

NOKIA

Edition 3

Know, now

Know the early signs in the
market and explore the future



Welcome

For CSPs, an awareness of industry-defining change is crucial to long-term success. That's why we've identified the latest trends across technology, business, and society to help you prepare, adapt and capitalize on new opportunities.

In Edition 1 of Know, now we identified the spatial web as a trend to watch for the future. Now that the Metaverse has become part of new culture we have revisited this hero trend in our Metaverse Special Edition.

The fourth industrial revolution (4IR) is well underway, spurred by the pace of innovation across communication networks. It forms a crucial part of our wider tech vision for 2030, and we've reflected on the 4IR's impact through the trends we've selected here.

Ultimately, 4IR and wider changes will be reshaped by communication services and architecture, from 5G to 5G-Advanced, 6G and beyond. This report will give you a snapshot of the early signals you need to look out for, and how you can take advantage of them now.

In this issue

The five signals to know, now.

Be in the know by understanding:

- What's happening?
- Why does it matter?
- Who to watch?
- How can you be prepared?

1. How will the Metaverse change the real world?
2. Can retailers thrive without digital experiences?
3. How 'human' could digital technology become?
4. How will going green shape the business landscape?
5. Will blockchain redefine the digital world?

Know the trends shaping the future for CSPs 2022–2030

1. **The Metaverse – a community worth investing in**
The Metaverse will combine our physical and digital worlds into one, which will require new technology and interoperability. We'll see an avatar economy with companies vying for data collection and mindshare to monetize. This will require continued development of the latest networking technologies and a big effort to coordinate an expanding ecosystem.

2. **Customer expectations are reshaping retail**
Online shoppers are being empowered with VR and AR elements – bringing that in-store experience into their homes. Bricks and mortar stores are also introducing virtual entertainment to attract customers. Meanwhile, the expectation for personalized products, delivered on demand, is impacting production and logistics. To meet demand efficiently, retailers will need an intelligent, scalable network that runs in real time.

3. **Our digital interactions are evolving**
The devices and interfaces we interact with are becoming a true extension of ourselves rather than just an accessory. New materials such as paper and plastic-based disposable sensors are fusing the physical, digital and biological worlds to create new levels of interaction.

4. **How ethics are influencing choice**
Ethical values and climate change awareness are now mainstream. Consumers are voting with their wallets based on environmental as well as ethical credentials, creating pressure on businesses to change their products, methods of production and corporate cultures.

5. **Blockchain – the digital world's building blocks**
Blockchain is breaking into a variety of sectors, providing transparent and secure operations for more than just cryptocurrency. Digital ledger technology has the potential to introduce new levels of fairness, reliability and security for applications in healthcare, IoT, voting, supply chains and personal identity.

Enter the Metaverse

How will the 'next internet' change the real world?



1

The Metaverse What's happening?

2

The Metaverse blends our physical and digital worlds into one. Driven by leaps in VR and computing power, it functions like a 3D spatial internet that user avatars can move through and participate in.

3

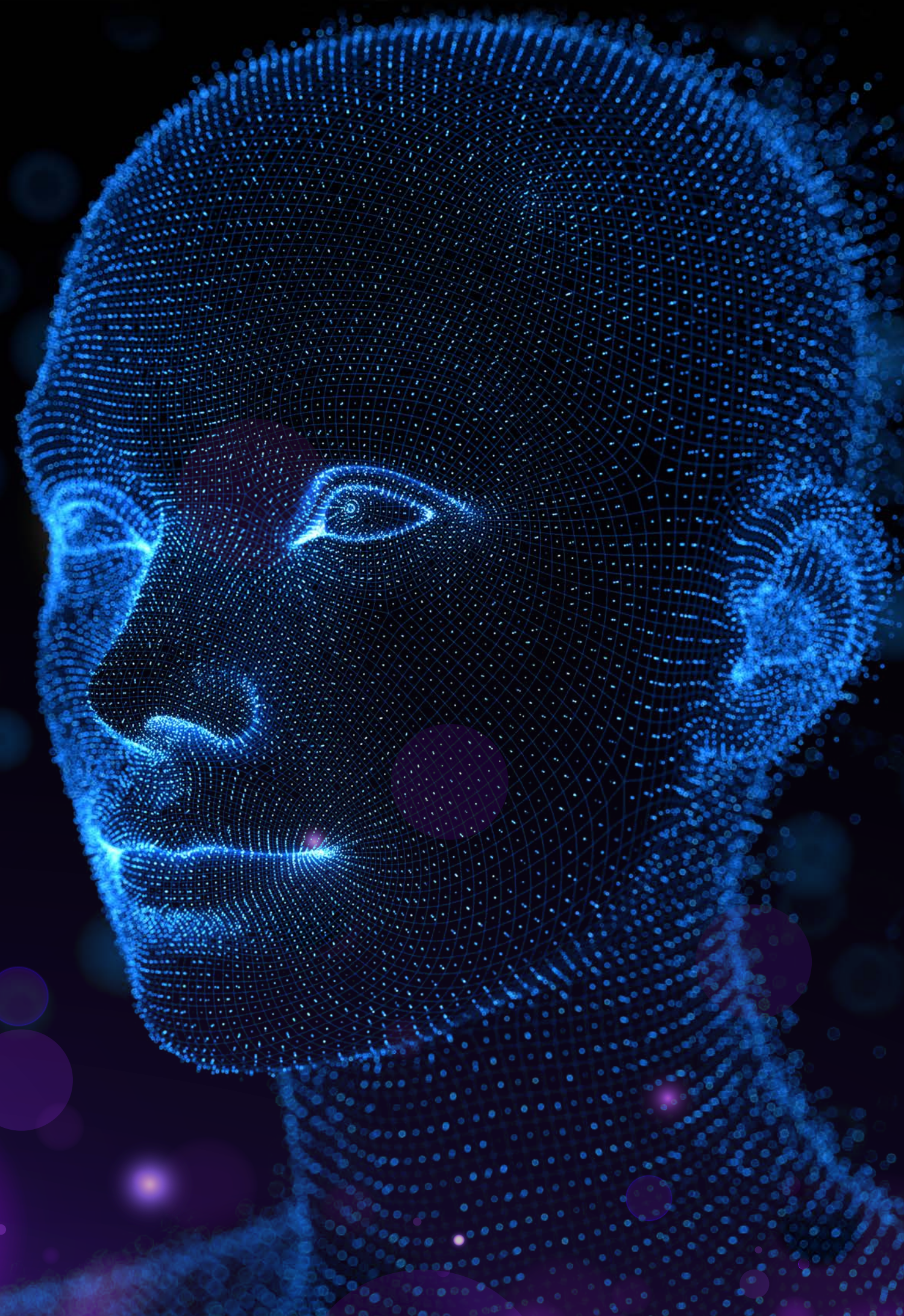
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World-leading companies will use the Metaverse to deliver information, entertainment and much more. In terms of hardware, users will access the Metaverse via wearable headsets and/or glasses.

