Touching
An Intelligent World

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giv@2025

10 Trends for 2025:
Touching the Intelligent World

The intelligent world is arriving - the fusion of 5G, AI, IoT and other emerging technologies promises new possibilities, opportunities, and experiences for everyone, everywhere. Huawei's Global Industry Vision 2025 describes 10 exciting trends that are shaping the future and inspiring a new age of digital inclusion. Together, we can bring the benefits of digital technologies to every person, home and organization.

Living with Bots

The adoption rate of intelligent domestic robots will reach **14%**.

Super Sight

The percentage of companies using AR/VR will increase to **10%**.

Augmented Creativity

97% of large companies will be using AI in their services or operations.

Frictionless Communication

Enterprises will be making efficient use of **86%** of the data that they produce.

Zero Search

The adoption rate of intelligent personal digital assistants will reach **90%**.

Tailored Streets

C-V2X (Cellular Vehicle-to-Everything) technology will be installed in **15%** of the world's vehicles.

Working with Bots

Industrial robots will work side by side with people in manufacturing, with **103** robots for every 10,000 employees.

Symbiotic Economy

85% of business applications will be cloud-based.

5G's Fast Arrival

5G networks will cover **58%** of the world's population.

Global Digital Governance

The amount of global data produced annually will reach **180 ZB**.

Contents

Executive Summary

The Intelligent World Is Close Enough to Touch

Change is coming and it's coming fast – AI, 5G, and IoT and other emerging technologies are converging to forge a world of new experiences and productivity for all.

Toddlers giving commands to smart assistants. Robots going where we can never go. The disappearance of touch-based commands as home appliances begin speaking to us. Traffic lights that see more than we do. Endangered species living in threatened ecosystems protected by smart devices and AI….these are just some of the changes happening around us.

The intelligent world is arriving. And it's close enough to touch.

Today, Huawei's end-to-end global capabilities are ready to deliver new functions, new opportunities, and unprecedented performance for every individual, company, and industry.
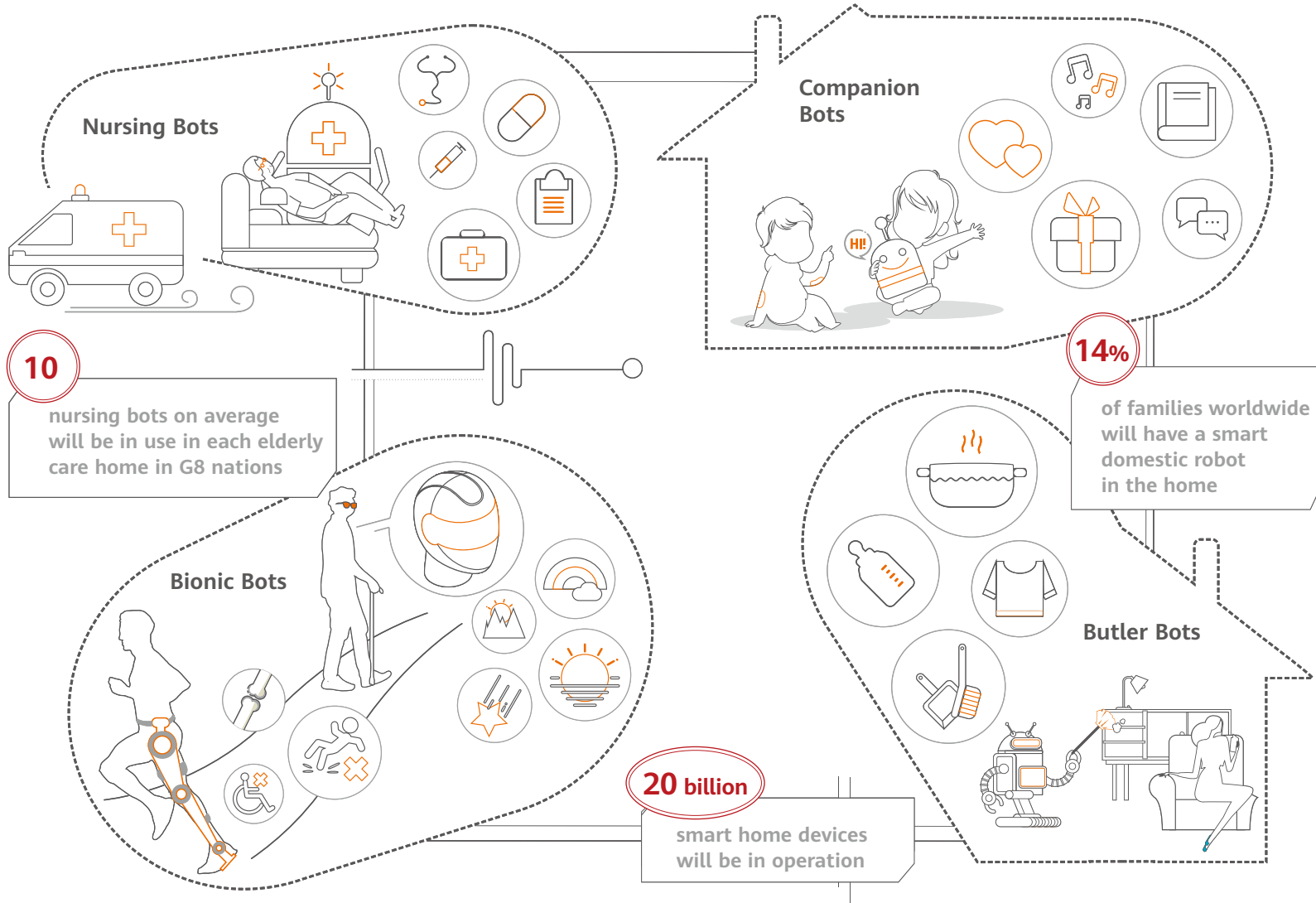
GIV describes 10 trends that explain how ICT is driving change for everyone, everywhere. We hope that you're as excited as we are about the intelligent world unfolding before us.

▸ Trend 1: Living with Bots

Increasingly smart, sophisticated, and versatile robots are poised to be a huge quality of life booster for individuals in and out of the home. Examples include nursing, companion, butler, and bionic bots.

Nursing Bots

Bionic Bots

Companion Bots
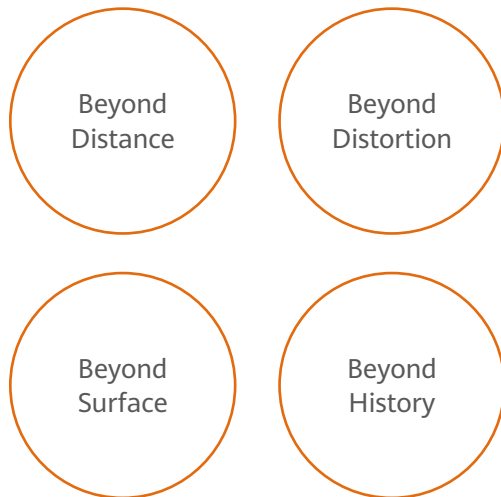
Butler Bots

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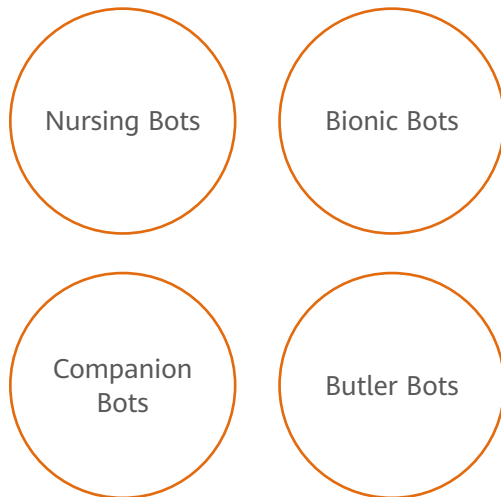
GIV predicts that by 2025, elderly care homes in G8 nations will have an average of 10 nursing robots and that over 14% of households worldwide will have an intelligent domestic robot at home.

Nursing Bots

Companion Bots

10

nursing bots on average will be in use in each elderly care home in G8 nations

14%

of families worldwide will have a smart domestic robot in the home

Bionic Bots

Butler Bots
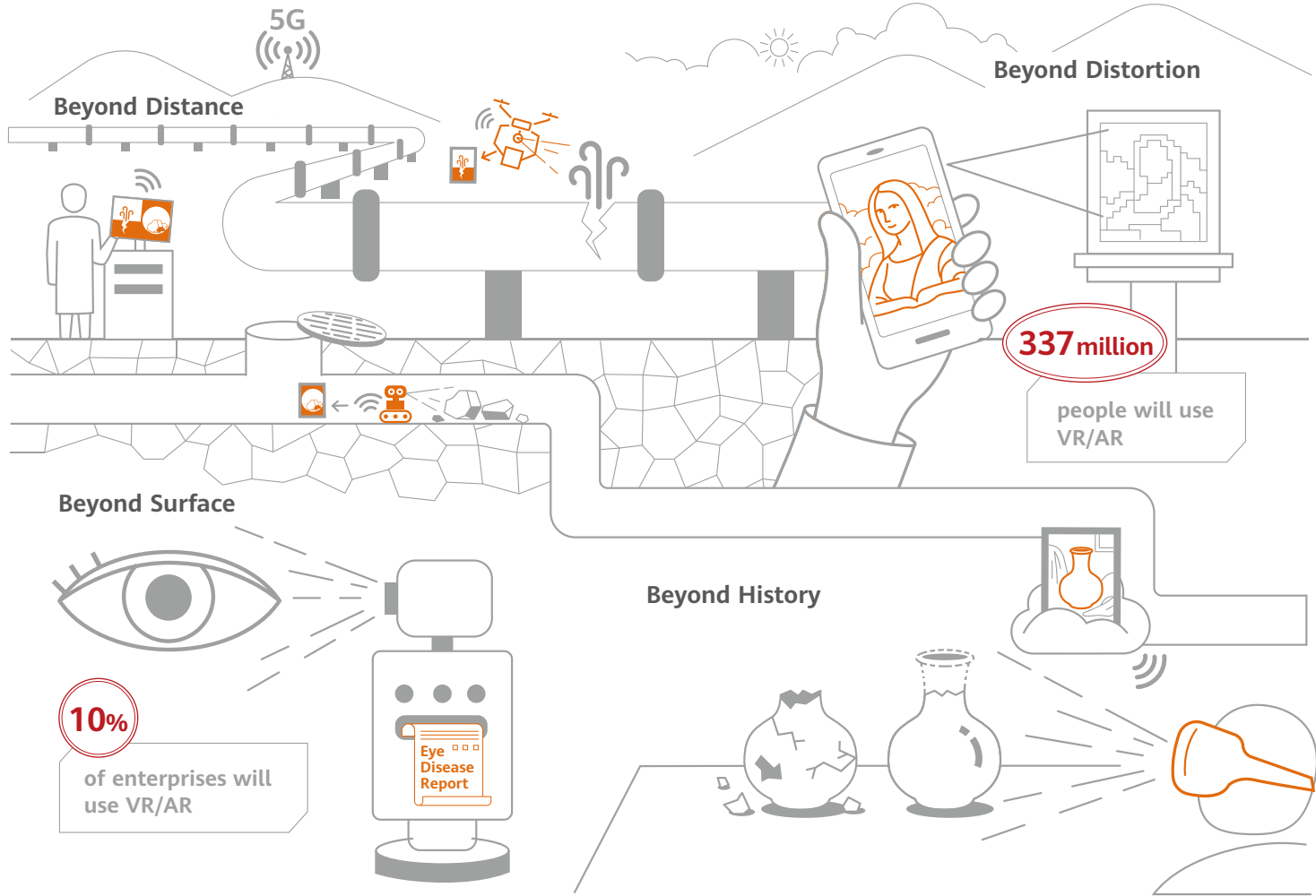
20 billion

smart home devices will be in operation

▸ Trend 2: Super Sight

See things like you've never seen them before at work and at play - the fusion of AI, VR/AR, 5G & UHD tech will open up new vistas for people, business, and culture.
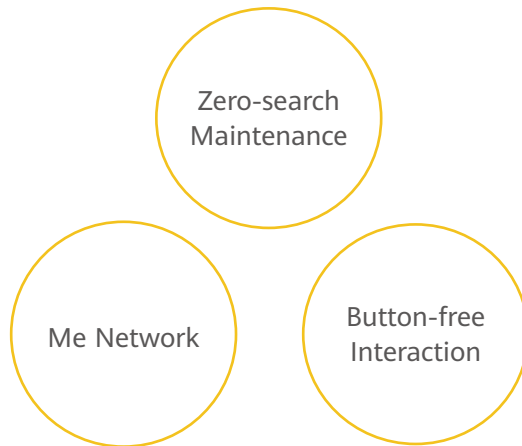
Beyond
Distance

Beyond
Distortion

Beyond
Surface

Beyond
History

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GIV predicts that by 2025, 337 million people and 10% of companies will use VR/AR.

5G

Beyond Distance

Beyond Distortion

337 million

people will use VR/AR

Beyond Surface

10%

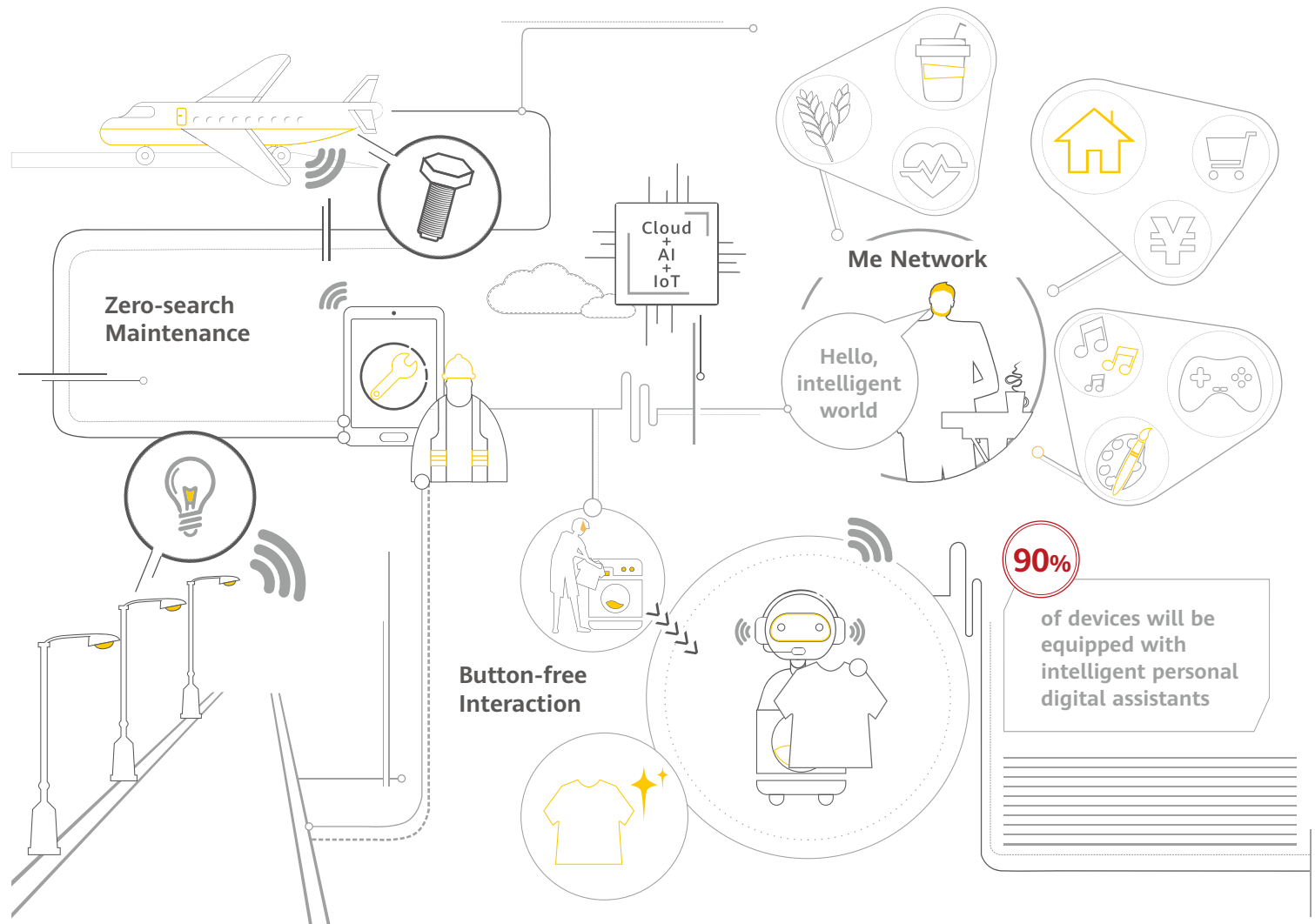of enterprises will use VR/AR

Eye Disease Report

Beyond History

▸ **Trend 3: Zero Search**

Seek and you shall find. The search experience of the future will be smart, smooth, and button-free – information will seek you out as appliances, cars, and devices begin speaking to you and anticipating your needs.

Zero-search Maintenance

Me Network

Button-free Interaction

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GIV predicts that by 2025, 90% of people will use personal assistants on their smart devices.

Zero-search Maintenance

Cloud + AI + IoT

Me Network

Hello, intelligent world

Button-free Interaction

90%

of devices will be equipped with intelligent personal digital assistants
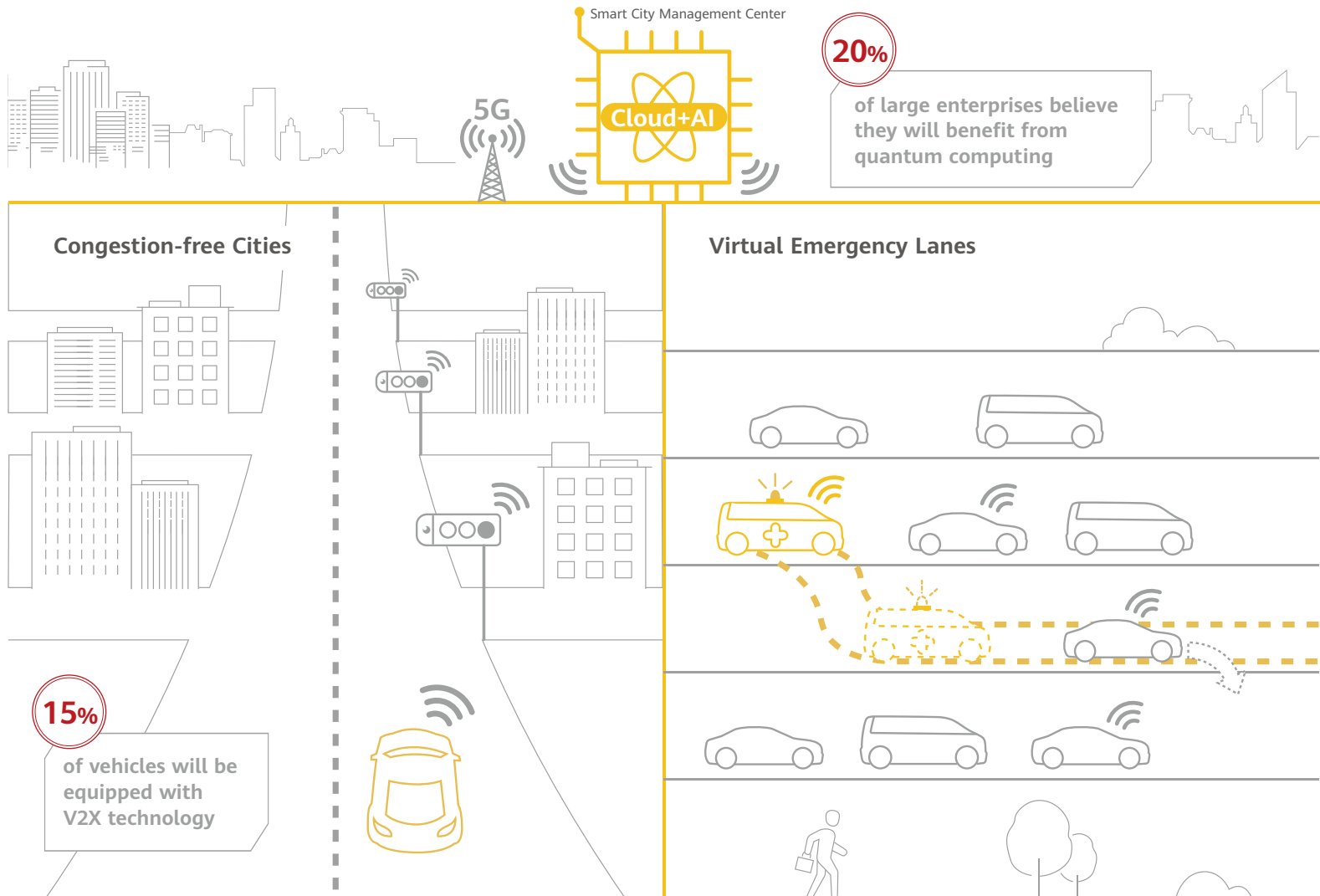
▸ **Trend 4: Tailored Streets**

Autonomous vehicles and connected network infrastructure will bring street smarts to getting around. Say goodbye to congestion and welcome in a faster, safer, and smoother travel experience based on dynamic networks.

Congestion-free Cities

Virtual Emergency Lanes

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GIV predicts that by 2025, 15% of vehicles will be embedded with Cellular Vehicle-to-Everything (C-V2X) tech.

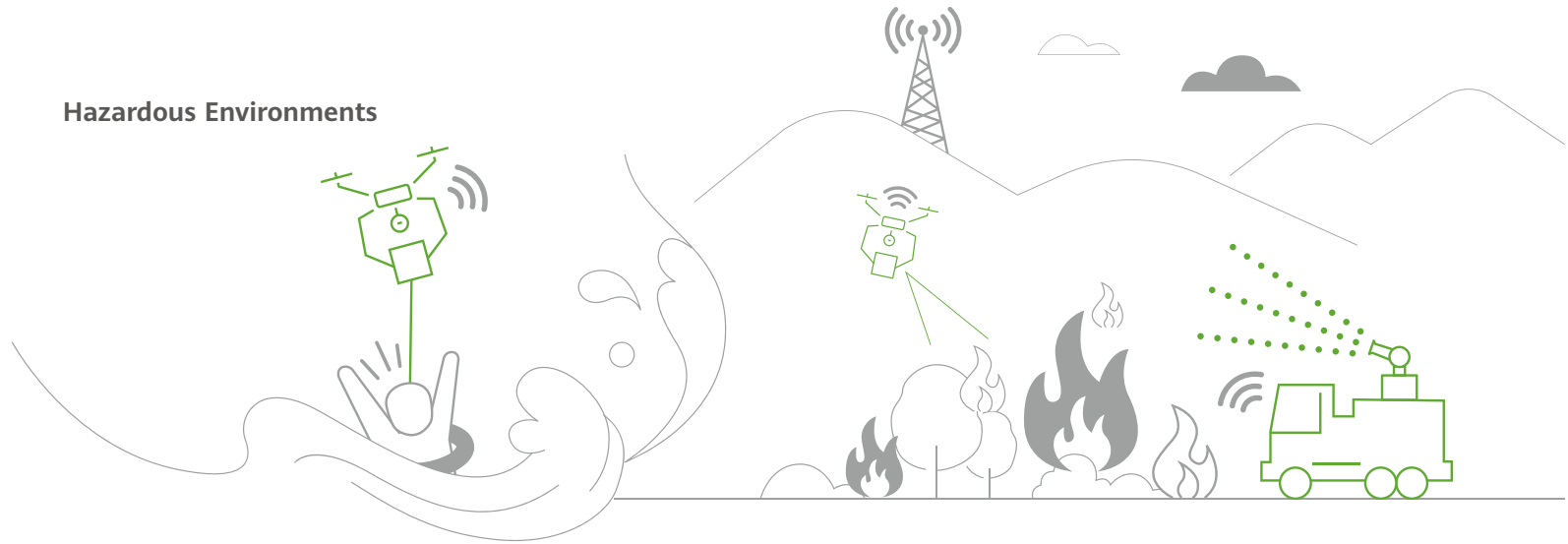20% of large companies expect to benefit from quantum computing.

