Alternative Connect America Cost Model Overview

CostQuest Associates

May, 2014

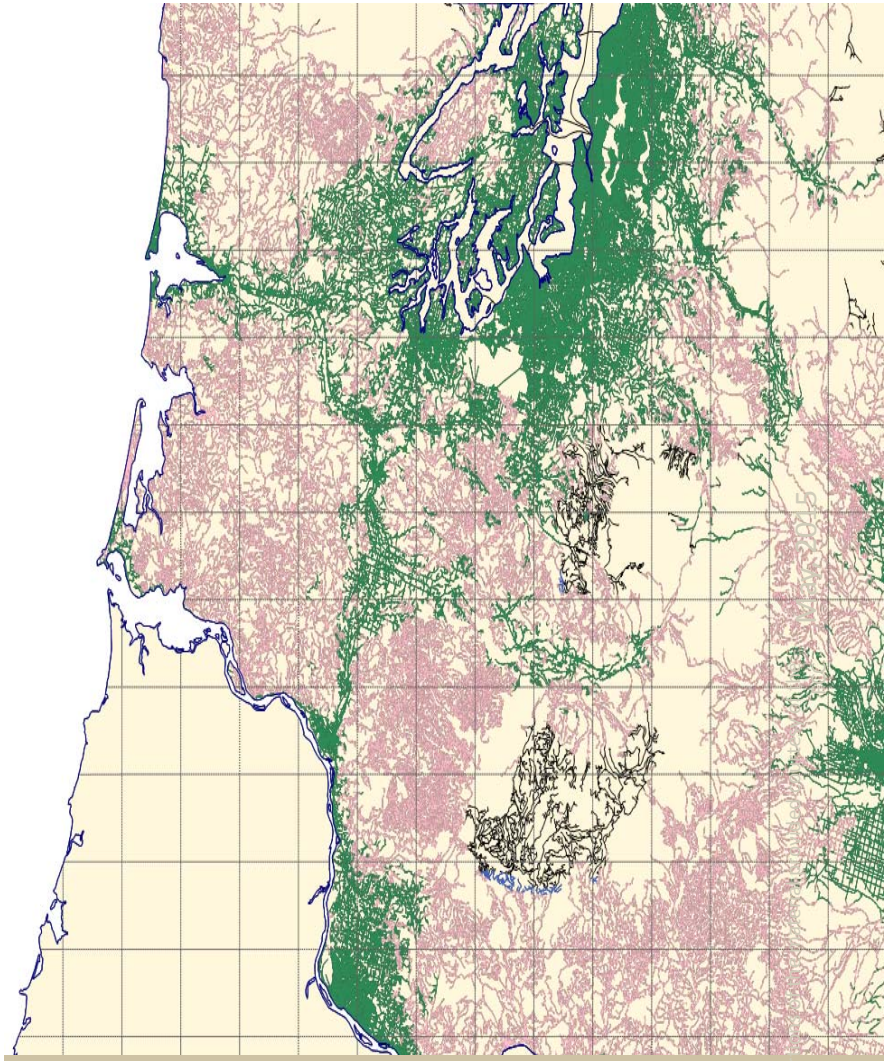
Agenda

- Background
- Key elements of model
- Illustrative model outputs (model for voluntary path to model-based support for RORs not finalized)
- Resources

Introduction

CostQuest Associates

- *Cincinnati – Seattle – Washington D.C.*
- *Formed in 1999*
- Internationally recognized as leading telecommunication network modeling, costing and profitability experts
  - Broadband and USF models: BAM used by FCC for NBP, CACM and A-CAM being used as national CAF/USF model, CPM California, CPM Hong Kong, BCPM, NUSC Australia, CostPro-Core New Zealand
  - RCN and Loop models: CostPro in use by carriers with operations in over 40 states, well received by commissions in all UNE and Tax proceedings
  - Wireless Costing: Wireless Models NTIA, CTIA, Wireless Carriers
  - Wireless Work: USAC Filings, Audits and Reviews, USAC/USF Workshops, GIS Analysis, Policy Support
  - Interconnection model: CostPro-Core in use by the New Zealand Commerce Commission to set rates
  - Profitability models: COMPASS, MAPS, ProfitMap, CPMS, and MIDAS – economic based contribution models over various business dimensions
- Global experience in developing, supporting regulatory and competitive practices



- Economic Network Modeling
- Mapping/GIS
- Regulatory Support
- Valuation/Costing
- Profitability
- Expert Testimony

A-CAM BACKGROUND

Commission proposes voluntary path to model-based support for rate-of-return carriers

- In the *April 2014 Connect America Order/FNPRM*, the Commission proposed a voluntary election by rate-of-return carriers to receive model-based support
  - Directed the Bureau to incorporate results of the study area boundary data collection in the Connect America Cost Model (CAM), and to make such other adjustments as appropriate for use of that model in rate-of-return areas
  - Sought comment on what specific changes should be implemented before using the model to calculate an offer of model-based support for rate-of –return carriers that voluntarily elect to receive model-based support
- On December 22, 2014, the Bureau announced the availability of version 4.2 of CAM and the first version of the Alternative Connect America Cost Model (A-CAM), being developed for potential use in rate-of-return areas
  - A-CAM v1.0 was fundamentally the same as CAM v4.2 to provide baseline for evaluating subsequent modifications; v1.0.1 uses 10 Mbps instead of 3 Mbps downstream
  - A-CAM v2.0 will incorporate the study area boundary data submitted by rate-of-return carriers
- On March 16, 2015, the Bureau released updated illustrative support amounts for several different scenarios support mechanisms using A-CAM version 1.0.1

Capturing Company and Geographic Differences

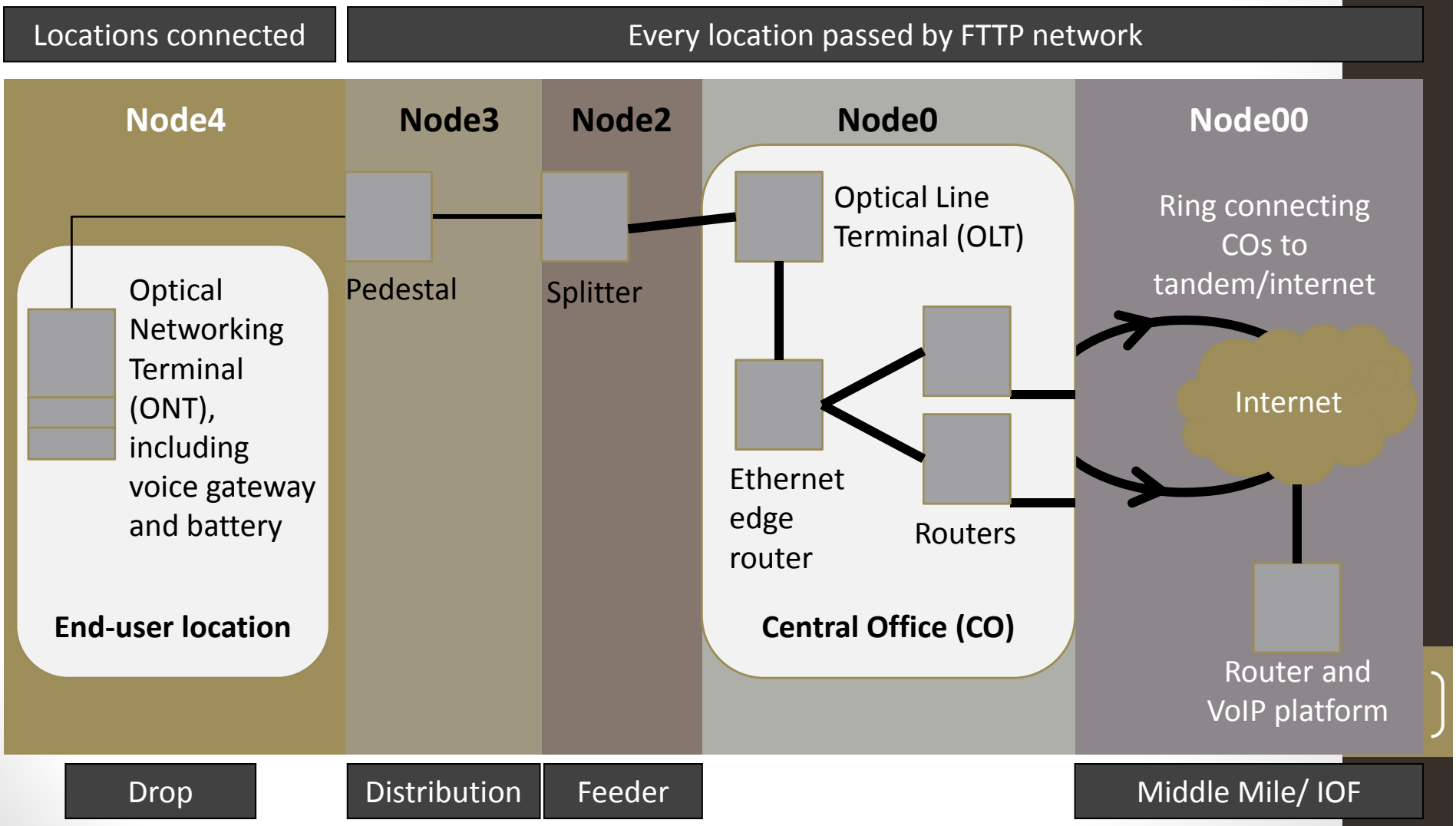
- A-CAM models the cost of an efficient provider, but recognizes the specifics of an operating area (and even a Census Block)
  - Plant mix captures variation between
    - State
    - Density
    - Distribution, feeder, interoffice
  - Company size impacts
    - Operation cost
    - Capex purchasing power
  - Terrain and density impacts
    - Construction and plant specific costs
  - Regional Cost Adjustment
    - Applied to capex to capture regional cost differences in construction costs – both material and labor
      - Impacts those operational costs that are a factor of capex
  - Sales Tax
    - Captures state by state differences
  - Loop design
    - Captures the specifics of the network build all the way down to a customer

A-CAM KEY ELEMENTS

Two components to A-CAM

- Cost model: calculates cost for all rate-of-return areas
  - Network topology – Geo-spatial- (or GIS-) based routing to meet engineering constraints for a given network technology
    - Uses geo-coded locations, where available; aligns location counts to census, placing additional locations along roads
    - Routing requirements based on distances along real roads to individual end-user locations
    - Incorporating rate-of-return study area boundaries as part of A-CAM 2.0
  - Costing – determination of cost to serve using that topology
    - Calculates cost to serve each end user location; these costs are then rolled up to the geographic level used in the support calculations
- Support model: calculates support
  - Calculated cost is an input
  - Rate-of-return areas eligible for support not yet decided
    - How to treat areas served by a competitor
  - Support per rate-of-return location not yet decided
    - What funding thresholds to use
    - Whether to average costs over larger areas
    - How to ensure total support for rate-of-return areas does not exceed budget

The model uses passive Gigabit Passive Optical Network (GPON) Fiber to the Premises (FTTP) technology



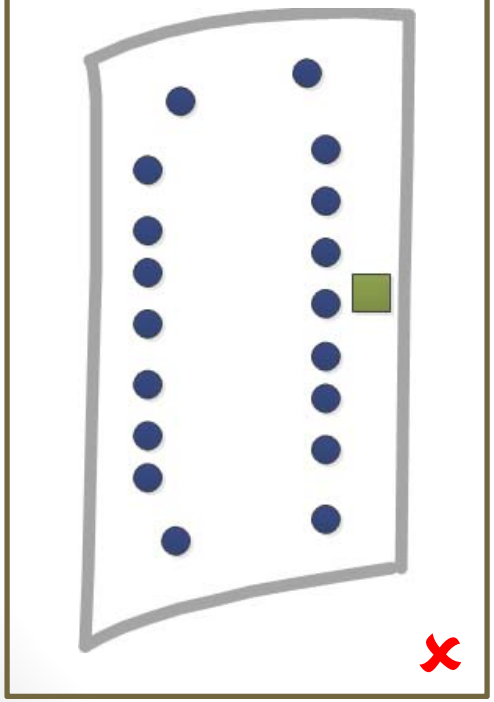
Cost model – network topology

- "**Simple" set of rules for all-IP FTTP (GPON) network** based on standard engineering principles:
  - Network facilities to "pass" every rate-of-return location in the country (>6 million) – essential network assets within a short distance of every location – with connections to a central office serving each location
  - For each block or street segment, determine location of pedestal (node 3) by minimizing cost in trade-off between placing a pedestal and drop to individual locations
  - Determine number and location of splitters (node 2) so that all locations in the splitter's fiber service area are within at most 5000-5,500 feet of splitter and splitter is equipped to serve up to 32 locations per GPON Feeder Fiber
  - Determine distribution path in the fiber service area to connect pedestals to the serving splitter using road path spanning tree optimization routines
  - Determine feeder path to connect splitters to central office using road path spanning tree optimization routines
- **Computationally intense** – can take weeks for a national data run

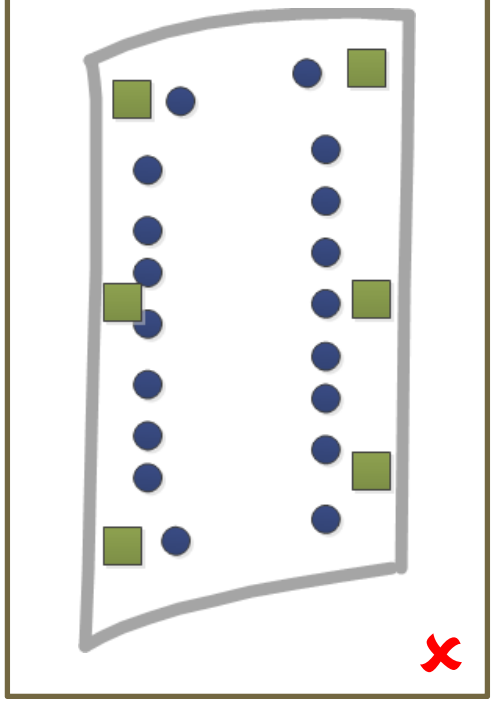
Simple topology example #1: Placing neighborhood pedestals (node 3)

