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Connectivity Challenges in a Digital World

The growth in IoT devices and Internet reliance is making ‘always-on’ connectivity increasingly critical in the business world. This report reveals the extent to which companies are being affected by network fragility and explores how it can be overcome with resilient solutions.

WHITE PAPER

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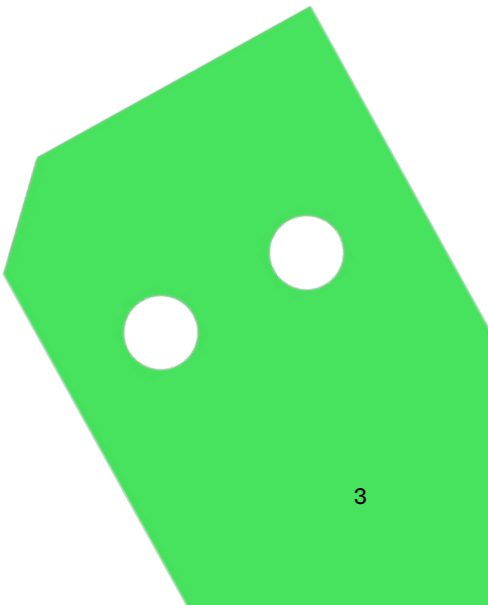
EXECUTIVE SUMMARY

This white paper explores the growth in IoT devices and their requirement for resilient connectivity, as ‘always on’, real-time communications become increasingly critical in the business world. The white paper delivers key findings from a survey of 3,367 respondents, conducted in February 2024, in which high-level business executives were questioned on connectivity issues and their effects.



> **Connectivity failures have caused frustration in 83% of businesses and violence in 40%.**

Mobile broadband networks are now within reach of 95% of the global population, keeping billions of IoT devices and businesses connected. By 2028, mobile data traffic is expected to be close to 330 exabytes per month and by 2035, when the full economic effect of 5G is likely to be realised, it is expected to be enabling up to $13.1 trillion of goods and services.

There were around 2 billion cellular IoT connections in 2023, a number which, according to Transforma Insights, is expected to grow to around 7 billion in 2033.

The increasing use of mobile connectivity has put a premium on network resilience, with an estimated 1.6 billion (83%) IoT connections deemed in some way 'critical' at the end of 2023. However, a typical target Service Level Agreement (SLA) of 99% on a best-efforts basis (in reality far lower), means a down-time of 1%, resulting in 1 hour and 40 minutes offline per week, or 7 hours and 15 minutes per month; nearly a full working day.

The survey, carried out independently by Mortar Research, showed that connectivity failures are almost ubiquitous and are resulting in financial penalties, reputation damage, mental health issues and even life-critical incidents. The top-line conclusions were:

- Connectivity is the number one issue faced by businesses all around the world
- 97% of businesses experience some form of connectivity loss every month
- 93% of businesses have suffered financial impact due to connectivity issues
- Almost 2/3 (63%) of businesses have lost sales or customers due to loss of connectivity
- Connectivity failures have caused frustration in 83% of businesses and violence in 40%
- A quarter of all businesses (25%) have been hacked due to connectivity issues
- Two thirds of businesses (67%) say data connectivity has become more critical
- A third of businesses (32%) would develop new services/products with better resilience

The survey, and additional interviews, revealed the many different real-life issues caused by connectivity issues. It also highlighted that many businesses simply put up with them, while that those who have sought an alternative have failed to find one. However, with increasing legislative requirements and consumer pressures, there is a growing need for a solution.

The use of multiple roaming SIMs offers improved connection, but issues remain and comments from new provider rSIM provides insight into how its solution can help. In conclusion, it is clear the pain of poor network resilience is peaking, and a solution must be found to avoid business-critical issues while maintaining a developing technology trajectory.

01

THE MOBILE WORLD

> Every moment spent offline comes at a cost: loss of reputation; loss of revenue; loss of customers; loss of jobs; and even loss of life.

Introduction

Mobile connectivity is entering a new era. The growth of SIM-based IoT smart devices, coupled with the continued evolution of mobile data use, is creating a world where companies are increasingly reliant on staying online. Businesses are entwined with technology and, as a result, live in a culture that is 'always-on' – yet in terms of connectivity, the networks that are used are far from 'always-on'.

