Reduction in Vf (max) and Associated Parameters (Comments 345-360)

Bill Simms

NVIDIA

Supporters

- Vishnu Balan, NVIDIA
- Matt Brown, Alphawave Semi
- Dave Cassan, Alphawave Semi
- John Calvin, Keysight
- Piers Dawe, NVIDIA
- Mike Dudek, Marvell
- Ali Ghiasi, Ghiasi Quantum
- Tom Palkert, Samtec
- Hossein Shakiba, Huawei
- Priyank Shukla, Synopsys
- Pavel Zivny, Independent

Reduction in Vf Max and Associated Parameters

Purpose

- Propose reduction of Vf(max) from 600mV to 500mV:
  - Associated Differential peak-to-peak values 1.2V to 1.0V
  - Associated COM parameters Av, Ane, Afe to appropriate scaled values for impedance mismatch

- Why now
  - Reduction in XTALK improves link performance in COM
  - Potential system power and radiated noise savings
  - Silicon process nodes are becoming less tolerant of high voltages
  - Removal of attenuators and limiters reduces noise in the receive chain

Proposed Changes to Draft

- In Sections:
  - 178. Physical Medium Dependent (PMD) sublayer and medium, type 200GBASE-KR1, 400GBASE-KR2, 800GBASE-KR4, and 1.6TBASE-KR8
  - 179. Physical Medium Dependent (PMD) sublayer and medium, type 200GBASE-CR1, 400GBASE-CR2, 800GBASE-CR4, 1.6TBASE-CR8
  - Annex 176C: Chip-to-chip Attachment Unit Interfaces 200GAUI-1 C2C, 400GAUI-2 C2C, 800GAUI-4 C2C, and 1.6TAUI-8 C2C
  - Annex 176D: Chip-to-module Attachment Unit Interfaces 200GAUI-1 C2M, 400GAUI-2 C2M, 800GAUI-4 C2M, and 1.6TAUI-8 C2M
- Comments # 356
  - Reduce Transmitter steady-state voltage Vf (max) to 0.5V (down from 0.6V)
- Comments #354, 348
  - Reduce Transmitter steady-state voltage Vf range 0.4V to 0.5V (down from 0.4 to 0.6V)
- Comments #352, 359, 346, 351
  - Reduce Ane from 0.578V to 0.482V (0.481) to be consistent with Vf (max) of 0.5V
- Comments #353, 355, 345, 347,
  - Reduce Differential pk-pk voltage (max) to 1.0V to be consistent with Vf (max) of 0.5V
- Comments #357, 358, 360, 349, 350,
  - Reduce Amplitude tolerance to 1.0V (down from 1.2V)

Impact of changes

- Improvements to receiver designs
  - Lowers the dynamic range of the signal seen at the front end
  - Reduces need for an additional limiter or attenuator for low-voltage silicon designs
  - Improves linearity of the system by not stressing the extremes of process voltage
  - May reduce need for RX to request amplitude reduction from remote TX
  - Reduces ESD complexity for low-power designs
  - Improves ENOB and reduces noise translated into RxFFE and DFE/MLSE
- Improvements to transmitter designs
  - Improves TX linearity and lowers probability of clipping
  - Improved P-N wave-shape matching lowers common-mode conversion and radiated emissions
  - Reduced amplitude for all transmitters reduces XTALK for the system

