

InfoCom 2018

5G-EVE

User KPI Definition & Analysis

Velissarios Gezerlis, Ph.D.

Tilemachos Doukoglou, Ph.D.

OTE Laboratories & Technologies Evaluation Department

21-11-2018



This Project has received funding
from the EU H2020 research and
innovation programme under
Grant Agreement No 815074



GROUP OF COMPANIES



5G EVE

5G EVE end-to-end facility

- 5G-EVE will develop and interconnect four existing European sites to create a unique 5G end-to-end facility. The four inter-working sites are located in **Greece (in OTE's facilities)**, Spain, France, and Italy.
- They are complemented by advanced labs (e.g. the Ericsson lab in Kista, Sweden).
- We will offer the facility to vertical industries for execution and validation of pilots. Access will be through a unified functional and operational API.
- The 5G EVE end-to-end facility will enable experimentation and validation with full sets of 5G capabilities. They will be initially Release 15-compliant, and by the end of the project they will be Release 16-compliant.



This Project has received funding from the EU H2020 research and innovation programme under Grant Agreement No 815074



GROUP OF COMPANIES



5G EVE

5G EVE - Requirements Definition & Analysis

- One of the OTE's Research Labs work was to **gather, define and analyze** the requirements from all vertical industries participating in 5G-EVE.
These requirements will be used as a reference to build the 5G-EVE end-to-end facility subsystems integration and capabilities.
- We focus on requirements definition and analysis of **6 main use cases and sub use cases**.
- The use cases can all fit under three main 5G umbrella scenarios, namely:
 - enhanced Mobile Broadband (**eMBB**), - *large payloads – high bandwidth*
 - massive Machine Type Communications (**mMTC**) - *huge number of devices in a BS*
 - and Ultra-Reliable Low-Latency Communications (**URLLC**) – *very low latency*



This Project has received funding from the EU H2020 research and innovation programme under Grant Agreement No 815074



Requirements Definition & Analysis

- The **main outcome** of this work consists in **detecting/extracting/collecting** and **analysing** a set of requirements from the use-cases defined by the internal vertical-industries participating in the 5G-EVE project.
- For each use case two types of requirements have been used, **general** requirements and more **specific** requirements.



This Project has received funding from the EU H2020 research and innovation programme under Grant Agreement No 815074



GROUP OF COMPANIES



5G EVE

Requirements Definition & Analysis

General Vertical/Use Case Requirement		Specific Vertical/Use Case Requirement	
	Latency (in milliseconds) - Min/MAX	for Network	Number of End Points
	Speed (in Mbps) - Min/MAX - bitrate		Number (Range) of End Devices per End Point
	Reliability (%) - Min/MAX		Density of End Devices (per sq. Kmeter)
	Availability (%) - Min/MAX		Bitrate needs per end point Uplink UL (Mbps)
	Mobility (in m/sec or Km/h) - Min/MAX	for End Devices	Bitrate needs per end point Downlink DL (Mbps)
	Broadband Connectivity (peak demand)		End -to-end Latency (msecs)
	Network Slicing (Y/N)		Highest Acceptable jitter (msec)
	Security (Y/N)		Number of Class of Service (1-8, more)
	Capacity (Mbps/m^2 or Km^2)		Type of Device (i.e. Smartphone, TV, VR)
	Device Density		Bitrate required Uplink (Mbps)
			Bitrate required Downlink (Mbps)
			Max Latency Allowable (in msecs)
			Max Moving Speed (km/h, 0 if stationary)
			IPv4 & IPv6 support (or both)
			Connection of Device to End Point (Wired/Wireless)
			Type of Connection (i.e. Ethernet, WLAN, Zigbee)
			Authentication method (i.e. SIM, eSIM, Key..)



