



INTEGRATED TECHNICAL EDUCATION CLUSTER
AT ALAMEERIA

E-716-A

Mobile Communications Systems

Lecture #1

Introduction to Mobile Communication

Instructor:

Dr. Ahmad El-Banna



Agenda



Course Objectives

Course Information

Introduction

Course Objectives

Being able to:

- ***Define and illustrate the basic concepts of cellular networks.***
- ***Compare between the multiple access methods.***
- ***Explain the types of cellular wireless networks.***
- ***Determine and analyze effects of mobile radio propagation.***
- ***Describe the cell site and mobile antennas.***
- ***Perform simulations of wireless networks using OPNET tool.***

Course Information

Instructor:	Dr. Ahmad El-Banna https://www.linkedin.com/pub/ahmad-el-banna/32/6a3/495 Office: Room #306 Email: ahmad.elbanna@feng.bu.edu.eg ahmad.elbanna@ejust.edu.eg
Lectures:	Tuesday 10:15 -11:45 Prerequisite: Digital Communications course
Office Hours:	Sunday (14:15~15:30) Tuesday (12:00~13:00)
T.A.:	Eng. Mena
Texts/Notes:	<ul style="list-style-type: none">• J. Chiller, Mobile Communications, 2003.• C. Cox, An Introduction to LTE, LTE-advanced, SAE and 4G Mobile Communications, 2012.
Additional References	<ul style="list-style-type: none">• W. Stallings, Wireless Communications and Networks, 2005.• W. Stallings, Data and Computer Communication, 2007.• A. Mitra, Lecture Notes on Mobile Communication, Indian Institute of Technology Guwahati, 2009.

Lectures List

Lec. 1

- ***Introduction.***

Lec. 2-3

- ***Concepts of Wireless Transmission.***

Lec. 4-5

- ***Multiple Access Methods.***

Lec. 6

- ***Wireless Channel Models.***

Lec. 7-8

- ***Concepts of Cellular Networks.***

Lec. 9-13

- ***Cellular Networks.***

Lec. 14-15

- ***Cell Site and Mobile Antennas.***

INTRODUCTION



Wireless Comes of Age

- Marconi invented the wireless telegraph in 1896
 - Communication by encoding alphanumeric characters in analog signal
 - Sent telegraphic signals across the Atlantic Ocean
- Communications satellites launched in 1960s
 - could only handle 240 voice circuits.
- Advances in wireless technology
 - Radio, television, mobile telephone, communication satellites
- More recently
 - Satellite communications, wireless networking, cellular technology.

Broadband Wireless Technology

- Higher data rates obtainable with broadband wireless technology
 - Graphics, video, audio
- Shares same advantages of all wireless services: convenience and reduced cost
 - Service can be deployed faster than fixed service
 - No cost of cable plant
 - Service is mobile, deployed almost anywhere

Limitations and Difficulties of Wireless Technologies

- Wireless is convenient and often less expensive to deploy than fixed services, but wireless is not perfect.
- There are limitations, political and technical difficulties that may ultimately prevent wireless technologies from reaching their full potential.
- Two issues are :
 - Lack of an industry-wide standard
 - Device limitations
 - E.g., small LCD on a mobile telephone can only displaying a few lines of text
 - E.g., old browsers of most mobile wireless devices use wireless markup language (WML) instead of HTML

Wireless networks in comparison to fixed networks

- Higher loss-rates due to interference
 - emissions of, e.g., engines, lightning
- Restrictive regulations of frequencies
 - frequencies have to be coordinated, useful frequencies are almost all occupied
- Low transmission rates
 - local some Mbit/s, regional e.g., 9.6kbit/s with GSM
- Higher delays, higher jitter
 - connection setup time with GSM in the second range, several hundred milliseconds for other wireless systems
- Lower security, simpler active attacking
 - radio interface accessible for everyone, base station can be simulated, thus attracting calls from mobile phones
- Always shared medium
 - secure access mechanisms important

