INTERNET DELIVERY - REVISITED
PART II - THE DISTRIBUTION SYSTEM

The concluding second part of this series provides details of the distribution system necessary to provide LAN connectivity to computers spread over several kilometers, for Internet delivery.

INTRODUCTION

The interconnection of computers over a LAN network is a mature technology and has been used in office environments, the world over, for more than 20 years. However, in the office environment, the computers are usually spaced close together, rarely more than a few meters apart. Even large offices would rarely have computers spread over a length of more than 100 meters of cable. For delivery of Internet signals to multiple residential units, requires that the client computers would be separated by fairly long distances even if they are all located within the same building. Further, customers may be located in different buildings where the buildings could be spread over a wide geographical area, with distances of 1 or 2 kilometers from the central server.
To distribute computer data reliably over such long vents, either Coaxial cable or CAT5 cable specifically used for LAN networks, needs to be deployed.

THE LAN CARD

Each customer's PC must be fitted with a LAN card. These cards are commonly available at a price of approximately Rs.600 each. The LAN card usually accepts an input through Coaxial cable and CAT5 cables. The user simply has to enable the port for the cable type that he is using.

CABLES

CAT5 cable consist of a bunch of 8 wires of which 4 are used for data on LAN networks. The remaining 4 are un-utilised in typical LAN systems. The Coaxial cable used in the distribution system have a 50 Ohm characteristic impedance, unlike CATV Coaxial cable which have a 75 Ohm impedance. The 50 Ohm equivalent of RG11 cable is RG213. While it is not recommended practice, practical experience has shown that 75 Ohm RG11 cable also works in the installation, as long as the end termination (dummy loads) are 50 Ohms.

The LAN network interconnecting the computers can support data transfer either at 10 MBps or at 100 MBps, depending on the system design. Coaxial cable supports 10 MBps data transfer speeds. CAT5 cable supports a faster data transfer speed of 100 MBps. While a 100 MBps speed would seem desirable, we shall see, later in the article, that in practice a 10 MBps connectivity is adequate, particularly given the high cost of bandwidth and commercial constraints which do not make it attractive to provide the customer connectivity of more than 128 KBps ISDN lines.

REPEATERS

Similar to a Cable TV system, signals suffered attenuation loss when transmitted over long lengths of cable. This loss needs to be compensated with Amplifiers or Repeaters are they are referred to in a LAN network. If RG213 Coaxial cable is used, the Repeaters could be located after 500 to 600 meters of cable length. If CAT5 cable is used, Repeaters would be required at intervals of 100 meters to 150 meters.
Practical experience indicates that a cascade of 4 to 5 Repeaters works well in an outdoor environment. Repeaters support data transfer speeds of 10 MBps only. They cannot be used in a 100 MBps system. Repeaters typically offer a choice of 2 or 4 output ports. A typical Repeater costs Rs.8,500 to Rs.12,000.

For a 100 MBps system, the Repeaters are to be replaced by switches. A switch typically also automatically senses whether the system speed is 10 MBps or 100 MBps. Switches are available with 8 or 12 output ports and range in price from Rs.9,000 to Rs.13,000.

