Wi-Fi & Bluetooth

Wi-Fi DCF & CSMA/CA

Wi-Fi DCF & CSMA/CA

❖ Wi-Fi Operations

- Wi-Fi standards use the DCF (Distributed Coordination Function) technique that employs CSMA/CA (Carrier-Sense Multiple Access with Collision Avoidance) networking

- Role of DCF & CSMA/CA
  - Used to avoid communication failure due to packet collision
  - Required because the unlicensed ISM band is used

Wi-Fi DCF & CSMA/CA

❖ Wi-Fi Operations

- CSMA/CA
  - Carrier Sense
    - To avoid communication failure (due to packets colliding), each node listens to the shared medium (i.e., 2.4 & 5 GHz wireless channel) to detect whether another node is communicating or not
  - Collision Avoidance
    - If another node's communication is detected, other nodes will not transmit for a specific period of time (NAV period)

Wi-Fi DCF & CSMA/CA

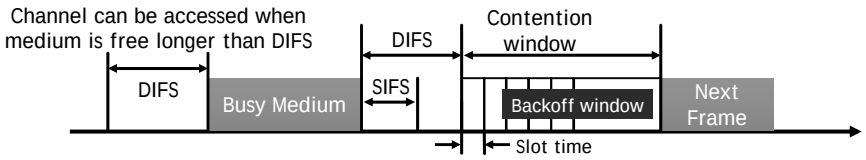
❖ Wi-Fi Operations

- CSMA/CA (DCF)
  - NAV (Network Allocation Vector)
    - Period of time to wait for another node to complete packet communications
  - RTS (Request To Send) / CTS (Clear To Send)
    - RTS/CTS enables the fine-tune of WLAN operations (a solution to the Hidden Node problem)
    - Communication is requested using a RTS frame
    - CTS frame is used to accept the communication request

Wi-Fi DCF & CSMA/CA

❖ Wi-Fi Operations

- IFS (Inter-Frame Space) Priority
  - Control priority using inter-frame space durations



  - SIFS (Short IFS): For immediate response action
    - Between RTS, CTS, and Data time duration
  - DIFS (DCF IFS): Minimum medium idle time for contention-based services

Wi-Fi DCF & CSMA/CA

❖ Wi-Fi Operations

- IFS (Inter-Frame Space) Priority
  - Stations use SIFS to maintain the highest priority of channel usage during its transmission opportunity (because it is the shortest duration)
  - DIFS = SIFS + (2 x Slot time)

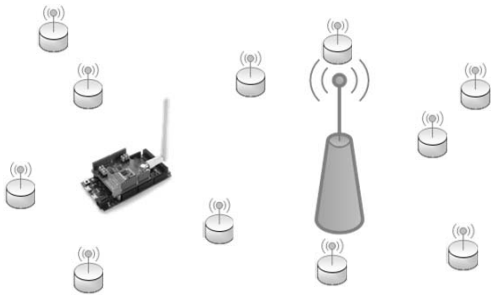
Standard	Slot time (μs)	SIFS (μs)	DIFS (μs)
IEEE 802.11a	9	16	34
IEEE 802.11b	20	10	50
IEEE 802.11g	9 or 20	10	28 or 50
IEEE 802.11n (2.4 GHz)	9 or 20	10	28 or 50

