

Connect America Cost Model Overview
September 12, 2013



**Federal
Communications
Commission**

Agenda

- Background
- Key elements of model
- Illustrative model outputs (inputs not adopted)
- Resources

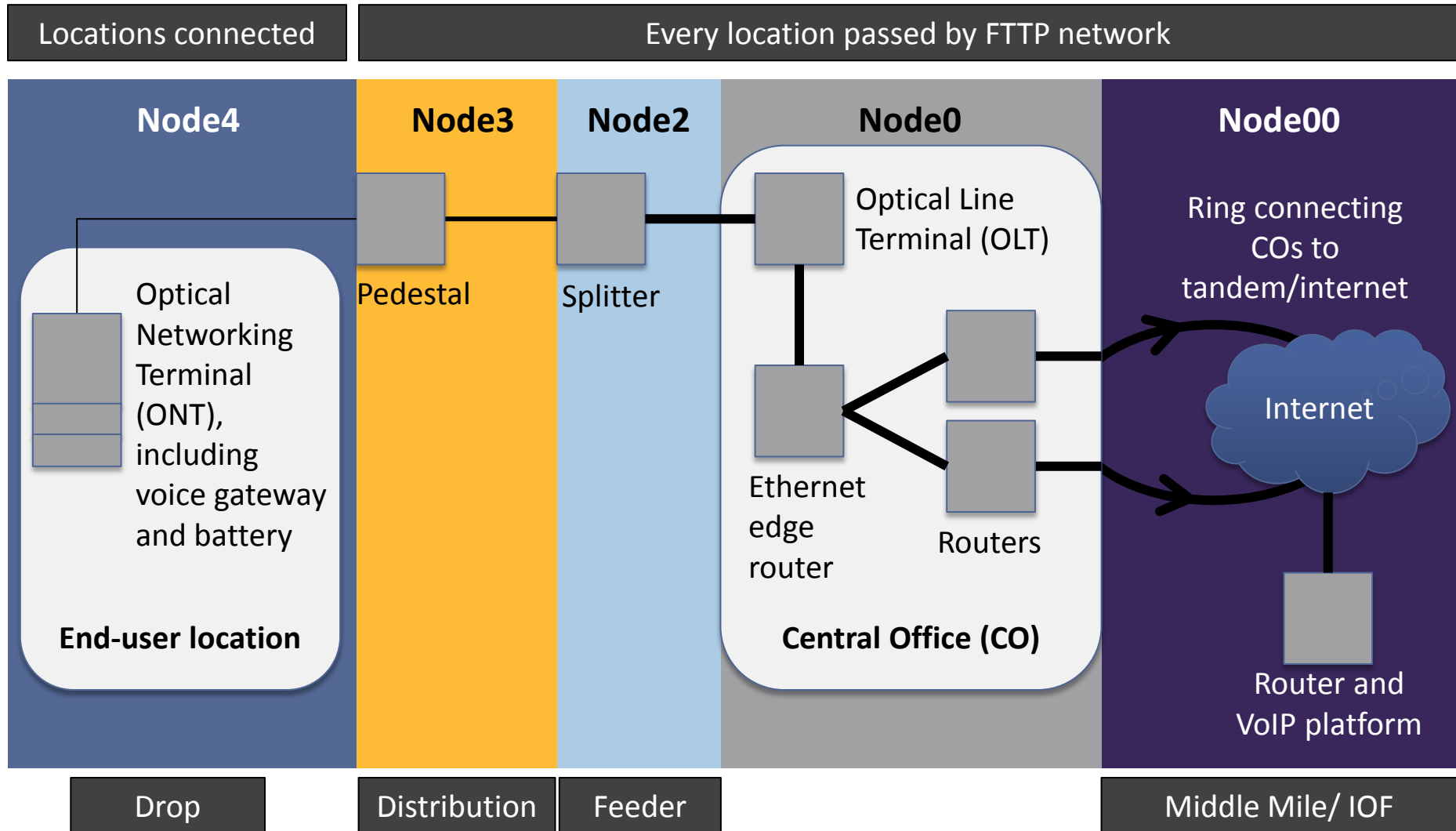
In the *USF Transformation Order*, the Commission decided to use a cost model to determine support for price cap carriers

- Delegated to Wireline Competition Bureau the task of adopting a cost model which must:
 - Estimate the forward-looking costs of an efficient provider
 - Estimate the cost of wireline network
 - Determine costs at a granular level – census block or smaller
- Declined to modify its existing high-cost model, because new modeling techniques and capabilities significantly improve the accuracy of the modeled costs, for example, by estimating the costs of efficient routing along roads in a way that the older model cannot
- Budgeted “up to” \$1.8 billion (including CAF-ICC) for territories served by price cap carriers and their rate of return affiliates
- Determined that model-based support will only be offered to areas where costs exceed a “Funding Threshold” and below an “Extremely High-Cost Threshold”
- Concluded no Connect America Phase II high-cost funding for areas already served by an unsubsidized competitor

Two components to the Connect America Cost Model

- **Cost model:** calculates cost for all areas of the country
 - Network topology – Geo-spatial- (or GIS-) based routing to meet engineering constraints for a given network technology
 - Costing – determination of cost for that topology
- **Support model:** calculates support for areas eligible for Connect America Phase II support
 - Calculated cost is an input
 - Exclude areas ineligible for Phase II support
 - Rate of return areas
 - Price cap census blocks served by an unsubsidized competitor (provider offering voice and 3/768 broadband)
 - Set lower threshold (benchmark or funding threshold) and upper threshold (alternative technology cutoff) so that support for eligible areas is within \$1.8 billion budget
 - Support per location is the amount over the benchmark as long as the census blocks are not excluded by the alternative technology cutoff

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

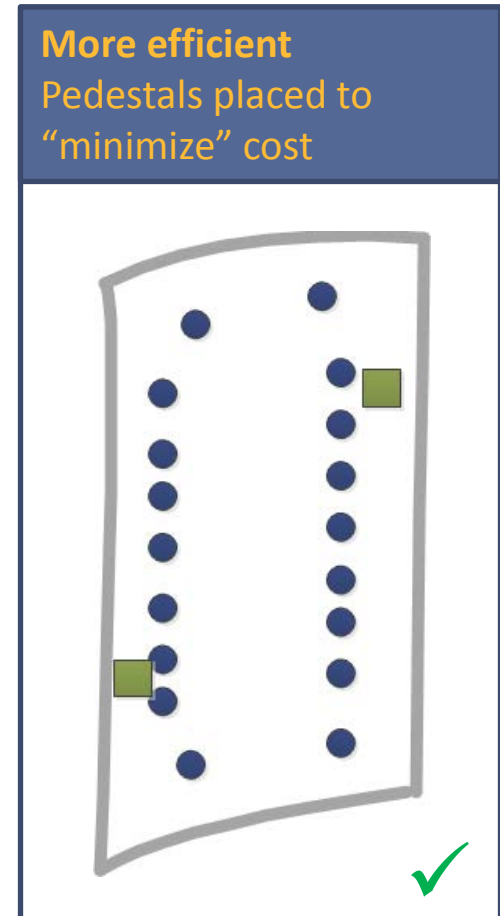
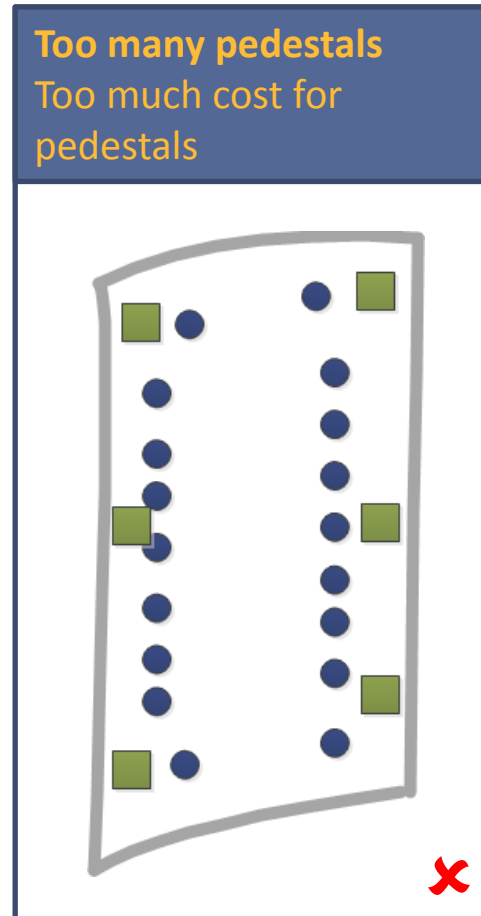
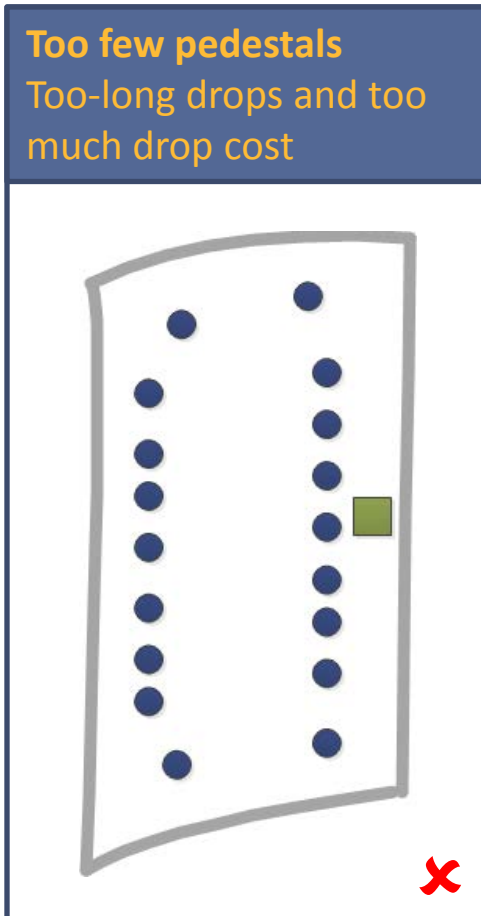


