Wireless Networks and Mobile Computing

Introduction to Wireless Networks

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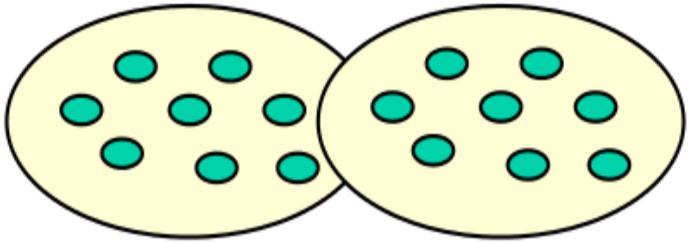
Classification

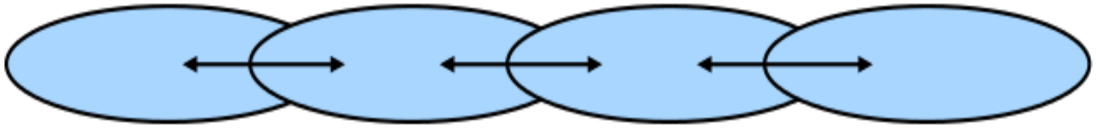
- Independent of the technology they use, wireless networks can be classified based on different criteria:
  - Coverage
  - Mobility
  - Architecture

Wireless Networks: Coverage & Mobility

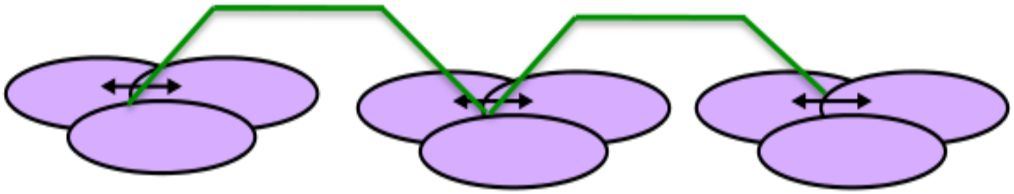
- Satellite



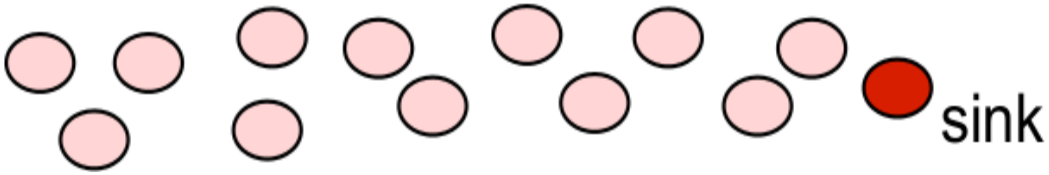
- Cellular



- Local/Personal



- Sensors



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In decreasing order of coverage and node mobility, wireless networks can be classified as:

- a) Satellite Systems:
  - Where each satellite has very huge foot print and
  - Ofcourse satellites can support high mobility (from trains to high speed cars and users with high speed mobility).
- b) Cellular Networks:
  - Are organized into cells where, each cell is controlled by a base station and the radius of a cell may range from average of meters to tens of kill meters
  - Can support high speed users(trains, cars on high ways – can use services that are supported by cellular networks)

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- Local Area Networks (Personal Area networks):
  - By Local Area Networks, we mean, e.g wi-fi networks
  - In this case every node can cover 100s of meters
  - By personal Area Networks, we mean, e.g Bluetooth – in general networks that are deployed around a single person.
  - Can cover 10s of meters
  - Both local and personal area networks can support mobility, but the users are either sitting or walking – they can't support high speed users.

- Sensors:
  - Sensors may be fixed nodes(no mobility at all) or they can be on other devices, and in that case they can be movable.
  - Their speed depends on the device they are dependent up on.
  - Coverage of sensors may vary from few centimeters to 10s of meters.