BASIC DISTRIBUTION SYSTEM

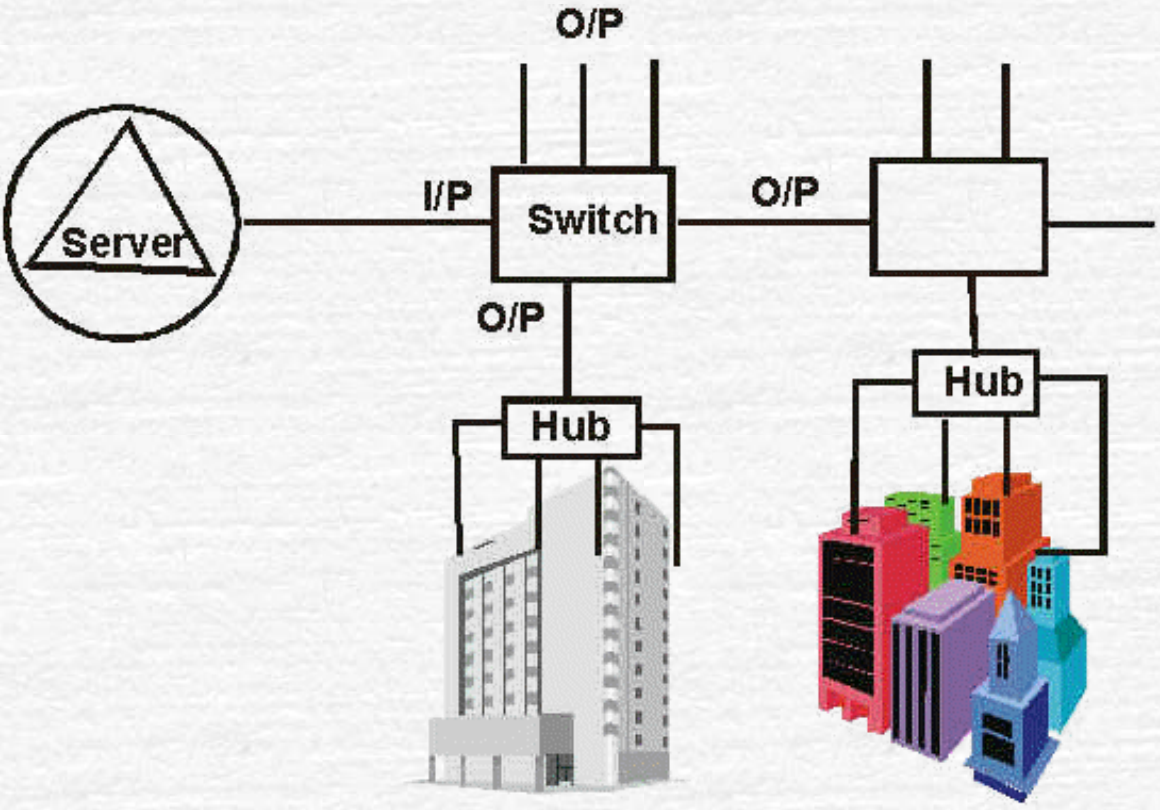


Fig. 1 shows a block diagram of a basic distribution configuration. The central server feeds a coaxial cable which hops from building to building. Each building is equipped with a switch. The switch in turn connects to a hub which then feeds individual customers using CAT5 cable. A dedicated cable is to be run from the hub to each customer.

MEDIA CONVERTERS

As indicated earlier, the system can be deployed using Coaxial cable or CAT5. When non-Coaxial cable is used, there is a choice of UTP (Unshielded Twisted Pair) or STP (Shielded Twisted Pair). At times it is necessary to switch from Coaxial cable to UTP or visa-versa. This conversion is done through Media Converters or Trans Receivers.

