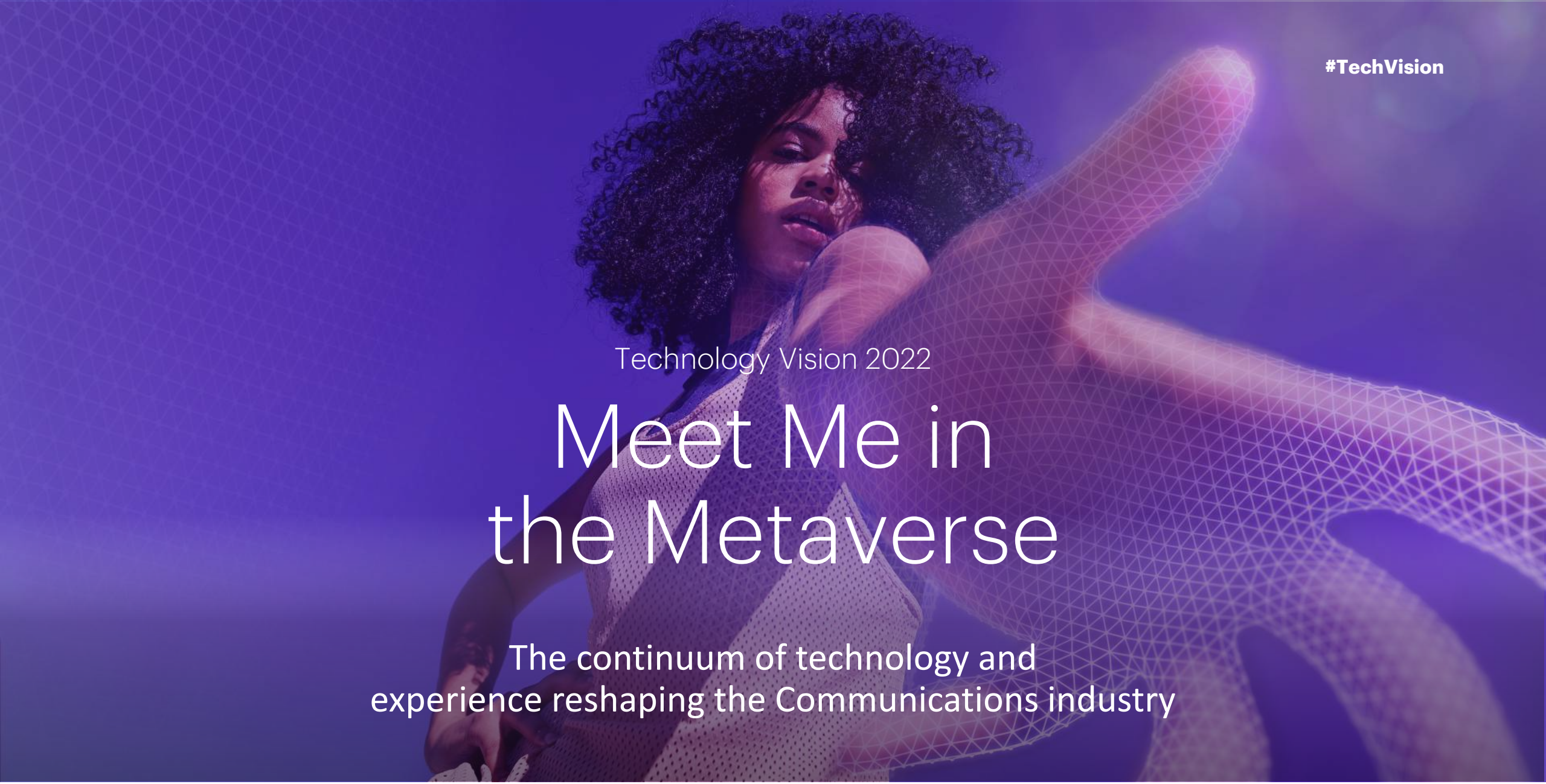


#TechVision

Technology Vision 2022

Meet Me in the Metaverse

The continuum of technology and experience reshaping the Communications industry

Voices of Change

From insights to action, the path to extraordinary value starts here.

accenture

The Metaverse Continuum is a spectrum of digitally enhanced worlds, realities, and business models poised to revolutionize life and enterprise in the next decade.

As industries are extending from a solely physical presence to a hybrid, or fully digital experience, encompassing the consumer and enterprise business models alike, the role played by Communications Service Providers (CSPs) has never been more vital.

The four building blocks of the Continuum, captured in this year's Technology Vision from Accenture - WebMe, Programmable World, The Unreal, and Computing the Impossible - are reimagining what the future world can be with CSPs as the backbone of global information, communications infrastructure, and technology services.

Our Four 2022 Technology Trends

WebMe

Putting the Me in Metaverse

The internet is being reimagined on two fronts: the metaverse and Web3. Together, these technologies are subverting long-held assumptions and driving a shift to a more human-centric internet.

Programmable World

Our Planet, Personalized

The rise of new technologies are seamlessly embedding digital capabilities into the fabric of our environments, giving people and enterprises unprecedented command over the physical world.