5

This is where fiber, 5G and 5G-Advanced comes into play. There are considerable connectivity demands of the Metaverse in order to render life-like social interaction. It will likely increase the need for low latency, high bandwidth ultra-resilient networks.

This next wave of human-computer interaction will also generate further trends and technological shifts. We'll see the ever-increasing collection of data for monetization, increased use of digital twins, AI beginning to act as intelligent agents and the creation of parallel digital worlds for games, commerce, healthcare, training and more.



What does this mean?

In the Metaverse, cutting-edge technologies come together to deliver rich, real-time, hyper-realistic experiences – virtually. Take gaming, for example: through AR and VR technologies, players can fully immerse themselves in fantastical new digital worlds in ways that were never previously possible.

Similarly, the Metaverse is also creating new opportunities for VR tourism – allowing travellers to explore continents and enjoy new cultural experiences, all from the comfort of their couch. Likewise, it's enabling consumers to discover, trial and buy new products virtually, expanding retail commerce.

The Metaverse isn't just a portal for entertainment and exploration though. Through the Metaverse, doctors will be able to collaborate, making diagnoses faster. Students will be able to learn through re-creating practical experiments. And those with disabilities will have the opportunity to move through a new world unhindered.

In September 2021, Facebook announced a \$50M investment fund to develop Metaverse products¹

1. <https://blockchain.news/news/facebook-sets-up-50m-investment-fund-the-development-Metaverse>



Why does it matter?

Running the Metaverse will require seamless connectivity and high levels of interoperability across devices, cloud platforms and networks. It will also need an ever-expanding team of experts not only from the world of tech – but beyond.

As the Metaverse is a broad term that is not explicitly defined, there will be a constant learning curve on how it will evolve. It is clear that the Metaverse requires technology and service interoperability.

A consistent end-to-end Metaverse platform will bring together CSPs, cloud providers, content developers and hardware manufacturers. This makes for highly valuable partnership opportunities.

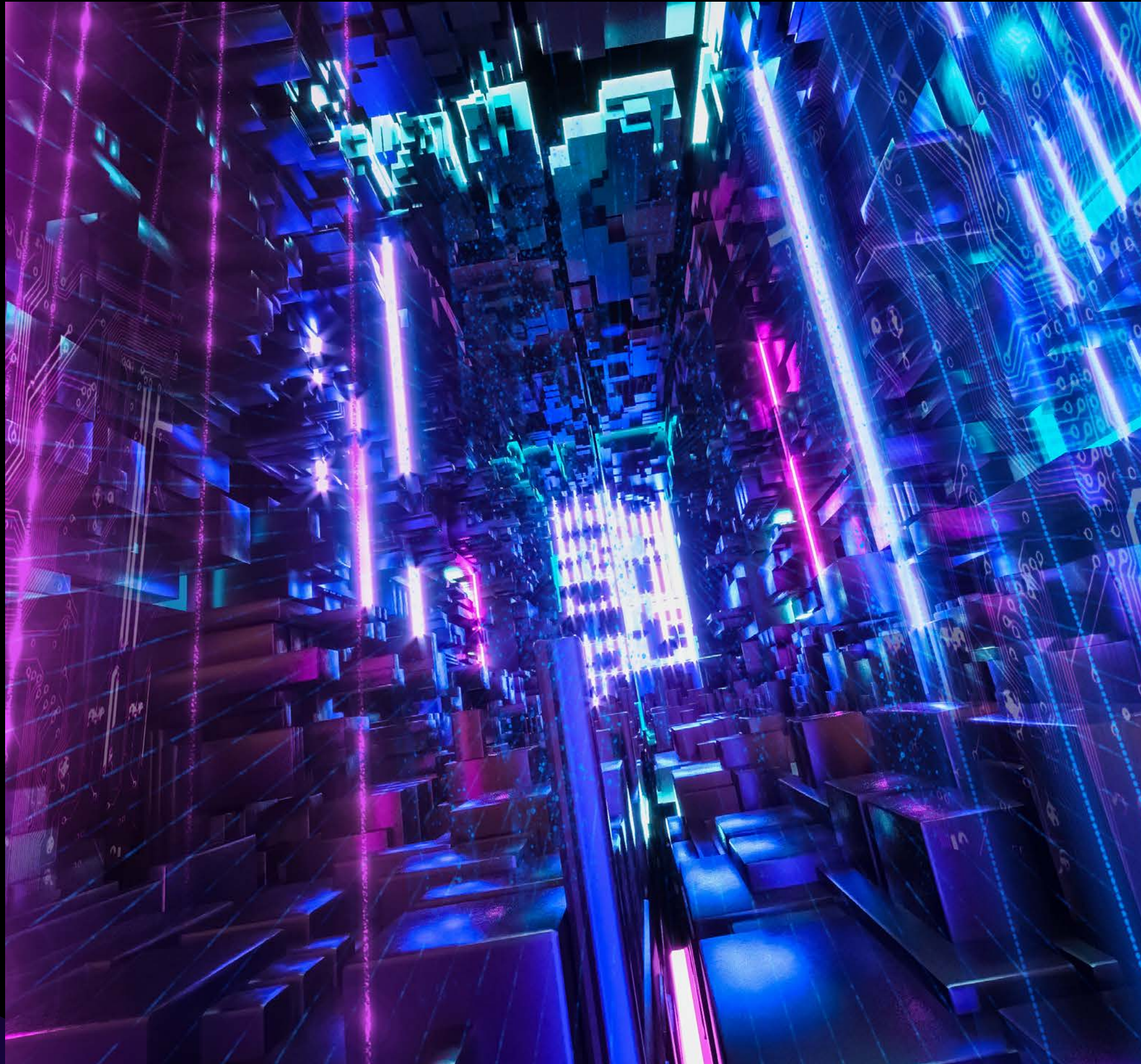
The brainpower behind the Metaverse will be vast and varied – from blockchain engineers and game designers, to product managers looking to deliver the ultimate experience for their customers. And as the Metaverse matures, so too will the expertise. Further into the future, companies will be employing Metaverse Planners, Metaverse Research Scientists, Metaverse Storytellers. And they may even recruit them via the Metaverse.



