



SYSTEMICS PAB
Network Quality Experts



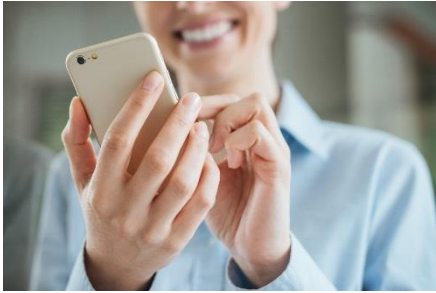
ITU-EKIP Regional Regulatory Forum for Europe

The 5G Readiness Scoring and Service Continuity

Jan Kondej, Technical Director, Systemics-PAB



SYSTEMICS – Who We Are?



WE MEASURE, MONITOR AND ANALYSE QOS OF MOBILE AND FIXED NETWORKS TO OPTIMISE CUSTOMER EXPERIENCE



WE EXAMINE NETWORK HEALTH, IDENTIFY PROBLEMS AND RECOMMEND EFFECTIVE INTEGRATED SOLUTIONS TO IMPROVE PERFORMANCE AND SERVICE ASSURANCE



WE PRODUCE SMART ACTIONABLE INSIGHTS THAT IMPROVE USABILITY OF MULTI-TECHNOLOGY NETWORKS

Recent Changes



GLOBAL PROVIDER OF NETWORK
QUALITY SOLUTIONS AND SERVICES



- 33 | ▶ Years in business
- 100+ | ▶ Professional experts
- 60+ | ▶ Customers in over 40 countries

Part of Apave Group since July 2023



Apave is an international group with over 150 years' experience in the management of human, technical, environmental and digital risks. It provides services in the fields of inspection, certification/labelling, professional training, tests and measurements, and consulting and technical support.

Key References

OPERATORS



TELECOMMUNICATIONS REGULATORY BODIES



EQUIPMENT VENDORS

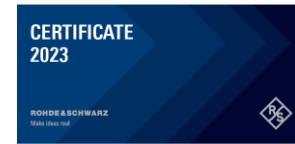


International Recognition & Presence

- ▶ ISO 9001:2015 certified company (valid till 28-04-2024)
- ▶ Audited for quality management systems and measurements in telecommunication networks



- ▶ ETSI Full member
- ▶ Active initiator and participant of STQQMobile developing ETSI TR 103 559)



- ▶ First company to be announced by Rohde & Schwarz in MNT Certified Partner Program
- ▶ Systemics performs system testing as part of R&S new products development



- ▶ Systemics pays the high attention to the social responsibility and sustainability
- ▶ It is in the top 5% of companies rated by EcoVadis in the Telecommunications industry



- ▶ Participant in 5GPERFECTA and IMMINANCE initiative
- ▶ International group under EC for defining 5G Network performance architecture, developing technologies to monitor 5G traffic and assure 5G compliance



Networks Benchmarking For RATEL In Serbia

- Telekom Srbija, Telenor and Vip mobile measured
- 55 cities and 16,000 km of drive route
- 6,000+ voice and 100,000+ data tests
- Voice and data KPIs according to ETSI TR103559 Annex A
- Interactive reporting accessible to the public

<http://benchmark.ratel.rs/en>

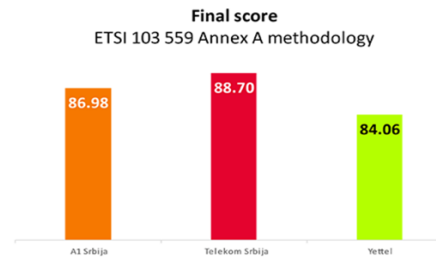
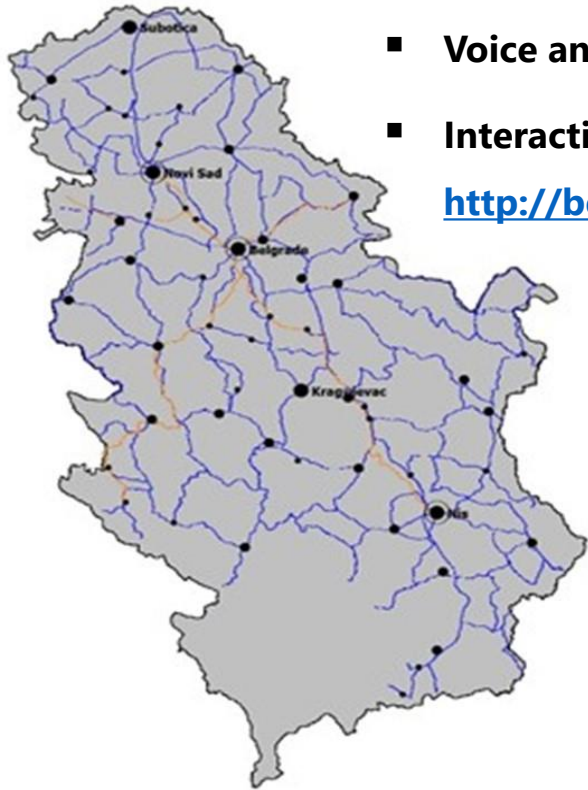


