

5G-PPP TMV Vertical TF TB WEBINAR

Methodology and results – Media and Entertainment

Scope

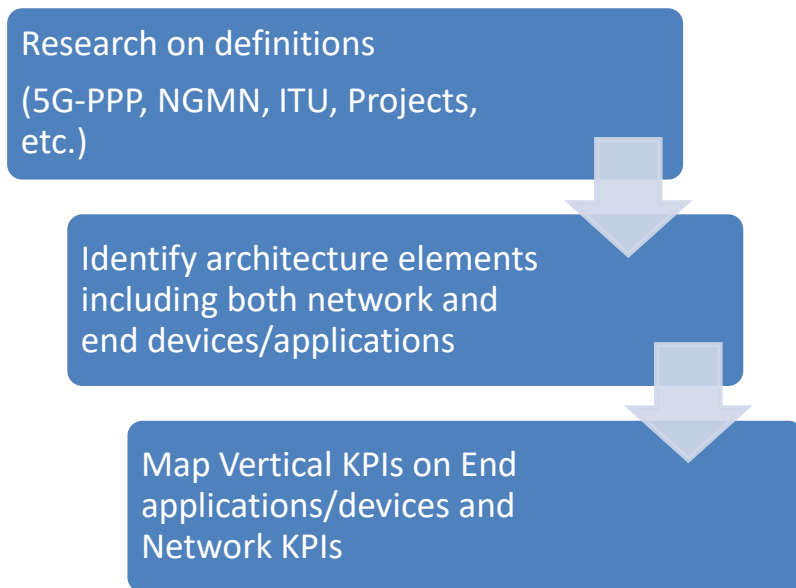
Scope:	Map the vertical KPIs on 5G network KPIs
Participants:	ICT-19 projects and other vertical projects
Methodology:	<ul style="list-style-type: none">• Define the state of the art (TMV core KPIs, NGMN precommercial trials, etc.)• Define vertical categories of interest according to the participating ICT-19 projects (FoF/Industry 4.0, Energy, Media/Entertainment, e-Health, Automotive, Smart Cities/(Air)ports)• Catalogue vertical KPIs from ICT19 projects-Create a Vertical KPIs register• Work in a top down methodology to formalize and map the vertical KPIs on the 5G network ones.• Produce a white paper - Contribute to 5G-PPP TMV white paper

- **Vertical:** the stakeholder belonging to an industrial or service sector providing goods or consuming services.
- **Vertical Service (VS):** From a business perspective, it is a service focused on a specific industry or group of customers with specialized needs (e.g., automotive services, entertainment services, e-health services, industry 4.0).

Source: 5G-PPP Architecture Working Group, View on 5G Architecture, v3.0 June 2019

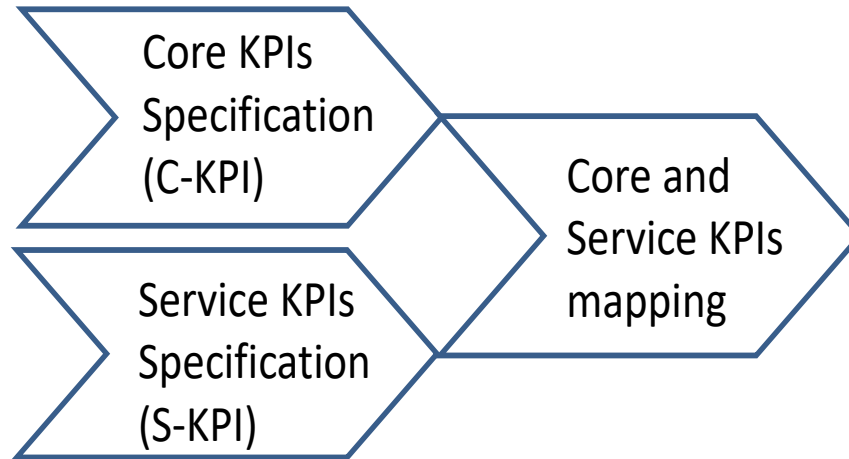
	Industry 4.0	Agriculture & Agri-food	Automotive	Transport & Logistics	Smart Cities & Utilities	Smart (Air)ports	Energy	E-health & Wellness	Media & Entertainment
5G DRONES				V					V
5G HEART		V	V					V	
5G GROWTH	V			V			V		
5G SMART	V								
5G SOLUTIONS	V				V	V	V		V
5G TOURS								V	V
5G VICTORY				V			V		V
5G CROCO			V						
5G-MOBIX			V						

