POTENTIAL OF 5G FOR CONNECTED CARS

Rémi BASTIEN
Renault Automotive Prospective VP

5G USE CASES
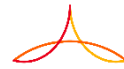
eMBB*, >10Gbps peak data rate,
100Mbps always
10000x more traffic
Enhanced Mobile Broadband

4K/8K/HDR video streaming
High Speed FOTA
High Speed Download
…

Gigabytes in a second

3D video, UHD screens

Smart Home/Building

Work and play in the cloud

Smart Vehicle & IoT

Augmented reality

Industry automation

Voice

Self Driving Car

Smart City

Future IMT

Mission critical
application
e.g. e-health

Massive Machine Type
Communications

Ultra-reliable and Low Latency
Communications
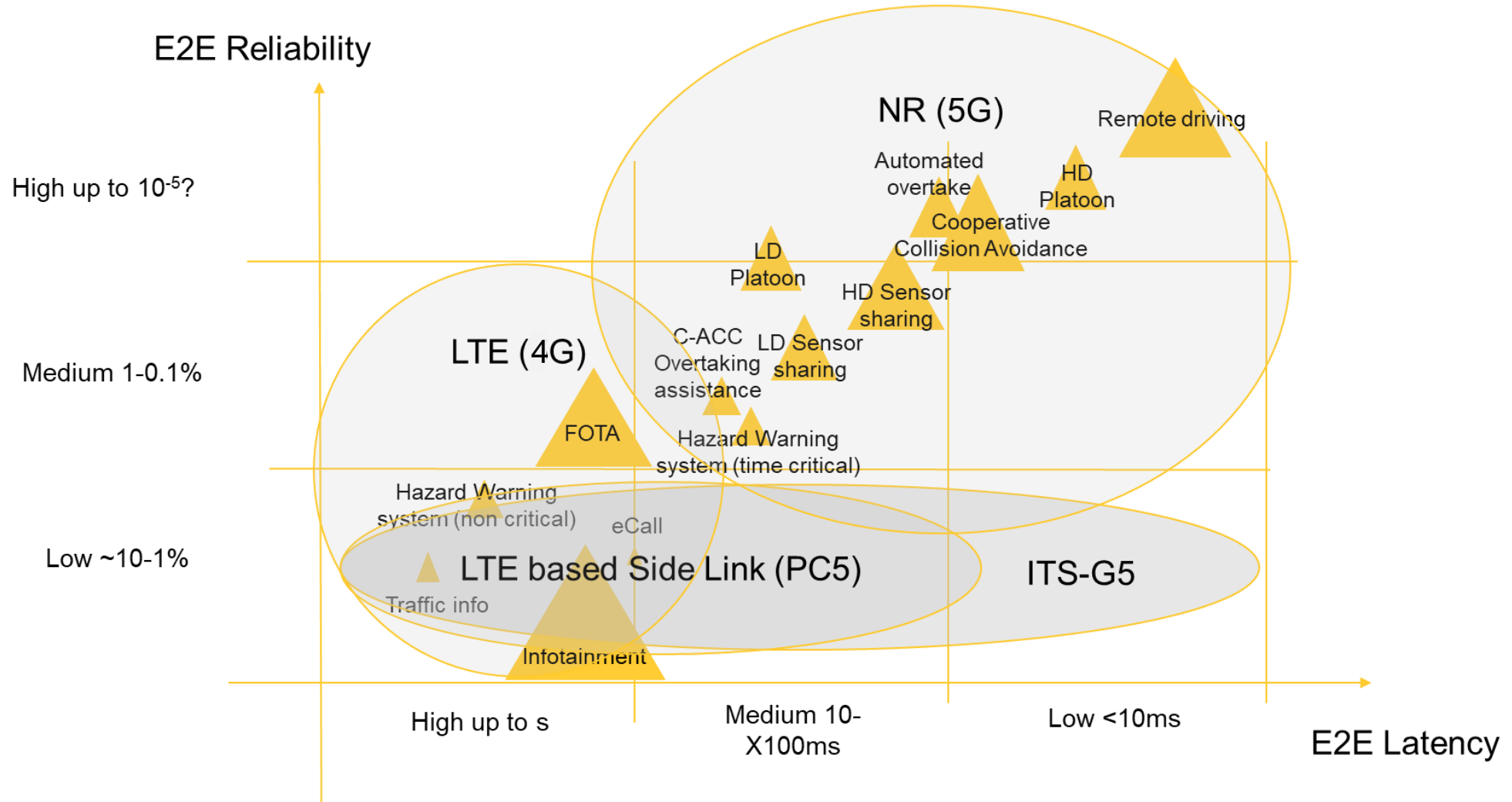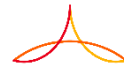
Cooperative Driving
Highly Automated Driving

