**Unit-II: PROPAGATION MECHANISM**

**Session -1:** propagation mechanism of EM waves

* **Introduction –**Reflection
* Diffraction
* scattering
* **presentation-**Free Space attenuation
* Reﬂection and Transmission

The d−4 Power Law video clips <http://www.youtube.com/watch?v=cY34qYoQCXg> for refraction

<http://www.youtube.com/watch?v=-apeihWhSKs>ppt multipath

**Remember by keywords**

<http://freepdfdb.org/ppt/wireless-communication-channels--33843677.html>

**Session – 2 :**2 –ray model derivation

Recap:Asking Questions-

Compare reflection, refraction and diffraction concepts

**Presentation by slides:** Analogy Presentation- light waves are visible to our eye. EM waves are invisible to our eye. So, by knowing the mechanism of light we can understand about EM waves also.

* **derivation by board activity-Single wedge,multiple screens**
* [**http://www.cse.wustl.edu/~jain/cse574-08/ftp/channel\_model\_tutorial.pdf**](http://www.cse.wustl.edu/~jain/cse574-08/ftp/channel_model_tutorial.pdf) **multipath**

**Conclusion:** Recall by keywords

1. Knife edge model
2. Wedge model – single, multiple screens

**1.Compare the Different Methods of diffraction.**

**• The Bullington method** is independent of the number of screens, and thus obviously gives awrong functional dependence.•

**The Epstein–Petersen** method adds the attenuations *on a logarithmic scale* and thus leads to an exponential increase of the total attenuation on a linear scale.

• Similarly, the **Deygout method and the ITU-R method** predict an exponential increase of thetotal attenuation as the number of screens increases.

• The slope diffraction method (up to 15 screens) and the *modified* ITU method lead to a linear

increase in total attenuation, and thus predict the trend correctly.

**Session – 3:**Scattering mechanism

* Recap:.

1. How diffraction will occur?

Diffraction occurs when the radio path between the transmitter and receiver isobstructed by a surface that has sharp irregularities (edges).

2. What is scattering?

When a radio wave impinges on rough surfaces, the reflected energy is spread out

(diffused) in all directions due to scattering.

3. Define reflection effect.

If an object is large compared to the wavelength of the signal, e.g., huge buildings,

mountains or the surface of the wavelengths, the signal is reflected.The reflected signal is not as strong as the original, as objects can absorb some of thesignals power.

**Presentation :**Scattering mechanismExplanation through Analogy -light waves are visible to our eye. EM waves are invisible to our eye. So, by knowing the mechanism of light we can understand about EM waves also.

**Video clipping :<http://www.youtube.com/watch?v=40i9ujVJ040>** scattering

 **:<http://www.youtube.com/watch?v=3QnD2c4Xovk>**

**Board Activity**

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Conclusion: Rapid fire

1. Enumerate on The Kirchhoff Theory
2. Conclude about Perturbation Theory

**Session -4:**different fading effects - Rayleigh fading

 **Presentation (content)**

**Board Activity**

**Rayleigh fading**

**Rician fading**

* **Video clipping :** <http://123seminarsonly.com/Seminar-Reports/043/76724967-Mobile-Communication.pdf> book nagagamidistribution
* <http://www.slideshare.net/nitin_jain_india/introduction-to-wireless-fading-channels>
* **Conclusion:** Rapid fire
* Activity Description: We can divide the learners into three teams and instruct each team to prepare 5 questions on the Feedback and its types. After 5 minutes of preparation, each team will ask the other team the questions prepared.
* . Differentiate the propagation effects with mobile radio.

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| S.No | Slow fading | Fast fading |
| 123 | It occurst when the large reflectors and diffracting objects along the transmission paths are distant from the terminal.Eg. Rayleigh fading, Rician fading, Doppler shiftMobile station moves slowlySlow variation in signal strength | It occurs when the user terminal moves for short distancesLocal objects reflect the signal causes fast fadingRapid variation in signal strength |

2.Explain the concept behind fading

Reduction in signal strength

3..Compare slow and fast fading.

 Small objects causes slow fading

 Large objects causes fast fading

1. What is the need of propagation models?

Propagation models have traditionally focused on predicting the average received

signal strength at a given distance from the transmitter, as well as the variability of the signal strength in close spatial proximity to a particular location.

Propagation models that predict the mean signal strength for an arbitrary transmitterreceiver (T-R) separation distance are useful in estimating the radio coverage area of a transmitter.

2. Define large-scale propagation models.

The propagation models that characterize the signal strength over large

T-R separation distance (several hundreds or thousands of meters).

**Session -5: Fast fading**

Recap: Question and answer

**Board Activity-**Indoor propagation Models

* Log-Distance path loss Model
* <http://freepdfdb.org/ppt/wireless-communication-channels--33843677.html>
* <http://www.cse.wustl.edu/~jain/cse574-08/ftp/channel_model_tutorial.pdf> multipath

**Doppler shift-** Fast fading

Conclusion: Buzz round

1. 1.What are major drawbacks in long-distance path loss model?

The long distance path loss model equation does not consider the surrounding

environment clutter may be vastly different at two different.

2. What is long normal shadowing?

The long-normal distribution describes the random shadowing effects which occur

over a large number of measurement locations which have the same T-R separation, but have different levels of clutter on the propagation path. This phenomenon is referred to as longnormal shadowing.