What do you need to know?

While the Metaverse will bring huge commercial opportunities it also creates major privacy concerns. The Metaverse relies on personal data to survive and thrive – and that data needs to be handled responsibly. Companies should adopt a ‘privacy by design’ approach, as multiple layers of technology will be in use and new types of personal biometric data available.





Who to watch?

Blurring physical and digital worlds

Chipotle's \$1 million burrito giveaway in Roblox: The Mexican food chain offered a free burrito to customers who attended its virtual restaurant within Roblox, the popular gaming platform.

[Read more](#)

The shift from traditional to crypto-gaming

The Sandbox, the newest blockchain-enabled Metaverse: Originally launched in 2011 as a mobile app, its creator Sebastian Borget has flipped the model to a decentralized blockchain Metaverse – enabling players and creators to monetize the content they make.

[Read more](#)



How can you be prepared?

Promote openness and collaboration to enable faster and wider adoption of the Metaverse.

Be ready to deliver the levels of connectivity required to experience the Metaverse. This includes Wi-Fi, 5G, and 5G-Advanced.

Explore what new user behavioral data can be captured in the Metaverse and understand the new levels of privacy required for protecting it.





Customer expectations are reshaping retail

Can retailers thrive without digital experiences?

1

Digital retail

What's happening?

2

What if you could increase online customer spend using VR? What if your customers checked-out their own purchases, safely and securely?

3

Online retailers are bringing the brick-and-mortar experience to online shopping with more 3D content and augmented reality (AR) 'try-ons' to boost buying confidence and influence purchase decisions. At the same time, physical stores are utilizing virtual elements to entertain and deliver a richer in-store experience.

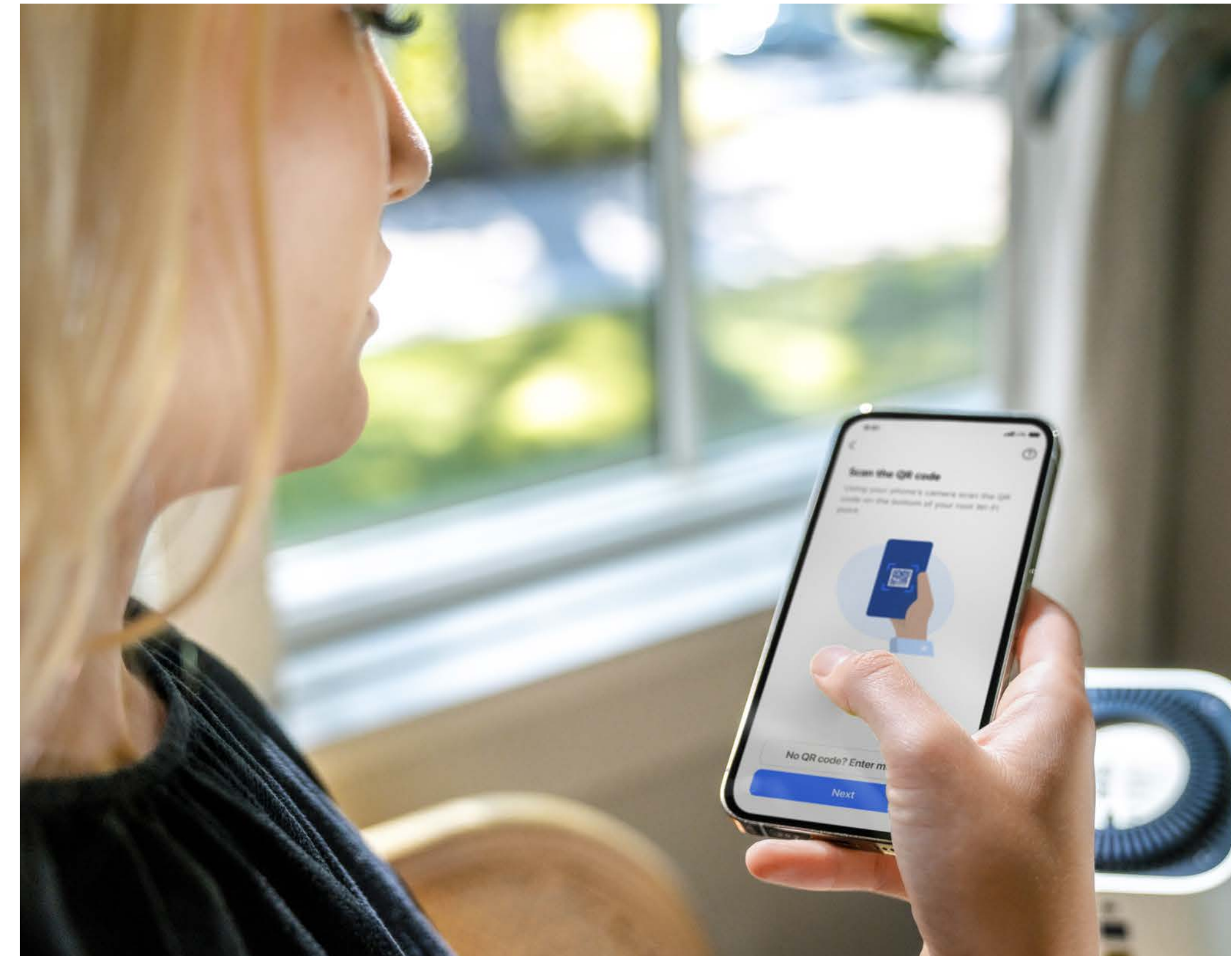
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Brands like Gucci are taking these digital experiences a step further, setting up virtual stores in gaming platforms – enabling customers' avatars to try and buy the latest collections with a revenue-share model that benefits both brands.

