Before the

Federal Communications Commission

Washington, D.C. 20554

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In the Matter of	)	
	)	
Modernizing the E-Rate Program	)	WC Docket No. 13-184
For Schools and Libraries	)	
	)	

October 23, 2017

COMMENTS OF THE FRIDAY INSTITUTE FOR EDUCATIONAL INNOVATION AT NORTH CAROLINA STATE UNIVERSITY

RELATED TO THE MATTER OF:
WIRELINE COMPETITION BUREAU SEEKS COMMENTS ON CATEGORY TWO BUDGETS

North Carolina's School Connectivity Initiatives

The Friday Institute for Education Innovation at North Carolina State University has been a thought leader in school connectivity for over a decade. In 2014, following the E-rate Modernization Order, the Friday Institute and the North Carolina Department of Public Instruction (NCDPI) developed a statewide program to promote the use of Category Two in the 2015 funding year. The program consisted of a statewide Form 470 and RFP procurement process, with multiple vendors awarded, covering the majority of Category Two eligible

products and services. Cabling, switching equipment, wireless equipment, installation and managed services services represent the bulk of the procurements through these contracts. Any public school in North Carolina is eligible to utilize the resulting contracts to obtain E-rate discount on specified goods and services.

Individual LEAs and charter schools performed mini-bids and filed a Form 471 against the statewide Form 470 and contracts. LEAs and charter schools that use the state's contracts receive state funding for the non-discounted portion of any funded Category Two FRN committed by USAC, up to the $150/student (inflation adjusted) budget cap. In short this means that any North Carolina public school filing for Category Two, using the state contract (and Form 470), pay nothing for internal connections up to $150/student.

The concept of the state covering the non-discounted portion of the E-rate funded expenses has its roots in the School Connectivity Initiative (SCI) established in 2006 whereby the state began aggregating LEAs to a non-profit backbone provider for Category One Internet Access. In the Category One SCI, NCDPI files state consortia E-rate applications for Internet Access and covers the cost fully. Additionally, the state provides what amounts to a grant for the portion of WAN costs not covered by E-rate. There is no support at the state level for any type of voice service.

The School Connectivity Initiative provides equitable Internet access to every public school student in the state, with a baseline level of connectivity (assuming the LEA/charter school follows a few simple rules) at no cost to the LEA or charter school. LEAs and charter schools are free to spend local funds beyond the $150/student limit, but the state does not fund these amounts using School Connectivity Initiative funds. By aggregating the procurement using

the vendors awarded through the Form 470 E-rate competitive bidding process, the State receives consistent quality products and services at very cost-effective pricing. Schools choose from a number of vendors using the mini-bid process, providing a balance of local control with state oversight, commensurate with the funding provided. This initiative has proved highly effective and efficient.

Statewide Targets for Digital Learning

As part of the Category Two RFP process the Friday Institute in consultation with school district staff, developed several targets for Wi-Fi density in schools. While each school is unique in design, the targets are meant to provide a reasonable starting place. These targets enabled the development of budget modeling at the statewide level and quickly identified schools that are statistically out-of-profile in our analysis.

One of the more controversial recommendations in the targets was the suggestion to place an access point in every traditional classroom. Significant feedback to our team suggested this would lead to poor Wi-Fi performance because of co-channel interference. As the world has predominantly moved to 5 GHz Wi-Fi, and most schools in North Carolina have concrete or masonry wall construction, we have not received complaints about the installation of an access point in each classroom. In fact we are now receiving feedback that one AP per classroom may not be enough as the density of student devices increases. However, we also received feedback that one AP per every two classrooms is acceptable for some teaching methodologies, grade levels and specific access point models and manufacturers.

Informally, without any details of a specific school building layout, 1.2 APs per traditional classroom is the target. Concretely, this means multiplying the number of traditional

(~25 seat) classrooms by 1.2 in determining the number of APs needed to cover the entire school, including offices and common areas such as media center, cafeteria and gymnasium. Another metric used to determine likelihood of sufficient Wi-Fi coverage is the number of students per AP. The target started at 16 students per AP, assuming 1.8 devices per student. The devices per student estimate includes teacher computers, security cameras, embedded devices, and all other Wi-Fi connected devices. Today that number is easily 2.2 devices per student and rising in many high schools.

It should be noted that not every school will require 1.2 APs per classroom. There are several conditions under which 0.6 APs per classroom would likely be acceptable:

1. Teaching methodology is not 1:1, only a fraction of students use devices on carts at any one time. This is particularly common in elementary schools.

2. The access point contains multiple radios in both bands, e.g. Xirrus

3. The building construction is such that the walls do not block a large portion of the signal and the rooms are relatively compact.

Analysis must consider this before blindly considering a school as insufficient based on these metrics.

Results of NC School Connectivity Initiative Category Two Program Since 2015

In this context, we now present our results for the first three years of the Category Two program for the public schools of North Carolina. In addition to data obtained from USAC, the North Carolina Department of Public Instruction conducts an annual survey of technology at the school level for all 2500+ schools in the state. This Digital Learning and Media Inventory (DLMI) data has been integrated with USAC data to develop our presented results. Our analysis is restricted to only public schools and has no relation to private schools, tribal schools or libraries which may have different needs.

E-rate Funds

In the three years since Modernization, and assuming all 2017 Category Two FRNs are fully funded, North Carolina will have received over $112MM in Category Two commitments by the end of this funding year. Based on analysis by Funds For Learning, this places North Carolina fourth in most Category Two expenditures (Pre-Discount total cost) per student at $94.41 each. North Carolina ranks 6th in total Category Two commitments and commitment per student ($71.38) since Modernization.

We believe the support of the North Carolina General Assembly in funding a Category Two program, and efforts of the Department of Public Instruction to acquire E-rate resources (people and training) for the districts and charter schools to utilize E-rate, has had a profound effect on the efficacy of our program.

