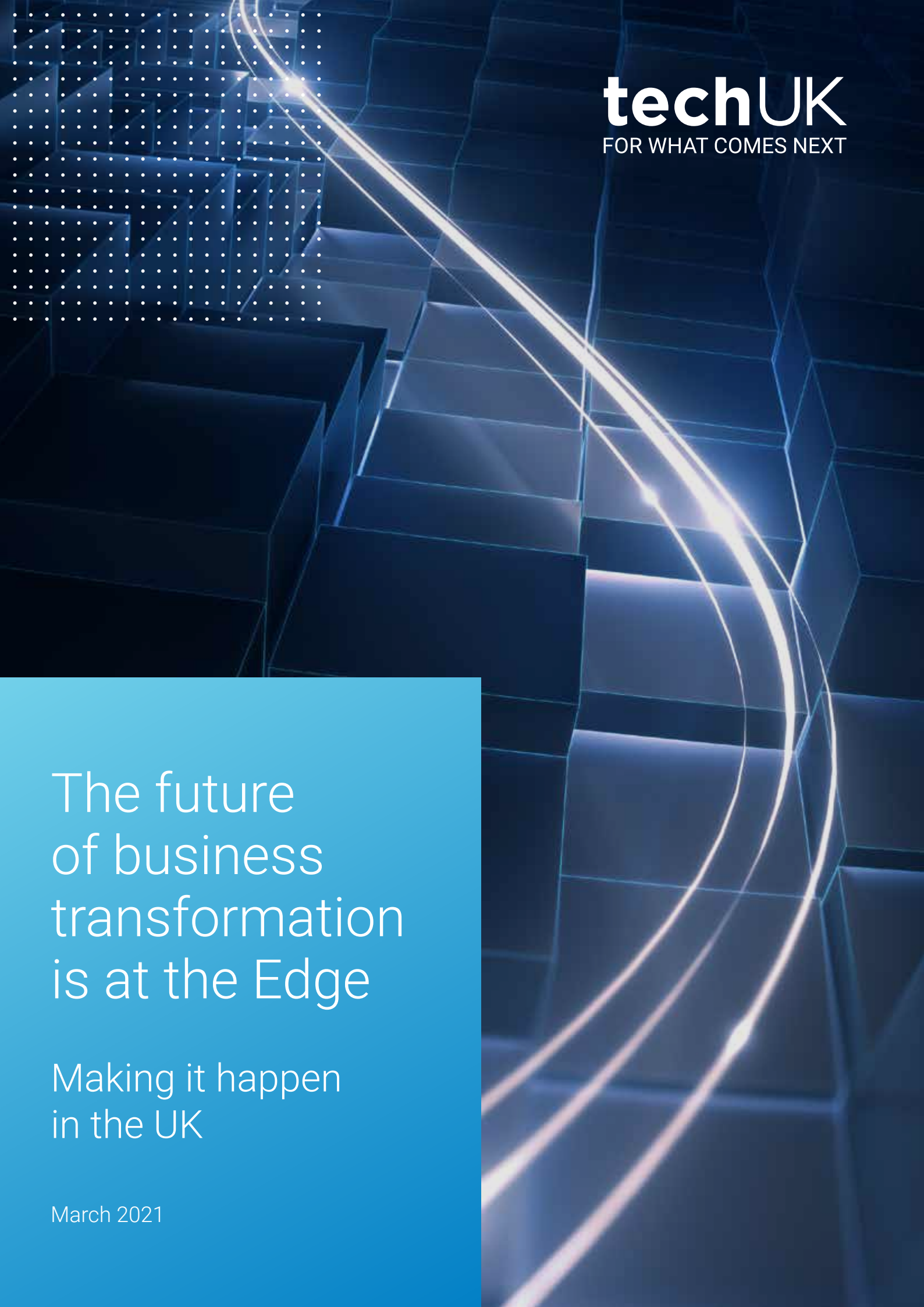
techUK
FOR WHAT COMES NEXT



The future of business transformation is at the Edge

Making it happen in the UK

March 2021

Edge Computing is set to transform UK businesses in the years ahead.

It is estimated by 2025, 75% of data will be processed 'at the Edge'.[1]

As a form of distributed computing that brings processing closer to the source of data, Edge Computing enables businesses to understand and unlock the value of data assets in real time and make key business decisions.

It is important to note that Edge is not a particular location in the network but can be in many parts that can create a continuum based on application need.

Edge brings additional advantages to businesses, including helping to reduce latency in data processing, overcoming bandwidth challenges and as a key enabler of intelligent automation.[2] Edge is also expected to become a key part of the digital infrastructure that will enable the full collective potential of transformative technologies like 4G and 5G, Digital Twins, IoT, and AI to be realised.[3]

As UK businesses increasingly look to digital solutions to recover, rebuild and reinvent their operations following the COVID-19 pandemic, Edge Computing will become even more important. The events of 2020 emphasised the importance of operational and supply chain resiliency for businesses and the role technology can play in helping organisations to adapt and respond quickly and efficiently to unprecedented situations and events. COVID-19 has exacerbated the difference between those who are agile and ready to move and those who are not. In other words, as business agility grows in importance, so too will Edge Computing.

