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

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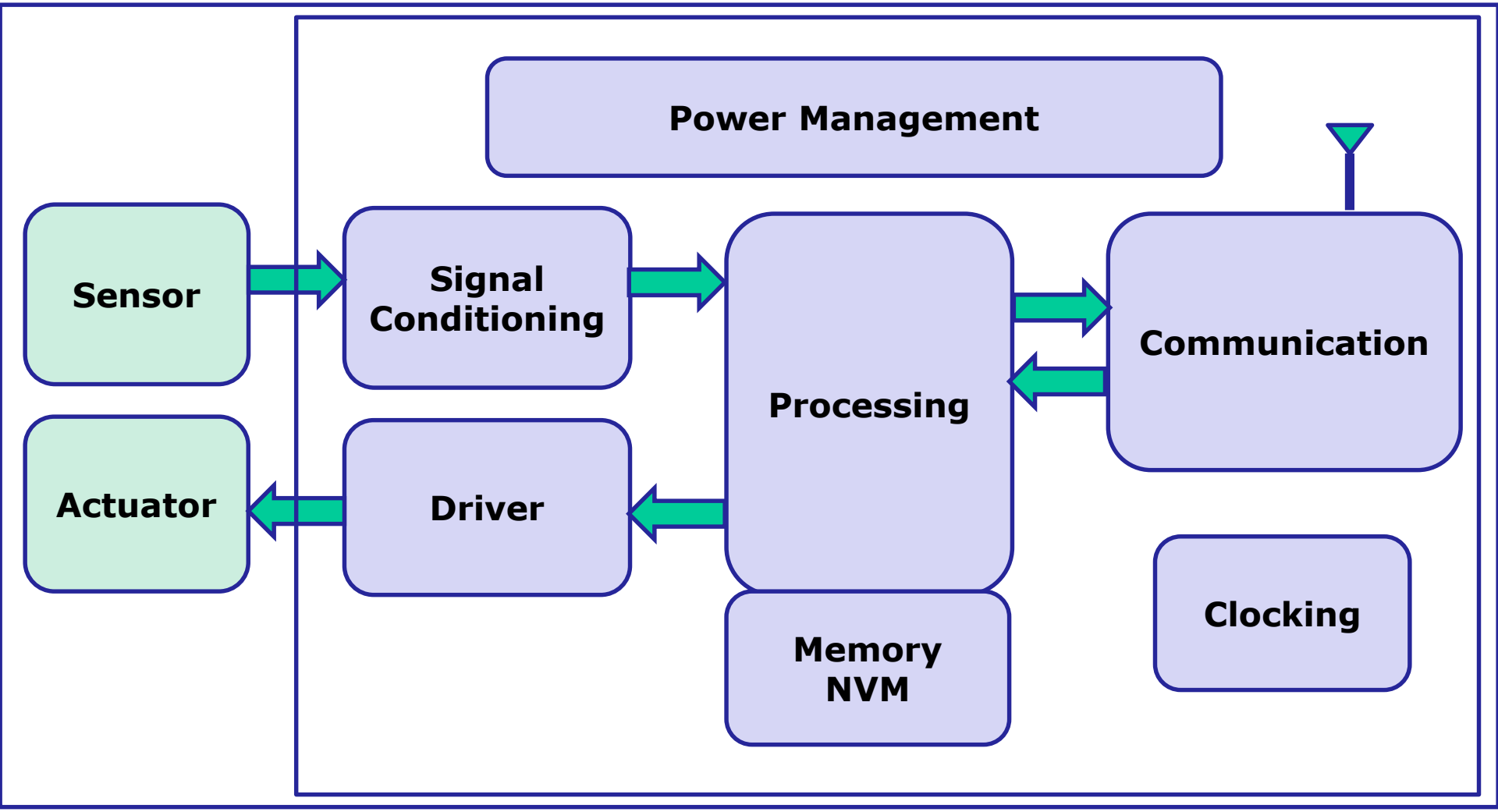
Internet of Things