Cost model – network topology

- **“Simple” set of rules for all-IP FTTP (GPON) network** based on standard engineering principles:
 - Network facilities to “pass” every location in the country (>160 million) -- essential network assets within a short distance of every location – with connections to central office currently serving each location
 - For each block or street segment, determine location of pedestal (node 3) by minimizing cost in trade-off between distribution plant and drop to individual locations
 - Determine number and location of splitters (node 2) so that all locations 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 feeder path to connect splitters to central office using spanning tree optimization routines
- **Computationally intense** – takes weeks for a national data run

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

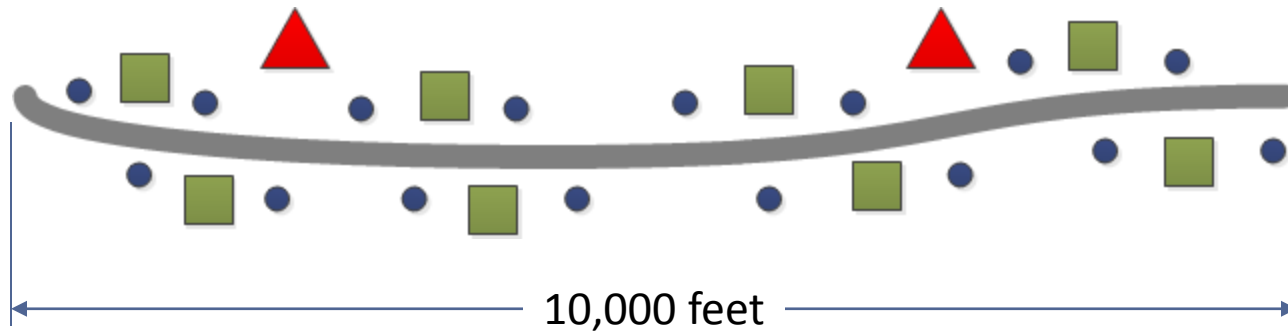
- Road segment
- End-user location
- Possible “pedestal” location



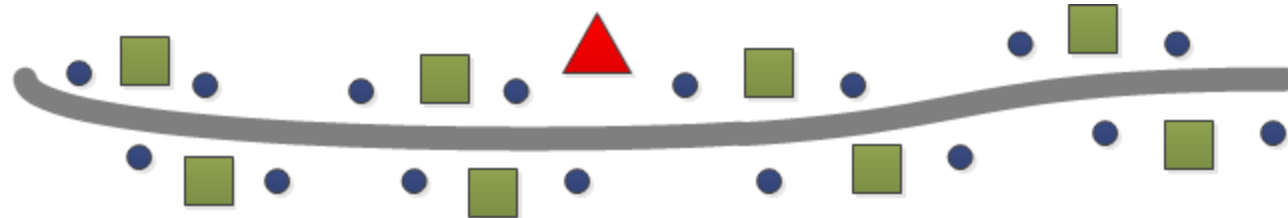
Simple topology example #2: Placing FTTP splitters (node 2)

- Road segment
- End-user location
- Possible “pedestal” location
- ▲ Possible splitter location

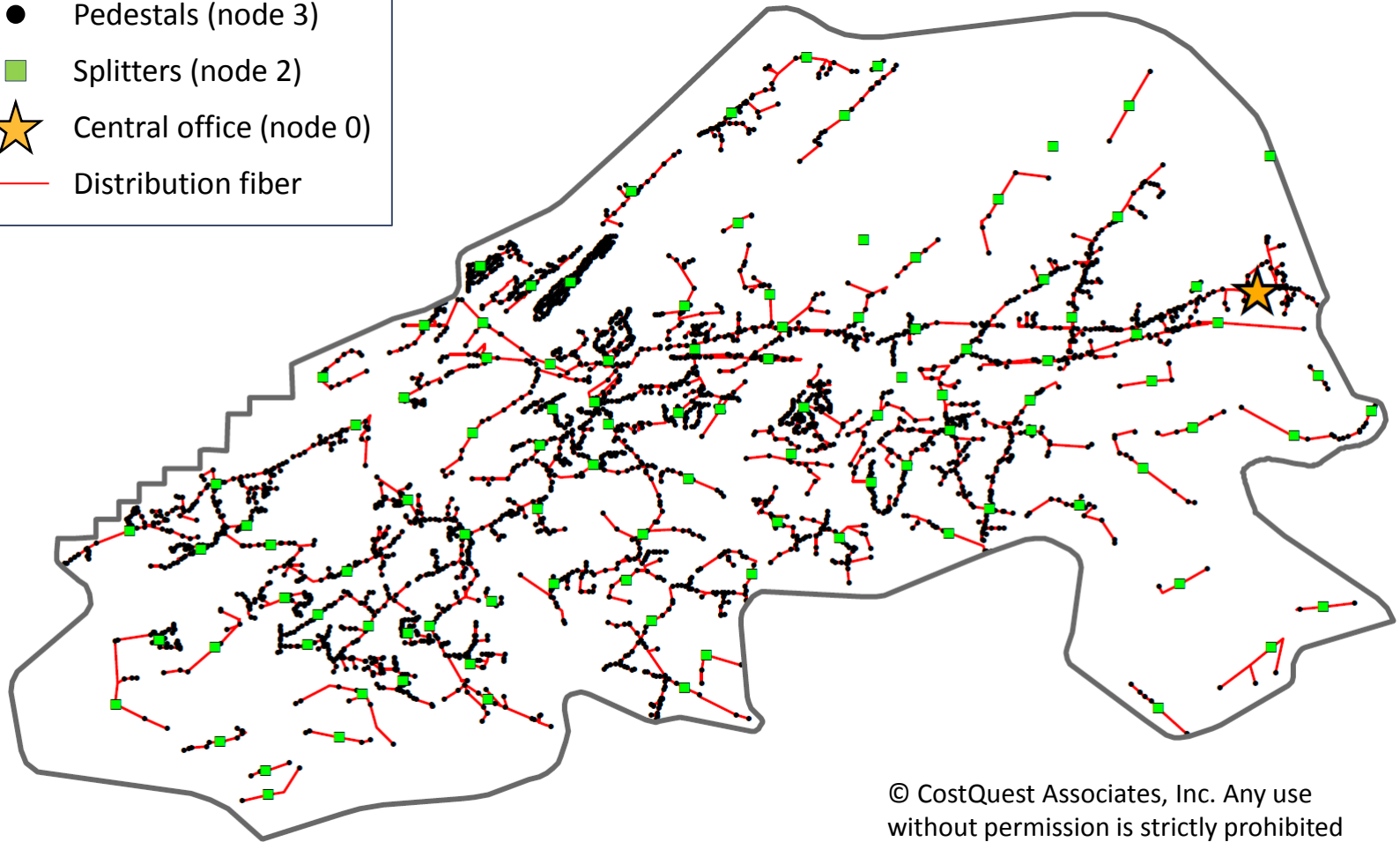
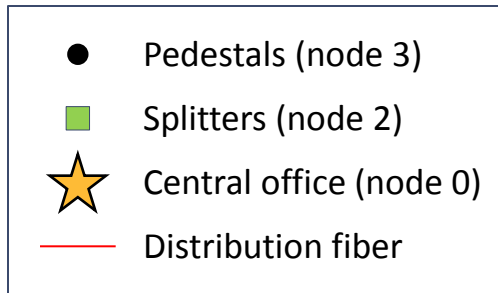
Too costly: Poor splitter placement means needing two splitters



