How 5G can accelerate digitalization and post-Covid growth in Norway

6. November 2020

Jon Fredrik Baksaas

Laxmi Akkaraju

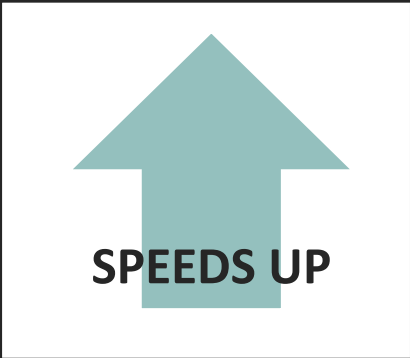# The two most important global trends right now:

1 DIGITISATION

2 GLOBALISATION

Opposing dynamics characterise and complicate these trends

1

ONE IMPACTS OTHER

2

DIGITISATION

GLOBALISATION

SPEEDS UP

NEED FOR REMOTE SERVICES

DIGITAL INCLUSION

TRANSFORMATIVE SERVICES

NEED FOR UBIQUITOUS TECHNOLOGY

NEED FOR UNIFORM DIGITAL EXPERIENCES

SLOWS DOWN

GLOBAL RECESSION DUE TO COVID19

TECHLASH, POTENTIAL NEGATIVE IMPACT OF TECHNOLOGY (DATA, ETHICS, SOCIETY)
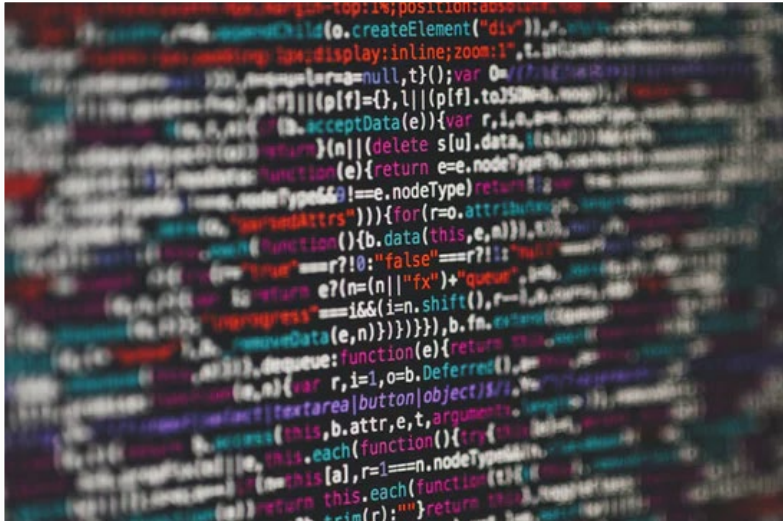
GEOPOLITICS + RISE OF WALLED GARDENS FRAGMENTS SCALE

DATA SOVEREIGNTY

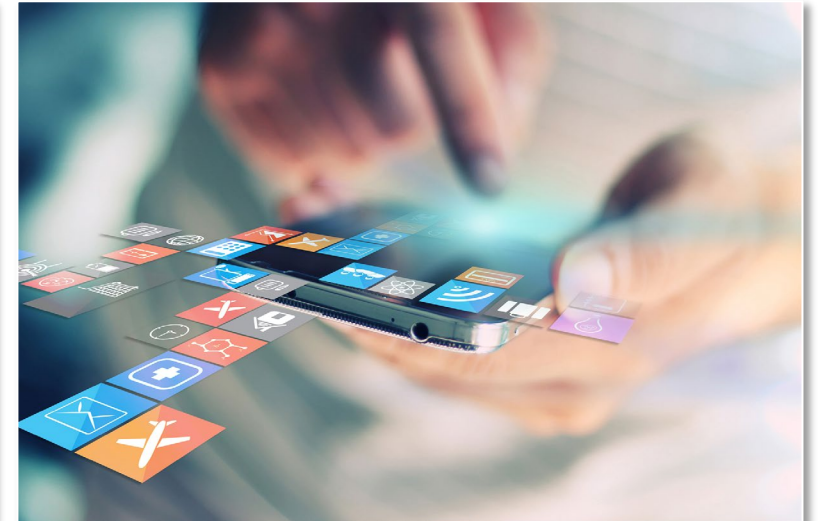# Three game changers within Digitisation:

DIGITISATION

SOFTWARE *VIRTUALISATION/CLOUD* *PLATFORM*
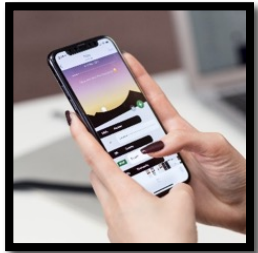
All of these new technologies leverage and enhance the digitization trends mentioned

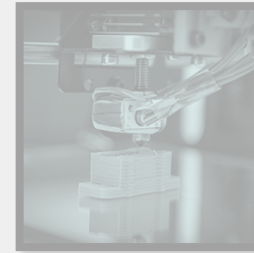*Examples*

5G NETWORKS
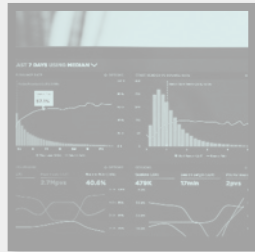
Artificial Intelligence

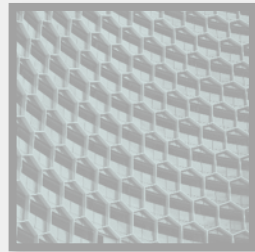Internet of Things

Robots and Cobots

Autonomous Vehicles

Additive Manufacturing

Big Data

Blockchain

Cloud and Edge Computing

Biotechnology
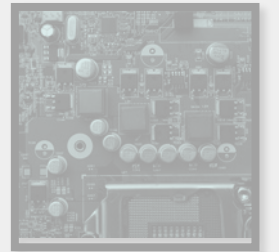
Quantum Computing

Agenda

What is 5G?

How will 5G accelerate growth post COVID?

The Challenges Ahead

What is 5G?

From infrastructure centric to software centric connectivity

Generational leap every 10 years...

| 3rd Industrial Revolution | 4th Industrial Revolution |

1980s **1990s** **2000s** **2010s** **2020s**

1G

Post-paid Market
- Proof-of-Concept for cellular
- Analog-based

2G

Prepaid Market
- Interoperability
- Interconnection
- Roaming

3G

Emerging Market
- Swappable SIM cards
- Open market devices

4G

Internet Market
- Always-on data
- Smartphones
- App stores

5G

Enterprise Market
- Horizontal enablers (AI, IoT, APIs, Network Slices)
- Industrialised partnership model (incl. NaaS / IaaS / PaaS)

How is 5G different?

Capacity/Latency

Radio innovations bring...

- Better **Spectral Efficiency**
- Higher **Spectral Capacity**
- More flexible **Spectral Reuse**

+

Flexibility

Software defined networks (SDN), network functions virtualisation (NFV), network slicing

5G

Stronger, better & faster next generation mobile technology

- **1000x** Capacity
- **1ms** Latency
- **10-100x** Data rates
- **-90%** Energy use

Plus infinite innovations & use cases...

The new features will enable many new service

ENHANCED MOBILE BROADBAND

CONSUMER AVR

WIDESPREAD IOT

2019   2020   2021   2022   2023   2024   2025

Fixed wireless Access

Public Safety Comms.