Road segment
End-user location
Possible "pedestal" location

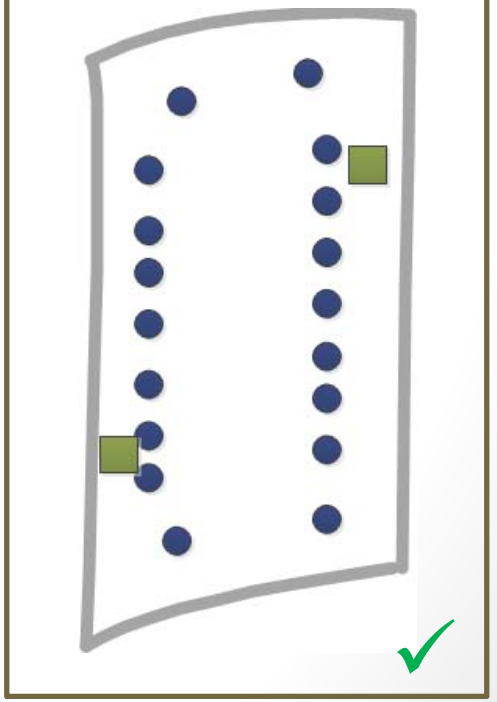
Too few pedestals
Too-long drops and too much drop cost



Too many pedestals
Too much cost for pedestals



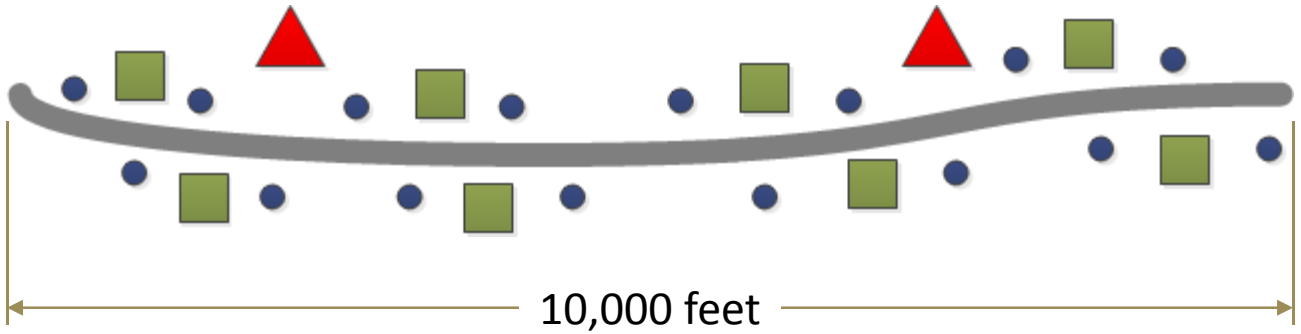
More efficient
Pedestals placed to "minimize" cost



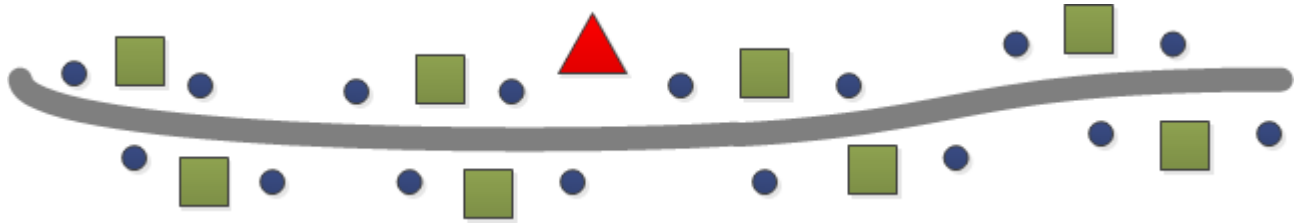
Simple topology example #2: Placing FTTP splitters (node 2)

Road segment
End-user location
Possible "pedestal" location
Possible splitter location

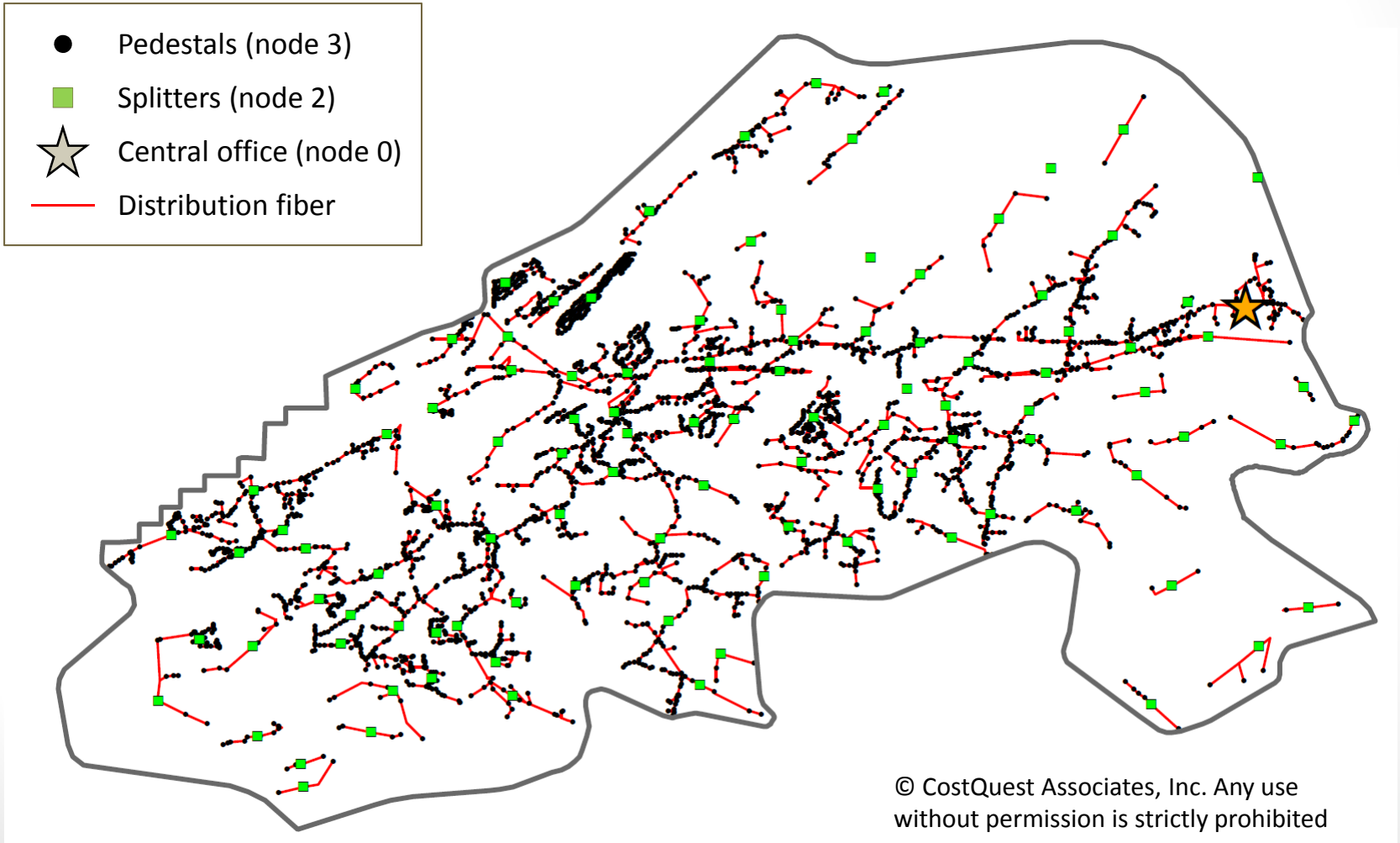
Too costly: Poor splitter placement means needing two splitters



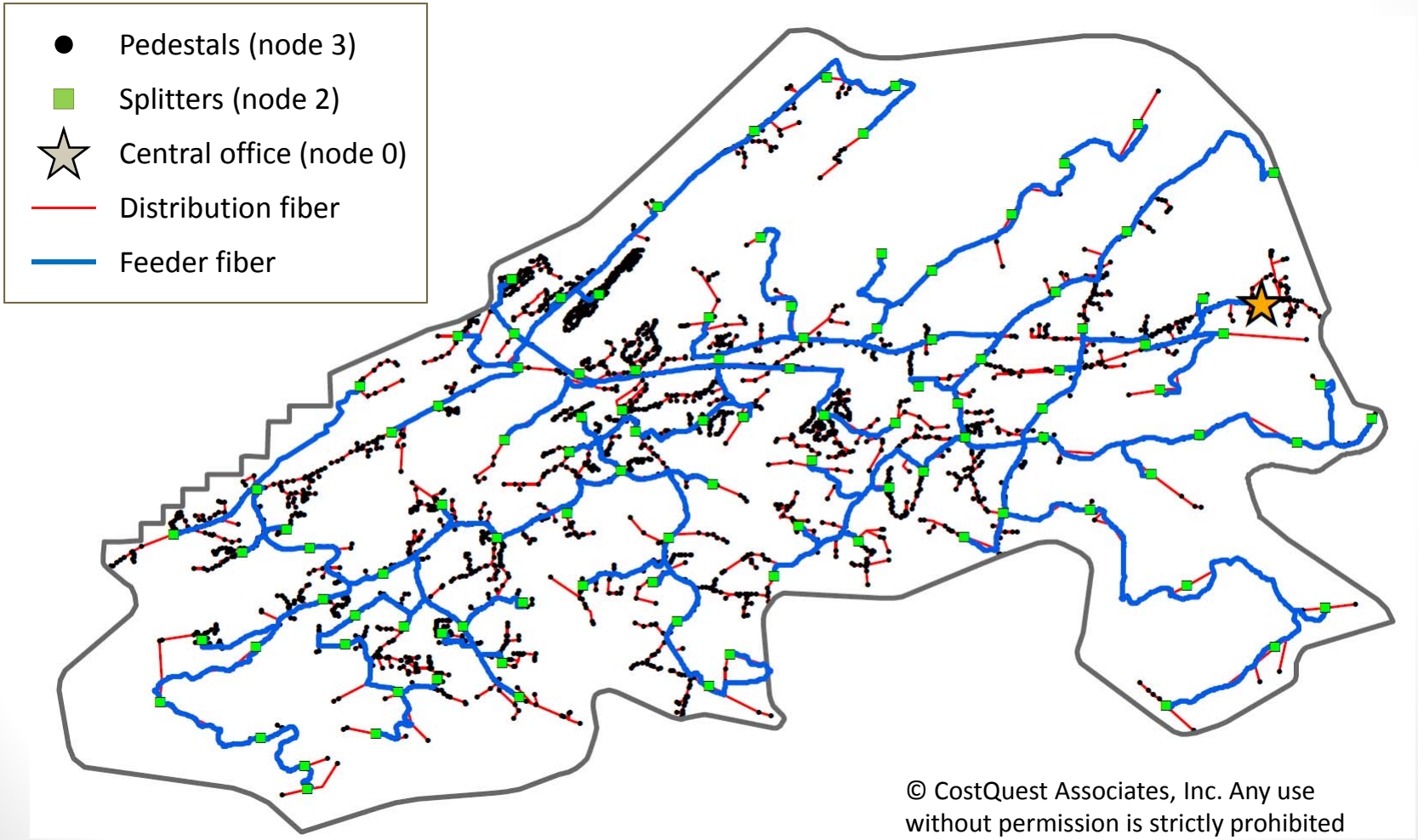
More efficient: Use fewer splitters to serve the area



Result is an efficient network that connects pedestals to splitters via a road-based distribution network…



…and connects splitters back to wire centers via road-based feeder network



Output of network topology: a large database that captures information relevant to calculating costs

- Census Block Based:
  - Number of locations in the block (both res and bus)
  - Feet of feeder plant and distribution plant (and overlap between them) associated with block
  - Pedestals associated with block
  - Portion of fiber service area Splitter apportioned back based on cost causation
  - Equipment and feet of transport (middle mile and/or undersea) for nodes (e.g., splitter, OLT, etc..) serving the block, apportioned back based on cost causation
  - Serving wire center (8 digit service area)
  - Area
  - Density zone – whether the block is rural, suburban or urban
  - Terrain of the block
  - Three-digit ZIP code associated with block

The model results are driven via user-configurable inputs

- Tied to the Block's GIS-based density and terrain, appropriate cost inputs are selected
  - Plant mix (mix of aerial, buried and underground facilities)
  - Tax rates
  - Regional cost adjustments
- Cost per unit for each network asset, including
  - Fiber
  - Outside-plant structure (e.g., poles, conduit, manholes)
  - FTTP hardware (e.g., splitters, ONTs, OLTs)
  - Network hardware (e.g., optical add-drop multiplexers or OADMs, routers)
- Asset lifetimes and cost of capital (through Annual Charge Factors)
- Customer connections (to determine number of drops and CPE in cost calculation)
- Capacity demand (to determine sizing of electronics)

Illustrative cost calculation for aerial plant in rural areas using A-CAM v1.0.1

	Materials	Placement
Fiber	+ $0.444 /foot for 48-fiber bundle	+ $1.185 placement / foot
	+ $0.118 /foot material loading	+ $0.0053 admin cost/foot
	= $0.562 /foot	+ $0.230 engineering cost/foot
		+ $0.540 splicing cost/foot
		= $1.960 / foot
Structure	+ $214.61 per pole → $1.25/foot	+ $452.97 per pole → $2.64/foot
	+ $86.56 per anchor → $0.072/foot	+ $184.25 per anchor → $0.154/foot
	+ $5.61 per guy → $0.0046/foot	+ $25.60 per guy →$0.021/foot
	+ $0.131/foot for material loading	+ $0.401 engineering cost/foot
	= $1.459 / foot pre-sharing	= $3.22 / foot pre-sharing
	= $.7005 / foot including sharing	= $1.54 / foot including sharing

Total cost

Total construction cost per foot for rural aerial plant:	$7.20
Aerial cost per foot (rural) *for ILEC*:	$4.77

Additional adjustments

- Multiply all costs by Regional Cost Adjustment
- For routes where feeder and distribution overlap, rural aerial structure shared 78% of the time (i.e., less structure cost incurred)
- Addition of state specific sales tax on material

