Local Area Networks

Introduction

Most schools in New South Wales have some form of Local Area Network (LAN) in place. Systems such as OASIS Administration / Finance and OASIS Library normally operate on a LAN. There are many advantages in networking computers, but there may also be many pitfalls.

What is a Local Area Network?

A LAN comprises the linking of two or more computers within a single site for the purpose of sharing data, software and ***peripherals*** such as printers.

peripherals**:** any additional devices added to the computer to give extra functionality eg printers, scanners.

Within a school, a LAN can vary in size from a few ***workstations*** in a room to a complete school network covering several buildings.

workstations**:** computers which are used to access data from a network.

To add computers to a network, each will require a Network Interface Card (NIC). Various forms of network cabling are available to link the computers. Some of these forms are discussed later in this section. Wireless links are also possible where physical cabling is either difficult or very expensive. Different types of ***server*** devices can be added providing centralised access for file, ***application***, printer, CD ROM and other services.

server**:** also called a file server, it is a computer which stores software and data which is shared (served) to other computers on a network.

Benefits of a Local Area Network

A local area network can provide solutions for a range of problems:

application**:** a software program designed to carry out a specific task eg. word processing

- Once established, workstations can be a simple, inexpensive option with only network boot software required on each workstation.
- Applications installed on the file server can be made available to any workstation and each application needs only be installed once. Users can easily share the same program files.
- Almost any peripheral device (printers / scanners / modems / fax cards etc.) can be networked and shared by any workstation. This minimises the number of peripheral devices required.
- Promotes collaborative work through the easy sharing of files.

- Electronic mail ***(E-mail)*** becomes a valuable communications tool, reducing the amount of paper messages being forwarded around the school.
- Individual users can be allocated levels of security depending on their areas of responsibility.
- ***Backup*** of data is more likely to occur than with standalone computers.
- ***Virus*** attacks can be managed more effectively using anti-virus software.
- (Refer to the section on *Virus Protection* in the support document titled "LAN Management")
- All servers can be administered from a single location.
- Servers can be secured in a strong-room, making theft of workstations less of a likelihood
- Software licence compliance is more easily managed on a LAN. e.g. ***Software tracking*** software. (Software licence control can become an issue when the number of workstations on the network exceeds the number of licences for any particular application. Schools must ensure there are sufficient licences for each application to cover the number of concurrent users of each product.)

E-mail: Electronic mail, messages sent through the network from one computer to another.

Backup**:** a copy of files which are kept in case of misadventure with the originals

Virus**:** an intentionally created piece of software designed to create system and software failures.

Software tracking: a program which is installed on the network that keeps track of software access with respect to the number of licences available.

Issues with a Local Area Network

- Cabling some sites can be difficult and expensive particularly where large distances are involved between buildings or within heritage buildings.
- As the system grows, there will be a need for a trained ***System Administrator*** or maintenance contract.
- When the stage is reached where the school relies on the network for its resources, a backup and ***disaster recovery*** (contingency) plan is needed.
- If the LAN covers the whole school, input into the planning and development of the LAN becomes a decision for the whole school community. This reinforces the need for a school technology committee and the development of a ***technology plan.***

System Administrator**:** a person who administers the day to day operation of the network.

disaster recovery**:** being able to recover from a system failure without permanent loss of information

technology plan: a written strategy which outlines how technology will be integrated into the school's administration and curriculum.

Cabling Issues

Cabling Types

Almost all school networks are based on the 10Mbps (megabits per second) Ethernet standard (***10Base2*** and/or ***10BaseT***) which is both effective and inexpensive.

10BaseT: standard which describes the use of twisted pair network cable runs to a maximum of 90m and able to carry data at 10 Mbps.

1 Thin Ethernet *(Co-axial or 10 Base 2)*

10Base2: standard which describes the use of coaxial network cable runs to a maximum of 200m and able to carry data at 10 Mbps.

Co-axial network cable looks similar to the cable used to connect a television to an antenna. It is often seen in smaller Oasis installations and is suitable for smaller workgroups (up to ten or so workstations) only.

In addition to this, co-axial cabling is considered old technology which restricts expansion and therefore should be avoided.

hub: serves as a central meeting place for cables from computers, servers and peripheral networkable devices.

