their premises, but they do not represent a candidate technology for widespread competition to the local telephone companies. As demonstrated above, the penetration of CAP-like services now and in the near future will remain quite modest;

- PCS and cable telephony can provide telephone service at a per-subscriber investment of $650 to $1375, depending on the geographic and demographic attributes of the service area, and the assumed penetration rate.

B. Qualitative Changes in the Technology Analysis

The analysis of new technologies is being conducted along lines similar to those of ELB. In particular, the same candidate technologies, and the same generic model of the local exchange network are being considered. But the analysis currently underway uses updated technology information, more detailed demographic and geographic information based on actual census data, and a more sophisticated model for how candidate technologies would be deployed and utilized in particular service areas.

The quantitative results from the new analysis are not yet available. But as the analysis proceeds, a number of qualitative changes in the results are becoming clear. These pertain to the nature of the technologies and the ways in which the technologies may be deployed and utilized to provide local telephone service. The qualitative changes suggest that, if anything, ELB may have been overly optimistic about the cost and deployment rate of competitive local exchange technologies.

The changes will be discussed in the following subsections. However, there are a number of factors that have <u>not</u> changed substantially since ELB was prepared two years ago.

- As pointed out in Section I above, there has been virtually no deployment of fixed-location telephone service to residential and small business customers based on any of the candidate technologies (or, for that matter, any other technology) in the interim. Thus "Year 1" of the business case analysis has slipped forward at least two years since the report was written;

- While there has been some additional provision of telephone and other telecommunications services to large businesses by CAPs and cable companies, the still-low penetration resulting from this activity has been documented earlier in this report;

- The seemingly-imminent availability of alternative cable and wireless technologies assumed by ELB have not yet materialized, thus at best they are still "imminent" two years later; and

- There have been no cost breakthroughs in the candidate technologies that would suggest the investment results found in ELB will substantially change, nor have any hypothetical "volume production" cost reductions materialized, since the technologies are not yet in mass production.

1. Existing Analog Cellular Telephone Service

High cost of existing cellular service. ELB concluded that existing cellular service was not a candidate technology for fixed telephone service due to the high costs involved. What was not emphasized strongly enough there, but has since become more germane, is that cellular customers are charged from three to five times more per month than a typical local telephone company customer, for usage that is typically only about 1/5 as much. Thus equivalent per-minute charges for cellular customers are fifteen or more times higher than for wireline customers. Mobile users are willing to pay a premium for the convenience and the unique capability of mobility that cellular systems offer. But fixed-location users would see no such advantage, and it is difficult to imagine they would be attracted to today's high-priced cellular service as an alternative to their existing telephone service.

Recently, there has been a slight leveling off of growth of cellular subscribers. Were this to become pronounced, cellular providers might attempt to target wireline subscribers. But as long as the demand for mobile service continues to expand, and as long as demand outstrips

supply, cellular providers will have no incentive to forego mobile customers who are willing to pay a premium for mobility, in order to provide dramatically lower-priced wireline services.

2. Personal Communications Service (PCS)

Cost of PCS licenses. An investment factor not taken into account in ELB was the cost of PCS licenses. In the top forty markets (Major Trading Areas), licensees paid between $4.08 and $31.90 per capita, with a weighted average across all markets of $15.29. While the license may be used to support both mobile and fixed-location telephone service, it is instructive to note that if a license were used entirely for fixed-location service, it would represent an additional expenditure of $125 to $380 per fixed-location subscriber.[40] This high premium suggests that PCS bidders were not planning to use the spectrum to compete for the low revenue wireline customers.

Initial emphasis on high-tier systems. The Commission PCS spectrum utilization rules allow two different kinds of PCS systems: so called "high-tier" and "low-tier" systems, roughly differentiated by the radiated power, and thus coverage area, of each radio site. High-tier systems will have antenna spacing and frequency reuse patterns similar to those for cellular systems, and in fact will compete primarily for cellular customers. Such systems are unlikely to be utilized for fixed-location service for the same reasons as cellular systems are not so utilized, and in fact would be capacity-limited if they were to do so.