The research in this white paper shows that businesses all around the world are regularly facing issues with their networks. It could be minutes, hours, or days, but however long an outage occurs, every moment spent offline comes at a cost: loss of reputation; loss of revenue; loss of customers; loss of jobs; and even loss of life.

The connected world is currently built on a wide range of technologies, from the original fixed copper wires to high-tech 5G networks, but in a future where everything will be mobile and data will be growing, securing a stable future for connectivity is vital. Outages can be caused by many things, but an unreliable mobile connection is one of them. A major one. And one that, without resolution, could hold us back in our relentless pursuit of technology.

The evolution of mobile

The latest evolution of global mobile networks, 5G, has taken performance capabilities to their highest-ever level. Data can move up to 100 times faster than on 4G networks, connectivity speeds are faster, latency is lower and bandwidth is bigger. Mobile broadband network infrastructure is now within reach of 95% of the global population, with 90% covered by 4G and 32% by 5G by the end of 2022.[1] By 2028, mobile data traffic is anticipated to be almost 330 exabytes per month, which is more than three times bigger than 2022 levels[2] and by 2035, when the full economic effect of 5G is likely to be realised around the globe, it is expected to be enabling up to $13.1 trillion worth of goods and services.[3]

The growth of advanced mobile technologies is now making older mobile networks, such as 2G and 3G, obsolete and is also driving a shift from fixed networks onto mobile. In the UK, for example, 93% of the landmass is now covered by good 4G with the 5G network reaching 85% of premises. UK mobile traffic increased by around 25% year-on-year in 2023, with 5G traffic up from 63 PB in 2022 to 151 PB in 2023, a growth of around 140%.[4] The country's 2G and 3G network switch-off has begun, with the former set to be terminated by 2033 and the latter shut down within the next decade, while ground-based copper wire PSTN telephone systems are also being phased out in the next two years, with devices that currently run on it either switching to fibre networks or moving to mobile.[5]

The current state-of-the-art 5G networks, and the 6G networks that will eventually follow, are capable of high capacity, high-speed data traffic. As a result, this has led not only to a greater reliance on the Internet for business operations such as VoIP, video conferencing and the use of cloud computing, but has also opened up the opportunity for an explosion of new business cases for connected technology.

> **Reliability and resilience in network infrastructure are crucial for IoT success.**

The growth of IoT

The Internet of Things (IoT) has grown from a relatively small demand on the network infrastructure to a colossal draw that is relentlessly increasing at unprecedented speed. This is driven by businesses seeking to use new technology to improve an existing process or introduce new solutions that deliver greater efficiency. In 2010, IoT devices only accounted for 9% of global network connections, but by 2025, that is set to reach 75%, meaning three-quarters of the global internet network will be focused on delivering IoT-based services.[6]

These IoT devices can, of course, be connected to fixed or mobile networks, and when it comes to cellular-based IoT devices, the world had an estimated two billion at the end of 2023, up 17% from the previous year, which itself was up 20% from the year before.[7] The CAGR of cellular 5G IoT devices is predicted to be 87% between 22-27[8], with the anticipation of seven billion cellular IoT connections by 2033, most of which will be focused on 5G RedCap, 5G Massive IoT and 4G LTE Cat-1bis modules.[9]

Cellular connections are being used for devices in virtually all sectors of business and every type of industry. Over the next 10 years of growth, remote monitoring solutions such as electricity and water smart meters, usage-based insurance logs and track-and-trace devices are expected to be some of the fastest growing markets for IoT. Others that are significantly expanding include devices that will be relied upon to deliver either life-critical services, such as security alarms and fire alarms, or crucial business operations, such as card payment terminals, stock level monitoring and vehicle telematics.[10]

The importance of connectivity

The networks that underpin all these IoT devices and connected workplaces are key to their success, and the key to that is reliability and resilience. Mobile Network Operators (MNOs) typically provide connectivity commitments through Service Level Agreements (SLAs), which define a promised percentage of 'uptime' when the network is operating as expected – a commitment which, in itself, is an acknowledgement that the service will not be faultless.

