Introduction to Wireless Networks

Chapter 8: Introduction to Mobile Ad Hoc Network (MANET)

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Model of Operations

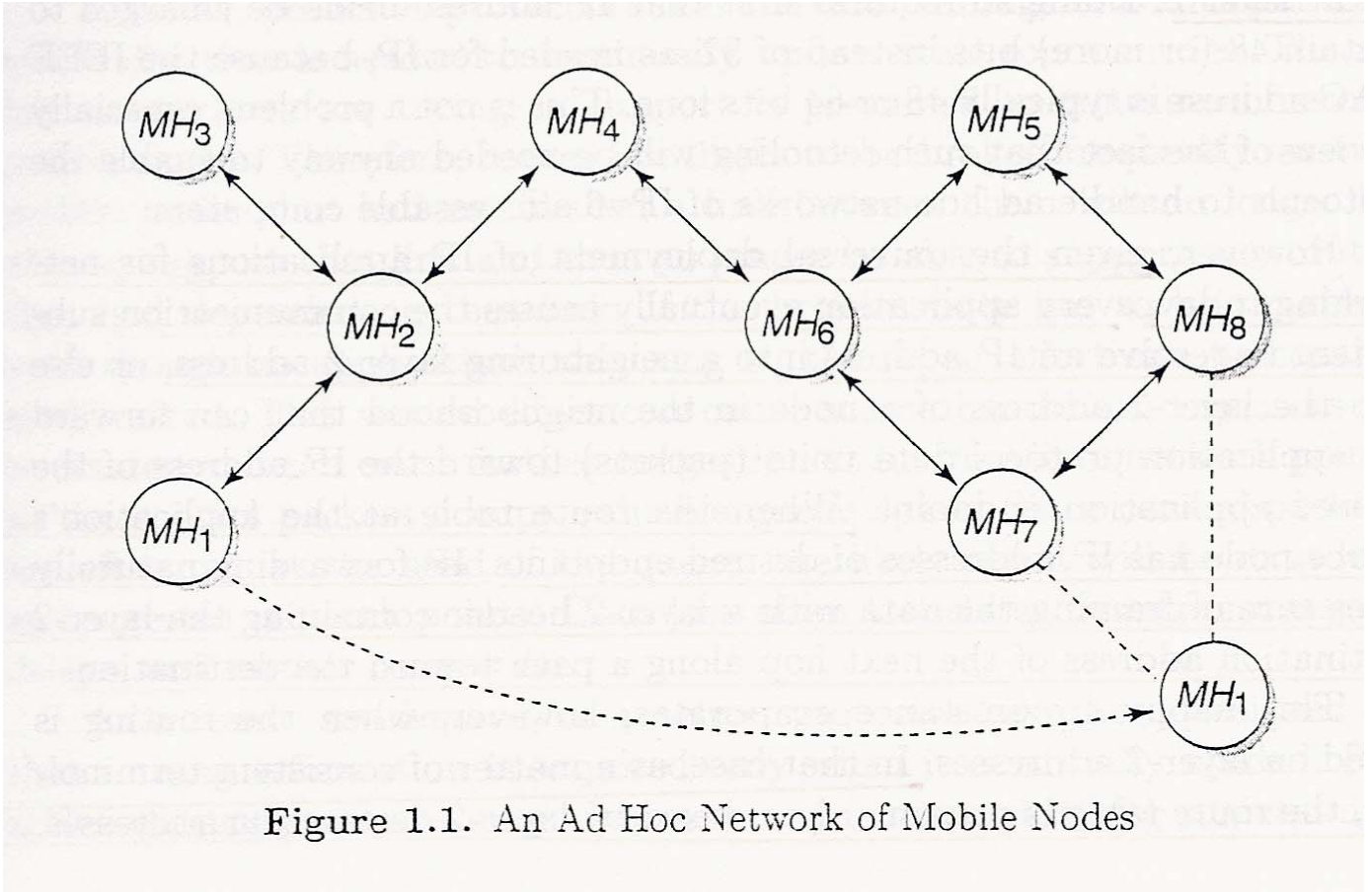


Figure 1.1. An Ad Hoc Network of Mobile Nodes

Assumptions

- Symmetric Links:
  - unidirectional links are difficult to dealt with, and sometimes at the verge of failure
- Layer-2 Routing:
  - Most protocols are presented in layer-3 routing, but can be easily retooled as a layer-2 ones.
- Proactive vs. Reactive Protocols
  - (to be elaborated later)

Applications

- Ad hoc conferencing
- Home networking
- Emergency services
- Personal area network (PAN)
- Ubiquitous computing
  - “computers are all around us, constantly performing mundane tasks to make our lives a litter easier”
  - “Ubiquitous intelligent internetworking devices that detect their environment, interact with each other, and respond to changing environmental condition will create a future that is as challenging to imagine as a science fiction scenario.”

- Sensor Dust: (wireless sensor network)
  - a large collection of tiny sensor devices
    - once situated, the sensors remain stationary
    - largely homogeneous
    - power is likely to be a scarce resource, which determines the lifetime of the network
  - can offer detailed information about terrain or environmental dangerous conditions.
- Automotive Integration:
  - may be integrated with positioning devices

Technical Factors

- Scalability
- Power budget vs. latency
- Protocol deployment and incompatibility standards
  - “Unless a miracle happens (e.g., the IETF manet working group is able to promulgate a widely deployed ad hoc networking protocol), ad hoc networks will gain momentum only gradually because users will have to load software or take additional steps to ensure interoperability.
- Wireless data rate
  - e.g., TCP over multi-hop wireless links
- Security issues

More Extensions (DoD's Perspective)

