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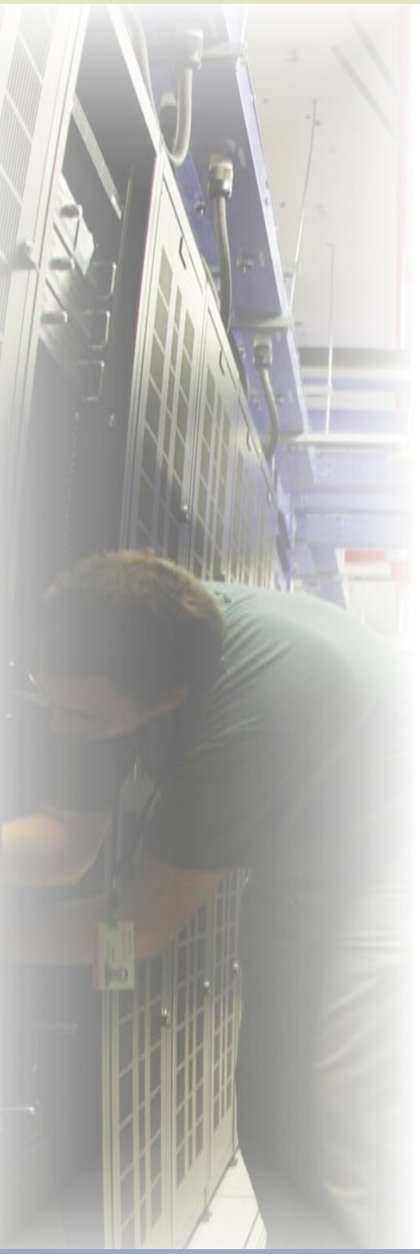
Data Centre Design
ready for your future

Introduction to Data Centres



What is a Data Centre?

The definition of a Data Centre according to TIA-942 is 'a building or portion of a building whose primary function is to house a computer room and its support areas'.

Although they have been around for many years in small numbers servicing very large corporations, the IP revolution and the increasing globalisation of business has placed significant demands on the performance of Data Centres. They have become a critical resource for many businesses, because of the heavy reliance upon digitally stored information. Now there is a need for most Data Centres to have an infrastructure which will support operations 24/7.

The cost to business for any prolonged downtime in a Data Centre is potentially disastrous. Ensuring that the Data Centre investment meets the needs of businesses and its customers is critically important. The building and its contents need to be secure, the systems that support it must be reliable, so the design must be robust and to the highest specification to meet the needs of the digital environment both today and tomorrow.

Data Centre Drivers

IP convergence, bandwidth and data storage are all factors that need to be considered as part of the Data Centre design, but ultimately it will be the cabling infrastructure implemented and its compliance with the industry standards that will determine performance and reliability.

Key Drivers:

- Security
- Data storage
- Bandwidth demands
- Data accessibility
- IIM system
- Cable management
- Disaster recovery
- Data speed and performance

Molex's involvement with Data Centres spans many years - from product design & innovation to advising and supporting customers and partners. The knowledge and support we can provide will assist our customers in selecting high performing solutions that support their business requirements.

Industry Standards Focus

Early involvement in the design of a Data Centre is critical. A Data Centre can typically contain up to 50 times more cabling than conventional office buildings, and therefore more consideration needs to be given to pathways, routing, spacing and containment. TIA-942 is a globally recognised standard (published in 2005) dedicated to the design and infrastructure of the Data Centre. In Europe, BS EN 50173-5 addresses communication cabling for Data Centres. These standards should be used in conjunction with other national and international cabling standards such as TIA/EIA 568, ISO 11801, AS/ANZ 3080 and CENELEC 50173.

TIA-942 provides information & guidance on:

- Room Layouts
- Cabling Infrastructure
- Tiering
- Safety Systems
- Mechanical & Electrical Systems
- Redundancy
- Environmental Considerations

TIA-942 covers a wide range of issues relating to Data Centre design and specifically addresses expandability and redundancy as history has proven Data Centre growth is constant year on year. Insufficient provision for expansion has proved costly for owners.

