

### 5.10 NS2 and its Extension to Sensor Networks

□ The NS-2 (Network Simulator-2) is a well-known network simulator for discrete event simulation. Simulations are based on a combination of C++ and OTcl.

□ NS-2 includes a large number of simulated network protocols and tools used for simulating transport control protocol (TCP), routing algorithm, multicast protocol over the wired or wireless (local connection or via satellite connection) networks.

□ NS-2 is committed to OSI model simulation, including the behaviour of physical layer and it is a free open source software and available for free download.

#### Limitations of NS-2

- It puts some restrictions on the customisation of packet formats, energy models, MAC protocols, and the sensing hardware models, which limits its flexibility.
  - The lack of an application model makes it ineffective in environments that require interaction between applications and the network protocols.
  - It does not run real hardware code.
  - It has been built by many developers and contains several inherent known and unknown bugs.
  - It does not scale well for WSNs due to its object-oriented design.
  - Using C++ code and OTcl scripts make it difficult to use.
- Actually, NS-2 was not initially designed to simulate wireless sensor network, but a few research groups had extended NS-2 in order to enable it to support wireless sensor network simulation, including sensor model, battery model, a small stack, and hybrid simulation tools.
- It is extensible, but not very scalable because of the split programming model and object-oriented structure. In addition, because NS-2 can simulate

very detailed data packet close to the exact number of running packets, it is unable to carry out large- scale network simulation.

□ To overcome the above drawbacks the improved NS-3 simulator was developed. NS-3 supports simulation and emulation. It is totally written in C++, while users can use python scripts to define simulations.

□ Hence, transferring NS-2 implementation to NS-3 require manual intervention. Besides the scalability and performance improvements, simulation nodes have the ability to support multiple radio interfaces and multiple channels.

□ Furthermore, NS-3 supports a real-time schedule that makes it possible to interact with real systems. For example, a real network device can emit and receive NS-3 generated packets.

### 5.11 COOJA

□ Cooja simulator is the efficient simulate wireless sensor networks. Cooja is the default simulator of Contiki operating system that helps to simulate the wireless sensor networks in addition it helps to do the performance evolution.

□ Contiki is a light weight operating system that is developed mainly for wireless nodes. The motes that are developed by the contiki offers many advantages.

□ Contiki offers a java based simulator called as cooja which is used to simulate the wireless sensors. Cooja simulator is more flexible so that many parts of the simulator is replaceable and extendable. The parts of the simulator like simulated node hardware, plug-ins and radio medium can be replaceable.

Characteristics of Cooja

- Scalability
- Efficiency
- Extensibility
- Flexibility

□ Wireless sensor network has the powerful tool called tool in which it can be simulate the idea before it is implementing in real time. Contiki Cooja WSN Simulator mainly used to simulate many wireless scenario.

Contiki Cooja WSN simulator

□ Contiki cooja is the best simulator to simulate any wireless sensors with its own property. For example, if we are designing a wireless sensor network that detects the earth quake, the sensor has its own property like lifetime, withstand ability, capacity, etc.

□ We can design this wireless sensors with the same property in contiki cooja. When compared to other simulators cooja is developed purely for wireless sensor networks.

□ In addition cooja is more flexible to change the properties of a node so that we could implement our own idea exactly. Wireless sensors play important role in IOT (Internet of Things), where contiki Operating system was developed mainly for IOT devices, cooja is a simulator comes with the Contiki. So we can use the Cooja simulator for simulating any wireless sensor networks.

