COMPUTER NETWORK SCE 4303

Wireless and Mobile Networks

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1 Introduction

2 Wireless links and their characteristics

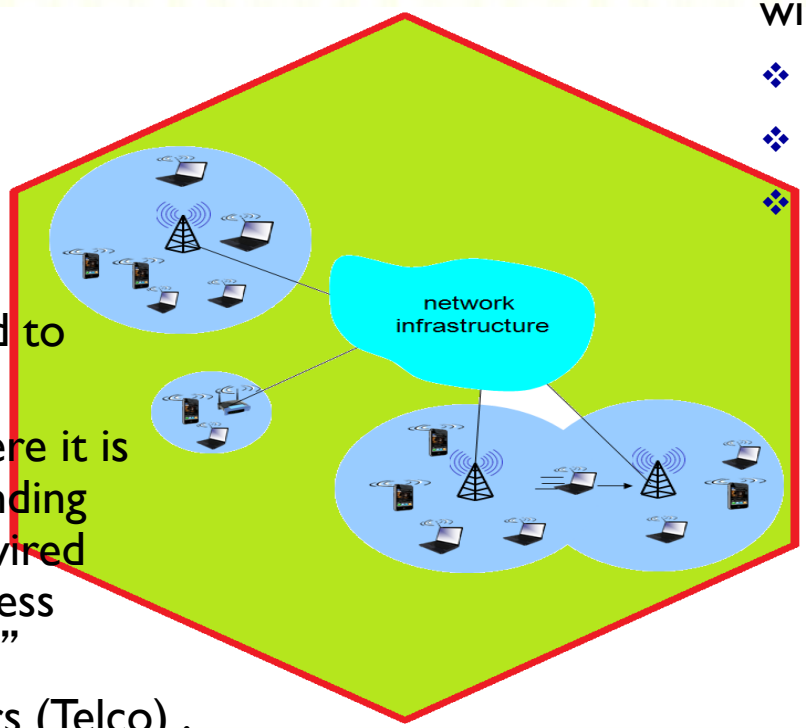
3 wireless LANs (“Wi-Fi”) : IEEE 802.11

4 Cellular Internet Access

Background

- Currently, number of wireless (mobile) phone subscribers exceeds number of wired phone subscribers (5-to-1)!
- Number of wireless Internet-connected devices equals to the number of wired Internet-connected devices
  - Laptops and smart phones promise anytime anywhere Internet access
- Two important challenges to be addressed:
  - *wireless:* communication over wireless link
  - *mobility:* handling the mobile user who changes point of attachment to network

Elements of a wireless network



wireless hosts

- laptop, Smartphone
- run applications
- may be stationary (non-mobile) or mobile
  - wireless does *not* always mean mobility

Base Station (BS)