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Design & Planning

Location. Location. Location

As the purpose of the Data Centre is to provide 100% reliability, its location is crucial. Thought should be given to the following:

- Accessibility
  (for staffing and utilities)
- Environmental considerations
  (wildlife, pollution, noise)
- Power supply
  (in some designs 2 power sources required)
- Proximity to risks
  (airports, underground train stations and major road junctions, nuclear plants and other high risk locations)
- Avoidance of geographically high risk areas
  (flood plains, dams, rivers, hills, seismic areas)

Design

TIA-942 recommends that the Data Centre is divided into specific functional areas. The benefits from doing this include reduced downtime, more efficient upgrades and expansion, and improved redundancy. The key functional areas identified in TIA-942 are:

Entrance room (s)

The space used for the interface between the Data Centre structured cabling system and inter-building cabling (this includes carrier demarcation hardware and equipment).

Main Distribution Area (MDA)

Often used to house core routers, LAN/SAN switches and PBX, and main cross-connects.

Horizontal distribution Area (s) (HDA)

This is the distribution point for cabling to the equipment distribution areas (it typically includes LAN/SAN switches Keyboard/video/mouse (KVM) switches for the end equipment located in the equipment distribution area).

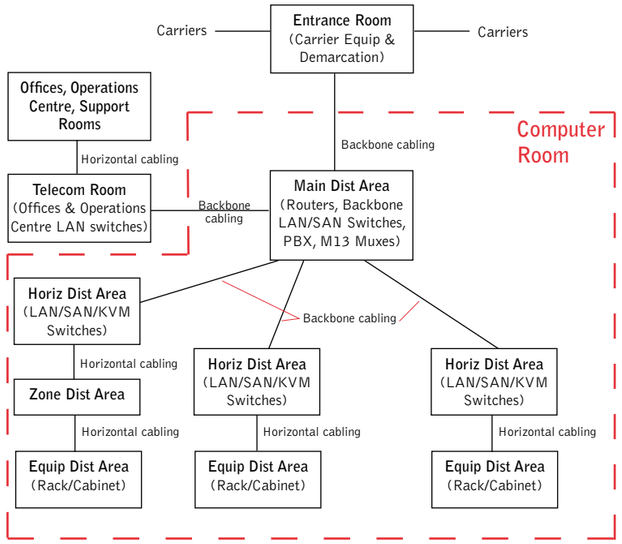
Equipment Distribution Area (s) (EDA)

Space allocated for end equipment, including computer systems and telecommunications equipment. There may be an optional connection to the zone distribution area.

Zone Distribution Area (s) (ZDA)

Located between the horizontal distribution area and the equipment distribution area to allow frequent reconfiguration and flexibility.

Design - Typical Data Centre Topology



In addition, consideration should be given to dedicated areas to accommodate general office space, support staff offices, operations room, maintenance workshop, office building support staff, electrical and mechanical rooms, fire suppression system room, storage rooms, network equipment build rooms and computer rooms.

Cabling Infrastructure

In support of the existing cabling standards, TIA-942 specifies the implementation of a permanent cabling system within the Data Centre. It also provides details on the cabling media suitable for this purpose. These cables include: 100-ohm twisted pair Category 6 UTP and F/UTP copper cabling, multi pair telephone cable, Multimode optical fibre cable – OM1, OM2, OM3 performance grade, Singlemode OS1, 75-ohm coaxial cable.
(Augmented Category 6 may be considered as a future option – but at the time of publication of TIA-942 it was not a ratified standard)

Quick Guide to Data Centre Planning

TOPICS	CONSIDERATIONS	EXAMPLES
Location	Water ingress, pollution, accidents, terrorism/ sabotage, reliable physical access	Not in flight path of airports > ¼ miles from airports Not near water/dam or 100 year flood plain Not near to or above underground stations, power stations Not on a hill subject to slides Not near major roads or road junctions
Power	Reliability, quantity, backup, safety, control	Must have adequate supply of power from one or more providers Must be able to support backup power from sources within or next to the building
HVAC/WATER	Reliability, quantity, backup, safety, control	Must have adequate supply of power from one or more providers Must be able to support backup power from sources within or next to the building
Security	Visible access, practicality	Site selection/location from a security perspective Must be available all around the building, inside and out Single file access to communications rooms CCTV, access control systems
Telecoms	System types, diversity, quality of service	Minimum of two service providers Two entrance rooms in diverse locations
Fire Suppression	Visible access, practicality	Two types of suppression required Automatic systems for computer rooms Water sprinklers for offices, including hand held
Data Infrastructure	System types, Data Centre standards, cabling medium	Backbone systems - copper and fibre Horizontal cabling - fibre and copper Category 6/Augmented Category 6/ ScTP Category 6 & 7 Topology design Redundant cabling systems
Internal Structure	System requirements, isolation environments, floor loading	Room sizing, internal design Access floors, ceilings, doors, lighting Computer room coverings BMS

