M.A.N. - AN ALTERNATE TO CABLE MODEMS ?

Does existing computer technology offer a low cost alternate to the cable modem ? SCaT takes a detailed view of the possibility along with technical details as well as practical implementation.

AN INTRODUCTION

The Internet is easily the fastest growing phenomenon that the world has ever witnessed. The number of Internet users is currently estimated at approximately 320 million and even more significantly, this figure is to grow by almost 50 Million in the next 12 months.

In India too, the Internet has caught the attention of both individual as well as corporate users. Every one now wants to be on "The Net".

In India, for most users, the only option is a dial up connection through an existing telephone line. This mode of Internet delivery has several disadvantages viz :

- The telephone line usage is billed every 3 minutes.
- Data exchange is very slow, not exceeding 56 KB/per second
- Relatively few phone lines for access to the ISP.

To add to the above woes, the country has very few phone lines - estimated at just around 15 Million, with erratic connectivity. Against this, India currently has more than 24 Million cable homes each delivered with approximately 300 MHz or more bandwidth. If a single channel bandwidth is utilised for delivering Internet content through a cable network, utilising cable modems, data speeds of 2 MBPS are consistently achieved, even on a fully loaded network. However, the major disadvantage of cable modems are :

- High cost - Typically US $300 each. This would yield a typical cost of Rs.15,000 to Rs.20,000 to the Indian custom after import duties and overheads are paid.
- The Reverse Path of existing cable networks is fairly noisy and be a source of major concern if a large number of cable modems are to be installed on a network.

However the strong customer pull for Internet delivery to cable networks has led to the networks exploring alternates. One such alternate currently being explored and infact successfully deployed at Bandra, Bombay is a fairly mature computer technology that promises most of the benefits of a cable modem, without its cost penalty and probably without the problems of noise, if the network size is small. However, this technology is unrelated to cable TV and cannot be integrated on an existing cable network. It requires the installation of a complete, separate and independent coaxial cable line for each customer. Lets take a closer look.

THE BASICS

A Local Area Network (LAN) is a common and low cost method for inter connecting a group of computers. LANs are commonly deployed in most offices that use multiple computers. The LAN enables all computers to access common files and transfer files between computers without the need to copy them on a floppy or other removable media.

A LAN typically requires each computer to have an Ethernet card. These cards are available as 10 base T or 100 base T cards. The 10 base T card provides for a data exchange rate of upto 10 MBps (Mega Bits per second). The 100 base T card provides a 10 times faster data exchange rate. For most practical applications, a 10 base T provides adequate connectivity and these Ethernet cards are freely available at a reasonable cost - approximately Rs.1,000 per card. The Ethernet card fits into a PCI slot in the machine and is automatically detected by the Windows Operation System (Plug & Play).

Two machines each with an Ethernet card can be inter connected with a coaxial cable and a BNC termination. Figure 1 indicates 3 computers connected in this manner. In principle any number of computers can be connected in this manner. However the following precautions must be taken.

1. The beginning an end of the network MUST be terminated with a dummy load (usually 50 Ohms)
2. The coaxial cable connecting all machines must provide a secure, permanent connection. Any break in the coaxial cable or even removing the end terminations will result in disruption of the entire network. This is a major factor affecting the reliability of a LAN.

Clearly, to ensure a reliable LAN network, the number of joints in the coax cable as well as possibly the number loops should be minimised. Two computers on the LAN network should typically be less than 180 meters apart. Technically, the maximum length of cable separating the 2 machines is approximately 200 meters. However in practice, for reliable, error free data exchange, the distance is usually restricted to 150 meters to 170 meters. Ethernet cards typically have a 50 Ohm system impedance. Hence, a 50 Ohm coaxial cable with 50 Ohm termination (dummy loads) need to be installed throughout the network.

