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Networking, Telephony, and USF Patterns in Higher Education

A Sample Snapshot

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The Federal Communications Commission (FCC) recently opened a proceeding to consider how to reform its collection of fees for the Universal Service Fund (USF) and may reach a decision in this matter later this year. In the first quarter of 2012, EDUCAUSE undertook a sample survey to assess college and university contributions to the federal USF governed by the FCC and how changes in the FCC formula might affect our members.

Universal Service Fund

For many decades, and greatly formalized in the 1990s, telephone users served by commercial providers have been slightly overcharged for interstate and international long-distance calls. The revenue collected by this "tax" goes into the USF. The USF, in turn, has subsidized rural telephone service and certain other equity-enhancing or socially beneficial services. More recently, its subsidies have extended to rural broadband Internet. The USF is expected to be approximately $8.5 billion in 2012.

The FCC, which oversees the USF, lacks statutory authority to tax intrastate calls. The current contribution system also does not extend directly to users within private networks, such as those within campuses that operate their own private branch exchanges (PBXes) or other internal telephone systems. Rather, USF fees are levied on the commercial entities that provide interstate and international long-distance services to end users (including to private networks).

There's a problem: People aren't making as many long-distance calls as they once did or are making them under rate plans not "taxed" by USF. Over a decade, as Figure 1 shows, the USF "base," which is approximately the total collected by phone companies for itemized interstate and international long-distance calls, shrank from $19.2 billion in the fall quarter of 2002 to $16.4 billion in the spring quarter of 2012. Partly for this reason, the USF "tax" rate more than doubled over the same period, from 7.3% to 17.4%. (These figures come from the FCC's quarterly "Public Notices on Proposed Contribution Factors"; the solid lines in Figure 1 smooth out the variation using 4th-degree polynomial fits.) Long-distance providers pass their USF "tax" on to consumers, although they do so inconsistently with the underlying rate: For example, the USF fee listed on my home AT&T landline long-distance bill is 9.6% of my itemized long-distance charge.

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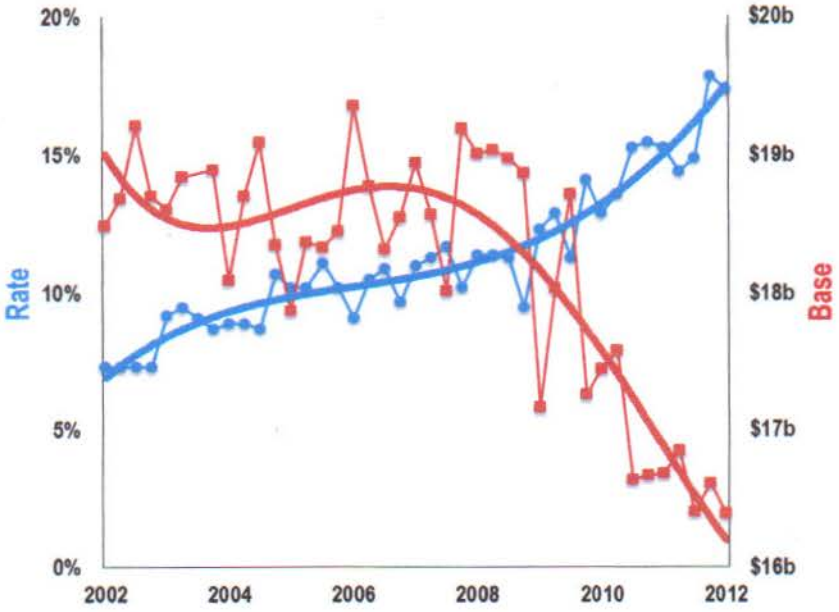
Figure 1. USF Quarterly Contribution Base and Rate, 2002–2012



The growth of the "tax" and the inconsistent "pass-through" of USF contributions to end users lead most observers to conclude that the current basing of USF fees on long-distance phone calls is unsustainable. Therefore, USF contributions likely will move to a metric other than long-distance calls. A revised USF formula might be very bad, very good, or perhaps inconsequential for colleges and universities. Effective advocacy requires that we understand how different metrics might affect higher education, and understanding those effects requires analysis based on member data.

