5 Technologies That Will Transform Your Digital Future

Nick Jones

Gartner®

Transformational Technologies
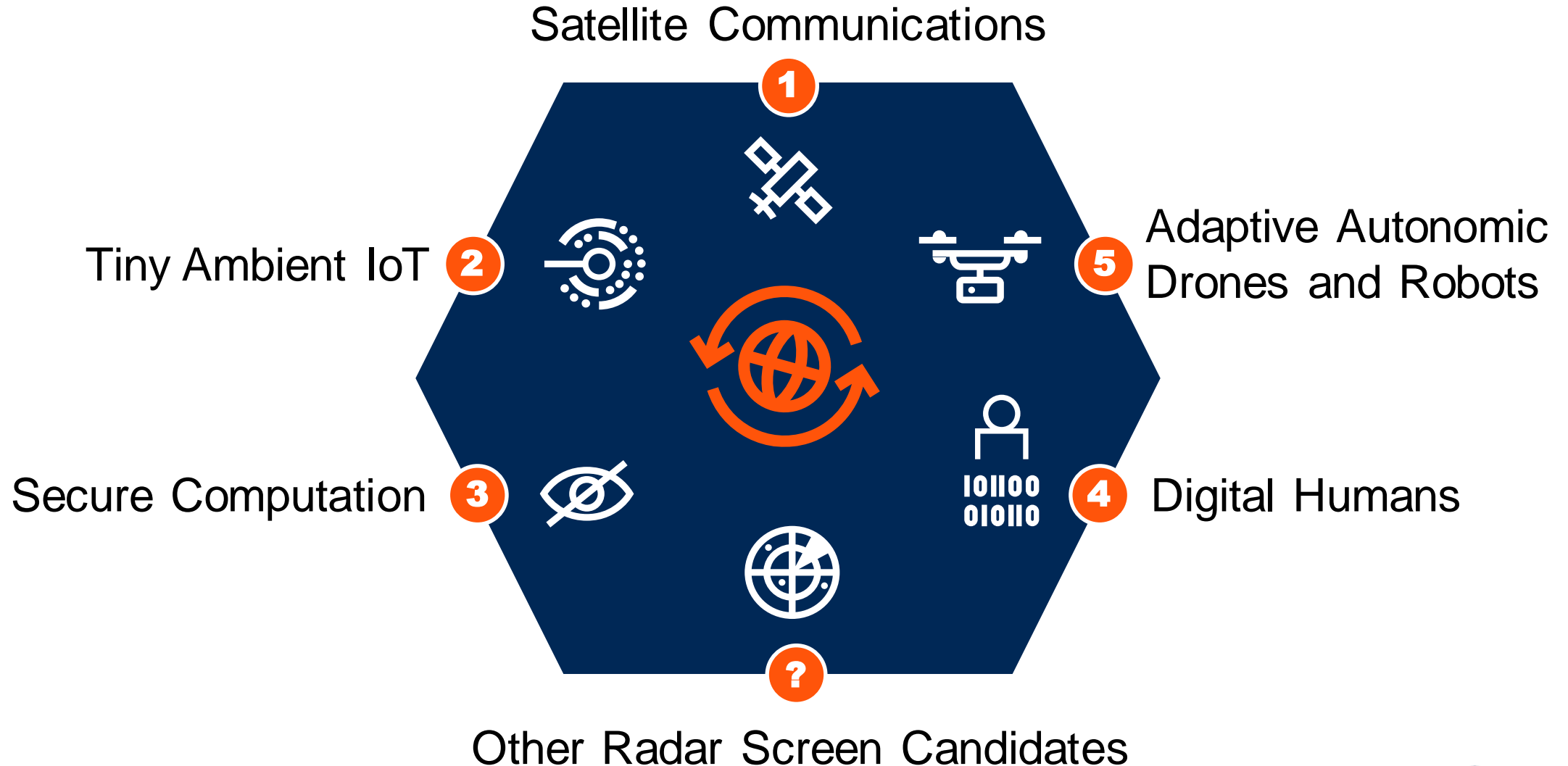
Satellite Communications

1

Tiny Ambient IoT

2

Secure Computation

3

Adaptive Autonomic Drones and Robots

5

Digital Humans

4

Other Radar Screen Candidates

?

