ITU-T Study Group 15

G.681 Distributed fibre optic sensing system for terrestrial optical transmission systems

Recommendation ITU-T G.681 specifies the distributed fibre optic sensing (DFOS) optical interface requirements for implementing DFOS within terrestrial optical transmission systems. The primary focus is to limit the impact on the dense wavelength division multiplexing (DWDM) channel required optical signal to noise ratio (OSNR) and receiver sensitivity when a DFOS signal is present, while enabling the enhancement of optical network infrastructure monitoring

Fig. 1 Backscattering DFOS

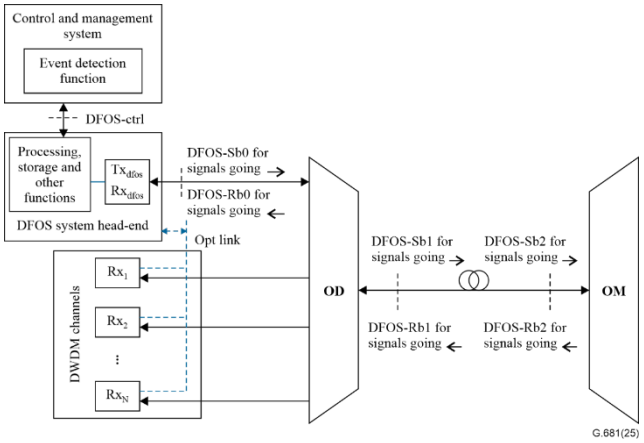
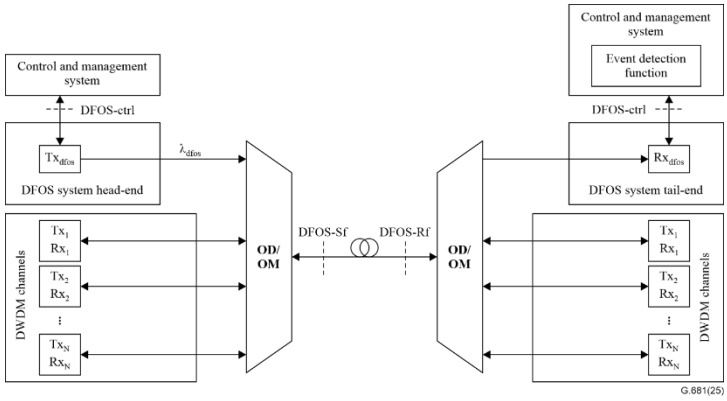


Fig. 2 Feedforward DFOS



ITU-T G.sup39 – Optical system design and engineering considerations

This supplement serves as a compendium for technical definitions, design aspects, and analysis methods useful for devising recommendations for optical transmission systems.

Overview of DFOS Systems

The Recommendation identifies two main DFOS system categories.

Backscattering DFOS (Fig. 1)

The transmitter and receiver both reside in the head-end, detecting Rayleigh, Brillouin, or Raman backscattering along the fibre. This category encompasses distributed acoustic, vibration, temperature, and strain sensing (DAS, DVS, DTS, DSS).

Feedforward DFOS (Fig. 2)

The transmitter resides in the head-end and the receiver is in the tail-end, typically utilizing digital signal processing in DWDM coherent receivers.

Wavelength Allocation

For a DFOS system to operate over an in-service fibre, G.681 outlines dedicated wavelength allocations. The DFOS wavelength can be in-band (using a DWDM channel wavelength in the C- or L-band on a specified grid) or out-of-band. The out-of-band options utilize bands not typically carrying data traffic, including S-band wide, S-band narrow, L-band, and U-band.

System Configuration

G.681 outlines several practical configurations depending on wavelength allocation, DWDM transmission direction (unidirectional vs. bidirectional), and the DFOS signal propagation relative to the traffic (co-propagating or counter-propagating).

Parameter Specifications and DWDM Protection

To ensure that the probing DFOS signal does not degrade the active telecom services, the standard specifies the required interface parameters. These include maximum allowable sensing distance, optical loss budget, DFOS signal peak power, and duration of the DFOS signal on-time. Importantly, the standard caps the maximum allowable impact on both the DWDM channel required OSNR and the receiver sensitivity to 0.1 dB in the presence of a DFOS signal.

Key Takeaways:

First standard of its kind: Specifies the optical interface parameters for using DFOS on in-service terrestrial telecom networks.

Covers interface parameter definitions, specifications and wavelength assignments: Details both in-band and out-of-band configurations.

Accommodates multiple topologies: Outlines system configurations for both backscattering and feedforward DFOS architectures.

Protects data integrity: Sets strict maximum impact limits (0.1 dB) on OSNR and receiver sensitivity to ensure data channels are not disrupted by sensing signals.

Enables smart infrastructure: Creates pathways for telecom network operators to use existing fibre for maintenance and monitoring of optical fibre network infrastructure, geohazard monitoring and seismic activity detection.

For more information, please visit the ITU-T Study Group 15 website at: www.itu.int/go/tsg15

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