Smart Home

Smart Factory (real time remote control)

Fleet and inventory management and tracking

ARVR in Healthcare

Energy and Utility

Autonomous cars

Real time banking

Widespread IoT (Smart cities and Agriculture)

Highly Dense Urban

Urban/Suburban

Selective Rural

Coverage

| Speed 1.5Gbps Latency:<20 ms | Speed 1.5Gbps Latency:<10 ms | Reliability :99.99% Latency <5 ms | Reliability :99.99% Latency: <1ms | Reliability <10 year battery Devices: up to 1 m/km2 |

... and 5G launches are gaining momentum

As of Q2 2020, 87 operators in 39 markets had deployed commercial 5G networks…

…including 3 operators in Norway
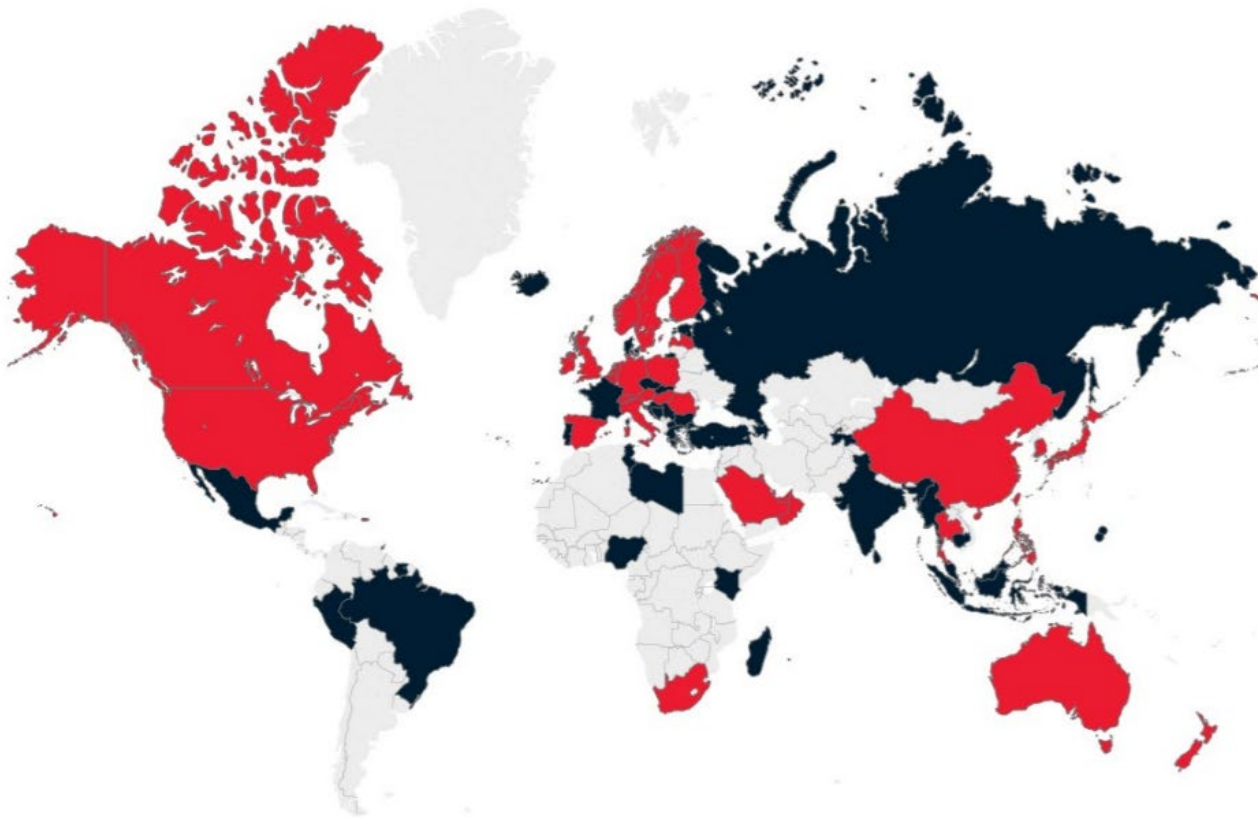
Planned commercial 5G network
Live commercial 5G network

Telenor opens first commercial 5G network in Norway

(Trondheim, 13 March 2020) Telenor's commercial 5G network opens today in nine different cities and villages across Norway, making Telenor the first mobile operator in the country to offer 5G to customers.

Published: 13 March 2020 14:07

TELIA LAUNCHES 5G IN NORWAY

2020-05-12

Today, Telia in Norway opens up its 5G network to customers in Lillestrøm and parts of Groruddalen in Oslo. During 2020, the 5G coverage will be extended throughout Oslo, and it will also be launched in Trondheim and Bergen. Telia's aim is to be first in Norway with a nation-wide 5G network by the end of 2023, and the ambition is [...] 5G over the course of

Nå åpner det tredje 5G-nettet i Norge

Ice begynner testfasen sin i Tromsø.

We have the opportunity to lead again...

4G Adoption By Region (%)

Norway: 0, 0, 0, 1, 9, 23, 51, 63, 72, 81
Scandinavia
World
Europe

2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
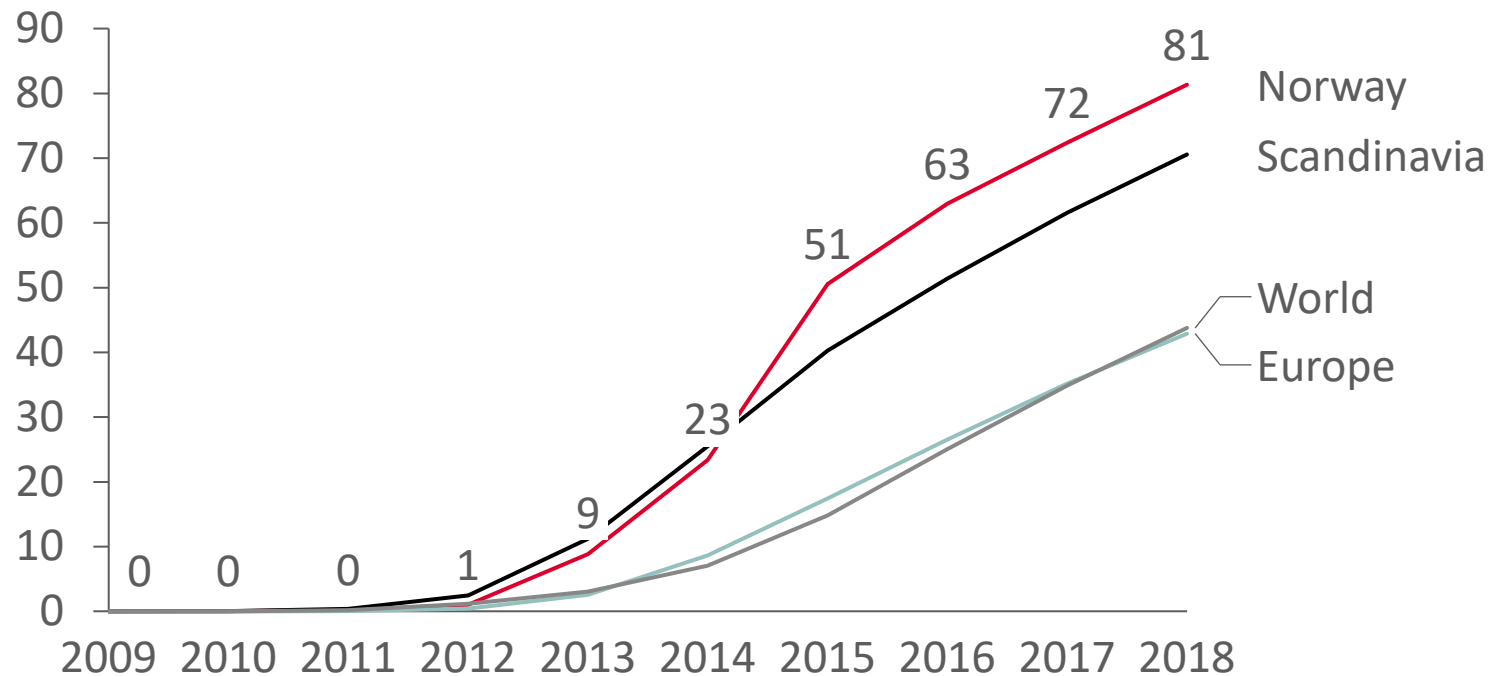
Adoption: % of connections that are of xG technology

