3GPP 5G-Advanced – outlook to Release 18– CELTIC-NEXT Jan 26, 2022

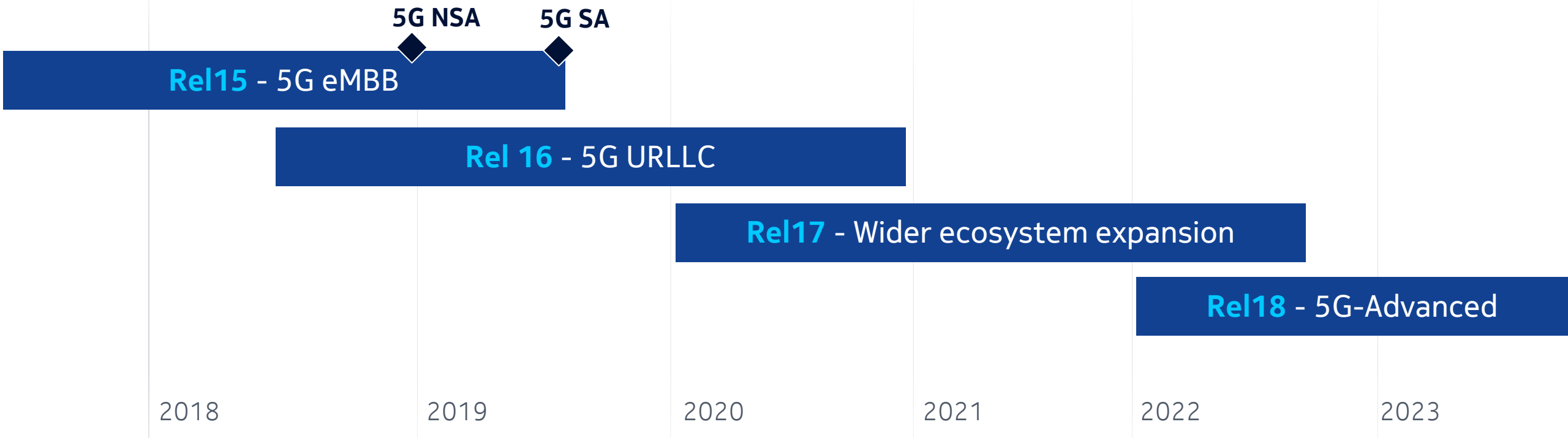
Antti Toskala
Bell Labs Fellow
Nokia
Espoo, Finland

Outline

3GPP schedule update

5G-Advanced in Release 18

3GPP Standards roadmap



Release 15
- Mobile broadband
- Commercial 04/2019

Release 16
- Industrial IoT (URLLC)
- Completed 12/2020

Release 17
- Wider ecosystem
- Completion mid-2022

Release 18
- 5G-Advanced
- Spec ready Q1/2024
- Deployment 2025 ->

5G-Advanced June workshop* demonstrated wide interest

+40 CSPs.

