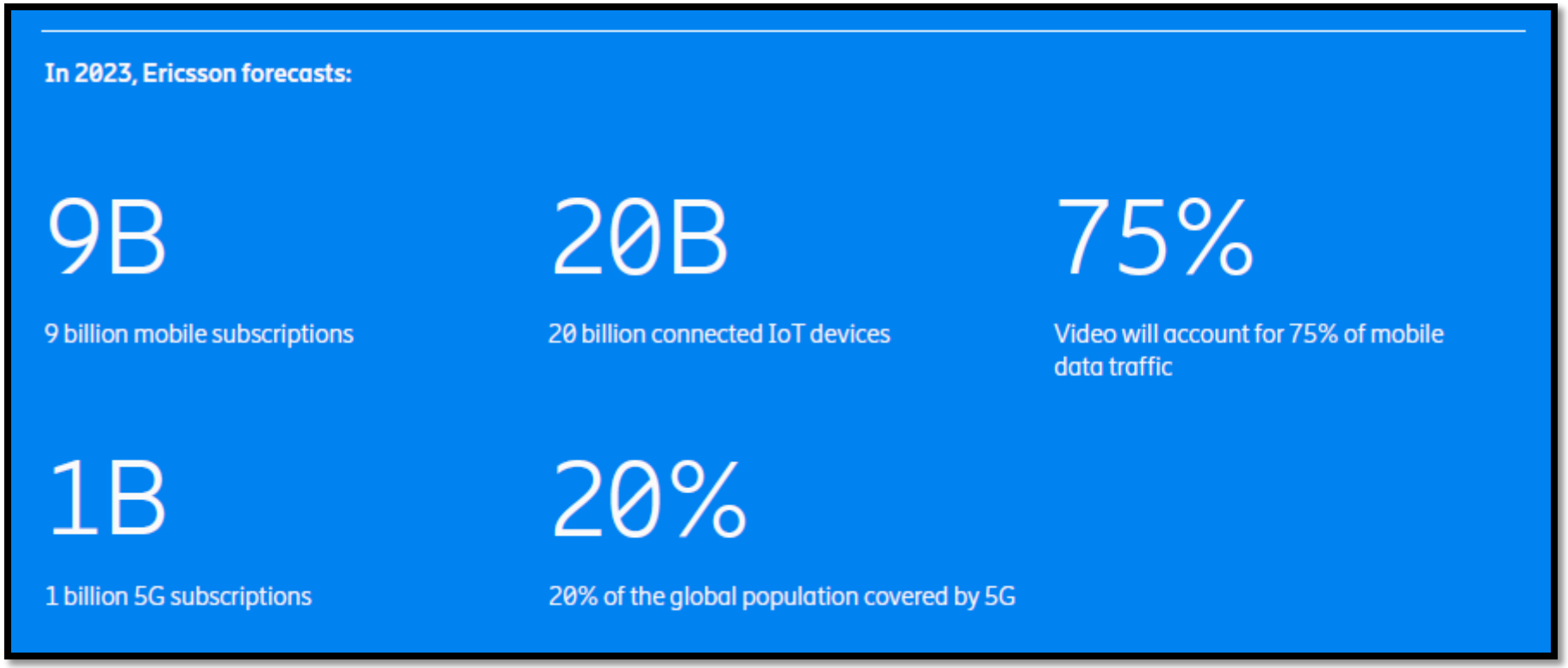
5G and Autonomous & Connected Vehicles

Designed by the M&C Support Hub
Latest updated: 2019-06-27

Agenda

- What is 5G?
- 5G and the auto industry
- Connected Vehicles
- Autonomous Vehicles