State	Approximate Enrolled	Rank Enrollment	C2 Pre-Discount	Rank C2 Pre-Discount	C2 Pre-Discount / Student	Rank C2 Pre-Disocunt / Student
Louisiana	725,600	25	$80,108,531	16	$110.40	1
Illinois	2,031,000	5	$198,827,992	5	$97.90	2
Alabama	731,900	24	$69,674,101	18	$95.20	3
North Carolina	1,577,900	9	$148,974,281	6	$94.41	4
Wisconsin	863,900	22	$79,975,288	17	$92.57	5
Mississippi	484,500	34	$44,264,042	27	$91.36	6
Kentucky	699,500	27	$63,351,059	22	$90.57	7
Washington	1,103,700	14	$99,534,558	12	$90.18	8
Arizona	1,133,800	13	$99,188,661	13	$87.48	9
Florida	2,840,900	3	$243,430,581	3	$85.69	10

Figure 1. 2015 to 2017 Category Two Pre-Discount Total Cost
(Data provided by Funds For Learning, www.fundsforlearning.com)

State	Approximate Enrolled	Rank Enrollment	C2 Committed	Rank C2 Committed	C2 Committed / Student	Rank C2 Committed / Student
Louisiana	725,600	25	$63,352,969	14	$87.31	1
Alabama	731,900	24	$55,346,958	17	$75.62	2
Mississippi	484,500	34	$36,205,020	26	$74.73	3
Illinois	2,031,000	5	$148,173,010	5	$72.96	4
Kentucky	699,500	27	$50,274,418	19	$71.87	5
North Carolina	1,577,900	9	$112,638,134	6	$71.38	6
Florida	2,840,900	3	$194,400,194	3	$68.43	7
Oklahoma	700,700	26	$45,901,234	23	$65.51	8
Arizona	1,133,800	13	$73,487,818	12	$64.82	9
South Carolina	777,800	23	$50,084,323	20	$64.39	10

Figure 2. 2015 to 2017 Category Two Commitments by Funding per Student
(Data provided by Funds For Learning, www.fundsforlearning.com)

Approximately 95% of all Category Two spending in North Carolina public schools since Modernization has utilized the state contracts and DPI Form 470. This enables the smallest districts and charter schools to leverage the volume discount of statewide consolidation, while still providing flexibility at the local level. The state does not file a Form 471 for Category Two,

but rather each individual district performs a mini-bid and files a Form 471. In 2015, the non-discounted portion of all Category Two procurements using the state contracts was paid with funds from NC's USED Race to the Top grant. The program was so successful, with $43MM in procurement on state contracts that year, that the North Carolina General Assembly authorized a recurring allocation in future budgets of $10.5MM annually to maintain the program. This $10.5MM is in addition to $19.9MM provided annually for Category One expenses. E-rate, coupled with the state's commitment to the program results in reliable Internet access to every public school classroom in the state. While some districts may still have pockets of poor connectivity, in the next two years all of these issues should be addressed. We anticipate over $200MM (pre-discount cost) in spending on Category Two products and services by the end of funding year 2019.

It is useful to put the NC Category Two program and Modernization into perspective as to its value to the state. According to Funds for Learning, for the first 17 years of E-rate, North Carolina public schools, in aggregate, received $238MM in Priority Two commitments with $197MM disbursed. As of October 20, 2017, in the three years since Modernization we anticipate $112MM in Category Two commitments with $87MM of that already disbursed. In particular we note that the move to statewide contracts in 2015 resulted in a 98% utilization rate (disbursed to committed ratio) as a direct result of the efforts by the NC Department of Public Instruction, Friday Institute, MCNC and the availability of USED Race to the Top grant funds. Due to the pent up demand from lack of Priority Two funding in the prior years, North Carolina public schools received over $51MM in commitments in 2015 alone. Modernization has allowed all schools, not just those with the highest NSLP participation, to receive some level of funding.

Across the entire state, 57% of students (over 896,000) qualify for NSLP (including CEP). Although the lowest district-wide NSLP percentage in North Carolina is 27%, Chapel Hill-Carrboro Public Schools, pockets of economically disadvantaged students exist in every district, including those perceived to be wealthy. The move from Priority Two to a Category Two budget allowing across-the-board funding is clearly more equitable.

Connectivity and Wi-Fi Sufficiency Metrics

As mentioned above, NCDPI conducts an annual Digital Learning and Media Inventory (DLMI) survey at the school and district levels. Virtually every public school participates in the survey. From the summer 2017 collection for 2,556 public schools completing the survey, the DLMI data indicates that there are now 118,160 wireless access points installed in schools with 101,187 classrooms in total. Of that number, 100,709 APs are less than five years old and 115,406 APs are reported to support the 5GHz band. The student population of all the schools responding to the survey is 1,540,840. It should be noted that the DLMI survey is a comprehensive tool requiring a login by authorized users as well as secondary checks by principals and other staff. The questions regarding network connectivity are only about one-tenth of the survey. The survey is often completed by staff at individual schools. Despite some anomalies, we believe this is the most comprehensive and accurate data regarding Wi-Fi deployments available in North Carolina.

At a statewide level, there are 0.995 access points per classroom which are less than five years old. This is short of our target of 1.2 APs per classroom. With two more years of E-rate Category Two and North Carolina School Connectivity Funding, and $116MM of budget remaining we are on target to achieve complete Wi-Fi sufficiency for every classroom.

Alternately, ignoring the age of the access points, the ratio is 1.168 access points per classroom; however, we are concerned that APs over five years of age are likely not meeting the density requirements of today's schools.

At a statewide level, there are 15.3 students per AP less than five years old. This *is* within the target we initially set in 2015 of 16 students per AP. It must be noted that the statewide average is just that, an average, and there are clearly still classrooms and potentially entire schools with limited Wi-Fi coverage. We hope that the publication of this data helps highlight those schools needing the most attention. In particular, charter schools prove to be the most challenging to engage on topics related to E-rate and connectivity.

The variability of classroom size and ways in which APs are shared by classrooms across the state prevents a direct mapping of students to classrooms to APs that is internally consistent. At a statewide level we expect the law of large numbers to gravitate toward our target, but individual schools may not ever meet the numeric target while still offering excellent Wi-Fi coverage to their students. To effectively use digital teaching methodologies, we consider both metrics (students:AP and APs:classroom) as acceptable in our analysis.

Using the USAC Category Two Budget Tool, we obtained remaining budget for each public school in North Carolina. That data is provided in the dataset to allow comparison of Wi-Fi density to remaining budget. By November 1, 2017 we plan to load this data into a data visualization tool providing more detailed analysis. The visualization and data will be available at: http://go.ncsu.edu/FCC2017CAT2Dashboard

