DIGITALIZATION: THINK, ACT, ACCOMPLISH





Embrace the digitalization towards an intelligent world

A profound technological transformation is sweeping the world, impacting our work and lives more than anything that has come before. New technologies that seemed unimaginable in the past are commonplace now, and are playing an increasingly important role in business operations. More and more companies are incorporating connectivity, cloud, big data, Internet of Things (IoT), and artificial intelligence (AI) into their core processes and management systems, aiming to boost efficiency and competitiveness. These developments reflect some of the most creative and futuristic thinking in today's marketplace.

Technological advances manifest themselves in many ways across industries, societies, and economies, with the latest cutting-edge developments ever more quickly permeating everyday life.

Here are a few numbers on how digital technology will impact us all:

- Gartner predicts: in the next five years, nearly 184 million new connected cars will be produced
- McKinsey estimates: the impact of the Internet of Things could reach a staggering US$11 trillion by 2025, equivalent to 11% of the world economy
- Huawei's Global Industry Vision forecasts: 77% of the world's population will be connected across 100 billion connections by 2025. 85% of enterprise applications will be cloud-based. 12% of households will have smart home robots. This market will be worth hundreds of billions of US dollars.

What we're seeing now is only the beginning. In the future, we envision a fully connected, ultra-intelligent world that will enable inspired experiences. These changes will positively impact our work and lives, and generate significant economic growth and prosperity.

Digital transformation is seen by more and more businesses as being absolutely necessary for future development. Businesses that have gone more digital are more likely to seize opportunities and benefits in the digital era, while other businesses risk being left behind or left out.

While a digital awareness is crucial to seizing opportunities, action is equally important. Once a business has set its strategic direction, it needs to take solid action and follow through on its plans. Industry policymakers need to encourage businesses to go digital. Huawei has worked to go digital itself. We are also an active partner in our customers' digital programs, helping them to achieve new growth. Together with leading universities, think tanks, and industry associations, we have studied the impact of digital spillovers.

This report sets out our key viewpoints gleaned from the digital transformations of Huawei, our customers, and our partners. The report also sheds light on best practices in digital transformation. We are ready to work with you, so that we can understand each other better, share ideas, and grow together.



Guo Ping
Deputy Chairman of the Board, Rotating CEO
Huawei Technologies Co., Ltd.



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Executive Summary

Enabling Technologies are the Catalyst

Technologies are the enabler of change in society. Four key technologies are especially important in today's digital transformation. These technologies are enabling the changes we see today and those we will see in the future.

Connectivity Makes Anything Possible
Connectivity is, in essence, the world's nervous system, and it is extending across the world to the point where it will soon be ubiquitous. From the data torrents of developed countries to the pent up demand of underdeveloped regions; from individuals to enterprises and countries; connectivity will open up unprecedented new possibilities.

Cloud: Services at Your Fingertips
The attraction of cloud is that it is scalable. It delivers resources as and when they are needed, enabling businesses to expand fast and at low cost. Cloud is a lynchpin in the global digitization process. Businesses are going cloud rapidly. Public cloud, private cloud, and hybrid cloud will coexist in the long term.

Internet of Things: Sensing Our Way into the Future
From monitoring your electricity usage, understanding your driving patterns to keeping escalators safe and preventing water leakage in pipelines, IoT is already improving operating efficiency and in future will drive digital transformation across business, government and our everyday life.

Video: Machines' Lens on the World
Be it entertainment, video chat, live streaming, conferencing, surveillance, or intelligent manufacturing, video is now ubiquitous. It is increasingly the essential ingredient, the secret sauce that brings people together. Video is helping to reshape the world in a variety of ways. It is an important enabler of digital transformation in different industries.

Cyber Security: Innovation and Cooperation

New technology is making our lives better and our work more efficient. New technology brings together resources in new configurations. It is the spark of life in the digital economy. However, new technology inevitably brings brand new security challenges for our networks. Huawei is addressing these challenges head on, seeking innovative solutions, pulling together international partners, and gradually building up codes of practice for new, high-tech scenarios. Together, Huawei and its partners are building a Better Connected World in which businesses and people can connect with confidence.

Opportunities within Industries

While the key technologies are known, the challenges within industries are many and varied. The combination of technology and industry-specific knowledge is fundamentally changing the way companies are doing business.

Digital Government, Intelligent Government
Digitizing public services is an urgent need for many governments around the world today. Good digital government can help business to flourish, increase citizen engagement, and drive economic growth. Digital governments and societies will succeed in the long term when they set clear policies, invest in ICT infrastructure, adopt open platforms, and secure participation from both the public and private sectors.

Banking in the Age of Internet Finance
New online financial services, such as cashless payments, remote video banking, and credit checks, are dealing a heavy blow to traditional banks. To rise above the challenges, banks need to embrace digital transformation and change the way they work and serve customers. More new products and more new and different initiatives arising from financial technologies are expected in future.

Intelligent Manufacturing: Connections for Success
Manufacturing is at the heart of the global economy. Today, however, manufacturers everywhere face an environment that is being reshaped by technological shifts, economic uncertainty, and fast-changing market demand.

Intelligent Transport to Drive Inspiring Experiences
We are moving toward a world where railways, highways, waterways, and airways can be integrated into a seamless automated global network. Future transport will be safer and more efficient, less congested and highly energy efficient, making our cities cleaner and quieter and providing exceptional user experience.

Digitally Transforming Energy
The energy industry needs to find new ways to secure reliable energy distribution, cut costs, and reduce its impact on the environment. The industry is introducing digital technologies to every aspect of energy production and delivery, to make sure that it can deliver safe, affordable, and reliable power. Digital transformation will enable us to use natural resources in a smarter, more efficient way, supporting sustainable development and tackling environmental challenges.

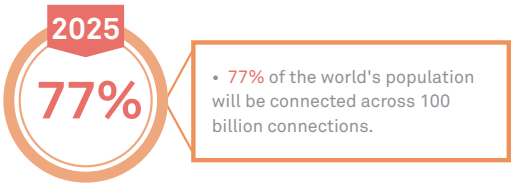
Telecom Carriers: ROADS to New Growth
Amid declining traditional business and rising competition across sectors, telecom carriers are under growing revenue pressure and striving for new growth. As enterprises worldwide navigate the route to digital transformation, for carriers that have always played an essential role in the traditional telecom industry, they bring new opportunities.

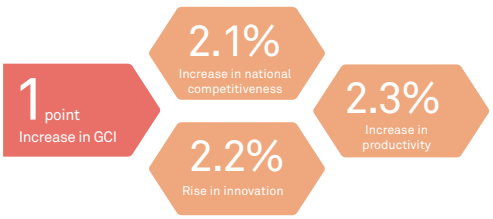
An Open, Collaborative, and Sustainable Ecosystem Amidst Digital Transformation

Digital technology is reshaping industry ecosystems. Industries are now overlapping each other, which makes for a more complicated ecosystem environment. An enterprise will be unable to compete in the market on its own. It will be necessary to join ecosystems in order to survive and prosper. With the convergence of industries and changes in consumer demands, enterprises need to become more open and flexible. They also need to choose sustainable ecosystems in order to establish long-term competitiveness.

Toward an Intelligent World

How digital technology will impact us all in the next decade:





What drives digitalization:



Cyber Security:

1 Innovation

2 Cooperation

How governments and companies can compete and win in the “+Intelligence” world?

Government

Digital Government,
Intelligent Government

Banking

Banking in the Age of
Internet Finance

Manufacturing

Intelligent Manufacturing:
Connections for Success

Transportation

Intelligent Transport to Drive
Inspiring Experiences

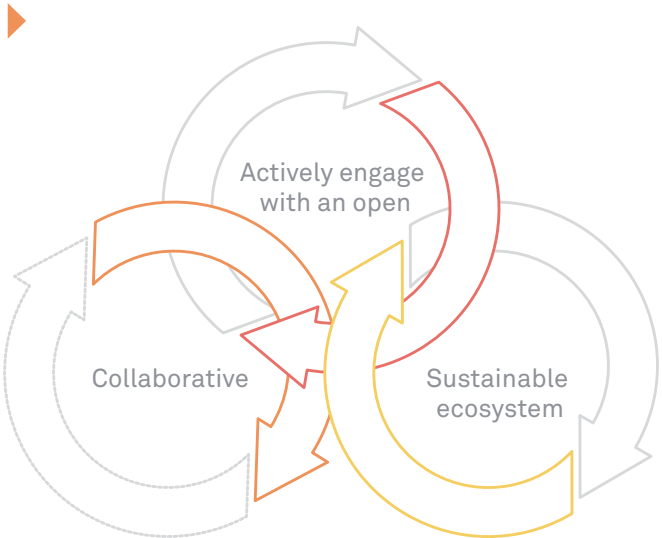
Energy

Digitally Transforming Energy

Telecom Carriers

Telecom Carriers:
ROADS to New Growth

Ecosystem:





FOR THE INTELLIGENT WORLD, EMBRACE DIGITAL

For the Intelligent World, Embrace Digital

In today's world, digital transformation is a critical choice for growth, for companies and countries alike. Countries need to open the data floodgates to irrigate slowing economies. Companies must take a tight grip on the opportunities of the digital age, and mine them for profit. In the midst of digital transformation, everyone is searching for ways to use new technologies, to pull ahead, to be a part of the Intelligent World, and to share in the digital dividend.

+Intelligence and the Intelligent World

What will the digital world be like? In a word: Intelligent. New chips and sensors mean that today, everything can be "+Intelligence". And with new computing, storage, and analytics, information and communications technology (ICT) is expanding the boundaries of what that +Intelligence can do.

When AlphaGo defeated the world's no. 1 go player, Ke Jie, it was no fluke. Rather, it was the inevitable culmination of a long process, in which algorithms and binary programming gradually became truly intelligent. It is easy to imagine more: Chatbots will soon be ubiquitous, giving personalized advice on fitness routines and recipes; AI doctors will be reading our x-rays and giving remote diagnoses; Industry 4.0 will reconfigure factories and supply chains in response to real-time demand. The rise of innovative ICT technologies and applications is only opening the throttle of the digital engine. Entire industries are transforming to become part of the +Intelligence age. Transport+Intelligence means that you won't need to know the way – the way will know you. Healthcare+Intelligence will be about curing the person, not the disease. Manufacturing+Intelligence will make what you need before you even know you need it. Progress in ICT will flip us from a world that fights over resources to a world that competes on smarts. We will soon be in a world where everything is sensing, everything is connected, and everything is intelligent.

Turning Intelligence into Action

The digital transformation is coming. But how can we seize its opportunities? The key lies in the actions we take now. Get ahead to stay ahead, because it will be ICT leaders who write the next chapter in our digital history.

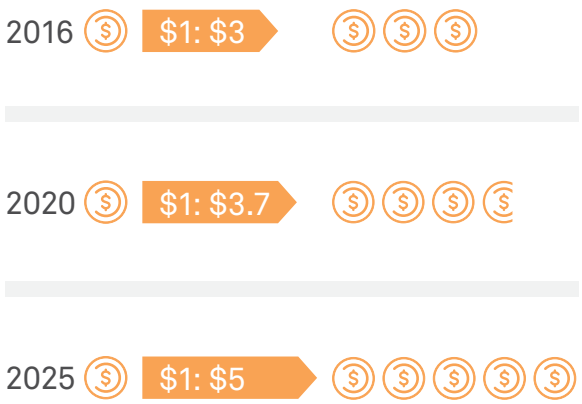
National ICT infrastructure: Springboard for the digital economy

Digital is increasingly the agent of disruption to the old commercial order. That means that ICT infrastructure is now the driver of high-quality

economic growth. McKinsey reports that in emerging nations, digital finance is set to deliver a 6% increase in GDP, which translates to US$3.7 trillion – equivalent to the size of the German economy.

"If you want to get rich, build a road." This is ancient wisdom in China, and today the role of ICT infrastructure demonstrates how vital it is. ICT connections are the road on which the digital economy runs. Huawei's Global Connectivity Index (GCI) 2017 reports that ICT's multiplier effect is only getting stronger. In 2016, every dollar spent on ICT infrastructure drove 3 dollars in GDP growth. By 2025, each dollar invested in ICT will create 5 dollars in added GDP[1].

An additional 10% investment in ICT infrastructure each year generates increasing returns to 2025[1]



But while the importance of ICT investment is growing, slow returns on infrastructure investment can sap the willingness of companies to bite the bullet. It can take at least 10 years to recoup money poured into fiber optic networks, for example. Governments need to provide more supportive policies to encourage investment in ICT. Decisive, visionary governments will set the policies that help companies turn digital transformation into digital reality.

Strategic implementation: Key to digital success

In 2013, MIT's Initiative on the Digital Economy surveyed 391 large companies in 31 countries around the world. They found that digitally mature companies are 26% more profitable and earn 9% more revenue than their average industry competitors. With this enormous commercial opportunity dangling in front of their noses, companies are scrambling to invest in digital technology. Industry analyst IDC predicts that in 2017, global corporate investment in digital products and services will rise by 17.8% to US$1.2 trillion[2].

In 2017, global corporate investment in digital products and services is predicted to[2]

↑17.8%

to US$ 1.2trillion

PwC's 2017 Digital IQ survey found that only 52% of companies thought that they had a strong "digital IQ". Clearly companies realize the importance of digital, and are positioning themselves to become digital enterprises. Now the question is how to proceed. Huawei has suggested a "digital triple jump" that companies can use to launch themselves into the future.

[1] 2017 Global Connectivity Index, http://www.huawei.com/minisite/gci/en/
[2] IDC Worldwide Semiannual Digital Transformation Spending Guide, http://www.idc.com/getdoc.jsp?containerId=prUS42327517



Hop:
Set a strategy

Every company needs to assess its digital progress in terms of users, planning, staff, operations, and innovation. In your industry, are you ahead of the curve? Or behind?

- **Users:** Are you delivering a digital user experience?
- **Products & services:** How much capacity do you have for agile innovation? Can you deliver differentiated products and services? Swiftly adapt to new, diverse demands?
- **Talent:** Are you using digital technology to inspire and enable your people?
- **Operations:** Are your operational decisions automated? Smart? Faster and better?
- **Ecosystem:** Are you part of a strong ecosystem? Are you leading it?

Companies need to be looking for opportunities, breakthroughs, and innovation across all of these five areas. That is the only path to new business models and the generation of new value.



Skip: Restructure IT,
put the customer at the center

On the road to digital, companies must first think of the customer. Target a better customer experience and design your digital transformation around it. McKinsey recommends that companies break open data silos to improve the flow of operations across the company. As Steve Jobs said: "You have to start with the customer experience and work backwards to the technology."

Transformation is a customer-centric process, not a self-centric process. Customer insight should inform all strategic decisions. Enable all departments to work together, make sure every step is a step in the right direction.



Jump: Actively engage
with an open ecosystem

Digitalization is not a one-off project. Digital is a process which will expand the borders of your company, and it will link your operations, people, knowledge, and things into a wider ecosystem of customers, partners, and suppliers. Innovative technologies and evolving processes will seed an endless series of new business models while elevating your efficiency, experience, and competitiveness. They will also create thicker links with long-term partners. Every company can use digital channels to wire itself in and become a better citizen in the open, beneficial and sustainable ecosystem. That is how whole industries will flourish.

Digital transformation is the necessary next step on our journey to the Intelligent World. To navigate this process, from setting the right strategy to introducing key technologies, companies will need specialist guidance and the help of solid partners. Huawei is a pioneer and an enabler of digital transformation. The company has committed to transforming itself over the next 3-5 years, and that experience will be used to help guide other companies along the digital path. Huawei wins when the ecosystem wins. Huawei succeeds through the success of its customers.

STORY

Malaysia: a pioneering digital economy builder



The Malaysian government is very aware of the importance of the digital economy. In 2016, the digital economy generated 17% of Malaysia's GDP, making Malaysia a model for other countries to follow. Malaysia's impressive digital performance comes from its active government and policy support for ICT. The government has realized that digital dividends must be shared among all citizens if they are to drive real economic growth and boost the country's competitiveness. In 2008, the Malaysian government officially launched the High Speed Broadband initiative, part of the National Broadband Initiative. It worked with the private sector, introducing a public-private partnership model, partnering widely, and sharing the risks and the benefits with its partners. Malaysia's investment and focus on ICT infrastructure has paid off. By 2014, the economy had grown 64%. It has been one of the fastest-growing economies since the financial crisis, and in the process it has created 100,000 new jobs.

STORY

Walmart's digital transformation journey



Retail giant Walmart set a far-sighted strategy in order to open up new markets, and has invested heavily in digital transformation. In 2011, Walmart set up an independent online retail unit, and began to invest. By 2015 it was spending US$1 billion on equipment and human resources for online sales, and employing 3,600 people. Walmart set its digital strategy, broke with its old models, and linked ecommerce seamlessly to its real-world stores and warehouses. New buying functions have been developed to respond to customer needs, with more phone options and more price transparency for a better customer experience[3]. Between 2011 and 2014, Walmart's online revenue grew by 150%. In Q1 2017, Walmart's online sales in the US were up 63%[4] on the previous year, making Walmart America's second-largest online retailer.

[3] Fast Company, "Walmart's Evolution from Big Box Giant to E-Commerce Innovator", November 2012
[4] Wal Mart Stores : Walmart U.S. Q1 comps(1) grew 1.4% and Walmart U.S. eCommerce GMV grew 69%



FOUR DRIVERS FOR DIGITALIZATION



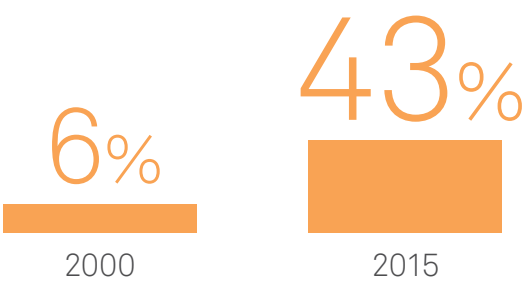
Connectivity Makes Anything Possible

In today's digital age, information is bringing change to every corner in the world, and connectivity is the medium through which all information is exchanged. Connectivity enables communications amongst people, exchanges information between people and machines, and allows machines to recognize and engage with each other. Connectivity is, in essence, the world's nervous system, and it is extending across the world to the point where it will soon be ubiquitous. From the data torrents of developed countries to the pent up demand of underdeveloped regions; from individuals to enterprises and countries; connectivity can open up unprecedented new possibilities.

Connectivity is a fundamental human need

With the arrival of the digital economy, the demands placed on connectivity across the world now cover the entire spectrum of Maslow's hierarchy of needs – from basic physiological needs to safety needs, esteem needs, and ultimately self-actualization. For those of us who live in big cities and are totally familiar with a digital lifestyle, even a few hours of disconnection from the Internet can leave us ill at ease. For those trapped in dangerous, life-threatening situations, connection to the outside world means the hope of survival. For those who are living away from their families, connectivity allows them to stay close to their loved ones. And for those living in poverty, connecting is like adding a new organ of sense, one that can "see" more opportunities and pathways to a better life.

Internet penetration around the globe[1]



The United Nations' Millennium Development Goals Report[1], published in 2015, revealed that in the year 2000, only 6% of the world's population was connected to the Internet. By 2015, it was 43%. However, there is still a long way to go before the whole world is connected. We may feel as though our planet is inundated with data, but it is important to realize that there are still 4.4 billion people – more than half of the global population – who remain unconnected[2]. Most of this unconnected population is living in developing countries. In 2010, the International Telecommunications Union and UNESCO jointly established the Broadband Commission for Digital Development. Its aim is to promote the development of broadband and Internet applications worldwide in order to accelerate progress towards the Millennium Development Goals (MDGs). Bringing the unconnected online and closing the digital divide are of crucial importance to any effort to build a more equitable world. These objectives are the shared responsibility of governments, telecom carriers, and the entire ICT industry.

Connectivity is competitiveness for enterprises

Huawei's 2016 Global Connectivity Index (GCI)[3] surveyed 3,000 enterprises from 10 different industries across 10 countries. It found that in today's digital economy, connectivity technologies, particularly broadband, have a bigger impact on their business than any other category of technology. Connectivity enables enterprises to escape the constraints of geography, collect more information, respond to customers more quickly, improve their productivity and efficiency, and make themselves more competitive.

Headforwards is a small software developer located in St. Agnes, a coastal village in Cornwall, on England's southwest coast. Cornwall is remote and thinly populated, and its broadband infrastructure was underdeveloped, meaning that local companies found it hard to connect to international markets. In 2015, the "Superfast Cornwall" project brought high speed fiber broadband networks to 80% of the area, including over 24,000 local enterprises. Thanks to the superfast 330 Mbit/s broadband, Headforwards was able to reach out to business opportunities around the world, including NTT, Japan's largest telecom company, which signed a contract with Headforwards to develop some core business software. This business partnership was only possible because of the high-speed connection between the two companies. The partnership has been highly successful because both companies are digitally connected. The contract has also led to further opportunities, enabling Headforwards to engage and win new clients and work with leading software talent around the world.

