CZECH TECHNICAL UNIVERSITY IN PRAGUE
FACULTY OF ELECTRICAL ENGINEERING
DEPARTMENT OF TELECOMMUNICATION ENGINEERING

B2M32BTSA - Bezdrátové technologie
BE2M32BTSA - Wireless Technologies and Sensor Networks

Medium Access Methods

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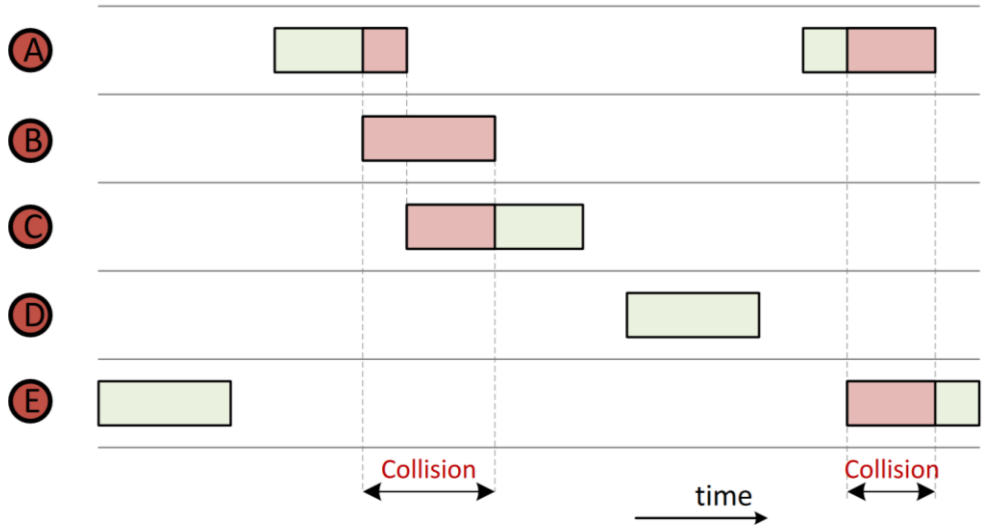
6G mobile RESEARCH LAB

ALOHA

Developed in 1970s at University of Hawaii

How does it work?

- If you have data then transmit
- When two or more packet transmissions overlap in time -> collision
- If ACK not received within timeout set backoff timer
- When backoff timer zero -> re-transmit



ALOHA - Analysis

Offered traffic G

- Average number of packets transmitted within packet time

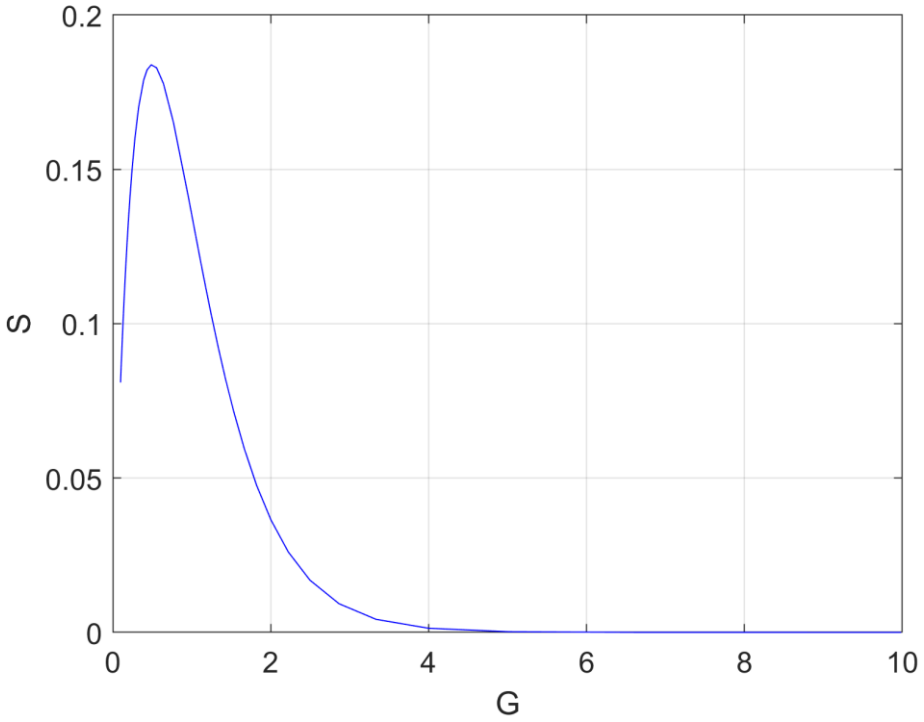
Throughput $S = Ge^{-2G}$

- Average number of acknowledged packets within a packet time (theoretical maximum is 1 => if there are no collisions)

