Considerations on objectives for Beyond 10km Ethernet Optical PHYs running over a point-to-point DWDM system

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Background

There is interest within the industry in defining new Ethernet optical PHYs with the ability to run over a single-channel (wavelength) port on a point-to-point DWDM multichannel optical system.

http://www.ieee802.org/3/B10K/public/17_09/villarruel_b10k_01b_0917.pdf

The intent of this presentation is to foster a better understanding of this application and associated terminology, with the ultimate goal of defining an objective for such a PHY.

Reference

This contribution draws heavily from the Peter Stassar and Pete Anslow presentation at the Nov 2017, B10K study group meeting in Orlando.

http://www.ieee802.org/3/B10K/public/17_11/stassar_b10k_01a_1117.pdf

Note, this presentation focuses on “option 2” from the above presentation.

Overview

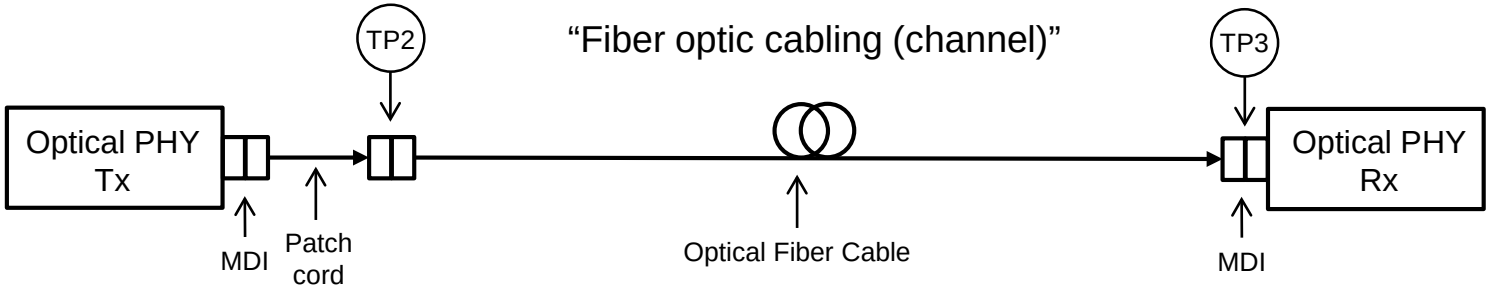
What we need to define:

An new Ethernet “DWDM PHY” that has optical interface specifications (i.e. at TP2 and TP3) enabling direct operation over single-channel (wavelength) ports of a point-to-point DWDM system (optical mux, optical amplifier, fiber, optical demux).

What do we not need to define:

The details of the point-to-point DWDM system itself.

Recap - Traditional Ethernet optical PHY link model



Ref: 802.3cd D2.2 Clause 139

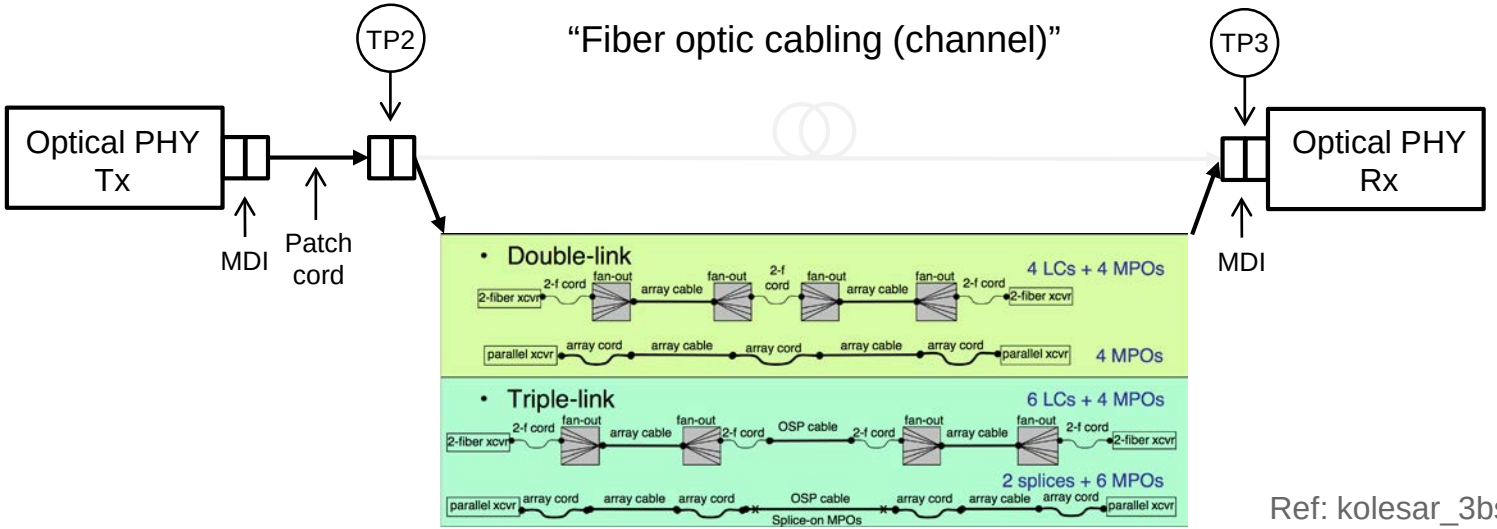
For clarity, only one direction of transmission is shown

In current IEEE 802.3 PHY's the optical link between transmitter and receiver, i.e. between TP2 and TP3, is in the form of a passive connection over a fiber optic cabling (channel).

