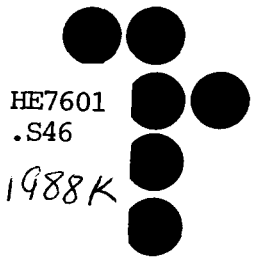



COMMUNICATIONS
FORUM

# METROPOLITAN AREA NETWORKS: HOW SOON?

November 3, 1988

Seminar Notes

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COMMUNICATIONS FORUM

This session of the Communications Forum provided the audience with an overview of Metropolitan Area Networks (MANs)--citywide networks for the transmission of high-speed data communications such as the interconnection of local area networks (LANs). Dr. James Mollenauer, Technology Manager for Networking at Computervision, and the Chairman of the IEEE 802.6 committee, discussed the MAN's dual-bus technology's development in the context of the 802.6 standards setting negotiations. He noted the recent fast-paced nature of the negotiations that are bringing U.S. debate on the standard to a close. Paul Chisholm, Vice-President & General Manager of Teleport Communications--Boston drew comparisons between the types of MAN services his company currently provides in New York and those proposed for the Boston system it's currently installing. George Clapp, a member of the Technical Staff at AT&T Bell Laboratories, like Dr. Mollenauer, provided an historical summary of the standards setting work of the 802.6 committee with additional commentary about the technical benefits of the committee's decisions. All three speakers were very positive about the future of MANs in terms of the benefits to be derived by corporate users and their design for compatibility with ISDN (Integrated Services Digital Network).

The first speaker, Dr. Mollenauer, addressed the question of how soon we should expect to see operational MANs. In his opinion, "MANs are a reality." He described MANs as outgrowths of the phenomena of LANs (local area networks). According to Mollenauer, the typical MAN connects several buildings of a corporation with multiple sites located in a metropolitan area. For instance, a company could use a MAN to connect computers for inter-building communications, in contrast to using LANs for intra-building communications.

Mollenauer explained that the original impetus for the IEEE 802.6 standardization effort for MANs was from the satellite industry. The assumptions for a MAN have been as follows:

- expect them to be a shared medium;
- optimized for a 50 km diameter area;
- offer support for data, voice & video;

- operate at speeds of 1 Mbps and up;
- provide choice of protocol and medium.

Dr. Mollenauer noted that as technology and markets have changed so have the specifications of MANs throughout the standards setting process.

According to Mollenauer the IEEE 802.6 committee views the following applications for MANs, starting with:

- the interconnection of LANs;
- support of voice communications;
- transmission of compressed video (100 megabits);
- support of high performance graphics, e.g., CAD, medical images, etc.;
- high volume data transmissions;
- support of data transactions;
- WAN gateway.

Mollenauer noted that the amounts of data transmitted via a MAN could become quite significant, especially when future high-resolution CAD applications will likely be in the range of 12+ Megabytes of data. Emphasizing this growing demand on data networks, e.g., LANs, he cited "Bill Joy's Law"*: computer workstation speed appears to double every year.

Dr. Mollenauer traced the technical standards setting process from the early work on LANs in the early '70s to the emergence of MANs and the on-going standards setting process in the '80s. The following is an historical overview according to Mollenauer:

1973: work starts on LAN standards with a paper by Boggs & Metcalfe as part of an MIT Thesis

1974: work on 3 Megabit Ethernet at Xerox CSMA/CD Protocol

1979: work begins on IEEE project 802

1980: DEC, Intel & Xerox publish an intermediate standard

1981: Other networking protocols emerge, e.g., baseband: token ring

1982: The MAN Committee begins work under the chairmanship of Cas Cheung of Satellite Business Systems (SBS);

1984: Burroughs proposed a slotted fiber optic ring proposal for MANs (Burroughs would later pull out of this development work due to its merger with Univac to form Unisys);

Sept.
1986: Telecom Australia submits its proposal

Nov.
1987: QPSX (DQDB) endorsed by the 802.6 Committee

According to Mollenauer, it was really the Australians with their technical drive that prevented the MANs standards work from dying after Burroughs dropped out of the process. Also, interesting to note is the current, very active involvement of the U.S. telcos who originally cursed the idea of metropolitan area networks as "bypass." The PTTs of Continental Europe are really the only major communications companies that remain absent from the 802.6 discussions (France actually participated in discussions early on).