Fig.1 the final score in 2022

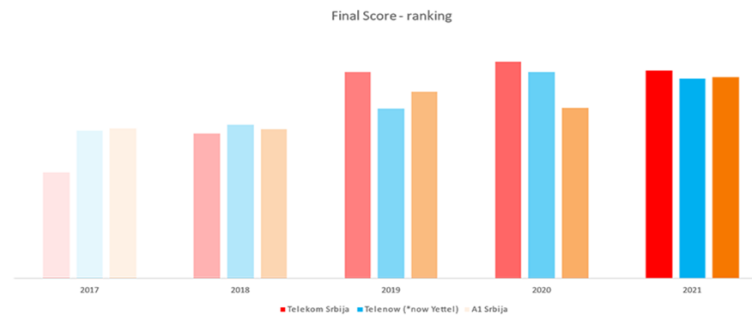
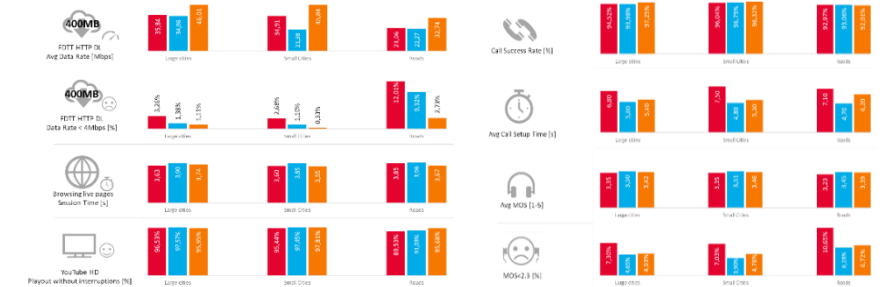
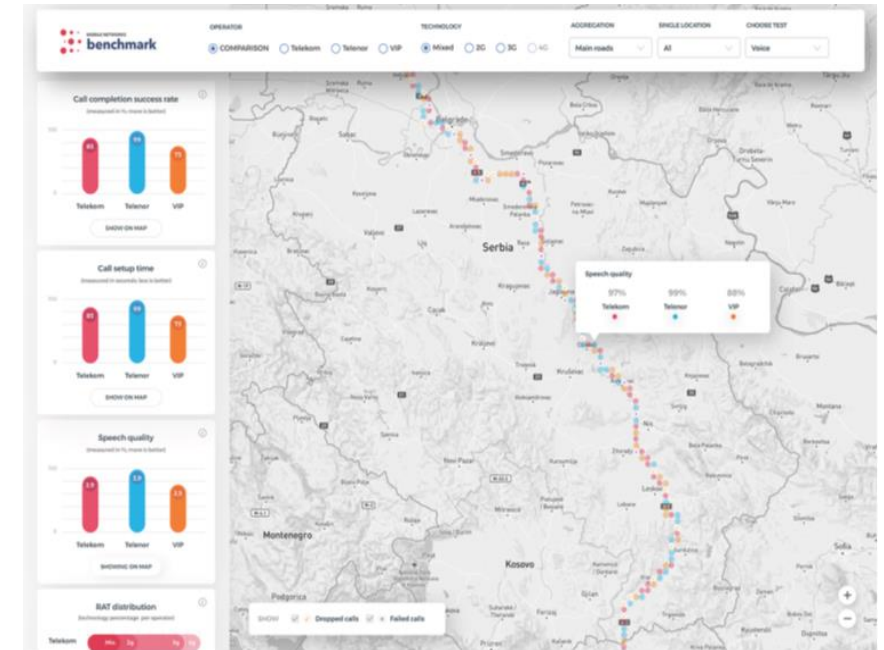