**Session -6** Channel classification

Introduction: Questions

Presentation (content): slides1. Time selective channel

2.Frequency selective channel

<http://www.slideshare.net/Dominque23/overview1ppt>

* <http://www.eecs.berkeley.edu/~dtse/Chapters_PDF/Fundamentals_Wireless_Communication_chapter5.pdf>
* <http://www.slideshare.net/deepakecrbs/propagation-model> selective fading

<http://shannon.cm.nctu.edu.tw/digitalcom/Chap13.pdf>

Conclusion: Questions and answers

1..Defineultrawideband channel

Any transmission where the RF bandwidth exceeds 1Ghz.Any transmission where the RF bandwidth at the -10dB points of the spectrum exceeds 25% of the center frequency.Ultra-wideband transmission is considered best for low power indoor application where there is high clutter, that is the surrounding environment causes significant amount of multipath.

2. Define time selective signal

The gain and signal strength of received signal are time varying means then the channel is time selective channel. The frequency response of the time selective channel Is constant so called frequency flat channel.

3. Define coherence bandwidth.

The coherence bandwidth is related to the specific multipath structure of the channel.

The coherence bandwidth is a measure of the maximum frequency difference for whichsignals are still strongly correlated in amplitude. This bandwidth is inversely proportional to the rmsvalue of time delay spread

4. what are the types of dispersion occur in time selective & frequency selective channels?

1. time dispersion – received signal duration > transmitted signal duration

2. frequency dispersion - received signal bandwidth > transmitted signal bandwidth

* **Session -7** Narrowband Models

Recap: Group quiz

* Activity Description: We can divide the learners into two teams and instruct each team to prepare 5 questions on the Feedback and its types. After 5 minutes of preparation, each team will ask the other team the questions prepared.

Presentation:1. Okumura-hata model

2.COST 231-walfish-ikegamimodel

<http://morse.colorado.edu/~tlen5510/text/classwebch3.html>hata model

<http://www.slideshare.net/deepakecrbs/propagation-model>

<http://shannon.cm.nctu.edu.tw/digitalcom/Chap13.pdf>

<http://www.wiley.com/legacy/wileychi/molisch/supp2/appendices/c07_Appendices.pdf>hata

<http://conan.diei.unipg.it/webtlc/dispense/survey_propagation.pdf>hata journal

Conclusion: Recall by keywords

1.Write the advantages of Okumura model.

(i) It is the simplest and best in terms of accuracy in path loss prediction.

(ii) It is very practical and become a standard for system planning in modern

land mobile radio systems in Japan.

(iii) This model is fairly good in urban and suburban areas.

(iv) All the correction factors are also available as Okumura curves.

2. What are the drawbacks available in Okumura models?

(i) Its slow response to rapid changes in terrain, so its not good in rural areas.

(ii) This model is fully based on measured data and does not provide any

analytical explanation.

3.What are the advantages of Hata model?

a) The predictions of the hata model compare very closely with the

original Okumura model, as long as d exceeds 1 km.

b) This model is well suited for large cell mobile systems.

**Session -8**

**Recap: Questionnaire**

**Presentation: Models for the Arrival Times of Rays and Clusters.**

[**http://www.slideshare.net/aniruddha\_chandra/combat-fading-in-wireless**](http://www.slideshare.net/aniruddha_chandra/combat-fading-in-wireless)

[**http://www.eecs.berkeley.edu/~dtse/Chapters\_PDF/Fundamentals\_Wireless\_Communication\_chapter2.pdf**](http://www.eecs.berkeley.edu/~dtse/Chapters_PDF/Fundamentals_Wireless_Communication_chapter2.pdf)

Conclusion: Keywords writing

**Session -9 Channel models**

Recap: Group quiz

Activity Description: We can divide the learners into two teams and instruct each team to prepare 5 questions on the Feedback and its types. After 5 minutes of preparation, each team will ask the other

**Content: Presentation slides**

* Board activity:Standardized Channel Model
* <http://www.ee.ccu.edu.tw/files/writing_seminar/882/246_aebfff14.pdf>sv model
* <http://www.slideshare.net/JohnsonDon/ee542452class1ppt>

**Conclusion :**Keywords writing**Typical values of the delay spread for different environments are as follows:**

• **Indoor residential buildings** : 5 – 10 ns are typical; but up to 30 ns have been measured.

• **Indoor office environments** : these show typical delay spreads of between 10 and 100 ns, but even 300 ns have been measured. Room size has a clear inﬂuence on delay spread.

• **Factories and airport halls** : these have delay spreads that range from 50 to 200 ns.

**• Microcells** : in microcells, delay spreads range from around 5 – 100 ns (for LOS situations) to 100 – 500 ns (for non-LOS).

• Tunnels and mines : empty tunnels typically show a very small delay spread (on the order of 20 ns), while car-filled tunnels exhibit larger values (up to 100 ns).

* • Typical urban and suburban environments : these show delay spreads between 100 and 800 ns, although values up to 3 μs have also been observed.
* • Bad Urban (BU ) and Hilly Terrain (HT ) environments : these show clear examples of multiple clusters that lead to much larger delay spreads. Delay spreads up to 18 μs, with cluster delays of up to 50 μs, have been measured in various European cities, while American cities show somewhat smaller values. Cluster delays of up to 100 μs occur in mountainous terrain.