



DVB & 5G Broadcast: A dynamic duo

Moderator: Thomas Stockhammer (Qualcomm)

Presenters:

- **Johann Mika (Big Blue Marble/ORS)**
- **Javier Rodriguez Fernandes (Qualcomm)**

Overview

- Intro: 5G Broadcast at IBC#2025
- 5G Broadcast: Challenges from an operator POV (Johann)
- Latest performance updates including TFI (Javier)
- DVB-T2 and 5G Broadcast on the same carrier (Javier)
- Demo (Johann and colleagues)

FUTURE MEDIA TOWN HALL

INSIGHTS FROM AND FOR THE MEDIA INDUSTRY



5G Broadcast - Ready for launch?

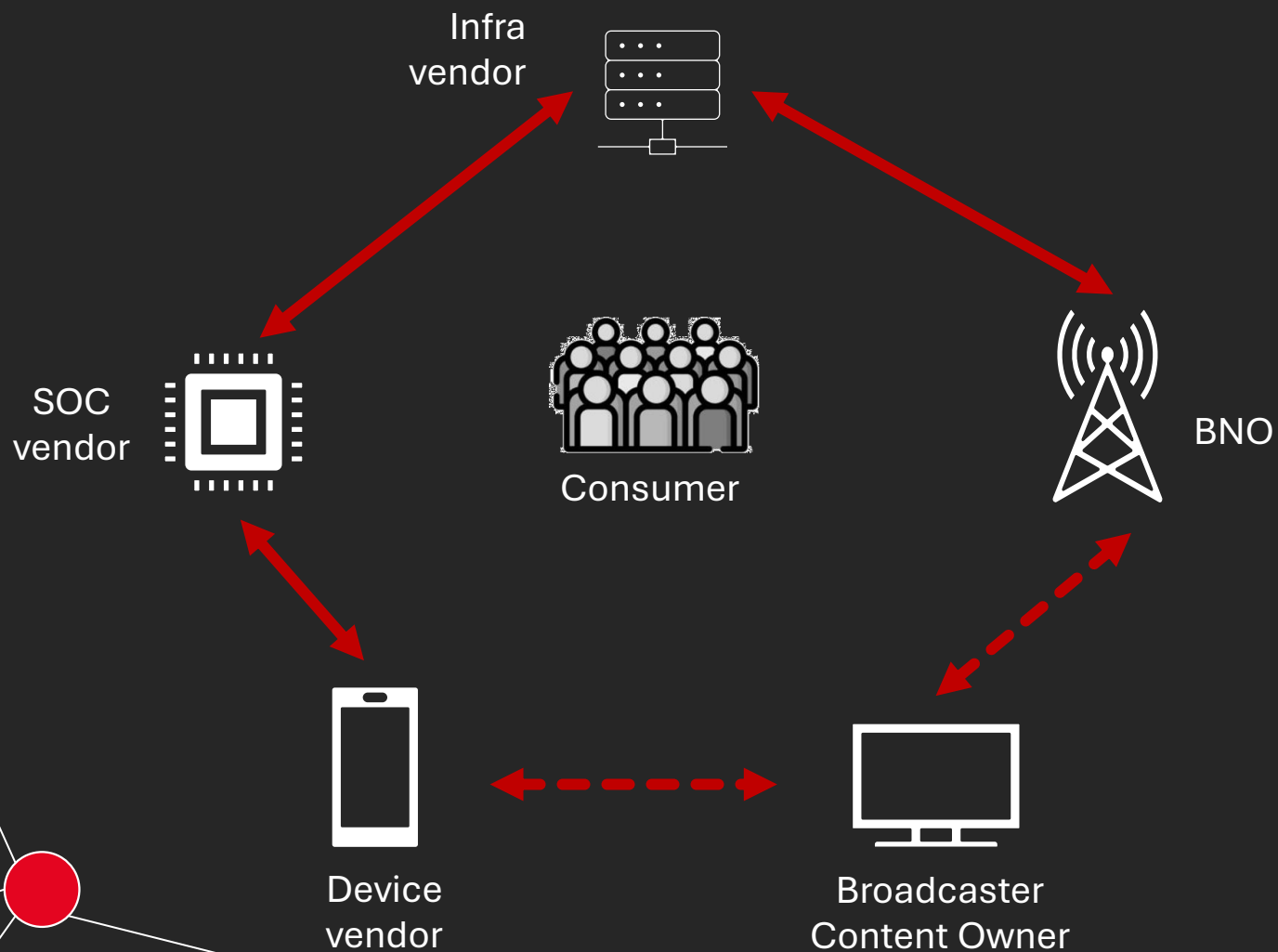
Where: Main IBC Conference Center Room E102

