This is 5G

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01 What is 5G?

Previous generations of mobile networks addressed consumers predominantly for voice and SMS in 2G, web-browsing in 3G and higher-speed data and video streaming in 4G. The transition from 4G to 5G will serve both consumers and multiple industries. With global mobile data traffic expected to grow eight times by the end of 2024, there is a need for a more efficient technology, higher data rates and spectrum utilization. New applications such as 4K/8K video streaming, virtual and augmented reality and emerging industrial use cases will also require higher bandwidth, greater capacity, security, and lower latency. Equipped with these capabilities, 5G will bring new opportunities for people, society, and businesses.

What will happen in the next five years?

More efficient networks will address the capacity needs from the growing mobile data traffic. Industries will be transforming by new capabilities brought on by 5G.. Examples of these capabilities include:

1. The ability to download a full-length HD movie in seconds
2. The quick reaction time (low latency) to enable remote robotics
3. The ability to spin up virtual networks on-demand with network slicing
4. Battery lifetimes beyond 10 years for remote cellular devices

Requirements of a 5G network

Up to 100 times faster data rates: instant access to services and applications

Network latency lowered by a factor of five; use cases in areas such as manufacturing, automotive, energy and utilities, healthcare

Mobile data volumes expanded by a factor of 1,000

10x better battery life: remote sensors and more sustainable networks

2G **Voice**
Massive mobile voice communication

3G **Browsing**
Feature phones and mobile broadband introduction

4G **Video**
Smartphone popularization and mobile data traffic exponentially increase

5G **Consumers and multiple industries**
More efficient networks, any device connected and new business opportunities across industries

In 2024, Ericsson forecasts:

9B
9 Billion worldwide mobile subscriptions

22B
22 billion IoT connections

74%
Video will account for 74% of mobile data traffic

1.9B
1.9 billion 5G subscriptions

45%
45% global 5G population coverage

02 Why 5G

Three areas of usage and applications have been defined by the International Telecommunication Union's Radiocommunication Sector (ITU-R) as part of its program to expand and support diverse usage scenarios and applications beyond 4G:

Enhanced Mobile Broadband
Mobile broadband is the first use case for 5G. It addresses traffic growth demands and higher consumer experience needs. 5G fixed wireless access doesn't only eliminate the need for costly deployment of deep-fiber fixed access infrastructure, it offers peak rates that few fixed technologies are be able to match.

Usage scenarios:
Widespread connectivity is needed as the demand for mobile broadband continues to grow
Human-centric use cases: Access to multi-media content, such as 4k streaming on a mobile device or on-site live experiences
4K/8K TV, health wearables and home sensor services.

Fixed Wireless Access
5G fixed wireless access doesn't only eliminate the need for costly deployment of deep-fiber fixed access infrastructure, it offers peak rates that few fixed technologies are be able to match.

Usage scenarios:
4K/8K TV, health wearables and home sensor services.

Massive Internet of things (IoT)

Usage scenarios:
Connectivity is required for millions of devices
Typically transmitting a low volume of non-delay-sensitive data (low bandwidth and not latency critical)
Devices must be low cost with extremely long battery lives

Critical IoT

Usage scenarios:
Ultra-reliable, resilient and instantaneous connectivity
Stringent requirements on availability, latency and throughput

Use cases:
Wireless control of industrial manufacturing and production processes, remote medical surgery, distribution and automation on a smart grid, and transportation safety.

Enhanced Mobile Broadband

Immersive content	Smartphones	Mobile/venue	4K/VR/AR
Mobile gaming			

Fixed Wireless Access

Wireless fiber	FWA CPE	Home/enterprise	4K/8K/health /home sensors

Massive Internet of things (IoT)

Smart building	Logistics, tracking and fleet management	Smart meter	Smart agriculture
Capillary network			

