



New Architectures and Disruptive Technologies for Future Wireless Networks

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Current vs. Future WN architectures

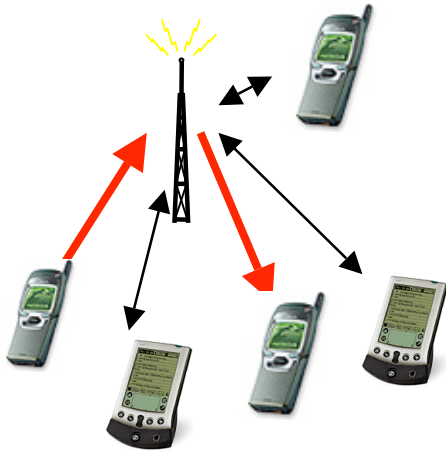
- Future with respect to:
- Research, Testbeds, Field trials, or Commercial applications ?
- ‘Do we really need these technologies?’



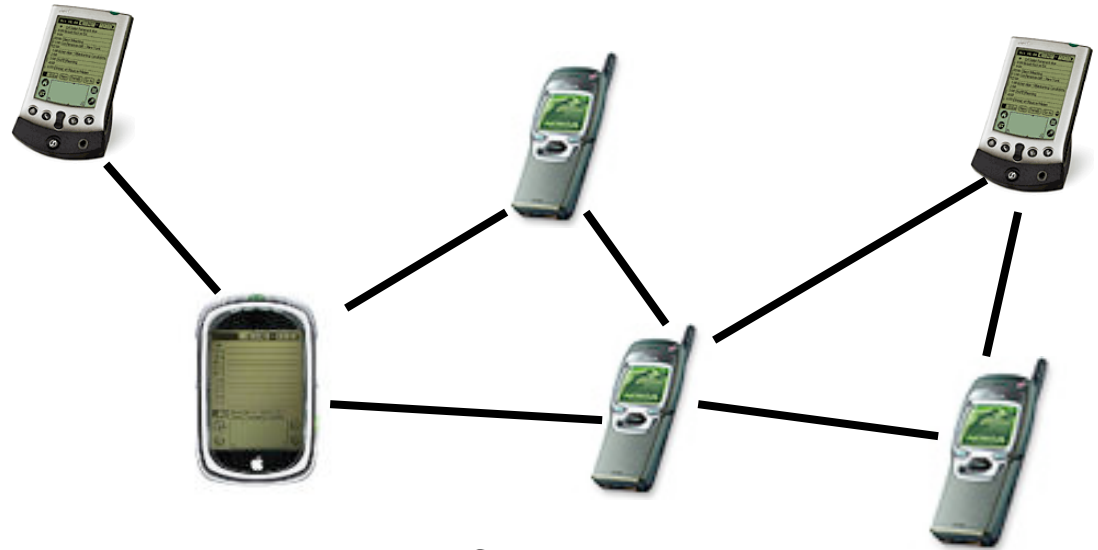
'Problems at the network layer'

- Will any of the future commercial WN have network layer?
- Is there any commercial application where **multi-hop** wireless communication was really beneficial and better than any **single-hop** alternative?

Current Wireless Networks ??