FIBRE OPTIC DISTRIBUTION

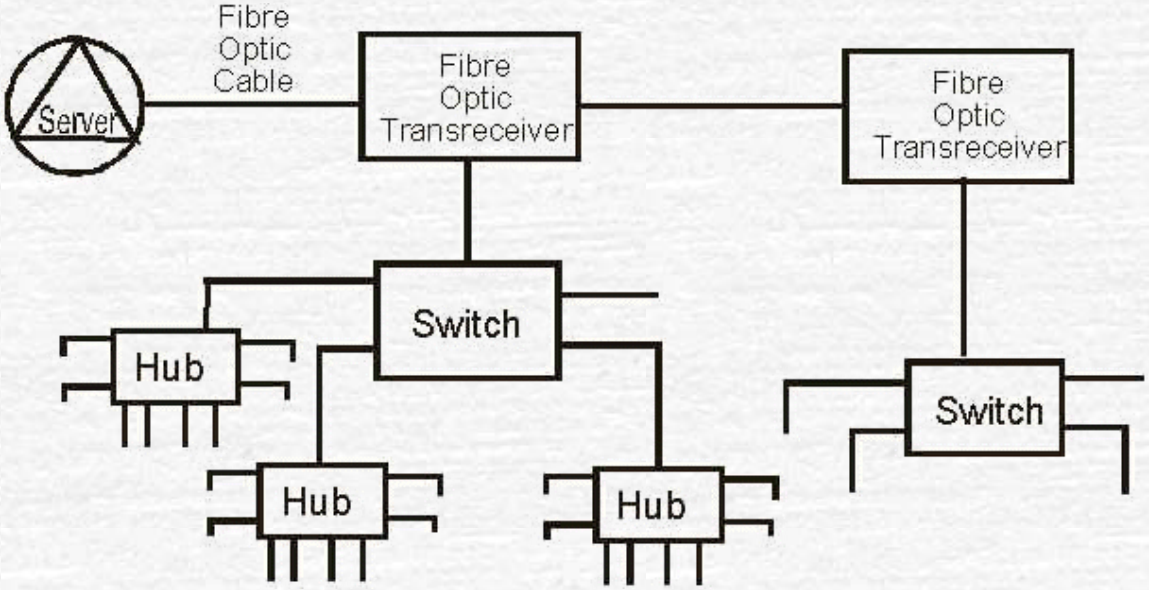
Similar to a CATV network, Fibre Optics can be used for distributing LAN signals also with the usual advantages of very low loss and immunity to electrical noise pickup. India is emerging as a large user of fibre optic cables. Several local manufacturers now offer fibre optic cable at reasonable prices. A 6 core fibre optic cable is available at less than Rs.60 a meter i.e. its price is comparable to that of 500 series Trunk cable. If fibre optic distribution is implemented, the fibre optic trans-receivers could be spaced at distances of 5 to 40 kilometers, depending on the output power of the fibre optic transmitter.

The fibre optic transmitter would also provide exceptionally large bandwidths. A network can be made using fibre optic trans-receivers with gigabit switches. A gigabit switch is priced at approximately Rs.40,000. Fig. 2 indicates a typical configuration using fibre optic trans-receivers which feed switches which in turn connect to hubs that provide connectivity to each individual computer.

WIRELESS LINK

Though the Indian Government severely curtails wireless broadcast for most applications, the

government does permit wireless links for Internet connectivity where LAN lines are not available. For practical purposes, this option will not be available in most towns and cities.



THE HUB

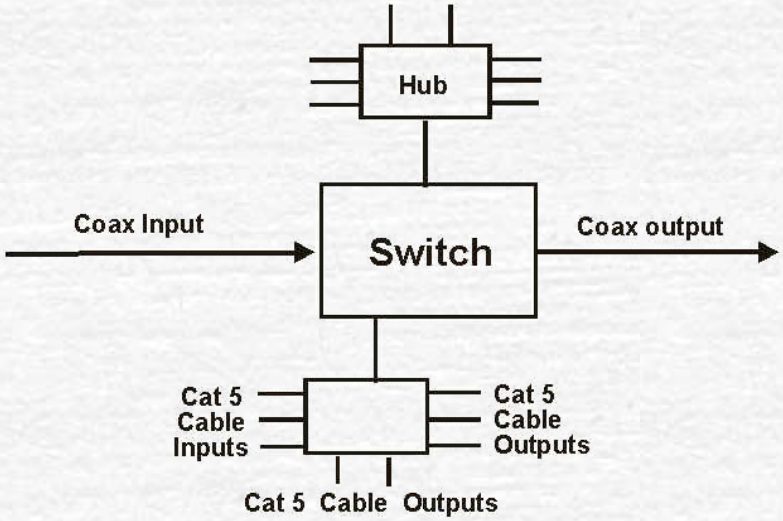
The Hub receives an input from a switch. Hubs are available with 8 or 12 output ports. A separate output port is required for each LAN card. Hubs are typically priced at Rs.2,000 to Rs.2,500.

POWERING

Switches as well as Hubs are active electronic devices and require external power for their normal operation. A Hub typically consumes 150 mA @ 12 volts DC. A switch requires 350 mA at 12 volts DC. Since LAN networks are not intrinsically designed for outdoor installation, they do not provide for line powering. However, Internet Datacom Technologies, a Bombay based value added LAN solutions provider offers distribution equipment with 60 volts AC line powering so that cable networks could utilise their existing line powering units and also feel comfortable with the technology.