It's not just the buying experience that's changing. Consumers also now expect much more from their products: they want personalized items, on demand. To deliver this, suppliers are having to reimagine their production models and supply chains – and they need intelligent, scalable and real-time networks to support them.

By 2030, the launch of 6G connectivity and Industry 5.0 technology is set to enable new levels of human-robot collaboration, in turn allowing for this mass customization and personalization. Naturally, CSPs will have a role to play in delivering the connections required to run next-generation production lines.



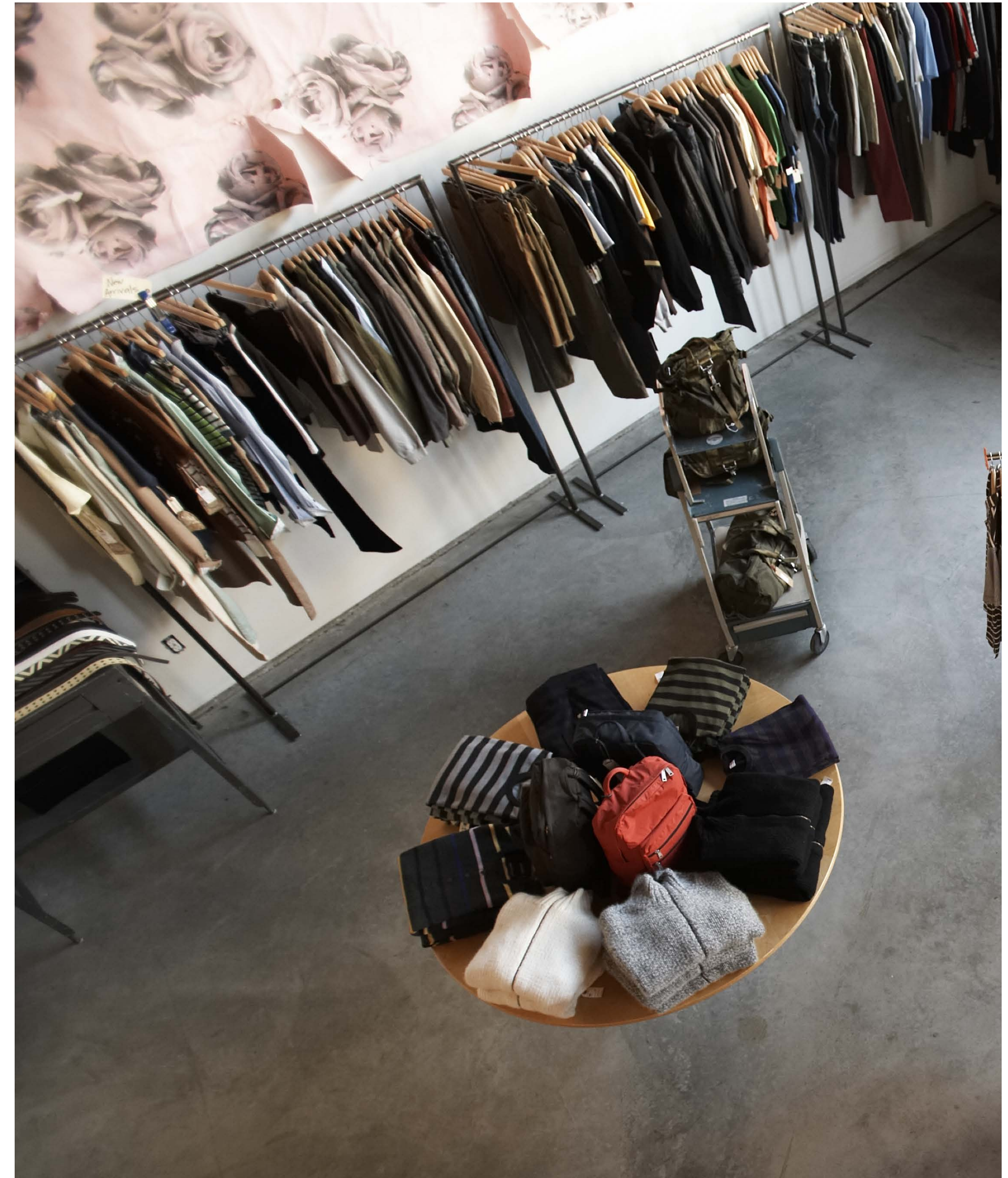
Why does it matter?

