Response to Professors Reed and Sirbu

We are grateful to Professors Reed and Sirbu for their comments and suggestions on version 2 of the Connect America Cost Model (abbreviated either CACM or CAM).[1] We are pleased that they found that "[t]he CACM does a reasonable job of providing an estimate of the cost of deploying a broadband network across a wide number of deployment scenarios found throughout the nation,"[2] and further that, "[t]he methodology to develop and estimate the cost of the network topology implemented in CACM show that reasonable assumptions are being made to simulate actual network deployment costs to the best ability of current estimation methods."[3]

Background

The CAM estimates, for every census block, the cost of providing a voice- and broadband-capable network. That cost is levelized, that is, is turned into a constant (or kind of average) monthly cost associated with serving the census block over the network's entire life.[4] Given costs for each block, the model can be used to calculate support.[5] In particular, a future Wireline Competition Bureau (Bureau) order will determine a lower "benchmark" that identifies areas that could be economically viable absent subsidies ("the funding threshold"), and an upper cost threshold that delineates those deemed to be extremely high cost. The total subsidy will be equal to the cost of supplying eligible Census blocks that are more expensive to serve than the funding threshold, but are not more expensive than the extremely high cost threshold. The total budget for support in price cap areas was set by the Commission to not exceed $1.8 billion.[6] Thus changes in cost or support calculations change the obligations that carriers have to accept to receive funding, but will not change the total amount of funding.

Professors Reed and Sirbu focused on six topics: documentation, network technologies, voice assumptions, network sizing, service scope, and cost and support model interactions. For ease of reference, Professors Reed and Sirbu's comments are provided in italics, and we have, as much as possible, responded to those comments in the order they appear in their review.

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[1] While the peer review refers to CACM throughout, this response, consistent with *Connect America Fund et al.*, WC Docket Nos. 10-90, 05-337, Report and Order, 28 FCC Rcd 5301 (Wireline Comp. Bur. 2013) (*CAM Platform Order*), will refer to the model as CAM.

[2] Letter from David P. Reed and Marvin Sirbu, Carnegie Mellon University, to Julie Veach, Chief, Wireline Competition Bureau at 1 (Feb. 18, 2013) (R&S).

[3] R&S at 5.

[4] *CAM Platform Order*, 28 FCC Rcd 5301, 5308, para. 15.

[5] *See Connect America Fund et al.*, WC Docket No. 10-90 et al., Report and Order and Further Notice of Proposed Rulemaking, 26 FCC Rcd 17663, 17715-16, paras. 134-135 (2011) (*USF/ICC Transformation Order*).

[6] *See id.* at 17764, 17729, 17738, paras. 25, 169, 193.

1. Documentation

. . . .there is room for improvement to the model, most importantly through better documentation that would invite more effective review of the methodology and assumptions employed in order to more easily verify the accuracy of the results.[7]

. . . model documentation. . . was. . . insufficient to allow one to operate or understand in straightforward fashion the key assumptions in each model calculation and report of results. . . . Another problem is that the model documentation is fragmented across different documents and sources.[8]

The most important improvement Professors Reed and Sirbu called for was better documentation.[9] We agree with the professors, and substantial progress has been made on this front since they reviewed the documentation.

The following improvements to documentation are currently available and centralized in one location, on the model website:

1. The CAM home page (cacm.usac.org) displays a "system updates page" link. This provides summary level details on model changes by version number and release date.
2. The CAM home page displays a "Resources" button to provide users a consolidated location for documentation and additional resources.
3. Current documentation listed under the "Resources" button:
    a. *Background Information on Connect America Cost Model* – Provides a summary of the Connect America Cost Model and its role within the Connect America Fund.
    b. *CACM Methodology* – Comprehensive documentation providing details on the model's methodology and the methodology used to derive various input values (updated as each new version is released).
    c. *Opex Overview* – Describes the development of the Opex inputs for the Connect America Cost Model.
    d. *Capital Cost Model* – Derives annual charge factors for depreciation, cost of money, and income taxes associated with capital investments, used as inputs in the model.
    e. *Capex Tutorial* – A link to a tutorial video explaining the capital expenditures workbook to help parties better understand the structure and inputs contained in the workbook.
    f. *User Guide* – Provides help to users with information on how to work with and analyze the Connect America Cost Model.
    g. *FAQ* - Frequently Asked Questions sent to CACM Support desk (CACMsupport@costquest.com).

