**LECTURE 2**

**Issues in Communication between Sensor Networks**

The key issues in the design of sensor networks that affect the communication between various sensor nodes are :

1. Data Centric Paradigm
2. Location Based
3. Real Time
4. Scalability
5. Fault Tolerance
6. Hardware Constraints
7. Resource Constraints
8. **Data Centric Paradigm**

Traditional networks put more emphasis on addressing and use addresses to route data. The data is communicated between two systems through a route which contains two or more addressed nodes. In contrast sensor networks are intrinsically data-centric. Data from various sources, sensing the same event in the same environment, must be aggregated. This does not give specific importance to any individual sensor node. Messages are not sent to individual nodes but rather to locations or areas based on data content. Hence it is important that the routing protocols used to route data take this data centric paradigm into consideration.

* Data Centric : Finding routes from multiple sources to a single

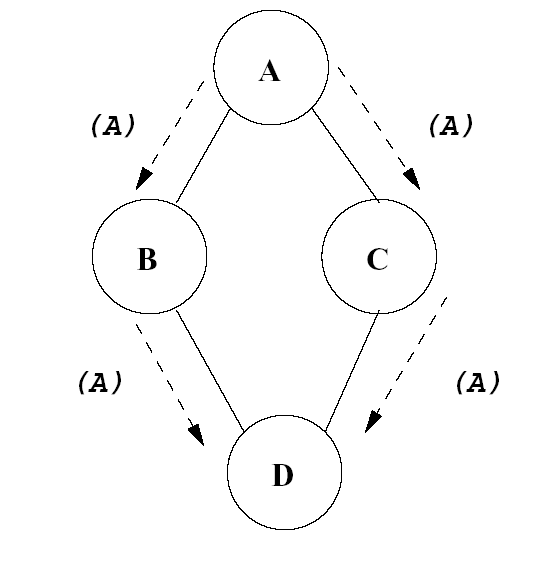
sink, allowing data aggregation

Various Routing Protocols

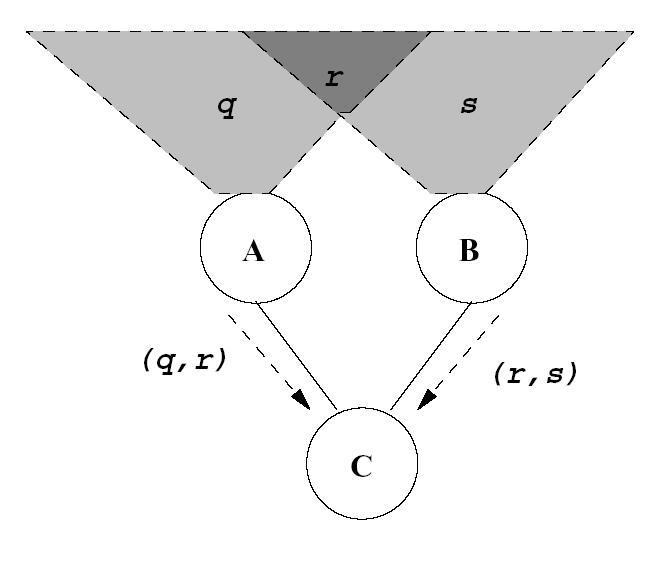
1. Classic Flooding
2. Gossiping
3. Ideal Dissemination
4. SPIN
5. **Classing Flooding** :Send data to all neighbors

**Classic Flooding Problems**

* **Implosion Problem:** A starts by flooding its data to all of its neighbors. Two copies of the data eventually end at node D. The system wastes energy and bandwidth.

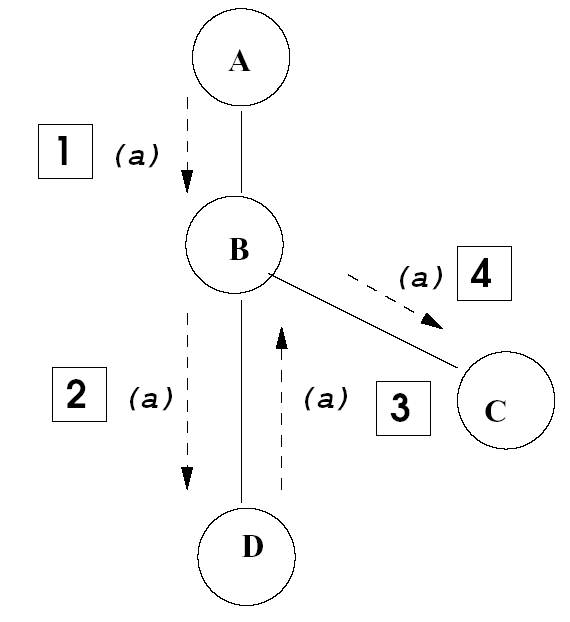


* **Overlap Problem:** Two sensors cover an overlapping graphic region. When the sensors flood their data to node, the Node receives two copies of the Data.