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Service & Availability

Tiering

The TIA-942 standard defines/documents/details tiers of reliability – critical for the location, design and services to a Data Centre.

This standard includes 4 tiers relating to various levels of availability of a Data Centre facility infrastructure. Higher tiers not only correspond to higher availability, but also lead to higher construction costs. In all cases, higher rated tiers are inclusive of lower level tier requirements, unless otherwise specified.

Data Centre Availability Tiers

Details about the various tiers make it easier to qualify and compare various aspects of Data Centre availability

Tier 1 — **Basic: 99.671% Availability**
- Susceptible to disruptions from both planned and unplanned activity
- Single path for power and cooling distribution, no redundant components (N)
- May or may not have a raised floor, UPS, or generator
- Takes months to implement
- Must be shut down completely to perform preventive maintenance

Tier 2 — **Redundant Components: 99.741% Availability**
- Less susceptible to disruption from both planned and unplanned activity
- Single path for power and cooling distribution, no redundant components (N+1)
- Includes raised floor, UPS and generator
- Takes up to six months to implement
- Annual downtime of 22.0 hours
- Maintenance of power path and other parts of the infrastructure require a processing shutdown

Tier 3 — **Concurrently Maintainable: 99.982% Availability**
- Enables planned activity without disrupting computer hardware operation, but unplanned events would still cause disruption
- Multiple power and cooling distribution paths but with only one path active, includes redundant components (N+1)
- Takes 15 to 20 months to implement
- Annual downtime of 1.6 hours
- Includes raised floor and sufficent capacity and distribution to carry load on one path while performing maintenance on the other

Tier 4 — **Fault Tolerant: 99.995% Availability**
- Planned activity does not disrupt critical load and Data Centre can sustain at least one worst-case unplanned event with no critical load impact
- Multiple active power and cooling distribution paths, includes redundant components 2(N+1), that is 2 UPS each with N+1 redundancy)
- Takes 15 to 20 months to implement
- Annual downtime of 0.4 hours

Redundancy

Redundancy is a critical consideration for Data Centre performance and the level of redundancy required must be determined at the design stage. TIA-942 details the levels of redundancy as follows:

Redundancy

N	Base Requirement - System meets base requirements and has no redundancy.
N+1	Redundancy provides one additional unit, module, path or system to the minimum required to satisfy the base requirement. The failure or maintenance of any two single units, modules or paths will not disrupt operations.
N+2	Redundancy provides two additional units, modules, paths or systems in addition to the minimum required to satisfy the base requirement. The failure or maintenance of any two single units, modules or paths will not disrupt operations.
2N	Redundancy provides two complete units, modules, paths or systems for everything required for a base system. "Failure or maintenance of one entire unit, module, path or system will not disrupt operations".
2(N+1)	Redundancy provides two complete (N+1) units, modules, paths or systems. Even in the event of failure or maintenance of one unit, module, path or system, some redundancy will be provided and operations will not be disrupted.

*Source: Telecommunications Infrastructure Standard for Data Centres 12th April, 2005