[7] R&S at 1.
[8] *Id.* at 3.
[9] *Id.* at 1, 3-5.

h. *Tile Query Field Definitions* – Lists the field definitions for data fields within the tile query results.

4. Additional resources listed under the "Resources" button to assist users in analyzing model results include:
    a. *TelcoMaster Table* – Provides holding company name associated with serving wire centers and includes state, company name, study area code, classification as rate-of-return or price cap, company size, and other data.
    b. *Coverage Data* – Identifies census blocks presumptively served by unsubsidized competitors.
5. CACMsupport@costquest.com – Link located on the home page for users to submit questions related to access, administration and output generation.
6. The CACM homepage also displays a "Posted Datasets" button to provide users with access to model inputs and model results from various model runs.
7. *System Evaluator* – Additional documentation is available via email with a link for download with a specific license agreement. Assists users to take a closer examination of the source code and the operation of the CACM.

These improvements in documentation address Professors Reed and Sirbu's suggestion for a comprehensive user manual, including documentation of the derivation of the values of input assumptions.

The Bureau continues to work with USAC and its contractor to improve the documentation available in a centralized location, the model website, reflecting changes in model versions and providing more complete explanations as warranted.

2. **Network Technologies**

Even for telephone companies, accepted engineering practices of the network technologies considered today for deployment of broadband services in a "green field" includes Hybrid Fiber Coax networks. The CACM should include this as an option.[10]

A true "green field" calculation would consider HFC approach since it can be deployed from the existing wire centers of the ILECs as required by the "scorched node" assumption of the model.[11]

Professors Reed and Sirbu suggest that hybrid fiber coax (HFC) deployment should be included as an option in the green field model, on the basis that this would be consistent with including "the lowest, potentially disruptive technical strategies available in the market."[12] We agree that the least-cost, most efficient, and reasonable wireline technology capable of providing the services specified in the

[10] *Id.* at 1.
[11] *Id.* at 7.
[12] *Id.* at 6-7.

USF/ICC Transformation Order should be used in the CAM,[13] but the Bureau has concluded for policy reasons that it is reasonable to focus on a fiber-to-the-premises (FTTP) in the CAM.[14]

The Bureau is only aware of one price cap carrier deploying an HFC network, and that carrier represents much less than 0.05% of all price cap lines.[15] In other words, HFC is a technology that no company eligible for the right of first refusal has deployed at a scale commensurate with the number of locations eligible for Connect America Fund Phase II support.

In any event, the levelized green field costs of an HFC network may exceed those of a fiber network in the areas of interest for the reasons laid out below. It is possible, though far from certain, that an HFC network could provide some near-term savings relative to a FTTP network.[16] However, given the extremely long life of many of the assets deployed in network builds, this must be weighed against the higher operating costs of maintaining active electronics in the field in an HFC network; and the possible upgrade costs of an HFC network over time (e.g., to upgrade electronics, to handle increasing customer bandwidth requirements and "tighten" the system to utilize more spectrum in the HFC system). Particularly in rural areas, where there are fewer potential customers per mile of outside plant, it is unclear whether the higher CPE cost or operating-cost savings would prevail; the impact of CPE cost would also depend heavily on assumptions made about take rate.
We note that several firms that are deploying high-capacity broadband are deploying FTTP rather than HFC, even when competing head-to-head with cable companies that have deployed HFC, suggesting that they view FTTP as more cost-efficient than HFC.[17]

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[13] *USF/ICC Transformation Order*, 26 FCC Rcd at 17736, para. 189.
[14] *CAM Platform Order*, 28 FCC Rcd at 5314-16, para. 33 (adopting FTTP); *see also Connect America Cost Model (CACM) version 3.1.4.*, at 17, 40, sections 5.2.2. and 8.3. (2013) (CAM v.3.1.4 Methodology), *available at* http://transition.fcc.gov/Daily_Releases/Daily_Business/2013/db0624/DOC-321774A1.pdf.
[15] Companies may rely on coaxial in-home wiring to distribute telco-provided video and broadband, but this is not the same as an HFC network. To the best of staff's understanding, only Vitelco among price cap carriers has provisioned an HFC network. *See CAM Platform Order*, 28 FCC Rcd at 5314, para. 33 n.59.
[16] For example, the customer premises equipment (CPE) in an FTTP network, the optical network terminal (ONT), is more expensive than comparable equipment in an HFC network.
[17] Google and Verizon's deployment of its FiOS network are two examples. *See also* Cedric Lam, Google Network Architect, *High Performance, Low Cost, Colorless ONU for WDM-PON* (2012) at 3, *available at* http://static.googleusercontent.com/external_content/untrusted_dlcp/research.google.com/en/us/pubs/archive/37746.pdf (concluding that "WDM-PON is the most

3. Voice assumptions

The per subscriber or variable cost estimation methodology applied for the cost of voice-specific network components is not consistent with the access network costing approach which includes fixed costs.[18]

We do not know how significant the percentage of hardware costs for IMS-based voice is relative to total costs (the base case CACM estimates this percentage to be roughly 30%, which is not insignificant). At a minimum, this per subscriber cost estimation methodology is not consistent with the access network costing approach by replacing these fixed costs with variable costs.[19]

The Bureau has not made a final decision on how to model the cost of voice capability, and has sought comment on that topic in the virtual workshop.[20] We note, however, that all costs are levelized, so the cost of any equipment required for service will be spread over time regardless of whether one assumes the costs are incurred as an initial capital expense or an ongoing expense. Furthermore, per-subscriber voice over Internet protocol (VoIP) equipment costs are much less scale-dependent than circuit-switched equipment costs. Instead, VoIP systems can be scaled from a few hundred lines to hundreds of thousands of lines. Consequently, even the smallest price cap carrier can purchase VoIP with per-line costs that are not radically different from the per-line costs faced by carriers many times their size.

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promising long-term, scalable solution for delivering high bandwidth to the end user; Mark Weigleitner, Verizon, *Verizon FiOS Architecture*, presentation to the Multimedia over Coax Alliance (2007), *available at* http://www.mocalliance.org/industry/presentations/2007_11_14_TechConference/docs/MarkWegleitner.pdf (showing FiOS FTTP architecture). Dr. Lam's research can be viewed on his web page. Cedric Lam, *Research at Google*, http://research.google.com/pubs/author38397.html (last visited July 1, 2013, 4:44 PM) (showing Google's FTTP architecture). Similarly, TDS Telecom is deploying FTTP in certain areas. *See , e.g.*, Press Release, TDS Telecom, TDS expands fiber network, brings TDS TV Fiberville concept to Concord and parts of Knoxville (July 2, 2013) http://www.tdstelecom.com/mediaroom/Article.aspx?id=69de9870-175f-4612-9734-97c13a6c73dc.

[18] R&S at 1.

[19] R&S at 6.

[20] *See* Letter from Michael J. Jacobs, Legal Advisor to the Chief, Wireline Competition Bureau, to Marlene Dortch, Secretary, FCC, WC Docket No. 10-90, Attach. at 15-17 (filed Feb. 6, 2013) (WCB Feb. 6, 2013 Virtual Workshop Submission Letter); Letter from Jamie Susskind, Legal Advisor to the Chief, Wireline Competition Bureau, to Marlene Dortch, WC Docket No. 10-90, Attach. at 1-2 (filed March 28, 2013) (WCB March 28, 2013 Virtual Workshop Submission Letter).

