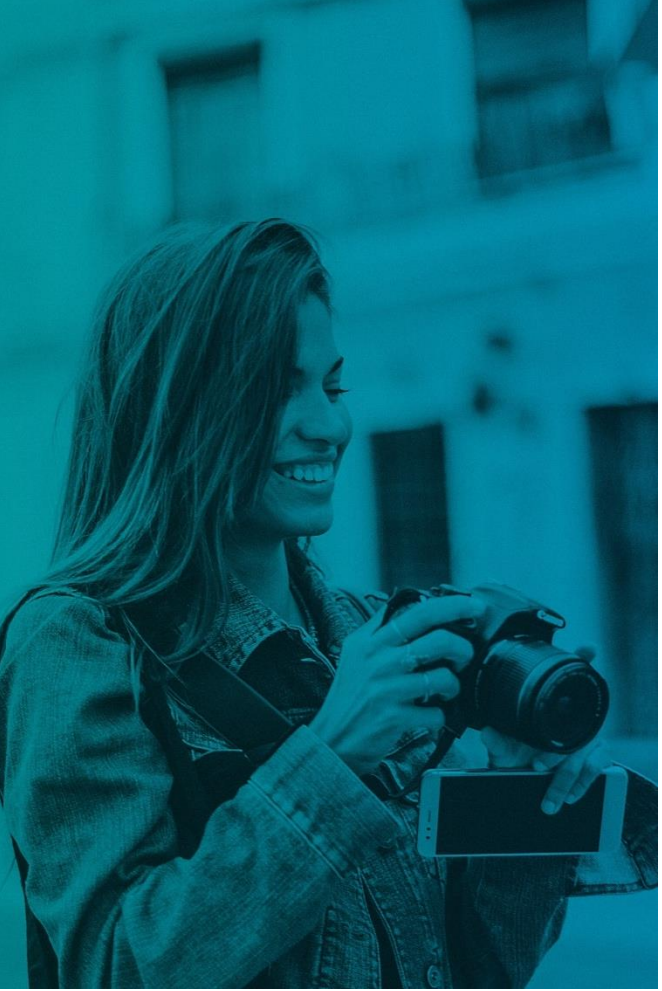
creating the living network. *together*

EMPOWER: Empowering Transatlantic Platforms for Advanced Wireless Research

Dr Alain Mourad

WWRF, May 15, 2019, Tokyo



Outline

- Introduction to EMPOWER
- B5G Technology Roadmap
- Invitation to WWRF for Collaboration

EMPOWER Introduction

- EMPOWER (2018-2021) is a H2020 project from the ICT-21-2018 call: **EU-US Collaboration** for advanced wireless platforms

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:

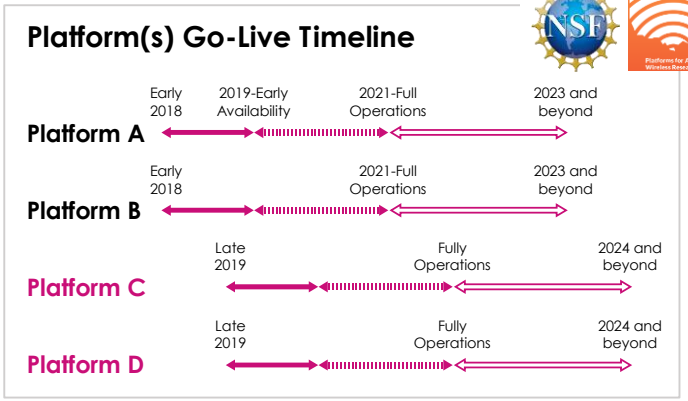
- **To develop a strategic agenda** fostering EU-US collaboration on the challenges of Advanced Wireless Platforms ahead of worldwide competition for beyond 5G connectivity standards.
- **To establish common wireless R&D technology roadmaps** at different time-scales covering scientific research, standards, 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.

EU EMPOWER and US NSF PAWR

- EMPOWER foresees **twinning** with the US NSF PAWR initiatives
- A **joint strategic advisory board** composed of EMPOWER and EU 5G/B5G leadership, and US PAWR leadership

EMPOWER/EU Leadership	US PAWR Leadership
Serge Fdida (Chair, PC Empower)	Tommaso Melodia (PAWR Research Director)
Arturo Azcorra (Empower Strategic Liaison Lead)	Abhimanyu (Manu) Gosain (PAWR Technical Program Director)
Alain Mourad (Empower Technology Roadmap Lead)	Ed Knightly (PAWR Platform A leadership)
Colin Willcock (Chair of 5G-IA)	Ivan Seskar (PAWR Platform B leadership)
Rui Aguiar (Chair of Networld 2020 ETP)	(PAWR Representatives of Platforms C and D to be added)

- US NSF PAWR: Platforms for Advanced Wireless Research
  https://www.advancedwireless.org/about-pawr/
  - PAWR will enable experimental exploration of robust new wireless devices, communication techniques, networks, systems, and services.
  - A $100 million public-private partnership between the NSF and the US wireless industry to deploy and manage up to 4 city-scale research testbeds.