Advantages:

- It is cheaper to install since no ***hubs*** are required for it to operate.
- Computers are connected in ***series***, so installation is very simple.
- Requires no special tools for installation. Co-ax cable is available in a variety of lengths and is normally supplied with the appropriate ***BNC plugs*** fitted.
- It has a higher immunity to ***electrical noise*** than ***twisted pair*** cable.

series: connected one after another in a similar fashion to a daisy chain.

BNC plugs: a metal bayonet type plug *(similar to a light bulb socket only smaller)* used with co-ax network cable (10Base2)

Disadvantages:

- A failure in any part of the cable can affect every workstation.
- Location of failures can be difficult to trace.
- It is difficult to add or remove workstations while the network is in operation.
- Not an industry supported solution for Fast Ethernet — therefore, it is not a ***scalable*** solution for the future.
- 185 metre limit on each ***segment*** with a maximum of 30 workstations.

electrical noise: spurious signals which are introduced into the cable by surrounding electrical sources.

twisted pair: cable that consists of two or more wires which are arranged in a regular spiral pattern. The cable can be shielded or unshielded (UTP).

2 Unshielded Twisted Pair (UTP)

UTP is a copper cable that is commonly available in two grades:

scalable: able to be upgraded to meet new demands.

- Category 3 (Cat3) — Usually has a grey jacket and is found in older installations.
- Category 5 (Cat5) **—** Usually has a blue jacket and is now standard in most new installations.

This cabling type is well suited to larger networks (10+ workstations). Cat3 and Cat5 cable can be used in 10***Mbps*** Ethernet LANs (10BaseT), while Cat5 cable can also be used in 100Mbps Ethernet LANs (eg. 100BaseT) providing automatic scalability.

Mbps: Megabits per second - the rate at which data is transmitted in the network cable.

NOTE: The NSW Department of Education and Training standard is Cat5.

All UTP cable should to be installed and tested to Australian Standard AS3084.

Structured cabling: consistent use of a high quality standard cabling capable of carrying data, voice and video signals and where the signal distribution occurs throughout the network via a standard patch frame.

Advantages:

- A **structured cabling** solution can be installed in a building if Cat5 is used. This will allow computer data, video and telephone to share a single connection point within a building.
- With UTP cabling, a fault in one cable will not normally interfere with the operation of other workstations.
- Workstations can be added or removed from the network at any time without interference to other workstations.
  (**NOTE:** The ***RJ45*** plugs and sockets used with UTP cabling will wear out if plugs are repeatedly inserted and removed. The expected life of some ***RJ45*** plugs and sockets can be as little as 500 insertions.)
- Scalable solution (particularly if Cat5 cable is used).

RJ45: a square modular plug which is used with networking. Typically on twisted pair cable.

Disadvantages:

- Each workstation and server must be cabled to one port on a hub.
- The cost of the hub must be included in the installation costs.
- The performance of the cable will be affected if it is crushed, bent, twisted, tied tightly or laid close to electrical power cables.
- Can be more expensive to install than Co-ax (10 Base 2) as greater lengths are normally required since cabling radiates from the central hub to each workstation rather than the serial layout of co-ax cabling.
- With Cat5 cabling, there is a limit of 90m from hub to workstation without amplifying.
- Copper based cables such as Cat5 are conductive and therefore need to be protected from the possibility of lightning strikes by choosing protected locations or using the appropriate lightning arresters.

3 Fibre-Optic

segment: a continuous length of network cable which is an electrical circuit.

Fibre-optic cable is constructed of flexible glass and plastic. It can be supplied with multiple cores (or fibres) within a single jacket capable of feeding separate ***segments*** of the network. Furthermore, fibre-optic can transmit signals much further than co-axial or twisted pair cabling. Schools are installing fibre-optic as a ***backbone*** between buildings because of this feature.

backbone: Cable that acts as the primary path or the network signals.

Advantages:

- It is virtually impervious to electronic or magnetic interference unlike

the other cable types listed e.g. Cat5.
- Offers higher bandwidth (capable of handling more data faster) for the future.
- ***10BaseF*** links can be up to 2000m long.

Disadvantages:
- Very expensive when compared to UTP, both in materials and laying charges.
- Harder to lay. Right angle bends are not possible as this would effect the light path. Larger arc curves are required when turning corners.
- Very fragile. Breaks can be difficult and expensive to repair.