The Unreal

Making Synthetic, Authentic

With sophisticated synthetic realness increasing in our world, trust in technology and enterprise is at stake. To earn clients', consumers' and partners' trust, authenticity should be the compass guiding business use of unreal technologies.

Computing The Impossible

New Machines, New Possibilities

The next generation of computers will reshape industries, breaking down the biggest barriers and constraints that have defined them until now.

CSPs are placed at the heart of the Metaverse Continuum.

Technological progress is essential to economic prosperity and development[1]. In fact, Communications executives believe that building anticipated technology advancements into long-term strategic planning is critical to their business.

Much of 5G technology's value lies in its potential to create economic value through new promising use cases such as digitizing towns and cities, wireless factories, real-time immersive learning experiences, development of new digital skills and jobs, more affordable and seamless healthcare to name a few. The GSMA Intelligence predicts $720 billion worth of spending on 5G networks between 2021-2025 globally[2].

CSPs stand to benefit immensely by riding the metaverse wave: the "meta" can become a formula to obtain income from the 5G networks they are deploying. But more uniquely for them, the "meta" also presents an opportunity to play an assertive role in shaping and defining the metaverse value chain.

69%

of Communications executives believe the Metaverse is a significant opportunity for their company*

*Based on a poll of 100 Communications executive from the US, Germany, UK, South Korea, France, Spain and Italy

Note: Source for all other the numbers and data points in this document: Technology Vision 2022 Business Executives and Consumers Survey. Global N=4,653; Communications industry N=279.

98%

of Communications executives agree that emerging technologies are enabling their organization to have a broader and more ambitious vision.

CSPs' journey with the metaverse: from enablers to disruptors

The metaverse applies across all aspects of business, from consumer to worker and across the entire enterprise; from reality to virtual and back; from cloud and artificial intelligence to extended reality, blockchain, digital twins, edge technologies and beyond.

With the advent of new technologies and the power of 5G, with all its mobility, superior speed and throughput benefits, CSPs will become the enablers of the metaverse. Their access to customers and trust will give them the advantage to bring new solutions to life in the "meta", while also using it to disrupt their own internal learning experience and operating models.

Think about typical telecom field service operations that consume enormous time. The same operations deployed in the metaverse could substitute massive operator guides and handheld devices with better user experience and hands-free operation abilities, ensuring better and more accurate remote troubleshooting, and simplifying the complex process of assembly and disassembly of parts.

Ambitious CSPs have started to shape the rules and expectations for our new worlds.

Telstra has teamed up with Accenture and Google on an augmented reality (AR)-based way finder experience for Melbourne's Marvel Stadium ahead of the AFL's 2023 season. The experience is designed to showcase the capabilities of Telstra's 5G network onsite as well as give fans and visitors the ability to use their cell phones to navigate their way around the venue[3].

Deutsche Telekom is the first telecommunications company to have created a metaverse experience on Roblox and to celebrate host, DJ and producer Boris Brejcha, who performed in avatar form. Users could also purchase digital items at the record store and watch short, animated films from selected artists at the movies. This initiative helps the CSP complement their real-world programs and boost customer loyalty[4].

Telefonica's 5G and edge computing are used by Gestamp, a large automotive player, in the digitalization of their plants. The smart combination between a real plant and a virtual laboratory where scenarios can be validated is allowing Gestamp to make strategic decisions faster[5].

Trend 01

WebMe

Putting the Me in Metaverse

The internet is being reimagined on two fronts: the Metaverse and Web3.

Metaverse initiatives are re-platforming the internet, reshaping how people experience it. Instead of the internet as a disparate collection of sites and apps, metaverse efforts let users move beyond browsing to inhabiting digital content.

Web3 is reinventing how data moves through our internet systems. Web3 aims to create a layer of transaction and trust across the web by making different parties the arbiters of their own data, bringing an undercurrent of provenance, veracity, and value to the web.

Activities that occur in metaverses may – and often will – be enabled by Web3. As such, Web3 is a critical and necessary complement that will bind our next internet together.

Web3 is CSPs' opportunity to reclaim a place in the internet of tomorrow, beyond traditional connectivity. They must now rethink their online presence and become a part of shaping the next platform revolution as they build new ways to connect to customers, partners, and their own digital workforce.

Web3 is ripe with opportunities for CSPs.

Very simply put, Web3 denotes a decentralized, blockchain-based Internet. CSPs will play a critical role in the next web revolution for they manage the communications networks that Web3 operates on. Their networks will carry the data traffic that provides decentralized validation and seamless integration of the next generation of the internet.

Looking-forward CSPs can use Web3 with edge computing, Artificial Intelligence (AI), digital twins, and hybrid cloud platforms to their advantage in order to build new business models and operational approaches. Web3 can greatly impact an operator's core management systems (Operation Support Systems/Business Support Systems) and enable interoperability between internal and external ones. This will reduce their infrastructure and compliance costs and save on revenue leakages from roaming and identity fraud.

94%

of Communications executives agree that the realization of Web3 over the next decade will fundamentally change how businesses engage with users online.

