Project 6 – Satellite communications

Consider a communication system with N terminals that receive packets from a Ground Station (GS) via a satellite, which acts as a simple relay node. Each terminal has its own dedicated FIFO queue at the ground station, with packets of size S bytes arriving at the queue every T seconds. S and T are uniformly and exponentially distributed RVs, respectively.
Transmissions from the GS occur in time slots of fixed and constant duration of 80 milliseconds and, on each time slot:

1. first, each terminal reports to the GS a packet including its Coding Rate (CR), which can have one of the following values: L3, L2, L1, R, H1, H2, H3. The reported CR determines the maximum data rate supported by the terminal and is selected randomly, as described later.
2. then, the GS composes a *frame* of M blocks by scheduling traffic from the terminals' queues, and sends the frame to the terminals, i.e. removing the corresponding packet(s) from the queues. A packet that cannot be transmitted entirely will not be scheduled in the current slot. A block can carry packets for multiple terminals, and one terminal can be scheduled in multiple blocks.

The GS serves the terminals using a *MaxCR* policy, i.e. by sorting them based on their reported CR and starting from the highest one (H3). When a terminal is considered for service, the GS tries to empty the terminal's queue before considering the next one. Each block is assigned the CR of the first terminal scheduled in that block, and that determines the number of bytes that can be included in that block, according to the following table:

CR	***L3***	***L2***	***L1***	***R***	***H1***	***H2***	***H3***
Bytes	904 / M	1356 / M	1808 / M	2260 / M	2712 / M	3164 / M	3616 / M

A terminal can only be scheduled in a block with CR smaller or equal to the one it reported to the GS at the beginning of the time slot.

Evaluate at least the throughput and delay for various values of N and M.

At least the following scenarios must be evaluated:

- CR extracted from a *uniform* distribution
- CR extracted from a *binomial* distribution, chosen so that the mean CR of different terminals are sensibly different

In all cases, it is up to the team to calibrate the scenarios so that meaningful results are obtained.

Project deliverables:

a) Documentation (according to the standards set during the lectures)
b) Simulator code
c) Presentation (up to 10 slides maximum)