



Lane Bonding Considerations

IEEE 802.3ba Interim Meeting...Portland

January 23-25, 2008

Larry Green, Technologist

lgreen@ixiacom.com



Lane Bonding Mechanisms

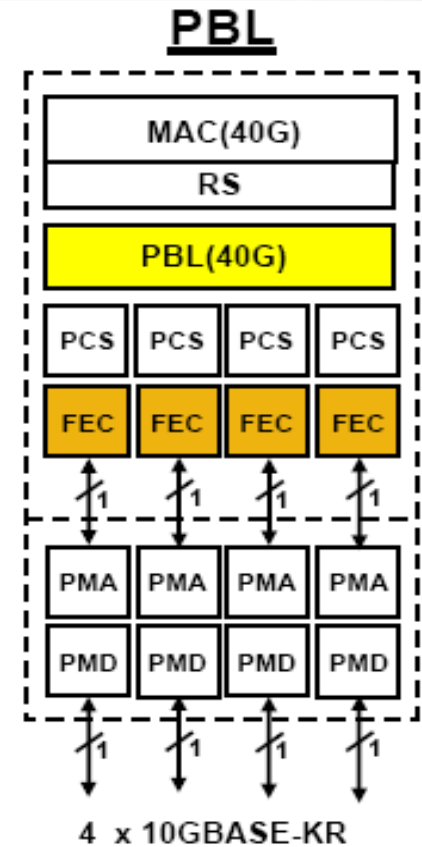
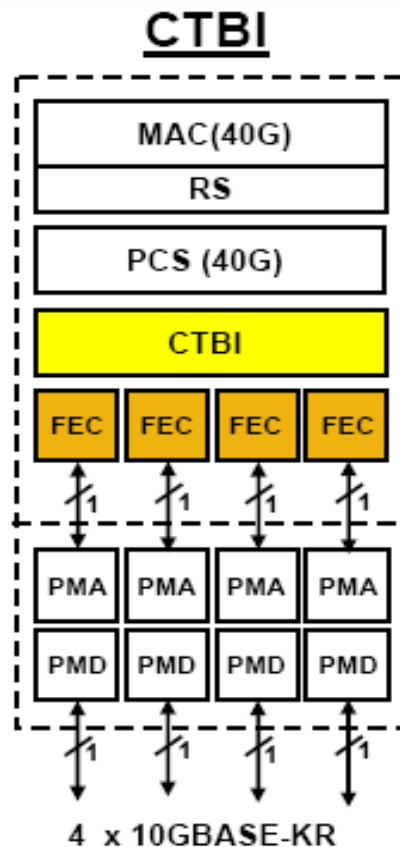
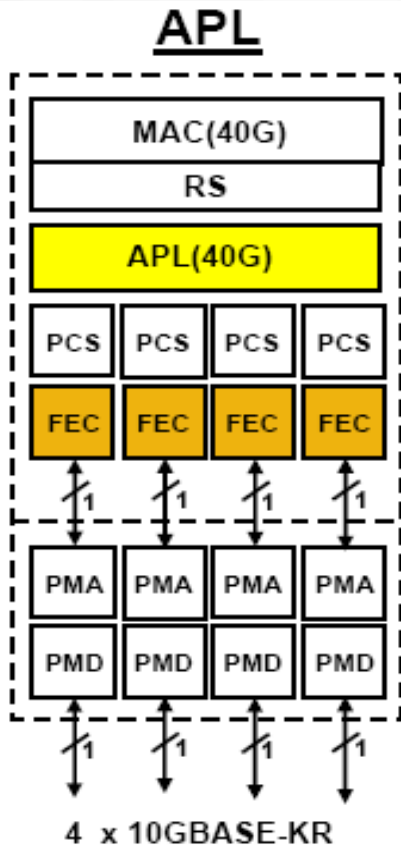
- 40G and 100G channels require multiple-lane PHYs based on MMF/SMF optical fibers, copper cables, PC traces, or WDM wavelengths.
- Bonding mechanisms are required to unify the lanes into a single channel.
 - 40G channel architecture may be 4X10G...1X40G (future)
 - 100G channel architecture may be 10X10G, 4X25G ...1X100G (future)
- Lane bonding proposals have been presented to HSSG...
 - Aggregation (at the) Physical Layer (APL)
 - 100G Ten Bit Interface (CTBI)
 - Physical Bundling Layer (PBL)
- Desirable to use a common mechanism for both 40G and 100G channels
- Other desirable objectives...
 - Simplicity
 - Ease of implementation
 - Scalability
 - Minimum size, power, heat