Illustrative cost calculation for buried plant in rural, soft rock areas using A-CAM 1.0.1

	Materials	Placement
Fiber	+ $0.466 /foot for 48-fiber bundle + $0.050 /foot material loading = $0.515/foot	+ $0.00 placement / foot + $0.0053 admin cost/foot + $0.001 engineering cost/foot + $0.531 splicing cost/foot = $.538 / foot
Structure	NA	+ 3.77/foot for labor + $0.538/foot for engineering = $4.310 /foot pre-sharing = $4.149 / foot including sharing

Total cost	Total construction cost per foot for rural, soft-rock, buried plant:	$5.36
	Buried cost per foot (rural, soft-rock) *for ILEC*:	$5.20

Additional adjustments

- Multiply all costs by Regional Cost Adjustment
- For routes where feeder and distribution overlap, rural buried structure shared 41% of the time (i.e., less structure cost incurred)
- Addition of state specific sales tax on material

Illustrative cost calculation for underground plant in rural, soft rock areas using A-CAM 1.0.1

	Materials	Placement
Fiber	+ $0.445 /foot for 48-fiber bundle + $0.057 /foot material loading = $0.502 /foot	+ $2.289 placement / foot + $0.0053 admin cost/foot + $0.442 engineering cost/foot + $0.582 splicing cost/foot = $3.319 / foot
Structure	+ $1372.10 per manhole → $1.52/foot + $2.04 / foot for duct + $0.466/foot for material loading = $4.03 / foot pre-sharing = $3.97 / foot including sharing	+ $793.66 per manhole → $0.882 / foot + $0.71/foot for duct (no sharing) + $8.33 /foot for excavation + $1.42 engineering cost/foot = $11.34 / foot pre-sharing = $10.89 / foot including sharing

Total cost

Total construction cost per foot for rural, soft-rock, underground plant:	$19.19
Underground cost per foot (rural, soft-rock) *for ILEC:*	$18.68

Additional adjustments

- Multiply all costs by Regional Cost Adjustment
- For routes where feeder and distribution overlap, rural underground structure shared 67% of the time (i.e., less structure cost incurred)
- Addition of state specific sales tax on material

Sources for aerial plant cost calculation

	Materials	Placement
Fiber	• **Fiber Material**: Size 24 Aerial Material cost: $0.3135/foot * 1.42 for 48-fiber cable = $0.444 per foot • **Labor Rates and Loadings**: AerialFO Total Material Loadings: .265177 → $0.118 per foot	• **Material Labor:** AerialFO Placing cost per foot**:** $0.836 * .142 for 48-fiber cable = $1.185 per foot • **Material Labor:** AerialFO Telco admin cost per foot**:** $0.0053 • **Labor Rates and Loadings:** AerialFO Engineering rate: .1925 → $0.230 per foot • **Splicing (see "Sources for Splicing" slide):** $0.540 per foot
Structure	• **Structure Material**: Size 35 Material cost per pole: $214.61 • **Engineering rules:** Size 35 pole spacing: 200 feet • **Engineering rules:** Typical aerial span: 1200 feet →7 poles over 1200 feet • **Structure Material:** $86.56 per anchor • **Structure Materials:** $0.11 per guy per foot • **Engineering rules:** Guy length to pole height ratio: 1.5 → $5.61 per guy (size 35 pole) • **Engineering rules:** Typical guy span: 1200 feet • **Labor Rates and Loadings:** Pole Total Material Loadings: .098305 → $0.131 per foot • **Plant Sharing Tables:** Aerial 48%	• **Structure Labor:** Size 35 pole: $452.97 per pole • **Engineering rules:** Size 35 pole spacing: 200 feet • **Engineering rules:** Typical aerial span: 1200 feet →7 poles over 1200 feet • **Structure Labor:** Size 35 pole: $452.97 per pole • **Structure Labor:** $184.25 per anchor • **Structure Labor: :** $25.60 per guy • **Engineering rules:** Typical guy span: 1200 feet • **Labor Rates and Loadings:** Pole: .1425 for engineering → $.401 per foot • **Plant Sharing Tables:** Aerial 48%

Sources for buried plant cost calculation

	Materials	Placement
Fiber	• **Fiber Material**: Size 24 Underground Material cost: $0.32878/foot * 1.42 for 48-fiber cable = $0.466 per foot • **Labor Rates and Loadings**: BuriedFO Total Material Loadings: .106440 → $0.050 per foot	• **Material Labor:** UndergroundFO Placing cost per foot**:** $0.00 • **Material Labor:** AerialFO Telco admin cost per foot**:** $0.0053 • **Labor Rates and Loadings:** AerialFO Engineering rate: .1925 → $0.001 per foot • **Splicing (see "Sources for Splicing" slide):** $0.531 per foot
Structure	• **NA**	• **Structure Labor:** Buried excavation, rural soft rock: $3.773 per foot • **Labor Rates and Loadings:** Conduit: .1425 for engineering → $0.538 per foot • **Plant Sharing Tables:** Rural, buried: 96.25%

Sources for underground plant cost calculation

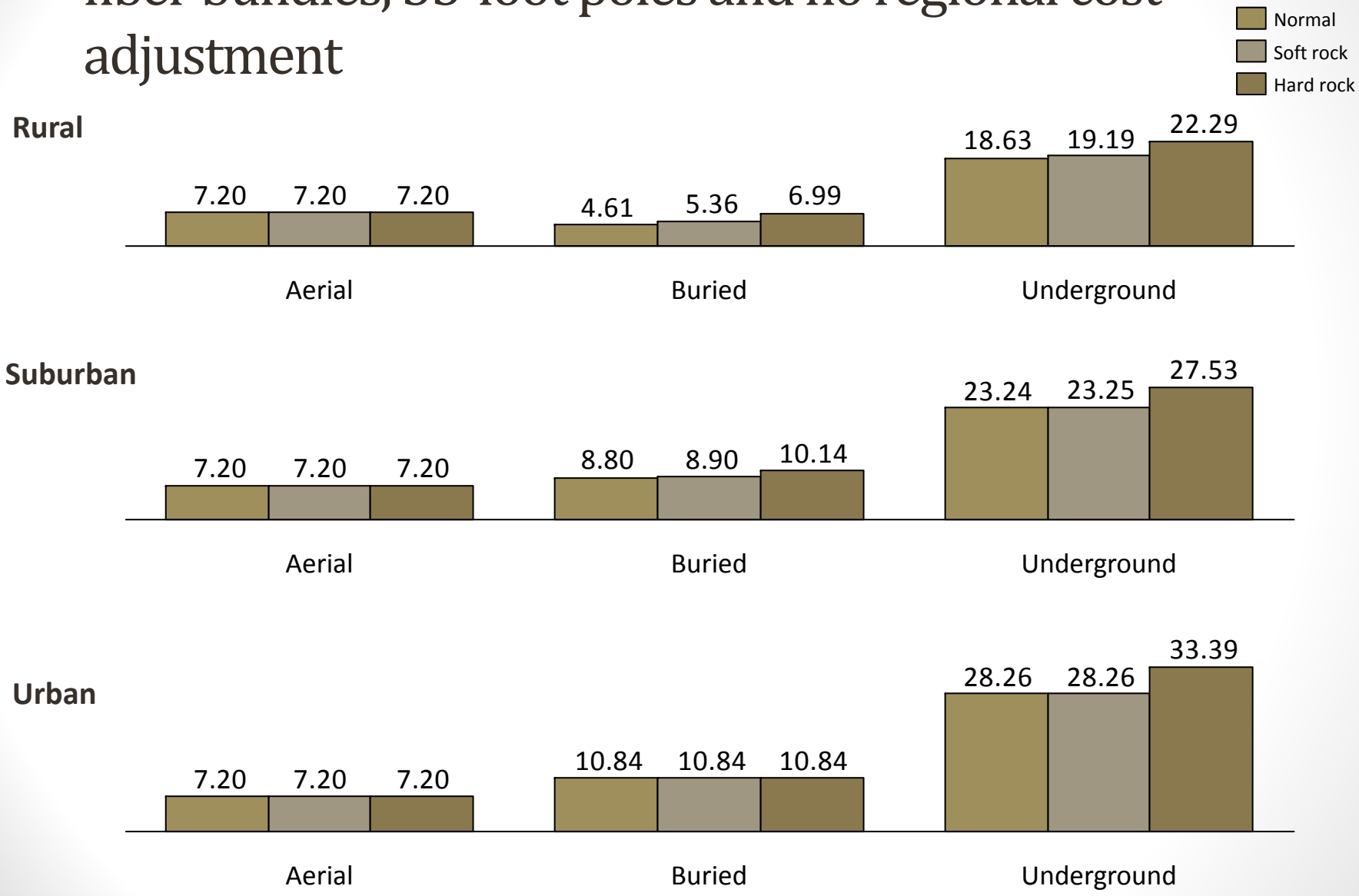
	Materials	Placement
Fiber	• **Fiber Material**: Size 24 Underground Material cost: $0.31407/foot* 1.42 for 48-fiber cable = $0.445 per foot • **Labor Rates and Loadings**: UndergroundFO Total Material Loadings: .127821 → $0.057 per foot	• **Material Labor:** UndergroundFO Placing cost per foot**:** $1.62* .142 for 48-fiber cable = $2.29 per foot • **Material Labor:** AerialFO Telco admin cost per foot**:** $0.0053 • **Labor Rates and Loadings:** AerialFO Engineering rate: .1925 → $0.442 per foot • **Splicing (see "Sources for Splicing" slide):** $0.582 per foot
Structure	• **Structure Material**: Size 2 manhole: $1372.10 • **Engineering rules:** Size 2 manhole spacing: 900 feet • **Structure Material:** Duct cost: $2.04/foot • **Labor Rates and Loadings:** Conduit: .130561 → $0.714 per foot • **Plant Sharing Tables:** Rural, underground: 95.78% (conduits are not shared)	• **Structure Labor:** Size 2, soft-rock manhole: $793.66 per manhole • **Engineering rules:** Size 2 manhole spacing: 900 feet • **Structure Labor:** Underground excavation, rural soft rock: $8.33 per foot • **Structure Labor:** Underground duct labor: $0.71 per foot • **Labor Rates and Loadings:** Conduit: .1425 for engineering → $1.42 per foot • **Plant Sharing Tables:** Rural, underground: 95.78% (conduits are not shared)

Sources for splicing cost

	Aerial	Buried	Underground
Closure and setup	• **Material Labor**: $83.85 • **Labor Rates and Loadings**: Engineering rate 0.1925 → $16.14 per splice	• **Material Labor**: $87.60 • **Labor Rates and Loadings**: Engineering rate 0.1925 → $16.86 per splice	• **Material Labor**: $121.80 • **Labor Rates and Loadings**: Engineering rate 0.1925 → $23.45 per splice
	Occurrences per foot (typical) determined by model/topology: 0.00084 (1 per 1189 feet)		
	• $0.084 / foot	• $0.088/ foot	• $0 .122 /foot
Splice cost	• **Material Labor**: $9.72 / fiber • **Labor Rates and Loadings**: Engineering rate 0.1925 → $1.87 per splice	• **Material Labor**: $9.46 /fiber • **Labor Rates and Loadings**: Engineering rate 0.1925 → $1.82 per splice	• **Material Labor**: $9.83/fiber • **Labor Rates and Loadings**: Engineering rate 0.1925 → $1.89 per splice
	Occurrences per foot (typical) determined by model/topology: 0.0393 (24 splices every 611 feet)		
	• $0.456 / foot	• $0.443/ foot	• $ 0.460 /foot
Total	• $0.540 / foot	• $0.531 / foot	• $0.582 / foot

Number of splices driven by network topology – splices are assumed wherever there is a branch (a "Y") in the network or when the number of strands drops enough to move to a smaller cable

Illustrative construction costs per foot assuming 48-fiber bundles, 35-foot poles and no regional cost adjustment



Calculating annual cost of initial investment: levelization using Annual Charge Factors

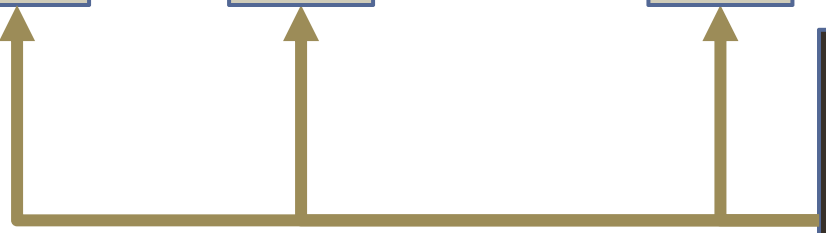
- Annual Charge Factors (ACFs) relate the initial investment to the cost over the useful lifetime of each asset – what is the monthly cost over time for a given investment
  - Based on lifetimes for each asset class using retirement curves
  - Includes asset replacement costs as well as future net salvage value or future net salvage cost as appropriate
  - Captures capital recovery (DEPR), and post-tax cost of money (COM and TAX)
- The model tracks each asset class separately (despite prior cost per foot calculation)
- Output is a cost per month for each asset attributable to each census block
- Asset classes include:
  - Aerial Fiber
  - Buried Fiber
  - Underground Fiber
  - Conduit
  - Circuit (network electronics)

Excel-based model (called the "CapCost model") is available to calculate ACFs for different assumptions

Operating expenses calculated with factors based on NECA data

Network plant specific opex (scales with investment in each plant type)

Plant specific [Plant type] **opex** = [Plant type] investment * ([Plant type] opex factor * (1 + size factor))



Plant types:
- Aerial fiber optic
- Poles
- Buried fiber optic
- Underground fiber optic
- Conduit systems
- Circuit

Non-network plant specific opex (scales with total investment)

