6G – Innovation for a sustainable digital transformation?

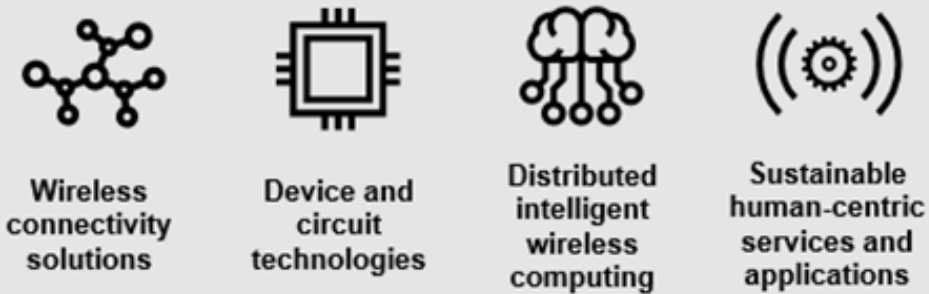5G.NRWeek 2022
10 November 2022, Dortmund, Germany

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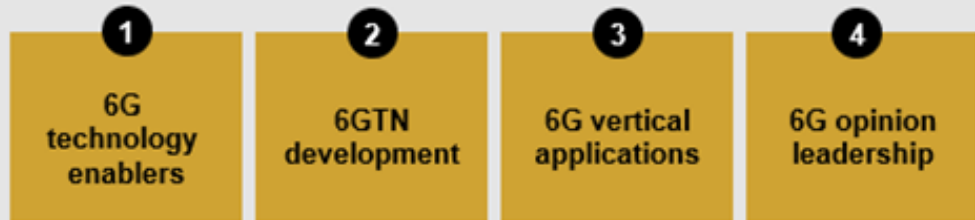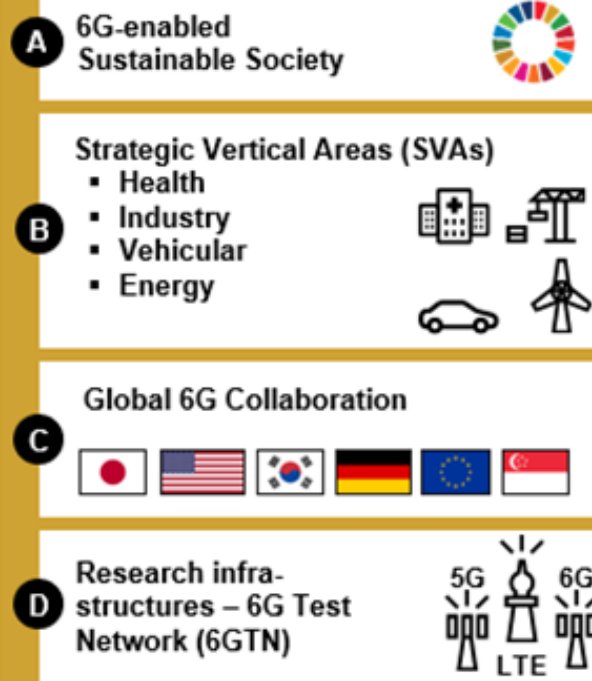marja.matinmikko@oulu.fi

THE FINNISH 6G FLAGSHIP

- 6G Flagship's multi-disciplinary research roadmap includes technology, business, sustainability, and regulation perspectives.

- Multi-stakeholder collaboration emphasises academia, industry, and public sector interplay.

- Sustainability and UN SDGs identified as global drivers for 6G R&D.

