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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Common Carrier Bureau Seeks	)	
Comment on Requests to	)	CC Docket No. 96-45
Redefine "Voice Grade Access"	)	
For Purposes of Federal	)	
Universal Service Support	)	

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Comments of the
Rural Utilities Service

Introduction

The Telecommunications Act of 1996, in Section 254(c)(1), states the rules for defining the level of telecommunications services that will be supported by universal service. Specifically, Section 254(c)(1)(B) says that the service that has "through the operation of market choices by customers, been subscribed to by a substantial majority of residential customers" will be supported. Section 254(b)(3) states that "Consumers in all regions of the nation, including low-income and those in rural, insular, and high cost areas, should have access to telecommunication and information services, including interexchange services and advanced telecommunications services, that are reasonably comparable to those services provided in urban areas and that are available at rates that are reasonably comparable to rates charged for similar services in urban areas."

To the Rural Utilities Service (RUS), these statements mean that when a rural user's telephone should perform and cost about the same as if he were an urban customer. This has been the mission of the RUS for over 50 years. The RUS has proven this to be technically possible and economically feasible for over 1000 rural local exchange carriers (LECS) under the existing universal service support mechanisms.

Background

The Federal Communications Commission (Commission) conducted a thorough public rulemaking process prior to establishing the supported services for universal service in the May 8, 1997 First Order. The result of this process was to establish the voice grade access frequency response requirement at 500 Hertz to 4000 Hertz. The RUS recognized that this bandwidth exceeded the practical voice channel bandpass for digital switches (although not the theoretical bandpass since digital switches use 8000 Hertz sampling rates), and also recognized that the short copper loops

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typical of urban areas, and longer copper loops with RUS-standard D66 loading, could meet the 4000 Hertz high-end requirement.

On October 8, 1997, during a weekly Cost Model Workshop meeting held by the Commission, the subject of bandwidth of voice grade service was raised by the Commission. The RUS provided this basic discussion of bandwidth in the existing network in the Ex Parte letter filed with the Commission Secretary on October 27, 1997:[1]

> Voice Grade Bandwidth
>
> In recent meetings, attention has focused on the bandwidth for voice grade service as established in the May 8 order. At the meeting, US West recommended that the Commission change its definition to 300 to 3200 Hz. The RUS does not agree.
>
> Bandwidth
>
> In common usage, Bandwidth denotes information carrying capability. Wide-band is used to describe a system with high capacity whether digital or analog.
>
> Such usage is incomplete and misleading. It is like trying to describe the volume of a jar by giving its diameter. For example, the information carrying capacity of an analog circuit depends on bandwidth and the maximum signal-to-noise ratio (the maximum volume compared to the ambient noise level). A 60 dB circuit has a greater information carrying capacity than a 30 dB circuit.
>
> Things are simpler in the digital world. Bit rate alone is a measure of information carrying capacity. The interrelation can easily be seen in modem performance. Modems convert the digital language of a computer to a different digital language, one whose frequency content is compatible with a voice circuit. Ignoring other limitations, the bit rate of a modem is proportional to both bandwidth and signal-to-noise ratio.
>
> Existing Telephone System Bandwidth
>
> Digital switches were first introduced a generation ago. At that time, there was little consideration of modem connections as the PC had not yet become popular. Digital theory (Nyquist Theorem) states that a digital signal can contain all the information contained in an analog signal if the analog signal is sampled at a frequency at least twice as high as the highest frequency in the analog signal. The designers of the original switches chose to sample at 8000 Hz to ensure a usable bandwidth of 300 to 3400 Hz. They chose to encode each sample with 8 bits which, after some signal processing, allows for a maximum signal to noise (s/n)

[1] See RUS Ex Parte Comments Regarding 10/8/97 Weekly Cost Model Meeting, attached.

> ratio of about 40 dB. The signal that results from 8000 samples per second, each containing 8 bits, is 64,000 bit per second (Digital signal zero or DS-0).
>
> Such a bandwidth and signal to noise ratio (300-3400Hz /~40 dB) is the industry standard. It is not the maximum bandwidth. Using more recently developed techniques like oversampling and digital filtering, modern digital systems can operate at nearly the theoretical limit. In other words, by applying inexpensive and widely used techniques, a digital switch's bandwidth could approach a full 4000 Hz.
>
> The RUS is not proposing that a 0 to 4000 Hz bandwidth be chosen or mandated for every element in the loop. Electronics have shorter lives and are easier to change than outside plant. Keeping in mind the "no roadblocks" philosophy, it should be recognized that the copper plant is the principal and longest lasting roadblock. As far as is practical, loop length in the cost models should be based on the maximum theoretical performance of the industry standard DS-0 channel which is 4000 Hz, the same as the top frequency given in the May 8 Order.

On December 30, 1997, the Commission on its own motion issued the Fourth Order on Reconsideration reducing the supported voice band required response to 300 Hertz to 3000 Hertz. At this point, the Commission departed from the direction it set for itself in its March 8, 1996 Notice of Proposed Rulemaking on Universal Service. In the March 1996 NPR, the Commission said:

> The third principle we address here is that "[c]onsumers in all regions of the nation, including low-income consumers and those in rural, insular, and high-cost areas, should have access to telecommunications and information services, including interexchange services and advanced telecommunications and information services" reasonably comparable to those provided in urban areas and at reasonably comparable rates. This principle directs us to go beyond the purpose and approach of the current Universal Service Fund (USF) program *by focusing on the comparability of access to services available throughout the country*, as well as on the comparability of rates.[2] [emphasis added]

Comparability is the primary theme of Section 254 of the Telecommunications Act of 1996. The RUS believes that defining voice grade access for purposes of universal service support should be a two-part process. First, we should determine the characteristics of voice grade access that urban customers receive. After doing that, we should design a support system that strongly promotes this level of voice grade access in rural America without detriment to existing rural services. If we do not focus on comparability, but instead study the capabilities of existing infrastructure in rural America (as the December 22 Public Notice does), the competitive

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[2] Notice of Proposed Rulemaking and Order Establishing Joint Board, March 8, 1996, Section III(A)(14)

telecommunications marketplace that is developing in urban America will rapidly widen the digital divide noted in the National Telecommunications and Information Administration's "Falling Through The Net" report.[3] By setting the bandwidth of voice grade service at 300 Hertz to 3000 Hertz, a new, reduced[4] standard for design and construction is set that primarily affects only those lines supported by universal service support, which are largely rural lines. This decision not only threatens to widen the digital divide, it encases it in a permanency that approximates the economic life of rural outside plant, which averages over 20 years.

The Public Notice expresses the Commission's concern that setting the voice grade access bandpass too high will exclude some providers from receiving universal service support. Such a concern can be easily addressed. In the May 8 First Order, the Commission provided "grandfathering" of multiparty service to prevent a similar exclusion of carriers who did not meet the new supported services requirement to provide all one party service. This same solution would work well with a voice grade access bandwidth requirement.

On January 27, 1998, the RUS met with representatives of the Commission to object to the unilateral reduction of rural bandwidth. The Ex Parte Presentation[5] filing covering this meeting is attached to these comments. The major points made in the RUS discussions and covered in the written filing are:

- The Commission set the definition of voice grade access for universal service support through an open and exhaustive rulemaking process. In its reconsideration, adopted December 30, 1997, the Commission significantly reduced the bandwidth component of that definition on its own motion.
- This reduction will be felt almost exclusively in rural America.
- The effect of this reduction will be to slow down rural America's access to information technology.
- A higher bandwidth would be more consistent with the Universal Service Principles in Section 254(b)(3) and 254(c)(1) of the Act.
- Carriers who have some loops that can't meet a higher bandpass requirement can be accommodated.
- The new bandwidth is based on a definition of voice grade access that is obsolete and possibly irrelevant to this proceeding.