When: Saturday, September 13, 12:15 - 13:00



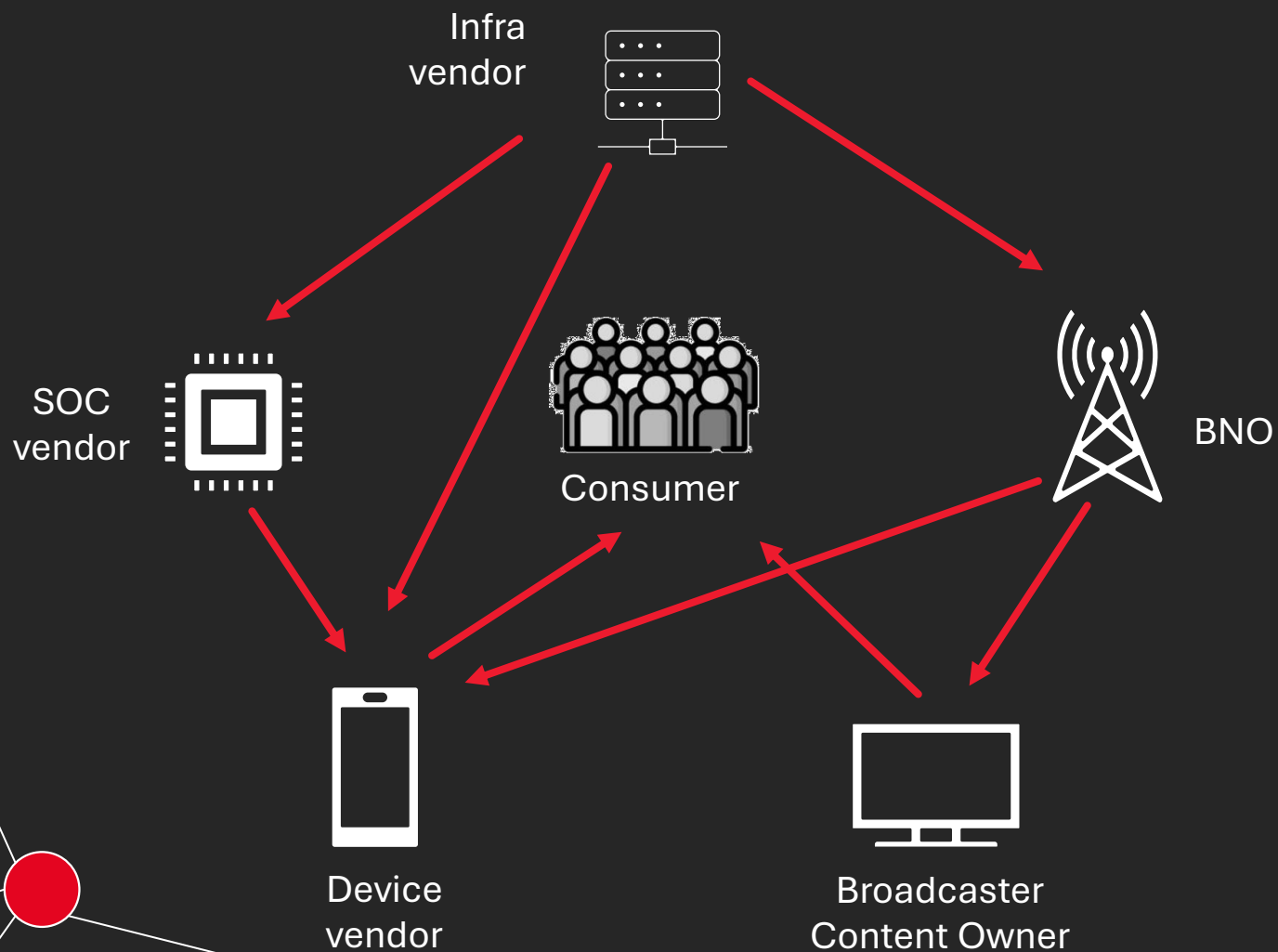
#FMT

Multi-vendor Interoperability



Johann Mika
CINO @ Big Blue Marble/ORS

Multi-Player Business Model



Aytac Biber
Qualcomm
Product Management

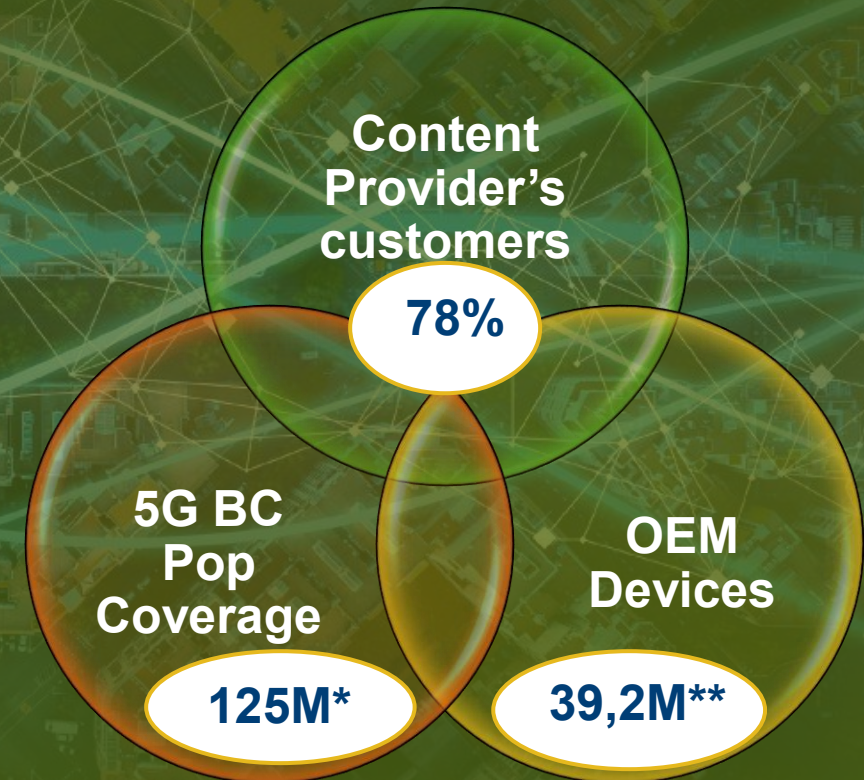
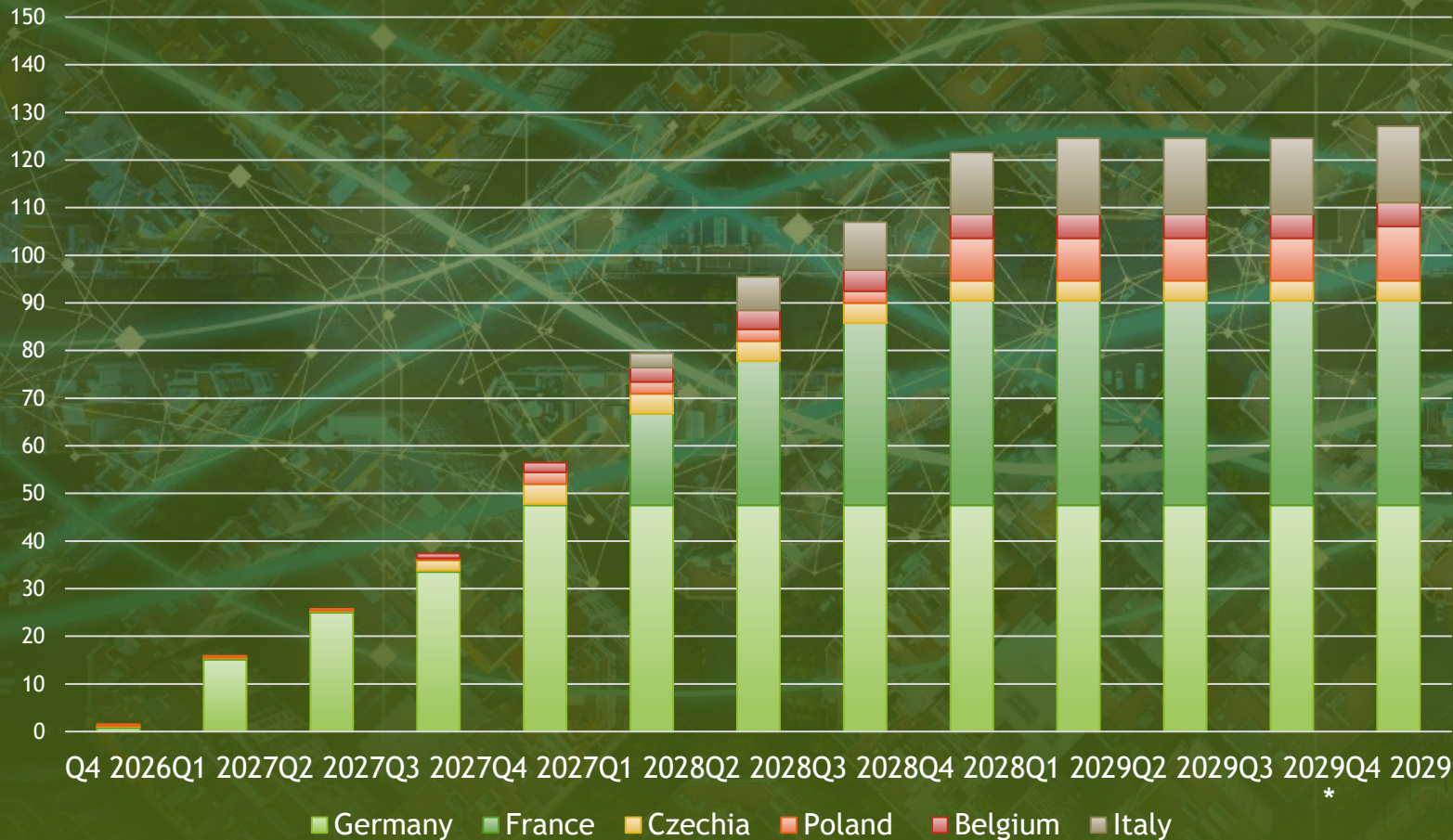


Markus Schneider
5G BC Business TF
Media Broadcast

POPULATION COVERAGE PLANNING

EU MARKETS COMBINED

5GB Pop Deployment Timeline

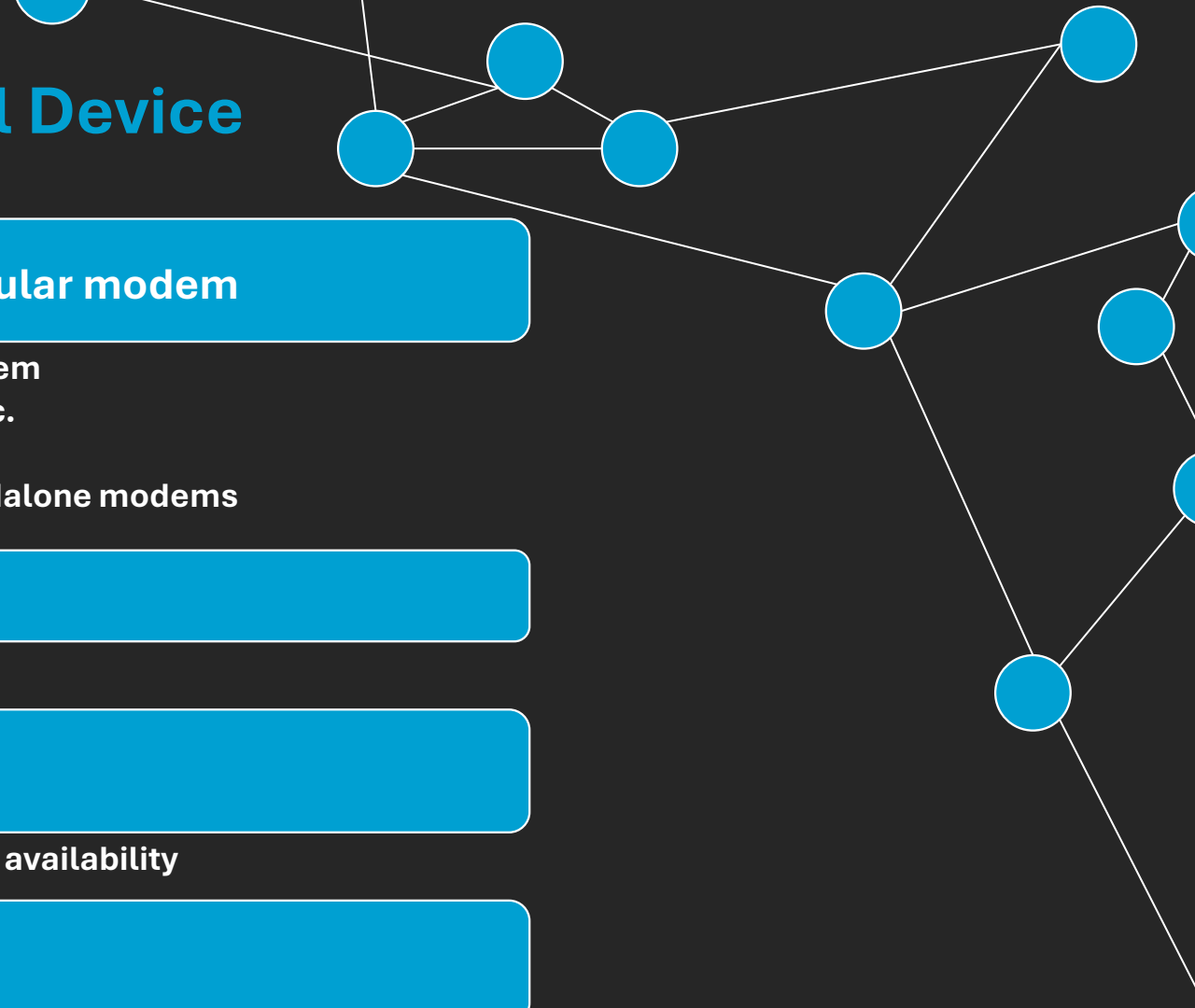


All numbers are assumptions of major BNOs in their countries, based on the precondition of market readiness.