Gartner®

Key Issues

1. Which five technologies will enable innovation and disruption?

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

Gartner.

1 Satellite Communications

Inter Satellite Links

LEO Broadband and IoT Satellites

In-Satellite Services

LEO Supplementary Cellular Satellite

Ground Station

Optical Receiver

Satellite Terminal

Ground Station

Cloud Data Centre

Internet

Standard Cellphone

Internet

Not to Scale

Gartner
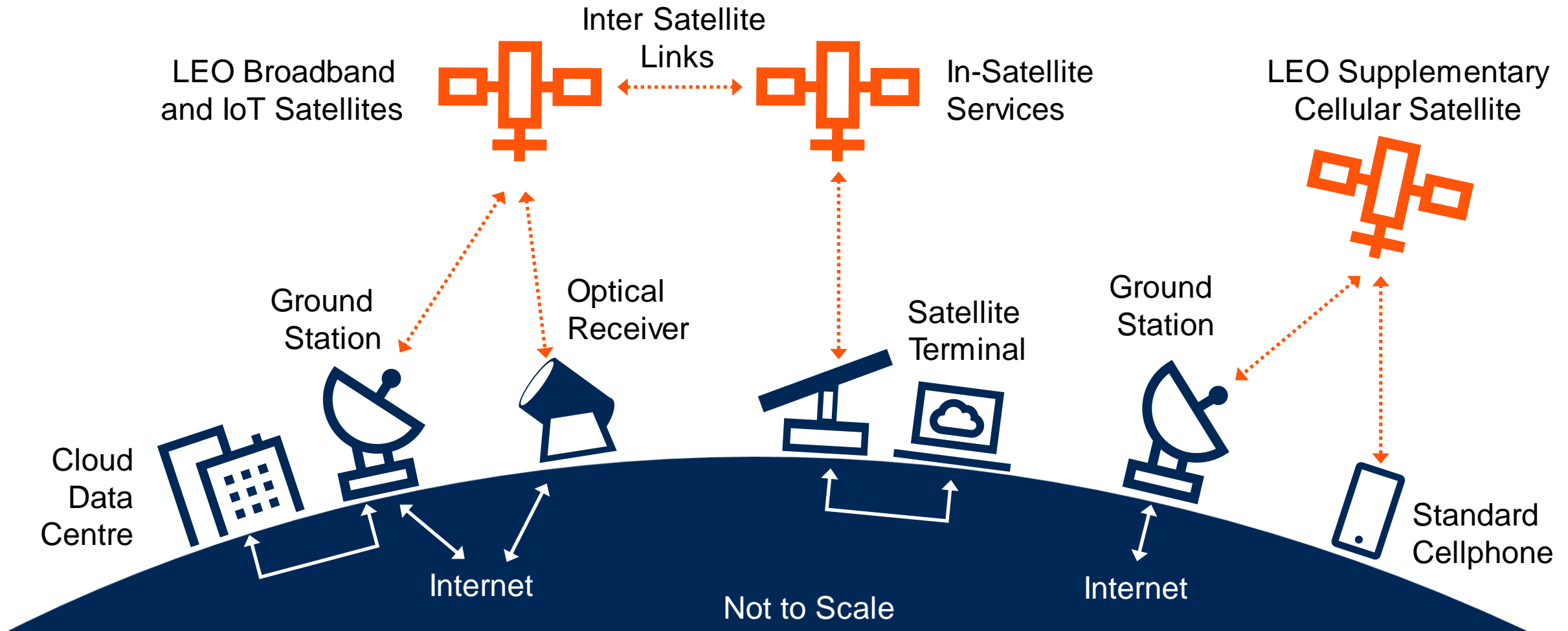
Satellite Opportunities

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

Gartner.
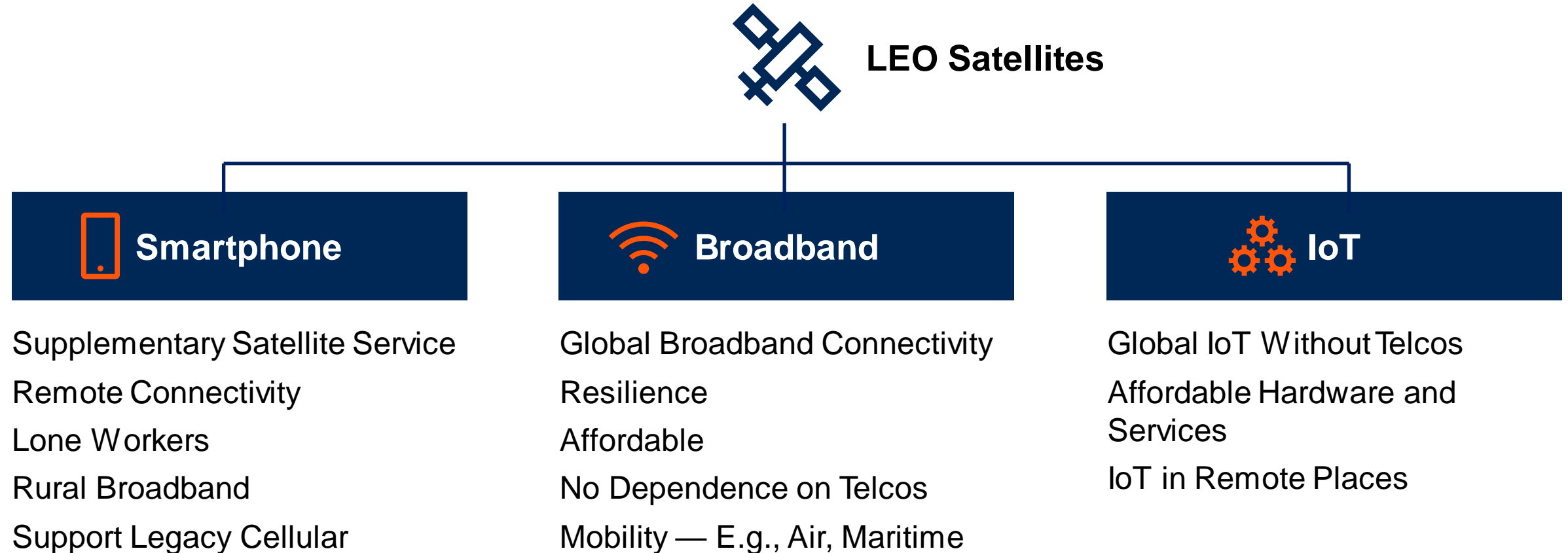
Satellite Future Directions and Challenges

!

Too many aspiring providers;

Inevitable failures;

