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The Norwegian Media Cluster

Empowering Stories

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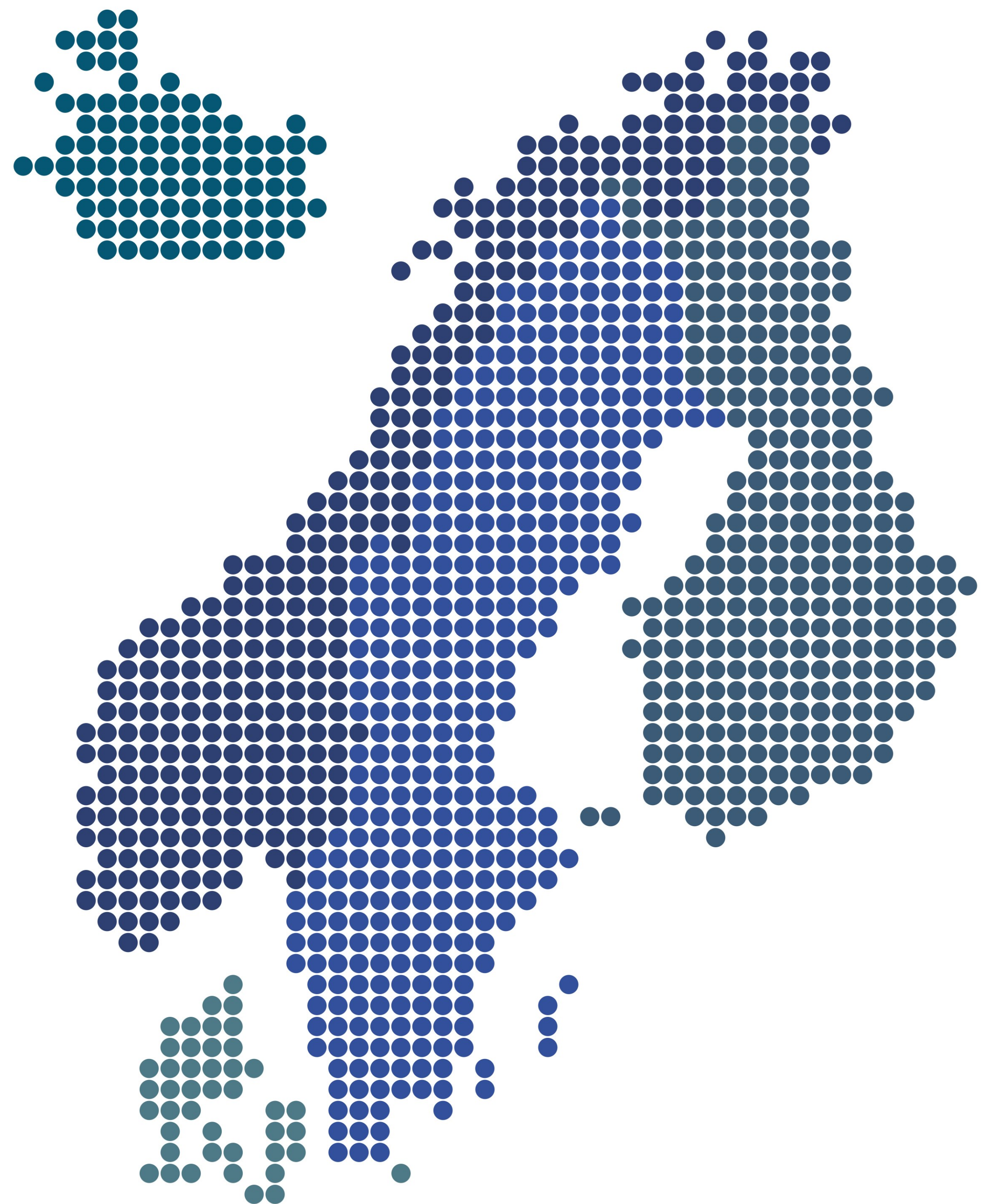


Norwegian Centres of Expertise

NCE Media

Nordic 5G Consortium

Facilitate development and commercialization of 5G services for content production and drive 5G innovation across the Nordic Countries



The Vision

A leading international environment for innovation and knowledge in media and media technology.

Uncertainty is an uncomfortable position. But certainty is an absurd one.



Voltaire 1694-1778



Nicholas Negroponte (1995) used a metaphor of shifting from processing atoms to processing bits.

«The problem is simple. When information is embodied in atoms, there is a need for all sorts of industrial-age means and huge corporations for delivery.

But suddenly, when the focus shifts to bits, the traditional big guys are no longer needed. Do-it-yourself publishing on the Internet makes sense. It does not for a paper copy.»

25 years later – we will have an infrastructure for media, and everything else, that will automate and disrupt.

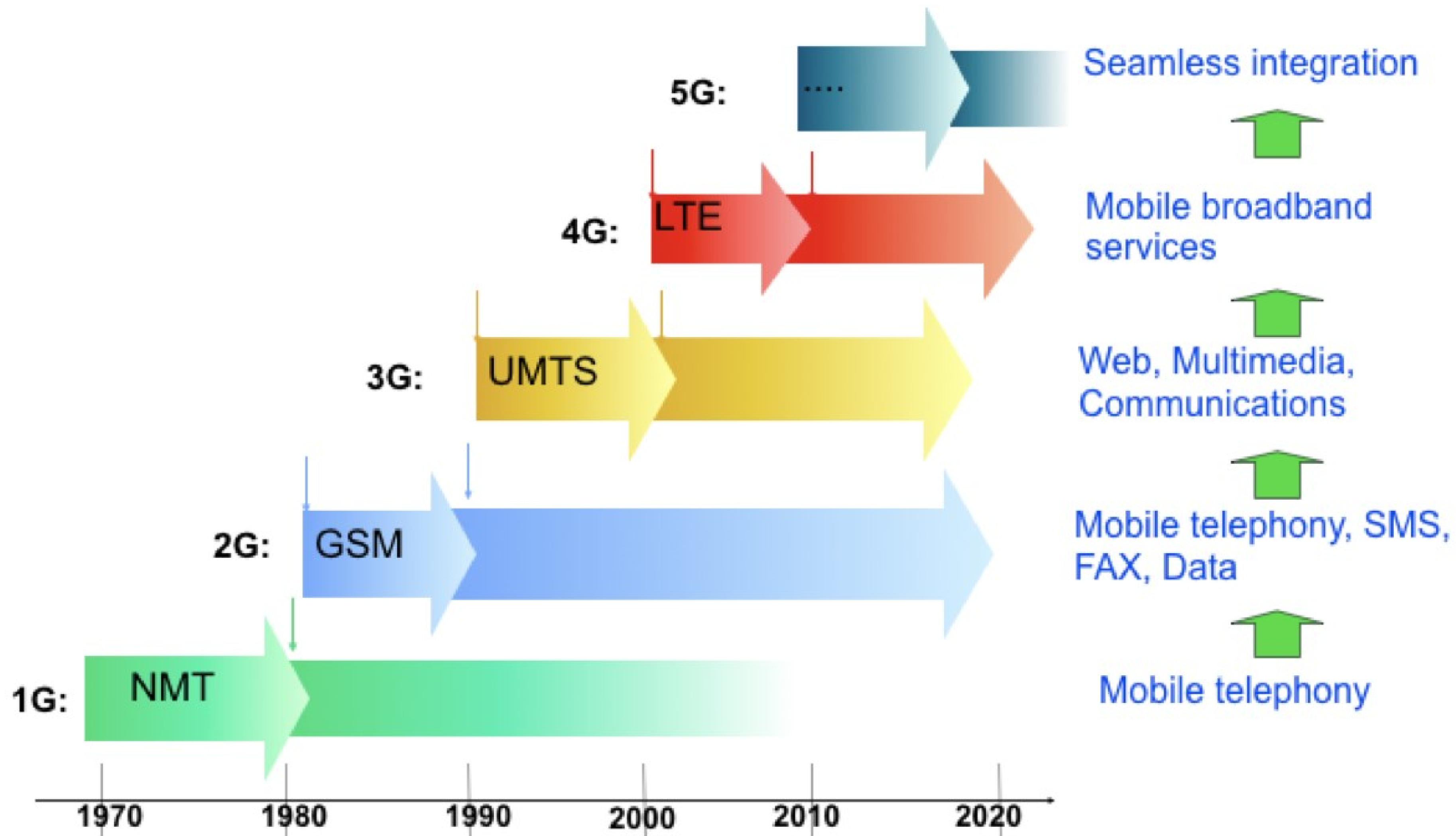
SONNR



NORDIC 5G CONSORTIUM

**What we will
cover today:**

- Tech
- AI
- Chances
- Trends



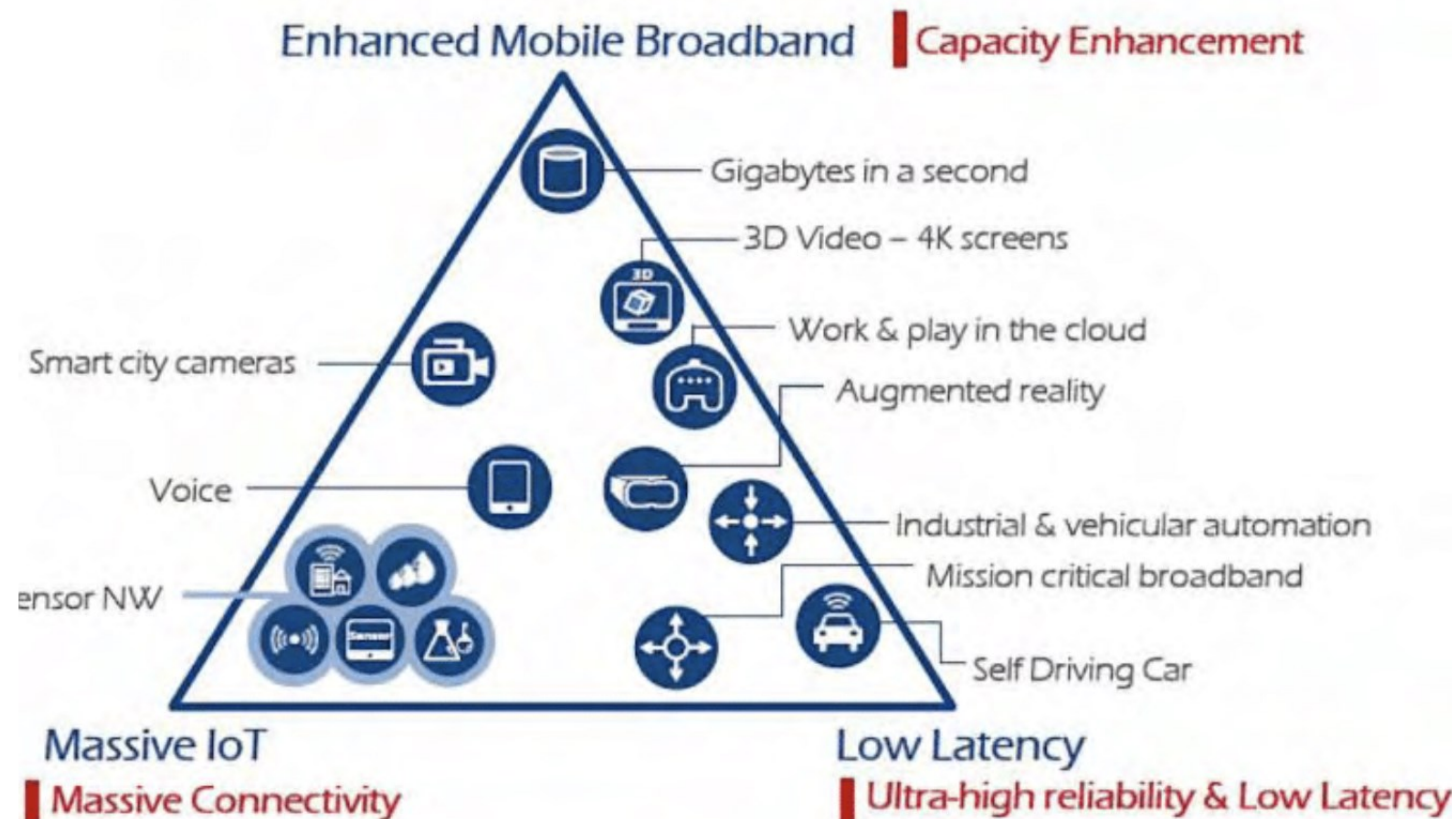
5G
 Standing on
 the
 shoulders
 of
 evolution.
 But what is
 different?

Figure 3. From 1G to 5G mobile network development



5G – THE 8 PROMISES

1. Speed 10 Gb «by design»
2. Latency down to 1 mS
3. One million units per Km²
4. Energyefficient and frequency efficiency thru MIMO.
5. SDN (software defined - core network) converging network with AI.
6. Uptime 99.999%
7. Core net speed 10Tb pr Km².
8. 500 Km/t vehicle speed.





Will 5G deliver?
Yes, - over
time!

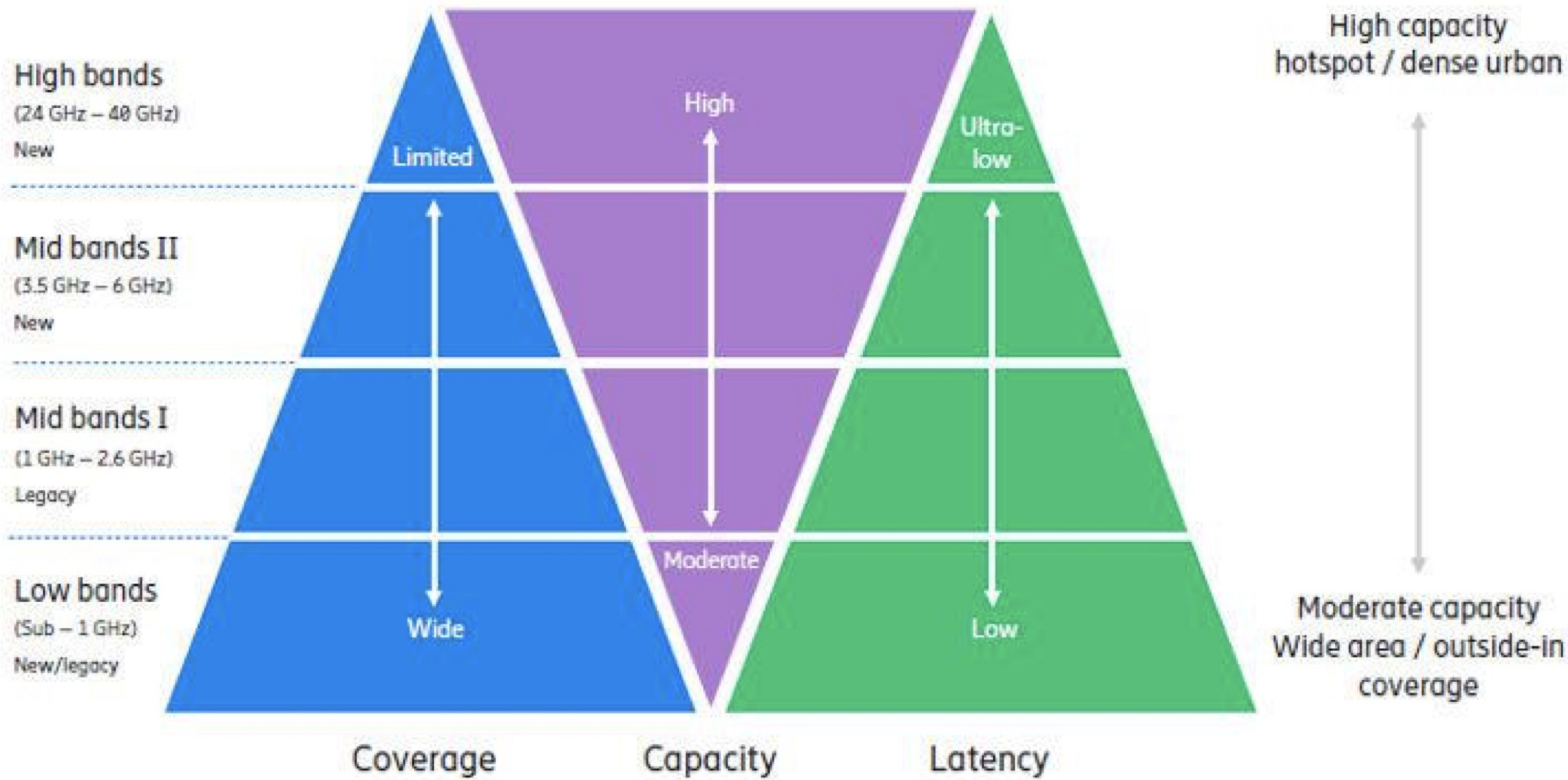
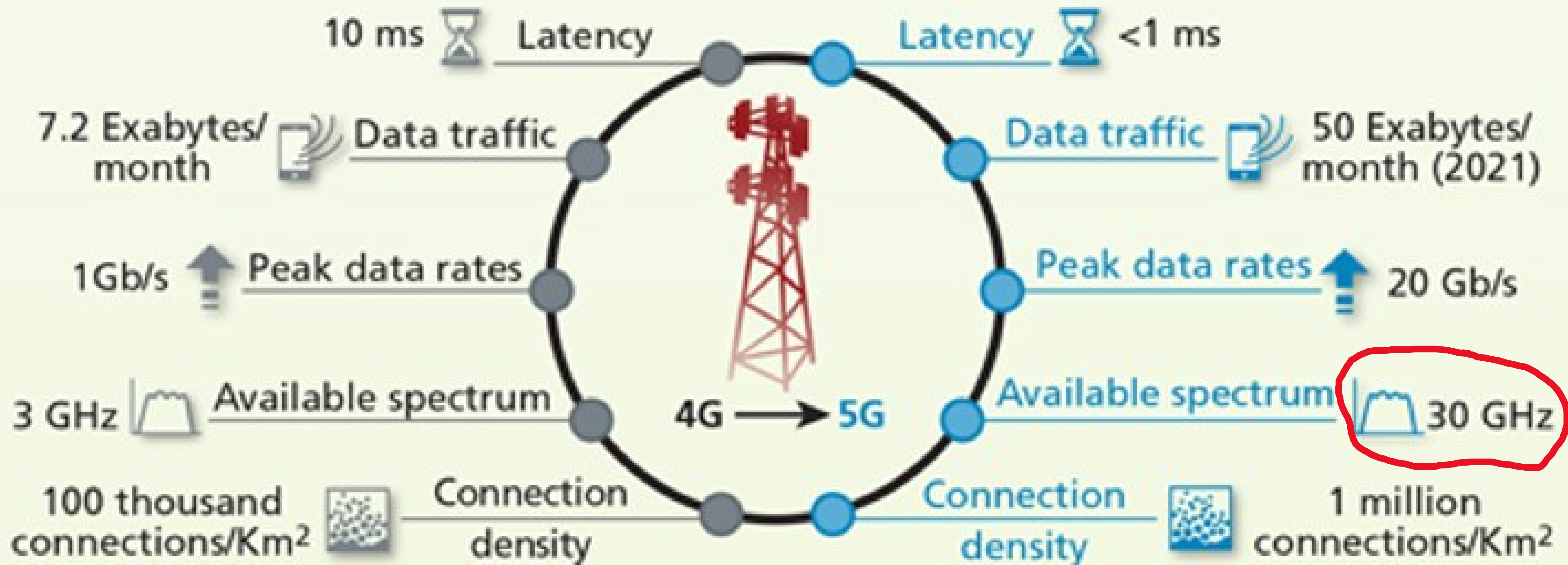
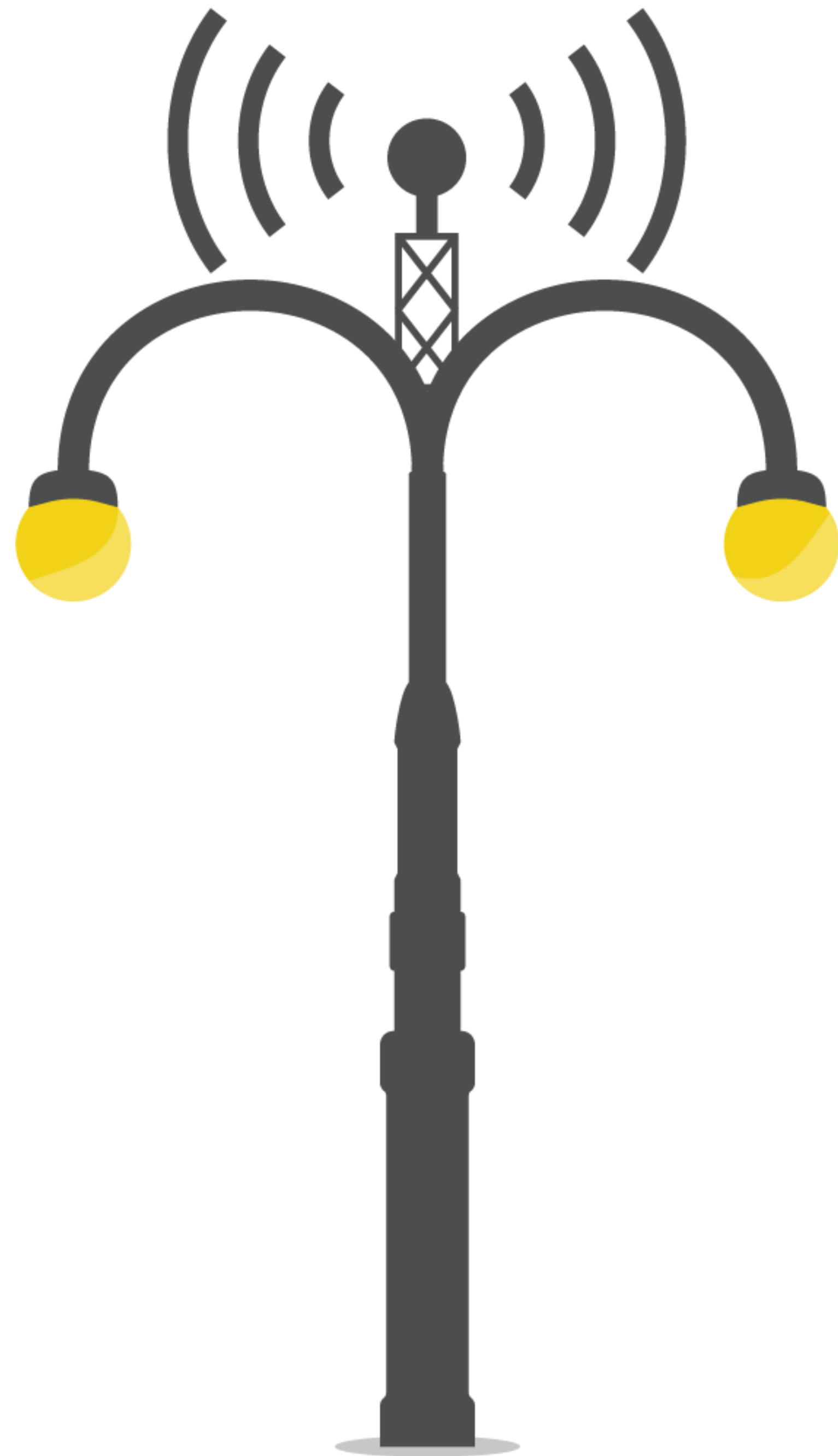


