

# Suitability for **5G** of existing ECC regulations for **3400 – 3800** MHz

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**For discussion**

HUAWEI TECHNOLOGIES



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- Introduction
- Existing regulations
- Out-of-block power limits for synchronised TDD
- Conclusions

# Motivation



- The EC has issued a **mandate** to CEPT to define (by **mid-2018**) **technical regulations** for **5G** in pioneer band 3400-3800 MHz.
- Technical regulations for **4G** in this band were specified in **2014**.
- CEPT will now review the **suitability** of the existing regulations for 5G and **amend** where necessary.
- In the following slides, we **review** the existing regulatory technical conditions as described in **ECC Decision 11(06)**.
- In light of expected use of **active antenna systems** (AAS) in **5G**, we propose specific amendments to the technical conditions which relate to “transitional region power limits” and the “baseline” power limit for **synchronised TDD** base stations (BSs).

These amendments are **aligned** with the recent information received in the **LS response** from **3GPP** TSG **RAN4** to ECC PT1.

- We also briefly **highlight** other areas where amendments **might** be considered.

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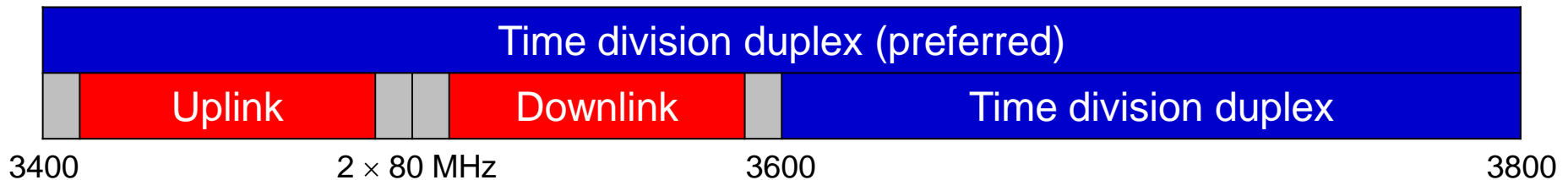
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# Frequency arrangement

ECC Decision (11)06

- The assigned **block sizes** shall be multiples of **5 MHz**.

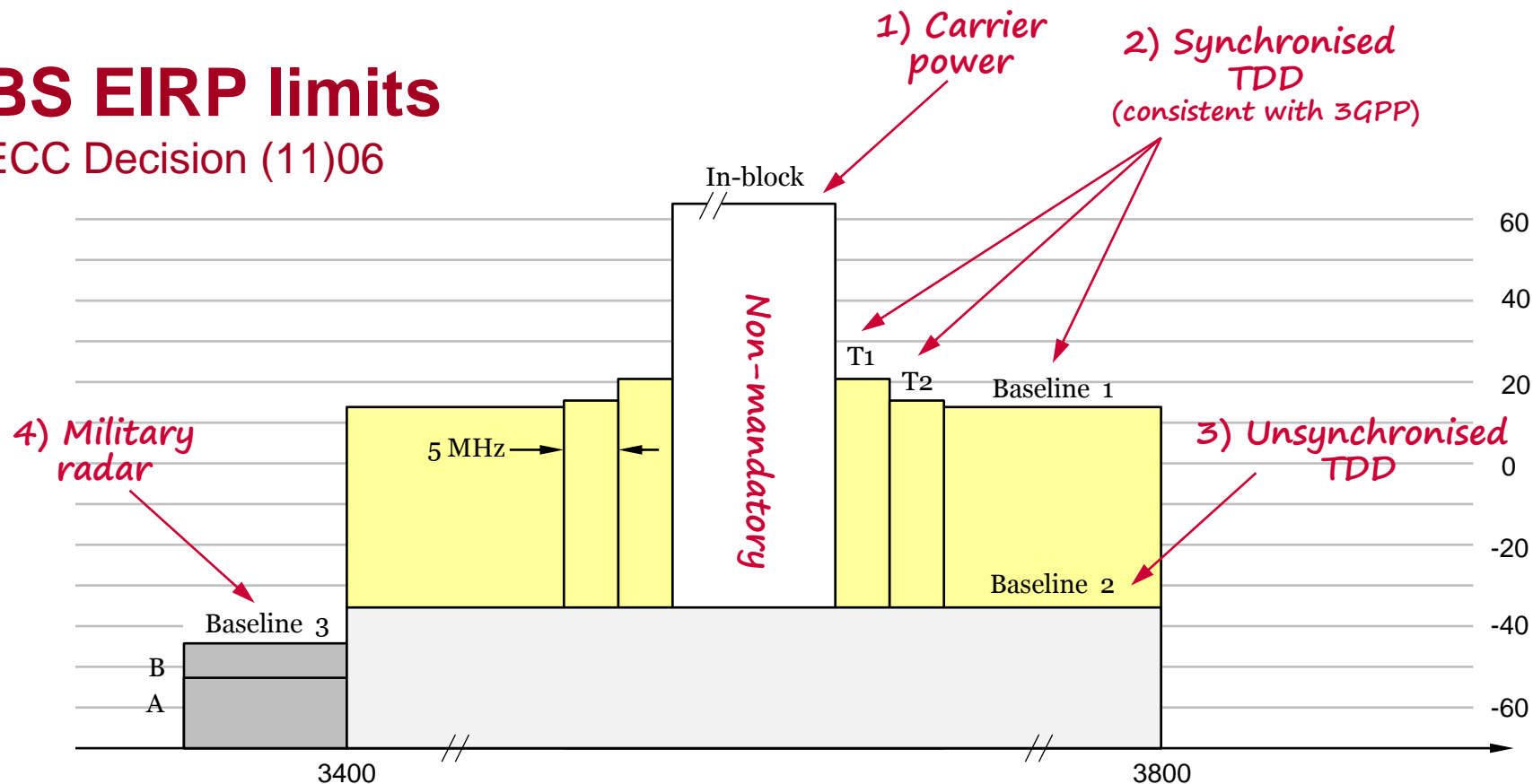
	Duplex mode
3400 – 3600 MHz	Preferred: TDD Alternative: FDD
3600 – 3800 MHz	TDD



