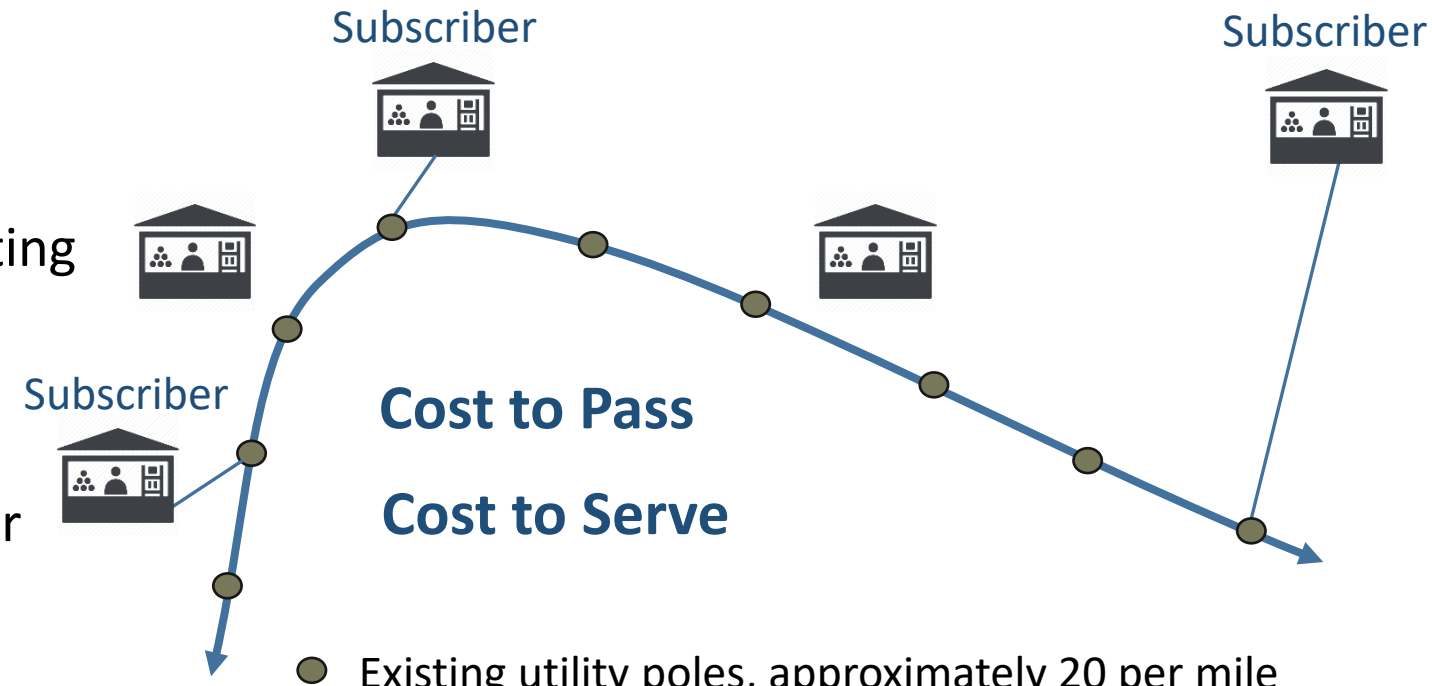
Fiber-to-the-Premise: *Aerial Example*

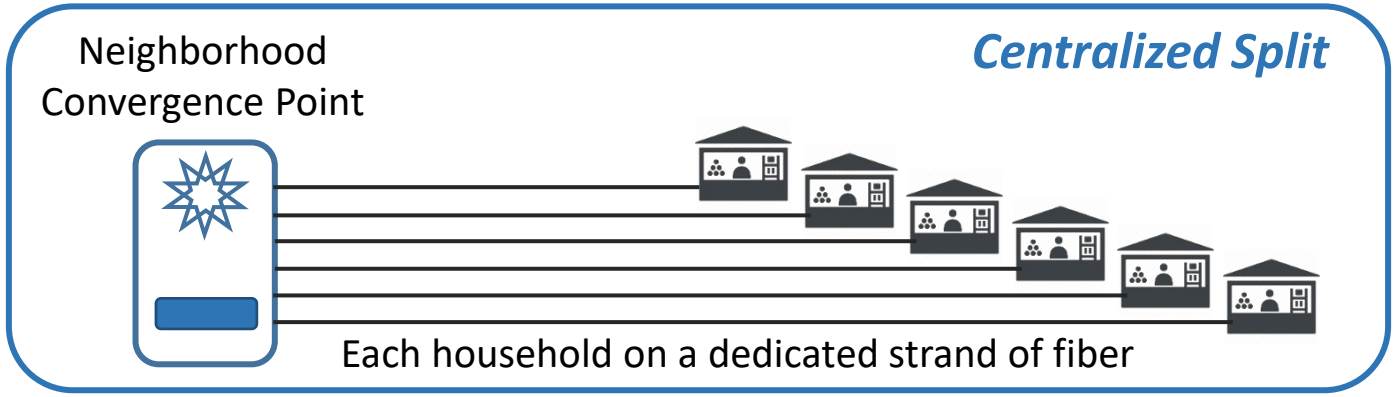
- Tremendous capacity
- Stable services
- High capital costs, low operating costs
- 30+ year lifetime
- Foundation required for other services including mobile
- Efficient use of investment