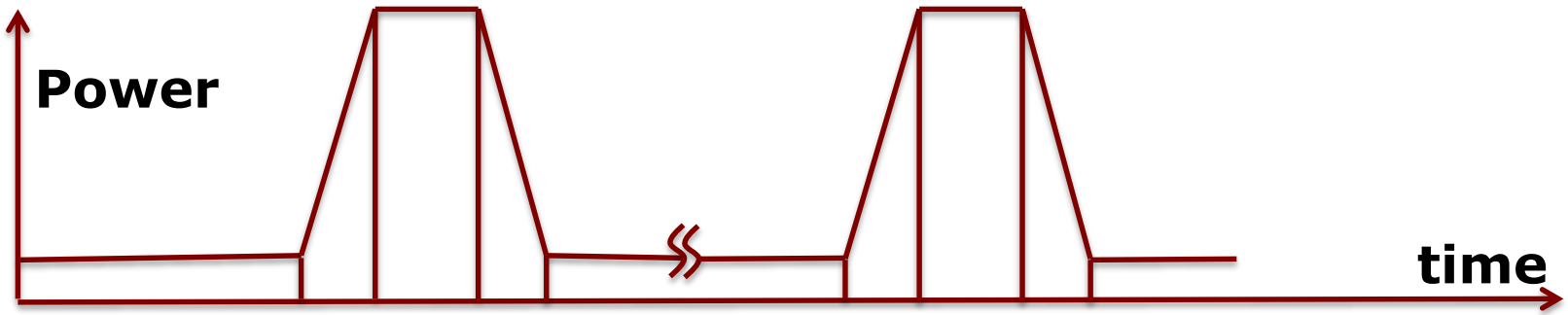
Sensor Node


Power Management
Sensor
Signal Conditioning
Processing
Communication
Actuator
Driver
Memory NVM
Clocking

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?

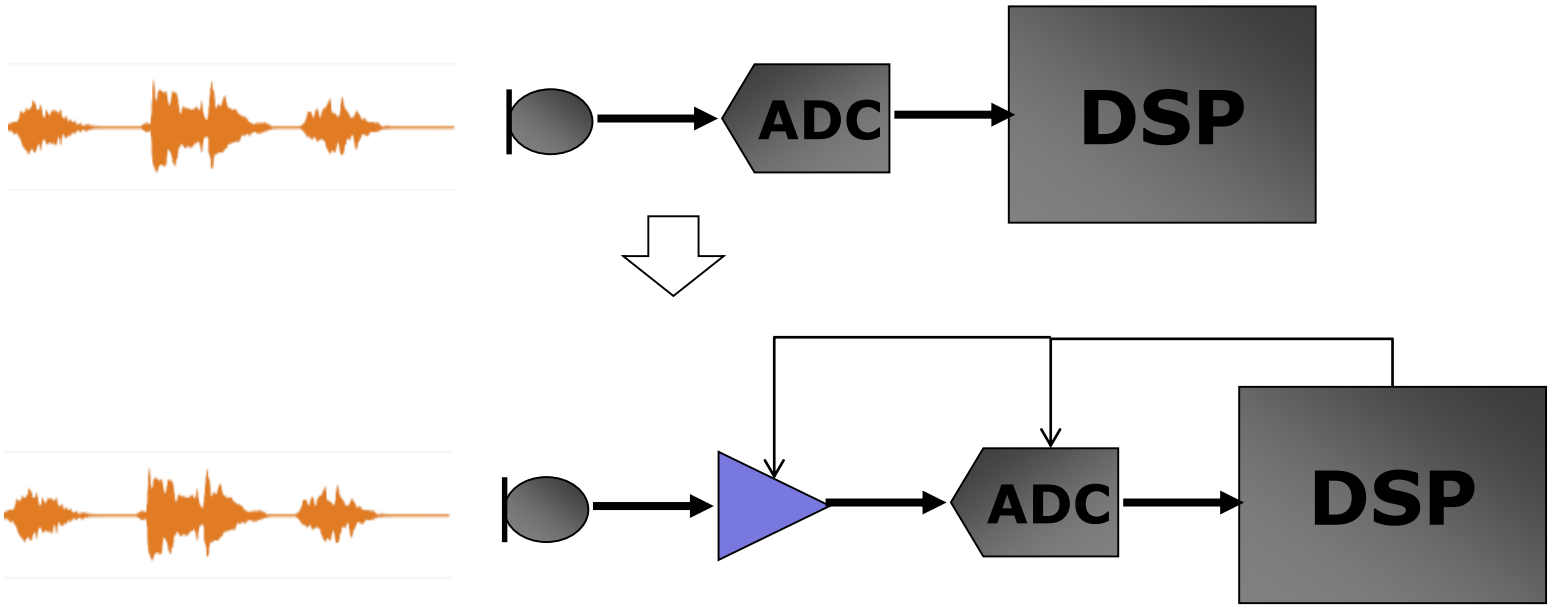
- Always-on/Asynchronous
- Autonomous/Intelligent

