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Finnish Transport and Communications Agency

How will 5G change the way we live

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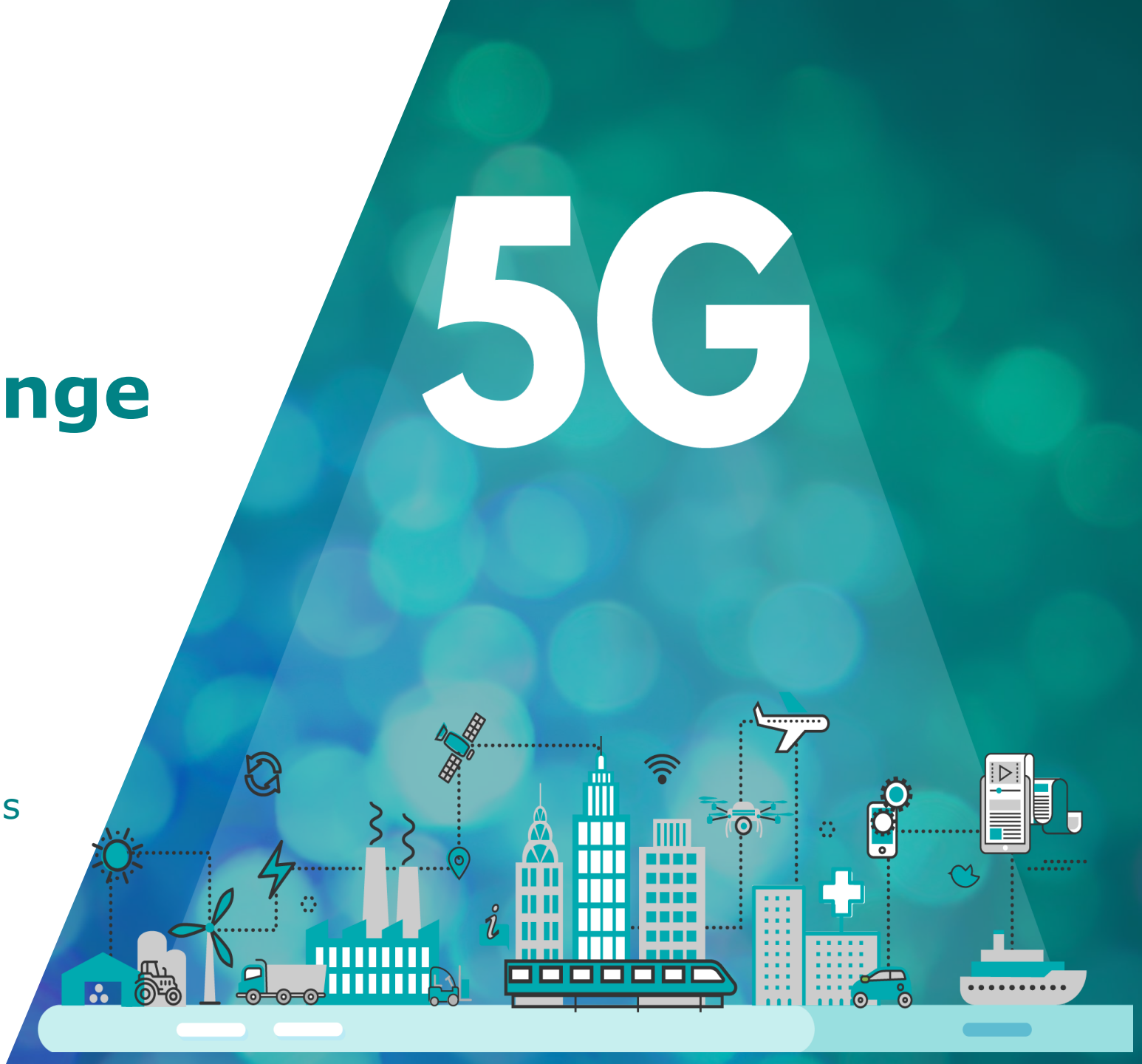

Agenda

- Where are we going and some history
- Spectrum as an enabler – international and national regulatory views
- Connectivity
- Security and trust
- 5G in different sectors
-

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Digitalisation and connectivity of everything

