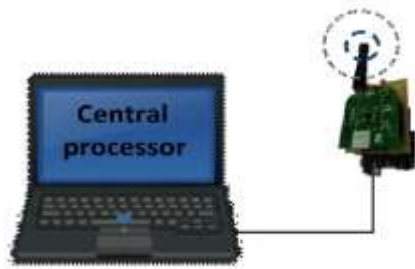# Long Range, Edge-based Wireless Monitoring & Anomaly Detection
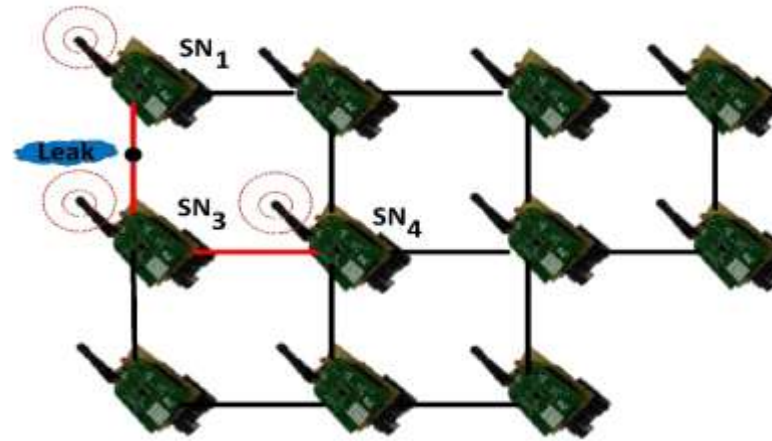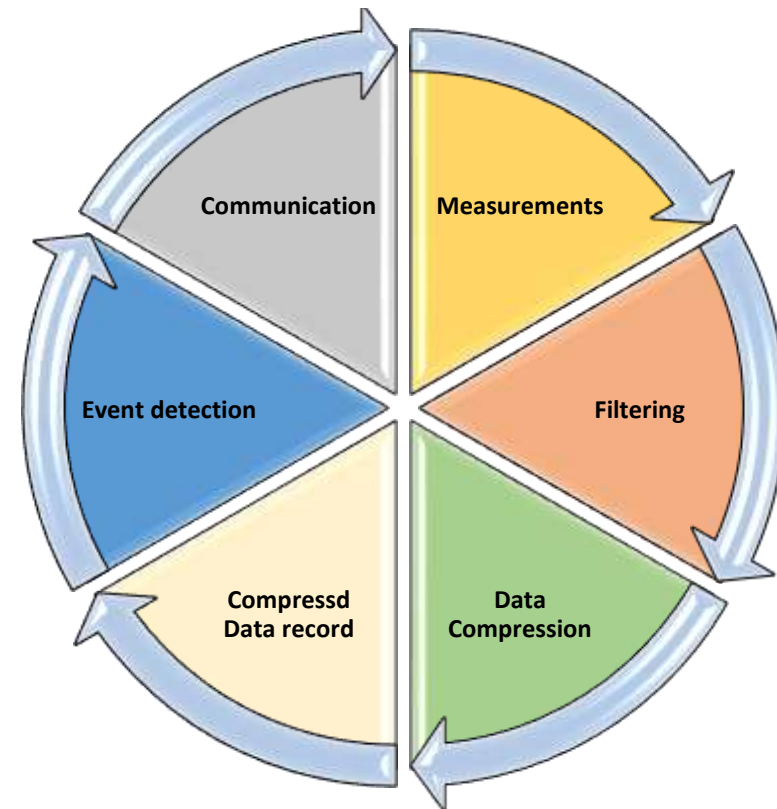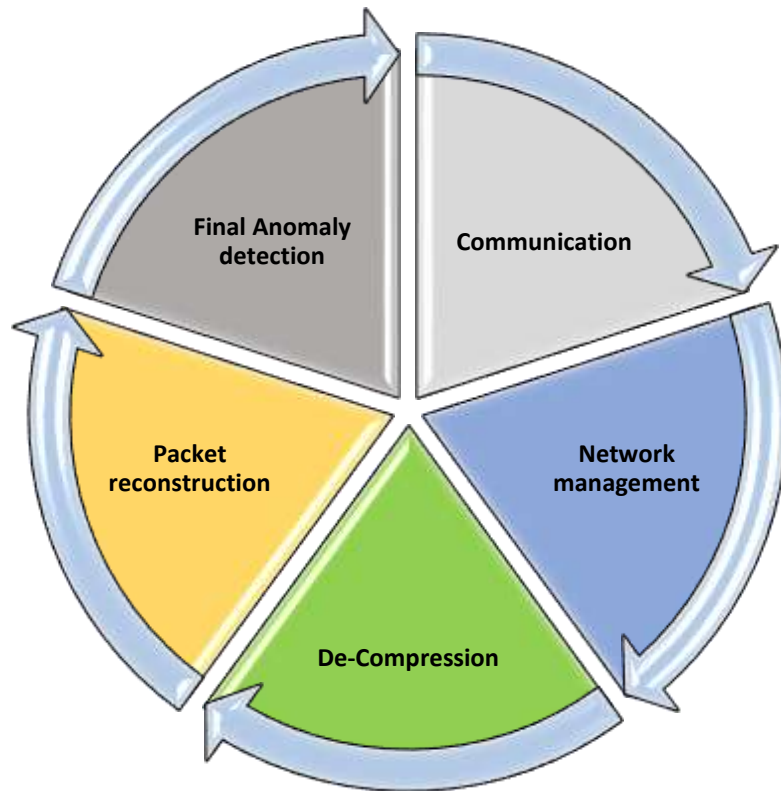

