

Washington State's Network Future

Report and Recommendations

The Technology Alliance, 1997

This Report has been prepared as part of an effort by the Technology Alliance ("TA") to promote the development of a world-class communications network in Washington State. Other organizations in Washington State are involved in similar efforts. For example, the Governor's Telecommunications Policy Task Force ("Governor's Task Force") issued a report on similar issues in April 1996 entitled, "Building the Road Ahead: Telecommunications Infrastructure in Washington State." Cities and counties have undertaken their own initiatives. The TA desires to contribute to rather than supersede these efforts.

The TA agrees with the Governor's Task Force's conclusion that telecommunications policies adopted in Washington State today will determine:

whether Washington businesses have the communications tools they need to remain competitive; whether Washington can succeed in the competition to attract and retain businesses; whether Washington's students have the educational resources to enable them to compete in the job markets of the twenty-first century; whether consumers will enjoy the benefits of robust competition for telecommunications and information products and services; and whether Washington residents will have universal access to first-rate medical care and government services.

The TA is particularly concerned about the effects of Washington State's information infrastructure in determining whether the region is competitive in today's global economy. Advanced communications networks have become a critical tool for states in the competition for new businesses and jobs. Firms increasingly consider communications infrastructure as much as skilled labor, roads or airports, in selecting a new site. New businesses are also far better incubated in an environment containing advanced communications networks.

The TA believes that information is becoming increasingly essential to all those things we associate with quality of life: economic opportunity, education, health care and public services. Communications networks represent an enabling technology for state and local governments, community organizations, businesses and citizens. In particular, it is vital that schools throughout the state have the facilities which enable students to take advantage of the rich learning opportunities available through modern communications systems – principally the Internet.

The TA's recommendations will outline a strategy to enable Washington State to take full advantage of the benefits of the communications age. These strategies will require continuous re-evaluation as the technology environment is changing at unprecedented rates. Creating a world class information infrastructure will require increased private and public sector investments, a flexible and supportive regulatory environment that provides business and consumers with confidence and certainty, advanced education and training as well as measures to ensure that sections of the state are not denied access to the benefits of an advanced communications network.

This Report will only briefly discuss the range of access delivery methods and technologies that can be utilized in improving today's information infrastructure in Washington State. The TA believes that there will be a range of communications networks and technologies operating in the future, each with an advantage in particular conditions, that will comprise the Washington information infrastructure. One of the major obstacles to comprehending this complex scene is the use of acronyms and terms of art which are meaningless to the ordinary reader. This Report includes a glossary which the TA believes will prove very valuable to the reader. Fiber, coaxial cable, copper, cellular radio, paging, trunk radio, broadcast television and radio, microwave, and satellites will all play a role. The exact nature of the resulting communications

infrastructure is far from clear. The only thing that is clear is that rapid technological change is inevitable and unpredictable.

This Report will not focus on the range of regulatory issues being considered by Federal, state and local governments related to the transition from an era in which communications services are provided by government-sanctioned monopolies to an era in which these services are provided by competing service providers. The Report will provide a brief summary of some of these regulatory issues. While the expeditious and wise resolution of these complex regulatory issues is critically important, the TA has chosen to focus on strategies and goals that are not directly part of this highly political process.

This Report by necessity has distilled issues and technologies that are exceedingly complex and evolving. The intent of the Report is to improve general understanding of these critical issues and to encourage further study and dialogue.

Among the factors which will bear heavily on the quality of the decisions made by our state will be the insight and the care which are exercised by our officials, appointed and elected, in deliberating the issues with which they are going to be presented. The political effort which will be exerted by advocates from industry segments will be unprecedented because the financial impact of the decisions being made will be enormous.

Today's Narrowband Infrastructure

Communications networks can be broken down into three parts: long distance transmission, switching systems and the 'local loop' – the link between each customer and the nearest telephone exchange. A transmission line that connects central offices is called a "trunk line." In the past few decades, technology has greatly increased the capacity and lowered the cost of long distance. Upgrading long distance infrastructure is made easier by the fact that it is a shared transmission medium. The costs of the upgrade can be distributed across many users. Nearly all trunk lines in Washington state are digital. Switching systems have advanced greatly powered by advances in computer hardware and software. Creating high capacity, high quality local loops, as well as reducing the cost of local service, is far more problematic since there are few opportunities to share the cost among several sources of traffic. A copper wire access line may be in use only minutes per day. The cost of building local loops can exceed 80 percent of the cost of building a network. For this reason, the transmission medium used in the local loop is largely the same copper wire that has been used for over a hundred years instead of high-capacity coaxial cable or fiber optic cable.

The enactment of the Telecommunications Act of 1996 will result in companies crossing traditional network boundaries. It is, however, still important to understand the three principal types of network companies: telephone, cable and wireless and the different facilities they employ.

Telephone Networks

The telephone system is the world's largest switched distributed network providing point-to-point connections for hundreds of millions of users. While today's telephone networks still primarily use analog transmission technologies, advanced digital transmission capabilities are being introduced particularly in trunks and switches. The information carrying capacity of telephone networks is unevenly distributed. High capacity fiber optic lines capable of handling broadband applications like interactive video are already ubiquitous in the backbone networks of long distance companies and in the links between the switching offices of local telephone companies. High bandwidth (i.e., high capacity) connections are also being used by local telephone companies, competitive access providers and long distance companies to serve very large businesses and government institutions. However, the bandwidth available to medium and small businesses (outside downtown metropolitan areas) on the access portion of telephone networks is severely constrained by the copper wire linking the local telephone company's central office.

The local exchange telephone network consists of the portion of the public switched network controlled by local exchange carriers. There are hundreds of companies across the United States that offer local telephone service. In general, they can be grouped into two categories – companies divested from AT&T in 1984, commonly called the Regional Bell Operating Companies (RBOCs) and the independent telephone

companies. The RBOCs control over 80 percent of the local exchange business. In Washington, US WEST serves 70% of the local exchange customers.