Digital-first retailers will be looking to add value and deliver cost efficiencies with predictive recommendations and automated fulfilment. They will utilize ever more complex AI/machine learning capabilities running between cloud-based platforms and a multitude of devices, from smartphones to AR glasses.

With the opportunity to customize and visualize products before purchase, digital-first retailers are taking care of pre-purchase objections and drastically reducing returns. The technology to employ VR/AR and machine learning into the shopping experience already exists but has not been implemented at scale.

Combining physical and mixed realities will be dependent on network capabilities to accelerate adoption.

Innovative autonomous stores and virtual shopping will require low latency networks to deliver the best customer experience. Plus these new forms of commerce could utilize more secure forms of authentication using various biometrics, which will, in turn, require expert knowledge from a trusted partner.



Who to watch?

Immersive stores

LEGO puts 'Fun' at the forefront of its 'Digital and Physical first' concept:

At LEGO's newest flagship store in New York City, LEGO Brick Lab is a 20-minute immersive experience where consumers can scan their physical LEGO build into the digital world and watch it come to life. Plus, the company has a reimaged the Minifigure experience where shoppers can customize and design their own Minifigure, watch it be printed in store and accessorize it with crazy hair or a snazzy outfit.

[Read more](#)

Social retail store

Burberry is using a dedicated WeChat mini-program to deliver a personalized shopping experience in China:

Customers can book appointments, learn about products, create and share content. Each action also rewards users with a virtual currency that can then be used towards an online gaming experience.

[Read more](#)



How can you be prepared?

1. Blending digital experiences in physical stores will generate huge amounts of data that can overload Wi-Fi, calling for next-generation connectivity in the form of 5G and edge computing.
2. Indoor 5G coverage will be critical to delivering enhanced shopping experiences utilizing HD video and AR.
3. Understanding next-generation device form factors to help support a seamless omnichannel experience for your customers.

In 2020, the global pandemic resulted in a 25.7% surge in ecommerce sales, amounting to \$4.21 trillion.

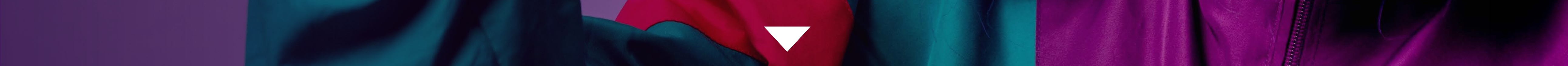
In 2022, sales are projected to rise further to \$5.545 trillion²

2. <https://www.emarketer.com/content/global-ecommerce-forecast-2021>

Our digital interactions are evolving

How 'human' could digital technology become?





Emerging devices and interfaces

What's happening?

1

2

3

4

5

Devices are becoming more sensitive, with new materials bringing the moment that they directly connect to our sight, smell, touch and even thought, ever closer.

Technological innovations have driven radical progress in human-machine and human-anything interactions (HXI). This means that devices can become 'part' of a human rather than just an accessory, all while enabling immersive experiences that go beyond two-dimensional screens and into fully fledged AR, VR, and extended reality (XR) that enhance our view of our physical and virtual environments. Digital twins and mobile holograms will have huge implications for healthcare, retail, training and manufacturing.

Digital-physical fusion means that by 2030, a huge number of physical objects will be connected to the internet or an intranet. Meanwhile,

voice-activated and gesture-based interfaces continue to improve, shaping the frontiers of gaming and 4IR. Machine learning and artificial intelligence will create 'almost human' responses for digital assistants and chatbots.

Recent research in emerging devices reflects the sheer variety of industries that could be radically altered. For example, in healthcare organic biosensors use light and microparticles to detect cancerous growths before they become deadly. In transportation, they've combined AR technology with traditional car interfaces to create new heads-up displays that deliver night vision and reveal obstacles before they come into view.



Why does it matter?

Emerging devices will create massive demand for network resources across both capacity and latency.

To realize this requires cloud native functions deployed on edge computing platforms. There will also be greater demand for slicing and private networks, and new requirements for privacy and security.



Who to watch?

Mixed reality

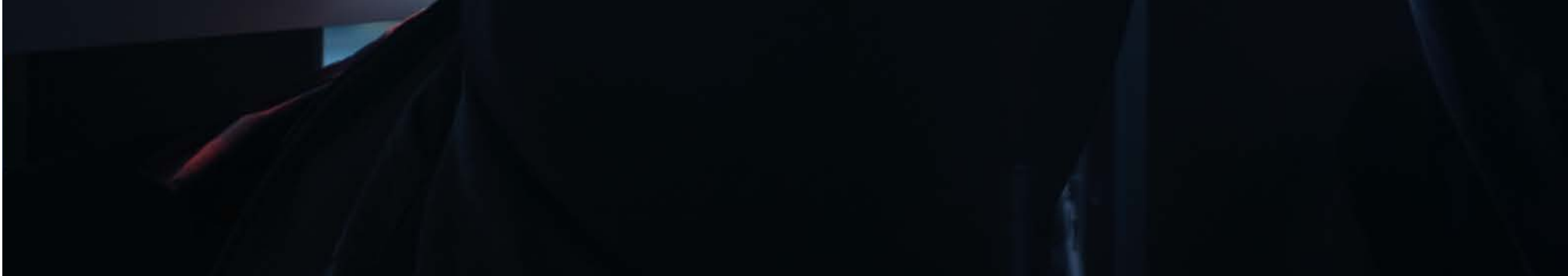
Microsoft debuts Mesh, a mixed reality platform powered by their Azure cloud service: Through a HoloLens headset, Microsoft Technical Fellow Alex Kipman used gestures to interact with characters from the popular app Pokémon Go, demonstrating the capabilities of the platform and the new experiences that Mesh enables.

