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Webinar: Advancing the 5G Era - **Benefits and Opportunity of 5G-Advanced**

Thursday 22nd September 10am (GMT+1)

Agenda

Time (GMT+1)	Duration	Topics	Speakers
1000-1010	10 min	Welcome / Introduction	Barbara Pareglio Executive Director for Advanced Air Mobility and IoT Technical Director, GSMA
1010-1030	20 mins	5G-Advanced: Targeting for a sustainable 5G future	Nan Hu Vice Director Department of Wireless and Terminal Technology Research, China Mobile Research Institute
1030-1040	10 mins	Drivers for 5G Advanced: an operator’s perspective	Benoit Graves Head of 3GPP RAN Standardisation, Orange
1040-1050	10 mins	Pave the way to 5.5G	John Gao 5.5G General Manager, Huawei
1050-1100	10mins	5G Advanced - Defining features	Olof Liberg Head of 3GPP RAN standards team, Ericsson
1100-1125	25 mins	Expert Panel and Q&A: The values and benefits of 5G-Advanced	Benoit Graves Head of 3GPP RAN Standardisation, Orange
			John Gao 5.5G General Manager, Huawei
			Olof Liberg Head of 3GPP RAN standards team, Ericsson
			Moderator: Barbara Pareglio Executive Director for Advanced Air Mobility and IoT Technical Director, GSMA
1125-1130	5 mins	Closing	Barbara Pareglio Executive Director for Advanced Air Mobility and IoT Technical Director, GSMA

Welcome and Opening

Barbara Pareglio

Executive Director for Advanced Air Mobility and IoT Technical Director, GSMA

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Advancing the 5G Era - Discovering 5G-Advanced

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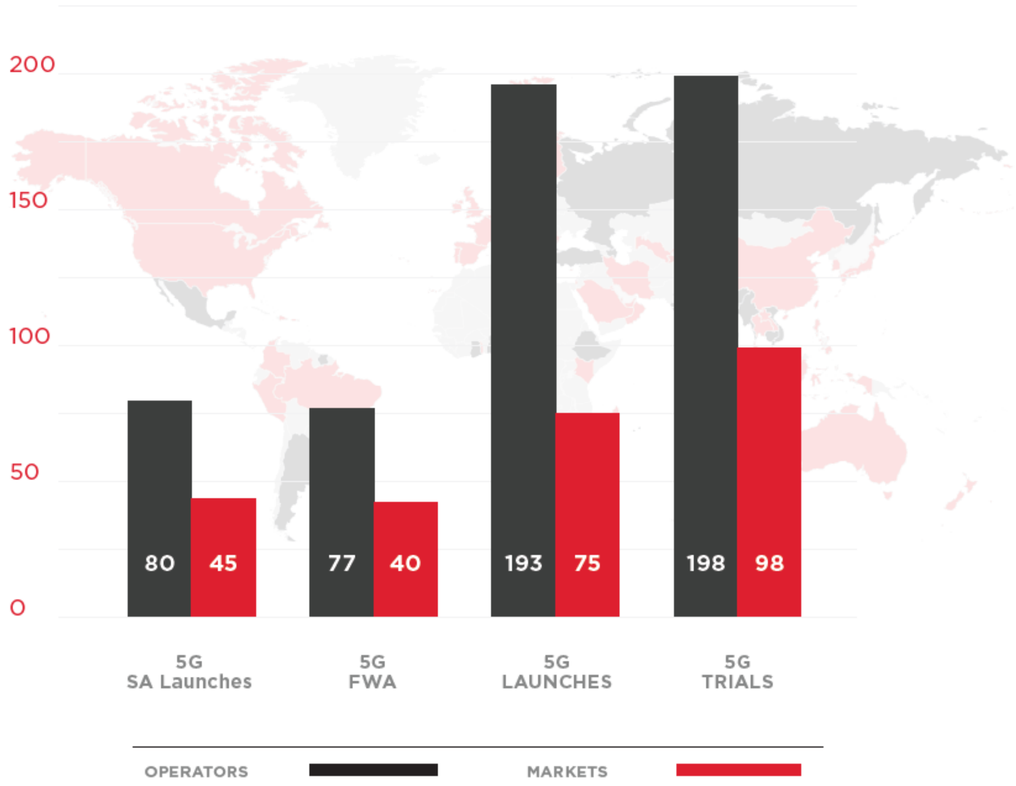
Introduction

5G today



Second phase of the 5G generation

- What is 5G-Advanced?
- What is the timeline for 5G-Advanced?
- What brings 5G-Advanced?
- Why is 5G-Advanced important?
- What do we need to do collectively?
- How can I join?

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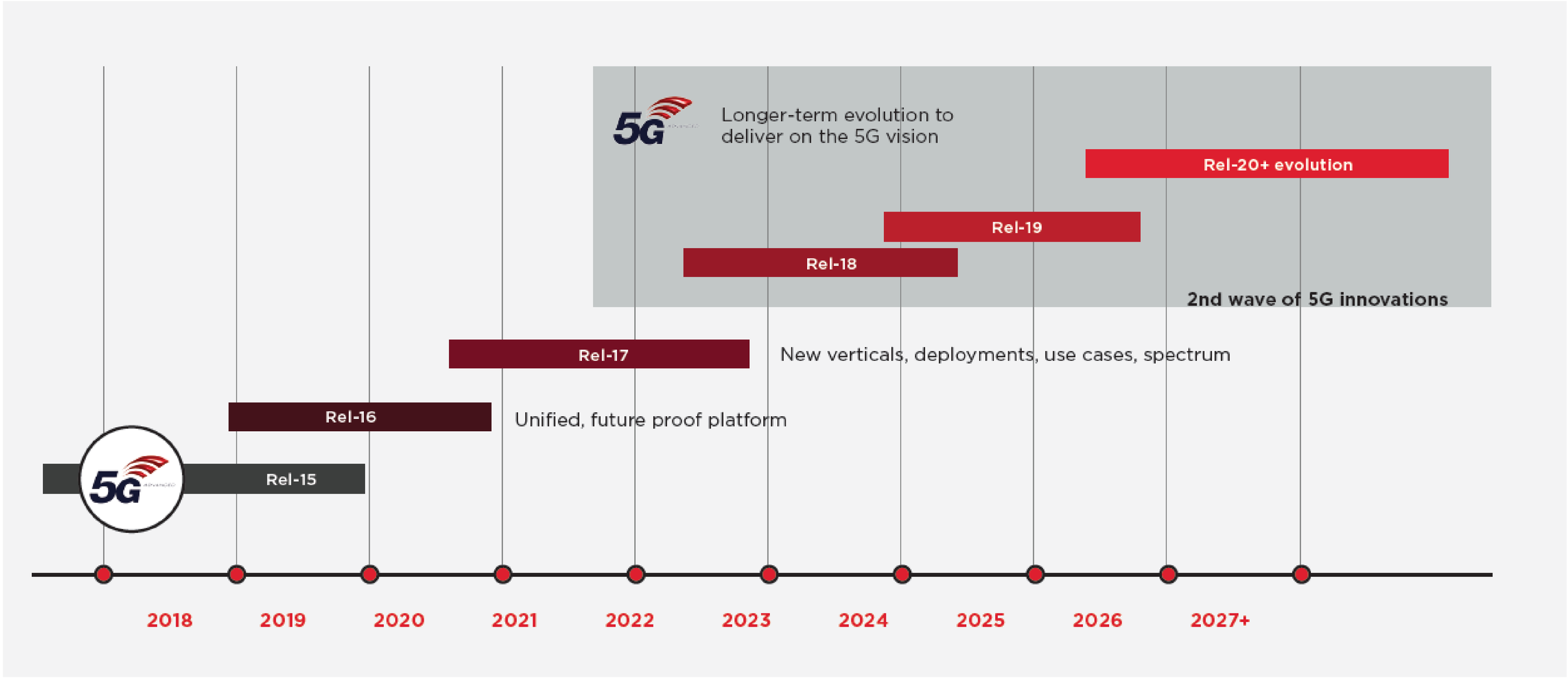
What is 5G-Advanced and expected timeline?