- Aggregation (at the) Physical Layer (APL) provides “variable-length fragment-based” lane bonding with packet fragmentation and reassembly mechanisms.
- Uses 64B/66B PCS technology as in 10GE.
- Frames are decimated into variable lengths that complicate reassembly and error control procedures...sublayer processing overhead may be high.
- May re-use 10G PHY technology.
- Potentially scalable to 4X25G SMF and 1X40G SMF channels.

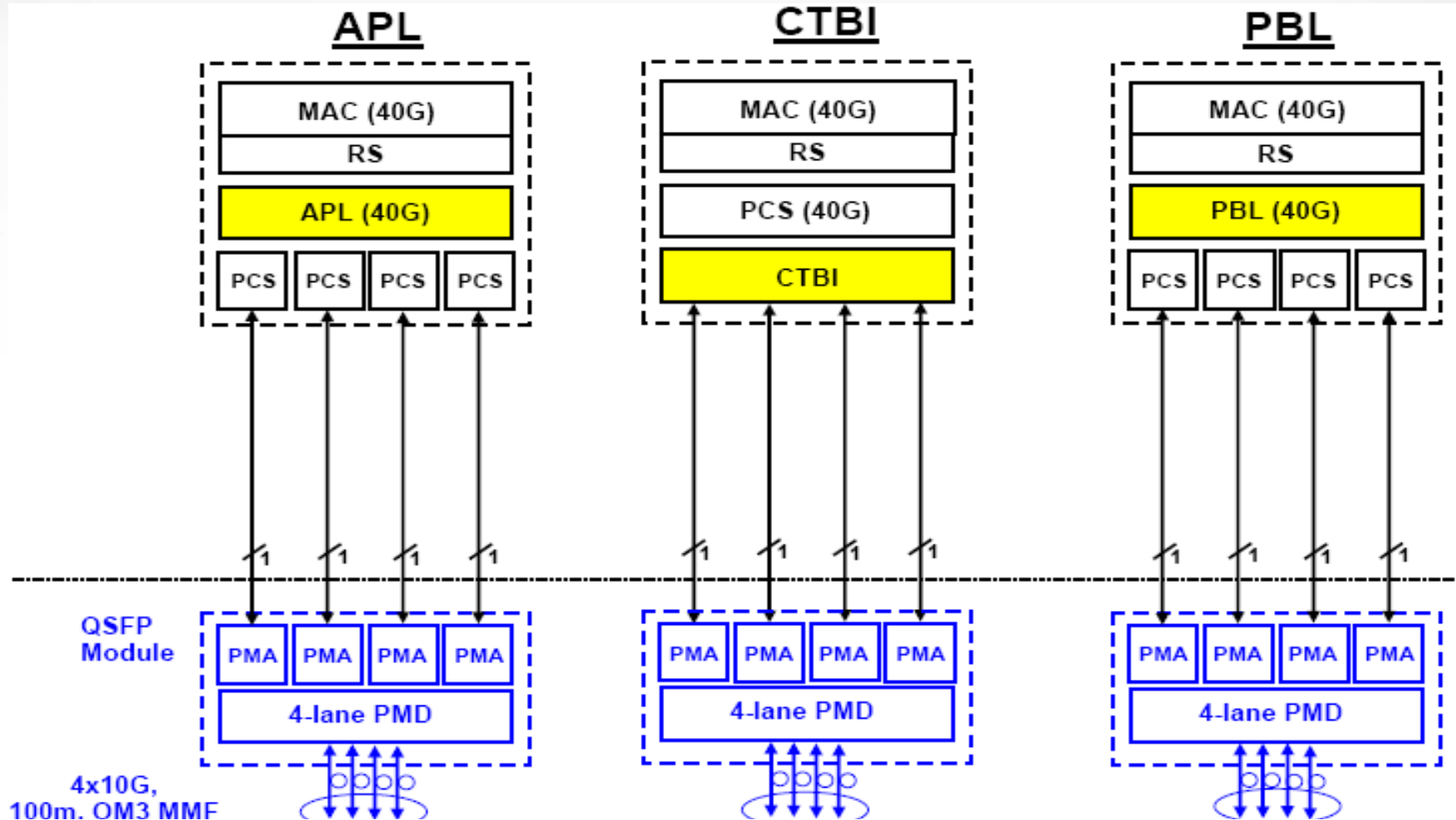
- 4X25G SMF or 1X40G SMF with APL would require new VLSI technology.
 - Requires PCS functions in optical transceiver modules...for example, two chip development cycles, one in CMOS, another in SiGe.