Mobile Communication

- Aspects of mobility:
 - user mobility: users communicate (wireless) “anytime, anywhere, with anyone”, i.e. the user can be mobile, and the services will follow him. Example: call-forwarding solutions.
 - device portability: devices can be connected anytime, anywhere to the network, example: hand over.
- Wireless vs. mobile Examples

✗	✗	stationary computer
✗	✓	notebook in a hotel
✓	✗	wireless LANs in historic buildings
✓	✓	Personal Digital Assistant (PDA) or GSM
- The demand for mobile communication creates the need for integration of wireless networks into existing fixed networks:
 - local area networks: standardization of IEEE 802.11
 - Internet: Mobile IP extension of the internet protocol IP
 - wide area networks: e.g., internetworking of GSM and ISDN



Mobile Devices

Pager

- receive only
- tiny displays
- simple text messages



Sensors,
embedded
controllers



Classical mobile phones

- voice, data
- simple graphical displays

Specialized PDAs

- graphical displays
- character recognition
- simplified WWW

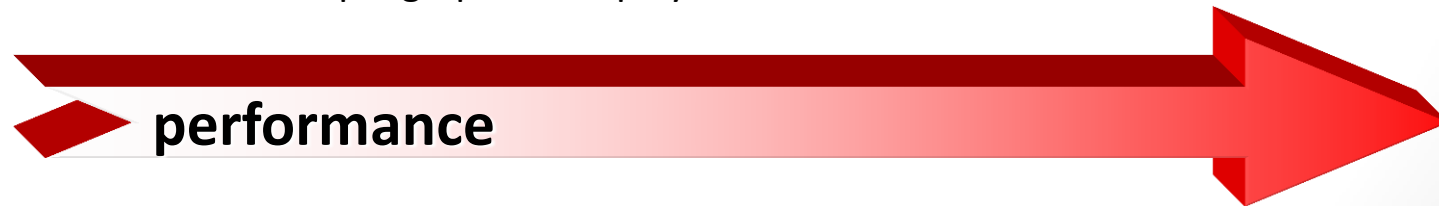


Smartphone/Tablet

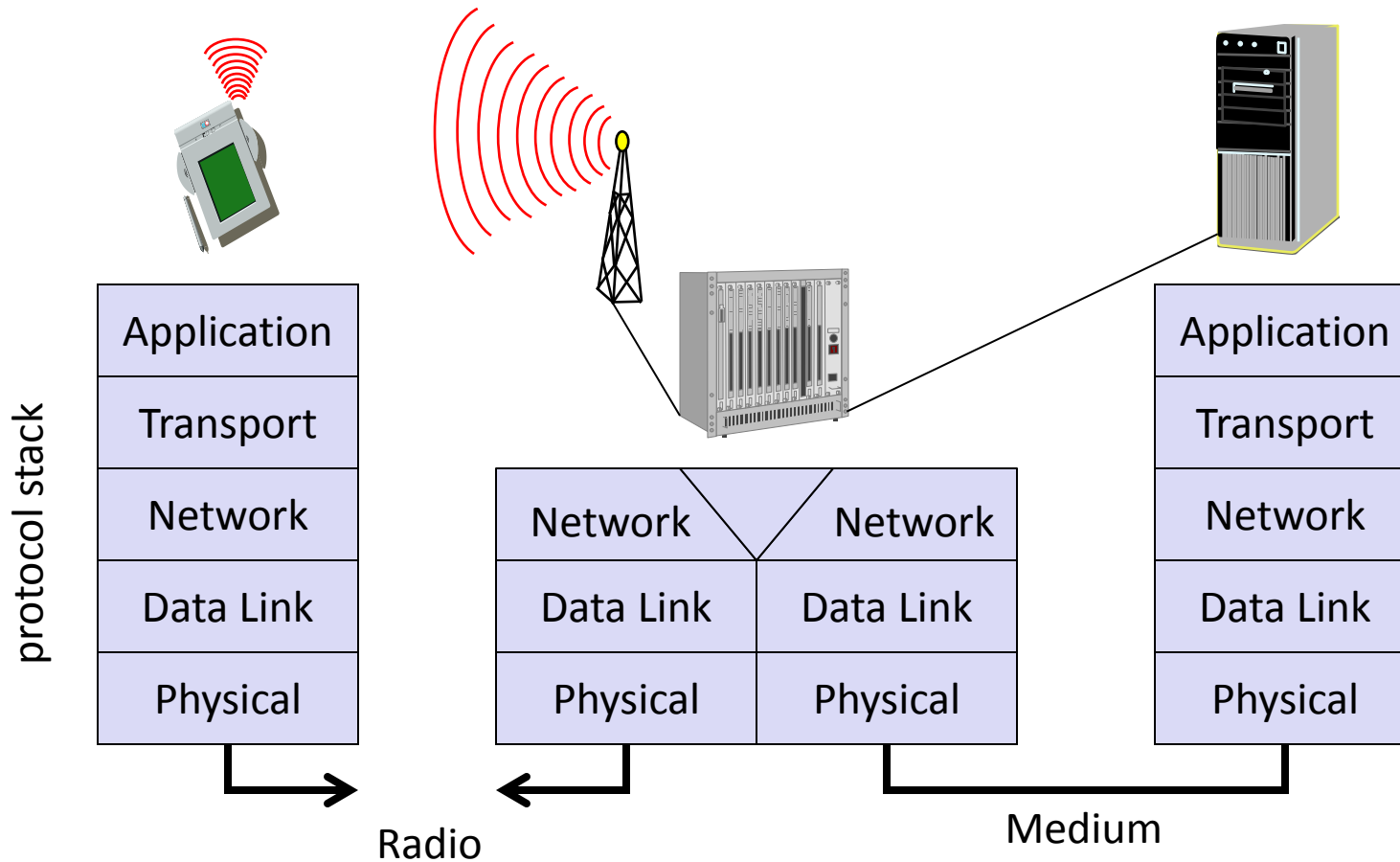
- tiny virtual keyboard
- simple(r) versions of standard applications

