



Introduction to Wireless Sensor Networks – Module 2

By

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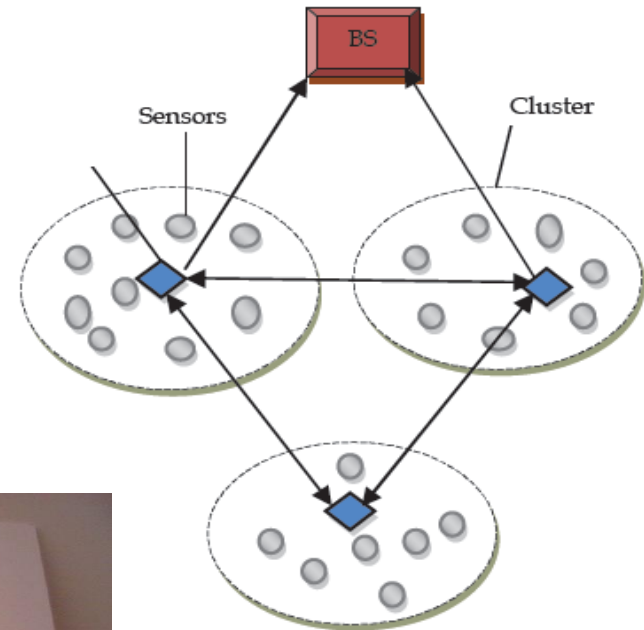
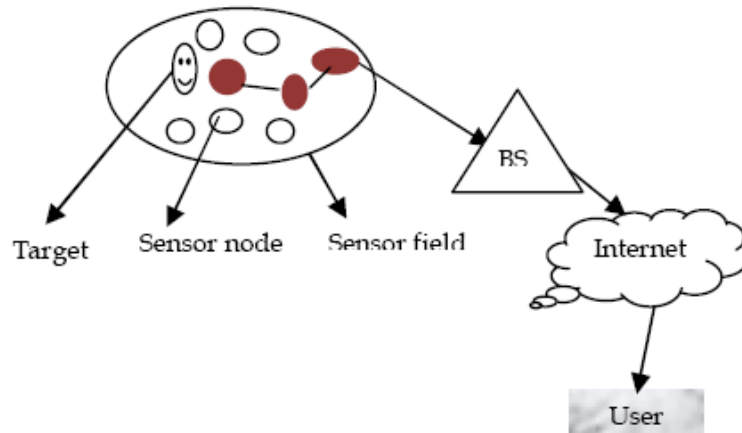
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Outline:

- Module I: Questions
- Data Collection by Sink or Base Station
- Data Generation and Protection Mechanism
- Secured Key Management Protocols
- Monitoring a Battle field boundary Using WSN (Intro)
- Pipeline Monitoring System (Intro)
- Alternative Protocol Implementations using IP
- Applications of WSN at University of Aberdeen

Data Collection by Sink or Base Station



Data Generation and Protection Mechanism



1. Sensors are located in each of the remote areas and networks
2. Data are collected automatically or upon Task managers request
3. The communicate with the Task manager at the centre over internet or 3G Network, data is stored in a centralised database.
4. The Task manager gets the network picture along with the current status, statistics and diagnostics event for each site.
5. The Task manager representative can trigger detailed analysis and run pre-defined scripts for any of the sites
6. Data can be shared with field engineers or R&D for detailed investigation

