Appendix D: The United States

D.1 Rural and urban service levels

In the United States the regulation of the provision of telecommunications services to rural and remote areas has undergone significant revision with the passing of the 1996 Telecommunications Act. The Act states that the "policy on universal service should be a fair and reasonable balance of all of those principles identified in section 254(b) and the additional principle of competitive neutrality".[128]

Section 254(b) sets forth principles upon which the Federal-State Joint Board on Universal Access and the Federal Communications Commission (FCC) are to base policies for the preservation and advancement of universal service. The seven principles are:

i. Quality services should be available at just, reasonable, and affordable rates.
ii. Access to advanced telecommunications and information services should be provided in all regions of the Nation.
iii. Consumers 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. These include inter-exchange services and advanced telecommunications and information 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.
iv. All providers of telecommunications services should make an equal and non-discriminatory contribution to the preservation and advancement of universal service.
v. There should be specific, predictable and sufficient federal and state mechanisms to preserve and advance universal service.
vi. Elementary and secondary schools and classrooms, healthcare providers and libraries are to have access to advanced telecommunications at a discount.
vii. The Commission should develop other guidelines or principles that are appropriate for protection of the public interest and are consistent with the Act.

The competitive neutrality principle specifies that the universal service support mechanism should not favour one provider or one technology over another.

A joint federal-state committee determines the scope of the universal service provision in terms of services covered. Section 254 (c)(1)(A-D) requires the Joint Board and the FCC to consider the extent to which telecommunications services included in the definition of universal service:

i. are essential to education, public health, or public safety;
ii. have, through the operation of market choices by customers, been subscribed to by a substantial majority of residential customers;

[128] Federal Communications Commission FCC 97-157.

iii. are being deployed in public telecommunications networks by telecommunications carriers; and
iv. are consistent with the public interest, convenience and necessity.

The state regulatory commissions establish their own definitions of a basic service. Most of these correspond to the following services:

i. Access to a telephone network with the ability to place and receive calls;
ii. Access to touch tone capability;
iii. Single-party service;
iv. Access to emergency systems including, where available, 911 and Enhanced 911;
v. Access to operator services;
vi. Access to inter-exchange services;
vii. Access to directory assistance; and
viii. Limited long distance calling (for those low-income users who qualify).

Some states also include a modem capable line (speeds vary from 2.4kbps to 14.4kbps), ANI capability, privacy protection and other advanced services within the definition of a basic service.[129]

Traditionally, universal service in the United States has been achieved through implicit subsidies designed to shift costs from rural to urban areas, residential to business customers and local to long distance services. The access charge payments made by long distance telephone companies for use of local exchange carrier facilities have been an important component of these cross-subsidies. Some explicit support mechanisms have also been employed in high cost areas and for low-income users.

Rural telecommunications operators are reliant on these universal service funds. On average two thirds of their revenues come from access charges and universal service funds, compared to an average of 40 percent for the multi-regional Bell Operating Companies (BOCs).

The FCC intends, by the end of 1999, to have restructured the funding mechanisms into 'an explicit, competitively neutral, and sustainable mechanism' (see Box D.1). The intention is that the total amount of support not decline materially but be restructured to better fit a competitive environment.[130]

[129] Arizona PUC. Universal service around the nation. http://www.state.az.us/tpo/new/report/univ_nation.htm

[130] NTIA. The New Universal Service: NTIA's guide for users, 24 June 1997. http://www.ntia.doc.gov/opadhome/uniserve/univweb.htm

Box D.1: The US Universal Service Funding Mechanism:

- The Telecommunications Act of 1996 requires all interstate telecommunications carriers to contribute to universal service.
- Beginning January 1, 1999, rural and non-rural local exchange carriers (LECs) are to receive federal universal service support determined by separate mechanisms. Non-rural LECs will begin receiving federal support based on a forward-looking economic cost mechanism in 1999. Rural LECs will continue to receive universal service support, from federal universal service mechanisms, based on their embedded costs, at least until 2001. The FCC has said it will initiate proceedings in order to evaluate forward looking cost models. The rural proceedings will commence in October 1998. The FCC has also indicated that it will consider the option of competitive bidding for funding support [131]
- The Joint Board recommended that the support that an eligible telecommunications carrier receives for serving a supported line in a particular geographic area should be the cost of providing the service calculated using forward-looking economic cost models less a benchmark amount.
- The Joint Board recommended setting the benchmark amount at the nationwide average revenue per line, because "that average reflects a reasonable expectation of the revenues that a telecommunications carrier would be reasonably expected to use to offset its costs."
- subsequently, the Joint Board recommended, in their second report to the FCC, the use of a benchmark based on the nationwide average cost of service as determined by the cost model. [132]
- The Universal Service Fund is projected to be US$4.4 billion in 1998.
- Originally, the FCC recommended that 75% of the funding responsibility for USO come from the states and only 25% to federal support mechanisms. Bodies such as the State and Local Government Advisory Committee argue that this 25/75 split will lead to an increase in intra- and inter-state rates as the states' share would have to come from service provider phone charges. It would also give high cost states the greater part of the burden (46% of non-metro areas are considered high cost). On 15 April 1998 the FCC called for more proposals on the subject. [133]
- The state commissions are able to designate those carriers eligible for universal service support.
- The FCC's Universal Service Order says that a rural incumbent's per line support will be calculated by dividing its support payment by the number of loops it serves. An entrant is eligible for universal service payments (portable support) at the incumbent's per line amount to the extent that the entrant captures the incumbent's customers.
- The National Exchange Carrier Association (NECA) has been appointed as interim administrator of the universal service support mechanism.