mMTC*, >10 years battery life
M2M Ultra low cost
10x -100x more devices

URLLC*, <1ms radio latency, <10ms E2E latency
99.999% Reliability

RÉMI BASTIEN

MARCH 2019

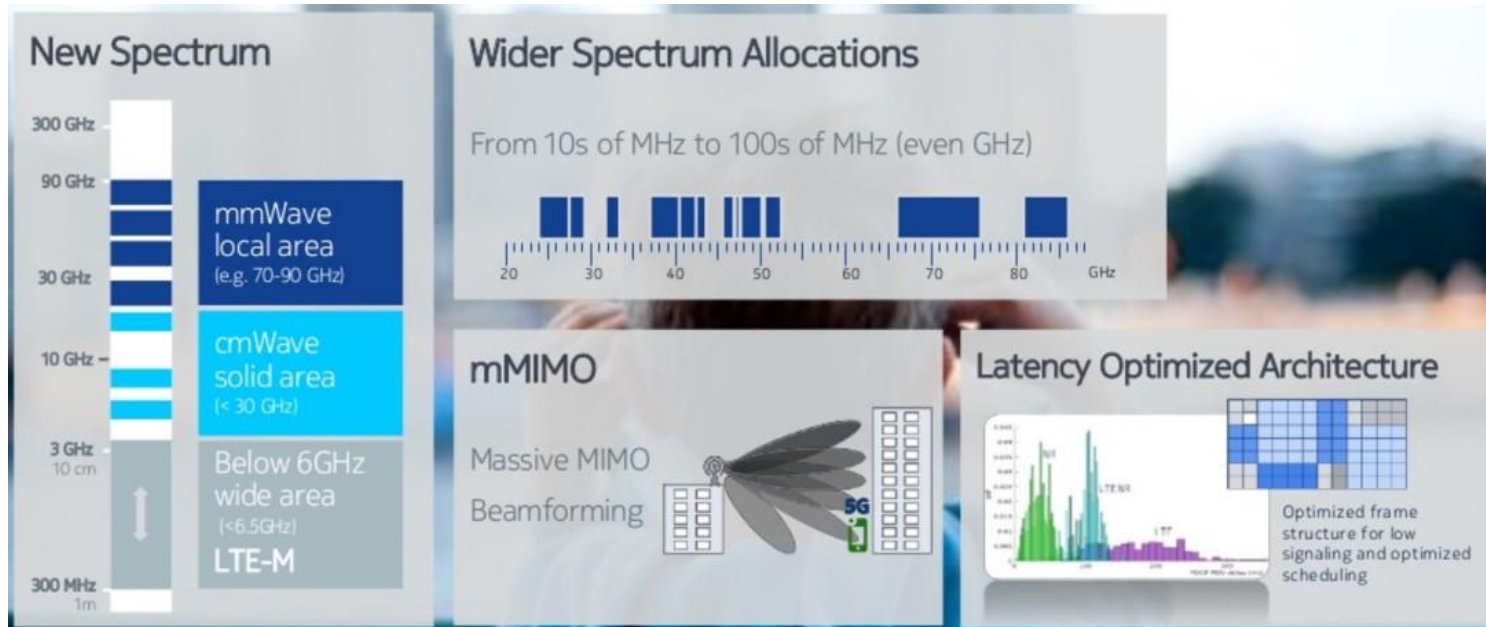CONFIDENTIAL B
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GROUPE RENAULT

