ABSTRACT

OTN (Open transport Network) is an optical fiber based system for voice, data, LAN and video applications, allowing to interconnect most electronic equipment one finds in a Motorway and Railway environment.

It offers a multitude of interfaces that enable the user to transfer in a transparent way information from different types of applications over long distances. Its high degree of reliability and redundancy makes sure that it is suitable for use in critical environments like motorway and railway tunnels.

1. OPEN TRANSPORT NETWORK

1.1. Network Topology

The basic OTN network topology consists of a double fiber optic ring. (See Figure 1) One ring is used for information transport (active), the second ring (standby) is used as a backup for redundancy reasons. The network has the ability to automatically reconfigure in case of fiber breaks or node failures.

Due to the large number of interface cards that have been developed for OTN during the last decade, all applications (analog or digital) are connected directly to the network nodes (See Figure 1). This means that no intermediate media-converters or multiplexers are used. In this way, no extra single points of failure are introduced in to the network.

Overview of the number of interface cards directly available on OTN:

a) Audio/Voice interface cards
   • Analog telephony
     2 wire a/b
     4 wire E&M
   • Digital telephony
     S0
     UPWE / UP0
   • Trunk
     E1 (2.048 Mbps)
     T1 (1.544 Mbps)
   • Voice PA
   • High Quality Audio (15 kHz)

b) DATA interface cards
   • RS-232, -422, -485 (Point to point, Multi point, Multidrop)
c) LAN Interfaces

- Ethernet (10/100 Mbps)
- Token Ring IEEE 802.5

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\[ \text{- Ethernet (10/100 Mbps)} \]
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\[ \text{d) Video} \]

- PAL, NTSC (M-JPEG compression)

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Figure 1: Typical OTN network

Analog signals are sampled and converted to a digital bit stream on the interface cards. Then they are transported over the fiber optic network. On the other side, the signals are again converted to the original analog signal. The advantage of digital transmission is that the digital signal can be regenerated without loss of quality, thus allowing the transport of the signal over long distances (1000km).

1.2. Transmission technology: TDM

OTN is an access and transport network, based on TDM technology. Time Domain Multiplexing (TDM) is a well-known technique in digital communications. It allows to transmit different signals, over one physical cable by allocating a timeslot to each signal. TDM is used in PDH (Plesiochronous Digital Hierarchy) and SDH (Synchronous Digital Hierarchy) transmission equipment, and also in OTN (Open Transport network). The advantage of TDM technology as opposed to packet based technologies (such as ATM or Ethernet), is that fixed timeslots can be allocated to a signal. Because of this no information is lost (even when the network capacity is used for 100%) and timing relations are maintained. In critical environments, as for instance tunnels, every application that is connected to the main transmission backbone is considered to be important in case of an emergency. In these moments no loss of information can be admitted.
1.3. OTN ring types

OTN provides rings with different capacities: 150Mbit/s, 600Mbit/s or 2,5 Gigabit/s. This allows the network to be designed optimally for the amount of bandwidth required by the applications. Another way of optimizing the use of the backbone capacity is the fact that bandwidth is allocated to the applications in small steps of 32 kbit/s. In this way no bandwidth is wasted and low speed applications like analogue telephony and serial data connections (RS232,...) can be handled in an economical manner.

1.4. Networking with OTN

If required, OTN ring networks can be coupled, using the OLM (OTN Link Module). This module allows the transfer of data between rings, using an E3 (34Mbps) or DS3 (45Mbps) link. Depending on the amount of data to be transferred between rings, one ore more OLM links can be used.

In the case of OTN150 (150Mbps) nodes can also be connected using SDH/SONET STM1/OC3 links. This allows the creation of OTN rings, which go partially or completely over an SDH/SONET network. This also allows SDH/SONET radio connections to be used for sections where it is not possible to install fiber optic cable.

1.5. OMS (OTN Management System)

The complete OTN network can be managed using OMS (OTN Management System). Using OMS, it is possible to monitor the complete OTN network from a central location, but also distributed network management is possible. The OMS can interact with other management system using SNMP (Simple Network Management Protocol). OMS uses a relatively inexpensive PC operating under Windows NT as hardware platform.
2. DIGITAL VIDEO SWITCHING ON OTN

Any type of video equipment (cameras, monitors, recording equipment), including the associated control signals, can be connected directly to the OTN system. The video switching capabilities are embedded in the OTN system itself, enabling any incoming picture to be displayed on any monitor connected to the OTN. This is a substantial advantage to security installations, reducing the (fiber optics) cabling enormously and reducing the extra cost for switching matrices and crossbars.

OTN’s video interface cards use M-JPEG for the transmission of high quality video signals. Both PAL and NTSC standards are supported. The video-input cards (camera side) and video-output cards (monitor or recorder side) are equipped with up to four video inputs/outputs and five data ports for e.g. PTZ control.

The bandwidth allocated to a channel can be assigned individually and can vary from one Mbps up to 12 Mbps. The picture quality can be customised by adjusting the colour information, the horizontal and vertical resolution and images/sec, all on a per channel basis.

3. CONCLUSION

The OTN product is meant for customers having vast premises, who are capable of installing their own optical fiber cabling and who need a wide diversity of communications. The maximum benefit of the system can be applied in applications such as railways, subway and tram networks, pipelines, intelligent highways, tunnels, airports, mines, industrial plants, harbors, etc.