More efficient: Use fewer splitters to serve the area

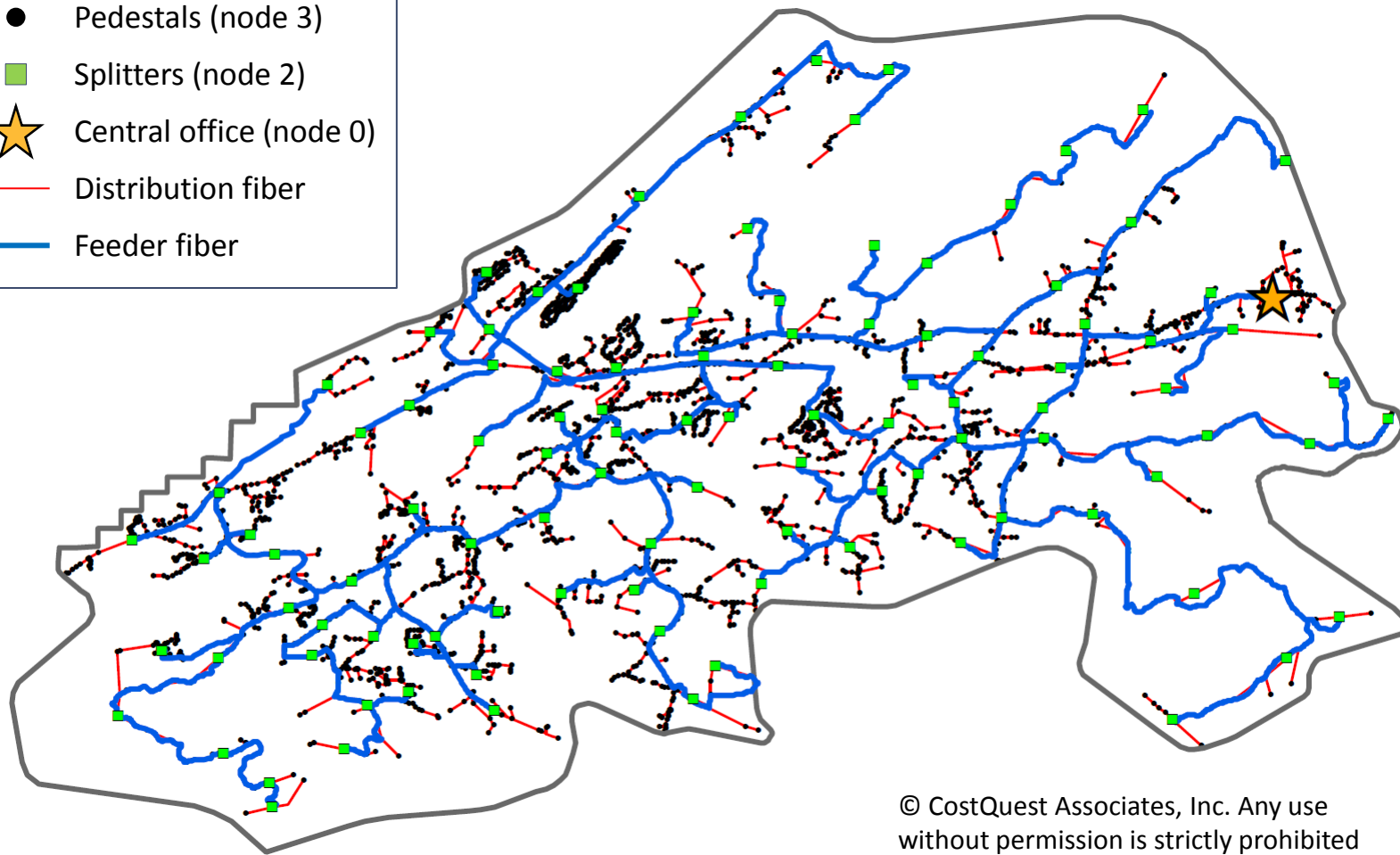
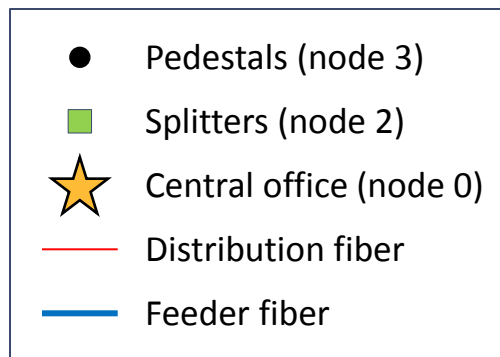


Result is route-tracing, efficient network that connects pedestals to splitters via a road-tracing distribution network...



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...and connects splitters back to wire centers via feeder network



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

- Number of locations
- Feet of feeder plant and distribution plant (and overlap between them)
- Pedestals associated with block
- 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 (by Common Language Location Identifier or CLLI codes)
- Area
- Density zone
- Terrain
- Three-digit ZIP code

The model provides more information via user-configurable inputs

- GIS-based information, based on density and terrain, used to calculate cost, including
 - 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)
- Take rate (to determine number of drops and CPE in cost calculation)
- Capacity demand
- **The bureau has not yet adopted inputs for the CAM**

Illustrative cost calculation for aerial plant in suburban areas using model version 3.2

	Materials	Placement
Fiber	+ \$0.444 /foot for 48-fiber bundle + \$0.118 /foot material loading <hr/> = \$0.562 /foot	+ \$1.185 placement / foot + \$0.0053 admin cost/foot + \$0.230 engineering cost/foot + \$0.540 splicing cost/foot <hr/> = \$1.960 / foot
Structure	+ \$214.61 per pole → \$1.25/foot + \$86.56 per anchor → \$0.072/foot + \$5.61 per guy → \$0.0046/foot + \$0.131/foot for material loading <hr/> = \$1.459 / foot pre-sharing = \$.7005 / foot including sharing	+ \$452.97 per pole → \$2.64/foot + \$184.25 per anchor → \$0.154/foot + \$25.60 per guy → \$0.021/foot + \$0.401 engineering cost/foot <hr/> = \$3.22 / foot pre-sharing = \$1.54 / foot including sharing
Total cost	Total construction cost per foot for suburban aerial plant: \$7.20 Aerial cost per foot for suburban <i>for ILEC</i> : \$4.77	
Additional adjustments	<ul style="list-style-type: none"> • Multiply all costs by Regional Cost Adjustment • For routes where feeder and distribution overlap, suburban 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 suburban, soft rock areas using model version 3.2

	Materials	Placement
Fiber	+ \$0.466 /foot for 48-fiber bundle + \$0.050 /foot material loading <hr/> = \$0.515/foot	+ \$0.00 placement / foot + \$0.0053 admin cost/foot + \$0.001 engineering cost/foot + \$0.531 splicing cost/foot <hr/> = \$.538 / foot
Structure	NA	+ \$6.87/foot for labor + \$0.979/foot for engineering <hr/> = \$7.844 /foot pre-sharing = \$6.275 / foot including sharing
Total cost	Total construction cost per foot for suburban, soft-rock, buried plant: \$8.90 Buried cost per foot (suburban, soft-rock) <i>for ILEC</i> : \$7.33	
Additional adjustments	<ul style="list-style-type: none"> • Multiply all costs by Regional Cost Adjustment • For routes where feeder and distribution overlap, suburban aerial 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 suburban, soft rock areas using model version 3.2

