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Future of Digital TV:

Spectrum Considerations for 5G-Xcast

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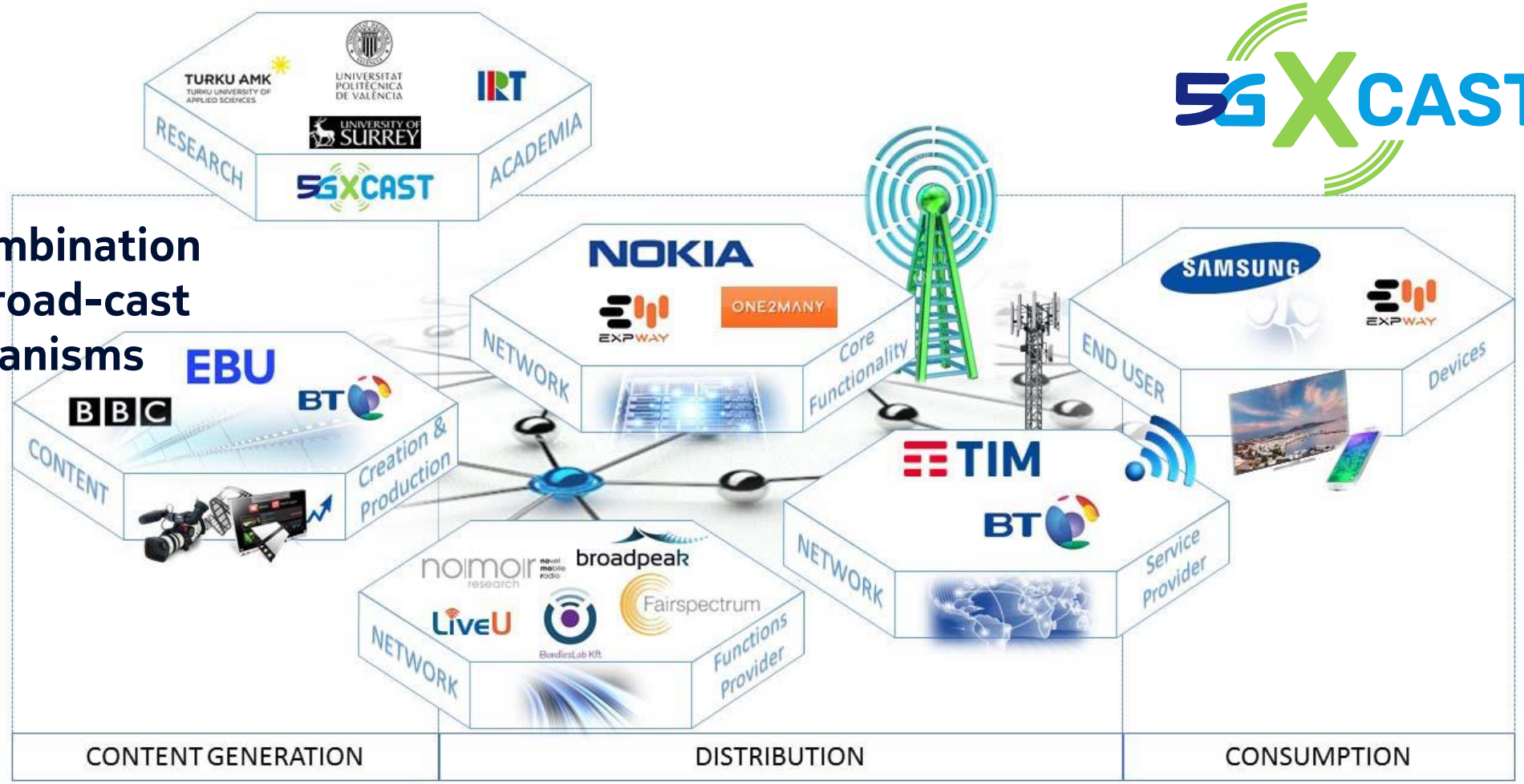
5G-Xcast Consortium

Xcast: An efficient combination of uni-, multi-, and broad-cast transmission mechanisms



- Broadcast and Multicast Communication Enablers for the Fifth-Generation of Wireless Systems (5G-Xcast)
  - Project Duration: June 2017 – May 2019 (24 months)
  - European Union funded project; Call **H2020-ICT-2016-2**; Grant Number: **761498**