Based on the 2017 DLMI data, the following histograms show the distribution (by schools) of the total number of APs and the number of APs per classroom.
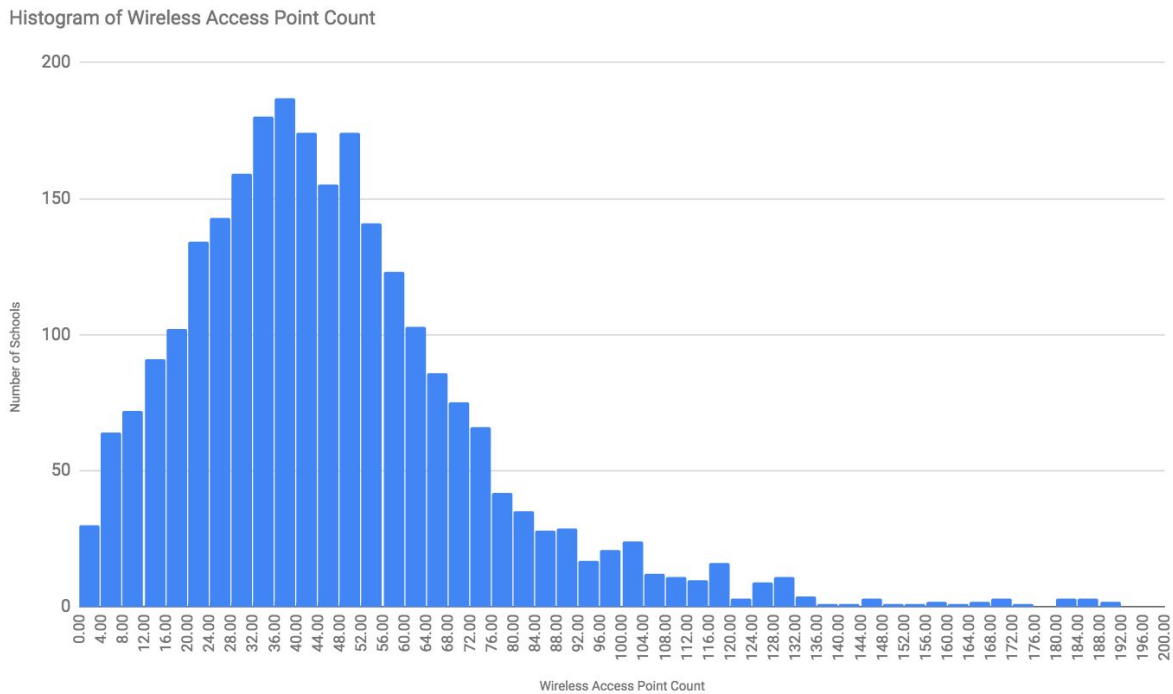
Histogram of Wireless Access Point Count

Figure 3. June 2017 DLMI Histogram of Access Points per School in NC

Hundreds of schools fall in the 30 to 60 access point range, while a significant number of schools still report no Wi-Fi. More investigation is needed but these are possible data entry errors or the result of schools simply not knowing the number. Again, charter schools are problematic in data collection.

In the following histogram we see that a significant number of schools are well above the target of 1.2 APs per classroom. This could be the result of high density Wi-Fi in common areas, especially in one-to-one schools where the utilization per student is much higher than other schools. The dashboard visualization will allow drill-down on this topic.
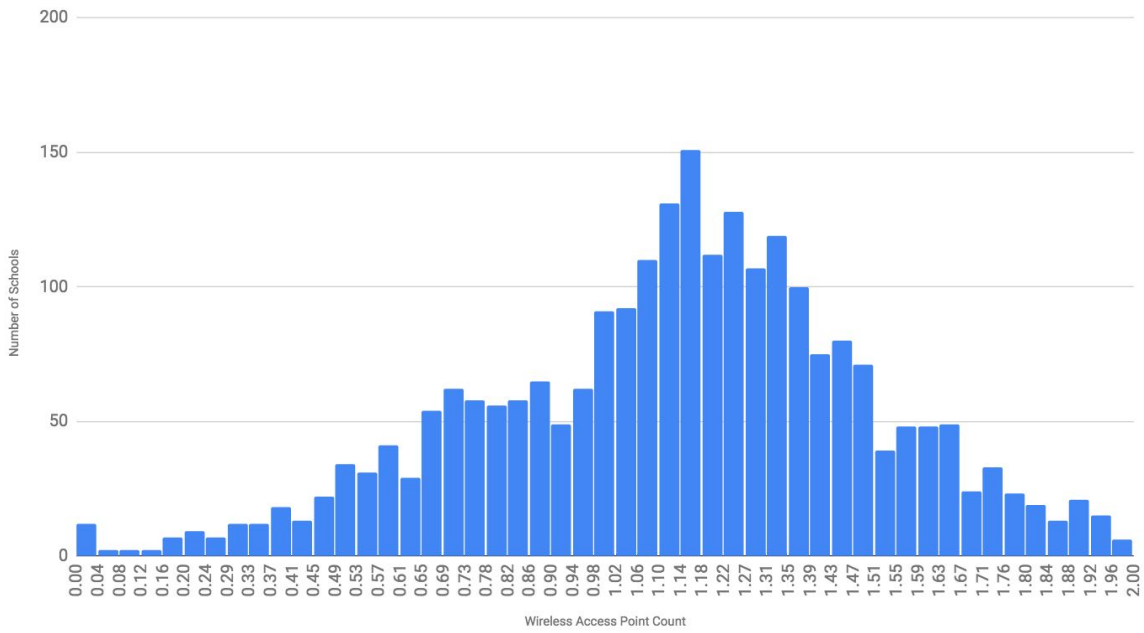
Figure 4. June 2017 DLMI Histogram of NC Schools, Access Points per Classroom

The following map shows all 115 school districts in North Carolina color coded by percentage of access points less than five years old - dark green indicates the most new access points and yellow indicates the least new access points.
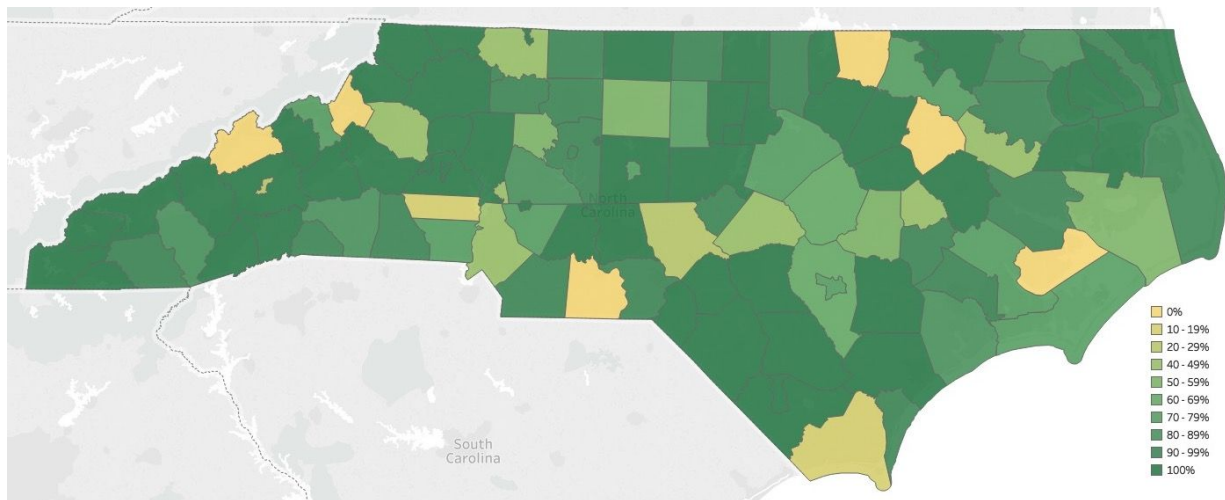
Figure 5. Percentage of APs Less Than 5 Years Old by School District

There does not appear to be a geographical bias affecting where new access points are prevalent. Of the 2,400+ schools in school districts (i.e., not charter schools), 1,204 are urban and 1,218 are rural according to the USAC Urban/Rural search tool.