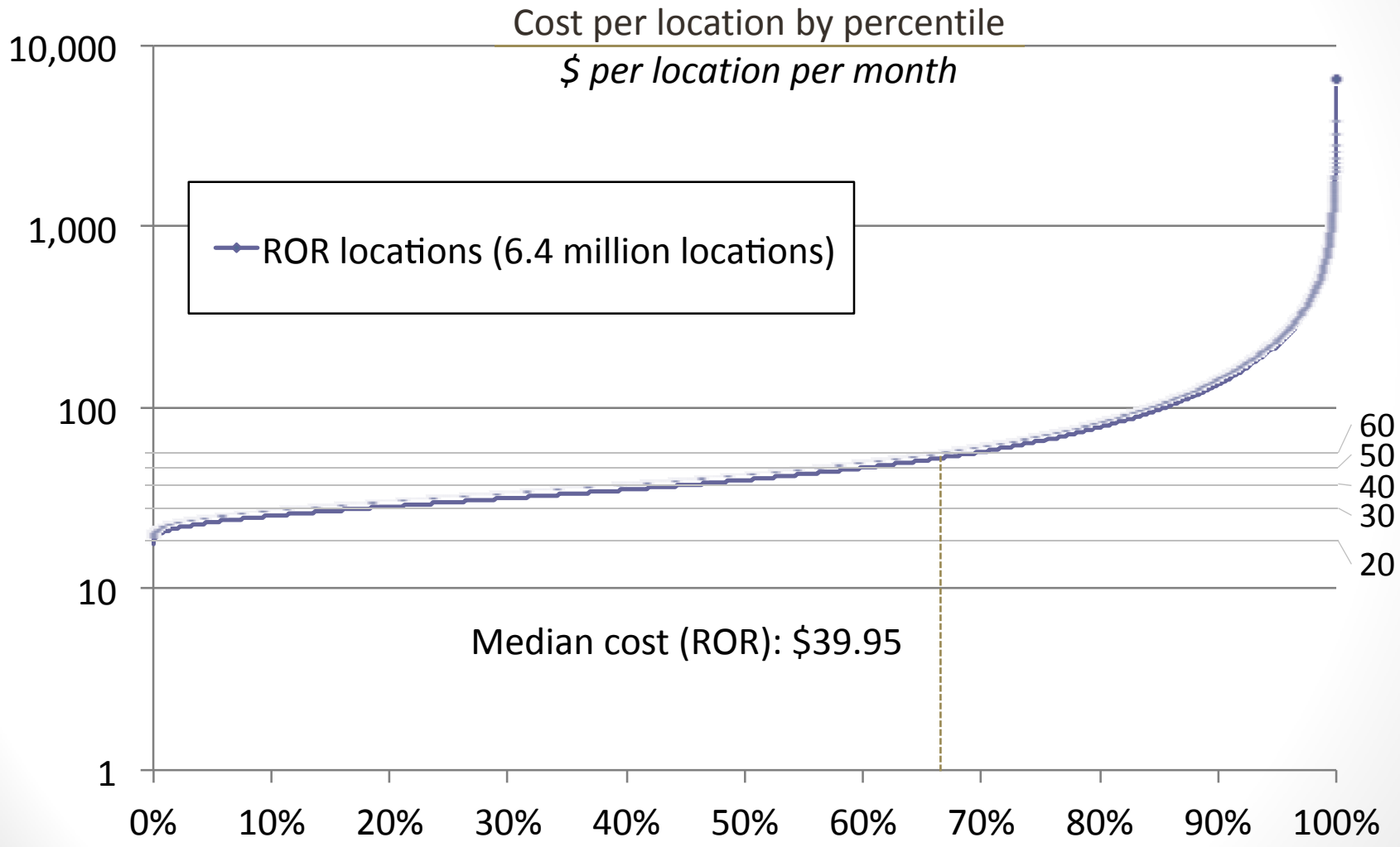
Plant non-specific opex = total plant investment * (network PNS factor * (1 + size factor))
Overhead G&A = total plant investment * (overhead G&A factor * (1 + size factor))

Additional opex (scales with number of customers)

Cust. ops & mark. opex = Customers * (Ops per customer * (1 + size factor))
Bad debt = Customers * (Bad debt per customer)

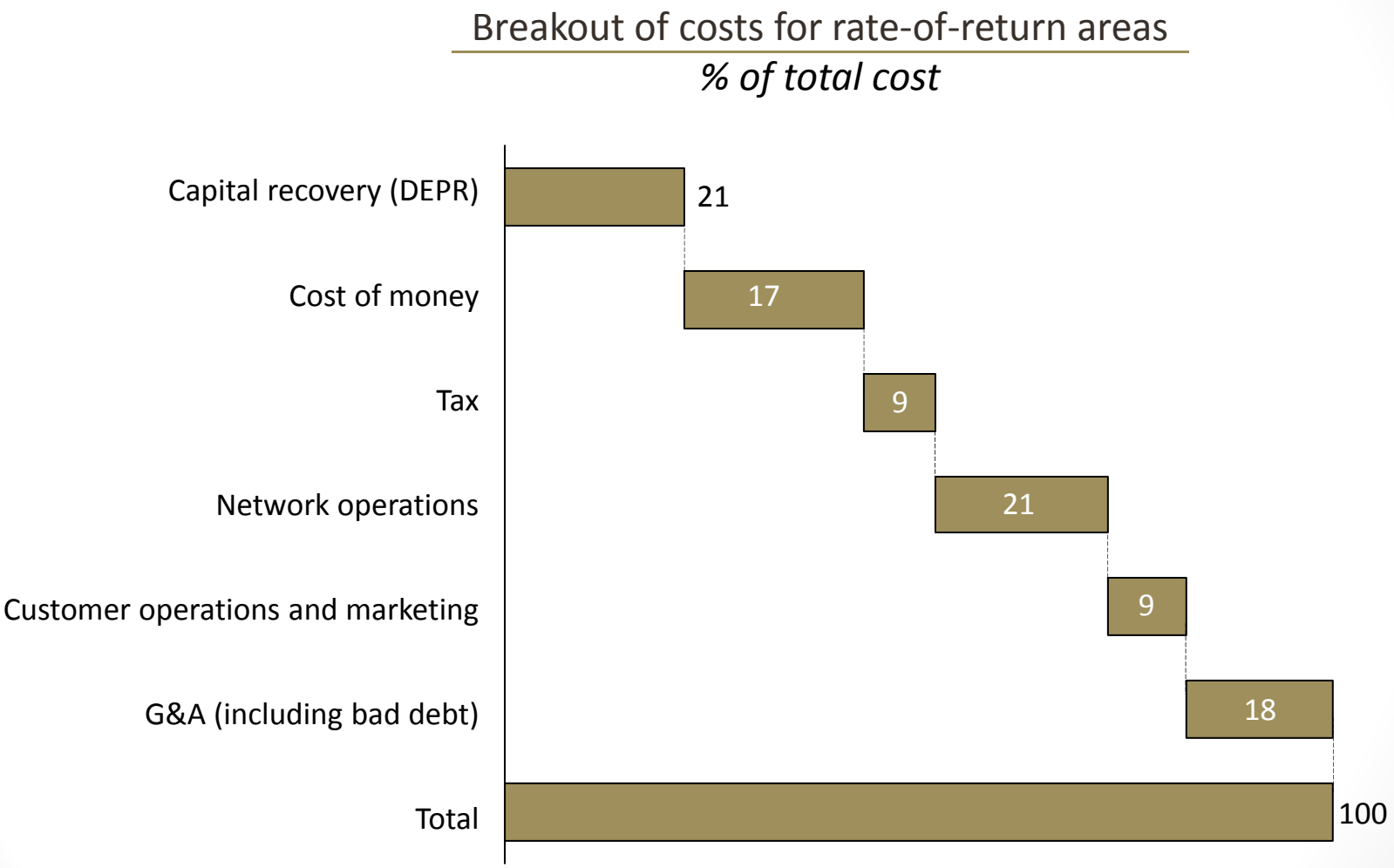
A-CAM ILLUSTRATIVE OUTPUT

Illustrative cost per location per month varies widely around the country*



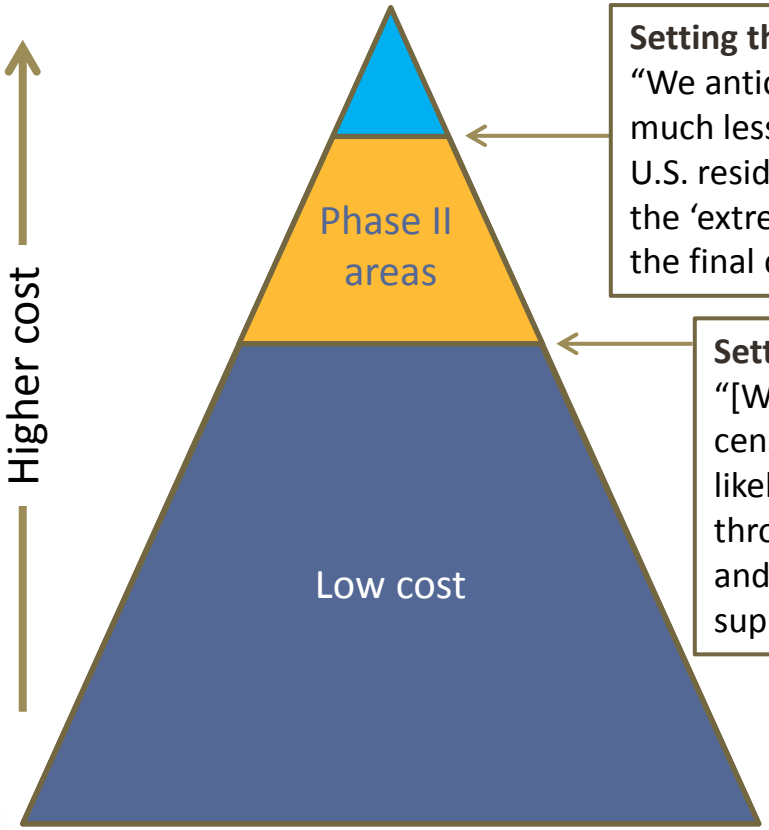
* Illustrative results A-CAM v1.0.1

Overall model results by cost category*



* Illustrative results for A-CAM 1.0.1

Support model for price cap carriers determined by Commission in 2011 Order



Setting the upper threshold
"We anticipate that less—and possibly much less—than one percent of all U.S. residences are likely to fall above the 'extremely high-cost' threshold in the final cost model" (fn 274)

Commission has not yet decided approach for ROR model

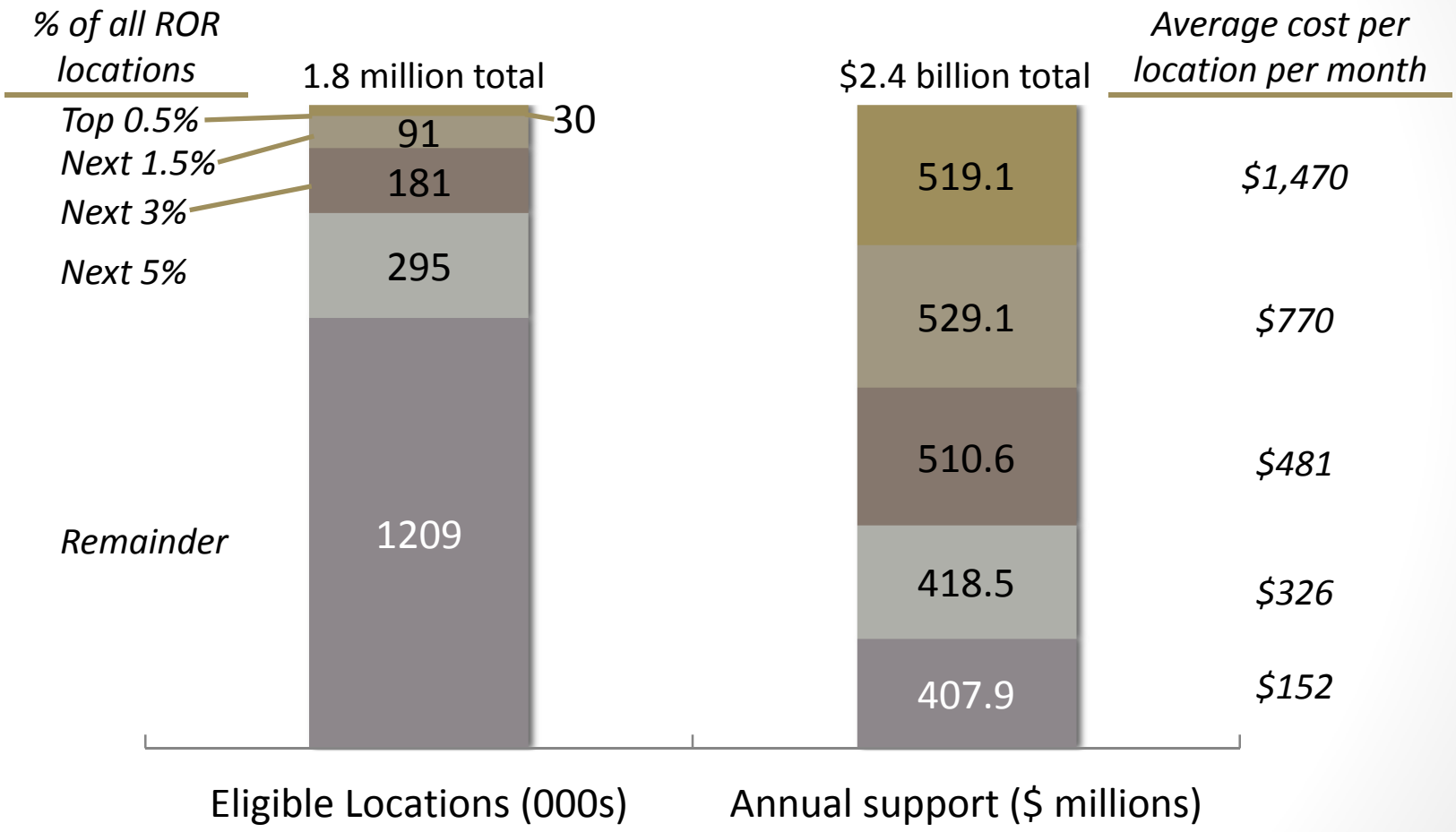
Setting the lower threshold
"[W]e will use the model to identify those census blocks where the cost of service is likely to be higher than can be supported through reasonable end-user rates alone, and, therefore, should be eligible for CAF support." (¶ 167)

Treatment of areas served by competition
"[W]e will also exclude areas where an unsubsidized competitor offers broadband service that meets the broadband performance requirements. . . ." (¶ 170)

Decisions regarding support calculation for rate-of-return carriers remain

- How to determine which areas are served by a competitor at 10 Mbps / 768 kbps or greater and therefore ineligible for support?
- What funding benchmark to use (i.e., what cost is not recoverable from a model-based mechanism)?
- Should costs be averaged over larger areas (e.g., census block groups)?
- What mechanism should be used to ensure that model-calculated support does not exceed the budget?
  - Use of an extremely high-cost threshold (locations with costs above this threshold are not eligible for support)?
  - Limit in support per location (with all locations above the funding benchmark eligible for support)?
  - Reduction in all support on a dollars-per-line or percentage basis?
  - Others?