5G-Xcast Vision

Personalized Broadcast

Converged and hybrid Xcast

Flexible and Cloud-native Architecture

OPPORTUNITY FOR THE CONVERGENCE OF FIXED, MOBILE AND BROADCAST NETWORKS

CLOUD-NATIVE ARCHITECTURE ENABLING UNPRECEDENT COMMUNICATION CAPABILITIES

NETWORK SLICING FOR BROADCAST SERVICES

PTM & CONTENT POSITIONING AS BUILT-IN NETWORK DELIVERY OPTIMISATIONS, NOT AS A SERVICE, FOR ALL VERTICALS

New media content delivery, OTT and µO network compliant

PTM: Point-to-Multipoint

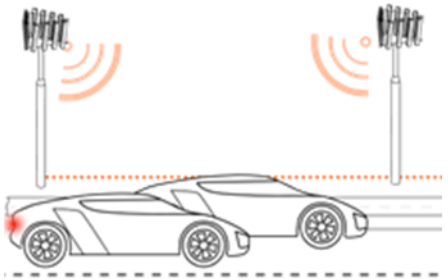
µO: Micro-Operator

5G-Xcast Vision

Multimedia & Entertainment

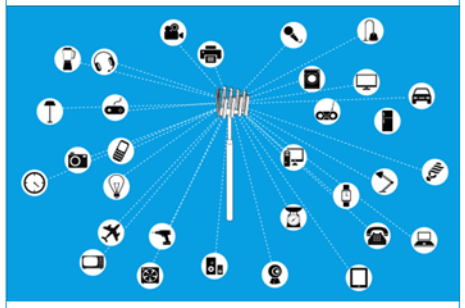
- UHDTV delivery
- VR, AR, 360° video
- Content prepositioning
- Push to X (talk/video)

Automotive



- Autonomous driving information
- Infotainment
- Safety applications
- Signage information

Internet of Things



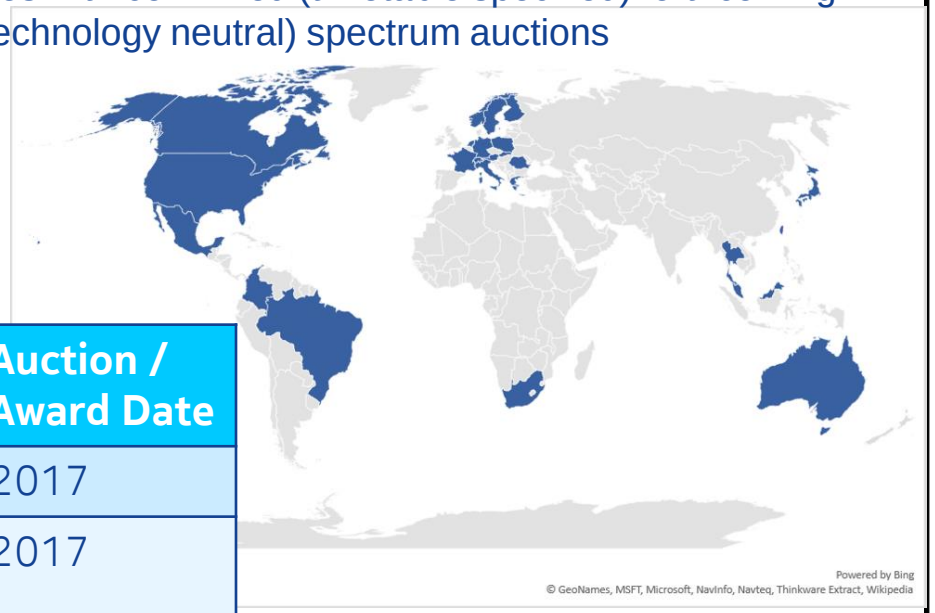
- Software & firmware updates
- Common control messages to devices

