PMD considerations for FTTR From a PON point of view

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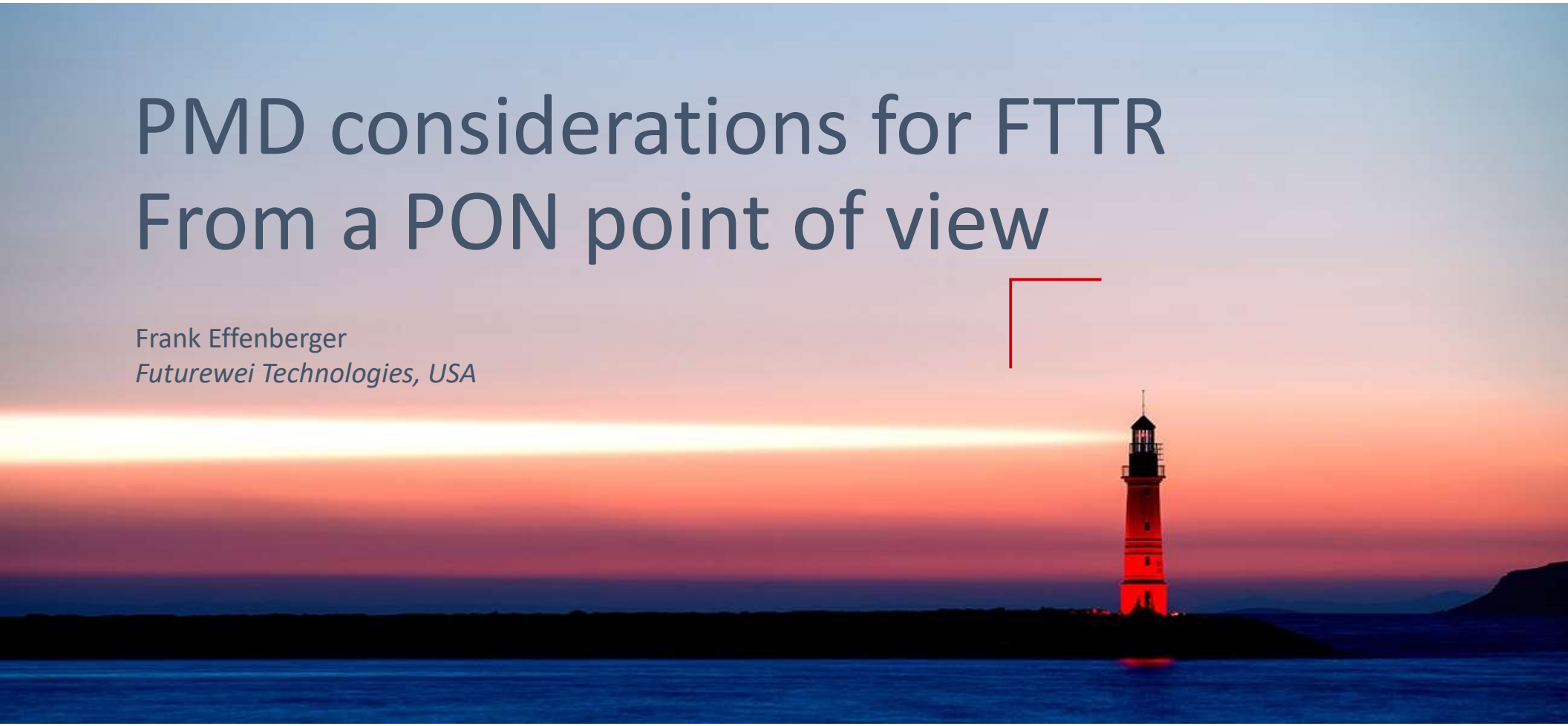

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Outline

- Choosing PON
- Fiber type
- Loss budget
- Laser and detectors
- Wavelength plan

