Development of Multi-Access Systems

Развитие систем множественного доступа

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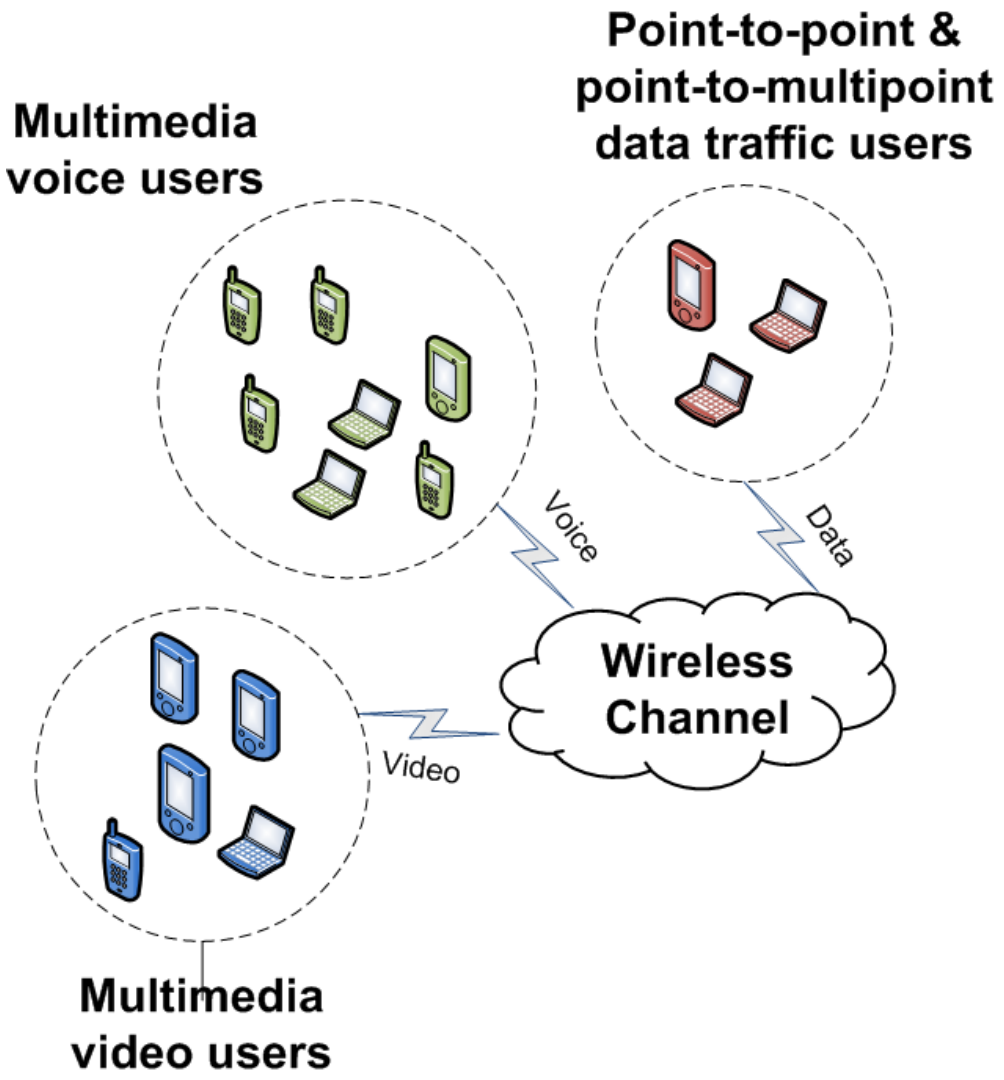
Outline

- Motivation
- Our targets
- State-of-the-art
- ALOHA protocol
- Binary Exponential Backoff (BEB) protocol
- Unicast and broadcast traffic
- Heterogeinity
- Validations
- Summary and open issues