Figure 1: Spectrum trade-off [14]

4G vs 5G - note frequency spectrum.

Comparing 4G and 5G





WHAT MAKES 5G faster?

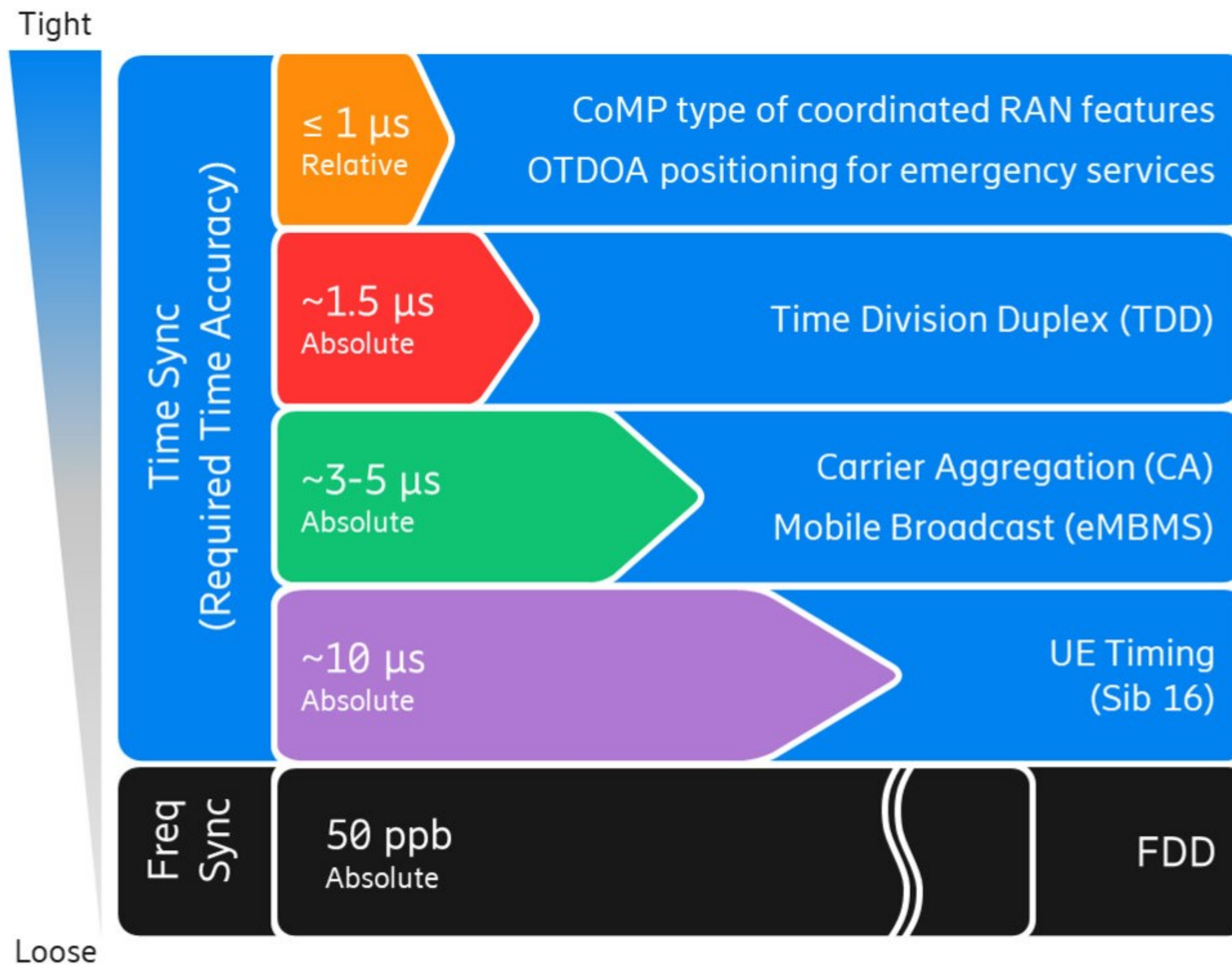
More frequency spectrum – and over time more base stations

Max speed will however only be on mm bands, well above 7 GHz.

NOTE! FR1 now 410 MHz to 7.125 GHz and FR2 24.250 to 52.699 GHz

Due to massive MIMO it will also utilize spectrum better.

- 2100 and 700 MHz already auctioned
- 738-758 MHz (700 MHz SDL (supplementary downlink))
- 1427-1518 MHz (1500 MHz SDL)
- 2300-2400 MHz (2.3 GHz)
- 2500-2690 MHz (2.6 GHz)
- 3400-3800 MHz (3.6 GHz)
- Unlicensed spectrum 5.925 – 6.425 GHz (US 7.125) < Competing with WiFi6E
- 24250-27500 MHz (26 GHz)

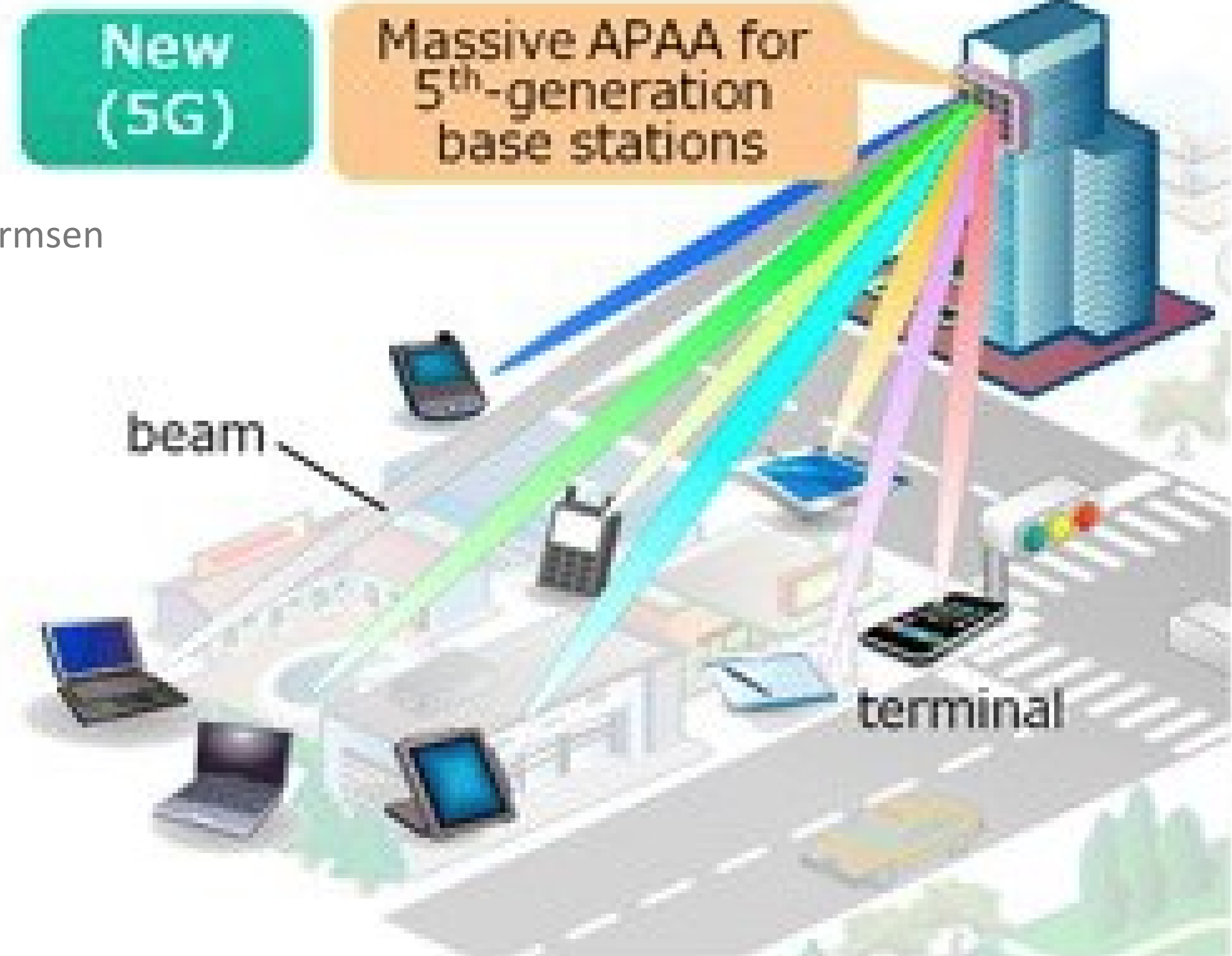
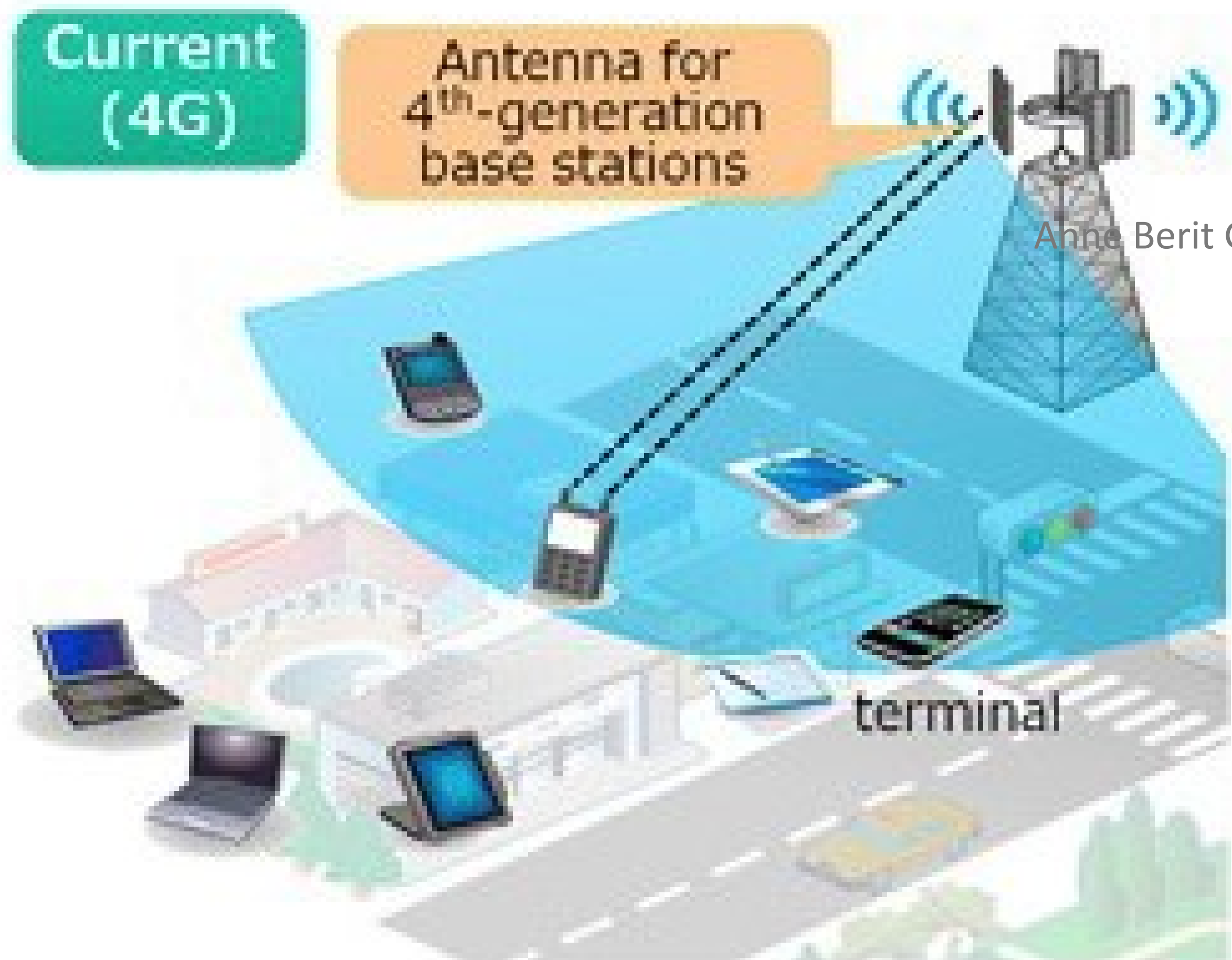


Synchronization requirements of RAN features

Vastly improved timing enables more services.

More on that later...

Massive MIMO (multiple in multiple out)



Anne Berit Guttormsen

Rakuten's CTO: We cut out the middlemen to build 5G



By Ray Le Maistre

Aug 25, 2020



Related Topics

[5G](#), [Analysis & Opinion](#), [Asia-Pacific](#), [News](#), [Open Networking](#), [Qualcomm](#), [Radio Access Network](#), [Rakuten Mobile](#), [Telco & CSP](#), [Telecoms Vendors & OEMs](#)

More Like This

[5G](#)

- Rakuten sourced network tech direct from component vendors
- That approach has cut costs dramatically
- mmWave gear up to 60% cheaper than 'traditional' kit, claims Tareq Amin
- 5G launch set for late September, early October

Rakuten Mobile CTO Tareq Amin claims his team has built mmWave 5G radio access network infrastructure systems that cost 60% less than 'traditional' vendor gear by sourcing the required technology direct from the component

The costs of building 5G networks. Could it be done differently? Is it enough innovation?

Betalte totalt 4,6 milliarder dollar for 3,5 GHz

De fem som hadde de høyeste budene i 3,5 GHz-auksjonen i USA er: Verizon, Wetterhorn Wireless, Spectrum Wireless, XF Wireless Investment og Cox Communications. Selv om Verizon betaler 1,9 milliarder dollar, er operatøren ikke på lista over de fem som fikk mest frekvensressurser. Det skyldes at det er betalt mest for frekvenser i byer.

[Kilde: FCC](#)



Project Coordination Group (PCG)

3GPP = 3rd Generation Partnership Project

(3GPP) is an umbrella term for a number of standards organisations which develop protocols for mobile telecommunications.