Volatile pricing & T&Cs

Not to scale

Bigger launch vehicles reduce costs & enable smarter satellites and bigger antennae
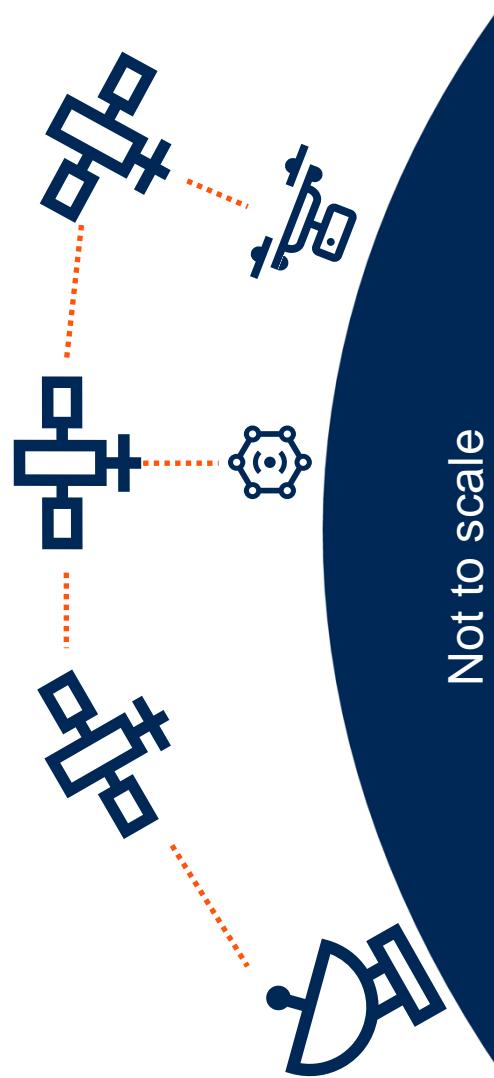
Optical links improve performance

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

Gartner

② Tiny Ambient IoT Principles

No Battery

Very Low Cost

Novel Manufacturing

Physically Small

Low Power Wireless

Intelligent

Gartner.

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

Gartner.

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
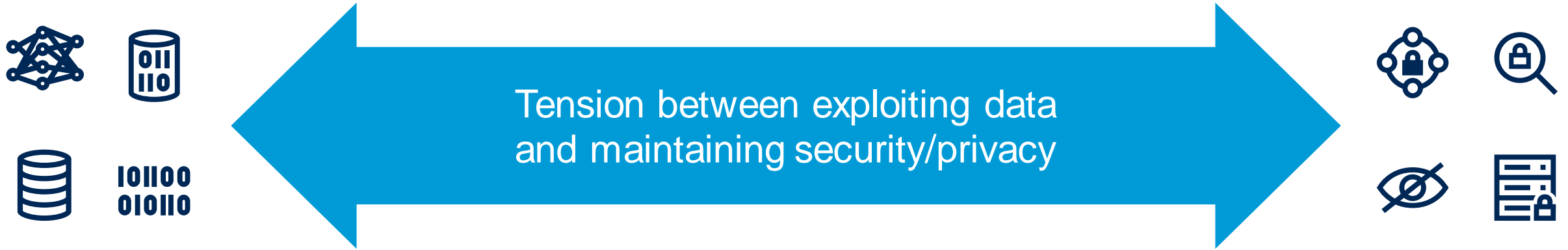
New business models based on behavior

Invisible IoT

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

Gartner

③ Secure Computation

Tension between exploiting data and maintaining security/privacy

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

Gartner.

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
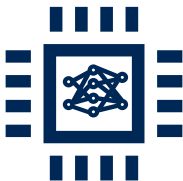
Secure IoT "things"