* Numbers for Italy refer to the pre-commercial transmissions started in 2024. No concrete plans yet in Italy.

** Current reports indicate that 40% of all streaming is performed on mobile devices

Outlook for Silicon and Commercial Device



5G Broadcast is considered a new feature for 3GPP cellular modem

- No plan for broadcast-only silicon, feature is added to cellular modem
- Major development to add bands, new numerology, concurrency etc.
- Forward looking, feature only available with new released devices
- Initial targets are Mobile and FWA devices with integrated and standalone modems

Feature scoping is underway

- based on receiver profile established by 5G-MAG

Business Case Development

- Secure alignment with mobile OEMs on commercial feature set and availability

Launch timeline (Contingent on OEM alignment)

- On track to support first wave of mobile devices in Q1/28
- Test devices will be available to OEMs in Q3/27
- Flagship phone models in first year
- Waterfall to mid and low tier phone SOCs following years
- Also, waterfaling to verticals like automotive



Frederico Siqueira
(Minister of Communications of Brazil)



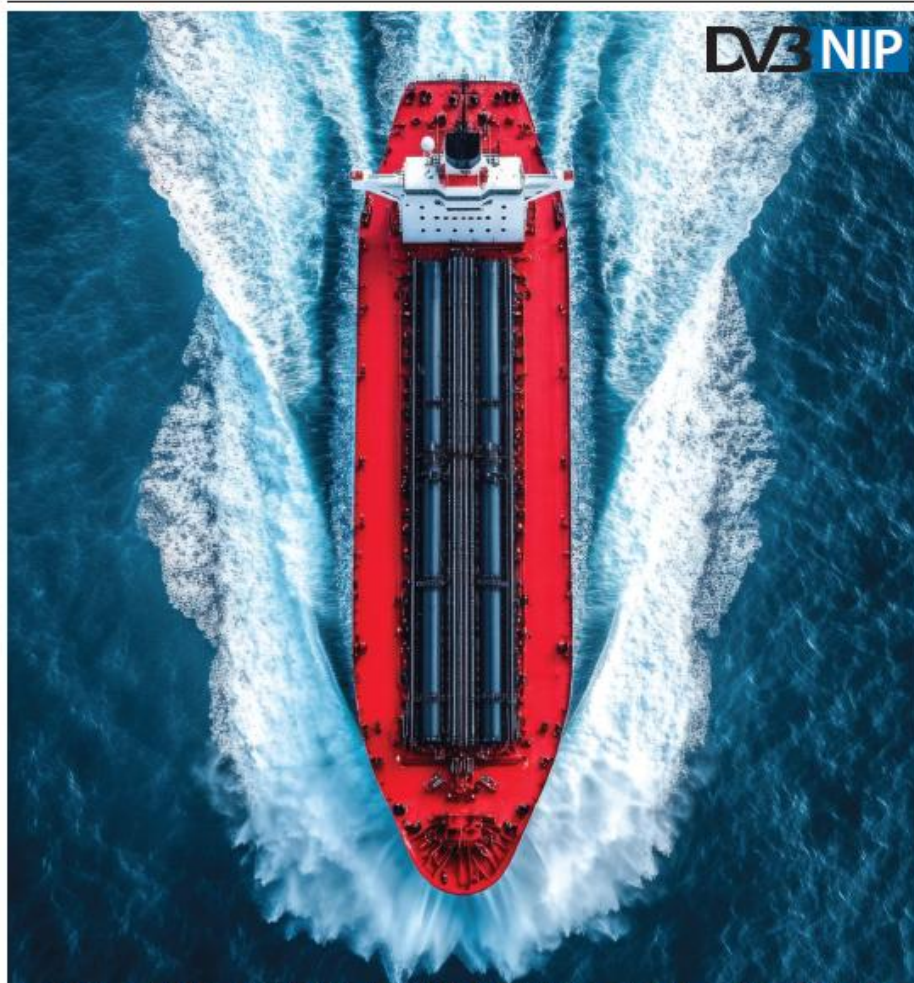
Wilson Wellisch
(Secretário Nacional de Comunicação Social
Eletrônica do Ministério das Comunicações)



5G Broadcast Tests







DVB NIP

DVB NATIVE IP ON LAND AND AT SEA

Plus...

DVB-I in Australia and New Zealand

Coexistence of DVB-T2 and 5G Broadcast • 2038 rollover: DVB's Y2K bug?

DVB-T2 and 5G Broadcast – tackling spectrum scarcity through coexistence

Javier Rodriguez Fernandez (Qualcomm) & Johann Mika (Big Blue Marble)

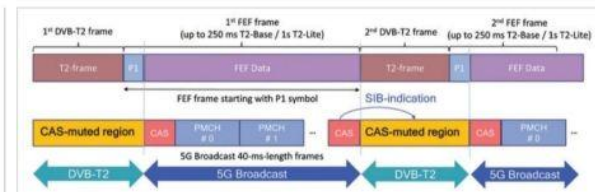
DVB-T2 is a widely deployed and proven broadcast standard, reaching millions of households across Europe and beyond. At the same time, 5G Broadcast is technically mature and ready to bring television, radio and other broadcast services directly to mobile devices. One of the greatest challenges in deploying new broadcast technologies like 5G Broadcast is the limited availability of spectrum and the significant up-front investment typically required for new infrastructure. Broadcasters may want to continue supporting legacy technologies like DVB-T2, while also introducing new capabilities that cater to modern consumption habits, particularly mobile devices. The core problem is this: how can 5G Broadcast and DVB-T2 share the same UHF channel to support both legacy TV sets and mobile-first use cases without requiring additional spectrum or disrupting existing services?

This is where the concept of coordinated time-division multiplexing (TDM) shines. It allows broadcasters to deliver content using both DVB-T2 and 5G Broadcast over a single physical radiofrequency (RF) channel, enabling a seamless transition to mobile-optimized broadcasting while continuing to serve traditional DVB-T2 receivers.

BROADCASTERS & OPERATORS

This approach offers several strategic and technical benefits for broadcasters and broadcast network operators.

- Service continuity: broadcasters can evolve their infrastructure without disrupting services to households still relying on DVB-T2.
- Expanded reach: 5G Broadcast enables direct-to-mobile content delivery (television, radio, streaming, ...), expanding the potential audience to include smartphones, tablets, and connected vehicles.
- Risk mitigation for early deployments: by using existing DVB-T2 infrastructure



Example of co-existence of DVB-T2 and 5G Broadcast in which 5G Broadcast data is transmitted within FEF frames (as adapted from J. Rodriguez Fernandez, A. Sengupta, A. Rico Alvarino, T. Stockhammer, "Smart Introduction of 5G Broadcast in Co-existence with Legacy Broadcast Systems," IBC Conference, Sep. 2024).

instead of a complete roll-out of a new 5G Broadcast multiplex from day one, upfront investments can be reduced while mitigating business failure and other risks.

- New use cases: from live sports to emergency alerts and software updates, 5G Broadcast supports a range of new, flexible services that are not supported in legacy systems.
- Flexible multiplex transition strategies: broadcasters can use free capacity in existing DVB-T2 carriers and gradually shift it from DVB-T2 to 5G Broadcast as device penetration increases and audience behaviour evolves.

HOW IT WORKS

The contribution of DVB-T2, which was designed with extensibility in mind, is the concept of Future Extension Frames (FEFs). These are special slots in the DVB-T2 frame structure (up to 250 ms in duration) that can be used to carry different types of signals or technologies, multiplexed in time on the same RF carrier. These FEFs can be occupied with 5G Broadcast signals, enabling coordinated insertion of new signals between DVB-T2 programme frames without impacting legacy receivers.

On the 5G Broadcast side, 3GPP Release 19 standards (to be published at the end of 2025) now support Cell Acquisition Subframe (CAS) muting for coexistence. This allows the 5G Broadcast transmission

to be flexibly activated or deactivated over time, making it possible to insert the signal in the FEFs (as illustrated), alongside DVB-T2 content within a shared carrier. CAS muting can be aligned with the FEF structure, enabling both systems to schedule their transmissions without overlapping in time. By coordinating the timing of DVB-T2 FEFs and 5G Broadcast CAS-muting windows, a time-multiplexed system is created.

DVB-T2-compatible TV sets continue to receive regular programming, while mobile devices receive 5G Broadcast content during alternating time slots – all over the same carrier.

This coexistence model enables broadcasters to:

- Launch hybrid deployments without additional frequency allocations.
- Offer next-generation services while retaining backwards compatibility.