The following graph shows the number of APs less than 5 years old by school, with student population as the horizontal axis. The trend line for this graph is described as Number of APs = 0.043 x Student Count + 17.2. The color coding is based on the percentage of Category Two Budget remaining. The darkest green indicates 100% budget still available, while the darkest red indicates no remaining budget. Schools below the trend line would be expected to have fewer APs than needed, and should have green dots, indicating they have funds available to enhance their internal networks.

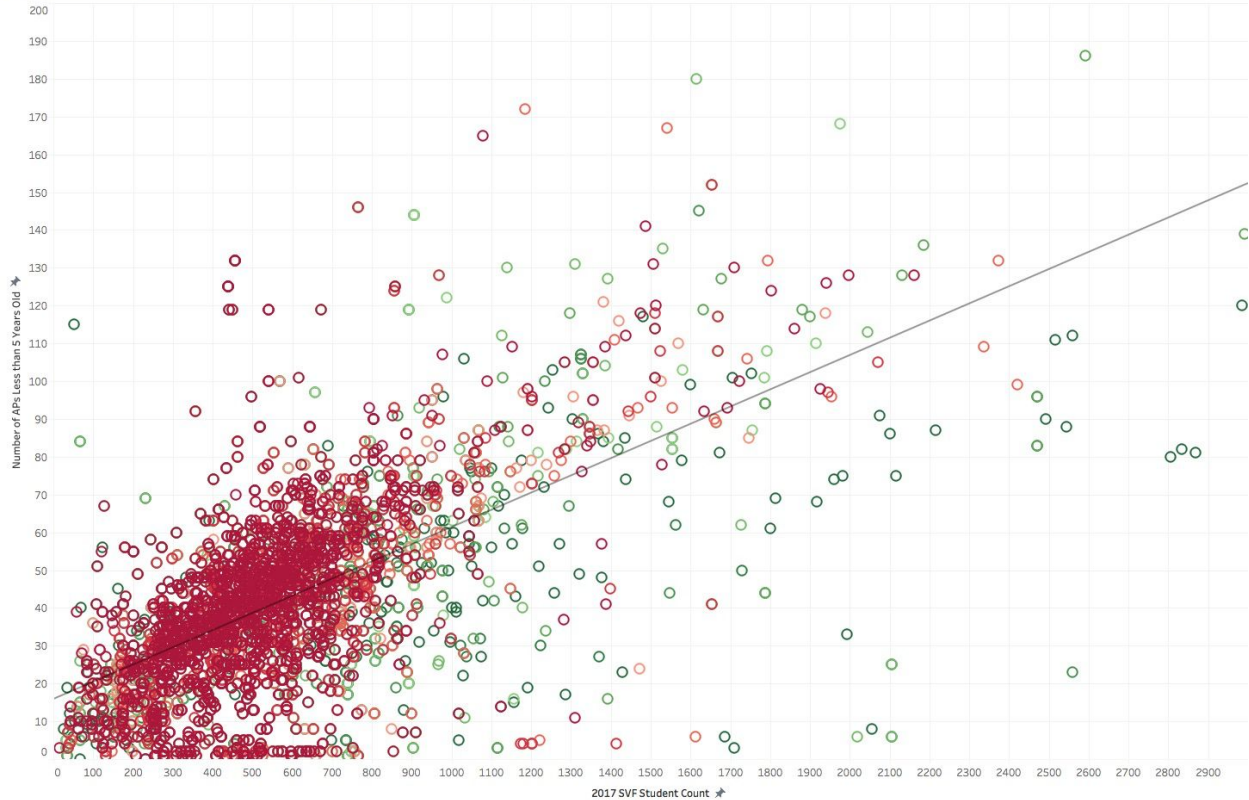Number of APs, by School Size (Color Coded By Budget Remaining)

Figure 6. Schools with APs Less Than 5 Years Old by School Size

The graph displays a significant number of smaller schools (left side) that are below the

trend line in red, indicating they have already depleted their Category Two budget. Similarly,

larger schools (right side) tend to still have significant budget available (green dots) while having

large numbers of APs. We expect any school above the trend line to have Wi-Fi sufficiency, thus

green dots above the trend line may indicate schools that have excess budget based on the current

formula. Note that very few schools less than 800 students have remaining budget *and* Wi-Fi

sufficiency.

Based on our target of one AP per 16 students, the target trend line would be Number of

APs = Student Count / 16. The point being that a linear algorithm for determining the number of

APs required for a school is not likely to build effective networks. While it is helpful for identifying outliers, many other factors affect the number of APs and associated wired network - meaning a linear formula is unlikely to capture the nuances of all possible designs. Similarly, Category Two budget calculation as a linear function is not sufficiently nuanced. It is therefore important for school technology staff to educate their School Boards and finance officers to understand that $150/student is not a panacea. On average across a large sample, it appears to work, but no school should expect that E-rate will cover every possible need for internal connections. This is a common misconception and numerous technology directors have reported that they have been told by their Boards that since the FCC set the budget, it must be correct. We ask the FCC to clarify that the budget is meant to be a baseline and is calculated primarily on the fair distribution of Universal Service Funds available rather than actual demand and needs at any one school.

As an example: using the 16 students per AP target for a 1,000 student school yields a target of 62 APs and a budget of $150,000, resulting in a budget of $2,419 per AP. That per AP budget includes the AP, the associated switch port, the cabling, installation, software licenses and portion of the remaining network infrastructure needed to support the AP (i.e., aggregation switches, firewall, etc.). The first question that must be asked: "Is 16 students per AP a fair target?" We welcome debate on this topic. Secondly, we must ask "What other E-rate eligible networking infrastructure is needed in addition to the AP, that is not captured in the simple linear budget model?" This too will likely lead to a conversation around different teaching methodologies, device density, and support for wired devices (like projectors and AppleTV, printers, etc.). Based on North Carolina's state contracts $2,419 would be highly excessive for

simply installing an AP and associated switch port. On the contrary, if the school needs new cable or if there are significant building layout challenges, then $2,419 will likely be insufficient.

