SYSTEMICS PAB
Network Quality Experts

5G

► **Systemics 5G readiness scoring approach**

Disclaimer

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► The 5G network readiness assessment methodology described in the following slides is in continuous development and may take a different shape once the work is completed.

► The aim of creating this methodology was to have a solution that can be used at the current stage of 5G network development until the time when standard solutions such as ETSI technical reports are adopted.

General Idea

► In accordance to the document created by Metis II (Mobile and wireless communications Enablers for the Twenty-twenty Information Society-II) we adopt 5 use cases to simulate the real scenarios which will be used by users of 5G networks
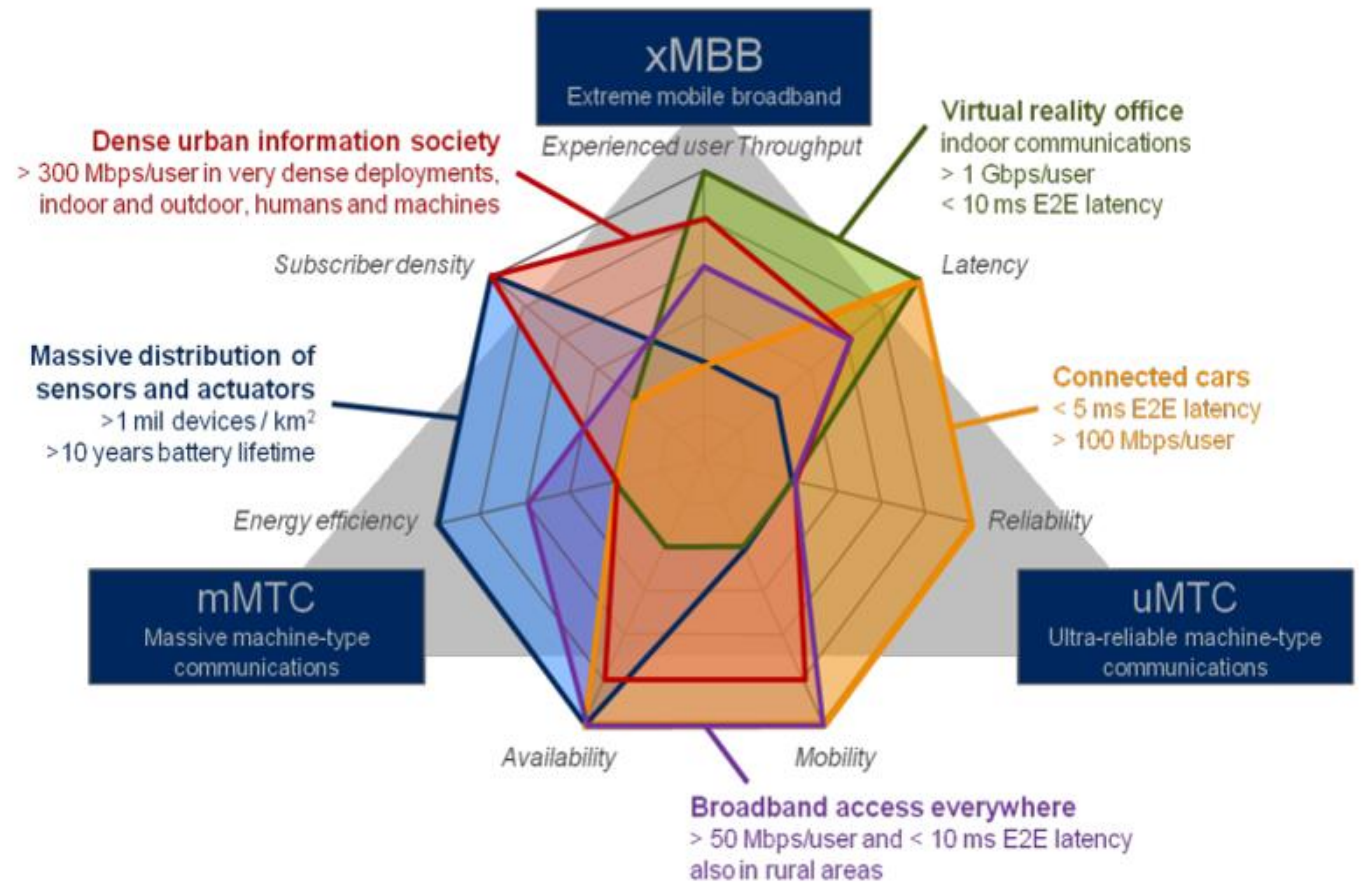
UC1 - Dense Urban Information Society

UC2 - Virtual Reality Office

UC3 - Broadband access everywhere

UC4 - Massive distribution of sensor and actuators

UC5 - Connected cars

Source: Metis II project

General Requirements

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

► Due to the fact that 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

Source: Metis II project

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Thresholds Values used by Systemics

- Each use case (UC) consists of multiple KPIs

- The thresholds provide scoring boundaries (from 0 to 100%) for each KPI. Exceeding the boundaries gives 0 or 100% respectively.

