Unit title:	Wide Area Networking technologies
Unit number:	27
Level:	5
Credit value:	15
Guided learning hours:	60
Unit reference number:	F/601/1562

UNIT AIM AND PURPOSE

The learner will develop their understanding and knowledge of wide area network (WAN) technologies and the services delivered across the WAN infrastructure, enabling them to plan, design and implement WAN infrastructure solutions.

LEARNING OUTCOMES AND ASSESSMENT CRITERIA

A pass grade is achieved by meeting **all** the requirements in the assessment criteria.

Learning Outcome (LO) The Learner will:	Pass The assessment criteria are the pass requirements for this unit. The Learner can:
LO1 Understand the impact of WAN technologies	1.1 critically evaluate different WAN technologies 1.2 critically analyse traffic intensive services and their performance 1.3 discuss WAN concerns and make recommendations to sustain network security, reliability and performance 1.4 critically evaluate different trust systems on a WAN
LO2 Be able to design WAN infrastructures	2.1 design a WAN infrastructure to meet a given requirement 2.2 critically evaluate the suitability of WAN components
LO3 Be able to implement WAN infrastructures	3.1 build and configure a WAN (including services) to meet a given requirement 3.2 implement network security on a WAN 3.3 critically review and test a WAN
LO4 Be able to manage WAN infrastructures	4.1 monitor and troubleshoot a WAN 4.2 resolve WAN issues to improve security, reliability and performance 4.3 critically evaluate the performance of a WAN

GRADING CRITERIA

A merit grade is achieved by meeting **all** the requirements in the pass criteria **and** the merit descriptors.

A distinction grade is achieved by meeting **all** the requirements in the pass criteria **and** the merit descriptors **and** the distinction descriptors.

Merit Criteria (M1, M2, M3) (M1, M2, and M3 are mandatory to achieve a merit grade. Each must be achieved at least once per unit to achieve a merit grade.)	Distinction Criteria (D1, D2, D3) (D1, D2, and D3 are mandatory to achieve a distinction grade. Each must be achieved at least once per unit to achieve a distinction grade.) (In order to achieve a distinction grade, all merit criteria must also have been achieved.)
MANDATORY TO ACHIEVE A MERIT GRADE	MANDATORY TO ACHIEVE A DISTINCTION GRADE
M1 Analyse concepts, theories or principles to formulate own responses to situations.	D1 Evaluate approaches to develop strategies in response to actual or anticipated situations.
M2 Analyse own knowledge, understanding and skills to define areas for development.	D2 Evaluate and apply strategies to develop own knowledge, understanding and skills.
M3 Exercise autonomy and judgement when implementing established courses of action.	D3 Determine, direct and communicate new courses of action.

TEACHING CONTENT

The Teaching Content describes what has to be taught to cover **all** Learning Outcomes.

Learners must be able to apply relevant examples to their work although these do not have to be the same as the examples specified.

LO1 Understand the impact of WAN technologies	
Technologies	- switched circuits, e.g. ISDN - packet-switched circuits, e.g. frame relay, multi-protocol layer switching (MPLS), switched virtual circuit (SVC) - point-to-point links, e.g. leased line, permanent virtual circuit (PVC) - dial-on demand, e.g. DDR - broadband, e.g. xDSL, 3G, HSDPA, WiMAX - routing protocols, e.g. RIP,EIGRP, OSPF - virtual private networks (VPN) - WAN devices e.g. routers, servers, modems, transceivers, concentrators
Traffic intensive services	- quality of service technologies, e.g. differentiated service code point (DSCP) - traffic handling mechanisms, e.g. aggregate traffic, peer-to-peer conversation, priorities, queues - congestion management, e.g. dynamic routing - area of need, e.g. voice over IP (VoIP), video conferencing, video/audio streaming, online gaming
Concerns	- security - reliability - performance - recommendations for sustaining security, e.g. firewalls, access control lists, tunnelling protocols, perimeter security, intruder detection systems - hash functions, e.g. MD5, SHA-1, RIPEMD - recommendations for sustaining reliability, e.g. back-up circuits - recommendations for sustaining performance, e.g. optimising bandwidth, forward error correction
Trust systems	- between connected networks on WAN - remote systems - intermediate systems,

LO2 Be able to design WAN infrastructures	
Design	• required number of devices • anticipated average and maximum bandwidth load • scalability, redundancy • cost considerations • service requirements, e.g. remote access, VPN • quality of service needs, addressing schemes • protocol management • security, e.g. authentication, trust management, access control • change management
WAN components	• technologies • devices, e.g. routers, modems, VPN concentrators, WAN switches • Services, e.g. domain name services (DNS), email, web, application, VoIP.

LO3 Be able to implement WAN infrastructures	
Build	• connect WAN devices, e.g. routers, servers, modems, transceivers, concentrators • install software components • implement external connections
Configure	• protocols, addressing, e.g. IP addressing scheme, naming conventions, interfaces • access management, e.g. users, groups, internal resources, external resources, services • security management, e.g. access control, trust management, VPN deployment, quality of service mechanism deployment • traffic management mechanism deployment
Test	• connectivity • functionality • security.

LO4 Be able to manage WAN infrastructures	
Performance management tools and techniques	• bandwidth monitoring • traffic analysis • network monitoring, user activity monitoring • configuration checking • methodology trouble shooting • ensuring resolutions are effective.

GUIDANCE

Delivery guidance
It will be beneficial to deliver this unit in a way that uses actual events, industry forecasts or sector specific contexts which offer the learner the opportunity to explore, develop and apply the fundamental principles of the sector or subject area. Where this unit is being delivered in the context of a large institution which deploys WAN technologies, observation of the technologies in use could be facilitated. Learner access to live networks in any organisation poses risk and learners must be made aware of the potential problems and their responsibilities when accessing these networks. Where access to resources is limited, network simulation software would allow students to test ideas and test planned infrastructures. Learners will benefit from being encouraged to exercise autonomy and judgement to evaluate the suitability of components and technologies for a given requirement, especially where this relates to a known local organisation; adapt their thinking and reach considered conclusions when planning a WAN infrastructure to fulfil the given requirement. Learners would benefit from being presented with subject/sector-relevant problems from a variety of perspectives, and being given the opportunity to explore them using diverse approaches and schools of thought. For example, consider the output of network management tools on existing networks with respect to potential changes to technologies or services.

Assessment evidence guidance
Evidence must be produced to show how a learner has met each of the Learning Outcomes. This evidence could be assignments, project portfolios, presentations or, where appropriate, reflective accounts. Where group work/activities contribute to assessment evidence, the individual contribution from each learner must be clearly identified. All evidence must be available for the visiting moderator to review. Where learners are able to use real situations or observations from work placement, care should be taken to ensure that the record of observation accurately reflects the learner's performance. This should be signed, dated, and included in the evidence. It is best practice to record another individual's perspective of how a practical activity was carried out. Centres may wish to use a witness statement as a record of observation. This should be signed and dated and included in the evidence.

<u>RESOURCES</u>

Books

Halsall, Fred., *Computer Networking and the Internet*, Addison Wesley (5th Ed), 2005, ISBN: 0321263588

Tanenbaum, Andrew., *Computer Networks* (International Edition) (4th Edition), 2002, ISBN: 0130384887

Reid, A., *WAN Technologies CCNA 4 Companion Guide,* Cisco Press, 2006. ISBN-10: 1587131722

Websites

http://docwiki.cisco.com/wiki/Introduction_to_WAN_Technologies
http://technet.microsoft.com/en-us/library/bb742465.aspx
www.networktutorials.info/
www.cisco.com
www.howstuffworks.com