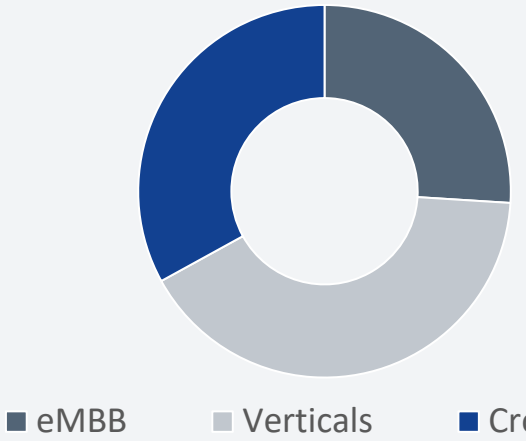
+40 Vertical players

+1200 Participants

+500 Contributions

+200 Companies

5G-Advanced workshop contributions



Enhanced MBB	26%
Verticals	41%
Cross-functional	33%

* 3GPP TSG RAN 5G-Advanced Workshop June 2021

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5G-Advanced in Release 18

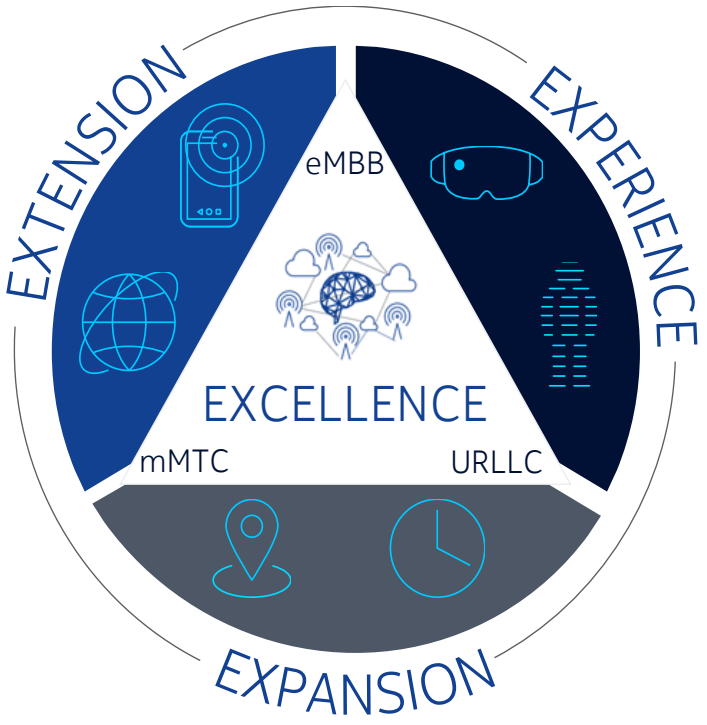
5G-Advanced provides new usage areas and services with boosted resiliency and operability

Extension

- Uplink coverage
- IoT optimized RedCap
- Non-terrestrial networks (NTN)
- UAV optimization
- Sidelink enhancements
- Sub 5MHz for verticals
- Wake-up Signal

Expansion

- Positioning
- Resilient timing



Experience

- Extended reality (XR)
- MIMO enhancements
- Mobility enhancements
- Duplex operations

Excellence

- AI/ML for NG-RAN
- AI/ML for Air Interface
- Network energy efficiency
- Centralized unit resiliency
- Network-controlled Repeater
- DSS enhancements
- Mobile IAB

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5G-Advanced brings improvements in many areas

Enhanced mobility

- Reliability to 99.9%
- Break from 50 to 0 ms (FR2)
- Improved FR2 Scell setup

Enhanced coverage

- PUSCH 2 dB
- RACH 5 dB

MIMO performance

- Enhanced uplink
- Multi-cell uplink
- +20% for high speed mobiles

XR (AR, VR, gaming)

- Guaranteed
- Seamless
- Low power consumption
- Edge computing

Resilient timing

- No GPS required
- Timing service over 5G network

5G to replace GSM-R

- Enable GSM-R migration to 5G with <5 MHz support for dedicated spectrum

Enhanced sidelink

- Sidelink meeting public safety needs
- Sidelink to XR display etc. with unlicensed

IoT optimized RedCap

- 70% lower cost
- Lower power consumption

Accurate positioning

- <10 cm indoor positioning, using carrier phase
- Complement to GNSS outdoors

Network operation efficiency

- More flexible TDD spectrum use
- AI/ML automation
- Energy efficiency

XR (Extended Reality)

Boosting AR, VR and Cloud Gaming Experience

Capacity & Low Latency

Match scheduling with XR services
periodicity, multiple flows, jitter, latency, reliability

Low Latency
files received within delay budget

Enhancements
SPS and configured grant enhancements
Dynamic scheduling/grant enhancements

Device Power Savings

Extended usage with limited space for battery
Energy efficiency
Extended battery life time

