Fibre optics has arrived! Although the technology made a brief incursion into the commercial aircraft world in the mid 90's with the Boeing 777 AVLAN system, little serious development work was carried out due to cost implications and availability of suitable components. However this has now changed dramatically over the past five years and there has been a huge growth in the use of fibre optics onboard commercial aircraft, with the main areas of implementation being real-time external imagery and IFE systems.

Airbus led the way with the introduction of the first fully integrated fibre optic backbone for an IFE system on the A380, with fibre optic links between the distribution servers and the area distribution boxes. This approach has also been adopted by Boeing on the B787. Plus, more fibre optic based IFE systems are being installed on numerous types including Airbus A330 and A320 type narrow body jets. This development has now expanded to include 'fibre to the seat' allowing greater data rates to be available to the passenger providing larger numbers of services.

The reasons behind using fibre optics? There are many: lightweight, high data rate transmission, not prone to external electromagnetic interference, in-built system scalability for future upgrades providing cost effectiveness, to name but a few.

However, as with every new technology there are additional issues to be considered such as training, testing and maintenance. Therefore there is a need to provide both installers and maintainers with the ability to support, test and fault diagnose the optical links between equipments. This requires a new set of tools, well-adapted to the specific needs of aerospace.

Currently the aerospace community has adapted some basic telecommunications test equipment for aerospace use. These include optical sources, optical power meters and optical loss testers, which enable to measure the total loss of an optical link. However, troubleshooting and fault diagnostic over a long fibre assembly, typically up to 100 m-long with several optical connectors is still fairly rudimentary and can be complicated and time consuming.

Various new technologies have been developed to address these issues, one of the most accurate being Optical Time Domain Reflectometry, originally developed specifically for long haul fibre optic links greater than 1km. Optical Reflectometry is a single-ended test method. The instrument sends a short pulse of light into the Fibre Under Test (FUT) and detects the back-reflected light. The arrival time of the reflections provides a direct mapping to the location of any event along the FUT. An Optical Time-Domain Reflectometer (OTDR) can characterize a complete optical link at a time. It will verify every optical connector, see loss induced by poor installation (for example excessive bending or pressure on a cable), and detect the location of any fault.

In the past, attempts have been made to develop this technology to try and cater for the very short haul installations of 10's of meters of multimode fibre optic cables typically found on commercial aircraft, with limited success. The resolution of such OTDRs, especially with the strong reflections found at the connectors, was simply too poor to separate various events and give valuable information about the assembly. Recently a new handheld 'high resolution' OTDR has been developed, providing both installers and maintainers with the means to carry out measurements to identify losses and to locate 'events' within a few centimetres of their location within multimode fibre optic cables typically used in aerospace. This instrument is shown in Figure 1 below.

Figure 1: The LOR-220, High Resolution OTDR

This portable instrument can detect all types of events and faults in a fiber assembly thus enabling a fast and precise characterization of the optical link.

The advantages of such a high resolution OTDR are already being recognized in the industry. It is now possible to verify a complete link, from a single end and without the need to remove aircraft interiors or dismantle harness assemblies. Both Airbus and Boeing have purchased their first units, which are now under evaluation in Toulouse and Seattle. A typical trace, with a 26 m-long fiber assembly is shown in Figure 2 below.

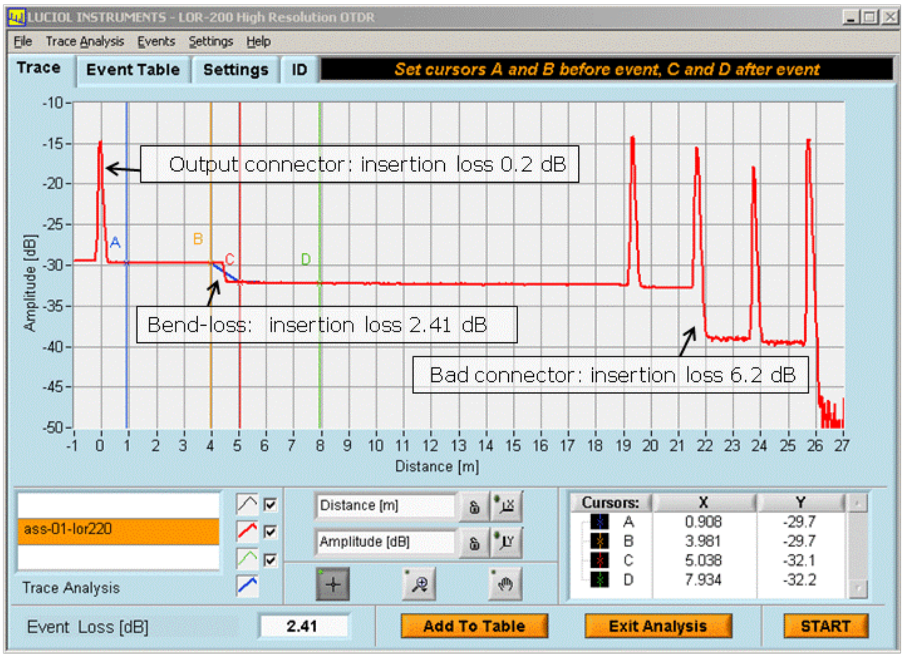

Figure 2: A Typical trace obtained with the LOR-220

This trace shows various events along the 26 m-long fiber assembly. The instrument measures loss and reflections at connectors, together with bend loss at a location where the fiber was sharply bent. Installers and maintainers can now locate the position of any problem and intervene directly at the right place.

This new tool is well-positioned to become a general purpose instrument for fiber optics in aerospace in the same way as its longer-range cousin, which has become ubiquitous in all telecom applications.

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