2021 will also showcase the importance of Edge Computing as a driver of emerging technology. This is because the adoption of Edge Computing can help businesses strengthen their digital infrastructure, build flexibility and resiliency into their operations as well as realise the full economic potential of innovative technologies such as 5G and Machine Learning.[4]

Given the potential opportunities and benefits of Edge Computing to UK businesses action is needed now to recognise the importance of Edge to the UK's digital future and ensure organisations, of all sizes and sectors, are ready, willing and able to embrace Edge Computing. To make this happen the following five issues have been identified as key areas where action is now needed in 2021:

1. **Equip organisations with the knowledge, understanding and skills needed to adopt Edge Computing.**
2. **Recognise Edge Computing as key to the UK's future in the upcoming Digital Strategy and the plan for growth.**
3. **Increase partnership and collaboration between academia, research institutions and industry to explore and encourage wider applications of Edge.**
4. **Increase research into the sustainability impacts and environmental potential of Edge Computing.**
5. **Address cyber security concerns and build trust and confidence in Edge.**

1. Equip organisations with the knowledge, understanding and skills needed to adopt Edge Computing.

Edge Computing is not a new technology. However, limited awareness and understanding by businesses, particularly SMEs, on how to drive value through Edge Computing, and its role in enabling the deployment and use of advanced digital innovations such as 5G, IoT and AI, has meant that companies are not utilising the full potential of Edge.

A single trial or use case may be increasingly straightforward for a business to deploy, but utilising edge at scale, with appropriate security, governance and deploying with other emerging technologies is still an intimidating task for many. At the end of 2020, it was estimated that only 44% of UK organisations were actively using Edge technologies.[5]

Whilst there was growing recognition (57%) of the urgency to handle data at the Edge, one-third of those surveyed highlighted a lack of expertise, skill or understanding to Edge as a top concern; and 87% thought they were missing at least some skills needed to help their organisation unlock the value of data.[5]

Increasing businesses awareness, knowledge and understanding about the real-life opportunities and value Edge Computing can bring and how it can help companies drive wider digital transformation is key. One key aspect of this will be showcasing cross-industry partnerships that enable adoption and deployment.[6] We are already seeing examples of this in the telecommunications sector, such as Vodafone Business and Amazon Web Services partnering to use Mobile-Edge Computing, also known as Multi-Access Edge Computing (MEC)[7], to drive deployment of 5G.[8]

The use of real-life case studies of Edge Computing adoption across different sectors and industries will be key to helping showcase and demonstrate the role Edge can play in organisations' digital transformation. However, right now there is no collection of industry wide case studies and examples of Edge adoption across different sectors and industries that business leaders can easily use to explore the benefits and advantages of Edge to their organisations. Government, industry and other key stakeholders should work together to build a community of advocates for Edge Computing that can develop business guides and promote use cases that will help to build the business case for investment and adoption of Edge Computing across both the public and private sector.

For example, it is suggested that there may be a role here for the UK's Catapult Network and bodies supporting organisations adoption of emerging technologies as part of the plan for growth. To support the adoption of Edge within the public sector this work should look to highlight how Edge is currently being used, or could be used, in Government backed projects to support public services delivery.

The way in which data is stored and processed is expected to drastically evolve over the coming 5 years, which means we need to increase the awareness and understanding of Edge Computing now to business leaders. In 2020, 80% of the processing and analysis of data takes place in data centres and centralised computing facilities, and 20% in smart connected objects and 'at the Edge'. By 2025 it is being suggested that these proportions will be reversed with more data being processed via connected objects and at the Edge.[9] Businesses need to be made more aware of the importance of Edge Computing (in addition to, and alongside, other key technologies such as Cloud Computing) in supporting them as the volume of data increases.Businesses need to proactively invest in Edge infrastructure in preparation for this data increase to mitigate any infrastructure challenges like legacy hardware.

At the end of 2020, it was estimated that only 44% of UK organisations were actively using Edge technologies.[5]

A crucial component of Edge Computing is its relationship with Cloud technologies. Rather than being competing technologies Edge and Cloud working together are both crucial for adoption of emerging technologies including Digital Twins, 5G and AI.[10] It is important therefore that awareness raising activities explain to business leaders the relationship and interconnection between Cloud and Edge Computing and why investing in both these technologies are key to digital transformation.

Key to ensuring greater adoption and use of Edge Computing will be ensuring businesses have access to a talent pool of skilled IT professionals with the necessary Edge expertise and experience needed to advise and support the deployment, adoption and use of this technology. Given the increase in the use of Edge Computing expected in the years to come, it is important that consideration is given now to whether the UK is developing a talent pool of IT professionals the technology sector will need to support and guide business use of Edge in the coming years. It is suggested that an analysis and assessment is conducted by Government of the digital skills needed to realise the benefits of Edge Computing to identify where skills gaps may exist that need to be addressed.