	Materials	Placement
Fiber	+ \$0.445 /foot for 48-fiber bundle + \$0.057 /foot material loading <hr/> = \$0.502 /foot	+ \$2.289 placement / foot + \$0.0053 admin cost/foot + \$0.442 engineering cost/foot + \$0.582 splicing cost/foot <hr/> = \$3.319 / foot
Structure	+ \$3084.38 per manhole → \$3.43/foot + \$2.04 / foot for duct + \$0.714/foot for material loading <hr/> = \$6.18 / foot pre-sharing = \$5.48/ foot including sharing	+ \$3131.12 per manhole → \$3.48/foot + \$0.71/foot for duct (no sharing) + \$11.88/foot for excavation + \$2.29 engineering cost/foot <hr/> = \$18.36 / foot pre-sharing = \$14.75 / foot including sharing
Total cost	Total construction cost per foot for suburban, soft-rock, underground plant: \$28.37 Underground cost per foot (suburban, soft-rock) <i>for ILEC</i> : \$24.05	
Additional adjustments	<ul style="list-style-type: none"> • Multiply all costs by Regional Cost Adjustment • For routes where feeder and distribution overlap, suburban aerial 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

Fiber

- **Fiber Material:** Size 24 Aerial Material cost: $\$0.3135/\text{foot} * 1.42$ for 48-fiber cable = $\$0.444$ per foot
- **Labor Rates and Loadings:** AerialFO Total Material Loadings: $.265177 \rightarrow \$0.118$ 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 \rightarrow 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 \rightarrow $\$5.61$ per guy (size 35 pole)
- **Engineering rules:** Typical guy span: 1200 feet
- **Labor Rates and Loadings:** Pole Total Material Loadings: $.098305 \rightarrow \$0.131$ per foot
- **Plant Sharing Tables:** Aerial 48%

Placement

- **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: $.1925 \rightarrow \$0.230$ per foot
- **Splicing (see "Sources for Splicing" slide):** $\$0.540$ per foot
- **Structure Labor:** Size 35 pole: $\$452.97$ per pole
- **Engineering rules:** Size 35 pole spacing: 200 feet
- **Engineering rules:** Typical aerial span: 1200 feet \rightarrow 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 \rightarrow $\$.401$ per foot
- **Plant Sharing Tables:** Aerial 48%

Sources for buried plant cost calculation

Fiber

Materials

- **Fiber Material:** Size 24 Underground Material cost: $\$0.32878/\text{foot} * 1.42$ for 48-fiber cable = $\$0.466$ per foot
- **Labor Rates and Loadings:** BuriedFO Total Material Loadings: $.106440 \rightarrow \$0.050$ per foot

Structure

- NA

Placement

- **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: $.1925 \rightarrow \$0.001$ per foot
- **Splicing (see "Sources for Splicing" slide):** $\$0.531$ per foot

- **Structure Labor:** Buried excavation, suburban soft rock: $\$6.87$ per foot
- **Labor Rates and Loadings:** Conduit: $.1425$ for engineering $\rightarrow \$0.979$ per foot
- **Plant Sharing Tables:** Suburban, buried: 80%

Sources for underground plant cost calculation

Materials

Fiber

- **Fiber Material:** Size 24 Underground Material cost: $\$0.31407/\text{foot} * 1.42$ for 48-fiber cable = $\$0.445$ per foot
- **Labor Rates and Loadings:** UndergroundFO Total Material Loadings: $.127821 \rightarrow \$0.057$ per foot

Structure

- **Structure Material:** Size 3 manhole: $\$3084.38$
- **Engineering rules:** Size 3 manhole spacing: 900 feet
- **Structure Material:** Duct cost: $\$2.04/\text{foot}$
- **Labor Rates and Loadings:** Conduit: $.130561 \rightarrow \$0.714$ per foot
- **Plant Sharing Tables:** Suburban, underground: 80% (conduits are not shared)

Placement

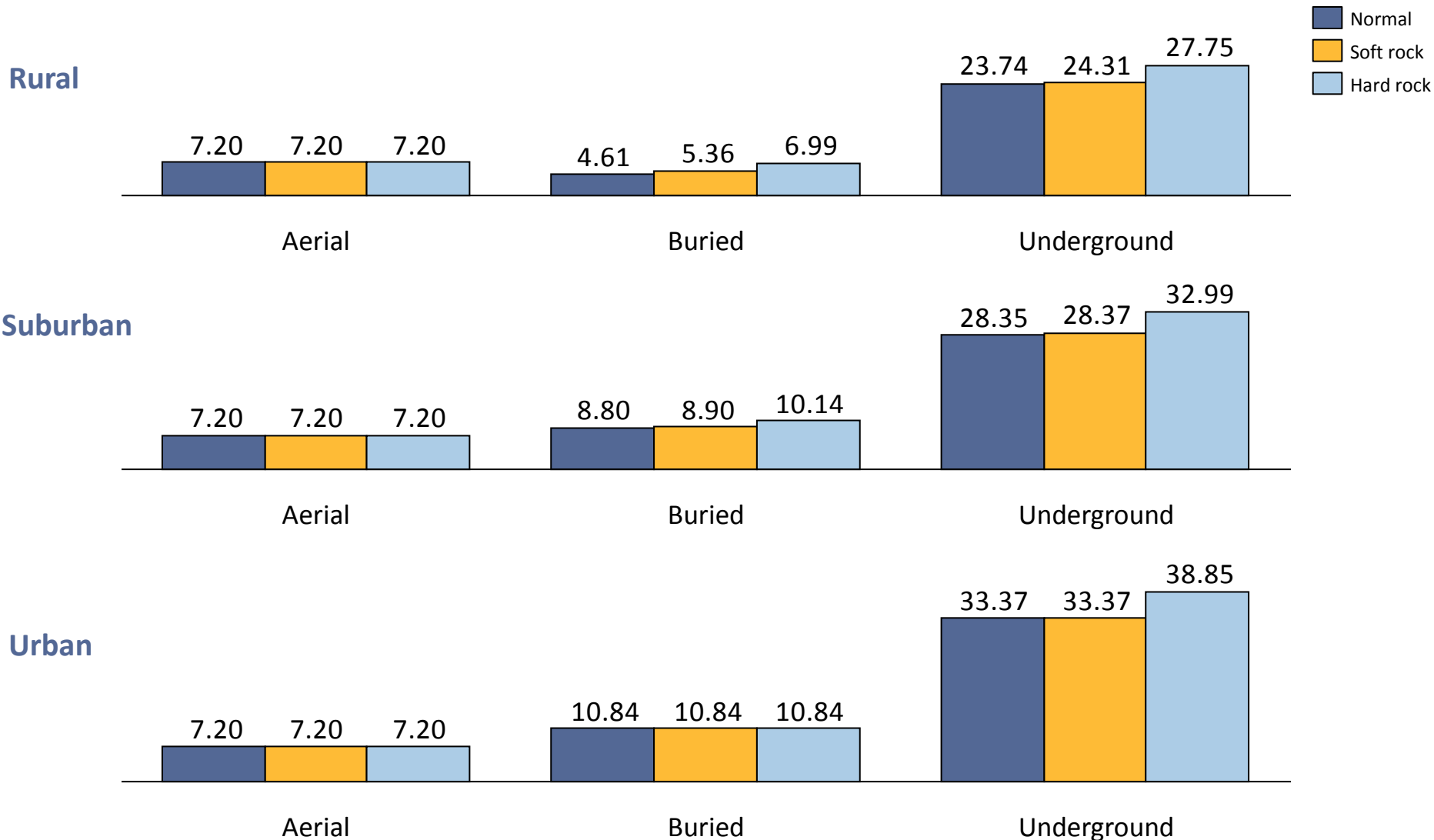
- **Material Labor:** UndergroundFO Placing cost per foot: $\$1.62 * .142$ for 48-fiber cable = $\$2.29$ per foot
- **Material Labor:** AerialFO Telco admin cost per foot: $\$0.0053$
- **Labor Rates and Loadings:** AerialFO Engineering rate: $.1925 \rightarrow \$0.442$ per foot
- **Splicing (see “Sources for Splicing” slide):** $\$0.582$ per foot
- **Structure Labor:** Size 3, soft-rock manhole: $\$3131.12$ per manhole
- **Engineering rules:** Size 3 manhole spacing: 900 feet
- **Structure Labor:** Underground excavation, suburban soft rock: $\$11.88$ per foot
- **Structure Labor:** Underground duct labor: $\$0.71$ per foot
- **Labor Rates and Loadings:** Conduit: $.1425$ for engineering $\rightarrow \$2.29$ per foot
- **Plant Sharing Tables:** Suburban, underground: 80% (conduits are not shared)