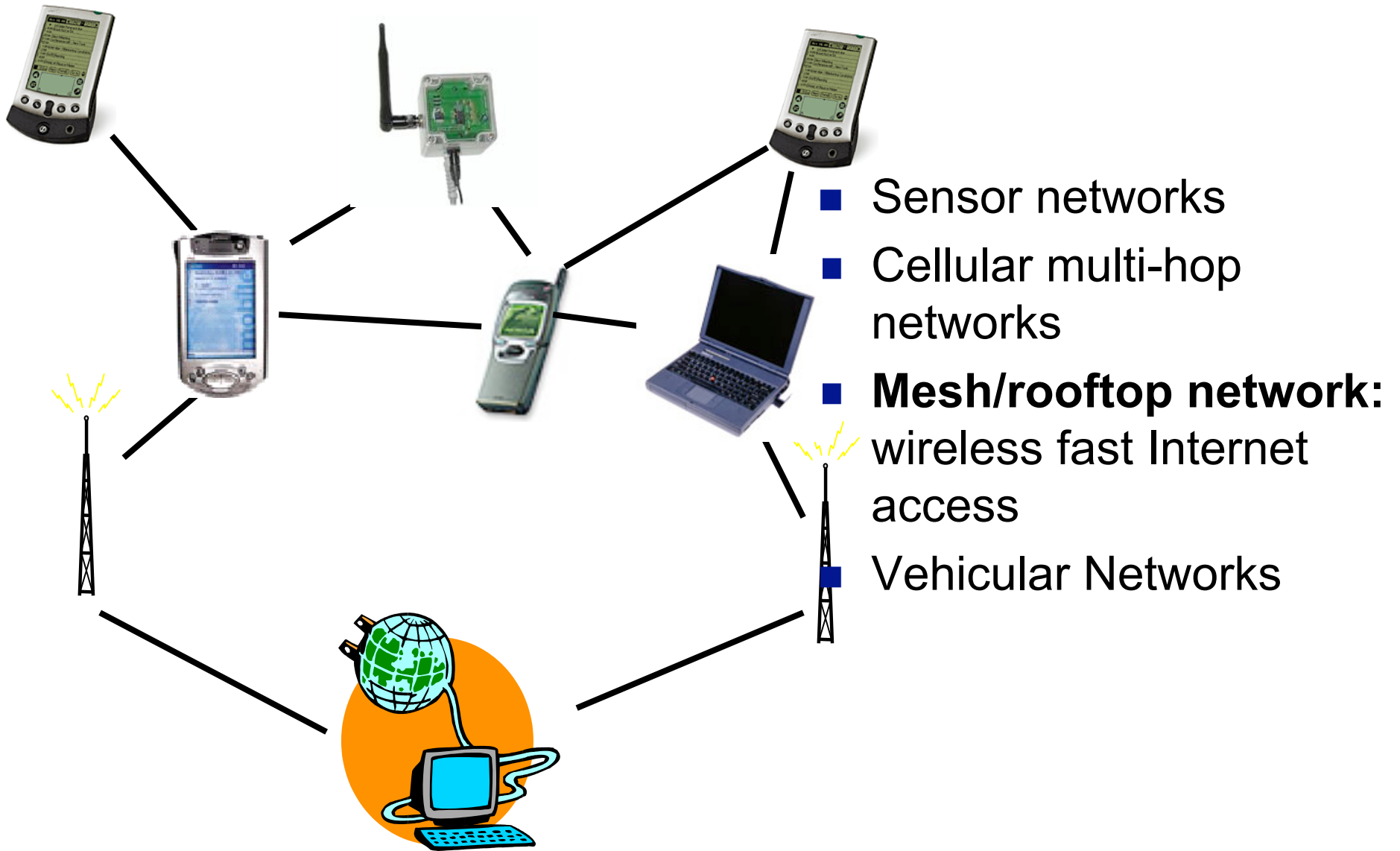


- ***Single hop networks***
- Cellular networks
- Satellite networks
- commercial



- ***Multi-hop self-organized networks***
- Conference, battlefield, rescue
- Peer to peer networks
- ***Ad hoc networks***
- ***Field trials, 2-3 hops***

Hybrid ad hoc wireless networks ??