Until certain regulatory conditions imposed by the Telecommunications Act are met, local exchange telephone companies provide long distance service only within designated areas. For RBOCs, these areas are called Local Access and Transport Areas (LATAs). Within each service area, a telephone company provides a myriad of services.

The inter-LATA interexchange network consists of the portion of the public network controlled by companies traditionally referred to as long-distance carriers. This industry has been radically changed by competition. Until 1969, AT&T was the only long distance service provider. Since then, hundreds of companies have sprung up to provide private or common-carrier interexchange services with or without their own facilities. Most of these companies resell the capacity of larger carriers. The bandwidth upgrade strategy of telephone companies for their copper-based local loops relies on several variations of what is called "Digital Subscriber Line" (DSL) technology, which is capable of higher bandwidth.

Cable Networks

Cable television networks currently provide customers with one-way broadband analog video transmissions through a web of "tree-and-branch" style coaxial cables. Customers are provided with access to broadcast (rather than switched) high bandwidth (typically 550 MHz vs. 3.4 KHz for copper) connections. Over 95% of U.S. homes are passed by cable and 64% subscribe. Cable systems are being converted to provide a digital signal. Upgrading and reconfiguring cable networks to provide telephony (e.g., providing line power, lowering service outage incidents and abandoning the tree-and-branch architecture) is beginning in some markets. Cable telephone companies are upgrading their cable networks to provide Internet access. The bandwidth upgrade strategy of cable networks relies on cable modem technology and upgrading existing cable facilities.

Wireless Networks

Terrestrial cellular (PCS), paging, point-to-point microwave and satellite-based networks are examples of wireless networks. Wireless access is also rapidly proliferating in form, including cellular telephone networks, wireless LANs, wireless local loop as well as satellite-based concepts. Cellular service has grown from virtually nothing in 1980, to serve 35 million people in the U.S. today. Wireless networks can be both narrowband (e.g., cellular or paging) or broadband (e.g., satellite or microwave). The bandwidth of a wireless network depends upon the frequency it has available. Lower frequencies can be utilized with omnidirectional antenna (e.g., TV and radio) while higher frequencies require line-of-sight between the receiver and the antenna.

Each of the three network types has advantages and disadvantages. Telephone systems lack bandwidth and are expensive to build, but have switching capacity. Cable networks generally lack switching capacity and are expensive to build, but deliver lots of broadcast bandwidth. Wireless networks have switching capacity and can be deployed in a less expensive manner, but are currently unable to provide high bandwidth inexpensively.

No one knows which companies will be successful. Intense competition between RBOCs and independent telephone companies, cable companies, long distance companies, wireless carriers, or even Internet service providers and on-line networks will occur and the results are unpredictable. It is clear, however, that these descriptions will disappear quickly as each category begins providing services across traditional boundaries.

Washington State's Information Infrastructure

Washington State's communications companies are an extremely important part of the region's economy producing both direct industry jobs and secondary benefits. The following three sections of the Governor's Task Force Report provide basic statistics on the Washington information infrastructure and the effect of communications networks on the State of Washington:

As of September 1, 1995, there were 282 telecommunications firms registered with the [Washington Utilities and Transportation Commission] (WUTC) and offering services to consumers in Washington. The dominant local exchange company is the regional bell operating company US WEST Communications, Inc., which serves 2.1 million access lines. The second largest company is General Telephone (GTE) with 670,000 access lines. There are 20 additional incumbent local exchange companies. (The TA is advised that as of April 1997 there are some 350 telecommunications firms registered with the WUTC.)

In addition, five new local exchange carriers either are providing or are planning to provide local dialtone, primarily in competition with US WEST and GTE in the Seattle and Spokane areas. Besides the local telephone companies, several larger interexchange toll carriers have extensive facilities in Washington, including AT&T, MCI, Sprint, and LDDS Metromedia. There are roughly 165 companies that resell toll, though many own and operate their own switches. (The TA is advised that as of April 1997 there are ten certified and four pending local exchange carriers who provide or plan to provide local telephone service in the Seattle and Spokane areas.)

Wireless telephone communications employment in Washington rose 71% between 1988 and 1993. During that five-year period, the total number of telecommunications companies doing business in Washington more than doubled to 522, and the number of wireless companies tripled to 90. Relative to the United States, Washington provides a dynamic environment for the non-telephone communications sectors of the core telecommunications industry. As a result of this positive environment, the more nontraditional and innovative telecommunications firms have flourished in Washington. In addition, Washington's robust software industry will play an increasingly important role as new advanced telecommunications systems evolve.

Telecommunications jobs also pay well. Core telecommunications job paid an average of \$42,074 in 1993, compared to a state average of \$25,753. Software jobs pay even more: an average of \$66,057 in 1993. These are family wage jobs that have helped offset the decline in high-paying aerospace and timber industry jobs over the last several years, and are key to maintaining quality of life in Washington.

The importance of telecommunications and information services to Washington State's economic future is readily apparent. Between 1988 and 1993, direct employment in telecommunications and information industries has grown dramatically. In core telecommunications industries - telephone, broadcast, cellular, paging, and related businesses - employment has increased 31%. In related industries such as computers and electronics, it has increased 20%. In the software industry, it has increased 114%.

What is more, the average wages in Washington telecommunications companies are more than 70% higher than the average of all industries. Between 1988 and 1993, the gross business income for Washington telecommunications industries grew from \$5.9 billion to \$12.2 billion - a 107% increase. The gross business income for the software industry alone grew \$5.3 billion - a 530% rise.