Illustrative support calculation using A-CAM 1.0.1 model, a $52.50 benchmark and no mechanism to meet budget



Note: Excludes 356,000 locations served by unsubsidized competitors (providing at least 10 Mbps downstream and 768 kbps upstream) from eligibility for support; if not excluded, those locations would be eligible for another $200 million in support

Illustrative results currently posted on FCC website – introduction page

Federal Communications Commission
CAFII - A-CAM 1.0.1 - Report Version 1.1
March, 2015

All reports utilize A-CAM 1.0.1 output, providing Support & Locations per Rate of Return Carrier per State per Study Area.

Report Reference Number	Mechanism to meet budget	Exclusion of competitive areas from eligibility (non-cost based)	Benchmark	Extremely High-Cost Threshold (EHCT)
1.1	Adjust extemely high-cost threshold (no funding above EHCT)	SBI data showing cable or fixed wireless	$ 52.50	$ 563.38
1.2	Adjust extemely high-cost threshold (no funding above EHCT)	None	$ 52.50	$ 461.19
1.3	Limit support per location to $230	SBI data showing cable or fixed wireless	$ 52.50	$ 230 Funding Cap per location
1.4	None	None	$ 60.00	NA
1.5	None	SBI data showing cable or fixed wireless	$ 60.00	NA
1.6	None	SBI data showing cable or fixed wireless	$ 52.50	NA
1.7	None	None	$ 52.50	NA

Multiple scenarios with and without competitive area exclusions

Two illustrative values for Benchmark

The Commission directed the Bureau to make the adjustments necessary to the Connect America Cost Model so it could be used for rate-of-return areas, including incorporating updated study area boundaries. The Bureau is currently working on incorporating revised study area boundary data into the Alternative Connect America Cost Model (A-CAM).

The attached reports are published so that rate-of-return carriers can see how different assumptions in the support module impact the support calculated for a particular study area.

Two scenarios use an extremely high cost threshold as the mechanism to keep total calculated support within the total budget for rate-of-return carriers: Report 1.1 is similar to the approach adopted for the Connect America Cost Model that will be used to calculate the offer of support for price cap carriers utilizing a $52.50 funding benchmark, with census blocks that are shown as served by cable or fixed wireless on the National Broadband Map excluded from support calculations. Report 1.2 uses the same funding benchmark as Report 1.1, but does not exclude any census blocks above that benchmark that are shown as served on the National Broadband Map from support calculations.

A third scenario utilizes a different approach to keep total calculated support within the total budget for rate-of-return carriers: a per-location funding cap. Specifically, Report 1.3 uses the same funding threshold as the prior two scenarios, but instead imposes a cap of $230 per location on support provided for eligible census blocks.

A fourth scenario utilizes a higher funding benchmark than $52.50, based on the assumption that census block groups where the average cost per location is less than $60 typically are served by cable competitors. Specifically, Report 1.4 calculates support using a $60 funding benchmark excluding from support calculations those census block groups with an average cost below $60. This scenario does not exclude from support calculations any census block groups above that benchmark that are shown as served on the National Broadband Map. A fifth scenario also utilizes a higher funding benchmark than $52.50. Specifically, Report 1.5 calculates support utilizing a $60 funding benchmark, but does not average costs across census block groups and excludes census blocks that are shown on the National Broadband Map as served by cable or fixed wireless. Neither of these scenarios utilize an extremely high cost threshold and therefore calculate total support that exceeds the rate-of-return budget; parties to the proceeding have suggested other mechanisms to keep total support within the budget, such as reducing support per location evenly across all locations in order to meet the budget target.

Finally, two additional scenarios that do not contain any budget constraint on support calculations are presented. In Report 1.6, we show support calculations utilizing a $52.50 funding benchmark, with census blocks that are shown on the National Broadband Map as served by cable or fixed wireless excluded from support calculations. In Report 1.7, we show support calculations utilizing a $52.50 funding benchmark, and no exclusion of any areas shown as competitively served on the National Boradband Map. These scenarios with no extremely high cost threshold are provided so that interested stakeholders can consider alternatives to an extremely high cost threshold to bring total rate-of-return support within the $2 billion overall rate-of-return budget.

Illustrative results posted on FCC website

Federal Communications Commission
CAFII - A-CAM 1.0.1 - Report Version 1.1
Report Summary Totals
March, 2015

Report Reference Number	Mechanism to meet budget	Exclusion of competitive areas from eligibility (non-cost based)	Benchmark	Extremely High-Cost Threshold (EHCT)	Speed Definition	Total Rate of Return Locations	Total Number of Rate of Return Locations in Census Blocks Receiving Model-Based Funding	Total Rate of Return Carrier Model-Based Support	Annual High-Cost Claims 2014 Total Support less CAF ICC Support	# of SACs w/ACAM Support > 2014 Support	# of SACs w/ACAM Support < 2014 Support
1.1	Adjust extemely high-cost threshold (no funding above EHCT)	SBI data showing cable or fixed wireless	$ 52.50	$ 563.38	10/1	6,410,112	1,742,918	$ 1,624,998,788	$ 1,642,409,236	607	485
1.2	Adjust extemely high-cost threshold (no funding above EHCT)	None	$ 52.50	$ 461.19	10/1	6,410,112	2,066,398	$ 1,624,997,764	$ 1,642,409,236	645	447
1.3	Limit support per location to $230	SBI data showing cable or fixed wireless	$ 52.50	$ 230 Funding Cap per location	10/1	6,410,112	1,805,812	$ 1,622,635,716	$ 1,642,409,236	615	477
1.4	None	None	$ 60.00	NA	10/1 CBG	6,410,112	2,440,861	$ 2,078,817,060	$ 1,642,409,236	613	479
1.5	None	SBI data showing cable or fixed wireless	$ 60.00	NA	10/1	6,410,112	1,552,857	$ 2,234,512,857	$ 1,642,409,236	653	439
1.6	None	SBI data showing cable or fixed wireless	$ 52.50	NA	10/1	6,410,112	1,805,812	$ 2,385,131,894	$ 1,642,409,236	690	402
1.7	None	None	$ 52.50	NA	10/1	6,410,112	2,101,931	$ 2,584,741,723	$ 1,642,409,236	749	343

Support available and number of locations covered for illustrative values

ACAM Support greater than 2014 Support for more than 50% of Study Areas

Illustrative results posted on FCC website

Breakouts by state, carrier and study area

Federal Communications Commission
CAFII - A-CAM 1.0.1 - Report Version 1.1
Report 1.1 - Utilizes a Funding Benchmark of $52.50 and an Extremely High Cost Threshold of $563.38, Voice Cable Voice Fixed Wireless equal True
March, 2015

	607
	485
SAC Qty Total	1092

State	Rate of Return Carrier	Rate of Return Study Area	Rate of Return SAC	Total Rate of Return Locations	Total Number of Rate of Return Locations in Census Blocks Receiving Model-Based Funding	Total Number of Locations in Column F Census Blocks Lacking 10/1	Total Number of Rate of Return Locations in Census Blocks Above Extremely High Cost Threshold (If Applicable)	Percent - Rate of Return Locations Above Extremely High Cost Threshold / Total Rate of Return Locations	Total Rate of Return Carrier Model-Based Support	Annual High-Cost Claims 2014 Total Support less CAF ICC Support
ROR Sub Total	ROR Sub Total	ROR Sub Total	ROR Sub Total	6,410,112	1,742,918	986,337	66,253	1.03%	$ 1,624,998,788	$ 1,642,409,236
ROR State Sub	ROR State Sub	ROR State SubTotal	ROR State SubTo	6,410,112	1,742,918	986,337	66,253	1.03%	$ 1,624,998,788	$ 1,642,409,236
ROR Nationwi	ROR Nationwi	ROR Nationwide Total	ROR Nationwide	6,410,112	1,742,918	986,337	66,253	1.03%	$ 1,624,998,788	$ 1,642,409,236
ME	OXFR	OXFORD WEST TEL CO	100002	8,410	845	845	34	0.40%	615,446	560,856
ME	LNCL2	LINCOLNVILLE TEL CO	100003	14,272	608	608		0.00%	163,271	577,062
ME	TDS	COBBOSSEECONTEE TEL	100005	1,079				0.00%		109,352
ME	TDS	ISLAND TEL CO	100007	943	433	341		0.00%	192,163	33,048
ME	TDS	HAMPDEN TEL CO	100010	3,834	158	32		0.00%	31,919	287,286
ME	TDS	HARTLAND & ST ALBAN	100011	5,190	1,201	1,025	7	0.13%	444,831	278,484
ME	OXFR	OXFORD COUNTY TEL	100019	7,011	619	619	1	0.01%	270,473	712,742
ME	OTLC	PINE TREE TEL & TEL	100020	7,456				0.00%		463,482
ME	OTLC	SACO RIVER TEL & TEL	100022	10,135	5	5		0.00%	5,506	565,428
ME	TDS	SOMERSET TEL CO	100024	16,477	3,675	3,324	132	0.80%	2,692,488	757,578
ME	UNNR	UNION RIVER TEL CO	100027	3,209	2,355	527	141	4.39%	2,249,681	1,406,818
ME	UNTK	UNITY TEL CO., INC.	100029	5,301	1,002	1,002	1	0.02%	319,895	594,408
ME	TDS	WARREN TEL CO	100031	1,968				0.00%		118,806
ME	TDS	WEST PENOBSCOT TEL	100034	3,055	905	776	4	0.13%	225,406	187,452
ME	OTLC	MID MAINE TELECOM	103315	7,755	1,780	1,780	1			932
MA	OTLC	GRANBY TEL & TEL -MA	110036	2,966						360
MA	CRNR	RICHMOND TEL CO	110037	1,049	9	9				724
NH	LCTC	BRETTON WOODS TEL C	120038	357	26	26				010
NH	YNKT	GRANITE STATE TEL	120039	11,078	610	541				656
NH	DXVL	DIXVILLE TEL CO	120042	371	352	352				284
NH	DNBR	DUNBARTON TEL CO	120043	1,708	291	291				594
NH	TDS	KEARSARGE TEL CO	120045	9,212	300	168				940
NH	TDS	MERRIMACK COUNTY T	120047	7,520	1,148	480				806

Support available and number of locations covered for illustrative values

Additional information

- **General information about access to the model** using the Third Supplemental Protective Order available at http://www.fcc.gov/document/connect-america-phase-ii-third-supplemental-protective-order. The TSPO includes
  - Acknowledgement of Confidentiality
  - Licensing Agreement
  - Non-Disclosure Agreement (provides access to source code and "Systems Evaluator" package)
  - Existing users of CAM who have signed and filed the appropriate documents can contact CACMsupport@cosquests.com to get a new link for login credentials for A-CAM
- The current versions of CAM and A-CAM are available at https://cacm.usac.org
- Additional resources and information available on CACM website, including:
  - User Guide
  - Frequently Asked Questions and link to CAM Support desk (CACMsupport @costquest.com)
  - Model inputs and results
- In addition, links to model documentation, illustrative results and additional A-CAM resources available on FCC website:
  - http://www.fcc.gov/encyclopedia/rate-return-resources

Inputs

REFERENCE MATERIAL

A-CAM External Data Sources

Data Category	Model Variables	Data Source
Census boundaries	Full Census Block; full Census Block Group; full Census Tract; full Census County; Census State	TIGER\Line 2010
Service Area boundaries and Central Office locations	Service Area boundaries, codes and Central Office points, as adjusted by public comment and USAC review	FCC, Public Notice
Geographic characteristics	Land area; total road length;	TIGER\Line 2010
Terrain	Terrain characteristics	USDA, NRCS-STATSTGO, SSURGO
Housing Units	Occupied housing units; total housing units; total households by block. Adjusted by Census Population and Housing Unit Estimates	Census 2010, SF1 housing units. Census Population and Housing Unit Estimates, 2011
Provider size and organizational structure	Corporate ownership; size of parent company; number of wire centers operated by carrier	ABC Coalition Members, Support Feedback, FCC, USAC
Company Opex financial data	A wide array of company-specific financial information (and underlying business volumes) from public and subscription service sources. Data centers on operating expense by category (e.g., maintenance, sales, interconnection, sales and marketing, G&A, bad debt, taxes, etc.).	Data sources available in methodology
High capacity locations	High capacity locations represent high demand business points and will be used to improve business location points for sizing the network. Community Anchor Institutions (CAI) taken from National Broadband Map.	GeoResults 3Q2012 National Building Database and Detail Business File. CAI from SBI Round 6
Wireless tower location	Wireless tower locations represent locations requiring fiber service and are used to supplement business and residential customer points for sizing the network.	CostQuest proprietary tower database

A-CAM Demand Data

- For A-CAM, GeoResults customer address data was used
  - Recognized shared buildings
  - Address was geocoded using Alteryx
    - Success rates: 96% for Res, 94% for business
      - Success indicates address or segment level geocode accuracy
  - Poorly geocoded residential data was discarded
- Residential Housing Unit (HU) counts are trued up with 2011 estimated census HU counts by census block

	GeoResults Based						
	ResOnly and BusOnly Node4		Shared Res/Bus Node4				
	Res	Bus	Res	Bus	Res - Census	CAI	Towers
"Buildings"	66,913,509	9,340,923	10,198,588		41,592,243	299,848	164,135
"Customers"	73,371,595	15,413,924	19,123,793	13,856,031	41,592,243	299,848	164,135

