

RT-WiFi: High-Speed Real-Time Communication Platform for Cyber- Physical Systems

Slides by:

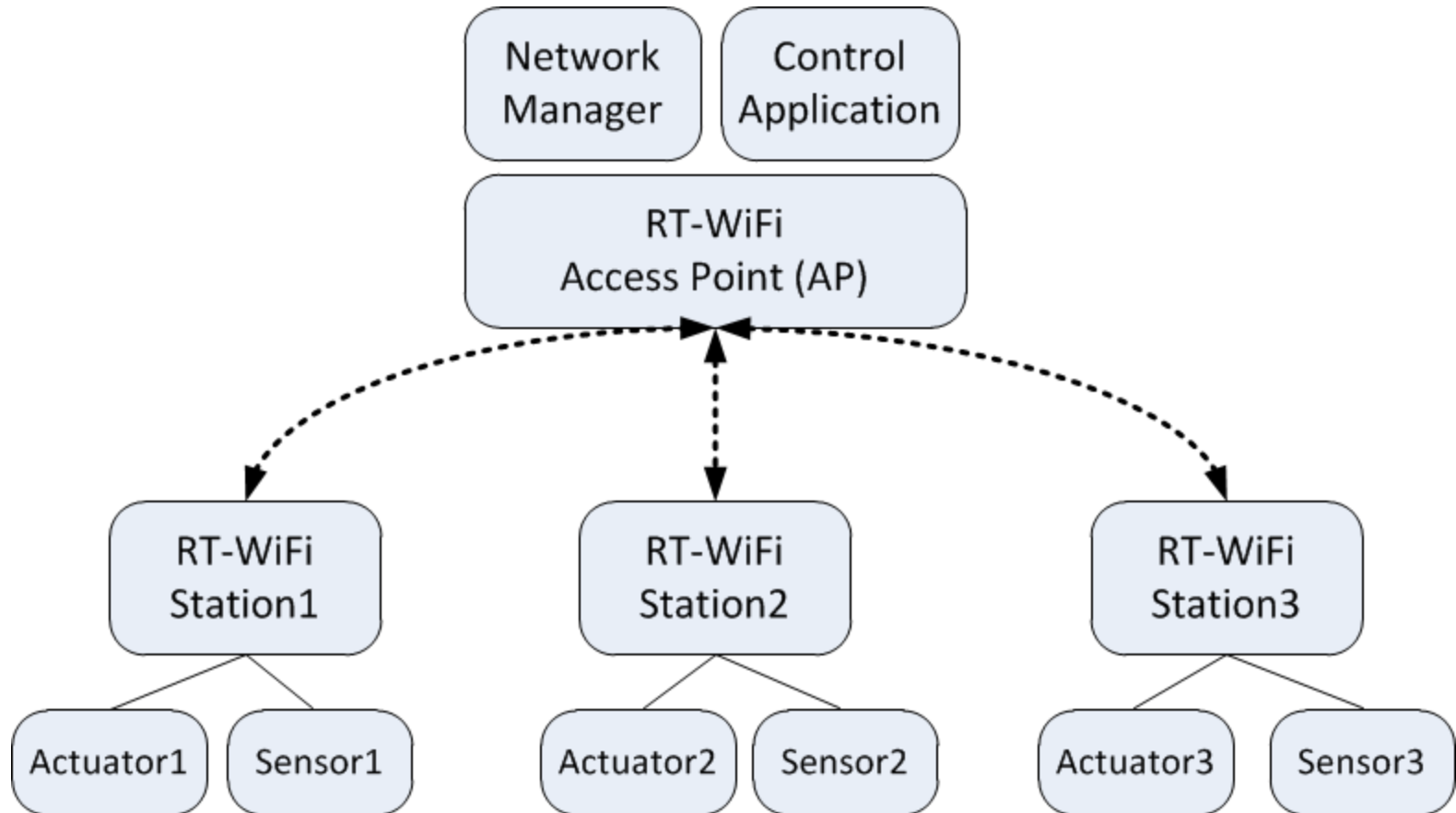
Prof. Dr. Song Han

Computer Science & Engineering Department
University of Connecticut

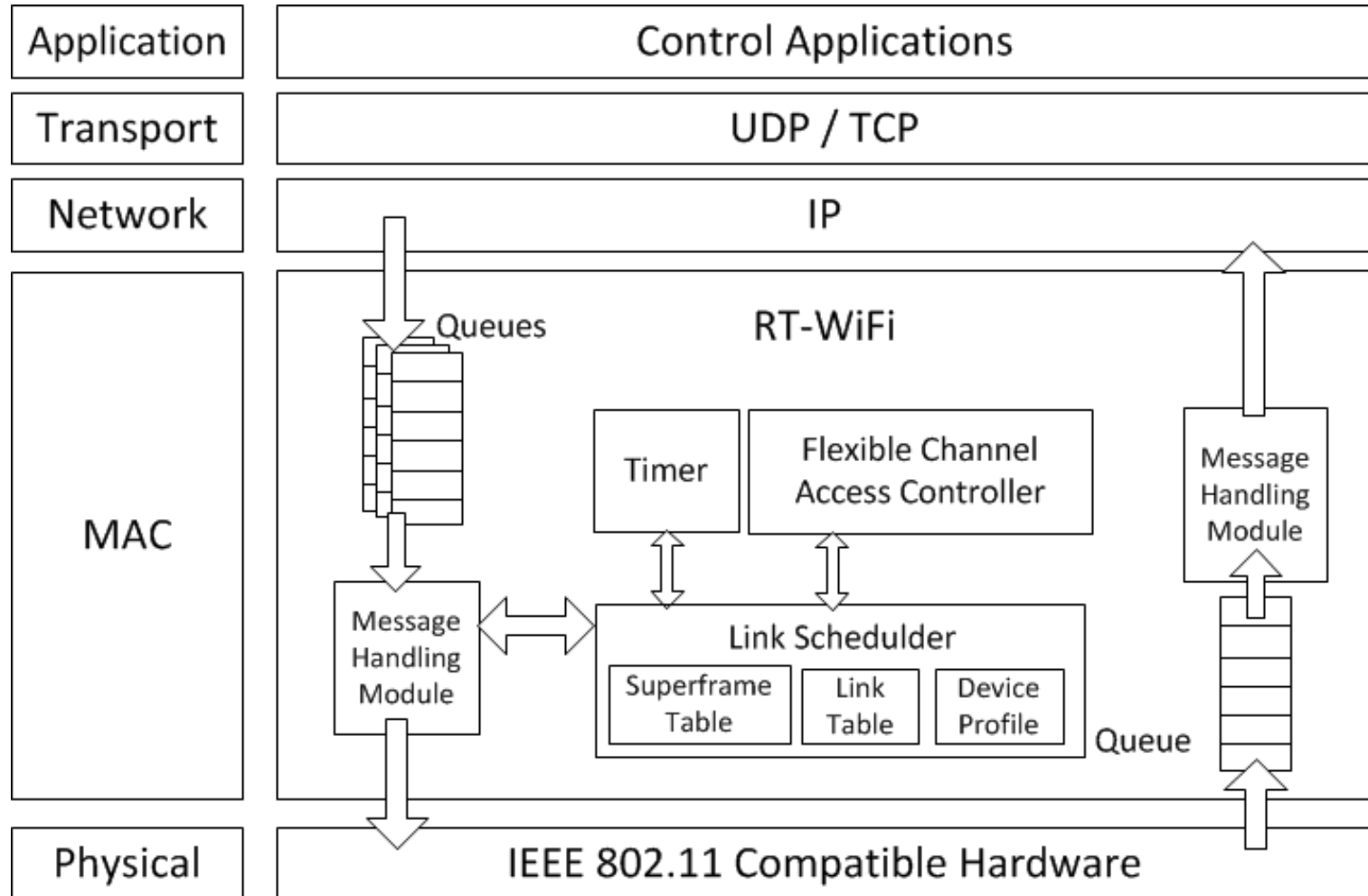
RT-WiFi Design Goals

1. Real-Time Data Delivery and High Sampling Rate
 - Aim to provide at least 1 kHz sampling rate
 - minimum requirement for many mechanical control systems
2. Flexible Configuration
 - Configurable parameters: sampling rate, predictability of real-time data delivery, reliability, co-existence with regular WiFi networks
3. Transparent System Design
 - Use commercial-off-the-shelf network card
 - Transparent to upper layer protocols

