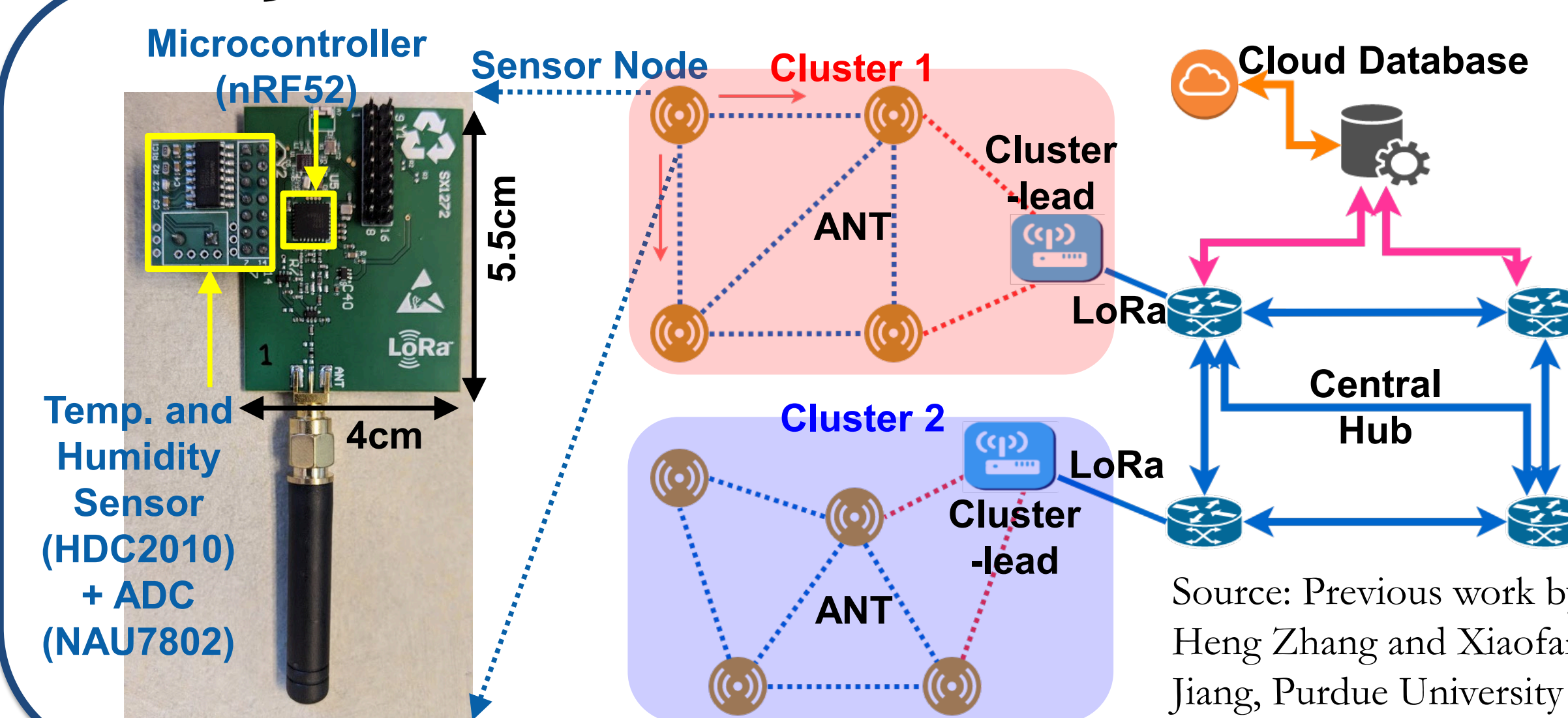


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I. Motivation

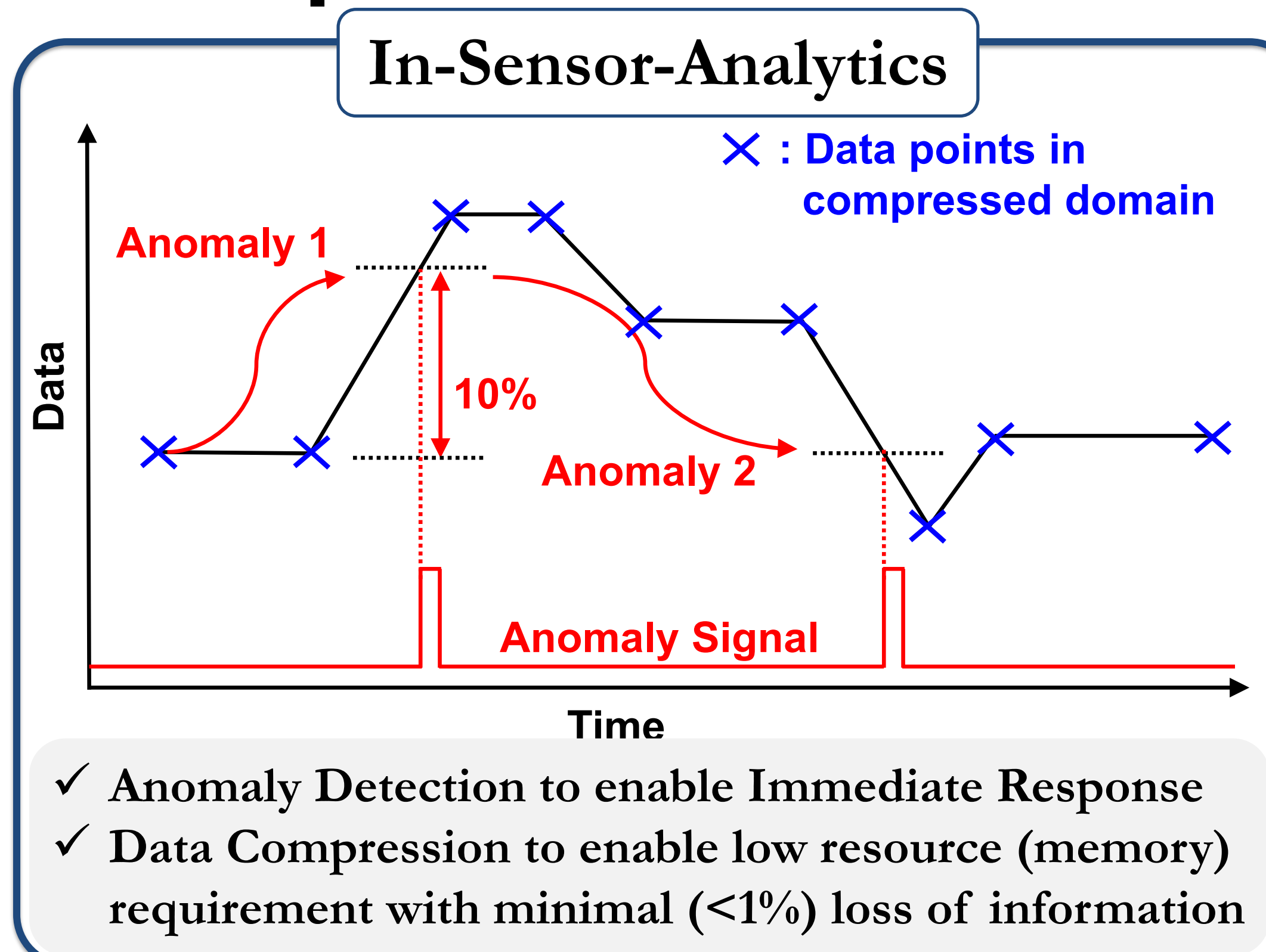
- Large Sensor Network Deployment:** Maintenance cost increases if batteries need to be changed regularly
 - Duty Cycling Causes Information Loss:** The traditional solution of duty cycling causes loss of information with decrease in on-time
- Solution:** a) Anomaly Detection for immediate response
b) Data Compression for to reduce temporal redundancy
c) Collaborative Intelligence to reduce spatial redundancy

II. System Architecture



- Sensor (HDC2010 for temperature and humidity, Purdue Nitrate sensors etc.), ADC (NAU7802), Microcontroller (nRF52) and Communication Modules (Long-range LoRa and Short-range ANT/BLE) in a 4cm x 5.5cm form-factor
- Each node has in-sensor-analytics capabilities (anomaly detection and data compression algorithms)
- ANT/BLE for short-range communication and LoRa for long-range communication that would enable further energy savings through collaborative intelligence (future work).