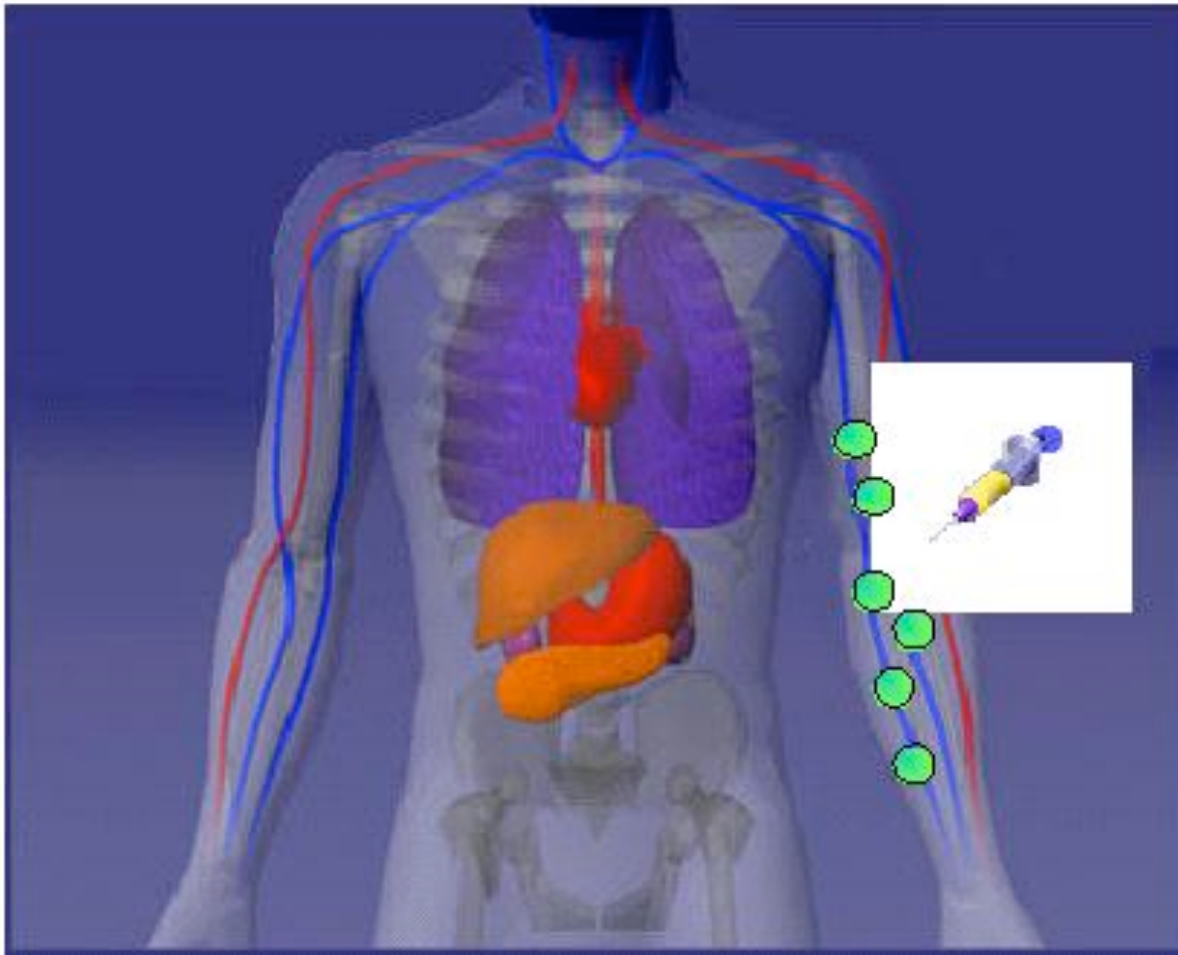




Mesh/rooftop networks

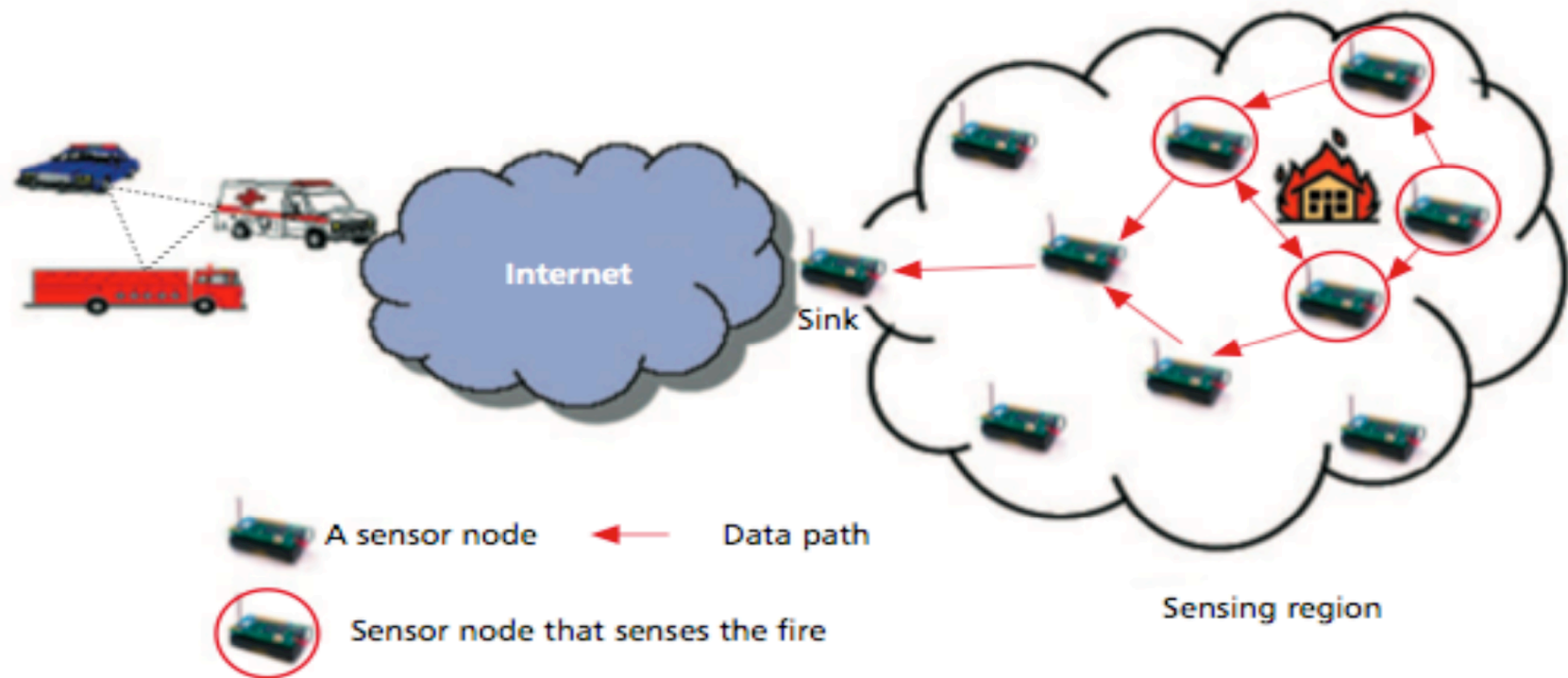
- Commercial ??
- I installed wireless terrestrial Internet access in 2007, replacing single-hop satellite access
- But it was only possible via single-hop direct link, by increasing signal strength over tree leaves; 2-hop line-of-sight access impossible

