Wiring the World:
A Telecommunications Industry Assessment

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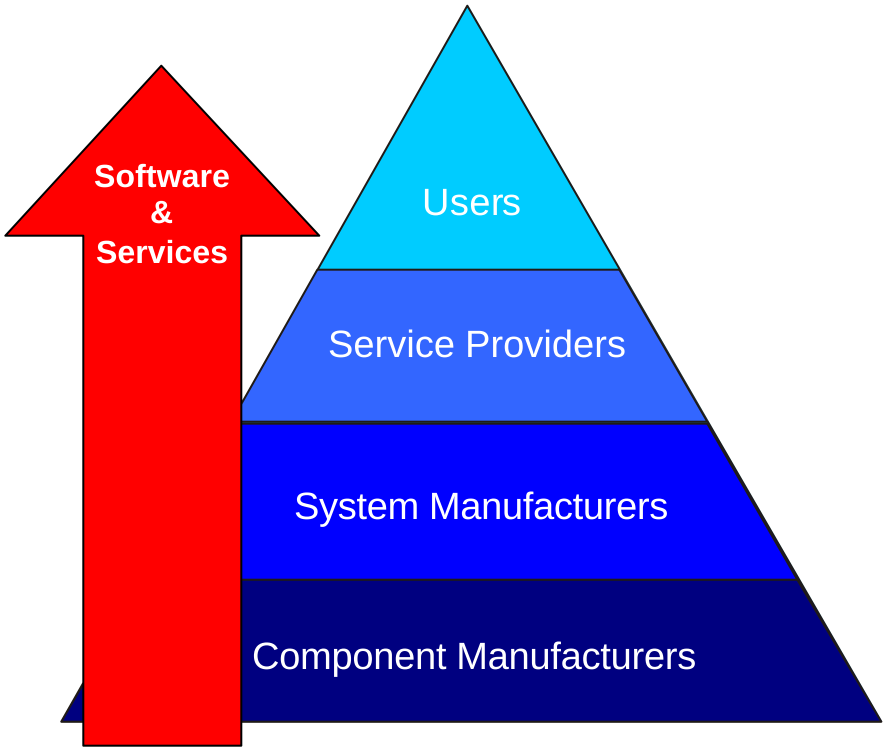
Introduction

I ask you this: Could there be a more interesting industry to work in than telecommunications? "Never a dull moment" doesn't come close to describing it. During the past decade telecomm has taken us on a roller coaster ride that, all claims to the contrary aside, hasn't come close to its grand finale. I have listened with amusement to industry pundits and players declaring that "the bubble has burst" and that telecomm has reached its proverbial End of Days. Nonsense. Since 1876, when Thomas Watson was shocked out of his shoes by A. G. Bell's voice emanating from the speaker of the Harmonic Telegraph that the two developed, we have continually installed telecommunications infrastructure and developed new applications without pause. And in spite of the recent dot-com to dot-bomb conversion (as many have taken to calling it), the supposed glut of installed optical fiber, the failure of company after company, the paucity of new, bandwidth-dependent applications designed to excite and inspire us, and the apparently rudderless movement of the wireless industry, there is still inexorable forward movement and room, therefore, for excitement, growth and technology-based investment successes.

There is also, however, fear, doubt, hysteria, and inaction, all of which erode confidence and inevitably lead to "analysis paralysis" on the parts of investors, analysts, and corporate decision-makers. This is a complex industry with more operational facets than a Marquis-cut diamond, and the task of analyzing each of them and their interdependencies is daunting at best and more often than not a showstopper.

As a professional telecommunications educator and consultant I make it my business to identify these trends, watch them closely, determine which are significant, and chart any interdependencies that emerge. This paper is designed to list the most significant of them and provide a vantage point for anyone looking to understand the current direction of the industry at large. "The industry" includes service providers, device and component manufacturers, regulators, software developers, and of course, the customers that dwell at the top of the technology food chain, shown below. Each segment is important and plays a critical role in the ongoing evolution of telecommunications technologies, companies and services.

Of course, this collection of observations and analyses represents one person's opinion. It is, however, an <u>*informed*</u> *opinion, based on interviews with hundreds of professionals in the industry, customers, and the intuition that comes from 20* *diverse years in telecomm*. As Dennis Miller likes to say, "Of course, this is just my opinion – I could be wrong."



I invite you to share your own thoughts and opinions on the positions taken in this paper. Please send correspondence to:

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Beginnings: What Do We Know?

Beginning in early 2000, the telecommunications industry has suffered a progressive and colossal meltdown. Several hundred thousand people have lost their jobs; stock options have dissolved and disappeared; and consumer confidence in the telecomm sector as a whole has eroded. JDS Uniphase, once a darling of the investment community, announced the largest loss in investment history ($50.6 billion). Manufacturers as a whole saw a 26% decline in second quarter revenues year-over-year, and new orders were down more than 50% in the same period. And while capital spending in the United States showed an admirable 25% growth rate, average revenues grew only 25% while profits dropped precipitously and return on equity faltered. Between 1996 and 2000, capital expenditures in telecommunications rose from $41 billion to $110 billion – but return on capital fell 50%. Finally, since 1984, the domestic consumer price index is up 73%, local communications volume is up 71%, but long distance prices are down 35% -- not a good sign for the long distance industry, particularly given the capital intensive nature of telecomm infrastructure.

Time is money, but speed is profit.

So why did the crash occur?

There are numerous reasons, but some are more glaring than others. Readers familiar with the children's story "The Emperor's New Clothes" will recognize similarities in telecomm's downfall.

Telecommunications is an industry that has historically been dominated by its reliance on technology and by a somewhat egotistical and techno-centric collection of companies that believed that technology itself was the final product. In the early, heady days of the industry's development, an argument could be made that this was indeed the case – but no longer. As technology became more commonplace and found its way deeper into the public psyche, its presence became an expectation rather than a special thing. There was a time when having a telephone was something to wake up and smile about in the morning – no longer. Today it is a given. Technology is a facilitation mechanism that makes possible a collection of applications that allow customers to position themselves more competitively. It is a business accelerant, a powerful catalyst that helps companies win. Companies don't buy high-bandwidth services for bragging rights: They buy them so that they can reach and respond to customer requests for service faster than the competition. In today's marketplace, time may equate to money, but speed equates to profit. The first company to reach the market wins the game, and the stakes in this game are extremely high.

So why did the crash occur? Because technologists positioned their technologies as products, and for a while, the market was fooled. When technologists offered multimedia, customers saw television. When they offered DSL, customers heard 'unlimited capability.' When they said wireless Internet, customers were foolish enough to believe them, as visions of Dick Tracy's wrist phone danced in their heads. This contrived anticipation of sexy new services drove demand for bandwidth to an all-time high. Bandwidth barons like Qwest and Global Crossing raced to install fiber in the network core at such a rate that they outstripped the cash available through traditional venture capital sources. Instead, they fell for and were seduced by junk bonds, the same kind that successfully (and lucratively) financed the cellular and optical fiber buildouts of the 1990s. In a normal market, there is nothing inherently bad about junk bonds; they are nothing more than a slightly riskier financial instrument that pays a relatively high interest rate, typically issued by a corporation that is so new that it does not have an established earnings history.

But this was not a normal market. There was a mania associated with it; any company that purported to have "the next big thing" became an instant money magnet. Venture capital flowed like a Class 5 river, because venture capitalists were blinded by the promises of technology. Meanwhile, the market clamored for services, applications and solutions. And few listened.

Soon, a gap began to develop. Like the little boy who was naïve enough to proclaim the king naked, customers began to question the growing disparity between whizbang technologies like 3G, DSL, the wireless Web and cable modems, and the services that they were not yet able to deliver. It soon became clear that the gap was not going to narrow anytime soon, and customers' academic questions became serious financial concerns. Complicating the situation was a set of Byzantine regulatory decisions, signed into law in 1934 and slightly modified in 1996 in the United States, that, while promising to open the local telecommunications marketplace and introduce unfettered competition, in fact accomplished the opposite. And the phenomenon was not limited to the United States. Confidence fell; investors pulled their investments. Debtors, left with huge loans, found themselves having to pay off accumulating debt with appreciating dollars, while cash flows declined and collateral evaporated. Major manufacturers like Lucent and Nortel, long accustomed to serving as financing entities for startups, suddenly found themselves holding the paper on enormous quantities of debt that would never be repaid. Banks turned off the capital spigot, refusing to roll loans over because of default jitters. The industry ground to a halt, and the sun set on a lot of rising stars.

Evolution

Since the divestiture of AT&T in 1984, the telecommunications services industry has metamorphosed from a small, easy-to-understand collection of companies to a rather complex jumble of players, all operating with varying degrees of success. On December 31st, 1983, there were 22 Bell Operating Companies (BOCs), two long distance providers, one significant hardware manufacturer, and about 1,500 independent telephone companies that provided telephony service throughout the US. On January 1st, 1984, the 22 BOCs coalesced into seven Regional Bell Operating Companies (RBOCs); the other players remained the same for quite a long time. In 1986, Sprint, an outgrowth of United Telephone, added its name to the list of nationwide long distance providers, and over time the cadre of hardware manufacturers grew as awareness of customer demands for choice grew. The same evolution took place at the local level. Initially competing in major metropolitan markets with the seven RBOCs were Teleport Communications Group (TCG) and Metropolitan Fiber Systems (MFS), the first pejoratively-named "Bypassers," soon relabeled "Alternative Access Providers." These companies built optical ring networks in the central business districts of large cities and competed effectively with the incumbent providers by offering redundant dual entry and an all-optical transport infrastructure. They flourished because they had the luxury to cherry-pick their markets. They did not labor to develop a presence in Dime Box, Texas, or Scratch Ankle, Alabama; they did, however, establish beachheads in Dallas and New York City, Minneapolis-St. Paul and San Francisco, Seattle and Miami – because, as bank robber Willie Sutton was wont to observe, "That's where the money is."

Petronius Arbiter, Emperor Nero's 1st century advisor on issues associated with luxury and extravagance, was once quoted as follows: ""I was to learn later in life that we tend to meet any new situation by reorganizing, and a wonderful method it can be for creating the illusion of progress while producing confusion, inefficiency, and demoralization."

Over time, these local loop competitors became known as Competitive Local Exchange Carriers (CLECs), while the RBOCs became known as Incumbent Local Exchange Carriers (ILECs). The line, however, blurred somewhat: some ILECs announced their intentions to enter the territories of other ILECs, effectively becoming de facto CLECs in their own right. Over time, the ranks of the CLECs swelled to several hundred in the United States alone. Meanwhile, other segments emerged from the service shadows. Beginning with the arrival of the Internet and Web in 1993, Internet Service Providers (ISPs) grew like mushrooms on a summer lawn – more than 5,000 in the US alone. Independent wireless providers like Winstar and Teligent sprouted in cities. A new market segment, the Data Local Exchange Carriers (DLECs), emerged with names like Northpoint, Rhythms NetConnections, and Covad. Taking advantage of a regulatory decision intended to further increase competition at the local loop level, they offered DSL service over existing local loops. In other words, a customer could purchase their phone service from the local ILEC, but had the option to buy broadband access from someone else. Pure bandwidth providers (sometimes called Bandwidth Barons) like Qwest, Global Crossing and 360Networks, riding on massive installed bases of long-haul optical fiber, offered ridiculously low prices on transport. Cable MSOs, having largely completed the digital and optical conversion of their local distribution networks, began to offer two-way interactive services including Internet access. Hardware manufacturers like Cisco, Nortel, Alcatel, and Lucent, feeling the growing pain of competition, built advertising campaigns around the technology that underlay their products.

Having good technology in this business is like table stakes in a poker game: If you don't have it, you can't play. The key to success and differentiation is what you do with the technology, not the simple act of having it.

Meanwhile, long distance companies began to feel the pinch of competition from the so-called Bandwidth Barons. Soon it dawned on them that their vaunted service was in fact a commodity, and that like any commodity the only way to be the preferred vendor was to have the lowest price – which they simply could not do when confronted with the massive over-installed base of the Bandwidth Barons and the regulatory structure under which they were required to operate. As we will see, that same regulatory structure resulted in problems for other segments as well.

Other cracks in the telecommunications armor began to appear as 2000 approached. The companies that made pure technology plays such as the ISPs, the standalone wireless companies, and the DLECs began to realize that their offered service was in fact not a service at all – it was technology, and commodity technology at that. Visions of world-changing capabilities and applications, riding on the promises of technology, began to show their limitations and customers and investors began to ask hard questions.

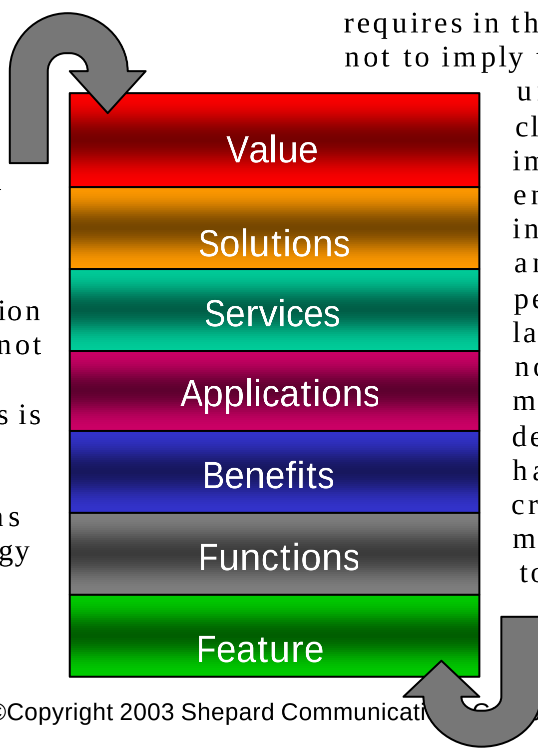
Aftermath

Today, the industry make-up is dramatically different. For the most part, the CLECs and DLECs are a dying breed. The biggest names – Covad, Northpoint, Rhythms – are gone. The herd of pure ISPs such as PSINet has been dramatically culled.

Teligent, Winstar, and Metricom, the pure wireless technology providers, have failed. Hardware manufacturers are shedding employees and restructuring, the universal panacea, and are awash in inventory. AT&T, WorldCom, and Sprint, the nation's premier long distance providers, are questioning their role in the evolving industry. And their nemeses, the Bandwidth Barons, are declaring bankruptcy.

Three segments of the industry are glaringly absent in the preceding paragraphs. During this technological bloodletting, the ILECs and the mixed breed content and service providers have escaped with minor cuts and bruises. The ILECs/PTTs – Bellsouth, Verizon, SBC -- have cash and are planning their capital expense budgets for the coming year. AOL-Time Warner, the biggest of the online service and content providers, grows apace and enjoys a constantly re-invigorated role in the marketplace. And Microsoft, with its .Net initiative, positions itself for the biggest gamble – and perhaps upside – in its 23-year history.

The Pivot Point: Customer Value and How to Measure It

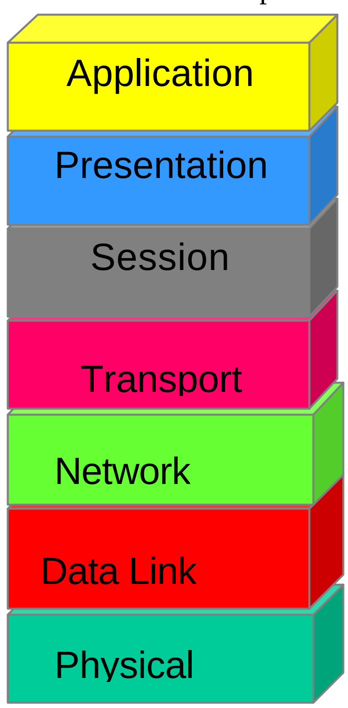


The painful realization that technology is not the answer to the market's challenges is reverberating throughout the telecommunications industry. Technology is a facilitation mechanism – nothing more. It is powerful, and necessary, but ideally should be invisible in the eyes of the end customer. The customer should see and be impressed by the effect of well-used and optimally positioned technology, not by the technology itself.

The brochures distributed by manufacturers at trade shows and via the Web typically describe their offered products in terms of three characteristics: features, functions, and benefits. Such characteristics as heat dissipation, footprint, power consumption, mean time between failure, accessibility, and the ability to upgrade easily are all described in this collateral. Unfortunately, these parameters mean nothing to senior managers in an organization that must make capital expense decisions for their companies. Their focus is on such factors as competitive positioning, the ability to resolve customer business challenges, and the resulting ability (or not) to preserve shareholder value. They just don't care about the amount of heat a box produces or the number of square feet the box requires in the central office. This is not to imply that these factors are unimportant: they clearly are. But they are important to office engineers, and installation technicians, and maintenance personnel. And by and large these employees do not sign checks. They may influence the decision, but they do not have the final say. It is critical, therefore, that manufacturers wishing to be noticed by the people who do sign the checks position their products using messages that carry information those people care about.

The hierarchy of motivation shown above illustrates the span of motivational forces. It comprises seven layers: Features, Functions, Benefits, Applications, Services, Solutions, and Value. As one progresses from the bottom to the top of the seven-layer stack, several truths emerge. From the dictionary, we derive the following definitions of each word:

Feature: A prominent or distinctive aspect, quality, or characteristic.
Function: The action for which (something) is particularly fitted or employed.
Benefit: Something that promotes or enhances well-being; an advantage.
Application: The act of putting something to a special use or purpose.
Service: An act of assistance or benefit to another or others.
Solution: The method or process of solving a problem.
Value: Worth in usefulness or importance to the possessor; utility or merit.