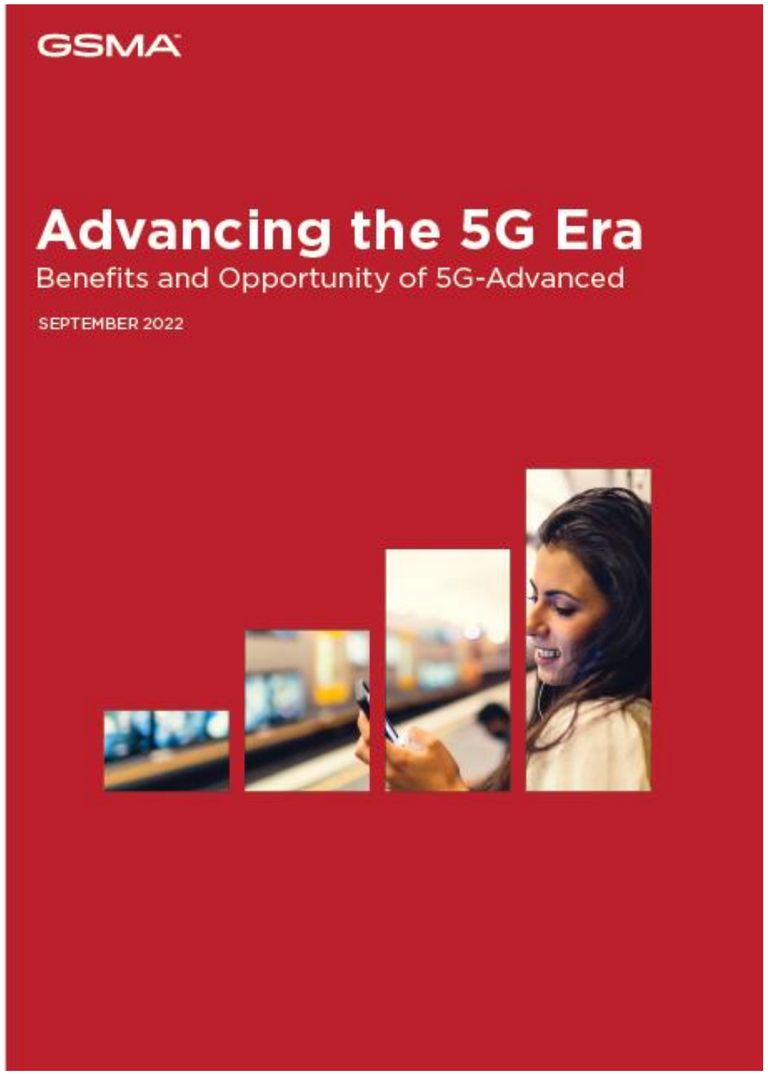


What does 5G-Advanced bring?

1. Strengthen the 5G system foundation by further improving speed, global coverage, mobility, power efficiency and more.

2. Support new use cases, as well as to proliferate 5G to virtually all devices and deployments involving connectivity.

GSMA whitepaper



Official launch of the whitepaper: **22nd of September 2022.**

Purpose: **inform about the content and the importance of 5G-Advanced**

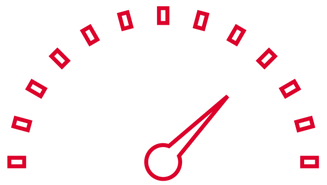
Audience: **MNOs, telco ecosystem and beyond.**

Link: https://www.gsma.com/futurenetworks/resources/advancing-the-5g-era-benefits-and-opportunity-of-5g-advanced-whitepaper/

Contact: **futurenetworks@gsma.com**

What do we need to do collectively and how to join?

Let’s accelerate the adoption of 5G-Advanced



- We need to make sure that 5G-Advanced is deployed successfully, and
- We have the right features to address the wide variety of business and verticals for tapping to those opportunities.
- We need your active engagement to drive 5G-Advanced forward

How can you help?

- Join our community to discuss 5G-Advanced

- Provide your interest by contacting us at: futurenetworks@gsma.com

Thank You

5G-Advanced: Targeting for a sustainable 5G future

Nan Hu

Vice Director, Department of Wireless and Terminal Technology Research
China Mobile Research Institute

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5G-Advanced
Targeting for a sustainable 5G future

Hu Nan
CMCC

China Mobile has built the world largest 5G SA network

New infrastructure construction

	No. of gNBs	Users	Empowers verticals
2022Q2	0.99 million >30%	5.11 million	300+ demonstrations 11000+ 5G industry commercial use cases, mining, factory, harbor, power plant

Continuous contribution in 5G standardization

81+ 3GPP WI/SI

7000+ contributions

Technical contributions and industry influence

Rel-15

5G new architecture and new radio interface

1. New architecture
2. New radio interface
3. New technology

Rel-16

Consolidate 5G capability triangle

1. Optimazation in base performance
2. Diversify URLLC capability
3. Cost reduction and network automation

Rel-17

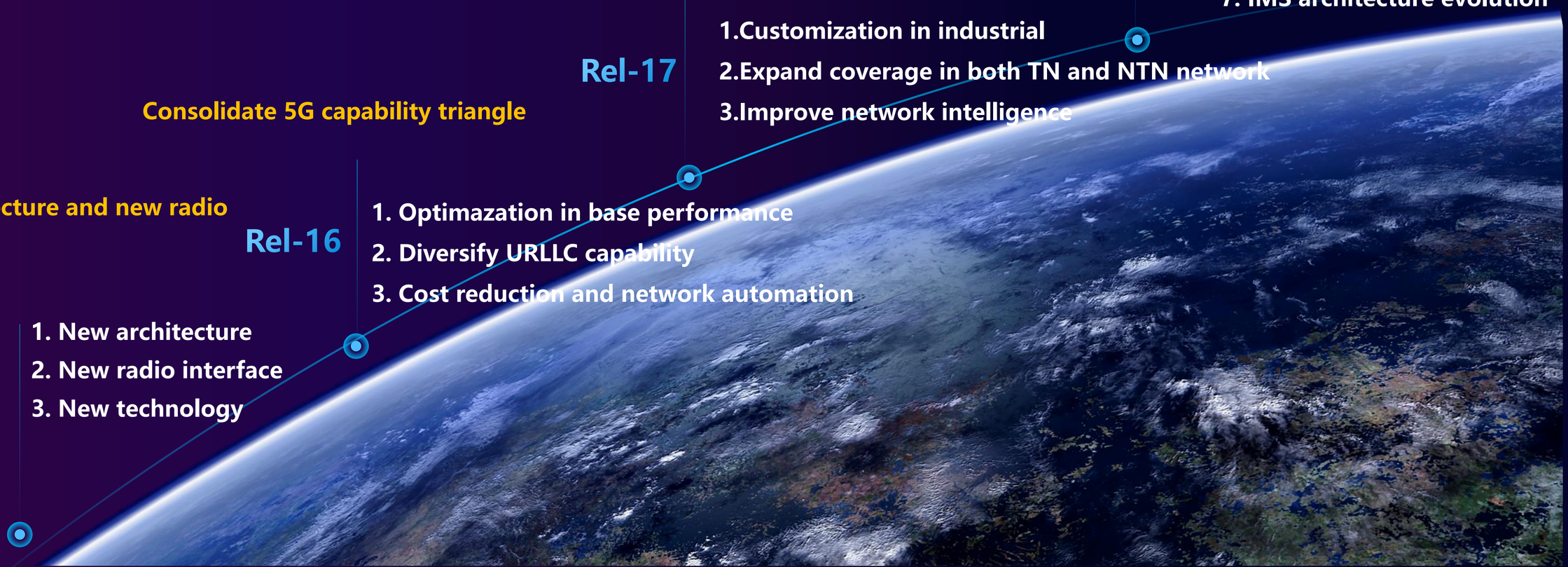
Further advanced ability, the first study on AI/ML for NG-RAN

1.Customization in industrial
2.Expand coverage in both TN and NTN network
3.Improve network intelligence

Rel-18

Continuously lead in multiple 5G-A key technologies

1. UDD
2. AI/ML for NG-RAN
3. SON/MDT enhancement
4. ATG
5. XR
6. UPF enhancement
7. IMS architecture evolution



Define 5G-A three key directions and ten key technologies

- August, 2021：5G-A innovation and industry chain integration action plan

- June, 2022：5G-A New technological capabilities and industrialization white paper

Capability of current network

DL exp. rate : ~100Mbps

UL exp. rate: ~10Mbps

Connectivity density: $10^6/km^2$

Positioning accuracy: sub-meter level

Advanced intelligent system

eIoT

5G+AI

Cloud+Network+Computation

Advanced Energy efficient industry

Network Energy saving

Advanced network

X-Layer UDD

NTN+TN

Integrated sensing and communication

Smart repeater; deterministic network

Requirement of future network

DL peak rate: 10Gbps

UL peak rate: 1Gbps

DL exp. rate: 1Gps

UL exp. rate: ~100Mbps

Hundreds of billions of connection

Deterministic SLA

Tenfold energy efficiency

Principles for a “Balanced” evolution

Requirement	Techniques	Evolution
Immediate and long term	Enhanced and New	Network and Terminal

X-Layer: cross-layer synergy empowers metaverse

XR is the bridge between cyber space and real world

Value In 2025, VR software market will reach 35 billion USD, and the number of VR HMD devices will reach 70 million.

