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HIGH THROUGHPUT LOCAL NETWORK

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INTRODUCTION

An architecture for digital network service integration must support a wide spectrum of user needs. Today, it is only a concept because such an architecture exists nowhere in the world. To satisfy the users needs the throughput must be very high. We give in table 1 the classical digital throughput for several services.

Alarm/Security System	4 bit/s
Computer terminal applications	256 bit/s
Digitized telephone speech	64 Kbit/s
Picture phone	2 Mbit/s
File mass transfer	8 Mbit/s
Interprocessor bus	16 Mbit/s
Color television	34 Mbit/s
High quality video service	512 Mbit/s

Table 1 : throughput of some classical sources

This paper proposes a review of some possible local multi purpose architecture with their advantages and their drawbacks. In the sequel we are mainly interested in very high throughput local networks. Finally, we shall present the ESCALIBUR project, a very high throughput local network of the MASI Lab.

A very high capacity local network could be used as a backbone network to connect smaller networks in an office environment, which is characterized by word processors, terminals, printers, etc. All of these devices feature a direct user interface, so computing power is not usually a primary concern. A LAN for office applications needs to support hundreds of nodes but does not necessarily have to runb at a high data rate.

A very high throughput network provides a higher data rate for compute intensive applications, such as computer-aided design equipment, graphics or imaging machines or mainframes.

Mainly a very high local network acts as a backbone network of a company linking the mainframes, the high throughput engineering workstations and departemental LAN including Cheapernet/Ethernet, token rings networks, PC-Net, Starlan...

Some solutions

A first solution is given with FDDI ring LAN (Fiber Distributed Data Interface) [1] [2]. The FDDi is currently being specified by ANSI (American National Standards Institute) committee as the standard for a 100 Mbit/s LAN and will use fiber optic cable. The FDDI ring is a combination of two independent counter-rotating rings, each running at a 100 Mbit/s data rate as shown in the figure 1. If both rings operate simultaneously, the effective throughput is 200 Mbit/s. It is also possible to have configurations where one ring connects all the nodes, with the second counter-rotating ring connecting only a few select nodes. The rings which reaches all the nodes is called the primary ring. The secondary ring carries data in the opposite direction and can be put to use during ring reconfiguration.

