



Network Management for Distributed Sensors

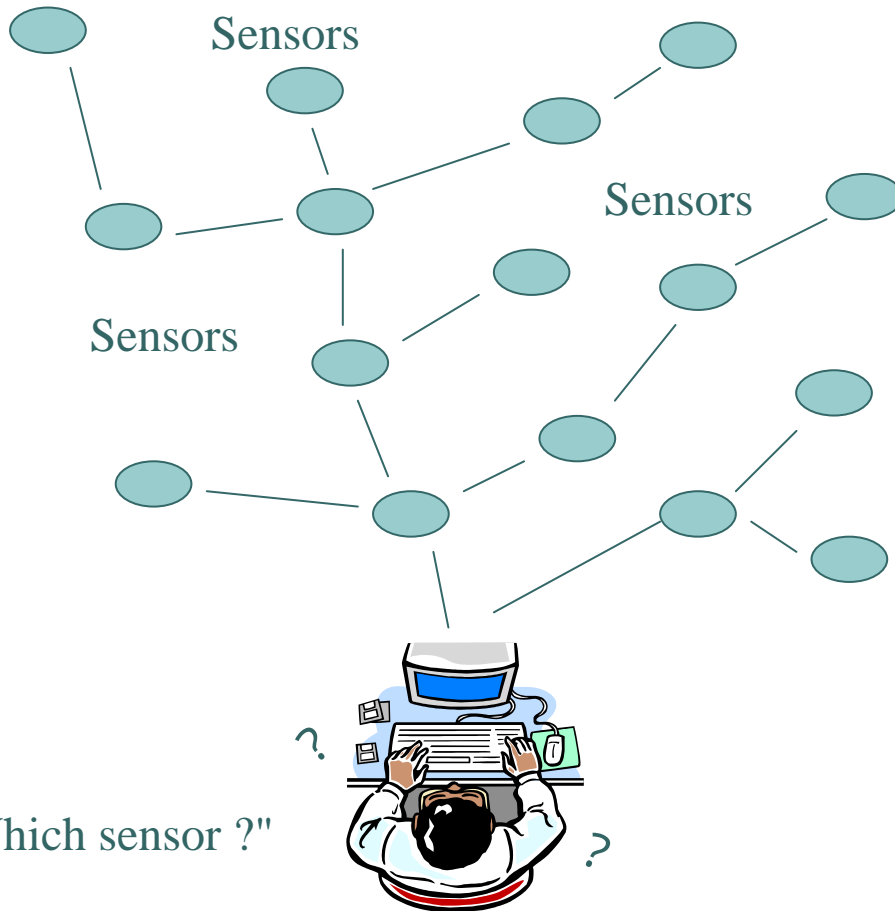
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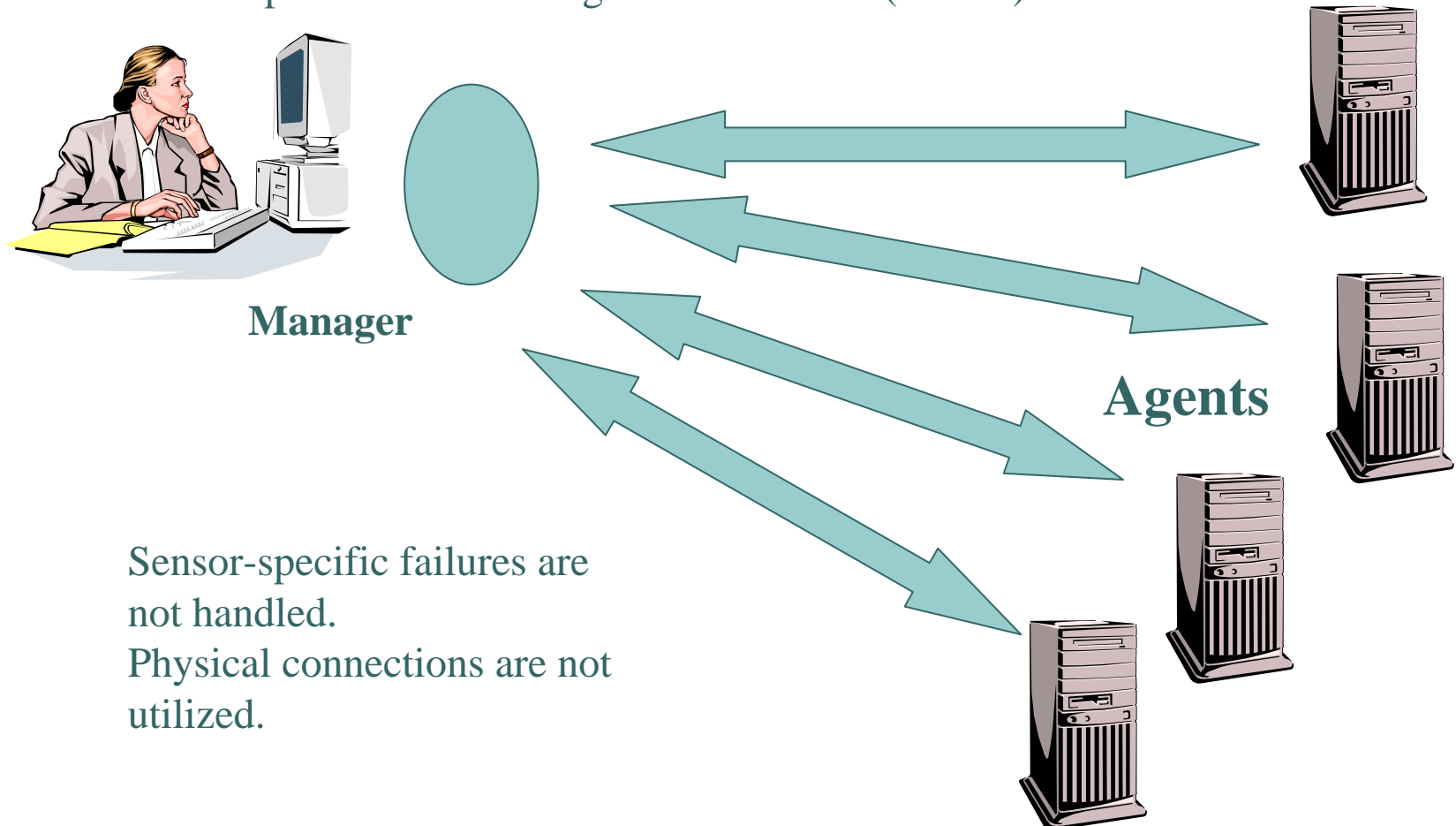
Problems on Sensor-Network Management



1. Specifying nodes is difficult.
2. Performance such as delay is unpredictable because network is self-configured.
3. When failures occur, identification of the failed nodes is difficult.
4. Replacing batteries is required before they run out.

Why is conventional network management not sufficient ?

Simple Network Management Protocol (SNMP)



Sensor-specific failures are not handled.
Physical connections are not utilized.

SNAC Objectives

- Notification of Sensor-Specific Failures
- Utilization of Physical Views
- Identification of Constructed Topology
- Statistical Management





Early Notification

It is desirable to replace the battery of the sensor node before it is depleted . Each node is equipped with battery, and NMN(Network-Management Node) is warned when the amount of the battery at a node falls below a certain threshold.

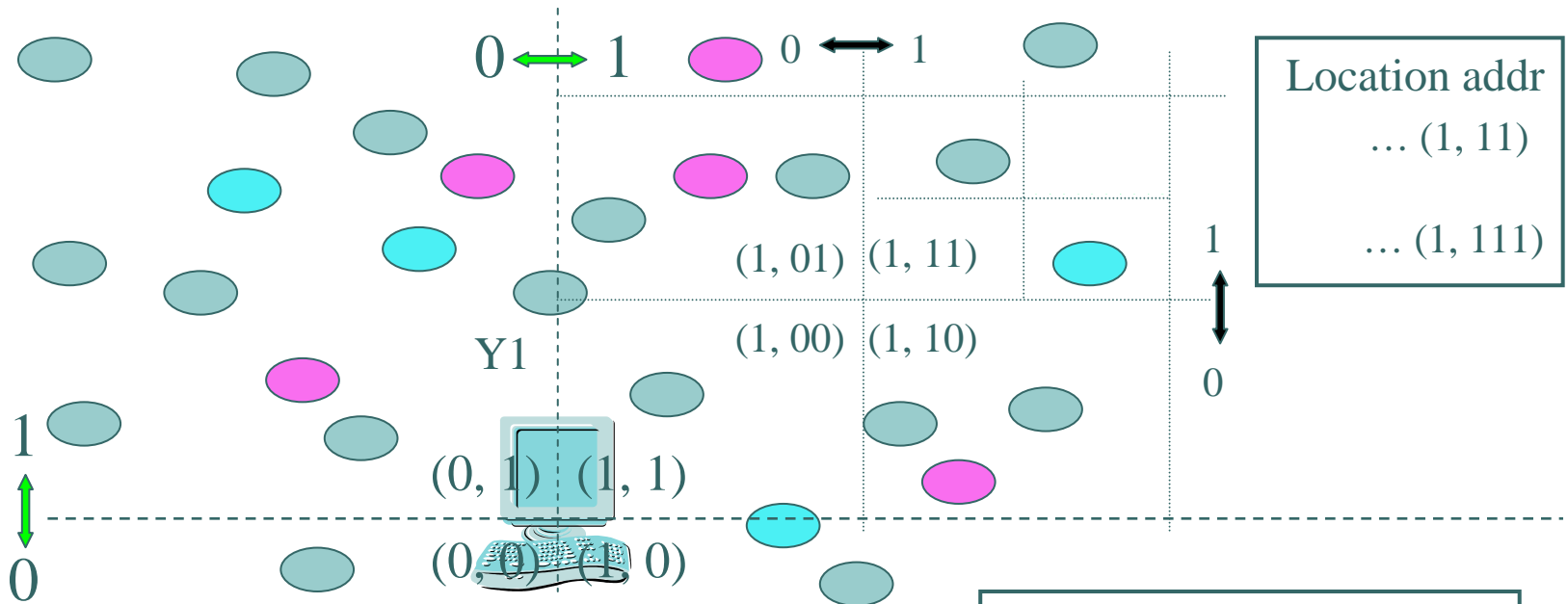
Node	remaining amount of battery
Alive Node	above threshold
Weakened Node	below threshold
Depleted Node	none

An event is transmitted to NMN to notify that a node becomes weakened. In some case, nodes surrounding a weakened node send events to NMN.

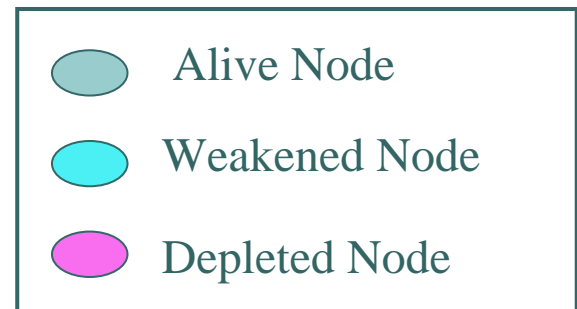
Geographical Management

Area-cast : specified in some range in geographical area.

Healthiness of an area is obtained using area-cast.

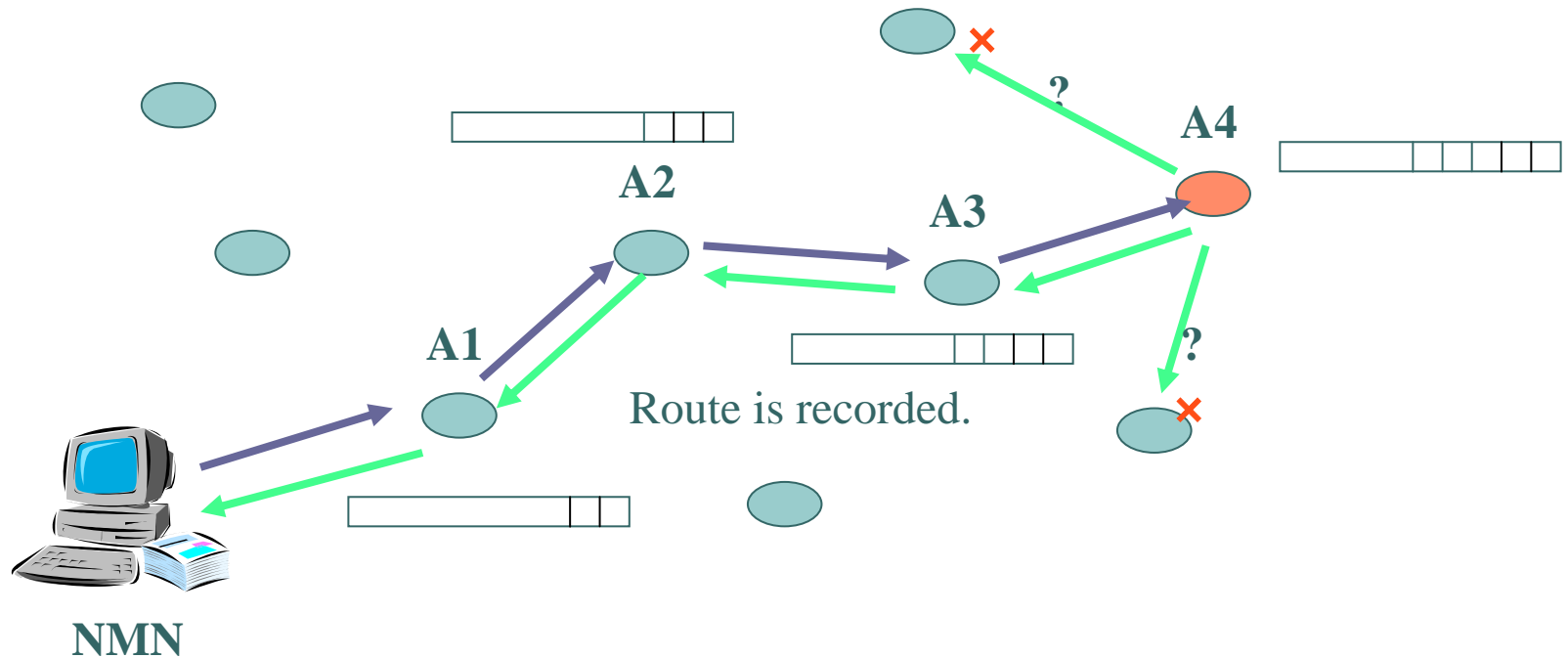


Area-cast is independent of the underlying routing protocol. However, if the routing protocol supports geographical information, the area-cast utilizes the information.