D.2 Access to standard services on the PSTN

Estimates indicate that approximately 900,000 American households do not have a standard telephone service because the cost of bringing wire or cable to their remote communities is prohibitive. However, in general terms, rural America are relatively well provided for in terms of PSTN access.

Table D.1 details the most recent national household telephone penetration data prepared by the Census Bureau for the US National Telecommunications and

[131] Fusting, Pamela. Universal service and the shape of things to come. *Rural Telecommunications*, Sep/Oct 1997.

[132] Federal Communications Commission, Universal Service Order, FCC 97-157, May 8, 1997

[133] Bowser, B. Getting on the information country road. *American City & County*, March 1998

Information Administration (NTIA). Telephone penetration in rural areas at 94.3% currently exceeds the national average and has risen slightly (by 0.4%) since 1994. On the other hand, urban areas (93.6%) and particularly central cities as a group (92.1%) trail the national average and have changed little since 1994.

Table D.1: Percentage of US Households with a Telephone by Geographic Location, 1994 and 1997

	U.S.	Rural	Urban	Central City
1994	93.8	93.9	93.8	92.0
1997	93.8	94.3	93.6	92.1

Source: NTIA. 1998. 'Falling through the Net II: New Data on the Digital Divide'. http://www.ntia.doc.gov.

The lower penetration rate in the central cities suggests that income is the major determinant of household telephony access, with significant levels of poverty in most inner American cities. This is borne out by the data in Table D.2, which ranks telephone penetration rates by income group and region. The rural poor, however, are the most under-privileged in terms of PSTN access with poor rural households less likely to have access to the telecommunications network then urban poor. Rural American Indian households are particularly disadvantaged, with only 50% having a telephone service. The opposite is true for wealthy rural households that record the highest penetration rates in the country (99.1%).

Table D.2: Percentage of US Households with a Telephone by Geographic Location and Household Income, 1997

Household Income	U.S.	Rural	Urban	Central City
Under $5,000	76.3	74.4	76.8	75.2
5,000–9,999	84.8	84.8	84.8	84.8
10,000–14,999	90.4	89.7	90.6	89.7
15,000–19,999	92.2	91.9	92.3	91.8
20,000–24,999	95.1	96.2	94.8	94.0
25,000–34,999	96.3	97.3	95.9	95.7
35,000–49,999	97.8	98.4	97.6	97.1
50,000–74,999	98.6	98.4	98.6	98.4
75,000+	98.8	99.1	98.7	98.7

Source: NTIA. 1998. 'Falling through the Net II: New Data on the Digital Divide'. http://www.ntia.doc.gov.

There are over 1,300 companies that provide local telephone service in the United States, ranging in size from rural cooperatives serving fewer than 100 customers to BellSouth, which has over 24 million urban and rural lines. Of these 1,300 companies, a National Exchange Carrier Association (NECA) survey indicates that there were 1,092 companies offering rural services in 46 states and Guam.[134] They

[134] National Exchange Carrier Association. *1997 Access market survey of NECA's traffic sensitive pool members: keeping America connected*, December 1997. NECA is the organisation, which manages the universal service subsidy in the United States. Also note, NECA counts a company more than once if it operates in more than one state.

had five million access lines comprising about four percent of the total number of access lines in the United States. Fifty three percent of these had operating areas greater than 200 square miles, about 50% had less than 2,000 access lines and over 70% had less than 20 customer access lines per square mile.

The Rural Utilities Service (RUS) has produced an estimate of over 19 million access lines in rural areas (see Table D.3). The difference between the NECA and RUS estimates could be because NECA is gathering statistics from telecommunications operators, which receive subsidies for providing services to high cost areas. The BOCs and larger telecommunications operators also provide services in rural areas, but would not be accounted for in NECA survey.

Table D.3: Number of access lines in rural America

	Rural Utility Service Carriers	Other Local exchange carriers
Access lines in towns of 0–5000	1,860,000	7,814,000
Access lines outside of towns	3,600,000	6,260,000
Total access lines in rural America	19,534,000	

Source: Rural Utilities Service, 12 April 1996

Some state governments have taken responsibility for providing services to rural areas and are building infrastructure in partnership with private companies. For example, Minnesota's departments of transportation and administration have joined with two private companies to lay 1,800 miles of fibre optic cable. The private companies have exclusive rights-of-way to the state's freeways for the first 10 years of a 30-year contract and, in turn, will provide free access to the network to state, city and county agencies. The network will revert to state ownership after 30 years.[135] Other examples are Iowa, Nebraska, which have upgraded their statewide networks with fibre optic cable.