Processing power

AI

Security and trust

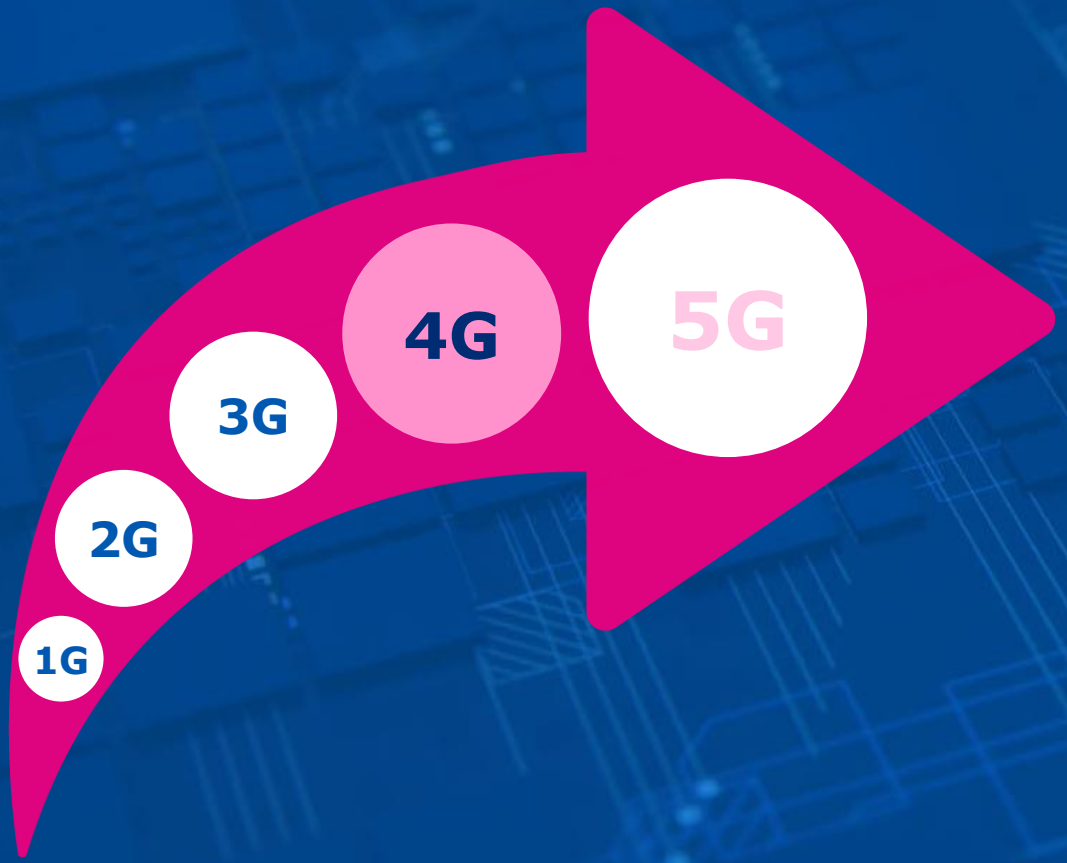
Digital society

IoT, mMTC

Quantum technology

Networks

Wireless generations



1G 1980s Analog voice calls, mobile connectivity (NMT)

2G 1990s, digital voice calls, text messaging (160 characters), encryption possible, 'slow' data services ~ 500 kbit/s (GSM)

3G 2000s, mobile broadband (10 Mbit/s), smartphones, better voice quality (UMTS)

4G 2010s, fast mobile broadband (100 Mbits/s), IP-based (LTE)

5G 2020s, enhanced mobile broadband 1Gbit/s, virtualisation, cloud services, IoT, URLLC

Spectrum Management

Recommendations
Reports

Radio Regulations

CEPT ECC
Electronic Communications Committee

ETSI
World Class Standards

Decisions, reports, recommendations

Decisions
Recommendatios

EN standards
Technical reports

Ministry of Transport and Communications	• Communications policy • Laws, decrees, network licences
Transport and Communications Agency Traficom	• Spectrum Management • Radio licences, regulations, enforcement