Fig. 2. Year to year ranking comparison



Systemics 5G Readiness Scoring



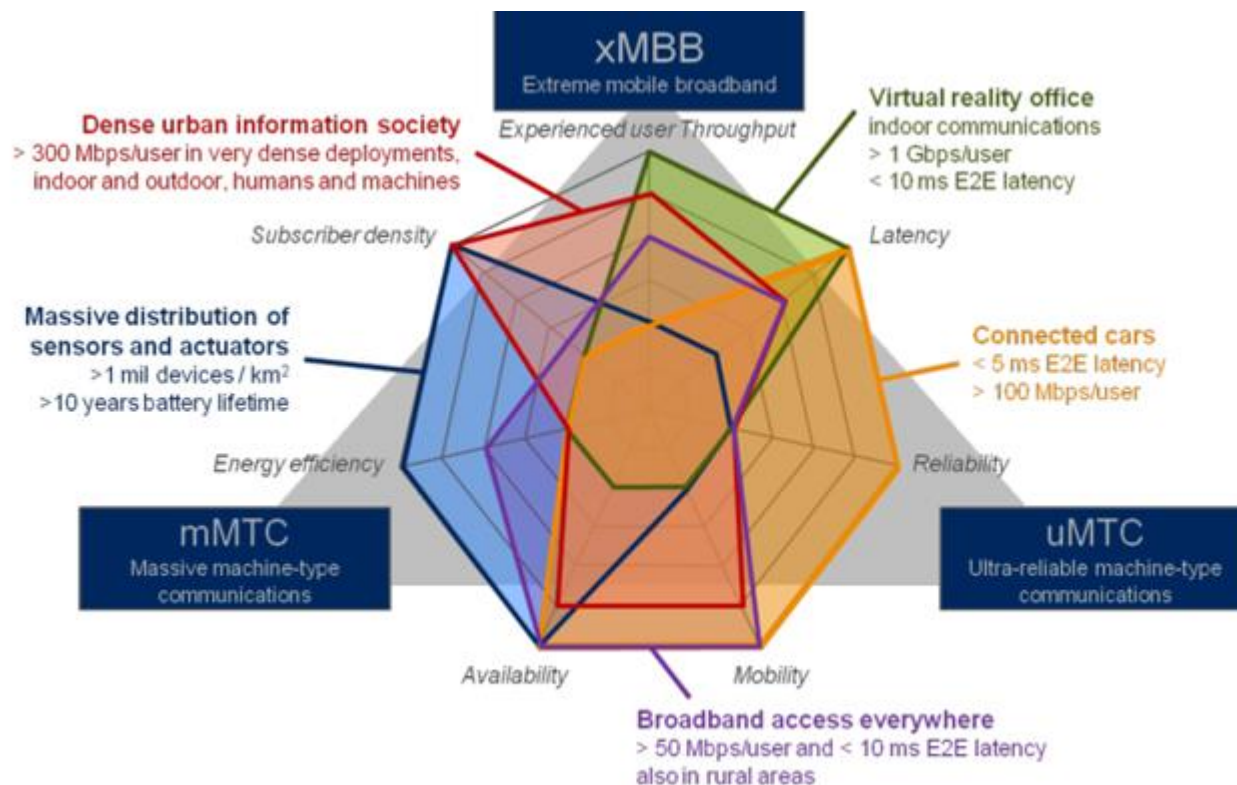
General Idea

There was an interest from our customers to get the comparison of 5G services

There is no 5G specific agreed scoring method yet. ETSI continues the work on best practices for measurements and benchmarking.

For the time being Systemics is working on its own scoring which can assess how existing 5G networks conforms with expectations set to 5G.

The In accordance with the document created by Metis II (Mobile and wireless communications Enablers for the 2020 Information Society-II) we adopt 5 use cases to simulate the real scenarios which will be used by users of 5G networks



- UC1** - Dense Urban Information Society
- UC2** - Virtual Reality Office
- UC3** - Broadband access everywhere
- UC4** - Massive distribution of sensor and actuators
- UC5** - Connected cars

The scoring methodology (1) – the concept

Each use case has defined acceptable level of KPIs as stipulated in METIS

Since these values are very challenging for early 5G networks we propose a lighter version presented on the next slide

Use Case (UC)	Key Performance Indicator (KPI)	Requirement
UC1 Dense urban information society	Experienced user throughput	300 Mbps in DL and 50 Mbps in UL at 95% availability and 95% reliability
	E2E RTT latency	Less than 5 ms (augmented reality applications)
UC2 Virtual reality office	Experienced user throughput	5 (1) Gbps with 20% (95%) availability in DL 5 (1) Gbps with 20% (95%) availability in UL both with 99% reliability
UC3 Broadband access everywhere	Experienced user throughput	50 Mbps in DL and 25 Mbps in UL at 99% availability and 95% retainability
UC4 Massive distribution of sensors and actuators	Availability	99.9%
	Device density	1 000 000 devices/km ²
	Traffic volume per device	From few bytes per day to 125 bytes per second
UC5 Connected cars	E2E one-way latency	5 ms (traffic safety applications)
	Experienced user throughput	100 Mbps in DL and 20 Mbps in UL (service applications) at 99% availability and 95% reliability
	Vehicle velocity	Up to 250 km/h

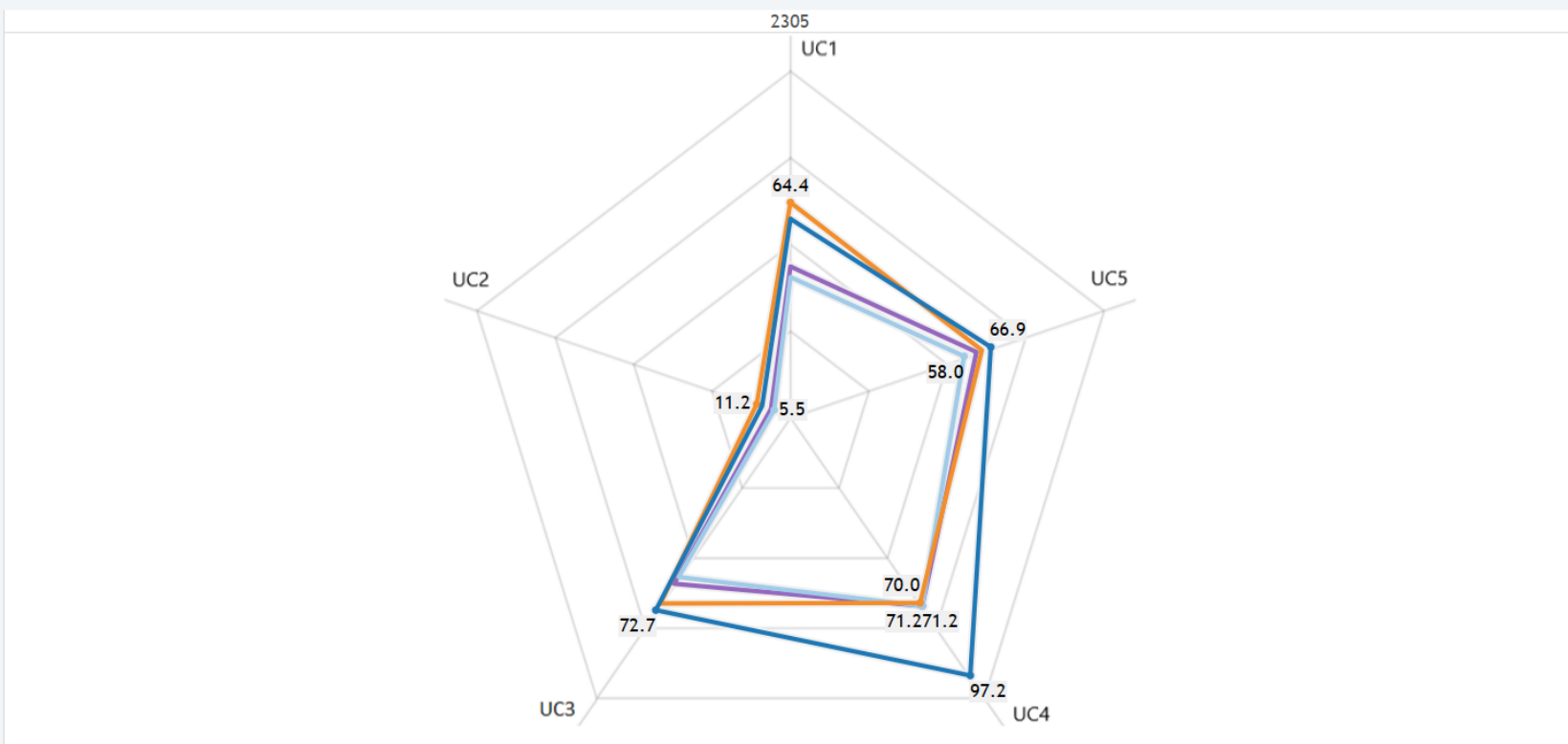
The scoring methodology (2) – KPIs and Thresholds

