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# Self-Diagnostics of Pluggable Optical Devices

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ABSTRACT

This disclosure describes techniques to perform self-diagnostics in optical devices such as pluggable optics. The pluggable optic includes a light source that can transmit a pulse of light of short duration. The pluggable optic additionally includes a receiver that can detect reflected/scattered signals. A short duration pulse is transmitted by the pluggable optic during self-diagnostics. Presence of contaminants on the end face of the connector can cause light from the light source to be scattered and/or reflected back towards the receiver. The optical signal characteristics, e.g., intensity, angle, etc. of the signal received at the receiver can be utilized to characterize any contamination that is detected. For example, a level and orientation of the contamination can be determined based on the received signal. The result can be displayed as a code of digits that indicates the nature of the contamination. Different codes can correspond to different levels and orientation of contamination.



KEYWORDS

- Optical connector
- Optical transceiver
- Pluggable optics
- Fiber optic
- Connector endface
- Endface contamination
- Reflectometer
- Continuous wave (CW) pulse

BACKGROUND

Fiber optic technology is commonly utilized in computer networks, e.g., data centers, enterprise computer deployments, etc. Computer networks typically utilize pluggable optics to connect devices such as switches, routers, etc. to the network. During use, the end faces of connectors can get contaminated with dirt, dust, or other particles, thereby degrading the optical signals passing through. Such contamination is time consuming to detect as it requires specialized tools and trained technicians.

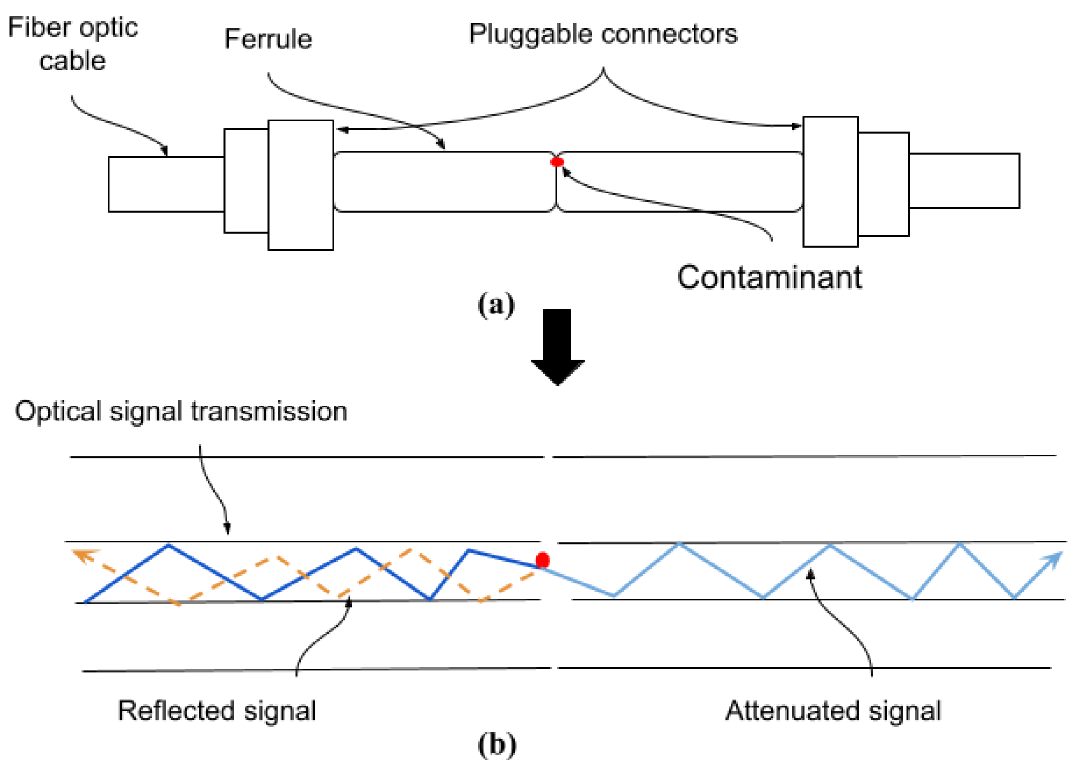


**Fig. 1: Contaminants on connector endfaces causes attenuated optical signal transmission**

Fig. 1 depicts an example pluggable connector. Fig. 1(a) depicts two pluggable connectors connected to each other. A contaminant (shown in red) is seen on the endface of one of the connectors. Fig. 1(b) depicts a magnified view of the contact surface region of the two pluggable connectors. The contaminant causes a portion of the optical signal transmission to be reflected back, while allowing an attenuated optical signal to pass through to the second pluggable connector and fiber optic cable. This can lead to data loss or even a link failure depending on the severity of the signal attenuation due to the contamination.