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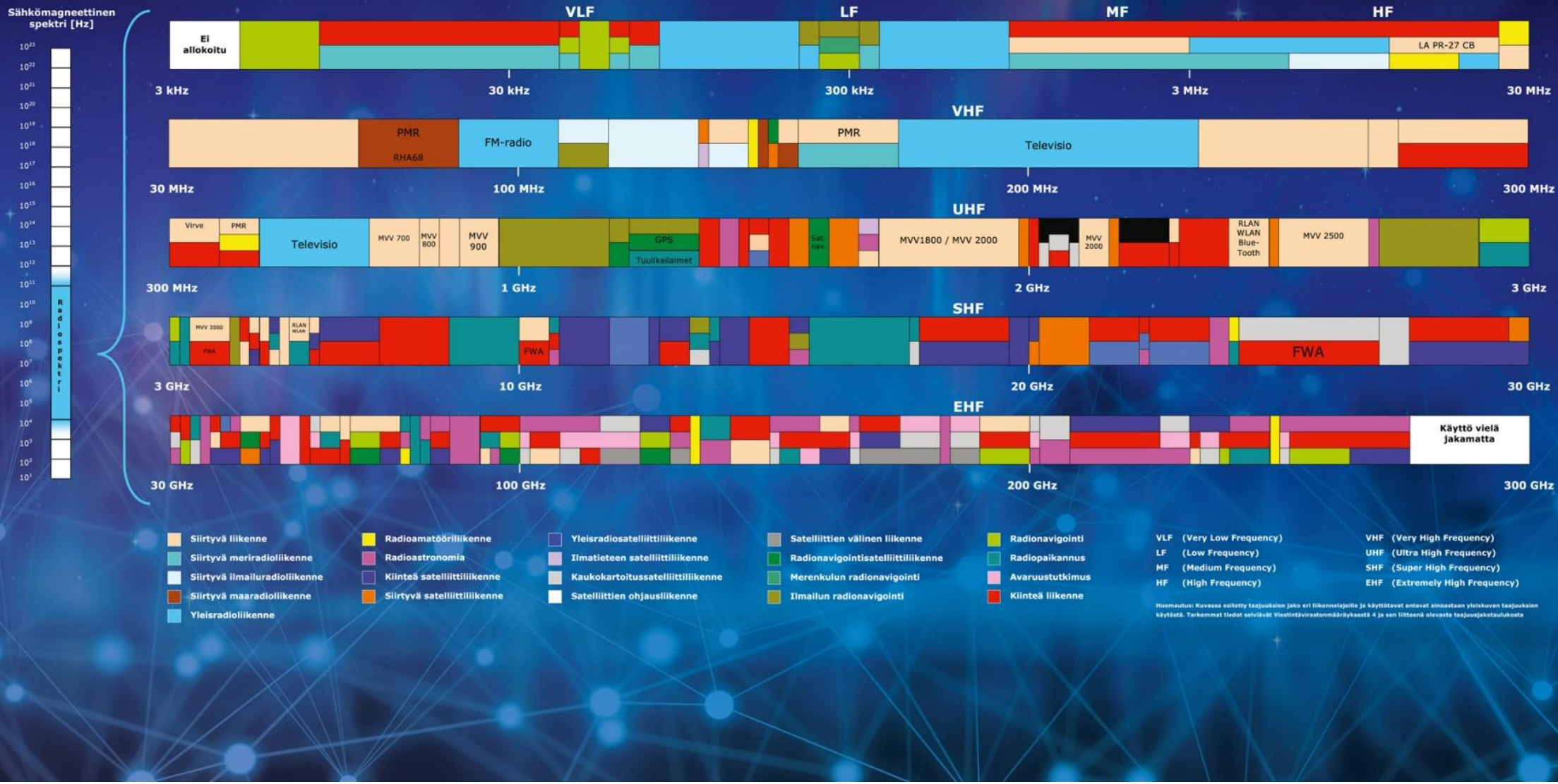
Spectrum allocation



Spectrum for mobile broadband in Finland

- GSM900 MHz beauty contest 1990, 2019, WARC79
- 1800 MHz beauty contest 199X, 2019, WARC 92
- UTMS beauty contest 1999, 2019; WRC97
- 2500-2690 MHz auctioned 2009, WRC2000
- 800 MHz auctioned 2013, WRC2007
- 700 MHz auctioned 2016, WRC2015
- 3410-3800 MHz auctioned 2018, WRC2015
- 25,1-27,5 GHz auctioned 2020, WRC2019

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EU Gigabit society & 5G Action plan

- **EU 2025 Connectivity objectives**
  - 100 Mbps networks reaching all European households by 2025, with the possibility to upgrade those networks to reach much higher speeds
  - Gigabit connectivity connecting all main socio-economic drivers - such as schools, universities, research centers, transport hubs, hospitals, public administrations, and enterprises relying on digital technologies - should have access to gigabit connectivity
  - Uninterrupted 5G coverage should be available in all urban areas and all major terrestrial transport paths to connect people and objects
  - Access to mobile data connectivity everywhere, in all places where people live, work, travel and gather
- 5G deployment across all EU Member states, targeting early network introduction by 2018, and moving towards commercial large scale introduction by the end of 2020 at the latest (5G Action plan)

”Make it available”

Spectrum for mobile broadband in Finland

- Three operators with nationwide coverage
  - > 99% of population with 2G, 3G & 4G
  - ~70% of households with 5G (700 MHz, 3,5 GHz ja 26 GHz bands)
  - New spectrum quickly into use without fiscal goals: cheaper to build, easier to plan, less congestion, more capacity
  - Unlimited data, inexpensive prices, developed networks, good coverage
  - Coverage obligations (99%)
    - 99% population, 100 % roads/rail
    - No requirements on quality
  - Technology neutrality

