Course Code	Course Title						Core / Elective
PE 821 CS	**Mobile Computing**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	-	-	-	**30**	**70**	**3**

Course Objectives

- To introduce basics of wireless voice and data communication technologies
- To build working knowledge on various telephone and satellite networks
- To study the working principles of wireless LANs and standards
- To study principles of adhoc networks and routing
- To gain knowledge on integration of mobile networks into Internet
- To build skills in working with wireless application protocols to develop mobile applications.

Course Outcomes

After completing this course, the student will be able to

1. Understand and apply various techniques involved in planning and construction stages.
2. Implement Adhoc Network Routing protocols.
3. Mini based project based on tracking, localization and routing in wireless networks.
4. Implement file transfer, access and authentication based applications for mobile computing.

UNIT-I

Introduction – Wireless transmission – Frequencies for radio transmission – Signals – Antennas – Signal Propagation – Multiplexing – Modulations – Spread spectrum – MAC – SDMA – FDMA – TDMA – CDMA – Cellular Wireless Networks.

UNIT-II

Telecommunication systems – GSM – GPRS – DECT – UMTS – IMT-2000 – Satellite Networks - Basics – Parameters and Configurations – Capacity Allocation – FAMA and DAMA – Broadcast Systems – DAB - DVB.

UNIT-III

Wireless LAN – IEEE 802.11 - Architecture – services – MAC – Physical layer – IEEE 802.11a - 802.11b standards – HIPERLAN – Blue Tooth.

UNIT-IV

Mobile IP, Dynamic Host Configuration Protocol, Routing in MANETs: DSDV, DSR, AODV and ZRP. MANETS vs VANETs

UNIT-V

Traditional TCP – classical TCP improvements – WAP, and WAP 2.0.
Mobile Transaction models, File Systems and Mobility Management

Suggested Readings:

1. Jochen H. Schiller, *Mobile Communications*, Addison Wesley, Second Edition, 2003.
2. William Stallings, *Wireless Communications and Networks*, PHI/Pearson Education, 2002.
3. Kaveh Pahlavan, Prasanth Krishnamurthy, *Principles of Wireless Networks*, Prentice Hall, 2003.
4. Uwe Hansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, *Principles of Mobile Computing*, Springer, 2003.
5. Krzysztof Wesolowski, *Mobile Communication Systems*, John Wiley and Sons Ltd, 2002.

UNIT-I

Define Mobile Computing:

Mobile computing can be defined as a computing environment of Physical mobility. the user of a mobile computing environment will be able to access data-information or other logical objects from any device in any network while on the move.

A mobile computing system allows a user to perform a task from any where using a computing device in the public [the web], corporate [business information] and personal information spaces [medical record, address book] while on the move.

While on the move the preferred device will be a Mobile device - while back at home or in the office the device could be a desktop Computer.

To make the mobile computing Environment ubiquitous — it is necessary that the communic ation bearer is spread over both wired and wireless media.

Mobile computing is absolutely necessary for optimal use of resource and increased productivity.

A2

Mobile computing is used in different context with different names-

the most common names are

- Anywhere Anytime information
- virtual home environment
- Nomadic computing
- pervasive computing - A computing environment which is pervasive in nature and can be made available in any environment
- ubiquitous computing
- Global Service portability
- Wearable computers

Mobile Computing functions

- User Mobility
- N/w Mobility
- Bearer Mobility
- device mobility
- session mobility
- Agent Mobility
- Host Mobility

User Mobility

the user should be able to move from one physical location to another and use the same service. the service could be in a home or ~~server~~ n/w. for example a user moves from london to newyork and uses Internet to access the corporate application the same way the user uses it in the home office.

Lecture: 1 UNIT-1 - JOCHEN SCHILLER

INTRODUCTION AND APPLICATIONS OF MOBILE COMPUTING.

a) What is computing ?

operation of computers.

b) What is the mobile ?

That someone / something can move or be moved easily and quickly from Place to Place.

c) What is mobile computing ?

users with portable computers - devices still have n/w connections - access n/w while they move. (without any wires - wireless).