Public Warning

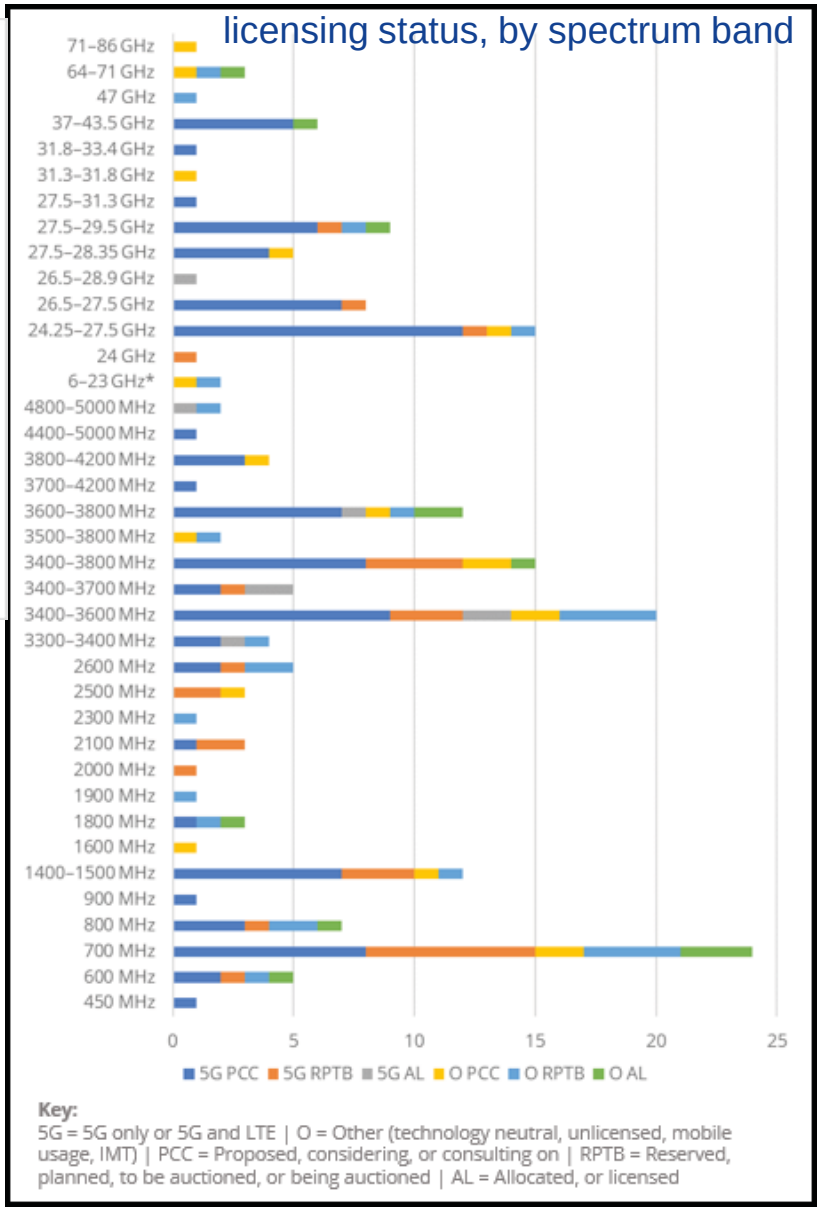
- Disaster alerts (e.g. tsunami, earthquake)
- Emergency alerts (e.g. hazar, amber alerts)

5G Spectrum Current Status

†Countries with confirmed (timetable specified) forthcoming 5G (or technology neutral) spectrum auctions



†Count of countries with various 5G licensing status, by spectrum band



†Completed 5G Auctions

Region / Country	Band / Licensing Basis	Auction / Award Date
Ireland	3.6 GHz / MBB, 5G	2017
Latvia	3.4 – 3.45, 3.65-3.7 GHz / 5G	2017
South Korea	3.42 – 3.7, 26.5 – 28.9 GHz / 5G	June 2018
Spain	3.6 – 3.8 GHz / 5G	July 2018
UK	3.4 GHz / 5G	2018

- **17 countries** have formally announced **5G spectrum** auction plans between 2018 – 2021
- **9 countries** have planned spectrum allocations in **potential 5G** bands

