EBU

OPERATING EUROVISION AND EURORADIO

5G FOR THE DISTRIBUTION OF MEDIA CONTENT: BACKGROUND

ANDREW MURPHY
BBC RESEARCH & DEVELOPMENT

WHERE DID THE STORY START?

2011 – EBU CTN-Mobile Group

- ‘What can 4G do for broadcasting?’
- Broadcaster & Mobile Industry representatives
- Concentration on technical & business aspects

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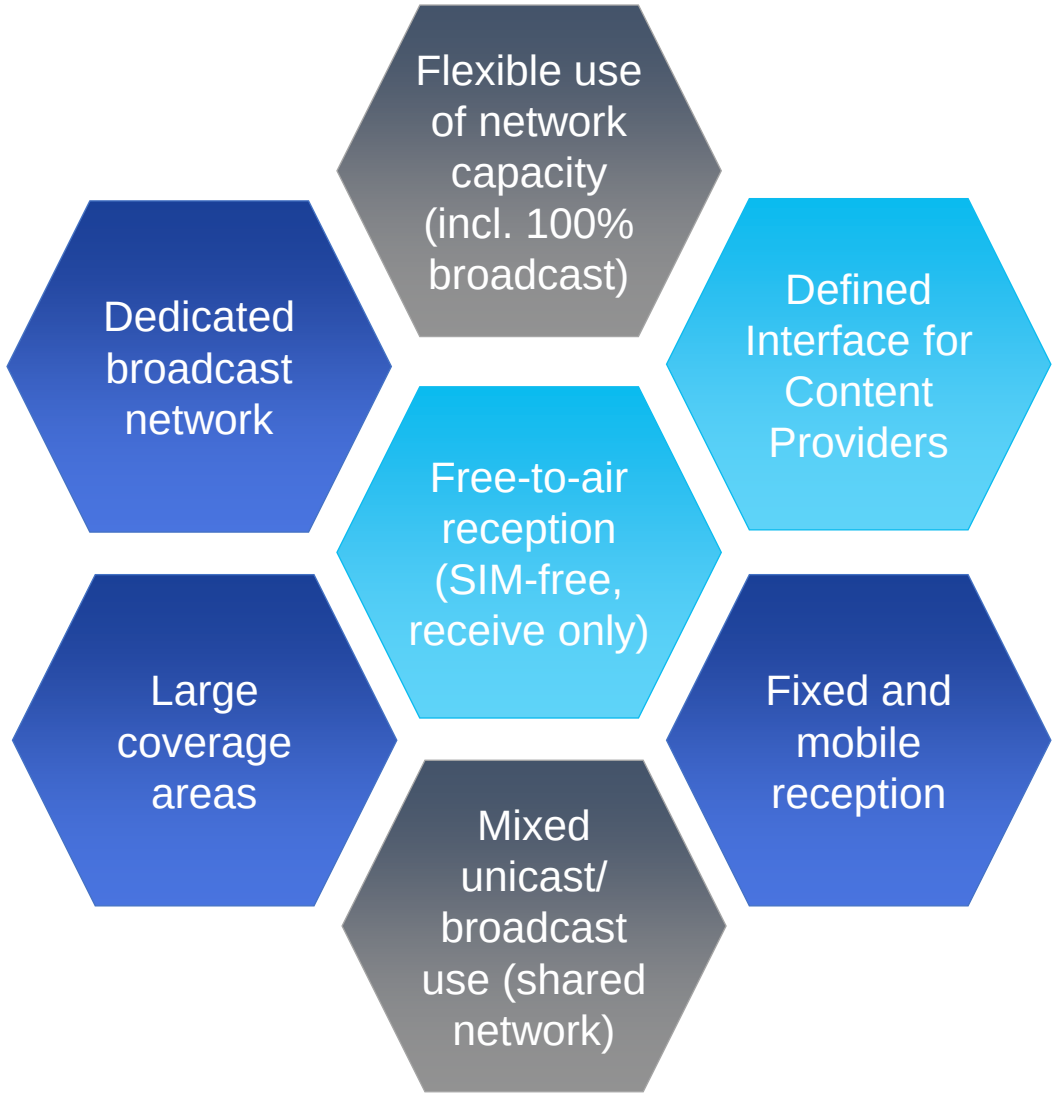

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- Mobile industry began looking at TV services
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WHERE DID THE STORY START?