Laptop/Notebook

- fully functional
- standard applications



Simple Model of communication systems



Influence of mobile communication to the layer model

Application layer

- service location
- new applications, multimedia
- adaptive applications

Transport layer

- congestion and flow control
- quality of service

Network layer

- addressing, routing, device location
- hand-over

Data link layer

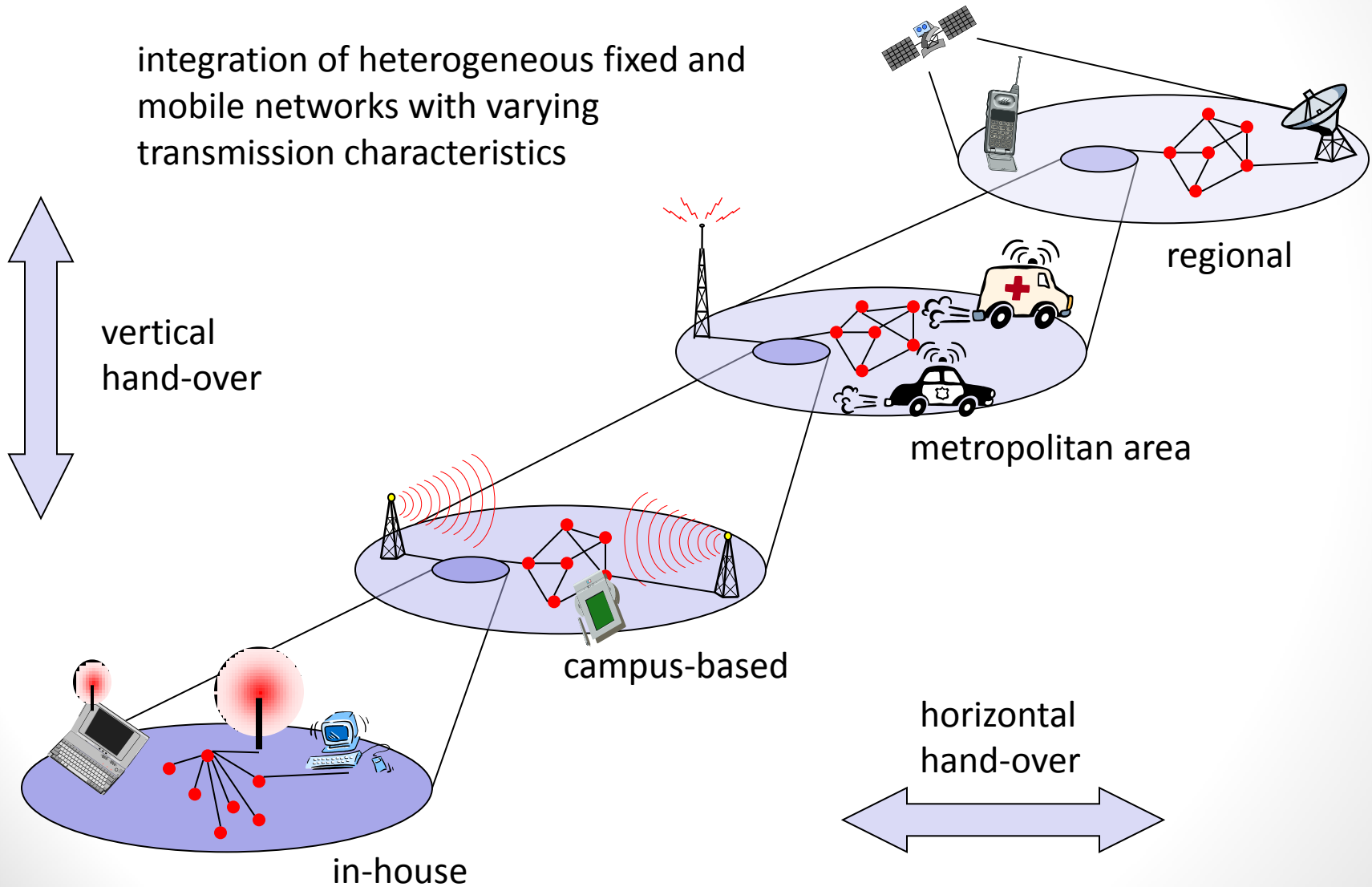
- authentication
- media access
- multiplexing
- media access control

Physical layer

- encryption
- modulation
- interference
- attenuation
- frequency

Overlay Networks - the global goal

integration of heterogeneous fixed and mobile networks with varying transmission characteristics