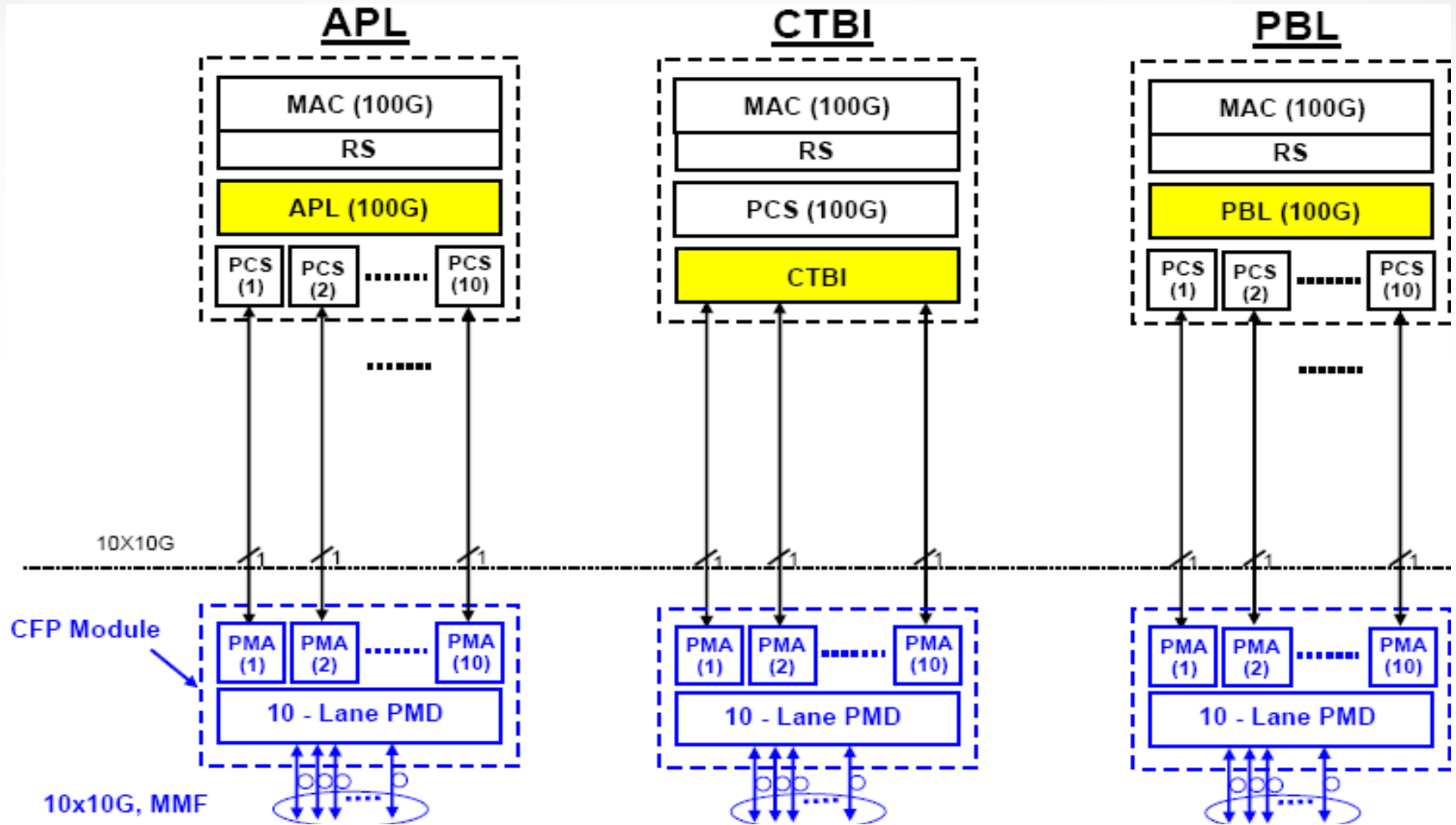
- 100G Ten Bit Interface (CTBI) concept based on inverse muxing to “Virtual Lanes”, bit mapping to/from electrical lanes with alignment and skew compensation at Rx PCS.
- Uses 64B/66B PCS technology as in 10GE.
- Efficient for all 802.3ba channel architectures...
 - supports full MAC line rate
- By inspection, PCS processing overhead is low.
- Flexible Virtual Lane architecture...
 - Independent of frame size
- Single PCS works with multiple, different PMDs.
- Can be implemented in current FPGA technology.
- 4X25G SMF and 1X40G with CTBI will require CMOS chip development, but no new technology.