KPIs Mapping Process & Methodology



- NGMN
 - Work will capitalize on NGMN KPIs definitions and descriptions
- Vertical KPIs
 - Define the service KPIs list per vertical
 - Identify **KPIs** descriptions from ICT-19 projects
 - Select/Prioritize KPIs based on description maturity
- Produce a matrix correlating the vertical KPIs to the Network KPIs
 - Evaluate current best practices
 - Finalize correlation method/template
 - Produce KPIs mapping roadmap

KPIs Mapping Notation



Business perspective - Media and Entertainment

Business Situation & Drivers – Why 5G is required

- **New business models and drivers include:**
 - **Cost-affordable media** production and contribution operations
 - Significantly reduced costs by reducing size and travel of big production teams and equipment trucks to event sites
 - Reduced costs compared to traditional media contribution over dedicated satellite, reduced costs due to enabling usage of cloud-based production software
 - **IP media workflows**, remote live production, where the video assets are in the cloud and the involved team members are in their homes or offices, as well as enhanced media production services, given that cloud resources and AI/big- data processing solutions can be used in real time with the live high-fidelity video uplink in a 5G network.
 - **Increased productivity** and revenues by enabling producing and handling more live events simultaneously
 - **Increasing viewers engagement** by providing more content and at a higher quality and higher overall QoE (such as more fluent and reliable video) content on TV and online including on social networks, using fewer modems and SIM cards in multilink bonded transmission (even from the same 5G operator), using multilink on the same operator for example by using “multi-slice” – a technology of bonding two modems on two different network slices
 - **Personalised onsite** live event experience is of key importance.
 - **Enhanced media fruition**

Source: White paper – ICT-19 performance KPIs “Service performance measurement methods over 5G experimental networks”

https://5g-ppp.eu/wp-content/uploads/2021/05/Service-performance-measurement-methods-over-5G-experimental-networks_08052021-Final.pdf

- Use Case: Ultra-High-Fidelity media (ref. UC4.1 in 5G-SOLUTIONS)
 - Highly immersive production and viewing experience with ultra-crisp, wide-view pictures with deep contrast and multi-channel sound. Ultra High-Fidelity Media (UHFM) experience.
 - Media streaming to devices using a variety of applications supported by the partners under different network configurations
 - 5G network should be able to support efficient network management, fair resource allocation, high speed transport capabilities and strategies, e.g. by means of local and network caching of content.
 - The challenge broadcasters currently face is the understanding of pros e.g. additional capabilities such as slicing, or limitations that emerging NGA networks (with focus on 5G) offer in order to take advantage and adapt technological infrastructures and business models.

Source: 5G-SOLUTIONS ICT-41 Project <https://www.5gsolutionsproject.eu/>

Service KPIs - Use Case: Ultra-High-Fidelity media

SKPI Id	SPKI Name/Description
ME-SKPI-1	the server accessibility (application accessibility)
ME-SKPI-2	the waiting time (time to first picture)
ME-SKPI-3	user defined timeout (emulates the user's patience) leads to a "fail"
ME-SKPI-4	picture quality (MOS for each 10s interval of a video, and certainly as the average MOS for the whole video)
ME-SKPI-5	freezing / stalling of the video in %
ME-SKPI-6	lost streams (constant freezing)
ME-SKPI-7	jerkiness in % (if frame rate is not high enough, e.g. < 20 fps, the video is not perceived as fluent)

