Future of the Connected World: A Roadmap for Mobilizing Global Action

VISION, PROGRESS AND MEASURES OF SUCCESS

APRIL 2021

Contents

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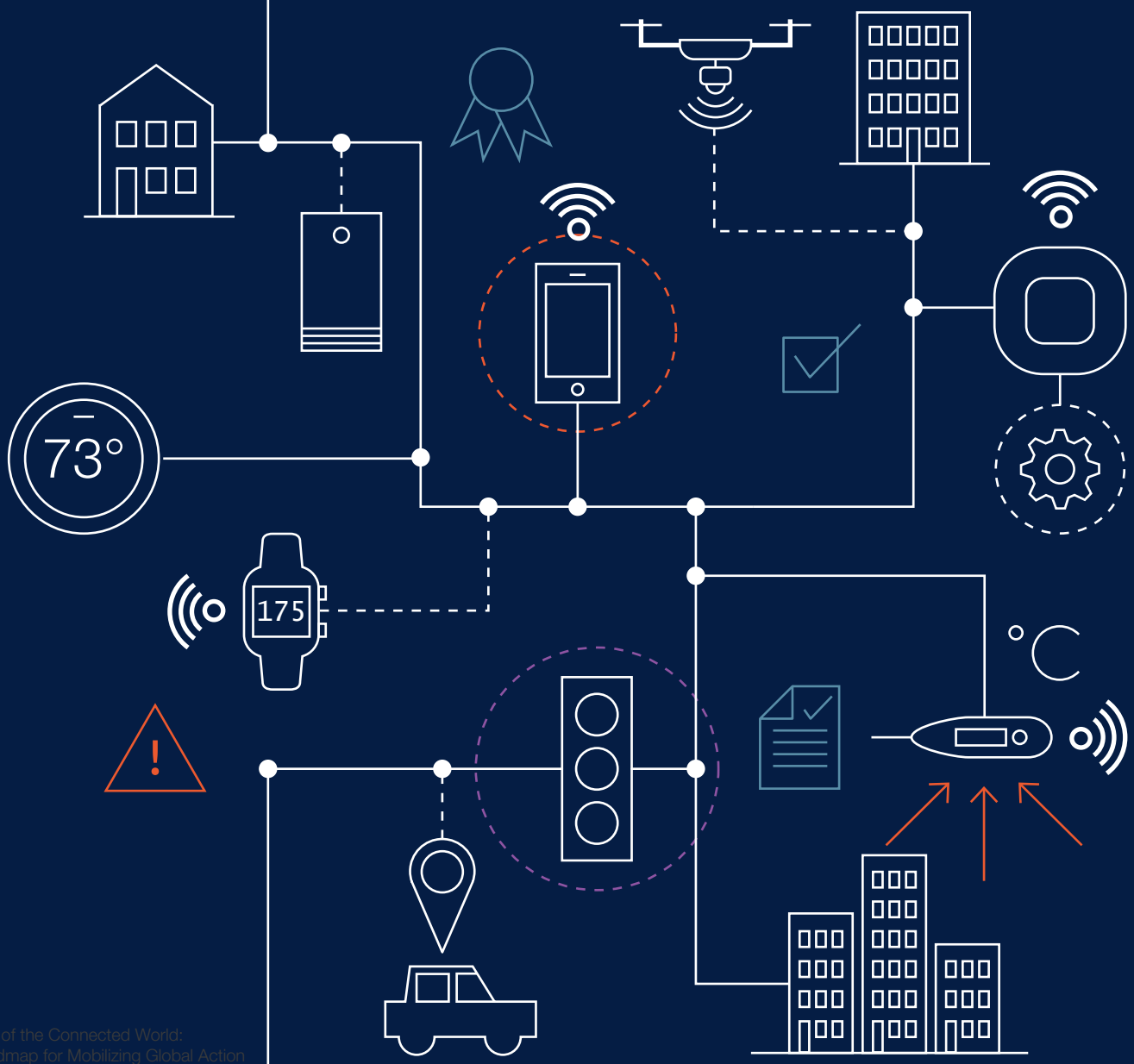
Introduction



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In December 2020, the World Economic Forum released its inaugural report on the State of the Connected World. The report underscores the critical role that the internet of things (IoT) plays in our lives and the enormous potential that these technologies can unleash for the benefit of society. Yet as we grow more dependent on these technologies, the risks associated with their misuse and the need for strong governance also increases with each passing day.

This challenge – shaping a connected future that benefits all – and the responsibilities that come along with it cannot be left to any one government or any one industry. Coordinated global action is essential, but also increasingly hard to come by. Polarized and fragmented efforts have all too often become the norm as the public and the private sector pass blame for governance failures and shortcomings.

The Council on the Connected World, formerly known as the Global IoT Council, was established to help turn the tide and chart a course towards greater collective action and shared responsibility. The council prides itself on its diverse and multistakeholder global membership. This includes public and private sector leaders representing more than a dozen countries on five continents, seven industries, and an equal mix of men and women. Its mandate is clear and ambitious: to define and advance a global agenda and action plan for tackling the most pressing governance gaps surrounding IoT and related technologies.

This work commenced with preparation of the inaugural State of the Connected World report, in which more than 400 stakeholders and experts were surveyed and interviewed to better understand how IoT is viewed around the world and to establish clear priorities for action. While there were some differences in how stakeholders viewed the opportunities and risks associated with these technologies, five priority actions emerged:

1. **Increasing education:** Increasing public education and understanding of connected devices, including the responsibilities of technology makers, sellers, buyers and users

2. **Improving security:** Easing and incentivizing adoption of cybersecurity policies, standards and best practices

3. **Driving positive impact:** Increasing awareness of the positive and negative impacts of connected devices

4. **Combatting inequity:** Accelerating adoption of connected devices and systems among small and/or under-resourced enterprises and communities

5. **Strengthening collaboration:** Increasing cooperation and sharing of information across the IoT ecosystem

The five actions are part of the the building blocks for a more sustainable, prosperous and connected world.