EMPOWER Technology Roadmap Introduction

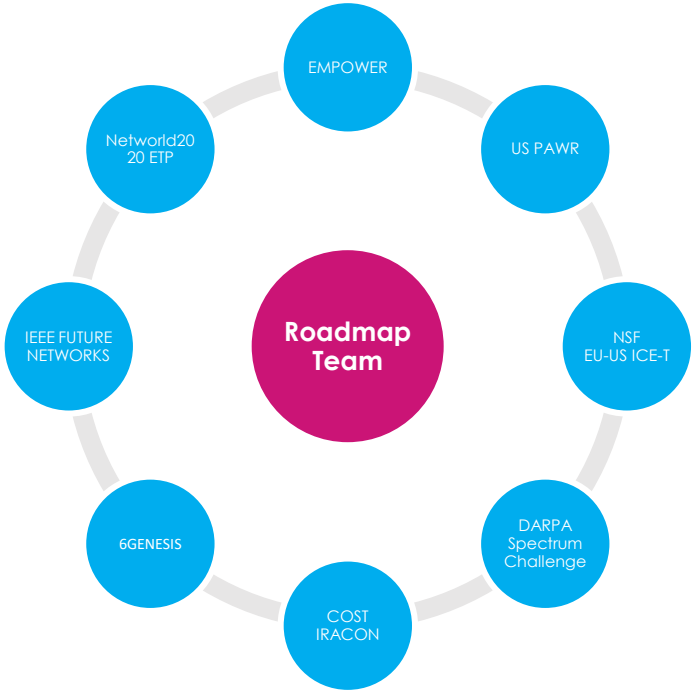
- Purpose is two-fold:
  1. Build a **common knowledge** for the EUUS wireless R&D communities on the future wireless research directions;
  2. To help define **areas of priority** for EUUS to co-work on ahead of worldwide competition for B5G standards
- The roadmap will have an **annual release**, in 2019, 2020, and 2021
- A **public consultation** will be carried out after each release and the results of the consultation will be announced at an annual workshop

- Roadmap **development methodology**:
  1. Identify roadmap team & agree need/use
  2. Define scope & boundaries for the technology roadmap
  3. Identify technology areas for roadmapping
  4. Determine critical system requirements (CSRs) for area of focus and define corresponding targets
  5. Specify major technical solutions pertinent to CSR targets and estimate corresponding maturity timelines
  6. Roadmap technologies towards targets
  7. Issue recommendations on areas of priority including analysis of risks

