Changing lives through learning

Qualification Unit

This unit forms part of a regulated qualification.

Unit Title: Advanced OTDR Testing

Unit Reference Number: M/618/8303

Level: Three (3)

Credit Value: 5

Minimum Guided Learning Hours: 30

Learning Outcome (The Learner will):	Assessment Criterion (The Learner can):
1. Understand and use dB units	1.1 Explain why dB units are used in fibre optic testing
	1.2 Describe the origins of the dBm unit
	1.3 Convert dB loss/gain to equivalent linear (percentage) unit
	1.4 Analyse loss budgets against power budgets and measured link loss results
	1.5 Compare loss budgets against power budgets ad measured link loss results
2. Perform insertion loss measurement (ILM) tests and basic fault finding	2.1 Explain different methods of referencing a light source and power meter or an equivalent ILM test set
	2.2 Evaluate the components included and excluded in a given test method and potential sources of measurement errors
	2.3 Explain the tests that could be carried out to fault find a fibre system and the limitations of such tests
3. Be able to use an OTDR effectively to test or measure a fibre system	3.1 Set-up an OTDR to perform a measurement, using suitable test parameters for the system
	3.2 Manipulate the OTDR trace

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	3.3	Measure features and events on the OTDR trace such as: connectors; splices; bends; and combination events
	3.4	Identify features and events on the OTDR trace
	3.5	Analyse features and events on the OTDR trace
	3.6	Analyse connector reflectance or return loss, demonstrating an understanding of the measurement sign (positive or negative)
	3.7	Explain the purpose of and use of launch leads and tail leads
	3.8	Explain why it is important to match the fibre types in the launch lead and the fibre under test
4. Understand and overcome measurement problems	4.1	Identify poor launch couplings to the OTDR
	4.2	Take appropriate corrective action for poor launch couplings to the OTDR
	4.3	Explain the causes and effects of mismatches.
	4.4	State solutions for correctly measuring losses caused by mismatches
	4.5	Recommend steps to eliminate the causes of “ghosts”
	4.6	Explain how events and portions of OTDR traces are saturated and how this affects the measurement
	4.7	Identify possible problems caused by polarisation effects, coherent pick-up/noise and trace merging
5. Be able to use advanced OTDR facilities to aid efficient testing	5.1	Demonstrate awareness of the capabilities of OTDR emulation/analysis software
	5.2	Explain how the manual (or semi-automatic) marking and OTDR events can aid the subsequent off-site analysis with emulation software
6. Understand and evaluate OTDR limitations and specifications	6.1	Demonstrate an awareness of different definitions of resolution
	6.2	Demonstrate an awareness of dynamic range, different definitions of dynamic range, and the effective measurement range in dBs

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	6.3	Explain the significance of distance measurement range specifications
	6.4	Compare distance measurement range specifications with realistic fibre loss measurements distances
	6.5	Describe how specialist OTDRs can aid more efficient testing of various fibre components or systems

Required Equipment List

In order to deliver this unit, centres will need to following equipment:
Sample traces from real fibre systems
CD and PMD test equipment or equivalent test system emulation software
Suitable fibre test systems and accessories

Indicative Content

AC 4.6	This assessment criteria is not about “dead zones” but rather the situation that can arise when the power level returning to the OTDR is above the linear response region/capability of the OTDR receiver and the detector output is "saturated". This can result in a missing portion of effective OTDR trace but more normally affects the reflection peaks that can saturate the receiver. The aim is to highlight to learners what saturation is, how to recognise when the receiver has saturated (such as flat, cut-off, reflection peaks) on an OTDR trace. Further we then ensure learners know that the full extent of the reflection peak is not seen and the reflection level has not been properly measured. Learners need to know that the solutions to saturation involve reducing the returned power level by attenuating this power. This can be done by using an attenuator (common on old OTDRs but not newer models), adding attenuation into the fibre (e.g. at the launch) or potentially by reducing the pulse width, although with the latter technique there can be a danger if the sampling frequency (resolution) is insufficient for a small pulse width.
AC 4.7	Trace merging is a very old technique that has been commonly used at least since the early 1990s to improve the OTDR capability with the multi-pulsewidth technique being a relatively new way to implement trace merging. The push for trace merging technology was driven by the requirement for analogue to digital converters to have a high bit-range whilst also working at high speed hence allowing both good signal power resolution and time resolution. The use of trace merging, often using multiple traces, was done without the knowledge of most OTDR users but was necessary in order to allow OTDRs with a dynamic range at or greater than 30 dB, with often 40 dB or more being required for single-mode fibre systems, so even before the use of multiple pulse width stages this was being done reliably. The issue is that all techniques like trace merging, whilst implemented for their benefits, can at

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	time create trace anomalies. Trace anomalies are rare, but when they are seen it is useful if they can be readily identified as OTDR problems rather than fibre problems.
AC 5.1 and 5.2	More the capabilities of software packages like FastReporter rather than a Link Mapper. Features like Link Mapper are more aimed at novice OTDR users rather than more expert users who can interpret the OTDR trace without the need for Link Mapper. The key consideration is that the expert OTDR user has an understanding of what the OTDR emulation software can do, which in summary is all of the manipulation and analysis of a trace that the OTDR can do with the only exception being the optical testing of the fibre. On long distance telecoms links it is often necessary to ensure that all splices are measured, but the auto-analysis feature will commonly miss some splices (particularly where they are low loss) and these splices need to be marked so they can be measured. OTDR users should know that this does not need to be done on-site with the OTDR but can be done off-site with a larger computer monitor at a desk. Learners need to know how to locate missed events by a number of techniques such as finding where they are located on alternative fibres in the same cable, and how to then position cursors to measure the loss of missed events. This varies between OTDRs and emulation software packages. Whilst learners may use different emulation software packages, including Fast Reporter, it would not suggest the training in these packages is part of this training or qualification. That is simply because time is limited and the training on the use of a software package is more proprietary rather than generic so is appropriate as a separate element for some trainees. For example, providers would not want to waste time teaching on how just one software package works.
AC 6.5	This AC highlight the learner to the more unusual specialist OTDRs such as ultra-high resolution OTDRs (e.g. the Luciol units with mm level resolution using photon counting technology) and OTDR techniques used for distributed sensing applications such as DTS and DAS. It is not a requirement to highlight all possible OTDRs but rather to point out that there are units with quite specialist applications rather that have trainees believe that OTDRs are in any way limited to the more usual units on offer. For example, and by way of analogy if we were examining people on use and capabilities of cars then a specialist vehicle might be considered to be a tracked tank, a farm tractor or a quad bike. Effectively a specialist vehicle could be considered something that is quite different from an everyday car, even though cars can be small city run-abouts or four-wheel drive Range Rovers. By that analogy, although some would argue that a live fibre OTDR is specialist, we would class it as a main-stream offering. Having said that the use of live fibre OTDRs is increasing. This out of band testing is perhaps specialist enough to be applicable under this heading, whereas a PON optimised OTDR I would not consider specialist.

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