10BaseF: standard which describes the use of optical fibre cable runs to a maximum of 2000m and able to carry data at 10 Mbps

Additional Cabling Issues
- The design of the school's network should be handled by professionals to ensure the viability and reliability of the system.
- Many cabling systems are supplied with substantial warranty periods (15+ years) provided they are installed and certified by authorised cabling contractors. Since cabling is the most vital part of the network (it remains static while other components are upgraded), this should always be professionally installed.
- It is recommended that large cabling projects be organised during school holidays where possible so as to minimise the interruption to normal school routine.

NetDay

NetDay is a DET supported project which involves the school community with a consortium of industries. Its objective is to provide schools with an opportunity to install cabling through the use of volunteer workers in conjunction with access to professional advice and equipment at reduced cost. District Technology Advisers can provide further information if required.

Connection Components

Network Interface Cards

Also known as a network adapter**.** Typically, a network interface card (NIC) slides into a computer's ***expansion slot***, providing a connector for attaching the network cable. NICs can also be external devices or built directly onto a computer motherboard. There are many types of NICs with the NE2000 standard being the most common.

expansion slot: slot inside the computer which allows additional pieces of hardware to be added and thus expanding its capability.

Boot PROMs

Boot: a term given to the starting up of the computer

When a workstation has a **boot PROM** fitted, it will send out a message to the first available file server and download its necessary startup files from the file server. A boot PROM therefore allows a workstation to be booted onto the network without the use of a hard disk or floppy disk, therefore avoiding the management problems that can sometimes result from using disks.

Advantages:

- Boot PROMs may be the best solution where your network consists of a number of identical computers without hard disks.
- Since the boot files are kept in a secured area of the file server, it is very difficult for them to be accidentally damaged or corrupted by a virus.
- The boot process is much faster than with a floppy disk.
- Reduces wear and tear on the floppy drive.
- Provided all of the network interface cards in the network are the same type e.g ***NE2000*** and the workstations have the same hardware, one boot (image) file can run all workstations.

NE2000: a standard of network interface card which is defined by the Novell networking company

Disadvantages:

- Boot PROMs are only available on PCs (not on Apple Macintosh). In some cases, they may not operate on workstations with hard disks or scanners attached.
- It will normally require a trained professional to produce a ***boot image file***.
- The image file must be copied to all file servers on the system.
- It may be necessary to have multiple boot image files if there are workstations with different configurations; eg. different sound cards.
- If the system is using multiple image files, any new workstations which are added to the network will need to be registered. This is a simple process but it can add to the maintenance cost of a network.
- A change in the way the workstation boots; e.g. a change in the DOS

Boot image file: a term given to the file which is needed to give the instructions to the computer at start up (boot)

version will require the boot file to be re-written and compiled.

Hubs

A hub serves as a central meeting place for cables from computers, servers and peripheral networkable devices. Hubs can be active (where they repeat the signals sent through them) or passive (where they do not repeat, but merely split, signals sent through them). Some hubs can be upgraded which means that the hardware can grow with the demands of the network.

Switching Hubs

Also known as Ethernet Switches. A switching hub adds to the network infrastructure and significantly increases data transmission rates. Essentially, an Ethernet switch is a multi-port hub for the network. It provides a dedicated 10Mbps Ethernet channel through its ports. As there are multiple ports, multiple 10Mbps connections can be established simultaneously, increasing the aggregate capacity of the entire network.

Most switches also provide Fast Ethernet links (100Mbps) for servers or the backbone of the network and connect workgroups with higher speed links. While more expensive than ordinary hubs, switches have a much quicker access and can provide dramatic speed increases on busy networks.

Routers

Routers forward data from one network to another based on information about the network traffic. Using this information they are able to choose the optimal path on which to send the data.

Additional Cabling Issues

- The process of laying cable, particularly throughout classrooms, can be disruptive and time consuming. Hazards may exist where long lengths of cable are laid out across the floor before fitting. Cablers will be able to work more effectively when they are given free reign to the school buildings which will also reduce labour costs.

- With all Ethernet networks in schools, it is recommended that the cable design incorporates separate segments to reduce traffic across the whole network. Segments can be created via the use of multiple network interface cards in servers, by using switching hubs or routers.
- All of this requires planning, Ethernet solutions can include all three types of cable with transceivers available to move from one medium to another. Doing this however will introduce delays in signal transfer. In some instances, this can significantly reduce the performance of sections of the network.