Many VoIP solutions (from Avaya, Brocade, Cisco, Nortel, Siemens and others) scale from small to large.[21] A modular and/or cluster-based framework allows these VoIP solutions to meet the specific size requirements for carriers of varying sizes. Additionally, many VoIP call control systems may be remotely located, providing additional flexibility and capabilities to allow smaller carriers and larger carriers to tailor the solutions needed to their requirements on a cost-effective basis. Many of the carrier grade VoIP solutions and/or gateways to the public switched telephone network (PSTN) are licensed solutions, with fees often being based upon the number of lines going to and from the PSTN – among other parameters – which supports a more linear or variable cost model.[22]

4. Network sizing

The description of the methodology or engineering practices applied for driving the network sizing in CACM deserve further attention as it has significant implications for future costs of the network to meet growing demand.[23]

A. Bandwidth Capacity

Professors Reed and Sirbu note that the amount of capacity for which the CAM calculates costs "is an important parameter for both the cost and viability of the broadband network in the future."[24] In this section, we provide additional explanation of the assumptions and methodology used in the current version of the CAM.

In summary, given the network sizing at the CAM aggregation points, and the likely range of reasonable take rates, the network in the current version of CAM provides much more than 5.4 Megabits per second (Mbps) of capacity per subscriber in rural areas. Additionally, the current version of the CAM allows users to specify even greater busy-hour offered loads to allow further examination of the impact of this variable on cost estimates. We note that the Bureau has not yet adopted an input value for assumed capacity per subscriber.

In the *CAM Platform Order*, the Bureau adopted an FTTP approach.[25] In the modeled Gigabet Passive Optical Network (GPON), there are three basic aggregation points or bottlenecks. The following is a list of capacity at the aggregation points:

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[21] As an example, *see* Cisco Unified Communications System Release 9.0 SRND (Solutions Reference Network Design), *available at* http://www.cisco.com/en/US/docs/voice_ip_comm/cucm/srnd/9x/uc9xsrnd.pdf

[22] For example, *see* Cisco Systems PWG 200 license agreement, *available at* http://www.cisco.com/en/US/docs/voice_ip_comm/pgw/9/feature/module/9.7_3_/FlexLM.html.

[23] R&S at 1.

[24] R&S at 8.

[25] *CAM Platform Order*, 28 FCC Rcd at 5314-16, para. 33; *see* CAM Methodology at 17, 40, sections 5.2.2. and 8.3.

- The first aggregation point is the fiber splitter which supports up to 32 lines/ subscribers with 2.5 Gigabits per second (Gbps) of backhaul;[26]
- The next aggregation point is the optical line terminal (OLT), where fiber-optic signals from multiple splitter fibers are aggregated and shifted onto a 10 Gbps connection to Ethernet switches and routers (10 Gbps total bandwidth for each OLT).[27] The CAM assumes that each OLT can handle as many as 58 splitter feeder fibers, or 1,856 subscribers (assuming all locations passed subscribe) (10,000 Mbps / 1,856 subscriber = 5.39 Mbps per subscriber). At full capacity of the splitter and the OLT, each subscriber will receive more than 5.4 Mbps of capacity;
- Toward the core network, aggregation points are Ethernet switches and routers, whose capacities (number of line cards) increase with the number of subscribers assumed to be on the network. In other words, the CAM captures the need for increased capacity in the Ethernet (backhaul) network according to the supported number of subscribers. Unit costs due to these capacity increases fall with greater capacity.

The capacity per subscriber is ultimately driven by the number of subscribers per splitter fiber, which depends on local demand: in denser areas, the splitter is typically fully consumed, while in more rural areas it is likely that there will be fewer than 32 subscribers per splitter fiber. In addition, in smaller service areas, the OLTs will not have as high utilization as those in larger service areas.[28] Denser, less-rural areas – areas less likely to have high costs – are more likely capacity constrained at the OLT. Regardless, in the most capacity-constrained areas, each subscriber will receive at least 5.4 Mbps of capacity.[29] In rural areas, with fewer

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[26] In fact, each splitter may have only a fraction of the 32 possible locations as subscribers, meaning the CAM allows for even more capacity per subscriber than described in this example. That means that each location has a minimum of 75 Mbps of downstream capacity.