Low-tier systems will have the more dense cell spacing originally associated with the notion of PCS, and have the capacity and motivation to serve fixed-location customers. What

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[40] This is based on the weighted average license cost of $15.29 per person, 2.5 people per household, and a penetration rate of 10-30 percent.

has become clear in the plans of PCS license holders, however, is that they will apparently strongly emphasize high-tier systems. Sprint's District of Columbia system, for instance, is such a high-tier system, not a wireless loop system. Thus the onset of a sufficient number of low-tier systems to represent a substantial penetration in the local exchange marketplace now appears to be problematic.

Problems with voice quality in PCS systems. It is often assumed that since PCS will use digital transmission, its voice quality will exceed that of analog cellular systems. In fact, however, this is not necessarily the case, as the bit rate assigned to a digitized signal is key. Conventional voice encoding systems used in wireline networks, and even conventional cellular networks, encode voice at 32,000 to 64,000 bits per second. By contrast, PCS systems will use around 8,000 bits per second in order to increase call capacity for a given amount of spectrum. This leads to a quality penalty, which at present is viewed by many people as leading to a substantially poorer quality than is normally associated with wireline service.[41] It is assumed that such quality problems may be resolved over the next few years, but the cost of the increased signal processing required is not yet known.

Insufficient data rate on cellular systems. The intense growth of, and interest in, the Internet is having a marked effect on the number of subscribers that demand high-speed data connections to the Internet. This can be seen, for instance, in a surge of interest in the Integrated Service Digital Network (ISDN) as a means of obtaining such higher-speed connections. ISDN provides speeds of 64 and, potentially, 128kbps to individual residences and small businesses.

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[41] See, Edmund L. Andrews, "When Digital Doesn't Always Mean Clear," New York Times, June 26, 1995.

This is by contrast to 14.4kbps, and, recently, 28kbps modems, on the voice network, which many users find simply do not give them the kind of speeds they seek in order to be able to deal with the multimedia information available on the Internet. Pacific Bell has characterized the interest in ISDN as "exploding," which it attributed to interest in the Internet and other on-line services. It has reportedly installed 60,000 ISDN lines, many in more remote areas of the state.[42]

Wireless telephone providers advertise the ability to support a data rate of 19.2 kbps. But due to protocol overhead and error correction, the actual rate is often substantially below that. Obtaining higher rates may be possible, but will consume a substantial amount of a system's capacity, and therefore may not be supported by the cellular providers. This suggests that as more and more customers access the Internet and other on-line services, and desire higher data rates to do so, wireless systems will be viewed as inadequate as they simply will not support the desired data rates.

Bottom Line: What is the end results of these developments? Even in a research report that is quite bullish on wireless technologies,[43] concluding "In the United States, the United Kingdom, and other developed nations . . . wireless systems for the local loop will be the technology of choice," the projected number of wireless lines in the Year 2000 ranges from only 1.2 to 2.5 million for all of North America, including Mexico.

3. Cable Telephony

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[42] "Citing High Costs, Pacific Bell Seeks ISDN Rate Hike," Telecommunications Reports Daily, January 5, 1996.

[43] The Worldwide Market for Fixed Wireless Technologies, Decision Resources, Inc., Waltham, MA, November, 1995.

Emphasis on large business customers. Some cable companies report they are providing telephone service to a substantial number of customers. In reality, the service they are providing is not cable telephony, in the sense of providing single-line or few-line service to individual customers, but a CAP service in which they run fiber to an individual business or a business park and meet the customer(s) in a DS-1 or DS-3 interface. The existence of such arrangements is therefore not proof of the onset of substantial residential and small-business competition, but only an increment to existing CAP services.