Challenge The demand of high throughput (>10^2 Mbps) and low latency (<5 ms) require massive radio resources, making RAN capacity a bottleneck.

X-Layer

Key concept

X-Layer info sharing to achieve global optimum

Key technologies

Service awareness of RAN -> Coding and transmission combining, adaptive code rate and content, to fit RAN status.

RAN awareness of Service-> frame-level protection and QoS, differentiated importance

Benefits

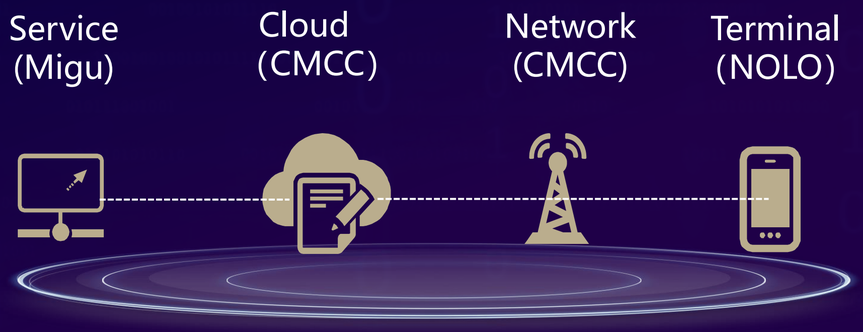
The E2E latency of Gb/s XR service will be 5~10 ms, and capacity increase by 5 times.

Industrial prototype for X-Layer

The X-Layer prototype demonstrate 5x capacity improvement.

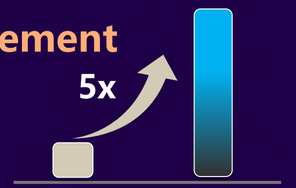
Terminal-Network-Cloud-Service

4-dimensional integrated cooperative innovation



System capacity:

- 5x capacity improvement
- 4.9G 100M 7D3U
- ≥20 XR terminal



User performance:

- Support 4K @ 60fps
- Speed rate: ~40Mbps
- Frame latency:10ms@99.9%

Integrated Sensing and Communications (ISAC)

Value **10 billions economic and industrial value** of road supervision, autonomous driving, and high-definition map construction, replying on advanced ISAC techniques.

Advantage Low-cost, high-precision, seamless and ubiquitous integrated sensing and communications.

Integrated Sensing and Communications

Integrated design

5G waveform based sensing signal design and software/hardware sharing to improve spectrum resource utilization.

Cooperative Sensing

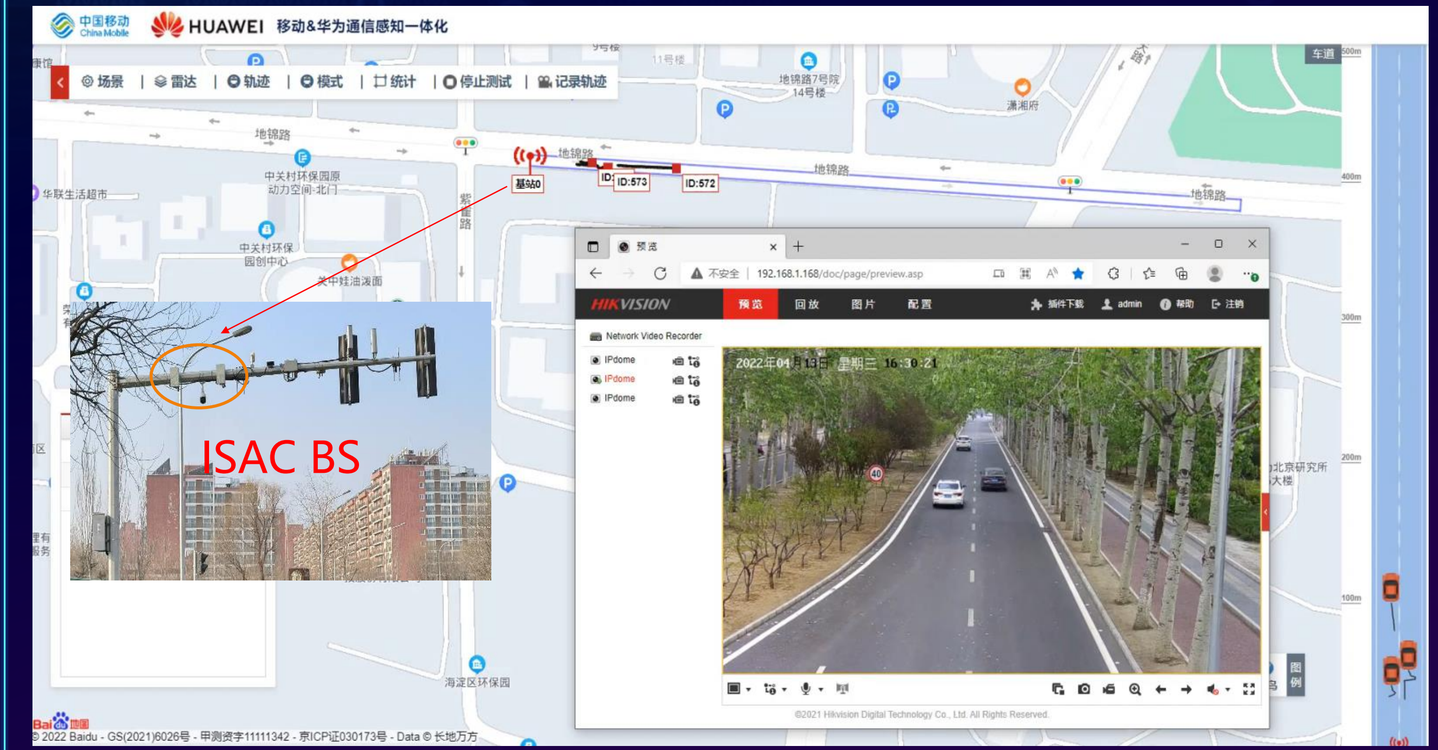
Cooperative sensing through 5G network to realize seamless and ubiquitous sensing coverage.

Network Architecture

Localized, independent, light and flexible architecture to reduce sensing delay.

Industrial prototype for ISAC

Sensing distance exceeded 800 meters @ sub-meter accuracy



Real-time tracking of vehicles

- ✓ Sensing performance improves 3~5 times
- ✓ Seamless and ubiquitous sensing

	ISAC	Radar
Bandwidth	800M	200M
EIRP	70dBm+	13dBm
Distance	**800m**	200m
Distance resolution	**0.19m**	1m
Velocity resolution	**0.1m/s**	0.2m/s
Angular resolution	**0.2°**	0.5°

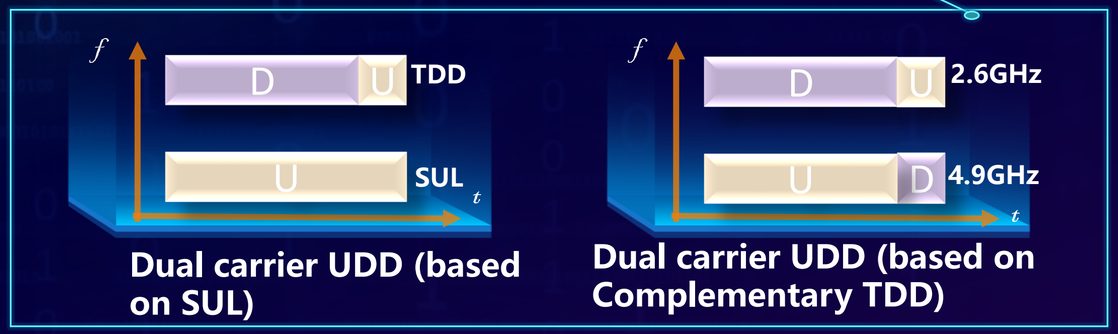
UDD initiate a new paradigm for spectrum utilization

中国移动 China Mobile

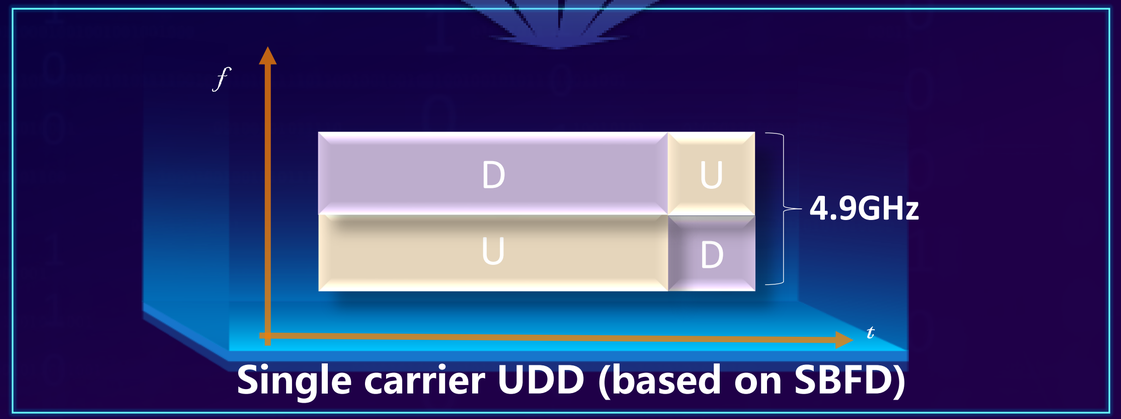
4G TDD/FDD frame structure integration -> 5G flexible frame structure -> UDD,

CMCC Duplex innovation constantly breaking the TDD performance ceiling

Challenge How to satisfy <1ms extreme delay requirement in industry scenario in TDD spectrum?