D.3 Prices for standard telecommunications services

The complexity of the US telecommunications market means that there are significant differences across the country in terms of the prices faced by rural consumers. In some states the RBOC has a single statewide residential rate, while in others there are a range of rates depending generally on the subscribers' geographic location and calling area. Of the states with a defined basic service, Wisconsin has the lowest reported rate (US$5.40) and New York State has the highest rate (US$22.27). The average basic service rate for states with defined basic services was US$11.95.

The range in residential rental rates for local exchange carriers (LECs) in almost all states was greater than the range of rates for the BOCs. There are some LECs in each state with lower rates for residential service than the BOCs and some with higher rates. LECs with the lowest rates typically have very limited calling areas, while LECs with the higher rates are in high-cost rural areas. Looking at those states with a defined basic service, the lowest LEC rate was in North Carolina ($2.56) and the highest was in West Virginia ($36.00).[136]

[135] Bowser, B. Getting on the information country road. American City & County, March 1998.

[136] Benton Foundation and the Consumer Federation of America. *Universal service: a historical*

The Bureau of the Census, using FCC data, estimates the average monthly residential rate across all customers as US$19.54 and the average monthly single-line telephone rate as US$41.77 (see Table D.4).

Table D.4: Telephone Systems: 1995

Local Exchange Carriers (Number)	53
Access lines (Million)	166
Business access lines (Million)	46
Residential access lines (Million)	101
Other access lines(1) (Million)	19
Number of local calls (originating) (Billion)	484
Number of toll calls (originating) (Billion)	94
Average monthly residential local telephone rate(2)	US$19.54
Average monthly single-line telephone rate(2)	US$41.77

[Covers principal carriers filing annual reports with Federal Communications Commission]

(1) Public, mobile, special

(2) Based on surveys conducted by FCC

Source: The Bureau of the Census Annual Survey of Communication Services (ASCS)

Despite these differences between rural and urban rentals, prices do not yet reflect costs in most rural centres in the United States. RUS contends that small, regional LECs have loop costs that are between two and five times higher than average BOC loop costs. RUS also claims that average rural operating costs (at US$ 692 per year) are substantially higher than urban costs for the same services, and that both rural and urban costs vary widely from state to state.

Furthermore, rural LECs have far fewer opportunities to recoup these costs. Around 18% of rural LECs' subscribers are businesses, compared with 25% for BOCs (see Table D.5). In addition, 50% of BOC business customers purchased multiple lines, compared to only 10% for rural LECs.

Table D.5: Comparison between rural LECs and BOCs

	Rural LECs	BOCs
Subscribers per square mile	4.4	330
Access lines served by a Central office	1,275	11,000
Business subscribers	18%	25%
Multiple lines purchased by business customers	10%	50%

Sources: National Telephone Cooperative Association, 1 April 1998, FCC, September 1995

A 1996 TVA Rural Studies paper found that if the combined subsidies for rural telecommunications were removed and the loss to carriers passed on to subscribers, rural rentals would increase by 72%, from an average of US$43.20 to $74.53 a

perspective and policies for the twenty-first century. Appendix 1: What does basic service cost? 1996. http://www.benton.org/Library/Prospects/prospects.html month. The range in rates would be US$4.13 per month for subscribers in rural Wisconsin to US$395.93 per month for subscribers in rural Texas. [137]

A Brookings Institution policy brief discusses the variance between local rates and costs of service.[138] In the largest cities, which have the shortest lines, small businesses paid about five times the incremental cost of service and residences about double this cost. In rural areas, which have the longest loops, customers paid less than the cost of service and less than their city counterparts.

However, with the 1996 reforms, the costs of the universal service funding are beginning to be charged back to rural customers, with cost recovery mainly coming from business services. Commencing in January 1998, AT&T is recovering its universal service fund costs and part of its access charge by levying a Universal Connectivity Charge and a Carrier Line Charge on business service customers. MCI, Sprint and others have also instituted charges to recover these costs.[139]

D.4 Quality of telecommunications services

Telecommunications service quality in the United States is under the control of the state regulatory commissions. . While very few of these regulatory commissions have developed rigorous reporting regimes, there are indications that they are ready to penalise telecommunications operators if there is sustained evidence of unsatisfactory performance

For example, South Dakota has penalised US West for unsatisfactory service levels[140] and now aims to develop standards. The South Dakota Public Utilities Commission (PUC) opened an investigation in April 1998 to determine which areas of the state are suffering from inadequate service quality. It will be followed by a rulemaking to develop statewide service quality standards binding on all telecommunications operators. State legislation passed in 1998 expanded the Public Utility Commission's authority to investigate service quality issues and to take action without the need for customer complaints.[141] US West also have a service quality reporting regime in place with the Oregon Public Utility Commission, which was agreed upon in December 1997.[142]

While, the FCC does not impose standards, at the end of 1983, in conjunction with the divestiture of AT&T's local operating companies, the FCC established a monitoring program to provide a basis for detecting any adverse trends in service quality. Over

[137] Parker, Edwin B. Telecommunications and rural development: threats and opportunities, *TVA Rural Studies*, May 1996.