Overly-optimistic view of fiber deployment. ELB developed costs for cable telephony under the assumption that all cable systems were already fiber-enhanced to the level of 2,000 homes or less. That being the case, the incremental cost of telephony was limited to allocating to telephony only a small portion of the investment in the fiber upgrade. In reality, the emerging cable telephony systems typically require fiber deployment to the 500-home level, not the 2,000-home level. They also require a separate fiber (or fibers) for upstream transmission, not simply a small amount of spectrum on a fiber already being utilized for video signals, as was assumed in the report. Finally, while it was noted in the report that only 35 percent of all cable subscribers are served by fiber-enhanced cable systems, this was not subsequently taken into account in the cost analysis. A system that has not already deployed fiber must do so as a prerequisite to providing cable telephony, and this may substantially increases the average cost of achieving a given level of penetration nationwide.

Problems with cable telephony systems. There has been a marked slowness in the commercialization and deployment of cable telephony systems. They are beset by a number of technical problems, a key one being that in some cases they interfere with, and degrade the video

signal quality of, television channels that are in nearby frequency bands. While such problems appear to be resolvable through careful tuning of the cable television system, mitigation may be expensive and time consuming, and highly dependent on the characteristics of particular cable networks.

Alternative uses of limited upstream spectrum. Cable telephony systems must share the upstream portion of a cable system, located from around 5 to 40 MHz with all other uses of that upstream spectrum, including control signals associated with video-on-demand and interactive video services, and broadband data communications. The cable industry has recently focussed a great deal of attention on the latter as a means to provide high-speed access to the Internet and other on-line services. Cable subscribers are purchasing this service in growing numbers, and are bullish about the results.[44] Due to the shared-access nature of the service -- all customers served by one fiber node must contend for the ability to send data, as in a conventional Ethernet LAN -- the cable companies may need to allocate more of the available spectrum to meet the demands for this service, leaving less spectrum for cable telephony.

4. Fiber Rings

Limited network scope. ELB noted that fiber rings are typically deployed only in communications-intensive downtown areas, where the high cost of a ring can be spread over many customers, services, and circuits. Thus, ring-based CAPs can primarily provide service only to large business customers, not to residences and small businesses. One criticism of the report was that it ignored the potential for a CAP to obtain unbundled loops from a local

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[44] See, for instance, "Cable Modems are Tested and Found to be Addictive," Wall Street Journal, December 27, 1995, p. A13.

telephone company, interfacing with the local telephone company at the local telephone company central offices, and tying those offices together using the CAP fiber ring.

That criticism actually illustrates an additional problem with CAP networks not considered in ELB: When it comes to service customers outside the downtown area, the rings essentially provide only the interoffice portion of the local exchange network. This is a small fraction of the total network investment;[45] and the remaining components -- switching, signaling, and the distribution portion of the network -- must be provided by the CAP, or obtained from a local telephone company or another party, independently of the ring. This being the case, the CAP is at best at the mercy of its local telephone company competitor to obtain the necessary connectivity to customers. At worse, unbundled loops and the associated interconnection capability may not be offered by a local telephone company, or may be offered at such a high price as to render them unusable for providing an entire local exchange network.

IV. TELEPHONE COMPANY COSTS

The local telephone companies argue that technological changes are opening their markets to competition. But technological change can cut both ways. Technology is producing billions of dollars in cost savings for local telephone companies. Therefore, potential new entrants are shooting at a moving target.

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[45] In the ELB treatment, the interoffice portion of all the alternative technologies was ignored, because it was assumed to be small enough as to be negligible.

The core of the telephone company savings will come from continued implementation of computer technology in the networks.[46] Modern switches are controlled by sophisticated computers consisting of microprocessors, memory, and other supporting semiconductor devices. The other components of switching machines, including the switching fabric (the components that actually make circuit connections) and port interfaces, similarly use semiconductor technology extensively. Switching machines, therefore, benefit from the continuing rapid evolution of semiconductor, and especially microprocessor, technology.