Sources for splicing cost

	Aerial	Buried	Underground
Closure and setup	<ul style="list-style-type: none"> • Material Labor: \$83.85 • Labor Rates and Loadings: Engineering rate 0.1925 → \$16.14 per splice 	<ul style="list-style-type: none"> • Material Labor: \$87.60 • Labor Rates and Loadings: Engineering rate 0.1925 → \$16.86 per splice 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Material Labor: \$9.72 / fiber • Labor Rates and Loadings: Engineering rate 0.1925 → \$1.87 per splice 	<ul style="list-style-type: none"> • Material Labor: \$9.46 /fiber • Labor Rates and Loadings: Engineering rate 0.1925 → \$1.82 per splice 	<ul style="list-style-type: none"> • 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

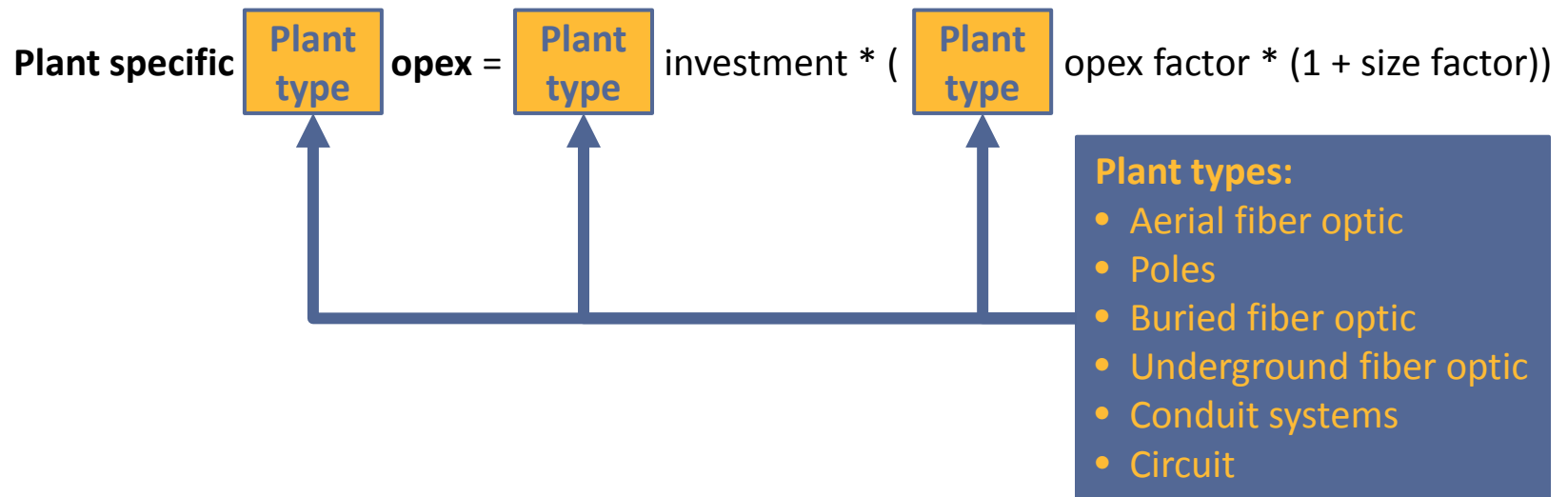


Calculating annual cost of initial investment: levelization using Annual Charge Factors

- Annual Charge Factors (ACFs) relate the initial investment to the cost over the useful lifetime of each asset
 - Based on lifetimes for each asset class using retirement curves
 - Includes 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)
- And excel-based model (called the “CapCost model”) is available to calculate ACFs for different assumptions

Calculating operating expenses

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



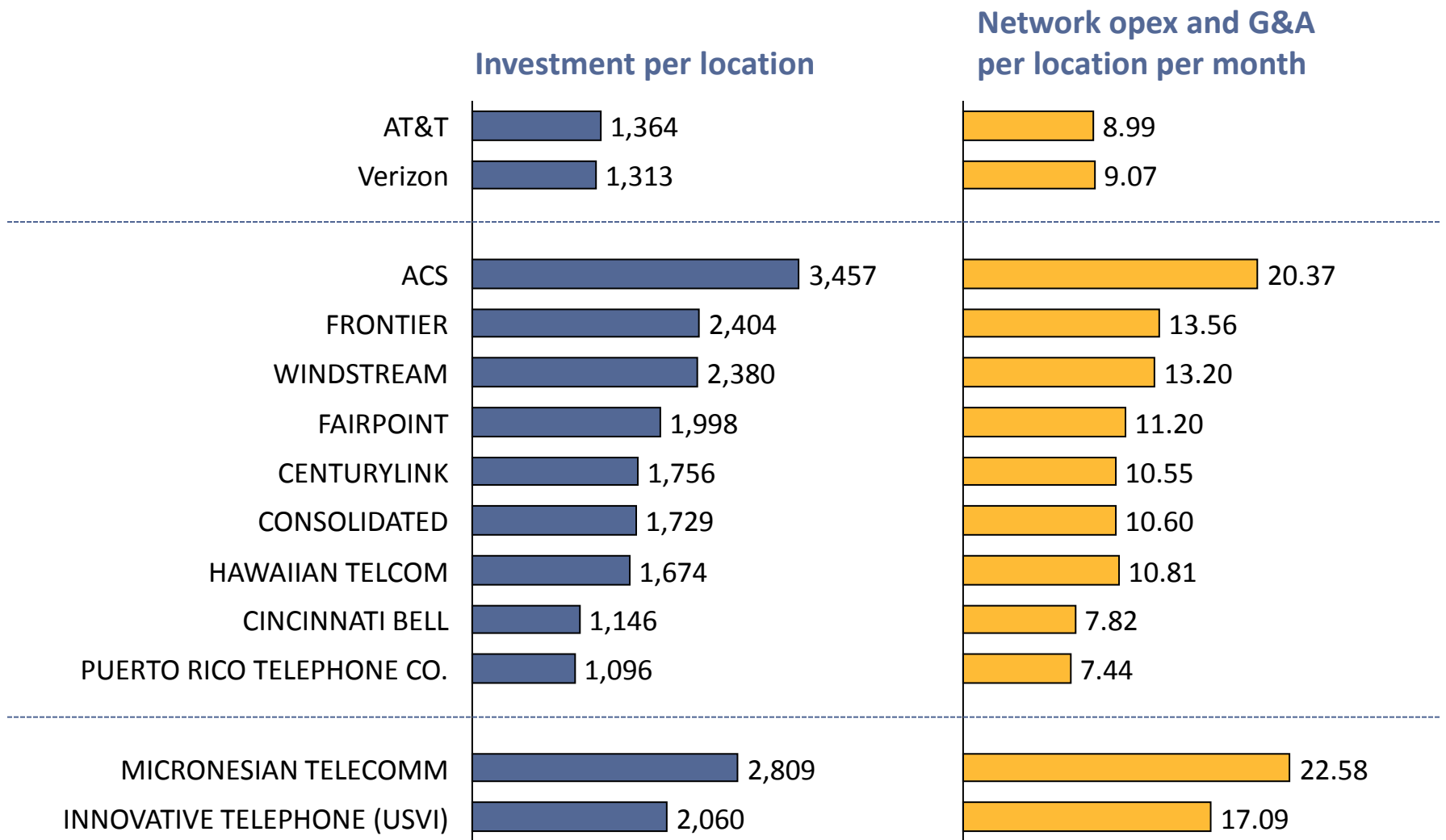
Non-network plant specific opex (scales with total investment)

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)

