Tx preset protocol

Leon Bruckman, Johan J. Mohr, Vishnu Balan, Ola Oluwole

Nvidia

400G proposal: Add a protocol for optional presets

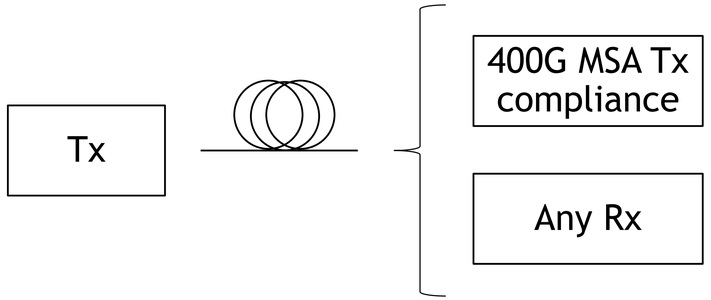
1. Adopt the IEEE ideas of Tx presets

- **Keep** Preset-0 as the 400G MSA (section 2.1) compliance setting
  - Use as the initial preset
  - Use as fallback state
- **Add** optional: Preset-1 to Preset-n
  - The Tx should
    - Expose the number of available presets (amount is TBD) – Can be read using BCET
    - Be able to switch “gently” between them
    - The only requirement from the presets is that after a preset-switch a reference receiver can lock to the Link Training frames (DME) within 10 msec
      - This will allow AGCs in the channel to settle after a preset-switch
    - Comply to maximum launch power specifications – Protect receivers
  - The Rx controls the Link-Training (LT) flow
    - Asks for: preset-n if it decides to do so (not a requirement)
  - Tx<->Rx communication and control can be implemented using BCET
  - Presets are vendor specific and non-regulated
    - Very unlikely that vendors decide on presets that does not allow LT frame lock (DME)
      - If LT frame lock is lost at the peer for a timeout period (as indicated by the Receiver frame lock bit) return to the initial preset
      - Receiver knows now to avoid the offending preset
    - The burden of preset-compliance significantly out-weights the disadvantage of (unlikely) fallbacks to preset-0

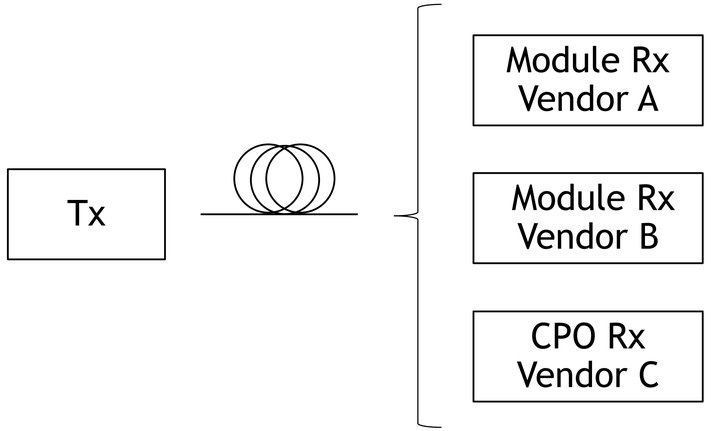
Problem statement:

"A 400G optical transmitter (Tx) may be used in different systems"

- Intention with 400G MSA:
  - Any Rx can receive from any Tx with BER anticipated in the MSA



- Real World:
  - Customers wants optimal performance
  - No Tx has a single setting optimal for all receivers
  - A wide range of receivers
    - Optical and electrical front-ends
    - DSP architectures
    - System architectures (modules, CPO, …)



- MSA with presets will serve both purposes

Different projects adopts different flexibility

1 preset (just turn it on)

802.3dj 200GBASE-DR1
(Optical PAM4, SMF)

180–8—200GBASE-DR1, 400GBASE-DR2, 800GBASE-DR4, and 1.6TE receive characteristics

Description	Value
e, each lane (range)	106.25 ± 50 ppm
format	PAM4
ngths (range)	1304.5 to 1317.5
shold[a], each lane	5
ive power, each lane (max)	4
ive power, each lane[b] (min)	–6.3
er (OMA_{outer}), each lane (max)	4.2
lectance (max)	–26
sitivity (OMA_{outer}), each lane[c] (max) Q < 0.9 dB B ≤ TECQ ≤ SECQ	–3.4 –4.3 + TECQ
iver sensitivity (OMA_{outer}), each lane[c] (max)	–0.9
f stressed receiver sensitivity test[d]:	
ssed eye closure for PAM4 (SECQ), lane under test	3.4
A_{outer} of each aggressor lane[e]	4.2

8 presets

802.3ds 200G MMF short-reach (SR-class)
(Proposal)

How one may configure the Prese

- Following Preset configuration allo or Preset table can be simplified to
  - Preset 1 – Default optimized for 6
  - Preset 2 – Optimized for B2B reac
  - Preset 3 – Optimized for max reac
  - Preset 4 – Reserved
  - Preset 5 – Reserved
  - Preset 6 – Reserved
  - Preset 7 – Reserved
  - Preset 8 – Reserved

A. Ghiasi

Full Tx FIR

802.3dj 200GAUI-1 C2M
(Electrical PAM4)

D–2—Summary of host output specifications at TP1a *(continue*

Parameter	Reference	Value
ate voltage, v_f (range)	176D.8.4	0.372 to 0.5
ratio, R_{peak} (min)	176D.8.4	0.161
match ratio, R_{LM} (min)	176D.8.5	0.95
ualization step size for all taps (range) state for $c(-3)$ (max) state for $c(-2)$ (min) state for $c(-1)$ (max) state for $c(0)$ (max) state for $c(1)$ (max)	176D.8.6	 0.005 to 0.025 –0.06 0.12 –0.34 0.5 –0.2
istortion ratio, *SNDR* (min)	176D.8.7	Table 179–9
ersymbol-interference ratio, SNR_{ISI} (min)	176D.8.8	26
	176D.8.9	 0.023 0.025 0.135

A preset protocol

- Gives flexibility compared to a single compliance setting
- Allows vendors to calibrate the optical modulator to different operation operation points (ER, BW, OMA,…)

What makes a good optical link?