As a second example, consider a small 100 student school. It would be expected to have 6 APs in our model. That is almost certainly not enough Wi-Fi coverage for 100 students when you consider commons areas like the media center, gym and offices. Some districts have suggested the Category Two budget be based on district-wide student count, rather than per school. While on the surface this sounds logical, it seems likely to lead to inequity. Depending on the teaching methodologies, some grade levels may specifically require more Wi-Fi density than others. This too is not reflected in a linear budget model, and is often given as a supporting reason to allow Category Two budgets to be calculated at the district rather than school level. We do not propose that district-wide budgeting is the best approach as it creates numerous challenges when implemented at the national level.

Category Two Budgets Remaining

Of the 2,564 public schools for which we could determine both accurate student counts and FCC Category Two budget data, the following graphs illustrate the remaining budget. In particular, the graph shows that 335 schools have no remaining Category Two budget, while three very large schools still have over $400,000 in budget remaining.
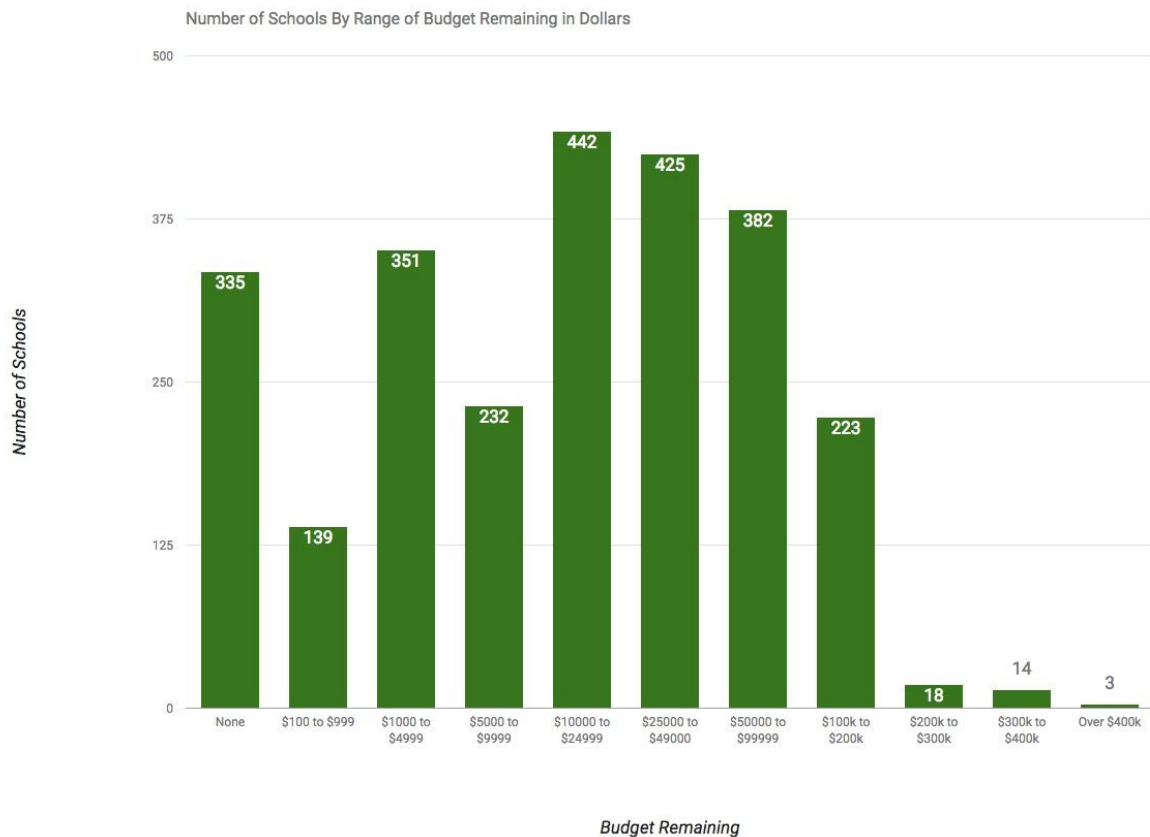
Number of Schools By Range of Budget Remaining in Dollars

Figure 7. June 2017 Histogram of Remaining Category Two Budgets by Amount

The following graph shows the same data as a percentage of budget remaining. There are 913 schools (approximately one third of the schools in the state) with 9% or less budget remaining. At the same time 395 schools still have 100% of their budgets remaining. This is an artifact of the switch from Priority Two to Category Two in 2015. With no Priority Two funding in 2013 and 2014, some schools chose to pay for Wi-Fi in those years with a combination of local funds and USED Race to the Top grant funds. We anticipate those schools are due for upgrades in the next two years.
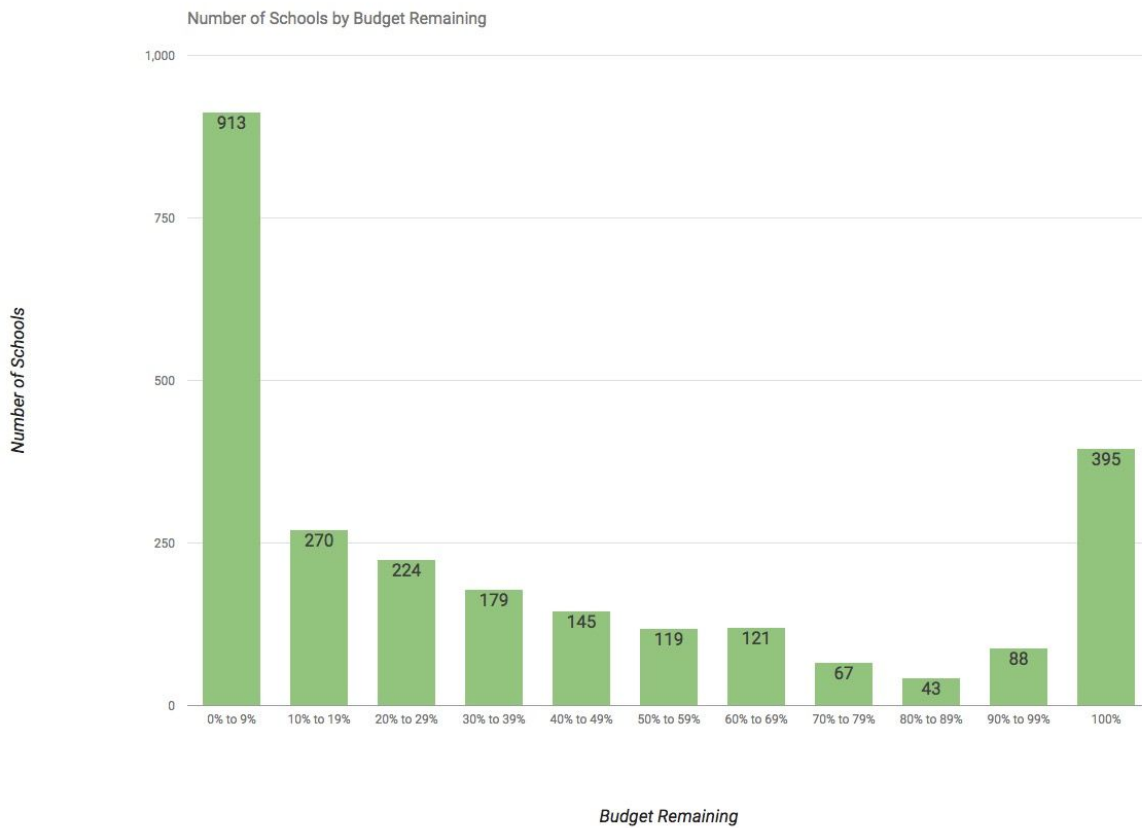
Number of Schools by Budget Remaining