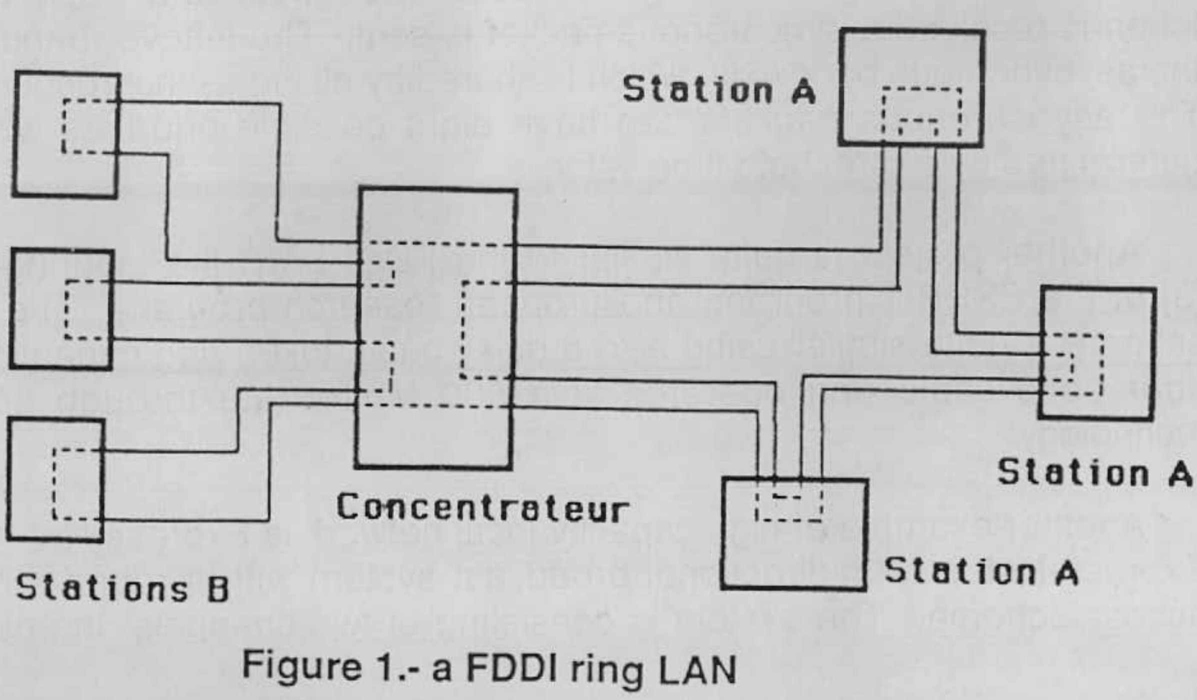

Figure 1.- a FDDI ring LAN

The FDDI LAN is designed to allow links of a least 2 km in length between adjacent nodes, with no optical bypasses on either end. The stations are serially connected by a transmission medium to form a closed loop. The packets are transmitted sequentially from one station to the next, where they are regenerated and retimed before they are passed on to the following station. The stations not participating in data transmission can either be bypassed or function as active repeaters. The addressed station copies the packet as it passes. Finally, the station that transmitted the packet strips the packet off the ring. A station gains the right to transmit when it has the token, a special packet that circulates on the ring behind the last transmitted packet. A station that wishes to transmit captures the token, puts its packet on the ring, and then issues a new token, which the next station can capture for its transmission.

The exact access scheme is called timed token access; it allows each node a fair share of access to the network while maintaining an upper limit on the token rotation time. The token rotation time determines how often the nodes get an opportunity to transmit. In order to satisfy the requirements of various applications, a node must know two things:

- the maximum latency before the token returns again to the given node;
- the amount of traffic that the node can send once the token returns.

The FDDT protocol allows the node to determine both these parameters through a negociation protocol.

A node can negotiate a synchronous throughput and every time the token is received a synchronous packet is sent. The leftover bandwidth in the asynchronous bandwidth which is shared by all the asynchronous nodes. The asynchronous packets can have eight possible priorities which are determined by a threshold time value.

Another project is quite similar to the FDDI LAN: the Lionring project [3] of the ESPRIT program, an European research program. The access scheme is quite similar using also a daisy chain token ring capability. The fiber optic cable ring operates at a 500 Mbit/s rate through an AsGa technology.

Another example of high capacity local network is Express-Net [4]. The Express-Net is a unidirectional broadcast system with a round-robin type access scheme. The system is consisting of two channels: the outbound channel which all users access in order to transmit, and the inbound channel which users access in order to read the transmitted information. In addition to the transmitting capability on the outbound channel, users can sense activity on that channel in a way similar to that required in other channel sensing systems such as CSMA (cf. figure 2).

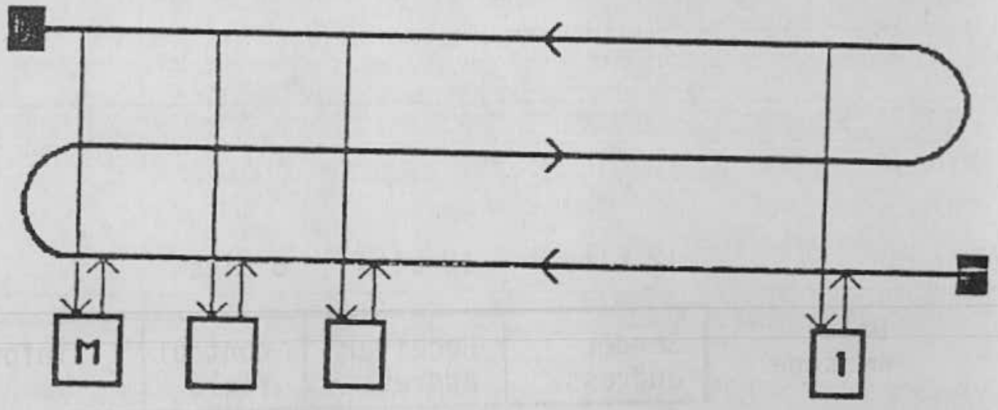

Figure 2.- the express-Net topology

The algorithm uses the End of Carrier on the outbound channel. The mechanism used in determining acces right to users in a given round is made independent of the propagation delay, decreasing the gaps between consecutive transmissions to values on the same order of magnitude as the time needed to detect carrier. Moreover, the idle time separating two consecutive rounds is kept as small as a round-trip propagation delay.

In more detail, it is assumed that stations are numbered sequentially following the direction of the traffic flow on the outbound channel. A station which senses the outbound channel busy, waits for the End of Carrier. Simultaneously, it sends carrier on the outbound channel. If carrier is detected, the station immediately aborts its transmission. Otherwise, it completes its transmission. All ready stations, which detect the End of Carrier act as described above. The only station to complete transmission is the one with the lowest index, among those ready stations which were able to detect the End of Carrier.

