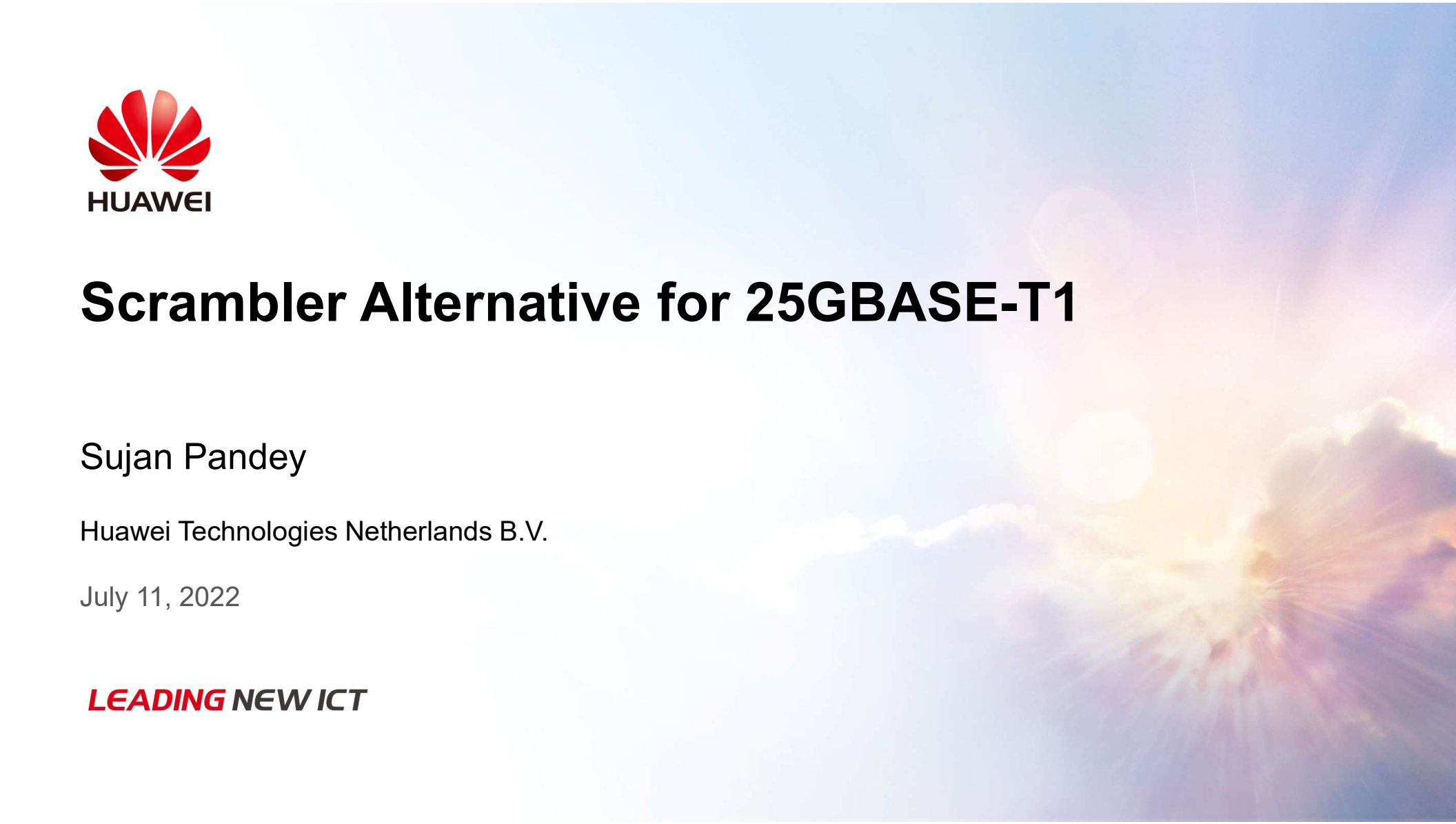

Scrambler Alternative for 25GBASE-T1

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LEADING NEW ICT

Overview

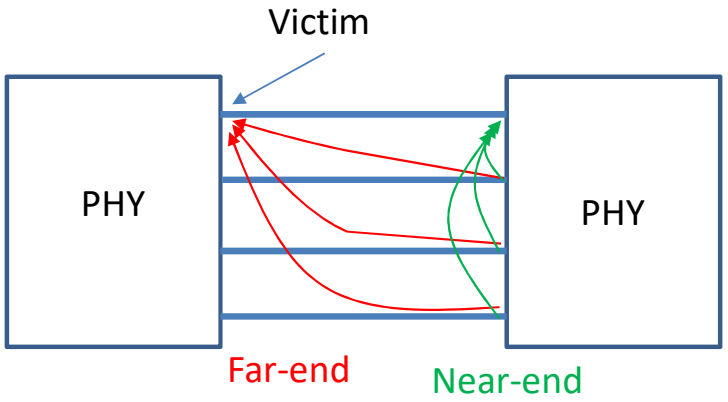
- The IEEE 802.3cy draft D1.3 uses 33-bits scrambler
- This scrambler is adopted from IEEE 802.3ch
- https://www.ieee802.org/3/ch/public/adhoc/tu_3ch_03_1018.pdf
- https://www.ieee802.org/3/ch/public/nov18/Pandey_3ch_01_1118.pdf
- In principle 33-bits scrambler worked for 10GBASE-T1 and it should also work for 25GBASE-T1

Assumption

- Future task force that defines 50GBASE-T2 and 100GBASE-T4 specifications will adopt PMA (physical medium attachment) and link segment of 25GBASE-T1 (motions_3cy_01_081920.pdf)
- Lane PMA + FEC + PCS (zimmerman_3cy_01_05_18_21.pdf)
- 25GBASE-T1 PHY will be replicated x2 for 50GBASE-T2 and x4 for 100GBASE-T4
- When replicated, the scramble polynomial for 25GBASE-T1, 50GBASE-T2, and 100GBASE-T4 PHYs will be the same

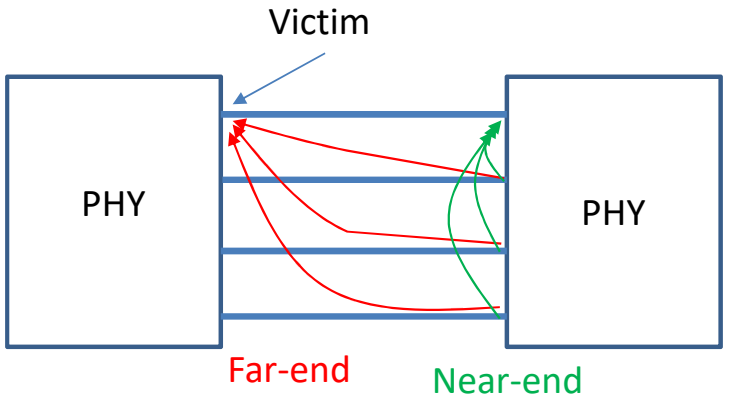
Problem (1/3)

- 25GBASE-T1 is already very close to the limit in terms of SNR (signal-to-noise ratio) margin
  - Alien-cross talk noise
  - Analog front-end (AFE) noise floor
  - RF Interference
  - Fast transient impulse noise
- Future, 50GBASE-T2 and 100GBASE-T4 will add further crosstalk noise to their respective lanes
  - Due to Cable, connector, and PCB



Problem (2/3)

- 50GBASE-T2 and 100GBASE-T4 will have two and four parallel lanes, respectively and crosstalk among lanes is unavoidable