There are two ways to approach the use of this network services hierarchy. One way is from the bottom-up, starting with features and passing through the various layers of the model; the other is to start with features at the top and work downward. Both are valid, but must be utilized appropriately. Let's consider the functional differences between the seven layers.

Features, *functions* and *benefits* are characteristics that define the

technical capabilities and defining parameters of a device or service. "A prominent or distinctive aspect, quality, or characteristic," the definition of a feature, clearly speaks to such things as physical footprint (space a device occupies in a central office), amount of heat it generates while in operation, amount of electricity it consumes, backplane capacity, and component redundancy. Function, "the action for which (something) is particularly fitted or employed," describes the technical inner workings of a device or software module that result in some sort of operational value for the purchaser of the product. A benefit, "something that promotes or enhances well-being; an advantage," provides precisely that: an advantage that the product conveys to the customer, although typically interpreted as a technical rather than a market advantage, such as the ability to perform a hot swap of a component.

Moving up the stack, we come to *application*, "The act of putting something to a special use or purpose." An application refers to the manner in which a product is actually used – usually the reason that the customer purchased the item in the first place and the first occurrence of possible value to the consumer. *Service*, "an act of assistance or benefit to another or others," refers to the process of converting what is usually a generic application set into a more focused, perhaps customized treatment to address a specific set of needs for a client. *Solutions*, defined as "methods or processes used to resolve a problem," carry the specificity of services to the next level, addressing the customer's specific business requirements and often presenting a product directed as much at the customer's customer as at the actual customer.

Finally, we come to *value*, something that is useful or important to the possessor and offers utility or merit. Value is the most critical of the seven elements, because it is universal and timeless. Value, custom-defined in the mind of each customer, is a personal, specific, and difficult-to-quantify essence is unique to every client. The other six – feature, function, benefit, application, service, and solution – are relatively static and time-dependent. In other words, an application that is timely, useful and effective today may not be six months from now. A solution that resolves today's vexing customer problem may not this time next year. Value, however, is a constant, and has little to do with technology: it has everything to do, however, with a discrete knowledge and understanding of what makes the customer tick.

"It sure is easy to go from the Internet poster boy to the Internet piñata."

–Jeff Bezos, Amazon founder

There are a number of other analogies that lend themselves to this discussion. Consider for a moment the OSI Reference Model shown on the previous page. Its seven protocol layers cover the waterfront from physical transmission of bits to the lyrical interpretation of the meaning of specific data structures at the Application Layer. However, there is another hierarchy at work here that is often overlooked: the hierarchy of customer proximity.

The lower three layers of the OSI Model – Physical, Data Link, and Network – have the following characteristics. They are based on clearly defined, widely accepted international standards; there is relatively little room for interpreting their very clearly-stated intentions; they rarely change; they are deeply embedded in the core of the network itself, and with few exceptions rarely touch the customer; and finally, they represent the current operational domain of the typical service provider. Transport, switching and routing are the responsibilities of the telephone companies, cable companies, and their various transport cousins.

The upper layers, on the other hand, have varied responsibilities and are characteristically quite different from the lower layers. They are open to broad interpretation because they are close to the customer and must therefore be able to accommodate the diverse requirements of diverse application types; while based on standards, the standards are fluid and constantly being augmented or modified to meet the changing demands of the clients they serve; they are found scattered around the periphery of the network, because that's where the clients are; and finally, they represent the operational domain of content providers, service providers (in the truest sense of the term), application providers (ASPs), and other companies that rely on the underlying network to transport their traffic, highly customized for each customer. Clearly, then, there is a functional separation that occurs between the bottom and top of the OSI food chain. At the bottom, the network reigns supreme; at the top, the customer is emperor of all that he or she surveys.

In the days when bandwidth held sway and was the money generator, the lower layers represented a cash cow ripe for milking. Today, however, with the perceived glut of bandwidth that is now available thanks to the optical network providers, the price of that bandwidth is plummeting to a number that is very close to zero, a frightening reality for those companies that have traditionally made their fortunes through the sale of bits-per-second. Today, the big money lies at the top of the stack, closer to the customer, a place where unique, specially-designed network products can be positioned on a customer-by-customer basis. The traditional service providers – the ILECs, CLECs and IXCs – are scrambling to establish a toehold that will allow them to climb the stack, to move out of the primordial network ooze into the lofty heights of content and services. Of course, they are in an enviable position if they play their cards correctly: they touch the customers with their networks, and as my friend Dave Hill observes, "When you've got them by the access lines, their hearts and minds will follow." The combination of network provisioning and content is unbeatable, and is fast becoming a major focus for converged providers. The ability to provision an end-to-end network as well as deliver application content is a powerful combination. Thus, the service providers' interest in moving up the food chain is a valid one. They do have a challenge before them, however. The traditional service providers enjoy a broad base of knowledge about the lower three layers, given the fact that they have been providing them for 125 years. Furthermore, it costs them very little to operate there because of their massive embedded base.

Don't bother me with all that technical babble, because I don't care. What I care about is the gozinta and the gozouta – as long as the stuff I transmit gets there correctly, I'm happy. The technology is your problem, not mine.

On the other hand, they have precious little knowledge about the upper layers, and the accumulation of that knowledge will be an extremely expensive undertaking, albeit a necessary one. The process of adding capability within the higher layer services to their collection of existing skills is a necessary next step for long-term viability.

The content providers and ASPs have the opposite problem: their knowledge of upper layer services is quite rich and well developed, but they have little if any network capability. The capital investment required to build a network of their own would be prohibitive, which explains why so many of them are forming alliances or ownership arrangements with network providers.

So: What's the Answer?

The efforts by service providers, content providers, manufacturers and software developers to satisfy customer demands are facilitated by an ongoing phenomenon that they would do well to pay attention to. For over two years now, **convergence** has held sway as an inexorable force that is guiding the development of the technology and communications sectors. Those companies that choose to heed its warnings and caveats are succeeding in their efforts; those that do not are disappearing.

Convergence

Telecommunications Convergence is a three-part phenomenon.

Technology Convergence represents the unstoppable drift toward a packet-based infrastructure with particular attention being paid to the Internet Protocol, IP. By creating a converged network infrastructure service providers can enjoy the benefits of lower overhead costs associated with network operations and the ability to offer unified services across a common, low-cost, simplified platform. Technology Convergence then, is a facilitation mechanism.

Company Convergence grew out of the realization that as customer demands grew and became more diverse, offered services needed to evolve as well. Service providers and manufacturers were thus presented with a choice: they could create the necessary enhanced capabilities in-house, or they could go out and form an operational relationship with someone who already had the capability, either through an alliance, partnership or outright acquisition. Company Convergence, then, is a convenience mechanism.

Services Convergence represents the ultimate goal that all players strive for: the ability to offer the customer exactly what they are seeking in the way of services and capabilities, ideally via a converged network and technology infrastructure facilitated by carefully planned company convergence efforts.

Companies that heed the words of the convergence oracle will benefit from its wisdom. Customers no longer care about the inner workings of networks or the devices that live within them; they care about what those devices and agglomerations of technology can do for them in terms of enhanced competitive advantage, customer base preservation, brand enhancement, and market longevity. Service providers and manufacturers that make it their mission to choose technology as their competitive advantage will most assuredly be relegated to the dim corners of market disinterest. This is not melodramatic: it is measurably true.

There is a vast sea change underway within the technology and communications sector, made up of many different but often highly interrelated forces. The purpose of this paper is to examine these forces and study their interrelatedness so that some sense can be made of them and the impact they have on the greater industry's overall direction. Coincidentally, all of them fit into one of the three convergence segments, as shown in the summary, below.

Technology Convergence

- The Internet's influence is far from over.
- Broadband access will continue to be important.
- The software industry will take on a more critical role as the players evolve.
- Optical technology will the next big techno-hero.
- The semiconductor industry's influence will grow substantially and products will become more application specific.
- In spite of the hype, 3G doesn't cut it. Wireless, however, is a critical component of broadband success.
- Mobile appliances will become a significant marketplace.
- The functional migration from the core of the network to the edge is underway.
- The metro environment will become a central marketplace in the next 3-5 years.
- Network management will take on an increasingly important role.

Company Convergence

- Companies will continue to form new and often strange alliances, and the number of players in the herd will continue to shrink.
- A new regulatory environment is needed and will happen.

Services Convergence

- Content was, is, and will be king. Period.
- Storage Area Networks (SANs) and related archival technologies will become centrally important as the core-to edge evolution continues.

In the pages that follow we will examine each of these components of the convergence troika, the drivers within them, and the manner in which they are interrelated.

The Internet's influence is far from over.

IP transport, specifically the Internet, represents the architecture of the future multimedia network. As we will see a bit later, the conversion from a largely circuit-switched infrastructure to a packet fabric will begin in the network's core and migrate outward to the edge. Packet switching is the protocol of the new network paradigm; IP, ATM and MPLS will collaborate to ensure that multiservice networks will be able to offer variable Quality-of-Service (QoS) levels as customers demand variable pricing structures for offered services. Furthermore, IP will continue to enter previously impenetrable areas such as voice as QoS becomes real. And while some may claim that the Internet's influence has reached a plateau, others differ: Larry Roberts, one of the true Internet pioneers who played a pivotal role in the early development of protocols used in the online world, recently observed that in the past year, Internet traffic has quadrupled. 80% of that traffic is corporate; the so-called dot-coms contribute less than 5%. Traffic from game-playing and chat will become large contributors to the overall traffic makeup, provided broadband access becomes available.

In computers, the resource to be expended is transistors. In networks, the resource to be expended is bandwidth.

Another area of great interest – and perhaps influence – is E-commerce. As a general rule, intelligence in online commerce will rule as "shopping bots" take over the onerous tasks of product search and price/feature comparison, purchasing, and delivery logistics, all consumer- (not provider) driven. Money will fundamentally change as digital cash becomes widely accepted and trusted thanks to evolving (and effective) privacy and security overlays as well as acceptance of trusted third party players. Additionally, taxation practices will have to evolve and the changes will be profound, given the global nature of the online marketplace. And this marketplace is real: Nicholas Negroponte, director of MIT's Media Lab and author of *Being Digital*, was right: the complete digitization of certain types of products is underway, converting them from physical entities to logical entities for delivery to the customer. Music, video, software, and games are shedding their dependency on physical media for delivery to the customer and are relying instead on the growing availability of broadband access and the customer's ability to download the product within a reasonably short time interval. **Make no mistake**: success is fundamentally dependent on the widespread availability of broadband access.

Another fact of digital life is that ISPs will become largely irrelevant, because pure technology plays do not succeed in this marketplace.

Commercial Service Providers (CSPs) and Business Service Providers (BSPs) will become centrally important because they combine access with some form of desirable online content. Furthermore, end-to-end transaction management will become an offered solution, and all players will vie for a piece of this market because it is close to the customer and therefore lucrative.

Protocols continue to play a key role. HTML has long been the preferred formatting language for Web-based activities, but this will soon change. XML will replace it because it is a uniform single-source standard and has the ability to separate the content from the delivery mechanism. The initial players in this evolution will be banks, access and transport companies, and software/hardware vendors. Companies like AOL, IBM and Microsoft will prove to be pivotally important as the vanguard of change.

The Internet deserves a great deal of attention because it has served for quite a few years as a catalyst for new ideas and thought. As a business tool, however, it has some limitations. The functional decentralization of the Internet yields a lack of reliability and responsibility that can be, at best, vexing; however, it does promote a high degree of innovative behavior. As applications emerge to take advantage of the newly intelligent Internet, application-specific access and transport protocols emerge as an opportunity for innovation. This is what Microsoft's .Net initiative is all about: become the monopoly network and application provider, recognizing that with the proper packaging, the two become functionally indistinguishable. Microsoft's initiative relies on network-based subscriptions for access to content; access device agnosticism; a PC-centric model; and a reliance on XML. The model should be watched closely.

Broadband access is the single most important area upon which service providers should focus their attention if they want staying power.

In computers, the resource to be wasted is transistors, because this practice allows **everyone** to have a low-cost computer. In networks, the resource to be wasted is bandwidth, because this allows everyone to have a dedicated, always-on connection. Broadband is a key success measure as evidenced by the sustained growth in DSL, cable, and wireless local loop access options that continues apace as customer demand for high-speed access increases in response to growth in multimedia applications. One clear sign of the importance of this area is that semiconductor manufacturers have focused on this segment as a major piece of the market. Furthermore, the functional development of the network continues to move inexorably toward the need for high-speed access to complement the network's high-speed core. This paucity of service is real: only 10 million US subscribers have broadband access today.
The three technologies with the greatest chance of bringing broadband to the masses are DSL,

cable and wireless. All, however, suffer from daunting challenges. Cable suffers from the old adage that observes, “In its success lie the seeds of its own destruction.” Cable wrestled for years to overcome the market perception of inadequacy as a delivery medium for interactive voice and data services. Now, as Internet use has grown and cable modems have come into their heyday, another challenges has arisen. The interactive cable network relies on a shared bandwidth infrastructure, which means that the more people use it, the less bandwidth is available for each subscriber. DSL, meanwhile, has its own challenges. In North America, more than half of all local loops are deployed over digital loop carrier systems that make available a maximum of 64 kbps of bandwidth for each subscriber. DSL, therefore, cannot be deployed over this infrastructure without significant technological change. Additionally, the technology is hobbled by distance limitations and highly publicized installation failures.

Network convergence requires network <u>divergence</u>.

Finally, wireless is positioned as the ultimate winner in the quest for broadband customers, but only if adequate spectrum is made available by government agencies and applications evolve to drive demand. In the United States, the FCC is currently considering the addition of spectrum in the 1910 to 2400 MHz range. This spectrum would have to be taken away from satellite, MMDS, unlicensed PCS, and amateur radio, and would be made available immediately to companies ready to deploy 3G infrastructure and services. There is, however, a further caveat. According to Gartner Group, in order for 3G to succeed, 50% of the population must have access to 75% of the offered services; 5% of the population must have the most recent devices; and an obvious and widely lauded “killer application” must be evident. Reality rears its ugly head, however: today, only 18% of U.S. and Canadian subscribers have access to broadband, while 20% simply cannot get it. This lack of broadband access cannot be allowed to continue: studies have shown that widespread broadband local loop technology can add three billion work hours annually to the North American economy, a number that is well worth considering seriously.

Driving the demand for bandwidth is content, which continues to become more and more media-rich, expanding demand for high-bandwidth access. Couple this with growth in the number of home-based workers, Small-Office/Home-Office (SOHO) workers, and telecommuters, and it is easy to see why demand for bandwidth is expanding.

Closely linked to the content market is the home/office access arena. Premises technologies such as the various flavors of 802.11, HomePNA, WAP, and Bluetooth will contribute to the success of broadband access, inasmuch as they will expand the variety of content that is reachable.

The software industry will take on a more critical role as the players evolve.

Software has never been particularly visible when standing in the shadows of such technological luminaries as optical transmission hardware and blazingly-fast computers, switches and routers. That, however, is changing. As Larry Ellison's vision of the network becoming the host for software applications approaches reality (something Microsoft has taken an enormous gamble with in its .Net initiative), Applications support software will become centrally important. It will include B2B, B2C, P2P, ASP, security packages, and more. It will be the element that causes hardware to perform at its highest level of capability and offer support for a diversity of service types.

A new network "philosophy and architecture" is replacing the vision of an intelligent network. The vision is one in which the public communications network would be engineered for always-on use, not intermittence and scarcity. It would be engineered for intelligence at the end-user's device, not the network. And the network would be engineered simply to "deliver the bits, stupid," not for fancy network routing or "smart" number translation. – David Isenberg

Optical technology will be the next big techno-hero – again.

The growing demand for bandwidth has driven service providers to invest deeply in optical infrastructure in the core of the network, and to a lesser degree in metro environments. This creates a layered have-and-have-not problem: the core is now over-provisioned, as evidenced by the focus on the glut of dark fiber that now exists. Unfortunately, the edge is massively <u>under</u>-provisioned, resulting in a very uncomfortable transport disparity. Optical switching, routing, and multiplexing, as well as unimaginably fast transport, are realities today; unfortunately, they encounter a wall when they try to leave the core and head for the customer over the largely narrowband local loop. Ultimately this problem will be resolved, but until that time, optical technology remains a transport technology rather than an access solution.

The functional migration from the edge of the network to the core is underway.

There was a time when universally centralized functions made sense for economic and technological reasons – no longer. High-speed networking has become a cost-effective reality, and service providers have realized that the closer the delivery point of a service is to the customer, the better the service can meet the demands of the customer. As a result, intelligence is migrating from the core to the edge, and intelligent, high-speed devices have become centrally important components in the overall network. The migration of intelligence from the core to the edge is necessary. IP, MPLS, MGCP and SS7 suddenly become peer protocols as they struggle with the demand for QoS-aware capabilities.

Furthermore, the migration of network functionality to the edge is also a requirement. By placing network resources and capabilities at the edge of the network, they are closer to the customer and can therefore be customized to meet individual client requirements.

It is interesting to note that network convergence requires network divergence. Examples are becoming more and more common: migration of the DSLAM from the central office to the neighborhood or business park; migration of intelligence into customer-resident PBXs; deployment of remote switch modules; and distributed, edge-based signaling.

In spite of the hype, Third Generation (3G) wireless doesn't cut it.

3G is a technology that is poorly positioned –a "technology in search of a problem to solve." Originally advertised as the facilitator of the wireless Internet, customers have come to realize that it is nothing of the sort. A recent study showed that the **average** number of clicks and scrolls a subscriber had to issue to pull up a stock quote on a Web-enabled cellphone was 22 – down from the 26 required on the previous year's model. The combination is doomed to fail inasmuch as it represents a deadly combination of immature, not-yet-ready-for-the-market technology, poorly established expectations, slow, spotty connections, useless screens, and non-existent content. Comparing the experiences of surfing the Web via a computer and surfing it with a cellphone is a laughable exercise – there is no comparison.