Mollenauer likened the entire 802.6 standards setting process to an Olympic bicycle race that starts slowly and then speeds up dramatically; the committee is currently working at a very face pace. Thus he is optimistic that the current draft will be ready for Committee Letter Ballot this month (November '88) and believes the IEEE standard will garner full approval of the membership by Spring 1989. He projects the ISO version will be approved by Spring 1990.

Technically, according to Dr. Mollenauer, the major advantage of the 802.6 MAN standard versus FDDI is the former can

operate as a private or a public network, while the latter is for private data communications only. Also, while 802.6 will support voice, data, and video services, FDDI supports only packet data transmission. Also, although FDDI supports 100 Mbps now, in comparison with MAN's 45 Mbps standard, the latter will soon be boosted to handle 150 Mbps or a total of 300 Mbps. Furthermore, Mollenauer believes that work on FDDI and 802.6 in North America still remains divided between the computer companies and the telephone companies respectively.

In general, Mollenauer is enthused about the current design of the MAN standard as a dual-bus configured like a ring since it provides the user with fail-safe capabilities, e.g., allows the user to reconfigure the network with no degradation of throughput. Mollenauer described the MAN's scheduling capabilities as similar to Ethernet with light loads and similar to token with heavy loads.

Mollenauer was also enthusiatic in noting the MAP standard with its broadband multiplexing capability will be compatible with T1S1.1 (Broadband ISDN) which will help MAP users take advantage of widearea services. He has coined a new term to describe this synergistic relationship between MANs and broadband ISDN: "Megalopolitan Area Networks." Mollenauer envisions that ultimately this means there will be MAC bridges, which act as switches, with worldwide routing capabilities and much of the processing will be transparent to the users.

The second speaker, Paul Chisholm, Vice-President and General Manager of Teleport Communications-Boston, gave the audience a look in to how a company actually enters the MAN business and what kinds of commercial offers are currently provided by Teleport Communications.

Mr. Chisholm described his company as the alternative to the local telecos in providing local communications services to business; it is operates as a certified common carrier. Teleport Communications of New York has been operating since 1985 as such an alternative provider in New York City and its sister company--Teleport Communications-Boston--is now in the process of constructing its fiber optic MAN in Boston. Chisholm described

Teleport Communications as a partnership between two companies--Fidelity Investments of Boston and Merrill Lynch of New York--which "at first sight look like competitors." He explained that these two companies both had a need for reliable communications and were not being satisfied by the offerings of their respective local telcos. While he noted that Fidelity brought its expertise in customer service to the partnership, Merrill Lynch had actually built a MAN so it had its technical expertise to share.

Mr. Chisholm explained that there will be technical differences between the design of the New York and Boston networks. For instance, the New York network originally planned for the connection of satellite uplinks and downlinks to connect with overseas, whereas the Boston network will be a purely fiber-optic distribution system. The Boston system covering Government Center, the financial center, and the Prudential Center will cover a smaller area than the 150-mile fiber network now operational in New York city. Teleport's Boston system, like the New York system, will provide point-to-point service using single mode fiber, rather than switched services, to corporate customers. The service his company will offer in Boston is a dedicated private-line service.

Chisholm noted that Teleport has just started constructing the Boston network which involves digging-up the street and installing conduit. The work actually started on November 2 (1988) and Teleport-Communications projects it will have its first customer operational in January (1989). An operation center for the Boston network has already been built and is located at 10 High Street. Chisholm estimates it will take about one year to install the entire Boston network.

Mr. Chisholm listed Teleport Communications-New York's major clients as long distance carriers, large corporations, and members of the broadcast community (e.g., ABC). He believes that these companies come to Teleport Communications because of Teleport's network availablity or "uptime" which he noted is running at 99.9%. He touted Teleport's loop design which provides customers with total redundancy. Chisholm also stated that neither interexchange carriers (IXCs), nor users, want to "put all their eggs in one basket" by using a single communications carrier since this is their "lifeline" and business.