Deployed in practical CMCC network



Serves as 3GPP R18 NR duplex evolution SI Rapporteur

Unified time & frequency Division Duplex(UDD)

Key technologies

Self- interference suppression

Cross-link interference suppression

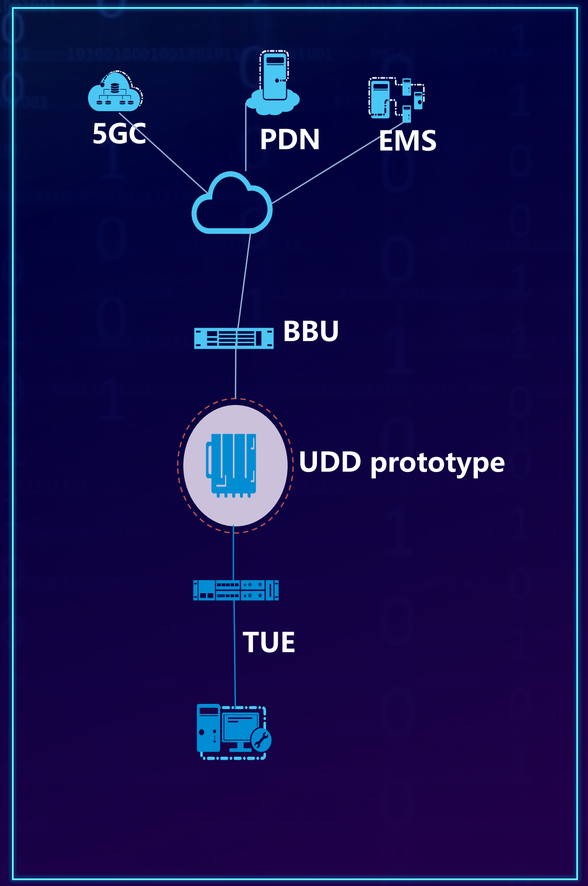
Configuration and scheduling signaling design for sub-band full duplex

Benefits

Opportunities for UL and DL transmission at any time to achieve "0" waiting delay, and improve UL rate and coverage.

Industrial prototype for UDD

Satisfy the requirements of UL high data rate and low latency simultaneously in TDD spectrum



1.4Gbps UL data rate @ 4ms delay

Extended-IoT enables billions of new connections

5G cellular e-IoT to solve the bottleneck of conventional RFID

Value

Vertical industries, including Retail, industry, smart grids, medical instruments, livestock, logistics, are predicted to contribute to 12.2 billion dollars in 2022 on the use cases of identification and sensors.


Warehourse

ETC


Retail


Smart grids


Medical instruments


Livestock

Challenge

Limited coverage, high cost of deployment and maintenance, not supporting positioning, limits the commercialization of conventional RFID.

E-IoT key technologies

Coverage enhancement

Interference mitigation techs including inter-node resource coordination, joint scheduling.

Cost and complexity reduction

Simplified protocol stack and signalling design.

Tag positioning

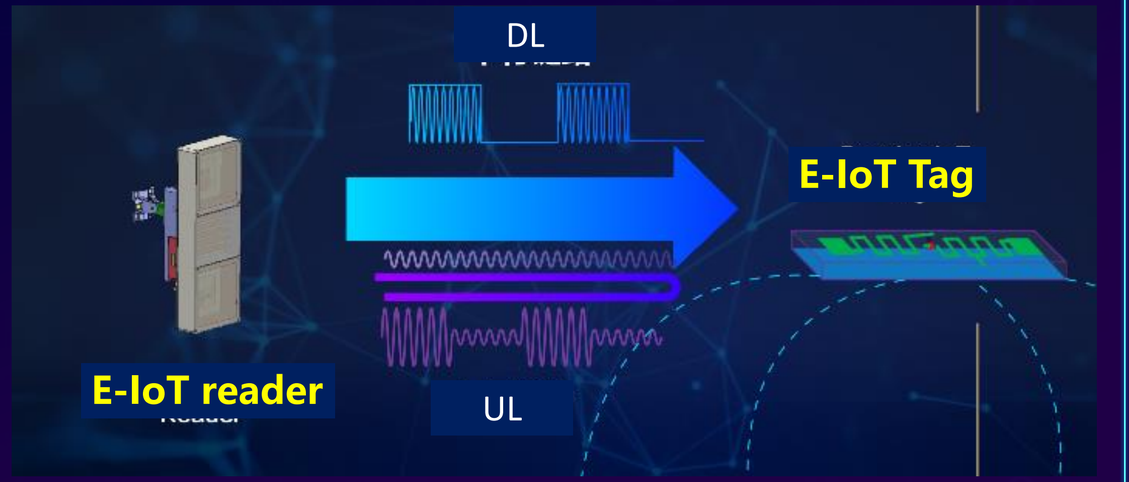
Combined with cellular positioning technologies.

Support wide-area deployment and connection to multi-servers

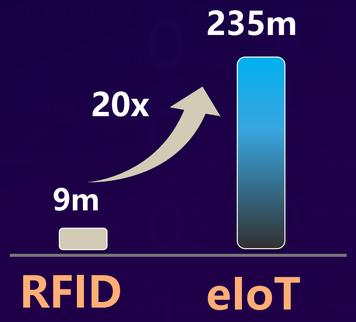
E2E e-IoT architecture design to support connection with multi-servers from different customers.

Industrial prototype for E-IoT

The first attempt to extend e-IoT coverage to 200m



E-IoT coverage：20X



	RFID	E-IoT
Coverage	9m	235m (20X+)
Deployment	Single reader	Wide-area cellular network
Inventory	Manually	Automatic
Tag cost	<0.1$	~0.3$

CMCC’s 5G-Advanced roadmap

中国移动 China Mobile

	2018	2019	2020	2021	2022	2023	2024	2025
Top-level design	Basic requirements and visions development			5G-A key techniques revolution strategy		Network construction strategy		
				Innovation and industry chains integration, innovation and development strategy				
Technology research	Key technology research		Candidate standard schemes study		Enhanced technology research			
Standard-setting			5G ADVANCED		R18 1st version of 5G-A		R19	
Industrial promotion			Key technology test		Innovation chain：network system test Industry chain：application test		Innovation chain：network pre-commercial deployment Industry chain: business scenario design	
Application Innovation						Establish 5G-A industrial innovation base		

中国移动
China Mobile

“Only those who will risk going too far
can possibly find out how far one can go”

