A World of Ubiquitous Data: Computing industry trends and the opportunity they offer the Signaling and Electromagnetic modeling community

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The computing industry is going through a sea of change. We are at the edge of a new digital revolution where data is going to be ubiquitous. AI, Autonomous driving and the internet of things will drive data consumptions into the realm of terabytes/second and create new usages that we can't yet fully fathom. Data will be like water or electricity… a necessity. While the exact new use cases and the associated problems that they will bring are evolving daily, there are some trends that can point to the types of challenges that the industry will face as we enter this new age.

- Ubiquitous data drives insatiable bandwidth requirements
- Moore's Law shows no sign of slowing down.
- Interface frequencies must scale with Moore's Law to feed the compute engines
- Higher bandwidth requires faster buses and new signaling techniques
- Radios in systems are multiplying – WiFi, LTE, 5G etc.
- Power budgets are decreasing, increasing SNR and challenging high-speed signaling
- Form Factors are going wild making standardization of solutions very challenging
- Compute devices are shrinking, inducing complex interactions between IOs and radios

In short radio frequencies, IO frequencies and form factors are on a collision course. These trends necessitates the need to think about delivering a "solution" vs delivering a "capability". While a new IO technology or radio technology may be interesting, if it cannot be economically integrated into a device, it will remain just an interesting technology. Adopting a solutions mindset is the opportunity for the EM, signaling and modeling community to get ahead of the curve and be enablers to this next wave of computing.

Some of the most promising areas to explore for solutions are:

- Fast and accurate full system extractions that can model complex system level IO & radio interactions.
- IO innovations that actively cancel crosstalk minimizing interference
- Alternative approach to solve EMC problems – such as predictably guiding fields to areas we don't care about
- Efficient non-linear analysis
- Silicon level floor planning assessment capabilities to determine IP to IP coupling at the silicon level

Bio: Sanjiv is the Sr. Director of the Client Physical Architecture team within the Client Computing Group at Intel Corporation. His organization has R&D operations in California, Oregon, Costa Rica, Malaysia & India focused on platform and package level architecture, analysis and engineering. Sanjiv joined Intel in 1996 as a validation platform design engineer in Chandler, AZ. Over the years he has held many engineering leadership positions at Intel in fields like VHDL design, validation, Signal Integrity, Power Integrity and Platform Power Delivery. Since 2017 he

has been leading the Client Physical Architecture team, with the charter to make the platform hardware solutions a competitive advantage for Intel, by making it smaller, cheaper and easier to implement while delivering category leading performance and user experiences. Some of his significant achievements were pioneering work on pkg and die level power delivery modeling and analysis, driving signal & power integrity co-simulation methodologies, delivering the first integrated on-package voltage regulator for Intel processors and driving a variety of platform power delivery strategies for Intel. Sanjiv has 3 patents and is a 2017 Intel Achievement Award winner.

Sanjiv has a B.Tech in Electronics and Communications Engineering from the National Institute of Technology, Kozhikode, India and an MS EE from Arizona State.