

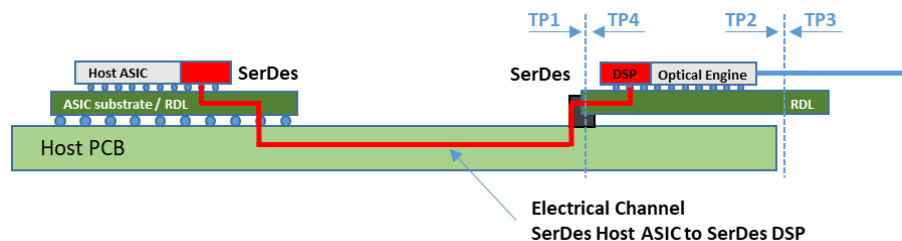
## Linear Drive Pluggable Optics

Linear Drive Pluggable Optics (LPOs) have gained tremendous attention during 2023 and this document attempts to de-mystify the terminology. The focus is on 400G and 800G LPOs using 56GBd lanes.

### It's all about the SerDes!

One of the first myths is that LPO transceivers do something new, but in reality, a big portion of the technology innovation and enabler for LPOs is the work done in the SerDes design.

Let's look at the current approach for retimed 800G links. The illustration below shows on the left-hand side a Host ASIC with an electrical SerDes interface. The Host ASIC could be an Ethernet switch ASIC, a NIC cards ASIC ... and have a 56GBd SerDes interface towards the optical module. On the right-hand side, a retimed optical module is illustrated consisting out of a DSP and an optical engine. The DSP inside the module has a SerDes facing the host ASIC. These two SerDes's need to communicate with each other and the TP1 and TP4 demarcation points are defined to enable this.

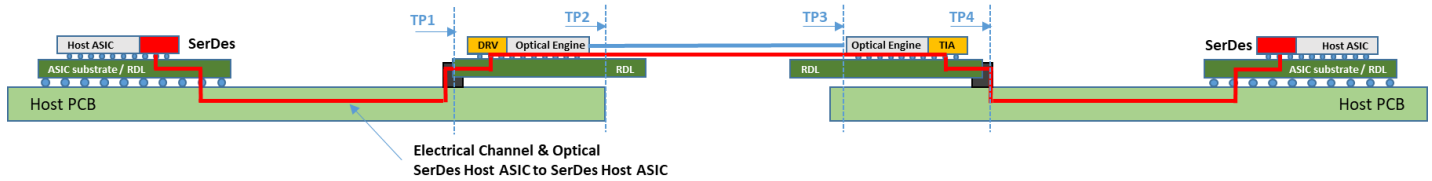


### Link using optical modules retimed by DSP

The red trace between the Host ASIC and module DSP illustrates the electrical channel. The electrical channel has a channel loss that varies depending on the design, material, and trace length.

The DSP in the module is not only key in defining TP1/TP4 it is also key element in defining the optical TP2 and TP3 performance to ensure the optical link operability.

In recent years, significant additional functionality has been added to the Host ASIC SerDes which supports longer transmissions over DAC/copper cables at higher speeds or to enable co-packaged optics. This resulted in the linear approach idea to remove the DSP in the optical module. In the linear approach, there is no regeneration present in the optical module and the challenge is now that the Host SerDes needs to handle both the electrical and optical link.



**Link using optical modules, Host SerDes equalizes the entire link**

On the transmit side a modulator driver and the optical transmitter is used for the electrical-to-optical conversion. On the receive side, Photodiodes and TIAs are performing the optical-to-electrical conversion. The Host SerDes performance needs to cover the electrical trace loss from the Host ASIC to the optical module, the E/O and O/E conversion, the optical transmission on the fiber and the trace loss from TIA to remote Host SerDes. The complete link is analog, and it is important that each element acts as linear as possible.

Please note, that it is also possible to operate LPO towards DSP based optics but this case is not covered here.

**Advantage of DSP based and Linear solutions**

The big advantage of DSP based solutions is the definition of clear and established demarcation points. OIF defines the TP1 and TP4 interface, IEEE defines the optical TP2 and TP3 interface standards. TP2 and TP3 are currently defined for DSP based solutions and not optimized for linear transmission.

The advantage of Linear pluggable optics is the lower power consumption and lower latency. The module power consumption gets reduced by around 40% when keeping the Host ASIC/system power consumption equal. This means that instead of 14W module power consumption, each module needs less than 8W. This is very important in both NIC card systems, Ethernet switches or in systems with extended temperature ranges.

In most applications the latency is of less importance, but in AI/ML applications it is reported that LPOs can result in performance improvements.

Eoptolink offers a full portfolio of LPO optics for OSFP, OSFP-RHS, QSFP-DD and QSFP112 transceivers. At ECOC 2023, Eoptolink will be conducting an interop demo to highlight Interoperability between LPO and DSP based modules. The demonstration is designed to prove:

- LPO modules can support links with VSR insertion loss in the host system.
- LPO modules are suitable to operate in all ports with different insertion losses, 2 FIR setting are sufficient.
- Power advantage of LPO optics.
- Interoperability between different module vendors.

Eoptolink will be exhibiting at ECOC 2023 in Glasgow, 2<sup>nd</sup> – 4<sup>th</sup> October 2023 and welcome you to join them at Booth #432 to find out more about these or any of their products.

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