



July 13, 2015

Marlene H. Dortch  
Secretary  
Federal Communications Commission  
445 12<sup>th</sup> Street, SW  
Washington, DC 20554

Re: Connect America Fund, WC Docket No. 10-90

Broadband is a vital part of our modern economy, education, and everyday life. The FCC is to be commended for their efforts to achieve additional fiber deployment across rural America. At Vantage Point we've helped hundreds of rural telecommunications providers in more than 40 states provide broadband to their customers.

Over the last several months, Vantage Point has monitored with interest the ongoing discussion on the accuracy of the Alternative Connect America Model (A-CAM). Vantage Point understands firsthand the issues and complexities associated with estimating construction costs in rural areas. We appreciate the progress the FCC has made in the development of the A-CAM model.

Our clients vary widely in size, location, approach toward technology, and opinions of model-based support. Many of our clients stand to gain substantial support under the proposed A-CAM, while many others stand to lose. Despite the great diversity exhibited by those with whom we work, all agree on one thing: **they want a model that is accurate.**

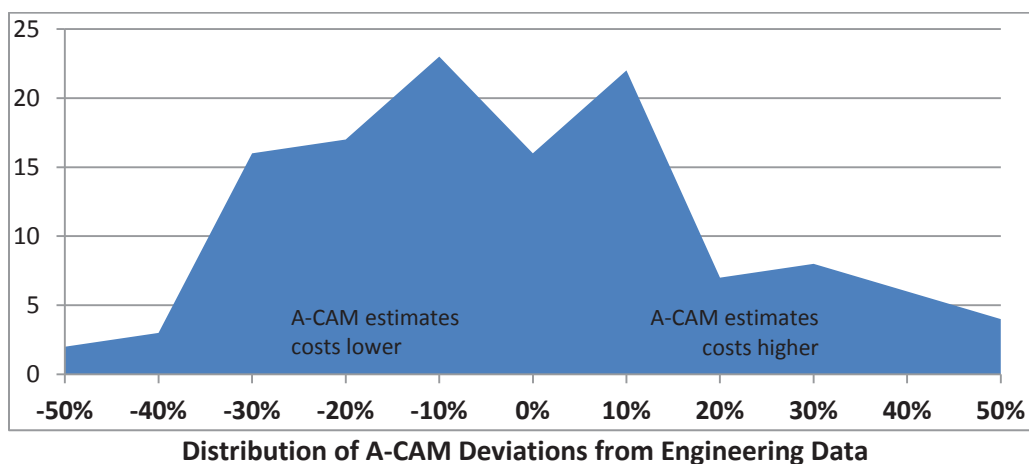
Recent ex parte filings with the FCC have raised concerns that A-CAM capital expenditure (capex) estimates differ substantially from experiences seen "on the ground" with rural fiber deployments. In an effort to understand to what extent such deviations may exist, Vantage Point has conducted two studies comparing the A-CAM to wire-center-specific data. The first is a broad analysis using information from 144 wire centers across the country. The second is a more focused case study analysis of three wire-center-wide fiber to the premises (FTTP) projects.

#### **Analysis #1 – Comparing A-CAM Results to Engineering Data of 144 Wire Centers Attachment A**

Vantage Point has compared results of the A-CAM "cost to serve" module to data from Vantage Point's database of FTTP engineering estimates and actual outside plant costs (collectively referred to as engineering data). Engineering data from 144 wire-center-wide FTTP projects in more than a

dozen states were utilized in this comparison. An early draft of this VPS analysis had limited distribution and has been referenced in ex parte communications filed by other consulting firms.

When considering A-CAM estimates for all 144 wire centers as a group, the A-CAM performs reasonably well, seeming to somewhat accurately estimate deployment costs. On a wire center-by-wire center basis, however, the model lacks precision. In almost a third of cases, the A-CAM capex results for a wire center differs by more than 30% from the engineering data for that wire center. The mean deviation is 28%. The A-CAM displays substantial deviation regardless of project size, state, or region. The A-CAM's deviations are greater for those wire centers that serve customers in very high cost or very low cost areas. This data suggests further refinements are needed to the model before it could be used to accurately estimate capital expenditure costs of fiber deployment at the wire center level.



## Analysis #2 – Case Study Analysis of A-CAM Node Results for Three FTTP Projects Attachments B, C, D

To gain a better understanding of these results, Vantage Point reviewed engineering data for three wire-center-wide FTTP networks that have been constructed. The wire centers were selected for review based on comparisons of model results to engineering data. In one case, the model overestimates support (Wire Center “Overestimated”). In another the model underestimates support (Wire Center “Underestimated”). In the third case the model produces cost estimates close to engineering data (Wire Center “Close”). Since the A-CAM breaks the various network elements into what is referred to as “nodes,” Vantage Point’s exchange-specific engineering data was compared, on a node-by-node basis, to assumptions made by the A-CAM for those three wire centers.

The model struggles with accuracy in each node that was reviewed. In all twelve nodes analyzed (four nodes for each of the three wire centers) the A-CAM misses the wire-center-specific engineering data by more than 40%. The model shows significant and consistent errors when viewed node-by-node. The model overestimates Node 0 and Node 2 costs and underestimates Node 3 and Node 4 costs in all three case studies. Even the A-CAM results for Wire Center “Close” feature substantial errors in each node and end up appearing accurate largely because the errors happen to cancel each other out.

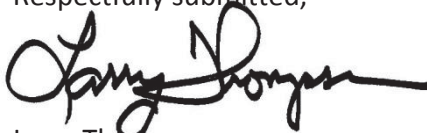
A-CAM Deviation from Wire-Center-Specific Engineering Data				
	Wire Center "Underestimated"	Wire Center "Close"	Wire Center "Overestimated"	Mean
<b>Node 0</b>	77%	100%	41%	73%
<b>Node 2</b>	2,332%	5,499%	27,876%	11,902%
<b>Node 3</b>	-57%	-41%	-58%	-52%
<b>Node 4</b>	-71%	-74%	-80%	-75%
<b>Total</b>	-29%	-3%	55%	8%

A review of data at the sub-node level uncovered similar deviations from wire-center-specific engineering data. For example, in six of nine Node 0 sub-nodes that were reviewed (Node 0 building, electronics, and fiber for each of the three wire centers), the model misses by more than 40%.