Smart City Management Center

Cloud+AI

5G

20% of large enterprises believe they will benefit from quantum computing

Congestion-free Cities

Virtual Emergency Lanes

15% of vehicles will be equipped with V2X technology

▸ **Trend 5: Working with Bots**

Precise, tireless, and always available, robots will be taking on more mundane, dangerous and delicate tasks in the workplace, freeing us up for higher-value work.

Hazardous Environments

Repetitive Tasks

High-precision Operations

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GIV predicts that 2025 will have 103 robots working alongside every 10,000 employees in manufacturing.

Hazardous Environments

Repetitive Tasks

High-precision Operations

103

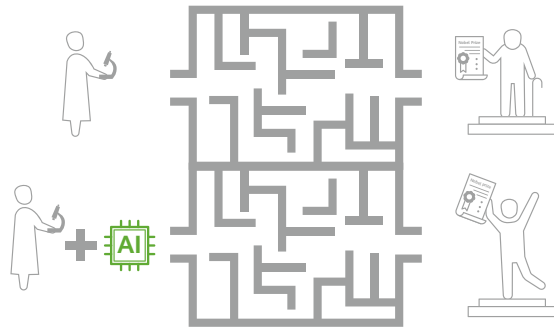**Industrial robots will work alongside every 10,000 workers in manufacturing**

180 320 268
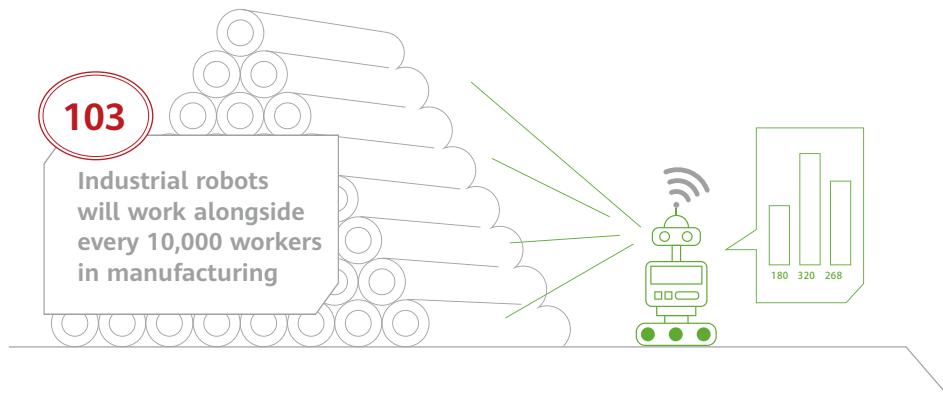
▸ **Trend 6: Augmented Creativity**

Want to unleash your inner genius artistically or at work? AI is the tool that can power huge gains in creativity and productivity for everyone.
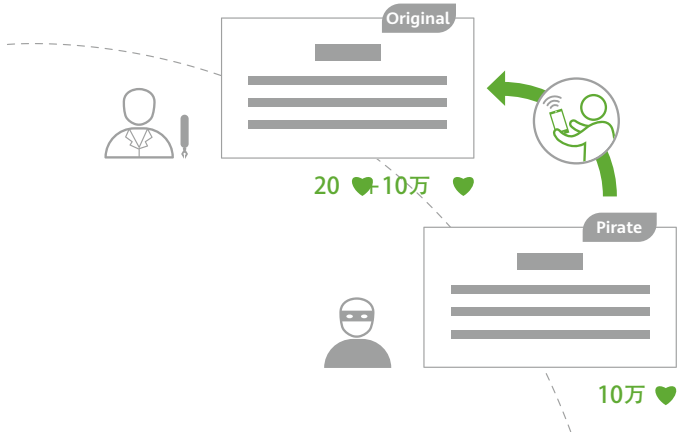
Trial and Error Discovery

AI-inspired Creativity

Protecting IP, Encouraging Originality

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GIV predicts that by 2025, 97% of large companies will be using AI.

Trial and Error Discovery

Protecting IP & Encouraging Originality

Original

20 ♥ → 10万 ♥

Pirate

10万 ♥

AI-inspired Creativity

97%
of large enterprises will use AI

6.1 billion
smart phones worldwide
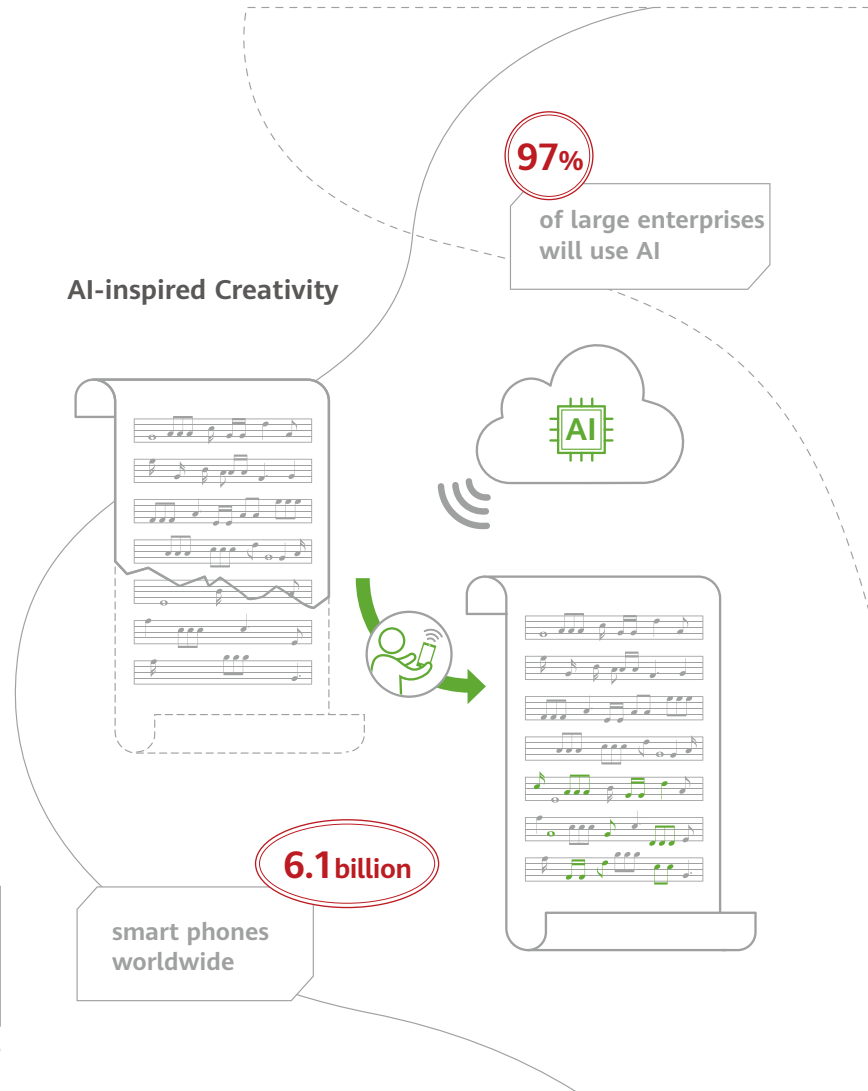
▸ **Trend 7: Frictionless Communication**

Accuracy, understanding, and trust will underpin tomorrow's communications. Expect companies that customize products just for you, an end to language barriers, and digital inclusion through tech.
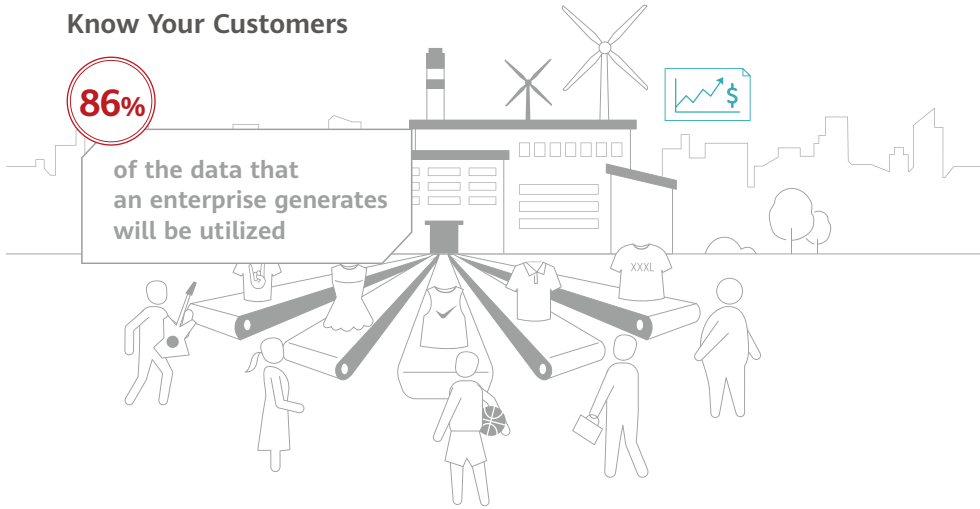
Know Your Customers

Inclusive Communication

Understand Your Product & Service Providers

Borderless Communication

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GIV predicts that by 2025, 100 billion connected devices will be in use and companies will utilize 86% of the data they generate.
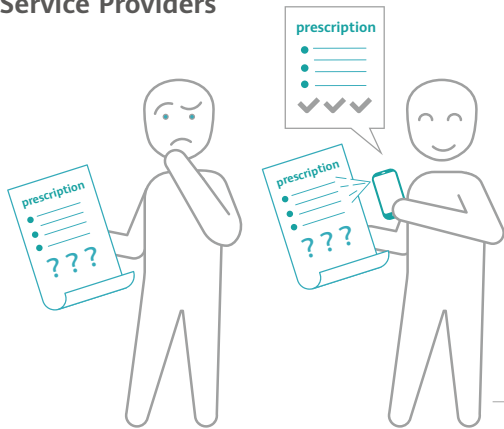
Know Your Customers

86%

of the data that
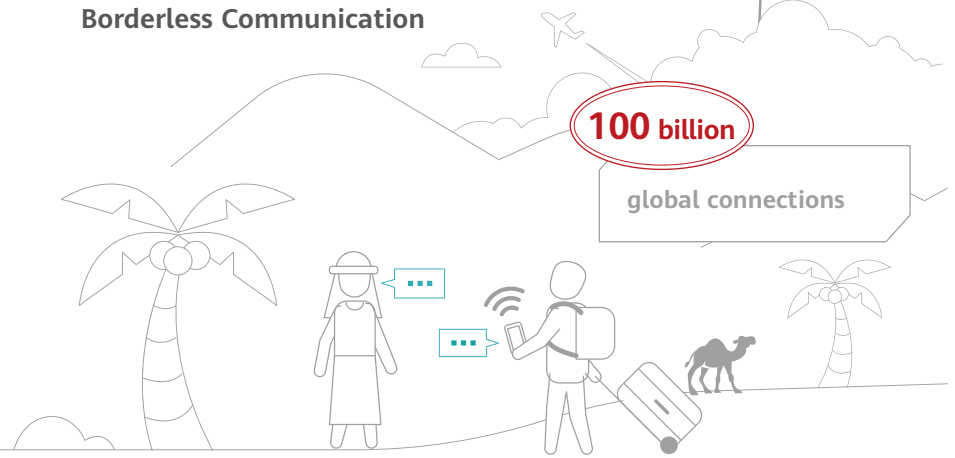an enterprise generates
will be utilized

Inclusive Communication

**Understand Your Product
 & Service Providers**

prescription

prescription

? ? ?

prescription

? ? ?

Borderless Communication

100 billion

global connections

▸ **Trend 8: Symbiotic Economy**

With cloud at the core, a global digital economy where resources and outcomes are shared is emerging based on three major features: inclusiveness, sustainability, and partnerships.

Technology for Inclusion

Technology for Partnerships

Technology for Sustainability

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GIV predicts that by 2025, every company everywhere will be using cloud technology and 85% of business applications will be cloud-based.

Technology for Inclusion

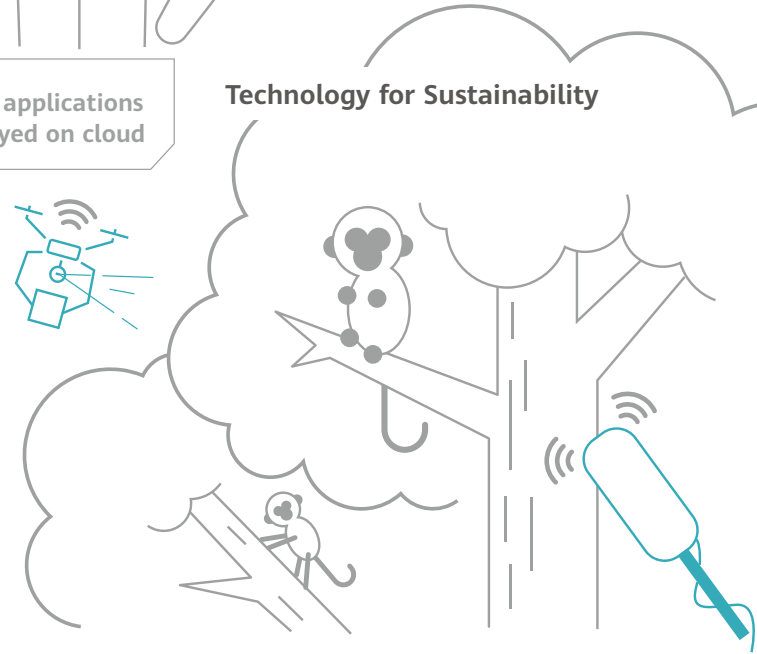**100%** of enterprises will have adopted cloud
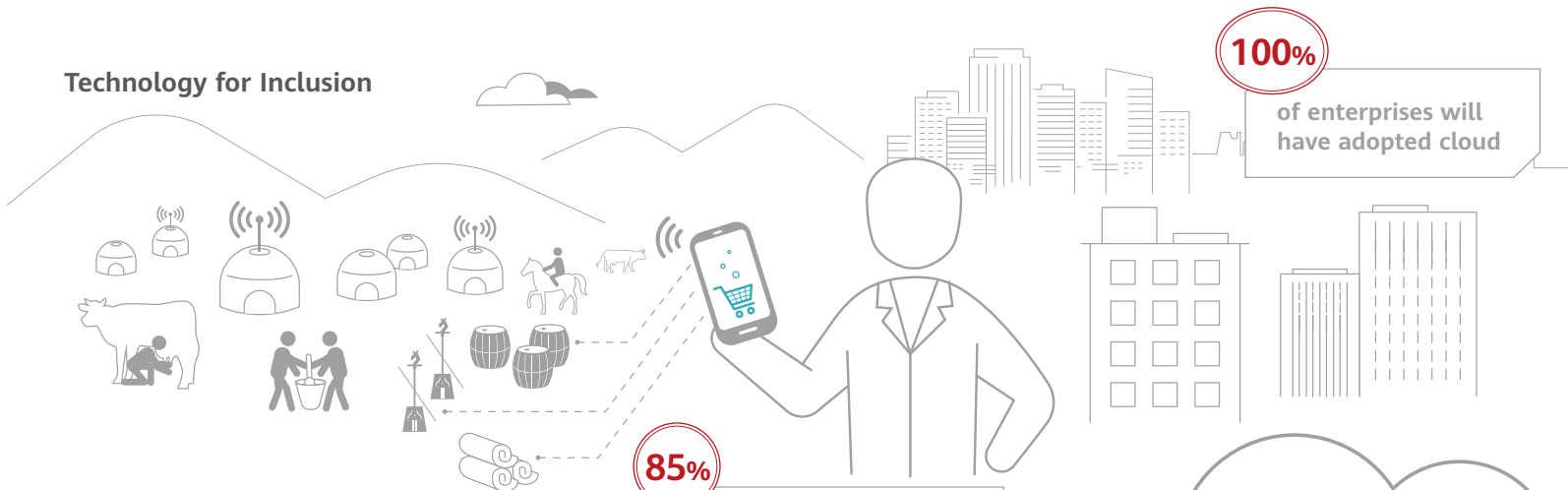
85% of enterprise applications will be deployed on cloud

Technology for Partnerships

Same cost Better result

Technology for Sustainability

▸ **Trend 9: 5G's Rapid Rollout**

10 years for full 3G rollout, 5 years for 4G, and just 3 for 5G. 5G is coming fast, but what does that mean for you, industry verticals, and society?

Massive
Connections

High
Bandwidth

Low
Latency

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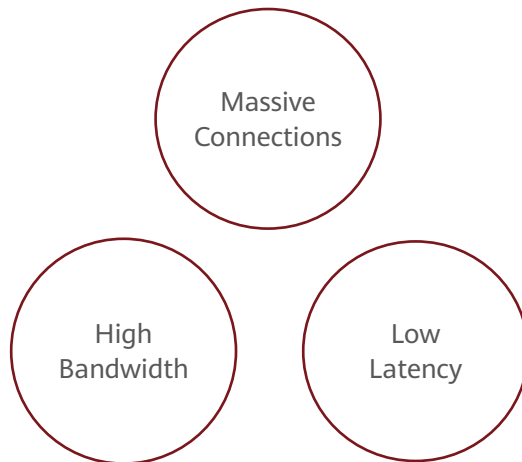
GIV predicts that by 2025, 2.8 billion people worldwide will be using 5G, with 6.5 million 5G base stations giving 5G access to 58% of the world's population.

6.5 million
5G base stations will be deployed worldwide

2.8 billion
people will use 5G networks globally

Massive Connections

58% of the world will be covered by 5G
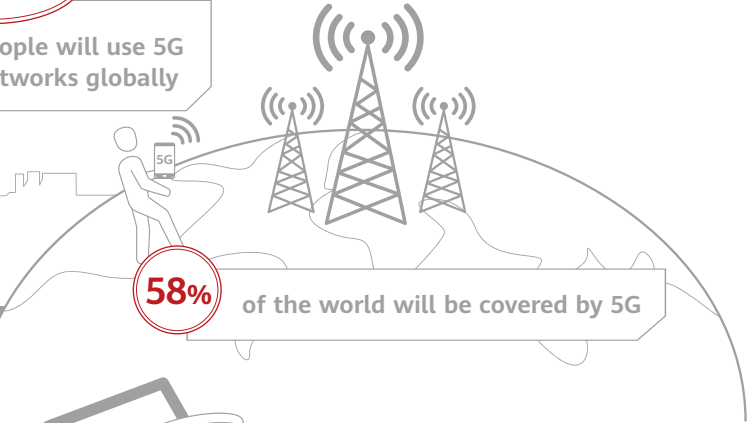
High Bandwidth
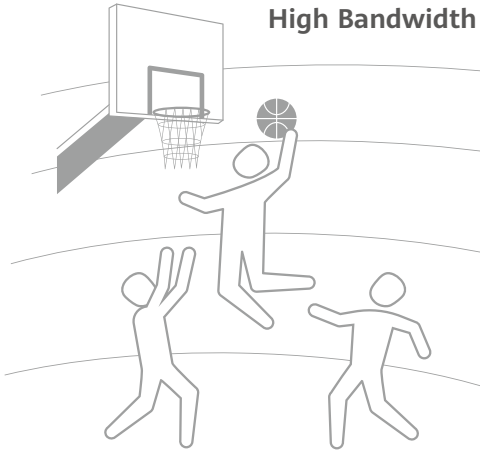
Low Latency
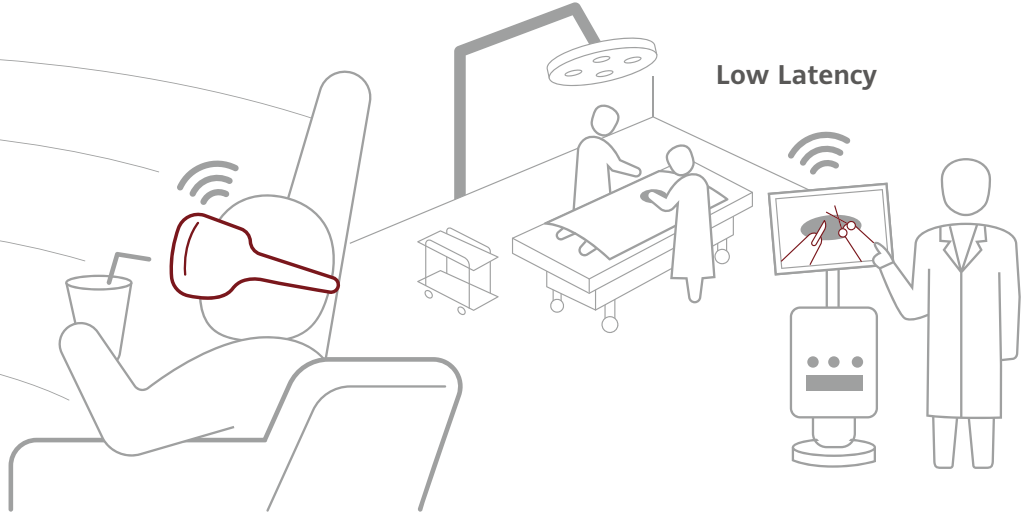
▸ **Trend 10: Global Digital Governance**

Advancements in digital tech must be balanced by shared data standards and principles for data use. We call for the creation of third-party data regulators and laws to underpin privacy, data security, and ethical compliance.

Standardized Digital Governance to Protect Digital Assets Worldwide

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GIV predicts that by 2025, 180 zettabytes will be generated each year, a fivefold increase over today.

**Standardized Digital Governance
To Protect Digital Assets Worldwide**

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GDPR

Data
Regulation

....

180 ZB

**Annual data
produced worldwide**
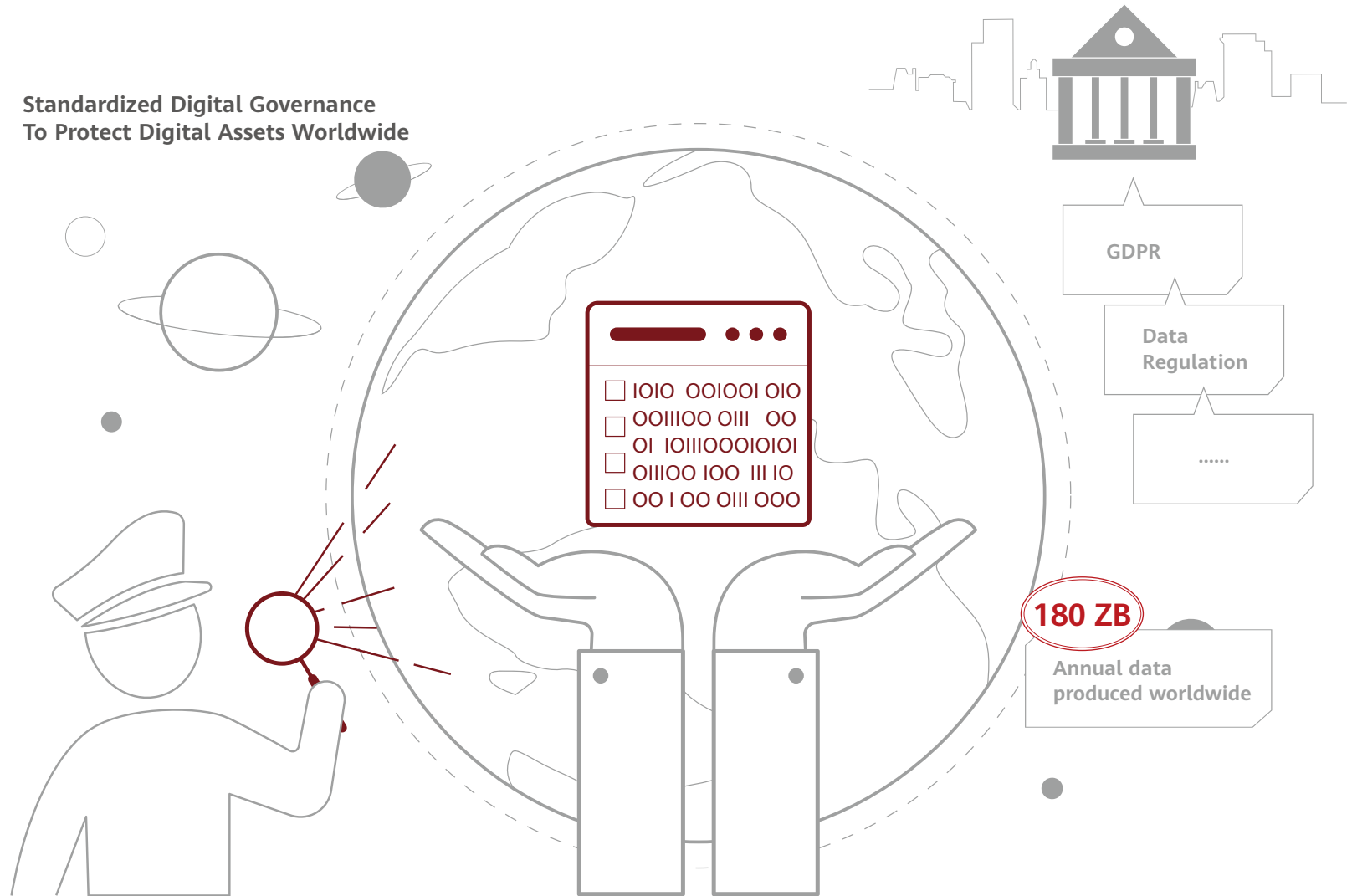
Methodology

High-quality quantitative forecasting relies on a suitable methodology selected based on the historical data of each metric. GIV 2025 utilizes an approach that combines trend extrapolation and time-series forecasting. A regression model based on historical data and business development patterns is the first choice in analysis. If the forecast results obtained from a simple linear regression model are not ideal, then the use of a multiple linear regression model or a time series forecast method is considered.