Recommendations

- Government, industry and key stakeholder bodies such as the UK's Catapult Network and UKRI should work together to build a community of advocates for Edge Computing to promote and raise awareness of the benefits of Edge adoption.
- Engagement tools such as a national Edge Computing Campaign, webinars and podcasts and events such as London Tech Week should be explored to showcase the benefits of Edge to UK organisations across both the public and private sector.
- Government should conduct an analysis and assessment of the digital skills needed to realise the benefits of Edge Computing and determine whether the UK is developing the talent pool of skills professionals in Edge Computing businesses may need in the near future.

Case Study | Hewlett Packard Enterprise

Seyvan Kellay, Edge & IoT Business Development Manager, Hewlett Packard Enterprise

We've all seen the hype around Edge Computing for a good while, but in 2021 Edge Computing has reached the tipping point where, as a trend, it flips from being an early adopter technology to bring mass market relevance and appeal.

The problem that 'Bleeding Edge' trends face is that they can be perceived as too complex, flash in the pan moments and nothing more. However, Edge Computing is different as it is more a continuation of what is already being done.

Where Edge Computing becomes interesting and holds long term relevance is where companies start to realise and unlock the value of their data.

Take a Retail store, it may already have Edge computing i.e. servers in store, however, while these servers may process standard IT workloads such as data produced by POS scanners, the full value of data isn't being unlocked. For example, how can retailers now use this POS scanning data not just to log what is being bought but to now combine this data with video analytics to ensure what is being scanned is actually being taken by the customer i.e. a customer doesn't try to scan a bunch of bananas but then puts a bottle of whiskey in their shopping bag.

The value that IoT & AI holds in providing long-term gain to Edge Computing becoming mainstream is incalculable and once Industries start to work with Technology vendors to place more importance for the need to have a right size Edge Computing platform with the right ecosystem of partners to enable tangible returns on investment, the sooner Edge Computing will flip from being a trend to an unconscious part of company strategy.

“Companies need to step up and work proactively with technology partners to realise the value of their data.”

It’s also important to note the difference of approaches that is being taken depending on what Industry is being talked about. I referenced above retailers, it makes sense why more and more are looking into the value Edge Computing enabled outcomes can provide, not only for their bottom line (reducing shrinkage) but also to stay ahead of the competition and ensure they can provide the best customer experience they can in a cut-throat industry where the customer is king.

On the flip side, consider the Water industry who operate in a natural monopoly, they don’t have competitors as they operate regionally but they are kept on their toes to provide a good service by the industry regulator OFWAT in order to avoid heavy fines for poor service.

Nearly all water companies have AI & IoT outcomes, enabled by Edge Computing in their strategy for the next 5 years, but they are approaching this differently to the retail sector. Instead of competing with one another to try and gain a competitive advantage, there is instead more scope for collaboration as their needs are common amongst each other, they aren’t fighting for each other customers so instead can share and work together to understand, work with and build the right solution outcomes for all.

Whilst most industries don’t have the luxury of being in a natural monopoly like water, there should be some level of learning in a collaborative approach. Working together to achieve common sustainability solutions to reduce energy consumption isn’t necessarily going to get companies more customers but it will help them all improve their bottom line and improve society as a whole. Small elements of collaboration between companies can make long-term progressive impact to society and the environment.

At HPE we aim to advance the way people live and work. Whether this is through our technology or the outcomes they provide, we are conscious that Edge Computing is going to be a crucial milestone to improve our customers ultimately their customer’s lives. Our innovation within edge computing, through either our consultative capability or our technology capability with our HPE Edgeline range put companies, be it water, retail or any other industry in a fantastic position to reap all of the benefits that Edge Computing provides for themselves and their customers.

In summation, Edge Computing is already here to stay. Companies need to step up and work proactively with technology partners to realise the value of the data. Only then will Edge Computing will be talked about as a milestone and not a future trend.

2. Government must recognise Edge Computing as key to the UK's future in the upcoming Digital Strategy and as a key technology for supporting the recovery.

The adoption of transformative digital technologies will be key to UK businesses recovery and reinvention following the COVID-19 pandemic. As Government is considering the digital technologies and infrastructures that are integral to making this happen and to turbo charge the UK's economic productivity and recovery, it is vital that Edge Computing is included in this conversation.

In 2020 the importance of Edge Computing to Europe's digital future was recognised in the EU's Data Strategy. The proposed European Edge Computing Consortium, along with Edge being a key technology to the EU's Horizon Europe funding programme and the work of the associated Coordination and Support Action (CSA), are all signs that Edge is seen as key to Europe's digital future.[11] These varied but complementing initiatives are focused on preparing European businesses to harness the economic, societal and technological benefits of Edge Computing, facilitate a greater awareness of Edge to lawmakers, government stakeholders and technology advocates, and disseminate practical use cases of Edge across small and medium sized businesses.[12] In comparison, the lack of recognition of the importance of Edge Computing by the UK Government is disappointing.

