

## CHAPTER 1

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# EVOLUTION OF THE TELECOMMUNICATIONS INDUSTRY

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### MONOPOLY STATUS

In order to gain insight into the telecommunications industry, first it is best to look at its history. Each country has its own way of handling this type of service, but there are many similarities in the treatment of telecom around the world. This chapter considers the trends of the evolution of telecom, which are mainly common around the world. Most of the background for this section comes from North America, and even in North America there were always some differences between the industry in the United States and that in Canada. The intent is not to give totally accurate specifics, since these vary country by country and also over time, but to show the trends that are essentially common to the telecom industry in most areas.

Initially, telecommunications service was treated as a “natural monopoly” essentially everywhere. The governments believed that this service, although very expensive to provide, was a basic right, and that it should be available to everyone at a reasonable price. Thus, in many countries, certainly in North America and in much of Europe, the government played a large part in the offering of telecommunications. In many countries, this service was provided by governments themselves, in a manner similar to the provision of other utilities such as electrical power. In North America, this was not the case, but the service was heavily regulated and many requirements and restrictions were placed on the companies that provided telecommunications. Regulation protected both the companies providing the service and the customers. Rates for basic service were kept low so that the service would be affordable by the masses, and requirements were often stringent, governing both the type and level of service that could be offered, as well as the rates that could be

charged for the service. Basic service was essentially voice service, and in North America the requirement was that local voice service capability should be offered at rates that were affordable to almost everyone.

In addition, companies providing basic telecommunications services were required to provide the capability of using the phone for immediate emergency support (medical, fire, and ambulance). This placed a requirement on the network that it be always available, so that someone who needed to place an emergency call would not be faced with an outage at a critical time. Since equipment and systems cannot be 100% reliable, the requirement placed on the telcos was that the lines and network be available 99.999% of the time. Thus, in North America the incumbent companies today provide very high quality telecommunications services at very reasonable rates, and almost everyone in these countries has access to telecom service. Because of this, most people have landline connections. This is not true in much of the developing world, where wireless services have blossomed due to the lack of affordable landline service in many areas.

Services that are not required for basic communication, such as data services, became known, generally through regulation, as enhanced services, or something a step above the basic service. These services, since they were not deemed essential by the regulators, did not have to meet the stringent criteria applied to basic communication services. So anything other than the basic landline voice services developed along somewhat different paths in many cases. But in many cases, these services were actually offered by the same carriers who provided the basic voice service, under separate regulatory rules.

Local voice service was provided to allow callers to place calls to others within a local calling area, generally the municipality in which they were located. In addition, these local networks were interconnected to each other, allowing callers to place long distance calls to people in other municipalities and even other countries. The interconnecting networks are often called backbone networks. In the United States, there were companies offering local service within towns and cities, and also interconnection between these towns and cities as long distance service. The names and sometimes the nature of these companies changed over time. Perhaps the largest ones were most notably known as the Regional Bell Operating Companies, or RBOCs. These companies were in turn interconnected with each other by one large interconnector called AT&T. The local calling capability was considered to be basic, whereas the long distance calling was discretionary. So the providers were allowed to charge more for the long distance calls than for local. Given the stringent requirements on the networks and the rates for local calls, companies were generally providing local service at a loss. They could balance this loss by making money on the long distance calls. However, even here they were restricted by the regulators. The provision of data services was also not basic, but data service was also regulated, and in the early days, not a large enough part of the service providers' business to really matter.

Because of the rules and restrictions, and also due to the high expense of providing such service, telecommunications grew to be a monopoly service almost every-

where. Even when there were other providers on the scene, they were generally either limited in what they could provide, or in the volume that they were allowed to provide, protecting the interests of the monopoly provider.