Wi-Fi DCF & CSMA/CA

❖ Wi-Fi

- CSMA/CA & RTS/CTS

T = 0

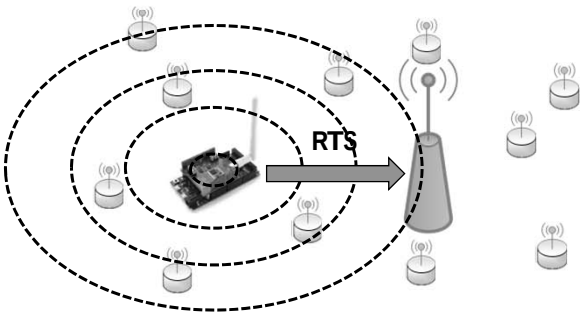


Wi-Fi DCF & CSMA/CA

❖ Wi-Fi

- CSMA/CA & RTS/CTS

T = DIFS

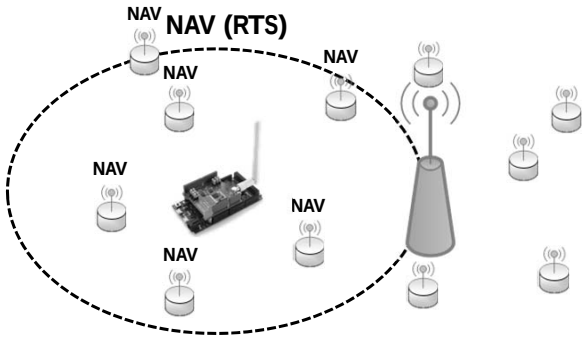


Wi-Fi DCF & CSMA/CA

❖ Wi-Fi

- CSMA/CA & RTS/CTS

$T = DIFS + T_{RTS}$

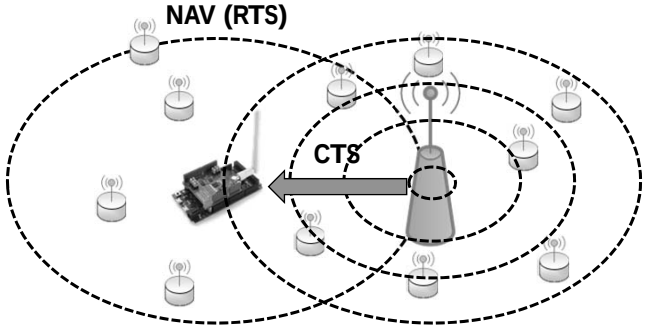


Wi-Fi DCF & CSMA/CA

❖ Wi-Fi

- CSMA/CA & RTS/CTS

$T = DIFS + T_{RTS} + SIFS$



Wi-Fi DCF & CSMA/CA

❖ Wi-Fi

- CSMA/CA & RTS/CTS

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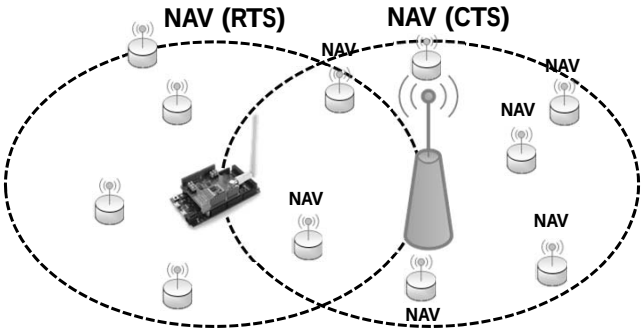

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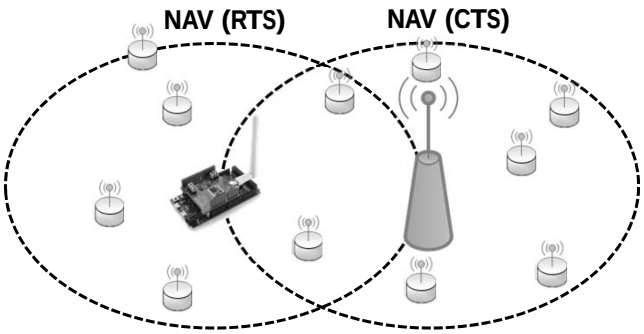

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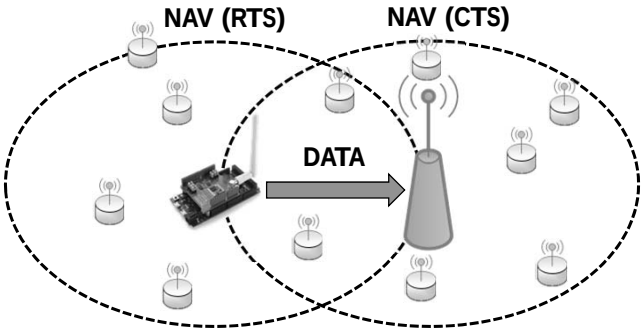

Wi-Fi DCF & CSMA/CA

❖ Wi-Fi

- CSMA/CA & RTS/CTS

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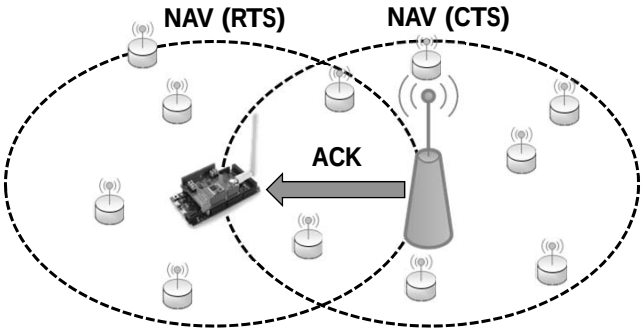
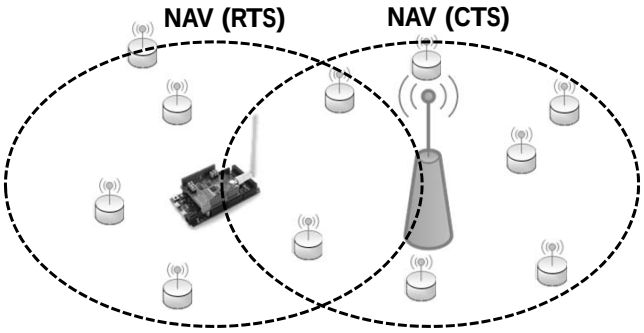