Greater adoption of Edge Computing could be the difference between UK businesses realising the potential of the fourth industrial revolution or being left behind in the next wave of global digital transformation. As such techUK believes Edge Computing must be included in the upcoming National Digital Strategy and the plan for growth. These strategies should outline the value of Edge Computing to the UK and outline ways in which increased adoption and use of Edge by organisations across all size and sector of the UK could be enabled.

For example, to unlock and explore the full benefits of Edge, UK Government should take a proactive role in showcasing, demonstrating and supporting the wider awareness of the benefits of Edge and encouraging increased take up and adoption of Edge solutions.

Government should also empower and support AI/IoT software vendors that are born out of the UK to realise and unlock the benefits of AI & IoT use cases with edge computing. Businesses and Governments should continue to pay particular attention to firms that look to invest, to create scalable, use cases that provide clarity to businesses looking at help on what use cases are effective in their industry.

The UK has well-established industries that set to benefit the most from Edge Computing, including manufacturing, healthcare and retail.[13] In 2021 the UK must recognise Edge in its own right as a key transformative technology for the UK with the appropriate visibility and funding it deserves.[14]

Recommendations

> The importance and role of Edge Computing in the UK's economic future should be included in the upcoming National Digital Strategy and the announced Government plan for growth.

Case Study | London Internet Exchange

Jennifer Holmes, Chief Commercial Officer, LINX

Edge Computing is a very versatile term and we see it being used a lot in many papers, press releases and projects at the moment. “The Edge” is not really something new, but a combination of practices that networks have always done. By using better tools and systems these networks are now making it more feasible to effectively combine computing resources locally (at the Edge) and centrally (in DCs or Cloud) and other emerging networks are following. The role of 5G and Internet of Things (IoT) in this brings the conversation back to the need for good, fast and reliable network connectivity between all of the compute locations (between data centres/Cloud and the Edge).

At LINX, a key part of our vision and strategy is to keep traffic local, an ethos mirrored by Edge computing. LINX has for many years, promoted regional peering in London, Wales, Manchester and Scotland and provides platforms in these regions for local, national, and international networks to peer with other networks to ensure their own services run quicker, with reduced latency whilst at the same time potentially cutting costs. Here at LINX we actively encourage our members to keep traffic as close to the end user as possible.

Many enterprises are beginning to think more carefully about how their traffic is stored and transported, and this focus has been heightened further by the global pandemic and subsequent surge in internet traffic. Keeping traffic at the Edge will play a big part in these company’s digitalisation journeys.

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This growing awareness of how data is stored and transported highlights the need for networks to utilise data sharing platforms like LINX and other IX’s for effectively transporting and trading internet traffic more quickly and cost effectively so that end users and customers reap the benefits. LINX also has the added benefit of being the leading non-profit, membership owned Internet Exchange Point (IXP) in the world. A key part of LINX’s role in the UK Internet Industry is to foster a community of experts who gather regularly to exchange ideas and theories about current and future network developments.

Reports like the one produced by techUK are useful in helping to raise awareness of networks and their traffic and where digitalisation journeys need to focus in the future. It is important to recognise, as highlighted in the report, that the use of “real-life case studies of Edge Computing adoption across different sectors and industries will be key to helping showcase and demonstrate the role Edge can play in organisations’ digital transformation.

3. Increase partnership and collaboration between academia, research institutions and industry to explore and encourage wider application of Edge.

If the UK is to realise the full potential of Edge Computing as a key enabling technology for accelerating the development and use of advanced, innovative digital technologies in the UK, such as 4G and 5G, AR/VR and AI, it is important that research activities and projects are supported to explore and test the wider applications and use of Edge Computing.

There are already examples of where collaboration between UK researchers, academia and industry is driving forward the application of Edge Computing and highlighting the power of Edge to UK businesses. The recent consumer focussed 5G Edge-XR project with BT and University of Bristol showcases the necessity of Edge for supporting next-generation technologies that will revolutionise immersive viewing.[15] AR and VR applications in particular, with many high-potential business applications in health[16], policing[17] and manufacturing[18], are highly-sensitive to delay and will require Edge Computing to support real time applications.[19] This is also similar with Edge and Cloud working together to support the next generation of Digital Twins. However, it is suggested that collaboration between UK researchers, academia and industry is an area where more activity is needed. This will be key to helping to make the business case for greater adoption and use of Edge Computing.

The good news is the UK has an Edge Computing community and industry that stands ready to support and collaborate with the UK's world leading academic and research institutions, such as UKRI, Innovate UK and ESPRC, to explore potential uses and applications of Edge Computing.

This is especially important in current and future work focused on supporting the development and adoption of other innovations such as AI, Immersive Tech, and Digital Twins. Research projects and activities can also play a key role in supporting earlier adoption by UK businesses particularly SMEs of innovative solutions, such as in Edge, by de-risking early-stage development of solutions and demonstrating the real-world application and deployment of innovations.

