Wireless Communication

Lec 1

* freevideolectures.com / Course / 2329 / Wireless - Communication

* Motivation and Introduction.

→ Video lecture - Dr. Ranjan Bose / EE / IIT Delhi

* Books

1) T.S. Rappaport - Wireless Comms / II nd Edition / Pearson Edu 2002
2) W.C.Y. Lee - Mobile cellular Telecommunication / " / McGrawHill / 1995
3) Kamilo Feher, wireless Digital Communications : Modulation and Spread Spectrum Applns / Prentice Hall / 2002

* Examples / Materials from Various Stds

→ GSM Phones & CDMA 2000 1X phones

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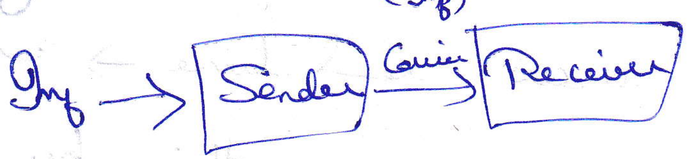
* What is Wireless Communication? [Free from Wire]

→ Tx / Rx eg Voice & Data in EM Waves in open Space.
→ People using cell phones ⇒ Voice & Data
→ Data traffic exceeds the Voice traffic.
↓
→ It gives tough Competition do " "

(Msg)

BW



Ex:- Spectrum 120 kHz / Each Ch occupies 40 kHz

→ overlaps / Interference

* Wireless Communication ?

→ Inf from S to R is Given over a well-defined freq band (channel)

→ Each channel has a Fixed freq BW and Capacity (bit-rate) // (Priced Commodity)

→ Different channels can be used to Tx informations in Parallel and Independently

Ex: Diff between allocated & what you end up with users.

→ Rx with filter

→ Filter char determines the BW

* Freq Overlaps will occur real time → Interfer

* Allocate some Space to overcome this by Introducing Guard Band for both time / freq.

* Trade off Between the money you have Spend and hardware Implementation needs.

* Types Of Wireless Communication.

a) Mobile
   - cellular Phones (GSM / cdma 2000. 1x)

b) Portable
   - IEEE 802.11b (wiFi) ‖ Laptop connected to wireless LAN
   - " 802.15.3 (UWB) ‖

c) Fixed
   - IEEE 802.16 (Wireless MAN) - 1st IEEE Std

Ex: Debate about

Fixed wireless ⟺ wired.

⇓ advantages

Freedom from wire } ↓
Installation cost & time }

⇓

* 1st Tested in South Asian Countries - South Korea
* Others are tested in US / Europe - usually all IEEE Stds " " " "
* Always used to → prefer fixed Wireless ∵ of its advantages.

Typical Frequencies

1) FM Radio ~ 88 MHz
2) TV Broadcast ~ 200 MHz
3) GSM Phones ~ 900 MHz & 800 MHz dual Band
4) GPS ~ 1.2 GHz
5) PCS Phones ~ 1.8 GHz
6) Bluetooth ~ 2.4 GHz UB.
7) Wi Fi ~ 2.4 GHz

* Wi Fi ~ 2.4 GHz is a Favourite band ∵ g Free band ISM Band
* used in Medical Industry / Educational Institutions
* 28/42/60/100 GHz used in 5G D.

Electromagnetic Spectrum

* Diff Freq's attenuated differently by air.
* Freq Limited times if we are using upto Gamma ray
* Air - Freq Selective channel.
* 1mW a power @ 2GHz, ↑ Power - clearly many

* Poor Cusion of the ~~ultraviolet~~ wide band – Bluetooth.
* ISM Band / Wi Fi / 802.11b @ 2.4 GHz.
* useful appliances comes out from Wi Fi ∵ licence free band.
* Yellow strip = By licensing the Spectrum Telecom regulatory authority of India – TRAI
* Stn's A & B ⟹ ↑ Power, to cover more distance
  ⟹ Radiation hazard
  ⟹ Peak Power & Avg Power

Base Stn
* 900 MHz ⟹ 5 to 10 kms ⇐ TV tower & Radio tower coverage
  LF travels a large distance
* ||| ly Base Stn with 900 MHz can travel upto 5 km with the same power.
* For the same power ↑ 2.4 GHz, Rays attenuated much more, i.e coverage area will get ↓ reduced
* Ex 28 GHz, range comes to 2 km.
  Ray / Dust / Fog ⟹ other factors

↑ Freq ⟹ ↓ wavelength, ∴
  if 30 GHz → mm range of wave.