- Eliot

Drivers for 5G Advanced: an operator’s perspective

Benoit Graves

Head of 3GPP RAN Standardisation
Orange

GSMA™

Orange Innovation

Drivers for 5G Advanced: an operator’s perspective

GSMA webinar

Advancing the 5G Era - Benefits and Opportunity of 5G-Advanced

September 22nd, 2022

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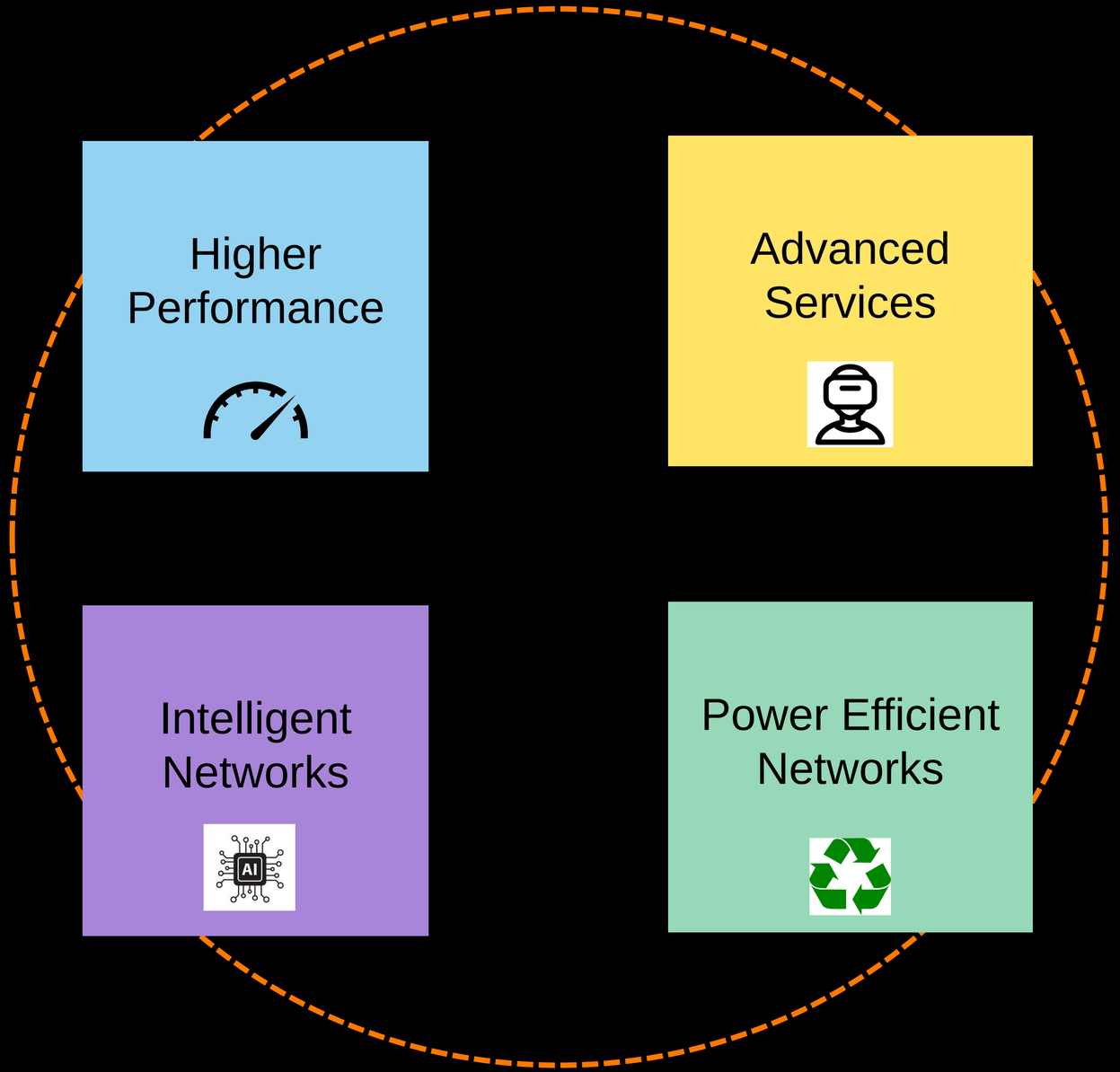
5G Advanced drivers for Orange



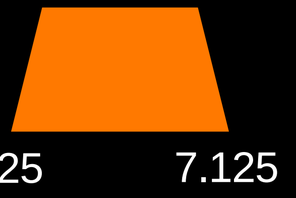
Higher Performance

6 GHz licensed

R17 R18

6 GHz licensed (6425-7125 MHz)

- Specified in Rel-17
- In discussion for Europe at CEPT



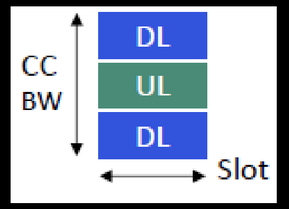
➢ Next major band to be deployed on macro networks after 3.5 GHz
➢ Supported by Orange for approval at WRC-23

UL perf

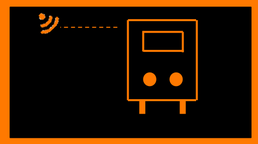
R18

NR duplex evolution

- new duplex mode “between TDD & FDD”
- flexibility to use different TDD frame formats on the network
- improved Interference management



➢ Demand for UL heavy services
  ➢ instant upload (e.g. train at station)
  ➢ mass events



Advanced Services

XR

R18

QoS and power saving management for XR and Cloud Gaming services

- XR-awareness in RAN & CN
- XR-specific power saving
- XR-specific scheduling

- XR is a key innovative service on the rise (Gaming, B2B, Metaverse,…)
- Optimisation useful to better manage user QoS & impact on network capacity

Advanced Services

RedCap

R17 R18

RedCap = Reduced Capability (“5G IoT”)

- Lower capability devices, for IoT market, i.e. Industrial wireless sensors, Video Surveillance, Wearables
- Lower complexity, with reduced bandwidth & number of antennas vs. eMBB

➢ Seen as evolution from LTE low complexity “cat 1 / cat 1bis” devices

Ambient Power IoT

R18 R19

Ambient Power Enabled IoT = “passive IoT”

- Zero / Ultra low energy devices with ambient energy harvesting (RF / solar)
- Passive tags (e.g. RFID) , asset tracking, ultra low complexity sensors

➢ Seen as an energy efficient, low cost & low complexity IoT service

Satellites

R17 R18

NTN = Non-Terrestrial Networks

- Satellites (LEO, MEO, GEO)
- Targeting commercial smartphones, public safety, maritime, automotive,…

- Based on direct connectivity to Earth-based devices
- Includes NB-IoT and LTE-M, to provide global IoT coverage
- Rel-18 enhancements: coverage & mobility enhancements, UE location reporting,…

➢ Potential solution to provide complementary coverage in white zones

Network Power Saving

R18

Network Power Saving

- network energy consumption model
- network power saving evaluation methodology to use Energy Efficiency as a criteria when evaluating new radio features
- network energy savings techniques with finer granularity

- Orange targets:
  - 30% less CO2 emissions by 2025 (vs. 2015)
  - Net Zero Carbon by 2040

Intelligent Networks

AI / ML

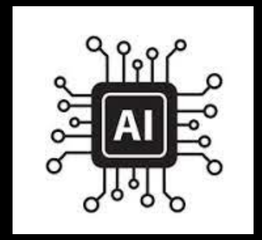
R18

AI / ML for Air Interface

- Predictive QoS for beam management & overhead reduction
- Improved positioning accuracy

AI / ML for NG RAN

- Network Energy Saving
- Load Balancing
- Mobility Optimization



- AI / ML for optimised performance with increased operational efficiency
- 3GPP & O-RAN Alliance driving standards for an open, secure & operator-controlled AI/ML ecosystem

THANKS

Pave the way to 5.5G

John Gao

5.5G General Manager
Huawei

GSMA™

Pave the way to 5.5G

John Gao

5.5G General Manager, Huawei

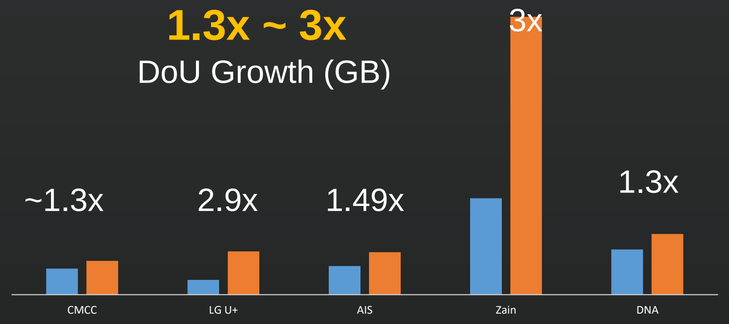
HUAWEI

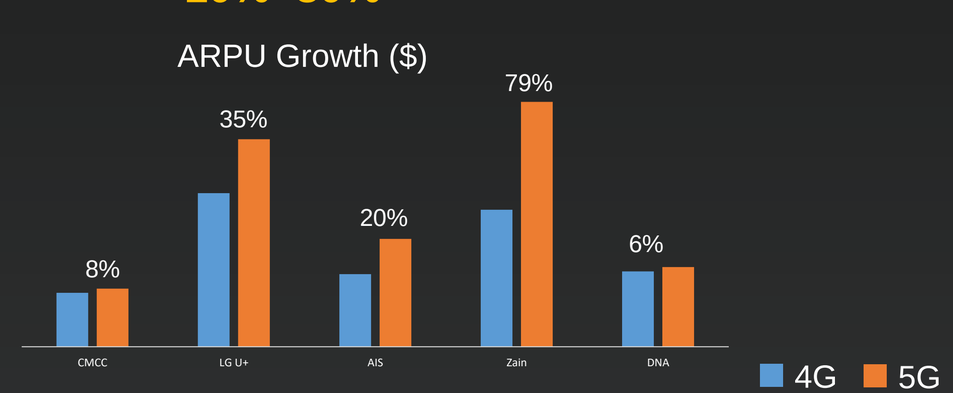
Global 5G Scale Commercialized & 1st Wave 5G Market Win Business Growth