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

Gartner

Many innovations Need Secure Computation

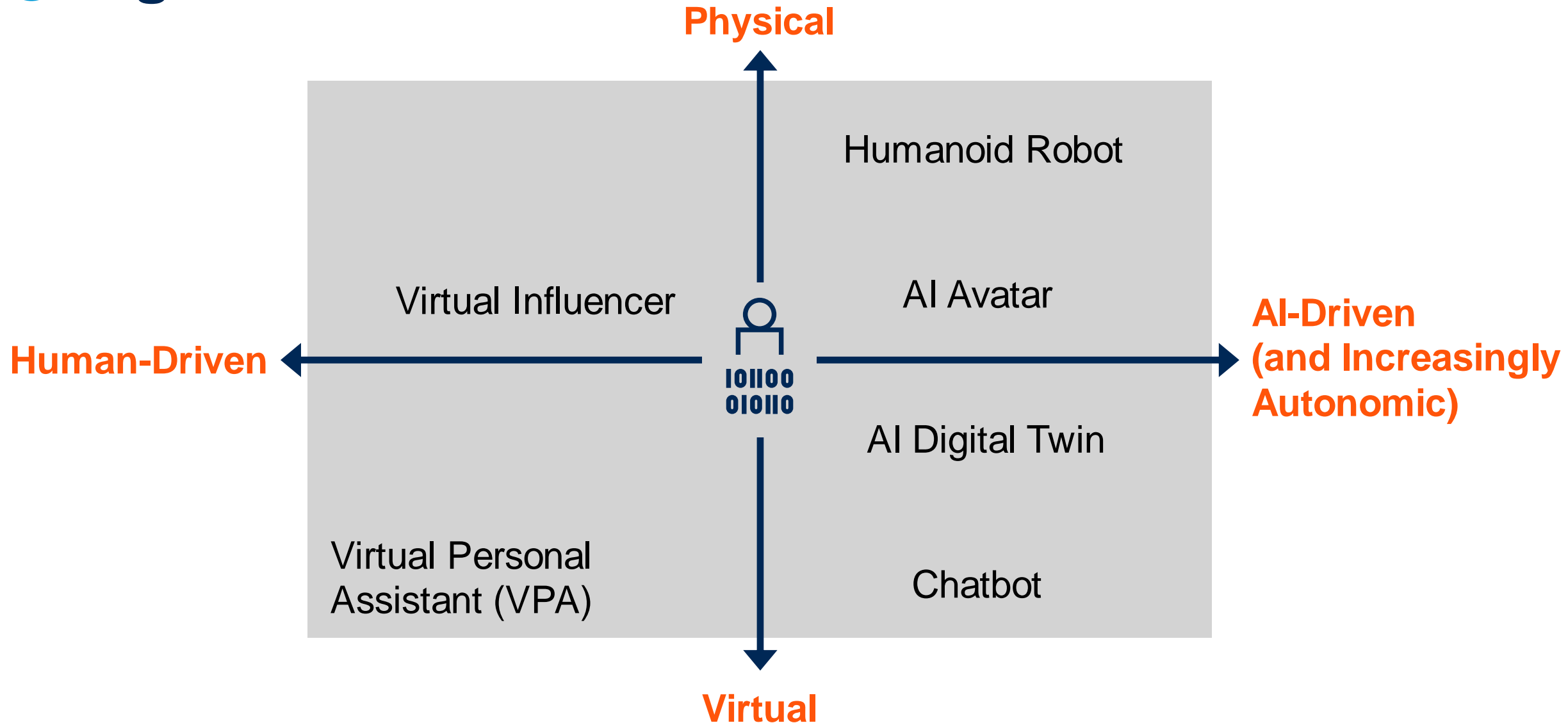|		
EV Charging	Car Rental	Online Advertising
Data Marketplaces	Physical Marketplaces	Drone Flight Control
Healthcare	Digital Payments	AI Training
Smart Home	Business Ecosystems	...

⚠️

- 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

Gartner

④ Digital Humans

Physical

Humanoid Robot

Virtual Influencer

AI Avatar

Human-Driven

AI-Driven (and Increasingly Autonomic)

AI Digital Twin

Virtual Personal Assistant (VPA)

Chatbot

Virtual

Gartner.

The Digital Human Economy

Mainstream

Customer Service	Training
Entertainment	Therapy
Influencers	Companions
Digital Assistants	...

