Pollution Monitoring using A Generic Nano Satellite and Wireless Sensor Networks

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Objective

Use of Sate-of-the-art Technology for Environmental Mon

Develop new Technologies and Architecture that enables

collaborative, self-organizing sensors that can effec
work together

Develop Quick and reliable space-based observation syste
Monitor Environmental pollution and natural disasters

Objective…

- To collect environmental pollution data using WSN
- To develop space infrastructures to enhance environment data collection capabilities
- To promote easy and fast ways for environmental pollution dataset access
- To focus on scientific and technical issues

Need for Environmental Pollution Monitoring Syste

Unforeseen climate change

Temperatures raise-up

Shift of Rainfall pattern

Melting of Glaciers and snow

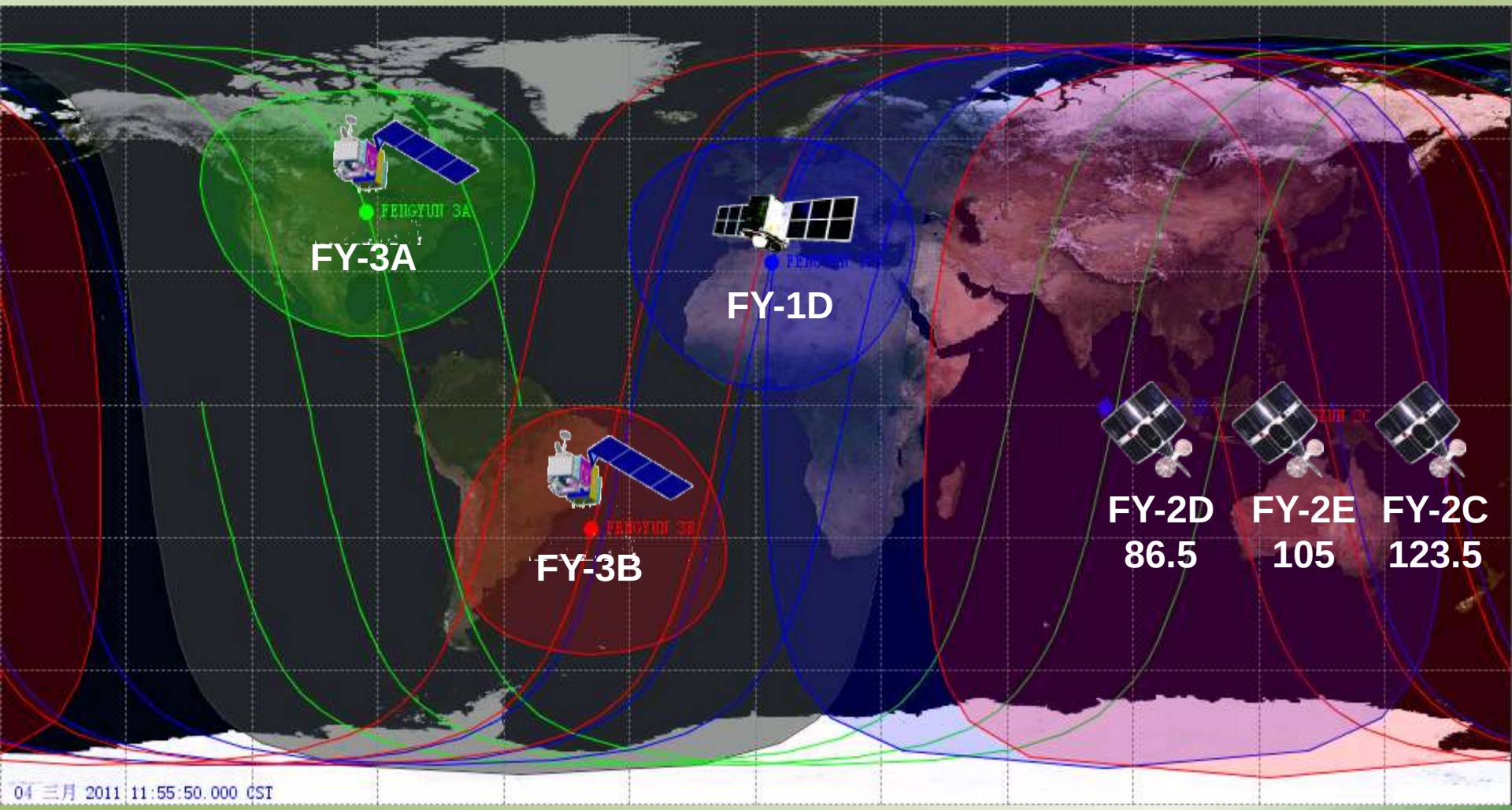
Rise of Global mean sea level

Extreme weather events resulting hazards(flooding and droughts)

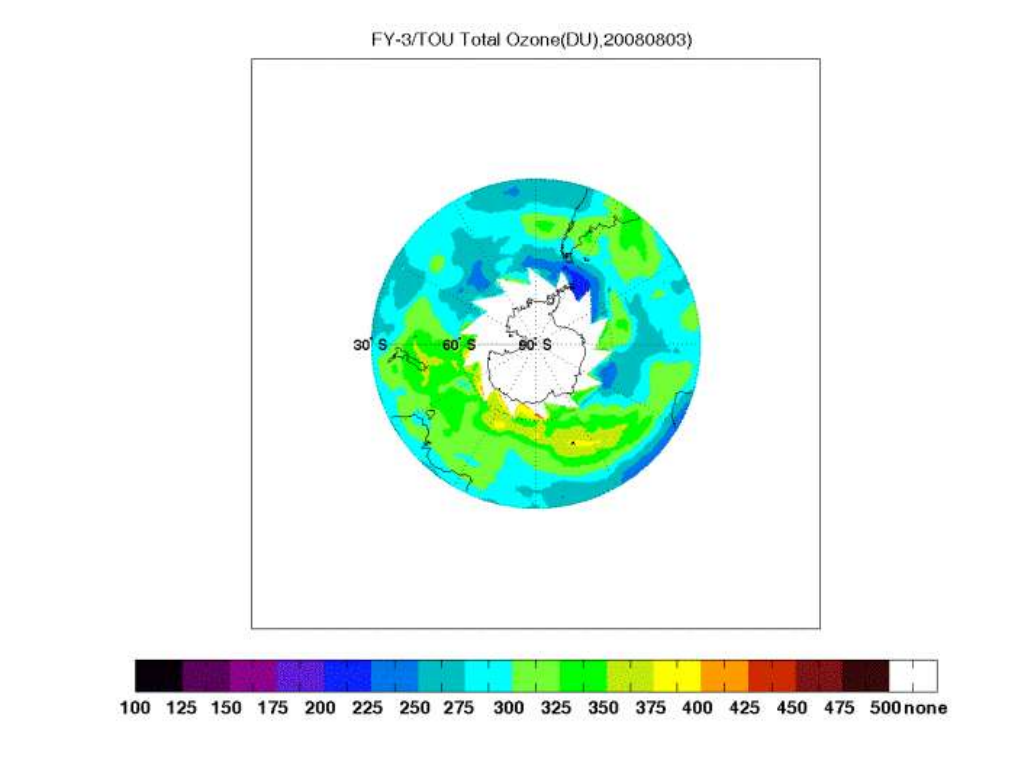
A cost effective solution is a Nano satellite equipped with a mechanism to collect data from the wireless sensor networks spread across any region

Our Mission

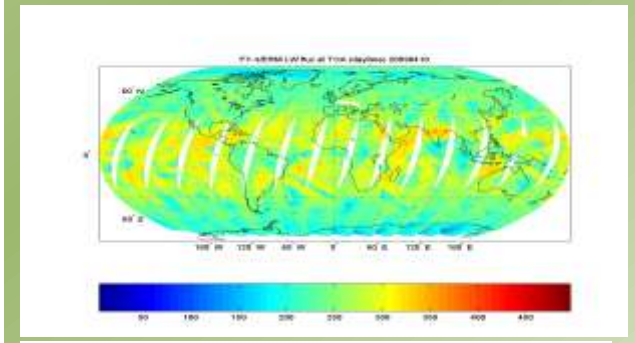
Current Environmental Monitoring Satellites In-orbit