Use Case	KPI	Meaning	Testcase	Threshold 1	Threshold 2	Threshold 3	Aggregation	Weight
UC 1 Dense Urban Information Society	DL Thr value	DL Throughput Value [Mbps]	Iperf 3 DL, 7s, TCP, 2Gbps	50 Mbps	360 Mbps		Avg	25%
	UL Thr value	UL Throughput Value [Mbps]	Iperf 3 UL, 7s, TCP, 2Gbps	10 Mbps	60 Mbps		Avg	15%
	DL Thr availability	Share of samples [%] with Throughput above Threshold 2	Iperf 3 DL, 7s, TCP, 2Gbps	80%	288 Mbps		-	25%
	UL Thr availability	Share of samples [%] with Throughput above Threshold 2	Iperf 3 UL, 7s, TCP, 2Gbps	60%	36 Mbps		-	15%
	Reliability	Session Success Rate [%]	Iperf 3 DL, 7s, TCP, 2Gbps Iperf 3 UL, 7s, TCP, 2Gbps	90%	99%		-	5%
	Browsing Time	Time to download 80% of webpage content	Browsing	0.5s	2.0s			5%
	Video Time	Time to First Picture	Youtube	0.5s	3.0s			5%
	Latency (RTT)	Average Latency	Interactivity Test	4 ms	40 ms		Avg	5%
UC 2 Virtual Reality Office	DL Thr value	DL Throughput Value [Mbps]	Iperf 3 DL, 7s, TCP, 2Gbps	200 Mbps	6000 Mbps		Avg	30%
	UL Thr value	UL Throughput Value [Mbps]	Iperf 3 UL, 7s, TCP, 2Gbps	40 Mbps	1200 Mbps		Avg	30%
	DL Thr availability	Share of samples [%] with Throughput above Threshold 2	Iperf 3 DL, 7s, TCP, 2Gbps	10%	600 Mbps		-	5%
	UL Thr availability	Share of samples [%] with Throughput above Threshold 2	Iperf 3 UL, 7s, TCP, 2Gbps	10%	120 Mbps		-	5%
	Reliability	Session Success Rate [%]	Iperf 3 DL, 7s, TCP, 2Gbps Iperf 3 UL, 7s, TCP, 2Gbps	90%	99%		-	5%
	Latency (RTT)	Average Latency	Interactivity Test	4 ms	40 ms		Avg	25%
UC 3 Broadband Access Everywhere	DL Thr value	DL Throughput Value [Mbps]	Iperf 3 DL, 7s, TCP, 2Gbps	10 Mbps	60 Mbps		Avg	15%
	UL Thr value	UL Throughput Value [Mbps]	Iperf 3 UL, 7s, TCP, 2Gbps	5 Mbps	30 Mbps		Avg	10%
	DL Thr availability	Share of samples [%] with Throughput above Threshold 2	Iperf 3 DL, 7s, TCP, 2Gbps	90%	54 Mbps		-	25%
	UL Thr availability	Share of samples [%] with Throughput above Threshold 2	Iperf 3 UL, 7s, TCP, 2Gbps	80%	24 Mbps		-	20%
	Reliability	Session Success Rate [%]	Iperf 3 DL, 7s, TCP, 2Gbps Iperf 3 UL, 7s, TCP, 2Gbps	90%	99%		-	10%
	Latency (RTT)	Average Latency	Interactivity Test	4 ms	40 ms		Avg	20%