The Internet has served to accelerate convergence in the communications industry. The Internet does not represent new infrastructure. Rather, it is a set of protocols for carrying digital data over the existing infrastructure, in a way that is oblivious (except for bandwidth) to the specific infrastructure being employed. The "national backbones" employ dedicated high-capacity fiber optic circuits, leased from or owned by the nation's long distance carriers. Regional backbones employ similar circuits, but also, for example, use microwave links where fibers are unavailable. Local area networks today typically employ Ethernet technology running on twisted pair or coaxial cable. International traffic is carried via satellite channels. Message-handling computers called "routers" move data packets through this fabric, relying on a set of protocols (software standards) that have been evolved over the past 25 years. Satisfactory use of the Internet as a learning tool requires higher capacity local lines than presently serve users except those few sophisticated, heavy users who have paid for the higher bandwidth connections.

The Regulatory Environment

Regulatory commissions such as the Federal Communications Commission ("FCC") and state Public Utility Commissions (PUCs) have traditionally been responsible for protecting users of regulated services by setting telecommunications rates (typically at cost plus a reasonable return). Regulators have traditionally thought it necessary to decide what portion of the costs of facilities constructed to provide both regulated and unregulated services could be attributed to the regulated services and recovered in their prices. Such

cost-allocation decisions are inevitably political. Many of these decisions are pending as this report is being prepared. The principal example of cost allocation has been the subsidization of residential phone service, particularly in rural areas, at the expense of higher charges to long-distance callers and business customers in larger cities. Not surprisingly, as competition has come to the industry, it has concentrated on providing services to business customers. Every major downtown area in the country, for example, now has at least one Competitive Access Provider, providing local service and catering mainly to big business customers. Seattle has five extensive fiber networks provided by Competitive Access Providers and local exchange carriers.

The Telecommunications Act is a sweeping reform of the Communications Act of 1934 that will have far-reaching effects on nearly every sector of the telecommunications industry. Among the more important aspects of the Telecommunications Act are:

RBOCs will be permitted to provide long-distance service outside of their local service areas immediately. They can sell long-distance within their local service areas after they demonstrate to the FCC that they have met certain requirements including but not limited to entering into an acceptable interconnection agreement with a facilities-based competitor for the provision of local exchange service;

RBOCs are permitted to provide cable television service, manufacture equipment, and eventually enter the alarm and electronic publishing businesses;

Local telephone companies must enter into interconnection agreements to allow competitors access to their switches and other unbundled facilities for the provision of local exchange telephone service.

Companies providing local telephone service are required to make a package of universal telecommunications services available to customers at an affordable price.

The Telecommunications Act retains much state authority over telecommunications services as long as such authority is applied in a competitively neutral manner. This may require changes in state legislation, regulation, fee and tax structures, and administrative procedures.

The Telecommunications Act preempts any state or local statute or regulation that "may prohibit or have the effect of prohibiting the ability of any entity to provide any interstate or intrastate telecommunications service." As long as state requirements are imposed "on a competitively neutral basis," the Telecommunications Act does not preempt state requirements that:

preserve and advance universal service; protect the public safety and welfare; ensure quality telecommunications services; or safeguard the rights of consumers. Determination of whether state requirements meet the "neutrality" test will be made by the Federal Communications Commission (FCC), which is given preempting authority after adequate notice and comment.

Tomorrow's Network Demands

Analog telephone technology was invented over 100 years ago. Since that time, networks have gradually evolved from analog to digital mode. While early experiments with digital technology began in the 1920s, commercial use of digital technologies in commercial communications networks did not occur until the 1960s. Communications networks have continued to evolve to include more digital technologies in the ensuing decades. Initially, the primary intent was to create higher quality and capacity voice connections. Today, the driving force in digital technology is the demand for interactive broadband connections. Real-time, two-way connections of very high speed can only be provided by interactive broadband networks.

The Governor's Task Force concluded:

With regard to basic telecommunications services, the infrastructure now exists in most areas. As noted above, a few pockets still exist where residents have no basic telephone service - for example, Libby Creek (pop. 18) and Goose Prairie (pop. 15). However, because of the isolation and small population bases of these communities, the costs of deploying even basic telephone infrastructure to these communities - which

can run upward of \$5,000 per mile per resident - are prohibitive. It is likely that in these cases, technologies such as satellite voice and data services, which are currently under development, provide the best solution. Moreover, except in these isolated communities, the Task Force finds that the state now has sufficient basic telephone infrastructure for most business and social applications. [Emphasis added.]

Washington State already has a network that is capable of supporting voice, text e-mail and other low data rate services. In other words, the challenges of building a basic voice network have largely been solved. Creating an interactive broadband Washington State information infrastructure is far more problematic. The rollout of ISDN and other advanced services is improving. Unfortunately, most customers who have access to advanced digital broadband services today are large businesses and government organizations located in large urban centers. There are difficult economic issues associated with extending these services to the rest of the state. The TA supports the Governor's Task Force on the need for accelerated deployment of advanced communications services. The TA believes that special emphasis needs to be directed toward providing accelerated deployment of advanced communication services and remedying the problems cited by the Governor's Task Force as follows:

The Task Force finds it unacceptable that many consumers are not able to choose from a diverse supply of communications services and providers. Although broadband services such as Integrated Digital Network (ISDN) have been widely distributed in some states, their deployment in Washington has been constrained by the apparent unwillingness of some local exchange carriers to make it available. The Task Force believes this slow deployment of advanced services demanded by consumers is inhibiting economic growth in the state. It asks the WUTC to encourage telecommunications providers to accelerate the deployment of cost-based services to fill the gap between demand and supply.

The Information Infrastructure Needs of Washington State's Technology Community

The TA believes that Washington State has a technology sector with unique characteristics that policy makers must consider in making decisions. A Seattle Times feature on high-technology on August 18, 1996 describes some of these unique attributes:

The region has made a high-tech name for itself with a few dominant players, including Microsoft and video-game king Nintendo, but the area is filled with hundreds of smaller technology companies hoping to make it big.