Harley-Davidson, a legendary American motorcycle maker, enjoyed outstanding sales in the 1980s and 1990s but ran into difficulties in the early 2000s. The market was changing, and its competitors introduced a range of new models. In order to adapt and reboot its competitiveness, between 2009

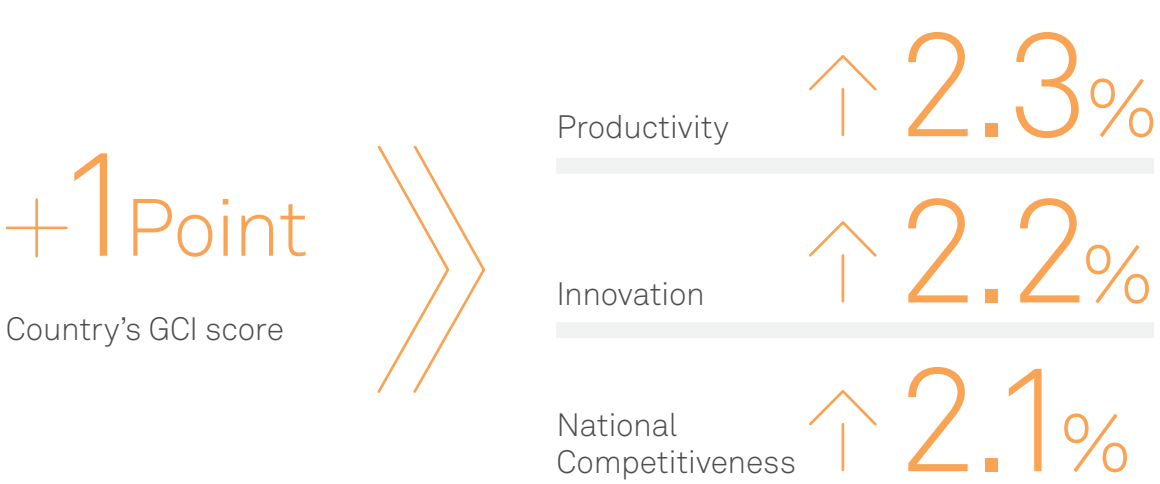
1 Millennium Development Goals and Post-2015 Development Agenda, http://www.un.org/en/ecosoc/about/mdg.shtml
2 Bringing the Next 4.4 Billion People Online (Chinese), http://www.c114.net/topic/4237.html
3 Harnessing the Power of Connectivity: Mapping Your Transformation into a Digital Economy with GCI 2017, http://www.huawei.com/minisite/gci/files/gci_2017_whitepaper_en.pdf

and 2012, Harley-Davidson introduced industrial Internet technologies to connect tens of thousands of manufacturing machines. This has enabled the machines to 'collaborate' with each other. It was a radical departure from Harley-Davidson's traditional manufacturing model, which had many disadvantages, including limited capacity and long lead times. Today, any production line in Harley-Davidson is able to produce many different motorbikes. A motorcycle comprised of some 1,200 parts can be assembled in 89 seconds, and the time from receiving an online order to delivery has been shortened from 21 days to just 6 hours. Connectivity has enabled Harley-Davidson to transform its business, with a far more flexible manufacturing infrastructure. This has helped the company to once again stand out from its competitors in the marketplace.

Connectivity is a catalyst for economic growth

Connectivity is a good way to measure a country's digital economy. According to Huawei's 2017 GCI report, an improvement of just one point in a country's GCI score equates to a 2.3% increase in productivity, a 2.2% rise in innovation, and a 2.1% increase in national competitiveness[4]. 151 countries worldwide have now recognized that broadband needs to be a critical part of their national development strategy, and have formulated policies to support it. The European Union has highlighted broadband as a key factor for competitiveness, and for achieving its 2020 goals for smart, inclusive, environmentally-friendly development. Japan has published the "e-Japan" strategy; South Korea has launched its "IT Korea Future Strategy". In 2013, China began implementing the "Broadband China" strategy[5], with goals for 2020 that include:

Global Connectivity Index (GCI) scores link to real world effects



[4] Harnessing the Power of Connectivity: Mapping Your Transformation into a Digital Economy with GCI 2017, http://www.huawei.com/minisite/gci/files/gci_2017_whitepaper_en.pdf

[5] Broadband China (Chinese), https://baike.baidu.com/item/%E5%AE%BD%E5%B8%A6%E4%B8%AD%E5%9B%BD/1945145?fr=aladdin#2

fixed home broadband penetration of 70%; 3G/LTE coverage for 85% of mobile users; urban connection speeds of 50 Mbit/s, rural speeds of 12 Mbit/s; and gigabit broadband available in some advanced city markets.

The Solomon Islands is an archipelago in the South Pacific, located to the northeast of Australia. In 2015, the country ranked 163 out of 179 countries for GDP[6]. For a long time the Solomon Islands has been reliant on satellite connections for basic communications. As a result, costs are high, and service uptake remains low, leaving the country starved of digital resources. To improve this situation, the government of the Solomon Islands in 2017 announced a massive investment in a seven-year project to deploy a 3,400 km fiber-optic submarine cable, with a capacity of 2.5 Tbit/s, between the country's capital and Sydney in Australia. The submarine cable represents not just high-speed Internet services, but hope for long-term, sustainable development in the Solomon Islands. Gordon Darcy Lilo, Prime Minister of the Solomon Islands, said, "This is a crucial project for our country, as it will provide the platform for our road, mining, agriculture, infrastructure, tourism, and commerce, and help improve in the social senses as well."

Building a Better Connected World

In today's world, receiving a parcel delivered by drone would seem futuristic and exciting. But in coming years, such a thing will become commonplace. Drones will be deployed in a wide array of commercial and industrial roles. Where human operatives cannot go, drones can still perform with agility and efficiency. For example, a medical drone can transport a defibrillator to a patient in cardiac arrest at a speed of 96.6 km per hour. It could deliver vital first aid within a minute, rather than the 10 minute response time today.

Within the next three to five years, every football fan could be enjoying astounding immersive experiences via augmented reality (AR). They will be more immersed in the game than spectators in the ground. AR helmets will allow them to sit in any pitch-side seat they please, but more than that, they could place themselves on the pitch, in the middle of the action, and even in position of a player.

These technological advances are not so far from becoming an everyday reality for many of us, but they are unlikely to be immediately and equally accessible to everyone. According to a report by the ITU, there is still a vast digital divide between developed and developing countries: Of the 4.4 billion unconnected people worldwide, less than 300 million are in developed economies. The majority are distributed across less developed parts of the world. To fully connect these people and deliver universal Internet access[7], which the UN advocates as a basic human right, governments will need to take active measures. They must offer dedicated funding and supportive policies to encourage telecom carriers to expand their networks. At the same time, carriers need to identify more efficient network coverage solutions if they are to eliminate digital blind spots, connect the world, and enable everyone to enjoy the infinite possibilities of the Internet.

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6 (Chinese) http://www.dugoogle.com/shijiezhizui/products-21067/
7 Bringing the Next 4.4 Billion People Online (Chinese), http://www.tuicool.com/articles/EZvAna



National broadband strategies for ICT development

Carriers are less motivated to build ICT networks in rural and remote regions. Governments may need to introduce incentive measures in the form of universal service subsidies, tax incentives, and low-interest loans to support network rollout in these areas. The public-private partnership approach may also be considered as a long-term financing solution.



Reduced costs through synergies with other infrastructure

Carriers face huge costs when building networks in dense urban areas. Governments should support and encourage collaboration amongst all sectors involved in the construction of urban infrastructure, including transportation, energy, and pipelines, and buildings. Governments should introduce standards, specifications, incentive policies, and annual reviews to help alleviate the cost pressure. The goal is a coordinated plan for connectivity.

According to the US Federal Communications Commission, laying one mile of fiber-optic cable costs US$144,000; but if implementation is coordinated with highways and other key infrastructure projects, the cost can fall to approximately US$101,000 per mile. These synergies can be especially large in emerging markets. For example, Phase 3, a fiber-optic network company in Nigeria, deployed its fiber along high-voltage cables, in cooperation with electric power companies, significantly reducing its build-out costs. It was then able to lease fiber-optic network services to carriers, enterprises, and governments at lower prices.



Spectrum resources for mobile network development

Mobile networks can be the key link for connection in sparsely populated areas, but mobile networks require ample spectrum resources. Governments and regulators should work to provide carriers with access to new spectrum resources.

Ofcom in the United Kingdom, for example, plans to reallocate the 700MHz spectrum in 2020, when some spectrum currently used for TV broadcasting will be assigned to mobile communications networks. Carriers can also use existing spectrum more efficiently by leveraging new technologies (spectrum refarming, for instance).



Better services to encourage consumption

The more people using connection services, the healthier the market. According to the UN Broadband Commission for Sustainable Development's The State of Broadband Report 2016[8], 5% of per capita GDP is an affordable level that people are willing to spend on fixed broadband services. Carriers can make use of innovative technologies and sound business models to provide better broadband services packages, making the services affordable to more users whilst ensuring reasonable profits.

[8] UN Broadband Commission for Sustainable Development: Digital Divide Has Shifted from Voice Telephony to the Internet (Chinese), http://it.people.com.cn/n1/2016/0923/c1009-28735910.html



Content to drive broadband demand

There is also a positive correlation between local content and broadband construction, with multi-language content playing an important role in stimulating broadband demand. In India, for example, the Internet is predominantly English content, but only some 10%–20% people in India speak English[9], leaving people who speak Hindi and other languages less motivated to go online. To reverse this situation, it is necessary for the government and Internet content providers to make joint efforts to localize and diversify Internet content. App developers also need to be involved to provide more user-friendly apps.



Digital skills and inclusivity

Internet penetration is not just a function of external forces. It also depends on the level of basic Internet skills in the population. In Africa, more than one third of the adult population is totally illiterate; in countries such as Benin and Sierra Leone, the figure is more than 50%[10]. For these people, the opportunities to access and benefit from the Internet are extremely slim. To equip more people with Internet skills, governments should work with education institutions, labor departments, and carriers to provide Internet-specific training to as many people as possible, particularly to improve digital literacy amongst underprivileged groups.

The past decade has seen the numbers of Internet users increase globally by 2 billion. We believe that the goal of getting the next 2 billion people online will be achieved within a far shorter time. Looking forward, countless systems, enterprises, cities, and groups around the world will complete their digital transformation by getting better connected. Huawei is committed to innovating around the needs of these customers, and working with partners to build a Better Connected World. Huawei is enriching people's lives through communications, bringing better experiences to our users, and creating value for our customers and communities.

[9] Localization is Vital for Chinese Companies to Succeed in India (Chinese), https://zhuanlan.zhihu.com/p/24835876
[10] Bringing the Next 4.4 Billion People Online (Chinese), http://www.tuicool.com/articles/EZvAna



Cloud:
Services at Your Fingertips

Cloud trends heading higher

During the past ten years, we've seen a surge of interest in cloud. It follows dramatic advances in the technology infrastructure to support it, along with far more knowledge and understanding about its benefits.

For many, the prospect of not having access to the cloud is unthinkable. After all, who wouldn't be drawn to a low-cost, on-demand, scalable and highly flexible service that drives business? Cloud is especially good for larger companies with complicated businesses, because it helps cross-border collaboration which fosters innovation while improving responsiveness and agility. It also facilitates work and internal communication among employees.

Benefits of cloud[1]:

- Accelerates the way companies create new products and services, and new business models, through faster research and information sharing
- Helps organizations serve their customers better through data mining and analysis
- Lowers spending on software, servers, data centers, etc.
- Enables leapfrog development with affordable access to advanced applications, tools, and infrastructure
- Empowers governments to provide healthcare, education, and financial services where they didn't previously exist
- Reduces our carbon footprint as economies of scale and less energy usage

[1] World Economic Forum

Enterprises moving faster to cloud; larger companies to drive the momentum

Not surprisingly, growth in cloud uptake is strong – and it's getting stronger. According to Gartner[2], the percentage of organizations using cloud is set to reach 77% in 2017, up from 58% in 2016 – by 2019, it is forecast to reach 85%.

Companies on cloud:
How has cloud enabled my business?[3]:



Early adopters were smaller businesses, often ones born in the Internet era. These so-called digital natives were the drivers of Cloud 1.0. But with their needs largely met, looking forward, it's the medium- and large-sized companies that will drive development, more so in public cloud as it closes the gap on private, and advances into the Cloud 2.0 era.

Public, private and hybrid clouds to coexist for a long time, but the trend is towards public

Cloud usage by enterprises generally falls into one or more of three formats: private, public, and hybrid. Large companies typically use private cloud; SMEs and individuals tend to use public cloud; and hybrid is a bit of both.

As public cloud technology develops, companies will look to transition more of their operations from private to public. It will likely be a slow transition, especially for medium- and large-sized enterprises with complicated business and legacy IT systems. Given the complex nature of their IT infrastructure, production systems, and business process, moving to public cloud is far from being a quick overnight task.

One consequence of this is that public, private, and hybrid clouds will need to co-exist for a lengthy period of time. A survey of companies by Rightscale[4] showed that 95% use cloud at present – 89% public, 72% private. The findings reflect the popularity of hybrid. Of those surveyed, 67% use hybrid, with just 5% using private only, and 22% using public only.

In the end, however, the trend will be with public cloud. Huawei Market Insights (MI) research sees

[2] Gartner estimates based on cloud adoption surveys (2014 to 2016)
[3] Harvard Business Review
[4] Rightscale 2017 State of the Cloud Report

the global cloud market growing about 19% a year over the next five years, with public cloud growing at 21% and private cloud at 18%.

Global cloud presents new challenges to enterprises

Cloud is a lynchpin in the global digitalization process. But there are challenges and, indeed, concerns about it. The ability to navigate them is important, so having a good partner that matches your needs is essential. Major concerns from large enterprises mainly include:

Protection of core data assets

In the digital age, data is a core asset for any enterprise. Ownership, privacy, access, security, and storage can all be a source of anxiety for company executives. The prospect of having their company data being accessed without their consent or awareness is enough to give them sleepless nights. And it's not just that; issues such as unplanned outages and security breaches can have broader ramifications.

Cloud almost by definition doesn't recognize borders; it's agnostic on jurisdiction. Regulation also differs widely. The US has stricter rules for certain industries, such as healthcare, while the European Union has blanket data privacy laws covering all data. There are multiple jurisdictions and varying levels of regulatory detail that help protect data. That's good, but it can also complicate matters and present significant challenges to businesses, making it vital to work with partners that have a deep understanding of the local regulations.

Overall security of their business on cloud

Clear standardized service level agreements (SLAs) are a tool for addressing concerns and making informed decisions. SLAs typically cover commitments to response times, service continuity, bandwidth, security, and so on. That's good, but can SLAs sustain such a high level on cloud? Do cloud vendors have the capabilities to ensure enterprises' businesses can run safely on cloud, for example with preparedness for disaster recovery, system backups, and anti-virus technology and procedures? In addition, enterprises need to abide by a variety of laws and regulations. It is fine when they operate locally; however, after they move the business to cloud, do these regulations still stay relevant considering the complexity of cloud?

Protecting past investment and avoiding vendor lock-in

Over decades, medium- and large-sized enterprises have grown their business and accumulated data from traditional IT systems. So, during the process of adopting cloud, they understandably vacillate between the new opportunities and utilizing established systems for the simple reason that they don't want to see previous investments go to waste. They need an open platform to ensure that data is portable and facilitate the transition from legacy systems.

In addition, to avoid putting all their eggs in one basket by being locked in to one provider, businesses are wise to also opt for a multi-cloud vendor approach. To seamlessly work with and switch between multiple partners, businesses need to deploy cloud on an open platform that enables data to be readily moved from one vendor to another.

Ensuring a timely response wherever businesses require it

To medium- and large-sized enterprises with

complicated business and legacy IT systems, migration to cloud is a long journey. During this journey, they need complete on-site support with last-mile service capability at any time. For both MNCs and local companies, cloud partners with local service support is vital. For enterprises with multinational operations, it is especially important for their cloud vendors to provide them with access to that local service all around the world.

Finding peace of mind

IDC[5] forecasts overall expenditure on public cloud to rise at a rate of 21.5% per year through 2020, when it will hit US$203.4 billion worldwide. That's a rate of increase almost seven times that of overall IT spending growth. Vast sums will be spent, but will it be spent wisely?

Migration to cloud is more than a technological revolution. It has significant implications on enterprises' operating and business models. Thus, choosing the right partner is paramount. Unlike startups and small businesses that don't have legacy pressures, medium- and large-sized enterprises need to look beyond pure technology, and identify long-term partners who match their business priorities. The right partners need to:



- Understand both traditional IT systems and new business needs so as to ensure future-oriented upgrades.
- Place customers' interests first, and respect customers' data integrity and privacy.
- Have the capabilities to ensure that customers' business can run safely on the cloud.
- Support an open structure that ensures seamless data transfers among various platforms in a way that protects earlier investments in legacy systems and helps smooth the migration to new systems.
- Offer proven local capabilities and on-the-ground support to respond quickly in every step of customers' journey to the cloud, while also providing complete adoption services, including evaluation of readiness, system transfer and testing, operations & maintenance, etc.
- Provide up-to-date industry knowledge and strong local partner networks, with a deep understanding of the local lay of the land, including regulations.

[5] IDC: Worldwide Semi-annual Public Cloud Services Spending Guide

Huawei builds trust with reliable, open and local service worldwide

With 20 years of experience serving medium- and large-sized enterprises, Huawei has built up a deep understanding of enterprise business needs. In China, Huawei is the market leader for private cloud, server, storage, and networks. Among the world's Fortune 500 companies, 172 have chosen its services. Of the Fortune 100 companies, 43 are customers of Huawei.

Huawei's cloud services help its customers to achieve real bottom-line success. Around the world, with so many different local and regional scenarios, there's no single model that will serve all needs. To support the diversity of its customer base, Huawei operates both the Huawei cloud service and localized joint services with its partners: China Telecom eCloud, Deutsche Telekom Open Telecom Cloud, Orange Flexible Engine, and Telefonica Open Cloud.

In all of its business relationships, Huawei fully respects the boundaries between its strengths and services, and its partners' strengths and services. It focuses on its own core strengths, only providing partners with application development platforms and data-processing tools. Huawei does not develop applications within its customers' current areas of business; and it never accesses or use customer data for commercial purposes without permission.

Huawei has a number of certifications and qualifications, all of which involved vigorous examination and assessment. These include some of the most stringent in the world: ISO27001 Information Security Management System, TÜV Trusted Cloud Service, MIIT Trusted Cloud Service Certification and, most recently, the Cloud Security Alliance® CSA C-STAR Assessment, for which Huawei achieved a gold certification in July 2017. Huawei is among the best-certified cloud providers in China.

From private to public cloud, from Huawei cloud to joint-clouds with partners, Huawei embraces the OpenStack open-cloud architecture, which ensures interoperability between clouds. A single API and a single ecosystem enable enterprise customers to migrate smoothly between private and public clouds: an open bridge to the future.

Huawei's local service capabilities worldwide help companies to migrate smoothly to the cloud. Besides having local service teams in 170 markets, Huawei works with more than 12,000 partners to provide consulting, delivery, and migration services. Huawei has 12 OpenLabs worldwide to make joint innovation with local partners and provide technical support and validation services.

As of the end of July 2017, Huawei has launched a total of 65 cloud services in 10 different categories[6]. Huawei cloud and joint clouds with partners serve some of the best known companies in China, Europe, North America, Latin America, South Pacific, and other regions.

[6] Huawei's 10 categories are: computing, storage, security, networks, management and deployment, application services, databases, data analytics, software development, and enterprise applications.

STORY

Open Telekom Cloud powers CERN

In collaboration with Huawei, Deutsche Telekom launched Open Telekom Cloud (OTC) in 2016. OTC is used by the European Organization for Nuclear Research (CERN) to meet their high performance computing needs. OTC's pay-as-you-go pricing and Huawei's fast, flexible deployment meant that CERN no longer had to worry about maintaining its own outsized technology infrastructure. Like CERN's previous, private cloud solution, OTC uses OpenStack architecture, which made migration simple. And the customer felt secure in the knowledge



that Huawei cloud is certified to Europe's most stringent standards: OTC is a TÜV Trusted Cloud Service, and passed the Cloud Security Alliance® CSA C-STAR Assessment.

STORY

12315 Internet platform for consumer surveys

In 2017, Huawei developed the "National 12315 Internet Service Platform" for China's State Administration of Industry and Commerce. The platform reaches consumers via WeChat, Weibo, or other apps, and enables fast interaction, processing, and response, for a consistent service experience across all channels. The platform can collect and manage customer data from across all channels to facilitate follow-up services. During the 2017 315 Gala Show



on CCTV, on global consumer rights day, the platform handled upwards of 210,000 viewer responses per minute.

STORY

Cloudification for Dong Feng



Huawei delivered a future-proofed hybrid cloud solution to Dong Feng Motor Group in 2016. In the first phase, Huawei deployed 300 cloud servers to support all of Dong Feng's office applications. The cloud has the capacity to handle more than 50 simultaneous projects, and over ten thousand external visitors; at the same time it has cut Dong Feng's IT costs by about 30%. Dong Feng and Huawei are together developing a plan for cloudification of all of Dong Feng's key business systems. In the future, they will jointly introduce artificial intelligence to help build complete smart enterprise systems.

STORY

Huawei and Philips team up on healthcare cloud applications



Philips China enjoys seamless data connectivity with its headquarters in the Netherlands via Huawei's open cloud platform. A local Huawei team provided support to ensure the swift deployment of cloud, and the system has helped Philips to rapidly develop its business in China, especially its healthcare business.

STORY

Huawei facilitates Chinasoft IT crowdsourcing platform



Huawei's comprehensive Cloud DevOps platform helps to speed up software development for universities and companies. Chinasoft International's IT crowdsourcing services platform uses Huawei's software development cloud for complete automation of the software development process in four separate environments. New applications can be deployed on the cloud efficiently; contributors can coordinate their efforts; and the development process has become dramatically easier. Since its launch, the Huawei software development cloud has served over 30 universities, more than 300 companies, and 20,000+ developers.



Internet of Things: Sensing Our Way into the Future

Governments worldwide are rolling out plans to develop the Internet of Things (IoT). A great many have policies designed to accelerate the trend towards smart cities, along with closer technological, economic and trade exchanges between countries. For them, it's all too obvious that IoT is a vital new growth engine that's essential for expansion of the digital economy.

What's less obvious, or at least less quantifiable, is the sheer scale of the economic impact that IoT will have. According to consulting firm McKinsey[1], the impact could be as large as a staggering US$11 trillion by 2025, equivalent to 11% of the world economy.