Future/Niche

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

Gartner®

Digital Human Challenges
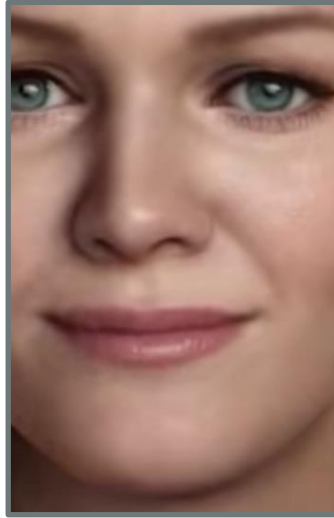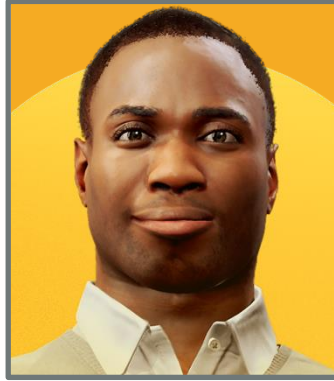
- Ethical usage and behavior

- 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

Gartner.

⑤ Adaptive Autonomic Drones and Robots
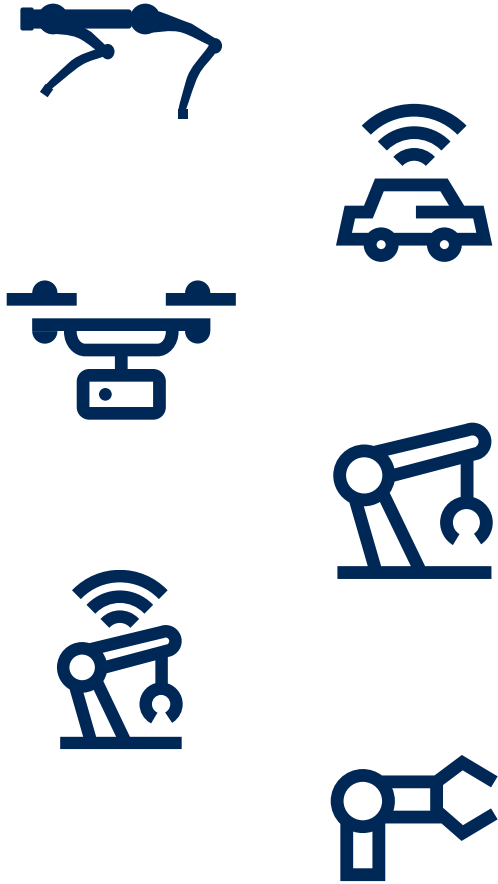
Autonomic systems are self-managing physical or software systems, performing domain-bounded tasks, that exhibit three fundamental characteristics:

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.

Gartner®

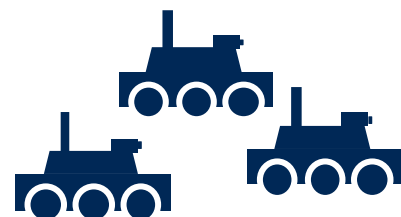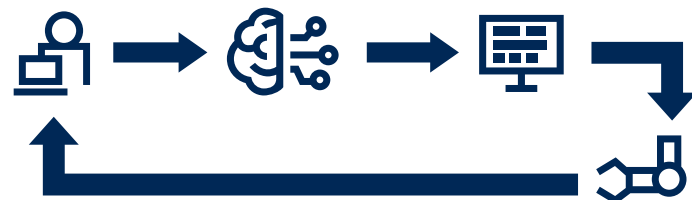# Key Technologies for Adaptive Robots