Global 5G Develop Faster than 4G

	2019	2022	
Commercial Networks	8	208 77 countries/territories	25X
Terminals	33	1200+ <$300，>25% Device	40X
Subscribers	1 Million	739Million >20% 5G Penetration Rate （Leading Countries）	700X

5G Development Bring DOU&ARPU Increase





Growing Diversified Services Drive 5.5G

Ubiquitous 10Gbps Experience + 100bln Connections + Native Intelligence

Experience gaps in toC services

XR Pro

Capability gaps in toB applications

Super-large uplink, connected vehicle, and high-precision positioning

Need more scenario-based IoT

Medium-speed IoT/Passive IoT

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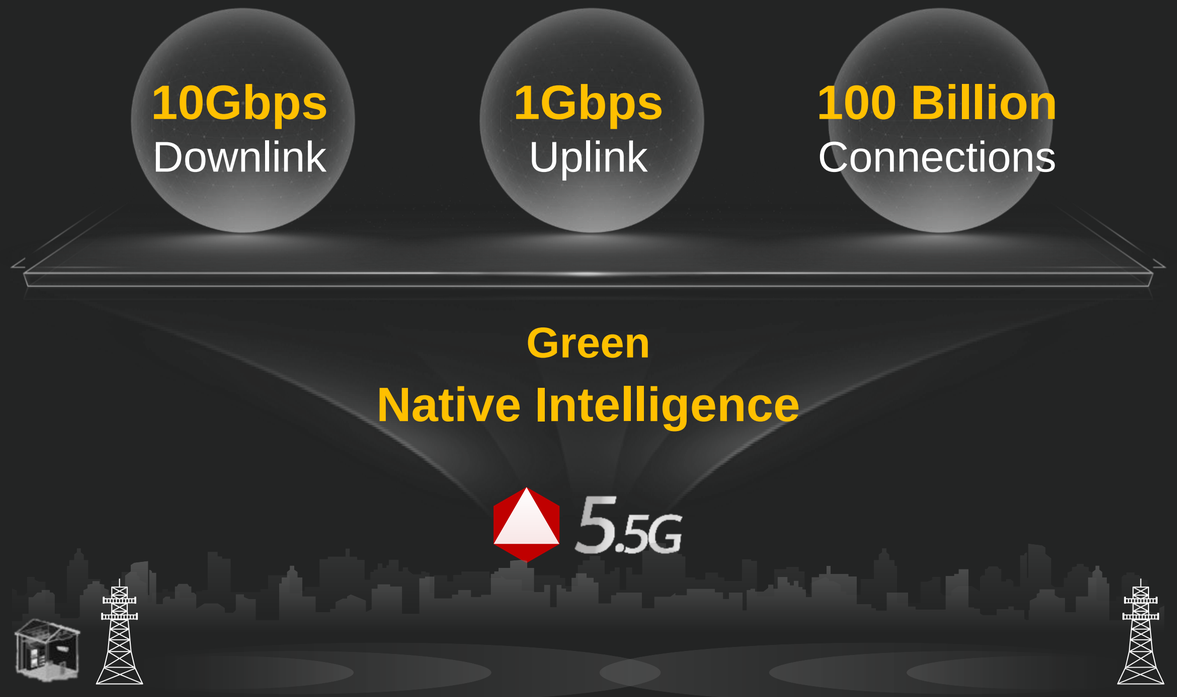
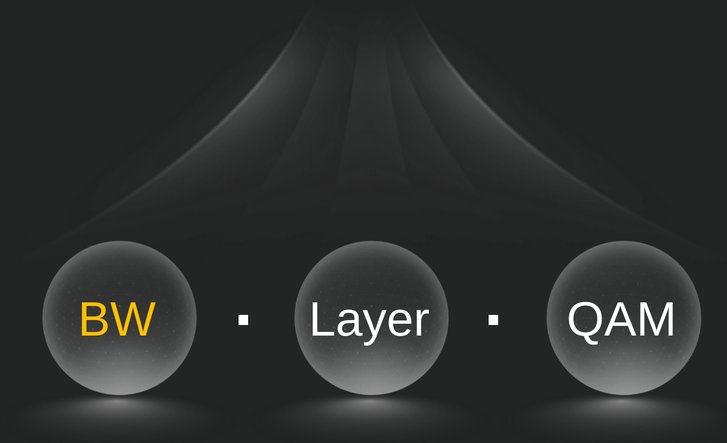


Ultra-High Bandwidth is the Foundation for 10 Gbps Experience

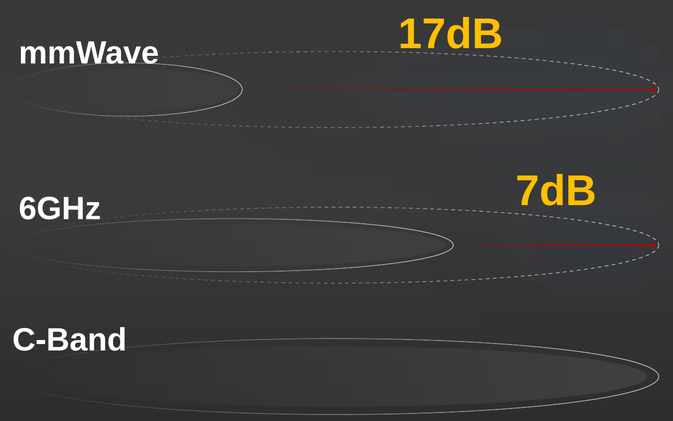
User Experience



Sub-100G helps realize ubiquitous 10Gbps experience

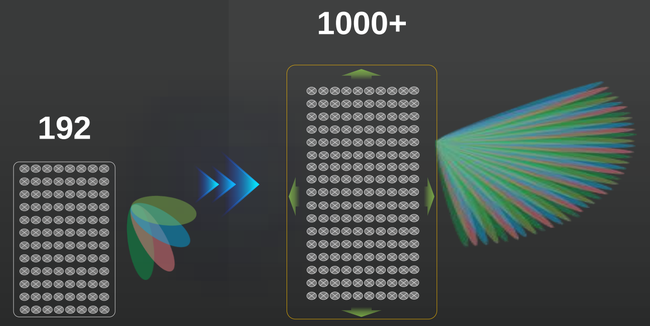
ELAA-MM for Continuous 10 Gbps Coverage

Unequal coverage with new bands to C-band



Higher frequency band =
Higher propagation loss

Towards larger antenna arrays



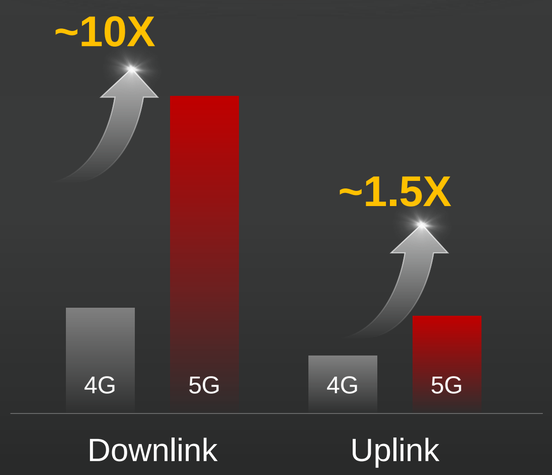
Cband

Higher Band

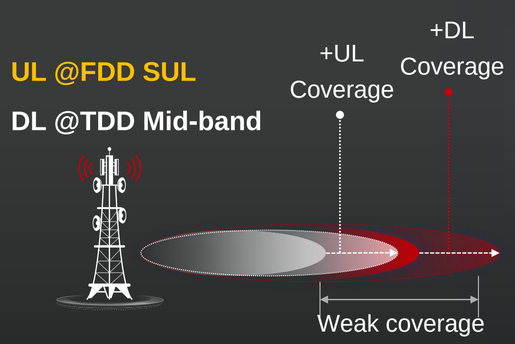
Higher band can Achieve Same Coverage with C-band

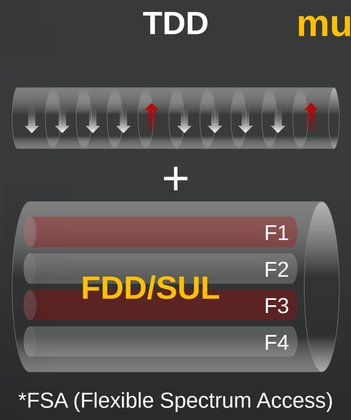
Continuous Innovation in UL&DL Decoupling for Uplink Gbps