- TDD has particular benefits in relation to **UL/DL** channel **reciprocity**.
- For the purposes of this document, we focus on the TDD arrangement only.

# BS EIRP limits

ECC Decision (11)06



In-block	$P_{MAX} \leq P_0$	Block assigned to operator	$P_0 \leq 68$	dBm/5MHz	Per antenna
Transition 1	$P_{OOB} \leq P_{T1}$	$\Delta f$ : -5 to 0 or 0 to +5 MHz	$P_{T1} = \min(P_{MAX} - 40, 21)$	dBm/5MHz	Per antenna
Transition 2	$P_{OOB} \leq P_{T2}$	$\Delta f$ : -10 to 0 or 0 to +10 MHz	$P_{T2} = \min(P_{MAX} - 43, 15)$	dBm/5MHz	Per antenna
Baseline 1	$P_{OOB} \leq P_{B1}$	Elsewhere	$P_{B1} = \min(P_{MAX} - 43, 13)$	dBm/5MHz	Per antenna
Baseline 2	$P_{OOB} \leq P_{B2}$	Elsewhere	$P_{B2} = -34$	dBm/5MHz	Per cell/sector
Baseline 3	$P_{OOB} \leq P_{B3}$	Below 3400	$P_{B3} = -59$ or $-50$ or N/A	dBm/1MHz	Per cell/sector

# UE EIRP limits

ECC Decision (11)06

- The existing regulations mainly apply to **base stations** (BSs).
- The **only** ECC technical condition for **UEs** is a recommendation that their in-block radiated power (EIRP for fixed, and TRP for nomadic/mobile) does **not exceed 25 dBm**.