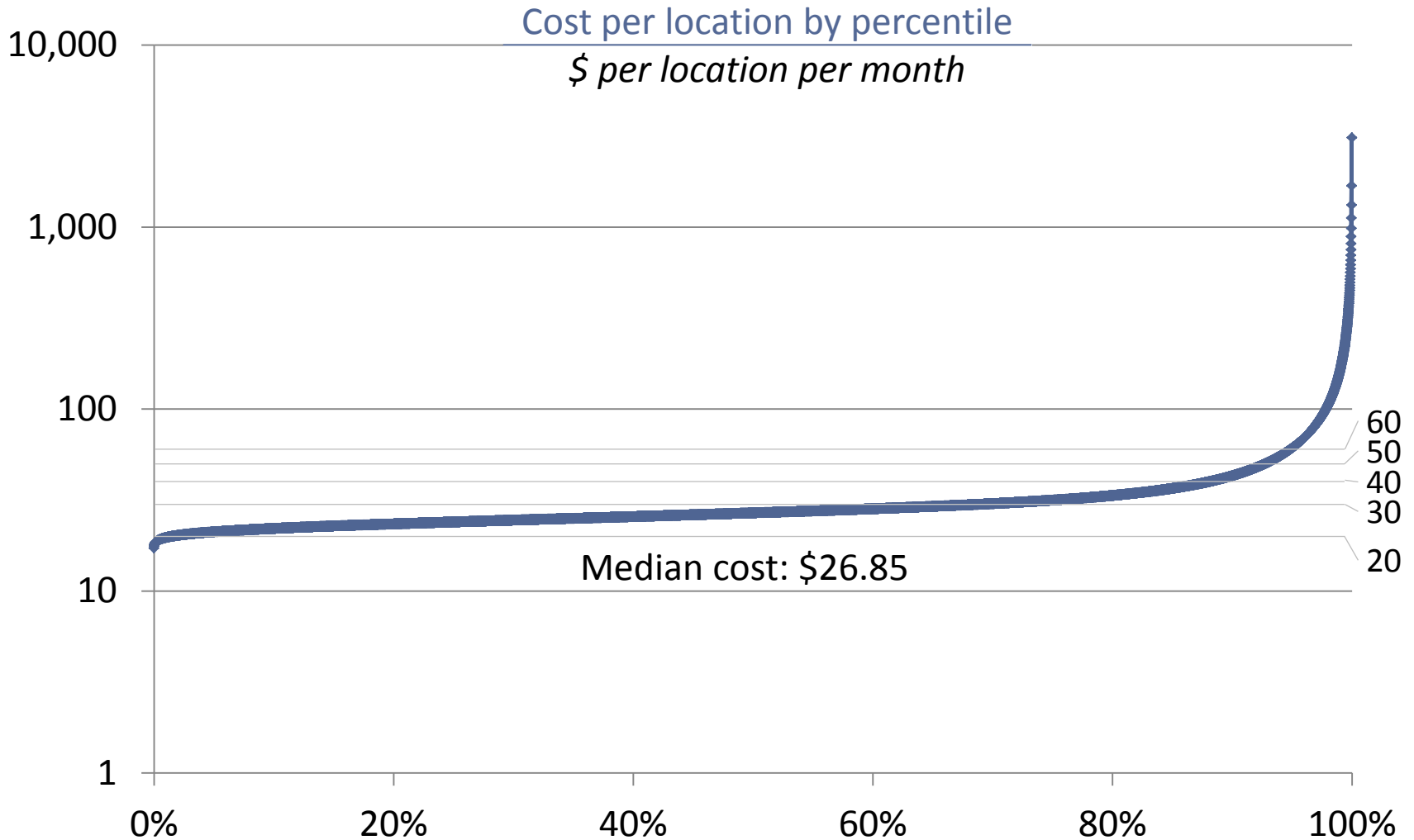
Cust. ops & mark. opex = Customers * (Ops per customer * (1 + size factor))
Bad debt = Customers * (Bad debt per customer)

Illustrative investment and investment-driven operating expenses per location by company*



* Illustrative results for model v3.2 using 8% cost of money

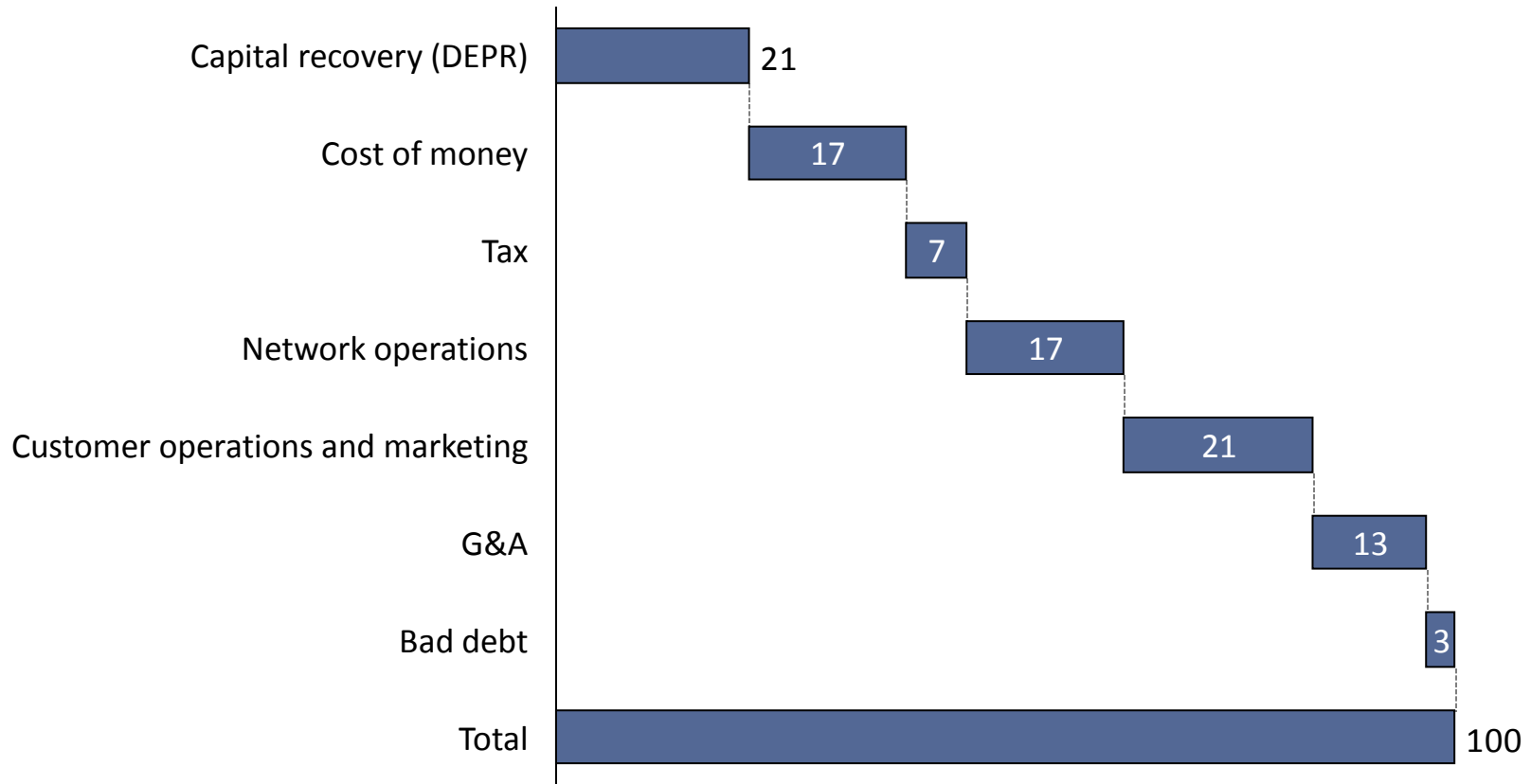
Illustrative cost per location per month varies widely around the country*