  - It is not the part of IEEE 802.3cy to define its limit line given its scope
- The crosstalk noise signal is correlated and can be cancelled out to improve SNR margin at receiver, if it is needed
  - Most of the IEEE 802.3 BASE-T PHYs need to cancel crosstalk to improve SNR margin



Problem (3/3)

- Adopted IEEE 802.3cy 33-bits scrambler has a scrambler cycle of 613ms
- Will the 33-bits scrambler sufficiently randomize the data from different lanes of 50GBASE-T2 and 100GBASE-T4 given a short scrambler cycle?
  - Note: It should not be the case for 25GBASE-T1 PHY because it has a single lane
- If transmitted signals from different sources are not sufficiently randomized then the crosstalk cancellation cannot be done at the receiver effectively, if needed
- If a group of aggressors source signals are not randomized then the effect of crosstalk will be even worst to the victim

Conclusion

- Higher order 58-bits scrambler gives scrambler period of half a year and provides more combinations than 33-bits scrambler
- In some scenarios, 58-bits scrambler results multiple tones in the transmit PSD
  - This has a direct impact on emission
- Looking at PSD, 25GBASE-T1 has ~4dB less PSD than 10GBASE-T1
- 33-bits scrambler looks better for the emission but it has relatively short scrambler period
- Question: Does 33-bits scrambler offer sufficient data randomization among multiple lanes (50GBASE-T2 and 100GBASE-T4)?


THANK YOU