Thoughts on interoperable PMD

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IEEE 802.3cz Multigigabit Optical Automotive Ethernet Interim Task Force

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Introduction

This presentation is not for proposals

Motivation

Based on the straw poll on 17th February, PMD options are proposed and comparison points prepared.
If the receiver can cover the whole range 850 nm to 1310 nm, can one PMD be used?

Purpose of this presentation

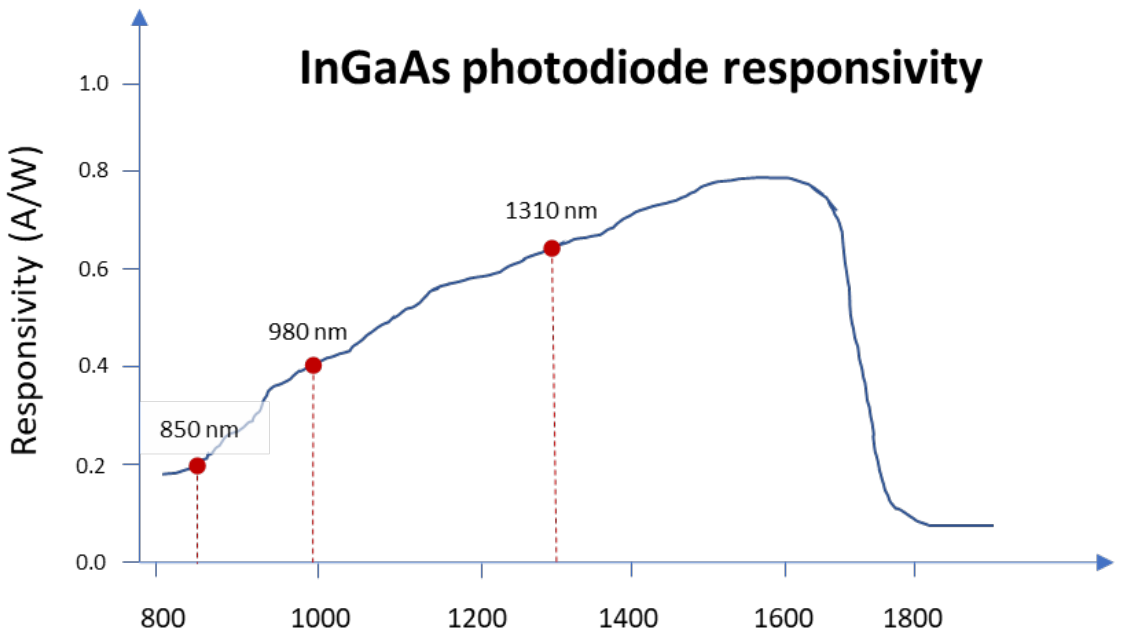
to consider the prospect of interoperability PMD covering the different technology options in this TF.
According to the discussion outcomes, straw polls will be prepared.

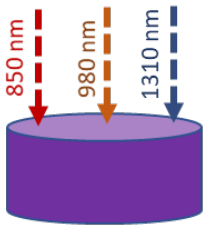
Diverse opinions from optical module vendors

Until we are certain about specification requests and reliability criteria, it would be better to have multiple options and the decision can be made by each of the OEMs according to their criteria.