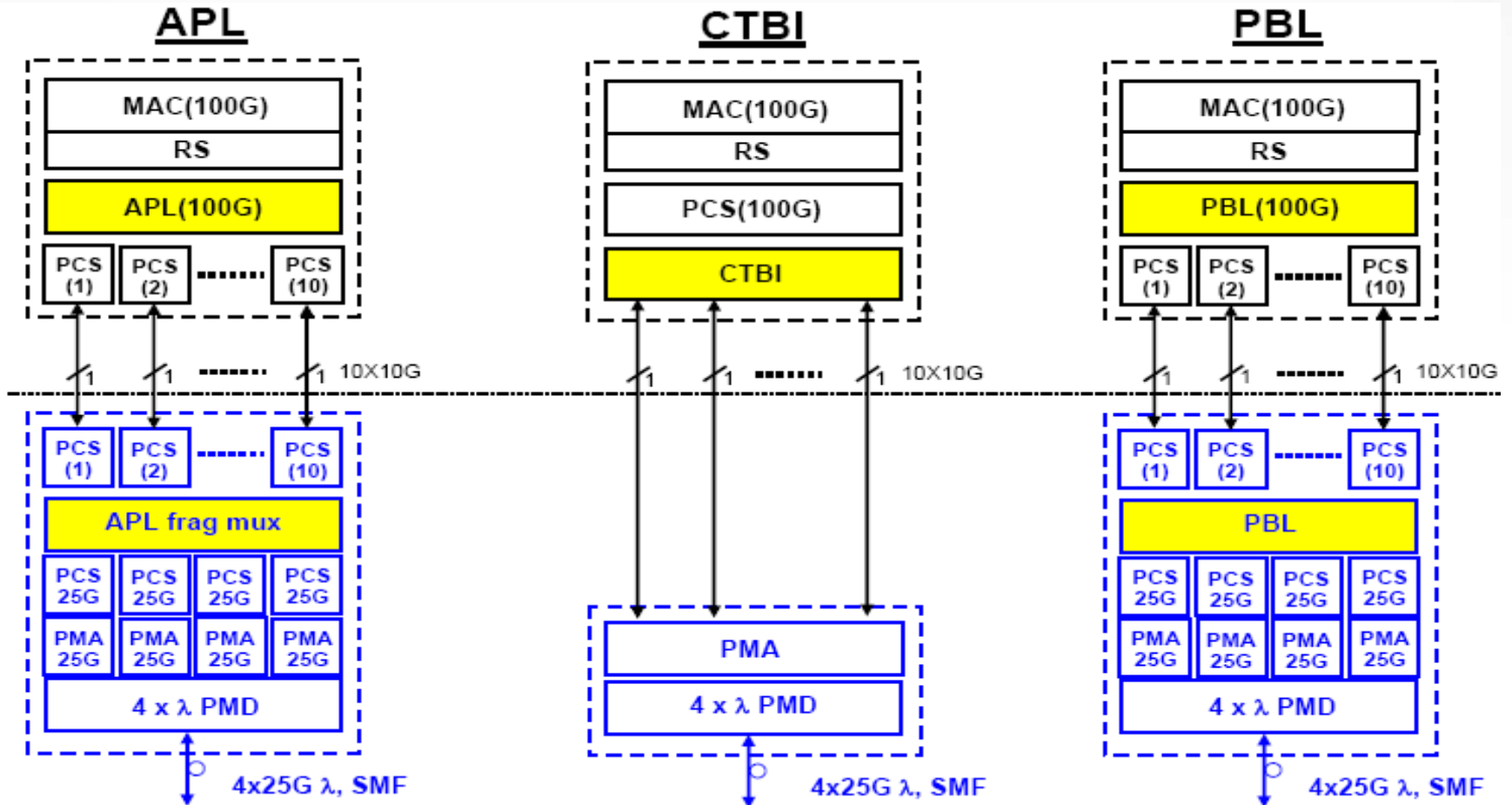
- Physical Bundling Layer (PBL) bonding is similar to APL...
 - Bonds physical layers with PCS for each PMD
- Uses 64B/66B PCS technology as in 10GE
- PBL performs distribution and reassembly of fixed-size, 64-bit data blocks over multiple lanes
 - Fixed-size blocks simplify implementation
- Multiple lane alignment mechanism may be complex...now under study.
- 4X25G SMF and 1X40G SMF with PBL will require new VLSI technology.
 - Requires PCS functions in optical transceiver modules...for example, two chip development cycles, one in CMOS, another in SiGe.



