Synopsis

This is a review of the developing market for data centre networks plus a summary of emerging standards for data centre cabling. There are a number of important differences between commercial office cabling and data centre cabling, and ISO/IEC, CENELEC and TIA standards are adopting different approaches in their specifications.

1. Market Evolution

Data centres have evolved as a secure repository for the exponentially increasing volume of information a company needs to function. According to the Gartner Group, the average company accumulated 120 terabytes of customer data by 2004. This is equivalent to 4,560 miles of traditional filing cabinets. Email is an essential service for modern business, and market analyst IDC estimates that some 35 billion messages will be sent each day throughout 2005. Emails carry an increasing number of complex attachments such as spreadsheets, photographs, slide presentations and video clips. With an estimated 1 in 17 Emails being stored for long periods of time, a significant burden is being placed on network and storage capacity.

Two distinct market sectors are evolving:

Internet Data Centres (IDC), where Internet Service Providers (ISPs) have large physical locations to house servers and networking equipment needed to attach to the Internet. Servers may be owned by an ISP or client organisation. The case where servers are owned by a client organisation is generally referred to as a *co-location environment* and will generally be used to create a corporate Intranet and/or company web site service.

Enterprise Data Centres (EDC), where a corporate organisation locates servers and networking equipment locally to support internal information and communication requirements, and also provide access to the Internet.

A generic data centre IT model is shown in figure 1. Gigabit network technologies are used to create Storage Area Networks (SANs) and Network Attached Storage (NAS) systems. Fibre Channel is typically used to form SANs, providing high throughput and long distance links (up to 10km) for backup storage systems. Copper-based SCSI is typically used as a lower-cost *jumper* for NAS systems. Gigabit and 10 Gigabit Ethernet is typically used to provide high throughput elsewhere in the data centre model and is also an excellent candidate for SANs.

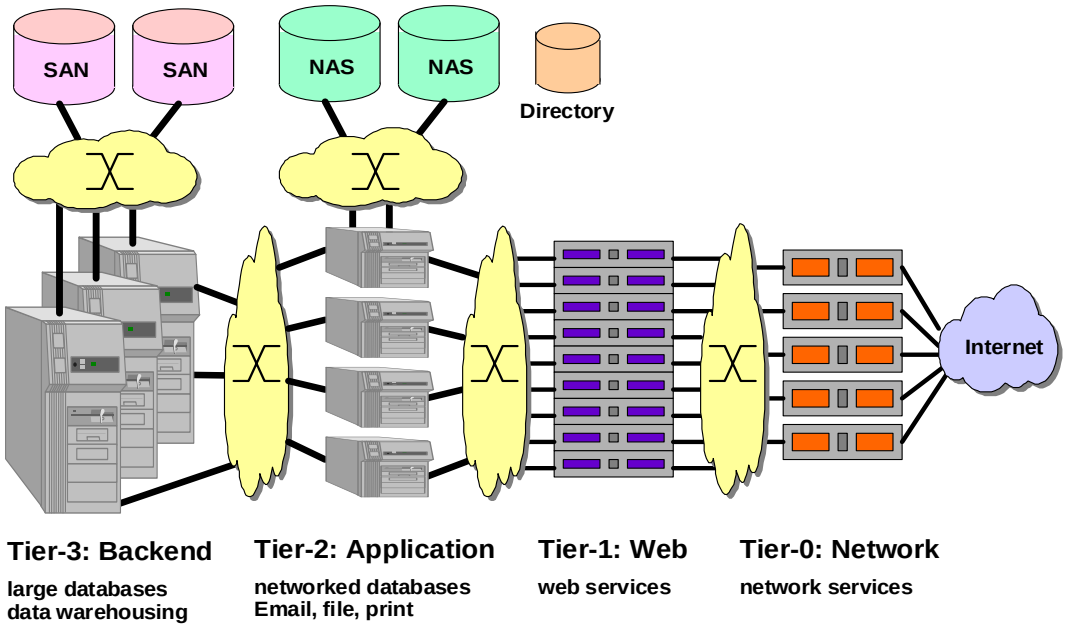

Figure 1: Data Centre IT Model

White Paper

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The data centre market took off aggressively with the *dot.com* boom but has been dogged by the telecom recession of 2000. Industry analysts believe that the market is now picking up and will gain pace within the 2005-2008 timeframe. Primary market drivers are:

- E-commerce
- Email
- Data warehousing
- Internet
- Intranet

2. Industry Standards Projects

International standards have been developed for SCSI and Fibre Channel for networked storage applications. SCSI supports bit rates of between 40 and 1,280 Mbit/s over 25m copper cable. Fibre Channel supports a bit rate of 2 Gbit/s over 30m copper or 10km with optical fibre. Gigabit and 10 Gigabit Ethernet may also be used in place of Fibre Channel.

Standards for data centre cabling have been published by TIA (TIA-942) and are still under development within ISO/IEC (ISO/IEC 24764) and CENELEC (EN 50173-5). ISO/IEC 24764 is based on EN 50173-5. It is worth noting that the structure and use of data centre cabling is significantly different from office structured cabling:

- data centre networks have more external (WAN) connections than in an office
- a data centre have fewer local equipment connections than the office
- data centre equipment is more static than in the office
- a data centre will see more incremental growth and less churn than an office
- a data centre environment is more controlled/managed than an office environment

3. CENELEC EN 50173-5 Overview

Cabling is defined to support the high-connectivity requirements found in data centres, with scalability to accommodate significant equipment growth/expansion (e.g. servers and storage devices). Data centre cabling supports high-speed WAN, SAN and LAN applications, including 10GBASE-T. Life expectancy of EN 50173-5 is at least 10 years.

The model defined for data centre cabling is shown in figure 2. Telecom services are terminated at an Equipment Network Interface (ENI) and attached to the Main Distributor (MD) via network access cabling. A Zone Distributor (ZD) provides connectivity for Equipment Outlets (EOs), either directly or via an optional Local Distribution Point (LDP). Optional links are allowed between LDPs to provide resilience. Patch cord lengths may be up to 10m.

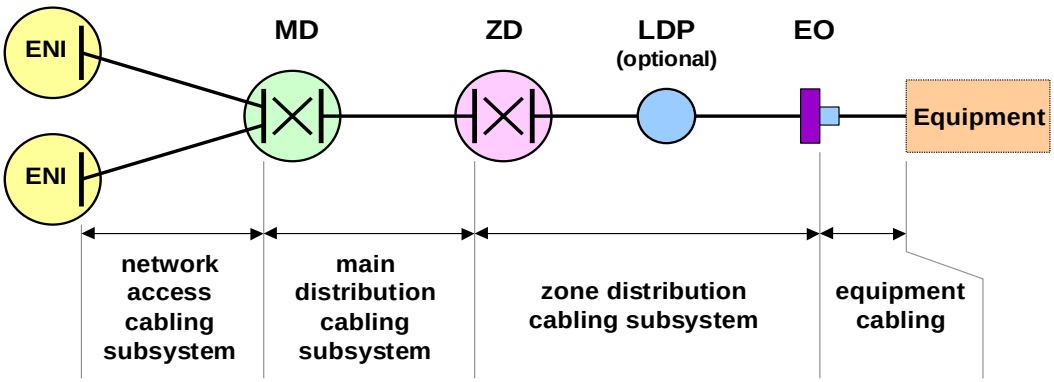

Figure 2: EN 50173-5 Cabling Structure

The maximum span of data centre cabling is specified as 2000m (with a 100m maximum horizontal channel within this distance). The minimum performance for balanced cabling is proposed to be Class E_A. The minimum performance for optical fibre is OF-300 using either OM-2 or OM-3 (OM3 is recommended).

Higher connectivity optical channels are supported by data centre cabling for high bit rate applications. The available connector loss is calculated in table 1 for 1G and 10G Ethernet operating over various lengths of OM1, OM2 and OM3 fibre. Dimensioning takes account of the non-linear power penalties and accommodates many connections in a single channel.