- Contributions to ITU-R on IMT towards 2030 and beyond.
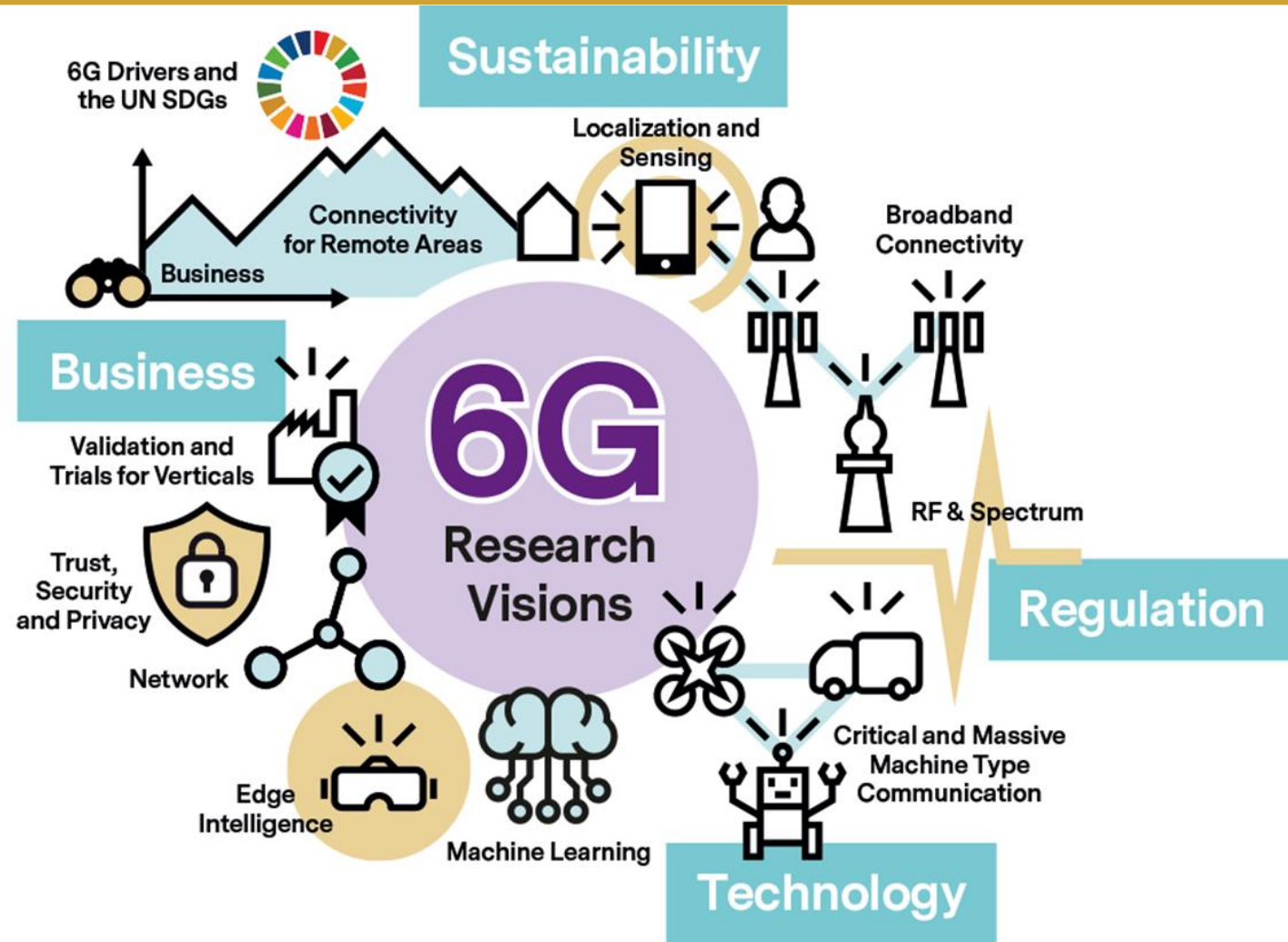
Success story: **Local 5G (private) (micro) operator concept with local licensing.**

Changing 5G/6G business ecosystem

- **6G will combine communication service with other capabilities, such as imaging, sensing, locationing, and computing.**

- **Different resource combinations provided by different stakeholder combinations will serve location specific needs of various end user groups with varying requirements.**