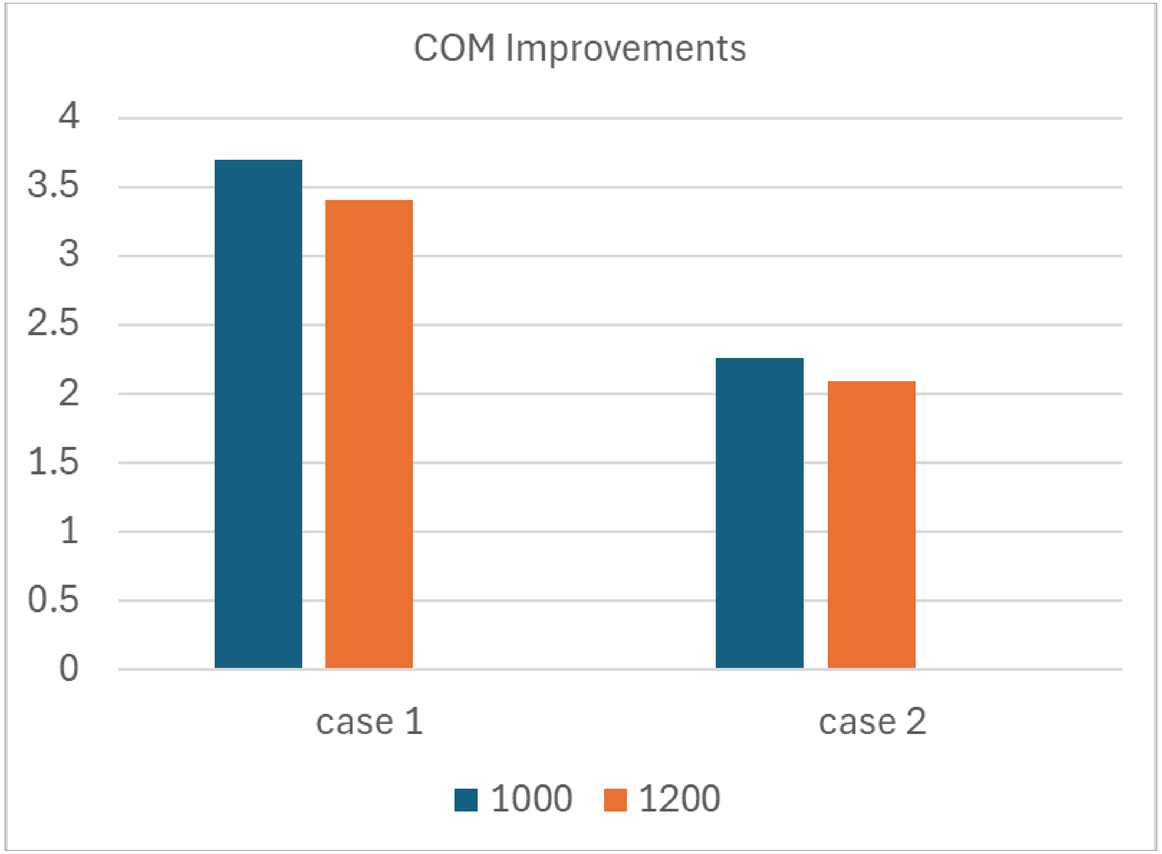
Industry Trend

- Aligns Ethernet with other SERDES standards like PCI Express
  - 5.0 spec all data rates 1200mV Differential peak to peak voltage (max) (2019)
  - 6.01 spec all data rates 1000mV Differential peak to peak voltage (max) (2022)
  - 36dB pad to pad loss in 5.0 and 32dB for 6.0
- Industry recognized that 50% margin on the nominal voltage was problematic
  - Process nodes no longer support higher voltages
  - Reducing the range from 50% to 25% better bounds the solution space and implementations
  - Calibration circuits from decades ago are greatly improved to allow better control and matching

Challenges of 0.6V Vf max support in current silicon

- Silicon process technologies have reduced voltage supplies over the last several node generations
  - Future technology nodes are unlikely to reverse this trend
- Many current RX designs cannot tolerate high TX Differential peak to peak voltage (max) and require use of swing control to request reduction
  - Overdriving the receiver front end can lead to linearity problems which impact accurate PAM4 recovery
  - Failure to respond to swing reduction request can lead to electrical overstress
- In short channel applications, RX will typically reduce Differential peak to peak voltage (max) to save power and reduce crosstalk

COM Simulations for CR



0.3dB and 0.17 dB COM improvements

- Example Case showing improvement of reducing the xtalk terms
- Simulations of marginal passing and marginal failing CR channels (Case 1 vs Case 2)
- Channels run with A_ne .6V and then 0.5V mV
- Improvements noted in COM by reducing A_ne relative to other parameters
- Further investigation may show additional improvements of other COM parameters

- This example:
  - uses akinwale_3dj_01_2311, 22dB channel vendor X
  - COM4.6

Summary

- Reducing Vf max from 0.6V to 0.5V
  - Reduces complexity of receiver design
  - Enables lower power supply SERDES
  - Enables current and future silicon process nodes
  - Increases compatibility with other SERDES Specifications
  - Reduces system power and noise