Maximal throughput?

$$\frac{\partial S}{\partial G} = e^{-2G} - 2Ge^{-2G} = 0$$

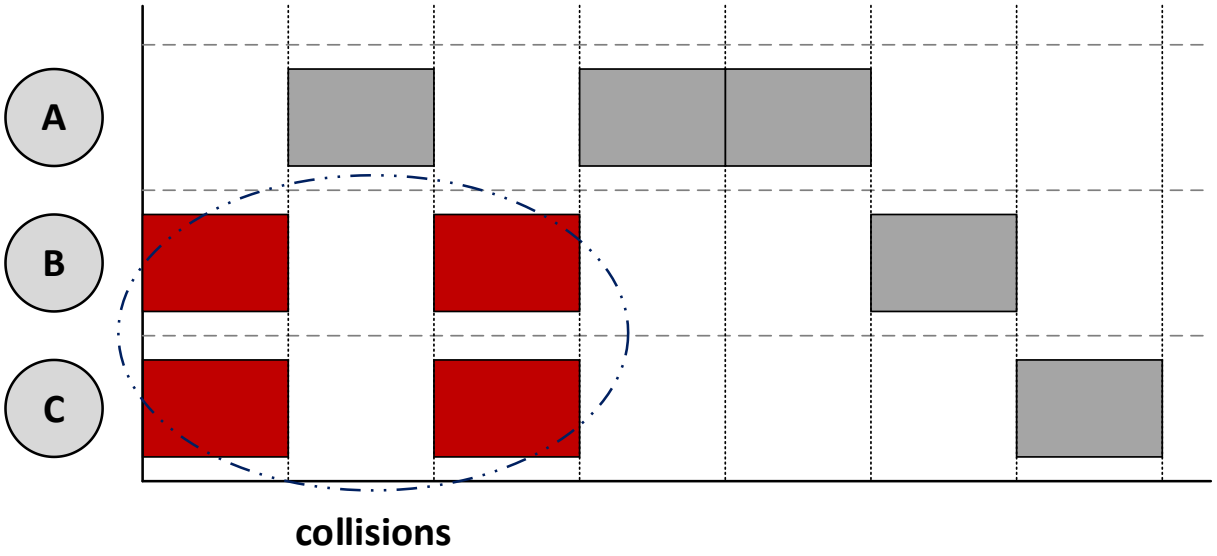
$$G = \frac{1}{2} \rightarrow S = \frac{1}{2e} = 0.184$$



Slotted ALOHA

Principle

- Transmit only at the beginning of each slot
  - Packet transmission duration equal as slot duration
- Collision only in slots
  - Backoff in multiples of slot times => transmit again