3GPP TR 22.816 V14.1.0 (2016-03)

Technical Report

3rd Generation Partnership Project;
Technical Specification Group Services and System Aspects;
3GPP enhancement for TV service
(Release 14)

A GLOBAL INITIATIVE

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The present document has not been subject to any approval process by the 3GPP Organizational Partners and shall not be implemented.
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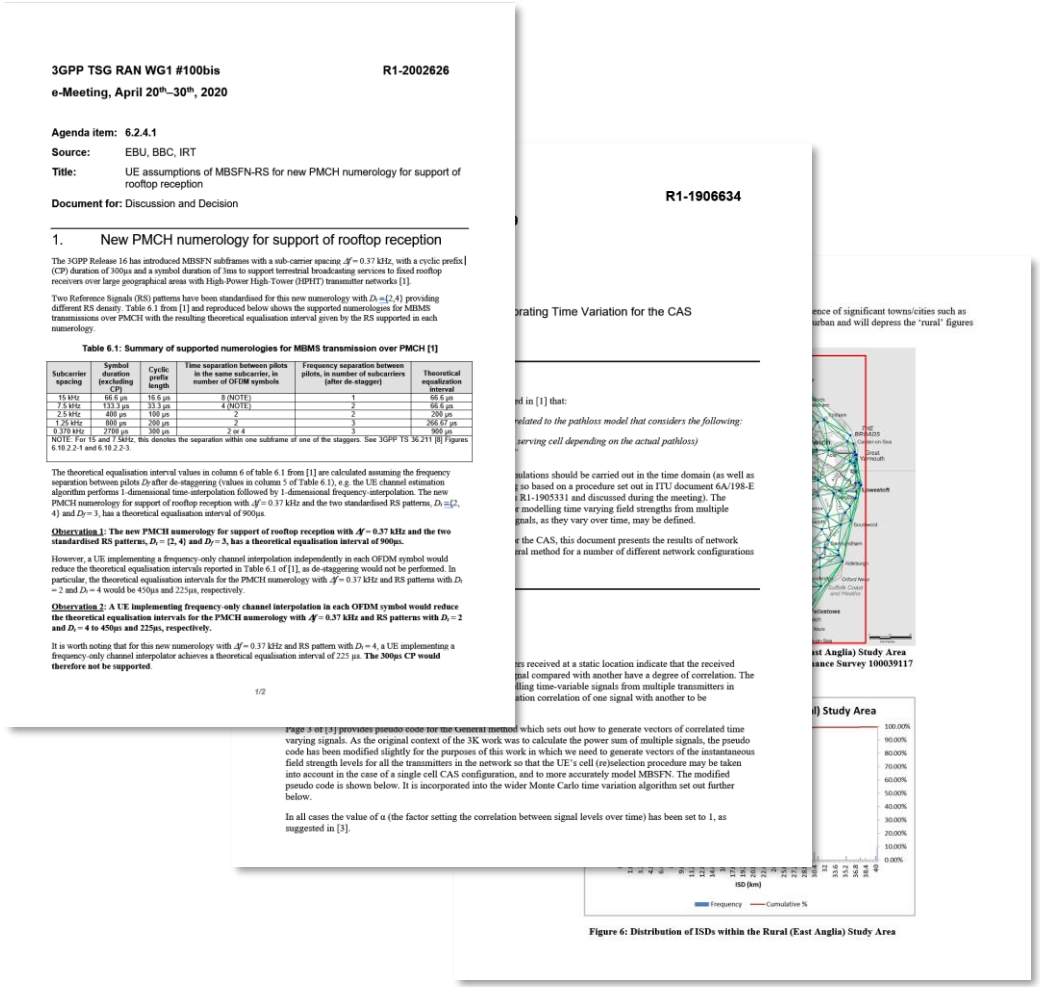

3GPP TSG RAN WG1 #100bis — R1-2002626
e-Meeting, April 20th–30th, 2020

Agenda item: 6.2.4.1
Source: EBU, BBC, IRT
Title: UE assumptions of MBSFN-RS for new PMCH numerology for support of rooftop reception
Document for: Discussion and Decision

1. New PMCH numerology for support of rooftop reception

The 3GPP Release 16 has introduced MBSFN subframes with a sub-carrier spacing $\Delta f = 0.37$ kHz, with a cyclic prefix (CP) duration of 300µs and a symbol duration of 3ms to support terrestrial broadcasting services to fixed rooftop receivers over large geographical areas with High-Power High-Tower (HPHT) transmitter networks [1].