[138] Brookings Institution. Are we deregulating telephone services? Think again, by Robert W Crandall. Brookings Policy Brief No 13, 1997. http://www.brook.edu/es/policy/polbrf13.htm

[139] AT&T. Access reform. http://www.att.com/access_reform/

[140] South Dakota PUC denied US West's application for an increase to its local residential rates because there was evidence from local hearings that US West was supplying unsatisfactory service, in South Dakota PUC Press release, 4 Feb 1998.

[141] Telecom AM, 20 April 1998.

[142] US West. US West tops customer service goal. Press release, 8 April 1998.

the period, the number of companies included in these surveys and the type of data collected has changed significantly.

In general, the data are collected from BOCs and are the product of customer satisfaction surveys. The companies also file a fairly extensive amount of raw data on switching outages, including duration and the number of lines affected. Distinctions between rural and urban service levels are not collected.

The most recent FCC survey reports data through to the third quarter of 1995.[143] It included data submitted by the Bell Operating Companies, GTE and Sprint. Upon review of these data the FCC concluded:

> While overall quality has generally remained high, specific problem areas within certain companies are evident in the complaint data... These areas of concern, to some extent, appear to be related to unexpected areas of growth and to downsizing and consolidation efforts within the companies. While the companies have a record of responding to problems, in an era of increased competition it will be increasingly important to ensure that adequate resources are devoted to service quality for all customers. Consistency in the monitoring process and in the quality and preparation of filed data, especially in areas of concern, will be increasingly important.

D.5 Access to advanced services

As in Australia, universal access to the Internet has received increasing attention in the United States as a new universal service regime is put in place. That "access to advanced telecommunications and information services should be provided in all regions of the Nation" is an explicit goal in the 1996 Telecommunications Act. However, the Universal Service Joint Board, in its advice to the FCC in 1997, said that Internet access need not be provided as a component of the universal service, despite the wording of the Act.

Internet access, however, is increasingly ubiquitous as a result of market activities. In a comprehensive study of Internet availability in the United States, Greenstein found that by 1997 "just under three quarters of the US population had easy access to the Internet".[144] Greenstein cites increasing evidence of local telecommunications operators entering the Internet access market to provide services to small rural towns. Although, at the time, about 25% of the US population lived in counties with "inadequate competitive supply" (three or less ISPs) of Internet access services. Half of those had no ISP at all. An informal study of pricing also found that a high-speed service cost US$237 per month in urban Portland, Oregon, and the equivalent service cost US$2,080 in rural Lakeview. [145]

According to the National Rural Development Council, 31% of rural customers have Internet access[146]. The National Telephone Cooperative Association says that over 1.4

[143] Federal Communications Commission, 1996, 'Update on Quality of Service for the Local Operating Companies', http://www.fcc.gov/Bureaus/Common_Carrier/Reports/FCC-State_Link/qualsvc.html

[144] Greenstein, Shane. Universal service in the digital age: the commercialization and geography of US Internet access. Harvard Information Infrastructure Project, Communications Policy conference, 3-4 Dec 1997. http://ksgwww.harvard.edu/iip/iicompol/Papers/Greenstein.html

[145] Bowser, B. Getting on the information country road. *American City & County*, March 1998.

[146] NTIA comments at an NRDC telecommunications meeting, 29 Sept 1997. http://www.rurdev.usda.gov/nrdp/telecom.html

million potential rural users have access to the Internet, and an additional 2.7 million potential users have access through connections to RUS affiliates.

Rural customers are also able to access the Internet using direct broadcast satellite services. Satellite services to rural areas commenced in 1994 at prices comparable to cable prices in urban areas and have proved particularly popular: rural utilities serve 23% of one satellite service provider's customers even though they only serve 8% of the American population. [147]

Both personal computer and modem penetration are, in most instances, lower in rural areas than urban areas. The percentage of rural households with a computer ranges from 18.6 percent in the South to 29.5 percent in the West. In the Northeast and Midwest, the percentage of rural households having computers is 27.4 and 24.6 respectively. Modem penetration in rural households with a computer ranges from 35.3 percent in the West to 46.9 percent in the Northeast. [148]

Internet access is increasingly being provided through public libraries, although rural areas appear to be lagging in this process. A study by the National Library Association in 1997 found that access to the Web in public library branches in central city, suburban and rural areas is mixed (see Table D.6). In central city areas, about 1 in 3 public library systems offer access in some or all of their outlets while the same number offer no Web access. In rural areas the difference is even greater, with less than 1 in 10 of public library systems offering Web access in some or all of their outlets, while over half of rural public libraries are not offering any Web access. [149] According to another study, while 78.9% of public libraries located in urban areas have Internet access only 16.8% of rural libraries have Internet access. Rural libraries are also less likely to have high speed Internet access over the PSTN and hence are more likely to use leased lines (see Table D.7).

