

King Saud University
College of Computer and Information Sciences
Department of Computer Engineering

CEN 538

Wireless LAN & MAN Networks

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LMS web site

References

Text book

Fundamentals of wireless networking, Ron Price, McGraw-Hill, 1st edition 2007.

- Wireless Networking Technologies
 - ✓ WLAN
 - ✓ WiFi Mesh and
 - ✓ WiMAX

Other References

Part of Slides and documents for this course are inspired from the following references:

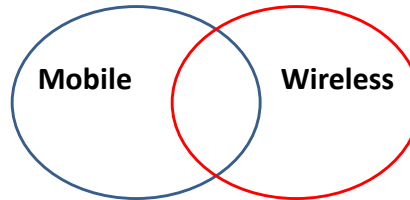
- **Sridhar Iyer**, K R School of Information Technology, Bombay.
- Raj Jain web site, <http://www1.cse.wustl.edu/~jain/>

Overview

- ☐ Goal of this Course
- ☐ Grading
- ☐ Contents of the course
- ☐ Tentative Schedule

Goal of this Course

Mobile vs Wireless



- ☐ Mobile vs Stationary
- ☐ Wireless vs Wired
- ☐ Wireless \Rightarrow Media sharing issues
- ☐ Mobile \Rightarrow Routing, addressing issues

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Grading

- ☐ Midterm Exams 40%
- ☐ Homeworks & Project 20%
- ☐ Final Exam 40%

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Contents of the course

1. Wireless Networks
 - Difference from wired
 - Mobility
2. RF Basics
 - Frequency, modulation
 - Medium access control
3. Multiplexing techniques
 - Spread spectrum
 - FHSS, DSSS
4. Wireless LANs (WiFi)
 - 802.11 standards
 - Mobility support
 - Voice and QoS support
5. Wireless Sensor Networks
 - Challenges and constraints
 - Energy efficiency
 - Clustering
6. Wireless MANs (WiMaX)
 - 802.16 standard
 - Voice and QoS support

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Tentative Schedule

- ☐ Midterm 1 Exam: **March 12, 2014**
- ☐ Midterm 2 Exam: **April 23, 2014**
- ☐ Homework
- ☐ Project: **May 1, 2014**
- ☐ Final Exam: **May 18 – 22, 2014**

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Chapter 1

Introduction to Wireless Networks

Note

Many technical information in this chapter will be discussed in detail in later chapters.

Wireless networks

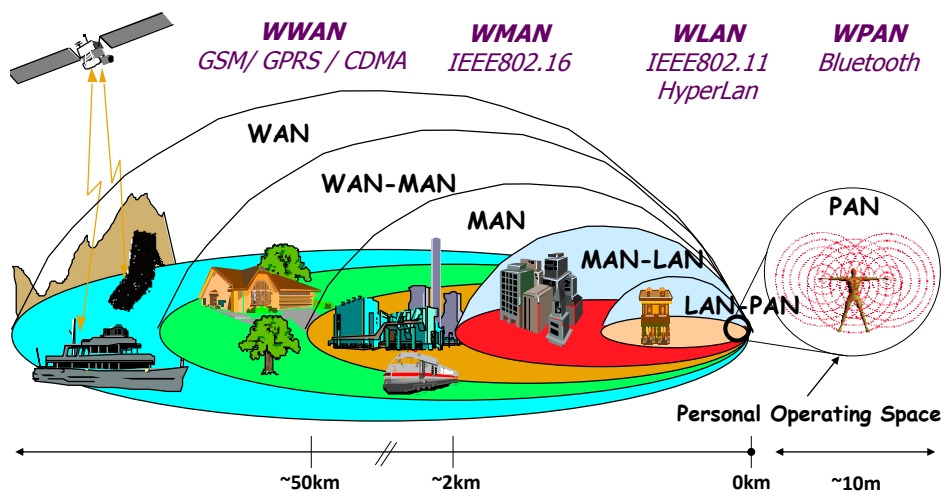
- Access computing/communication services, **on the move**
- Wireless WANs
 - Cellular Networks: GSM, GPRS, CDMA
 - Satellite Networks: Iridium
- Wireless LANs
 - WiFi Networks: 802.11
 - Personal Area Networks: Bluetooth
- Wireless MANs
 - WiMaX Networks: 802.16
 - Mesh Networks: Multi-hop WiFi
 - Adhoc Networks: useful when infrastructure not available

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Wireless Classification



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Wireless features

- Wireless signals are electromagnetic waves
- No physical medium is necessary
- The ability of radio waves to pass through walls and cover great distances makes wireless a versatile way to build a network.

