The Impact of Local Competition on Network Quality

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INTRODUCTION

In 1985 the Teleport Communications Group in New York provided its first customer with a fiber-based, dedicated, DS-1, digital circuit and launched an era of facilities-based competition in the local exchange. By the end of 1992, 36 carriers, referred to as Alternate Local Transport (ALT) or Competitive Access Provider (CAP) companies, were providing services on networks in 65 Metropolitan Statistical Areas in competition with the Local Exchange Carriers (LEC)[1]. Although these networks covered over 4,000 miles, linked 3,800 major commercial buildings and provided access to hundreds of long distance carrier "points of presence", total ALT industry revenues for 1992 were only $260 M which is less than 0.3% of total LEC revenues. Nevertheless the presence of this competition has had large effects on industry behavior and has stimulated a LEC competitive response. The purpose of this paper is to address the impact of this competition on network quality.

Competitive activity in the Local Exchange is growing rapidly both in terms of areas served and in service offerings and is commonly believed to be leading us toward a universally competitive telecommunications marketplace in the United States. New participants (e.g. cable television companies, PCS companies) are taking an interest in these markets and some are investing in network facilities. Regulatory developments at both the FCC and state level are progressively increasing the arena in which competitive entry is possible. Interconnection between ALT networks and LEC networks for dedicated access has been mandated by the FCC and interconnection for switched access is under consideration. We appear to headed for a "network of networks" - an infrastructure of interconnected but competing networks of varying quality.

SERVING THE INTEREXCHANGE CARRIER MARKET

Most ALT companies began operations by serving Interexchange Carriers (IXCs). The IXCs were interested in obtaining local, high speed (DS-1 & DS-3 rates - 1.544 Mbps and 45 Mbps - capable of supporting 24 and 672 voice channels respectively), digital, fiber links for several purposes. One was to provide trunking between an IXCs multiple switches or "points of presence" in a large city. Another was to provide trunks between the "points of presence" of different IXCs so that they could aggregate traffic, lease capacity, etc. Traditionally, the IXC's choices had been either to build these facilities or to buy dedicated circuits from the Local Exchange Carrier. The presence of an ALT created a third choice. The advantages for the Interexchange Carrier were that the new ALT network provided service that incorporated the latest fiber and digital technology, was priced under the LEC price umbrella, was more customer responsive and created pressure on the LEC to lower prices, improve service and improve network quality. Thus, IXCs saw ALTs as a means to increase the quality of their local access facilities while reducing their costs.

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[1] *"1992 Alternate Local Transport ... a Total Industry Report", Connecticut Research*

As greater numbers of voice grade circuits are multiplexed onto a single, high speed, digital fiber channel, the potential outage impact produced by a fiber cable cut or other malfunction is multiplied, increasing the need for high reliability. ALT service and network quality were strongly controlled by the IXCs as the dominant and sometimes sole customer. Major IXCs imposed their own "certification standards" as a prerequisite for doing business.

High reliability was achieved by using multiplexers with redundant electronics and automatic switchover in case of component failure. Further reliability was achieved by adopting robust network architectures with the capability to automatically switch at high speed (~50 msec) from transmitting over a primary fiber to an alternate fiber in case of the loss of signal in the primary fiber. Such fiber circuits were called "self-healing" and produced network availability numbers previously unavailable. One measure of network reliability is "network availability", presented in the form of the percentage of the time the average circuit was available for service during the year. Teleport Communications Group reported[2] that for the year 1988 it achieved an average circuit availability of 99.99%, which is equivalent to 52.6 minutes of outage per year.

Techniques for achieving high reliability continued to advance with secondary fiber paths being physically separated from primary fiber paths to decrease vulnerability to a common disaster and network monitoring being used to detect and counteract system quality degradation before hard failure occurrences. Diverse fiber routing took the form of fiber "rings" in which the primary and secondary fiber paths operated in counter-rotation around the ring so that no two points could be isolated by a single cable cut. For the year 1991, Teleport Communications Group achieved average circuit availability of 99.999% (equivalent to 5.26 minutes of outage per year) in its Boston network. [The achievement of "five nines" is said to now be a requirement for a Teleport local operations manager in a given city to qualify for a bonus.]