Confidential C

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WHAT MAKES 5G DIFFERENT?
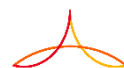
NEW RADIO

_ 3x spectral efficiency; 5x energy efficiency compared to LTE
_ Massive MIMO
_ < 1ms radio latency

CORE NETWORK

_ **Network Slicing** enabled by Network Function Virtualization (NFV) and SW Defined Network (SDN) for dynamic mapping of U-plane traffic to dedicated (and distributed) edge clouds
_ <10ms E2E latency
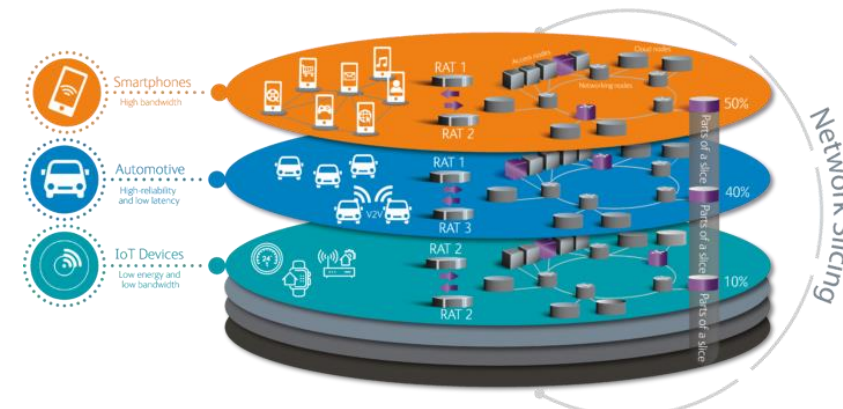
MVNO

_ **Business model:** network slices administered by MVNO (Mobile Virtual Network Operator)

_ **Multi-Access Edge Computing (MEC) moves the computing power close to where it is exploited** reducing latency and bringing real-time performance even for high bandwidth applications

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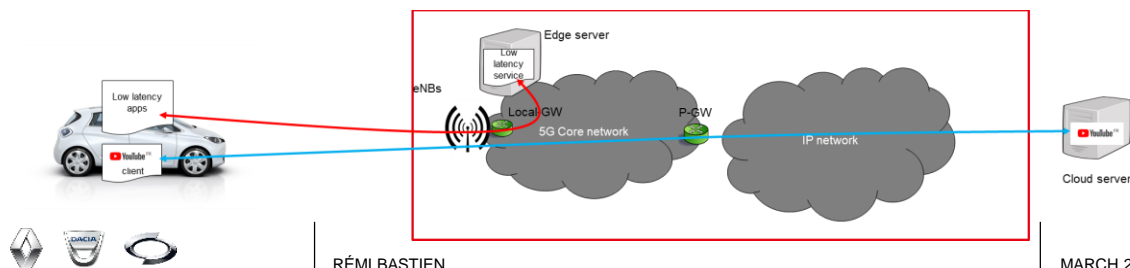
RENAULT ENGAGEMENTS IN 5G PROJECTS

Example of near real time service providers, virtualized services executed in MEC