Huawei forecasts[2] that by 2025, there will be 100 billion connected devices, used in every area of business and life. This will be a time when, for example, your refrigerator will know what is inside it, and use that knowledge to send a shopping list to your mobile phone.

The impact of IoT by 2025:

US$ 11 trillion

11% of world economy

100 billion connected devices

[1] *The Internet of Things: Mapping the Value Beyond the Hype*, McKinsey Global Institute
[2] Huawei Global Industry Vision

As you drive past your favorite restaurants, your phone will automatically grab the vouchers and offers they are broadcasting – and find you a parking space in real time. Your car will continuously collect and analyze data on your driving habits, which will help insurance companies to set premiums at just the right level.

In the world of IoT, possibilities lie everywhere. All things sensing, all things connected: IoT offers enormous opportunities which all farsighted policymakers are striving to grasp.

Facing up to the challenges

IoT has the potential to significantly raise levels of efficiency and drive digital transformation in companies. However, challenges abound:

Standardization
There are a number of different IoT architectures used in different industries, meaning that IoT as a whole is still fragmented and not well scaled. The industry is exploring how to integrate the various different IoT standards to reduce barriers to entry.

Connection parameters and security
Depending on the use case, each industry places a different emphasis on the type of IoT connection it requires. Some specify the breadth and depth of coverage; for some it is low-power devices, or low latency. Given the range of IoT technologies available, how does an industry select the right type of IoT and integrate it into commercial operations? How to put in place a holistic security process?

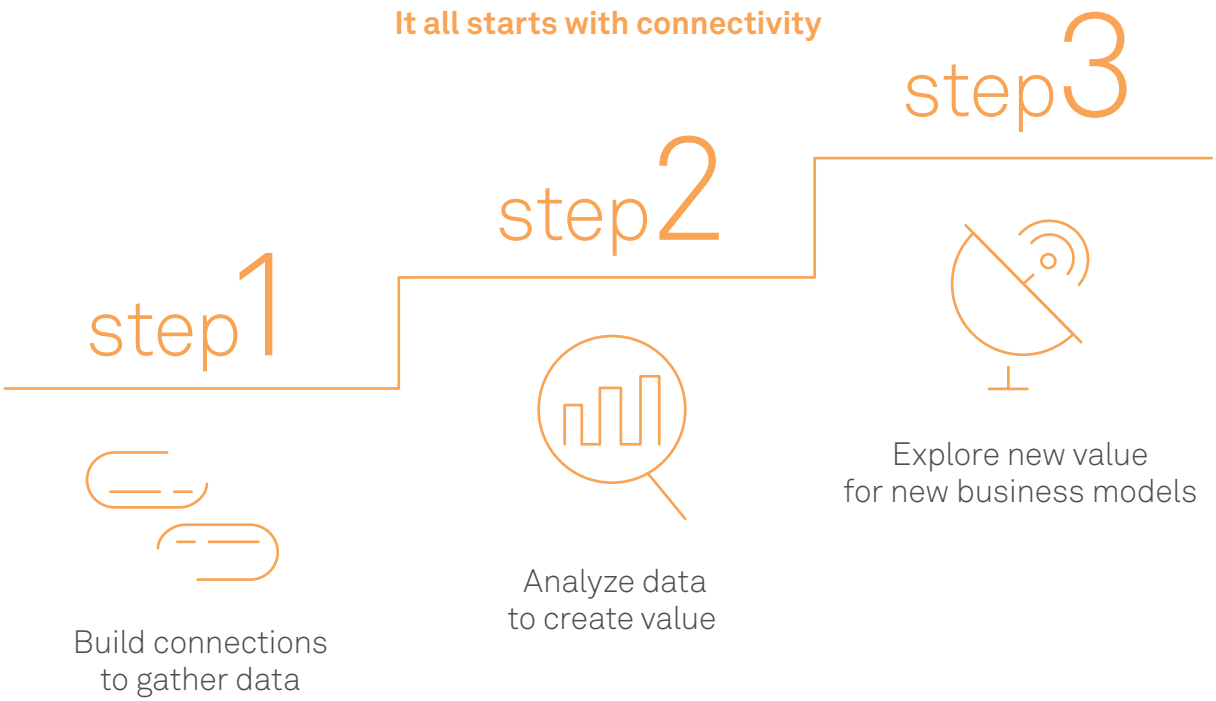
Monetization
Any new technology ultimately has to serve business objectives. Every industry needs to consider how it can leverage IoT and develop digital services to drive new growth.

Industry and ecosystem development
IoT is a complex ecosystem. The supply chain behind any IoT system is long, involving multiple manufacturers, integrators, operators, and vertical customers. How do you build wide-ranging alliances to knit partners into stable, sustainable business models in which all parties can succeed? How do you protect the interests of everyone and grow together? These questions are of crucial importance for the commercial application and the sustainable growth of IoT.

IoT starts with connectivity

From planning to deployment, commercial use, and expansion, companies will need to make significant investments of time and capital in IoT. To ensure a satisfactory return on their investments, companies will have to set clear goals based on their business strategy. Then their IoT journey can truly begin.

The start is often the hardest part, but once the momentum builds and the steps fall into place, so it becomes easier for enterprises as they move ahead. A simple three-step process can be applied:



Step 1: Build connections to gather data.
Connectivity is the foundation of IoT. Connections vary in type and match different scenarios. When deciding on which type of connection, companies need to have a forward-looking strategy in mind; they need a connection that's stable, secure, and scalable – and, of course, at the optimum cost. For example, with smart parking, remote metering, and smart homes, as well as a myriad of industrial and manufacturing scenarios that have massive data transmission requirements, it is important to build connections that ensure low latency, wide coverage, and low power consumption. This is where Narrowband IoT (NB-IoT) comes into play.

Step 2: Analyze data to create value.
The value of IoT goes far beyond data gathering and real-time monitoring. Companies will increasingly see the need to upload massive amounts of data to the cloud, to support flexible resource scheduling and visualized operations. They will also look to process their data using machine learning and cognitive analytics in order to develop the new services that will bring them success. Looking forward, IoT platforms that are open, deployed on the cloud, and with big data analytics capabilities will be the ones to watch.

Step 3: Explore new value for new business models.
Riding the wave of digitalization, there is a gradual shift by industries from focusing on their own verticals to open collaboration with each other, forging closer ties across verticals. We will see traditional industry blend with digital, one sector link to another, and downstream loop back into upstream. Companies will jointly explore and incubate new business models and commercial applications. In this process, it will be important for companies to bring an open and long-term perspective to their selection of IoT partners. They will need stable, win-win relationships to secure success in IoT.

Developing the IoT industry

As a global leader in information and communications technology with three decades of experience, Huawei has the capability to deliver full-stack IoT solutions, from chipsets to operating systems, from IoT connections and platform to cloud computing and big data analytics, and even ecosystem development. Huawei is well positioned to provide industry customers and partners with seamless, full-stack services and experiences.

Huawei is also committed to respecting the boundaries and specialisms of its customers. There are five areas that are solely the domain of Huawei's customers and partners: customer data; industry-specific IoT applications; IoT device development; IoT device resale; and end-to-end integration services for enterprise customers.



IoT chipsets

With its strong expertise in telecommunication, Huawei has developed a high-performance IoT chipset called Boudica. Boudica features high integration and low power consumption, and is perfectly designed to support large-scale NB-IoT deployments.



IoT operating system

To help promote the development of smart devices, Huawei offers a lightweight, open source IoT operating system – Huawei LiteOS.



Diversified and secure connections

Huawei enables wired connections (agile IoT gateways, home IoT gateways, and edge computing IoT) and wireless connections (NB-IoT, 5G, eLTE, etc.) in order to serve different scenarios. It also provides end-to-end security solutions.



Cloud-based IoT platform

Huawei has built an open, cloud-based IoT platform – Huawei OceanConnect IoT Platform – which supports cloud deployment and all types of connections, ensuring greater reliability and efficiency. The platform also comes with big data analytics tools to help customers to generate extra value from their data.



Standardization and ecosystem collaboration

- Huawei has developed a network of more than 700 IoT partners in a wide range of industries, including smart home, smart manufacturing, smart energy, and Internet of Vehicles, etc. Huawei hopes to share its rich industry experience with its IoT ecosystem partners, so that all parties can grow and succeed together.
- As of the end of 2016, Huawei belongs to over 300 standards organizations, industry alliances, and open source communities, including NB-IoT Forum[3], the Alliance for

[3] NB-IoT Forum was jointly established by 14 world's leading enterprises and institutions, including GSMA, Huawei, Etisalat, China Mobile, China Unicom, Qualcomm, Vodafone, GTI, Intel, LGUplus, NOKIA, Ericsson, Telecom and Italia Telefonica.
[4] The Alliance for the Internet of Things Innovation (AIOTI) was initiated by the European Commission in 2015, with the aim of strengthening the dialogue and interaction among IoT stakeholders in Europe. It currently has more than 170 members.
[5] The Industrial Internet Consortium (IIC) is a leading global industry organization which promotes the Industrial Internet of Things (IIoT) and aims to define and develop the reference architecture and frameworks, share and exchange real-world ideas.

the Internet of Things Innovation (AIOTI)[4], and Industrial Internet Consortium (IIC)[5]. Huawei's objective is to help accelerate industry standardization, and lower barriers to IoT commercialization.

- For solution partners and developers, Huawei launched the "IoT Solution Partner Program". This program offers support for the design, development, integration, certification, and marketing of IoT solutions. Huawei will provide US$1 billion to support developers in its developer community. In addition, Huawei has established 12 Open Labs worldwide to provide IoT partners with open lab services, including joint innovation, validation services, and joint marketing.

Looking ahead, Huawei will continue to increase its investment in IoT. Alongside its partners, Huawei aims to help the IoT industry flourish.

A member of

300+ organizations

700+ IoT partners

US$ 1 billion developers funds

12 Open Labs

STORY

Internet of Elevators Helps Schindler Cut Costs, Enhance Safety and Experience

Operating more than one million elevators and escalators globally, the Swiss-based Schindler Group is one of the world's leading providers of elevators, escalators, and related services. In the past, Schindler's elevators were mainly operated and maintained manually, resulting in high maintenance costs and inherent safety risks in the event of human error or negligence.

Now, Huawei is working with its partners to provide Schindler with an industry-leading Internet of Elevators solution. The solution will manage over a million elevators around the world on a single platform, automate operations and maintenance, and help Schindler overcome safety challenges.

Huawei's industrial predictive maintenance solution collects and transmits elevator data in real time to reduce the need for physical inspections. Using sophisticated data analytics on the cloud, it is possible to identify potential issues and send an alert in advance of a likely elevator malfunction. The solution helps reduce downtime by 90%, and maintenance costs by 50%.

Predictive maintenance not only eliminates safety risks, but also extends elevator service life. The solution also allows for new services, such as in-elevator advertising and innovative digital services for data monetization, which can create additional commercial value.

STORY

AOD Smart Street Lighting Saves Energy and Costs

Advanced Optronic Devices (AOD) is the world's largest supplier of LED street lights. Its LED lights are designed for outdoor, commercial, and industrial use. Huawei partnered with AOD to deploy a smart street light solution in Weifang, a city located in China's Shandong province.

The smart street light solution uses Narrowband-IoT (NB-IoT) over licensed spectrum, which offers excellent coverage and reliability. It allows for precise control, down to the brightness of each individual light, with options to program lighting patterns based on the season, weather, or other specific needs. LED lighting already delivers power savings of 50% over traditional street lights; the smart lighting solution enables a further 10%–20% improvement in power savings.

The smart street light solution also supports remote fault detection and troubleshooting, thereby eliminating the need for manual inspections. Combined with lifecycle management based on the record of each street light, remote monitoring can reduce maintenance costs by about 50%.

STORY

Smart Water Solution Helps Keep Drinking Water Safe

Sending utility staff to homes to read water meters in the traditional way has a variety of problems. It is costly, and sometimes meters are missed by mistake. More importantly, the traditional method does nothing to record water losses from pipes, which is a waste of resources and a cost. Incomplete measurements in China suggest that 37% of all mains water is lost through leaking pipes.

In March 2017, Huawei partnered with Shenzhen Water Group and China Telecom to launch the world's first commercial smart water network, deploying more than 1,200 NB-IoT-enabled smart water meters in Shenzhen as part of a comprehensive upgrade of the city's water management system. It was a complicated deployment, one requiring broad coverage across the entire city, plus physical depth of coverage, because the water meters are mostly located on underground inlets or in basements.

However, the NB-IoT smart water meters provide exactly the functionality required. The meters use very little power because they stay in sleep mode except during the occasional meter readings. This means less maintenance and longer between battery replacements.

Smart water meters not only help save on the cost of labor involved in meter reading, but also improve data completeness and accuracy. To date, the utility is getting data from over 99.5% of its meters at every reading. The meters are also able to check water pressure, and compare throughput at different nodes of the pipe network, which enables the company to identify leaks and carry out preventive maintenance before problems escalate. Smart meters also enable differentiated rates at peak/non-peak times of day, helping the utility to smooth demand and use its water resources more efficiently.

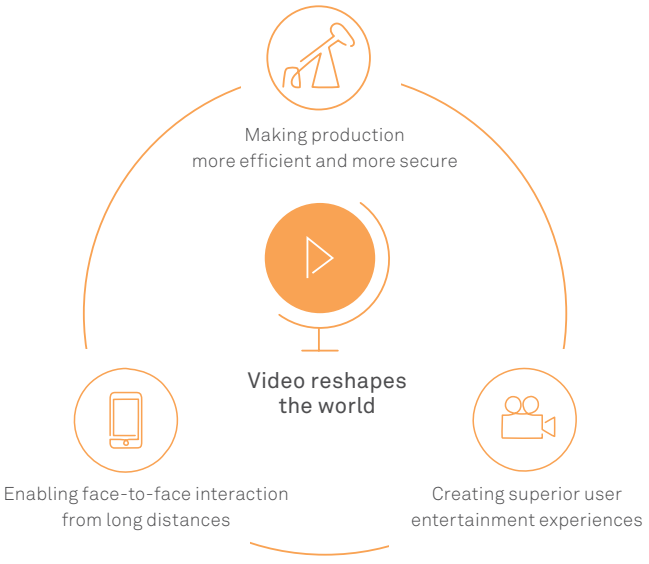


Video: Machines' Lens on the World

Be it entertainment, video chat, live streaming, conferencing, surveillance, or intelligent manufacturing, video is now ubiquitous. It is increasingly the essential ingredient, the secret sauce that brings people together. Video is intuitive, convenient, and informative. It has become the preferred medium of information delivery, alongside text and image, and is helping to reshape the world in a variety of ways.

People look for security and efficiency from video surveillance, they like to interact through video communications, and, more and more, they seek an immersive ultra-HD experience via entertainment video. All of these require a network that is cloud-based, integrated, open, and that has high bandwidth and low latency. As an important enabler of enterprises' digital transformation, video is evolving from a basic service of businesses to a fundamental capability.

As an important enabler of enterprises' digital transformation, video is evolving from a basic service of businesses to a fundamental capability.



Video reshapes the world

Video changes the way we produce, making production more efficient and more secure

In Industry 4.0, robotic arms and robots that can view and respond to their environments make automatic, intelligent, and flexible manufacturing possible. In industries with high security requirements, such as in petroleum and petrochemical, cameras are extensively deployed at locations such as oil fields, factories, drilling platforms, and pipelines. This is with the aim of identifying and flagging potential security vulnerabilities in real time. When machines can view and respond to their environment in this way, production and operations become more efficient and secure.

Video changes the way we communicate, enabling face-to-face interaction from long distances

Video is everywhere, including on mobile phones and tablets, computers and televisions. Video is making communications more efficient and affordable for individuals and businesses. New technologies, such as holographic delivery, make videos much more expressive, enabling people to interact face-to-face despite being separated by long distances. For example, Professor Stephen Hawking once beamed a live hologram of himself to the Sydney Opera House, speaking to the audience about his thoughts on technology, the universe, and life. The potential of the technology is clear for education, for business, and for entertainment.

Video changes the way we entertain, creating superior user experiences

Today's entertainment videos are rich in content and form, raising expectations for a premium video experience, such as with 4K ultra-HD video. We live in a mobile era with a fast-growing live streaming industry. People increasingly create and watch live videos on their mobile phones. Live streaming applications introduced by Internet giants such as Facebook, Google, and Twitter have fueled this trend. Also part of this trend are new technologies such as augmented reality (AR) and virtual reality (VR), which are regularly applied in live streaming as well as in games, films, and other areas. These developments are bringing a more immersive and interactive experience to users.

Enterprises set sights on the video trend

Data from MarketsandMarkets[1] shows that the global video surveillance market is set to reach around US$75.6 billion by 2022, with a compound annual growth rate (CAGR) of 15.4% between 2017 and 2022. In terms of the video communications market, using video conferencing as an example, the global market for video conferencing is forecast to expand at a CAGR of 8.5% from 2016 to reach US$7.85 billion by 2023, according to Transparency Market Research[2]. For entertainment video, taking video-on-demand (VOD) as an example, Transparency Market Research forecasts[3] that the global VoD market will expand at a CAGR of 9.3% from 2016 to reach US$73.9 billion by 2024.

Amid this explosion in video innovation, many enterprises are setting their sights on developing video as a key productive force to support their digital transformation. In healthcare, for example, video can be used to support medical services delivered to remote communities where there is a scarcity of local know-how or a complete lack of resources. Elsewhere, insurers are applying video to remote damage assessment for road accidents,

[1] MarketsandMarkets Video Surveillance Market by System, Hardware, Software, Service, Vertical, and Region - Global Forecast to 2022
[2] Video Conferencing Market - Global Industry Analysis, Size, Share, Growth, Trends and Forecast 2015 - 2023
[3] Video on Demand Market - Global Industry Analysis, Size, Share, Growth, Trends, and Forecast 2016 - 2024

thereby expediting assessment-to-repair process, as well as claims. Such applications also reduce labor costs and save time. In telecommunications, carriers are offering IPTV-based HD TV video chat services to connect children of migrant workers with their parents, and senior citizens with their families.

Yet, while trendy, video is very data-heavy. Its data requirements are far greater than those of audio and text. This is placing growing pressure on network bandwidth and analytics capabilities. Enterprises therefore need more intelligent video processing systems, as well as access to larger broadband capacity. Efforts across the entire video ecosystem are required to make this a reality.

Video surveillance: from "seeing" to "seeing clearly" and "understanding"

From factory production to city management and emergency communications, video surveillance enhances efficiency and security. It also facilitates informed decision-making, which is why so many state and city governments around the world use them.

In today's ecosystem, "seeing" is no longer sufficient for intelligent video surveillance. It is now about "seeing clearly" and then "understanding". Seeing clearly means cameras have to guarantee 4K or even higher quality in all conditions. Enabling "understanding" requires cloud-based platforms built on intelligent and connected networks capable of sharing and analyzing massive amounts of data and extracting their true value.

Where there are opportunities, challenges follow

How to tap latent network intelligence to generate better analysis and interaction

Most current video surveillance systems can only analyze video data around one location or within a very limited area. The systems are generally unable to intelligently interact with data from surrounding devices to broaden the coverage and analysis. Their front-end devices typically have to send the original video data to a back-end computing center for analysis. This takes up network resources, affects analysis efficiency, puts pressure on the computing center, and impedes the center's big data and data mining capabilities.

How to connect platforms so that data can be easily shared

Traditional video surveillance systems tend to be built in silos by different industries and departments, with manufacturers using a wide range of standards and types of architecture. The massive amount of video data is stored in separate data servers. All of this results in repetitive system construction. Connecting platforms becomes harder, while making it tougher to combine and share video data fast enough to support timely and informed decision-making that requires inter-departmental collaboration.

How to flexibly allocate resources via cloud-based video surveillance systems to quickly roll out new services

With the rapid expansion of enterprises and urbanization, traditional video surveillance systems can no longer keep up with the changing needs. Cloud deployment is vital to ensuring flexible allocation of computing, storage, and network resources to handle massive volumes of data. This, in turn, opens up capacity for new services, features, and businesses to be rolled out.

How to ensure data security

The security of video surveillance systems is a concern as the threat of cyber-attacks and viruses

grows. As networks become more connected, an attack at any point can impact the entire network. At critical moments, if the video surveillance system fails and data loss or damage occurs, the compromised functionality could render the investment worthless or close to it. There can also be data privacy implications.

A multi-tiered approach to building intelligent video surveillance infrastructure for security

- Deploy video cloud to distribute intelligence across the network – from front-end devices, to network edge, to cloud center. Put in place ultra-HD front cameras that have a wide range of sensing and pre-processing capabilities, so that the cloud center can focus on big data analytics and data mining to rapidly find valuable insights that support timely and effective decision-making.

- Connect different video surveillance platforms to one network in order to maximize the value of video data. To do so, it is important to unify industry standards and use multi-protocol gateways to enable cross-sector connections (such as those of public security, transport, and tourism), making it possible to rapidly retrieve related video data.

- Build cloud-based video platforms and optimize the network architecture to satisfy changing usage needs. This is with the aim to flexibly allocate computing, storage, and network resources, while also enabling rapid capacity expansion and roll-out of new services.

- Increase investment in the security of video surveillance and put in place a holistic protection program that covers cloud, networks, and devices to secure the system, data, and personal privacy.

- Combine resources with other parts of the ecosystem to bring in cutting-edge algorithms and develop general-purpose systems and uniform standards. This is to accelerate integration of third-party applications to support the evolution and innovation of verticals.

Video communications: face-to-face chat anytime, anywhere

Wide usage of video communications across all industries has transformed the role of enterprise communications systems, moving them from a supporting role to one that guides production. Video communications is now a must-have capability for enterprise management, production, and business processes. Having such capabilities allows companies to benefit from significantly lower communications costs, as well as improved operating efficiency and productivity. The rapid development of real-time communications video has helped accelerate the digital transformation of industries including healthcare, education, tourism, finance, and others.

