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EMPOWER 6G Roadmap

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WE INVENT THE TECHNOLOGIES THAT MAKE LIFE BOUNDLESS

EMPOWER in a nutshell

- H2020-funded project targeting **EU-US Collaboration** for advanced wireless (B5G/6G)
- Mission: To accelerate the joint development between the EU and the US of advanced wireless platforms targeting the **new connectivity frontiers beyond 5G**
- Main Objectives:

Focus here

  - **To establish common wireless R&D technology roadmaps** at different time-scales covering scientific research, standards, spectrum and regulation.
  - **To orchestrate and support cross Atlantic collaboration** on tools for advanced wireless platforms experimentation, evaluation and data management.
  - **To establish and sustain the growth of advanced wireless communities** in Europe and USA through engagement of all stakeholders.

empower

www.advancedwireless.eu

SORBONNE UNIVERSITÉ · uc3m Universidad Carlos III de Madrid

EURECOM · INTERDIGITAL EUROPE

NOKIA Bell Labs · telenor

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The EMPOWER Technology Roadmap

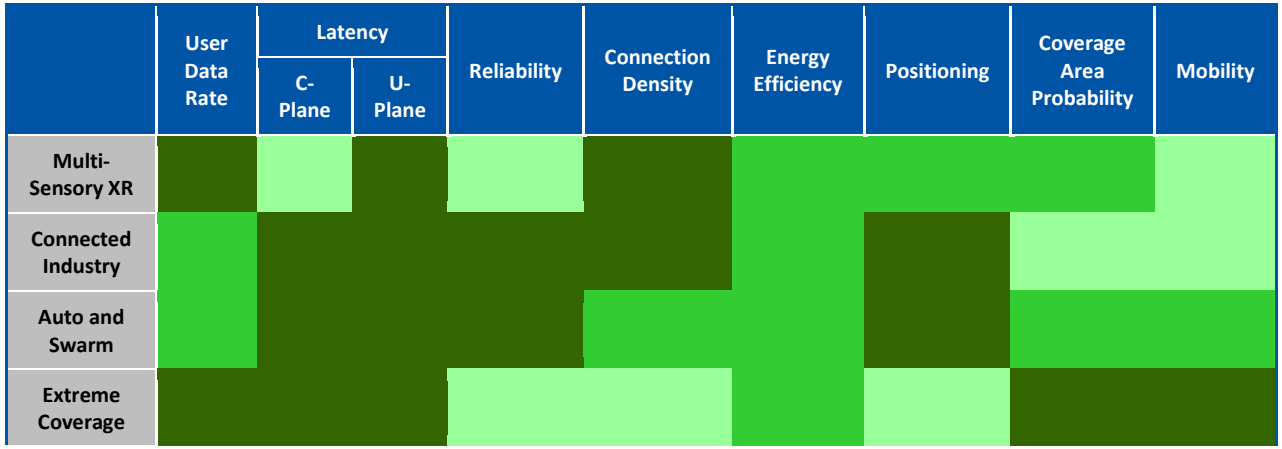
- Purpose is two-fold:
  1. Build a **common knowledge** for the EUUS wireless R&D communities on the future wireless research directions;
  2. To help define **areas of priority** for EUUS to co-work on ahead of worldwide competition for B5G standards
- Roadmap was released **annually** in 2019, 2020, and 2021
- **Final roadmap** downloadable from EMPOWER:

  https://www.advancedwireless.eu/sdm_downloads/deliverable2-5/
- Roadmap effort contributed actively to the **incubation of ETSI RIS ISG**
- It also contributed to **ITU-R IMT-2030 Vision and Tech Trends** draft report

EMPOWER Roadmap: Envisioned Services

H2020 EMPOWER www.advancedwireless.eu

1. Multi-Sensory Extreme Reality (XR) and Haptics
2. Connected Industries and Automation
3. Autonomous Vehicles and Swarm Systems
4. Extreme Coverage and Reaching the last Billion