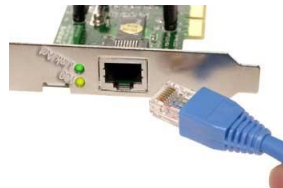
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What is a wireless LAN?

- **Wireless LAN (WLAN)** - provides all the features and benefits of traditional LAN technologies such as Ethernet and Token Ring, but without the limitations of wires or cables.



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What is a wireless LAN?



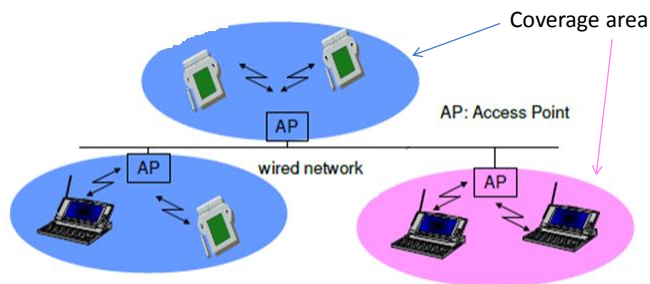
- WLAN, like a LAN, requires a physical medium to transmit signals.
- Instead of using UTP, WLANs use:
 - **Infrared light (IR)**
 - 802.11 does include an IR specification
 - limitations, easily blocked, no real 802.11 products (IrDA)
 - **Radio frequencies (RFs)**
 - Can penetrate 'most' office obstructions

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Wireless devices and functions



AP. Access Point

WT. Wireless Terminal (laptop etc..), Mobile Terminal (MT)
Wireless does not mean mobile

Wired network. Connecting APs (Distribution system).

Note. AP establishes links with MT within a **coverage area**.
Outside, the connection is broken.

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Limitations of the mobile environment

- Limitations of the Wireless **Network**
 - limited communication bandwidth
 - frequent disconnections
 - heterogeneity of fragmented networks
- Limitations Imposed by **Mobility**
 - route breakages
 - lack of mobility awareness by system/applications
- Limitations of the Mobile **Device**
 - short battery lifetime
 - limited capacities









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Mobile communication

- Wireless vs. mobile Examples

   	   	stationary computer laptop in a hotel (portable) wireless LAN in historic buildings Personal Digital Assistant (PDA)
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- Integration of wireless into existing fixed networks:
 - Local area networks: IEEE 802.11, ETSI (HIPERLAN)
 - Wide area networks: Cellular 3G, IEEE 802.16
 - Internet: Mobile IP extension