Table D.6: Library system connectivity to the Internet

Connectivity	Rural	City Centre	Suburban
No Web access offered	50%	36%	43%
Web access in main library	40%	31%	39%
Web access in all branches	6%	23%	14%
Web access in some branches	3%	11%	4%

Table D.7: Most common type of Library connectivity

Type	Rural	City Centre	Suburban
Dial-in (28.8K)	46.4%	51.6%	53.6%
Leased lines (56K/T1)		38.7%	
	67.9%		50.3%

[147] Utility companies battle for satellite TV buyers' customers. *Inter@ctive Week*, 6 October 1997.

[148] National Telephone Cooperative Association. Rural clearinghouse digest on rural telecommunications, February 1996. <http://www-personal.ksu.edu/~rcled/publications/tele/teledigest.html>

[149] American Library Association. The 1997 National Survey of U.S. Public Libraries and the Internet.

Another measure of the accessibility of the Internet in rural areas is the number of schools of a certain size with Internet access, assuming that those with smaller enrolments are more likely to be in rural or remote areas. In the US only 30 percent of schools with enrolments under 300 have Internet access. In comparison, 58 percent of schools with enrolments of over 1,000 have access to the Internet

The importance of demand side factors in determining internet access in the United States is apparent from the results of a recent NTIA survey of household telecommunications usage.[150] Table D.8 details the strong significant relationship between income and household access to online services by geographic location. Online access amongst the poorest households in both rural (2.3%), central city (4.6%) and urban (4.4%) America is dramatically below that of the richest rural (44.4%), central city (49.4%) and urban (50.3%) households. A weighted average for each geographic area is not provided, however, it is apparent that rural households are 2%–5% below the national average in terms of Internet access across all income groups.

Table D.8: Percentage of US Households with Online Access by Geographic Location and Household Income, 1997

Household Income	U.S.	Rural	Urban	Central City
5,000–9,999	3.9	2.3	4.4	4.6
10,000–14,999	4.9	2.8	5.6	5.7
15,000–19,999	7.0	4.5	7.8	9.6
20,000–24,999	9.0	6.5	9.9	10.0
25,000–34,999	13.9	11.6	14.7	13.3
35,000–49,999	20.8	16.0	22.6	23.0
50,000–74,999	32.4	27.6	33.9	35.1
75,000+	49.2	44.4	50.3	49.4

Source: NTIA, 1998, 'Falling through the Net II: New Data on the Digital Divide', http://www.ntia.doc.gov.

Similarly, the NTIA data indicate a strongly significant relationship between household education levels and access to the Internet (see Table D.9). Households with the lowest levels of formal educational attainment in both rural (1.2%) and urban (2.1%) areas are much less likely to access the Internet then those rural (35.6%) and urban (39.0%) households with higher educational levels.

[150] The National Telecommunications and Information Administration, 1998, '*Falling Through the Net II: New Data on the Digital Divide*', http://www.ntia.doc.gov

Table D.9: Percentage of US Households with Online Access by Geographic Location and Education, 1997

Education Levels	U.S.	Rural	Urban	Central City
Elementary	1.8	1.2	2.1	2.2
Some High School	3.1	2.5	3.4	2.5
High School Diploma	9.6	9.2	9.8	7.9
Some College	21.9	20.5	22.3	19.7
College Degree	38.4	35.6	39.0	36.1

The available evidence on the quality and speed of Internet access services in rural areas suggests that rural customers in the US pay more for ISDN services and are less able to get these services than their urban counterparts. NECA estimates that 224 of their traffic sensitive pool members (i.e., small and rural providers) provide ISDN in 40 states on 1,425,793 (27%) access lines (see Table D.10).[151]

Table D.10: Availability of advanced services from small and rural providers, 1997

Service	Number of companies	Access lines	% of total lines	# of states
DS 1	575	4,136,246	77%	46
DS 3	97	1,293,345	24%	32
Switched 56	256	1,639,524	31%	42
ISDN	224	1,425,793	27%	40

Source: NECA. 1997 Access market survey of NECA's traffic sensitive pool members: keeping America connected. 12/97

RUS found that in remote areas the monthly fixed charges for ISDN service can be around US$475 with an installation charge of US$623. The annual difference in price between urban and rural users for the same ISDN circuit was US$5,100. In another comparison, RUS found that the annual difference in price of T-1 services between urban and rural users varied from US$9,084 in one study, to as much as US$19,200 in another.[152]

However, the range of services available and the prices paid for these services in rural areas are likely to increasingly converge with those in urban areas as competitive entry expands. A number of telecommunications operators are undertaking initiatives in order to provide data services to rural areas. For example, MCI, in partnership with Northwest Iowa Telephone Co. and Northwest Iowa Power Co-operative, announced in March 1997 that it would offer high speed data services to rural areas in 10 states

[151] National Exchange Carrier Association. 1997 Access market survey of NECA's traffic sensitive pool members: keeping America connected. Dec 1997.