Although the findings of each case study differ somewhat, together they do provide some common lessons. In each case study the model overestimates the number of locations, assumes an inefficient network design that is not consistent with the actual FTTP architecture deployed in rural wire centers, features inaccurate route mile data, and underestimates optical network terminal (ONT) costs at the customer premises. The size and impact of these errors is different for each wire center, but collectively they reveal a model that lacks precision and accuracy. When the model capex values do get close to matching wire-center-specific engineering data (as with Wire Center "Close"), it is better attributed to the fortune of offsetting errors at the node level rather than to accuracy.

Vantage Point brings these model deficiencies to the attention of the FCC so that it can work to improve the A-CAM. A forward-looking cost model can benefit hundreds of rural providers and many thousands of rural citizens across the country.

Respectfully submitted,



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Attachments:  
Attachment A – Comparing A-CAM Capital Expenditure  
Estimates to Wire-Center-Specific Engineering Data  
Attachment B – Case Study for Wire Center  
"Underestimated"  
Attachment C – Case Study for Wire Center "Close"  
Attachment D – Case Study for Wire Center  
"Overestimated"



## Comparing A-CAM Capital Expenditure Estimates to Wire Center-Specific Engineering Data

The FCC has developed a model as an alternative method to distribute support to rate-of-return (RoR) carriers. This model is called the Alternative Connect America Cost Model (A-CAM). The “cost to serve” module of the A-CAM estimates the capital expense required to build a fiber to the premises (FTTP) network in each of the RoR carrier’s wire centers. Over the last thirteen years, Vantage Point Solutions (VPS) has been involved with hundreds of FTTP projects in RoR carrier areas across the country. VPS does not intend to enter the debate regarding the need for such as model, but is uniquely qualified to help determine the accuracy of the model.

In an effort to determine the accuracy of the A-CAM, VPS has compared results of the “cost to serve” module to data from VPS’s database of FTTP engineering estimates and actual outside plant costs (collectively referred to as engineering data). Engineering data from 144 wire-center-wide FTTP projects in more than a dozen states were utilized in this comparison.

In almost a third of cases, the A-CAM capital expenditure (capex) results for a wire center differ by more than 30% from the engineering data for that wire center. The mean deviation was 28%. The A-CAM displays substantial deviation regardless of project size, state, or region. The A-CAM’s deviations are greater for those wire centers that serve customers in very high cost or very low cost areas. This data suggests further refinements are needed to the model before it could be used to accurately estimate capital expenditure costs of rural fiber deployment at the wire center level.

### Methodology Overview

- **Base comparison** – VPS has compared, wire-center-by-wire-center, the results from the A-CAM “cost to serve” module with FTTP wire-center-specific engineering estimates conducted over the last ten years.
- **Augmentation with actual expenses** – When the actual outside plant expenses for a wire-center-wide FTTP project were available, the engineering estimates were replaced by the actual expenses. Actual outside plant expenses were within 11% of the wire-center-specific outside plant estimates. As a result, the inclusion of this data improves confidence in the engineering estimates, but has little impact on the overall results.

- **Wire-center-wide comparison** – The A-CAM contains cost estimates at the wire-center-level, so engineering data were utilized for comparison only when they encompassed an entire wire center.
- **Adjustment to historical costs** – Since the engineering data included estimates and actuals that occurred over the last 10 years, the expenses were converted to 2014 dollars using the C-CPI (Chained-Consumer Price Index).

## Summary of Findings

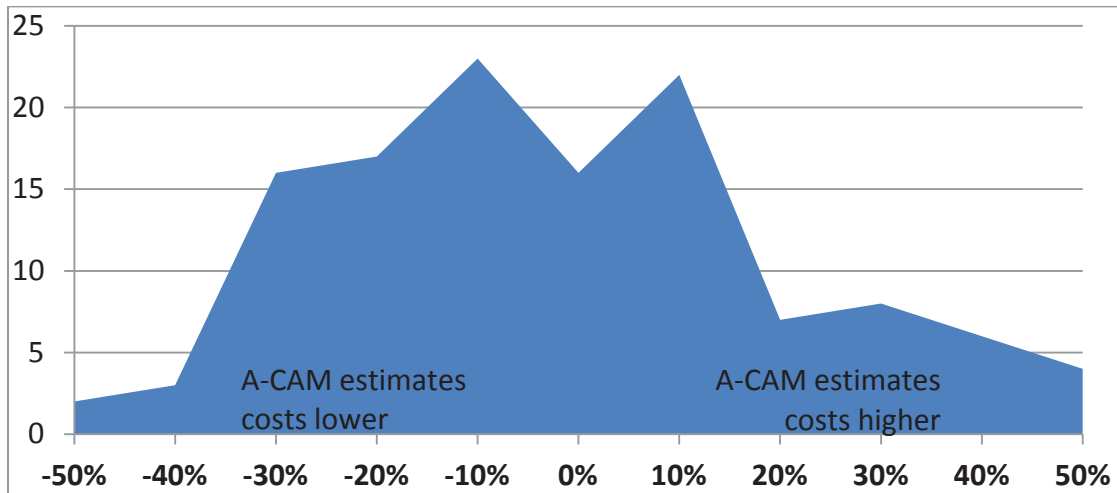
1. **At a glance, the model looks somewhat accurate.** The A-CAM calculates a mean wire-center-wide deployment cost of \$4.8 million for the 144 wire centers analyzed by VPS. The engineering data for those 144 wire centers averaged \$5.6 million, a difference of 13%. When considering all of the wire centers as a group, the A-CAM seems to at least somewhat accurately estimate costs for the average wire center.

Mean A-CAM Estimate	Mean Engineering Data
\$4,844,025	\$5,587,377

**Table 1. Mean A-CAM & Engineering Amounts**

The model deviates from the engineering data both high and low in roughly equal measure. Slightly less than half the time (48.6%), the model estimates costs lower than those indicated by engineering data and slightly more than half of the time (51.4%) it estimates costs higher than the engineering data for that wire center.