5G Adoption 2020 (%)

Norway 0.2 | Scandanavia 0.6 | Europe 0.5 | China 12.5 | USA 2.8 | World 2.2

How will 5G accelerate growth?

How?

ECONOMIC CONTRIBUTION and JOB CREATION
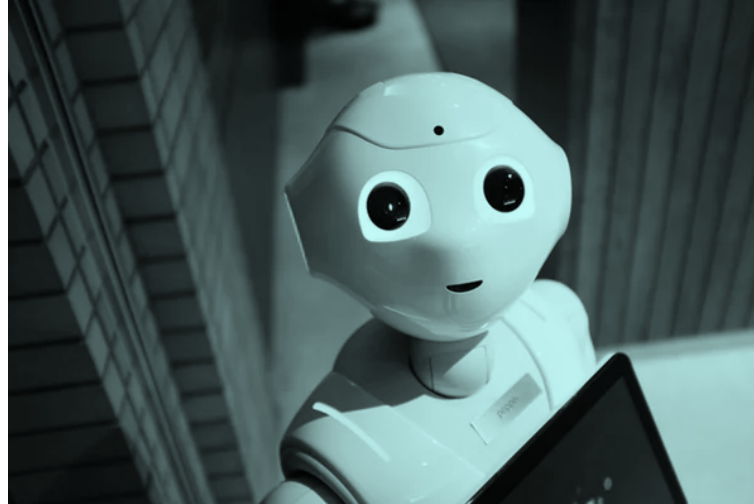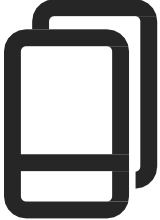
**DIGITISATION OF INDUSTRIES INNOVATION /
NEW SERVICES**

SOCIAL VALUE – DIGITIAL INCLUSION CLIMATE & SUSTAINABILITY

Mobile technology is everywhere...

	Unique Mobile Subscribers	Mobile Internet Users	Internet of Things	Smartphones
2019	**5.2b (67%)**	**3.8b (49%)**	**12.0b**	**65%**
2025	**5.8b (70%)**	**5.0b (61%)**	**24.6b**	**80%**

Mobile technology – economic contributions

MOBILE CONTRIBUTION TO GDP
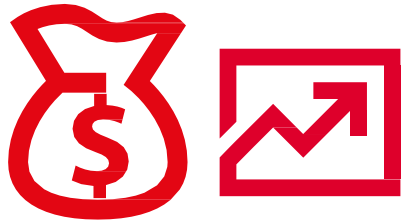
2019
$4.1tn

2024
$4.9tn
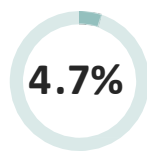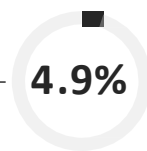
4.7% of GDP ———— **4.9%** of GDP

EMPLOYMENT

2019
16m

Jobs directly supported by the mobile ecosystem

+14m indirect jobs

OPERATOR CAPEX

2025
$1.14tn

Operator capex (78% on 5G)

Economic contribution of mobile in the Nordic* region

2019

2030

Total economic contribution of the mobile ecosystem ($ billions, % of GDP)
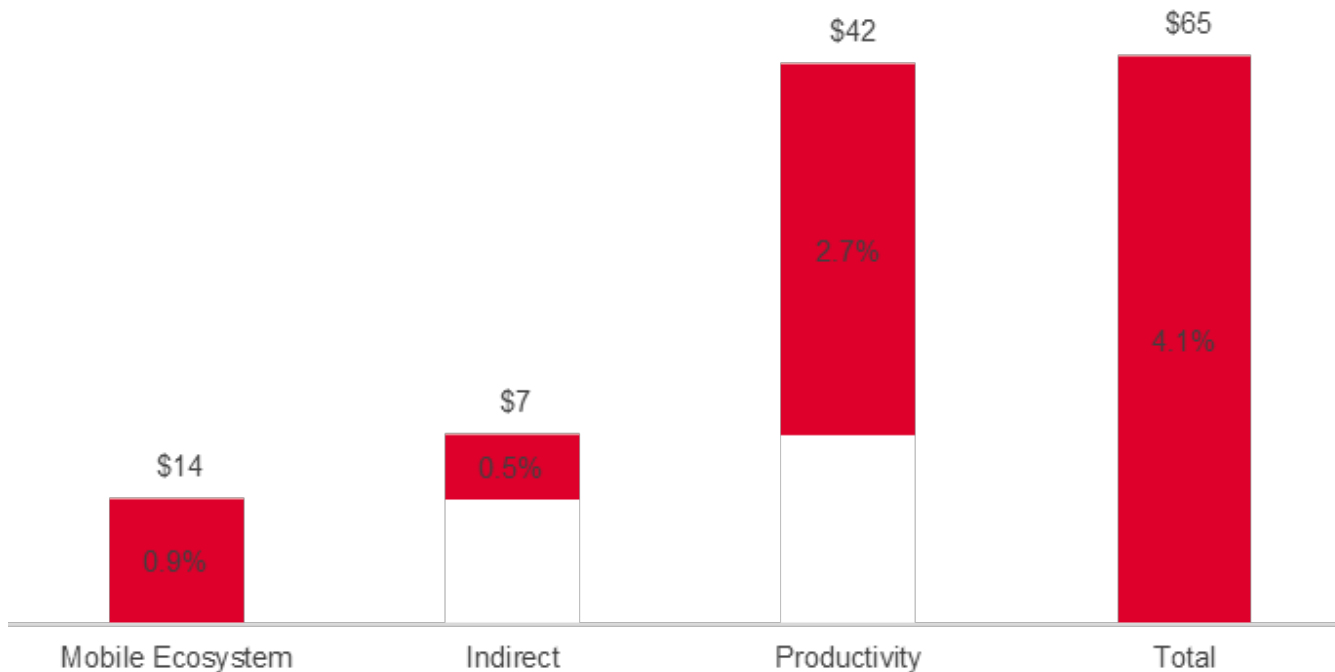
An addition **$10 B** (.5%) of annual regional GDP is expected

	Mobile Ecosystem	Indirect	Productivity	Total
	$14	$7	$42	$65
	0.9%	0.5%	2.7%	4.1%

Source: GSMA Intelligence (Total may not add up due to rounding)

Nordic region includes Denmark, Finland, Iceland, Norway and Sweden.