The 1,900 software companies in Washington State last year generated \$9.5 billion in revenue, up 24% from the year before and expected to grow to \$20 billion by 2000.

Most of the companies are tiny operations that dream of hitting it big. Two-thirds last year employed fewer than 11 people each. Most had annual sales of less than \$1 million.

The companies employed more than 22,000 state residents last year, paying \$2 billion in wages.

When telecommunications companies are added in, the numbers nearly double: 3,500 companies, 56,000 employees, \$3.6 billion in payroll.

The principal unique character of the technology sector is the vast and diverse number of small and medium sized businesses. The membership of groups like the Washington Software Association are comprised of a larger number of businesses with from one to 20 employees. State-of-the-art telecommunications services are essential to these businesses, and to an increasing number of more traditional businesses as well. Whether they are located in metropolitan areas or in suburban or rural areas, they must be able to obtain the telecommunications services that they require within a reasonable period of time. The TA believes that regulators should consider a request for broadband service by a customer and the unwillingness or inability of a provider to sell broadband service to be as great a problem as a consumer's ability to obtain a voice grade line.

The Information Infrastructure Needs of Washington State's Rural Community

Citizens in medium and smaller cities as well as rural areas will not have the same access to broadband networks as urban areas. For this reason, the TA wants to encourage the development of an interactive broadband Washington information infrastructure in all regions of the State. In developing this interactive broadband Washington information infrastructure, a balance needs to be struck between cost and the desire to give a broad group of citizens access to advanced broadband services. The goal is not technology itself (faster, better, cheaper networks), but to enable the services that will improve the well being of all residents of the State of Washington.

The Governor's Task Force also noted:

The economic problems facing many small communities and rural areas in Washington State are not disputed. According to 1989 figures, unemployment in rural areas is roughly 10% higher than in urban areas, while the average rural working person is paid at least \$5000 a year less than his or her urban counterpart. The percentage of rural residents living below the poverty line is about 15%. Moreover, the economies of many small communities are based on a single industry, such as lumber or fishing. Where those industries are in decline, job layoffs or lower wages often result. Because the economy is not diversified, opportunities for re-employment within the community are small.

What is the potential of telecommunications infrastructure to address these economic problems? Researchers have found a clear relationship between economic growth and telecommunications investment. According to Francis Cronin and others, "economic growth caused telecommunications investment and telecommunications investment caused economic growth in a cyclical bi-directional feedback process."

Despite the state's considerable progress in providing basic services to rural areas, several issues face policy makers in the 1990s and into the next century. First, the state must ensure that universal service subsidies for basic phone service in rural areas, which are now subsidized by long-distance access charges and local exchange companies' services in high-density urban areas, are maintained in the face of increased competition in urban areas by competitive access providers. The state's local exchange companies, including its independent telephone companies, have stated their commitment to continue to provide service to rural areas for the foreseeable future.

Second, the state has an interest in ensuring efficient infrastructure beyond basic telephone service - for example, telecommunications bandwidth necessary for high-speed or high-volume applications to allow Washington's rural communities to remain economically competitive with their urban counterparts, and with rural areas in other states. It must also seek to promote sufficient infrastructure to allow residents of rural areas parity with regard to social services and educational opportunities.

Tomorrow's Regulatory Environment

Deregulation of telecommunications is a powerful trend both locally, nationally and worldwide. However, even the most ardent supporters of this trend see a need for transitional regulation. Others see a permanent need for some regulation. There is no reason why any of the groups in the State of Washington seeking to promote the development of a world class communications network must "reinvent the wheel" in determining what principles should serve as the platform in constructing tomorrow's regulatory environment. A number of groups have examined similar issues and decided to base future regulatory policy on basic guiding principles.

The Governor's Task Force's recommendations for Washington State cover five broad areas:

achieving regulatory consistency in converging industries; leveling the taxation playing field; balancing local interests with state infrastructure needs; bringing infrastructure to rural areas; and leveraging the state's role as a large purchaser, user and provider of telecommunications services.

The TA believes that while the broad principles developed by these state, federal and international administrations should all be applied to some degree in shaping tomorrow's regulatory environment in Washington State, the unique nature of Washington State's technology community must be considered in making regulatory policies. These high technology users are relatively small in size, widely dispersed and

therefore expensive to serve. Of course, all businesses are increasingly using technology and rural users are no exception. Servicing these rural users will be particularly expensive.

Schools, Hospitals and Community Centers

Education has a key role to play in the successful adoption and use of information services. As these services become more pervasive, skills in information technology are becoming a fundamental requirement for many jobs, and necessary in many other areas of society. Children can gain competencies in information services in a variety of ways and in a number of settings. Washington State's education systems must teach these skills so that children can use the new services with confidence and to best advantage, and to enable them to make informed choices about the kinds of services they use and the way they use them.

Information services are themselves valuable educational tools. For example, multimedia and on-line services can provide students with a whole range of useful information (an interactive "virtual" library) to complement traditional sources of information, and broaden their experience.

Before passage of the Telecommunications Act, carriers had no federally mandated special obligations towards schools or libraries. Congress now believes the ability of schools and libraries to obtain access to advanced telecommunications services is critical to ensuring that these services are available. The Telecommunications Act creates a universal service support mechanism for schools and libraries and other special categories. The extent of this support mechanism and how it will actually operate are the subject of a proceeding currently pending before the FCC as well as part of the deliberations of a Federal-State Joint Board for universal services that will be making recommendations to the FCC on these issues.