One hop sensor network: Patient monitoring



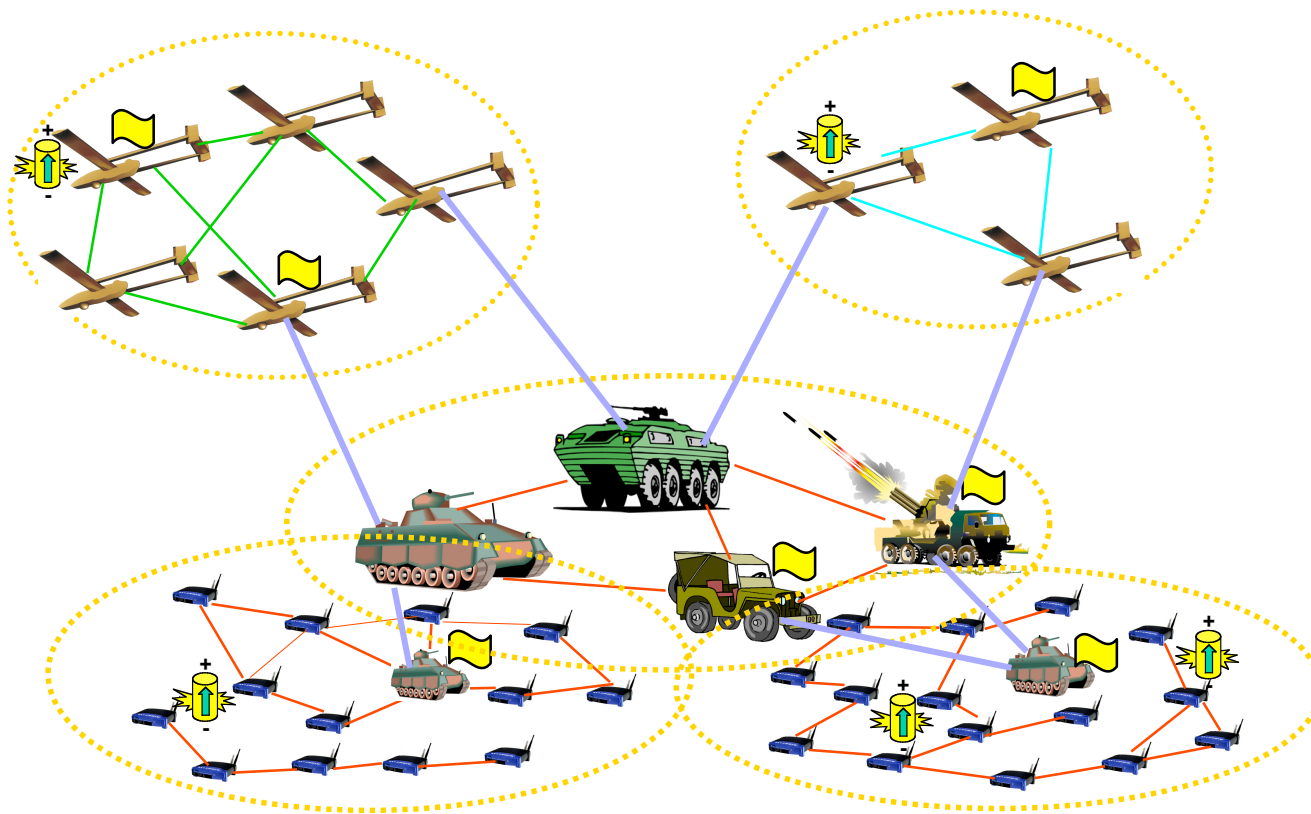
Traditional wireless sensor networks

Field trials, multi-hop is a bottleneck, energy hole around sink



Research: Future technologies

- Hybrid sensor and ad hoc networks



Mobile Sensor Network







Mobile Sensor Networks Reality

- Network can be very sparse
- seals can meet in clusters but then they meet rarely at sea
- multi-hop communication again questionable

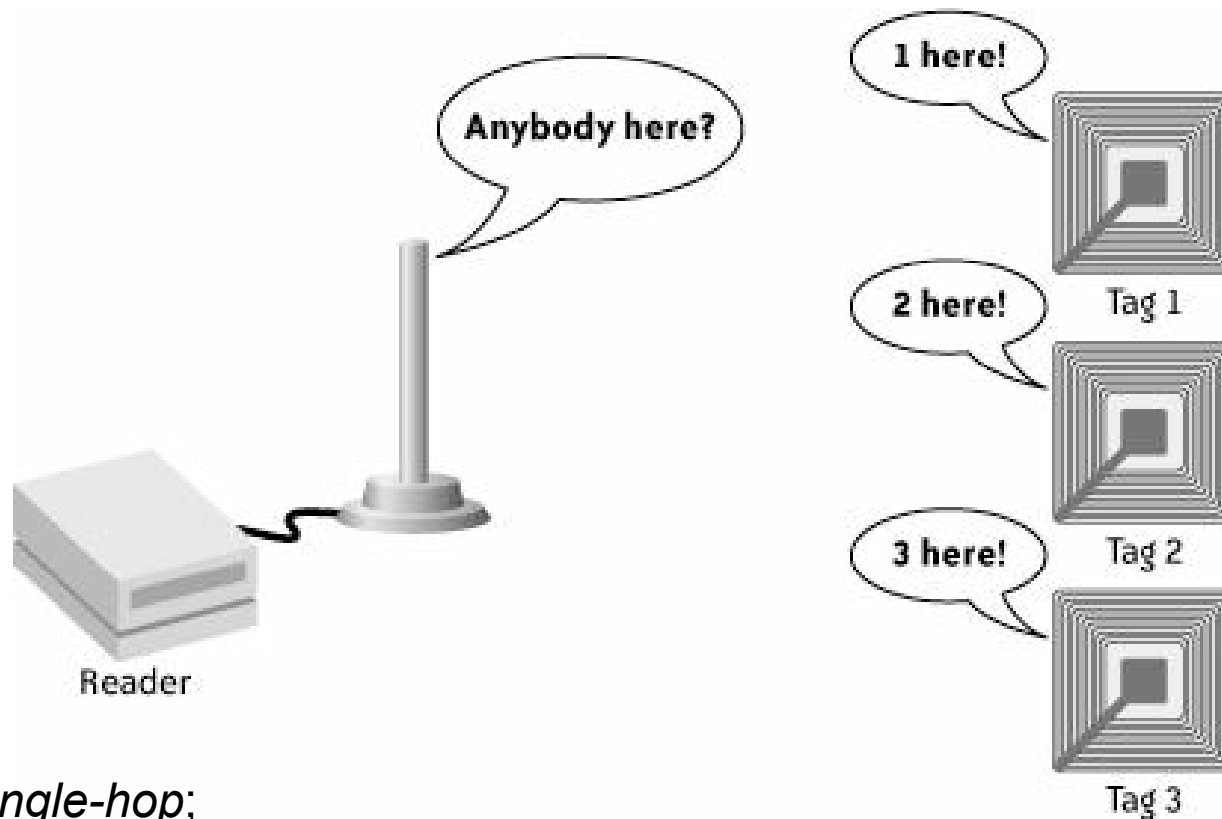
Vehicular Networks

Current commercial solutions based on Road Side Units = infrastructure = single-hop