Where there are opportunities, there are also challenges

How to ensure a premium video experience on any device in any scenario

Real-time video communications services should provide users with a simple and smooth experience whether users are using mobile phones, tablets, computers or televisions, and whether users are at

home, in the office or on the go. The user interface needs to be intuitive and friendly. But devices vary in terms of network interface and line-quality varies too, meaning that poor and inconsistent performance can deter users from trying out new services.

How to boost connectivity and interactivity to make video more accessible

At present, there is no uniform standard for the interoperability of video services. Different video communications services use different media signals and protocols, resulting in silos and fragmentation. It also increases development costs, impedes new application development, and negatively affects user experience.

How to help video service innovation and vertical development

It is difficult, if not impossible, to win user loyalty and achieve broader commercialization if enterprises rely on video communications alone. It is important to build core video capabilities into premium video services that users can really experience. But fragmented traditional industry chains are generally not open, which makes it difficult to bring together all the required resources. This in turn leads to higher costs and lower development efficiency.

A three-pronged approach

- **Enhance the video communications experience.**
  Use HD video encoding technologies, such as H.265, and provide quality of service (QoS) across the network to ensure that users receive a premium video experience in 1080p and 4K ultra-HD formats. Ensure collaboration between devices and cloud, so as to flexibly meet user needs in different scenarios, and win loyalty right from the entry point.

- **Develop a connected communication cloud.**
  Connect the audio/video output/input ports from different networks to eliminate silos. Build a connected, secure, and reliable video communications network to improve accessibility.

- **Collaborate across the industry in ecosystem development.**
  Bring together the power of the industry as a whole. Make video communications on any device more accessible through cloud and open APIs, making it easier to develop communications video applications in different sectors, such as healthcare, education, security, and other common scenarios.

Video entertainment: creating an overwhelming momentum

Verizon's acquisition of AOL and AT&T's of Time Warner, along with Facebook Live's move to support 4K streaming for 360-degree video and Google Daydream working with Major League Baseball on a VR documentary series, highlight how quickly the entertainment video business is evolving.

With opportunities come challenges

How to provide an user-friendly experience

Video content is everywhere and new technologies, such as 4K and VR, are rapidly developing. This means users now have far more options. But it is also more difficult to choose content across platforms. In addition, for televisions, tablets, and VR headsets, along with mobile phones and video devices in smart cars, it is essential to offer users

a fast, friendly, and unified interface to deliver an immersive video experience.

How to increase the value of video content
Users have a strong interest in video, but it is not always easy for them to find the content they like. Analysis of user intentions and providing appropriate recommendations is key to improving the value of video content.

How to achieve efficient service operation and maintenance
The explosive growth of video content, the need for a premium experience on any device, and the need to meet users' personalized demands have all raised the bar for video service operation and maintenance (O&M). A robust end-to-end video service O&M system is now necessary to deliver high-quality services and build competitiveness.

How to adjust and upgrade networks to deliver ultra- HD experience
User interest in ultra HD video, live streaming, and mobile entertainment has led to higher network requirements. As demand for entertainment video diversifies, network architecture will only meet the needs of business if it is based on the cloud and is not focused only on data transfer.

Multiple strategies for premium entertainment video experience

- Optimize end-to-end user experience with a fast, robust, scalable, and secure network. This will facilitate the aggregation of content, deployment of cloud-based platforms, and service distribution. The next step is then to create a premium experience that is simple, enjoyable, and personalized.
- Develop capabilities in video big data analytics to help innovate in operating models. Aggregate content from different platforms and study user behavior on these platforms. Then create user profiles and provide users with personalized video content, recommendations, and targeted advertising, so as to fully leverage the value of video. Use smart operation analysis reports to measure performance in real time and maximize value.
- The O&M of video services requires a complete visual interface for both quality control and measurement of user experience. This will enable the platform to identify malfunctions, optimize user experience, and improve operating efficiency.
- Establish a broadband network with wide-coverage and fixed-mobile hybrid capabilities, and transition data-centric networks to video-centric networks. This will meet video transfer needs, support development of scenario-specific services, and ensure the network can smoothly evolve to meet future needs. Network operators need quantifiable standards to evaluate video experience. This will allow them to establish guidelines for network planning, construction, adjustment, and optimization.

Ecosystem expansion to promote video industry growth

The video industry is huge and complex. It involves many different areas of specialization and a variety of stakeholders with a multitude of skillsets – filming, editing, production, operation, transmission, analysis, and delivering an end-to-end experience. There are also the skillsets covering devices,

networks, platforms, and applications. In order to achieve robust, fast-paced, and sustainable development, governments, enterprises, and industry organizations must actively work with these parties to lead the industry in the right direction, toward innovation, development, and wider application.

As a strong advocate of the industry ecosystem, Huawei is committed to promoting the development of video with an open strategy in the hope of achieving shared success in every collaboration. This includes helping enterprises to use video as an enabler in their digital transformation. Huawei hopes to explore ways to boost the development of the video industry with partners in the following ways:



Devices

Push for upgrades of related devices, such as ultra-HD cameras, VR headsets, and set-top boxes, and further popularize the use of these devices to users, in order to give them a better experience.



Platform

Develop an open, cloud-based, and integrated video platform; share video capabilities with partners by opening up algorithms and application interfaces, aiming to accelerate the integration of third-party applications; explore innovation in operating models to amplify the value of video in different industries.



Network

Enhance the capabilities of fixed and mobile networks; unify industry standards and achieve interconnection; work with industry partners to optimize the standards for video experience evaluation[4], in order to improve operating efficiency and to provide the best possible video experience.



Analysis

Realize intelligence and connectivity across the entire network; continue to optimize intelligent algorithms to effectively analyze massive amounts of video data and to flexibly allocate computing, storage, and network resources. This will enable flexible expansion and underpin smart decision-making.



Joint innovation and the development of standards

Actively promote the development of the video industry, working with video-related industry organizations around the world to establish alliances in niche markets and verticals. Facilitate the research, verification, and optimization of related technologies and standards so as to enable agile innovation in high-quality video services.

The rapid development of video-related technologies and applications has not only accelerated digital transformation in traditional industries and improved quality and efficiency, but also given rise to new industries and business models. Huawei is a strong supporter of video services, and is committed to working with partners to seize the opportunities that arise to expand the industry in a commercially viable, stable, and sustainable way.

[4] Huawei offered a video experience measurement system called U-vMOS in 2015. With technical analysis on samples of subjective video experience, Huawei created a set of objective video measurement criteria.

STORY

Shenzhen builds a cloud-based safe city management platform

To cope with the growth in video data amid ongoing migration, Huawei provided the Shenzhen Municipal Public Security Bureau with a new generation of intelligent cloud-based video solution with Video PaaS (Platform-as-a-Service) as its core. The solution innovated the network, strengthened security, and unified video storage and retrieval. It ensured the speed, security, and reliability of the transmission, storage, and retrieval of a massive amount of video data. With an intelligent analysis platform, compatible software, and the powerful network management capabilities of Huawei's eSight IVS (intelligent video surveillance) system, control and sharing of a massive amount of video data is made possible while also unifying the operation and maintenance of a large quantity of video equipment.

In the third phase of this project, a comprehensive intelligent cloud-based video solution from Huawei was adopted, making it easy to share all types of video data and facilitating the development of intelligent applications for the future. Huawei deployed a total of 22,758 HD cameras in just three months. Also, 692 video cloud nodes were successfully deployed in 29 data centers across Shenzhen to form a video cloud, which enables continuous filming and storage in the event of a network failure or a cut in the power supply of the data center.

STORY

Video surveillance as the foundation of "Safe City" in Kenya

Huawei built Africa's first modern "Safe City" system in Kenya using new information and communications technology. As part of this project, Huawei deployed 1,800 HD cameras and 200 HD traffic surveillance systems across the country's capital city, Nairobi. A national police command center supporting over 9,000 police officers and 195 police stations was established to achieve monitoring and case-solving. The system worked during Pope Francis' visit to Kenya in 2015, where more than eight million people welcomed his arrival. With Huawei's HD video surveillance and a visualized



integrated command solution, the efficiency of policing efforts as well as detention rates rose significantly. The regional crime rate has since dropped by 46%. In 2016, the number of international tourists travelling to Kenya rose by 13.5% year-on-year. Even Kenya's president spoke highly of this project on Facebook.

STORY

China Telecom Sichuan adopts the "012" strategy on the video transformation



China Telecom Sichuan introduced its "012" transformation strategy a few years ago. It aims to integrate video, fixed broadband, and mobile broadband on a single network. As part of its strategy, the carrier identified three main requirements for video: to be entertaining, interactive, and spanning a wide range of industries. The carrier also launched its "Missing Home" video telephone service, allowing users to connect with their friends and family anytime and anywhere. The Missing Home service is deployed across different sectors and industries, including education, healthcare, and entertainment. Since its launch in mid-2015, more than 5.48 million people have used it, including 2.23 million television users and 3.25 million mobile app users. China Telecom Sichuan worked with more than 20 video partners in this business to generate greater value, including China Telecom Guangdong which launched a similar service in Cantonese.

STORY

Turkcell makes breakthrough with Hybrid Video Solution



Turkcell is the largest mobile carrier in Turkey. Using Huawei's Hybrid Video Platform, the carrier achieved a breakthrough by enabling users to access video services on different devices with a single Turkcell account and password. Users can access a vast amount of personalized content as well as live video streaming and video-on-demand services after choosing their preferred service packages. Users can synchronize videos on different devices, share and comment, as well as link to their social media accounts. These offerings ensure a premium user experience. In the first half of 2017, the number of Turkcell OTT users and IPTV users has increased by approximately 30% and 20%, respectively. Video is now a key growth engine for the carrier's business strategy.

STORY

Deutsche Telekom offers the best fixed-mobile hybrid video experience



As Deutsche Telekom's former video service was unable to support its strategic development, Huawei provided the carrier with a hybrid video solution that enabled Deutsche Telekom to integrate fixed broadband, mobile broadband, and content delivery services on a single network. The solution provides a consistent user experience across all devices, and supports features such as live streaming, video-on-demand, live-streaming video play-back, multi-screen interactivity, and personal video recorder (PVR). After implementation of this solution, the carrier's total cost of ownership was greatly reduced, with the cost of maintenance labor also cut significantly. The solution also provides users with a premium video experience, which led to a rapid increase in the number of new users. The solution also helps accelerate integration with third-party services. Because Deutsche Telekom adopted an effective revenue-sharing strategy with its partners, a video ecosystem was successfully developed that has greatly reduced time to market while increasing the competitive edge of Deutsche Telekom's video services. Video has become a pillar of Deutsche Telekom business.



CYBER SECURITY: INNOVATION AND COOPERATION

Cyber Security: Innovation and Cooperation

In today's increasingly digital world, new technology is increasingly the driver of our digital evolution. New technology is making our lives better and our work more efficient. New technology brings together resources in new configurations. It is the spark of life in the digital economy. However, new technology inevitably brings brand new security challenges for our networks. Huawei is addressing these challenges head on, seeking innovative solutions, pulling together international partners, and gradually building up codes of practice for new, high-tech scenarios. Together, Huawei and its partners are building a Better Connected World in which businesses and people can connect with confidence.

Digital evolution brings new security challenges

As mobile networks evolve, all things will become connected, and they will always be online. In the 5G era, there will be upwards of a million connections per square kilometer. Every object we encounter in our personal and professional lives will be connected. With 5G, network response times will be 50x faster than it is with 4G technologies. The lag between action and reaction will be an ultra-low 1 millisecond. That will make possible many real-time applications that today simply do not exist.

Big data and artificial intelligence (AI) will turn scenes from science fiction into reality: machine learning, machine vision, diagnostic assistants, etc. For example, in the healthcare industry, we will see DNA tests performed by tiny AI chips, and huge "medical brains" that can analyze millions of those test results simultaneously. The potential value of big data and AI will finally begin to be realized, bringing benefits for all of humanity.

The use of cloud technology will also become much more widespread, and costs will drop. Over the next 10 years, 100% of companies will start connecting to cloud services. 85% of applications will migrate to the cloud. As a result, corporate efficiency will rise sharply. We will be able to develop and launch new software on the cloud, and the cloud will become a kind of digital brain, available to enhance all kinds of mental labor.

However, there are two sides to every coin. Mobile networks and sensors will make for a much more densely connected world; but the attack surface of our ICT systems will grow exponentially. AI and big data will enable deep data mining; but the risk of data leaks will also soar. Cloud will enable the sharing of resources and open up closed systems; but that means traditional, defendable boundaries will also become blurred.

Huawei believes that new challenges are no excuse for standing still. Challenges are part and parcel of technological advancement and social progress, and we should not shy away from them.

Security built into the innovation process

As a technology provider in the digital age, one of the first tasks for Huawei is to find innovative ways to build security into our innovative technologies. Here are some of our key initiatives:



Security as a pillar of corporate governance

If the board of directors and senior executives don't prioritize cyber security, their employees won't either. One of the principles underlying Huawei's cyber security framework is a commitment to putting cyber security ahead of profits, every time. In 2010, the company established a Global Cyber Security Committee, with oversight of all Huawei operations. Committee members include principal board members and senior executives, and this high-level engagement helps to ensure that cyber security is integrated into the company's strategy, governance, and operations from the start. It makes cyber security a part of Huawei's DNA.



Active research into new technology

Given the complexity of today's cyber security challenges, technology providers have a duty to deliver technological solutions. We must develop new security capabilities so that we can give our customers products and services that they can trust. Huawei is an active player on the cutting edge of security research, looking at ways to incorporate new technologies like blockchains and quantum cryptography into our products and services, so that we can protect the integrity of distributed systems, and better encrypt our transmission and storage.

We are also seeing increased investment in cyber security by many other companies, and this is driving the emergence of new security techniques, including big data and AI. Huawei has invested in leading research in security for data pipes and devices, virtual security, and algorithm security, and we have made important advances. For example, the Open Networking Foundation (ONF) has adopted an SDN Northbound Interface technology developed at Huawei's European Security Lab.



New security concepts

ICT technology is changing rapidly, and in this mobile, cloud-based world of infinite connections, technology providers need to think long and hard about how to best protect our networks. For years, security efforts have focused on setting a hard perimeter: a "great wall", basically a sophisticated firewall. However, as new technology emerges, traditional sharp boundaries are becoming increasingly blurred. It is no longer clear where the control points should be; and when we do set up controls, there are now many more ways to circumvent them. The "perimeter defense" concept is no longer effective. So Huawei will have more immersive focus to the concept of "defense in depth", and combine this concept thoroughly with new technologies. In this approach you have to assume that at some point your firewall will be

breached, so you have to consider how to identify, contain, and eradicate a given threat at every level of an ICT system.

- Defense in depth requires big data technologies, to compare current system data to known benign and malicious behaviors.
- It also requires the use of sophisticated AI to assess what processes should be allowed to continue, and what needs isolating for further examination.
- When dynamic blocks are imposed, all hardware and systems that might have been infected need to be isolated as well. Policies need to be updated in real time to prevent further spread and fully eradicate the threat.

To build these security concepts into Huawei's products and solutions, from 2012, Huawei has adopted the following three security practices into our security framework:

- **Security in development**
  In the early stages of product planning, Huawei first considers all the available security technologies, relevant security standards, legal requirements, and the customer's cyber security needs. As part of the initial product specification, we include our security positioning and target security features. This allows us to determine what resources will be required in the later development phases. From product design and coding to testing, Huawei embeds strict security requirements into every product development process.
- **Security by design**
  We follow the fundamental security principles during the design phase, including least privilege, defense in depth, and complete mediation. Huawei has a Security Competence Center which sets security standards. This center has over 300 people, and is responsible for improving the security skills of our nearly 80,000 R&D engineers. The Competence Center also coordinates with R&D teams working on new technologies to develop comprehensive security solutions. Two examples are our cloud and IoT security solutions:

Cloud

Huawei's cloud technology is predicated on effective data protection. Big data analytics dynamically assess the security status of a Huawei cloud network, identify major risks and threats, then take defensive action to mitigate and remediate. Multi-dimensional, multi-layer defenses and analytics support secure cloud operations by delivering swift identification, containment, and recovery.

IoT

The Huawei IoT security framework encompasses endpoint security, network layer security, platform and application security, and security situational awareness. In IoT endpoints (sensors and devices), chipsets incorporate Trusted Platform Module (TPM) and Trusted Execution Environment (TEE) techniques, and secure boot and secure upgrade processes. At the network level, security is assured through mutual authentication, security zone

isolation, and encryption of transmitted data. For platforms and applications, there is sandboxing, web application firewalls, DDOS defense, etc. Together, these individual measures form a deep, layered defense. Over the top runs security situational awareness: monitoring, big data analytics, and policy management. The system is constantly sensing and analyzing the network and its behavior to detect potential risks and threats.

- **Independent security verification**
  Huawei has an independent cyber security lab, led by a dedicated Global Cyber Security Officer. This lab carries out a completely independent verification of all products before launch. No product which fails to meet security standards can be released onto the market, and faulty development processes are carefully investigated.



End-to-end supply chain security

The research, manufacturing, delivery, and use of ICT products are heavily dependent on a globalized supply chain. Therefore, our security practices must also encompass the entire supply chain, end to end. Internally, this means every phase of product manufacturing, delivery, and service. Externally, it includes supplier management. End-to-end security is complex and demands a highly systematic approach, with commitment from all stakeholders. The following issues are especially important:

- **Traceability of hardware and software**
  Complex technologies include thousands of components and millions of lines of code. We must ensure that every component of every product is traceable and identifiable. Huawei is able to trace all replaceable components, down to the level of a single capacitor or diode. For software, we have rapid traceability at the source code level.

- **Secure deployment and maintenance**
  Security during product deployment and maintenance has a direct impact on the security and stability of customer networks, and also the services that run on them. Huawei aligns its delivery and service processes with its customers, and complies strictly with local law and the customer's cyber security requirements. For both onsite delivery and remote maintenance, Huawei's internal software and tools force full process compliance at every step.

- **Supplier management**
  If a supplier's technology or processes are not secure, they threaten the security of products and services that are delivered to end customers. Huawei was the first company in the communications industry to sign a cyber security agreement with its suppliers to help them strengthen the security of their products and services. When selecting and auditing suppliers, Huawei assesses and tests their cyber security systems and the quality of their security controls. Only suppliers that pass these audits can become Huawei partners.



Security must be part of a company's culture

Security ultimately comes down to people. Awareness of cyber security is not just an issue for technology operations. It should be an important consideration in hiring, training, incentives, and performance management. Huawei operates in over 170 countries and regions, and regularly delivers education and training on cyber security to its 180,000 employees. All Huawei employees must pass a cyber security examination, and must sign Huawei's Business Conduct Guidelines, which include a section on cyber security. Cyber security is a key competency in Huawei's internal skills assessment system, and is a mandatory competency for many positions. The company has developed comprehensive cyber security training programs to meet its employees' training needs.

Security through cooperation

Today's networks are diverse and extensive. Technology providers cannot be the sole architects of security. They must build a shared awareness of cyber security with all stakeholders. Active collaboration will be vital for effective cyber governance.



Intergovernmental cooperation

Governments should establish common codes of conduct through bilateral talks and multilateral consultations. They should proactively share experience and best practices, and work together to crack down on cyber attacks and cybercrime. These measures will help build trust in a transparent, collaborative, and open environment. For example, at the end of last year, the National Cyber Security Agency of France (ANSSI) and Germany's Federal Office for Information Security (BSI) signed an MoU to cooperate on the ESCloud label, for which they established a joint working group. This effort has set the stage for Germany and France to develop shared standards for cloud security, improve the security of cloud services, promote trust, and build more business links. The UK's National Cyber Security Center (NCSC) is another good example. Recently, this organization put online guidance for infrastructure security and supply chain risk control. It offers an excellent reference for governments around the world.



Development of ecosystems

Industries need to work with governments to formulate widely-accepted security standards. They also need to encourage all stakeholders to invest more in open source security, which is a vital resource for enhancing industry security. Agreement on standards is an important link in any cyber security system. Industry organizations should work with technology providers to develop comprehensive international standards that will give industries clear, consistent guidance on security. Industry organizations should also work with governments to recognize that supply chains are now global. Governments must realize that uncoordinated national standards will not solve their security issues. Moreover, having different standards will break supply chains, block technological progress, and increase the cost of doing business.

Unified international standards are of paramount importance. Moving forward, open source will be an increasingly important part of software development, as almost all products directly incorporate large amounts of open source code. Today, open source communities lack the personnel and the funding to respond quickly to the security challenges of new technology, so the security features of open source software lag behind. In the future, open source cannot rely solely on the inputs of community members for its security features. Broader investment from all stakeholders will be required.

Huawei has long been active in both of these aspects. It is a member of over 20 international security standards organizations, and is one of the major contributors to working groups in the major standards bodies. In 2016 alone, over 200 Huawei proposals on security were accepted by 3GPP SA3 and ETSI NFV working groups. Together with other corporate partners, Huawei also provided funding and shared experience with open source communities. This helped to fix vulnerabilities and improve the quality of security code in Linux and other open source initiatives.



Building user awareness

In order to protect technology users and the public, every company and citizen needs a greater awareness of cyber security, data ownership, and privacy. Major countries around the world have made public education on cyber security a key part of their national data protection and privacy strategies. Governments hope to raise general levels of knowledge and skills to help control cyber crime and threats to cyber security. If the general public knows how to protect itself, this reduces the cyber vulnerability of individuals, and even of the nation as a whole. The EU, Austria, the Netherlands, and Australia have made educating young people on cyber security a key measure in their national cyber strategies. By giving young people the awareness and skills they need to protect themselves, these countries are taking a vital step toward protecting their citizens' interests, reducing cybercrime, and stopping cyber threats.