Context and Motivation

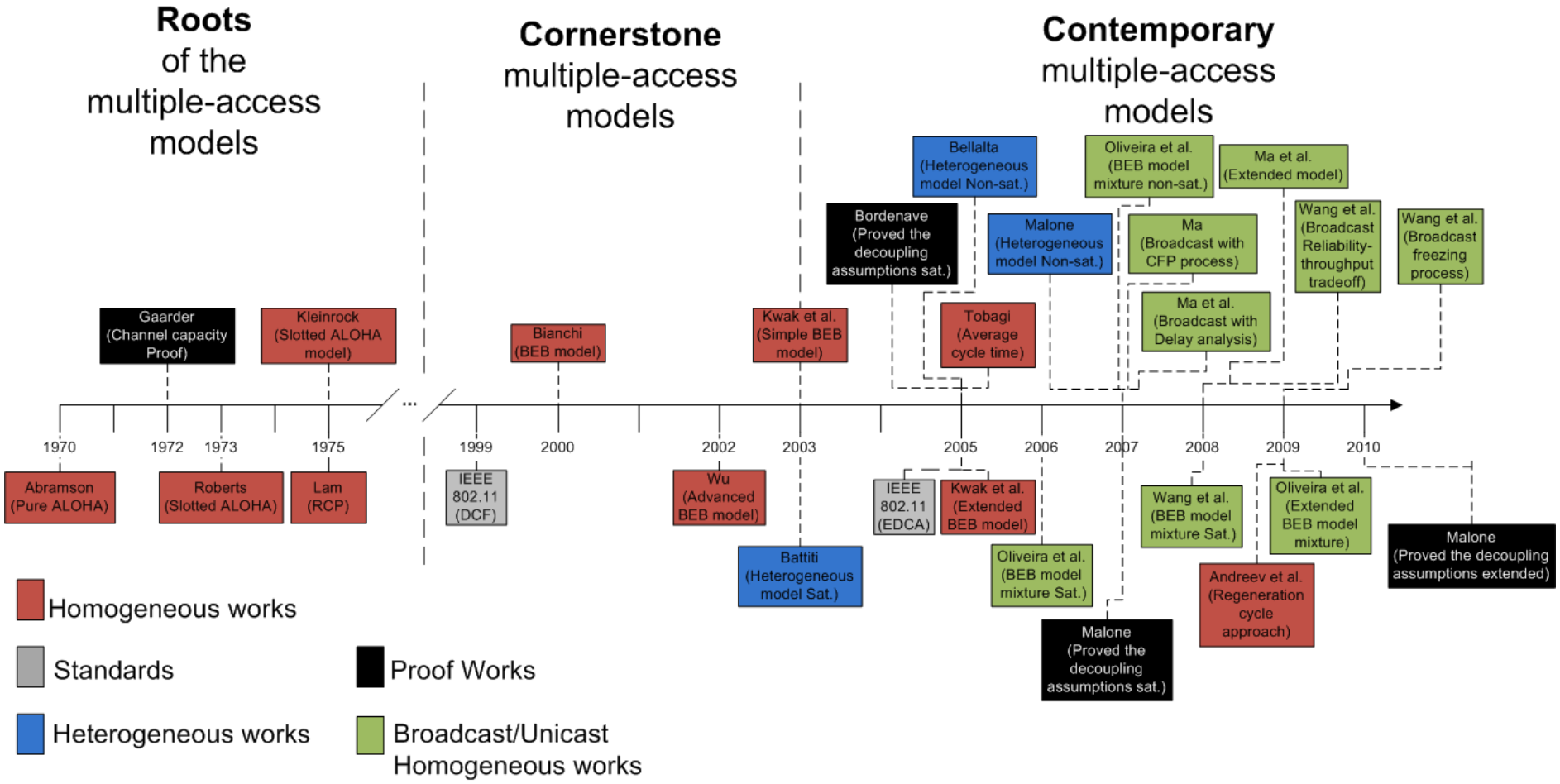


- IEEE 802.11-based networks
- One-hop link
- Broadcast traffic
- Heterogeneity
- **Saturation**