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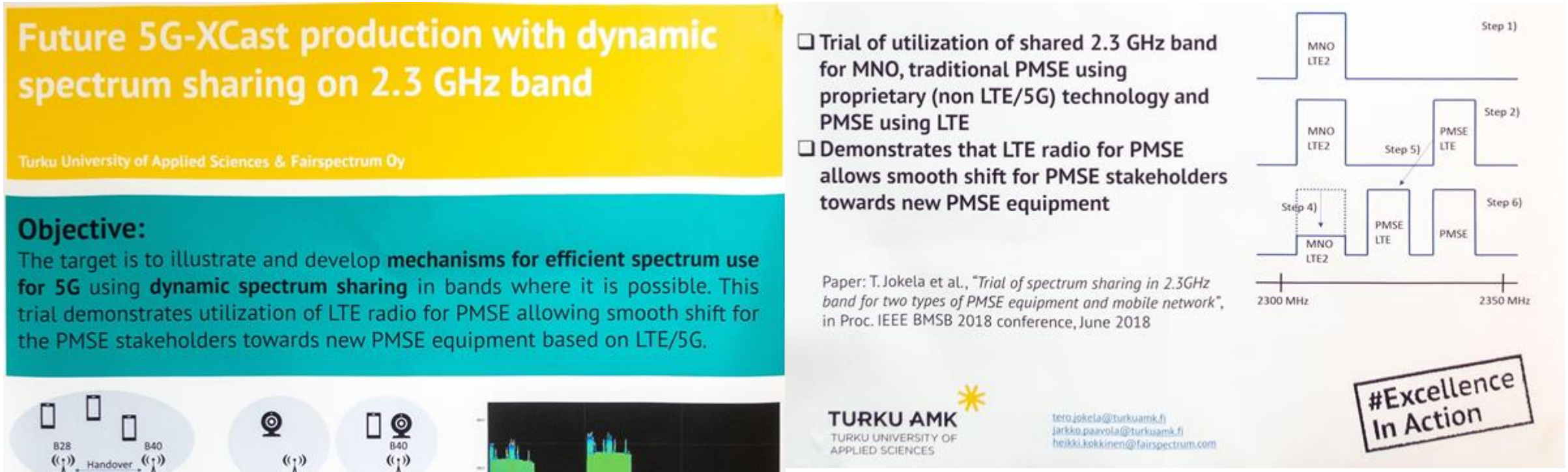
†**Source**: GSA Report: "Spectrum for Terrestrial 5G Networks: Licensing Developments Worldwide", July 2018. (https://gsacom.com/)

5G Spectrum
Broadcast / Digital TV Context

Region / Country†	Band / Licensing Basis	Broadcast Relevance
Australia	1.5, 3.6, 25.25 – 27 GHz / 5G	The 1.5 GHz spectrum is planned for auctioning in Q2 2019. The band is currently in a process of re-farming for mobile services and broadcasting satellite services.
Slovakia	700 MHz / Under consideration 3.6 – 3.8, 10 GHz / Unspecified 26, 29 GHz / Consultation	Considering allocating spectrum at 700 MHz after freeing it up from use by digital TV. In May 2018 RU launched an auction for spectrum in the 10 GHz band, designated for public wireless access comms.