Forecast



— Source: https://www.ericsson.com/en/5g/what-is-5g

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

— Source: https://www.ericsson.com/en/5g/what-is-5g

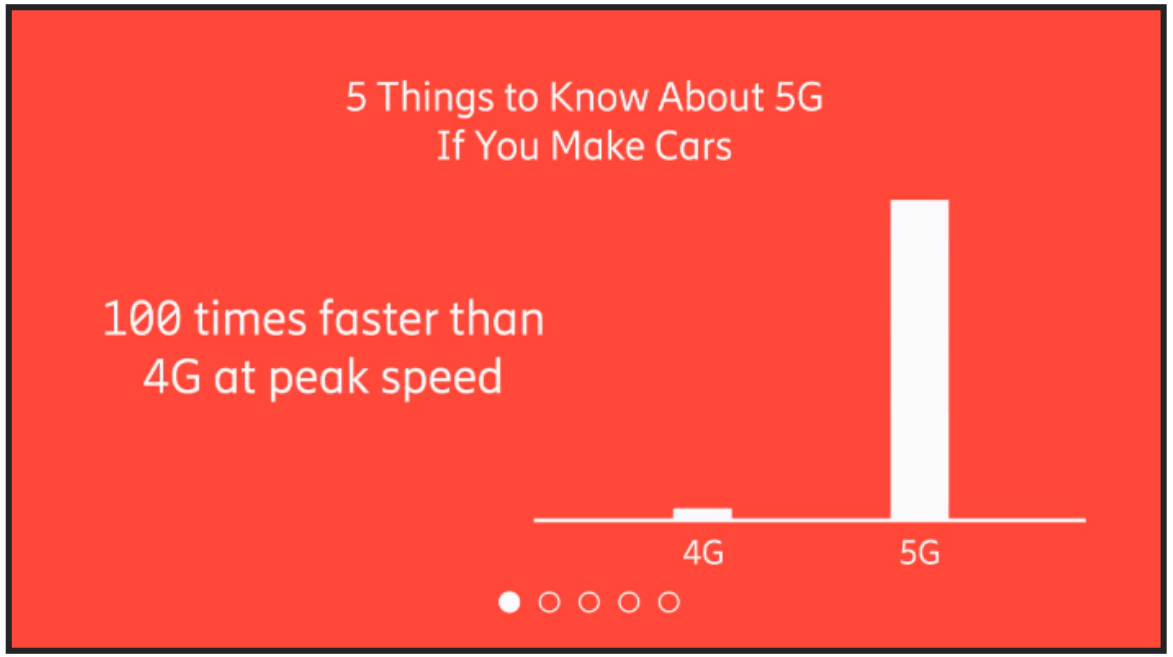
Technical expectations of 5G

Peak rate data 1-20 Gbps	**Area traffic capacity** 0.1-10 Mbps/m²
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 10-10 ms	**Position accuracy** 10m ‹ 1m
Connection density 10k-10m devices/km²	**Network energy efficiency** x10-x100

— Source: https://www.ericsson.com/en/5g/what-is-5g

5G and the auto industry: speed



According to Dr. Joy Laskar, CTO of Maja Systems, **future autonomous cars will generate nearly 2 petabits of data**, which is equivalent of 2 million gigabits. "With an advanced Wi-Fi connection, **it will take 230 days to transfer a week-worth of data from a self-driving car**," Laskar said.

With 5G, that time would go from **230 days to just over 2 days**.

— Source: https://www.ericsson.com/en/5g/what-is-5g/5-things-to-know-about-5g-if-you-work-in-the-auto-industry

5G and the auto industry: latency

Human reaction speed is a bit above 200 milliseconds, leading to accidents every day. **5G's 5 millisecond latency** is practically real-time, which can be used to provide the user with additional safety information before it is visible, for example **roadworks, fast moving emergency vehicles and visually hidden pedestrians about to cross the street**. These cooperative Advanced Driver Assistance Systems (ADAS) will help the driver to drive safely and avoid accidents.

— Source: https://www.ericsson.com/en/5g/what-is-5g/5-things-to-know-about-5g-if-you-work-in-the-auto-industry

5G and the auto industry: reliability

Reliable communication means **guaranteed delivery of time-critical information**. For example, for remotely driving an autonomous vehicle in real-time in case its autonomous function fails.

We expect adoption of fully autonomous capabilities in limited areas initially leveraging 5G signal coverage, with long-term evolution towards fully autonomous transport eco-system for maximizing safety, efficiency, and sustainability.

— Source: https://www.ericsson.com/en/5g/what-is-5g/5-things-to-know-about-5g-if-you-work-in-the-auto-industry

5G and the auto industry: new cases

In Europe, the **5GCAR** project, led by Ericsson, is helping to develop an overall 5G system architecture. As part of their work, they identified a **number of new use cases that need 5G** to unlock the future of transportation, from **lane merge coordination** to **long range sensor sharing** and **increased protection for pedestrians**.

— Source: https://www.ericsson.com/en/5g/what-is-5g/5-things-to-know-about-5g-if-you-work-in-the-auto-industry

5G and the auto industry: Industry 4.0

Jörg Burzer, Member of the Divisional Board of Management of Mercedes-Benz Cars, Production and Supply Chain, said: "With the installation of a local 5G network, **the networking of all production systems and machines in the Mercedes-Benz Cars factories will become even smarter and more efficient in the future.** This opens up completely new production opportunities."

— Source: https://www.ericsson.com/en/5g/what-is-5g/5-things-to-know-about-5g-if-you-work-in-the-auto-industry

