



Australian Government

Department of Education, Employment and Workplace Relations

ICTOPN6128A Design a dense wavelength division multiplexing system

Release: 1

ICTOPN6128A Design a dense wavelength division multiplexing system

Modification History

Not Applicable

Unit Descriptor

<p>Unit descriptor</p>	<p>This unit describes the performance outcomes, skills and knowledge required to design a high capacity dense wavelength division multiplexing (DWDM) optical network suitable for a metropolitan area network (MAN) or long haul applications.</p> <p>It involves link budget design and providing specification details for configuration and commissioning teams.</p> <p>DWDMs use optical multiplexing techniques to increase the carrying capacity of a fibre network by transmitting multiple optical wavelengths each carrying high speed data stream over a single fibre. DWDM systems offer up to 128 wavelengths, with each wavelength carrying up to 100 Gbps.</p> <p>No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement but users should confirm requirements with the relevant federal, state or territory authority.</p>
-------------------------------	--

Application of the Unit

<p>Application of the unit</p>	<p>Technical officers and supervisors apply the skills and knowledge in this unit when designing DWDM systems for the deployment of high capacity networks using optical technologies.</p> <p>Optical networks using DWDM provide services in Next Generation Networks (NGN) using emerging technologies.</p> <p>NGN services include internet protocol TV (IPTV), video on demand (VoD), interactive TV and cloud computing.</p>
---------------------------------------	---

Licensing/Regulatory Information

Refer to Unit Descriptor

Pre-Requisites

Prerequisite units		

Employability Skills Information

Employability skills	This unit contains employability skills.
-----------------------------	--

Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge section and the range statement. Assessment of performance is to be consistent with the evidence guide.
---	--

Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1. Prepare to produce a DWDM system design	1.1. Obtain the planning document from <i>appropriate person</i> and determine <i>site details</i> 1.2. Obtain the <i>service type</i> and the number of channels required between customer traffic sources and destinations and the type of <i>protection</i> required 1.3. Obtain <i>specifications</i> of the <i>optical fibre</i> between sites 1.4. Determine the fibre loss between sites
2. Calculate link budget for each wavelength path	2.1. Use vendor's engineering design rules, specifications and data to calculate link budget and link margin for each DWDM wavelength and path 2.2. Evaluate link budget and assess the calculated margin and make recommendations for improvement if warranted 2.3. Analyse the specifications of the installed optical fibre and determine if dispersion will limit the maximum traffic data rate 2.4. Generate options for system design that are realistic for the enterprise and network 2.5. Evaluate and select preferred option based on enterprise business strategy outcomes, service policy and compliance with relevant legislation 2.6. Discuss and confirm selected option with customer
3. Prepare detailed configuration documents for the DWDM system	3.1. Outline the <i>detailed requirements</i> of the DWDM system for <i>configuration document</i> 3.2. Prepare a configuration document according to the customer's traffic needs 3.3. Prepare an internet protocol (<i>IP</i>) <i>address allocation</i> for all DWDM shelves and associated routers and gateways 3.4. Submit documentation to appropriate person for approval and sign off
4. Investigate upgrade options using emerging technologies	4.1. Investigate the option of using a reconfigurable optical add-drop multiplexer (ROADM) and make recommendations outlining the benefits 4.2. Investigate the feasibility of a future upgrade up to 100 Gbps system using optical transport network (OTN)-DWDM technology

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

This section describes the skills and knowledge required for this unit.

Required skills

- analytical skills to identify details relating to the project from the approved network plan
- communication skills to discuss project brief with enterprise design and installation personnel, vendors, customers and contractors
- literacy skills to:
 - write project briefs and interpret results and evaluate different types of technical data
 - interpret technical documentation and write reports in required formats
- numeracy skills to:
 - interpret results and evaluate different types of technical data
 - analyse site survey data
- planning skills to:
 - consider current, new technology, facilities and features when developing options
 - plan, prioritise and monitor own work and that of others
- problem solving skills to address and analyse specific customer requirements
- research skills to:
 - analyse impacts on planning processes
 - obtain and study information relating to emerging DWDM technologies
 - obtain geographical site information
 - study relevant legislation and associated operational codes
 - technical skills to identify barriers to plan realisation and evaluate emerging DWDM technologies

Required knowledge

- configuration of DWDM shelf
- DWDM principles of operation
- electrostatic discharge
- features and operating requirements of test equipment including:
 - optical time domain reflectometer (OTDR)
 - hand-held optical power meter
 - transmission test set
 - optical spectrum analyser
- functions of optical add drop multiplexer (OADM)
- functions of reconfigurable optical add drop multiplexer (ROADM)

REQUIRED SKILLS AND KNOWLEDGE

- IP addressing, subnet mask, dynamic host configuration protocol (DHCP) and default gateway
- International Telecommunications Union (ITU) wavelength grid for DWDM
- laser stability
- dispersion compensation devices
- link budget calculations and link margins
- optical fibre connector types and characteristics
- optical fibre types and characteristics
- path protection and protection switching
- physical optical loopbacks and software loopbacks
- traditional protocols and emerging OTN technologies used on optical DWDM systems
- ring topologies and linear network topologies
- specific occupational health and safety (OHS) requirements that impact on the safe inspection of optical connectors and the safe measurement of optical power from laser transmission systems

Evidence Guide

EVIDENCE GUIDE	
<p>The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, range statement and the Assessment Guidelines for the Training Package.</p>	
Overview of assessment	
Critical aspects for assessment and evidence required to demonstrate competency in this unit	<p>Evidence of the ability to:</p> <ul style="list-style-type: none"> • determine the fibre loss between sites • calculate link budget and link margin • prepare DWDM shelf configuration and specifications • produce a configuration document • investigate an emerging DWDM technology.
Context of and specific resources for assessment	<p>Assessment must ensure:</p> <ul style="list-style-type: none"> • sites on which design of a DWDM system may be conducted • manufacturer's technical documentation, relevant regulations and specifications.
Method of assessment	<p>A range of assessment methods should be used to assess practical skills and knowledge. The following examples are appropriate for this unit:</p> <ul style="list-style-type: none"> • direct observation of the candidate undertaking DWDM calculations • review of data gathered, reports and project plans prepared by the candidate • oral or written questioning to assess knowledge of design and configuring of DWDM systems.
Guidance information for assessment	<p>Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended, for example:</p> <ul style="list-style-type: none"> • ICTOPN6125A Manage dense wavelength division multiplexing transmission system • ICTOPN6129A Analyse optical transmission systems. <p>Aboriginal people and other people from a non-English speaking background may have second language issues.</p>

EVIDENCE GUIDE

	<p>Access must be provided to appropriate learning and assessment support when required.</p> <p>Assessment processes and techniques must be culturally appropriate, and appropriate to the oral communication skill level, and language and literacy capacity of the candidate and the work being performed.</p> <p>In all cases where practical assessment is used it will be combined with targeted questioning to assess required knowledge. Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.</p> <p>Where applicable, physical resources should include equipment modified for people with special needs.</p>
--	---

Range Statement**RANGE STATEMENT**

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

Appropriate person may include:

- consultant
- planning engineer
- project engineer
- project supervisor
- site supervisor.

Site details may include:

- location of network sites
- number of network sites
- optical fibre path distance between sites
- straight line distance between sites
- type of site:

RANGE STATEMENT	
	<ul style="list-style-type: none"> • OADM • ROADM • terminal.
<i>Service type</i> may include:	<ul style="list-style-type: none"> • interface requirements • protocol and bit rate: <ul style="list-style-type: none"> • digital video broadcasting - asynchronous serial interface (DVB-ASI) • enterprise system connection (ESCON) • ethernet <ul style="list-style-type: none"> • fast ethernet 100 Mbps • 1 GbE • 10 GbE • fibre channel • OTN • synchronous digital hierarchy (SDH) • synchronous optical networking (SONET) <ul style="list-style-type: none"> • STM-1 155 Mbps • STM-4 622 Mbps • STM-16 2.48 Gbps • STM-64 10 Gbps • STM-256 40 Gbps • 100 Gbps • HD-SDI • SD-SDI.
<i>Protection</i> may include:	<ul style="list-style-type: none"> • equipment protection • path protection.
<i>Specifications</i> may include:	<ul style="list-style-type: none"> • chromatic dispersion (ps/nm*km) • cladding diameter • core diameter • end-to-end attenuation or dB loss per km at nominated wavelength • fibre type <ul style="list-style-type: none"> • non-zero dispersion shifted fibre (NZDSF) ITU-T G.655 • non-dispersion shifted fibre (NDSF) ITU-T G.652 also known as standard single mode fibre 'SMF' • dispersion-shifted fibre (DSF) ITU-T G.653

RANGE STATEMENT	
	<ul style="list-style-type: none"> • 1550-nm loss-minimised fibre (ITU-T G.654) • ITU-T G.656 • LEAF fibre • number of fusion splices • polarisation mode dispersion • refractive index profile of core.
<i>Optical fibre</i> may include:	<ul style="list-style-type: none"> • existing fibre • fibre optimised for DWDM system • new fibre.
<i>Detailed requirements</i> may include:	<ul style="list-style-type: none"> • actual wavelengths specified • chirp parameter • dispersion compensation devices • maximum allowable span length • optical amplifier • optical signal to noise ratio (OSNR) • receiver threshold • transmit laser: <ul style="list-style-type: none"> • maximum power • minimum power • stability • type.
<i>Configuration document</i> may include:	<ul style="list-style-type: none"> • channel configuration information • fixed optical attenuators • protection details • slot positions and circuit card type • type and quantity of circuit cards.
<i>IP address allocation</i> may include:	<ul style="list-style-type: none"> • default gateway IP address • shelf IP addresses • subnet mask.

Unit Sector(s)

Unit sector	Telecommunications
--------------------	--------------------

Co-requisite units

Co-requisite units		

Competency field

Competency field	Optical networks
-------------------------	------------------