Slotted ALOHA - Analysis

Offered traffic G

- Average number of packets transmitted within one slot

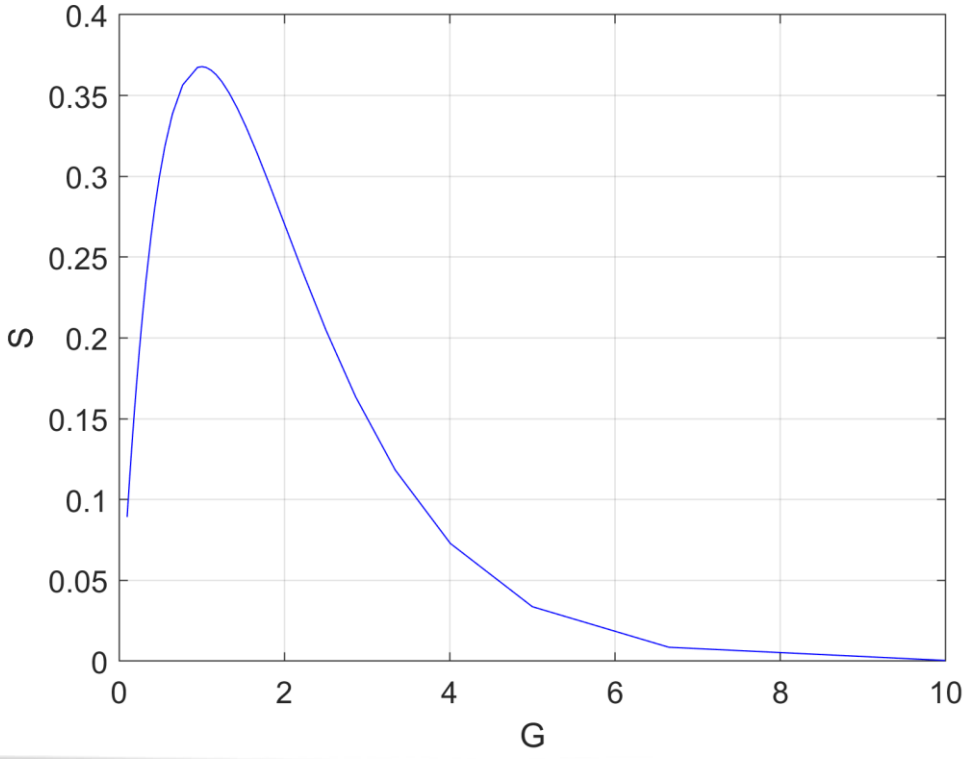
Throughput $S = Ge^{-G}$

- Average number of acknowledged packets within a slot (theoretical maximum is 1 => if there are no collisions)

Maximal throughput?

$$\frac{\partial S}{\partial G} = e^{-G} - Ge^{-G} = 0$$

$$G = 1 \rightarrow S = \frac{1}{e} = 0.368$$



http://web.cse.msstate.edu/~ramkumar/assignmentsolutions.html

Objectives

Implement slotted ALOHA (and/or pure ALOHA) in Matlab

Show figure(s)

- See slide 10 for more details

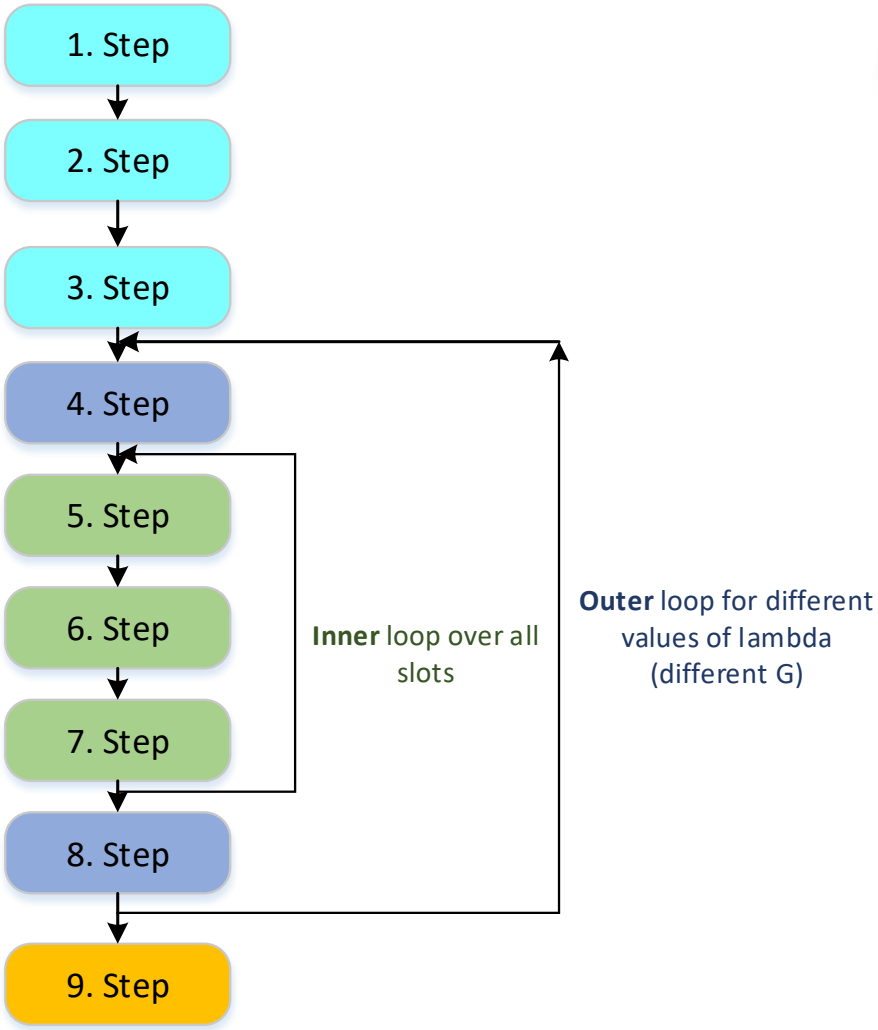
Assumptions

- Offered traffic generated with Poisson distribution
- Number of stations (N) is 20
- Simulation lasts over 10 000 time slots

Template

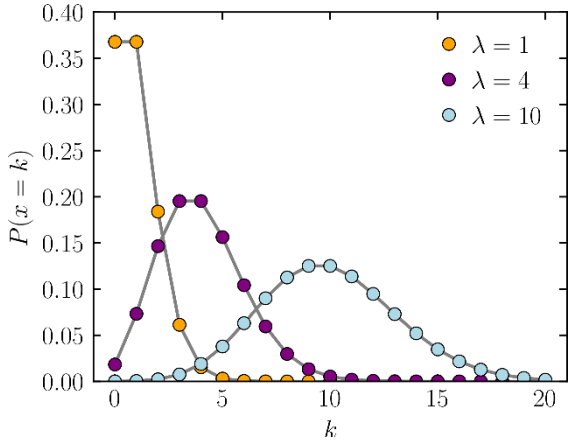
- It is possible to use a template (available at moodle)
- **You can write your own code without the use of template!!**

How to proceed?



