MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga

Ministry of Education

Information Technology Infrastructure - Switching

Policy and Guidelines For Schools

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Information Technology Infrastructure Switching Policy and Guidelines for Schools

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Table of Contents

1 Introduction

This document outlines the minimum switching standards adopted by the Ministry of Education for Information Technology Infrastructures in New Zealand schools.

This document is updated regularly as standards change. Prior to using this document please confirm that it is the latest version. The latest version of the document may be obtained at http://www.minedu.govt.nz/goto/networks

1.1 Purpose

This document has been prepared by the Ministry of Education for use by New Zealand schools and other organisations which participate in the design, supply, and implementation of information technology infrastructures for New Zealand schools. The document addresses the planning for switching systems in new schools but applies equally to existing schools planning significant upgrades and extensions to existing infrastructures. Where appropriate, existing older switches should be retained for redeployed in less critical locations.

It provides guidance in the following areas:

- Technical requirements for switching systems
- Product selection and system dimensioning
- Design, installation and testing requirements
- Switching administration and documentation

1.2 Scope

This document addresses the following areas:

- Switching system and product selection for use in New Zealand schools
- Switching equipment installation in New Zealand schools

2 Definitions and Abbreviations

2.1 Definitions

Category 5 (Cat 5)
A definition of cabling components which provide AS/NZS 3080 Class D performance

Category 5e
Any reference to Category 5e shall be interpreted as Category 5.

Category 6 (Cat 6)
A definition of cabling components which provide AS/NZS 3080 Class E performance

Channel
The end-to-end transmission path connecting two pieces of application specific equipment

Enclosure
A housing for accommodation of equipment and cabling that includes mounting rails and protective panels

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Registered Jack 45
In the USA RJ45 is the Universal Service Ordering Code (USOC) for circuit configuration 45 (neither T568A nor T568B) for an 8-position modular connector. In this document RJ45 shall mean a modular 8-pin connector wired according to T568A configuration in accordance with AS/NZS 3080 Z.A.2.

Structured Cabling System
A set of cabling and connectivity products that are constructed according to standardized rules to facilitate integration of voice, data, video, and other signals

Uplink
A high-speed connection for aggregating traffic from an edge switch to a backbone switch or a server

2.2 Acronyms and Abbreviations

10GbE	10 Gigabits per second Ethernet
AC	Alternating Current
BGPv4	Border Gateway Protocol version 4
CLI	Command Line Interface
DHCP	Dynamic Host Configuration Protocol
DVMRP	Distance Vector Multiple Routing Protocol
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EPR	Earth Potential Rise

FD	Floor Distributor
GARP	GARP (Generic Attribute Registration Protocol)
GbE	Gigabit per second Ethernet
GBIC	Gigabit Interface Converter
Gbps	Gigabits per second
GVRP	Group VLAN Registration Protocol
HSRP	Hot Standby Router Protocol
HTTP	HyperText Transfer Protocol
HW	Hardware
ICMP	Internet Control Messaging Protocol
ICT	Information and Communication Technology
IEEE 802.1D	Spanning Tree Protocol standard
IEEE 802.1Q	VLAN tagging standard
IEEE 802.1w	Rapid Spanning Tree Protocol Standard
IEEE 802.1x	Access control standard
IEEE 802.3a	Port aggregation standard
IEEE 802.3ab	1000Base-T (Gigabit UTP copper standard)
IEEE 802.3ad	Trunk aggregation standard
IEEE 802.3p	VLAN Priority tagging standard
IEEE 802.3u	Fast Ethernet standard
IEEE 802.3z	1000Base-SX/LX (Gigabit fibre standard)
IEEE	Institute of Electrical and Electronic Engineers
IGMP	Internet Group Management Protocol
IP	Internet Protocol
ITD	Information Technology Directorate
LACP	Link Aggregation Control Protocol
LAN	Local Area Network
LASER	Light Amplification by Stimulated Emission of Radiation
LC	A small form factor optical fiber connector
LED	Light Emitting Diode
MAC	Media Access Controller
Mbps	Megabits per second
MDI	Medium Dependent Interface
MDI-X	Medium Dependent Interface Crossover
MMF	Multi-mode Optical Fibre

