Energy Efficient Wireless Sensor Technology for Precision Farming

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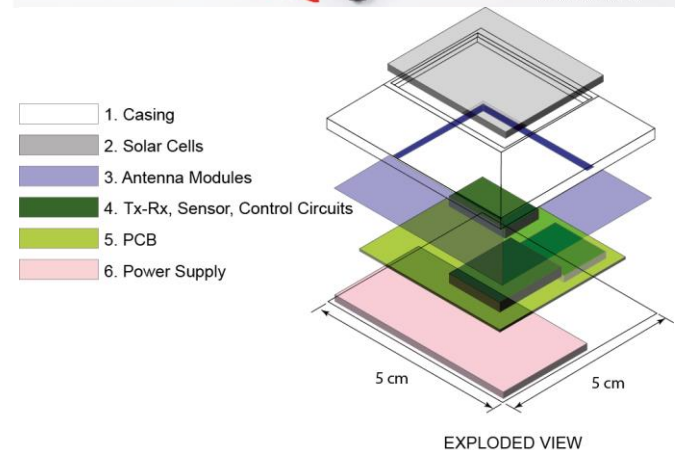Sensors, Circuits and Systems Group

Department of Electronic and Electrical Engineering, UCL
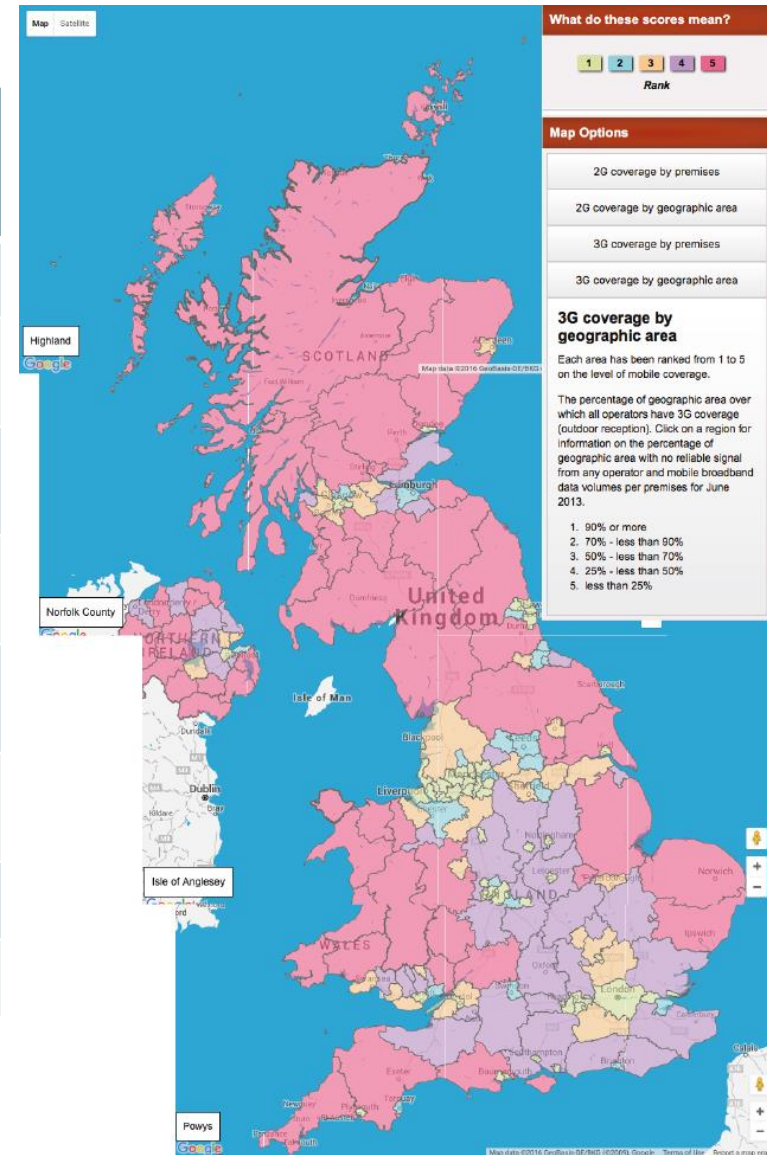
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Background