ITU-R IMT2030 DRAFT

1. Holographic communication, tactile internet and VR/AR-based sensing
2. Industry 4.0, fully autonomous driving and navigation, and smart rail-systems
3. UAV-based systems, integrated satellite and radar networks
4. Smart cities and massive IoT

EMPOWER Roadmap: IMT-2030 Target Capabilities

Wireless Capabilities	IMT-2020	IMT-2030
Spectrum	Up to 100 GHz	Carrier frequencies up to 300 GHz
Bandwidth	At least 100 MHz; Up to 1 GHz	Single channel bandwidth above 10 GHz
Peak data rate (DL/UL)	20 Gbps (DL) 10 Gbps (UL)	Peak data rate exceeding 200 Gbps (downlink) and 100 Gbps (uplink) Update: 1 Tbps (current IMT-2030 assumption)
User data rate (DL/UL)	100 Mbps (DL) 50 Mbps (UL)	Average user data rate exceeding 1 Gbps (downlink) and 0.5 Gbps (uplink) for multi-sensory XR and volumetric media streaming
U-plane Latency	4 ms for eMBB 1ms for URLLC	U-plane latency below 0.5 ms for connected industries, autonomous vehicles and tactile use cases Update: 25 us to 1 ms (current IMT-2030 assumption)
C-Plane Latency	Below 20 ms (10 ms desired)	Control plane latency below 5 ms for connected industries, autonomous vehicles and tactile use cases
Reliability	Up to 5 nines	Reliability up to 8 nines for connected industries and autonomous vehicles
Connection Density	1 device per sqm	Connection density up to 10 devices per sqm (10m devices per km2) for ultra-massive sensor networks
Energy Efficiency	Qualitative	Terminal and network energy efficiencies up by 1000x today's values 5G system Update: 100 to 1000x (current IMT-2030 assumption)
Positioning Accuracy	NA	Positioning accuracy below 5 cm (indoor) and 10 cm (outdoor) helped by joint sensing and communications
Mobility	Up to 500 kmh	Mobility exceeding 1000 kmh for flying objects (e.g. airplanes) supported by the integration with non-terrestrial networks

