Edge security: industry perspective on evolving technology and defenders' positioning

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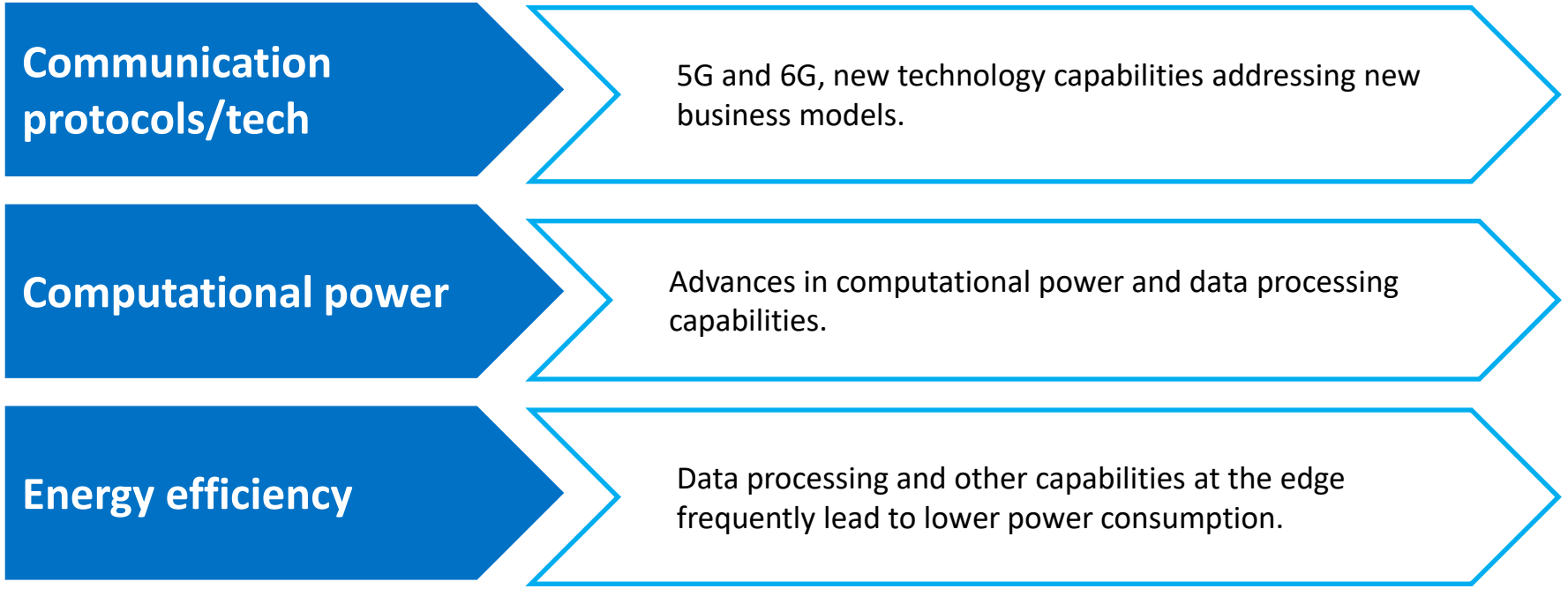
Abstract

Network edge is becoming increasingly complex and diverse. This short talk will provide an overview of significant challenges the new technologies bring,

highlight new opportunities for the defenders and present the main technology trends, describe challenges and present some actions to address them.