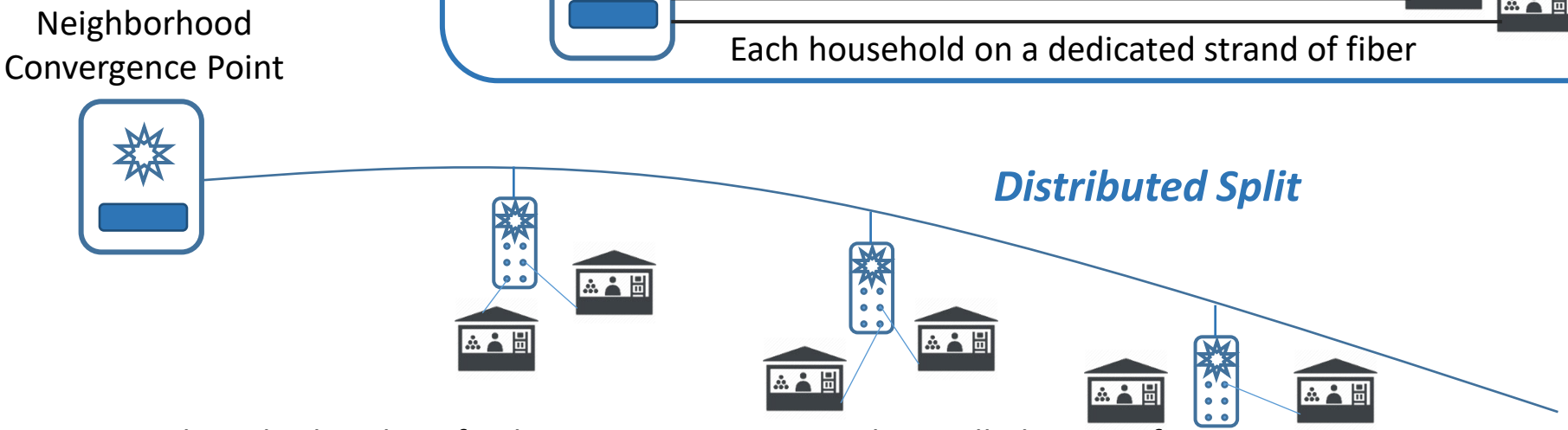


Once "cost to pass" covered, network is profitable except in very low density areas

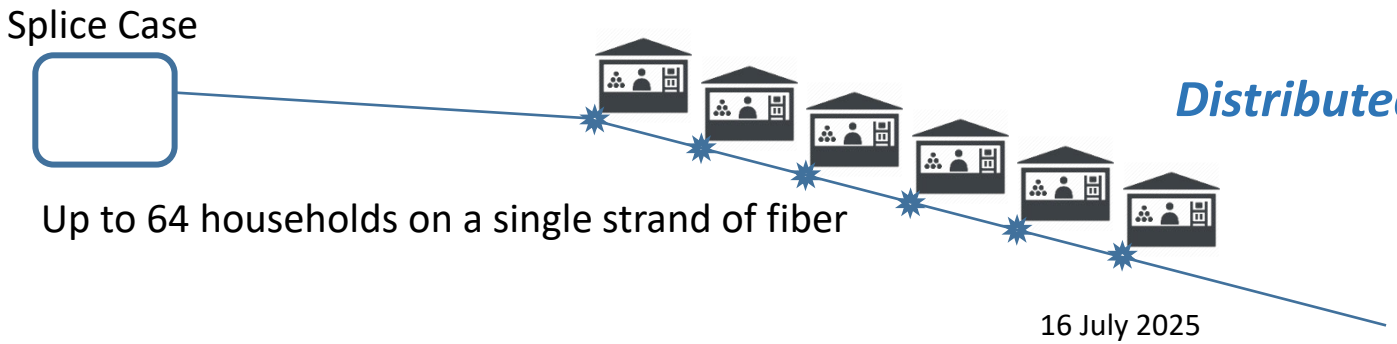
Fiber Architecture Options for Passive Optical Networks

Recommended and Budgeted





Distributed splits along feeder routes using terminals installed at transformers



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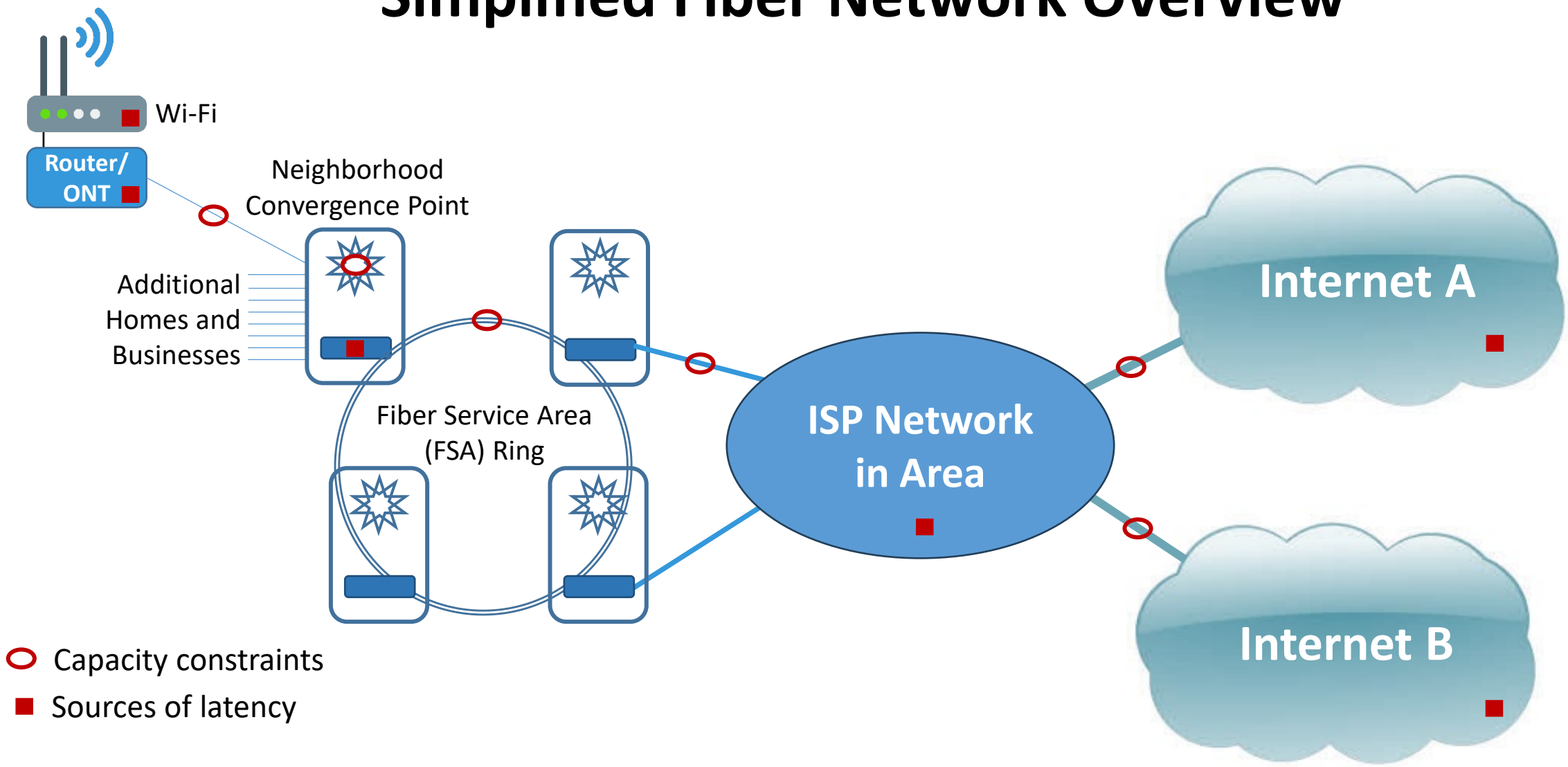
Simplified Fiber Network Overview