Types of Local Area Networks

Server-Based LANs

- This normally uses a dedicated file server which contains the Network Operating System as well as software and data to be shared.
- The workstations on the LAN utilise the programs and data from the server.
- These LANs can be very reliable and responsive and can cater for hundreds of workstations.

Peer-to-Peer LANs

- The network operating system (NOS) software is installed on all workstations.
- Because workstations are behaving both as workstations and servers, this type of network can be slow and restrictive. For example, if someone is word processing on the computer with the printer attached and another user sends a large print job, the word processor may suspend operation for a period until the print job is complete, causing inconvenience.
- The built-in networking on Apple Macintosh computers and in Windows 95 and Windows for Workgroups are forms of peer-to-peer networking.
- As peer-to-peer networking is now provided as standard with most modern computers, the only additional cost is cabling and ***connectivity***. But this form of networking is typically only suitable for small workgroups of up to six or so computers.

***onnectivity*:** the ability of one computer to connect to and communicate with another computer.

It should be noted that most server-based network operating systems can co-exist with peer-to-peer on the same server network, providing the advantages that each offer. Similarly, Apple Macintosh computers can exist on the same network as IBM or 'Wintel' (Windows-Intel) compatible

computers. It should also be noted that these hybrid networks require additional administration.

Selecting a Suitable Network Operating System (NOS)

The NOS is the software which makes the network operate and allows the sharing of files and resources. There are several network operating systems available on the market. Examples are Novell NetWare, Microsoft NT and Artisoft's LANTASTIC.

Most network operating systems are released in versions which have different features built into them, such as the number of computers that can be supported and the way that printing is completed. It is not always necessary to instantly upgrade a network operating system when a new version is released. Consider carefully the additional costs and administration required versus the benefits before upgrading.

Before choosing a NOS, check with your District Technology Adviser to determine whether the Department has a Licence Agreement in place (e.g. Novell 4.11 and Windows NT) and how this can be accessed.

Some points to consider before purchase are:

- How well supported is the operating system?
- Are other schools using the same system? What are their experiences? How readily can technical assistance be obtained?
- How easy is the system to administer? Can a high level of automation be included in the installation to reduce future costs and maintenance?
- Is the NOS scalable? Can it easily be extended to other parts of the school or be integrated into other existing networks in your school in the future?
- Can the system be ***remotely managed***?
- Are costs calculated per server or per workstation? Is there an education pricing ?

remotely managed: the network administration can be carried out from a remote computer. Either on or off site.

Selecting Suitable Software for Installation on the Network

Some versions of software have been specifically developed for use on networks. These versions clearly indicate the types of networks on which they have been tested. However, most software will contain little or no reference to its suitability for operation on a network. In this case, it is highly recommended that written verification be provided by the vendor as to the suitability of the software for use on the school's network. It may be useful to ask about sites where the software has been installed and the

extent of support after the installation phase.

It is important to note that while most software can be made to run on a network, the additional cost and effort may make its installation unviable. Therefore such titles may be best run from a workstation's hard disk.

Some other points to consider:

- Standardisation is important. There is little point installing four different word processors because of the existing differences in experience among staff. This will only generate incompatibility between data files and complicate staff training requirements. Standardise on one product in each category.
- How many users will need to access the software? If only a few users need access to a specific software package, installation onto a local hard drive of a workstation at the desired location may be the most cost effective solution.
- Will the software reduce the security of the workstation by providing access to the operating system e.g. *Exit to DOS?*
- Some CD ROMs are designed to operate from a local CD drive only and are not suitable for installation on a network.
- Be sure to check the licensing arrangements for the network use of each software package.

Network Design and Implementation

(Adapted from: Education Victoria 1997: Learning Technologies Planning Guide for Schools. Using IT to Improve Teaching and Learning, Appendix D.)

A well designed network will serve the whole school community as a reliable tool. It is wise to seek assistance from networking professionals (preferably those that understand the nature of schools and their clients) before installing or expanding a network.

Consider the following tasks that all contribute to network design. There may be tasks in this list that can be completed by staff, perhaps with the support of parents with skills in this area. If the necessary skills are not readily available, consider requesting your chosen network services supplier to provide some of the following services:

- Network design and specification;
- Network component installation;
- General network consultancy services; and /or
- Development of a system and network administration / operations guide.

