

Title	Demonstrate and apply introductory knowledge of computer network engineering principles		
Level	4	Credits	15

Purpose	<p>This unit standard covers introductory knowledge of computer networks, the devices used in these networks, and their relationship to the Open System Interconnect model.</p> <p>People credited with this unit standard are able to:</p> <ul style="list-style-type: none"> – apply basic techniques required to connect a PC to a network; – demonstrate knowledge of fundamental networking principles; – demonstrate and apply knowledge of the physical characteristics of media used for networking; – apply signalling theory to cable testing; – use cable to connect a LAN and a WAN in accordance with a given specification and test the connection; – demonstrate knowledge of Ethernet networks; – demonstrate knowledge of the TCP/IP protocol suite and IP addressing; and – demonstrate knowledge of routing methods and subnetting.
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Classification	Electronic Engineering > Computer Engineering
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Available grade	Achieved
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Guidance Information

- 1 This unit standard is intended for use in engineering courses at diploma level.
- 2 This unit standard is one of four designed to cover knowledge of computer network engineering principles, the others being Unit 22717, *Demonstrate and apply intermediate knowledge of computer network engineering principles*; Unit 11583, *Demonstrate and apply advanced knowledge of local computer network engineering principles*; and Unit 16989, *Describe and apply advanced knowledge of computer network engineering techniques to set up a WAN*. It is recommended that competency in this unit standard be achieved before assessment against unit standard 22717 is attempted.
- 3 References
CCNA 1 and 2 Companion Guide, Revised (Cisco Networking Academy Program), 3rd Edition; By Cisco Systems, Inc. Published by Cisco Press; ISBN 1587131501;
 IEEE802.3 Ethernet standard;

Networking Basics CCNA 1 Companion Guide; by Thomas Knott, Wendell Odom;
published by Cisco Press; ISBN: 1587131641;
and all subsequent amendments and replacements.

4 Definitions

ARP – address resolution protocol.

BOOTP – bootstrap protocol.

BRI – basic rate interface.

Cable – coaxial, copper, optical fibre.

CIDR – classless inter-domain routing.

Coaxial cable – includes 10Mbps baseband coaxial cable (Thinnet) (10Base-2) and 10Mbps baseband coaxial cable (Thicknet) (10Base-5).

DHCP – dynamic host configuration protocol.

DNS – domain name system.

DSL – digital subscriber line.

EGP – external gateway protocols.

Ethernet – a process called Carrier Sense, Multiple Access, Collision Detection (CSMA/CD), which has data collision detection, it is used to pass data across a physical media.

FTP – file transfer protocol.

HTTP – hypertext transfer protocol.

IGP – internal gateway protocols.

Industry practice – practice used and recommended by organisations involved in the electrotechnology industry.

Introductory knowledge – means employing a broad knowledge of the subject matter, incorporating some theoretical concepts, to make an informed judgement.

IP – internet protocol.

ISDN – integrated services digital network.

LAN – local area network.

MAC – media access control.

MAN – Metropolitan Area Network.

Mbps – megabits per second.

Network media – cable, wireless.

OSI – Open System Interconnect, a model developed by the International Standards Organisation.

PC – personal computer.

RARP – reverse address resolution protocol.

SAN – storage area network.

SMTP – simple mail transfer protocol.

STP – spanning tree protocol.

Subnetting – the subdivision of a CIDR block into smaller CIDR blocks.

TCP – transmission control protocol.

TCP/IP – transmission control protocol over internet protocol.

UDP – user datagram protocol.

UTP – unshielded twisted pair.

VPN – virtual private network.

WAN – wide area network.

5 All measurements are to be expressed in Système International (SI) units, and, where required, converted from Imperial units into SI units.

- 6 All activities must comply with: any policies, procedures, and requirements of the organisations involved; the standards of relevant professional bodies; and any relevant legislative and/or regulatory requirements.
- 7 Range
- a performance in relation to the outcomes of this unit standard must comply with the Health and Safety at Work Act 2015;
 - b laboratory and workshop safety practices are to be observed at all times.

Outcomes and performance criteria

Outcome 1

Apply basic techniques required to connect a PC to a network.

Performance criteria

- 1.1 Networking mathematics is applied to a PC network application in accordance with industry practice.
- Range binary to decimal, decimal to binary, dotted decimal, hexadecimal conversions.
- 1.2 A PC is connected to the Internet via a LAN and tested to confirm correct operation in accordance with industry practice.
- Range PC network configuration, ping and traceroute, setting of basic parameters in a web browser.

Outcome 2

Demonstrate knowledge of fundamental networking principles.

Performance criteria

- 2.1 Networking terminology is explained in accordance with industry practice.
- Range may include but is not limited to – common networking devices, topology, protocols, LAN, MAN, WAN, SAN, VPN.
- 2.2 Bandwidth is described in terms of its importance in relation to information transfer.
- Range measurement, limitations, throughput data transfer calculations, digital versus analogue.
- 2.3 The use of networking models is explained in terms of operation of data communication.
- Range use of layers, OSI model, TCP/IP model, encapsulation process.