What the market actually wants is quite simple: universal, good voice service; reasonable prices without a distance or roaming fee; and instant messaging or SMS. Considering the fact that more than 15 billion SMS messages are sent daily around the world, someone should sit up and take notice. GSM appears to be the only wireless access scheme on the planet that was actually designed around what the customer wanted.

Key to the success of broadband, obviously, is spectrum availability. The spectrum battles that are underway between broadcasters and telecomm players create enormous problems that cannot be overcome without a shift in regulatory policy. Television has always been a sacred cow in the United States and Canada, and it has always enjoyed the rights of first refusal for newly available spectrum. As a result they have amassed huge bunkers of bandwidth. The fact that they only use a relatively small percentage of what they hold appears to be irrelevant. It's high time Federal regulators recognize that sacred cows sometimes make very good burgers, and redistribute spectrum as appropriate to level the services playing field.

Of course, exceptions abound. The enormous fees paid by service providers for 3G licenses have turned out to be proverbial albatrosses around their necks. Some of them are attempting to give the licenses back to the governments that sold them in the first place. In August 2002, Dutch service provider KPN announced a $9 billion write-down of its 3G investments; Datamonitor analyst Nick Greenway tells license holders that they should give away their 3G spectrum before they suffer even greater losses than they have already incurred because of a dearth of compatible, feature-rich handsets. Once again, 3G appears to be a technology in search of a problem to solve, a problem in the form of the ever-elusive "killer application."

Mobile appliances will become a significant marketplace.

Handheld functionality represents a significant share of the application and device market. It is one of the few segments that is truly market-agnostic, largely because of the plethora of applications available for the devices. Most users have replaced the paper functionality of the three-ring planner, while many have gone farther, adding E-books, games, digital camera modules, and wireless functionality. What will emerge are devices that are actually useful, built around the functionality that the customer wants to use, not what the technologists want to deliver. Configurable PDAs will rule.

"In the old economy, restructuring and reengineering an organization were really about an aim of wringing inefficiency out of (the) organization. Reinvention requires new skills, new business models, and new behaviors. Vital companies, like vital people, reinvent themselves over and over again." –Carly Fiorina

Adding to this successful evolution will be wireless protocols such as Bluetooth, WAP, and especially 802.11. They will facilitate the entry, uptake and success of mobile appliance-based applications, provided they have access to adequate bandwidth and can support the suite of applications that customers actually want.

The computer and peripheral device industry segment will evolve in strange and wonderful ways.

With the arrival of such technologies as FireWire, the ability to create a global area network (GAN) will become a reality – and a much-vaunted capability. This will redefine network computing as we know it today as the physical locations of processors and peripherals, particularly storage devices, become immaterial. Similarly, the storage area network concept will take advantage of this evolution and will become central to the success of businesses. As the Economist observed in **The Death of Distance**, physical distance and geography become immaterial.

The metro environment will become a powerful marketplace in the next 3-5 years.

It is almost unthinkable that only 10-12% of all business facilities in the United States and Canada are "wired" with fiber today. Once again, broadband access, this time in the business environment, is hobbled by the lack of a simple infrastructure component.

There was a time when "corporate headquarters" was exactly that – a single, monolithic building that housed all of the corporation's employees. Today that environment is evolving such that multiple corporate locations within a metro area are the norm as companies learn to place staff close to major customer clusters. Unfortunately, this shift in real estate philosophy brings with it an additional challenge, this one technological: they need to be interconnected. Thus, metropolitan area networking will experience serious growth and interest in the next few years. Companies like Yipes and Telseon will rule this marketplace with such offerings as native Ethernet transport. Equally important is the fact that the overall connectivity architecture for metro will be mesh-based; rings will be used primarily in long-haul networks.

The semiconductor industry's influence will grow substantially and products will become more application specific.

The introduction of the microprocessor offered one key advantage: it brought the flexibility of computer programming to non-computer applications, resulting in the widespread proliferation of computing capability. At the same time, it made embedded, silicon-based software trivial.

The next stage was the programmable logic device, such as the Field Programmable Gate Array (FPGA). This allowed designers to use the most abundant resource available (transistors) to reduce the requirement for the scarcest resource available (system designer time). The goal of this overall effort was to convert processors, peripherals, and other devices to custom design files known as Intellectual Property (IP).

Moore's Law, based on the mandate to put more transistors on less silicon real estate for a fraction of the cost, permitted the migration of such peripheral devices as MPEG encoders/decoders, serial channel units, amplifiers, and multiplexers from external positions to the chip itself, resulting in exponential reductions in space utilization (real estate). This resulted in an expansion of microprocessor-controlled devices, the functional result of which is the Application-Specific Integrated Circuit (ASIC).

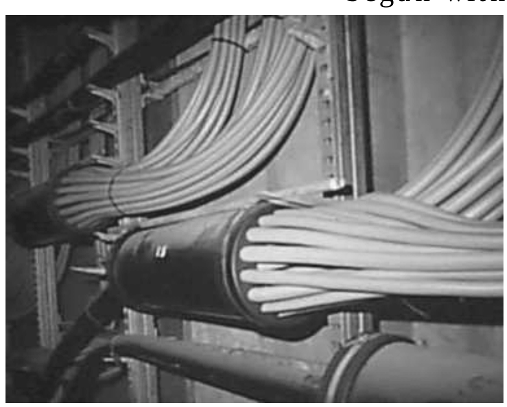
The result was a move away from wholesale chipset manufacturing to more customer-specific chipset designs. Thus, System-on-a-Chip

(SoC) functional models will begin to appear in greater numbers and with far greater specificity – but with far greater financial rewards, as well. Intellectual property (the other IP) will become the real moneymaker in the industry and will become coveted and carefully protected.

The semiconductor industry will most likely be the first segment to recover economically since it represents the "plankton" at the bottom of the food chain upon which all higher layers rely.

Network management (NM) will take on an increasingly important role.

Network management, as opposed to Element Management, has already become a focal point and rallying cry within the industry, more because of the number of companies that do not have it than those that do. Many companies in the industry offer element managers with their products, but these are device-specific and often based on proprietary software infrastructures. Furthermore, because of their proprietary nature they do not readily integrate into higher-level management systems designed to monitor the entirety of the deployed network. One thing is certain: the company that releases a single-seat, vendor-agnostic network manager that is truly capable of managing an entire network will immediately rise to the top of the credibility chart and enjoy substantial returns on their own hardware offerings. Because of vendor specificity and a commonly seen lack of understanding of the difference between element and network managers, the critical process of managing a deployed infrastructure is far more onerous, costly and complex than it needs to be. This area needs the attention of the industry.



Company Convergence

Company Convergence refers to the ongoing feeding frenzy that currently characterizes the greater telecommunications industry. As the players morph and recreate themselves in response to the dynamics of the industry and evolving customer demand, the landscape changes.

The players in the game will continue to evolve in terms of who they are and what they do.

The recreation of the telecommunications industry that began with the divestiture of AT&T in 1984 reaches far beyond the borders of the United States. It has become a global phenomenon as companies move to compete in what has become an enormously lucrative business. Customers, however, have been quick to point out that technology is a wonderful thing, but unless the provider positions it in a way that makes it useful to the would-be customer, it has zero value. Customers expect account representatives to have strong technical knowledge as well as knowledge about them as customers: business issues, competition, major segment concerns, etc. Furthermore, the level of customer satisfaction or dissatisfaction varies from industry segment to industry segment. ILECs are too rigid and expensive. CLECs must compete on price but must also show a demonstrated ability to respond quickly and offer OSS/NM capabilities. 92% of all business customers want to work with an account team when purchasing services. However, account teams by and large are not creating long-lasting relationships or loyalty. 88% of those same customers say that they buy their services from the local provider, but only 53% say that they would continue to use them if given the choice. According to numerous studies, the single most important factor that customers take into consideration when selecting a service provider is c*ost*. Yet the most important factor identified for improvement is *customer service.*

A new regulatory environment is needed and will happen.

The greatest challenge that has historically faced service providers is the requirement to provide true universal service, both in rural areas as well as in metropolitan and suburban areas. The American Communications Act of 1934, signed into law by President Roosevelt, mandated that telephony service would be universal and affordable. In order to make this happen, AT&T agreed in the 1940s to offer low-cost service with the tacit approval of the Justice Department to charge a slightly higher price for long distance, some business line services, and value-added services as a way to offset the cost of deploying high-cost rural service and to support low-income families. These subsidies made it possible to offer true universal, low-cost service.

Success in the local service business is fundamentally dependent upon network ownership.

Today, 60 – 70% of the local loops in the United States are still subsidized to the tune of anywhere from $3 to $15 per month. As a result, the incumbent service providers often charge significantly less for the service they sell than it actually costs them to provide it.

The problem with this model is that only the ILECs have the right to enjoy these subsidies, which means that CLECs are heavily penalized right out of the starting gate. As a result, they typically ignore the residence market in favor of the far more lucrative business markets. Business markets are significantly easier and less costly to provision than residence installations because of the dominance of multi-tenant buildings (MTUs) and Multiple Dwelling Units (MDUs).

The current regulatory environment in many countries does not address the disparity that exists between incumbent providers and would-be competitors. Recent decisions, such as the United States' Communications Act of 1996, consisted of a series of decisions designed to foster competition at the local loop level.

Unfortunately, by most players' estimations, it has had the opposite effect.

New technologies always convey a temporary advantage to the first mover. Innovation involves significant risk; the temporary first mover advantage allows them to extract profits as a reward for taking the initial risk, thus allowing innovators to recover the cost of innovation. As technology advances, the first mover position often goes away, so the advantage is fleeting. The relationship, however, fosters a zeal for ongoing entrepreneurial development.

Under the regulatory rule set that exists in many countries today, incumbent providers are required to open their networks through element unbundling, and to sell their resources – including new technologies – at a wholesale price to their competitors. In the minds of regulators this creates a competitive marketplace, but it is artificial. In fact, the opposite happens: the incumbents lose their incentive to invest in new technology, and innovation progresses at "telco time." Under the wholesale unbundling requirements, the rewards for innovative behavior are socialized, while the risks undertaken by the incumbents are privatized. Why should they invest and take substantial economic risk when they are required by law to immediately share the rewards with their competitors?

WorldCom paid more than six times the value of MFS' in-place assets for the company.

Ultimately, the truth comes down to this: success in the access marketplace, translated as sustainable profits, relies on network ownership – period. Many would-be competitors such as E.spire and ICG bought switches and other network infrastructure components, built partial networks, and created business plans that consciously relied on the ILECs for the remainder of their network infrastructure. Because of the aforementioned subsidies they quickly learned that this model could not succeed, and many of them have disappeared.

Consider this: When WorldCom bought Metropolitan Fiber Systems (MFS), they weren't after the business: they were after the in-place local network that MFS had built and which would allow WorldCom to satisfy customer demands for end-to-end service without going through the cost of a network build-out. They paid more than six times the value of MFS' in-place assets for the company. The message? Network ownership is key.

Two major bills currently before the U.S. Congress

(Tauzin-Dingell, HR 1542, and Cannon-Conyers, HR 1697) aim to reposition the players. 1542 makes it easier for ILECs to enter the long distance, Internet, and data businesses. 1697 tightens controls over their entry and applies significant fines for failure to open incumbent networks to competitors. 1542 has already passed the senate, but a major battle is expected in the House of Representatives. Most pundits believe that the industry needs less government controls, more competition; the FCC appears to agree.

Solutions

So what are the possible solutions? One is to eliminate the local service subsidies and allow the ILECs to raise rates so that they are slightly above the actual cost of provisioning service. Subsidies could continue for high-cost rural areas and low-income families (roughly 18% of the total), but would be eliminated elsewhere. New entrants would then have a grater chance of playing successfully in the local access business. The subsidy dollars, estimated to be in the neighborhood of $15 billion, could then be redeployed to finance universal broadband access deployment. The monies could be distributed among ILECs, CLECs, cable companies, ISPs, wireless companies, and DSL providers, to facilitate broadband.

Perhaps it's time we accepted the fact that in today's telecommunications marketplace, the local loop is a natural monopoly.

A second solution is to call for the structural separation of the ILECs, which would result in the establishment of retail and wholesale arms. The retail arm would continue to sell to traditional customers, while the wholesale arm would sell unbundled network resources to "all comers." The result would be enhanced innovation; the downside would undoubtedly be strong resistance from the ILECs.

Many believe that high-speed data and Internet access should have been exempted from the Communications Act of 1996's mandates, that it should have only targeted traditional voice services where the ILECs have clear monopoly positions. They contend that unbundling and wholesale requirements should not be required for non-voice services.

The new regime at the FCC, led by Michael Powell, has indicated that it wants less government intervention in the telecommunications marketplace rather than more, a good thing in light of the current industry. One could argue that well-intended regulatory strictures have in fact done damage. Consider the case of WorldCom. The company's original plan in the late 1990s was to challenge local service providers all over the world by creating a broadband voice and data IP network through acquisitions and mergers. The regulators, concerned by WorldCom's aggressive plans, felt that the intended company looked too much like a monopoly. They forced the divestiture of MCI's Internet company to Cable &

Wireless and rejected the proposed merger with Sprint because of fears that they would control 80% of the long distance market. This decision was made while long distance revenues were plummeting due to the influence of such disruptive technologies as multi-channel optical transport and IP. The result is two badly weakened companies that have not yet recovered – and may not. In fact, they could be prime acquisition targets by the ILECs. At the time of this writing, AT&T is in talks with BellSouth over a proposal to sell AT&T's wireline long distance assets to the company.

Another example is AT&T itself. There was a huge expectation that AT&T would be a big winner in the local broadband access game following its acquisitions of cable properties for its plans to deliver high-speed Internet and interactive services. Many analysts expected a market cross-invasion between the ILECs and cable providers, but it never happened. Cable providers concentrated on adding Internet service and additional channels; telephone companies concentrated on penetrating the long distance market. Furthermore, when talk of open access and loop unbundling began to be targeted at the cable industry in 2000, AT&T's hopes of a competitive advantage through cable ownership were dashed.

There were also expectations that ILECs would work hard to penetrate each others' markets, but this never happened, either. Who better than the ILECs knows that network ownership is the most critical factor for success in the local access game? If you control the network, you control the customers. More importantly, **if you don't have that control, don't get into the game.**

Services Convergence

We observed earlier that Technology Convergence is a facilitator, while Company Convergence is more of a convenience mechanism. We now turn our attention to the third aspect of the convergence troika, Services Convergence. Here we must observe one fundamental truth: the seat of telecomm power is shifting away from the service provider and closer to the customer. Success in this marketplace lies with the ability to deliver a complete solution that satisfies customer requirements for competitive positioning. This is the promise of Services Convergence, and it is supported by the very capable pillars of Technology and Company Convergence. It means that a company must offer much more than pure technology if it is to be successful in the long term. The key to success isn't the technology – it's what is done with the technology that really matters. Content, applications and access appliances are the drivers; technology is the facilitator of those drivers. In an ideal situation the technology itself is invisible, while digital media, broadcast content, online publishing, and digital copyright protection become very visible – and lucrative. Services, solutions, and competitive advantage become the real goals for businesses in the digital economy. And the most important differentiator of all is quality of service (QoS), the measure of the degree to which offered applications and services transported across a network infrastructure satisfy customer requirements. It is <u>not</u> measured in terms of network availability, response time, or mean time between failures, because those are measures that service providers care about. QoS must be measured in terms defined by the customer.

Storage Area Networks (SANs) will become increasingly important.

In concert with the core-to-edge migration of intelligence and bandwidth, Direct Attached Storage (DAS), Network Attached Storage (NAS) and Storage Area Networks (SAN) will take on an increasingly important role as the network's role itself changes. Furthermore, the services set that can be offered by an edge-intelligent network is quite broad and provides a significant enabler for bandwidth companies wishing to broaden their offered services set. Working in harmony with high-speed, low- cost transport technologies such as Fibre Channel and FireWire, SANs will become powerful facilitators of service evolution, especially among such segments as the ASP market. Growth in storage technologies is largely the result of growing competition, the need to move faster to *beat* the competition, and the realization that the best way to do that is to know more about the customer than the competitor does. And the only way to do *that* is to engage in data mining, information management, knowledge management, customer relationship management, supply chain management, and enterprise resource planning. And the only way to do *those* is to have ready access to massive storehouses of customer data. Hence the interest in storage technologies and the connectivity options that support them.IBM's recent announcement of its intent to move toward a centralized application and computing power distribution model is a clear indicator that this direction is real.

Looking Ahead: Actions Required

There are really two key actions that must be taken to preserve the long-term health of the technology and communications sectors. The first is a general overhaul of the regulatory structure; the other is to refocus the various segments of the industry.

Regulatory Overhaul. The following steps should be taken. First, recognize that the local loop is for all intents and purposes a natural monopoly, and that this fact will not change without a significant regulatory shift. This is not a U.S. phenomenon: Canada has undergone the same wrenching evolution with minimal positive effects, as has the UK. British Telecom (BT) complied with the Oftel mandate to unbundle the local loop as the first step toward creating a competitive local telecomm market; months later, they are still asking where the competitors are that wanted element unbundling in the first place.

One way to approach the conundrum is to remove the subsidies on local service to begin the complex process of creating a competitive market. Next, allow the ILECs to raise their rates such that they reflect the actual cost of delivering service. Subsidies can be preserved in the 18% of the local loops that are high-cost or serve low-income families. Subsidy dollars can then be reallocated to pay for broadband access. The model works: In Massachusetts, Verizon has slowly raised their rates from $8 per access line to an average of $21 -- $2 more than the actual cost of deployment. 161 viable competitors now exist in the local market, and they hold 20% of the market – more than five times the national average. Furthermore, studies indicate that a $2 surcharge on qualifying local loops in the U.S. would generate an additional $3 billion to further the broadband effort.

The second area that requires attention is a renewed focus on market dynamics by each of the industry groups, including both manufacturers and service providers. **The ILECs and PTTs**, for example should focus on cost reduction efforts that can be passed on to customers; push hard for regulatory relief to enter the long distance business for Internet and high-speed data; offer premium pricing terms that mirror the plans offered by interexchange carriers (multi-year contracts with annual renegotiation terms and discounts for volume purchases); offer outsourcing services; and work hard to increase their service areas.

The CLECs or second carriers, on the other hand, must focus on becoming solution providers rather than purely alternative access carriers. They must partner with content companies, ASPs, Web hosting services, E-mail providers, Security companies, and online storage companies. They must build account teams that know the market and the companies that make up the market, and should do everything in their power to offer the best possible customer service **as measured by the customer**.

Long distance companies must also create account teams that know the market well, and offer full-service solutions with seamless connectivity. Customer service must be made the number one priority, and value, not price, should be the focal point. Consider this: In 1999, an OC-3/STM-1 between the UK and North America cost $12 million. Today, because of optical technology and the proliferation of core bandwidth, the same circuit costs $1.8 million.

Hardware manufacturers must operate under the knowledge that technology is not their ultimate product. There is no question that technology plays a fundamental and critical role in the marketplace, but its most critical role is as a facilitator of service, not a service in its own right. Their focus should be on the direction that their customers are taking with regard to their own customers' demands, delivering products that facilitate their ability to satisfy them.

Both service providers and manufacturers must realize that while there is a glut of bandwidth in the network core, there is precious little growth at the edge, and that's where the customers dwell. The customers have the money and they are fully prepared to throw it at whatever company is willing to give them what they want. What they want is broadband access. They don't care if it comes via DSL, wireless, or a cable modem; all they really care about is that (1) it's available, and (2) it is accompanied by a suite of applications that provide tangible value in the form of differentiation or competitive advantage. A recent FCC decision to reclassify DSL and cable modem service from telecommunications services to information services is huge: as a result of this decision DSL providers no longer have to share their infrastructure with would-be competitors, and cable providers no longer will be required to share their infrastructure with other ISPs.

Conclusion

So: What is to be learned from this? First of all, the perceived decline and fall of the great telecommunications empires is not the beginning of a decent into chaos and technological barbarism, nor does it herald the beginning of a Dark Age in the marketplace. The evidence of this lies in the fact that the market remained strong (albeit with a few speed bumps) following the horrific acts of terrorism in September. The telecomm players in all their many forms are coming back, and while their return is a slow one, it is inevitable. Now, then, is the time for them to reconsider their position and the way they will play that position when the market returns to its normal state of robustness in the near future. Here are some suggestions.

Equipment: Focus on those products that lie closest to the company's core capability set, and consider jettisoning the rest. Focus on services, solutions, and tools for the creation of competitive advantage among clients; position products as the facilitators of those tools. Place the ability to manage at the network level high on the list of offered capabilities. Also, recognize that certain key technologies – optical transport, metro geography, and wireless access – will hold sway in the catbird seat for some time to come. Pay attention to them. Finally, recognize that technology without a problem to solve is cute, but largely without utility -- or marketshare -- today. Consider the lessons learned from the 3G debacle which continues to rage.

Wireline: Remember that 'service' means more than access and transport. Customers today are looking for a business partner that can help them better position themselves among the steadily growing field of competitors. They should focus, therefore, on expansion of their core capability set by adding functionality in the form of alliances or mergers with ASPs and content providers so that they become more than just a deliverer of dial tone. Furthermore, they should learn to chant the mantra of QoS and accept the fact that it must be defined by the customer, not by the service provider.

Wireless: Recognize that declining ARPU is a function of competition and lack of differentiation. Move to offer content as quickly as possible with bundled packaging, similar to what Disney will undoubtedly do in its recent announcement of plans to play in the wireless world. Commit to an access standard and go after it at full-tilt: the market is confused and needs encouragement and a calming move on somebody's part.

Content: The game is yours to lose. However, a delivery mechanism is a requirement for success, so partner with as many delivery media as possible to create desirable packages that actually fulfill a market demand. Maintain a constant focus on privacy, security, and confidentiality: the content business has gotten is fair share of scrutiny of late and this trend will continue.

Cable: Continue to hammer hard on broadband: in the residence market you clearly have the upper hand, although recent numbers seem to indicate that things are slowing down AND that DSL-based customer service is outrunning that of cable providers. It would also behoove this segment to develop an enterprise sector strategy in the same way that they have successfully gone after the education market.

Regulators: The Dark Ages are over – it's time for the Age of Enlightenment to begin. This is a very different telecommunications industry than it was at the dawn of its creation, so the rules that governed it then, and that to a large extent still govern it today, should be carefully examined for appropriateness and discarded without emotion when they are found to not be appropriate. It is time to recognize that from an economic point-of-view the local loop is a natural monopoly and should be treated as such. If, however, the access marketplace is to be competitive, then drastic measures such as structural separation should be undertaken to make it happen. Broadband is a requirement for economic growth under the general mandate of national security, prosperity, and longevity; steps should be taken to move its widespread deployment to a position of national attention and importance.

If these steps are undertaken, telecommunications will be able to accomplish the mandate of the Communications Act of 1934 of universal, affordable service. The mandate, however, will extend beyond telephony, beyond affordability, and beyond the borders of the United States. Universal telecommunications capability is a critical component of the worldwide effort toward a globalized economy, and should therefore be treated to the attention it so rightly deserves.

Steven Shepard Biography

Steven Shepard is the president of the Shepard Communications Group in Williston, Vermont. A professional writer and educator with 22 years of varied experience in the telecommunications industry, he has written books and magazine articles on a wide variety of topics. He is the author of *Telecommunications Convergence: How to Profit from the Convergence of Technologies, Services and Companies* (McGraw-Hill, New York, 2000); *A Spanish-English Telecommunications Dictionary* (Shepard Communications Group, Williston, Vermont, 2001); *Managing Cross-Cultural Transition: A Handbook for Corporations, Employees and Their Families* (Aletheia Publications, New York, 1997); *An Optical Networking Crash Course* (McGraw-Hill, New York, February 2001); *SONET and SDH Demystified* (McGraw-Hill, 2001), *A Telecommunications Crash Course* (McGraw-Hill, New York, October 2001); *Telecommunications Convergence, Second Edition* (McGraw-Hill, New York, February 2002); *Videoconferencing Demystified* (April 2002, McGraw-Hill); *Metro Networking Demystified (*McGraw-Hill, New York, October 2002); and *Telecom Jeopardy: Charting a Path in Uncertain Times* (August 2003). *Storage Technologies Demystified* and *Telecomm Regulation Demystified* will be released later in 2003. Steve is also the Series Editor of the McGraw-Hill *Portable Consultant* book series.

Mr. Shepard received his undergraduate degree in Spanish and Romance Philology from the University of California at Berkeley and his Masters Degree in International Business from St. Mary's College. He spent eleven years with Pacific Bell in San Francisco in a variety of capacities including network analysis, computer operations, systems standards development, and advanced technical training, followed by nine years with Hill Associates, a world-renowned telecommunications education company, before forming the Shepard Communications Group. He is a member of the Boards of Directors of Transylvania Telecom (Really!), Circus Smirkus, the Regional Educational Television Network, Intechron USA, and a member of the Board of Trustees of Champlain College in Burlington, Vermont. He is also the Resident Director of the University of Southern California's Executive Leadership and Advanced Management Programs in Telecommunications and adjunct faculty member at the University of Southern California, The American Graduate School of International Management (Thunderbird University), the University of Vermont, Champlain College and St. Michael's College. He is married and has two children.

Mr. Shepard specializes in international issues in telecommunications with an emphasis on strategic technical sales; convergence and optical networking; the social implications of technological change; the development of multilingual educational materials; and the effective use of multiple delivery media. He has written and directed more than 40 videos and films and written technical presentations on a broad range of topics for more than 70 companies and organizations worldwide. He is fluent in Spanish and routinely publishes and delivers presentations in that language. Global clients include major telecommunications manufacturers, service providers, software development firms, multinational corporations, universities, advertising firms, and regulatory bodies.

Common Industry Acronyms

AAL	ATM Adaptation Layer
AARP	AppleTalk Address Resolution Protocol
ABM	Asynchronous Balanced Mode
ABR	Available Bit Rate
AC	Alternating Current
ACD	Automatic Call Distribution
ACELP	Algebraic Code-Excited Linear Prediction
ACF	Advanced Communication Function
ACK	Acknowledgment
ACM	Address Complete Message
ACSE	Association Control Service Element
ACTLU	Activate Logical Unit
ACTPU	Activate Physical Unit
ADCCP	Advanced Data Communications Control Procedures
ADM	Add / Drop Multiplexer
ADPCM	Adaptive Differential Pulse Code Modulation
ADSL	Asymmetric Digital Subscriber Line
AFI	Authority and Format Identifier
AIN	Advanced Intelligent Network
AIS	Alarm Indication Signal
ALU	Arithmetic Logic Unit
AM	Administrative Module (Lucent 5ESS)
AM	Amplitude Modulation
AMI	Alternate Mark Inversion
AMP	Administrative Module Processor
AMPS	Advanced Mobile Phone System
ANI	Automatic Number Identification (SS7)
ANSI	American National Standards Institute
APD	Avalanche Photodiode
API	Application Programming Interface
APPC	Advanced Program-to-Program Communication
APPN	Advanced Peer-to-Peer Networking
APS	Automatic Protection Switching
ARE	All Routes Explorer (Source Route Bridging)
ARM	Asynchronous Response Mode
ARP	Address Resolution Protocol (IETF)
ARPA	Advanced Research Projects Agency
ARPANET	Advanced Research Projects Agency Network
ARPU	Average Revenue per User
ARQ	Automatic Repeat Request
ASCII	American Standard Code for Information Interchange
ASI	Alternate Space Inversion
ASIC	Application Specific Integrated Circuit
ASIC	Application-Specific Integrated Circuit
ASK	Amplitude Shift Keying
ASN	Abstract Syntax Notation
ASP	Application Service Provider

AT&T	American Telephone and Telegraph
ATDM	Asynchronous Time Division Multiplexing
ATM	Asynchronous Transfer Mode
ATM	Automatic Teller Machine
ATMF	ATM Forum
AU	Administrative Unit (SDH)
AUG	Administrative Unit Group (SDH)
AWG	American Wire Gauge
B8ZS	Binary 8 Zero Substitution
BANCS	Bell Administrative Network Communications System
BBN	Bolt, Beranak, and Newman
BBS	Bulletin Board Service
Bc	Committed Burst Size
BCC	Blocked Calls Cleared
BCC	Block Check Character
BCD	Blocked Calls Delayed
BCDIC	Binary Coded Decimal Interchange Code
Be	Excess Burst Size
BECN	Backward Explicit Congestion Notification
BER	Bit Error Rate
BERT	Bit Error Rate Test
BGP	Border Gateway Protocol (IETF)
BIB	Backward Indicator Bit (SS7)
B-ICI	Broadband Intercarrier Interface
BIOS	Basic Input / Output System
BIP	Bit Interleaved Parity
B-ISDN	Broadband Integrated Services Digital Network
BISYNC	Binary Synchronous Communications Protocol
BITNET	Because It's Time Network
BITS	Building Integrated Timing Supply
BLSR	Bidirectional Line Switched Ring
BOC	Bell Operating Company
BPRZ	Bipolar Return to Zero
Bps	Bits per Second
BRI	Basic Rate Interface
BRITE	Basic Rate Interface Transmission Equipment
BSC	Binary Synchronous Communications
BSN	Backward Sequence Number (SS7)
BSRF	Bell System Reference Frequency
BTAM	Basic Telecommunications Access Method
BUS	Broadcast Unknown Server
C / R	Command / Response
CAD	Computer-Aided Design
CAE	Computer-Aided Engineering
CAGR	Compound Annual Growth Rate
CAM	Computer-Aided Manufacturing
CAP	Carrierless Amplitude / Phase modulation
CAP	Competitive Access Provider
CAPEX	Capital Expenditure
CARICOM	Caribbean Community and Common Market
CASE	Common Application Service Element

CASE	Computer-Aided Software Engineering
CAT	Computer-Aided Tomography
CATIA	Computer-Assisted Three-dimensional Interactive Application
CATV	Community Antenna Television
CBEMA	Computer and Business Equipment Manufacturers Association
CBR	Constant Bit Rate
CBT	Computer-Based Training
CC	Cluster Controller
CCIR	International Radio Consultative Committee
CCIS	Common Channel Interoffice Signaling
CCITT	International Telegraph and Telephone Consultative Committee
CCS	Common Channel Signaling
CCS	Hundred Call Seconds per Hour
CD	Collision Detection
CD	Compact Disc
CDC	Control Data Corporation
CDMA	Code Division Multiple Access
CDPD	Cellular Digital Packet Data
CD-ROM	Compact Disc-Read Only Memory
CDVT	Cell Delay Variation Tolerance
CEI	Comparably Efficient Interconnection
CEPT	Conference of European Postal and Telecommunications Administrations
CERN	European Council for Nuclear Research
CERT	Computer Emergency Response Team
CES	Circuit Emulation Service
CEV	Controlled Environmental Vault
CGI	Common Gateway Interface (Internet)
CHAP	Challenge Handshake Authentication Protocol
CICS	Customer Information Control System
CICS/VS	Customer Information Control System/Virtual Storage
CIDR	Classless Interdomain Routing (IETF)
CIF	Cells In Frames
CIR	Committed Information Rate
CISC	Complex Instruction Set Computer
CIX	Commercial Internet Exchange
CLASS	Custom Local Area Signaling Services (Bellcore)
CLEC	Competitive Local Exchange Carrier
CLLM	Consolidated Link Layer Management
CLNP	Connectionless Network Protocol
CLNS	Connectionless Network Service
CLP	Cell Loss Priority
CM	Communications Module (Lucent 5ESS)
CMIP	Common Management Information Protocol
CMISE	Common Management Information Service Element
CMOL	CMIP Over LLC
CMOS	Complementary Metal Oxide Semiconductor
CMOT	CMIP Over TCP/IP
CMP	Communications Module Processor
CNE	Certified NetWare Engineer
CNM	Customer Network Management

CNR	Carrier-to-Noise Ratio
CO	Central Office
CoCOM	Coordinating Committee on Export Controls
CODEC	Coder-Decoder
COMC	Communications Controller
CONS	Connection-Oriented Network Service
CORBA	Common Object Request Brokered Architecture
COS	Class of Service (APPN)
COS	Corporation for Open Systems
CPE	Customer Premises Equipment
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
CRM	Customer Relationship Management
CRT	Cathode Ray Tube
CRV	Call Reference Value
CS	Convergence Sublayer
CSA	Carrier Serving Area
CSMA	Carrier Sense Multiple Access
CSMA/CA	Carrier Sense Multiple Access with Collision Avoidance
CSMA/CD	Carrier Sense Multiple Access with Collision Detection
CSU	Channel Service Unit
CTI	Computer Telephony Integration
CTIA	Cellular Telecommunications Industry Association
CTS	Clear To Send
CU	Control Unit
CVSD	Continuously Variable Slope Delta modulation
CWDM	Coarse Wavelength Division Multiplexing
D/A	Digital-to-Analog
DA	Destination Address
DAC	Dual Attachment Concentrator (FDDI)
DACS	Digital Access and Cross-connect System
DARPA	Defense Advanced Research Projects Agency
DAS	Dual Attachment Station (FDDI)
DAS	Direct Attached Storage
DASD	Direct Access Storage Device
DB	Decibel
DBS	Direct Broadcast Satellite
DC	Direct Current
DCC	Data Communications Channel (SONET)
DCE	Data Circuit-terminating Equipment
DCN	Data Communications Network
DCS	Digital Cross-connect System
DCT	Discrete Cosine Transform
DDCMP	Digital Data Communications Management Protocol (DNA)
DDD	Direct Distance Dialing
DDP	Datagram Delivery Protocol
DDS	DATAPHONE Digital Service (Sometimes Digital Data Service)
DDS	Digital Data Service
DE	Discard Eligibility (LAPF)
DECT	Digital European Cordless Telephone
DES	Data Encryption Standard (NIST)

DID	Direct Inward Dialing
DIP	Dual Inline Package
DLC	Digital Loop Carrier
DLCI	Data Link Connection Identifier
DLE	Data Link Escape
DLSw	Data Link Switching
DM	Delta Modulation
DM	Disconnected Mode
DM	Data Mining
DMA	Direct Memory Access (computers)
DMAC	Direct Memory Access Control
DME	Distributed Management Environment
DMS	Digital Multiplex Switch
DMT	Discrete Multitone
DNA	Digital Network Architecture
DNIC	Data Network Identification Code (X.121)
DNIS	Dialed Number Identification Service
DNS	Domain Name System (IETF)
DOD	Direct Outward Dialing
DOD	Department of Defense
DOJ	Department of Justice
DOV	Data Over Voice
DPSK	Differential Phase Shift Keying
DQDB	Distributed Queue Dual Bus
DRAM	Dynamic Random Access Memory
DSAP	Destination Service Access Point
DSF	Dispersion-Shifted Fiber
DSI	Digital Speech Interpolation
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
DSP	Digital Signal Processing
DSR	Data Set Ready
DSS	Digital Satellite System
DSS	Digital Subscriber Signaling System
DSSS	Direct Sequence Spread Spectrum
DSU	Data Service Unit
DTE	Data Terminal Equipment
DTMF	Dual Tone Multifrequency
DTR	Data Terminal Ready
DVRN	Dense Virtual Routed Networking (Crescent)
DWDM	Dense Wavelength Division Multiplexing
DXI	Data Exchange Interface
E/O	Electrical-to-Optical
EBCDIC	Extended Binary Coded Decimal Interchange Code
EBITDA	Earnings before Interest, Tax, Depreciation and Amortization
ECMA	European Computer Manufacturer Association
ECN	Explicit Congestion Notification
ECSA	Exchange Carriers Standards Association
EDFA	Erbium-Doped Fiber Amplifier
EDI	Electronic Data Interchange
EDIBANX	EDI Bank Alliance Network Exchange