Source: Definition of the Testing Framework for the NGMN 5G pre-commercial Networks Trials

https://www.ngmn.org/wp-content/uploads/Publications/2019/190111_NGMN_PreCommTrials_Framework_definition_v2_small.pdf

Content Streaming KPIs Interpolation into Generalized MOS

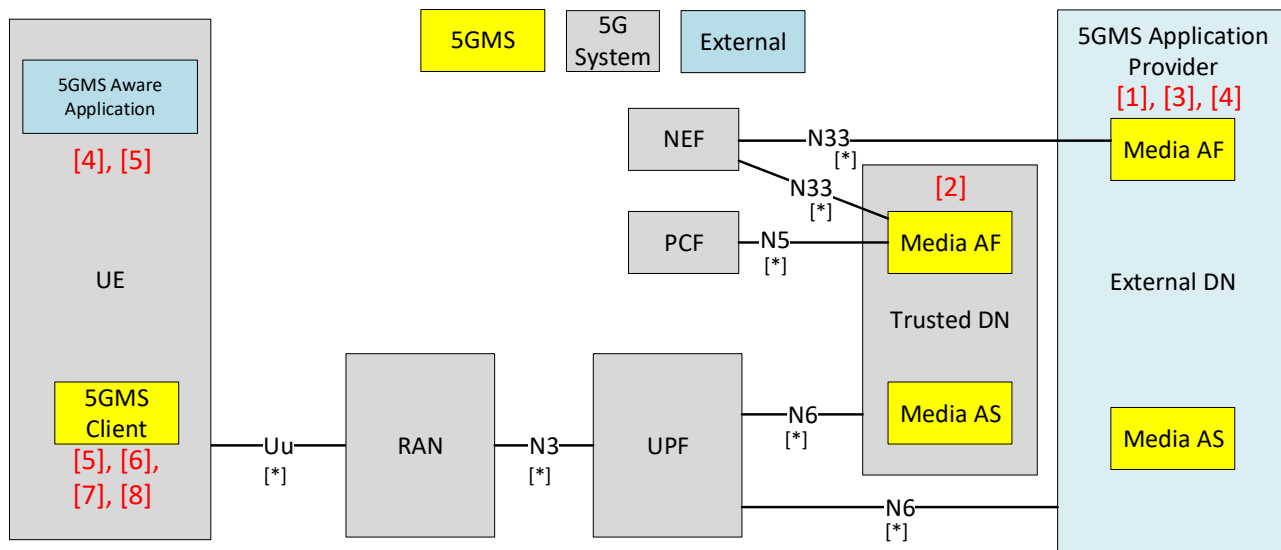
KPI	Target	Function		
			min _{KPI}	max _{KPI}
<i>App Access Time (s)</i>	Average	Type II	10	0.1
<i>App Accessibility (%)</i>	Ratio	Type I	50	100
<i>App Availability (%)</i>	Ratio	Type I	50	100
<i>Content Load Time (s)</i>	Average	Type II	10	0.1
<i>Feature Availability (%)</i>	Ratio	Type I	50	100
<i>Content Stall (%)</i>	Index	Type I	5	0
<i>Content Search Time (s)</i>	Average	Type II	10	0.1
<i>Content Download Throughput (Mbit/s)</i>	Average	Type I	1	1000
<i>Content Upload Throughput (Mbit/s)</i>	Average	Type I	1	1000
<i>Content Resolution</i>	Mode	Type I	Lowest	Highest

SKPI Id
ME-SKPI-1, ME-SKPI-2, (ME-SKPI-3)
ME-SKPI-1
ME-SKPI-1, (ME-SKPI-3)
ME-SKPI-5, ME-SKPI-6
ME-SKPI-5, ME-SKPI-6, (ME-SKPI-7)
ME-SKPI-1, ME-SKPI-2, (ME-SKPI-3)
ME-SKPI-6, ME-SKPI-7
ME-SKPI-6, ME-SKPI-7
ME-SKPI-4, ME-SKPI-7

Source: Definition of the Testing Framework for the NGMN 5G pre-commercial Networks Trials

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5G Media Streaming within the 5G System (1)



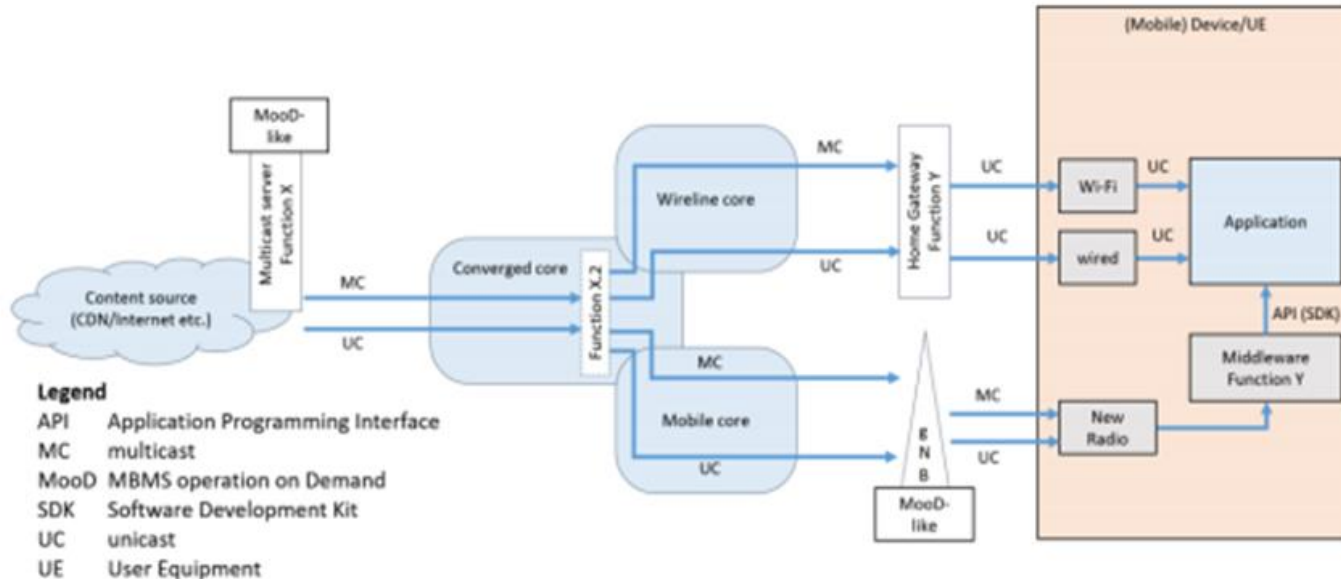
[*] The Uu and N3, N5, N6 and N33 are the interfaces and reference points as defined in ETSI TS 123 501 V16.8.0 (2021-04)

- Uu communication interface between RAN and UE
- N3 Reference point between the (R)AN and the UPF
- N5 Reference point between the PCF and Media AF
- N6 Reference point between the UPF and a Data Network (UPF and Media AS)
- N33 Reference point between NEF and Media AF

5G Media Streaming within the 5G System (2) - Steps for the service provision

1. The **5GMSd Application Provider** creates a Provisioning Session and starts provisioning the usage of the 5G Media Streaming System
2. When media hosting is provided, then there may be interactions between the **5GMSd AF** and **5GMSd AS**, e.g. to allocate 5GMSd ingest and Media Distribution resources
3. The **5GMS Application Provider** starts the Ingest Session by ingesting content. In case of live services, the content is continuously ingested
4. The **5GMS Application Provider** provides the service announcement information to the **5GMS Aware Application**
5. When the **5GMSd Aware Application** decides to activate the streaming service reception, the service access information (all or a reference) is provided to the **5GMSd Client**
6. When the **5GMSd Client** got a reference to the service access information, then it acquires the service access information
7. The **5GMSd Client** uses the Media Session Handling API towards the **5GMSd AF**
8. The **5GMSd Client** activates reception of the Media Content