2. **Not all wire centers are average, though.** Looking at mean cost estimates, however, obscures the model's errors. In many cases, the A-CAM estimates deviate substantially from the engineering data, but because the model deviates in both directions equally, estimates that were substantially lower were offset by estimates that were substantially higher. The result is a model that might work well for carriers able to rely on the law of large numbers to "even out" inaccurate high and low estimates across their service territory. Unfortunately, few RLECs have a large enough number of wire centers over which to spread the A-CAM's offsetting errors.



**Figure 1. Distribution of A-CAM Deviations from Engineering Data**

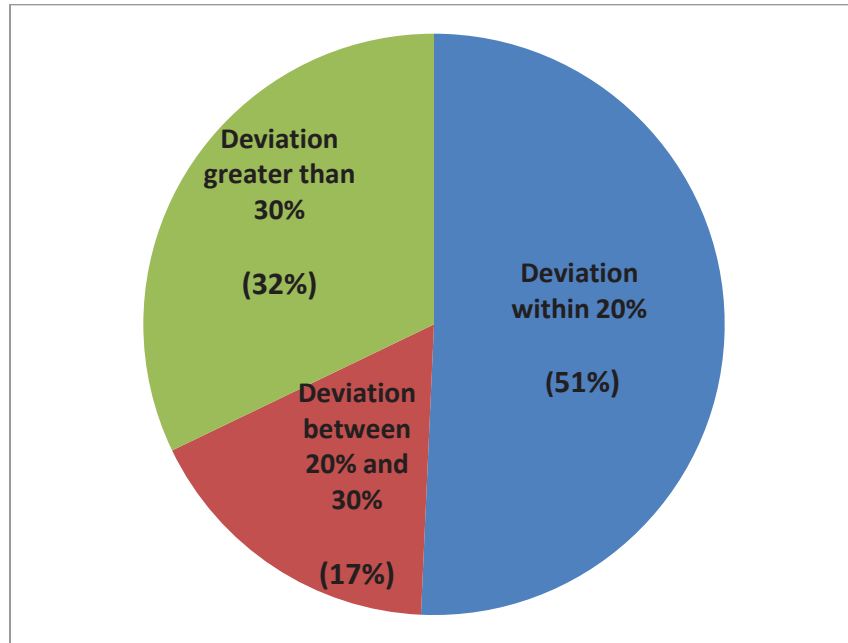
3. **On a wire-center-by-wire center basis, the model isn't accurate.** When reviewing the absolute value of the variances, the model's inaccuracy comes to light. The A-CAM "cost to serve" module misses the engineering data on a wire-center-by-wire center basis by an average of 28%.

Mean Model	Mean Engineering Data	Mean A-CAM Deviation (\$)	Mean A-CAM Deviation (%)
\$4,844,025	\$5,587,377	\$1,843,759	28%

**Table 2. A-CAM Deviation from Engineering Data**

If one defines a "substantial deviation" as instances where the A-CAM overestimates or underestimates the costs of constructing FTTP by more than 20%, almost half (49%) the A-CAM results feature a substantial deviation. In fact, in almost one-third (32%) of wire centers reviewed, the model deviates from the engineering data by more than 30%.





**Figure 2. Frequency of A-CAM Deviation by Magnitude**

4. **The A-CAM's inaccuracy is not easily explained by size of project or geography.** The model shows substantial deviation from the engineering data regardless of project cost or the location of the wire center.

For both large (more than \$5.25 million) and small (less than \$3.25 million) projects, the model misses the engineering data by more than 27%. For medium projects the A-CAM deviation is 25%.

Cost Tier	Mean Deviation
Less than \$3.25 million	30.1%
Between \$3.25 and \$5.25 million	25.2%
Greater than \$5.25 million	27.9%

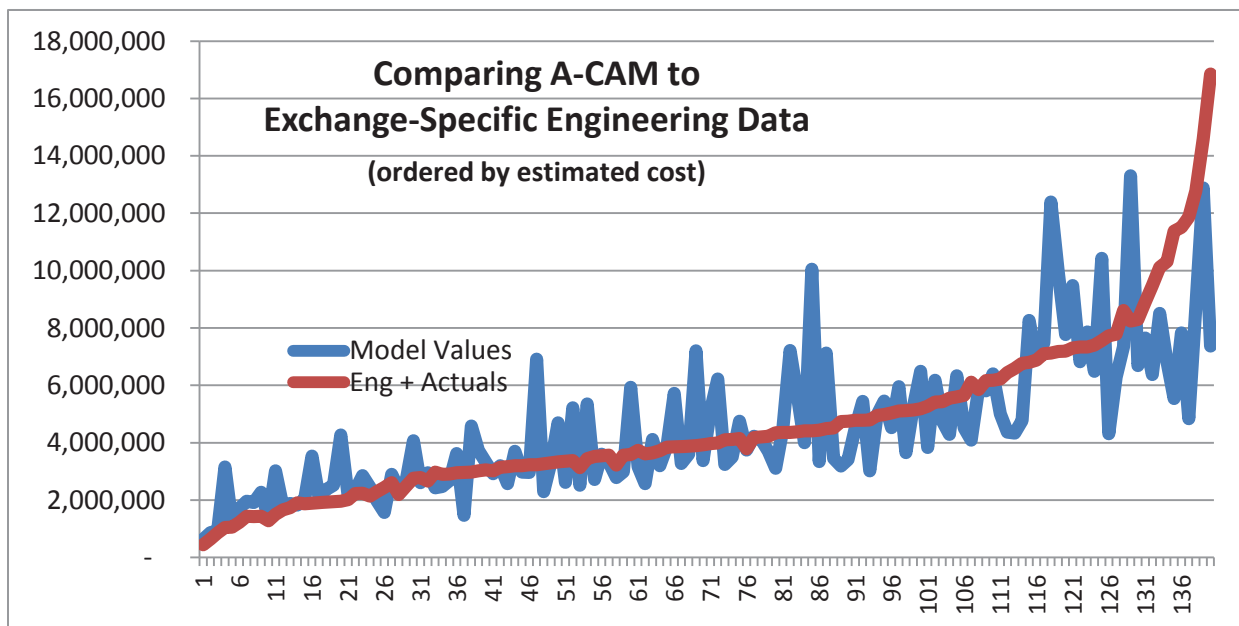
**Table 3. A-CAM Deviation by Cost**

The engineering data being used in this comparison comes from four regions of the country and more than a dozen states (Colorado, Florida, Idaho, Iowa, Illinois, Indiana, Minnesota, Montana, North Carolina, North Dakota, Ohio, South Dakota, and Tennessee). The A-CAM displays substantial deviations from engineering data in each of the four geographical regions as shown in Table 4.