5G will accelerate digitization and enable platforms across all industries

Smart Cities

Media & Content

Auto & Mobility

Manufacturing

Healthcare

Software & Tech

Energy & Utility
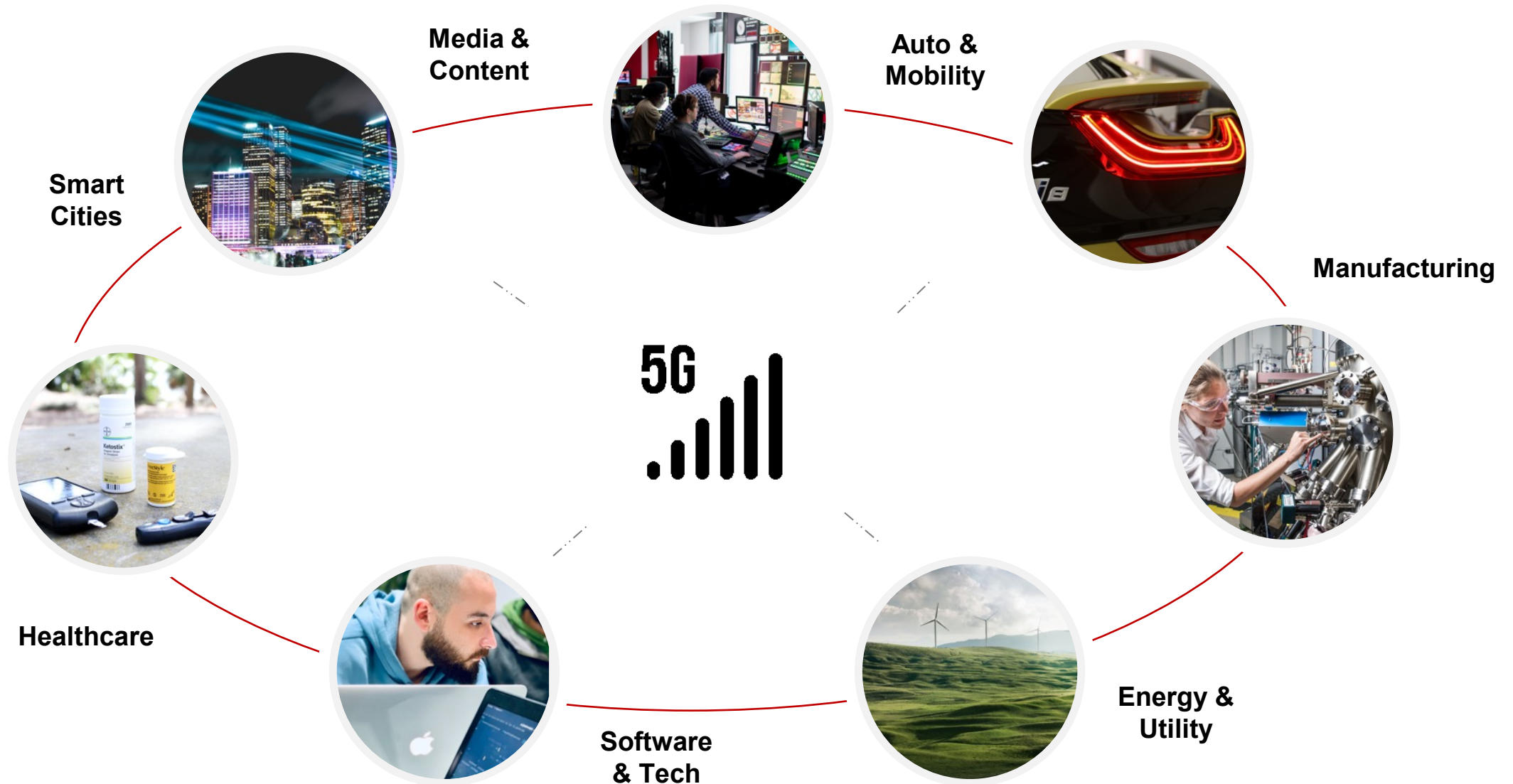
The intersection of AI, IoT and 5G will help bring intelligent connectivity to life

