MARKET OVERVIEW

MAJOR INDUSTRY TRENDS

A wide variety of business, computer and communication industry megatrends are now converging to create demand for a high performance data communications. Three key trends include:

- decentralization of decision making authority, and of information within an organization, with the networked personal computers as the catalyst
- changes in the quality of information products as visual computing, imaging, graphics, and voice become major factors in information processing
- dramatic changes in communications usage patterns resulting from technology changes and deregulation in the telecommunications industry

LANS ARE EVERYWHERE

As a result of the widespread adoption of personal computers and local area networks, there are now over 37 million personal computers and workstations used in business within the US. Of these, 42 percent are connected to a local area network. LAN connected computers are becoming the backbone of American Industry. IDC estimates that there are 1.1 million local area networks in 1991, with expectations of 1.8 million in 1995[1]. Within the Fortune 1000, a 1991 survey of 401 LAN Administrators in sites with 1000 employees or more conducted by the Business Research Group[2] (BRG) defined a typical (average) site as having:

951 Personal Computers, of which 447 were networked
27 Servers, with 17 PCs per server
18 LANs, with 1.5 servers per LAN, 25 PCs per LAN
51% of all LANs were interconnected
10% of all respondents had 100% of their PC's networked

The problem of interconnecting local area networks is further complicated by the fact that the rapid adoption of graphics and imaging technologies[3], and the impending voice annotation and multi-media technology is increasing the quality of information which is transmitted between LAN users. This, in turn, causes an

1 International Data Corporation (IDC) "1991 Analysis of LAN Internetwork Market", and additional information provided directly by IDC.

2 Business Research Group, PC LAN Integration and Management: User Trends, June 1991

3 A Computerworld Survey of 50 Key Information Systems executives identified Local Area Networking Technology and Imaging Systems as the most important technologies to be acquired in 1992.

order of magnitude increase[4] in network bandwidth. The net effect of the geographic growth of data networks and the increase of bandwidth per user is that data traffic is growing at 35% a year, and will equal voice traffic for enterprise networks by 1996[5].

INNOVATIVE CUSTOMERS

Innovative firms are already putting in place major high bandwidth communications networks to provide the communications capacity that provides strategic advantage in their businesses. For example,

- Shell Oil has built its own 50 mile 565M bit/sec fiber-optic network to connect it's 5 data and research centers in Houston. In the 3 years that the network has been in place, Shell has had to double the network capacity to 1.2G bit/sec. The impact upon the effectiveness of Shell users has been significant enough that they have justified Shell extending the high bandwidth service to remote sites in Bakersfield, CA and New Orleans. Shell is not building its own dedicated fiber links to those sites.

- The Boeing Corporation created its own 50 mile FDDI ring to connect all of its manufacturing sites in the Puget Sound area, to provide a distribution facility for engineering drawings. The network allows Boeing personnel to access a 20M byte drawing within 2-3 seconds. Many of Boeing's airline customers have petitioned Boeing to allow them to have the same kind of on-line access to the drawings.

- The Los Angeles County Transportation Commission is installing a high speed network to connect its 4 primary engineering and drawing distribution centers to allow it to put all of its engineering drawings on-line, eliminating the duplication of the paper infrastructure. When the project is complete the 150 remote CTC offices will all have electronic access to engineering drawings in 3D, reducing design iterations and simplifying the change and change distribution process.

- Bear Sterns is installing a wide area interconnect to link 450 workstations in Manhattan with secure file servers in New Jersey. The application involves 40 high speed Ethernet connections, and requires an effective bandwidth in excess of 250M bit/sec. This application at Bear Sterns justified establishing a 30 mile fiber link between the sites.

- A major financial services firm is in the process of developing an image based system to process all customer correspondence electronically. The system will scan daily the hundreds of thousands pieces of customer

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4 For Example, a page of text is typically 4000 bytes, a page image is typically 1 megabyte

5 The Yankee Group, Yankee Watch Communications, July 22, 1991, page 1

correspondence at one site and distribute images nationwide for processing.

