

COURSE ELT3330: WIDE AREA NETWORKS**Level:** Advanced**Theme:** Computer Networking Systems**Prerequisite:** ELT2310: Network Structures, ELT2320: Network Media & Devices, ELT2330: OSI Model (Open System Interconnection), ELT2340: Network Protocols, ELT2350: Local Area Networks**Description:** Students develop basic knowledge of the technologies employed in a wide area network (WAN) and of how a WAN may be used to connect local area networks (LANs) at different locations. They gain practical experience in using WAN technologies to establish remote network access, and they analyze emerging WAN technologies with respect to impact on global networking.**Parameters:** Designed to be delivered in conjunction with other advanced level courses in the Computer Networking Systems theme. Schools have the option of delivering courses within this theme in conjunction with one or more Project courses from the Career Transitions theme if they wish to extend learning and/or address other vendor-specific technologies.

Access to a computer work centre equipped with networking hardware, software, tools and consumable supplies, and to instruction from an individual with specialized knowledge and skills in computer networking.

Particular emphasis is placed on introductory-level knowledge of WAN concepts, and on the application of WAN technologies. Students model and assume personal responsibility for ethical behaviour in their use of networking technologies and in their access to electronic sources of information. They also demonstrate an understanding of industry-based policies regarding network use and security.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> • describe the general structure, function and communication services provided by a WAN 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • a teacher-directed evaluation designed to test ability to: <ul style="list-style-type: none"> – describe and illustrate the basic structure and function of a WAN – differentiate between and give examples of analog and digital carrier systems and services – describe basic processes of modulation, synchronization and multiplexing in a WAN 	15

COURSE ELT3330: WIDE AREA NETWORKS (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> • explain and illustrate basic concepts of circuit switching and packet switching and their application in a WAN • demonstrate applications of WAN technology in providing network users with remote access • identify and describe security issues in a WAN and the function of network security protocols and methods • analyze emerging WAN technologies with respect to design, evolution and impact on global networking 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • a presentation or project designed to: <ul style="list-style-type: none"> – explain and illustrate how a typical circuit-switching and packet-switching session works – describe the physical characteristics (i.e., speed, capacity, media), basic function and user services offered by common circuit-switching and packet-switching technologies – compare the quality of service (QoS) offered by selected circuit-switching and packet-switching technologies • a project in which the student demonstrates ability to: <ul style="list-style-type: none"> – describe and compare different approaches used to provide network users with remote access – explain the function of a remote access server (RAS) and common remote access protocols and services – select an approach, protocol and configuration; implement remote access; and troubleshoot and identify the cause of potential connection problems, given a need for remote connectivity in a small office or home office scenario • a presentation or project identifying and describing: <ul style="list-style-type: none"> – major security issues in a WAN – the purpose and function of common security protocols – the purpose, characteristics and benefits of firewalls and proxies • a presentation or project identifying three or more emerging WAN technologies and analyzing each with respect to: <ul style="list-style-type: none"> – elements of design – historical evolution – benefits provided to global networking 	<p>25</p> <p>30</p> <p>10</p> <p>15</p>

COURSE ELT3330: WIDE AREA NETWORKS (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> demonstrate established laboratory procedures and safe work practices demonstrate basic competencies. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> observed performance in following: <ul style="list-style-type: none"> established laboratory procedures established network use policies and practices safety regulations specific to the network technologies being used <p><i>Assessment Tools</i> <i>Assessment Checklist: Wide Area Networks (ELT3330-1)</i> <i>Assessment Checklist: Laboratory Procedures and Safety Practices, ELTPSP</i></p> <p><i>Standard</i> <i>Performance rating of 3 on each criterion</i></p> <ul style="list-style-type: none"> observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p>5</p> <p>Integrated throughout</p>

Concept	Specific Outcomes	Notes
<p>WAN Characteristics</p>	<p><i>The student should:</i></p> <ul style="list-style-type: none"> describe and illustrate the basic structure and function of a WAN compare and contrast the structure of, and communication services provided by: <ul style="list-style-type: none"> local area networks (LANs), metropolitan area networks (MANs) and WANs public networks, private networks and virtual private networks (VPN) describe and give examples of: <ul style="list-style-type: none"> analog and digital carrier systems and services major standards for digital carrier services; e.g.: <ul style="list-style-type: none"> data signaling (DS) standards T- and E-carrier standards describe basic processes of modulation, synchronization and multiplexing in a WAN 	<p>Prior to computer networking, telephone companies had developed the Public Switched Telephone Network (PSTN). Discuss the significance and relationship of PSTN to WAN development.</p> <p>VPNs combine the advantages of public and private networks. Identify reasons for implementing VPNs in specific situations.</p> <p>Compare baseband and broadband communication and their application in LAN and WAN environments.</p>

COURSE ELT3330: WIDE AREA NETWORKS (continued)