The scoring methodology (3) – KPIs and Thresholds

Use Case	KPI	Meaning	Testcase	Threshold 1	Threshold 2	Threshold 3	Aggregation	Weight
UC 4 Massive Distribution of Sensors	Coverage Availability 5G	Share of RSRP geographic bins samples [%] above Threshold 1 /All Geo samples	Scanner	-100 dBm	-		-	25%
	DL Thr value	DL Throughput Value [Mbps]	Iperf 3, DL, TCP, 5s, 120Mbps, 3 TCP streams	20 Mbps	120 Mbps		Avg	8%
UC 5 Connected Cars	UL Thr value	UL Throughput Value [Mbps]	Iperf 3, UL, TCP, 5s, 24Mbps, 3 TCP streams	4 Mbps	24 Mbps		Avg	7%
	DL Thr availability	Share of samples [%] with Throughput above Threshold 2	Iperf 3, DL, TCP, 5s, 120Mbps, 3 TCP streams	25%	30 Mbps		-	20%
	UL Thr availability	Share of samples [%] with Throughput above Threshold 2	Iperf 3, UL, TCP, 5s, 24Mbps, 3 TCP streams	25%	6 Mbps		-	15%
	Reliability	Session Success Rate [%] Sample as considered successful when: - TCP Transfer Successful (no interruption on TCP Layer)	Iperf 3, DL, TCP, 5s, 120Mbps, 3 TCP streams Iperf 3, UL, TCP, 5s, 24Mbps, 3 TCP streams	90%	99%		-	25%
	Latency (RTT)	Average Latency	Interactivity Test	4 ms	40 ms		Avg	25%

5G Score – Overall

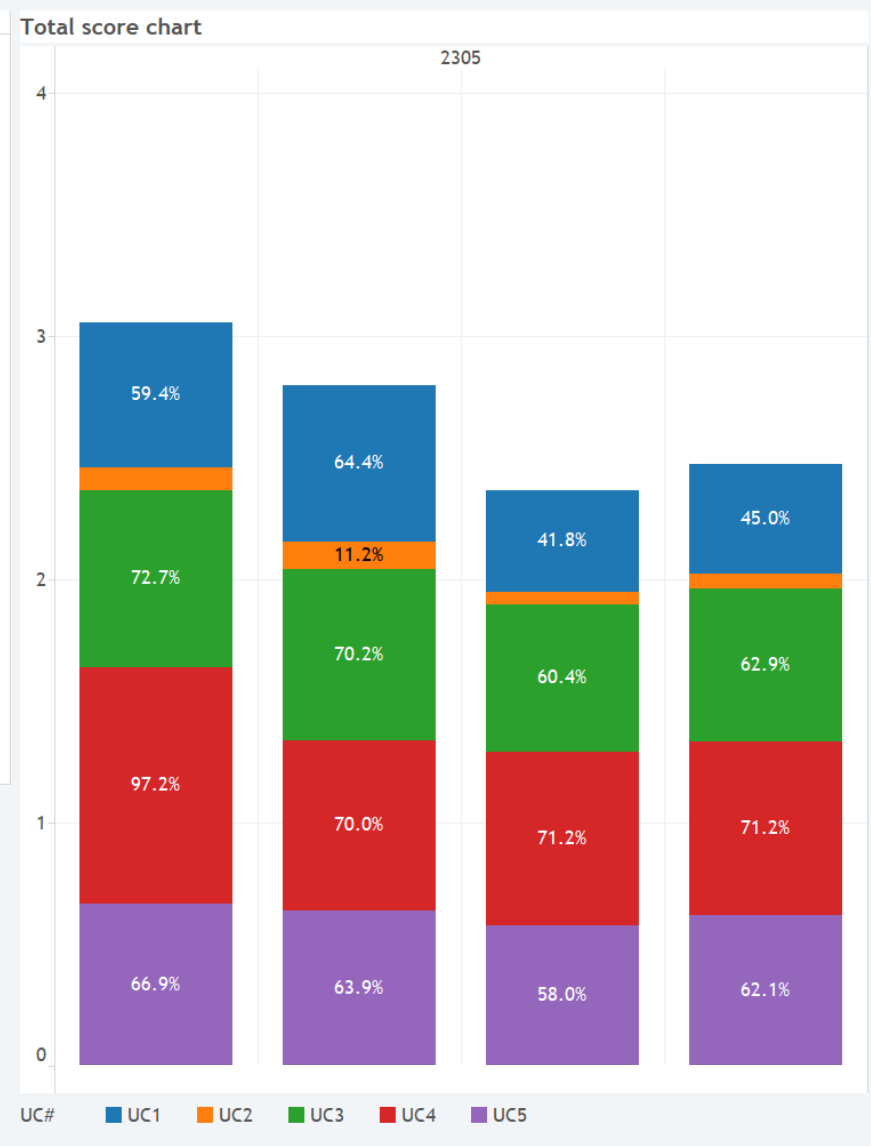


Scale range is zero to one, with zero at the center. The chart shows gradients from zero at 0.25, 0.50, 0.75, and then 1.