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[3] Falling Through The Net, National Telecommunications and Information Administration, July 1999, Executive Summary at xv: "Regardless of income level, Americans living in rural areas are lagging behind in Internet access. Indeed, at the lowest income levels, those in urban areas are more than twice as likely to have Internet access than those earning the same income in rural areas."

[4] This standard is lower than the AT&T and Bellcore recommended standards, referenced later in this Comment, and current RUS design standards.

[5] See Ex Parte Presentation of the Rural Utilities Service, January 27, 1998, attached.

Bandwidth Comparability is Important in Speech Recognition

The December 22 Public Notice focuses on the data transport capabilities of voice grade access, but the Hertz at issue here are also important to the human ear.

The RUS has been concerned with the acoustics of speech for over 40 years. In the early 1960's, when cable replaced open wire as the mainstay of rural outside plant, the RUS introduced D66 loading to improve the bandwidth performance of loaded loops as compared to the H88 loading that was standard in the industry. H88 loading provided a "real-world" bandwidth of about 200 Hertz to 3400 Hertz, whereas D66 loading provided a real world bandwidth of about 200 Hertz to 4000 Hertz. The RUS adopted D66 loading to make rural telephone service comparable to urban service.

Why are frequencies above 3000 Hertz important to speech? Acoustically, speech has two components: vowel sounds and consonant sounds. Vowels provide the power and continuity of the spoken word, and consonants provide the intelligibility. The vowel sounds are low frequency in nature. The consonants are higher, and the differences between certain letters, such as "s" and "f", have large components above 3000 Hz.

This is compounded by normal hearing loss. Neurosensory hearing loss is the loss associated with aging, and it is very common in our aging population, particularly among males. This form of hearing loss is frequency selective – the loss occurs in the higher frequencies. As this hearing loss progresses, people often have hearing attenuation that begins as low as 3000 Hertz. These people can understand live conversation and television and radio dialog quite adequately, but they will have more difficulty comprehending speech over a 300 Hertz to 3000 Hertz voice circuit, particularly in the presence of line noise which long rural loops often have. They would have fared much better on the originally-adopted 4000 Hertz voice circuit, and they would also be better off if they move to town. Even a 300 Hertz to 3400 Hertz loop would give a noticeable improvement in speech intelligibility over the current requirement.

Congress Directed the RUS to Build Broadband-Capable Rural Plant in 1993, So Why is Voice Grade Bandwidth Important?

In 1993 the Congress spoke clearly on its expectations for broadband deployment. The Rural Electrification and Loan Restructuring Act of 1993 (RELRA) required the RUS to lend only into states that had State Telecommunications Modernization Plans that required, among other things, LECs to be capable of providing access to information services at a rate of 1 million bits per second. The RUS began building feasible rural telephone exchanges across the nation that were capable not only of evolving to broadband services through digital subscriber loop technology, but also of supporting the level of voice band access that the RUS argues for here. Sections 254 and 706 of the Telecommunications Act of 1996 only served to reinforce the promise of RELRA, and the RUS has continued building broadband-capable plant. In Fiscal Years 1997-1999, the RUS financed construction of 591 rural exchanges, which will serve 783,268 customers, with these capabilities. The average number of lines per exchange is 1,325 and the average density is 5.73

customers per route mile of line. When we are making this kind of progress toward being able to provide rural households with a broadband connection, why is the RUS concerned with voice grade access to the Internet?

Today, the modern telecommunications network not only accommodates voice conversations but is the primary means to access the Internet. The bandwidth of voice grade service is important because it is one factor that can limit modem performance. It is not the only factor, but it is the only factor quantified in the Commission's definition of voice grade service. At the currently-specified bandwidth of 300 Hertz to 3000 Hertz, supported voice grade access will not permit passage of a 28.8 Kilobit-per-second (Kb/s) modem signal. Most urban and suburban customers can connect at 28.8 Kb/s. Rural voice grade access that does not include the ability to connect at this rate, or very near it, is not comparable.

Modem traffic on the public switched network (PSN) today is a major if not predominant use, and it's growth is such that it will be the overwhelming use of the PSN in a couple of years.[6] Data is no longer a permissive or secondary use of the PSN.

Is Providing Good Modem Performance In Voice Grade Access Inconsistent with Evolving Broadband Service Capabilities?

The availability of broadband access will not diminish the growth of voice band data transmission because increases in computer ownership among rural households will compensate for it.[7] The RUS believes that for most urban and rural households, voice grade telephone service will provide the basic access to information services for many years. Telcordia estimates that 70% to 95% of all customers will continue to use voice grade access for their voice and data needs.[8] This is due to the considerably higher cost of broadband access, the lack of availability of broadband access in many urban and rural areas, and the fact that broadband access has not yet been included as a supported universal service.

Building a rural outside plant that will deliver 28.8 Kb/s modem speed is absolutely consistent with the evolution toward broadband capability. In fact, the plant architecture adopted in the Commission's HCPM/HAI Synthesis Model (Synthesis Model) can provide it. The Synthesis Model's short copper loops, coupled with most of today's lightwave carrier equipment, will provide a combination of frequency response, phase integrity and noise rejection needed to connect with at least 28.8 Kb/s performance.

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[6] Bellcore (now Telcordia) estimated that data traffic surpassed voice traffic on the PSN in 1998, and that by year end 2000 data would be 75% of all PSN traffic. See Next Generation Networks, Grant F. Lenahan, at www.telcordia.com/newsroom/knowledgebase/index.html

[7] Computer ownership in rural areas lags behind ownership in urban areas, central cities, and the nation on average, for 9 of 11 income categories, see Falling Through The Net, Ibid, at 17.

[8] Ibid, Next Generation Networks, at 8

On the other hand, a universal service support strategy that permits inductive-loaded plant to remain in place permanently may be inconsistent with Section 706 of the Telecommunications Act of 1996. Inductively-loaded plant not only defeats voice grade modem access at modern speeds, it also acts as a barrier to the delivery of advanced services to rural Americans.

At What Speeds Do Urban Users' Modems Connect?

3Com's website says "[t]esting initiatives have determined that a vast majority of phone lines in North America can support 56K."[9] The website v.Unreliable reports results of a survey performed by this website of popular modems. The survey of 3Com users shows that only 13% of 603 surveyed reported connecting at speeds less than 28.8 Kb/s.[10] Owners of Lucent LT modems reported in their survey that 27% connected at speeds less than 28.8 Kb/s, based on 6,606 respondents.[11] Owners of HCF modems reported that 24% of the 5569 responding connected at a speed less than 28.8 Kb/s.[12] CyberAtlas reports on a Neilson//NetRatings survey that shows that 85.9% of Internet users in the United States connect with V.34 or V.90 modems.[13] If owners of V.90 modems can connect at 28.8 Kb/s or better, then owners of v.34 modems can connect at 28.8 Kb/s or better at similar percentages. These figures indicate that the majority of customers in the nation are receiving telephone service that has considerably greater than the currently-specified voice grade bandwidth of 300 Hertz to 3000 Hertz. They also show that the majority of customers are not served by the few bit-robbing carrier systems on the market and that their loops are not inductively-loaded.

This commentary on the capability of urban and suburban loops is not surprising to the RUS. Short loops predominate in these areas. Good plant administration practices, including cutting dead the unused portions of customers loops (the portion beyond the customer), ensure that customer loop lengths are essentially the rectilinear distance to their central offices. If subscribers in high density areas are served by carrier serving area plant architecture, the copper distribution loops are very short, with exceptionally high frequency response. Judging from the survey results, the plant in urban and suburban areas is providing modem speeds of 28.8 Kb/s to a substantial majority of customers.