DIGITALIZATION RESHAPING INDUSTRIES



Digital Government, Intelligent Government

Digitizing public services is an urgent need for many governments around the world today. Good digital government can help business to flourish, increase citizen engagement, and drive economic growth.

Over the past decade, more and more countries have started to deliver digital services to their citizens. According to the United Nations E-Government Survey, in 2003, only 33 countries provided any form of online government service. Thirteen years later, the 2016 report found that 148 countries were providing some form of online service[1].

Number of countries provide any forms of online service[1]

2003		2016
33	»	148

Many governments are engaged in wholesale digital transformation, aiming to turn themselves into fully-fledged digital governments. Digital government will help make public institutions more inclusive, effective, accountable, and transparent. However, against this backdrop of increasing digitalization, there are substantial regional disparities. In many countries, the digital divide persists, or is even growing wider. Migrating to digital government before all citizens have Internet access could potentially widen the gap, rather than closing it.

Open, participatory government

Governments which invest in and deliver digital services can dramatically improve the welfare of their citizens. Digital government enables broader access to high-quality public healthcare and education, targeted social programs, improved security and prevention of crime, fast response to epidemics, and

[1] UN E-Government Survey 2016

increased efficiency across a wide range of other services. More importantly, digital technology has the capacity to turn the one-way street of government information and services into a two-way relationship, in which citizens, companies, and governments actively engage with one another.

As digital government expands, the public will see how governments are becoming more transparent, and that will build higher levels of public trust. With more trust comes more engagement, and so the government will start to hear a wider range of voices. When government processes are open and transparent, and when people and businesses can understand and have a say in decisions that ultimately affect them, public confidence will naturally increase.

As an example of this virtuous spiral, the European Union-funded E-UROPa project enables e-participation within European countries. EU institutions have created a range of online tools to encourage citizen participation, so that every European citizen can participate in the development of policies. These tools come in many different forms, and can be applied to any public policy: Citizens might sign a petition online to save a forest, or comment on the mayor's proposal to renovate a school[2].

For years now, digital citizens have enjoyed fast and secure access to information from a wide array of sources, which helps us to make better-informed decisions in personal and professional lives. In many parts of the world, governments are opening up their databases to enable more transparency and more public scrutiny. For example, 128 countries now provide datasets on government spending in machine-readable formats, according to the United Nations E-Government Survey 2016[3].
This investment in digital government and open data is helping to create a digital ecosystem that will support the growth of enterprises and boost long-term economic growth. Governments can build efficient, safe, enjoyable cities, and this will help them to attract a highly-educated workforce.

Challenges: From financing to privacy

At every stage of digital development, governments have to overcome barriers to success. These include both technical and cultural challenges that hinder collaboration within and between government organizations at local and national levels.

The challenges also include financing and security issues. Government budgets are chronically constrained, so effective financing models need to be found for digital projects. Smaller projects, such as online license applications, with a clear revenue or cost-saving strategy and minimal upfront investment, are more likely to be successful. But the larger the scale and the more sophisticated the services, the more expensive government projects become. Finding a sustainable financing model becomes harder. Many digital government projects will not produce returns for 10 or even 20 years, so governments will need to bring a long-term vision to their digital strategies.

Protecting the personal data and privacy of citizens is critical in digital government projects, because this is the key to user trust. Data protection is both a policy issue – e.g. the passing of privacy legislation – and a question of deploying the most advanced security technologies. Talent is another issue. You can't design, implement, and operate digital projects without a highly skilled workforce. Sometimes key workers will need to be drawn from global resource pools.

[2] E-UROPa: Enabling European e-Participation
[3] UN E-Government Survey 2016

Transformation is a commitment to the future

It is possible to provide open, efficient, secure, and reliable public services in a cost-effective way, while also laying the groundwork for a more connected and intelligent future. Huawei has collected more than 30 projects by national governments in which digital transformation is playing a vital role in improving the quality of government services, healthcare, and education. Here are some of the insights gleaned from this global experience.



Digital government is not just a question of investment

It requires political commitment and the adaptation of institutional frameworks. Governments need to have a long-term vision and to understand that ICT investments today are for the benefit of future citizens. Governments need to review their laws and regulations to clear the way for the use of new technologies in both the public and private sectors, so that when new tech emerges, it can quickly find users.



Digital government requires digital skills

Training programs are needed for senior officials, public sector workers, and private organizations, including digital literacy for vulnerable groups. Some jobs may disappear during the process of digital transformation, even as new positions are created. Government workers will need to be retrained to adapt to the new environment. Governments should reach out to partners such as ICT providers and universities to train more ICT professionals. Steps like these can significantly boost public digital literacy, and pave the way for future growth in the digital economy.



A long-term vision is also required

Budget and approvals for digital projects can be difficult to secure in the public sector, with its abundance of stakeholders and strictly defined mandates. Governments are more likely to be successful when they have a vision for future development, and can see money spent on digitalization as an investment, rather than a cost. Governments with limited funds should consider making digital infrastructure a priority, and see digital transformation as a long-term growth strategy.

The purpose of digital government is to provide better services to citizens. However, these benefits may not be enjoyed by the entire population. A digital divide runs through the middle of today's society, in terms of both access and the skills required to make the most of digital services. Even within the United States, according to the Pew Research Center, some 13% of Americans don't use the Internet. Internet use is highly correlated with age, level of education, household income, and community type. For example, adults from households earning less than US$30,000 a year are roughly eight times more likely than the most affluent adults to not use the Internet, and around a third of adults with less than a high school education do not use the Internet[4].

Huawei believes that digital government requires ubiquitous, inclusive connectivity so that services can benefit every citizen equally. Strong ICT infrastructure is a foundation of digital government. New technologies such as cloud computing can be an important tool for increasing accessibility, sharing information, and lowering the cost of ownership. There is also a need to provide education and training so that all citizens have the ability to make use of digital services.

Digital governments and societies will succeed in the long term when they set clear policies, invest in ICT infrastructure, adopt open platforms, and secure participation from both the public and private sectors.

[4] 13% of Americans don't use the internet. Who are they?

STORY

Singapore: A leader in digital government

Since its earliest efforts to computerize the civil service in the 1980s, Singapore has always been an enthusiastic user of new technologies. Today, it is an undisputed leader in digital government.

In Emerging Technologies Make Their Mark on Public Service, Accenture surveyed almost 800 public service technology professionals across nine countries. The company found that senior public service leaders in Singapore are significantly better informed about most intelligent technologies than their American and European counterparts[5].

In the 1990s, Singapore built one of the world's first national broadband networks. In the early 2000s, the government set up free Wi-Fi hotspots across the country[6]. In 2014, Singapore launched its Smart Nation initiative, and significant progress has been made using digital and smart solutions to provide better services for citizens and businesses. These digital services are already having a major impact on life in Singapore:

- The HealthHub app gives citizens access to hospital test results via smartphone.
- The SG Secure app enables citizens to send video, photos, and messages to the police in emergency situations, for example, if they suspect a possible terrorist attack.
- Smart electricity meters connect to the Smart Nation Sensor Platform, enabling accurate metering without having to go onsite.
- The government agency GovTech has partnered with ride-sharing company Grab to release an app that lets commuters pre-book rides on private buses[7].

These digital services have been designed using an "outside in" approach: The government looks at the problem from the perspective of a user, not a government agency. As a result, they offer simpler and faster user interfaces.

Singaporeans are also able to use freely available datasets to explore their own insights and make changes in their living environment. The website Data.gov.sg was created specifically for that purpose. Through interactive dashboards, data visualizations, and data-driven blog posts, the portal aims to make government data more relevant and understandable to the public, to enable citizens to make informed decisions in their own lives[8].

The Singaporean government also encourages citizens and businesses to help shape how Singapore is developing as a Smart Nation. Citizens can start at the eCitizen ideas! Portal, where they can find and give input on all current public consultations. For businesses, the National Trade Platform enables the digital exchange and re-use of data between business partners and the government[9]. Singapore's Smart Nation initiative is an excellent reference for other countries and cities around the world as they try to raise standards of living, build stronger communities, and create more jobs and opportunities for all.

[5] Singapore can be a world leader in government innovation
[6] Leading digital transformation
[7] Smart nation and digital government
[8] Leading digital transformation
[9] Engagement & Co-Creation with Citizens & Businesses



Banking in the Age of Internet Finance

Banking and tech go hand-in-hand

Banks have positioned themselves as a source of stability and reliability for centuries. They safeguard their customers' wealth, which means it is paramount that they are seen as secure and trustworthy. Any change to their business must be carried out in a way that avoids causing concern amongst customers. Making change easy and painless is part of a bank's job, but this can create the impression that banks are averse to change and blind to technological advances.

"If it ain't broke, don't fix it" seems to be the mantra of the banking sector. It also seems like common sense given that a system failure at a bank could be catastrophic from both a customer and regulatory perspective. But the reality is that behind the scenes, banks have been innovating and bringing new technologies to the various aspects of their business. The idea that banks are stuck in their ways and don't embrace innovations in technology clearly doesn't stand up to scrutiny. Both technology and banking have moved hand-in-hand over the decades, often ahead of the curve.

One example of this is cashless payments. Credit cards, the most familiar form of cashless payment, have been in existence for over 60 years[1]. Debit cards appeared about 30 years ago, enabling direct transactions to and from customer bank accounts – no credit involved. And now it's all available on a smartphone app, rendering plastic cards obsolete – almost. Credit card companies now offer swipe or touch technologies that make the services offered to customers easier and faster than ever before. In some markets, where Quick Response (QR) codes are more widely used for fast transmission of

[1] Familiar brands started launching cards around 60 years ago: Diners Club in 1950, American Express 1958, Visa 1958 and MasterCard 1966
[2] https://newsroom.mastercard.com/press-releases/mastercard-expands-qr-payments-choice/

information on smartphones, international brands are adapting and adopting QR codes[2].

Cashless payments long predate credit cards – barter has existed for millennia. More recent banking terms, money orders and traveler's checks first appeared about 140 years ago. As a concept, cashless payments are not new at all, but the technology behind it has driven change – dramatically so, offering speed, scale, volume, interoperability and, importantly, security. It is here that banking and technology align.

Jump forward a few decades to the 1980s and 1990s and you have the emergence of High Frequency Trading (HFT), or algorithmic trading, involving powerful data analytics and very low latency connections. When approved by the US Securities and Exchange Commission in 1998, investment banks were able to execute trades 1,000 times faster than ever before. That changed again with the introduction of nano-trading technology in 2011, which could execute trades within a billionth of a second. The ultra-low latency connectivity, essential for this type of business, is now being pushed into other areas of banking.

Recent developments – mobile payments soar; big data makes credit more accessible

Mobile payments

During the past 3–4 years, digital wallet operators, such as Ant Financial's Alipay and Tencent's WeChat Pay have come of age, receiving wider acceptance and greater usage worldwide. During the first six months of 2017, these two operators helped drive the number of online payment users in China to 502 million. While China doesn't represent all global trends, it is very much at the forefront in terms of e-payment systems. The developments in China are likely to set trends for most other parts of the world. Both Alipay and WeChat Pay are looking to expand into the US, Europe, and Southeast Asia, to cater to Chinese tourists who travel abroad and are accustomed to making online payments. Alibaba's recent global agreement with Marriott International is one case in point[3].

According to a United Nations report, Alipay and WeChat Pay enabled US$2.9 trillion in Chinese digital payments in 2016, a 20-fold increased over four years[4]. Estimates by iResearch put overall Chinese third-party mobile payments at US$5.5 trillion in 2016, three times that of 2015. This contrasts with the US, where credit cards are more entrenched, which saw a 39% increase to US$112 billion, according to Forrester. Fueled also by the roll-out and take-up of Apple Pay, the trend towards e-payments is set to continue.

Third-party mobile payments in 2016

CHINA

US$ 5.5trillion

x3 that of 2015

US

US$ 112billion

↑ 39%

[3] http://www.alizila.com/albaba-marriott-team-up-to-redefine-travel/
[4] http://www.prnewswire.com/news-releases/un-report-social-network-payments-now-reach-nearly-us3-trillion-in-china-300438866.html

What's very clear, particularly from the success of WeChat Pay, which is linked to the ubiquitous WeChat app, is that providing functionality and a great user experience is essential. Security is assumed. Integrating mobile payments and banking with the day-to-day living of individuals who are often on the move is good business. Users now want their banks to provide quicker and cheaper services anytime and anywhere, all in an ultra-intuitive and user-friendly way.

Micro credit

Although micro credit continues to receive mixed reviews, it is here to stay with organizations – many of which are not traditional banks – offering loans to those in need in developing markets. This phenomenon has enabled a variety of businesses including online commerce companies like Alibaba, to enter the lending market and compete with banks. For banks, this may not have a significant commercial impact yet, but down the line it will. The small businesses of today will grow into the bigger businesses of tomorrow, and they will likely stay loyal to those lenders that helped them at the outset.

An example of banks, data, and technology coming together, is credit.alibaba.com. Launched in early 2016, tapping data and know-how from more than 25 financial institutions and global credit reporting agencies, it was a milestone for SME credit reporting in China. This showcased how the market can find solutions to a problem to make finance and credit more inclusive for small businesses. In China, like in other parts of the world, especially in the wake of the financial crisis of 2008, banks under pressure to keep non-performing loans down preferred to lend to state-owned enterprises (SOEs), rather than SMEs lacking a credit history. At least with SOEs, the government would effectively underwrite the loan.

The ingenuity of the solution is that it is based on sophisticated data analytics, available real-time, and draws on vast quantities of data. The result is far more accurate and timely decision-making than was previously possible – mitigating risk and offering far greater reliability than a meeting with the bank manager of yesteryear.

Individual credit checks

Just as it has helped small businesses get access to capital, the market is also providing a solution for individuals looking for a loan or other financial services. In China, the number of people using Internet services to manage their money grew 27.5% during the first six months of 2017 to 126 million, according to the China Internet Network Information Center (CINIC). Again, this is all possible because of the powerful data analytics that underpin the services available. Lenders trying to evaluate risk where individual credit histories don't exist are coming up with alternative measures, often ones that look at lifestyle and behavioral patterns.

Companies such as Lufax, Tencent, and Alibaba look at a wide range of data sets. They also have ways to analyze unstructured data, such as graphics, photos, and documents, thereby combining quantitative metrics with qualitative content. And, of course, social media feeds into that a rich stream of content by offering a closer look into people'' lives, activities, and preferences.

Where is banking now?

What's very clear is that banking, like every other industry, is in the midst of a period of dramatic and rapid change brought about by digitalization. While

change was constant and generally incremental in the past, it is now a wild ride that is keeping financial institutions and regulators on their toes as they try to keep up. The next two decades will see the banking industry change beyond recognition. It's happening faster in China and parts of the world with less legacy bricks-and-mortar banking, but it will be a global phenomenon.

The evolution of banking in this way, driven by digitalization and rapid advances in technology, will change the nature of some town centers and result in less demand for certain job skills. But if banking services fail to keep up with these developments and instead seek to avoid the pain, banks run the risk of going the way of rustbelt industries in many countries. So careful planning is needed.

It' not all doom and gloom, though; fresh opportunities do exist for those who want them.

Legacy modernization and other challenges

From a technology perspective, the challenges for banks are legacy modernization and delivering a new level of connectivity. Banks need far more advanced data aggregation and processing systems for regulatory reporting – including know-your-customer, or KYC, reporting – and to deliver new products and initiatives to customers. The latter, in part of a broader digital transformation, need to include mobile, omni-channel, and API technologies.

To succeed in this new very fast-moving business environment, banks need to seamlessly integrate applications, data, and devices, and at the same time provide a premium user experience. They need to meet the needs of increasingly demanding customers at any time, in any place, in a world that is now both mobile- and cloud-based. Those that embrace and tackle these challenges will be well placed to succeed.
Some of the key challenges they face include:

Outdated information technology (IT) infrastructure This infrastructure is typically old, centralized, and often on closed architecture, making it far harder to accommodate new services and adapt to market changes. Clearly, this is not a good platform from which to drive growth, attract new customers, and reduce costs, but what's the best solution? Do nothing, completely replace, or find a happy medium? (The clue is in "happy".)

Improving operating efficiency
A significant part of a financial institution's cost base is IT applications and infrastructure maintenance, much of it to do with legacy technology. According to MuleSoft, industry analysts estimate that IT departments spend 60% to 90% of their budgets managing and maintaining older systems, leaving little room for investment in new systems or other initiatives. What is the best way to deal with this?

Data integration
Financial institutions need to be able to access and interpret data real-time, yet collating and processing the data can be very difficult. It can be very expensive to deal with massive amounts of unstructured data, which is difficult to manage, protect, access, and process. An important question to address is how companies can best resolve these difficulties and convert the data into something that genuinely adds value.

Migration to open source
Open source solutions involving software, cloud,

and other platforms are increasingly popular. Software licensing costs, desire to avoid vendor lock-in, and source code protection, which in itself can draw public scrutiny, are all reasons why a growing number of banks are taking the open source route. It is an approach that supports the developer community and fosters innovation. What is the best way to migrate to open source?

Combining traditional strengths with the latest technologies

Banks need to have a clear strategy in place before proceeding with any sort of overhaul. Part of that should be to build on the strengths of their traditional advantages, including customer relationships, product know-how, networks, and brands. The incorporation of new technologies is also needed, including cloud, data analytics, and being available anytime anywhere.

Of the options available regarding outdated infrastructure, to do nothing would say as much about an organization's management as its infrastructure – it is not a viable option. To replace the IT system completely may sound appealing, but that route is expensive, can take longer to implement, and presents far higher risks – after all, a new system can face issues in early stages of operation. According to Cognizant, about 25% of core banking system transformations fail without any result, and 50% fail to achieve the transformation objectives, while costs can either double or triple.

Banking system transformations fail

25% without any result

50% without achieving the objectives

Predictably, it's the happy medium that is usually the preferred option. This approach acknowledges the need for change, but not in the short-term. This approach typically has the lowest risk and is more manageable. It allows for a two-speed IT structure: one to keep the core functions operating, and another to fuel growth and innovation.



Cloud

As banking systems evolve, the real game-changer is cloud. Banking systems must be built using cloud architecture to ensure IT and business solutions are secure, scalable, flexible, efficient, and economical. It's difficult to imagine a bank not having cloud-based IT infrastructure in this day and age. It is a key competency to remain competitive.



Integration

The single most important ingredient for a successful infrastructure transition is integration. In this context, integration connects the old system and the new one, while at the same

time closing off and insulating the old system from further changes and coding. It effectively decouples the old and new systems, while keeping them effectively linked.



Operating efficiency

From the outset, the programming, infrastructure, and all minor details must be absolutely correct. Small errors, poor coding, makeshift quick-fixes and so forth tend to accumulate on top of each other. Over the lifespan of the system this can cause considerable drag on the efficacy of the infrastructure, hurting budgets, competitiveness, and revenues.



Data analytics

As illustrated above with the likes of Alibaba, Tencent, and other companies, banks need to extract as much value as they can out of the data they collate in order to serve customers better and, importantly, to carry out faster and more rigorous regulatory and compliance processing. Speed of response, being able to confirm a loan today rather than tomorrow or next week, is a critical competency for banks. Clever data usage can provide a more satisfying personal experience for the end user, such as an interface tailored to individual users, with the right mix of curated content, design features, and products. Banks that master the use of data will gain deeper insights into their customers' needs, recognize those needs at an early stage, and grow faster as a result.



Anywhere, anytime

Banks need to ensure their services and products on all channels are available to customers at all times. The user experience is very important. Business will benefit from a richer user experience. To support this level of responsiveness, banks need to look beyond their traditional strengths to partnerships and a nimbler technology platform.

STORY

HSBC looks to agility, flexibility, and speed

HSBC has a long history, global scale, and an extensive suite of financial services. Valuable assets, yes; but no longer enough in a world that is going mobile. The pace of change is such that digital adaptability and speed now count for more than size and experience. For HSBC, the challenge is to move at the pace its customers are moving – and that's fast. Its customers expect financial products to be on-demand, mobile, and personalized.

To meet those customer expectations, HSBC required itself to be more agile, more flexible, and have "a much higher clock speed for delivering solutions." Its agile technology strategy focuses primarily on the mobile space, where most of its customers interact with the bank.

But while agility, flexibility, and speed are at the fore, HSBC also has a customer base of 47 million people and legacy systems to look after. Given the need to protect its existing investment, ripping out existing IT infrastructure and starting again was not on the agenda. Instead, the company opted for consolidation as much as revolution, because its legacy platforms continued to provide a reliable, function-rich foundation that still had much to offer.

Because HSBC has a long cycle where change is involved, a focused infrastructure with built-in agility is necessary to re-engineer and digitize internal processes, recreate customer experience through digital channels, and explore forward-looking technology and solutions such as virtual teller machines, cloud, and big data.



To do that, it needs strong partnerships with technology companies that have a proven track record in R&D and innovation.

With the help of its partners, including Huawei, HSBC is moving to what it describes as "service-oriented architecture" that includes an integration layer between the legacy back-end and the front-end on customers' mobile phones. This integration layer is key to quickly and securely getting services from the back-end into the hands of consumers.

To offer a great experience requires more than just being mobile and functional, it means offering something innovative and useful. To create such features, the ability to extract and analyze a large volume of data is very important. One example is HSBC's Nudge app, designed to encourage responsible money management. It uses behavioral science and data analytics, to warn users if they are over-spending on items in over 300 categories. HSBC is looking to integrate this data-driven tech into its product and service portfolio.

Through digitalization and agile technology, HSBC is raising its game with relevant, secure, and timely services.