Two Reference Signals (RS) patterns have been standardised for this new numerology with $D_1 = \{2, 4\}$ providing different RS density. Table 6.1 from [1] and reproduced below shows the supported numerologies for MBMS transmissions over PMCH with the resulting theoretical equalisation interval given by the RS supported in each numerology.

Table 6.1: Summary of supported numerologies for MBMS transmission over PMCH [1]

Subcarrier spacing	Symbol duration (excluding CP)	Cyclic prefix length	Time separation between pilots in the same subcarrier, in number of OFDM symbols	Frequency separation between pilots, in number of subcarriers (after de-stagger)	Theoretical equalization interval
15 kHz	66.6 µs	16.6 µs	8 (NOTE)	1	66.6 µs
7.5 kHz	133.3 µs	33.3 µs	4 (NOTE)	2	66.6 µs
2.5 kHz	400 µs	100 µs	2	2	200 µs
1.25 kHz	800 µs	200 µs	2	3	266.67 µs
0.370 kHz	2700 µs	300 µs	2 or 4	3	900 µs

NOTE: For 15 and 7.5kHz, this denotes the separation within one subframe of one of the staggers. See 3GPP TS 36.211 [8] Figures 6.10.2.2-1 and 6.10.2.2-3.

The theoretical equalisation interval values in column 6 of table 6.1 from [1] are calculated assuming the frequency separation between pilots D_f after de-staggering (values in column 5 of Table 6.1), e.g. the UE channel estimation algorithm performs 1-dimensional time-interpolation followed by 1-dimensional frequency-interpolation. The new PMCH numerology for support of rooftop reception with $\Delta f = 0.37$ kHz and the two standardised RS patterns, $D_1 = \{2, 4\}$ and $D_f = 3$, has a theoretical equalisation interval of 900µs.

Observation 1: The new PMCH numerology for support of rooftop reception with $\Delta f = 0.37$ kHz and the two standardised RS patterns, $D_1 = \{2, 4\}$ and $D_f = 3$, has a theoretical equalisation interval of 900µs.

However, a UE implementing a frequency-only channel interpolation independently in each OFDM symbol would reduce the theoretical equalisation intervals reported in Table 6.1 of [1], as de-staggering would not be performed. In particular, the theoretical equalisation intervals for the PMCH numerology with $\Delta f = 0.37$ kHz and RS patterns with $D_1 = 2$ and $D_1 = 4$ would be 450µs and 225µs, respectively.

Observation 2: A UE implementing frequency-only channel interpolation in each OFDM symbol would reduce the theoretical equalisation intervals for the PMCH numerology with $\Delta f = 0.37$ kHz and RS patterns with $D_1 = 2$ and $D_1 = 4$ to 450µs and 225µs, respectively.

It is worth noting that for this new numerology with $\Delta f = 0.37$ kHz and RS pattern with $D_1 = 4$, a UE implementing a frequency-only channel interpolator achieves a theoretical equalisation interval of 225 µs. **The 300µs CP would therefore not be supported.**

1/2

R1-1906634

...rating Time Variation for the CAS

...ed in [1] that:

...related to the pathloss model that considers the following:

...serving cell depending on the actual pathloss)

...ulations should be carried out in the time domain (as well as ...so based on a procedure set out in ITU document 6A/198-E ...R1-1905331 and discussed during the meeting). The ...modelling time varying field strengths from multiple ...gnals, as they vary over time, may be defined.

...the CAS, this document presents the results of network ...ral method for a number of different network configurations

...ence of significant towns/cities such as ...urban and will depress the 'rural' figures

...st Anglia) Study Area ...nance Survey 100039117

...l) Study Area

...rs received at a static location indicate that the received ...al compared with another have a degree of correlation. The ...lling time-variable signals from multiple transmitters in ...ation correlation of one signal with another to be

Page 3 of [3] provides pseudo code for the General method which sets out how to generate vectors of correlated time varying signals. As the original context of the 3K work was to calculate the power sum of multiple signals, the pseudo code has been modified slightly for the purposes of this work in which we need to generate vectors of the instantaneous field strength levels for all the transmitters in the network so that the UE's cell (re)selection procedure may be taken into account in the case of a single cell CAS configuration, and to more accurately model MBSFN. The modified pseudo code is shown below. It is incorporated into the wider Monte Carlo time variation algorithm set out further below.

In all cases the value of α (the factor setting the correlation between signal levels over time) has been set to 1, as suggested in [3].

