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SPECIAL REPORT

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Transforming Production and Service

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HUAWEI

IoT Crossing the Chasm

| By *Swift Liu, President, Huawei Switch & Enterprise Communications Product Line*

The emergence of the Internet of Things (IoT) will give market makers the opportunity to cross the chasm multiple times for many different consumer and industrial end-users. The scope of IoT is so vast that, over time, each of us as individual consumers will be participating in a variety of early and majority adoptions across vertical industries.

Huawei predicts that by 2025, the number of IoT devices will reach approximately 100 billion nodes, and sensor deployments will grow to an installation rate of almost two million per hour. Fifty-five percent of IoT use-cases will be realized from business and government sectors that include manufacturing, eCommerce, Smart Cities, and utilities such as electricity and water.

Huawei is actively contributing to the promotion and development of IoT industrial alliances whose goals include providing standard, open architectures, and solutions tailored to meet specific industry requirements.

Currently composed of physical, sensor, connectivity, control, analysis, and service layers, secure and reliable IoT connections are configured using standard gateway products for data transmission over broadband networks. Cloud platforms are being used to provide single logical points for collection and management, operation of Big Data analytics, and production of correlated data services to the end-users.

Early adopters from each industry require vision and commitment to build in first-order reference installations, as it is only when these early adopters succeed in demonstrating new value that the chasm be crossed and a new normal established.

Over the past few years, Huawei has seen many promising and proven practices in city management, smart metering, fitness device monitoring, remote water heating, and building energy management. We welcome the chance to work with an increasing number of industry partners to create further growth throughout the IoT industry chain.

We expect that the next two years are especially critical in our effort to enable the deployment of the state-of-the-art networks necessary for businesses large and small to launch their IoT services with the aim of crossing the chasm to strong and sustaining positions in the market.▲

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Success

Forum

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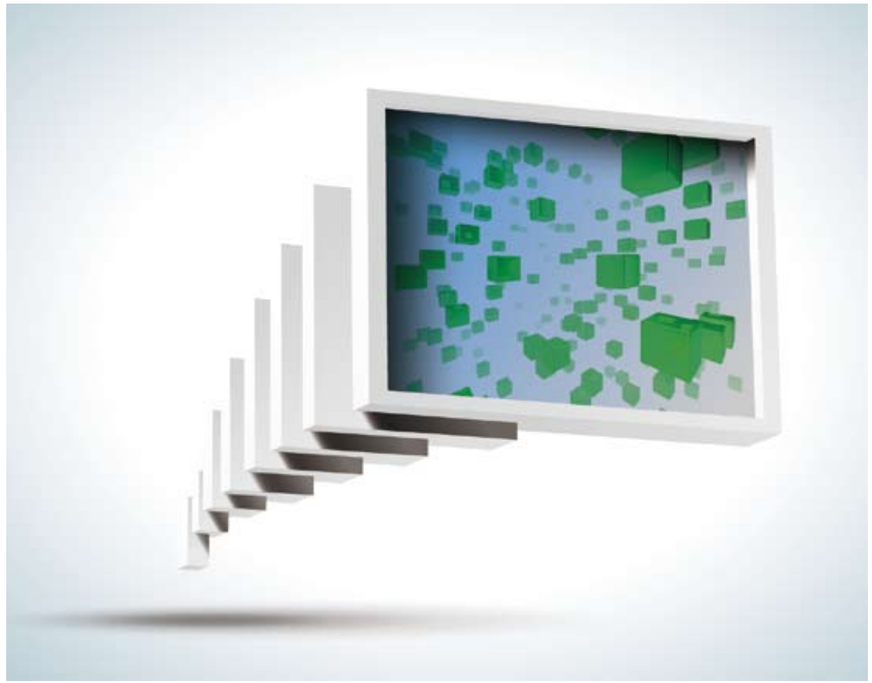
Free-view interpolation is a key element in synthesizing images and video from new points of view using only a limited number of original sources. It helps to define a new class of lightweight mobile phone solutions that are capable of high quality. >>

IEEE Award Paper:

High-Resolution Interpolation of Planar Structures

| By *Dongqing Zhang, Senior Staff Researcher, and Heather Yu, Director, Media Lab, Huawei Technologies, Inc.*



Researchers at the Huawei America Media Lab, in collaboration with the State University of New York (SUNY), received the Best Paper Award from the *IEEE International Conference on Multimedia and Expo (ICME 2014)* for the submission of "High-Resolution, Free-View Interpolation of Planar Structure." ICME is a flagship conference that promotes the latest advances in multimedia technology, systems, and applications. The Best Paper Award is granted to the single most outstanding paper selected from about one thousand annual submissions from around the world.

Step Inside Your Smartphone Photos

Have you ever wished you had taken that photograph from a different angle? Perhaps that cute shot of your child is partially blocked by the playground or contains unwanted objects or other people. Maybe the mountain in the background is too far to the left of your family, or the beautiful old car needs to be re-framed. What if you could dynamically and virtually "walk around" existing photos to find the best points of view?

Our paper presents an innovative, "free view" interpolation from multiple images.

Free-view interpolation is a key element in synthesizing images and video from new points of view using only a limited number of original sources. Users are able to create 2D and 3D virtual free view experiences that allow viewers to "step inside" their photos.

The traditional approaches for resolving depth from 2D photos — 3D reconstruction and image stitching — have yet to show the ability to generate high-resolution results. 3D reconstruction schemes require upwards of 300 to 500 photos to construct the point clouds from which the new views are extracted, and image-stitching technologies scale poorly, as finished size is directly proportional to the quantity of source material. Further, both techniques are computationally expensive, and outside strict smart phone power budgets.

Our research helps to define a new class of lightweight mobile phone solutions that are capable of high-quality, free-view interpolation — with zoom and rotation capabilities — from a small number of photos. The method allows new viewpoints to be created when a dominant planar structure exists in the frame, such as a building or a road.

Immerse Yourself in "Free Dimensional" Space

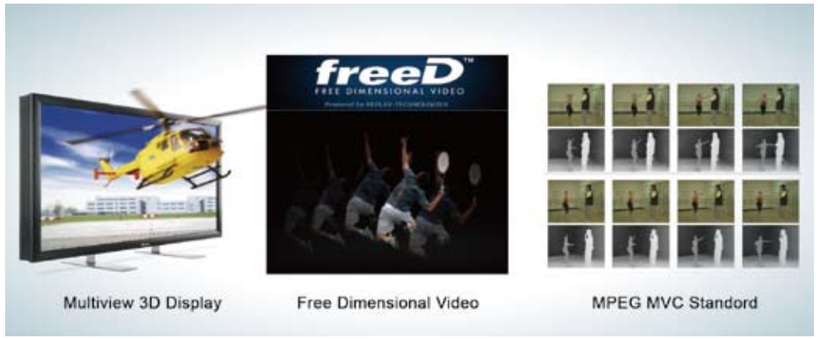
The technologies described in this paper are only a beginning. Further research works is planned to extend the present scheme to incorporate unrestricted structures and more complex scenes. We expect future work in the field to give people the ability to find novel views of scenes or objects in multiple resolutions, including the ability to "walk" through fully immersive scenes generated from a handful of still images.

Significant efforts are underway within the media industry to develop free-view interpolation and closely related technologies for displaying multi-dimensional imagery on mobile phones and other devices.

- Glasses-free displays with support for at least five views are already in the market.
- Free-view interpolation is used in sports broadcasting today for synthesizing 3D instant replays with inputs from multiple cameras.
- A related standardization activity is the development of Multiview Video Coding (MVC) for MPEG. Free-view interpolation is a key component in the MVC system for rendering multiple viewpoints by using the depth maps within the MPEG bit stream.