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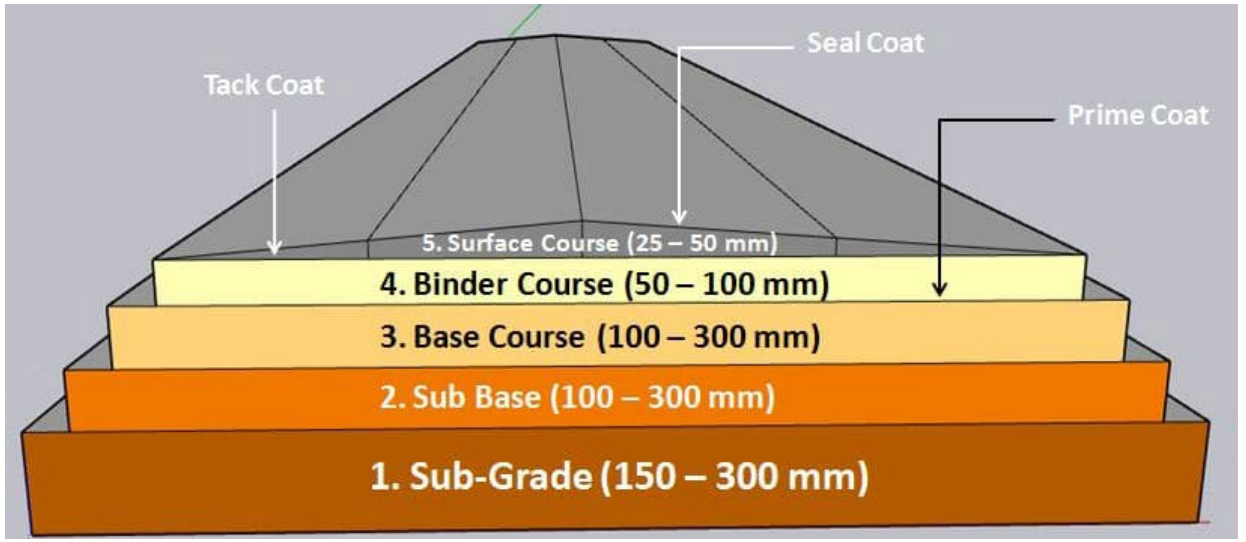
Specifications Important



- Infrastructure projects require specifications
- Unlike roadway projects, broadband efforts have largely lacked detailed specifications
- Key topics such as strand count, installation in conduit vs. direct buried, depth of conduit, etc

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Aerial

Area on Poles
Communications Space
Power Space (pole owner only)

Methods
Strand and Lash
Self-Supporting (ADSS*)

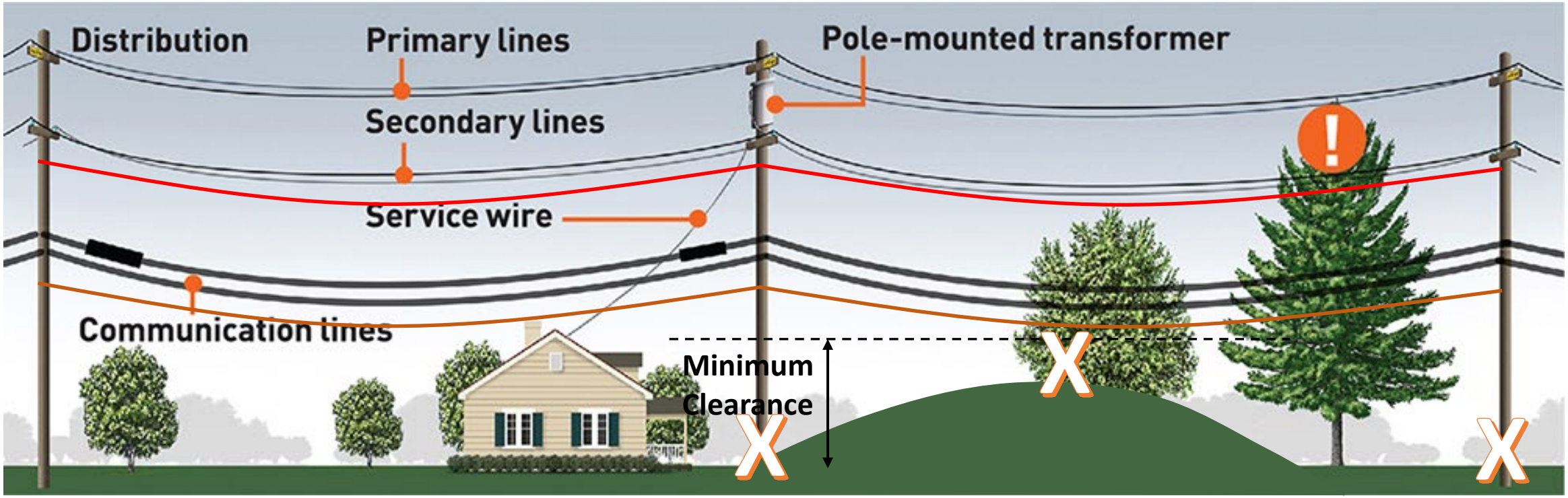
Major Cost Factors
Overlash Existing Facilities
Make-Ready
Strand Density

*ADSS = All-Dielectric Self-Supporting

Make-Ready Realities

Getting the existing poles ready for an additional attachment

- Clearance issues
- Age of poles



Make-Ready Improves Grid Resiliency

Building aerial fiber often also results in improved resiliency of the electric gird due to required pole replacements

Unpredictable variation in “make-ready” costs
@ $20,000 to $55,000 per mile

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Aerial Backbone and Distribution Fiber

