

Microsystems Technology Roadmap Overview

Canada's National Design Network, June 2018



	NDN Technology Space	Year 1 2018	Year 2 2019	Year 3 2020	Year 4 2021	Year 5 2022
SYSTEMS, ARCHI- TECTURES, NETWORKS	Embedded System and Machine Learning Demonstrators	✓ Neural network co-processor ✓ Form-factor optimized IoT node ✓ Heterogeneous cloud computing	✓ Power-efficient embedded machine learning ☆ Application-oriented training dataset ✓ OpenCL for embedded FPGA/GPU ☆ ASIP for Machine Learning ☆ AI edge/cloud demonstrator ☆ KGD/CSP embedded processing library	☆ Multi-die-based heterogeneous processing ☆ Configurable hardware/software AI platform ☆ Neuromorphic co-processor ● High Bandwidth Memory integration ☆ Heterogeneous operating system ☆ Secure edge/cloud demonstrator	☆ Memristor-based FPGA ☆ Optical-interconnect processing node ☆ Real-time heterogeneous operating system ☆ Quantum Co-processor	
DEVICES, CIRCUITS, TOPOLOGIES, SUBSYSTEMS	Microelectronics, MEMS/NEMS	✓ New flavors: SiGe; Imaging(CIS), LP ✓ FinFET Simulation Modeling ☆ MEMS pressure sensors	● CMOS integrated Non-Volatile Memory ☆ 22nm SOI ☆ GaN(power switching) ● Package PDK (Advanced CMOS) ☆ Cryogenic CMOS ☆ CMOS Wafer post processing (integration/ packaging) ● CMUT on CMOS	● RF MEMS for optical communications ● 130nm SiGe with Opto ☆ non von Neumann architecture modeling ☆ Photonics and Microelectronics co-design flow ● Graphene coatings ☆ Advanced materials and processes for 2.5D Heterogenous Integration ☆ Integrated package / chip PDK ● THz communication (systems)	● GAA/Nanowires ● Heat dissipation (microfluidics) ● Cryogenic Memory ● Low actuation voltage devices	
	Photonics: Silicon- Photonics, III-V, Optics	● SOI optimized for long wavelength ☆ Hybrid SOI and Si3N4 platform ☆ III-V integration platform ✓ Experimentally verified compact models in Si-P ✓ Integrated Si-P CAD tools with IP libraries ✓ e-beam prototyping ☆ SOI on 300 mm wafers ☆ III-V bonded to Si ✓ Schematic-driven Si-Photonics design flow ● Si3N4 for low loss and/or shorter wavelengths	☆ Monolithic photonic/microelectronic PDK ☆ Si-P PIC LVS with thermo-mechanical modeling ● Photonic device package PDK ☆ Sub-wavelength structures	✓ Integrated package / chip PDK ● Si-P in "zero change" CMOS ☆ Photonics & Microelectronics co-design flow ● Ge waveguides with Si cladding for longer wavelength applications (8-10µm) ● Strained Ge for direct gap applications	● Intra-chip optical interconnect ☆ Epi-based III-V gain block in SOI PDK	
	Packaging and Multi- scale Integration	● Photonic wirebonds ✓ III-V epi on Si ☆ Device scale III-V bonded to Si ✓ Sub dB passively-aligned edge coupling in Si-P PDK ● LTCC ✓ 2.5D Si-based interposer ● Flip Chip BGA ☆ Fan-Out WLP	☆ Interposer with optical I/O ● Wafer scale III-V bonded to Si ☆ Photonics PDK with DFPackaging content ☆ Glass Interposer	☆ Optical interposer with integrated source ● Transfer printing of III-V to Si-Photonics ● Package/chip PDK with thermo-mechanical modeling ☆ Advanced materials and processes for 2.5D Heterogeneous Integration ☆ Flip chip at fine pitch ☆ Optical interconnect in organic substrate (PCB)	● Intra-chip optical interconnect ● Nanowire or templated heteroepitaxy in Si-P PDK ☆ PDK for co-design of chip and package	
	Nanofabrication Labs: Quantum nanotechnology, processes (linked to microelectronics and photonics)	☆ Josephson junction circuit ✓ EBL 200 mm Si-P rapid prototyping ☆ post-process released opto-MEMS ☆ roll-to-roll process ☆ 2-photon stereolitho. ✓ GaN power HEMT ✓ THz antenna ✓ PFIB polish edge waveguide ✓ shared process design environment ✓ OG JFET package for liquid sample ● Plasmonic structures integrated with PV ● Plasmonic interconnect in Si-Photonics	● TMDC device ● 3D print Si-P bandgap material ● CNT waveguides ☆ OG JFET on interposer	☆ N-qubit device ● photonic qubit device ● 3D print optical interconnect ● graphene FET circuit ☆ arrayed thermal SPL	● quantum memory ● CMOS integration ● multi-beam EBL	

✓	Key technology feature of a planned Product or Service; Development activities are underway and/or supply chain is available.
☆	CMC is seeking collaborators, suppliers to deliver capability.
●	Anticipated technology feature based on roadmap sources.