Therefore, rural voice grade access should provide the same modem performance over voice grade access to a substantial majority of rural customers.

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[9] See http://www.3com.com/56k/need4_56k/index.html, copy attached.
[10] See http://808hi.com/56k/_out/3comsurvey.htm, summary attached.
[11] See http://808hi.com/56k/_out/ltsurvey.htm, summary attached.
[12] See http://808hi.com/56k/_out/hcfsurvey.htm, summary attached.
[13] See http://cyberatlas.internet.com/big_picture/hardware/print/0,1323,5921_277191,00.html, copy attached.

Would It Be Better at this Point to Specify a Modem Speed Capability Requirement?

In view of the huge dependence that the nation's households and small businesses have on voice grade access for connection to the Internet, the RUS believes the time has come for a dual voice grade access specification that cites a frequency bandwidth component and a specific modem speed capability requirement. The bandwidth requirement should not be abandoned, because network designers and modem designers need guidance as to the parameters they must work within. But the RUS agrees with the Commission when it states in the Public Notice that bandwidth is not the only plant characteristic determining modem performance. Since there seems to be no publicly-available data on plant bandwidth, phase integrity and noise incursion, but there is data on modem speed performance, the time has come to specify the performance of voice grade access in terms of both bandwidth and modem speed capability.[14]

The current voice grade access bandwidth requirement of 300 Hertz to 3000 Hertz is clearly insufficient. It represents a devolution of universal service, not evolution or advancement. In the Fourth Order on Reconsideration, dated December 30, 1997, the Commission referred to the different standards for voice grade bandwidth in place at the time:

> We note that AT&T operating principles recommend that voice grade access be 200 Hertz to 3500 Hertz,[15] while Bellcore recommends a range of 200 Hertz to 3,200 Hertz or 3,400 Hertz.[16] American National Standards Institute (ANSI) defines voice grade access bandwidth as 300 Hertz to 3,000 Hertz.[17]

Thus, in adopting this lowest common denominator of bandwidth standards, the Commission singled out customers of carriers receiving universal service support to receive voice grade service that is inferior to that available in urban areas. The ANSI standard for bandwidth dates to the

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[14] In the January 27, 1998 Ex Parte meeting, the Commission staff stated that a bandwidth without tolerances or certain other performance requirements is incomplete, and the RUS agrees. It could be argued that since the tolerances are unstated, it must be assumed that this is measured from the half power point (-3 db) but one cannot be sure. Signal-to-noise ratio is important, too, not just for data but for ordinary voice service. High noise levels reduce quality and user satisfaction even more than the removal of several hundred Hertz from the top of the frequency band yet the definition does not address this important specification. Since modern modems (V.34 and better) require both reasonable bandwidth and signal-to-noise ratios, stating a modem performance standard would go a long way towards ensuring high quality voice service as well as data performance.

[15] "See AT&T, Engineering and Operations in the Bell System 194-195 (Second Edition)" – quoted from Fourth Order on Reconsideration, Paragraph 16, December 30, 1997

[16] "See Bellcore, Principles of Bellcore's Telecommunications Transmission Engineering 666, 680-681 (Third Edition)." – quoted from Fourth Order, Paragraph 16.

[17] "American National Standards Institute, *Interface between Carriers and Customer Installations – Analog Voicegrade Switched Access Lines with Distinctive Alerting Features 4 (1995)*" – quoted from Fourth Order, Paragraph 16.

1950's when the telephone set itself limited useful bandwidth of a telephone line. In those days, there were no digital switches to limit bandwidth, and very few customers were served with carrier products because of the cost and low reliability of those products. Open wire plant had enormous bandwidth capability. The AT&T and Bellcore standards that the Commission could have chosen are standards that a major interexchange carrier set for itself, and that the standards writer for the major urban and suburban local exchange carriers wrote for the Regional Bell Operating Companies. Either of these standards would have supported better modem performance than the ANSI standard. We enter this new century with not only the lowest common denominator of bandwidth standards in effect for rural America, but the oldest common denominator as well.

Concerns About Competitive Neutrality Do Not Justify Deepening the Digital Divide

Although it isn't mentioned in the Public Notice, it is possible that the setting of this lowest common denominator standard for voice grade access is connected to the limited bandwidth capability of some potential new entrants who might wish to qualify for universal service support. The RUS is in favor of competitive neutrality, but competitive neutrality should not cause a general degradation of service quality in rural America at the same time competition is firing giant leaps forward in urban and suburban America. This service degradation will prevent rural families from enjoying the benefits of the nation's newest educational, social and economic resource, the Internet. If a would-be provider uses a technology that does not provide modern voice band access to the voice and information networks in this nation, it should not receive universal service support. If it does receive support, it should not receive the same amount as carriers who provide all of the components of voice grade access set by the Commission in compliance with Section 254 through its facilities or its facilities in combination with other facilities.

A very positive feature of the traditional investment-based support system was that LECs with new plant received more support than carriers with old plant, which generally rewarded the carriers who provided the most modern service. The forward-looking-cost-based system recently adopted for the non-rural carriers does not have a link between service quality and support. The RUS believes a link is necessary. If a carrier can provide all of the components of voice grade access except one, and it almost meets that one, the Commission could authorize the states to order reduced support to that carrier. Such "scaling" of support would encourage eligible telecommunications carriers (ETCs) to phase out "grandfathered" voice grade access exceptions, such as multi-party service, or, as we suggest here, provision of less than 28.8 Kb/s modem speed to the substantial majority of all rural customers.

Scaling of support might even enhance the competitive neutrality of voice grade access because it would give states a tool to use to bring compliance *after* ETC certification. States could certify new entrants as ETCs even though they have a reservation about the carrier's ability to provide the required services.

What Would This Cost?

The plant architecture needed to provide the substantial majority of rural customers with a modem speed of 28.8 Kb/s, carrier serving area architecture, is standard in the industry. It was adopted by the Commission in the Synthesis Model. It has been employed by RUS-financed LECs since the late 1980's. Universal service support for the non-rural LECs is already being calculated based on this plant architecture, so one could argue for non-rural LECs that this plant is already being supported by universal service payments.

Implementing carrier serving area architecture costs little if it is done at the time of a plant rebuild that is otherwise necessary. Before RELRA, the RUS compared the cost of every proposed carrier serving area design with the cost of a loaded plant design and if the added cost was over 20%, the policy was to require the loaded plant design. We do not recall rejecting any carrier serving area designs because of this test. Our experience running the Synthesis Model has not contradicted this. Even though the cost of a single loop or cluster may be far higher than the cost of serving with loaded plant, our runs of the model have shown that on an exchange basis, and particularly a system basis, the cost of rebuilding with a carrier serving area design usually does not exceed the cost of rebuilding with a loaded loop design by over 20%.

On a system where outside plant is fairly new and is adequate, the cost of a rebuild solely for the purpose of achieving a greater modem speed might seem high. But a system that needs to be rebuilt to provide 28.8 Kb/s would also need to be rebuilt (or overlaid with another technology) to provide advanced services.

The RUS since the passage of RELRA has funded the rebuilding of over one fifth of its exchanges to carrier serving area architecture. As stated before, the projects funded in the last three years had an average system density of only 5.73 customers per route mile, which is below the average density of 6.32 for all RUS borrowers. If these systems can be feasibly rebuilt to modern standards, it should be feasible for the higher density systems.