TECHNOLOGY EVOLUTION TO MEC

Some drivers for move to the edge



According to the Edge AI market report by Fortune Business Insights, The market for edge AI had a valuation of USD 11.98 billion in 2021. It is expected to expand from USD 15.60 billion in 2022 to USD 107.47 bn by 2029, showing a CAGR of 31.7% within the years 2022-2029. The global market was led by North America, with a market share of 40.8% in 2021

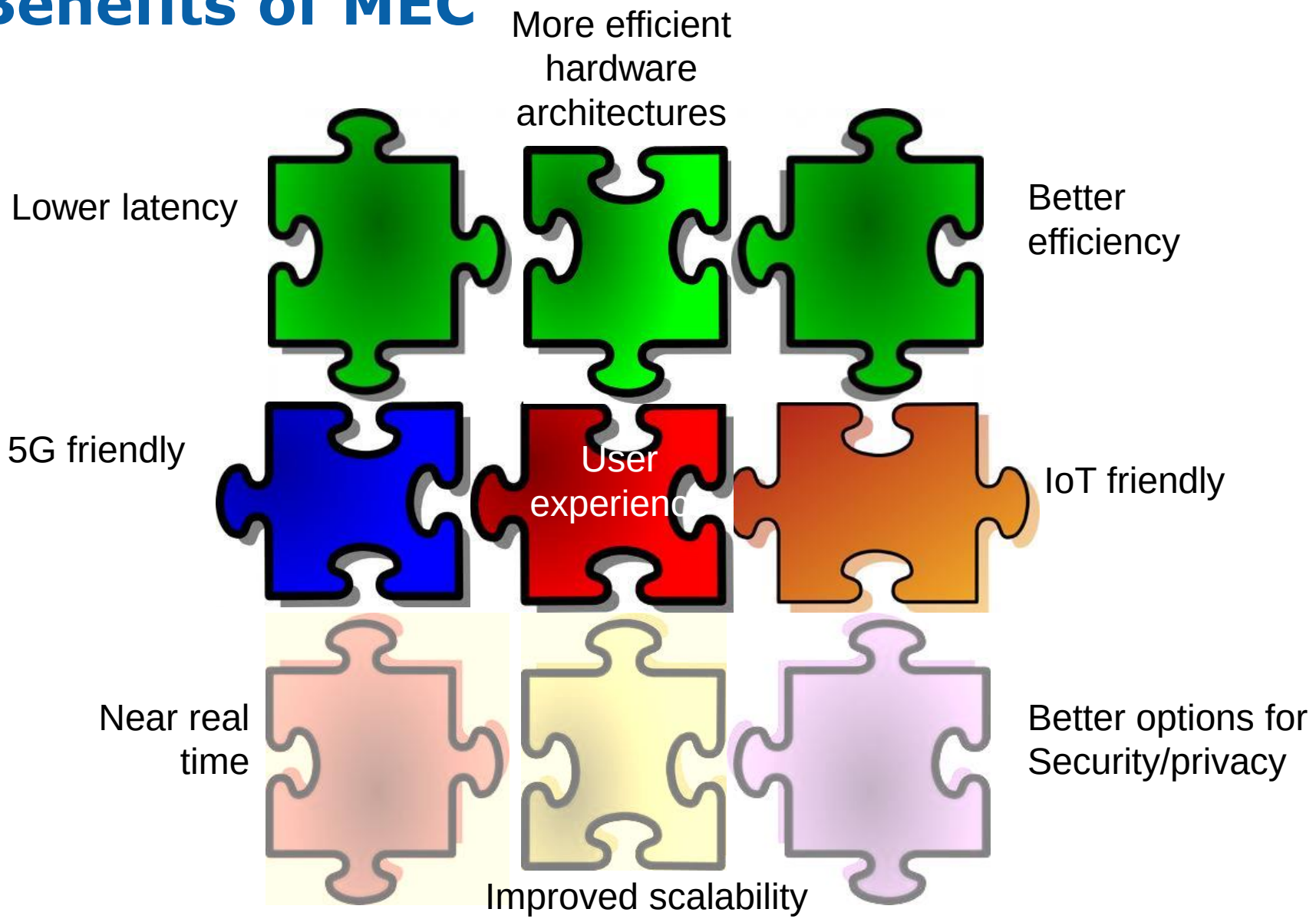
MEC

"Multi-Access Edge Computing edge" or MEC is a network architecture where computing power is positioned close to the network's edge, allowing for data processing and analysis near where it is generated reducing latency and improving performance.

Some predecessor paradigms:

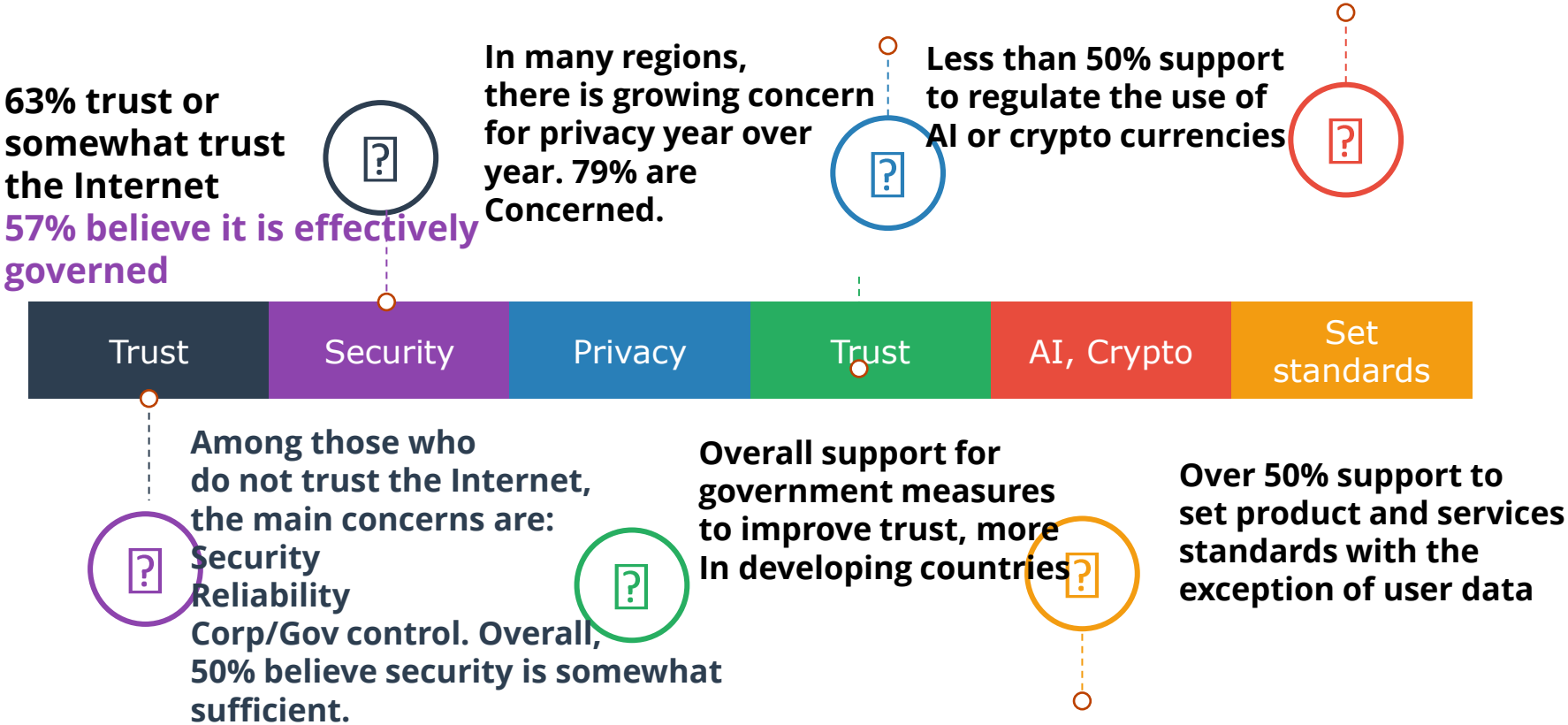
- Intelligent network
  - Counterbalancing traditional architecture where the network is “dumb” and the edge is intelligent; MEC includes elements of both.
- Near data processing (NDP)
  - Moves computation closer to data; similar intent, but different approaches

Benefits of MEC



MEC: potential to improve trust

Although a large proportion of global Internet users don't trust the Internet, they continue to use it. But they may use it differently. Trust is lower in advanced economies.



From CIGI/IPSOS Survey of users in 24 countries in 2022: https://www.cigionline.org/internet-survey.

MEC INNOVATION POTENTIAL

MEC enabled trends: examples

- **Architectures**
  - Decentralization. Greater modularity of the computing infrastructure
  - Intelligence at the edge. Analytics and edge AI.
- **Operational**
  - Performance. Lower latency.
  - Efficiency. Near real time response
- **Business**
  - New models (e.g., pay per use; novel enterprise models)
  - Standards based
- **Security and privacy**
  - Better options (geo, area, application focus)
  - Better transparency (simpler, more explainable transactions and data paths)

Some Challenges

- High upfront costs
- Significant redesign of some services
- **Deployment (integration, optimization, risk)**
- User mobility
- **Performance**
- **Security implementation**
- **Legacy integration**
- Bandwidth management
- Supply chain (including software)

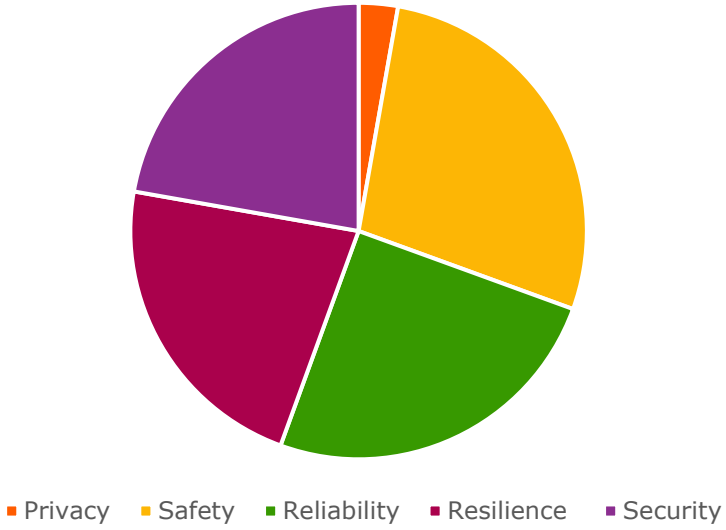
- Those who implemented MEC like environments highlight some challenges (in boldface above)

SECURITY IN MEC ENVIRONMENTS

Edge/MEC security

Can be described along the following generic characteristics (NIST):

- Security
- Safety
- Privacy
- Reliability
- Resilience



Not all the characteristics are necessary to secure all applications (as discussed below).

MEC environments Security Components

- **Conventional** (availability, integrity, confidentiality, etc).

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- **MEC Specific**
  - **Architectural** (network slicing, mobility management, traffic steering, virtualization)
  - **Locational** (access network, mobile edge and core network)
  - **Business** (billing, mobile offloading, etc.)

- **General comment:** a lot of literature on "MEC security," but most articles are generic and not focused on ETSI MEC architecture

MEC security in use cases

- Different for sectors: e.g., manufacturing, commerce, UAV management, eHealth or finance all have different key requirements.
  - E.g., attacks on accuracy/process; speed of processing; confidentiality, or privacy will have differing effects on MEC environments in different sectors.
- Resilience measures for foundational features are common
  - But skills and knowledge, even in this area, are still evolving. E.g., a lot of functionality in 5G ranges focuses on 4G attacks.
- User equipment and Mobile Edge Platform Manager (MEPM) have different requirements
- 5G change to 5G MEC can cause availability/speed issues with parameter transition

Mostly traditional tools are used

For example,

- Encryption
- Access control
- Isolation

But

- Combining several security models
- Supporting full MEC benefits with user mobility
- Protecting data and devices