Typical SLAs are currently around 98% or 99%, with the Holy Grail seen as the 'five nines' of 99.999%. Although those current typical SLAs represent just 1% or 2% of downtime, that can add up to a significant amount over the course of a day, week or year. The following table, calculated using the website www.slatools.com, shows the amount of downtime experienced for current SLAs and the ultimate 'five nines' target – noting that even a currently perceived best-in-class SLA of 99% totals almost one working day (7 hours 12 minutes) spent offline per month and a total of 87.5 hours of downtime in a year.

Network providers in the UK are obliged to report any incidents that cause a 'significant impact' to their service to the regulator, Ofcom. During the most recent period of record (September 2022 to August 2023), the regulator received 1,209 reported network incidents, of which around 50% (609) involved mobile networks. These total incidents affected 17.5 million customers and caused approximately 107 million customer hours of service to be lost during the period.[11] However, that is just reported incidents. In 2022, Ofcom noted several significant outages, reported in the media, had occurred below the reporting thresholds. As a result, it has introduced new reporting guidelines, acknowledging that digital infrastructure is becoming "increasingly critical" as it is now relied upon by many essential services.[12]

Digital Infrastructure Table

SLA	OUTAGE	Per day	Per week	Per month	Per year
98%	2%	28m 48s	3h 21m 36s	14h 24m	7d 7h 12m
99%	1%	14m 24s	1h 40m 48s	7h 12m	3d 15h 36m
99.999%	0.001%	<1s	6s	26s	5m 15s

Critical connections

The term 'critical connectivity' is, in fact, now formally used within the IoT industry. This is a firm and clear acknowledgement of how important a reliable network has become for many businesses. Even an outage that simply affects basic Internet provision can cause critical operational issues for some businesses. However, when it comes to IoT devices, there is a growing number of services that are becoming critically reliant on connectivity, which can be categorised in the following ways:

Mission Critical

- Critical National Infrastructure / National Security: Necessary for a country to function (e.g. national grid, transportation systems, water management, communication networks)
- Life Critical: Ensure the safety, health and wellbeing of individuals in situations where immediate and accurate data is essential (e.g. medical wearables for emergency response, monitored alarms, lone workers)

Business Critical

- Commercially Critical: Result in an immediate, serious commercial risk in the absence of a consistent, reliable connection (e.g. ePoS Point-of-Sale systems, supply chain management, asset tracking and management)
- Commercially Important: Result in a noticeable knock-on impact on commercial operations or everyday life without connectivity (e.g. access control, remote diagnostics, retail analytics, fleet management)

Non-Critical

- Commercially Required: Unlikely to have a significant implication for life, wellbeing or business continuity (e.g. customer experience enhancement, maintenance applications, non-critical sensors in manufacturing, retail digital signage)

The importance of critical connectivity cannot be understated. It is estimated that 1.6 billion of the world's active network IoT connections (83% of the total) were in some way 'critical' at the end of 2023. In 10 years, that figure is expected to grow to 4.8 billion. As a result, it has been noted by digital transformation research agency Transforma Insights that IoT buyers are "very conscious of who they are selecting to take their connectivity from, doubly so for more critical applications."[13]

Outage effects

A brief sweep of the Internet quickly highlights the level of impact that connectivity issues have had on businesses around the world in recent years. One of the most notable occurred in Australia in November 2023[14], when the Optus mobile and fixed line networks went down for 12 hours. The outage affected more than 10 million individuals and 400,000 businesses and services. It led to countless stories in the media, which included:

- The health service collapsed with ambulances uncontactable and surgeries impossible
- The train network shut down because signalling and route operation uses IoT
- Uber prices spiked 200% when thousands of drivers on the network dropped offline

The issue of connectivity is now so high on the agenda that a dedicated network analysis website, Downdetector.com, has been set up

- ATMs and WiFi terminals failed, leaving millions of businesses unable to make sales
- People complained of being lost on the streets without Google Maps
- Someone's cat was left without food when its smart feeder failed!