International interconnection settlement and supply chains can exist in web3 creating more secure, more persistent business processes.

Enhanced with the power of 5G, web3 will serve not only to reduce operating costs, but also in potential legal fees arising from disputes that can be avoided with the use of smart contracts.

Decentralized applications are another instance of how web3 will allow CSPs to set themselves up for success - NFTs are just an example of another unanticipated market that can massively benefit from 5G, one that providers will need to be able to support and secure.

Decentralized applications also imply that the user is the key player and central entities that verify identities are no longer needed. Those players having a deep knowledge about their customers and who can develop new sources of revenues out of this will be the ones to gain a competitive advantage.

CSPs have traditionally known a lot about their customers. They know who they are, what they like and have access to their payment history. All of these are verifiable credentials that can add value to third party business models.

Besides, CSPs can easily and trustworthily deploy a wallet in their subscribers' hands to make it easier for them to manage their credentials.

Pioneers in this space will gain advantages like those the first digital natives saw.

Telefonica

has been one of the major global telecom players that have shown technological leadership in the new era of the internet with a series of ecosystem partnership announcements and use cases. In the summer of 2021, Telefonica and IBM launched new hybrid cloud solutions poised to fuel enterprise digital transformation using AI and blockchain[6].

Telefonica also developed with Granada Club de Fútbol a transformation project based on Telefonica's Global Sport Platform Tech IoT & Big Data to attract talent and monitor and improve the performance of the players in the men's first team[7].

In the retail space, Telefonica turned La Torre Outlet Zaragoza into the most digitalized shopping centers in Spain. As one of the technological partners of the project, the telco was responsible for providing the connectivity, communications and Wi-Fi infrastructure with the most advanced IoT, Big Data and Artificial Intelligence solutions to offer customers a unique experience combining both real and digital worlds[8].

Accenture's Nth Floor

As pioneers and supporters of emerging technologies, Accenture decided to step in the metaverse among the first ones. Working closely with Microsoft, Accenture started this journey pre-pandemic by building a virtual campus called the "Nth floor" for people to gather and participate in community events. Soon after the pandemic hit, Accenture began building on these capabilities for onboarding new employees and then extended them to serve learning and collaboration needs within the organization[9].

SK Telecom

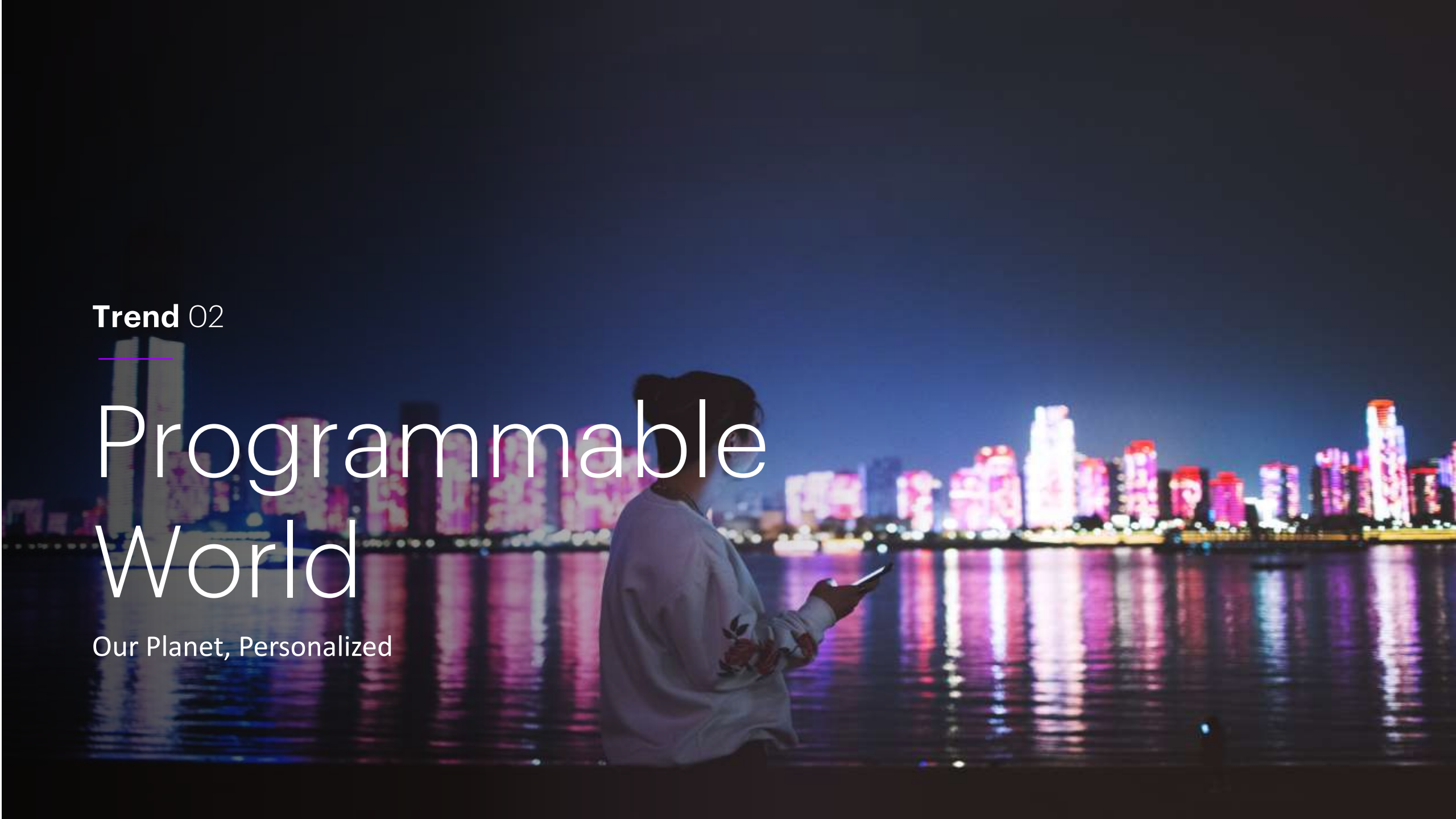
launched in 2021 a metaverse platform, ifland, which accounts today for more than 1.1 million monthly active users. The platform allows users to build their own avatars and explore 18 digital environments from an outdoor stage to a campsite. The mobile carrier has been eyeing more practical uses of the platform beyond social networking and incorporated online meeting features, such as sharing PDF and MP4 files. A single meeting on the platform can host up to 130 users, and the company plans for an update so that it can host large conferences attended by hundreds of users.[10]

