A Management Briefing on

Emerging Direct Access Markets and the Central Office Dilemma

General DataComm

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General DataComm

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PREFACE

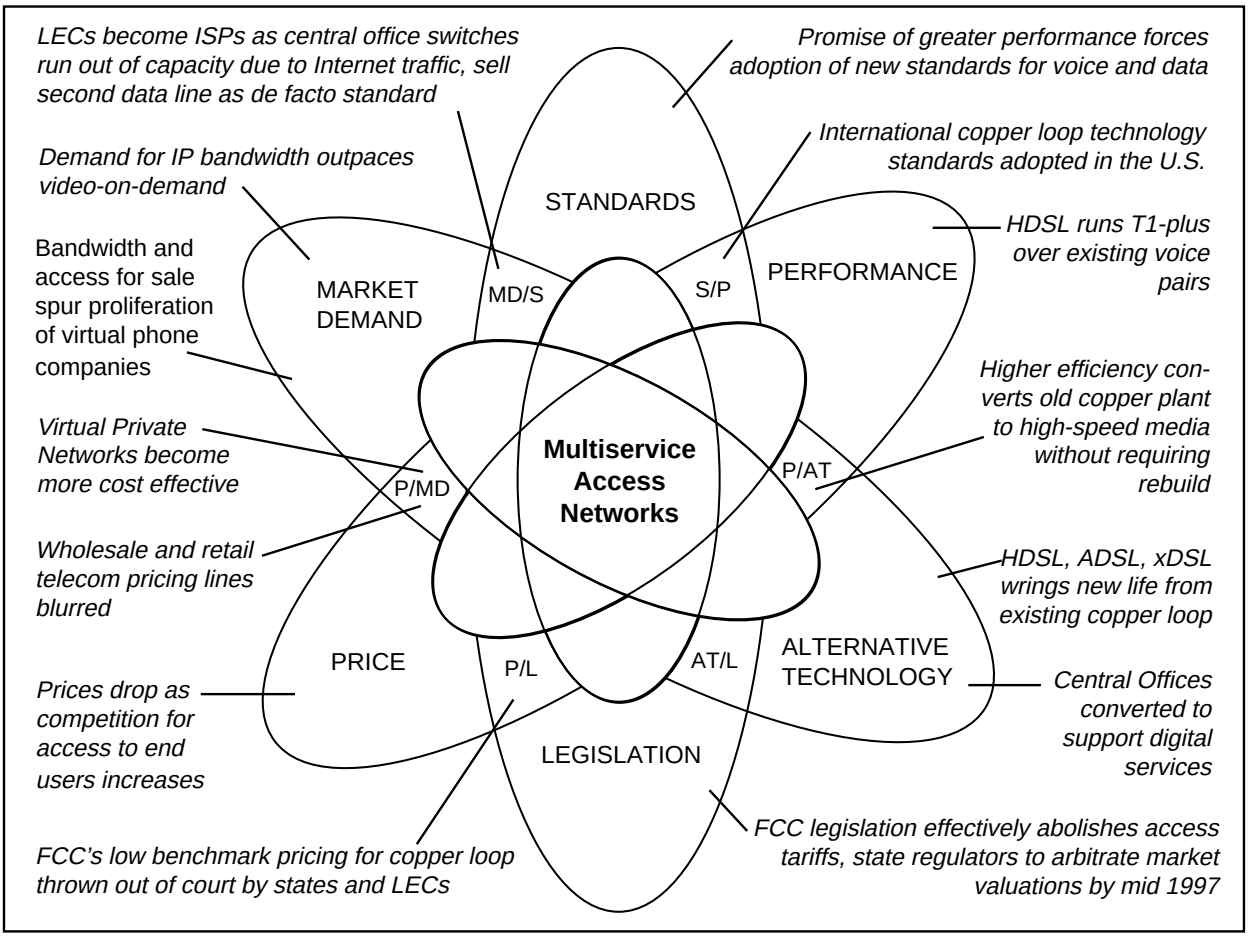
The traditional public switched telephone network was always the epitome of quality and reliability — that is, until the on-line explosion of the nineties. Between 1995 and 1997, on-line services such as CompUServ, America OnLine and a galaxy of World Wide Web services found their way into nearly half the computer households in the U.S. courtesy of local exchange carriers. Many early business arrangements between Internet Service Providers (ISPs) and Local Exchange Carriers (LECs) were signed without foreseeing the possibility of such widespread usage.

