# UNIT 1 –Overview of Wireless Networks

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# Introduction

voice-oriented and data-oriented, further divided into local and wide-area markets

- Voice
  - Local: low-power, low-mobility devices with higher QoS – cordless phones, Personal Communication Services (PCS)
  - Wide area: high-power, comprehensive coverage, low QoS - cellular mobile telephone service
- Data
  - Broadband Local and ad hoc: WLANs and WPANs (WPAN-Wireless Personal Area Network)
  - Wide area: Internet access for mobile users

# Evolution of Voice-Oriented Services

| Year | Event |
|---|---|
| Early 1970s | Exploration of first-generation mobile radio at Bell Labs |
| Late 1970s | First-generation cordless phones |
| 1982 | Exploration for second-generation digital cordless CT-2 |
| 1982 | Deployment of first generation Nordic analog NMT |
| 1983 | Deployment of U.S. AMPS |
| 1983 | Exploration of the second-generation digital cellular GSM |
| 1985 | Exploration of wireless PBX, DECT |
| 1988 | Initiation for GSM development |
| 1991 | Deployment of GSM |
| 1993 | Deployment of PHS/PHP and DCS-1800 |
| 1995 | PCS band auction by FCC |
| 1995 | PACS finalized |
| 1998 | 3G standardization started |

# Evolution of Data-Oriented Services

| Date | Event |
|---|---|
| 1983 | ARDIS (Motorola/IBM) |
| 1985 | SM bands for commercial spread spectrum applications |
| 1986 | Mobitex (Swedish Telcom and Ericsson) |
| 1990 | IEEE 802.11 for Wireless LAN standards |
| 1991 | RAM mobile (Mobitex) |
| 1992 | Formation of WINForum |
| 1993 | Release of 2.4, 5.2, and 17.1-17.3 GHz bands in EU |
| 1994 | PCS licensed and unlicensed bands for PCS |
| 1996 | Wireless ATM Forum started |
| 1997 | U-NII bands released, IEEE 802.11 completed, GPRS started |
| 1998 | IEEE 802.11b and Bluetooth announcement |
| 1999 | IEEE 802.11a/ HIPERLAN-2 started |