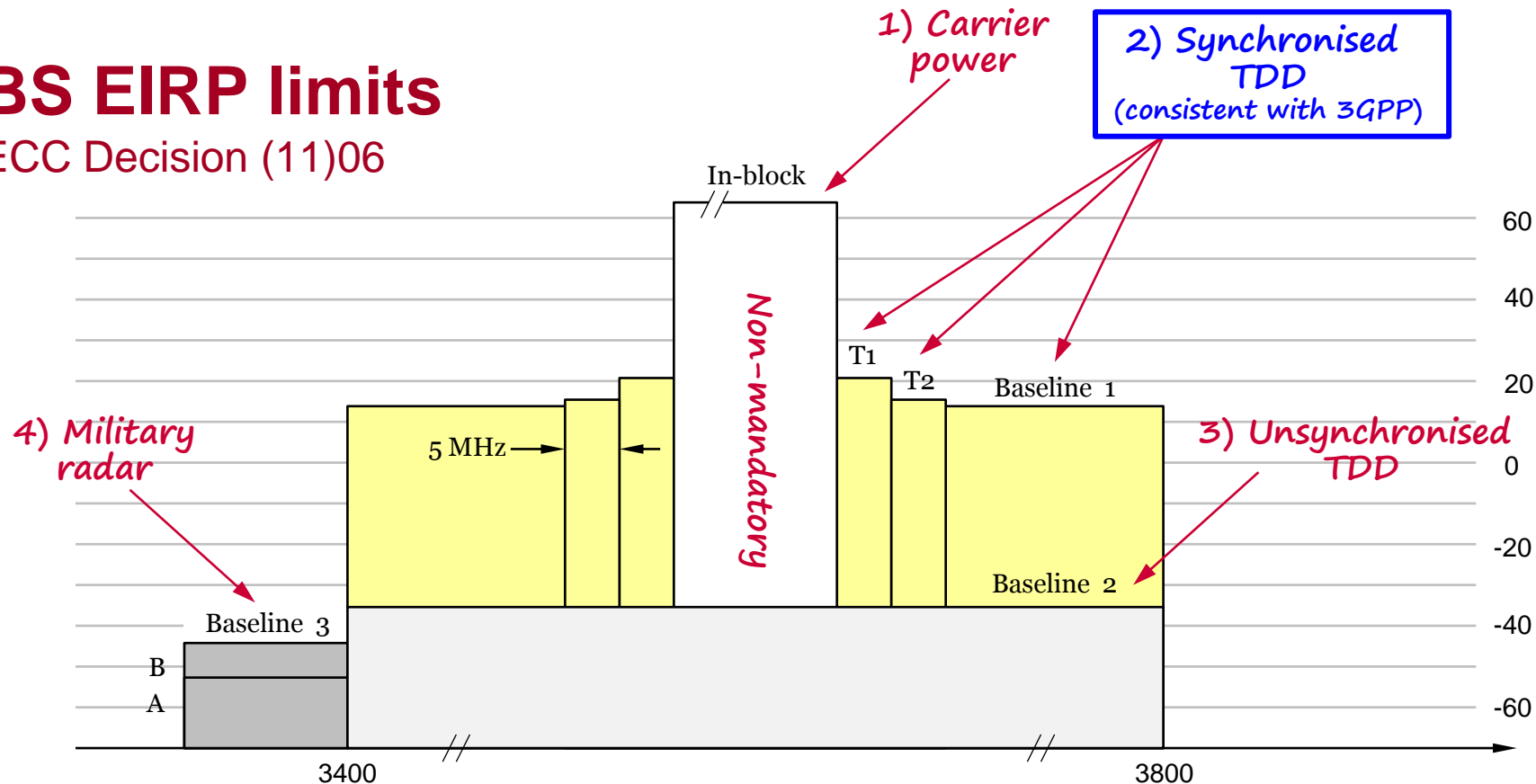
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# BS EIRP limits