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Wireless v/s Wired networks

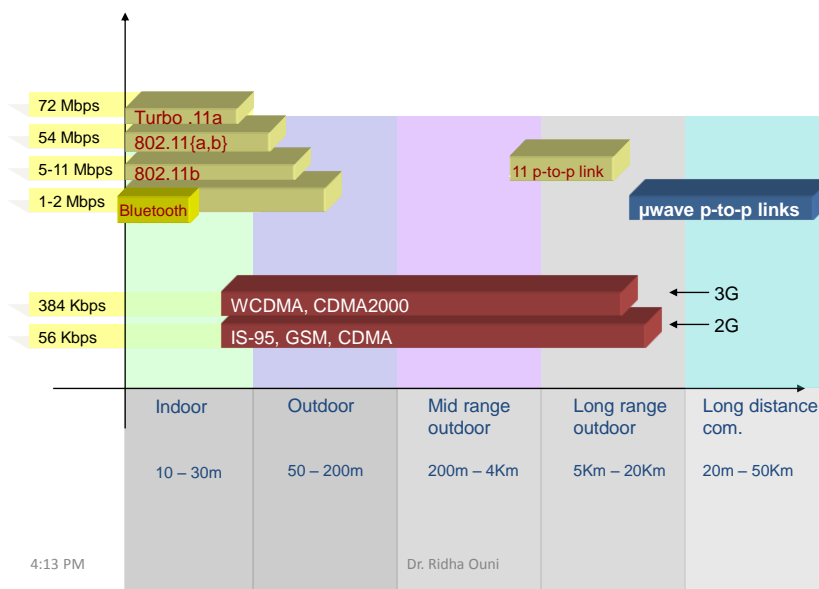
- **Regulations of frequencies**
 - Limited availability, coordination is required
 - useful frequencies are almost all occupied
- **Bandwidth and delays**
 - Low transmission rates
 - few Kbits/s to some Mbit/s.
 - Higher delays
 - several hundred milliseconds
 - Higher loss rates
 - susceptible to interference, e.g., engines, lightning
- **Always shared medium**
 - Lower security, simpler active attacking
 - radio interface accessible for everyone
 - secure access mechanisms important

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Wireless Technology Landscape

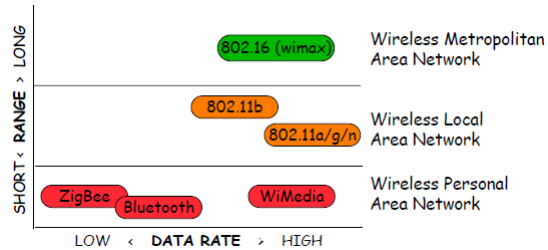


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Wireless Networking Technologies



Standards typically define the Medium Access Control (MAC) and the Physical layers

	Bluetooth	WiFi (802.11)	WiMax (802.16)
Data rate	2.1 Mbps	54 Mbps	70 Mbps
Link length	10 meters	100 meters	10 km
Application	Peripheral devices	LAN	Access

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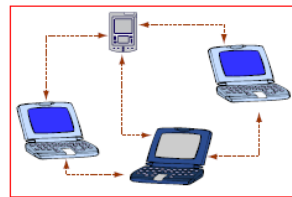
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Ad Hoc and Infrastructure Modes

Ad Hoc mode (Independent WLAN)

- The stations communicate with one another
- Not connected to a larger network
- Stations can move during communication



Infrastructure mode

- An Access Point connects Stations to a wired network
- Overlapping Access Points connected to each other
- Allows Stations to roam between Access Points



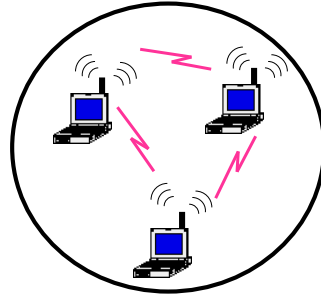
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Ad Hoc mode (Independent WLAN)

- Ad Hoc
- Simplest
- Rapid deployment
- Peer-to-peer
- No administration

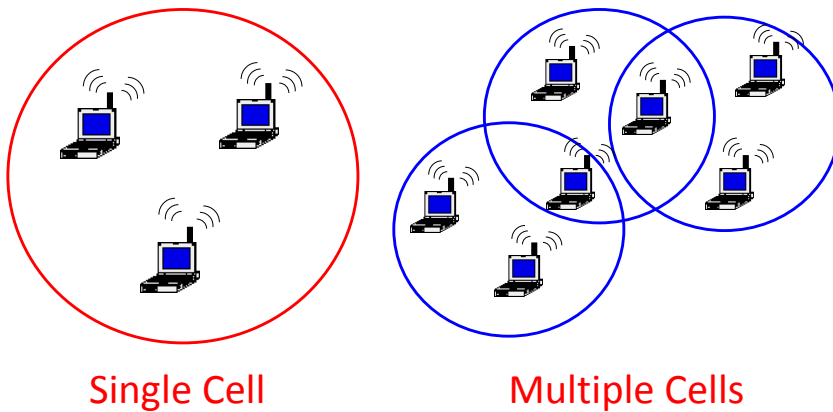


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Ad Hoc mode (Independent WLAN)