Market insights forecasting

International organizations forecasting

Consulting companies forecasting

Industry manufactures forecasting

Regression Analytical Modeling: Linear regression, logical regression, polynomial regression

Huawei judgments

Surveys of customers and partners

GIV quantitative predictions & qualitative judgments

Definitions of the Metrics

Dimension	No.	Metric / sub-indicator (procedural)	Definition	2025
Digitisation	1	Penetration of V2X-equiped vehicles	Percentage of motor vehicles equipped with V2X technology; specific definition of V2X: C-V2X communications via 3GPP-based C-V2X technology, including both short-range communications (V2V/V2I/V2P) and data exchange between vehicles and the application server (V2N)	15%
	2	VR/AR individual user amount	Individual users of head mounted VR/AR devices	337M
	3	Adoption of AR/VR by enterprise	Percentage of enterprises using AR/VR technologies for business operations. This indicator is enriched by information on the Top 5 industry verticals that has adopted AR/VR technologies	10%
	4	Smart home devices	Includes all types of smart appliances and smart safety equipment such as smart TVs, smart speakers, smart cameras, smart lights, smart sockets, and smart locks	20B

| Dimension	No.	Metric / sub-indicator (procedural)	Definition	2025
Connection	5	Global connectedness	Amount of devices connected globally	100B
	6	Global Internet population	Amount of Internet users globally via any access method	6.2B
	7	5G network coverage rate	Percentage of global population living in areas covered by 5G networks	58%
	8	Global 5G network users	Total number of 5G network users worldwide	2.8B
	9	5G base stations worldwide	Total number of 5G base stations deployed worldwide	6.5M

Dimension	No.	Metric / sub-indicator (procedural)	Definition	2025
Intelligence	10	Global data volume generated annually	Global data volume generated and stored annually, including copied data	180 ZB
	11	Enterprise data utilization rate	Data utilized or analyzed by enterprises worldwide	86%
	12	Cloud adoption rate by enterprise	Percentage of enterprises using cloud services（including IaaS, PaaS, and SaaS）	100%
	13	Cloud-based deployment rate of applications	Percentage of enterprise applications deployed on cloud	85%
	14	Adoption rate of intelligent personal digital assistants	The penetration rate of software-based chatbots or voice assistants among smartphone users	90%
	15	Global adoption rate of intelligent domestic robots by families	The penetration rate of domestic machines with motion and AI capabilities	14%
	16	Average number of nursing bots per elderly care home in G8 nations	Average number of nursing bots in each care home for the elderly in G8 nations (Canada, France, Germany, Italy, Japan, Russia, the UK and the US.)	10%
	17	AI adoption rate by large enterprises	Percentage of large enterprises that use AI for business, operations or management processes	97%
	18	Industrial robot density globally in the manufacturing industry	Number of robots per 10,000 employees in the global manufacturing industry	103
	19	Percentage of large enterprises expecting to benefit from quantum computing by 2025	Percentage of large enterprises expecting to benefit from quantum computing by 2025	20%

Living with Bots

Nursing Bots

Companion Bots

Bionic Bots

Butler Bots
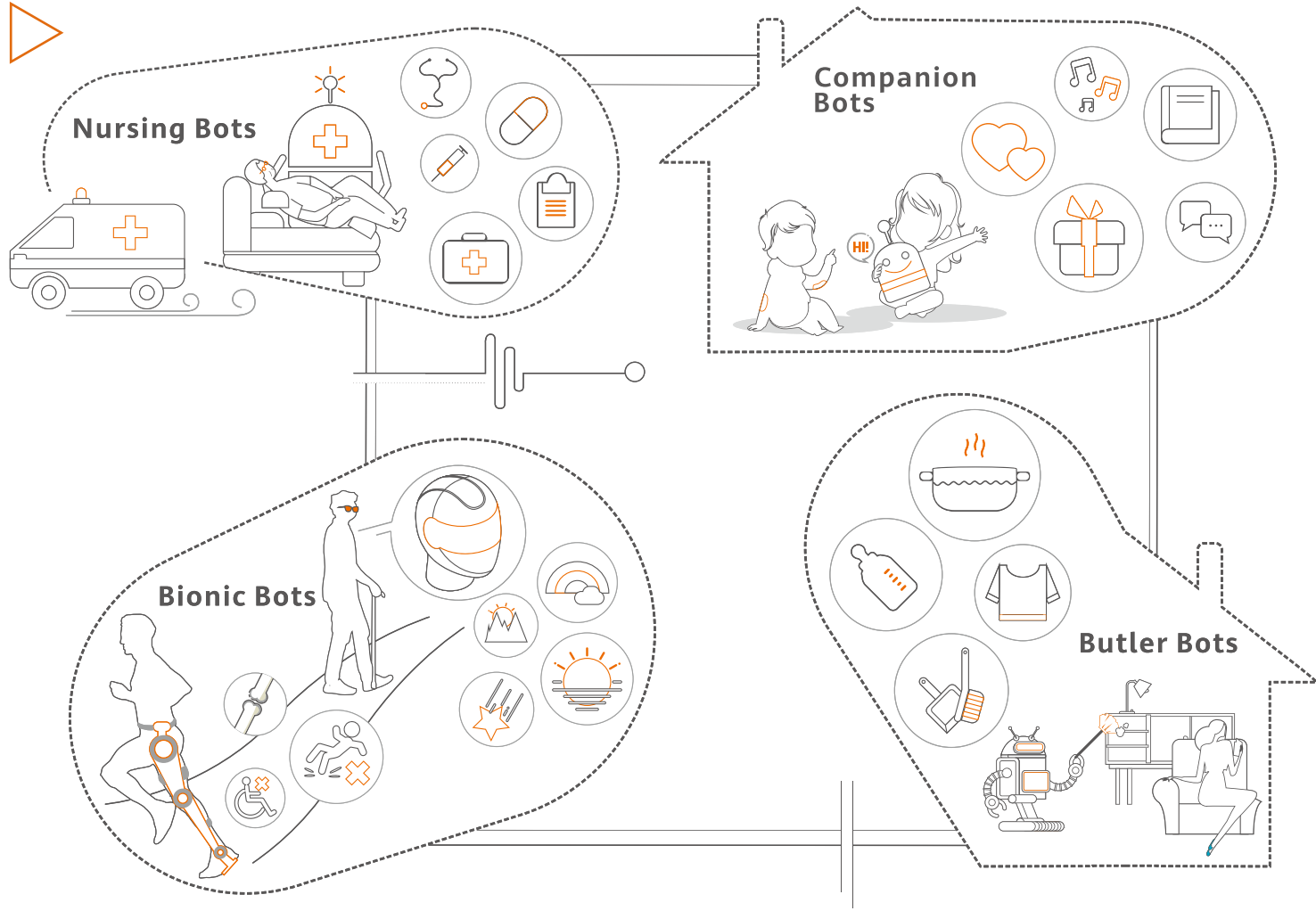
GIV predicts that by 2025, the global adoption rate of intelligent domestic robots will be 14%.

Think of a robot and what springs to mind? Something cute like a child's smart robot toy or the vac bot bumping around your home? Or something iconic from dystopian sci-fi like iRobot or the Terminator?

Whatever it is, robots are here to stay. And that's a good thing. Advances in materials science, perceptual AI, and network tech like 5G and cloud are making it possible that

a robot will be making your life better by 2025. GIV predicts that by then, 14% of global households will have a robot in the home.

From housework to education to providing physical and mental health services, robots are improving in capabilities, benefits, and ubiquity. Let's take a look at some of the bots that are shaping today and tomorrow's trends.

Nursing Bots

There are two main trends driving the demand for nursing bots: (1) The human race is aging and (2) There aren't enough healthcare professionals.

On a global scale, the number of people hitting the senior demographic – the age of 65 – is increasing by 3% per year. In today's Europe, for example, 20% of people are over 60 [1]. For society, the prognosis of this "demographic transition" isn't great. It means fewer people of working age are taking care of more elderly people.

The World Health Organization (WHO) estimates that by 2030, a global shortfall of 9 million healthcare professionals will exist, with Southeast Asia and Africa hit hardest [2]. Fewer healthcare workers per patient statistically means that more infections are picked up in hospitals and readmission rates are higher.

Moreover, it's predicted that the future demand for home care workers, especially for the elderly, will far outstrip supply.

Many nations are stepping up research and investment in nursing-specific bots and applications to ensure that they stay ahead of the crisis curve. The functions of such bots outside of clinical settings will include:

▶ Collecting data from sensors embedded in wearables or from around the home. Sensors will enable predictive analytics to anticipate and respond to potential health issues.

▶ Acting as "smart first-aiders" that can respond at the millisecond level to sudden incidents such as heart attacks or asthma attacks, greatly increasing health outcomes by administering care in the "golden 6 minutes [3]."

▶ Performing medical functions such as checkups, either autonomously or under the instruction of a healthcare professional working remotely.

▶ Contacting emergency services to request home visits based on real-time analytics, which will reduce hospital residency by up to a predicted 50% [4].

▶ Transmitting medical data to clinics and hospitals, thus ensuring healthcare professionals have real-time patient information.

▶ Serving as automated medication dispensers that can prescribe and deliver medication, ensuring that it's taken at the correct time and at the correct dose by accurately dispensing medicines in powder, liquid, or pill form.

▶ Performing sanitation tasks, for example, using UV light and hydrogen peroxide vapors to disinfect a room in minutes [5].

▶ Ensuring that increasingly stretched healthcare resources aren't wasted by unnecessary visits to clinics or hospitals.

Bionic Bots

Who doesn't want to run faster, see better, stave off the effects of aging, or be safer at work? Demand for bionic bots is unsurprisingly on the rise, and here are some examples:

► **Exoskeletons:** In both the US and UK, 3 out of 10 people over the age of 65 fall over each year, which increases to 5 out of 10 for the over 80s [6]. The cost to the economy is staggering, totaling US$2.3 billion in the UK, for example, and US$30,000 per person per fall in both China and the US [6]. While various ailments affect us as we age, falls often trigger a long-term decline in health from which the individual doesn't recover.

Combining mechanics, sensors, AI, and mobile computing, smart exoskeletons are already available, and demand is set to increase. As well as a mobility and protective tool for the elderly, exoskeletons will boost safety in industrial scenarios, help with gait rehabilitation, and allow those

with neurological disorders or stroke patients to get about. Algorithms in rigid exoskeletons for the shin and foot can customize assisted walking to the wearer. A 2017 study reports an energy-efficiency increase of 24% after a purpose-specific algorithm learned the gait of each participant [7].

The market for exoskeletons is expected to be worth US$1.89 billion at a CAGR of 41.3%.

► **Prosthetics:** Smart prosthetics are getting smarter, with machine learning able to make the brain-limb connection that automatically conveys the intention of an action to the limb [8]. However, ML isn't the ideal solution for prosthetics, as the wearer needs to "teach" the limb a given motion by mentally repeating it over and over again. Current research is focusing on a musculoskeletal computer model that acts as a bridge between the brain and prosthetic.

► **Augmentation devices:** Advances in augmented vision will be welcomed by the 1.3 billion people worldwide who suffer from some degree of visual impairment. The China-developed Eye See helmet uses laser technology to perform omni-directional scans to sense obstacles up to a distance of 3 meters [9]. Cloud AI further opens a window to the world by recognizing text on signs and identifying certain features about people, such as age. Simultaneous mapping and positioning map the path of the user in real time. Bionic lenses that can potentially replace the eye's natural lens with camera optics are also on the horizon. This technology would naturally format images, bringing with it immediate improvements to eyesight and clarity of vision regardless of distance.

Over 39 million fully blind people and more than a billion people with visual impairments worldwide will benefit from vision-augmenting technologies [10].

As they evolve, nursing and bionic bots will solve a host of problems associated with an aging population and our fragile physiology.

Gartner predicts that by 2023, daily out-patient traffic will be reduced by 20 million person-times per day patients with chronic diseases gradually turn to AI-based, virtual caring services [11].

Companion Bots

The evolution of perceptual AI, such as natural language processing and computer vision (including facial recognition), will enable multiple-round, multiple-level dialogues with nuanced, real-time changes in tone and intonation based on increasingly complex decision trees. In short, chatting to your robot buddy will start becoming indistinguishable from chatting to another person.

What kind of applications and experience can we expect from the artificial linguist?

▶ **Study bots:** Today's digital natives have their first experience of educational bots at just over 3 years old, primarily for learning language [12]. Toy-type semi-smart robots are loved by many small family members, and these bots are increasing in sophistication. By 2025, it's expected that every child will benefit from an "Einstein-like" smart tutor that will customize study plans based on personalized interests and preferred learning methods, reflecting differences between abilities and fast and slow learners. AI-powered bots will also be able to

evaluate performance beyond grading multiple-choice tests, and analytics will be able to spot correlations too sophisticated for human teachers, for example, if exercise before math class improves performance or how nutrition affects learning outcomes.

Bots are also in development that can teach muscle memory in the form of a wearable device that can instruct in art, piano or other tasks by haptic feedback, though the effectiveness of this learning method has yet to be proven.

▶ **Therapy bots:** While machines may never replace the human connection, they can have – and are having – a predictive and therapeutic role in certain health scenarios [13]. Research using humanoid social robots is underway to evaluate the brain signals of children with Autism Spectrum Disorder (ASD) using EEG and video cameras to record interaction with the robot. ASD affects 1 in 68 children and its early diagnosis has a large impact on treatment efficacy [14]. Moreover, ongoing

research has shown that robot-assisted interventions can teach social and academic skills to autistic children, including emotion recognition [15].

With the WHO estimating that 300 million people worldwide suffer from depression, [16] emotionally intelligent robots that employ empathy and decision-tree dialogues are also proving valuable in helping to address mental health issues. And unlike human therapists, virtual ones are always available: Woebot uses cognitive behavioral therapy techniques to help manage anxiety and depression, while mind.me monitors mental health by analyzing data streams from the user, with notifications sent to user-defined circles of family or friends if early signs of depression are revealed [17].

▶ **Friendship bots:** Many surveys hold that depression's unpleasant sibling, loneliness, is becoming a public health issue. For example, a sense of disconnectedness has tripled in the US since the 80s, 14% of UK citizens report that they are

lonely, and in Japan, there are enough "lonely deaths" among the elderly to warrant a niche "clean-up" industry [18]. Many companies are specializing in friendship bots in a variety of humanoid and animal forms. The same advances in perceptual and cognitive AI that will benefit other scenarios will increase the sophistication of decision trees and subtle responses to human stimuli, creating either a new member of the family or a companion for warding off loneliness.
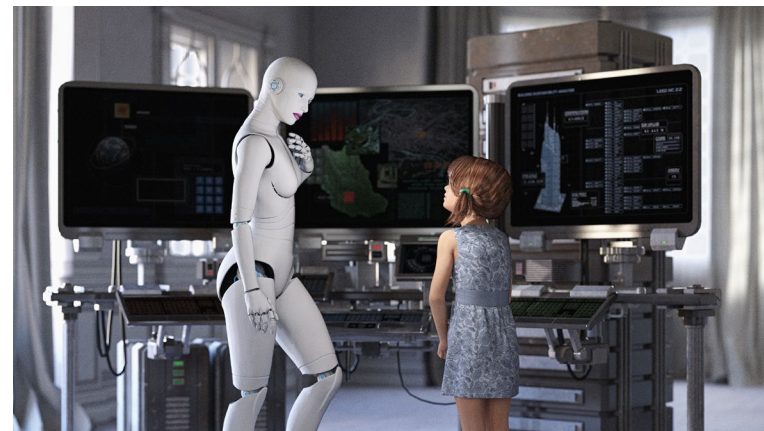
Butler Bots

When it comes to housework, the majority of people would rather be doing something else. In many nations, demand for domestic staff vastly outstrips supply – 50 million unfilled posts in China's case [19].

Currently, we're seeing bots perform basic tasks like folding clothes, vacuuming, and picking things up. However, this functionality range is likely to increase in complexity to include things like household security and safety.

In scenarios like fires, gas leaks, or break-ins, butler bots can serve a variety of functions, for example, (1) averting potential disasters through alerts; (2) performing first response actions like locking doors, shutting down a gas supply, or activating a home sprinkler system; (3) using embedded cameras to transmit home layouts to the authorities in image, plan, or video form via cloud; and (4) preventing false alarms – in 2017, the London fire service attended 38,000 false alarms at a cost of £323 per call out [20]. A total of 180,000 people per year die in fires globally, 90% of

which occur in the home [21]. Butler bots have the potential to make a serious dent in this statistic.

Already in 200 million homes around the world [22], butler bots will continue to learn the preferences and usage habits of individual family members and provide a range of home services for individuals and families based on voice commands, sensors, and apps.

Summary

GIV predicts that by 2025:

▶ The number of smart nursing bots will increase from 6.2 million in 2017 to 23 million. Each care home for the elderly will have 10 nursing bots in G8 nations (Canada, France, Germany, Italy, Japan, Russia, the UK, and the US.)

▶ The number of smart home devices will rise to 20 billion.

▶ 470 million homes, or 14% of households worldwide, will have smart butler bots, quadrupling the 25 million shipments made in 2018 and creating a market worth US$9 billion.

Increasingly connected, networked, and function-rich robots are creating a blue ocean that will be worth billions of dollars to the ICT industry. Carriers, developers, robotics companies, and AI companies will benefit, alongside individuals, homes, and industry verticals like health and education.

Personal robots will also be a boon for inclusivity, empowering people who are at risk of being sidelined, for example, the elderly and those with physical disabilities and mental health issues. They will also give children an early and fun start to education, and free up more time for family members to do something more productive than housework.

It's time to start thinking about that new family member.

What Is a Bot?

The definition of what a robot is varies even in the industry, especially when we consider robotics in the context of artificial intelligence. For the purposes of the trends the GIV looks at, we're looking at bots as a machine that:

▶ Has sensors and actuators that can interact with the world.
▶ Is programmable and can carry out a series of simple or complex actions.
▶ Is semi or fully autonomous.

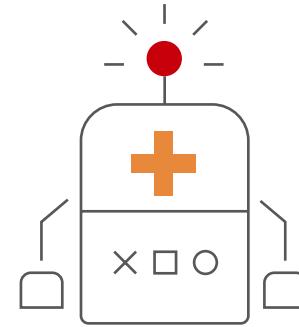The number
of smart home
devices will rise to

20 billion

14%

of families across
the globe will
have an intelligent
domestic robot

10

nursing bots on
average will be
helping out in
elderly care homes
in G8 nations

(Canada, France, Germany,
Italy, Japan, Russia, the UK
and the US)

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Trend 1 ▶▶
Living with Bots

The adoption rate of intelligent domestic robots will reach 14%.

Trend 2 ▶▶
Super Sight

The percentage of companies using AR/VR will increase to 10%.

Trend 3 ▶▶
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The adoption rate of intelligent personal digital assistants will reach 90%.

Trend 4 ▶▶
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C-V2X (Cellular Vehicle-to-Everything) technology will be installed in 15% of the world's vehicles.

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Industrial robots will work side by side with people in manufacturing, with 103 robots for every 10,000 employees.

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97% of large companies will be using AI in their services or operations.

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85% of business applications will be cloud-based.

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5G networks will cover 58% of the world's population.
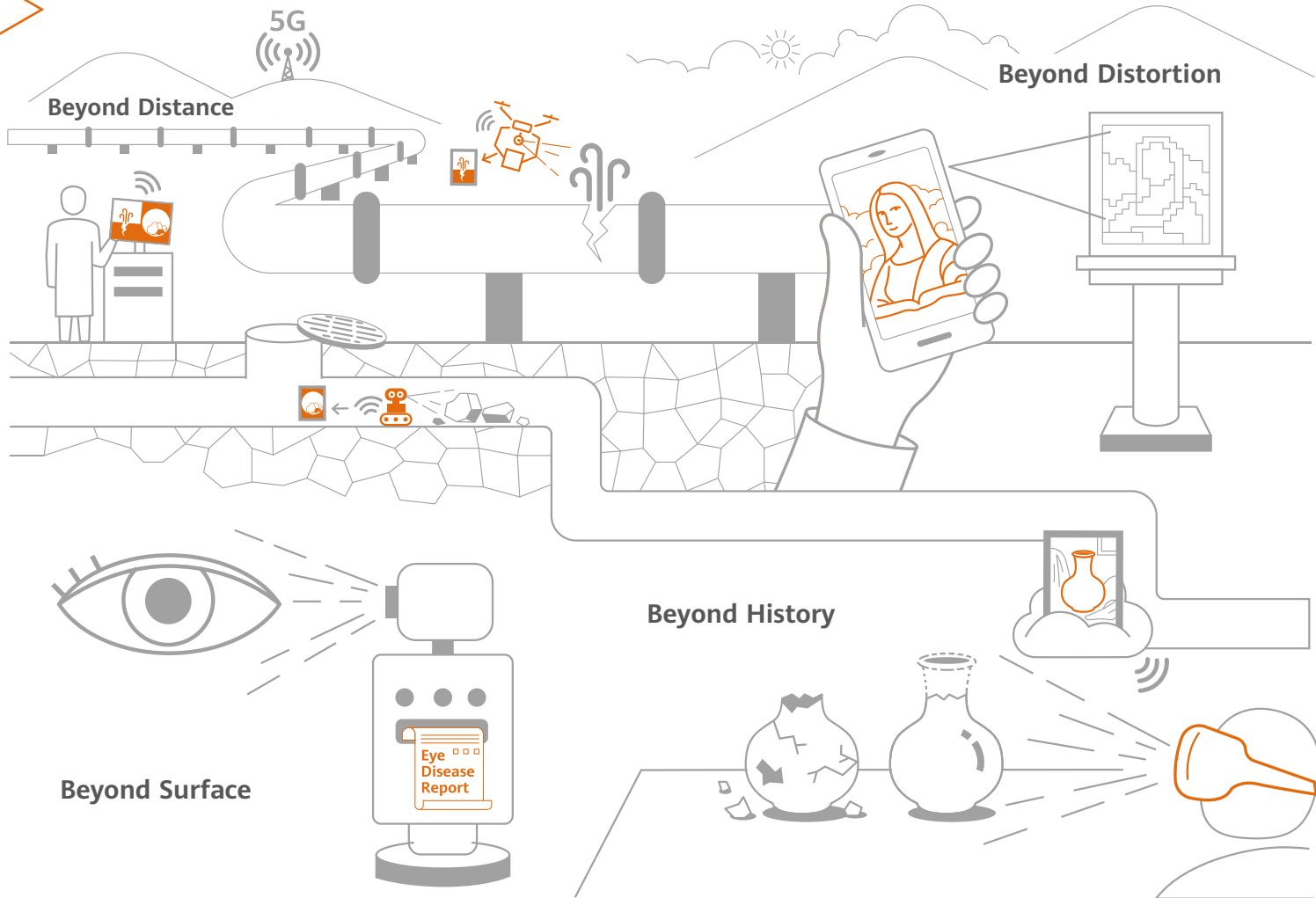
Trend 10 ▶▶
Global Digital Governance

The amount of global data produced annually will reach 180 ZB.