Wireless Networks: Architecture

Based on the architecture they have wireless networks can be classified as:

- Networks that include infrastructure nodes and
- Networks that don't

- Infrastructured:
  - All nodes communicate directly with an infrastructure node, which is a gateway towards the wired network
  - Example, cellular networks or wi-fi networks with access points
  - They all include a fixed node, like a base station or access point
  - In those types of networks, all communications are handled by the fixed infrastructure node.
- Ad Hoc:
  - Networks that don't include infrastructure nodes are represented by ad-hoc networks, where in principle we don't have any infrastructure.
  - We only have user nodes that can communicate directly between each other
  - In this case, we have a peer-to-peer(p2p) communication system – direct communication between the nodes.
  - e.g user laptops using 802.11

- Hybrid:
  - Infrastructure + ad hoc
  - Networks that include the ad hoc paradigms and the infrastructure nodes
  - We have some nodes that communicate between each other by using the ad hoc paradigm and there is a gateway node, through which the group of nodes are connected to the Internet.
  - The nodes communicate between each other, when they need to exchange data. When, instead, they need to upload or download something to/from the Internet, then they will need to interact with the gateway node(infrastructure node).

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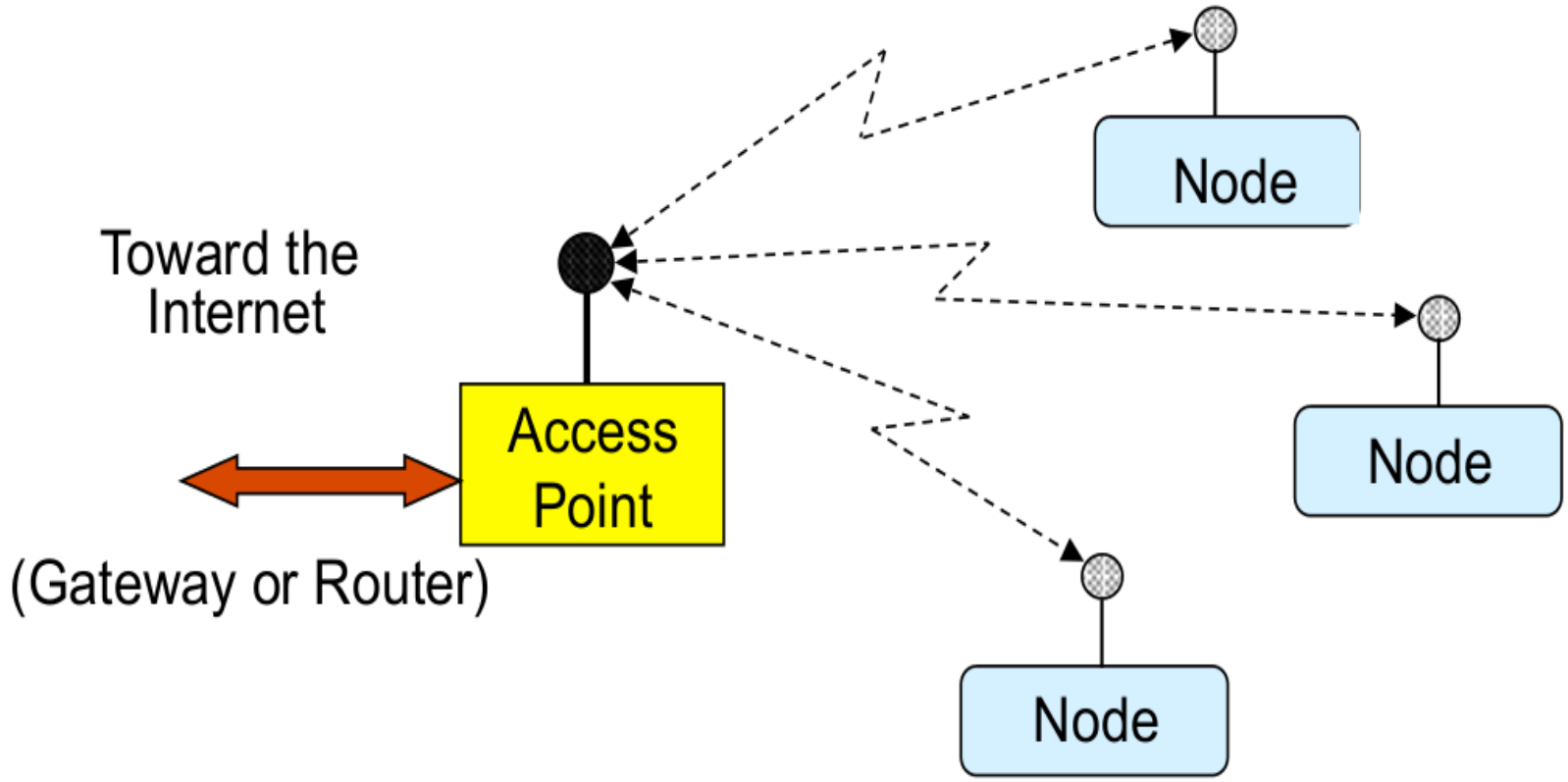
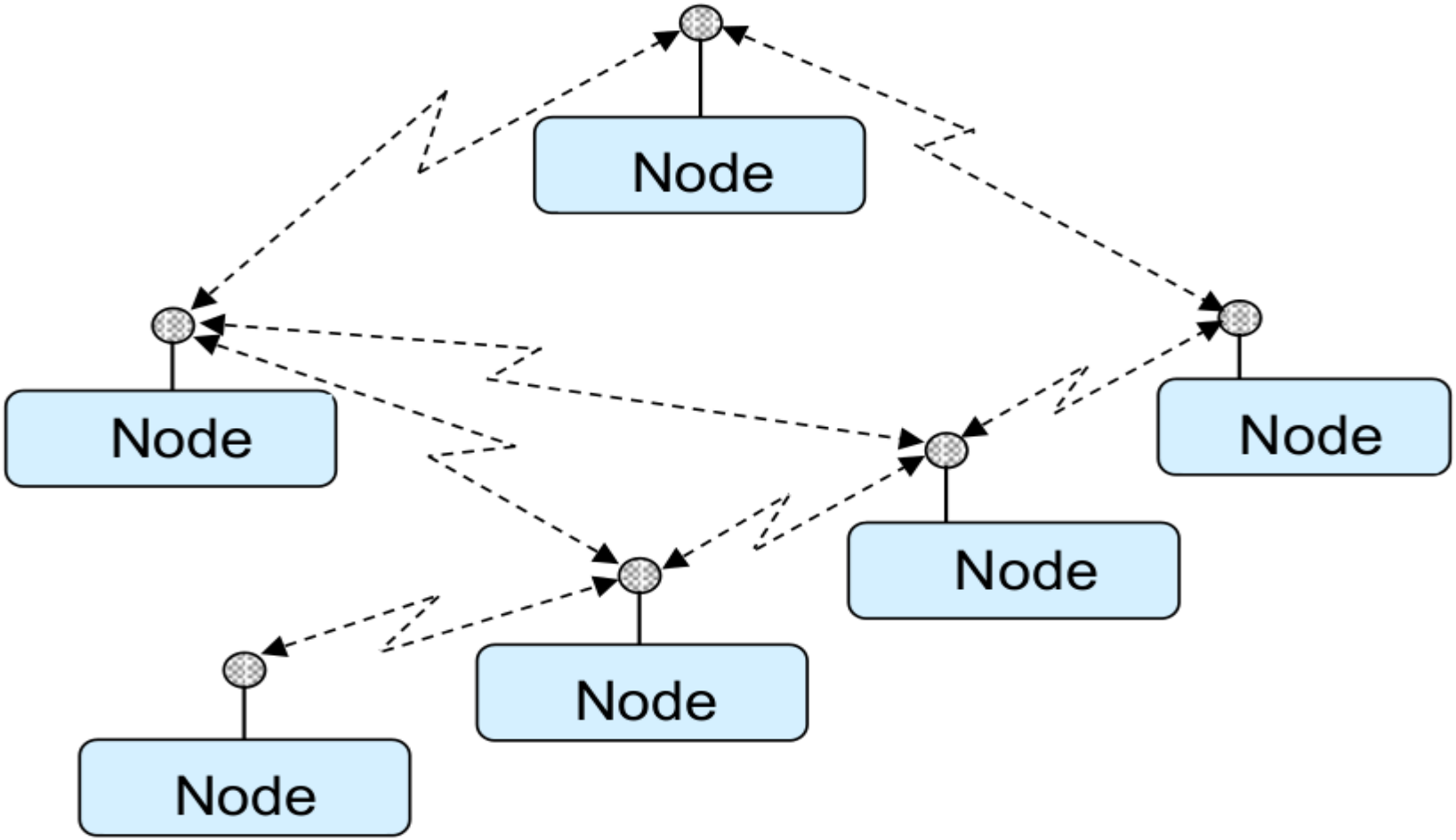
- Mesh Networks:
  - Set of fixed wireless nodes connected with each other (mesh nodes), including one or more gateway nodes to the Internet.
  - There are also a set of mobile nodes, that can access the network only through the mesh nodes.