Inputs: ACF

- Annual Charge Factor (ACF)
  - This table captures the Annual Charge Factors that convert Investment into monthly costs
    - The values loaded into A-CAM are produced by CostQuest's CapCost model which is available for download
    - The basis of the model is the economic determination of the depreciation, cost of money, and income taxes associated with various plant categories
    - The calculation incorporates industry standard procedures, such as Equal Life Group methods, inclusion of future net salvage, impact of deferred taxes, and mid-year conventions
    - Key inputs into the derivation are lives of plant, assumed tax lives, survival curve shapes, cost of money, cost of debt, debt/equity split, and future net salvage
      - Uses depreciation lives consistent with those prescribed by the FCC's Wireline Competition Bureau's latest general depreciation in CC Docket No. 92-296
  - Converts Investment into monthly values of Depreciation (DEPR), Cost of Money (COM), and Income Taxes (TAX)

Inputs: ACF

Account	Economic Life (years)	Tax Life (years)	Future Net Salvage (percent)
Land	0	0	0%
Motor Vehicle	7.5	3	10%
Tower	25	3	0%
Radio	9	5	0%
Microwave	9	5	0%
Building	40	31.5	0%
Furniture	15	5	10%
Office Support	10	5	0%
General Purpose Computers	6	5	0%
Switching	12	5	0%
Circuit/DLC	11	5	0%
Pole	25	15	-75%
Aerial Copper	20	15	-35%
Aerial Fiber	25	15	-25%
Underground Copper	25	15	-30%
Underground Fiber	25	15	-20%
Buried Copper	20	15	-10%
Buried Fiber	25	15	-10%
Conduit	50	15	-10%

Financial Data		
ReturnOnEquity	9.7%	Return on Equity
DebtRate	7.0%	Debt Rate
DebtRatio	25.0%	Debt Ratio
DiscountRate	9.00%	Discount Rate
Tax Data		
FederalTaxRate	34.0%	Federal Tax Rate
StateTaxRate	5.3%	State Tax Rate

CostQuest CapCost Model

PlantAcct	COM	DEPR	FedTAX	StateTAX	OthTAX
AerialCU	0.0042	0.0059	0.0018	0.0003	0.0000
AerialFO	0.0043	0.0045	0.0018	0.0003	0.0000
Building	0.0052	0.0023	0.0022	0.0004	0.0000
BuriedCU	0.0043	0.0047	0.0018	0.0003	0.0000
BuriedFO	0.0044	0.0038	0.0018	0.0003	0.0000
Circuit	0.0033	0.0076	0.0014	0.0002	0.0000
Conduit	0.0049	0.0019	0.0020	0.0003	0.0000
DSLAM	0.0033	0.0076	0.0014	0.0002	0.0000
Furniture	0.0032	0.0052	0.0013	0.0002	0.0000
Computers	0.0035	0.0136	0.0015	0.0002	0.0000
Land	0.0075	0.0000	0.0031	0.0005	0.0000
Microwave	0.0034	0.0092	0.0014	0.0002	0.0000
MotorVehicles	0.0033	0.0097	0.0014	0.0002	0.0000
OfficeSupport	0.0029	0.0085	0.0012	0.0002	0.0000
Pole	0.0043	0.0061	0.0018	0.0003	0.0000
Radio	0.0034	0.0092	0.0014	0.0002	0.0000
Switching	0.0034	0.0069	0.0014	0.0002	0.0000
Tower	0.0034	0.0035	0.0014	0.0002	0.0000
UgdCU	0.0043	0.0046	0.0018	0.0003	0.0000
UgdFO	0.0043	0.0043	0.0018	0.0003	0.0000

Development of the ACF inputs

Inputs: Bandwidth

- Bandwidth
  - Provides the busy hour bandwidth
  - Used to size appropriate network components

Tech3	VoiceBandwidth	DataLowBandwidth	DataHighBandwidth
FTTn	0.00	0.440	0.440
FTTd	0.00	0.440	0.440
FTTp	0.00	0.440	0.440

Inputs: Business Take Rate

- Business Take
  - Derives the voice and data demand for the business market

Tech1	LowerCTDensity	UpperCTDensity	CT	Tech3	GorB	Competitors	DataLowTakeRate	DataHighTakeRate	VoiceTakeRate
Telco	*Lower Census Track Location Density*	*Upper Census Track Location Density*	*Census track*	*Type of network: FTTd, FTTn, FTTp*	*Represents take for Greenfield (G) build or Brownfield (B) augmentation or ALL*	*Broadband Competitors (0, 1, 2)*	*% of Active customers with Broadband Voice only*	*% of Active customers taking Broadband data service*	*% of Active customers taking Voice service*
Telco	0	10000000000	#	@	A	0	0%	80%	80%
Telco	0	10000000000	#	@	A	1	0%	40%	40%
Telco	0	10000000000	#	@	A	2	0%	27%	27%

Inputs: Capex

- Capex
  - Provides the material and installation costs for the plant build
  - Data are applied against the network topology data to derive total build-out investment levels
  - Inputs capture technology, network node, network function, and plant sharing

Inputs: Capex

Sample Capex Inputs

Fiber Cable

Plant Type	Type or Size	Underground Material Cost	Buried Material Cost	Aerial Material Cost
Fiber	24	$ 0.31	$ 0.33	$ 0.31
	48	0.44	$ 0.45	$ 0.44
	72	0.57	$ 0.58	$ 0.57
	96	$ 0.64	$ 0.64	$ 0.63
	144	$ 0.81	$ 0.80	$ 0.81
	216	1.10	$ 1.12	$ 1.10
	288	1.49	$ 1.50	$ 1.49
	360	1.87	$ 1.88	$ 1.87
	432	2.24	$ 2.24	$ 2.23
	576	3.00	$ 3.01	$ 2.99

Aerial Structure

Plant Type	Type or Size	Material Cost
Poles	25	$ 131.92
	30	$ 154.99
	35	$ 214.61
	40	$ 303.10
	45	$ 337.90
	50	$ 416.39
	55	$ 539.92
	60	$ 695.86
Anchor	NA	$ 86.56
Guy (all types)	NA	$ 0.11

Fiber Splitter (PFP / FDH)

Item	MaterialCost	Minimum Capacity	Maximum Capacity	CapacityUOM
Cabinet	$ 2,719.60	-	128	ONTs
Cabinet	$ 4,335.47	129	256	ONTs
Cabinet	$ 7,312.89	257	512	ONTs
Splitter	$ 903.06	-	16	ONTs
Splitter	$ 1,010.86	-	32	ONTs

Telco Media (copper and fiber cable) Splicing and Placing Labor Costs

Item	Closure and Setup (Cost per Splice)	Placing Cost per Foot	Splicing (cost per 100pairs or per FO strand)	Telco Admin/Inspect Hrs per Media Segment
AerialFO	$ 83.85	$ 0.84	$ 9.72	0.22
BuriedFO	$ 87.60	$ -	$ 9.46	0.22
UndergroundFO	$ 121.80	$ 1.62	$ 9.83	0.22

Inputs: COSize

- COSize Adjustment
  - Provides the user the capability to adjust the assumed purchasing power of small, medium, and large providers
  - The current inputs assume that all providers can achieve the same purchasing power (either as a result of their size or their ability to buy as a consortium)

Tech2	CoSize	AdjRate
Copper	S	1
Copper	M	1
Copper	L	1
Copper	Y	1
Copper	Z	1
Fiber	S	1
Fiber	M	1
Fiber	L	1
Fiber	Y	1
Fiber	Z	1

Inputs: COSize

- OCNCoSize
  - Provides correspondence for OCN, company size category and SAC
  - Categorizes the size of each company

CoSize	ILECHoldingCompanyName	OCN	ShortNan	SAC	State	USACStudyAreaName
S		3314	SML	100002	ME	OXFORD WEST TEL CO
S		3311	SML	100003	ME	LINCOLNVILLE TEL CO
S		0003	SML	100003	ME	LINCOLNVILLE TEL CO
M		0004	Fair	100004	ME	CHINA TEL CO.
M		0005	TDS	100005	ME	COBBOSSEECONTEE TEL
M		0007	TDS	100007	ME	ISLAND TEL CO
M		0010	TDS	100010	ME	HAMPDEN TEL CO

Inputs: COSize

- OCNCOSize
  - Determining the Size Category for each company
    - Company ownership (i.e., Holding Company) based on file from FCC
    - Company Size Categories
      - XXSmall: 0 – 1000 lines
      - Xsmall: 1000 – 4000 lines
      - Small: 4000 – 100,000 lines
      - Medium: 100,000 – 1M lines
      - Large: > 1M lines
    - Company size drives
      - Opex, Capex differentiation

Inputs: Operational Cost (Opex)

- Opex
  - Based upon NECA, ARMIS, public reports, and information provided by various telcos
  - Provides the estimated operation costs to run and maintain voice and broadband-capable networks

Inputs: Operational Cost (Opex)

Opex

- Network Operation Expense
  - Plant Specific
    - Outside Plant Cable by Cable Type
    - Poles
    - Conduit
    - Circuit / Transport
  - Plant Non-Specific
    - Network Operating Expense
    - General Support & Network Support
- General & Administrative (overhead)
- Selling & Marketing
- Bad Debt

Inputs: Operational Cost (Opex)

Opex

- Portion of Opex input table

						DENSITY				SIZE ADJUSTMENT			
Cost Face				Driver/CostType		Large Urban	Large Suburban	Large Rural	Code Source	Medium size Company (100,000 to 1,000,000 Loops)	Small Company (4,000 to 99,999 Loops)	XSmall Company (1,000 to 3,999 Loops)	XXSmall Company (< 1,000 Loops)
CostFam	CostArea	CostCntr	CostElem	QtyUOM (Driver)									
										-17.49%	26.16%	22.05%	52.24%
Network	Plant Specific	Cable & Wire Expense	FO Aerial Expense	Investment		0.0375600	0.0375600	0.0494765		-26.96%	29.59%	47.82%	64.33%
			FO Aerial Expense	Investment		0.0053131	0.0053131	0.0121196		-26.96%	29.59%	47.82%	64.33%
			FO Underground Expense	Investment		0.0414877	0.0414877	0.0368124		-26.96%	29.59%	47.82%	64.33%
			Poles expense	Investment		0.0255119	0.0255119	0.0191459		-26.96%	29.59%	47.82%	64.33%
			Conduit Systems expense	Investment		0.0037020	0.0037020	0.0027929		-26.96%	29.59%	47.82%	64.33%
		Circuit Equipment / Transport		Investment		0.0279932	0.0279932	0.0248874		0.01%	36.29%	40.66%	132.71%
		Switching		Investment		0.0847925	0.0847925	0.1194936		0.01%	36.29%	40.66%	132.71%
	Plant Non-Specific	Network Operating Expense		Investment		0.0218370	0.0218370	0.0144184		-5.34%	13.76%	-8.86%	7.62%
		General Support & Network Support Expense		Investment		0.0158211	0.0158211	0.0104291		-28.55%	14.73%	-5.88%	23.08%
Customer Operations	Sales & Marketing	n/a	n/a	Node4WorkingCust		6.81	6.81	6.81		0	-7.00%	24.01%	67.80%
Customer Operations	Sales & Marketing	n/a	n/a	Investment		-	-	-		4.70%	-41.22%	-67.35%	-112.88%
General & Administration	G&A	n/a	n/a	Node4WorkingCust		-	-	-		20.37%	81.46%	223.31%	526.47%
General & Administration	G&A	n/a	n/a	Investment		0.035029	0.035029	0.023553		18.08%	28.45%	102.56%	205.84%
Uncollectible revenue	Bad Debt	n/a	n/a	Node4WorkingCust		1.05	1.05	1.05		0	0	0	0
Uncollectible revenue	Bad Debt	n/a	n/a	Investment		0.002862	0.002862	0.002862		0	0	0	0

Inputs: Plant Mix

- PlantMix
  - Provides the estimated mix of outside plant facilities by type: aerial, buried, and underground required to serve an area

		Dist			FDR			IOF		
State	Density	Aerial	Buried	Under	Aerial	Buried	Under	Aerial	Buried	Under
@	Rural	29.8%	67.9%	2.2%	34.1%	55.5%	10.4%	33.2%	57.5%	9.3%
@	Suburban	29.3%	65.2%	5.5%	23.0%	44.9%	32.0%	23.8%	49.5%	26.8%
@	Urban	36.2%	54.9%	8.9%	15.4%	33.5%	51.1%	17.8%	39.6%	42.5%
AK	Rural	25.00%	65.00%	10.00%	25.00%	65.00%	10.00%	28.00%	58.00%	14.00%
AK	Suburban	23.76%	72.24%	4.00%	23.76%	72.24%	4.00%	24.00%	55.00%	21.00%
AK	Urban	20.00%	56.00%	24.00%	20.00%	56.00%	24.00%	15.00%	50.00%	35.00%
AL	Rural	34.4%	64.9%	0.7%	37.6%	55.8%	6.6%	34.8%	59.6%	5.6%
AL	Suburban	28.4%	68.7%	3.0%	26.0%	47.9%	26.1%	26.0%	54.1%	19.9%
AL	Urban	38.5%	54.8%	6.7%	20.6%	26.8%	52.6%	21.8%	34.3%	43.9%
AR	Rural	15.3%	83.6%	1.1%	17.8%	73.6%	8.6%	15.1%	77.3%	7.6%
AR	Suburban	15.3%	81.7%	3.0%	10.8%	68.3%	20.9%	10.8%	73.3%	15.9%
AR	Urban	20.3%	73.6%	6.0%	7.2%	50.5%	42.2%	9.7%	56.8%	33.5%

Inputs: Property Tax

- Ptax
  - Sourced from property tax rates in each state compared to a national average
  - Provides the impact of property tax on the G&A operation costs given the difference of the state rates versus the national average
  - Captured in the multiplier used for the operational element

State	AdjRate
AK	1.0514
AL	0.9029
AR	0.9664
AZ	0.9804
CA	0.9745
CO	0.9649
CT	1.0318
DC	0.9979
DE	0.9880
FL	0.9871
GA	1.0378
HI	0.9874

Inputs: Regional Adjustment

- RegionalCostAdjustment
  - Sourced from third party source – RSMeans (2011)
  - Provides the estimated difference in the cost to build and operate in each part of the county
  - Used to drive differences in Capex and Opex costs due to labor and material cost differences across the country at the ZIP3 level
    - Applied to All Capex and indirectly to specific Opex components that are derived from Capex