Among the universal service principles set out in the Telecommunications Act is the principle that "elementary and secondary schools and classrooms . . . and libraries should have access to advanced telecommunications services." The Telecommunications Act authorizes the Commission to designate a separate definition of "universal service" specifically targeted at schools and libraries. The FCC has sought public comment and a recommendation from the Joint Board on the additional services that carriers must make available to schools and libraries. The Governor's Task Force noted:

The Washington School Information Processing Cooperative (WSIPC) estimates that school districts have already invested approximately \$250 million in creating local area data networks, excluding the \$12 million to \$20 million spent annually on telephone and data lines from telecommunications providers. In addition, more than \$164 million in local technology bonds and levies have been passed by voters and used for technology in schools. Even with the considerable investment to date, OSPI reports that "technology is not an everyday learning tool for the majority of K-12 students in the state."

The recent elimination of federal funding sources, such as those administered by the U.S. Commerce Department (money used to fund demonstration and pilot projects that showcased the potential of educational technology) further increases pressure on state governments to seed development. A 1995 study by the Milken Family Foundation estimates that it will take \$31.5 billion in additional funds to wire the nation's schools, buy software, train teachers, and put four to six computers in each classroom. Washington's share, given its size and proportion, could exceed \$1 billion.

The Governor's Task Force believes that the cost of developing and maintaining an educational network is prohibitive without other offsetting benefits to communities across the state. Scarce dollars must be stretched to address the concerns of a number of constants. The Task Force believes that part of the solution is to recognize that the common interests of education and community and rural development, and to develop a shared resource.

The Task Force also encourages the use of public-private partnerships in addressing the daunting funding challenges facing education technology and its integration into the local community. Public-private partnerships are conceived broadly here to include multiple public agencies and businesses working together to develop a shared resource. The federal Department of Education advocates an aggressive, proactive approach to such partnerships. "Education needs to SELL its beliefs . . . that technology fully integrated into the curriculum can make a difference . . . to industry (and community) and start a cooperative partnership."

Universal Service

The universal service principle that underlies U.S. telecommunications policy has resulted in one of the great success stories of modern government. More than 94 percent of U.S. households have access to basic voice service – one of the highest percentages in the world and extraordinary for a territory as vast and diverse as the United States. The Governor's Task Force describes how this was achieved:

A variety of subsidies have evolved with the telecommunications industry. Enhanced 911, the Telephone Relay Program for the hearing impaired, the Telephone Assistance Program for low-income residents, and universal service pools are explicit subsidies. Others are implicit, such as the use of statewide average rates and toll access rates to even out the cost of service among customers. While some of these subsidies have helped provide essential public services and should continue in force, other subsidies have been called into question by increasingly heated competition. It may no longer make sense for some ratepayer groups to defray the costs of providing services to other ratepayer groups.

But access to "basic" service is no longer enough for many users. The unanswered question is how can this success in basic services be extended to include interactive broadband services? As access to more advanced information services becomes increasingly essential to economic development and social welfare, there is a danger that the gap will increase between those who have affordable access to such new information services and those who do not. Central to the universal service debate is how to reconcile the twin objectives of expanding the scope of universal service to include advanced information services, while placing greater reliance on competitive market forces. Today's deregulatory and competitive environment creates a fundamental tension as it erodes the cross subsidies that are at the center of the U.S. universal service regulatory policy. Telecommunications services can be provided most cost effectively in densely populated areas. Today, the fact is that services in remote areas are priced below cost, subsidized partly by a universal access fund, and partly by above-cost pricing in other markets. Under deregulation, the latter cross-subsidy will end, because new carriers will attack the most lucrative markets, and existing carriers will need to respond to protect these markets.

The Telecommunications Act includes the general principle that "[a]ccess to advanced telecommunications information services should be provided in all regions of the Nation" and requires the FCC to review periodically the definition of universal service "taking into account advances in telecommunications and information technologies and services. The Telecommunications Act further requires that "[e]lementary and secondary schools and classrooms, health care providers, and libraries should have access to advanced telecommunications services.... While Congress did not specify what services would constitute universal service for education, libraries and healthcare, it does authorize the FCC to define universal service differently for this group of public institutional telecommunications users, thus opening the door for an expanded definition of universal service generally.

Whether universal service is a legal mandate, a political imperative or simply a social aspiration, its scope and importance will increase with increasing demand for bandwidth. As broadband applications proliferate, this gap between the information "haves" and "have nots" will be increasingly unacceptable politically, socially and economically. The challenge, and the opportunity, in this changing world is no longer how to provide basic telephony but how to provide access to real-time broadband services to areas of moderate or low user density.

With regard to broadband services, network economics are likely to dictate that universal service for a certain class of service provided to all citizens be supplemented by a class of service that are universally available to all citizens. The intent would be to deliver equality of opportunity to access these advanced services by matching the needs of the user with the most cost effective delivery technology, rather than providing costly uniform capacity to all users. This is consistent with the wide range of needs people have for communications networks. With the introduction of new technologies (e.g., ADSL, cable modem, wireless), there may be cost effective options to deliver advanced services to geographically diverse users. In many cases, the most effective mechanism for providing such services may be to create opportunities for access in libraries, schools, hospitals and community centers.

Recommendations Of The Technology Alliance

Accelerate the creation of the K-20 Educational Telecommunications Network.

The single most important initiative that we can undertake is to ensure that the State of Washington's educational institutions have access to state-of-the-art information technology. Students must have the benefit of access to the world's information resources, and must be educated in a way that prepares them for tomorrow's jobs and creates a competitive workforce for tomorrow's companies. Teachers must be brought to the forefront and kept there. Both quality and access will be facilitated by information technology. And private sector investment will be encouraged through the stimulation of market demand for advanced telecommunication services on the part of individuals, schools, and school districts.

The Legislature took the first step during the 1996 special session by passing E2SSB 6705, appropriating funds to begin a three-phase effort to create a statewide "K-20 Educational Telecommunications Network." Already, just through the technical and programmatic planning processes, important linkages have been established among K-12, the Community and Technical Colleges, and the four-year and research institutions.