Infrastructured Networks



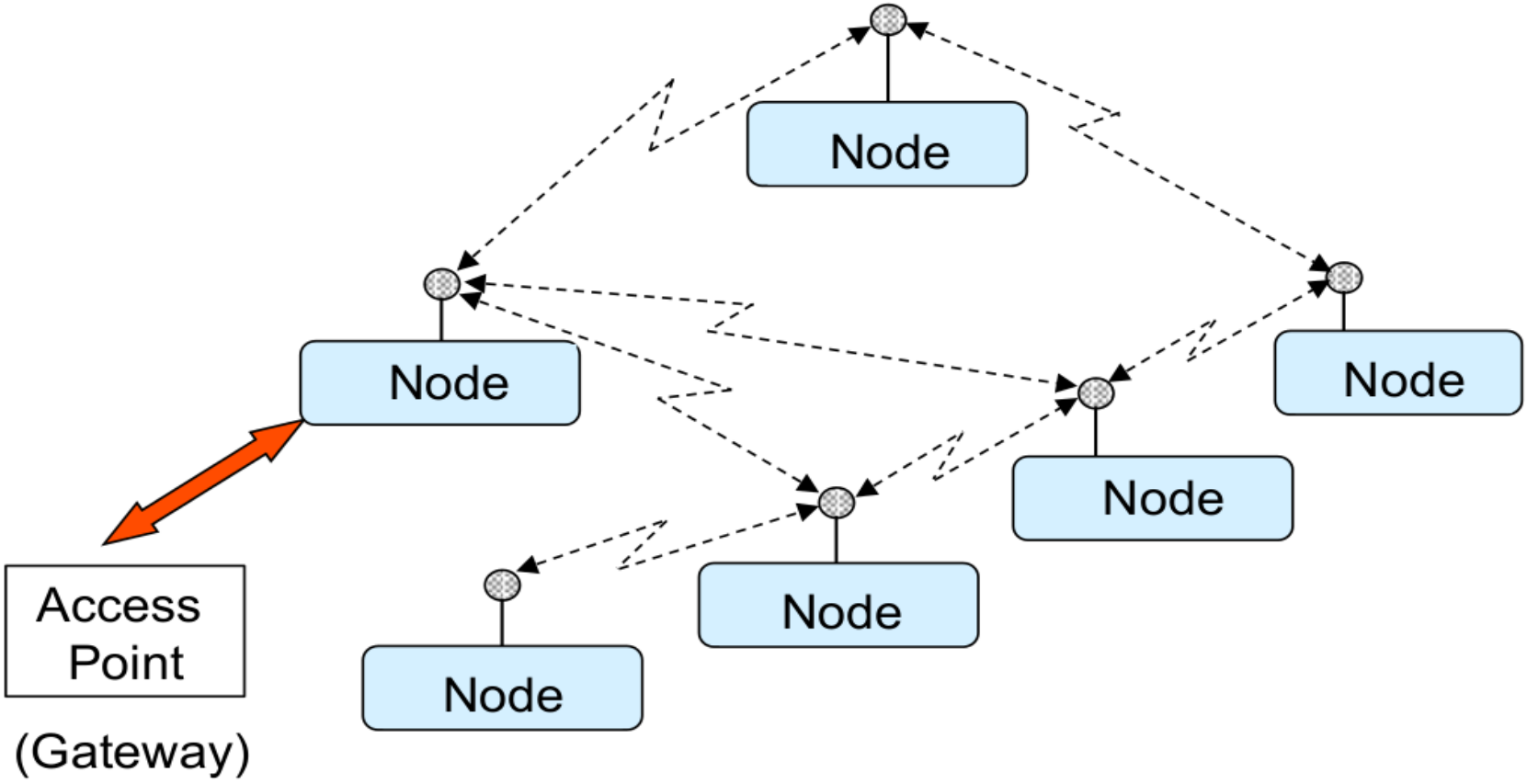
Key Note: All communications happen through the access point(gateway). There is no direct communication between individual nodes.