Region	Mean Deviation
West	41.5%
Midwest	23.2%
East	37.0%
Great Lakes	24.8%

**Table 4. Mean Deviation by Region**

While the other three regions featured a mixture of A-CAM estimates that deviate high and A-CAM estimates that deviate low, the A-CAM capex estimates are consistently lower in the eastern region than engineering data for that region. It appears that the A-CAM doesn't properly estimate costs in that part of the country, but the eastern region featured fewer than a dozen comparisons in the VPS study, so it is difficult to draw conclusions from that sample size. The next section identifies a factor that may be impacting A-CAM estimates for LECs in the eastern region.



**Figure 3. A-CAM Compared to Engineering Data**

- The model shows consistent deviation based on cost per subscriber (or drop).** For projects featuring typical expenses per drop (between \$6,500 and \$8,500), the model deviates from the engineering data both high and low in roughly equal measure. For wire-center-wide projects with average expenses per drop above \$8,500 or below \$6,500 per location, that is not the case.



For expensive projects (those with mean cost per drop greater than \$8,500), the A-CAM consistently overestimates costs when compared to the engineering data. For relatively inexpensive projects (those with mean cost per drop less than \$6,500), however, the A-CAM consistently underestimates costs when compared to the engineering data.

	Frequency that A-CAM is <b>higher</b> than engineering data	Frequency that A-CAM is <b>lower</b> than engineering data
Low cost per drop (<\$6500)	28%	<b>72%</b>
Average cost per drop	51%	49%
High cost per drop (>\$8500)	<b>78%</b>	22%

**Table 5. Mean Deviation by Region**

Because the A-CAM deviations are asymmetrical for high- and low-cost wire centers, the model's impact may not "even out" over time, even for companies with many wire centers. The data suggests LECs in areas with lower costs per drop (areas with greater density, for example) would more frequently receive A-CAM support below what engineering estimates indicate is reasonable. In essence, those companies face two threats. First, almost half the time the model will misestimate their capital expenses for a wire center by a substantial amount (more than 20%). Second, low cost wire centers face an additional threat insofar as 72% of the time those substantial deviations will underestimate their costs.

The overall impact may be substantial. A-CAM estimates for the high-cost-per-drop wire centers are an average of 22% higher than engineering data. A-CAM estimates for the low-cost-per-drop wire centers are an average of 6% lower than engineering data.

Wire Center Type	Mean Impact to Support for Those Wire Centers
Low cost per drop (<\$6500)	-6%
Average cost per drop	2%
High cost per drop (>\$8500)	22%

**Table 6. Model Deviation by Drop Cost**

Certain states, like those in this comparison's "eastern region," generally have lower capital expenses per drop. That, combined with the model's tendency to underestimate expenses for those low-cost wire centers (compared to engineering data) may explain geographic shift of high-cost support caused by the A-CAM.



## Comparing A-CAM CapEx Results to Engineering Data Case Study WC-Underestimated

Recent ex parte filings with the FCC have raised concerns that A-CAM capex estimates differ substantially from experiences seen “on the ground” with rural fiber deployments. This case study is one of three that has been conducted in an effort to better understand what causes any deviations. The case studies reviewed engineering estimates and actual outside plant expenses for wire center-wide fiber to the premises (FTTP) networks that have been constructed, and compared that information with assumptions made by the A-CAM for that wire center.

**Wire Center “Underestimated”** – The subject of this case study is Wire Center “Underestimated” (WC-Underestimated). WC-Underestimated has fully deployed FTTP. Prior to construction, engineering studies were conducted that included estimates of likely costs for installing FTTP. Records of actual outside plant costs encountered in construction were maintained and were consistent with the pre-construction estimates. Together, the engineering estimates and actual outside plants costs are referred to as “engineering data.” In an effort to protect the identity of WC-Underestimated, the A-CAM estimates have been adjusted by a minor random factor which had no impact on the case study findings. The A-CAM estimate for FTTP construction in WC-Underestimated is 29% lower than the engineering data.

**Key Findings** – The A-CAM underestimates a number of major cost drivers for WC-Underestimated. The model overestimates the number of locations, underestimates electronics costs for Nodes 0 and 4, and significantly underestimates OSP drop length within Node 4. These incorrect assumptions work to underestimate by 29% the actual cost of deploying fiber for WC-Underestimated.

**Node Analysis** – This case study began by segregating WC-Underestimated’s engineering data into the four nodes used by the A-CAM. Differences between model values and engineering data prompted a deeper analysis in an attempt to determine possible causes.

Node Analysis			
Case Study WC-Underestimated			
	A-CAM	Engineering Data	% Difference
Node 0	[REDACTED]	[REDACTED]	77%
Node 2	[REDACTED]	[REDACTED]	2,332%
Node 3	[REDACTED]	[REDACTED]	-57%
Node 4	[REDACTED]	[REDACTED]	-71%
<b>Total Investment</b>	[REDACTED]	[REDACTED]	<b>-29%</b>

Chart 1

**Node 0** – The A-CAM overestimates Node 0 investment by 77%. The primary driver for the model’s miss is that it assumes substantial investment [REDACTED] in a building and land for a new structure to house electronics. For WC-Underestimated, a new building was not necessary for the fiber deployment. Over time, existing buildings will need to be replaced, so there may be a need to include some building-related costs within a forward-looking cost model, but this is a significant difference between the model and actual experience for this wire center.

