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Is 5G ready to onboard Metaverse

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What is Metaverse

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An universe where physical world and digital world come together to offer seamless experience in everything we do

- **Walk into a car showroom sitting at home and feel the real car**
- **Test drive a real car on real road sitting at home**
- **Walk in a retail outlet and trial a garment as if it happened in real with just a click**
- **Call your friend across the continent and engage into a badminton match**
- **A robotic surgeon performs cataract surgery of a real patient remotely**

What do we have in common in all the above use cases?

- **A connectivity fabric that provides the information highway**
- **The evolved internet that provides transport on this highway with the use cases as its payload**
- **Digital twin of all physical entities**
- **A boundary-less cyber-physical system that transcends across digital and physical world, blurring the boundary**

The connectivity fabric

Can 5G deliver what is takes to run Metaverse?

- **Latency**
- **User experience data rate**
- **Reliability**

The connectivity fabric – service requirement

Use Cases	Characteristic parameter (KPI)			Influence quantity			Remarks
	Max allowed end-to-end latency	Service bit rate: user-experienced data rate	Reliability	Message size (byte)	UE Speed	Service Area	
Immersive multi-modal VR (UL: device → application sever)	5 ms (note 2)	16 kbit/s -2 Mbit/s (without haptic compression encoding); 0.8 - 200 kbit/s (with haptic compression encoding)	99.9% (without haptic compression encoding) 99.999% (with haptic compression encoding) [40]	1 DoF: 2-8 3 DoFs: 6-24 6 DoFs: 12-48 More DoFs can be supported by the haptic device	Stationary or Pedestrian	typically < 100 km^2 (note 5)	Haptic feedback
	5 ms	< 1Mbit/s	99.99% [40]	1500	Stationary or Pedestrian	typically < 100 km^2 (note 5)	Sensing information e.g. position and view information generated by the VR glasses
Immersive multi-modal VR (DL: application sever → device)	10 ms (note1)	1-100 Mbit/s	99.9% [40]	1500	Stationary or Pedestrian	typically < 100 km^2 (note 5)	Video
	10 ms	5-512 kbit/s	99.9% [40]	50	Stationary or Pedestrian	typically < 100 km^2 (note 5)	Audio
	5 ms (note 2)	16 kbit/s -2 Mbit/s (without haptic compression encoding); 0.8 - 200 kbit/s (with haptic compression encoding)	99.9% (without haptic compression encoding) 99.999% (with haptic compression encoding) [40]	1 DoF: 2-8 3 DoFs: 6-24 6 DoFs: 12-48	Stationary or Pedestrian	typically < 100 km^2 (note 5)	Haptic feedback

Source: 3GPP 22.261

The connectivity fabric – service requirement

Use Cases	Characteristic parameter (KPI)			Influence quantity			Remarks
	Max allowed end-to-end latency	Service bit rate: user-experienced data rate	Reliability	Message size (byte)	UE Speed	Service Area	
Remote control robot	1-20ms	16 kbit/s -2 Mbit/s (without haptic compression encoding); 0.8 - 200 kbit/s (with haptic compression encoding)	99.999% [40]	2-8 (1 DoF)	high-dynamic (⩽ 50 km/h)	≤ 1 km^2	Haptic feedback
	20-100ms	16 kbit/s -2 Mbit/s (without haptic compression encoding); 0.8 - 200 kbit/s (with haptic compression encoding)	99.999% [40]	2-8 (1 DoF)	Stationary or Pedestrian	≤ 1 km^2	Haptic feedback
	5 ms	1-100 Mbit/s	99.999% [40]	1500	Stationary or Pedestrian	≤ 1 km^2	Video
	5 ms	5-512 kbit/s	99.9% [40]	50-100	Stationary or Pedestrian	≤ 1 km^2	Audio
	5 ms	< 1Mbit/s	99.999% [40]	-	Stationary or Pedestrian	≤ 1 km^2	Sensor information