State	Zip3	City	AdjRate
NA	000	NA	0.93
NA	001	NA	0.93
NA	002	NA	0.93
NA	003	NA	0.93
NA	004	NA	0.93
NY	005	MID-ISLAND	0.99
PR	006	SAN JUAN	0.78
PR	007	SAN JUAN	0.78
PR	008	SAN JUAN	0.78
PR	009	SAN JUAN	0.78
MA	010	SPRINGFIELD	1.04
MA	011	SPRINGFIELD	1.04
MA	012	PITTSFIELD	1.02
MA	013	SPRINGFIELD	1.02
MA	014	CENTRAL	1.07
MA	015	CENTRAL	1.10
MA	016	WORCESTER	1.10
MA	017	CENTRAL	1.11
MA	018	MIDDLESEX-ESX	1.13
MA	019	MIDDLESEX-ESX	1.13
MA	020	BROCKTON	1.18
MA	021	BOSTON	1.18
MA	022	BOSTON	1.18
MA	023	BROCKTON	1.12
MA	024	NORTHWEST BOS	1.18
MA	025	CAPE COD	1.07
MA	026	CAPE COD	1.09
RI	027	PROVIDENCE	1.10
RI	028	PROVIDENCE	1.05
RI	029	PROVIDENCE	1.05

Inputs: State Sales Tax

- StateSalesTax
  - Sourced from appropriate sales tax rates for telecommunications plant in each state
  - Impacts Capex derivation, applies State Sales Tax to material

State	SalesTax
AL	0.0715
AK	0.0086
AZ	0.0777
AR	0.0736
CA	0.0796
CO	0.0475
CT	0.06
DC	0.0575
DE	0
FL	0.0663
GA	0.0676
HI	0.0438

Inputs: Residential Take Rate

- Residential TakeRate
  - Derives the data and voice demand for the residential market

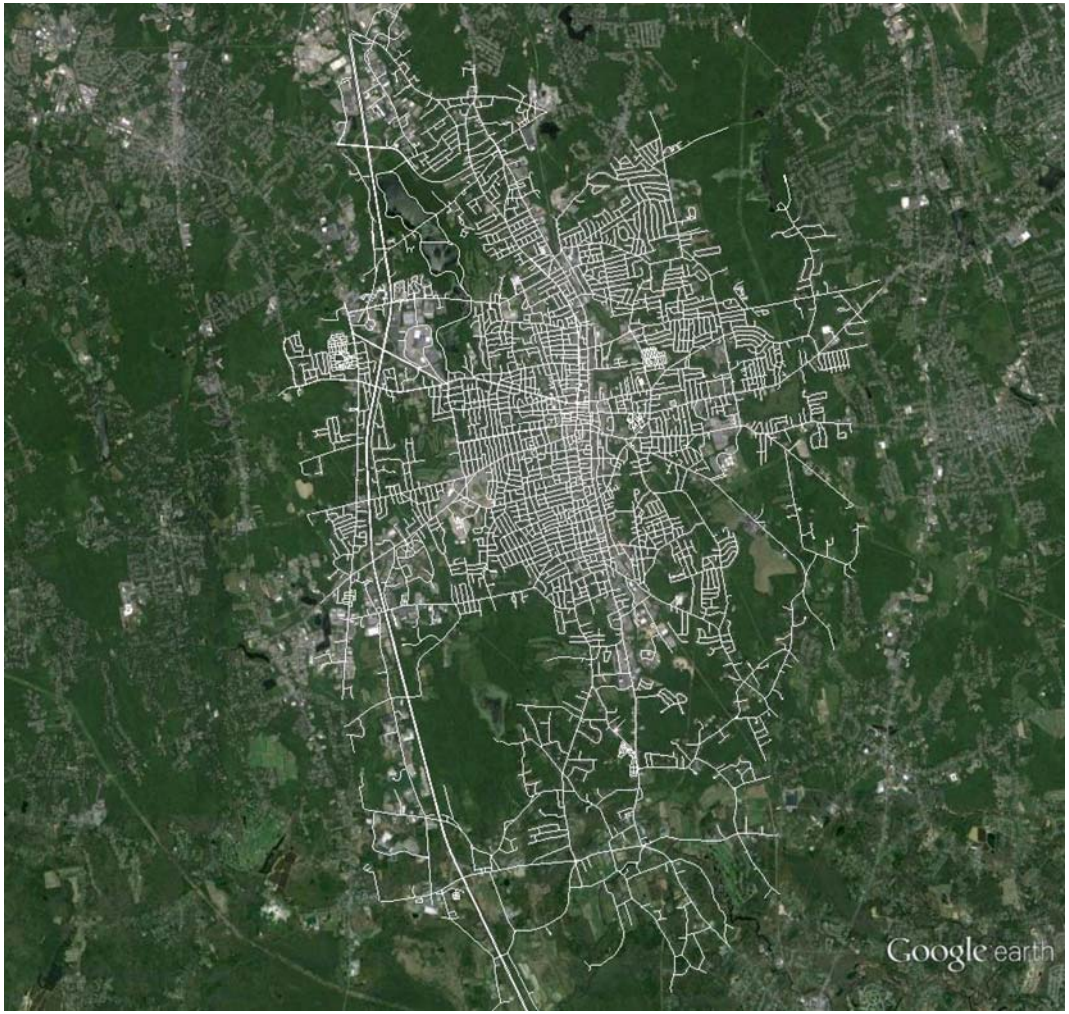
Tech1	LowerCTDensity	UpperCTDensity	CT	Tech3	GorB	Competitors	DataLowTakeRate	DataHighTakeRate	VoiceTakeRate
Telco	*Lower Census Track Location Density*	*Upper Census Track Location Density*	*Census track*	*Type of network: FTTd, FTTn, FTTp*	*Represents take for Greenfield (G) build or Brownfield (B) augmentation or ALL*	*Broadband Competitors (0, 1, 2)*	*% of Active customers with Broadband Voice only*	*% of Active customers taking Broadband data service*	*% of Active customers taking Voice service*
Telco	0	10000000000	#	@	A	0	0%	80%	80%
Telco	0	10000000000	#	@	A	1	0%	40%	40%
Telco	0	10000000000	#	@	A	2	0%	27%	27%

Network Topology Review

REFERENCE MATERIAL

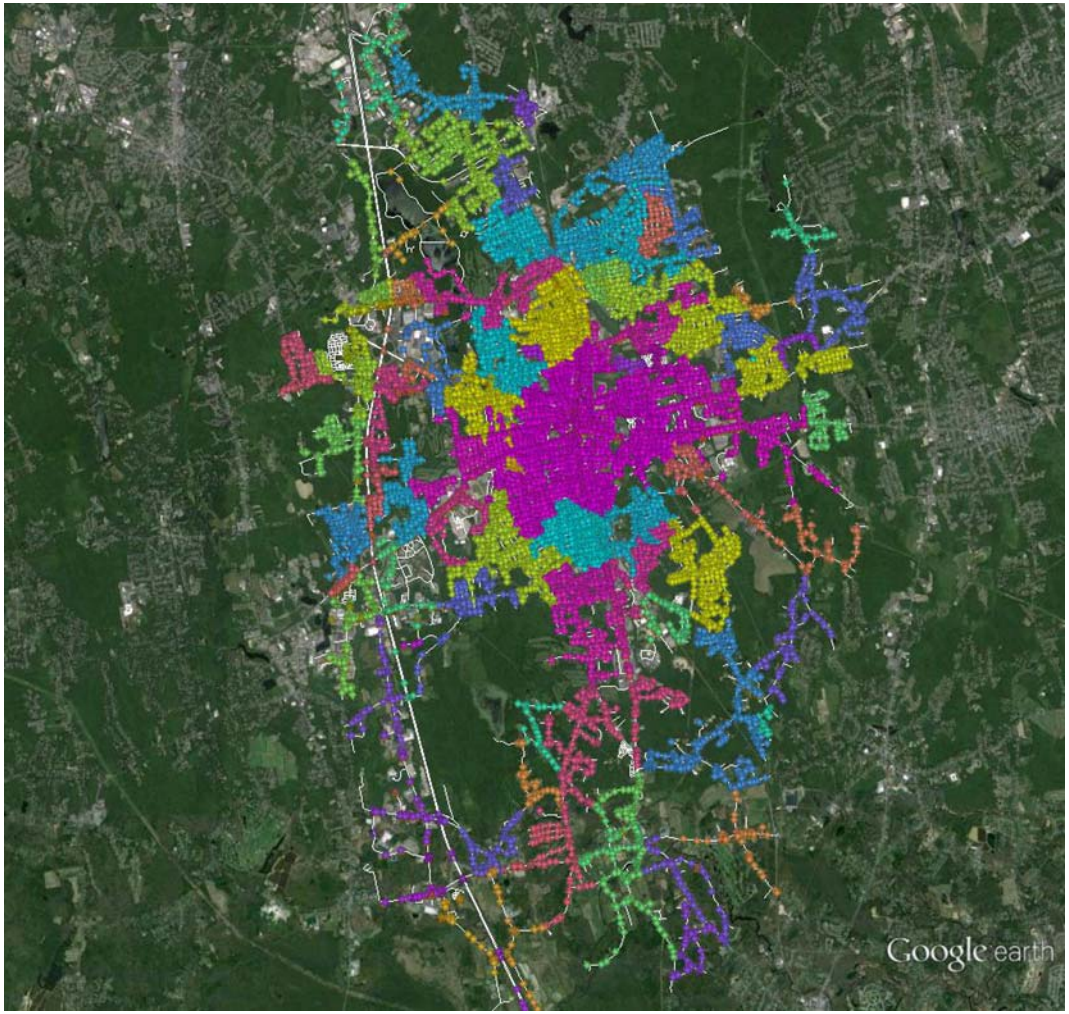
Portions of the material provided courtesy of the FCC May, 2015