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Choosing PON

- PON is the answer! (Now, what was the question?) ☺
- PON has several advantages for home networks
  - Point to multipoint capable, enabling diverse connection topologies
    - Typical central splitter
    - Multi-stage splitters
    - Tapped-line “bus”
  - Large volume of potential reuse components
    - PON volumes approaching 1 billion ONUs in the world
  - Could logically interconnect to access PON
    - The issues surrounding this have been covered in a Q3 contribution

Fiber type

- The default choice of fiber is G.652 or G.657 type
  - This has become the largest volume fiber in the world by far
  - It has quite good transmission characteristics
  - Many components (splitters, connectors, cabling) are developed
- There are other fiber types, but not so favorable
  - Multimode fiber: More costly and splitters are not practical. Pro is that connectors are more resistant to dirt, but SMF has solved these issues
  - Plastic fiber: Multimode by necessity, and very high loss due to intrinsic properties. Non-typical wavelengths need to be used
- The rest of this work will assume G.652/7 compatible fiber

Loss budget

- We can estimate that 8 ports of connection could be sufficient to serve most homes
  - 1:8 splitter = 10 dB loss
- Central splitter PON might have 4 connectors in the path
- Tapped line might have 8 connectors in the path = 4 dB
- The fiber itself is a minor loss = 1 dB

- The total loss can be estimated to be 15 dB

Laser and detectors (1)

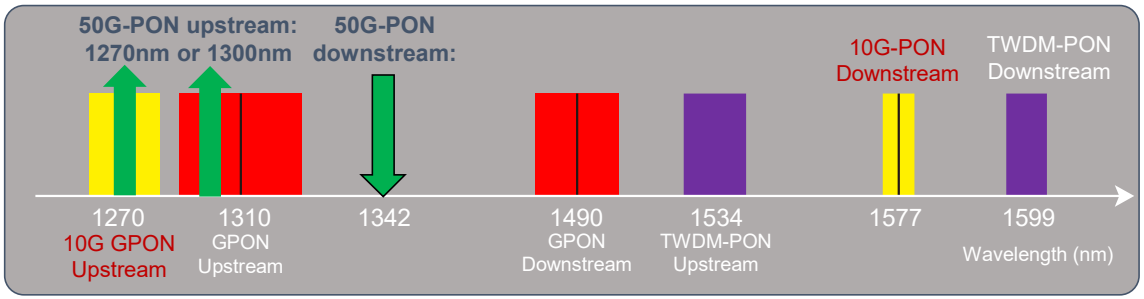
- Given the low loss budget, we can definitely leverage lower cost component designs
- VCSELs offer many advantages, but could never be used in PON because of their low power
  - Now we could get by with a -5 dBm output power
- PIN detectors have low sensitivity, but here we could use a -20 dBm sensitivity level
- Such surface-emitting/absorbing components could fit into typical bidi optics using a TFF to route wavelengths

Lasers and detectors (2)

- The Holy Grail of PON optics is to use integrated optics (a single III-V chip in the ONU directly coupled to the fiber!)
- This never got off the ground, because
  - Performance of integrated optics usually considerably lower
  - Requisite wavelength plans cover a lot of spectrum
    - It is hard to grow the laser and detector on a single wafer
    - Such broadband wavelength muxes are hard to make
- However, for FTTR, maybe we can finally make this work
  - Loss budget is very modest
  - The wavelength plan is open – perhaps we use closer wavelengths

Wavelength plan

- The existing PON wavelength plan is quite complicated, and represents 20 torturous years of system development



- For FTTR, we have very few constraints
- For example, the upstream and downstream could both be in the O-band, like some of the bidirectional optics in G.9806
- If so, then an integrated optical chip becomes quite possible

Conclusions

- PON optical components can be leveraged in FTTR
- Fiber, splitters, connectors and cabling hardware can be used directly
- PMD modules could go in two directions
  - Stay with the current wavelength plans, but support much lower loss budget, which enables more cost-effective components to be used
  - Create a new wavelength plan that enables the optimal low cost integrated optical PMD
- This consideration is just starting, so more input would be welcome

Thank you! Any questions?

Any questions on PON?
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