How the Internet is Altering the Communications Industry

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Japan's data communications market has grown rapidly in recent years against the backdrop of the growth of the Internet. Meanwhile, there has been a worldwide trend to go beyond computer data and integrate voice and video signals into the Internet Protocol (IP).

The integration of telephone services, which comprise the lion's share of carrier revenue, into the Internet would radically alter how carriers do business. The communications industry thus rests at an important inflection point.

1. Rapid Growth of Communications Services

(1) Rapid Growth of the Data Communications Market

The market for data communications, which consists of computer data transfers over communications lines, is growing rapidly.

A breakdown of NTT's operating revenue growth reveals that while telephone revenue has declined for three straight years, ISDN and data transfer revenue has grown rapidly.

Table 1 NTT Operating Revenue Growth by Service

	Telephone	Leased line	ISDN	Data transmission	Total
FY 92	-3.7	13.9	–	2.3	-3
FY 93	-2.1	3.4	86.3	-4.4	-1.4
FY 94	0.4	0.9	62.8	-4.4	1.4
FY 95	5.8	-1.6	38.7	-2	5.8
FY 96	-0.2	10.3	40.6	0.2	1.9
FY 97	-7.2	17.5	81.5	25.3	-0.8
Sept. 98 interim	-10.2	8.1	50.7	21.3	-3.8

Source: NTT financial statements

The sharp growth in data communications revenue can be largely attributed to the booming growth of the Internet. In particular, most of the growth in ISDN services is thought to be Internet related.

Before the Internet boom, large computers played the primary role in data communications, which occurred among companies and research organizations. Today, a growing share of users are companies and individuals maintaining some level of web presence and exchanging email using personal computers.

Looking at international communications between Japan and the U.S., data traffic already exceeds telephone traffic. In fact, the capacity of lines dedicated to data has been expanded to 800 MBPS, far exceeding the 500 MBPS capacity of dedicated telephone lines. Most of the data traffic stems from Internet demand.

(2) Data Communications Consists Mainly of Packet Switching

Data communications services provided by Japan's major carriers can be divided into three categories.

The highest level of reliability is obtained using dedicated or leased lines. Because data is exchanged directly between computers that are interconnected 24 hours a day, there is no switching involved, making data communications very stable. One drawback is the high cost of maintaining a dedicated line. However, since the cost is a fixed monthly rate, dedicated lines are suited to users who are constantly exchanging large volumes of data such as financial institutions.

With switched lines, a temporary connection is established as needed over a switching network such as the telephone network. High network efficiency and relatively low cost; on the other hand, users are billed according to usage time even if no data is exchanged. Switched lines had been used for small data exchanges until packet switching services were begun, and have recently been declining.

Replacing switched lines and becoming the mainstream of data communications services is packet switching (Table 2). Data is divided into small packets, addressed and sent over the connection. The receiving end then reassembles the packets and restores the data to its original form.

Table 2 Data Communications Categories

Network connection	Features	Multiplex method	Max. speed	Rate basis	Uses	Remarks
Switched line (temporary link)						
Dial-up network	Low speed transmission via modem and public telephone network	Freq.-division	56 k	Duration, distance	PC access (DDX-TP)	
ISDN	Digital transmission with integrated user network interface	Synch. time-division	64k	Duration, distance	PC access (INS-P)	
Dedicated line (constant link between 2 points)						
Analog	Low speed data transmission via analog leased line	Freq.-division	33.6k	Monthly rate		Variable speed & bandwidth, but basically a 2-point link.
Digital	High-speed transmission suited for interconecting corporate LANs and for video transmission	Synch. time-division	150M	Monthly rate	Video transmission, online banking, newspaper remote printing, production line control	Expensive at low volumes, but high in quality and reliability
Packet switching (store and forward switching)						
Packet	Data is divided into variable length packets and transmitted via DDX (digital data exchange network) and packet switching. While speed is limited by error correction, method offers inexpensive form of high quality transmission over long distances.	Synch. time-division	64k	Data volume		There are 3 ways to access a packet network: leased line, telephone network, and ISDN
Frame relay (STM transfer)	Faster than packet switching due to lack of resend and flow control. Alternative to leased lines for inter-LAN connection; allows constant link like leased line but at lower cost.	Synch. time-division	1.5M	Monthly rate	Image transmission, high-speed inter-LAN burst transmission	
Cell relay (ATM transfer)	Uses fixed length cells shorter than packets, and achieves very fast transmission via ATM switching.	Asynch. time-division	156M	Mainly data volume	HDTV, inter-LAN connections, CAD/CAM data transmission	Alternative to leased lines for inter-LAN connection. Candidate for B/ISDN transmission.

Before packet switching services were offered, an expensive mesh-like network of dedicated lines had to be maintained to freely exchange data between multiple points. The emergence of packet switching allowed a relatively inexpensive alternative for data communications. Packet switching is also used when personal computers link up to the Internet via ISDN services.

The continuing drive toward high speed data transmission has recently given rise to two new variations of packet switching called frame relay and cell relay. These methods are used when a 24-hour connection is needed but the data volume is not large enough to justify a dedicated line.