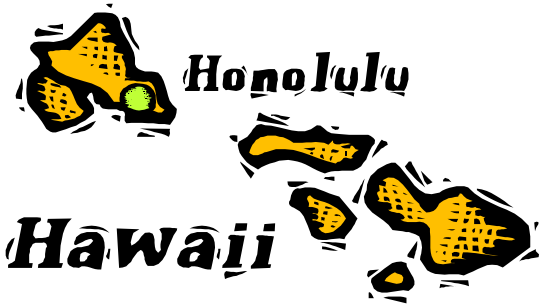
Our Targets

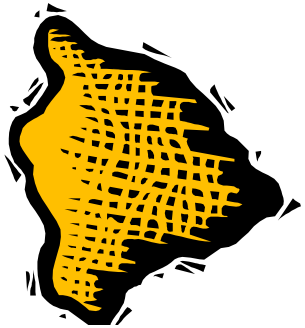
- Studying past models
- Simple analytical model for **saturated** traffic
- Accounting for the amount of Unicast/**Broadcast** traffic
- Considering **groups** of users
- **Saturation throughput** estimation

State-of-the-Art

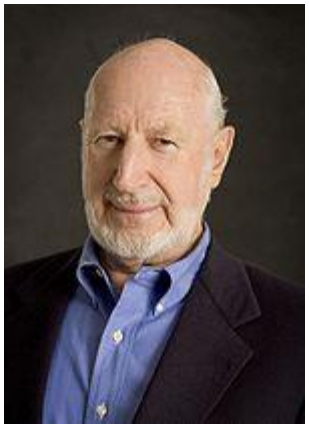


Why ALOHA?

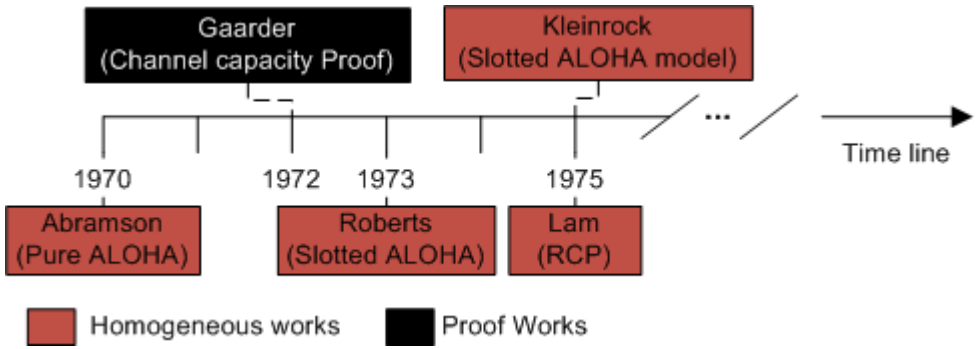




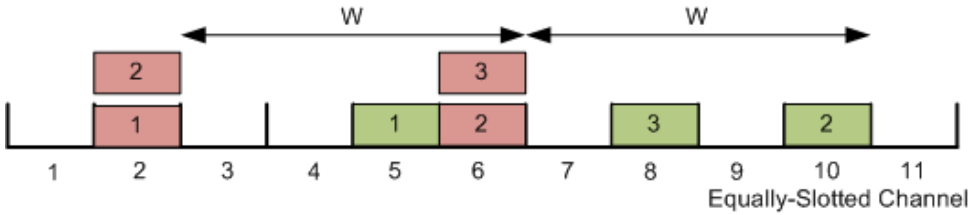
1968



ALOHA “Flavours”