EDIFACT	Electronic Data Interchange For Administration, Commerce, and Trade (ANSI)
EFCI	Explicit Forward Congestion Indicator
EFTA	European Free Trade Association
EGP	Exterior Gateway Protocol (IETF)
EIA	Electronics Industry Association
EIGRP	Enhanced Interior Gateway Routing Protocol
EIR	Excess Information Rate
EMBARC	Electronic Mail Broadcast to a Roaming Computer
EMI	Electromagnetic Interference
EMS	Element Management System
EN	End Node
ENIAC	Electronic Numerical Integrator and Computer
EO	End Office
EOC	Embedded Operations Channel (SONET)
EOT	End of Transmission (BISYNC)
EPROM	Erasable Programmable Read Only Memory
EPS	Earnings per Share
ERP	Enterprise Resource Planning
ESCON	Enterprise System Connection (IBM)
ESF	Extended Superframe Format
ESP	Enhanced Service Provider
ESS	Electronic Switching System
ETSI	European Telecommunications Standards Institute
ETX	End of Text (BISYNC)
EWOS	European Workshop for Open Systems
FACTR	Fujitsu Access and Transport System
FAQ	Frequently Asked Questions
FASB	Financial Accounting Standards Board
FAT	File Allocation Table
FCS	Frame Check Sequence
FDD	Frequency Division Duplex
FDDI	Fiber Distributed Data Interface
FDM	Frequency Division Multiplexing
FDMA	Frequency Division Multiple Access
FDX	Full-Duplex
FEBE	Far End Block Error (SONET)
FEC	Forward Error Correction
FEC	Forward Equivalence Class
FECN	Forward Explicit Congestion Notification
FEP	Front-End Processor
FERF	Far End Receive Failure (SONET)
FET	Field Effect Transistor
FHSS	Frequency Hopping Spread Spectrum
FIB	Forward Indicator Bit (SS7)
FIFO	First In First Out
FITL	Fiber In The Loop
FLAG	Fiber Ling Across the Globe
FM	Frequency Modulation
FOIRL	Fiber Optic Inter-Repeater Link
FPGA	Field Programmable Gate Array

FR	Frame Relay
FRAD	Frame Relay Access Device
FRBS	Frame Relay Bearer Service
FSK	Frequency Shift Keying
FSN	Forward Sequence Number (SS7)
FTAM	File Transfer, Access, and Management
FTP	File Transfer Protocol (IETF)
FTTC	Fiber to the Curb
FTTH	Fiber to the Home
FUNI	Frame User-to-Network Interface
FWM	Four Wave Mixing
GAAP	Generally Accepted Accounting Principles
GATT	General Agreement on Tariffs and Trade
GbE	Gigabit Ethernet
Gbps	Gigabits per Second (Billion bits per second)
GDMO	Guidelines for the Development of Managed Objects
GDP	Gross Domestic Product
GEOS	Geosynchronous Earth Orbit Satellites
GFC	Generic Flow Control (ATM)
GFI	General Format Identifier (X.25)
GFP	Generic Framing Procedure
GFP-F	Generic Framing Procedure-Frame-Based
GFP-X	Generic Framing Procedure-Transparent
GMPLS	Generalized MPLS
GOSIP	Government Open Systems Interconnection Profile
GPS	Global Positioning System
GRIN	Graded Index (fiber)
GSM	Global System for Mobile Communications
GUI	Graphical User Interface
HDB3	High Density, Bipolar 3 (E-Carrier)
HDLC	High-level Data Link Control
HDSL	High-bit-rate Digital Subscriber Line
HDTV	High Definition Television
HDX	Half-Duplex
HEC	Header Error Control (ATM)
HFC	Hybrid Fiber / Coax
HFS	Hierarchical File Storage
HLR	Home Location Register
HPPI	High Performance Parallel Interface
HSSI	High-Speed Serial Interface (ANSI)
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol (IETF)
HTU	HDSL Transmission Unit
I	Intrapictures
IAB	Internet Architecture Board (formerly Internet Activities Board)
IACS	Integrated Access and Cross-connect System
IAD	Integrated Access Device
IAM	Initial Address Message (SS7)
IANA	Internet Address Naming Authority
ICMP	Internet Control Message Protocol (IETF)
IDP	Internet Datagram Protocol

IEC	Interexchange Carrier (also IXC)
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IFRB	International Frequency Registration Board
IGP	Interior Gateway Protocol (IETF)
IGRP	Interior Gateway Routing Protocol
ILEC	Incumbent Local ExchangeCarrier
IML	Initial Microcode Load
IMP	Interface Message Processor (ARPANET)
IMS	Information Management System
InARP	Inverse Address Resolution Protocol (IETF)
InATMARP	Inverse ATMARP
INMARSAT	International Maritime Satellite Organization
INP	Internet Nodal Processor
InterNIC	Internet Network Information Center
IP	Internet Protocol (IETF)
IPX	Internetwork Packet Exchange (NetWare)
IRU	Indefeasible Rights of Use
IS	Information Systems
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ISO	Information Systems Organization
ISOC	Internet Society
ISP	Internet Service Provider
ISUP	ISDN User Part (SS7)
IT	Information Technology
ITU	International Telecommunication Union
ITU-R	International Telecommunication Union-Radio Communication Sector
IVD	Inside Vapor Deposition
IVR	Interactive Voice Response
IXC	Interexchange Carrier
JEPI	Joint Electronic Paynets Initiative
JES	Job Entry System
JIT	Just in Time
JPEG	Joint Photographic Experts Group
KB	Kilobytes
Kbps	Kilobits per Second (Thousand Bits per Second)
KLTN	Potassium Lithium Tantalate Niobate
KM	Knowledge Management
LAN	Local Area Network
LANE	LAN Emulation
LAP	Link Access Procedure (X.25)
LAPB	Link Access Procedure Balanced (X.25)
LAPD	Link Access Procedure for the D-Channel
LAPF	Link Access Procedure to Frame Mode Bearer Services
LAPF-Core	Core Aspects of the Link Access Procedure to Frame Mode Bearer Services
LAPM	Link Access Procedure for Modems
LAPX	Link Access Procedure half-duplex

LASER	Light Amplification by the Stimulated Emission of Radiation
LATA	Local Access and Transport Area
LCD	Liquid Crystal Display
LCGN	Logical Channel Group Number
LCM	Line Concentrator Module
LCN	Local Communications Network
LD	Laser Diode
LDAP	Lightweight Directory Access Protocol (X.500)
LEAF®	Large Effective Area Fiber® (Corning product)
LEC	Local Exchange Carrier
LED	Light Emitting Diode
LENS	Lightwave Efficient Network Solution (Centerpoint)
LEOS	Low Earth Orbit Satellites
LER	Label Edge Router
LI	Length Indicator
LIDB	Line Information Database
LIFO	Last In First Out
LIS	Logical IP Subnet
LLC	Logical Link Control
LMDS	Local Multipoint Distribution System
LMI	Local Management Interface
LMOS	Loop Maintenance Operations System
LORAN	Long-range Radio Navigation
LPC	Linear Predictive Coding
LPP	Lightweight Presentation Protocol
LRC	Longitudinal Redundancy Check (BISYNC)
LS	Link State
LSI	Large Scale Integration
LSP	Label Switched Path
LSR	Label Switched Router
LU	Line Unit
LU	Logical Unit (SNA)
MAC	Media Access Control
MAN	Metropolitan Area Network
MAP	Manufacturing Automation Protocol
MAU	Medium Attachment Unit (Ethernet)
MAU	Multistation Access Unit (Token Ring)
MB	Megabytes
MBA™	Metro Business Access™ (Ocular)
Mbps	Megabits per Second (Million bits per second)
MD	Message Digest (MD2, MD4, MD5) (IETF)
MDF	Main Distribution Frame
MDU	Multi-Dwelling Unit
MEMS	Micro Electrical Mechanical System
MF	Multifrequency
MFJ	Modified Final Judgment
MHS	Message Handling System (X.400)
MIB	Management Information Base
MIC	Medium Interface Connector (FDDI)
MIME	Multipurpose Internet Mail Extensions (IETF)
MIPS	Millions of Instructions Per Second

MIS	Management Information Systems
MITI	Ministry of International Trade and Industry (Japan)
ML-PPP	Multilink Point-to-Point Protocol
MMDS	Multichannel, Multipoint Distribution System
MMF	Multimode Fiber
MNP	Microcom Networking Protocol
MON	Metropolitan Optical Network
MP	Multilink PPP
MPEG	Motion Picture Experts Group
MPLS	Multiprotocol Label Switching
MP?S	Multiprotocol Lambda Switching
MPOA	Multiprotocol Over ATM
MRI	Magnetic Resonance Imaging
MSB	Most Significant Bit
MSC	Mobile Switching Center
MSO	Mobile Switching Office
MSPP	Multi-Service Provisioning Platform
MSVC	Meta-signaling Virtual Channel
MTA	Major Trading Area
MTBF	Mean Time Between Failure
MTP	Message Transfer Part (SS7)
MTSO	Mobile Telephone Switching Office
MTTR	Mean Time to Repair
MTU	Maximum Transmission Unit
MTU	Multi-Tenant Unit
MVS	Multiple Virtual Storage
NAFTA	North American Free Trade Agreement
NAK	Negative Acknowledgment (BISYNC, DDCMP)
NAP	Network Access Point (Internet)
NARUC	National Association of Regulatory Utility Commissioners
NAS	Network Attached Storage
NASA	National Aeronautics and Space Administration
NASDAQ	National Association of Securities Dealers Automated Quotations
NATA	North American Telecommunications Association
NATO	North Atlantic Treaty Organization
NAU	Network Accessible Unit
NCP	Network Control Program
NCSA	National Center for Supercomputer Applications
NCTA	National Cable Television Association
NDIS	Network Driver Interface Specifications
NDSF	Non-Dispersion-Shifted Fiber
NetBEUI	NetBIOS Extended User Interface
NetBIOS	Network Basic Input / Output System
NFS	Network File System (Sun)
NIC	Network Interface Card
NII	National Information Infrastructure
NIST	National Institute of Standards and Technology (formerly NBS)
NIU	Network Interface Unit
NLPID	Network Layer Protocol Identifier
NLSP	NetWare Link Services Protocol
NM	Network Module

Nm	Nanometer
NMC	Network Management Center
NMS	Network Management System
NMT	Nordic Mobile Telephone
NMVT	Network Management Vector Transport protocol
NNI	Network Node Interface
NNI	Network-to-Network Interface
NOC	Network Operations Center
NOCC	Network Operations Control Center
NOS	Network Operating System
NPA	Numbering Plan Area
NREN	National Research and Education Network
NRZ	Non-Return to Zero
NRZI	Non-Return to Zero Inverted
NSA	National Security Agency
NSAP	Network Service Access Point
NSAPA	Network Service Access Point Address
NSF	National Science Foundation
NTSC	National Television SystemsCommittee
NTT	Nippon Telephone and Telegraph
NVOD	Near Video on Demand
NZDSF	Non-Zero Dispersion-Shifted Fiber
OADM	Optical Add-Drop Multiplexer
OAM	Operations, Administration, and Maintenance
OAM&P	Operations, Administration, Maintenance, and Provisioning
OAN	Optical Area Network
OBS	Optical Burst Switching
OC	Optical Carrier
OEM	Original Equipment Manafacturer
O-E-O	Optical-Electrical-Optical
OLS	Optical Line System (Lucent)
OMAP	Operations, Maintenance, and Administration Part (SS7)
ONA	Open Network Architecture
ONU	Optical Network Unit
OOF	Out of Frame
OPEX	Operating Expenses
OS	Operating System
OSF	Open Software Foundation
OSI	Open Systems Interconnection (ISO, ITU-T)
OSI RM	Open Systems Interconnection Reference Model
OSPF	Open Shortest Path First (IETF)
OSS	Operation Support Systems
OTDM	Optical Time Division Multiplexing
OTDR	Optical Time-Domain Reflectometer
OUI	Organizationally Unique Identifier (SNAP)
OVD	Outside Vapor Deposition
OXC	Optical Cross-Connect
P/F	Poll/Final (HDLC)
PAD	Packet Assembler/Disassembler (X.25)
PAL	Phase Alternate Line
PAM	Pulse Amplitude Modulation

PANS	Pretty Amazing New Stuff
PBX	Private Branch Exchange
PCI	Pulse Code Modulation
PCI	Peripheral Component Interface
PCMCIA	Personal Computer Memory Card International Association
PCN	Personal Communications Network
PCS	Personal Communications Services
PDA	Personal Digital Assistant
PDH	Plesiochronous Digital Hierarchy
PDU	Protocol Data Unit
PIN	Positive-Intrinsic-Negative
PING	Packet Internet Groper (TCP/IP)
PLCP	Physical Layer Convergence Protocol
PLP	Packet Layer Protocol (X.25)
PM	Phase Modulation
PMD	Physical Medium Dependent (FDDI)
PNNI	Private Network Node Interface (ATM)
PON	Passive Optical Networking
POP	Point of Presence
POSIT	Profiles for Open Systems Interworking Technologies
POSIX	Portable Operating System Interface for UNIX
POTS	Plain Old Telephone Service
PPP	Point-to-Point Protocol (IETF)
PRC	Primary Reference Clock
PRI	Primary Rate Interface
PROFS	Professional Office System
PROM	Programmable Read Only Memory
PSDN	Packet Switched Data Network
PSK	Phase Shift Keying
PSPDN	Packet Switched Public Data Network
PSTN	Public Switched Telephone Network
PTI	Payload Type Identifier (ATM)
PTT	Post, Telephone, and Telegraph
PU	Physical Unit (SNA)
PUC	Public Utility Commission
PVC	Permanent Virtual Circuit
QAM	Quadrature Amplitude Modulation
Q-bit	Qualified data bit (X.25)
QLLC	Qualified Logical Link Control (SNA)
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying
QPSX	Queued Packet Synchronous Exchange
R&D	Research & Development
RADSL	Rate Adaptive Digital Subscriber Line
RAID	Redundant Array of Inexpensive Disks
RAM	Random Access Memory
RARP	Reverse Address Resolution Protocol (IETF)
RAS	Remote Access Server
RBOC	Regional Bell Operating Company
RF	Radio Frequency
RFC	Request For Comments (IETF)

RFH	Remote Frame Handler (ISDN)
RFI	Radio Frequency Interference
RFP	Request For Proposal
RHC	Regional Holding Company
RHK	Ryan, Hankin and Kent (Consultancy)
RIP	Routing Information Protocol (IETF)
RISC	Reduced Instruction Set Computer
RJE	Remote Job Entry
RNR	Receive Not Ready (HDLC)
ROI	Return on Investment
ROM	Read-Only Memory
ROSE	Remote Operation Service Element
RPC	Remote Procedure Call
RPR	Resilient Packet Ring
RR	Receive Ready (HDLC)
RTS	Request To Send (EIA-232-E)
S/DMS	SONET/Digital Multiplex System
S/N	Signal-to-Noise Ratio
SAA	Systems Application Architecture (IBM)
SAAL	Signaling ATM Adaptation Layer (ATM)
SABM	Set Asynchronous Balanced Mode (HDLC)
SABME	Set Asynchronous Balanced Mode Extended (HDLC)
SAC	Single Attachment Concentrator (FDDI)
SAN	Storage Area Network
SAP	Service Access Point (generic)
SAPI	Service Access Point Identifier (LAPD)
SAR	Segmentation and Reassembly (ATM)
SAS	Single Attachment Station (FDDI)
SASE	Specific Applications Service Element (subset of CASE, Application Layer)
SATAN	System Administrator Tool for Analyzing Networks
SBS	Stimulated Brillouin Scattering
SCCP	Signaling Connection Control Point (SS7)
SCP	Service Control Point (SS7)
SCREAM™	Scalable Control of a Rearrangeable Extensible Array of Mirrors (Calient)
SCSI	Small Computer Systems Interface
SCTE	Serial Clock Transmit External (EIA-232-E)
SDH	Synchronous Digital Hierarchy (ITU-T)
SDLC	Synchronous Data Link Control (IBM)
SDS	Scientific Data Systems
SEC	Securities and Exchange Commission
SECAM	Sequential Color with Memory
SF	Superframe Format (T-1)
SGML	Standard Generalized Markup Language
SGMP	Simple Gateway Management Protocol (IETF)
SHDSL	Symmetric HDSL
S-HTTP	Secure HTTP (IETF)
SIF	Signaling Information Field
SIG	Special Interest Group
SIO	Service Information Octet