[152] The Consumer Project on Technology has published a comparative US survey of ISDN prices at http://www.cptech.org/isdn/survey20.html. The typical price for Basic Rate usage in a city like Kingston, New York is about US$125 for phone company installation, US$300 for the ISDN adapter, and an extra US$20 a month for a line that supports ISDN.

initially, commencing in Iowa. The partnership, MCIutility, intended offering the service over DSL or cable modem.[153]

Sprint is also testing high-speed data technologies in order to determine how practical they would be for rural areas. Many of Sprint's local telephone service areas, throughout eight states, have rural markets. Sprint began testing SDSL (single-line high-speed digital subscriber line) technology with Pairgain Megabit Modems at a college in Scottsbluff in mid 1997. The testing included the simulation of long loop lengths.[154]

In another rural data initiative, National Rural Telecommunications Co-operative (NRTC) commenced offering an Internet service to its 800 rural utility members in 1997. The service, nrtc.net, avoids the switched phone network by using Nortel's Internet Thruway technology. Internet Thruway is an ATM-based technology, which recognises data calls before they reach the switch and reroutes them to the Internet access points. Nrtc.net provides a complete Internet service, including ISDN (where available) and 56kbps access. It had nine rural utility participants by November 1997.[155]

However, some recent policy initiatives appear to act as a disincentive to telecommunications operators seeking to provide the full range of advanced services to rural customers. For example, the FCC's decision to bar incumbent local telephone companies, including rural local telephone companies, from holding Local Multi-point Distribution Service (LMDS) licenses in the same geographic areas in which they provide telephone service, for three years from the date of the upcoming LMDS auction. LMDS is a new wireless mode of communication that supports video, voice, and data services and would enable telecommunications operators to provide advanced services in rural areas. The FCC explains that its Order is designed to prevent LECs from pre-empting competition in local telephone markets.[156]

Recently the BOCs have been working to have the Telecommunications Act's restrictions on data traffic lifted, claiming that it is inhibiting them from building fibre optic infrastructure and possibly retarding provision of services to rural areas. Ameritech, Bell Atlantic and US West have recently petitioned the FCC to remove these restrictions. The Act prohibits regional carriers from sending traffic (voice or data) across LATAs (local access and transport areas) so the BOCs can only transport data traffic and not process it.[157]

The FCC, in a recent decision regarding Internet telephony and universal service funding, has said that companies that transmit phone calls via the Internet will not be designated as long distance carriers. Whereas telecommunication service companies have to contribute directly to the US universal service fund, companies providing

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[153] Rural high-speed access. *Informationweek*, 24 March 1997.

[154] SDSL blooms on Nebraska prairie. *Inter@ctive Week*, 7 July 1997.

[155] Rural utilities, NorTel to bypass phone switching. Inter@ctive Week, 13 March 1997.

[156] United States Court of Appeals, Argued January 16, 1998, Decided February 6, 1998 <http://www.fcc.gov/wtb/auctions/lmds/melcher.txt>

[157] Bells push FCC for relief. *Inter@ctive Week*, 16 March 1998.

Internet telephony services have been classified as information services, rather than long distance providers and are exempt from USO fund obligations. However, the FCC is likely to re-examine this issue and the possibility remains that IP telephony companies could be classed as telecommunications operators in the future. The impact of these decisions on rural consumers is difficult to foresee, but are potentially very significant.[158]

[158] CNET News.Com, 10 April 1998

Appendix E: Statistical analysis of the effect of extreme weather on faults in the Telstra network

Fault data from 34 regions over 78 months from January 1992 to June 1998 were matched with rainfall data from 107 meteorological areas. An extreme weather event was defined as rainfall which was less than the first decile or greater than the ninth decile for the month, where the deciles were set using 86 years of data for each month in each meteorological region. For each month in each of the 34 telecommunications regions, an index of extreme weather was created as follows:

$I_{it} = \sum e_{nt} / N_i$

Where $e_{nt} = 1$ if an extreme weather event occurred in meteorological area n in month t and N_i is the number of meteorological regions in telecommunications region i. This index varies between zero and one, with the latter value indicating that *all* of the meteorological areas in the relevant telecommunications region experienced an extreme weather event in the relevant month.

For each telecommunications region, a simple linear regression model was estimated to explain the variation in the number of faults over the time period. Region specific intercepts were used to represent un-modelled characteristics of the area including population density. A single lag of the number of faults was included to account for the strongly auto-regressive nature of the fault data. Finally, the extreme weather index was included and its statistical significance was tested. Table reports the results by region.