Figure 8. June 2017 Histogram of Remaining Category Two Budgets by Percentage Remaining

In terms of where the E-rate Category Two spending has been focused with regards to economic disadvantage, the following graph shows the last three years (2015 to 2017) of Category Two requests in public schools, by E-rate discount rate. It should be noted that in 2015 the state specifically targeted districts and charter schools with 80% and 85% discount rates. Since 2016 all schools are able to receive state funding for the non-discounted portion, regardless of E-rate discount. This has an interesting effect resulting in the majority of state funds being applied to more wealthy school districts, but the net result is $150/student of *non-local* funding available to *every student* in North Carolina public schools.
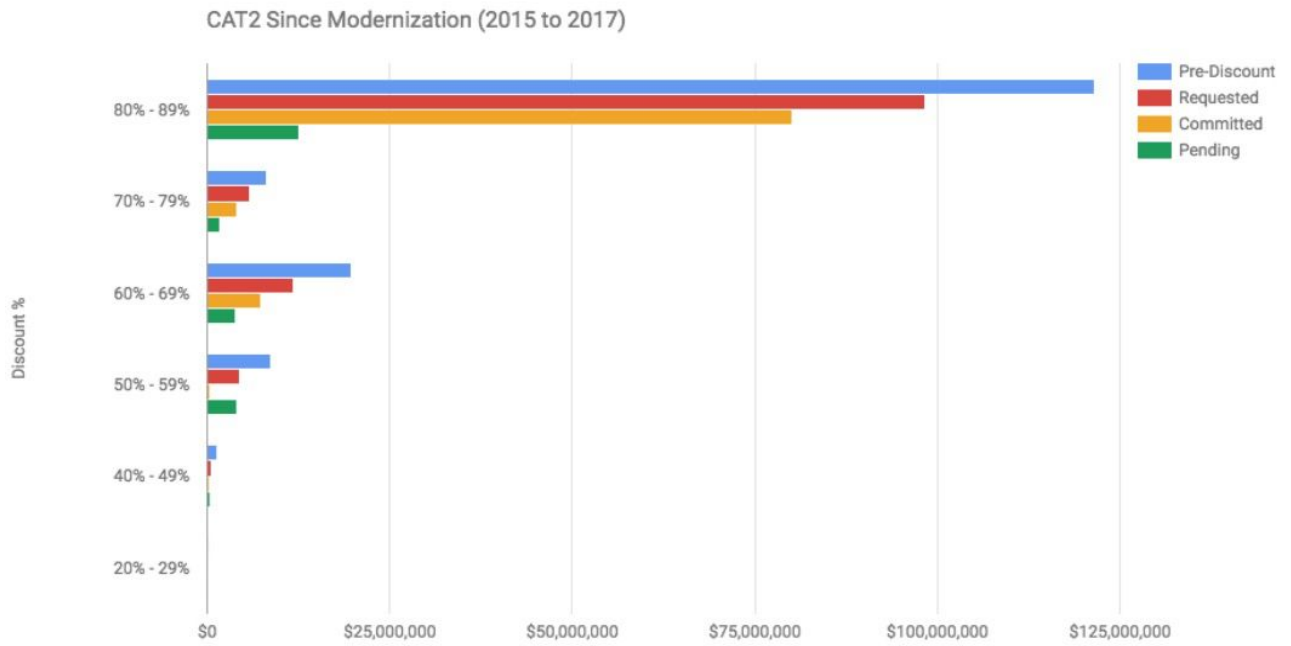
Figure 9. Category Two Funding Since Modernization by Discount Rate

North Carolina Category Two Data Set

In response to the Bureau's request for specific, measurable data to assist in its analysis of the Category Two program, we submit a spreadsheet listing virtually every public school in the state of North Carolina (derived from the State Valid File provided to USAC), integrated with data from USAC and the North Carolina Department of Public Instruction. This file provides the answers to several questions asked at the school level in the NCDPI annual Digital Learning and Media Inventory. The data is available for download at http://go.ncsu.edu/FCC2017Cat2Data.

Among the data provided, we publish the number of classrooms, number of APs, number of APs less than 5 years old, number of APs supporting 5GHz, WAN connection speed, WAN connection type, prevalence of one-to-one and BYOD, predominant access point vendor name, address of school, urban/rural status, grade levels in the school and opening date of school. Researchers should consider the fidelity of this data before drawing conclusions. There are clearly statistical anomalies in some of the responses which would indicate errors. In our analysis we ignore statistical outliers, for example schools with less than 10 students per classroom would be highly suspect. We have provided raw data from the NCDPI DLMI and USAC tools, with the expectation that those wishing to perform more detailed analysis will detect clear violations of logic. Also provided are number of students (small cell suppressed decile of number of students qualifying for NSLP), NCES ID, state school ID, actual 2015 and 2016 Category Two commitments, as well as 2017 Category Two requests and anticipated budget remaining. Some district level data is also provided where available. For example, the average per student utilization of Internet Bandwidth measured at the Internet service provider is provided. This data,

while given for each school, is a district level measurement. Funding data was gathered after the close of the 2017 filing window and before the first commitment in 2017. For the purposes of remaining budget, we assume that all 2017 FRNs will be fully committed.

Prior to developing this response for comments, the Friday Institute solicited input from all North Carolina districts and charter schools regarding the use of additional, non-E-rate funding sources for Category Two eligible services and products. Time did not permit for a detailed quantitative analysis, but generally those districts going beyond $150/student occurred in schools with low student counts or in schools that required significant cable installation.

We anticipated a significant number of districts to indicate the procurement of firewalls and wireless controllers (Category Two eligible devices) as being obtained outside of E-rate, but that was surprising not widely reported. We will continue to gather data related to this topic as resources permit.

Recommendations

New Budget Formula

We suggest that the FCC investigate new methods of calculating budget, specifically an easy to calculate, but non-linear formula, that is slightly biased to provide more funding per student in smaller schools.

For schools (not libraries), student count is the most reliable and verifiable fact on which to base the allotment of funds. In North Carolina we have attempted to determine square footage of schools and found this to be difficult on a statewide basis. We find student and teacher counts are much more accurate and independently verifiable. Square footage alone also does not address the problem of school layout (and construction material) differences in the budget equation, so it does not seem to have any advantage over student count, and could lead to incorrect or difficult-to-verify numbers.

In the left graph below the current funding formula is shown, defined roughly as:

Budget = student count * $150, for student count >= 62
Budget = $9,200, for student count < 62

On the right is a non-linear curve which has the same area as the linear budget but is biased to provide a higher per student budget for smaller schools. With properly selected parameters a simple formula could be developed which does not alter the total commitment of funds provided annually by the USF, but realigns funding to reflect the economies of scale obtained by larger schools. Rather than providing budget at the district level, this approach would result in the same funding being committed annually, but prevents possible inequities that could be created by allowing funds to be disproportionately allocated locally.
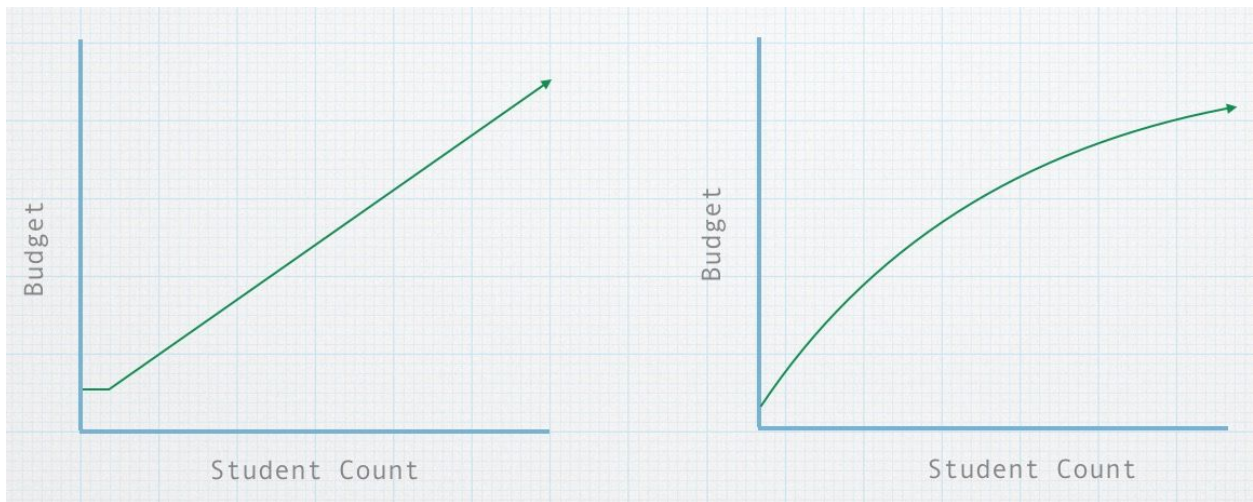
Figure 10. Two budget functions that produce identical USF obligations annually.

Numerous formulae could produce appropriate curves with the same total annual cost to ratepayers. We do not propose parameters to the curve at this time, but only state that a definitive and unambiguous budget, based purely on student count, with bias toward smaller schools be developed. Other parameters to consider in budgeting include:

1. Percentage of students with special needs (usually drives total student count lower)

2. Percentage of students issued a school-owned device

3. Verification of a digital learning methodology deployed in the school

4. Does the school provides residence to the students, particularly special needs students

Another situation that skews the budget is when a school requires substantial cable installation. We find many schools are not merely in need of a few new cable runs, but rather a full cable refresh, updating their decades-old, original wiring. These schools report low data rates and high error rates. With IEEE 802.11ax multi-gigabit access points on the horizon, the need for CAT6A (or better) cabling is apparent. Without exception, we find a full-school re-wire will not

fit in the $150/student budget. As such, we recommend that the FCC consider a separate budget and application process for large scale cable installation.

E-rate Process and Administration Recommendations

In response to the bureau's request for input related to the burden on applicants during the application process as well as the administration of the program from a policy perspective, we offer the following thoughts.

Variability of Item 21 Data on Form 471

In terms of evaluating the effectiveness of E-rate, one challenge that makes comparing data across districts and states difficult is the variability of input in the Item 21. Ideally a common list of SKUs, or at least product families that are selected from a list rather than free form data entry fields is helpful. We find many applications where hundreds of APs are procured but the line item lists a quantity of 1 with a description that roughly reads "Install Wi-Fi in x number of schools."

We attempted to use hashtags, such as #AP and #SWITCH, in North Carolina's Form 471s this year, in hopes of being able to perform more quantitative analysis on pricing variability by searching USAC data for the various hashtagged FRN line items. This proved to also be highly variable, but we welcome suggestions from others on ways to programmatically perform apples-to-apples price comparisons on SKUs and parts across large numbers of Form 471s. We also encourage the FCC to reduce the ambiguity and add fields to the Form 471 which can further aid in pricing and budgetary analysis.

Additionally, we suggest USAC not deny or modify Category Two applications such that they are under the $150/student budget cap. Instead, we suggest USAC allow Form 471 to be

filed for any amount and to only make commitments up to the budget limit. This would allow for the accurate collection of quantitative data regarding the sufficiency of the budget for each given school. We also suggest that there be some consistency applied in ensuring that FRN line items can be properly attributed to recipients of service. Over the last several years our analyses have been hampered by inconsistent mapping of FRN line items to recipients of service.

Connectivity Questions on Form 471

We find the current connectivity questions related to Wi-Fi sufficiency to be statistically useless. There are a number of factors that prevent the data collected from these questions from being useful.

1. The individuals who file for E-rate are not always technologists and may not fully understand the questions. It is not uncommon for finance, rather than technology staff to complete the E-rate filing.
2. The fear by some that the questions *do* have an impact on funding means they will never admit to having sufficient Wi-Fi.
3. The questions are completely qualitative and open to interpretation.

If the FCC wishes to collect more useful data on network sufficiency we suggest a more quantitative approach to the collection. For example, collecting the number of access points, switch ports, cable runs, etc. on each FRN, would lead to a more quantitative prediction of network sufficiency and efficacy of funding.

Complexity of Process Impedes Deployment

While USAC has attempted to modernize via the E-rate Productivity Center (EPC) and related systems, the entire process is fraught with pitfalls leading to inefficient use of funds and resources both at the school and at USAC. Statewide contracts, let under the penalties and

procedures of a state's procurement law should be considered a special case in PIA review. While we understand there are consortia led by well-intentioned educators, we find there are also consortia configured in ways not consistent with the most efficient use of tax dollars, but rather to "alleviate" procurement processes. In dealing with the state of North Carolina as well as several other states, specifically in regard to E-rate Category Two, we find that the rigor provided by the state procurement agency yields contracts which do not require the same level of scrutiny year over year. Once numerous districts have commitments on a contract, it seems unlikely that an additional detailed review will find issue. That said, we understand that some level of review is obviously necessary on every application.

North Carolina's statewide contracts currently offer very attractive prices: one of our contracts offers a 59% discount off MSRP for a major brand. Small districts would likely not obtain that level of discount without the consolidated buying power of the state or a consortia. We ask the FCC to consider a streamlined process for state master contracts which have quantitative evidence showing cost effective solutions and results.

More Focus on Managed Service

We encourage the FCC to consider a new class of "all-in" Internet service, provided from the student desktop to the Internet, metered by an easy to understand Service Level Agreement. This service could be based on metrics for cost per Mbps per student ($/Mbps/student) in an attempt to provide a level comparison across multiple vendors in the bid evaluation. A subset of schools could greatly benefit from the complete outsourcing of the Internet (including Internal Connections) to service providers. Charter Schools and small, remote rural districts in particular often have the most trouble finding (and keeping) skilled networking professionals.

Creating a method to easily file for this type of service from a single provider would be helpful. The FCC could also create baseline SLAs and require contracts to have specific language regarding SLA validation in order to be funded by E-rate. Of course managed services can create issues when there is a disconnect between what the students require in terms of signal strength and throughput and how the service provider goes about maximizing profit. Clearly some standards and metrics need to be set as to what would be E-rate eligible for this type of service. With that understanding, the $150/student budget would likely not be sufficient, especially considering that this new service class would be a combination of Category One and Two. The advantage of a single provider for this service is the elimination of finger pointing between the WAN and LAN service providers and more cohesive problem resolution, resulting in higher uptimes and reliability for students.

Additional Support for Districts with Shrinking Student Populations

Like much of rural America, North Carolina has many districts which are decreasing in population. This decrease results in schools which are "too big" for their populations, but for numerous logistical reasons it is not possible to use fewer classrooms. Many of these schools are also very old, with significant amounts of masonry and concrete creating less than ideal RF conditions and resulting in more expensive cable installations. Biasing the budget slightly for smaller schools is needed, but additional support for schools that have lost a significant percentage of students year over year for multiple years must also be considered.

Closing schools is a difficult option for many districts. One frequent result of closing schools is increased bus ride times. Allowing E-rate funds to be used to provide school bus Wi-Fi helps mitigate the challenges in shrinking districts and geographically dispersed districts.

Additional Wi-Fi Spectrum

The Friday Institute is generally supportive of the efforts of equipment manufacturers seeking to open more spectrum, particularly in the 6 GHz range, for use by Wi-Fi products. Regarding the comments by All Points Broadband et. al. to GN Docket No. 17-183, we agree with these vendors on the need for more spectrum, ultimately improving network performance and reducing total network and operational costs. School networks are some of the most demanding Wi-Fi implementations in the world. Large numbers of devices are concentrated in much tighter spaces than commonly found in a corporate network, and the roaming of devices from classroom to classroom in short periods of time are proving a challenge. In North Carolina numerous schools have already migrated all student devices to 5 GHz, while maintaining 2.4 GHz SSIDs only for specific embedded devices that are expensive or impossible to upgrade. Any efforts the FCC can take to increase Wi-Fi spectrum in such a way that minimizes product costs would have profound effects of the usefulness and productivity level achieved on school Wi-Fi networks.

More Skilled Technicians and RF Education

We live in an increasingly wireless world. As a final comment, indirectly related to the Category Two budget discussion, is the need for talented network and communications engineers. One key inhibitor to ubiquitous, reliable Wi-Fi networks in every school is the lack of available human resources. This indirectly drives the cost of Category Two services higher. Many rural communities simply do not have access to ample, skilled people in communications technologies. Many schools must then rely on distant vendors that charge travel costs (which are E-rate eligible) to provide services.

Thus we suggest the FCC take every opportunity possible to encourage K-12 students to take an active interest in understanding the technology they use everyday. One great way the FCC can encourage networking education, specifically RF skills in K-12 schools, is through the promotion of amateur radio. It would be ideal to see more STEM schools actively involved in amateur radio licensing and activity. The fundamental and underlying technology of amateur radio and Wi-Fi are the same and inspiring students to take an interest in RF and networking endeavours could have huge dividends for the workforce of the future.

Data Links

Spreadsheet of 2017 North Carolina Category Two and DLMI data related to E-rate:
http://go.ncsu.edu/FCC2017CAT2Data

North Carolina Category Two Data Visualization:
http://go.ncsu.edu/FCC2017CAT2Dashboard

Interactive Map of North Carolina Internet Bandwidth Utilization:
https://www2.mcnc.org/ncren/portal/reporting/ncren_utilization_map

Friday Institute Category Two District Estimator Spreadsheet:
http://go.ncsu.edu/CAT2DistrictModel

Publicly Available Category Two Budgeting Tool

The Friday Institute developed a Category Two estimator tool that some districts may find useful. We make no warranty to the accuracy of the tool and in fact it is designed specifically with parameters for many of the assumptions to be changed by districts for their own use. The model presents a basic framework for a high level estimate of Category Two products. The model is world-readable at http://go.ncsu.edu/CAT2DistrictModel so users may make a local copy to their Google Drive or download as an Excel file to edit their unique copy. The model is provided as is, with no warranty. We welcome comments and feedback regarding the accuracy, and emphasize that this is a budgetary starting point and professional guidance from vendors is required for final product selection. A sound network design is always the best starting point before procuring any equipment. This tool could be used to backtest actual implementations to the FCC budget. From this we could identify commonalities in over-budget schools. We welcome feedback and collaboration with states and researcher interested in this.

We also are developing an interactive, single school Category Two budgeting tool specifically geared for charter schools and small schools. Users complete a small questionnaire and the tool calculates an starting point budget and emails a document explaining the expected needs and budget. The questionnaire is available at http://go.ncsu.edu/CAT2Estimator.

Contact Information

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