Vodafone

presents Vodafone 5G Reality, which defines as "The first virtual and interactive commercial solution on the 5G network for customers" and it is presented as "the first metaverse open developed in Spain ". The platform will allow users "Immerse yourself in a different world where you can live adventures and be the protagonists of the story". The operator says that in this way "They will be able to attend concerts with their friends, record themselves with their favorite celebrities from their living room, travel the world, learn as a family, enjoy adrenaline experiences or relax under a sky of stars, all virtually".[11]

Orange

has long been engaged in research to study how its products and services will in future be able to embrace the immersion habits of its customers. Live concert broadcasts in a virtual environment, immersive video to watch a soccer game or 360° documentaries are integrated into their "Immersive Now" beta platform, an Orange virtual exhibition, allowing their test customers, wearing their Oculus Quest headsets or simply via their cellphone/tablet, to experience 2D content. In B2B, Orange is also thinking about the representation of its own stores in the metaverse.[12]



Trend 02

Programmable World

Our Planet, Personalized

The physical world is becoming programmable.

People and enterprises are gaining unprecedented command over the physical world as it becomes innately programmable.

The rise of new technologies including 5G, ambient computing, digital twins, augmented reality and smart materials is embedding digital capabilities into the fabric of our environments. These environments will reshape not just how people engage with worlds, but also redefine everything built in it, how people sense and interact and the control they have over it.

To meet our new expectations for digital and connectivity conveniences, CSPs will need a deep understanding of three layers that comprise the programmable world: the Connected, the Experiential, and the Material.

78%

of Communications executives believe programming the physical environment will emerge as a competitive differentiation in their industry.

92%

of Communications executives agree that leading organizations will push the boundaries of the virtual world to make it more real, increasing the need for persistence and seamless navigation between the digital and physical worlds.

Leveling up the connected foundation.

Up to now, smart devices have been limited in compute power and operated separately through discrete apps, but emerging technologies like ambient computing and 5G are bringing their true promise to life. As they mature, they will enable the creation of hyper-connected environments.

CSPs, through the deployment of 5G networks, are poised to enable the interaction between these hyper-connected worlds. Beyond speed and low-latency, 5G's advantage over 4G is its ability to connect significantly more devices with precision – as many as 1 million devices per square kilometer. This is critical as the number of devices connected to the network is increasing by more than 25% each year[13].

Moreover, 5G comes with security and privacy enhancements too, enabling zero-trust communications that will in turn allow innovators to create these personalized, scalable programmable worlds.

CSPs could join forces with ecosystem partners to integrate interoperable communication functions that would accelerate deployments, streamline maintenance, and connect users to an unlimited number of potential services.

Moreover, providing a turn-key 5G solution could also allow businesses they serve to stay focused on their business core, while transparently connecting to both physical and virtual worlds they'll be operating in.

74%

of Communications executives report the number of IoT/edge devices deployed in their organizations significantly or exponentially increased over the past three years.

Transforming experiences.

With AR glasses and digital twins, any environment can be augmented with a digital experience.

In the communications industry, digital twins can monitor and manage complex networks, while also gathering data from social media. They can help CSPs optimize operations, detect and predict anomalies, pivot to prevent unplanned downtime, enable greater autonomy, and dynamically adjust their designs and strategies, better and faster.

A new generation of manufacturing and materials.

Advances in digital manufacturing are making on-demand and hyper-customized products a reality, and the invention of new smart materials and programmable matter is driving a new generation of smart things that can embed digital capabilities and customizability into physical reality.