Critical IoT

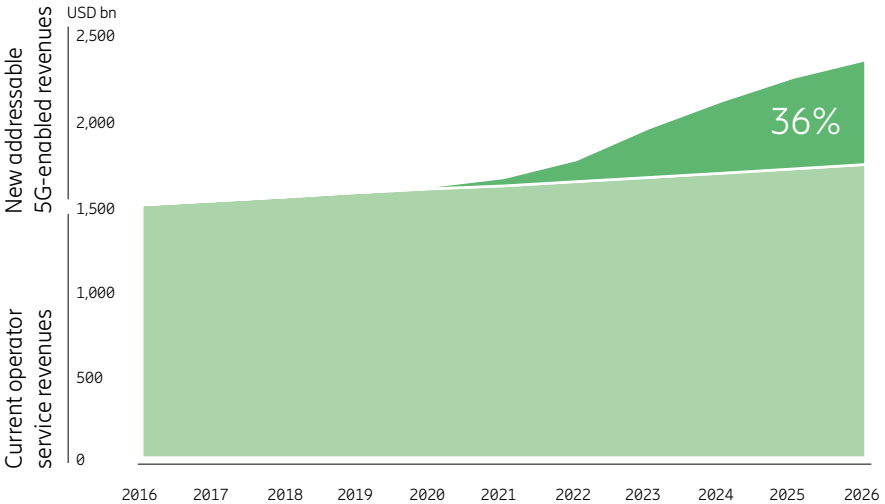
Traffic safety and control	Remote manufacturing, training, surgery	Industrial application and control	

03 What will 5G mean for operators?

The introduction of 5G will bring more efficient networks, addressing the capacity needs. Evolution to 5G will enable 10 times lower cost per gigabyte than current 4G, based on Ericsson's economic study of enhanced mobile broadband.

5G will also enable new services, new ecosystems and new revenues. By digitalizing 10 industries with 5G, operators can benefit from up to USD 619 billion market opportunity globally in 2026, based on Ericsson's report The 5G business potential, representing potential of additional up to 36 percent growth in revenues. Operators will find the greatest opportunities in the manufacturing and energy/utilities sectors. Capturing this market potential requires investment in technology, as well as business development, go-to- market models, and organizational adaptation.

Figure 5: Current and 5G-addressable revenues (global)



Source: Ericsson and Arthur D. Little

The 5G value chain

Figure 4: Operator adressable 5G market in ten industries (USD billion)

Source: Ericsson and Arthur D. Little

Based on the 10 industries examined in the study, the graph above illustrates the potential revenue for operators addressing industry digitalization with 5G in 2026.

The three main roles for the operator when it comes to generating revenue through 5G industry digitalization have been identified as follows:

Network developers excel in operating network infrastructure, including access, core and transport, and apply powerful IT enablers to support consumers and businesses with uniquely tailored connectivity solutions that maximize the power of digital.

Service enablers, in addition to empowering connectivity, provide digital platforms on which businesses can easily configure and integrate value-enhancing digital capabilities into their business processes in highly automated ways.

Service creators create new digital services, build innovative businesses and collaborate beyond telecoms to set up new digital value systems, in addition to providing digital platforms and infrastructure services.

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Blazing the 5G trail

From 2011 to 2020 – and beyond

Ericsson and its key industry partners have reached several important milestones on the road to global 5G standardization.

2011

We initiated discussions among the top four mobile infrastructure vendors to ponder 4G's successor

2012–2015

We managed the METIS project, collaborating with universities and research institutes to address the challenges of 5G mobile and wireless communications