This Project has received funding from the EU H2020 research and innovation programme under Grant Agreement No 815074



GROUP OF COMPANIES



5G EVE

6-Main Use cases (12 sub use cases in total)

a/a	Use Case	Description
1	Use Case 1	Smart Transport – Intelligent Railway for smart mobility - TRENITALIA
2	Use Case 2	Smart Tourism - Augmented Fair experience - SEGITTUR - Spain
3	Use Case 3a	Industry 4.0 – Autonomous vehicles in manufacturing environments – ASTI Spain
4	Use Case 3b	Industry 4.0 – Autonomous vehicles in manufacturing environments – Ericsson GR
5	Use Case 4	Utilities - Smart Energy - Fault management for distributed electricity generation in smart grids – WINGS GR / EDF FR
6	Use Case 5a	Smart cities - Safety and Environment - Smart Turin – COMUNE DI TORINO Italy
7	Use Case 5b	Smart cities - Safety and Environment – eHealth/eAmbulance – NOKIA GR
8	Use Case 5c	Smart cities - Safety and Environment – Health Monitoring and Forecasting, Smart Mobility, Smart Home – WINGS GR
9	Use Case 6a	Media & Entertainment – UHF Media – TELEFONICA Spain
10	Use Case 6b	Media & Entertainment – On-Site Live Event Experience – TELEFONICA Spain
11	Use Case 6c	Media & Entertainment – Immersive and Integrated Media – TELEFONICA Spain
12	Use Case 6d	Virtual Visit – Virtual 360° Visit for real estate or tourism – ORANGE FR



This Project has received funding from the EU H2020 research and innovation programme under Grant Agreement No 815074