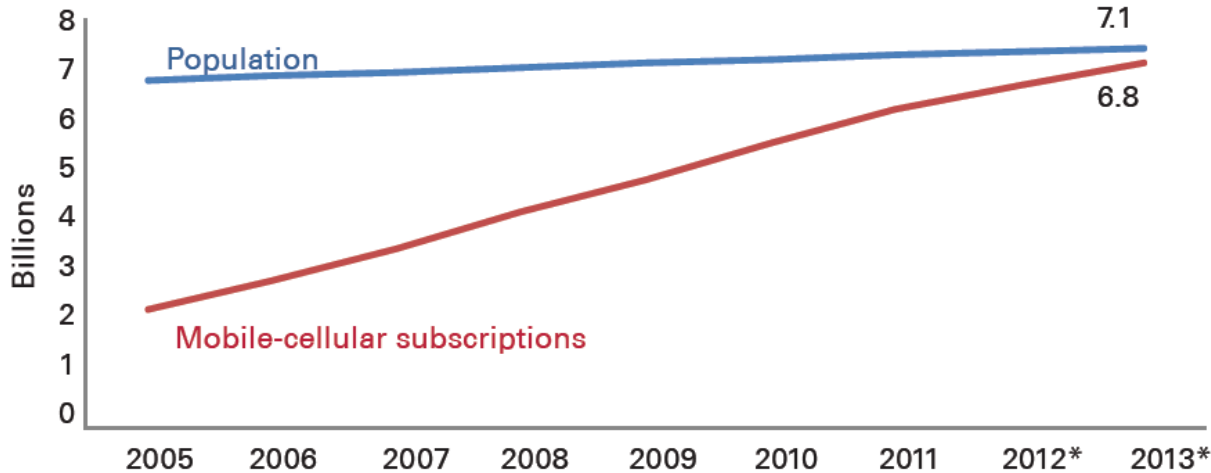


Cellular Systems Evolution



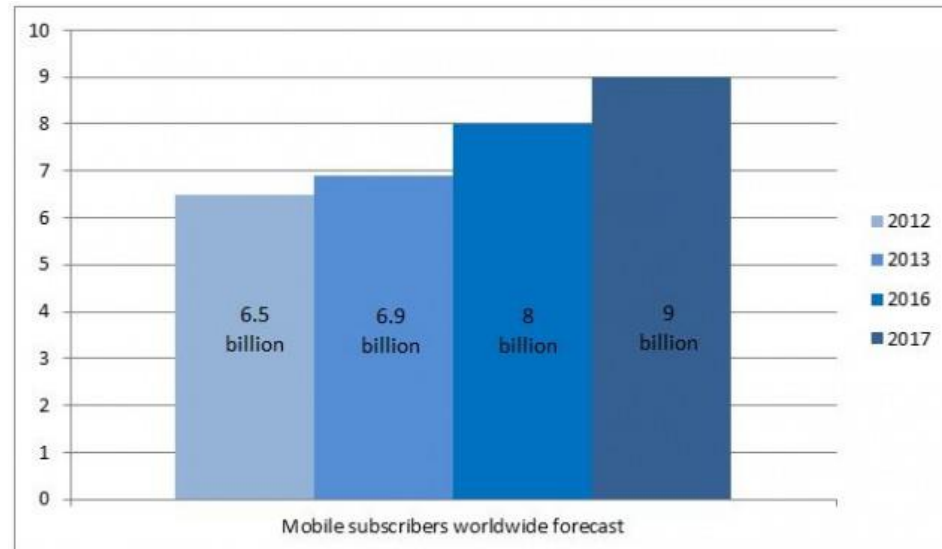
<h2>1G</h2>	<h2>2G</h2>	<h2>3G</h2>	<h2>4G</h2>
<p>1ST GENERATION <i>wireless network</i></p>	<p>2ND GENERATION <i>wireless network</i></p>	<p>3RD GENERATION <i>wireless network</i></p>	<p>4TH GENERATION <i>wireless network</i></p>
<ul style="list-style-type: none"> • Basic voice service • Analog-based protocols 	<ul style="list-style-type: none"> • Designed for voice • Improved coverage and capacity • First digital standards (GSM, CDMA) 	<ul style="list-style-type: none"> • Designed for voice with some data consideration (multimedia, text, internet) • First mobile broadband 	<ul style="list-style-type: none"> • Designed primarily for data • IP-based protocols (LTE) • True mobile broadband
<p>THE NEED FOR SPEED <i>in kilobits per second</i></p>			
<p>2.4 <i>kbps</i></p>	<p>64 <i>kbps</i></p>	<p>2,000 <i>kbps</i></p>	<p>100,000 <i>kbps</i></p>

Worldwide wireless subscribers



Source: ITU World Telecommunication /ICT Indicators database

Note: * Estimate



- For more details, refer to:
 - Chapter 1, J. Chiller, Mobile Communications, 2003.
 - Chapter 1, W. Stallings, Wireless Communications and Networks, 2005
- The lecture is available online at:
 - https://speakerdeck.com/ahmad_elbanna
- For inquiries, send to:
 - ahmad.elbanna@fes.bu.edu.eg
 - ahmad.elbanna@ejust.edu.eg