Chisholm believes that providing "service" to customers is key to competing with the local telcos. He noted that his company can expand services for a corporate client as the client grows given Teleport's broad product line. Chisholm also stressed that a company using Teleport's facilities, e.g., Teltrac Diagnostics, "can get better control over their networks."

In Boston, Teleport Communications will offer services such as DS1 (1.544 megabit) and DS3 (45 megabit), as well as custom configurations. In contrast to the local telco which typically charges a customer for service on a monthly basis, Teleport Communications-Boston will offer a 1-3-5 year fixed monthly rate for its standard services and negotiable terms for custom configurations. Chisholm elaborated on three broad categories of applications that he believes will attract customers to Teleport's services:

- connectivity between interexchange carriers' points of presence;
- connections from corporate customers to interexchange carriers involving data, voice, and/or video;
- connectivity between customer premises, e.g., LAN interconnection, connecting data centers to administrative areas, and disaster recovery configurations.

Looking toward the future, Chisholm expects that his company's fiber optic network will be supporting applications to the desk-top such as high-speed graphics and high-speed facsimile. He believes the major challenges in this business will continue to be the task of building the network(s).

The third speaker, George Clapp of AT&T Bell Laboratories, is also Secretary of the 802.6 committee. In general, he expressed agreement with James Mollenauer's description of the 802.6 fast-paced standards setting process and how the work on MANs has grown out of the LAN environment (refer to Exhibit 1). He emphasized that IEEE 802.6 and ANSI T1S1.1 are not only compatible, but identical. The 802.6 proposal was presented and approved at a meeting of the Broadband Task Group of T1S1.1 in New Orleans in October (1988). He also reviewed with the

audience the technical composition of the 802.6 structures: 5 octet header and a 64 octet information field for connection-oriented services versus a 5 octet header, 2 octet adaption layer, and a 62 octet information field for connectionless services (refer to Exhibit 2).

Clapp alluded to research done at the University of Michigan. Even though the token ring network ran at 100 Mbps, when most networks today operate at 200 Mbps, the backbone ring was unable to handle network growth and there were also maintenance problems. In contrast, the new architecture proposed to 802.6 introduced a central switch into the architecture (refer to Exhibit 3). Clapp also characterized the 802.6 proposal as a flexible architecture, e.g., can grow transparently to accommodate increased traffic and handle clusters of workstations.

Clapp refered to some security issues that might arise in using a MAN. The current architecture keeps buses separate for security reasons. He explained that a company could add new sub-buses if the traffic between two companies justified doing so and security was not a problem.

Mr. Clapp noted that neither of the two previous speakers had talked about Private Virtual Networks (VPNs). He described these VPNs as means to "allow the facilities of a public carrier to share its facilities among a number of users in a way transparent to the users." In essence the user thinks he is commmunicating over a private network, but communications facilities are actually being shared resulting in reduced communications costs. Clapp also explained that to provide multicast and broadcast functionality using a dual-bus subnet and multiplexing can reduce the number of packets sent through the central switch.

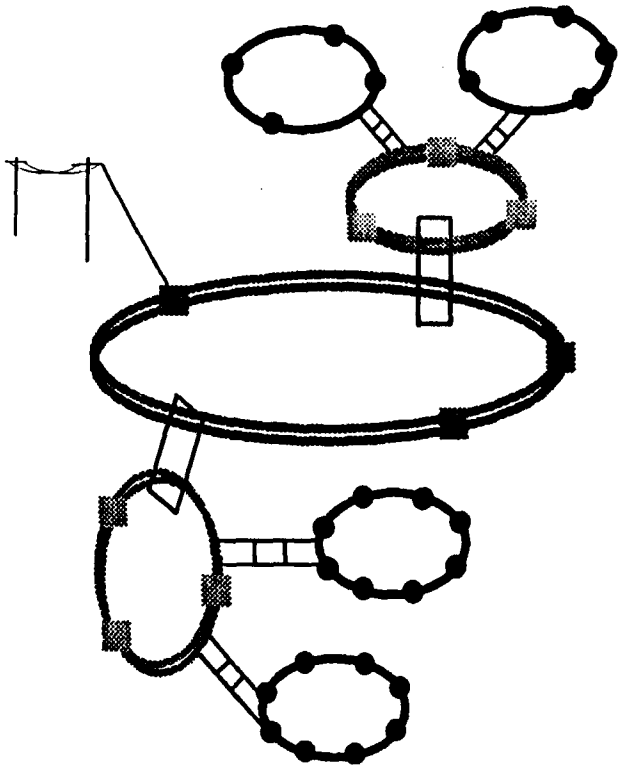
Clapp noted that the architecture adopted by the IEEE 802.6 working group in November 1987 is actually a "multiport bridge." He believes that the work done thus far on 802.6 will ensure its "seamless integration to broadband ISDN (Integrated Services Digital Network)." Clapp believes that 802.6 is positioned well for the future.