Connected Vehicles

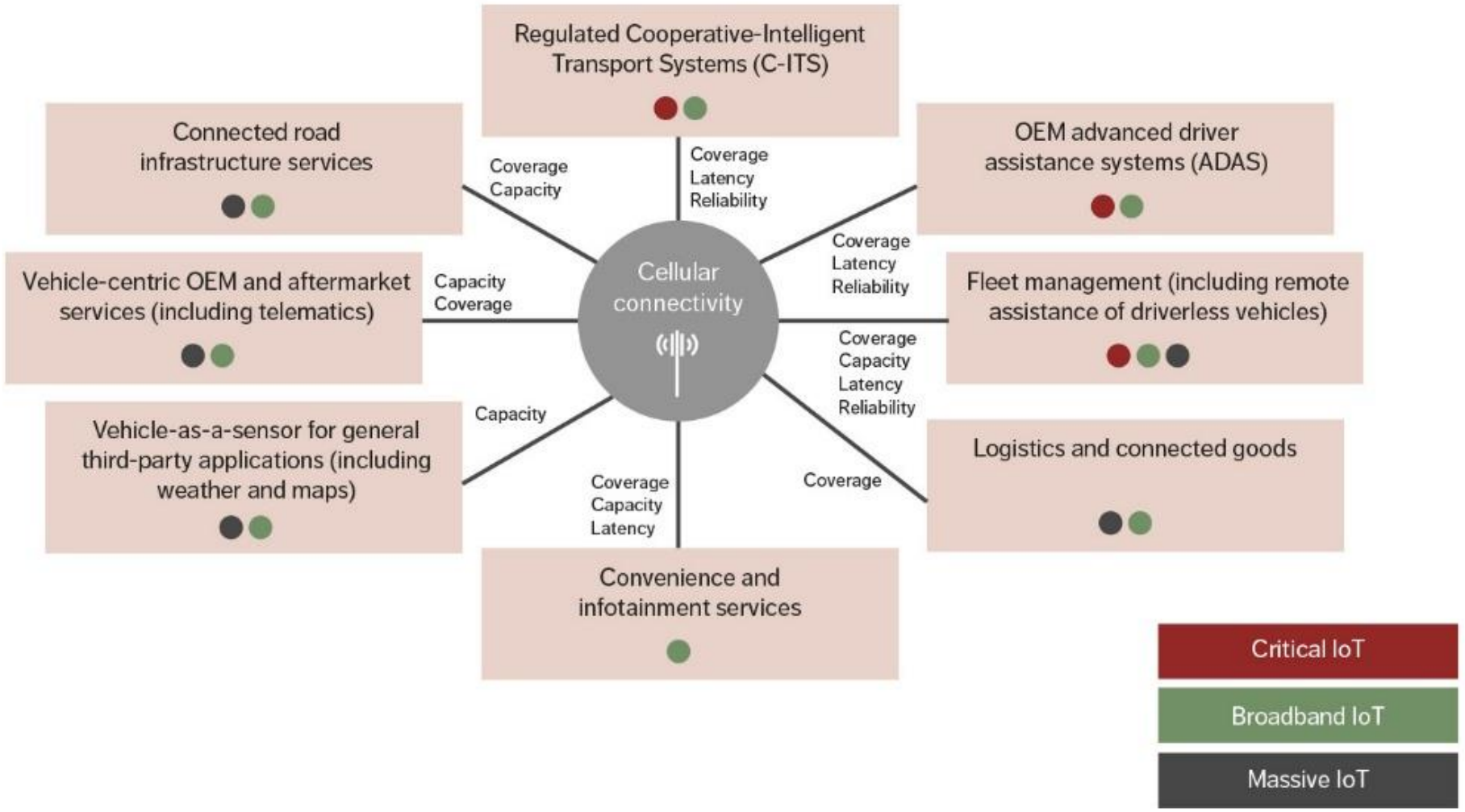
— Once considered merely "nice to have," connectivity is rapidly becoming a critical part of road transportation systems. Ericsson predicts that **the number of connected cars in operation will rise to more than 500 million in 2025.**

— At the same time, traffic and road authorities are seeking new technology solutions to **reduce carbon emissions, traffic congestion and casualties** – solutions that are often dependent on vehicle functionality and the ability to provide various types of support for drivers and vehicles.

— While it is true that many of today's 2G-4G networks can provide sufficient connectivity for numerous Internet of Things (IoT) applications, the higher data rate, lower latency and improved capacity provided by 5G New Radio (NR) access make **5G systems the ideal choice to maximize the safety, efficiency and sustainability of road transportation**

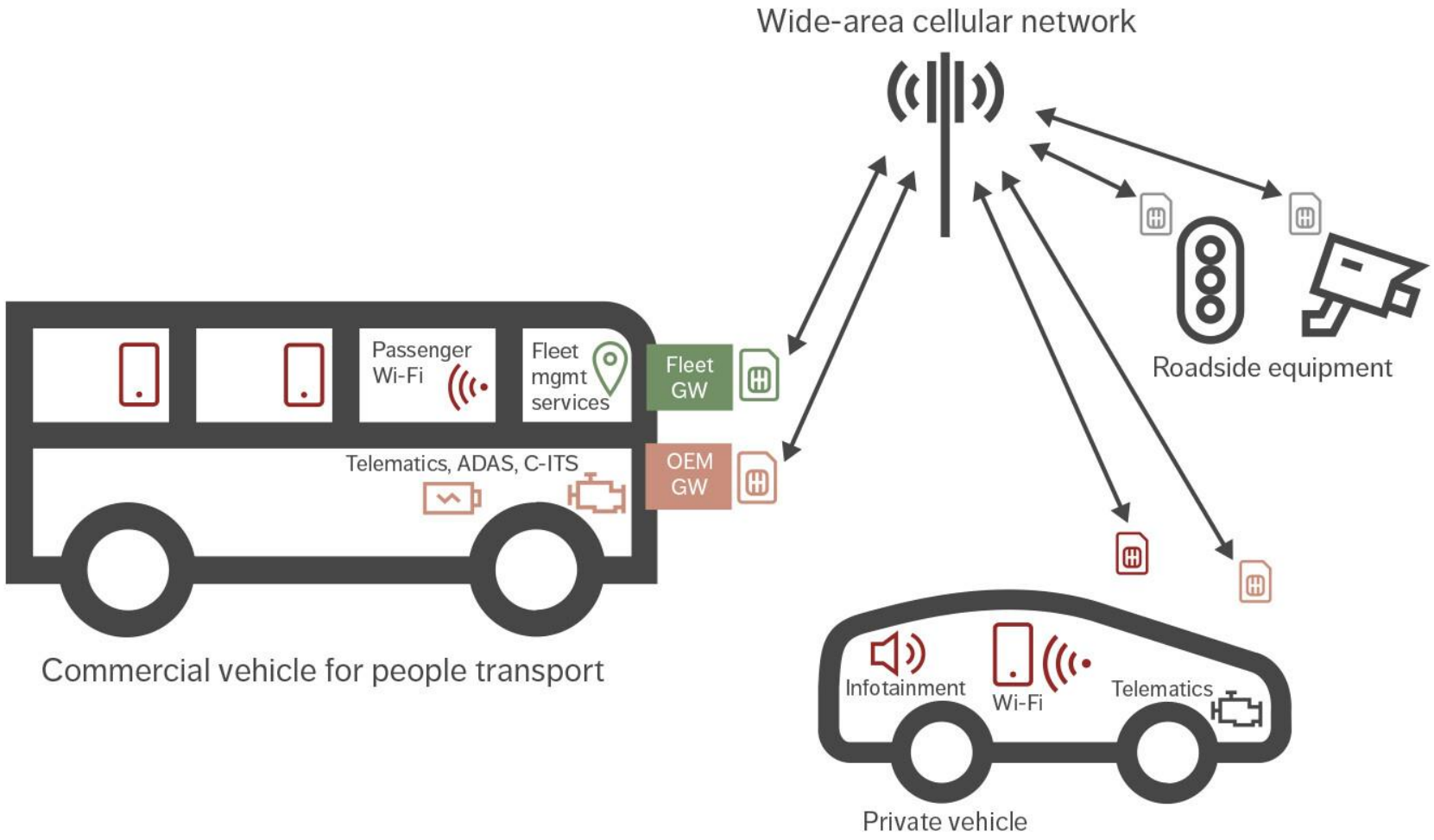
Source: https://www.ericsson.com/en/reports-and-papers/ericsson-technology-review/articles/transforming-transportation-with-5g