- Could be a group of hosts supported by one or more radios

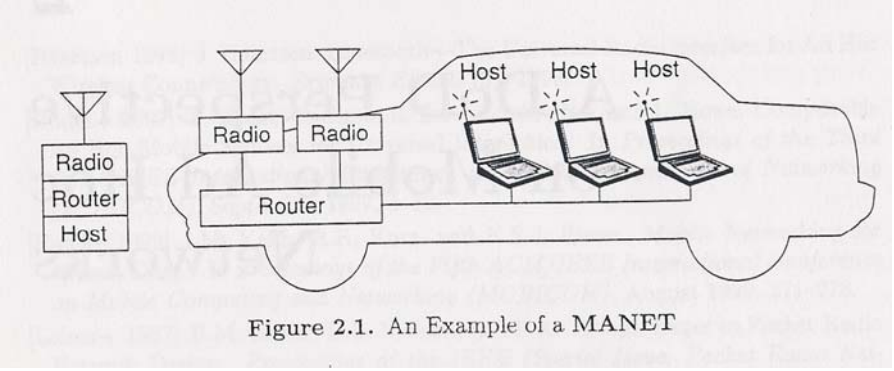


Figure 2.1. An Example of a MANET

- Could across the Internet

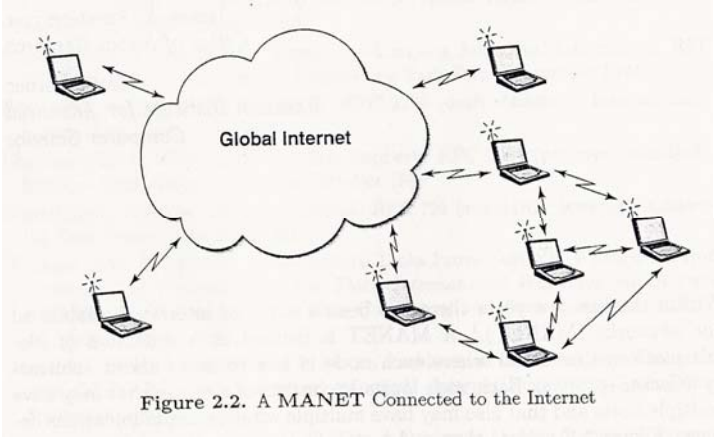


Figure 2.2. A MANET Connected to the Internet

IETF MANET Working Group

- Goal:
  - To standardize an interdomain unicast routing protocol which provides one or more modes of operation, each mode specialized for efficient operation in a given mobile networking “context”, where a context is a predefined set of network characteristics.
- A dozen candidate routing protocols have been proposed.

IETF MANET Routing Protocols

- Mobile Ad-hoc Networks (manet) Working Group (http://www.ietf.org/html.charters/manet-charter.html)
  - The Zone Routing Protocol (ZRP) for Ad Hoc Networks (38377 bytes)
  - Ad Hoc On Demand Distance Vector (AODV) Routing (84395 bytes)
    The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks (192667 bytes)
  - On-Demand Multicast Routing Protocol (ODMRP) for Ad-Hoc Networks (59372 bytes
  - Topology Broadcast based on Reverse-Path Forwarding (TBRPF) (112739 bytes)
  - Landmark Routing Protocol (LANMAR) for Large Scale Ad Hoc Networks (50155 bytes)
  - Fisheye State Routing Protocol (FSR) for Ad Hoc Networks (38463 bytes)
  - The Interzone Routing Protocol (IERP) for Ad Hoc Networks (40534 bytes)
  - The Intrazone Routing Protocol (IARP) for Ad Hoc Networks (32486 bytes)
  - The Bordercast Resolution Protocol (BRP) for Ad Hoc Networks (35570 bytes)

Applications of Ad Hoc Networks

Network Architectures

- Infrastructure:

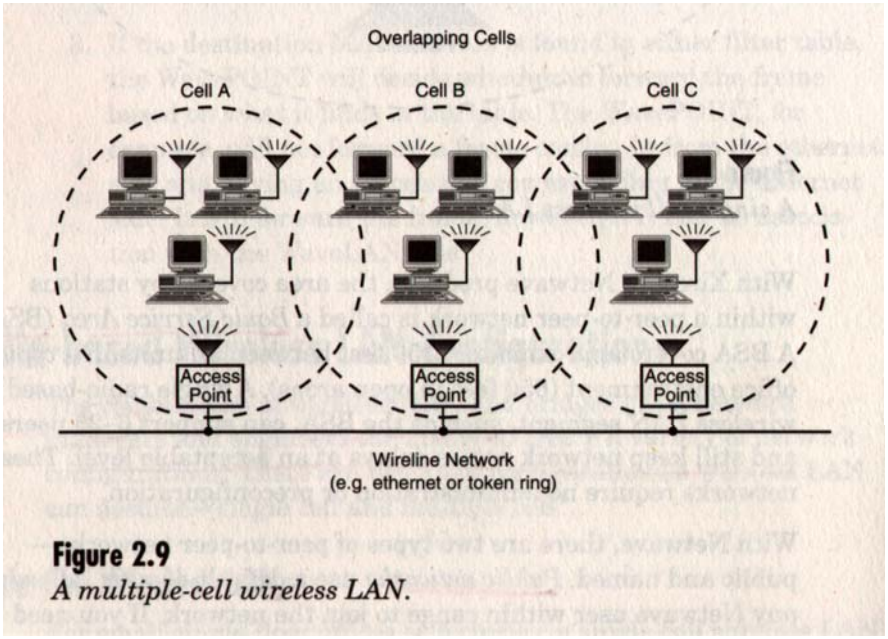


Figure 2.9
A multiple-cell wireless LAN.