We are honored to receive this award. As a leader in the high-tech industry, Huawei will continue to invest in multimedia innovations that develop more intelligent products; increasing the global economy by enriching human intelligence and interaction. ▲

http://dx.doi.org/10.1109/ICME.2014.6890281



Examples of emerging technologies that require free-view interpolation

News

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Shan Zhiguang

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Applications-Driven Networking

| By *Shan Zhiguang, Deputy Director, Information Research Department of the State Information Center*

As Internet access has expanded from fixed networks to mobile devices on wireless networks, applications have become the driving force for the direction of network development, and the influence of applications will only intensify going forward.

Over the next five to ten years, we can expect to see the following trends play out:

Network Transformations

Mobile Internet access provides a primary example of the influence of applications on networks. In the early days of 3G cellular technology, the industry was laser focused on so-called killer applications to stimulate the use the new network. And as time went on, the industry realized that data traffic was the main factor behind increasing 3G utilization. The arithmetic could not be simpler: the more people used applications to transfer data, the more traffic volumes increased, and attentive cellular carriers made money. From the point of view of carriers, any application that required data access was a killer App. This driving force has been widely recognized in the industry to be effective for 3G networks, 4G networks, and (we speculate) future 5G networks.

Regarding fixed Internet access, for the foreseeable future the general concern is to get people more bandwidth for less money. In this case, technology will remain a force, but one with a shrinking influence.

The Internet of Things (IoT) and its derivative networks will be the main driver shaping the business models of the foreseeable future. This trend will reach across an increasing range and variety of service innovations created to meet discreet requirements, i.e. the Internet of Vehicles (IoV), smart homes, smart factories, et al.

Not lacking for strategic purpose, this trend involves all matter of national and industrial policy initiatives such as those represented by the cooperation pact announced between "Industry 4.0" in Germany and China's "Internet Plus" program.

Enterprise Networks Creating Value

At the most basic level, we can identify three types of networks:

- Networks for the general public, including business and non-business users.
- Networks for specific user groups, such as enterprises, organizations, or government agencies; collectively we can refer to these as enterprise-level networks.
- Networks used to access the other two types of networks.

The industry has reached a consensus that enterprises and industry players alike need carrier-grade networks. This need is especially apparent in key sectors such as finance, transportation, and energy, as well as other types of multi-regional or multi-national enterprises. A few enterprises have begun to invest in backbone networks. All of these factors mean that the enterprise-level network market has great potential for rapid growth and value-added gains.

One sector in particular, hotels, has a long track record of value-added gains from enterprise-level networks. High-end hotels can easily gain value by servicing the need and the ability for visiting customers to pay for "last mile" network access. For enterprise networks, Wi-Fi access is constantly improving due to the ever-wider adoption of micro-cell technologies. The enterprises that provide advanced network and business services to their user base are able to generate, sometimes unexpected, value from their existing installations.

The IoT will be one of the main drivers helping to shape the business models for future networks. This trend will cover a variety of innovative services to meet each individual's requirements, as well as addressing national industrial upgrade initiatives. >>

In places where large numbers of people come and go, such as football stadiums, colleges, and public transportation, networks can also generate significant additional value. In the future, it is expected that even more value will be mined from these networks, as more services are delivered to users. These gains are easily realized simply by integrating and reusing existing technologies, with no technical breakthroughs required.

Many Concepts Together

Over the past decade, people have been concerned about technology-centric constructions such as trusted computing, grid computing, and the transition from IPv4 to IPv6. At the same time, we have witnessed the emergence of cloud computing, virtualization, IoT, and Big Data from a set of service-driven requirements.

In the matter of a few more years, these systems and all matter of data types will converge further — video cameras and sensors everywhere, on wearables and machines, in enterprises, and inside household appliances. Everything becomes an object on a network of networks. "Small" cloud computing and IoT applications will operate on networks built to support resource conservation, accurately analyze trends, and support efficient decision-making.

The benefits are just beginning to emerge. In the future, application-driven network development patterns will dramatically impact the entire industry chain, and stimulate a vast industrial transformation. Companies that pioneer these new application-driven paradigms have promising prospects. ▲

Chen Qiulin

Huawei's newly announced Agile IoT Solution features an agile gateway, agile controller, and lightweight operating system. >>

IoT Platform for Global Connectivity

| By *Chen Qiulin, LiteOS Architect, Huawei 2012 Laboratories*

Announced at the 2015 Huawei Network Congress (HNC), the Agile IoT Solution enables objects to connect to the Internet and communicate with each other, with convenience tools for network management and maintenance.

Huawei's IoT roadmap for consumers and industry expands the benefits of a fully connected global marketplace in a sector where many other tech giants are pushing for their own standards and communication protocols, such as IBM, Intel, and even Google. Samsung and Apple are also on the IoT bandwagon of companies who are bundling Internet connectivity to enable communications between "things" and their owners.

"Huawei believes that standardizing ICT infrastructure will foster the development of Internet applications, including IoT applications," said William Xu, Huawei's Chief Strategy and Marketing Officer, in his HNC keynote speech.

Three Core Components of Agile IoT

The Huawei Agile IoT Solution consists of three core components:

- Agile Controller
- Agile IoT Gateways
- LiteOS

The 10 kilobyte LiteOS kernel, plus extensions, enables automatic discovery and an auto-networking connection that requires no user configuration with the ability to power a wide range of smart devices — including smartphones and watches, home appliances, and now cars. An open source system that provides a unified development platform, the system fosters IoT development via code that is available free of charge for building IoT devices quickly — and especially from product categories that have previously not been connected to the Internet.

Agile IoT Gateways, designed to bridge sensor and IP networks, have the following key features: Access to more than seventeen types of IoT interfaces that can dynamically load protocols from the Agile Controller to meet service requirement specifications, and support for local decision-making by integrating computing and storage resources. With an industrial-grade design, the Agile IoT Gateway is water and dust proof, shock resistant, and engineered for anti-electromagnetic interference and operation under a wide range of temperatures.

The Huawei Agile Controller is an IoT host for enabling unified management of IoT terminals, gateways, computing resources, applications, and data. The controller provides seamless scalability to support management and control of large IoT terminal networks, and is also built on an open software architecture that enables access across a wide range of industry applications.

LiteOS is open to all developers to create products through collaborations with upstream and downstream partners. "We wish to build a rich ecosystem of IoT applications," says

The Huawei Agile IoT Solution consists of three core components: Agile Controller, Agile IoT Gateways, and LiteOS. The complete Agile IoT Solution is a flexible platform built to enable the installation of wireless equipment for businesses and industries that have never been connected to the Internet. >>

The source code for LiteOS is open to all developers, and Huawei invites the participation of the open source community (www.oiotc.cc) for chipsets, modules, open source hardware boards, and software developers. >>

Yan Lida, President of Huawei's Enterprise Business Group. "We have established a Business-driven ICT Infrastructure (BDII) program that is working with standards organizations, research centers, open labs, and developer communities to foster rapid IoT development." The BDII goal is to simplify the learning curve for smart hardware development.

The complete Agile IoT Solution is a flexible platform built to enable the installation of wireless equipment businesses and industries that have never been connected to the Internet. For consumers, LiteOS extends smart hardware into homes, connected wearables, and the Internet of Vehicles (IoV) for the smarter cars. For business and government, the Huawei solution will enable Smart Cities, equip electric power utilities with smart metering, and advance the Industrial Internet for manufacturing with typical applications such as data collection and real-time control.

Open Community Partners are Welcome

The source code for LiteOS is open to all developers, and Huawei invites the participation of the open source community (www.oiotc.cc) for chipsets, modules, open source hardware boards, and software developers.