- Each KPI contributes at a given weight (last column) to the final case score.

- "UC4 – coverage availability" is calculated as the percentage of grid bins (ex. 25m x 25m) which have sufficient coverage (SS-RSRP > -100dB) to all locations that where measured during the drivetest.

UC#	KPI	Meaning	Threshold1	Threshold2	Weight in UC
UC1	DL Thr value	DL thr [Mbps] scored between Threshold1 and Threshold1 values	50	360	25%
	UL Thr value	UL thr [Mbps] scored between Threshold1 and Threshold1 values	10	60	15%
	DL Thr availability	% (Threshold1) of samples with DL thr [Mbps] >Threshold2	80%	288	25%
	UL Thr availability	% (Threshold1) of samples with UL thr [Mbps] >Threshold2	60%	36	15%
	Reliability (session success rate)	SR [%] scored between Threshold1 and Threshold1 values	90%	96%	5%
	Latency (RTT)	avg RTT [ms] scored between Threshold1 and Threshold1 values	4	40	15%
UC2	DL Thr value	DL thr [Mbps] scored between Threshold1 and Threshold1 values	200	6000	30%
	UL Thr value	UL thr [Mbps] scored between Threshold1 and Threshold1 values	40	1200	30%
	DL Thr availability	% (Threshold1) of samples with DL thr [Mbps] >Threshold2	50%	3000	5%
	UL Thr availability	% (Threshold1) of samples with UL thr [Mbps] >Threshold2	50%	600	5%
	Reliability (session success rate)	SR [%] scored between Threshold1 and Threshold1 values	90%	96%	5%
	Latency (RTT)	avg RTT [ms] scored between Threshold1 and Threshold1 values	4	40	25%
UC3	DL Thr value	DL thr [Mbps] scored between Threshold1 and Threshold1 values	10	60	20%
	UL Thr value	UL thr [Mbps] scored between Threshold1 and Threshold1 values	5	30	10%
	DL Thr availability	% (Threshold1) of samples with DL thr [Mbps] >Threshold2	90%	54	25%
	UL Thr availability	% (Threshold1) of samples with UL thr [Mbps] >Threshold2	80%	24	20%
	Reliability (session success rate)	SR [%] scored between Threshold1 and Threshold1 values	90%	96%	5%
	Latency (RTT)	avg RTT [ms] scored between Threshold1 and Threshold1 values	4	40	20%
UC4	Coverage availability	(samples with 5G coverage above Threshold1 [dBm]) / (all measured samples)	-100	NULL	100%
UC5	DL Thr value	DL thr [Mbps] scored between Threshold1 and Threshold1 values	20	120	8%
	UL Thr value	UL thr[Mbps] scored between Threshold1 and Threshold1 values	4	24	7%
	DL Thr availability	% (Threshold1) of samples with DL thr [Mbps] >Threshold2	25%	30	20%
	UL Thr availability	% (Threshold1) of samples with UL th [Mbps] r>Threshold2	25%	6	15%
	Reliability (session success rate)	SR [%] scored between Threshold1 and Threshold1 values	90%	96%	25%
	Latency (RTT)	avg RTT [ms] scored between Threshold1 and Threshold1 values	4	40	25%

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Live network results - Radar Graph

► Score obtained for each use case can be presented on a radar chart.

► Following is an example based on live data from 5G network.

► Each arm of the pentagram represents a score form zero (at the center) to 100% for each use case

► The final score for each operator is the total area inside the pentagon

► This view can be presented for each aggregation (Cities, Towns, Roads) separately or as a overall aggregation (per country)