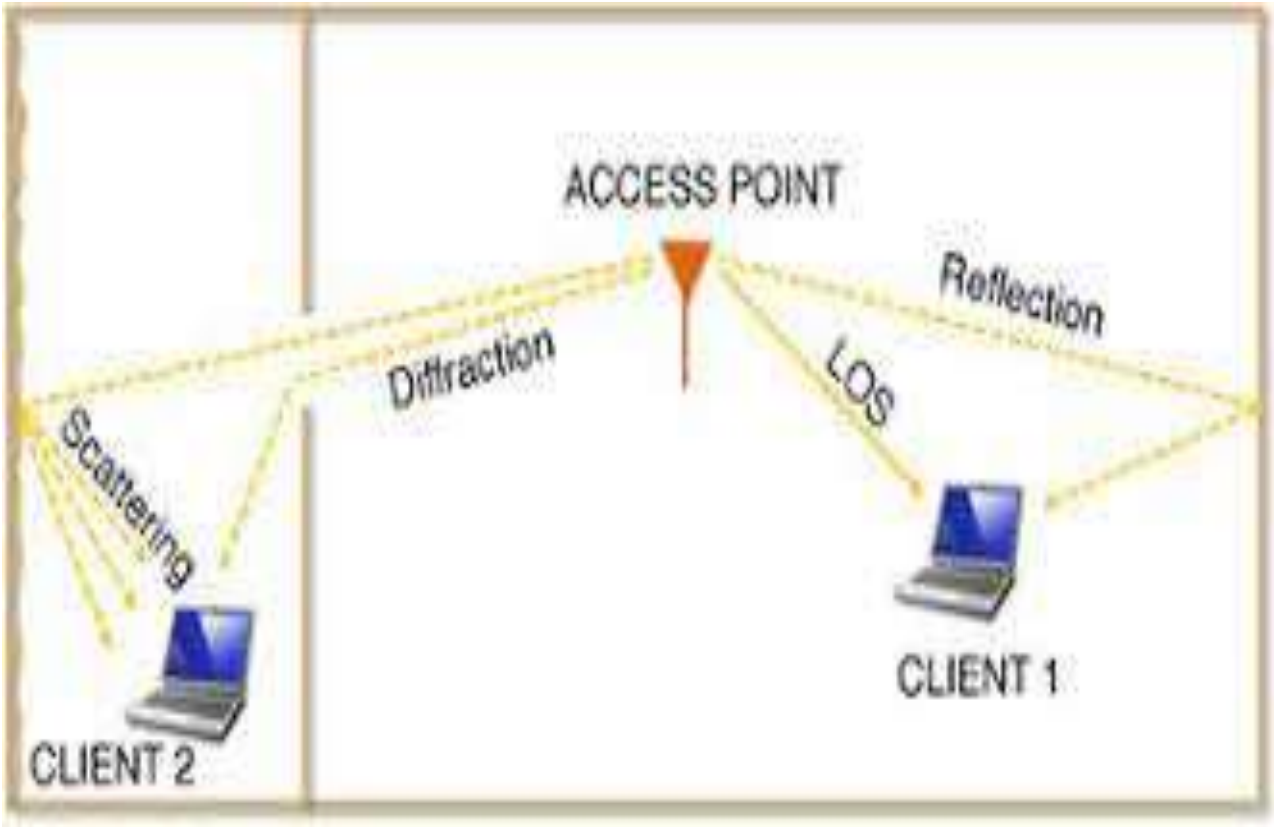
# Comparison of wired and wireless media

| PARAMETER | WIRED | WIRELESS |
|---|---|---|
| Communication Medium | Copper, Fiber etc. | Air |
| Standard | IEEE 802.3 | 802.11 family |
| Speed / Bandwidth | High Speed upto 1 Gbps | Lower speed than Wired Network. |
| Installation Cost | High | Low |
| Maintenance (Upgrade) cost | High | Low |
| Installation Time | Takes longer time to perform | Very less deployment time |
| Mobility and Roaming | Limited | Higher |
| Reliability | High | Lower than Wired |
| Interference | Very Less | High |