* Illustrative results for cost model v3.2 using 8% cost of money

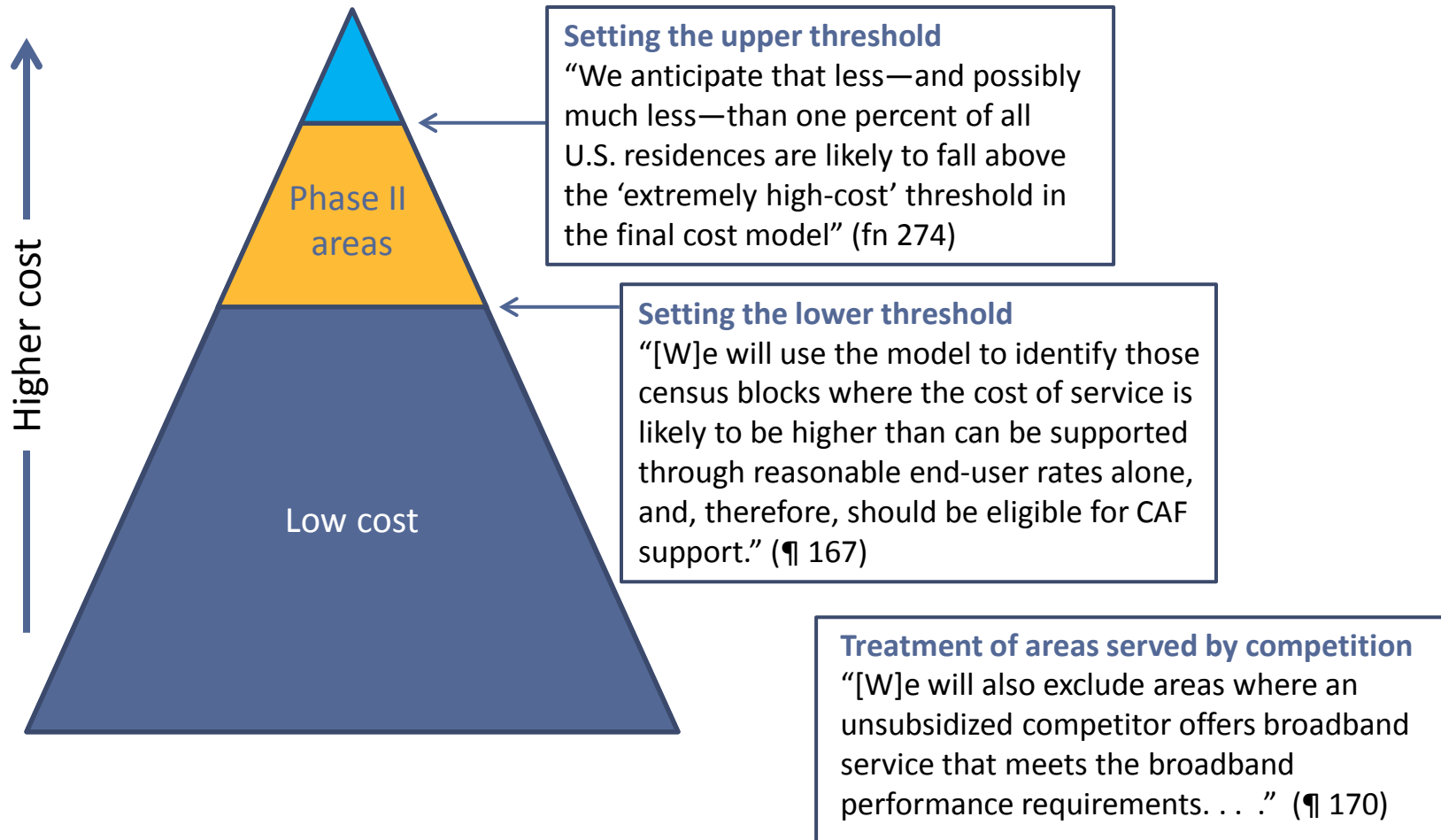
Overall model results by cost category*

Breakout of costs for the country
% of total cost

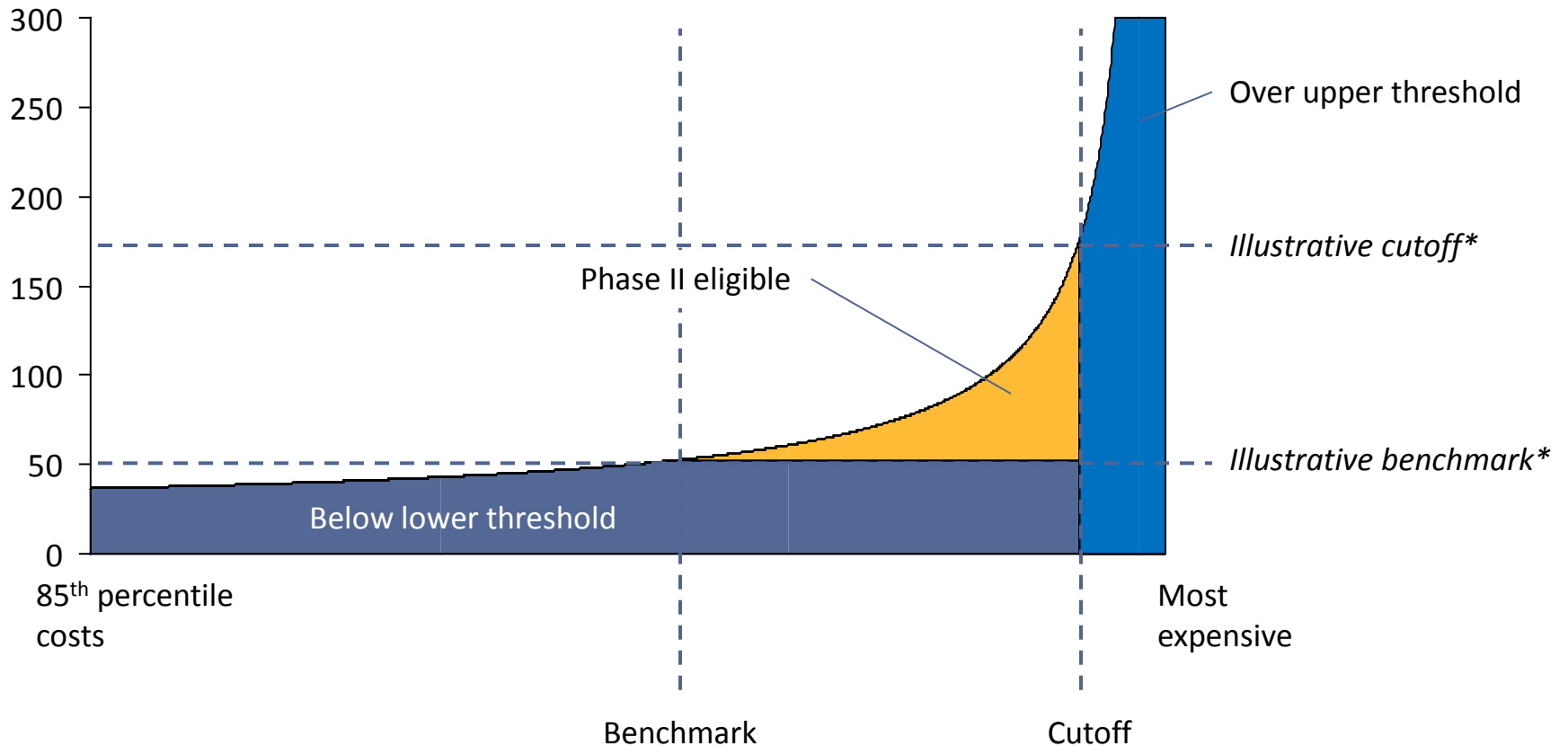


* Illustrative results for cost model v3.2 using 8% cost of money

Support model: setting eligibility and thresholds to provide support within the budget



Costs above benchmark for locations with cost below the cutoff are eligible for funding...if there are no unsubsidized competitors



* Figures selected for illustration; the Bureau has not yet determined these cutoffs

Illustrative results currently posted on FCC website – introduction page

Report Reference Number	Reports	Cost of Money	Benchmark (Lower Threshold)
1.1	Estimated Support & Locations per State per Carrier per Study Area	8%	\$ 49.15
1.2	Estimated Support & Locations per State per Carrier per Study Area	8%	\$ 52.00
2.1	Estimated Support & Locations per State per Carrier per Study Area	9%	\$ 55.40

Company Name Cross Reference Table	
ACS	ACS SYSTEMS, INC
ATT	AT&T
CBT	CINCINNATI BELL
Cent	CENTURYLINK
Cons	CONSOLIDATED COMMUNICATIONS
Fair	FAIRPOINT COMMUNICATIONS
Fron	FRONTIER COMMUNICATIONS
FSMT	MICRONESIAN TELECOMM
HTC	HAWAIIAN TELCOM INC -HI
PTRC	PUERTO RICO TELEPHONE CO.
VIT	VIRGIN ISLANDS TEL. CORP. DBA INNOVATIVE TELEPHONE
VZN	VERIZON
Wind	WINDSTREAM COMMUNICATIONS

Please note:
 All reports utilize the following:
 CAF II Budget Amount of \$1.75b (assumes \$50 million annually in Connect America ICC funding)
 CAM 3.2 Solution Sets
 Census blocks shown as served on National Broadband May by 3/768 cable or fixed wireless (data as of June 2012) and reporting voice connections on FCC Form 477 (data as of June 2012) excluded from support calculations (Voice Cable/Voice Fixed Wireless)
 Unit costs are calculated on a per-location-passed basis
 Benchmark and rate of return selected to illustrate results
 Results reflect support model detail results at the 'service area' level, rolled-up to study areas by state, since some study areas cross state lines.