The incident was so significant that the company's CEO, Kelly Bayer Rosmarin, resigned soon after. And just three months later, in February 2004, another CEO also suffered as a result of connectivity issues when DBS, the largest bank in Singapore and Southeast Asia, experienced disruptive outages. Its CEO, Piyush Gupta, is reported to have taken a 30% pay cut and the business was also impacted heavily as Singapore's central bank imposed additional capital requirements for a month and enforced a six-month hiatus on non-essential IT services.[15]

The business-critical effect of outages was demonstrated in the US in September 2023, when business payments provider Square went offline leaving thousands of restaurants and shops unable to take payments or orders on ePoS (electronic point of sale) devices, creating a significant dent in the small business economy. Although it was a relatively short period, one Cincinnati pizza restaurant calculated they lost around $740 in direct sales and tips, while others were forced to shut until connectivity resumed.[16] In June 2023, an issue with BT's network in the UK led to a far more life-critical issue when a total of 11,470 unique calls failed to connect with the '999' emergency services number.[17]

The issue of connectivity is now so high on the agenda that a dedicated network analysis website, Downdetector.com, has been set up to monitor a wide range of globally significant businesses and websites and allow people to report connectivity issues as they happen. In fact, as this white paper was being written, UK operator Three was suffering an outage that occurred on three consecutive days and led to 12,000 customers reporting issues on the Downdetector site.[18] From all these stories, and many more, it is clear just how important connectivity is to businesses around the world, and how critical it can be when it is lost.

How AI feels about its own connectivity

The relentless rise of AI is one of the advances that is set to push the network capabilities to their limits, with more reliance on data transmission leading to an even greater reliance on resilience. So, perhaps it is only fair to ask ChatGPT itself what it thinks about connectivity. Its response? "Mobile network connectivity has become an indispensable part of our lives, hasn't it? It's amazing how much we rely on it for staying connected, accessing information, and even running businesses…."

Pressed further as to how it feels about the potential failure of the mobile networks that support it, it added: "As an AI, I don't have feelings or emotions, so I don't experience concern or apprehension about potential failures of mobile networks. However, I recognise that disruptions in mobile networks can impact users' ability to access information and interact with me."

The Chatbot concluded that outages can "pose significant challenges for IoT devices, especially since they rely heavily on uninterrupted connectivity to function effectively" and that, overall, "the criticality of a loss of connectivity underscores the importance of robust and resilient network infrastructure, redundancy measures and disaster recovery plans to minimise the impact of disruptions on essential services and operations."

02

CONNECTIVITY SURVEY

> **Businesses are facing a growing and increasingly critical challenge when it comes to connectivity and resilience.**

Survey methodology

This survey involved a total of 3,367 respondents between 9th-14th February 2024 and explored the impact of network resilience on day-to-day business activity through a set of 16 questions. It was focused on business decision makers around the world who are "reliant on the internet for day-to-day business activities" and involved only individuals working at manager level or higher in seven different regions (USA, UK, Germany, Spain, Italy, France and the Nordics), all nationally representative of gender and region.

The process, carried out by Mortar Research, sourced responses from participants on mobile and desktop devices. Respondents were incentivised to carry out the survey and each was provided opt-in consent in line with MRS and GDPR guidelines. A multi-sourced recruitment method was used, with measures in place to ensure no duplication or link manipulation.

Headline statistics

The survey responses clearly demonstrated that businesses are facing a growing and increasingly critical challenge when it comes to connectivity and resilience. This is causing issues both financially and operationally, while it is also affecting the mental health of staff, the security of data and the ability to innovate for the future.

Critical connectivity

- **Connectivity is the number one issue faced by businesses all around the world.**
  Internet and device connectivity topped the overall list of business challenges and was also the biggest issue in every individual global region. Data and device security was second and both were deemed more problematic than securing and retaining business or staff.
- **87% of businesses say that reliable connectivity is essential for operation.**
  One in two businesses (50%) said that connectivity is critical for their day-to-day operations and that they cannot operate without it, while a further 37% cited it as a major concern, where their everyday operations would be severely disrupted without connection.
- **Two thirds of businesses (67%) say data connectivity has become more critical.**
  The ability to connect to a resilient network is becoming increasingly important, with 34% of respondents stating it has become "much more critical" and 33% "somewhat more critical" to their business activities in the last three years.