We are here! ☛

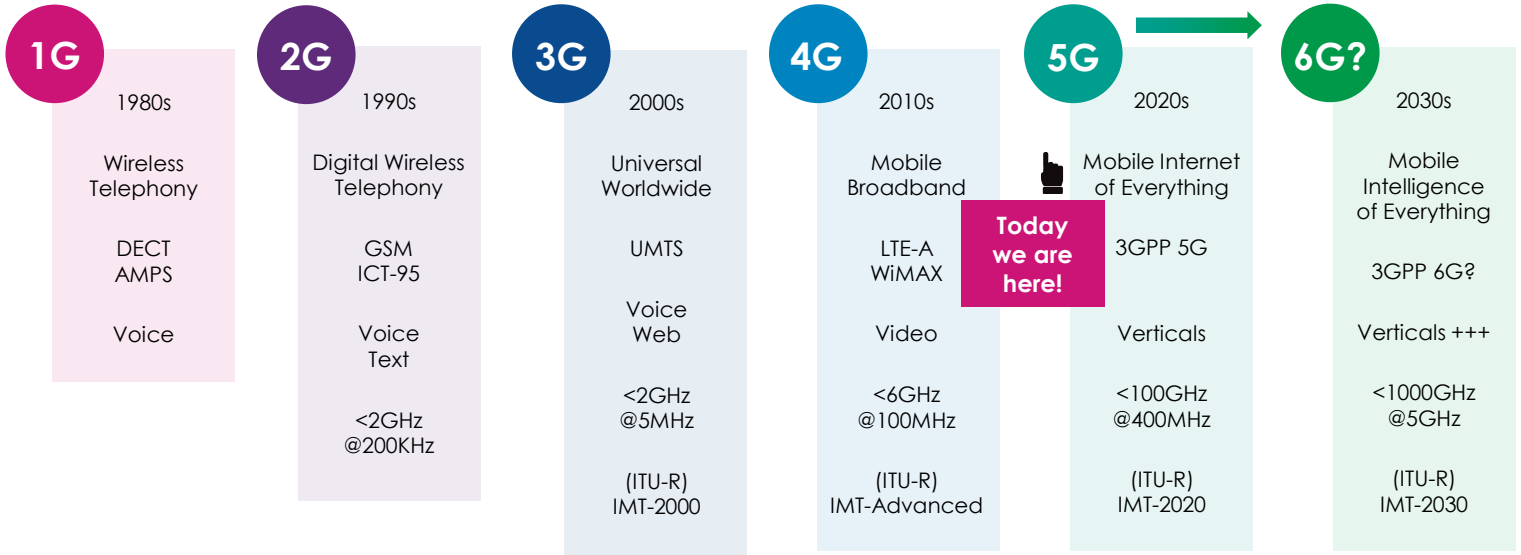
Step 1: Roadmap Team

- A team strong of a dozen experts is being assembled
- Experts involved in B5G roadmap activities in various programmes
  (e.g. PAWR, NSF, NetWorld2020, COST, 6GENESIS, IEEE Future Networks)
- Experts represent a good coverage of different B5G technology areas and from research, standards, and regulatory perspectives



Step 2: Roadmap Scope

- Scope is set on wireless technology advances that are pertinent to the **evolution of 5G over the next decade**



Step 3: Roadmap Technology Areas

1. **Circuits and devices** at nanometers level with node scaling targets of Power-Performance-Area-Cost (PPAC) breaking through the limits of Moore's Law
2. **Radio transceivers** supporting extreme requirements at Tbps data rates, sub-ms latency, and sub-mWatts power
3. **Radio system** expanding to integrate (un)licensed, (non)terrestrial, and (non)comms sub-systems, in a 3-D space with fluid topologies
4. **Network protocols** catering for the requirements of next generation internet including determinism, time-sensitivity, and automation
5. **Data** (small and big) driven E2E optimizations with pervasive collaborative **intelligence** distributed across terminals, edge, fog and cloud

Step 4: Critical System Requirements

- Enhanced Capabilities **beyond IMT2020** through
  i. New targets for existing KPIs; and ii. New and redefined KPIs