ISD (km)

Frequency — Cumulative %

Figure 6: Distribution of ISDs within the Rural (East Anglia) Study Area

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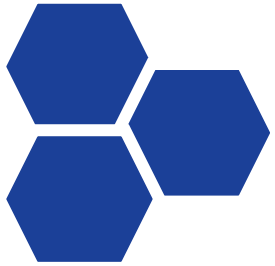
2020 – 5G BROADCAST

- broadcaster engagement continues…

WHAT IS 5G?



Mobile Network

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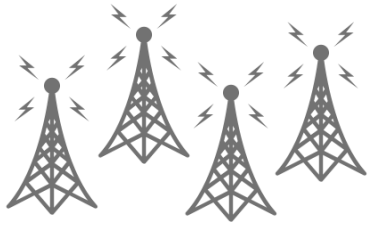
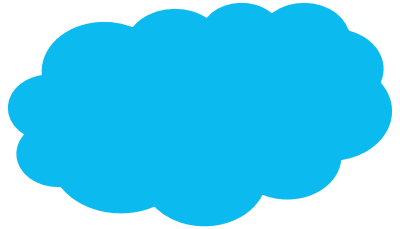


Radio Access Network

+

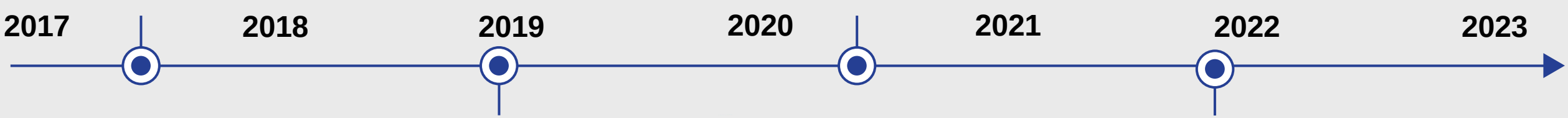


Core Network

4G (LTE)	=	**E-UTRAN**	+	**Evolved Packet (4G) Core**
5G (Standalone)	=	**5G New Radio (NR)**	+	**5G Core**
5G (Non-Standalone)	=	**{5G NR + E-UTRAN}**	+	**Evolved Packet (4G) Core**

3GPP RELEASES

- 3GPP Standards are based on ‘Releases’
- Not the same as DVB generations that result in completely new documents
  - More akin to an evolution



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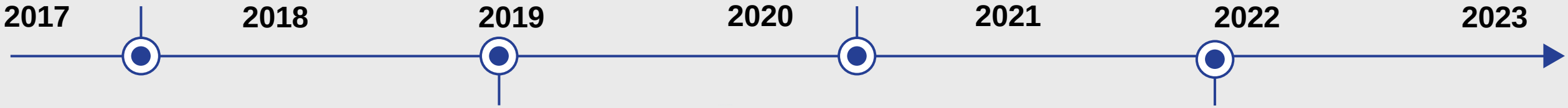
RELEASE 14 LTE Advanced Pro

4G Broadcast – FeMBMS (**EnTV**)

- Broadcaster requirements



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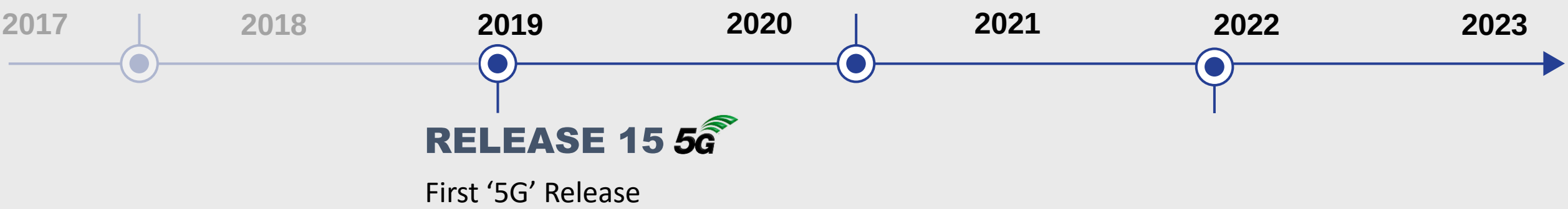