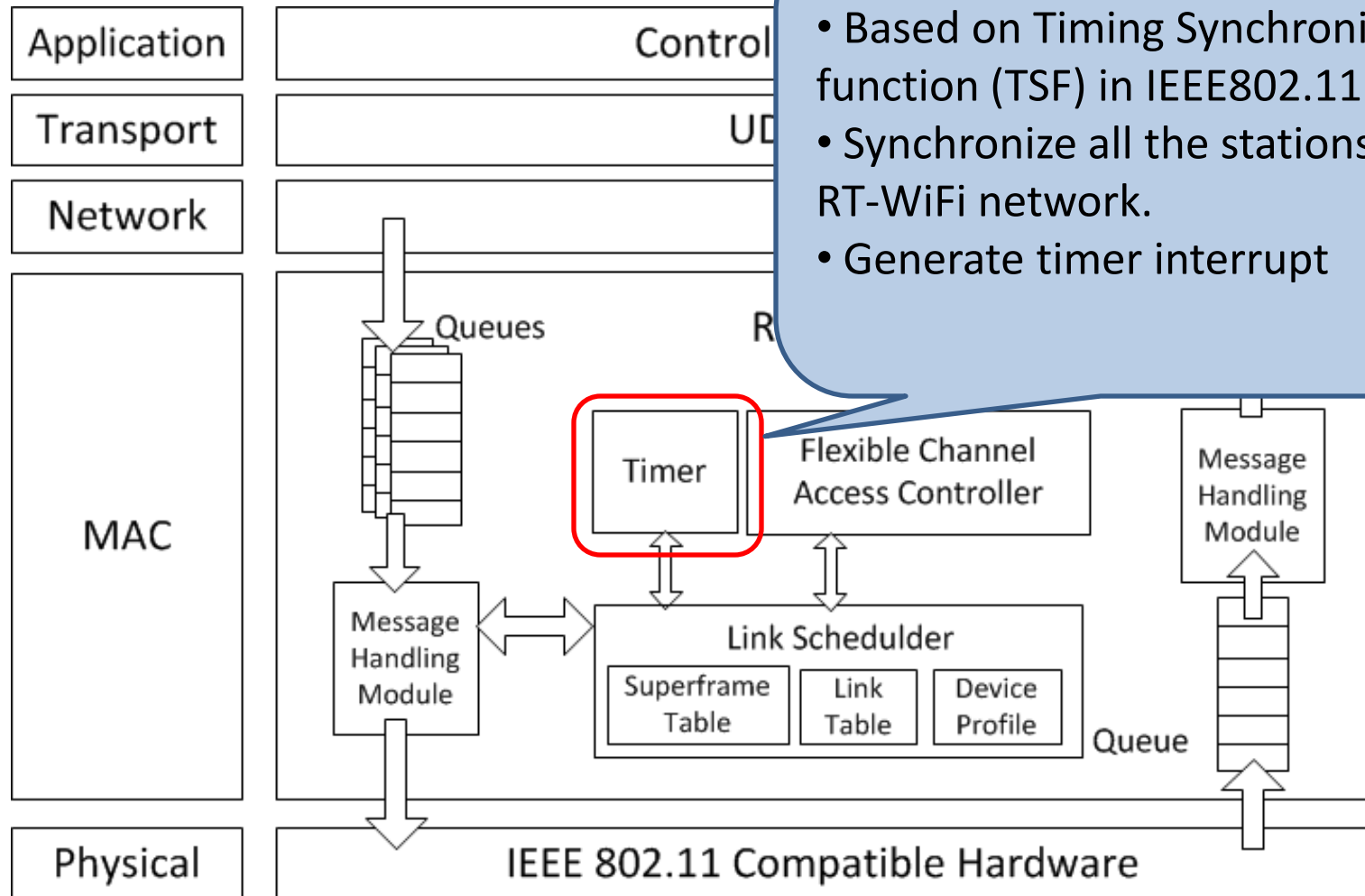
Overview of a Control System using RT-WiFi Network