Source: 3GPP 22.261

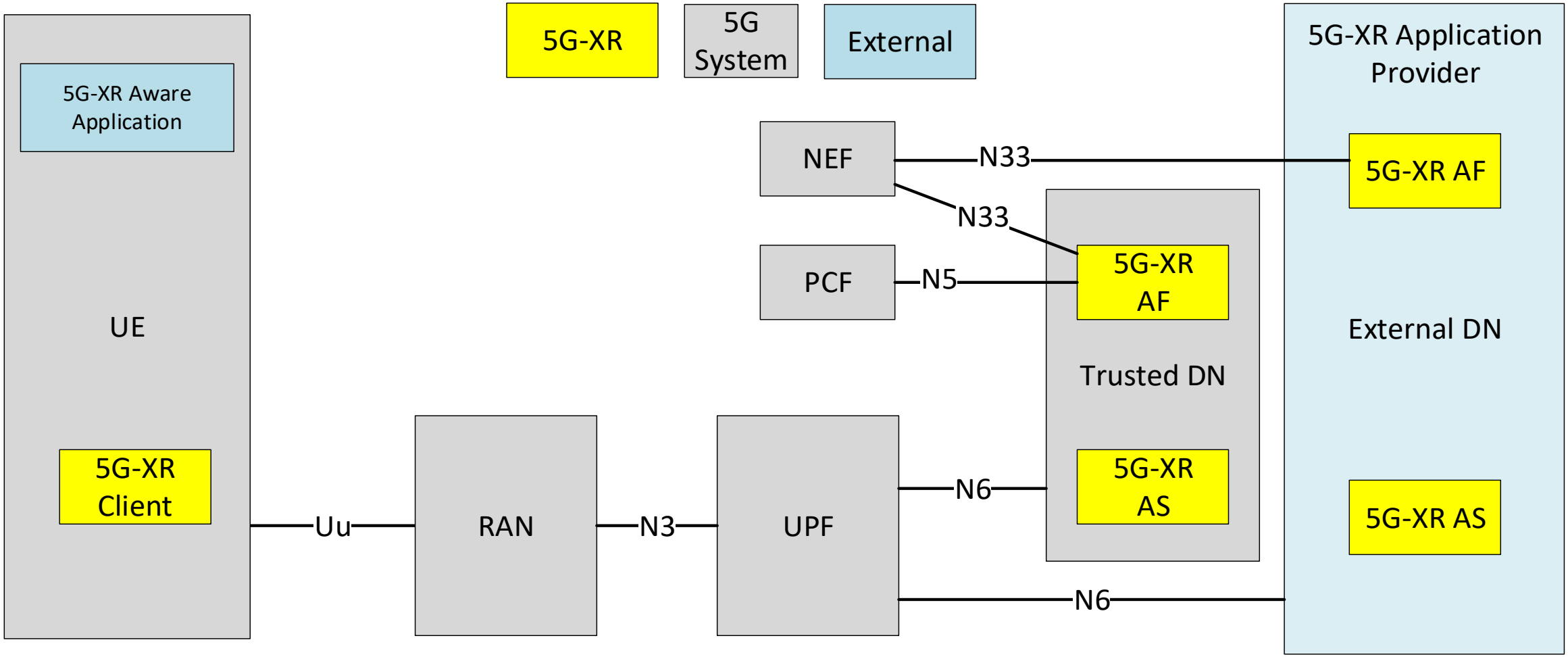
Service quality requirements

Use Cases	Characteristic parameter (KPI)			Influence quantity		
	Max allowed end-to-end latency	Service bit rate: user-experienced data rate	Reliability	# of UEs	UE Speed	Service Area (note 2)
Cloud/Edge/Split Rendering (note 1)	5 ms (i.e. UL+DL between UE and the interface to data network) (note 4)	0,1 to [1] Gbit/s supporting visual content (e.g. VR based or high definition video) with 4K, 8K resolution and up to120 frames per second content.	99,99 % in uplink and 99,9 % in downlink (note 4)	-	Stationary or Pedestrian	Countrywide
Gaming or Interactive Data Exchanging (note 3)	10ms (note 4)	0,1 to [1] Gbit/s supporting visual content (e.g. VR based or high definition video) with 4K, 8K resolution and up to120 frames per second content.	99,99 % (note 4)	≤ [10]	Stationary or Pedestrian	20 m x 10 m; in one vehicle (up to 120 km/h) and in one train (up to 500 km/h)
Consumption of VR content via tethered VR headset (note 6)	[5 to 10] ms (note 5)	0,1 to [10] Gbit/s (note 5)	[99,99 %]	-	Stationary or Pedestrian	-

NOTE 1: Unless otherwise specified, all communication via wireless link is between UEs and network node (UE to network node and/or network node to UE) rather than direct wireless links (UE to UE).
NOTE 2: Length x width (x height).
NOTE 3: Communication includes direct wireless links (UE to UE).
NOTE 4: Latency and reliability KPIs can vary based on specific use case/architecture, e.g. for cloud/edge/split rendering, and can be represented by a range of values.
NOTE 5: The decoding capability in the VR headset and the encoding/decoding complexity/time of the stream will set the required bit rate and latency over the direct wireless link between the tethered VR headset and its connected UE, bit rate from 100 Mbit/s to [10] Gbit/s and latency from 5 ms to 10 ms.
NOTE 6: The performance requirement is valid for the direct wireless link between the tethered VR headset and its connected UE.

Source: 3GPP 22.261

Evolved fabric with immersive services



Source: 3GPP 26.928

Summary

- 5G network fabric has the base to onboard metaverse
- Further work is required to enhance network capacity and capability
- Evolution of tactile internet plays a key role
- Application-integrated networking fabric plays a key role
- Identity, trust and data protection are of key attributes of the fabric

Thank You.

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