1 Increasing education
2 Improving security
3 Driving positive impact
4 Combatting inequity
5 Strengthening collaboration

To advance this global action plan, the World Economic Forum and Council on the Connected World identifies and helps scale the impact of leading initiatives on technology governance from around the world. Where gaps exist and as additional needs emerge, new initiatives and strategies will be developed.

In a world where technological change is a constant, transparency and ongoing public dialogue are critical to track progress, measure impact, highlight shortcomings, and keep sight of new challenges and obstacles ahead. This paper is the beginning of a multi-year process and journey. We invite you to join us in driving this work forward and helping to create a connected future that benefits all.

This action plan will continue to evolve based on new ideas and feedback from our community. To learn more or get involved, visit https://www.weforum.org/connectedworld.

Global action plan in numbers

5 global actions
37 world-leading initiatives spanning
25 countries (and growing)

Championed by a council of more than **30** leading industry, public sector and civil society organizations, including the World Wide Web Foundation, Government of South Africa, Qualcomm, Consumers International, University College London, the Zigbee Alliance and World Enabled

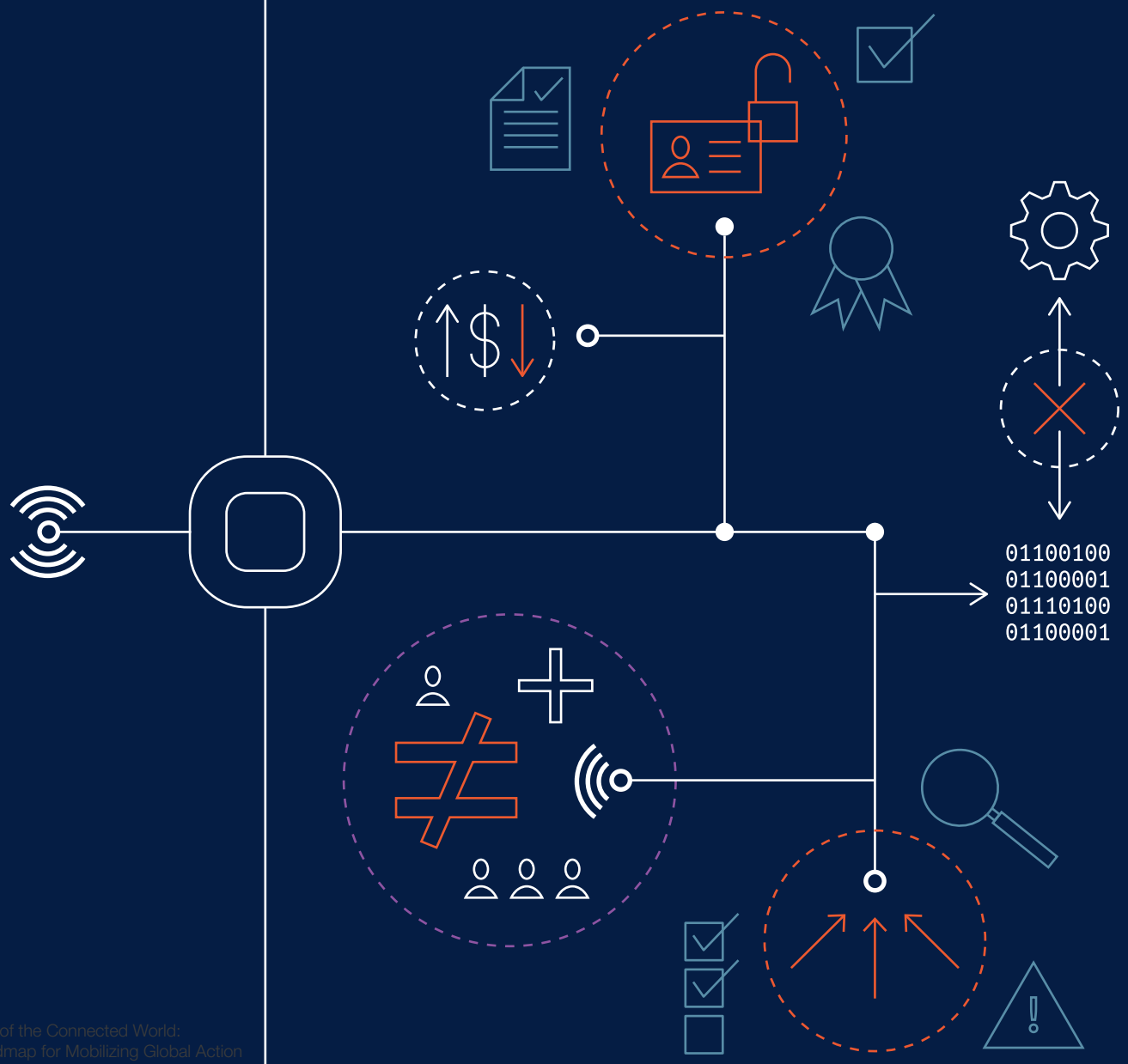
Tracking progress every year through **3-5** clear measures of success per action

Hosting **10+** expert briefings, workshops, futures sessions and global showcase events every year to catalyse action, grow initiatives and connect our community to the latest thought leadership

Supported by a diverse community representing more than **100** partners across all major industries, sectors and regions

1

Action 1: Increasing education



Increase public education and understanding of connected devices – including the responsibilities of technology makers, sellers, buyers and users – to empower individuals and organizations to make more informed decisions regarding design, adoption and use of these devices.