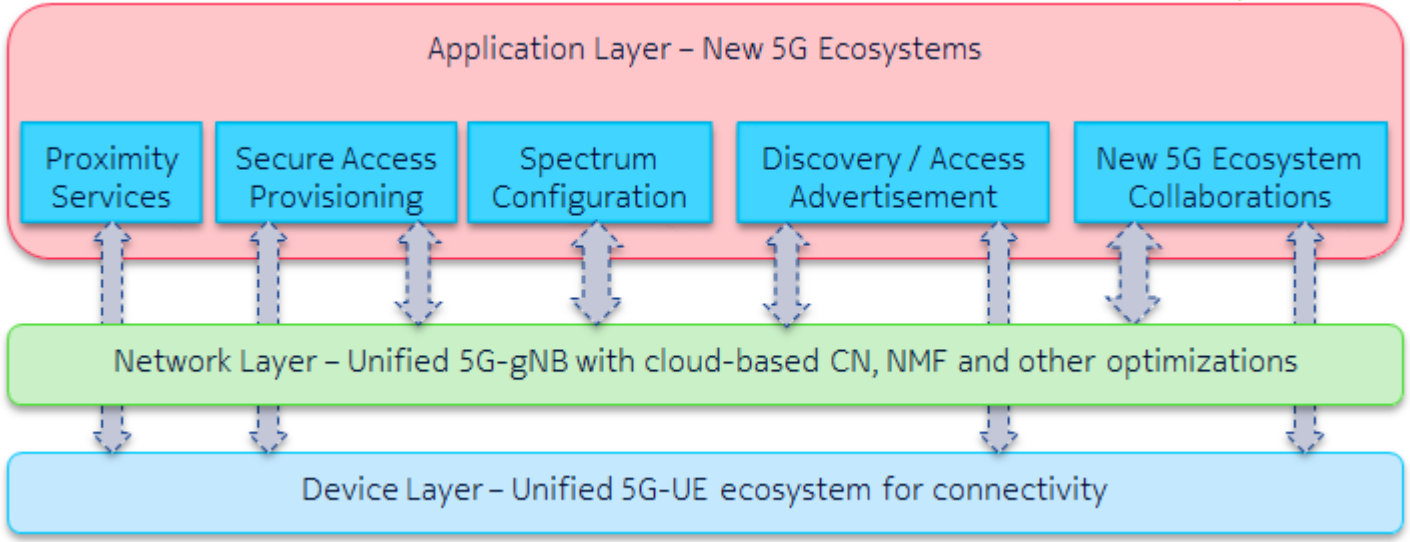
†**Source**: GSA Report: "Spectrum for Terrestrial 5G Networks: Licensing Developments Worldwide", July 2018. (https://gsacom.com/)

Future Digital TV Production
Demo at EuCNC 2018



- ETSI has specified how Licensed Shared Access (LSA) helps mobile operators to use the same spectrum band as a secondary user.
- Part of the 2.3 GHz Program Making and Special Events (PMSE) users are expected to migrate the camera communication to LTE or 5G.
- The demo showcased how the current license holders - PMSE, can be prioritized and how LSA can be used to manage spectrum sharing between current PMSE use, LTE based PMSE use and commercial LTE operator network.