MPLS	Multi Protocol Label Switching
MT-RJ	A small form factor optical fiber connector
NEBS	Networking Equipment Building Standards
NMS	Network Management Systems
NTP	Network Time Protocol
OEM	Original Equipment Manufacturer
OSPF	Open Shortest Path First
PIM	Protocol Independent Multicast
PING	Packet Internet Groper
QoS	Quality of Service
RFC	Request for Comment
RFI	Radio Frequency Interference
RFP	Request For Proposal
RIP	Routing Information Protocol
RJ45	Registered Jack 45 (USOC reference)
RMON	Remote Monitoring Agent
RU	Rack Units (1RU = 44.5mm)
SCS	Structured Cabling System
SFF	Small Form Factor (connector)
SFP	Small Form Factor Pluggable (alternative to SFF)
SME	Small to Medium Enterprise(s)
SMF	Single Mode Optical Fibre
SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol
SOHO	Small Office(s) and Home Office(s)
STP	Shielded Twisted Pair
TFTP	Trivial File Transfer Protocol
UPS	Uninterruptible Power Supply
USOC	Universal Service Ordering Code
UTP	Unshielded Twisted Pair (cable)
VLAN	Virtual Local Area Network
VoIP	Voice over Internet Protocol
VRRP	Virtual Router Redundancy Protocol
WLAN	Wireless Local Area Network

3 Reference Documents

Switching systems and equipment shall be installed in accordance with the manufacturers' specifications and Regulations, Codes and Standards listed below.

Where New Zealand and International Standards are referenced in this document the application of the Standard shall be, unless specifically stated to the contrary, the latest edition and amendments available on the date 30 calendar days prior to the issue of any request for a quote, tender or proposal.

Where specifications or standards or any other references referred to in this document refer in turn to other specifications, standards or documents whether whole or in part, those consequential references shall apply to this specification as if they were completely contained in their entirety in the original reference.

3.1 New Zealand and International Standards

The work covered by this document shall comply with the following New Zealand and International Standards, Specifications and Technical Bulletins.

Standard/Specification or Technical Bulletin Number	Description
NZS 2772.1:1999	Maximum exposure levels - 3kHz to 300GHz (Radiofrequency Fields)
AS/NZS CISPR 22	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
AS/NZS 1269	Occupational noise management
AS/NZS 2107	Acoustics – Recommended design sound levels and reverberation times for building interiors
AS/NZS 2211.2	Laser safety – Safety of optical fibre communications systems
AS/NZS 3000	Electrical installations (known as the Australian / New Zealand Wiring Rules)
AS/NZS 3080	Telecommunications Installations – Integrated Telecommunications Cabling Systems for Commercial Premises
AS/NZS 3084	Telecommunications Pathways and Spaces for Commercial Buildings.
AS/NZS 3085.1	Telecommunications Installations Administration of Communication Cabling System - Part 1: Basic Requirements.
AS/NZS 3087	Balanced cable testing
AS/NZS 4117	Surge protection devices for telecommunication applications
AS/NZS 4251.1:1999	Electromagnetic compatibility (EMC) – Generic emission standard. Residential, commercial and light industry. This Standard is identical with and has been reproduced from CISPR/IEC 61000-6-3:1996
IEC-60297 Part 1 and Part 2	Dimensions of mechanical structures of the 482.6 mm (19 in) series
IEEE 802.3	Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications

3.2 Regulatory Requirements and Codes of Practice

Other than for compliance with the Electrical Regulations 1993 and relevant New Zealand Codes of Practice, there are NO regulatory requirements for telecommunications switching components or design practice in New Zealand. This includes electromagnetic compatibility (EMC)

The Telecommunications Act 1987 gives Telecom New Zealand and any other Network Operators the right to refuse connection or to disconnect from their networks any equipment which does not comply with Telecom PTC specifications or equivalent.

For equipment connected to Telecom New Zealand's network, compliance with Telecom PTC specifications is a contractual requirement.

3.3 Application of the Standards

It is recommended that the switching systems be designed and installed in general accordance with this document by inclusion in tender and contract documents.

In the event of conflict between Ministry standards or specifications and other regulations, codes or standards the order of precedence shall be:

i) Statutory Codes and Regulations

ii) Standards or Specifications within the tender or contract

iii) This document

iv) Referenced New Zealand and International Standards

4 General Conditions

4.1 Switching System Works

The scope of work for the provision of switching systems and equipment in schools typically includes supply, installation, testing, commissioning, and documentation.

4.2 Switching Equipment

The switching system supplier/reseller shall maintain a list of equipment which complies with these standards.