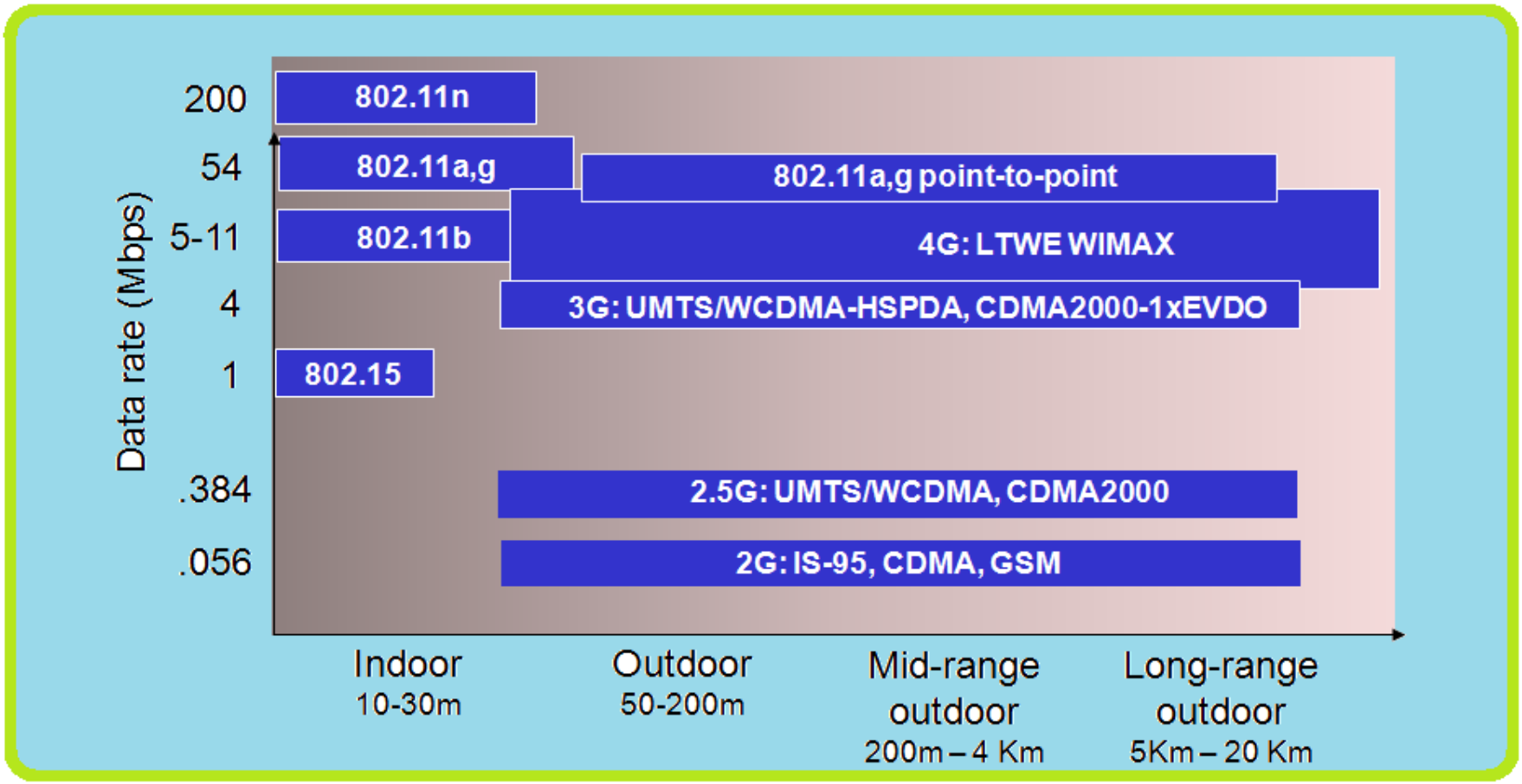
- Must be connected to wired network
- It acts as relay where it is responsible for sending packets between wired network and wireless host(s) in its "area"
  - e.g., cell towers (Telco) , 802.11 WiFi: access points

Elements of a wireless network

wireless link

- used to connect mobile(s) to base station
- used as backbone link
- multiple access protocol coordinates link access
- Supports different data rates and transmission distance

Characteristics of some wireless links in terms of Capacity & Distance



Elements of a wireless network

infrastructure mode

- base station connects mobiles to wired network
- handoff: mobile changes base station providing connection into wired network

ad hoc mode

- no base stations is needed
- nodes can only transmit to other nodes within link coverage
- nodes organize themselves into a network: route among themselves

Taxonomy of Wireless network

	single hop	multiple hops
infrastructure (e.g., APs)	host connects to base station (WiFi, WiMAX, cellular) which connects to larger Internet	host may have to relay through several wireless nodes to connect to larger Internet: *mesh net*
no infrastructure	no base station, no connection to larger Internet (Bluetooth, ad hoc nets)	no base station, no connection to larger Internet. May have to relay to reach other a given wireless node MANET, VANET

Vehicular Ad-Hoc Network (VANET): e.g. for moving car

mobile ad hoc network (*MANET*): e.g for mobil device

IEEE 802.11 Wireless LAN

802.11b

- 2.4-5 GHz unlicensed spectrum
- up to 11 Mbps
- direct sequence spread spectrum (DSSS) in physical layer
  - all hosts use same chipping code

802.11a

- 5-6 GHz range
- up to 54 Mbps

802.11g

- 2.4-5 GHz range
- up to 54 Mbps

802.11n: multiple antennae

- 2.4-5 GHz range
- up to 200 Mbps

- all use CSMA/CA for multiple access
- all have base-station and ad-hoc network versions

802.11 LAN architecture

- Wireless host communicates with base station
  - base station = access point (AP)
- Basic Service Set (BSS) (aka "cell") in infrastructure mode contains:
  - wireless hosts
  - access point (AP): base station
  - ad hoc mode: hosts only