CSPs continue to be placed at the heart of the future cross-industry innovations. Blockchain technology and 5G -powered Internet of Things (IoT) will make huge numbers of man-made objects interconnect through sophisticated wireless networks to allow great improvements in areas like real-time monitoring of supply chains, real time control of electrical grids, connected (and eventually autonomous) vehicles, and smart agriculture, among many others.

Private and secure interoperability will be critical.

Most businesses aren't going to develop all these real-world technologies in-house, so interoperability between different companies' products will be key to scaling digital capabilities and presence in the physical world in a way that drives customer satisfaction.

However, as more connected, intelligent devices are introduced to the world – and more devices from more companies are connected – risks to privacy and security are growing.

CSPs have worked hard to earn their unique levels of consumer and business trust. As they reimagine services and experiences in the programmable world, they must maintain their reputation of protecting data privacy and security.

CSPs' ability to safely connect programmable world technologies will impact the environments they can design or be part of, the partners they can have, and how quickly they can introduce new offerings.

The future of programmable networks is here.

TIM Brazil

teamed up with Accenture to deliver a 5G Industrial Application for the car manufacturer Stellantis. The solution combines a private 5G network, cloud, artificial intelligence and IoT to enhance quality, compliance and efficiency at the automotive plant[14].

China Mobile

developed an integrated NB-IoT based solution, paving the way for all three million electric bicycles in Zhengzhou to be equipped with NB-IoT-enabled positioning modules. Via China Mobile's NB-IoT network, the platform can collect information on the position, speed, time, space and temperature of an electric bicycle using the Beidou satellite point technology and various on-board sensors in the urban area of Zhengzhou and eight nearby counties[15].

Telia's

narrowband IoT (NB-IoT) technology will be used by EON to connect smart meters in one million homes in Sweden. The meters will be prepared to handle micro-production: households that both consume and feed electricity to the grid from solar panels. In addition, the customers will be able to monitor both the production and consumption of electricity in close to real-time. To enable this, in addition to a new electricity meter, a modern communication solution is required[16].

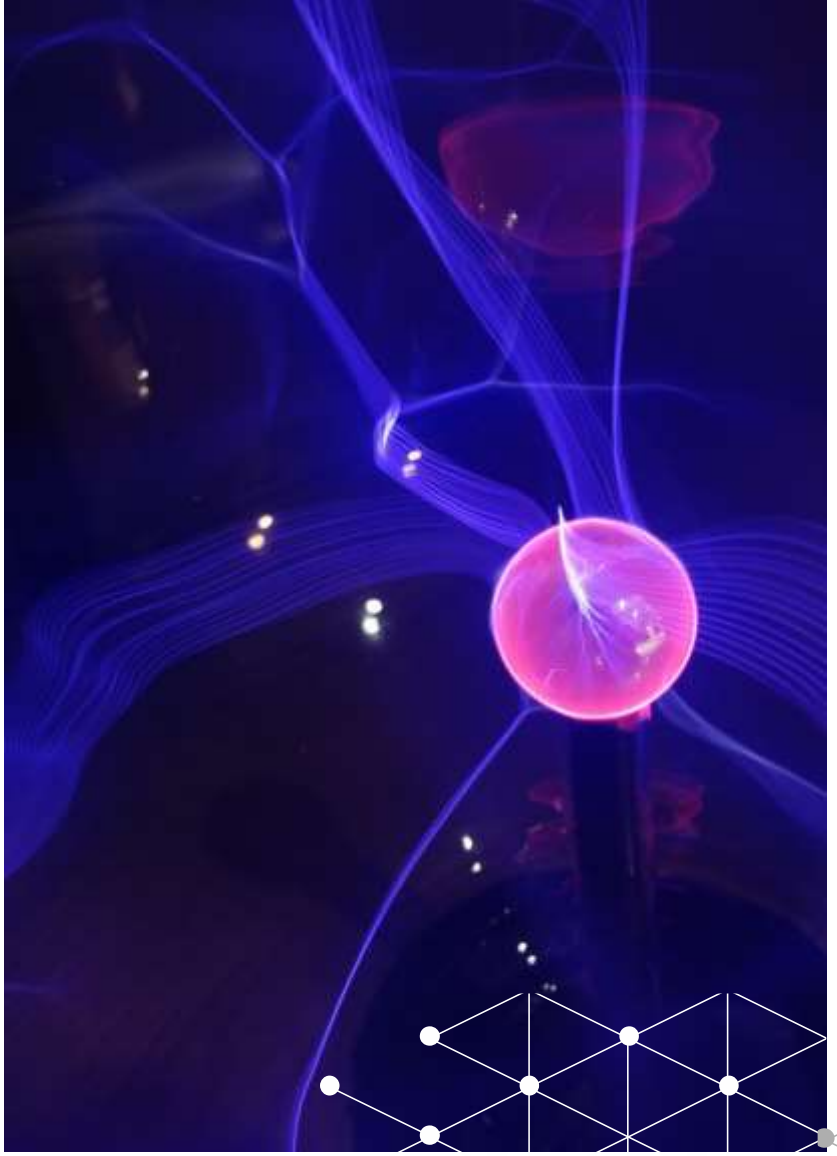
Our planet – personalized, sustainable and inclusive

CSPs have been experiencing a record demand for connectivity and become cross-industry enablers[17], playing a more valuable and active role in our everyday lives and in society's progress.. However, the great digital acceleration triggered by the pandemic has given the communications industry two big challenges.