In more than one third of the regions, extreme weather is a significant factor in explaining the number of faults. Disregarding statistical significance for a moment, the table also shows that the point estimates for the effect of extreme weather are positive in all but five instances. Furthermore, most of the largest point estimates are positive and significant, indicating that weather is not only a contributing factor in the incidence of faults, but also accounts for a large number of the recorded faults.

Table E1

Area	Weather Coefficient	T ratio	R^2
WNG	0.39	0.005	0.79
WMD	63.68	0.88	0.84
WGM	-483.12	-1.09	0.84
NT	-51.37	-0.06	0.09
CNS	173.8	2.42**	0.15
CAD	18.38	0.14	0.11
CSA	102.9	0.67	0.10
QCA	255.6	1.06	0.45
QC	161.8	0.25	0.39
QTV	-122.6	-0.67	0.36
BM	2337.8	2.18**	0.32
QWB	66.56	0.90	0.12
QTO	714.20	2.45**	0.16
NNC	427.70	1.62*	0.19
ASR	250.39	2.56**	0.19
ASG	206.7	1.70*	0.15
NNE	222.7	1.39	0.30
NNN	696.2	2.54**	0.29
NNM	34.86	0.47	0.26
NNH	1.86	0.01	0.16
ASC	-27.7	-0.39	0.06
SS	887.5	1.96**	0.48
SN	1483.2	2.44**	0.22
ASW	36.16	0.34	0.24
NS	842.1	1.48	0.14
ASA	-73.5	0.65	0.13
VNW	200.62	2.80**	0.25
VWI	42.3	1.11	0.27
VNE	201.74	2.17**	0.28
VGI	336.7	4.24***	0.40
MM	91.85	0.18	0.08
VOT	9.69	0.12	0.18
VTN	168.4	2.26**	0.14
VTS	74.9	0.97	0.16

* denotes significance at the 10% level

** denotes significance at the 5% level

*** denotes significance at the 1% level

For those areas in which extreme weather is a significant explainer of faults, the percentage of faults attributable to extreme weather was calculated. This was done by multiplying the weather coefficient by the weather variable and expressing the result as a percentage of total faults in the region for each month. To aggregate these percentages over time a simple average was taken. To highlight the size of the impact of weather, the maximum percentage over the sample period is also reported in Table 2.

Table E2

Area	Average Weather Effect (%)	Maximum Weather Effect (%)
CNS	4.0	18.1
BM	1.7	35.8
QTO	4.1	35.6
NNC	2.8	15.4
ASR	3.0	21.8
ASG	2.6	17.0
NNN	2.3	40.5
SS	1.5	13.8
SN	1.7	19.5
VNW	3.0	16.8
VNE	3.2	14.3
VGI	3.5	27.6
VTN	3.0	17.1

To consider the possibility that weather may effect not just the number of faults in any period, but also the average *change* in the number of faults over time, an additional series of tests were performed. In this analysis, a linear time trend was added to the model and the weather variable was interacted with this. The regression was of the following form

$$F_t = \beta_0 + \beta_1 F_{t-1} + \beta_2 W_t + \beta_3 t + \beta_4 W_t \times t + u_t$$

where u_t is a serially independent random disturbance term and $t = (1,2,3,\ldots, 34)$ is the linear time trend —note that 34 such models were estimated, one for each region. The combined impact of extreme weather is estimable as

$$W_t^* = b_2 W_t + b_4 W_t \times t$$

where b_j is the estimated value of β_j. The joint hypothesis that weather has no effect can be framed as H_0: $\beta_2 = \beta_4 = 0$ and this was tested using a Wald statistic which is distributed as a chi-square random variable with two degrees of freedom under the null hypothesis. Table 3 presents the results for each area.