Architecture of RT-WiFi Protocol



Architecture of RT-WiFi Protocol

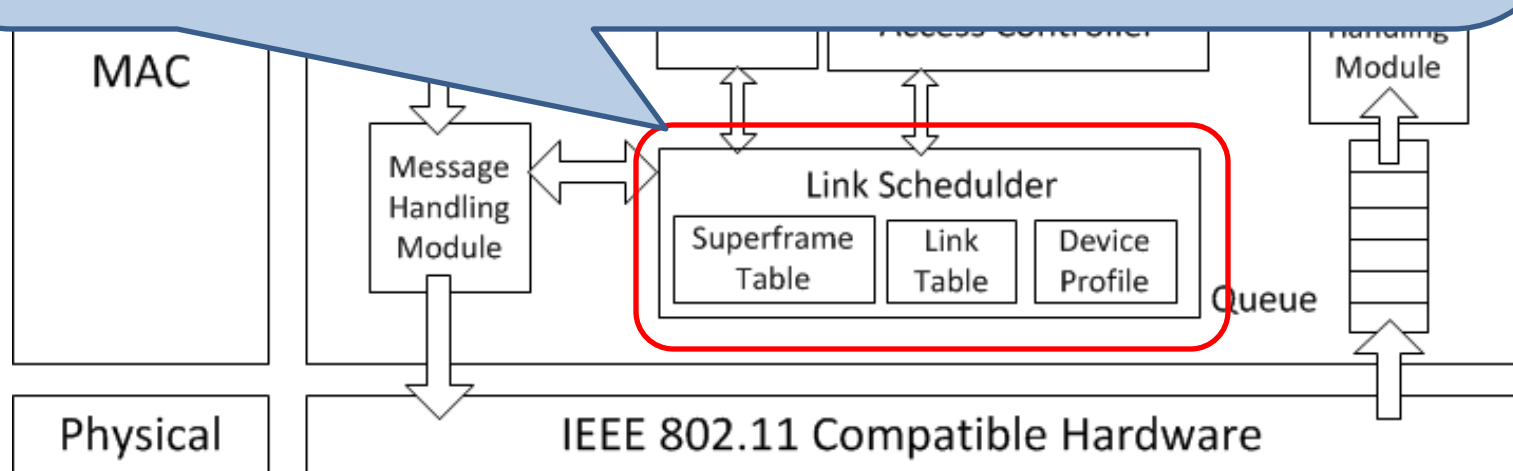


- Based on Timing Synchronization function (TSF) in IEEE802.11
- Synchronize all the stations in the RT-WiFi network.
- Generate timer interrupt