Center side

Sensor-side

1. **Works in:**

   a. **Event trigger mode:** In case of any event, it waits for a specific period (for example 1 min) and then detects the worst event in that period. Then notifies center about the worst event. Center will ask for the pre-fault data of that event later in time.

   b. **Time based mode:** Every T second, SN notifies center with a dummy event notification. Then center asks for the pre-fault data of that event later in time.

2. **Can set to either of the followings:**

   a. To measures environmental variables.

   b. To take photos every pre-defined time.

3. **Gets permission to join the network while transmitting its Battery status together with other information.**

4. **Compresses all pre-filtered measured data.**

5. **Stores compressed data on SD card with related Timestamps.**

6. **In case of event:**

   a. **Detects possible Events.**

   b. **Selects the worst event during a pre-defined period.**

   c. **Notifies the worst event to the center together with its battery status.**

7. **If a data request receives from center:**

   a. **SN prepares pre-fault compressed data of required pre- fault.**

   b. **Transmits the compressed data in a LoRa accepted sub-packet format to the center by request.**

1. **Manages the whole network by:**

    c. Synchronizing all nodes.

        i. Broadcasting important settings and clock time.

        ii. With/Without SD memory card data removal.

        iii. Special Synch command only to newly joined nodes.

    d. Detecting any packet losses and reacts accordingly by repeating the previous request.

    e. Assigns new Ids to newly joined sensor nodes.

    f. Protects network against enemy nodes.

    g. Detects and extracts failed sensors and announce it.

1. **Decompresses received sub-packets, concatenates them to rebuild original data (sensor data or photos).**

2. **Evaluates the full data to detect real anomalies among suspicious events.**

Achievements & Innovations

The Implemented edge-based system offers a novel distributed data analytic architecture with the following Advantages:

- **Management of the whole network in two stages:**
    1. **On-edge**
    2. **By the Central node**

- **Optimal edge-based Monitoring & Anomaly detection by minimization of:**
    1. **Needed RAM space used by the processor.**
    2. **Memory space needed for recording compressed data on the SD memory card.**
    3. **Communication Payload size.**
    4. **Power consumption.**

- **Demonstrates:**
    1. **The highest possible sensor-rate analytic performed at on-edge nodes without requiring the whole data to send back to the server.**
    2. **Either of the Center and Sensor Nodes (SNs) are implemented on the single-core Intel Curie Arduino101 platform.**

- **No data packet loss due to:**
    1. **The center that effectively manages all the communications within the network.**
    2. **Implementation of a lossless compression algorithm.**