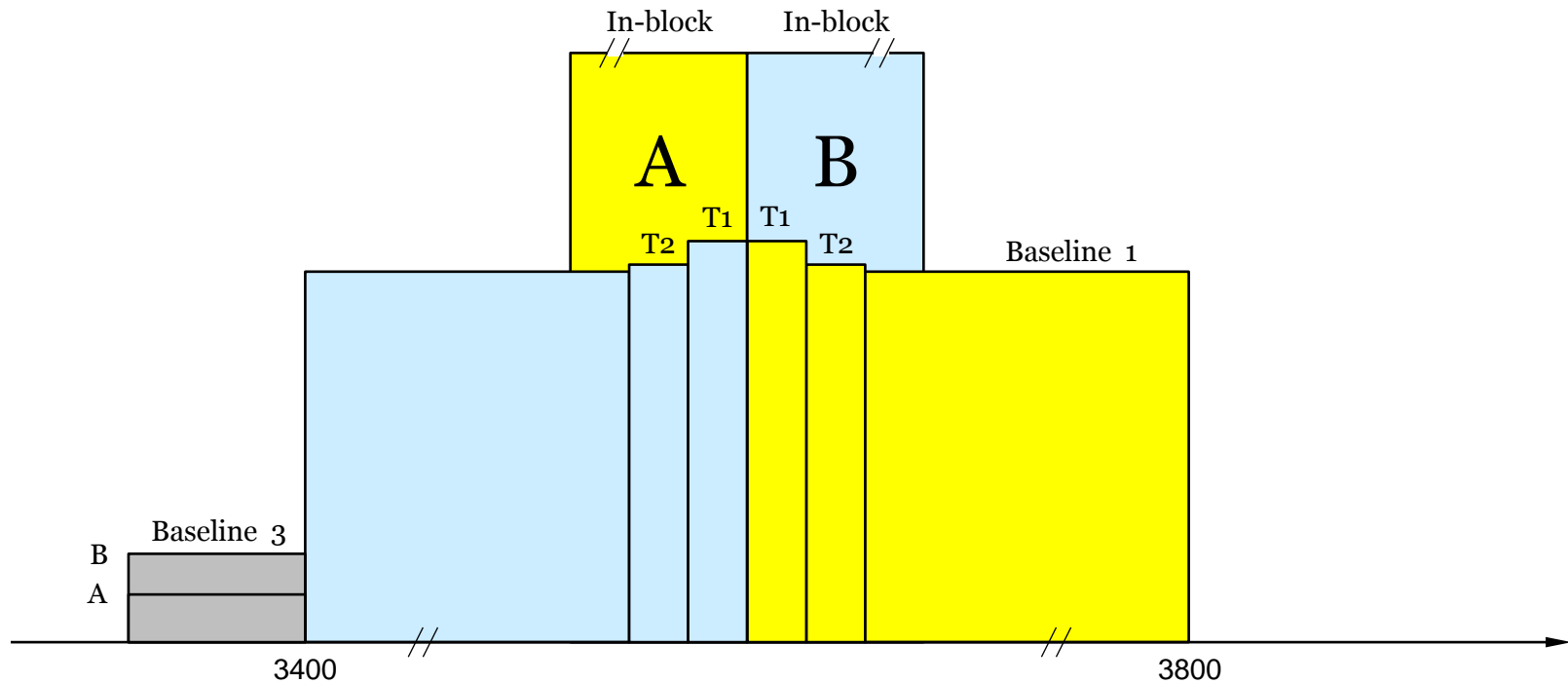
ECC Decision (11)06



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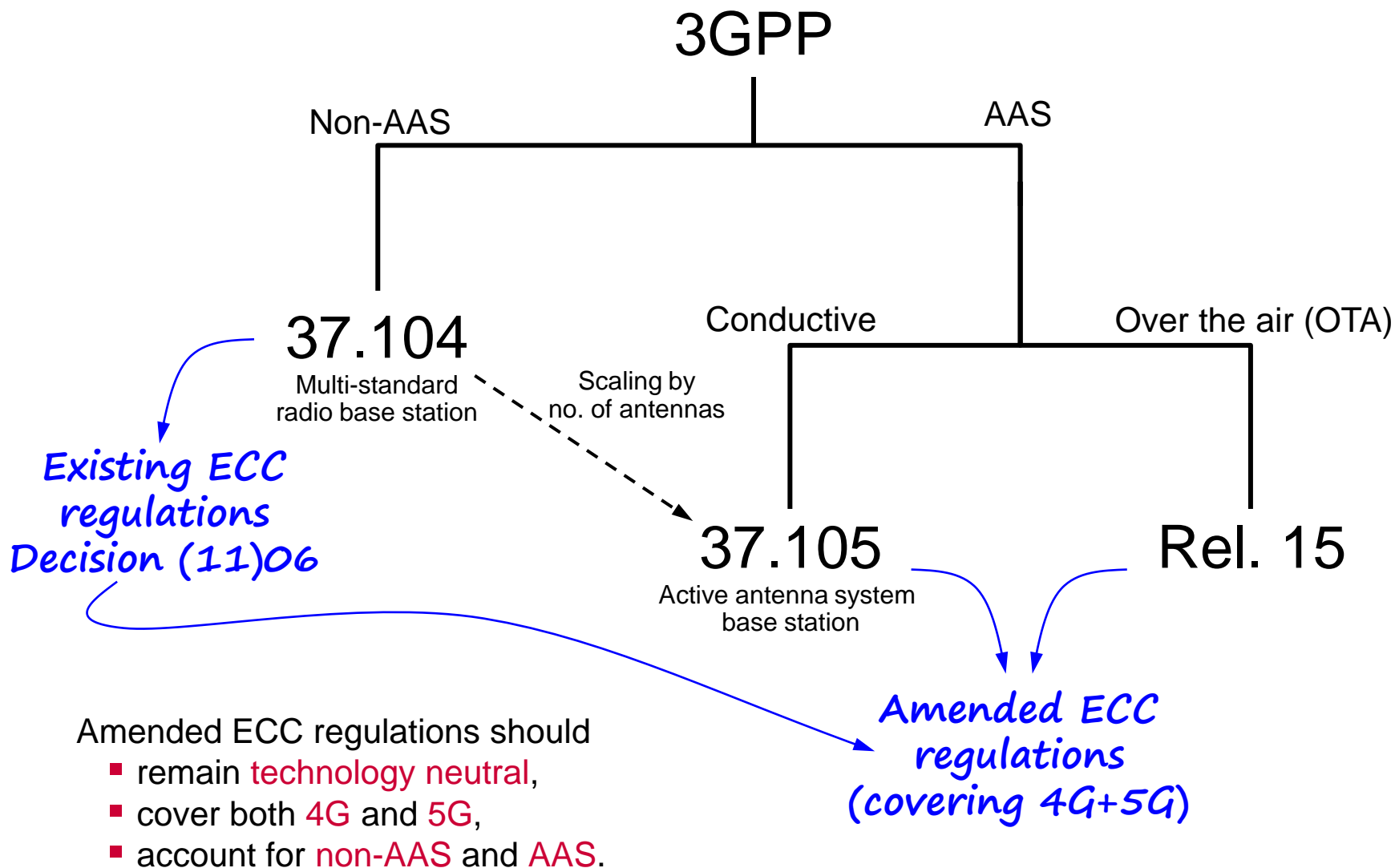
# Synchronised TDD BSs