Helena Leurent
Director-General, Consumers International; Member of the Council on the Connected World, Chair for Action 1

The vision

This action moves us towards a future where connected devices and systems are both trusted and trustworthy.

We envision a future where organizations across the product lifecycle design IoT devices and services that value consumer needs, including privacy, security and data ownership. When buying connected devices, such as security systems, energy metres or health trackers, individuals and organizations will have a greater understanding of how to make informed purchasing decisions – how the device will serve them, how the system will protect their data and how to best use them.

Information will be readily available online, in stores and on the device itself about which standards of best practice the product and service providers adhere to; for example, how data is used, stored and disseminated.

In this future, there would be:

- **Increased uptake of trust by design guidelines,** either through industry self-regulation, or mandated by governments across the world.
- **Clear and easily understood trustmarks, labels and support** to enable individuals to understand the benefits and risks associated with connected devices.
- **A culture of user protection and consumer rights principles among device manufacturers and service providers** who are incentivized to provide the most secure, sustainable and transparent products and services in a “race to the top”.
- **Increased knowledge** among the public of how connected devices function, how they collect data and how this data is used/disseminated.

The need for action

There is clear evidence of a widening trust gap between consumers and their connected devices. The 2020 Digital Attitudes Report finds that only 19% of people believe tech companies are designing products and services with their best interests in mind.[1] Consumers International reports that 63% of people think their connected devices are "creepy", with just over half saying they do not trust devices to protect their privacy or handle their information respectfully. More broadly, the 2021 Edelman Trust Barometer indicates a 9% decline in trust in the technology industry over the last 10 years.[2]

This feeling of distrust is compounded by the rapid expansion of IoT applications in every sphere of life and the continued lack of education of these devices. Understanding connected devices, and how best to use them, is not easy. Only 50% of people are aware of how to disable data collection features on their smart home device[3]. Any given IoT application is made up of hardware and software components, often managed by multiple organizations, complicating the visibility of how information is collected and used, and who controls it.

This lack of understanding, and lack of trust, inhibits the ability to unlock the true potential of IoT, not just inside the home, but for other major goals like transforming healthcare, creating safer public spaces and reducing global energy usage. These transformations can only take place if connected devices are genuinely trustworthy, transparent and trusted.

Action taken so far

The global action plan is mobilizing the international community to drive this change by:

- **Scaling world-leading initiatives**, such as Digital Trust for Places and Routines, an emerging open-source communication standard for digital technologies that will enable more agency for people in public spaces. The action plan will connect the initiative to cities and organizations looking to pilot the new standard, and help to scale the solution to at least one pilot in every global region in its first three years.

- **Catalysing new action**: The Trustworthy IoT Coalition was formed as a new initiative to increase public understanding of connected devices and build a more trustworthy system. The coalition will initially focus on best practice in the development of labels and trustmarks, and improving sustainability of consumer IoT devices, sharing their work at the Global Technology Governance Summit 2022.

- **Leading the global conversation on these issues**: A session on Building a Trustworthy and Connected Future at the World Economic Forum's Davos Agenda, convened more than 80 CEOs and executives from the public and private sector to jumpstart a global dialogue on advancing trust across the industry.

If you want to nominate an initiative to be part of Action 1, or have an idea for a new solution, send an email to IoT@weforum.org.