Reliability is not “a nice to have”. Reliability cannot be compromised

InGaAs PIN suitability for all cases





InGaAs photodiode suitable for all wavelengths under consideration

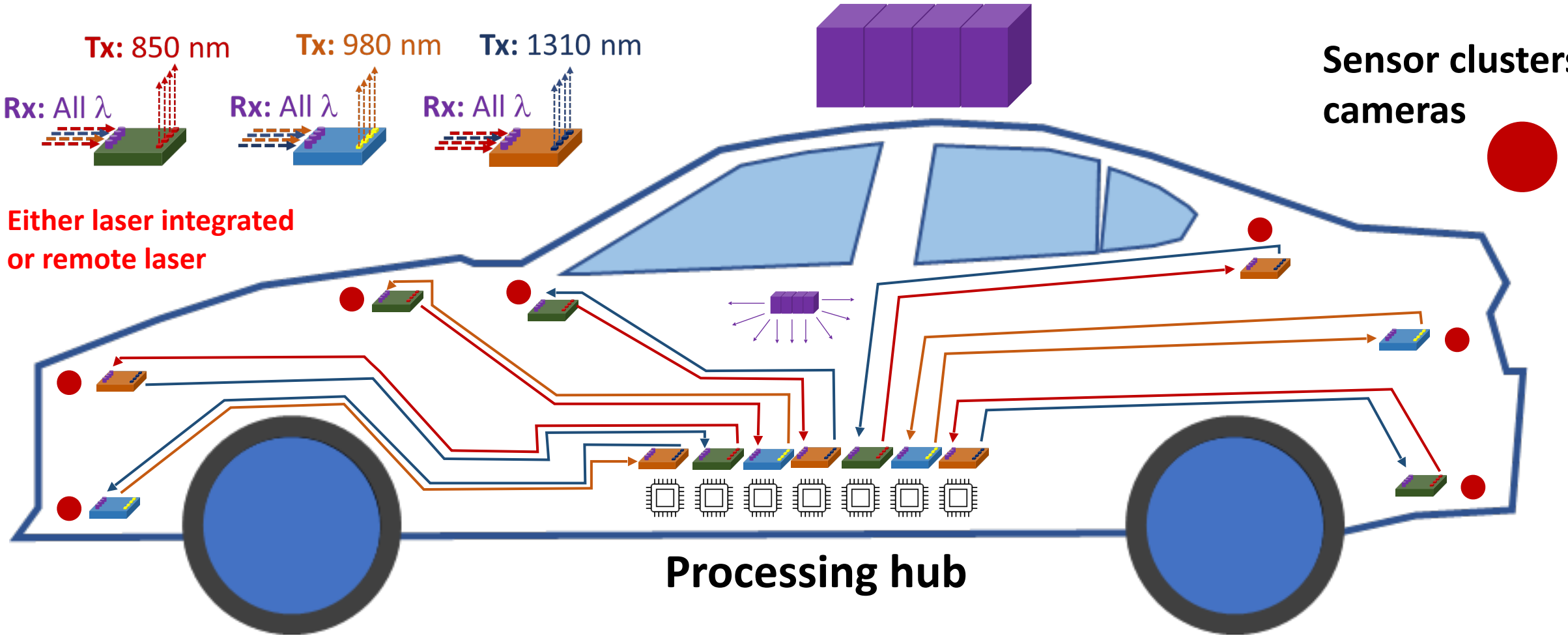
Proposals under consideration — Proposal 1

- **VCSEL + OM3**
- **Objectives: 100% fulfilled**
  - 2.5, 5, 10, 25 Gbps over 40 m + 4 inline connections
  - 50 Gbps over 15 m + 2 inline connections
  - Feasibility: [1], [2], [17], [18]
  - Link budget: [3], [4], [5], [6]
- **Industry support (multi-source, automotive volume): the biggest**
  - OM3: many suppliers, good knowledge, decades of experience of deployment
  - InGaAs VCSEL: even bigger than 850 nm if we move to 980nm
  - In/GaAs PIN PD: big
  - PHY technology: standard CMOS, the biggest volume technology
- **Technical characteristics: mature knowledge**
  - OM3: well established parameters and test methods, validated independently by many laboratories. See [7]
  - VCSELs: identified concern of performance in extreme temperatures, but well supported in 802.3cz TF. See [8], [9], [10], [11], [12], [13]
- **Reliability: long experience and deep analysis of identified concerns**
  - OM3 is already used in harsh environments with extreme temperatures and mechanical requirements, e.g. avionics, militar, industrial automation, etc.
  - CMOS: automotive quality management services in place in the biggest foundries
  - In/GaAs PIN PD: very low current densities, long experience, no concerns
  - InGaAs VCSELs: identified concern of reliability, but well supported in the TF. See [14], [15], [16]
  - TRUMPF is running extensive reliability testing of 850nm and 980nm VCSELs. TRUMPF will report in summer, and the TF should decide wavelength based on results
- **Relative cost: well known, technology leveraging**
  - CMOS, In/GaAs PIN PD, inGaAs VCSELs, and fiber are leveraged from datacenter and other markets

InGaAs more suitable for 1310 nm than for 850 nm or 980 nm

Interoperable, interchangeable transceiver modules

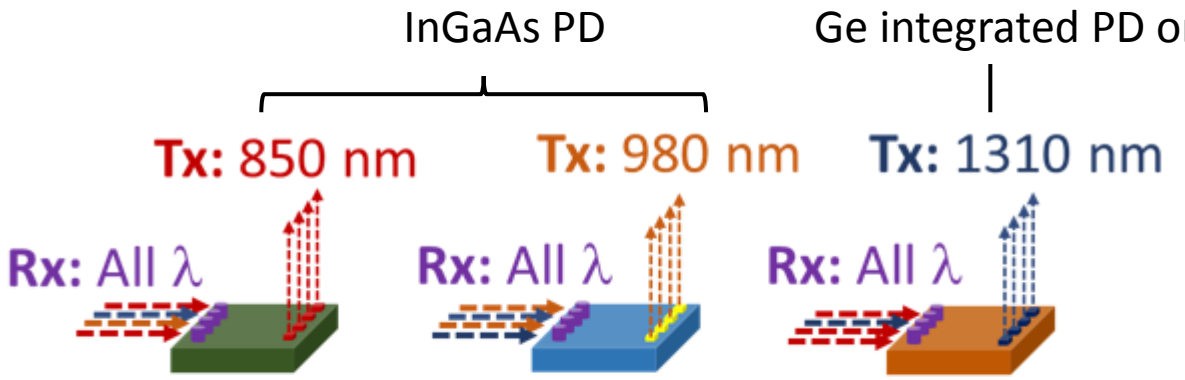
Interchangeable redundant remote light source modules



