



Australian Government

ICTRFN8181B Analyse a satellite communications system

Release 1

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Modification History

Release	Comments
Release 2	This version first released with <i>ICT10 Integrated Telecommunications Training Package Version 3.0</i>. References to other units updated. Outcomes deemed equivalent.
Release 1	This version first released with <i>ICT10 Integrated Telecommunications Training Package Version 1.0</i>.

Unit Descriptor

This unit describes the performance outcomes, skills and knowledge required to analyse the performance of a satellite communications system.

The analysis may be required for a new installation project or an upgrade of capacity or technology in an existing network or as a result of convergence to Next Generation Networks (NGN).

Application of the Unit

Supervisors and engineers who analyse satellite communications systems apply the skills and knowledge in this unit when writing specifications, planning, designing and implementing satellite communications systems.

Licensing/Regulatory Information

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.

Pre-Requisites

Not applicable.

Employability Skills Information

This unit contains employability skills.

Elements and Performance Criteria Pre-Content

Element	Performance Criteria
<i>Elements describe the essential outcomes of a unit of competency.</i>	<i>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.</i>

Elements and Performance Criteria

1. Research satellite communication systems	1.1 Research satellite applications with various orbit types for assessing their spatial positioning for specific purpose 1.2 Analyse and report on the architecture, major subsystems and critical components in the communication systems of a recently launched commercial satellite 1.3 Research and report on multiple access techniques and their typical applications
2. Analyse uplink and downlink variables	2.1 Determine uplink and downlink criteria that impact on carrier to noise ratio 2.2 Determine up/down link criteria that impact on baseband signal to noise ratio 2.3 Determine the critical parameters of a satellite system 2.4 Research common types of baseband signal processing, their spectral and noise improvement parameters for determining criteria for link budget evaluations
3. Conduct a link budget analysis	3.1 Produce a satellite link budget and calculate link margin for a satellite system with specified modulation types 3.2 Analyse the relationship between the bit error ratio (BER) for a given energy per bit per noise power density (E_b/N_0) and forward error correction (FEC) parameter for determining the operational performance of the link
4. Analyse properties of geostationary satellites	4.1 Calculate the look angles for a geostationary satellite from any receiving location 4.2 Research and report on frequency re-use in conjunction with polarisation selection and the use of spot beams 4.3 Analyse and specify the major features of very small aperture terminal (VSAT) systems, and calculate link reliability in high rainfall regions

Required Skills and Knowledge

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

Required skills

- analytical skills to solve complex problems by making informed judgements and assumptions
- literacy skills to prepare reports following an analysis or evaluation
- planning and organisational skills to develop systems and procedures in solving complex mathematical formulas
- problem solving and contingency management skills to manage unforeseen issues
- research skills to gather and record data from measurements
- technical skills to visualise radio frequency (RF) systems on board operational satellite platforms.
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Required knowledge

- antenna calculations:
 - gain
 - beamwidth
 - polarisation
 - effective isotropic radiated power (EIRP)
- BER
- carrier/noise ratio
- constellation and eye diagrams
- decibels, dB, dBm, dBW
- distance to satellite and typical delays
- frequency spectrum (satellite bands)
- G/T ratio
- geostationary orbit
- link budget calculation
- look angle calculations
- low earth orbiting (LEO) satellites
- modulation types:
 - n-FSK:
 - 2FSK
 - 4FSK
 - n-PSK:
 - 2PSK
 - 4PSK
 - 8PSK
 - 16PSK
 - n-QAM:
 - 16 QAM

- 256QAM
- spread spectrum:
 - direct sequence
 - frequency hopping.

Evidence Guide

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.

Overview of assessment	
Critical aspects for assessment and evidence required to demonstrate competency in this unit	Evidence of the ability to: - analyse satellite communications system architecture - produce a satellite link budget and calculate link margin for a range of digital modulation types - calculate the look angles for a geostationary satellite from any receiving location - analyse and specify the major features of (VSAT) systems.
Context of and specific resources for assessment	Assessment must ensure: - site on which satellite analysis may be conducted - data, calculators and appropriate software tools.
Method of assessment	A range of assessment methods should be used to assess practical skills and knowledge. The following examples are appropriate for this unit: - direct observation of the candidate performing analysis - review of link budget documentation completed by the candidate - review of look angle calculation reports - oral or written questioning to assess knowledge of satellite communications systems.
Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended, for example: ICTRFN7182B Produce a radio link budget. Aboriginal people and other people from a non English speaking background may have second language issues. Access must be provided to appropriate learning and

	assessment support when required. 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. 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. Where applicable, physical resources should include equipment modified for people with special needs.
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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.

<i>Satellite applications</i> may include:	• broadcasting: • broadcast satellite service (BSS) • fixed service satellite (FSS) • defence • domestic communications • earth observation: • mapping • meteorology • international communications: • Intelsat • global positioning system (GPS) • navigational.
<i>Orbit</i> may include:	• geostationary • inclined orbit • low earth orbiting (LEO): • polar • non-polar • Molniya highly elliptical orbit.
<i>Multiple access techniques</i> may include:	• code division multiple access (CDMA) • frequency division multiple access (FDMA) • hybrid multiple access schemes: • FDMA/time division multiple access TDMA • polarisation division multiple access (PDMA) • space division multiple access (SDMA) • time division multiple access (TDMA).
<i>Uplink and downlink criteria</i> may include:	• antenna gain • bandwidth • error correction bits • modulation type • path loss • transmitter power.
<i>Specified modulation</i>	• m-PSK:

types may include:	• 8PSK • OQPSK • QPSK • M-QAM: • 16QAM • spread spectrum: • direct sequence • frequency hopping.
Look angles include:	• azimuth • elevation.
Frequency re-use may include:	• orthogonal polarisation • spatial discrimination directional beams.
Very small aperture terminal may include:	• availability • latency • multicast • topology.

Unit Sector(s)

Telecommunications - Radio frequency networks