Enhancements
Adaptive and dynamic DRX
PDCCH monitoring

XR-awareness in radio

Guaranteed XR QoS
gNB-awareness
Information to aid XR-specific traffic handling

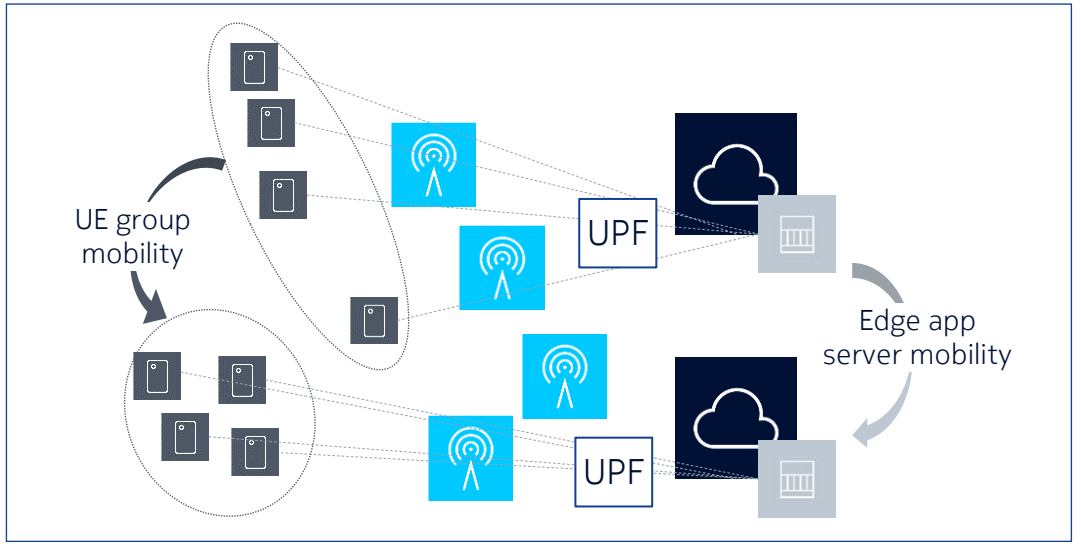
XR = AR/VR
DRX = Discontinuous reception

AR = Augmented Reality
VR = Virtual Reality
SPS = Semi-persistent scheduling

Edge computing

Previous releases

- Rel-15: Edge computing basic functionality, with User Plane Function (UPF) offload capability and Application Function influence on traffic steering
- Rel-17: Dynamic insertion of offload capability depending on actual traffic



Main expected capabilities in Rel-18

- Roaming support to access Edge Hosting Environment (EHE) in VPLMN
- Further enhancements for scenario where 5G Core and EHE are operated by different organizations
- Improved network exposure of UE traffic related information to Edge Application Server (e.g. for XR services or AI / ML applications)
- Offload policies for more granular sets of UE(s)
- Influence on UPF and edge application server (re)location for collection of UEs in scenarios when UE(s) should be treated the same way (e.g. for multi-user gaming)

Boosting 5G Uplink Coverage

Dynamic DFT-S and OFDM switching

Fast waveform change

Data coverage up to 2dB

Frequency Domain Spectrum Shaping (FDSS)

Frequency Domain Spectrum Shaping (FDSS) with spectrum extension enables up to 2 dB coverage extension

FDSS function can be left for UE implementation

Applies both for FR1 and FR2

RACH coverage up to 5dB

RACH repetition with beamforming

UAV (Drone) support in 5G-Advanced

5G RAN doesn't contain any UAV (Unmanned Aerial Vehicle) specific features so far

First step in 5G-Advanced is to include solutions done with LTE

- Flight path reporting, height reporting etc. as in LTE

The new areas in 5G-Advanced are:

- Beamforming with UAVs to reduce interference they create
- Subscription based UAV identification
- UAV ID broadcast (ideally with unlicensed spectrum to avoid interference)

Key benefits

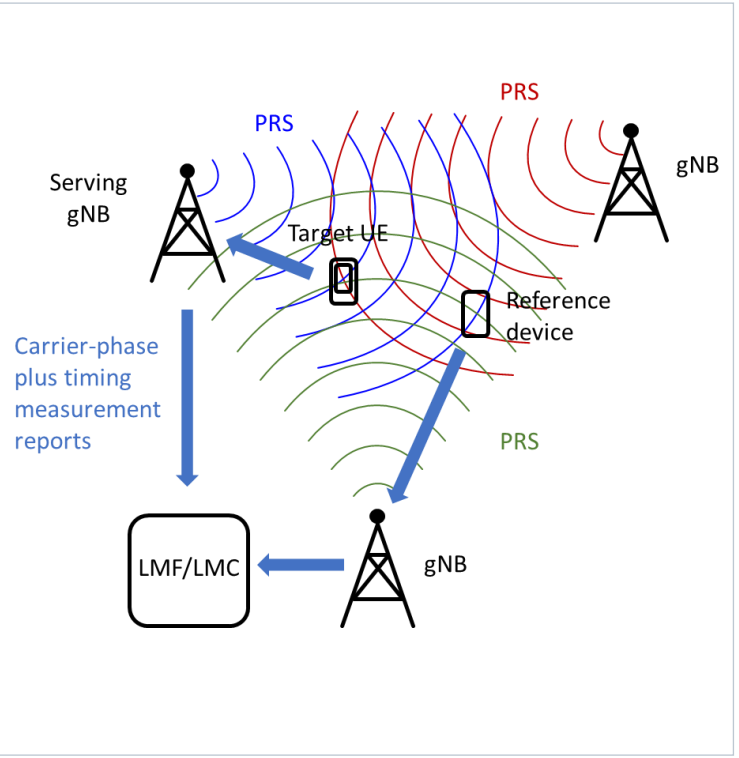
- UAV with HD-Video stream transmission will create a lot of interference due to visibility to many base stations, thus use of 5G beamforming can greatly reduce the interference with the use of antenna directivity in UAVs
- UAV identification important to secure responsible use of UAVs, avoiding interference for example to air traffic