First, CSPs must meet the increasing data demand while keeping a check on their carbon emissions. 5G will lead to a rapid rise in data use as its adoption in both industrial and consumer sectors spreads, potentially leading up to 160% increase in power demands by 2030.

The zettabytes of data traffic that underpin our digital world could be zero-carbon, through hyper-efficiency and use of 100% renewable energy[18]. Communications and tech companies that lay the infrastructure for the digital world are using innovation to cut operational emissions, while collaborating with suppliers and other industries to decarbonize the wider value chain. A flexible network topology combined with smart materials, programmable matter and other adaptable physical capabilities can create this new network fabric.

Second, CSPs play a crucial role in ensuring that the most isolated parts of society have connectivity, and investments in mobile infrastructure and fiber networks could bridge that gap. Rural homes and businesses, where 5G becomes available, could get fast wireless internet through either 5G fixed wireless access services or portable routers. Boosting economies, generating new jobs, creating commercial opportunities and facilitating better training and education are just a few of the transformative benefits of having access to connectivity can bring[19].



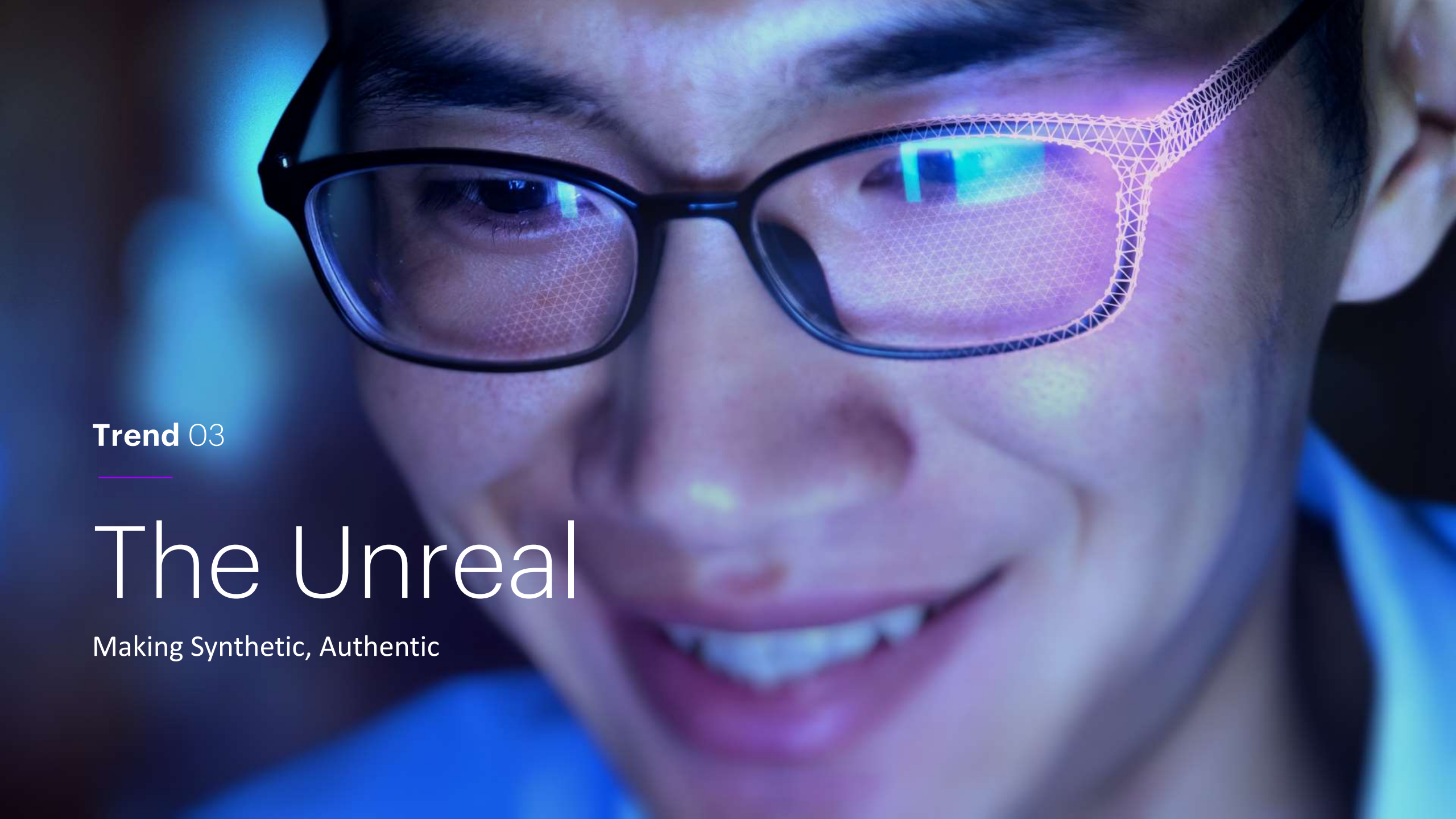
CSPs are becoming sustainability stewards - for the industry and beyond.