Nearly all ALTs have seen their business mix begin with an initial dependence on providing IXCs with POP-to-POP links and shift to a broader market. This progression is illustrated in the case of Intermedia Communications of Florida (one of the few ALTs whose stock is publicly traded) as follows[3]:

Year	% Total Traffic IXC POP-to-POP
1988	100%
1989	85%
1990	62%
1991	60%

SERVING THE "SPECIAL ACCESS" MARKET

The second market targeted by ALTs was to provide dedicated access fiber links (usually at DS-1 speed) between the premises of large telecommunications end users and the POPs of their chosen IXCs. These dedicated circuits, called "special access" by

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[2] Teleport Report Spring 1989

[3] *SEC S-1 Filing, Intermedia Communications of Florida, Inc.*

telephone companies, reduce the cost of access to long distance carriers for large volume users since the circuit price is flat-rated whereas for switched access circuits pricing is tied to traffic volume through "minutes of use" rates. In both of these markets customers seek high quality transmission and high reliability. Most "special access" end users are in telecommunications sensitive industries such as financial services, telemarketing, etc.

Although their influence is not as great in the "special access" market, IXCs still play a strong role. Traditionally, IXCs have often been the purchasers of "special access" from LECs on behalf of end users. Even where end users deal directly with LECs and ALTs, their choice of vendor can depend on IXC recommendations. Therefore the IXC's opinion can also drive vendor network quality in the "special access" market.

LOCAL EXCHANGE CARRIER RESPONSE TO COMPETITION FROM ALTS

Local Exchange Carriers have responded to the competitive challenge to meet the high reliability needs of IXCs and "special access" end users and have installed their own "self-healing" and diverse fiber rings. Truly diversified fiber routing throughout an entire fiber system has been difficult for both LECs and ALTs to achieve and, in practice, many systems retain some "spurs" which are subject to single point failure. Most LEC conduit was originally installed for "star" or "tree and branch" cable deployment and not for "rings". Both LECs and ALTs find that building owners often object to the construction of additional telecommunications "entrance facilities" through the walls of their structure.

In their reports of fiber deployment, the Industry Analysis Division of the Common Carrier Bureau of the FCC began including information on LEC fiber rings in 1990[4]. Many of these LEC installations are not counter-rotating rings but are path switched multiple fiber systems which are often physical "stars" but logical "rings". Generically all these self-healing networks are referred to as "rings". The 1990 FCC report showed that LECs had deployed fiber rings in 56 cities, primarily in the vicinity of competing ALT networks. The 1991 report[5] showed that the number had grown to 127 cities and, based on LEC announcements of new installations, the 1992 report is expected to indicate continued rapid deployment of fiber rings and other fiber networks.

U.S. West announced in May 1990 that it would deploy fiber rings in five major cities - Denver, Minneapolis/St. Paul, Seattle, Portland and Phoenix - with circuit availability performance of 99.99%. This announcement also included the most aggressive performance guarantee standard publicly offered. U.S. West guaranteed that any customer on the ring that suffered a network outage in excess of one second would receive a full month's refund of the circuit's lease rate. Although actual circuit availability data has not been given by U.S. West, they have indicated that guarantee payments to date have totaled less than 0.5% of the relevant revenue.

NETWORK QUALITY RESULTS

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[4] "Fiber Deployment Update ... End of Year 1990", Industry Analysis Division, Common Carrier Bureau, FCC, Jonathan Kraushaar, March, 1991

[5] "Fiber Deployment Update ... End of Year 1991", Industry Analysis Division, Common Carrier Bureau, FCC, Jonathan Kraushaar, March, 1992

The Regional Bell Operating Companies have published[6] their standards for network availability of dedicated access circuits as follows:

Carrier	Network Availability Standard
Ameritech	99.975 %
Bell Atlantic	99.925 %
NYNEX	99.7 % (IntraLATA)
NYNEX	99.925 % (InterLATA
Pacific Bell	99.975 %
Southwestern Bell	99.975 %
U.S. West	99.7 % (99.99 % Fiber Ring)

These are operational standards and actual network availability achieved has not been reported. Since at least five of the seven RBOCs have adopted internal incentives for senior managers tied to network quality performance these standards are likely to be raised.

Metropolitan Fiber Systems, one of the largest ALTs with 14 networks, has been outspoken on the issue of network quality. They note that network quality is more than physical parameters such as network circuit availability. Network quality from the end user's perspective also includes the organizational responsiveness of the carrier in terms of installation and repair intervals. Therefore, MFS has published [7] comparisons of its own standards and performance for network availability, installation interval and service repair interval versus those of the Regional Bell Operating Companies (RBOCs).

MFS indicated that although its standard for network availability was 99.99 % it routinely exceeds this standard. Its average circuit availability in the first quarter of 1992 was 99.99898 % (5.36 minutes per year) for DS-1 circuits and 99.99976 % (1.26 minutes per year) for DS-3 circuits. For this same period, MFS achieved average installation intervals of 7.8 calender days and 7.6 calender days, respectively, for DS-1 and DS-3 circuits. MFS also achieved average repair intervals of 90 minutes and 23 minutes, respectively, for DS-1 and DS-3 circuits. These intervals are significantly better than the published standards of the LECs.