FASTER

5G

IoT

AI

MORE CONNECTED

SMARTER

Example - Mobility

5G powered driverless cars

5G road management

Seamless connectivity, communication and data transfer between multiple devices and vehicles
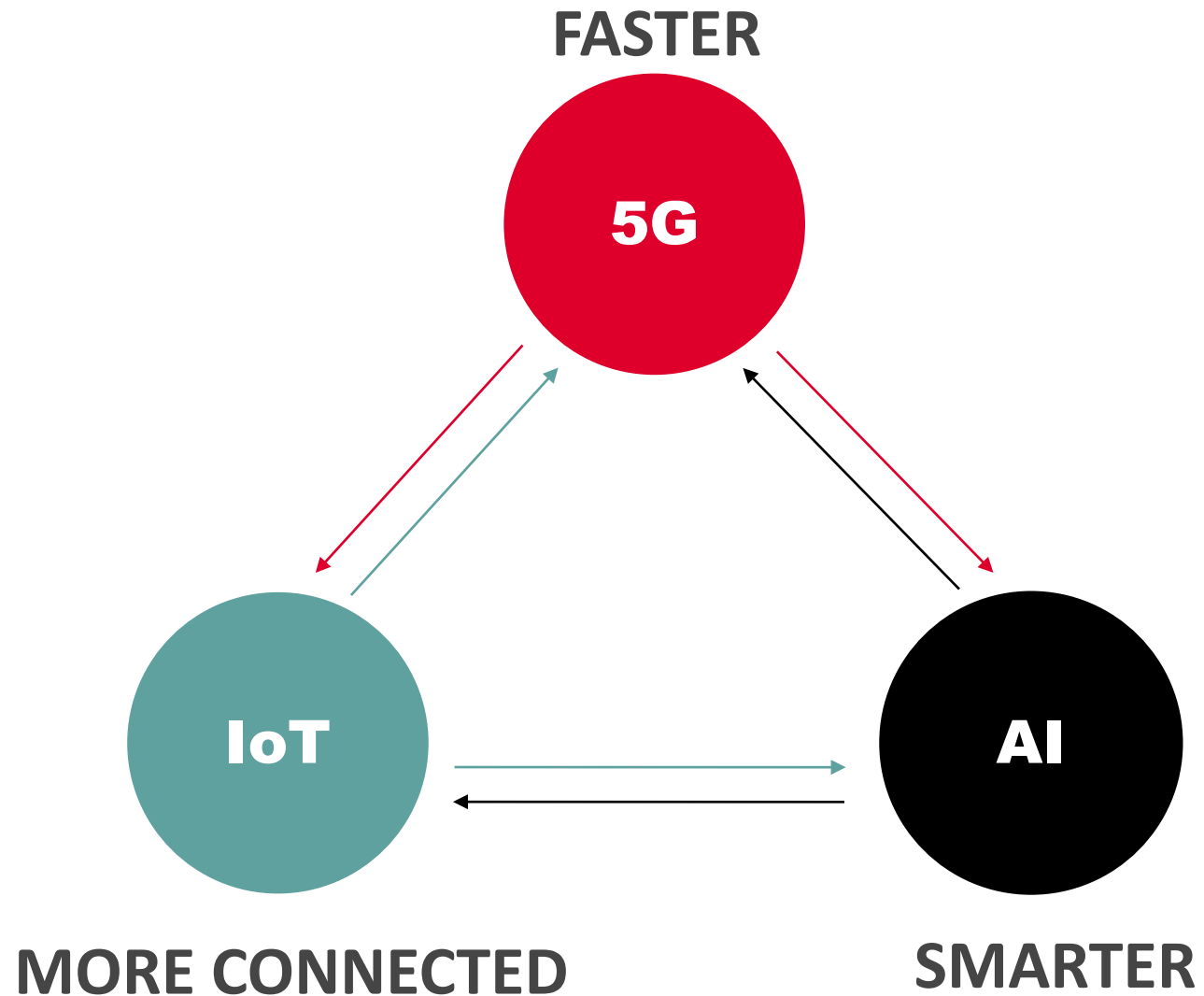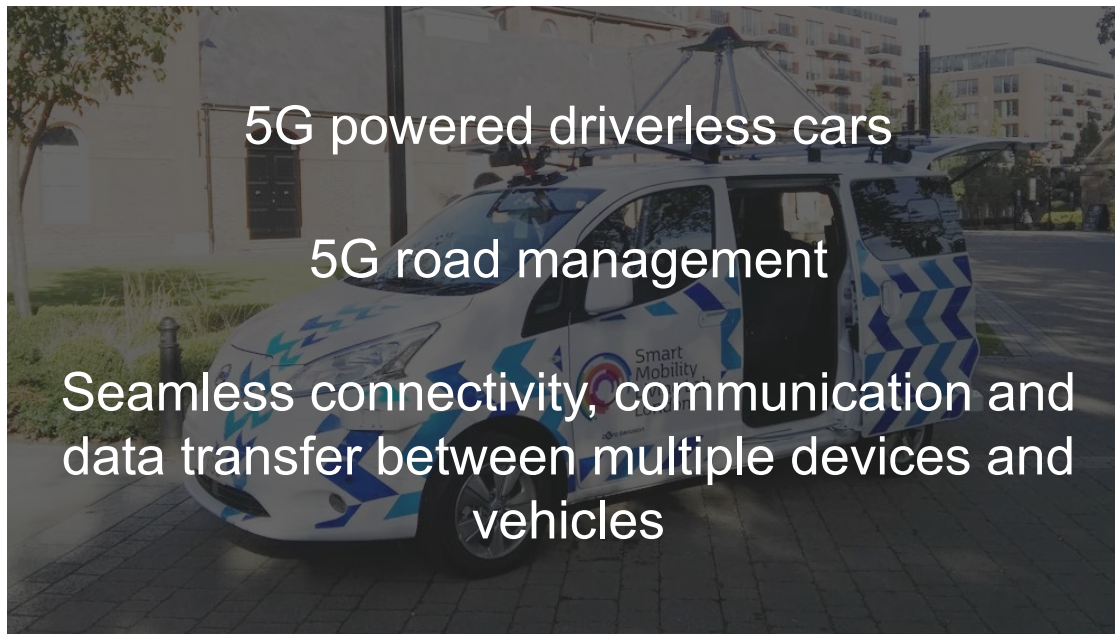
Partnership
O2   CISCO   Loughborough University

Business benefits: Mobility

Reduce motorists time in traffic	Reduce CO2 emissions	Reduce economic costs through 5G-based road management	Upsell of other digital services e.g. media, insurance products

Functional drivers of 5G

Enhanced mobile broadband	Ultra-reliable low latency comms.	Massive machine- type comms.	Security critical	Power efficiency

Manufacturing

Optimized and more robust processes

Flexible, adaptable production lines

Intelligently 5G connected production systems

Partnership		
ERICSSON	Telefónica	Mercedes-Benz
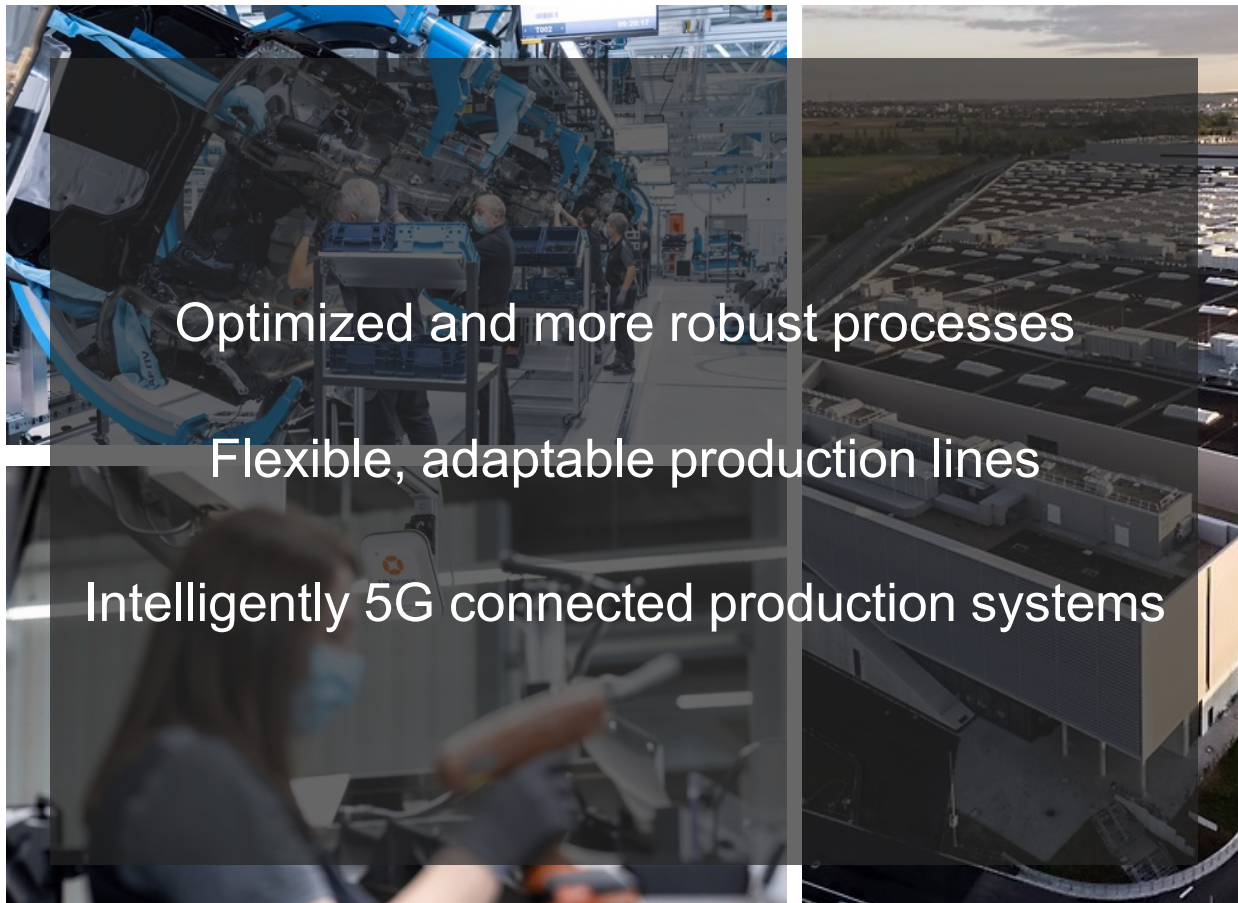
Business benefits: Manufacturing processes		
Customized and personalized products	Improved worker safety/reduced fatalities	Managing carbon footprints/ CO_2 emission per unit of value added