RFID readers and sensor networks



Readers are *single-hop*;

tags could be attached to sensors and be even mobile

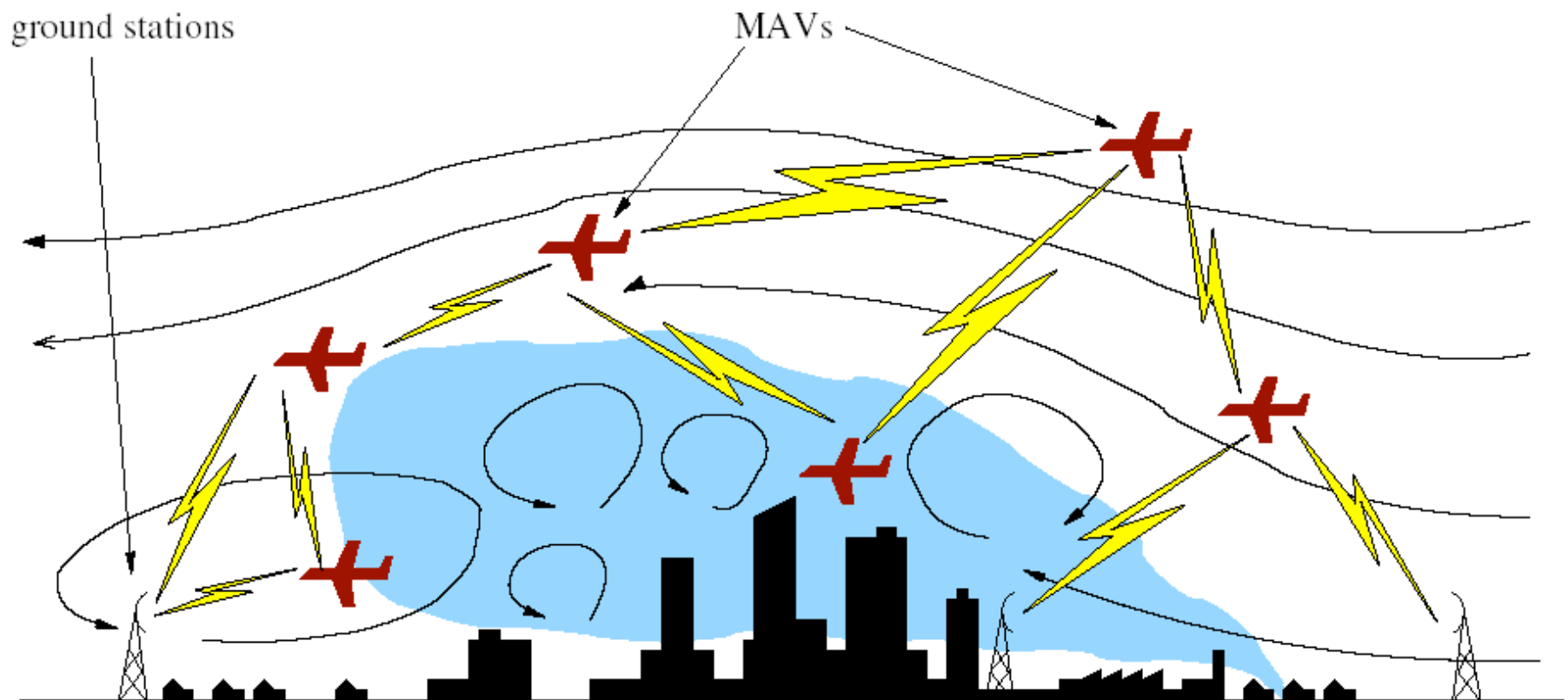


Delay Tolerant Networks ?

- Appear multi-hop viable
- But require a priori knowledge of all node movements

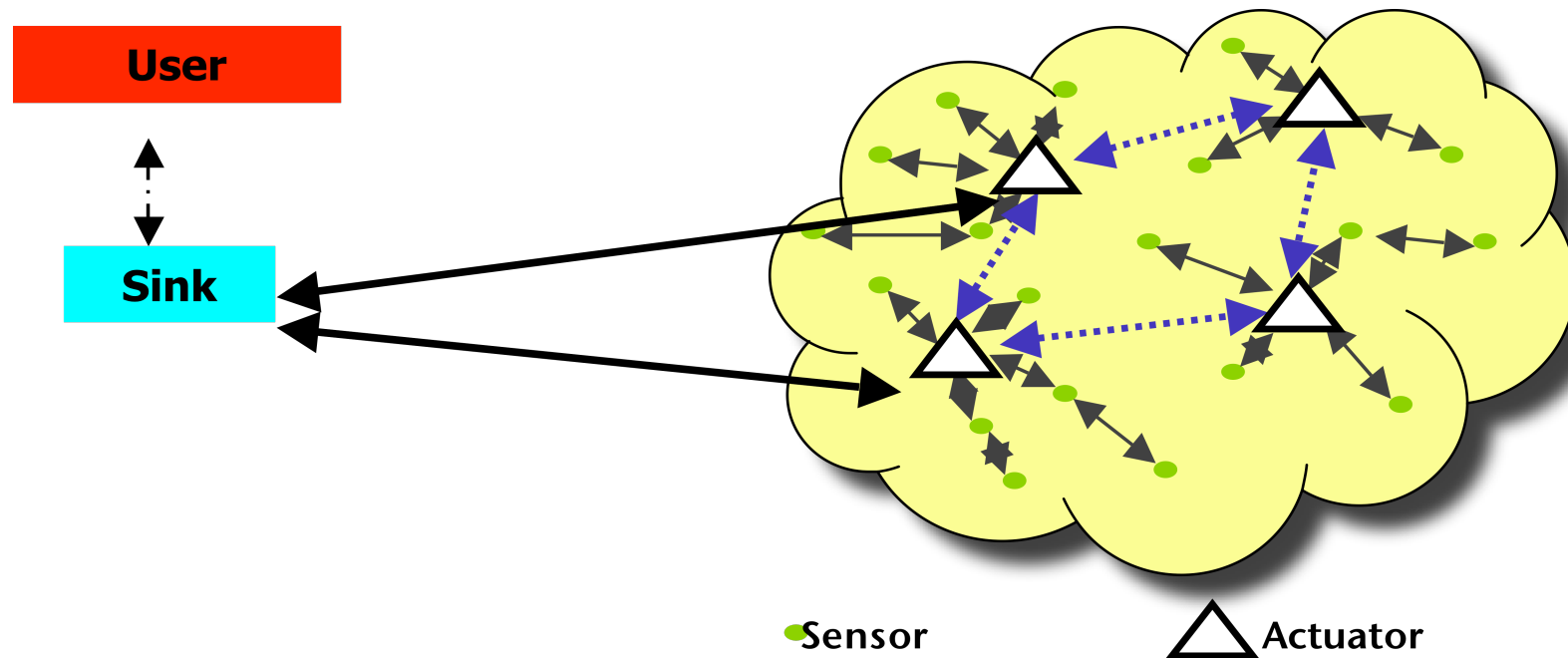
SensorFlock: Flying sensors

- An Airborne Wireless Sensor Network of Micro-Air Vehicles
- Univ. Colorado at Boulder, *Field trials, 2007*



Wireless sensor and actor networks =SANET

Actors: can act on sensors and environments,
higher energy and computation, may be mobile





Applied SANET ?

Daniel Steingart, Wireless Industrial Technologies, USA, 2007:

Sensors measure temperature in aluminum production
(one-hop communication to sink)

Human (-actuator) adjust energy supply to keep temperature stable

Equipment as actuators:

Light and sound signals, augmented reality
(firefighting applications) *single-hop*



One-hop wireless links only ?

