

# MYTHICAL 5G: WHAT TO EXPECT

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Senior Systems Engineer

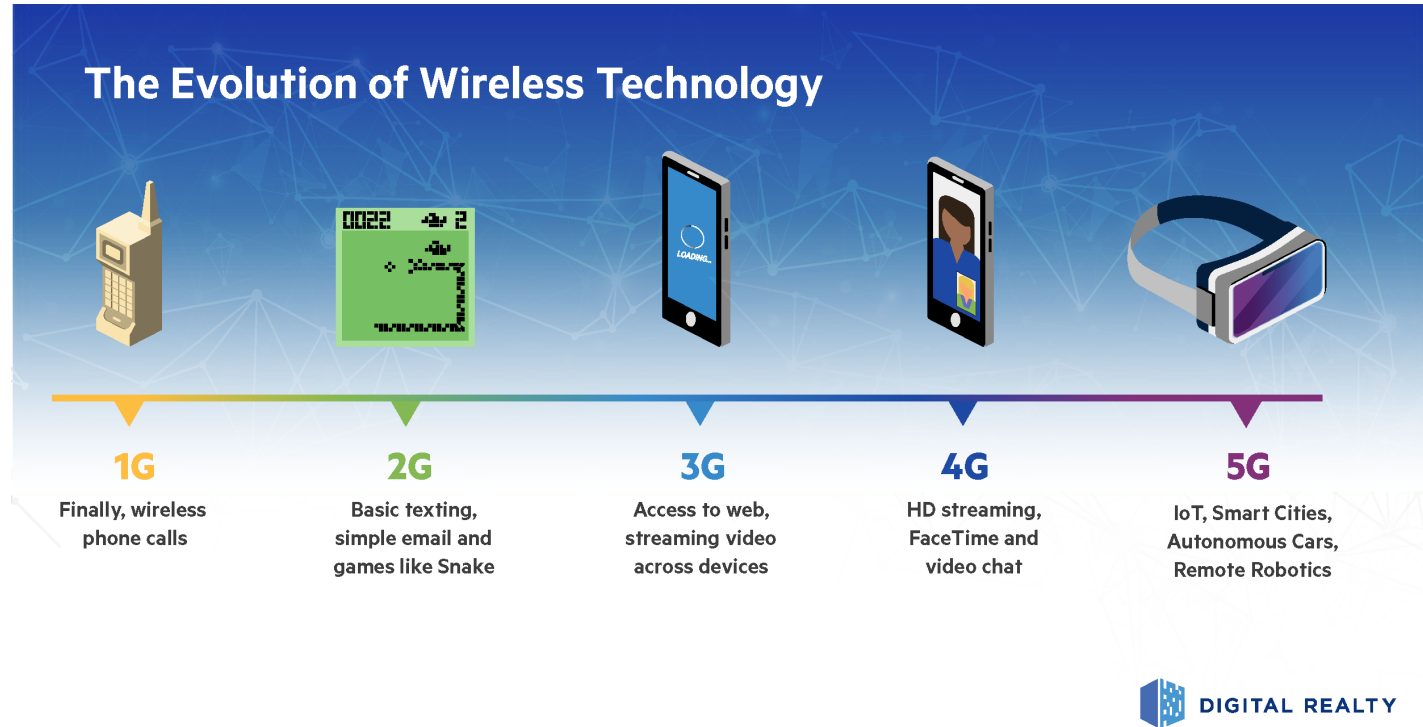
September 2019

Kiev, Ukraine

JUNIPER  
NETWORKS

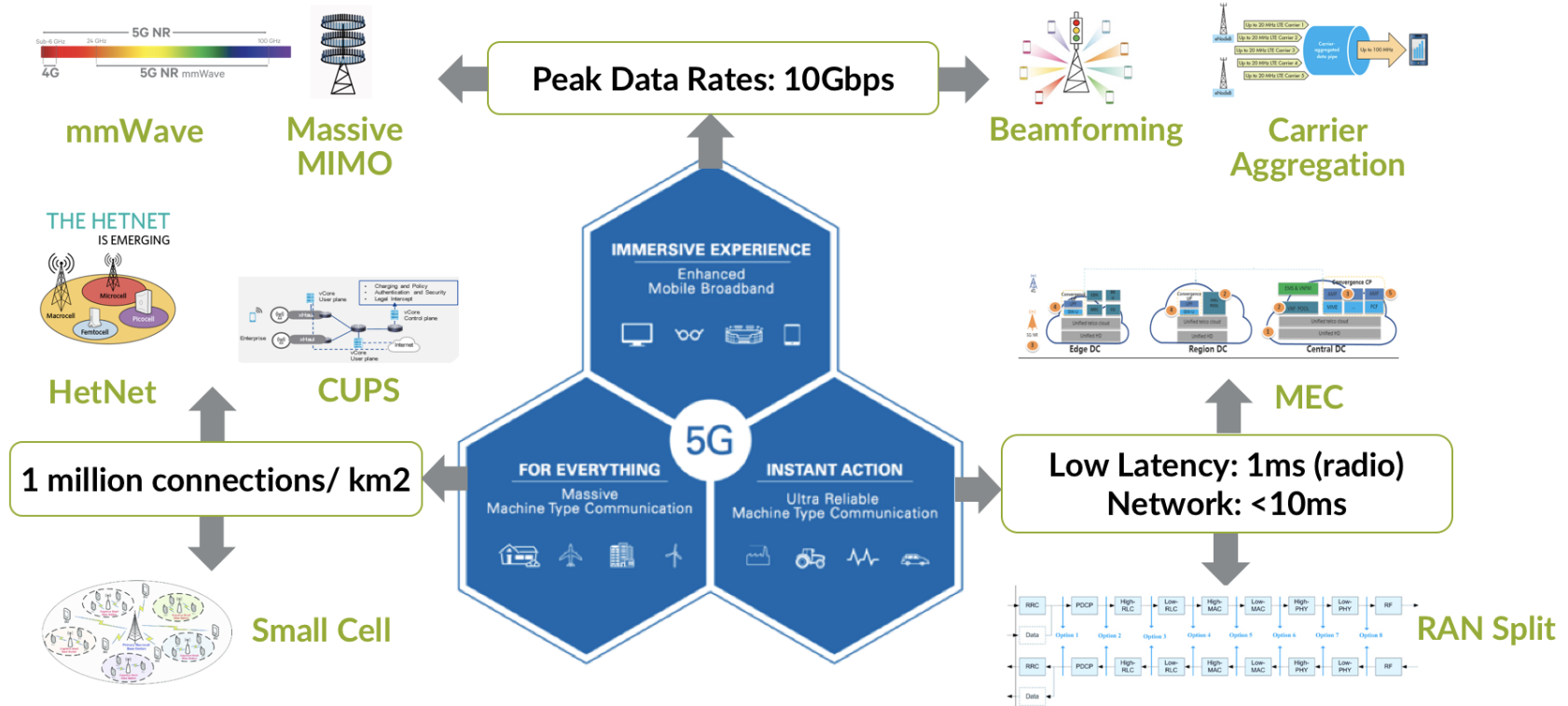
Engineering  
Simplicity

# WHAT IS 5G?





# 5G TECHNOLOGY DRIVERS



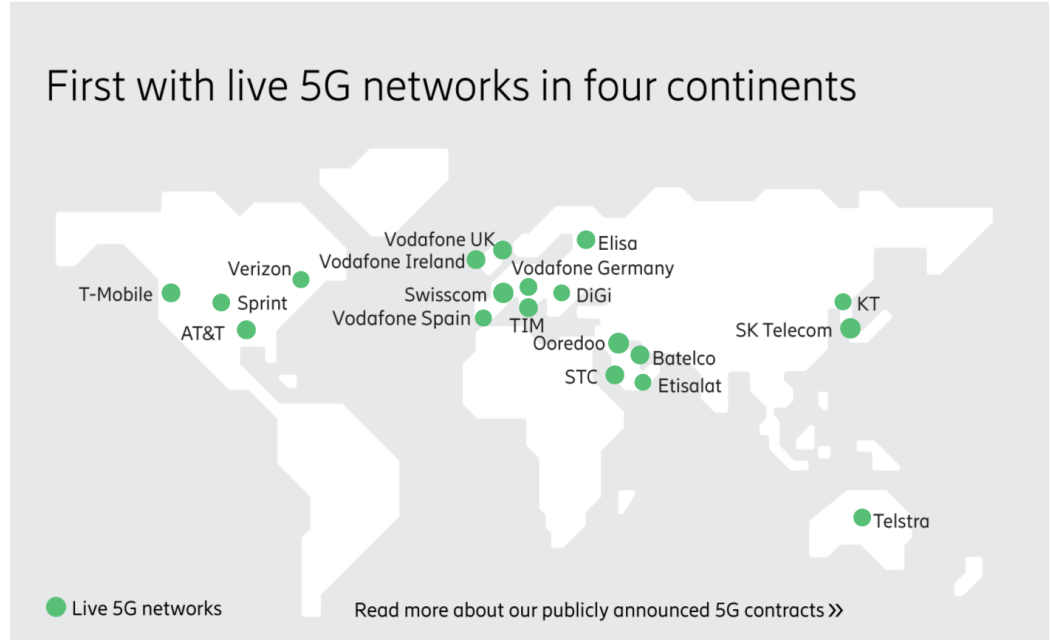
# 5G IS HERE!



First 5G networks now live across Americas, EMEA and APAC:

- Still early days, mass nationwide roll-outs will still take several years.