III. Implementation Details



Data Integrity

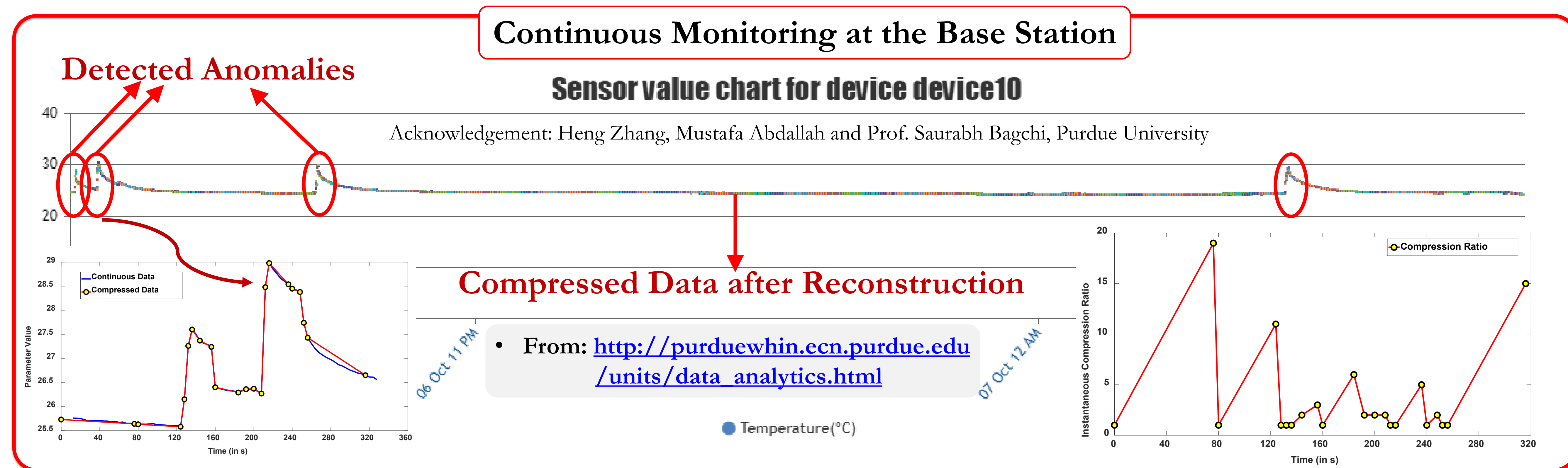
Reliable storage of large data essential for Compression

Source: Nordic

Fast data storage implementation

- Minimizes risk of data corruption
- Simplifies interaction with the persistent storage (flash)

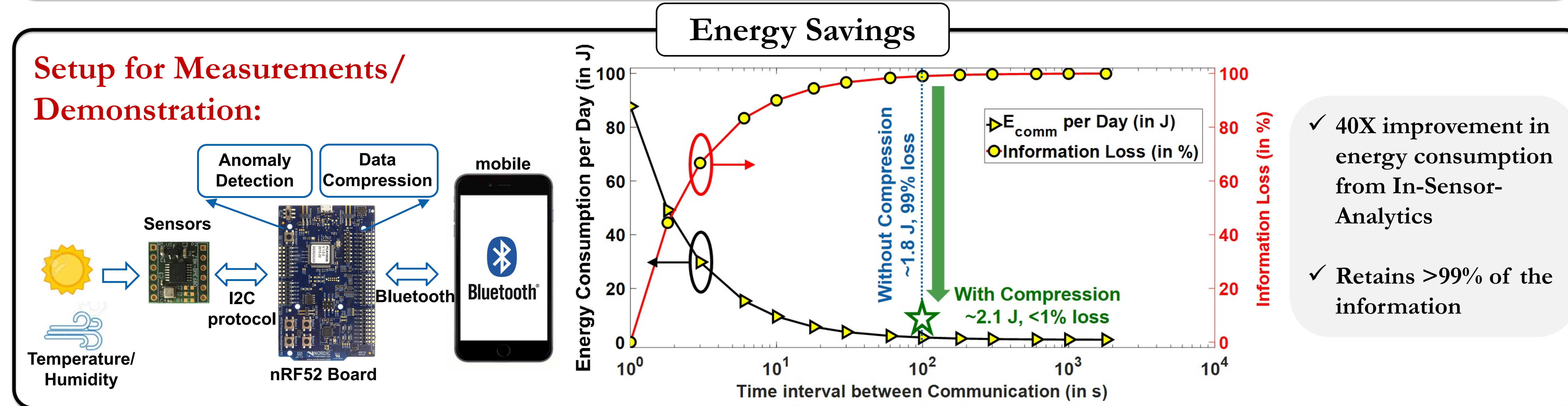
- Integrity verified through multiple read/write cycles



Ongoing Work: Collaborative Intelligence

- ANT multicast (8B) for sending Anomaly Information
- Can be extended to:

Device ID (1B)	Initial Reading (1B)	Modified Reading (1B)	Time Instant (1B)	Battery Remaining (1B)



IV. Impact of Our Research

- A platform for In-Sensor-Analytics is developed, which could result in upto 40X energy savings per node.
- Anomaly detection, with proper thresholding could be utilized to enable an Immediate Response System for critical failures/dramatic change in environmental conditions which could potentially hamper normal operation
- Data compression relaxes the memory resource requirement in each node, and helps to communicate almost losslessly (99% information retention) with lower power consumption.

Collaborators:

