5 Technologies That Will Transform Your Digital Future

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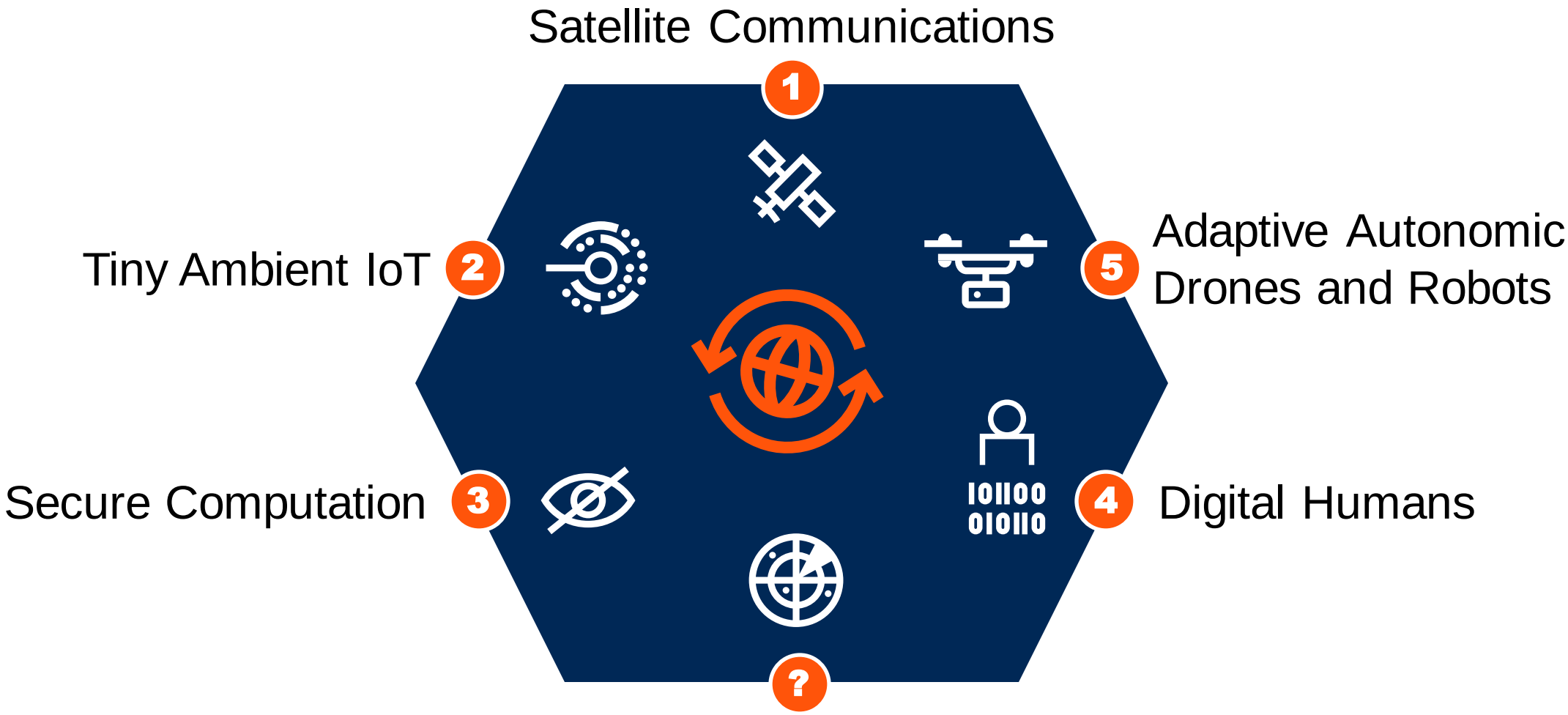
Transformational Technologies



Key Issues

1. Which five technologies will enable innovation and disruption?

2. Which additional innovative technologies should be on your watch list?

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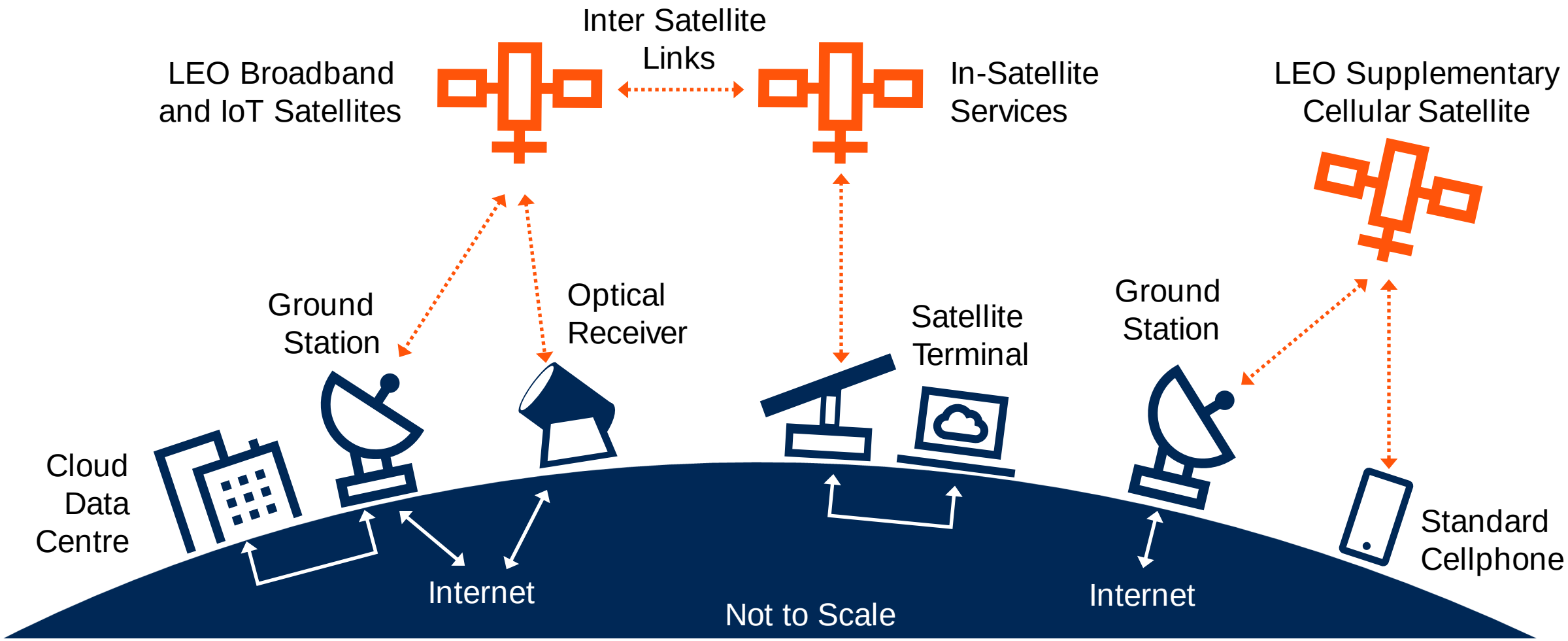
1 Satellite Communications



Satellite Opportunities

LEO Satellites

Smartphone

Supplementary Satellite Service

Remote Connectivity

Lone Workers

Rural Broadband

Support Legacy Cellular

Broadband

Global Broadband Connectivity

Resilience

Affordable

No Dependence on Telcos

Mobility — E.g., Air, Maritime

IoT

Global IoT Without Telcos

Affordable Hardware and Services

IoT in Remote Places

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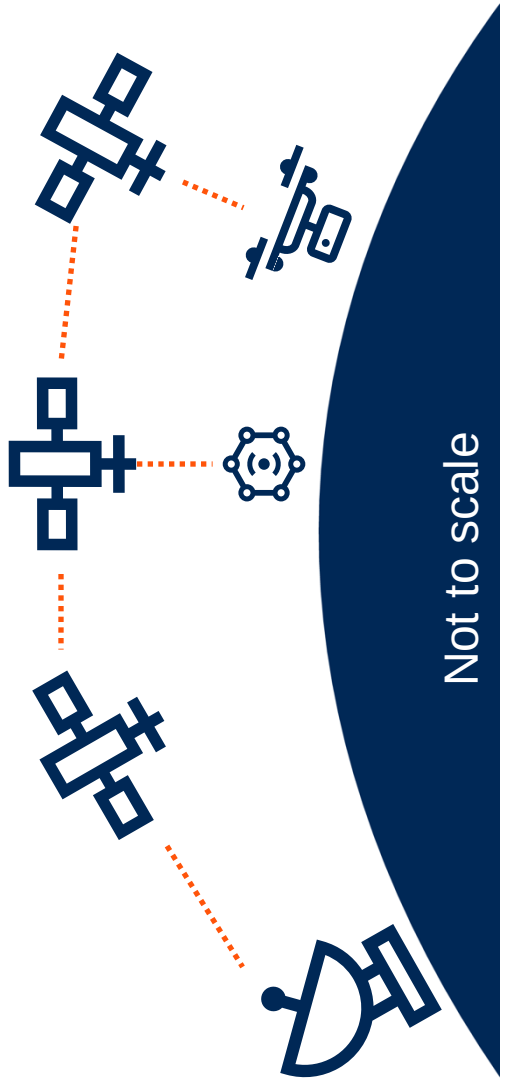
Satellite Future Directions and Challenges

Too many aspiring providers;

Inevitable failures;

Volatile pricing & T&Cs



Bigger launch vehicles reduce costs & enable smarter satellites and bigger antennae

Optical links improve performance

More constellations, Kuiper joins the crowd

Lower latency than fibre

More standardization, e.g., 5G NTN

Satellite drone connectivity becomes mainstream

Tighter integration between satellite comms and cloud zones

In-orbit data processing

Maintain 2G without a network

Constellation as a service

2 Tiny Ambient IoT Principles

No Battery

Very Low Cost

Novel Manufacturing

Physically Small

Low Power Wireless

Intelligent

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Ambient IoT Technologies & Applications

Sensor attached to a butterfly

Printed 1c processor

Energy harvesting Bluetooth tags

Backscatter wireless at 2.4 Ghz and mm wave

- Printed electronics (including processors)
- Future active tags < 10c
- Wireless power
- Power harvesting
- Stretchable electronics and substrates
- Ultralow power/zero power wireless
- Physically small devices, e.g., mm scale computing
- Task-specific ultra-low-power chips, e.g., for AI
- Biodegradable electronics
- Gateways, edge and smart access points
- New Bluetooth and Wi-Fi standards

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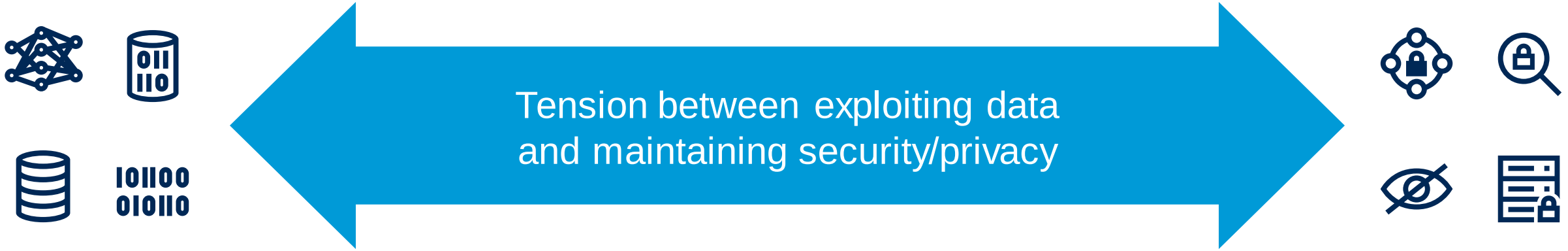
Ambient IoT Opportunities & Challenges

New ecosystems	Garments + shop + washing machine + cleaners
	Consumables + shop + smart home
Track and monitor anything relevant to your business	
Reduced loss, damage, theft	
Novel product behavior, e.g., products that report expiration	
Unforgeable provenance, product passports	
New business models based on behavior	
Invisible IoT	

- Privacy concerns
- Invisible IoT concerns
- E-waste
- Requirements for new infrastructure
- Regulations