Trend 2

Super Sight

5G

Beyond Distance

Beyond Distortion

Beyond History

Beyond Surface

Eye
Disease
Report

GIV predicts that by 2025, 10% of enterprises will use AR/VR.

Imagine swimming with bottlenose dolphins, strolling through the Summer Palace in Beijing in all its glory in 1778, or walking on the moon. Exploring the deepest depths or the vastness of space and bringing the past to life are just some of the things that will soon be possible from the comfort of your own home due to "Super Sight".

By 2025, the percentage of people living in areas covered by 5G networks will have reached 58%. At that time Super Sight will have arrived – the convergence of cloud, 5G, 4K+, virtual reality (VR), augmented reality (AR), and artificial intelligence. As well as delivering a new experience for individuals, the confluence of these technologies will drive up productivity across industry verticals and enable us to see things in a way that we haven't been able to before. By removing the constraints of distance, space, time, and even physiology, Super Sight has the potential to deliver huge benefits to individual experience, enterprise, and society.

Beyond Distance

▶ **Power:** Natural gas currently supplies 22% of the world's energy resources, with demand increasing by 1.6% per year [1]. Usually supplied by land-based pipelines covering thousands of kilometers, natural gas often has to traverse remote, unmonitored, and challenging terrain, resulting in hugely wasteful faults and leaks. For example, an average of 90 incidents per year in the US loses enough gas to fuel 10 million homes [2].

It can take an experienced engineer up to one month to locate a fault. This inefficiency is then exacerbated by imperfect repairs, which in turn is the third largest cause of gas pipe accidents.

However, that's starting to change. By 2025, pipeline patrol robots equipped with 5G transmitters and 4K cameras will be able to fully monitor and examine pipes [3]. From a control room, engineers can examine the cause of faults by switching the angle of vision, making an assessment, and sending repair commands to the robot.

▶ **Sewage systems:** Sewage pipes range in size from 6 inches (150 mm) in diameter to concrete-lined tunnels as large as 30 feet (9 m) in diameter [4]. Low-pressure systems tend to

use a small grinder pump located at each point of connection [4]. Inspecting smaller pipes for corrosion, deformation, and blockages can be impossible for humans. However, robust, waterproof, and dirt-resistant robot rovers can break through human limits, monitoring faults and performing minor repairs [5]. Equipped with an optional memory module to enable the storage of video and still images, fully autonomous un-tethered robots with strong computing capabilities can relay high-res images capable of showing cracks and detecting the location and orientation of faults between two manholes, fulfilling a task that humans are incapable of.

Beyond Surface

▶ The World Health Organization (WHO) estimates that a global shortfall of 4.3 million medical professionals and nurses exists, which will increase to 9 million by 2030 [6]. 5G, VR, AR, and their applications are now bringing Super Sight to the global healthcare sector, allowing healthcare resources to flow past geographical and economic divides to provide greater and more equal healthcare access to everyone, everywhere.

5G networks will be a great enabler of telemedicine and remote surgery, offering gigabit bandwidth to transmit audiovisual signals and data from tests like ultrasound, with medical experts controlling ultrasound wands remotely [7]. The system will transmit the exact topography of a patient's body back to the physician's hands through a sophisticated haptic system. During remote surgery, every detail of a patient's organs can be transmitted to a physician controlling a robot arm in a VR operating theater in 4K or 8K. The surgeon can adjust medical parameters like the flow of medicine in real time in response to changes in vital signs.

Remote surgery will help reduce the pressure on senior physicians, especially in remote areas that suffer an acute shortage of medical experts. WHO estimates that by 2021, global life expectancy will increase by one year due to the improved quality of medical services [6].

By 2025, we anticipate that a mature supply chain of 5G, intelligent computing, VR, and AR will develop. The intelligent healthcare ecosystem will expand, and we will see increasingly sophisticated medical supplies, intelligent hospitals, remote checkups, and remote surgeries. Insurance and national health systems will become integrated into the intelligent medical service ecosystem, with new services making up for shortfalls in medical staff in specific areas.

According to KPMG, by 2025 the global market for remote wireless medical services will be worth US$58.8 billion [8].

Vision impairment is a major global issue, with around 1.3

billion people suffering from a near-vision or distance-vision impairment [9]. As we age, the likelihood of an age-related eye disease increases, as the eye's natural crystalline lens undergoes changes and gets cloudier, potentially leading to a cataract and compromised visual acuity.

AI-powered bots are now able to detect more than 50 diseases as well as a human doctor can. One particular test showed that AI made the same diagnosis as a panel of eight doctors 94% of the time [10]. To reduce errors, a group of algorithms work in tandem, so that an error by any one algorithm will be overruled by the others. Moreover, the AI system rates the possible explanations it gives for each diagnosis in terms of diagnostic probability [11].

Gradual changes happening to our eyes are hard for human doctors to notice until a particular disease manifests. AI diagnostic tools can help give early warnings of possible eye disease and prompt treatment, preventing the condition from

escalating. Another avenue that's currently being explored is bionic lenses, which can potentially replace the eye's natural lens with camera optics. This technology would naturally format images, bringing with it immediate improvements to eyesight and clarity of vision regardless of distance.
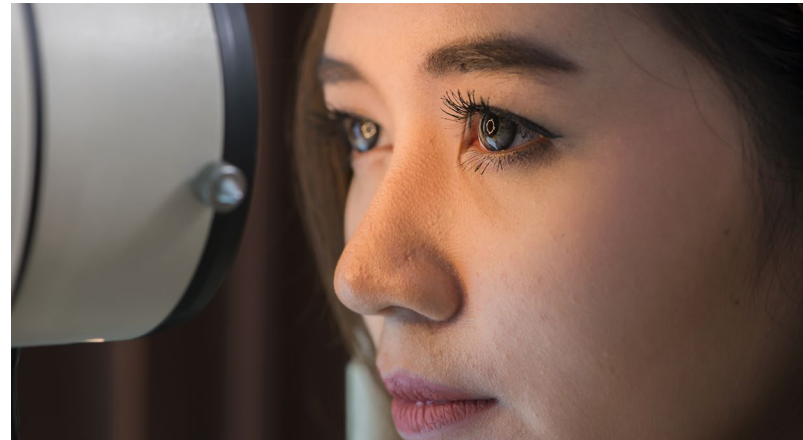
Beyond Distortion

Digital imaging is getting smart, enabling distorted or fragmented images to be transformed into a masterpiece of clarity. How does it work? The AI can figure out the "true" scene behind a distortion caused by, for example, rain or dirt. It also works on images that are heavily pixelated, low-res, or partially obscured [12]. And it's not just confined to images – the tech can work on video, too.

More than just an advanced photo editing tool, AI-powered machines will be able to interpret the real world in the same context as we can. One application is to help autonomous vehicles to navigate poor road and weather conditions, which will make a potentially huge difference to safety.

Beyond History

The world is immeasurably enriched by the vivid history that humanity has encapsulated in architecture and art.

Unfortunately, the vibrancy of our cultural landscape isn't matched by our skill at preserving it. The Art Loss Register (ALR) calculates that 12,000 cultural artifacts are stolen or lost every year [13]. There are also larger losses, and here are a couple of examples: Thought to be the pinnacle of Chinese imperial gardens, the Old Summer Palace in Beijing was destroyed in 1860 in a three-day fire during the Opium Wars. Fast forward to the present, and the devastating fire that struck the National Museum of Brazil in 2018 turned 90% of its 20 million artifacts into ash [14]. In April 2019, the fire that tore through Notre Dame left a trail of destruction, completely collapsing its iconic spire.

Moreover, time can also prove to be the enemy of architecture and art. While still glorious testaments to human artistry and skill, structures like the Colosseum and the Parthenon cannot be seen as they first existed.

Super Sight has the potential to revitalize or recreate history before our eyes. And this is something that's already happening. Carved 1,500 years ago, the Buddhas of Bamiyan in Afghanistan were destroyed in 2001. To recreate full-scale versions of the 53-meter high statues, technologists have used AR and cutting-edge 3D laser projectors with a power of 600,000 lumens, the equivalent of 30 cinema projectors. A triumph of technology, the project has precisely recreated a national cultural icon that had stood for centuries [15].

In Europe, VR has been used to maximize the reach of a particular period of art in the shape of a VR art museum [16].

After amassing 74 paintings by Dutch and Flemish masters from the 17th century, Dutch art collector George Kremer considered displaying his collection in a bricks-and-mortar museum. However, not only did he have trouble finding the right site, he also worked out that the limit on visitors topped out at 9 to 10 million a year.

VR offered him a way to create a virtual museum that could be visited by anyone, anywhere in the world for the cost of a US$6.99 VR headset [17]. Now, visitors can view the paintings from any angle, and enjoy the art up close – all without spending potentially thousands of dollars on an actual visit.

Super Sight pushes through the barriers of time, bringing history in the realm of today. It brings new commercial opportunities for tourism, culture, and education, with smart tourism – a mix of

AI, VR, AR, and 5G – poised to be a huge growth area.

As a whole, it's expected that the VR market will generate US$1.3 trillion in revenue over the next decade [18].

Summary

Super Sight will be enabled by technologies like 5G, AI, machine learning, VR and AR. It will help us to see beyond distance, surface, distortion, and history. With Super Sight, we will be able to see things we couldn't see before. And we will be able to better understand what we already see.

By 2025, GIV forecasts that:

▶ The number of VR/AR users will have increased to 337 million.

▶ 10% of companies will be using VR/AR.

337 million people will use VR/AR

VR

360°
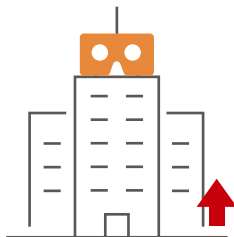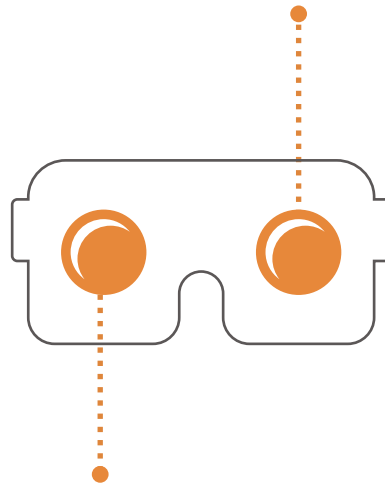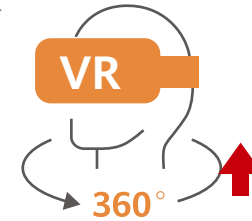
10% of enterprises will use VR/AR

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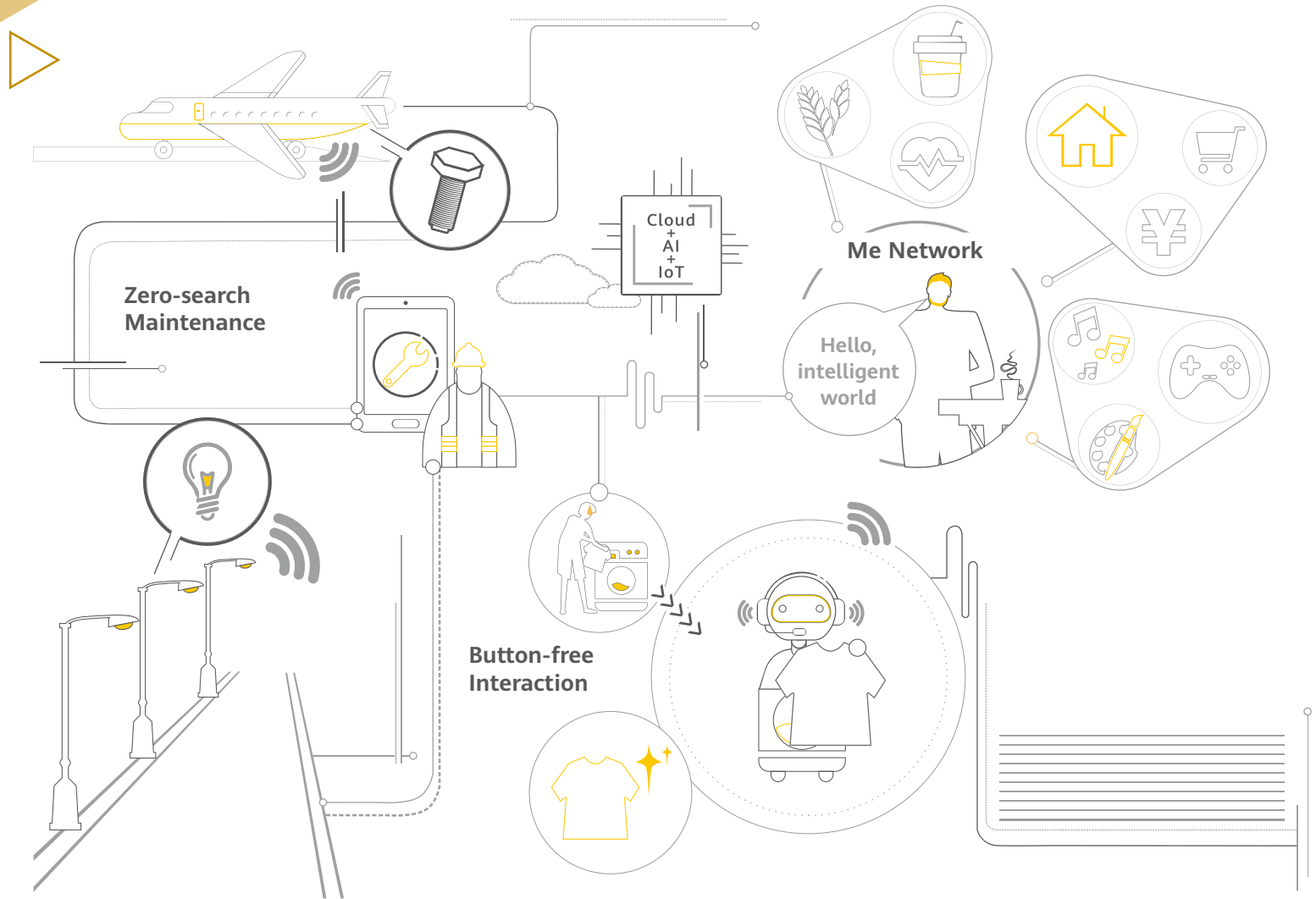
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Trend 3

Zero Search

giv
global
industry
vision

Zero-search
Maintenance

Cloud
+
AI
+
IoT

Me Network

Hello,
intelligent
world

Button-free
Interaction

GIV predicts that by 2025, the adoption rate of intelligent personal digital assistants will reach 90%.

If you're anything like the average Internet user, you spend around 21% of your online time on searches, an activity that can be both time-consuming, imprecise, and convoluted [1]. Although finding information is easier today than it was a decade ago, we still spend too much time searching for, reading, and filtering through information to get the exact data, products, or services we want, or to find groups we want to engage with.

Every free search is also a huge resource drain. Globally, data centers use roughly 416 terawatts of power per year, four times the annual electricity consumption of a mega city like Beijing [2]. In many cases, multiple queries are required, leading to high costs and low-quality search results.

And when it comes to equipment maintenance scenarios
in different industry verticals, searching for faults has
typically been time- and resource-intensive, causing service
disruptions and lost profits.

How people interact with information shapes the way we live
and work today. In the future, GIV predicts that zero search
is set to change this forever in three key ways: Zero-search
Maintenance, Button-free Interaction, and Me Networks.

Zero-search Maintenance

Typical maintenance scenarios have traditionally required significant personnel resources and time to identify and locate faults and output technical reports. Equipment has to be taken out of use to wait for maintenance, causing service disruptions and financial losses.

With the development of IoT and AI, faults and recommended maintenance solutions can be automatically sent to the mobile devices of maintenance personnel. Zero search enables automatic fault alerts and predictive maintenance, shortening the maintenance process and reducing operation and maintenance costs.

According to IATA, MRO (Maintenance, Repair, and Overhaul)

expenditure represents 11% of airlines' operational costs [3]. Oliver Wyman reports that global airlines spent US$77.4 billion on MRO in 2018 [4], which is expected to increase to US$116 billion by 2029 [5]. Preventing or being better prepared for unplanned maintenance will help mitigate flight disruptions, reducing repair costs and time, and improving aircraft turnaround and utilization. Two effective approaches are predictive maintenance (identifying potential faults before they occur) and fast troubleshooting (locating the root cause of a fault).

The industry leaders in this area are designing maintenance tools that use advanced technologies such as AI, IoT, and AR/VR. For example, by using machine learning to track maintenance and pilot records, recurring defects can be

spotted, ranked, and trended every few hours. Airline operators and maintenance staff will be alerted to potential faults based on the latest emerging defect trends [6]. Currently, between 70% and 80% accuracy has been achieved in predicting failures on the first try, with performance set to continually improve as more data is gathered and analyzed [7]. By using natural language processing, we can parse the content of repair manuals and records to accumulate data on the symptoms, causes, and solutions of past faults and failures. Mining these datasets will reveal patterns that can guide engineers and technicians to quickly locate the most likely cause of any issue, enabling even a novice mechanic to reduce troubleshooting time by 75% without any help [7]. In the near future, we expect to see intelligent systems that can automatically identify and pinpoint faults, damage, and causes. A zero-search

maintenance system will reshape the airline MRO experience, drive down overall costs, reduce the risk of accidents, and prevent disruption to flight schedules. Given the current shortage of senior technicians with the experience to maintain aircraft, zero search will free experienced personnel from low-end maintenance tasks and enable novices to perform tasks with confidence.

In the past, streetlamp engineers had to drive along each road to find malfunctioning lights. After finding a fault, they then had to analyze, report, and fix the problem. Slow inspections like this are inefficient and costly in large cities, and faulty streetlamps can present significant safety hazards. Now though, smart streetlamps mean that technicians no longer have to physically search for malfunctioning streetlamps by wandering the city. This is what we call zero-search maintenance. For example, a smart streetlight solution provided by an ICT vendor can enable zero search for malfunctioning streetlamps. Smart streetlamps can transmit their own maintenance requirements, fault diagnostics, and location to a technician when a fault occurs, or when a component approaches the end of its service life. This can reduce a city's infrastructure maintenance costs by up to 50% [8].

For both specialist equipment maintenance and the normal maintenance of city infrastructure, the convergence of IoT and AI will help labor-intensive industries to save manpower and resource costs in finding, screening, checking, and identifying faults, resulting in higher efficiency and the better use of resources.

Button-free Interaction

AI technologies like voice, facial, and gesture recognition are already up and running in various scenarios. In many cases, we no longer need to click buttons to search or give instructions. And we can expect to increasingly engage with our digital devices through natural interactions: home appliances, automobiles, and machines will soon be able identify your needs and make automatic adjustments accordingly.

For example, without any instructions, your phone can remind you that your friend's birthday is next week and that you need to buy a scarf for them [9]. Your phone can also provide a link to a store that, for example, has scarves on special offer. Or when you begin to feel sleepy while driving, your car can automatically pull over and recommend nearby coffee shops

while you take a break. When you're driving to a programmed destination, your map app can recommend the nearest parking lot as you draw close. When you get home, lights, curtains, air conditioners, and bathtubs can automatically turn on as soon as you open the front door, as if you have a butler ready and waiting for you.

Smart speakers acting as home hubs will offer zero-touch search, as users can simply talk to a device to search for information rather than going through the button-pressing ritual. You can ask your smart speaker to play your favorite track without having to search through your playlist. Or in the kitchen, you can ask your personal digital assistant to read aloud the recipe for a dish without searching the Internet yourself.

There are many other real-world examples of zero search. In the evening, when you sit in a chair, open a book, or make a minor gesture, the nearest light can brighten to the right intensity for you. If you want to take a bath before bed, you will only need to make a gesture or give a voice command to automatically adjust the temperature of your bathwater.

Thanks to no-button interactions, people's hands will be free and everything they want will be more easily available. This will allow people to interact more naturally and freely with home appliances, automobiles, and other objects during everyday activities like reading, driving, studying, and much more. Button-free interaction will greatly improve efficiency at work and convenience at home.
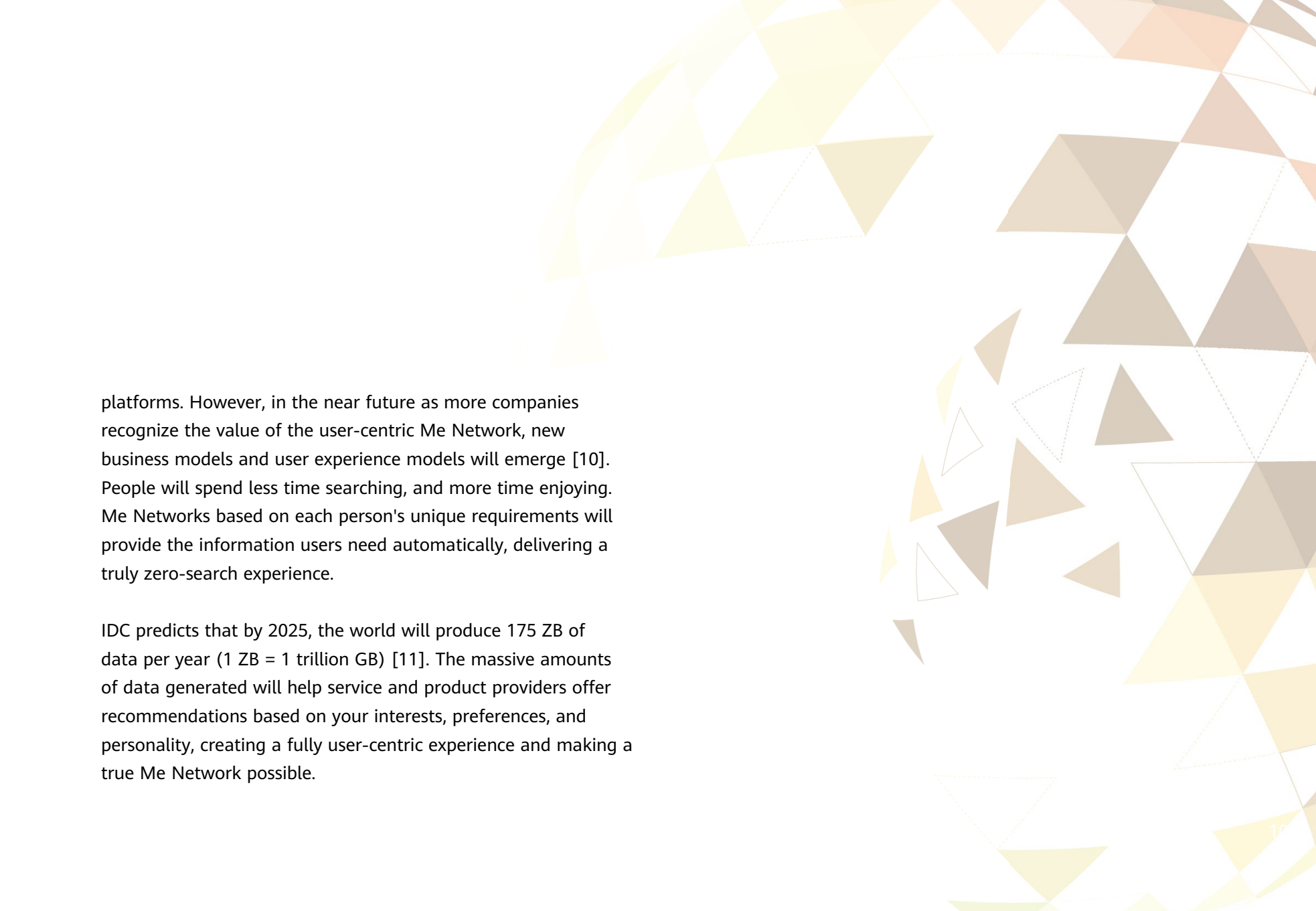
Me Network

Zero search can help realize the "Me Network", a social network that's focused on you.

As AI technologies are deployed in platforms that offer travel shopping, dining, and other services, various types of data will be integrated and analyzed to automatically recommend friends, artists, exhibitions, concerts, and other events that the user will like based on their preferences. You will no longer have to search: like-minded friends, hobby groups, lifestyle and entertainment services will be recommended to you in real time.