Budgetary Projections

Aerial Build per Mile	Low	High
Total Cost	$75,000	$120,000
Make-Ready	$20,000	$55,000
Fiber Build	$55,000	$65,000

- High Strand-Count
- Strand and Lash
- Third-Party Attacher
- No Overlash Option

- Big risk if budgeting too low
- Make-ready costs exceptionally variable

Incumbent Telcos have an overlash advantage

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Underground

Methods
Boring (shown)
Trenching
Plowing

Major Cost Factors
In Conduit vs Direct Buried
Rock Prevalence
Depth

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Underground Backbone and Distribution Fiber
Budgetary Projections

Underground Build per Mile	Low @ 10% Rock	High @ 40% Rock
Total Cost	$80,000	$160,000
Fiber Build in Conduit	$70,000	$80,000
Rock Add	$10,000	$80,000

Big risk if budgeting too low
In suitable soils, plowing fiber can reduce costs from the estimates above

- High Strand-Count
- Primarily Boring
- In Conduit
- Depth of 36”

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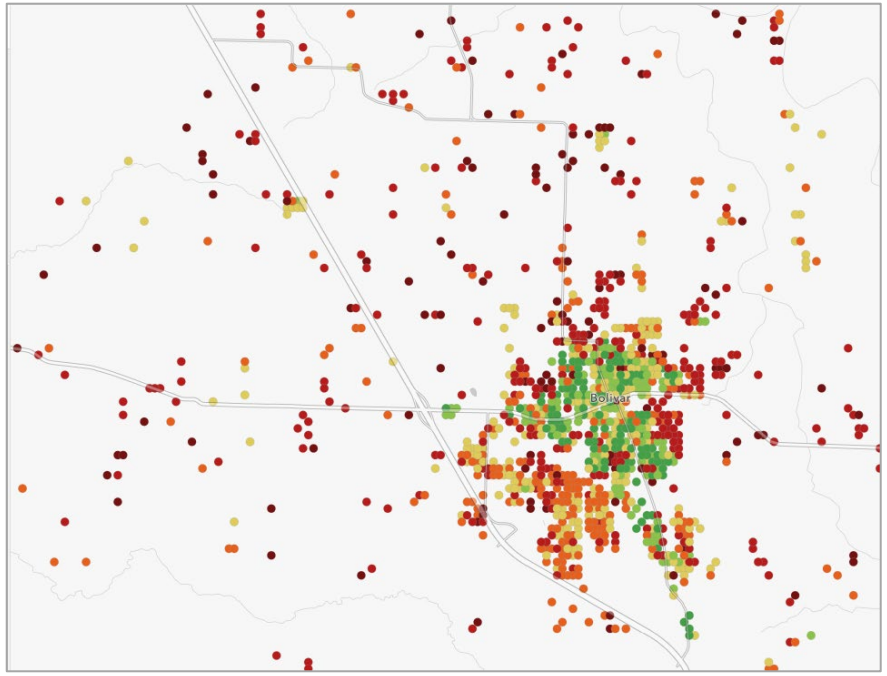
Mystery Solved



Crowdsourced speed tests deliver:

a. Concrete availability maps

b. Progress tracking for accountability

Preponderance of evidence based on millions of test results

OOKLA®

Ookla® Speedtest Intelligence® for Fixed Networks

Require ISPs to prove their capabilities

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Debunking ISP Myths

Myth A: *People in that area only subscribe to the low-speed packages*

Reality: 25% to 33% of subscribers opt for the top speed offered.

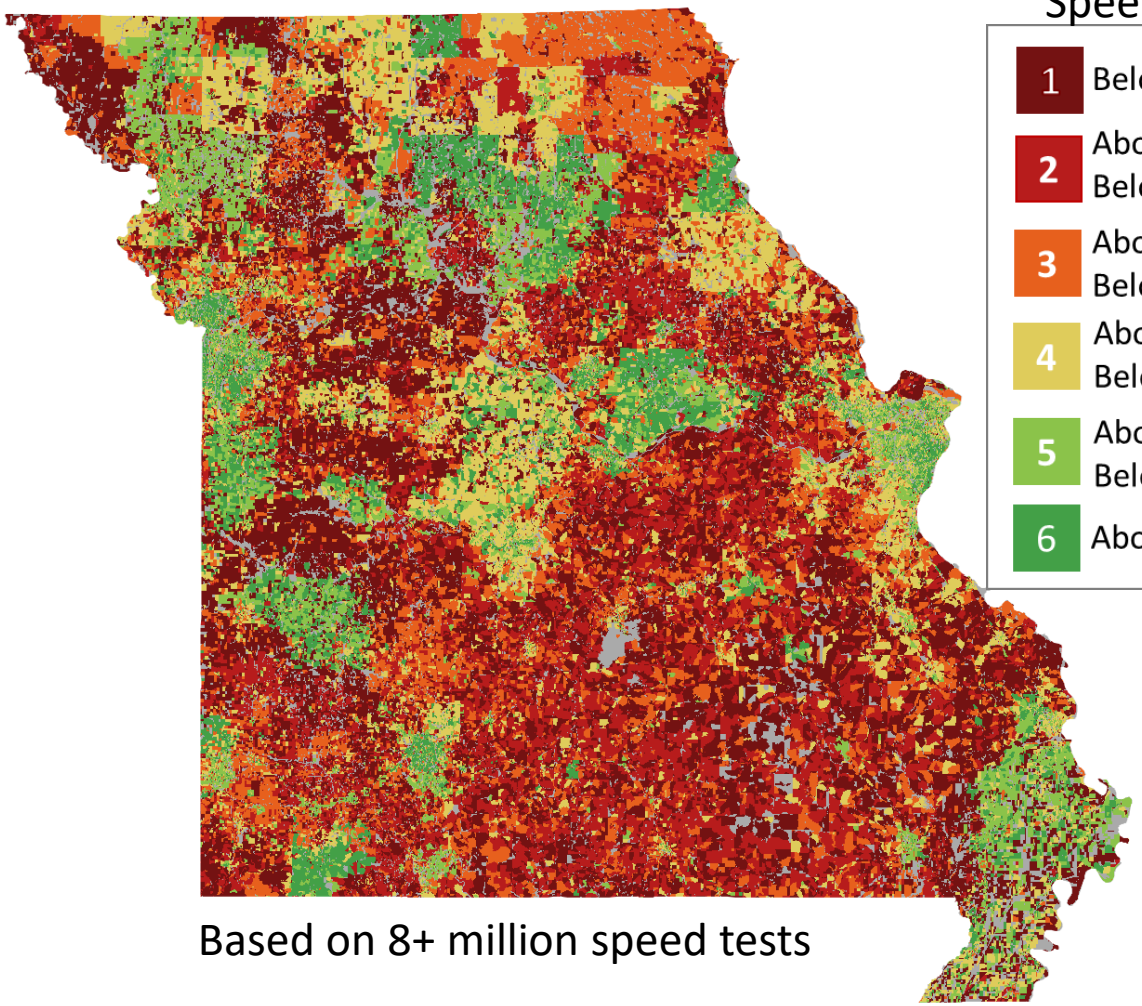
Myth B: *Bad tests are because of poor Wi-Fi*