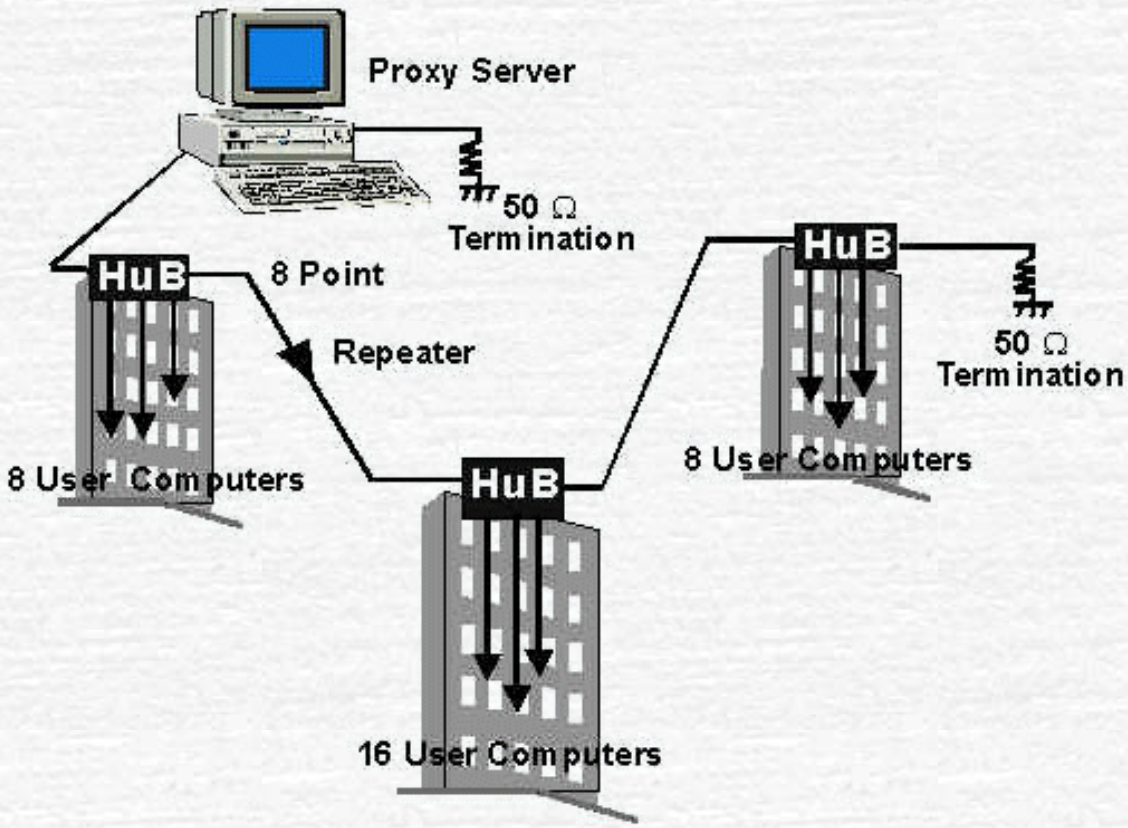
The Satellite & Cable TV office infact uses a LAN network with 50 Ohm terminations but with 75 Ohm RG11 coaxial cable. While the system works, this is definitely not a recommended procedure, particularly for a LAN network connecting computers over a large distance.

THE M.A.N. NETWORK

A LAN inter connects computers usually in the same room or in adjacent rooms or floors of the same building. If computers are to be inter connected over large distances (spread over multiple buildings), the network is usually referred to as a Metropolitan Area Network (MAN). The MAN typically utilises the same design principles as a LAN but with minor changes.

THE WAN NETWORK

In contrast a Wide Area Network (WAN) is used to inter connect computers over large distances such as across different cities. The WAN link may not (and is usually not) via a cable. Satellite connectivity is often used for WANs.



SYSTEM CONFIGURATION

Figure 2 shows a typical MAN. Computers in 3 different multi storied buildings are connected to a central server.

SERVER & SOFTWARE

The central server can be any general purpose personal computer, capable of running the Windows NT4 operating system. The prime hardware requirement is adequate memory (RAM). 128 MB of

RAM will typically suffice and cost not more than Rs.10,000. A Celeron or better will do nicely.

The only software that is required is Windows NT. Windows NT4 provides excellent security and options to monitor each of the customers computers connected on the network. Each customer's computer can also be authorised, or if subscriptions are unpaid, de-authorised to access the network. The main server computer operates as a proxy server, in this application.

Windows 98 will also provide the connectivity however it lacks any facility for reasonable security and authorisation. Additional software such as Win-Gate could probably also be used on Win'98 to configure the machine as a versatile proxy server.

Alternately, the server could be operated using the Linux oprerating system. The advantage of Linux is that it is Free & stable ! The server is connected to the internet using a router. The entire setup at the Headend, which would include the Server, rouiter & switch would cost less than Rs 4 lakh, assuming the use of Linux as the operating system, which is free !

Additional custom developed software can also be created and installed to monitor customer's usage in terms of data and time. As always, software control opens up a variety of options. However it must be stressed that for a fully functional secure operating system, nothing more than Windows NT4 is required.