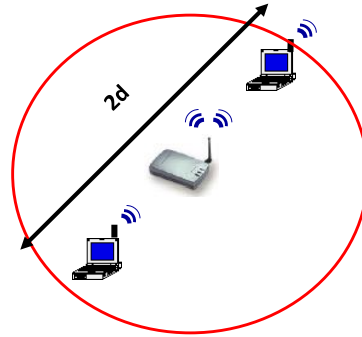
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Ad Hoc mode (Independent WLAN)

- Can extended range by using an Access Point (acting as a repeater)



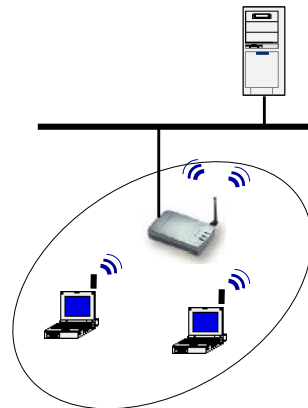
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Infrastructure mode

- Need an Access Point
- Connect to the wired LAN
- Need Infrastructure
- Need administration



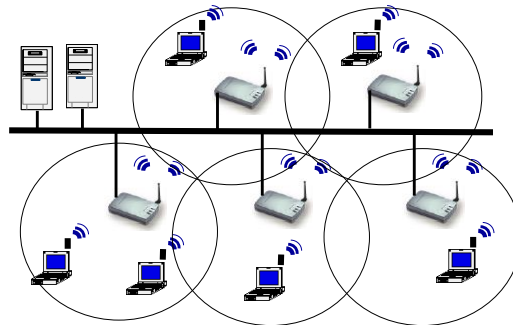
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Infrastructure mode

- Many overlapping cells are created,
- Each cell is managed by an AP,
- Interconnected by a distribution system,
- Cover a large area (support many users),



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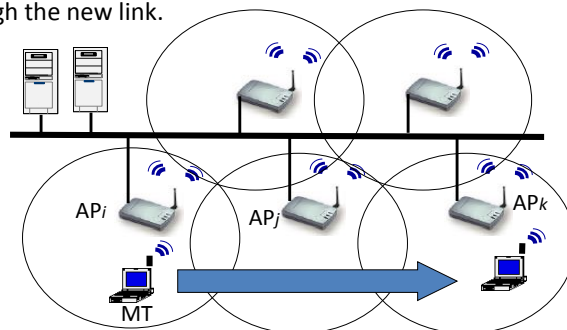
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Infrastructure mode

Allowing mobility of wireless devices among cells

- An established connection over AP_i is maintained when the MT becomes near the AP_j
- Handover (Handoff)
 - Establish new link over AP_j ,
 - Release the old link over AP_i ,
 - Route packets through the new link.