- Mainly Mid bands in EMEA and APAC, High bands in Americas
- Worldwide 45%~65% coverage expected by 2024.

First with live 5G networks in four continents

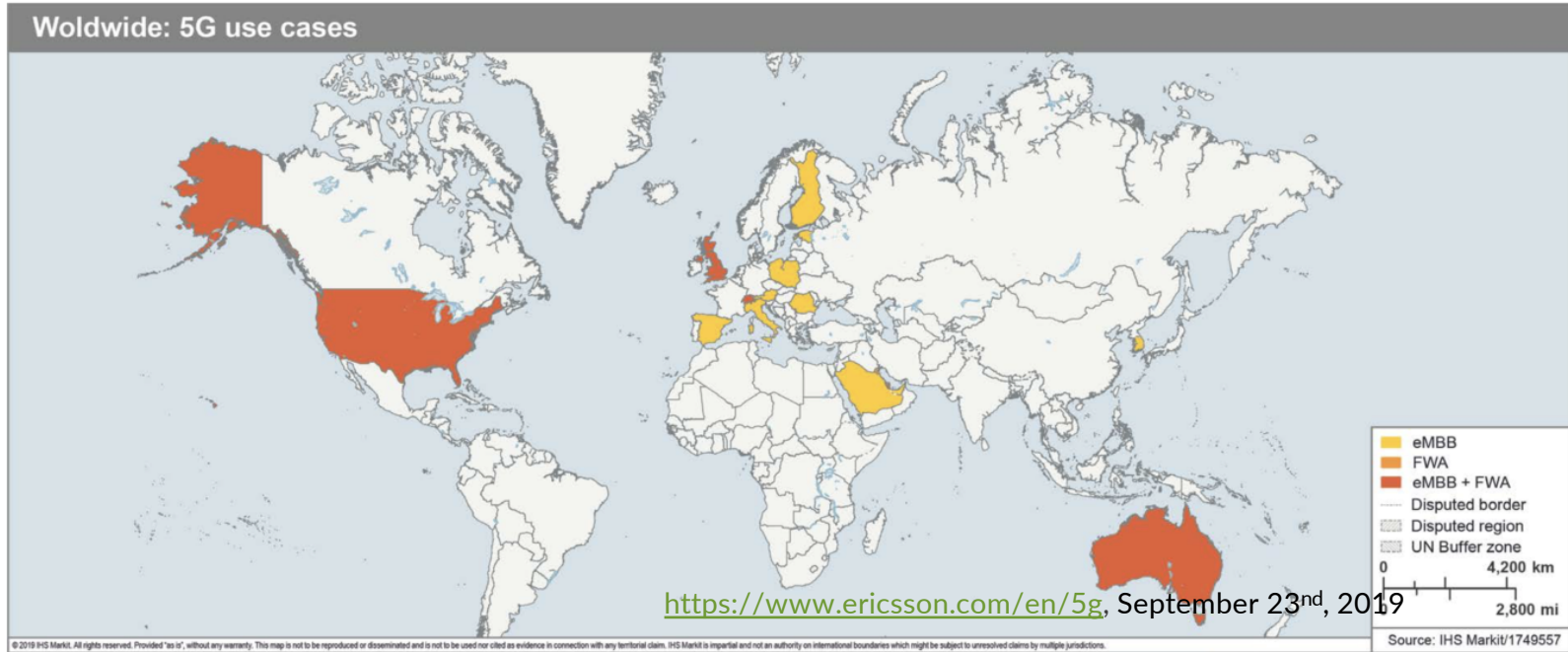


<https://www.ericsson.com/en/5g>, September 23<sup>rd</sup>, 2019



# BUT WAIT A SECOND...

Enhanced mobile broadband and fixed wireless access are the primary use cases applied by operators so far



# 5G STANDARTIZATION PROCESS

## RELEASE 15 – 5G first phase (commercial deployments)

5G non-standalone (Dec 2017) and 5G standalone definitions (Jun 2018)