3 Secure Computation



Trusted computation environment

E.g., Trusted third party, trusted hardware environment

Decentralized/Distributed processing

E.g., Federated machine learning

Transform data & algorithms

E.g., Homomorphic encryption, differential privacy, zero-knowledge proof

Emerging Technologies to Facilitate Secure Computation

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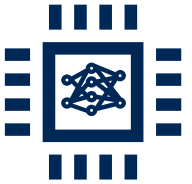
Growing Portfolio of Secure Technologies

X	Homomorphic encryption
TDX	Accelerator chips
X	Differential privacy
TD	Secure multiparty computation
	Trusted execution environments
T	Secure edge processing
X	Data anonymization
	Special case secure algorithms
X	Encrypted data storage algorithms
TD	Privacy-preserving ML
	Secure IoT “things”

Camera with integrated anonymization

Private drone anti-collision and management algorithms

Prototype homomorphic accelerator chips



DNN on a chip, for edge AI

T	Trusted computation
X	Decentralized/distributed processing
D	Transform data/algorithms

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Many innovations Need Secure Computation

EV Charging	Car Rental	Online Advertising
Data Marketplaces	Physical Marketplaces	Drone Flight Control
Healthcare	Digital Payments	AI Training
Smart Home	Business Ecosystems	…

- Some tactics are computationally infeasible without accelerators
- No technique addresses all requirements
- Some tactics are still technically complex to implement and immature
- Some organizations may resist on cost or complexity grounds
- Accuracy of results may be impacted
- Limits computations and algorithms that maybe used
- Governments may want access to information

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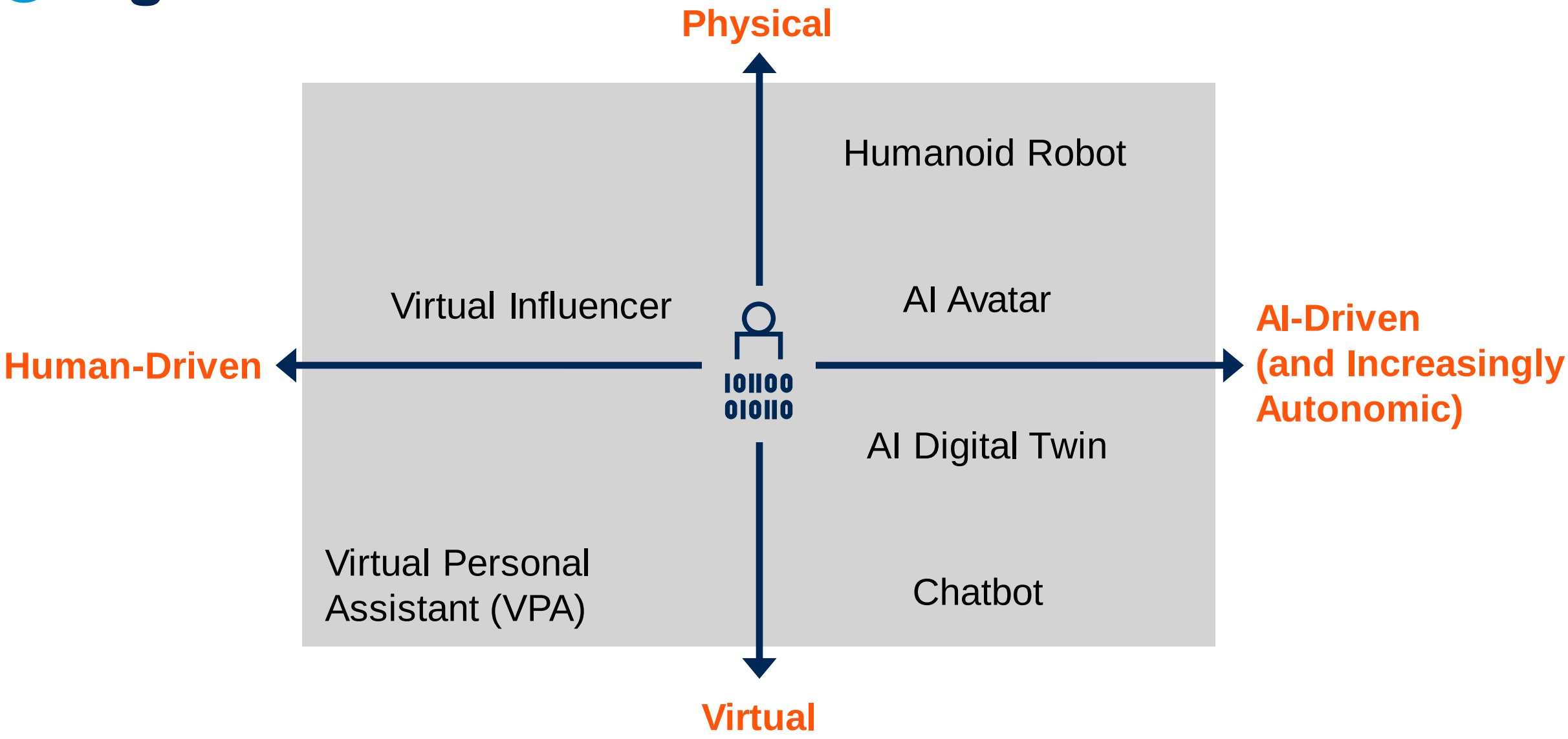
4 Digital Humans



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The Digital Human Economy

Customer Service	Training
Entertainment	Therapy
Influencers	Companions
Digital Assistants	…

Mainstream

Licensed Personas	Resurrecting the Dead
Cybercrime	Employed Agents
Multipresence	Digital Nonhumans
Metaverse	…

Future/Niche

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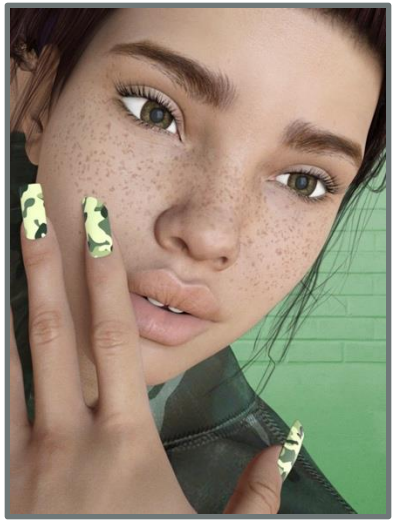
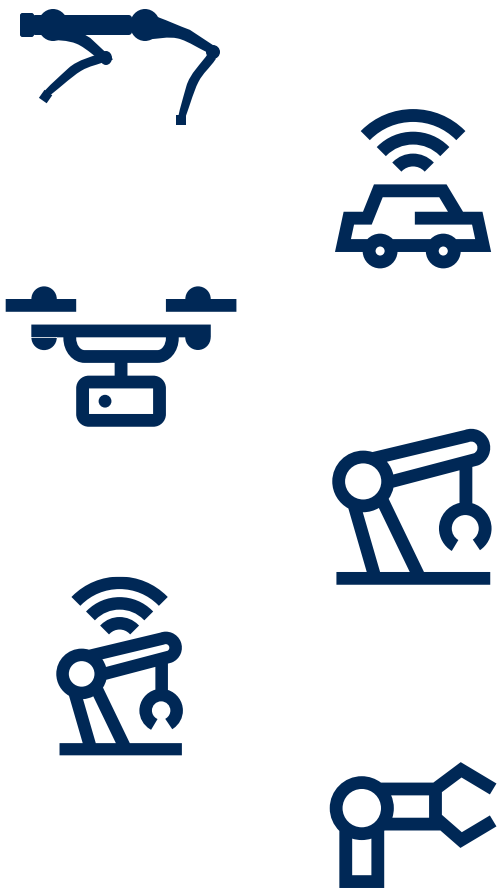
Digital Human Challenges



- Ethical usage and behavior
- Bias and stereotypes
- Regulation of digitals humans and the associated AI
- Social backlash
- Incomplete behavior/appearance
- Crime, inappropriate influence, fake reality
- Technical complexity and computational requirements
- Varying cultural attitudes to digital humans
- Customers/staff may have inappropriate expectations or treat digital humans differently

5 Adaptive Autonomic Drones and Robots



Autonomic systems are self-managing physical or software systems, performing domain-bounded tasks, that exhibit three fundamental characteristics:

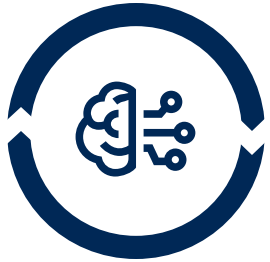
Autonomy. They execute their own decisions and tasks autonomously without external assistance.