Interoperable PMD to serve automobile industry with multiple technologies for reliable automobile optical network. OEMs and suppliers can access optical technologies to test and select according to their requirements

Interoperable, interchangeable transceiver modules

Receiver with InGaAs and Ge PD can cover 850-1310nm range



TX	850 nm	980 nm	1310 nm
RX	850 nm, 980nm, 1310nm	850 nm, 980nm, 1310nm	850 nm, 980nm, 1310nm

Detector	detector Wavelength range (nm)
InGaAs	800-1700
Ge	800-1800

PMD (long) and PMD (short)

Distinct identity 40m: only 980nm VCSEL and OM3 can satisfy 40m reach under 105 °C with reliability for use in buses and trucks, not limited to passenger vehicles

15m reach: High speed optical link for automobile for limited use in passenger vehicles

To avoid a case of “double standard”, short reach may use OM2

PMD type		Long (present)	Short (interoperable)			
PMD Name (media oriented)		PMD-L	PMD-SG (Glass)		PMG-SP (Plastic)	
Reach	m	40	15			
Wavelength range	nm	980nm	850-1310nm (comply in the receiver end)			
Media		OM3	OM2		POF	
Description	unit	VCSEL+ OM3	VCSEL+ OM2	Si-photonics +OM2	VCSEL+ POF	Si-photonics +POF
Nominal Transmitter wavelength	nm	980	850	1310	850	1310
Bandwidth	MHz · km	950 Laser launch	500 OFL	500 OFL	To be specified	To be specified
Attenuation	dB/km	2.0	3.5	1.5	To be specified	To be specified

850-1310 interoperable phys will enable (for example)

Bidi

850/1310 single fiber cable
Reduce number of connections and save wiring space
Robust connection of cables with simple wavelength filtering

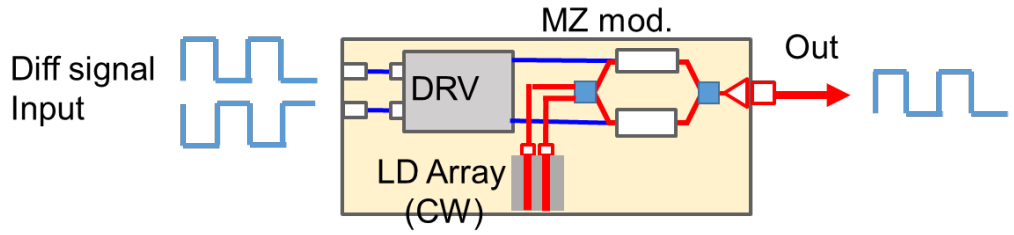
Remote light source for reliability in Si-photonics

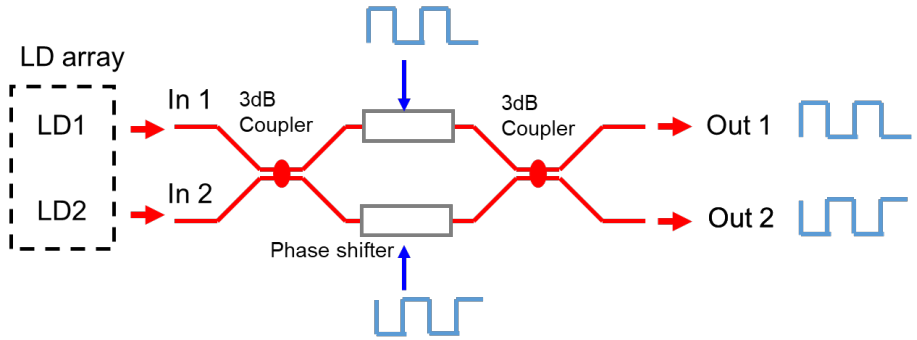
Telecom and co-package applications request remote and redundant light source for Si-photonics
feasible solution for reliable systems
Light sources are placed in moderate circumstances that are easily accessible (i.e. automobile battery or Li-ion battery in e-car)

Built-in dual redundancy in Si photonics Transceiver

MZI-modulator configuration allows for dual light sources to be operated as redundancy

Redundant light sources integrated in Si Photonics chip





Appreciate your opinions