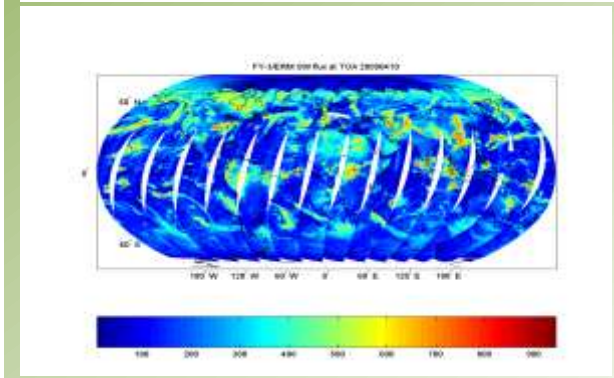


TOU/SBUS: Global Ozone Monitoring



ERB/SIM: Earth radiation budget





Air Pollutants

- *Carbon dioxide*
  - released into the atmosphere by the burning of solid waste, wood and wood products
- *Nitrous oxide*
  - emissions occur during various agricultural and industrial processes
- *Methane*
  - emitted when organic waste decomposes

Air Pollutants

Nitrogen Dioxide: NO2

- brownish gas irritates the respiratory system originates from combustion (N2 in air is oxidized); NOx sum of NO, NO2, other oxides of N

Sulfur Dioxide: SO2

- formed when fuel (coal, oil) containing S is burned and metal smelting
- Precursor to acid rain

Carbon monoxide: CO

- reduces bloods ability to carry O2
- product of incomplete combustion

Proposed Plan

Identify different the types of sensors required for sensing the Air Pollutants

Embed different types of sensors to collect and transmit the environmental pollution data

Spatially distribute the sensor nodes for Sensing and Actuation

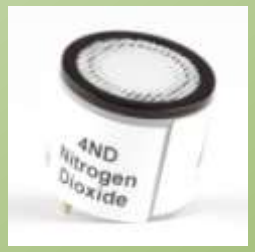
Network these devices for accumulating the localized environmental data in a sink node

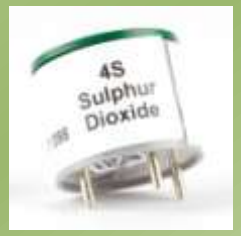
Collect the data periodically via a nano satellite using the store and forward payload

Download the data from satellite and disseminate it for further analysis

Wireless Sensor Networks (WSNs)

A network of small sensor devices that are deployed in an ad-hoc fashion to sense atmospheric air pollutants





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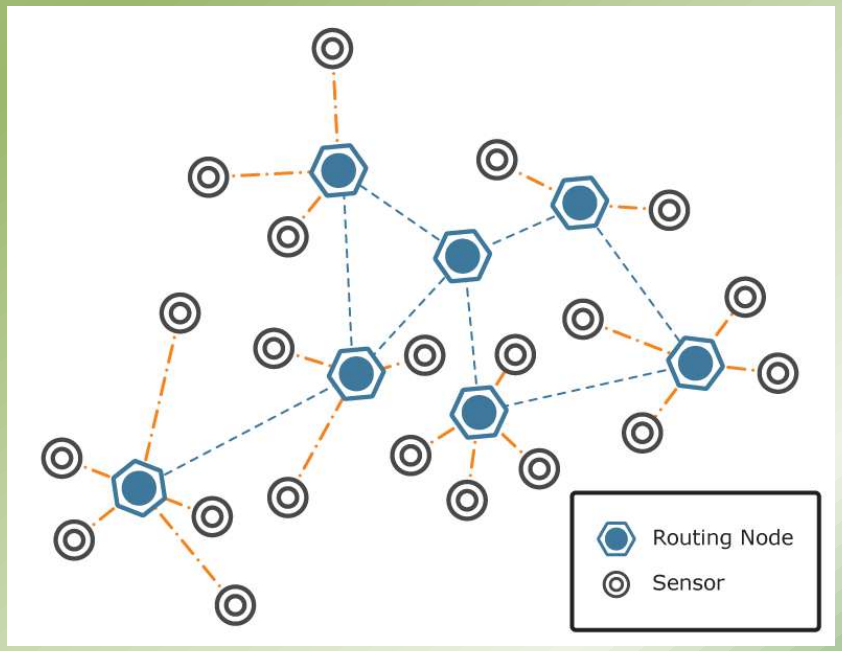
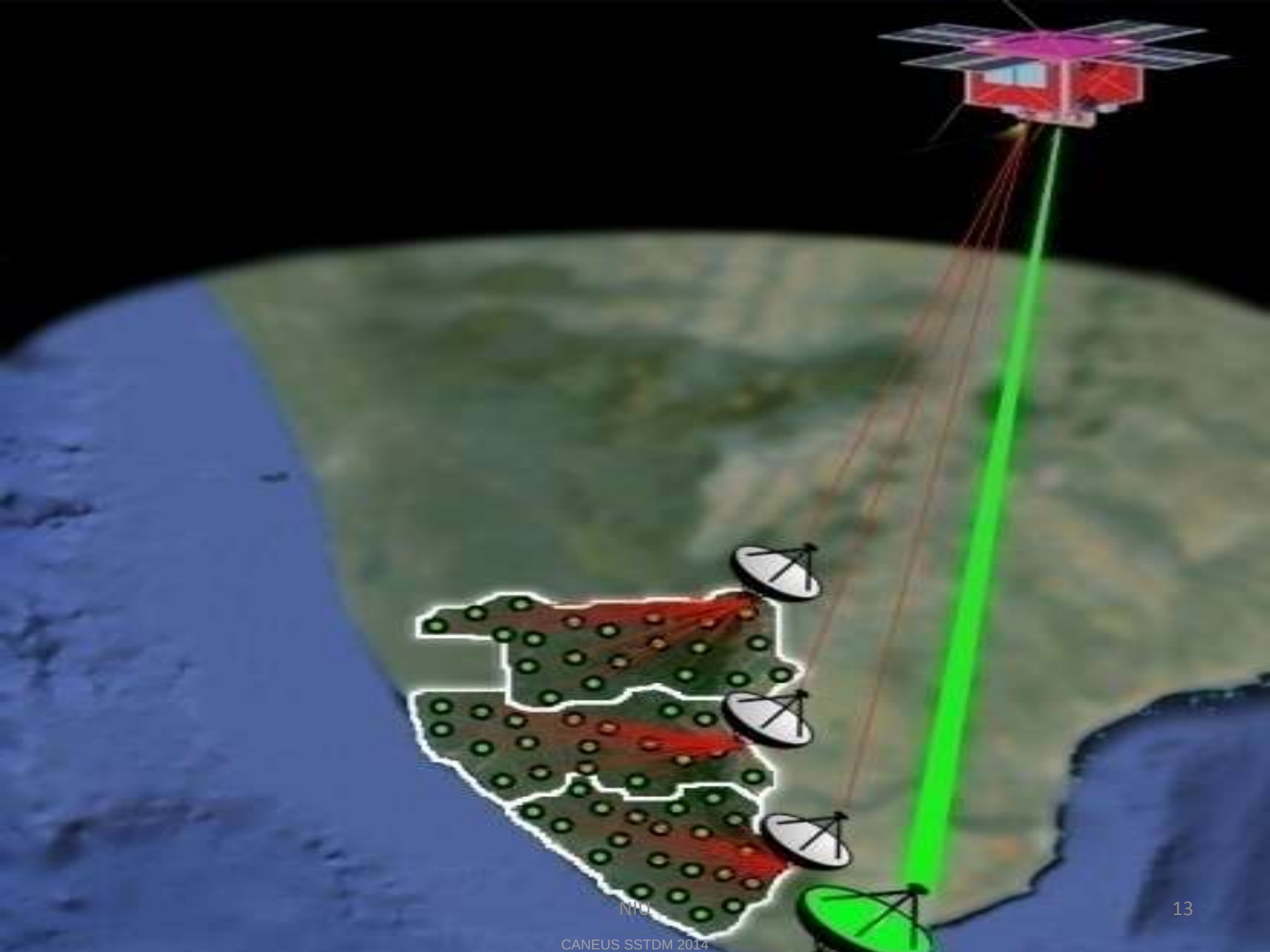
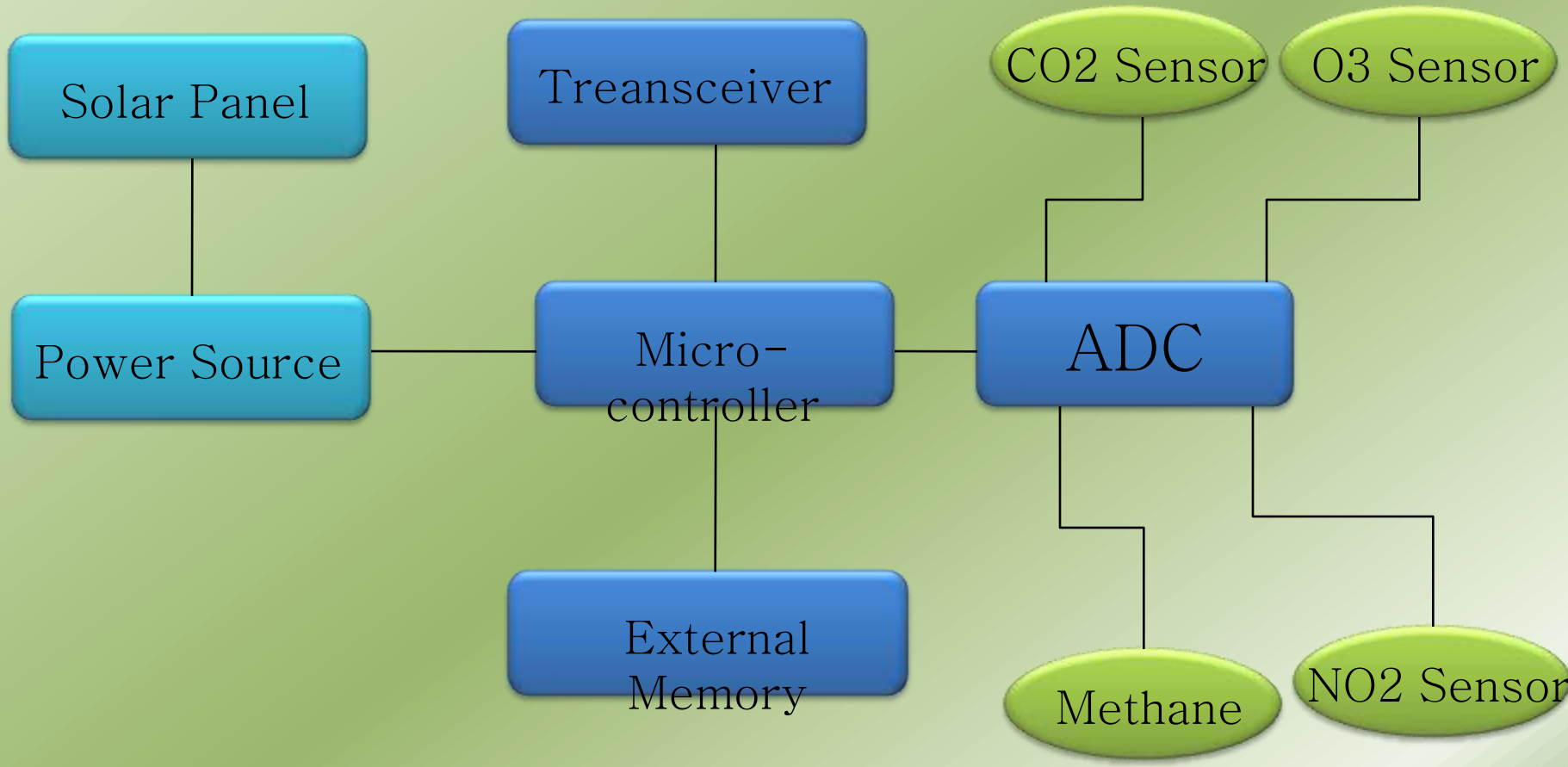
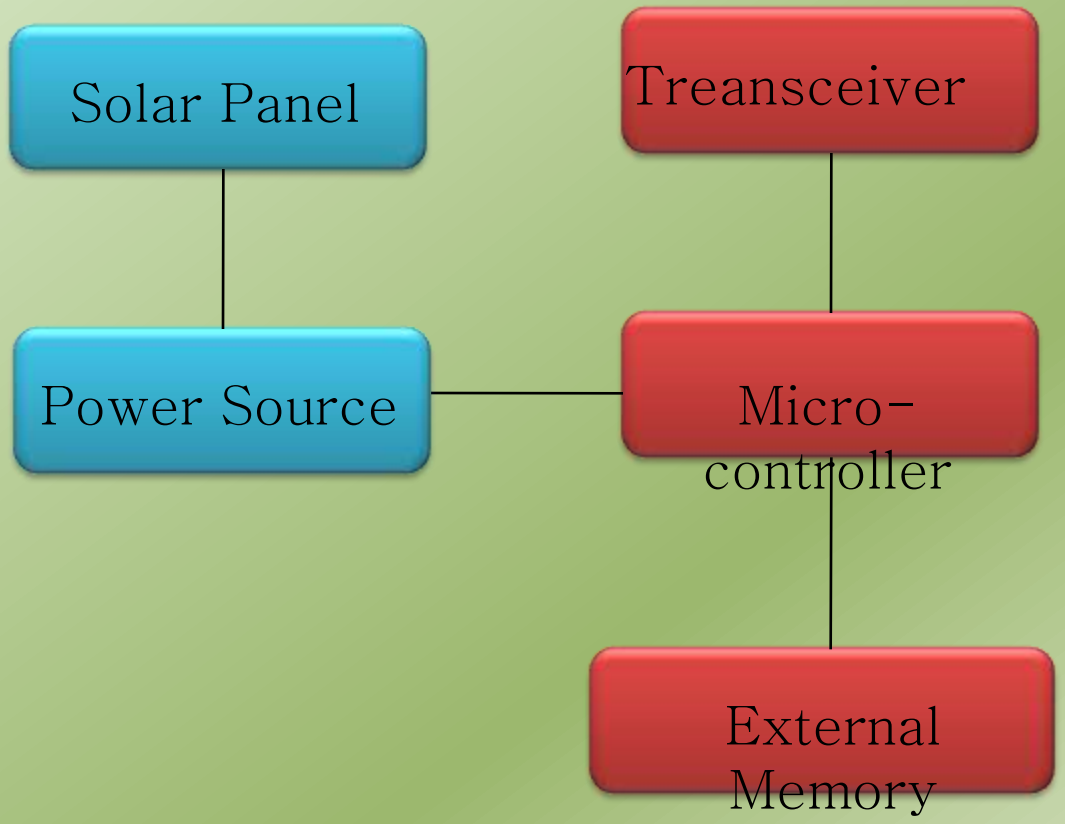