Huawei wishes to extend smart IoT partnerships in the following ways:

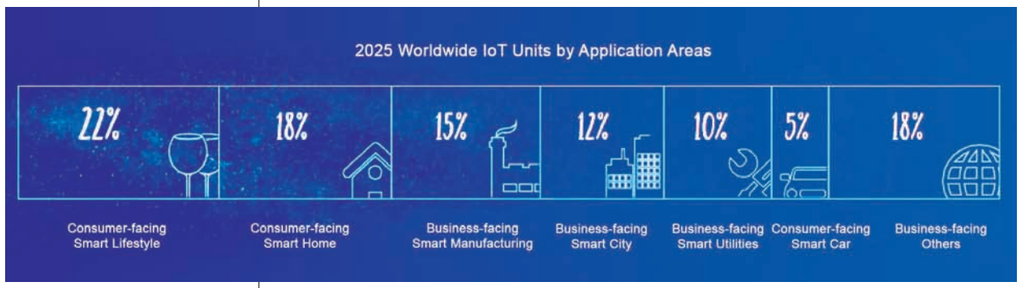
- Simplified Hardware Development

Developers can also select third-party chipsets such as the ARM CorteM, CortexA etc. To expanded design needs, LiteOS runs on a variety of smart hardware boards being used by community developers to create IoT-enabled applications.

- Extends Software Development

LiteOS provides a complete software stack that includes a kernel, middleware components, and open Application Programming Interfaces (APIs). The OS platform is application-independent and achieves low power consumption using Huawei's unique kernel scheduling technology, network protocol stack, and route optimization technology.

Heterogeneous network protocols interoperate with each other, thus allowing developers to utilize any of protocols they may need. Centralized application control, uniform profiles, and interoperation plug-ins are all advantages for enabling services among Huawei-native and third-party devices. For End-to-End (E2E) security, LiteOS provides a security mechanism integrated with the chipset at different levels such as the kernel, transmission, API access, and application loading. In addition, RESTful APIs have been selected to make the work of developers dramatically easier.



By 2025, Huawei predicts 100 billion global connections

The middleware supports cross-OS deployment used in other devices like smart routers and Set-top Boxes (STBs) running Android/Linux OS. Seamless interoperation with smart home devices is also assured.

- Straightforward Large-Scale Deployment

Since IoT sensors generally have no display or input services, issues such as configuration and networking for smarter homes, streetlights, or highway signs must be addressed during hardware deployment. LiteOS resolves these issues with an easy configuration module that permits users to connect to the network via a physical button or smartphone application. Moreover, automatic discovery, connection, and adhoc networking modules enable Agile IoT OS-equipped devices to automatically discover each other and establish a mesh network after power on.

Agile IoT Builds a Better-Connected World

With connectivity as a driving global force, the Huawei Agile IoT solution offers many advantages for users to build an open-source IoT ecosystem. Together, the Agile IoT portfolio opens up developer opportunities areas impacting our lifestyles in exciting and unforeseen ways. Huawei's vision for having agile infrastructures is to provide the easiest way to deploy solutions for crucial issues in the consumer and industrial interconnection and security markets. ▲

Huawei's vision for having agile infrastructures is to provide the easiest way to deploy solutions for crucial issues in the consumer and industrial interconnection and security markets. >>

Ian Webster
Ian Webster has worked in financial services for fifteen years, and is now responsible for corporate strategy and transformation growth for Accenture's Financial Services Department.

Internet of Things (IoT) creates unprecedented opportunities for financial services companies to deliver tailored products, and services based on real-time information. >>

Accenture Foresees BoT as Future Megatrend

| By *Ian Webster, General Manager, Accenture Financial Services*

For banks, the current information revolution known as the Internet of Things (IoT) offers an unprecedented level of data and data-driven customer services. What opportunities can this revolution bring to the financial services industry? The first obvious impact is that banks will be able to offer their business and individual customers a truly tailored experience, with advice and services that closely correlate with day-to-day events in each of their lives. Fully unleashed, the potential of IoT for banks is expected to evolve into something completely new and exciting — what we call Bank of Things (BoT).

Let's look at two scenarios to get a glimpse of the kind of innovative services BoT will bring.

Virtual and Physical Worlds Meet…

- Scenario 1

Tokyo, 2019 — Yumi Sato's car flashes a dashboard alert while she is on her way home: A major engine repair is necessary. While calculating how to pay for a large, unexpected expense, an alert from her bank pops up on the screen of her mobile phone: her car maintenance system had also reported her vehicle status to the bank, and the bank is providing two mechanics' quotes and available appointment times. And, as if reading her mind, the bank also provides Yumi with the suggestion that she finance the repair by reducing her vacation savings for six months. When the job is complete, the bank will automatically transfer funds to pay the selected mechanic.

- Scenario 2

New South Wales, Australia, 2021 — John Martin's family farm has been growing wheat for over one hundred years. These days, micro sensors monitor the farm's daily operations, including soil and crop conditions, fertilizer levels, livestock health, and use of farm equipment. John's bank uses this wealth of data from the farm to assess property value, asset depreciation, and potential yield value to continually adjust the loan financing available to him. Using the best possible advice from the bank, John uses the tabulated results to manage his farm more efficiently, and additionally, over the past several years, the bank has found multiple opportunities to leverage the value of John's land and production capacity to improve the farm's financial position.

Brand-New Customer Experiences

BoT will become a trusted advisor, facilitator, and value aggregator for its customers. Having entered the "Customer 3.0" age, banking customers are more technology-savvy and have high expectations for their service experience. Powered by a vast flow of data, BoT will anticipate customer needs, respond to changing circumstances, and offer timely, targeted solutions.

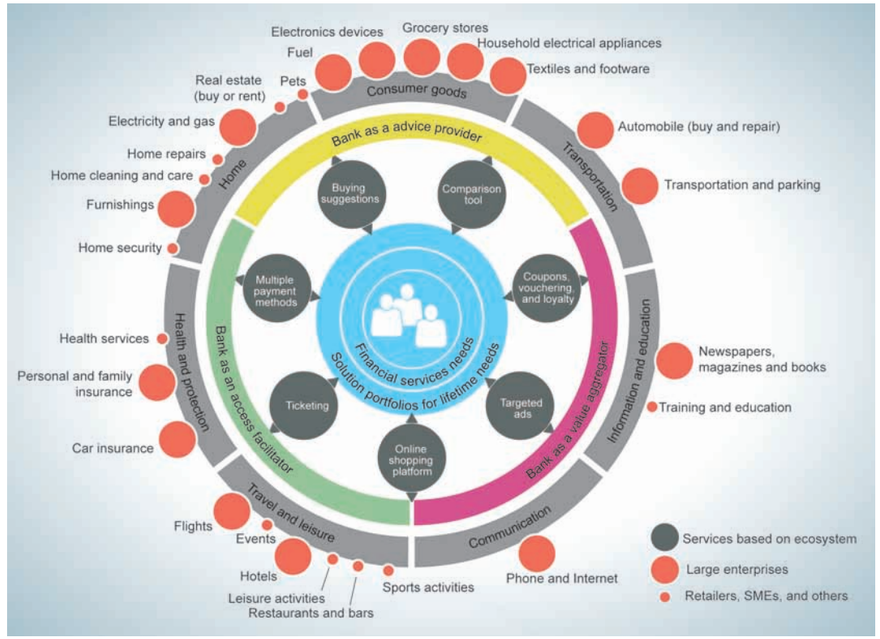
- Personal Banking

By accessing the data captured by smart devices of all kinds, BoT will provide customers with a holistic, real-time updated view of their personal finances. These data-driven insights will offer tailored products and solutions for each customer. In this way, BoT is expected to become an ever-watchful, always useful facilitator for building customer loyalty and increasing the likelihood of additional business.

US-based auto insurers Progressive and Travelers have taken the lead in using telematics devices to monitor customers' actual driving behaviors and adjusting their premiums accordingly. In the future, we may well see home insurance coverage and premiums regularly adjusted based on data streams from household appliances and smart devices. Although only a minor step towards BoT, this example forecasts the huge potential of BoT.

- Business Banking

By analyzing data across the entire value chain from suppliers to distributors and retailers, BoT will invariably deliver deeper customer insights than are possible or routine today. Banks will be uniquely equipped to provide data-driven insights for customizing the products and services that allow their business customers to keep their competitive edge in a highly connected, hyper-competitive market.



Expansion of the Banking Ecosystem

Data analytics will allow BoT to optimize commercial pricing models by combining customer demographic and market segment data with the bank's own data set of regional market differences and demand fluctuations.