The Me Network will be a unique platform that integrates data from multiple social network platforms. At present, data is still fragmented, so users must search for services across different

platforms. However, in the near future as more companies recognize the value of the user-centric Me Network, new business models and user experience models will emerge [10]. People will spend less time searching, and more time enjoying. Me Networks based on each person's unique requirements will provide the information users need automatically, delivering a truly zero-search experience.

IDC predicts that by 2025, the world will produce 175 ZB of data per year (1 ZB = 1 trillion GB) [11]. The massive amounts of data generated will help service and product providers offer recommendations based on your interests, preferences, and personality, creating a fully user-centric experience and making a true Me Network possible.

Summary

Zero search requires AI algorithms that are continuously trained using massive sets of user data. These algorithms offer high-quality user experiences. The increasing population of Internet users will undoubtedly provide more data to train AI and optimize its recommendations. Zero-search maintenance is driven by the growth in IoT, 5G networks, intelligent devices, and cloud apps, and will become an important part of smart cities and high-end equipment manufacturing. Button-free interaction and the Me Network will provide users with simpler digital experiences based on complex groups of intelligent technologies that support a wide range of user scenarios. Ubiquitous connectivity means constant data transmission and 24/7 connectivity between many devices that connect people to things and things to other things. With the help of intelligent devices and edge computing, smart home appliances and intelligent connected cars can perceive user needs and automatically adjust.

GIV forecasts that by 2025:

▶ The adoption rate of intelligent personal digital assistants will reach 90%.

▶ 470 million smart speakers will be in use worldwide.

▶ 6.2 billion people will use the Internet globally.
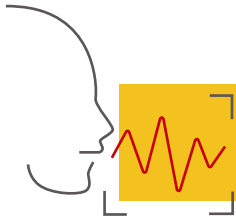
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C-V2X (Cellular Vehicle-to-Everything) technology will be installed in 15% of the world's vehicles.

Trend 5 ▶▶
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Industrial robots will work side by side with people in manufacturing, with 103 robots for every 10,000 employees.

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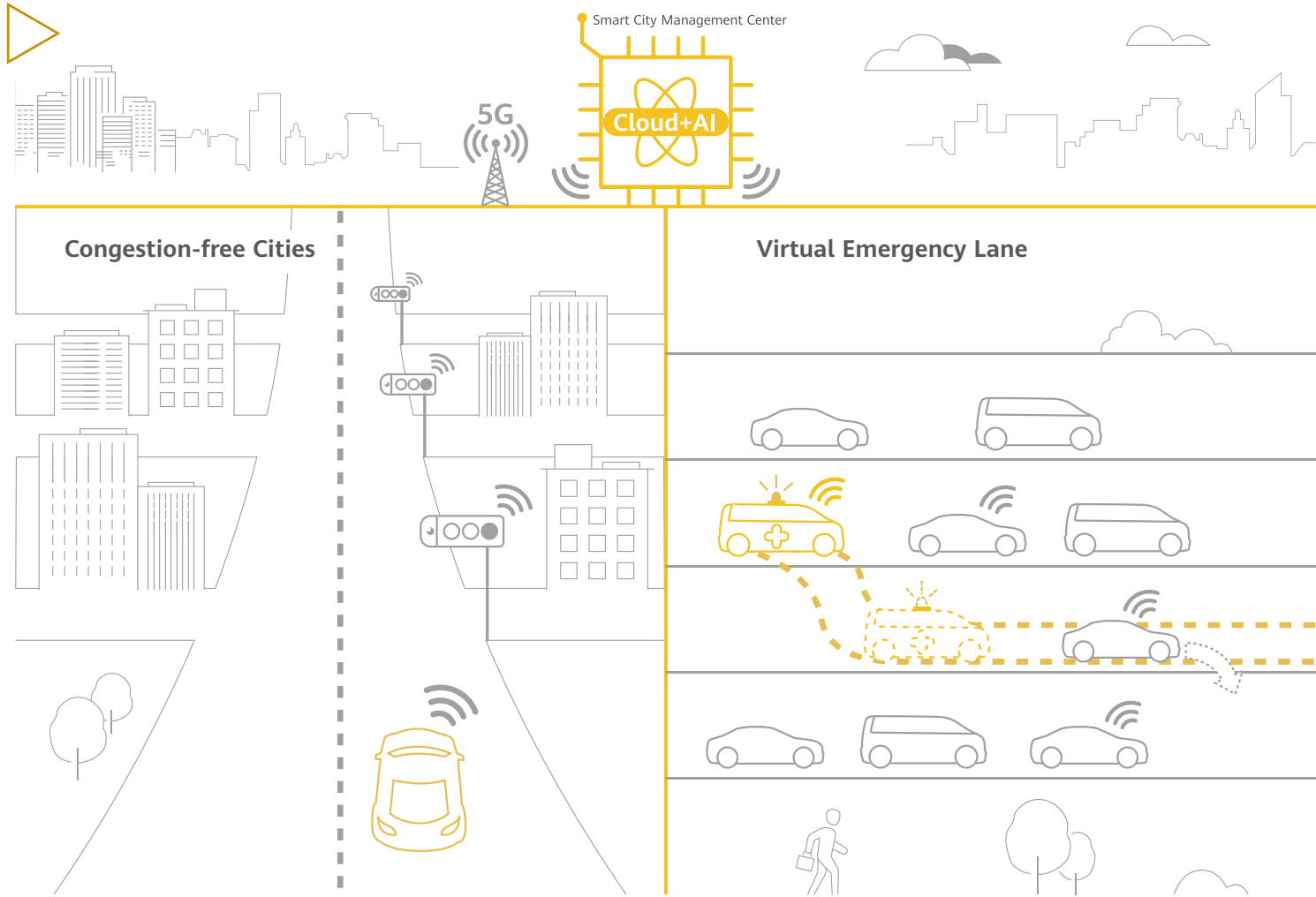
Trend 10 ▶▶
Global Digital Governance

The amount of global data produced annually will reach 180 ZB.

Trend 4

Tailored Streets

Smart City Management Center

5G

Cloud+AI

Congestion-free Cities

Virtual Emergency Lane

GIV predicts that by 2025, C-V2X (Cellular Vehicle-to-Everything) technology will be installed in 15% of the world's vehicles.

For those of you who have played the computer game SimCity, here's a question: What's the most searched-for tip online? How to design a futuristic cyberpunk skyline for your city, perhaps? As a matter of fact, the most popular tip is about something much simpler: how to prevent traffic congestion at new intersections. In fact, this is a question that still confounds transport planners in the real world. Streets and roads carry the lifeblood of the city, and the health of

a city's transport systems can be judged by looking at how smoothly traffic flows through their intersections. Ultimately, traffic flow impacts the efficiency of a city, its living costs, and local happiness and livability indexes.

What does a healthy urban transport system look like? For residents of megacities, the key factor is zero traffic jams, even during rush hour. They want faster or more economical options

to be available as needed. And they want the roads kept clear of accidents, with special arrangements for emergency vehicles so that they can arrive on the scene quickly to clear obstructions and save lives.

By applying cloud and AI technologies, the health of an urban transport network can be continuously improved, with cities moving towards the full utilization of road resources. This means that transport systems will become more efficient, and cities will become much more habitable. But the foundation of these ideal transport networks isn't a guarantee of free-flowing traffic on every road. To achieve this, streets need to be customized to the real time needs of their users.

By combining intelligent cloud centers, edge computing, and ubiquitous connections, cities can transmit and analyze the vast amounts of data generated by people, vehicles, and urban streets in real time. Data from complex traffic systems can be crunched in an intelligent analytics hub to instantly calculate optimal routes, adjustments to traffic light timings, and vehicle dispatch. GIV forecasts that by 2025, C-V2X (Cellular Vehicle-to-Everything) technology will be installed in 15% of the world's vehicles. Meanwhile, since an intelligent transport system needs to process massive volumes of multi-dimensional data and handle extremely complicated algorithms, advances in quantum computing will be a major benefit on the computation side. According to GIV forecasts, 20% of big companies expect to benefit from quantum computing.

Congestion-free Cities

Traffic jams are increasing in frequency and severity worldwide. On average, every person in the world wastes at least 15 minutes per day in traffic jams. In Bogota, the capital of Colombia and the world's most congested city, drivers wasted an average of 272 hours (over 11 days!) in traffic jams during 2018 [1]. Congestion also causes significant losses to the economy. For instance, it has been calculated that congestion costs Beijing residents 30 yuan (US$4.35) every half an hour [2] and American drivers over US$1,000 each year [3]. In addition to the lost time and money, congestion also adds significantly to noise, CO_2 emissions, and air pollution.

Quick and easy transport has become a major demand for urban residents. They want to be able to drive from A to B

without hitting a single red light. To address this need, AI algorithms for dynamic traffic planning can optimize road resources. Intelligent signal lights at every intersection can then provide clear routes, with all-green lights.

Other potential solutions to traffic congestion include overall traffic forecasts, and advance route planning for special or major events to prepare for dynamic real-time management.

▶ **Smart traffic lights:** The average green/cycle ratio at intersections (the fraction of the time that vehicles are allowed to proceed) is just 0.22 [4], so a clear need exists to optimize traffic signal control policies in real time. The city of Shenzhen has trialed AI technology at nine major congestion blackspots, where junctions were frequently blocked during morning and evening rush hours. As a result,

average vehicle speed has increased by 15%, saving drivers 10 minutes on average [5]. The Economist also reports that Los Angeles, a city notorious for traffic congestion, has managed to increase traffic speed by 16% by connecting and simultaneously regulating 4,500 traffic lights across its landmass of 469 square miles [6]. As intelligent, connected vehicles become more common, vehicles will communicate with each other and with traffic lights, so traffic lights at critical intersections can be optimized more quickly and drivers can better plan routes in real time.

▶ **Intelligent traffic control:** Unusual situations such as roadworks or a major concert can cause traffic delays to spike if plans are not made in advance. For example, in the runup to the Rio Olympics, traffic delays increased by 51% because of roadworks [7]. Reports indicate that if

traffic conditions can be accurately predicted an hour in advance for a single intersection, traffic efficiency through that intersection can be increased by 50% to 100% [8]. Intelligent traffic control solutions can help monitor and predict potential congestion by analyzing data from multiple sources in real time [9]. Traffic police can prepare accordingly, before the event occurs, and temporarily re-route traffic as needed. Regulators can use intelligent algorithms designed for complex traffic coordination problems to make real-time, dynamic arrangements for road usage and develop countermeasures for potential future issues that take the whole city's traffic situation into account. Connected vehicles traveling towards the problem location will receive information on traffic diversions and parking arrangements from an AI algorithm. These same algorithms can also assist traffic police to optimize nearby

routes and parking. This type of solution has helped shorten average delays in the most crowded sections of Beijing by 15.2% and cut delays on surrounding roads by 10% to 20% [10].

By 2021, the intelligent transport industry will be worth US$220 billion [8]. By fully utilizing 5G, intelligent connected cars, IoT, quantum computing, and other intelligent technologies, a "healthy" intelligent transport system can help ease the lives of busy urban residents, reduce travel costs and travel time, and boost efficiency across the city. "Green-light journeys" will be standard much sooner than you might imagine, because of highly-automated, intelligent, and user-friendly city infrastructure. And a congestion-free city will have a faster-growing economy, as goods and services circulate faster and faster [9].

Virtual Emergency Lanes

Emergency lanes are a critical safety measure. Despite stringent laws and penalties, rescue vehicles are frequently blocked by motorists who stray into emergency access lanes. At the same time, a dedicated emergency lane is a waste of valuable road space, because most of the time it must carry little or no traffic. Cities need a more effective mechanism to ensure that emergency vehicles can get through, but use road space efficiently when there's no emergency. The dynamic management of lanes and routes makes this possible.

In the future, emergency response will be handled by a combination of automated and human systems, rather than by human operators alone. Self-driving technologies and connected cars enabled by 5G will render physical emergency

lanes unnecessary. Instead, road resources will be allocated on-demand, so that when an emergency occurs, first responder vehicles can be guaranteed free passage.

As more vehicles are connected via technologies such as C-V2X, they'll be able to communicate with each other, with traffic lights, and with the city traffic control center. In the event of an emergency, the central systems will immediately generate the most efficient solution using real-time data on traffic across the entire city. It will then issue instructions to all relevant vehicles so that they can clear a temporary emergency route.

Audi China has completed China's first V2X test under real highway conditions. During this test, with the help of AI the

company's L4 self-driving car successfully changed routes in multiple real highway scenarios, performing actions such as emergency braking, accident warnings, automatic diversion, automatic lane change, deceleration, and emergency stops. L4 self-driving cars will become more widely used in the future, with AI algorithms analyzing broader road scenarios and automatically arranging alternate routes and lane changes [13]. Vehicles will also cooperate with each other on traffic control, taking action to change lanes, merge lanes, or choose alternates.

According to IHS Research, by 2025 the global market for autonomous vehicles will soar to US$2 trillion [14]. Traffic accidents will be reduced, and fuel consumption and air pollution will drop by 10% and 20% respectively [15].

Summary

Congestion-free traffic management systems and virtual emergency lanes lie at the heart of the Tailored Streets concept. They will form key basic technologies for the smart city and safe city projects of the future. These systems will dynamically connect pedestrians, drivers, vehicles, and roads in a unified network. Dynamic planning will enable intelligent transport systems to make more efficient use of road resources, and shorten emergency response times. In addition to saving lives, savings will be created in public budgets, and productivity for citizens and businesses will increase due to less time wasted in commuting and transportation. Intelligent systems will also reduce the environmental pollution caused by traffic.

All of this requires vast computing resources, carrying out high-dimensional analytics on spatio-temporal data, which cannot be supported by current computing architecture. As a result, companies and research institutes are increasing their R&D efforts to speed the development of new technologies like quantum computing.

GIV forecasts that by 2025:

▶ 15% of the world's vehicles will be equipped with C-V2X (Cellular Vehicle-to-Everything) technology.

▶ 20% of large companies expect to benefit from quantum computing.
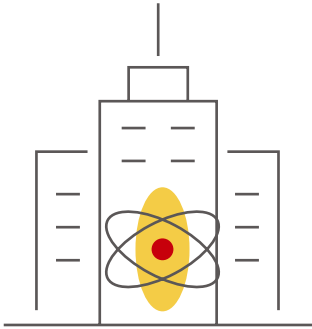
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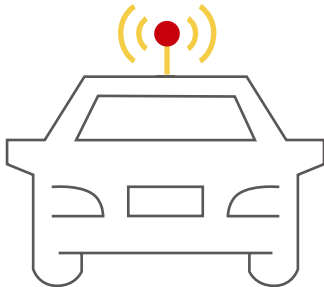
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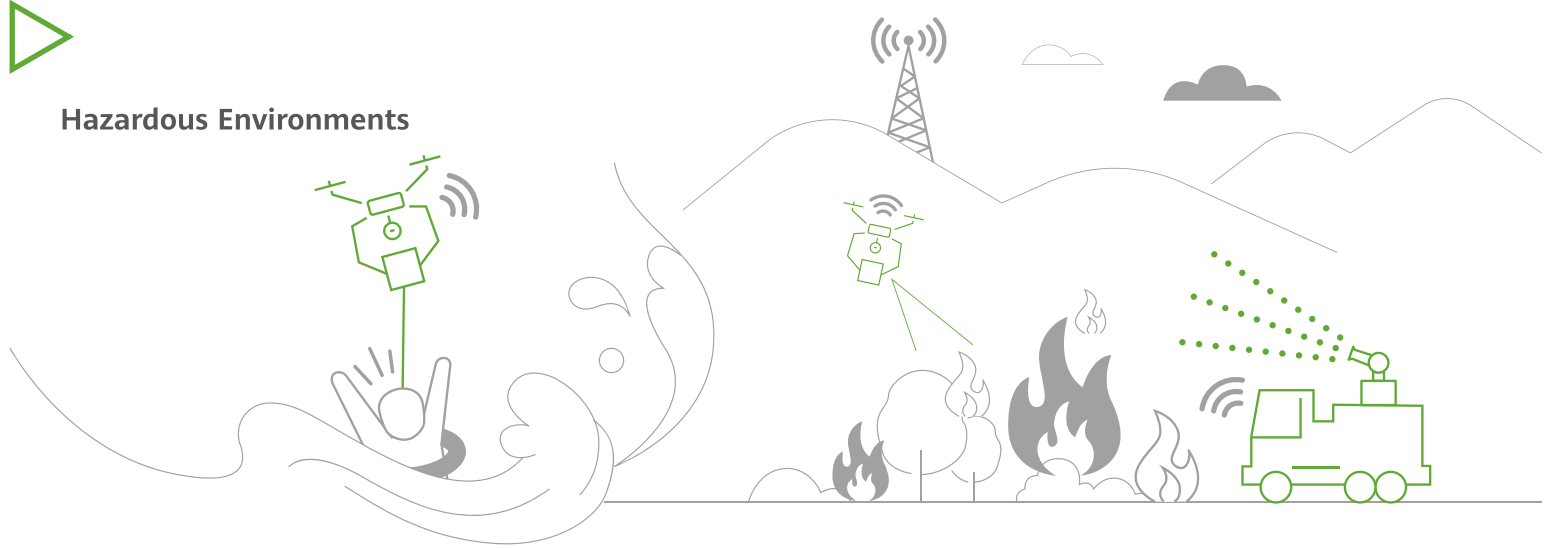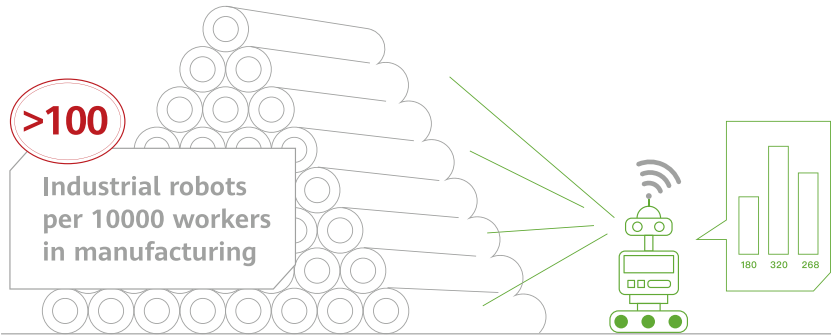The amount of global data produced annually will reach 180 ZB.

Trend 5

Working with Bots

Hazardous Environments

Repetitive Tasks

High-precision Operations

>100

Industrial robots
per 10000 workers
in manufacturing

180   320   268

GIV predicts that by 2025, industrial robots will work side by side with people in manufacturing, with 103 robots for every 10,000 employees.

Robots are an increasing fixture in a wide variety of workplace roles. And when it comes to choosing your colleagues, there are three particular work scenarios where a robot is in many cases the best choice: danger, repetition, and precision.

Consider that an average of 2.78 million people each year are killed at work, 387,500 (or 13.7%) of which are attributable to accidents [1]. The number of non-fatal accidents is far higher, reaching 374 million per year [1].

As well as saving time, increasing productivity, and freeing people up to concentrate on more creative and high-value tasks, robots have the potential to have a hugely positive impact on reducing work injuries and deaths.

Hazardous Environments

Emergency rescue tends to be dangerous and unpredictable, especially given the precarious and unstable environments that can follow any given disaster. But, a new breed of light, nimble robot is playing a crucial role in rescue efforts. Able to operate in complex environments and small spaces, they can minimize the risk to rescuers and perform tasks that humans are often unable to.

► **Nuclear spills:** After a 9.0 earthquake crippled three reactors in the Fukushima nuclear power plant in 2011, the rescue robot series Quince was able to traverse terrain on four separate sets of caterpillar tracks powered by six electric motors [2]. Equipped with an infrared sensor that doubled as a carbon dioxide sensor, Quince was able to detect breathing and the warmth of survivors in Fukushima.

Designed with sufficient agility so as not to disturb volatile radioactive rods, the robot rovers could scour every building in the affected area, checking for rising temperatures and radiation. Equipped with remotely controlled pinchers, Quince could probe debris that was suspected to contain molten nuclear fuel at the bottom of Fukushima's nuclear reactors,

helping to plan cleanup.

Cleanup efforts are still ongoing, with an estimated additional 40 years and US$75.7 billion required to tear down and clean up the facility [3]. To complete this long-term goal, new generations of robots have emerged – and are still emerging – for specific scenarios. The Scorpion, so named because it could curl up its camera-equipped arm to give wider viewing angles, was put into action in 2016 to relay images from inside the reactor [4]. While Scorpion relayed valuable data, the first incarnation of the bot failed in its overall mission. However, it delivered important lessons in designing robust, purpose-built bots, with the next iteration – Sunfish – able to successfully relay images of the melted reactor.

With robots emerging as an essential part of handling this disaster, engineers are continuing to develop new form factors to complete specific tasks.

▶ **Fighting fires:** Every year, 2,500 firefighters are injured or lose their lives protecting people and property [5]. Firefighting robots are already playing an important role in the incidents that firefighters typically tackle: fires, explosions, and gas leaks. They can collect, process, and transmit data in places that we can't, for example, where it's toxic, flammable, or affected by dense smoke, or in dangerous environments such as collapsed tunnels and metro systems.

In 2018, researchers from Japan's Tohoku University developed a new kind of firefighting robot that can rise on high-pressure jets of water and propel water into the heart of a fire [6]. Equipped with both optical and

infrared cameras, it can relay what's happening on site so that firefighters have a greater insight into how to approach a particular incident. Robots can also make up for personnel shortages in nations such as China, Vietnam, and Laos, each of which has just one firefighter per 10,000 people [7].

► **Ocean disasters:** Much like fires, sea rescues are invariably complex and unpredictable. Using a machine learning model, the artfully named drone "Little Ripper Lifesaver" can spot swimmers in trouble as well as threats like sharks [8]. During one training exercise, one such unit alerted its handler to a swimmer in distress. The drone handler was able to reach the swimmer in 70 seconds, using the drone to drop a life vest [9].

Throwing in bodies to save more bodies is an outdated, dangerous, and inefficient way to ensure successful search and rescue. As the use of robots in hazardous environments spreads, robot models will be developed that are more economical and more effective – much like they've been optimized in Fukushima for specific scenarios. These robot rovers will no longer be confined to their current roles of observation and exploration. Like human rescuers, they will perform a wide range of complex tasks, including supplying trapped victims with food and water, detecting breathing, and measuring environmental factors.

Equally, they will have an increasing role in highly dangerous jobs such as welding, working underground, underwater exploration, and cleaning ducts.

Repetitive Tasks

Robots are far better suited for highly repetitive tasks than we are not only because of their tireless accuracy, but also because they aren't injury prone – or at least not in the same way as we are. It's estimated that Repetive Strain Injury is responsible for around 50% of industrial injuries [10]. Below are some of examples of repetition where AI and robots can excel.

► **Policing**: Today's computers are significantly better at recognizing faces than people. They're not confused by lighting, angle, expression, age, image fuzziness, or partial shots of faces. For the police, manually scanning huge archives of mugshots is becoming a thing of the past thanks to the widespread adoption of AI. And at 1 billion faces per second and an error rate of one per 1 million, the speed and accuracy contrast between bots and humans simply cannot be compared [11]. Think about this: AI can scan the face of everyone on earth in less than 8 seconds.

How does that directly benefit us? One way is missing persons: Gartner predicts that AI facial recognition will help to reduce the number of people who go missing by 80% by 2023. To put that in context, an estimated 8 million children go missing per year [12]. AI, therefore, has the potential to cut that figure by 6.4 million.

Crime will also start to become less attractive. AI today can help the police by locking in on the face of a suspect in surveillance footage with more than 99% accuracy. It can track suspects' locations, follow their movements, and develop an arrest strategy. For example, in 2018, a police officer wearing facial recognition glasses identified a heroin smuggler at a train station in Zhengzhou, China [13].

► **Construction**: AI isn't just used to scope faces and protect copyright; it's also boosting productivity by taking over unskilled drudgery in many sectors. In the construction industry, for example, counting steel rebar is a time-consuming task, as each piece needs to be counted by hand at different stages of the delivery process, with each truckload taking about half an hour per time [14].

While a truck is being weighed, the AI quickly scans the freight to determine the type, quantity, and thickness of the rebar. Construction staff can then get on with skilled work. Coupled with the time-savings, AI in construction represents a major

efficiency gain for companies that deploy the tech.