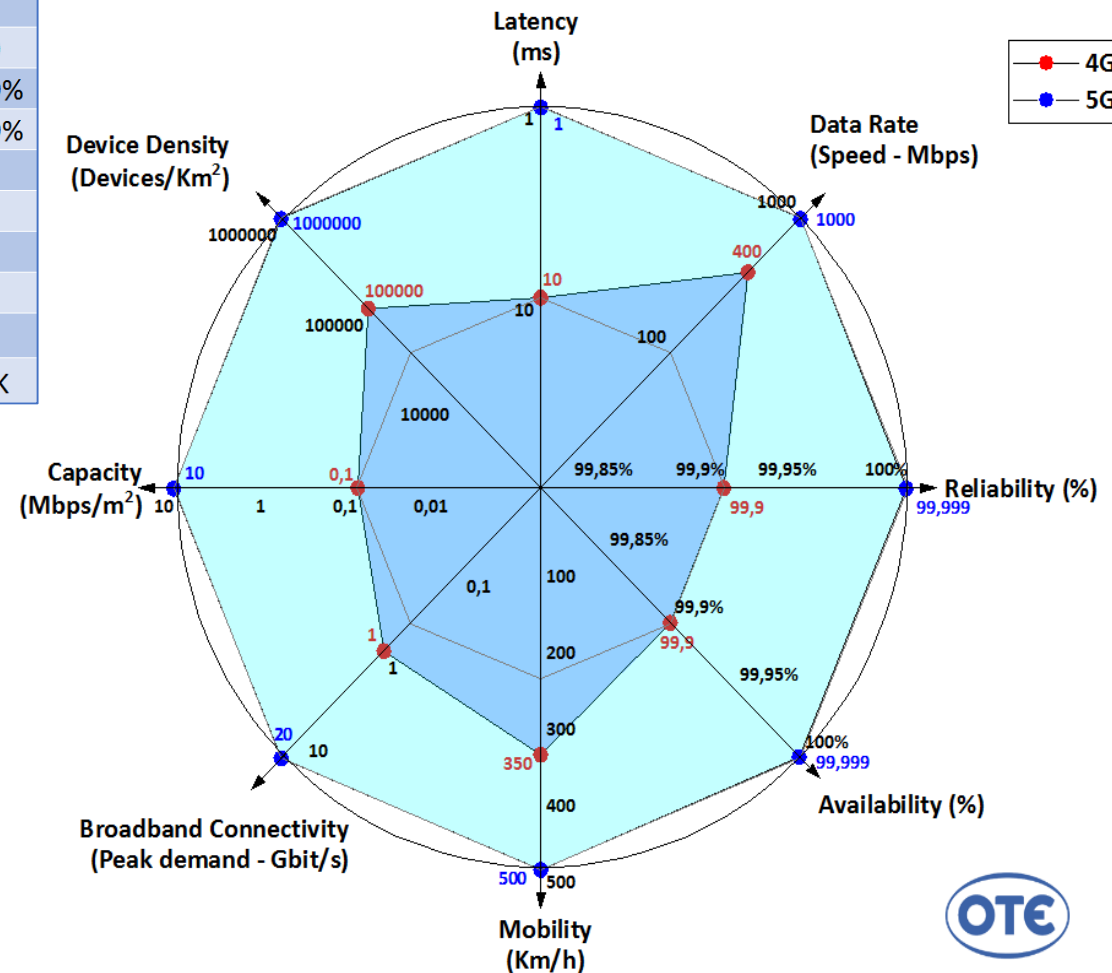


Radar chart Visualization for 4G/5G capabilities

General 4G/5G capabilities		Units	4G	5G
1	Latency (in milliseconds)	msec	10	1
2	Speed (in Mbps) - bitrate	Mbps	400	1000
3	Reliability (%)	%	99,9%	99,999%
4	Availability (%)	%	99,9%	99,999%
5	Mobility (in m/sec or Km/h)	Km/s	300	500
6	Broadband Connectivity (peak demand)	Gbps	1	20
7	Network Slicing (Y/N)	Y/N	N	Y
8	Security (Y/N)	Y/N	Y	Y
9	Capacity (Mbps/m ² or Km ²)	Mbps/m ²	0,1	10
10	Device Density	Dev/Km ²	100K	1000K

- *This is the first radar chart which corresponds to a comparison of 4G/5G capabilities.*
- *It was subsequently used as a reference since all the Use Case Requirements was mapped on this one to access their existing and future needs.*

5G-EVE: 4G/5G capabilities and Use Case Requirements



This Project has received funding from the EU H2020 research and innovation programme under Grant Agreement No 815074



Questionnaire table where all general and specific 5G requirements for each use case was collected.

		Units	Use Case description			Priority	Range	
			URLLC	mMTC	eMMB ¹⁰		Min	Max
General Vertical/Use Case Requirement								
1	Latency (in miliseconds) - Min/MAX	msec						
2	Speed (in Mbps) - Min/MAX - sustained demand	Mbps						
3	Reliability (%) - Min/MAX	%						
4	Availability (%) - Min/MAX	%						
5	Mobility (in m/sec or Km/h) - Min/MAX	Km/s						
6	Broadband Connectivity (peak demand)	Y/N or Mbps						
7	Network Slicing (Y/N)	Y/N						
8	Security (Y/N)	Y/N						
9	Capacity (Mbps/m^2 or Km^2)	Mbps/m ²						
10	Device Density	Dev/Km2						
Specific Vertical/Use Case Requirements								
Network	Number of End Points							
	Number (Range) of End Devices per End Point							
	Density of End Devices (per sq. meter)							
	Bitrate needs per end point (Kbps,Mbps, Gbps)							
	End -to-end Latency (msecs)							
	Highest Acceptable jitter (msec)							
End Devices	Number of Class of Service (1-8, more)							
	Type of Device (i.e. Smartphone, TV, VR)							
	Bitrate required (Kbps / Mbps / Gbps)							
	Max Latency Allowable (in msecs)							
	Max Moving Speed (km/h, 0 if stationary)							
	IPv4 & IPv6 support (or both)							
	Connnection of Device to End Point (Wired/Wireless)							
	Type of Connection (i.e. Ethernet, WLAN, Zigbee)							
	Authentication method (i.e. SIM, eSIM, Key..)							
Other Vertical Specific (non-Network related Requirements)								
	i.e Battery life requirement							
5G-EVE Site Services USER REQUIREMENTS								
	City							
	Address & End Tel. Number ¹							
	Competent, Tel. Number, FAX							
	Type of Service ²							