In addition, technological advances have for years increased the capability and reduced the per-call processing costs on existing switches, making it possible for local telephone companies to realize savings through upgrades. rather than incurring new investment costs. For instance, AT&T has upgraded the processor complex of its electronic switching systems many times since such systems were first introduced for commercial use in 1962. Generally, over the past twenty years, the per-line cost of central office switching has fallen over 80 percent.[47]

Savings are also possible in transmission. Initially, the most costly part of transmission involves obtaining right-of-way (ROW) and the construction required to install the transmission medium. But such costs are, for the most part, one-time costs; once incurred, the incremental cost of increasing transmission capacity on a given transmission route is relatively small. The

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[46] This discussion is condensed from Hatfield Associates, Inc., Rate of Return Regulation and Consumer Protection, October 26, 1995.

[47] "Indeed, while the cost of network ownership -- the cost of a central office line -- has fallen sixfold in the last 20 years, the cost of MIPS (millions of instructions per second) ownership has fallen well over 1 millionfold -- with no end in sight." John Celentano, Frances McInerney and Sean White, Telephony, "Who's Got the Money for these Multimedia Networks?", May 29, 1995, pp. 32-36.

reason for this is that for a number of years the medium in new cable facilities has typically been optical fiber; in most cases fiber is now installed in interoffice transmission routes and is commonly used as well in new feeder construction.[48] The inherent capacity, efficiency, and quality of the single-mode fiber universally installed by telephone companies, as well as other carriers, as a general rule far exceeds that of existing transmission equipment.

A large portion of the cost of operating and maintaining a local telephone network is in labor and expenses. Operating, General and Administrative, and Billing and Collection expenses all contain substantial labor components. Computer technology, however, is driving those costs down as well. Billing and Customer Service are increasingly automated. Network reconfigurations can now be accomplished in a few minutes at a computer console by entering relatively simple commands instead of requiring technicians to climb over huge distribution frames in large wire centers or spend hours in the field.

Many trouble reports can be analyzed and resolved at centrally located network operations centers, instead of requiring on-site work involving costly "truck rolls."[49] SONET systems, for example, include highly-evolved network management, administration, and maintenance functions that allow complex and widely-separated SONET networks to be managed from central sites, with consequent operational cost savings.[50] As a result, seldom do

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[48] "...[M]ost telephone company fiber deployment is in the interoffice and feeder portions of the network." Richard Karpinski, Telephony, "Fiber by the Numbers," June 13, 1994, pp. 34-38.

[49] Telephony, November 14, 1994, pp. 54-58.

[50] "These systems use remote testing for some network elements and the intelligence inherent in newer systems such as SONET gear to bring information from around the network to

more than a few months go by between announcements that one telephone company or another is reducing its work force by thousands, or tens of thousands, of employees.

As noted above, the investment in equipment needed to construct a modern telephone network is much lower than it used to be because the cost of the components has declined so dramatically. Moreover, the cost of carrying that capital has declined dramatically as well. Borrowing costs and the cost of equity have both fallen with the reduction of inflation in the economy since the 1980s. The 30-year Treasury bond rate has fallen from 12.41 percent in 1984 to around six percent today.

Modernizing networks to take advantage of the cost saving capabilities of computer driven technology requires investment. Local telephone companies claim that depreciation expenses must rise to finance this investment and to pay for the obsolete equipment that remains on their books. Regulators have in fact been liberalizing depreciation policies since the 1970s. As a result, the local telephone network has been modernized and past depreciation reserve imbalances have been largely eliminated.[51] New technologies such as digital switching, fiber optic transmission and Signaling System 7 have already been deployed in the network.

All of these factors taken together show that existing prices are far from the economic cost of providing telephone service. Regulators have not squeezed noneconomic costs out of local telephone company rates. In 1993, the United States Telephone Association ("USTA")

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a centralized place where it can be analyzed and correlated." Carol Wilson, Telephony, "Computers in the Network: the New Era," April 18, 1994, pp. 44-46.