- Agricultural Banking

Real-time data transmission will enable farmers and their banks to continuously and precisely assess external factors such as weather and commodities futures for the purpose of forecasting crop and livestock health, and to more exactly predict yields, changes in property value, and the overall condition of their businesses.

Farmers and their banks will not need to rely only on past performance to guide to financing and payment schedules. Based on the data, BoT can calculate flexible, proportionate payments based on current conditions — even for unforeseen events such as natural disasters. The result is a better financial position for farmers and a stronger relationship with their banks.

Preparing for the Future

IoT-related technology and services revenue is estimated to grow from US$4.8 trillion in 2012 to US$8.9 trillion by 2020, and today's banks need to get started immediately in order to fully leverage BoT advancement.

Banks must take on the following three responsibilities:

- **Advice provider:** Banks must deliver personalized advice that matches customer's financial and non-financial needs.
- **Value aggregator:** Banks must provide exclusively priced offers that appeal to value-seeking customers.
- **Access facilitator:** Banks must connect with other service providers by delivering targeted offerings that support customer needs and lifestyles.

Simultaneously, banks need to focus on three areas for building a business ecosystem that supports these new models:

- **Right partnerships:** Banks need to collaborate with ecosystem partners to integrate products and services with all areas of their customers' lives. Partners may include other financial services institutions, mobile payment innovators, utility companies, telecom companies, retailers, or technology firms.
- **Collective data analytics:** Customer insights drawn from data analytics provide strong support for banks' strategic business decisions. BoT, however, can only deliver a truly complete, integrated customer experience by aggregating data with all ecosystem partners.
- **High connectivity:** Creating a seamless user experience across multiple channels is essential for the success of BoT. BoT is unique in the promise of integrating new external distribution channels and developing an interconnected network that reaches beyond the traditional channels we see today. ▲

Today's banks need to get started immediately in order to fully leverage BoT advancement. Banks must take on three responsibilities: advice provider, value aggregator, and access facilitator. >>

Wu Di
An independent economist, Mr. Wu has published in Chinese and foreign financial media, and has served as an Assistant Professor with the University of Chinese Academy of Sciences.

The conditions are ripe for unleashing the full potential of the Internet of Things (IoT) and Internet of People (IoP). Computer intelligence, combined with far-reaching connectivity, are improving the way factories work, farmers bring crops to market, and cities provide services to individual people. >>

Smarter Connectivity Brightens Our World

| By *Wu Di, Economist, Tsinghua University Beijing, China*

The conditions are ripe for unleashing the full potential of the Internet of Things (IoT) and Internet of People (IoP). A "smart planet" is emerging as the result of sensors embedded in everyday objects that transparently connect consumers via cloud technologies. Computer intelligence, combined with far-reaching connectivity, are improving the way factories work, farmers bring crops to market, and cities provide services to individual people. Each person becomes transparently immersed in always-connected support across industries and in homes, vehicles, and entertainment.

Innovative business models are creating tremendous opportunities for applications and services that use Big Data analytics to closely connect large volumes of sensor data that can be filtered by person, business, or geographical area. The European Union has made the IoT a priority in its Digital Agenda for Europe, funding IoT-related projects and developing standards for adoption among the first-to-market leaders.

It is in this environment that Huawei chose to acquire Neul, the UK-based IoT radio module developer in September, 2014.

Mobile World Congress

In March 2015, a variety of IoT advances were announced at the annual Mobile World Congress (MWC) in Barcelona, Spain. Keynotes and other presentations highlighted early-adopters and industry movers in telemedicine, automobiles, transportation fleet tracking, smart meters, smart grids, and sensors in running shoes and watches. Huawei's CarFi features a unique 4G LTE mobile hotspot for car passengers to connect while on the road.

Showcase examples of IoT from around the globe using Huawei solutions included Intelligent Cloud solutions for Hong Kong-based telecom operator Pacific Century Cyberworks (PCCW), Vodafone, and Telecom Italia. Mobile Internet Apps become enabled with Huawei's Digital Journey Solution. In Australia, Optus delivered a significant reduction in the cost of energy for University of Melbourne using a Huawei M2M platform equipped with IoT smart sensors combined with the Smart Building Intelligent Management System.

Invisible IoP Connectivity

ITC Limited, a multi-business conglomerate based in Kolkata, India, originally established as the Imperial Tobacco Company in 1910, faced great challenges with its agricultural export and food processing services. In 2000, low-quality agricultural products were not meeting export standards, and a low food processing capacity was failing to keep up with ITC's rapid growth. The problems stemmed from a combination of widely scattered and inefficient agricultural production, and a lack of transparency for the farmers through the intermediate distribution channels. The traditional solution to such problems was to consolidate many small plots of land into bigger, more efficient farms via acquisition or lease to achieve the necessary scale — at the expense of disenfranchising the small farmers.

Instead, ITC deployed e-Choupal, an Internet-based Agricultural Information Center that helps farmers discover and master efficient agricultural technologies, which served to strengthen their role in the value chain. This advance provides farmers with a variety of agriculture-related services, including weather prediction, price negotiation, supply and demand monitoring, planting methods, online expert consulting, and eCommerce.

At the core an IoP project, local farmers with strong leadership abilities are selected by ITC to train as coordinators, or "sanchalaks," to manage the e-Choupal and organize learning activities for other farmers. Not employees of ITC, the sanchalaks incur operating costs but, in return, earn a service fee for the eCommerce transactions completed through the e-Choupal. Each sanchalak, in turn, shares the benefits with other farmers. The result is a stronger, intermediary distribution channel that helps ITC reduce procurement costs by twenty-five to thirty percent and to build a reliable supply chain able support their rapid business growth.

With support from Huawei to leverage IoT features such as Big Data and cloud computing, the e-Choupal has provided training services for fifteen million farmers by helping them improve efficiency and competitiveness while eradicating poverty.

A Bright, Globally-Connected Future

The ITC example shows how our ICT-enabled world is enlightened by maximizing the value chain that is transforming enterprise products and services in both visible and invisible ways. The full integration of connected technologies — such as IoT and IoP — with people-centric business models provide a wealth of creative resources for enterprises large and small to stay competitive in a fast-evolving marketplace. ▲

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Li Xianyin

Huawei's answer to incorporating the Internet of Things into the global manufacturing industry is Agile IoT. >>

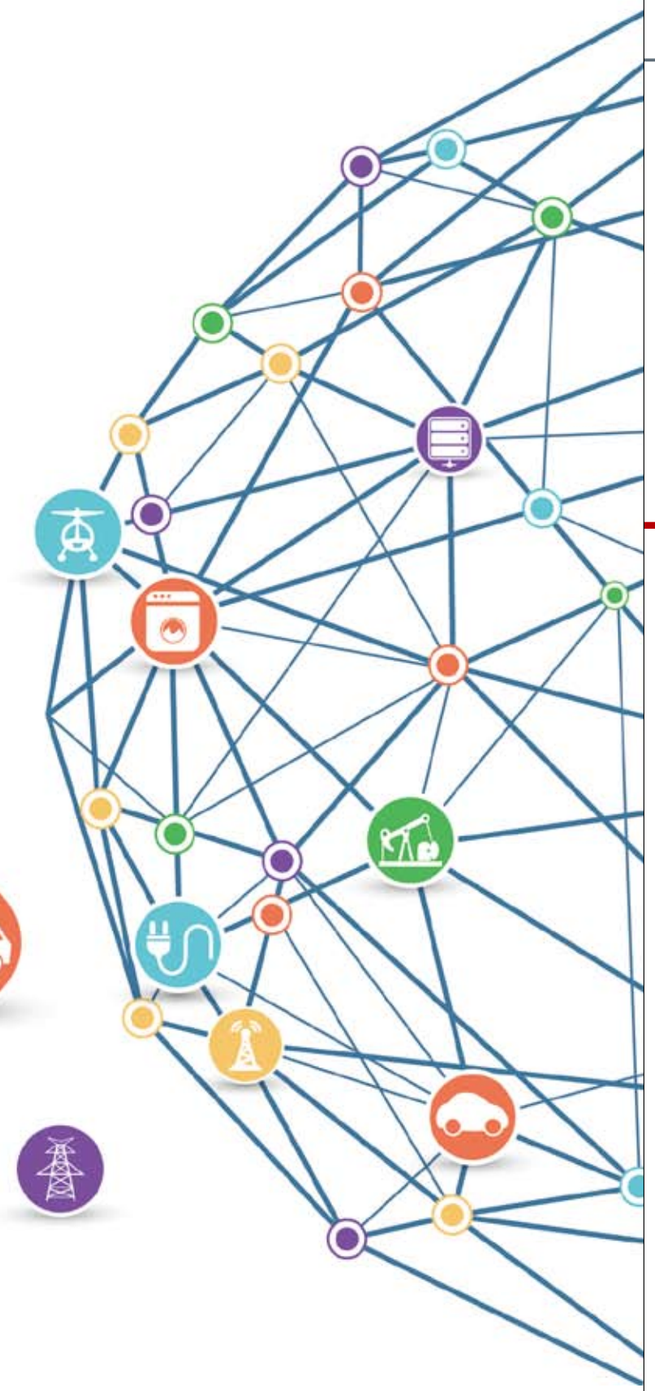
Agile IoT
Transforming Production and Service