The fiber optic cabling (channel) characteristics are defined in terms of a few key parameters, e.g. distance, loss, dispersion, DGD and return loss.

The detailed implementation of the fiber optic cabling (channel) is not defined by the standard.

Recap - Traditional Ethernet optical PHY link model



Ref: kolesar_3bs_01_0514

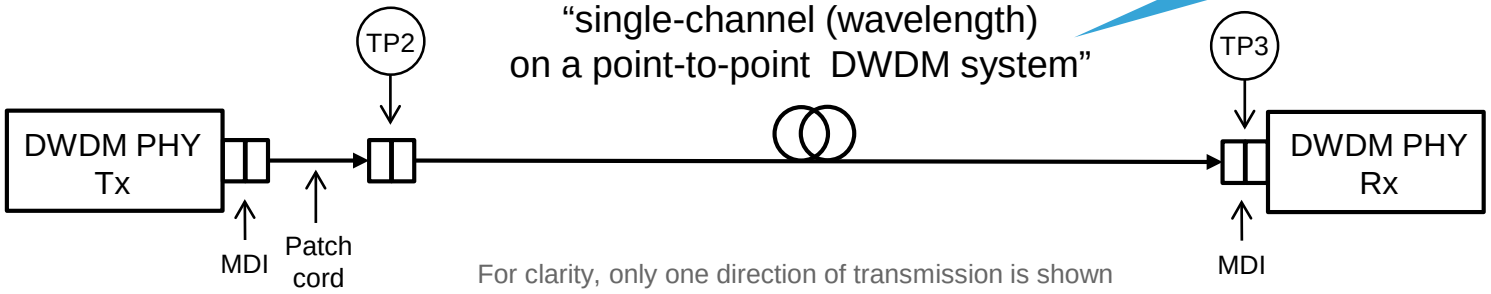
For clarity, only one direction of transmission is shown

The terms of reference in kolesar_3bs_01_0514 were ***used*** to help define the optical interface parameters at TP2 and TP3.

The terms of reference in kolesar_3bs_01_0514 are ***not*** part of the IEEE specification.

Ethernet “DWDM PHY” optical link model

Traditionally – “Fiber optic cabling (channel)



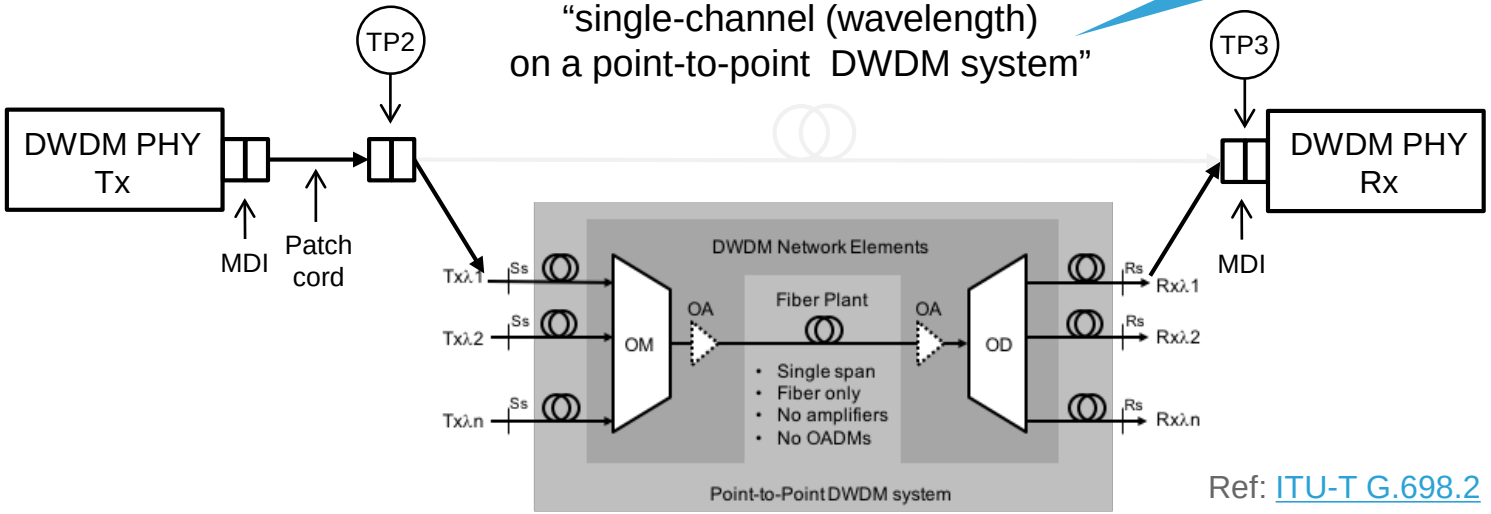
We need to define a “DWDM PHY” where the optical link between transmitter and receiver, i.e. between TP2 and TP3, is in the form of an optical channel connected over single-channel (wavelength) ports of a point-to-point DWDM system (optical mux, optical amplifier, fiber, optical demux).

