5G challenges in shared spectrum

Unlicensed band - ISM (NII 5GHz) band

Spectrum Sharing

- Situation

1. meeting growing spectrum demand is constrained by **lack of vacant spectrum**.
2. high price associated with re-allocating spectrum to new uses (cost, delays and the occasional need to **switch off incumbent users**).

- FCC policy

1. TVWS – shared band
2. 2.4GHz & 5GHz ISM unlicensed band
3. 3550-3650GHz - Enabling Innovative Small Cell

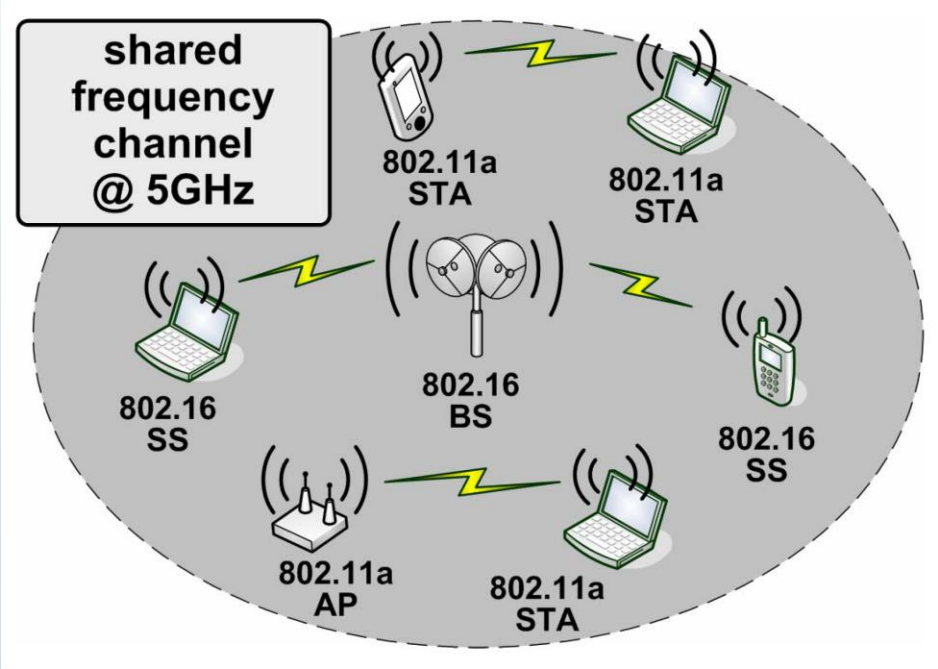
Features in shared band

Incumbents

- Licensed User
- DoD(department of defense) radar
- FSS(fixed satellite station)