To make this happen it is suggested continued engagement and collaboration is needed between the Edge Computing industry and academia and researchers across the UK.

The current work being conducted by UK Government to take forward the UK's R&D Roadmap is an opportunity to explore ways in which industry and the UK's research and development community could work more closely to explore the application of Edge Computing. COVID-19 has hindered effective collaborations between industry and academia and the UK should look to incentivise this as part of recovery.

Edge Computing is particularly valuable when used for high-potential business applications that are highly-sensitive to delay and will require Edge Computing to support real time applications.

It is, however, important to remember that research into the innovative application and use of Edge Computing will not just happen in the UK. The EU's Data and Digital Strategies have earmarked Edge Computing as a technology that will be key to the EU's economic future and it is expected that the upcoming EU Horizon Europe future programme may include funding opportunities for projects and initiatives that highlight the importance of Edge Computing. With the UK-EU Trade and Cooperation Agreement stating that the UK will associate to the Horizon Europe programme this means that leaders in Edge Computing in the UK will have an opportunity to bid to be part of European funding projects. Given this opportunity and expected focus on Edge Computing in the work of the EU going forward, it is important that UK Government work with industry to ensure visibility and awareness of the opportunities to work with other research bodies and European academics that may become available through the Horizon Europe programme. techUK stands ready to work with BEIS to raise awareness of the Horizon Europe programme as and when it gets underway.

Recommendations

- Government should work with industry to explore areas for increased engagement and collaboration between the Edge Computing industry and leading UK academia and research bodies, including UKRI, InnovateUK and EPSRC, on the possible application of Edge Computing to support innovation in areas such as AI, 4G and 5G, IoT, Immersive tech and Digital Twins.
- UK Government should work with industry to raise greater awareness and encourage UK participation in future EU Horizon Europe research funding opportunities.

Case Study | Atos

Paul Wood, High Performance Computing, Big Data & AI, Big Data and Cyber Security Division, Atos

Sam Wilson, UK&I Head of Innovation, Business and Platform Solutions, Atos

Many questions posed by our digital society can be answered with the help of Edge Computing.

When people talk about Edge Computing, they almost always talk about data. They talk about the 2.5 quintillion bytes of data created every day, the promise of 1 millisecond latency, the 18 billion IoT devices predicted by 2022 and a stake in a market currently worth £2.65 billion. However, to diminish Edge Computing to data points and statistics means that we often overlook the power of Edge Computing to transform the way that we interact with services and people.

As the UK high-street struggles to stay afloat, with problems exacerbated by the global pandemic, it's clear that we need to start thinking outside the box (or at least near the Edge). With the power of Edge Computing we envisage a high street transformed with a more connected and personal experience for citizens. Atos MyCity provides a glimpse into this vision: a partnership with the city of Eindhoven to deliver a smart city that responds to the activity of its citizens. We've created solutions for smart traffic management and pedestrian flow, personalised advertising, predictive maintenance, optimised waste collection and much more to ensure that each citizen has a safe, streamlined and tailored experience while also reducing emissions.

Another area worth considering is health and care. Our healthcare system is ill-equipped to deal with the burden of an aging population that will require a significant amount of resources and treatment. The opportunity to provide telehealth care - treating the patient from the comfort and familiarity of their own home - will be paramount to ensuring that our system can provide the right support for those that need it.

“With the power of Edge Computing we envisage a high street transformed with a more connected and personal experience for citizens.”

This approach to healthcare will rely heavily on the Internet of Things and Edge Computing to sensitively and securely transform sensor data into actionable alerts and information, enabling healthcare providers to deliver the appropriate response. Atos has already run several telehealth trials across the UK and Europe, and the results yield not only increased patient outcomes, but also higher patient satisfaction who feel they have greater autonomy on their lives and understanding of their health.

Furthermore, as we look to return to work in a safe and controlled manner, Edge Computing offers fast, secure and accurate mechanisms to test individuals for symptoms of COVID-19. The Atos and Siemens greeting terminal enables a frictionless and safe work site experience for visitors whilst also using heat detection systems and artificial intelligence to verify that the individual appears healthy and is wearing PPE.

These applications are powered by our proprietary Atos BullSequana Edge Computer that delivers industry-leading performance. The BullSequana Edge is also leading the way in greener, decarbonised Edge Computing offerings whilst almost entirely eliminating the energy cost associated with transferring data to the Cloud.

Edge Computing is often described in facts and figures. Yet, our vision for Edge Computing focuses far more on how it can help solve challenges for organisations and create better outcomes for our citizens in a digital society, including the push to a green and decarbonised future via, for example, the use of intelligent traffic infrastructure and connected and autonomous vehicles.

4. Increase research into the sustainability and environmental potential of Edge Computing.

A move to greater decentralization of data, enabled by Edge, has significant potential to support the net zero transition of key sectors of the economy.

In the energy sector, Edge Computing has a potentially important role in supporting the move to smart electricity grids, by helping optimise loads and manage demand response, which can hugely improve domestic and business energy efficiency. In a recent survey, 54% of businesses stated their intention to use Edge Computing applications for energy management within three years, with organizations also expecting Edge Computing to decrease their annual power consumption up to 11.5% within five years.[21]

In mobility, Edge Computing could also enable greater take up of smart grid technologies, Connected and Autonomous Vehicles (CAV) and support the electrification of transport. Whilst in agriculture, it could unlock smart agricultural technologies to support precision farming in remote locations.

However, determining the full potential environmental opportunities and, in parallel Edge Computing's own environmental impacts, is hindered by lack of research.

More research is needed to identify and test promising use cases. Research is also needed to determine the data that would be required by Edge Computing users and customers to help them understand and demonstrate the sustainable use and deployment of Edge Computing.

The development of user-friendly tools to support transparency in energy consumption and related carbon emissions, such as carbon calculators for Edge Computing, should also be considered to help users of the technology understand, manage and take account of the environmental impact of Edge adoption, so that it can be reflected in companies' low carbon business strategies.

Government and industry should come together to consider what research is needed and how this could be funded and prioritised to ensure the UK works towards the sustainable and responsible adoption, deployment and use of Edge Computing.

Recommendations

- Use cases for edge computing in supporting the net zero transition should be identified and explored.
- Research exploring the environmental impact Edge Computing may have as adoption increases is needed, alongside options to minimise the impact.
- The development of user-friendly tools, such as energy and carbon calculators for Edge Computing, based on common methodologies, should be developed to help users understand, manage and account for the environmental impact of Edge adoption.
- Work should be undertaken to explore and articulate the sustainability benefits of Edge, both on a systems level (i.e. in support of the energy transition) and at a company level (i.e. in support of corporate climate strategies).

Case Study | Cradlepoint

Peddi Indukuri, Sr. Product Manager at Cradlepoint

Network architectures built on the traditional Cloud computing model alone are not sufficient for applications that require real-time response and low latency at the Edge.

Until a few years ago, the role of Edge computing in the IoT context was confined to gathering, filtering, and sending data to applications in the Cloud. Thanks to plummeting silicon costs and the miniaturization of silicon devices, more computing power is executed in smaller-footprint Edge devices such as IoT gateways and routers. Due to this, modern infrastructure at the Edge is capable of processing analytics, running machine learning models, and taking action at the Edge in real time.

Edge containers enable enterprises to decentralize services by moving key components of their application workloads and services to the edge environment, while they can still be managed centrally from the Cloud and integrated with a core set of services running in the Cloud or data center. By moving intelligence to the edge of the network, enterprises can reduce network costs drastically and deliver low latency for applications that require real-time response.

Containers virtualize at the operating system level, not at the hardware level, which is the case with VMs. Docker is the most popular container technology, and it became the industry standard with its open source Docker Engine. So, what is a container? It is a software model that packages all the code and its dependencies so that an application can be run independently and moved from one computing environment to another consistently and easily. As a result, containers continue to see widespread adoption as enterprises are deploying container-based applications virtually everywhere — data center, Cloud, and Edge infrastructure.

There are several Edge compute use cases for containers running on Cradlepoint's Wireless WAN edge infrastructure across branch, mobile, and IoT segments:

- **Preprocess and Filter IoT Data** — Containers running on a Cradlepoint router at the Edge can process data from sensors and devices connected to the router. These containers can preprocess and/or filter much of the raw data from all sensors and send only relevant data to the Cloud. Customers deploying IoT solutions in manufacturing floors, retail environments, smart buildings, and smart cities can save bandwidth and costs associated with transferring raw IoT data from sensors to the Cloud.

“By moving intelligence to the edge of the network, enterprises can reduce network costs drastically and deliver low latency for applications that require real-time response.”

- **Real-Time Response at the Edge** — In mobile environments such as school or public buses, customers can deploy edge containers for public safety solutions. For example, containers running on Cradlepoint routers can trigger video recording from connected cameras in the buses when a driver or passenger presses a panic button and send the footage to the Cloud for a public safety agency to respond to the incident in real time.
- **Offline Device Operation** — Cradlepoint supports AWS IoT Greengrass containers for IoT deployments based on AWS Cloud. Greengrass is designed to operate when connectivity to the AWS Cloud is intermittent or lost. As a result, Greengrass containers are ideal for remote monitoring applications to gather, process, and store IoT data locally when the connection to the Cloud is lost. When the device is back online, Greengrass containers can synchronize the data stored on the local device with Cloud services providing seamless functionality regardless of connectivity.
- **Low-Latency Applications** — Applications that require time-sensitive action suffer from latency if the data is processed and analyzed in the Cloud to take action at the edge. For example, industrial customers can use NCCO to deploy containers that help to make decisions rapidly based on events generated by SCADA systems at the Edge and control (turn on or off) other systems in real time, without sending data to the Cloud.
- **Privacy and Regulatory Compliance** — In industries such as healthcare, there are privacy and regulatory requirements for enterprises sending sensitive personal data of patients to applications in the Cloud. Containers running at the Edge help these enterprises filter Personally Identifiable Information (PII) and send only preprocessed data to the Cloud.