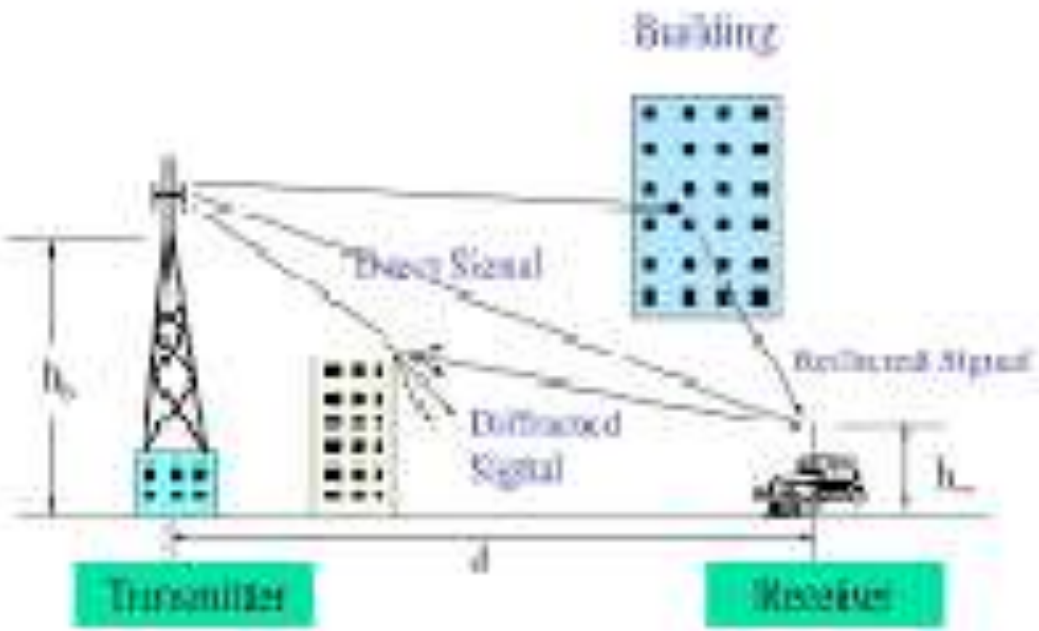
# Radio Propogation

- Radio waves can propagate from transmitter to receiver in four ways
- ground waves, sky waves, free space waves, and open field waves. ...
- The transmitted radiation induces currents in the earth, and the waves travel over the earth's surface, being attenuated according to the energy absorbed by the conducting earth.

# Indoor Mechanism



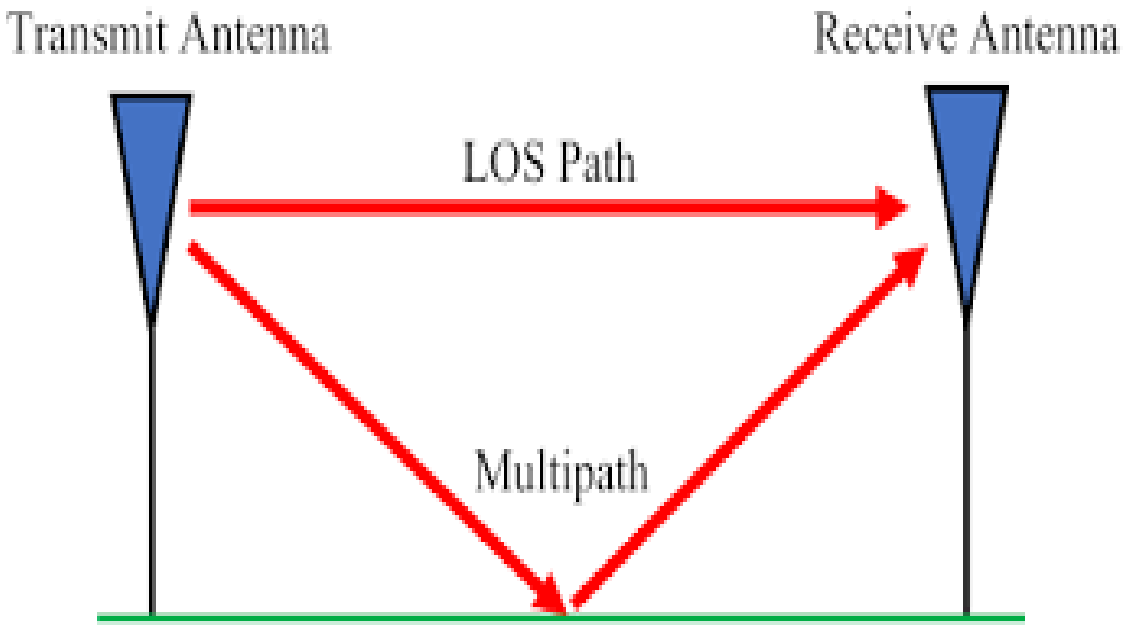
# Outdoor Mechanism



# Multipath

- In wireless mobile communication system a signal can travel from transmitter to receiver over multiple reflective paths This phenomena referred to as multipath propagation
- which can cause fluctuations in the received signal's amplitude, phase and angle of arrivalAlso the signal suffers from reflection, scattering, ISI (intersymbol interference) and weathercondition