STORY

Huawei helps four major banks in China adapt to the digital age



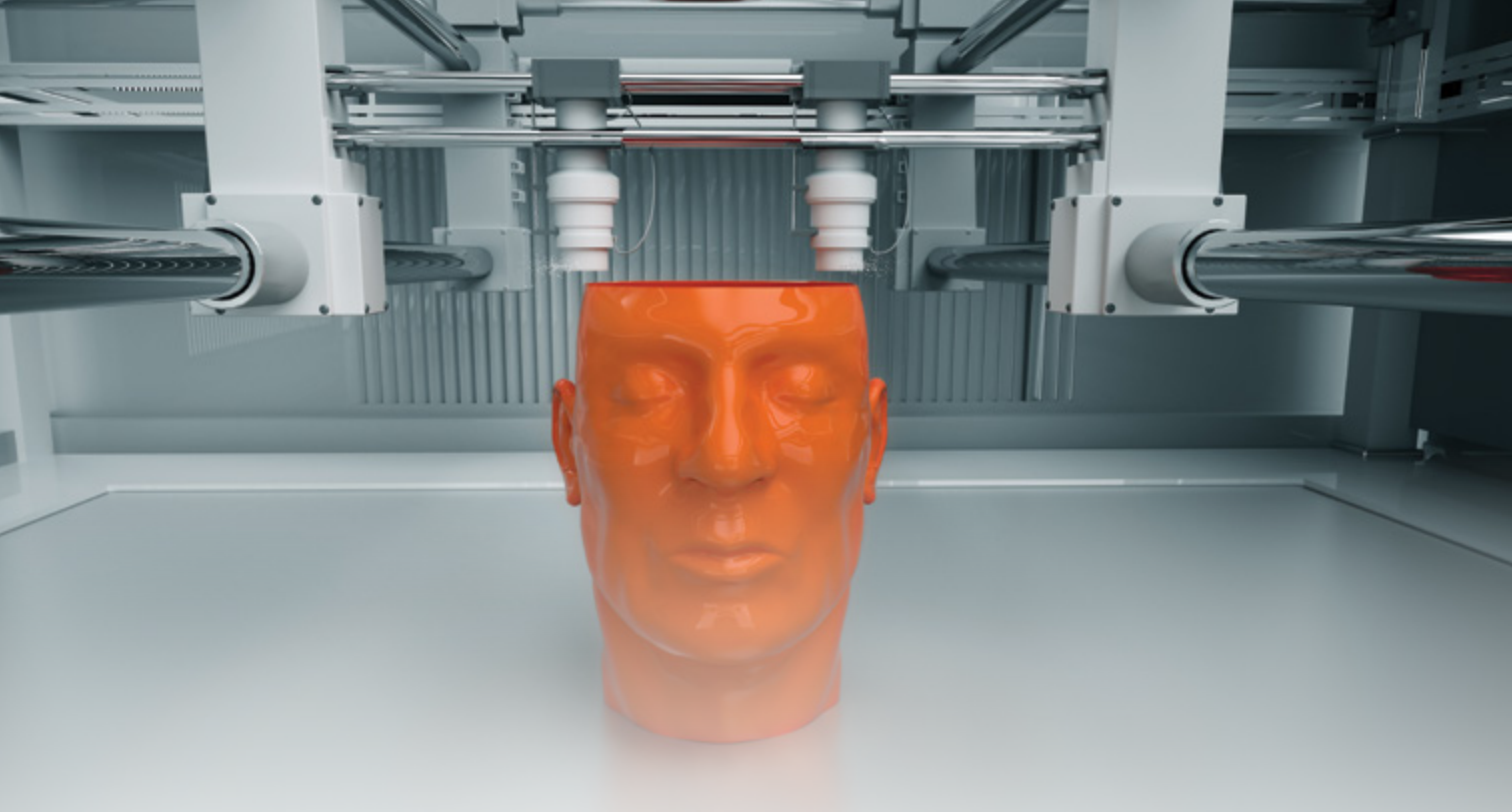
Internet finance has brought significant challenges to traditional banking. Since 2015, major global banks have shut thousands of branches. For example, HSBC has closed 321 branches in the UK alone[5]. China is undergoing the same changes. So far in 2017, a total of 99 branches, 98 community sub-branches, and 8 small and micro branches of 13 stock-listed banks across the country (including 5 major banks and 8 shareholding banks) have closed. As this occurred, mobile financial services have grown in popularity[6]. In 2015, more than one-third of bank accounts were opened via digital channels, and active users of mobile banking increased by 17%, according to JP Morgan.

Traditional banks have realized that they must adapt to the digital age. Utilizing advanced ICT technology like cloud computing and big data, Huawei joined hands with China's four major banks to provide a real-time, on-demand, all-online, automated experience for customers. The move is helping traditional banks to transform from branch-focused service to digital service in order to remain competitive.

China's four major banks are Bank of China, Agricultural Bank of China, China Construction Bank, and Industrial and Commercial Bank of China.

[5] http://www.dailymail.co.uk/news/article-4030936/World-s-local-bank-shuts-one-four-British-branches-HSBC-axes-321-just-two-years-big-lenders-look-cut-costs.html?ITO=1490&ns_mchannel=rss&ns_campaign=1490

[6] http://www.sohu.com/a/121820783_119038



Intelligent Manufacturing Connections for Success

Manufacturing is at the heart of the global economy. It accounts for about 30% of global gross domestic product (GDP)[1], with the US and China both contributing more than US$2 trillion[2] to the world economy each year from their manufacturing activities.

Today, however, manufacturers everywhere face an environment that is being reshaped by technological shifts, economic uncertainty, and fast-changing consumption patterns.

The world's top manufacturing nations have responded with strategies that seek to build on their traditional strengths and help them to remain competitive as conditions change. Germany, most famously, has Industry 4.0. China's equivalent is Made in China 2025. Korea has an initiative named Manufacturing Industry Innovation 3.0; the UK's policy vision is Industry 2050; and France has Industry of the Future. In the US, efforts to modernize manufacturing and distribution are being driven by the private sector, which has come together in the Industrial Internet Consortium.

World's top manufacturing nations

Germany	Industry 4.0
China	Made in China 2025
Korea	Manufacturing Industry Innovation 3.0
UK	Industry 2050
France	Industry of the Future

All of these approaches share a common core: intelligent manufacturing.

[1] https://en.wikipedia.org/wiki/List_of_countries_by_GDP_sector_composition
[2] Manufacturing Output by Country. http://greyhill.com/manufacturing-by-country/

The era of intelligent manufacturing is here

With continuous change destabilizing the competitive environment, it is now harder for manufacturers to create value through traditional business models. Customers today have more options and less brand loyalty than ever. Demand is diversified and volatile. Markets are also more competitive and fast-paced, with just-in-time business models. Meanwhile, rising wages and other costs add further complexity.

Flexible manufacturing based on digital technologies is now becoming the norm. Intelligent, connected systems enable machines and humans to collaborate on "mass customization", where factories maintain the efficiencies of mass production while quickly creating personalized products for highly specific customer needs.

Manufacturers are also beginning to extend their after-sales service and increase customer engagement. With an ecosystem of equipment, devices, and sensors communicating in real time, manufacturers are empowered to create exceptional customer experiences and build long-term relationships with users.

From cost to culture, barriers go beyond the technical

While seeking to improve agility and responsiveness, these new business models also bring their own challenges.

Cost constraints

Production costs continue to escalate, with raw materials, labor, and energy now more expensive worldwide. The need to meet stringent environmental regulations adds to the challenge. Instead of moving production to lower-cost locations, siting production hubs closer to markets and investing in intelligent manufacturing technologies are seen as more sustainable solutions. Unfortunately, many manufacturers, especially those with tight margins, do not have the capital budget to put this into practice.

Technology issues

The transition to intelligent manufacturing requires that companies combine advanced operations and information technologies to enable collaborative design, virtual simulation and data-driven planning and analysis. This demands visibility and information sharing between all parties in the supply chain, from factory floor to distributor, dealer, or retail outlet, with synchronized processes and zero inventory. However, this is difficult to achieve, as data tends to exist in silos in traditional manufacturing systems. The machine-to-machine (M2M) and machine-to-human/human-to-machine (M2H/H2M) communications necessary for intelligent manufacturing are also beyond the capabilities of legacy IT infrastructure.

Predictive maintenance is a case in point. It boosts productivity by avoiding the need to shut down plant and equipment to fix failures or for unwarranted routine maintenance. But to accurately predict when maintenance is necessary, data about in-service equipment and actual operating conditions must be available and analyzed in real time. This data must also trigger field mechanics' work orders and spare parts inventory management and ensure that regulatory requirements are being met.

Appetite for change

Commitment and vision from the C-suite is essential if companies are to make the most of the potential of intelligent manufacturing. Leaders may not understand what is possible, or they may doubt that intelligent manufacturing technology is applicable to their industry or at the scale of their operations. Some may see this as an IT issue, rather than a strategic concern.

Holistic sustainable approach

Intelligent manufacturing is about much more than technology adoption. It touches on all aspects of the production process including human capital, quality control, environmental issues, and more. Intelligent manufacturers need to find the right balance: between using existing talent and new technology; between outright profit and impact on the environment; and between ensuring that workers are supported and giving them opportunities to upgrade their skills.

A willingness to change is the prerequisite for success

What capabilities do manufacturers need to develop and meet their business objectives in an era of smart manufacturing?



Improve productivity through cloud

Investing in intelligent manufacturing helps companies move up the value chain and be more flexible, productive, and competitive. A key shift is the switch from traditional servers to cloud-based business models. The cloud provides the vast, agile, and open computing and data storage resources needed for cost-effective intelligent manufacturing, ensuring compatibility so that enterprises can work closely with diverse partners throughout the value chain.



Create new business models with IoT and robotic that supported by better connectivity

In a manufacturing setting, the Internet of Things (IoT) enables efficiency improvements, as when combined with industrial robots and connected equipment, and supports the development of new business models based on after-sales service. In-factory networks, such as today's Narrowband-IoT and upcoming 5G cellular communications, will help manufacturers connect people and machines in human-machine networks to revolutionize the way factories work. Deploying artificial intelligence and machine learning will let them precisely control equipment, sensors, robots, and other systems in real time, and generate actionable insights from their data.



Require mindset change and a long-term commitment

Building a digital factory demands open-minded leaders with a long-term perspective. Managing change and motivating others with a vision of the future are essential skills, as the intelligent manufacturing journey can be unpredictable. The leaders of tomorrow must be curious and have a passion that creates a forward-looking corporate culture. Without these attributes, longer term competitiveness will prove elusive and get lost in the drive for immediate results.

Conduct more sustainable business operation

Intelligent factories will optimize their organizational structure to improve productivity and minimize costs. They have exactly the size of workforce they need, with an emphasis on hiring and training people with IT-relevant skills.

The employees of the future will be tech-savvy and multi-talented. New IT and communications infrastructure will require less energy, and will be cleaner and more efficient than traditional technologies, leading to less impact on the environment.

STORY

Huawei embraces intelligent manufacturing

Huawei produces several thousand different products, including mobile phones and laptops for the consumer market, Wi-Fi routers for home use, and wireless base stations for telecom carriers. Its products routinely set records for quality and performance, and it consistently delivers these products on schedule and at volume in more than 170 countries and regions around the world.

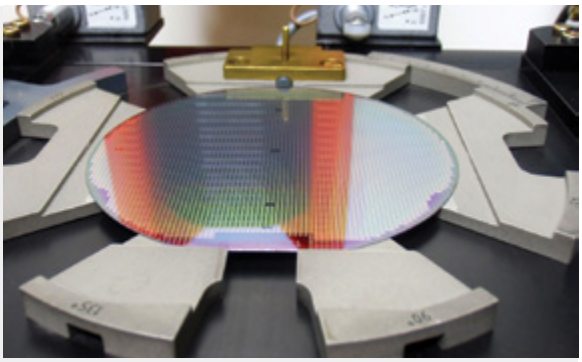
The digitalization of Huawei's manufacturing operations is a major part of the company's ongoing success. A pioneer of automation and smart manufacturing, Huawei has connected people, business systems, digital processes, and equipment to achieve agile manufacturing and a smarter supply chain.

Throughout the years of its ongoing digital transformation, Huawei has focused on maintaining sustainable growth as a customer-centric business with sensible cost controls. It has adopted a range of intelligent solutions in its own manufacturing operations, including mobile Internet of Things, cloud computing, artificial intelligence, robotics, and big data. It also advocates openness, collaboration, and shared success through joint innovation with partners and peers. Huawei is helping build a robust industry ecosystem by sharing insights with its fellow manufacturers and developing the next generation of ICT talent. This approach has made Huawei an enabler and preferred partner for the digital transformation of industries worldwide.



STORY

Advanced chip simulator for GlobalFoundries



GlobalFoundries is a global semiconductor leader, with 10 foundries around the globe, including six in Singapore. To respond quickly to the requirements of its customers, GlobalFoundries Singapore needed an updated chip simulation system. Huawei provided a new open source computing platform with the capacity to scale rapidly for enhanced reliability. Using this new platform, GlobalFoundries increased the performance of its simulation system by more than 10 times, so simulations can now be completed in an hour instead of a day. As an added benefit, the hardware failure rate at GlobalFoundries reduced by 15%, enhancing the company's reputation for reliability in the provision of chip simulation services.

STORY

eBIZ Cloud platform revitalizes European fashion industry

Small and medium enterprises (SMEs) account for the majority of businesses in the European market. However, many have yet to benefit from digital transformation. According to EuroStat, only 21% of SMEs use cloud. SMEs that fail to take advantage of the benefits of cloud will see lower efficiency and commercial agility. Europe's fashion supply chain has long been under pressure from lower-cost regions. European garment makers are hurt by high order management costs and long response times. All of these issues are impacting their bottom line and time-to-market.

To combat this, the European Commission launched eBIZ, a public-private program promoting the use of e-commerce and greater



interoperability in the fashion supply chain. Using the eBIZ cloud platform, Europe's fashion houses and suppliers are able to collaborate more easily. As a result, they have seen improved productivity, and better design and innovation. With the platform, order management costs dropped by 65% in just one year, and the average response time for an order was shortened by 50%. To date, over 150 small textile and footwear companies, in 20 European nations, have benefited from eBIZ.



Intelligent Transport to Drive Inspiring Experiences

Innovations in transport have always driven economic growth. This remains true today as our land, water, and air transport systems extend further, and we enjoy ever faster and more efficient transport around the world. A record 1.2 billion international tourist trips were made last year[1]; the value of goods exported worldwide was US$15.46 trillion[2]; seaborne trade volumes surpassed 11 billion tons[3]; and the global gross domestic product was US$75.6 trillion[4]. But what's on the horizon is even more impressive.

The frictionless commute

As an airline or mass transit operator, imagine delivering a single mobile platform that your customers use to access all modes of transportation and related services, from accommodation to dining, shopping, tours, local spas and gyms, and more. When they have an important overseas meeting, you'll deliver immediate insight into the fastest transport options, and they'll be able to book tickets and arrange luggage drop-off or drone collection as necessary.

Throughout their journey, the customer will always be connected. They will enjoy broadband Internet access at every stage – on the subway, in the plane, and on a train in the remote highlands of a distant country. And this connection will be as fast and as reliable as if they were sitting in their front room at home.

When it comes to goods and cargo, the tyranny of distance will be banished once and for all. Drones and automated vehicles of all shapes and sizes will conquer challenging physical environments across

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1 Sustained growth in international tourism despite challenges. http://www2.unwto.org/press-release/2017-01-17/sustained-growth-international-tourism-despite-challenges
2 World trade and GDP growth in 2016 and early 2017. https://www.wto.org/english/res_e/statis_e/wts2017_e/WTO_Chapter_03_e.pdf
3 World Seaborne Trade: Still Providing Volume. http://www.hellenicshippingnews.com/world-seaborne-trade-still-providing-volume/
4 http://databank.worldbank.org/data/download/GDP.pdf

land, sea, and air. And every item in every box in every container will be tracked and traced every minute, ensuring rapid, on time, secure delivery. The ongoing digitalization of our transport systems is accelerating us towards this world – a world where railways, highways, waterways, and airways are integrated into a seamless global network. This will make transportation safer and more efficient, dramatically improving the experience for passengers, shippers, and workers in the sector. It will reduce congestion and travel times, cut energy use and make our cities cleaner and quieter. But to achieve these goals will require careful attention to the needs of our customers, and the kind of transportation infrastructure that new technologies are only just making possible.

Bridging the gap

Bridging this gap between possibility and reality will not be easy. Shared standards and safety concerns are two key roadblocks standing between us and a more integrated future. Interoperability is the cornerstone of global networks. Cross-border cooperation on standards and regulations is vital to ensure that our transport networks speak each others' languages. And ensuring safety on every form of transport will depend on the reliability of the electronic data systems that will work alongside the traditional mechanical and electrical systems spanning road, rail, air, and sea.

Beyond these two challenges is the issue of how to manage the transformation: the challenge of building new information and communications technology (ICT) infrastructure on top of aged, highly variable legacy systems, while keeping the trains and planes running. Transport networks have to span complex geographies and challenging environments while respecting local history and heritage, and all without compromising the efficiency and safety of the service. Construction of the London Underground began in Victorian times, but this venerable network has yet to achieve full mobile phone coverage. In a modern metropolis like London, this is a stark reminder of the challenges that lie ahead.

Video, openness, connectivity

The transport sector needs to focus on three key advances if it is to respond to the challenges of the future, and remain financially successful.



Video-oriented monitoring brings safety to a new level

Widespread introduction of CCTV video monitoring across entire transport systems will bring improved safety for people, cargo, infrastructure, and vehicles. This kind of wholesale increase in visibility will require the sector to upgrade its systems from data-oriented to video-oriented. Transport systems will need massive connectivity and massive computing power to handle data from extensive networks of video feeds and Internet of Things (IoT) systems. For transport operators, this means taking advantage of new communications technologies, such as today's Narrowband-IoT and the upcoming 5G cellular networks, along with video management and data center solutions.



Drives efficiency through integration and cooperation

Nothing will happen without openness and sharing. The sector needs to be able to integrate transportation systems both locally and globally.

Working out how to share information between transport authorities, transport operators, and innovators around the world should be a top priority. All stakeholders will need to leverage ICT solutions such as big data, IoT, and artificial intelligence, and flexible cloud platforms will make this possible. Cooperation plus enabling technologies will drive progress and efficiency.

Fast and robust networks are essential to reliable operations

Ubiquitous connectivity will be vital to support full digitalization. Over vast distances, complex geography, and challenging environments, transport networks will need broadband wireless links to stay connected and integrated together. For fast and reliable communications, transport operators need robust networks that deliver maximum security and high redundancy, even through severe weather and unstable power supply. Delivering this vision will require the transport industry to work with urban planners, local government, and other infrastructure builders to develop long term plans which will benefit all stakeholders.

STORY

DHL explores IoT solutions for end-to-end efficiency

The Internet of Things could generate up to US$1.9 trillion in additional value for the global logistics industry by 2025. Huawei and DHL are collaborating on innovation projects focusing on cellular-based Internet of Things technology, which can connect large volumes of devices across long distances with minimal power consumption. The greater connectivity will deliver a more integrated logistics value chain by providing critical data and visibility in warehousing operations, freight transportation, and last-mile delivery.



Huawei is making its IoT devices, connectivity experts, and network infrastructure accessible to DHL, which is exploring new advances in areas from enhanced asset tracking to driverless delivery vehicles. Together, the two companies will market the results of their innovations, starting with pilot projects in Europe and China.

STORY

ICT innovation helps China build high-speed rail

In the past decade, China has built 20,000 km of high-speed rail lines, 65% of the world's total high speed rail network. Even more impressive, China's rail network delivers passengers and cargo safely and efficiently while spanning some of the most challenging environments on the planet: mountains, rainforests, deserts, and ice fields.

ICT has played a key role in the success of China's rail expansion. Huawei has served China Railway for over 20 years, and is one of its most important partners. Today, Huawei



is an essential component of the majority of China's high-speed railway systems, including the Guangzhou-Shenzhen-Hong Kong Express Rail Link, the Harbin-Dalian High Speed Railway, and the 12306 China National Railway ticketing system.

STORY

Smart transport for Shenzhen Traffic Police

With the explosive growth in the number of cars on China's roads, urban transport has become a major problem. Traffic congestion costs China's economy around CNY1 trillion every year, equivalent to nearly 2% of GDP. One estimate found that the country needs more than 50 million new parking spots.

Huawei worked with Shenzhen Traffic Police to build a brand new ICT platform and smart transportation solution with intelligent algorithms, big data analytics, and other innovative technologies. The platform is able to process 700 million data points every day, and make smart decisions to smooth traffic flows and eliminate hazards. Meanwhile, the



broad deployment of Huawei's NB-IoT intelligent parking system has solved the problem of finding a parking space and ended fiddly payments by connecting every parking spot in the city to a single system. Huawei's IoT solution has delivered advances from top to bottom of the transport value chain, and has helped to ease the city's rising congestion.



Digitally Transforming Energy

Reliable, safe energy is fundamental to modern society. Fossil fuels and electricity power every second of our lives, from vehicles and transport to air conditioning, lights and entertainment. However, the energy industry needs to find new ways to secure reliable energy distribution, cut costs, and reduce its impact on the environment. The industry is introducing digital technologies to every aspect of energy production and delivery, to make sure that it can deliver safe, affordable, reliable power, and support sustainable development.

Electricity Providers: Building the Grids of the Future



In 1881, the world's first ever power station began supplying electricity to streetlights along London's roads. Since that date, humanity has been generating and distributing electric power continuously, using basically the same approach as Victorian Britain. But in just the last 20 years, the industry has suddenly started to produce a wave of new models and new technologies.

