No Ack in IEEE 802.11e Single-Hop Ad-Hoc VoIP Networks

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Outline

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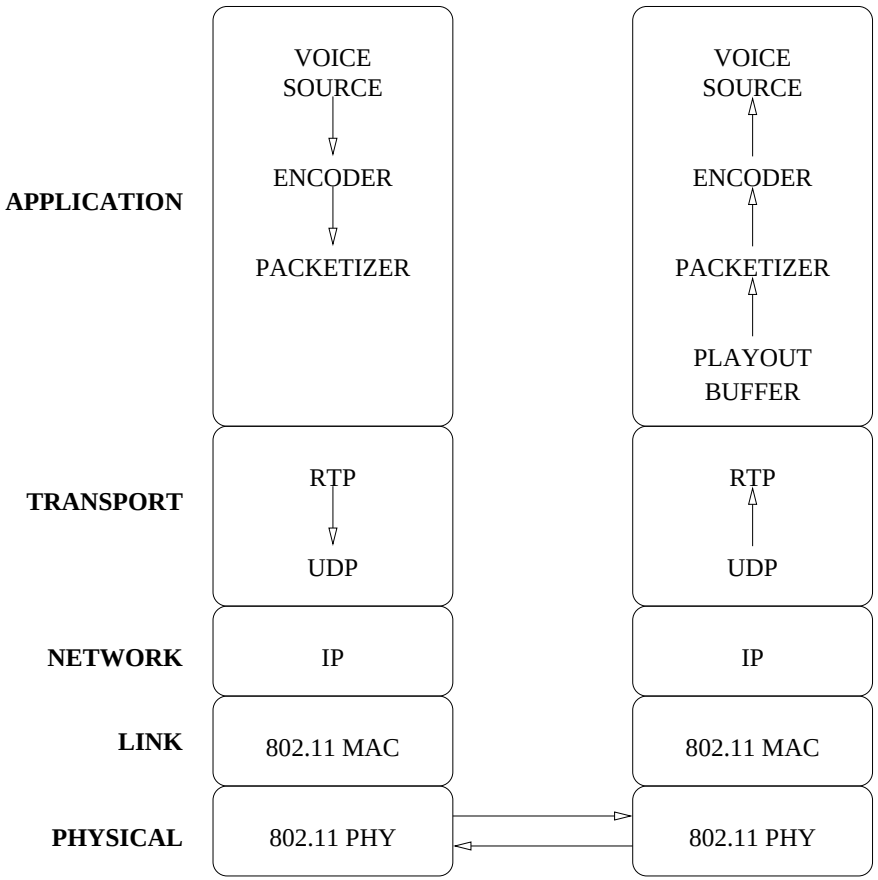
Protocol Stack



Example

- Codec: G.711
- Packetization interval: 20ms
- Playout buffer: 60ms
- RTP: 12 bytes
- UDP: 8 bytes
- IP: 20 bytes
- MAC: 34 bytes
- PHY: Preables at PHY rate. Data at 11Mbps.

Internet Flows: Elastic vs. Rigid

Simplified summary:

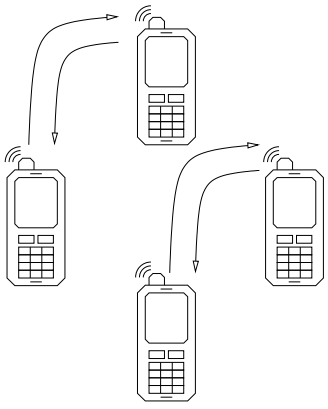
Elastic (TCP)

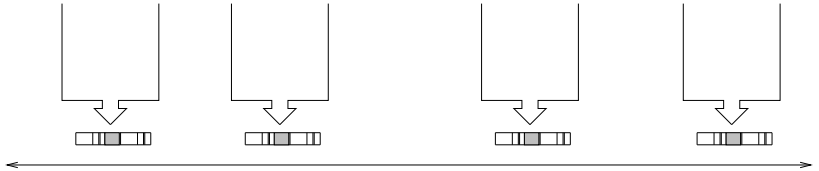
- Self-regulating sending rate.
- Congestion window halves when packet loss is detected.
- Reliable (end-to-end acknowledgements and retransmissions).
- Used when errors are unacceptable (e.g. file transfer)

Rigid (UDP)

- Not regulates sending rate.
- Oblivious to packet loss.
- Unreliable.
- Used when delay/jitter is to be minimized (Multimedia communications).