2. The Internet's Impact on the Communications Industry

(1) Relationship Between Carriers and ISPs

The spread of the Internet, which is in large part driving growth in the data communications market, is supported by the services provided by communications operators called ISPs (Internet Service Provider).

ISPs are Type 2 carriers who provide communications services over leased lines. They provide users an access point to the Internet and collect connection fees in return. ISPs connect with each other by leasing lines from carriers. Since leased line charges are fixed, increases in Internet data traffic do not translate into higher revenue for carriers.

Because the Internet uses a packet switching protocol called TCP/IP (Transmission Control Protocol/Internet Protocol), there is no need to purchase expensive switching and transmission equipment costing billions of yen. On the other hand, it does require routers costing several million yen to interconnect with the Internet over leased lines.

(2) Low Returns of Data Communications Operators

The inexpensive computer network built using low-cost routers is altering the communications industry and beginning to impact the profit structure of established carriers.

As the Internet has grown, large volumes of data traffic have flowed into the trunk lines of carriers. Presently, since both telephone and data traffic are transmitted together as digital signals, carriers cannot distinguish Internet traffic from telephone traffic. Thus growth in Internet traffic does not translate directly into revenue growth for carriers. At best, they can hope to increase revenue indirectly as ISPs grow and lease more lines.

In fact, although data traffic is growing rapidly, revenue from data communications remains a small portion of total carrier revenue.

Even assuming that leased lines carry data communications almost exclusively, data communications revenue still amounts to only 20 percent for NTT, the largest carrier, and about 10 percent for NCCs (new common carriers) DDI and Japan Telecom. Earnings are even less; in ISDN services, the fasted growing segment, the capital investment needed to keep up with demand growth has left all companies in the red (Figure 2).

Figure1 Internet Service Providers (ISP) and the Internet

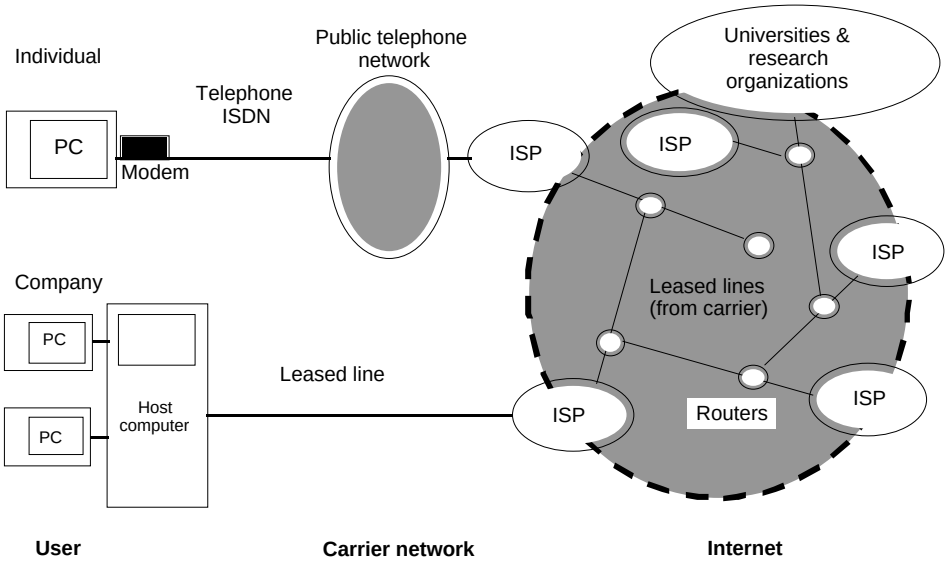
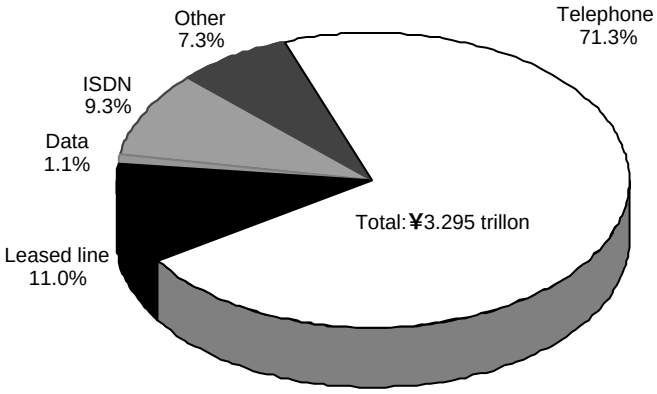


Figure 2 NTT Revenue Breakdown by Service (FY 1998 interim)



(3) The Internet's Significance to the Communications Industry

The reason that growth in data communications demand does not lead directly to carrier revenue growth is the telephone-oriented business model of carriers.

In contrast to telephone rates, which consists of a basic charge and a usage charge, data communications services typically charge a fixed rate. Thus carrier revenue growth slows as the share of data communications increases. When the Internet first began growing, AT&T and

other world-class carriers discounted the Internet's growth and said it would not become the mainstream of communications.