RELEASE 15 5G

First ‘5G’ Release

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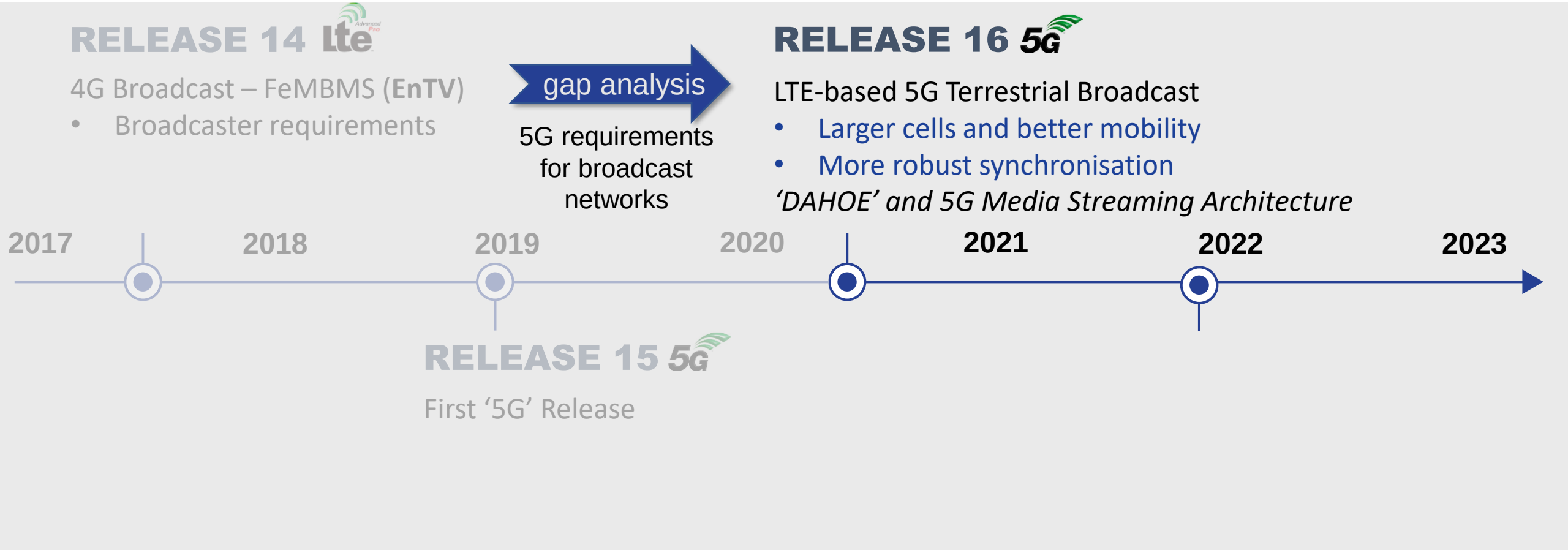

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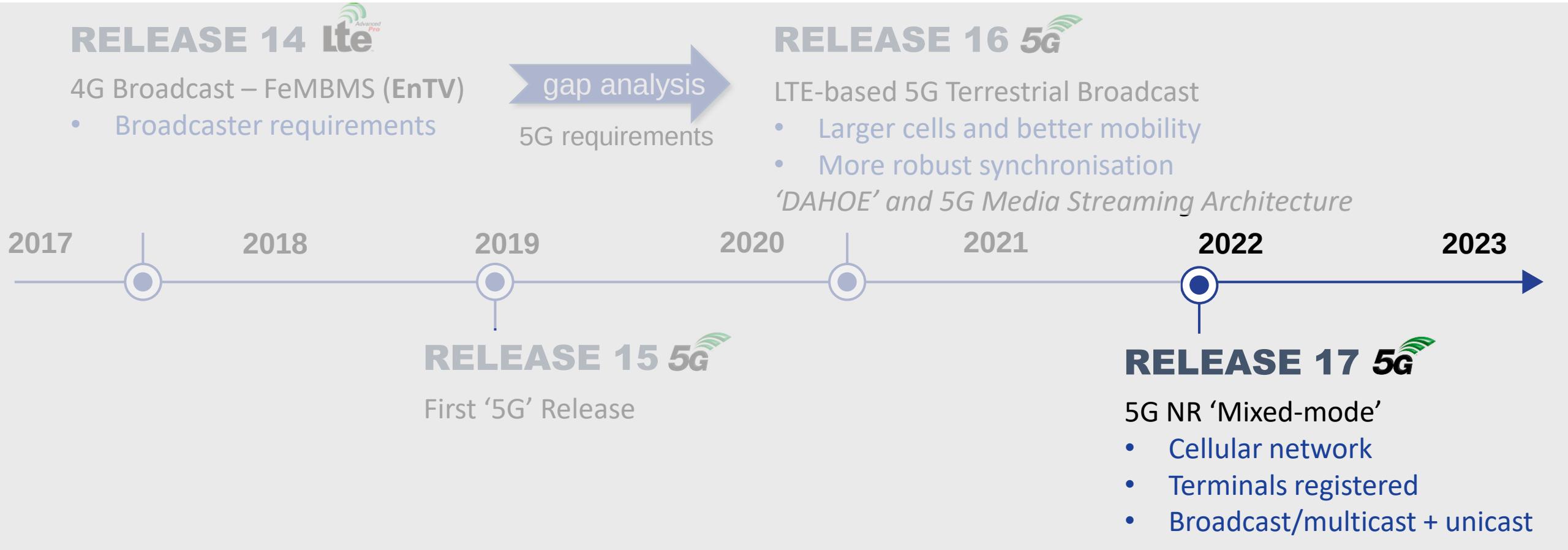