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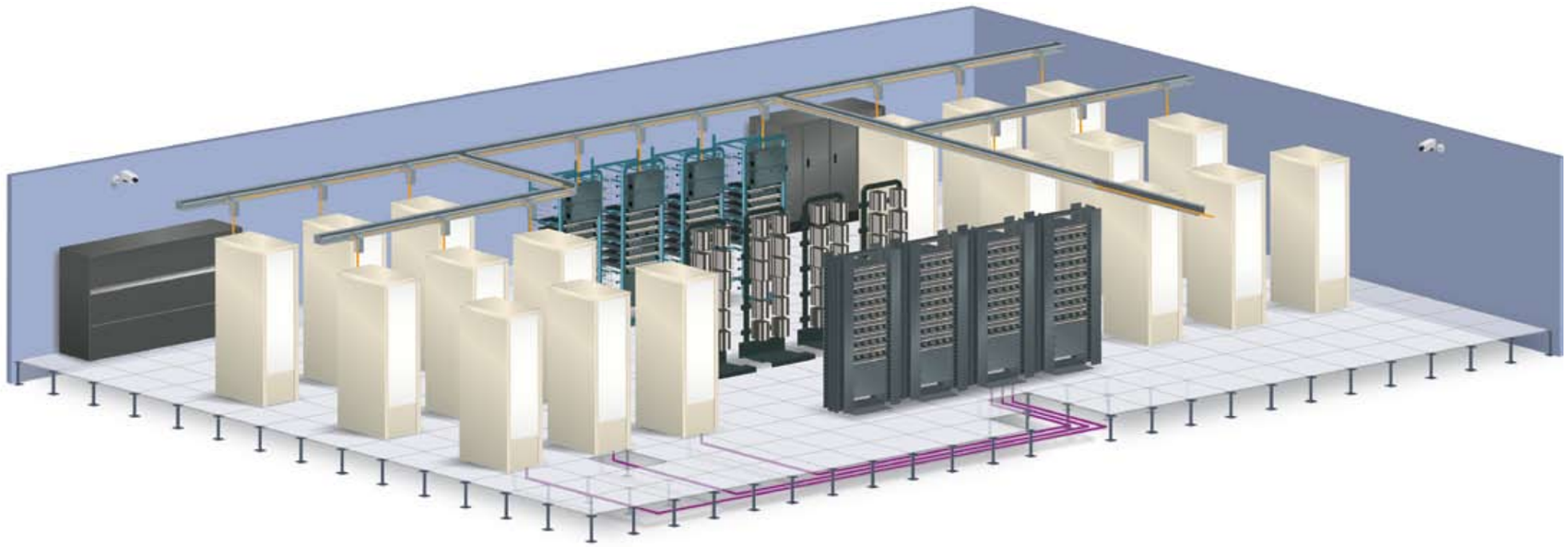
Molex Solutions for Data Centres



Molex Solutions for Data Centre Design

As a pioneer of structured cabling systems – Molex has over 20 years experience in the design, engineering and manufacturing of end-to-end solutions for use by enterprises. The growth in the deployment of Data Centre infrastructures on a global basis has increased the demand for high performance products for use in this environment. Molex offers an extensive portfolio of innovative products and solutions to meet the needs of these demanding applications.

The quality of the installation in a Data Centre is critical to its performance and reliability. We have a global network of installers supporting our customers all around the world to the same quality and high standards. We've trained thousands of communications experts who regularly install our solutions in the field. These installers are rigorously trained and constantly updated on industry developments to ensure that their workmanship and support results in high performing networks.

10G Fibre Pre-terminated end-to-end solutions

Fibre offers the greatest level of performance in terms of speed, bandwidth and security and is ideally suited for deployment in Data Centres. The Molex pre-terminated end-to-end 10G fibre solution offers a number of advantages over traditional fibre installations. The cables are factory terminated and supplied with guaranteed optical performance specifications. On site installation time is also minimised as all cabling is supplied ready to install. The pre-terminated cables and patch cords can be configured using a number of cables and industry standard fibre connectors.

ModLink™ Plug & Play

The ModLink solution is ideal for mission critical applications such as Data Centres and Storage Area Networks (SANS) – where fast installation is required and moves, adds and changes (MAC's) are frequent. This solution comprises self contained, factory assembled cassettes which convert an MTP/MPO interface to a choice of standard fibre connectors.

This solution is modular, flexible and easily configurable.

Specification Grade Fibre Enclosures

Molex offers a comprehensive range of rack mount fibre enclosures enabling secure management of fibres. These high quality enclosures are designed to accommodate high fibre counts.

Fibre cable management is an integral element of the enclosure design and many incorporate the 6-Pak™ adaptor plates that assist the installation in terms of ease & accessibility.

