

Name: Siddharth Pandya

Roll No.: A023

classmate

Date

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~~Activity~~

## Mobile Computing

Ans) The main problems of signal propagations are:

- 1) **Attenuation:** The strength of signal falls with distance over transmission medium. The extent of attenuation is a function of distance, transmission medium, as well as the frequency of the underlying transmission.
- 2) **Distortion:** Since signals at different frequencies attenuate to different extents, a signal comprising of components over a range of frequencies gets distorted, i.e., the shape of the received signal changes.  
A standard method of resolving this problem is to amplify higher frequencies and thus equalize attenuation over a band of frequencies.
- 3) **Dispersion:** It is the ~~phenomena~~ phenomenon of spreading of a burst of electromagnetic energy during propagation. Bursts of data sent in rapid succession tend to merge due to dispersion.
- 4) **Noise:** The most pervasive form of noise is thermal ~~noise~~ noise. Thermal noise is due to thermal agitation of electrons and is uniformly distributed across the frequency spectrum.
- 5) **Fading:** Fading refers to the variation of the signal strength with respect to time/distance and is widely prevalent in wireless transmissions. The most common causes of fading in the



wireless environment are multipath propagation and mobility.

- 6) **Multipath Propagation:** In wireless media, signals propagate using three principles, which are reflection, scattering, and diffraction.
- 7) **Delay Spread:** The delay spread is determined by the density function of the resulting spread of the delay over time.
- 8) **Doppler Spread:** This is a measure of spectral broadening caused by the rate of change of the mobile radio channel. It is caused by either relative motion between the mobile and base station or by the movement of objects in the channel.

Radio waves do not follow a straight line because of blocking objects in its path.

Reflection is both useful and harmful because without reflections radio reception in towns would be almost impossible. A line of sight almost never exists. However, reflection is the main reason for multipath propagation causing ISI.

Ans 2

There are several mechanisms which exist to mitigate narrowband interference.

- 1) **Dynamic Frequency Selection:** Senders can sense the medium for interference and choose a frequency range with lower/no interference. HiperLAN2 and 802.11h use this scheme. Network operators can also use this dynamically assign frequencies to cells in mobile phone systems. DFS has a relatively low complexity.
- 2) **Frequency hopping:** Slow frequency ~~hopping~~ hopping may avoid frequencies with interference most of the time with a certain probability. This scheme may be used in GSM. Furthermore, wireless systems can use this principle for multiplexing as it is done in Bluetooth systems. Fast hopping schemes transmit a symbol over several frequencies thus creating a spread spectrum. FH systems have medium complexity.
- 3) **Direct Sequence Spread Spectrum:** Data is XORed with a chipping sequence resulting in a spread signal. This is done in all CDMA systems, but also in WLANs. The signal is spread over a large spectrum and, thus, NBI only destroys a small fraction of the signal. But this requires more powerful receivers to extract the signal from the mixture of spread signals.
- 4) **Spread Spectrum:** It is the techniques involve spreading the bandwidth needed to transmit data.

By transmitting over a large bandwidth, robustness



against external narrowband interference is increased, since the wider the bandwidth on any transmitted signal the lower will be the relative influence of interference over a small part of the bandwidth.

One disadvantage is the increased complexity of receivers that have to despread a signal.

Ans

Several ISI Mitigation :

i) Equalizer and training sequence: If the receiver knows the delays of the different paths, it can compensate for the distortion caused by the channel. The sender may first transmit a training sequence known by the receiver. The receiver then compare the received signal to the original training sequence and programs an equalizer that compensates for the distortion.

ii) Large guard spaces:

- Using higher frequencies reduces the effects of multipath propagation and thus ISI.
- The higher the symbol rate the stronger the ISI.
- If senders or receivers move fast the chances of ISI are higher because the location of obstacles changes.

In TDM, ISI lowers the bandwidth of a TDM scheme as the guard spaces require some time.

Ans 4 The main benefits of a spread spectrum system are:

- 1) Cross-Talk Elimination
- 2) Better output with data integrity
- 3) Reduced effect of multipath fading
- 4) Better security.
- 5) Reduction in noise
- 6) Co-existence with ~~other~~ other systems
- 7) Longer operating distances
- 8) Hard to detect
- 9) Not easy to demodulate / decode
- 10) Difficult to Jam signals.

Spread spectrum were originally for military uses, ~~now~~ now being used widely for commercial purpose.

Spreading can be achieved by XORing a bit with a chipping sequence or frequency hopping that is by using 2 methods

- a) Direct sequence spread spectrum (DSSS)
- b) Frequency hopping spread spectrum (FHSS)

Ans 5 Cellular Network is an underlying technology for mobile phones, personal communication system, wireless networking etc. The technology is developed for mobile ~~radio~~ radio telephone to replace high power transmitters / receiver systems. Cellular networks use lower power, shorter range and more transmitters for data transmission.



Wireless Cellular Systems solve the problem of spectral congestion and increase user capacity.

It has following advantages:

- 1) Offer very high capacity in a limited spectrum.
- 2) Reuse of radio channel in different cells.
- 3) Keep interference levels within tolerable limits.
- 4) Frequency reuse or frequency planning.
- 5) Organization of wireless cellular network.

Cellular Systems for mobile communications implement space division multiplexing (SDM). Cellular systems are used for frequency reuse or spectrum reuse. In this system frequency is limited all communication is enabled via base station. Cellular system with small cells must be used.

Each transmitter typically called a base station, covers a certain area, a cell. The shape of cell depends on the environment or sometimes on the system load. Typically each cell holds a certain number of frequency bands. Neighbouring cells are not allowed to use the same frequency.



Ans 6

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