NOTE :- "People and their machines should be able to access information and communicate with each other easily and securely, in any medium and combination of media - voice - data - image - video, & multimedia - any time, any where in a timely cost - effective way".

→ GSM : Global system for mobile communication
→ DECT : Digital Enhanced Cordless telecommunication
→ UMTS : Universal mobile telecommunication system
→ IMT-2000 : International mobile telecommunications

(b) The Wireless n/w maybe WLAN, Wi-Fi, GSM, CDMA, Wimax, or GPRS. The cellphones and laptops are the most Commonly used Mobile Computing devices.

c) Mobile computing Enables improvements in the operational efficiency of organizations that integrate the technology into their fixed I/s. Mobile Computing Can improve efficiency in many ways including a) Saving time b) Reducing waste c) Cutting cycle times d) Reducing Rework e) Enabling business Process Re-engineering. f) improving accuracy. g) Decreasing time spent on Customer Complaints and h) Reducing Unnecessary travel.

e.g. Bank transactions.

There are two different kinds of mobility: User mobility and device Portability.

User mobility:- refers to a user who has access to the same or similar telecommunication services at different places; (i.e) the user can be mobile, and the services will follow him or her. Examples for mechanisms supporting user mobility are simple call-forwarding solutions known from the telephone or computer desktops supporting roaming (i.e the desktop looks the same no matter which computer a user uses to log into the n/w).

Device Portability:

The communication device moves (with or without a user). Many mechanisms in the n/w and inside the device have to make sure that communication is still possible while the device is moving. A typical example for systems supporting device portability is the mobile phone system, where the system itself hands the device from one radio transmitter (also called a base station) to the next if the signal becomes too weak.

NOTE:- With regard to devices, the term wireless is used.
this only describes the way of accessing a n/w or other Communication Partners. (i.e) without a wire.
The wire is replaced by the transmission of electromagnetic waves through "the air" (although wireless transmission does not need any medium).

A communication device can thus Exhibit One of the following characteristics:

a) fixed and wired.
b) Mobile and wired.
c) fixed and wireless.
d) Mobile and wireless.

A) fixed and wired:

This configuration describes the typical desktop computers in an office.
The devices use fixed n/w for Performance & reasons.

B) Mobile and Wired :-

Many of today's laptops fall into this category ; users carry the laptop from one hotel to the next, reconnecting to the company's n/w via (through) the telephone n/w and a modem.

C) fixed and wireless :-

This mode is used for installing n/ws, e.g. in historical buildings to avoid damage by installing wires, or at tradeshows to excuse fast n/w setup. Another Example is bridging the last mile to a customer by a new operator that has no wired infrastructure and does not want to lease lines from a competitor.

D) Mobile and wireless :-

No cable restricts the user, who can roam between different wireless networks.

e.g. GSM with more then 800 million users.

Applications :-

1) Emergencies :- Just imagine the possibilities of an ambulance with a high-quality wireless connection to a hospital.
Vital information about injured persons can be sent to the hospital from the scene of the accident. All the necessary steps for this particular type of accident can be prepared and specialists can be consulted for an early diagnosis. Wireless networks are the only means of communication in the case of natural disasters such as hurricanes or earthquakes. In the worst cases, only decentralized, wireless ad-hoc networks survive.

2) Business :-
A travelling salesman today needs instant access to the

Company's database; to ensure that files on his or her laptop reflect the current situation; to enable the company to keep track of all activities of their travelling employees, to keep databases consistent etc. With wireless access, the laptop can be turned into a true mobile office, but efficient and powerful synchronization mechanisms are needed to ensure data consistency.

Note:- What may happen when employees try to communicate off base. At home, the laptop connects via a WLAN or LAN and DSL to the Internet. Leaving home requires a handover to another technology, e.g. to an enhanced version of GSM, as soon as the WLAN coverage ends.

Due to interference and other factors data rates drop while cruising at higher speed.

No matter when and where, mobile communications should always offer as good

Connectivity as possible to the internet, the company's intranet, of the telephone network.