- **Stakeholder roles are evolving already in 5G and will further change in 6G, and new roles will emerge.**
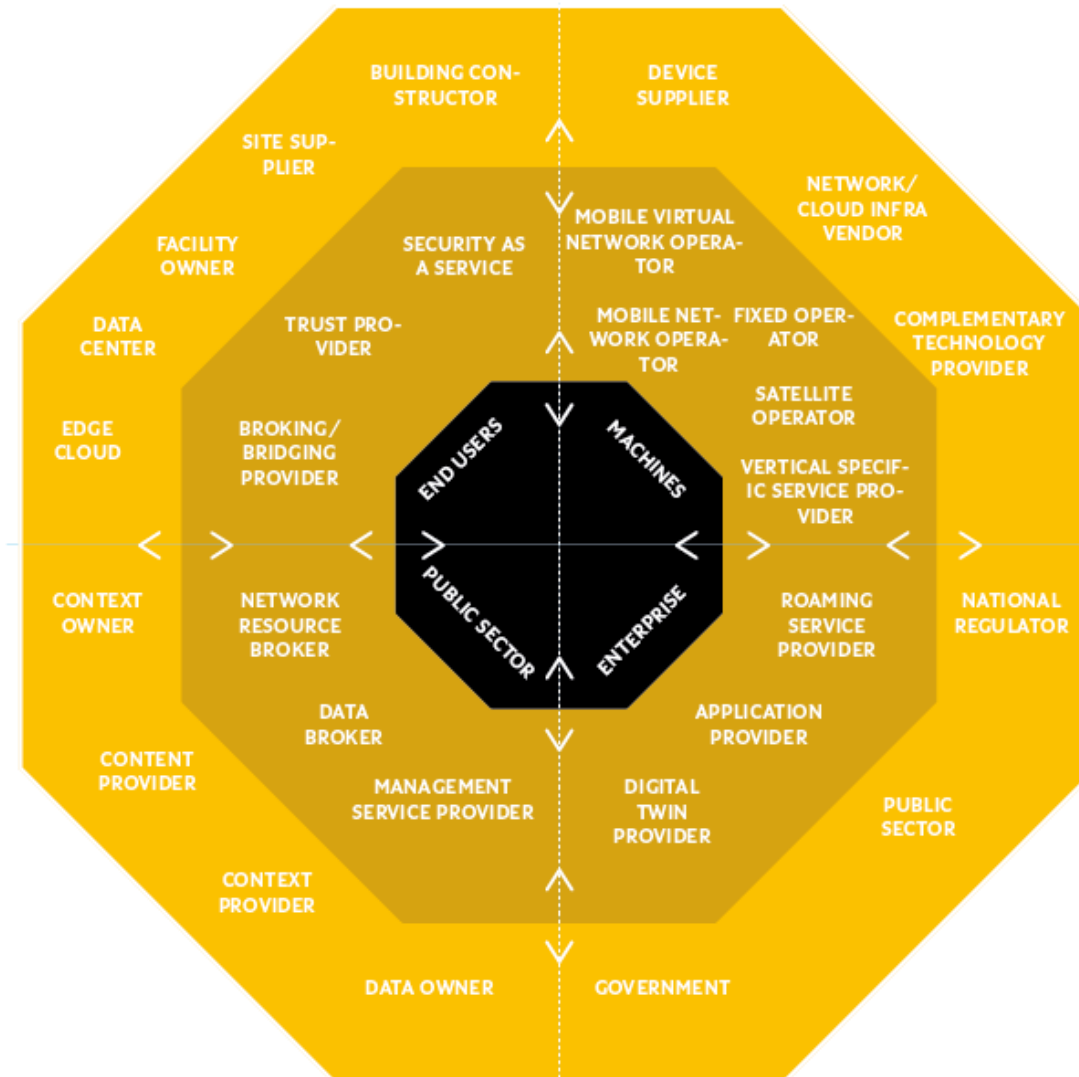
Key Drivers and Research Challenges for 6G Ubiquitous Wireless Intelligence - 6G Flagship
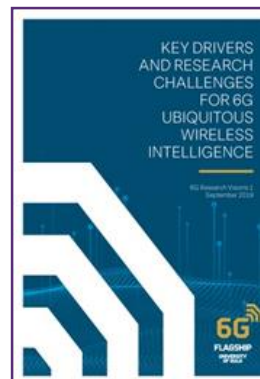
- **Different stakeholders can deploy their own local and often private 5G/6G networks[1], independent of mobile network operators (MNOs).**