Table E3: Joint Tests of Weather Effect

Area	b(2)	b(4)	Chi-Sq	Mean	Max	R^2
WNG	-173.62	5.15	1.54	-8.07	165.72	0.81
WMD	**-199.8**	**7.42**	**7.3**	**68.42**	**4847.05**	**0.86**
WGM	-242.64	-5.66	1.27	-2.25	0	0.84
NT	3460.44	-80.99	3.75	0.39	12.56	0.13
CNS	235.83	-3.09	4.28	3.13	19.79	0.19
CAD	**534.78**	**-15.73**	**7.15**	**-0.08**	**12.47**	**0.19**
CSA	242.44	-4.09	0.7	0.75	8.1	0.12
QCA	**-384.97**	**18.58**	**5.52**	**1.73**	**31.56**	**0.53**
QC	149.07	1.53	0.12	0.4	3.41	0.42
QTV	-176.82	2.4	0.32	-1.05	0.25	0.39
BM	**616.45**	**47.82**	**6.99**	**1.62**	**31.21**	**0.42**
QWB	17.96	1.55	1.21	1.14	12.26	0.14
QTO	**-648.13**	**38.05**	**13.81**	**3.73**	**41.04**	**0.27**
NNC	**-185**	**19.27**	**4.94**	**2.98**	**23.86**	**0.22**
ASR	**422.1**	**-5.94**	**6.52**	**2.56**	**21.17**	**0.24**
ASG	**642.18**	**-11.56**	**7.39**	**2.38**	**28.32**	**0.21**
NNE	209.66	0.51	2.01	1.73	18.06	0.3
NNN	**1476.56**	**-15.29**	**7.46**	**2.34**	**47.63**	**0.30**
NNM	222.51	-3.78	0.52	0.39	7.97	0.26
NNH	183.96	-4.66	0.61	-0.14	5.66	0.21
ASC	219.43	-6.83	4.05	-0.6	11.13	0.11
SS	990.03	-7.38	2.98	1.17	13.48	0.59
SN	**3774.06**	**-55.19**	**10.6**	**1.42**	**30.71**	**0.30**
ASW	369.57	-8.41	2.88	0.17	12.47	0.28
NS	**2746.08**	**-46.4**	**5.3**	**2.42**	**19.22**	**0.19**
ASA	-79.11	0.35	0.32	-0.47	0	0.14
VNW	**321.4**	**-4.28**	**7.42**	**2.03**	**17.5**	**0.28**
VWI	66.36	-0.34	2.08	1.44	8.19	0.34
VNE	**367.09**	**-5.59**	**5.55**	**2.56**	**20.41**	**0.33**
VGI	**504.57**	**-4.58**	**19.56**	**3.42**	**37.92**	**0.42**
MM	1436.65	-35.16	1.95	0.14	7.56	0.13
VOT	141.32	-3.91	1.49	-0.05	5.57	0.27
VTN	162.14	-0.62	3.76	2.48	14.75	0.23
VTS	76.75	-0.09	0.88	1.52	10.67	0.16

Rows presented in **boldface** are the areas for which the joint hypothesis of no weather effect was rejected, so weather has a significant effect. The estimated coefficients β_2 and β_4 are presented in columns two and three respectively. Notice that most of the β_4 coefficients are negative but the β_3 coefficients are positive. This indicates that while extreme weather increases the number of faults, it reduces the growth rate of faults, presumably because latent weaknesses are fixed ahead of their expected failure time.

The Mean column of Table 3 gives the average percentage of faults over the sample period which are attributable to weather for each region, while the Max column reports the largest percentage of faults for any month over the sample period.

The above analysis has established that extreme weather conditions are a significant explanatory variable of the occurrence of faults in a number of areas. Taking this relationship between extreme weather and faults into account, the percentage of faults attributable to the time trend can be calculated. The first step is to determine whether the time trend is significant. The hypothesis to be tested for each region is $H_0: \beta_3 + \beta_4 = 0$. In other words, the hypothesis to be tested is that whether the sum of the trend coefficients is significantly different from zero. Table 4 lists the test value, which is simply the sum of the trend coefficients, along with the t-statistic and p-value for the hypothesis tests. The final column indicates that only five of the 34 regions have a trend that is significant and positive.

Table E4

Region	Test Value (?3 + ?4)	T Statistic	P-Value of T Statistic	Significantly Positive at 5% Level
WNG	5.9465	1.8036814	0.07546	
WMD	8.2736	3.1258626	0.00256	●
WGM	-10.128	-0.61712127	0.5391	
NT	-74.285	-1.9587284	0.05402	
CNS	-4.0614	-1.4618734	0.14813	
CAD	-12.147	-2.4902946	0.01507	
CSA	-4.9052	-0.86439831	0.39024	
QCA	22.774	2.4176478	0.01815	●
QC	39.382	1.2076369	0.23114	
QTV	5.6507	0.87516269	0.3844	
BM	89.988	2.189665	0.03179	●
QWB	2.839	0.81577397	0.41732	
QTO	39.063	2.875618	0.0053	●
NNC	19.466	1.4773947	0.14393	
ASR	-8.1312	-1.7244953	0.08891	
ASG	-7.9212	-1.5754046	0.11955	
NNE	-0.38097	-0.04359454	0.96535	
NNN	-17.08	-0.84346841	0.40176	
NNM	-3.5401	-0.54552051	0.58708	
NNH	0.33656	0.05953384	0.95269	
ASC	-6.2471	-2.0092817	0.04826	
SS	35.161	2.2111817	0.0302	●
SN	-29.97	-1.337748	0.18519	
ASW	-9.4997	-1.9868764	0.05074	
NS	-42.82	-2.0139894	0.04775	
ASA	-1.5495	-0.27080348	0.78732	
VNW	-5.5399	-1.6859326	0.09614	
VWI	-2.3024	-1.5666625	0.12158	
VNE	-7.1877	-1.936396	0.05674	
VGI	-4.0048	-1.3222876	0.19026	
MM	-17.622	-0.74231251	0.46031	
VOT	-6.6457	-2.3222861	0.02305	
VTN	-2.6943	-0.90937417	0.36619	
VTS	0.29995	0.090691836	0.92799	

The five regions that have significant positive trends were studied in more detail as reported in Table 5. This table shows (in row 1) the average number of faults over the