5G uplink is bottleneck

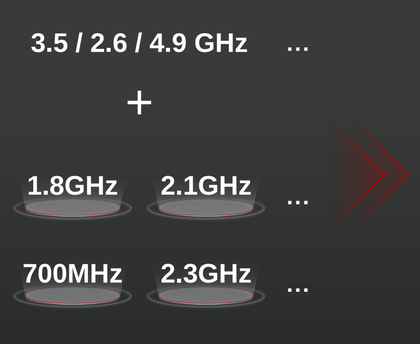


UL & DL decoupling for ultra-high uplink with multi-band convergence





*FSA (Flexible Spectrum Access)



~Gbps

Ultra-high uplink

All scenario IoT Support 100 Billion Connections in the Next 10 Years

Fragmentation of industry wireless technologies

ISA100.11a

WirelessHART

Zigbee

UWB

WiFi

Bluetooth

WIA-PA

Mobile networks enable 100Bn IoT with scale effects

Billion-level

RedCap

Mid-speed

Ten billion-level

NB-IoT

LPWA

Tens of billions

Passive IoT

Passive

Label + Battery-free + **<￥1**

Label Reading + Sensor collect

…

Goods stocktaking

Industrial sensor

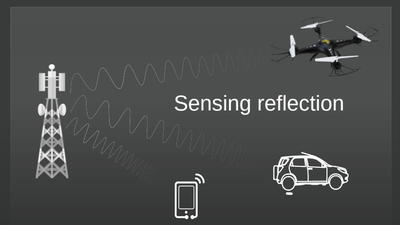
Agricultural detection

…

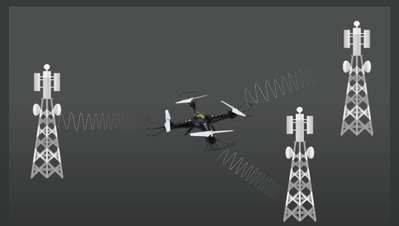
Sensing & Communications Integration Enable Digital Replica

Large BW mmWave
for high-precision sensing capability

Beam reflection sensing



Multi-site coordination



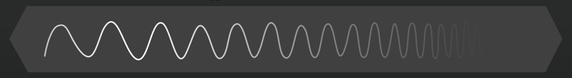
speed

distance

image

…

mmWave: High band and wide BW



Vehicle Awareness @ Smart Transportation

Smart Traffic

Smart Fencing

Low-sky security

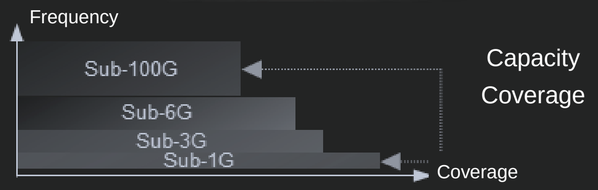
…

Native Intelligence for Wireless Capability Enhancement

Multi-dimensional service requirements

DL thrp. UL thrp. Latency ...

Varying capabilities of different bands



Energy saving for 100x traffic growth

.....

Native intelligence

IntelligentRAN for 5.5G Capability Enhancement

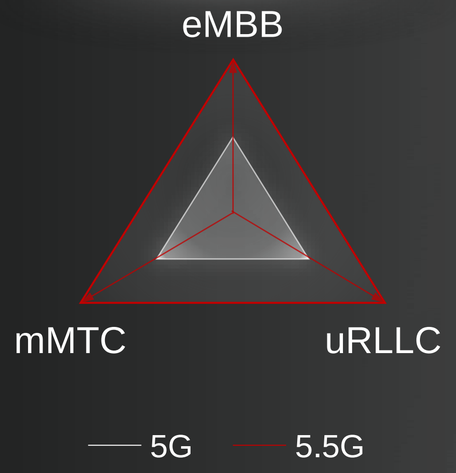
Real-time awareness	Analysis & prediction	Intelligent decision-making
Frequency/Power	Time & space prediction	Multi-service, multi-goal
Thrp./Latency	Service trend changes,	self-optimization
Interference/Load	network resource satisfaction	Multi-dimensional,
…	(requirement, track...)	multi-frequency optimization

Performance ~ 50% +

Energy Efficiency ~ 10X

5.5G Evolution on the Way

Continuous capability enhancement



5.5G

DL **10Gbps**

UL **1Gbps**

100Bn Connections

Native **Intelligence**

New revolutionary capabilities

- Sensing
- Passive IoT
- High-precision positioning
- Intelligence
- …

Thank you.

5G Advanced – Defining features

Olof Liberg

Head of 3GPP RAN Standards Team
Ericsson

5G Advanced

Defining Features

Olof Liberg

Head of Ericsson 3GPP standards team

2022-09-13

5G Advanced vision

Sustainable networks

Intelligent RAN automation

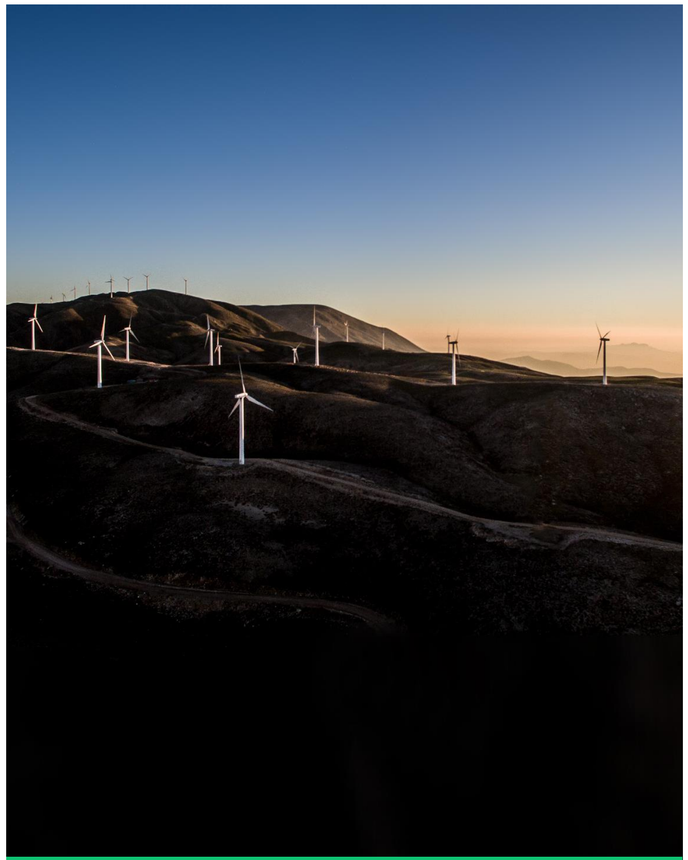
Immersive experience

New applications

- 5G supports enhanced MBB, critical IoT and massive IoT since 3GPP Release 15. Support for carefully selected verticals were added in Releases 16 & 17.
- 5G Advanced builds on 5G and paves the way towards 6G.
  - From the start in Release 18, 5G Advanced focuses on providing sustainable and intelligent mobile networks.
  - Enhanced support for services and applications such as wearables and virtual reality will be defining for the 5G Advanced experience.

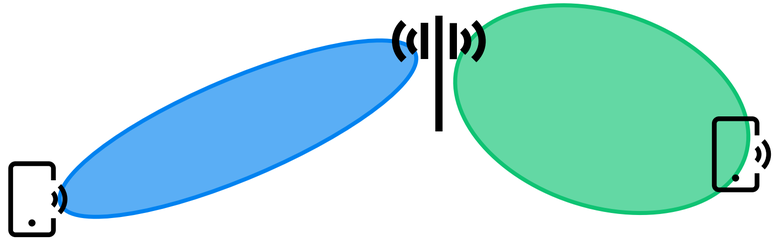
Defining 5G-Advanced: Sustainable networks

- 5G Advanced follows the principles of a lean and power efficient RAN design established in 5G.
- Release 18 will develop a detailed NW power consumption evaluation methodology.
- 3GPP will use this model to identify opportunities to make the 5G RAN even leaner, and to focus on features that provide sustainable gains.



Sustainable networks

- Early identified opportunities include
  - Energy savings in cells/beams that serves limited traffic.
  - Dynamic RX/TX port adaptation to adapt base station RF front end power consumption to device channel quality needs.