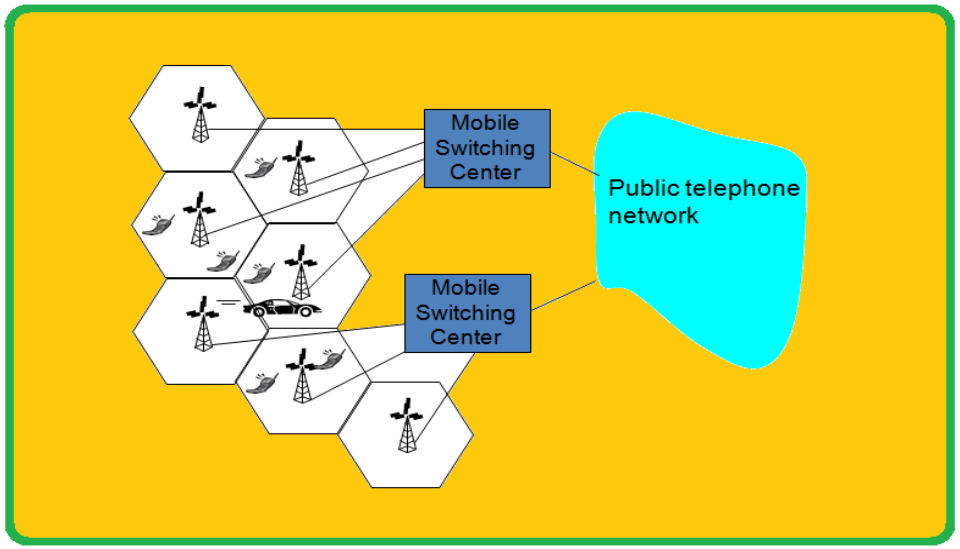
Cellular Network Architecture: Components