*Update based on ITU-R IMT-2030 DRAFT compared to initial EMPOWER roadmap

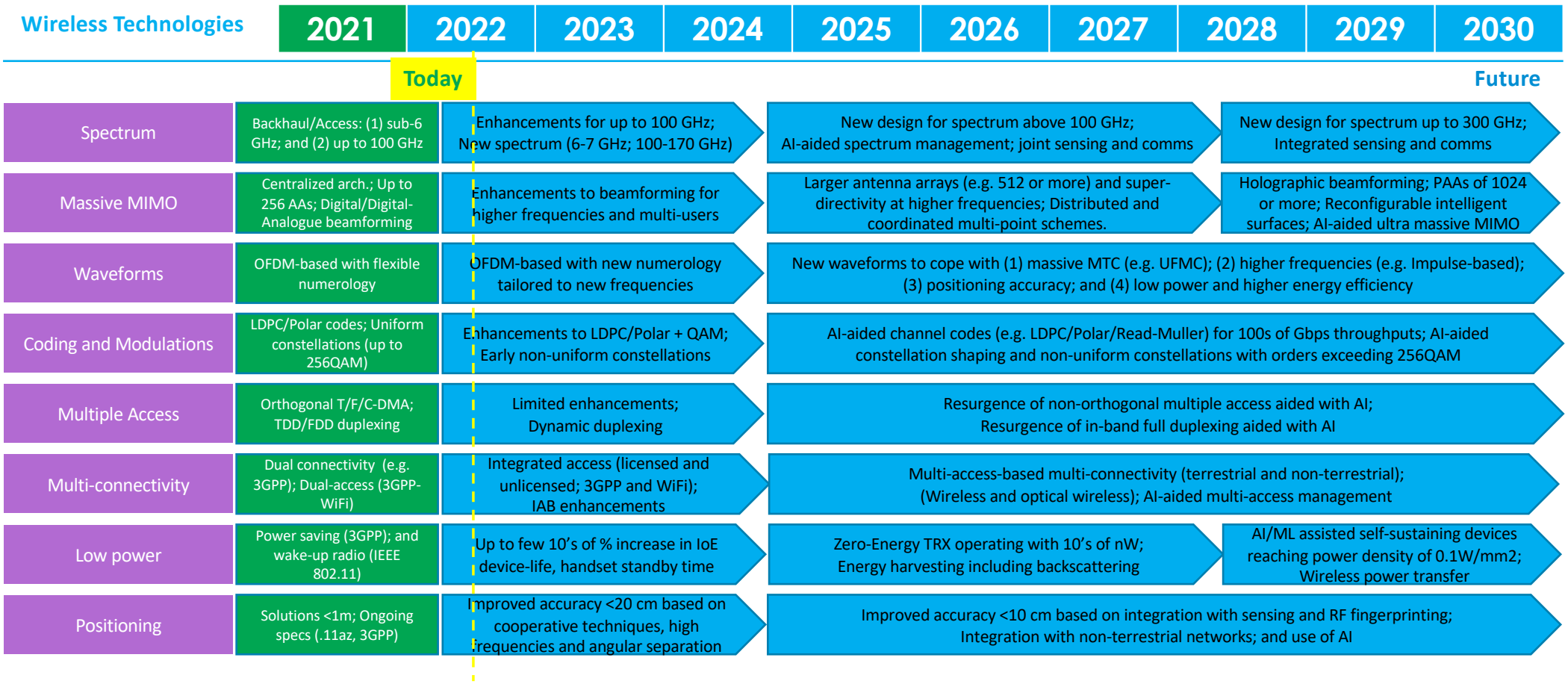
EMPOWER Roadmap: NET-2030 Target Capabilities