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

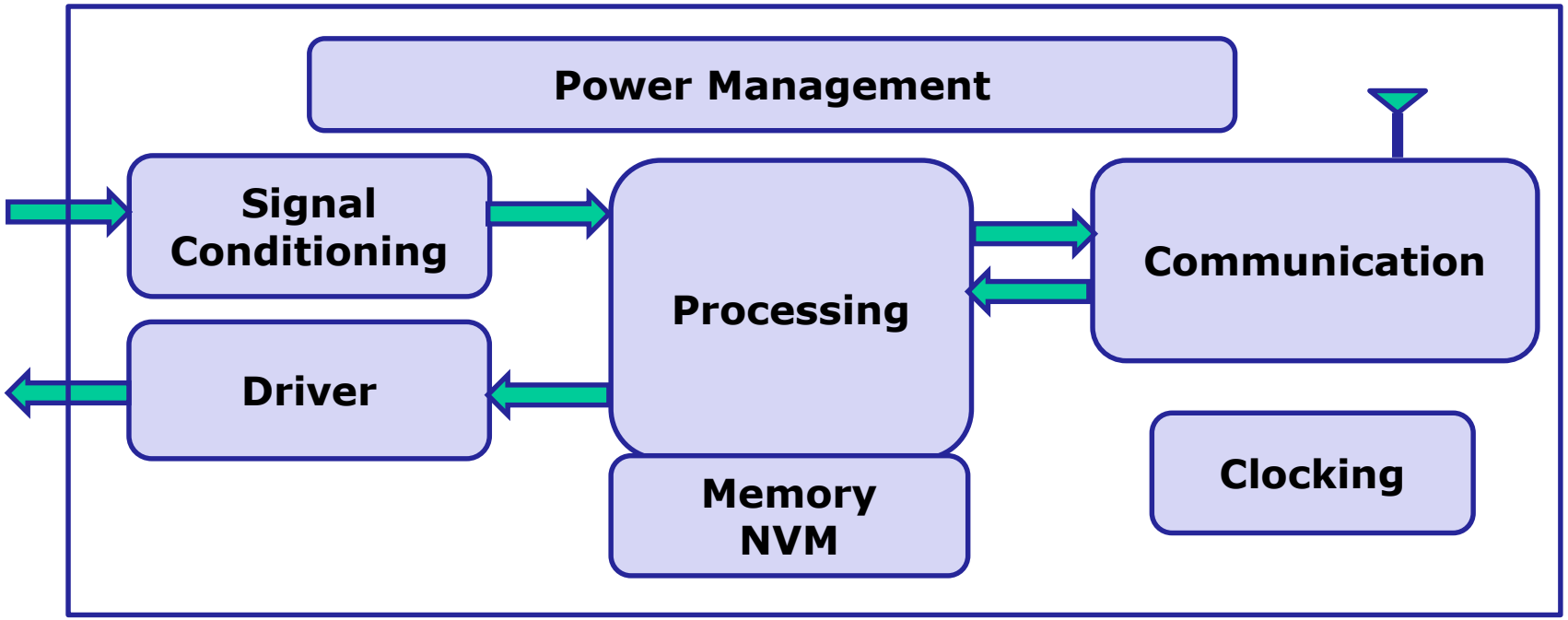
- Context aware modulation of sample rate and bit precision
- Moving from Analog-to-Digital conversion to Analog-to-Information conversion