Without digitalization there can be no successful economic and social development. Leading CSPs have understood this and already started their journey to a sustainable future.

Swisscom is doubling up on its ambitious sustainability goals in a race to Net Zero by addressing Scope 4 emissions with Accenture's help on integrating carbon-related KPIs and parameters into decision making and product development processes to ensure a sustainable product portfolio and emission reductions[20].

Vodafone plans to reuse, resell, or recycle 100% of its network waste by 2025, and work with consumers to recycle devices[21].

British Telecoms Group has already reduced carbon intensity of operations by 57% over the five years to 2021, partly from shifting to electric vehicles by 2030 and it has already switched to 100% renewable energy use worldwide[22].



Trend 03

The Unreal

Making Synthetic, Authentic

CSPs are trusted certificate authorities in a world with synthetic realness.

Historically, CSPs have been trusted partners for consumers and businesses. They provide the most critical resource in a digitally connected world -- connectivity.

However, the digital world is getting more sophisticated, to the point that it can convincingly reflect reality. In this world of synthetic data, images, and chatbots, as well as augmented and virtual realities, CSPs must play an active role in establishing authenticity.

They can promote and maintain sovereign digital identity for their customers, certify the authenticity of traffic on their networks and establish trust and permanency for digital objects such as media content.

59%

of Communications executives say that the Metaverse will create new data security and privacy risks, and that Digital Identity fraud and manipulation is a concern*

*Based on a poll of 100 Communications executive from the US, Germany, UK, South Korea, France, Spain and Italy

Self-sovereign identity

Deployed authentically, synthetic realness can push AI to new heights – for instance, by solving for issues of data bias and data privacy, synthetic data can bring next-level improvements to AI models in terms of both fairness and innovation. However, bad actors are using these same techniques to create deepfakes and disinformation, undermining people's trust in the technologies.

Because of CSPs' critical role as industry orchestrators, they must pursue digital identity management solutions to help them in four key areas: know their customers, be relevant for their customers, help customers remain in control of their digital self, and finally monetize their own investments without compromising privacy, security, or data sovereignty laws.

As identities are continuously intertwining with advanced IoT applications, like personal identity in smart homes, corporate IP in industrial advanced intelligence, and the expanding services ecosystems, CSPs are in many ways data gatekeepers.

Digital content authenticity and rights management

Authenticity in a world of digital content is incredibly difficult to control. A focus on authenticity taking heed of four primary tenets – provenance of data, people who are held responsible for the data, policies regulating the use of data and the purpose of its use – will help CSPs unlock new attitudes towards AI, unleashing the full benefits of the unreal world while maintaining and increasing users' trust in them.

Content that has been established on a blockchain-based platform can always be authenticated. In addition, blockchain-based content can be collaboratively enhanced to add metadata that establishes richer customer experiences.

CSPs' opportunity lies in combining their strengths in connectivity and trust with blockchain technology advantages in security and speed.

For example, with blockchain implementation on services like smart contracts, CSPs can reinforce their responsibility to protect, leverage and track the dynamic use of rights between companies, consumers and creators, and own this part of the business transaction as a new capability.

Many industry leaders are already securing our future worlds.

WEF Known Traveler Digital Identity

Accenture partnered with the World Economic Forum for the KTDI project. KTDI leverages blockchain, cryptography, biometrics and passengers' mobile devices to give travelers control over, and the ability to share their digital credentials (Digital ID, Boarding Pass) with security officials, government authorities and airlines in advance, facilitating a touchless journey. The solution is based on Accenture's ID2020 biometrics solution and industry thought leadership[23].

Project Origin & Streambed

led by Microsoft, the BBC, CBC, and The New York Times, is tackling the spread of disinformation using Distributed Ledger Technology to establish provenance from publishing to presentation[24].

And the startup Streambed is enabling content creators to easily mint NFTs of their social media posts, letting them set terms of use, license their content accordingly, and have greater control over the use of content by others[25].

KDDI

has partnered with Mawari to launch a Digital Human as a Service (DHaaS) using AWS Wavelength. 5G, edge computing and metaverse combine to let "digital humans" stream to your phone in real time instead of running natively on your phone's chip. As an AWS based solution, the "digital assistants" benefit from a data center and network architecture that are built to meet the requirements of the most security-sensitive applications. This is even more important as KDDI anticipates 3rd party deployments of these capabilities in locations spanning sports facilities, universities, hospitals, tourist destinations, museums and educational centers.[26]

Trend 04

Computing the Impossible

New Machines, New Possibilities

95%

of Communications executives believe that their organization's long-term success will depend on the next generation computing they leverage to solve the seemingly unsolvable problems not addressable by classical computing.

Source: Accenture Report: Untangling the future of quantum communications, 2021

CSPs play a crucial role in accelerating the quantum future.