| By *Li Xianyin, Enterprise Gateway General Manager, Huawei Switch & Enterprise Communications Product Line*

Over the past three centuries, three industrial revolutions have transformed business and society based first on mechanization, then electricity and assembly-line production, and most recently, Information Technology, or IT.

A fourth industrial revolution is approaching that will be characterized by digitization and networked production combined with self-organizing machinery.

Built on a combination of the Internet of Things (IoT) and Cyber-Physical Systems (CPS), a key enabler — the Central Nervous System (CNS) — for "Agile IoT" will be Information and Communications Technology (ICT).



Much like the Internet in the past, IoT is evolving as the new value creator for industry that will inevitably accelerate today's hyper-competitive global market and produce trillions of dollars in global output. Agile IoT, powered by ICT, will become a key enabler for industrial innovation and transforming manufacturing. >>

IoT Market Opportunities

Developed economies such as the United States, European Union, Japan, and South Korea have all announced national IoT initiatives. For example, as part of their national strategies, IBM has proposed the "Smarter Planet", General Electric the "Industrial Internet", and Germany "Industry 4.0".

China has introduced its own strategies, such as "China Manufacturing 2025" and "Internet Plus". These plans also encourage the foundational use of IoT for re-inventing traditional industries.

Much like the Internet in the past, IoT is evolving as the new value creator for industry that will inevitably accelerate today's hyper-competitive global market and produce trillions of dollars in global output.

As traditional industries embrace IoT as a way to accelerate innovation, IoT is finding wide application in market sectors such as energy, construction, and manufacturing.

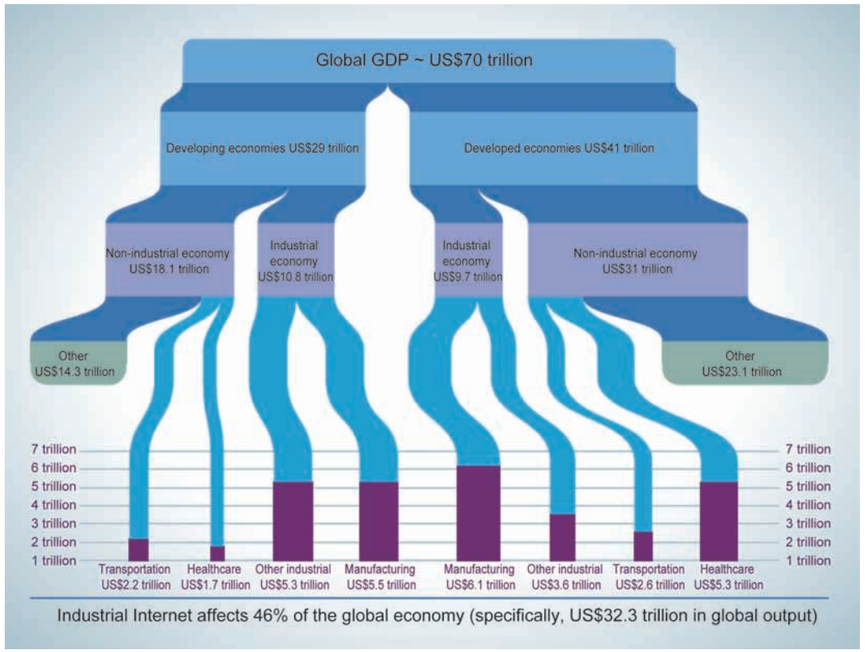
Energy Industry: Smart Grid

A Smart Grid is a modernized electrical power grid that has been integrated with advanced sensors, metering, network communications, and computer control technologies within an infrastructure of generation plants, transmission towers, transformer components, and premises distribution.

Smart Grids provide continuous, fault tolerant supplies of electricity under the command of an optimized, demand-based, resource allocation controller that assures product reliability, physical security, and environmental compliance.

Sensor-rich substations, distribution networks, and meters are embedded in a fabric of ICT gateways, servers, and storage solutions that support the addition of important value-added services.

Special Report



Potential GDP Share of the Industrial Internet (Source: GE's research on Industrial Internet)

Smart Grids provide continuous, fault tolerant supplies of electricity under the command of an optimized, demand-based, resource allocation controller that assures product reliability, physical security, and environmental compliance. >>

The architecture for the Advanced Metering Infrastructure (AMI) makes possible power consumption automation based on real-time, two-way communication between all active components from generation to premises. The energy management platform, an IoT data center, enables the network of AMI smart devices to combine the high-quality, baseline data with the live stream in order to conduct the type of Big Data processes that track demand fluctuations dynamically, find weak spots in the physical plant long before they become critical, and monitoring for loss prevention.

Real Estate: Managing Energy Efficiency

Low-carbon, eco-friendliness, and energy conservation are dominant themes in building construction today. Green buildings maximize energy conservation, reduce emissions, and provide healthy, comfortable living conditions.

Buildings use a significant proportion of total energy consumed, and managing their efficiency is a top priority for governments and industry around the world. In 2013, China's State Council predicted that green buildings would grow to more than one billion square meters in floor area by 2015, with 20 percent of new buildings in urban areas built with green technologies.

Old school management systems relied on manual switches and walk-by metering. More recently have come motion sensor lighting, and automated heating and air conditioning. Often missing are the purpose-built data analysis systems for improving Operations and Maintenance (O&M) efficiency.

The current era of intelligent and self-adaptive controls, remote metering and data collection technologies, centralized analysis, and unified management have provided a dramatic positive to lowering operating costs and improving customer satisfaction.

Huawei's Building Energy-Efficiency Management System (BEMS) Solution uses IoT technologies to centrally manage, monitor, and control all in-building systems, including power distribution, lighting, air conditioning, and heating. To optimize energy conservation, building owners apply the results of energy consumption data captured from all monitored systems using Big Data platforms and methods.

The Huawei solution supports flexible energy control policies that intelligently adapt to ambient changes and automate energy conservation. For example, air conditioning can be automatically powered on or off in response to changing light.

In an on-campus pilot, Huawei saved 455,000 kWh of electricity a year in a four-story office building with a total floor area of 5,000 square meters: 125,000 kWh in lighting, 250,000 kWh in air conditioning, and 80,000 kWh from other sources for an annual savings equivalent of 165 tons of coal, 436 tons of CO^2, and 29 tons of SO^2 and other greenhouse gas emissions. If installed across China — enterprise and commercial campuses, and school buildings — the solution could save upwards of ten billion kWh of electricity each year, conserving millions of tons of coal and dramatically reducing PM 2.5 particulates in the atmosphere.