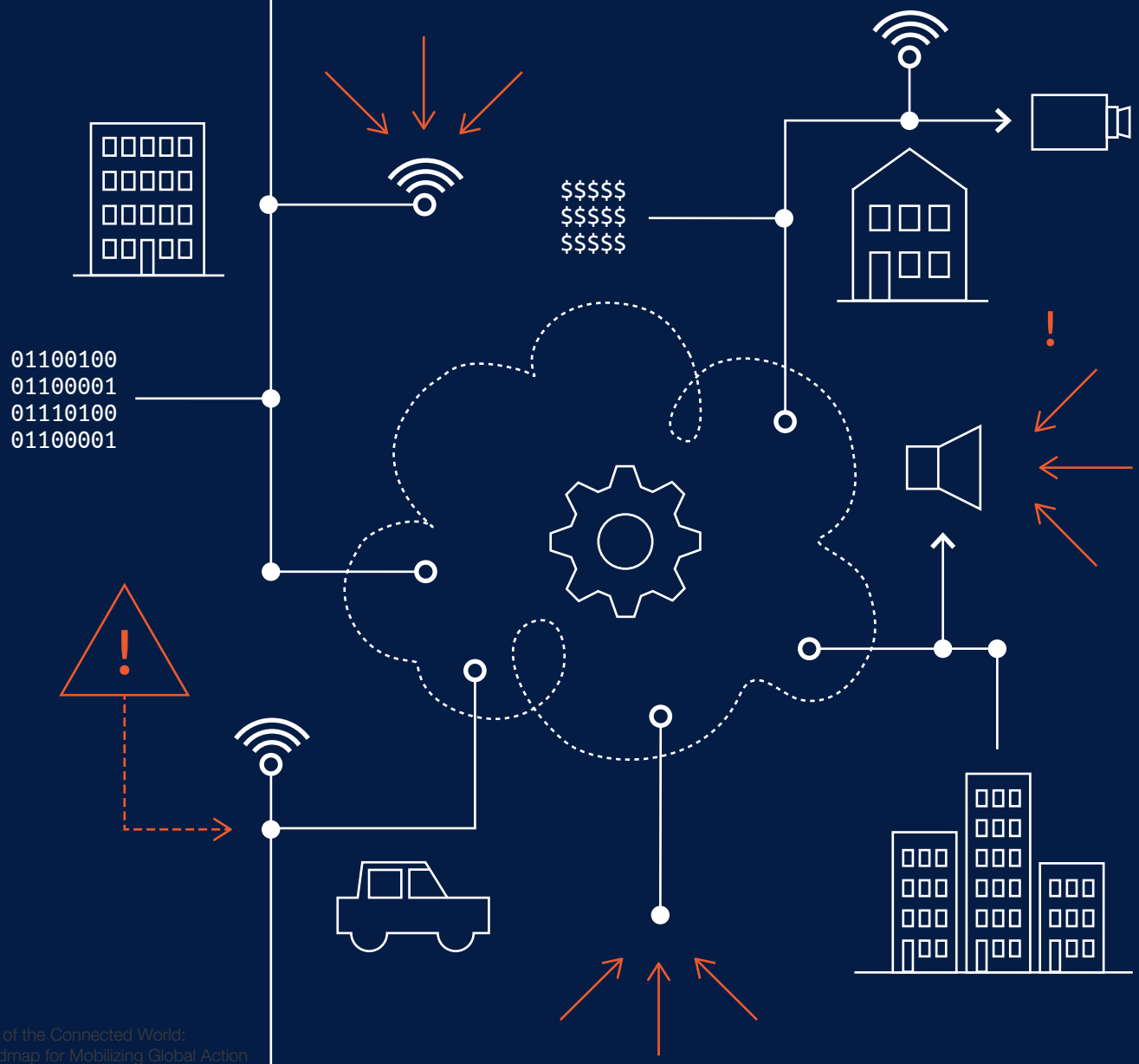
Measuring success

- **Positive gains in public trust and/or public education** (long-term impact) as measured by public opinion surveys, including the Edelman Trust Barometer, Digital Attitudes report and Consumers International research
- **Launch of new public awareness and education campaigns** related to privacy and security of connected devices
- **Creation and adoption of new decision-making tools or certifications** to help individuals and organizations evaluate product offering and/or optimize their use
- **Adoption of new industry norms and/or regulatory approaches to increase transparency** and protections related to privacy and security

In 2021, we will set the baseline for each of these measures, reporting on progress against them in spring 2022.

2

Action 2: Improving security



Ease and incentivize adoption of cybersecurity best practices to ensure a common duty of care among connected device manufacturers, system integrators, service providers, purchasers and users.

Madeline Carr
Professor Global Politics and Cybersecurity at University College London, Director of the Research Institute for Socio-technical Cyber Security (RICS); Member of the Council on the Connected World, Chair for Action 2

The vision

This action moves us towards a future where connected devices and systems are secure by design.

We envision a future where the public, business, organizations and government can trust that the connected devices they purchase and interact with have been designed with security and resilience at their core. Everyone across the global supply chain for IoT, including manufacturers, service providers, systems integrators, retailers, governments, purchasers and users, should understand their common duty of care and the part they play in keeping data and networks safe. Security standards will be more universally adopted, including among smaller and medium-sized enterprises. Mechanisms and processes for risk assessment, response and validation will be dynamic and able to adapt to technologies as they change and evolve.

In this future, there would be:

- **A more coherent approach to security standards development and deployment by governments and organizations around the world,** with further convergence around a set of minimum baseline requirements, including the adoption, implementation and review of these requirements.
- **Increased uptake of secure-by-design practices for enterprises throughout the whole supply chain**, which have the policies and controls in place to continuously monitor and update the security of their products and services.
- **Increased transparency of security risks and mitigations** for individuals, organizations and communities that use, interact with and are impacted by connected devices.

The need for action

The 2020 State of the Connected World report identifies safety and security as the highest risk factors for IoT. Every hour sees new data-collecting end-points connected to the global infrastructure, which creates an ever-increasing number of targets attractive to bad actors. Moreover, the way in which IoT is becoming more intimately entwined in every aspect of our lives is creating new and unique risks. University College London (UCL), for example, has highlighted the emerging risks of health wearables and children's toys for potential misuse of sensitive data as they are increasingly adopted, as well as the potential for unsecure device data to be used by perpetrators of domestic abuse as a means to monitor and control victims.

Some clear progress has been made over recent years. The European Telecommunications Standard Institute (ETSI) released the first globally applicable industry standard for IoT consumer devices in 2019. In December 2020, the US passed the IoT Cybersecurity Improvement Act, which requires federal agencies to adhere to a minimum level of cybersecurity when procuring connected devices. This is expected to accelerate improvements in cybersecurity across the country.

However, the global standards landscape remains fragmented, dominated by de facto standards developed by a wide range of industry bodies and associations. Compliance for companies therefore remains confusing and costly, a particular burden for small and medium-sized enterprises (SMEs) that are often a critical part of the global IoT supply chain.

Without further defragmentation of the standards industry, better understanding of the duty of care for companies throughout the supply chain, plus sellers and users of IoT, and a culture of dynamic risk assessment and response, it is difficult to imagine a world that can fully benefit from such innovations as autonomous vehicles or remote healthcare without exposing significant risk to the public.

Action taken so far

The global action plan is mobilizing the international community to drive this change by:

- **Scaling world-leading initiatives**: Initiatives include the Cybersecurity Tech Accord, which fosters commitments from global technology companies to protect customers and help defend against malicious threats.

- **Catalysing new action**: A new initiative focused on enhancing the cybersecurity of the global aviation industry was established in 2019, bringing together businesses, government entities and international organizations through a benchmarking pilot to amplify best practices and accelerate their adoption sector-wide. Key findings from this two year-long effort will be published in April 2021 and promoted through the action plan.