Functional drivers of 5G				
Enhanced mobile broadband	Ultra-reliable low latency comms.	Massive machine-type comms.	Security critical	Power efficiency

Logistics – Harbour

Upgrade from manual to automated operations e.g. automated cranes remoted controlled over 5G connection

5G connections to HD cameras and control data for programmable logic controllers

Devices that can communicate with each other

Partnership

ERICSSON

China unicom 中国联通

ZPMC 上海振华重工 SHANGHAI ZHENHUA HEAVY

Business benefits: Logistics

~70% Labour cost savings	Increased flexibility of equipment	Higher Efficiency of equipemnt

Functional drivers of 5G

Enhanced mobile broadband	Ultra-reliable low latency comms.	Massive machine-type comms.	Security critical	Power efficiency

Healthcare

Nokia logo

5G remote controlled ward inspection

Enhanced remote diagnosis over 5G

5G connected ambulance service

Partnership
Neusoft	中国移动 China Mobile	中国电信 CHINA TELECOM

Business benefits: Healthcare			
Bridging digital divide/ proportion of population covered by a network, technology	Effective and speedy recovery	Value added as a proportion of GDP and per capita due to reduced operating costs	Scalability of solutions/faster proof of concepts

Functional drivers of 5G				
Enhanced mobile broadband	Ultra-reliable low latency comms.	Massive machine-type comms.	Security critical	Power efficiency

Fighting COVID19

Fever

No PPE

Too close

NVIDIA DeepStream SDK delivers a complete streaming analytics toolkit for situational awareness through computer vision, intelligent video analytics (IVA) and multi-sensor processing.
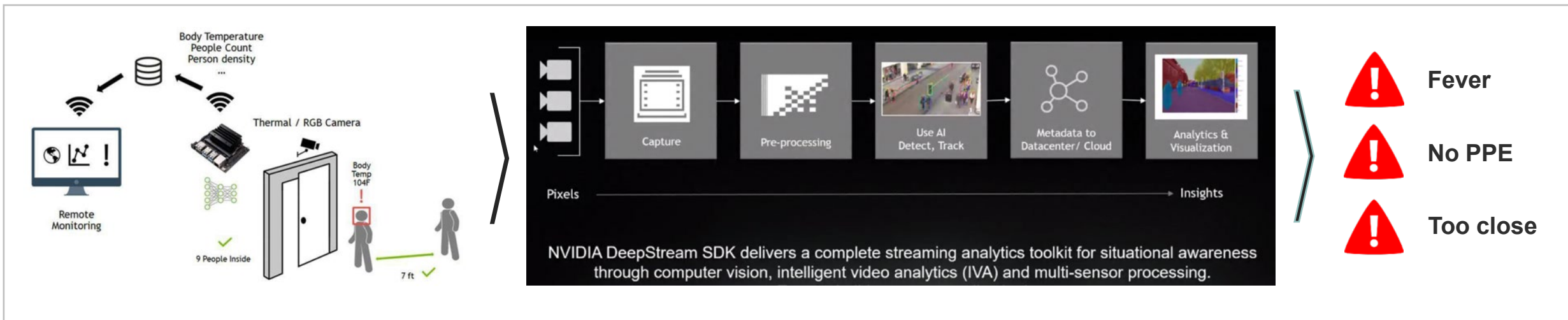
Thermal imaging for Body Temperature alerts

Personal Protective Equipment compliance
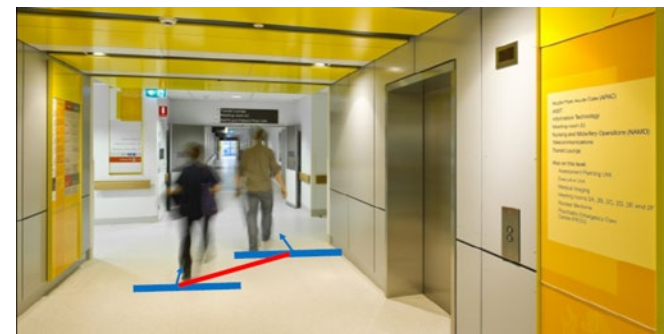
Proximity assessment for social distancing

Media and Entertainment is the biggest consumer use case for 5G

Global Market Size

$2.5tr

Global media and entertainment market size 2024

Where 5G Brings Media and Entertainment to Life

Cloud gaming

The ability to play a game on any device without owning the physical hardware or needing a local copy of the game itself

Immersive entertainment

The ability to experience standard media in a multi-dimensional realm achieved by combining reality with technology

MNOs are already making huge strides in 5G + Media and Entertainment

Immersive technology brings in offline world elements online…

…and enhances the customer experience and creates virtual worlds offline

360 Live Streaming Sports Events

VR/AR eSports Live Streaming

AR to enhance experience

VR Theme Parks

Mobile isn't just about economic value, generates social value too

Climate change, environment, disaster response

Reducing inequalities

Connecting underserved areas

Education

Health

Citizen Inclusion (financial, social, economic)

Privacy, fraud and consumer protection
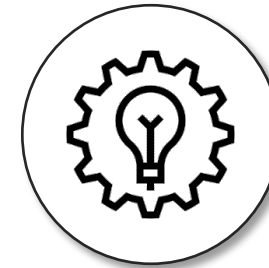
Economic growth and Innovation

5G Fixed Wireless Access (FWA) will help connect the unconnected

Half the world in still unconnected...

50% Population that had no internet access in 2019 (ITU)

1.9X More likely that households with internet access in developed countries than developing countries

11.8% % of households in less developed countries that had internet access

...5G FWA can help bridge this divide

- FWA: established means of providing internet access to homes using wireless mobile network technology rather than fixed lines

- 5G FWA can be used to quickly and cheaply deliver an alternative to wired broadband

- It can provide a level of service bandwidth capacity comparable to fibre optics

- Therefore a great technology to help connect the unconnected

Mobile enables X10 carbon savings in other sectors than our own emissions

How much?

How?