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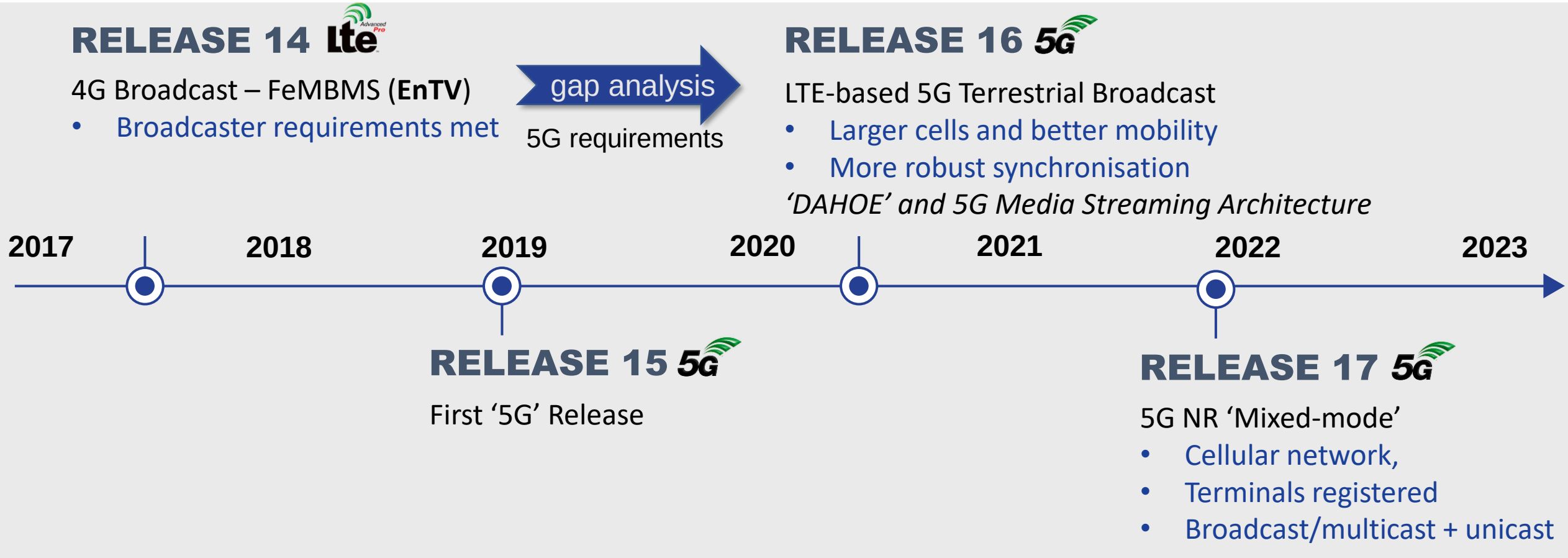

SUMMARY – CAPABILITIES

Large coverage areas
100 µs, 200 µs & 300 µs Cyclic Prefixes
Improved Synchronisation Robustness (CAS)

Fixed and Mobile reception
Broadcast and mobile networks
Support for higher velocities

Flexible network capacity
100% allocation of broadcast sub-frames

Dedicated broadcast networks
Specified TMGI (PLMN) for broadcast carriers

LTE-based 5G Terrestrial Broadcast

3GPP
Release 16

Free-to-air reception
Receive-only devices without SIM

Defined Interfaces
xMB for Content Providers
MBMS-API for Application Developers

Transport-only mode
Option to carry existing A/V formats

Shared broadcast
Common broadcast carrier available to multiple mobile networks