ECC Decision (11)06



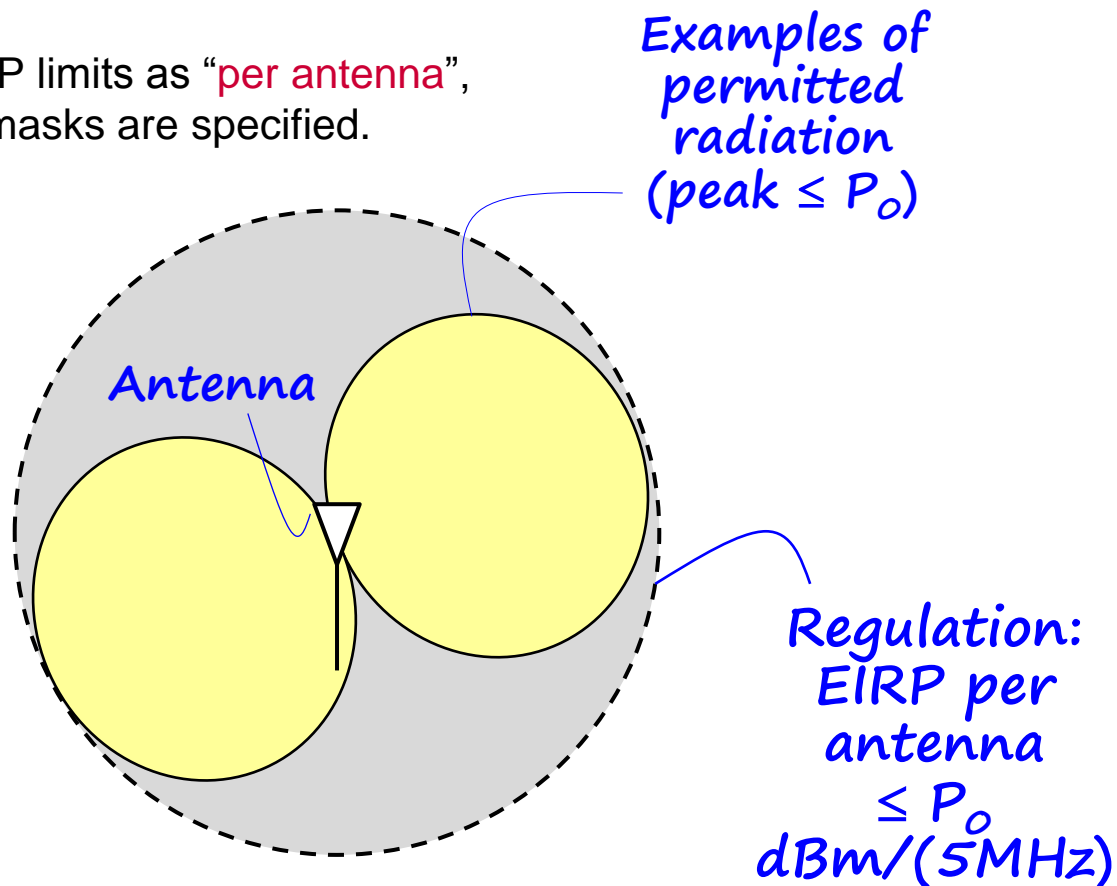
- ❑ Figure depicts adjacent and **synchronised** MFCNs.
- ❑ Transition and Baseline-1 limits relate to **inter-MFCN** interference.
- ❑ Inter-MFCN interference is addressed by **3GPP** unwanted emission **masks**.