Automotive and road transport services



Source: https://www.ericsson.com/en/reports-and-papers/ericsson-technology-review/articles/transforming-transportation-with-5g

in-vehicle and wide-area connectivity



Source: https://www.ericsson.com/en/reports-and-papers/ericsson-technology-review/articles/transforming-transportation-with-5g

Road safety and efficiency

— Cooperative Intelligent Transport Systems (C-ITSs).

— allow **vehicles, infrastructure** and vulnerable road users (VRUs) such as **pedestrians with smartphones to be connected and exchange information** relating to traffic and roads.

— supported by cellular 4G and 5G networks, they will be able to transmit data with very low latency.

Source: https://www.ericsson.com/en/blog/2020/5/how-cellular-networks-improve-road-safety-and-efficiency

Connected Vehicles

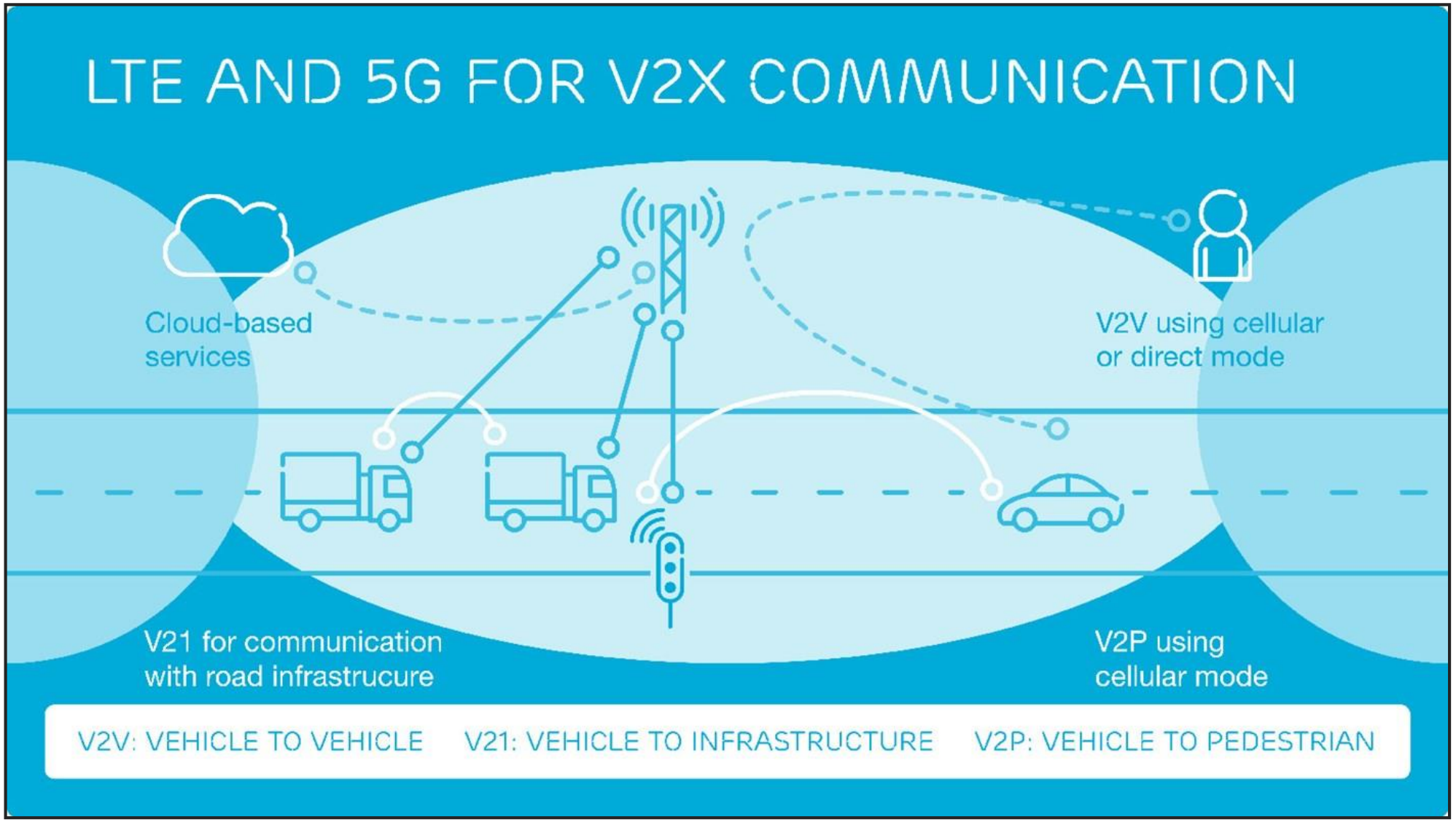
— There are already more than **100 million vehicles on the road today with cellular network connectivity capabilities**, and more than 500 million vehicles will be connected by 2025.