Mainly focused on enhanced Mobile Broadband (eMBB) and fixed wireless

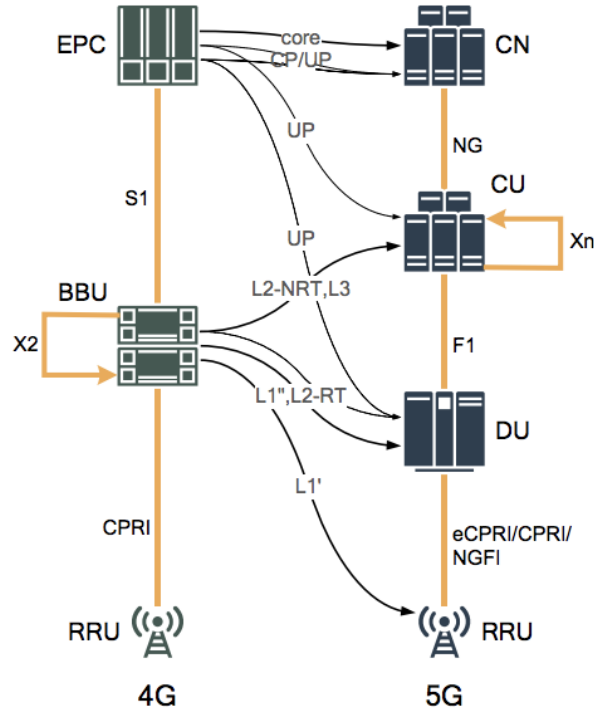
May perform on lower speed (on sub-6GHz bands) comparable to LTE Advanced Pro (LAA – Licensed Assisted Access, Rel 13) -> Gigabit Class LTE on 20MHZ of licensed spectrum + 5Ghz unlicensed part

## RELEASE 16 – 5G second phase (further evolution)

To be completed by the end of 2019

Focus on Ultra-Reliable Low-Latency Communications (URLLC, 1ms latency -> SD cars) and Massive Machine Type Communications (MMTC, 1m devices per km2 -> Industrial IOT)

# BASE STATIONS EVOLUTION

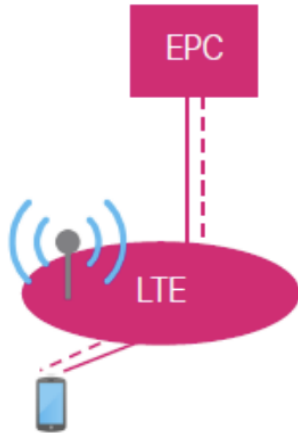


**Evolving from single-node in 4G to split function architecture in 5G**

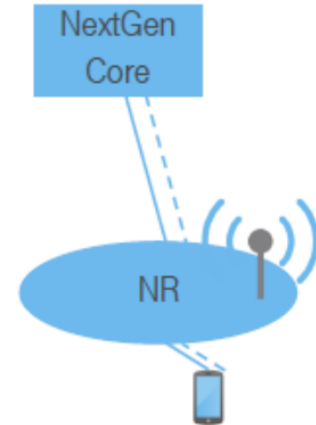


# TRANSITION TO 5G

1) Standalone LTE, EPC connected - legacy



2) Standalone NR, NGCN connected



# TRANSITION TO 5G

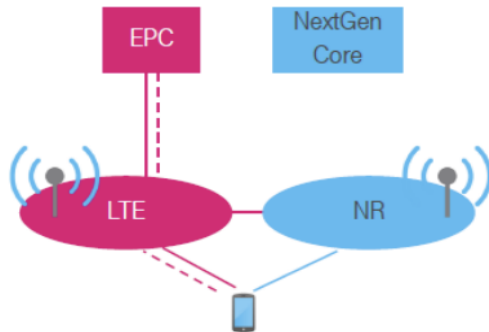
1) Standalone LTE, EPC connected - legacy

EPC

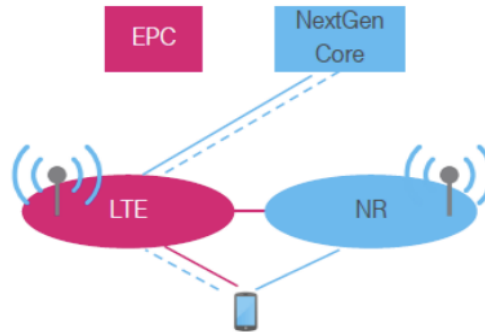
2) Standalone NR, NGCN connected

NextGen

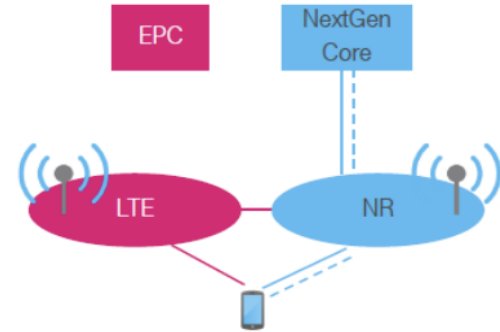
3) Non-Standalone/"LTE assisted", EPC connected