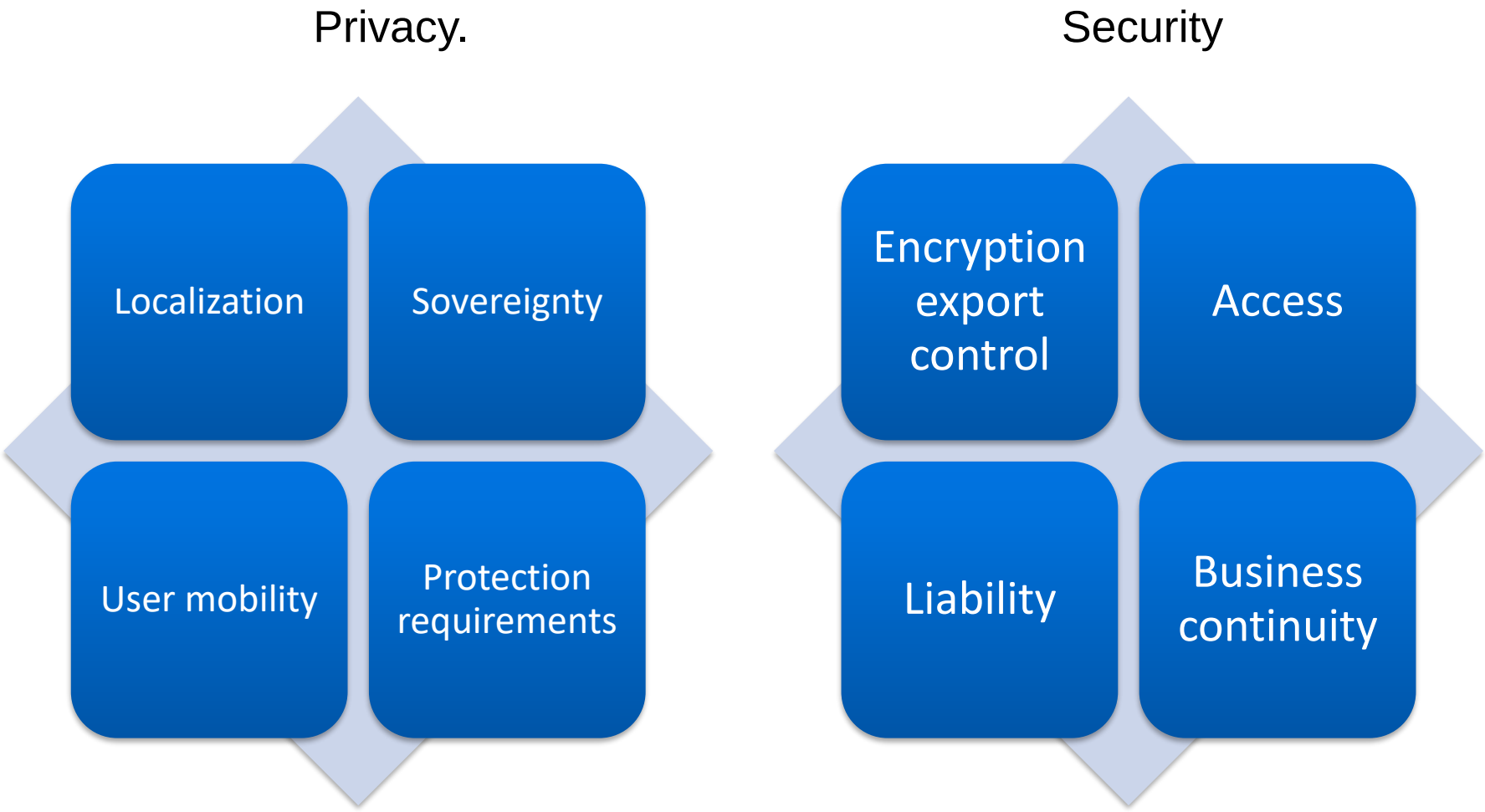
remain a challenge

REGULATORY CHALLENGES

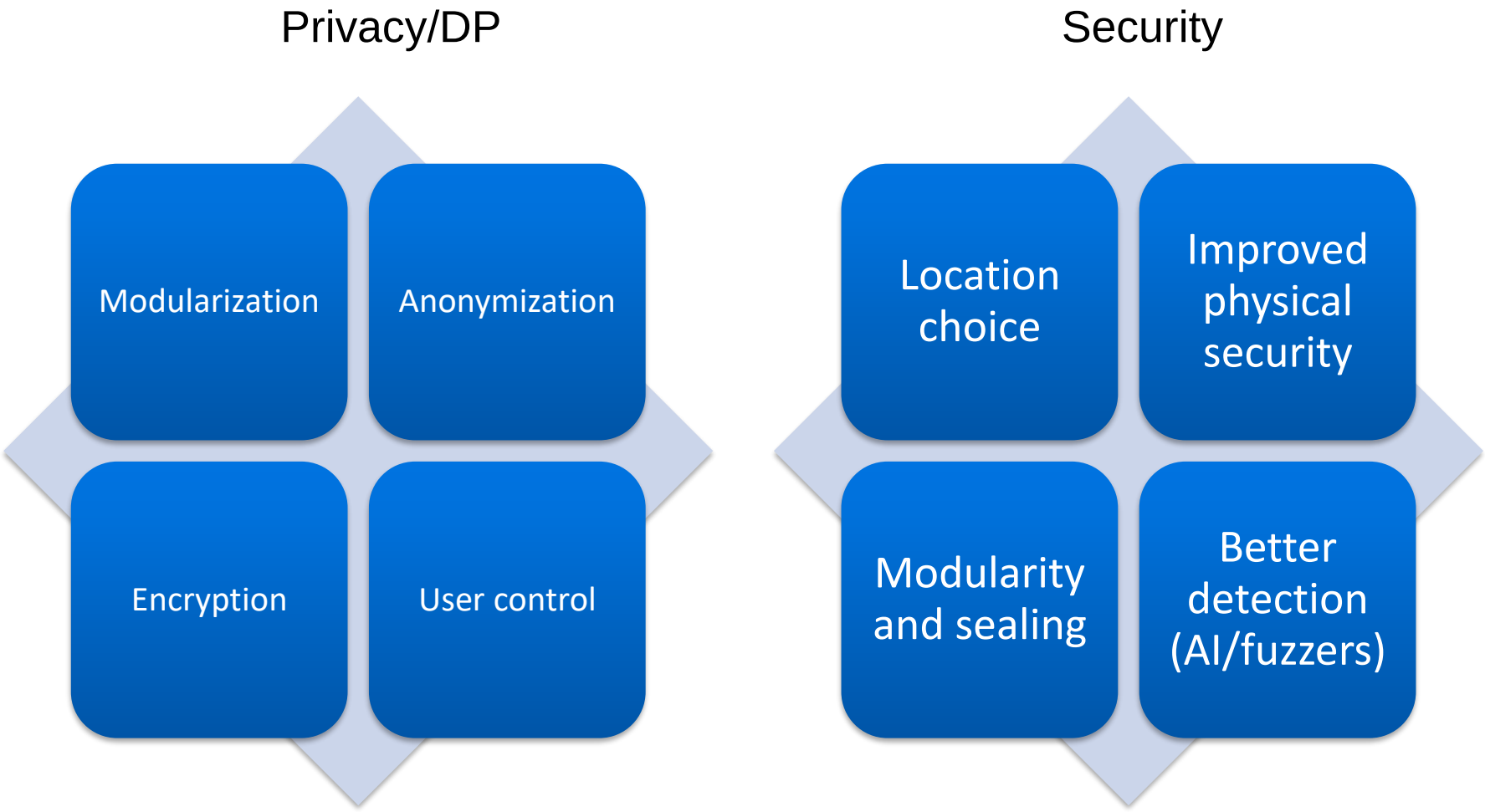
Some broad concerns

- Promising for highly regulated environments
  - Finance
  - Telecommunications
  - Automotive
  - Government
- Related to data processing
- User mobility
- Benefits from and uses AI
- Ubiquitous applications with different security requirements and capabilities

Some specific regulatory concerns

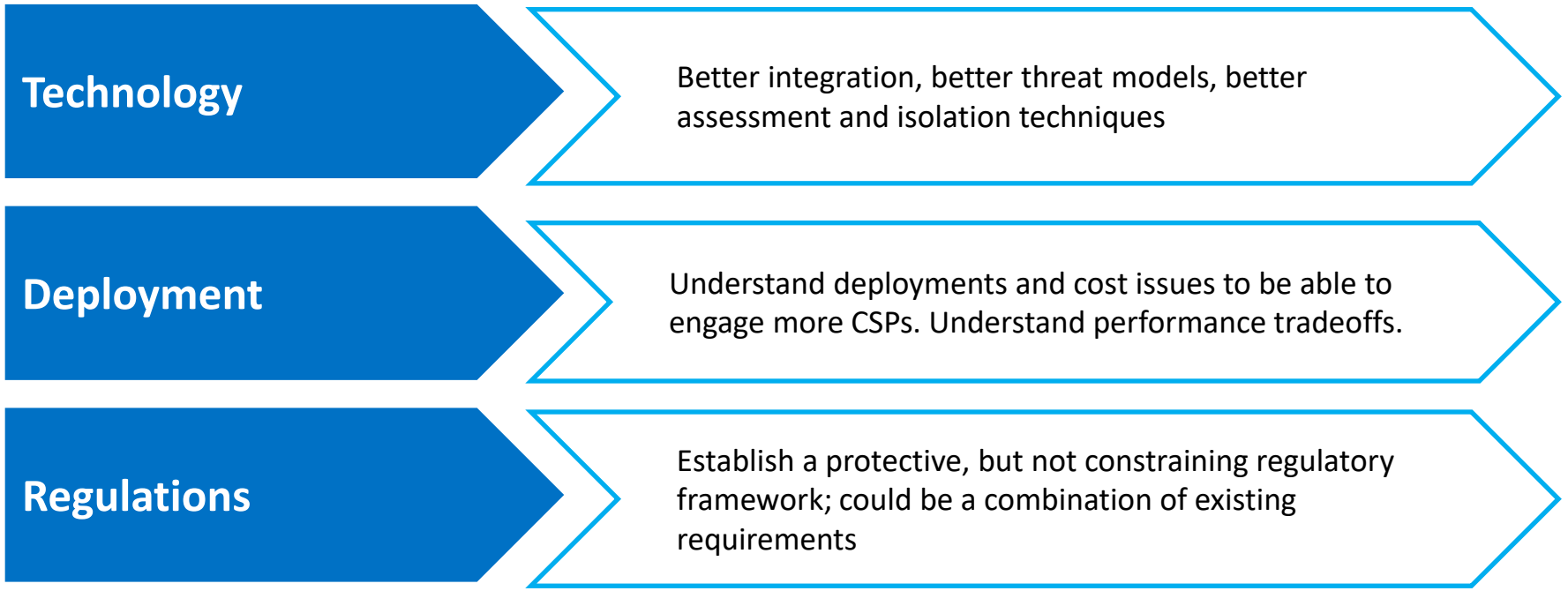


Potential tech approaches (but new regulatory frameworks are needed)



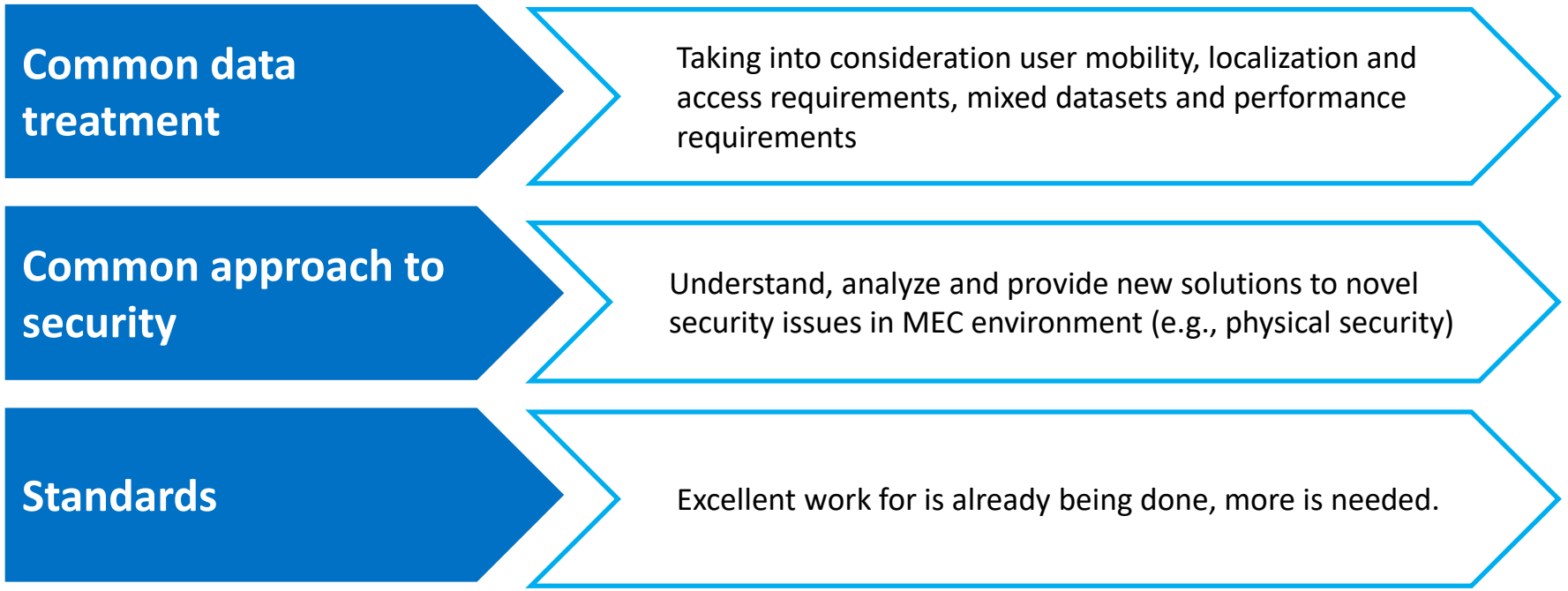
CONCLUSIONS

What needs to be done



The movement towards the edge is in progress.
But practical operational issues need to be addressed

What needs to be done: privacy and security



The future is bright if practical issues are resolved

READING LIST

Some recent sources

- Ranaweera, Pasika, Anca Delia Jurcut, and Madhusanka Liyanage. "Survey on multi-access edge computing security and privacy." *IEEE Communications Surveys & Tutorials* 23.2 (2021): 1078-1124.
- Sabella, Dario, et al. "MEC security: Status of standards support and future evolutions." *ETSI white paper* 46.1 (2021): 26.
- Wang, Cheng, et al. "The security and privacy of mobile edge computing: An artificial intelligence perspective." *IEEE Internet of Things Journal* (2023).
- Nowak, Tomasz W., et al. "Verticals in 5G MEC-use cases and security challenges." *IEEE Access* 9 (2021): 87251-87298.
- Gür, Gürkan, et al. "Integration of ICN and MEC in 5G and beyond networks: Mutual benefits, use cases, challenges, standardization, and future research." *IEEE Open Journal of the Communications Society* 3 (2022): 1382-1412.
- Yang, Jinming, Awais Aziz Shah, and Dimitrios Pezaros. "A survey of energy optimization approaches for computational task offloading and resource allocation in MEC networks." *Electronics* 12.17 (2023): 3548.
- Singh, Ramesh, Radhika Sukapuram, and Suchetana Chakraborty. "A survey of mobility-aware multi-access edge computing: Challenges, use cases and future directions." *Ad Hoc Networks* 140 (2023): 103044.

Thank you!