All equipment shall be new and selected to ensure satisfactory operation under the environmental conditions present at the site.

4.3 Minor Materials, Fittings and Consumables

All materials and fittings or any work which is necessary for the installation and satisfactory functioning of the equipment or which is generally provided in accordance with accepted trade practices shall be provided or carried out as part of the works even though such material or work may not be explicitly mentioned in this specification or shown on the drawings.

4.4 Electrical Installation Works

All electrical power system work shall be undertaken by qualified Electricians in accordance with the relevant New Zealand Standards (AS/NZS 3000:2000).

4.5 Site Conditions

Suppliers shall undertake the necessary investigations to fully inform themselves of the site conditions which could impact the cost of the job. This shall include but not be limited to:

- Available cabinet space
- Environment conditions
- Power provisioning

4.6 Coordination with Other Works

Where the switching system installation and commissioning is dependent upon or carried out in conjunction with other works at the site such as building, electrical or cabling works, the switching system provider shall coordinate activities with the other works.

5 Switching Systems

5.1 General

Because of the diversity of school sizes, building layouts, and networking requirements, a range of common switching system architectures is described. Schools are encouraged to discuss their requirements with the Accredited Switch Suppliers or System Integrators prior to purchasing hardware. Schools should consider the following when selecting network switching system hardware:

- Required number and speed of access ports
- Requirement for up-link bandwidth and interface type
- Present or future requirement of IP telephony
- Requirement for network management and reporting
- The use of proprietary and generic network management tools
- Adherence to international standards for connectivity
- Need for uninterruptible power supplies and redundancy in the network to avoid "single points of failure" and the maximum acceptable downtime of the network
- Ability to backup complex device configuration files and to restore to replacement devices in the event of a failure
- Total number of proposed devices (workstations, servers, printers etc.) on the network, network segmentation and network use which may impact on other users
- Complex security requirements such as segmenting administration and curriculum networks (protecting administration server whilst allowing Internet access and messaging to all students and staff)
- Requirements for bandwidth management, traffic prioritisation and traffic filtering
- Requirement for future growth e.g. stackability
- Performance capacities of switching devices e.g. non blocking internal bandwith and packet buffering capacity. Many switch manufacturers offer both SOHO and SME switch product ranges. Schools should not employ switches with performancee capacities designed for the SOHO market.
- The ability of the switch management system to provide health checking, error and performance monitoring, and reporting.

Some of the above considerations can be particularly complex and will involve specialist product and network skills. Accredited network integrators should be used to ensure that value for money is obtained when purchasing complex networking solutions.

5.2 Minimum Standards

The Ministry's minimum standard for new switching installations is based on providing Gigabit Ethernet (GbE) over the backbone and between the switches and servers, and 100BASE-T to the desktop. It is likely that 10 Gigabit Ethernet (10GbE) backbones will be required in the future.

The Recommended Suppliers offer a selection of switching solutions which simplify the integration of applications and ensure cost-effective reliability and optimum performance across the entire network. Integrated software provides built-in functionality for end-to-end integration, including bandwidth aggregation.

The Fast Ethernet and Gigabit Ethernet switching architectures described below provide a combination of high data transfer rates, manageability, and expandability ideally suited to schools. A selection of switches also has the ability to support networks that integrate data, voice, and video applications. Support for IP telephony applications, such as unified messaging, desktop integration, and e-learning, requires fast LAN switches with QoS capabilities and high-availability components.

5.3 Generic Network Architectures

The network hierarchy for large installations includes three functional divisions or layers: edge or access, distribution, and core. In smaller installations one or more of these layers may be “collapsed” into a single layer.

Unless able to be included very cost effectively, redundancy may be considered a luxury for most schools. However, careful design can minimise the “single points of failure” in the network and the impact of failure of a component on the rest of the network, for example, the use of Spanning Tree Protocol, and uninterruptible power supply to the core switch and server.

5.3.1 Access Layer

The access layer provides the first level of access to the network and provides terminal device addressing and attachment. Layer 2 switching, security, and QoS reside at this layer. These switches should be manageable to provide for the detection and resolution of problems such as broadcast storms, auto-negotiation failures, excessive collisions and other transmission errors which may arise.

Because architectures up to Layer 2 allow end station connectivity, it is possible to construct a Layer 2–only network, providing simple, inexpensive, high-performance connectivity for small installations. However, Layer 2 does not extend beyond the school boundary and Layer 3 (routing) capabilities are required to connect to the Internet.