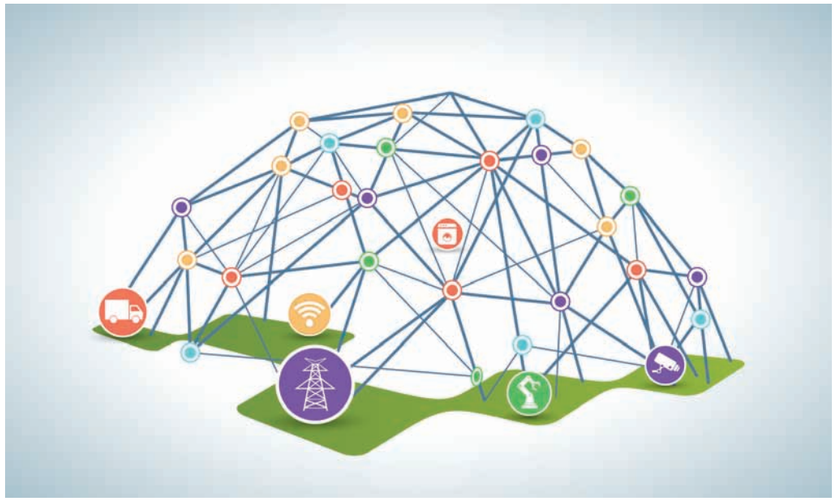
Data captured during the trial is being used for future energy conservation and emission reduction projects as a reference for helping customers with their investment choices for energy conservation measures.

21st Century Smart Manufacturing

The Economy and Information Department in China's Zhejiang Province recently encouraged enterprises to implement Internet of Machines (IoM) initiatives. It suggested the following IoM devices be incorporated into the network: Computer Numerical Control (CNC) machine tools, industry-specific devices, large machinery, and in-plant auxiliary devices.

Networked CNC machine tools are essential in the automobile, steel, building materials, machinery, and electronics industries. A CNC machine-tool network links all necessary equipment, including hydraulic machinery and cranes, for the centralized management of all procedures, and promotes the use of agile manufacturing models.

With Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), and IoT-capable platforms in place, enterprises will become paperless digital factories, with end-to-end design, fabrication, and production processes. Industry-specific platforms will include networked support for textile, clothing, plastics, chemicals, building



Low-carbon, eco-friendliness, and energy conservation are dominant themes in building construction today. Huawei's Building Energy-Efficiency Management System (BEMS) Solution uses IoT technologies to centrally manage, monitor, and control all in-building systems. >>

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Most IoT applications today remain siloed in specific industries or inside individual enterprises. To promote IoT within the enterprise, industries must focus on three aspects of IoT networks: device compatibility, service deployment, and collaboration. >>

materials, shipping, automobile, and photoelectric industries.

Key goals for IoM manufacturing platforms include:

- Automated production lines and deployment of industrial robots.
- Strong online monitoring of energy consumption, pollutant discharge, and security vulnerabilities.
- Use of energy-efficient technologies, such as frequency conversion, as needed.
- Promotion of energy conservation, emission reduction, and management efficiency.
- Establish central control for enhanced, real-time equipment monitoring.
- Data integration with the upper-layer Enterprise Resource Planning (ERP) and Supply Chain Management (SCM) systems.

IoT and Open Co-operation

Most IoT applications today remain siloed in specific industries or inside individual enterprises. These applications have proprietary protocols, standards, and platforms that are incompatible with, and isolated from each other, making information difficult to share, collect, or analyze. To promote IoT within the enterprise, industries must focus on three aspects of IoT networks: device compatibility, service deployment, and collaboration.

- **Multiple protocols:** Currently, sensors and terminals from multiple vendors co-exist on IoT networks. Because these endpoints use different communication interfaces and protocols, connecting them to IoT networks remains challenging. To facilitate device access in complicated and diverse network situations, IoT suggests open, embedded communications modules or gateway devices that support multiple communications interfaces and protocols.
- **Open networks bring new capabilities:** Deploying IoT requires new services and applications; however, traditional network devices generally have fixed services and limited functionality. Long development cycles and difficult service adaptation with traditional devices complicates new IoT deployments. A network controller platform presents a viable solution by easily responding to new service rollouts, on-demand service deployments, and flexible application releases, as needed.
- **A win-win collaboration for the industry chain:** Stakeholders in the IoT industry chain include terminal chip manufacturers, sensor vendors, gateway equipment providers, network operators, service integrators, service providers, and end customers. These individual stakeholders cannot compete aggressively in global markets without extensive collaboration.

To advance the standardization and development across the IoT industry chain, IoT alliances, open software architectures, and open-source communities are helping to promote partnerships, stakeholder collaborations, and cross-vendor and cross-industry applications.

Agile IoT is a Win-Win Solution

IoT application silos are contrary to IoT value creation. An open, shared IoT ecosystem must be created that encourages development across the entire IoT industry chain.

As a committed contributor to the IoT supply chain, the Huawei Agile IoT Solution creates an open, shared, flexible IoT platform that consists of software and hardware gateways that are accessible to customers and partners.

The software is built on OpenDayLight (ODL), an open source Linux platform that encapsulates the differences between underlying sensors. Additional highlights of ODL are its flexibility to work in multiple application scenarios, support for fast evolution of service and business models, and the ability to manage millions of devices.

The hardware gateway supports multiple types of IoT interfaces — 10, as of now — and is compatible with reconciling the protocols necessary to allow diverse sensors to quickly and reliably connect to an IoT network. The integration Information Technology (IT) with Communications Technology (CT), provisions the hardware gateway to support routing, switching, security, voice, local computing, and storage control on a single platform, including the ability for the sensors to implement local survival functions.

The hardware platform also supports software-defined IoT deployments for quick responses to service changes and evolutions.

Success cases include, Huawei and ChinaSoft International partnering to build an upper-layer application system, and Huawei and Wuhan Fenjin Electric Power Technology Co., Ltd. collaborating on networking smart robots and IoT terminals. Huawei also helped a large tobacco company in China deploy Industry 4.0 applications as part of an effort to reinvent the company's core production and execution systems.

Combining components from both Huawei and its partners, in Huawei's private trial, BEMS provided valuable data for managing energy efficiency on a large enterprise campus. At the University of Melbourne in Australia, energy costs were reduced by 30% when using the BEMS solution.

As a company that is dedicated to enriching life through a better connected world, Huawei understands that IoT is paving the way for that reality. Higher levels of intelligence, lower energy consumption, and widespread connectivity are key enablers of this approach. And as the cost of sensors, cameras, chips, and radio transceivers continues to drop, the qualities of automated efficiency, integrated ERP and SCM, and the collection of feedback will continue to improve communication between people, people and things, and things themselves that creates increasing value for end-users and enterprises far and wide. ▲

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Swift Liu

Next-Generation Networks: Feel What You Feel

| By *Swift Liu, President, Huawei Switch & Enterprise Communications Product Line*

A new perspective, focused on the creation of agile networks, is positioned to provide positive outcomes for enterprises through dynamic monitoring of IP network quality. >>

Data creation and consumption have exploded, with as much as 90 percent of the world's data having been created in the last two years (from *Science Daily*, May 22, 2013). Data-driven trends such as mobile, cloud, social media, Big Data, and the Internet of Things are making the requirements for real-time service transmission, network mobility, and scalability much more complex for enterprises. A new perspective, focused on the creation of agile networks, is positioned to provide positive outcomes for enterprises through dynamic monitoring of IP network quality.

Multiple-Service Platforms Offer New Challenges

Multiple-service platforms are a challenge to networks in terms of capacity because individual services, such as voice or HD video, require different things of the network at the same time. Without proper network management, user experiences can be greatly diminished due to unpredictable, bursty traffic. With the increase of real-time services, and the network congestion that is generated, enterprises are finding it more and more difficult to provide the seamless experience users expect.

An example of a common capacity-related issue is pixelation during video conferences. In general, enterprises must put up with this issue because it is impossible for traditional Internet Protocol (IP) networks to isolate whether the problems are occurring with the videoconferencing system or at the network level.