These applications in widely disparate industries are typical of the kinds of communications intensive activities which are allowing the organizations to exploit their information base as a competitive weapon.

GROUPWARE AND OTHER DRIVING APPLICATIONS

Horizontal "groupware" applications software products are also instrumental in stimulating the projected 35% data capacity growth.[6] Groupware is the name for a class of capabilities which allow individuals who are remote from each other (either geographically or in the time domain) to it effectively without the need for direct face to face contact. Groupware is widely deployed in many technical applications such as computer aided design and technical publishing where many individuals simultaneously contribute to development of a shared work product. Primitive Groupware capabilities such as electronic mail, bulletin boards and conferences are now being widely adopted with significant impact upon the culture and basic business practices of many corporations. The use of an electronic conference to determine "has anyone ever been able to ...?" is now the standard mode of operation for problem solving by independent consultants and corporate specialists. Electronic communications makes it possible for field sales and support personnel to stay abreast of all current activities and to participate in fully in problem solving and planning exercises as though they were stationed at headquarters.

Groupware products such as IBM Office Vision[7], Lotus Notes[8], NCR Cooperation and IBM Image Plus[9] have all been developed to allow users to communicate and work effectively together. The products include work flow capabilities, automatic information distribution, and support for users with intermittent connections (i.e. traveling staff with notebook PCs). These applications are being adopted today and will have immediate impact upon communications requirements within the user organizations.

Other classes of software technologies are in the initial process of being released to commercial markets in volume. Imaging, Graphics Visualization, and Multimedia technologies include the ability to create, distribute, and use photo realistic

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6 Wall Street Journal, March 11, 1992, Page B1, "More Firms Outsource Data Networks"

7 The Branch office communications problem: IBM forecasts that 64K bit/sec connection will only support 3-5 users Office Vision users, according to Gartner Group conference Fifth Annual Enterprises Network Strategies Conference P III-7.

8 Lotus Notes represents a major information communications breakthrough for cooperating individuals who are geographically distributed. Anderson Consulting recently ordered 20,000 copies to distribute throughout the comapny, for both local and customer site employees.

9 IBM Systems Journal, Volume 29, No 3, 1990 recommends a dedicated T1 per location for response time-sensitive Image+ applications (Gartner Group Fifth Annual Enterprise Network Strategies Conference Proceedings, P I-11.

graphics, voice, and video information with the same ease in which users manipulate words and numbers today. The improvement in the quality of information communications between individuals dramatically changes with these enhanced data types, but the new data types tax our computing and communications systems. For example, the graphics alone which are part of this business proposal more than double the physical size of the document as stored on a computer, or transmitted across a network. The implications would be even more significant where voice, animation, or video are included in the document.

TABLE 3 - SIZE OF SAMPLE DATA ELEMENTS

Object	Size	Ratio
Character mode screen update	256 bytes	1
8.5*11 page image	256k bytes	1000
Graphic mode screen update 512*512*8 bit	262k bytes	1000
photo realistic CAD image 4k*4k*256 bit color	16 Mbytes	62000
1 Minute Voice Clip	600kb	2500
1 Video Frame (24 bit Color)	2MBytes	10000

The larger quantities of data will quite naturally require faster network connections to allow users to effectively communicate. As the following table shows, Local Area Networks such as Ethernet are adequate to support these objects, except for full motion video, which can only operate with 200*200 pixel images (1/4 screen image). Wide area connections are most commonly implemented using DS-0 connections or DS-1 connections which are clearly unsatisfactory for these applications.