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		Total Connector Loss Supportable (dB) vs Cable Length						
Application	Fibre Type	25m	50m	75m	100m	250m	500m	750m
1000BASE-SX	OM-1 62.5	6.05	5.90	5.65	5.40	2.70		
	OM-2 50.0	5.90	5.80	5.70	5.60	4.70	2.45	
	OM-3	6.05	5.95	5.90	5.80	5.20	4.00	2.45
1000BASE-LX	OM-1 62.5	5.80	5.75	5.70	5.65	5.10	3.55	1.05
	OM-2 50.0	5.30	5.25	5.20	5.10	4.40	2.15	
	OM-3	5.30	5.25	5.20	5.10	4.40	2.15	
10GBASE-SR	OM-1 62.5	4.45						
	OM-2 50.0	5.85	5.00	3.50	0.90			
	OM-3	6.10	6.00	5.80	5.60	3.50		
10GBASE-LX4	OM-1 62.5	5.90	5.85	5.70	5.55	3.45		
	OM-2 50.0	5.90	5.85	5.70	5.55	3.45		
	OM-3	5.90	5.85	5.70	5.55	3.45		

Table 1: EN 50173-5 Optical Channel Budget for 1G + 10G Ethernet

Reference Implementations are defined for optical fibre and balanced cabling based on standard components. It is based on existing reference implementations with a requirement for components to meet applicable environmental specifications for a data centre. Implementation equations are provided to determine the maximum channel lengths using OM-1, OM-2, OM-3, OS-1 & OS-2.

The Cat 6 modular connector is specified for Class E cabling (IEC 60603-7-5 and IEC 60603-7-6). The *Terra* Cat 7 connector (IEC 61076-3-104) is specified alongside the Cat 7 modular connector (IEC 60603-7-7). The duplex LC APC (8^{o}) connector (IEC 61754-20-7) has been selected for use at the ENI, where the return loss of SMF connectors must be at least 55dB to terminate telecom services. The duplex LC connector has also been selected for the EO when optical fibre is used.

4. Comparison of EN 50173-5 with TIA-942

TIA-942 adopts a similar approach to EN 50173-5 but has a much broader scope. EN 50173-5 specifies IT cabling for the data centre. TIA-942 also contains guidelines on infrastructure redundancy, pathways & spaces, separation of power and data cables, and application support cabling for 802.3 LANs, computer interfaces and telecom links. TIA-942 refers to TIA-568-B for channel and component specifications and adopts a “component up” approach to dimensioning high-connectivity optical channels. TIA optical channel dimensioning for 1G and 10G Ethernet is shown in Table 2. Unlike EN 50173-5, which derives optical connector budget from total cable length, TIA-942 derives available cable length from the number of connectors in a channel, based on 0.75dB worst case connector loss for 100% matings. This accommodates up to 8 optical connections in a single channel, a shown.

		max supportable channel length (metres) number of connectors in a channel								
Application	Fibre Type	2	3	4	5	6	7	8	9	10
1000BASE-SX	OM1	300	270	240	210	170	120	0	0	0
	OM2	570	510	450	370	280	160	0	0	0
	OM3	860	780	680	540	400	240	50	0	0
10GBASE-SR	OM1	39	36	33	30	25	19	8	0	0
	OM2	94	88	79	70	55	39	0	0	0
	OM3	330	300	270	230	180	120	20	0	0

Table 2: TIA-942 Supported Cable Lengths for 1G + 10G Ethernet

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5. Status of Industry Standards

TIA-942 was published early 2005. CENELEC EN 50173-5 is expected to be approved early 2007 and ISO/IEC 24764 will be approved later.

About Brand-Rex

Brand-Rex is a designer and manufacturer of copper and fibre based cabling systems, headquartered in Glenrothes, Scotland with facilities across Europe. Brand-Rex has two primary businesses: Connectivity and Speciality. Its Connectivity division designs and manufactures cabling systems (both copper and fibre) for data communications and is the No.2 player in Europe. The Speciality division exclusively produces cables that are used for control, communications, power and instrumentation within hostile environments.

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