1 Theory, assumed state of knowledge

Lecture (CE II, Script): Chaper 9; Queueing Theory, ALOHA protocol

2 What is shown?

This demo deals with the ALOHA (or pure ALOHA) protocol and its variant "slotted ALOHA". A queuing theory model is shown (call of aloha1Pure.m or aloha2Slotted.m) or a more physically orientated illustration with a bus (aloha3PureBus.m). For ALOHA and slotted ALOHA there are three users at the left hand side, symbolized by boxes with different colors. User-generated packets to be transmitted are also shown. For each user the waiting time between a transmission of two successive packets is negative exponentially distributed. The packets have a fixed length, so the waiting queue type is M/D/1.

The queue is shown in the middle, and the serving unit can be seen at the right. Each packet in the queue is numbered and arranged in a chronological way. Above the waiting queue the current arrival rate λ is shown at the left and the current serving rate μ at the right. Below the queue there is the traffic offer ρ and the traffic load ρ_A. The arrival rate can be set by a gui button. A click with the left mouse button increases the value, a click with the right button decreases it. Alternatively the keyboard buttons +/- can be used.

If two users transmit in the same interval of 2 (slotted ALOHA 1) times the packet duration, a collision will happen. The collision will be marked by red color. Demaged packets will be transmitted again. Additionally, the traffic load versus traffic offer can be seen as a curve, with the current value marked by a red point. This point is calculated from a short-term statistic.

In priciple the variant with the bus illustration is identical with ALOHA. Instead of a single queue the three individual queues are shown and the bus illustration points a little bit more to a technical realization.

3 What is demonstrated?

Depending on the traffic offer λ set by the user, the ALOHA protocol seems to be working quite well for small traffic offers ρ. As soon as ρ gets closer to the limit 0.18, the instable behaviour becomes obvious. For $\rho > 0.1$ the red point moves more or less quickly to the upper part of the curve and stays there. The protocol is then only busy with retransmissions of packets, and there is nearly no chance for a transmission of new packets. It can be seen that the average length of the queue is increasing steadily in this case. For slotted ALOHA the same behaviour can be seen. The only difference is that the traffic offer allowed is twice of that of the pure ALOHA protocol.