Regularity of outages

- **97% of businesses suffer from some form of connectivity loss every month.**
  Monthly outages clock up to an hour for 60% of businesses, while 37% experience even more time offline.
- **More than half (58%) of businesses suffer connectivity problems with IoT or smart devices.**
  The hardest hit industry was cosumer electronics, where more than three quarters of businesses (77%) were affected. The communications, information and IT industries were next, with 73% suffering issues.
- **43% of businesses experience at least one connectivity issue every week.**
  Reliability of connection is a daily issue for many around the world, with 16% of businesses suffering a connectivity incident every day – a figure that rises to 30% on average in Western Europe, with 35% specifically in France and Italy.

> We could not send files to the printers, so I saved the work in a USB drive and drove into the city – it was like going back to 2007!

Business Impact

- **Nearly two thirds (63%) of businesses have lost sales or customers due to connection issues.**

  Direct financial impact has been felt by 93% of businesses, with 22% stating this has been "severe" or "very severe" while 1 in 3 businesses have also been fined due to loss of data connectivity.

- **Connectivity issues cause staff frustration in 83% of businesses and violet outbursts in 40%.**

  More than 1 in 2 companies (55%) admit to having experienced swearing or shouting in their office when technology failed to connect, with 44% noting heated exchanges between staff and 40% seeing people physically take anger out on the technology that is not working.

- **A quarter of all businesses (25%) say they have been hacked due to connectivity issues.**

  Connectivity issues can cause devices to be left open to cyber attack and 22% of businesses said that the believed connectivity issues resulted in their IoT device experiencing a hacking incident, with 27% stating it had caused internet security breaches.

Deep-dive: business impacts

Delving deeper into the data reveals more insight into how businesses are being affected in different areas and how that is manifesting within their day-to-day operations, their use of IoT devices, their relationships with clients and, ultimately, their bottom line.

Outages and impacts

The growth of IoT devices is being challenged by a wide range of different connectivity issues. More than a quarter of businesses have experienced data transmission/collection failures (28%), cloud application connection failures (28%) or remote monitoring device connection issues (26%), while 24% reported machine-to-machine disconnect issues. The problems also extend to general connectivity, with Internet dropouts experienced by two thirds of businesses (66%), while one third (34%) suffered network coverage issues.

Serious outages have caused 1 in 2 businesses to come to a complete standstill at least once, while 43% of the respondents said connectivity problems had caused "life affecting changes" to staff or the users of their products. More than half (52%) of businesses have experienced reputational damage, while the financial impacts have been felt in many different ways: 63% of respondents said they have lost sales, clients or customers; a third (33%) have been fined; 31% have faced some sort of litigation or been sued; and 37% have had to pay out on an SLA for missing targets.

Real-life experiences

The following examples offer insight into the wide variety of business issues the respondents have experienced as a result of IoT-related connectivity failures:

- Our security cameras missed a break-in on site and items were stolen
- We were unable to print out legal documents and, as a result, we lost a case
- Our remote devices could not connect and we suffered five hours of delays
- Our palletiser lost connection and over stacked, damaging our products

- We are a same-day courier network and we lost all contact with our drivers
- We were unable to verify insurance information, leading to a delay in patient treatment
- We could not access laboratory test results, delaying patient diagnosis and treatment
- We suffered a safety issue as we could not register which staff were in the building
- A product was damaged so we had to stop production and did not meet targets
- All the card machines went down in our supermarket
- We suffered a fire
- We could not send files to the printers, so I saved the work in a USB drive and drove into the city – it was like going back to 2007!

Deep dive: human effects

Dealing with outages when thousands of critical IoT devices go down in the field can be stressful, and the overall effect of connectivity issues on the mental wellbeing of staff is not something that is often considered. However, the survey underlined that connectivity issues can cause notable frustration, discomfort, anxiety or even aggressive behaviour, causing staff stress and sleepless nights for more than half (58%) of the respondents. It is no secret that connectivity issues can be frustrating – as confirmed by 83% of businesses – but just how frustrating may come as somewhat of a surprise: 55% of businesses have had staff shouting and swearing as a result; 44% have experienced heated exchanges between staff members; 40% have seen a member of staff throw, kick or smack the technology that is not connecting; and one in three (33%) have actually had a staff member quit because of it.