Beyond traditional linear programming, 5G Broadcast introduces flexibility and intelligence to content delivery. It supports dynamic, data-driven distribution models, enabling broadcasters to tailor content by time of day, audience preferences, regional demand, or real-time events, all entirely under the broadcaster's control.

The result is a future-proof and interoperable broadcasting system, ready to serve both TV screens and mobile displays.

Javier Rodriguez Fernandez is a Senior Engineer with Qualcomm, working on 3GPP standardization related to 4G, 5G and 6G. Johann Mika is Chief Innovation Officer at Big Blue Marble (formerly ORS Group), focused on emerging technologies with strategic relevance.



**BIG BLUE
MARBLE**



DVB & 5G Broadcast: A dynamic duo

Johann Mika, CINO

BIG BLUE  **MARBLE**



5G Broadcast: Challenges from an operator POV



Lack of customers (and devices)



Interoperability of infrastructure



Financial risk of deployment



5G Broadcast: Challenges from an operator POV



Financial risk of deployment

Goal: Reduce the investments at the beginning as much as possible

- **Use of existing infrastructure:** Co-existence of DVB and 5G Broadcast
- Increase the robustness of the signal: **lower tower density** and **improved coverage**
→ „Time-Frequency-Interleaving“

2024: Broadcast Networks Europe (BNE) joined efforts with EBU to engage in 3GPP for Release 19



DVB & 5G Broadcast: Why Co-Existence Matters

The Challenges:

- **Spectrum scarcity:** no new UHF bands available
- **Audiences split:**
 - Millions still rely on DVB-T2 TV sets
 - Growing demand for mobile-first consumption (smartphones, cars, tablets)
- Broadcasters need to **innovate without disruption**

Our Opportunity:

- Use **existing DVB-T2 capacity** to introduce **5G Broadcast**
- Deliver **TV + Mobile services in parallel** on **one RF channel**



5G Broadcast: Why TFI matters

Robust Reception, Everywhere

- Enhances **coverage in challenging environments** (urban canyons, indoor, high-speed mobility)

Consistent Quality of Service

- Reduces risk of service degradation → fewer complaints from viewers

Efficient Deployment

- **Maximizes spectrum use** by improving robustness without needing more transmit power or sites

Bridging the broadcast and cellular worlds: CAS Muting and Time/Frequency Interleaving in Release 19 5G Broadcast

Javier Rodriguez-Fernandez, Senior Standards Engineer
Qualcomm Technologies, Inc.