How to proceed?

- 1. Define number of stations and number of slots in the simulation
  - **Matlab example:**
```
No_stations=20;
No_slots=10000;
```
- 2. Define packet arrival (lambda) for Poisson distribution
  - 41 predefined values of lambda (between 1 and 200)
  - Lower value of lambda => more packets are transmitted (i.e., higher G)
  - **Matlab example:** `packet_arrival=[1:20 25:5:50 60:10:200];`
- 3. Define variables for results
  - G = Offered traffic
  - S_analyt = Analytical throughput
  - S_sim = Simulated throughput
  - **Matlab example:**
```
G=zeros(1,41);
S_analyt=zeros(1,41);
S_sim=zeros(1,41);
```



- 4. Select current lambda value used for Poisson
  - Selection from “packet_arrival” defined in 2. Step
    - For example, lambda=1 in the first loop, lambda=2 in the second loop, etc.
  - **Matlab example:** `lambda=packet_arrival(1,lambda_set);`

How to proceed?

- 5. Generate initial packet arrival for each station
  - Only for first slot!
  - Determine slot in which each station is going to transmit data for the first time
  - **Matlab example:**

```
if slot==1
    StationTimeToTx=poissrnd(lambda,1,No_stations);
end
```

    - For example, if StationTimeToTx = 5, station waits for 5 slots and generates packet in the 6th slot
- 6. Determine if there are stations that are supposed to transmit
  - If value in StationTimeToTx for any station is 0
- 7. Check for collisions (only if there is some station transmitting in the current slot)
  - Determine next packet arrival or backoff (use Poisson for both)
- 8. Save results for current lambda
  - G = No. of all transmitted packets/No_slots
  - S_analyt (see slide 5 for calculation)
  - S_sim = Transmitted packets w/o collisions/No_slots
- 9. Plot the results

Expected results and rating

Slotted ALOHA

- Analytical throughput (1 point)
- Simulated throughput (1 point)
- Probability of collisions/successful transmission (1 BONUS point)
- Try different distribution for packet arrival (1 BONUS point)

Pure ALOHA

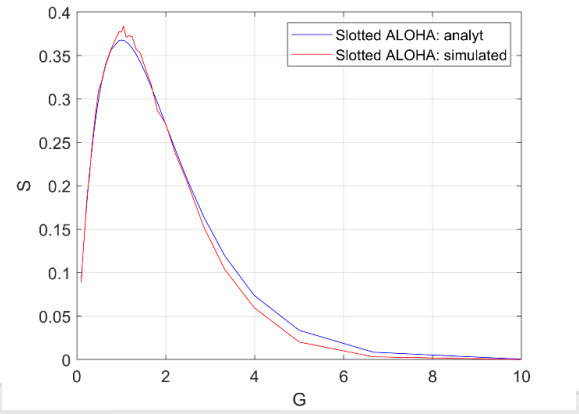
- Analytical throughput (0.5 BONUS point)
- Simulated throughput (1.5 BONUS point)

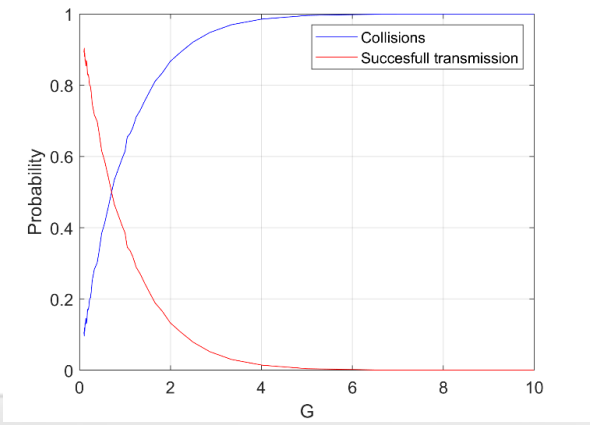
Optional (each student can select what can be done)

Maximum is 4 points!

Evaluation

- During courses
- 4th week of the semester (17.3.)
  - Short discussion on results and code understanding
  - Points given only if student is understanding the code and basic principle of (Slotted) ALOHA!!





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Questions?

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