3) Vehicles :- Cars will comprise, many wireless communication systems and mobility aware applications.
Music, news, road conditions, weather reports and other broad cast information are received via digital audio broadcasting (DAB) with 1.5 Mbit/s.
for Personal Communication, a Universal mobile telecommunications system (UMTS) Phone might be available offering voice and data connectivity with 384 Kbit/s.
for remote areas, Satellite Communication Can be Used; while the current Position of the car is determined via the GPS (Global positioning system).
Cars driving in the same area build a local ad-hoc network for the fast exchange of information in emergency situations & to help Each other keep a safe distence

Wireless transmission :- Lecture: 2

Wireless telecommunications is the transfer of information between two or more points that are physically not connected.

Distances can be short, as few meters, as in television remote control, or long ranging from thousands to millions of kilometers for deep-space radio communications.

It encompasses various types of fixed-mobile and portable two-way radio, cellular telephones, Personal digital assistants (PDAs), and wireless networking.

Note :- Telecommunications systems (e.g. radio transmitters — receivers — remote controls — computer n/w — n/w terminals etc) which use some form of energy (e.g. Radio frequency (RF), Infrared light — laser light — visible light — Acoustic energy etc) to transfer information without the use of wires.

Wireless communication is based on the principle of broadcast and reception of electromagnetic waves.

These waves can be characterized by their frequency (f) (or) wavelength (λ).

Frequency:-

The frequencies used for wireless transmission are all regulated.

→ Frequency is the number of cycles (oscillations) per second of the wave and is measured in Hertz (Hz).

→ frequency is the number of waves per unit time.

→ If a current completes one cycle per second, then the frequency is 1 Hz, 60 cycles per second equals 60 Hz.

→ larger units of frequency include

KiloHertz represents thousands (1000's) of cps

MegaHertz represents Millions (1000000's) of cps

Gigahertz represents billions (1000000000's) of cps

Then Terahertz (1 THz) = 1,000,000,000,000 cps.

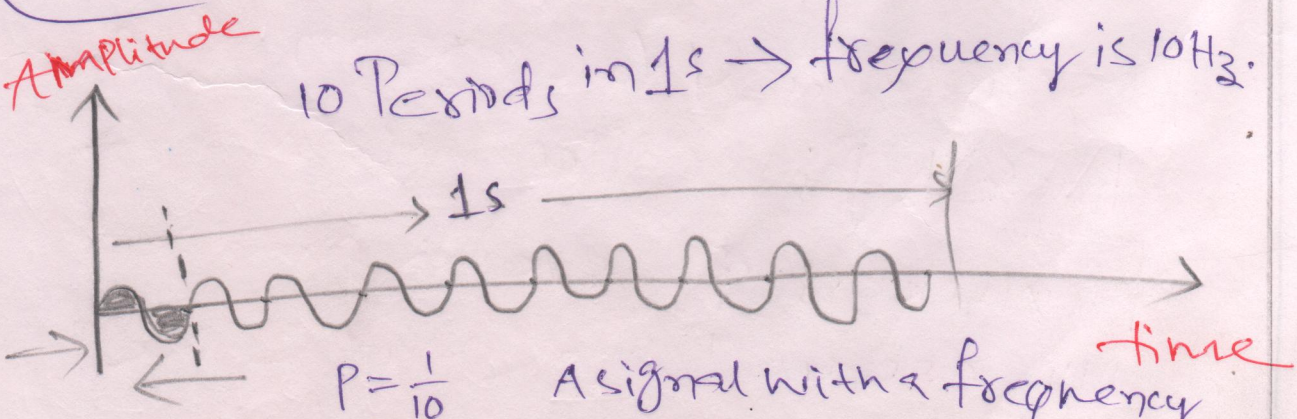
Computer clock speed is generally clocked in Megahertz and more recently in Gigahertz.

frequency refers to how many waves are made per time interval.
this is usually described as how many waves are made per second, & as cycles per second.
If ten waves are made per second, then the frequency is said to be ten cycles per second. (10 cps).
Usually, we use the unit Hertz to state frequency.
A frequency of 10 cps is noted as a frequency of 10 Hertz.
& one cycles per second is one Hertz.

$$1\ cps = 1\ Hertz$$
$$1\ Hertz = 1\ Hz.$$

Note: frequency and Period (time) are the inverse of each other.

$$f = \frac{1}{T} \quad \text{and} \quad T = \frac{1}{f}.$$



The duration of a single wave is known as period.