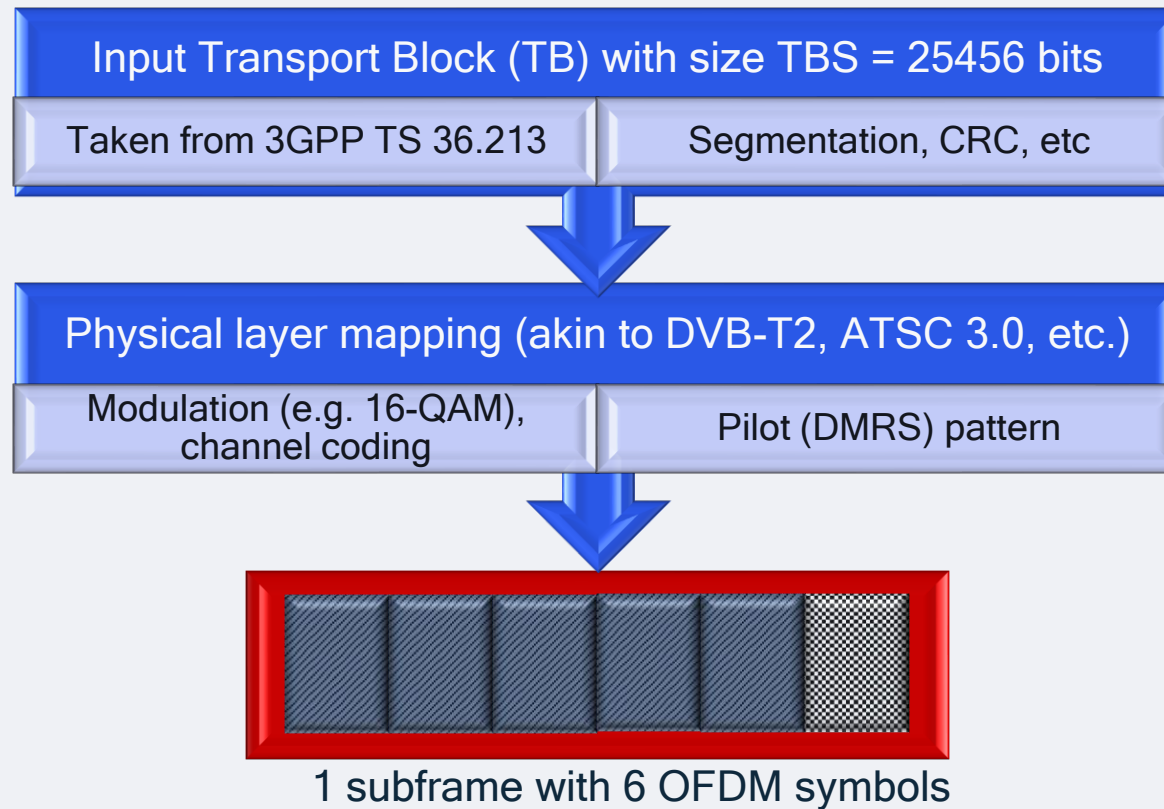


Convergence of broadcast and cellular

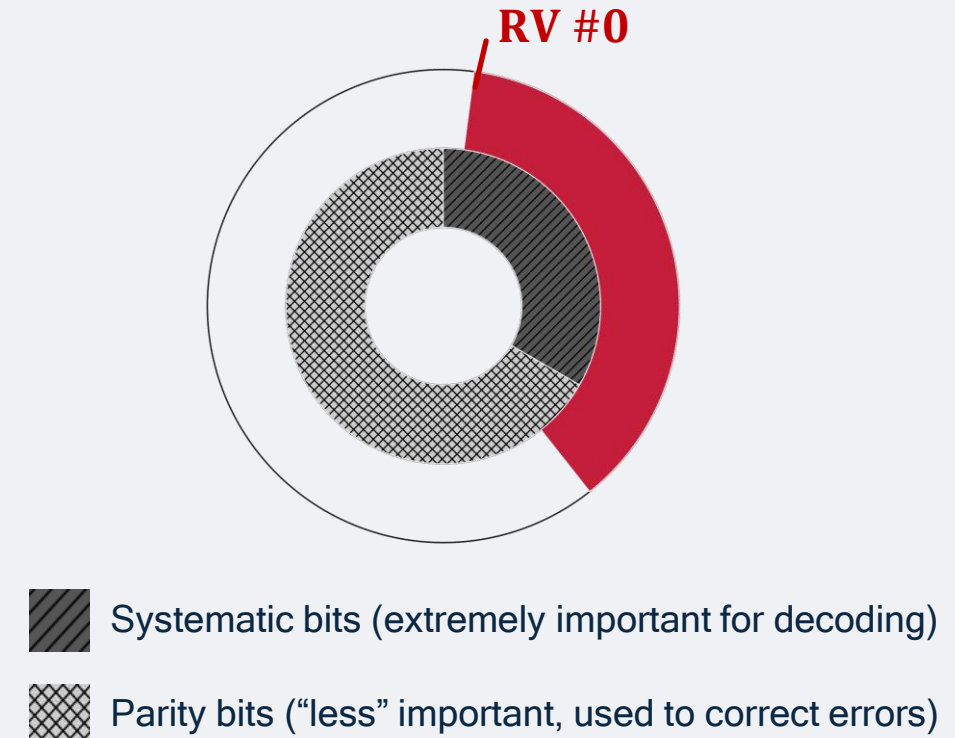


Cellular unicast: mapping data (bits) to a subframe

TB generation and subframe mapping in 3GPP

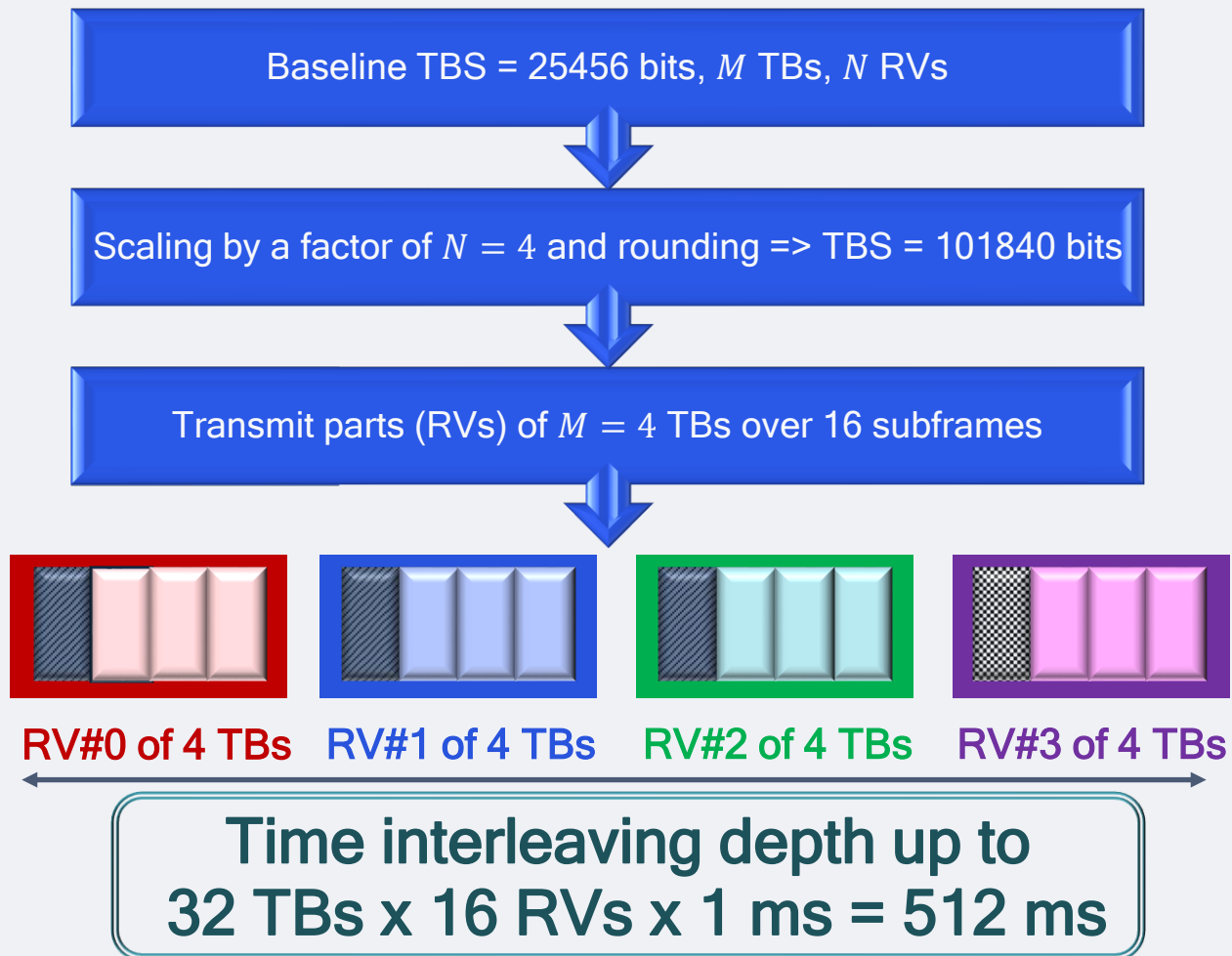


HARQ buffer Cellular unicast in 3GPP

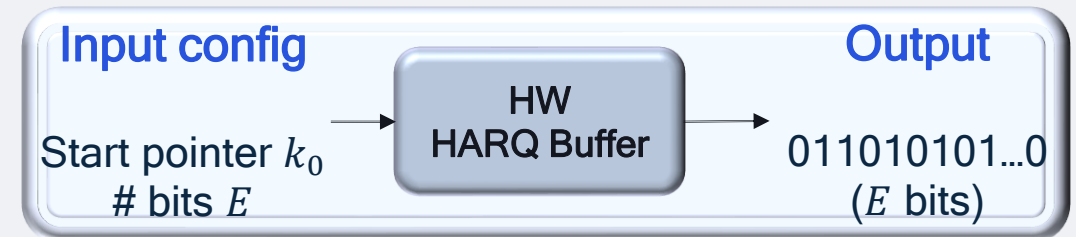


Time interleaving in 3GPP Release 19: continuous RVs

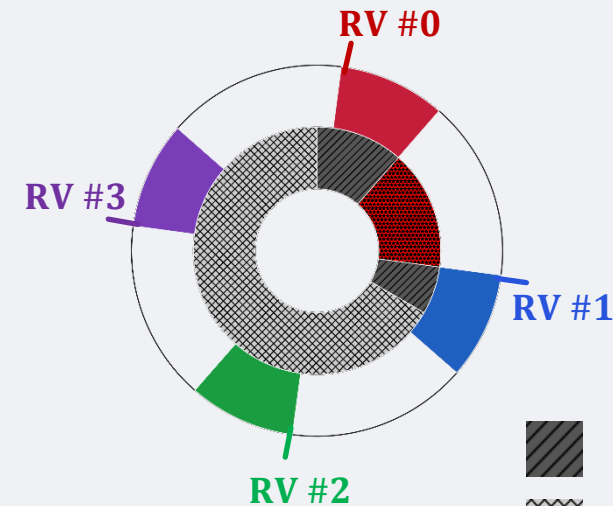
Time interleaving in Release 19



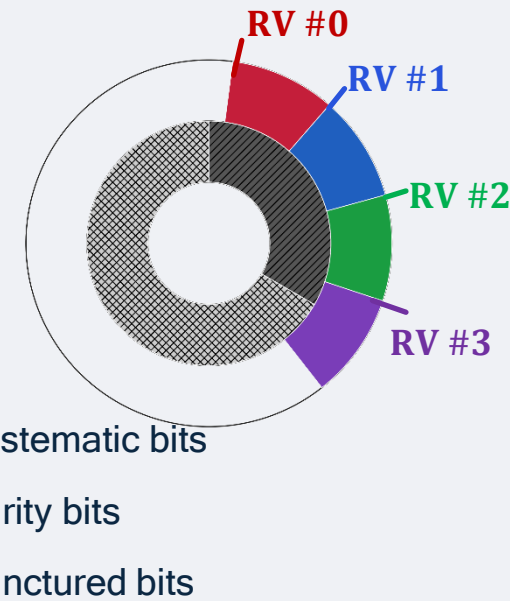
Firmware configuration



Cellular unicast RVs



5G Broadcast Rel. 19



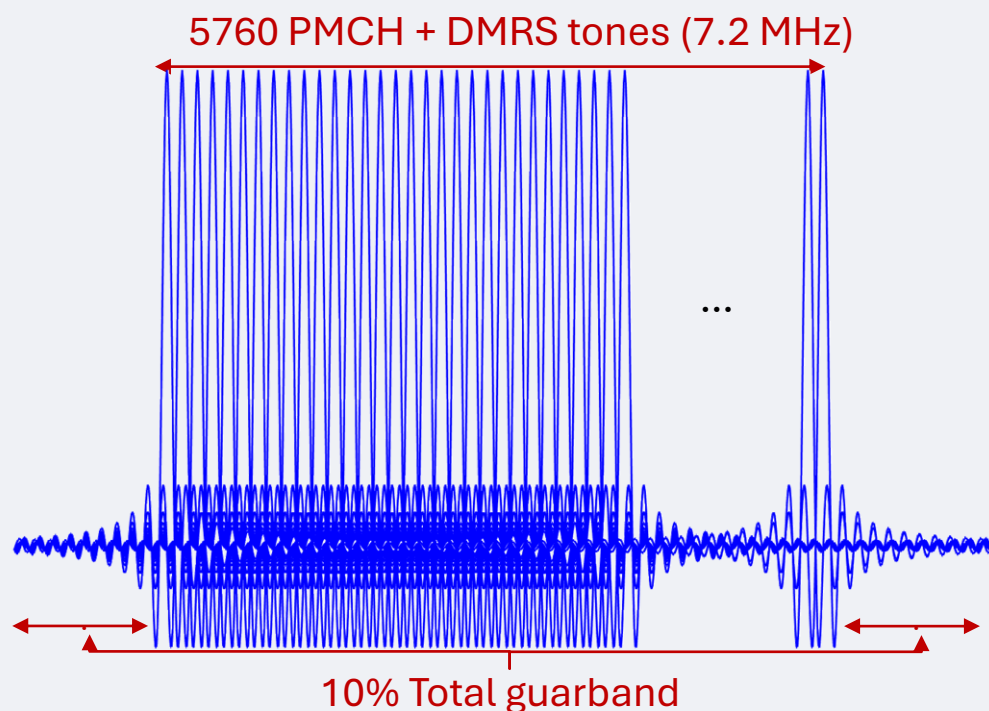
Performance analysis methodology



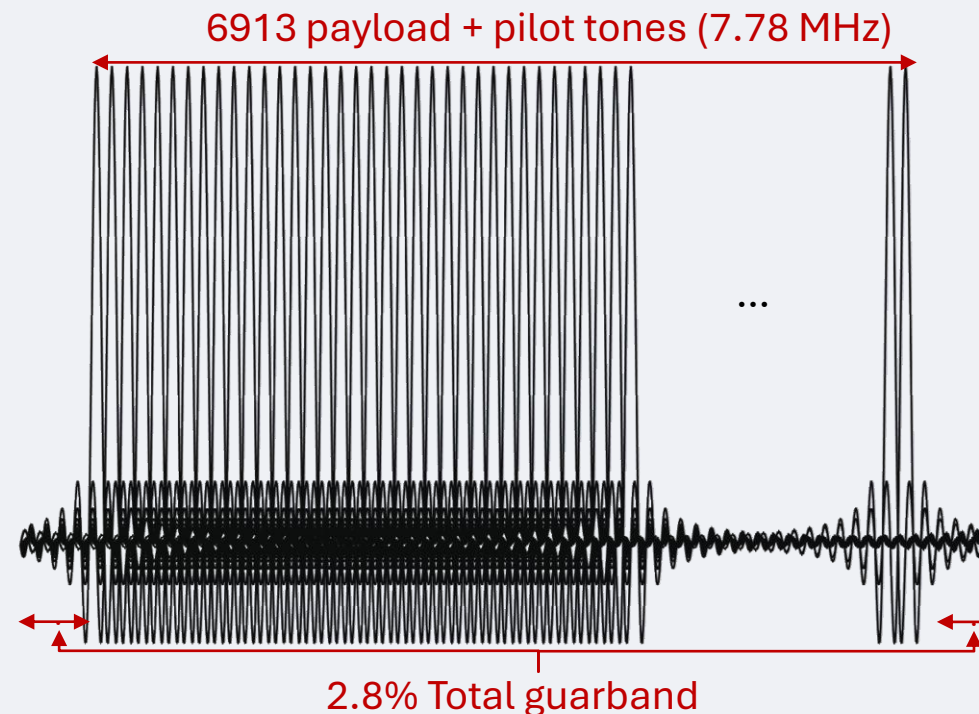
OFDM allocation within 8 MHz channel BW

- **Different useful BW in 5GB and ATSC 3.0**, and **LLS operate on an average SNR per tone**
 - ATSC 3.0 power $\uparrow$ for the same system (i.e. SNR) quality
- **Measure performance over useful BW for each system** => ATSC 3.0 still has an advantage due to e.g. more frequency diversity and extra coding rate

5G Broadcast



ATSC 3.0



Spectral efficiency computation

5G Broadcast

- M time interleaved (scaled) TBs
- Each TB of size TBS bits
- Such TBs are collectively mapped to $M \times N$ subframes
 - Single OFDM symbol per subframe with 200/800 numerology (1.25 kHz SCS)
 - Each OFDM symbol has $N_{\text{active}} = 5760$ PMCH + DMRS tones
- $$\text{SE(MCS)} = \frac{\text{TBS}}{N \times T_{\text{OFDM}} \times N_{\text{active}} \cdot \text{SCS}} \text{ (bps/Hz)}$$
- Spectral efficiency measured at 0.1% BLER
- Same CP overhead and pilot pattern ratios

