Distributed access procedures for supporting real-time traffic: Blackburst

Motivation

- Wish to support real-time applications with QoS guarantees, e.g., voice, video
- Basic access method - CSMA/CA
  - Does not provide QoS guarantees
- Centralized access method - polling
  - Cannot operate simultaneously in adjacent cells
  - Requires an access point

Requirements

- Three interframe spacings, as in the IEEE 802.11 standard
  - T_{SHORT} - acknowledgment minipackets
  - T_{MED} - real-time (RT) stations
  - T_{LONG} - data stations
- Sensing capabilities, as in CSMA/CA
- Ability of RT stations to send *black bursts*

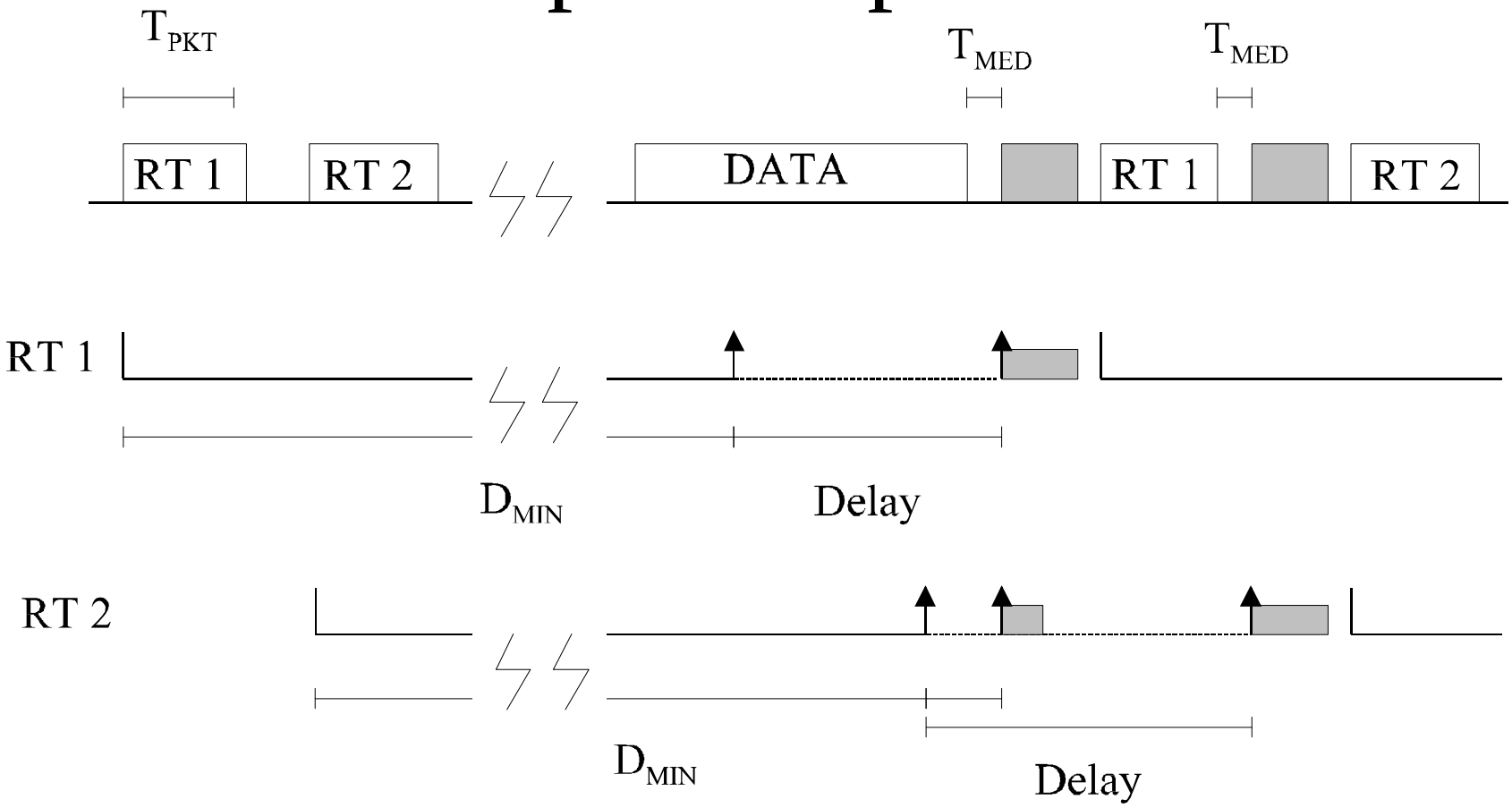
Basic operation

- RT station has an access instant
  - Transmits for at least T_{PKT} s.
  - Schedules the next access instant to D_{MIN} s. in the future
- RT station has a scheduled access instant
  - If channel has been idle for T_{MED} s., it transmits
  - Otherwise, waits until channel has been idle for T_{MED} s. and enters into black burst contention

Black burst contention

- Length of black burst is proportional to delay in accessing the channel
- Access instants of distinct stations differ by at least T_{PKT} ⇨ black bursts differ by at least a black slot
- Unique winner after a black burst contention period - the station that has been waiting the longest

Example of operation



Negative Acknowledgment

- Upon reception of an RT packet, a receiver knows when to expect the next packet
- Possibility of using a negative acknowledgment scheme
  - Reduced overhead
  - Robustness against hidden stations (implied RTS scheme)

Properties

- Compatible with IEEE 802.11
- RT traffic has priority over data traffic
- RT stations access the channel in round-robin order
- RT packets are not subject to collisions
- Supports RT stations with distinct bandwidth requirements
- Robust against hidden stations

Voice over 802.11 DS - Performance

2 Mbps 802.11 DS

Average data packet delay = 10 ms

Data Load = 22%

# of voice stations @ 64 Kbps = 14

@ 32 Kbps = 21

Data load = 41%

# of voice stations @ 64 Kbps = 8

@ 32 Kbps = 12

Publications on Blackburst

- João L. Sobrinho and A.S.Krishnakumar, Real-Time Traffic over the IEEE 802.11 Medium Access Control Layer, Bell Labs Technical Journal, Autumn 1996
- João L. Sobrinho and A.S.Krishnakumar, Quality-of-Service in Ad Hoc Carrier Sense Multiple Access Wireless Networks, IEEE Journal on Selected Areas in Communications, Vol. 17, No. 8, August 1999