RSFS Report 1 (IEEE 802.11 Standards, DCF, PCF)

Author: Diogo Fonseca
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IEEE 802.11 Standards

IEEE 802.11 standards specify the set of MAC and physical layer protocols for implementing WLAN (Wireless Local Area Network) for computer communication. These standards are created and maintained by IEEE (Institute of Electrical and Electronics Engineers), more specifically, the LAN/MAN Standards Commitee (IEEE 802).

The 802.11 protocol family emplys CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance) where stations listen to a channel to check if it's idle before transmitting each frame.

Generation	IEEE standard	Adoption	Link rate (Mbits/s)	~Range (indoor)	~Range (outdoor)	2.4 Ghz	5 Ghz	6 Ghz
-	**802.11b**	1999	1-11	35m	140m	✓		
-	**802.11a**	1999	6-54	35m	120m		✓	
-	**802.11g**	2003	6-54	38m	140m	✓		
Wi-Fi 4	**802.11n**	2009	6.5-600	70m	250m	✓	✓	
Wi-Fi 5	**802.11ac**	2013	6.5-6933	35m	120m		✓	
Wi-Fi 6/6E	**802.11ax**	2021	0.4-9608	30m	120m	✓	✓	✓
Wi-Fi 7	**802.11be**	2024	0.4-23059	30m	120m	✓	✓	✓

DCF – Distributed Coordination Function

DCF, or Distributed Coordination Function, is defined in the IEEE 802.11 WLAN standard. This is a mechanism for implementing CSMA/CA (Carrier Sense Multiple

Access with Collision Avoidance) in Wireless networks. Carrier sense refers to a station's ability to detect whether the wireless medium is currently occupied by another station or if it's free for transmission.

DCF allows multiple stations to communicate without centralized control, it can be used both in ad-hoc and in infrastructure network types. Each station checks the medium before transmitting, transmitting only when the medium is idle. If the medium is busy, stations defer transmission and use a simple exponential back-off algorithm to avoid collisions.

Stations also emply a random backoff procedure after each frame transmission. The station that wins the backoff seizes the channel. In specific situations, DCF may also utilize the CTS/RTS (Clear To Send/Request To Send) clearing technique to further decrease the chances of collisions.

Transmissions in the DCF concept have two main rules:

- A transmission can be initiated if the medium has been idle for a greater period than the DIFS (Distributed interframe Space) period. The medium is considered free for at least the duration of DIFS if the previous frame was received without errors. If errors occurred during the previous frame reception, however, the medium must be free for a duration equal to EIFS (Extended Interframe Space).
- If the medium is occupied, the station must wait until the channel becomes free or idle. This waiting period is called "access deferral" in IEEE 802.11. The station then waits for the medium to be free for the duration of DIFS and sequentially prepares for the exponential backoff (waits for a random amount of time that isn't too long).

PCF – Point Coordination Function

PCF, or Point Coordination Function is utilized to ensure contention-free access to the medium (no "fighting" between stations). Point coordinators reside within access points, meaning that PCF is centralized and as such can only be used in infrastructure networks. To gain priority over standard contention-based services, PCF allows stations to transmit frames after a shorter interval.

PCF isn't as widely used as DCF, however the IEEE designed PCF to ensure that stations that only implement DCF can still interoperate with point coordinators.

Contention-free service isn't provided continuously. Instead, periods of contention-free service (arbitrated by the point coordinator) alternate with standard DCF-based service.

In PCF, the stations cannot transmit until they are explicitly polled by the point coordinator. This is why it's called contention-free (no collisions for polled stations). The polling process consists of sending a special poll frame to each station which gives both permission for that station to transmit (one data frame) and also an acknowledgement of previous data received from that station.

Bibliography

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