Current spectrum

Future spectrum

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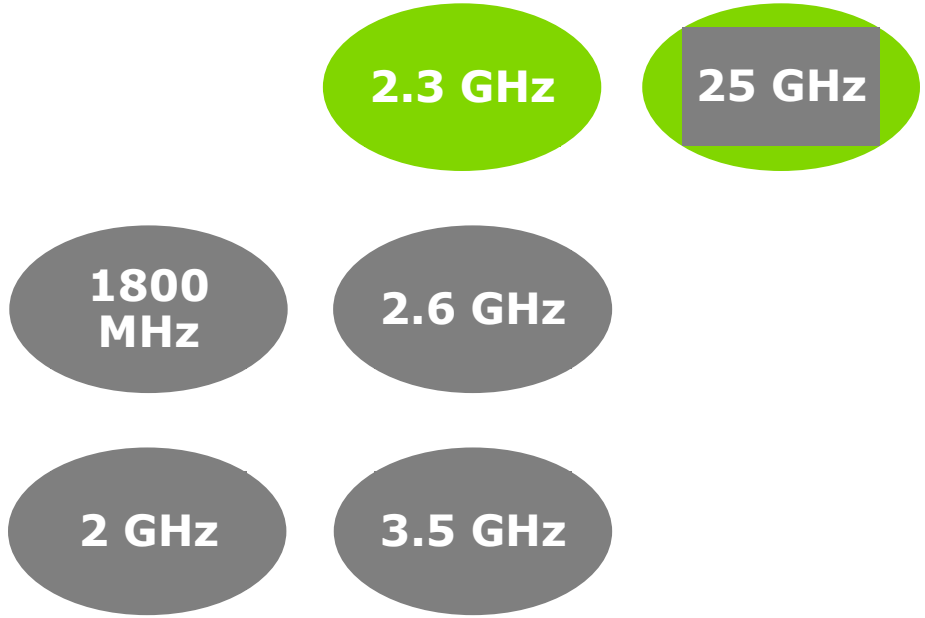
Spectrum for local mobile broadband and RDE in Finland

- Dedicated spectrum for local networks
  - 2300 – 2320 MHz (20 MHz)
  - 24.25 – 25.1 GHz (850 MHz)
- Spectrum available for Research, Development and Education (RDE) purposes
  - 1800 MHz, 2 GHz, 2.6 GHz, 3.5 GHz and 25 GHz bands

Current spectrum



Future spectrum

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Local 4G/5G networks in Finland

- 2300-2320 MHz and 24.25-25.1 GHz are available now for local 4G/5G networks.
  - Radio licenses are granted by Traficom.
  - 3,8-4,2 GHz (or parts of) available in future?
- The local bands can be used for
  - local private use: factories, power plants, ports, industry and university campuses
  - small-scale public networks: shopping centres, sports arenas, passenger harbors, etc.
    - Previously all public mobile networks required a network license issued by the Government.
  - Fixed wireless access: Subscriptions can only be used in the pre-defined operating location, primarily using a fixed outdoor antenna installed in the building.

Frequencies Allocated for Mobile Networks in Finland

450	452.425-456.925 MHz / 462.425-466.925 MHz
700	703-733 MHz / 758-788 MHz
800	791-821 MHz / 832-862 MHz
900	880-915 MHz / 925-960 MHz
1800	1710-1785 MHz / 1805-1880 MHz

2	1.92-1.98 GHz / 2.11-2.17 GHz
2.3	local 2.30-2.32 GHz
2.6	2.50-2.69 GHz
3.5	3.41–3.80 GHz
25	local 24.25-25.10 GHz
26	25.1-27.5 GHz
Coming?	•1.5 GHz •3.8-4.2 GHz •40.5–43.5 GHz