As its highest priority in the telecommunications arena, the Technology Alliance urges that the creation of the K-20 Educational Telecommunications Network be carried out as rapidly as possible. This will require a significant degree of trust among the educational sectors, the Telecommunications Oversight and Planning Committee, and the Legislature – a willingness to set aside parochial interests and to minimize bureaucratic overhead. If we fail to do this -- if we delay -- then Washington's children will be deprived of the educational opportunities that they deserve, and Washington's private sector telecommunications providers will be denied the incentives for service deployment that this effort will provide.

Encourage private investment in advanced communications networks.

Advanced communications infrastructure will be developed in the private sector. The development of advanced communications networks in Washington State by private industry requires a flexible, predictable and supportive regulatory environment. The TA believes that communications providers should compete on the basis of price and service. Companies should be rewarded by the market and not by regulators for innovation and responsiveness to consumer demand when genuine competition exists in a market. As the State's carriers break down industry barriers, regulators should ensure that tax and regulatory policies do not favor certain competitors over others. Where technological advances allow companies in formerly discrete industries to offer increasingly similar services, state and local government must review and revise outdated and potentially anti-competitive regulations. Where former monopoly markets are opened to competition, state and local government must work to ensure that the former monopolists do not use their continued market dominance to inhibit new competitors or limit consumer choice. At the same time, regulators must create a level playing field for competitors and allow sufficient returns on invested capital to support the deployment of new infrastructure.

Encourage government and businesses to adopt a leading role in demonstrating the benefits of interactive broadband services

Large business and institutions are inevitably early adopters of new technology. Not only do they have the resources to deploy equipment and purchase services, but they can justify costs based on significant productivity gains. Allowing smaller groups to see the benefits of these services will benefit the entire state. The state itself is a major user of telecommunication services and may be able to use this position to influence progress in making advanced facilities more broadly available.

Create opportunities for all Washington State citizens to be educated and trained for the communications age

Information technology is so closely associated with one's quality of life that every citizen of Washington State should have the opportunity to learn certain basic skills. Some will choose not to pursue this opportunity, but at least the choice should be made available. What constitutes a "basic" skill will evolve as quickly as the underlying technology. Skills training should not be neglected in the rush to acquire new

technology. Studies have shown that as much as 40% of all funds invested in technology must be devoted to training if the full benefits of technology are to be realized.

GLOSSARY

ADSL see Asymmetrical Digital Subscriber Line

AFOR see Alternative Form of Regulation

Asymmetrical Digital Subscriber Line A technology that allows compressed digital signals to be transmitted along with voice signals over existing copper telephone wires.

Alternative Form of Regulation A type of regulatory scheme which the WUTC can impose on a telecommunications company. The WUTC can apply AFOR if it finds that such regulation will, among other things, further the public interest, is necessary to respond to changes in technology and industry structure, is better suited to achieving state policy than traditional rate-of-return regulation, will not result in degradation of services, and produces fair and equitable rates. US West has been regulated pursuant to AFOR since 1990.

Analog A property of a radio signal, such as its voltage, magnetic field or frequency, that varies continuously such that the output is "analogous" to the input. Voice and video messages originate in analog form since sound and light are wave-like functions, so they must be converted into digital format.

Asynchronous Transfer Mode A high-speed packet-based information transfer standard that relays traffic by way of an address contained within the first five bytes of a standard fifty-three byte cell.

ATM see Asynchronous Transfer Mode

Backbone A centralized high-speed network that interconnects smaller, independent networks.

Bandwidth The number of bits of information which can move through a communications medium in a given amount of time (often in bits per second).

Bit The smallest single unit of information (either a 1 or 0 in a binary system).

Broadband An imprecise term describing a transmission facility with a large bandwidth (capacity). A network that can only send analog signals or compressed digital voice communications is not a broadband network.

CAP see Competitive Access Provider

Competitive Access Provider A company that provides its customers with an alternative to the local exchange carrier (LEC) for local transport of private line and special access telecommunications services.

Carrier Any company providing communications services.

Central Offices The switching centers or central switching facilities of the telephone company.

Circuit Switching A method of opening communications lines, as through the telephone system, creating a link between the initiating and receiving parties. In circuit switching, the connection is made at a switching center, which connects the two parties and maintains dedicated circuit between them for as long as needed.

Coaxial Cable A transmission link constructed as a pair of conductors, held in position by insulating material so that the physical distance between the conductors is maintained. Most coaxial cable is used to broadcast analog television by cable television companies. Upgraded coaxial cable can be used to send switched digital signals.

Collocation The ability of a carrier to connect its network to another carrier's central offices. Physical collocation occurs when a carrier places its network connection equipment inside the other carrier's central offices. Virtual collocation is an alternative to physical collocation pursuant to which the carrier permits another carrier to connect its network to the carrier's central offices on comparable terms, even though the carrier's network connection equipment is not physically located inside the central offices.

Copper Wire Also known in the industry as twisted pair, it is the primary local loop communications medium. There are more than 600 million copper lines in use worldwide. It is less expensive than fiber optics because the raw cable is less costly and easier to work with, and because the electronic components needed to connect the copper to computers are cheaper than their fiber optic counterparts.

Cream Skimming This practice occurs when a company attempts to sell services and products to the most profitable customers, or offers only those services that generate the best profit margin.

Cross-Subsidization The practice of using revenues from one service or product to support another service or product that is sold below cost.

Depreciation An accounting term that represents the difference between the first cost of a capital item and its estimated net salvage value at the end of its expected life. For tax purposes, this amount is treated as an expense to offset revenues over the years of the expected life of the asset. Regulators adopt their own definitions of depreciation.

Digital A method of storing, processing and transmitting information through the use of distinct electronic or optical pulses that represent the binary digits 0 and 1. Digital transmission and switching technologies employ a sequence of these pulses to represent information as opposed to the continuously variable analog signal.