The nations where most frustration occurs are in Western Europe, where 61% of French businesses experience aggressive behaviour towards faltering technology (21% higher than average) while 68% of Italian and 69% of Spanish businesses have witnessed swearing and shouting (compared to the 55% average). In both France and Italy, this is more likely to lead to staff walk-outs, with more than half of businesses (54%, over 20% higher than average) reporting at least one staff member choosing to quit over a connectivity-related issue. In contrast, UK workers seem most tolerant of connectivity failures. Just over a quarter of UK businesses (27%) reported violent behaviour and 47% suffered verbal outbursts, which is 13% and 8% less than average respectively.

Due to the critical nature of IoT connectivity in particular, outages always require urgent attention and this can have knock-on effects on the personal life of staff members too. Staff have to adopt an emergency response approach, dropping regular work to try to resolve the issues while also having to handle uncomfortable calls from angry or frustrated customers. As a result, 68% of businesses said they would require staff to work longer, and that percentage remains similar for all the surveyed nations. Just over a quarter of the individuals who completed the survey (26%) said they had missed an important family or social gathering because of an outage, while 47% said they had experienced anxiety issues and 17% had even been forced to take time off work due to stress.

The following examples offer insight into the wide variety of human issues the respondents have experienced in their business as a result of IoT-related connectivity failures:

- A customer became furious and took their anger out on staff when a transaction failed
- Many employees left their jobs in anger and I had to hire new staff
- One of our staff members was fired.
- An argument broke out between staff and we had to break up a fight
- Our manufacturing machines failed to start, causing staff to work overtime to catch up
- A member of staff badly injured himself

CASE STUDY

To provide some detailed experiences of connectivity issues, three different companies were interviewed for this white paper. All three currently use or provide SIM-based connectivity in different industries and were selected to offer a range of use cases in relation to resilience.

Caburn Telecom

Caburn Telecom has developed a platform that uses machine-to-machine intelligence to enable the management of SIMs at scale in IoT devices. Its CEO, Paul Bandell, explained some of the challenges the company experiences with connectivity and resilience.

"Companies that are developing IoT solutions typically start with the platform, the data, the requirements and the device and usually leave connectivity to the end. They will get a SIM card, put it in and it will work, but as soon as they start to get to scale, they encounter problems – and when you have 100,000 SIMs out there and you have a problem with a network, that is a big problem. As the number of devices that are connecting expands, being able to connect does become critical because to run and operate your business, whatever it is, there is a reliance on it.

"If a SIM is on a particular network and it cannot send data, it will just stay on that network and even if you block the network and reboot, it will go for the last network it was on, so it will still re-connect, even if there is a problem with the data. Currently, to solve the issue, we sometimes bar a network, so when it recycles it will see that network is barred and jump on the nearest available alternative. Another solution is to write some code within the device that will check if it is connected but not sending data, try it several times, and if it continues to be unable to send data will cycle round and try the next network."

> “We have up to 18,000 calls per day and even a downtime of five minutes can cause issues.

Careium AB

Careium provides social alarm services to private customers and local authorities, with 24/7 support available at the touch of a button. The company’s CSCO, Ulrik Nilsson, explained the importance of resilience.

“We have up to 18,000 calls per day and even a downtime of five minutes can cause issues. If we have an outage of several hours, that is an absolute catastrophe. We are expected to answer calls within 30 seconds and we have IT staff on call in all key regions 24/7 to manage incidents if they happen. All our business customers also have business continuity processes they can activate, where they get care givers to call or visit users to ensure they are OK and continue to do so as long as the outage lasts.”

ParkingEye

ParkingEye provides car park management for b2b clients using Automatic Number Plate Recognition (ANPR) cameras and is now expanding into EV charging and other services. Chief Product & Technology Officer Adrian Cunliffe explained its growing connectivity challenges.

“We do not currently need real-time connectivity because we have caching and we can send data in batches. However, ideally, we do not want data stored on the camera in the car park, we want it back at base, so we would like remove servers from the car parks altogether and to do that we need better connectivity. When we have a long outage, we can run out of storage and then we are no longer able to operate the car park. The backlog of data can then take days to clear, with extra staff needed to manage the process – and as we are not issuing letters, we are not bringing in money so that starts to impact on cash flow.