Learning. They modify their behaviour and internal operations based on experience and changing conditions as well as potentially changing goals. The ability of autonomic systems to learn and evolve their behaviour means some may be nondeterministic.

Agency. They have a sense of their own internal state and purpose which guides how and what they learn and enables them to act independently upon decisions made.

Key Technologies for Adaptive Robots

Adaptive AI

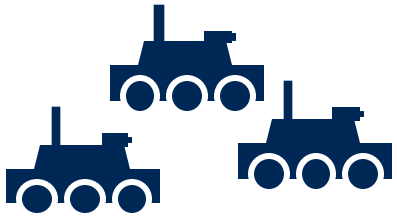


Adaptive AI for robots

Goal-oriented, real-time feedback

Adapts to changing environments

New Ways to Learn



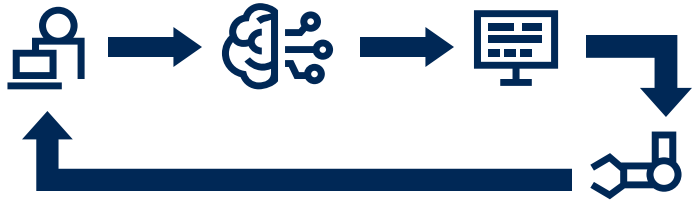
Collaborative learning

Collaborative autonomy, e.g., swarm mapping

ChatGPT helps robot understand instructions

Virtual training environments

New Ways to Teach Robots



Learn by watching examples

ChatGPT writes robot code

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Adaptive Autonomic Opportunities

We can't train robots for all possibilities

Need agility and flexibility to handle new tasks

Adaptive behaviour enables personalized behaviour

Enables the use of robots to scale by orders of magnitude
- Custom programming is impractical
- Directed by consumers and nonexperts
- Learning instead of programming

Adapt to wear and tear

Robots operating out of touch with human minders

- Nondeterministic behaviour
- Explainable AI is immature
- Warranty and liability challenges
- LLM data and behaviour may be unreliable or unpredictable
- Trial and error learning doesn't work for many tasks
- Some technologies are very immature, e.g., learn by observation

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Key Issue Take-Away:

Task your technology strategy team to evaluate digital humans, satellite communications, ambient tiny IoT, secure computation and autonomic robots.

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Key Issues

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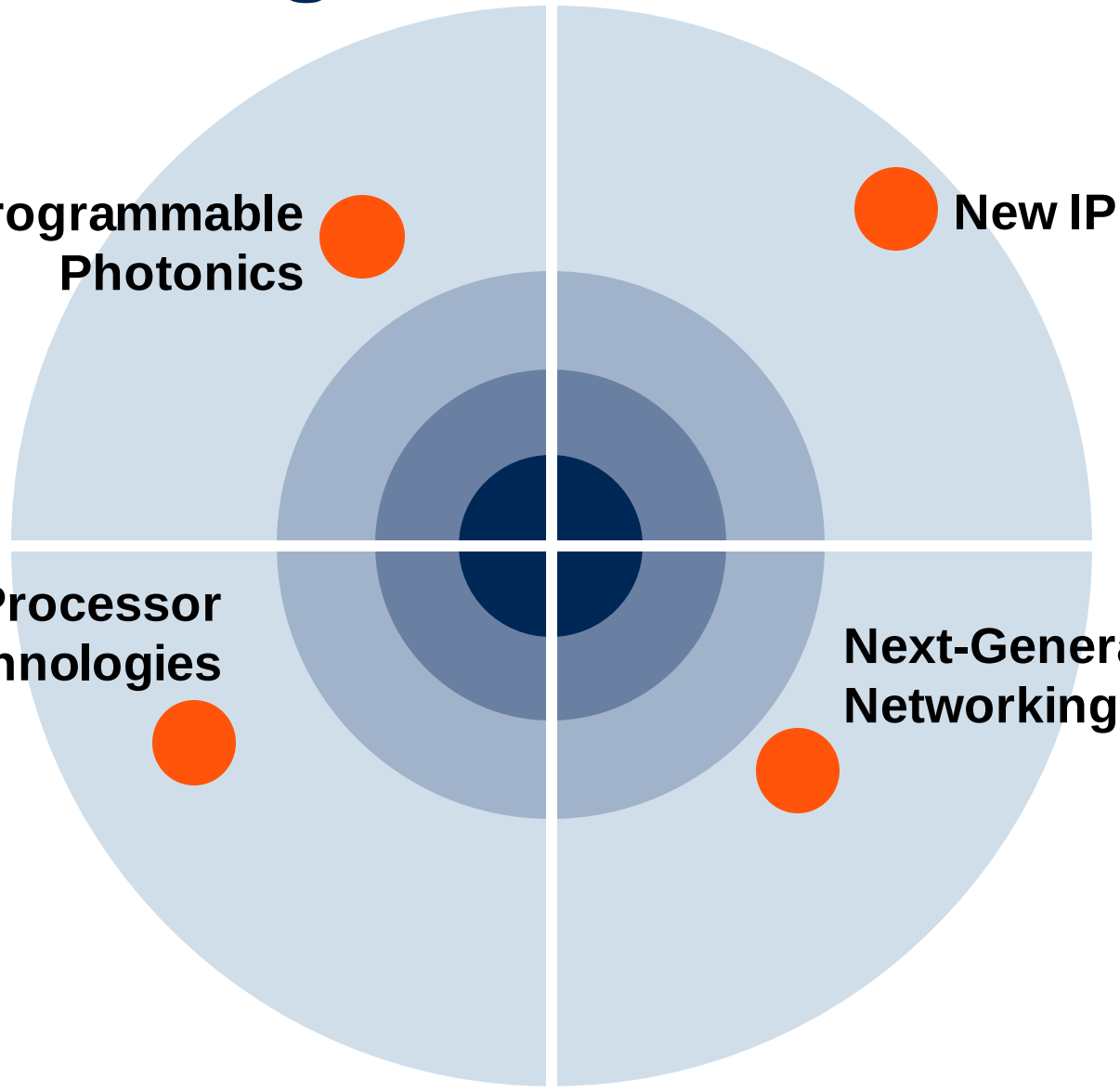
Maintain a Watching Brief



Programmable Photonics

- Programmable optical chips
- Enables agile/wider use of photonics

New IP

- Major revision of internet protocols and architecture
- Shift of internet control toward ITU
- Highly disruptive
- Uncertain need
- Politically contentious

New Processor Technologies

- Quantum
- Edge supercomputing
- Optical processing
- Postsilicon electronics
- Task-specific accelerators

Next-Generation Networking

- 6G
- Quantum networking
- Terahertz
- Network becomes a platform
- Long range optical networks

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Key Issue Take-Away:

Establish a trend and technology watching team and process to identify and categorize disruptive technologies.

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Recommendations

- Seek new business opportunities enabled by individual technologies and combinations of these emerging technologies.
- Review the effectiveness of your trend and technology spotting process to ensure it’s capturing the relevant material.
- Build strong communications channels with a wide range of business peers to understand where emerging technologies can address their needs.
- Consider academic partners to provide advice on more advanced techniques.
- Assess the potential social and regulatory issues of technologies such as digital humans and ambient IoT before adoption.

Recommended Gartner Research

- **Three Critical Use Cases for Privacy-Enhancing Computation Techniques**
  Bart Willemsen, David Mahdi and Mark Horvath
- **Quick Answer: Which Next-Gen Computing Technologies Will Organizations Favor Based on Their Transformation Potential?**
  Nick Jones and Arun Chandrasekharan
- **LEO Satellites Will Be an Essential Part of Your Future Networking Strategy**
  Nick Jones, Bill Ray and Bill Menezes
- **Quick Answer: What Is a Digital Human?**
  Marty Resnick, Adrian Lee and Annette Jump
- **Complexity, Chaos and Confidence: A Tapestry of Trends Across Brave New Worlds**
  Marty Resnick, David Cearley and Others

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