Digital Switch A telecommunications switch that operates with digital signals (rather than analog).

DS-1 A data communications circuit capable of transmitting data at 1.5 Mbps (sometimes called T-1).

DS-3 A data communications circuit capable of transmitting data at 45 Mbps (sometimes called T-3).

Ethernet A local area network technology used for connecting computers, printers, workstations, terminals, etc., within the same building. Ethernet operates over twisted wire or coaxial cable typically at a speed of 10 megabits per second. Ethernet is the most popular LAN technology. Companies are introducing Ethernet products with speeds greatly in excess of 10 megabits per second.

Electronic Redlining Refers to telecommunications providers seeking the most lucrative customer groups, but failing to serve those offering lower returns. (See Cream Skimming.)

Exchange Area The area in which all calls are considered local.

Facility Refers to any equipment or media that forms part of the complete end-to-end telephone connection, such as transmission lines, switches, and central offices.

Facility-Based Competition Occurs when a communications provider builds its own facilities (such as lines, equipment, and switches) for delivering telecommunications services. This type of competition is increasing. Most new competitors initially purchase capacity from incumbent common carriers and then resell these services to the public. Most of the firms in the long-distance market, for example, purchase existing capacity at wholesale rates and then resell services to the public.

FCC Federal Communications Commission.

Flat Rate A method of pricing communications service so that customers pay a fixed charge each period (typically a month) for unlimited use.

Frame Relay A type of fast packet technology using variable length packets called frames. By contrast, a cell relay system, such as ATM, transports user data in fixed-sized cells.

Frequency The number of times a complete electromagnetic wave cycle occurs in a fixed unit of time, usually one second.

Geosynchronous Orbit The orbit of a satellite in which the speed and path are precisely timed to position its 22,300 miles over a fixed location on Earth.

Gigabyte The precise meaning of this term often varies with the context; strictly, a gigabyte is 1 billion bytes.

Gigahertz One billion (10⁹) Hertz, or one thousand Megahertz (MHz).

Hertz In alternating current or radio transmission, one complete reversal of polarity in one second; a measure of frequency. Formerly "Cycles per Second."

HTML see Hypertext Markup Language

Hypertext Markup Language A simple hypertext document-formatting language that uses tags to indicate how a part of a document should be interpreted. The standard format used on the Web.

Hypertext A system in which documents scattered across many sites are directly linked, so that a word or phrase in one document becomes a door into an entirely different document.

Independent Telephone Company A local exchange carrier that was not part of the Bell system.

Information Superhighway A popular term for the emerging global broadband digital network of networks. Also known as the information infrastructure or infobahn. This phrase has been attributed to a 1991 Scientific American article written by then U.S. Senator Al Gore.

Integrated Services Digital Network A technology which provides a variety of standard digital interfaces for telephone subscribers. The technology creates an end-to-end digital circuit and brings more bandwidth to the user (e.g., 128 Kbps) than is possible using analog technology.

Interexchange Carrier A company providing long-distance phone service between Local Exchange Carriers and Local Access Transport Areas. With regards to the Internet, an IXC is known as an Interexchange Circuit, or a circuit that connects POPs.

InterLATA A call originating in one local access and transport area (LATA) and terminating in another LATA or internationally.

Internet The Internet is a global network of networks linked by the TCP/IP protocol enabling computers of all kinds to directly and transparently communicate and share services.

Internet Protocol A technical standard for communicating on the Internet system of computers and networks.

Internet Service Provider A business that allows companies and individuals to connect to the Internet by providing the interface to the Internet backbone in return for a fee (often a flat amount per month).

Intranets Internally secure networks, which are being rapidly developed by many large corporations, using the same protocols as the Internet. An internal intranet structure is similar to an external Internet structure. It utilizes TCP/IP protocol and manages documents in the Web's HTML format. Although the intranet infrastructure is the same as for the Internet, the intranet is only open to those inside an organization.

IP see Internet Protocol

ISDN See Integrated Services Digital Network.

ISP see Internet Service Provider

IXC see Interexchange Carrier

Kbps See Kilobits per Second.

Kilobits per Second One thousand bits per second.

LANs See Local Area Network.

Last Mile Popular term for the last segment of the connection between the communications provider and the customer. A captivating topic in recent years has been how to provide broadband services in the last mile or from curb to home.

LATA see Local Access Transport Area

LEC See Local Exchange Carrier

Local Access and Transport Area A geographic region ranging from a metropolitan area to a state, created with divestiture of AT&T and used to define service areas for regulated versus unregulated services (e.g., intra-LATA local services versus inter-LATA long-haul services).

Local Area Network A group of computers and other devices dispersed over a relatively limited area and connected by a communications network that enables a device to interact with any other on the network.

Local Exchange An exchange where subscriber's lines are terminated.

Local Exchange Carrier A company providing local telephone services.

Local Loop The connection between a user's premises and the local exchange.

Low-Earth-Orbit Loosely defined as satellite orbits at altitudes between 525 kilometers and 3000 kilometers.

Microwave High-frequency radio transmissions sent via wireless (rather than through wires or cables) used to beam voice, data, and video signals. Microwave transmitters must be in "line of sight" with receivers because they operate at high frequency.

Modem A device connecting two computers or network systems over telephone or similar wired communications system.

Multicast A variant of broadcast, a technology allowing information to be sent to selected recipients instead of all subscribers of a particular communications system.

Multimedia Simultaneous transmission of some combination of audio, video, still images, graphics, text, animation, and other forms of information.

Narrowband An imprecise term describing a communications medium supporting a low transmission rate (bandwidth). Voice-grade networks are narrowband in nature.

National Information Infrastructure: Another term for the information superhighway of a country.

Network Architecture The underlying structure of a network, including hardware, functional layers, interfaces, and protocols (rules) used to establish communications and ensure the reliable transfer of information.