- No Infrastructure (ad hoc networks):
  - no base stations; no fixed network infrastructure

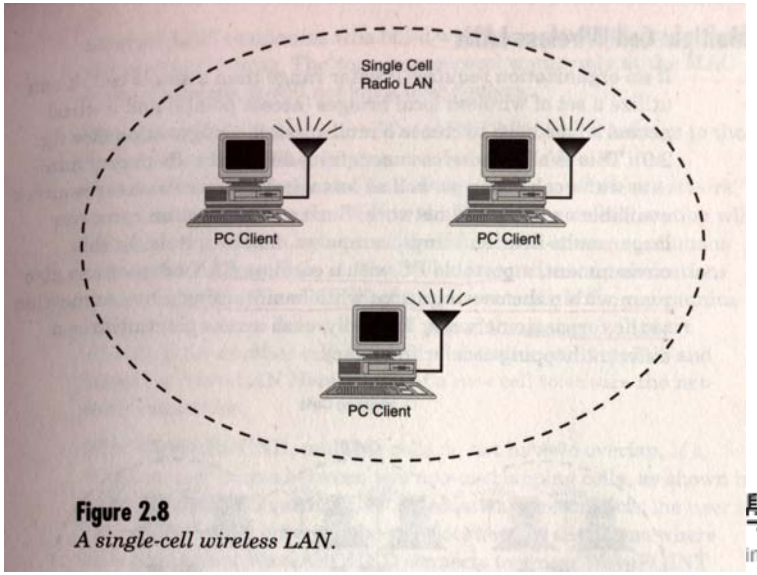
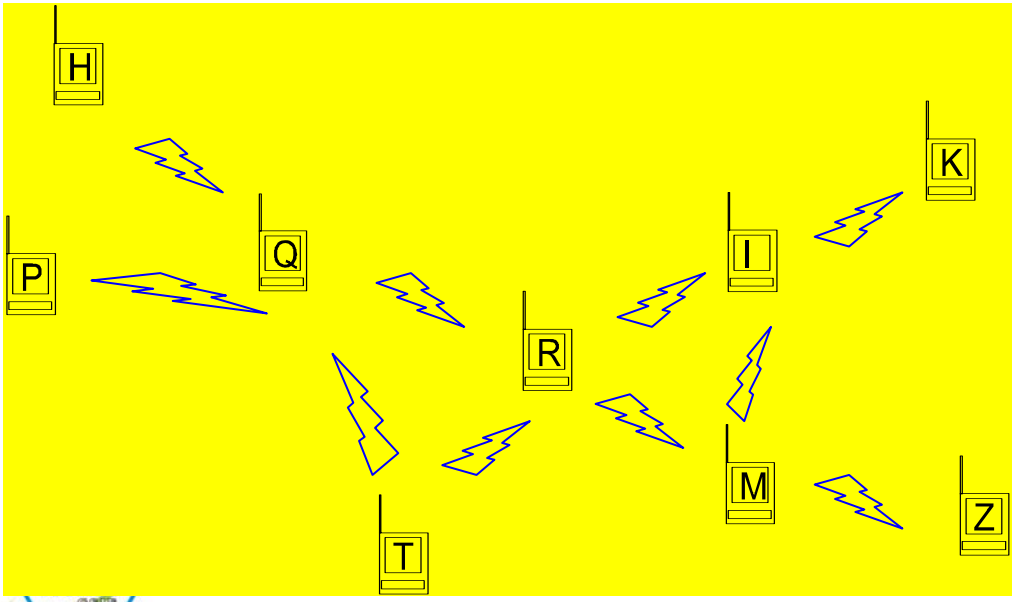
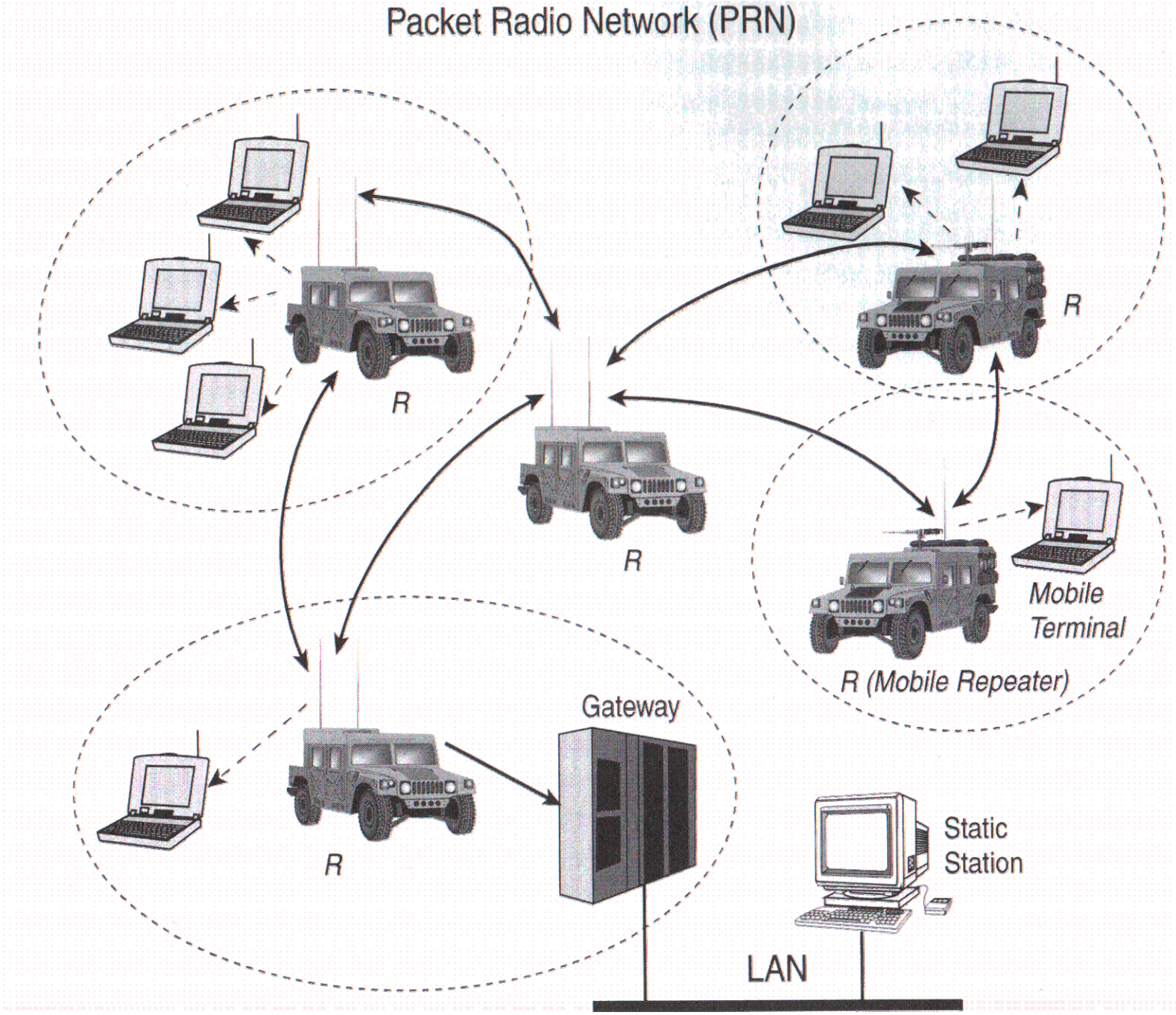