5G-Advanced UAV will be a clear step improvement over LTE

Super-Accurate Positioning

5G-Advanced provides an opportunity for a step-change in accuracy, especially indoors

- **Carrier-phase positioning** using signals from the NR base stations gives **sub-10cm accuracy**
  - Factor of ~10 higher accuracy than purely time-based positioning methods
  - Based on proven techniques from GNSS-RTK (which has been available outdoors since Rel-15), but applied to NR base station signals without reliance on satellites
  - Uses carrier-phase measurements on 5G NR signals on top of time measurements
- Enables consistently accurate positioning service, indoors and outdoors
  - Indoors as a complement to outdoor GNSS
    - In buildings (industrial automation/logistics)
    - In tunnels (automotive, public safety)
  - Outdoors as a resilient alternative to GNSS, e.g. in case of GNSS non-availability / interruption



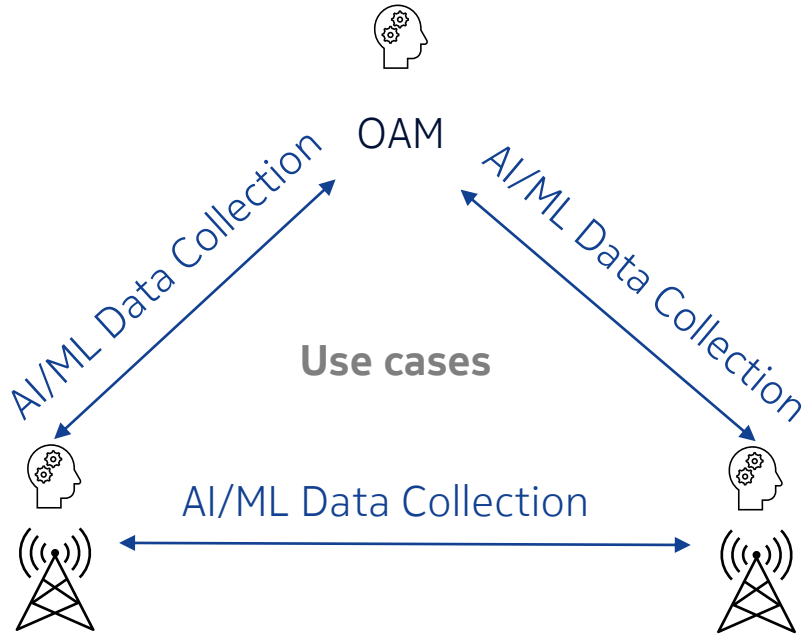
Other positioning enhancements in Rel-18:

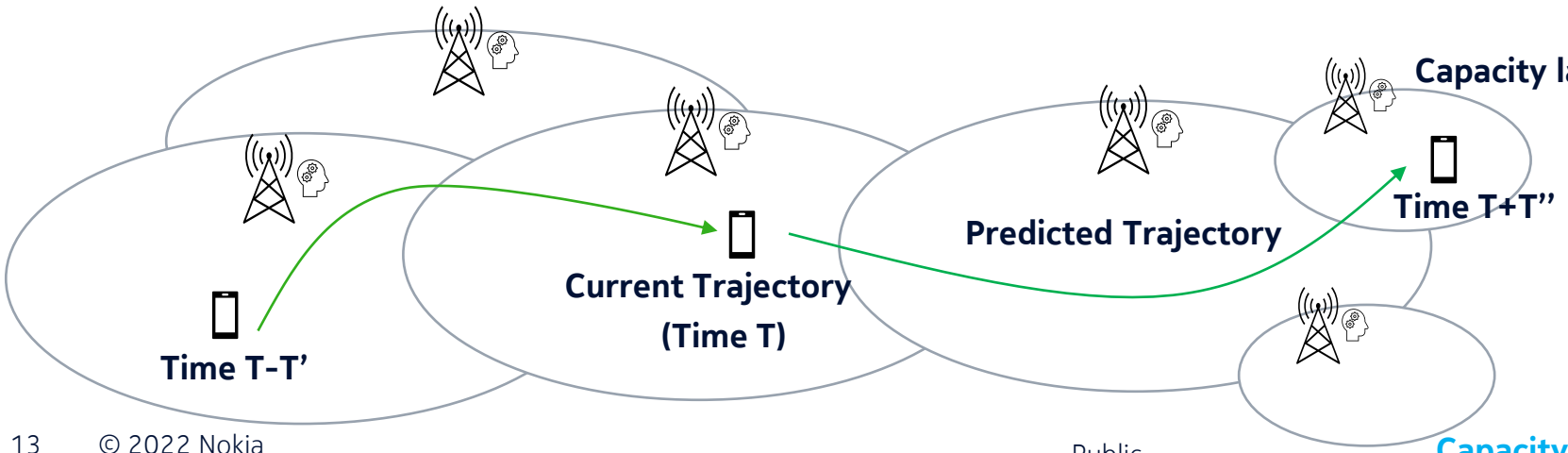
- Sidelink positioning / ranging: especially targeting automotive
- Integrity for RAT-based positioning (only GNSS integrity was handled in Rel-17)
- RedCap positioning: evaluate accuracy achievable with reduced bandwidth, and consider enhancements where possible