[51] See, Kenneth C. Baseman and Harold Van Gieson, Depreciation Policy in the Telecommunications Industry: Implications for Cost Recovery by the Local Exchange Carriers, December, 1995.

sponsored a study that showed that the contribution to local services above incremental cost generated by current local telephone company toll and access rates was 20 billion dollars, or approximately 12 dollars per month per telephone line.[52] Other local telephone company services (e.g., local business and vertical) are also often priced above cost. Moreover, HAI's own cost modeling suggests that the incremental cost estimates used by USTA are excessive. This means that the difference between current prices and economic costs is even greater than USTA claims.

The 20 billion dollar figure is made up of a number of components. Some portion of this amount represents subsidies to local telephone service. Assuming that regulators will maintain subsidies regardless of the regulatory regime, some portion of the 20 billion dollars will not be available to reduce rates. A prior study by HAI demonstrated that only approximately four billion dollars of this amount is needed to maintain current residential subsidy flows.[53] The remaining 16 billion dollars consists of excess profits, costs imposed by the use of technology that is no longer state of the art, excessive staffing, cross-subsidies, especially through investments in video and interLATA facilities, or under-depreciated assets.[54]

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[52] See, Calvin S. Monson and Jeffrey H. Rohlfs, The $20 Billion Impact of Local Competition in Telecommunications, July, 1993.

[53] *Supra*, note 2.

[54] Baseman and Van Gieson, *supra,* note 50, show that under-depreciation is a small portion of this total. An example of a cross-subsidy is investing in capacity needed to provide interLATA long distance or video services and charging the expenses to monopoly local telephone service.

The implication is that the incremental cost of local telephone service is at least 16 billion dollars less than current rates. A business case of the viability of local exchange competition should not assume that entrants will compete against current prices. In order to attract customers away from the incumbent local telephone companies, new entrants may have to set prices that are less than the economic cost of providing local services and exchange access. Therefore, the reduced profitability can be expected to retard the rate of entry.

V. QUALITATIVE CHANGES IN THE ELB BUSINESS CASE ANALYSIS

Chapter 5 of ELB presented a business case economic analysis of providing local telephone service, using the results of the technology analysis of Chapter 3. The analysis used a standard capital budgeting model to determine the net present value (NPV) of the decision to enter the local exchange business under alternative business scenarios. If the NPV under a given scenario was positive, then the project was considered to represent a potentially successful financial venture; if negative, however, it was not.

The business case analysis varied a number of parameters. These included:

- The per-subscriber monthly revenue, ranging from $35 to $50;
- The marketplace penetration, ranging from 18 percent to 30 percent;
- The cost of capital, ranging from 14 percent to 18 percent; and
- The choice of alternative technology -- cable telephony and PCS were the choices.

The analysis yielded the following results. For cable telephony, positive cash flow occurred only after five to eight years of operation. Many scenarios showed a negative NPV even with the 15-year study period used in the analysis. In the most optimistic scenario considered -- $50 in monthly revenues, 30 percent penetration, and 14 percent cost of capital -- NPV was positive

only if a study period greater than 11 years was considered. In all other scenarios, the period required to yield a positive NPV was 14 years or more.

For PCS, positive cash flow occurred at 7-8 years in various scenarios. NPV was negative for many of the scenarios assumed. Thus, the business case analysis concluded, it will be a "long, hard climb" for cable and wireless providers to compete with the incumbent local telephone companies.

As is the case with the technology analysis, the business case analysis is being reestimated to determine whether any factors have changed sufficiently to warrant a greater degree of optimism than that provided by ELB. In doing so, several qualitative factors that suggest the answer is no have been identified.