SIP	Serial Interface Protocol
SIR	Sustained Information Rate (SMDS)
SLA	Service Level Agreement
SLIP	Serial Line Interface Protocol (IETF)
SM	Switching Module
SMAP	System Management Application Part
SMDS	Switched Multimegabit Data Service
SMF	Single Mode Fiber
SMP	Simple Management Protocol
SMP	Switching Module Processor
SMR	Specialized Mobile Radio
SMS	Standard Management System (SS7)
SMTP	Simple Mail Transfer Protocol (IETF)
SNA	Systems Network Architecture (IBM)
SNAP	Subnetwork Access Protocol
SNI	Subscriber Network Interface (SMDS)
SNMP	Simple Network Management Protocol (IETF)
SNP	Sequence Number Protection
SOHO	Small-Office, Home-Office
SONET	Synchronous Optical Network
SPAG	Standards Promotion and Application Group
SPARC	Scalable Performance Architecture
SPE	Synchronous Payload Envelope (SONET)
SPID	Service Profile Identifier (ISDN)
SPM	Self Phase Modulation
SPOC	Single Point of Contact
SPX	Sequenced Packet Exchange (NetWare)
SQL	Structured Query Language
SRB	Source Route Bridging
SRP	Spatial Reuse Protocol
SRS	Stimulated Raman Scattering
SRT	Source Routing Transparent
SS7	Signaling System 7
SSL	Secure Socket Layer (IETF)
SSP	Service Switching Point (SS7)
SST	Spread Spectrum Transmission
STDM	Statistical Time Division Multiplexing
STM	Synchronous Transfer Mode
STM	Synchronous Transport Module (SDH)
STP	Signal Transfer Point (SS7)
STP	Shielded Twisted Pair
STS	Synchronous Transport Signal (SONET)
STX	Start of Text (BISYNC)
SVC	Signaling Virtual Channel (ATM)
SVC	Switched Virtual Circuit
SXS	Step-by-Step Switching
SYN	Synchronization
SYNTRAN	Synchronous Transmission
TA	Terminal Adapter (ISDN)
TAG	Technical Advisory Group
TASI	Time Assigned Speech Interpolation

TAXI	Transparent Asynchronous Transmitter / Receiver Interface (Physical Layer)
TCAP	Transaction Capabilities Application Part (SS7)
TCM	Time Compression Multiplexing
TCM	Trellis Coding Modulation
TCP	Transmission Control Protocol (IETF)
TDD	Time Division Duplexing
TDM	Time Division Multiplexing
TDM	Time Division Multiplexing
TDMA	Time Division Multiple Access
TDR	Time Domain Reflectometer
TE1	Terminal Equipment type 1 (ISDN capable)
TE2	Terminal Equipment type 2 (non-ISDN capable)
TEI	Terminal Endpoint Identifier (LAPD)
TELRIC	Total Element Long-Run Incremental Cost
TIA	Telecommunications Industry Association
TIRKS	Trunk Integrated Record Keeping System
TL1	Transaction Language 1
TLAN	Transparent LAN
TM	Terminal Multiplexer
TMN	Telecommunications Management Network
TMS	Time-Multiplexed Switch
TOH	Transport Overhead (SONET)
TOP	Technical and Office Protocol
TOS	Type of Service (IP)
TP	Twisted Pair
TR	Token Ring
TRA	Traffic Routing Administration
TSI	Time Slot Interchange
TSLRIC	Total Service Long-Run Incremental Cost
TSO	Terminating Screening Office
TSO	Time-Sharing Option (IBM)
TSR	Terminate and Stay Resident
TSS	Telecommunication Standardization Sector (ITU-T)
TST	Time-Space-Time Switching
TSTS	Time-Space-Time-Space Switching
TTL	Time to Live
TU	Tributary Unit (SDH)
TUG	Tributary Unit Group (SDH)
TUP	Telephone User Part (SS7)
UA	Unnumbered Acknowledgment (HDLC)
UART	Universal Asynchronous Receiver Transmitter
UBR	Unspecified Bit Rate (ATM)
UDI	Unrestricted Digital Information (ISDN)
UDP	User Datagram Protocol (IETF)
UHF	Ultra High Frequency
UI	Unnumbered Information (HDLC)
UNI	User-to-Network Interface (ATM, FR)
UNIT™	Unified Network Interface Technology™ (Ocular)
UNMA	Unified Network Management Architecture
UPS	Uninterruptable Power Supply

UPSR	Unidirectional Path Switched Ring
UPT	Universal Personal Telecommunications
URL	Uniform Resource Locator
USART	Universal Synchronous Asynchronous Receiver Transmitter
USB	Universal Serial Bus
UTC	Coordinated Universal Time
UTP	Unshielded Twisted Pair (Physical Layer)
UUCP	UNIX-UNIX Copy
VAN	Value-Added Network
VAX	Virtual Address Extension (DEC)
vBNS	Very High Speed Backbone Network Service
VBR	Variable Bit Rate (ATM)
VBR-NRT	Variable Bit Rate-Non-Real-Time (ATM)
VBR-RT	Variable Bit Rate-Real-Time (ATM)
VC	Venture Capital
VC	Virtual Channel (ATM)
VC	Virtual Circuit (PSN)
VC	Virtual Container (SDH)
VCC	Virtual Channel Connection (ATM)
VCI	Virtual Channel Identifier (ATM)
VCI	Virtual Channel Identifier (ATM)
VCSEL	Vertical Cavity Surface Emitting Laser
VDSL	Very High-speed Digital Subscriber Line
VDSL	Very High bit rate Digital Subscriber Line
VERONICA	Very Easy Rodent-Oriented Netwide Index to Computerized Archives (Internet)
VGA	Variable Graphics Array
VHF	Very High Frequency
VHS	Video Home System
VID	VLAN ID
VINES	Virtual Networking System (Banyan)
VIP	VINES Internet Protocol
VLAN	Virtual LAN
VLF	Very Low Frequency
VLR	Visitor Location Register (Wireless / GSM)
VLSI	Very Large Scale Integration
VM	Virtual Machine (IBM)
VM	Virtual Memory
VMS	Virtual Memory System (DEC)
VOD	Video-on-Demand
VP	Virtual Path
VPC	Virtual Path Connection
VPI	Virtual Path Identifier
VPN	Virtual Private Network
VR	Virtual Reality
VSAT	Very Small Aperture Terminal
VSB	Vestigial Sideband
VSELP	Vector-Sum Excited Linear Prediction
VT	Virtual Tributary
VTAM	Virtual Telecommunications Access Method (SNA)
VTOA	Voice and Telephony over ATM

VTP	Virtual Terminal Protocol (ISO)
WACK	Wait Acknowledgment (BISYNC)
WACS	Wireless Access Communications System
WAIS	Wide Area Information Server (IETF)
WAN	Wide Area Network
WAP	Wireless Application Protocol (Wrong Approach to Portability)
WARC	World Administrative Radio Conference
WATS	Wide Area Telecommunications Service
WDM	Wavelength Division Multiplexing
WIN	Wireless In-building Network
WTO	World Trade Organization
WWW	World Wide Web (IETF)
WYSIWYG	What You See Is What You Get
xDSL	x-Type Digital Subscriber Line
XID	Exchange Identification (HDLC)
XNS	Xerox Network Systems
XPM	Cross Phase Modulation
ZBTSI	Zero Byte Time Slot Interchange
ZCS	Zero Code Suppression

Glossary of Terms

Numerical

3G 3G systems will provide access to a wide range of telecommunication services supported by both fixed telecommunication networks and other services specific to mobile users. A range of mobile terminal types will be supported, and may be designed for mobile or fixed use. Key features of 3G systems are compatibility of services, small terminals with worldwide roaming capability, Internet and other multimedia applications, high bandwidth, and a wide range of services and terminals.

4G 4G networks extend 3G network capacity by an order of magnitude, rely entirely on a packet infrastructure, Use network elements that are 100% digital, and offer extremely high bandwidth.

A

Abend A contraction of the words 'Abnormal End' used to describe a computer crash in the mainframe world.

Absorption A form of optical attenuation in which optical energy is converted into an alternative form, often heat. Often caused by impurities in the fiber, hydroxyl absorption is the best-known form.

Acceptance Angle The critical angle within which incident light is totally internally reflected inside the core of an optical fiber.

Access The set of technologies used to reach the network by a user.

Add-Drop Multiplexer (ADM) A device used in SONET and SDH systems that has the ability add and remove signal components without having to demultiplex the entire transmitted transmission stream, a significant advantage over legacy multiplexing systems such as DS3.

Aerial Plant Transmission equipment (including media, amplifiers, splice cases, etc.) that is suspended in the air between poles.

Alternate Mark Inversion The encoding scheme used in T-1. Every other 'one' is inverted in polarity from the one that preceded or follows it.

ALU Arithmetic Logic Unit; the "brain" of a CPU chip.

Amplifier A device that increases the transmitted power of a signal. Amplifiers are typically spaced at carefully selected intervals along a transmission span.

Amplifier A device used in analog networks to strengthen data signals.

Amplitude Modulation A signal encoding technique in which the amplitude of the carrier is modified according to the behavior of the signal that it is transporting.

Amplitude Modulation The process of causing an electromagnetic wave to carry information by changing or modulating the amplitude or loudness of the wave.

AMPS Advanced Mobile Phone Service; the modern analog cellular network.

Analog A signal that is continuously varying in time. Functionally, the opposite of digital.

Analog A word that means "constantly varying in time."

Angular misalignment The reason for loss that occurs at the fiber ingress point. If the light source is improperly aligned with the fiber's core, some of the incident light will be lost, leading to reduced signal strength.

Armor The rigid protective coating on some fiber cables that protects them from crushing and from chewing by rodents.

ASCII American Standards Code for Information Interchange. A 7-bit data encoding scheme.

ASIC Application-Specific Integrated Circuit, which is a specially designed IC created for a specific application.

Asynchronous Data that is transmitted between two devices that do not share a common clock source.

Asynchronous Transfer Mode (ATM) A standard for switching and multiplexing that relies on the transport of fixed-size data entities called cells which are 53 octets in length. ATM has enjoyed a great deal of attention lately because its internal workings allow it to provide quality of service (QoS), a much-demanded option in modern data networks.

ATM Adaptation Layer (AAL) In ATM, the layer responsible for matching the payload being transported to a requested quality of service level by assigning an ALL Type which the network responds to.

ATM Asynchronous Transfer Mode; one of the family of so-called fast packet technologies characterized by low error rates, high speed, and low cost. ATM is designed to connect seamlessly with SONET and SDH.

Attenuation The reduction in signal strength in optical fiber that results from absorption and scattering effects.

Avalanche Photodiode (APD) An optical semiconductor receiver that has the ability to amplify weak, received optical signals by "multiplying" the number of received photons to intensify the strength of the received signal. APDs are used in transmission systems where receiver sensitivity is a critical issue.

Average Revenue per User (ARPU) The average amount of revenue generated by each customer, calculated by dividing total revenue by the total number of subscribers.

Axis The center line of an optical fiber.

B

Back Scattering The problem that occurs when light is scattered backward into the transmitter of an optical system. This impairment is analogous to echo which occurs in copper-based systems.

Balance Sheet The balance sheet provides a view of what a company owns (its assets) and what it owes to creditors (its liabilities). The assets always equal the sum of the liabilities and shareholder equity. Liabilities represent obligations the firm has against its own assets. Accounts payable, for example, represent funds owed to someone or to another company that is outside the corporation, but that are balanced by some service or physical asset that has been provided to the company.

Bandwidth A measure of the number of bits per second that can be transmitted down a channel.

Bandwidth The range of frequencies within which a transmission system operates.

Baseband In signaling, any technique that uses digital signal representation.

Baud The *signaling rate* of a transmission system. This is one of the most misunderstood terms in all of telecommunications. Often used synonymously with bits-per-second, baud usually has a very different meaning. By using multibit encoding techniques, a single signal can simultaneously represent multiple bits. Thus the bit rate can be many times the signaling rate.

Beam Splitter An optical device used to direct a single signal in multiple directions through the use of a partially reflective mirror or some form of an optical filter.

BECN Backward Explicit Congestion Notification; a bit used in frame relay for notifying a device that it is transmitting too much information into the network and is therefore in violation of its service agreement with the switch.

Bell System Reference Frequency (BSRF) In the early days of the Bell System, a single timing source in the Midwest provided a timing signal for all central office equipment in the country. This signal, delivered from a very expensive cesium clock source, was known as the BSRF. Today, GPS is used as the main reference clock source.

Bend Radius The maximum degree to which a fiber can be bent before serious signal loss or fiber breakage occurs. Bend radius is one of the functional characteristics of most fiber products.

Bending Loss Loss that occurs when a fiber is bent far enough that its maximum allowable bend radius is exceeded. In this case, some of the light escapes from the waveguide resulting in signal degradation.

Bidirectional A system that is capable of transmitting simultaneously in both directions.

Binary A counting scheme that uses Base 2.

Bit Rate Bits-per-second.

Bluetooth An open wireless standard designed to operate at a gross transmission level of 1 Mbps. Bluetooth is being positioned as a connectivity standard for personal area networks.

Bragg Grating A device that relies on the formation of interference patterns to filter specific wavelengths of light from a transmitted signal. In optical systems, Bragg Gratings are usually created by wrapping a grating of the correct size around a piece of fiber that has been made photosensitive. The fiber is then exposed to strong ultraviolet light which passes through the grating, forming areas of high and low refractive indices. Bragg Gratings (or filters, as they are often called) are used for selecting certain wavelengths of a transmitted signal, and are often used in optical switches, DWDM systems and tunable lasers.

Broadband Historically, broadband meant "any signal that is faster than the ISDN Primary Rate (T1 or E1). Today, it means "big pipe" – in other words, a very high transmission speed.

Broadband In signaling the term means analog; in data transmission it means "big pipe" (high bandwidth).

Buffer A coating that surrounds optical fiber in a cable and offers protection from water, abrasion, etc.

Building Integrated Timing Supply (BITS) The central office device that receives the clock signal from GPS or another source and feeds it to the devices in the office it controls.

Bus The parallel cable that interconnects the components of a computer.

Butt Splice A technique in which two fibers are joined end-to-end by fusing them with heat or optical cement.

C

Cable An assembly made up of multiple optical or electrical conductors, as well as other inclusions such as strength members, waterproofing materials, armor, etc.

Cable Assembly A complete optical cable that includes the fiber itself and terminators on each end to make it capable of attaching to a transmission or receive device.

Cable Plant The entire collection of transmission equipment in a system, including the signal emitters, the transport media, the switching and multiplexing equipment, and the receive devices.

Cable Vault The subterranean room in a central office where cables enter and leave the building.

Call Center A room in which operators receive calls from customers.

Capital Expenditures (CAPEX) Wealth in the form of money or property, typically accumulated in a business by a person, partnership, or corporation. In most cases capital expenditures can be amortized over a period of several years, most commonly five.

Capital Intensity A measure that has begun to appear as a valid measure of financial performance for large telecom operators. It is calculated by dividing capital spending (CAPEX) by revenue.

Cash Flow One of the most common measures of valuation for public and private companies. True cash flow is exactly that – a measure of the cash that flows through a company during some defined time period after factoring out all fixed expenses. In many cases cash flow is equated to EBITDA. Usually, cash flow is defined as income after taxes minus preferred dividends plus depreciation and amortization.

CCITT Consultative Committee on International Telegraphy and Telephony. Now defunct and replaced by the ITU-TSS.

CDMA Code Division Multiple Access, one of several digital cellular access schemes. CDMA relies on frequency hopping and noise modulation to encode conversations.

Cell Loss Priority (CLP) In ATM, a rudimentary single-bit field used to assign priority to transported payloads.

Cell Relay Service (CRS) In ATM, the most primitive service offered by service providers, consisting of nothing more than raw bit transport with no assigned AAL types.

Cell The standard protocol data unit in ATM networks. It comprises a five-byte header and a 48-octet payload field.

Cellular Telephony The wireless telephony system characterized by the following: low-power cells; frequency reuse; handoff; central administration.

Center Wavelength The central operating wavelength of a laser used for data transmission.

Central Office A building that houses shared telephony equipment such as switches, multiplexers, and cable distribution hardware.

Central Office Terminal (COT) In loop carrier systems, the device located in the central office that provides multiplexing and de-multiplexing services. It is connected to the remote terminal.

Chained Layers The lower three layers of the OSI Model that provide for connectivity.

Chirp A problem that occurs in laser diodes when the center wavelength shifts momentarily during the transmission of a single pulse. Chirp is due to instability of the laser itself.

Chromatic Dispersion Because the wavelength of transmitted light determines its propagation speed in an optical fiber, different wavelengths of light will travel at different speeds during transmission. As a result, the multi-wavelength pulse will tend to “spread out” during transmission, causing difficulties for the receive device. Material dispersion, waveguide dispersion and profile dispersion all contribute to the problem.

CIR Committed Information Rate; the volume of data that a frame relay provider absolutely guarantees it will transport for a customer.

Circuit Emulation Service (CES) In ATM, a service that emulates private line service by modifying (1) the number of cells transmitted per second and (2) the number of bytes of data contained in the payload of each cell.

Cladding The fused silica “coating” that surrounds the core of an optical fiber. It typically has a different index of refraction than the core, causing light that escapes from the core into the cladding to be refracted back into the core.

CLEC Competitive Local Exchange Carrier; a small telephone company that competes with the incumbent player in its own marketplace.

CMOS Complimentary Metal Oxide Semiconductor, a form of integrated circuit technology that is typically used in low-speed and low-power applications.

Coating The plastic substance that covers the cladding of an optical fiber. It is used to prevent damage to the fiber itself through abrasion.

Coherent A form of emitted light in which all the rays of the transmitted light align themselves the same transmission axis, resulting in a narrow, tightly focused beam. Lasers emit coherent light.

Compression The process f reducing the size of a transmitted file without losing the integrity of the content by eliminating redundant information prior to transmitting or storing.

