

# 5G for Industry and beyond...

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# Overview

- Who's Nokia?
- The three Cs
- How does 5G deliver the three Cs?
- What else is Nokia doing with 5G?
- A look to the future



# Who's Nokia?



9,600



# Building technology leadership across the industry



## Mobile Networks

- Radio Access Networks
- Microwave Radio Links
- Related network management software and services

**€9.7 bn** net sales 2021



## Cloud and Network Services

- Business applications
- Core network solutions
- Cloud and cognitive services
- Enterprise solutions

**€3.1 bn** net sales 2021



## Network Infrastructure

- IP networks
- Optical networks
- Fixed networks
- Alcatel Submarine Networks

**€7.7 bn** net sales 2021



## Nokia Technologies

- Brand licensing
- Patent licensing
- Technology licensing

**€1.5 bn** net sales 2021

# Nokia Radio Solutions

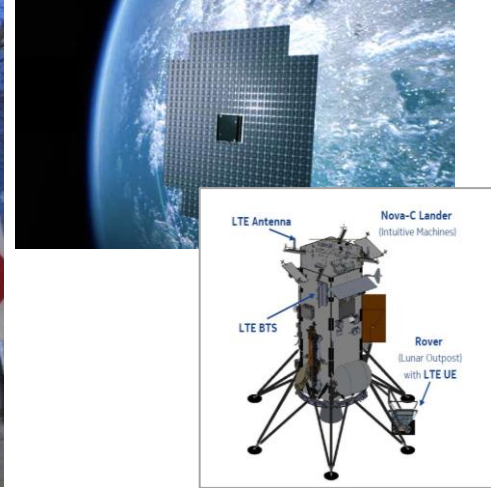
Deployed widely across the globe and beyond ...



Nokia Radios in Transit Rural  
Myanmar 2015



Nokia 5G mmWave Radio  
Trial Melbourne 2021



Nokia in Space & on the  
Moon 2023

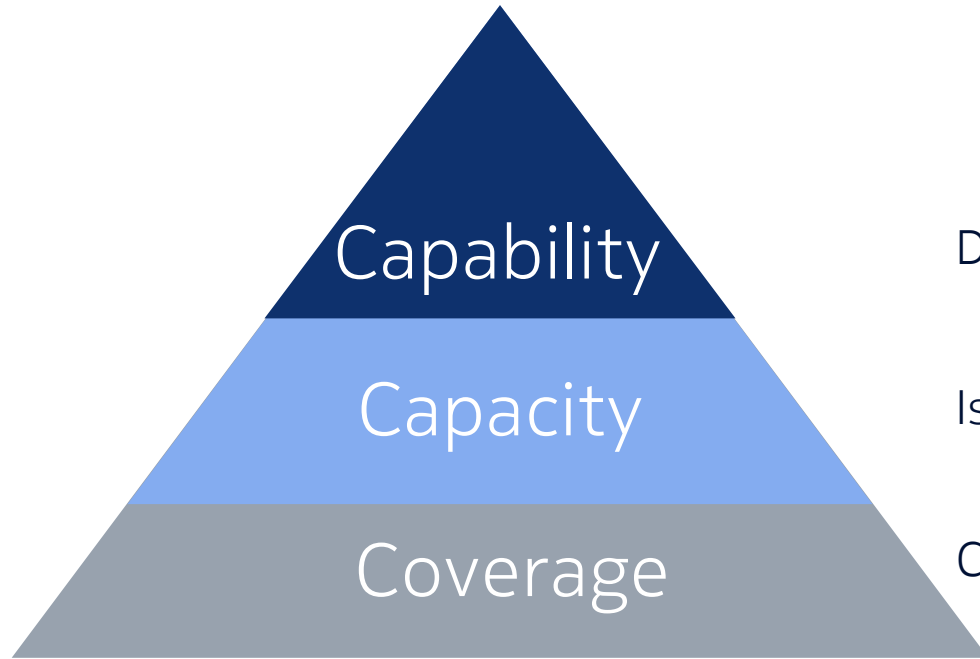


# The three Cs of any network



Regardless of technology .... the three C's still apply ...

Coverage, Capacity, Capability



Do I get the fastest service possible?

Is the throughput adequate?

Can a user actually make/maintain a call?