Single-Hop Ad-Hoc VoIP Networks

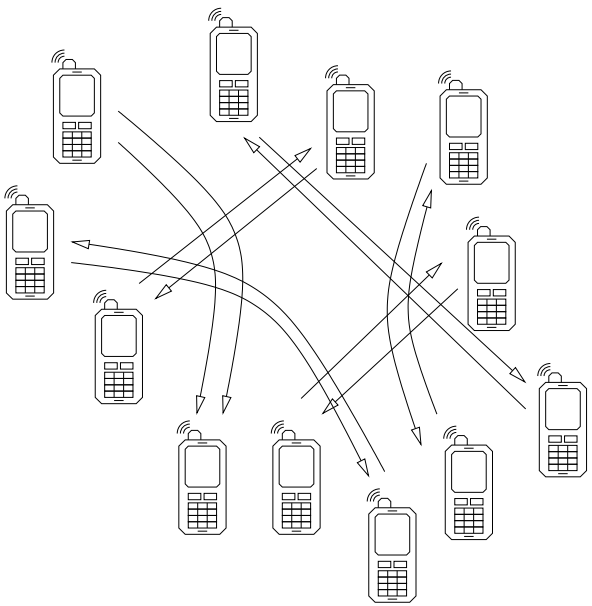


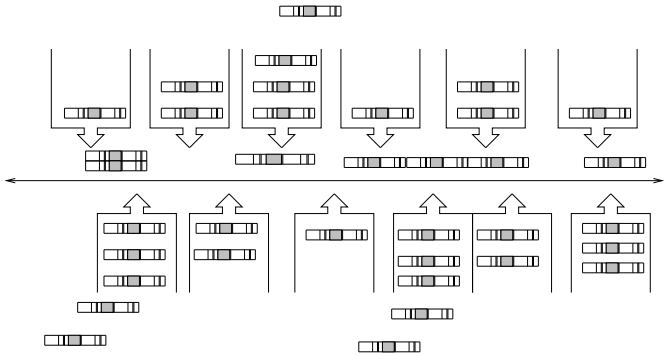


Limited number of stations

- No collisions.
- MAC queues empty.
- No packet loss. Limited delay/jitter.
- The maximum number of flows before congestion appear depends on: codec, packetization interval, data rates.