Unlicensed Xcasting
Enabling New Services

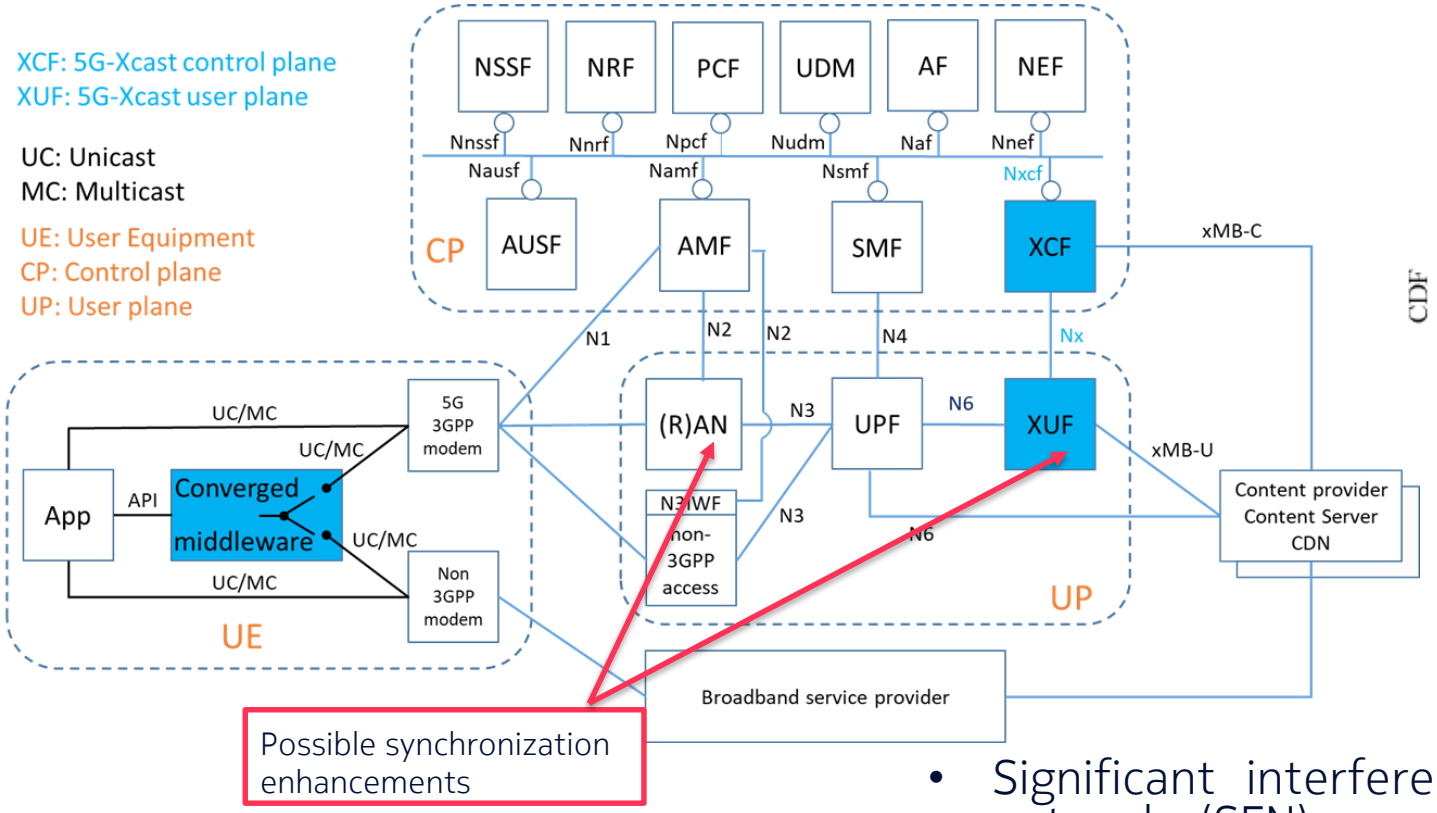


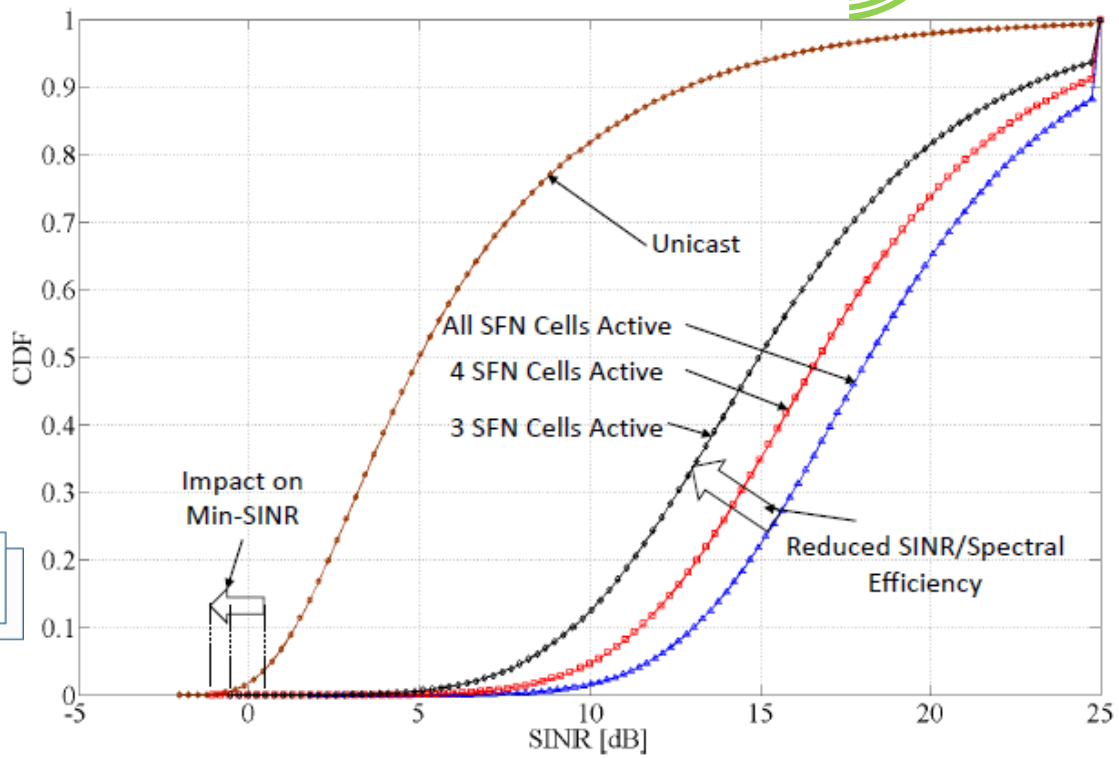
- Data rates growing exponentially
- Spectral resources limited & expensive
- Micro-operator networks – a key enabler for technology adoption in 5G
  - Need cost-efficient solutions for massive scale deployments
  - Redefining end user trust paradigms and relationships between incumbents
- Need to investigate competitive technology enablers for 5G, as compared to currently available radio access technologies