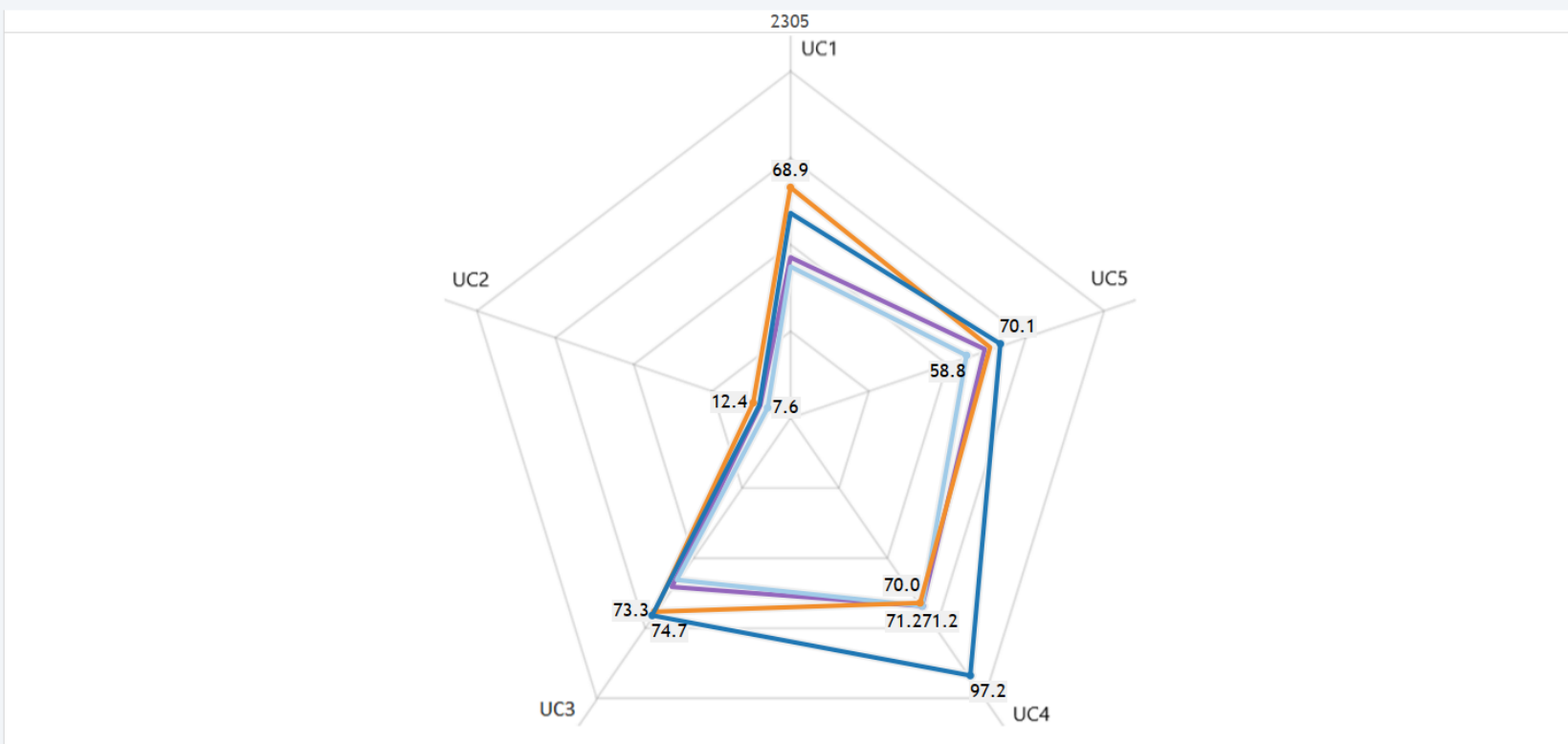
Use Case score table
(green=best, red=worst)

	2305			
UC1	59.4%	64.4%	41.8%	45.0%
UC2	9.4%	11.2%	5.5%	6.5%
UC3	72.7%	70.2%	60.4%	62.9%
UC4	97.2%	70.0%	71.2%	71.2%
UC5	66.9%	63.9%	58.0%	62.1%

- UC1 - Dense Urban Information Society
- UC2 - Virtual Reality Office
- UC3 - Broadband access everywhere
- UC4 - 5G coverage availability
- UC5 - Connected cars