[27] For simplicity's sake, the FCC assumes 1 Gbps = 1,000 Mbps. *See, e.g.*, FCC, *2013 Measuring Broadband America—February Report*, Conclusion and Next Steps, *available at* http://www.fcc.gov/measuring-broadband-america/2013/February#Conclusion ("Google offers 1 Gbps (1000 Mbps) service in Kansas City, MO").

[28] OLTs are often, though not necessarily, located in central offices and can therefore aggregate demand from an entire service area. While this reduces the likelihood of an OLT being only partly filled, it does not eliminate that problem entirely.

[29] This corresponds to a busy-hour offered load of 5.4 Mbps. Maximal usage of a 4 Mbps connection will result in a busy hour offered load of 4 Mbps. Therefore the 5.4 Mbps busy-hour offered load corresponds to more capacity than the amount required if all subscribers were using every bit of available bandwidth on a 4 Mbps network at one time. And, as noted above, more rural areas, with fewer splitters per

than 32 subscribers per splitter fiber and fewer than an average of 58 splitters connected to each OLT, each subscriber will have many times this 5.4 Mbps capacity by default, with the exact amount determined by local conditions.

Lastly, several parameters of the CAM can be adjusted to influence the bandwidth requirements. The number of subscribers can be adjusted to influence the bandwidth capacity requirements for the projected solution set. Additionally, the solution set can be adjusted by changing the busy-hour offered load and thus increasing or decreasing the capacity available to subscribers.

B. Residential vs. Business Sizing

Professors Reed and Sirbu state that the model "*also does not differentiate in the bandwidth input assumptions for residential and business users even though these two sets of customers typically purchase different service tiers*."[30] They note that "*an important business consumer of fiber trunking – wireless backhaul – is not specified*."[31]

The CAM differentiates the type of services assumed to be purchased by residential and business subscribers, as noted in the documentation. The CAM's network topology assumes certain business locations are served using a dedicated, special access/private line fiber.[32]

The model estimates the potential demand for services based on the type of business; businesses are classified as "technology oriented" or "all other business" based on their North American Industry Classification System (NAICS code) and the number of employees at each location. The model provisions dedicated fiber connections to technology oriented business locations that have 10 or more employees and all other business locations that have 50 or more employees.[33] The model does not include any cost for the associated electronics necessary to light the dedicated fiber service to business locations that are assumed to purchase such

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OLT, each subscriber will have more capacity than that. The current version of the model calculates costs based on a "greater of" approach, using either the default capacity implied by the FTTP architecture or a specified busy-hour offered load, whichever is greater. This enables users to specify capacity uses far in excess of what a 4 Mbps downstream network can provide to test the impact on cost estimates.

[30] R&S at 9.

[31] *Id.*

[32] Additional information about how CAM models demand for higher bandwidth services and treats the costs associated with such services can be found in the CAM Methodology. CAM Methodology at 19-21, sections 5.2.3.2 and 5.2.3.3.

[33] Business locations with fewer employees are provisioned the same as voice and broadband services at residential locations. CAM Methodology at 20, tbl.3.

services, nor are those locations included when unitizing total cost within a census block.[34]

The CAM determines how many fiber strands are used by the various demand locations and allocates the cost of fiber and structure between special access/private line locations (including cell towers, business locations with more employees, and community anchor institutions) and other locations (i.e., residential locations and those business locations assumed to be purchasing residential-type services), with support calculated based only on costs related to the latter group of locations. The model similarly captures the sharing of the middle mile network by estimating that 50 percent of the costs of an interoffice route are attributable to special access/private line data services provided to certain business locations, community anchors and wireless towers, and those costs are excluded from cost calculations. Locations served by such special access/private line services (which includes direct Internet access) are also excluded from the unitization of total middle mile cost of a census block, i.e., when the total middle mile cost of serving the census block is divided by all locations passed, the locations passed only include residential and those business locations assumed to receive the same type of voice and broadband services as residential subscribers.