A good link

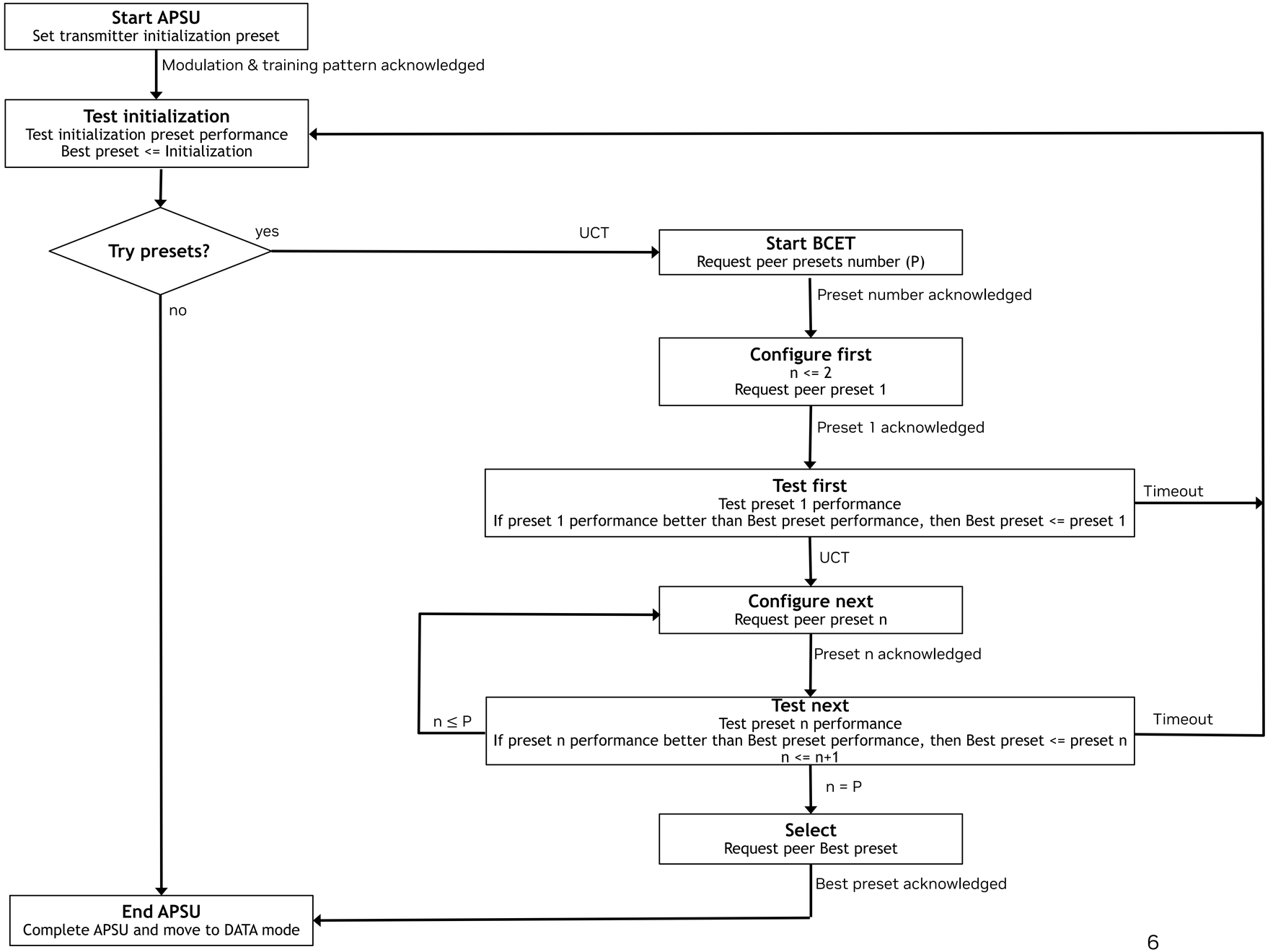
- Good bandwidth
- High optical power
- Low noise
  - Balance RIN vs. Extinction ratio
- Cleanliness
  - good static linearity (RLM)
  - good dynamic linearity (pattern dependence)
- The best balance depends on the receiver (system)

Difficult to quantify

- More bandwidth is good,
  - but optical links often have a very steep roll-off
  - => a TxFIR is not as efficient as in electrical links
- More power is most often good –
  - but only if nonlinearity is not excessive
- TDECQ has some prediction power
  - but many studies show that it cannot stand alone
  - by design valid for one BER, but customers want better BER

- **TxFIR exposes: driver FIR coefficients**
  - Valid option for linear transmitters
- **Presets exposes: id's only**
  - Very powerful since vendor have access to unexposed knobs in transmitter
    - bias, swing, analog peaking, …
  - Mimics the way an optical transmitter is optimized in real life

Link training process



Summary

- We presented a proposal for a specification of a preset selection protocol
  - Allow transmitter compliance test with a mandatory preset
  - Allow N vendor defined preset for maximum flexibility and performance optimization
- Minimal requirements for the unregulated presets were presented
  - Link training frame lock after preset switch
  - Maximum launch power compliance
- Feedback towards consensus on a baseline proposal is welcome

Thanks