Outcome 3

Demonstrate and apply knowledge of the physical characteristics of media used for networking.

Performance criteria

- 3.1 The prime characteristics of media used for networking are explained in accordance with industry practice.
- Range copper, optical fibre, wireless.
- 3.2 The correct termination of cables is demonstrated in accordance with industry practice.
- Range includes but is not limited to – the termination of UTP cable, production of UTP patch cables.

Outcome 4

Apply signalling theory to cable testing.

Performance criteria

- 4.1 Methods of signal transfer through a medium, signal attenuation, and signal measurement methods are explained in accordance with industry practice.
- Range sine and square waves, frequency, bandwidth, decibel, analogue and digital signals, time and frequency display, noise.
- 4.2 The effects of noise on signals in networking media and the methods of measurement of these effects are explained.
- Range attenuation, insertion loss, sources of noise, crosstalk, testing standards.
- 4.3 Test equipment is used to measure cables in accordance with industry practice.
- Range may include but is not limited to – measurement of wire map, length, attenuation.

Outcome 5

Use cable to connect a LAN and a WAN in accordance with a given specification and test the connection.

Performance criteria

- 5.1 The types of connections and cables required to connect LANs and WANs are described in accordance with industry practice.
- Range may include but is not limited to – Ethernet, serial, ISDN, BRI, DSL, console connections.
- 5.2 Patch cables are used to interconnect pre-configured LAN and WAN devices in accordance with industry practice.
- Range hubs, switches, routers and workstations.
- 5.3 Basic tests are used to ensure correct connection of LAN and WAN devices in accordance with industry practice.
- Range ping, telnet and use of web browser.

Outcome 6

Demonstrate knowledge of Ethernet networks.

Performance criteria

- 6.1 The frame structure, standards, and terminology used for Ethernet networks are explained in accordance with industry practice.
- Range Ethernet II, IEEE802.3, naming rules, OSI model, frame structure, purpose of fields.
- 6.2 Fundamental operation of Ethernet is explained in terms of operation and application.
- Range includes but is not limited to – MAC, timing, interframe spacing, collisions, auto-negotiation.
- 6.3 10 Mbps and 100 Mbps Ethernet systems' characteristics are described in accordance with industry practice.
- 6.4 Gigabit and 10 Gigabit Ethernet systems' characteristics are described in accordance with industry practice.
- 6.5 Basic Ethernet switching principles, techniques, and standards are explained in accordance with industry practice.
- Range may include but is not limited to – bridging, switching, latency, switch modes, STP.

6.6 The differences between Ethernet switching collision domains and broadcast domains are explained in accordance with industry practice.

Range shared media, collision domains, segmentation, broadcast domains, data flow.

Outcome 7

Demonstrate knowledge of the TCP/IP protocol suite and IP addressing.

Performance criteria

7.1 The TCP/IP model layers are identified and their purpose is explained in accordance with industry practice.

Range history and future, application layer, transport layer, internet layer, network access layer, compare with OSI model.

7.2 IP addressing is explained in accordance with industry practice.

Range may include but is not limited to – dotted decimal, IP version 4, IP address classes, reserved addresses, public/private addresses, subnetting, comparison of IPv4 and IPv6.

7.3 Methods of obtaining an IP address are explained in accordance with industry practice.

Range may include but is not limited to – static, RARP, BOOTP, DHCP, ARP.

7.4 Protocols used in the transport of data are explained in terms of the application of the TCP/IP suite layers in accordance with industry practice.

Range may include but is not limited to – TCP, UDP, DNS, FTP, HTTP, SMTP, SNMP, Telnet.

7.5 The operation of the TCP/IP suite of protocols is examined and explained in terms of packet exchanges between two hosts; addresses, headers, packet content; the layers and the processes, functions, or tasks that are performed within these layers.

Range includes but is not limited to – use of a protocol analyser to examine TCP/IP in action;
protocols examined include but are not limited to – TCP handshake, DHCP operation, ICMP ping, DNS operation.

Outcome 8

Demonstrate knowledge of routing methods and subnetting.

Performance criteria

- 8.1 Differences between routed and routing protocols are identified and IP protocol propagation through a router is described in terms of routing tables and network addresses.
- 8.2 Differences between switching and routing are identified and the operation of an IP routing protocol is described in terms of metrics and establishment of routing tables.
- Range may include but is not limited to – routing tables, algorithms and metrics, IGPs, EGPs, link state and distance vector.
- 8.3 The purpose of subnetting and how it is achieved is explained in terms of number of hosts and/or number of subnets.
- 8.4 Subnet masks are established and applied to the three classes of IP address in accordance with industry practice.

Planned review date	31 December 2021
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Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	18 December 2006	N/A
Rollover and Revision	2	28 June 2018	N/A

Consent and Moderation Requirements (CMR) reference	0003
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This CMR can be accessed at <http://www.nzqa.govt.nz/framework/search/index.do>.

Comments on this unit standard

Please contact The Skills Organisation reviewcomments@skills.org.nz if you wish to suggest changes to the content of this unit standard.