TSG RAN Radio Access Network
RAN WG1 Radio Layer 1 spec
RAN WG2 Radio Layer 2 spec Radio Layer 3 RR spec
RAN WG3 Iub spec, Iur spec, Iu spec UTRAN O&M requirements (Radio CN Interfaces)
RAN WG4 Radio Performance Protocol aspects
RAN WG5 Mobile Terminal Conformance Testing
RAN WG6 GSM EDGE Radio Access Network

TSG CT Core Network & Terminals
CT WG1 MM/CC/SM (Iu) (end-to-end aspects)
CT WG3 Interworking with external networks
CT WG4 MAP/GTP/BCH/SS (protocols within the CN)
CT WG6 Smart Card Application Aspects

TSG SA Service & Systems Aspects
SA WG1 Services
SA WG2 Architecture
SA WG3 Security
SA WG4 Speech, audio, video, and multimedia Codecs
SA WG5 Telecom Management
SA WG6 Mission-Critical Applications

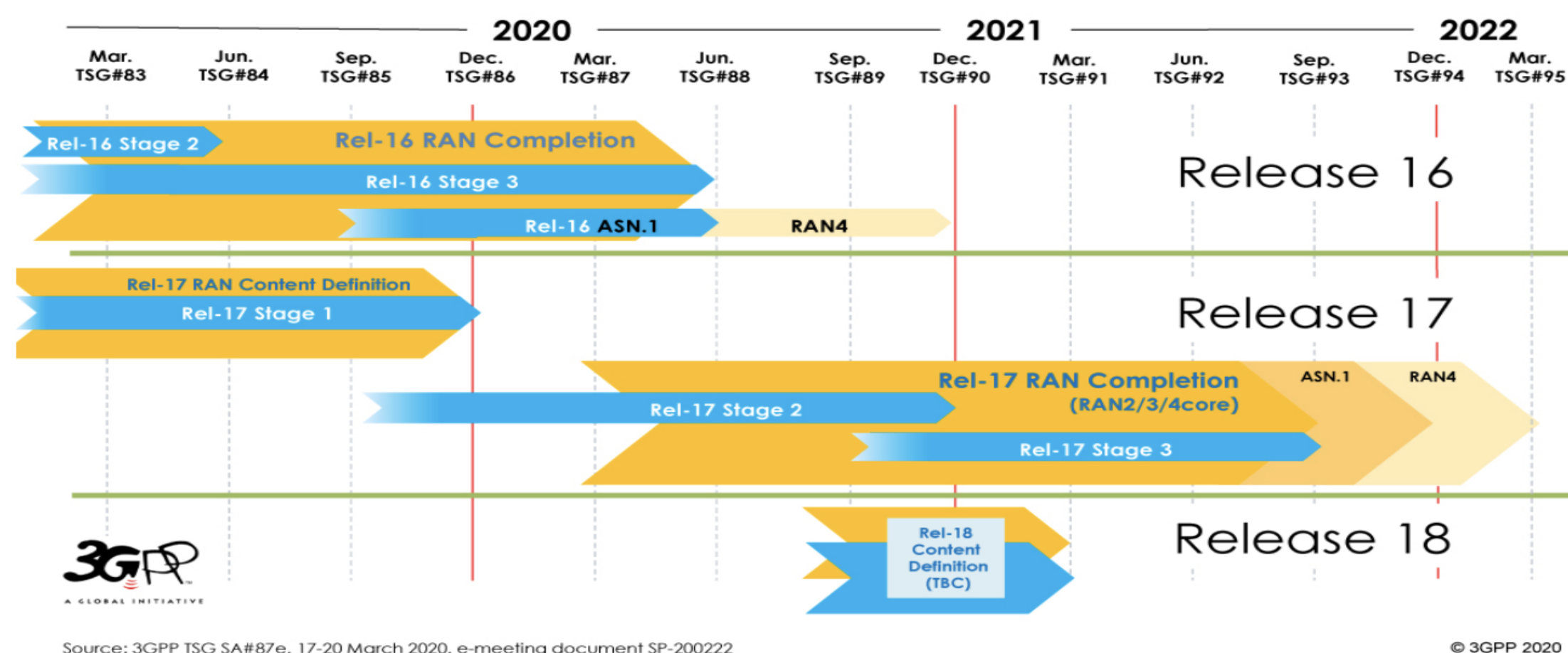
March 23, 2020

A shift of the Rel-16 timeline was approved at last week's TSG#87 plenary e-meetings.

- Rel-16 Stage 3 freeze now June 2020 (shifted by 3 months)
- Rel-16 ASN.1 and OpenAPI specification freeze will also be complete in June 2020 (stays as planned)

At the same meeting, a TSG and WG leadership proposal to shift the Rel-17 timeline by 3 months was also agreed:

- Rel-17 Stage 3 freeze September 2021
- Rel-17 ASN.1 and OpenAPI specification freeze: December 2021



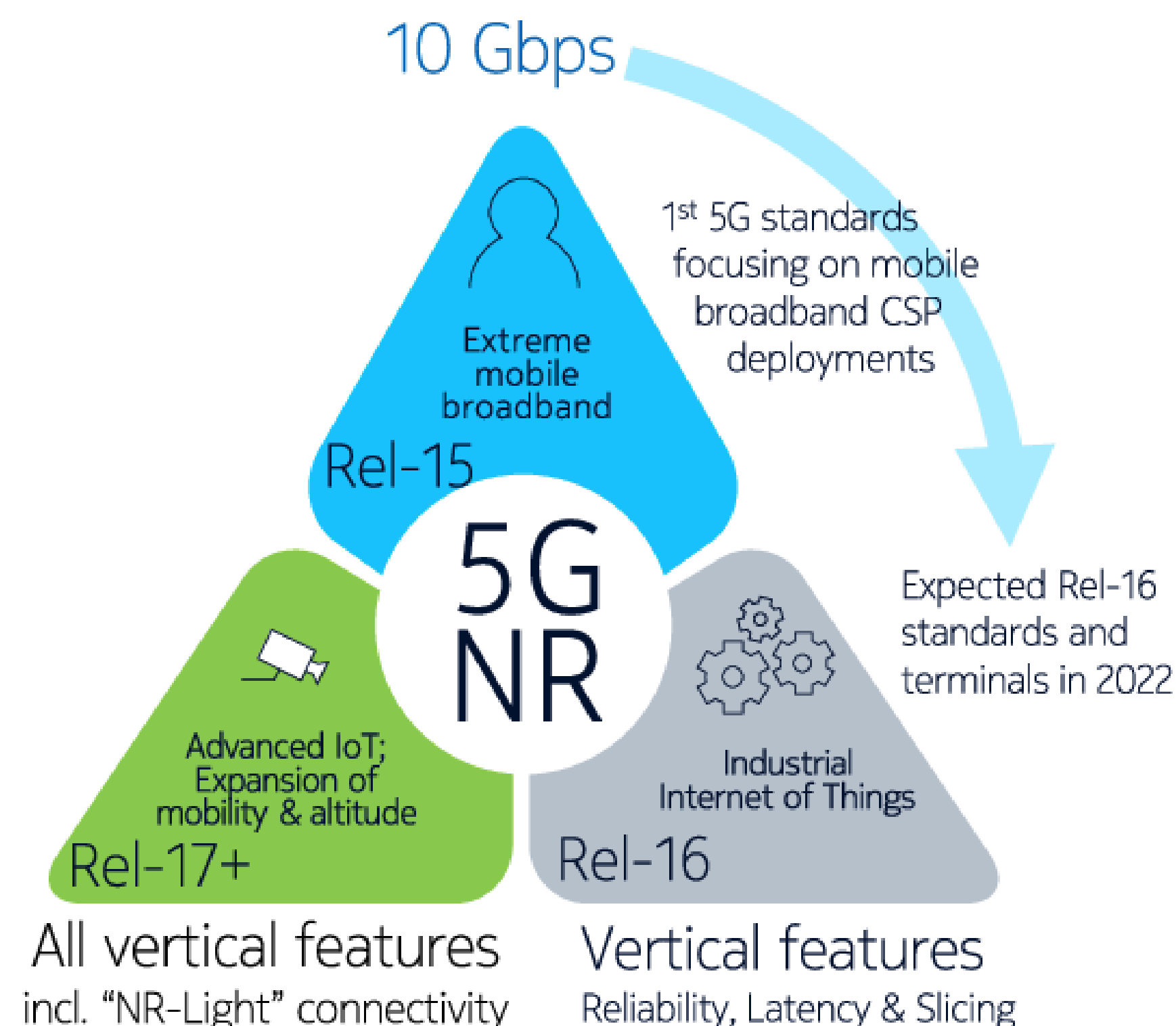
The table below, shows the most recent Releases only. The data is extracted from the 3GPP portal at <https://portal.3gpp.org/>, select the "Releases" tab, which shows all of the Release dates (since 1987). Please refer to the Portal page for the most up-to-date information.

Future dates are proposals, subject to change.

Release #	Status [Note 3]	Functional Freeze (Stage 3 complete)	End date (Protocols stable)
Release 17	Open	2021-09-17 (SA#93)	2021-12-17 (SA#94)
Release 16	Open	2020-06-19 (SA#88)	2020-06-19 (SA#88)
Release 15	Frozen	2019-03-22 (SA#83)	2019-06-07 (SA#84)
Release 14	Frozen	2017-03-10 (SA#75)	2017-06-09 (SA#76)

Functionality and new features comes with releases.

However, there is no guarantee that this means that this feature will ever become a success part of 5G.



Multicast for traditional broadcasting.

Approved and ready for coding...

Release 17

7

3GPP TR 23.757 V0.3.0 (2020-01)

1 Scope

This Technical Report studies and evaluates architectural enhancements to the 5G System to address the following objective.

Objective A: Enabling general MBS services over 5GS.

Support general multicast and broadcast communication services, e.g., transparent IPv4/IPv6 multicast delivery, IPTV, software delivery over wireless, group communications and IoT applications, V2X applications, public safety.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 23.501: "System architecture for the 5G System (5GS)".

[3] 3GPP TS 22.101: "Service aspects; Service principles".

[4] [3GPP TS 23.246: "Multimedia Broadcast/Multicast Service \(MBMS\); Architecture and functional description"](#).

[5] [3GPP TS 23.468: "Group Communication System Enablers for LTE \(GCSE_LTE\)"](#).

[6] [3GPP TS 26.348: "Northbound Application Programming Interface \(API\) for Multimedia Broadcast/Multicast Service \(MBMS\) at the xMB reference point"](#).

S2-2001537r1
slettet: s

S2-2001537r1
slettet: Objective B: Enabling TV/Radio specific services over 5GS.¶
Support broadcast communication services for TV Video and Radio Services in 5GS (including linear TV, Live, and radio services).¶



EBU REPORT CONCLUDES 5G CAN BE MADE TO WORK FOR MEDIA



The EBU has published a ground-breaking [report](#) on the potential of 5G to be used for the distribution of audiovisual media content and services to mobile devices. Current fastest mobile broadband connections lack the cost

WHAT DOES EBU SAY? EBU TR 054

Yes, 5G has support for broadcast standards, but will it ever be used?

What are the technical synergies with industry and other businesses?

More on that later...

RELEVANT LINKS

[EBU TR 054 – 5G for the Distribution of Audiovisual Media Content and Services](#)

JOIN OUR WEBINAR

[Webinar: 5G for the distribution of media content](#)

CONTACT US



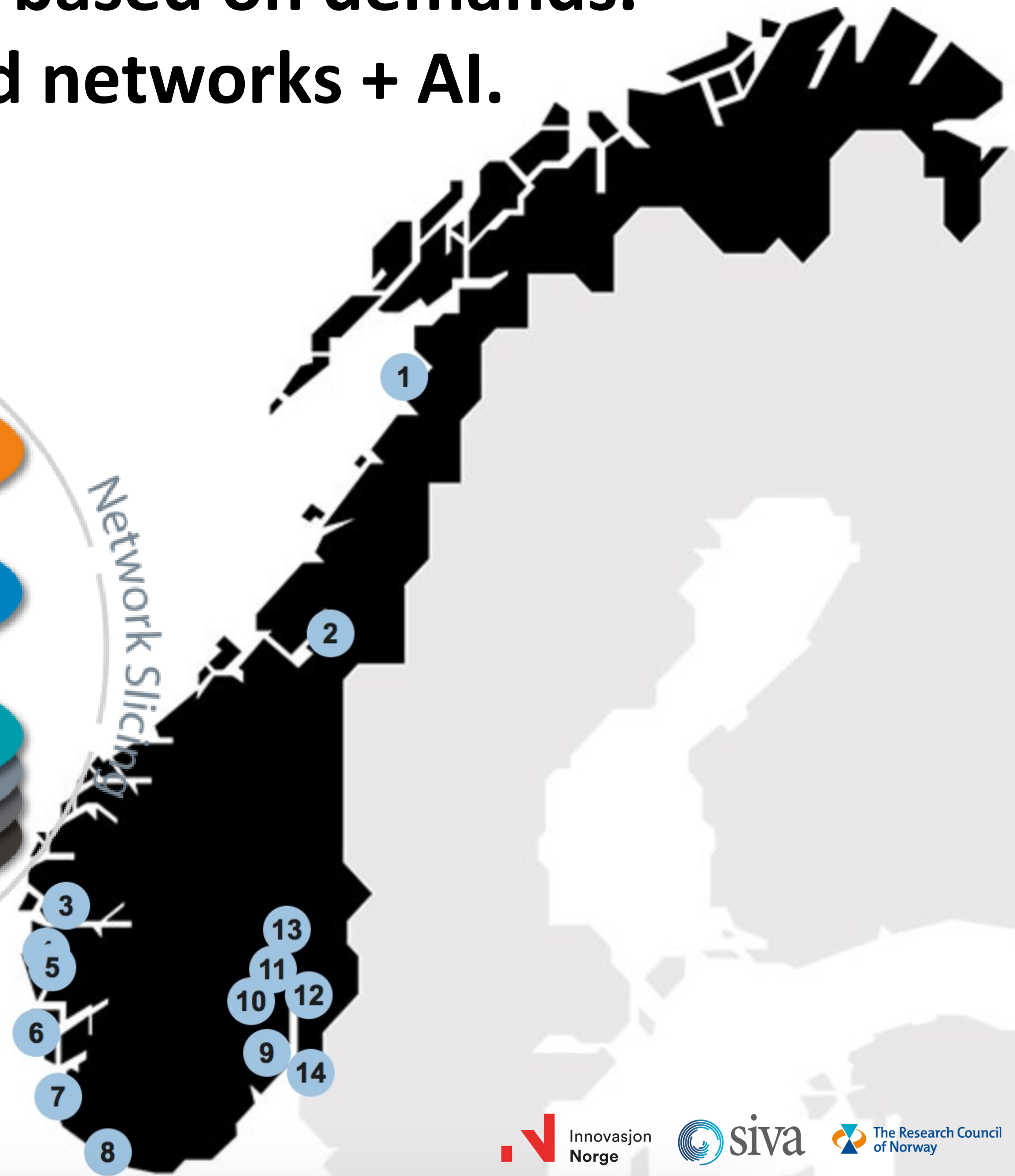
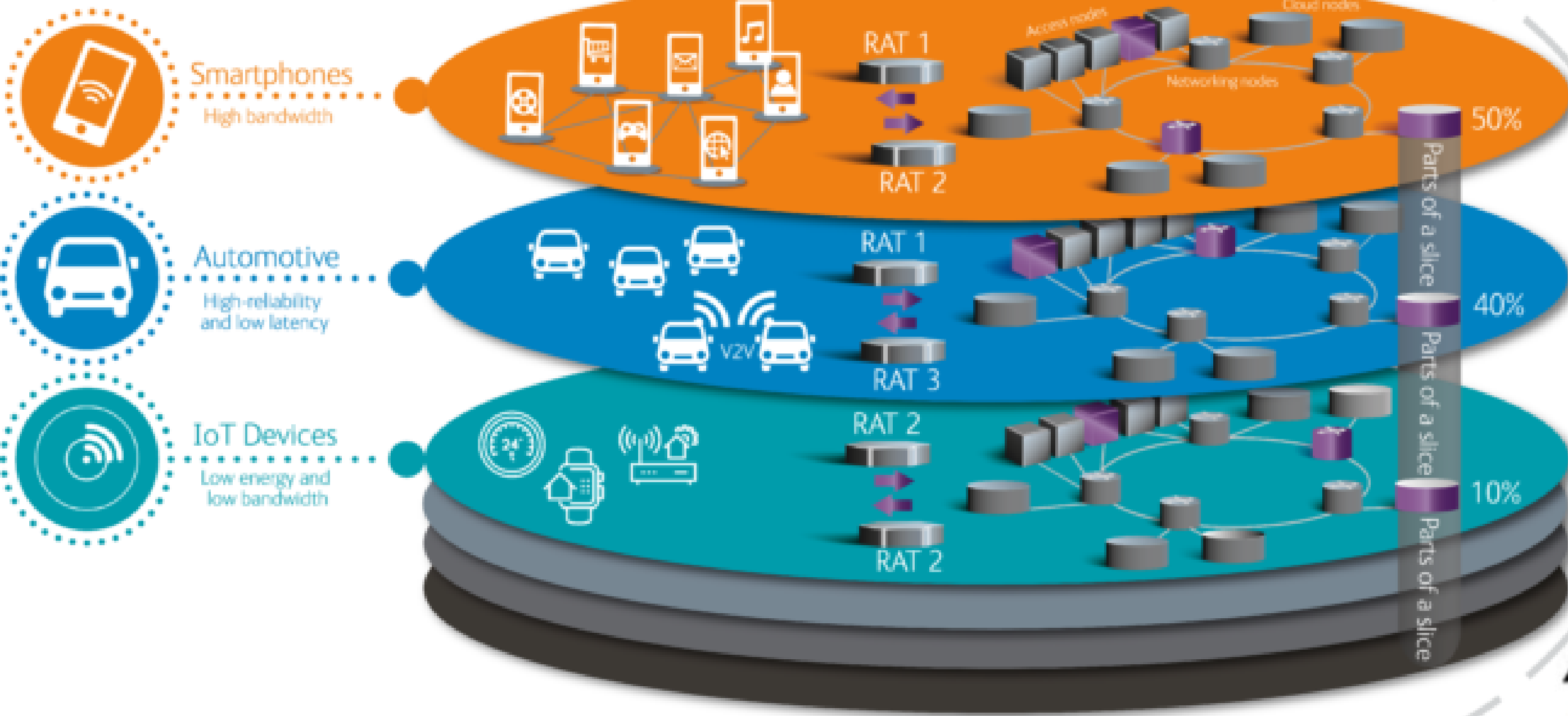
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Delivery & Services
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Network slicing – how split network based on demands.

The benefits of software defined networks + AI.



Demands and mapping for different business verticals.

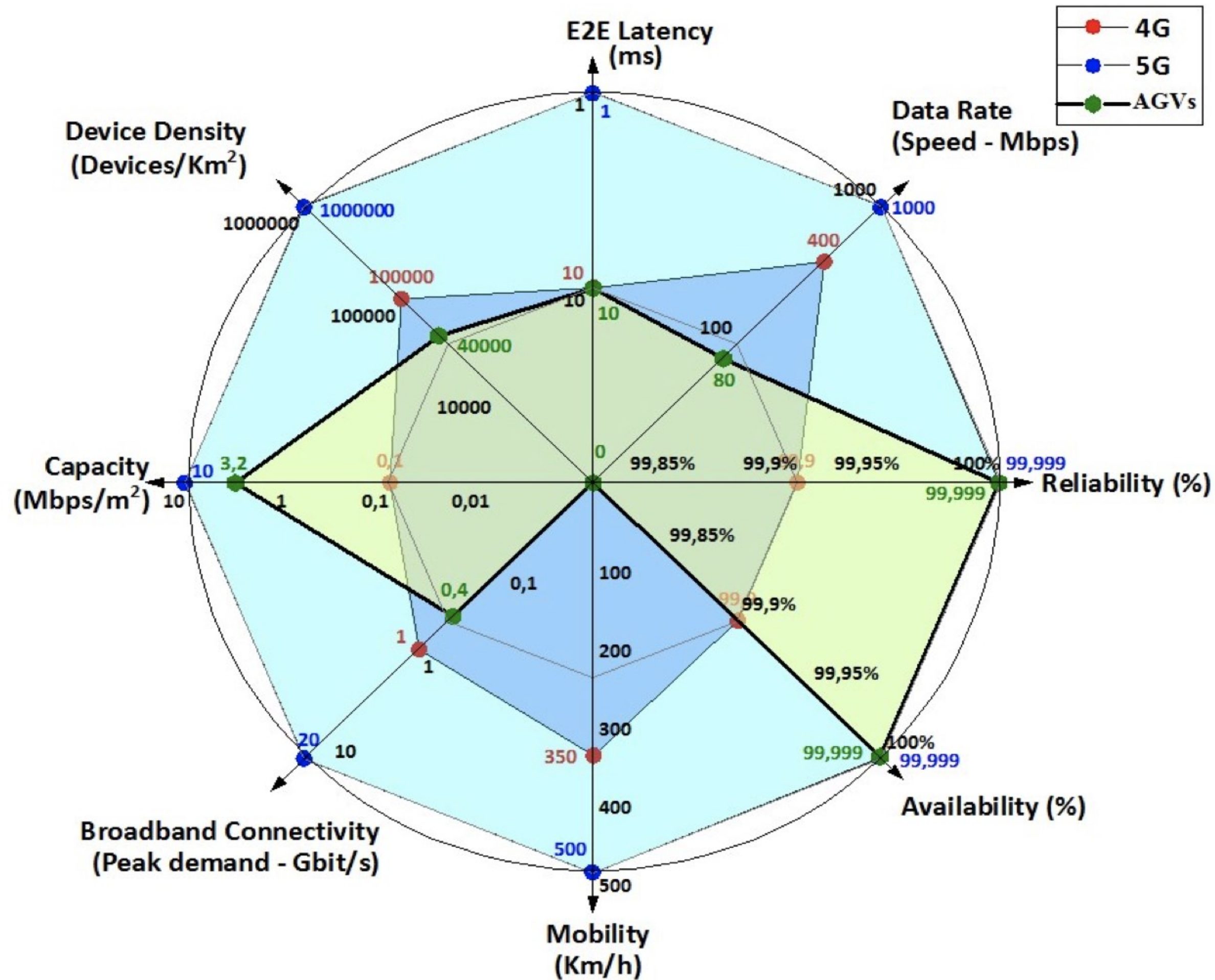


Figure 3: 4G/5G capabilities and AGV Use case - Autonomous guided vehicles in manufacturing environments.

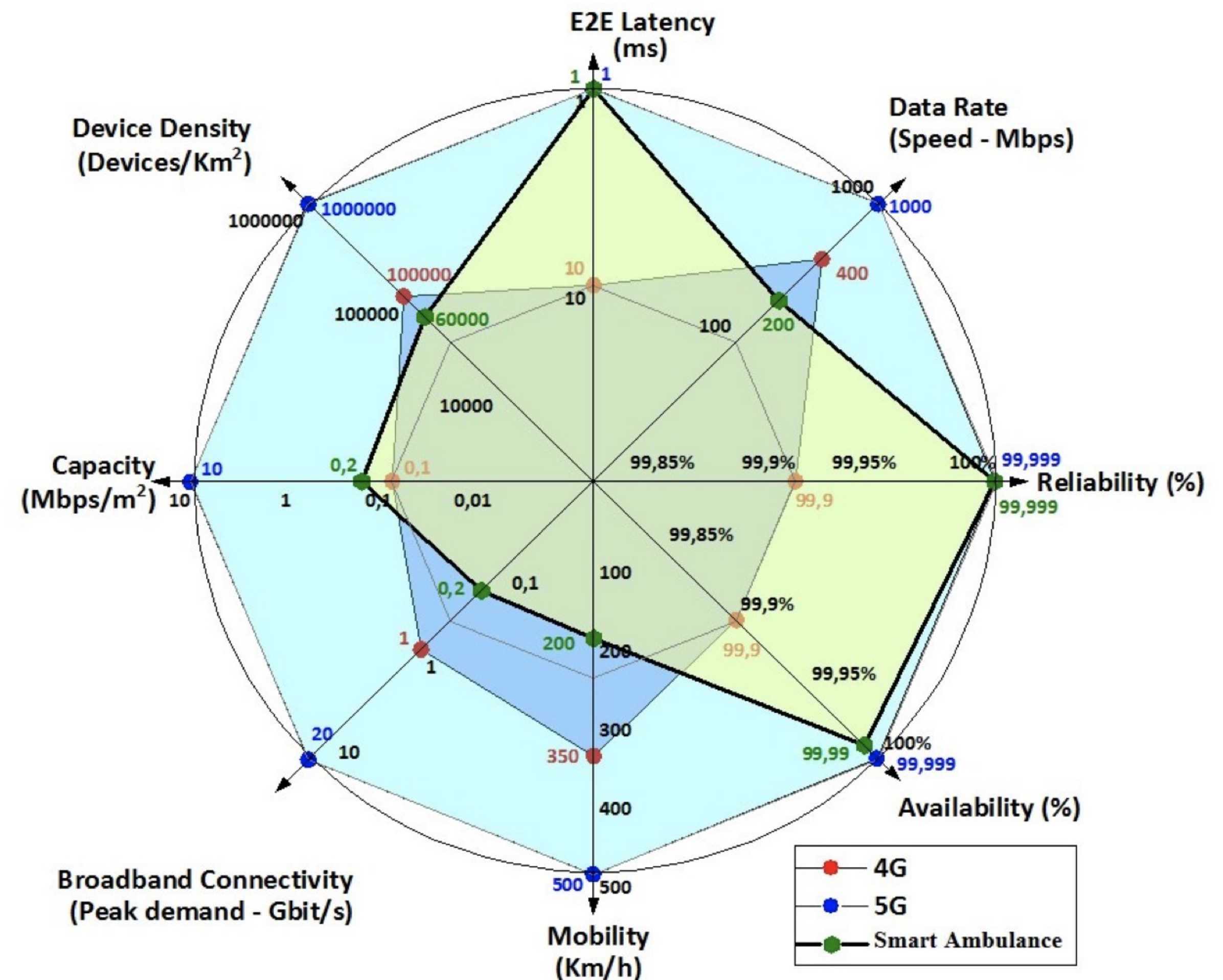
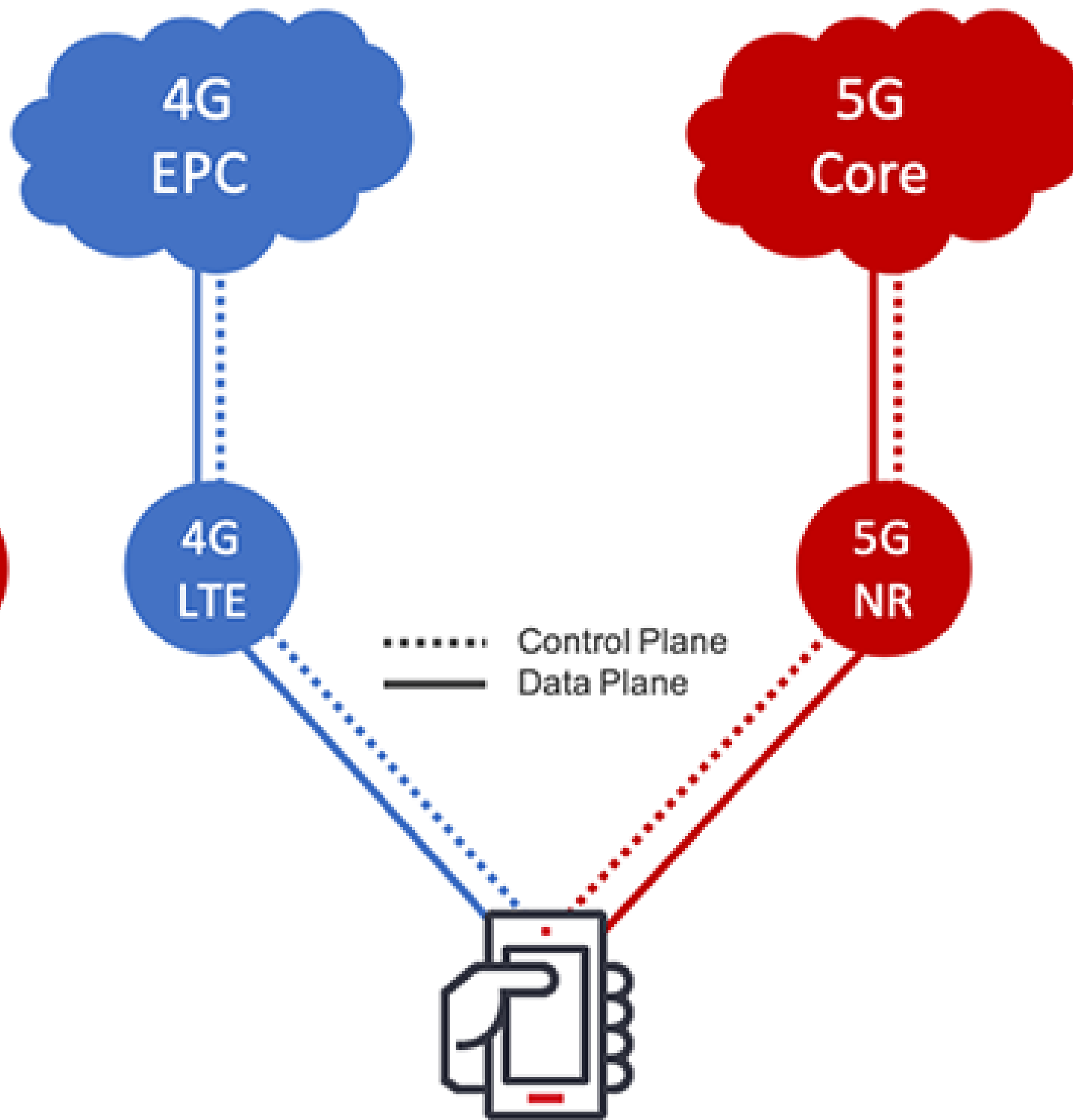
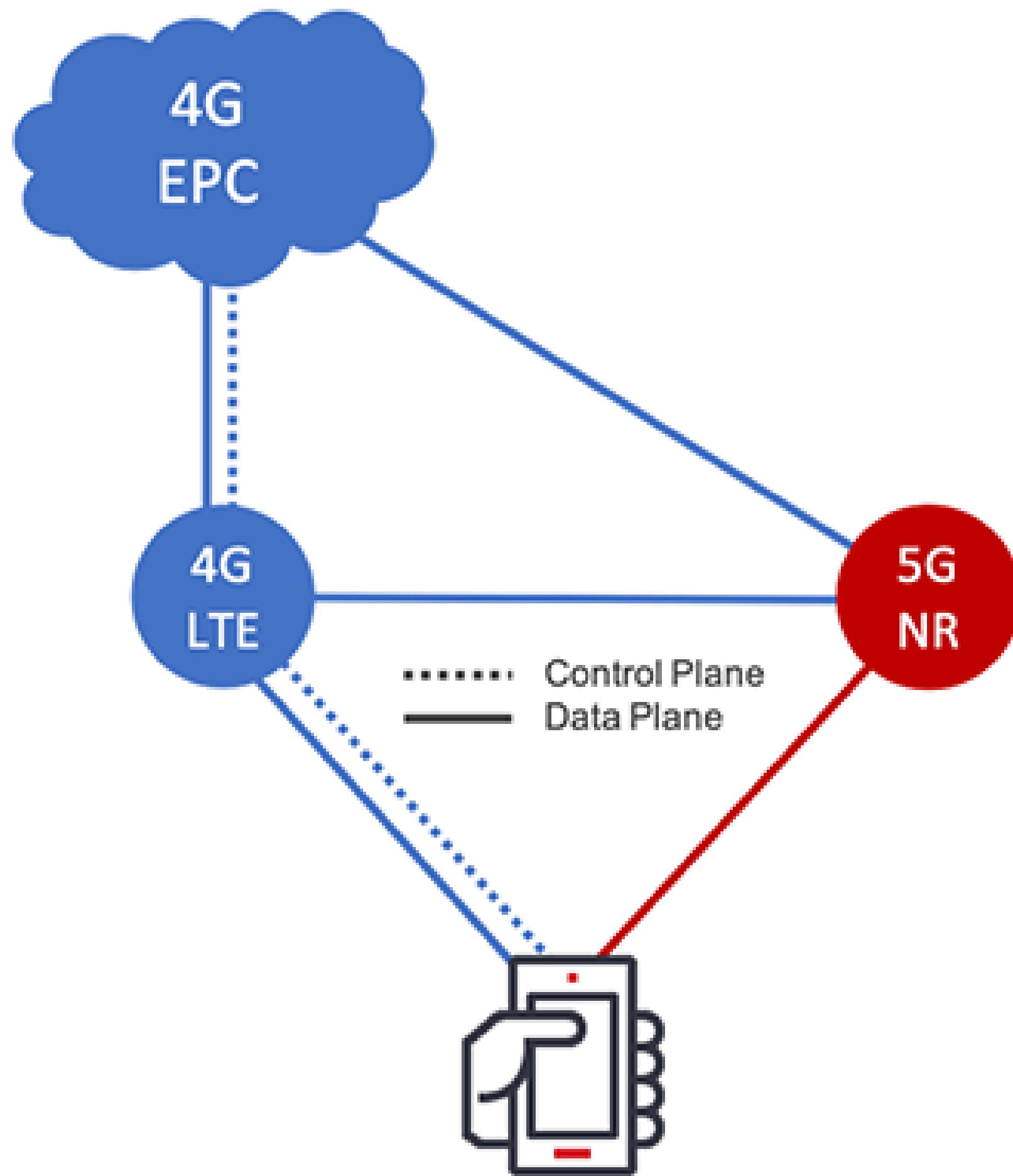


Figure 4: 4G/5G capabilities and Smart Ambulance Use case



SA (standalone 5G net)

vs

NSA (non standalone 5G – LTE core network)

LTE Missing slicing etc

When will 5G be SA 5G?

CHANGE

As a mediacompany... Are we able to adapt and see the opportunities?



Kieran Kunhya • 1st
Founder and CEO at Open Broadcast Systems

1w ...

Clever people at SpaceX, not trying re-enact the past like some people in the broadcast industry.

👍 · 5 Likes | 💬



Add a reply...



Anthony Kuzub • 2nd
Chair at Audio Engineering Society, Toronto Section
1w · 🌐

Software defined... not hardware limited. Wow



👍 129 · 12 Comments

👍 Like 💬 Comment ➦ Share

Most Relevant ▾



FROM HERE TO THERE?





What about the
5G **technology** by
itself?

Industry 4.0



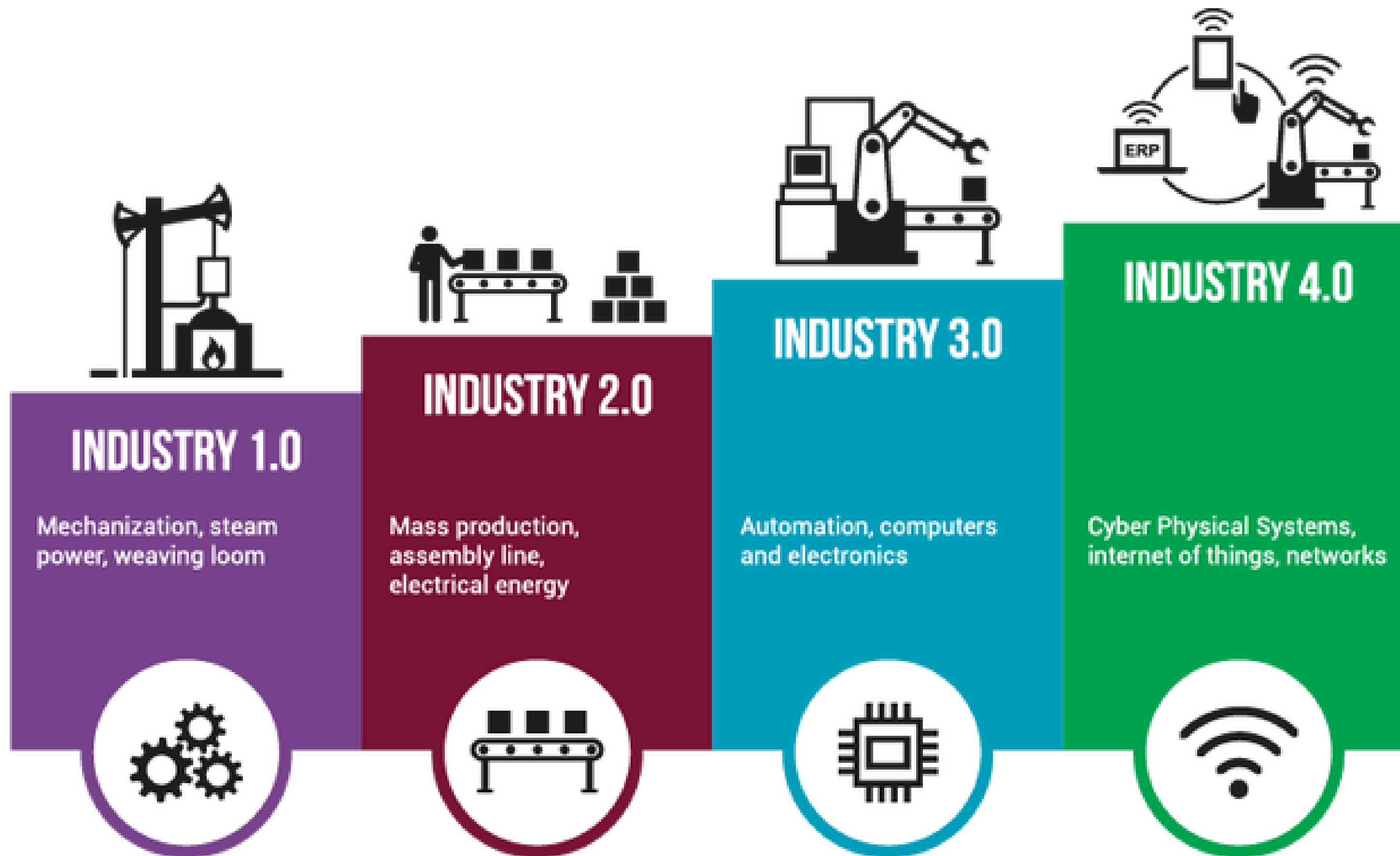
Why is Germany
ahead on 5G ?
and does it matter ?

A photograph of an industrial factory environment. In the foreground, a large orange robotic arm is positioned over a white tray containing several black cylindrical components. The background shows a complex assembly line with various mechanical parts and safety railings. The lighting is bright and industrial.

Are we totally behind
in Denmark ?

Grundfos first in Denmark
5G in live production, [Link](#)

CHALLENGE FOR GERMAN INDUSTRY IS EXACTLY THE SAME AS IN BROADCAST INDUSTRY.