* **Resource Blinding:** Resources do not modify their activities based on the amount of energy they have.

1. **Gossiping**



* Gossiping is an alternative to the classic flooding approach that uses randomization to conserve energy.
* At every step each node only forwards data on to one neighbor, which it selects randomly. After node D receives the data, it must forward the data back to sender (B), otherwise the data would never reach node C

1. ***Ideal Dissemination***

Ideal Protocol

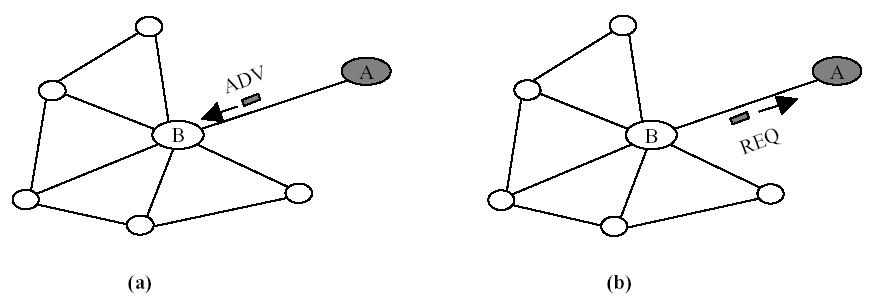
* + Shortest-path routes
  + Avoids overlap
  + Minimum energy
  + Need global topology information
* Every node sends sensor data along shortest path
* Receives each piece of distinct data only once
* Ideal Dissemination of observed data a and c. Each node in the figure is marked with its initial data and boxed number represent the order in which data is disseminated. In Ideal dissemination both implosion caused by B and C’s common neighbor .

**SPIN: Sensor Protocols for Information Negotiation**

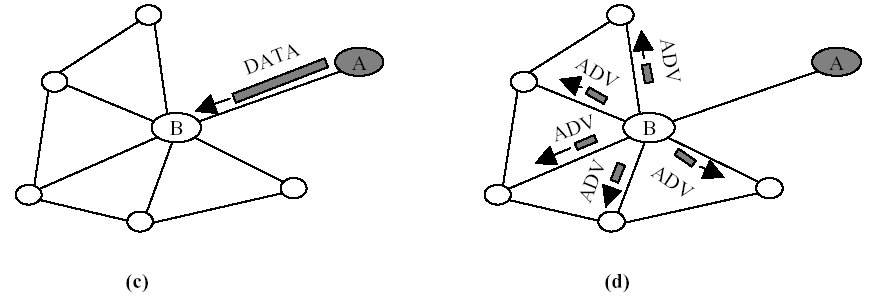
* One of the most dominant form of routing in the wireless sensor networks

**Uses three types of messages**:

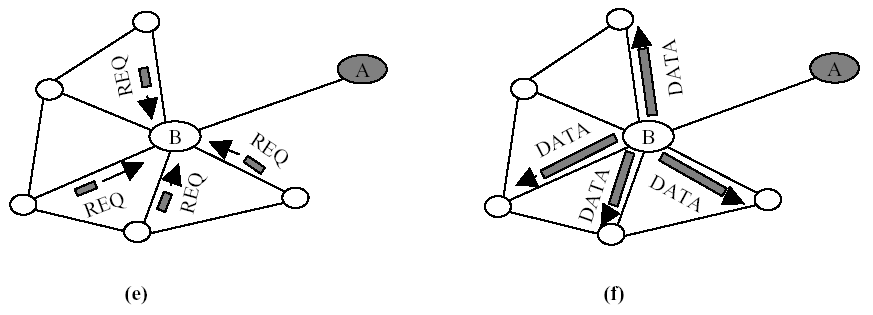
* ADV – advertise data
* REQ – request for data
* DATA – data message, contains actual sensor data



* **Sensor A sends meta-data to neighbor**
* **Sensor B requests data from Sensor A**



* + **Sensor A sends data to Sensor B**
  + **Sensor B aggregates data and sends meta-data for A and B to neighbors**



* + **All except 1 neighbor request data**
  + **Sensor B sends requested data to neighbors**

**Conclusions**

* SPIN is simple to implement compared with other protocols.
* SPIN seems to be the best protocol. It is better than flooding because it overcomes data implosion and overlap.
* More energy-efficient than flooding or gossiping while distributing data at the same rate or faster than either of these protocols.
* These is no redundant data sent through the network.