Schools that have no preferred supplier should speak with their surrounding schools to determine services rendered and satisfaction gained from network service suppliers they have used.

Network Design and Specification Services

Suppliers offering these services should, as a minimum, provide the following:

- Site Survey;
- Network Design Report;
- Physical Network Plan; and
- Specification of all components.

The design should fully consider and describe the following matters:

- The most suitable network architecture for the site, consistent with relevant requirements, and including connectivity of standard and existing hardware and software products on the site, connectivity with the State Government wide area network (when available), modularity, ease of implementation, ease of use, reliability, and ease of modification;
- The components and methods of implementing the LAN which ensure compatibility with the supported LAN environment of new or upgraded versions of equipment, software and applications proposed to be added by the school;
- The findings of any capacity plans and/or disaster recovery plans which may have been prepared for the facilities included on the LAN, including file servers;
- The security requirements for restricting access to administrative and other information on the network; and
- All issues associated with the possible logical and / or physical integration of administration, curriculum and other networks at the site.

Site Survey

A site survey needs to be conducted as part of the design of a new network, or the upgrading of an existing network where existing records are otherwise insufficient, prior to the preparation of the network plan. The site survey should encompass and record the following:

- General site characteristics, including location and categorisation of buildings by use (e.g. administration offices, library, computing laboratory, classroom);

- The number of floors and structure of each building (eg, concrete floor, flat roof), and the location and extent of paved surfaces and other obstructions between buildings, as well as any other aspects which could present site installation difficulties;
- Current cabling type and quantity (if a network already exists), including testing and reporting on the cabling;
- The location of the public telecommunications main distribution frame, and the location, suitability and spare capacity of all components of the existing telecommunications infrastructure, including closets, risers, pathways, access holes, distributors and outlets;
- Existing electrical infrastructure, including availability of power and each power outlet (to be checked by an Electrician), and its ability to meet the anticipated demand; and
- The presence of any hazardous electrical, non-electrical or electromagnetic radiation situations, requiring the protection of facilities, operations personnel, or the public.

Network Design Report

The Network Design Report (which may be included as a section of the Physical Network Plan document) would document all design parameters, standards and other criteria used for a network design, including all items outlined above.

This report would provide details of all aspects involved in the investigation and design of the network, including:

- All information gathered during the site survey;
- Pertinent information obtained as part of any previous network planning exercise;
- A discussion of general network planning and implementation issues, including:
  - ❍ The planning period required by the school, which could be for a single installation within a restricted time frame, or for a staged implementation over three to five years;
  - ❍ Site characteristics, including geographical dispersion of buildings, and locations of the public telecommunications **MDF**, administration offices, and key computing areas;
  - ❍ Site installation difficulties, including structure of buildings (e.g. number with concrete floors or flat roof), and extent of paved surfaces or obstructions between buildings;
  - ❍ Existing telecommunications infrastructure;

***MDF*:** Main Distribution Frame - a device consisting of rows of sockets which will accept cables to be plugged into it in various combinations, thus providing a means of allocating network resources (such as phone and computer data) to workstations.

- ❍ Estimates of the network traffic and loads on the active components and segments of the proposed cabling infrastructure, for each source of load (e.g. administration, Internet, general curriculum, exams and assessments, library, video-conferencing, voice, numbers of workstations and their average function);
- ❍ The anticipated impact of loads on each network active and passive component, in terms of the component and overall network performance, for each major parameter generally used in industry to measure performance of the hardware component;
- ❍ Security requirements, including telecommunications cross-connects and cabling in public areas;
- ❍ ***Cable redundancy*** requirements, cable pathways, and other network products;
- ❍ The measures incorporated into the network design which meet the above requirements in the most cost-effective manner available, including an outline of available options and of any proposed staging of upgrading or other activities; and
- ❍ The design parameters, standards and other criteria adopted for the design, including the number of outlets in each classroom (e.g. by category of work area) or to each workstation (e.g. in the administration area, computer laboratories, etc).

***Cable redundancy*:** having extra pairs of cables available in the main bundle to allow spares to be used in the case of failure

Physical Network Plan

The Physical Network Plan clearly and fully documents a cabling installation and should be prepared as part of the design for each proposed new or upgraded network installation.