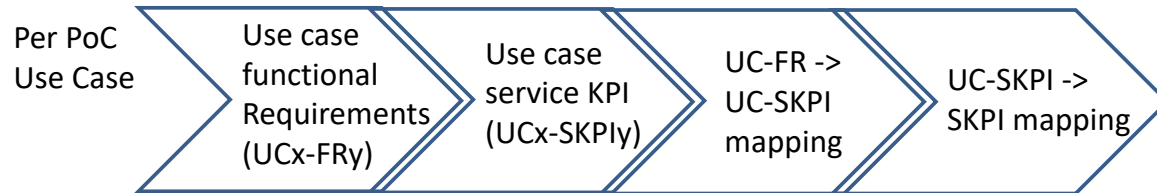
Overall end to end architecture for efficient content delivery over 5G networks (1)



Overall end to end architecture for efficient content delivery over 5G networks (2)

- Enabling **multicast** and **broadcast** capabilities should require a small footprint on top of the existing **unicast architecture**.
- Wherever possible, treat multicast and broadcast as an internal optimization tool inside the network operator's domain.
- Consider terrestrial broadcast as a service offered also to Ues without uplink capabilities that can be delivered as a self-containing service by subset of functions of multicast and broadcast architecture.
- Simplify the system setup procedure to keep the system cost marginal. The design aims to develop an efficient system in terms of architecture/protocol simplicity and resource efficiency. Despite simplified procedures, the architecture also should allow flexible session management.
- Focus on the protocols that allows efficient IP multicast.
- Enable caching capabilities inside the network.

Mapping process of UC functional and service level KPIs



Core KPIs in media & entertainment vertical use case

CKPI Id	CKPI Name	CKPI Description	Units
CKPI-1	End-to-end Latency	Aggregation of one-way time delays measured between specific components of the logical architecture of the use case.	Ms
CKPI-2	Packet Loss	The number of packets that fail to reach their destination, measured in specific interfaces of the use case logical architecture.	%
CKPI-3	Guaranteed Data Rate	The data rate is the number of bits per unit of time sent over a specific interface of the use case logical architecture. The guaranteed data rate is the minimum expected data rate for the overall use case to function correctly.	Mbits/s
CKPI-4	Coverage	Radio access coverage area on the pilot premises.	M ²
CKPI-5	Availability	Percentage of time during which and locations in which a specific component of the use case (application, server, network function, etc.) is responding to the requests received with the expected QoS requirements. That is, it is the ratio between the up-time of a specific component over the total time the component has been deployed.	% of time
CKPI-6	Slice Creation Time	Time elapsed since the creation of a slice is triggered until the slice is fully operational.	Ms
CKPI-7	Connection Density	The number of users/devices that can be connected simultaneously to the use case network infrastructure without degrading the performance of the users/devices that are already connected.	1/m ²
CKPI-8	Data Volume	The total quantity of information transferred over a given interface during specific use case operations, measured in bits.	Gbits
CKPI-9	Jitter	Variation of the end-to-end latency for the communications between specific components of the use case. This core KPI is useful to correlate QoE KPIs for the different video visualizations performed in the use cases.	Ms
CKPI-12	Area Network Capacity	Total network capacity that is provided over a specifically defined geographic area.	Gbps
CKPI-13	Mobility / Speed	The network capability to provide connectivity to end user devices moving at various speeds.	Km/h
CKPI-14	Handover time	Time between the moment that a change to another access node is triggered up to the time that the session is transferred to the other access node and served.	Ms
CKPI – 15	Reliability	Percentage of times in which a specific component of the use case (application, server, network function, etc.) is responding to the requests received with the expected QoS requirements given the availability of the service. That is, it is the ratio between the up-time of a specific component over the total time the component has been deployed for the time that the service is supposed to be available.	% of times (frequency metric)