5. Addressing cyber security concerns that could hold back adoption and building trust and confidence in Edge.

The expected increase in the adoption of Edge in coming years means it is more important than ever to identify, understand and address cyber security concerns and help businesses securely adopt Edge.[22]

As with any new advanced digital technology there are cyber security concerns and challenges that must be considered when applying Edge Computing. For example, Edge networks that support local hubs or IoT devices can escalate the attack surface exponentially. Both in cyber and physical terms, local hubs that handle sensitive or critical information can become key targets to cyber criminals. At the end of 2020, 57% decision makers surveyed said connecting IoT devices at the Edge had or would make their business more vulnerable, while 33% highlighted security concerns as one of their top three barriers to implementation.[23]

As Edge can act as a gateway between an organisations' physical on-premise data and their Cloud infrastructure, there is even more imperative for a consolidated security-first approach to Edge adoption, especially across hybrid environments. This is not only critical from an information security standpoint but may also be important from a compliance standpoint particularly where data is involved. Security and privacy concerns will also vary by industry use case and for areas like healthcare security of patient data is a must

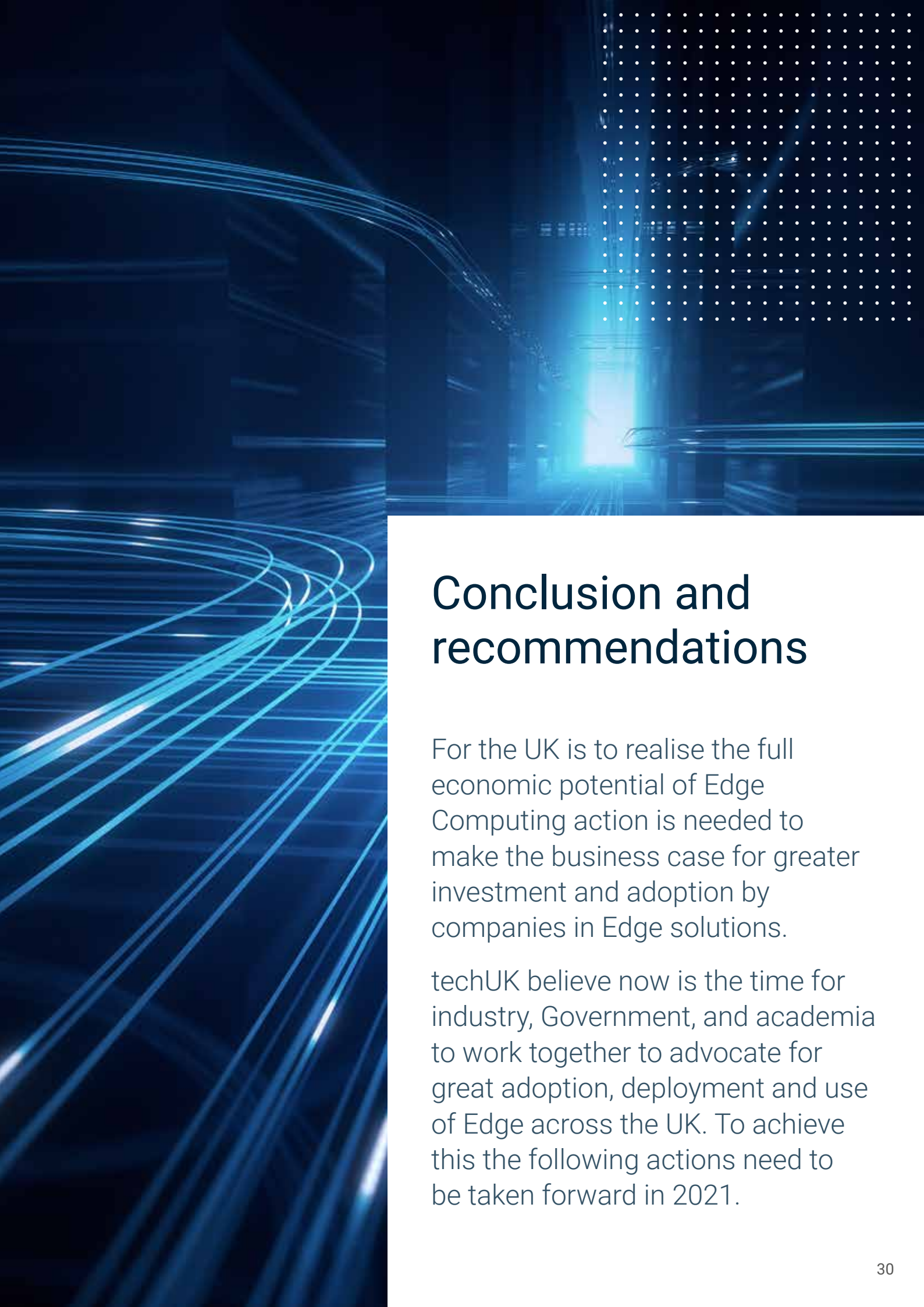
While cyber risks and the online threat environment are constantly evolving and changing, it is important that we ensure that cyber security concerns are dealt with so they do not become a barrier to greater adoption and use of Edge Computing in the UK. Action is needed to demonstrate how Edge Computing can be deployed and used safely and securely and the tools and solutions that exist to support organisations to adopt a security and privacy by design approach to Edge Computing. It is suggested that the UK's National Cyber Security Centre (NCSC) could have a role to play to support businesses in the secure adoption and use of Edge Computing in the UK. The development of Edge Security Principles, similar to the 14 Cloud Security Principles, should be explored as a possible approach. The role the NCSC could play in supporting wider Edge adoption should be outlined in the Government's upcoming updated National Cyber Security Strategy.