We built a 5G radio testbed

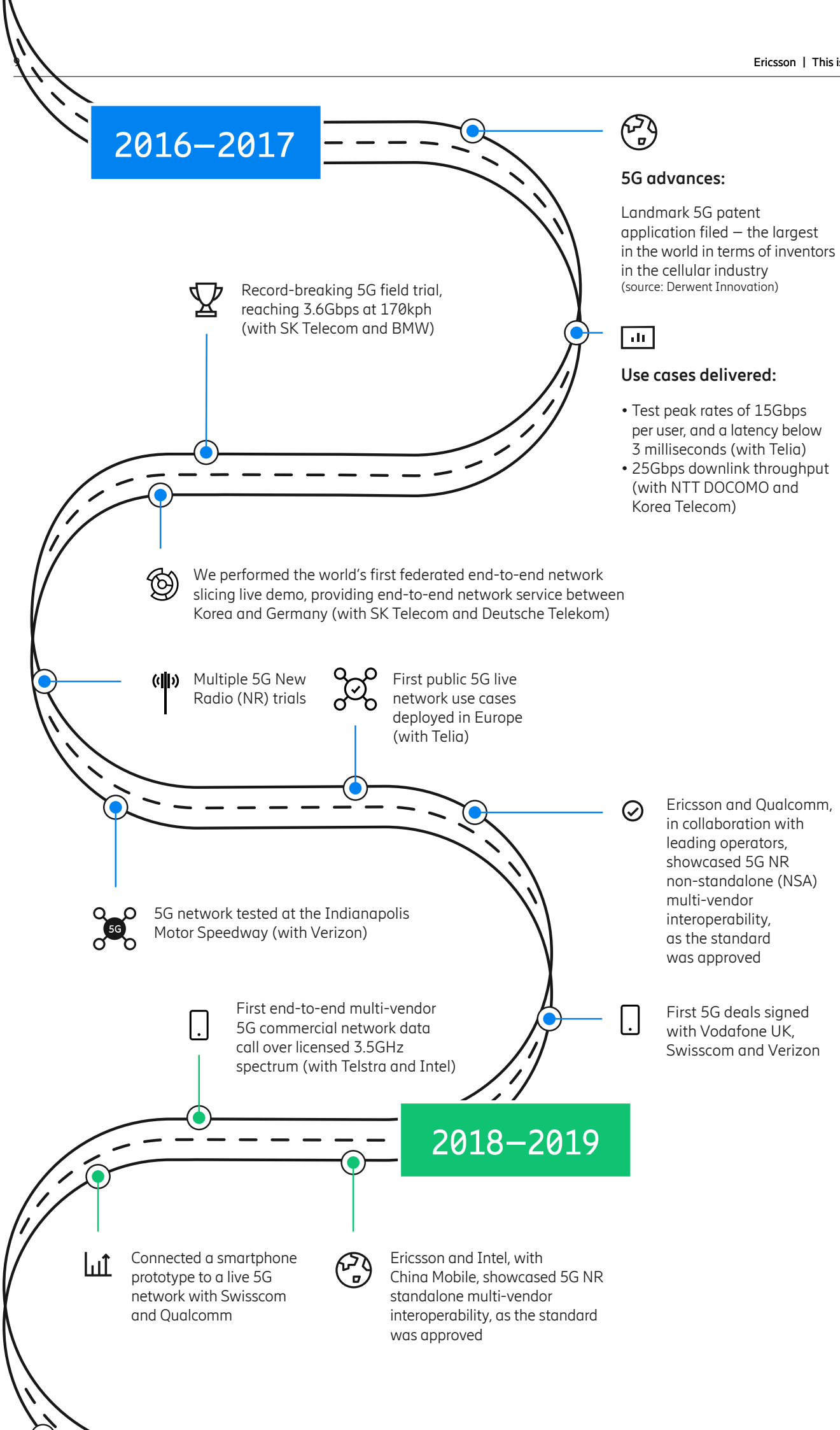
2015–2016

We proved several tech concepts, including:

- 5G-LTE dual connectivity
- 5G multipoint connectivity with distributed multiple-input and multiple-output (MIMO)
- 5G data rates exceeding 5Gbps

We won several early 5G awards, including:

- Biggest Contribution to 5G Development
  LTE Asia Awards
- Biggest Contribution to 5G Standards
  LTE & 5G World Awards


2016–2017
5G advances:
Landmark 5G patent application filed – the largest in the world in terms of inventors in the cellular industry
(source: Derwent Innovation)
Record-breaking 5G field trial, reaching 3.6Gbps at 170kph (with SK Telecom and BMW)
Use cases delivered:
• Test peak rates of 15Gbps per user, and a latency below 3 milliseconds (with Telia)
• 25Gbps downlink throughput (with NTT DOCOMO and Korea Telecom)
We performed the world's first federated end-to-end network slicing live demo, providing end-to-end network service between Korea and Germany (with SK Telecom and Deutsche Telekom)
Multiple 5G New Radio (NR) trials
First public 5G live network use cases deployed in Europe (with Telia)
Ericsson and Qualcomm, in collaboration with leading operators, showcased 5G NR non-standalone (NSA) multi-vendor interoperability, as the standard was approved
5G
5G network tested at the Indianapolis Motor Speedway (with Verizon)
First end-to-end multi-vendor 5G commercial network data call over licensed 3.5GHz spectrum (with Telstra and Intel)
First 5G deals signed with Vodafone UK, Swisscom and Verizon
2018–2019
Connected a smartphone prototype to a live 5G network with Swisscom and Qualcomm
Ericsson and Intel, with China Mobile, showcased 5G NR standalone multi-vendor interoperability, as the standard was approved

First to successfully perform interoperability tests with third-party device chipsets in high, mid and low bands

Leading 5G standardization, with the most 5G-related contributions submitted in the key 3GPP Working Groups RAN 1 and RAN 2 through the end of 2018

Over 3 million 5G-ready (hardware) radios shipped to our customers since 2015

By end of April 2019, publicly announced commercial 5G deals with 18 named, not claimed, operator customers

47 Memorandums of Understanding (MoU) for 5G collaborations with operators

First with commercial live networks in the US, South Korea and Switzerland and deployed operational 5G networks based on commercial equipment in Europe, the Middle East, Australia and Asia

Tomorrow

We will see 5G in action:

There will be even more use cases and applications deployed, for both consumers and industries

Discover how we are enabling future innovation
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05 Technologies at the heart of 5G

Whereas 2G, 3G and 4G were primarily radio focused, 5G will represent an entire system with radio, a telecom core, and OSS all transformed to support new requirements. This process will involve new radio technologies, a virtualized cloud-based core, and end-to-end management and orchestration to facilitate automation and new concepts like network slicing. The system will not be standardized – instead many technology areas and interfaces will be standardized in different environments.