Network Capabilities

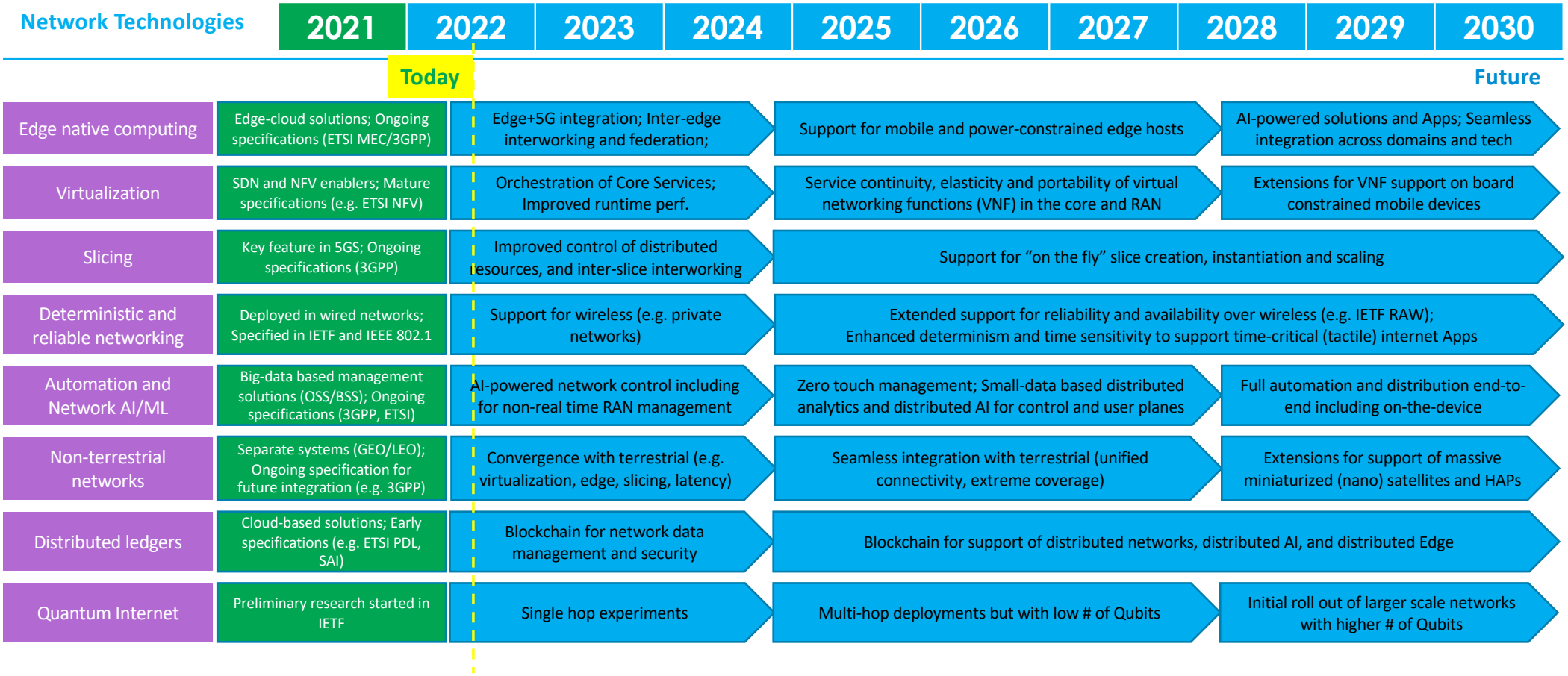
	NET-2020	NET-2030
Automation	Human operated	Self-operating requiring human operators to only validate the decisions
Flexibility	Service-based and slicing limited to core/transport	Fine-grain flexibility based on micro-services and improved end-to-end slicing (core; transport; access; device)
Service deployment time	Few hours	Reduced by a factor of 10 compared to similar tasks in 2020, based on slice creation and instantiation on the fly
Latency	Few tens of ms	Enabling application to application response time in the few milliseconds range
Determinism and Resilience	Limited to wired	Extended to support deterministic and resilient networking for industrial wireless
High network bandwidth	100s Gbps and a few biillion devices	Supporting Terabits per second throughputs and trillions of devices
Data-driven and distribution	Centralized big-data based analytics in core and cloud	Supporting small-data based distributed analytics and distributed AI
Energy consumption	Moderate	A significant energy reduction of network operation compared to 2020
EMF-awareness	Moderate	Support deployment in areas with challenging EMF limits (due to spectrum bands and network densification)
Coverage	Segregated terrestrial and satellite	Ubiquitous based on integration of terrestrial and non-terrestrial networks (satellites and HAPs)
Security and trust	Moderate	Enhanced security based on cyber-physical integration; AI; and quantum keys

*Reference: Horizon Europe, Smart Networks and Services, 2021-2027

EMPOWER Roadmap: IMT-2030 Technology Trends



EMPOWER Roadmap: NET-2030 Technology Trends



Next Steps

- Whilst EMPOWER project has officially ended, the roadmap update and dissemination **continue ...**
- Focus ahead is given for supporting the **IMT 2030 and NET 2030** requirements in NGMN, HEU 6GSNS, ATIS NGA, and ITU-R.
- Strong interest in supporting efforts at **ETSI** for roadmapping and pre-standards activities similar to ETSI RIS ISG paving the way towards 6G.

The Networking Channel
https://networkingchannel.eu/

- An **online platform** between EMPOWER, US PAWR, and ACM Sigcomm, for the global wireless networks research community to meet and share the latest on research trends, tools, platforms, etc.
- Started in **March 2021** to host fortnightly webinars quite popular with the community

MARCH 2022

WED 2

Panel discussion. Click here for more information and to register (required, no cost)

Transatlantic perspectives on 6G Vision, Roadmap and Development Model

David Boswarthick – ETSI

Mikko Uusitalo – Nokia Bell Labs, Finland

Douglas Castor – InterDigital

Moderator:

Alain Mourad – InterDigital Europe, EMPOWER Roadmap Lead