Ad Hoc Networks



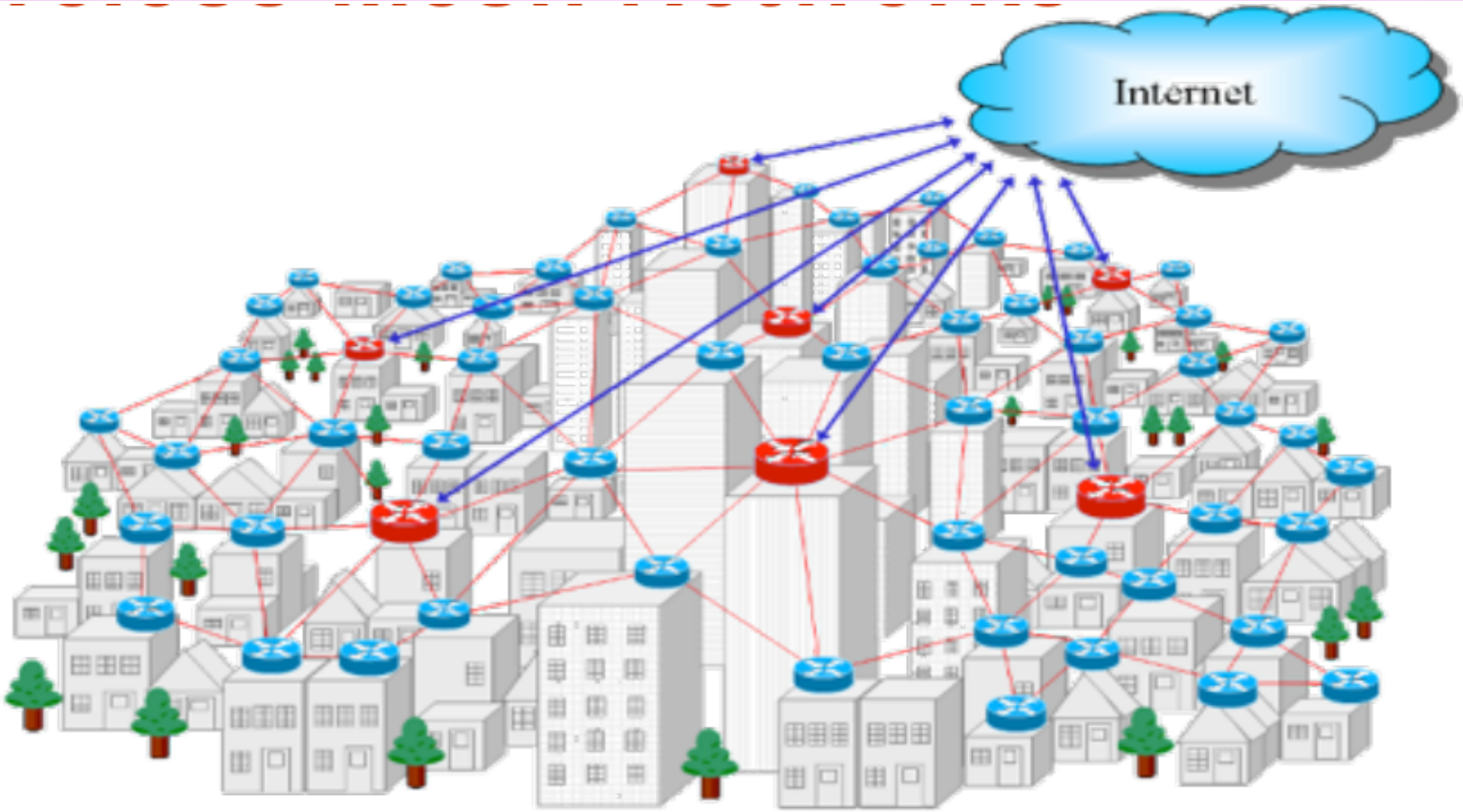
We have a bunch of nodes that can communicate between each other

Hybrid Networks



There are a set of nodes that communicate using the ad hoc paradigm and there is a fixed access point that is used as a gateway for communication to/from the Internet.

Wireless Mesh Networks



There are nodes(blue nodes), fixed nodes, that can communicate directly between each other. Therefore, they form a wireless mesh network. These blue nodes however, can communicate with some gateway nodes (red nodes). The gateway nodes are the ones that have connectivity with the Internet.

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- The blue nodes can be thought as access points deployed in buildings in urban areas. Assume people who live inside the buildings equipped with smart phones, laptops, … that access the network through the blue nodes.
- Example: people can communicate to one of the blue nodes through wi-fi, in which the blue nodes will be wi-fi access points.
- In mesh networks, we have different layers:
  - **Bottom layer:** users(mobile users), that can access the network only by using the access points.
  - **Middle layer:** composed by nodes that can communicate between each other.
  - **Upper layer:** we have the links between the access points and the gateway nodes, which represent the connectivity with the Internet.