The unnecessary land and building is not the only inaccurate Node 0 assumption made by the model. As shown in chart 2, the A-CAM also underestimates the electronics costs by 43% and underestimates the investment in Node 0 fiber by 62%. These variations may well be caused by market fluctuations for these products. Engineering staff working to estimate costs routinely have an up-to-date and nuanced understanding of market conditions and integrate that understanding into cost estimates, allowing for greater accuracy than seen under the model.

Node 0 Investment			
Case Study WC-Underestimated			
	A-CAM	Engineering Data	% Difference
Node 0 Building	[REDACTED]	[REDACTED]	∞
Node 0 Electronics	[REDACTED]	[REDACTED]	-43%
Node 0 Fiber	[REDACTED]	[REDACTED]	-62%
	[REDACTED]	[REDACTED]	77%

Chart 2

**Node 2** – The A-CAM estimates substantial costs [REDACTED] into Node 2. There were almost no Node 2 costs for WC-Underestimated’s construction, however.

The difference is a result of the assumptions A-CAM makes about network design and construction. Node 2 includes costs between the central office and the splitter. The model is designed around distributed splitter Gigabit-Capable Passive Optical Network (GPON) architecture. It consists of a GPON port on an optical line terminal (OLT) card located in the central office that is connected to a splitter located in the field. This GPON splitter can service up to 32 subscribers. WC-Underestimated was designed and constructed using a dedicated OSP architecture, which utilizes a dedicated fiber between each customer and the central office electronics and uses no splitters in the field. A dedicated OSP design such as was used by WC-Underestimated is a popular architecture, since it allows the company to deploy either GPON or Active Ethernet over the same OSP infrastructure. If GPON is used with a dedicated OSP design (as was the case with WC-Underestimated), the splitters are placed in the central office (or another centralized location) and the cost to connect the OLT to the splitters is minor, consisting of fiber jumpers in the central office. If the company later decides to deploy Active Ethernet architecture, they can bypass the splitters in the central office and connect directly to the OSP fiber. In many ways, this engineering design results in a “future-proof” investment consistent with values the FCC has often advocated.

Since the A-CAM assumes splitters are placed in the field, there is significant OSP investment required to connect the OLT in the central office to the splitters located in the field. In the A-CAM, all splitters are placed within 5,000 feet of the customer. Since WC-Underestimated is a rural wire center, there are often fewer than 32 subscribers within 5,000 feet of a splitter location. In those instances, the GPON port on the OLT is underutilized since it is capable of serving 32 customers and is often serving far fewer. Therefore, when the A-CAM calculates Node 2 costs for WC-Underestimated, it estimates more GPON ports on the OLT than what is required under the design approach that was used for actual FTTP in WC-Underestimated (and is used in many other rural wire centers).

As such, the A-CAM’s design methodology results in an inefficient use of OLT GPON ports and splitters (and the corresponding investment). This is another reason why many FTTP designs use a dedicated OSP architecture and splitters in the central office. The placement of splitters is a fundamental difference between A-CAM engineering methodology and the engineering design used for WC-Underestimated.

**Node 3 (combined with Node 2)** – A-CAM assumes substantial fiber costs within Node 2 that the engineering design for WC-Underestimated included as part of Node 3 (beyond the splitter). As a result, this case study also compared the combined A-CAM Node 2 and Node 3 values against WC-Underestimated engineering data for both nodes. The model substantially understates the combined costs of Node 2 and Node 3.

Combined Node 2 and 3 Investment Case Study WC-Underestimated		
A-CAM	Engineering Data	% Difference
[REDACTED]	[REDACTED]	-30%

**Chart 3**

The A-CAM uses census data to determine the number of locations, whereas Vantage Point utilizes actual counts from clients records and “on the ground” determination of actual subscriber locations. The latter method of determining locations results in a more accurate subscriber count. The model overestimates the number of locations in more than 85% of the 144 wire centers examined by Vantage Point, and does so by an average of 22%. For WC-Underestimated, the model overestimates the number of locations by 14%.

Locations Case Study WC-Underestimated		
A-CAM	Engineering Data	% Difference
[REDACTED]	[REDACTED]	14%

**Chart 4**

In addition, when comparing route miles, Vantage Point noticed substantial differences between the model and reality. The A-CAM audit solution set listed Node 2 cable mileage as [REDACTED] miles. This is an extremely high number of route miles, so VPS contacted CostQuest to confirm what comprises Node 2 route miles. Per CostQuest, Node 2 cable mileage recognizes the length of the feeder network to the location in the record. This captures the distance from Node 2 (splitter) to the Node 0 (CO). As a result, this field indicates sheath distance, not strand weighted distance. However, this did not appear to have an appreciable impact on the construction estimates.

The Node 4 mileage is closer in comparison, but the model still underestimates the Node 4 mileage by 63% (see chart 5).

Route Miles Case Study WC-Underestimated			
	A-CAM	Engineering Data	% Difference
Node 2 & 3	[REDACTED]	[REDACTED]	1,242%
Node 4	[REDACTED]	[REDACTED]	-63%

**Chart 5**

**Node 4** – The model substantially underestimates Node 4 costs for WC-Underestimated. There are two key inaccurate A-CAM assumptions that may explain this deviation. The OSP drop length in the A-CAM is usually between [REDACTED] and [REDACTED] feet, with one location

[REDACTED] feet in length. For WC-Underestimated, however, some OSP drops are as short as [REDACTED] feet, and others are as long as [REDACTED]. The A-CAM average drop length is [REDACTED] feet, but the actual average drop length is [REDACTED] feet. The model's tendency to underestimate drop length would result in a lower-than-actual estimate of Node 4 costs.

Additionally, the A-CAM's Node 4's estimated optical network terminal (ONT) investment was significantly lower than the WC-Underestimated ONT engineering data even though the A-CAM estimated a higher number of subscribers. WC-Underestimated actual ONT costs were [REDACTED] for each residential location. The model appears to allow [REDACTED] in expenses per WC-Underestimated ONT, close to half the actual cost.