5.3.2 Distribution and Core Layers

All school networks need a “core” switch to connect to servers and support management for the detection and resolution of problems which may arise such as broadcast storms and auto-negotiation failures.

The core is the backbone of the network. This layer is designed to be fast converging, highly reliable, and stable. The core may provide load balancing, fast convergence, and scalability.

The distribution layer, which fits between the access and core layers, aggregates wiring closets and provides policy enforcement. Layer 3 protocol switches offer benefits such as load balancing, fast convergence, granular security and greater scalability. This layer can also provide first hop default gateway redundancy to end stations.

Simplicity is the key - “Switch where you can; route where you must”. Keeping the network architecture simple offers the advantages of easy support and troubleshooting. Only the largest schools are likely to have the need for a layer 3 (routing) switch architectures. Since these switching systems will require specialist design they are not discussed in detail here.

5.3.3 Internet Connectivity

Layer 3 (routing) functionality is required for network connection to the Internet. Routing is included in Layer 3 switches but is typically performed in a separate router for this particular application.

5.3.4 Wireless LAN Interfaces

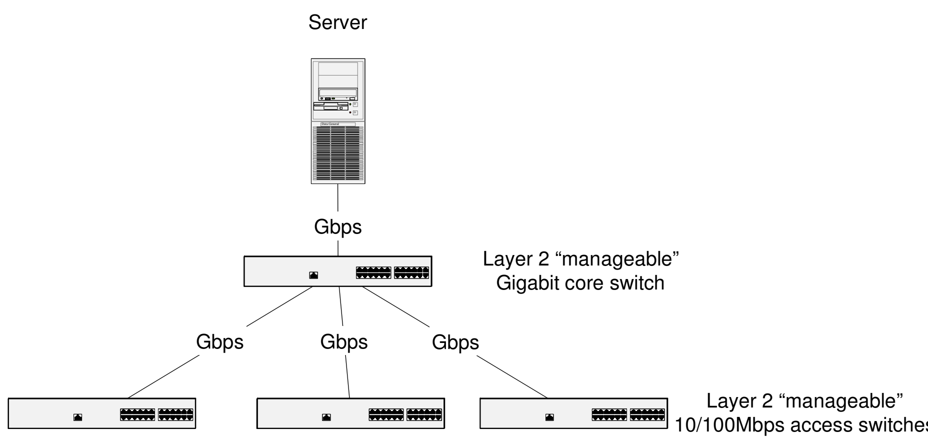
Wireless LAN (WLAN) equipment conforming to the IEEE 802.11 standards is progressively being deployed as an access technology at the network edge. Wireless bridges and routers are also available for access between buildings and campuses where wired Ethernet is not a cost effective option.

WLAN equipment is not considered in detail in this document because of the requirement for specialist design and the much lower performance than wired access. However, WLANs may be used to provide a cost effective alternative to extending the coverage of existing network infrastructures where reduced performance is acceptable.

5.4 Typical Network Architectures

5.4.1 Small Schools

For a school with less than about 50 edge ports, the core and distribution layers are typically combined into a single layer. This limits scale to a small number of access switches. A very small school, typically contained within one building, may have a single 12, 16, or 24 port switch which provides all required networking and management functionality.