Optical fiber systems can include upwards of 16 or more connections per device. Consequently, contamination detection can be time consuming and can delay the turn up time of network devices.

## DESCRIPTION

This disclosure describes techniques to perform self-diagnostics in optical devices such as pluggable optics. Per techniques of this disclosure, a short duration pulse is transmitted by the pluggable optic during self-diagnostics. A reflectometer function is built into the pluggable optic that can detect the presence of contamination on the end face of the connector within the optic itself.

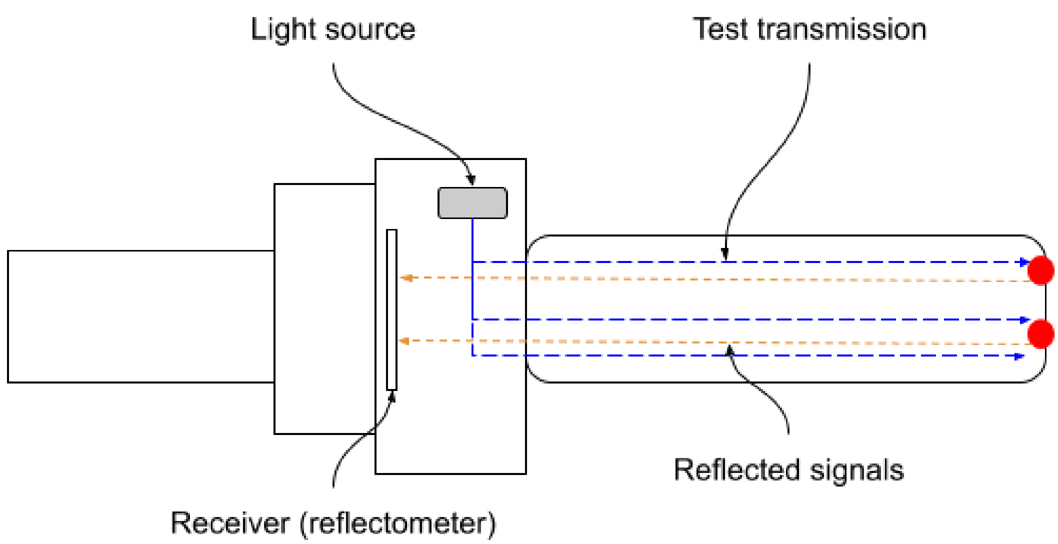


**Fig. 2: Diagnostic transmission to test a connector**

Fig. 2 depicts an example of a pluggable optic, e.g., a connector, configured to perform self-diagnostics. As depicted in Fig. 2, the pluggable optic includes a light source that can transmit a pulse of light of short duration, e.g., a continuous wave (CW) pulse. For example, an existing laser light source can be repurposed for self-diagnostics by being configured to be driven at a different power level by a laser driver. The pluggable optic additionally includes a receiver, e.g., reflectometer, that can detect reflected/scattered signals. The receiver can be placed at a suitable location within the pluggable optic.

As depicted in Fig. 2, presence of contaminants, pits, etc. (shown in red) on the end face of the connector causes light from the light source to be scattered and a portion of the light reflected back towards the receiver. The optical signal characteristics, e.g., intensity, angle, of the signal received at the receiver can be utilized to characterize any contamination that is detected. For example, a level and orientation of the contamination can be determined based on the received signal.

The result can be displayed as a code of digits that indicates the nature of the contamination to a user. Different codes can correspond to different levels and orientation of contamination. The capability to self-diagnose can be embedded into the pluggable optic with a combination of hardware and software modifications, e.g., by modifying a laser included in the pluggable optic. The settings can be user configurable. For example, the pluggable optic can be configured to perform continuous testing at a predetermined frequency, or upon installation or connection to another connector or device.

The described techniques enable efficient self-diagnosis of pluggable optics. The techniques can be utilized to make a determination of whether an optical connector end face is contaminated (e.g., fail) or not contaminated (e.g., pass). Such determination can help a technician to perform a network turn up process (if the connector is detected to not be contaminated) or replace failed optical connectors (if the connector is detected to be contaminated).

## CONCLUSION

This disclosure describes techniques to perform self-diagnostics in optical devices such as pluggable optics. The pluggable optic includes a light source that can transmit a pulse of light of short duration. The pluggable optic additionally includes a receiver that can detect reflected/scattered signals. A short duration pulse is transmitted by the pluggable optic during self-diagnostics. Presence of contaminants on the end face of the connector can cause light from the light source to be scattered and/or reflected back towards the receiver. The optical signal characteristics, e.g., intensity, angle, etc. of the signal received at the receiver can be utilized to characterize any contamination that is detected. For example, a level and orientation of the contamination can be determined based on the received signal. The result can be displayed as a code of digits that indicates the nature of the contamination. Different codes can correspond to different levels and orientation of contamination.