This paper addresses the emergence and establishment of a separate direct access tier of telecom service for business and small business users operating out of their homes: a dedicated high performance data line for a fixed monthly premium. Using existing copper loop facilities, this alternate access loop is optimized to accommodate all Internet, dial-up and intranet traffic by bypassing the central office switch, or perhaps the entire network access point. Terminating directly in universal access frames inside the central office, it is connected directly to the ISP's equipment without occupying or usurping voice switch capacity.

The Powers That Be

The forces shaping the market are volatile and constantly changing, however, considering them as an energy system, like the diagram below, begins to yield some definition of the nucleus of tomorrow's Multiservice Access Networks.

FIGURE 1 - MULTISERVICE ACCESS NETWORKS



Today's market has effectively turned up the heat on this system, to the extent that its particles are moving at faster and faster rates, and its fundamental properties are on the verge of a nuclear reaction, or at the very least, a change of state.

One thing's for certain in the telecommunication business: Something's got to give — and soon.

Two Schools of Thought

Incumbent Local Exchange Carriers (ILECs) and Competitive Local Exchange Carriers (CLECs) represent two fundamental schools of thought in debating this issue, agreeing on certain technical conclusions, but for different political and economic reasons.

The Regional Bell Operating Companies' (RBOC) case is positioned to justify legislation that would allow LECs to charge access fees to ISPs, just as they do to long distance carriers (to complete calls in the local loop). Bell companies claim that the largest problem comes not from business Internet usage, but from the combined traffic of social calls, which peak about 7 PM, and residential Internet traffic, which rises steadily during early evening and peaks at about 10 PM (illustrated later in Figure 4). Together, peak social and Internet traffic exceed even the business calling peak of 4 PM. To drive their point home, RBOCs have presented studies to the FCC which illustrate such an acute impact on essential public network traffic, that the resulting switch congestion includes possible blockage of 911 calls by Internet traffic on the voice switch.

The alternative position comes from the Data Coalition, a consortium of computer manufacturers, software and data communications companies who have resolved to keep the Internet free and its users unburdened by arbitrary fees and unnecessary legislation. Members include Compaq, CompuServ, Intel, Microsoft, Netscape and Novell.

The Data Coalition contends that switch congestion is largely overstated, and that peak Internet traffic periods do not overlap those of peak business traffic. Estimating that six million phone lines, or about 5.5 percent of all phone lines are already being used for dedicated Internet traffic, the Data Coalition thinks the LECs' revenue stream resulting from additional phone lines is adequate compensation for the additional switch capacity, and that access fees would effectively snuff out most public enthusiasm for the Internet.

Both factions agree that switches are becoming more congested. Beyond that, each camp has its own interests to pursue. This paper presents the basic arguments for readers to use in leveraging independent solutions better serving their own business needs.

INTRODUCTION

Explosive Growth in Internet Traffic

In the past, the high cost of computing and the level of technical competence required to develop and support applications on the Internet limited participation to government, scientific and academic institutions. Today's new generation of users, armed with powerful, low-cost computing and friendly graphical user interfaces (GUI) fuel the demand for new applications on the Internet.

With prices dropping below $1,000 for increasingly powerful personal and business computers, consumer costs for unlimited Internet access dropping to as little as $14.95 per month and modem prices falling below $100 for 28.8 Kbps, the robust growth of Internet subscribership is a fact of life that shows no signs of weakness.

In the United States, there are over 100 million copper circuits in Public Switched Telephone Networks (PSTN) now connected to central offices, with 20 million or more used for Internet access at some point during any 24-hour period. As many as three million calls occur simultaneously, and that number may double during peak on-line hours between 8:00 and 10:00 PM.

In November, 1996, the Internet was nearly brought to the verge of collapse during prime time on election night as web surfers from all parties, regions and persuasions logged in, seizing analog circuits for the latest election returns. Response times stretched from seconds into minutes, with seemingly interminable downloads taxing the patience of even the most loyal poll-watchers and campaign volunteers, not to mention the corresponding impact on voice switching capacity during the same time period.

Internet Traffic Robs Capacity of Voice Switches

On the average, a voice call is about three minutes long and a switch port can handle 20 three-minute calls an hour. One switch port traditionally services ten customers and, except on Mother's Day, busy signals were once about as rare as lottery winners. But the Internet's World Wide Web changed all that.