► **Financial Services**: One of the easiest areas for the application of AI is the financial industry. AI can automate uploading forms and checking documents for errors, boosting processing times by 80% and cutting error rates in half [15].

The Legal Profession: AI can provide a quick and accurate assistant to legal processes [16]. Legal documents tend to have the same structure, including names, applicable laws, evidence, testimonies, court opinion, and final judgments. Companies are already researching how to use natural language processing on statutes and court judgments, and tools are in use today that can analyze data faster and more accurately than humans. This will affect things like red flag reports, which require consultants to view and define key documentation for due diligence. Requiring a huge amount of time, AI will perform the bulk of the legwork (or eye work), allowing consultants to concentrate on the most important documents.

High precision

The third area in which robots eclipses humans is high-precision tasks.

▶ **Linguistics**: When it comes to lip reading, data from McKinsey shows that AI can perceive subtle movements of the lips and changes in the shape of the mouth to hit 95% accuracy, far outstripping the 52% achieved by human experts [17]. Applications include allowing deaf people to communicate more easily and assisting the police in forensic linguistics.

▶ **Surgery**: The human brain contains tens of thousands of neurons, making brain surgery a life-threatening prospect for patients. Robots mitigate the risks, letting surgeons perform fast and accurate keyhole surgery using multimodal imaging, precision optical recognition, and surgical positioning and
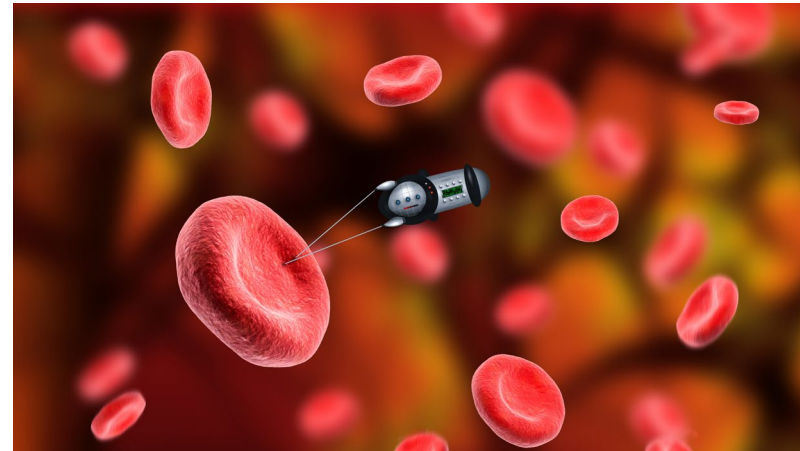
guidance [18]. By making it safer and easier for doctors to control surgery, these robots radically shorten the length of procedures, greatly improving the outcome for patients.

Hospitals in China use robots to help with the guidance and the positioning of craniotomy openings to remove cysts when treating epilepsy [19]. The improved accuracy means that the openings can be smaller, cutting the probability of complications.

We're already at the tipping point of autonomous surgery. In 2016, the Smart Tissue Autonomous Robot (STAR) successfully sutured two pig tubular structures in a series of experiments, which was more precise than a professional surgeon [20]. Using the latest 3D imaging systems and high-precision sensors to complete the stitching of wounds, robot surgeons are accurate to within a millimeter.

Boston Consulting calculates that medical robot sales in 2016 were worth more than US$7 billion, of which about 60% was spent on surgical robots [21].

► **Manufacturing**: High-precision components require levels of precision that the human eye simply cannot see. The precision of an industrial robot mainly depends on the gear box in its joints: the larger the robot arm, the lower the precision. As software develops, electronic components become smaller, which improves precision.

Each year, robots contribute between 0.8 and 1.4 percentage points to global productivity and have cut maintenance costs in industry by up to 25% [22]. By 2025, the industrial robot market will grow 175% to be worth US$33.8 billion [23].

Summary

Automation and robots, particularly AI-powered bots, are changing the way we live and work. This technology will allow us to focus our energy on creative, knowledge-based tasks.

Intelligent robots will handle hazardous, repetitive, and high-precision tasks without rest or error, greatly boosting productivity and safety. Today, smart automation is widespread in various fields, including manufacturing, the law, biopharmaceuticals, and surgery.

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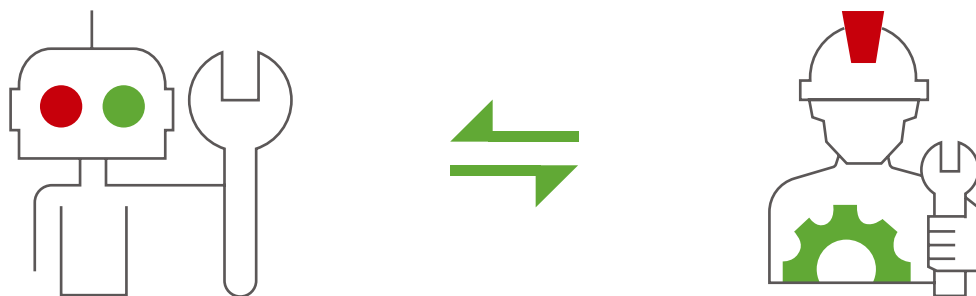
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Trend 1 ▶▶

Living with Bots

The adoption rate of intelligent domestic robots will reach 14%.

Trend 2 ▶▶

Super Sight

The percentage of companies using AR/VR will increase to 10%.

Trend 3 ▶▶

Zero Search

The adoption rate of intelligent personal digital assistants will reach 90%.

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C-V2X (Cellular Vehicle-to-Everything) technology will be installed in 15% of the world's vehicles.

Trend 5 ▶▶

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Industrial robots will work side by side with people in manufacturing, with 103 robots for every 10,000 employees.

Trend 6 ▶

Augmented Creativity

97% of large companies will be using AI in their services or operations.

Trend 7 ▶▶

Frictionless Communication

Enterprises will be making efficient use of 86% of the data that they produce.

Trend 8 ▶▶

Symbiotic Economy

85% of business applications will be cloud-based.

Trend 9 ▶▶

5G's Rapid Rollout

5G networks will cover 58% of the world's population.

Trend 10 ▶▶

Global Digital Governance

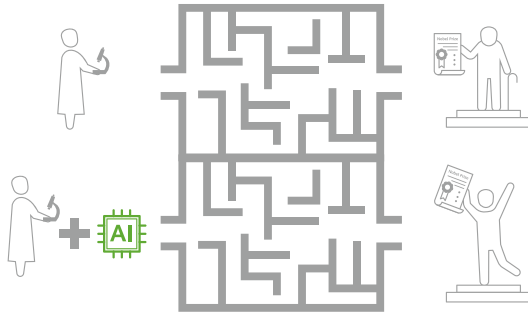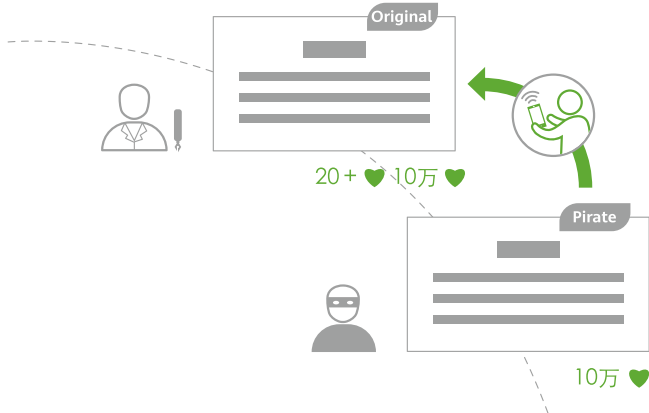The amount of global data produced annually will reach 180 ZB.
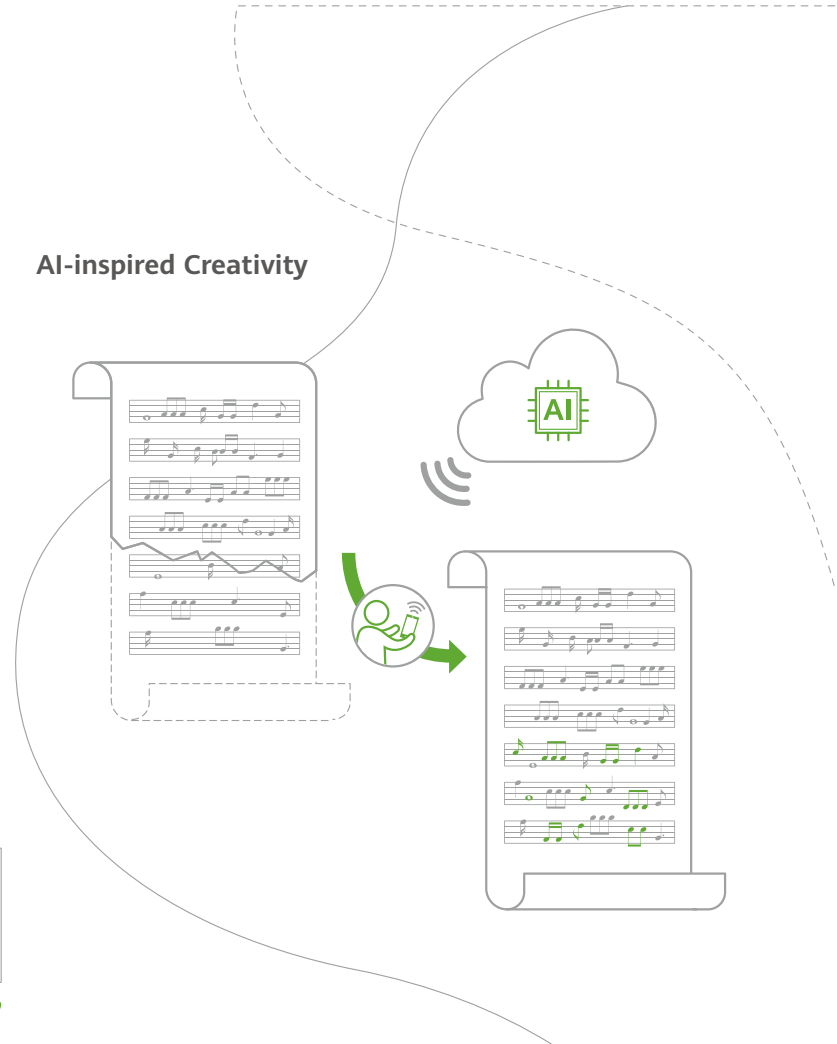
Augmented Creativity

Augmented Creativity

Trial and Error Discovery

AI-inspired Creativity

Protecting IP & Encouraging Originality

Original

20 + 💚 10万 💚

Pirate

10万 💚

GIV predicts that by 2025, 97% of large companies will be using AI in their services or operations.

The invention of new medicines that can help save millions of lives may need 10 to 15 years to perfect, given the huge number of chemical compounds that exist – 154 million according to the CAS registry [1]. If you were a pharmaceutical researcher, would you want to spend most of your career on a single project? Or would you welcome a gifted virtual assistant that could slash the screening and testing time and make the creative leap that would let you discover a target molecule in a few days?

Equally, modern media is saturated with information, much of which is either duplicated or homogeneous content, obscuring the useful, original information that readers seek. If you were an editor, would you appreciate a virtual content expert to help you quickly identify and eliminate unnecessary content, so you could

provide articles with in-depth and unique perspectives to your audience?

If you enjoy classical music, could you see yourself completing Schubert's unfinished Symphony No. 8 in your own way with the help of your phone?

As cloud-based intelligent technologies are applied more widely in various industries and the power of personal computing devices continues to grow, the scenarios mentioned above are quickly becoming reality. GIV forecasts that the adoption rate of AI technologies in large companies will increase from 46% in 2018 to 97% by 2025.

Trial and Error Discovery

The road to discovery is full of trials, failures, and mistakes. Researchers usually face countless forks with no clear path to success – it's not uncommon for a research team to spend decades on a single project before getting a meaningful result. Therefore, it's important to learn how to manage risk and, more importantly, how to improve success rates.

Trial and error is common in pharmaceutical research, as there are huge numbers of molecules with drug-like properties. That's why pharmaceutical scientists can spend decades finding target molecules to develop a reference listed drug (RLD). For instance, to find the RIP 1 inhibitor (an inhibitor that can block the progression of multiple

sclerosis), scientists first needed to find three specific skeletal structures of active molecules from among 7.7 billion labeled compounds in their library [2].

According to Deloitte, despite the expensive price tag for new drugs, the ROI of the top 12 pharmaceutical companies in 2018 was only 3.2% [3].

Cloud-based super computing and AI algorithms can significantly reduce the amount of trial and error required for candidate drugs once a drug target is confirmed. It has been estimated that adopting AI in pharmaceutical research can reduce R&D costs by 60% and shorten R&D times from three years to one [4]. By the end of February 2018, 16 pharmaceutical companies and over 60 start-ups worldwide were using AI technologies to develop drugs, according to the biotechnology company BenchSci [5]. Bringing down R&D costs can help stabilize and reduce the final prices of pharmaceuticals, improving overall affordability.

With AI systems trained with massive amounts of data and intelligent devices, trial times can be greatly reduced and success rates significantly increased, enabling more people to make discoveries sooner in a range of fields.

Protecting IP and Encouraging Originality

The Internet and social media platforms have become the main channels through which the public gets information. To attract views, the feeds of many news apps are filled with thin content with catchy titles – aka clickbait. Some outlets repost popular videos after stitching clips together and changing the file bitrates so that they won't be identified as duplicates or aggregated content. Content generation software can generate an "original" news report by combining popular content, and these news pieces usually have extensive reach.

Such approaches undermine journalists who pursue authenticity and the creation of original articles, leading to high-quality content being sidelined by poor-quality clickbait. As a result, it's harder for us to quickly find original, in-depth content and insights that feature a unique viewpoint. Moreover, the public may gradually lose its ability to make well-informed judgments and think critically if they're overwhelmed by junk news feeds.

Fortunately, AI technology can address false news reports and stories from unknown sources. Duke Reporter's Lab maintains a database of over 100 fact-checking sites. Users can report fact-checks and use AI to check whether news pieces are copies or re-edited versions of other content [6]. And leading Internet search engines are introducing functions that checks for copies in videos and news photos.

Attempts at using AI to protect original journalism can encourage the healthy development of media outlets, and encourage journalists to focus on investigative articles and insights.

In academic settings, charts and diagrams are the essence of how many authors approach research papers and theses. Creating charts not only requires a great amount of knowledge, but also accurate judgment and strong data analysis skills. As a result, authors frequently copy them either directly or indirectly from other work without referencing the source. According to a report jointly released by Science and Retraction Watch, the retraction of papers containing plagiarized charts caused US$1 billion worth of losses in 2018 [7].

AI and deep learning algorithms can help address plagiarism and protect academic integrity. In 2018, a machine learning research team from Syracuse University developed an algorithm that can identify chart plagiarism in papers [8], even if the graphs are rotated, sizes adjusted, and colors changed. This technology can help researchers fight against plagiarism and provide the assurance they need for ongoing innovation.

AI-inspired Creativity

Creative professionals like musicians, designers, and writers spend an average of 65% of their time on selecting the basic elements that feed into the creative process [9]. As intelligent applications thrive in creative industries and intelligent devices become ubiquitous, everyone can produce their own creations with the help of AI as soon as they find inspiration. Artistic creativity is no longer just a playground for professionals and the gifted – everyone will have the ability to add to humanity's creative pool.

AI has been used as a tool to help users write film scripts and TV

plays in standard formats [10]. As most people are unfamiliar with these formats, they're unable to convert a potentially great plot idea into a viable show or movie. AI algorithms can be used to learn and then create scripts that can be used by users at all levels. Users can present their stories in frameworks that suit their stories best, regardless of skill.

In addition to creating scripts, AI can also help people complete the unfinished works of great musicians. With the support of deep learning algorithms, AI can write melodies by learning and analyzing the characteristics of a certain type of music or the works of a certain composer. You can select melodies based on your preferences, and use the suggestions made by AI to complete an unfinished classical work.

The great composer Franz Schubert died when he was only 31, with his Symphony No. 8 left unfinished. In February 2019, Huawei unveiled a unique version of the Symphony No. 8 in London that served as one way of completing this great work [11]. With the help of the Dual-Neural Processing Unit (NPU) AI accelerator embedded into a smartphone, Lucas Cantor, the US film music composer, analyzed 90 songs created by Schubert as well as certain works by other composers who had influenced Schubert in his earlier years. The entire melody was composed using AI and a smartphone. Cantor used only his smartphone to select melodies, adapt them, and finish the composition. Although the last two movements were co-generated by AI and Cantor, the unique style of Schubert can be clearly heard in the melody.

Summary

Not only will technologies help reduce the time take to discover new drugs, it also lowers the barrier of entry into artistic creation. With a smartphone embedded with AI chips, anyone can realize their creative potential. As more people get involved in creative pursuits, technology will help lay the foundation for mass creativity.

GIV forecasts that by 2025:

▶ 97% of large companies will introduce AI into their business operations or management processes.

▶ The total number of smartphones in use around the globe will reach 6.1 billion.
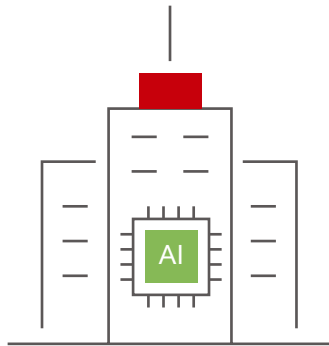
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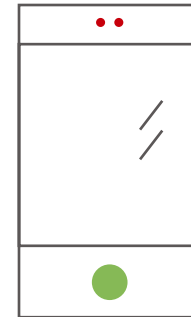
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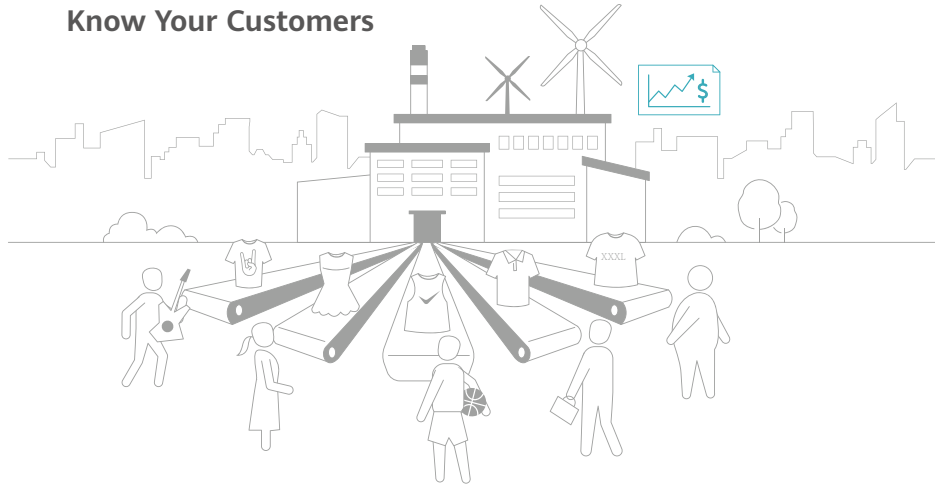The amount of global data produced annually will reach 180 ZB.

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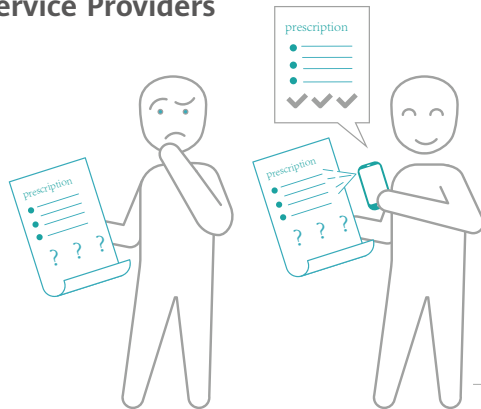
Frictionless Communication

Know Your Customers

Inclusive Communication

Understand Your Product/ Service Providers

Borderless Communication

GIV predicts that by 2025, enterprises will efficiently use 86% of the data that they produce.

You may have read the classic sci-fi story *Understand*, later filmed as the action movie *Lucy* starring Scarlett Johansson. In the story, the hero is given a drug that expands the power of his mind. So, what's the first thing he does with his new-found super-intelligence? Does he immediately explore fundamental truth and the reality of the universe? No. His first act is to invent a form of communication: a new language so efficient that it eliminates all friction, error, and repetition. He could talk almost telepathically, exchanging ideas with nothing more than a glance.

We read science fiction to be inspired. What a company wants more than anything is to deliver tailored, personal products and services that respond to its customers' specific individual needs. We want an AI that records and understands a customer's insurance needs, history, and problems with past claims so that it can sympathetically listen, comprehend, and provide the perfect individualized insurance solution. Not only that: health insurance that responds to your real-time health status would give people the right financial incentives to get fit and stay healthy. We want fitness equipment designed for customers' budgets and health needs, combining data from each person's physiology with award-winning design to produce fitness equipment that fits the user. Just imagine:

What if the companies that serve you knew you like an old friend? If company and customer could experience that level of comfort and communication, wouldn't that give any company an amazing advantage and opportunities for more innovation?

Now, imagine the benefits of a customer truly and deeply understanding the companies that they use. A customer would not be bombarded with advertising puff, but could see an accurate breakdown of a product's positives and negatives, and receive personalized advice on the best deal for them. This would help prevent the kind of cutthroat competition on cost that drives quality and satisfaction down. Moreover, medical patients would no longer have to worry that they don't understand the medical terminology on the label of their medicine, because AI comparison sites can explain the medication to them in terms that everyone can understand in real time. The sense of security that this communication engenders will mean a better experience for customers, and will help companies attract more potential customers, maintain their long-tail customers, and keep their business growing.

As AI technologies advance, we're starting to realize borderless communication that enables companies to offer diverse services to customers around the world with no language barriers. Technology will also give us a more enjoyable travel and social experience, as we find ourselves able to ask for directions or share a joke in a local language.

Thanks to smart wearables and AI sign language interpretation devices, people with hearing or speech impairments will be able to participate in social situations, workplace discussions, and creative collaboration. Inclusive communication means more momentum for innovation and social progress.

Huawei's GIV forecasts that by 2025, companies will be making effective use of 86% of their data, and by 2025, 97% of large companies will be using AI technologies. Frictionless communication will mean lower communication costs for companies, lower error rates, and more efficiency for all.

Understanding Customers

Many companies still design products or services based on false assumptions about customer needs. As a result, people are frequently disappointed with services, or worse still, just completely ignore them.

To understand customers better, companies are now using intelligent technologies to help them design innovative business models. Service providers have always had access to surface-level data, like customer buying patterns and social interactions. But now they can dig deeper into information like user emotions and personality. They can find online and offline information about a customer's career, interests, preferences, and social attitudes, creating a vivid profile and high-quality input data for AI algorithms to uncover real and hidden needs.

Take the fitness industry as an example. For amateurs, buying the most expensive equipment may not be the wisest choice. Worse still, for those with injuries, standard equipment may not be suitable at all. If a fitness equipment vendor can learn

its consumers' background, level of fitness, and exercise objectives, they can recommend the right equipment or even make customized equipment in response to their customer's needs [1]. Whether you just want to lose weight or build strength after an injury, working with the right equipment can help you achieve their goals faster. And by tracking and monitoring progress on an ongoing basis, vendors can work with fitness advisors to suggest future exercise programs, thus expanding the role of the vendor in your fitness journey and boosting brand loyalty.

In the manufacturing industry, OEM/ODM vendors in developing countries can better manage their inventory and reduce the amount of goods they stockpile by using AI to analyze real-time sales data. Vendors can even create

their own brands and enhance their ability to innovate. As manufacturers gain a deeper understanding of the real needs of end users, they can develop products that better satisfy the needs of the brand-name firms that sell their products, and increase their own value within the supply chain by identifying and recommending new business opportunities. Consumer-facing companies can use AI technologies to combine their own customer databases with information from social media and from third-party retailers to better understand users' spending patterns and psychology. This will help companies reduce marketing spend and build sustainable value into their brand. At the same time, innovative service delivery platforms deeply integrated into user activities will create a burgeoning new sector in the intelligent economy.