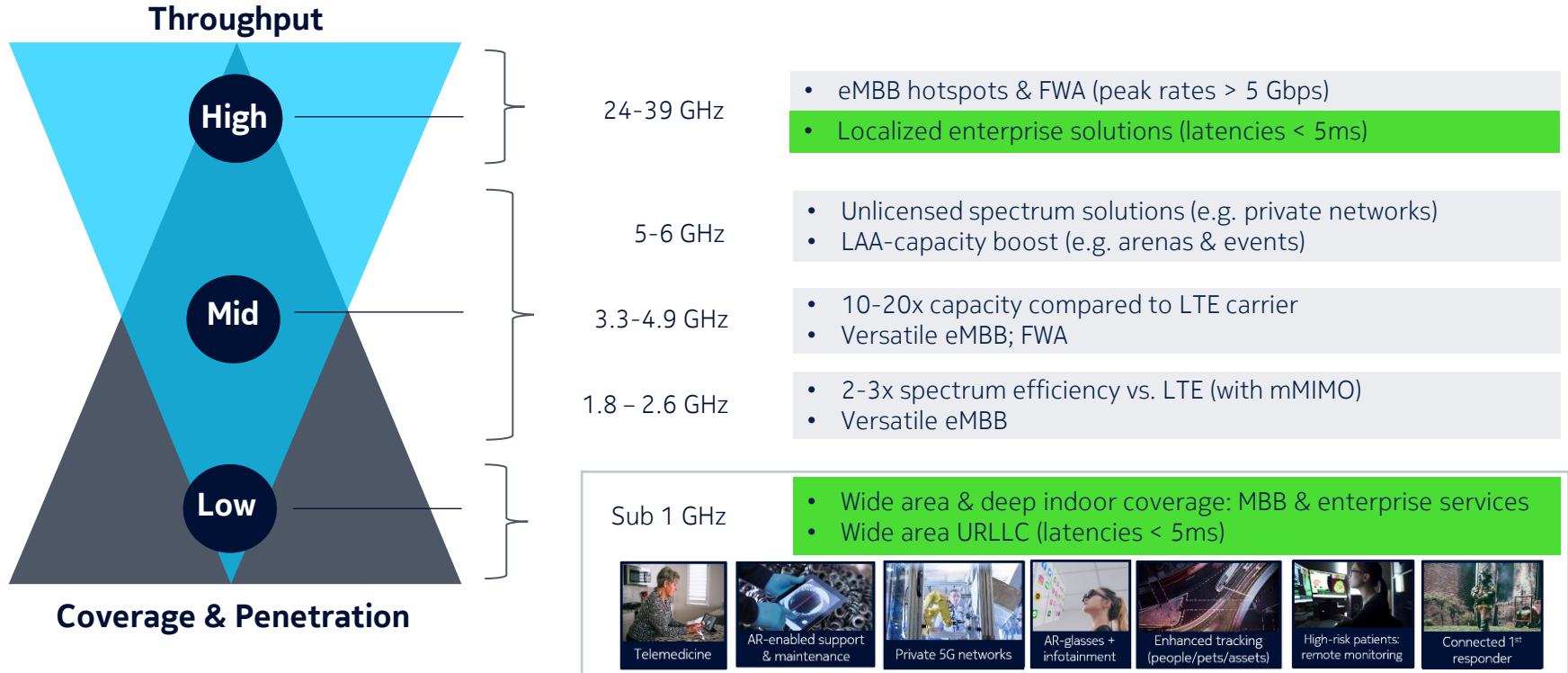
# How does 5G deliver the three Cs?





# Coverage: 5G spectrum bands to serve different use cases

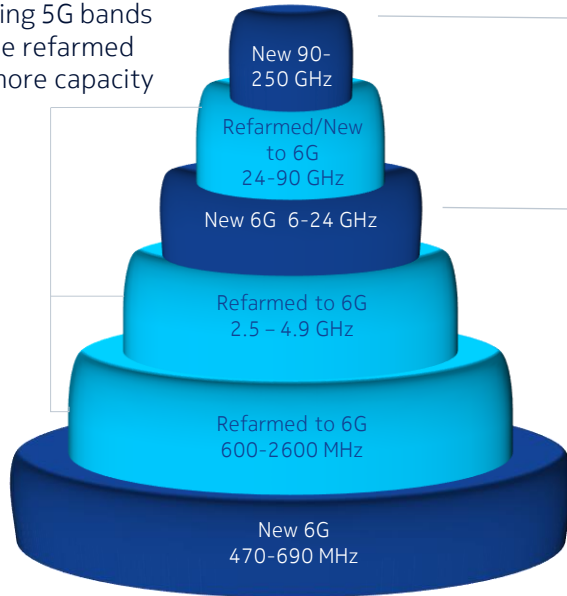
Sub-1GHz offers key value in terms of coverage, penetration, latency