**Conclusion** – The findings of Case Study WC-Underestimated revealed differences in engineering methodologies and calculation of FTTP investment for each node. Numerous wire center-specific factors (placement of the splitters outside of Node 0, cost of electronics, estimates of locations, and route miles) are not properly forecast or considered by the model, and they can have significant impacts on the costs of projects, as evidenced by WC-Underestimated. Ultimately, major cost drivers for Nodes 0, Nodes 2/3, and Nodes 4 are all underestimated by the model, causing A-CAM estimates for FTTP construction to be 29% lower than WC-Underestimated's engineering data.





## Comparing A-CAM CapEx Results to Engineering Data Case Study WC-Close

Recent ex parte filings with the FCC have raised concerns that A-CAM capex estimates differ substantially from experiences seen “on the ground” with rural fiber deployments. This case study is one of three that has been conducted in an effort to better understand what causes any deviations. The case studies reviewed engineering estimates and actual outside plant expenses for wire center-wide fiber to the premises (FTTP) networks that have been constructed, and compared that information with assumptions made by the A-CAM for that wire center.

**Wire Center “Close”** – The subject of this case study is Wire Center “Close” (WC-Close). WC-Close has fully deployed FTTP. Prior to construction, engineering studies were conducted that included estimates of likely costs for installing FTTP. Records of actual outside plant costs encountered in construction were maintained and were consistent with the pre-construction estimates. Together, the engineering estimates and actual outside plants costs are referred to as “engineering data.” In an effort to protect the identity of WC-Close, the A-CAM estimates have been adjusted by a minor random factor which had no impact on the case study findings. The A-CAM estimate for WC-Close’s FTTP construction appears quite accurate, being only 3% lower than the engineering data.

**Key Findings** – The A-CAM’s apparent accuracy is, in part, attributable to large offsetting errors at the node level. The model’s estimates deviate substantially from engineering data in each of the four nodes. The model overestimates the number of locations, assumes an inefficient network design that is not consistent with the actual FTTP architecture deployed in rural wire centers, features inaccurate route mile data, and underestimates optical network terminal (ONT) costs at the customer premises.

**Node Analysis** – This case study began by segregating WC-Close’s engineering data into the four nodes used by the A-CAM. Differences between model values and engineering data prompted a deeper analysis in an attempt to determine possible causes.

Node Analysis Case Study WC-Close			
	A-CAM	Engineering Data	% Difference
Node 0	[REDACTED]	[REDACTED]	100%
Node 2	[REDACTED]	[REDACTED]	5,499%
Node 3	[REDACTED]	[REDACTED]	-41%
Node 4	[REDACTED]	[REDACTED]	-74%
<b>Total Investment</b>	[REDACTED]	[REDACTED]	<b>-3%</b>

Chart 1

**Node 0** – The A-CAM overestimates Node 0 investment by 100%. The primary driver for the model’s miss is that it assumes substantial investment [REDACTED] in a building and land for a new structure to house electronics. For WC-Close, a new building was not necessary for the fiber deployment. Over time, existing buildings will need to be replaced, so there may be a need to include some building-related costs within a forward-looking cost model, but this is a significant difference between the model and actual experience for this wire center.

The land and building investment is not the only inaccurate Node 0 assumption made by the model. As shown in chart 2, the A-CAM also overestimates the electronics costs by a modest 5% and underestimates the investment in Node 0 fiber by 17%.

Node 0 Investment Case Study WC-Close			
	A-CAM	Engineering Data	% Difference
Node 0 Building	[REDACTED]	[REDACTED]	∞
Node 0 Electronics	[REDACTED]	[REDACTED]	5%
Node 0 Fiber	[REDACTED]	[REDACTED]	-17%
	[REDACTED]	[REDACTED]	100%

Chart 2

**Node 2** – The A-CAM estimates substantial costs [REDACTED] into Node 2. There were almost no Node 2 costs for WC-Close’s construction, however.

The difference is a result of the assumptions A-CAM makes about network design and construction. Node 2 includes costs between the central office and the splitter. The model is designed around distributed splitter Gigabit-Capable Passive Optical Network (GPON) architecture. It consists of a GPON port on an optical line terminal (OLT) card located in the central office that is connected to a splitter located in the field. This GPON splitter can service up to 32 subscribers. WC-Close was designed and constructed using a dedicated OSP architecture, which utilizes a dedicated fiber between each customer and the central office

electronics and uses no splitters in the field. A dedicated OSP design such as was used by WC-Close is a popular architecture, since it allows the company to deploy either GPON or Active Ethernet over the same OSP infrastructure. If GPON is used with a dedicated OSP design (as was the case with WC-Close), the splitters are placed in the central office (or another centralized location) and the cost to connect the OLT to the splitters is minor, consisting of fiber jumpers in the central office. If the company later decides to deploy Active Ethernet architecture, they can bypass the splitters in the central office and connect directly to the OSP fiber. In many ways, this engineering design results in a “future-proof” investment consistent with values the FCC has often advocated.

Since the A-CAM assumes splitters are placed in the field, there is significant OSP investment required to connect the OLT in the central office to the splitters located in the field. In the A-CAM, all splitters are placed within 5,000 feet of the customer. Since WC-Close is a rural wire center, there are often fewer than 32 subscribers within 5,000 feet of a splitter location. In those instances, the GPON port on the OLT is underutilized since it is capable of serving 32 customers and is often serving far fewer. Therefore, when the A-CAM calculates Node 2 costs for WC-Close, it estimates more GPON ports on the OLT than what is required under the design approach that was used for actual FTTP in WC-Close (and is used in many other rural wire centers).

As such, the A-CAM’s design methodology results in an inefficient use of OLT GPON ports and splitters (and the corresponding investment). This is another reason why many FTTP designs use a dedicated OSP architecture and splitters in the central office. The placement of splitters is a fundamental difference between A-CAM engineering methodology and the engineering design used for WC-Close.

**Node 3 (combined with Node 2)** – A-CAM assumes substantial fiber costs within Node 2 that the engineering design for WC-Close included as part of Node 3 (beyond the splitter). As a result, this case study compared the combined A-CAM Node 2 and Node 3 values against WC-Close engineering data for both nodes. Under that approach, the model overestimates the combined costs of Node 2 and Node 3 by 8%.

Combined Node 2 and 3 Investment		
A-CAM	Case Study WC-Close Engineering Data	% Difference
[REDACTED]	[REDACTED]	8%

**Chart 3**

The A-CAM uses census data to determine the number of subscribers, whereas Vantage Point utilizes actual counts from clients records and “on the ground” determination of actual

subscriber locations. The latter method of determining locations results in a more accurate subscriber count. The model overestimates the number of locations in more than 85% of the 144 wire centers examined by Vantage Point, and does so by an average of 22%. The model overestimates locations for WC-Close by 23%.

Locations Case Study WC-Close		
A-CAM	Engineering Data	% Difference
[REDACTED]	[REDACTED]	23%

Chart 4

In addition, when comparing route miles, Vantage Point noticed substantial differences between the model and reality. The A-CAM audit solution set listed Node 2 cable mileage as [REDACTED] miles. This is an extremely high number of route miles, so VPS contacted CostQuest to confirm what comprises Node 2 route miles. Per CostQuest, Node 2 cable mileage recognizes the length of the feeder network to the location in the record. This captures the distance from Node 2 (splitter) to the Node 0 (CO). As a result, this field indicates sheath distance, not strand weighted distance. However, this did not appear to have an appreciable impact on the construction estimates.

The Node 4 mileage is closer in comparison, but the model still underestimates the Node 4 mileage by 69% (see chart 5).

Route Miles Case Study WC-Close			
	A-CAM	Engineering Data	% Difference
Node 2 & 3	[REDACTED]	[REDACTED]	1,331%
Node 4	[REDACTED]	[REDACTED]	-69%

Chart 5

**Node 4** – The model substantially underestimates Node 4 costs for WC-Close. There are two key inaccurate A-CAM assumptions that may explain this deviation. The OSP drop length in the A-CAM is usually between [REDACTED] and [REDACTED] feet, with one location [REDACTED] feet in length. For WC-Close, however, some OSP drops were as short as [REDACTED] feet, but others were as long as [REDACTED]. If the average of the drop length is considered, the A-CAM average drop length is [REDACTED] feet, but the actual average drop length is [REDACTED] feet. The model’s tendency to underestimate drop length would result in a lower-than-actual estimate of Node 4 costs.

Additionally, the A-CAM's Node 4's estimated optical network terminal (ONT) investment was significantly lower than the WC-Close's ONT engineering data even though the A-CAM estimated a higher number of subscribers. WC-Close's actual ONT costs were almost [REDACTED] for each residential location. The model appears to allow [REDACTED] in expenses per WC-Close ONT, less than 70% of the actual cost.

**Conclusion** – The findings of Case Study WC-Close reveal even though the A-CAM appears accurate at the wire center level, there are still differences in engineering methodologies and calculation of FTTP investment for each node. The model's estimates deviate substantially from engineering data in all four nodes. As such, much of the A-CAM's apparent accuracy is attributable to large offsetting errors at the node level. Even though the A-CAM calculation for Nodes 2 & 3 can be considered somewhat accurate when the nodes are combined, the differences in the Node 1 and Node 4 calculations raise concerns about the accuracy of the A-CAM.



## Comparing A-CAM CapEx Results to Engineering Data Case Study WC-Overestimated

Recent ex parte filings with the FCC have raised concerns that A-CAM capex estimates differ substantially from experiences seen “on the ground” with rural fiber deployments. This case study is one of three that has been conducted in an effort to better understand what causes any deviations. The case studies reviewed engineering estimates and actual outside plant expenses for wire center-wide fiber to the premises (FTTP) networks that have been constructed, and compared that information with assumptions made by the A-CAM for that wire center.

**Wire Center “Overestimated”** – The subject of this case study is Wire Center “Overestimated”. WC-Overestimated has fully deployed FTTP. Prior to construction, engineering studies were conducted that included estimates of likely costs for installing FTTP. Records of actual outside plant costs encountered in construction were maintained and were consistent with the pre-construction estimates. Together, the engineering estimates and actual outside plants costs are referred to as “engineering data.” In an effort to protect the identity of WC-Overestimated, the A-CAM estimates have been adjusted by a minor random factor which had no impact on the case study findings. The A-CAM estimate for WC-Overestimated’s FTTP construction is 55% higher than the engineering data.

**Key Findings** – The model overestimates the number of locations in WC-Overestimated by 34% and critically overestimates the costs of infrastructure between the central office and end user. The A-CAM Node 2 and Node 3 values are \$2.5 million higher than WC-Overestimated’s engineering data for those expense types.

**Node Analysis** – This case study began by segregating WC-Overestimated engineering data into the four nodes used by the A-CAM. Differences between model values and engineering data prompted a deeper analysis in an attempt to determine possible causes.



Node Analysis			
Case Study WC-Overestimated			
	A-CAM	Engineering Data	% Difference
Node 0	[REDACTED]	[REDACTED]	41%
Node 2	[REDACTED]	[REDACTED]	27,876%
Node 3	[REDACTED]	[REDACTED]	-58%
Node 4	[REDACTED]	[REDACTED]	-80%
<b>Total Investment</b>	[REDACTED]	[REDACTED]	<b>55%</b>

Chart 1

**Node 0** – The A-CAM overestimates Node 0 investment by 41%. The primary driver for the model’s miss is that it assumes substantial investment [REDACTED] in a building and land for a new structure to house electronics. For WC-Overestimated, a new building was not necessary for the fiber deployment. Over time, existing buildings will need to be replaced, so there may be a need to include some building-related costs within a forward-looking cost model, but this is a significant difference between the model and actual experience for this wire center.

The unnecessary land and building is not the only inaccurate Node 0 assumption made by the model. As shown in chart 2, the A-CAM also overestimates the investment in Node 0 fiber by 42% and underestimates the electronics costs by 29%. These variations may well be caused by market fluctuations for these products. Engineering staff working to estimate costs routinely have an up-to-date and nuanced understanding of market conditions and integrate that understanding into cost estimates, allowing for greater accuracy than seen under the model.

