The Role of System Modelling in the Design of Always-On IoT Sensor Nodes

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Internet of Things
Sensor Node – key requirements

- Low cost
- Smaller form factor
- Security
- Ease of use
- Ultra low power

  - Extended battery life of 10+ years
  - Cheaper/smaller batteries
  - Ability to run from harvested energy with form factor constraints limiting harvester size
Ultra Low Power

Key parameters:
- Active mode power (energy per function)
- Sleep mode power
- Transition energy
- Wake-up Latency (sleep mode to active mode transition)

Goal: Reduce total energy (area under the curve)
Sensor Nodes – what’s new?

◆ Always-on/Asynchronous

◆ Autonomous/Intelligent
ULP 2.0

- System level power optimization –
  - generation, storage, conversion, delivery and consumption

- Dynamically adaptive architectures
  - data, environment, available energy, communication link
Signal Conditioning – for always on sensing

- Context aware modulation of sample rate and bit precision
- Moving from Analog-to-Digital conversion to Analog-to-Information conversion
ULP 2.0

- System level power optimization –
  - generation, storage, conversion, delivery and consumption

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  - data, environment, available energy, communication link

- Attack each component. Optimal process technology selection for each system component + passives integration => More than Moore diversification as against More of Moore miniaturization
Sensor Node: a “More than Moore” system

Design challenges:
- Analog – Digital partitioning
- HW–SW partitioning
- Chip level vs package level vs board level integration
Role of System Modelling

◆ Verify functionality

◆ Verify/optimize performance

◆ Verify/minimize power
System Context influences power and performance of sensor nodes.
Summary

- IoT sensor nodes
  - Asynchronous
  - Autonomous
  - Adaptive
  - More than Moore systems

- Functionality, Performance and power – heavily dependent on “system context”

- System modelling plays a critical role not only in functional verification and performance optimization, but also in power minimization.
THANK YOU