Figure 2.8
A single-cell wireless LAN.

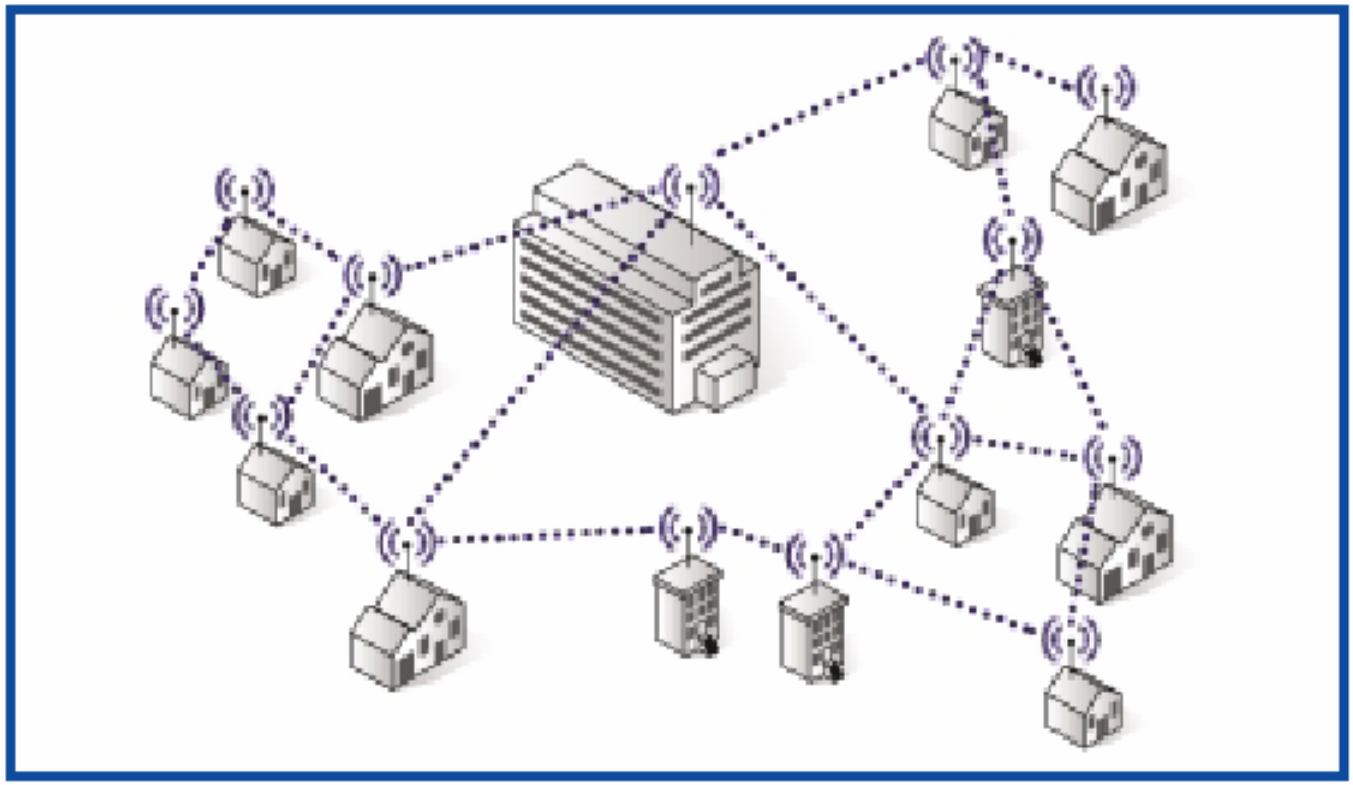
MANET

- MANET = Mobile Ad Hoc Networks
  - Multi-hop communication
  - Needs support of dynamic routing protocols




Packet Radio Network (PRN)
R
R
R
R
R (Mobile Repeater)
Mobile
Terminal
Gateway
Static
Station
LAN