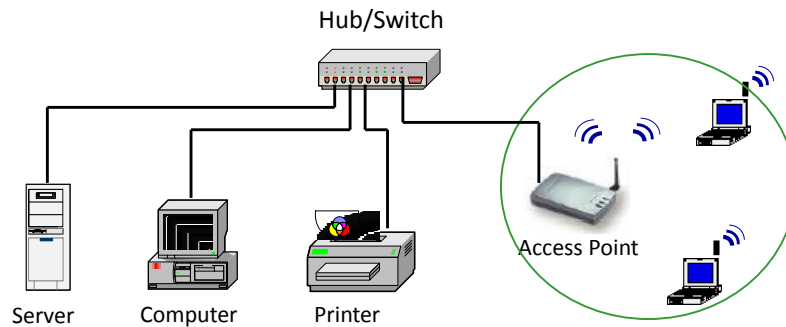


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Infrastructure mode

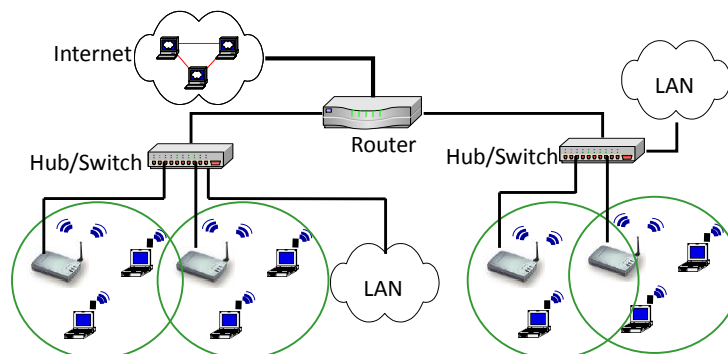


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Large Infrastructure WLAN



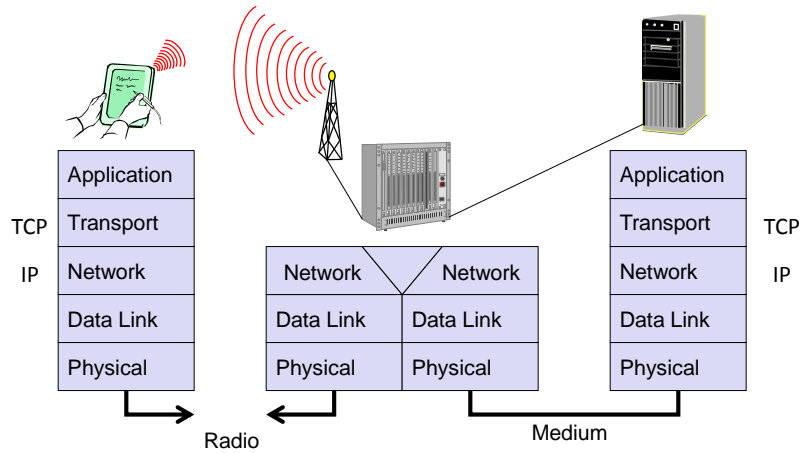
Mobile.....AP.....Hub/Switch.....Router
 ← Cell →
 ← WLAN →
 ← IP network → (Mobile IP, later)

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Reference model

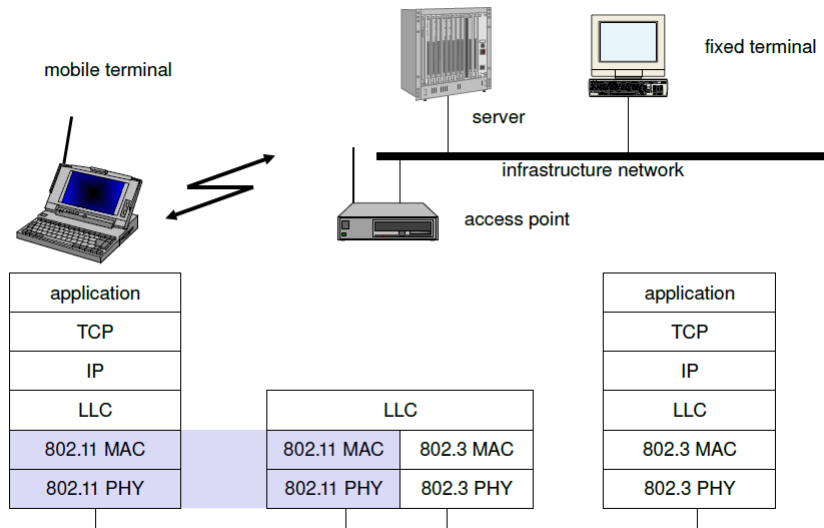


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Reference model



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Effect of mobility on protocol stack

- Application
 - new applications and adaptations
 - service location, multimedia
- Transport
 - congestion and flow control
 - quality of service
- Network
 - addressing and routing
 - device location, hand-over
- Link
 - media access and security
- Physical
 - transmission errors and interference

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Perspectives

- **Network designers:** Concerned with cost-effective design
 - Need to ensure that network resources are efficiently utilized and fairly allocated to different users.
- **Network users:** Concerned with application services
 - Need guarantees that each message sent will be delivered without error within a certain amount of time.
- **Network providers:** Concerned with system administration
 - Need mechanisms for security, management, fault-tolerance and accounting.

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