- **Leading the global conversation on these issues**: As part of an ongoing event series, an expert briefing on the US Cybersecurity Improvement Act was organized in March 2021, with key insights from the National Institute of Standards and Technology (NIST), Microsoft, Siemens Energy and Checkpoint Software Technologies. Additional global showcases on security and resilience are scheduled for 2021.

If you want to nominate an initiative to be part of Action 2, or have an idea for a new solution, send an email to IoT@weforum.org.

Measuring success

- **Reduction in the global risk associated with cybersecurity incidents** (long-term impact) related to IoT devices and systems, as measured by the World Economic Forum's Global Risk Report and comparable indicators
- **Creation, alignment and adoption of new assessment tools or certifications** to help individuals and organizations ensure a baseline level of security across devices and systems
- **Adoption of new industry norms and/or regulatory approaches** to establish minimum security practices that are able to change and adapt to the dynamic risk associated with emerging technologies
- **Launch and/or expansion of capacity-building initiatives** to boost cybersecurity capabilities in organizations of all sizes, particularly focused on SMEs
- **Initiation of global discussions about how to reconcile safety and security** in such critical systems as connected autonomous vehicles, measured by inclusion at key cybersecurity summits, including the United Nations Internet Governance Forum (UNIGF)

In 2021, we will set the baseline for each of these measures, reporting on progress against them in spring 2022.

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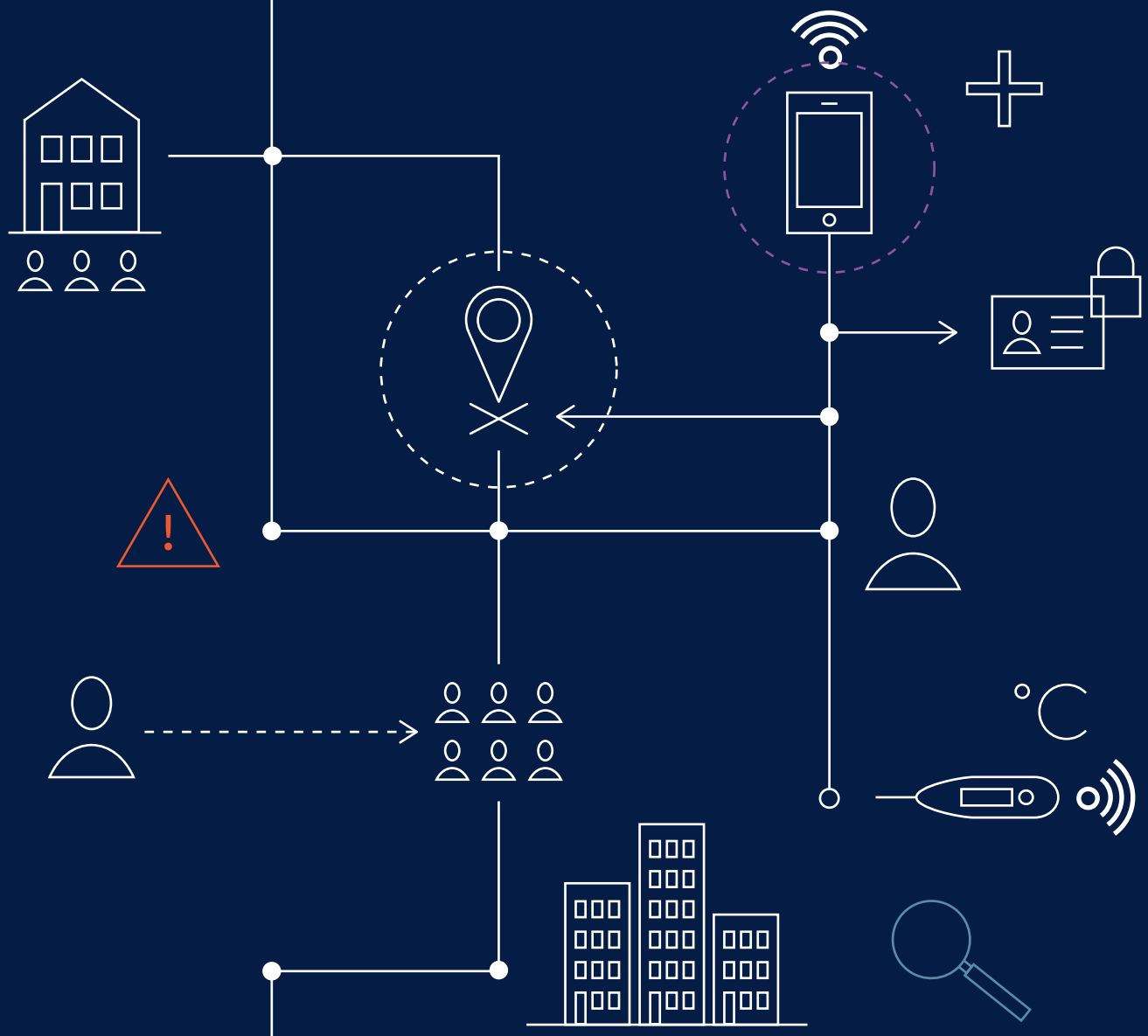
Action 3: Driving positive impact



Increase awareness of the positive and negative impacts of connected devices on the well-being of individuals, organizations and society to incentivize adoption that benefits the world.

Victor Pineda
President, World Enabled; Member of the Council on the Connected World, Chair of Action 3

The vision

This action moves us towards a future where we use connected devices and systems in more intentional ways to maximize social benefit.

We envision a future where the impact of connected systems on all stakeholders is more fully understood. Measurement, disclosure and consequence scanning frameworks will be freely accessible and routinely used as part of the design, planning and implementation process for all new connected devices and systems. Organizations, cities and governments will develop and deploy these technologies to improve public spaces and homes, transform the way we travel, communicate and connect, and strengthen the feeling of safety in our communities, with a greater understanding of how these technologies will impact everyone. Equity, sustainability and real-world impact will become critical components of the decision-making process, and these decisions will be communicated more broadly to all those impacted.

In this future, there would be:

- **Wide adoption of measurement and disclosure frameworks** for the public and private sectors that help identify and communicate the positive and negative impact associated with the use of connected devices and systems.
- **Widespread use of incentive programmes and public indices to accelerate adoption** of connected devices with societal benefits.
- **An increase in regulatory, procurement, financing and/or investment requirements** to ensure that equity considerations and public benefit are incorporated into decision-making.

The need for action

It is difficult to fully predict and quantify the range of impacts that IoT and related technologies will have on individuals, communities, organizations and society. For the few tools and frameworks that exist, uptake has been slow and has remained relatively small-scale. In the public sector, for example, 60% of global experts believe that smart cities are failing persons with disabilities, and only 18% know of a smart city that use ICT accessibility standards. It is clear that equity and accessibility, and the impact of IoT for people with disabilities, are not fully considered during the design and implementation of new technologies, nor does it seem to be a common requirement of public bodies, investors or the cities themselves.

In the tech sector, nearly a third of workers have experienced a situation at work where decisions were made about the design, creation or marketing of a technology that could have negative consequences for people or society, and this increases to 43% for those working in emerging technologies.[8] Technology companies are often incentivized through a culture of innovation to "move fast and break things", but this can mean that societal and community impact are not fully considered during the product development cycle.[9]

There is a significant opportunity to embed a culture of impact measurement, consequence scanning and transparency within all public and private sector organizations that design and deploy connected devices. Investors and governments could play a critical role in setting formal procurement or funding requirements that this process has taken place. Not only would this incentivize the deployment of IoT for societal benefit on a mass scale and reduce the risk of harm, it also fosters greater transparency and brings communities and individuals into the heart of the decision-making process.

Action taken so far

The global action plan is mobilizing the international community to drive this change by:

- **Scaling world-leading initiatives**: The G20 Global Smart Cities Alliance has developed a model privacy impact assessment for cities based on best practice from around the world and is providing support to help cities roll out these policies. Conducting a privacy impact assessment prior to the use of smart city technologies can increase transparency and accountability, support public trust, mitigate potential privacy harms, improve compliance, and enable more confident and consistent decision-making about data and technology by city officials, their partners and the public.
- **Catalysing new action**: This includes the Cities for All Knowledge hub led by World Enabled, which will serve as a catalyst to develop, disseminate and scale up data collection, research, knowledge exchange and training, in the themes of inclusion and accessibility, for the built environment and cities. The action plan will help to launch this initiative in 2021 and connect the hub to our global network of cities through dedicated workshops and inclusion in our global showcase events.

If you want to nominate an initiative to be part of Action 3, or have an idea for a new solution, send an email to IoT@weforum.org.

Measuring success

- **Reduction in deployment of connected devices and systems that have harmful, unequitable, or unforeseen negative consequences for organizations, individuals and society**, (long-term impact) as measured by research reports from organizations such as World Enabled and DotEveryone
- **Creation and adoption of new assessment tools** to help identify and communicate the positive and negative impact associated with the use of connected devices
- **Creation and adoption of incentive programmes, public indices and regulatory, procurement, financing and/or investment requirements** to accelerate adoption of connected devices and systems with positive societal benefits
- **Launch of education campaigns or training programs** to increase awareness of positive and negative impacts of IoT and related technologies

In 2021, we will set the baseline for each of these measures, reporting on progress against them in spring 2022.

4

Action 4: Combatting inequity

Accelerate adoption of connected devices and systems among small and/or under-resourced communities and organizations through the introduction of new funding models, incentives and capacity-building mechanisms.

The vision

This action moves us towards a future where everyone can equally access the benefits of a connected world.

We envision a future where differences in income, age, gender, education level, nationality, abilities, or disabilities do not determine an individual's access to the internet and connected devices. Small and medium-sized organizations will have the support and resources to utilize all emerging technologies and can tap into the same productivity, safety and efficiency benefits enjoyed by larger businesses. Big cities and rural communities will have access to reliable connectivity infrastructure and will be able to use IoT and related technologies to increase quality of life for all, from reducing city traffic to increasing farm yields.

In this future, there would be:

- **An increase in global collaboration on large-scale digital infrastructure initiatives** to reach more remote and rural communities who do not yet have reliable access to the internet
- **Widely adopted support mechanisms for small and medium-sized organizations**, including educational tools, funding and online marketplaces, to enable digital transformation
- **A formulation of global agreements** to help enable a more equitable distribution of the economic benefits associated with a more connected future

The need for action

IoT is beginning to touch every aspect of people's lives, from tracking traffic patterns and easing navigation on city streets, to monitoring of our health and individual heartbeats. Given the vast impact connected systems are already having on people's lives, there is a significant risk that the benefits of this transformation will be unequally distributed. The State of the Connected World report identified equity as the biggest governance gap for IoT, highlighting concerns that connected devices and systems could exacerbate the "digital divide" and existing inequalities, and yet very little concrete action is being taken to address this.[10]

Today, just under 4 billion people are still without access to the internet, representing about half of the global population, with women, elderly people and those from poorer and more remote regions less likely to be online.[11] Often, the places that could benefit most from IoT-enabled services, such as water quality monitoring, are the places that lack the critical infrastructure to put this in place. The same disparities exist within cities and their high and low-income neighbourhoods. Economic disparities are relevant in all new technologies, said Swarun Kumar, Assistant Professor of Electrical and Computer Engineering, at Carnegie Mellon University in the State of the Connected World report. "We need to be careful about their public and private deployment, because low-income neighbourhoods might not get the same support [as high-income neighbourhoods]. For example, a luxury high rise might have air-quality sensors, leak detectors and security sensors, whereas none of these features would be found in a low-income housing project."[12]

Similarly, SMEs are significantly behind large firms in the digital transition. Across OECD countries, SMEs are only half as likely as large firms to be using e-commerce or cloud computing.[13] They often lack the time, resources and easy access to vendors to design, purchase and execute digital transformation strategies. Considering SMEs make up 90% of businesses, and contribute significantly to the GDP of many economies, this is an inequity with major economic repercussions.

We are on the precipice of major digital transformations that could increase quality of life for all. Without further efforts to ensure that all individuals, businesses and regions have access to the internet, and to the capabilities and tools needed to utilise the benefits of IoT, these transformations could further entrench existing inequities and serve to divide rather than connect the world.

Action taken so far

- **Scaling world-leading initiatives**: This includes an innovative pilot launched in Brazil to help build the technological capacity of SMEs. The action plan has helped to grow this regional initiative into a global network of pilots led by Brazil, Colombia, Kazakhstan, South Africa and Turkey, and aims to reach more than 5,000 companies within the next three years with new training and support services.

- **Catalysing new action**: In January 2021, the EDISON Alliance was launched to prioritize digital inclusion as foundational to the achievement of the Sustainable Development Goals (SDGs). The alliance is an open ecosystem of change-makers, mobilizing joint effort and aligning priorities to enhance the case for digital investment. The alliance will prioritize three focus areas related to the SDGs each year. For 2021, the alliance will focus on health and healthcare, education and financial inclusion.

If you want to nominate an initiative to be part of Action 4, or have an idea for a new solution, send an email to IoT@weforum.org.

Measuring success

- **Reduction in global disparities in access to the internet and emerging technologies** (long-term impact), as measured by the OECD, World Bank and such organizations as the World Wide Web Foundation
- **Increase in successful and sustainable adoption of IoT solutions among SMEs**
- **Launch and/or expansion of capacity building initiatives** to boost technical capabilities in organizations of all size
- **Increase in funding and incentives** to support adoption of connected devices and systems

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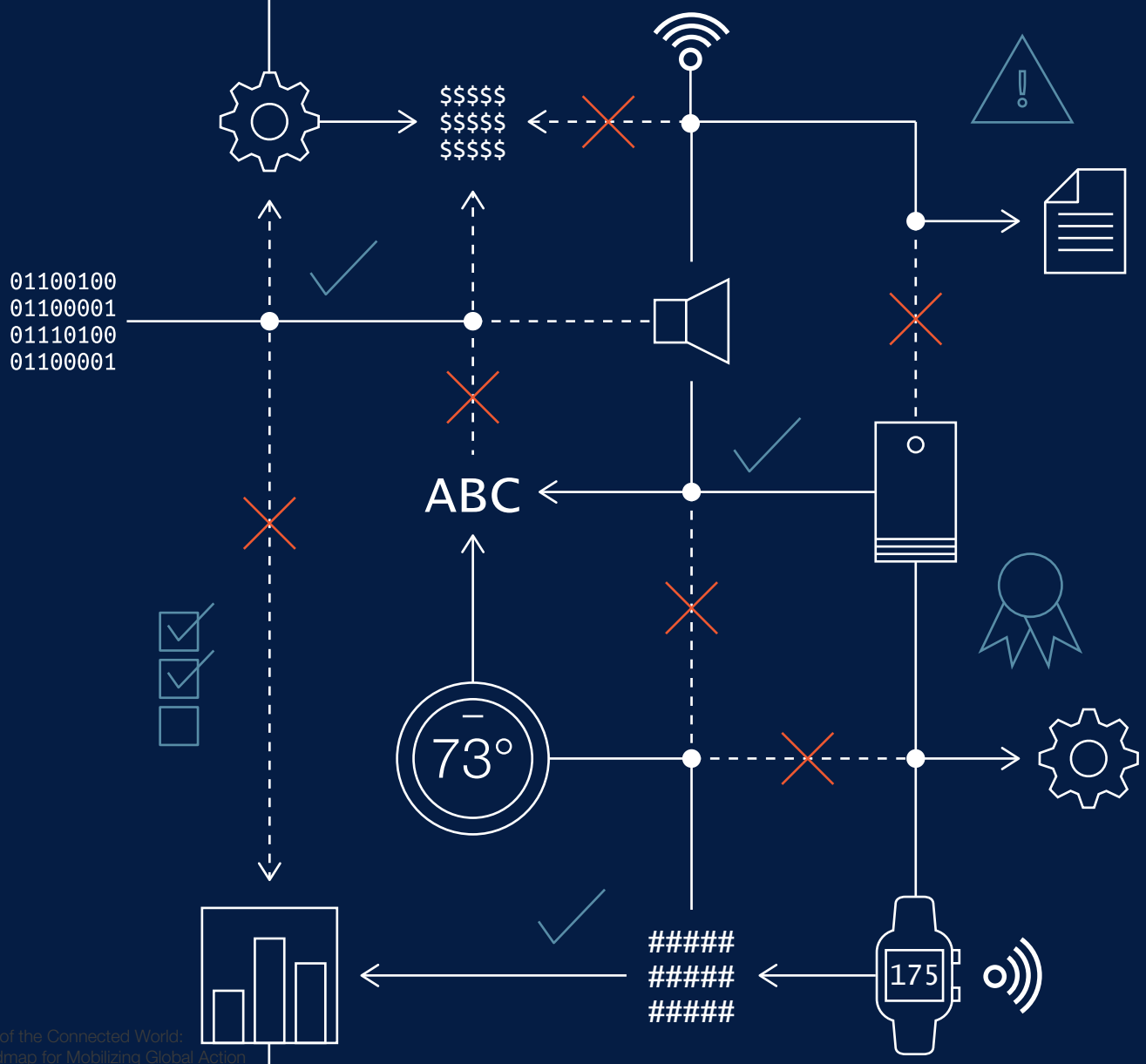
Action 5: Strengthening collaboration