In addition, the UK can continue to be an international leader in cyber security by continuing to invest and support academic research into Edge and IoT security. The work of PETRAS, National Centre of Excellence for IoT System Cybersecurity on evaluating the trustworthiness of Edge-based multi tenanted IoT Devices is an example of the way in which academics and industry are working together to address and resolve issues such as cyber security in a way that helps Edge Computing to become a viable option for businesses.

It is also important that the work currently underway by ISO and ETSI to develop cyber security standards to help the management of data and of networks for resilient Edge architecture should also be supported. Ways should be found to raise greater awareness and understanding of the existence and role of industry standards in this area. As this work develops techUK will consider way to promote the work of ISO and ESTI with the wider tech community.[25]

Recommendations

- The Government's upcoming updated National Cyber Security Strategy should outline the importance of building trust in the security of Edge Computing and the role to be played by the National Cyber Security Centre (NCSC) in supporting the secure adoption and use of Edge Computing in the UK.
- The work of PETRAS, National Centre of Excellence for IoT System Cybersecurity on evaluating the trustworthiness of Edge-based multi tenanted IoT Devices[26] should continue to be funded and supported.
- Greater awareness and understanding of the existence and role of industry standards being developed to support secure Edge adoption and use will be key in 2021.



Conclusion and recommendations

For the UK is to realise the full economic potential of Edge Computing action is needed to make the business case for greater investment and adoption by companies in Edge solutions.

techUK believe now is the time for industry, Government, and academia to work together to advocate for great adoption, deployment and use of Edge across the UK. To achieve this the following actions need to be taken forward in 2021.

Recommendations

- Government, industry and key stakeholder bodies such as the UK's Catapult Network and UKRI should work together to build a community of advocates for Edge Computing to promote and raise awareness of the benefits of Edge adoption.
- Engagement tools such as a national Edge Computing Campaign, webinars and podcasts and events such as London Tech Week should be explored to showcase the benefits of Edge to UK organisations across both the public and private sector.
- Government should conduct an analysis and assessment of the digital skills needed to realise the benefits of Edge Computing and determine whether the UK is developing the talent pool of skills professionals in Edge Computing businesses may need in the near future.
- The importance and role of Edge Computing in the UK's economic future should be included in the upcoming National Digital Strategy and the announced Government plan for growth.
- Government should work with industry to explore areas for increased engagement and collaboration between the Edge Computing industry and leading UK academia and research bodies, including UKRI, InnovateUK and EPSRC, on the possible application of Edge Computing to support innovation in areas such as AI, 4G and 5G, IoT, Immersive tech and Digital Twins.

- UK Government should work with industry to raise greater awareness and encourage UK participation in future EU Horizon Europe research funding opportunities.
- Use cases for edge computing in supporting the net zero transition should be identified and explored.
- Research exploring the environmental impact Edge Computing may have as adoption increases is needed, alongside options to minimise the impact.
- The development of user-friendly tools, such as energy and carbon calculators for Edge Computing, based on common methodologies, should be developed to help users understand, manage and account for the environmental impact of Edge adoption.
- Work should be undertaken to explore and articulate the sustainability benefits of Edge, both on a systems level (i.e. in support of the energy transition) and at a company level (i.e. in support of corporate climate strategies).
- The Government's upcoming updated National Cyber Security Strategy should outline the importance of building trust in the security of Edge Computing and the role to be played by the National Cyber Security Centre (NCSC) in supporting the secure adoption and use of Edge Computing in the UK.
- The work of PETRAS, National Centre of Excellence for IoT System Cybersecurity on evaluating the trustworthiness of Edge-based multi tenanted IoT Devices[26] should continue to be funded and supported.
- Greater awareness and understanding of the existence and role of industry standards being developed to support secure Edge adoption and use will be key in 2021.

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FOR WHAT COMES NEXT

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