- **Local spectrum availability[2] through local spectrum licensing is a key pre-requisite. Currently, divergence between countries is high[3], leading to market fragmentation and competitive disadvantages.**
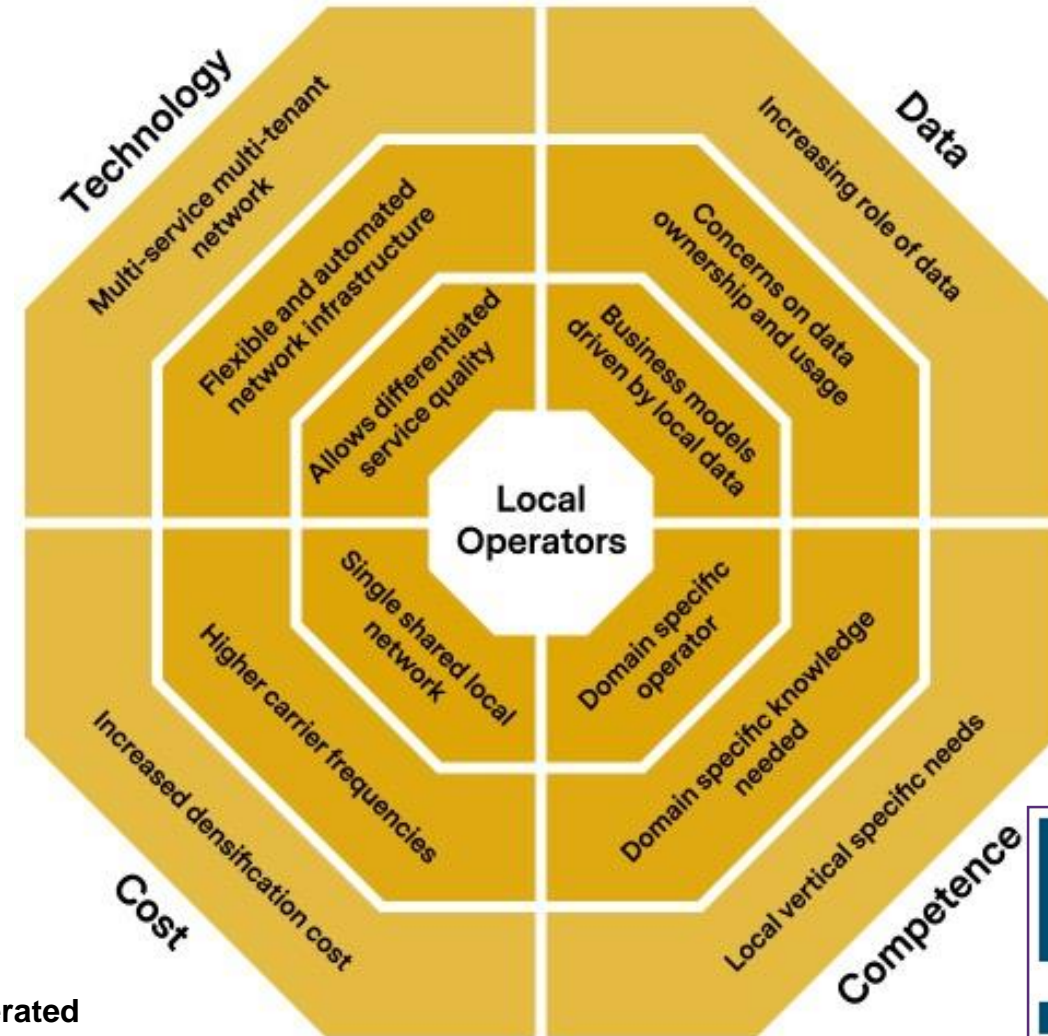

[1]M. Matinmikko, et al. (2017) **Micro operators to boost local service delivery in 5G**. Wireless Personal Communications, 95(1), 69-82.
[2]M. Matinmikko, et al. (2018) **On regulations for 5G: Micro licensing for locally operated networks**. Telecommunications Policy, 42(8), 622-635.
[3]M. Matinmikko-Blue, et al. (2019). **Analysis of Spectrum Valuation Elements for Local 5G Networks: Case Study of 3.5-GHz Band**. IEEE Transactions on Cognitive Communications and Networking, 5(3), 741-753.

Key Drivers and Research Challenges for 6G Ubiquitous Wireless Intelligence - 6G Flagship

SUSTAINABILITY AND SUSTAINABLE DEVELOPMENT IN 6G

- World's first 6G Wireless Summit gathered major telecom players to vision 6G in Finland in 2019 and launched the world's first 6G White Paper development.

- Consensus that 6G is driven by sustainability and United Nations' Sustainable Development Goals (UN SDGs).

- Follow-up work connected 6G with the UN SDGs.

M. Latva-aho & K. Leppänen (eds.) (2019). Key drivers and research challenges for 6G ubiquitous wireless intelligence. (6G Research Visions, No. 1). University of Oulu, Finland. http://urn.fi/urn:isbn:9789526223544
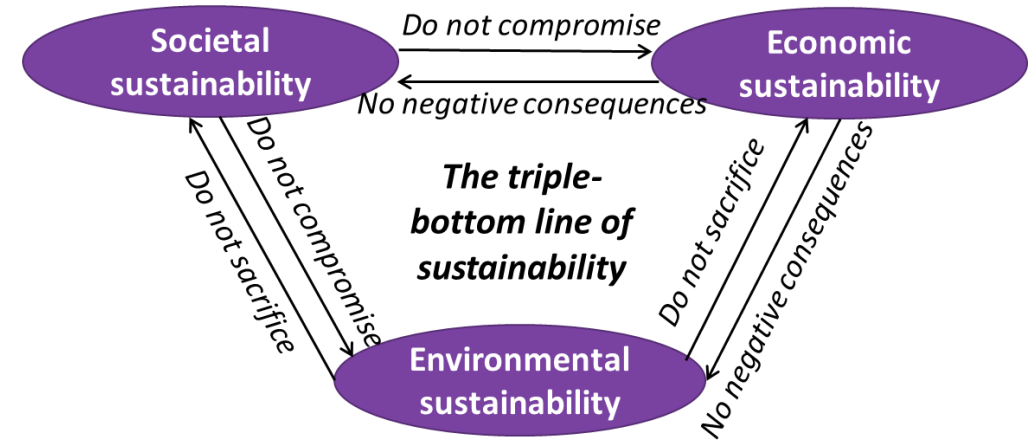

