

Exam 2015/2016 Part 2

Question 1

The **PLR** (Packet Loss Ratio) represents the probability that a packet is lost. It is closely related to a number of factors:

- BER (bit error probability), where and increasing probability of errors also increases the probability of losing the packet to also errors.
- SNR, where channel noise increases the BER
- SINR, where channel interference increases the BER
- P_r (Signal power at the receiver), where lower power means bigger BER
- P_t (Signal power at the transmitter), where lower power means lower P_r , and therefore lower BER

Question 2

FDMA (frequency Division Multiple Access) consists on dividing the bandwidth into multiple channels (different frequencies) and assign each one as a transmission slot for each user. The transmission is therefore continuous but with lower rate. Requires guard-bands to reduce ISI.

TDMA (Time Division Multiple Access) consists on dividing the transmission time into multiple timeslots and assign each one as a transmission slot for each user. Each user is assigned a cyclically-repeating timeslot to transmit. It is no continuous but with higher rate as it uses the whole bandwidth of the channel.

OFDMA is an extension of FDMA and TDMA, where channels are assign both based on time and frequency. The scheduling is opportunistic, basing its decision on a deciding factor (BEST SNR, Best Global throughput, fairness).

CDMA is assign a code to spread his information signal (codes need to be orthogonal). It is based on multi-user spread spectrum. The resulting spread signal consists on signals that occupy the same band and are transmitted at the same time.

Question 3

Ad-hoc networks are based on a dynamic topology, where information needs to be refreshed more frequently as the network topology is always changing. Excessive polling is major concern as mobile networks have limited resources (bandwidth, energy, etc).

The protocols for this topology can be:

- Reactive, like AODV.
- Pro-active, like OLSR.

AODV stands for Ad hoc On-demand Distance Vector, when a route is only searched when a packet needs to be sent. It broadcasts Route-Request to find the route. It uses less resources but is also slower to update

and therefore has a bigger average delay.

OLSR stands for Optimized Link State Routing Protocol and is a pro-active protocol, which means that despite routes being always available, it uses significant network resources to maintain a continuous network control traffic. These messages are HELLO messages, meant to signal neighbours of their presence. It makes use of MPR to minimize traffic in the network.

Question 4

The **LTE Admission Control** admits that a new arrival is characterised by R_j bit/s, requiring N_j blocks/frames. If there are blocks available, considering the ones that are already assigned, then the call is accepted. These blocks are characterised by the frequency and the frame period.

Question 5

GSM to GPRS

The main objective was to simplify the access to the Internet and improve the network efficiency, achieved by adding packet switching to GSM, where data is transferred as packets.

Two new network elements were added_

- SGSN, Serving GPRS Support Node, for authentication, switching, mobility and accounting.
- GGSN, Gateway GPRS Support Node, for IPv4/IPv6 internet routing.

GPRS to UMTS

The main objective was to provide a standard way for personal communications to support large quantities of users. Makes use of WCDMA, where all users share the same time and frequency domain.

Two new components were added:

- UTRAN, Provides and manages the air radio interface for entire network.
- Core Network, Provides all management and central processing of the System (new Network switching subsystem).

UMTS to HSPA

Routing Information Protocol

HSPA to LTE

Routing Information Protocol