Reality: We drop speed tests with poor Wi-Fi signal strength. We also included tests from GPS-enabled wired devices.

Myth C: *People only run a test when there is a problem*

Reality: We focus on the **maximum** speed tests. Network problems do prompt tests, as do resolutions of problems.

Speed Tests @ Max

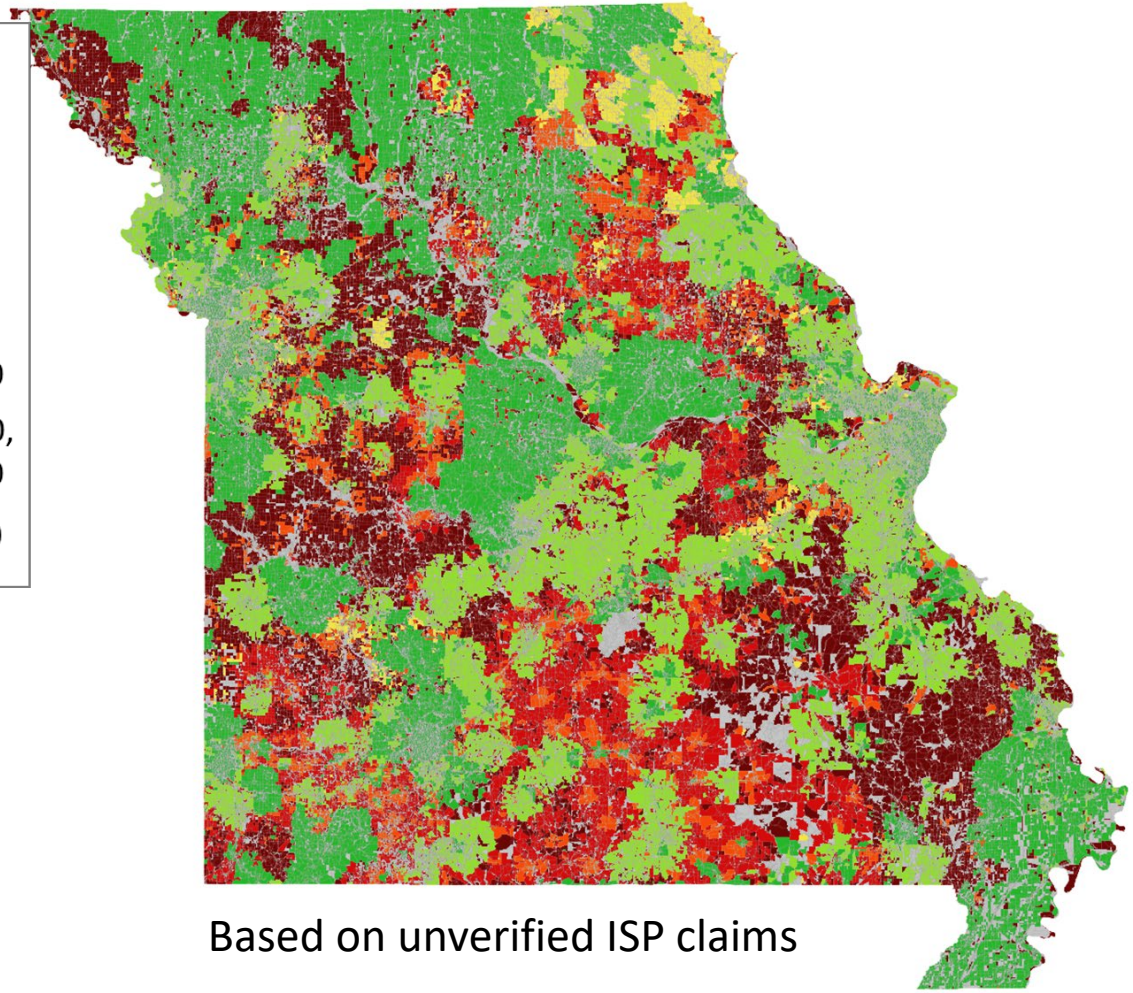


Based on 8+ million speed tests

Speed Tiers

1	Below 10/1
2	Above 10/1, Below 25/3
3	Above 25/3, Below 50/10
4	Above 50/10, Below 100/20
5	Above 100/20, Below 200/50
6	Above 200/50

ISP Speeds Reported to FCC



Based on unverified ISP claims

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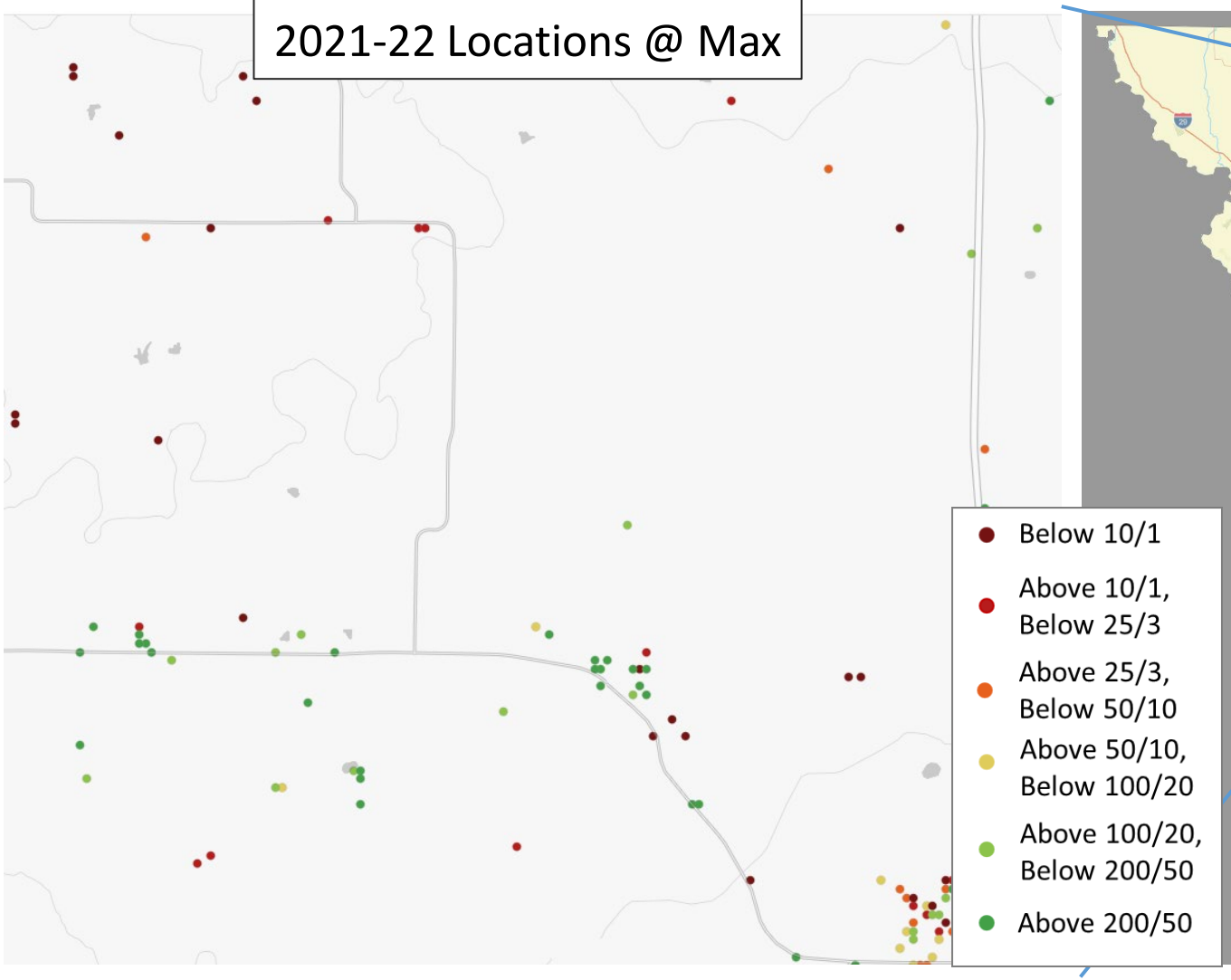
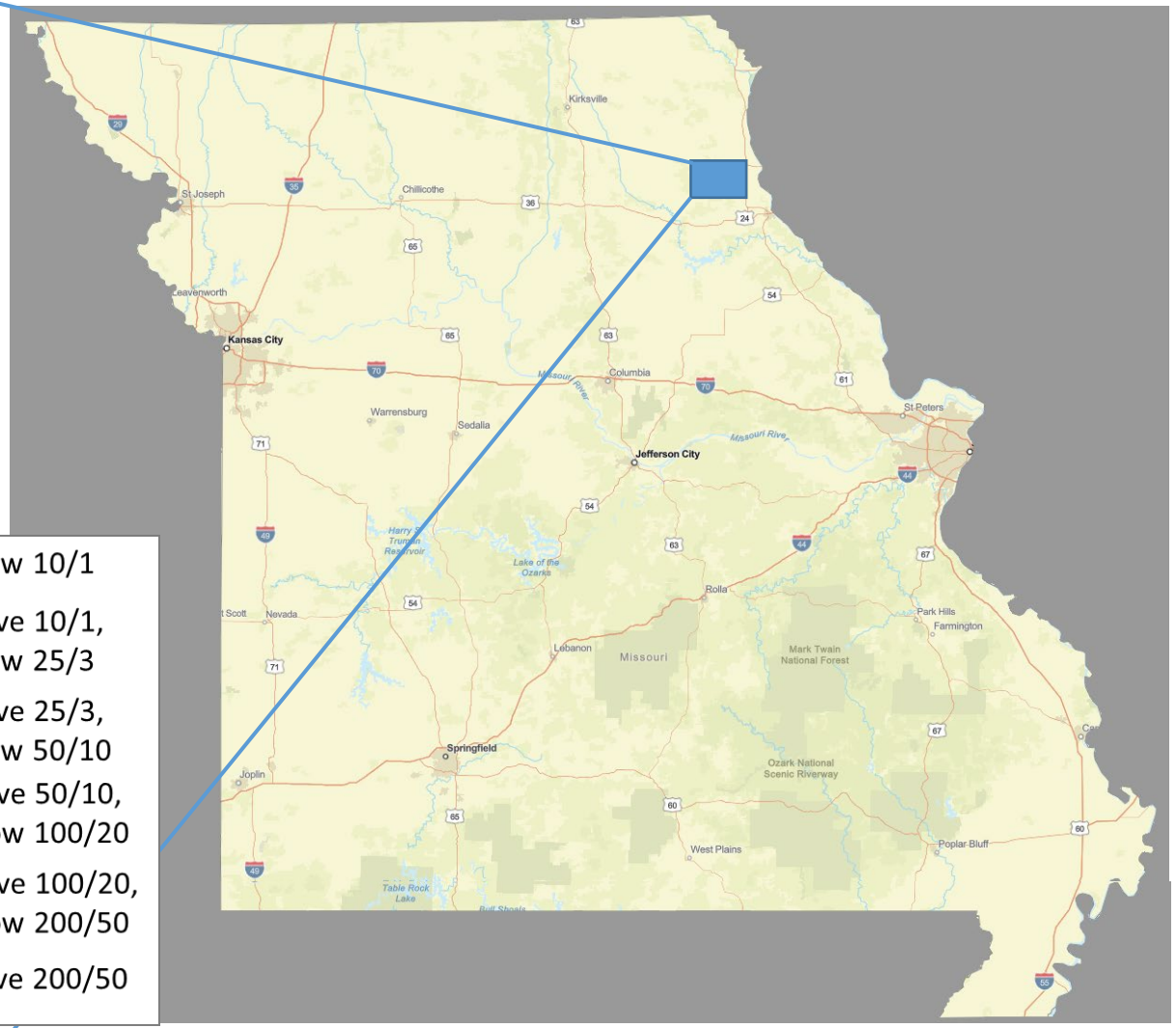
Ookla Locations – Palmyra Area

Before

2021-22 Locations @ Max



- Below 10/1
- Above 10/1, Below 25/3
- Above 25/3, Below 50/10
- Above 50/10, Below 100/20
- Above 100/20, Below 200/50
- Above 200/50



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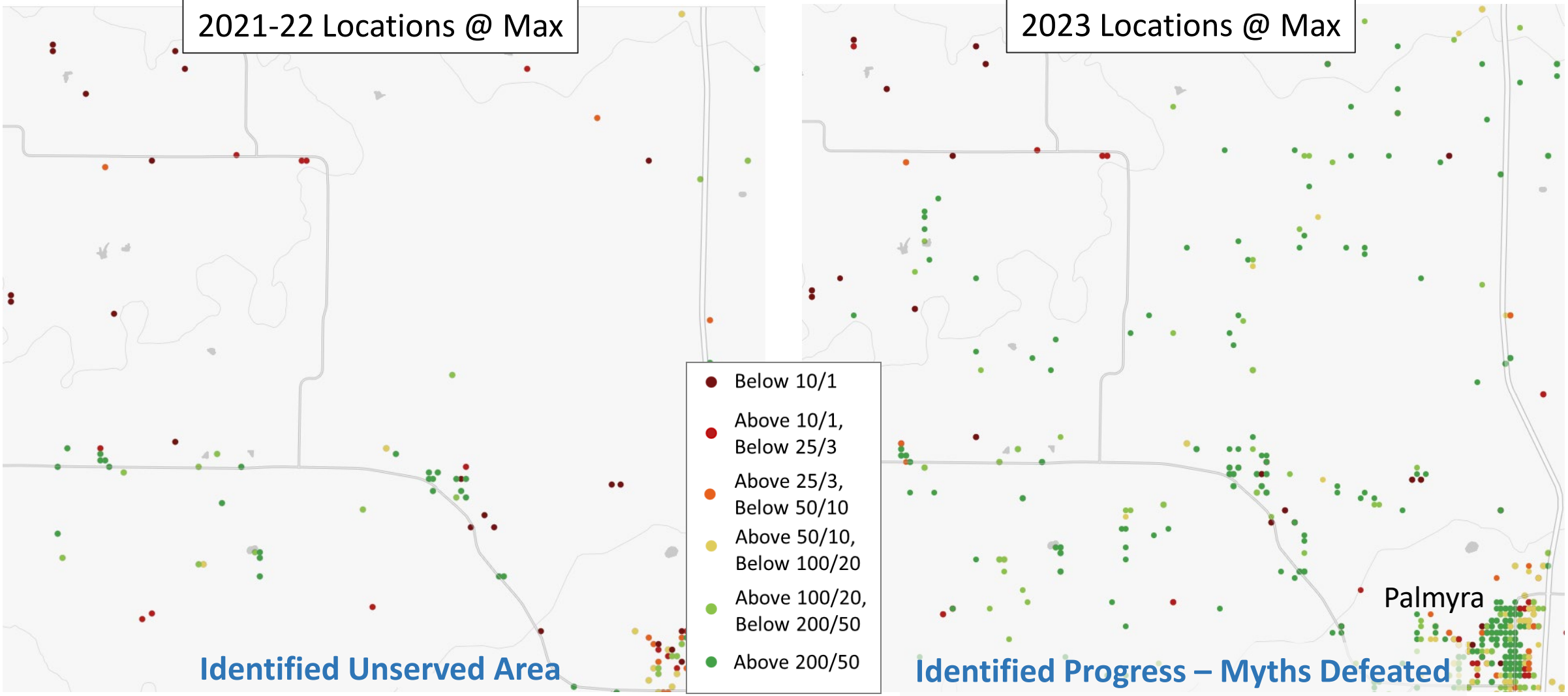
Ookla Locations – Palmyra Area