Survey

To help guide advocacy, I worked with colleagues within EDUCAUSE and on member campuses to design and field a sample survey to gather data that might help model the effect of various USF proposals. The survey sample concentrated on research universities and selective liberal arts colleges—that is, those with substantially more applicants than they accept. I chose these groups because they are well defined and are accustomed to sharing IT data, and also because they are quite different from one another. I also sampled other kinds of colleges and universities, but for various reasons we were less successful in getting sufficient response from them.

The survey instrument requested data on off-campus network connections, externally assigned telephone numbers and Internet addresses, payments to communications providers, and USF "taxes" on those. I augmented the survey data with institutional attributes from the federal Integrated Postsecondary Education Data System database.

It became clear during response processing that many institutions lack consolidated data on their telecommunications expenses, and especially on how these break down among services and between services and government fees. In many cases this is because detailed data are maintained separately from overall totals. For example, although central IT organizations

generally know from campuses' central finance and budget systems how much they spend on telephony, the underlying detail on USF fees often does not carry forward into those systems and so is available only from the phone bills themselves. The actual bills usually are accessible only to accounting staff or by reanalyzing detail within voluminous paper or electronic statements.

It is important, therefore, to treat statistics from the sample survey, such as those summarized here, as general indicators rather than precise estimates. In what follows, I present some initial statistics separately for research universities (33 campuses responded from this group, about 68% of those sampled), selective liberal-arts colleges (16, 50%), and a more diverse group comprising other large and medium-sized campuses (23, 20%).

Networking and Telephony

The median research university in the survey sample enrolls almost 30,000 students and has almost 10,000 employees, of whom about 2,000 are faculty. The median liberal arts college enrolls only about 2,500 students, and its 800+ employees include about 230 faculty; for the diverse group of large and medium-sized campuses the medians are about 8,500 students, 1,100 employees, and 350 faculty.

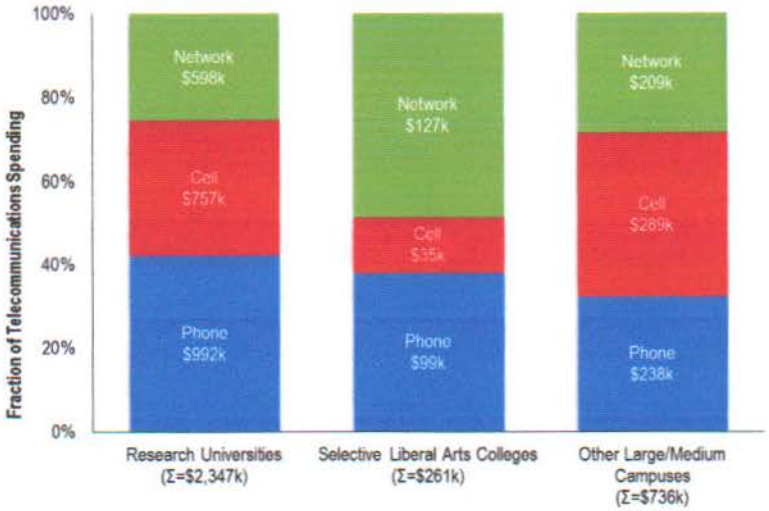
Table 1 summarizes networking, telephone, and USF statistics for respondents that provided reasonably complete data. Gross size differences account for much of the variation among the groups on external communications spending. The mean annual spending on external telephony, external broadband connectivity, and cellular services together is $2.3 million at research universities, while liberal arts colleges spend $261,000 and the medium/large group spends $736,000. (These figures reflect off-campus connectivity only, excluding the cost of campuses' internal telephone systems and data networks.)