The documentation included in the Physical Network Plan should be understandable to non-technical as well as technical people, and should include:

- A single line diagram or schematic of the proposed or upgraded network, detailing cabling segmentation and outlet sequence;
- A combined services floor plan, illustrating cable routes and outlet locations and numbers;
- Identification and location on the above plans of each physical component to be installed, including active network components and servers; and
- Identification of other works required, including upgrading the electrical power system and management of power leakage problems.

Copies of the Physical Network Plan and the Network Design Report should be filed with the staff member who coordinates the network and the Principal. A further copy should also be placed in a suitable enclosure inside each communications room or closet.

Design and Specification of all Network Components

The design and specification of LAN products should include the following:

- Design and specification of cabling and passive components, including the integration of these with existing network cabling, components and other facilities at the site, where appropriate;
- Specification of active network components;
- Specification of servers and related products; and
- Specification of other products or works required, including upgrading the electrical power system and management of power leakage problems.

The documentation required as part of the above specifications should include:

- A complete list of products and product components, including model and part numbers, quantities, and installation requirements;
- A complete set of manufacturer's specifications describing and illustrating standard and special components and materials;
- A complete set of drawings of special items; and
- Illustrations and scale drawings of the layout of communications cabinets, equipment racks, and other configurations of products or components.

Cabling Design and Specification

Structured Cabling Design

The design of cabling infrastructure for any site should be based on structured cabling principles and conform to current Australian Standard structured cabling methodology (Current Austel regulations, AS 3080, 3084, 3085 Part 1 at time of print).

The installation of a new cabling system is a long term investment, and should therefore incorporate an appropriate level of "future proofing". This would typically require that relevant industry trends be taken into account, such as incorporating video and voice into the LAN, and the use of fibre

optic cables for backbone cabling. The School should clearly understand the benefits, risks and rationale for undertaking any particular network cabling solution.

Server Specification

The network design should include a specification of the requirements for any necessary file servers. This must specify the required location and environmental conditions for the server(s), including any facilities and/or building modifications which may be needed to meet these.

The specifications need to ensure that the relevant hardware manufacturer(s) environmental specifications are met on an ongoing basis. Factors which need to be considered include measures to control, or else minimise the impact of, temperature, humidity, dust, static electricity, water, wind, fire, and hazardous chemicals and gases.

Factors which need to be considered when determining the best location for the server(s) include network traffic (total and distribution across the site), geographical dispersion of buildings, the relative location of the more computer intensive rooms (including computer laboratories, library, administration offices, science / technology centre, etc) and the location of existing network infrastructure.

Specification of All Components

Suppliers should specify the brand, model number, data capacity and relevant parameters of proposed network components, including certification of any compatibility issues with Network Operating Systems, if applicable.

All passive components on the network should be individually priced with the number required being specified.

Server Capacity Planning

This involves the investigation and preparation of a Capacity Plan for all servers on a school site. A Server Capacity Plan would typically include the following:

- Estimated existing and future volumes and types of system load on each existing and proposed server at the site, including break-up of loads by source (e.g. administration, Internet, general curriculum, exams and assessments, library, video conferencing, voice);

- Performance of existing servers, including system response and resource usage (CPU capacity, random access memory, hard disk storage, input/output processing, etc), and any available capacity of the servers to cope with additional loads;
- Performance goals, in terms of anticipated; school needs at the site;
- Estimated impact of future loads on the performance and resource usage of each server;
- Alternatives for coping with future loads, including upgrading existing servers, adding new machines, and/or modifying user or system procedures to optimise the use of existing facilities;
- Recommended measures, including a summary of the costs and benefits, and the possible staging of upgrades or other actions; and
- Provision of subsequent ongoing advice on capacity planning for an initial period of twelve months as part of the initial price, with provision for extensions as further agreed.

Disaster Recovery Planning

This service involves an investigation and preparation of a Disaster Recovery Plan for all LAN and related IT facilities at a school site. A Disaster Recovery Plan would typically include:

- Procedures and management arrangements for the overall coordination of responses to disasters affecting IT facilities and operations;
- Detailed procedures and arrangements for assigning responsibilities, staff and resources, for the recovery of each facet of IT operations, including computer facilities, application systems and software, telecommunications, databases and data (for a discussion on data backup, refer to the support document titled “LAN Management”);
- Procedures and arrangements for maintaining effective communications between staff and suppliers participating in disaster recovery processes, and other staff at the site; and
- Provision of subsequent ongoing advice on disaster recovery for an initial period of twelve months as part of the initial price, with provision for extensions as further agreed.