Coexistence

- General Authorized Users



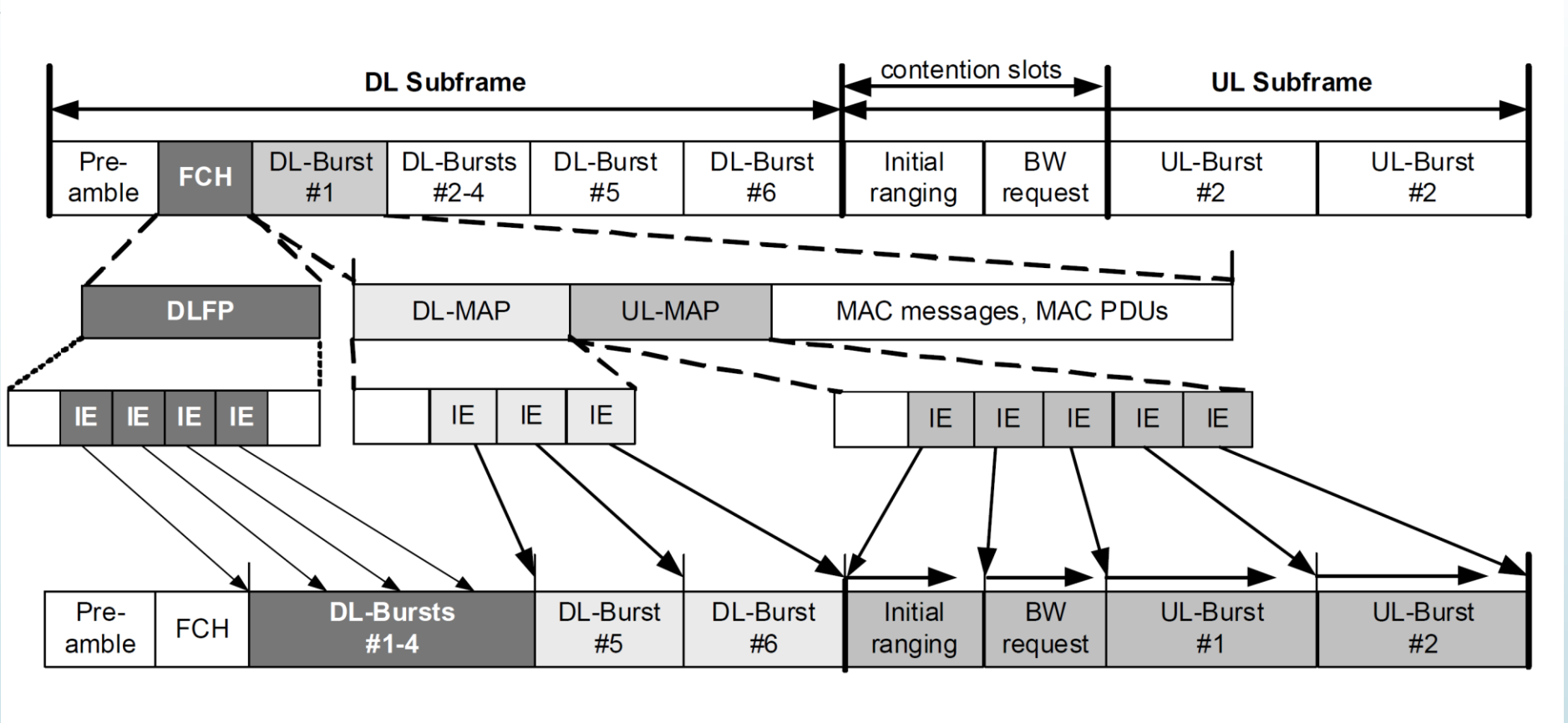
WiMax 802.16 , WiFi 802.11a

- OFDM based systems are very sensitive to symbol timing errors
- Different media access control.
- IEEE 802.16 has a centralized architecture provided by a central *Base Station* (BS) with associated *Subscriber Stations*(SS).
- 802.16 offers guaranteed multimedia QoS.

