3GPP TSG RAN Meeting #101
Bangalore, India, Sep. 11-15, 2023
Agenda Item: 8A.2.13.5

RP-231975

Qualcomm

Views on scope for Broadcast / Multicast in Rel-19

Qualcomm Incorporated

Rel-19 Scope

- For Rel-19, we propose to have a small work item on necessary enhancements for 5G Broadcast (5GB) that are essential for its deployment.
  - In this document, 5G Broadcast refers to “LTE-based 5G Broadcast” as defined by 3GPP in Rel-16.

- The scope of the proposed enhancements is limited to coexistence with other broadcast systems (mainly ATSC 3.0) due to regulatory constraints, and standardizing one mechanism already discussed in Rel-16 (time-frequency interleavers).

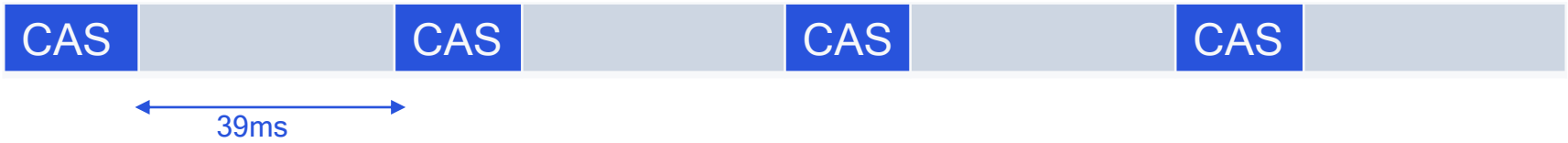
- The main proposals are:
  - **Proposal 1:** Standardize “**CAS muting**” for 5G Broadcast, i.e., the CAS can be dropped with some pattern that is known to the UE.
  - **Proposal 2:** Standardize **time-frequency interleavers** for 5G Broadcast, taking as baseline the mechanism in R1-1913439.

Background - Coexistence with other broadcast systems

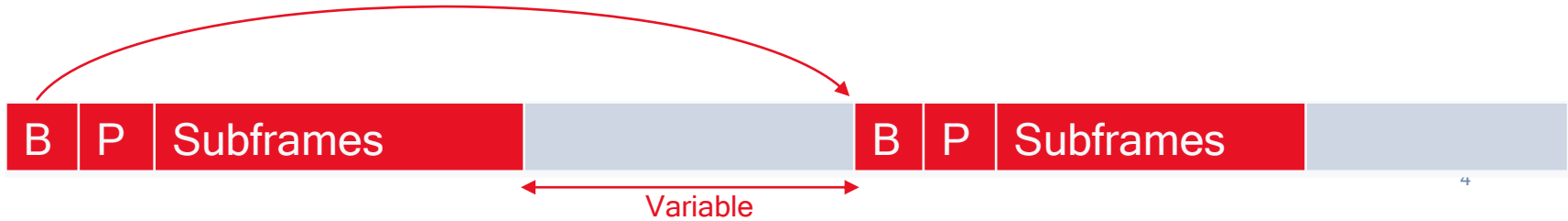
- Due to FCC regulation, US broadcasters shall broadcast one *free to air* stream using ATSC 3.0 in their allocated spectrum (6 MHz carrier).
- Outside of this mandatory stream, the rest of the radio resources can be used for any other purpose using any technology (“ancillary services”)
- Therefore, to enable 5G Broadcast deployments in the US under current regulation, both technologies may need to coexist in the same 6 MHz carrier.
  - The only feasible coexistence is by TDM

Background - Mechanisms for coexistence

- Both ATSC and 5GB implement basic mechanisms for coexistence / forward compatibility:
- **5G Broadcast:**
  - In 5GB, the only signal that is “always on” is the CAS, with a periodicity of 40ms.
  - The MBSFN subframes in between CAS can be signaled to belong to a given MBSFN area.
  - For subframes not belonging to any MBSFN area (or not scheduled), the UE cannot assume presence of any signal.
  - This mechanism was used in Rel-16 to introduce new numerologies, and in Rel-17 to introduce new PMCH bandwidth in a backward compatible way.