System and Network Administration / Operations Guide

This involves the preparation of a *System and Network Administration / Operations Guide*, or similar document that could include:

- Network Facilities Operation and Administration - procedures and guidelines for the operation and maintenance of all active and passive network facilities and servers at the site, including preventative and emergency maintenance procedures;
- Network Software Administration — procedures and guidelines for the installation of software on servers and workstations, Internet access and usage, and electronic mail usage and administration;
- User Access — procedures and guidelines for the registration of users and administration of user profiles, access rights and privileges;
- Security — procedures and guidelines for implementing the site's logical and physical security policies;
- Data Management — procedures and guidelines for the management and storage of user data files; and
- Data Backup — a data backup strategy and procedures.

All procedures and guidelines need to be consistent with other school operations as advised by relevant representatives throughout the school, expressed in a clear and well structured manner, and capable of being readily understood by teaching staff who have not had specialist network training.

A Supplier engaged to install a LAN at a school should be required to provide the following installation services:

1 Installation Plan and Project Management;
2 Site Survey;
3 Product Installation;
4 Electrical Installation Works;
5. Installation and Acceptance Testing and Certification;
6 Product Training for Acceptance; and
7 Site Reinstatement.

Networks need to be installed in accordance with a Network Plan (design), which should have been prepared prior to the supply and installation of a LAN.

Network products and servers are to be installed by properly qualified personnel. Cabling is to be installed by Communication Cabling Specialist personnel who are:

- Trained in the requirements of the current Australian Standard (at

time of print, Telecommunications Installation / Cabling Installation, current *Austel* regulations, AS 3080, 3084, 3085 Part 1);
- Authorised by the cabling system manufacturer;
- Licensed by *Austel* to carry out general premises cabling; and
- The Supplier (and sub-contractor if applicable) must have a manufacturer's certification to install and maintain the selected cabling system prior to commencing work on the installation of that cabling. The Supplier should provide documentation detailing its level of certification.

Consult the *NSW Government Contract ITS 2012* for a list of approved suppliers capable of providing licensed services in this area.

Project Management of Network Installations

The Supplier undertaking the installation of products must ensure that the entire project is managed so as to ensure that the network facilities are satisfactorily installed to school requirements. This is to include ensuring that the design, specification, supply, installation, configuration and testing of all necessary network products, as well as acceptance testing and certification of the total installed network and any necessary training on the operation of products, are undertaken to the satisfaction of the school representative(s). Ask your Technology Adviser for a copy of the Government contract suppliers lists for IT related products and services.

Servers

Servers must be located and installed in suitable room(s) in such a manner that the relevant hardware manufacturer(s) environmental specifications are met. This must include the appropriate control of, or minimisation of the impact of, temperature, humidity, dust, static electricity, water, wind, fire, and hazardous chemicals and gases. Sufficient space must also be available for servicing the server(s).

Where required, installation shall include loading and configuration of the server network operating system and all components necessary to make the server operational and accessible to all designated workstations and devices on the network.

Certification

If all required tests are successful, the completed system shall be certified by personnel trained and authorised by the cabling or termination system manufacturer, and a formal certificate detailing the certification results shall be provided to the school's representative. The certification must demonstrate that the installed cabling system meets the requirements of the current industry standard (Current Austel regulations, AS 3080, 3084, 3085 Part 1 at time of print), and that UTP cabling meets the Category 5 Class D link performance levels.

On completion of the certification phase the installed system shall be guaranteed by one single cabling manufacturer, confirming that the entire cabling system will perform to the manufacturer's specification for the period of warranty (15 — 20 years).

NOTE: Systems that include cable components from more than one manufacturer cannot be certified. Only the sections containing cable components exclusively from a single manufacturer will be certified as each manufacturer has slightly different specifications.

Final Inspection and Hand-over

The school must be supplied with all appropriate documentation, including all relevant commission test records, and full details of the manufacturer's performance standards.

Training for Acceptance of Products

The Supplier is to provide the training reasonably required by the school to enable school personnel to properly operate any particular product for the purposes of conducting any required acceptance procedures, and carrying out moves, additions and changes to the patching and connected equipment.

▪ ▪ ▪