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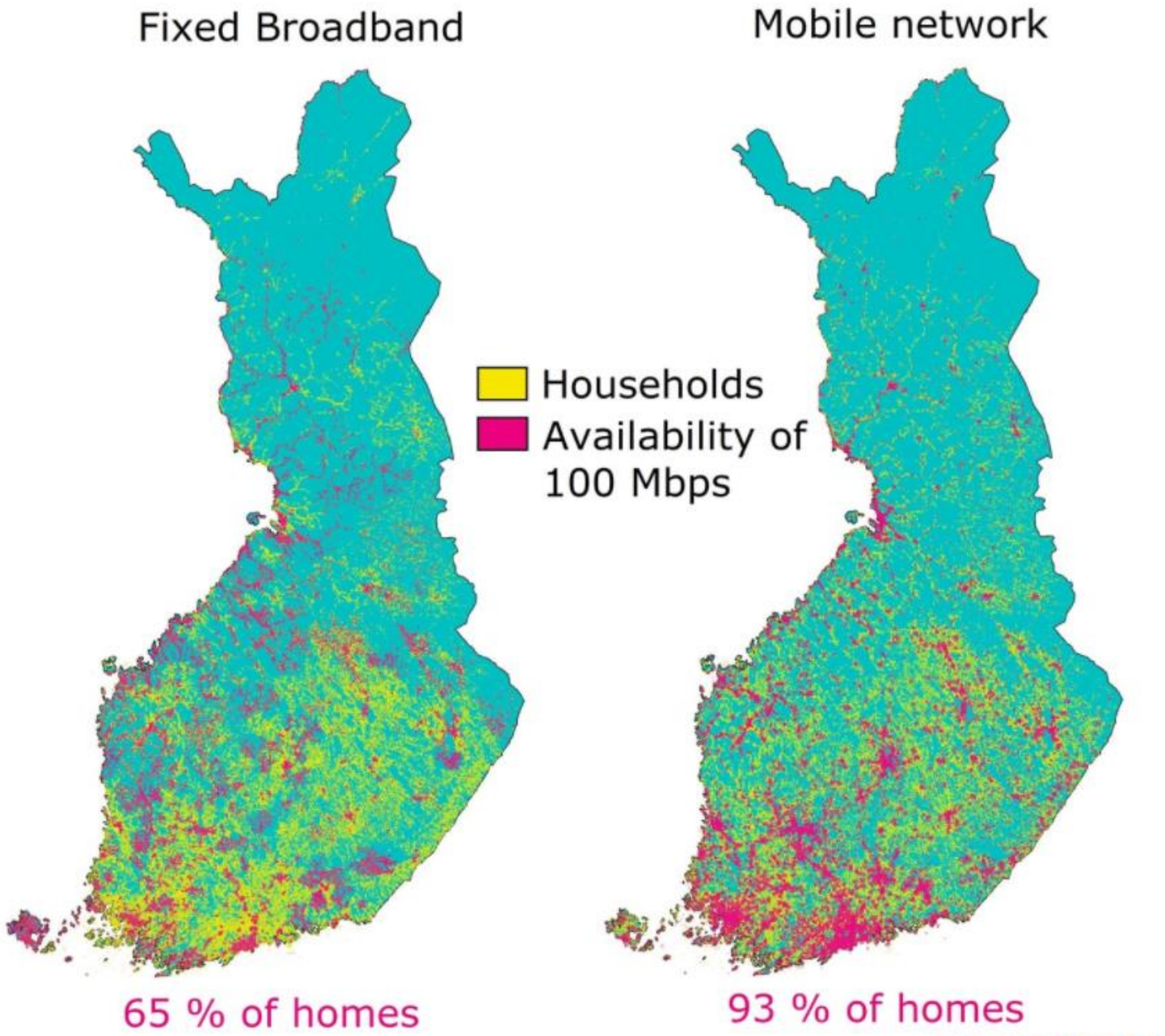
Broadband Coverage