Angled Patch Panels

The angled patch panels are ideal for installations of high density or which utilise extensive side and end-of-the-rack cable management. The angled feature provides enhanced port access and minimises patch cord bend radius to the rack.

Each port features a patented spring-loaded shutter and can be colour coded using an icon for site specific network administration. The panel provides both front and rear port number identification.

RealTime® Intelligent Infrastructure Management

This intelligent connectivity management system provides IT managers with the ability to manage and monitor the physical network layer and associated IT hardware.

IIM systems offer a number of benefits in terms of reduced downtime, asset tracking & utilisation, disaster recovery & online network audits. This system is scalable and can be managed locally or remotely. It is therefore ideally suited to the Data Centre environment.

PowerCat™ 10G Solution

10GBase-T Networks are being specified for high performance, high data transfer environments such as Storage Area Networks and Data Centres. The PowerCat 10G solution is specifically designed for use in 10 Gigabit applications and is channel compliant to the 10 Gigabit standard, when installed as an end-to-end solution.

This solution is available in both unshielded and shielded versions and is backed by the Molex 25 Year, Product, System Performance and Application Assurance warranty.

Cable Management Solutions

Cable management is important in any installation, but with the increasing volume of cable deployed in Data Centres, it can become more of a challenge. Molex offers a comprehensive range of cable management products that combine both aesthetics and functionality.

PowerCat™ 6 end-to-end Solution

The PowerCat 6 solution is a high performance Category 6 solution – that exceeds the requirements of the TIA/EIA 568B 2.1, ISO IEC11801 & EN 50173 standards and has been independently tested by Intertek ETL SEMKO for component compliance.

This solution incorporates the DataGate™ jack which features the integral shutter that prevents dust ingress and eliminates the problems caused by incorrectly inserted patch cords.

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for peace of mind

Other Considerations

Other services within the Data Centre that use structured cabling systems include:

BMS Building Management Systems
- Power
- HVAC
- CCTV systems
- Access control systems
- BMS
- Power monitoring system (may be part of the EMS)
- EMS
- Other Management Systems (IIM, KVM, Wireless)

Power Systems in Data Centres normally cover three elements: local UPS for an area or floor or building, a generator covering the UPS on the computer floor or floors, building services and offices if required. Mains power supplying power to the whole building provided by the local energy supplier. Depending on the level of redundancy required in the Data Centre, all of these elements can have more than one source. The power systems should have transient voltage surge suppression (TVSS) with the floor PDU's.

Air conditioning should provide the computer room or rooms with an ambient air temperature of 20 to 23°C with relative humidity of 45% to 55%. Depending on the redundancy of the system there should be a backup path for the power and water to these systems. Additionally the computer floor should have a drainage path in the case of floods from pipes or sprinkler systems.

CCTV Systems can be IP based and the cameras connected by copper or fibre cabling. The system can be set up with each camera acting as a mini server or as a PC. As this is a network it can be connected locally or globally with the option of voice communication through a speaker mounted next to the camera.

Access Control Systems can vary dramatically depending on the levels of security required within the Data Centre. In its simplest form the access control system can be a lock on the computer room door. Typically, more sophisticated security systems are deployed in Data Centres – these are single entry systems to computer rooms and lockable systems on individual cabinets.

Power Monitoring Systems can be part of an environmental system or separate IP based units that can be operated in stand-alone mode or networked. These units network together and can be monitored over a LAN or WAN system anywhere in the building, country or world.

Environmental Monitoring Systems are normally an IP based system or unit that can monitor a number of sensors at one time in single or multiples of cabinets or a single room. Similarly to power monitoring systems, units networked together can be monitored remotely from any location.

Building Management Systems (BMS) can control heating,lighting and plant equipment in the Data Centre. If the Data Centre is large then the systems should be split up into staff and staff support systems and Data Centre and Data Centre support systems which should have at least one redundant path. The level of segregation may vary depending on the tiered performance level required of the Data Centre.

IIM Molex RealTime® Systems

The RealTime system is an Intelligent Infrastructure Management (IIM) system which allows the user to monitor the connections on the network cabling system on a LAN, MAN or WAN. The system monitors connections either on one site or multiple sites across the globe. By adding different software modules the system can support Network Asset Management and Diagnostics using AutoCAD and Visio packages for planning and documentation.