MEC (Multi-Access Edge Computing), Available computing power for new service enabling orchestrated by operators or network providers
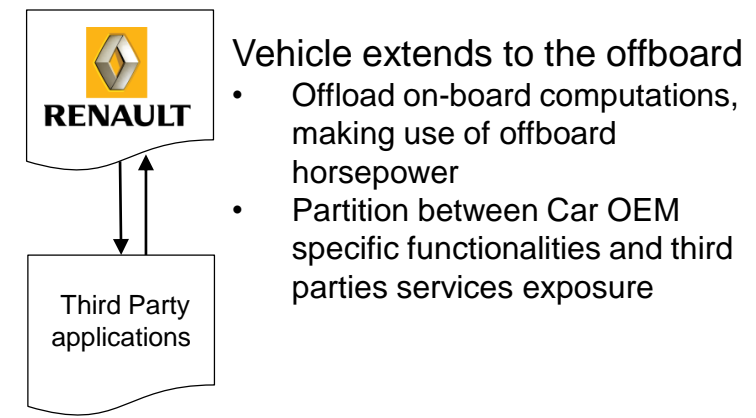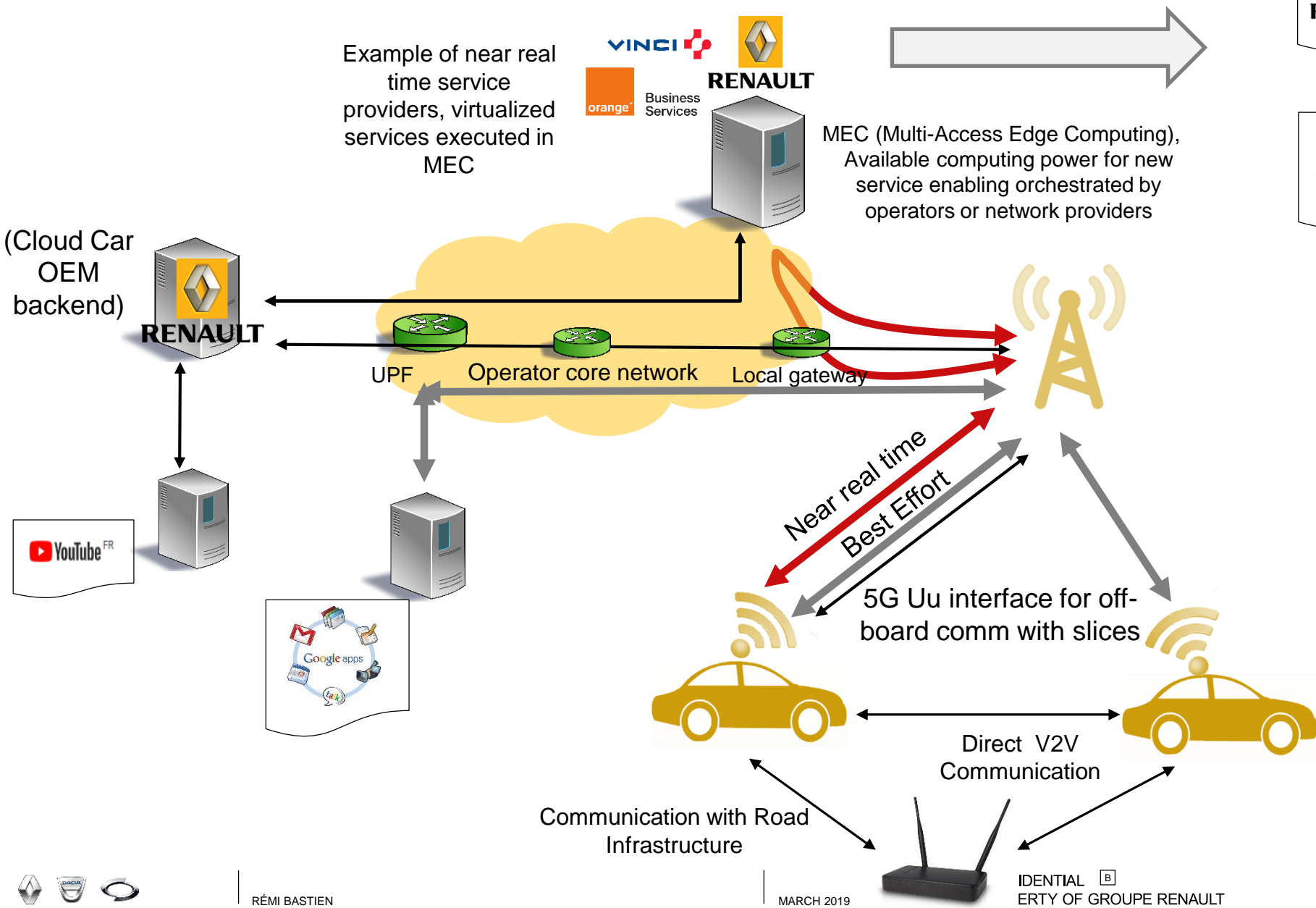
(Cloud Car OEM backend)

UPF   Operator core network   Local gateway

Near real time
Best Effort

5G Uu interface for off-board comm with slices

Direct V2V Communication

Communication with Road Infrastructure

Vehicle extends to the offboard
- Offload on-board computations, making use of offboard horsepower
- Partition between Car OEM specific functionalities and third parties services exposure

Third Party applications

Renault's activities

5GCroCo

- Anticipated Cooperative Collision Avoidance, characterize the performance with MEC

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- **Thesis**: Optimal use of MEC computing power for integrated connected services

- MoU Renault/Orange/E/// (on going) for virtualization of services in MEC infrastructure for multiple service providers.

Backup

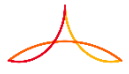GROUPE RENAULT

5G advantages over 4G

- Up to +10ys battery life for IoT devices
- 90% reduction in network energy usage
- 100% coverage
- 99.999% availability
- 10-100x improvements in peak data rate compared to 4G (up to 10Gbps)
- 1ms latency (air latency)
- 1000x bandwidth per unit area
- Up to 100x connected devices per unit area compared to 4G

- **Not all KPI can be achieved in the same time**
- **Deployments will take some time before reaching ubiquous availability of E2E 5G**
  - **Non Standalone deployments** (5G radio over an LTE Core network) deployed first
  - **Standalone** (full E2E 5G Radio network + Core network) deployed later

Use-Case					Delivered by Network Slice				
Application Category	Examples	Cost Sensitivity	Deploy-ment		Throughpt (bps)		Latency (RTT)		Reliability
					UL	DL	E2E Appl.	Network	
Consumers: Mobile Broadband	Mobile Broadband	· Smartphones in dense urban · Corporate mobile office	Medium	mass	10-50M	100-300M	50-200ms	15-25ms	Medium - High
	Fixed Wireless Access	· 5G for residential homes · Wireless SOHO/VPN	High	targeted	100-200M	1-5G	150-200ms	1-20ms	High
Events, Entertainment	Event experience	· Immersive VR360 · AR gaming	Medium	targeted	1-5G	1-100M	5-50ms	1-5ms	Medium - High
SoHo/Homes	In-Vehicle Entertainment	· Private cars · Public transport	Medium	mass	1k-1M	5-100M	150-200ms	1-20ms	Medium-High
Industries: Manufacturing	Critical automation	· Collaborative robots/drones · Electrical grid tele-protection	Low	mass	1-10M	1M	5-50ms	1-5ms	High/Very High
Seaports, Mining	Tele-operation	· Video-based remote control · Video w/haptic remote cntrl	Medium	targeted	1-10M	1M	50-150ms	1-25ms	High/Very High
Agriculture, Utilities	Highly interactive AR	· Co-present Mixed Reality · 360° volumetric video AR/MR	Medium	targeted	1-100M	5-100M	50-100ms	1-10ms	Medium
Smart Cities	Mass sensor arrays	· Agriculture field sensors · Smart city sensors & meters	Very High	mass	1k-1M	1k-1M	1-2s	200-500ms	Medium-Low

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Data Volume 1000x
10Gb/s/km2 → 10 Tb/s/km2

Network Latency 10x
10ms → 1ms

Peak Rates 100x
100Mbps → 10Gbps

Reliability +90%
4 → 5 9's

5G / LTE

Mobility 500km/h

Service Intro -93%
90 days → 90 min

IoT Density 1000x
1K → 1M/km2

BTS Energy -80%
(idle, no connected users)