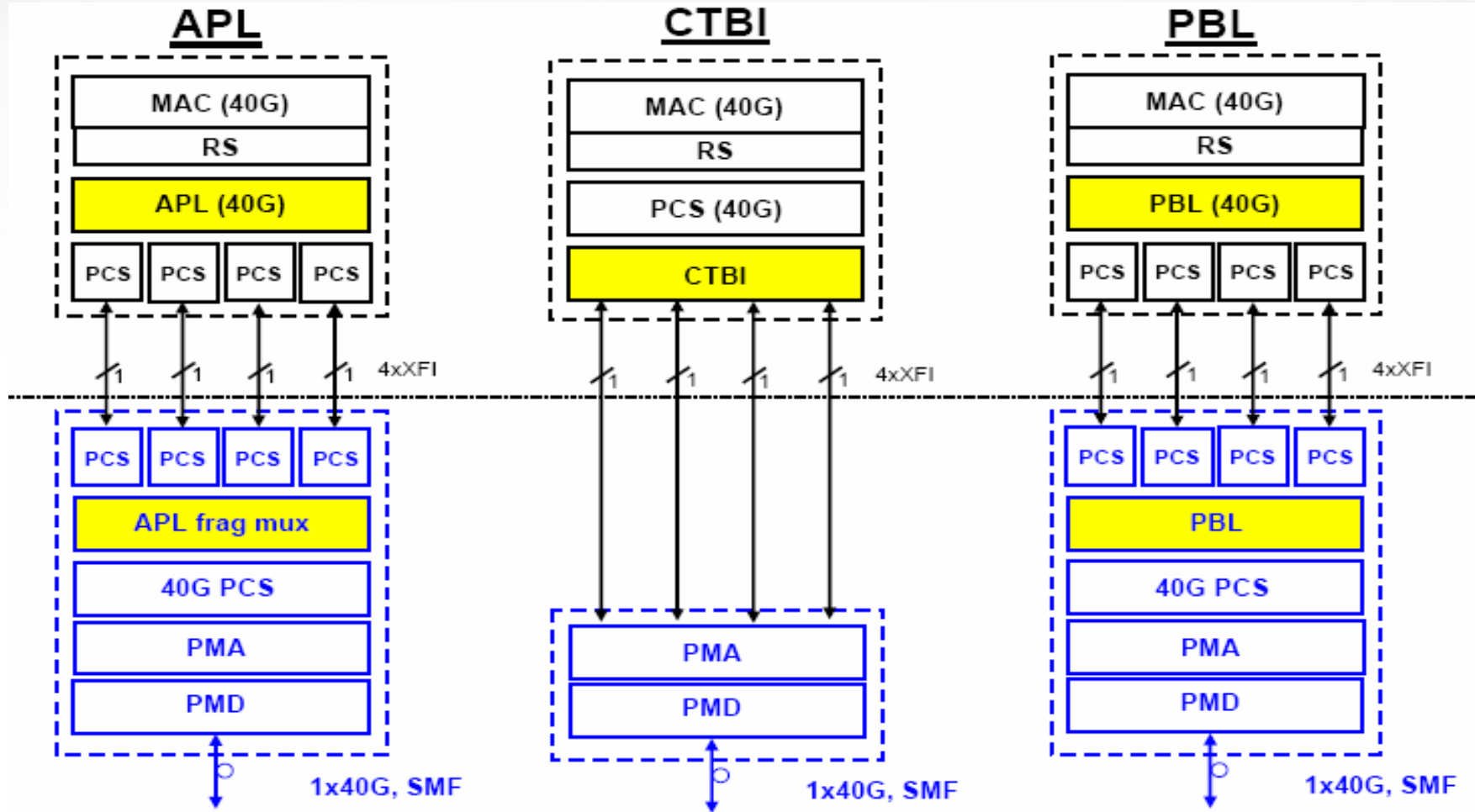
FEC = 10GBASE-KR FEC (Clause 71)