Knowingly or unknowingly, most individuals and businesses use the traditional plain old telephone service, or POTS, to dial up the Internet. When they connect, they tend to stay connected for a lot longer than three minutes. Half-hour or even hour-long on-line sessions are becoming a daily habit for mainstream users preferring the Internet over television, whose ratings have shown hard-to-ignore decreases among households using computers.

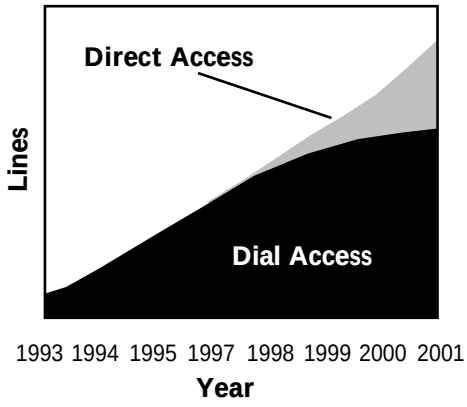
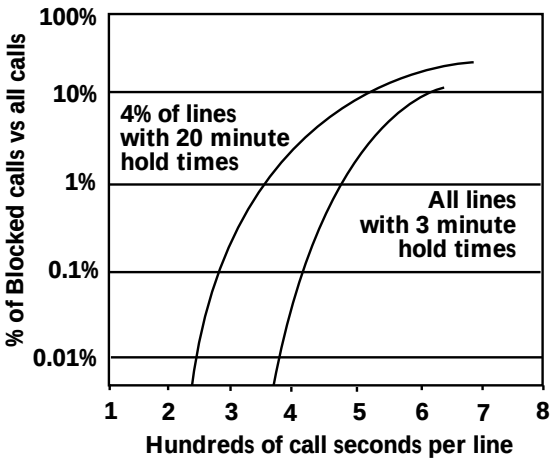


FIGURE 2 - MIGRATION TO DIRECT ACCESS

Private internal networks, or Intranets, have become the de facto standard for corporate information distribution. Growing Small Office/Home Office (SoHo) businesses are using the Internet for communicating cost-effectively with markets and customers.

More are coming on-line every day. Internet usage is still growing at over 30 percent per year, with traffic increasing at about 10,000 on-line hours per day worldwide, predominantly from residential usage in the United States.

There is little doubt as to the viability of the trend and while actual growth variables may be quantified in



source:Bellcore

FIGURE 3

places other than this paper, the bottom line to central office operators is this:

- Every 60 minute Internet call to a central office switch prevents twenty other three-minute voice calls from getting through.

- Every switch port occupied by an Internet session forces twenty voice calls per hour to seek other ports.

- Every 60 minute zero-revenue Internet session can represent lost revenue of up to $0.30/minute, or $18.00/hour in toll charges.

Suppose that this type of zero-revenue call were becoming more and more frequent each month and growing at a rate of over 30% per year. And suppose that you were required by law to absorb these costs as part of your ordinary business operation. What actions would you take to compensate?

- Each simultaneous Internet call further compounds switch congestion.

- If one in ten calls within the next hour is an Internet call, two more ports may be seized for an hour, thereby sending the next 19 calls seeking other ports.

- In a switch of 1,000 ports, how many simultaneous Internet calls would it take to drive switch utilization to 80 percent? Only 40, or four percent of the traffic. If five percent of traffic is Internet calls, the displacement of voice calls can result in switch utilization approaching 100 percent.