7) Non-Standalone/"LTE assisted", NGCN connected

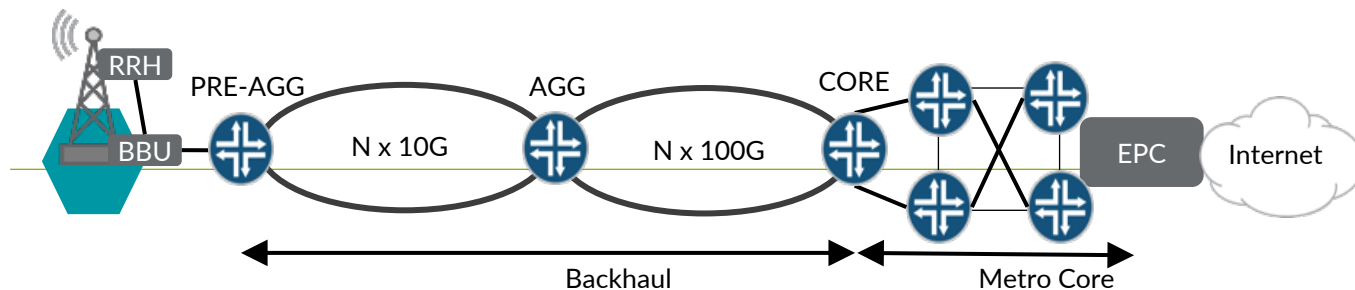


4) Non-Standalone/"NR assisted", NGCN connected



# MBH ARCHITECTURE TODAY (4G / LTE-A)

Massive MIMO  
Carrier Aggregation

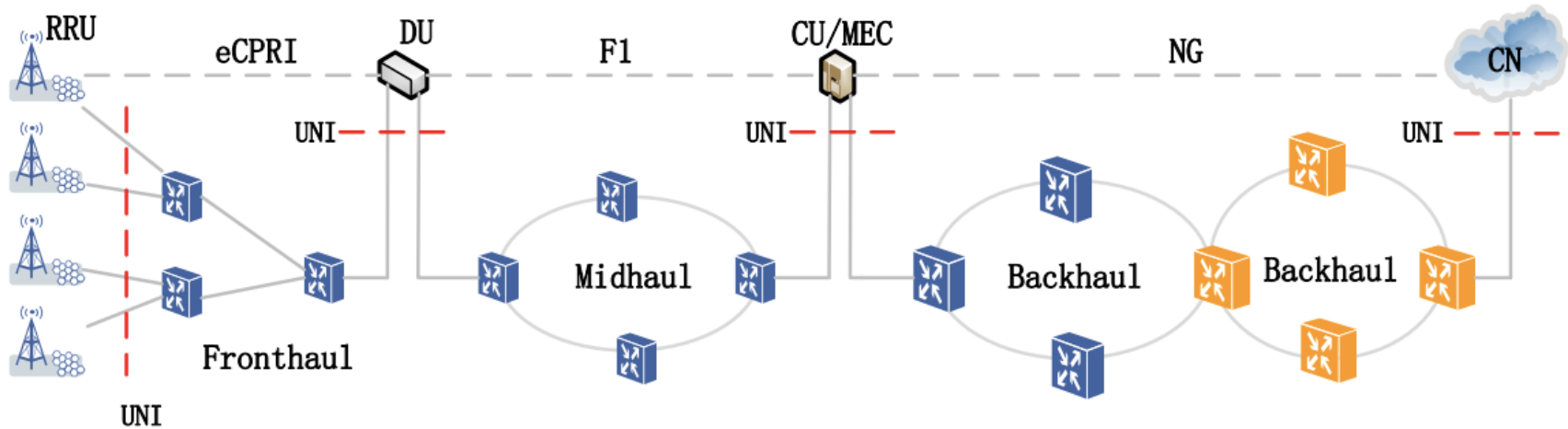


Most deployed CSR architecture for 4G / LTE-A today:

- Operators start to implement Massive MIMO and Carrier Aggregation for better spectrum efficiency to improve density and bandwidth. This requires CSR upgrades at Cell Sites from **1GE to 10GE**.
- **10GE CSR** typically deployed at single site or to aggregate multiple cell sites, depending on reach between sites.
- Requires hardened CSR with **3 ... 8 x 10GE ports** (downlink & uplink).



# MBH ARCHITECTURE EVOLUTION (5G)



**Table 7-3 Network reach requirements**

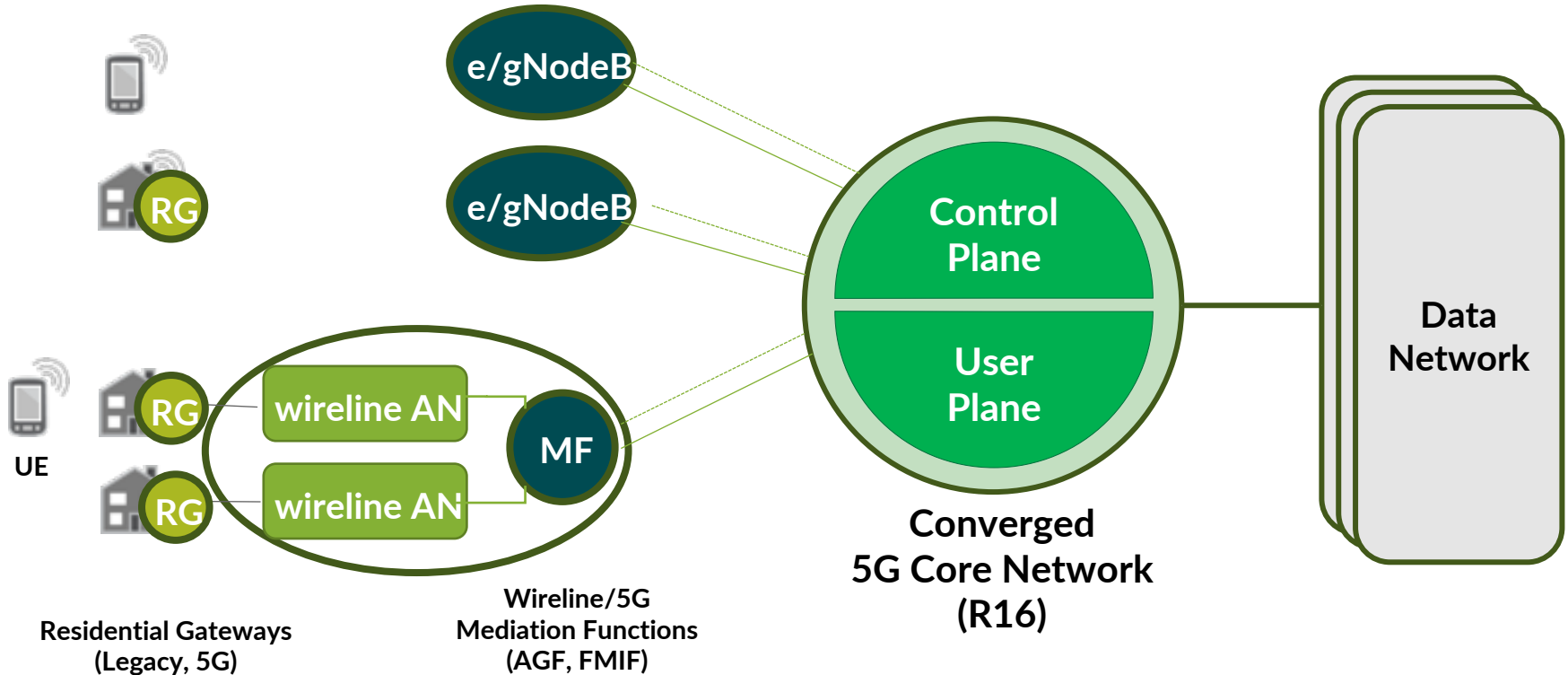
Fronthaul	1~20km
Midhaul	20~40km
Backhaul	1~10km Aggregation: 5-80km Core: 20~300km

## L2 fronthaul evolution with eCPRI

- Maximum 100 us (microsecond) latency and 65 ns delay variation
- Ethernet Switch with RoE and TSN: typically 6 x 10/25GE + 2 x 100GE

# HIGH LEVEL CONVERGED ARCHITECTURE

## WWC: WIRELINE WIRELESS CONVERGENCE
















частоты  
для 5G

Сотовые  
операторы



	24-28GHz	37-40GHz	64-71GHz
	24.25-24.45GHz 24.75-25.25GHz 27.5-28.35GHz	37-37.6GHz 37.6-40GHz 47.2-48.2GHz	64-71GHz
	26.5-27.5GHz 27.5-28.35GHz	37-37.6GHz 37.6-40GHz	64-71GHz
	24.5-27.5GHz		
	26GHz		
	26GHz		
	26GHz		
	26.5-27.5GHz		
	24.5-27.5GHz	37.5-42.5GHz	
	26.5-29.5GHz		
	27-29.5GHz		
	24.25-27.5GHz	39GHz	