Units of Period and frequency

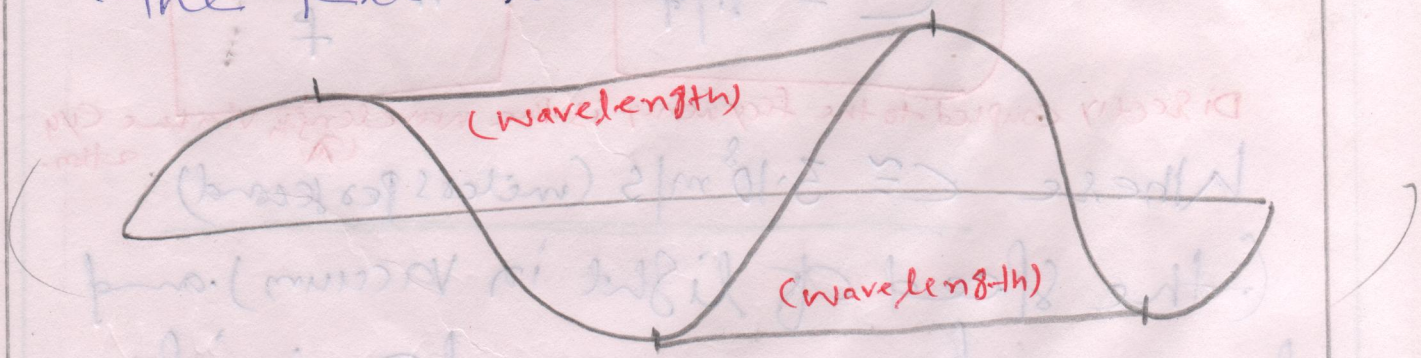
Unit :-	Equivalent :-
Second (s)	1 s
Milli Seconds (ms)	10^{-3} s
micro seconds (μs)	10^{-6} s
Nano seconds (ns)	10^{-9} s
Pico seconds (ps)	10^{-12} s

Unit	Equivalent
Hertz (Hz)	1 Hz
KiloHertz (KHz)	10^{3} Hz
Megahertz (MHz)	10^{6} Hz
Gigahertz (GHz)	10^{9} Hz
Terahertz (THz)	10^{12} Hz.

Wavelength:-

The wavelength of a wave is the distance between any two adjacent corresponding locations on the wave train.
This distance is usually measured in one of three ways.

1) crest to next crest
2) trough to next trough
3) from the start of a wave cycle to the next starting point.



Actually, the wavelength exists between any point on a wave and the corresponding point on the next wave in the wave train.

Note:

The length of a single wave on the x-axis is wavelength.

→ Wavelength is the distance between two consecutive maxima and/or minima in the wave.

The speed of propagation of these waves varies from medium to medium, except in a vacuum where all electromagnetic waves travel at the same speed, the speed of light.

$$c = \lambda / f \quad \text{or} \quad \lambda = \frac{c}{f}$$

Directly coupled to the frequency is the wavelength via the equation.

Where $c \cong 3 \cdot 10^8$ m/s (meters per second) (the speed of light in vacuum) and f is the frequency and λ is its wavelength in meters.

For the traditional wired n/ws, frequencies upto several hundred KHz are used for distances upto some km with twisted pair copper wires, while frequencies of several hundred MHz are used with coaxial cable fiber optics are used for frequency

Ranges of several hundred THz.

Infrared transmission

→ These signals can be used for short range communication in a closed area using line of sight propagation.

eg. T.V remote, wireless speakers, automatic doors.

- due to short range it is considered to be one of the most secure transmission

Radio waves

- It is used for multicast comm eg. radio / television
- they can penetrate through walls
- It is highly regulated
- omni directional antenna