Experience Awareness is a "Must-Have" for Next-Generation Networks

IP lacks the capability of network-quality awareness since it is a connectionless protocol. In practice, fault location has long been a major problem for every telecommunications carrier that has adopted an IP infrastructure. The wide use of IP continues because of the reliability its intelligent end nodes. For example, when Class 4 hurricanes hit the East Coast of the United States in 2008 — with mobile and landline telephones unavailable — the only functioning communication channel was email.

iPCA for Network Quality Awareness

The iPCA (Internet Packet Conservation Algorithm) is a network quality awareness mechanism. In an unrealistically simple example, suppose devices A and B are directly connected and device C is added as a tester. To detect packet loss, tester C can send and receive 10,000 packets after passing through interfaces A1, A2, B1, and B2 in sequence. If only 9,999 packets are retrieved and the counters show interfaces A1 and A2 receiving 10,000 packets while B1 has only received 9,999 packets, we can confirm that one packet has been lost on the link between interface A1 and B1.

In the real-world, this scenario does not work because of the sheer number of packets being sent every second. A 10G (10 gigabit) interface, for example, sends millions of packets each second, and packet loss at that rate can be detected only if we are reading the counter values simultaneously. Even when deploying the highly precise IEEE 1588v2 protocol, absolute time synchronization between network devices is currently impossible.

iPCA solves the problem by leveraging a reserved bit of the IP packet — by sending packets at a certain time interval labeled "0" and at another time interval as "1," packet loss detection is achieved by counting the reserved bits across those intervals. The iPCA method allows that the time difference between packets not only has little influence on the resulting count but also, in fact, actually increases accuracy. Now, even the simplest Network Time Protocol (NTP) is able to realize time synchronization between devices.

iPCA is Beneficial in Many Ways

- Wide Area Network (WAN) Quality Monitoring

Today, most enterprises lease dedicated lines from ISPs to interconnect their WANs. Never merely a single strand of fiber, a dedicated line could be an L2 or L3 Virtual Private Network (VPN) circuit passing through many routers and switches through a network of ISPs. And, even though transmission through dedicated lines is known to generate numerous packet losses, there is limited impact on user experience because of the retransmission mechanisms of the Transmission Control Protocol (TCP) and the application layer prevents service interruptions. Nonetheless, service quality can still be noticeably compromised. The issue is covered by deploying iPCA on the ingress and egress of dedicated lines to record all packet losses.

- Quality Control of HD Video Conferencing

The deployment of iPCA helps enterprises precisely locate and record packet losses occurring over video conferencing networks. Because conference network structures can be known in advance, network administrators can detect and eliminate both existing and potential faults in time to ensure excellent quality video transmission.

- Campus Network Quality Monitoring

Packet loss is also common within campus networks due to traffic congestion. Most of the time, packet loss is negligible, again, because of the TCP and application-layer retransmission mechanism. However, when the issue does occur, customers have no choice but to endure an unstable user experience. Compared to the traditional location-based approach, iPCA can precisely identify the locations and causes of packet loss on network nodes. iPCA is a technology with great potential for network management because it is not only capable of detecting link faults, but also able to isolate faults to specific devices, cards, or even chips.

iPCA is compatible across vendors and devices because it only leverages the reserved bit of standard IP packets. The high compatibility of iPCA helps simplify network reconstruction as quality monitoring can be realized by the deployment of iPCA on key network nodes. Huawei expects iPCA to be a game-changer in the industry due to its ability to help enterprises address the challenge of network quality detection to enable more-simplified system management operations. ▲

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Pan Haotao

Expectations are high that SDN is a panacea for large enterprise campuses. >>

Agile Data Center Networks: Fact or Fiction?

| By *Pan Haotao, Data Center Network Architect, Huawei Switch & Enterprise Communications Product Line*

Software-Defined Networking (SDN) is promoted as the solution for structural operating challenges faced in non-SDN enterprise data centers today. What changes will SDN bring to the enterprise data center, and how has SDN been put into commercial use to date?

Having supported more than forty commercial SDN projects for twenty large enterprise or carrier deployments around the globe, Huawei is in an excellent position to have seen and responded to the challenges necessary to complete this important network transformation.

Challenges Faced in Enterprise Data Centers

- Ultra-Broadband Pipes

When Facebook launched its Altoona, Iowa data center in 2014, the company announced — to an industry ever hungry for more ultra-broadband capacity — that a single cluster equipped with 10-GE interfaces could support up to 100,000 servers — a capacity sufficient to transmit the contents of the British Museum data center, 30 trillion bytes of electronic books, in only one second!

The ongoing explosive growth in the markets for Big Data is sustaining the continuing push for exponential increases in data center network capacity. Until the accomplishment of this level of interface density, it was understood that three to four years were needed to build-out a network cluster from 1,000 to 100,000 servers.

To support ultra-broadband pipes, not only has the capacity of single networks been expanding, but the number of networks has been increasing as well, largely through the use of multi-stage Clos architecture.

When single devices transition from high-density 10-GE and 25-GE interfaces to 40-GE and 100-GE interfaces, they approach design limits in capacity. A single cluster in a multi-stage Clos architecture can support thousands of non-blocking networks, well beyond the capabilities of Open Shortest Path First (OSPF) point-to-multipoint networks or the Intermediate System to Intermediate System (IS-IS) data link method.

In all cases, there remains a strong need for a more refined and automated Operations and Management (O&M) process.

- Refined O&M, Lower Cost

Data Center Interconnect (DCI) solutions require process optimization to compensate for the typical high cost and low utilization rates — less than 30% — for backbone rentals that are unable to guarantee Quality of Service (QoS) for key accounts. Network, hosting, and traffic fees can add up quickly under these conditions.

Huawei's SDN Path Computation Element Plus (PCE+) technology delivers 90% bandwidth utilization by a) using an optimal path-scheduling algorithm that can be modified to meet specific service requirements, and b) a unified network topology with the intelligence to dynamically reassign best-case service paths. The result is that when network congestion does occur, the QoS for priority services is guaranteed. This technology leverages the advantages of overlay networks so customers only need to upgrade edge devices rather than modify the configurations of running routers.

China Telecom, Tencent, and 21Vianet have each deployed Huawei's Cloud Fabric SDN PCE+ Solution for commercial use.

- Greater Efficiency, Higher Profits

Time-to-market is a key metric for success in today's global marketplace.

For Spain's Telefonica, a global broadband and telecommunications service provider headquartered in Madrid, this meant a network rebuild. The inability to deliver products and services to customers at the desired speed was found wanting due to simple resource fragmentation: ninety-six data centers worldwide, independent data silos, isolated in age and capacity from all others.

To resolve these issues, Telefonica and Huawei jointly launched the UNICA infrastructure. The UNICA infrastructure uses SDN and Virtual Extensible LAN (VxLAN) overlay technologies to construct pools of virtual network resources and SDN and service chain technologies to pool the resources needed to support value-added services.

Telefonica reduced IT costs by 20% to 30% through the new ability to manage a combined SDN/unified resource pool solution. Shanghai Telecom, China National Petroleum Corporation (CNPC), and Vipshop have each also deployed Huawei's Cloud Fabric SDN Solution to improve operational efficiency.

Practice and Innovation

21Vianet, the largest carrier-neutral IT service provider in China, teamed up with Huawei to commission the world's first SDN-based, commercial DCI network in September 2014. The result is that bandwidth utilization was improved by 80%, the introduction of new services was vastly simplified; and network planning and service provisioning was shortened from eight days to less than four.

In April 2014, Huawei worked with China Telecom to provide a hybrid Cloud Fabric SDN Solution for government and enterprise markets. The solution integrated thirty-six physical data centers into a single resource pool that connects government agencies and small- to medium-sized businesses. The value-added resource pool provides services on demand, and traffic optimization technologies are used to improve link utilization on the backbone network.

Fact: Win-Win Ecosystems

Assembling a data center involves co-ordinating between an array of network, application, and system vendors whose best interests are met in a healthy, everyone-wins ecosystem.