# COVERAGE RESTRICTIONS



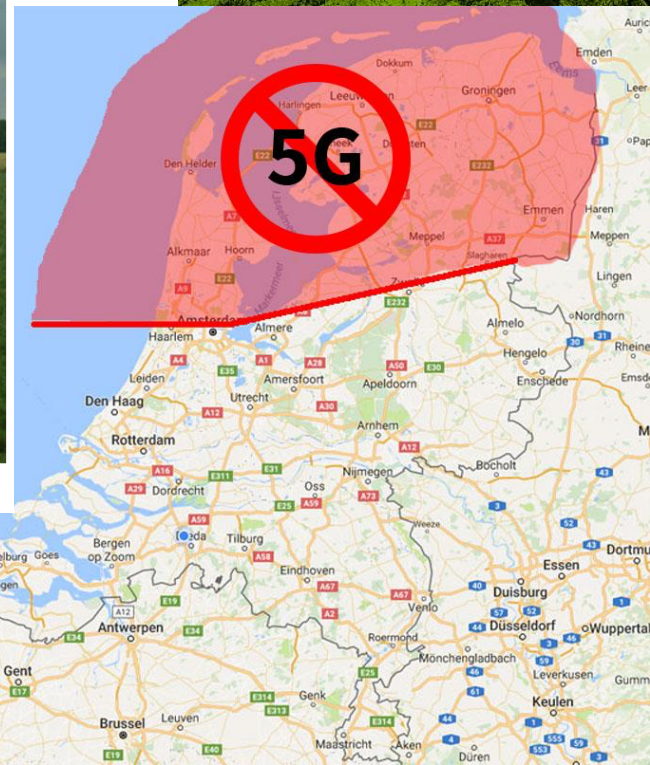
Nieuws

08 februari 2018 - Ron Smeets

**Staatsveiligheid zit 5G uitrol in de weg**  
**Providers vrezen een achterstand voor Nederland**

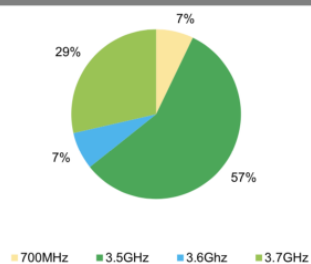
In 2020 moet het eerste commerciële 5G netwerk een feit zijn. Het is de bedoeling dat in en rond de Amsterdam Arena, een van de speelsteden van Euro 2020, een 5G netwerk actief is. De kans dat dat gebeurt wordt echter steeds kleiner vanwege enkele afuisterschotels in het Friese Burum. De providers, en KPN in het bijzonder, luiden nu de noodklok en vrezen dat Nederland een achterstand zal oplopen als deze kwestie niet snel opgelost wordt. Wat is het geval?

Ook interessant



# FREQUENCIES USED

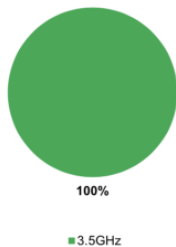
Total 5G launches by band in Europe



Source: IHS Markit

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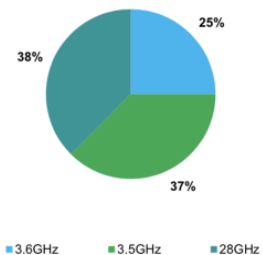
Total 5G launches by band in Middle East



Source: IHS Markit

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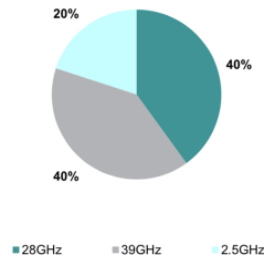
Total 5G launches by band in APAC



Source: IHS Markit

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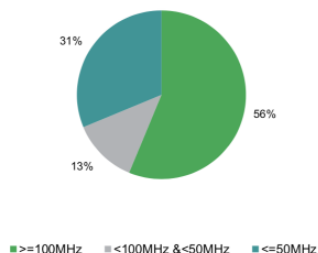
Total 5G launches by band in North America



Source: IHS Markit

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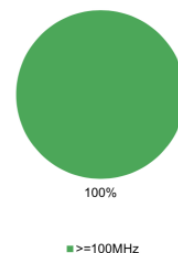
Total 5G launches by bandwidth in Europe



Source: IHS Markit

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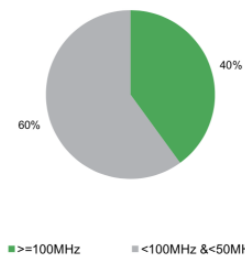
Total 5G launches by bandwidth in Middle East



Source: IHS Markit

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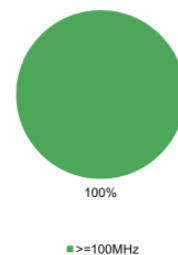
Total 5G launches by bandwidth in Asia Pacific



Source: IHS Markit

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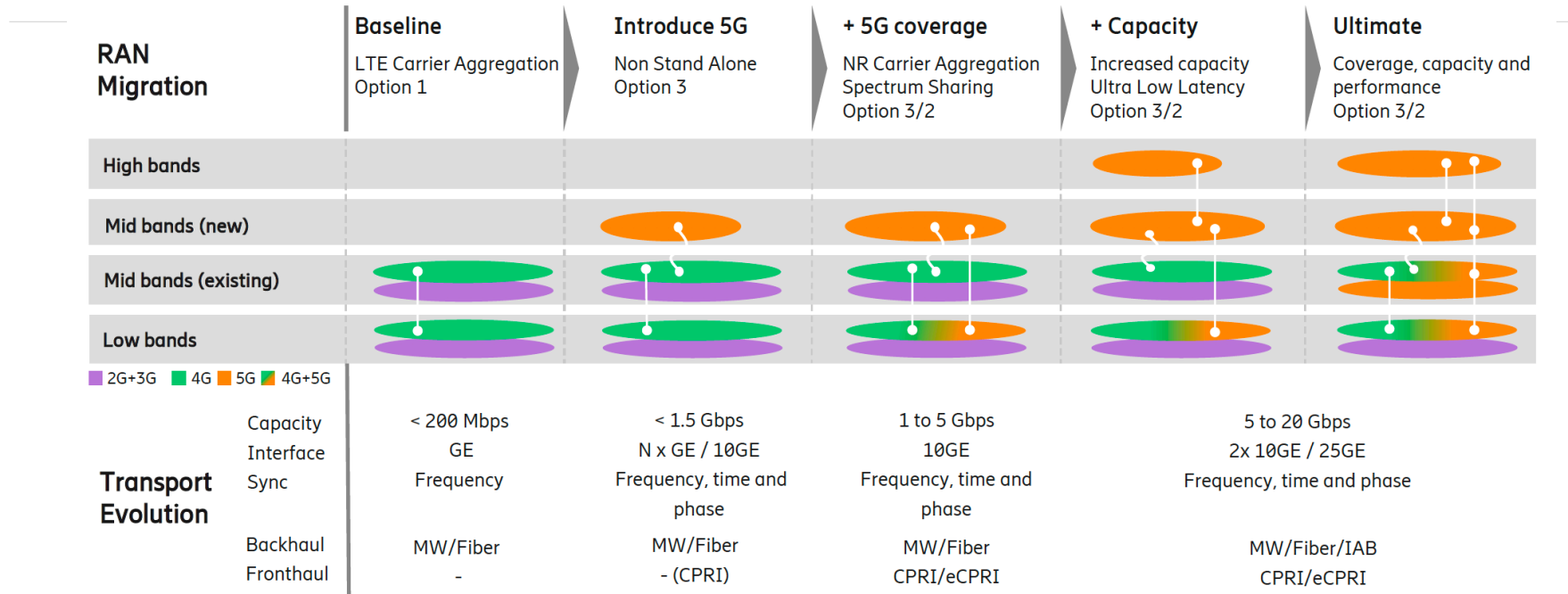
Total 5G launches by bandwidth in North America