Figure Source: A. Prasad, Z. Li, S. Holtmanns, M.A. Uusitalo, "5G Micro-Operator Networks – A Key Enabler for New Verticals and Markets," IEEE 25th Telecommunications Forum (TELFOR), Belgrade, Nov. 2017.

Unlicensed Xcasting
Architecture & Performance

Source: 5G-Xcast Deliverable D4.1

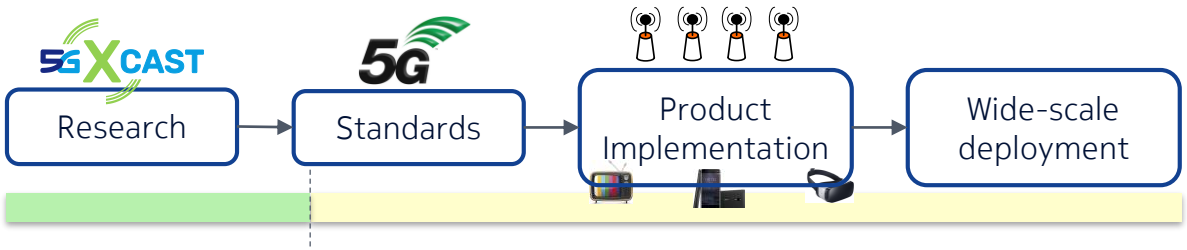




- Significant interference reduction using enhanced single frequency networks (SFN)
  - To enable higher spectral efficiency for multicast / broadcast content
  - Complying with listen-before-talk constraints
  - Significant improvement in cell-edge user SINR
    - Key metric for multicast / broadcast

Source: A. Prasad, P. Lundén, M.A. Uusitalo, Z. Li, "Enhancements for Enabling Point-to-Multipoint Communication Using Unlicensed Spectrum," IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB), June 2018.

5G-Xcast
From Vision to Reality



Discussions expected to start in Oct. 2018

- New study on "LTE-based 5G Terrestrial Broadcast" approved in 3GPP RAN meeting (June 2018)
  - Supported by a wide range of partners from 5G-Xcast consortium and advisory board
  - Enabling covergence of different worlds

- Core Objective [Source: 3GPP TDoc RP-181342, Qualcomm Inc.]
  - "For the broadcast requirements in 3GPP TR 38.913, and taking as baseline Rel-14 LTE:
    - Identify which of the broadcast requirements in TR 38.913 are relevant for dedicated terrestrial broadcast networks.
      - Capture the gap analysis and potential solutions (if needed) to meet the broadcast requirements in a TR."
    - Rel-14 LTE eMBMS have been expanded to include terrestrial broadcasting (also referred as "EnTV" incl. features such as dedicated eMBMS, larger inter-site dist. (new cyclic prefix of 200µs), network sharing and receive-only mode.
      - Further requirements for the 5G radio access were defined in TR 38.913.
    - LTE-based eMBMS has undergone a deep transformation in the Rel-14 such that many of the 5G requirements for dedicated broadcast networks may be already fulfilled, thereby requiring gap-analysis
      - The gap analysis will compare the current LTE broadcasting capabilities with the requirements for 5G dedicated broadcast networks in TR 38.913

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Public deliverables, scientific papers, presentations:
http://5g-xcast.eu/documents/

Website:
www.5g-xcast.eu

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Videos:
https://www.youtube.com/channel/UCCl2iSgTDx42UiLoRcDyDBg
https://youtu.be/daFOf30NG2U

DISCLAIMER: This work was supported in part by the European Commission under the 5G-PPP project Broadcast and Multicast Communication Enablers for the Fifth-Generation of Wireless Systems 5G-Xcast (H2020-ICT-2016-2 call, grant number 761498). The views expressed in this contribution are those of the authors and do not necessarily represent the project.