Today, renewables occupy an increasingly important share in our energy mix. They are the key driver of new technology in the power generation industry[1]. On the demand side, consumers are starting to use smart meters and battery technology to give themselves more control over their power use. Even traditional power producers are starting to introduce power storage units as an alternative to switching on more turbines to meet peak demand. Power infrastructure is also becoming more complicated. The old centralized, centrally managed, one-way transmission networks are evolving into distributed systems with generation, storage, and management capabilities built into nodes throughout the network.

Huge challenges, from reliability to security

As the complexity of power infrastructure increases, power companies are finding it harder to guarantee continuity of supply. Particularly in developed countries, aging networks are struggling to keep up with changing patterns in the market. Falling levels of reliability, rising costs, soft demand, and increasing competition are presenting severe challenges to every power company. Management needs to boost productivity with careful investments to meet these challenges and maintain profitability.

Developing nations have an advantage over the older economies in that demand for electricity is growing, and will continue to grow for the foreseeable future. That is why most of the best performers in the power generation industry are in the developing world. The focus in developing nations is still on investment in more generation capacity to meet rising demand, but there is also a need to harden their infrastructure and networks against natural disaster, accident, human error, theft, or deliberate damage.

[1] New poll: Power industry insiders rank key issues facing energy sector

Digital strategies

All power companies today are busily deploying digital technologies to try to help with cost, supply, safety, and environmental issues. They are making their networks and their operations smarter and safer.



Smart technology end-to-end

Modern smart grids are a perfect integration of electricity transmission and Internet of Things (IoT) technology. High speed wide area connections and IoT help power companies embed low-cost sensors and controls into every part of their networks, from the power station to the transmission lines to the meters.

Smart grids enable power utilities to see instantly what is happening on the generation, distribution, and demand sides of their networks. This enables them to deliver stable supplies of power to the right network nodes, providing a better service in a complex environment. Digital infrastructure makes advanced monitoring and automation possible, and makes for lower-cost, safer operations. For example, smart meters cut meter reading costs; remote maintenance reduces the likelihood of component failure. Automation and robotics help reduce the need for specialist training, and enable companies to react faster to incidents.

And what do end users get out of digital technology? Well, they get more insight into which appliances use the most power, which gives them more control over their electricity bills. In some developed countries, consumers have the option to pick between multiple power suppliers, and can make themselves eligible for special prices by only using power at certain times of day. Some users also install their own solar panels, and actually receive a subsidy for feeding into the grid.

It is not just grids which need a digital overhaul. Power companies are working on their own digital transformations to get the most out of the new digital technologies. When physical equipment, applications, processes, and data can be effectively integrated, companies will have access to unprecedented levels of insight into the future, which will help them to manage their people and make well-grounded decisions on long-term strategy.



Reliability and security: Always top priorities

The reliability of the power supply has a direct impact on a country's commerce and the lives of its citizens. In developed countries, aging equipment and grid breakdowns are a threat to energy security. In developing nations, the threats often come from illegal tapping of grid power, and natural disaster.

Real-time video surveillance can help improve security and reliability. With new IoT, CCTV, and data transmission technologies, power companies can monitor and control their equipment remotely. CCTV and smart meter technologies are making power companies much more efficient, reducing cost, and helping to ensure energy security. This is especially vital for power utilities in developing nations, because it helps secure their revenues, and gives them the ability to make sustained investment in their infrastructure.

STORY

Ikeja Electric

Ikeja Electric is Nigeria's largest power distribution company. It buys power from the national grid, and retails it to users. Ikeja's biggest problem is collecting on its bills: On average, it is only able to collect 60% of the money owed to it. Illegal tapping of power lines is also very common in Nigeria. These drains on revenue have hindered the company's ability to invest further in its infrastructure.

Nigeria's power distribution networks are very underdeveloped. Many distribution boxes and transformers are old, and 40% of power is lost during transmission. And collecting on bills means walking round houses one by one to read the meters – a process which is expensive and frequently inaccurate.



Ikeja has now introduced smart metering equipment, which it is installing on homes and the facilities of industrial customers. As a direct result, power leakage is down by 31%, the accuracy of meter readings has shot up to 100%, and 90% of the human resources costs of meter reading have been eliminated.

Oil and Gas: From Cost Reduction to Value Prospecting



Over the past three years, the price of crude oil has fallen steeply. Oil companies are struggling to maintain profitability, and the capacity to invest in their own future. The challenges are severe, even for the world's biggest and best-known oil and gas producers. As a result, these companies are seeking to use digital technologies to streamline their organizations and their operations, cut costs, boost efficiency, and restore their competitiveness.

Goldman Sachs predicts that success of fracking means the price of crude oil per barrel is likely to stay in the US$55–65 band[2]. The industry is also keeping a nervous eye on demand: Within the next 2–3 decades, could world demand actually start to fall? Car engines are getting more efficient, and electric vehicles are taking over the roads; and renewables are supplying an increasing fraction of our power. So both demand and supply side signals suggest that oil prices will remain low in the long term.

This places the oil and gas industry in a position it has never faced before.

Digital strategies for better operations

Oil and gas business leaders are exploring a number of ways to improve efficiency and optimize their operations throughout the exploration, production, and distribution phases. For example, CEOs are seeking new models to lower the cost-per-barrel in offshore production.

They are also keen to improve the productivity of their workforce, and the efficiency of their supply chain. New communication technologies represent significant potential for savings. For example, in offshore wells, 70–80% of costs are time-related (McKinsey). If producers can speed up communications and the transfer of information among platform workers, it could have a significant impact on the bottom line. However, the supply chain is long and highly complex. Keeping tabs on everyone and everything involved in the oil and gas supply chain is an enormous challenge.

From exploration, through drilling and production, to refining and distribution, the oil and gas industry generates massive flows of data that have not yet been fully captured and analyzed. Now, with

[2] Fracking, Now The Dominant Technology, Will Keep Oil Price Around $55: Goldman Sachs

companies under pressure as revenue falls, decision-makers are increasingly seeking valuable information from big data to guide their decisions on operations and investment. And every oil and gas operator is keen to learn the lessons of the Deepwater Horizon spill. Executives are coming to realize that big data insights can also help ensure safe operations.

The industry has realized that digital technology is essential to help it achieve its operational goals. So it is hardly surprising that even as total capital expenditure falls, 80 percent of upstream oil and gas companies still plan to maintain or increase their spending on digital technologies[3].

From day-to-day to strategic decision making

The short term goals of digital transformation are:

- Increase worker productivity with mobility and automation technologies
- Reduce infrastructure costs by deploying flexible cloud resources
- Improve the efficiency of project and asset management through the use of data analytics

In the long term, investment in digital technologies will deliver the greatest long-term value, for example by boosting capacity for predictive maintenance and making management smarter and more precise.



Smarter operations at lower cost

Industry leaders are keen to simplify, automate, and optimize complex processes to make their operations smarter. Communication is a key enabler for this process. Leading companies are equipping their well workers with mobile technology and deploying Internet of Things and video cameras along the entire production chain. These technologies provide the basis for connecting the workforce, automating production, and gathering and sharing information.

For example, high-cost, repetitive activities such as drilling can be automated to raise efficiency and cut costs. Connected sensors at wellsites gather data on pressure and flow, and relay it to a central system for analysis and control. Operators can see the well and control the equipment from off site, which reduces their travel costs and enables faster response to critical situations. And video surveillance of facilities can also help reduce pipeline damage and theft. All of these benefits can only be realized when production is supported by robust, high-speed networks.

Robots are another technology which will come to play an increasingly important role in the oil and gas industry. Robotic guards will help to secure facilities and assets. Drones can be used to inspect oilfields and pipelines. Connected robots will help reduce the number of human workers needed, particularly those in remote and hazardous locations. According to a study by the World Economic Forum, drones and autonomous robots are expected to cut more than 20% from the cost of drilling, inspection and maintenance, and HR spending[4].



Investing for flexibility

In a quickly changing market environment, business leaders making capital investment and operational decisions are seeking to

[3] Upstream Oil and Gas Companies Spend Smarter on Digital Technologies to Drive Value, Reduce Costs in Downturn, Accenture and Microsoft Survey Finds
[4] Digital Transformation Initiative Oil and Gas Industry - WEF

build in maximum flexibility. Adopting cloud is an important step towards simplifying their IT infrastructure. Cloud improves business agility by breaking down the functional silos within the company, enabling cost-effective supply chain controls, delivering standardized interfaces for sharing data, and facilitating the digital ecosystem, which delivers collaborative innovation. Cloud also helps unlock the value of big data analytics and Internet of Things.

Big data analytics bring tangible value

Drilling rigs, smart pipelines and retail gas stations can generate terabytes of data every day. The industry has many opportunities to improve its production and operations using data analytics, but oil companies currently are only exploiting a small fraction of this data. The future potential for mining more value out of this data is enormous.

For example, predictive maintenance technologies will use big data to help companies carry out repairs and maintenance before failure ever occurs. Real-time 3D graphics are being deployed to help prospectors predict the location of productive oil reserves and guide the exploration process. These analytical capabilities can also facilitate real time, data driven decision-making processes, from choosing where to drill to selecting the right well completion and deciding what form of artificial lift can maximize a project's value. In the next three to five years, digital investments by oil companies are likely to be concentrated in the areas of big data and analytics, using cloud and industrial IoT technologies[5].

STORY

Tampnet's LTE network in the North Sea

Tampnet is a Norwegian telecommunications operator providing high-bandwidth communications services for oil and gas companies in the North Sea. In 2012, its old microwave communications system was struggling to cope with its customers' increasing demand for data. The company decided to deploy an end-to-end LTE communications system connecting drilling platforms, floating facilities, tankers, and onshore stations.

Today, Tampnet's high-speed network covers all platforms, tankers, and floating facilities out to 50 km, and it offers advanced services



like video transmission. Converged multimedia communications, combining voice, video, and data, enables remote visual inspection and control, and videoconferencing. The network gives local oil companies a strong foundation on which they can base the next phase of their digital migration.

[5] Upstream Oil and Gas Companies Spend Smarter on Digital Technologies to Drive Value, Reduce Costs in Downturn, Accenture and Microsoft Survey Finds

Supporting sustainable development

The digital transformation of the oil and power industries is vital for sustainable economic development. It will enable us to use natural resources in a smarter, more efficient way.

Increasing the amount of renewables in our energy mix will reduce our carbon footprint, and help to mitigate climate change. So at the same time as supporting the operations and the success of energy companies, we should also be developing an explicit renewable energy strategy. That is part of the corporate social responsibility of the energy industry and its partners.



Telecom Carriers: ROADS to New Growth

Being a key player at the forefront of the digitalization wave

Amid declining traditional business and rising competition across sectors, telecom carriers are under growing revenue pressure and striving for new growth. As enterprises worldwide navigate the route to digital transformation, for carriers that have always played an essential role in the traditional telecom industry, they bring new opportunities.

According to IDC, digital transformation will be the key strategy for 67% of the top 2,000 enterprises by 2018. In the digitalization process, verticals' needs vary, but what they have in common is a focus on adopting a customer-centric strategy and a readiness to embrace digital technologies, such as cloud computing, big data, Internet of Things (IoT), and video. The ultimate aim is to establish a digital operating model, facilitate innovation, and foster transformation.

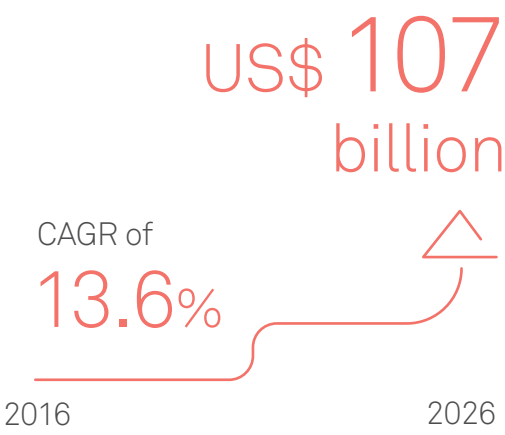
An enterprise's digital journey requires flexible and open networks, so carriers are well positioned to be key enablers given their strong network resources around the world, established customer bases and channels, as well as brand image and reputation in the enterprise market. All of this makes the business-to-business (B2B) market a logical growth engine for carriers.

Data from Future Market Insights[1] shows that the global B2B telecom market is set to reach US$107 billion by 2026, with a compound annual growth rate (CAGR) of 13.6% between 2016 and 2026. Behind this huge market growth is enormous demand for

[1] "B2B Telecommunication Market: Global Industry Analysis and Opportunity Assessment, 2016-2026", by Future Market Insights

cloud, IoT, video, and enterprise communications technologies. To tap into higher-value businesses of the B2B market, it is important for carriers to use cloud as a vehicle to serve enterprises in different industries.

Global B2B telecom market is set to reach[1]



To ride the digitalization wave, carriers have become increasingly aware of the need to reinvent the way they run their businesses. This includes changing legacy mindsets in response to the changing market and fierce competition. Indeed, with an eye to unlocking new growth, carriers are making an effort to transform their organizational structures, operating models, business processes, people management, and business models as they seek to nurture ecosystem development with an open mind.

Nurturing innovation: build a cloud-based, convergent, and open platform

Many carriers are striving for new revenue growth by tapping into cloud, IoT, video, and enterprise communications.

Serve enterprises and governments with cloud

For many, the prospect of not having access to the cloud is unthinkable. After all, who wouldn't be drawn to an on-demand, scalable, and highly flexible service? It's a service that drives business by facilitating collaboration, fostering innovation while improving responsiveness and agility. Not surprisingly, growth in cloud uptake is strong – and it's getting stronger. According to Gartner[2], the percentage of organizations using cloud is set to reach 85% in 2019, up from 58% in 2016. Supporting this growth presents huge market potential for carriers.

To further tap the B2B market, a good approach for carriers is to adjust their business models to suit their existing strengths. This includes creating cloud-based platforms to serve governments, public utility departments, as well as large and medium-sized enterprises. This is conducive to business innovation and facilitates the digital transformation of different verticals. Many carriers are making inroads into cloud, including China Telecom eCloud, Deutsche Telekom Open Telecom Cloud, as well as the "Cloud of Clouds" strategy of British Telecom.

In 2016, Telefónica helped Angeles Hospital, Mexico's third largest healthcare provider, to migrate its Digital Doctor service to the "Telefonica Open Cloud" platform. The purpose was to help the hospital to flexibly expand its business, efficiently cope with soaring traffic, and manage data amid rising demand for the Digital Doctor service. The new platform provides users with innovative online medical services, such as storage of medical images, faster response times for medical queries,

[2] Gartner estimates based on cloud adoption surveys (2014 to 2016)

and local payment support. It also allows patients to manage their personal information, identify nearby doctors, and consult medical professionals via video or online chat.

Another area where cloud makes a discernible difference is with the Geographic Information System (GIS), something that all governments heavily rely on in the management of cities. GIS is widely used across government departments, such as planning, land, environmental protection, water resource, and forestry. However, these systems are very often developed in silos, stifling data sharing and cross-department collaboration. Through the use of cloud, China Telecom Xuzhou helped the local government to integrate all GIS resources into a single cloud. This improved collaboration, enabled faster emergency response times, and ensured more efficient city management.



Identify high-value cloud service markets and target verticals

All verticals have their own unique business processes, and need to follow different industry standards and security regulations. To achieve a high-value return from their cloud services, carriers need to have a genuine understanding of customer needs in different verticals. That typically means working with partners from those verticals, as well as developing a good ecosystem that is open, aiming to foster collaboration with a wider pool of experts. It is also important to improve the ability to deliver cloud services by streamlining organizational structures and nurturing employee empowerment, both of which create a foundation for ensuring rapid response times and agile innovation.

Explore the Internet of Things

We now live in a world where all things are sensing, connected, and intelligent. At its heart is the IoT. Huawei forecasts[3] that, by 2025, there will be 100 billion connected IoT devices used in every facet of business and life. This presents huge opportunities to carriers. Huawei cites 10 areas that are most suited for carriers looking to tap into IoT: smart metering, smart parking, smart tracking, smart street lighting, smart farming, smart home, connected vehicles, fleet management, Internet of Elevators and Escalators, and retail.

In the US, the IoT has long been a key source of carrier revenue growth. Taking Verizon as an example, revenue from its IoT business reached US$690 million in 2015, recording 18% year-on-year growth. This was far higher than the 3.6% general revenue growth of the company over the same period. Verizon has set a 2017 target for its IoT revenue at above US$1 billion. To achieve that figure, it needs to provide a full package of "IoT connectivity + Cloud platform + Big data + Solution" services to meet the unique needs of different verticals. Hahn Family Wines Vineyard in California is among many users of Verizon's ThingsSpace IoT platform. The platform enables on-demand irrigation based on soil nutrients, moisture of the soil, and the humidity of the surrounding environment. This lowers costs and improves efficiency for the vineyard by reducing water consumption. It also meets different water and nutrition needs for each growth stage of the crops.

In 2017, China Telecom helped Shenzhen Water Group to upgrade its water management system by launching the world's first smart water project

[3] Huawei Global Industry Vision

based on narrow-band IoT (NB-IoT). With China Telecom's network and its "eCloud 3.0" platform, the project helped Shenzhen Water avoid losses from missing readings and water leakages from pipelines. The outcome was significantly lower costs compared to those of traditional manual meter readings. By analyzing the water usage patterns of different consumer groups, the system also provides clear guidance for the construction and maintenance of pipelines.

Building on existing strengths and working with partners across the industry chain

The IoT is a huge, complex system wherein different devices need different types of connections. Carriers need to advance their technologies to provide connections, security protection, big data analytics, and artificial intelligence capabilities to suit verticals' differing needs. It is important for carriers to get government support for obtaining licenses and spectrum.

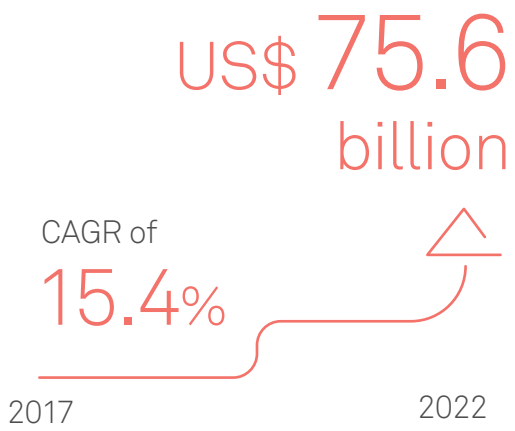
At the same time, establishing alliances with equipment and ICT manufacturers, software developers, research organizations, governments, and other related parties plays an essential part in fostering collaboration to innovate and develop new business models.

Surveillance video will be a growth driver

In building safe city and when migrating to smart city, many city authorities have deployed surveillance video in key public areas, as well as locations of special significance. And in industries where there are high security requirements, HD cameras are widely used to locate and flag potential security vulnerabilities on a real-time basis.

Video is set to become a core business for global carriers, and surveillance video will be a major driver of growth. Data from MarketsandMarkets[4] shows that the global video surveillance market will grow to a size of around US$75.6 billion by 2022, and will record a CAGR of 15.4% between 2017 and 2022.

Global video surveillance market is set to reach[4]



Safaricom, a leading telecom carrier in Kenya, is one of many examples of the successful development of video business. It built Africa's first modern "Safe City" system in Nairobi, Kenya's capital, using new information and communications technology. During the project, 1,800 HD cameras and 200 HD traffic surveillance systems were deployed across the capital. A national police command center, which supports over 9,000 policemen and 195 police stations, was set up to help with monitoring and case-solving. Since the completion of the project in 2015, the regional crime rate has since dropped by 46%. In 2016, the number of international tourists travelling to Kenya rose by 13.5% year-on-year.

[4] MarketsandMarkets Video Surveillance Market by System, Hardware, Software, Service, Vertical, and Region - Global Forecast to 2022

In 2017, China Mobile launched several new products in its series of integrated video surveillance products. Built on the company's high-speed network and a centralized platform that supports cloud storage and provides services with a unified access, the video products serve many industries with smart surveillance applications and intelligent analysis capabilities. The solution has been used in a wide range of situations, such as public security inspection, insurance damage assessment, forest fire prevention, construction site security, and security of water and electricity systems. The technology demonstrably increases efficiency and safety in public security, transportation, electricity, petroleum, environmental protection, water conservancy, financial services, and other industries. China Mobile sees revenues from surveillance video growing to more than CNY10 billion over the next five years, serving 10 million users in 11 industries.



Building on network and platform strengths to amplify the value of video

From smart cities to safe production, the market for surveillance video is enormous. Behind this market are a large number of users with different needs. There are also innumerable players in niche markets. It is important for carriers to support the ecosystem in order to understand how best to work with all parties to achieve the best outcomes. Building on their network and platform strengths, carriers wanting to move up the value chain can develop smart surveillance video services, and amplify the value of video to end users by offering a range of video applications, including facial recognition, big data, and other technologies.

Enterprise video communications offers new potential for growth

Agile, efficient, and on-demand enterprise connectivity and communications services, such as HD videoconferencing and unified communications, will be a green-field site for carriers' future growth. Taking unified communications as an example, the market size is set to hit US$96 billion by 2023, according to a research[5] by Global Market Insights. That number reflects the huge potential of the enterprise communications market as a whole.

By relying on its enterprise communications cloud, China Telecom Guangdong managed to provide enterprise users with seven types of services on the cloud all through a single optical fiber, including internal call network, unified communications, call center, and enterprise private network. Vodafone has also put enterprise connection services and "OneNet", its enterprise communications service for SMEs, at the core of its B2B business.