Source: IHS Markit

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# 5G DEPLOYMENT SCENARIOS



5G deployments only increase spectral efficiency with ~20%, so more spectrum and denser site deployments are needed for capacity growth



# ENHANCED MOBILE BROADBAND

Initial growth on LTE/LTE-A before giving way to 5G

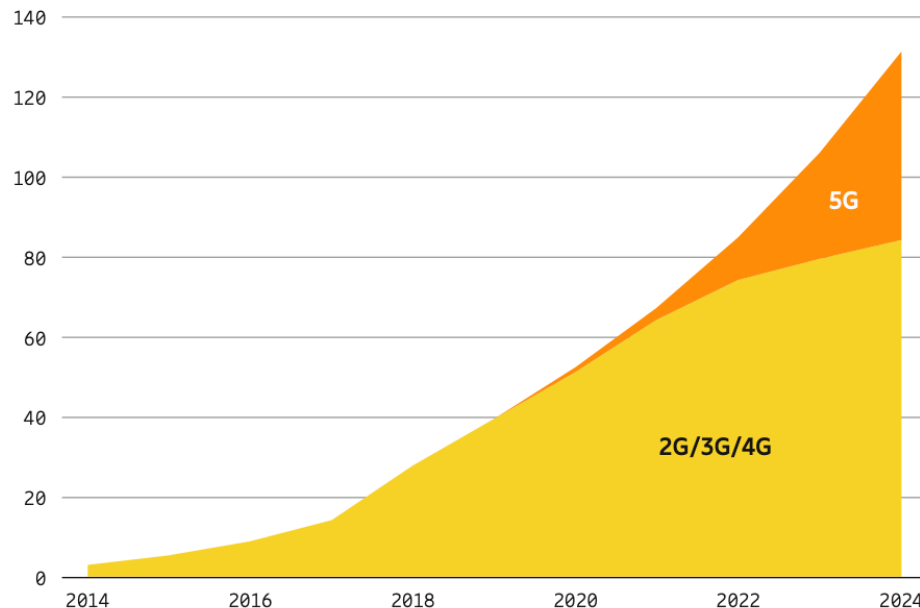
Mobile traffic is still growing rapidly:

- Growth from 28 EB/month in 2018 to 131 EB/month in 2024, 30% CAGR (4.7x)
- Total fixed data traffic grows only with 22% CAGR (3.3x).

5G starts to contribute in earnest to traffic volume by 2021-2022:

- Main growth on LTE/LTE-A until 2022, then this will start to saturate.
- Needs much more spectrum to be available and deployed (especially mid- and high-bands).
- Needs much denser site deployments to deal with worse propagation of high-bands.

Global mobile data traffic (EB per month)



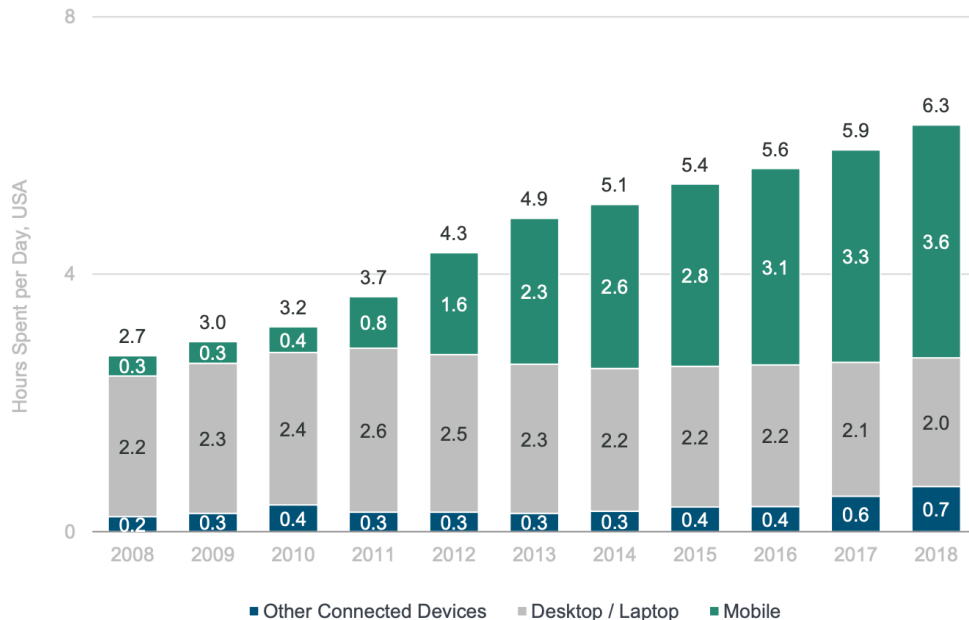
From: Ericsson Mobility Report, June 2019

# ENHANCED MOBILE BROADBAND

## What's driving the traffic growth?

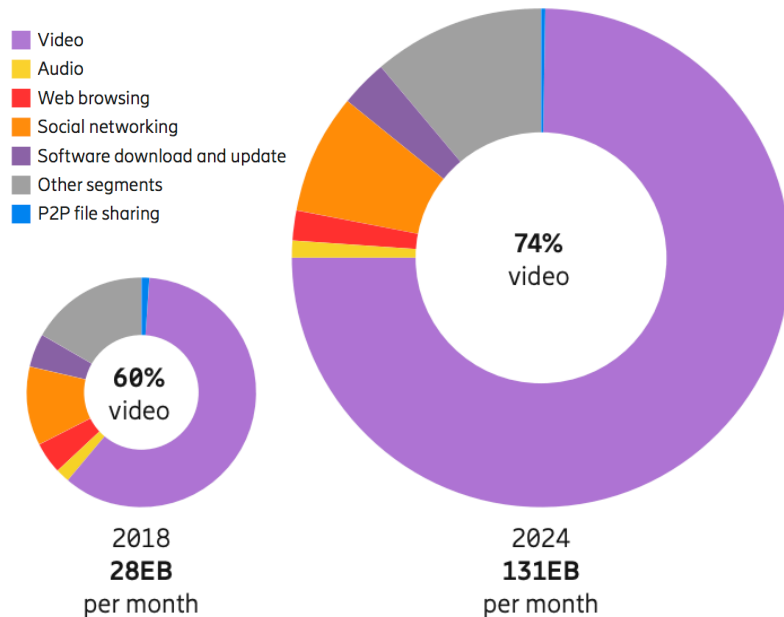
We're getting addicted to the small screen...

### Daily hours spend with digital media per adult user



watching ever more (and higher definition) video

### Mobile data traffic by application



From: Mary Meeker, Internet trends 2019, June 2019

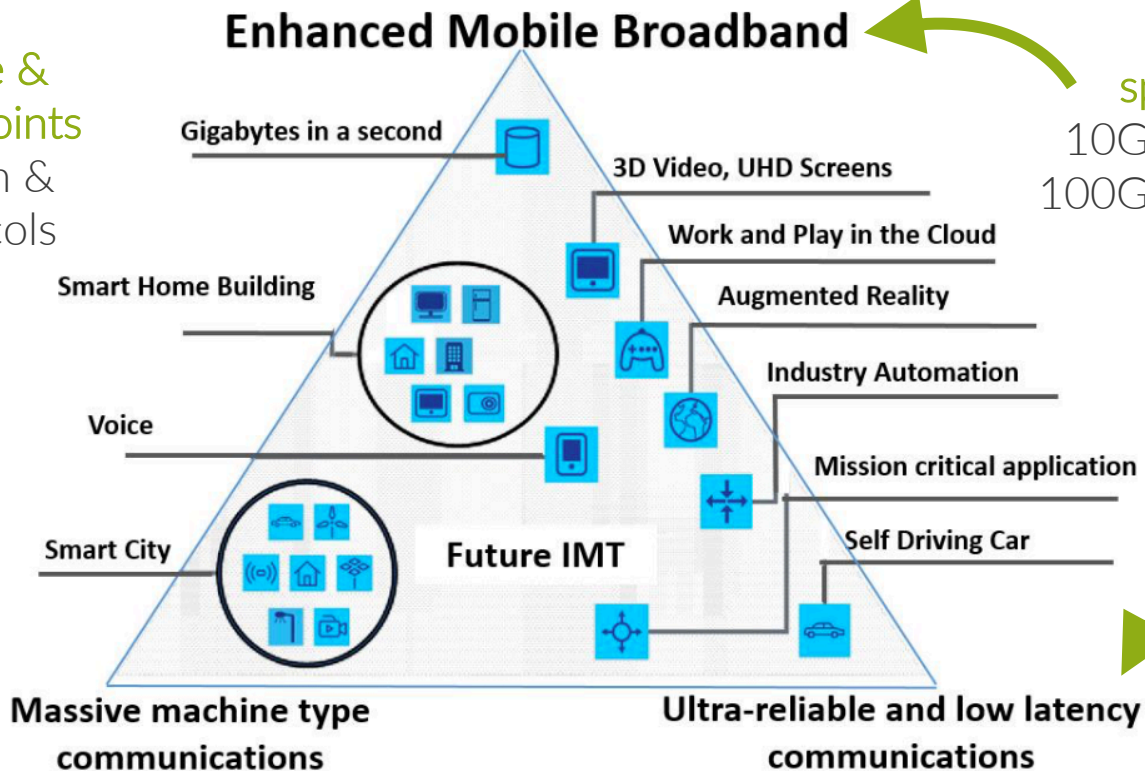
Adapted from: Ericsson Mobility Report, June 2019

# 5G USE CASES

More than just Enhanced Mobile Broadband

Large scale &  
many end-points

Automation &  
new protocols  
like SR



Ethernet port  
speed migration

10GE is the new 1GE  
100GE is the new 10GE

Timing and  
synchronization  
becomes very  
critical





MAKING INDUSTRY SMARTER: PORTS & SHIPPING

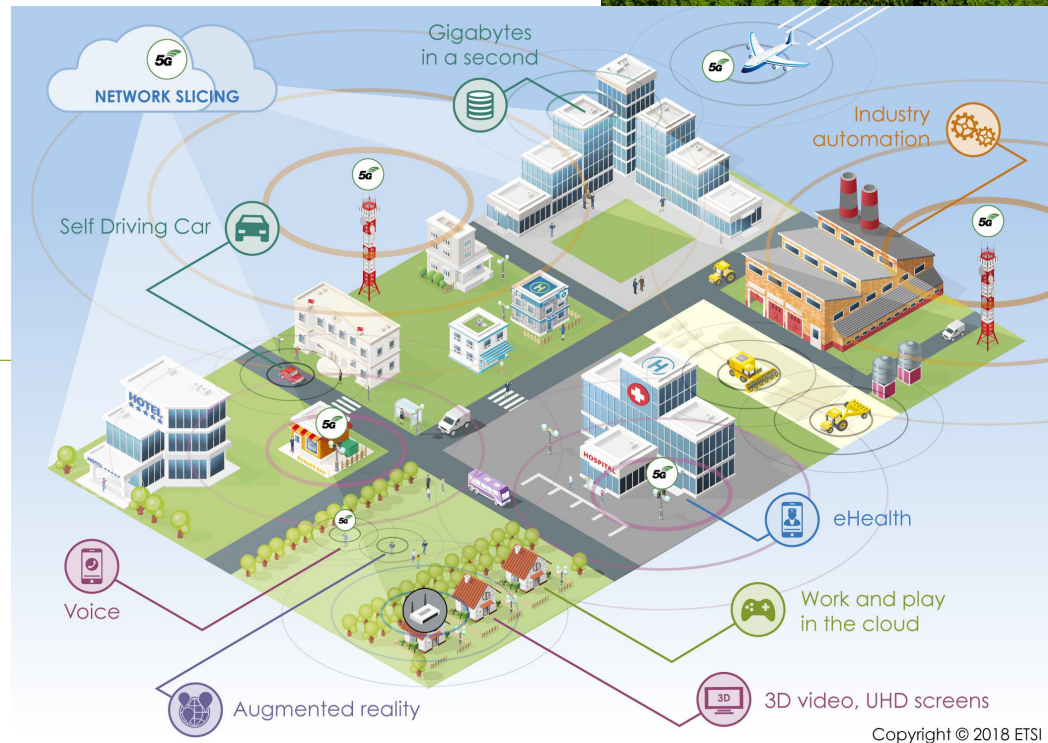
enterprise **iot**  
**insights**

JULY 2019

# SMART PORTS

*Automation and intelligence  
with private LTE/5G networks  
and public network slices*