Concept	Specific Outcomes	Notes
<p>WAN Characteristics (continued)</p>	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • describe and compare: <ul style="list-style-type: none"> – dial-up and dedicated connections – asynchronous and synchronous modems • identify common types of lease lines and the advantages and disadvantages associated with dedicated lease lines. 	
<p>Switching Technologies</p>	<ul style="list-style-type: none"> • explain and illustrate how a typical circuit-switching and packet-switching session works • compare design features of switched virtual circuits and permanent virtual circuits • describe the physical characteristics (i.e., speed, capacity, media), basic function and user services offered by: <ul style="list-style-type: none"> – common circuit-switching technologies, including: <ul style="list-style-type: none"> • Integrated Services Digital Network (ISDN) • Digital Subscriber Line (DSL) – common packet-switching technologies, including: <ul style="list-style-type: none"> • x.25 • Frame Relay • Asynchronous Transfer Mode (ATM) • Synchronous Optical Network/Synchronous Digital Hierarchy (SONET/SDH) • define the concept of quality of service (QoS) • compare the QoS offered by selected circuit-switching and packet-switching technologies • explain WAN design considerations related to: <ul style="list-style-type: none"> – committed information rate (CIR) – error rate and packet loss. 	<p>Plan for activities that compare circuit-switching and packet-switching technologies with respect to:</p> <ul style="list-style-type: none"> • basic processes and transfer modes • related services and applications. <p>Examine the basic operation of an ATM network, and compare ATM with traditional networking technologies. Explain how LAN Emulation (LANE) and Multiprotocol Over ATM (MPOA) enable ATM to integrate with traditional networks.</p> <p>Discuss the influence of QoS on WAN design and the way information is transmitted in a WAN.</p>

COURSE ELT3330: WIDE AREA NETWORKS (continued)

Concept	Specific Outcomes	Notes
Remote Access	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • describe and compare different approaches used to provide network users with remote access; i.e.: <ul style="list-style-type: none"> – dial-up connections – VPN connections • explain the function of a remote access server (RAS) and common remote access protocols and services; e.g.: <ul style="list-style-type: none"> – Serial Line Internet Protocol (SLIP) – Point-to-Point Protocol (PPP) – Point-to-Point Tunneling Protocol (PPTP) – Independent Computing Architecture (ICA) • recommend a remote access connectivity solution, select a remote access protocol/service, configure client and server for remote access, and troubleshoot potential connection problems, given a need for remote connectivity in a small office or home office scenario. 	<p>Remote access allows users to connect to a network from a remote location through dial-up lines and high-speed connections.</p> <p>Plan for activities that enable students to:</p> <ul style="list-style-type: none"> • choose the approach, protocol and configuration for a given remote connectivity situation • identify the cause of network, connection or authentication failure in a situation involving dial-up or dedicated services.
Network Security	<ul style="list-style-type: none"> • identify internal and external security issues in a WAN • identify the purpose and components of a network security policy • describe/illustrate the purpose and function of common security protocols; e.g.: <ul style="list-style-type: none"> – Internet Protocol Security (IPSec) – Kerberos – Layer 2 Tunneling Protocol (L2TP) – Secure Sockets Layer (SSL) • explain the purpose, characteristics and benefits of: <ul style="list-style-type: none"> – a firewall – a proxy server • predict the impact of implementing a particular security strategy on network functionality. 	<p>Network security involves protecting networks from internal threats, such as unauthorized access and accidental data destruction, as well as protecting networks from external threats by hackers and viruses.</p> <p>Demonstrate processes for configuring:</p> <ul style="list-style-type: none"> • password policies • security options • audit policy.

COURSE ELT3330: WIDE AREA NETWORKS (continued)

Concept	Specific Outcomes	Notes
Emerging Technologies	<p><i>The student should:</i></p> <ul style="list-style-type: none"> • identify and briefly describe five or more emerging WAN technologies • analyze three or more emerging WAN technologies, including any of the following, with respect to elements of design, historical evolution and benefits to global networking: <ul style="list-style-type: none"> – Plain Old Telephone System (POTS), xDSL, ISDN and cable as examples of last mile solutions – technologies designed to address bandwidth requirements – Internet Protocol version 6 (IPv6) – tunneling protocols – VPN solutions – wireless/satellite networks – Internet telephony. 	<p>Discuss relationships between:</p> <ul style="list-style-type: none"> • technological development and the needs of society • emerging technologies and unified networks. <p>Research phases and methodology of network design.</p> <p>Discuss:</p> <ul style="list-style-type: none"> • the role of carrier extensions and frame bursting in Gigabit Ethernet • advantages of IPv6 or IPv4 • Dense Wavelength Division Multiplexing (DWDM) as a solution for exhausted SONET lines • recent technologies designed to enhance wireless transmission • advantages of unifying data and voice networks.