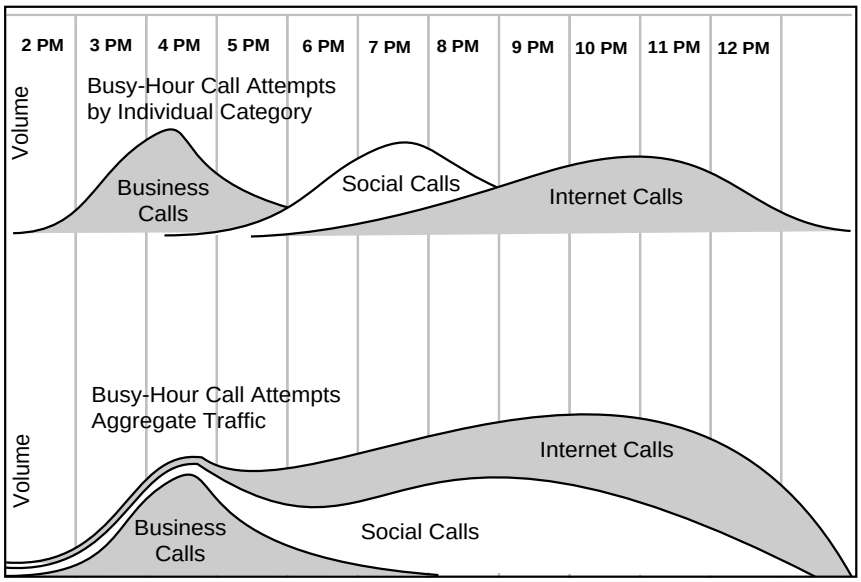


FIGURE 4

How long before such data calls force you to invest in upgrading switch capacity? How long before such calls reduce available switch capacity to the extent that local exchange rate payers experience too many busy signals? How long before dissatisfied rate payers begin to raise their collective voices in a cry for opening your markets to alternate local exchange carriers?

Internet Calls Least Profitable to Voice Carriers

Given a switch port's revenue producing potential, for example, of $1.78 every eight minutes for toll calls, or $178.00 every eight minutes for 100 switch ports, the top LEC priority is to make available as many ports as possible to accommodate toll-paying traffic. Evidence of the profitability of this type of traffic lies in the amount of sales and marketing resources LECs dedicate to increasing it. *

The next revenue priority for the LEC is to make as many connections as possible for toll calls entering or leaving the LEC's sphere of influence. The LEC derives an access fee from each call it accepts from a third party carrier, plus a percentage of the outbound per-minute rate paid by the subscriber. Such a port might reach the optimal profit during a transaction (call) of approximately three minutes.

Local Voice Calls Second Priority

Local service, optimized primarily for goodwill, is balanced somewhere between loss prevention and customer satisfaction. Although covered by the basic subscriber rate of $20.00 to $30.00 per month, local calls actually represent cost liabilities. The fewer the number of calls, the greater the number of switch ports that can be devoted to high priority toll calls. Adjusting the number of subscriber lines to the number of switch ports, from 8:1 to 10:1 effectively improves the cost per port (and operating profits) by 25 percent, but also increases the likelihood of busy signals.

Zero Revenue Calls of Extended Duration Lowest Priority

LECs must also allow for calls of different durations to ensure that everything more or less balances out at the end of the day, and that legally mandated "lifeline" availability requirements are met.

The greatest operating liability is the call which occupies a switch port for an extended period of time, yet contributes no toll revenue, such as an Internet call. These calls not only endanger the all-important foundation of goodwill by occupying valuable switch resources, but also prevent other revenue-producing activity from taking place on the switch.

Congestion Multiplier Effect

The principles by which extended duration calls degrade switch performance are further compounded when the call must travel through multiple switches en route to its destination.

- Local calls within the same exchange experience no further value reduction.

- Internet calls which must travel through multiple carrier-owned switches en route to the ISP/CAP POP cost more.

Bandwidth of telco trunk lines between switches, similarly consumed by extended duration Internet calls, take a similar toll on their performance with degraded capacity.

Toll calls carried through local switches before arriving at the long distance POP are compensated by access and toll revenues from the long lines carrier.

To calculate the negative impact on switch capacity caused by an Internet call of one hour in duration:†

ICM x %PA x (%T x ($TR + $C)) = $ETR

* Many local exchange and interexchange carriers carriers have begun to offer free Internet access to their long distance subscribers. This allows the service provider to subsidize the loss-leading Internet service with a more predictable variable revenue stream from long distance calls.

† (incoming calls per minute) x (probability of port availability) x (probability of toll call) x ((average duration of toll call x average toll rate) + (Connect charge)) = estimated toll call revenue.

In fact, unprepared LECs are compounding the switch congestion problem by selling second voice lines to end users for Internet access. Unless the second line is used exclusively for data, the LECs must continue to make switch ports available for Internet calls.

While certain Internet customers may initially take advantage of the low (voice grade) price, most professional (SoHo) users seek a better value through a new business category. However, the next step up in price is often unnecessarily large, as many LEC organizations offer no product at a price point between the $25 a month voice service and the $300-$400 a month 56K leased line, or $500-$1,000 per month for ISDN.

Obviously, careful planning and strategic marketing are needed by the industry to facilitate the growth of the new direct access data network.

BIRTH OF A NETWORK

The ideal solution to switch congestion is the separation of voice and data traffic onto two separate pairs that terminate at the central office in two separate, specialized types of network equipment: TDM/PCM for voice and Frame Relay/IP/ATM for data.