BANDWIDTH SHARING

So far we have taken an overview of the technology and devices utilised for establishing a LAN network over large distances. Lets now take a closer look at the data transfer speeds and simple calculations for estimating the final throughput received by the customer. The throughput on the main "trunk" shown in Fig. 1 will be either 10 MBps or 100 MBps, depending on the interconnecting cable used between the switches and the speed of the switches i.e. 10 MBps or 100 MBps switches installed.



Each output of the switch provides the same throughput as the input. Hence if a 2 output switch is used, it will receive an input at say 10 MBps and provide 2 outputs, each of 10 MBps. One of these outputs passes on to the next switch along the trunk. The second output is fed to a hub. If a 4 output coax switch is used, the input and outputs would be on 50 Ohm coaxial cable. The switch would also provide 3 additional outputs which can be connected to 3 separate hubs via separate coaxial cables. This is shown in Fig. 3.

The Hub receives the input of say 10 MBps and shares it equally between each of its outputs. Hence a 10 MBps input fed to an 8 port Hub would result in each output port of the Hub receiving 10 MBps / 8 i.e. 1.25 MBps per port. Even if a 12 port Hub is used, each output port will receive a throughput of 833 KBps. Clearly these speeds are adequate and comparable to an ISDN line for internet connectivity. Ofcourse if a 100 MBps system is used along the main path, all throughput would increase by a factor of 10.

BANDWIDTH

Last month, in Part I of this article, we have had a close look at Bandwidth, particularly the high cost at which it is sold in India. Market reports also indicate that the end customer is typically reluctant to pay much more than Rs.1200 per point for 24 hour internet connectivity. Keeping this financial constraint in mind it is not economically viable to support the consumer with Internet bandwidth throughput of 64 KBps or at the most, 128 KBps. These speeds are equivalent to ISDN connectivity. Infact it is reliably learnt that cable modem service providers often throttle or disable their devices so that even the cable modem does not deliver more than 128 KBps.

THE CUSTOMER PACKAGE

Most LAN networks have now evolved a fairly standard customer tariff. An installation charge of Rs.3,000 is taken from each customer. This amount more than adequately pays for the entire new distribution network that needs to be provided for the LAN service. Infact past experience shows that the distribution network typically costs Rs.1,500 per user, or even less. Hence even though an entire new network is to be established, there is no cost penalty of this to the service provider. Infact Rs.1,000 to Rs.1,500 surplus collected goes towards offsetting the cost of the internet server located at the "headend".

Typically, LAN networks charge a flat monthly fee of Rs.1200 to Rs.1500 per user for 24 hour connectivity. The LAN networks subscribe to a 128 KBps ISDN line which currently is priced at approximately Rs.38,000 a month. This is shared between 75 to 100 users. This typically yields a profit of almost 50% per month on the cost of the ISDN line. The cost of the Headend is recovered within 4 to 6 months at the most. Care should be taken not to be overcome by grief and share the ISDN line between 100 or more users. This will certainly increase the income substantially without an increase in the cost outflows. However the customer would get very poor throughput and would soon throw up his hands due to poor quality of service !

SUMMARY

It is apparent that today's financial constraints do not permit delivery of a large bandwidth to each consumer irrespective of whether the consumer subscribes to a permanent internet service through cable modems or LAN networks. Economic constraints effectively limit each user to 128 KBps or less. Under these constraints, a LAN network delivers the same quality of service as a

cable modem service. The LAN network requires its own dedicated wiring. It cannot share the existing CATV distribution network. However from a customers prospective, LAN connectivity is offered at an installation cost of typically Rs.3000 + the installation of a LAN card if it does not already exist on the computer. Compared to this a cable modem user needs to shell out Rs.15,000 for the cable modem and ofcourse an additional cost for the LAN card.

A DSL user is asked to pay an installation cost of Rs.30,000. Clearly, LAN delivery of Internet services, today provides the most cost effective method of internet connectivity for speeds matching those of an ISDN line.

ACKNOWLEDGEMENT

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