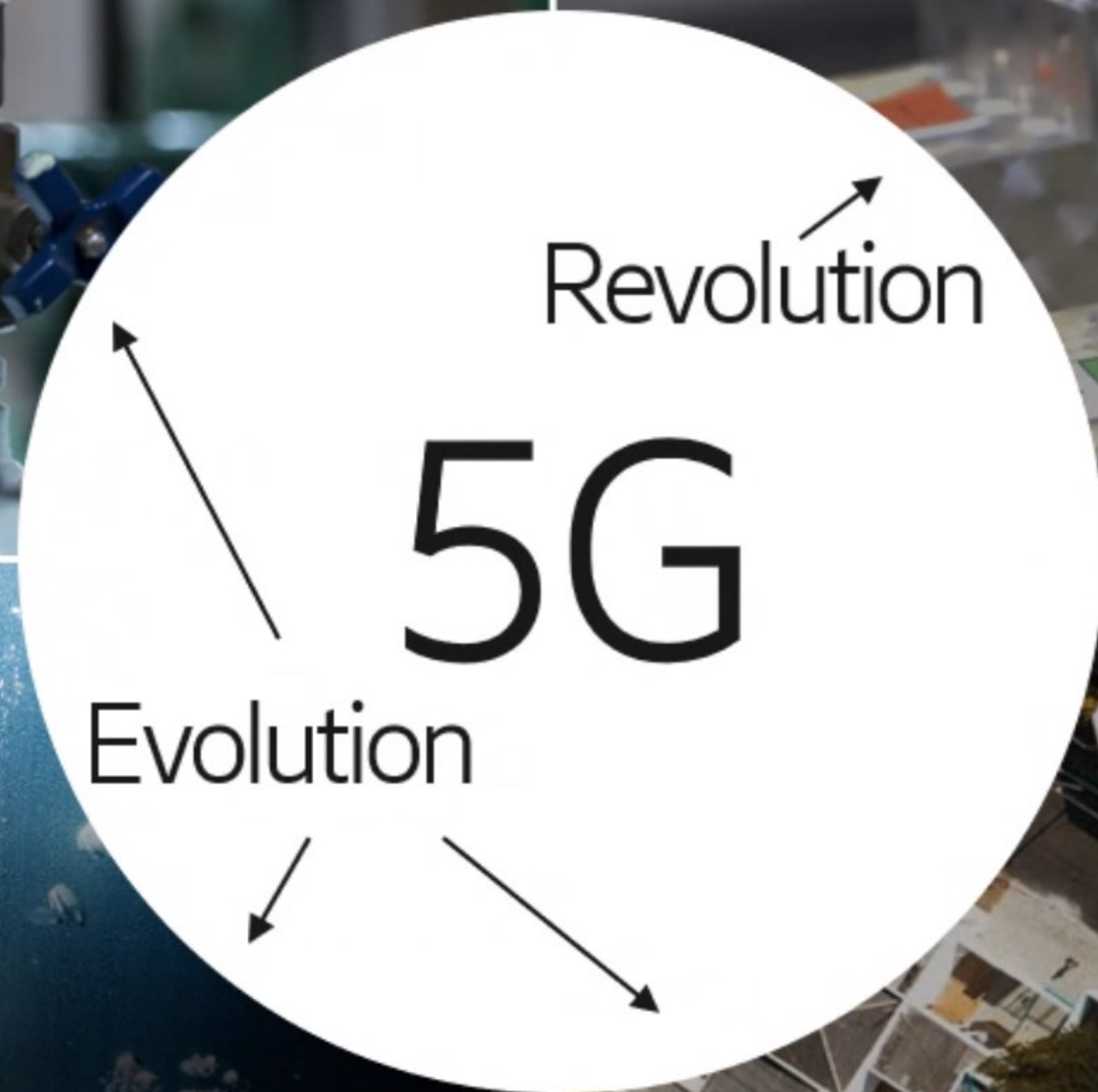
What does industry 4.0 mean?

Industry 4.0 has been defined as:

“a name for the current trend of automation and data exchange in manufacturing technologies, including cyber-physical systems, the Internet of things, cloud computing and cognitive computing and creating the smart factory”.

Massive IoT

Industrial IoT



Enhanced
Mobile Broadband

Fixed Wireless Access

5G in Manufacturing

Private 5G Factory Networks | Status Quo

- NPN (non-public networks)
- Media and industry is converging into common production interests.
- Need spectrum.

Frekvenser for mobilkommunikasjon og 5G

Dir

De frekvensbåndene som er aktuelle for tildeling til mobilkommunikasjon og 5G de neste årene er:

- 738-758 MHz (700 MHz SDL)
- 1427-1518 MHz (1500 MHz SDL)
- 2300-2400 MHz (2,3 GHz)
- 2500-2690 MHz (2,6 GHz)
- 3400-3800 MHz (3,6 GHz)
- 24250-27500 MHz (26 GHz)

Su

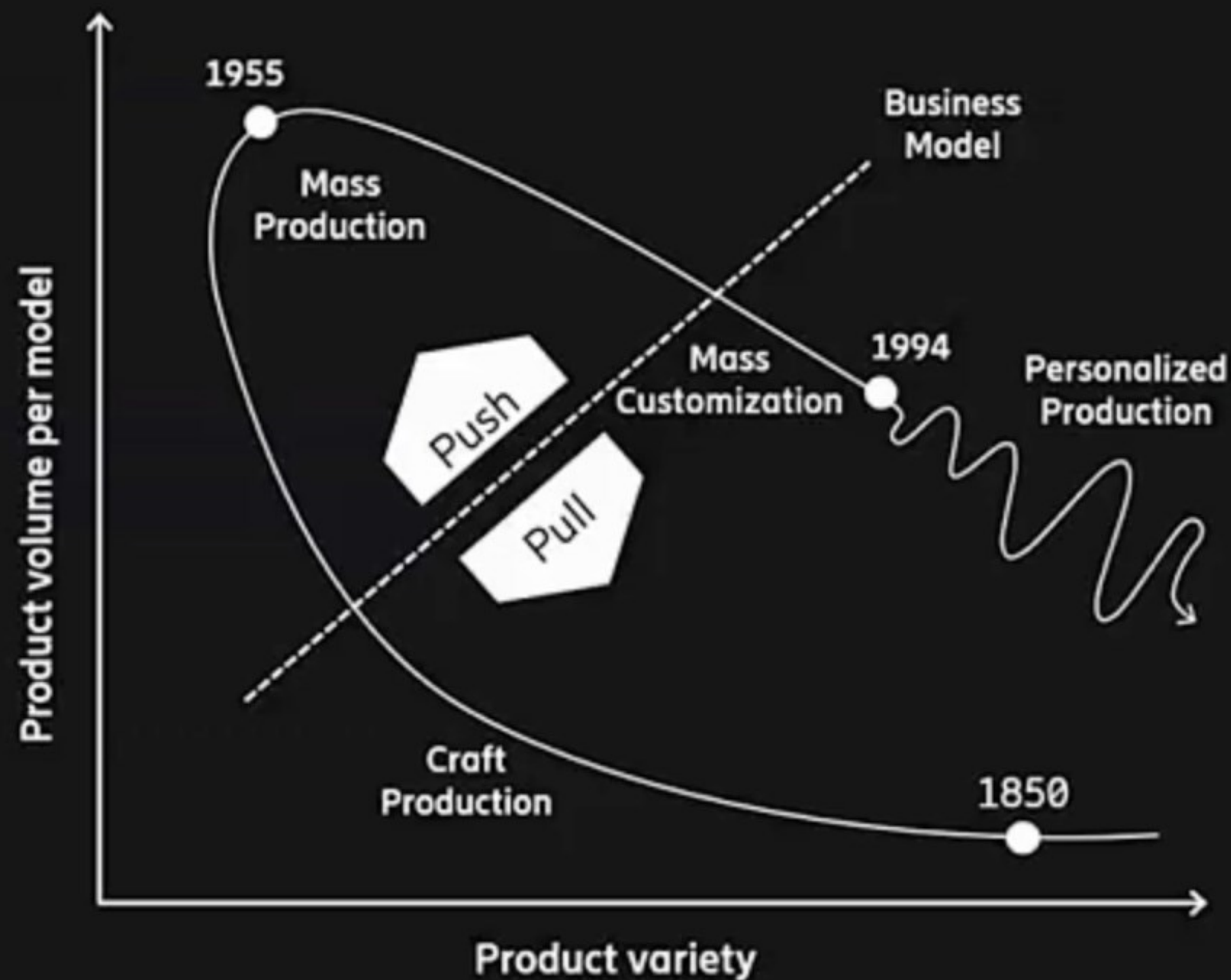
3,6 GHz- og 26 GHz-båndene er av EU definert som pionerbånd for 5G og vil kunne bidra til betydelig kapasitetsøkning i mobilnettene. Europeisk harmonisering og regulering er fastsatt, og dette vil forenkle veien videre mot en tidlig innføring av 5G.

Båndene vil trolig tildeles ved flere ulike tildelinger, og det er ikke avklart hvilke frekvensbånd som skal tildeles i den planlagte auksjonen i 2021.

roaming to 7 interaction with PLMNS



Industry 4.0 - Manufacturing



Challenge: Worker Shortage, Inflexible processes



Solution: Automate, digitalize, Cut the cable

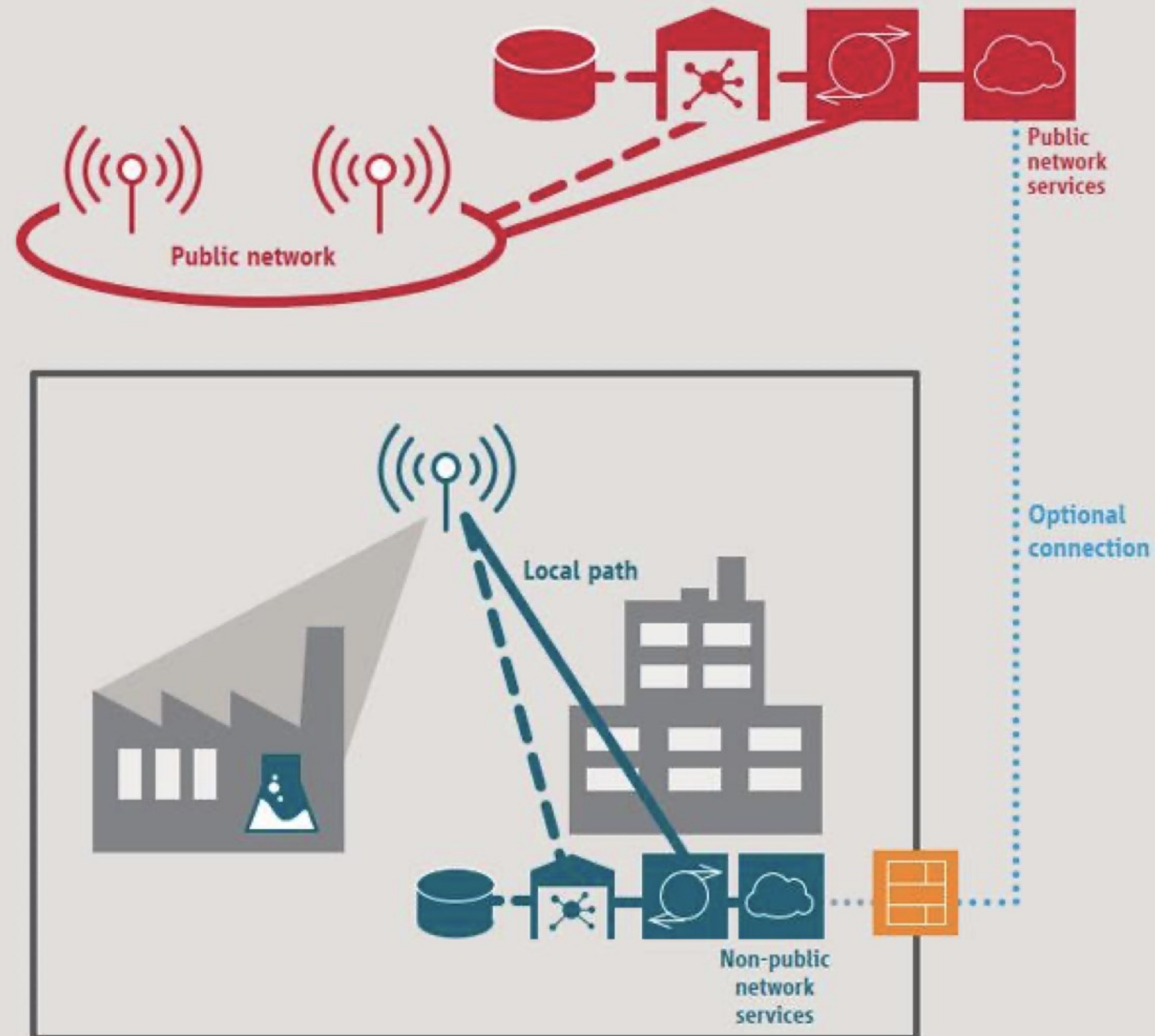


5G is by all purposes
and use an automation
project!

So,
what is 5G NPN

Non-Public
Networks
(your own 5G
network island)