# ECC and 3GPP limits



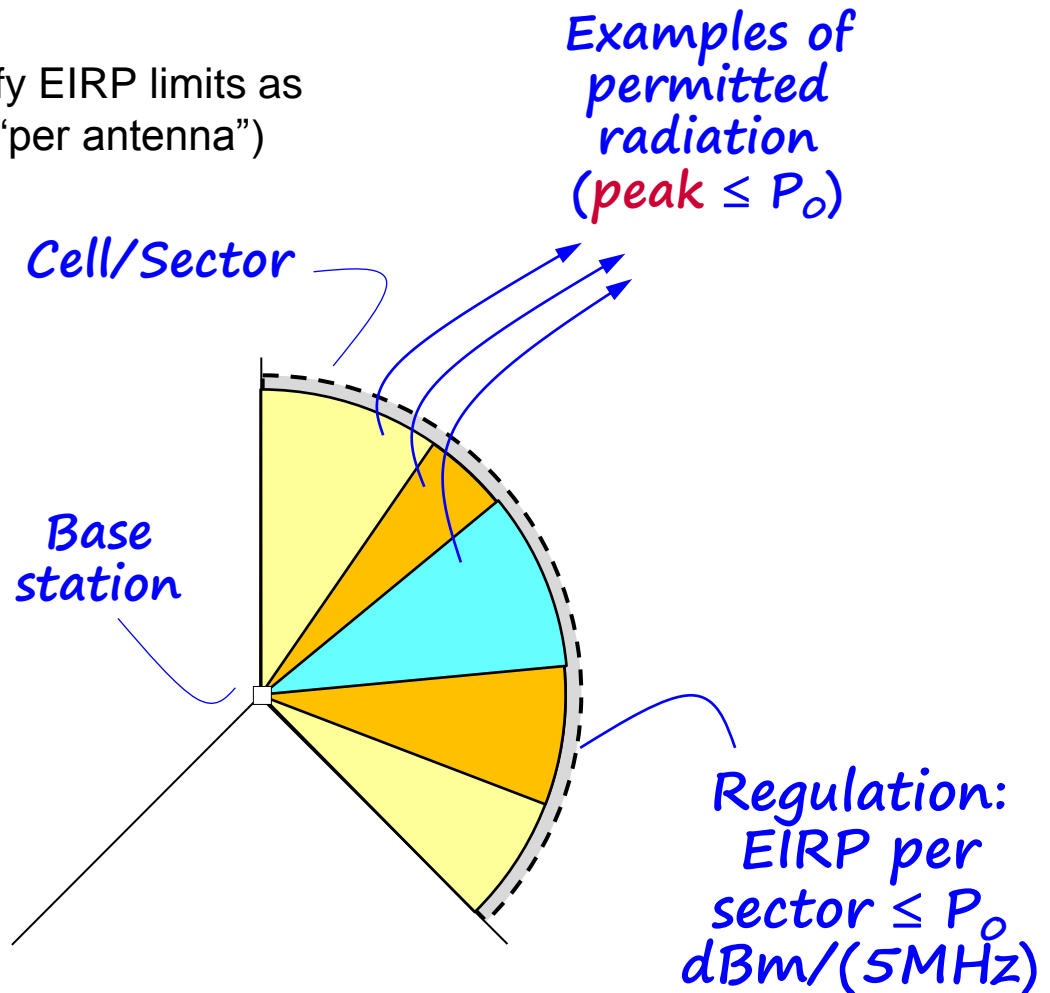
# ECC's existing limits derived from TS 37.104

- Existing ECC EIRP limits are derived from 3GPP conducted unwanted emission mask, assuming a 21 dBi antenna gain (see Annex).
- ECC specifies these EIRP limits as “per antenna”, aligned with how 3GPP masks are specified.



# ECC's preference

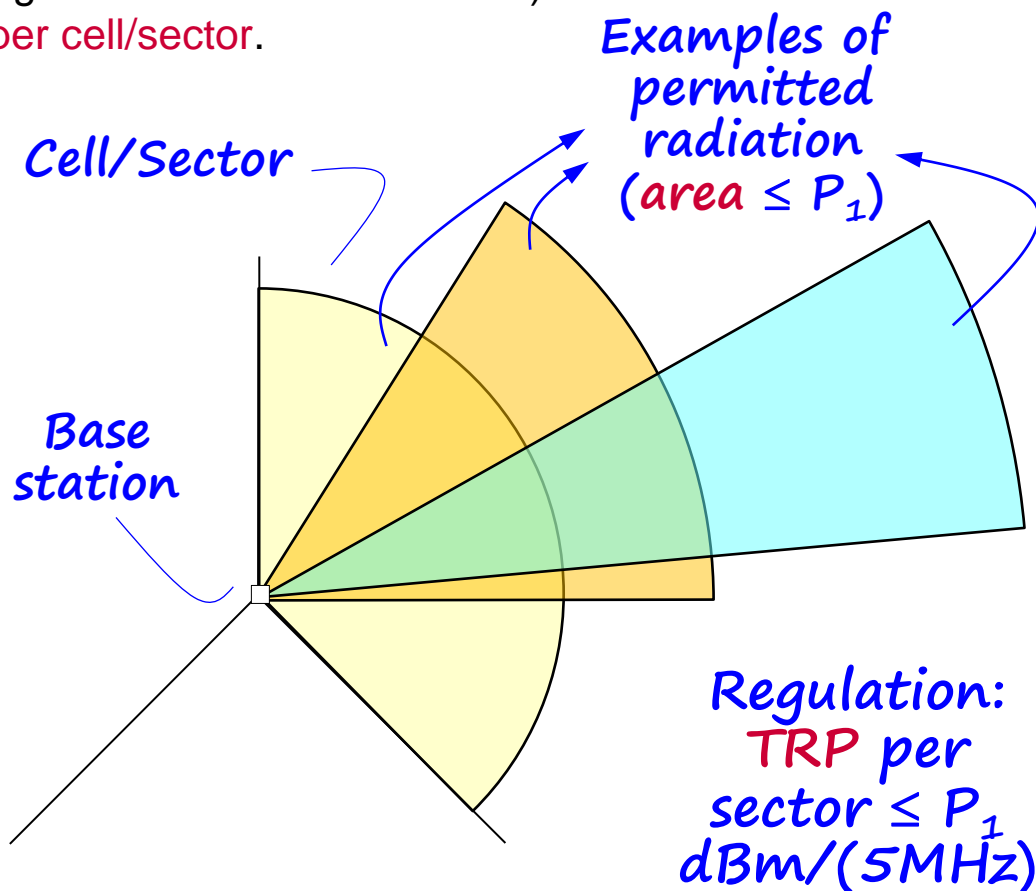
- ECC usually **prefers** to specify EIRP limits as “**per cell/sector**” (rather than “per antenna”) when it conducts its own coexistence analysis.
- These limits apply **equally** and **independently** to each sector.