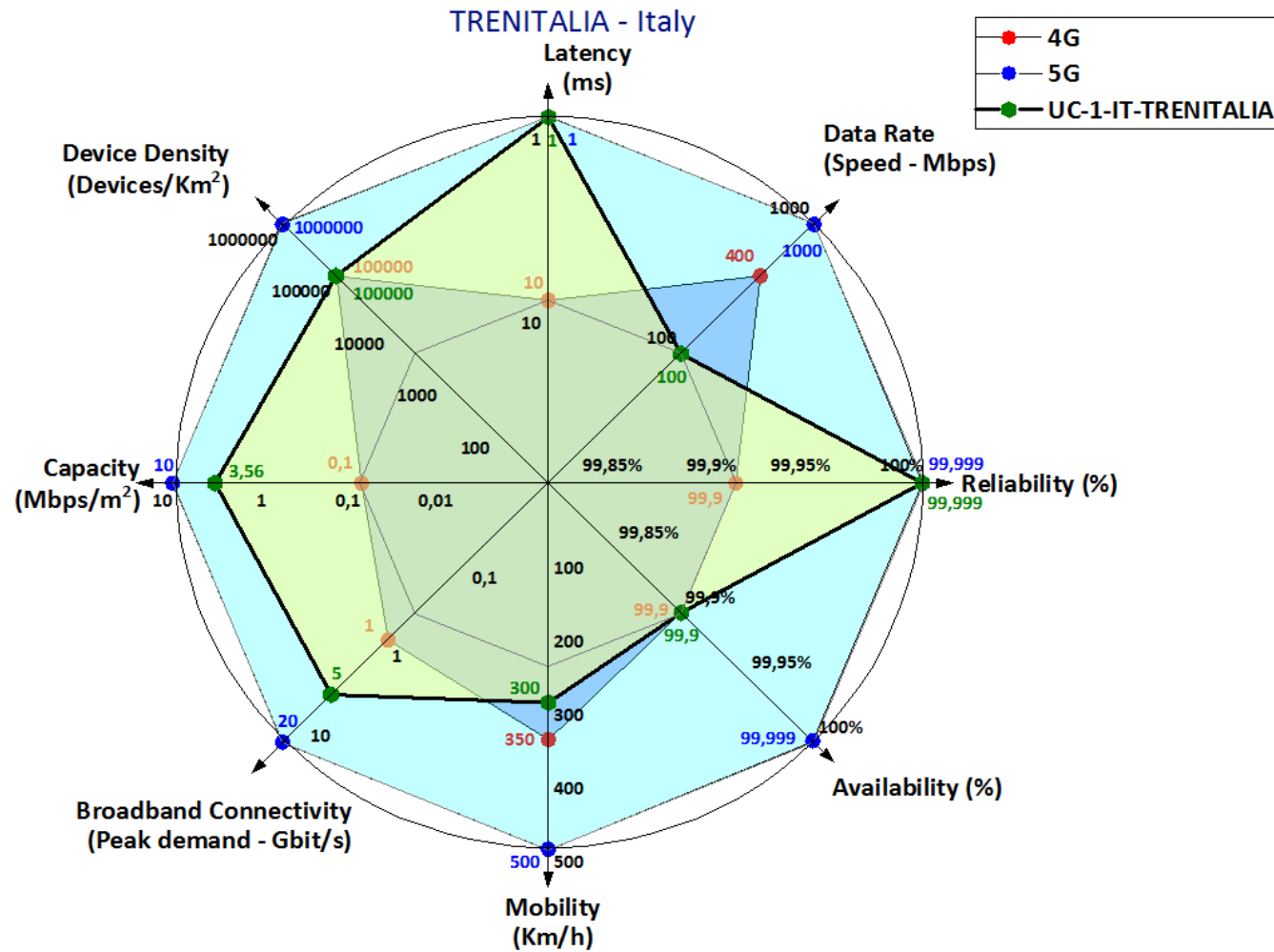


This Project has received funding from the EU H2020 research and innovation programme under Grant Agreement No 815074



4G/5G capabilities and Use Case 1 Smart Transport Requirements by TRENITALIA

5G-EVE: 4G/5G capabilities and Use Case 1 Smart Transport Requirements



This Project has received funding from the EU H2020 research and innovation programme under Grant Agreement No 815074



