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# Hierarchical In-Network Processing

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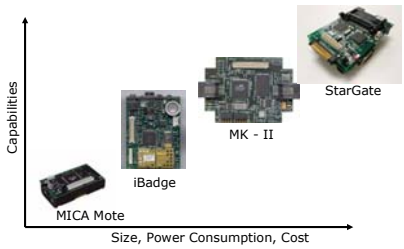
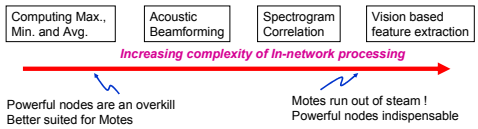
## Introduction: Exploit the heterogeneity

### Diversity in Sensor Node Platforms

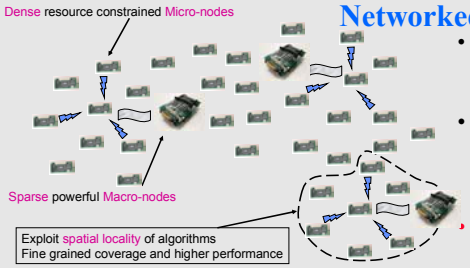



### Why heterogeneous systems ?



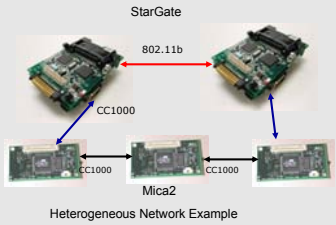

- **Solutions ?**
  - Reconfigurable sensor nodes
    - FPGA: High standby power consumption is a show stopper
    - Stacked Arch.: PASTA Node USC/ISI – High cost of individual nodes, prohibitively expensive
  - *Exploit the heterogeneity of the sensor node platforms !*

## Problem Description: Heterogeneous Sensor Networks




### Networked System Architecture Design Challenges

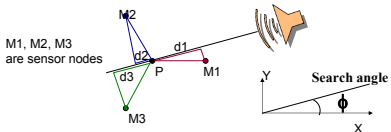
- **Energy efficient application partitioning and mapping**
  - Influenced by the architecture for nodes
  - Complexity of mapped tasks
- **Determining the optimal network composition**
  - Number of macro-nodes and micro-nodes
  - Latency of data transfer is critical
  - Cost vs. performance trade-offs
- **Self-configuration mechansim**
  - Cluster micro-nodes based on proximity to macro-node
  - Offload computation onto the macro-node in the cluster



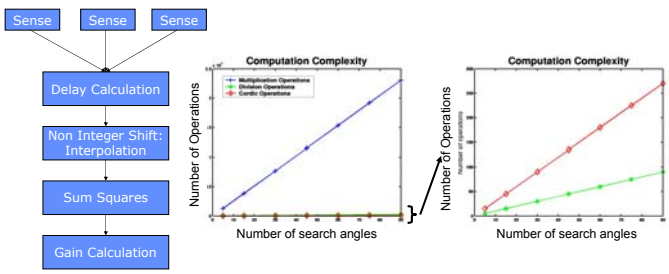
Heterogeneous Network Example

## Proposed Solution: Hierarchical organization of Acoustic Beamforming application

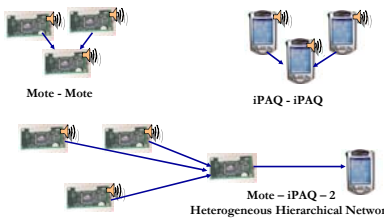
### Target Tracking Application

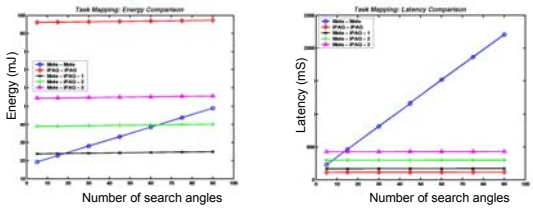



- Parametric, Time-domain Line of Bearing computation
- Sound source located far away from the sensor nodes
- Sensor nodes try estimate the angle of arrival of signal
- Accuracy depends on number of search angles
  - More search angles implies better accuracy

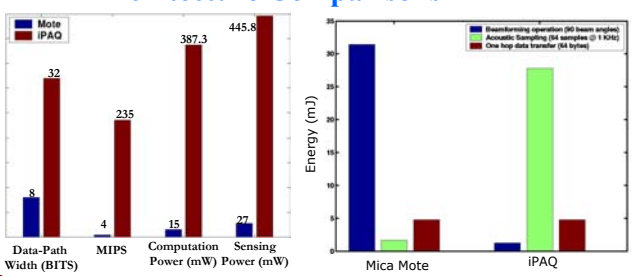



### LOB Energy and Latency Measurements




### Architecture Comparisons




### Node Density Effects