Node 0 Investment			
Case Study WC-Overestimated			
	A-CAM	Engineering Data	% Difference
Node 0 Building	[REDACTED]	[REDACTED]	∞
Node 0 Electronics	[REDACTED]	[REDACTED]	-29%
Node 0 Fiber	[REDACTED]	[REDACTED]	42%
	[REDACTED]	[REDACTED]	41%

Chart 2

**Node 2** – The A-CAM estimates substantial costs [REDACTED] into Node 2. There were almost no Node 2 costs for WC-Overestimated’s construction, however.

The difference is a result of the assumptions A-CAM makes about network design and construction. Node 2 includes costs between the central office and the splitter. The model is designed around distributed splitter Gigabit-Capable Passive Optical Network (GPON) architecture. It consists of a GPON port on an optical line terminal (OLT) card located in the

central office that is connected to a splitter located in the field. This GPON splitter can service up to 32 subscribers. WC-Overestimated was designed and constructed using a dedicated OSP architecture, which utilizes a dedicated fiber between each customer and the central office electronics and uses no splitters in the field. A dedicated OSP design such as was used by WC-Overestimated is a popular architecture, since it allows the company to deploy either GPON or Active Ethernet over the same OSP infrastructure. If GPON is used with a dedicated OSP design (as was the case with WC-Overestimated), the splitters are placed in the central office (or another centralized location) and the cost to connect the OLT to the splitters is minor, consisting of fiber jumpers in the central office. If the company later decides to deploy Active Ethernet architecture, they can bypass the splitters in the central office and connect directly to the OSP fiber. In many ways, this engineering design results in a “future-proof” investment consistent with values the FCC has often advocated.

Since the A-CAM assumes that splitters are placed in the field, there is significant OSP investment required to connect the OLT in the central office to the splitters located in the field. In the A-CAM, all splitters are placed within 5,000 feet of the customer. Since WC-Overestimated is a rural wire center, there are often fewer than 32 subscribers within 5000 feet of a splitter location. In those instances, the GPON port on the OLT is underutilized since it is capable of serving 32 customers and is often serving far fewer. Therefore, when the A-CAM calculates Node 2 costs for WC-Overestimated, it estimates more GPON ports on the OLT than what is required under the design approach that was used for actual FTTP in WC-Overestimated (and is used in many other rural wire centers).

As such, the A-CAM’s design methodology results in an inefficient use of OLT GPON ports and splitters (and the corresponding investment). This is another reason why many FTTP designs use a dedicated OSP architecture and splitters in the central office. The placement of splitters is a fundamental difference between A-CAM engineering methodology and the engineering design used for WC-Overestimated.

**Node 3 (combined with Node 2)** – A-CAM assumes substantial fiber costs within Node 2 that the engineering design for WC-Overestimated included as part of Node 3 (beyond the splitter). As a result, this case study compared the combined A-CAM Node 2 and Node 3 values against WC-Overestimated engineering data for both nodes.

Combined Node 2 and 3 Investment Case Study WC-Overestimated		
A-CAM	Engineering Data	% Difference
[REDACTED]	[REDACTED]	90%

**Chart 3**

The model substantially overstates the combined costs of Node 2 and Node 3. This case study identified one possible explanation, which was a substantial difference between the number of locations identified by the model and the number of locations that were actually constructed for WC-Overestimated’s wire-center-wide FTTP project.

Locations		
Case Study WC-Overestimated		
A-CAM Locations	Actual Locations	% Difference
[REDACTED]	[REDACTED]	34%

Chart 4

The A-CAM uses census data to determine the number of subscribers, whereas VPS utilizes actual counts from clients records and “on the ground” determination of actual subscriber locations. The latter method of determining subscriber location results in a more accurate subscriber count. The model overestimates the number of locations in more than 85% of the 144 wire centers examined by Vantage Point, and does so by an average of 22%. For WC-Overestimated, however, the model overestimates locations by 34%.

In addition, when comparing route miles Vantage Point noticed substantial differences between the model and reality. The A-CAM audit solution set listed Node 2 cable mileage as [REDACTED] miles. This is an extremely high number of route miles, so VPS contacted CostQuest to confirm what comprises Node 2 route miles. Per CostQuest, Node 2 cable mileage recognizes the length of the feeder network to the location in the record. This captures the distance from Node 2 (splitter) to the Node 0 (CO). As a result, this field indicates sheath distance, not strand weighted distance. However, this did not appear to have an appreciable impact on the construction estimates.

The Node 4 mileage is closer in comparison, but the model still underestimates the Node 4 mileage by 64% (see chart 5).

Route Miles			
Case Study WC-Overestimated			
	A-CAM	Engineering Data	% Difference
Node 2&3	[REDACTED]	[REDACTED]	1,779%
Node 4	[REDACTED]	[REDACTED]	-64%

Chart 5

**Node 4 –** The model substantially underestimates Node 4 costs for WC-Overestimated. There are two key inaccurate A-CAM assumptions that may explain this deviation. The OSP drop length in the A-CAM is between [REDACTED] and [REDACTED] feet. For WC-Overestimated,

however, some OSP drops are as short as [REDACTED] feet, and others are as long as [REDACTED]. The A-CAM average drop length is [REDACTED] feet, but the actual average drop length is [REDACTED] feet. The model's tendency to underestimate drop length would result in a lower-than-actual estimate of Node 4 costs.

Additionally, the A-CAM's Node 4's estimated optical network terminal (ONT) investment was significantly lower than the WC-Overestimated's ONT engineering data even though the A-CAM estimated a higher number of subscribers. WC-Overestimated's actual ONT costs were [REDACTED] for each residential location. The model appears to allow [REDACTED] in expenses per WC-Overestimate ONT, less than half the actual cost.

**Conclusion** – This case study has identified sizable model errors in each node. Critical differences in estimated electronics costs, route miles, and locations directly impact A-CAM values for network investment. Numerous wire center-specific factors are not properly forecast or considered by the model, and they can have significant impacts on the costs of projects, as evidenced by WC-Overestimated.