Introduction | 1.1 49.15 ACF8 | 1.2 52 ACF8 | 2.1 55.40 ACF9

Two illustrative values for cost of money

Three illustrative values for benchmark

Illustrative results posted on FCC website

State	Carrier	Study Area	Study Area Code	Sum of Total Demand Units Under r_Alt_Tech_Cutoff	Sum of Total_Max_Fundings
AK	ACS	ACS OF ANCHORAGE	613000	8,845	\$ 1,514,845
AK	ACS	ACS-FAIRBANKS, INC	613008	9,735	2,196,833
AK	ACS	ACS-N GLACIER STATE	613010	54,370	10,183,742
AK	ACS	ACS-AK JUNEAU	613012	739	154,711
AK	ACS	ACS-N SITKA	613020	2,587	951,442
AK	ACS	ACS-AK GREATLAND	613022	548	68,808
AL	ATT	SO CENTRAL BELL-AL	255181	6,679	22,746,283
AL	Cent	GULF TEL CO - AL	250298	1,476	334,676
AL	Cent	CENTURYTEL-AL-SOUTH	259788	20,836	7,397,163
AL	Cent	CENTURYTEL-AL-NORTH	259789	28,636	9,647,793
AL	Fair	GTC, INC.	210291	1,512	669,926
AL	Fron	FRONTIER-LAMAR CNTY	250301	1,233	503,012
AL	Fron	FRONTIER COMM.-AL	250306	4,214	1,578,446
AL	Fron	FRONTIER COMM-SOUTH	250318	2,222	857,276
AL	Wind	WINDSTREAM AL	250302	1,504	427,680
AR	ATT	SOUTHWESTERN BELL-AR	405211	60,758	22,569,909
AR	Cent	CENTURYTEL NW-AR-RUS	401142	24,776	8,675,518
AR	Cent	CENTURYTEL NW-AR-SIL	401143	2,742	1,105,276
AR	Cent	CENTURYTEL-CENTRAL A	401144	19,145	8,667,528
AR	Cent	CENTURYTEL- ARKANSAS	401705	8,750	3,950,892
AR	Cent	CENTURYTEL-MTN HOME	401711	3,750	1,017,396
AR	Cent	CENTURYTEL-REDFIELD	401720	461	148,910
AR	Cent	CENTURYTEL-SOUTH AR	401727	831	386,396
AR	Wind	WINDSTREAM AR	401691	34,055	13,376,840
AZ	Cent	QWEST CORP-AZ	455101	21,538	8,514,491
AZ	Fron	CITZENS-FRNTR-RURAL	452172	3,020	1,084,659
AZ	Fron	VERIZON CA(CONTEL)	452302	1,795	633,427
AZ	Fron	CITZENS-FRNTR-WH MT	454426	3,061	1,201,621
AZ	Fron	NAVAJO-AZ-FRONTIER	454449	14,152	8,199,959
CA	ATT	PACIFIC BELL	545170	129,398	49,737,588
CA	Cent	CENTURYTEL-OREGON	532361	19	24,807
CA	Cons	SUREWEST TEL.	542334	2	359
CA	Fron	Frontier Communications of the	541863	3,310	1,301,996

Breakouts by state, carrier and study area

Support available and number of locations covered for illustrative values



Additional information

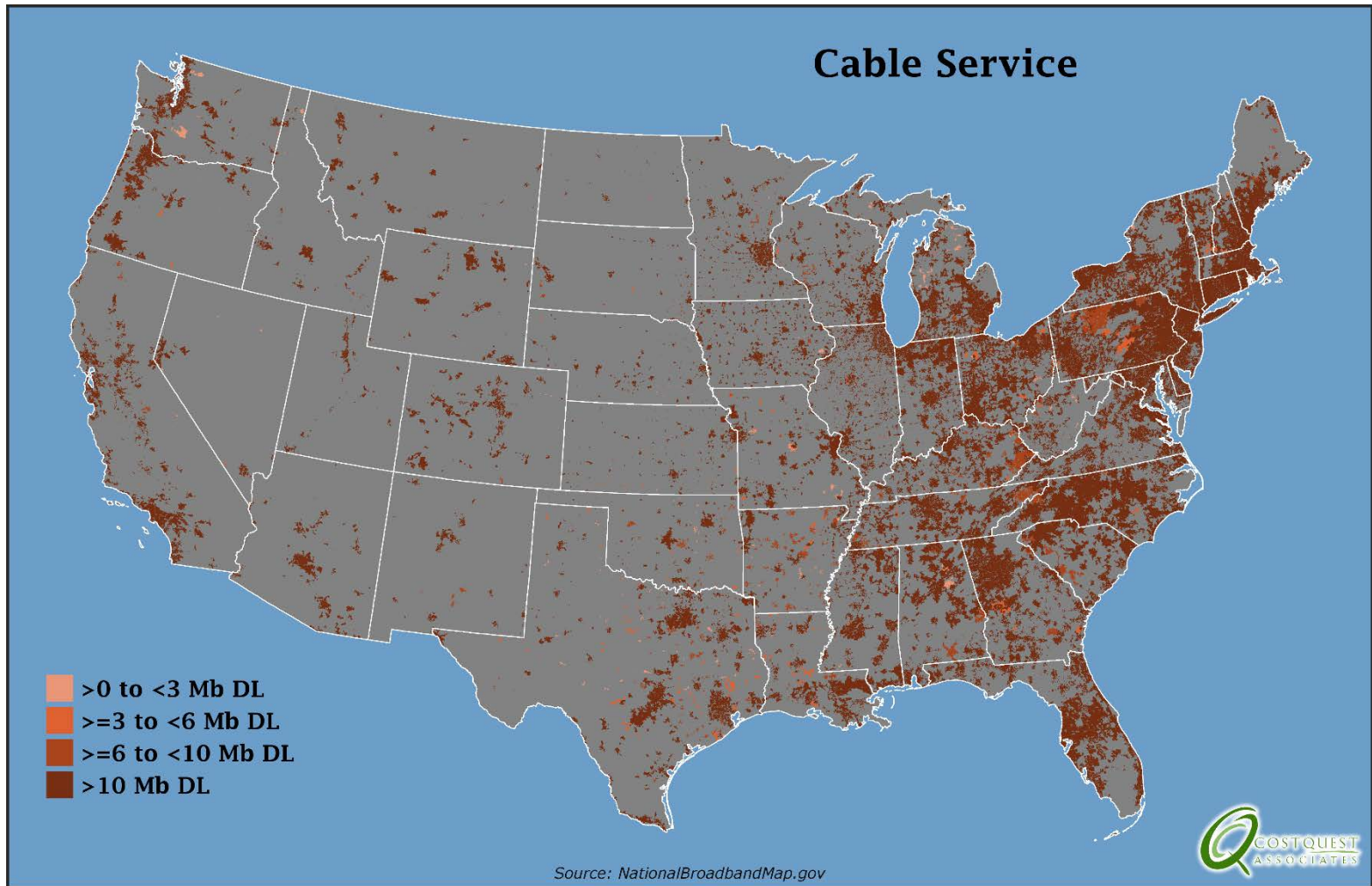
- **Access to the model:** Parties must follow the terms of the Third Supplemental Protective Order to access the model; available at <http://www.fcc.gov/document/connect-america-phase-ii-third-supplemental-protective-order>. The TSPO includes
 - Acknowledgement of Confidentiality
 - Licensing Agreement
 - Non-Disclosure Agreement (provides access to source code and “Systems Evaluator” package)
- The current version of CAM is 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)
 - Capex Tutorial
 - Opex Overview
 - Model inputs and results from various model runs
- In addition, model documentation and illustrative results available on FCC website:
 - http://transition.fcc.gov/Daily_Releases/Daily_Business/2013/db0624/DOC-321774A1.pdf
 - <http://www.fcc.gov/encyclopedia/connect-america-cost-model-illustrative-results>
- Links to all these resources and more can be found at <http://www.fcc.gov/encyclopedia/caf-phase-ii-models>

Thank you!



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Cable footprint (NTIA/SBI round 6, as of June 2012)



Fixed wireless footprint (NTIA/SBI round 6, as of June 2012)