Strengthen collaboration and sharing of information and data across the IoT ecosystem to combat fragmentation of governance efforts, accelerate value creation and scale best practices across geographies and industries.

Tobin Richardson
Chief Executive Officer, Zigbee Alliance; Member of the Council on the Connected World, Chair for Action 5

The vision

This action moves us towards a future where everyone benefits from a shared language and collaborative ecosystem for IoT.

We envision a future where networks are seamless, and stakeholders across the IoT ecosystem can interact both as customers of IoT and as owners, developers and managers with virtually no friction. With that shared language, a 25-year old building automation Python developer living in Shenzhen can choose to switch cities and start coding for airport planning. Technology policies will be shared between cities and governments around the world, with a growing knowledge base of which policies work in practice for governing the safe, interoperable and sustainable usage of connected devices and systems. Data will be more easily shared across industries and countries for the purpose of improving quality of life by, for example, improving healthcare outcomes on a mass scale, or protecting the environment.

In this future, there would be:

- **Broad collaboration between commercial players**, where industry competitors work together to create open standards, open-source accelerators and integration frameworks, and manufacturers can design on common platforms and deploy globally with lower total cost of delivery and ownership.
- **Greater understanding and alignment between policy-makers, consumers, advocates and commercial markets**, where there is a more clear and common view of the IoT – both the opportunities and risks – and where regulatory frameworks enable global use of open standards for the common good.
- **Creation of a common and continually maturing language for the IoT**, with a shared view across consumer, enterprise and public domains and where operational data can be easily used, and within privacy constructs, shared to create new consumer, commercial and public sector value.
- **Emergence of a new era of interoperability and accessibility**, first breaking down today's "walled gardens" and moving to common standards that allow IoT products to "just work", spur innovation, reduce costs and accelerate value.

The need for action

The global IoT landscape is currently fragmented and siloed and growing in complexity without the tools and language to keep pace with its potential. However, much of today's fragmentation is market-made as innovators respond to market signals and create unique solutions for sets of early adopters. Unfortunately, this has long-lasting and far-reaching impacts on a system whose value is derived in great degree from collaboration, scale and interoperability.

As the IoT market has matured, this has become much more acute. There are nearly 100 different IoT standards and protocols from which to choose – from registered IEEE standards to proprietary systems – and while some are specific to industry needs, others are simply alternate methods to achieving similar results. This creates serious challenges across the IoT value chain, resulting in confusing and costly experiences for consumers as well as making interoperability and operations management overly complicated for public sector and enterprises. As noted by Juan Pablo Cosentino, Dean of the School of Engineering, at Argentina's Austral University in the State of the Connected World report: "We cannot create economic viability with lots of silos".[14] To move the IoT to its next stage, one of both accelerating growth for the industry and increasing and equitable value delivery to consumers globally, this fragmented and confusing ecosystem must be consolidated, harmonized and simplified.

The world is at a tipping point. If silos and walled gardens prevail, in the short term IoT will remain the purview of the techno-savvy and benefits will accrue to the few. Long term, IoT markets may slow and stall, as the costs of managing complexity outweigh the benefits of connectivity. It is imperative to strengthen commercial collaboration, accelerate public sector alignment and create the tools necessary for a common language and shared framework for a more connected world.

Action taken so far

The global action plan is mobilizing the international community to drive this change by:

- **Scaling world-leading initiatives**: This includes such initiatives as the Zigbee Alliance, which is a global standard-bearer for open and interoperable IoT. The action plan will help transition the Zigbee Alliance into a wider role as the "platform of platforms" for interoperability standards and trustworthy IoT.

- **Catalysing new action**: The G20 Global Smart Cities Alliance was established by the World Economic Forum to strengthen collaboration between cities around the world. The alliance and its partners represent more than 200,000 cities and local governments, leading companies, start-ups, research institutions and civil society organizations. In 2020, the alliance released a set of baseline smart city policies, which will be trialled by 36 cities over the coming year; the action plan will help to scale this to hundreds of cities over the next five years.

If you want to nominate an initiative to be part of Action 5, or have an idea for a new solution, send an email to IoT@weforum.org.

Measuring success

- **Decrease in fragmentation of the IoT ecosystem** (long-term impact), as measured by survey data and interviews with global stakeholders as part of the biannual State of the Connected World report
- **Increase in collaborative partnerships within the IoT ecosystem** to uncover and address systemic challenges of IoT adoption and value delivery
- **Adoption of new cross-industry or cross-sector global standards**
- **Increase in visibility and alignment of global policy perspectives** on IoT governance, including at key geopolitical and industry summits such as the G20 and the Global Technology Governance Summit.

In 2021, we will set the baseline for each of these measures, reporting on progress against them in spring 2022.

Endnotes

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