[Read more](#)

Neurotechnology

French start-up NextMind develop wearables that harness mindpower: Their non-invasive brain-computer interface fits into headphones or headbands and uses sensors to detect neural activity in the visual cortex, allowing users to dim lights, play videos or measure productivity.

[Read more](#)



\$345.77 billion

The global sensor market was valued at \$166.69 billion in 2019 and is projected to reach \$345.77 billion by 2028³

3. Allied Market Research





How can you be prepared?

1. AI-drive automated processes will be needed to manage an increasing number of connected devices.
2. Applications like immersive extended reality (XR), mobile holograms and digital twins will need massive low-latency computational capabilities via Cloud and Edge Computing.
3. Thousands of connected devices are vulnerable to hacking, so security and privacy will become even more important.
4. Dynamic traffic and load management are needed for network efficiency and a seamless user experience.
5. Sensor analytics, drones and robotic control will create new business opportunities.

Sustainable living

How ethics are influencing choice

Will new ethical standards redefine the way we live?

1

Sustainable living

What's happening?

2

Environmental credentials, ethical standards and values are all becoming more influential on consumer choice. Investors are also placing more importance on Environmental, Social and Governance (ESG) criteria. To stay competitive, businesses must adapt their strategies – and fast.

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Consumer preference for sustainable living has seen an upsurge, from the consumption of organic foods to building residential solar panels and recycling metals, plastics and food waste.

5

Some countries are making similar changes in the public sector. In Norway, leading real estate and technology firm MIRIS has created AirFrame Open Edge data centers. These support the delivery of sustainable smart city and IoT applications, including connected vehicles and local services. Many of the centers will recycle excess heat for use in local homes and businesses.

Developments in sustainable living have been accelerated by sustainable crowdsourcing projects and a do-it-yourself culture. For companies who are slow to change, the risks are clear. For companies who can support sustainable behaviors, the opportunities are growing.





Governments and companies are expected to issue \$500bn in green debt in 2021, a 10x increase from 2015⁴

4. Nataxis' 'Everyone's on the ESG Investing Bandwagon' report 2021.

<https://www.im.natixis.com/us/resources/2021-esg-investor-insight-report-executive-overview>

5. <https://blog.akachain.io/top-enterprise-blockchain-platforms-predictions-in-2021/>

Why does it matter?

Changing values and behaviors create new challenges and opportunities for businesses.

Climate change awareness is increasing among CSPs, who are beginning to realize the cost of inaction. As there is 'no green without digital', CSPs are also enabling other business sectors to decarbonize. Sustainability is an ethical duty, but also a business imperative, providing advantages in the form of energy savings, new markets, financing and greater customer intimacy.

Also critical to long-term sustainable business performance are environmental, social and governance (ESG) criteria.

In addition to financial impact, not meeting ESG criteria can lead to significant reputational damage. As a result, companies taking ESG seriously are becoming preferred investment targets for private equity, hedge funds and institutional investors. In 2021, 57% of institutional investors said they were turning to ESG concepts to align their assets to organizational values.⁵

Who to watch?

Eco-friendly transport

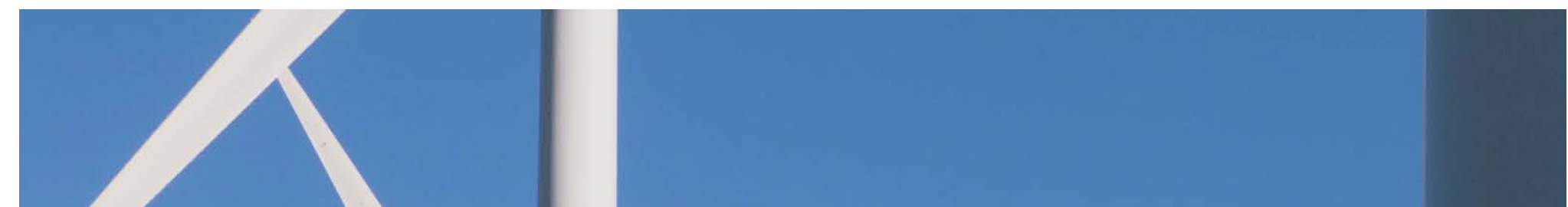
Environmentally conscious ride-sharing app BlaBlaCar reaches 100 million downloads: BlaBlaCar connects travellers to eco-friendly carpools and buses, minimizing carbon footprint while maximizing travel plans. Sustainability is top of mind for many consumers and BlaBlaCar has proven that new demands create new opportunities.

[Read more](#)

