Cracking the Broadband Puzzle in Appalachia

Misty Crosby
Executive Director
MCrosby@BuckeyeHills.org

Tom Reid
Broadband Consultant
Tom@ReidConsultingGroup.com

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Agenda

- 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?

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

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

- 75% of the 8-county study area lacking broadband according to current FCC definition of 25/3
- Further, in many areas availability severely limited due to deteriorating copper cables
- Combination of FCC Form 477 Data and USAC HUBB Data reveals a stark image of the digital desert
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

### Any 100,000 households in rural expanse*

<table>
<thead>
<tr>
<th>5,000 to 8,000 square miles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FCC Form 477</strong>&lt;br&gt;Trusted, not verified</td>
</tr>
<tr>
<td>10/1 Broadband Availability</td>
</tr>
<tr>
<td>Unserved</td>
</tr>
<tr>
<td>Unserved Households</td>
</tr>
</tbody>
</table>

* Rural expanse defined as area with 20 or fewer households per square mile
FCC vs Microsoft Data

FCC indicates broadband is not available to 24.7M people

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

7:1 Over-Estimation of Coverage

* 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

Broadband usage

Microsoft data from September 2018
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 facto 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

Noble County data collection underway, Meigs not measured
“But dear..., the maps say you have both fixed broadband and mobile services”
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 Zone A
Meigs County

- Terrain typical of broader service area
- Population density below 20 households per square mile
- Scattering of businesses across the study area
- Significant foliage cover
- Pre-existing middle mile fiber
- 45 square miles

- 930 households
- 116 miles of fiber

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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
- Lightening takes out entire tower’s worth of electronics
# TV White Spaces

## Disadvantaged Reality

<table>
<thead>
<tr>
<th>Specifications</th>
<th>TV White Space</th>
<th>When Broadcasters Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>“Congested”</strong></td>
<td><strong>“Uncongested”</strong></td>
</tr>
<tr>
<td>Transmitter Height</td>
<td>100 feet</td>
<td>300 feet</td>
</tr>
<tr>
<td>Transmit Power</td>
<td>4 Watts</td>
<td>10 Watts</td>
</tr>
</tbody>
</table>
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

Existing utility poles, approximately 25 per mile
## Subsidy Required

### Fiber-to-the-Home Financials – 10 Year Lifecycle – Total Replacement of Existing Copper

<table>
<thead>
<tr>
<th></th>
<th>8-County Study Area</th>
<th>34-County Extrapolation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rural Expans Only</td>
<td>All Areas Below 25/3</td>
</tr>
<tr>
<td>Square Miles</td>
<td>1,995</td>
<td>2,683</td>
</tr>
<tr>
<td>Households</td>
<td>20,139</td>
<td>57,873</td>
</tr>
<tr>
<td>Households per Sq Mi</td>
<td>10.1</td>
<td>21.6</td>
</tr>
<tr>
<td>Total Fiber Network Costs</td>
<td>$366 million</td>
<td>$492 million</td>
</tr>
<tr>
<td>Less Projected Revenue</td>
<td>$ 96 million</td>
<td>$129 million</td>
</tr>
<tr>
<td><strong>Required Subsidy</strong></td>
<td>$270 million</td>
<td>$363 million</td>
</tr>
<tr>
<td>Average Per Household</td>
<td>$13,416</td>
<td>$6,279</td>
</tr>
</tbody>
</table>

“Required Subsidy” covers the capital and operating costs of the base fiber infrastructure.

8-county study total = 3,600 square miles; 34-county total = 16,400 square miles
## Last Mile Funding Opportunities

<table>
<thead>
<tr>
<th>Source</th>
<th>Total Funding</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCC Rural Digital Opportunity Fund</td>
<td>$20 billion in subsidy</td>
<td>Reverse auction</td>
</tr>
<tr>
<td>FCC Rural 5G Fund</td>
<td>$9 billion in subsidy</td>
<td>Reverse auction</td>
</tr>
<tr>
<td>USDA ReConnect</td>
<td>$300 million in grants, $300 million in loans</td>
<td>Competition</td>
</tr>
<tr>
<td>Appalachian Regional Commission</td>
<td>$25 million in grants</td>
<td>Competition</td>
</tr>
<tr>
<td>State of Ohio Broadband Fund</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Federal Infrastructure Fund</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

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 to equip rural America with telecommunications services, 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
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

<table>
<thead>
<tr>
<th>Cost Element</th>
<th>Per Mile</th>
<th>Per Household</th>
<th>BHRC “Mini-CAM”</th>
<th>FCC CAM, Auction 903</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Fiber Infrastructure to Pass</td>
<td>$30,432</td>
<td>$3,900</td>
<td>$33</td>
<td>Calculated based on FCC Connect America Fund Model (CAM)</td>
</tr>
<tr>
<td>Base Make-Ready to Pass</td>
<td>$25,080</td>
<td>$3,200</td>
<td>$27</td>
<td></td>
</tr>
<tr>
<td>Base Operations and Maintenance</td>
<td></td>
<td></td>
<td>$24</td>
<td></td>
</tr>
<tr>
<td>Subscriber Costs – Allocated*</td>
<td></td>
<td>$731</td>
<td>$25</td>
<td></td>
</tr>
</tbody>
</table>

**Monthly Costs = Connect America Fund Model**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>$109</th>
<th>$87 to $116</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Revenue per Subscriber</td>
<td></td>
<td></td>
<td>$50</td>
<td>$75</td>
</tr>
<tr>
<td>Market Penetration in First Six Years</td>
<td></td>
<td></td>
<td>x 40%</td>
<td>x 70%</td>
</tr>
<tr>
<td><strong>Less Subscriber Revenue Offset</strong></td>
<td></td>
<td></td>
<td>-$20</td>
<td>-$53</td>
</tr>
<tr>
<td><strong>Reserve Price in RDOF Auction</strong></td>
<td></td>
<td></td>
<td>$89</td>
<td>$34 to $63</td>
</tr>
</tbody>
</table>

* Subscriber costs of $2,200 plus $34 per month for the projected 40% take-rate extended across the entire base of eligible premises

CAM may underestimate make-ready costs in Appalachia
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

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# Infrastructure Takes Time

## Rural Digital Opportunity Fund (RDOF) Example

<table>
<thead>
<tr>
<th>Event</th>
<th>Year – Quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCC Issues RDOF Order (after considering all comments received in 2019)</td>
<td>2020 - Q1</td>
</tr>
<tr>
<td>FCC Issues List of Eligible Census Blocks and Conducts Challenge Process</td>
<td>2020 – Q2</td>
</tr>
<tr>
<td>FCC Conducts Phase 1 Auction</td>
<td>2020 – Q4</td>
</tr>
<tr>
<td>FCC Releases Funding After Due Diligence of Auction Winners</td>
<td>2021 – Q4</td>
</tr>
<tr>
<td>Auction Winners Reaches <strong>40%</strong> of Homes (Year 3)</td>
<td>2024 – Q4</td>
</tr>
<tr>
<td>Auction Winners Reaches <strong>95% to 100%</strong> of Homes (Year 6)</td>
<td><strong>2027</strong> – Q4</td>
</tr>
<tr>
<td>RDOF Funding Expires</td>
<td>2031 – Q4</td>
</tr>
</tbody>
</table>

- 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
Suggested Next Steps

- Continue voicing your concerns to State and Federal legislators
- Apply for planning grants to prepare applications for implementation grants
- Support efforts by electric companies and co-ops to participate in fiber to the home deployments

The region needs to speak with a unified message!