# Coverage: Spectrum identified for 6G

## Expected characteristics of 6G

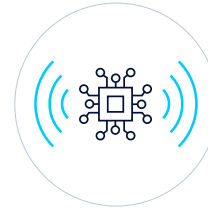
Existing 5G bands will be refarmed for more capacity



Sensing and short range

New “Golden Band” for Urban macro capacity and 5G grid

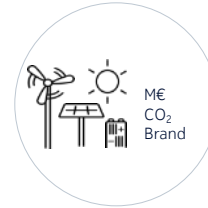
New extreme low and high spectrum will create new CSP and Enterprise business opportunities



Seamless evolution of architectures, chipsets, software and 5G/6G platforms



Focus on new use cases to drive revenue or driving up efficiency, for example using AI and machine learning



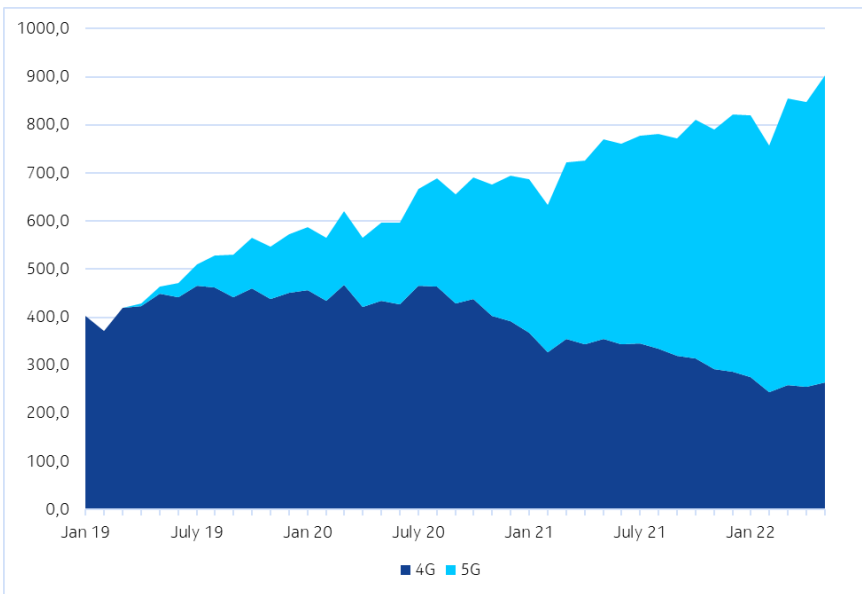
Ensure sustainability and energy efficiency targets are met



# Capacity: South Korea example

Large 5G subscriber base and traffic with positive indications on 5G monetization

5G eMBB statistics from South Korea, end of June 2022  
4G and 5G smartphone traffic (Petabytes)



Source: MSIT S-Korea, operator reports

24 million 5G subscribers	5G data / month	
<b>32,7%</b> of total mobile base	<b>3x</b> LTE usage (8.6->26.4 GB)	
<b>70%</b> of total mobile data traffic on 5G		
Higher 5G usage vs. LTE		
VR <b>7x</b>	Video <b>3.6x</b>	Gaming <b>2.7x</b>
All operators report regular increases in wireless revenue		

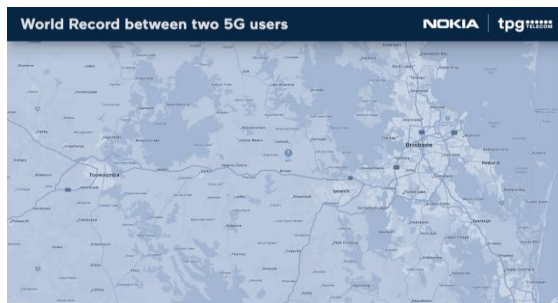
# Capability : Some key highlights in Australia and New Zealand