by James Blackman Editor, Enterprise IoT Insights

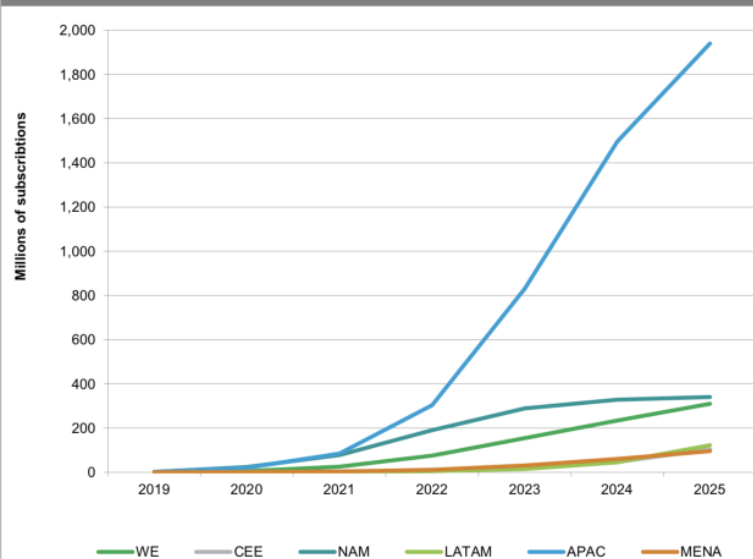


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juniper  
networks

# 5G BUSINESS CASE

5G regional subscriptions forecast 2019-2025

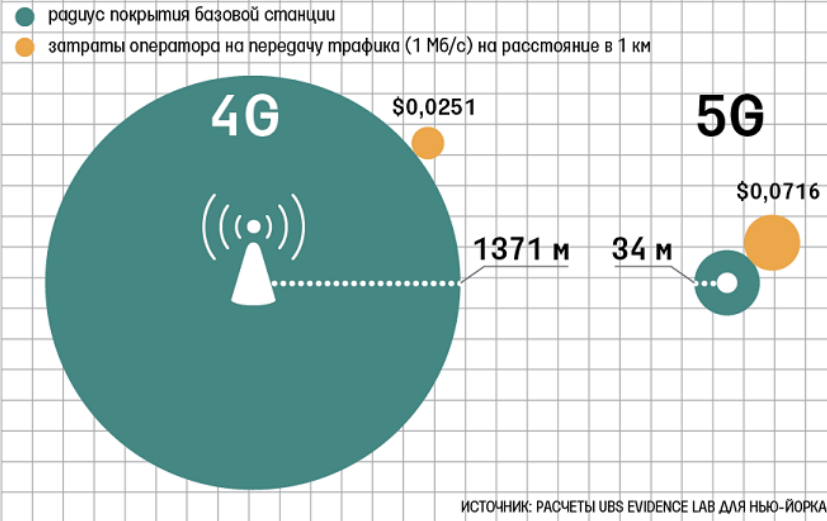


Source: IHS Markit

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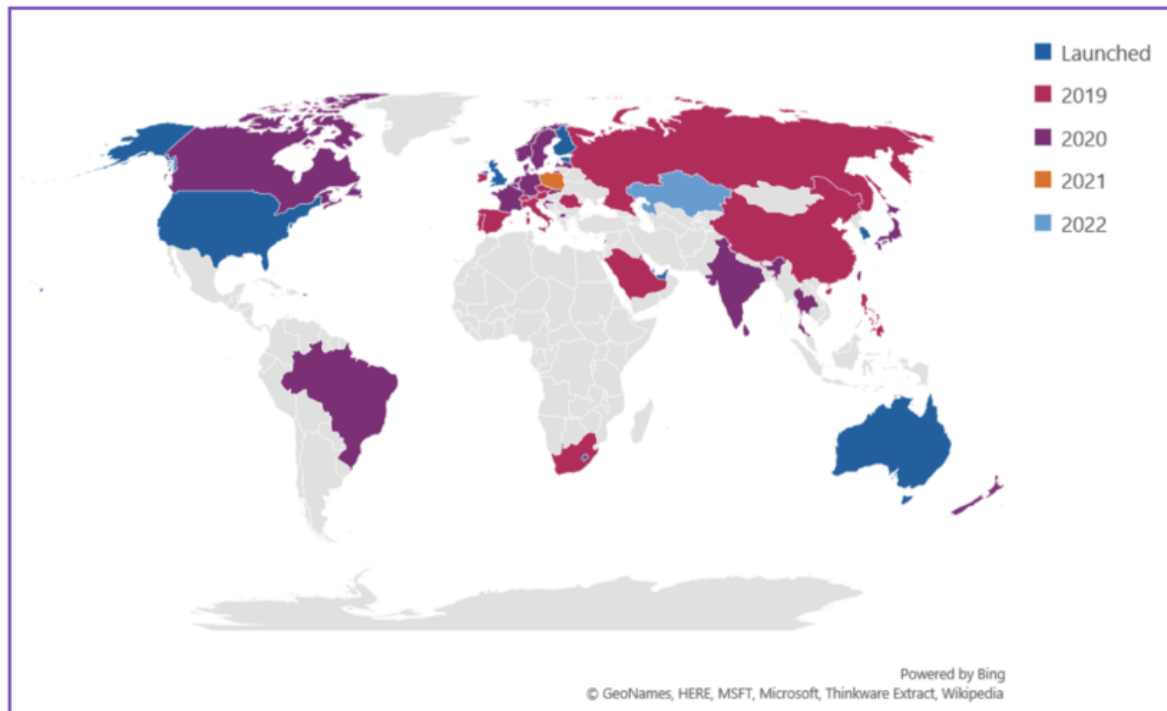
## Дорого и близко

СРАВНЕНИЕ СТАНДАРТОВ ЧЕТВЕРТОГО И ПЯТОГО ПОКОЛЕНИЙ



# 5G ROLLOUT ROADMAP

Figure 14: Earliest expected 5G commercial launch dates (includes mobile or FWA, includes limited availability launches)







QUESTIONS?

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NETWORKS

Engineering  
Simplicity



The background of the slide is composed of a central vertical green stripe and two grayscale fingerprint patterns on either side. The fingerprint patterns are detailed, showing ridges and valleys. The green stripe is a solid, vibrant green color.

# THANK YOU!

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NETWORKS

Engineering  
Simplicity