GROUP OF COMPANIES

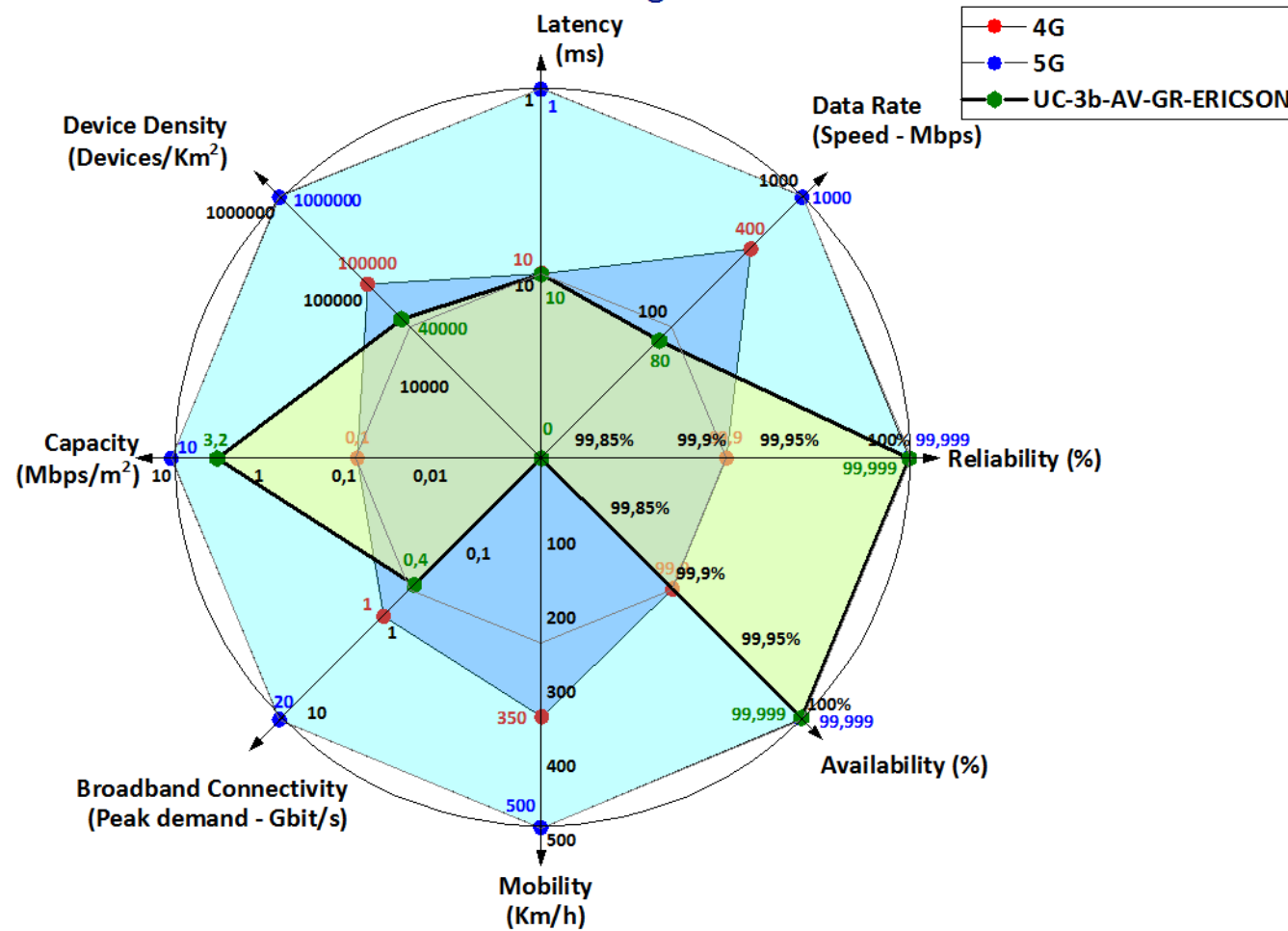


5G EVE

4G/5G capabilities and Use Case 3 – Industry 4.0

Autonomous vehicles in manufacturing environments by Ericsson GR

5G-EVE Radar graph for 4G-5G comparison with Use Case 3b
Autonomous vehicles in manufacturing environments - Ericsson GR