Carbon tracking apps

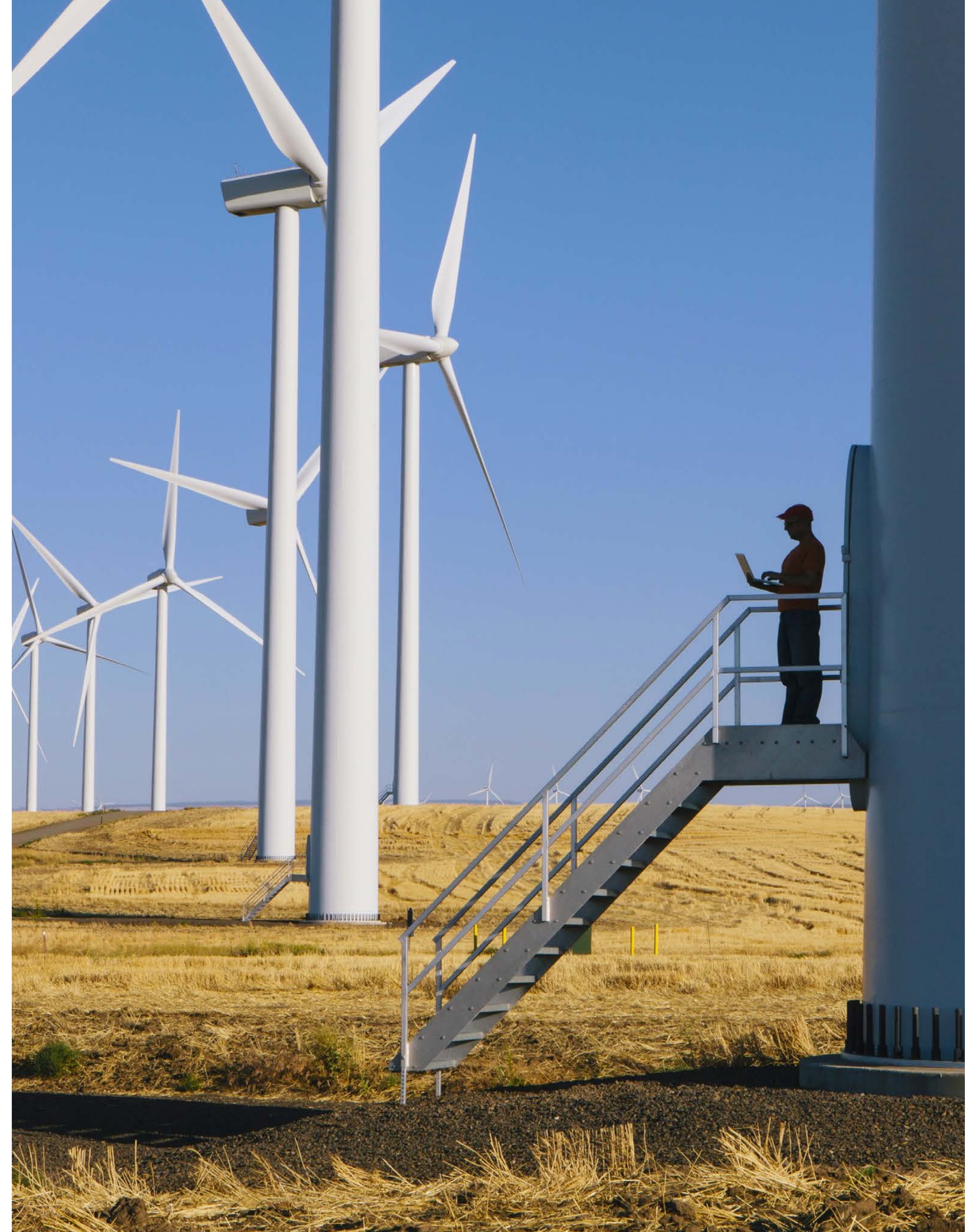
The city of Lahti in Finland has launched an app that rewards eco-friendly behavior: Lahti residents can download a free app that tracks their means of transport. When the app detects that a car has been replaced with walking or biking, it awards the user virtual coins. These can be used to buy tickets for buses, swimming pools, bags and pedestrian reflectors.

[Read more](#)



How can you be prepared?

1. CSPs can use sustainability and the introduction of green technologies to open up new markets, attract financing and create greater customer intimacy.
2. CSPs also have relationships with a significant number of consumers, giving them a chance to shape wider behavior for the better.
3. With such a crucial position in the technology industry, CSPs have an opportunity to also help by improving their own energy efficiency.



The rise of blockchain

Will new technology bring fairness and transparency to the digital world?



1

Blockchain What's happening?

2

Blockchain is a form of digital ledger technology that stores records of transactions. It's the technology behind cryptocurrencies, but it has the potential to transform everything from music royalties to personal ID, voting and more.

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As blockchain works without involving any third party, it records all transactions in a highly secure way. This makes changing or hacking the data very difficult, creating new levels of transparency and fairness.

The technology therefore has a wide array of applications, from enforcing contracts to cross-border payments, sharing medical data, anti-money laundering, supply chains and NFT (non-fungible token) marketplaces.



The size of the global blockchain market is expected to grow from \$3.0 billion in 2020 to \$39.7 billion by 2025⁵

5. <https://blog.akachain.io/top-enterprise-blockchain-platforms-predictions-in-2021/>

Why does it matter?

The digital world needs technology like blockchain to make transactions more equitable, data more secure and the true sustainability of goods more transparent.

The importance of blockchain and other systems that support cryptocurrency are set to increase as digital worlds, goods, investments and services develop further. Industries, such as eHealth, require transparency and trust in transactions – and blockchain is key in enabling that.

The Internet of Things (IoT) could be the next boom in blockchain applications. IoT has millions of applications and more opportunities

for hackers to steal data. Blockchain-infused IoT adds a higher level of security, preventing data breaches by utilizing transparency and virtual incorruptibility.

Blockchain can also help remove data silos across industries. It can provide a marketplace for secure data that's automated to help enterprises exchange information and improve workflows. This could save billions of dollars each year in operational costs.





Who to watch?

Automated settlement

The telco blockchain network that automates roaming settlement:

Mobile industry body the GSMA has announced a blockchain network that simplifies and automates wholesale roaming settlements, replacing the many back-end legacy systems used by industry leaders.