Boundary-free collaboration with one-stop services

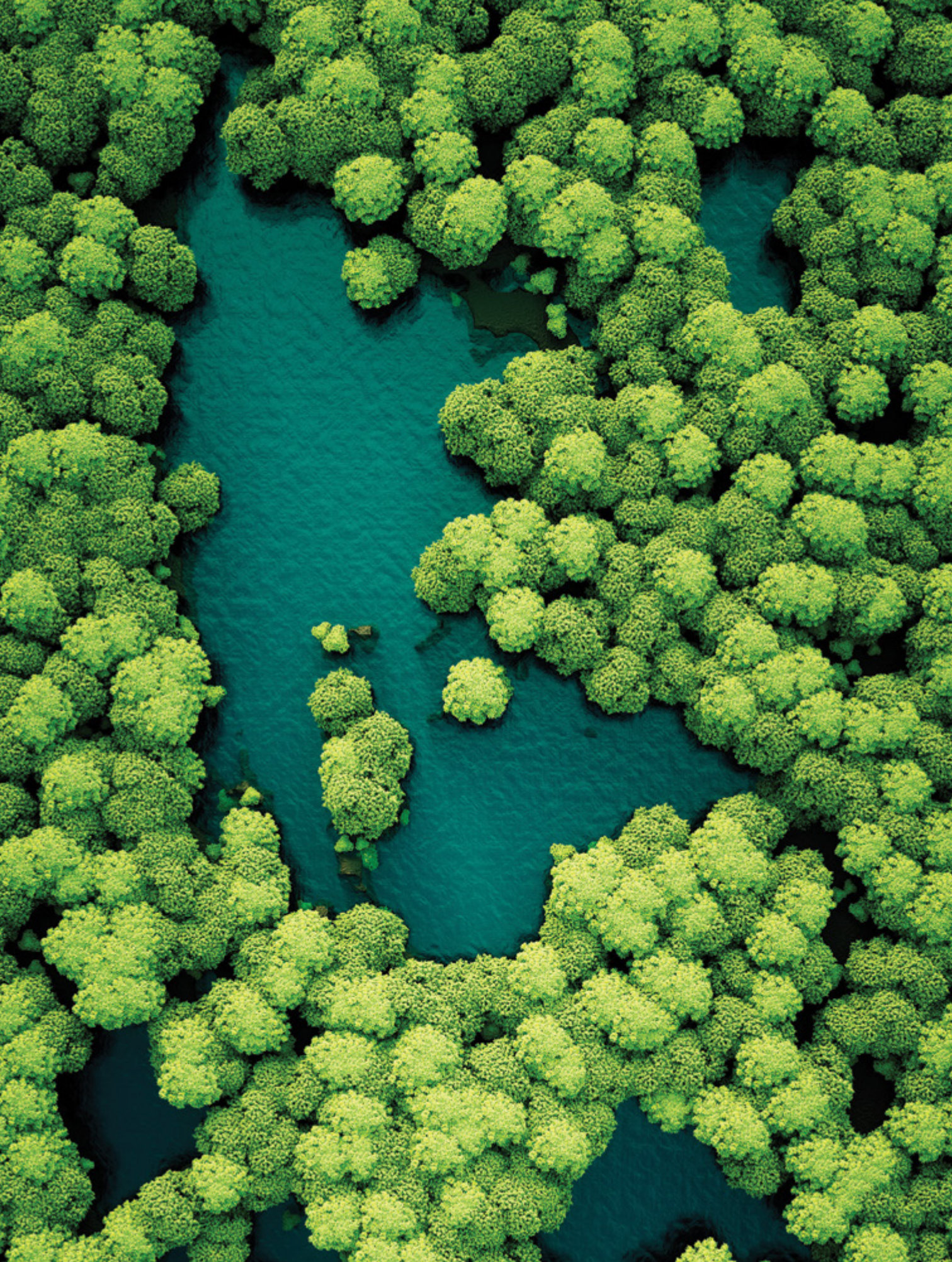
Connectivity and telecommunications are carriers' greatest strengths. By fully incorporating these technologies into enterprises' production and operational processes, carriers can create a boundary-free collaboration experience for enterprises with one-stop service that achieves greater agility and efficiency.

Riding the wave together

In video, cloud, and many other emerging areas of business, carriers work with over-the-top (OTT) players, aiming to leverage the rich applications that exist in OTT to bring users a premium experience. In the long run, however, carriers need to fully embrace the cloud. This means they not only need to digitalize their own business, but also need to enable their enterprise customers to go digital.

As part of this, they need to change mindsets, upgrade technologies, and promote ecosystem development. As a long-term partner, Huawei is committed to helping carriers seize new growth in their digital journeys. It does so by supporting expansion in B2B markets through cloud services and by collaborating on ecosystem development in an open, stable, and mutually-beneficial way.

[5] Global Market Insights, Inc: "Unified Communications Market Size, 2016 - 2023" Report



AN OPEN, COLLABORATIVE, AND SUSTAINABLE ECOSYSTEM ADMIST DIGITAL TRANSFORMATION

An Open, Collaborative, and Sustainable Ecosystem Admist Digital Transformation

Digitalization is transforming business ecosystems

Today, society is becoming more digital and intelligent. Systems used in industries today are also becoming more complex. The latest technologies like big data, Internet of Things (IoT), mobility, and cloud services are advancing rapidly, and are enabling more connections and interactions among enterprises and industries. As a result, new operating models and business models are emerging every day. To benefit from the trend of digital transformation, enterprises need to transform their IT infrastructure and organizations at a fundamental level. Industry boundaries are continuously expanding. These developments are also reshaping the business ecosystems they rely on.

Traditionally, the business ecosystem is linear. From suppliers, manufacturers, to distributors and customers, they form a unidirectional supply chain. However, the digital transformation shakes up the system and changes the roles of industry players. Industries are now overlapping each other, which makes for a more complicated ecosystem environment.

John Deere started his company in 1837. At the beginning, this agricultural machinery company only sold products to farmers. Today, the company is using wireless connectivity, cloud computing, and big data to provide a wide range of agriculture management solutions covering meteorological data, seed selection, and irrigation. The company has established a comprehensive digital ecosystem that supports business development.

In the ecosystem, digitalization and connectivity make real-time monitoring of equipment possible, improving the efficiency and reliability of operations. Sensors deployed on farms gather important agricultural information that helps guide farmers in sowing, fertilization, and harvesting. The remote information management platform helps support the decision-making process. John Deere is now the world's largest supplier of agricultural machinery, industrial equipment, forestry equipment, and agricultural management solutions. The company even has business in credit cards, healthcare, and specialized technology, which has enlarged its ecosystems and created greater shared value among its partners.

If you also run an enterprise supplying agricultural machinery solutions, how do you compete with John Deere in the market?

In the future intelligent world, an enterprise will be unable to compete in the market on its own. It will be necessary to join ecosystems in order

to survive and prosper. From transportation, finance, energy to education and healthcare, the business environment in almost every industry is becoming more complicated. With the convergence of industries and changes in consumer demands, enterprises need to become more open and flexible. They also need to choose sustainable ecosystems in order to establish long-term competitiveness.

Embrace an open and sustainable "Costa Rica" ecosystem

Hawaii is located in the middle of the Pacific Ocean and is over 3,000 kilometers away from the nearest continent. It has an ecosystem comprised of more than twenty thousand animal species. Its ecosystem is relatively closed and fragile.

On the other side of the spectrum is Costa Rica, which is situated between North and South America, connected to Panama to the south and Nicaragua to the north. Costa Rica is linked to two continents and has an open and diverse ecosystem that has a high degree of biological symbiosis. The ecosystem has approximately 500,000 species, roughly 25 times as many as Hawaii. Its open, inclusive environment nurtures a healthy, prosperous, and sustainable ecosystem. The same also applies to the ICT industry.

Openness leads to an inclusive and sustainable partnership

In the past, enterprises chose suppliers based on the quality of products and their price performance. In the new digital era, as technology advances quickly and customer demand evolves over time, enterprises are choosing their partners based on the ecosystems they participate in. The focus is now on the open, inclusive, sustainable ecosystem that suppliers participate in and represent.

Openness is key to the success of the iOS and Android platforms. Numerous developers create applications for the two mobile platforms, greatly expanding the capability of mobile phones and enhancing user experience. The prosperous ecosystems provide value to all players. Microsoft is also opening up and embracing other platforms like iOS, Android, and macOS.

Because of the difference between industries and enterprises, the cloud service ecosystem needs to be open. As an open source cloud architecture, OpenStack frees enterprises from being bound to solution providers. The cloud platform enabled by OpenStack allows the IT team to become a cloud service provider. OpenStack enables a controllable, interoperable, and expandable environment that is valued by participants in the ecosystem. The OpenStack community has more than 16,000 members in over 130 countries. It also receives support from over 200 technology leaders including IBM, Intel, Oracle, Cisco, Dell, HP, Red Hat, and VMware. According to 451 Research, revenue in the OpenStack ecosystem will increase from US$1.27 billion in 2015 to US$5.75 billion in 2020.

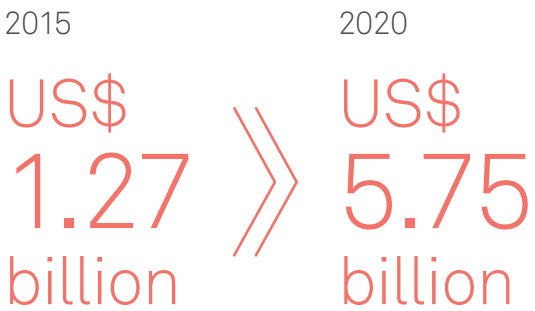
OpenStack community has

>16K members in over 130 countries

support from

200+ technology leaders

Revenue in the OpenStack ecosystem will increase from



Customer centricity is the ultimate goal that underpins healthy ecosystems

From traditional product- and solution-focused supply chains to new ecosystems oriented toward digital transformation, the customer-centric approach is always important. The goal of an ecosystem is to connect a wide range of partners and serve fast evolving customer demands. By doing this, it also guarantees a healthy and sustainable ecosystem.

An enterprise can increase its business scale by investing more capital. It can also become strong by improving its competitiveness in the market. However, if an enterprise wants to establish a healthy and sustainable ecosystem in the long run, it needs to embrace a customer-centric approach.

For example, the finance industry is moving into a new phase of intelligence and digitalization. Customer behaviors are changing quickly. The adoption of mobile payment is reducing demand for credit cards and cash. Customers are more accustomed to using financial services through the Internet or mobile banking than lining up in banks. Today, customers prefer the bundling of finance, entertainment, transport, and social media products. Banks need to understand the changes that are occurring in customer preferences. They need to leverage their advantages in customer relations, channels, data, technology, and risk control to create services that integrate mobile communications, retail, healthcare, bill payments, and social media. By achieving this, banks can expand their market share through the building of ecosystems.

Create value and embrace a business model founded upon shared success

Enterprises have to create value for their customers. The employees, technology, products, operational processes, and organizational structures of an enterprise are employed and built to create value. A reliable and sustainable ecosystem doesn't rely on a single, big company but rather on multiple players that seek out robust business models in the system. Apple's iOS was the first mobile operating system to allow developers to sell their apps directly to users. Users can also make payments within apps. Since the launch of the App Store in 2008, Apple has helped the global developer community to earn more than US$70 billion in revenue. A robust business model founded on shared success and supported by an enterprise is key to the long-term success of an ecosystem.

A solid platform is essential to maintaining a sustainable ecosystem

In the natural environment, the composition and health of the soil impacts the growth of plants and the formation of an ecosystem. In the digital era, a solid, end-to-end platform is the rich soil that can

nurture the ICT ecosystem in the long term. This ensures that the ICT ecosystem is adaptive and long-lasting.

A good example of how enterprises, customers, and partners can work together to establish an end-to-end platform solution is how Huawei has partnered with General Electric to provide an industrial predictive maintenance solution. The cooperation combines Huawei's open Edge Computing-IoT (EC-IoT) architecture and GE's cloud-based Predix platform to provide an integrated ICT industrial solution. The solution was rapidly adopted by leading elevator and escalator manufacturer Schindler, allowing the company to monitor over one million elevators and escalators in real time. The company can gather data to perform big data analytics, predict malfunctions, control equipment remotely, and repair systems before problems arise. This makes maintenance more intelligent, reliable, and cost-effective. The solution has the potential to be applied in other industries such as manufacturing, oil & gas, and logistics.

The "Costa Rica" ecosystem proposed by Huawei is not about how to win through competition, fairly distribute market benefits among participants, or limit customer choices through bundling. Its focus is to create an open and collaborative ecosystem founded on shared success, aiming to fulfill diverse and evolving customer demands in the new digital era. Its cross-industry approach brings together governments, industry alliances and organizations, developers and academia to create a larger market for all participants so that they can share benefits in the long run.

Alliance

Huawei conducts cross-industry and cross-regional cooperation with industry partners. As the end of 2016, Huawei had strategic alliances with SAP and Accenture, as well as partnerships with more than one hundred leading industry players such as GE, ABB, BOSCH, Honeywell, Infosys, Veolia, T-Systems, Alston, Hexagon, and etc. By working together, the companies have jointly developed nearly 200 innovative and competitive solutions, helping customers to succeed in industries such as public safety, transport, energy, manufacturing, finance, and smart cities.

Partners

As of the end of 2016, Huawei had more than 12,000 channel partners across the globe. The company also has more than 400 solutions partners, over 2,100 service partners, and more than 46,000 Huawei certified engineers.

R&D Investment

A sustainable ecosystem relies on strong R&D investments. Huawei has approximately 80,000 R&D staff, accounting for 45% of all employees (as of the end of 2016). Huawei invests more than 10% of its sales revenue in R&D. Over the past ten years, R&D investment has totaled over US$45.07 billion. The company's R&D investment was US$11 billion in 2016, equivalent to 14.6% of revenue. Although investment in basic research doesn't directly contribute to sales, Huawei's investment to its 2012 Lab still reached US$2 billion in 2016. The spending on basic science research will be in the range of 20% to 30% of total R&D spending in the coming years.

Developer Enablement Plan

In the next 5 years, Huawei will invest US$1 billion to implement its "Developer Enablement Plan" initiative. This is a program that enables developers to build products and solutions based on Huawei's products, platforms, and APIs, achieving innovation and sustainable business success.

OpenLabs



In order to better understand customer demands in local markets, Huawei has established a series of OpenLabs in cities including Suzhou, Munich, Mexico City, Singapore, Dubai, Johannesburg, Bangkok, Paris, Cairo, and Moscow. By cooperating with leading laboratories and more than 400 partners in various industries across the world, Huawei continuously develops innovative and customer-centric solutions.

- In terms of smart city solutions, Huawei is serving more than 200 cities in over 80 countries and regions across Europe, Africa, and Asia-Pacific, reaching more than 800 million people.
- In the finance industry, Huawei is co-innovating with over 10 leading global financial institutions and independent software developers. The aim is to support the digital transformation of financial institutes in terms of platform transition, product innovation, and channel services. Huawei has also successfully built cloud-based infrastructure for the Industry and Commercial Bank of China. Huawei is serving 300 financial institutions globally, including six of the top ten global banks.
- In digital urban rail, Huawei cooperates with more than 30 partners in the areas of CBTC, PIS, CCTV, and TAU terminals, as well as trunking and integrated surveillance systems. The collaborations aim to create, test, and verify urban rail solutions, and provide interoperable IoT test reports to support the development of the ecosystem.
- In industries such as manufacturing, education, Internet, energy, and public safety, Huawei cooperates with numerous partners to jointly create solutions and enable digital transformation.

In the coming three years, Huawei will invest US$200 million to establish 20 OpenLabs. Huawei will create a global OpenLab network to take advantage of global resources and capabilities, capturing opportunity in various industries while supporting the ongoing trend of digitalization and serving local ICT ecosystems.

Epilogue: Building a Better Connected World

The human need to communicate is a constant. From the earliest gestures, symbols, first language and writing, to today's digital torrents, people have always felt the need to connect, share, and reach out to each other. Huawei's vision is to build a Better Connected World, to enrich lives through communications.

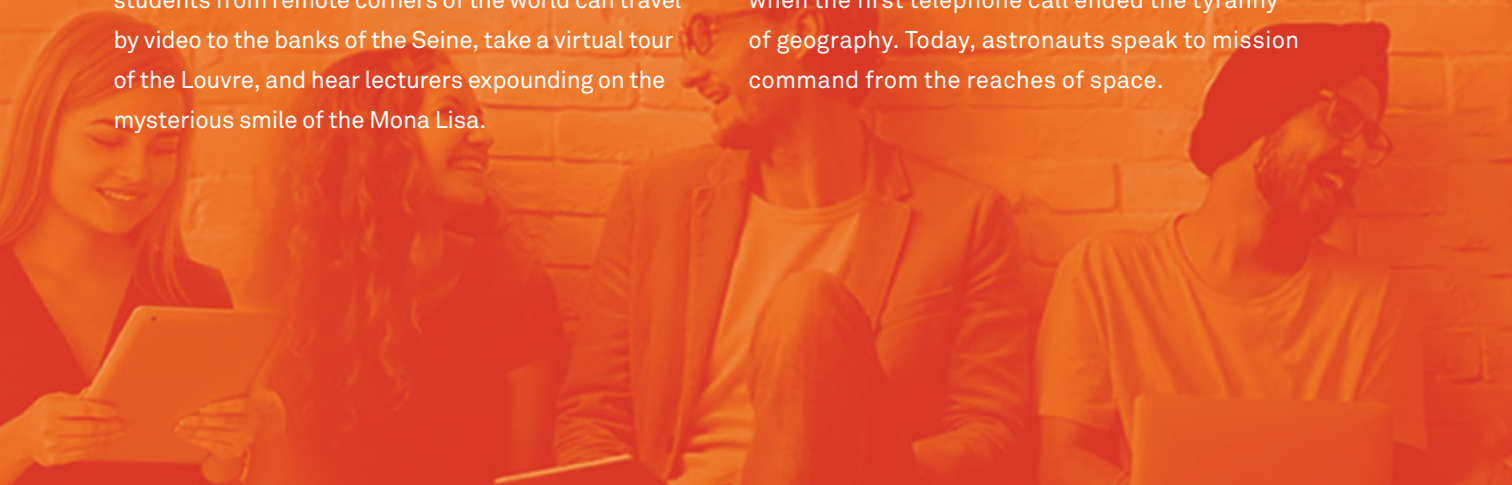
36,000 years ago, in the Chauvet Cave in France, Palaeolithic humans used hematite and charcoal to draw images of animals, and record the spectacle of a volcanic eruption. Today, we select emojis to compose and communicate our emotions. The technology may change, but not even the profoundest gulfs of time can alter the impulse to connect.

Connection can be a spoken exchange; it can be the transmission of knowledge; or the spread of culture. In the past, the urge to record and communicate drove us to painstakingly hew wooden tablets, or use the skins of wild beasts to make parchment. Now, art students from remote corners of the world can travel by video to the banks of the Seine, take a virtual tour of the Louvre, and hear lecturers expounding on the mysterious smile of the Mona Lisa.

Connection is an expression of love. Years ago, youths from the village over the hill would write long letters avowing their love for girls they had only glimpsed a few times. And how many of those letters actually made it into the hands of the intended recipients? Today, our boyfriends and girlfriends are only a video call away, and we do not have to miss a moment with them. Over a video connection, smiles still draw an instinctive smile in reply, and tears can be shared.

Connection is a way to work better, together. In the past, the fastest pony express would still take days to arrive. For the most part, we had to solve our own problems. Today, a Silicon Valley scientist can consult seamlessly with a research team in Singapore and a customer in Brazil. All it takes is a broadband connection.

Connection is an exploration beyond the boundaries of physics and physiology. Little more than 100 years ago, the world was stunned when the first telephone call ended the tyranny of geography. Today, astronauts speak to mission command from the reaches of space.



Huawei believes that connection makes for a better world. Our sons and daughters may travel far from home, but connection transmits their love and care back to the parents to whom they owe so much. Students have always buried themselves in textbooks, but connection opens up new worlds for them to learn. Our sweetheart may not be by our side, but connection can carry love across the miles and down the years.

In the future, a Better Connected World will bring us a different kind of experience. It will revolutionize every part of our lives, our economy, our communities.

China, 2035. Liu Wei climbs into his new driverless vehicle. The car has no indicator lights at the front or back – but of course, the roads are fully automated now, so who needs indicators? Liu tells the car where he wants to go, and the onboard navigation system connects to city transport control, to check for traffic jams. The roads are clear, and the computer displays a precise estimated time of arrival.

On the way, Liu schedules his next few days of work, with music on in the background. Every second of the journey, his car is making digital "handshakes" with hundreds of other vehicles, learning their speed, route, whether they are about to change lane. This is how the roads have been made safe: today there are almost no injuries or deaths from traffic accidents.

The central transport network is constantly collecting data from tens of thousands of cars on the road, analyzing traffic flows, and delivering optimum route advice. In fact, this data is now being used to help plan where new roads should be built.

As a result, even for residents of Liu's packed city, "I was stuck in traffic" is no longer an excuse that holds any water.

USA, 2028. Every second of the day, Internet users all over the world upload millions of video footage. John is developing a new search engine that will recognize and understand the people, objects, and situations in those videos. An AI engine with machine learning capabilities is reaching out to data centers all over the world, collecting the archives of HD video that they contain. John is confident that the new engine will help users find exactly the video clips that they want. More important, though, will be its analytic capabilities. It will tell fashion designers what colors and cuts young people are favoring. It will show toy makers the latest games. And it will help governments understand what their citizens think of the latest public projects.

In the future, we believe that connectivity will be as ubiquitous as the air that we breathe. Connections between people, person to device, and thing-to-thing, will feed into real-time intelligent analysis and communications. They will help satisfy our every economic need. Using these connections will feel as natural to us as breathing. In fact, we will barely be aware that they exist. Our focus will naturally lie on the applications and services that connectivity enables.

From the deep past of Chauvet, to real-time video links; from messages that echo down the millennia to data that flash across continents. Connection is a human need, the vector of human love, the texture of our future. Welcome to the Better Connected World.

Notes:



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