Multiple World Firsts → Breaking Boundaries & Records

World 1<sup>st</sup> 5G SA at 700MHz



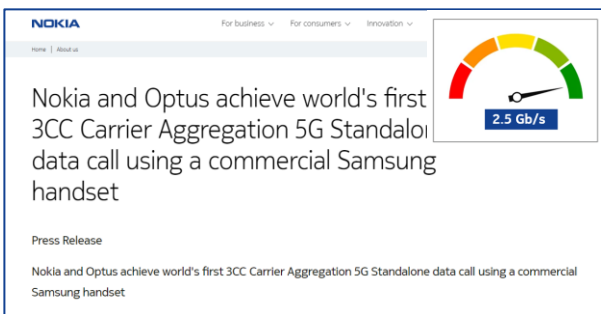
World's Longest Range 5G Call: 148km



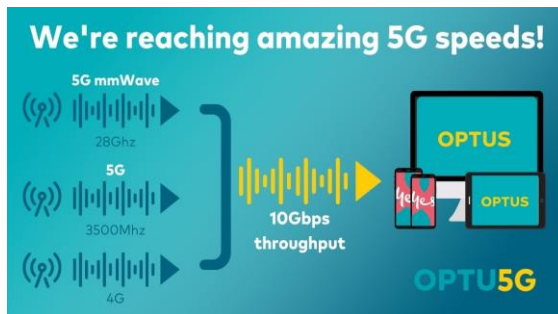
APAC 1<sup>st</sup> 5G Femto Cell



World's First 3 Carrier Aggregation



World Record 10GB/s Site



Australia's First 5G Stadium