TABLE 4 - COMMUNICATIONS IMPLICATIONS

	Bandwidth	256 Bytes	262 Kbytes	1.2 Mbyte Drawing	4096*4096 24 bit Pixel
DS-0	64K bit/sec	.03 sec	31 sec	180 sec	6200 sec
DS-1	1.5M bit/sec	.001 sec	1 sec	8 sec	269 sec
Ethernet	10M bit/sec	.00015 sec	.015 sec	1.1 sec	38 sec
DS-3	565M bit/sec	.00005 sec	.009 sec	.25 sec	9 sec

45mbs

The last major technological evolution which will drive the process of interconnecting users, and the requirement for high bandwidth linkages is called "Live Links" by Apple, and "Object Linking and Embedding" by Microsoft. A similar capability has existed in UNIX for some time. These capabilities permit individual users to create linkages between objects in which changes to data in a spreadsheet, for example, will be implicitly synchronized with a linked copy of the same information in a document. This capability is available today for a single user, and will be available within the next 12 months for distributed applications. The ability to interconnect distributed PC applications with implicit linkages allows individual users to create information webs with their direct managers, without needing to involve an MIS applications development group, which in turn will accelerate the demand for interconnectivity and bandwidth. Remote users will be able to have information as current as is desired, without explicit operator action.

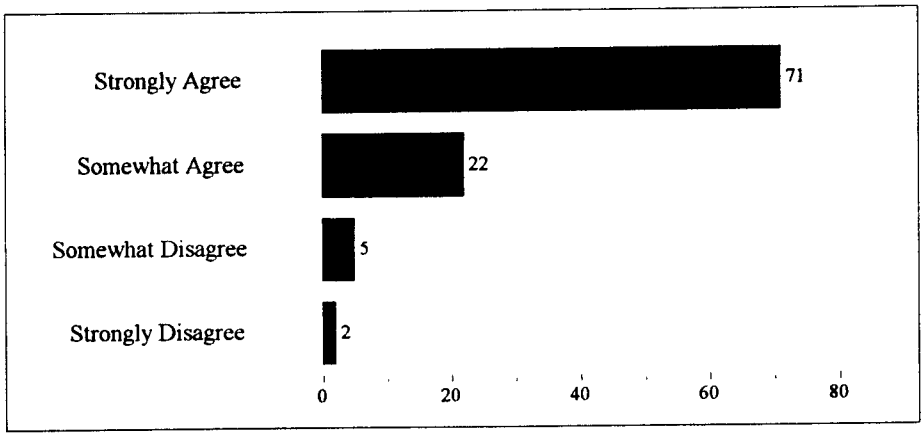
Clearly, the evolution of the use of personal computing will be one of the most significant drivers of the projected 35% CAGR data communications growth, a growth which will continue for many years.

THE CHASM

A tremendously vital business approaching $1B has developed in the area of LAN interconnect equipment in support of this growth[10]. Existing technology is evolving to meet most inter-networking needs within a building, and within local campuses. Ethernet Networks operate in the 10M bit/second range, and Token Rings operate at 4 and 16M bit/second. Intra-building interconnectivity solutions are simple, and 100 Megabit/second FDDI backbone networks provide cost effective campus solutions.

The interconnection of LANs is a very timely and topical issue throughout American Business. A Computerworld survey of 50 key information systems executives identified LAN and LAN interconnect as the #1 technology to be acquired in 1992. The BRG survey of Fortune 1000 LAN administrators asked whether "Interconnecting LANs will be a very important task of our company's IS strategy over the next 2 years. Ninety-three percent of all respondents agreed. Sixty-three percent reported that MIS has already taken the responsibility for internetworking

FIGURE 3 - INTERCONNECTING LANS WILL BE A VERY IMPORTANT TASK OF OUR COMPANY'S IS STRATEGY OVER THE NEXT 2 YEARS.



Response Percentages

10 IDC has published an extensive report on this interconnect market from the perspective of sales of network bridges, routers, and other interconnect products. The IDC surveys are traditionally the most conservative surveys available, and have been therefore selected as a base of this analysis. For interconnect hardware vendors, IDC recognizes worldwide revenues in excess of $1B in 1992, rising to $1.5B in 1995. The IDC survey does not cover the sales and revenues of the communications products which are used to interconnect the LANs.

Unfortunately, there is no cost effective solution available today for connecting Local Area Networks which are geographically distributed. The most common alternatives are dial-up or leased telephone circuits and public packet networks. The effective upper bound of these options is 56K bytes per second, approximately two-tenths of one percent of local area network speeds. As a result of this disparity, the full capabilities of existing computer systems and applications are severely limited.

COMPLEXITY OF AD HOC SOLUTIONS

For those organizations which recognize the value of high performance interconnects, the process of building a private network from currently available building blocks is complex and challenging. Evolving telecommunications technologies make it extremely difficult to design a network.. This network design problem is further complicated by dramatic and often unpredicted capacity demands resulting from changes in usage patterns of existing applications and new applications developed by end users.

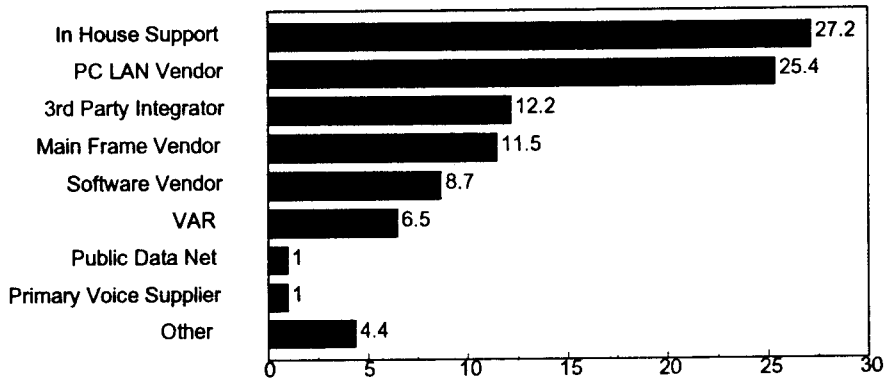
To connect two or more Local Area Networks, an inter-networking specialist identifies the points to be connected, selects and purchases network interface controllers (NICs), network routers, network switch equipment, local communications vendors, and long distance communications vendors. Each of these selection processes involves an architectural and competitive evaluation and the systems integration process involves products from several vendors, with all of the attendant issues of installation coordination and problem isolation typical of systems integration. Network systems designers must decide what level of integration they should most appropriately choose. For high performance solutions, options range from purchasing "dark" fiber or microwave and buying all of the electronics as one (fairly common) extreme, to buying bundled local and long distance communications services from an RBOC, IXC or third party. Similar choices are required for network interface equipment such as modems, bridges, routers, and switches. Each of these decisions involve communications technologies and products, which are evolving rapidly due to both technological and regulatory issues. Thus, "optimal" solutions, and even basic expertise in this area are very short lived.

Unfortunately for most corporate data networking organizations, there is not a uniform set of components or vendors who provide products which work in high bandwidth and low bandwidth environments, at short and long distances, for intermittent or continuous operation. As a result, most networks of any consequence involve a large number of vendors and products, which further complicates the installation and problem resolution processes, and which can turn operations and network planning into a nightmare unless managed carefully by technically competent and street smart team.

CROSSING THE CHASM

As a result, it is nearly impossible for most organizations to implement cost effective programs. As a result of these issues 80% of the Fortune 1000 organizations in the sample[11] reported that they expected to use outside sources to help with inter-networking. Yet, less than 1% report that they would turn to their primary voice communications vendor for support. This apparent paradox results from the fact that communications products and vocabulary are completely disjoint from the concepts and vocabulary within MIS organizations.

FIGURE 4 - WHO WOULD YOU CALL TO HELP WITH DEFINING YOUR PC LAN TO PC LAN INTEGRATED NETWORK?



Response Percentage

Thus, the Chasm between LAN performance and LAN interconnect performance represents a serious challenge for MIS departments trying to interconnect LANs throughout the corporation. At the same time, the options to bridge the Chasm require a very strong level of telecommunications and systems integration expertise, and are likely to evolve rapidly due to changes in the telecommunications industry and to dramatically increasing user demands for data communications services as applications evolve to include graphics, image, multimedia, and dynamic data linkages.

MFS Datanet is poised and uniquely qualified to meet this need.

11 Source: Business Research Group

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