1 X 40G SMF





Lane Bonding Mechanism Evaluation

- Desirability of the three lane bonding proposals was evaluated with four criteria...
 - Simplicity
 - Ease of implementation
 - Scalability
 - Minimum size, power, heat
- The five criteria were considered with five 802.3ba cases...
 - 4X10G KR Backplane
 - 4X10G MMF
 - 10X10G MMF
 - 4X25G SMF
 - 1X40G SMF
- “Relative Desirability” was estimated for each case.

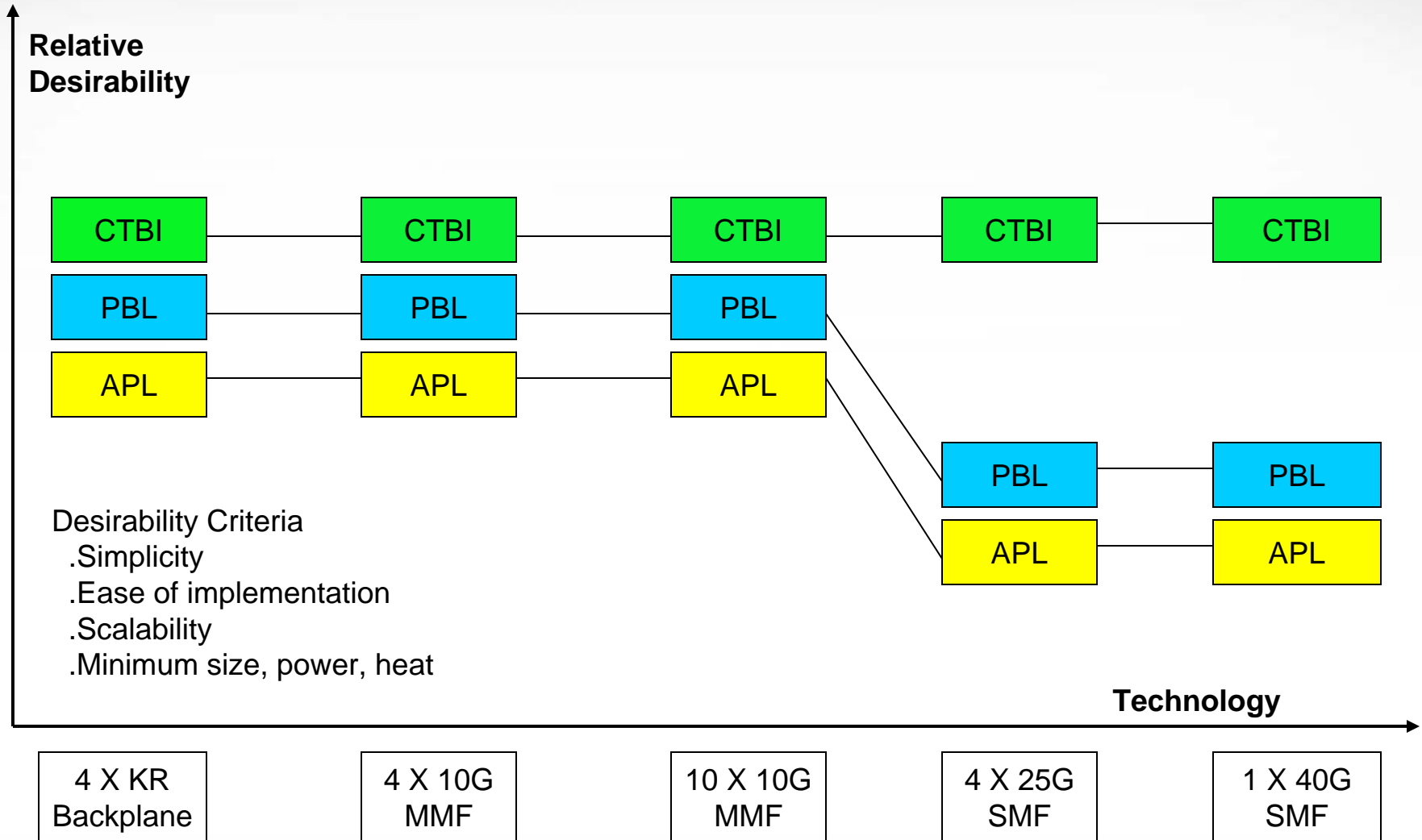


Evaluation Observations

- **APL...**
 - High-level complexity, probably with high sublayer processing overhead
 - Difficult implementation...new VLSI technology for 4X25G SMF
 - Scalability diluted by complexity
 - Complexity drives increased size, power, heat
- **CTBI...**
 - Lower-level complexity compared with APL and PBL
 - Implementation with current VLSI technology for 4X25G SMF
 - Scalable from 4X10G KR to 1X100G SMF
 - Simplicity drives reduced size, power, heat
- **PBL...**
 - Moderate-level complexity in current proposals
 - Difficult implementation...new VLSI technology for 4X25G SMF
 - Scalability diluted by complexity
 - Complexity drives increased size, power, heat



Relative Desirability





Conclusions

- With 4X10G KR, 4X10G MMF, 10X10G, APL, CTBI and PBL have similar Relative Desirability
- With 4X25G 10/40km SMF, APL and PBL have decreased Desirability due to protocol functionality in the optical module, requiring new VLSI.
- With 1X40G SMF, APL and PBL have decreased Desirability, requiring new VLSI technology in the optical module.
- In the future, the simplicity of CTBI will enable scaling to 1X100G SMF.
- CTBI emerges as the most Desirable lane bonding mechanism.
- Recommendation...adopt CTBI as the lane bonding mechanism for IEEE 802.3ba.