Sensor Node Architecture



Routing Node Architecture



STORE AND FORWARD PAYLOAD

- An on-board receiver
  - a digital receiver operating in UHF band
  - Data storage unit
    - 32 GB flash storage

- Gateway Nodes
  - A deployable mono pole antenna
  - AX.25 protocol for uploading the sensor node data

- Ground Station Data Transmission
  - QPSK at 1 Mbps

Challenges

Device Level

Sensors for sensing the air pollutants in the atmosphere

Life Time

Cost of Sensor Nodes

Integration Mechanism

Calibration Scheme to validate the sensed data

Integration of different sensor in a single sensor node

Development of eco-friendly sensor nodes

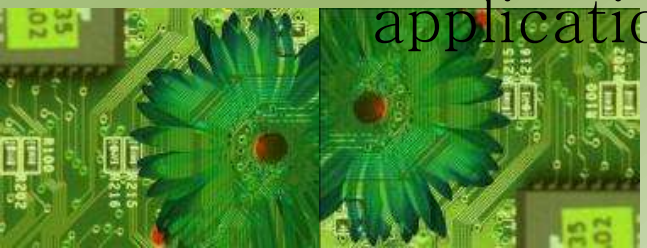
Biodegradable sensor nodes

Challenges …

Dynamics and Control
- Effective Power Management Scheme
- Power Aware Routing Schemes
- Deployment Methods
  - Sensor Nodes
  - Sink Nodes
  - Gateway Nodes

Configuration of Routing Nodes and Gateway Nodes

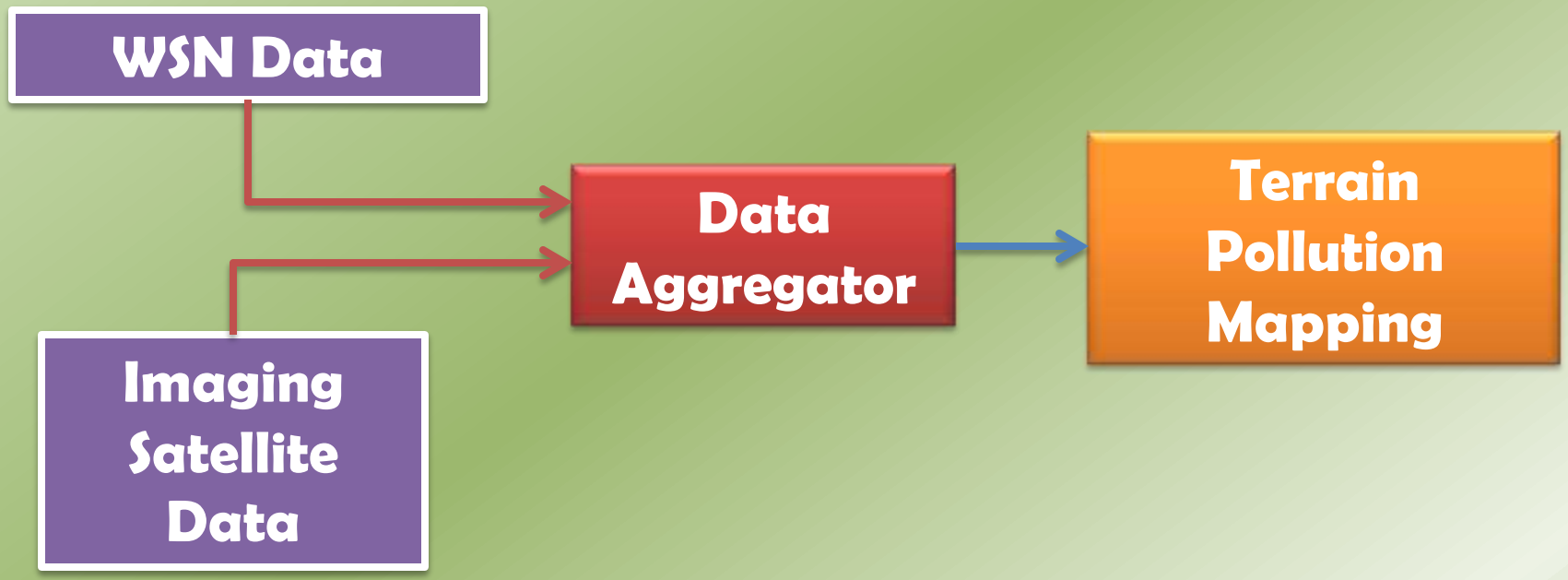
Discovery
- New Protocols
- Failure Handling Schemes
- Open environment (new technologies, new applications, standards)



Possible Collaborations

- Development of Echo friendly wireless sensor nodes
- Power Aware Routing Scheme for Wireless Sensor Networks
- Cost effective Gateway nodes for up-loading sensor node data
- New Failure Handling schemes
- Store and forward Payload

Data Aggregation



CONCLUSION

- WSN provides a potential technique for monitoring the environmental pollution and dust storm monitoring without the need of human intervention

- WSN consists of dense sensor nodes helps to continuously observe the changes in the environment and pollution conditions

- Due to the technological development of small sensors,
  - WSN and the Nano satellites provide huge potential for environment and pollution monitoring
  - Disseminating the data to large number of users with much less cost and effort
  - Make the society aware of the environmental pollution globally