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21st-Century NanoSystems for Abundant-Data Computing: The N3XT 1000X

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Abstract

The world's needs for analyzing massive amounts of data is growing dramatically. The computation demands of these abundant-data applications, such as AI machine learning, far exceed the capabilities of today's computing systems. We must create new transformative NanoSystems which exploit unique properties of underlying nanotechnologies to implement new architectures. Such 21st-century NanoSystems are made possible by tremendous progress in nanotechnologies since 2000, from logic, memory and sensing devices to new integration approaches enabled by such nanotechnologies.

This talk will present the N3XT (Nano-Engineered Computing Systems Technology) approach that enables such NanoSystems through: (i) new architectures leveraging emerging (logic and memory) nanotechnologies and their dense 3D integration with fine-grained connectivity for computation immersed in memory, (ii) new logic devices (such as carbon nanotube transistors for high-speed and low-energy circuits) as well as high-density non-volatile memory (such as resistive RAM that can store multiple bits inside each memory cell), amenable to (iii) ultra-dense (monolithic) 3D integration of thin layers of logic and memory devices that are fabricated at a low temperature.

A wide variety of N3XT hardware prototypes (built in research facilities and also in the US foundry as part of DARPA's 3DSoC program) represent leading examples of transforming scientifically-interesting nanomaterials and nanodevices into actual 21st-century NanoSystems. N3XT NanoSystems target 1,000X system-level energy-delay-product benefits especially for abundant-data applications. Such massive benefits enable coming generations of applications that push new frontiers, from deeply-embedded computing systems all the way to the cloud.

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