... in the range of mm wavelength

⇒ Size of the wavelength is the size of the Coverage is the order of the dey.

* Need to go ↑ freq ⇒ to Support ↑ BW.
  Deigning ↑ fey ckt is a challenging
  More BW hungry needed today
* ↑ DR ⇒ ↑ BW. i.e ∝ potential

Voice - 4kHz

* Wireless MAN is going to Solve the last mile pblm.

⇓

* Fibre to the home / curb — too much effort ⇒ Purely Broad band.
  using using pblm with wifi from the curb to home.
* FTC ⇒ Optic to curb → Put up the power → wifi → to home ⇐ FTH
  Last mile using pblm with wifi

Propagation

* Propagation characteristics are different in each freq band

1) Electromagnetic Spectrum
2) Maxwell's Equation
3) Time line of wireless Comm Development.

* Why Wireless Comm?

1) Freedom from Wires

→ No Cost of Installing Wires or rewiring
→ No bunches of wires running here & there
→ "Automagical" instantaneous Communication without physical connection Setup e.g Bluetooth, WiFi

2) Global Coverage

→ Comm can reach where wiring is infeasible or costly e.g rural areas, old buildings, battlefield Vehicles, outer Space (through Comm Satellites)

* Rural
→ Wireless is reconfigurable & Self configurable
→ Today { Rural areas are particularly significant.
At any density
is very very low close 4/100 on and average.

* Battle field
Wireless & Adhoc N/w ∵ of above reason

* **Vehicles**

Wireless reader — Electronic cards — RFID (Passive Device)
avoid traffic & waiting for long time in Toll gate.

* **Medicines**

New corporation have been soon in PC by RFID

3) **Stay connected**

- Roaming allows flexibility to stay connected anywhere and any time
- Rapidly growing market altogether to public need for mobility & uninterrupted access.

4) **Flexibility**

- Services reach you wherever you go (mobility)
  Eg: No need to go to lab to check your mail.
- Connect to multiple devices simultaneously (No physical connection)

Eg: Reaching (or) My wallet and give you business card, once I have reached my customers near to handshake distance, It will be passed to them. Electronically card is transferred then in hand No need to keep ... in E way.

→ Increasing dependence on tele communication services for business and personal reasons.

→ Consumers and businesses are willing to pay for it.

(Basic Mantra: Stay Connected – anywhere, anytime)

Challenges (1):

* Efficient Hardware
  → low power Tx's, Rx's
  → Low Power digital Processing Tools

* Efficient use of finite radio Spectrum
  → cellular frequency reuse, Medium access control protocols

* Integrated Services
  → Voice, data, Multimedia over a single N/w
  Service differentiation, priorities, resource sharing

Multimedia Requirements:-

	Voice	Data	Video
Delay	< 100ms	—	< 100ms
Packet loss	< 1%	0	< 1%
BER	10^{-3}	10^{-6}	10^{-6}

Challenges (2)

→ Network support for user mobility (mobile scenarios)
  - Location Identification, handover, ...
→ Maintaining QOS over unreliable links.
→ Connectivity and Coverage (internetworking)
→ Cost efficiency

Challenges (3)

→ Fading → { [Signals travel in multipath & superimpose @ Rx].
  Rxed data differs from Txed data.
  [LOS].

→ Multipath
→ Higher probability of data Corruption
  Hence, need for Stronger ch codes.
→ Need for Stronger Security mechanisms.
  Privacy, authentication

Wireless Vs Mobile

Note * Wireless doesn't necessarily mean mobile

* Wireless systems may be
  → Fixed [Eg MAN]
  → Portable [Eg. Wireless Interaction between PC & UCR]
  → Mobile