ATSC 3.0

- Single PLP comprising multiple baseband packets after input formatting
 - Such baseband packets collectively transport N_{bits} information bits
 - The N_{bits} information bits are computed within the TI depth for each QAM size and code rate
- Such baseband packets are time interleaved using CTI interleaving mode across several OFDM symbols
 - Every OFDM symbol has 222.2/889 numerology (1.125 kHz SCS)
 - Each OFDM symbol has $N_{\text{active}} = 6913$ payload plus pilot tones
- $$\text{SE(MCS)} = \frac{N_{\text{bits}}}{N \times T_{\text{OFDM}} \times N_{\text{active}} \cdot \text{SCS}} \text{ (bps/Hz)}$$

Spectral efficiency **metric** measures *effective number of information bits* that each standard can carry per time and frequency unit

Numerical simulations conducted for each MCS (i.e. QAM size, code rate, and corresponding TB / baseband packet size for 5G Broadcast and ATSC 3.0)

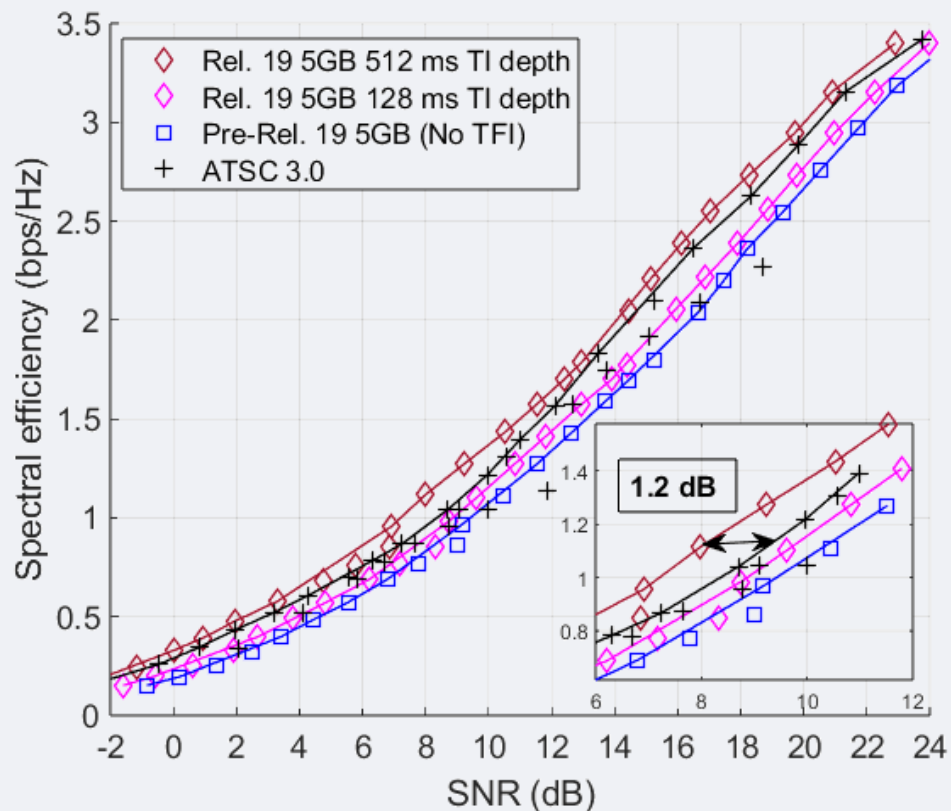
Numerical performance



Spectral efficiency results

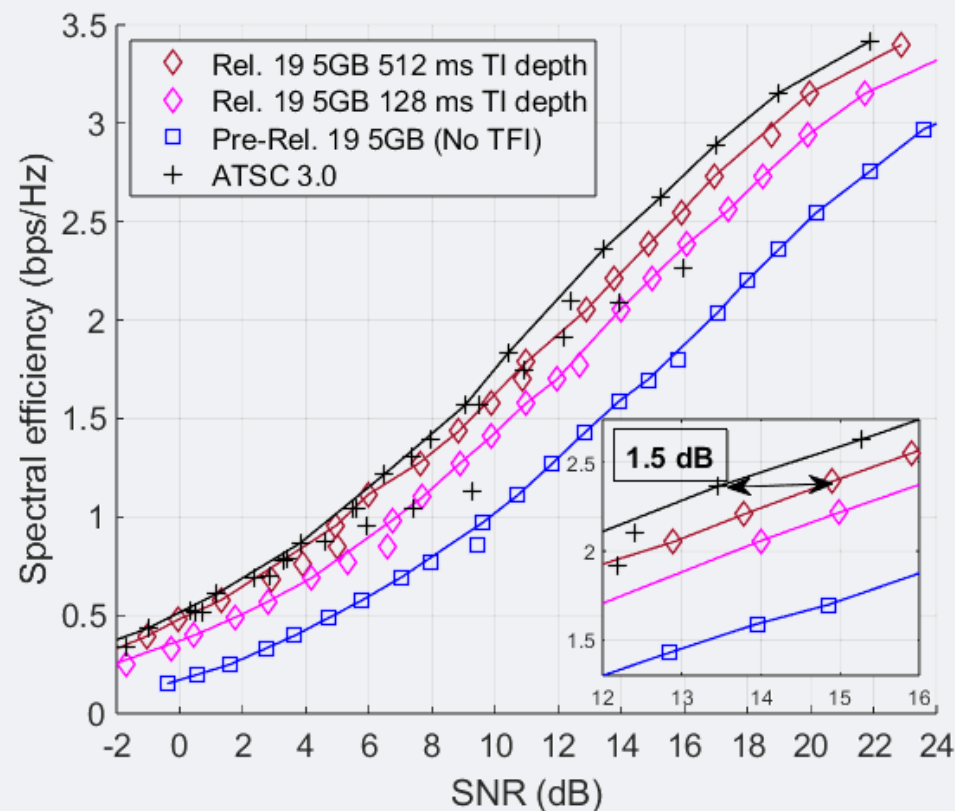
- Key takeaways at low speed (3 km/h)

- Performance **improvement of 2-3 dB** with respect to **pre-Rel. 19 5GB**
- **Time-interleaved 5GB** shows **net performance gain of 0.5-1.2 dB** over **ATSC 3.0**
- **Extra time diversity** outmatches **NUC shaping** and **BICM** gains



- Key takeaways at higher speed (60 km/h)

- Performance **improvement of 4-7 dB** with respect to **pre-Rel. 19 5GB**
- **Time-interleaved 5GB** shows **small gap of 0.5-1.5 dB** versus **ATSC 3.0**
- Combination of **continuous time interleaving + NUC shaping gain and BICM**

