



Australian Government

MEM29007 Apply networking technology principles for manufacturing and engineering applications

Release: 1

MEM29007 Apply networking technology principles for manufacturing and engineering applications

Modification History

Release 1. New unit.

Application

This unit defines the skills and knowledge required to analyse traditional open systems interconnect (OSI), transmission control protocol/internet protocol (TCP/IP) and cloud networking technologies in order to support the implementation of Industry 4.0 systems in a manufacturing, engineering or related workplace. The unit includes evaluating cloud networking options for a workplace and installing and configuring a traditional OSI network and identifying and determining the requirements to connect a traditional network to the cloud.

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite Unit

Nil

Competency Field

Applied technologies

Elements and Performance Criteria

Elements	Performance Criteria
Elements describe the essential outcomes.	Performance criteria describe the performance needed to demonstrate achievement of the element.
1. Identify main network types and key features used for manufacturing and engineering applications	1.1 Identify existing and emerging types of local, remote and cloud networks for manufacturing and engineering applications 1.2 Identify key methods of data transmission for each of the above type of networks 1.3 Establish the function and operation of key devices used in local, remote and cloud networks 1.4 Evaluate methods, tools and infrastructure used to connect to the internet from a workstation
2. Determine information and	2.1 Determine services only requiring local area network (LAN)

Elements	Performance Criteria
Elements describe the essential outcomes.	Performance criteria describe the performance needed to demonstrate achievement of the element.
operational technology services requiring a network connection	connectivity 2.2 Determine services requiring wide area connectivity (WAN) to remote assets 2.3 Determine services requiring connections using cloud technologies
3. Evaluate Industry 4.0 cloud deployment models and infrastructure for workplace	3.1 Evaluate implications of workplace access management and cyber-security requirements for network selection and installation 3.2 Identify workplace health and safety (WHS) procedures and risk control measures relevant to installing and configure networking technologies for engineering and manufacturing applications 3.3 Examine existing wired and 4G and 5G WiFi internet connections and determine if additional connections or capacity is required 3.4 Analyse workplace cloud connectivity needs and determine if edge computing devices and gateways are in place or required 3.5 Evaluate web browser interfaces and software for cloud connectivity requirements 3.6 Determine requirements to connect workplace traditional networks and components to Industry 4.0 cloud networks
4. Install and configure a basic OSI network for engineering and manufacturing applications	4.1 Identify the key features and structure of the network operating system according to specifications 4.2 Identify appropriate OSI layer protocols for network 4.3 Implement an IP addressing scheme and IP services to meet network requirements 4.4 Identify and connect cabling networking devices according to network diagrams 4.5 Perform configurations for the device according to OSI protocols and standards and workplace services requirements 4.6 Apply appropriate cyber-security procedures and protocols for installed network and connected services 4.7 Perform end-to-end troubleshooting to identify and resolve common switched network issues 4.8 Document and report on network installation and configuration according to workplace requirements

Foundation Skills

This section describes those language, literacy, numeracy and employment skills that are essential to performance.

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

This field allows for different work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.

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| Industry 4.0 related systems include one or more of the following: | <ul style="list-style-type: none">• industrial internet of things (IIoT) devices• collaborative robots• networked and cloud connected traditional robots and other industrial automation• networked and cloud connected supervisory control and data acquisition systems (SCADA)• networked and cloud connected enterprise resource planning (ERP) systems• networked and cloud connected CAD and CAM systems• digital twins• augmented and virtual reality systems• networked and cloud connected CNC and additive manufacturing machines• networked and cloud connected data storage and processing facilities• networked and cloud connected edge devices• other networked and cloud connected digital devices and systems relevant to the workplace |
| Information technology services that may need networking include one or more of the following: | <ul style="list-style-type: none">• cloud-based data programming and storage• remote access applications• enterprise application programmable logic controllers (PLCs)• enterprise resource planning (ERP) systems• business servers• web servers |
| Operational (or industrial) technology services that may need networking include one or more of the following: | <ul style="list-style-type: none">• supervisory control and data acquisition (SCADA) systems• human-machine interfaces (HMIs)• PLCs• remote terminal units (RTUs)• IIoT devices |

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- sensors
- detectors
- actuators

Types of networks include:

- local area network (LAN)
- wide area network (WAN)

plus one or more of the following:

- metropolitan area network (MAN)
- wireless LAN (WLAN)
- virtual LAN (VLAN)
- virtual private network (VPN)
- internet of everything (IOE)
- radio-frequency identification (RFID)
- low power wide area network (LoRaWAN)

Key networking devices include one or more of the following:

- routers
- cables
- switches
- firewall
- wireless access points
- Bluetooth

Edge devices placed near sources of data include one or more of the following:

- sensors
- PLCs
- remote terminal units (RTUs)
- actuators
- computers
- cameras
- edge servers/gateways
- edge routers
- switches
- firewalls
- wireless access points (WAPs)
- power management and backup devices

Components include one or more of the following:

- networking
- data storage
- computing
- virtualisation

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Models include one or more of the following:

- open systems interconnection model (OSI)
- infrastructure as a service (IaaS)
- platform as a service (PaaS)
- software as a service (SaaS)
- monitoring as a service (MaaS)
- communication as a service (CaaS)
- anything as a service (XaaS)

Infrastructure includes one or more of the following:

- on demand services
- products
- virtual servers
- virtual PCs
- virtual switches
- storage clusters
- networking

Key protocols include one or more of the following:

- address resolution protocol (ARP)
- reverse address resolution protocol (RARP)
- transmission control protocol (TCP)
- user datagram protocol (UDP)
- internet protocol (IP)
- internet control message protocol (ICMP)
- file transfer protocol (FTP)
- simple mail transfer protocol (SMTP)
- domain name server (DNS)
- internet group management protocol (IGMP)

OSI Layer 3 routed and routing addressing protocols includes one or more of the following:

- routing information protocol (RIP)
- enhanced interior gateway routing protocol (EIGRP)

OSI Layer 4 protocols includes one or more of the following:

- transmission control protocol (TCP)
- user datagram protocol (UDP)

OSI Layer 5 to 7 protocols includes one or more of the following:

- hypertext transfer protocol (HTTP)
- file transfer protocol (FTP)
- trivial file transfer protocol (TFTP)
- simple mail transfer protocol (SMTP)
- domain name server (DNS)

This field allows for different work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.

Troubleshooting includes one or more of the following:

- bottom-up testing
- ping
- traceroute

Unit Mapping Information

No equivalent unit

Links

Companion Volume implementation guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b7050d37-5fd0-4740-8f7d-3b7a49c10bb2>

Assessment Requirements for MEM29007 Apply networking technology principles for manufacturing and engineering applications

Modification History

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Performance Evidence

There must be evidence the candidate has demonstrated the ability to:

- research information and documentation from sources that include manufacturer's and provider's specifications for information relevant to installing traditional and cloud networks connections to a manufacturing or engineering workplace
- install, configure and test one OSI workplace network and ensure interoperability within the local network and between local services and the cloud including:
 - working collaboratively with others during network installation and troubleshooting activities to minimise downtime
 - problem-solving network installation and connectivity problems
 - selecting and preparing appropriate tools, equipment and network devices required for network installation and configuration
 - installing required access and cyber-security protocols
 - documenting OSI network installation and configuration according to workplace requirements
- apply network topologies, protocols and standards to at least two actual or simulated workplace cloud networking requests including:
 - preparing a verbal or written report on network installation and configuration requirements
 - preparing a network map showing sources of data to be connected, required network devices including any required edge devices, materials, and standards and protocols to be followed.

Note: Where a volume and/or frequency is not specified, demonstration must be provided at least once.

Knowledge Evidence

There must be evidence the candidate has knowledge of:

- the binary number system and hexadecimal number systems as used in OSI and TCP/IP
- the function and basic operation of key protocols of the TCP/IP layered communication model including:
 - Ipv4 addressing
 - Ipv6 addressing
- the function and basic operation of the OSI layered communication model including:

- OSI Layer 1 standards and infrastructure
- OSI Layer 2 protocols, standards and media access control (MAC) addresses for both local area networks (LANs) and wide area networks (WANs)
- OSI Layer 3 routed and routing addressing protocols
- OSI Layer 4 protocols for common ports
- OSI Layer 5 to 7 protocols for networking applications
- differences and commonalities between the OSI and TCP/IP models and their implication for industry networks
- media access control (MAC) addresses
- web browser interfaces for connecting networks to the cloud
- edge computing as the placement of computing, storage and analytics close to the place where data is created
- integration of edge devices into cloud-based networks
- advantages of edge computing including:
 - reduction in bandwidth
 - greater suitability for applications requiring minimal latency,
 - greater capacity where there are a large number of data sources
- relationship between edge computing and 5G wireless
- cloud-based storage architectures (IaaS, PaaS, SaaS, CaaS, MaaS, XaaS)
- cloud deployment models (public cloud, private cloud, single hosted cloud, multi hosted cloud)
- cloud infrastructure (storage, network and computing)
- user datagram protocol (UDP)
- function and operation of network layer protocols
- function and operation of application layer protocols
- routers, switches, firewall fundamentals and wireless access points
- end-to-end test commands
- workplace safety requirements and work health and safety (WHS) legislation relevant to installing and configuring a basic network for manufacturing and engineering applications
- manufacturer's specifications and other relevant technical information relating to network technologies for manufacturing and engineering applications
- techniques used to install, configure and test the network elements to ensure interoperability within the network
- common network faults and fault-finding principles in troubleshooting a basic network
- processes and techniques relevant to end-to-end troubleshooting
- formats for documenting outcomes of a network installation and configuration.
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Assessment Conditions

- Assessors must:

- have vocational competency in applying networking technology principles for manufacturing and engineering applications at least to the level being assessed with relevant industry knowledge and experience
- satisfy the assessor requirements in the *Standards for Registered Training Organisations 2015* or its replacement and comply with the *National Vocational Education and Training Regulator Act 2011*, its replacement or equivalent legislation covering VET regulation in a non-referring state/territory as the case requires.
- Where possible, assessment must occur in operational workplace situations. Where this is not possible or where personal safety or environmental damage are limiting factors, assessment must occur in a sufficiently rigorous simulated environment that reflects realistic operational workplace conditions that cover all aspects of workplace performance, including environment, task skills, task management skills, contingency management skills and job role environment skills.
- There must be access to all tools, equipment, materials and documentation required, including relevant workplace procedures, product and manufacturing specifications.
- Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.
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