The only relevant parameters routinely reported through the FCC's Automated Reporting and Management System (ARMIS) for the LECs is Average Repair Interval and the Average Missed Installation Days for special access services. The latest available data is for the third Quarter of 1993.[8]

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[6] *U.S. House of Representatives Review of Telephone Network Reliability and Service Quality Standards*, Feb. 1992

[7] *"MFS Urges the FCC and House of Representatives to Raise U.S. Network Reliability Standards"*, MFS Press Release, April 8,1992

[8] *"Quality of Service for the Local Operating Companies Aggregated to the Holding Company Level"*, Jonathan M. Kraushaar, FCC Common Carrier Bureau, Feb. 1993

Carrier	Avg. Missed Installations (Days)	Avg. Repair Interval (Hours)
Ameritech	5.0	2.3
Bell Atlantic	4.7	1.9
Bell South	3.7	4.4
NYNEX	4.2	5.9
Pacific Telesis	3.2	4.8
Southwestern Bell	4.0	2.8
U S West	10.6	8.5
Contel	2.9	NA
GTE	3.0	6.2
United	NA	3.2

END USER VIEWS OF COMPETITION AND NETWORK QUALITY

There is evidence that end users with critical telecommunications requirements view the ability to acquire access circuits from multiple vendors as desirable no matter how high the quality of the network offered by any single vendor. In a section of the Boston financial district where MFS, Teleport and New England Telephone all serve the same buildings with fiber circuits, a survey of 21 major end users was taken by Connecticut Research in 1990. The survey showed that 24% of the sample had "special access" circuits from two vendors and another 24% had such circuits from all three vendors. Although there was some functionality differentiation among the vendor services, the primary driver for the end users seemed to be to obtain the maximum possible diversity in both network and service provider in order to assure maximum network reliability.

Although end users do not speak with a single voice, a spokesman[9] for a group of large telecommunications users has expressed their view as follows:

> "Based on their experience over the last twenty years, large users believe that competition is far superior to regulation as a means of satisfying their needs. Users therefore strongly support the introduction of local exchange competition wherever feasible."

Particularly as competition has shifted to direct marketing to corporate end users, LECs and ALTs have both sought to project themselves as "value added" service providers. Although comprehensive quantitative data is not available, IXCs and "special access" end users believe they have seen increased network availability and reliability, enhanced service responsiveness and lower circuit prices as a result. They believe, based on these results, that increased competition in the Local Exchange has increased network quality for "special access" circuits and promises to do likewise for other network service offerings as competition spreads to include them.

OTHER MEASURES OF NETWORK QUALITY

Network availability is a very basic indicator of network quality. More detailed indicators of quality include measurements such as bit error rate (BER), errored seconds, etc. Such quality measurements are of greater importance as networks are used for data

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[9] *"A User Perspective on Competition in the Provision of Local Exchange Service"*, Henry D. Levine, Levine, Lagapa & Block, March, 1993

transmission. Most Carriers and ALTs quote BERs of 10-9 for fiber circuits. Customers with critical data needs can obtain performance standard quotations from vendors but such standards are not routinely published nor are actual performance figures given.

FUTURE DEVELOPMENTS

Competition in Local Exchange services is at a very early stage. The impact on network quality, to date, has been limited primarily to dedicated access circuits in major urban centers. In these locations, high volume end users and Interexchange Carriers have experienced increased network quality as both LECs and ALTs have competed for their business and have provided self-healing fiber transport.

This competition is rapidly accelerating and major capital investment in the deployment of fiber networks has been announced by all participants. These facilities continue to incorporate more advanced technology including SONET electronics, integrated network management and complex network architectures.

These network improvements enable higher operational performance. Since these operating parameters are used as marketing tools in competitive situations, it is expected that the competition will stimulate all carriers to attain, track and publicize higher quality standards. Performance guarantees, such as those offered by U.S. West and those recently announced by Ameritech are likely to become widely employed.

In a fully competitive telecommunications environment, some network investment may be curtailed in order to achieve competitive costs but this lack of ability to "gold plate" the network will be somewhat offset by the existence of multiple, interconnected networks. This implies the desirablility of "mutual assistance" aggreements among competitors in the case of major disasters. Events following the february, 1993 bombing of the World Trade Center in New York , which occurred just one year following the signing of the New York Carriers mutual aid and restoration pact, demonstrated the value of such cooperation.

There appears to be no negative aspect of competition on network quality except that regions or services which do not develop into viable competitive markets may suffer from under investment in the networks serving them. To the extent that competitors seek to be value added service providers, end users can expect to benefit from higher network and service quality. Service guarantees, standards which include more detailed measures of quality, and regular reports of actual performance parameters will soon be the norm.