Crowded Single-Hop Ad-Hoc VoIP Networks



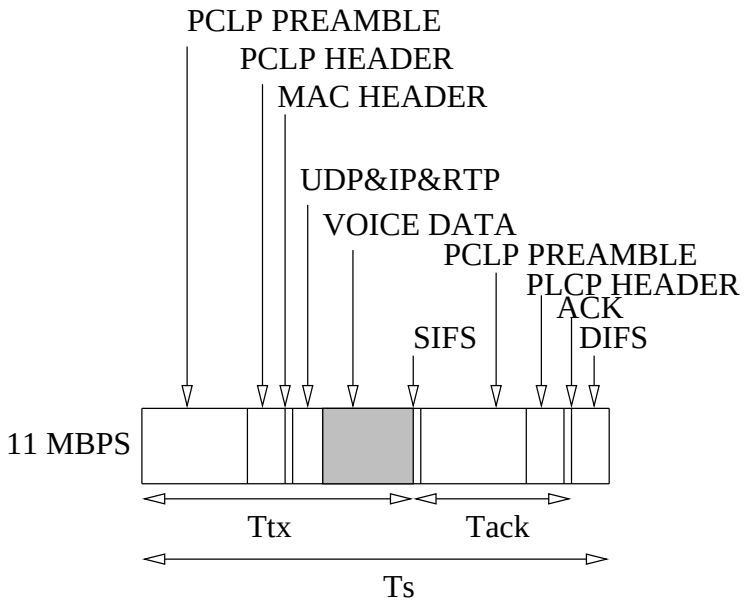


Large number of stations

- Collisions and retransmissions.
- MAC queues full.
- Packet loss. Significant delay/jitter.
- Automatic Rate Fallback: slower transmissions and longer packets.

Outline

Shortening the voice packet



Reduce the size of the packets

- Compress headers? Limited gain .
- Get rid of ACKS!.

Consequences of Ack Suppression

- Pros
  - Congestion is alleviated due to
    - shorter packets.
  - Less delay.
  - Less jitter.
  - Less packet loss.
  - More simultaneous calls.
- Secondary effects
  - Packets cannot be retransmitted.
    But remember: Retransmission would aggravate the congestion.
  - Lack of feedback prevents data rate fallback.
    But remember: Low data rates would aggravate the congestion.

Consequences of Ack Suppression

- Pros
  - Congestion is alleviated due to
    - shorter packets.
    - lack of retransmissions.
    - higher data rates.
  - Less delay.
  - Less jitter.
  - Less packet loss.
  - More simultaneous calls.

IEEE 802.11e

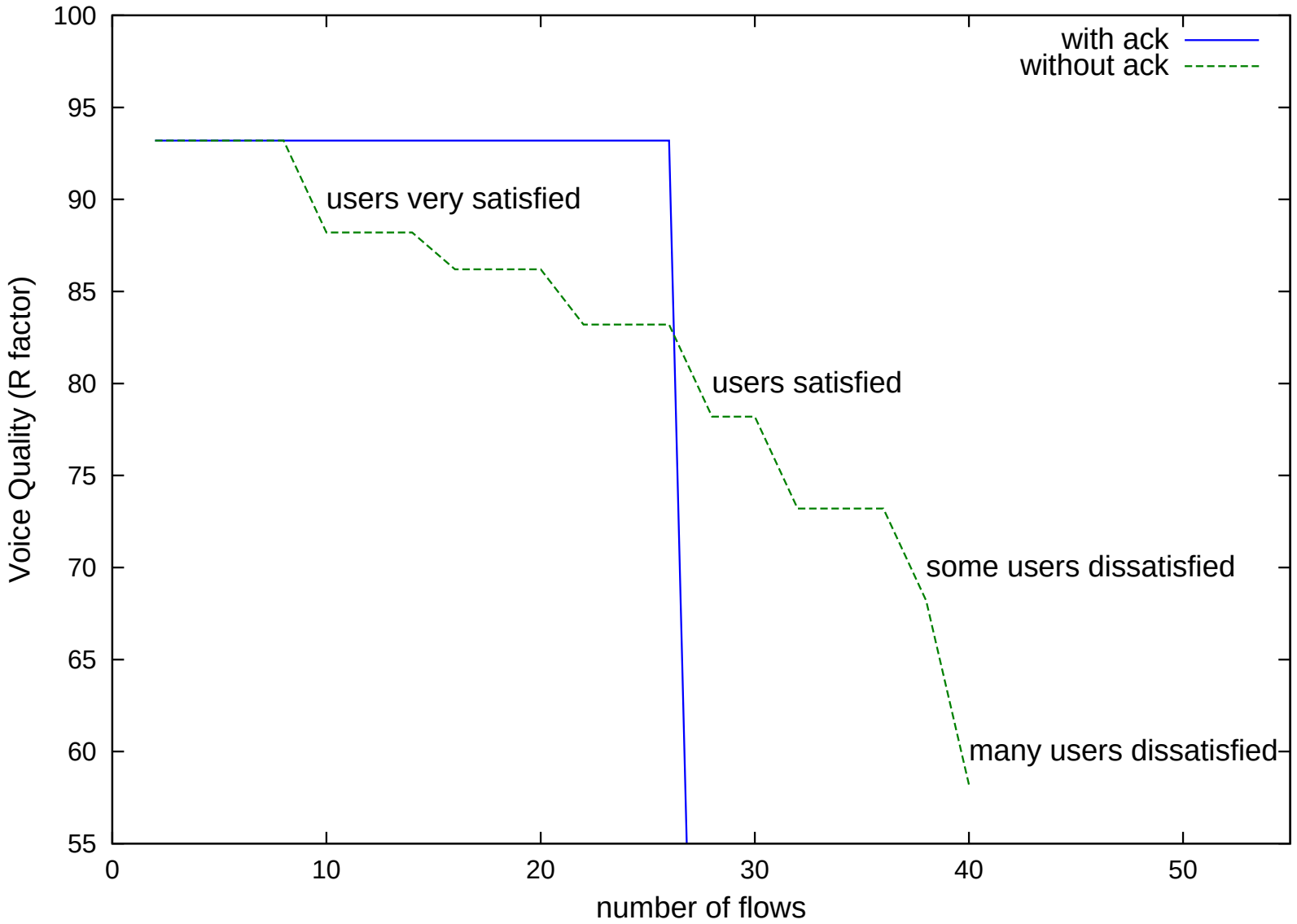
- The suppression of Acks is a feature already included in IEEE 802.11e standard amendment for QoS.

Voice Quality Evaluation

- A model that computes:
  - packet loss and
  - maximum number of flows before congestion occurs.

- Then E-model is used to :
  - map network metrics to perceived voice quality.
  - obtain R-factor which represents subjective voice quality (a value between 0 and 100).

Voice Quality



Outline

Implementation Issues

- Switch to No Ack policy at the first symptom of congestion.
- The mechanism must be implemented in a distributed fashion.

Implementation

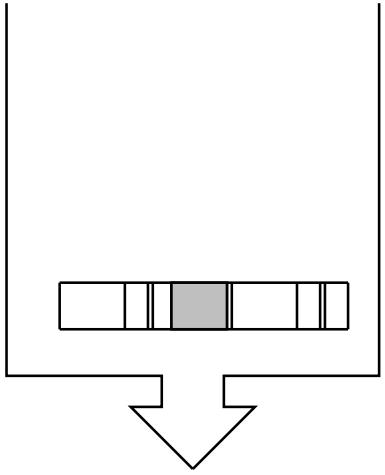
- Continuously monitoring real-time MAC queues.
- Switch to *No Ack policy* as soon as two packets are present in the queue.

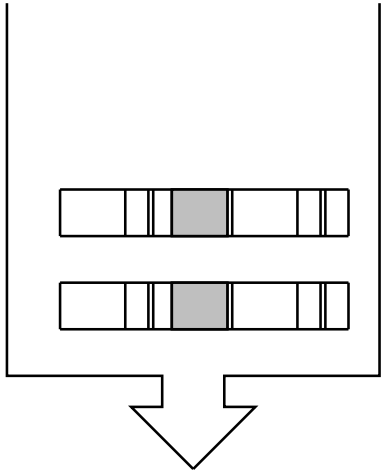
Standard Support for No Ack

IEEE 802.11e Table 3c - Ack Policy subfield in QoS Control field of QoS data frames

Bits in QoS Control field	Meaning
0 0	Normal Ack
1 0	No Ack
0 1	No explicit acknowledgement
1 1	Block Ack

Distributed Implementation





Ack

- to guarantee correct reception.

No Ack

- to alleviate congestion.

Summary

- No Ack is useful to prevent call drop in congestion-limited scenarios.
- The voice quality is degraded.
- The policy switch can be implemented in a simple and distributed fashion.

Thank you for your attention.