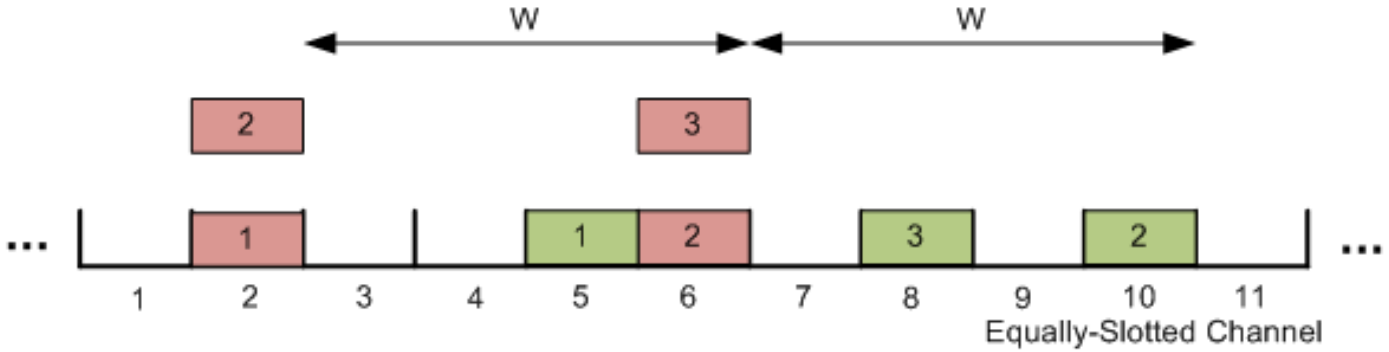
- **Pure** ALOHA [Abramson 1970]
- **Uniform** ALOHA origins [Roberts 1973]:



W is the fixed **contention window**

- 1-D Markov Chain model [Kleinrock 1975]
- Enhancement to **mitigate congestion** [Lam 1975]

Uniform ALOHA



- Each user waits at most *W-1* idle slots before starting the transmission
- Considering **equally-slotted** channel
- The **transmission probability** takes the form:

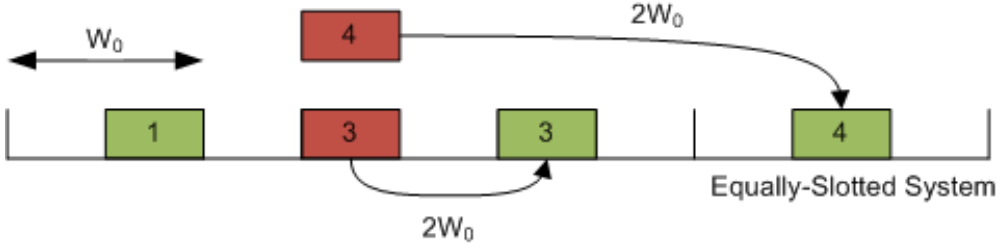
$$p_t = \frac{2}{W+1}$$

- *M* users saturation **throughput**:

$$S_{out} = Mp_t(1-p_t)^{M-1}$$

Retransmission Control Procedure (RCP)

- **Congestion** control mechanism
- Initial window W_0. Users uniformly choose a number between 0 and W_0 to start the **counter**
- The counter is **decremented** by each idle slot
- After a collision users **increase** the window
- The window is **reset** after a successful transmission