To support such ecosystems, the Huawei Cloud Fabric SDN controller is based on the OpenDayLight (ODL) open-source platform, on which we have invoked the necessary northbound and southbound interfaces to enable full-featured, agile data center networks for plug-and-play modularity, and compatible with third-party applications and devices selected to provide optimal function sets for customers. ▲

Special Report

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Chang Yue

NaaS Transforms Enterprise Infrastructures

| By *Chang Yue, Chief Architect, Huawei Switch & Enterprise Communications Product Line*

Advances in virtualization have changed the focus of network equipment to enhanced platforms that feature software-enabled, Network-as-a-Service (NaaS) functionality. >>

Challenges Create Opportunities

Today's agile business platforms combine powerful new technologies such as cloud computing, Big Data, ubiquitous wireless connectivity, the Internet of Things (IoT), and other elements. In addition, network managers continually need to revise their defensive strategies to stay ahead of a flood of security threats. The answers to these promises and threats are new management frameworks that can handle the complicated nature of advanced enterprise networks.

Enterprise IT departments cannot continue to use legacy methods to design and implement their network infrastructures because there are too many previously unforeseen enhancements to common IT network devices such as routers, switches, firewalls, and Wi-Fi controllers. On the other hand, these new technologies are creating more business opportunities for new IT and network services.

- Changing Traffic Patterns

Data Centers (DCs) continue to grow in scale to accommodate technologies for public, private, and hybrid clouds. The dynamics of DC traffic are notably changing: East-West traffic between servers inside DCs is far exceeding the North-South traffic between DC servers and their end users. Enterprises are adopting the Leaf-Spine network topology, in which a hierarchy of switches form the access layer. This enables enterprises to build non-blocking Points of Delivery (PoDs) for non-blocking clusters — a proven method for traffic to reach its destination minus interference, delay, or packet loss.

As interface bandwidth between servers expands from 1 Gbit/s to 10 Gbit/s, the bandwidth between leaf and spine switches and between PoDs and core switches is being upgraded to 40 and 100 Gbit/s. As the bandwidth capacities of leaf, spine, and core switches are being continuously upgraded; core switches will be manufactured to support 400 Gbit/s interfaces in the near future.

- Deploying Converged of ICT Applications

The impetus for converging ICT technologies and applications comes from two sources. First, the increasing interconnection between legacy enterprise office networks, mobile Internet, and IoT means that value-added applications and services (i.e. protocol conversion, management policies, and security control) need to be deployed in devices on the borders of enterprise networks instead of within the much greater number of devices within the interior of the network — and, applications are being built by network equipment suppliers and third-party IT developers, as well as traditional sources. Second, improvements in cloud computing requires Data Center service providers to dynamically provision compute, storage, and network functions for different services and applications.

- Wireless Popularity Grows

Technologies for wireless communications are ever more popular in enterprise networks. The growth of IoT and the mobile Internet has fueled a mix of wireless technologies that includes LTE, Wi-Fi, ZigBee, Bluetooth, and sub-GHz. In this context, the co-ordination, performance, efficiency, deployment, and management of wireless networks are all equally important.

- Network Boundaries are Complicated

Many factors contribute to the increased blurring of enterprise network boundaries. First, public, private, and hybrid clouds eliminate any classical geographical constraint for deploying an application. Next, the increasing popularity of Bring Your Own Device (BYOD) and wireless access technologies enable the potential for dynamic access and mobile offices that are anywhere and everywhere. Virtualization and on-demand scheduling of resources inside DCs are needed to assure optimal utilization of IT applications.

- Defense Against Unknown Threats

Advanced Persistent Threats (APTs) exploit zero-day viruses to circumvent defense mechanisms, and render useless most traditional, feature-based threat detection methods. "Advanced" signifies attack methods based on complex social engineering, strong intelligence gathering, and improved vulnerability analysis. "Persistent" suggests the existence of an external command and control system that is orchestrating attacks with clear targets and specific agendas, including dire financial consequences to the victims.

Protecting against these damaging APTs requires enterprises to establish mission-critical security mechanisms capable of real-time analysis for the discovery of attack behaviors. Once new threats are identified, fast adjustments to network security policies are crucial to the database that is tracking threat features.

Special Report

Opportunities such as Networks-as-a-Service (NaaS) have come about due to the growing list of changing requirements: dynamic resource scheduling, flexible deployment of management policies, and applications for creating new policies. Huawei has developed a technical architecture to help enterprises address these business and technical challenges that includes adaptability, flexibility, openness, usability, and security. >>

NaaS-based Enterprise Infrastructures

Opportunities such as Networks-as-a-Service (NaaS) have come about due to the growing list of changing requirements: dynamic resource scheduling, flexible deployment of management policies, and applications for creating new policies. Complicated management and operational considerations involve capacity, performance, and costs. Baseline requirements must assure connectivity, management efficiency, and value-enabling services are "must-haves" for every enterprise network.

Huawei has developed a technical architecture to help enterprises address these business and technical challenges that includes adaptability, flexibility, openness, usability, and security.

- Adaptable

Enterprise network performance improves when it is able to increase connection capacity, support multiple wired and wireless connection protocols, and accommodate both office and manufacturing scenarios. The result is a deep and extensive integration of DCs, Wide Area Networks (WANs), campus networks, and branch networks. All the better if the solution, as does Huawei's, improves users' mobile Internet experience for the purpose of promoting the growth of IoT.

- Flexible

Huawei's R&D efforts have resulted in the development of optimized silicon chips for forwarding and calculation that can be re-programmed on-the-fly to suit evolving business needs and changes in network protocols. These capabilities deliver impressive flexibility and are easy to scale. In addition, new operating systems support the virtualization of network devices so that permissions may be granted for management and control by third parties, or run third-party functions or applications.

NaaS is not only the core of the network infrastructure architecture, but also a new source of enterprise business. Leading-edge technologies integrated into this architecture consist of: a) an SDN controller, b) virtualized operating systems for network devices, and c) software-enabled network functions that adapt to multiple operating environments. >>

- Open

Network controllers perform centralized allocation, management, and control of network resources and functions. Enterprises dynamically manage their networks in real time with status information provided to applications.

- Usable

Centralized network controllers provide user-friendly operation and provide interfaces for network resources, functions, and status. These functions are more convenient than conventional network management methods with complicated command-line inputs.

- Secure

Built-in security utilities are able to sense and detect network threats in real time, enabling dynamic adjustments to network security configurations and immediate updates to threat detection databases. The results are more secure network operations.

Three Key Components

NaaS is not only the core of the network infrastructure architecture, but also a new source of enterprise business. Leading-edge technologies integrated into this architecture consist of: a) an SDN controller, b) virtualized operating systems for network devices, and c) software-enabled network functions that adapt to multiple operating environments.

- SDN Controller

SDN uses separate control plane processers to define and capture network service pools that consist of a switch fabric and a management controller. RESTful Machine-to-Machine (M2M) interfaces enable the pool to be managed by network-based IT service systems. Legacy network management methods are device-centric and inflexible, and offer no such resource pool aggregation, as they depend on manual and static configuration for hundreds and sometimes thousands of machines.

SDN ushers in a new industrial ecosystem with an open-source network infrastructure as the mainstream model. OpenDayLight (ODL) and Open Network Operating System (ONOS) are two of the most influential open-source network operating systems.

Huawei's ODL-based controller platform improves the management of network infrastructures by providing a comprehensive network service capability that has been designed to help solve the everyday challenges faced by enterprises.

- OS for Virtual Network Devices

SDN requires centralized management to handle complex and diverse network functions. In addition, gateways on the borders of the mobile Internet, IoT, enterprise branches, and DCs require powerful centralized management, network functions, and virtualized and dynamic deployment of applications. A key factor for the IT-enabled management of network devices is software and device resource virtualization. To balance performance and openness, network devices have developed to require and support multiple virtualization technologies such as Linux Container (LXC), Kernel-based Virtual Machine (KVM), and Virtual Machine (VM) operating systems.

- