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Appalachian
Partnership
for Economic Growth

Cracking the Broadband Puzzle in Appalachia

for



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Topics

- What we found regarding broadband
- Review of network architecture options
- Magnitude of funding required and possible sources
- Long road – we need a unified voice

In the digital desert... McDonalds as Study Hall

- Even more prevalent today than when published in the [Wall Street Journal on Jan 28, 2013](#)
- More schools assume home broadband in types of assignments
- Snow-day e-school becoming common
- Huge handicap for job seekers as well
- Precludes remote work opportunities



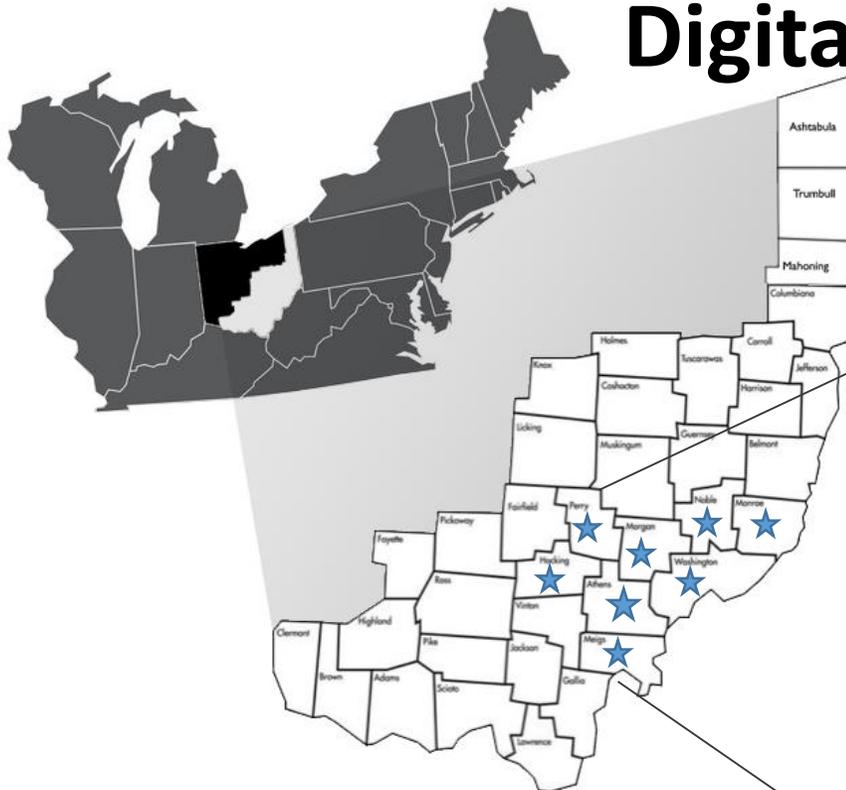
The [recent follow-up story](#) published on November 11, 2019, captures the lack of progress.

Why is broadband still an issue?

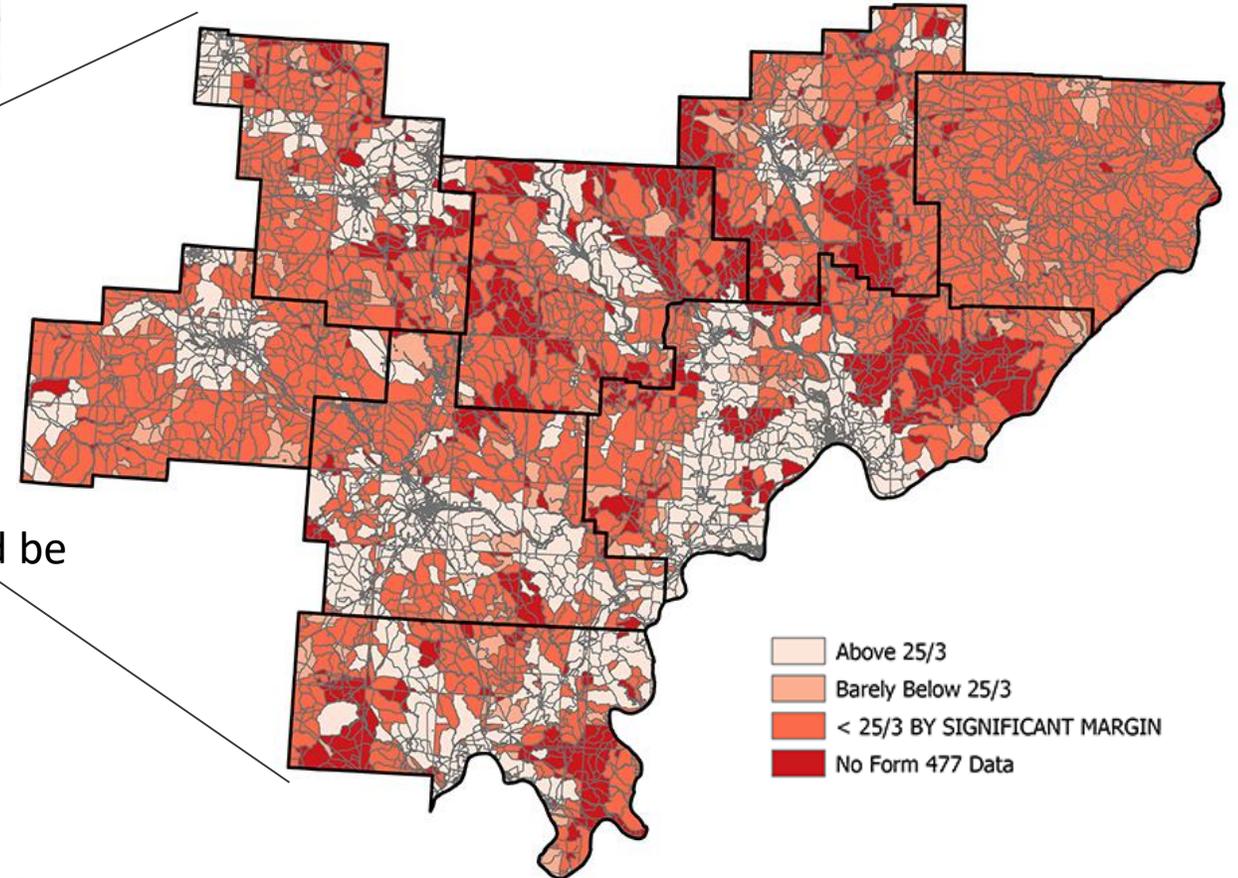
	City or Area of Ohio	Households per Square Mile	Median Household Income	Density Compared to Columbus
Cities and Towns	Columbus	1,510	\$49,478	100%
	Marietta	693	\$35,556	46%
	Logan	604	\$29,691	40%
	McConnelsville	486	\$25,563	32%
Rural Expanse	Entirety of Meigs County	26	\$33,407	1.7%
	Carthage Township, Athens County	17	--	1.1%
	Monroe Township, Perry County	12	--	0.8%

No terrestrial provider can serve 100% of the “rural expanse” without ongoing subsidy

Digital Desert Persists



ARC-Funded Eight County Study Area

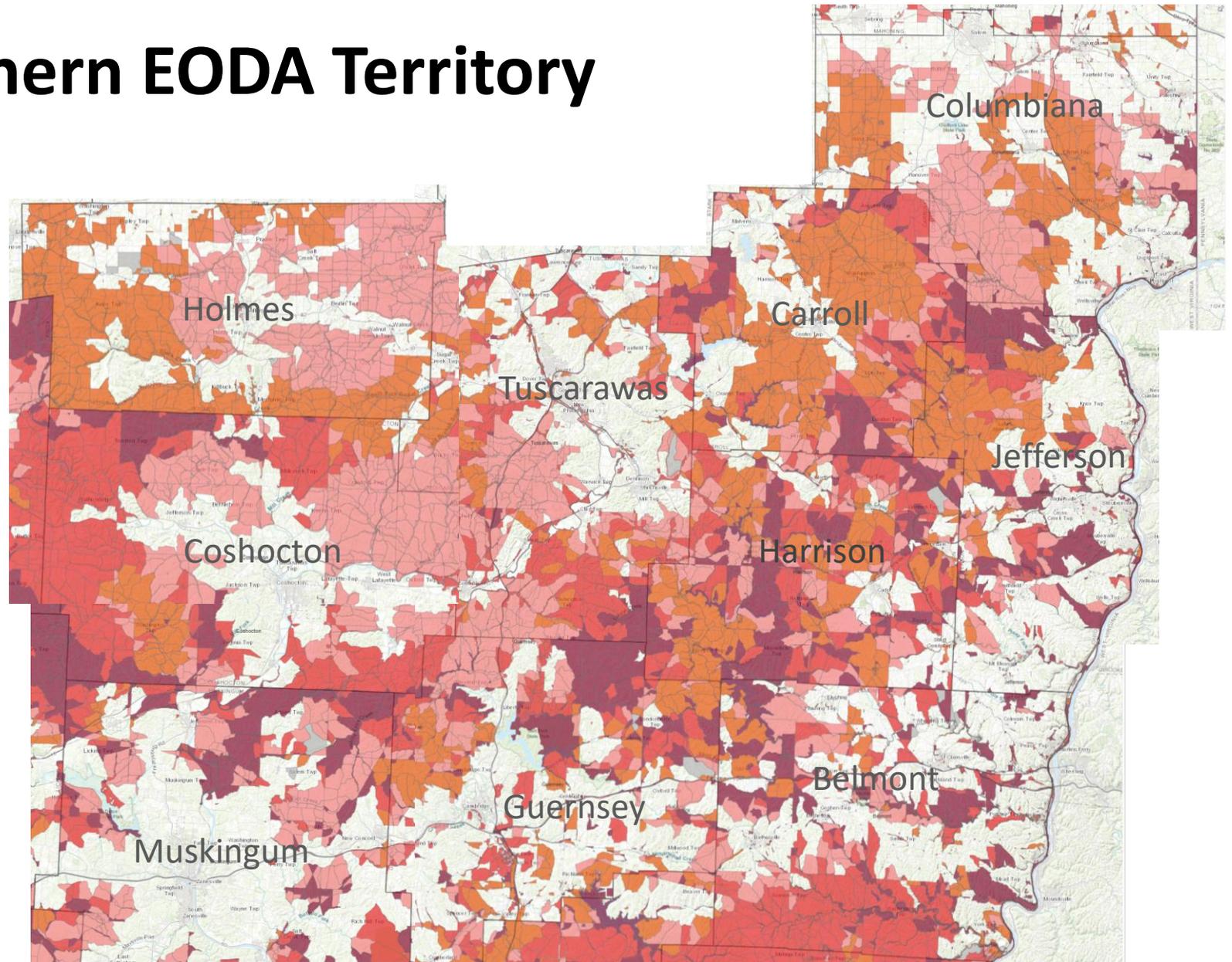
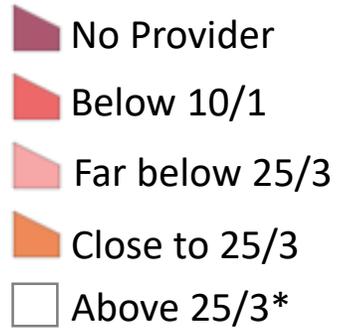


- **75% of the area lacks broadband at 25/3 and should be in Phase I auction of Rural Digital Opportunity Fund**
- Availability further limited due to de minimis deployments and **deteriorating copper cables**
- Analysis underway across entire 37-county area
32 counties in Appalachia + 5 adjoining rural counties in the service area of the Southern Ohio Health Care Network

Combination of FCC Form 477 and USAC HUBB Data

Northern EODA Territory

- Many areas of poor coverage broadband through the area
- Many of the reportedly served areas in white also suffer from low quality broadband



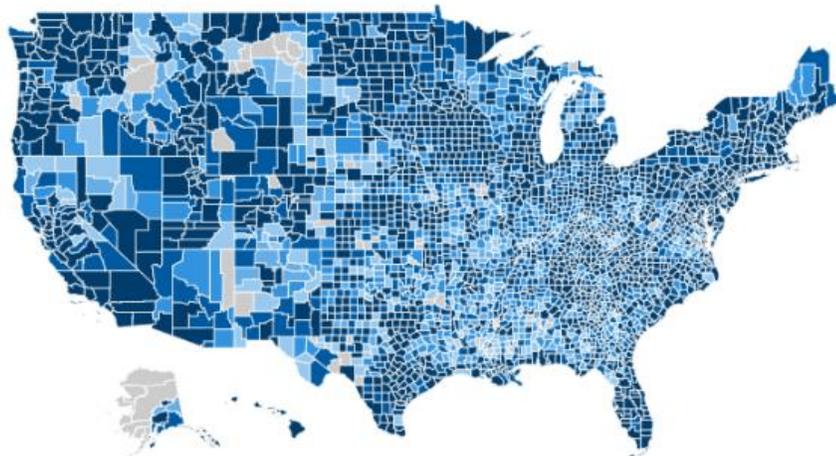
Reality Even Worse

Any 100,000 households in rural expanse*			
5,000 to 8,000 square miles			
	FCC Form 477 Trusted, not verified	Range of Research-Informed Corrections	
10/1 Broadband Availability	62%	21%	10%
Unserved	38%	79%	90%
Unserved Households	38,000	79,000	90,000

- Research utilized combination of FCC Form 477 and USAC HUBB data
- Helps in understanding the magnitude of the broadband availability problem
- Does **not** identify defensibly unserved areas to escape “carve-outs” meant to prevent over-building

FCC vs Microsoft Data

FCC indicates broadband is not available to 24.7M people

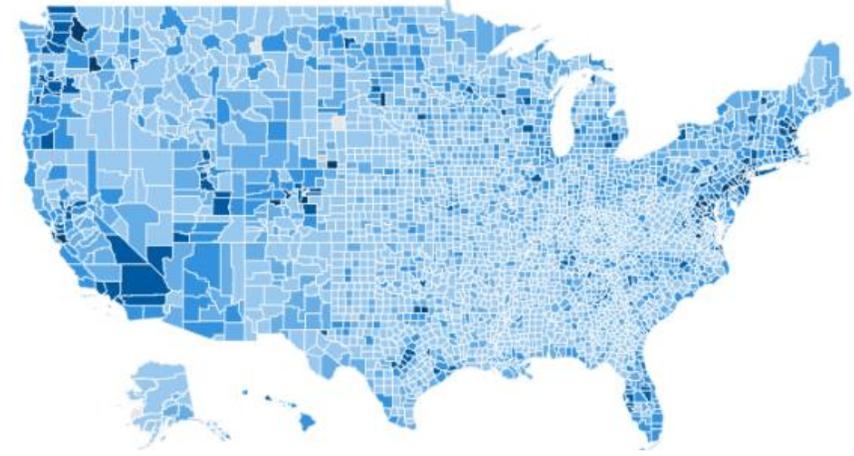


* FCC fixed broadband has or "could" provide greater than or equal to 25Mbps / 3Mbps



Data sources: FCC 2018 Broadband Report based on Form 477 data from December 2016 and M

Microsoft data indicates 162.8M people do not use the internet at broadband speeds



Broadband speed greater than or equal to 25Mbps



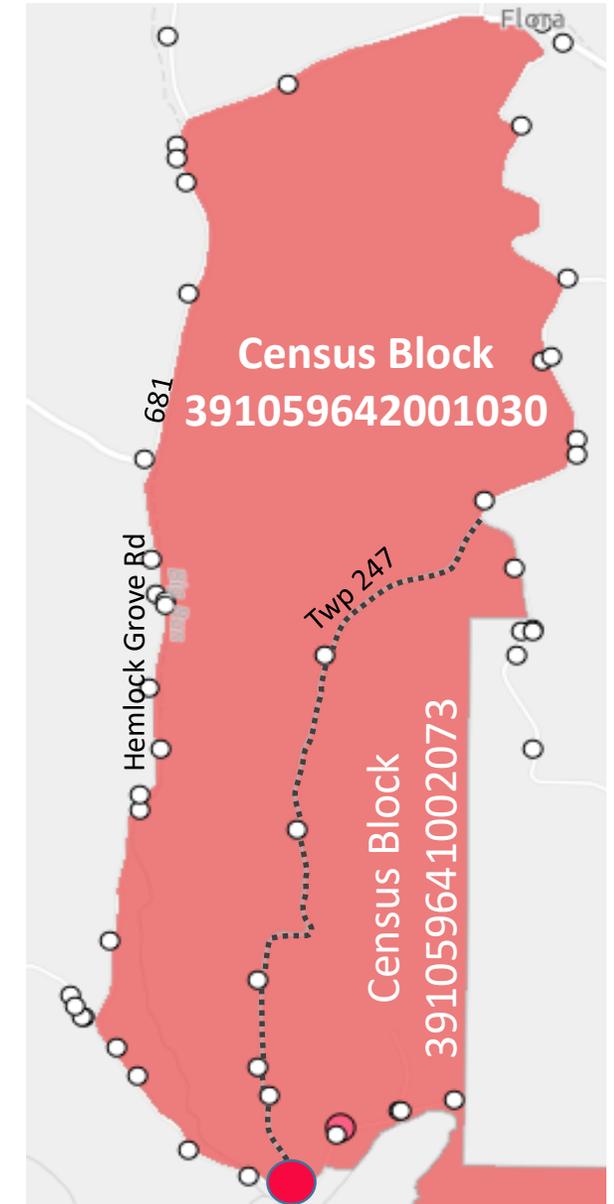
Microsoft data from September 2018

7:1 Over-Estimation of Coverage

De Minimis Deployments Leave Many Households Unserved

- Typical Example
 - Census Block 391059642001030 in Meigs County, Ohio
 - 740 Acres
 - 12 households per square mile
 - 14 Households in block, many others adjacent (white dots)
- Funded under CAF II
 - Frontier deployed broadband to one household (pink dot in far south of block)
 - Entire census block mapped as served by FCC
 - Thus blocked from receiving funding from other programs

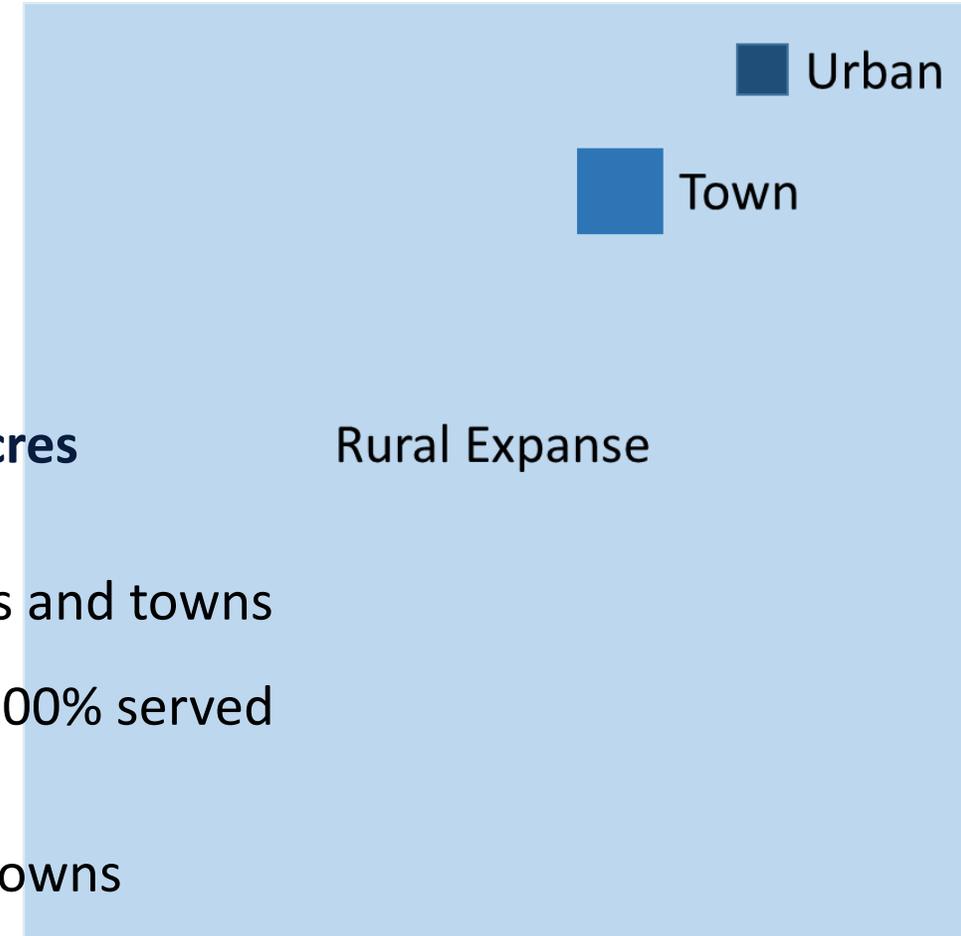
13:1 Over-Estimation of Coverage



Census Blocks

Urban-Rural Differences

- Census blocks sizes
 - As small as 0.7 acres, no maximum size
 - Cities = 2 acres on average
 - Small town = 6 acres on average
 - Southeastern Ohio rural expanse = **250 to 3,500 acres** (750 in illustration)
 - **40 to 1,500 times the size** of census blocks in cities and towns
- A single served location marks entire census block as 100% served in current FCC approach
 - May offer an acceptable assumption in cities and towns
 - In rural areas leaves large areas marked as “served” that are not and will not be served



De Facto Cooper Abandonment Exacerbates Issues

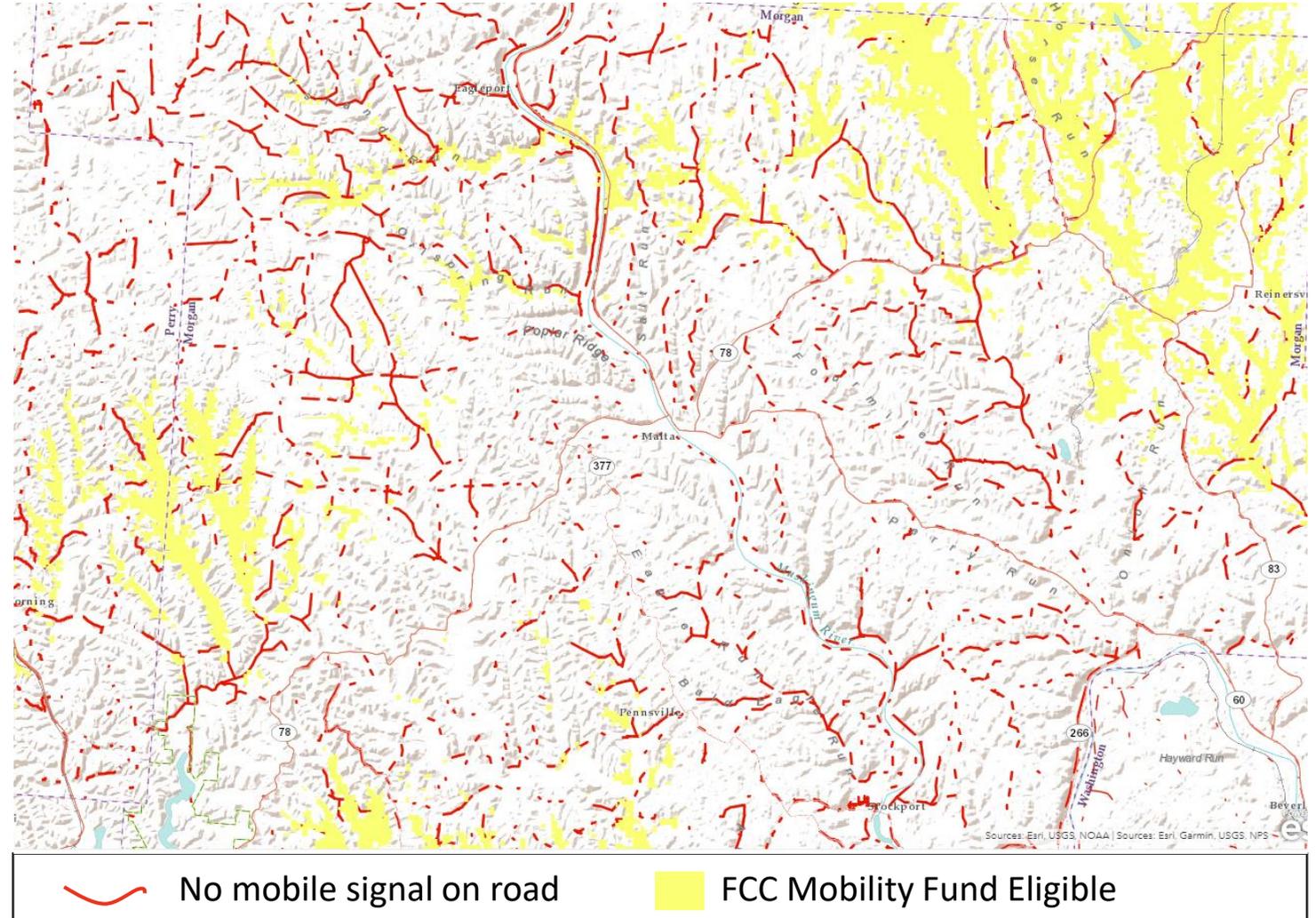
- Large incumbent telcos petitioning to abandon aged copper cables – **doing it de facto now**
- Allowed to deteriorate in place
- Insufficient to provide reliable telephone service let alone broadband
- Staffing so low that restoration takes multiple weeks
- Poses life/safety risks, particularly in areas also lacking cell service (**much more prevalent than maps indicate**)



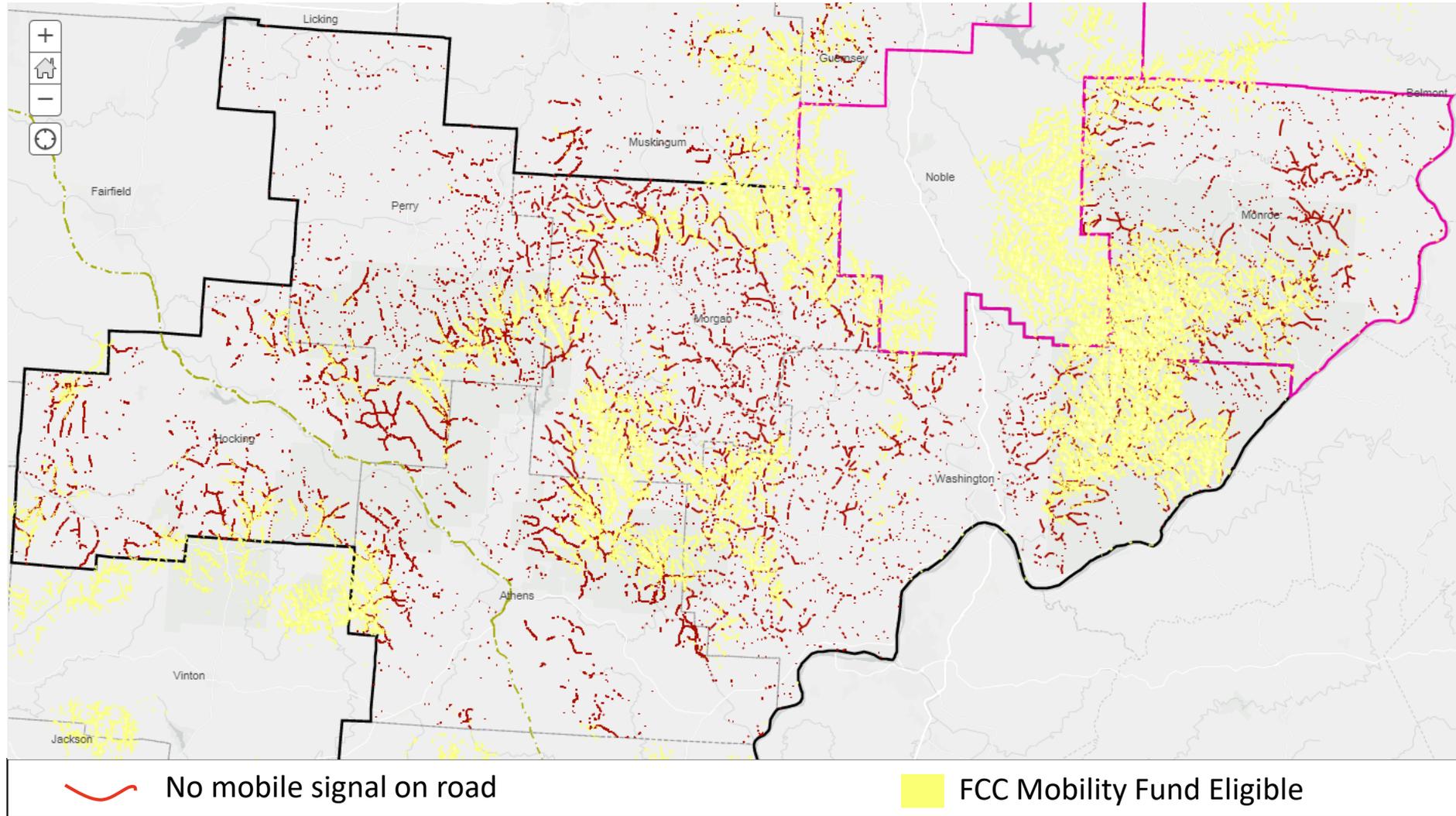
Mobile Services Overstated as Well

- Mobile services also dramatically overstated in our region
- Further diminishes opportunity for broadband services
- Exacerbates the life/safety issues from de factor copper abandonment
- Red lines shows lack of coverage on roads from:
 - AT&T,
 - Verizon,
 - T-Mobile, or
 - Sprint

Source: Ohio Department of Transportation, 2017 drive study conducted by ConnectedNation

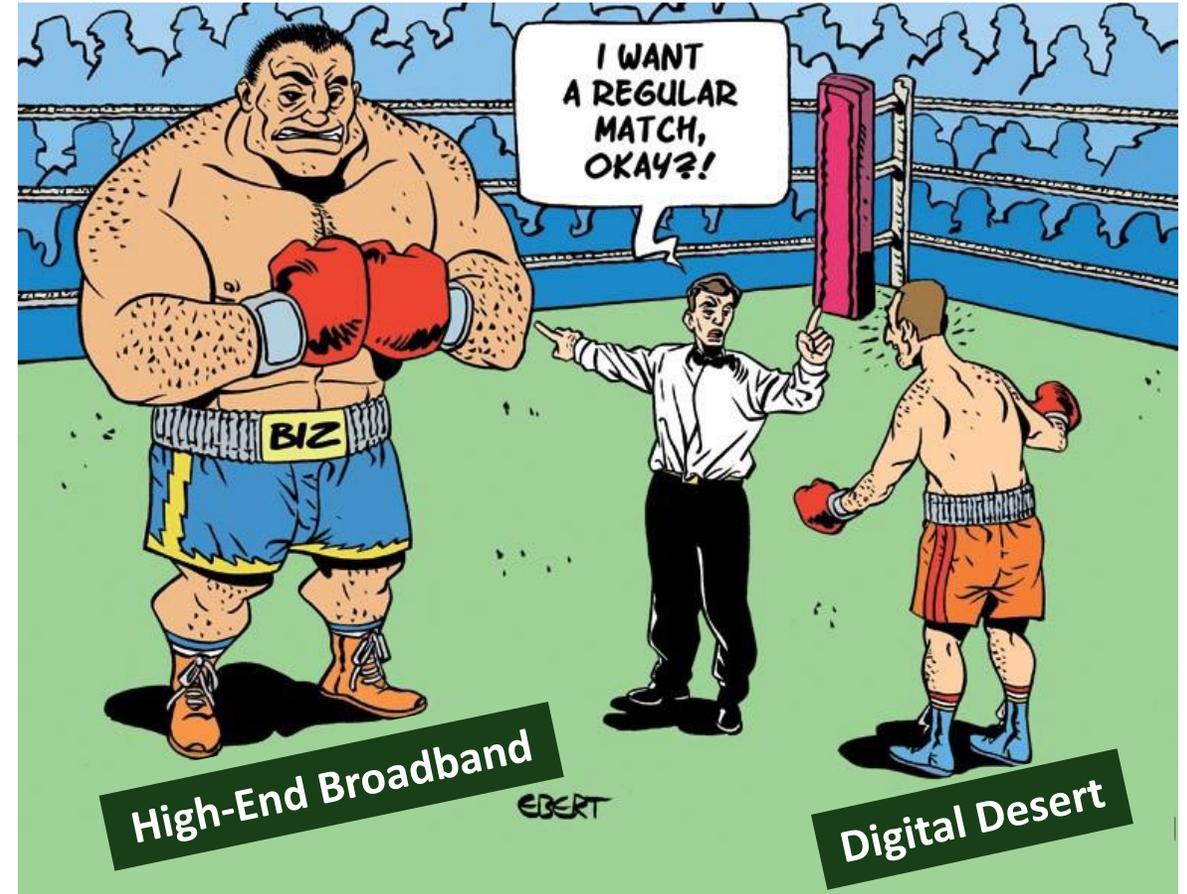


Mobile Services Overstated as Well



Region at Unfair Disadvantage

No wonder the region is having difficulty competing in the 2020 economy



Overarching Architecture

- Select representative study areas based on business and population density plus terrain
- Model technology options for feasibility
- Determine realistic cost estimates for **100% coverage**
- Extrapolate architecture across service area
- Generate financial pro forma to determine magnitude of subsidy required

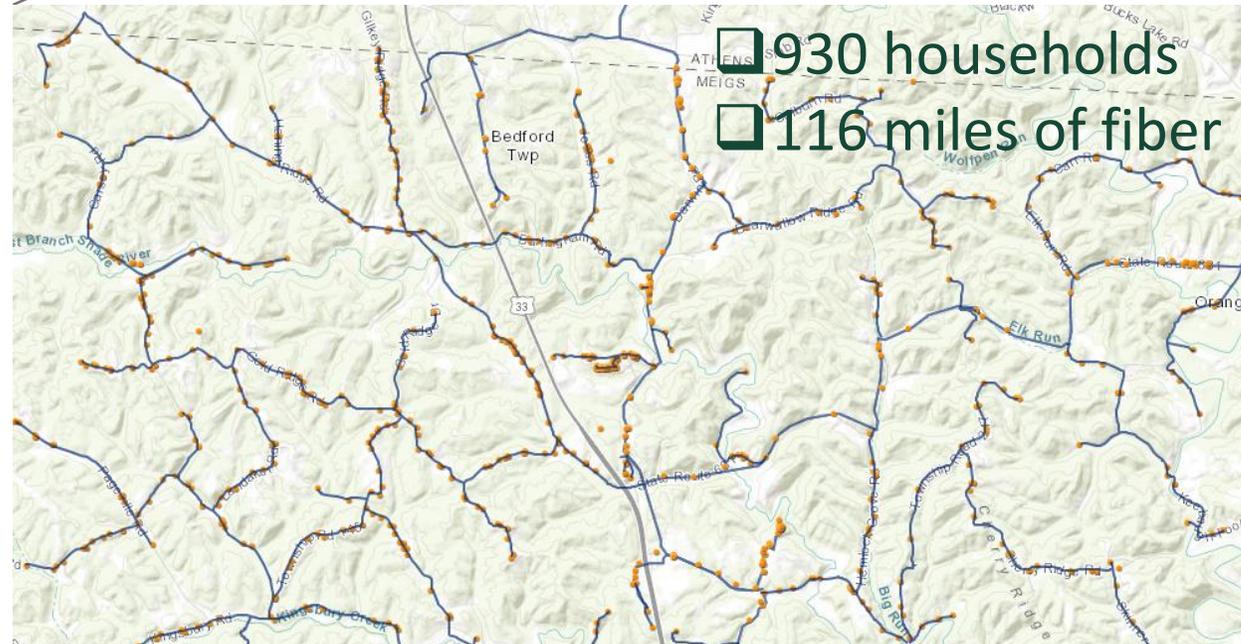
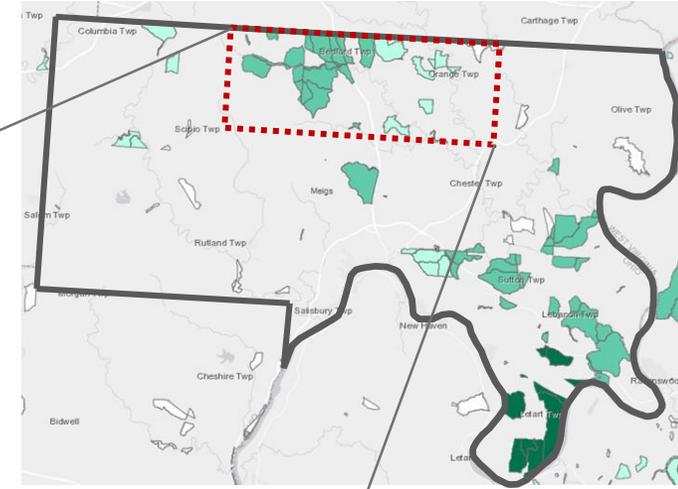


Three Options

1. Satellite
2. Hybrid Wireless and Fiber
3. Fiber-to-the-Premise

Engineering Zones

- One in Meigs County and one in Washington County
- Terrain and population density typical of region
- Significant foliage cover
- ~ 50 square miles
- Consistent results
- Extrapolation across region



Satellite Woes

- Round-trip creates signal delays (latency) that hamper video/web/audio conferencing
- Data caps and subsequent “throttling” reduce effectiveness for streaming services
- Many potential sources of interference of the low strength signals
- New low-orbit satellites face daunting technical challenges for the frequent hand-offs
- Rugged terrain and heavy foliage limits reach of satellite services



Worst-case option for our region

Wireless Limitations



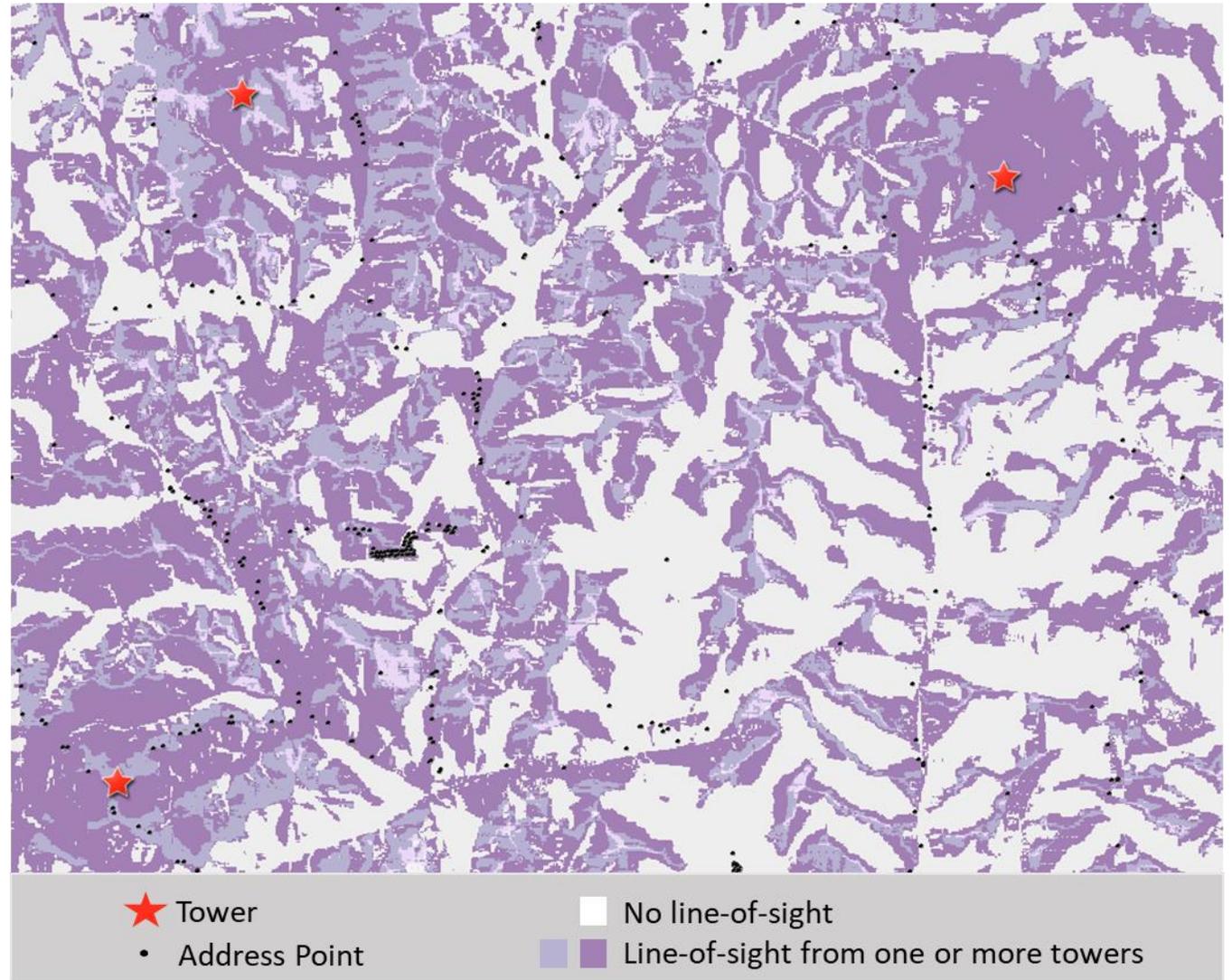
Wireless signals travel unobstructed across flat farmland, a feasible solution in these types of areas



In our region, the combination of rugged terrain and heavy foliage cover severely limit both coverage and capacity

Wireless Propagation Challenges Engineering Zone A

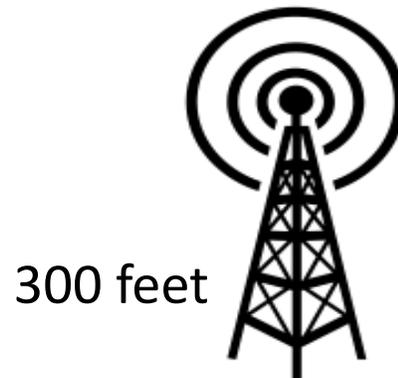
- 4 towers on high points, each 300' tall (3 shown)
- >\$1.5 million in infrastructure for just 60 square miles
- Many locations still unreachable
- High winds cause dish misalignments
- Lightning takes out entire tower's worth of electronics



TV White Spaces

Disadvantaged Reality

Specifications	TV White Space		When Broadcasters Use
	“Congested”	“Uncongested”	
Transmitter Height	100 feet	300 feet	Up to 1,800 feet
Transmit Power	4 Watts	10 Watts	Up to 50,000 Watts



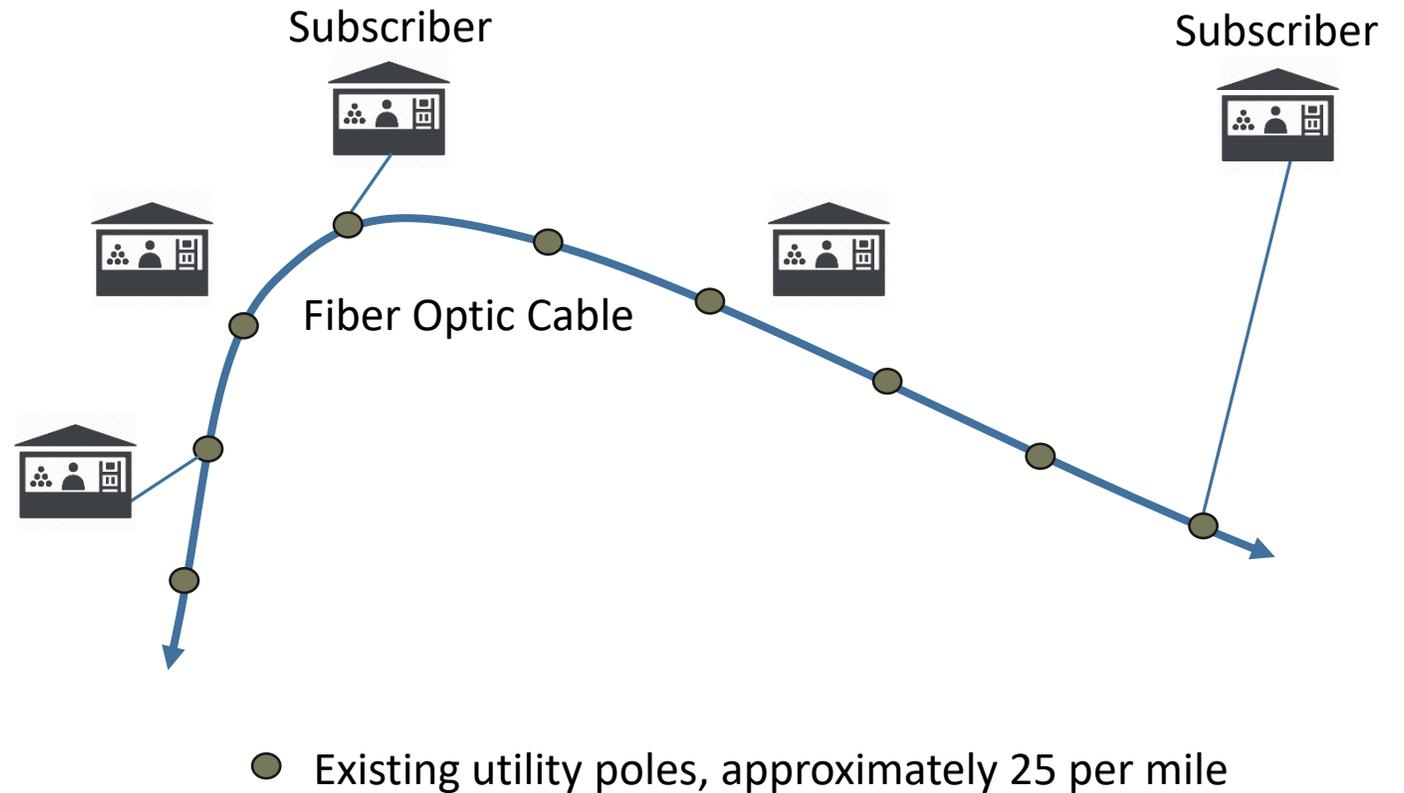
1,000 feet

FCC Chairman Pai announced in early February the intent to enable White Space to utilize taller towers and higher output power – no details yet

Fiber-to-the-Premise

Only option for 100% Coverage

- Tremendous capacity, initial and for growth over time
- Stable services
- High capital costs, low operating costs
- 30+ year lifetime
- Foundation required for other services including mobile
- Would leapfrog the region
- Efficient use of investment



Highway Comparison

Highways a fundamental infrastructure element

- \$10 million to \$20 million per mile (fully loaded)
- Requires continual government-funded upkeep

Fiber a fundamental infrastructure element

- \$50 thousand to \$60 thousand per mile
- ISP responsible for upkeep



Nelsonville Bypass Example

- 8.5 miles of highway construction
- \$160 million = \$18.8 million per mile
- Enough money to extend fiber to 12,000 homes in the rural expanse

Subsidy Required

Fiber-to-the-Home Financials – 10 Year Lifecycle – Total Replacement of Existing Copper				
	8-County Study Area		34-County Extrapolation	
	Rural Expanse	All Areas < 25/3	Rural Expanse	All Areas < 25/3
Square Miles	1,995	2,683	9,164	12,324
Households	20,139	57,873	92,506	265,831
Households per Sq Mi	10.1	21.6	10.1	21.6
Total Fiber Network Costs	\$366 million	\$492 million	\$1.68 billion	\$2.26 billion
Less Projected Revenue	\$ 96 million	\$129 million	\$ 440 million	\$ 592 million
Required Subsidy	\$270 million	\$363 million	\$1.24 billion	\$1.67 billion
Highway Mile Equivalent	14.3	19.3	65.9	88.7

Analysis of remaining three counties underway

Last Mile Funding Opportunities

Source	Total Funding	Distribution
FCC Rural Digital Opportunity Fund	\$20 billion in subsidy	Reverse auction
FCC Rural 5G Fund	\$9 billion in subsidy	Reverse auction
USDA ReConnect	\$300 million in grants	Competition
Appalachian Regional Commission	\$25 million in grants	Competition
State of Ohio Broadband Fund	TBD	TBD
Federal Infrastructure Fund	TBD	TBD

Combined are 97x the size of next largest program

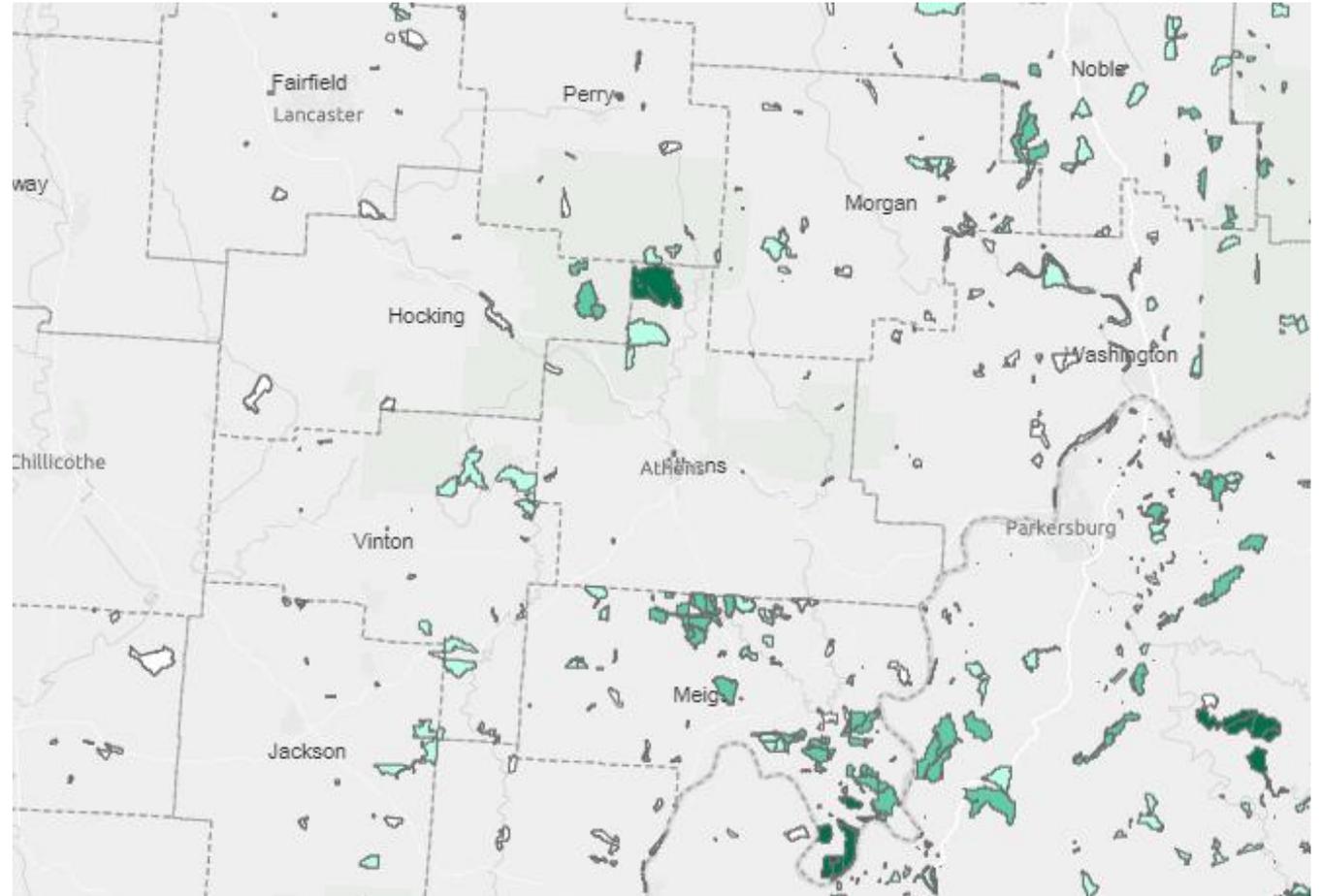
The FCC programs draw monies from the **Universal Service Fund**, established in 1934 by the US Congress, designated **to deliver telecommunications services to rural America at rates and capabilities comparable to urban areas**, paid for by surcharges on telephone bills

Do Not Want to Repeat FCC Auction 903 in 2018

- The scattered teal-shaded census blocks were identified by FCC as unserved
- Ten-year subsidy offered
- In Meigs County, Ohio, the FCC funding totaled \$3.3 million

\$1.5 billion awarded nationwide

- **No one bid on any of the census blocks in Appalachian Ohio**
- The subsidy offered in these areas was too low to attract bidders



FCC Rural Digital Opportunity Fund

- **\$20 billion, 10-Year Program**
 - FCC [Notice of Proposed Rule Making](#) and [Our Filed Comments](#)
 - By far the largest source of last mile funding on the horizon
- Crucial modifications to deliver higher subsidy per household
 1. **Strongly favor gigabit speeds in auction weighting**
to incentivize long-term investments, e.g. fiber-to-the-premise
 2. **Lower market penetration assumption to 40%**
from the current FCC assumption of 70%
 3. **Lower the average revenue per household to \$50**
from the current FCC assumption of \$75

Nationwide only 45 entities filed reply comments in October regarding the program

19 of which came from Appalachian Ohio in support of Buckeye Hills comment filing



Fiber-to-the-Premise Determining FCC Reserve Price

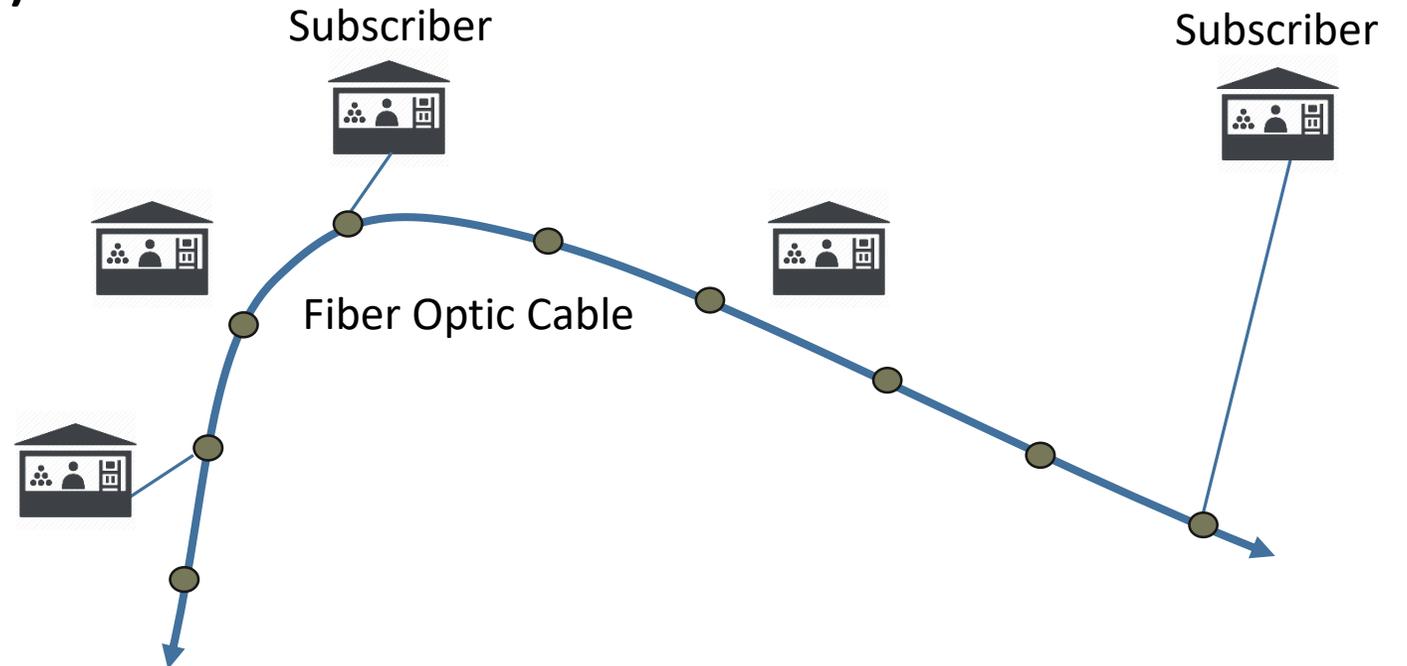
Connect America Cost Model (CAM)

- Pass the House
- Connect to the Subscribers
- Operate and Maintain the Service

Less **Projected Revenue**

- % Market Penetration
- \$ of Average Bill

Equals the **Reserve Price**
offered in reverse auction



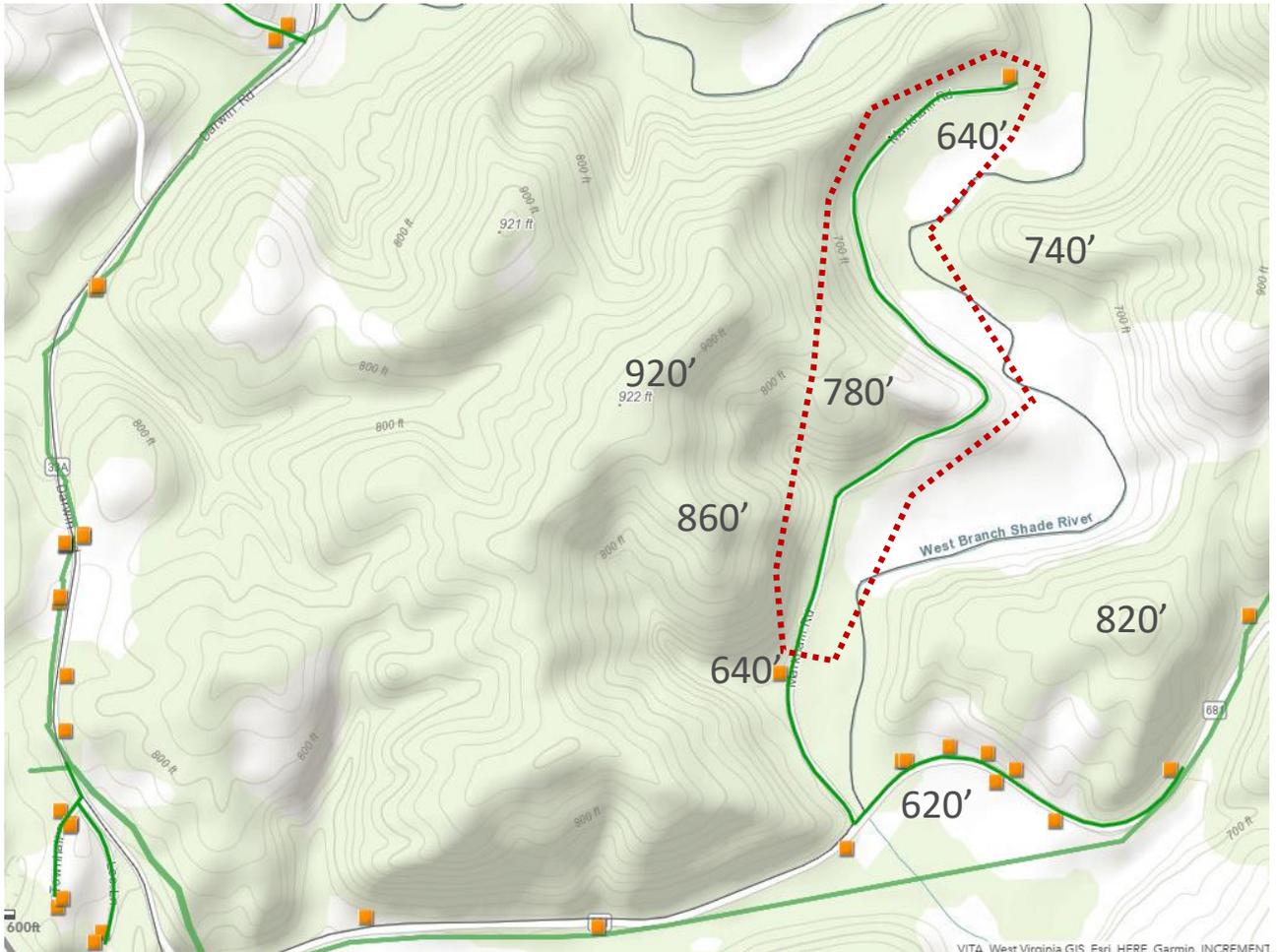
● Existing utility poles, approximately 25 per mile

Costs and Reserve Requirements

Cost Element	Per Mile	Per Household	Per Month Each Household		
			BHRC "Mini-CAM"	FCC CAM, Auction 903	Draft RDOF Order
Base Fiber Infrastructure to Pass	\$30,432	\$3,900	\$33	Calculated based on FCC Connect America Fund Model (CAM)	
Base Make-Ready to Pass 45%	\$25,080	\$3,200	\$27		
Base Operations and Maintenance			\$14		
Subscriber Costs – Allocated*		\$650	\$22		
Monthly per Household = Connect America Fund Model			\$96	\$87 to \$116	\$87 to \$116
Average Revenue per Subscriber			\$60	\$75	No market milestones
Market Penetration in First Six Years			x 50%	x 70%	
Less Average Monthly Subscriber Revenue Offset			- \$30	- \$53	-\$40 or -\$30
Monthly per Household Reserve Price Needed			\$66	\$34 to \$63	\$57 to \$86

* Subscriber costs of \$1,300 plus \$44 per month for the projected 50% take-rate extended across the entire base of eligible premises

Reaching 100% vs. 95%



- Delete the one home at far end of the road
- Save > 4,100 feet of fiber
- Reduces project cost by between \$19,400 and \$38,800
- Given intervening terrain and foliage, no affordable wireless option exists

■ Potential service location — Planned fiber along centerlines - - - Example of high-cost fiber extension

Infrastructure Takes Time

Rural Digital Opportunity Fund (RDOF) Example

Likely Timeline – Actual TBD	Year – Quarter
FCC Issues RDOF Order (after considering all comments received in 2019)	2020 - Q1
FCC Issues List of Eligible Census Blocks and Conducts Challenge Process	2020 – Q2
FCC Conducts Phase 1 Auction	2020 – Q4
FCC Releases Funding After Due Diligence of Auction Winners	2021 – Q4
Auction Winners Reaches 40% of Homes (Year 3)	2024 – Q4
Auction Winners Reaches 95% to 100% of Homes (Year 6)	2027 – Q4
RDOF Funding Expires	2031 – Q4

- **This example illustrates the long duration of infrastructure projects**
- Other funding programs such as ReConnect will incur similarly long processes
- Actual dates for FCC actions remain indeterminant

Potential RDOF Subsidy

Max RDOF Reserve per Household*	Monthly	\$57	\$72	\$86
	10 Year Total	\$6,840	\$8,580	\$10,320
Households That Should Qualify		200,000		
Potential RDOF Subsidy Totals in Southern and Eastern Ohio		\$1.4 billion	\$1.7 billion	\$2.1 billion

Maximum reserve prices will be subject to reverse auction, seeking the most cost-effective bidder

*Exact figures will become available shortly after the FCC publishes the eligible blocks



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Next Steps

1. Continue voicing your concerns to State and Federal legislators
2. Encourage our region's electric cooperatives and AEP to participate in the FCC Rural Digital Opportunity Fund
3. Join BHRC, APEG, ACEDC, OHIO and the SOHCN in pooling funding to continue the advocacy and research efforts

Rural Ohio needs to speak with a unified voice!

Bonus Material

State of Ohio Recommendations



Measures to Attract Funding from Large Federal Pools

- Creating a broadband fund of \$167 million per biennium for three biennium
- Fund projects that directly connect 100% of unserved and underserved rural households and businesses in a designated service area
 - 30% match for Federal funds
 - Full cost “to pass” for freestanding projects in rural expanse
- Award zero-match planning grants to enable regional organizations to develop successful applications for federal broadband funding
- Establish a steering committee of rural broadband advocates to review applications for funding
- Pass legislation to enable fiber to be installed on existing utility poles without seeking separate easements.

State of Ohio Recommendations



“100% Grant” Portion of Program
Requires 25% Match

+ Pre-Application Costs* @ 5%

+ Compliance Costs* @ 5% to 10%

Actual Match = 35% to 40%

* USDA authorizes up to 5% of award can go toward pre-application costs. Compliance can also be covered by award. Much of the pre-application and compliance activities involve work that would not ordinarily occur in broadband deployments, e.g. environmental assessments and historic preservation evaluations

The Urgent Need for State Match



Fiber to the Home	Rural Township with a Town*	Rural Expanse		Columbus
Households per Sq Mi	45	20	10	1,510
Cost to Pass	\$3,200	\$7,100	\$14,000	\$900
Cost to Serve**	\$1,100	\$1,100	\$1,100	\$450
Match Percentage***	34%	15%	8%	NA

Cannot make a sustainable business case in the areas of need without additional match

A 30% State match would tip the scales to “yes” for investors

* Such areas unlikely to meet the ReConnect threshold that 90% of the service area be devoid of 10/1 broadband

** Assume 50% take rate on full cost to serve of \$2,200 in rural areas and \$900 in urban areas

*** Assumes Cost to Pass in rural areas paid by grant. ISP to cover operational and fiber maintenance costs from revenues