Wi-Fi DCF & CSMA/CA

❖ Wi-Fi

- CSMA/CA & RTS/CTS

$T = DIFS + T_{RTS} + SIFS + T_{CTS} + SIFS + T_{DATA} + SIFS + T_{ACK} + DIFS$
$T' = 0$



Wi-Fi DCF & CSMA/CA

❖ Wi-Fi

- CSMA/CA & RTS/CTS

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Wi-Fi DCF & CSMA/CA

❖ Wi-Fi

- CSMA/CA & RTS/CTS

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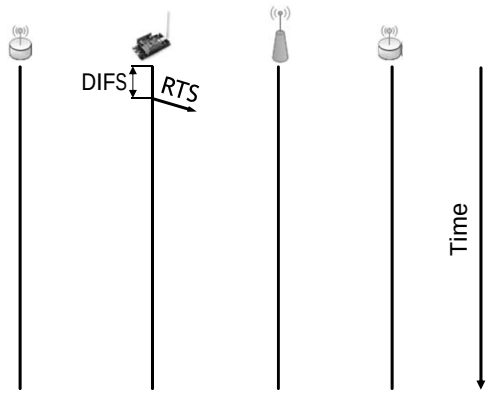

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- CSMA/CA & RTS/CTS

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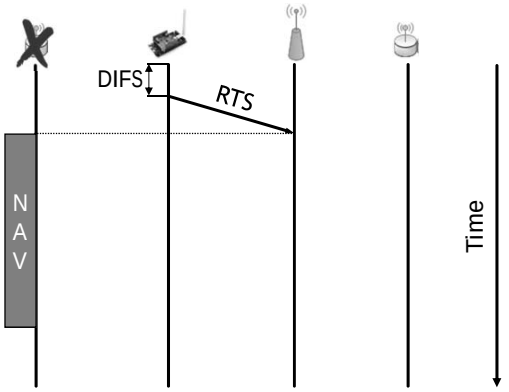

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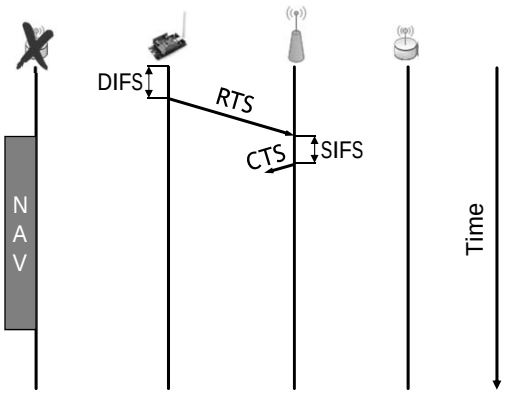

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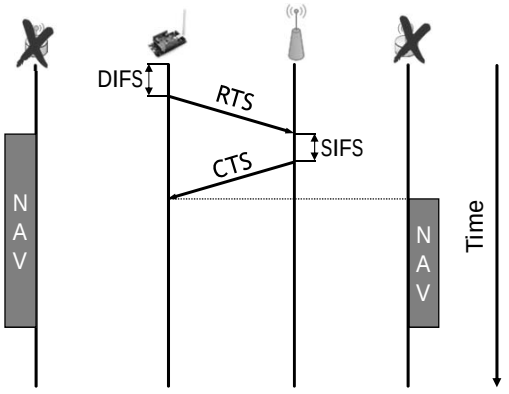

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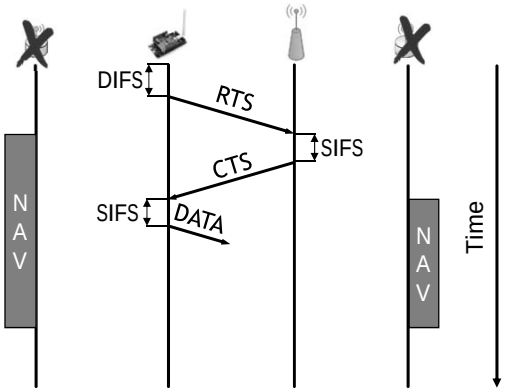

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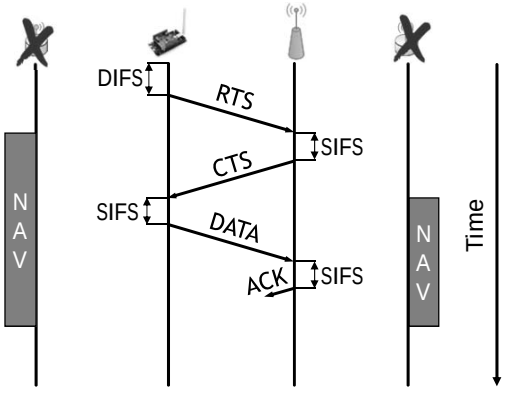

Wi-Fi DCF & CSMA/CA

❖ **Wi-Fi**

- CSMA/CA & RTS/CTS

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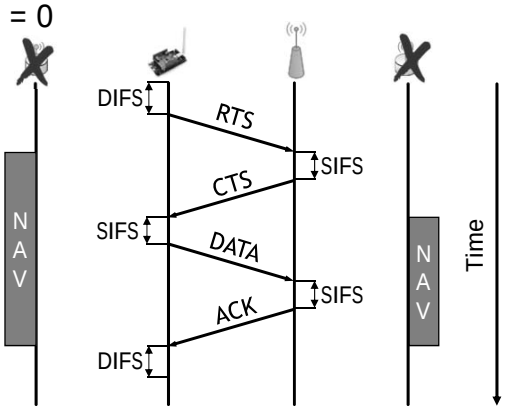

Wi-Fi & Bluetooth

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