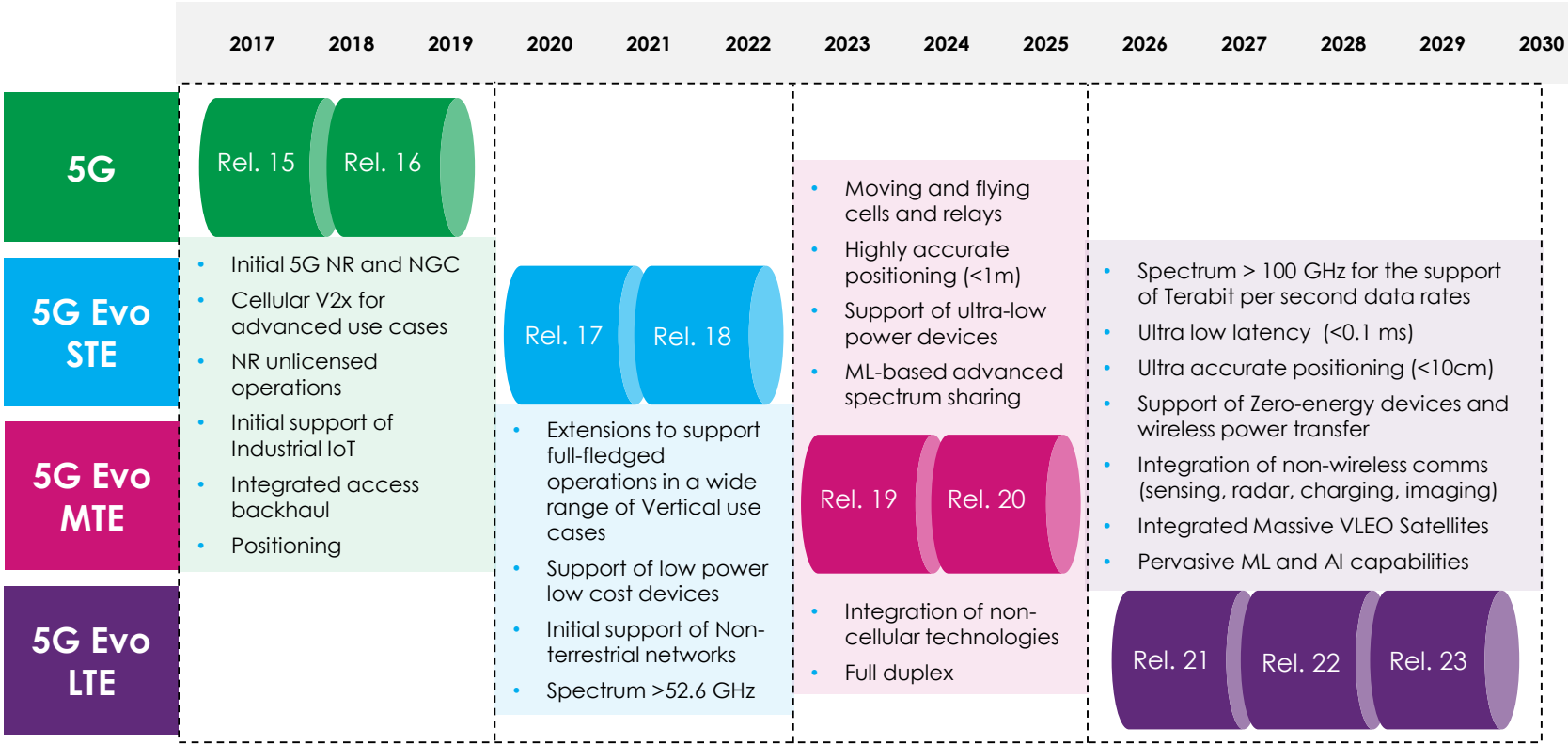
Capability/ CSR	2020-2022 (5G STE)	2022-2025 (5G MTE)	2025-2030 (5G LTE)
Spectrum / Bandwidth	<100 GHz @<1 GHz	<500 GHz @<5 GHz	<1000 GHz @<10 GHz
Peak Data Rate	(DL/UL) >50/25 Gbps	(DL/UL) >200/100 Gbps	(DL/UL) >1000/500 Gbps
User Data Rate	(DL/UL) >100/50 Mbps	(DL/UL) >400/200 Mbps	(DL/UL) >2/1 Gbps
Spectral Efficiency	(DL/UL) >30/15 bpsHz	(DL/UL) >50/25 bpsHz	(DL/UL) >100/50 bpsHz
Traffic Capacity	20 Mbps/sqm	100 Mbps/cum	1000 Mbps/cum
Density	>1 device/sqm	>5 device/cum	>10 device/cum
Reliability	>99.999%	>99.9999%	>99.99999%
U-Plane Latency	<1 ms	<0.5 ms	<0.1 ms
C-Plane Latency	<10 ms	<5 ms	<1 ms
Power (Terminal)	<100's mWatts	<10's mWatts	<1 mWatt
Positioning accuracy	<30 cm	<10 cm	<1 cm
Mobility	<500 Km/h	<1000 Km/h	<1000 Km/h

Step 5: Enabling Technical Solutions

- **Work in progress** to specify major technical solutions pertinent to the CSR targets and estimate corresponding maturity timelines

Technology Area	Evolution Trend	Reference Roadmap(s)
Circuit & Device	Nanometers level with node scaling targets of Power-Performance-Area-Cost (PPAC) breaking through the limits of Moore's Law	ITRS 2.0
Radio transceiver	RF frontend and baseband design to support extreme requirements (e.g. Tbps data rate, sub-ms latency, sub-mWatt power)	3GPP 5G NR Evolution WiFi 802.11 Evolution NFC 2.0 IEEE Future Networks Networld2020 SRIA
Radio system	Integrating licensed and unlicensed, terrestrial and non-terrestrial, comms and non-comms, in a volumetric space with fluid topologies	
Network	Protocols catering for the requirements of next generation internet including determinism, time-sensitivity, and automation	3GPP 5G Core Evolution IRTF RGs ITU-T NET2030 FG Networld2020 SRIA
Data & Intelligence	Data-driven E2E optimizations with pervasive collaborative intelligence distributed across terminals, edge, fog and cloud	ITU-T ML5G FG ETSI ENI ISG

Reference Example – 3GPP 5G NR Evolution



Steps 6-7: Roadmap & Recommendations

- **Step 6:** Roadmap technologies towards targets
- **Step 7:** Issue recommendations on areas of priority including analysis of risks

Invitation to WWRF for Collaboration

- **Establish a liaison** for alignment on the B5G technology roadmap
- **Name** an expert to join the EMPOWER roadmap team
- **Participate in our consultations and workshops** for collecting and acting upon the community feedback

Thank You

Alain MOURAD, PhD

Director Engineering R&D, InterDigital Europe Ltd.
64 Great Eastern Street, London, EC2A 3QR
+44 7920 798 685

Alain.Mourad@InterDigital.com

empower

www.advancedwireless.eu

INTERDIGITAL.