The business case overestimated the potential revenues. As discussed in Section IV, it has become clear since ELB that local telephone companies cost of providing basic local exchange service is substantially lower than price in many geographic areas in which competitive providers may wish to provide service. As a result, the local telephone companies may be able to substantially reduce their prices. That being the case, the assumption that competitors can price their service only a small amount below current local telephone company prices is likely to be wrong. This has particularly troubling implications for one of the technologies considered in the ELB report: PCS. As already noted, the per-subscriber revenues assumed in ELB were $35-$50 per month, prior to any such price-cutting reaction by the LECs. But a recent authoritative analysis of PCS economics has suggested that

> First, no PCS provider may be able to survive the Ice Age if [Average Revenue per Subscriber] drops to $25 per month. Second, companies in smaller markets

will have a much more difficult time surviving. Third, reasonable aggressive market shares (e.g., 25 to 40 percent) appear adequate for survival only in medium and large markets and only when ARPS exceed $40 per month . . . If ARPS drops to $35, . . . at least some of the three to five new facilities-based providers won't survive."[55]

The business case may have underestimated risk. The business case analysis reflects risk only in the cost of capital it assumes. But given the onset of competition, and the ability of the local telephone companies to reduce their prices, the risk may be substantially greater than previously assumed. Furthermore, would-be entrants must obtain financing, and this may not be readily available in such a competitive environment.

The two most likely providers face strong competition in their core businesses. Two developments since ELB cast uncertainty on the ability of PCS providers and cable companies to successfully undertake the provision of telephony because they face substantial risks in their primary businesses. Given the PCS license structure adopted by the Commission, PCS companies will be operating in markets in which they face as many as six competitors for their primary wireless business. One might argue that fixed-location telephony might provide an attractive alternative service for such providers, but as already noted: 1) the per-minute revenues obtained by today's wireline companies are substantially below those of cellular companies, which is likely to considerably dampen a PCS company's enthusiasm for this alternative; and 2) even if a PCS provider were to attempt to enter the fixed-location business, its service might not

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[55] "The Challenges of the Wireless Ice Age," Carl Aron, Business Communications Review, October, 1995, p. 40 et seq.

be viable due to poorer voice quality, and, more importantly, the limited data rate it could support in the face of the burgeoning consumer interest in high-speed Internet access.

Until recently, the competition between cable companies and local telephone companies for video services seemed likely to be focussed on video-on-demand, interactive television, games, and other forward-looking services. Now, however, local telephone companies are investing heavily in existing cable franchises as well as MMDS, DBS, and so-called "broadband cable," all of which provide direct competition in the core broadcast television service of the cable companies. For instance,

> [Ameritech] already has won 7 cable franchises in 7 communities with 170,000 residents since shifting from VDT to franchise route in April, and expects at least 2 more "in the next few weeks," [Ameritech New Media Enterprises President Gregory] Brown said. Next year, Ameritech expects to seek 35-40 franchises in territory, building its video-only network in competition with cable operators.[56]

Under assault in their core broadcast television business, cable companies may find it much more difficult to finance the large investment required to provide telephone service on a ubiquitous basis.

Local telephone company absorption of alternative technologies. ELB may have underemphasized the distinction between competitive technologies and competitive service providers. Even if a particular technology appears to offer an attractive alternative to existing local telephone company technology, that does not necessarily mean it poses a competitive threat to the local telephone companies, because the incumbent local telephone companies themselves

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[56] "Ameritech Drops VDT Approach, Sees Growth in Security Unit," Telecommunications Reports Daily, December 15, 1995.

can utilize the same technology. The incumbents, with their greater capital resources and staying power, can use the technology to thwart or eliminate their would-be competitors.

The adoption of competitors' technology by the local telephone companies has happened several times already:

- When CAPs began to compete with the local telephone companies, the latter quickly discovered the power of fiber rings, and began their own ring-based offerings, thereby achieving the same advantages that technology initially afforded to the CAPs. In short order, the CAPs then discovered that the provision of high-quality, highly-reliable dedicated circuits no longer provided sufficient differentiation from the local telephone companies. Several have responded by emphasizing switched, value-added services, the provision of outsourcing services, and the like; as discussed in Section II, all are still struggling to gain a significant foothold in the local exchange marketplace.