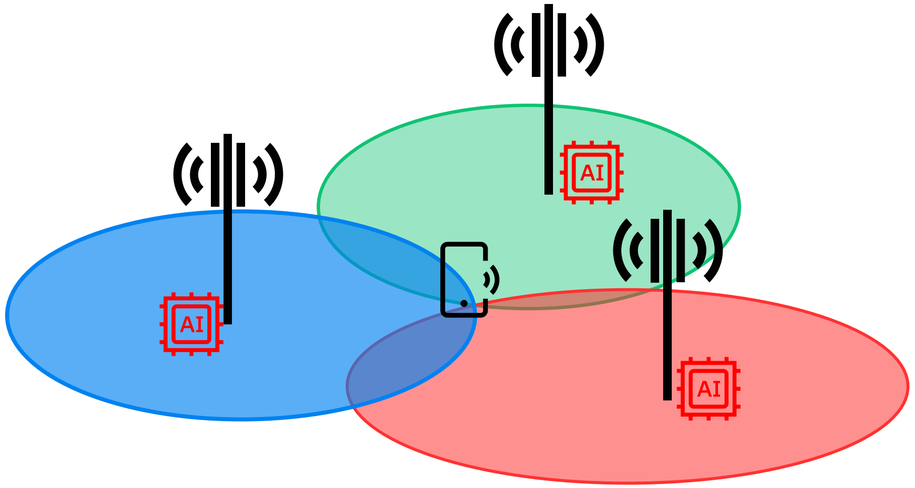


Defining 5G-Advanced: Intelligent RAN automation

- 5G Advanced will enable a new level of RAN intelligence and automation through standardized support for AI/ML.
- The work is use case driven and based on the current 5G architecture.
- Release 18 will use AI to enhance network energy efficiency, load balancing & mobility management.
- Release 18 also considers how AI can improve the 5G air interface functionality.

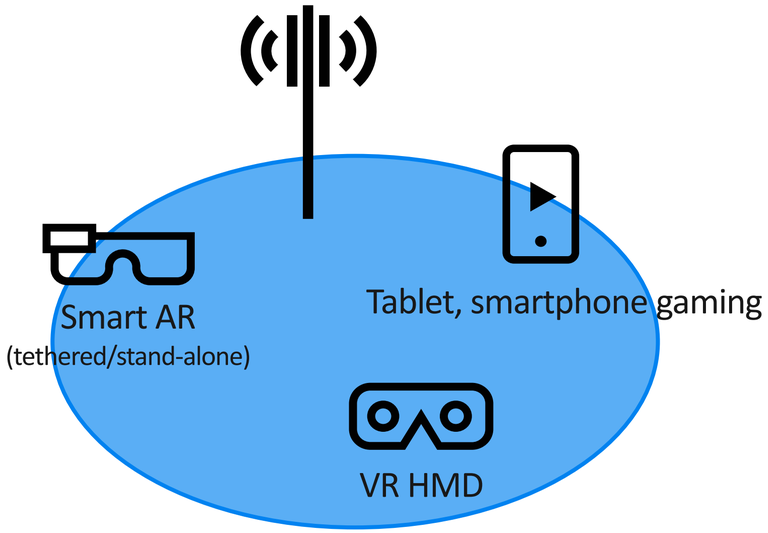
Intelligent RAN automation

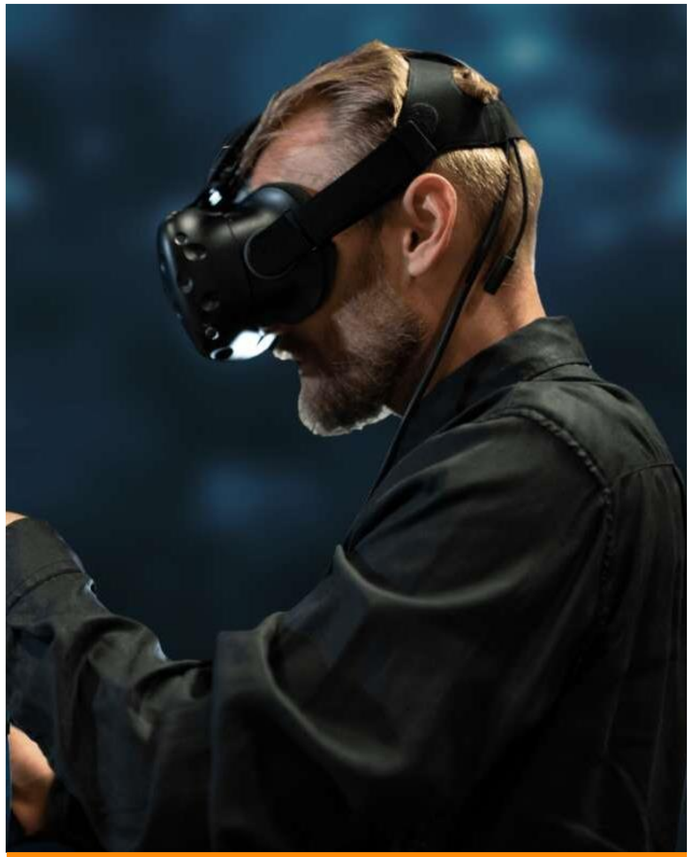
- The air interface work is focused on studying enhancements of channel state information feedback, beam management and positioning.
  - Positioning accuracy can be enhanced by training the RAN to detect line-of-sight conditions.



Defining 5G-Advanced: Immersive experience

- 5G Advanced will strengthen the 5G support for Extended reality (XR).
- XR is an umbrella term that covers Cloud Gaming, Virtual reality & Augmented reality





Immersive experience

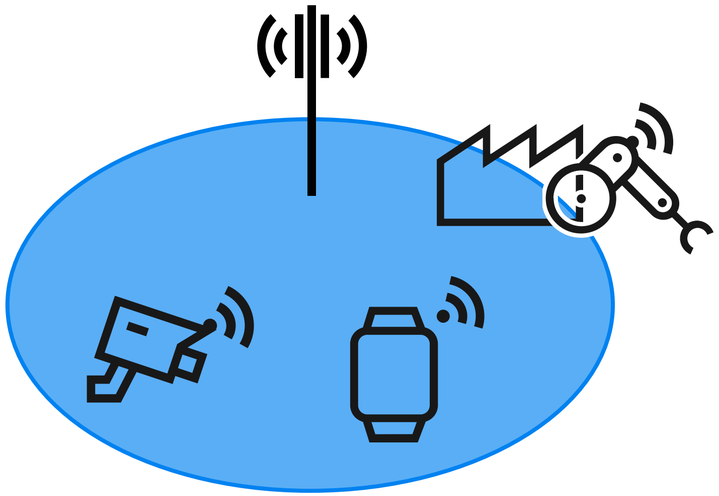
- XR services demand a challenging combination of bounded latency and high data rates.
- In 5G Advanced XR will use application awareness to address resource management to improve latency, system capacity and device energy efficiency by means of
  - Scheduling improvements, Connected mode DRX adaptations, QoS enhancements and application-level rate adaptation.

Defining 5G-Advanced: New applications

- 5G Advanced continues the work to enable new applications and to connect new device types.
- RedCap (Reduced Capability) devices will provide cost friendly and power efficient connectivity to wearables and industrial wireless sensors
- Key enablers for the reduced cost and compact form factor are reduced # antennas and reduced bandwidth.

New applications

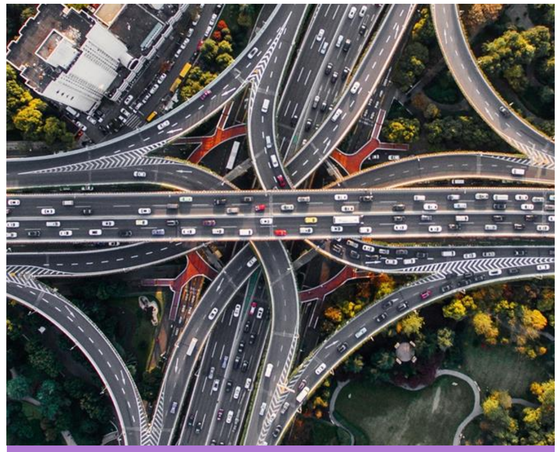
- In Release 18 support for further reduced complexity and power efficiency is in the scope together with positioning.
  - Data rate reductions, extended DRX operation and wake up receivers are among the considered solutions.



Summary

- 5G Advanced starts with 3GPP Release 18 builds on 5G and paves the way towards 6G.
- It enhances the 5G support in a number of key areas including:

Sustainable networks



Intelligent RAN automation

Immersive experience

New applications

Panel discussion and Q&A:
The values and benefits of 5G-Advanced

Panellists:

Olof Liberg
Head of 3GPP RAN standards team, Ericsson

John Gao
5.5G General Manager, Huawei

Benoît Graves
Head of 3GPP RAN Standardisation, Orange

Moderator:

Barbara Pareglio
Executive Director for Advanced Air Mobility and IoT Technical Director, GSMA

GSMA

Closing

Barbara Pareglio

Executive Director for Advanced Air Mobility and IoT Technical Director, GSMA

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Thank you!