Secured Key Management Protocols

- ▶ **Key Generation:**

- D matrix Generation
- G generation - known
- K pairwise key generation

- ▶ **Key Allocation:**

K keys in the Base station using unicast method

- ▶ **Key Pre-distribution:**

Easy deployment of security key algorithm

- ▶ **Mesh pre-allocation, routing and set-up stage for encryption**

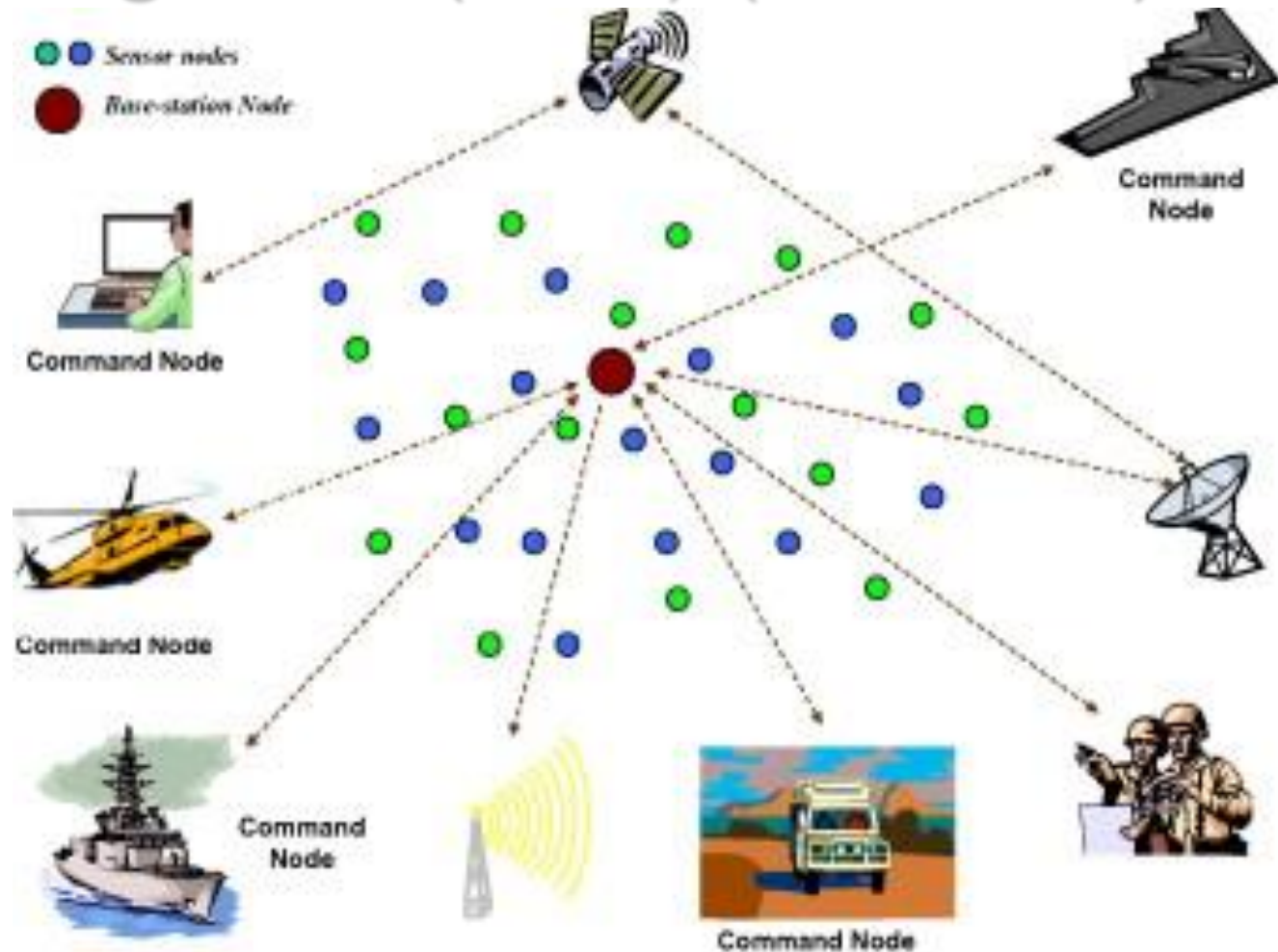
- ▶ **Encrypting the Pairwise Key with AES- Advanced encryption Standard**

- ▶ **Alternative security mechanisms** - An interface with sensor nodes within an IP address. A modification of uIP open source stack to accommodate the sensor nodes code using the key distribution method as basis for routing mechanism- No problem of overhead memory capacity