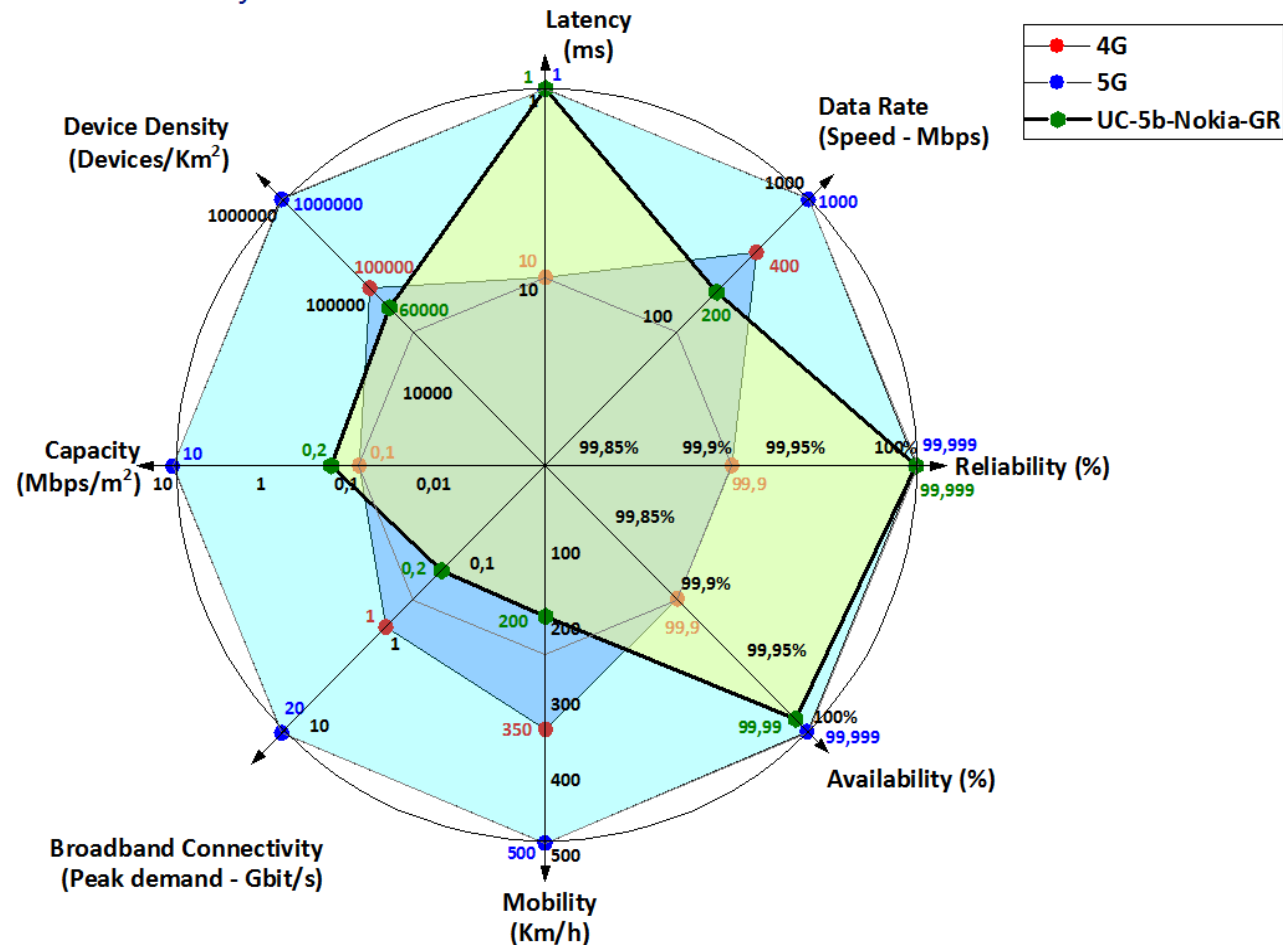
This Project has received
from the EU H2020 resea
innovation programme u
Grant Agreement No 815



4G/5G capabilities and Use Case 5b Smart cities - Safety and Environment – eHealth/eAmbulance – by NOKIA GR

5G-EVE: 4G/5G capabilities and Use Case 5a Smart Cities Requirements

Safety and Environment - eHealth - eAmbulance - Nokia GR



This Project has received funding from the EU H2020 research and innovation programme under Grant Agreement No 815074