Systemics 5G Readiness Score
Monitoring the five, UE test cases
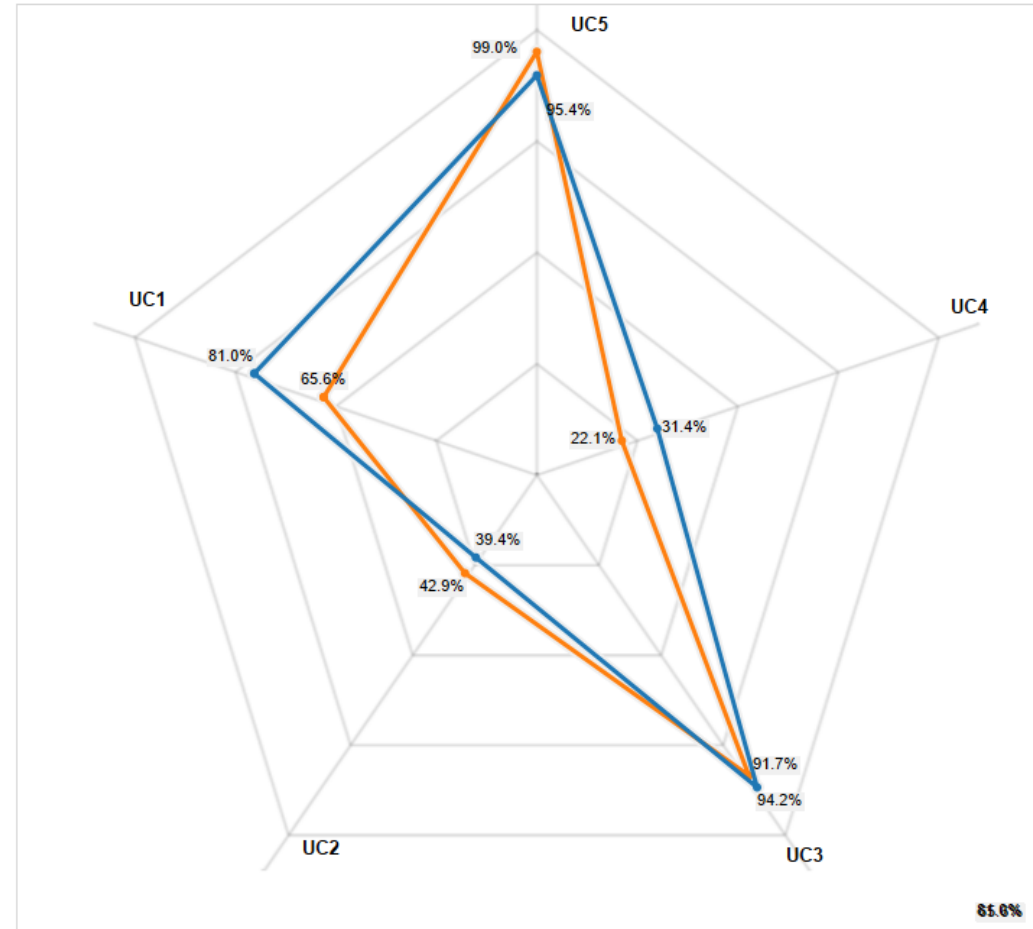
Home Operator
- OP1
- OP2

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

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.

Live network results – Detailed Comparison

► A more detailed view can present percentage of each KPI contribution for each use case.

► Based on such representation, the component KPIs can be compared between operators and locations