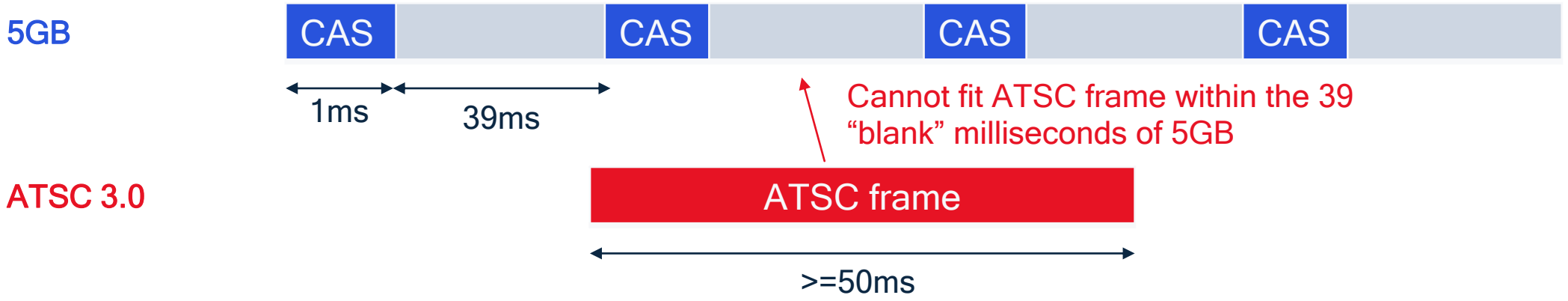
- **ATSC 3.0:**
  - In ATSC 3.0, forward compatibility is created by combining the “bootstrap” signal and limited frame length.
  - The bootstrap can be seen as a sync signal (with a common structure) that can be used for future technologies
    - A common bootstrap signal allows for the receiver to potentially search for two technologies with the same searcher hardware.
  - The preamble after the bootstrap signal indicates the length of the frame. The bootstrap signals the minimum gap to the next bootstrap (min_time_to_next)



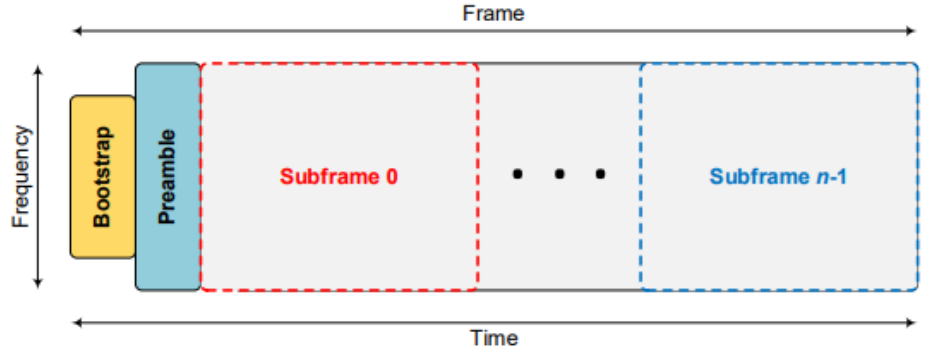
B: Bootstrap. P: Preamble

Limitations to coexistence

- Unfortunately, the approaches followed in both technologies are not compatible:
  - In 5GB, the CAS (1ms) is periodic with a 40ms periodicity.
  - In ATSC, there are no periodic signals, but every ATSC frame has a duration of at least 50ms.