Thus, initially, incumbent providers were heavily regulated and provided basic local voice services at low rates. They generally also provided long distance calling, usually at rates that were higher than the costs, to cover for the noncompensatory local services. And many of these companies also provided some other services, generally in small amounts, to make additional profit. This was the trend almost everywhere for many years, even though the specific rates and services offered varied over time and location, and by company. As mentioned earlier, trends were generally similar around most of the world and in most companies, although the changes that occurred happened at different times in different locations. Initially, also, the incumbent companies were government owned, or at least government controlled, which caused some differences by country. Most incumbents provided mainly voice services and small amounts of data. Generally, in the late 1900s the networks carried about 80% voice and 20% data services. And until the 1980s, most of the voice services and some of the data services were carried on analogue networks, in both the access and the backbone. Data services were a mix of analogue and digital until the late 1980s when the trend was to convert networks to digital technologies end to end.

## **COMPETITION FOR LONG DISTANCE SERVICES**

In North America, new technologies that allowed different methods of carrying traffic and also changes in the attitudes of those using the services caused pressures to begin attacking the business models. Initial attacks targeted the long distance services, since the incumbent telcos were making good profits on these services. Others understood the economics of these services and wanted part of the action. They recognized that they could provide this service at low cost and charge rates much lower than those charged by the incumbents, still making a profit. So the initial successful attacks on the established business of the incumbent telcos targeted lucrative long distance services. These attacks came from new long distance providers, resellers, and value-added carriers who leased network capacity from the incumbent telcos and used it to provide services of their own. Today, everyone is quite familiar with this evolution and the competition has driven the rates for long distance to a fraction of what they were 10 or 15 years ago. As we will see below, other factors are also impacting these rates, as everyone is also aware.

The next stage in the trends was the change in the providing of data services. Initially, except for the earlier telegraph services, data was carried, by the incumbents at least, on the same analogue backbone as the voice services. Data entered the access network via a modem, which had an analogue output, or a dataset, which outputs signals in a digital format. From there, it traversed usually private lines, some-

times multipoint lines allowing many terminals to share a port on a host, or it operated in a switched mode along the same (circuit switched) lines as the voice services. In the 1970s to 1980s, this started to change with the advent of packet switching.

The access and the backbone of the telephone network were designed to accommodate the patterns and needs of voice traffic. The network is optimized as a network that receives a call on a single circuit, checks the destination number for that call, and sets up an end-to-end circuit for the duration of the call, dropping this at each step along the path when the call has been completed. This type of network is called circuit switched, and huge numbers of man years of research and implementation went into optimizing the circuit switched networks to very efficiently serve voice traffic. Much of this development was done by Bell Laboratories in the United States, where hundreds of research projects were underway at any time.

Around the 1970s, packet switching technology started to emerge. This had been used earlier for private and small networks, and it was optimized for data traffic. This traffic did not need to have a circuit established end to end for the duration of the call and, in fact, given the nature of the traffic, establishing an end-to-end circuit was quite wasteful. Packet switching technology began to be deployed widely around the world by data services providers and also by incumbent telcos. Initially, these packet switched networks served only specific data services—digital data services—and the traffic volumes were low in relation to voice traffic volumes. Some data continued to be carried on the old analogue networks, with certain services being carried on the packet switched networks. During this period, the Internet started its well-known growth and, of course, that growth continues even today. As the Internet expanded from researchers and universities initially, then to companies, and finally to individuals, it was to be expected that the amount of data traffic and the routing patterns of that traffic would change drastically. And, at least initially, this Internet traffic was data traffic. So by the year 2000, that 80/20 ratio of voice-to-data traffic on the network was changing to a much higher percentage of the traffic being data. In parallel, technology development enabled video and multimedia traffic to be carried on the network. And as these enhanced services spread, the amount of traffic and especially the amount of nonvoice traffic continued to increase.

## **COMPETITION FOR LOCAL SERVICES**

One of the next developments was the attack on local service provision by many other companies. In some cases, this was cellular service, since mobile companies had been growing even in North America, where essentially everyone had access to reasonably priced land line service. By the mid 1990s regulation allowed companies other than the incumbent telcos to offer local service, so other companies started to move into territory previously covered by telcos. New companies sprang up and other utilities, such as cable companies and even power companies, also decid-

ed to offer data and voice services. At the same time, telcos requested permission to expand their service offerings to include those offered in the past by other providers. Specifically, telcos requested, and often gained, permission to provide broadcast video service.