However, as the Internet's TCP/IP protocol became universal, people began to realize its usefulness not only for viewing web sites and sending email, but for building corporate networks and sending voice and image data efficiently. In the U.S., new areas of business emerged to construct inexpensive corporate networks using TCP/IP and provide cheap telephone services over the Internet. Sensing a threat to their core business, the established carriers saw they could no longer afford to ignore the vast business opportunities of the Internet.

In the mid 1990s, carriers themselves began entering the ISP business, starting with NTT's OCN (Open Computer Network) in late 1996, with Japan Telecom and DDI close behind. Thus we are seeing the universally accepted TCP/IP protocol alter the traditional structure of the communications industry.

3. The Present and Future of the TCP/IP Network

(1) Established Communications Services to Integrate with IP Network

Due to the expanding use of TCP/IP in communications, there is a growing consensus among industry observers that all telecommunications will be integrated into the TCP/IP network in the 21st century. In fact, a growing number of services are using TCP/IP to transmit not only computer data but voice and image data.

While it is not yet clear that all communications services will one day be integrated into the TCP/IP network, the existing networks built to provide telephone services are finding it difficult to compete in cost or efficiency. Although Internet phones still suffer from low quality (delayed or severed transmissions) compared to real phones, they are expected to catch up as network technologies and software improve.

(2) Major Impact on International Calls

Of the existing telephone services, the most likely to be integrated into the TCP/IP network are long distance and international calls, which are charged by duration and distance. Because TCP/IP offers significant cost advantages, it will continue to make inroads into regular telephone services despite the lower level of quality. The greatest impact will to international

gateway services, the international telephone companies who charge fees for connecting public telephone networks of different countries.

However, Internet phones will have a much more difficult time competing with NTT in local telephone services due to the massive cost of constructing the necessary network. One possible alternative is to combine TCP/IP with CATV networks. But the impact will be minimal because of the small size of CATV networks in Japan.

In fact, the real threat to local telephone services comes from the mobile phone network, which is expected to eventually have as many subscribers as the telephone network (60 million). Data communications services are expected to grow most in the mobile phone network for at least the next decade. Mobile carriers have significantly enhanced the data communications services they provide. Recent growth in data traffic (mostly text) over the mobile phone network exceeds that of the fixed-line network. It is only a matter of time before TCP/IP traffic is integrated into the mobile phone network.

(3) IP Accelerates Electronic Commerce

Corporate intranets and extranets, which are expected to comprise a major part of carrier operating revenue in the future, are likely to be exclusively TCP/IP. If so, it is quite possible that carriers' data communications services will eventually become limited to a few heavy users.

One of the most promising areas of data communications is electronic commerce (EC). Although EC is often thought of as simply being retail on the Internet, it means much more that this from the viewpoint of the communications industry – the diversion of transaction and settlement data from leased lines to the public phone network. Presently, settlement data for EC is controlled by a huge number of leased lines that link financial institutions and companies. If buyers and sellers use TCP/IP to exchange settlement data directly over the Internet, there would be a diversion of a huge volume of traffic that would in all likelihood affect the profit structure of carriers.

While TCP/IP offers convenience, the security of such data exchange has been a longstanding issue. However, recent advances in data filtering by routers and encoding technology have raised the level of security to equal to that of leased lines. As a result, financial firms, communications companies and even distributors have entered electronic commerce, and competition is underway for the standardization of transaction data. The impact of the TCP/IP network is thus spreading beyond the communications industry and into industries such as finance and

distribution.

(4) Shifting Global Alliances

In the early 1990s, the biggest issue for the telecommunications industry was the liberalization of communications markets in industrialized economies. A series of global alliances ensued among mega-carriers with the primary aim of interconnecting their leased lines for seamless global communications in the lucrative market for multinational corporations. Then came the TCP/IP network offering far cheaper communications services. New operators such as WorldCom, Quest, and Level 3 of the U.S. constructed low-cost networks using TCP/IP to acquire large corporate customers, thereby eating into the revenue base of mega-carriers such as AT&T. The limits of global alliances were becoming clear.

In July 1998, AT&T and British Telecom, once bitter transatlantic rivals, suddenly announced plans for a joint venture that would combine the international communications divisions of both carriers (total annual sales of $8 billion), and reconstruct trunk lines based on TCP/IP. What caused both carriers to spin off their most significant operations and form an alliance was a strong sense of danger that their survival in the global communications market required that they reconstruct their trunk network based on TCP/IP. This alliance has greatly altered the structure of global alliances formed in the early 1990s.

Similar developments are occurring in Japan as well. IIJ (Internet Initiative), Toyota Motor, and Sony announced plans to form a joint venture in the TCP/IP based data communications services market. Meanwhile, major carriers Japan Telecom and DDI have announced plans to reconstruct their domestic trunk networks from 2000 based on TCP/IP. In addition, NTT announced that it will offer Internet phone services in 1999.

The cost advantages of the TCP/IP network have accelerated the entry of companies into communications services once dominated by a few communications companies. At the same time, it is shaking up the century-old business structure of carriers.

Figure 3 Shifting Global Alliances