# Another Australia 5G First – 2Gbps Uplink

3.35ms Round Trip Latency

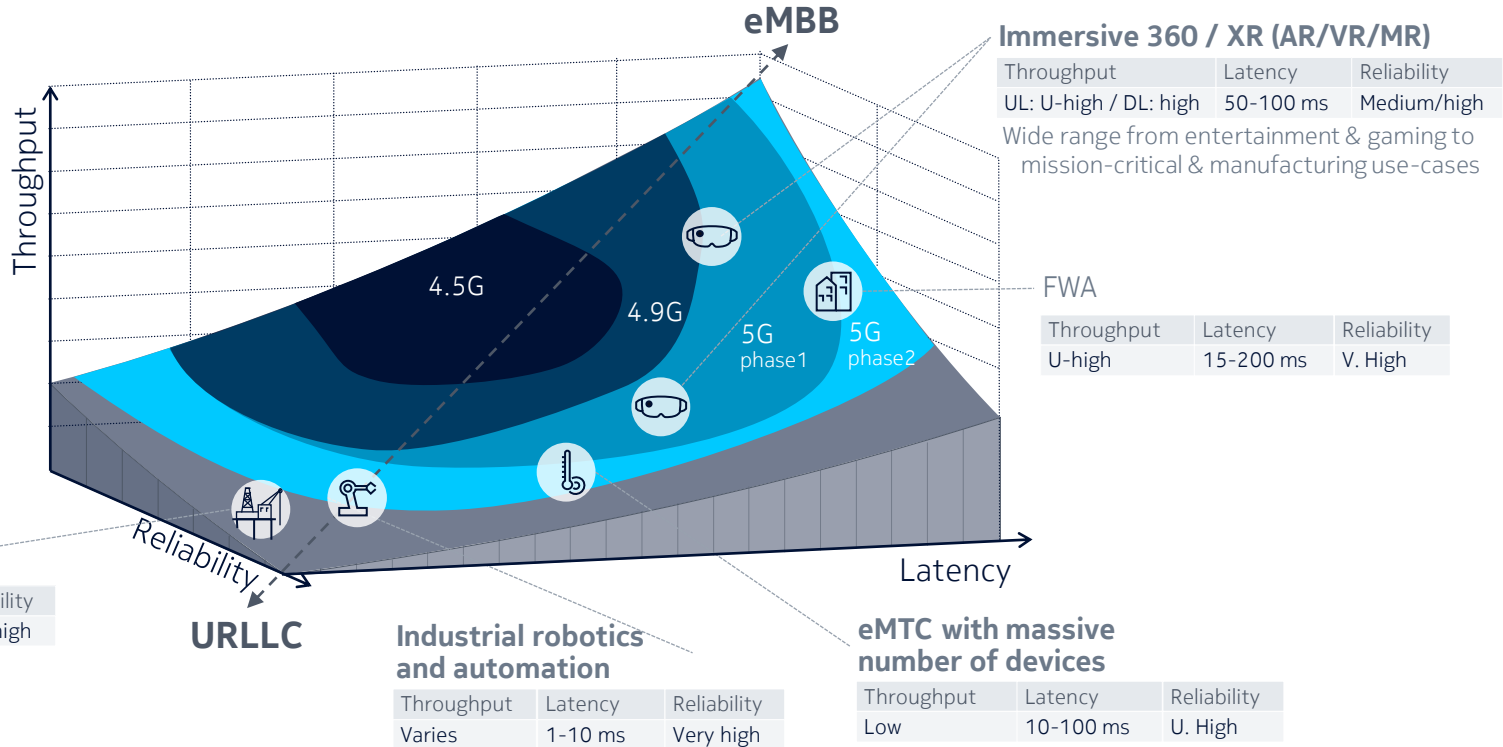


9,600 -> 2,000,000,000 (x200k)

# New use cases require capabilities beyond those of 4G

Throughput, reliability and latency improvements of 5G are the key dimensions

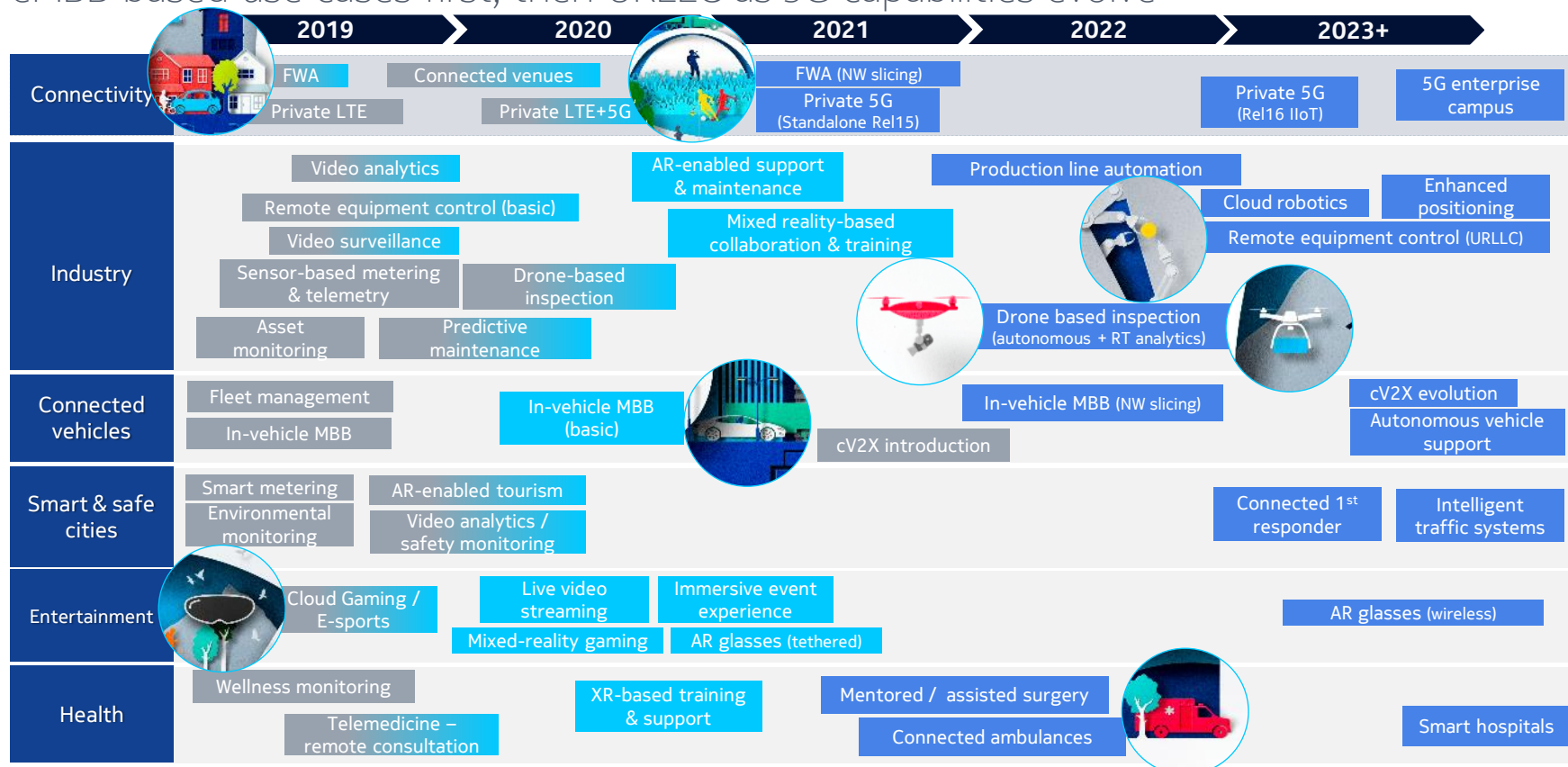
**5G provides unique capabilities in the eMBB and URLLC segments**





# 5G monetization – Anticipated use case evolution

eMBB based use cases first, then URLLC as 5G capabilities evolve



# We have a clear and definitive vision of the metaverse opportunities

Concepts of 'Human Augmentation' and 'Digital-Physical Fusion' frame this vision

## Metaverse enablers



### Human Augmentation

Handhelds  
VR HMDs  
Tethered AR glasses  
Haptic-enabled remote control

Connected bio-medical implants  
Industrial exoskeletons  
Ergonomic, untethered XR glasses  
XR interoperability



### Digital-Physical Fusion

Basic, organization-level digital twins  
Smart sensor networks  
Persistent virtual worlds & objects

Complex, enterprise-wide digital twins  
Ecosystem interoperability  
Interactive 3D digital twins  
6G network sensing

## Metaverse opportunities

Consumer  
Metaverse



Enterprise  
Metaverse  
(IT-centric)



Industrial  
Metaverse  
(OT-centric)

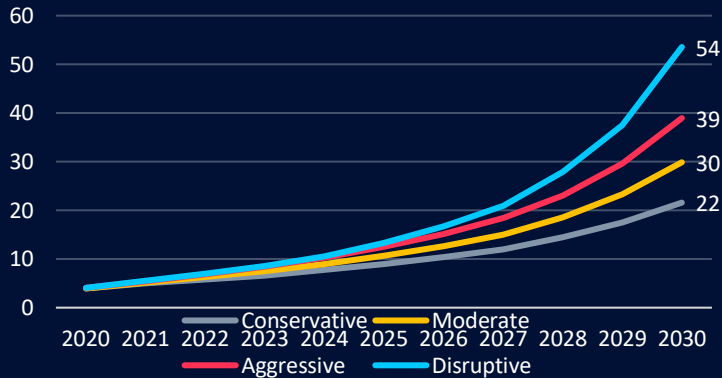


**Nokia well ahead of the current 'meta-hype':  
based on Nokia Bell Labs research over 5+ years**

# Network performance continues to be key for the future

## Total global fixed and wireless traffic

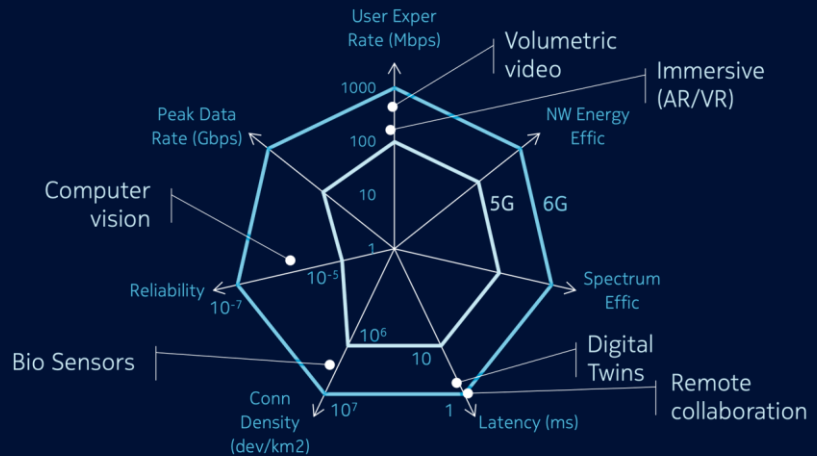
### Global Traffic (ZB/yr)