Number Portability The ability of an end user to change carriers while retaining the same telephone number.

On-Line Services Commercial information services that offer a computer user access to a specified slate of information, entertainment and communications menus on what appears to be a single system.

Optical Fiber A lightguide for waves traveling in the infrared and visible light spectrum. An optical fiber consists of two different types of glass, core and cladding, surrounded by a protective coating. The core is the light-guiding region of the fiber, while the cladding ensures that the light pulses remain within the core.

Packet In general usage, a unit of information transmitted as a whole from one device to another on a network. In packet-switching networks, a packet is defined more specifically as a transmission unit of fixed maximum size that consists of binary digits representing both data and a header containing an identification number, source and destination addresses, and, sometimes, error-control data.

Packet Switching A message-delivery technique in which small units of information (packets) are relayed through stations in a computer network along the best route currently available between the source and the destination. A packet-switching network handles information in small bits, breaking long messages into multiple packets before routing. Although each packet may travel along a different path, and the packets composing a message may arrive at different times or out of sequence, the receiving computer reassembles the original message.

PBX see Private Branch Exchange

Personal Communications Network An advanced cellular communication that relies on microcellular technology-many low -power, small-coverage cells, and a common channel signaling technology, to provide a wide variety of features in addition to the basic two-way telephone service.

Plain Old Telephone Service Traditional voice-based telephone services.

Points of Presence With respect to voice communication, locations where a long distance carrier has installed transmission equipment in a service area that serves as, or relays call to, a network switching center of that long distance carrier, and with respect to an Internet access services network, geographic areas within which such network provides local access.

POPs see Points of Presence

POTS see Plain Old Telephone Service

Price Cap An alternative to rate-of-return regulation that sets the maximum price that telephone companies can charge for general services. The price cap changes over time, usually escalating at a rate based on the inflation index.

Price Regulation A method of regulating a carrier's prices and quality of services instead of the traditional emphasis on rate of return, which focused on earnings, profits, and return on investment.

Private Branch Exchange A telephone switching system, usually on a customer's premises, that is connected to a common group of lines from a central office and provides telephone service to many phones

and terminals.

Private Line A dedicated telecommunications connection between end users.

Protocol A set of rules defining the way that information can flow in a system to ensure correct interaction. (PSTN) see Public Switched Telephone Network

Public Switched Telephone Network That portion of the switched telephone network available to all users generally on a shared basis (i.e., not dedicated to a particular user).

Public Utility Commission A state regulatory body, established in most states, which regulates utilities, including telephone companies providing intrastate services.

PUC see Public Utility Commission

Rate Base The total amount of investment made by a company. It is the denominator in the rate-of-return formula used to calculate an allowed rate of return.

Rate Case A regulatory proceeding by the state public utility commission for adjusting or reviewing the rate structure for local and intrastate telephone service.

RBOCs see Regional Bell Operating Companies

Reciprocal Compensation The same compensation of a new competitive local exchange carrier for termination of a local call by an existing carrier on its network, as the new competitor pays the existing carrier for termination of local calls on the existing carrier's network.

Regional Bell Operating Companies The holding companies that AT&T formed at divestiture to manage the twenty-two Bell operating companies. The seven RBOCs are Ameritech, Bell Atlantic, BellSouth, NYNEX, Pacific Telesis, Southwestern Bell Communications or SBC Communications (formerly Southwestern Bell) and U.S. West.

Reseller A company that buys transmission services at wholesale rates for resale to the public for a profit.

Routers Devices that examine the destination address of a message and select the most efficient route over the network. Routers are a key part of the technology of the Internet.

Satellite Communications An orbiting system in space that receives radio signals from earth stations on earth and then retransmits them to earth stations at distant locations.

SMR see Specialized Mobile Radio

SONET see Synchronous Optical Network

Specialized Mobile Radio A two-way, radio-dispatch service being upgraded to provide digital cellular-like phone services.

Switch An electronic or mechanical device that opens or closes or selects the paths or circuits to be used for transmission of information. Switching is a process of interconnecting circuits to form a transmission path between users. Switches can be analog or digital.

Synchronous Optical Network An international standard for transmitting information over fiber, specifying standardized optical-signal formats and interfaces and integrated into the ATM packet-switching system.

T-1 A data communications circuit capable of transmitting data at 1.5 Mbps (sometimes called DS-1).

T-3 A data communications circuit capable of transmitting data at 45 Mbps (sometimes called DS-3).

TCP/IP see Transmission Control Protocol/Internet Protocol

Telecommunications A general term for the electronic transmission of information of any type.

Transmission Control Protocol/Internet Protocol A group of protocols that allow computers with different architectures and operating system software to communicate with other computers on the Internet.

Trunk Line The connection between two exchanges (switches) within a telephone company's network.

Unbundled Access Access by competitive telecommunication carriers to unbundled elements of a telecommunication services provider's network facilities, equipment, features, functions and capabilities, at any technically feasible point within the network.

Universal Service The provision of access to the telephone network at affordable cost for all who want it.

This definition is evolving to include some advanced interactive services as the demand for these services increases in addition to basic voice service.

Universal Service Fund A government program, financed by carrier revenues, that provides support to those local telephone companies whose costs of providing basic service are higher than the national average so that they can charge affordable rates. USF assistance is distributed on a sliding scale, with the highest cost study areas receiving the most assistance.

USF see Universal Service Fund

WAN see Wide Area Network

Web see World Wide Web

Wide Area Network A communications network that connects geographically separated areas. Typically, a WAN connects one or more LANs.

Wireless The transmission of radio signals through the air.

World Wide Web A networked collection of computer systems supporting a communications protocol that permits multi-media presentation of linked information over the Internet.

WUTC The Washington Utilities and Transportation Commission is the public utilities commission in Washington State.