Recommendations:

1. The Commission should redefine voice grade access to require a bandwidth comparable to the real level of performance of urban voice service. The RUS believes, and modem performance surveys suggest, that urban loop performance includes useful response to above 3400 Hertz.
2. Voice grade access service should be amended include the requirement to provide 28.8 Kb/s modem connection to the substantial majority of rural customers, since the substantial majority of urban customers receive this modem performance.
3. The Commission should authorize states to "grandfather" ETCs who cannot provide this service, under terms negotiated at the discretion of the states.
4. The Commission should authorize states to provide reduced support payments to ETCs who do not provide the required bandwidth or modem speed.

Conclusion

The RUS appreciates the opportunity to comment on voice grade access bandwidth. Since suggesting that the Commission reconsider the definition of voice grade access, the Internet has grown into the engine powering a great national economic surge. Unfortunately, rural Americans are not connected to this resource at nearly the high rates their urban counterparts are. Rural Americans can have the same access to the economic, educational and social opportunity promised by the Internet as their urban counterparts if we adopt the right definition of voice grade access.

Thank you for this chance to participate.

Dated: JAN 19 2000

Christopher A. McLean
Acting Administrator
Rural Utilities Service

Attachments

October 27, 1997

Office of the Secretary
Federal Communications Commission
1919 M Street, NW
Room 222
Washington, DC 20554

To Whom It May Concern:

The Rural Utilities Service (RUS or the Agency) hereby reports *ex parte* representations to members of the Federal Communications Commission (Commission) staff on October 8, 1997, at Commission offices at 2100 M Street. The meeting was open to the public and is one of a series of regular weekly meetings being held by Commission staff to analyze cost models as they relate to universal service support (CC Docket Nos. 96-45 and 97-160). The focus of the meeting was outside plant design.

The enclosed list of attendees for the meeting was supplied by Commission Staff. In addition to reporting the nature of RUS comments at the meeting, we have provided additional comment on these topics as suggested by Commission staff.

Meeting Comments:

Universal Service Support for Wireless Telephony

Michael L. Katz made a presentation on behalf of Airtouch Communications. After noting that different types of wireless service provide markedly different levels of service, RUS representatives asked Mr. Katz how such disparate service could be compared to the relatively well-defined quality of a typical copper circuit. Mr. Katz responded that in cases where the wireless was being provided by a new entrant, it should be a matter of customer choice, not government regulation. When questioned further, he advocated that a wireless new entrant should be entitled to the wireline model-based support level, even if the wireless system does not fully provide the supported services inherent in the plant design of whatever model is adopted by the Commission as a means of implementing the May 8 Order and the Order's universal service requirements. The RUS representatives argued that this was not a proper approach.

Structure Sharing

As in several previous meetings, structure sharing was discussed. Once again, the example used was a new house. RUS representatives repeated the arguments made in previous comments and ex partes, that new-development costs are not a realistic basis for estimating structure sharing.

Additional Comments:

Universal Service Support for Wireless Telephony

The RUS has long supported the appropriate application of wireless technology to lower the cost of rural plant. The Agency financed fixed-station rural radio which operated under IMTS rules in the early eighties. In the late eighties, the Agency led a coalition which developed BETRS radio. The Agency is supportive, not hostile, towards wireless technology.

On the other hand, wireless service is not a panacea. The high fixed costs of common equipment in terrestrial systems have to spread over a number of customers for this service to be feasible. In some rural areas, costs of BETRS systems have exceeded $20,000 per subscriber. Nevertheless, these were built if they provided a real long-term savings when compared to wireline service. As far as was practical, it was attempted to make the service appear equivalent to wireline service and RUS area coverage policy required that it was billed on the same basis, i.e., flat rate, like the wireline service.

Terrain is another problem for wireless carriers. All terrestrial systems (for which spectrum has been allotted by the Commission) are line-of sight. This can make implementation prohibitively expensive in low density, mountainous areas.

The prospective satellite services look promising but the rate structure of these services are expected to be highly usage sensitive and are thus not comparable to the non-usage sensitive service found in urban areas. Further, some of these proposed services are distinctly inferior to the quality of service envisioned in the Telecommunications Act and assumed by the modelers. Most important, these services are not yet implemented which means the estimated costs and dates of availability cannot be relied upon for planning or modeling purposes.

Caps on Wireline Investment

During the meeting, Commission staff said it was their intention that the plant design not have unnecessary built-in impediments to the provision of advanced services. This was why they had found that load coils should not be used in the outside plant design. This outlook is consistent with the RUS view that plant design should be capable of migration to advanced services without wholesale plant abandonment which the Agency characterizes as "no roadblocks." The plant designed by the BCPM can be reasonably augmented to provide advanced services without the

wholesale discarding of plant. The loop plant does not present an advanced services roadblock. As far as the RUS can tell, the Hatfield model is also designed not to build roadblocks.[1]

At this time, if a carrier were to use an alternative technology, the most likely would be fixed station cellular (BETRS) provided as an adjunct to a cellular mobile service. This type of BETRS does not provide access to advanced services in its conventional form. Not only that, modem access is typically slower than on an ordinary POTS line. Any attempt to provide usage sensitive advanced services would require multiple channels resulting in unaffordable access. BETRS reliability and access are generally inferior to conventional service. In one way or another, this alternative to wireline service fails to provide the supported services inherent in the outside plant designs of the models being considered by the Commission as a means of implementing the May 8 Order and the Order's universal service requirements.

In previous versions of the BCPM, a wireline cap of $10,000 per customer was assumed. Above this level, which would be characteristic of the most remote rural areas, customers were to be served by an unspecified wireless technology. The concept of a wireless cap has also been discussed by Commission staff in their presentations on cost models.

Such an approach does not account for the fact that the reasons for high wireline cost in rural areas, low customer counts, remoteness, and terrain, are serious problem areas for wireless applications as well. At this time, the RUS knows of no wireless service that is both equivalent and cost-competitive to wireline service in remote rural areas and there is no indication that this is about to change. The Agency does not dispute the importance of wireless technologies as a service alternative in special applications, but unless there is an available wireless service[2] that is equivalent to the wireline service being modeled, both in its in its ability to provide supported services <u>and</u> in its ability to provide access to advanced services, wireless should not be considered as an equivalent alternative, and thus, a reasonable way to set a cap on the costs developed by the models. Further, support based on a wireline model should not be portable to a wireless carrier if it does not provide equivalent supported services.

Linking Universal Service Support to Performance

The RUS has previously commented on the need to tie universal service support to the provision of quality service, to serve as the incentive intended under the Telecommunication Act. Minimum service standards should be uniform among ETCs and, after a reasonable implementation period,

1. It is unclear at the moment exactly what type of subscriber carrier the Hatfield model will eventually provide for customers served by "T-1" circuits. At present, the model builds a discrete facility to each remote customer so it would not present a roadblock.

2. By available, the RUS means available today with known operating characteristics and costs. It must also be designed for a frequency band that has been approved by the Commission for telephone use.

providers that do no meet those standards should not receive support. If support is available, independent of some standard of service, the support will provide the wrong incentive, one which encourages the provision of inferior service.

From a customer standpoint, one of the most important service standards recommended to the States by both the Joint Board and the Commission is that a local usage component be included as part of a local service package. For the supported service to be comparable to that found in urban areas, local call minutes should not be dominated by a usage charge. There must be a reasonable period of time included in the base rate, or the usage charge must be quite low as it is for measured service in urban areas, or there could be some combination of the two.