- **5G core network technologies**
- **5G radio network technologies**

Artificial Intelligence (AI) is the ability of machines to learn processes.

Automation makes all configurations of services and network connections, which are mainly manual today, automated. This reduces time to market for new services and improves the quality with less risk of error.

Beam tracking is used to follow the position and movements of a given device. 5G Radio points one or more beams in the best direction for that device in real-time, to ensure consistently reliable connections.

Cloudification is the conversion and/or migration of data and application programs to make better use of cloud computing.

Cross-domain orchestration manages provision, end-to-end services and connectivity across 5G system domains like radio, transport and core.

eCPRI interface is an evolved front-haul standard agreed by industry leaders, which makes it possible to move the beamforming processing from the baseband to the radio. This simplifies Massive MIMO deployment and offers the flexibility needed in real-life site environments.

Edge computing is the technology to move the execution applications closer to the users. This will enable latency sensitive applications e.g AR/VR or mission critical use cases. This is done by having cloud platforms distributed further out in the radio network.

Federated network slicing is designed to enable the provision of network slices globally, making sure that customers do not need individual agreements with different operators for a global service experience.

Gigabit LTE offers LTE-based download peak speeds higher than one gigabit per second.

Internet of things (IoT) describes the enablement of connectivity of physical devices, vehicles, and appliances to connect, exchange and store data.

Massive Multiple-Input and Multiple-Output (MIMO) is the combination of MIMO and beamforming with large number of antenna elements – to improve both throughput and energy efficiency.

- **5G core network technologies**
- **5G radio network technologies**

Network Function Virtualization (NFV) enables the on-demand instantiation of functions in a format easier to load-balance, scale up/down, and allow for the movement of functions dynamically across distributed hardware resources in the network.

Network slicing enables mobile network operators to provide dedicated virtual networks with functionality specific to the service or customer over a common network.

Network slice management automates the setup of service connections to secure service quality, save costs and gain fast time to service.

NR Carrier Aggregation is the combination of two or more 5G NR Carriers in different frequency band to improve both network coverage and capacity.

Radio Access Network (RAN) connects individual devices to other parts of a network through radio connections.

RAN Compute is the RAN processing platform of the future that supports a greater deployment flexibility required for the growing diversity of 5G use cases.

Software-Defined Networking (SDN) centrally configures and manages physical and virtual network devices in datacenters, such as routers, switches, and gateways.

Spectrum Sharing is software that dynamically shares spectrum between 4G and 5G carriers based on traffic demand, intended for quick introduction of 5G within 4G carriers on existing infrastructure.

Virtual Network Functions (VNF) describes telecom core functions like packet core, IP Multimedia Subsystem and Subscriber data management when implemented as software on cloud-based hardware platforms. The software will be optimized for the cloud environment. This evolution has started and will be applicable also for LTE networks.

Virtualization combines hardware and software network resources and functionality into a single, software-based administrative entity – a virtual network.

5G Architecture is 5G non stand-alone (NSA) refers to a 5G network that requires a 4G one to work. 5G stand-alone (SA) is not linked to a 4G network and will provide support for a wider set of use cases.

5G New Radio (NR) is the radio access interface that will become the foundation for the next generation of mobile networks.

5G policy and user data for Network Slices ensure users get the right service quality with data integrity.

5G transformation services ensure the migration of the network and operation from legacy to 5G core, virtualized and based on an automated operational model.

Technical expectations of 5G

Peak rate data

1-20 Gbps

Area traffic capacity

0.1-10 Mbps/m^2

User experience data rate

10-100 Mbps

Availability

99.999% (of time)

Spectral efficieny

x1-x3

Battery life

10 years*

Mobility

300-350 km/h

Reliability

99.999% (of packets)

Latency

1-10 ms

Position accuracy

10m ‹ 1m

Connection density

10k-10m devices/km^2

Network energy efficiency

x10-x100

Security

Stronger subscriber authentication, user provacy and network security

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