Fig. 1: Deployment as isolated network



Source: 5G-ACIA

(S)NPN

**Non-public
5G
Network**

Fig. 1: Deployment as isolated network

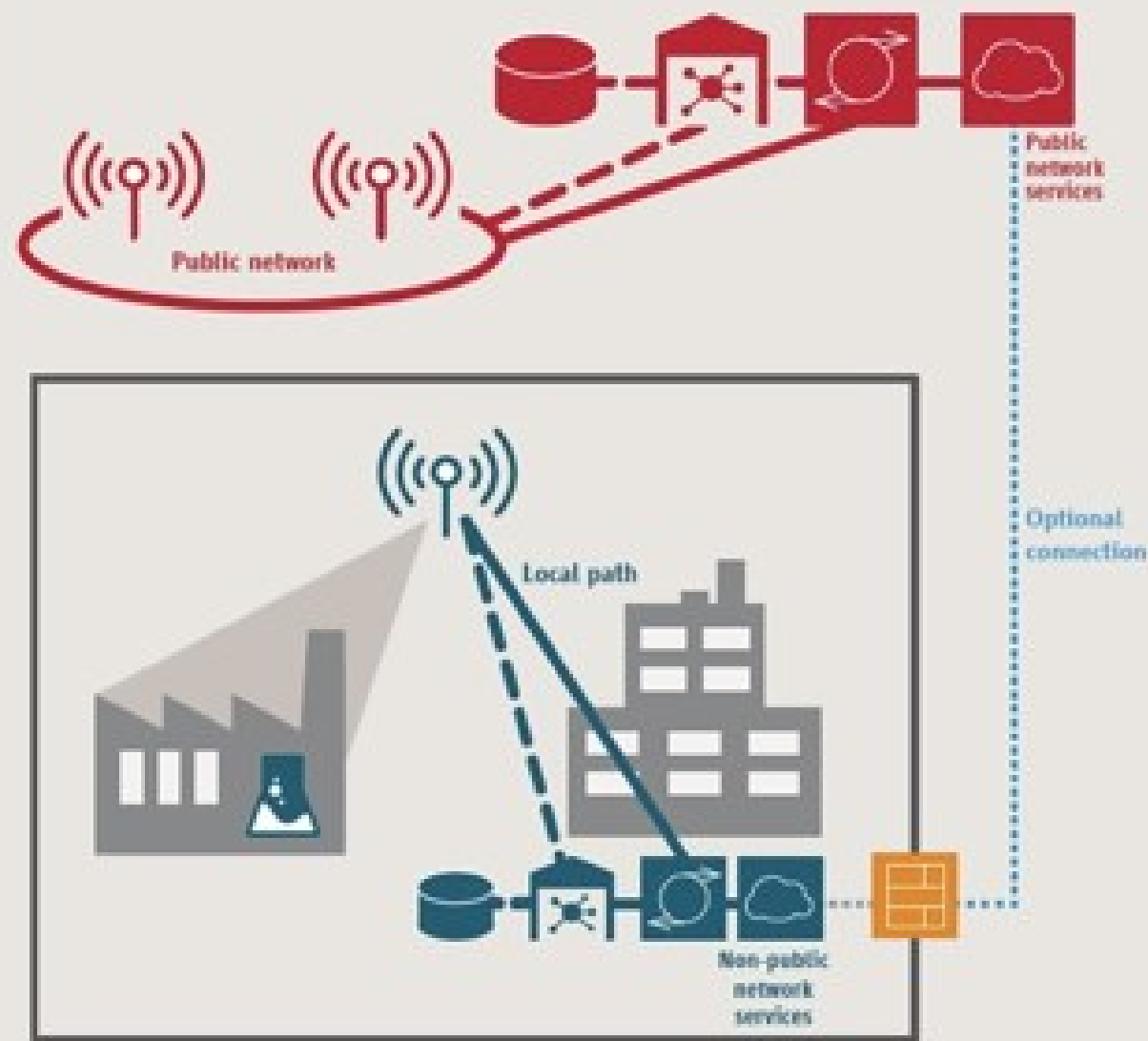


Fig. 2: Deployment with shared RAN

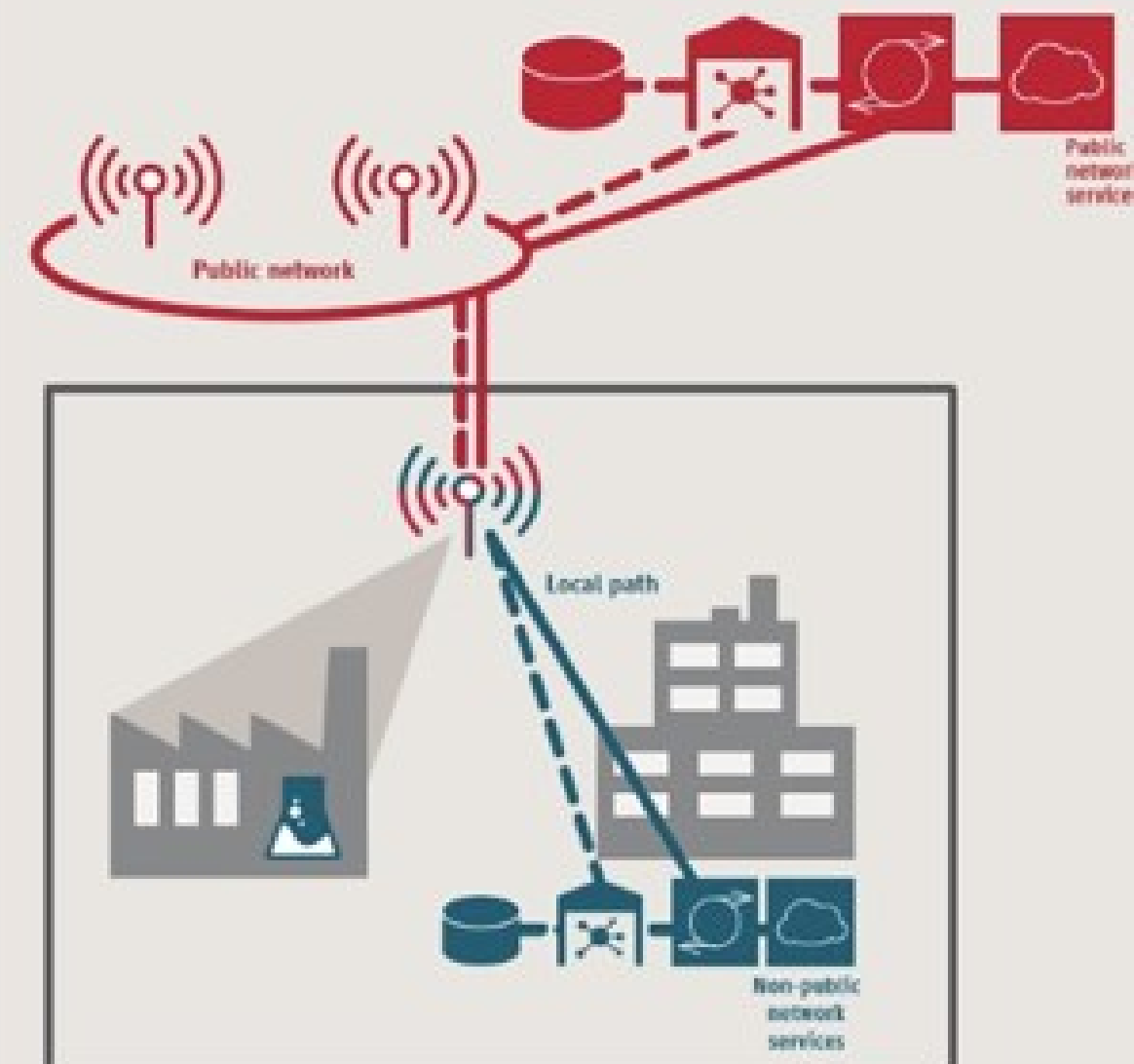


Fig. 3: Deployment with shared RAN and control plane

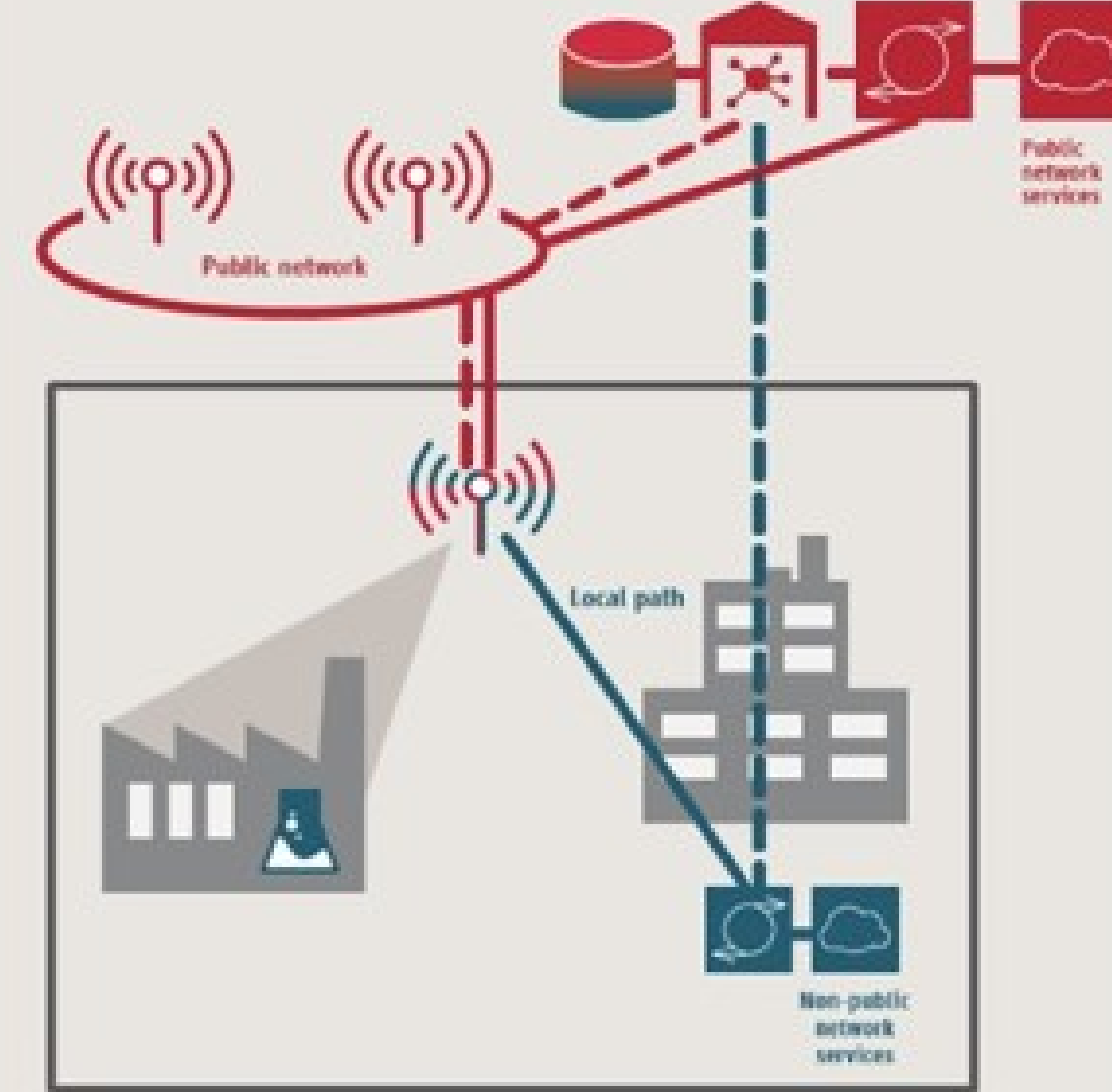
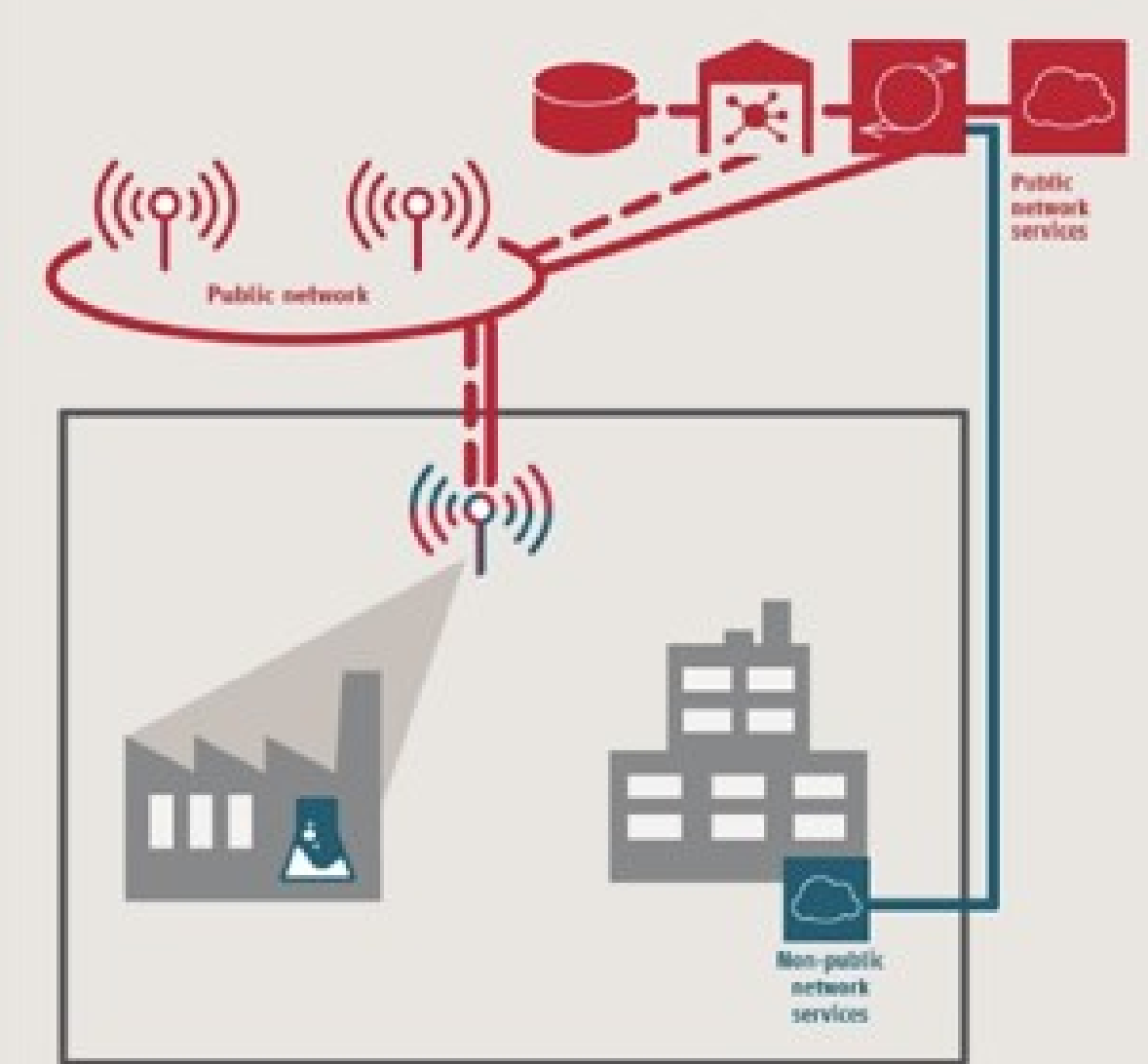


Fig. 4: NPN deployed in public network



1

2

3

4

	Standalone Private Network	Hybrid Private Network		Virtual Private Network
Applications	Customer	Customer	Customer	Customer
Management	Customer	Customer / SP	SP	SP
Services	Customer	Customer / SP	Customer / SP	SP
Infrastructure	Customer	Customer / SP	Customer / SP	SP
Spectrum	Customer / SP	SP (Customer - optional)	SP (Customer - optional)	SP
Devices	Customer	Customer	Customer	Customer
SIMs	Customer	Customer	SP	SP

WHY NPN IN BROADCAST?

Early adoption to 5G – SA (full 5G end to end)

Bring your own coverage.

Very predictable and secure.

Massively cost saving on no-wire rigging, personell and travelexpenses.

Adopt to the new technology and try, test and learn.



VIRKSOMHEDER

Blinkende lampe med lilla lys kan skabe TV-historie

En lampe, der kan skifte lysstyrke og farve ved hjælp af en mobiltelefonforbindelse, er med til at skrive verdenshistorie. Den kan gøre transmissionen af TV-udsendelser og filmproduktion langt mere sikker og hurtigere med den nye 5G-teknologi.



Denne studielampe kan være med til at ændre hele den måde, som TV-stationer og filmselskaber arbejder på fremover. Dens »hemmelighed« er, at der ikke er noget kabel – betjeningsforbindelsen leveres trådløst gennem routeren, der står på bordet foran. Det lyder ikke særligt nyskabende, men det er faktisk ikke gjort før. Foto: Thomas Breinstrup

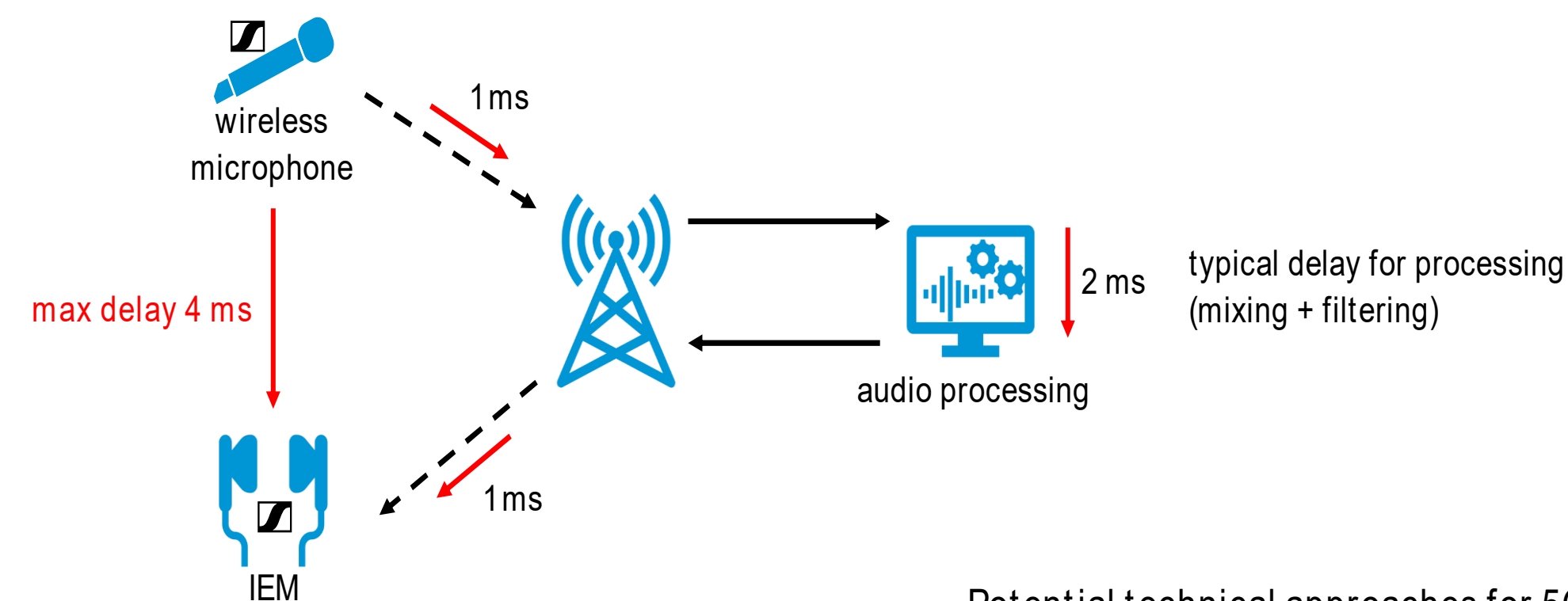
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Foto: Thomas Breinstrup

HOW DO WE START TESTING?

The 5G NR broadcast equipment is already here!

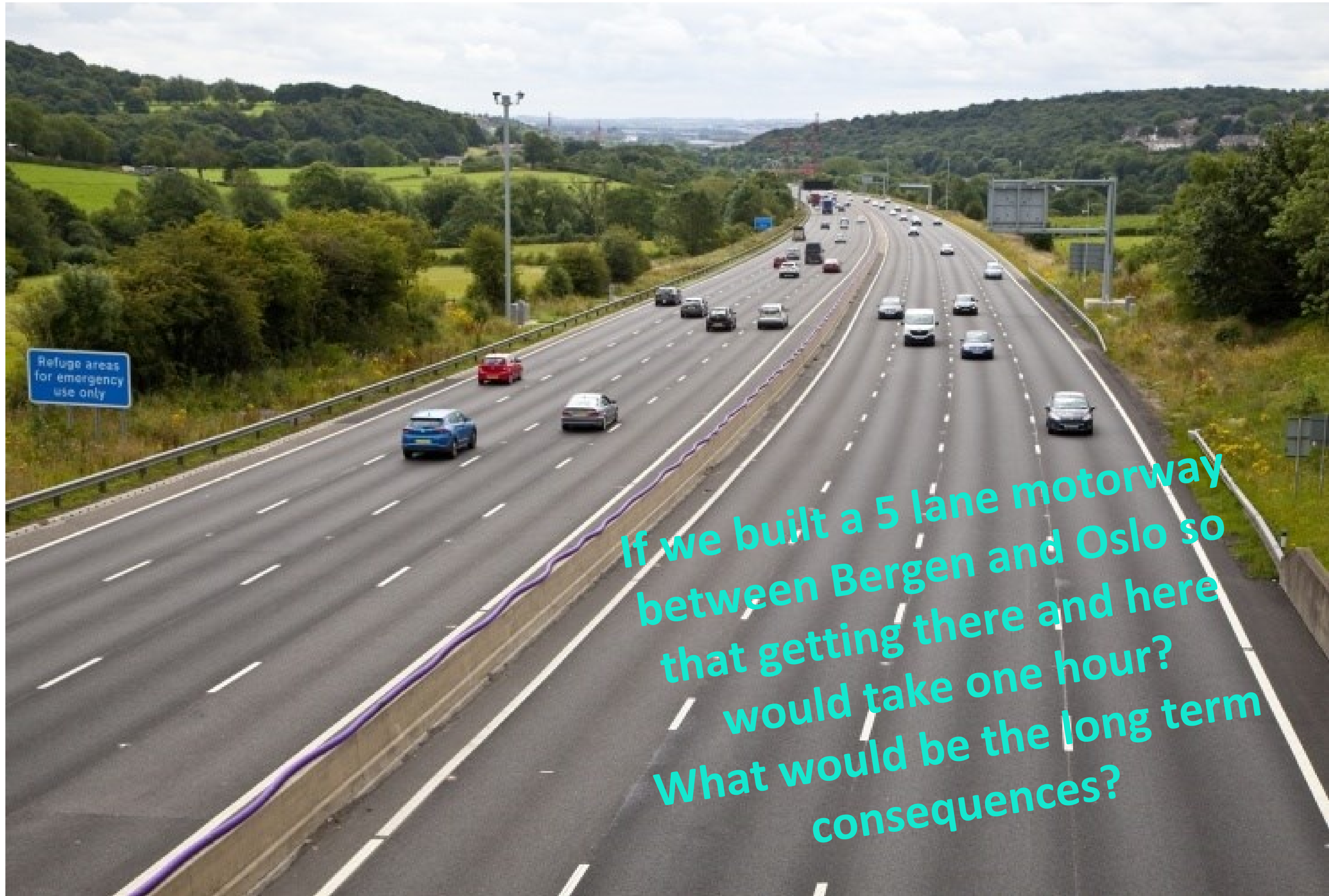
Technical challenges for 5G NR used within professional audio production
Example: latency



Less than 1 ms for the wireless transmission (end-2-end) in one direction.

Potential technical approaches for 5G NR

- Reduction of slot duration
- Utilization of mini-slots
- SPS (semi persistent scheduling)
- Time alignment of radio and audio systems to reduce scheduling time



If we built a 5 lane motorway
between Bergen and Oslo so
that getting there and here
would take one hour?
What would be the long term
consequences?



If distance and capacity is irrelevant...