- Korber, Wattar, School,
- IEEE Trans. Industrial Informatics May 2007
- Star topology
- Base station (BS) is master, several nodes (SAM = sensor actuator modules) are each directly linked to BS, on separate channels
- Argues that this topology is needed for reliable industrial applications

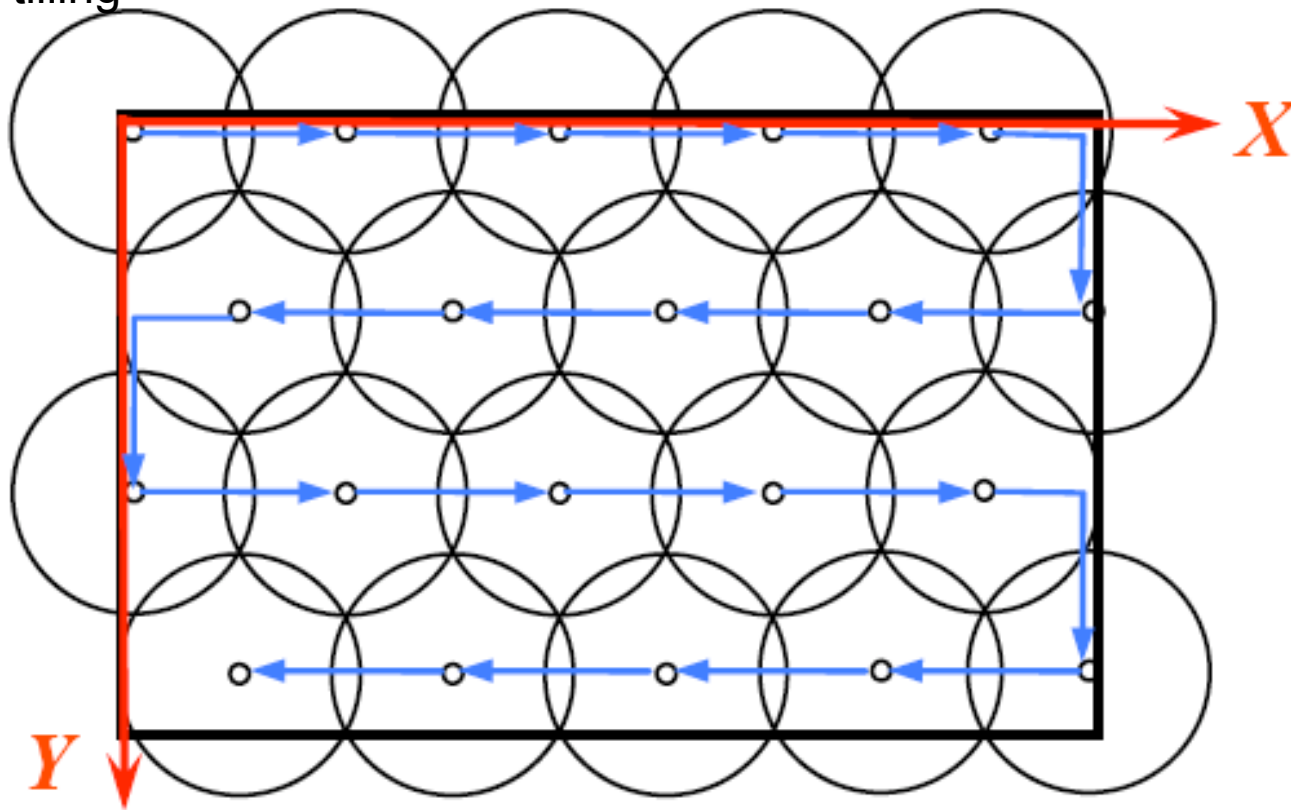
Networked robots/actuators



Robot deploys sensors: Snake-like coverage

Chang et al IEEE WCNC 2007

Robot moves within area in snake-like order and drops sensors at vertices of hexagonal tiling





Network layer issues

- **SANET models:** what is mobile, acting range etc.
- **Generating sensor and actuator networks**
- **Coordinated movement of actors/robots**
 - Move to establish (bi)connectivity while serving sensors
- **Movement for energy optimal routing**
 - Actors move to improve quality of sensor reporting (video)
- **Anycasting:** send report from sensor to any actor
- **Multicasting:** from sensor to fixed set of actors



Network layer continuing

- **Sensor relocation:** mobile actors/sensors move to replace failed monitoring sensors
- **Moving to collect sensor readings**
 - Design routes for actors to optimize energy/mobility and collect reports periodically (e.g. TSP tour)
- **Actor coordination**
 - Which actor should act?
- **Coordination for location service**
 - How sensors maintain position information about the nearest actor, and how actors help sensors in providing their position information

The 'Father' of wireless communication

Nikola Tesla
1856-1943

- The Serbian-American
- inventor,
- electrical engineer,
- scientist
- www.teslasociety.com