1.4bn MwH

Mobile's contribution to reduction of electricity and gas consumption

520bn litres of fuel

Volume of fuel not used globally due to mobile connectivity

Smart connected technologies

The mobile industry contributes less than 1% of global greenhouse gas emissions

Global Greenhouse Gas Emissions by Economic Sector

Other Energy — 10%
Electricity and Heat Production — 25%
Industry — 21%
Transportation — 14%
Buildings — 6%
Agriculture, Forestry and Other Land Use — 24%
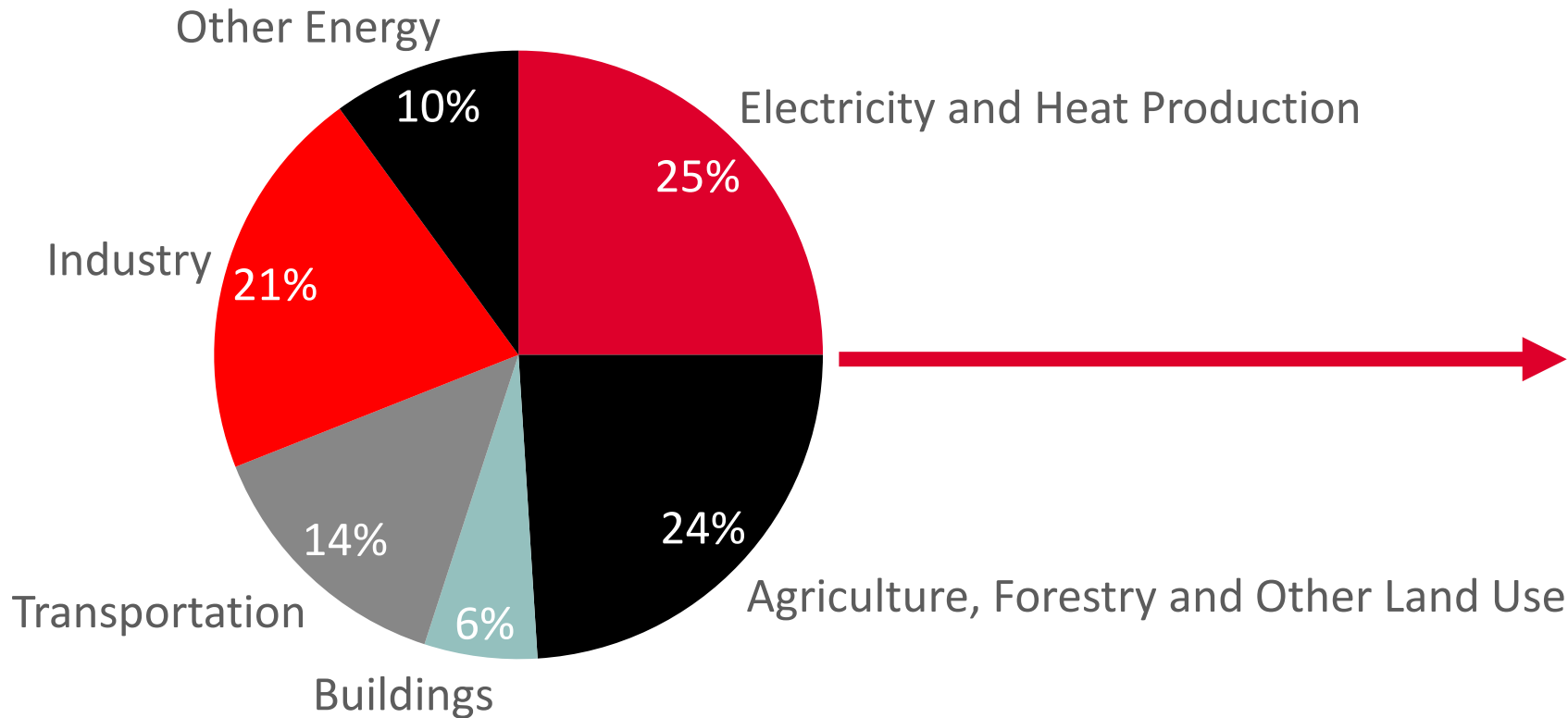
<1% Global Emissions

COVID19 highlighted how mobile can provide more than just resilient connectivity

VARIETY

HOME > TV > GLOBAL

MARCH 11, 2020 9:11AM PT

Spain's Telefonica Announces Measures to Aid in Struggle Against COVID-19 Spread

You are here: Latest News / Health News

Amid coronavirus crisis, BSNL introduces free broadband for a month to support 'work from home'

Press Trust of India   Mar 20, 2020 19:55 PM IST

NEWS / CHINA

How China is using AI and big data to fight the coronavirus

AT&T and Verizon Cancel Customer Shutoffs During Coronavirus Pandemic

Both companies seem to understand the struggles many Americans may face.

Daniel B. Kline (TMFDankline)
Mar 16, 2020 at 4:20PM
Author Bio

Follow @worstideas   18.2K followers

Motley Foo
STOCK ADVISOR

HELPING HAND Vodafone is giving 500,000 customers and vulnerable people free unlimited internet data for 30 days

Levi Winchester, Senior Digital Consumer Reporter
27 Mar 2020, 12:44 | Updated: 27 Mar 2020, 13:49

Coronavirus will not stand in the way of Telenor's 5G

By Harry Baldock, Total Telecom
Monday 16 March 20

HOME > BUSINESS > TECHNOLOGY > ARTICLE

TELECOMMUNICATIONS | 01 APRIL, 2020

Covid-19: Etisalat offers free internet video, voice calls for two months

1ST APRIL 2020 12:12PM   ANALYSIS   COMMENT WIRE

Coronavirus: Chilean 'Solidarity Plan' aims to secure telecom for all

The Challenges Ahead

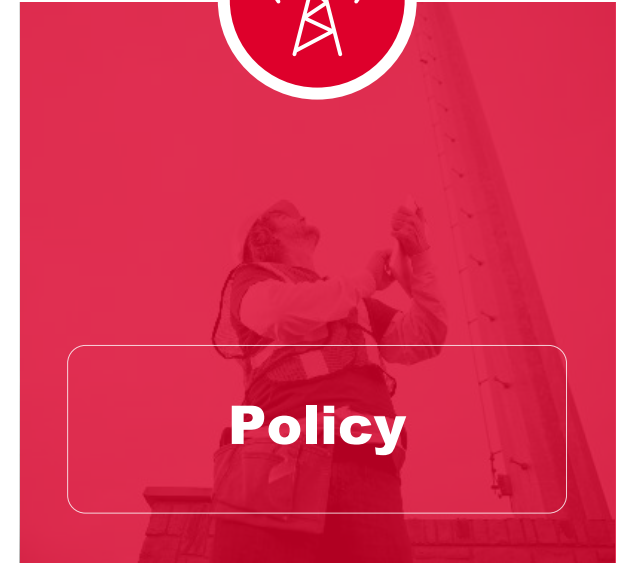# We've got a couple of hurdles to overcome

Technology

Commercial

Policy

| Infrastructure | Market readiness | Regulatory Framework |

| Standardization | Business Models | Spectrum |

GEOPOLITICS

SKILLS

Examples of 5G Licence Obligations

Obligations include population and/or geographical coverage, data speeds, deployment, investment, sharing

- **Several countries have imposed coverage obligations (population and/or geographical):**
  - E.g. Germany 98% of HH, Netherlands 98% of all municipalities, Italy 80% of commutes, Czech Republic 95% of population
- **Several countries included covering roads and railways:** Germany, Qatar, Norway
- **QoS obligations:** Germany 100 Mb/s for HH covered, 10 ms latency for highways and federal roads
- **Network deployment obligations:** Singapore MNOs have to deploy 5G SA networks over 3.5 GHz band from the start and deploy mmWave within 12 months
- **Investment ($) and number of BTS to be deployed:** Korea (150,000 base stations - 22.500 within three years (2021 - 15%), 45,000 within five years (2023 - 30%))
- **Sharing:** Finland (leasing spectrum for the purpose of providing services in the area not covered); France (option to share/assign spectrum to verticals to cater for their needs);
- **Commitments to expand optical fiber networks (Japan)**
- **Solutions for verticals:** France imposed commitments for MNOs to grant reasonable requests from vertical industry companies by providing customised solutions or share the spectrum spectrum; slicing or tiers services by 2023 imposed
- **Higher prices in exchange for no coverage obligations:** Sweden, Denmark
- **Lower or no upfront fees in exchange for coverage obligations:** Austria, UAE, Qatar