# Proposal for 5G: TRP instead of EIRP

- 1) Switch from **EIRP** to **TRP** (aligned with **3GPP OTA** limits).
- 2) Switch from **per antenna** to **per cell/sector**.

- Why switch?  
Because according to 3GPP studies<sup>1</sup>, inter-MNO **interference** is **dictated** by **TRP** rather **than EIRP**.
- The shown **example** radiation patterns each correspond to the **same TRP** (i.e., 2D area), and **affect** throughput of adjacent systems in **roughly the same way** even though they correspond to widely different EIRPs.



<sup>1</sup> Huawei, "R4-168430 – On NR BS ACLR requirement," 3GPP TSG-RAN WG4 Meeting #80bis, Oct. 2016.

# What might the ECC regulations look like?

## Non-AAS

- No reason to change these for 4G ( $BW \leq 20$  MHz).
- To accommodate wider bandwidths (5G  $BW \geq 40$  MHz), we may need to add additional blocks (5 MHz or otherwise) based on the specified conductive unwanted emission masks.

Transition and baseline power limits — BS BEM out-of-block EIRP limits per antenna<sup>1</sup>

Out-of-block emission limit	Frequency from block edge	EIRP limit (dBm)	Measurement bandwidth	Application <sup>1</sup>
Transition 1	$\Delta f$ : -5 to 0 or 0 to +5 MHz	$\min(P_{MAX} - 40, 21)$	5 MHz	Per antenna
Transition 2	$\Delta f$ : -10 to 0 or 0 to +10 MHz	$\min(P_{MAX} - 43, 15)$	5 MHz	Per antenna
Baseline 1	Elsewhere	$\min(P_{MAX} - 43, 13)$	5 MHz	Per antenna

<sup>1</sup> The EIRP limits apply for **one to seven antennas** which service a particular cell/sector.

### *Proposed amendment to existing rules:*

- The amended rules would be backward compatible with the existing rules.
- The limits apply where 1 to 7 antennas serve a particular cell/sector.
- For 8 or more antennas, regulations for AAS apply (see next).

# What might the ECC regulations look like?

## AAS

- No reason to change these for 4G (BW  $\leq$  20 MHz).
- To accommodate wider bandwidths (5G BW  $\geq$  40 MHz), we may need to add additional blocks (5 MHz or otherwise) based on the specified conductive unwanted emission masks.

Transition and baseline power limits — BS BEM out-of-block TRP limits per cell/sector<sup>1</sup>

Out-of-block emission limit	Frequency from block edge	TRP limit (dBm)	Measurement bandwidth	Application <sup>1</sup>
Transition 1	$\Delta f$ : -5 to 0 or 0 to +5 MHz	TBD	5 MHz	Per cell/sector
Transition 2	$\Delta f$ : -10 to 0 or 0 to +10 MHz	TBD	5 MHz	Per cell/sector
Baseline 1	Elsewhere	TBD	5 MHz	Per cell/sector

<sup>1</sup> The TRP limits apply to any base station which uses **eight or more antennas** to service a particular cell/sector. The limits apply to the radiations within the cell/sector.