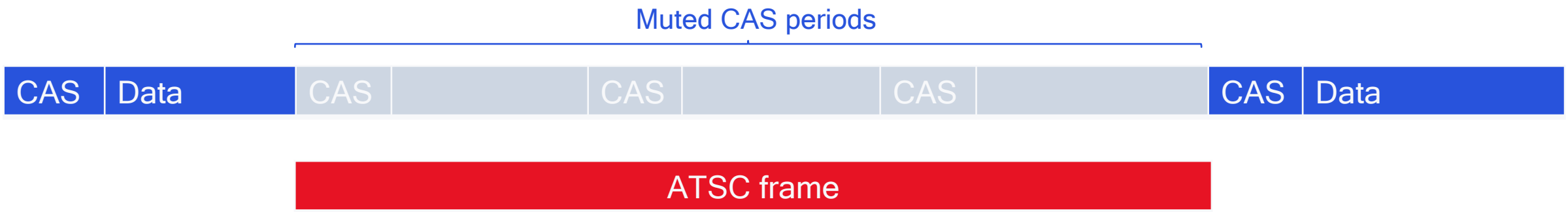
ATSC 3.0 frame structure (from A/322)



- "Bootstrap": ≥ 2 ms with configurable periodicity between 50 ms and 5 s
- "Preamble": ≥ 1.2 ms (assuming a single preamble OFDM symbol with shortest numerology)
- "Data subframes": ≥ 20 ms/subframe
- "Frame": ≥ 50ms

Proposal to enable clean coexistence

- **Proposal 1:** Standardize "CAS muting", i.e., the CAS can be dropped with some pattern that is known to the UE.
  - The muting of other signals (e.g. MCCH) would follow "CAS" muting.
  - MTCH will be scheduled during the ON periods.



Time-frequency interleaver

- Time-frequency interleaving for 5G Broadcast was discussed in Rel-16 and was shown to provide large gains in time-varying channels.
- The following was captured in the RAN1#99

Chairman's notes:

> **R1-1913439** **On time and frequency interleaving for terrestrial broadcast EBU, BBC, IRT, NHK, ABS, DISH, Eutelsat, Shanghai Jiao Tong University, Fraunhofer HHI, Fraunhofer IIS, Enensys, Qualcomm, Rohde&Schwarz, Nokia, Nokia Shanghai Bell, ATEME, Nomor Research, Sony**
>
> Time and frequency interleaving for terrestrial broadcast was discussed even though it was not explicitly in the scope of the WID. However, consensus was not reached. It can be considered for a later release.

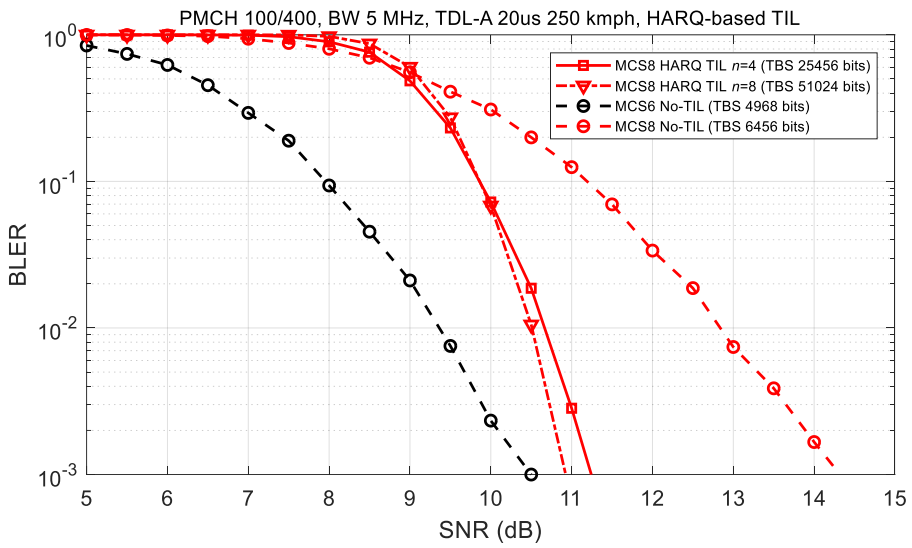


Figure (from R1-1913439) showing a 3+dB gain or a ~30% throughput gain from interleaving (at 0.1% BLER target)

- **Proposal 2:** Standardize time-frequency interleavers for 5G Broadcast, taking as baseline the mechanism in R1-1913439.

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Thank you

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