Understanding Product & Service Providers

If you've attempted to contact a large organization (and you probably have) to solve a problem or get an enquiry answered, you may be familiar with the accompanying feelings of frustration and anxiety. In fact, the experience can often deeply damage customer relationships. In particular, complex internal structures and technical information can be very off-putting for an outsider.

Picture a mother who has just rushed her young daughter to hospital. Perhaps the hospital's resources are thinly stretched, so the doctor doesn't have much time to sit with the parents and is only able to give them a few words of technical explanation: "I'm prescribing her an anti-bacterial for streptococcus pneumoniae." How would this mother react? Doctors have to deal with people who are already stressed by the fear of illness, and by the

physical effects of the illness itself. It's no wonder that conflicts between patients and doctors eat up 6% of hospital efficiency every year, and 75% of doctors and nurses report that they have been subject to physical or verbal attacks caused by problems in
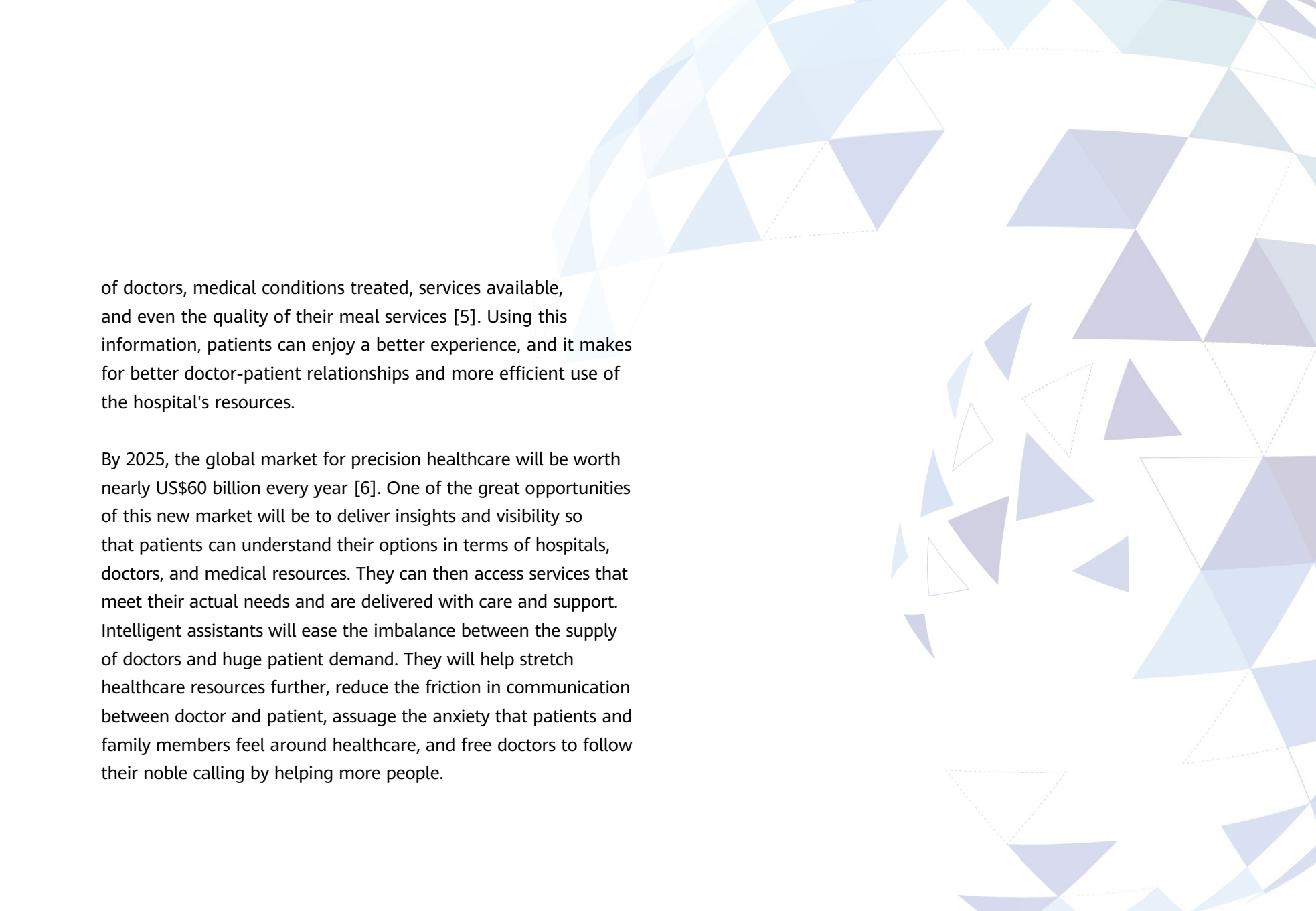
communication [2].

An AI assistant could greatly ease tension between doctors and patients. For example, an AI assistant could interpret a doctor's prescription in layman's terms to make it easier for patients to understand [3]. This will allow patients to feel more certainty about the health issues they face, their risks, treatment plans, and expected effects. Doctor-patient interaction can be smoother and calmer, without the stress of complex terminology.

After receiving a prescription, AI tools can also help patients understand what the doctor has given them, confirm that it's the right drug for them, check for any alternative therapies, and calculate the correct dosage for their current condition [4]. For the elderly and other patients who need support, these tools can make sure that drugs are taken on time, in the correct dose, without any confusion [4].

In developing countries, the healthcare system is often poor at directing patients to the most appropriate medical resources. Long queues are frequently seen in public hospitals and doctor-patient relationships can be fractious, largely because patients have no access to information about what medical resources are available. As patients cannot learn about a doctor's schedule and choose the best option in advance, they often end up shuttling back and forth from hospital to hospital, which means unnecessary repeated tests and delays in diagnosis and treatment.

A health service with effective big data systems gives patients a transparent view of all doctors and resources available to them, along with information about the quality of services available. This means less time spent queuing and carrying out repeated tests, and a better healthcare experience. In the US, the health information exchange (HIE) system gives patients comprehensive information about thousands of hospitals, including the names

of doctors, medical conditions treated, services available, and even the quality of their meal services [5]. Using this information, patients can enjoy a better experience, and it makes for better doctor-patient relationships and more efficient use of the hospital's resources.

By 2025, the global market for precision healthcare will be worth nearly US$60 billion every year [6]. One of the great opportunities of this new market will be to deliver insights and visibility so that patients can understand their options in terms of hospitals, doctors, and medical resources. They can then access services that meet their actual needs and are delivered with care and support. Intelligent assistants will ease the imbalance between the supply of doctors and huge patient demand. They will help stretch healthcare resources further, reduce the friction in communication between doctor and patient, assuage the anxiety that patients and family members feel around healthcare, and free doctors to follow their noble calling by helping more people.

Borderless Communication

With 6,500 or so spoken languages in existence, the ability to communicate across language barriers is vital for global companies and organizations. Picture a conference room. Around the table sit CEOs from London, Rio de Janeiro, Beijing, and Tokyo, locked in delicate negotiation. Today, a team of interpreters and stenographers would be required to support this meeting, bringing added cost, logistical difficulties, and additional layers of potential error and ambiguity. If few professional interpreters are available in the languages required, these difficulties multiply. What are the chances of a successful conference with speakers of Arabic, Swahili, and Hausa?

UN interpreters work in short bursts just 20 minutes, before they swap out with a partner. Even with a full team, they're able to convey an average of about 60% of the content in a speech [7]. EU institutions, which produce content in two dozen different languages, were spending around €1.123 billion on translation and interpretation ten years ago [7]. This single internal overhead accounts for about 1% of the entire annual budget of the EU. An official EU website must have 24 different language versions, as must all EU software [7]. Huge investments of time and manpower are needed to ensure consistency between different versions.

AI-enabled translation devices can help people speaking different languages communicate effectively [8]. The combination of human plus AI translators makes for a much more effective team: Together, they can achieve 95% accuracy with 0% omissions [9]. This fundamental transformation of the translation process means greater efficiency, completeness, and accuracy. Some tasks can also be fully automated: AI can maintain websites and electronic documentation without any human input [10].

Inclusive Communication

AI devices for sign language can help the deaf communicate more easily, encouraging a more inclusive society. There are approximately 230,000 deaf people in Shanghai, 120,000 of whom use sign language, but there are only about 30 sign language translators in the entire city [11]. StorySign is an app that helps deaf children to read using AI technologies such as image recognition and optical character recognition [12]. When a user scans a page from a story book, the StorySign app shows a cartoon signer who signs the words. Currently, StorySign can translate text into 10 different sign languages: British (BSL), Irish (ISL), Dutch (NGT), Flemish (VGT), Italian (LSI), Spanish/Catalan (LSE & LSC), French (LSF), Portuguese (LGP), Swiss German (DSGS), and German (DGS). More languages will be added in the future.

AI devices and software allow those with speech or hearing impairments to contribute on an equal footing. But at present, satisfaction with assistive devices for deaf people stands at just 10% worldwide [11], a level that indicates a massive unmet need and a great business opportunity. Use of smart devices is also a measure of how inclusive our society is, as the deaf will use them to access learning and personal development opportunities, innovate and contribute to the digital economy, and reap the corresponding benefits.

Summary

Frictionless communication gives companies a clearer, more precise understanding of their customers at lower cost. More importantly, it reduces error and misunderstandings by providing open and transparent information for all. AI translation devices will enable communication and business to flow across borders, helping companies around the world expand their reach globally. IoT technologies and smart wearables will draw everyone into the economy, offer each person opportunities to realize their unique value, and deliver the benefits of the digital economy.

AI is the enabler for frictionless communication. AI systems are not static; they can be continuously improved by training them with complete and diverse datasets. To capture, transport, and deliver the vast amounts of data generated, we need to create a web of ubiquitous connectivity.

GIV forecasts that by 2025:

▶ Companies will be making efficient use of 86% of the data that they produce.

▶ There will be 100 billion connected devices in the world.

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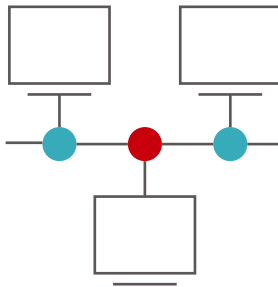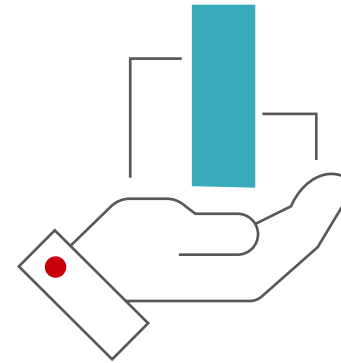
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Trend 1 ▶▶

Living with Bots

The adoption rate of intelligent domestic robots will reach 14%.

Trend 2 ▶▶

Super Sight

The percentage of companies using AR/VR will increase to 10%.

Trend 3 ▶▶

Zero Search

The adoption rate of intelligent personal digital assistants will reach 90%.

Trend 4 ▶▶

Tailored Streets

C-V2X (Cellular Vehicle-to-Everything) technology will be installed in 15% of the world's vehicles.

Trend 5 ▶▶

Working with Bots

Industrial robots will work side by side with people in manufacturing, with 103 robots for every 10,000 employees.

Trend 6 ▶

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97% of large companies will be using AI in their services or operations.

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Enterprises will be making efficient use of 86% of the data that they produce.

Trend 8 ▶

Symbiotic Economy

85% of business applications will be cloud-based.

Trend 9 ▶▶

5G's Rapid Rollout

5G networks will cover 58% of the world's population.

Trend 10 ▶▶

Global Digital Governance

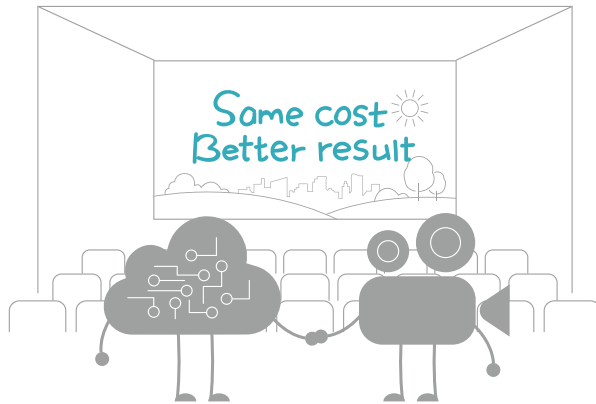The amount of global data produced annually will reach 180 ZB.

Trend 8

Symbiotic Economy

Technology for Inclusion

Technology for Partnerships

Same cost
Better result

Technology for Sustainability

GIV predicts that by 2025, 85% of business applications will be cloud-based.

If we turn the clock back 30 or 40 years, we come to a period labeled "economic globalization". Many giant companies were expanding their business and beginning to launch global partnerships.

Back to the present and the Internet alongside cutting-edge smart technologies have created a vibrant global explosion of economic activity that includes all countries, governments, companies, and people, and gives them the opportunity to work across different regions, different economies, and different industries. It no longer

matters where you are, what language you speak, or whether you share the same culture: Digital technology and smart applications are being adopted by industries all around the world, mainly working through unified access platforms. Companies around the world have the opportunity to work together, and share in the resources of global ecosystems. Together, they can create high-value intelligent business models that will change individual lifestyles and working practices across whole industries.

The symbiotic economy is a product of this platform-based

model of development. It offers a way for companies to grow their business and for global companies to work together and work with partners. The single-minded pursuit of profit is no longer the only aim of a responsible corporation; transactions on a purely buy-and-sell basis aren't the best model for ecosystem partners to work together. Companies must ask new questions: How can they fulfill their social responsibility, and create a symbiotic ecosystem so that countries, regions, and consumers in every corner of the world can benefit equally from inclusive and intelligent technology? How can they build ecosystems that support cooperation between multiple businesses? How can all customers, business partners, and supply chains, no matter how large or small, be drawn into an alliance, so that they can all take advantage of the opportunities in the new ICT ecosystem?

These are the basic questions that the intelligent society asks of its technology companies.

Technology for Inclusion

There are still many nations and regions where citizens are unable to access basic communication technologies or Internet services due to economic, political, social, and geographical conditions. Digital inclusion is the attempt to make technology accessible and affordable to all companies and individuals, from connectivity to applications to digital skills. True inclusion, combined with economic growth, will enable the benefits of technology to flow to all groups and companies.

Mongolia is a vast country with few people, most of whom do not live in towns and cities. It still has a large contingent of nomadic herders keeping alive the traditional Mongolian way of life on the grasslands. They live in yurts and very rarely have access to an Internet connection. In fact, of the 850,000 households in Mongolia, only about 100,000 can get online [1]. Working with Huawei, the service provider Unitel launched the Ger Internet project in 2017 to deliver wireless home connections based on a plug-and-play Wi-Fi solution [1]. The goal was to provide wireless connectivity across the vast and sparsely populated areas of rural Mongolia.

Over 50,000 families in remote parts of Mongolia now use Ger Internet, selecting the customized level of service that's right for them [1]. Internet connections mean that herders can listen to the weather forecast, and learn about new farming technologies that can significantly raise local productivity. By 2020, Ger Internet will connect 300,000 previously unconnected households, giving them opportunities for online learning, e-commerce, and remote medicine, which will potentially greatly boost quality of life [1]. Inclusive technology means giving residents in hard-to-reach regions equal opportunity to experience the power of technology. When the uptake of a new technology is widespread, then that technology can be used more efficiently, which means that local people will have more opportunities to learn and

acquire new skills.

Most women in Bangladesh still don't have enough basic education to be able to use the Internet on their own. Promulgating basic technology skills is the main bottleneck that must be overcome to develop the nation's digital economy. However, Bangladeshi villages lack educational resources and computers to learn on. Building new schools or transporting women to cities to attend courses would be very difficult to arrange and manage. As a response to this problem, the Ministry of Posts, Telecommunications and Information Technology and several partners launched a digital bus project, which offers digital skills and training opportunities to women in Bangladesh's most remote areas [2].

The three-year digital bus project equipped six buses with training equipment and dispatched them to deliver critical instructions and Internet skills to 240,000 women in 64 districts across the country [2]. The project is already changing Bangladeshi women's lives. Many have learned how to use the Internet, mobile banking apps, and other common phone apps, and are now able to communicate online. The digital buses have helped women learn vital Internet and technology skills, so that they have the opportunities to understand this new sector alongside men. The project also enables women to enjoy the benefits that new tech can bring, and to play an equally important role in Bangladesh's journey to becoming a digital nation. Eliminating the gap in access to technology means that everyone has the equal opportunity to learn about technology and to take control of their own life.

Inclusive technology means that technologies travel far beyond their country of origin. This allows households and individuals, regardless of their geographic or economic situation, to acquire knowledge through online learning platforms, and enjoy digital household services through ubiquitous connectivity. On open digital platforms or cloud platforms, companies can use the digital capabilities they need securely, easily, and at low cost. Inclusive technologies, spreading without barriers throughout the global economy, are a core driver of growth and a key factor in a flourishing intelligent society.

Technology for Partnerships

Advances in technology are no longer just the product of one company's or one individual's success. Today, the question is how to deliver technology to the world, so that all companies (large companies, SMEs, and startups), all individuals, and the environment we live in can benefit from smart technology. This is the primary goal for the global symbiotic economy.

Inclusive technology means that technologies become available to the smallest and most easily overlooked members of the ecosystem: SMEs and individuals. They will be able to compete with the big players on an equal footing in terms of digital capabilities and thus write their own success stories. SMEs make up 90% of all companies worldwide, and they create 70% of jobs [3]. But they're at a natural disadvantage compared to

industry giants when it comes to technology and financing. As a result, they're often overlooked in global supply chains, or shut out of the competitive arena. Platforms that make new technologies easily available provide SMEs with combinations of digital capabilities and services that suit their needs. They then have the opportunity to experience cutting-edge knowledge and technologies, boosting their ability to compete with firms around the world on a level playing field.

In the cloud era, no single company will be able to succeed on its own. Big data, IoT, and AI are drawing previously unconnected businesses into webs of connection. Multilateral projects involve building and then using the ecosystems that will drive future business success. The roles of customers, independent software vendors (ISVs), and distributors are no longer as distinct as they were, and ecosystem members

are increasingly accepting that development of the entire ecosystem should be a shared goal. They're working together in different ways to tackle the challenges and uncertainties of the business world.

The ICT ecosystem is evolving from bilateral cooperation to full-ecosystem coordination, creating an open, profit-sharing environment with coordinated resource allocation and a workforce trained in the right skills. We encourage more companies to work with business partners to build a new business environment that focuses on the shared development of new industry opportunities.

Hailed as China's first special effects triumph, the movie *Wandering Earth* involved the massive use of new technology. The Great Red Spot on Jupiter, floating bands of gas, an

atmosphere made of boiling liquid hydrogen and helium, thousands of rocket boosters firing in unison… All these fantastic images were rendered in stunning, photorealistic detail. To achieve this, the special effects team abandoned ordinary computer rendering in favor of the higher power of cloud rendering engines [4]. For the special effects company, this was a new area, because their area of expertise is movie effects, not cloud technology. And as rendering one frame can take up to half an hour and because movies show 24 frames per second, the total computing time required would have run into the tens of thousands of hours [4]. That meant the special effects would be years in the making. It was not a realistic option for the producers of the film.

Instead, the special effects company chose to link up with a specialist cloud partner, who could deliver almost limitless resources, massive storage, and fast network connections. They enabled the special effects rendering to be completed in good time, so that the company could deliver stunning, smooth, and realistic effects. The massive reduction in rendering time also helped the effects company to reduce staffing and other costs.

A technology ecosystem is a mechanism for sharing technical capabilities, so that partners can mine value in their respective industries together. Only truly open business and sharing business opportunities will inject the growth and vitality that ecosystems need. That will enable every partner to see the sustained value of the ecosystem reflected in business growth, and it will encourage every player to contribute actively to the development of the ecosystem. Then the symbiotic economy will truly take off.

Technology for Sustainability

The rainforest is nature's orchestra. But illegal logging and poaching is depriving many species of their natural habitats and many are on the brink of extinction. If that happens, the orchestra of nature could fall silent. The Osa Peninsula in Costa Rica is one of the world's richest rainforests. It's also home to a species that helps plants distribute their seeds and reproduce: the spider monkey. Ensuring that the population of spider monkeys stays in balance is key to maintaining the health of the rainforest. It's not just a question of diversity: they are vital to the very life of the forest. Rainforest Connection (RFCx) is a non-profit organization that brings cutting-edge intelligent technology into the green economy. RFCx is combining smartphones, smart sensors, cloud AI, and other advanced technologies to protect spider monkeys and the rainforest environment in which they live.

RFCx creates solar powered audio monitoring systems called Guardians [5] that serve as the ears of the system, deep in the heart of the forest. They're able to collect and transmit sound data in an environment of high temperature, high humidity, and no fixed power supply, clearly sensing and transmitting the sound of saws and illegal logging. They can also identify the sound of trucks and other sounds that are potentially associated with damage to the environment. When suspicious sounds that could be associated with illegal logging or poaching are picked up, a signal is sent to rangers out in the forest, who can quickly go to the exact location. Now, with the help of AI, Guardians are also sending the sounds of rare animals, like the spider monkey, back to the cloud. AI algorithms sort through their recorded database of the cries of 200,000 different animals to identify what species they are, and whether the cries represent

danger, injury, or hunger. This information can also be passed on to forest rangers.

The more we understand animals, the better we can protect them. Smart technology can be successfully applied even in the most extreme of natural environments, and it may finally help us understand the animals and the environment in which they live. Starting with the sounds they make, we can use the analytic power of cloud AI to find them and protect them in real time.

Even the tough conditions of rainforests will no longer prevent us from protecting animals and the environment. Smart technology helps humanity in its duty to protect the Earth's diversity and ecosystems, enabling new breakthroughs in sustainability.

Summary

Open, diverse ecosystems based on cloud platforms will benefit every participant in the ecosystem. They represent a core channel for the broader uptake of the latest technologies and the future of the global symbiotic economy. Cloud technology is constantly advancing: Cloud is already the platform on which most corporate innovation occurs, and the primary tool for increasing the speed and effectiveness of innovation. The platforms for developing artificial intelligence, and the ecosystem of partners who apply AI technologies to industrial use cases, will create new opportunities for innovation by industries, companies, and developers. As industries produce richer streams of data, AI algorithms and learning tools will only become more effective. AI is already the key tool for growth for many companies; soon it will also offer vital support for company management and operations.

GIV predicts that by 2025:

▶ 100% of companies around the world will be using cloud technology. 85% of business applications will be cloud-based.

▶ 97% of large companies will use artificial intelligence.