“As we start to introduce services such as EV charging, having reliable real-time connectivity becomes very important. Motorists tether their vehicle to a charge point with a cable and we need to know they have paid for charging before it can be released. Any delay confirming that will cause frustration and if it goes down completely, the vehicle will not be able to be disconnected. The UK government now sees charge points as critical infrastructure that must be reliably available, so we have a mandate of 99% up time. In the future, we will also see new technologies such as autonomous cars that need to know where spaces are, so the need for car park connectivity is becoming much, much greater.”

> The inability to rely on good connectivity has caused 44% of businesses to actively choose not to adopt new technologies.

Into the future

The issues with connectivity and IoT devices are not just affecting businesses in the present day, they are affecting the potential for them to innovate, develop and evolve for the future. The responses showed that with a more resilient network, businesses would be able to improve efficiencies, develop new products and services and, ultimately, accelerate the creation, adoption and acceptance of new technologies.

The inability to rely on good connectivity has caused 44% of businesses to actively choose not to adopt new technologies, with 47% saying that better connectivity would give them the confidence needed to make more use of IoT or smart devices, a figure that rises to 52% in the USA. More than a third of businesses (35%) also said improved connectivity would encourage them to allow more people to work remotely, 29% said it would help them reduce their overheads through the use of more automation, and 21% said it would enable them to operate with fewer staff members. Tellingly, only 14% of businesses felt that better connectivity would not actually affect them in any particular way.

The survey also showed that challenges with network resilience as a whole are directly stifling IoT innovation. Almost a third of companies (32%) said better connectivity would enable them to develop new services and/or products they cannot currently offer, while 22% said that a major outage could cause concerns to investors, suggesting that it would be more difficult to secure investor support or external funding for new business offerings that rely on good connectivity, as they would be seen as being higher risk.

Matt Hatton, the founding partner of Transforma Insights, is a technology industry analyst with his finger firmly on the pulse of Digital Transformation. He spends his days evaluating how new technologies will change the markets in which they operate, and determining the potential transformational use cases for new technologies such as IoT, hyperconnectivity, human-machine interfaces, AI, robotic systems, process automation, data sharing, edge computing, and many more.

He concurs with the survey findings that the adoption of IoT devices could accelerate if connectivity confidence grows and explains: “IoT does not follow a hockey stick adoption curve like mobile phones or social media; the enterprise space has quite a lot of inertia and takes quite a lot of time to go through the process of testing and putting it in place. There is a lot of interest in developing applications that rely on ultra-reliable, low-latency communication, but the networks are not there. Anything that involves split-second decisions cannot buffer, so it needs to work in real time. Beyond that, if you are sure the connectivity would be there, it is simply a question of how limited your imagination is.”

> The best solutions are often simple and we decided to make rSIM as simple as possible. We can always make it more complicated later.

The rSIM solution

The industry has been trying to solve connectivity issues for years, with limited success. Approaches include multi-IMSI, non-country roaming and eSIM profile changing, but these either do not conform to standards, cannot work with all devices, or need specific software to be created to function, which would become disconnected if the operator suffered a core outage. Now, there is new solution that aims to crack the connectivity conundrum once and for all. The device-agnostic rSIM is marketed as the world's first truly resilient and intelligent SIM card. It constantly monitors connectivity and when disruptions occur, it switches to a backup mobile operator profile stored on the card.

Two Mobile Operator profiles can be stored on the SIM, each tied to distinct core infrastructures, meaning the chances of a loss of connection beyond the outage detection period will be reduced substantially. It offers two layers of connectivity protection: roaming and resilience. The primary resilience function will autonomously sustain connectivity in the field, offering a proactive solution for uninterrupted internet access, while roaming outside the home country, provided the device supports this, gives time to move to multiple networks before triggering a switch to the backup profile.

The innovative solution, which has been created by CSL, was launched just prior to Mobile World Congress 2024 in Barcelona. Richard Cunliffe, Director of rSIM was involved in its development and explained how it came to be. "We had initially attempted to create a dual SIM solution that used a tray to support two tiny SIM cards, with an adapter that slid into the device to offer twin network connectivity," he says. "That proved to be unsuccessful, but at the same time, the eUICC (Embedded Universal Integrated Circuit Card) was just coming out, so we started to explore what it was.