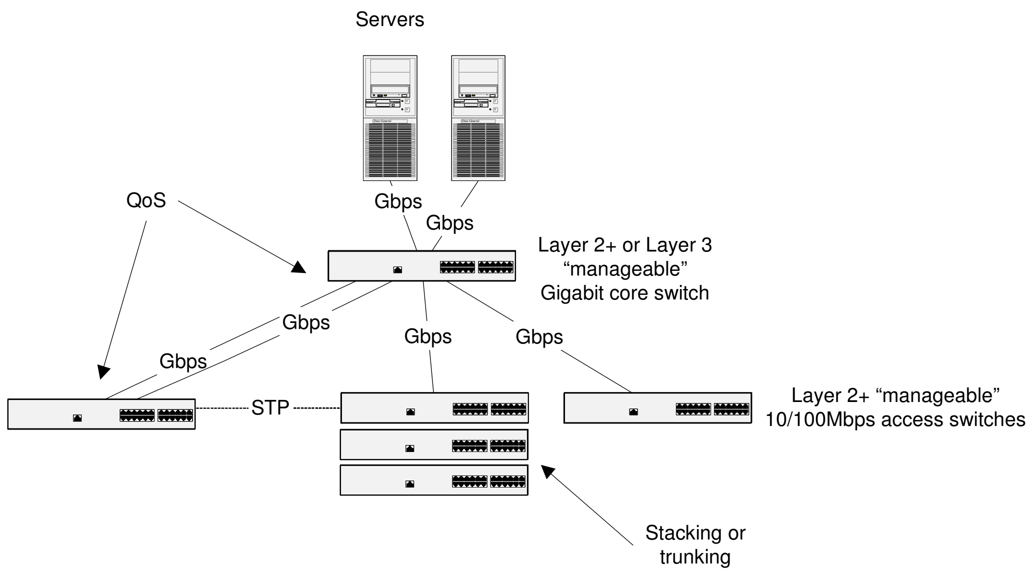
5.4.2 Medium Schools

For schools with more than about 50 edge ports network performance and priority becomes an issue as users compete for limited network resources such as:

- Core switching capacity
- File server processor and data transfer performance
- Bandwidth on links between switches
- Bandwidth on links to file servers
- Internet connection bandwidth

To ensure the network fabric is not a bottleneck, three design opportunities are available:

1. Optimisation of network performance may be effected by putting terminals in the same network VLAN or subnet as the servers they use. VLANs are used to segment the network logically into well-defined broadcast groups and for application and security management. Networking for a medium school is designed for high availability, performance, and manageability. The core switch may also use layer three switching or overlapping VLAN layer 2 constructs to allow devices in different VLANs or subnets to communicate with each other and with common resources.
2. Optimisation of network performance by prioritising critical traffic with QoS prioritisation mechanisms.
3. Increased network bandwidth by increasing Ethernet speeds or aggregating ports and links between devices.



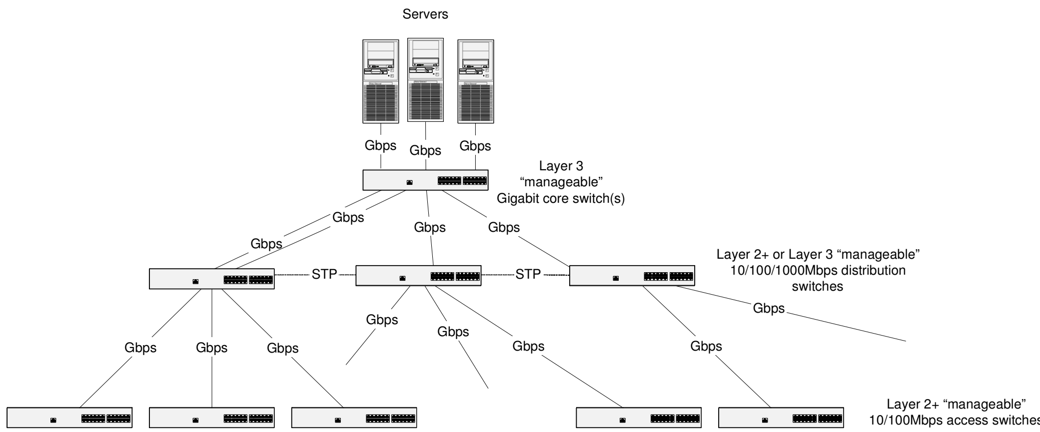
5.4.3 Large Schools

A typical large school network connects multiple buildings with each other across a high-performance, switched backbone and may have requirements for high availability, performance, and manageability in handling high bandwidth applications, and services such as video, IP multicast, and increasingly voice.

While voice and video traffic may be relatively low bandwidth applications, the key issue for networks carrying real-time applications is latency. Unlike normal data traffic, voice and video are real-time applications unable to tolerate delay or retransmission of packets. Prioritisation of real-time traffic by QoS prioritisation mechanisms ensures timely delivery of voice and video packets ahead of other less sensitive traffic.

Where IP telephony is of interest, consideration should be given to switches that support POS (Power over Ethernet) to provide power to telephones.

A separate distribution layer allow for flexibility and future growth. Layer 2 Backbone designs are commonly used when cost effectiveness is a high priority. Redundant links and data paths help ensure high availability. Redundancy may be achieved by using redundant paths and STP or by IEEE 802.11ab port trunking.