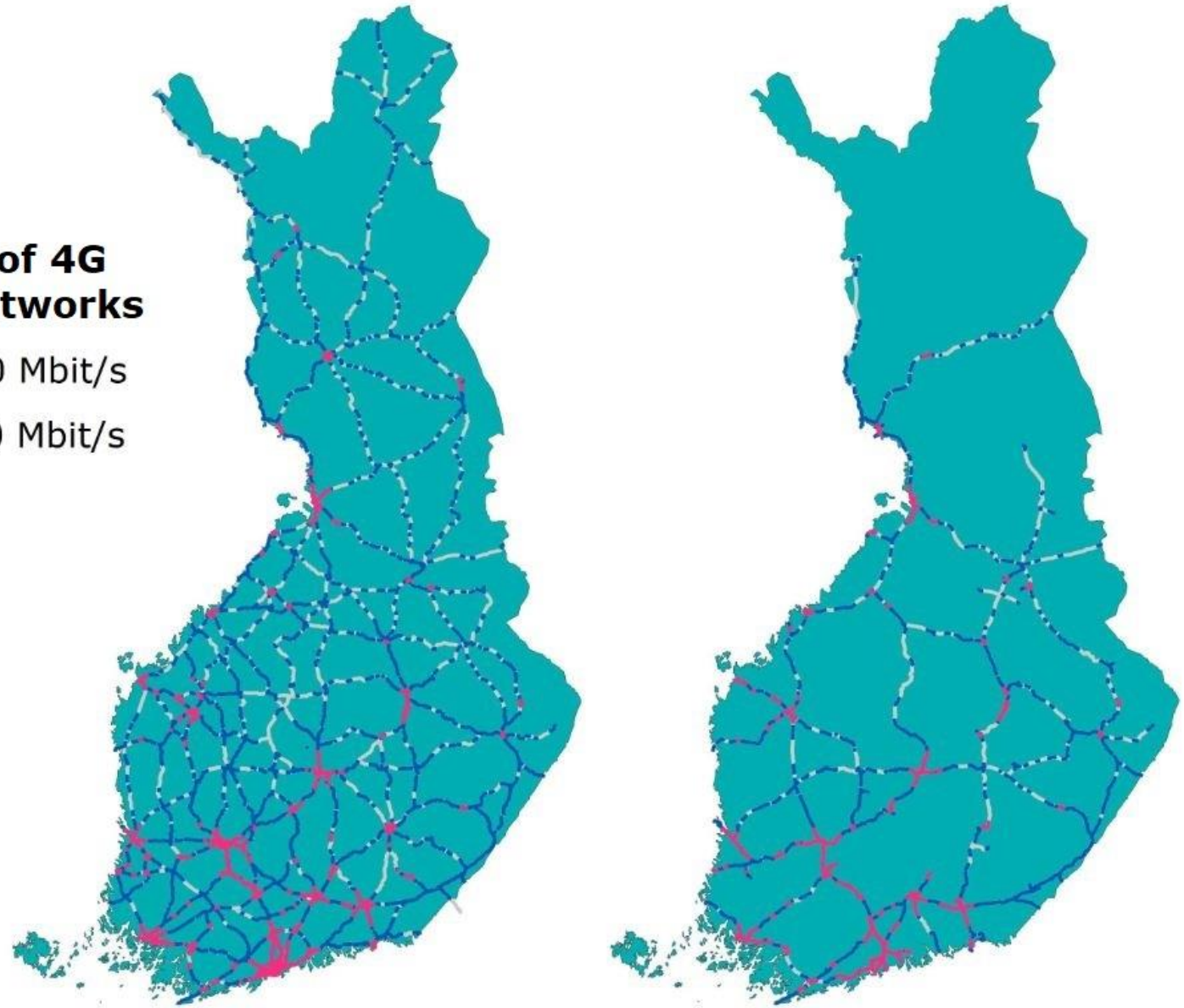


Class I & II main roads

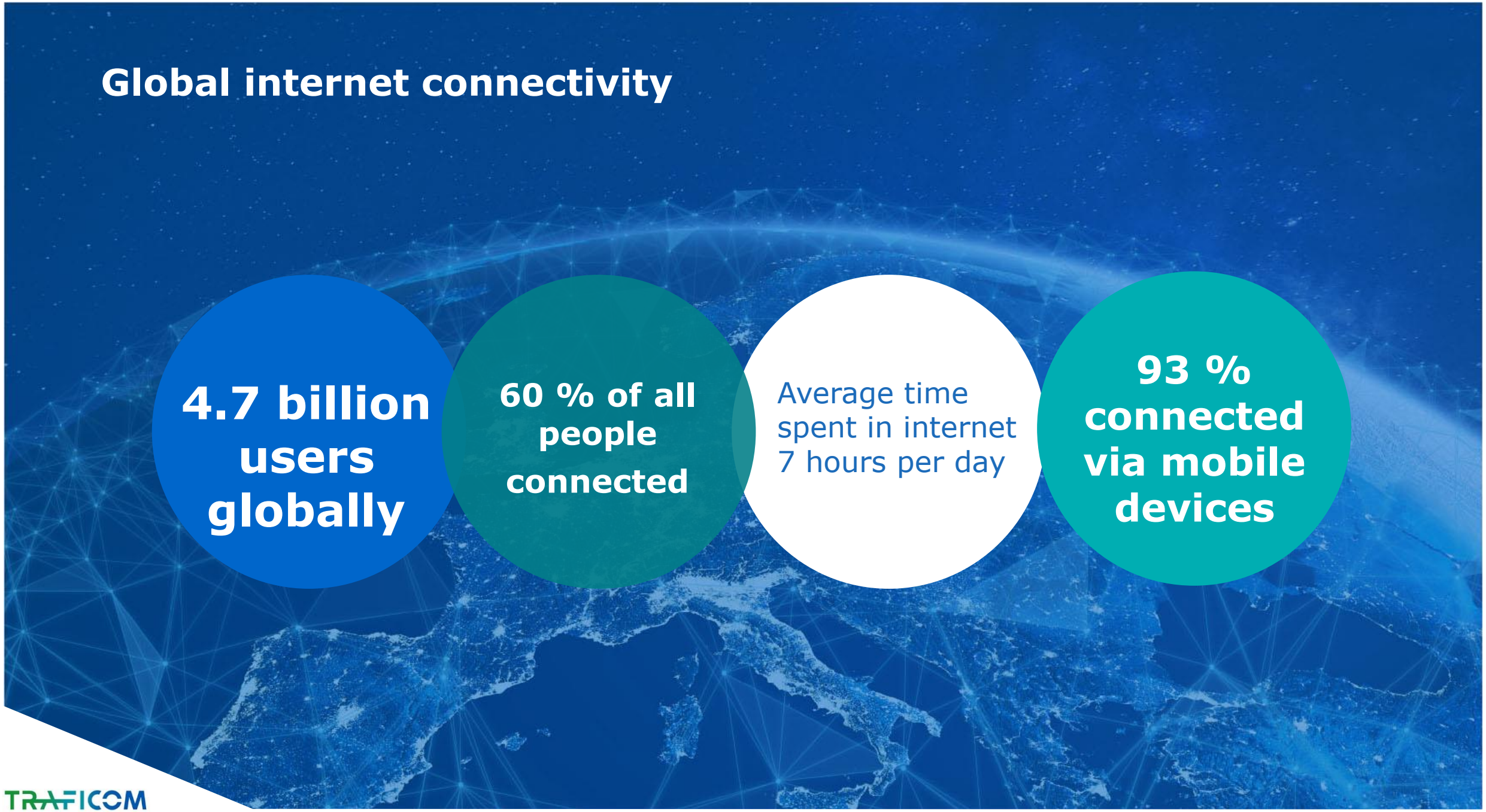
Rail network

Coverage of 4G and 5G networks

- 4G 100 Mbit/s
- 5G 100 Mbit/s



Global internet connectivity



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Global internet connectivity

- Terrestrial networks have limited coverage
  - Sparsely populated areas
  - Seas
  - Arctic(polar) areas
- One (and posibbly only) possibillity for global coverage is satellite
  - Limited terrestrial infrastrure
  - Large number of satellites (if similar connection speeds as in terretrial networks)
    - SpaceX Starlink (~12 000/30 000), OneWeb (~700 satellites)
- 5G?

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Trusted and secure systems and infrastructure are prerequisites for our Digital society

Security and trust

Technology risks

- More complex systems
- Open and/or virtualised systems/platforms
- Shared infra more difficult to control
- Variation in skill sets and drivers among actors
- Different and/or separate network architecture
- Connectivity to public telecommunication network
- Physical protection of 5G-sites

Security and trust

Human factor

- People are helpfull
- People want to feel important and that they matter
- People want positive outcomes
- People are afraid to be humiliated and negative consequence
- People act on the fly (and make mistakes)
- People have a tendency or a skill to deceive themselves

EU Toolbox for 5G security

Member States should have measures in place and powers to mitigate risks, and they should:

- strengthen security requirements for mobile network operators;
- assess the risk profile of suppliers; apply relevant restrictions for suppliers considered as high risk,
- ensure that each operator has an appropriate multi-vendor strategy to avoid or limit any major dependency on a single supplier