The next generation computers such as high-performance, biology-inspired and quantum have started to emerge, making industry-altering capability increasingly feasible.

The prospect of a quantum internet has people excited about endless possibilities, and CSPs are again at the forefront of a new, ground-breaking technology. Quantum network expansion requires developing capabilities to conduct cost-effective simulations before pursuing complex strategies. The breadth of new technologies that need to be integrated ranges from nodes, repeaters and quantum-encrypted phones to next-generation fiber and software. And there's no shortage of innovation for CSPs to make them happen.

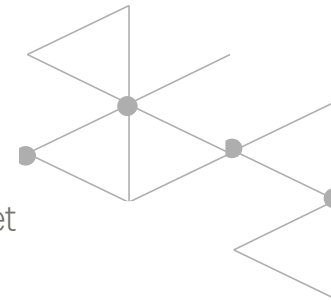
The emergence of quantum networks will transform communications, cybersecurity and the Internet. CSPs who start learning quickly about the rapidly evolving world of quantum communications, find partners and fund to jumpstart their quantum journey are the ones poised for success in the new quantum Internet era.

Securing quantum communications will become an industry imperative.

Quantum computing can solve many business processes but also make conventional encryption more vulnerable to attack.

Quantum entangle swapping will allow networks to cover some these weaknesses to re-secure networks while Post Quantum Cryptography (PQC) will offer stronger encryption, protecting businesses and consumers, and develop new, smarter products and services.

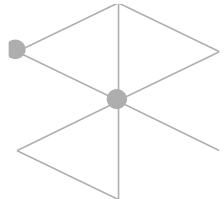
Forging tomorrow's industries will require partnerships and consortiums.



Many of the problems that next-generation computers will let enterprises solve are large, systemic challenges that require collaboration. Forward-thinking CSPs that are creating quantum networks today will help shape the rules that govern the new communications landscape tomorrow[27] by partnering up with researches, governments and cross-industry players.

For example, Orange is one of the founding members of the EU-funded EuroQCI initiative to design and build an ultra-secure fiber optic network.[27]

The "QSAFE" consortium, comprised of strong European industry partners as Deutsche Telekom, Thales, Thales Alenia Space and Telefónica and the Austrian Institute of Technology, announced a blueprint project to develop a continent-wide quantum communications infrastructure and bolster the EU's cybersecurity strategy for the next years.[28]



Quantum mechanical systems, in the form of qubits, form the heart of this trend. The technology now allows us to set, manipulate and measure their states; entangle these particles together, and even transmit them over far distances. The combination of these advancements opens the door to three new business opportunities for CSPs:

Quantum computing to manipulate qubits to solve intractable problems.

The potential processing power of quantum computing presents exciting opportunities in optimizing telecoms infrastructure, operations planning and path calculations[29]. Other use cases where quantum technology could improve CSPs' efficiency is anomaly detection in network optimization, and database search at the data management level. Another application could be offering user experience quality prediction for gaming and streaming[30].

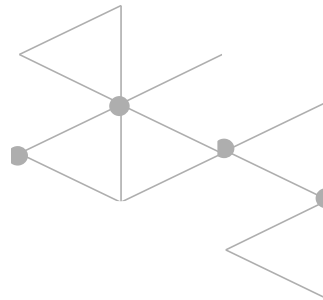
Quantum communication to entangle and distribute qubits for ultra-secure communication.

The fiber and satellite networks that CSPs have already deployed bring together these components to capture the value they bring. The breadth of new technologies that is needed to be integrated to fully realize the vision ranges from nodes, repeaters and quantum-encrypted phones to next-generation fiber and software.

Quantum sensing to provide insights into the world impossible before.

Qubits can capture changes in the physical world leading to novel insights. By doing so, quantum sensing can provide marked improvements to inertial navigation, land surveys, biomedical monitoring, volcano monitoring and resource exploration. As quantum sensor deployments scale, the need for robust backhaul capabilities increases too.

Industry leaders are navigating their quantum journey already.



British Telecoms

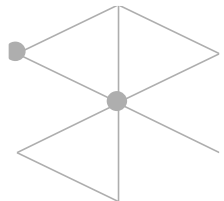
is building the world's first commercial quantum-secured network in London[31].

Telefonica

has been operating the MadQCI testbed with the aim of integrating quantum capability into their network security. The project also involves looking at potential applications for quantum to users like software network management, proof of transit and 5G and edge computing and even e-health[32].

SAMSUNG's

Galaxy A Quantum is the first smartphone with a quantum random number generator for secure encryption[33].



Starting today

Competing in this next decade will require more than just increasing technology and innovation skills. As we have learned to understand, the metaverse phenomenon will give CSPs the chance to boost 5G's adoption and monetize their investments by leveraging technological breakthroughs like AI, digital twins, cloud computing to name a few. However, to unlock the full spectrum of opportunities within the metaverse, CSPs must act now by expanding beyond traditional connectivity services, to new capabilities and operational models. The Metaverse Continuum is an opportunity for CSPs to both enable and benefit from. And just as was the case with previous revolutions before, those who do not join in timely are at risk of being left behind.

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