- When local telephone companies observed the cable companies deploying the powerful hybrid fiber-coaxial cable distribution architecture in order to improve the quality and reliability of the existing broadcast television services and potentially support other voice and video services, the telephone companies quickly announced the deployment of the same architecture in order to combine voice and video dialtone (VDT) services on a single network. By then attempting to allocate an unreasonably high portion of the costs of the hybrid system to voice, they then set the stage for offering VDT services at well below the true costs of those services. They have since started to adopt a different strategy for attacking the core business of the cable companies.

- The top five winners in the PCS spectrum auction are generally viewed as being WirelessCo, AT&T, PCS Primeco, Pacific Telesis Group, and GTE.[57] The last three of these are local telephone companies, or subsidiaries of holding companies that also own local telephone companies.

- On the chance that wireless loop technologies might become viable, the RBOCs are trialing such technologies from Alcatel, AT&T, Motorola, and other companies. Different technologies are being tried that might be suitable for use in both rural and suburban areas.[58]

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[57] Telecommunications Magazine, May 1995, p. 17.

[58] Network World, May 29, 1995, p. 24.

None of this is intended to suggest there is anything wrong with the telephone companies adopting such technologies in the fashion described for competitive reasons. Rather, it suggests that the existence of promising technologies does not in and of itself indicate that a robust competition will ensue, since those technologies may be absorbed by the incumbents.

VI. SUMMARY

A complete quantitative analysis of potential competitive technologies is underway. This qualitative assessment shows that the findings of the original ELB Report remain valid today. Cable, CAP and wireless technologies can provide substitutes for some or all of the services currently provided by local telephone companies. However, before sufficient competition to discipline local telephone company market power arrives, substantial, risky investments over a period of many years are required. Public policy must not be based on an assumption that effective local competition is imminent, and, in fact, to the extent that such competition is viewed as the appropriate means of achieving such discipline, policies must be adopted and maintained that encourage the creation of a competitive environment.