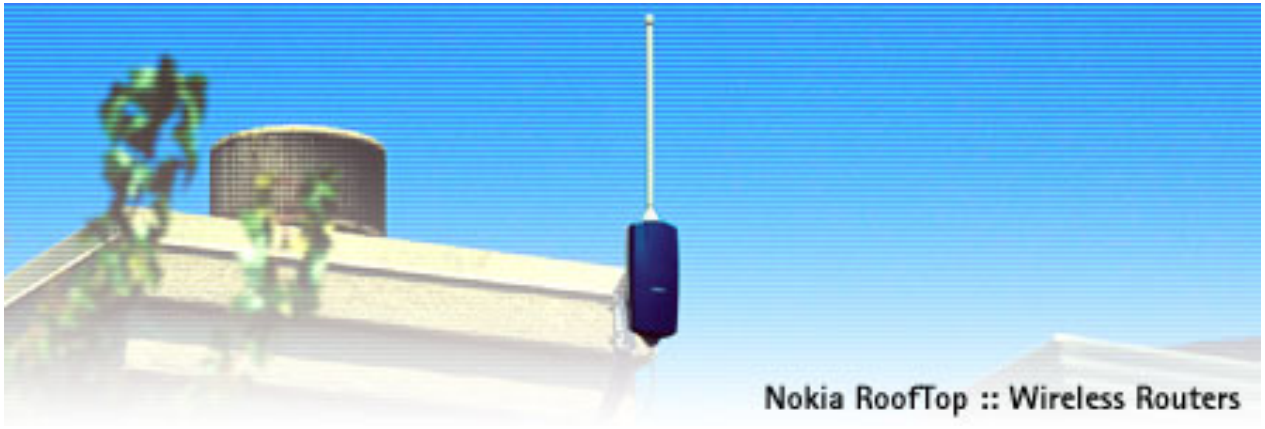
Nokia Rooftop Product



Multipoint-to-Multipoint Mesh Network

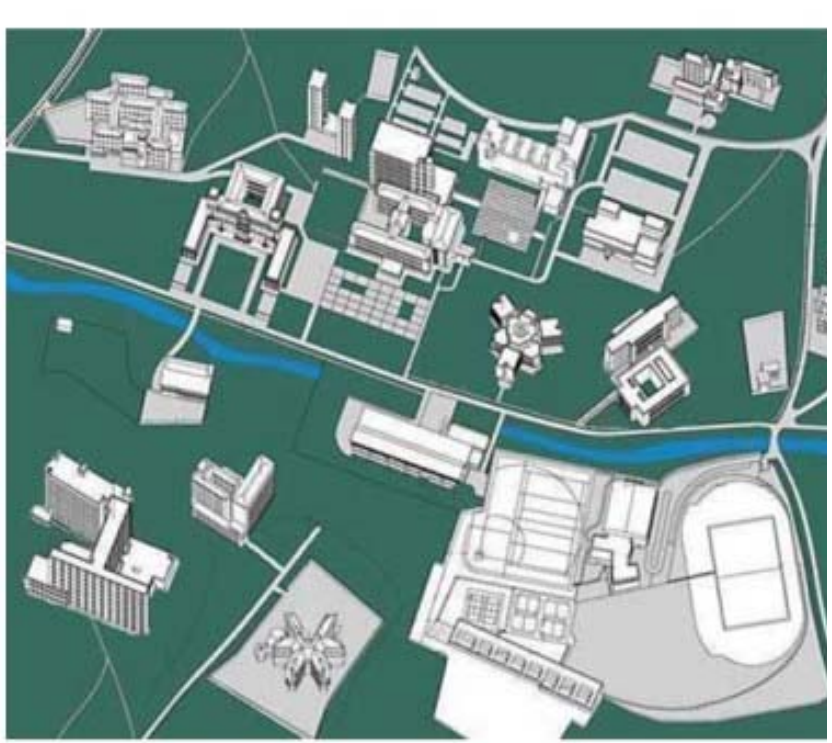
Nokia RoofTop

- RoofTop solution (Nokia, Finland)
  - Wireless router
    - a radio frequency (RF) modem
    - a digital Internet protocol (IP) router