A relatively low monthly charge with high per minute charges does not meet the Universal Service Principle of service that is reasonably comparable to that found in urban areas. Such service would discourage Internet connections. The Internet is quickly becoming a way for parents, students and teachers to stay in touch. Homework assignments are posted. Parents can keep track of student progress and make contact with teachers. The elderly can maintain contact with the world. Perhaps most important, Internet access is crucial for rural students. High usage charges means no student Internet access. At a time when the Internet with its long hold times is expected to become a dominant form of telephone use, a service with a high usage charge should not be supported by Universal Service Funds since it encourages precisely the opposite of the results intended by the Act.

Although the local usage component will be determined by the States, it is important that the Commission not adopt an outside plant design which ignores the rate characteristics of the technology employed and thus, might preclude the States from setting a reasonable local usage component if it adopts the Federal model.

Facilities-Based Competition

As a result of the focus on wireless support at the meeting, there was considerable discussion of the disconnect between the cost models and facilities-based competition. This raises questions such as:

- Assuming there were an equivalent wireless telephone system, what is the proper level of support for a wireless competitor?
- How does one calculate the proper support for the now smaller wireline competitor?

These kinds of questions lead to a consideration of a problem with the current computer models which was generally recognized at the meeting: the models assume one provider. Even if a model could accurately calculate the cost of an efficient wireline monopoly, it is difficult to imagine how two or more facilities-based competitors in high cost areas can be supported by a model which assumes only one provider and a uniform type of cost structure. The Act requires that State Commissions name more than one ETC for areas served by non-rural companies. Any model must properly account for this mandate.

The RUS believes that this is yet another reason that costs should be aggregated at as small a level as possible, no higher than at the census block level, so that any support lost to a competitor is proportional to the cost of service to the lost customer. Further, the models must be capable of recalculating the support level of a carrier based on market share.

Structure Sharing

The Commission has directed the developers to construct a model which calculates forward-looking costs. As we understand the Commission's concept of forward-looking costs, the costs should represent what an efficient new entrant would face if, starting from the existing wire centers, it built a complete system. This is referred to by the Commission staff as a "scorched node" design because it assumes that everything has been removed except for the node. The prospective customers to be served by this system, at a minimum, would include all current customers. It has been a matter of contention whether the models should also build plant to serve unserved households and habitable but uninhabited establishments. Whatever customer base is finally decided upon by the Commission, no one has ever suggested building plant to uninhabitable establishments which is what new developments are at the time of construction. Even if the model were to design plant to serve new developments under construction at the time the model is run, these new establishments would account for only a tiny percentage of the prospective customers.

Therefore, continued discussion about structure sharing based on practices in new developments has little value because it does not comport with the Commission's own direction about what the models are supposed to do. If a new entrant were to build Gunnison, CO, that new entrant would receive almost no coordinated assistance from the other existing utilities. To assume the types of sharing which occur in new developments, it would have to be assumed that all the nation's physical infrastructure were being built along with the telephone system. The proper sample on which to extrapolate sharing is a complete exchange rebuild.

Voice Grade Bandwidth

In recent meetings, attention has focused on the bandwidth for voice grade service as established in the May 8 order. At the meeting, US West recommended that the Commission change its definition to 300 to 3200 Hz. The RUS does not agree.

Bandwidth

In common usage, Bandwidth denotes information carrying capability. Wide-band is used to describe a system with high capacity whether digital or analog.

Such usage is incomplete and misleading. It is like trying to describe the volume of jar by giving its diameter. For example, the information carrying capacity of an analog circuit depends on bandwidth and the maximum signal-to-noise ratio (the maximum volume compared to the ambient noise level). A 6o dB circuit has a greater information carrying capacity than a 30 dB circuit.

Things are simpler in the digital world. Bit rate alone is a measure of information carrying capacity. The interrelation can easily be seen in modem performance. Modems convert the digital language of a computer to a different digital language, one whose frequency content is compatible with a voice circuit. Ignoring other limitations, the bit rate of a modem is proportional to both bandwidth and signal-to-noise ratio.

Existing Telephone System Bandwidth

Digital switches were first introduced a generation ago. At that time, there was little consideration of modem connections as the PC had not yet become popular. Digital theory (Nyquist Theorem) states that a digital signal can contain all the information contained in an analog signal if the analog signal is sampled at a frequency at least twice as high as the highest frequency in the analog signal. The designers of the original switches chose to sample at 8000Hz to ensure a usable bandwidth of 300 to 3400 Hz. They chose to encode each sample with 8 bits which, after some signal processing, allows for a maximum signal to noise (s/n) ratio of about 40 dB. The signal that results from 8000 samples per second, each containing 8 bits, is 64,000 bit per second (Digital signal zero or DS-0).

Such a bandwidth and signal to noise ratio (300-3400Hz /~40 dB) is the industry standard. It is not the maximum bandwidth. Using more recently developed techniques like oversampling and digital filtering, modern digital systems can operate at nearly the theoretical limit. In other words, by applying inexpensive and widely used techniques, a digital switch's bandwidth could approach a full 4000 Hz.

The RUS is not proposing that a 0 to 4000 Hz bandwidth be chosen or mandated for every element in the loop. Electronics have shorter lives and are easier to change than outside plant. Keeping in mind the "no roadblocks" philosophy, it should be recognized that the copper plant is the principal and longest lasting roadblock. As far as is practical, loop length in the cost models should be based on the maximum theoretical performance of the industry standard DS-0 channel which is 4000 Hz, the same as the top frequency given in the May 8 Order.

Summary

A wireless cap is not a practical way of limiting the estimated cost of universal service support unless the wireless technology provides equivalent supported services. The cost models need to be capable of dealing with the differing market share and cost structures of competing ETCs. Structure sharing should be extrapolated from complete system rebuilds, not construction in new developments. The copper portion of the loop should be designed for service up to 4000 Hz, the maximum frequency of a voice grade DS-0 circuit.

RUS appreciates the opportunity to attend these weekly meetings.

Sincerely,

ORREN E. CAMERON III
Director
Telecommunications Standards Division

Enclosure

cc: Charles Keller, FCC
Robert Loube, FCC
Richard N. Clarke, AT&T
Glenn Brown, US WEST
Rowland L. Curry, Texas PUC

Before the
Federal Communications Commission
Washington, D.C. 20554

FCC 96-93

In the Matter Of	)	
	)	
Federal-State Joint Board on	)	CC Docket No. 96-45
Universal Service	)	
	)	

Ex Parte Presentation of the
Rural Utilities Service

The Rural Utilities Service (RUS) hereby reports *ex parte* representations to members of the Federal Communications Commission (Commission) staff on January 27, 1998, at Commission offices at 2100 M Street. The meeting was on the subject of voice grade access (CC Docket No. 96-45), and was attended by the following:

Attendee	Representing
Lisa Boehley	Federal Communications Commission
Bob Loube	Federal Communications Commission
Diane Law	Federal Communications Commission
Abdel Eqab	Federal Communications Commission
Bill Howden	Federal Communications Commission
Whitey Thayer	Federal Communications Commission
Sonja Rifken	Federal Communications Commission
Stagg Newman	Federal Communications Commission
Fred Lee	National Telecommunications Information Agency
Christopher A. McLean	Rural Utilities Service
Elizabeth Jones	Rural Utilities Service
Ed Cameron	Rural Utilities Service

Introduction

The RUS (formerly the Rural Electrification Administration) is a rural development agency of the U.S. Department of Agriculture that has promoted universal service in rural America for 48 years through targeted lending, technical support and policy guidelines. RUS telecommunications borrowers provide service to 40 percent of the landmass of the country, which is roughly half of the rural portions of the continental United States. Comprising 80 percent of the landmass, but only 20 percent of the population, rural America needs modern telecommunications to bring high quality education, health care, and commerce to rural families and businesses. Telecommunications frees the rural population from limitations of time and space.