"We discovered it was a SIM card that could hold more than one mobile operator profile, then suddenly the next question was whether it was capable of testing as part of the data process. It turned out it can open its own comms link, and test directly from the SIM out to the wide world and back. So, now you have a SIM that can hold two profiles and can test the connection and it just needed some logic to work out how long the loss of connection is happening for and switch if it was over a certain period. We explored each element, stitched it all together and developed a whole new SIM that no one has ever done before

"Now, suddenly every single SIM device can be a dual SIM. We were really careful not to move away from the standards and not to change the operating system that lives on the SIM card, because as soon as you start tweaking the operating system, you need new GSMA certifications and that might affect how it works with devices. So, this works with any device that supports eUICC, which is any device from around 2010. It has benefits right across the ecosystem: the firmware manufacturer no longer needs to implement extra software to manage connections and the device manufacturers do not need to do anything to their devices, because all the intelligence is living on the SIM card.

"Multi-IMSI SIMs do something similar to rSIM, but they are not standards-based. They have a single profile containing lots of IMSIs, which are small files provided by the operator that all sit within one package, normally linked to one core, to be authenticated onto the network. Multi-IMSI gives the manufacturer of the SIM more options – for example, it can fetch and analyse signal data from the device and choose the strongest network, or it can request a list of network prices and select the cheapest option. But because it is working with the device, fetching that signal data or bandwidth speed test data, it slows the SIM significantly. And because none of those things are in the standards, most devices will not know how to share this additional information, so the device will have to be adapted to work with the SIM and every time a new firmware is release, its functionality has to be re-checked."

Matt Hatton believes the rSIM solution is "interesting as one of a selection of options for supporting connectivity" and explained: "There has been a presumption of best efforts when it comes to connectivity, and if a company contracts with any provider they will be given parameters for compensation for service outages. But you do not want compensation, you want no service outages. There are a number of different ways of connecting to multiple networks, such as multi-IMSI, non-country roaming or eSIM profile changing, and at first glance rSIM seems to offer some advantages against those solutions."

> **Mobile network connectivity has become an indispensable part of our lives, hasn't it? It's amazing how much we rely on it for staying connected, accessing information, and even running businesses.**

03

CONCLUSION

> People currently accept that mobile connectivity is just not reliable. That is the norm.

The survey results clearly demonstrate an increasing pain point within businesses when it comes to connectivity, and indications are that this will continue to increase as the inevitable growth of IoT devices marches on. The development of a variety of different multi-SIM and multi-operator solutions also demonstrates that there is a desire to solve this problem, and that it is being worked on by different companies in different areas of the industry. However, it is also apparent that without specialist solutions, the standard networks simply cannot provide the reliability required for 'critical connectivity.'

In Sweden, Ulrik Nilsson is finding that changes in legislation are putting pressure on his industry, and others, to offer guarantees on connectivity, and he believes that is a trend that will continue all around the world. "There is a very high focus on SIM connectivity and resilience in all markets," he says.

The challenge of offering connectivity guarantees are only going to get greater, however, as the network operators build out of different versions of 5G whilst simultaneously closing down 2G and 3G networks and the old copper cable systems. This will continue for many years to come and with that work comes added network unpredictability, which is out of the control of device owners and internet users. As an example, during the COVID-19 pandemic, the increased pressures on networks resulted in a significant rise in outages, according to a report from global sensor operator Thousand Eyes.[19] The analysis used network telemetry from the company's network to study outages and performance degradation and found that global network outages had increased by 63% in March 2020, compared to January 2020, and were elevated through half of 2020.

Caburn Telecom has been trying to solve the problem for years, working with different companies on multi-IMSI technologies, but is yet to find an answer. Its CEO, Paul Bandell, explained: "The resilience solution is the next big thing for this industry. Confidence in connectivity will drive innovation. It just seems logical. However, right now, the impact of downtime is a problem – people accept smaller outages, but you want to prevent the catastrophic events."

Richard Cunliffe concludes: "People currently accept that mobile connectivity is just not reliable. That is the norm. And that is why this term 'critical connectivity' has come up. In the past, it has not always been critical; businesses could live with bad connectivity, but the more that the world gets connected, the less we can live with it and the more it becomes critical. It then becomes a real problem. New solutions are never usually developed until the pain points become bigger and need fixing. People will either live with that pain for a while or someone will solve it – but now, it has got to the point where that pain has bubbled over. So, we have found a solution for it."

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