Table 1. Selected Attributes of Sample Respondents Means, Complete-Data Subsample, by Institutional Type

	Research Universities	Selective Liberal Arts Colleges	Other Large/Medium Campuses
Current USF Pass-Through	$23,960	$1,777	$7,356
Active Phone Numbers	21,249	2,166	4,958
Network Links	3.3	2.5	2.7
Network Capacity (Mb/sec)	20,761	3,711	3,352
IP Addresses	700,742	47,616	39,920
Telephone Charges	$991,614	$99,270	$237,705
Cellphone Charges	$757,203	$34,985	$289,461
Network Charges	$598,360	$127,033	$208,661
Total Charges	**$2,347,178**	**$261,288**	**$735,827**

As Figure 2 shows, the composition of external telecommunications spending also varies across the groups. Research universities spend almost as much on cell phones as they do on regular telephone connections to the outside world and more on each of those than on off-campus network connections. Selective liberal arts colleges spend a much larger fraction on broadband and much less on cellphones; for the third category, spending splits more evenly among the three networking types.

Figure 2. Composition of Telecommunications Spending, by Service Type and Institutional Category



In part, this is because proportionally more of a research university's campus population is faculty and staff rather than students. The former usually get institutional landline and even cell phones, but students usually do not. Moreover, telephony costs vary more than networking with staff size, since the former involve various "metered" charges (lines and calls, for example), whereas network costs are based largely on capacity. Whatever the explanation, that spending patterns vary across institutional types is important in evaluating potential USF formulas.

USF Contributions

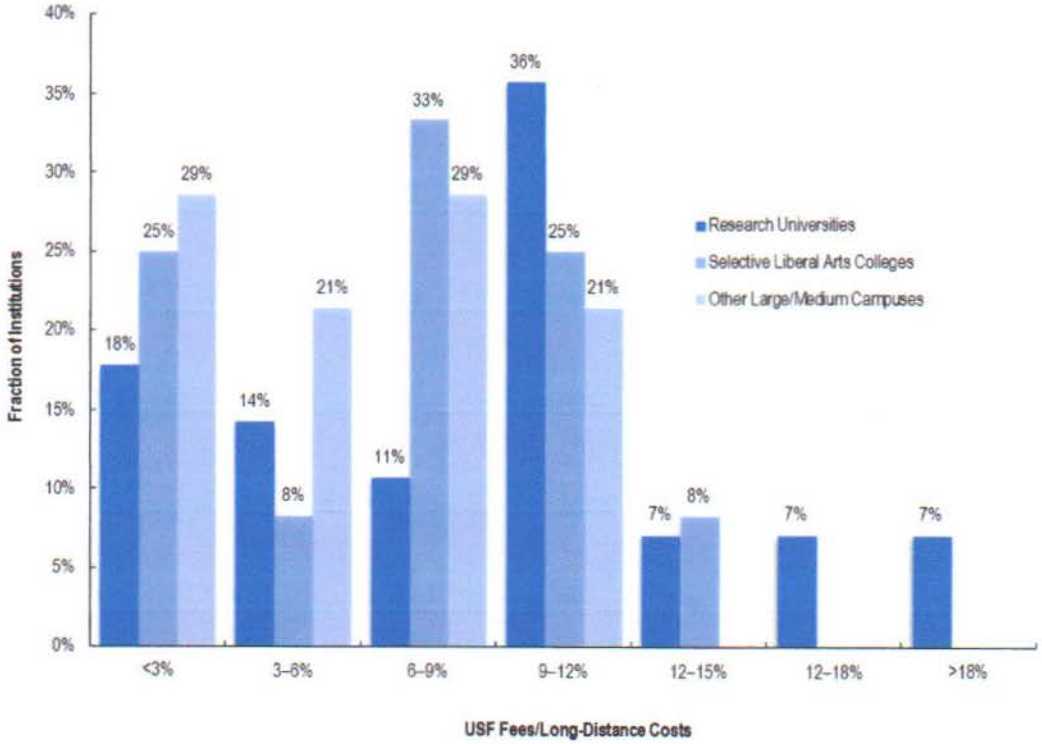
The USF contribution rate at the time of the survey (first quarter of 2012) was 17.9%. This is the percentage that "[a]ll telecommunications service providers and certain other providers of telecommunications must contribute to the federal USF based on…their interstate and international end-user telecommunications revenues."[1] The contribution requirement falls on "telecommunications service providers," which are the "direct contributors" into the fund. Colleges and universities—rather than the individual student, faculty, and staff users of campus phones—are the "end users" under the current USF contribution methodology. It thus is campuses rather than individuals that pay USF pass-through charges on campus telephone bills. The same is true for other organizations that have their own internal telephone and/or network facilities. (If students are billed directly by outside carriers for phone service, which is increasingly the case as campuses outsource dormitories or certain dormitory services, then students receive bills for and pay USF pass-through fees directly to the outside provider.)

As noted above, it proved difficult for survey respondents to report how much their institutions actually paid in USF fees. Based on queries during the survey, the principal reason for this was the lack of detail recorded in central financial systems. This meant that identifying and reporting USF fees required extra effort or staff involvement.

In addition, how USF fees are listed on phone bills apparently varies with different vendors. Compounding the problem further, vendors appear to use different formulas to calculate how much of USF contribution they collect from customers. Providers may pass along no more than what they pay into USF, but some pass along none or part of the USF contribution explicitly. In effect, carriers that do not pass through their entire USF contribution simply move the rest into their rates for other services.

Not surprisingly, given the inconsistency and inaccessibility of USF "taxes," the USF pass-through charges campuses report (Figure 3) vary both from the FCC-specified contribution rate and among institutions. Many institutions report no USF charges, which is plausible if all or most of the interstate calls are covered by some kind of bundled service and/or blanket plan. (Equally likely, it might have been hard to find USF fees on bills.)

Figure 3. USF Fees as a Fraction of Itemized Long Distance, Fraction of Survey Respondents, by Institutional Category



About half the institutions in each category report USF fees that are 6–12% of their long-distance charges (which is about the same as my AT&T long-distance bill). Only a few report higher percentages.

Alternative Metrics

Some potential criteria for choosing a new USF contribution mechanism are that it

- depend on metrics readily accessible to those who collect it;
- robustly accommodate likely technological progress; and
- resist manipulation, gaming, and subterfuge by end users.

Whether the new contribution mechanism should shift the USF burden from one group to another is a policy choice rather than a technical criterion. In any case, a new contribution should cause such shifts only if they serve the public interest.

The current mechanism that uses long-distance calls as the base for USF contributions clearly is failing the second test. Business and technology changes ranging from calling plans to Skype have detached long-distance calling from long-distance charges, and other communications mechanisms—e-mail and texting, for example—have replaced calls entirely.

Using attributes internal to a household or organization, such as internal network capacity or scope, would fail the first test. Using active telephone numbers as the base, as was favored by a previous FCC chairman some years ago, would fail the second and third tests: An end user with a large number of assigned phone numbers, such as a university, can easily replace them with a drastically smaller number of trunks and an automated "if you know your party's extension...otherwise spell your party's name" system that forwards calls to internal extensions. (Of course, this "gaming" would yield potential benefits to others, since it would release blocks of phone numbers for reassignment.)

Based on the sample data, I can sketch the broad outlines of how various alternative USF contribution-formula proposals might affect sectors within higher education. I do this not by estimating exactly how much different proposals would generate from different user categories—that would require comparable data on all payers—but rather by hypothesizing how different proposals might be specified so as to hold a "typical household" harmless, and then calculating how each specification would affect higher education.

As the "typical household," I use my reasonably ordinary home circumstances: one landline, a long-distance package plan, two cellphones with their own calling plans, 25Mbps cable Internet service, four network links, and three IP addresses—landline, cable Internet, and each cellphone count as network links, and cable and cellphones have IP addresses. I price these using my recent Chicago AT&T and Comcast bills: $840/year for the landline (including long distance), $1,680 for the cellphones, $600 for network, and $59 for USF fees on the landline and cellphones.

As the "small organization," I use EDUCAUSE's Colorado office, where about 50 of my colleagues work. Because EDUCAUSE does not contract directly for employee cellphones, there's no cellphone expense comparable to that reported by sample colleges and universities. In recent years, the office spent $11,353 on telephony and $28,548 on broadband. It has 102 phone numbers, 67 externally addressable IP addresses, and 3 network connections with a total capacity of 72 Mbps. (A sign of how technology evolution causes dramatic shifts in basic parameters: A few years ago EDUCAUSE had 50 times the broadband capacity I had at home, whereas today the ratio is about 3:1; over the same period, the ratio of EDUCAUSE's phone

numbers to mine has been essentially constant at 25:1. It is structural technology changes like these that a new contribution formula must accommodate rather than ignore.)

To explore alternative USF contribution mechanisms, as noted above, I set pricing for each alternative so that it is revenue-neutral for the typical household—that is, so that the mechanism would require the same USF contribution the household pays now. Using those same price settings, I then use data from the sample to estimate how much an average institution in each of the survey's three categories would pay into USF under each alternative mechanism.

Table 2 repeats the data from Table 1, adding the comparable data for the example "household" and "small organization."

Table 2. Current Long Distance Charges, USF Fees, and Other Metrics, Complete-Data Respondents, by Institutional Type and Comparison Categories

	Research Universities	Selective Liberal Arts Colleges	Other Large/Medium Campuses	Typical Household	Small Organization
Current USF Pass-Through	$23,960	$1,777	$7,356	$59	$905
Active Phone Numbers	21,249	2,166	4,958	3	102
Network Links	3.3	2.5	2.7	4	3
Network Capacity (Mb/sec)	20,761	3,711	3,352	25	72
IP Addresses	700,742	47,616	39,920	3	67
Telephone Charges	$991,614	$99,270	$237,705	$840	$11,353
Cellphone Charges	$757,203	$34,985	$289,461	$1,680	$0
Network Charges	$598,360	$127,033	$208,661	$600	$28,548
Total Charges	**$2,347,178**	**$261,288**	**$735,827**	**$3,524**	**$39,901**

In theory, USF fees are calculated as a percentage of long-distance charges. This is not consistent in practice: Some telephone companies do not pass along the entire USF contribution as fees, and some USF fees are levied on calling plans that bundle interstate and/or international calls with local calls or line charges. There also are some exceptions.

My landline and two cellphones pay USF fees of $59/year, which turns out to be 18.9% of itemized long-distance calls and calling plans. Since this is a higher rate than AT&T is paying, some of the USF fees I pay must be based on some fraction of my landline and wireless calling plans, which bundle some of my long-distance calls with local calls. EDUCAUSE pays itemized USF fees amounting to 23.3% of its itemized long-distance calls and plans. As is common for business customers, EDUCAUSE's provider bundles much long-distance service into charges for "local" connections such as PRI circuits and collects USF pass-through fees based on both the former and the latter. For similar reasons, the ratio of USF pass-throughs to itemized long distance in higher education varies from 1:7 up to about 1:10.

The second panel in Table 2 summarizes some other metrics that might figure in new USF mechanisms:

- "Active Phone Numbers" is the number of externally dialable telephone numbers assigned to the household or institution under the North American Numbering Plan and in use by some kind of telephone or device.
- "Network Links" is the number of external Internet connections the household or institution has, and "Network Capacity" is the total bandwidth across all these links.
- "IP Addresses" is the number of externally addressable IP addresses in the ranges assigned to the household or institution. Many colleges and some universities have one or two "Class C" networks; a Class C network has just over 65,000 IP addresses.
- "Telephone Charges," "Cellphone Charges," and "Network Charges" are the total spending of each type across all of a campus's or household's providers. The "Total Charges" item is the sum of these three.

Evaluating Alternatives

Consider a proposal that emerged a few years ago, one favored by a past FCC chairman: setting USF contributions as a fixed amount per telephone number per month. From Table 2, the "typical household" has three telephone numbers and currently pays $59 in annual USF fees. Under the phone-numbers proposal, to hold the typical household harmless the USF contribution rate would be set at $1.64 per month per phone number—($1.64)(3)(12) = $59. (The earlier proposal was close to this: it suggested $1 per number per month.)

Now I can apply this same plan to the three categories of higher education. The average research university has 21,249 telephone numbers, and so in I can calculate that it would pay ($1.64)(21,249)(12) = $417,893 annually in USF fees—almost 20 times what it pays under the current formula (Table 3). The increase would be proportionally larger for selective liberal arts colleges and almost as much for large and medium-sized campuses.

Table 3. USF Fees Based on Alternative Contribution Formulas, Complete-Data Respondents, by Institutional Type and Comparison Categories

	Research Universities	Selective Liberal Arts Colleges	Other Large/Medium Campuses	Typical Household	Small Organization
Current USF Pass-Through	$23,960	$1,777	$7,356	$59	$905
Active Phone Numbers ($1.64/month)	$417,893	$42,595	$97,505	$59	$2,006
Network Links ($1.23/month)	$48	$36	$40	$59	$44
Network Capacity (Mb/sec) ($0.20/month)	$48,996	$8,757	$7,912	$59	$169
IP Addresses ($1.64/month)	$13,781,252	$936,448	$785,087	$59	$1,318
Telephone Charges (7.0%)	$69,649	$6,973	$16,696	$59	$797
Cellphone Charges (3.5%)	$26,592	$1,229	$10,166	$59	$0
Network Charges (9.8%)	$58,839	$12,492	$20,518	$59	$2,807
Total Charges (1.7%)	**$39,320**	**$4,377**	**$12,326**	**$59**	**$668**

From higher education's perspective, using phone-number counts to set USF contributions is a terrible proposal. It would be comparably terrible for any other organization with many telephone numbers. In fact, using phone numbers even penalizes small organizations, whose USF contributions would double.

Using the data-networking equivalent of dialable phone numbers—externally addressable IP addresses—has even more bizarre, unbalanced, and unfair consequences and is an even worse idea for all but individual households. Basing USF contributions on assigned IP address space would increase the average research university's USF contributions to almost $14 million annually. It would have similar effects on other major network users, transferring the vast majority of the USF burden from households and small organizations to entities with large assigned IP ranges such as large corporations, government agencies, and many campuses.

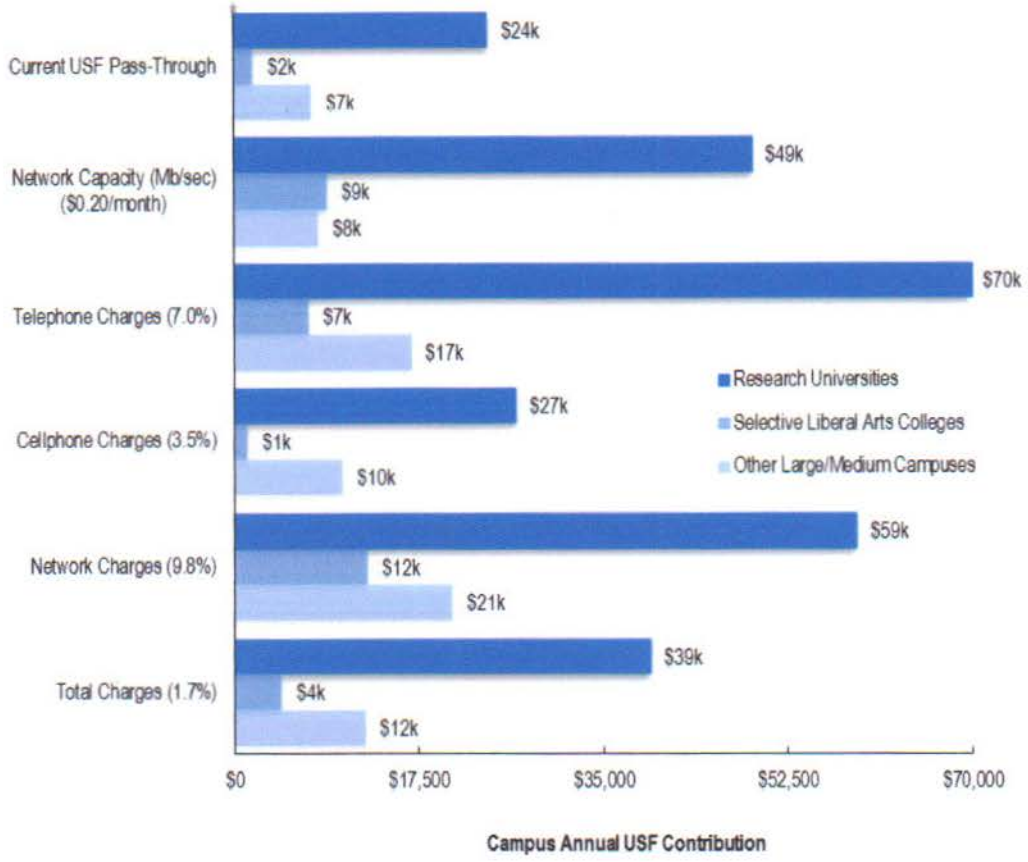
To illustrate an option that would have the opposite effect, consider basing USF fees simply on how many network links a household or organization has. The "typical household" has four (a landline, a broadband connection, and two cellphones), and so a USF contribution rate of $1.23 per month per network link would keep the household's USF fee at $59/year.

Unlike the phone-numbers proposal, the flat-rate network-links proposal (that is, charging the same per link regardless of its capacity) would benefit higher education and other large single-campus organizations. The average research university would pay $48/year based on its 3.3 links, and the other two higher-education categories would pay even less. Even EDUCAUSE's small office would pay slightly less. (In the sample, no institution reported more than 6 network links.) Under this obviously simplistic plan, overall USF collections from households would have to increase dramatically to compensate for reduced contributions from large organizations, one of many reasons it makes no sense. A hybrid approach based on links but scaling the per-link cost to capacity (that is, for example, charging more for 100Mbps links than 1Mbps links) would mitigate this problem. However, such a hybrid, if carried to an extreme, would become a charge on link capacity, and that could cause equivalent problems in the other direction by shifting costs from households to large organizations.

Neither phone numbers, IP addresses, nor a simplistic, undifferentiated count of connections is an effective, fair basis for USF contributions. Among other problems, they all would have substantial redistributive effects. As Figure 4 shows, some other metrics, especially those based on total charges for telephony and/or broadband rather than on long-distance charges alone, would have less extreme effects. Even so, although charges-based USF formulas appear to reduce redistribution, they do not eliminate it.

The key point is this: Because of the different scale and spending patterns documented in Table 1 and Figure 2, no simple formula can treat all institutions and households exactly as the current formula treats them. Indeed, it may make sense for the revised formula to increase contributions from some users. Whatever the redistribution, it must be transparent, serve the public good, and result from open discussion and comment from those affected by it.

Figure 4. Hypothetical Impact of USF Alternatives Based on Selected Metrics, Complete-Data Subsample, by Institutional Type



Although simplicity is an obvious *desideratum*, it will prove elusive. To strike a balance among manageability, effectiveness, and transitional equity, a new USF contribution mechanism may need to be multi-tiered. For example, instead of "taxing" total telecommunications charges at 7.0%, a new formula might have brackets. Similarly, instead of relying on the number of connections or their capacity alone, a rate might propose tiered rates for connections with capacities in a few distinct ranges.

As pointed out above, assessing the overall redistributive effect of proposed USF changes requires data on all major categories of payers, not just on a few categories within higher education, households, and small organizations. With such data, estimates such as those I used above to illustrate impacts on higher education could help deliberations converge on reasonable USF alternatives that meet the criteria suggested above and provide the federal USF program with some sustainability for the future.

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Note

1. See http://www.fcc.gov/guides/universal-service-support-mechanisms.