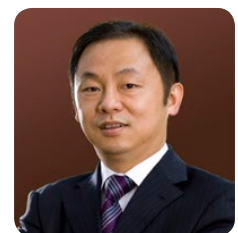# Open innovation for a Better Connected World

> Innovation is the key to improving our capabilities and tackling the challenges in a diverse world. To build a Better Connected World, Huawei has defined three levels of innovation: fundamental, allied, and ecosystem.

Ryan Ding
President of Products & Solutions, Huawei

Challenges in a diverse world

Over the past two decades, people-to-people voice communications has been a hot topic. As the Internet became more popular, and as IP-based networks and social media became more common, we saw technologies evolve from TDM to IP, 2G to 3G and 4G, among others. However, our networks have always been built around people.

Looking ahead, we need to address three important requirements: a latency of one millisecond, 100 billion connections, and 10Gpbs of bandwidth. If we consider their implications, we will see that future network requirements no longer only relate to people.

Let's take one-millisecond latency as an example: 100 millisecond latency over 3G networks and 50 millisecond latency over 4G networks have both worked for people-to-people communications. However, for time-

critical industrial applications, latency presents a huge obstacle. For example, with a latency of 50 milliseconds, a self-driving car travelling at 100km/h will continue to move 1.4 meters from detecting a failure to applying the brakes. This is unacceptable for self-driving. That's why we are striving to achieve an end-to-end latency of one millisecond in the 5G era.

Future virtual reality (VR) applications will require 10Gpbs of bandwidth, far surpassing previous requirements of only 100Mbps. And the 100 billion connections will connect far more than the seven billion people on this planet. In the future era of 5G, we will be connecting things, not just people.

These requirements present a challenge. Over the past century, people-to-people communications have not had many diverse requirements on networks. But in the future, diversity will become the new norm. Against this backdrop, how can we better develop our network application architecture to satisfy diverse requirements? At Huawei, we believe that for infrastructure, we can only achieve high efficiency and low cost through economies of scale. To this end, we will need to create a uniform physical network and apply virtualization technologies to satisfy the diverse requirements of different industries.

Applications will become increasingly diverse in the future. At the MWC 2015 in Barcelona, we launched an energy-efficient IoT module. It's a very small chip, but it can run for 10 years without recharging on just two or three button cells. Some of our carrier customers were very excited to see this solution, and proposed many new ideas. Some said they wanted to embed this chip in a pet's collar, so they would always know where their pets are. Some customers from the manufacturing sector wanted to install the chip in

their bicycles, so that they would never lose them. Logistics customers said they could install this chip in their containers, and track them anywhere in the world.

We currently offer E2E solutions to carriers, including BSS, infrastructure architecture, and devices. However, we are unable to provide pet or tap water management systems. Therefore, in the future, we will need to openly collaborate with industry partners. We will jointly innovate with our partners to provide diverse vertical applications to users. This will no doubt become a common practice in the diverse world of the future.

We will not be able to do everything ourselves. Instead, we need to focus on areas where we can excel and create value for industries. After analyzing our own capabilities, we have come up with three basic areas to focus on over the next 10 years.

First is network infrastructure, a traditional area of focus for Huawei. We will continue to invest and maintain our leadership in this sector. Second is IT infrastructure. This includes computing, storage, networks, and operating systems. We will keep investing in innovating cloud data centers. Third is digital infrastructure. Right now we are focusing our efforts on carriers, for example, providing them with cloud platforms and big data analytics systems.

Three-level innovation

To improve our capabilities to address future challenges, we believe innovation is the key. Huawei has always relied on innovation to achieve success. But in the future we will require an expanded definition of innovation. That means Huawei will innovate on three levels: fundamental innovation, allied innovation, and

ecosystem innovation.

Fundamental innovation

Fundamental innovation is the foundation of all other innovation activities. In this area, we will continue to invest in chips, including ultra-broadband chips, 5G chips, silicon photonics chips, and all-optical chips. In the IoT era, we will sustain our investment in LTE-M, including chips, infrastructure, and core networks. In software, our investments will focus on helping customers, including the customers of our carrier customers, to achieve Internetized operations. Our purpose is to bring Internetized operations to the traditional communications sector.

Fundamental innovation is very important. However, it is also very challenging, as it requires longer payback periods. As a key player in the ICT industry, Huawei has made longterm investments in basic research to drive the industry forward. This is our unshakable commitment to the industry. Over the past 26 years, we have invested at least 10% of our annual sales revenues in R&D every

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year. Just last year, Huawei spent 14% of its annual sales revenue on R&D. We also allocate 10% of our total R&D investment to research future technologies. Over the past 10 years, we have invested over CNY190 billion in R&D, and are committed to maintaining this level of investment in the future.

Allied innovation

We have been heavily involved in innovation, mainly in cooperation with carriers, such as Vodafone, China Unicom, and China Mobile. However, this is not enough. Diversity will be a key part of future development. To address diverse requirements, we must adopt a new innovation mindset. Let me give you an example on how

Huawei innovates and integrates this new concept of innovation with vertical industry innovation. For 5G, Huawei set up a 5G Vertical Industry Accelerator (VIA) and two testbeds. One testbed is near London and the other is in Munich. We are not simply concerned about carriers. The VIA also includes members from several other sectors, including standards organizations such as 3GPP, IERC, and PPI. All policy makers and standards setters in these sectors are now cooperating with us. We believe that it is also essential to introduce players from vertical industries, including SAP, Siemens, BMW, and Volkswagen. We have conducted E2E system integration and verification with these players to promote 5G-based innovative applications.

We also work with industry partners to conduct research in other new areas. We are currently cooperating with SAP and Intel on IoT. We are integrating our infrastructure with SAP's HANA big data platform to enter the IoT and Industry 4.0 domains. We are also working with Sony and Harmonic to promote the E2E commercialization of 4K videos. In terms of SDN, we play a leading role in the SDN alliance, which comprises over 30 companies. As a founding member, we are working with Stanford University and AT&T to jointly establish ONOS, the industry's first open-source SDN organization.

Ecosystem-based innovation

In the future, hundreds of millions of applications will exist. This will require us to create an ecosystem-based innovation mechanism. Compared with Apple and Google, Huawei is still a new player in this arena. However, we are willing to work with more industry partners to promote this kind of innovation. We are striving to develop uniform standards and conduct compatibility tests to increase platform capacity. In doing so, we aim to cooperate with more partners and contribute more to open-source organizations. In addition, we are working hard to create an industry ecosystem, and hope to attract more developers to open-source communities and labs to develop applications.

Take cloud computing as an example. We have launched an OpenStack-based cloud OS and made many efforts in this area. First, we completed compatibility testing on the OS with over 50 major vendors. Second, we have collaborated with the OpenStack open-source community, and are now one of the top 10 community contributors. We aim to increase our ranking to the top five this year. Third, we have actively cultivated independent software vendors (ISVs) to develop more software on our platform.

Make dreams come true

To satisfy the diverse needs in the Better Connected World, Huawei will remain focused on fundamental innovation and continue to invest heavily in basic research. This is the foundation for our future sustainable growth. We are also committed to joint innovation. We will jointly innovate with upstream and downstream partners to create a healthy value chain. Our efforts will of course include ecosystem-based innovation. We aim to aggregate more applications developed by our business partners, which will enable us to serve more sectors and scenarios. Through this we can grow together with the whole ecosystem and push the entire industry forward.

We believe that these three levels of innovation will allow us to realize our vision of a Better Connected World.