- The limits apply for 8 or more antennas.
- The “TBD” values will be derived from the 3GPP over-the-air (OTA) specifications, as described in the LS response from 3GPP RAN4 (R4-1704402); i.e., a 9 dB addition to the per antenna conducted power limits.



# Summary

- Technology neutral: No distinction between 4G and 5G.
- Distinguish between non-AAS and AAS base stations:
  - A non-AAS base station is considered to have 1 to 7 antennas serving any specific cell/sector.
  - An AAS base station is considered to have 8 or more antennas serving any specific cell/sector.
- The ECC limits for non-AAS would be the same as existing EIRP limits, and scaled with the number of antennas (up to 7) serving any given cell/sector.
- The ECC limits for AAS would be based on 3GPP over-the-air specifications, and specified as the TRP which applies to the radiations within any given cell/sector. The limits would not be scaled with the number of antenna (will be capped at the TRP value which corresponds to 8 antennas).

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# Conclusions

## BS out-of-block EIRP limits (synchronised TDD)

- 3GPP specifies unwanted emission masks in order to mitigate harmful interference between MFCNs in adjacent frequencies.
- For this reason, existing ECC out-of-block limits for synchronised TDD BSs were derived from 3GPP MSR unwanted emission masks for LTE.
- As such, ECC out-of-block limits for 5G synchronised TDD base stations can also be derived from 3GPP unwanted emission masks for 5G.

## Proposal

- We have proposed specific amendments to the existing ECC out-of-block limits for synchronised TDD BSs to account for the use of active antenna systems (AAS) in 5G, and the importance of total radiated power (TRP) as a measure of 5G BS emissions.

# Other items for consideration

## BS out-of-block EIRP limit (unsynchronised TDD)

- The existing ECC out-of-block limit for **unsynchronised** TDD base stations is **more stringent** than **3GPP** unwanted emission **masks** for LTE.
- The derivation of this limit is **technology neutral** and based on **MCL** analysis. In principle, the limit may directly apply to 5G.
- However, it would be **prudent** to **re-assess** the suitability of the **assumptions** in the **derivation** of this limit, specifically those relating to
  - a) **coupling gain** between interferer and victim base stations, and
  - b) **target desensitisation** of the victim base station.
- It is also important to assess the role of **total radiated power** (rather than EIRP) as a measure of 5G BS emissions in specifying this limit.

# Other items for consideration

## BS in-block limit

- ECC Decision (11)06 **does not** mandate a regulatory in-block limit. However, it does **recommend** that if such a limit “is desired by an administration, a value which does not exceed **68 dBm/5 MHz per antenna** may be applied”.
- Furthermore, administrations often specify regulatory in-block EIRP limits on a “**per cell/sector**” basis.
- Is such a recommendation **necessary** for **5G** BSs?

## UE in-block limit

- The **only** ECC technical condition for **UEs** is a recommendation that their in-block radiated power (EIRP for fixed UEs, and TRP for nomadic/mobile UEs) does **not exceed 25 dBm**.
- Is such a recommendation **necessary** for **5G** UEs?



# Annex

# Transition and Baseline-1 limits

Inter-MNO interference (synchronised)



From TS 37.104

Table 6.6.2.1-1: Wide Area operating band unwanted emission mask (UEM) for BC1 and BC3

Comparison between 3GPP and ECC limits

Frequency offset (MHz)	3GPP unwanted emission mask ( <b>37.104</b> , Table 6.6.2.1-1)	Average Tx power	Units	3GPP: Tx Power (dBm/5MHz)		<b>3GPP: EIRP* (dBm/5MHz)</b>	<b>ECC EIRP** limits (dBm/5MHz)</b>
0 to 0.2	-14	-14.0	dBm/30kHz	8.2	0.1	<b>21.1</b>	<b>21</b>
0.2 to 1	-14 to -26	-16.7	dBm/30kHz	5.5			
1 to 5	-13	-13.0	dBm/1MHz	-6.0			
5 to 10	-13	-13.0	dBm/1MHz	-6.0	-6.0	<b>15.0</b>	<b>15</b>
10 to 15	-15	-15.0	dBm/1MHz	-8.0	-8.0	<b>13.0</b>	<b>13</b>
* Assuming a nominal antenna gain of 21 dBi.							
** Assuming a carrier EIRP of 61 dBm/5MHz or more.							

- The existing ECC **transition** and **baseline** limits for interference between synchronized TDD base stations are specified **relative** to the maximum **carrier** EIRP of the base station (per cell/sector), and are specified **per antenna** element.
- The limits are **capped** at values that are **consistent** with the 3GPP MSR *wide area* unwanted emission mask (assuming a **21 dBi** antenna gain).

# Thank you

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