Global traffic will grow between **5.5x** (Conservative) to **13x** (Disruptive) between 2020 and 2030

Bell Labs Modeling

## Metaverses, human augmentation, digital physical fusion place new demands on network characteristics



High performance networks are crucial, but the market is changing

# Bringing the future to life

Six key technology areas for the 6G essential infrastructure



Explore the  
Nokia 6G eBook



# Nokia 5G Futures Lab @ UTS Tech Lab, Sydney + Campus Private 5G





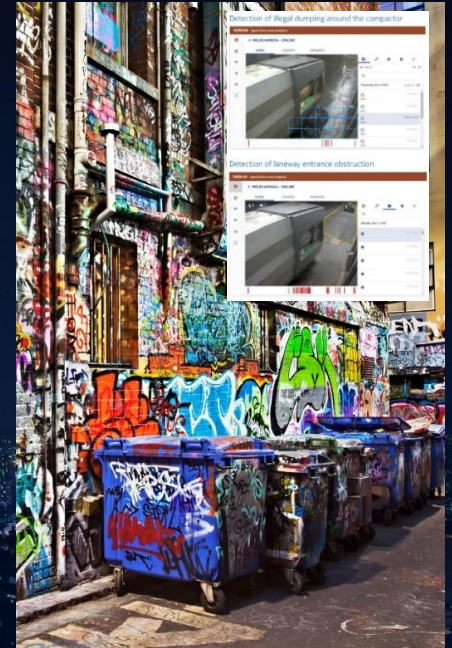
# Current applications of 5G Technology – in Australia



5G Connected Robots  
(Nokia Futures Lab - Sydney)



5G Connected Farm  
(with TPG in Tamworth)



5G Connected Bins  
(Melbourne)



# The Killer 5G Use Case – The World’s 1<sup>st</sup> 5G Connected Brewery

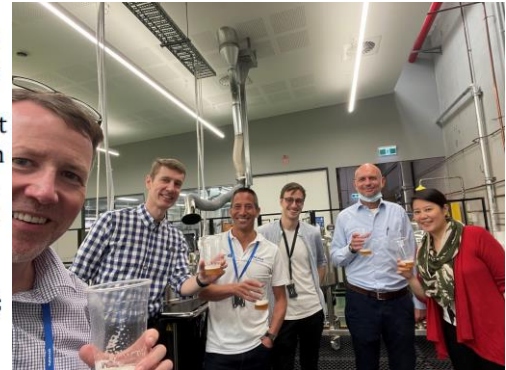


## Nokia and UTS showcase world’s first 5G connected microbrewery

Nokia and the University of Technology Sydney today announced the successful operation of what it claims is the world’s first private wireless 5G connected digital microbrewery.