A Trusted and Secure 5G Enabled Digital Society

- Cyber security of 5G networks represents a global challenge that has a significant impact in the society and enterprises – and also on the daily life of 5G-based service users
- Cyber Security Hacks
  - Our aim as a national Agency is to create **new type of collaboration between** different players in the field and to build and strengthen the **5G cyber security community**
  - Our approach is **hands-on testing** of 5G technology and its use cases in collaborative hacking events aiming to **improve understanding and capabilities** to better secure the emerging 5G enabled digital society
  - We proactively want to strengthen the collective 5G security competence and **make the efforts and identified development areas visible** within the international 5G community and initiate new discussions

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Highlights from the 5G Cyber Security Hacks

- The aim is to create new type of collaboration between national agencies, international technology vendors, academia, ethical hacker community and leading security professionals **around the globe**
- The first 5G hack organized in Oulu Finland, in November 2019 was the **world's first open 5G Cyber Security Hack**
  - In 2019: 3 challenges provided to 70 hacker participants with 15 different nationalities
  - In 2021: 4 challenges provided to 130 hacker participants with 30 different nationalities
- => As a result the organizers, the challenge providers and hackers learned about vulnerabilities and security perspectives of 5G technology and future attack surfaces

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Organizers: *Finnish Transport and Communications Agency and National Cyber Security Centre – Finland and National Emergency Supply Agency - Finland*