Concatenation The technique used in SONET and SDH in which multiple payloads are "ganged" together to form a super-rate frame capable of transporting payloads greater in size than the basic transmission speed of the system. Thus, an OC-12c provides 622.08 Mbps of total bandwidth, as opposed to an OC-12, which also offers 622.08 Mbps, but in increments of OC-1 (51.84 Mbps).

Conditioning The process of "doctoring" a dedicated circuit to eliminate the known and predictable results of distortion.

Congestion The condition that results when traffic arrives faster than it can be processed by a server.

Connectivity The process of providing electrical transport of data.

Connector a device, usually mechanical, used to connect a fiber to a transmit or receive device or to bond two fibers.

Core The central portion of an optical fiber that provides the primary transmission path for an optical signal. It usually has a higher index of refraction than the cladding.

Core The central high-speed transport region of the network.

Counter-Rotating Ring A form of transmission system that comprises two rings operating in opposite directions. Typically, one ring serves as the active path while the other serves as the protect or backup path.

CPU Central Processing Unit. Literally the chipset in a computer that provides the intelligence.

CRC Cyclic Redundancy Check; a mathematical technique for checking the integrity of the bits in a transmitted file.

Critical Angle The angle at which total internal reflection occurs.

Cross-Phase Modulation (XPM) A problem that occurs in optical fiber that results from the nonlinear index of refraction of the silica in the fiber. Because the index of refraction varies according to the strength of the transmitted signal, some signals interact with each other in destructive ways. Cross-Phase Modulation is considered to be a fiber nonlinearity.

CSMA/CD Carrier Sense, Multiple Access with Collision Detection; the medium access scheme used in Ethernet LANs and characterized by an "if it feels good do it" approach.

Current Ratio Calculated by dividing the current assets for a financial period by the current liabilities for the same period. Be careful: a climbing current ratio might be a good indicator of improving financial performance, but could also indicate that warehoused product volumes are climbing.

Customer Relationship Management (CRM) A technique for managing the relationship between a service provider and a customer through the discrete management of knowledge about the customer.

Cutoff Wavelength The wavelength below which single mode fiber ceases to be single mode.

Cylinder A stack of tracks to which data can be logically written on a hard drive.

D

Data Raw, unprocessed zeroes and ones.

Data Communications The science of moving data between two or more communicating devices.

Data Mining A technique in which enterprises extract information about customer behavior by analyzing data contained in their stored transaction records.

Datagram The service provided by a connectionless network. Often said to be unreliable, this service makes no guarantees with regard to latency or sequentiality.

DCE Data Circuit Terminating Equipment; a modem or other device that delineates the end of the service provider's circuit.

DE Discard Eligibility bit; a primitive single-bit technique for prioritizing traffic that is to be transmitted.

Debt to Equity Ratio Calculated by dividing the total debt for a particular fiscal year by the total shareholder equity for the same financial period.

Decibel (dB) A logarithmic measure of the strength of a transmitted signal. Because it is a logarithmic measure, a 20 dB loss would indicate that the received signal is one one-hundredth its original strength.

Dense Wavelength Division Multiplexing (DWDM) A form of frequency division multiplexing in which multiple wavelengths of light are transmitted across the same optical fiber. These DWDM systems typically operate in the so-called L-Band (1625 nm) and have channels that are spaced between 50 and 100 GHz apart. Newly-announced products may dramatically reduce this spacing.

Detector An optical receive device that converts an optical signal into an electrical signal so that it can be handed off to a switch, router, multiplexer, or other electrical transmission device. These devices are usually either NPN or APDs.

Diameter Mismatch Loss Loss that occurs when the diameter of a light emitter and the diameter of the ingress fiber's core are dramatically different.

Dichroic Filter A filter that transmits light in a wavelength-specific fashion, reflecting non-selected wavelengths.

Dielectric A substance that is non-conducting.

Diffraction Grating A grid of closely spaced lines that are used to selectively direct specific wavelengths of light as required.

Digital A signal characterized by discrete states. The opposite of analog.

Digital Hierarchy In North America, the multiplexing hierarchy that allows 64 Kbps DS-0 signals to be combined to form DS-3 signals for high bit rate transport.

Digital Literally, 'discrete.'

Digital Subscriber Line Access Multiplexer (DSLAM) The multiplexer in the central office that receives voice and data signals on separate channels, relaying voice to the local switch and data to a router elsewhere in the office.

Diode A semiconductor device that only allows current to flow in a single direction.

Direct Attached Storage (DAS) A storage option in which the storage media (hard drives, CDs, etc.) are either integral to the server (internally mounted) or are directly connected to one of the servers.

Dispersion Compensating Fiber (DCF) A segment of fiber that exhibits the opposite dispersion effect of the fiber to which it is coupled. DCF is used to counteract the dispersion of the other fiber.

Dispersion The spreading a light signal over time that results from modal or chromatic inefficiencies in the fiber.

Dispersion-Shifted Fiber (DSF) A form of optical fiber that is designed to exhibit zero dispersion within the C-Band (1550 nm). DSF does not work well for DWDM because of Four Wave Mixing problems; Non-Zero Dispersion Shifted Fiber is used instead.

Distortion A known and measurable (and therefore correctable) impairment on transmission facilities.

Dopant Substances used to lower the refractive index of the silica used in optical fiber.

DS-1 Digital signal level 1, a 1.544 Mbps signal.

DS-2 Digital signal level 2, a 6.312 Mbps signal.

DS3 A 44.736 Mbps signal format found in the North American Digital Hierarchy.

DSL Digital Subscriber Line, a technique for transporting high-speed digital data across the analog local loop while (in some cases) transporting voice simultaneously.

DTE Data Terminal Equipment; user equipment that is connected to a DCE.

DTMF Dual-Tone, Multi-Frequency; the set of tones used in modern phones to signal dialed digits to the switch. Each button triggers a pair of tones.

Duopoly The current regulatory model for cellular systems; two providers are assigned to each market. One is the wireline provider (typically the local ILEC), the other an independent provider.

DWDM Dense Wavelength Division Multiplexing; a form of frequency division multiplexing that allows multiple optical signals to be transported simultaneously across a single fiber.

E

E1 The 2.048 Mbps transmission standard found in Europe and other parts of the world. It is analogous to the North American T1.

Earnings Before Interest, Tax, Depreciation and Amortization (EBITDA) EBITDA**,** sometimes called *operating cash flow*, is used to evaluate a firm's operating profitability before subtracting non-operating expenses such as interest and other core, "non-business" expenses and non-cash charges. Long ago, cable companies and other highly capital-intensive industries substituted EBITDA for traditional cash flow as a *temporary* measure of financial performance without adding in the cost of building new infrastructure. By excluding all interest due on borrowed capital as well as the inevitable depreciation of assets, EBITDA was seen as a temporary better gauge of potential future performance.

Earnings per Share (EPS) Calculated by dividing annual earnings by the total number of outstanding shares.

EBCDIC Extended Binary Coded Decimal Interchange Code; an 8-bit data encoding scheme.

Edge The periphery of the network where aggregation, QoS and IP implementation take place. This is also where most of the intelligence in the network resides.

EDGE Enhanced Data for Global Evolution; a 384 Kbps enhancement to GSM.

Edge-Emitting Diode A diode that emits light from the edge of the device rather than the surface, resulting in a more coherent and directed beam of light.

Effective Area The cross-section of a single-mode fiber that carries the optical signal.

EIR Excess Information Rate; the amount of data that is being transmitted by a user ABOVE the CIR in frame relay.

Encryption The process of modifying a text or image file to prevent unauthorized users from viewing the content.

End-to-End Layers The upper four layers of the OSI Model that provide interoperability.

Enterprise Resource Planning (ERP) A technique for managing customer interactions through data mining, knowledge management and customer relationship management (CRM).

Erbium-Doped Fiber Amplifier (EDFA) A form of optical amplifier that uses the element erbium to bring about the amplification process. Erbium has the enviable quality that when struck by light operating at 980 nm, it emits photons in the 1550 nm range, thus providing agnostic amplification for signals operating in the same transmission window.

ESF Extended Superframe; the framing technique used in modern T-carrier systems that provides a dedicated data channel for non-intrusive testing of customer facilities.

Ethernet A LAN product developed by Xerox that relies on a CSMA / CD medium access scheme.

Evanescent Wave Light that travels down the inner layer of the cladding instead of down the fiber core.

Extrinsic Loss Loss that occurs at splice points in an optical fiber.

Eye Pattern A measure of the degree to which bit errors are occurring in optical transmission systems. The width of the "eyes" (Eye Patterns look like figure eights lying on their sides) indicates the relative bit error rate.

F

Facility A circuit.

Faraday Effect Sometimes called the magneto-optical effect, the Faraday Effect describes the degree to which some materials can cause the polarization angle of incident light to change when placed within a magnetic field that is parallel to the propagation direction.

Fast Ethernet A version of Ethernet that operates at 100 Mbps.

Fast Packet Technologies characterized by low error rates, high speed, and low cost.

FDMA Frequency Division Multiple Access; the access technique used in analog AMPS cellular systems.

FEC Forward Error Correction; an error correction technique that sends enough additional overhead information along with the transmitted data that a receiver can not only detect an error but actually fix it without requesting a resend.

FECN Forward Explicit Congestion Notification; a bit in the header of a frame relay frame that can be used to notify a distant switch that the frame experienced severe congestion on its way to the destination.

Ferrule A rigid or semi-rigid tube that surrounds optical fibers and protects them.

Fiber Grating A segment of photosensitive optical fiber that has been treated with ultraviolet light to create a refractive index within the fiber that varies periodically along its length. It operates analogously to a fiber grating and is used to select specific wavelengths of light for transmission.

Fiber-to-the-Curb (FTTC) A transmission architecture for service delivery in which a fiber is installed in a neighborhood and terminated at a junction box. From there, coaxial cable or twisted pair can be cross-connected from the O-E converter to the customer premises. If coax is used, the system is called Hybrid Fiber Coax (HFC); twisted pair-based systems are called Switched Digital Video (SDV).

Fibre Channel A set of standards for a serial I/O bus that supports a range of port speeds including 133 Mbps, 266 Mbps, 530 Mbps, 1 Gbps, and soon, 4 Gbps. The standard supports point to point connections, switched topologies, and arbitrated loop architecture.

Financial Accounting Standards Board (FASB) The officially recognized entity that establishes standards for accounting organizations to ensure commonality among countries and international accounting organizations.

Four Wave Mixing (FWM) The nastiest of the so-called fiber nonlinearities. FWM is commonly seen in DWDM systems and occurs when the closely spaced channels mix and generate the equivalent of optical sidebands. The number of these sidebands can be expressed by the equation $\frac{1}{2}(n^3-n^2)$, where n is the number of original channels in the system. Thus a 16-channel DWDM system will potentially generate 1,920 interfering sidebands!

Frame A variable size data transport entity.

Frame Relay Bearer Service (FRBS) In ATM, a service that allows frame relay frame to be transported across an ATM network.

Frame Relay One of the family of so-called fast packet technologies characterized by low error rates, high speed, and low cost.

Freespace Optics A metro transport technique that uses a narrow unlicensed optical beam to transport high-speed data.

Frequency Modulation The process of causing an electromagnetic wave to carry information by changing or modulating the frequency of the wave.

Frequency-Agile The ability of a receiving or transmitting device to change its frequency in order to take advantage of alternate channels.

Frequency-Division Multiplexing The process of assigning specific frequencies to specific users.

Fresnel Loss The loss that occurs at the interface between the head of the fiber and the light source to which it is attached. At air-glass interfaces, the loss usually equates to about 4%.

Full-Duplex Two-way simultaneous transmission.

Fused Fiber A group of fibers that are fused together so that will remain in alignment. They are often used in one-to-many distribution systems for the propagation if a single signal to multiple destinations. Fused fiber devices play a key role in passive optical networking (PON).

Fusion Splice A splice made by melting the ends of the fibers together.

G

Generally Accepted Accounting Principles (GAAP) Those commonly recognized accounting practices that ensure financial accounting standardization across multiple global entities.

Generic Flow Control (GFC) In ATM, the first field in the cell header. It is largely unused except when it is overwritten in NNI cells, in which case it becomes additional space for virtual path addressing.

GEOS Geosynchronous Earth Orbit Satellite; A family of satellites that orbit above the equator at an altitude of 22,300 miles and provide data and voice transport services.

Gigabit Ethernet A version of Ethernet that operates at 1,000 Mbps.

Global Positioning System (GPS) The array of satellites used for radiolocation around the world. In the telephony world, GPS satellites provide an accurate timing signal for synchronizing office equipment.

Go-Back-N A technique for error correction that causes all frames of data to be transmitted again, starting with the errored frame.

Gozinta "Goes into."

Gozouta "Goes out of."

GPRS General Packet Radio Service; another add-on for GSM networks that is not enjoying a great deal of success in the market yet. Stay tuned.

Graded Index Fiber (GRIN) A type of fiber in which the refractive index changes gradually between the central axis of the fiber and the outer layer, instead of abruptly at the core-cladding interface.

Gross Domestic Product (GDP) The total market value of all the goods and services produced by a nation during a specific period of time.

GSM Global System for Mobile Communications; the wireless access standard used in many parts of the world that offers two-way paging, short messaging and two-way radio in addition to cellular telephony.

GUI Graphical User Interface; the computer interface characterized by the "click, move, drop" method of file management.

Half-Duplex Two-way transmission, but only one direction at a time.

Haptics The science of providing tactile feedback to a user electronically. Often used in high-end virtual reality systems.

Headend The signal origination point in a cable system.

Header Error Correction (HEC) In ATM, the header field used to recover from bit errors in the header data.

Header In ATM, the first five bytes of the cell. The header contains information used by the network to route the cell to its ultimate destination. Fields in the cell header include Generic Flow Control, Virtual Path Identifier, Virtual Channel Identifier, Payload Type Identifier, Cell Loss Priority, and Header Error Correction.

Hertz (Hz) A measure of cycles per second in transmission systems.

Hop Count A measure of the number of machines a message or packet has to pass through between the source and the destination. Often used as a diagnostic tool.

Hybrid Fiber Coax A transmission system architecture in which a fiber feeder penetrates a service area and is then cross-connected to coaxial cable feeders into the customers' premises.

I

ILEC Incumbent Local Exchange Carrier; an RBOC.

Income Statement The income statement is used to report a corporation's revenues, expenses and net income (profit) for a particular defined time period. Sometimes called a *Profit and Loss (P&L) Statement* or *Statement of Operations*, the Income Statement charts a company's performance over a period of time. The results are most often reported as *earnings per share* and *diluted earnings per share*. Earnings per share is defined as the proportion of the firm's net income that can be accounted for on a per-share basis of outstanding common stock. It is calculated by subtracting preferred dividends from net income and dividing the result by the number of common shares that are outstanding. Diluted earnings per share, on the other hand, takes into account earned or fully vested stock options that haven't yet been exercised by their owner, and shares that would be created from the conversion of convertible securities into stock.

Indefeasible Rights of Use (IRU) A long-term capacity lease of a cable. IRUs are identified by channels and available bandwidth and are typically granted for long periods of time.

Index of refraction A measure of the ratio between the velocity of light in a vacuum and the velocity of the same light in an optical fiber. The refractive index is always greater than one and is denoted 'n.'

Information Data that has been converted to manipulable form.

Infrared (IR) The region of the spectrum within which most optical transmission systems operate, found between 700 nm and 0.1 mm.

Injection Laser a semiconductor laser (synonym).

Inside Plant Telephony equipment that is outside of the central office.

Intermodulation A fiber nonlinearity that is similar to four-wave mixing, in which the power-dependent refractive index of the transmission medium allows signals to mix and create destructive sidebands.

Interoperability Characterized by the ability to logically share information between two communicating devices and be able to read and understand the data of the other.

Interoperability In SONET and SDH, the ability of devices from different manufacturers to send and receive information to and from each other successfully.

Intrinsic Loss Loss that occurs as the result of physical differences in the two fibers being spliced.

ISDN Integrated Services Digital Network; a digital local loop technology that offers moderately high bit rates to customers.

ISP Internet Service Provider; a company that offers Internet access.

ITU International Telecommunications Union; a division of the United Nations that is responsible for managing the telecomm standards development and maintenance processes.

ITU-TSS ITU Telecommunications Standardization Sector; the ITU organization responsible for telecommunications standards development.

J

Jacket The protective outer coating of an optical fiber cable. The jacket may be polyethylene, Kevlar®, or metallic.

JPEG Joint Photographic Experts Group; a standards body tasked with developing standards for the compression of still images.

Jumper An optical cable assembly, usually fairly short, that is terminated on both ends with connectors.

K

Knowledge Information that has been acted upon and modified through some form of intuitive human thought process.

Knowledge Management The process of managing all that a company knows about its customers in an intelligent way so that some benefit is attained for both the customer and the service provider.

L

Lambda A single wavelength on a multi-channel DWDM system.

LAN Emulation (LANE) In ATM, a service that defines the ability to provide bridging services between LANs across an ATM network.

LAN Local Area Network; a small network that has the following characteristics: privately owned; high speed; low error rate; physically small.

Large Core Fiber Fiber that characteristically has a core diameter of 200 microns or more.

Laser An acronym for 'Light Amplification by the Stimulated Emission of Radiation.' Lasers are used in optical transmission systems because they produce coherent light that is almost purely monochromatic.

Laser Diode (LD) A diode that produces coherent light when a forward biasing current is applied to it.

LATA Local Access and Transport Area; the geographic area within which an ILEC is allowed to transport traffic. Beyond LATA boundaries the ILEC must hand traffic off to a long-distance carrier.

LEOS Low Earth Orbit Satellite; satellites that orbit pole-to-pole instead of above the equator and offer near-instantaneous response time.