THE HUBS

The server is connected via a 50 Ohm coaxial cable to LAN hubs. Each hub connects 8, 16 or 32 individual computers. The LAN network throughput of 10 MBps is shared by the number of outputs on the hub. Hence a user connected to an 8 port hub would receive 10 MBps / 8 = 1.25 MBps while a user connected to a 32 port hub would receive a throughput of only 312 KBps. Clearly it is more advantageous, in terms of throughput to each end user, to use an 8 port hub rather than a 32 port hub. However we will explore the practical implications of this, later in the article.

Typically an 8 port Hub would cost approximately Rs.4000 to Rs.5000. A 16 port Hub would cost approximately Rs.1500 more than an 8 port Hub i.e. it would cost approximately Rs.5500 to Rs.6000. A 32 port Hub would cost less than Rs.10,000. We are informed that as an alternate to the Hub, a switch can be used. the switch does not have the drawback of bandwidth sharing, we are informed however, a switch is much more expensive.

REPEATERS

As indicated earlier in the article, a MAN is really just an extended LAN network. It is subjected to similar restrictions of length of coax cable between 2 hubs to be approximately 150 m to 180 m. If longer lengths are required, a Repeater (conceptually similar to a CATV Amplifier) is required. LAN Repeaters are available easily and at a fairly low cost ranging from Rs.1000 to Rs.1500. Just as in the case of a CATV network, there is no limit or restriction on the number of Repeaters.

We visited an actual installed & operating system, where the entire cabling was done with 75 Ohm CATV co-ax cable, even thoyugh the system was a 50 Ohm system. The system that we saw had its furthest point 2.5 kilometers away from the control room. A cyber cafe was being run at this location and a reasonable download speed of approximately 13 KBps was observed. Clearly, impedance is not a very crucial issue in successful implementation.

There seems to be more than one opinion on the repeaters that are currently available in the market. A location that we checked out, came to use a combination of a repeater and switch. The 4 Way Switch + Repeater combination, is available for approximately Rs.12000, we were informed. In practice these provide a link for upto 500 meters, using RG11 coax cable. Considering the large price descripancy, we can only assume that a hefty margin has been retained by the system integrater, in the latter case.

LAN systems are a mature technology and in fact, coaxial cable based LAN distribution networks are being phased out internationally. The UTP cable is often being used instead. As a result there are relatively fewer sources of coaxial cable based HuBs, Splitters and Repeaters. The imports would probably be priced based on what the market can bear, particularly given this renewed interest for its use in distribution of Internet services.

There is little doubt that these products would be rapidly indegenised and sold in the local market at a fraction of the cost that existing Repeaters and Switches are priced.

THE INTERNET CONNECTIVITY

While the above outlines the hardware requirements and implementations, a key system requirement ofcourse is the Internet connectivity to the proxy server. The proxy server can connect to the Internet via a dial up line or a permanent, leased line. If a 24 hour service is to be provided to the customers, it is imperative to obtain a permanent or leased line. A dial up line provides service only when a connection is established with the Internet. It is cheaper but is typically (particularly at

peak usage times) much slower than a lease line. Table 1 indicates Internet tariffs charged by VSNL for various capacities of dial up and lease lines.

It is apparent that the Internet connectivity is a major recurring expense. Judicious selection of the line requirement will go a long way in optimizing expenses. However taking low connectivity would lead to customer dissatisfaction as their browsing and downloads would be very slow. The capacity of the Internet connectivity required would depend on the number of simultaneous users. While actual estimates would probably be achieved best with a working system and customer feedback, a guess is that a 128 KBps lease line should provide a reasonable level of service to approximately 50 to 100 subscribers.

An Entrepreneur in Calcutta is currently providing a similar service through a LAN network, using a 128 KBps ISDN dial up line. The service is provided only from 7 PM to midnight everyday. This arrangement works fine since he is primarily addressing a residential area. Internet tariffs both for bulk and individual customers are falling rapidly. At the time of writing, MTNL is already offering unlimited access for Rs.1,000 per month or Rs.6,000 for an entire year i.e. just Rs.500 per month, using a dial up telephone line. Ofcourse, the recurring cost of the telephone call at Rs.1.40 every 3 minutes is extra and would certainly add up to more than the Internet tariff. Given this situation with dial up lines, Retailing price of Internet delivery through coaxial cable would also have to be revised downwards.

HUB CAPACITY

As earlier outlined, a 32 port Hub would provide each outlet (whether it is connected to a computer or not is irrelevant) a throughput of 312.5 Kbps (i.e. 10,000 K/32). While this throughput may seem low it is adequate, given the fact that smaller MAN networks are unlikely to subscribe to a connectivity of more than 128 Kbps.