Performance Management

Sensor network is self-configured. Therefore, a route that is undesirable in terms of delay could be created. To diagnose such performance, NMN can identify a route between nodes. NMN can indicate to reconfigure a route depending on the reported performance.



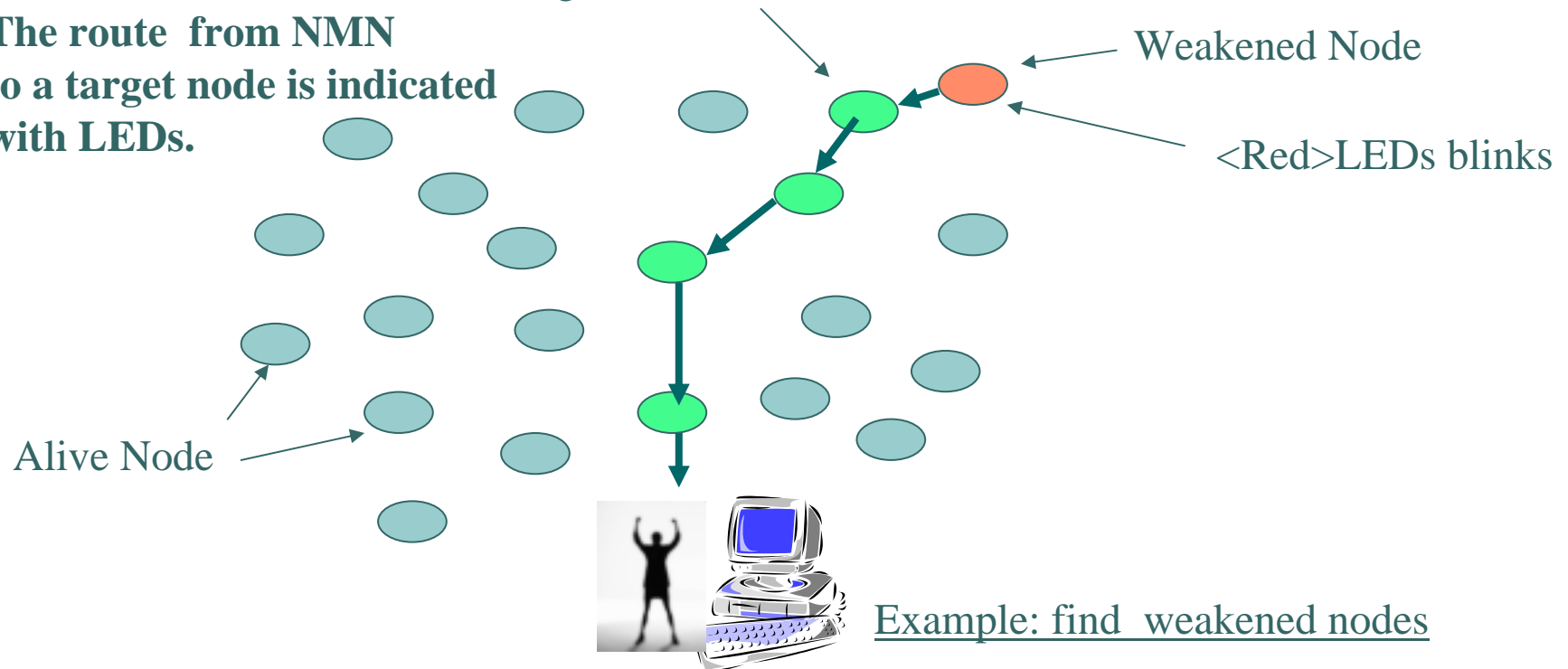
Visual Enhancement

Nodes can be equipped with indicators such as LEDs.
Network management can be enhanced with the aid of such indicators.

Commands: `show-route-to-node`

`show-congested-nodes`
<green>LEDs blinks.

The route from NMN to a target node is indicated with LEDs.





SNAC Prototype

20 MICA Motes

Implementation built on TinyOS

Commands: (1) Show-route-to-node

(2) Light-all-alive-nodes

Event Notification

weakened node