MSC

- connects cells to wired tel. net.
- manages call setup
- handles mobility

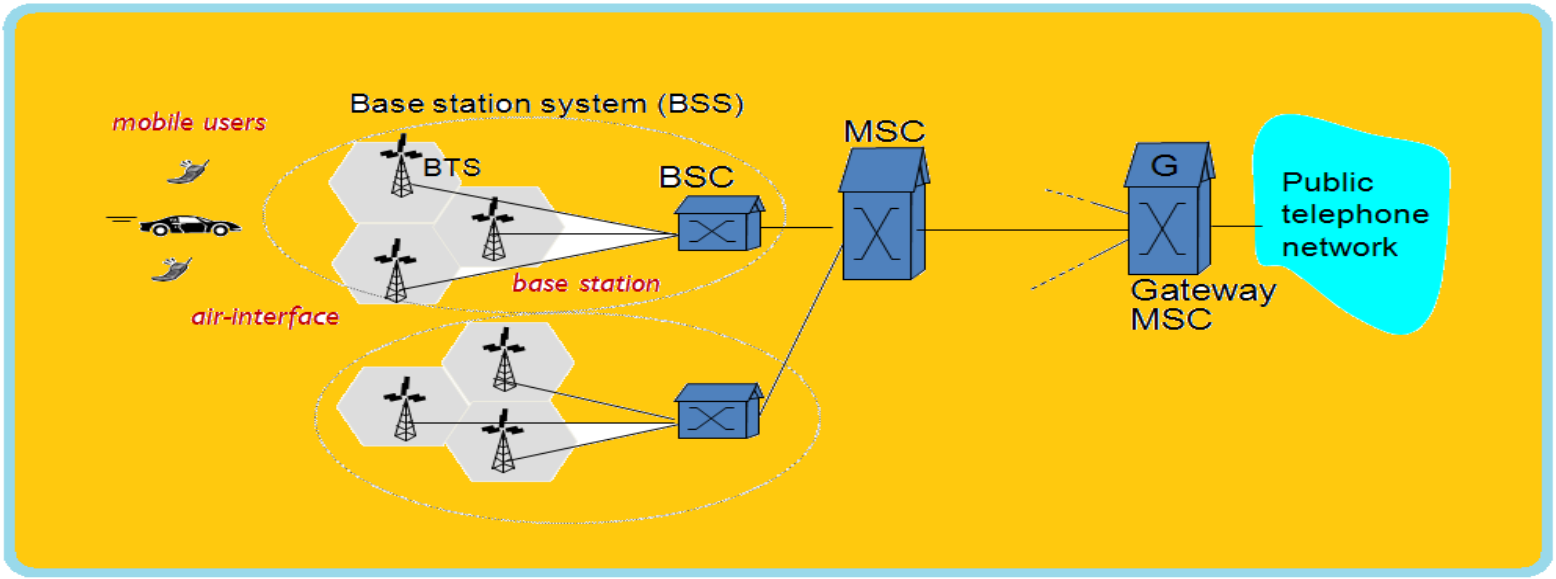
cell

- covers geographical region
- *base station* (BS) analogous to 802.11 AP
- *mobile users* attach to network through BS
- *air-interface:* physical and link layer protocol between mobile and BS



wired network

Cellular Network Architecture: 2G (voice)



Legend

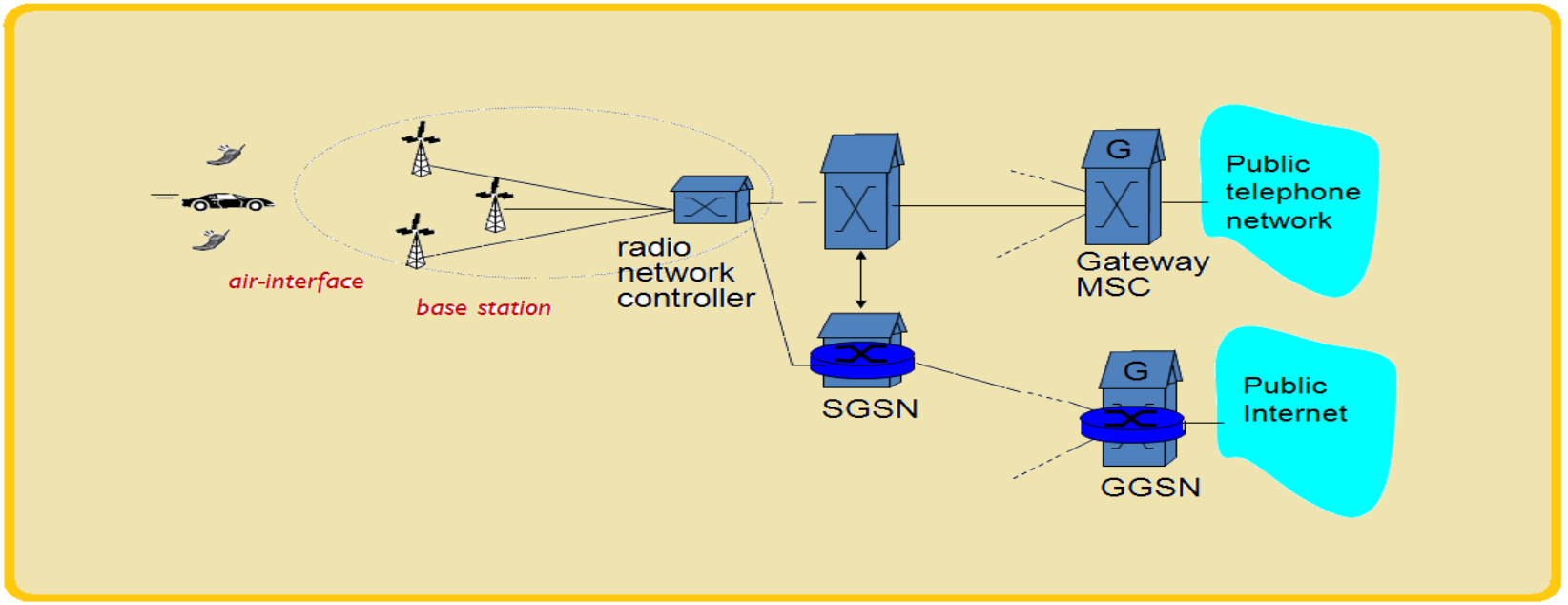
Base transceiver station (BTS)

Base station controller (BSC)

Mobile Switching Center (MSC)

Mobile subscribers

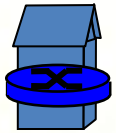
Cellular Network Architecture: 3G (voice + data)



Remark: new cellular data network operates *in parallel* (except at edge) with existing cellular voice network

- voice network unchanged in core
- data network operates in parallel


Serving GPRS Support Node (SGSN)


Gateway GPRS Support Node (GGSN)