M. Matinmikko-Blue, et al. (eds.). (2020). White Paper on 6G Drivers and the UN SDGs. (6G Research Visions, No. 2). University of Oulu. http://urn.fi/urn:isbn:9789526226699

Sustainability and sustainable development

Sustainability refers to the "**principle of ensuring that our actions today do not limit the range of economic, social, and environmental options open to future generations**" [Elkington 1997].

Sustainable development refers to the "**development that meets the needs of the present without compromising the ability of future generations to meet their own needs**" [Brundtland report 1987].

Societal sustainability — *Do not compromise* → **Economic sustainability**
No negative consequences
Do not compromise / *Do not sacrifice* / *Do not sacrifice* / *No negative consequences*
The triple-bottom line of sustainability
Environmental sustainability

There are only 7 ICT indicators in the UN SDG framework of 169 targets and 231 indicators. In reality, the linkage to ICT is stronger.

- J. Elkington. Cannibals with forks: The triple bottom line of 21st-century business. Capstone Publishing Ltd. 1997.
- World Commission on Environment and Development's Brundtland report ´Our Common Future`. 1987.
- The 2030 Agenda for Sustainable Development. United Nations, 2015.

ICT sector's dual role

- Enabling role to help different sectors of society to renew their operations via sustainable ICT solutions and services (handprint).

- ICTs' own sustainability burden (footprint), where the growth of digitalisation keeps increasing and usage patterns change.

> - The role of ICTs for **emitting less** is equally important, as is support for **absorbing more** in other sectors.
> - Urgent need for **new indicators, measurement methods and design criteria** for future sustainable ICT solutions and services and their use.

Sustainability considerations for 6G

- 6G combines communication with other services, like imaging, sensing, and locationing, providing a **measurement tool** with hyper-local granularity.

- New mechanisms are needed to reduce the carbon footprint through **sharing and optimizing the use of all potential resources**.

- **Optimization of the collection, processing, storage and transfer of data** between different network locations is critical.

- **Life cycle analyses of devices, network and services** and related material efficiency are needed.

- Technologies for significant improvement of **energy efficiency** and **reduction of total energy consumption** for 6G are needed including new end to end measures, measurement methodologies and techniques.

- Social sustainability considerations should drive **digital inclusion** and rural communications.

- **Sharing of data and methods** on the impact of the wireless communications sector **between sectors and stakeholders** is needed to develop sustainable solutions.

Preliminary action plan on 6G and the UN SDGs

6G

Users

Inclusion of a variety of users into human-centric 6G development.

Governmental, regulatory and standardization organizations

Lead in pro-active manner with long-term visions of the role of ICT/6G in achieving UN SDGs and formulate policies. Develop new indicators to complement pure technical performance indicators.

Research and educational organizations

Conduct unbiased research and facilitate stakeholder interactions.

ICT industry

Flexible approaches to serving different challenge areas. Develop cost and consumption optimized solutions. Develop services matching the varying level of skills of people.

Verticals

Early engagement in 6G development to transform their operations towards UN SDGs.

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https://www.6gchannel.com/portfolio-posts/6g-white-paper-6g-drivers-un-sdgs/

Conclusions

- Sustainability is about ensuring that our actions today do not limit the range of economic, social, and environmental options open to future generations.

- Sustainability and UN SDGs drive 6G R&D globally. Detailed sustainability related requirements are yet unknown.

- It is our responsibility to translate sustainability perspectives into R&D by making sustainability the key design criteria for 6G systems and services:
  - What future sustainable solutions could solve major sustainability challenges?
  - What are the new sustainable 6G and ICT design and usage criteria?
  - How to assess 6G's enablement effect in other sectors?
  - How to assess 6G's own sustainability burden?
  - What could be learnt from other fields in terms of sustainable development?
  - How to integrate the triple bottom line of sustainability into every aspect or organisations and individuals' operations?

Thank you!

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