5G Momentum ecosystem

promotes development of 5G-services and introduction of 5G by forming a novel collaboration network for 5G trials

promotes trials to enable new 5G services and innovations

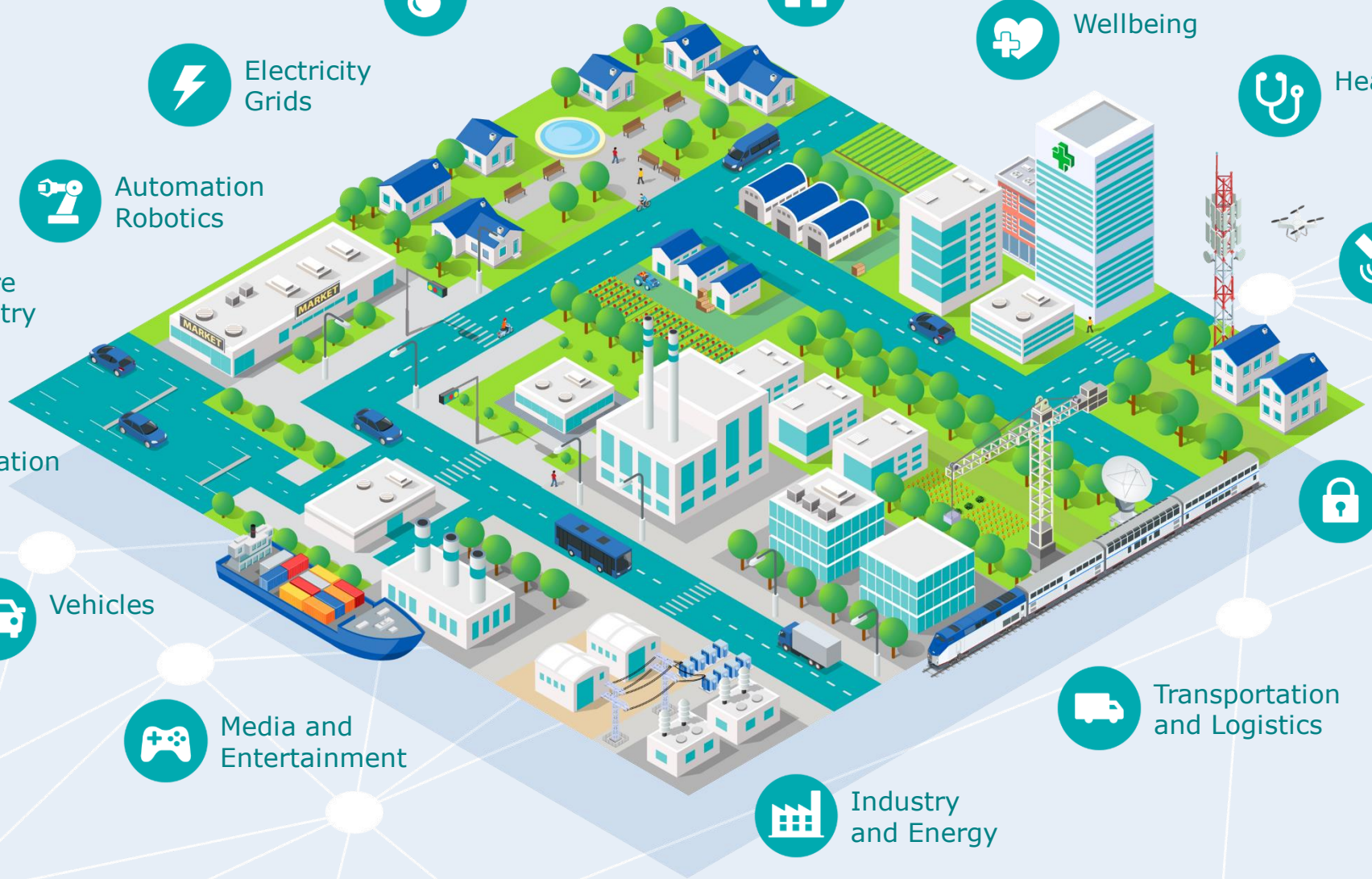
recognizes challenges related to the operational and regulatory environment

makes Finnish 5G knowledge visible

”Communicate and cooperate”

5G Momentum – enabling Finnish leadership in 5G

5G World



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Transportation and Logistics

SECURITY,RELIABILITY TRACEABILTY

Logistic industry

Automated vehicles

Industry and energy

R

RELIABILITY, LOW LATENCY

Factory

Smart grids

Smart cities

TRACEABILITY, RELIABILITY

Large sensor networks – monitoring of city functions

Edge computing – enables low latency services

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SMART HOME

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We all share the drive to move and communicate. Your connections are close to our heart.

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