RUS is in a unique position to comment on rural America's telecommunications needs. The Agency's goal has always been to provide every rural household with affordable service. Our point of reference is the urban and suburban subscriber. We have sought to ensure that RUS borrowers provide telecommunications service that works like, sounds like, and costs like the urban and suburban customers' service. Since this is much harder to do in low density areas, RUS has created its own practices and standards which addressed the rural challenges. RUS stretches available funding resources by examining costs and system designs. RUS-financed systems are designed to be expandable and upgradable to meet rural America's needs economically throughout the anticipated economic life of the plant installed.

As with the RUS' previous filings on this docket, this presentation addresses all of rural America, not just those portions served by RUS borrowers. Although RUS has an outstanding portfolio of approximately $5.2 billion in loans outstanding or guaranteed, and RUS does have a concern about loan security, the overriding issue is the health, education, and economic condition of all of rural America. And as in the past, we are technology neutral and favor any technology that will economically establish and maintain universal service, be it wireline, wireless, or satellite.

The purpose of this presentation is to summarize what was said in the January 27, 1998, meeting.

The January 27, 1998 Meeting

- **The Commission set the definition of voice grade access for universal service support through an open and exhaustive rulemaking process. In its reconsideration, adopted December 30, 1997, the Commission significantly reduced the bandwidth component of that definition on its own motion.**

The RUS pointed out that as part of the Telecommunications Act of 1996 (Act), a Federal State Joint Board (Joint Board) was established to provide guidance to the Commission as

it prepared regulations to implement the Act's Universal Service Provisions (Section 254). The Joint Board recommended that voice grade service be defined as having a frequency range (bandwidth) of 500 to 4000 hertz. This definition was recommended after extensive public input was obtained in hearings and written comments, including comments filed by the RUS. The Commission adopted the Joint Board's recommendation concerning voice grade bandwidth in its *Universal Service Report and Order* dated May 8, 1997 (May 8 Order), after having received further comment including extensive comment on the Joint Board's recommendations.

In the Fourth Order on Reconsideration, issued December 30, 1997 (Fourth Order), the Commission significantly changed the definition of voice grade bandwidth without seeking comment. The new definition of voice grade access is 300 to 3000 Hz.

- **This reduction will be felt almost exclusively in rural America.**

Short urban and suburban loops inherently have a wide voice bandwidth. Most urban and suburban loops do not require loop treatment which restricts bandwidth. Most rural loops do have loop treatment. (Loops over 18,000 feet require treatment.)

Each circuit element in a local loop can limit bandwidth, and those effects will compound if the limits are close together. Loops comprise central office switches, physical wires (usually copper) which connect customers to those switches, and other electronic systems which are used to minimize or replace copper wires. All loops use a switch, so all are subject to the bandwidth limitations of the switch. Currently, digital switches limit the top frequency of a loop to somewhere between 3400 and 3500 Hz. This limit is a design decision made by the switch manufacturer, and it could change - the theoretical top frequency of devices using the current standard sampling rate is 4000 Hz. Most other electronic systems are based on the same sampling technology, so they offer the same upper frequency limits as digital switches.

The equality between urban and rural loops ends there. Rural loops are bandwidth limited by their copper wires. High frequency performance of copper loops declines as the loops get longer. Urban and suburban loops have short wires (most are under 18,000 feet) which will pass fairly high frequencies. For example, a 6,000 foot copper wire pair will support T1 carrier, the spectral density of which is centered at 750 kilohertz. Urban loops rarely limit voice bandwidth. Longer loops which serve rural subscribers (most are well over 18,000 feet) require loading with inductors which limits higher frequencies and also introduces phase shift across the voice band. Rural loops can be economically designed to pass frequencies higher than the current digital switch cutoff, or they can be designed to provide lower cutoffs such as the 3000 Hz specified by the Commission in the Fourth Order.

The economic life of a digital switch is estimated by RUS to be under 12 years, and the economic life of copper cable is over 20 years. The reduction in required bandwidth,

which will affect primarily rural copper plant, could be a permanent barrier between rural subscribers and the important (and economically available) frequencies above 3000 Hz.

- **The effect of this reduction will be to slow down rural America's access to information technology.**

The higher frequencies in the voice band are critical to any users' access to information services via computer modems. Modern popularly-priced home computers are equipped with modems with a capability of data transmission at a rate of 28.8 kilobits per second (Kbps). Modems test the telecommunications circuit they are operating over and select a data transmission scheme and rate for maximum speed without error. They test for the top frequency the circuit will transmit, and they test other performance factors. A circuit that is limited to only 3000 Hz will cause the modem to operate at a significantly lower speed than one that will pass higher frequencies, if other factors test about the same.

A 3400 Hz circuit will not guarantee that a modem will connect at 28.8 Kbps, but 3000 Hz circuit will practically guarantee that a it will not. A wider voice band makes a modem more tolerant of other circuit performance flaws that are more common on rural loops, such as phase shift. Restricted bandwidth is not the only impediment to modem performance, but it is the most permanent.

The Commission staff stated that it realized, after issuing the May 8 Order, that few telecommunications circuits in the nation could pass 4000 Hz. The RUS agreed with this, but argued that the Commission has gone too far in reducing the top end of the voice band to 3000 Hz.

- **A higher bandwidth would be more consistent with the Universal Service Principles in Section 254(b)(3) and 254(c)(1) of the Act.**

The RUS believes that the Act is intended to provide rural Americans with access to telecommunications and information services comparable to the access that urban and suburban customers enjoy. The reduced bandwidth requirement for voice grade access, which is now at a level below that which is available to urban and suburban customers, will hurt rural customers.

- **Carriers who have some loops that can't meet a higher bandpass requirement can be accommodated.**

A requirement for voice grade access higher than 3000 Hz would not have to deny universal service support to carriers who cannot yet meet it because the requirement could be phased in.

The Commission defined universal service as one-party service despite the fact that there are many four-party lines in rural areas today. The RUS believes that this was the right

decision. The May 8 Order requires one-party service but provides for a phase-in to prevent carriers from losing support until they can reasonably eliminate lower grades of service.

Rural bandwidth comparable to urban bandwidth could be phased in the same way.

Until the Fourth Order, it was clear that the objective of the Commission in defining the supported services was not to find the lowest common denominator of services offered around the Nation. Universal service should be defined in a manner that is fully consistent with the Act.

- **The new bandwidth is based on a definition of voice grade access that is obsolete and possibly irrelevant to this proceeding.**

In the Fourth Order, the Commission states it chose to reduce bandwidth for voice grade access because that is the way voice grade access is defined by the American National Standards Institute (ANSI). This not a new ANSI definition. It was in effect when the Commission issued the May 8 Order, it was in effect while the Joint Board deliberated, and RUS believes it has been in effect for over 40 years. The RUS has documents from the 1950's that state the same 300 to 3000 Hz bandwidth for telephone service. These documents were based on the national standards of the day. Of the several bandwidths to which the Commission makes reference in the Fourth Order, the Commission chose the oldest and most restrictive.

The core service definition of voice grade access for universal service support purposes should not be written by a national standards setting organization. Congress provided the guidelines for defining the supported services in Section 254(c) of the Act. Standards setting organizations do not necessarily have to follow such guidelines - they are more likely to search for consensus among service providers and therefore may engage in a lowest common denominator search. Public policy decisions such as the definition of supportable services should be made only after the public has an opportunity to be heard. Standards setters do not conduct standards setting in a manner that encourages comment from the general public. For example, parties with an interest in this issue, such as rural educators and rural small businesses, do not have access to the national standards setting process.