Media & Entertainment – Mapping of Core and Service KPIs (1)

SKPI	Mapping to CKPI
SKPI-1: the server accessibility (application accessibility)	<ul style="list-style-type: none"> • End-to-end • Latency Coverage • Availability • Slice Creation Time • Connection Density • Area Network Capacity • Mobility / Speed • Handover time
SKPI-2: the waiting time (time to first picture)	<ul style="list-style-type: none"> • End-to-end Latency • Coverage • Availability • Slice Creation Time • Connection Density • Area Network Capacity • Mobility / Speed • Handover time
SKPI-3: user defined timeout (emulates the user's patience) leads to a "failure"	<ul style="list-style-type: none"> • End-to-end Latency • Packet Loss • Coverage • Availability • Slice Creation Time • Connection Density • Area Network Capacity • Handover time • Reliability

Media & Entertainment – Mapping of Core and Service KPIs (2)

SKPI	Mapping to CKPI	
<p>SKPI-4: picture quality (MOS for each 10s interval of a video, and certainly as the average MOS for the whole video)</p>	<ul style="list-style-type: none"> • End-to-end • Packet Loss • Guaranteed Data Rate • Data Volume • Jitter 	<ul style="list-style-type: none"> • Area Network Capacity • Mobility / Speed • Handover time • Reliability
<p>SKPI-5: freezing / stalling of the video in %</p> <p>SKPI-6: lost streams (constant freezing)</p>	<ul style="list-style-type: none"> • Packet Loss • Coverage • Availability • Jitter 	<ul style="list-style-type: none"> • Connection Density • Mobility / Speed • Handover time • Reliability
<p>SKPI-7: jerkiness in % (if frame rate is not high enough, e.g., < 20 fps, the video is not perceived as fluent)</p>	<ul style="list-style-type: none"> • Packet Loss • Coverage • Availability • Slice Creation Time • Jitter 	<ul style="list-style-type: none"> • Connection Density • Mobility / Speed • Handover time • Reliability

Media & Entertainment – Mapping of Core and Service KPIs (3)

M&E SKPIs	Core 5G KPIs														
	CKPI-1	CKPI-2	CKPI-3	CKPI-4	CKPI-5	CKPI-6	CKPI-7	CKPI-8	CKPI-9	CKPI-10	CKPI-11	CKPI-12	CKPI-13	CKPI-14	CKPI-15
ME-SKPI-1	v			V	V	V	V					v	V	V	
ME-SKPI-2	v			V	V	V	V					v	V	V	
ME-SKPI-3	v	v		v	v	v	v					v		v	v
ME-SKPI-4	v	v	v					v		v		v	v	v	v
ME-SKPI-5		v		v	v		v		v				v	v	v
ME-SKPI-6		v		v	v		v		v				v	v	v
ME-SKPI-7		v		v	v		v		v				v	v	v

SKPIs identify the business and operational-oriented benchmarks and figures of merit that must be met in order to certify that the vertical services, once implemented, are fully functional (i.e., they work as expected to satisfy the demanded vertical requirements and agreed SLAs).

In a nutshell, the SKPIs are the promises that the underlying management institutions make to the verticals. **Each service's set of SKPIs is a list of observable, measurable, and quantifiable parameters that are only important and meaningful for that service.** As a result, even if both coexist and are carried out over a similar (computing and network) infrastructure, **the collection of SKPIs for a given service may not be relevant to other vertical services.**

The latter then creates a collection of **CKPIs that are connected to the computing and networking resources which will be allocated to support the vertical service.**

CKPIs are measurable performance parameters associated with the network and computing infrastructure that supports the vertical service's functions, applications, connectivity, etc. As a result, an **relationship is established between a vertical service's SKPI and its determined set of CKPIs.**