5G Score – 5G samples only

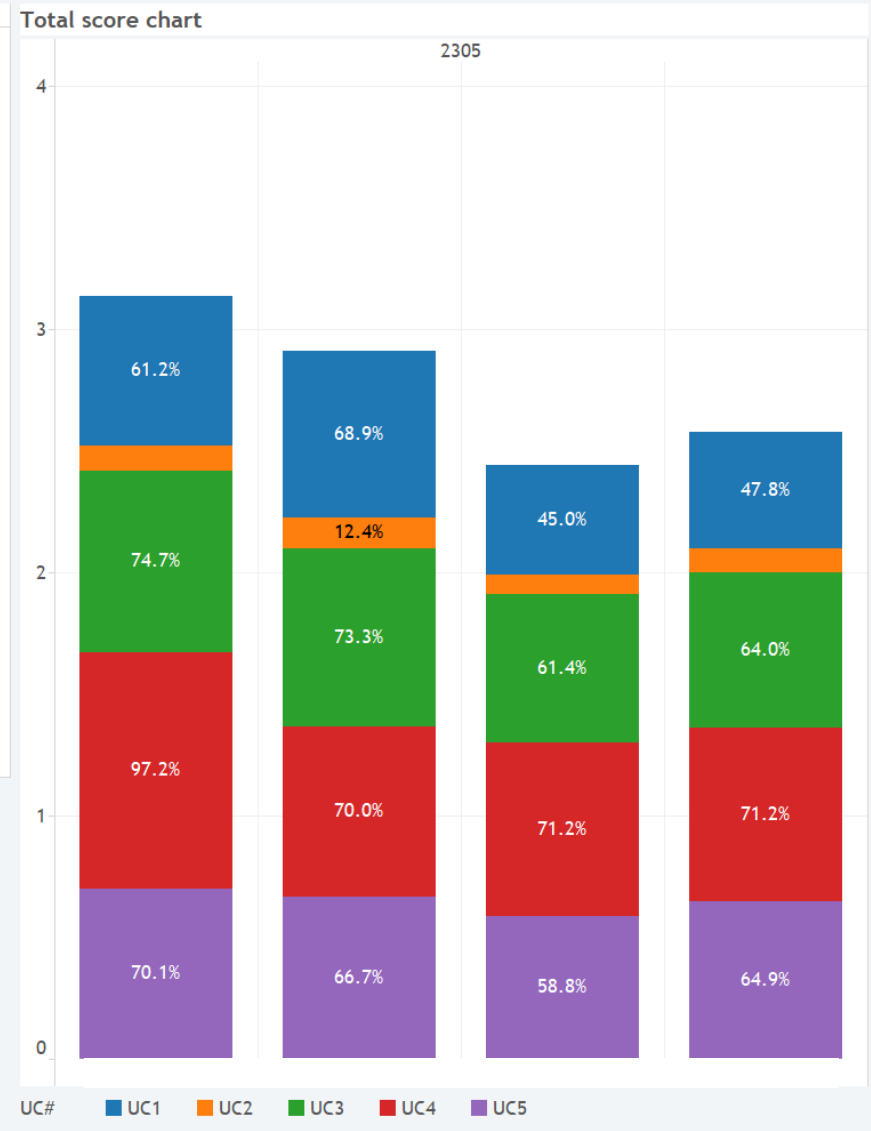


Scale range is zero to one, with zero at the center. The chart shows gradients from zero at 0.25, 0.50, 0.75, and then 1.

Use Case score table
(green=best, red=worst)

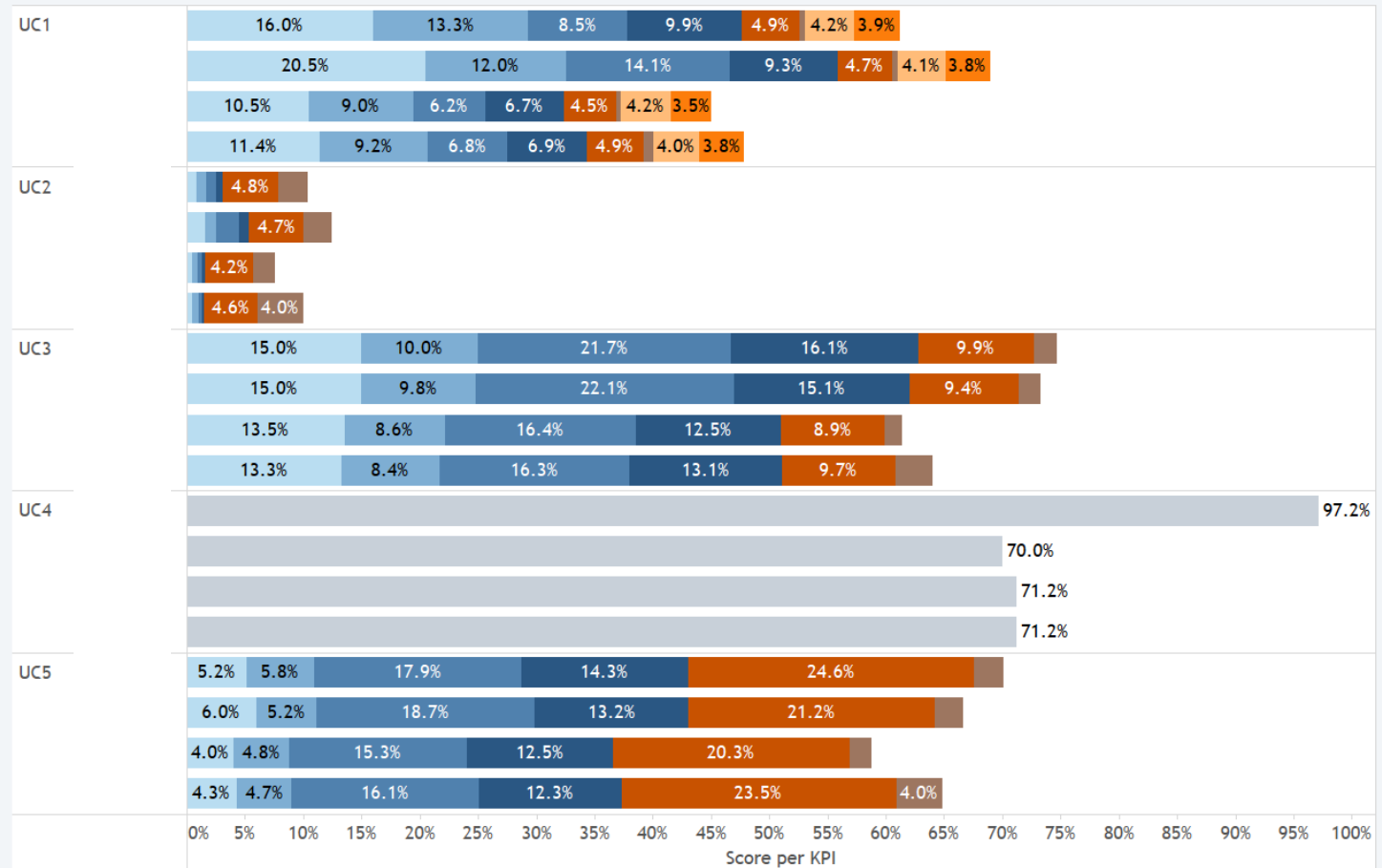
	2305			
UC1	61.2%	68.9%	45.0%	47.8%
UC2	10.4%	12.4%	7.6%	10.1%
UC3	74.7%	73.3%	61.4%	64.0%
UC4	97.2%	70.0%	71.2%	71.2%
UC5	70.1%	66.7%	58.8%	64.9%