The Escalibur Project

The Escalibur project has the same goal as FDDI LAN on Express-Net. The new concept provided by ESCALIBUR [5] concerns frame transport. A frame is carried in parallel over the network. The frame structure is classical and is described in figure 3.

	12 bits	12 bits	8 bits	
Data message	Sender address	Receiver address	control field	Information

Figure 3.- an ESCALIBUR frame structure

The communication medium is constituted of N parallel channels. In the first approach N is equal to 64 parallel lines. The capacity of each line can reach 10 Mbit/s. This asks only for a relatively simple technology.

Our access scheme can be considered as new for a local network architecture. The cable interface is shown in figure 4.

The access is dealt through four parallel registers to guaranty the absence of collision. Let T = 100ns the maximum register replacement time. The replacement time can be 10, 20, ... or 100ns. It depends upon the activity of the node in the following way.

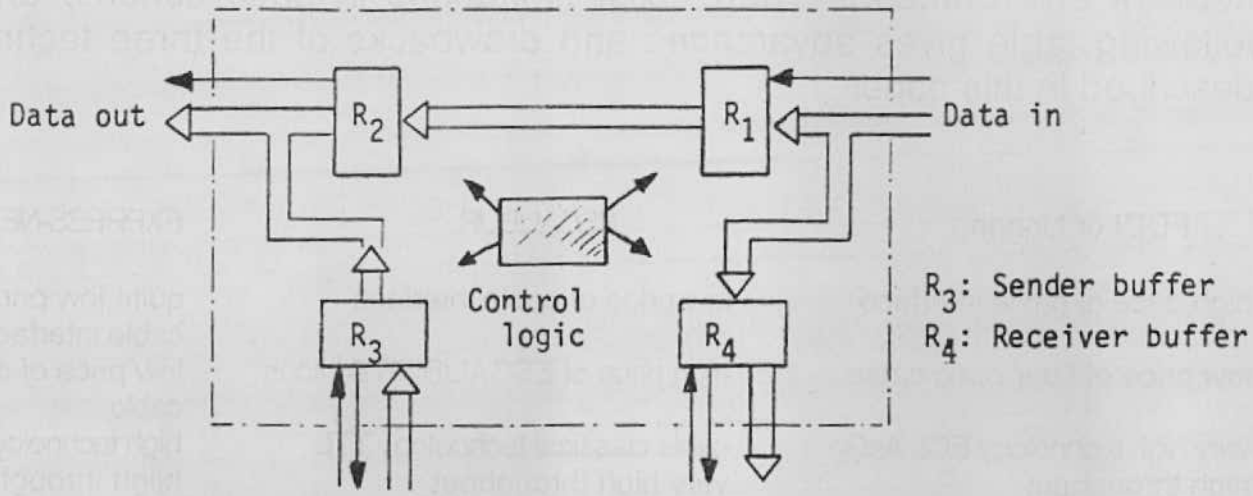

Figure 4.- the cable interface

• *Introduction of a frame*

When register R_3 is full the frame is inserted on the ring and the next frame is delayed if necessary using the smallest possible value for the replacement time.

• *Passage of a frame*

The replacement time is minimum if the cable interface is not under an insertion phase. If an insertion takes place, the replaçement time should be adjusted to loose a minimum of time.

In the ESCALIBUR network a circuit switch possibility is mixed with the packet switch through the possibility for a station of recovering regularly an insertion possibility.

The experiences performed by MASI Lab and ENST showed a possibility of 100 meters between cable interface at 10 Mbit/s per line.

Conclusion

Many other high throughput local networks have been described [6,7,8] in the literature and this study is not at all exhaustive.

Finally, it is very difficult to choose which techniques to use for a local network environment. There exist limitations in each scheme and the following table gives advantages and drawbacks of the three techniques described in this paper.

FDDI or Lionring	ESCALIBUR	EXPRESS-NET
high price of cable interface	low price of cable interface	quite low price of cable interface
low price of fiber optic cable	high price of ESCALIBUR 64 lines	low price of coaxial cable
very high technology ECL AsGa	cable classical technology TTL	high technology ECL
high throughput	very high throughput	hjigh throughput
reliability (2 lines)	low reliability in the first approach (it is necessary to have some more lines to replace lines under failure).	reliability (passive cable)

Rererences

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