KVM (Keyboard Video Mouse) switches

To successfully monitor, upgrade and maintain large numbers of servers in environments like a Data Centre, a comprehensive switching system is very important. The latest KVM switch systems have become very sophisticated with the ability to communicate in a number of different ways. They communicate in the standard point to point cable connection which will service switch distances up to 300 metres between devices. Using IP addressing, the KVM can communicate over hundreds of miles and can use standard network or simple USB connections locally. This allows the flexibility to connect to hundreds of servers either locally or globally.

Wireless Networks and Telecommunications Systems

Wireless networks and telecommunications systems allow system operators and maintenance staff to work in remote areas. They provide reliable, high-speed wireless Data and VoIP connectivity and offer mobility and flexibility within the work environment.

FAQ's

1. Why are Data Centres more complicated from a planning perspective than standard office buildings?

A Data Centre's primary function is the moving, process capturing and storing of data. Although they may have structural similarities to that of a typical office building, the equipment housed within is more complex, each having specific requirements for heating, cooling, power and accessibility. To ensure compliancy with all related codes and standards in place, Data Centres must be planned carefully prior to building.

2. Why was the TIA-942 standard developed – what is its main purpose?

The standard was developed to provide information on factors that should be considered when planning and preparing the installation of a Data Centre or computer room. The document presents an infrastructure topology for accessing & connecting the respective elements in cabling system configurations found in Data Centres.

3. How does TIA-942 interact with the Industry Cabling Standards?

TIA-942 provides information on planning the layout and design of Data Centres. TIA-942 compliments the Industry Cabling Standards which cover the installation practices of cabling systems in Data Centres and other buildings.

4. Is there a specific cable that is preferable for use in Data Centres?

Within TIA-942 there are recommendations for a number of cable types both copper and fibre. No one cabling medium is recommended over another, but, as the cables have different properties, data transmission capabilities and costs, careful consideration should be given to the choice of cables at the project planning stage.

5. Why is redundancy so important in Data Centres?

Downtime, either planned or unplanned, costs money. Building redundancy into the cabling of a Data Centre enables the continuity of data transmission via alternative cable paths – thus avoiding downtime. TIA-942 outlines different levels of redundancy that can be selected for use in Data Centres.

6. What is 'tiering'?

The term 'tiering' relates to levels of availability and security of the Data Centre infrastructure. The 1st tier offers the basic level of availability and the 4th tier offers the highest level of availability. The complexity of the cabling and the cost of the infrastructure will vary depending on the tiering level selected for a given Data Centre.

7. What are the key elements from a planning perspective for Data Centres?

The required levels of tiering and redundancy must be decided at the early project planning stages. Once these have been determined a number of key elements will follow – these include: the design team, location of the building, as well as design and specification of the equipment deployed in the building.

8. What are the key challenges when cabling a Data Centre – how can these be overcome?

One of the key challenges is ensuring that the design includes cable redundancy, including diverse routing paths when required, with upgrade and expansion paths.

9. Are different cable management techniques/measures required for Data Centres – what's different about them?

The volume and density of cabling in Data Centres is significantly more than that in typical office buildings. Well-designed containment systems are important to ensure accessibility, segregation and allow room for future expansion.

10. What are the implications of the volume of cable installed in Data Centres?

Pathways and spaces including under floor and overhead systems must be designed carefully. They must not interfere with other services such as air flows and need to be able to support cable systems for the life of the Data Centre.

Molex Capabilities

For over 20 years Molex Premise Networks, part of Molex Incorporated, has manufactured comprehensive copper and Optical Fibre data transport solutions for the transmission of voice, data and video imaging signals. As one of the original pioneers of structured cabling we have provided state-of-the-art cabling solutions to some of the largest organisations in the world.

Whether you require one product or a total end-to-end solution, Molex is committed to assisting you in making the right choice for your business requirements.

Molex Warranty

By choosing Molex you can be safe in the knowledge that whatever the project, our goal is to ensure that your transfer to a new system runs as smoothly as possible. We work closely with our installation partners to maintain the same high standards, regardless of the complexity or simplicity of the project. This commitment to our customers is reflected in our 25 year Product, System Performance and Application Assurance Warranty and the ongoing support we provide to our business partners.

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