1. **Location Based**

Sensor networks deal with physical environments and hence must work with physical locations rather than logical IDs. In fact sensor networks do not have permanent IDs assigned to them. One of the reasons is the sheer volume of sensor networks existing globally and the constraint on their memory and processing capabilities. Thus any query must refer to location rather than to a particular ID.

1. **Real Time**

Sensor networks are deployed in environments dealing with real world events. Hence there is a necessity for real time guarantees for communication and data transfer.

For instance a sensor network may be deployed in a nuclear plant. Many protocols that can deal with real-time nature of sensor network have to be designed.

1. **Scalability**

When the sensor network is designed to be scalable, the communication protocols must maintain minimum global state and incur as little control overhead as possible. It must easily work with highly dense sensor networks.

1. **Fault Tolerance**

Sensor nodes are highly susceptible to failures. These failures may be due to environmental noise or obstacles. power depletion, physical destruction. The protocols must be such that the sensor network performs properly in the event of failure of many nodes. They must be able to self stabilize.

1. **Hardware Constraints**

This is the crucial design factor as it defines the efficiency of a node. Each node primarily

comprises of the following components (Figure 2.1).

* **Sensing unit** Used to convert analog signals to digital signals which are generated

by sensor nodes

* **Processing unit** Used to manage the functions that are responsible for communicating

with the other sensor nodes. This unit is usually associated with the small

storage capacity.

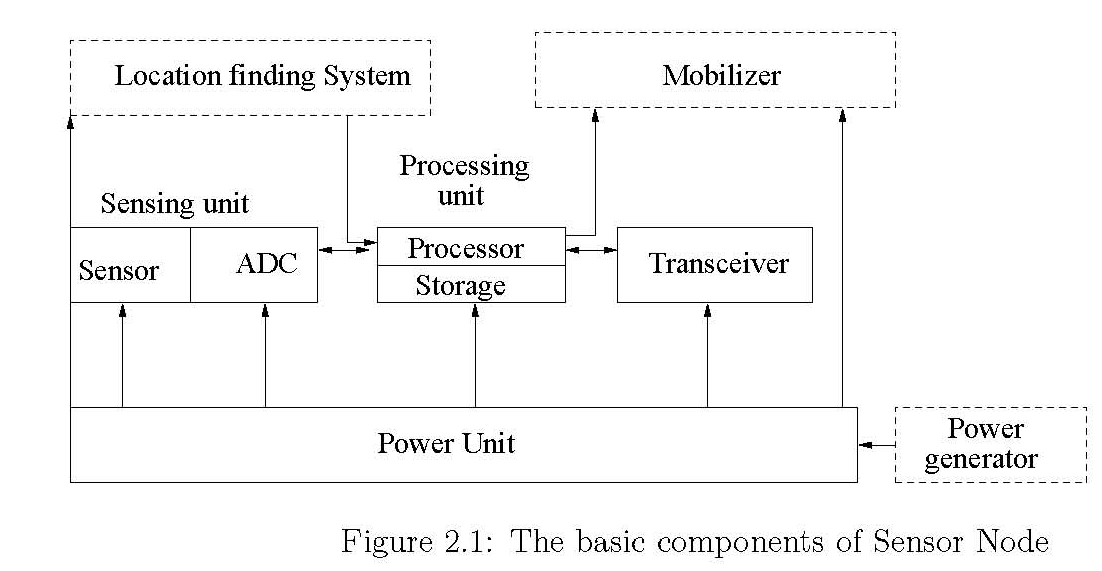
* **Transceiver unit** Used to connect a node to the sensor network.
* **Power unit** This is the heart of the node which determines the life time of a sensor

node. Power can be saved by switching off the node when not necessary and bringing

up only when needed. It can also use solar energy for charging itself.

* **Mobilizer** A mobilizer is needed in cases where a sensor node has to move from

one location to another.



1. **Resource Constraints**

Sensor networks use small batteries to operate and radio transmissions take up most of this power. Hence power conservation is the key issue in sensor networks, especially at the communication layer. Energy efficient routes can be found based on available power in the nodes or the energy required for transmission in the links along the routes. An energy efficient route can be selected either by selecting a route which has the maximum available power among all nodes or selecting the route that consumes minimum energy to transmit data from the node to the destination in the route or by selecting a minimum hop route or by selecting a route in which the minimum power is larger than the minimum powers of the other routes.