Adaptive AI
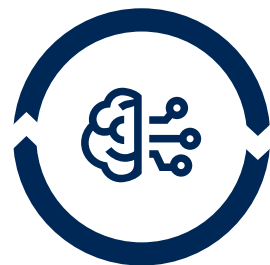
Adaptive AI for robots

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

Gartner

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
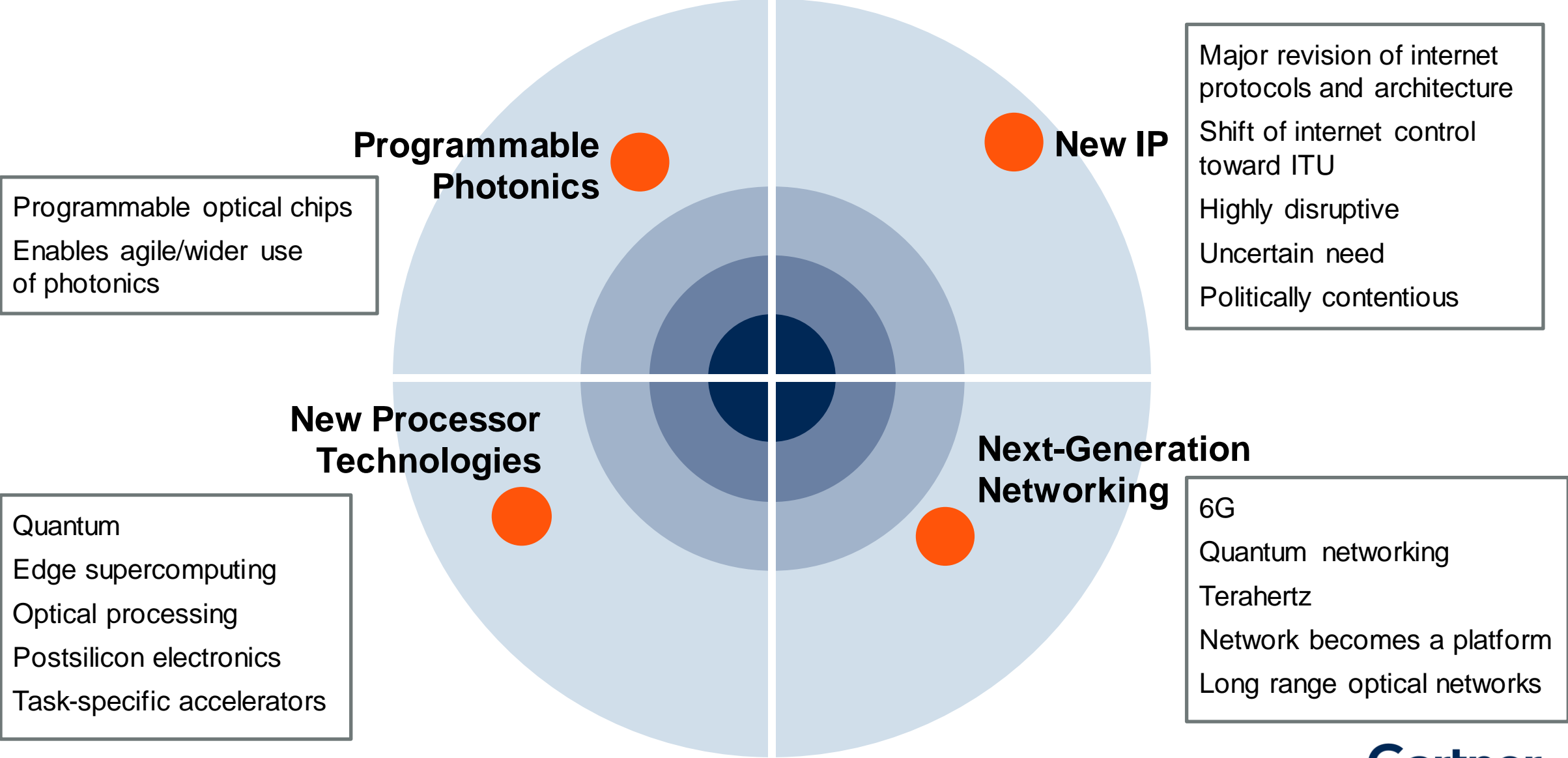
Gartner

Key Issue Take-Away:

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

Gartner

Key Issues

1. Which five technologies will enable innovation and disruption?

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

Gartner®

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

Gartner.

Key Issue Take-Away:

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

Gartner®

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.

Gartner.®

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

Gartner