State regulatory bodies have much legislation yet to write, the absence of which continues to postpone LEC commitments to one technology or another. LECs freely encourage subscribers with increasing voice traffic to install more voice lines as their business grows, however the inclination for LECs to encourage frequent Internet users to install dedicated data lines is not quite so cut-and-dried.

To High-End Users: "Buy a Dedicated Data Line and Get a Discount on Voice!"

LECs must provide the pricing, packaging and promotional incentives to make dedicated data lines more attractive to end users.

The existing leased line market segment delivers the highest revenues per kilobit, for perhaps the highest internal rate of return vs. higher (and lower) speed services. Average tariffs for leased 56/64 Kbps service range between $250 and $500 per month, not including installation fees. *

Lower-cost, value added services up to 128 Kbps can efficiently preserve and improve market share, especially if packaged with other subscriber benefits, such as Internet access, for which ISPs now charge separately.

As LECs and CAPs increasingly assume additional roles as ISPs, an example of such an incentive is a $40-$100 per month base service, which includes one voice line and one dedicated Internet subscriber line, along with any number of long distance incentives of various types.

Such a service enables LECs to route, terminate and manage the dedicated data line, with highly efficient network management tools such as Frame Relay, ATM and a variety of effective bandwidth optimization facilities, such as those provided by GDC's APEX™ ATM products and systems.

ILECs and LECs alike are becoming intensely competitive in proposing Virtual Private Networks (VPNs) for larger business users. In exchange for minimum annual commitments of volume, VPNs provide voice and data access as well as additional services, such as fixed 5 cent per-minute long distance rates.

LECs that take the care to install these dedicated data lines on the cleanest copper pairs will be in the best position to escalate the performance curve as the markets demand progressively higher speeds and higher reliability. Identifying the high grade pairs also helps LECs quantify the relative costs of installation, conditioning and upgrading existing facilities for new tiers of universal access service, such as 768 Kbps or 1.544 Mbps over HDSL, or up to 6.3 Mbps with ADSL.

CAPs intending to lease or acquire copper loop facilities from ILECs may wish to use Bell Labs' battery of 15 benchmark tests to ensure conformance to minimum loop quality assurance standards. For more information on these standards, please refer to Bell Labs TR-NWT-000393, Issue 2, January, 1991.

* Most ISDN service providers assess a monthly rate plus a per minute charge. One LEC in New England, for example, charges $49 per month plus $0.07 per minute. At 30 hours per week, the total usage comes to $1,260 per month.

UNIVERSAL ACCESS SYSTEMS

Narrowband universal access systems, often referred to as UAS, operating at either 64 or 128 Kbps, give local exchange users access to data resources through ISDN, PPP sites or private Internetworks, while at the same time deriving new revenue streams for their owners, including: access revenues, connection revenues and transaction revenues, even if resold to a competitive access provider.

The fixed monthly subscriber rate allows the carrier to implement more sophisticated data shaping, policing and compression technology to gain the maximum utilization advantage from existing transport facilities. Universal access strategy, which uses standard IP protocols with established transport methods such as Frame Relay and ATM, allows more effective bandwidth utilization by employing techniques such as connect admission control (CAC), which uses statistical multiplexing principles to overbook line capacities well in excess of 100 percent.

Unlike “symmetrical” voice lines, which transmit and receive over circuits of equal bandwidth, and must be transmitted in real time without perceptible latency or delay, “asymmetrical” IP or Frame Relay-based data can be transmitted or received over circuits of different bandwidths, buffered/delayed during transmission while maintaining data accuracy, compressed and decompressed during transmission, and statistically multiplexed for greater efficiency and bandwidth utilization.

Dedicated subscriber Internet/data lines bring many economic advantages, reducing costs and improving strategic positioning for future competition and deregulation. Benefits include: free voice switch capacity, defer/eliminate investment in switch hardware upgrade, create new revenue streams and new classes of product/services, tap new markets, subsidize construction of (unregulated) infrastructure for multiservice networks, provide a new valuation basis for subleasing copper loop facilities, set benchmarks or tariffs for central office lease rates, and set legal/price benchmarks for unbundling of subloop facilities.

CONCLUSION

Interim Investment in Upgradable Technologies

The ways that carriers present new access utilities to service providers must take advantage of existing plant and equipment wherever possible to keep costs down and the price attractive enough to meet immediate demand. Service providers must take advantage of existing economies of scale, strategic market management, financial leverage and available technology.