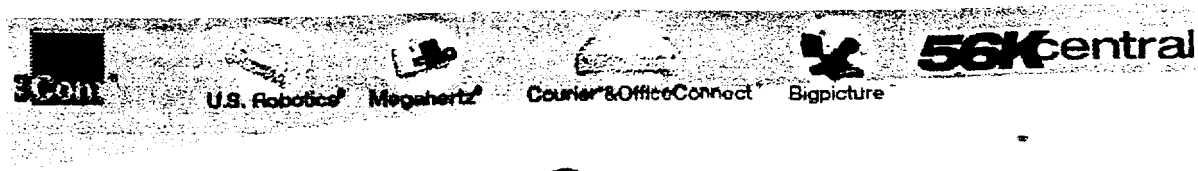
Conclusion

The reduction in the definition of voice grade bandwidth will not provide comparable service in rural areas as required by the Universal Service Principles, will be felt almost exclusively in rural America, and will hamper rural customers as they try to use the Internet and other information services. The few hundred Hertz above 3000 are crucial to rural Americans and to fulfilling the Act's goal that rural service be comparable to that in urban areas. Without these few Hertz, rural schoolchildren will be waiting for information to be delivered to their computers while their urban cousins have moved on to the next question.

The RUS recommends that the Commission reconsider this reduction in the quality of voice grade bandwidth.

CHRISTOPHER A. McLEAN
Deputy Administrator
Rural Utilities Service

cc: All attendees



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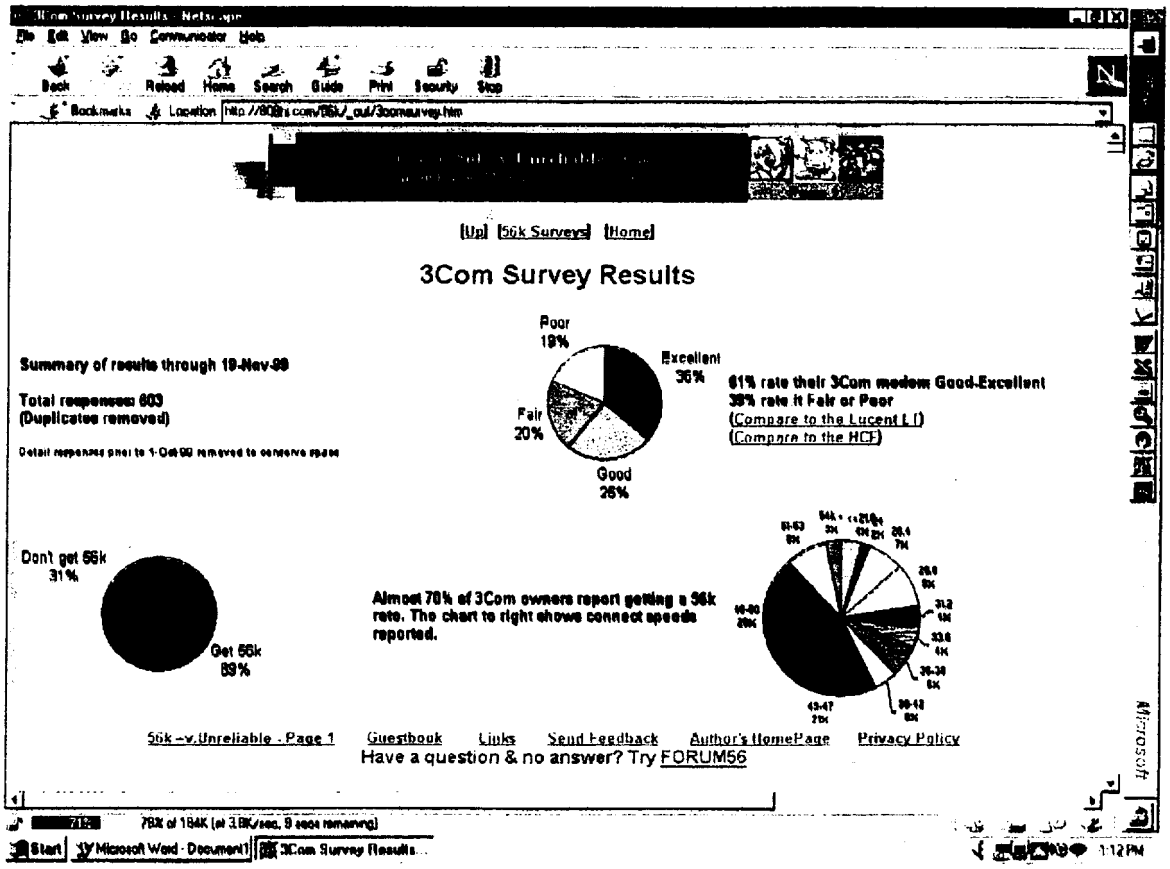
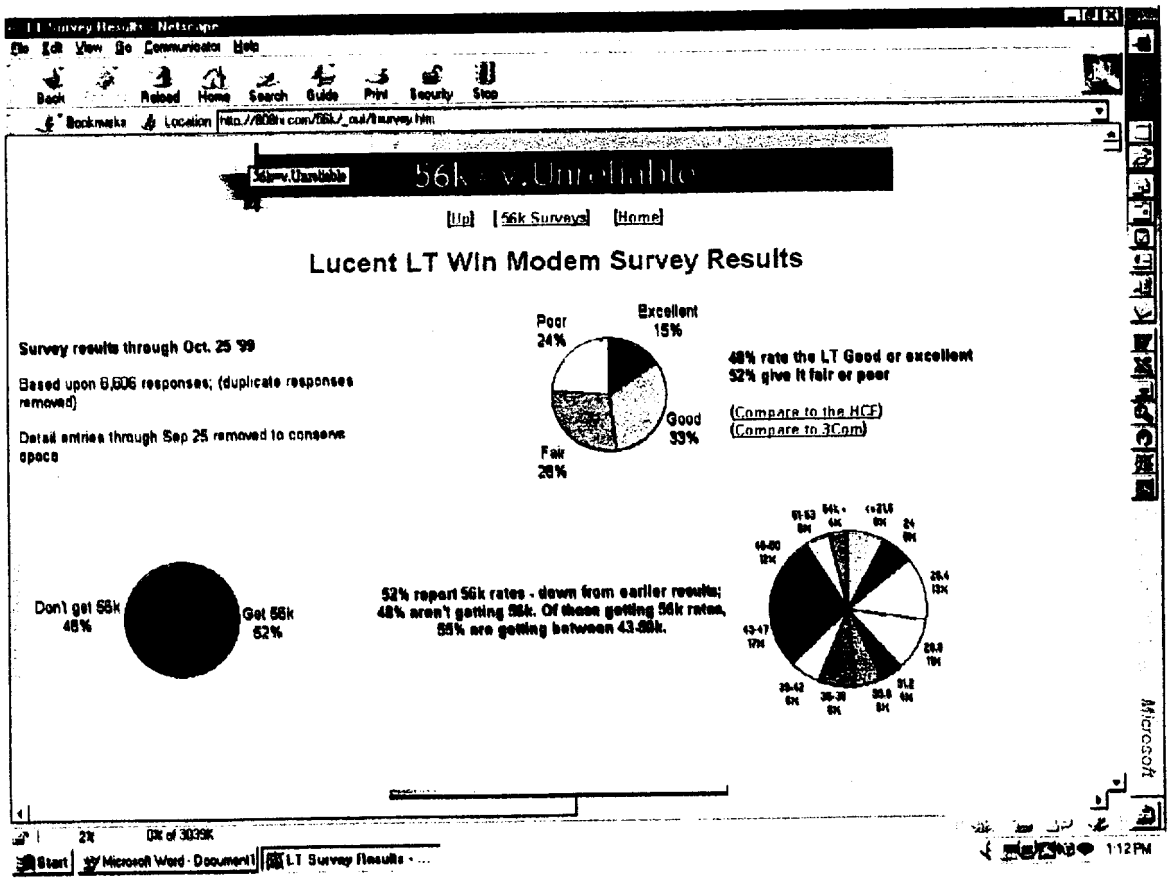
3Com Survey Summary