UC score
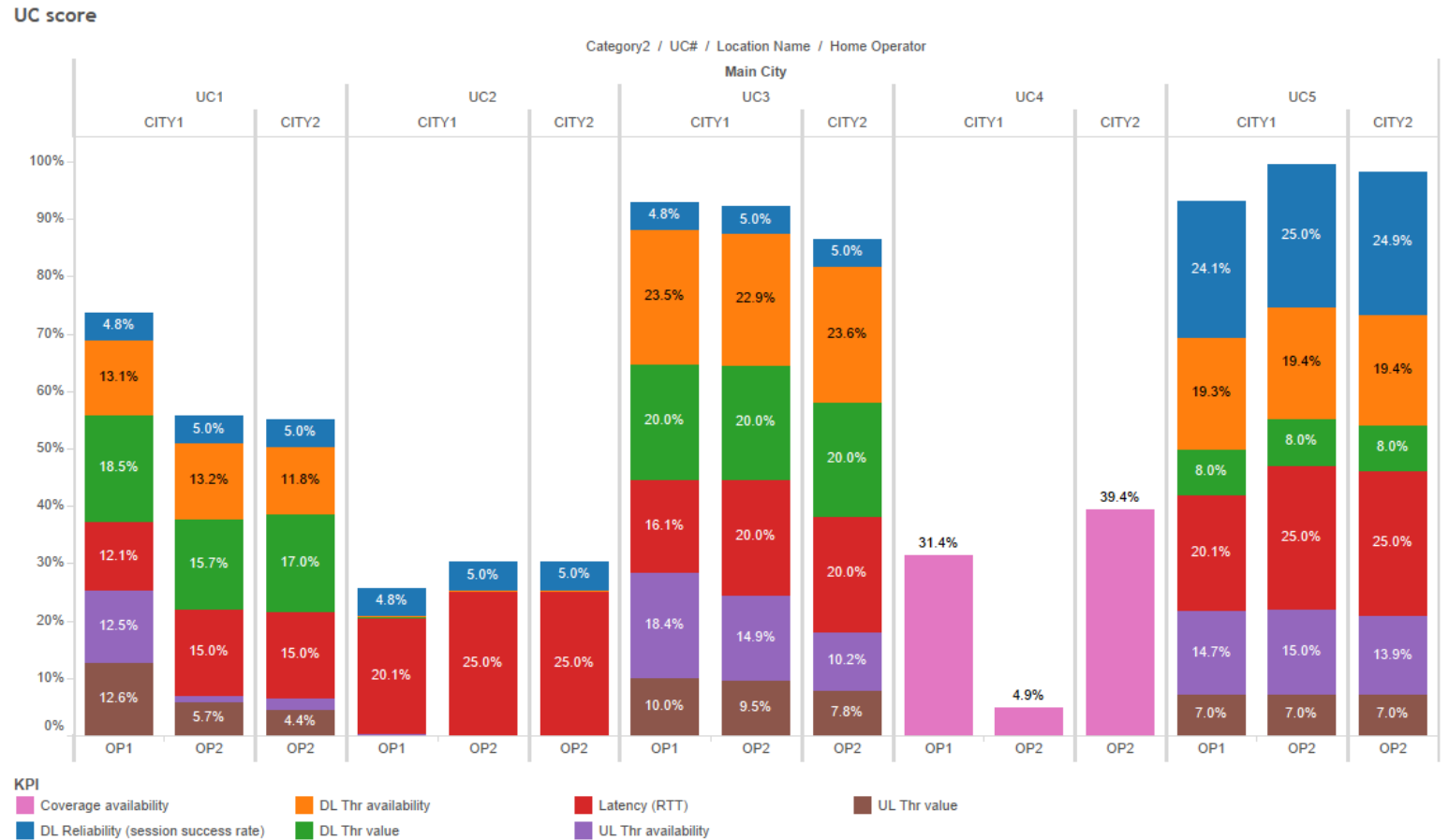
Proposed 5G testing scenario

► The proposed scenario consists of multiple data tests to test different network capabilities:

► Preload Ping tests ensure "connected" state at the start of the next test.

► IPerf3 tests for UL, DL throughput and Success rates assessment

► Interactivity tests for latency, packet loss and jitter assessment

► Additional tests "on top of the score":

- HTTP Browser – testing live webpages for QoE (Quality of Experience) results such as Time to First Paint or Time to load [%] of content

- YouTube test to check 4K VMOS Performance in accordance with newest P.1204.4 standard *(not supported yet in current SwissQual Implementation)*

Parameter	Timeout	Pause	Destination	Content	Comments
Preload Ping	1 sec	0 sec	IP	800B	Series of 5 Ping, Interval 1000 msec, max duration 10 sec
IPerf3 - Downlink	3 sec	0 sec	IP	Random Data	Mode = Download Transfer Duration = 3 sec Protocol = UDP Target Bandwidth = 100Mbps, Parallel Streams = 10 Total Bandwidth = 100Mbps x 10 = 1Gbps Burst Mode Packets = 0 (disabled) Buffer size UDP = 1200B – possible range [16-65506B] Max setup time = 5 sec (default) Max test duration = 34 sec (needs to be min. 30 sec difference between transfer duration)
Preload Ping	1 sec	0 sec	IP	800B	Series of 5 Ping, Interval 1000 msec, max duration 10 sec
HTTP Browser 1	10 sec	0 sec	Google.com	Live page	Min test duration 2 sec, Force DNS lookup ON
HTTP Browser 2	10 sec	0 sec	Facebook.com	Live page	Min test duration 2 sec, Force DNS lookup ON
HTTP Browser 3	10 sec	0 sec	Wikipedia.org	Live page	Min test duration 2 sec, Force DNS lookup ON
Preload Ping	1 sec	0 sec	IP	800B	Series of 5 Ping, Interval 1000 msec, max duration 10 sec
IPerf3 – Uplink	3 sec	0 sec	IP	Random Data	Mode = Upload Transfer Duration = 3 sec Protocol = UDP Target Bandwidth = 100Mbps, Parallel Streams = 10 Total Bandwidth = 100Mbps x 10 = 1Gbps Burst Mode Packets = 0 (disabled) Buffer size UDP = 1200B – possible range [16-65506B] Max setup time = 5 sec (default) Max test duration = 34 sec (needs to be min. 30 sec difference between transfer duration)
Interactivity Test	10 sec	0 sec	IP	Random Data	Custom Pattern eGaming Pattern if custom patter definition not possible Available patterns: - constant low - constant medium - constant high - constant long - eGaming real-time
Preload Ping	1 sec	0 sec	IP	800B	Series of 5 Ping, Interval 1000 msec, max duration 10 sec
YouTube	30 sec		Youtube		Connection timeout 30 sec Stream lost timeout 20 sec VMOS enabled Max. test duration 60 sec Display duration = Timeout (30 sec) 4K capable player with P.1204.4 VMOS estimation. Player version = newest available [14.07.59]
Preload Ping	1 sec	0 sec	IP	800B	Series of 5 Ping, Interval 1000 msec, max duration 10 sec
Reselection pause	5 sec				