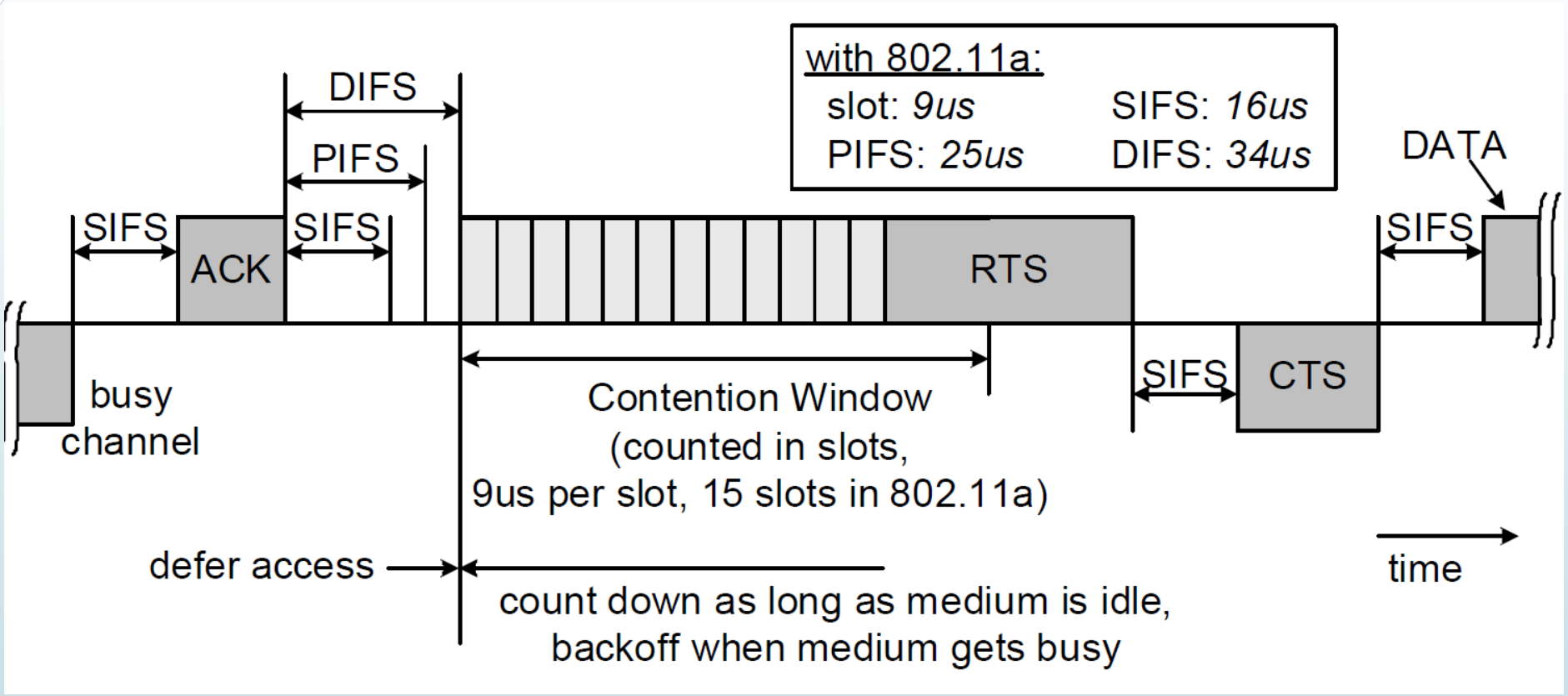
parameters

- 802.16 - Contention Slot Duration for BW Requests 2 Symbols 27.78 µs
- 802.16 - Contention Slot Duration for Initial Ranging 10 Symbols 138.9 µs
- 802.11 - DIFS length 34 µs, backoff slot 9 µs
- 802.11 – data package transmission 2 ms

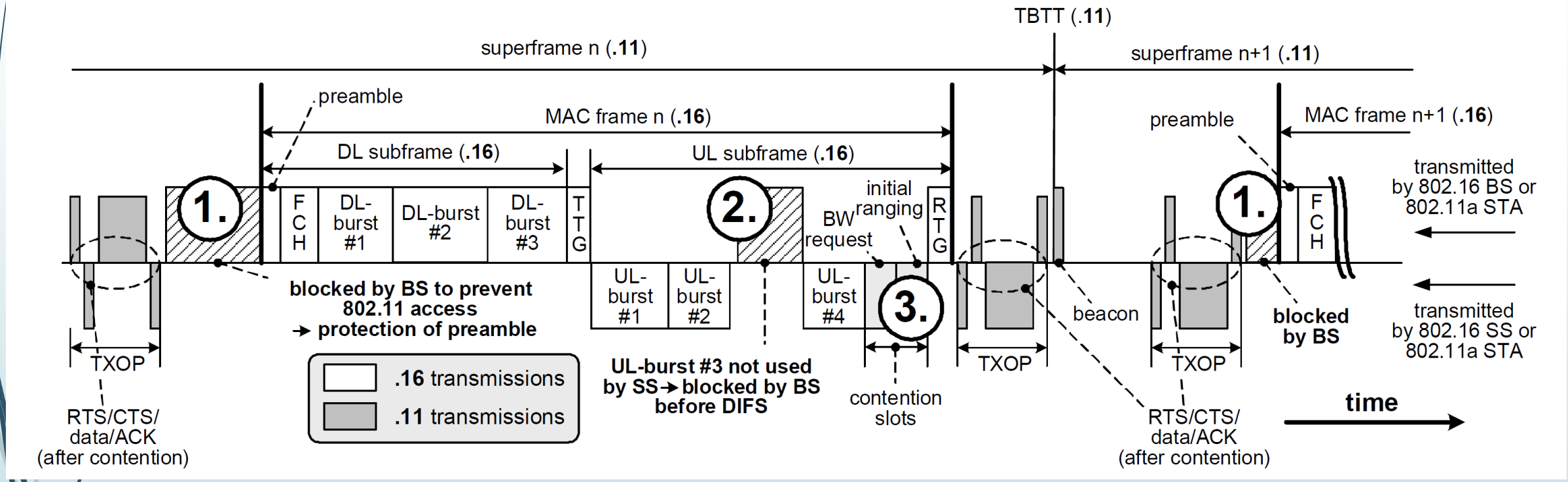
IEEE 802.16 MAC frame



IEEE 802.11 MAC frame



Collisions


TBTT (.11)
superframe n (.11)
superframe n+1 (.11)
preamble
MAC frame n (.16)
DL subframe (.16)
UL subframe (.16)
preamble
MAC frame n+1 (.16)
1.
FCH
DL-burst #1
DL-burst #2
DL-burst #3
TTG
2.
initial ranging
BW request
RTG
1.
FCH
transmitted by 802.16 BS or 802.11a STA
UL-burst #1
UL-burst #2
UL-burst #4
3.
blocked by BS to prevent 802.11 access → protection of preamble
beacon
blocked by BS
transmitted by 802.16 SS or 802.11a STA
TXOP
TXOP
TXOP
.16 transmissions
.11 transmissions
UL-burst #3 not used by SS → blocked by BS before DIFS
contention slots
time
RTS/CTS/ data/ACK (after contention)
RTS/CTS/ data/ACK (after contention)

Conclusion

- Guarantee of QoS in 802.16 takes extra mechanisms.
- Blocking 802.11(a) out of the medium is proposed in reference paper.
- From the perspective of 802.11a, the proposed method can be regarded as unfair.
- Better approach: Hybrid Coordinator