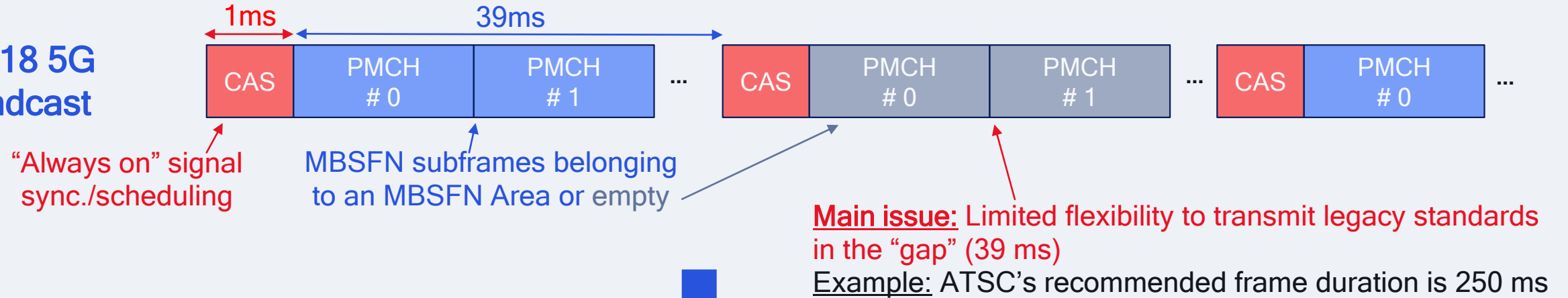


Convergence of broadcast standards: CAS muting



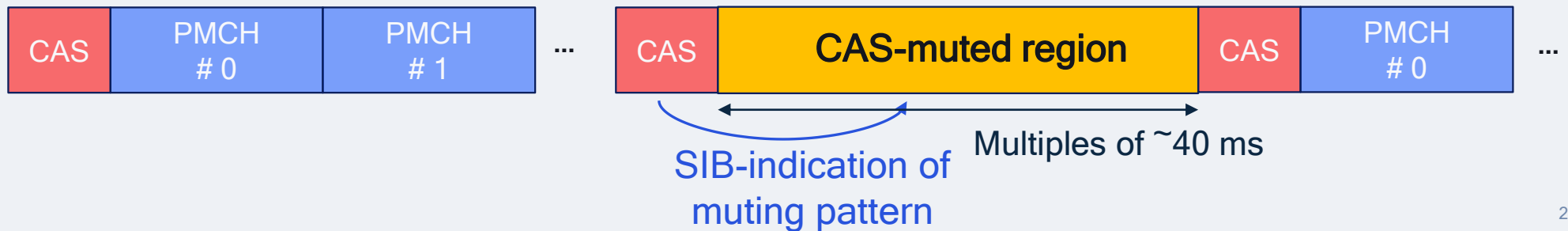
CAS muting as a feature enabling co-existence

Rel. 18 5G Broadcast

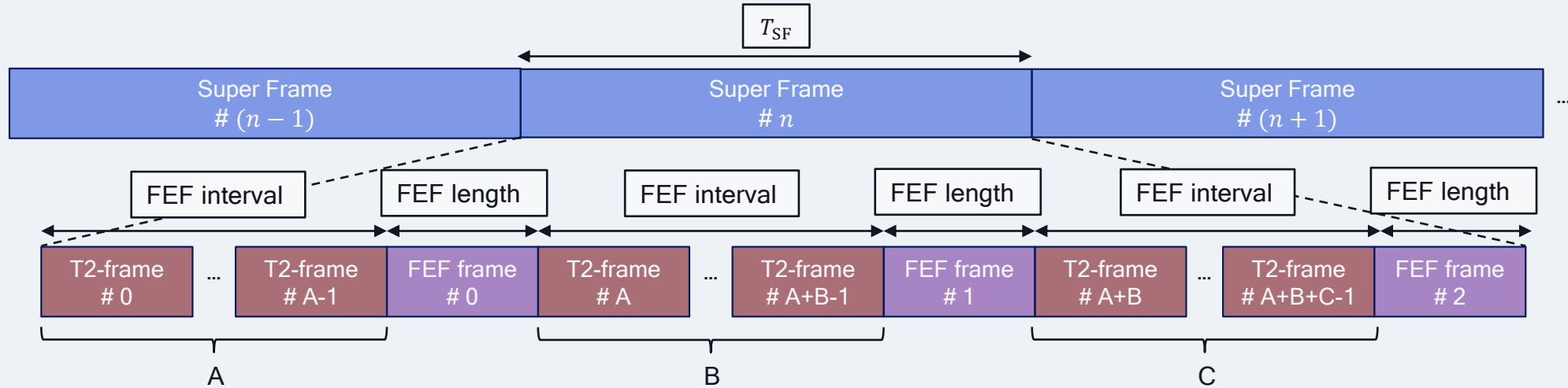


Now adopted as part of Release 19 features for 5G Broadcast

CAS muting Enhancement



DVB-T2 mechanisms for in-band coexistence



FEF type (4 bits): reserved for future use
FEF interval (8 bits): up to 255 T2-frames
FEF length (22 bits): up to 250 ms / 1s

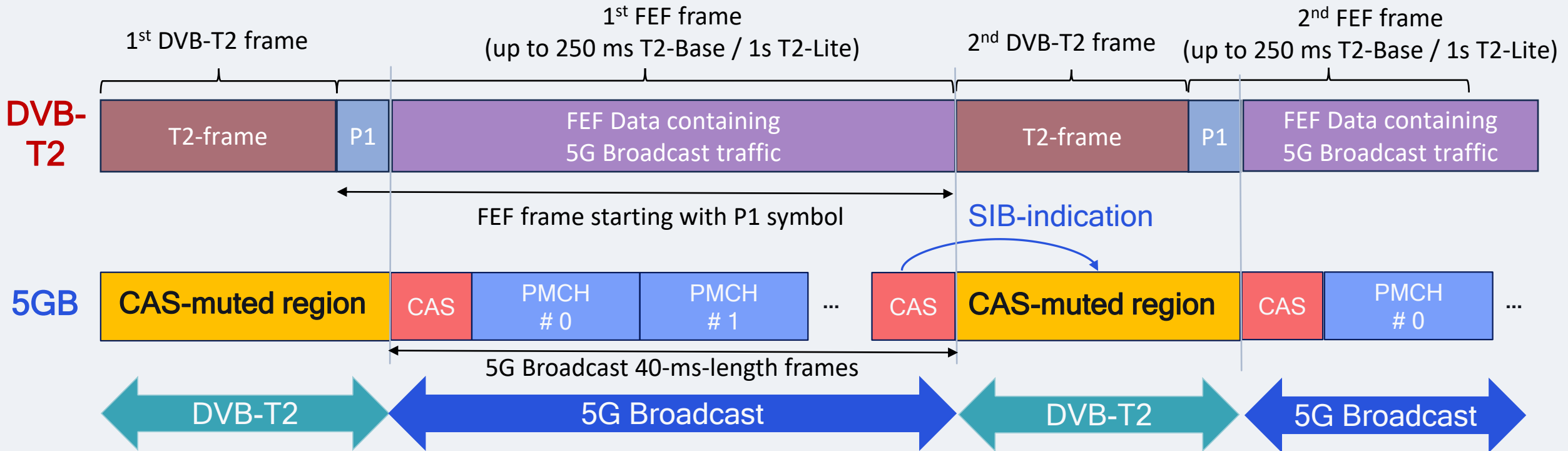
$$A + B + C = N_{T2} \text{ frames}$$
$$A = B = C = \text{FEF interval}$$

DVB-T2 supports **Future Extension Frames (FEF)**

- DVB-T2 introduces FEF frames to enable coexistence with other broadcasting technologies
 - L1-signaled FEF interval and FEF length would control the duty-cycle of DVB-T2 and 5G Broadcast
 - Lots of flexibility to attain different time shares for DVB-T2 and 5G Broadcast
- If T2-Lite is also deployed, both the Lite profile and 5G Broadcast can coexist with different time shares

DVB-T2 and 5G Broadcast in-band coexistence

Efficient integration of 5G Broadcast within DVB-T2 superframes



- DVB-T2 receivers expected to detect FEF frames and ignore the content of FEF data
 - FEF frame starts with P1 symbol, which should be contained within the 5G Broadcast CAS-muted region
- DVB-T2 receivers to keep AGC gain constant during FEF parts to avoid interference
- DVB-T2 and 5G Broadcast transmitters need to coordinate for dynamic allocation of resources