DISTRIBUTION THROUGH SWITCHES

We have been informed that Switches do not have the bandwidth sharing limitation of a HuB, though they are more expensive. We must stress here that we are not in a position to authoritatively confirm this. More information will certainly be available but unfortunately, beyond the deadline for writing this article. Interested readers are welcome to write in.

PRACTICAL CONSIDERATIONS

Various practical considerations need to be addressed. Some of these are:

LICENSES

An Internet Service Provider (ISP) needs to obtain a government license. This license is expensive and its cost depends on the area for which the license is required. The cost of a license to service metro cities is much higher than the cost of the license to provide ISP service in a small town. However, there are various means to address this requirement.

- A MAN service provider may affiliate himself to one of the existing ISPs in the region from whom he obtains his Internet connectivity. He therefore simply becomes - in the eyes of the government - a distributor or Value Added Reseller (VAR) for that ISP. In such a case no separate licensing is required, by the MAN network.
- We were informed of an interesting alternate - a cable operator in Calcutta offers Internet connectivity through a LAN. In his application for the lease line he has indicated his service as "An Extended Cyber Cafe" i.e. a Cyber Cafe which extends to the users homes rather than the user physically visiting a central Cyber Cafe ! This has been accepted by the local authorities and the entrepreneur has been providing this service for several months now.

ENTERTAINMENT TAX

Do note that since the MAN is a completely separate network, the person setting it up does not even require a cable operator's license. No Entertainment Tax is applicable to the monthly subscription fees or the installation cost.

POWER REQUIREMENTS

As most cable operators are acutely aware, obtaining 230 VAC local power is difficult at times. Unlike in Cable TV, the Hubs cannot be line powered through the coaxial cable. Each Hub needs to be provided with 240 VAC. Hence cooperation of a local subscriber in the building or the building society is required. One vendor indicates that his combination of switch + repeater can be line powered and is in fact being used in the line powered mode in the line practical system.

INITIAL COST

While a cable modem service is distinctly superior in all respects to a MAN network, the cable modem cost of approximate Rs.15,000 to Rs.20,000 each, is currently a concern. The hardware cost of a MAN network are relatively low. An 8 port HUB cost less than Rs.5,000 i.e. Rs.625 per

customer. Add to this the cost of the Ethernet card (Rs.1200) which is to be installed inside the customers PC and the cost of the local drop cable. A service provider in Bombay currently offers service against an initial installation cost of Rs.3000 which more than adequately covers the cost of Hub, amortised cost of Switch + Repeater and local drop cable. The Ethernet card is charged extra at rates ranging from Rs.1000 to Rs.1200. Ethernet cards can in fact be obtained in bulk in the local market for about half that price.

CONCERNS

While the above discussion seems to point heavily in favour of a MAN network, the following issues need to be kept in mind.

i) The MAN network is NOT part of the Cable TV network. A complete new and separate network consisting of coaxial cables, repeaters and hubs needs to be set up.

ii) The ENTIRE network fails if the coaxial link is disrupted at any point. Unlike a Cable TV network which is extremely fault tolerant, the entire MAN network collapses if even one of the end terminations is removed or the coaxial cable breaks or a repeater fails.

iii) Clearly a MAN is cost effective and practical only for small network sizes. As the coaxial cable length increases, the possibility of a single cable break disrupting the entire network is very high and the customers would receive very poor quality of service.

iv) Also as the cable length increases, so does the possibility of ingress of external electrical noise.

OTHER TECHNOLOGIES

A Metropolitan Area Network is not the only means for delivering Internet content to a network of computers. Other solutions such as a Thick Net and Layout Topologies such as a Token Ring are possible. A Token Ring configuration utilises a coaxial cable running in a complete circle or "Token Ring". The system is often slower in practice, than a MAN.

A MAN system can also be implemented using Fiber Optic cables to connect between Hubs or Switches. Use of Fiber Optics would essentially eliminate the need for use of Repeaters to compensate for transmission loss. Since this is not high bandwidth Fiber Optics, the cost is not substantial. The hardware cost excluding cable would be less than Rs.50,000. Sterlite offers a 6 core Fiber Optic cable priced at Rs.36 per meter which though more expensive than RG11 is cheaper than trunk cable and can be used for this application. Typically fiber optic MAN systems utilise ST Connectors.

CONCLUSION

This article provides details of an alternate technology - MAN - providing Internet delivery to customers. The end user may see this as a cable service but infact the delivery is not at all through a cable network it requires a setting up of a complete, computer network. However since CATV professionals are well conversant with distribution of signals through an extensive coaxial cable network, they are in a position to easily absorb this technology. The system does not require a great knowledge of computers. Infact most computer users familiar with the Windows operating system would be able to operate and maintain the system.

CREDITS

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