GROUP OF COMPANIES

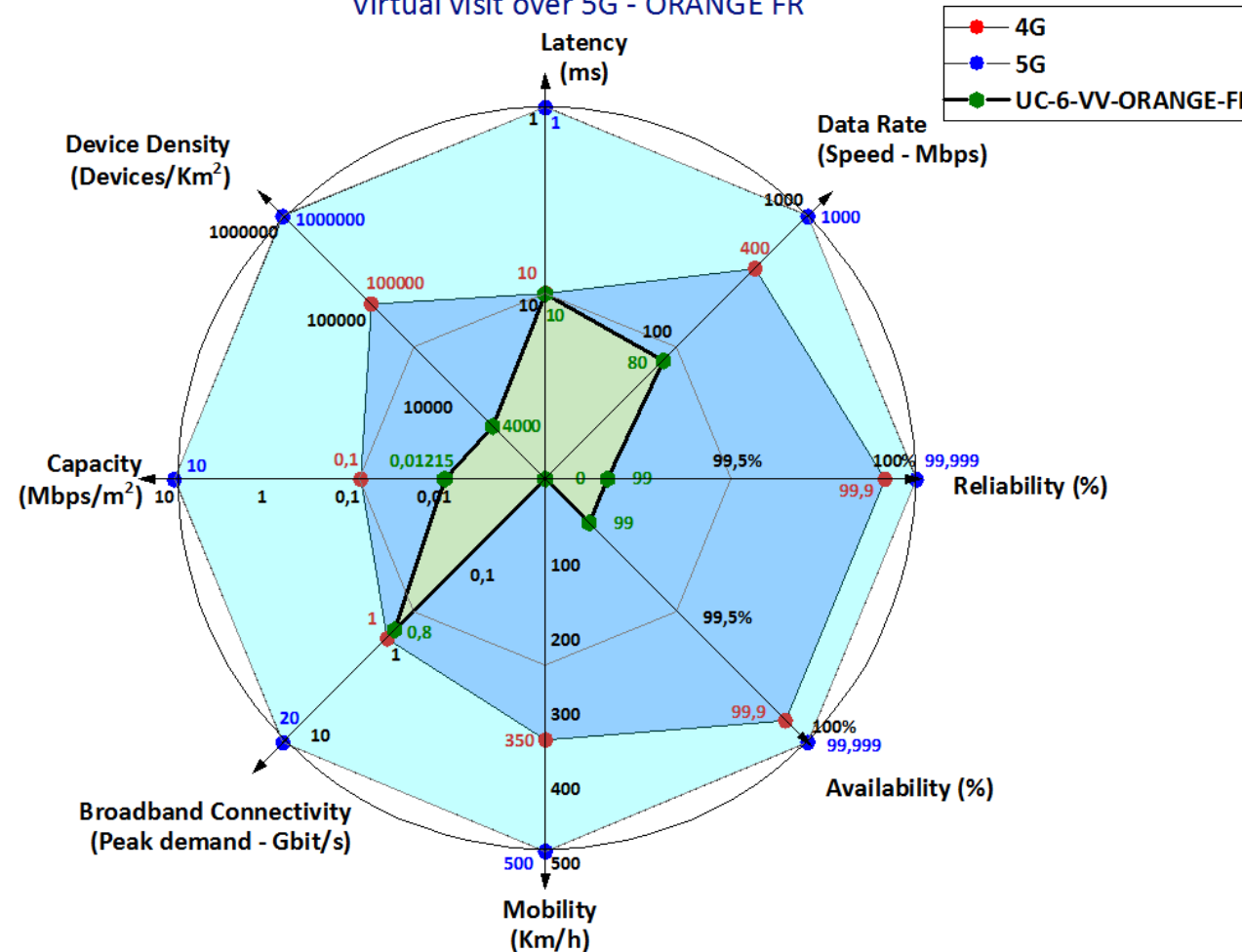


5G EVE

4G/5G capabilities and Use Case 6d – Virtual Visit – Virtual 360° Visit for real estate or tourism by ORANGE FR

5G-EVE: 4G/5G capabilities and Use Case 6 Media & Entertainment Requirements

Virtual visit over 5G - ORANGE FR



This Project has received funding from the EU H2020 research and innovation programme under Grant Agreement No 815074