With the rate of technology now outpacing the life cycles of most products, local exchange carriers must plan incremental investments to match incremental growth in demand. Scalable architectures and upgradable facilities must form the basis of the carrier's evolving competitive advantage.

New standards and advancements in copper loop technology, such as xDSL, are capable of symmetrical throughput of up to 2 Mbps and asymmetrical signals of over 6 Mbps.

Separating Internet traffic from voice traffic increases network efficiency while alleviating switch congestion. Universal access concentrators, collocated in the central office, connect high performance users directly to the Internet, wide area network or virtual private network.

The U.S. Telecommunications act of 1996 effectively eliminates the regulatory barriers for CAPs to lease, add value to, and resell central office and copper loop facilities from ILECs. "Unswitched" ISDN and any other unregulated, untariffed services can be priced according to private reciprocal compensation arrangements without arbitrary legal restriction.

The Big Boom

Armed with a new set of high performance cost saving tools, a newly deregulated telecommunications environment and rapidly increasing demand for Internet-based data transfer, ILECs, CAPs and ISPs face immediate changes in supply, demand, price, performance, legislation and business climate.

End users, cognizant of declining prices and increasing numbers of options, have created a new price point in the market for dedicated data (Internet) lines with speeds of 56 Kbps to 2 Mbps in the price range of $40-$100 per month.

LECs diversifying into the ISP business are realizing immediate returns on xDSL technology by bundling together monthly Internet subscriber fees, line charges and some combination of long distance, paging or E-mail, thereby doubling or tripling the revenue per subscriber.

ISPs are leveraging their IP, Frame Relay and ATM expertise to partner with LECs and CAPs, gaining direct access to high-end clients and their increasing Internet traffic.

Continuing improvements in xDSL technology promise still longer life spans for the telcos' existing copper loop, whether used for voice, data or video, or whether unbundled or resold to competitive access providers, ISPs or private networks.

Watch That Basket!

For CAPs and LECs alike, managing the local data line market is as important as managing the network and equipment. In the early stages of implementation, demand for the new service(s) are largely based on availability of competing technology within the service area.

In California, for example, 68% of the state's telecom revenues originate from only 22% of the geographical area, and from only 19 of its 58 counties. Los Angeles currently enjoys the one of the lowest cost telecom infrastructures in the country, less than $10.00 per line*. Wyoming, Idaho and Montana, with their sparse population centers, carry the highest costs, at up to $27.00 per loop.

The advertising and public relations investment required to preserve demand in narrowband services cannot be underestimated, especially in light of multi-megabit service to the home offered by multiple CAPs, including CATV carriers in certain major markets.

Positioning narrowband services for small business markets is perhaps the best strategy for deriving the most immediate return on the smallest investment.

* (FCC wholesale estimates)

Acronyms

ADSL	Asymmetrical Digital Subscriber Line
APEX	ATM Packet eXchange
ATM	Asynchronous Transfer Mode
CAC	Connect Admission Control
CAP	Competitive Access Provider
CLEC	Competitive Local Exchange Carrier
DS0	Digital Signal, Level Zero
DSL	Digital Subscriber Line
E1, E2, E3	European digital transmission hierarchy
FCC	Federal Communications Commission
Gbps	Gigabits per second
GDC	General DataComm, Inc.
GUI	Graphical User Interface
HDSL	High bit Digital Subscriber Line
ILEC	Incumbent Local Exchange Carrier
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
ITU-T G.703	Transmission facilities running at 2.048 Mbps (E1) and 64 Kbps. The standard for the physical and logical traits of transmission over digital circuits
Kbps	Kilobits per second
kHz	KiloHertz
LEC	Local Exchange Carrier
Mbps	Megabits per second
PCM	Pulse Code Modulation
POP	Point of Presence
POTS	Plain Old Telephone Service
PPP	Point-to-Point Protocol
PSTN	Public Switched Telephone Network
SoHo	Small Office/Home Office
T1, T2, T3	North American digital transmission hierarchy
TDM	Time Division Multiplexing
UAS	Universal Access System
V.35	CCITT standard for trunk interface between a network access device and a packet network that defines signaling for data rates greater than 19.2 Kbps.
VPN	Virtual Private Network
xDSL	Generic for any digital subscriber line technology

ABOUT THE COMPANY

General DataComm Inc. (GDC), is an international communications company headquartered in Middlebury, Connecticut, USA. General DataComm designs, markets and supports networks and networking products which integrate voice, data, image, video and LAN applications for national and multinational companies, governments and communications service providers worldwide.

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