— For road authorities, road operators and cities that aim to communicate with vehicles and other road users, the **use of cellular networks is a cost-efficient option**.

— communication between vehicles involved in the traffic allows them **to inform each other of any upcoming dangers**, which is the key to further reducing the number of traffic accidents.

Source: https://www.ericsson.com/en/blog/2020/5/how-cellular-networks-improve-road-safety-and-efficiency

Connected Vehicles

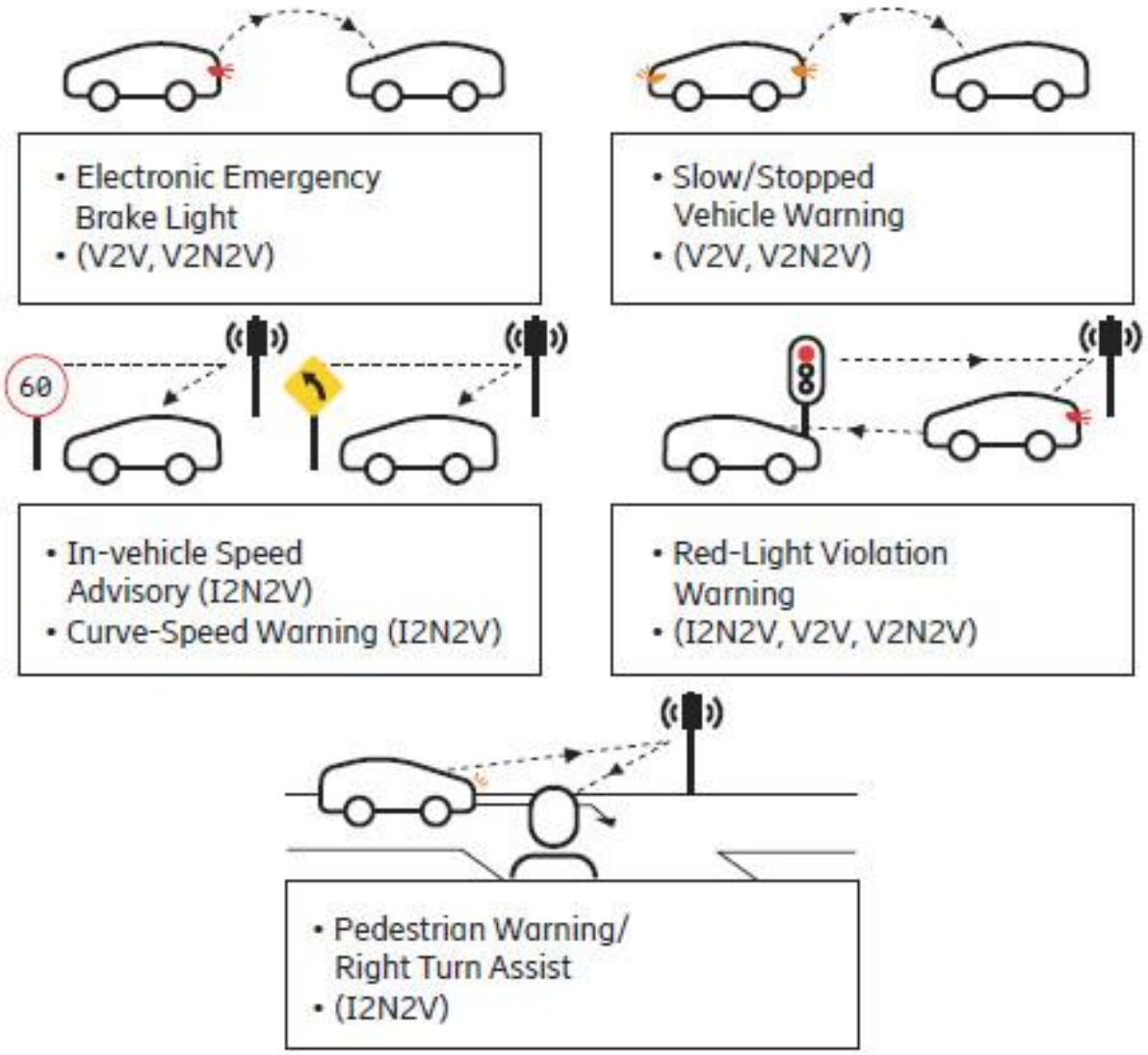


Source: https://www.ericsson.com/en/cases/2017/scania-connected-transportation

Use case trial: Victoria, Australia

— joint field trials of **4G-based** connected vehicle technology in Victoria, Australia with **Telstra, Lexus Australia**, and local government bodies such as the **Department of Transport** (formerly VicRoads) and the **Transport Accident Commission** (TAC).