Carrier-phase NR positioning provides resilient, consistent sub-10cm positioning, indoors and out

AI/ML for NG-RAN

- Artificial Intelligence (AI) /Machine learning (ML) provides a tool to help operators improve network management and user experience, by analyzing data collected and autonomously processed.
- 5G-Advanced will provide enhancements to support AI/ML techniques in:
  - Network Energy Saving
  - Load Balancing
  - Mobility Optimization
- Further use cases will be studied towards the end of Release 18.





gNB can use predicted UE Trajectory to predict best candidate Target gNB(s)

Capacity Layer can use predicted UE Trajectory to predict switch-off

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Key Takeaways

1

5G evolution continues strongly on top of the first 5G Release

2

5G-Advanced in Release 18 to introduce large set of improvements

3

Release 18 specs ready in 2024, products for 2025 onwards

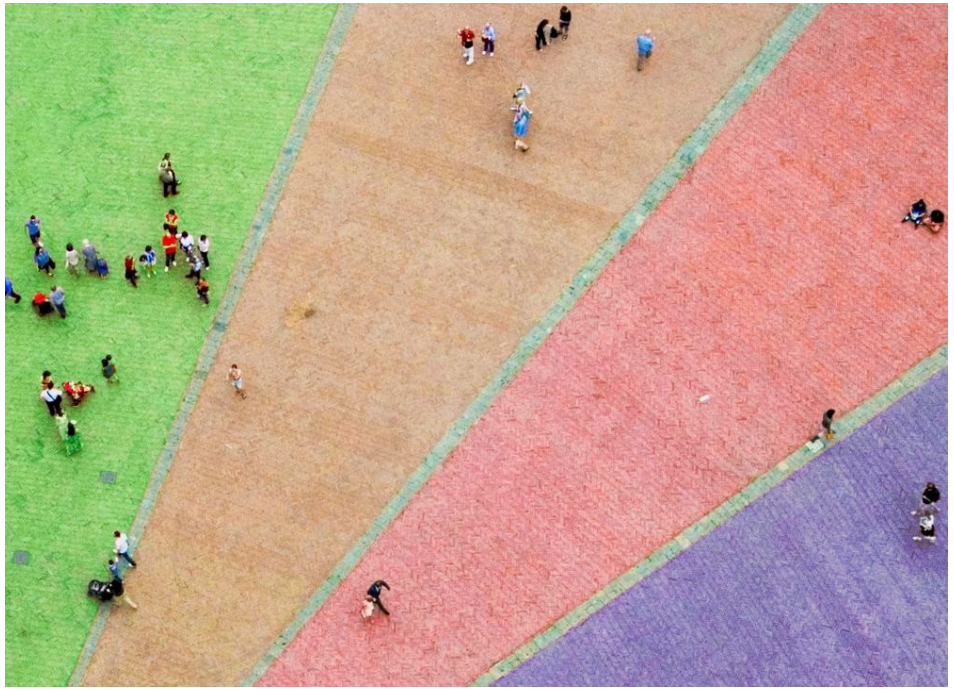
4

Release 18 is just the first step, work then continues for Release19 and beyond

Further information about 5G-Advanced

5G-Advanced page

Link



Now the real work on 5G-Advanced begins

Blog (14.12.21) - Link

LinkedIn 5G-Advanced:
https://www.linkedin.com/groups/14006501/

Thank you

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