A-CAM Network Topology



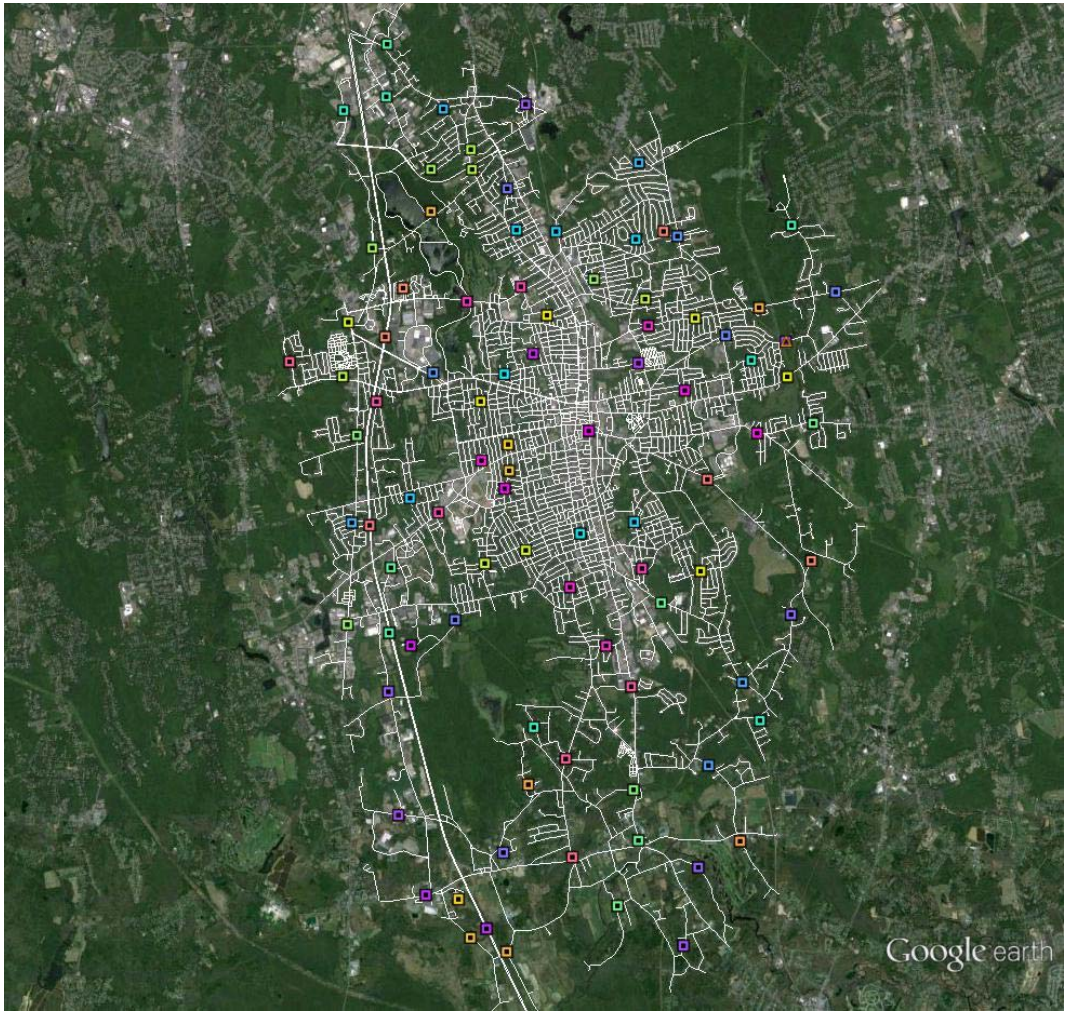
Service Area Footprint – Roads

A-CAM Network Topology



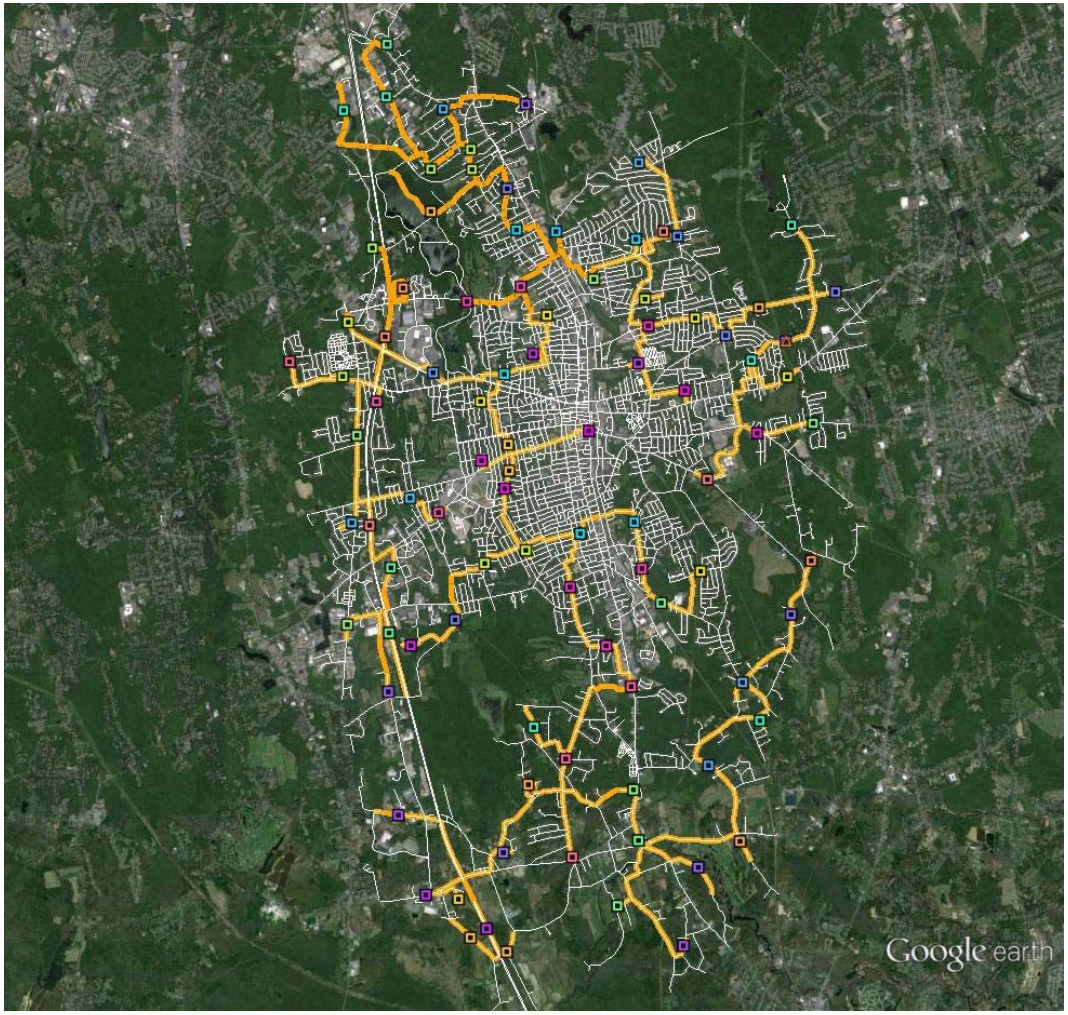
Service Area Footprint – Pedestals for Customers

A-CAM Network Topology



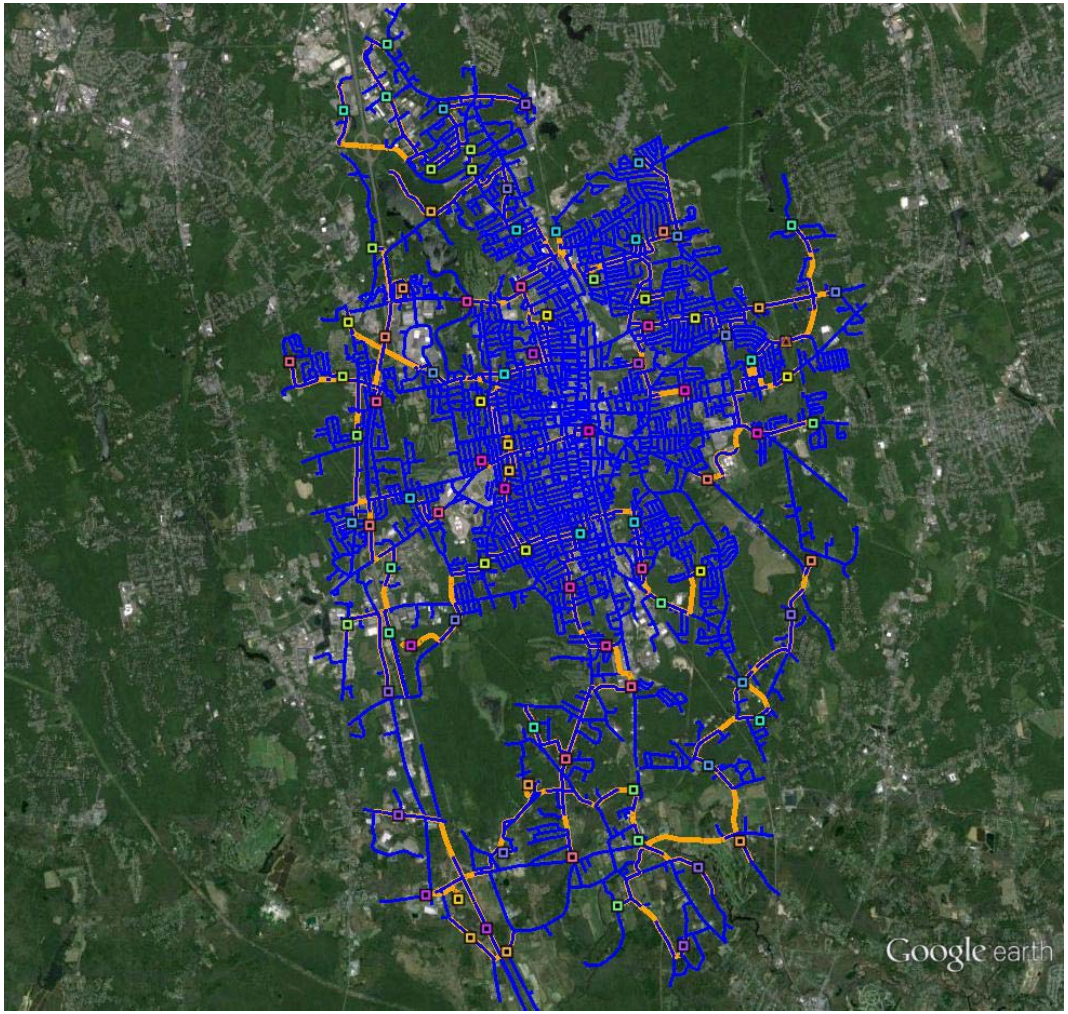
Service Area Footprint – Splitters

A-CAM Network Topology



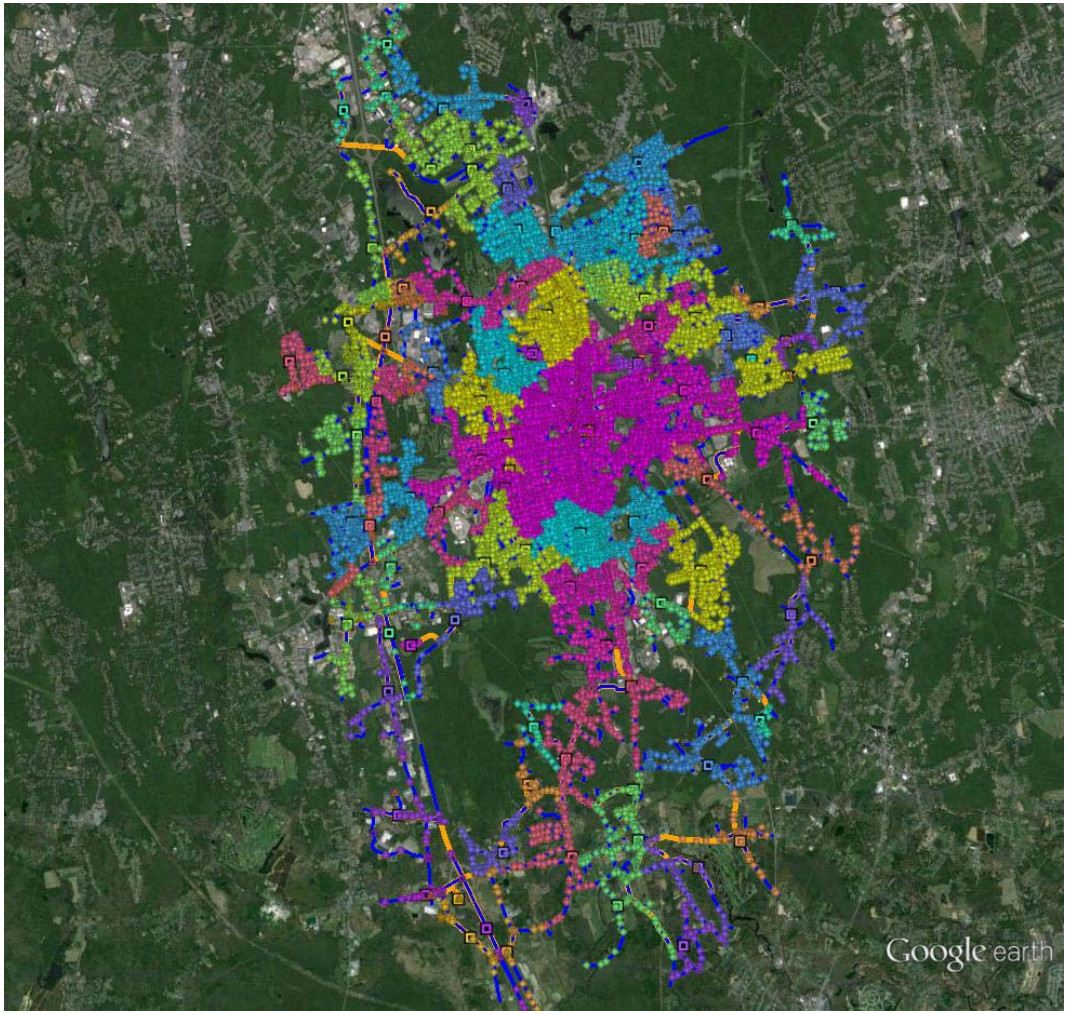
Service Area Footprint – Feeder Routing

A-CAM Network Topology



Service Area Footprint – Distribution Routing

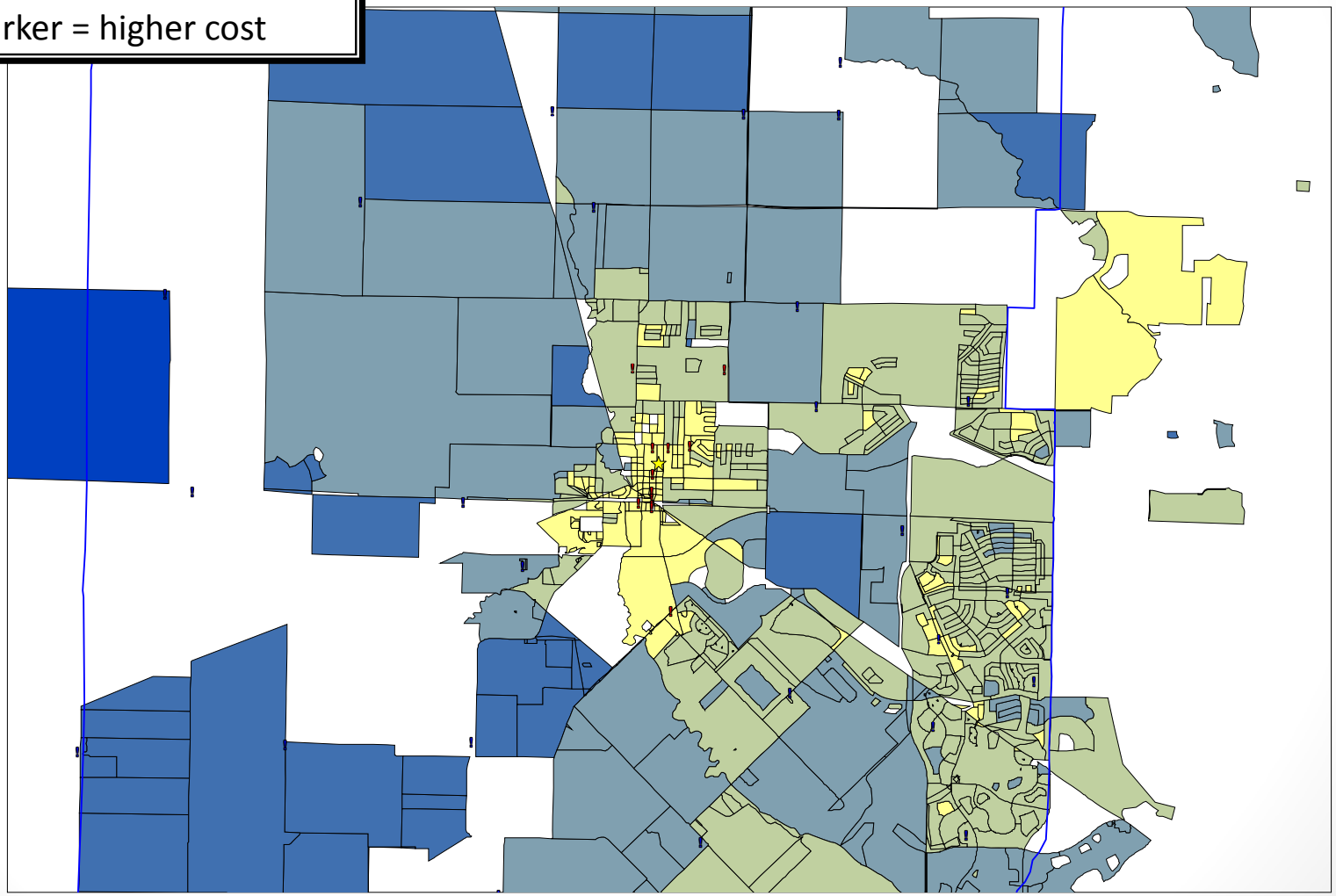
A-CAM Network Topology



Service Area Footprint – FTTp Network

A-CAM Network Topology

Census Block Cost Surface
- Darker = higher cost



Portions of the material provided courtesy of the FCC May, 2015