5.5 Switch Selection

Network architects will generally choose switching products according to the formula provided in the next section.

6 Switching System Technical Requirements

6.1 General

Ranges of Ethernet switches from a number of Accredited Suppliers have been selected by the Ministry for deployment in schools. The ranges cover edge or access workgroup switches and core switches for all schools, and distribution switches required for larger installations.

Each switch will have a range of features specific to that model which may determine the selection for particular situations.

6.2 Edge Switches

Basic edge switches are typically used as workgroup switches at small to medium sized schools. The basic Layer 2 models are typically fixed configuration, non-blocking switches with from 12 to 48 ports for creating cost effective LANs with high performance and functionality. The 10/100Mbps auto-sensing and auto-negotiating ports support QoS for prioritizing different traffic streams. Switch management is typically by direct RS232 connection.

At least one modular or fixed uplink interface which supports Gigabit Ethernet transmission over Category 5 or higher copper cable and single-mode and multimode optical fibre cables are a feature of some models.

Advanced edge switches are typically used as workgroup switches at medium to larger sized schools. The advanced Layer 2 models are typically fixed configuration, non-blocking switches with from 12 to 48 ports for creating cost effective LANs with high performance and functionality. The 10/100Mbps auto-sensing and auto-negotiating ports support QoS for prioritizing different traffic streams. A greater range of switch management options are available.

At least two modular uplink interfaces which support Gigabit Ethernet transmission over Category 5 or higher copper cable and single-mode and multimode optical fibre cables are a standard feature. Some models are stackable to provide high density switching in the wiring closet.

Features and standards supported as a minimum by this range of switches include the following:

Minimum specifications for Edge Switches			
School Size / Feature	Small	Medium	Large
Rack mounting	19 inch rack mountable	19 inch rack mountable	19 inch rack mountable
Power supply	Internal 230V	Internal 230V	Internal 230V
External UPS	-	-	-
Stackable	-	Yes	Yes
Speed	10/100 + 1xGb slot	10/100+ 2xGb slots	10/100+ 2xGb slots
IEEE N-way auto negotiation, Speed, duplex, & MDI-X	All ports	All ports	All ports
Manual override of auto negotiation	Yes	Yes	Yes

Minimum specifications for Edge Switches			
Feature \ School Size	Small	Medium	Large
IEEE 802.3a Port aggregation	Yes	Yes	Yes
Gigabit port options	1000Base-T 1000Base-SX 1000Base-LH	1000Base-T 1000Base-SX 1000Base-LH	1000Base-T 1000Base-SX 1000Base-LH
Web browser manageable (HTTP)	Yes	Yes	Yes
SNMP V2 manageable	-	Yes	Yes
RMON management	-	1,2,3 & 9	1,2,3 & 9
Telnet management	-	Yes	Yes
CLI management	-	Yes	Yes
Configuration files loadable via TFTP or web interface	Yes	Yes	Yes
Firmware upgradeable	Yes	Yes	Yes
Port Mirroring	Yes	Yes	Yes
Layer	2	2	2
VLAN Security options	IEEE 802.1q IEEE 802.1x	IEEE 802.1q IEEE 802.1x	IEEE 802.1q IEEE 802.1x
IP Address setting	Static	Static	Static
IP filtering for management security	-	Yes	Yes
Minimum number of VLANs	16	100	100
Non Blocking & Wire Speed operation	Yes	Yes	Yes
Minimum size of Packet buffers	500KBytes	8MBytes	16Mbytes
Minimum size of MAC address tables	4K	8K	8K
IGMP V2 or above	-	Yes	Yes
ICMP Ping send and receive	-	Yes	Yes
Status LEDs	Link Speed Activity	Link Speed Activity	Link Speed Activity
QoS Queues	2	4	4
IEEE standards	802.1p 802.1Q 802.3x 802.3a 802.3ab 802.3z 802.1D	802.1p 802.1Q 802.3x 802.3a 802.3ab 802.3z 802.1x 802.1D	802.1p 802.1Q 802.3x 802.3a 802.3ab 802.3z 802.1x 802.1D 802.1w 8002.1s

6.3 Core Switches

Basic core switches are typically used as the core switch at small to medium sized schools and as distribution switches at large schools. The basic core switch models are typically fixed configuration, non-blocking switches with from 12 to 24

10/100/1000Mbps auto-sensing and auto-negotiating ports. To avoid a traffic bottleneck from occurring between the 10/100Mbps switches at the edge of the network and its core, Gigabit Ethernet is used at the core of the network. Multiple Gigabit Ethernet uplinks can be used to provide redundant connections to the backbone and ensure high network availability for users connected at the edge.