[Read more](#)

Ethical logistics

Using blockchain to create guaranteed supply chains:

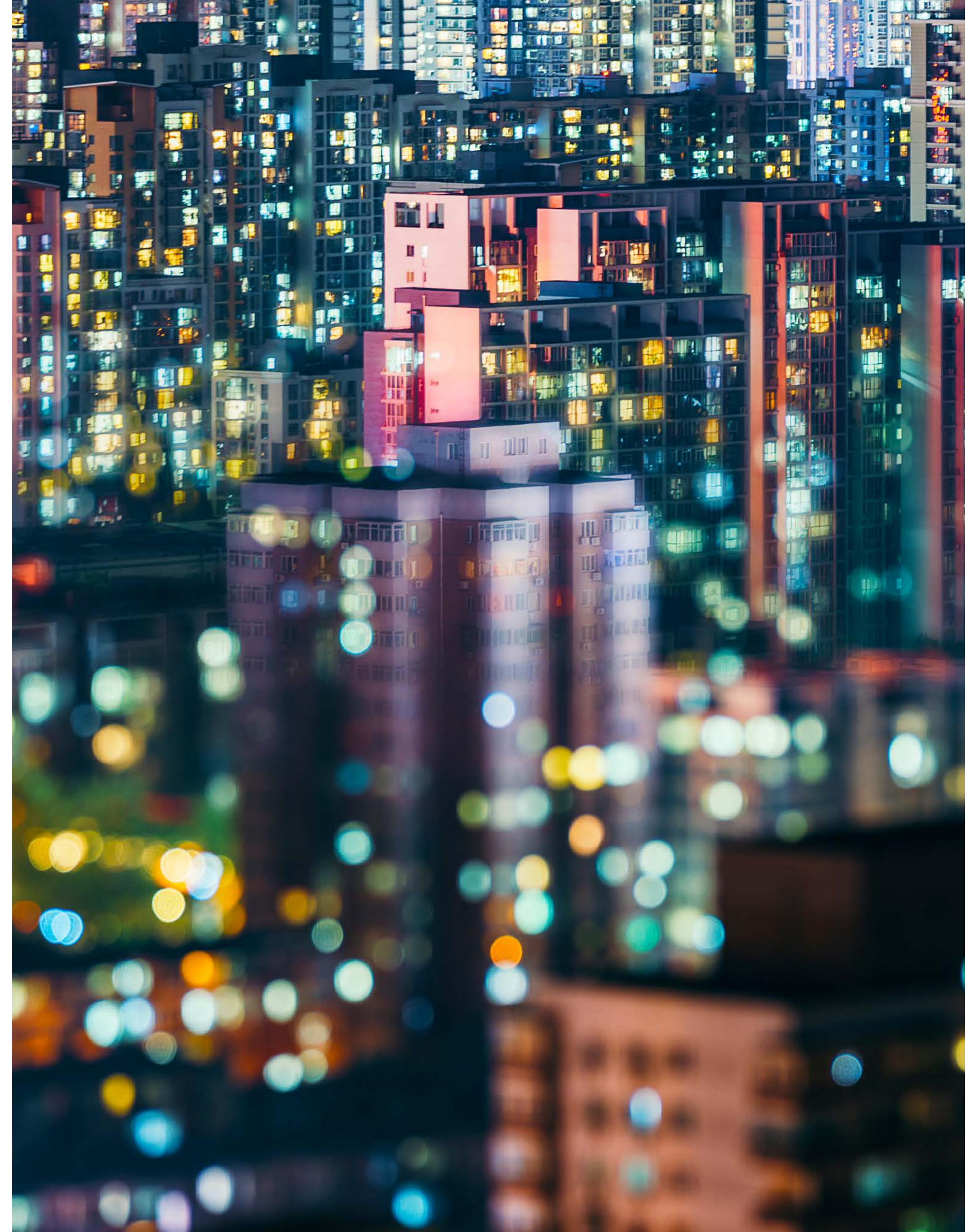
The Provenance Chain Network harnesses blockchain to deliver Transparency as a Service (TaaS), helping companies improve fairness, traceability and provenance across their supply chains.

[Read more](#)



How can you be prepared?

1. Blockchain can transform the way CSPs work by streamlining and automating operations, reducing overall costs.
2. It can be used to reduce fraud and keep sensitive information secure.
3. It can also unlock new business models and use case opportunities for CSPs, providing customers with the means to deliver value added services like smart contracts, safer IoT connectivity, identity management and mobile data tokenization.



In the fourth industrial revolution (4IR), we'll see an amalgamation of digital technologies continue to push possibilities and blur the line between the virtual and real worlds.

To deliver standout products and experiences – and remain competitive – businesses will need to embrace these digital technologies and the Metaverse. And to truly satisfy their customers, they'll not only need to be imaginative in their approach but also green and ethical. Ultimately, many businesses will be forced to reassess their strategies – rethinking everything from data privacy to sustainability. It will be the ultimate balancing act.

Gradually, we'll witness the 4IR transform how we all live and work. And CSPs will play a critical role in enabling this.

Technologies like AR/VR and both AI and IoT will require significant investments to unlock societal value by extending connectivity. But first, the telecoms industry can also unlock significant value through its own digital transformation.

Network transformation is happening and new business models leveraging emerging technologies will require collaboration with vertical industries and cloud platforms.

The challenge will be to analyze the data, act quickly and target value opportunities. If CSPs are to help shape the future, it's time to know now, how the technological revolution will impact your business.

Visit our Insights page to explore further.

Contact us if you want to hear more about these trends, the impact on the CSP landscape, and the steps you can take to prepare for your near, middle, and long-term horizons.

[Contact us](#)

A person and their shadow are shown in profile, looking at a large digital display that shows a vibrant, colorful nebula or galaxy. The person is standing on a dark, reflective floor, and their shadow is cast onto the wall behind them. The overall scene is dimly lit, with the primary light source being the digital display itself.

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With our commitment to innovation and technology leadership, driven by the award-winning Nokia Bell Labs, we deliver networks at the limits of science across mobile, infrastructure, cloud, and enabling technologies.

Adhering to the highest standards of integrity and security, we help build the capabilities we need for a more productive, sustainable and inclusive world.

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