Thank You

Backup

Comments

	Sub-clause	Line #	Comment	Proposed Change
345	178.9.2	18	Table 178-6 has the Differential pk-pk voltage (max) Transmit enabled as 1.2V. This should be reduced to 1.0V to be consistent with Vf of 0.500	Reduce Differential pk-pk voltage (max) to 1.0V when Transmitter enabled
346	178.10.1	12	Table 178-13 has Ane set to 0.578V which is consistent with 0.6Vf but should be reduced to 0.482 to match Vf of 0.5V	Reduce Ane to 0.482
347	179.9.4	40	Table 179-7 has the Differential pk-pk voltage (max) Transmit enabled as 1.2V. This should be reduced to 1.0V to be consistent with Vf of 0.500	Reduce Differential pk-pk voltage (max) to 1.0V when Transmitter enabled
347	179.9.4	51	Table 179-7 has Transmitter steady-state voltage, Vf (range) 0.4 to 0.6 V. This range should be reduced to 0.4 to 0.5 to be consistent with Vf of 0.500	change Transmitter steady-state voltage, Vf (range) to 0.4 to 0.5V
349	179.9.5	40	Table 179-10 has the Amplitude tolerance set to 1.2V. This should be reduced to 1.0V to be consistent with Vf reduced to 0.5V	Change Amplitude tolerance to 1.0V
350	179.9.5.2	4	Amplitude tolerance set to 1.2V. This should be reduced to 1.0V to be consistent with Vf reduced to 0.5V	Change Amplitude tolerance to 1.0V
351	179.11.7.1	34	Table 179-17 has Ane set to 0.578V which is consistent with 0.6Vf but should be reduced to 0.482 to match Vf of 0.5V	Reduce Ane to 0.482
352	176C.5.1	9	Table 176C-7 has Ane set to 0.578V which is consistent with 0.6Vf but should be reduced to 0.482 to match Vf of 0.5V	Reduce Ane to 0.482

Backup

comments

	Sub-clause	Line #	Comment	Proposed Change
353	176D.5.3	24	Table 176D-1 has the Differential pk-pk voltage (max) Output enabled as 1.2V. This should be reduced to 1.0V to be consistent with Vf of 0.500	Reduce Differential pk-pk voltage (max) to 1.0V when Transmitter enabled
354	176D.5.3	34	Table 176D-1 has Transmitter steady-state voltage, Vf (range) 0.4 to 0.6 V. This range should be reduced to 0.4 to 0.5 to be consistent with Vf of 0.500	change Transmitter steady-state voltage, Vf (range) to 0.4 to 0.5V
355	176D.5.4	19	Table 176D-2 has the Differential pk-pk voltage (max) Output enabled as 1.2V. This should be reduced to 1.0V to be consistent with Vf of 0.500	Reduce Differential pk-pk voltage (max) to 1.0V when Transmitter enabled
356	176D.5.4	31	Table 176D-2 has Transmitter steady-state voltage, Vf (max) 0.6 V. This should be reduced to 0.5 to be consistent with Vf of 0.500	change Transmitter steady-state voltage, Vf (range) to 0.4 to 0.5V
357	176D.5.5	27	Table 176D-3 has the Amplitude tolerance set to 1.2V. This should be reduced to 1.0V to be consistent with Vf reduced to 0.5V	Change Amplitude tolerance to 1.0V
358	176D.5.6	17	Table 176D-4 has the Amplitude tolerance set to 1.2V. This should be reduced to 1.0V to be consistent with Vf reduced to 0.5V	Change Amplitude tolerance to 1.0V
359	176D.6.2	9	Table 176D=6 has Ane set to 0.578V which is consistent with 0.6Vf but should be reduced to 0.482 to match Vf of 0.5V	Reduce Ane to 0.482
360	176D.7.11	36	Amplitude tolerance set to 1.2V. This should be reduced to 1.0V to be consistent with Vf reduced to 0.5V	Change Amplitude tolerance to 1.0V

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- **Annex 176D: Chip-to-module Attachment Unit Interfaces 200GAUI-1 C2M, 400GAUI-2 C2M, 800GAUI-4 C2M, and 1.6TAUI-8 C2M**