97% of large companies will use artificial intelligence in sales, operations, or management processes.
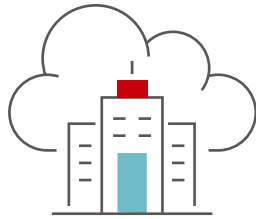
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Trend 9
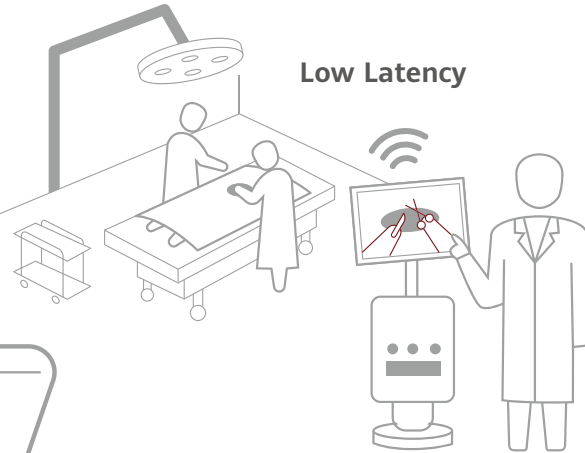
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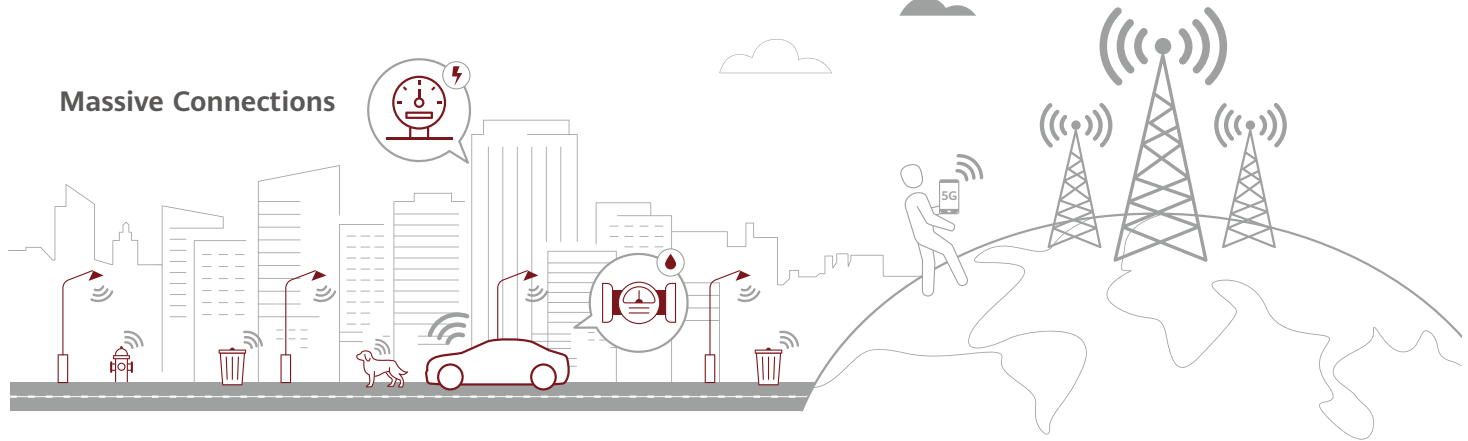
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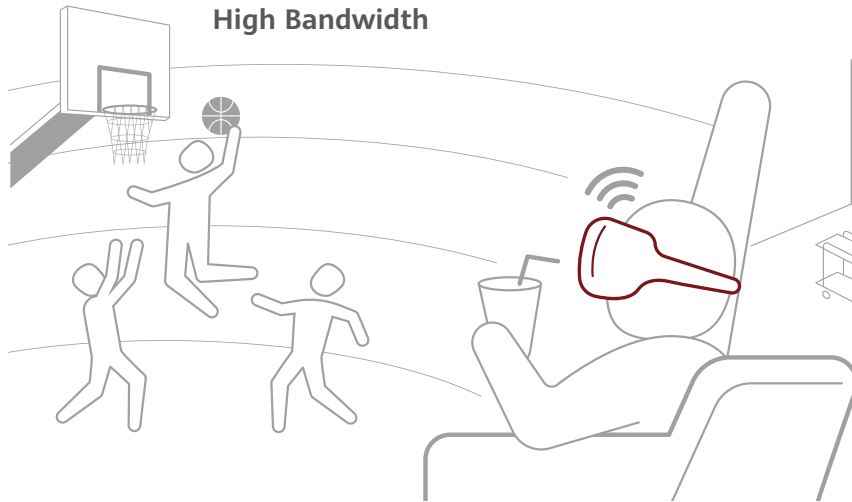
Low Latency

GIV predicts that by 2025, 5G networks will cover 58% of the world's population

5G and speed go hand in hand. The rollout of 5G networks has been far faster than predicted and 5G services will be equally as rapid – you'll be able to download four HD movies to your 5G device in the time it's taken you to read this sentence. Today, all the big phone makers are ready for 5G rollout, with more than 40 5G-enabled smartphones expected to appear on the market in 2019.

But 5G is much more than a way to download movies at lightning speeds.

If 4G marked the time when the Internet really came to life, 5G marks a turning point in history. It will change how you consume content. It will change industry verticals and cities. And it will change how we define connectivity.

GIV predicts that by 2025, 58% of the global population will be covered by 5G networks. Permanent, real-time connectivity will become the default setting for people and for things. Intelligent cloud and cloud-edge technologies will form the environment in which all of society will operate. Developers will be able to create

applications more easily for use in every part of life and work.

5G devices with bigger and foldable screens will offer more freedom and ease of use to gamers and online super-learners. 5G+VR will emerge as a powerful combination, consigning the clunky headgear and nausea-inducing latency from slow networks to the trashcan of history. Virtual reality applications will take off, delivering customers unprecedented levels of immersion.

GIV predicts that by 2025, 337 million people will use VR.

The ITU has defined three key features in its 5G standards: high network speeds, massive numbers of connections, and low latency [1].

5G will offer Mobile Beyond Giga, with peak download speeds of up to 20 Gbps; A Real-time World, with latency as low as 0.5 ms; and All-Online Everywhere, with up to 1 million connected devices every square kilometer, forming a vast connected mesh of people and things [1].

As 5G, artificial intelligence, big data, IoT, and other technologies continue to develop, more businesses will adopt virtual and augmented reality; wireless factories will evolve and develop; and autonomous vehicles will start to rise up the autonomy scale from L0 to L5, with L5 representing fully-automated self-driving technology. 5G's high bandwidth will also drive revolutions in education and telemedicine. Scenes that now exist only in the realms of sci-fi will become commonplace.

5G is being deployed fast in many different industries, driven by demand for massive connections, high bandwidth, and low latency.

5G in Action

▶ **Sport broadcasts:** The camera crews for live broadcasts of Britain's FA Cup are used to working through the night setting up lights, camera positions, and running through rehearsals. Anchored by masses of cables, camera mobility is poor, broadcasts tend to be limited to a few angles, and it takes eight to nine cameras to cover the whole pitch.

That changed in 2018 with the first live broadcast over 5G. The high bandwidth enabled production crews to remotely adjust the lights and change camera positions, while wireless cameras gave the camera crew much greater freedom of movement and slashed equipment costs.

Preparation for the broadcast on BT Sport was much faster and cheaper because fewer staff were needed for rehearsals [2]. Remote direction coordinated all camera

resources, allowing the crew to capture multiple angles at the same time, giving audiences better views and more options. The combination of wireless cameras and camera

drones provided an instant and immersive experience.

Now let's imagine another group of viewers: NBA fans. Tickets for major games can set you back US$26,500 [3]. If you want to sit near the action and get a clear view of your hero, the cost can soar to an eye-watering six figures.

5G+VR can offer a golden ticket to basketball fans across the globe, with close-ups of every feint, pass, and facial expression. Courtside seats, interacting with the crowd around you, and close-ups of players on the bench...all this is possible with just a US$6.99 headset [3]. Virtual reality users will experience fine-grained immersion in any play, with the ultra-low latency of 5G meaning that a truly real-time experience is possible.

5G's bandwidth coupled with virtual and augmented reality offers a revolutionary experience: immersive, real-time, and crystal clear.

► **Health:** Imagine heart surgery...without the surgeon in the operating room. In April 2019, doctors in southern China carried out an endoscopic heart procedure with the support of a consultant surgeon 400 kilometers away [4]. Able to watch the entire procedure in high definition over a real-time 5G connection, the consultant could oversee the surgery, guide incisions, and more.

The adoption of 5G technology in wireless medicine will mean that experts can be shared, essentially appearing at the operating table or bedside as needed, which will help

to offset the global shortage of 4.3 million doctors and 27.3 million nurses [5].

▶ **Autonomous vehicles and the Internet of Vehicles (IoV)**: Autonomous vehicles need fast, reliable network connections with very low latency to ensure fast reaction times in complex conditions. With peak speeds of up to 10 Gbps, 5G data rates are up to 100 times faster than 4G. 5G will also offer latency as low as 1 ms, just one-fiftieth of 4G, meaning a total round-trip time for vehicle control signals of less than 10 ms [5]. That means that in an emergency situation where a vehicle is traveling at 90 km/h and transmits a signal requiring an instant response, it will have moved just 24 cm by the time the response arrives [5].

5G will be a vital factor in the widespread adoption of the IoV and autonomous driving. It will also spark fast growth

in V2X applications, fleet management, and remote driving. 5G will also bring bright prospects for smart transport. According to Huawei Wireless X-Labs, by 2022 the IoV market will be worth up to US$145 billion [6]. GIV predicts that by 2025, 200 million 5G-connected cars will be driving on the world's roads.

▶ **Smart Cities:** Adding the smart to any city means integrating separate systems, including infrastructure, transport, government, business development zones, and hospitals, and taking them online. Data is connected and intelligently analyzed on the cloud.

As the number of connections will grow exponentially, it's vital that smart cities are underpinned by fast, reliable, high-capacity networks.

In theory, 5G can connect millions of devices – at least ten times as many as 4G networks – and thus reliably connect all of the subsystems of a city, including IoT networks, smart grids, and intelligent transport. 5G networks will include 5G smart devices and edge computing resources in every corner of the city to guarantee full connectivity all the time.

By the end of November 2018, smart city projects were underway in over 500 Chinese cities. In 2019, the smart city market in China is predicted to be worth more than 10 trillion yuan (US$1.48 trillion). Over the next five years, this will grow at 33.38% per year to reach US$3.7 trillion by 2022 [7].

5G Rollout Will Be Faster Than 4G

It took ten years – from 2001 to 2010 – for 3G networks to become universal. 4G networks took five years, from 2009 to 2014 [8]. 5G is expected to take just three years, from 2019 to 2022. By 2022, 5G will be accessible to billions of users.

In less than one year since the first version of the 5G standard – Release 15 – was frozen, 35 countries have allocated 5G spectrum. In the first round of 5G rollout, the world's telecom operators built more than 10,000 5G base stations in less than six months, compared to 200 in the same timeframe for 4G [9].

5G-ready devices are already hitting the market in parallel with the rollout of 5G networks. More than 40 5G-ready devices are available now [10].

The public has high expectations of 5G, particularly the higher speeds and new experiences that it will make possible. But the rollout of 5G will be progressive because it takes time to increase network coverage and bandwidth.

Industries like autonomous driving and industrial IoT will see investments of billions of dollars in 5G equipment and wireless services. In fact, every industry will step up the pace of digitalization following the introduction of 5G, because 5G is simple, powerful, and intelligent.

Summary

5G's biggest impact will come not so much from technical breakthroughs, but from how it enables industries to advance and consumers to enjoy and share smarter lifestyles. For many people, their most direct experience of 5G will come from access to HD live video broadcasts. Autonomous vehicles and virtual/augmented reality devices will become widespread following the rollout of 5G. The widespread application of 5G technology will also stimulate the growth of cloud services and the development of new applications on the cloud. The global rollout of 5G networks will not just lead to higher sales of 5G-ready phones, it will stimulate massive growth in intelligent lifestyle sectors.

These sectors range from microchips and batteries, phones, tablets, PCs, and smart home equipment, to services like photography.

GIV predicts that by 2025:

▶   There will be 2.8 billion 5G users around the world.

▶   5G networks will cover 58% of the world's population.

▶   6.5 million 5G base stations will be installed globally.
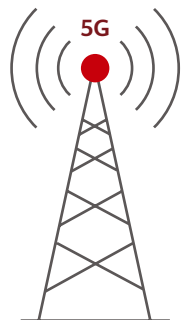
6.5 million 5G base stations will be deployed, with **2.8 billion** 5G users around the world.

58% of the world's people will live in areas with full 5G coverage.
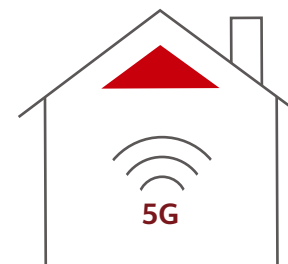
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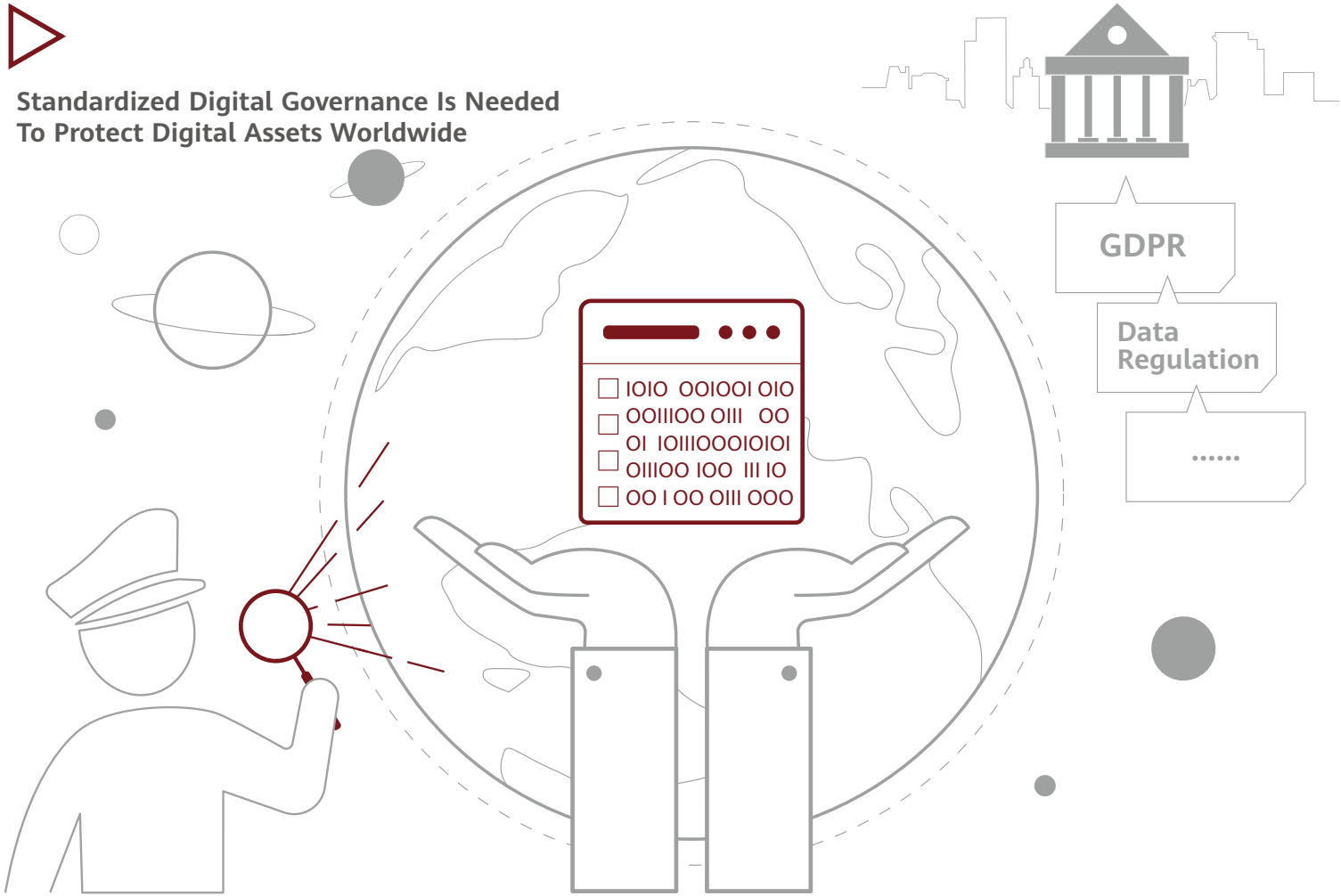The amount of global data produced annually will reach 180 ZB.

Trend 10

Global Digital Governance

**Standardized Digital Governance Is Needed
To Protect Digital Assets Worldwide**

GDPR

Data Regulation

......

GIV predicts that by 2025, the amount of global data produced annually will reach 180 ZB

We may be more familiar with wealth in the form of cash, property, or stocks, but the Internet has created another type: data wealth. Every second, each person on this planet generates an average of 2 MB of new data – the equivalent of a short documentary [1].

Stored in the servers of companies both large and small, data now permeates every aspect of life. In the past, its value wasn't extracted, but today's intelligent technology has changed that. Data is a basic resource. It powers advanced technologies like cloud computing, artificial intelligence, and Blockchain, and helps keep the world moving forward.

Who's in Control?

Personal data belongs to the individual. And everyone has the right to control their data – you have the right to exchange your own data for the services you need. However, the rules for data privacy and protection as well as data transactions lag far behind the huge increases in data traffic and advances in data technology. As a society, we haven't formed a broad consensus or created proper legal parameters that fully cover data ownership, data use, and data regulation.

It's now a matter of urgency that we find ways to govern data and prevent the infringement of data rights. We need to develop rules for buying and selling data and balance the rights and needs of data owners and data users.

Digital Governance

Fine-grained data management can provide customized services. Mining user data for value will be the key for companies to unlock profits from a long tail marketing approach. In the China app market, just 200 apps account for 55% of all app downloads and updates, with user data already heavily skewed towards the leading apps [2].

The Matthew Effect is already seen in global data wealth. Apps with vast numbers of users are carving out their own digital empires, and have become one of the primary drivers of the development of social infrastructure and new services. The major social media and e-commerce apps are pioneering the development of new smart services and business models;

however, if most user data is held by just a few big players, then they have a monopoly on the resources needed to improve the quality of their intelligent algorithms in the artificial intelligence era.

Access to data becomes even more unbalanced. If users become reliant on just a few digital giants to provide them with high-quality, ubiquitous smart services, then users will lack bargaining power when it comes to controlling their own personal data.

But personal data is personal property. Everyone has the rights for their data. It should not be hoarded by a few powerful service providers.

Users today are forced to choose between a very few high-

quality service providers, and when they do, their data disappears into a black box. Users cannot see how it's being used, or where it's being sent. No one informs them of the rules that are being applied, the protection systems for private data, or the processes for resolving data disputes. This is a cause for anxiety and fear among users who are concerned about their privacy. The Pew Research Center reports that more than 25% of Internet users globally have suffered from data theft including social media account details, credit card details, social security numbers, or similar online information [3]. There are many stories about abuses of data and infringement of privacy, with up to 86% of Internet users having tried to protect themselves by taking measures to erase their digital footprint [3].

It's clearly a matter of great urgency that we regulate the digital

world by creating global digital standards for protecting personal digital assets, and applying open, transparent, internationally approved standards.

Over 30 laws on data protection have been passed in Europe and the US, including the EU's General Data Protection Regulation (GDPR). The GDPR took effect across Europe on May 25, 2018. It requires that all companies in EU countries put in place strict new protections on user data. These rules protect European citizens from data leaks and infringement of privacy, and they have redefined the way organizations in the EU protect data and privacy [4].

The GDPR also expanded the definition of personal data: It requires that companies handle IP addresses or cookie data in the same way as other confidential information [5]. These major changes are causing a significant impact on companies

around the world, both in the EU and beyond.

Data regulators may be neutral third parties, or they may be government agencies subject to legal and public scrutiny. The Data Protection Officer (DPO) is a new position created inside companies, and is a key element in ensuring corporate compliance with privacy standards [6]. The DPO is responsible for checking GDPR compliance, and is the contact for data issues for all stakeholders like regulators. As the global digital industry continues to expand and develop, the DPO can make dynamic decisions and changes. They need to balance the interests of all parties, and reduce user concerns that their data will be misused.

AI and cloud computing will enable the deeper mining of larger amounts of higher-quality personal data. A new appreciation of the importance of data among individuals and organizations will drive the evolution of laws for governing the digital realm. Laws will mainly call for equal data rights and protect the rights of all people with respect to their own data. Digital governance issues will also be a new and evolving area for law enforcement, and raise higher requirements for their data governance capabilities. Industries and sectors that produce large quantities of personal data, including healthcare (the birthplace of big data), the Internet, and the entertainment industry must all invest more time and resources in building trust among their users. This will help to promote the standardized use of data across industries.

Is Data Too Personal To Sell?

Not at all. Each person has full autonomy to decide what to do with the data that they generate. The problem today is a lack of effective privacy mechanisms. That leaves us worried about the security of our data and removes the transparency to monitor fair use. If we can engage in data transactions with trusted companies, that would help us realize the value in our data and exchange it for the smart and higher-quality services that we need.

The current processes for managing data transactions are underdeveloped. Some companies are careful to inform new users that their data may be used for other purposes in the future to encourage them to sign up for services now. They explain this to users and require their consent. But the data processes are still not transparent: Where does the data go? How is it used? Has it been diverted for other purposes? Users often have no way of finding out how data that belongs to them is being used by which companies, and whether it has been used for purposes that they didn't approve. Even more seriously, some companies fail to protect user data, and the result is frequent data leaks and theft. These situations break down the trust of customers in the companies that use their data, and become a barrier to the virtuous cycle of secure data transactions and the development of new data technologies.

Have I Got Your Attention?

"Attention merchant" is an online business model where the company obtains the user's attention, then processes and mines the data generated by the user's engagement to produce value in a sustainable way [7]. With the wider adoption of AI, new business models are emerging that enable customers to deliver more customized or personalized services for users. With smart speakers, smart cars, and other devices spreading into every corner of our lives, the information collected is increasingly detailed and granular. Attention merchants can use this information to deliver highly personalized services that make customers feel valued and understood.

However, at present many users obtain services from integrated network service platforms that provide services spanning video, search, advertising, email, social media, and e-commerce. They agree that their personal data may be used to deliver one kind of service, but they haven't agreed for their data to be used for others. However, when they go back online they find ads relating to a video that they recently watched. This kind of reuse of data may be legal, but it's a violation of the user's right to know what's going on with their data. It's neither fair nor transparent, and doesn't represent a true agreement between the service provider and the user.

The difference between digital and traditional services is that digital services aren't limited in any way by time or location. This means that international cooperation is vital when setting digital governance standards, privacy protection regulations, and standards for data transactions. Nations will have to work together to ensure that every company and individual strictly complies with data governance rules. Governments and regulators around the world need to take action and draft regulations for data transactions that will be effective on a global scale to enable global trade in data and for data products to develop sustainably. Corporate digital giants should set an example by defining what data transactions are permissible for each service, and should work for transparency and consensus with their users at every step. They must also ensure full compliance with the data laws of every country. Service consumers should learn more about the industries that serve them and develop the habit of inquiring about data. Consumers should make rational decisions, balancing the value of the services they use against the cost that they pay in data. In this way, they'll be able to maintain privacy, protect their interests, and enjoy the convenience and the new services that technology makes possible.

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Summary

Ubiquitous connectivity will generate vast quantities of data, and the analysis and mining of this data will help to drive further progress in Internet technologies. The ability to obtain and mine customer data in a legally compliant manner is now one of the key capabilities that companies require to sustain growth. Legal data capture determines smart data analytics and conversion, and data analytics and conversion determine a company's ability to innovate and compete.

GIV predicts that by 2025:

▶   The amount of global data produced annually will reach 180 ZB.

The amount of data generated globally will reach **180 ZB**
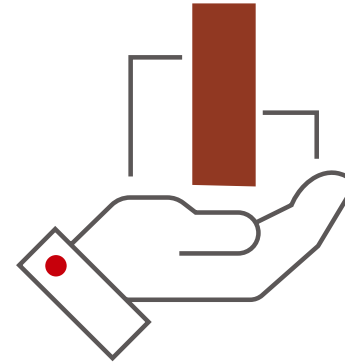
Companies will be making efficient use of **86%** of the data that they produce.

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Trend 1 ▶▶
Living with Bots

The adoption rate of intelligent domestic robots will reach 14%.

Trend 2 ▶▶
Super Sight

The percentage of companies using AR/VR will increase to 10%.
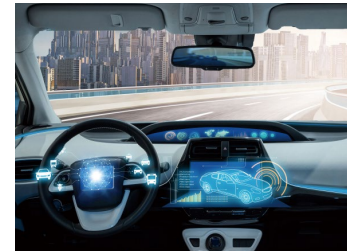
Trend 3 ▶▶
Zero Search

The adoption rate of intelligent personal digital assistants will reach 90%.

Trend 4 ▶▶
Tailored Streets

C-V2X (Cellular Vehicle-to-Everything) technology will be installed in 15% of the world's vehicles.

Trend 5 ▶▶
Working with Bots

Industrial robots will work side by side with people in manufacturing, with 103 robots for every 10,000 employees.

Trend 6 ▶
Augmented Creativity

97% of large companies will be using AI in their services or operations.

Trend 7 ▶▶
Frictionless Communication

Enterprises will be making efficient use of 86% of the data that they produce.

Trend 8 ▶▶
Symbiotic Economy

85% of business applications will be cloud-based.

Trend 9 ▶▶
5G's Rapid Rollout

5G networks will cover 58% of the world's population.

Trend 10 ▶▶
Global Digital Governance

The amount of global data produced annually will reach 180 ZB.

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