— Conducted over **Telstra's existing commercial 4G network**, the trials focused on C-ITS **"in-vehicle signage"** use cases, where information is provided inside vehicles.



Source: https://www.ericsson.com/en/blog/2020/5/how-cellular-networks-improve-road-safety-and-efficiency

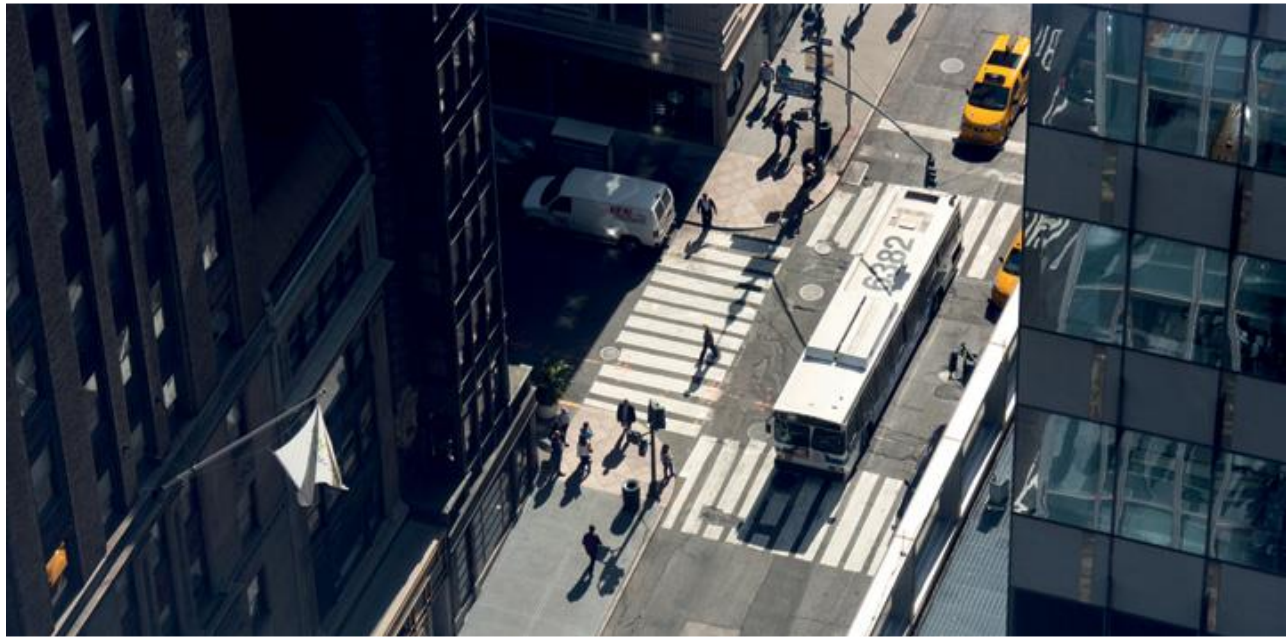
5G for traffic management

— https://youtu.be/Vs7bUQgwiIU

Remote operation of vehicles with 5G

— At its headquarters in Södertälje, Sweden, Scania has a 5G proof-of-concept test network devoted to **controlling a bus remotely** from a vehicle operations center.

— The Integrated Transport Research Lab at KTH Royal Institute of Technology also has a research concept vehicle (RCV) which is remotely operated.



Source: https://www.ericsson.com/en/mobility-report/articles/remote-monitoring-and-control-of-vehicles

Remote operation of vehicles

— **Idea:** address the **autonomous vehicle safety concern**, with remote operation which brings a safety mechanism that allows **public buses to be monitored and controlled by a remote operator** from a distance, if needed.

— **Network requirements** for remote operation include **broad coverage, high data throughput and low latency** to enable continuous **video streaming** and to **send commands** between a remote operations center and a vehicle.