APPENDIX

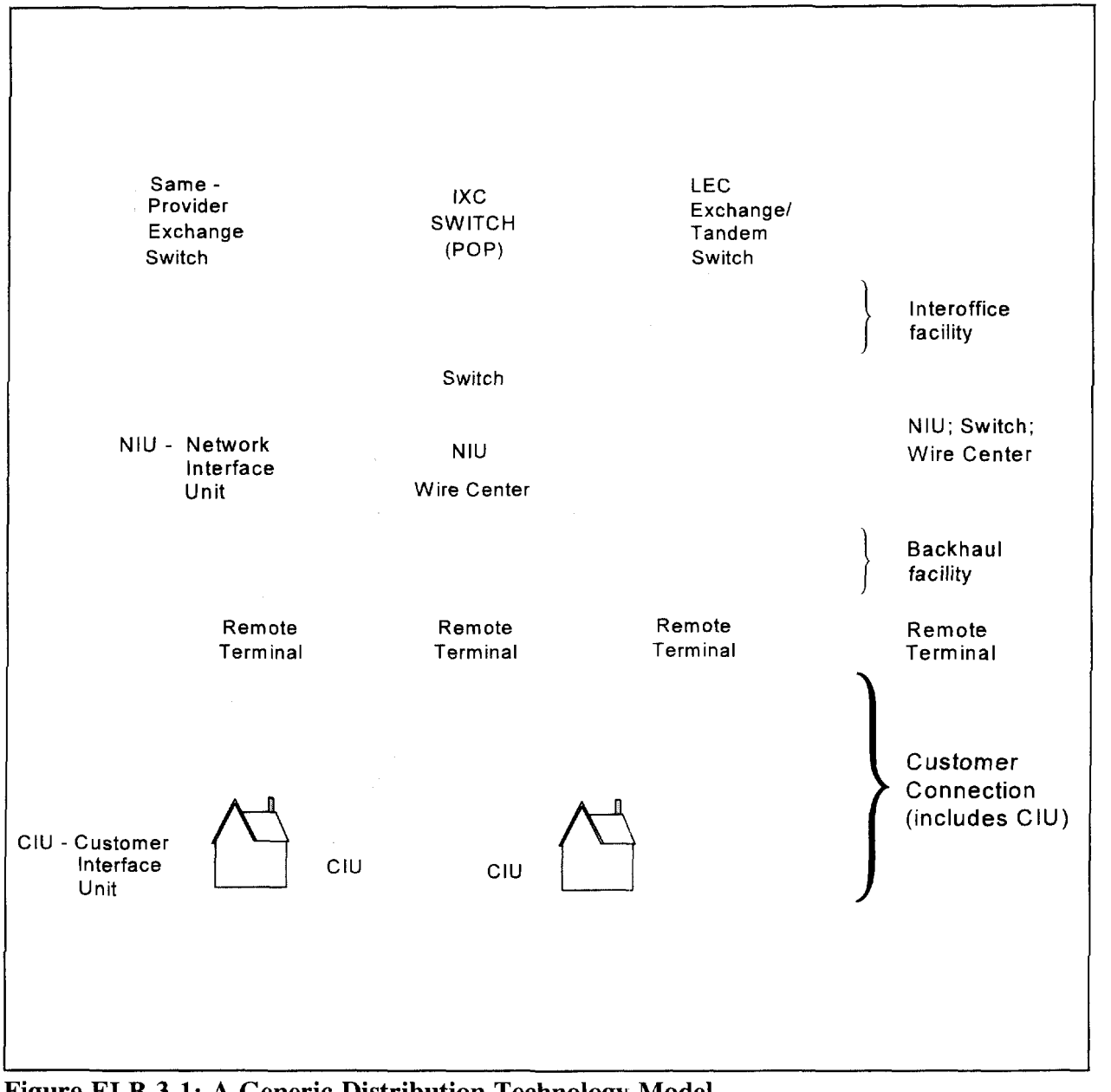

Figure ELB-3.1: A Generic Distribution Technology Model

Component	Cellular Radio/PCS	Cable Telephony	CAP Fiber Ring	LEC Network
Signaling	SS#7 Network	SS#7 Network	SS#7 Network	SS#7 Network
Interoffice Facilities	LEC Circuits; CAP Ring	LEC Circuits; CAP Ring	Fiber Ring	LEC Circuits
Switch (Wire Center)	MSC	Switch (Headend)	Switch (Network Control Center)	Switch (Central Office)
Network Interface Unit	Site Controller	Headend Unit	---	---
Backhaul Facilities	Microwave or Terrestrial Circuits	Fiber Optic Cable	Fiber Ring	Feeder Plant (loop carrier)
Remote Terminal	Radio Site	Existing RF to/ from optical converter	ADM	Serving Area Interface
Customer Connection	Airwaves and Transceiver Unit	Coaxial Cable and Subscriber Unit	None (or ring extension)	Distribution Plant (wire pairs)

Table ELB-3.1: Mapping of Specific Technologies into the Generic Model

Component	Cellular Radio	PCS	Cable Telephony	CAP Fiber Ring
Interoffice Facilities	0	0	0	0
Wire Center	60	60	60	60
Switch	190	190	190	190
Network Interface Unit	50	50	225	0
Backhaul Facilities	100	100	40	630
Remote Terminal	2160	400	0	230
Customer Connection	$300	$300	$320	$100
Total	**2860**	**1100**	**835**	**1210**

Table ELB-3.2: Per-Subscriber Technology Costs

Scenario	Cable Telephony	PCS
A (Low Cost)	$660	$940
B (High Cost)	1,130	1,375
C (Business Case)	745	1,030

Table ELB-3.3: Per-Subscriber Costs for Three Sensitivity Analysis Scenarios

Scenario	Cable Telephony	PCS
A (Low Cost)	$660	$940
B (High Cost)	1,130	1,375
C (Business Case)	745	1,030

Table ELB-3.3: Per-Subscriber Costs for Three Sensitivity Analysis Scenarios

CERTIFICATE OF SERVICE

I, Stan Miller, do hereby certify that copies of the foregoing Comments on were sent via first class mail, postage paid, to the following on this 6th day of February 1996.

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