Before
2021-22 Locations @ Max

After
2023 Locations @ Max



Identified Unserved Area

Identified Progress – Myths Defeated

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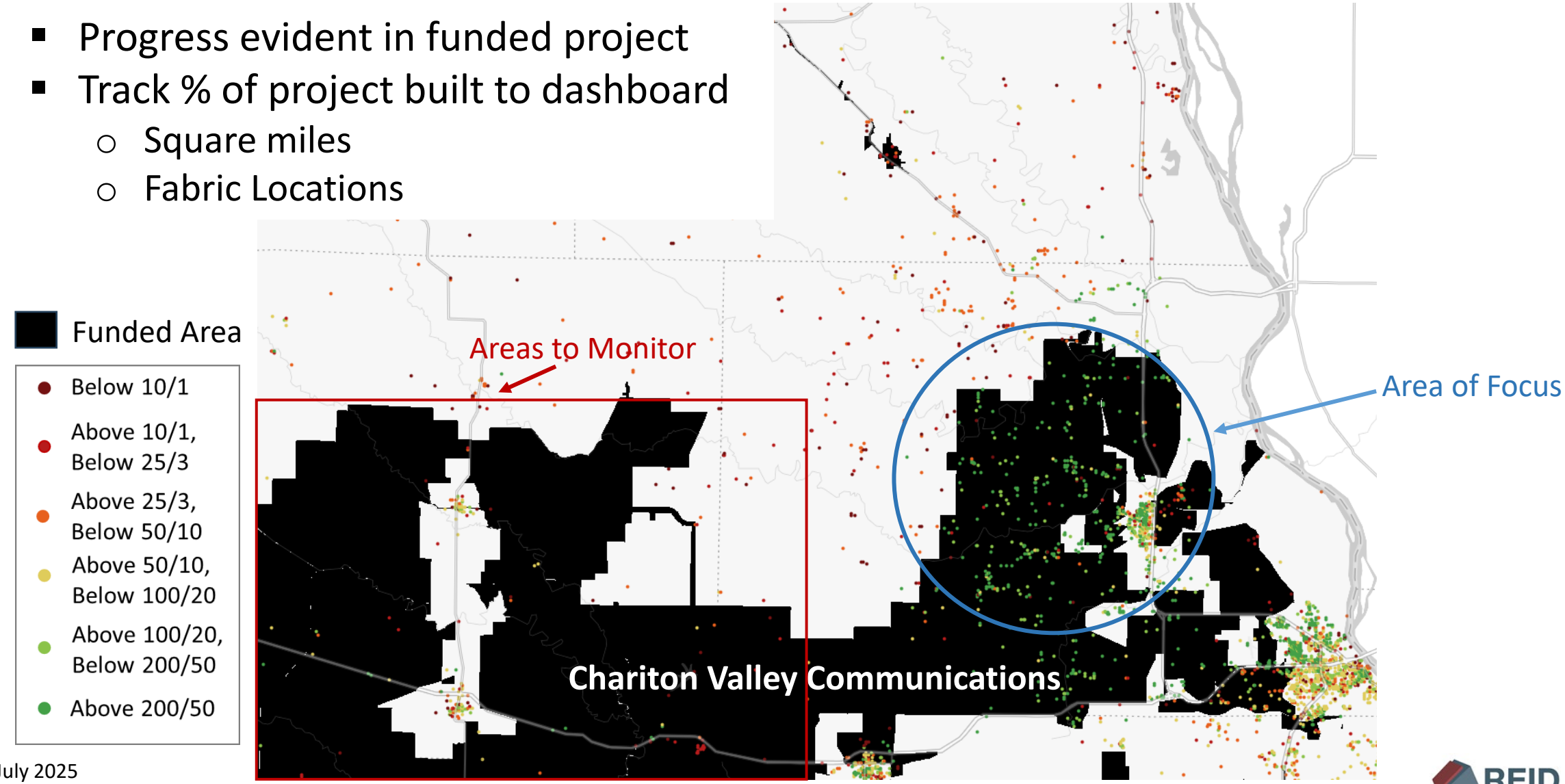
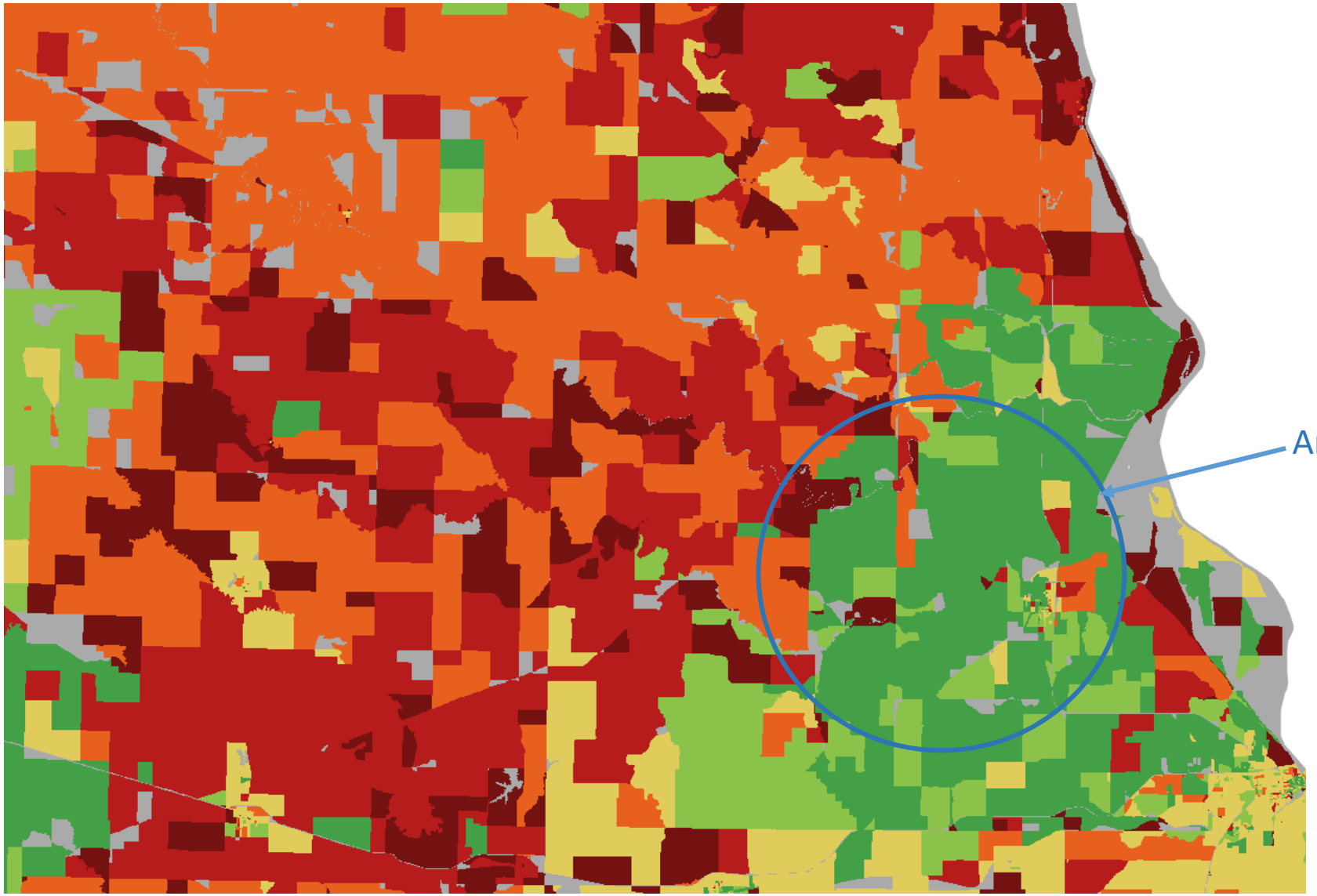
Clear Impact of the Funding

- Progress evident in funded project
- Track % of project built to dashboard
  - Square miles
  - Fabric Locations



Ratings Change Also Clear Indication of Progress



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Why do we need the Fabric?

- Addresses surprisingly unreliable
  - E-911 usually to the mailbox
  - Widely varied quality
  - No single-source-of-truth
- FCC contracted with CostQuest to:
  - Process satellite images and property records
  - Identify all Broadband Serviceable Locations (BSLs)
  - Intended to include all residential and small business locations
- Licensing complexities have limited the usefulness

Questions?

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