Broadcaster and BNO Benefits

Service Continuity

Protect investments, no disruption to households with DVB-T2

Expanded Reach

Direct-to-mobile delivery: smartphones, vehicles, portable devices

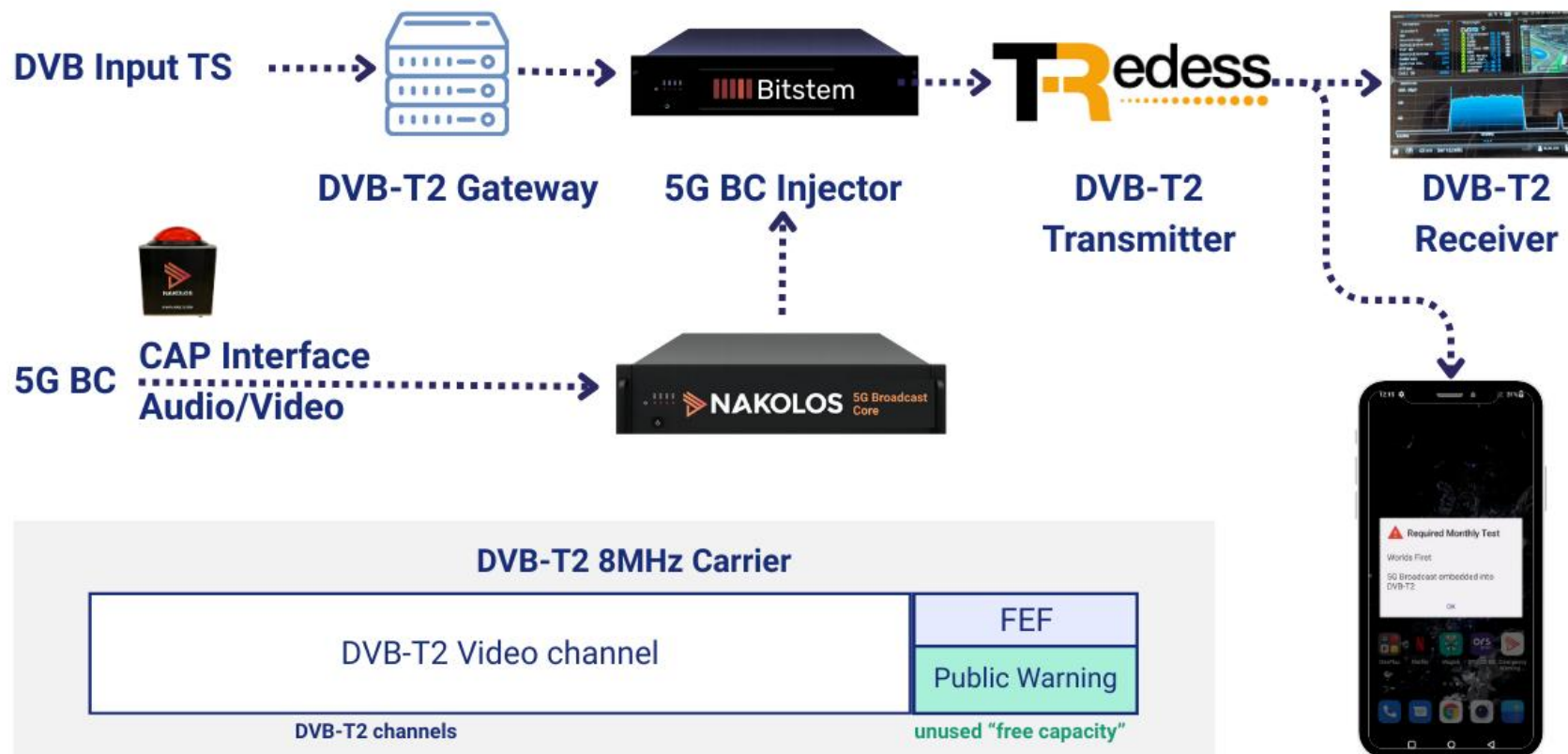
Risk Mitigation

No need for full new multiplex rollout → lower upfront investment

→ Allows **smooth integration** and **lower pre-investment deployment scenarios** for Broadcast Network Operators (and faster deployment of Public Warning Services)



Worlds First: 5G Broadcast embedded in DVB-T2



Worlds First: 5G Broadcast embedded in DVB-T2

Benefits for broadcasters and broadcast network operators:

- Service continuity
- Expanded reach
- Risk mitigation for early deployments
- New use cases
- Flexible multiplex transition strategies

Result: Ready-for-deployment coexistence model that proves DVB-T2 and 5G Broadcast can share the same carrier – ensuring compatibility today while unlocking innovation for tomorrow.

Appendix: Simulation parameters



Simulation parameters

Rx ant.
related

BICM
related

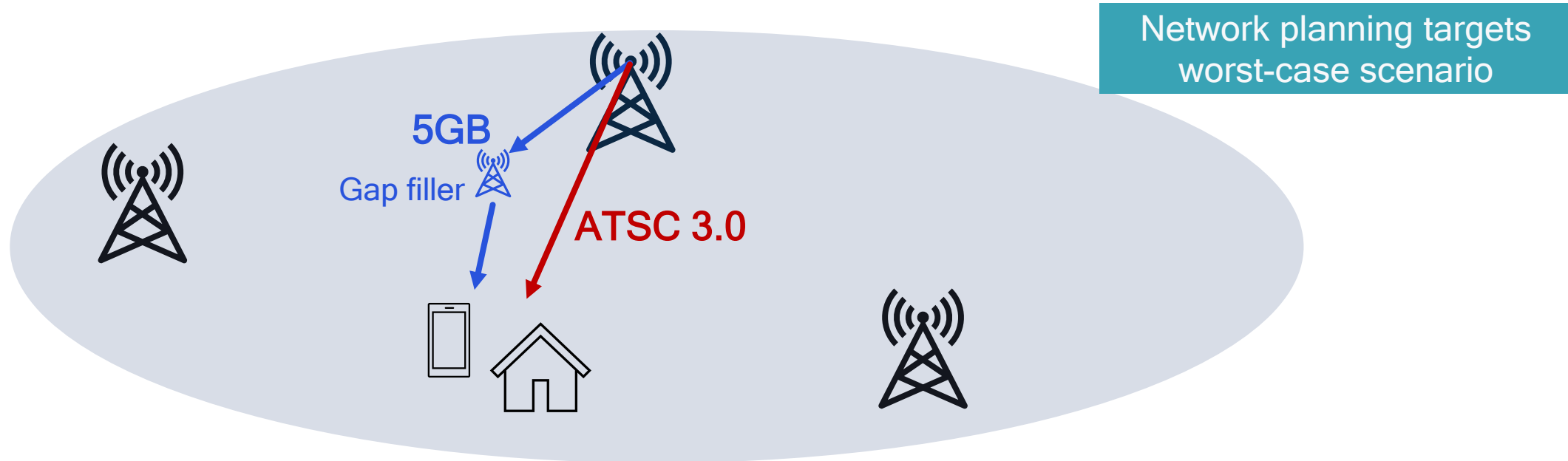
Time Intlv.
related

Parameter	5GB	ATSC 3.0
Carrier frequency (MHz)	600	
Channel bandwidth (MHz)	8	
Subcarrier spacing (kHz)	1.25	1.125
Useful bandwidth (MHz)	7.2	7.776
Number of active carriers N_{active}	5760	6913
Number of data carriers	$N_{\text{MTCH}} = 4800$	$N_{\text{cell,data}} = 5711$
Channel model	MBMS model in [16], Table B.2.6.2-1	
Number of Tx antennas	1	
Number of Rx antennas	2	
Rx antenna correlation	High (0.9)	
Useful OFDM symbol duration (μs)	800	889
CP duration (μs)	200	222.2
Overall OFDM symbol duration T_{OFDM} (ms)	1	1.11
Pilot overhead (%)	16.7	16.7
Channel code type	Turbo	LDPC
Channel codeword length (bits)	Maximum of $L_{\text{turbo}} = 18444$	$L_{\text{LDPC}} = 64800$
Outer code type (overhead bits)	N/A	BCH ($L_{\text{outer}} = 192$)
Frequency interleaver	Enabled	Enabled
Time interleaver type	HARQ-based	CTI
TI config 1 (depth in ms)	$N = 4$ RVs (128 ms) 32 TBs	1448 rows (QPSK, 400 ms) 1024 rows (others, 200 ms)
TI config 2 (depth in ms)	$N = 16$ RVs (512 ms) 32 TBs	Same as config 1
Number of OFDM symbols per TI interval	$N_{\text{OFDM}} = N$ symbols per TB	$N_{\text{OFDM}} = \lfloor T_{\text{TI,depth}}/T_{\text{OFDM}} \rfloor$
Number of codewords transmitted per TI interval	1 per TB	$N_{\text{FEC}} = \lfloor N_{\text{cell,data}} \times N_{\text{OFDM}} \times \log_2(M_{\text{QAM}})/L_{\text{LDPC}} \rfloor$ [3]
Number of data bits transmitted per TI interval	$N_{\text{bits}} = \text{TBS}$ [10]	$N_{\text{bits}} = N_{\text{FEC}} \times (L_{\text{LDPC}} \times R_{\text{LDPC}} - L_{\text{outer}})$ [3]
Spectral efficiency (bps/Hz)	$N_{\text{bits}}/(T_{\text{OFDM}} \times N_{\text{OFDM}} \times \text{SCS} \times N_{\text{active}})$	

Appendix: Network planning



Implications of different link budgets of 5G Broadcast and ATSC 3.0



- Network planning is usually carried out for the worst-case link-quality scenario
- Worst-case link budget differences can be compensated by
 - Introducing gap-fillers operating at another band
 - Adjusting the MCS, transmit power
 - Adjusting the video stream quality
- Improving the corresponding standard to reduce link margin differences