Each switch can support at least two modular Gigabit Ethernet interfaces for a range of copper and Optical Fibre cable types.

Advanced Core Switches would be typically used as a core switch at a large school. For networks of more than about 250 users, networks where the deployment of IP telephony is planned, Layer 3 switching should be provided in the backbone. Layer 3 switches are essentially wire-speed routers. These devices are ideally suited to delivering high-performance routing between VLANs or LAN segments. Layer 3 switches also provide advanced security services, such as access control lists and advanced quality of service features to support real-time applications such as IP Telephony.

Features and standards supported as a minimum by this range of switches include the following:

Minimum specifications for Core Switches			
School Size / Feature	Small	Medium	Large
Rack mounting	19 inch rack mountable	19 inch rack mountable	19 inch rack mountable
Power supply	Internal 230V	Internal 230V	Internal 230V
External UPS	Yes	Yes	Yes
Redundant power supply option	-	Yes	Yes
Stackable	Yes	Yes	-
Chassis based system	-	-	Yes
Hot card swap	-	-	Yes
Speed	10/100/Multiple Gbps slots	10/100/Multiple Gbps slots	10/100/Multiple Gbps slots
IEEE N-way auto negotiation, Speed, duplex & MDI-X	All ports	All ports	All ports
Manual override of auto negotiation	Yes	Yes	Yes
802.3ad Port aggregation	Yes	Yes	Yes
Gbps port options	1000Base-T 1000Base-SX 1000BaseLX	1000Base-T 1000Base-SX 1000BaseLX	1000Base-T 1000Base-SX 1000BaseLX
Web browser manageable (HTTP)	Yes	Yes	Yes
SNMP V2 Manageable	Yes	Yes	Yes
RMON management	1,2,3 & 9	1,2,3 & 9	1,2,3 & 9
Telnet management	Yes	Yes?	Yes
CLI management	Yes	Yes	Yes
Configuration files loadable via TFTP	Yes	Yes	Yes
Firmware upgradeable	Yes	Yes	Yes
Port Mirroring	Yes	Yes	Yes
Layer	2	3	3

Minimum specifications for Core Switches			
School Size / Feature	Small	Medium	Large
IP Address setting	Static	Static	Static
IP filtering for secure management	Yes	Yes	Yes
Minimum number of VLANs	100	100	100
Non Blocking & Wire Speed operation	All ports	All ports	All ports
Minimum size of Packet buffers	1MB	2MB	16MB
Minimum size of MAC address tables	8kB	8kB	8kB
IGMP V2 or above	Yes	Yes	Yes
ICMP Ping send and receive	Yes	Yes	Yes
Status LEDs	Link Speed Activity	Link Speed Activity	Link Speed Activity
QoS Queues	8	8	8
Traffic Classification (COS) defined on:	TOS Diffserv (DSCP), switch port MAC Address, IP Address, TCP/UDP port No.	TOS Diffserv (DSCP) port-based MAC Address IP Address TCP/UDP port No.	TOS Diffserv (DSCP) port-based MAC Address IP Address TCP/UDP port No.
Network Security	802.1x port and MAC, RADIUS, SSH, TACAS,	802.1x port and MAC, RADIUS, SSH, TACAS,	802.1x port and MAC, RADIUS, SSH, TACAS,
Access Control List	MAC, VLAN, 802.1p, Diffserv (DSCP), IP Address, Protoclo Type, TCP/UDP, destination port No.	MAC, VLAN, 802.1p, Diffserv (DSCP), IP Address, Protoclo Type, TCP/UDP, destination port No.	MAC, VLAN, 802.1p, Diffserv (DSCP), IP Address, Protoclo Type, TCP/UDP, destination port No.
Event log	Syslog	Syslog	Syslog
Routing	-	RIP 1 & 2 OSPF, DVMRP, Static Routing,	RIP 1 & 2 OSPF, DVMRP, Static Routing,
VRRP/HSRP	-	-	Yes
Wire Speed Routing	-	Yes	
Broadcast storm control	Yes	Yes	Yes
DHCP forwarding	-	Yes	Yes
IEEE standards	802.1p 802.1Q 802.3x 802.3ab 802.3ad 802.3z 802.1x 802.3u	802.1p 802.1Q 802.3x 802.3ab 802.3ad 802.3z 802.1x 802.3u	802.1p 802.1Q 802.3x 802.3ab 802.3ad 802.3z 802.1x 802.3u

Minimum specifications for Core Switches			
School Size / Feature	Small	Medium	Large
	802.1D 802.1w	802.1D 802.1w	802.1D 802.1w 802.1s

7 Switching System Installation Practice

7.1 General

The switching system supplier/reseller shall supply all labour, materials and equipment required for installing, testing and commissioning the network.