Light Emitting Diode (LED) A diode that emits incoherent light when a forward bias current is applied to it. LEDs are typically used in shorter distance, lower speed systems.

Lightguide A term that is used synonymously with optical fiber.

Line Overhead (LOH) In SONET, the overhead that is used to manage the network regions between multiplexers.

Linewidth The spectrum of wavelengths that make up an optical signal.

Load Coil A device that tunes the local loop to the voiceband.

Local Loop The pair of wires (or digital channel) that runs between the customer's phone (or computer) and the switch in the local central office.

Loose Tube Optical Cable An optical cable assembly in which the fibers within the cable are loosely contained within tubes inside the sheath of the cable. The fibers are able to move within the tube, thus allowing them to adapt and move without damage as the cable is flexed and stretched.

Loss the reduction in signal strength that occurs over distance, usually expressed in decibels.

M

M13 A multiplexer that interfaces between DS-1 and DS-3 systems.

Mainframe A large computer that offers support for very large databases and large numbers of simultaneous sessions.

MAN Metropolitan Area Network; a network, larger than a LAN, that provides high-speed services within a metropolitan area.

Market Cap(italization) Market cap is the current market value of all outstanding shares that a company has. It is calculated by multiplying the total number of outstanding shares by the current share price.

Material Dispersion A dispersion effect caused by the fact that different wavelengths of light travel at different speeds through a medium.

MDF Main Distribution Frame; the large iron structure that provides physical support for cable pairs in a central office between the switch and the incoming / outgoing cables.

Message Switching An older technique that sends entire messages from point to point instead of breaking the message into packets.

Metasignaling Virtual Channel (MSVC) In ATM, a signaling channel that is always on. It is used for the establishment of temporary signaling channels as well as channels for voice and data transport.

Metropolitan Optical Network (MON) An all-optical network deployed in a metro region.

Microbend Changes in the physical structure of an optical fiber caused by bending, that can result in light leakage from the fiber.

Midspan Meet In SONET and SDH, the term used to describe interoperability. See also *interoperability*.

Modal Dispersion (See Multimode Dispersion)

Mode A single wave that propagates down a fiber. Multimode fiber allows multiple modes to travel, while single mode fiber allows only a single mode to be transmitted.

Modem A term from the words ‘modulate’ and ‘demodulate.’ It’s job is to make a computer appear to the network like a telephone.

Modulation the process of changing or *modulating* a carrier wave to cause it to carry information.

MPEG Moving Picture Experts Group; a standards body tasked with crafting standards for motion pictures.

MPLS A level three protocol designed to provide quality of service across IP networks without the need for ATM, by assigning QoS “labels” to packets as they enter the network.

MTSO Mobile Telephone Switching Office; a central office with special responsibilities for handling cellular services and the interface between cellular users and the wireline network.

Multi-dwelling Unit (MDU) A building that houses multiple residence customers such as an apartment building.

Multimode Dispersion Sometimes referred to as modal dispersion, multimode dispersion is caused by the fact that different modes take different times to move from the ingress point to the egress point of a fiber, thus resulting in modal spreading.

Multimode Fiber Fiber that has a core diameter of 62.5 microns or greater, wide enough to allow multiple modes of light to be simultaneously transmitted down the fiber.

Multiplexer A device that has the ability to combine multiple inputs into a single output as a way to reduce the requirement for additional transmission facilities.

Multiprotocol over ATM (MPOA) In ATM, a service that allows IP packets to be routed across an ATM network.

Multi-tenant Unit (MTU) A building that houses multiple enterprise customers such as a high-rise office building.

N

Near-End Crosstalk (NEXT) The problem that occurs when an optical signal is reflected back toward the input port from one or more output ports. This problem is sometimes referred to as 'isolation directivity.'

Net Income Another term for bottom-line profit.

Network Attached Storage (NAS) An architecture in which a server accesses storage media via a LAN connection. The storage media are connected to another server.

Noise An unpredictable impairment in networks. It cannot be anticipated; it can only be corrected after the fact.

Non-Dispersion Shifted Fiber (NDSF) Fiber that is designed to operate at the low-dispersion second operational window (1310 nm).

Non-Zero Dispersion-Shifted Fiber (NZDSF) A form of single mode fiber that is designed to operate just outside the 1550 nm window so that fiber nonlinearities, particularly FWM, are minimized.

Numerical Aperture (NA) A measure of the ability of a fiber to gather light, NA is also a measure of the maximum angle at which a light source can be from the center axis of a fiber in order to collect light.

O

OAM&P Operations, Administration, Maintenance and Provisioning, the four key areas in modern network management systems. OAM&P was first coined by the Bell System and continues in widespread use today.

OC-n Optical Carrier level n, a measure of bandwidth used in SONET systems. OC-1 is 51.84 Mbps; OC-n is n times 51.84 Mbps.

Operating Expenses (OPEX) Those expenses that must be accounted for in the year in which they are incurred.

Optical Amplifier A device that amplifies an optical signal without first converting it to an electrical signal.

Optical Burst Switching (OBS) A technique that uses a "one-way reservation" technique so that a burst of user data, such as a cluster of IP packets, can be sent without having to establish a dedicated path prior to transmission. A control packet is sent first to reserve the wavelength, followed by the traffic burst. As a result, OBS avoids the protracted end-to-end setup delay and also improves the utilization of optical channels for variable-bit-rate services.

Optical Carrier Level n (OC-n) In SONET, the transmission level at which an optical system is operating.

Optical Isolator A device used to selectively block specific wavelengths of light.

Optical Time Domain Reflectometer (OTDR) A device used to detect failures in an optical span by measuring the amount of light reflected back from the air-glass interface at the failure point.

OSS Operations Support Systems; another term for OAM&P.

Outside Plant Telephone equipment that is outside of the central office.

P

Packet A variable size entity normally carried inside a frame or cell.

Packet Switching The technique for transmitting packets across a wide area network.

Path Overhead In SONET and SDH, that part of the overhead that is specific to the payload being transported.

Payload In SONET and SDH, the user data that is being transported.

Payload Type identifier (PTI) In ATM, a cell header field that is used to identify network congestion and cell type. The first bit indicates whether the cell was generated by the user or by the network, while the second indicates the presence or absence of congestion in user-generated cells, or flow-related Operations, Administration & Maintenance information in cells generated by the network. The third bit is used for service-specific, higher-layer functions in the user-to-network direction, such as to indicate that a cell is the last in a series of cells. From the network to the user, the third bit is used with the second bit to indicate whether the OA&M information refers to segment or end-to-end-related information flow.

PBX Private Branch Exchange; literally a small telephone switch located on a customer prem. The PBX connects back to the service provider's central office via a collection of high-speed trunks.

PCM Pulse Code Modulation; the encoding scheme used in North America for digitizing voice.

Phase Modulation The process of causing an electromagnetic wave to carry information by changing or modulating the phase of the wave.

Photodetector A device used to detect an incoming optical signal and convert it to an electrical output.

Photodiode A semiconductor that converts light to electricity.

Photon The fundamental unit of light, sometimes referred to as a quantum of electromagnetic energy.

Photonic The optical equivalent of the term 'electronic.'

Pipelining The process of having multiple unacknowledged outstanding messages in a circuit between two communicating devices.

Pixel Contraction of the terms 'picture element.' The tiny color elements that make up the screen on a computer monitor.

Planar Waveguide A waveguide fabricated from a flat material such as a sheet of glass, into which are etched fine lines used to conduct optical signals.

Plenum Cable Cable that passes fire retardant tests so that it can legally be used in plenum installations.

Plenum The air handling space in buildings found inside walls, under floors, and above ceilings. The plenum spaces are often used as conduits for optical cables.

Plesiochronous In timing systems, a term that means "almost synchronized." It refers to the fact that in SONET and SDH systems, payload components frequently derive from different sources, and therefore may have slightly different phase characteristics.

Pointer In SONET and SDH, a field that is used to indicate the beginning of the transported payload.

Polarization Mode Dispersion (PMD) The problem that occurs when light waves with different polarization planes in the same fiber travel at different velocities down the fiber.

Polarization The process of modifying the direction of the magnetic field within a light wave.

Preform The cylindrical mass of highly pure fused silica from which optical fiber is drawn during the manufacturing process. In the industry, the preform is sometimes referred to as a 'gob.'

Private Line A dedicated point-to-point circuit.

Protocol A set of rules that facilitates communications.

Pulse Spreading The widening or spreading out of an optical signal that occurs over distance in a fiber.

Pump Laser The laser that provides the energy used to excite the dopant in an optical amplifier.

PVC Permanent Virtual Circuit; a circuit provisioned in frame relay or ATM that does not change without service order activity by the service provider.

Q

Q.931 The set of standards that define signaling packets in ISDN networks.

Quantize The process of assigning numerical values to the digitized samples created as part of the voice digitization process.

Quick Ratio Calculated by dividing the sum of cash, short-term investments and accounts receivable for a given period by the current liabilities for the same period. It measures the degree of a firm's liquidity.

R

RAM Random Access Memory; the volatile memory used in computers for short-term storage.

Rayleigh Scattering A scattering effect that occurs in optical fiber as the result of fluctuations in silica density or chemical composition. Metal ions in the fiber often cause Rayleigh Scattering.

RBOC Regional Bell Operating Company; today called an ILEC.

Refraction The change in direction that occurs in a light wave as it passes from one medium into another. The most common example is the "bending" that is often seen to occur when a stick is inserted into water.

Refractive Index A measure of the speed at which light travels through a medium, usually expressed as a ration compared to the speed of the same light in a vacuum.

Regenerative Repeater A device that reconstructs and regenerates a transmitted signal that has been weakened over distance.

Regenerator A device that recreates a degraded digital signal before transmitting it on to its final destination.

Remote Terminal (RT) In loop carrier systems, the multiplexer located in the field. It communicates with the central office terminal (COT).

Repeater See regenerator.

Resilient Packet Ring (RPR) A ring architecture that comprises multiple nodes that share access to a bi-directional ring. Nodes send data across the ring using a specific MAC protocol created for RPR. The goal of the RPR topology is to interconnect multiple nodes ring architecture that is media-independent for efficiency purposes.

Retained Earnings Represents the money a company has earned less any dividends it has paid out.

Return on Investment (ROI) Defined as the ratio of a company's profits to the amount of capital that has been invested in it. This calculation measures the financial benefit of a particular business activity relative to the costs of engaging in the activity.

The profits used in the calculation of ROI can be calculated before or after taxes and depreciation, and can be defined either as the first year's profit or as the weighted average profit during the lifetime of the entire project. Invested capital, on the other hand, is typically defined as the capital expenditure required for the project's first year of existence. Some companies may include maintenance or recurring costs as part of the invested capital figure, such as software updates.

A word of warning about ROI calculations: Because there are no hard and fast rules about the absolute meanings of profits and invested capital, using ROI as a comparison of companies can be risky because of the danger of comparing apples to tractors, as it were. Be sure that comparative ROI calculations use the same bases for comparison.

ROM Read Only Memory Memory that cannot be erased; often used to store critical files or boot instructions.

S

Scattering The "backsplash" or reflection of an optical signal that occurs when it is reflected by small inclusions or particles in the fiber.

SDH The abbreviation for Synchronous Digital Hierarchy, the European equivalent of SONET.

Section Overhead (SOH) In SONET systems, the overhead that is used tomanage the network regions that occur between repeaters.

Sector A quadrant on a disk drive to which data can be written. Used for locating information on the drive.

Securities and Exchange Commission (SEC) The government agency that is responsible for regulation of the securities industry.

Selective Retransmit An error correction technique in which only the errored frames are retransmitted.

Self-Phase Modulation (SPM) The refractive index of glass is directly related to the power of the transmitted signal. As the power fluctuates, so too does the index of refraction, causing waveform distortion.

Sheath One of the layers of protective coating in an optical fiber cable.

Signaling The techniques used to set up, maintain and tear down a call.

Signaling Virtual Channel (SVC) In ATM, a temporary signaling channel used to establish paths for the transport of user traffic.

Simplex One way transmission only.

Single Mode Fiber (SMF) The most popular form of fiber today, characterized by the fact that it allows only a single mode of light to propagate down the fiber.

Soliton A unique waveform that takes advantage of nonlinearities in the fiber medium, the result of which is a signal that suffers essentially no dispersion effects over long distances. Soliton transmission is an area of significant study at the moment, because of the promise it holds for long-haul transmission systems.

SONET Abbreviation for the Synchronous Optical Network, a multiplexing standard that begins at DS3 and provides standards-based multiplexing up to gigabit speeds. SONET is widely used in telephone company long-haul transmission systems, and was one of the first widely deployed optical transmission systems.

Source The emitter of light in an optical transmission system.

Spatial Reuse Protocol (SRP)

SS7 Signaling System Seven, the current standard for telephony signaling worldwide.

Standards The published rules that govern an industry's activities.

Statement of Cash Flows The Statement of Cash Flows illustrates the manner in which the firm generated cash flows (the sources of funds) and the manner in which it employed those cash flows to support ongoing business operations.

Step Index Fiber Fiber that exhibits a continuous refractive index in the core which then "steps" at the core-cladding interface.

Stimulated Brillouin Scattering (SBS) A fiber nonlinearity that occurs when a light signal traveling down a fiber interacts with acoustic vibrations in the glass matrix (sometimes called photon-phonon interaction), causing light to be scattered or reflected back toward the source.

Stimulated Raman Scattering (SRS) A fiber nonlinearity that occurs when power from short wavelength, high power channels is bled into longer wavelength, lower power channels.

Storage Area Network (SAN) A dedicated storage network that provides access to stored content. In a SAN, multiple servers may have access to the same servers.

Store-and-Forward The transmission technique in which data is transmitted to a switch, stored there, examined for errors, examined for address information, and forwarded on to the final destination.

Strength Member The strand within an optical cable that is used to provide tensile strength to the overall assembly. The member is usually composed of steel, fiberglass or Aramid yarn.

Surface Emitting Diode A semiconductor that emits light from its surface, resulting in a low power, broad spectrum emission.

SVC A frame relay or ATM technique in which a customer can establish on-demand circuits as required.

Synchronous A term that means that both communicating devices derive their synchronization signal from the same source.

Synchronous Transmission Signal Level 1 (STS-1) In SONET systems, the lowest transmission level in the hierarchy. STS is the electrical equivalent of OC.

T

T1 The 1.544 Mbps transmission standard in North America.

T-3 In the North American Digital Hierarchy, a 44.736 Mbps signal.

Tandem A switch that serves as an interface between other switches and typically does not directly host customers.

TDMA Time division Multiple Access; a digital technique for cellular access in which customers share access to a frequency on a round-robin, time division basis.

Telecommunications The science of transmitting sound over distance.

Terminal Multiplexer In SONET and SDH systems, a device that is used to distribute payload to or receive payload from user devices at the end of an optical span.

Tight Buffer Cable An optical cable in which the fibers are tightly bound by the surrounding material.

Time-Division Multiplexing The process of assigning timeslots to specific users.

Token Ring A LAN technique, originally developed by IBM, that uses token-passing to control access to the shared infrastructure.

Total Internal Reflection The phenomenon that occurs when light strikes a surface at such an angle that all of the light is reflected back into the transporting medium. In optical fiber, total internal reflection is achieved by keeping the light source and the fiber core oriented along the same axis so that the light that enters the core is reflected back into the core at the core-cladding interface.

Transceiver A device that incorporates both a transmitter and a receiver in the same housing, thus reducing the need for rack space.

Transponder A device that incorporates a transmitter, a receiver, and a multiplexer on a single chassis.

Twisted Pair The wire used to interconnect customers to the telephone network.

U

UPS Uninterruptible Power Supply; part of the central office power plant that prevents power outages.

V

Venture Capital (VC) Money used to finance new companies or projects, especially those with high earning potential. They are often characterized as being high-risk ventures.

Vertical Cavity Surface Emitting Laser (VCSEL) A small, highly efficient laser that emits light vertically from the surface of the wafer on which it is made.

Virtual Channel (VC) In ATM, a unidirectional channel between two communicating devices.

Virtual Channel Identifier (VCI) In ATM, the field that identifies a virtual channel.

Virtual Container In SDH, the technique used to transport sub-rate payloads.

Virtual Path (VP) In ATM, a combination of unidirectional virtual channels that make up a bi-directional channel.

Virtual Path Identifier (VPI) In ATM, the field that identifies a virtual path.

Virtual Private Network A network connection that provides private-like services over a public network.

Virtual Tributary (VT) In SONET, the technique used to transport sub-rate payloads.

Voice/Telephony over ATM (VTOA) In ATM, a service used to transport telephony signals across an ATM network.

Voiceband The 300 – 3300 Hz band used for the transmission of voice traffic.

W

WAN Wide Area Network; a network that provides connectivity over a large geographical area.

Waveguide A medium that is designed to conduct light within itself over a significant distance, such as optical fiber.

Waveguide Dispersion A form of chromatic dispersion that occurs when some of the light traveling in the core escapes into the cladding, traveling there at a different speed than the light in the core.

Wavelength Division Multiplexing (WDM) The process of transmitting multiple wavelengths of light down a fiber.

Wavelength The distance between the same points on two consecutive waves in a chain – for example, from the peak of wave one to the peak of wave two. Wavelength is related to frequency by the equation
where lambda (?) is the wavelength, c is the speed of light, and f is the frequency of the transmitted signal.

Window A region within which optical signals are transmitted at specific wavelengths to take advantage of propagation characteristic that occur there, such as minimum loss or dispersion.

Window Size A measure of the number of messages that can be outstanding at any time between two communicating entities.

X, Y, Z

Zero Dispersion Wavelength The wavelength at which material and waveguide dispersion cancel each other.