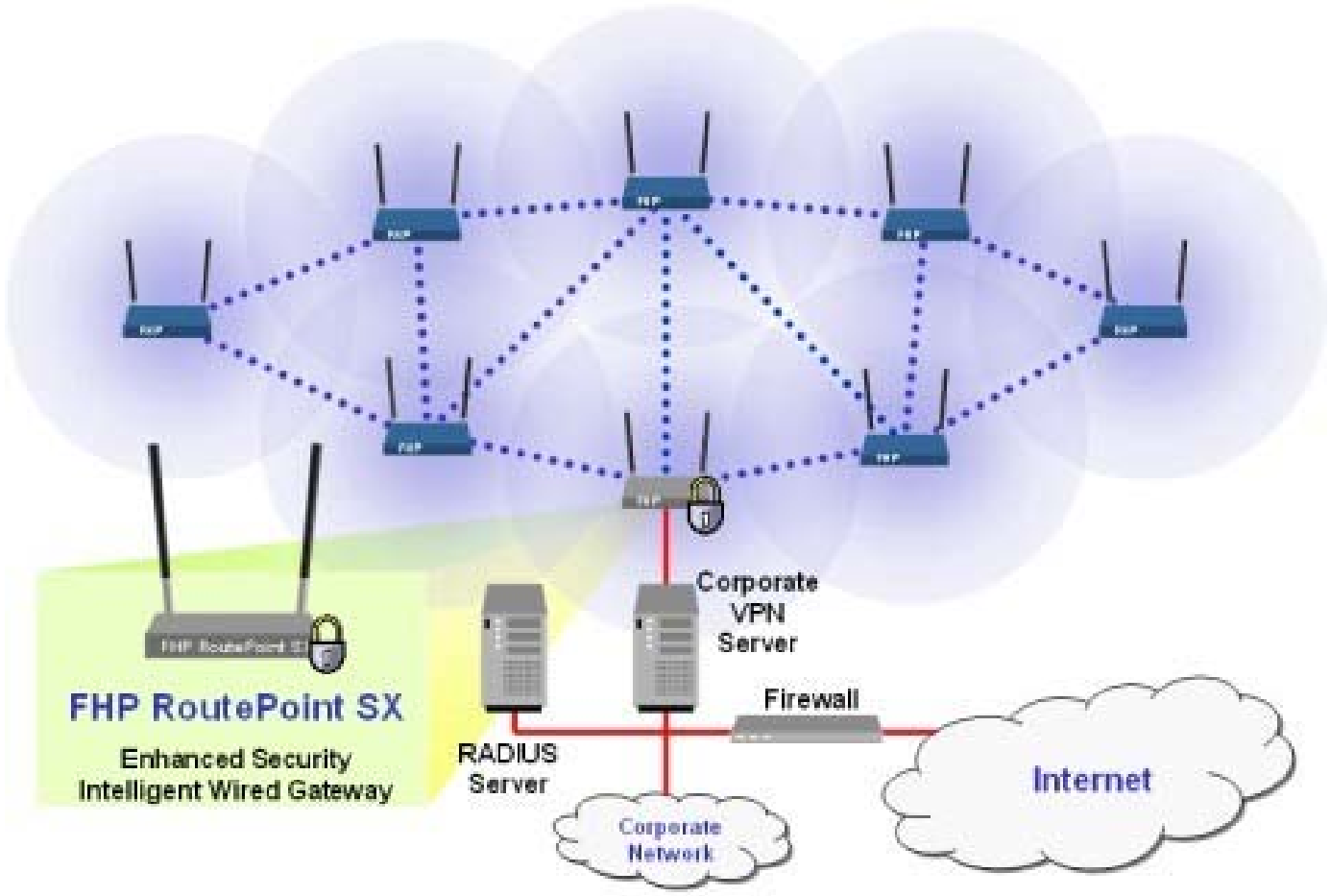


FHP

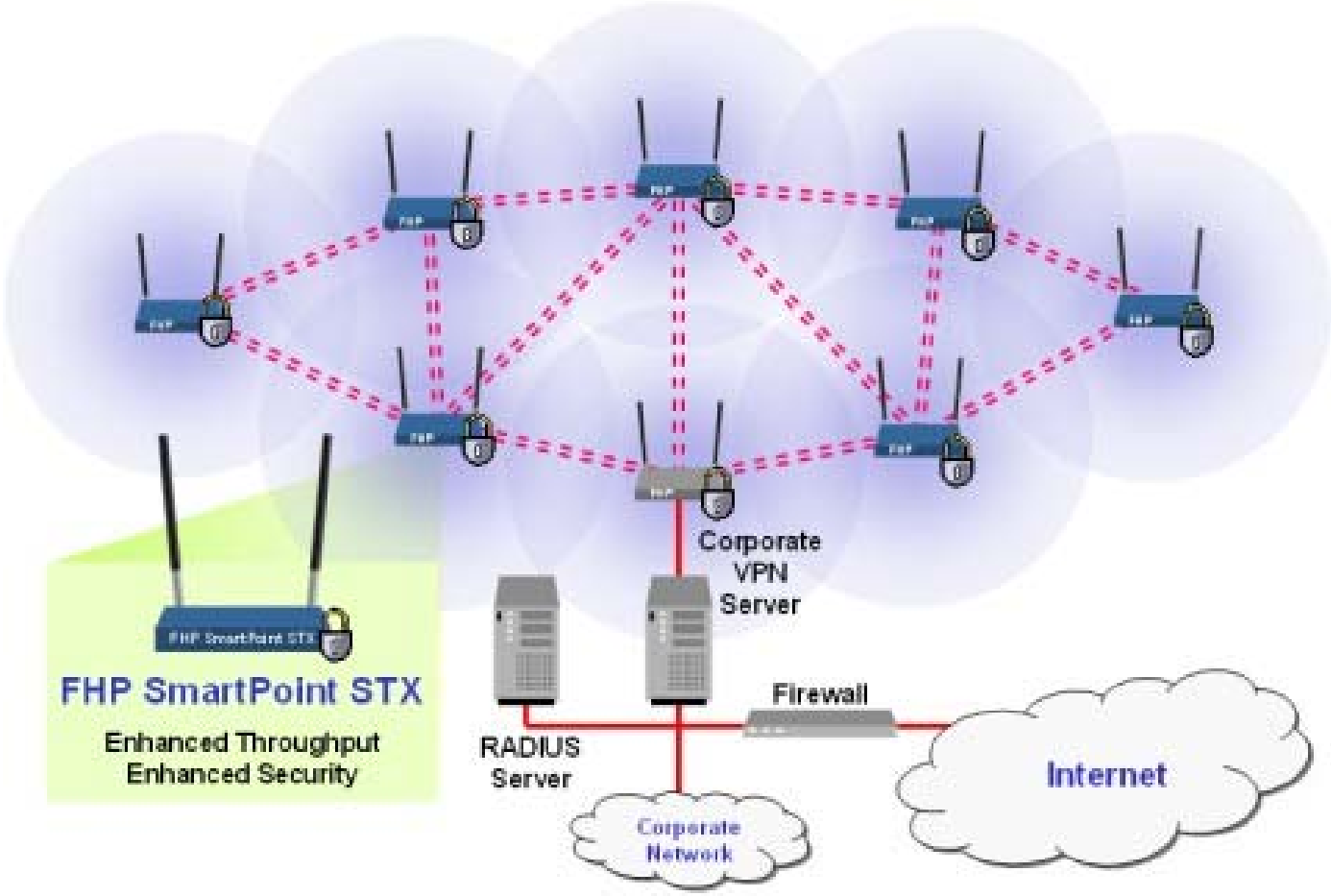
- FHP Wireless, USA



FHP Wireless

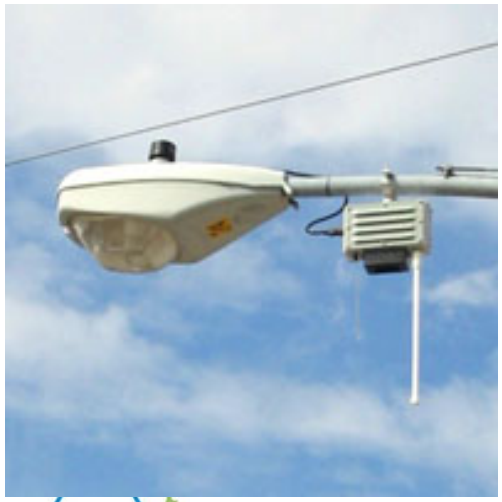


FHP Wireless