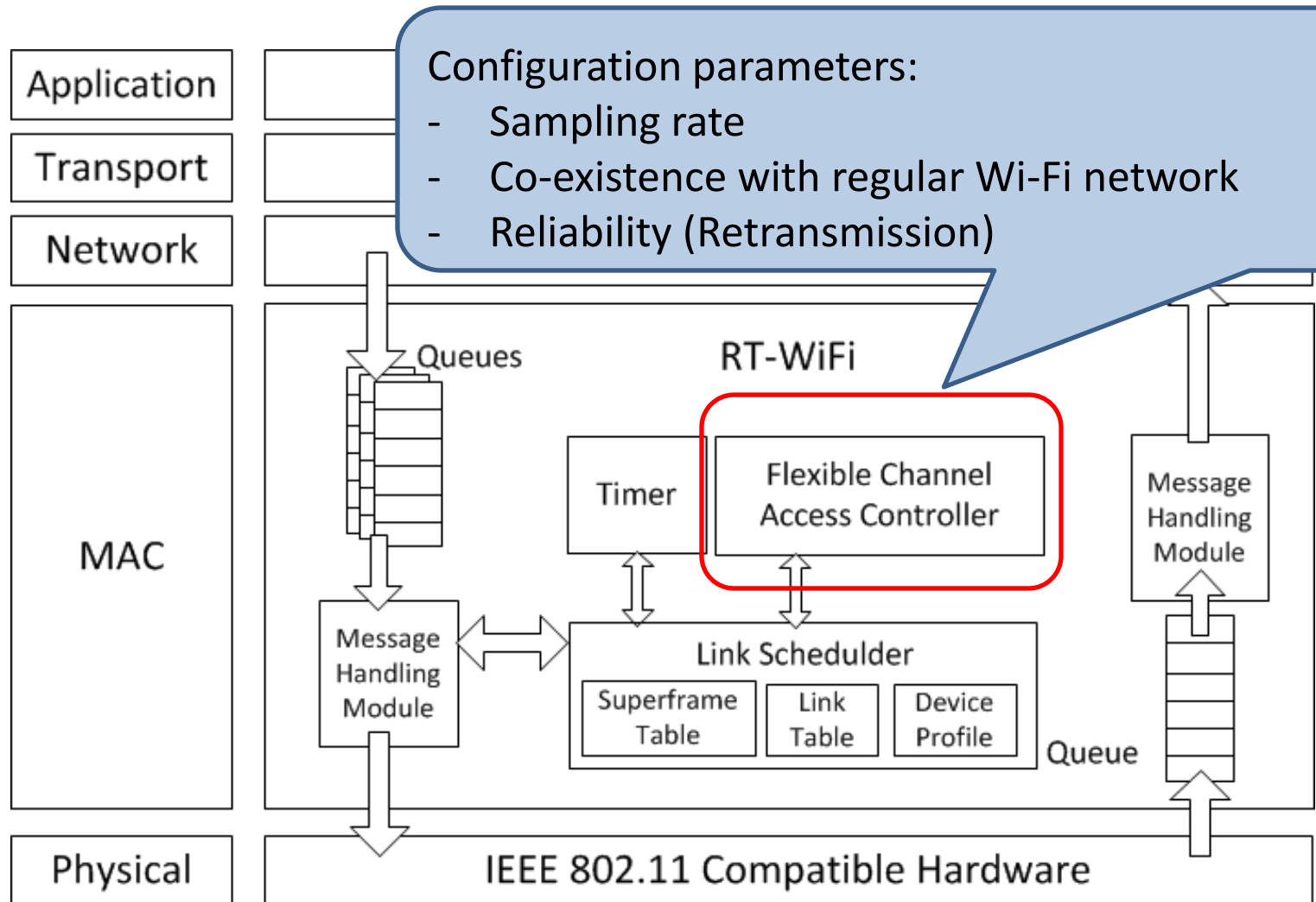
System Architecture of DT WiFi Protocol

- Coordinate channel access among the stations
- Link: Broadcast link, transmit link, receive link, shared link
- Superframe:

Slot 0	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7
AP Broadcast	Shared	STA1 ↓ AP	AP ↓ STA1	STA2 ↓ AP	AP ↓ STA2	STA3 ↓ AP	AP ↓ STA3

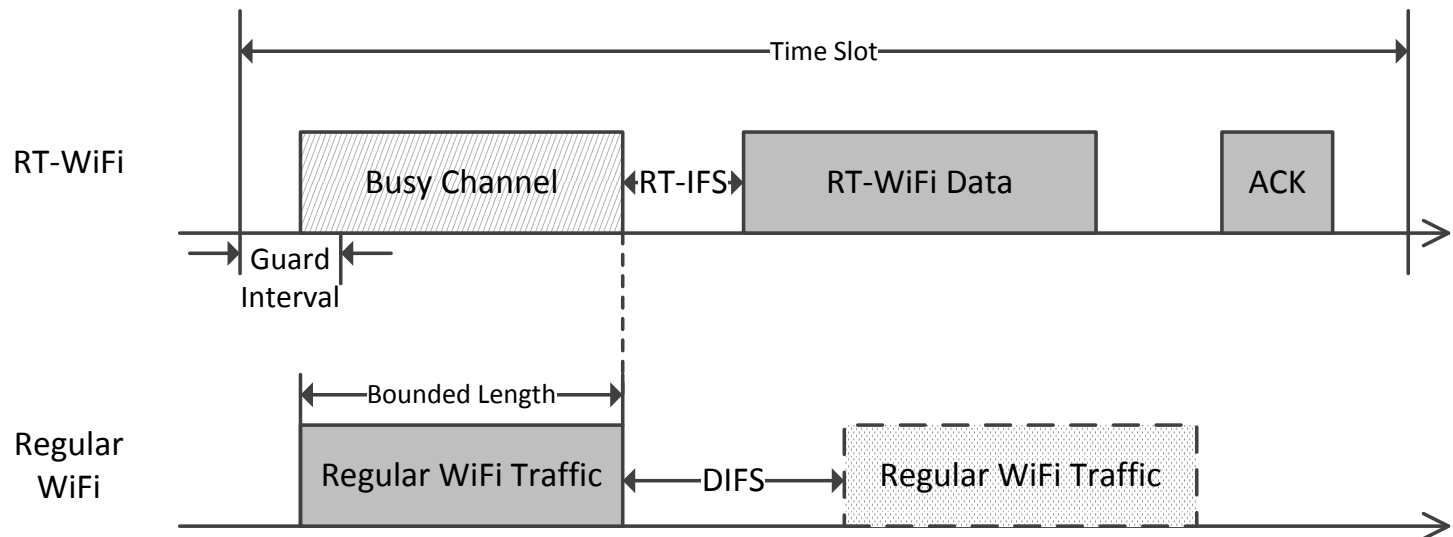


System Architecture of RT-WiFi Protocol



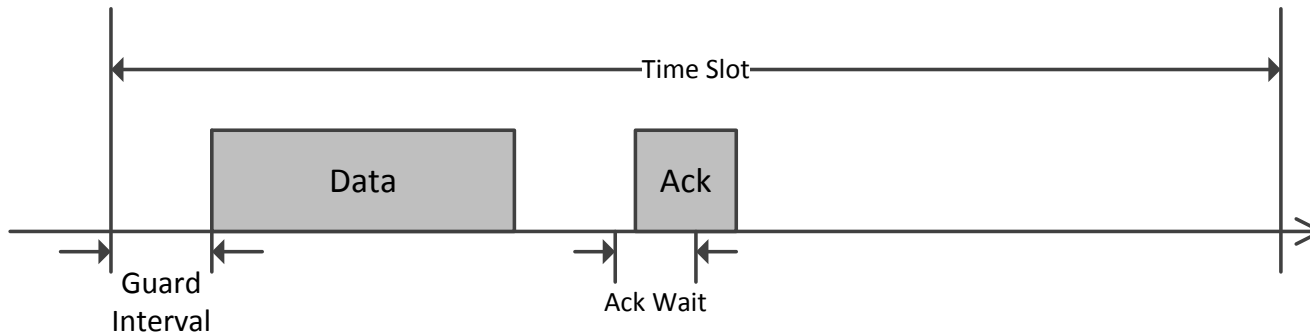
Enabling Co-existence with Regular WiFi

1. Assume bounded length for regular WiFi data frames to ensure bounded latency
 - Limit maximum transmission unit to at most some upper bound
 - Limit lowest data rate to at least some lower bound
2. For RT-WiFi:
 - Enable carrier sense
 - Use shorter interframe space (IFS)

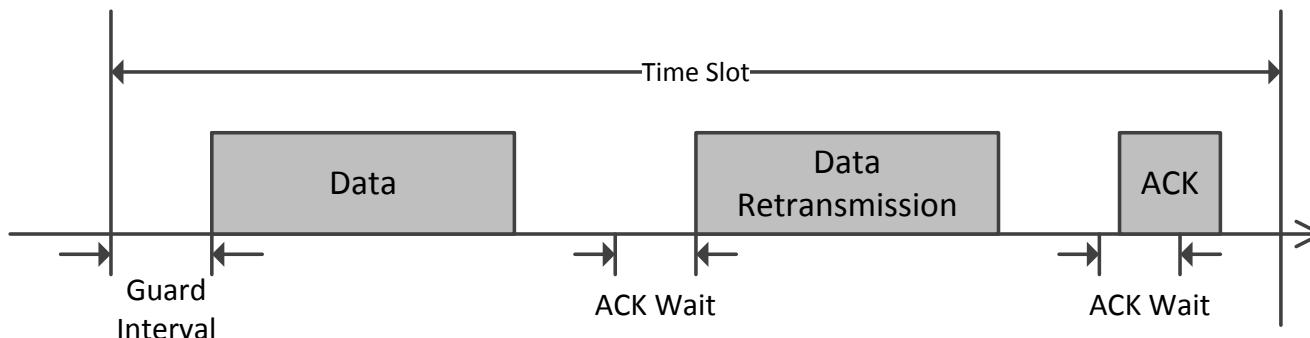


How to Increase Reliability in TDMA?

- Retransmission
 - In-slot retransmission
 - Out-of-slot retransmission



(a) Regular time slot



(b) Time slot with in-slot retransmission