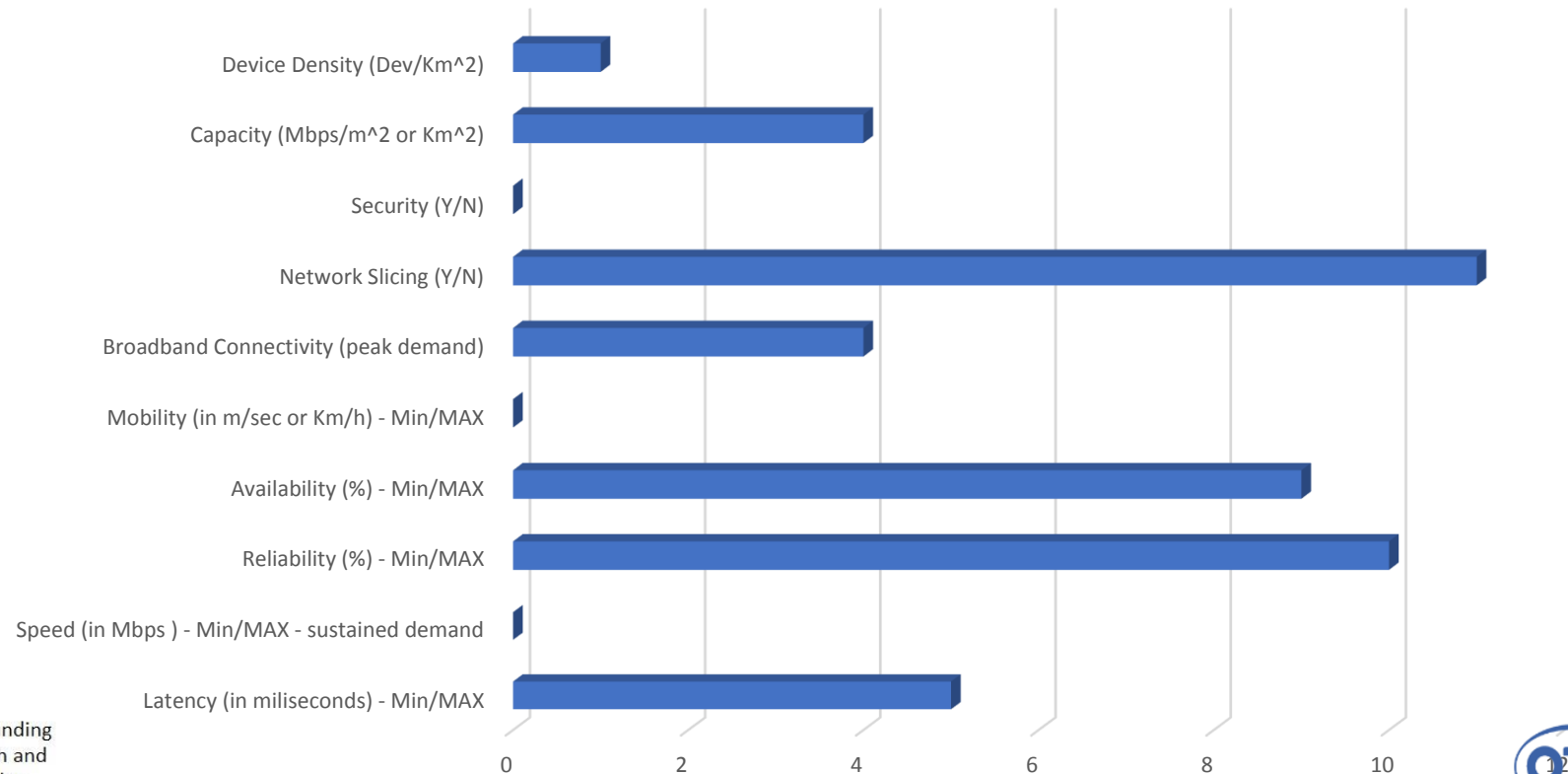
GROUP OF COMPANIES



5G EVE

Prioritization of UCs' 5G Capabilities by the frequency that appears in the requirement tables

Requirements for 5G capabilities in terms of demand (overall)



This Project has received funding from the EU H2020 research and innovation programme under Grant Agreement No 815074



GROUP OF COMPANIES



5G EVE

Analysis and Conclusion

- The most desirable capability is **Slicing**.
- The second most asked-for capability is **Reliability**. It is an indication that mobile networks should reach a much higher level of reliability (of 5-nines)
- Paired with Reliability is the **Availability** requirement (of 5-nines). The importance of these two parameters, indicate that service providers and end users alike want the Service to be available “always”, not only in temporal terms but also in spatial terms (everywhere).
- Fourth requirement in priority is **Latency**, followed by **Capacity**. It appears that more and more real time applications need to be introduced in the network.



This Project has received funding from the EU H2020 research and innovation programme under Grant Agreement No 815074



GROUP OF COMPANIES



5G EVE

5G-EVE Future work

- We are awaiting for new verticals from ICT-19,
- So, we have to gather more requirements,
- Update our analysis with new use cases,
- New radar charts have to be produced for new use cases and be analyzed,
- Introduce the new type of requirement (**dependability**)
 - dependability= reliability + availability + maintainability +...
- **Implementation of the Greek site in OTE's facilities with the co-operation of Ericsson Hellas, Nokia GR, WINGS.**



This Project has received funding from the EU H2020 research and innovation programme under Grant Agreement No 815074



GROUP OF COMPANIES



5G EVE

5G-EVE - User KPI Definition & Analysis

Thank you!



This Project has received funding
from the EU H2020 research and
innovation programme under
Grant Agreement No 815074



GROUP OF COMPANIES



5G EVE