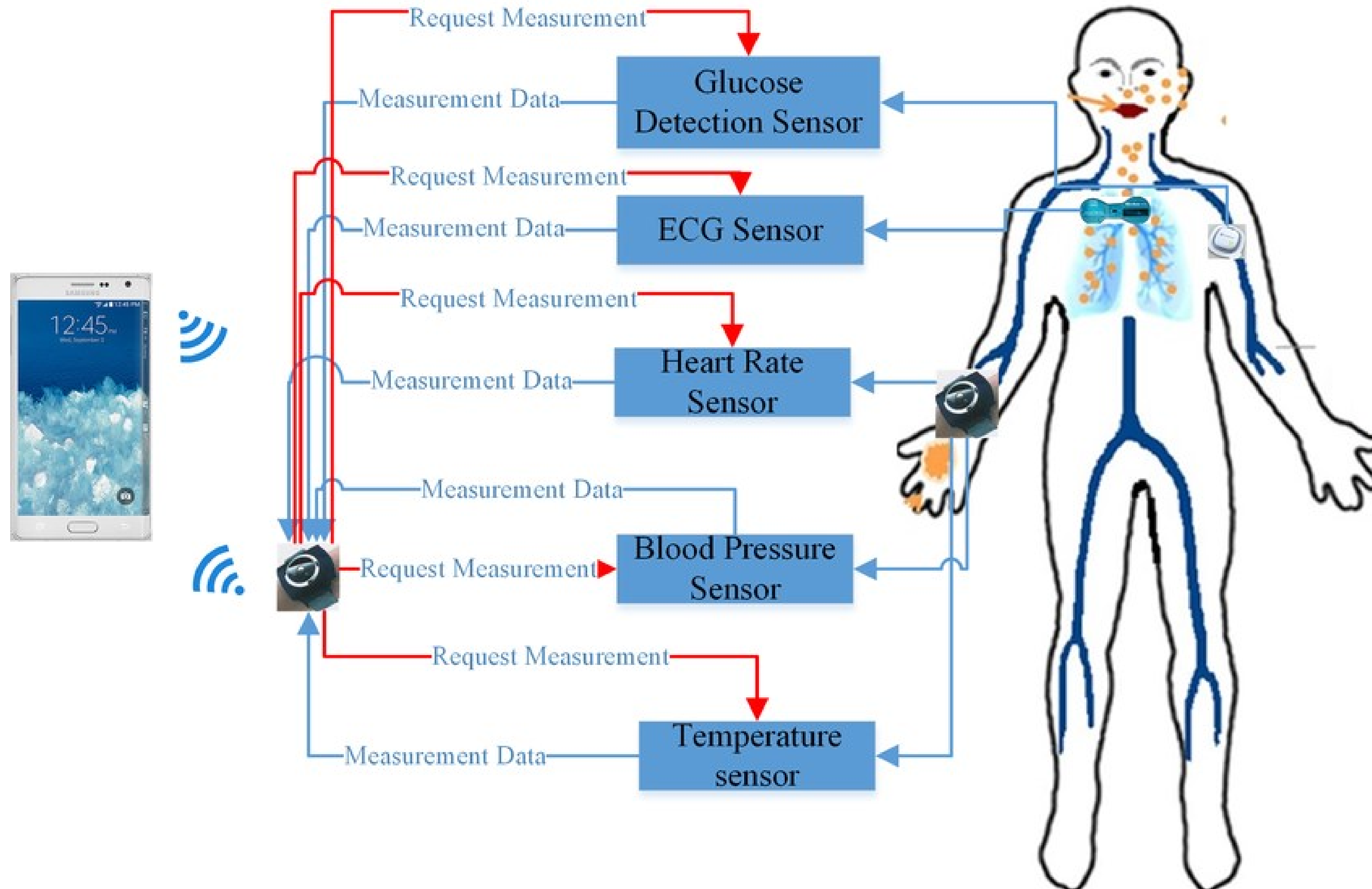
Sensors everywhere...



Even the road will have sensors.



Humans health sensors.



WBAN – wireless body area network

ieeexplore.ieee.org/document/8369035

Conferences > 2018 IEEE Wireless Communicat...

5G and wireless body area networks

Publisher: IEEE [Cite This](#) [PDF](#)

Richard W. Jones ; Konstantinos Katzis [All Authors](#)

5 Paper Citations 536 Full Text Views

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Abstract

Document Sections

- I. Introduction
- II. 5G Technologies
- III. Wireless Body Area Networks
- IV. 5G Enabled WBANs
- V. Wireless Power, Security and Privacy

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[Citations](#)

[Keywords](#)

Abstract:

5G wireless is the next step in the evolution of mobile communications with the aim being to provide connectivity for any kind of device and any kind of application. Wireless Body Area Networks (WBANs) constitute just one component of connected healthcare utilising small intelligent physiological sensors either on or implanted in the human body. This contribution examines the 5G technologies that will make a significant contribution to providing secure healthcare-orientated WBANs with improved energy efficiency, interference mitigation and wireless power transfer capability.

Published in: 2018 IEEE Wireless Communications and Networking Conference Workshops (WCNCW)

Date of Conference: 15-18 April 2018 **INSPEC Accession Number:** 17806271

Date Added to IEEE Xplore: 31 May 2018 **DOI:** 10.1109/WCNCW.2018.8369035

ISBN Information: **Publisher:** IEEE

Conference Location: Barcelona, Spain

I. Introduction

Fifth generation (5G) wireless access is the next step in the evolution of mobile communications with goals that include; providing connectivity for any kind of device, an order of magnitude increase in data rate, higher energy efficiency as well as compatibility with previous technologies - the ultimate aim being successful management of future mobile device requirements. To be able to achieve these goals a variety of 5G enabling technologies are being developed. These include extending wireless communication to



What if you could track devices down to 30 cm? How can it be used?



Figure 2: Multilateration

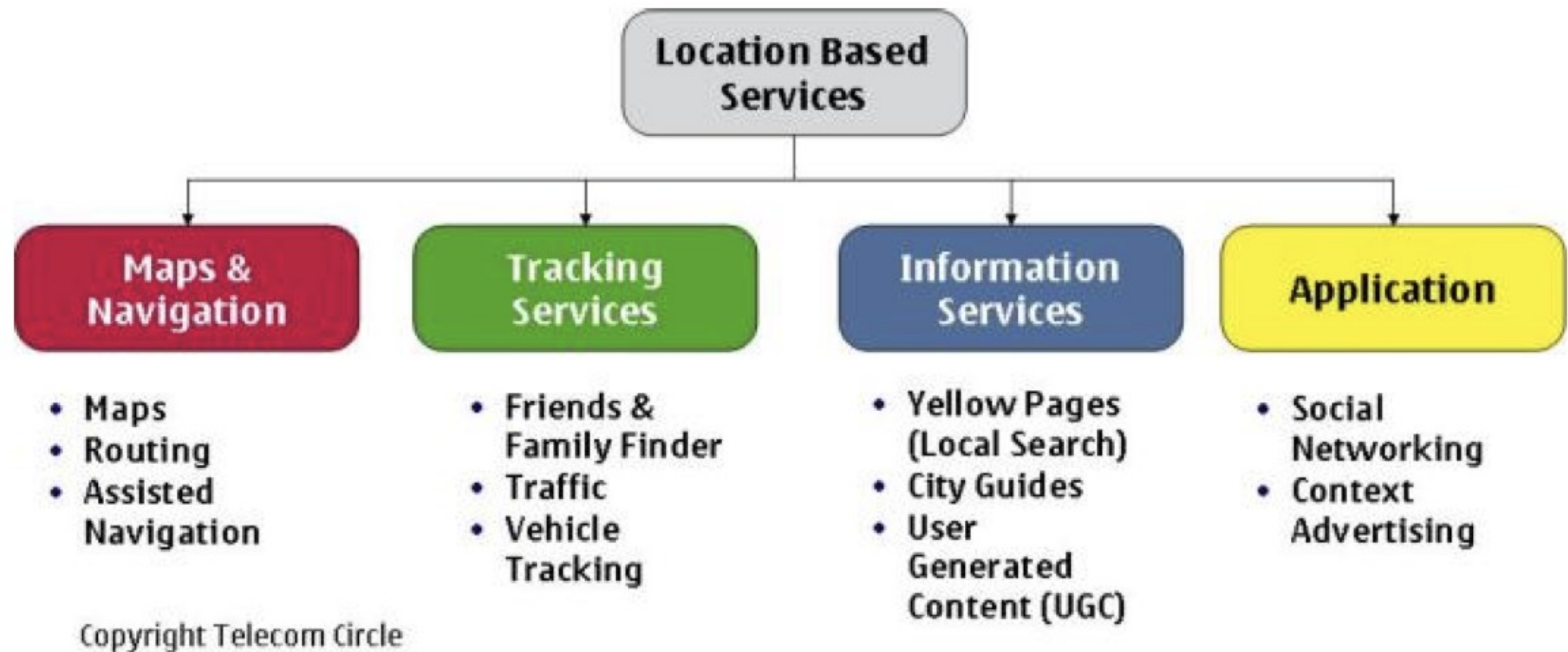
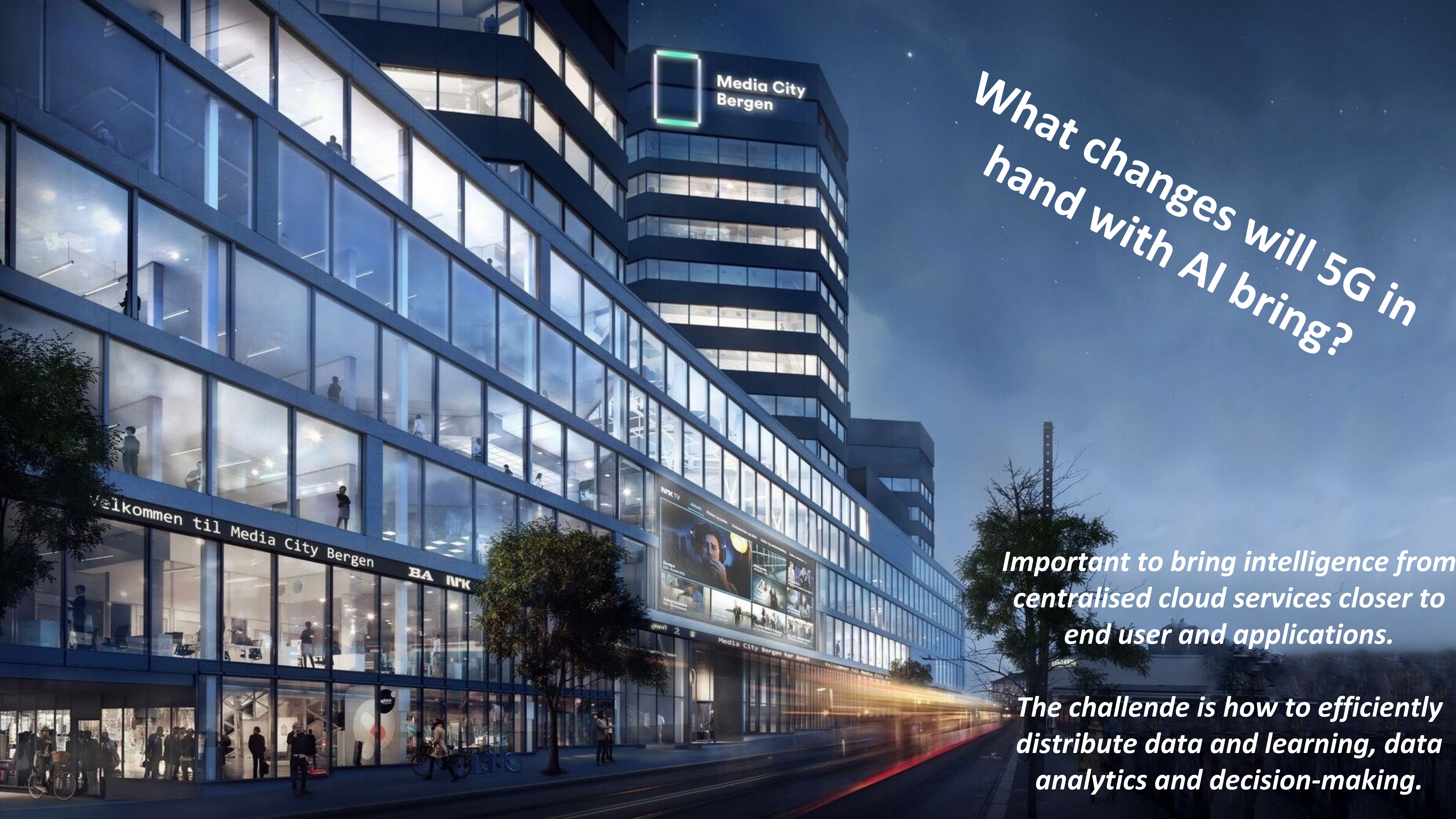


Figure 1: Location Based Services



What changes will 5G in hand with AI bring?

Important to bring intelligence from centralised cloud services closer to end user and applications.

The challenge is how to efficiently distribute data and learning, data analytics and decision-making.

AI

DAI

Distributed Artificial Intelligence

Distributed Artificial Intelligence (DAI) is an approach to solving complex learning, [planning](#), and decision making problems. It is [embarrassingly parallel](#), thus able to exploit large scale computation and spatial distribution of computing resources. These properties allow it to solve problems that require the processing of very large data sets.

DAI systems consist of autonomous learning processing nodes ([agents](#)), that are distributed, often at a very large scale. DAI nodes can act independently and partial solutions are integrated by communication between nodes, often asynchronously. By virtue of their scale, DAI systems are robust and elastic, and by necessity, loosely coupled.

Furthermore, DAI systems are built to be adaptive to changes in the problem definition or underlying data sets due to the scale and difficulty in redeployment.



AI

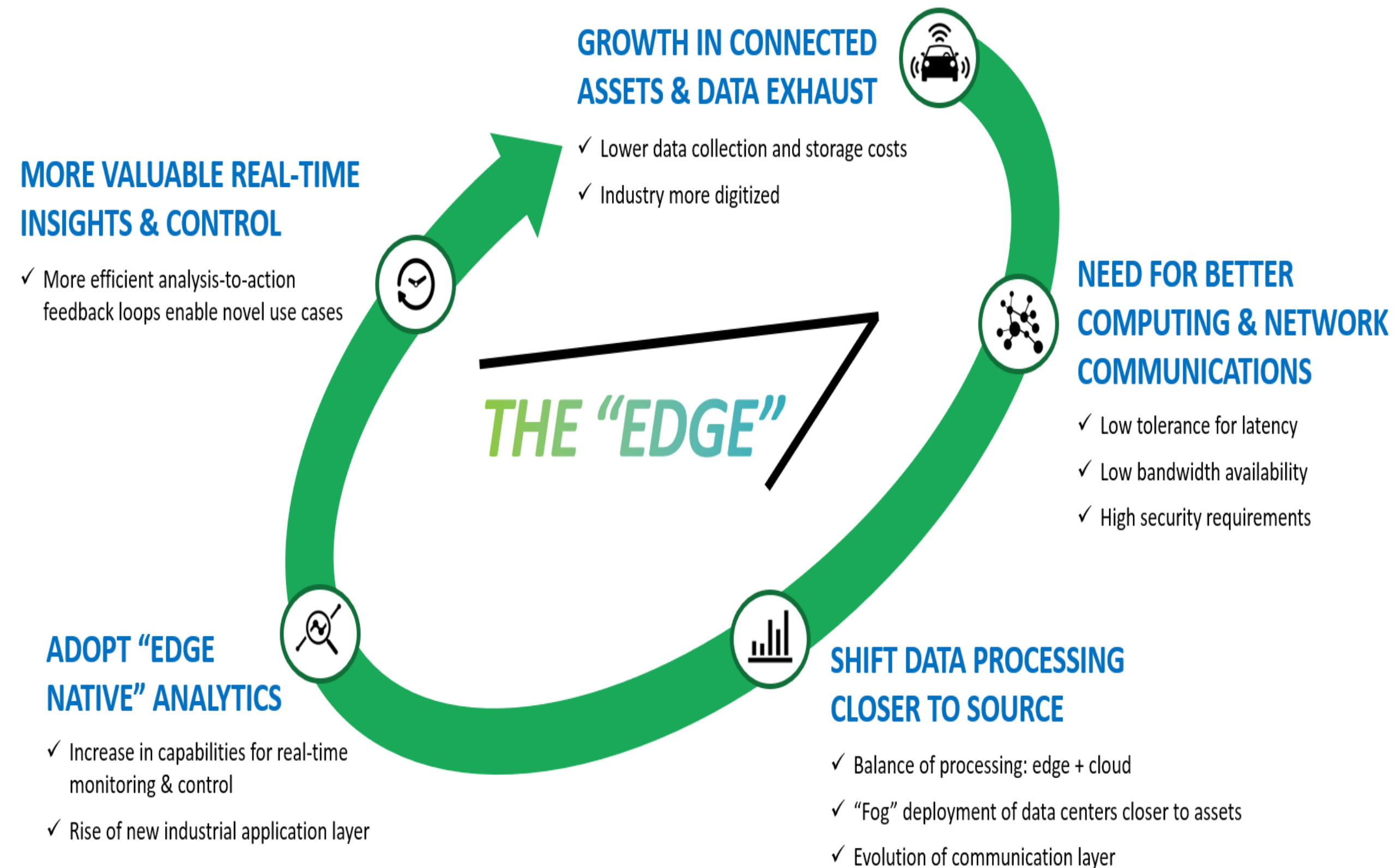
Edge-native application platforms

It is essential to remember that there is no single “edge”. The edge is anywhere and everywhere outside of traditional IT environments. The Edge Native approach is a natural corollary to Cloud Native because the edge native assumes that the edge is a natural extension of the cloud to expand infrastructure to build a cloud-to-edge continuum.

There are some fundamental differences between the cloud and the edge, specifically the architecture, principles, and primitives. An edge compute platform takes advantage of core edge attributes such as location, network topology and latency, and disparate hardware. Edge native systems are aware of these attributes and incorporate it into their core operations.

An Edge Native approach takes into account the primitives and principles of edge computing outlined above and combines it with the modern architectural approach that has come to define Cloud Native. Namely, that Edge Native applications are architected in a similar way as Cloud Native to be elastic and distributed using microservices-based application architecture and modern methodologies such as agile development, CI/CD and containers.

Like the Cloud Native approach, Edge Native applications are architected such that they are loosely coupled and not hard-coded to any one type of infrastructure, that way applications can be deployed and optimized for edge attributes as opposed to any immutable edge.



AI

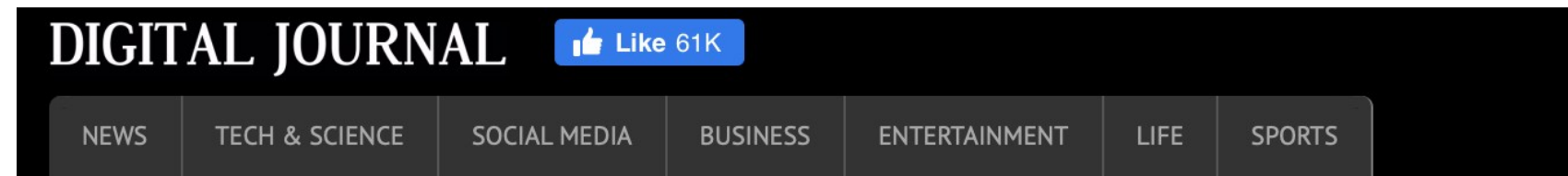
Advanced Network Security

- Network Threat Analysis
- Malware detection
- Improved security analysis
- Threat Mitigation
- Alarming

IT security is an IT management job, but has a security outcome. The safest solution is to automate and let AI handle it.



AI mediaspecific to fit into this?



Digital transformation of the media is all about tailored content

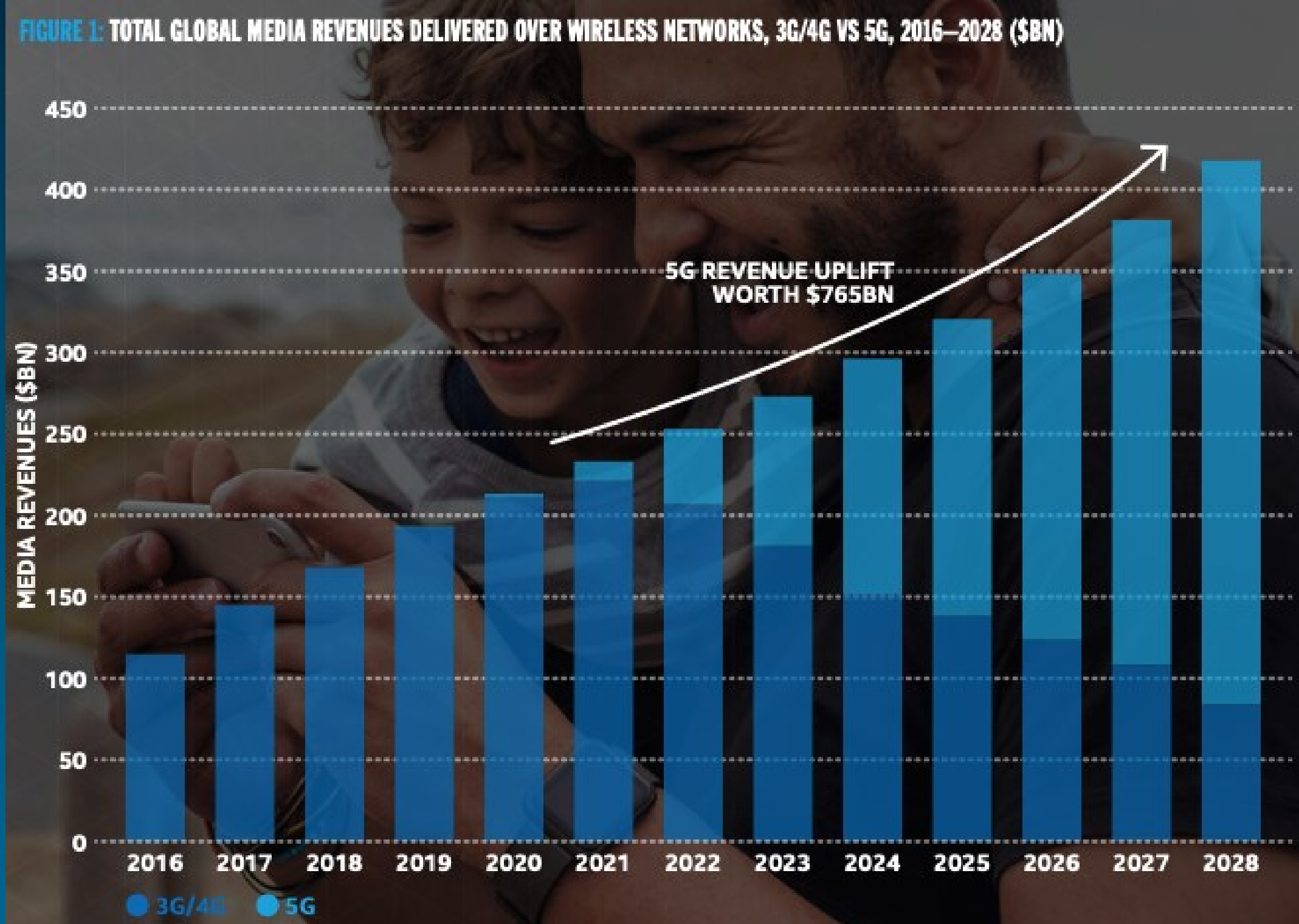
BY TIM SANDLE NOV 14, 2019 IN BUSINESS LISTEN | PRINT

The digital transformation of media is happening at a rapid pace, To survive, media companies need to introduce new content, services and tailored offerings, according to a new report from [Accenture](#).



Media companies are focusing on one clear message when it comes to the digital transformation of the sector -'people want content on demand—tailored to their interests—and accessible any time they want it' - as Daniel Newman writes in an [article for Forbes](#). The old models, where content is provided at a fixed time and

1. Automate
2. Simplify operations.
3. Zero Base Spend (cut opex).
4. Invest in the intelligent enterprise.



Media and entertainment on the mobile platform will grow from \$170 billions/year in 2018 to \$420 billions/year in 2028.

A CAGR of 9,8% over 10 years.

In 2028 will 5G alone generate \$200 billion.

<https://newsroom.intel.com/wp-content/uploads/sites/11/2018/10/ovum-intel-5g-ebook.pdf>

CAGR = compound annual growth rate. $CAGR = \left(\frac{EV}{BV}\right)^{\frac{1}{n}} - 1$ (EV=ending value, BV=beginning value, n=years)

“The transformative impact of 5G will go well beyond just enhanced mobile media.

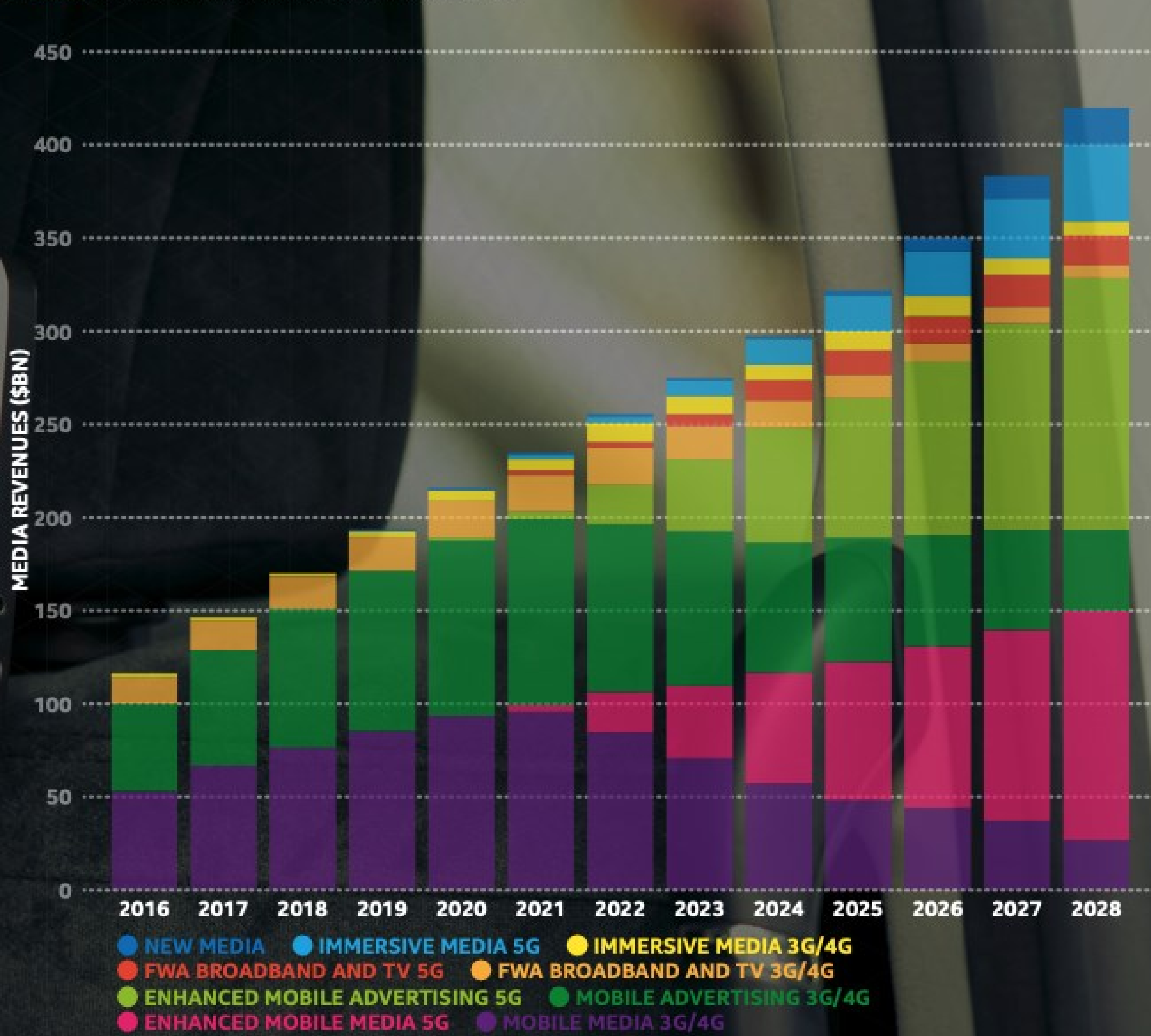
It will disrupt the industry on many levels, with new business models and new immersive* interactive experiences to capitalize on.

Video, gaming, music, advertising, AR, and VR will all see fundamental changes due to 5G, bringing content and audiences closer.

Ultimately, we expect 5G to help bring a new, tactile dimension to entertainment.”

*** Immersive = seeming to surround the audience, player, etc. so that they feel completely involved in something**

FIGURE 2: 5G IMPACT ON MEDIA REVENUES, GLOBAL, 2016–28

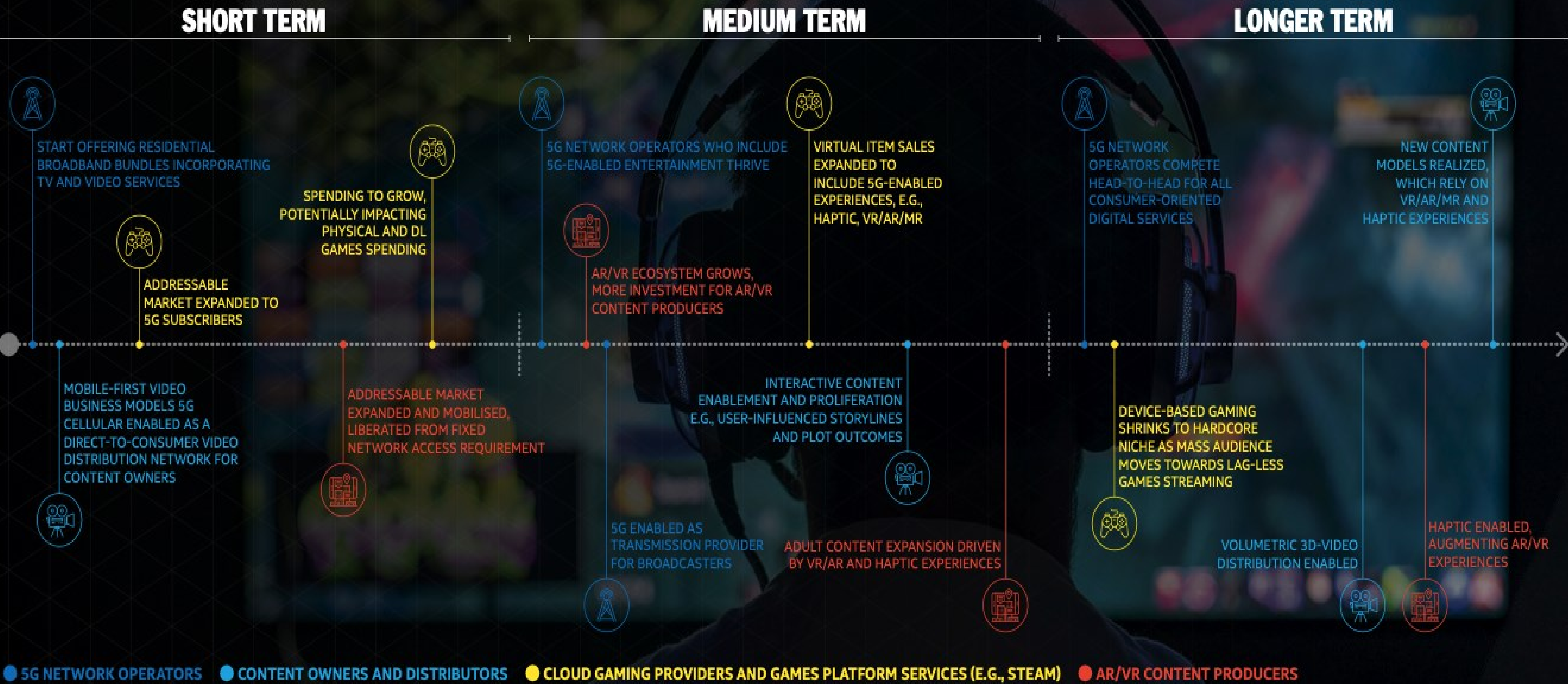


5G media revenues:

- Enhanced mobile media (video, music and games)
- Enhanced mobile advertising
- Home broadband and TV
- Immersive media (AR, VR and cloud gaming)
- New media

Significant competitive impacts for key 5G entertainment ecosystem players

FIGURE 6: 5G ECOSYSTEM ROADMAP





Welcome back in 2030

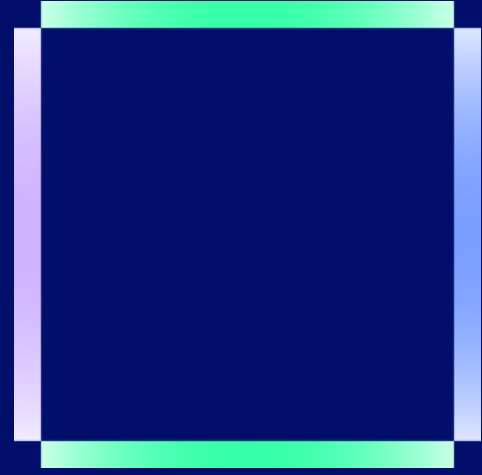


Topics

6G Will Be 100 Times Faster Than 5G—and Now There's a Chip for It



Media City Bergen
Media Lab



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NCE Media

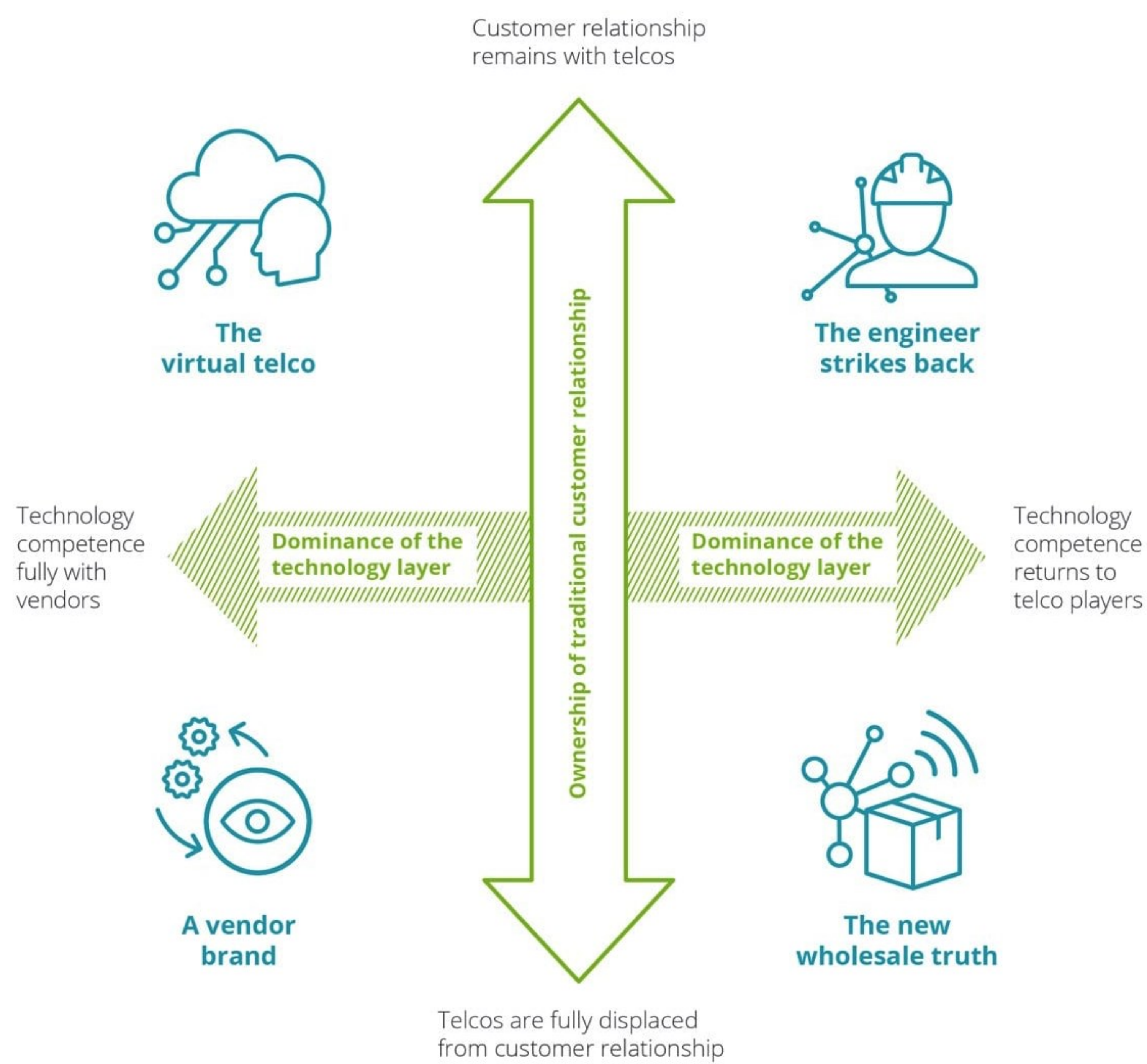
The engineer strikes back. In “The engineer strikes back”, telco companies own the network technology domain and infrastructure as well as the customer relationship. This is where telcos come from and where they hope to end up. They drive network innovation with their technological competence and have the ability to maintain and operate their assets. The telco players furthermore master the customer relationship and can thus focus on the whole value chain. They own the revenue control points, having direct access to their B2B and B2C customers.

The new wholesale truth. In the scenario “The new wholesale truth”, telco companies have finally lost the end-user control points they cherished for so long. To remain relevant, telcos have gone back to taking over full control over the network technology where they still have their core competencies.

The virtual telco. In the scenario “The virtual telco”, telcos remain the primary customer relationship holders but are displaced from the network layer as they transfer tech domain sovereignty fully to vendors and other players who move into the network by becoming new infrastructure players.

A vendor brand. In the scenario “The telco brand – powered by vendors”, telco players have been driven out of both domains, customer relationships and technological mastery. They focus on their few remaining capabilities, trying to find their sweet spot in the market to maintain their relevance.

Telcos are mere ghosts of their former selves, and serve as the wholesale sales and service teams of their parent tech companies for B2B customers.



6G WAVES MAGAZINE

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- Also see:
- <https://singularityhub.com/2020/08/21/6g-will-be-100-times-faster-than-5g-and-now-theres-a-chip-for-it/>