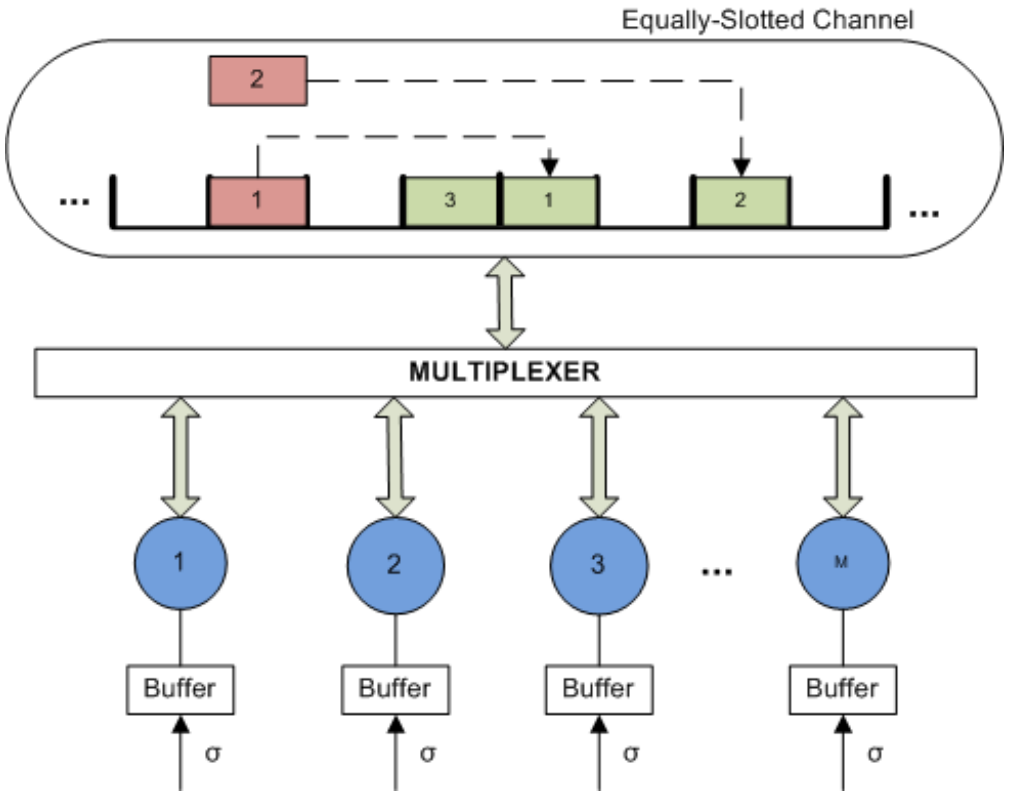


Binary Exponential Backoff is a particular case of RCP when the window is adapted as follows: $W_i = 2^i W_0$

Where *i* is the number of the **retransmission** attempt

System Model Assumptions

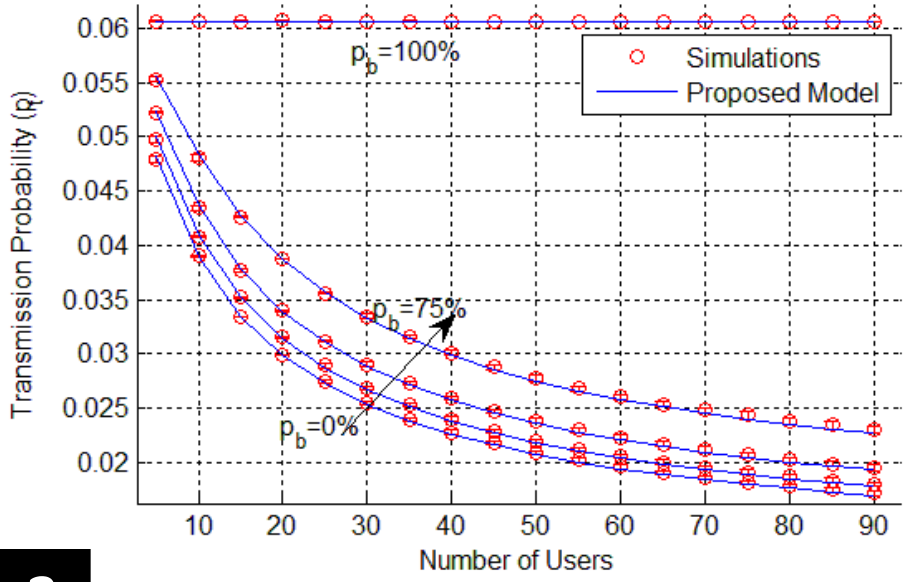
- Communication system
  - Synchronization
  - Fixed Network Topology
- Transmission Channel
  - Channel Events
  - Saturated Traffic
- Feedback Information
- Retransmissions
  - Lossless System
  - Lossy System



Validation Results

Simulation results using ns-2 package

- **Homogeneous** scenario
- Different amounts of broadcast traffic
- The transmission probability p_t matches with a small error.



M	Group 1	Group 2	Group 3
5	0.182%	0.196%	0.035%
10	0.287%	0.270%	0.202%
15	0.614%	0.480%	0.132%
20	0.077%	0.114%	0.016%

- Error values for a **Heterogeneous** scenario
- Group 1: 0% broadcast traffic
- Group 2: 50% broadcast traffic
- Group 3: 100% broadcast traffic