The supplier shall include a copy of all relevant specifications, compliance reports, documentation and diagrams including the switch IP address assignments for installation in an "as-built" document manual.

7.2 Safety

Any electrical work will be carried out by a registered electrician.

IEEE 802.3 compliant transformer coupled MDI and MDI-X ports may be an important consideration if UTP copper cable is to be used to connect switches in separate buildings which have their own earth connections.

7.3 Qualifications of Installer

Switching infrastructures shall be installed only by organisations accredited by the manufacturer of the switches and by personnel properly trained and certified by the manufacturer to install their products.

7.4 Manufacturers Recommendations

All equipment shall be installed and performance tested in full accordance with manufacturer's and distributor's recommendations and instructions.

8 Warranty and Support

8.1 General

The switching system supplier shall warrant that products will operate to the standards and specifications claimed by the manufacturer and that the product is free from any defects in materials or workmanship.

The supplier shall make technical and user documentation on the product available to the school.

8.2 Manufacturers Warranty

8.2.1 Hardware Warranty

The supplier shall provide a limited lifetime replacement warranty on the switch and associated hardware. Warranty provisions shall include on-site repair or replacement and the Supplier should hold sufficient replacement stock in New Zealand to deliver a replacement unit to any school suffering a failure no later than 'next business day'.

8.2.2 Software Warranty

The supplier shall provide limited lifetime software support on the switch and free access to firmware upgrades within the firmware feature set purchased.

8.2.3 Service Level Agreements

Quotations for service support may include an option for a Service Level Agreement. In event of hardware failure the Service Level Agreement should stipulate within what time frame a replacement unit will be dispatched to the school. Premiums will be charged for service outside normal business hours. Quotations may be formulated to include financial penalties for failure to meet the agreed SLA.

9 Qualifications

9.1 Installer Qualifications and Selection

The specialist contractor engaged to design, supply, install, and commission the selected switching system shall be approved as a reseller and certified as an installer by the manufacturer or distributor of the equipment in New Zealand prior to commencing work on the installation. The specialist contractor shall also be capable of maintaining the selected switching system.

When calling for tenders or requesting quotations schools should invite responses from resellers/installers who can provide documentation detailing their level of manufacturer/distributor certification together with the following information:

- Company overview and profile
- Copy of warranty certification statements from the manufacturer
- Customer reference letters with contact details (3 required)
- Company staff details and number of certified engineers
- Full-time staff & responsibilities
- Part-time contractors & responsibilities
- Training
- Industry specific training e.g. (Cisco, Allied Telesyn, D-Link, 3Com)
- Manufacturer/distributor certification held by the reseller/installer
- Manufacturer certification held by the New Zealand supplier/distributor
- Type, make and model of testing equipment used e.g.
    - UTP and Fibre cable certification equipment
    - Traffic performance analysers
    - Packet capture and protocol analyses tools
    - IP addressing audit tools

A list of organizations who have already submitted this information to the satisfaction of the Ministry of Education is available on request.

9.2 Supplier Qualifications

The New Zealand specialist supplier/distributor approved by the equipment manufacturer as a qualified supplier/distributor shall provide second level support services to the reseller/installer of the switching system.

The supplier/distributor shall maintain an engineering staff specifically to support their resellers. The engineering staff shall be certified to install and maintain the selected switching systems.

The installer shall provide documentation detailing the level of manufacturer certification held by their supplier/distributor when submitting quotations and tender responses.

10 Other Considerations

10.1 Allied Systems

The following systems and peripheral components should be considered in conjunction with the design and implementation of the switching system:

- UPS system capacity requirements, accommodation, battery maintenance and life span.
- Fire sprinklers in server and communications rooms
- Smoke detection in server and communications rooms
- IP telephony systems
- Video conferencing