— **Scania's 5G proof-of-concept test network** involve a **remote operator** driving a bus around the test track, as well as to and from the parking facilities. Sensor data from the bus, including a high-resolution video feed, is streamed to the remote operations center over **LTE radio access** with an **evolved 5G core network**

Source: https://www.ericsson.com/en/mobility-report/articles/remote-monitoring-and-control-of-vehicles

contributors to system response time

The 5G proof-of-concept network is not the biggest source of latency in the complete remote operation system. Additional factors that cause delays include servo-driven mechanics, as well as the video encoding and decoding

5G radio access lowers round trip time to under 4 ms

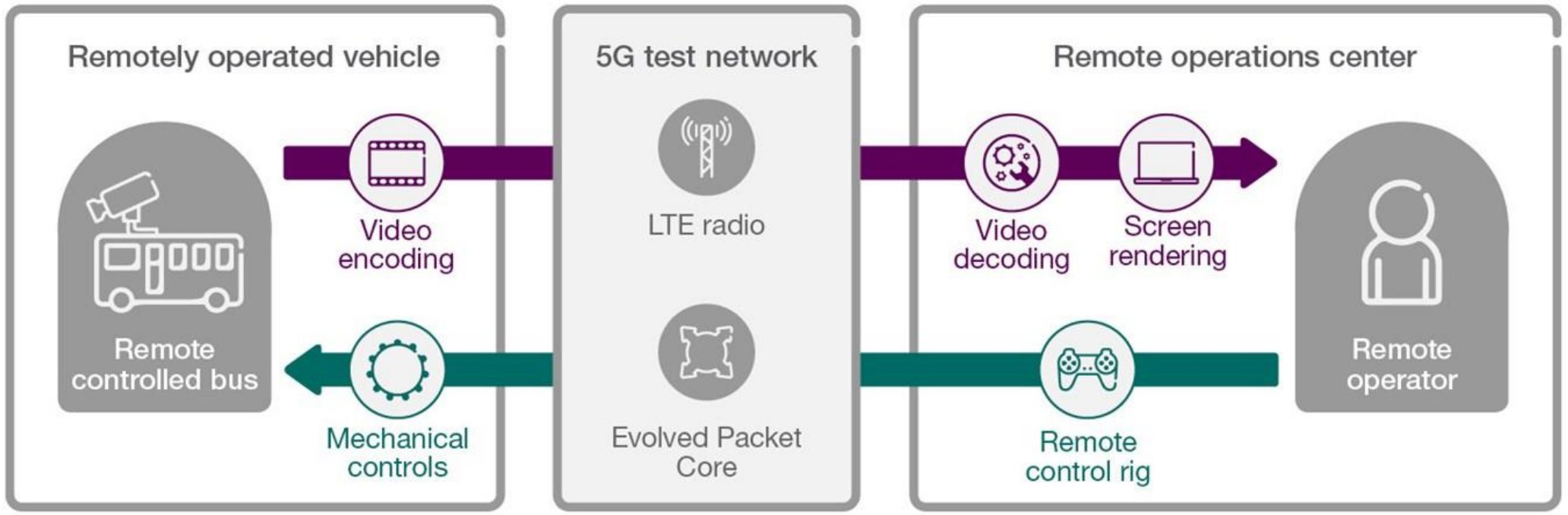
— During the tests, total s**ystem response times of around 185 ms** were achieved.

— most significant contributors to the response time and its variation were **mechanical delays** (physical actuators controlling the bus), followed by the **video processing delay** and, finally, the **network delay** (round trip time (RTT)).

— Network RTT mostly stayed **under 50 ms** during the study

Source: https://www.ericsson.com/en/mobility-report/articles/remote-monitoring-and-control-of-vehicles

System response time and its components



Source: https://www.ericsson.com/en/mobility-report/articles/remote-monitoring-and-control-of-vehicles

RCV from The Integrated Transport Research Lab at KTH

— A 5G testbed radio, using a **15 GHz carrier frequency**, provided sufficient bandwidth for **remotely operating multiple vehicles** in the same cell.

— Delivering the throughput on 15 GHz is accomplished using **beamforming**; that is, tracking the moving vehicle and focusing the radio power for maximum effect.

— Due to the low latency of the 5G radio access, **RTT was under 4 ms**.

Source: https://www.ericsson.com/en/mobility-report/articles/remote-monitoring-and-control-of-vehicles

Demonstration Video

— https://youtu.be/lPyzGTD5FtM

Use case: Einride T-Pod Autonomous 26-ton Electric Truck

— **Ericsson, Einride and Telia** partner to show driverless trucks are one step closer to being safe for public roads.

— In October 2018, Ericsson and Telia in partnership with Einride are showing how from now on, driverless truck transportation is possible through enhanced connectivity based on 5G at the DB Schenker facility in Jönköping, Sweden.

Source: https://www.ericsson.com/en/cases/2019/ericsson-5g-powers-environmentally-friendly-self-driving-vehicles

Case: Einride T-Pod Autonomous 26-ton Electric Truck

— The goal is to power an **all-electric, autonomous transport ecosystem** that takes fleet management to the next level.

— Robert Falck, CEO and Founder of Einride, says: "Our driving mission is to lead the **sustainable transition** of road freight transportation. 5G provides the connectivity and reliability we need to safely introduce the T-pod onto public roads, paving the way for a **90 percent reduction in CO2 emissions and the elimination of nitrogen oxide (NOx) emissions**."

Source: https://www.ericsson.com/en/cases/2019/ericsson-5g-powers-environmentally-friendly-self-driving-vehicles

Case: Einride T-Pod Autonomous 26-ton Electric Truck

— Einride's T-pod and autonomous transport system, powered by 5G, can potentially **replace more than 60 percent of today's transport** with a cost-competitive and sustainable alternative.

— Self-driving technology allows us to **remove the driver's cab from trucks, making them smaller and lighter**, in turn allowing for a transition from **diesel to electricity**, eliminating dangerous NOx emissions, and reducing CO2 emissions by 90 percent.

