Assignment

Figure 1 depicts a transmitter sending packets to a receiver over a wireless channel.

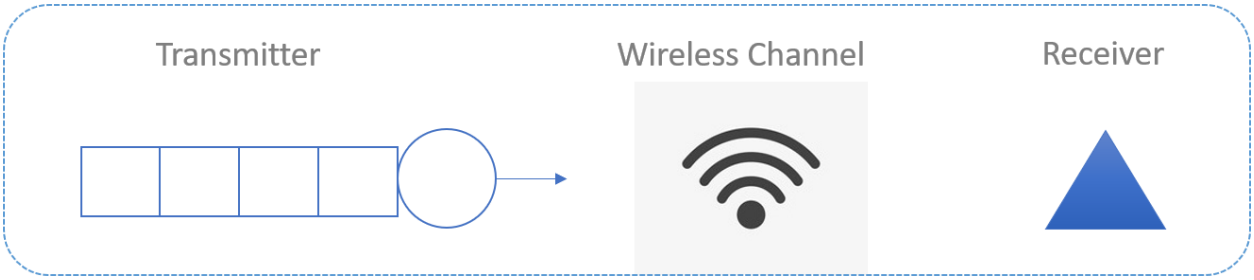

Figure 1. A wireless system

The transmitter is associated with a buffer of size L (i.e., the buffer can hold up to L packets). Furthermore, the transmitter allows F transmission attempts per packet. A packet is dropped if and only if all attempts fail. The failure is probably caused due to the time-varying nature of the wireless channel. Let $prob_{Error}$ denote the probability of an unsuccessful packet transmission and $(1 - prob_{Error})$ the probability of a successful packet transmission. It is worth mentioning that if the queue (i.e., the buffer) is full, a packet will be lost. This situation corresponds to the *Loss Event* and the condition on the edge connecting it with the *Arrival Event*. The queue is assumed to be a FIFO queue meaning that it operates on a first-in, first-out (FIFO) principle. Hence, a packet will be scheduled for transmission once it enters the queue and it is at the head of the queue. For each *Transmit Event*, the following two events are scheduled: *Receive Event* and *Timeout Event*. Since a packet is successfully received, its corresponding *Timeout Event* is removed from the event list and the next packet in the queue is scheduled for transmission.

If the delivery of a packet to the receiver is not successful and a number of transmission attempts are available (a threshold can be set), its *Timeout Event* will eventually fire, resulting in a re-transmission process. Alternatively, a *Drop Event* is scheduled. Moreover, after the current packet is rejected, the next packet in the queue is scheduled for transmission. The following table presents the simulation parameters:

Table 1. Simulation parameters

Parameter	**Value**
Number of packets to be simulated	100000
Probability of an unsuccessful packet transmission	0.64
Size of Q	100
Length of a timeout period	1
Arrival rate	0.7
Maximum allowed number of transmission attempts	4

To do:

1. Identify the state variables needed for designing an event-graph for the system described above.
2. Design the event-graph for the system (e.g., using M/S Office Visio).
3. Create the flowchart of the event-driven simulation process putting a special emphasis on *simulator* and *model* components (e.g., using M/S Office Visio).
4. Build an event-driven simulation program in Python (or other desired programming language) for calculating performance estimates such as: average delay, standard deviation, percentage of successfully received packets, as well as the 80%, 90%, 95% and 98% confidence intervals for the population mean.
5. Discuss the computational results obtained and design additional experiments by tuning simulation parameters and improving the system (e.g., the size of queue or the maximum allowed number of transmission attempts, etc.).
6. Plot a graph for depicting how the average packet delay is correlated with the probability of an unsuccessful packet transmission.

Students should work in groups of two for the assignment. Assignments (word + source code in a .zip file) should be sent to pzlappas@gmail.com one day before the exam-day of the course (name convention for the .zip file: surname_of_student_1-surname_of_student_2.zip; subject for the e-mail: Simulation Assignment – DMST 2022 – Surname_of_student_1 – Surname_of_student_2).