ULP 2.0

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



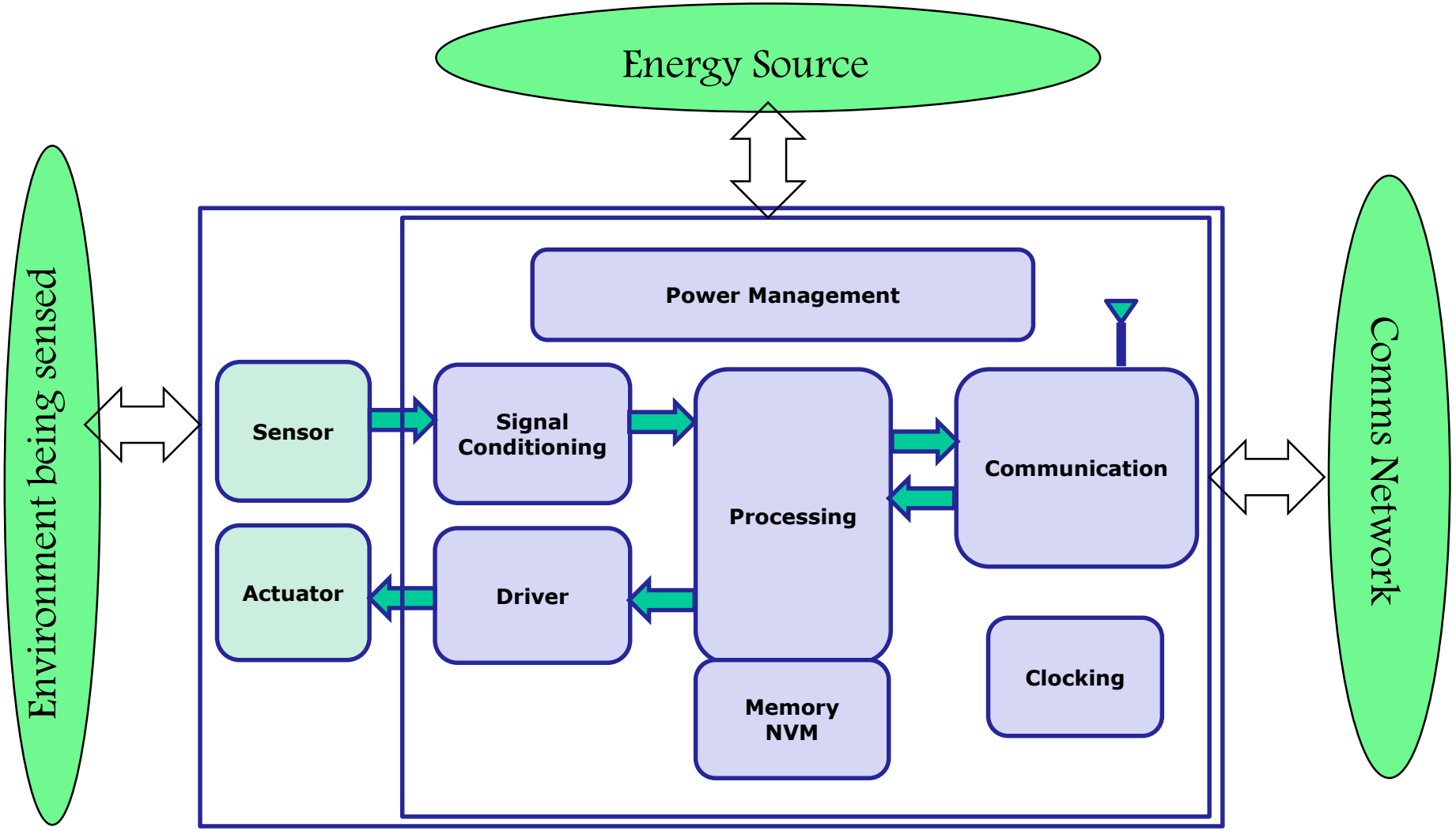
Design challenges:

- 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