Geopolitics is polarising technologies

Governments increasingly restrict certain vendors

8/10 largest software companies are US-based

Asia Pacific region (excluding Japan) now accounts for 63% of global semiconductor revenues

AI as a geopolitical arms race

	The world leader	**The ethical approach**	**The future AI super-power**
	Cutting-edge expertise held by private tech companies	*AI leadership based on European principles*	*Seeking AI world leadership by 2030*
Public policy	No central AI policy	Focus on role of ethics in addition to AI capabilities	National plan to accelerate AI development by 2020
Public funding	$0bn for 2018-2020 $2bn DARPA funding	EU investing €1.5bn by 2020 UK £1bn, France €1.8bn	Estimated government investment ~$30bn by 2020
Strategic advantage	Mature research, talent and venture capital pools	Strong regulation and privacy protection	Enormous amount of data Relaxed regulation on privacy

How can companies, regions, countries enhance digital competitiveness?

Regulatory & Technology	Future Readiness	Knowledge
Identify and amplify specific country's unique drivers	Long-term vision + swift implementation	Talent
Public Policy	Adaptive attitudes	
Capital Investment	Business agility	Training & education
Technological framework	IT integration	Encourage innovation and entrepreneurship

In the last 3 years Norway has become less digital competitive compared to peers

Bar chart showing digital competitiveness change by country:

Country	Value
Bulgaria	+130
Montenegro	+111
France	+95
Latvia	+78
Serbia	+78
Romania	+71
Lithuania	+62
Luxembourg	+50
Hungary	+44
Spain	+42
Canada	+13
Denmark	+8
Netherlands	-2
Ireland	-4
Slovenia	-5
UK	-6
Iceland	-8
Poland	-17
Switzerland	-19
Malta	-25
Austria	-30
Greece	-32
USA	-33
Finland	-41
Germany	-52
Portugal	-63
Estonia	-67
Belgium	-75
Italy	-77
Bos. & Herz.	-82
Sweden	-83
Cyprus	-84
Czech Rep.	-84
Norway	-100
Slovak Rep.	-102
Albania	-121
Croatia	-142

Source: European Centre for Digital Competitiveness – Digital Riser Report 2020

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However, we must we wary of "stall-out"

Plotting the Digital Evolution Index, 2017
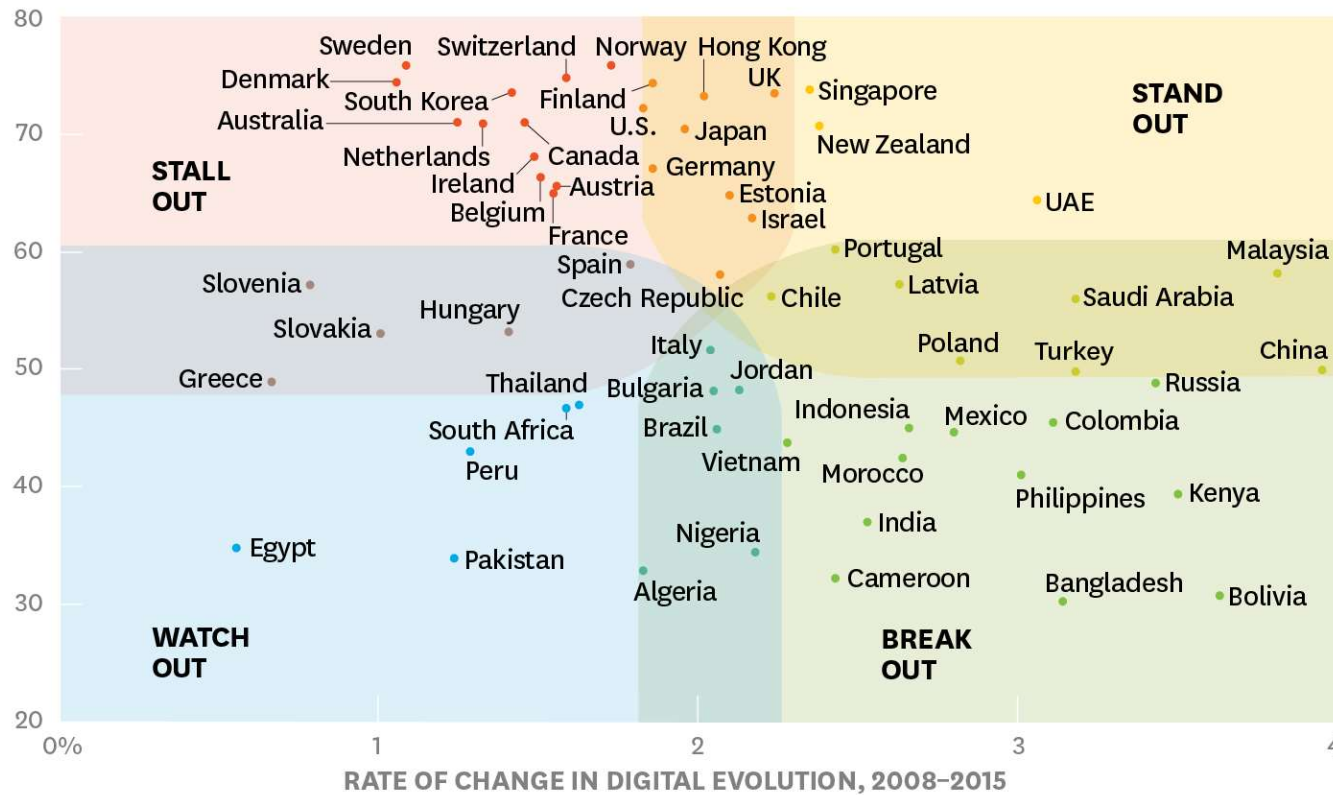Where the digital economy is moving the fastest, and where it's in trouble.

HOW COUNTRIES SCORED ACROSS FOUR DRIVERS ON THE DIGITAL EVOLUTION INDEX (OUT OF 100)

STALL OUT
STAND OUT
WATCH OUT
BREAK OUT

Sweden, Switzerland, Norway, Hong Kong, Denmark, UK, Singapore, South Korea, Finland, U.S., Japan, New Zealand, Australia, Netherlands, Canada, Germany, Ireland, Austria, Estonia, UAE, Belgium, Israel, France, Spain, Portugal, Malaysia, Slovenia, Czech Republic, Chile, Latvia, Saudi Arabia, Slovakia, Hungary, Poland, Turkey, China, Greece, Italy, Jordan, Russia, Thailand, Bulgaria, Indonesia, Mexico, Colombia, South Africa, Brazil, Morocco, Peru, Vietnam, Philippines, Kenya, Egypt, Pakistan, Nigeria, India, Algeria, Cameroon, Bangladesh, Bolivia

RATE OF CHANGE IN DIGITAL EVOLUTION, 2008–2015

Thank You!