C. CACM Projection for Demand Growth

Several of the reviewers' questions deal with how the CAM handles demand which grows over time; they suggested that "it would be more intuitive if the model allowed for direct input of a projected traffic growth rate, and generated reasonable fill factors to be used in order to minimize costly future reinforcement."[35] Costs that are calculated based only on near-term demand may exclude the additional investment required to handle future demand.

We believe the approach that the CAM takes provides the Bureau with a reasonable means of testing alternative approaches. First, the number of subscribers used to calculate costs can be chosen to include the total number of locations connected over time, rather than just the number of locations connected at any one point.[36] Second, as described above, the model can be adjusted to make assumptions about busy-hour offered load at the end of the time period of interest rather than the

[34] CAM Methodology at 51-53, app. 2.

[35] R&S at 9.

[36] The Bureau has sought comment on a reasonable take rate assumption for the CAM and will adopt a take rate for the CAM in a future order. *See* WCB Feb. 6, 2013 Virtual Workshop Submission Letter, Attach. at 39-43.

beginning.[37] We note that the costs calculated by CAM are not particularly sensitive to these assumptions.[38]

D. Additional Questions

Professors Reed and Sirbu ask several specific questions which we address below:

- *How much of the network is installed initially?* As discussed above, consistent with the policy decisions made in the *USF/ICC Transformation Order*, the current version of the CAM determines the total investments needed to build the green field network at ultimate customer demand and calculates levelized annual costs of that initial investment. The Bureau expects that network to be consistent with end-of-period demand.
- *How much working capacity is deployed for each user in the near term?* The version of CAM reviewed by Professors Reed and Sirbu assumes at least 5.4 Mbps of downstream access for each subscriber. As noted above, the current future version of the model includes the ability to specify a greater capacity.
- *What investment is made in the plant upfront to support the FCC goal that most locations receive a 6 Mbps/1.5 Mbps or faster service at the end of 5 years?* The Commission said that 6 Mbps/1.5 Mbps service needs to be available to "a number of supported locations to be specified."[39] The Bureau has not yet specified that number. We note that because the Bureau has adopted a FTTP network architecture in the *CAM Platform Order*, there is no incremental additional cost in the model for locations to receive 6 Mbps/1.5 Mbps service.[40]
- *How does the model incorporate the annual projected increases in broadband traffic per user?* As noted above, by assuming a capacity consistent with the

[37] Again, the input values for capacity will be set by the Bureau in a future order. *See* WCB Feb. 6, 2013 Virtual Workshop Submission Letter, Attach. at 20; WCB March 28, 2013 Virtual Workshop Submission Letter, Attach. at 3.

[38] All Phase II supported lines must offer at least 4 Mbps downstream, with some supplying at least 6 Mbps. *USF/ICC Transformation Order*, 266 FCC Rcd at 17702, 17726-27, 17735, paras. 105, 160-163, 187. The maximum busy-hour load from lines of such speed is likely less than the capacity as described above, so there is no cost impact for greater capacity assumptions. Even with assumptions about higher busy-hour usage (i.e., assuming higher-speed connections), the impact on costs is likely to be limited.

[39] *USF/ICC Transformation Order*, 266 FCC Rcd at 17726, para. 160. The direction that "the most locations possible" receive service is subject to the constraint of being "consistent with the CAF Phase II budget." *Id.* at 17735, para. 187.

[40] This is not to say that providers may not incur some incremental cash costs in providing the higher-speed service, only that there is no impact on the calculation of costs in the model.

end of the modeling period, the Bureau believes the current version of the model allows for reasonable bandwidth growth.

5. Service scope

The scope of CACM includes voice and broadband services, but not video services. Given that video is rapidly emerging as an application in the broadband space, this distinction is not logically consistent with current technical and market trends in broadband. The implications of this omission are that economies of scale and scope between broadband and video services may not be realized or properly reflected in the results of the CACM.[41]

Professors Reed and Sirbu suggest that video costs and presumably revenues should be accounted for in determining the efficient subsidy. At the outset, we note that the Bureau has not yet made a determination of what types of revenues should be included when determining the funding threshold. The decision of whether to include video revenues in determining the support threshold is a policy decision not subject to peer review.