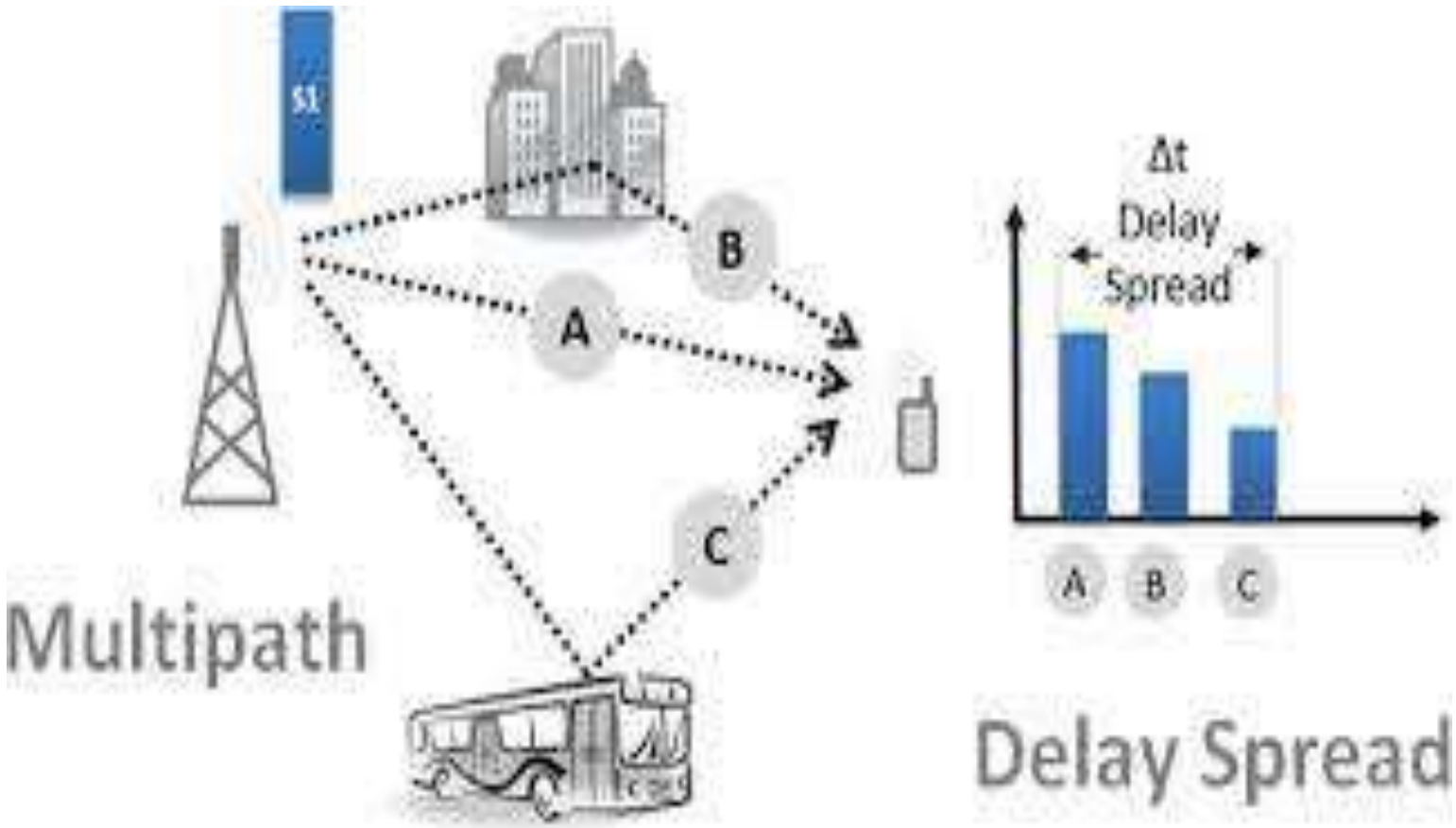
# Multipath Fading



# Delay Spread

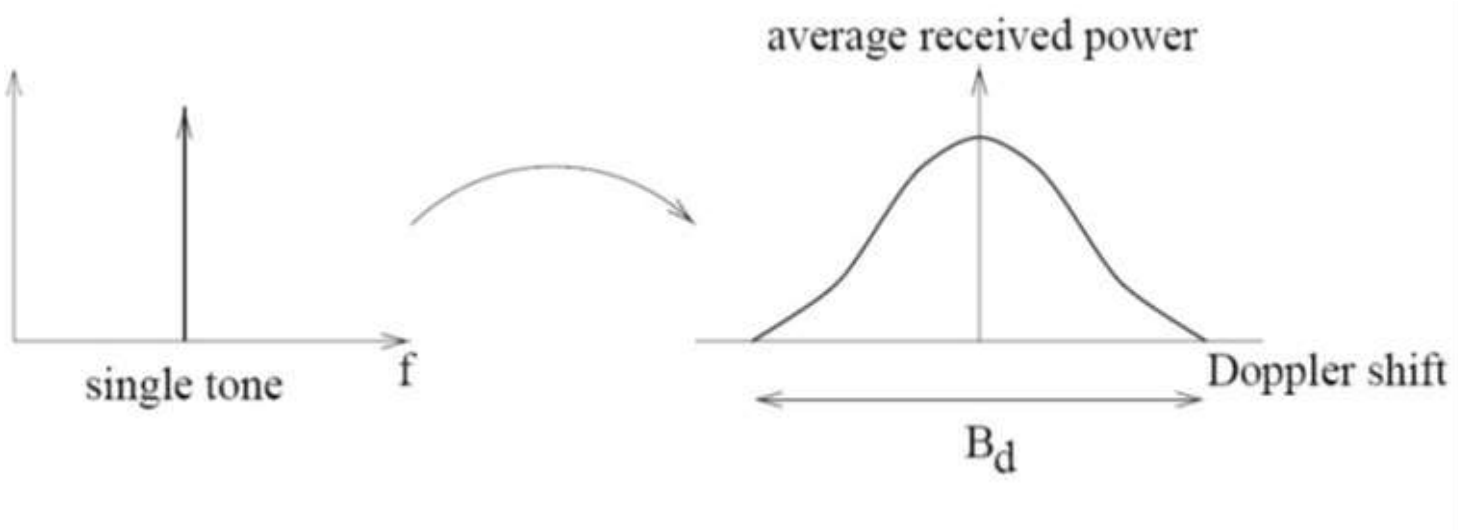
- The different signal paths between Tx and a Rx corresponds to different transmission times. For an identical signal pulse from the Tx, multiple copies of the signals are received at the receiver at different moments.
- The signal on the shortest path reaches first than those on longer paths. The direct effect of these un-simultaneous arrivals of signal causes the spread of the original signal in time domain.
- This spread is called the DELAY SPREAD.

# Multiple Delay Spread



# Doppler Spectrum

- Doppler spread refers to the widening of the spectrum of a narrow-band signal transmitted through a multipath propagation channel. It is due to the different Doppler shift frequencies associated with the multiple propagation paths when there is relative motion between the transmitter and the receiver.



# Fast Fading

- Fast Fading is a kind of fading occurring with small movements of a mobile or obstacle.
- Depending upon how rapidly the transmitted base band signal changes as compared to the rate of change of the channel.
- channel may be classified either as a Flat fading or Slow fading channel.
- In a Fast fading channel, the impulse response changes rapidly within the symbol duration. That is, the coherence time of the channel is smaller than the symbol period of the transmitted signal. This causes frequency dispersion (also called the selective fading) due to Doppler spreading, which leads to signal distortion.

# Slow Fading

- Slow Fading is a kind of fading caused by larger movements of a mobile or obstructions within the propagation environment. This is often modeled as log-normal distribution with a standard deviation according to the Log Distance Path Loss Model .
- In a slow fading channel, the channel impulse response changes at a rate much slower than the transmitted base band signal .