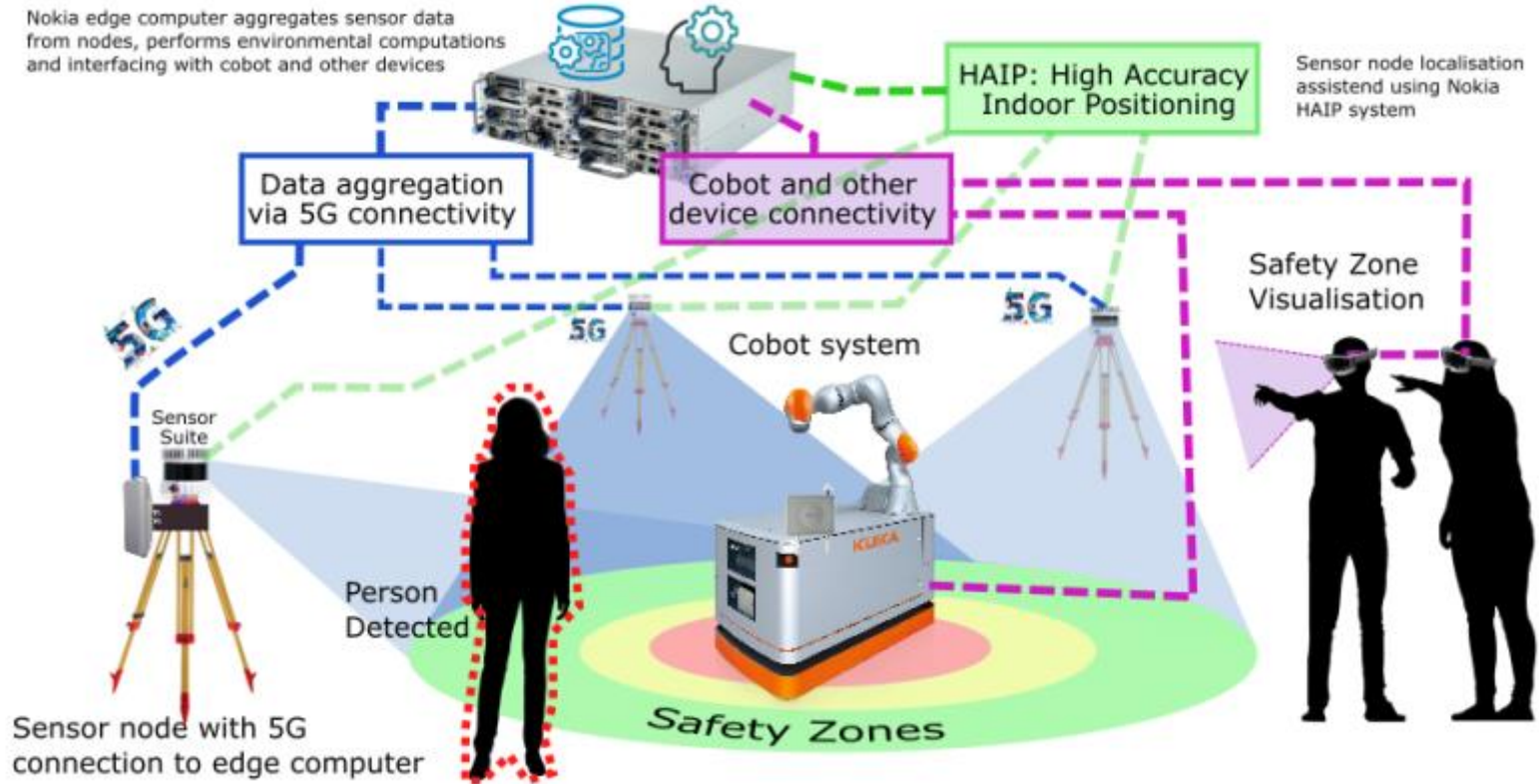
The Young Henry’s nano-brewery forms part of an international **EXCLUSIVE** production network, with an identical physical twin set up in TU Dortmund University in Germany. The 5G connected brewery captures and monitors production data at every step of the brewing process and uses this data, together with data from the physical twin in Dortmund and a digital twin in the cloud, to optimise the process.

Nokia CTO ANZ Rob Joyce told CommsDay the physical and digital twins allow the brewers to refine the beer, tweaking parameters like hop temperature, malt and barley and how many times you brew in each cylinder. “There’s a loop back into the AI model to then say, okay, actually, this change made this happen, so then the digital twin remembers that for next time,” he said. The digital twin can learn the discrepancies between the processes in the two physical sites and the aim is to use this to produce the same output, tasting the same, at both sites. He added Nokia could actually develop this model into a brewery-as-a-service where the digital twin and connected micro-breweries ensure output consistency.



# Welding Robot Safety Proposal – 5G Innovation Grant Round 2

Nokia edge computer aggregates sensor data from nodes, performs environmental computations and interfacing with cobot and other devices



# In Summary

## 1

### The Three C's

- The three C's still apply to 4G, 5G & 6G.
  - Coverage
  - Capacity
  - Capability
- Low band key to achieving coverage.
- Mid & High Bands key for capacity

## 2

### 5G Evolution

- 5G was designed initially for FWA and eMBB
- 5G will evolve through 5G-Advanced to support both consumer, Mission Critical, Public Safety, IoT and Industrial applications.
- Throughput (especially uplink), latency and capacity will be key for Industrial applications.

## 3

### A look to the future

- Two 5G Labs in Australia
- 5G Futures Lab (Sydney) & 5G II Lab (Adelaide)
- Private 5G network now delivered throughout UTS Tech Lab campus.
- 5G II Grant Projects now completed and have delivered some interesting learnings
- Nokia is leading the drive of 5G into Industry 4.0 both regionally and globally.
- 6G is coming ....

**NOKIA**