Moreover, even if video revenues are relevant, they would only be so to the extent that they exceed the incremental cost of video provision, and hence contribute toward shared costs. It is possible that the contribution from video services would be relatively small, and therefore unlikely to distort the CAM subsidy estimates.[42] Being late entrants, incumbent local exchange carriers (ILECs) have a relatively small share of all video subscribers.[43] Because of their video market share, ILECs typically face higher per subscriber programming, consumer premise equipment, and customer acquisition costs than their cable and satellite rivals,[44] reducing their

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[41] R&S at 1.

[42] The choice to model a FTTP network, with or without video revenues, does not imply carriers accepting model subsidies must deploy an FTTP network and offer (or not offer) video services.

[43] The combined shares of all telephone multichannel video distributors (MVPDs) accounted for approximately 8.4 percent of MVPD subscribers at the end of 2011, compared to 6.9 percent at the end of 2010. The largest of these, Verizon, was the 7th largest MVPD, while the 2nd largest, AT&T, was the 9th largest. *Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming*, MB Docket No. 12-203, Fifteenth Report, FCC 13-99 at 12-13, paras. 28, 30 (rel. July 22, 2013) (*15th Video Competition Report*). According to one analyst, as of March 2013, telephone MVPD share has risen to closer to ten percent of the market (Leichtman Research Group, press release, May 20, 2013, http://leichtmanresearch.com/press/052013release.html, viewed May 31, 2013).

[44] *15th Video Competition Report*, FCC 13-99 at 34-35, paras. 69-72. *See* Steve Donohue, *Verizon proposes paying cable networks based on viewership*, FierceCable (Mar. 18, 2013), *available at* http://www.fiercecable.com/story/verizon-proposes-paying-cable-networks-based-viewership/2013-03-18 (noting that Verizon's

per video subscriber margins. In fact, the per video subscriber contribution from video could be negative, but the operator might still provide the service because it prevents further loss of voice customers to mobile and other rivals.[45] The failure to include a net contribution from video therefore may be unlikely to lead to an overstatement of the necessary subsidy required for a voice and broadband-capable broadband network.

6. Cost and support model interactions

Arriving at consistent results between the assumed take rates and the level of universal service support requires a time consuming iteration process of running first the cost model at a lower take rate, and then the support model to see if that level of take rate can be satisfied within the universal service budget cap in order to end up with consistent results for both the cost and support models.[46]

Professors Reed and Sirbu argue that a model that does not consistently model take rates and universal support assumptions simultaneously "is ultimately not sufficient for evaluating policy options, and the Commission would benefit from a model which made convergence on consistent numbers easier to achieve."[47]

We agree that a model that could simultaneously take assumptions about price, service standards and demand as inputs to determine subscription rate decisions, which in turn would be used to identify the optimal CAM take rate, and ultimately determine the upper threshold for the CAF subsidy given the Commission's budget, would be a useful tool. However, such a modeling exercise would require substantial additional programming and computational resources unavailable to us. Given these constraints, we are using manual iteration so as to ensure consistency across our assumptions about the variables in play.

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attempt to negotiate fees paid for content is unlikely to succeed given the market power and most favored nation clauses of Comcast and DirecTV). SNL Kagan reports that larger MVPDs face lower programming costs. *See* Telco TV Outlook: Competitive analysis of US telco video deployments, 2007 edition, SNL Kagan, June 2007 ("volume discounts and most-favored-nation (MFN) clauses ensuring multichannel giants such as Comcast and Time Warner Cable always pay rates [for programming] less than or equal to those charged their competitors. . . . We polled some small operators and found they were paying about 30% more than the average for a dozen networks randomly chosen for our survey.").

[45] For example, this would be true if packaging video with voice (and perhaps broadband) makes, holding other things constant, customers less likely to switch their voice services to another provider.

[46] R&S at 11. *See also id.* at 1.

[47] *Id.* at 11.