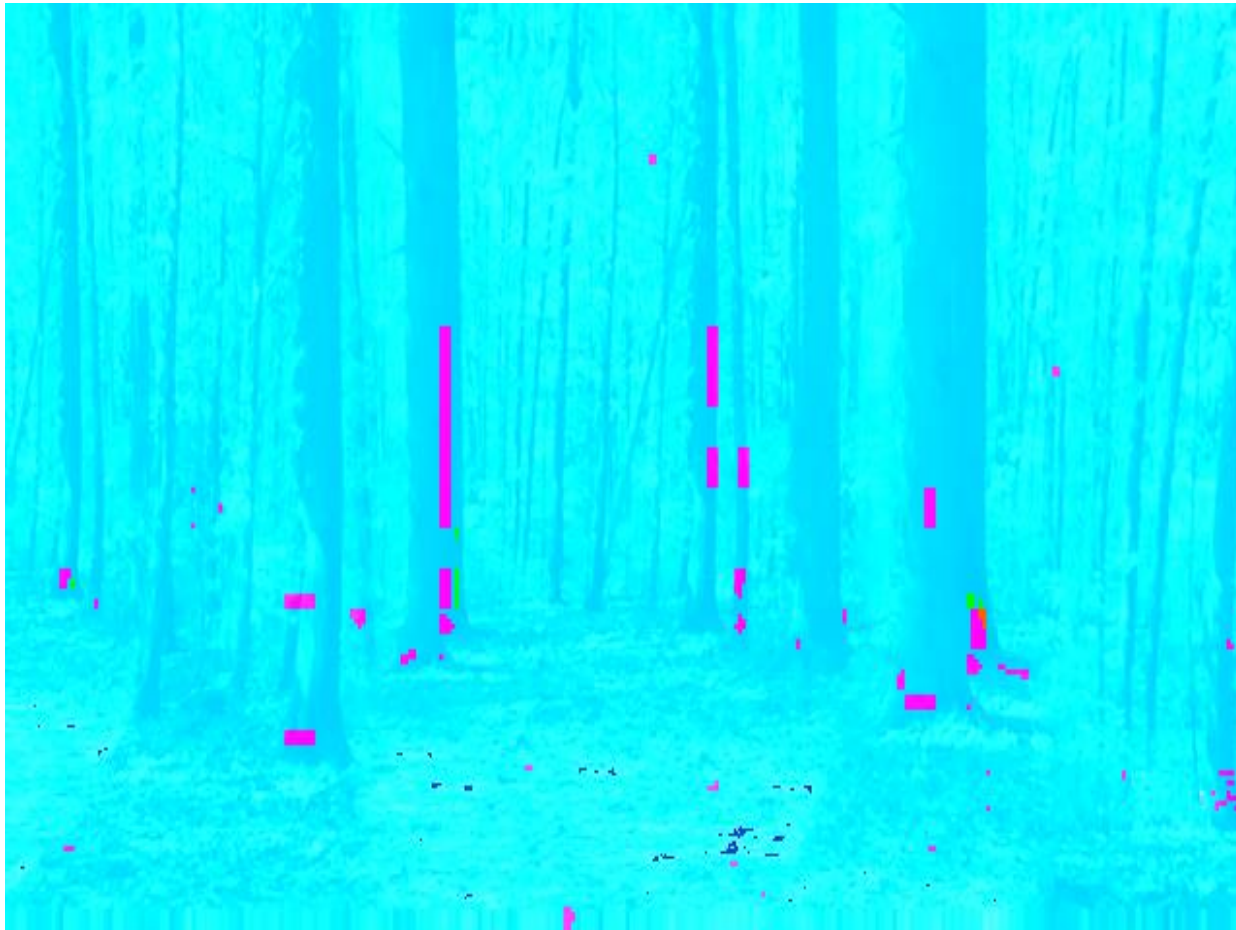
Secured Key Management Protocols

- ▶ In Generation of D matrix, G matrix and pairwise key K .
But the exact implementation of Blom scheme would not be very effective because:
 - ❖ We would have to store information for every single node
 - ❖ We would have to know the exact number of nodes in the network
 - ❖ When adding a new node we would have to update information on every single node
- ▶ A key allocation and Key Pre-distribution smart security technique to secure the Base station and the sensor nodes before deployment
- ▶ A unique mesh routing mechanism technique that will set-up the stage for encryption, with trade-off in power consumption.
- ▶ A unique combination of advanced encryption standard (AES) with key management technique.
- ▶ Methods are needed for Alternative security mechanisms using TCP/IP.

Monitoring a Battle field boundary Using WSN (Intro) (3D video)



Monitoring a Battle field boundary Using WSN (Intro) (3D video)



Pipeline Monitoring System (Intro)

The application of this technology includes:-

- Real time monitoring and response to the Oil leakages & protection of pipelines in the Oil Industry
- Detection of abnormal vibrations in pipelines
- Advanced sensor and actuator based systems for safety and security of pipelines in the Oil Industry
- A complete system-wide capability that is able to address challenges at the physical, communication, data and information integration levels.
- A systems integration expertise with the capability to prototype systems throughout a stacked architecture
- Spring forth of other implementation including Energy Harvesting mechanism to power the sensors, Operating system (OS) peculiar to Oil & Gas Development, Real time monitoring, Test bed for future oil & Gas Development.
- Knowledge Exchange Program (KEP) & Collaboration between industry and academia to create jobs

Alternative Protocol Implementations using IP

- The uIP is an open source TCP/IP stack capable of being used with tiny 8-bit and 16-bit microcontrollers [108]. It implements RFC-complaint IPv4, IPv6, TCP and UDP (the latter two compatible with IPv4 and IPv6). uIP is very optimized, only the required features are implemented. For Instance there is a single buffer for the whole stack, used for received packets as well as for those packets to send.
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- Contiki's uIP networking stack comes with initialisation of various modules required for correct communication in wireless sensor network such as uip-fw (uIP forwarding) and uip-over-mesh (uIP over Rime's mesh) modules.

Biography

- **Dr. Celestine Iwendi** is the Founder and CEO of WSN Consults Limited and a sensor researcher at the School of Engineering of the University of Aberdeen Scotland. He obtained a BSc and MSc in Electronics and Computer Engineering from Nnamdi Azikiwe University Nigeria, MSc Communication Hardware and Microsystems from Uppsala University Sweden and a PhD in Engineering at the University of Aberdeen, Scotland. He has carried out many Independent and supervised designs that apply knowledge of Wireless Sensor Networks, Signal processing and Communications engineering to analyze and solve problems at Nnamdi Azikiwe University, Awka Nigeria, and Nigerian Telecommunication (Nitel), Uppsala University Sweden, Norwegian University of Science and Technology, and University of Aberdeen, Scotland. He is member of the IEEE ,IEEE Communication Society, Swedish Engineers, Nigerian Society of Engineers. The Editor-in-Chief of the leading magazine in WSN (www.wsnmagazine.com), Journal of Wireless Sensor Networks (www.wsn-journal.com). An IEEE, IET and top journals and conference speaker and reviewer. He is also an Associate at Centre for Sustainable International Development.