- **Wireless Network / Sensor Network Projects**
  - Booster Brolly
  - Asset Tracker
  - Smart Meters
- **Networks used in the projects**
  - Mobile (GSM, 3G)
  - Wi-Fi, Bluetooth, Zigbee
  - Long Range Radio (LoRa ®)
- **Features**
  - Compact
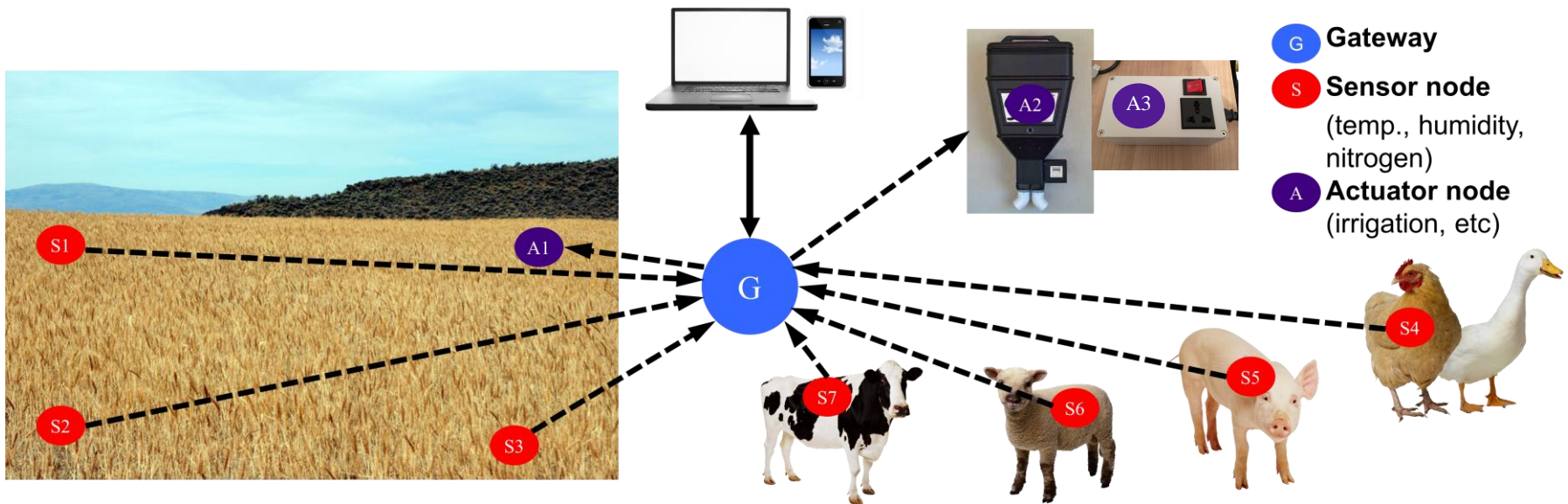 - Weather proof
  - Robust
  - Low cost

Connectivity Comparsions

	Mobile Network (GSM, 3G)	Wi-Fi, Bluetooth, Zigbee	Long Range Radio (LoRa)
Range	3 km	<150m	12km
Coverage in rural areas	Not good	Good	Good
Power consumption	High	Medium	Low
Data rate (speed)	Medium	High	Low
Network Ownership	Companies	Users	Users
Network Deployment	Difficult	Easy	Easy
Setup cost	High	Medium	Low
Running cost	High	Low	Low

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Source: http://maps.ofcom.org.uk/mobile-services/, 17/04/2016

Smart Farm

Environmental monitoring	Weather, Soil moisture
Precision Agriculture	Controlled irrigation, Monitored electricity consumption, Automated fertilizer, Supplying data to farmers, Machinery management, Greenhouse control and Animal feeding, Pest and Fungus detection
Traceability Systems	Livestock handling, Animal identification and Health monitoring, Food source tracing

G   **Gateway**

S   **Sensor node**
(temp., humidity, nitrogen)

A   **Actuator node**
(irrigation, etc)

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How UCL's Research Can Help

Hardware

- Energy Harvesting
  - Ambient Energy Harvesting
  - Low Cost Solar Cells
- Low Power Consumption
  - Antenna and RF Circuits
  - Integrated Sensors

Software

- Network Algorithms
  - Mesh / Peer-to-Peer Network Technology
- Data Retrieval, Fusion and Analysis
  - Combine the global and sensor collected data for weather prediction, pest and fungus detections

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Technologies

Low-Power Integrated Sensors

- Full-custom integrated sensors with conditioning circuits.
- Manufactured by advanced silicon process.
- High-sensitive sensor front end
- On-chip or on-board data management for extremely low-power operation and optimized communication.

Example:
2-in-1 sensor chip
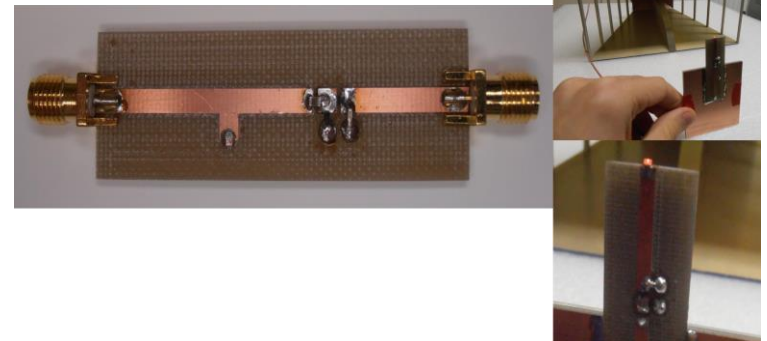(temp + humidity)
in 0.6-µm silicon
process
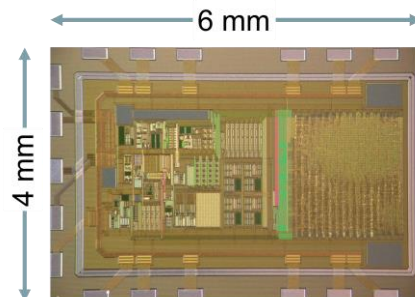
Ambient Energy Harvesting

- Wireless charging technologies which extend battery life to keep minimum maintenance. Collect energy from the environment, such as solar energy , radio and TV stations, or WiFi routers for powering up the wireless sensor networks.
- Fast charging for short data transmission
- Specialized very wideband and compact integrated antenna technology and solar cells.

Example:
RF energy harvesting
at Wi-Fi band

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Thank you!