Clapp summarized the 802.6 Committee's upcoming schedule. He explained that at the meeting next week (November 1988) 75% of the voting members must respond and 75% of those responding must approve, while the committee must consider all negative comments. The voting is done by letter ballot. Voting members of the working group must respond with written comments in thirty days. If approved then the 802.6 Working Group will meet the week of January 23, 1989, in Perth, Western Australia. There the results of the letter ballot will be considered and the draft will be released for a confirmation ballot. If all goes according to plan, the IEEE 802 plenary session will take place in March, 1989. At this time, the Committee will vote on whether to approve the standard.

*Bill Joy is known as the "father of U.C. Berkeley version of Unix" and is currently with Sun Microsystems.

## Hierarchy of LANs

# MANs Built as a Hierarchy of LANs



## Limitations

- Capacity
- Performance
- Maintenance

Exhibit 1

IH GB60T204

# IEEE 802.6 Cell Header Format

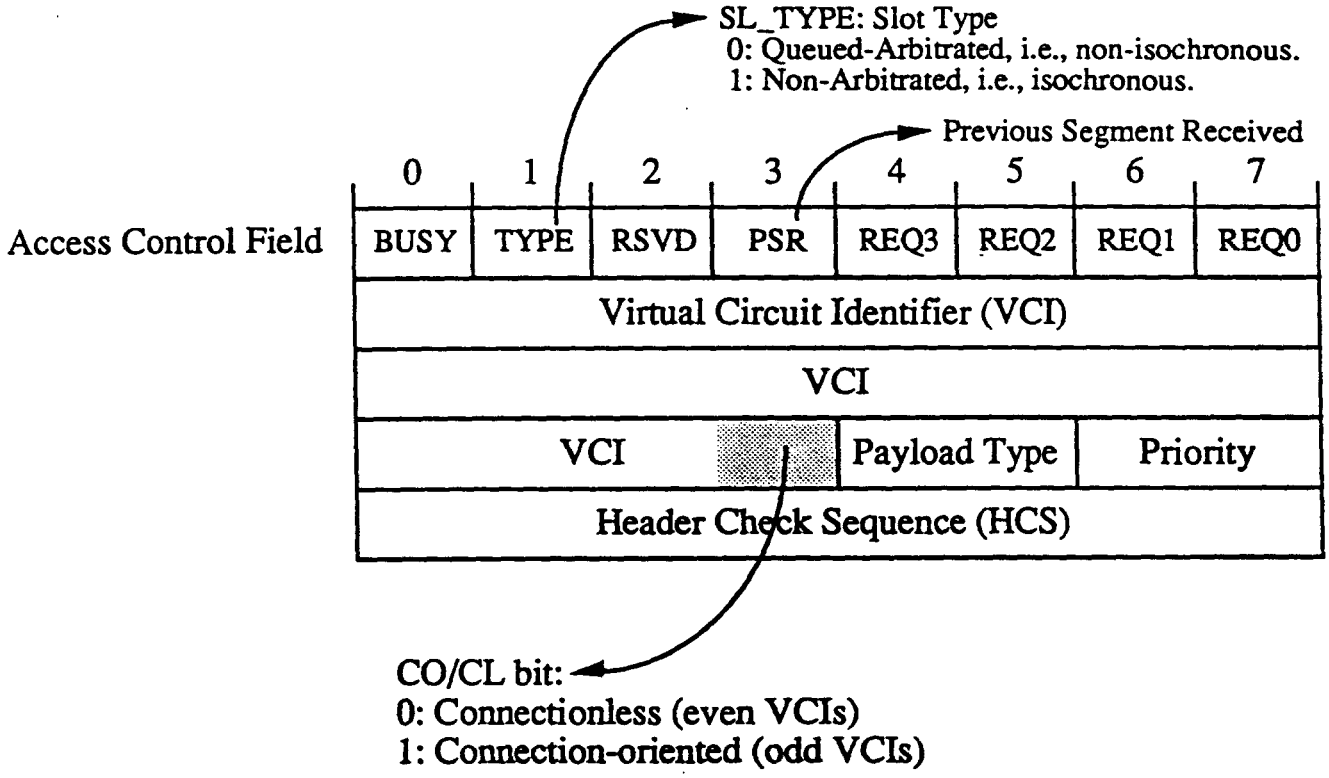
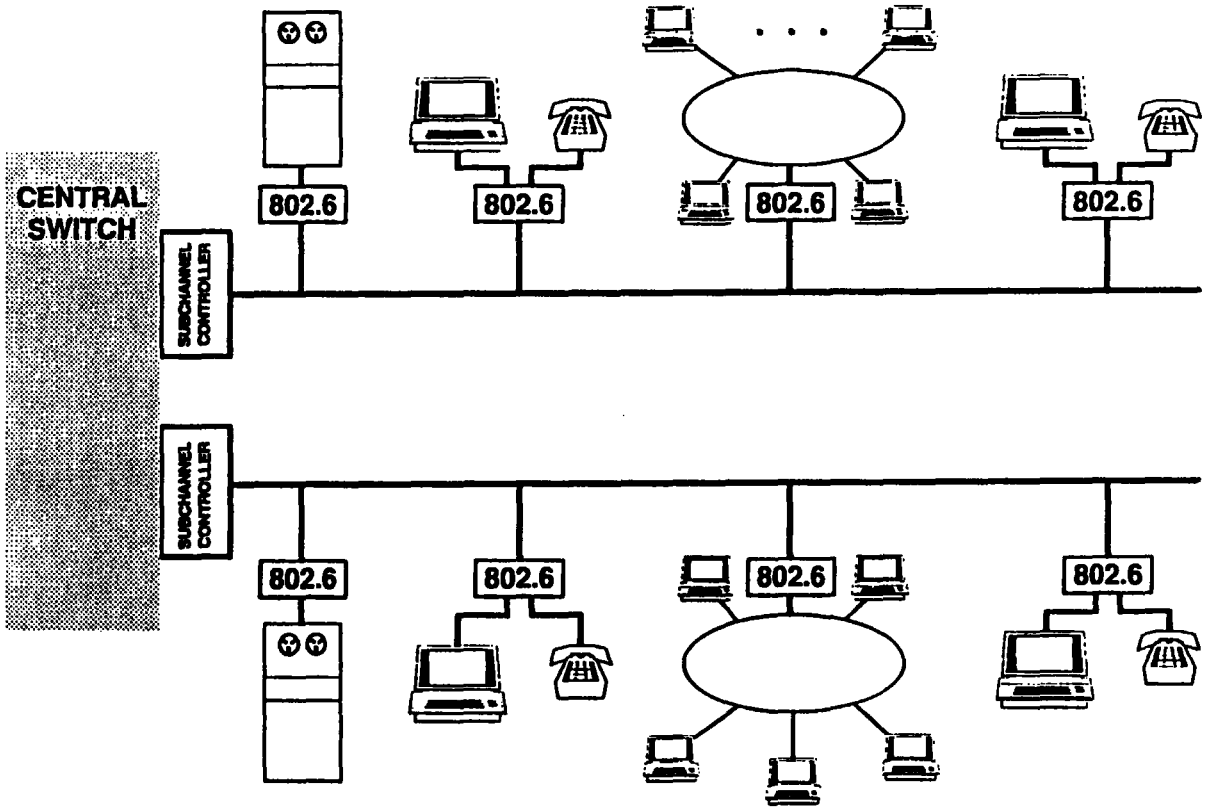



Exhibit 2

## 802.6 MAN Architecture

### Addition of a Central Switch




- A Central Switch Interconnects Distributed Queue Dual Bus (DQDB) Subnetworks

IH G86072.04

Exhibit 3