

# Wireless Networks

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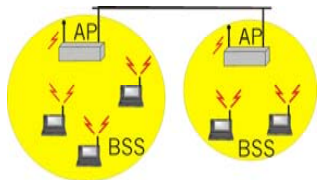
## Wireless Networks

- Advantages of wireless links:
  - Mobility, easy setup
- Wireless networks:
  - Infrastructured wireless networks
  - Ad hoc wireless networks
  - Often mobile, but sometimes fixed location

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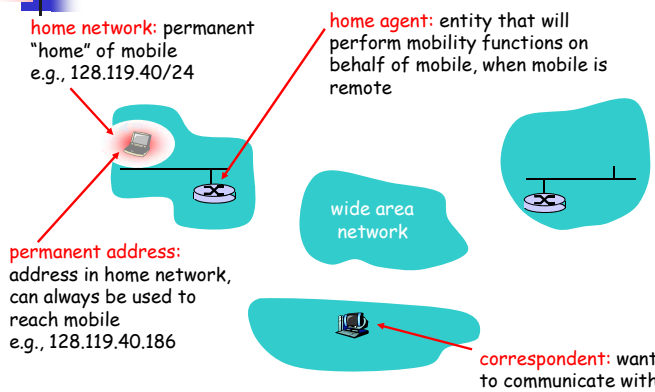
## Infrastructured Network Model

- Wireless host communicates with a **base station** or **access point (AP)**.
- **Basic Service Set (BSS)** contains:
  - a base station;
  - wireless hosts reachable from the base station.
- Base stations are connected to each other and wide-area network through wired links.



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## Addressing: when mobile is at home



**home network:** permanent "home" of mobile  
e.g., 128.119.40/24

**home agent:** entity that will perform mobility functions on behalf of mobile, when mobile is remote

**permanent address:** address in home network, can always be used to reach mobile  
e.g., 128.119.40.186

**correspondent:** wants to communicate with mobile

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### Addressing: when mobile is moving around

**Permanent address:** remains constant (e.g., 128.119.40.186)

**Care-of-address:** address in visited network. (e.g., 79.129.13.2)

**visited network:** network in which mobile currently resides (e.g., 79.129.13/24)

**foreign agent:** entity in visited network that performs mobility functions on behalf of mobile.

wide area network

correspondent

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### Mobile Registration

home network

visited network

wide area network

foreign agent contacts home agent home: "this mobile is resident in my network"

mobile contacts foreign agent on entering visited network

**End result:**

- Foreign agent knows about mobile
- Home agent knows location of mobile

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### Principles of Mobile Routing

- Indirect routing**
  - communication from correspondent to mobile goes through home agent, then forwarded to remote
- Direct routing**
  - correspondent gets foreign address of mobile, sends directly to mobile

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### Mobility via Indirect Routing

home network

visited network

wide area network

correspondent addresses packets using home address of mobile

home agent intercepts packets, forwards to foreign agent

foreign agent receives packets, forwards to mobile

mobile replies directly to correspondent

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### Forwarding Packets to Remote Mobile: Encapsulation

foreign-agent-to-mobile packet

packet sent by home agent to foreign agent: a *packet within a packet*

Permanent address: 128.119.40.186

Care-of address: 79.129.13.2

packet sent by correspondent

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### Indirect Routing: Discussions

- Mobile uses two addresses:
  - permanent address: used by correspondent
  - care-of-address: used by home agent to forward packets to mobile
- triangle routing: corres.-home-network-mobile
- suppose mobile user moves to another network
  - registers with new foreign agent
  - new foreign agent registers with home agent
  - home agent updates care-of-address for mobile
  - packets continue to be forwarded to mobile (but with new care-of-address)

⇒ Mobility, changing foreign networks transparent

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### Mobility via Direct Routing

home network

visited network

wide area network

foreign agent receives packets, forwards to mobile

correspondent forwards to foreign agent

correspondent requests, receives foreign address of mobile

mobile replies directly to correspondent

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### Indirect Routing vs. Direct Routing

- Efficiency
  - Indirect routing is inefficient, especially when correspondent, mobile are near but home is far
- Transparency
  - Indirect routing is transparent to correspondent, smoother handoff when moving between networks

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## Mobile IP

- Network-layer mobility protocol interoperable with IP [C. Perkins, 2002]
- Has many features we've seen:
  - home agents, foreign agents, foreign-agent registration, care-of-addresses, encapsulation (packet-within-a-packet)
  - use indirect routing

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## Ad Hoc Network Model

- No base stations or access points
- Wireless hosts communicate with each other directly
  - to get packet from wireless host A to B may need to route through wireless hosts X, Y, Z
- Compared with based station model
  - more flexible
  - require complex support
- Applications:
  - "laptop" meeting in conference room, car
  - interconnection of "personal" devices
  - battlefield



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## Addressing in Ad Hoc Networks

- Requirements for addressing in ad hoc networks?
- Hierarchical
- Unique

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## Routing in Ad Hoc Networks

- Any ideas?
- DSR [Johnson 1994]
  - Broadcast-style path discovery
  - Source maintains whole path, each packet carries whole path
- AODV [Perkins and Royer 1999]
  - Every node maintains a routing table, routing hop by hop
- Source routing vs. hop-by-hop routing?

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## Geographic Location-based Routing

- [Li et al. 2000]
  - Each device is identified by its geographic location (e.g., longitude and latitude)
  - At each routing step, the packet is directed to the current node's neighbor with shortest Cartesian distance to dest.
- Advantage:
  - Simple scheme, low routing overhead
- Problem?
  - Routing loops or "dead ends"
  - Work best for dense networks

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