EN2053 Communication Networks
Assignment on Wireless Communication

Analyze various factors of the propagation model and understand different routing protocols found in ADHOC networks

Learning Outcomes
At the end of this assignment, the student should be able to

1. Model a wireless communication network with various propagation models
2. Understand different routing protocols used in mobile Ad hoc networks (MANETs)

Task 1

In this exercise you will be modelling the RF propagation model using Matlab.

A transmitter is used to transmit a voice signal over to a receiver located at distance of 10km apart.

The average rain fall rate , ambient temperature and water density of the surrounding are 20mm/hr,31 ^{o}C and 0.5 g/m^3 respectively. The link margin is 11 dB. Transmission power is 50 kW and the transmitter and receiver gains are 1000 and 300 respectively.

The transmission network is given below.
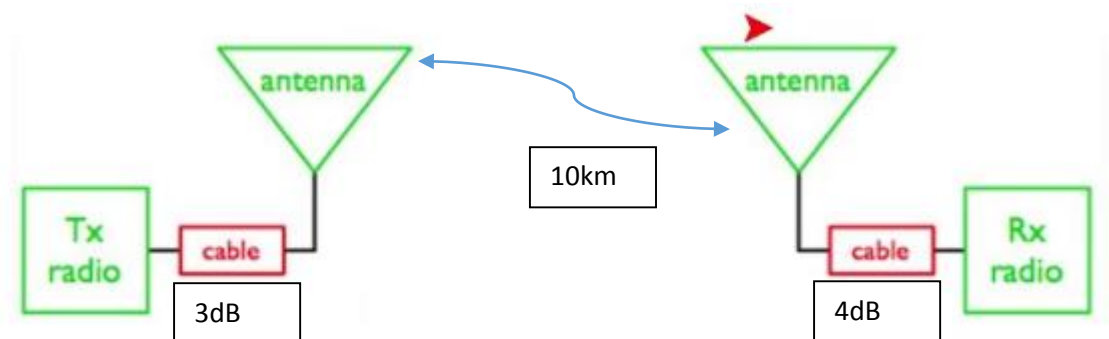
1. Establish the relationship between free space path loss and frequency and plot how the free space propagation loss varies with frequency. [Mathematical derivation of the equation should be included in the report]
2. Rain attenuation, Fog attenuation and Atmospheric gas attenuation are few other forms of losses found in RF propagation. Plot how the aforementioned attenuations vary with frequency.

3. Combine the above attenuation factors to the free space model to plot the variation of the total path loss with frequency. From this model find a suitable frequency for transmission.
4. Using the above transmission frequency calculate the receiver sensitivity and plot the link budget.
5. Transmit a voice signal over a noisy channel using the above transmission frequency and the propagation model.

All the codes and the models should be attached to the report.

Task 2

In this exercise you will be implementing a simplified version of the DSR(Dynamic source routing) routing protocol using python

Routing Protocol

Each packet has the following attributes

- Pkt_id: A unique id for the packet within the local network
- Pkt_type: RREQ/RREP/DATA
- Source_route : A list of nodes the packet has to go through to reach the destination
- Source: The originating node of the packet
- Target: Destination node of the packet
- next_hop: Points to next node the packet should hop within the source route

Suppose node A (source) wants to send a DATA packet to node B(target). Node A first checks whether a **route** from A to B exists within its **route cache .** If it does exits the source route of the packet is updated from the route cache and the packet is forwarded to the next node in its source route. If a route does not exist in the route cache, the DATA packet is stored in a buffer and a RREQ (Route request) packet is broadcasted from the source. If a RREQ is received by a node it does the following

- If (pkt.source,pkt.target,pkt.id) is within the recent history of packets received it will discard the packet
- If node address is within the pkt.source_route, discard the packet
- If pkt.target is the node address, send a RREP packet
- Else add the node address to the pkt.source_route and broadcast pkt to all of its neighboring nodes

A RREP packet is a Route reply packet sent from the target to the source with the newly found source route from the RREQ packet. For simplicity of the protocol the transmission ranges of all the nodes is assumed to be the same and hence bidirectional communication is possible between two neighboring nodes. Therefore, the source route of the RREP is replaced with source route of RREQ packet. The RREP is forwarded to the source node in the reverse order found in the source route. Once the RREP reaches the source node, the source node updates the route cache of the node and copies the source route of the RREP to the DATA packet and forwards the DATA packet based on the source route. Route maintenance found in DSR is skipped in the above protocol for simplicity.

During packet forwarding the pkt.next_hop must point to correct index of the next node in the source-route. This is not required when broadcasting pkts.

Each route in the route cache has an expiration period which will be renewed if the route in the cache is accessed.

1. In this exercise you are given a partially completed code for implementing the DSR routing protocol using python. Your task is to go through the python code and complete the routing algorithm. Codes for visualization is also provided. A simulation of a MANET with at least 6 nodes is required along with all the codes used. At the end of the simulation provide average number of hops per packet and the percentage of packets loss as evaluation parameters.
2. Describe how you can improve the efficiency by further exploiting the route cache in the above routing protocol.
3. Describe how to handle disconnections during transmission.[Need not be implemented in the code].
4. Compare how the DSR protocol differs from Distance Vector Routing protocol

All codes must be attached to the report. The code base for the simulator can be downloaded from the following link https://github.com/sahan-liyanaarachchi/EN2053