At some level the link model is the same as a traditional Ethernet optical PHY. The difference is that the optical channel is more complex (see next slide).

Ethernet “DWDM PHY” optical link model

Traditionally – “Fiber optic cabling (channel)

“single-channel (wavelength) on a point-to-point DWDM system”

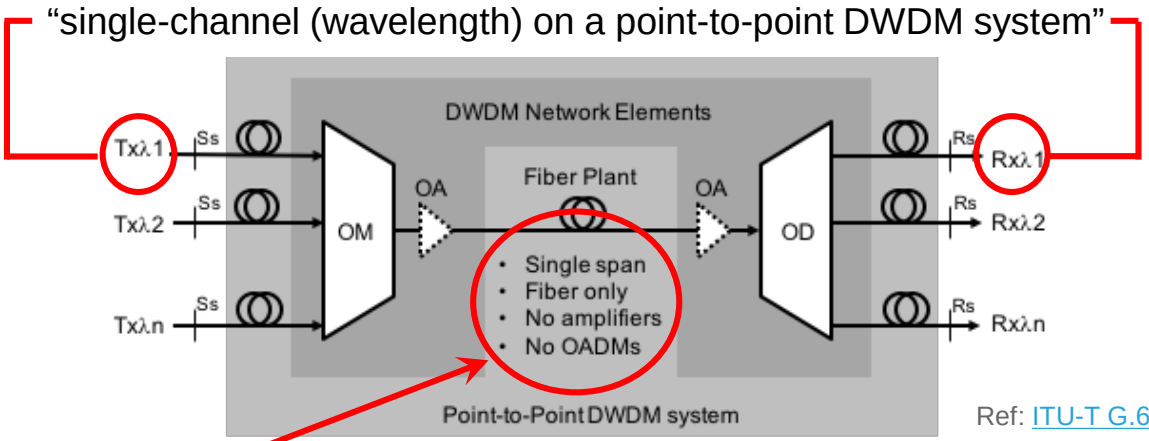


Ref: ITU-T G.698.2

In this example the “DWDM PHY” runs over an optical channel comprising of λ1ports on the point-to-point DWDM system

Note, λ2-λn ports of the same DWDM system could carry other Ethernet DWDM PHYs, or other (non-Ethernet) signals.

What is a “single-channel (wavelength) on a point-to-point DWDM system (i.e. optical channel for ”DWDM PHY”) ?



Ref: ITU-T G.698.2

This is important as it simplifies the challenges of defining the “DWDM PHY” compared to a more complex DWDM channel that could include concatenated in-line amplification or optical add-drop multiplexors enabling an any-to-any wavelength/fiber reconfiguration to happen.

This “limited” topology is anticipated to be the extent of Ethernet “DWDM PHY” specifications

Writing Objectives

Given above discussion, a key goal is how to structure an objective in an IEEE project.

The full reference channel details do not need to be “captured” in the objective language

However, the Study group needs to look at, and agree upon some (many?) target reference channels in order to know the correct technical values to put into the objective language. This will be the subject of future contributions.

Objectives evolve to match the challenges. E.g. backplane objectives moved away from the relatively simple:

- (802.3ba) Provide Physical Layer specifications which support 40 Gb/s operation over at least at least 1m over a backplane

To the more complex:

- (802.3bj) Define a 4 lane PHY for operation over a printed circuit board backplane with a total channel insertion loss of <= 35 dB at 12.9 GHz

Strawman language of a “DWDM PHY” Objective

Traditional Ethernet optical PHY objective language:

- “Define a single-lane 50 Gb/s PHYs for operation over SMF with lengths up to at least 2km”

Possible Ethernet “DWDM PHY” objective language:

1. Define a single-lane 100 Gb/s PHY for operation over single-channel (wavelength) ports on a point-to-point DWDM system which provides an OSNR of greater than X dB.
2. Define a single-lane 100 Gb/s PHY for operation over single-channel (100 GHz wavelength spaced) ports on a point-to-point DWDM system which provides an OSNR of greater than X dB.

Next Steps

- Establish clear terminology. Ethernet terms and ITU/Transport terms are not 100% interchangeable
- Review a number of reference channels that would satisfy the target applications
- Agree upon a wording structure for an objective for a “DWDM PHY”
- Pick the correct technical values for the objective that can then be used to build successful CSD responses against (Technical Feasibility, Economic feasibility, Broad Market Potential)

Q&A ?

Thanks