The net result of all of this was the creation of competition in every stronghold of the incumbent telcos. By the time this happened, they had already been struggling to change their internal culture and focus to ones equipped to deal with competition. The competition for local service and for the provision of data services just heightened that requirement.

Initially, companies offering competing local services positioned these as secondary services to avoid the requirement that they provide emergency call service. Over time, developments in the mobile service technologies have made it possible for some of the emergency capabilities to be provided even from mobile phones. Specifically, it is now possible to locate someone with a medical emergency within very short distances, even if they call for help using a mobile phone. This ability is one of the reasons that many people today are quite comfortable having a mobile phone as their only phone, even in areas with the well-established, high-performance, and low-rate landline service

As this evolved, the nature of the traffic carried on the networks also changed over time. As all facilities became digital, all traffic, whether it was initially voice, data, or video, was carried in a digital format. While it is still possible to determine the nature of the traffic at the end points (and, with the right protocols, information identifying the traffic type can also be carried through the network), once traffic is converted to bits, it becomes less relevant to distinguish the difference between voice and data. And when we add to the picture other traffic such as video and multimedia, the picture becomes even more cloudy. Even though the actual nature of the traffic might be known, the fact is that as it travels through the network it looks like data, so the most effective mechanism for carrying this traffic is packet-switched networks.

## **COMPETITION STARTS TO SPREAD**

By the early 2000s, telcos faced serious competition to all aspects of their business from many others, most of whom had not been on the horizon of telecom a decade earlier. These other companies were starting into the telecom business from different starting points. Some had established networks, as the telcos did, which reached most or at least many of the clients interested in voice and data services. However, most of these established networks had been initially designed for other services and were not optimal for the provision of two-way, high-quality voice and data services. So those other providers with established networks faced the problem of high costs of conversion of their networks to ones that could effectively provide the voice services.

## INTERNET AND MULTIMEDIA DISRUPT THE BASIC NETWORKS

By this time, the Internet had become almost a commodity in itself and multimedia services were blossoming. One very significant development then was the use of the Internet protocol (IP) to carry not only the data services, for which it had been optimized, but also voice service. Why not? The voice traffic in the network was already in a digital format. Of course, the transmission requirements for voice differ from those for data, as they do for video and other forms of multimedia. So the introduction of Voice Over IP (VOIP) was not a simple, straightforward transition. But, for someone who had no established high-cost, high-performance circuit-switched network, it made more sense to introduce packet-switched networks, which are better for carrying the new forms of digital traffic. And by this time, the network traffic patterns had evolved to a point where the traffic was no longer 80% voice. In fact, depending on how one defines traffic, the voice traffic will soon be (or maybe already is) 80% other than voice.

In parallel, new and very different providers appeared on the scene, developing vastly different, but also wildly popular, new services which could not even have been imagined a few years earlier. Internet services had blossomed through the 1990s, and they continued to grow even through the demise of the hundreds of .com companies that initially sprang up to take advantage of the predictions of huge market share by providing data and multimedia services. Music was one of the initial multimedia services, and some of the initial service providers tested the regulatory and legal environments in which these services could be provided. Legal issues also abounded related to some of the less savory Internet services, and these still continue today. Some such services were actually illegal in some countries, whereas others just raised questions about what should and could be allowed. Probably, many people remember the Napster service, which provided a platform for end users to share their files. In the case of Napster, the files shared were usually music files. What this amounted to, essentially, was one end user downloading a music file from somewhere. The initial file was probably paid for by the user, so the musician and the user were both happy. But then Napster provided a platform for one user to check out the music owned by another user, and people started sharing these files amongst themselves for free, cutting the original artist out of revenue for his or her product. As expected, this did raise legal issues and, in the end, Napster had to stop this service. However, the next generations of this type of sharing capability were not such easy targets for the legal systems. Kazaa, a peer-to-peer-based application, allowed one user to look at the contents of another user's computer, and they shared directly, without middleman control. Whereas it is certainly possible for legal systems to determine who is sharing the files that are IP protected, and they might be able to win in court, the sharing by individuals is generally too small to warrant the cost of court action, and to complicate things further, there is no middleman to sue as there had been with Napster. It can certainly be possible to put some sharers out of business, but in the time it takes to prosecute one or a few transgressors, hun-

dreds more spring up. So the landscape has changed from a service perspective as well as in other ways that make service decisions more complex for the service providers. Think about the issues that face project managers charged with implementing projects with such services included. Not only do they face the usual project and service dilemmas, but they also have to spend time and energy worrying about how best to manage potential legal and ethical issues.