— An autonomous vehicle relies on input from several different sensors: lidars, radars, and cameras. We're talking **serious amounts of data, processed every second**. For the human-machine interaction to work as it should, all that data must be **communicated over long distances** – hundreds of miles – continuously and instantly, **reliably and without latency**.

Source: https://www.ericsson.com/en/blog/2018/12/time-is-running-out-can-5g-curb-climate-change

Video

— https://youtu.be/XWDim0nCYUc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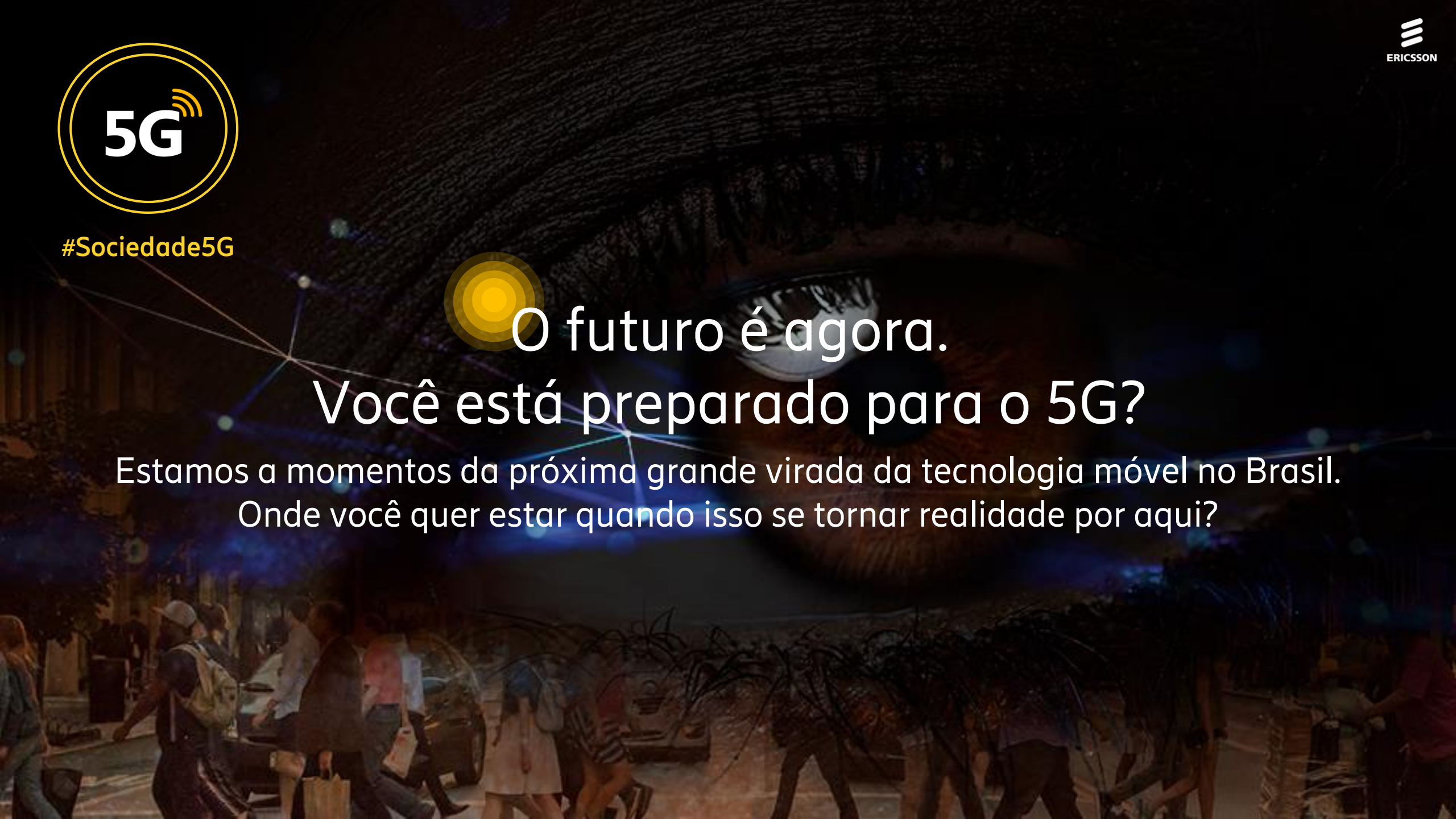
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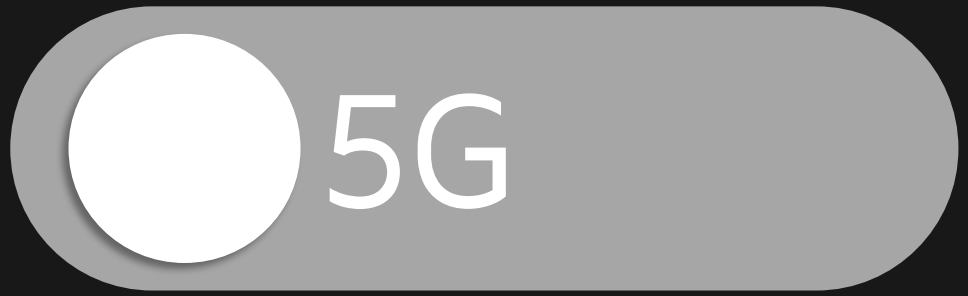

A evolução para o 5G feita de forma simples

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