Intelligent Microsystems:
Convergence at the Interface of Analog Systems and Digital Processing

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Flow of Technology Innovation

Investment in Technology Innovation is Investment in Options to be Exercised at Higher Levels

10-20 Years

Science
Fabrication
Device
Circuits
Subsystem
Systems
Applications

Military
Commercial
MTO

Yesterday
Today
Future
Military Information Systems

Sense (Analog)
- RF
- μW
- MMW
- IR
- UV
- Visible
- Bio

Process (Digital)
- Memory
- Controller
- Switching
- I/O
- Processor(s)
- A/D

Actuate (Analog)
- Human Interface
- Machine Interface
- Weapon Interface
- Network Interface
- Output

MTO Technologies Inside
- Analog/RF
- Digital Electronics
- MEMS
- Photonics
Technology Transition Strategy

Indirect DARPA-to-Industry-to-Service Path

DARPA
Establishment Of Enabling Technology Base

Defense Industry Assimilation of DARPA Technology

Services System Development

Services Acquisition

Operational System

Defense Industry Assimilation of Technology

MTO $$$

University

Business Unit $10-100M/yr

Small Business $10-100M/yr

R&D Labs FFRDC/ Defense/ Commercial

Commercial Industry (COTS) Assimilation of Technology
MTO Photonic Interconnect Programs

Network Scale:
- Chip
  - CS-WDM
  - CS-WDM
  - C2CO-I
- Board
  - VLSI-P
  - GaAs based O/E
  - Si electronics
  - Freespace
  - 2-D arrays
  - DOE/VCSELs
- Platform
  - OMNET
  - GaAs based O/E
  - Si electronics
  - Freespace
  - 2-D arrays
  - DOE/VCSELs
- Global
  - NGI
  - Global

MTO Program:
- University Opto Centers
  - InP based O/E
  - SM-glass Fiber
  - Very high speed TDM
  - WDM
- Ultra Photonics; MOST
  - Transition to Quantum Devices
  - Accessing Quantum Systems

Photonic Technologies:
- Heterogeneous O/E Integration
- Dense 2-D Waveguide & Free Space
- WDM
- GaAs based O/E
- Si electronics
- Freespace
- 2-D arrays
- DOE/VCSELs
- GaAs based O/E
- VCSELs
- mm Fiber/POF
- Gb/s
- Serial/parallel
- InP based O/E
- SM-glass Fiber
- Very high speed TDM
- WDM

STAB
AOSP
RFLICS

Projected Limits to CMOS (2015)
VLSI Today (2000)
Transition to Quantum Devices
MicroElectronic Device Technology

Application:

- RF/Analog Processing
  - Switch
  - LNA, Mixer, PLL, Video Processing, LogAmp, Power Amp
- Data Conversion
  - Mux, DeMux, A/D
- High Speed Digital
  - DDS, High Speed FIR, IIR
- High Gate Count CMOS
  - Digital Processing, Tuner, FIR, IIR, FFT, T&C, Control

Density: Transistors/Chip

Managing Precision

Managing Complexity

MicroElectronic Device Technology

MIMIC Mixed Signal

VLSI CMOS n-CMOS

InP GaAs
MicroElectronic Device Technology
MEMS Technology Trend and Roadmap

increasing ability to compute

increasing ability to sense and act

Number of Transistors

- ADXL-181 (mil)
- ADXL-50
- ADXL-05
- ADXL-76

- DMD (mirror array)
- Terabits/cm² data storage
- distributed structural control
- inertial navigation on a chip
- displays
- weapons, safing, arming and fuzing
- integrated fluidic systems
- optical switches & aligners
- parts handling
- adaptive optics
- RF MEMS Signal Processors

Number of Mechanical Components

- distributed structural control
- RF MEMS Signal Processors
- inertial navigation on a chip
- DMD (mirror array)
- Terabits/cm² data storage
- increasing ability to compute
- increasing ability to sense and act