Electronic commerce evolved throughout this time and continues to do so. Not far behind came many other creative offerings, including Skype, Second Life, and Facebook, to name just a few. Skype was one of the first big VOIP services, offering voice calls totally free to anywhere in the world as long as people were willing to talk through their computers, or for tiny fractions of the rates charged by the telcos (even after the huge rate reductions mentioned above) for calls terminating on actual telephones. Second Life is essentially a real-life video game in which those who wish to set up a personality, called an avatar, can interact in real time with other individuals, and, more importantly, with the companies and others who purchase space to offer their electronic (and sometimes real) wares over the Internet. Many companies have already established their presence in this virtual world. Facebook, which followed an earlier version called MySpace, started initially as a mechanism to allow college students to share rich communications with their friends. (MySpace was initially aimed at high school students). Facebook expanded their market to include anyone, and it is a good example of the new types of services. Although the Facebook platform was developed with a number of features, many developers who have nothing to do with the Facebook developers have added additional applications that Facebook users can use to enrich their experience on the site. The users pay nothing to use the facility; it is supported by advertisers who post ads on the site. Generally, they pay by the number of clicks, so most of the applications are designed to encourage a lot of activity on the site. Many cute, fun games are featured, which the users share with their friends. Of course, all of these applications generate a lot of network traffic, and most of this traffic is data. Even the voice traffic is carried as VOIP, which is best carried by packet-switched networks. Thus, there are not only new services to think about, but the services are built using a new model, which is much more open than that of any of the services that were offered over the previous history of telecom. And at the same time, the service providers must consider whether they want to offer their services based on the long-established models of either pay per use or pay a flat rate for some amount of service, or whether they wish to move to a new business model in which the revenue does not come from the user at all.

## **A NEW TELECOM ENVIRONMENT**

The implications of this traffic evolution have become evident—the established network provided by the large incumbents is no longer optimal for carrying the

bulk of the traffic. Thus, the industry has evolved to a position in which the telco incumbents face many problems. Every service they have offered for years as a monopoly is no longer protected, each attacked by competitors. Competition is appearing from every direction at the same time, mainly from sources the incumbents have difficulty in predicting or sometimes even identifying as competition. At the same time, the billions of dollars that they have invested in networks, both to carry the actual traffic and as back-office systems to support the business, is becoming less and less relevant to providing current services. Incumbent telcos face problems that are probably bigger than those faced by other utilities moving into the provision of communications services because they have to essentially remove all the established networks, replacing them with packet-switched networks. This involves many extremely large technology-based projects and also many more that involve the creation of new processes, procedures, and business strategies. Not only must the networks be replaced, but also the provisioning, ordering, billing, and other service-recording systems must all be converted as well. These would be interesting projects under any conditions, but they must be carried out at an accelerated pace, at the lowest possible cost, producing extremely high-quality products, in order to maintain their customer bases in the face of extreme competition.

These telco network conversions are much bigger projects in terms of time, cost, and impact than these companies ever faced before. In parallel with all the primary business conversions, most of these companies also need to address their internal corporate culture, since the way in which they have conducted business for many years will not generate success in the current environment. Thus, projects often have components of all the standard business areas such as engineering, operations, IT, marketing, and sales, as well as additional components addressing the business attitudes and methodologies.

So, what type of projects might the service provider undertake? Let us consider but a few of these:

- Developing a new service
- Developing new features for an existing service
- Analyzing the introduction of another company's competing new high-speed access service, enabling the service provider to determine the best competitive response
- Work with a major national customer to implement his network in a way that gives him significant savings, while at the same time improving his service by moving him onto a new broadband network with better management capabilities.
- Design, implement, and manage a network within a conference complex for a group of UN leaders who will be attending a meeting in your city. The communications includes incoming and outgoing voice and data calls to and from the complex, internal communications amongst the politicians and their sup-

port staff while in the complex, plus a secure LAN within the meeting room itself, which allows each politician to communicate and share files with his or her own “sherpa” during the meeting.

- Managing a serious cable cut in a remote area, in which the cable was carrying over 40% of the national backbone traffic and the redundant backup facility is currently being upgraded and, therefore, cannot reliably carry its full traffic capacity
- Implement a new IPv6 capability in a separate network for customers willing to move to the leading edge protocol.
- Equip the current network with a new billing system that is more flexible than the current one, allowing new rating models to be adopted when desired.
- Training all current employees on the new network model and its benefits
- Move all customer service for medium business clients to one common national call center
- Introduce a new culture to the employees that is more conducive to determining customer requirements clearly before initiating design of a new service and provides them with the tools to be able to do this.
- Learning to be more effective at marketing product and service lines

Thus, even within service providers, the variety of projects, and their requirements for skills, knowledge, and people, the inputs and deliverables are extremely varied. This makes life very interesting for project managers and team members in these companies.

So far, we have mentioned only telco service providers and research facilities such as Bell Labs. While this part of the business is obviously huge, these companies in no way comprise the full telecom industry. There exists a complete continuum from the people who create the initial ideas for new technologies and designs, through the people who design and build technologies, networks, and support systems, to the companies that provide direct end-user communication services, whether voice, data, multimedia, or value added, and also to the governments who set regulations and policies, and control things like spectrum allocation.

So at one end of this continuum we might find companies that do basic research. Bell Labs was an example of such a company over the years, although today not many companies are funding the basic research that enabled the telecom environment to develop many of the highly innovative technologies and designs that made the industry so successful. Also, somewhere in this continuum we would also find companies that do the research into potential new technologies and products, and who also provide assistance in the technical and management aspects of integrating these upcoming products into the current networks and environments. We can include these under the equipment vendor heading, although not all such companies fall into that place in the overall model. These companies face the issues of setting the standards for the technologies, often in parallel with their initial product devel-

opment. So their world is changing as described above, and also changing due to their own work in the standards areas.

Of course, there are also the long-time incumbent telcos in the line, as we have discussed above. But in the service provider position, we now also have many, many others who fit very different profiles. There are the new entrants to the network and/or service business. These companies may already have networks, such as cable companies or power companies. Alternatively, they might be companies building new networks, which would naturally use the most modern technologies and designs, optimized to carry the current and future services. In addition, there are the new entrants to the value added business such as those who develop new applications and features for Facebook services.

Corporate cultures differ from one company to another. The business goals are different, as well as the equipment they own and services that they provide. Thus, the projects will be different. Even if two companies develop similar services, they do this under different conditions, within different cultures, using different technologies and with very different business goals. All of this has to be kept in mind when viewing any telecom project.

One thing, though, that is evident is that there are many, many exciting and critical projects underway and on the horizon for any company participating in the electronic communications business.

## **WHAT ABOUT THE FUTURE?**

As we move forward, telecommunications is becoming less an independent infrastructure and more a part of the overall ecosystem. Telecommunications capabilities are starting to become an integral part of activities in almost all fields of life. In medicine, many governments have huge projects underway, not only to electronically store and work with data, but to use communications equipment as one of the tools in performing operations and other activities. In many other areas of life, sensors and monitors will allow humanity to track, record, and even modify conditions that endanger the future of the world. This is true in the case of water use in agriculture, reduction of pollution, and control of automobile traffic. The projects that will design and implement these technologies will be extremely exciting, with huge potential gains for individuals, corporations, and society. We see huge changes in entertainment and commerce all enabled by electronic communications. The scope of the projects will be even broader than they are now, and the stakes for success will be even higher. With telecommunications infrastructure playing an enabling role in world economic development, the projects will be highly visible to other disciplines and, in many cases, around the world.

All of this means that projects are here to stay for the foreseeable future, and success is critical. Project success is much more likely when proper project management is used. Thus, project management is needed.