- UC1 - Dense Urban Information Society
- UC2 - Virtual Reality Office
- UC3 - Broadband access everywhere
- UC4 - 5G coverage availability
- UC5 - Connected cars



5G Score – Use Case breakdown

Use Case score - All



UC1 - Dense Urban Information Society
 UC2 - Virtual Reality Office
 UC3 - Broadband access everywhere
 UC4 - 5G coverage availability
 UC5 - Connected cars

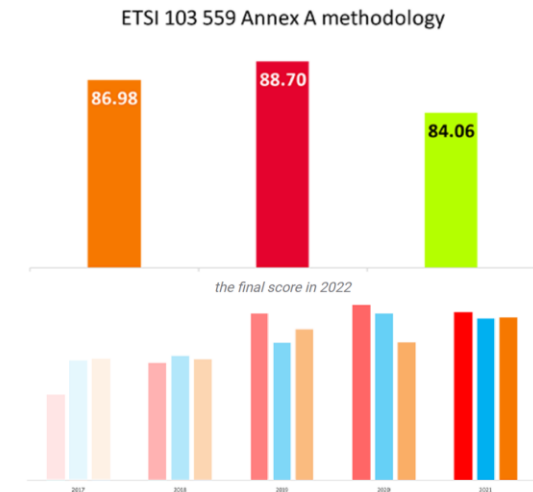
DL Thr value
 UL Thr value
 DL Thr availability
 UL Thr availability
 Reliability
 Latency (RTT)
 Video Time
 Browsing Time
 Coverage availability

Use Case score

UC#	KPI	Max Score	Score 1	Score 2	Score 3	Score 4
UC1	DL Thr value	25%	16.0%	20.5%	10.5%	11.4%
	UL Thr value	15%	13.3%	12.0%	9.0%	9.2%
	DL Thr availability	25%	8.5%	14.1%	6.2%	6.8%
	UL Thr availability	15%	9.9%	9.3%	6.7%	6.9%
	Reliability	5%	4.9%	4.7%	4.5%	4.9%
	Video Time	5%	4.2%	4.1%	4.2%	4.0%
	Browsing Time	5%	3.9%	3.8%	3.5%	3.8%
UC2	DL Thr value	30%	0.9%	1.6%	0.5%	0.5%
	UL Thr value	30%	0.8%	0.9%	0.4%	0.5%
	DL Thr availability	5%	0.9%	2.0%	0.4%	0.3%
	UL Thr availability	5%	0.6%	0.8%	0.2%	0.2%
	Reliability	5%	4.8%	4.7%	4.2%	4.6%
	Latency (RTT)	25%	2.5%	2.4%	1.9%	4.0%
	UC3	DL Thr value	15%	15.0%	15.0%	13.5%
UL Thr value		10%	10.0%	9.8%	8.6%	8.4%
DL Thr availability		25%	21.7%	22.1%	16.4%	16.3%
UL Thr availability		20%	16.1%	15.1%	12.5%	13.1%
Reliability		10%	9.9%	9.4%	8.9%	9.7%
UC4	Coverage availability	100%	97.2%	70.0%	71.2%	71.2%
	Coverage availability	100%	97.2%	70.0%	71.2%	71.2%
UC5	DL Thr value	8%	5.2%	6.0%	4.0%	4.3%
	UL Thr value	7%	5.8%	5.2%	4.8%	4.7%
	DL Thr availability	20%	17.9%	18.7%	15.3%	16.1%
	UL Thr availability	15%	14.3%	13.2%	12.5%	12.3%
	Reliability	25%	24.6%	21.2%	20.3%	23.5%
UC5	Latency (RTT)	25%	2.5%	2.4%	1.9%	4.0%
	Latency (RTT)	25%	2.5%	2.4%	1.9%	4.0%

Conclusions

- **The expectations related to 5G are probably higher that networks can meet**
 - Virtual office is hard to reach from macro network
 - Even good coverage doesn't guarantee good quality
- **Networks' development should be continuously monitored by regulations body**
 - Fulfilling promises to the market
 - Spectrum efficiency
 - Public safety
- **Continuity of the service availability with decent quality limits digital exclusion**
 - DL throughput is not the main KPI for quality of the network
 - Latency plays serious role in the perception of the quality
 - Majority of applications do not need more than 10-15Mb/s
- **Systemics has clear examples how public benchmarking can stimulate development of networks**



Thank You.



Systemics-PAB Sp. z o.o.
46B Wolodyjowskiego St.
02-724 Warsaw, POLAND



j.kondej@sypab.eu



www.sypab.eu



[Systemics-PAB](https://www.linkedin.com/company/systemics-pab)