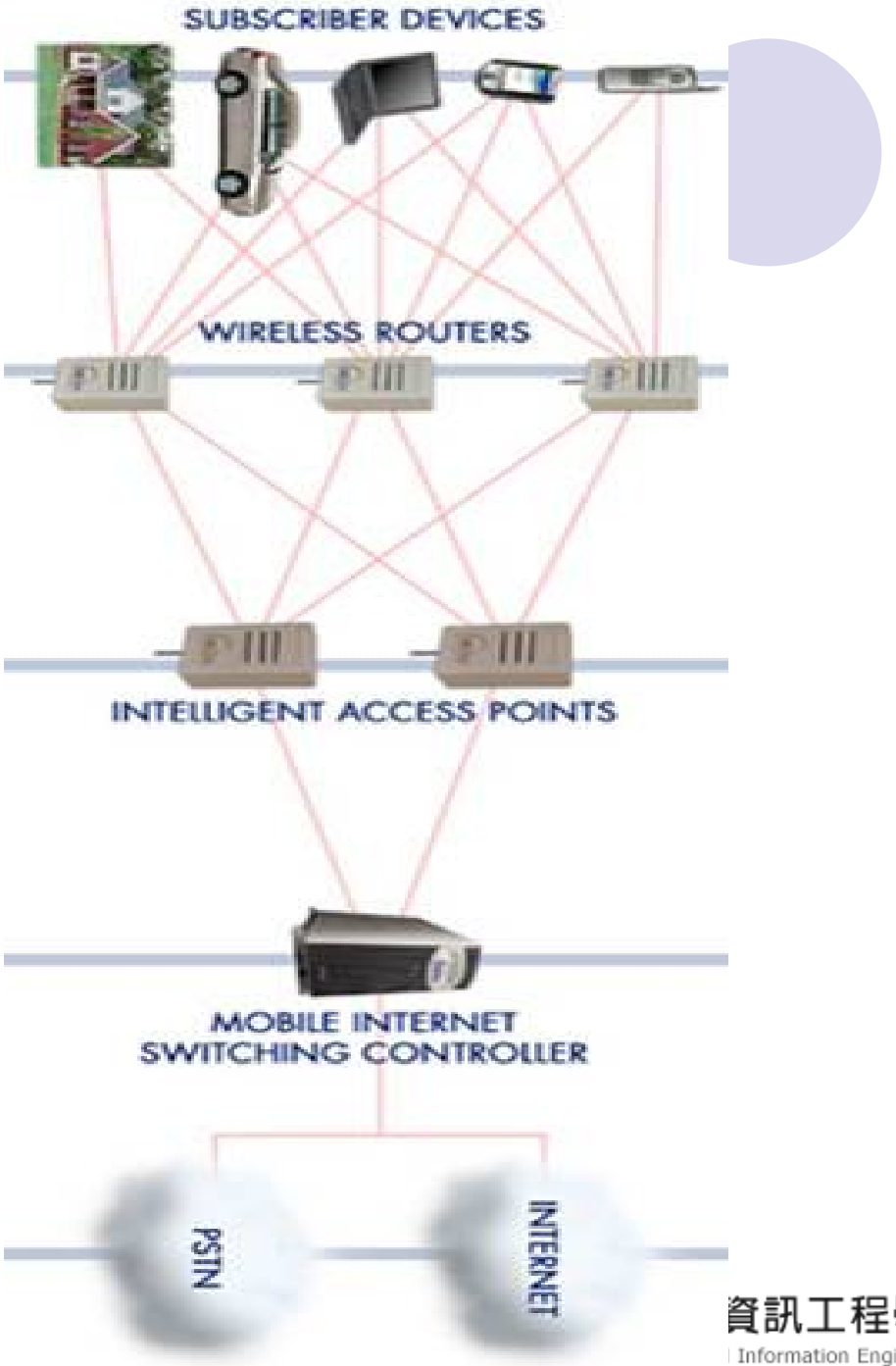
MeshNetworks

- rks, US

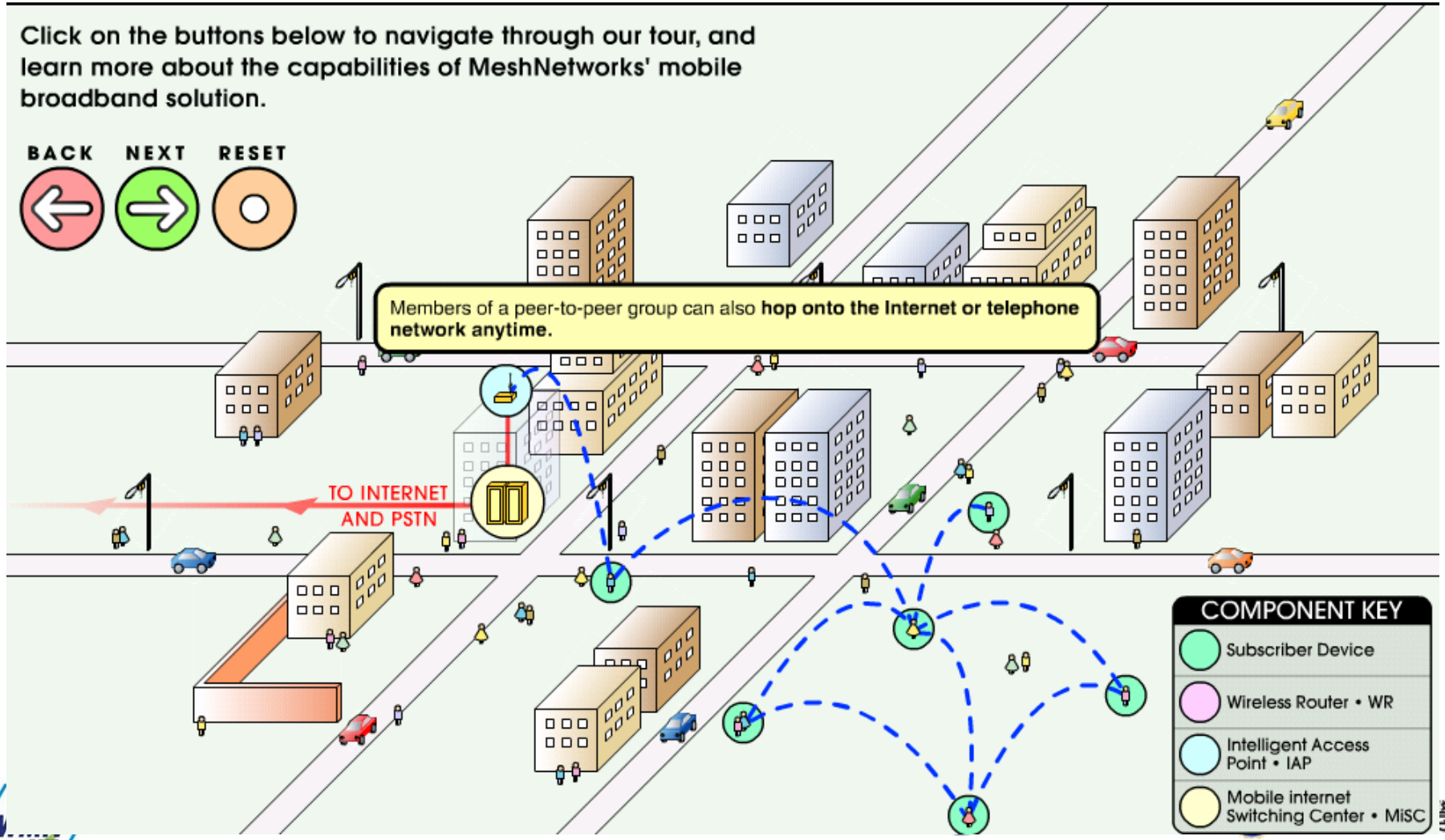


MeshNetworks

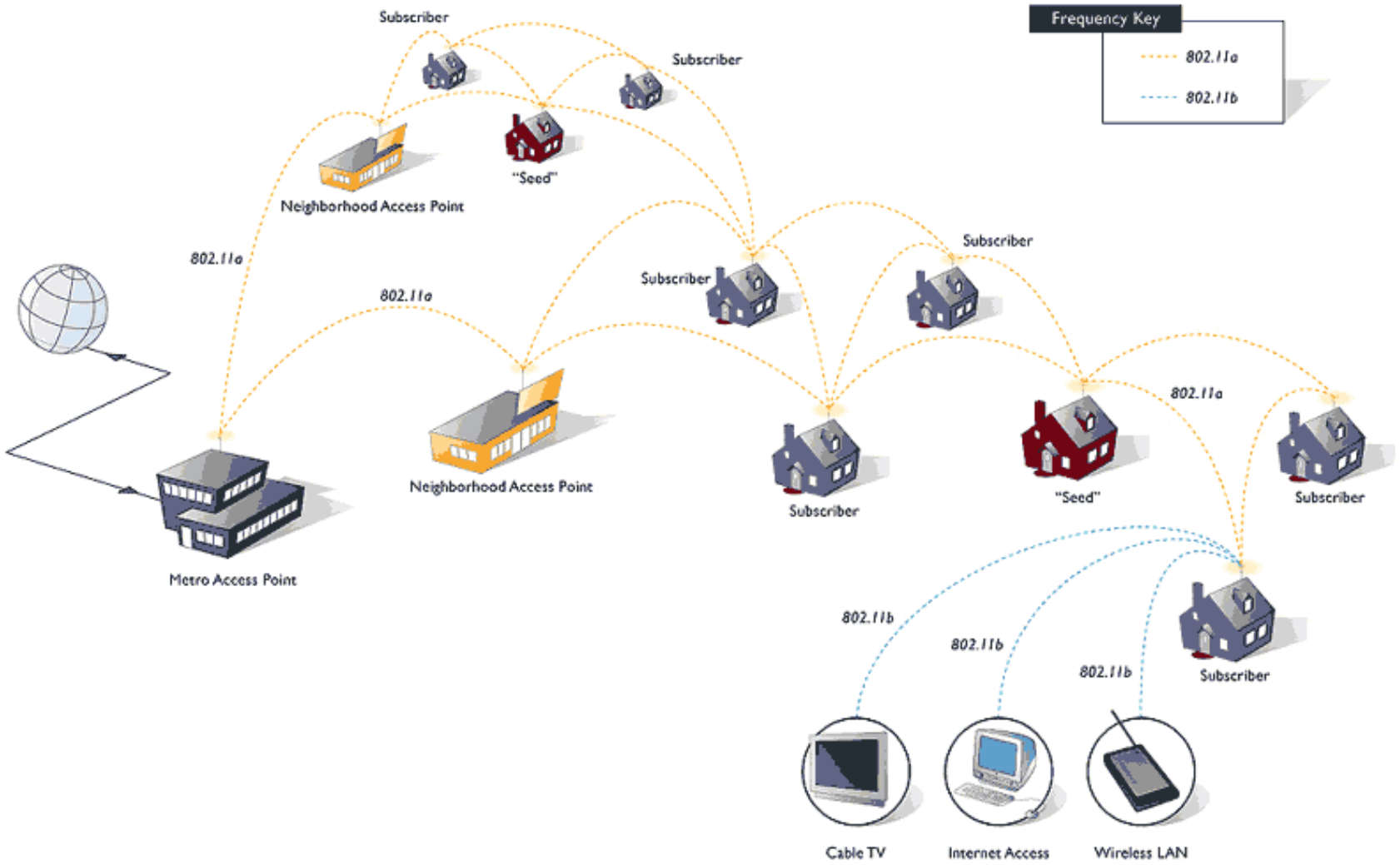
- Architecture



Networking Scenario (III) : To Internet



SkyPilot NeighborNet



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Homework #8:

1. What's mobile ad hoc network ?
2. What's possible applications of mobile ad hoc networks ?