Comments of the Rural Utilities Service
Redefining Voice Grade Access
January 19, 2000

Appendix

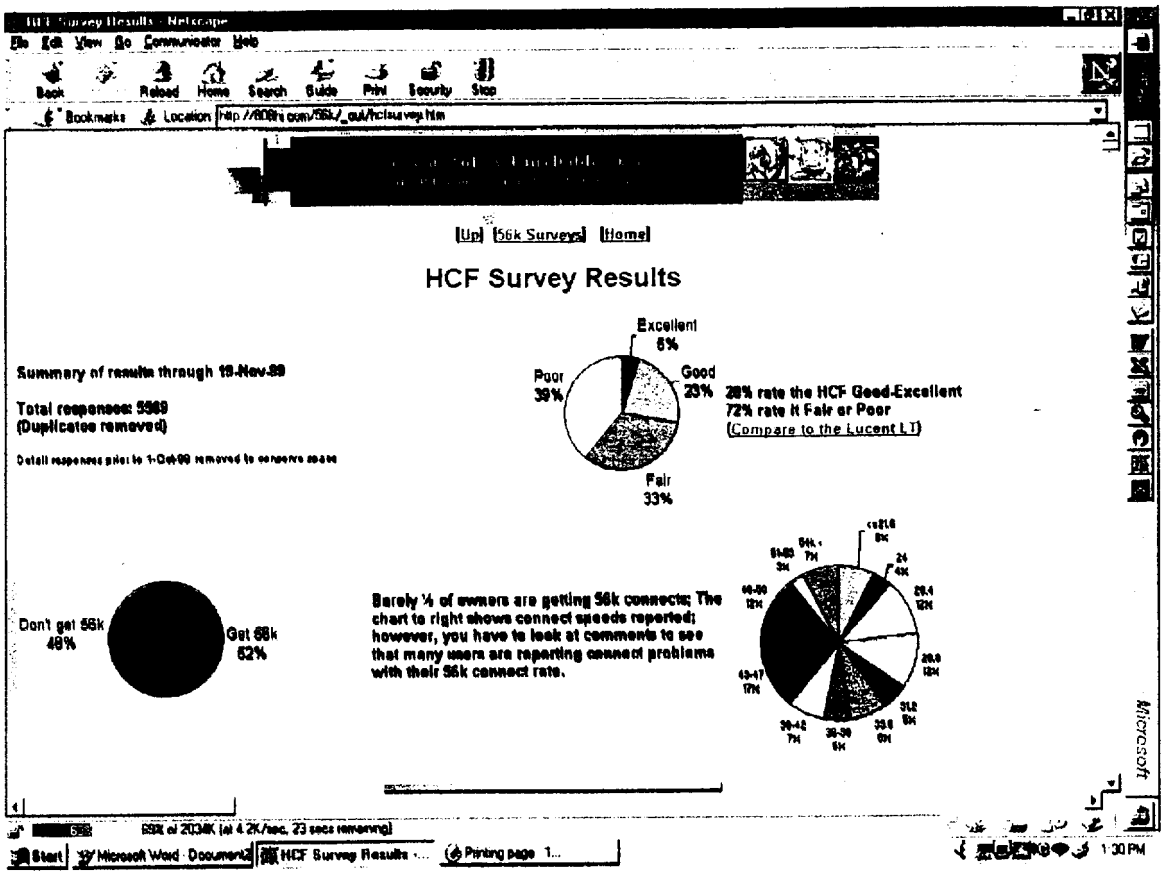
Lucent LT Survey Summary



Comments of the Rural Utilities Service
Redefining Voice Grade Access
January 19, 2000

Appendix

HCF Survey Summary



CyberAtlas
The Web Marketer's Guide to Online Facts

This article can be found online at:
http://cyberatlas.internet.com/big_picture/demographics/article/0,1323,5921_277191,00.html

Slow Modems Still Dominate Home Internet Scene

Real Player from RealNetworks, Inc. remains the most popular media player in use, with a reach of 12.1 percent in the active Internet universe, according to research by Nielsen//NetRatings.

By measuring content specific to each type of media player, Nielsen//NetRatings found that, in addition to Real Player's 12.1 percent reach, Apple's QuickTime had a 7.4 percent reach and Microsoft's Windows Media Player held a reach of 3.2 percent.

"The battle of media players on the end user's desktop is as significant as the battle of desktop operating systems many years ago," said Allen Weiner, VP of Analytical Services at NetRatings. "Media players enable developers to fuse TV and radio events with Internet content, providing an experience for users that transcends a single medium. Our data shows three leaders setting the early pace, and they will guide the industry in how information and entertainment are delivered."

The typical media player user is a white male, 25-49 years of age, and well educated with a strong concentration in professional and executive/managerial job classifications, according to Nielsen//NetRatings. Users fell strongly in the $25,000 to $75,000 income brackets. Microsoft's Windows Media Player had an audience that consisted of approximately 70 percent men, as compared to Real Player's 61 percent male audience. Apple's QuickTime had more females (41 percent) than those using Microsoft and RealNetworks' players.

The other half of the streaming media equation is the speed at which a user connects to the Internet. When it comes to Internet usage at home, Web consumers in the US live in a modem-based world, Nielsen//NetRatings found. In November of 1999, only 5.9 percent of home users were accessing the Internet via a high-speed connection, which includes ISDN, T-1 lines, satellite, cable modem service, and the various types of digital subscriber lines. Among modem users, most are concentrated among mid-speed access, 28.8/33.6Kbps, with 45 percent market share. Faster modems offering 56Kbps access make up 41 percent of the market.

This information reveals a significant opportunity for network providers to offer higher bandwidth to the consumer's computer. Those with high-speed access view more pages and surf the Web more often than those with 28.8/33.Kbps-modem access. In visits per person, those with higher speed access visit the Internet 83 percent more and view a 130 percent more pages than those with mid-range modem speed.

Bandwidth in the US
November 1999

Speed	Unique Audience	Pages/ Person	Visits/ Person	Percent of Net Users
14.4	6,050,900	282	11	8.3%
28.8/33.6	32,991,289	451	15	45.2%
56	29,671,057	587	18	40.7%
High speed	4,266,023	1036	28	5.9%

Source: Nielsen//NetRatings

"The numbers suggest that those with higher-speed access will be more inclined to look at an increased number of Web ads and won't have to face the annoying download wait that currently plagues the overwhelming number of US Internet users," Weiner said.

As would be expected given the higher costs involved, Nielsen//NetRatings found that Internet users with a high-speed connection at home are wealthier than modem users. Some 37.1 percent of high-speed users who head households earn more than $75,000 a year; only 27.7 percent of 28.8/33.6Kbps consumers are in this income bracket. In addition, Internet users who head households with ISDN or better connectivity have a higher concentration of college degrees, 59.4 percent, versus 50.1 percent among 28.8/33.6Kbps users.

January 7, 2000

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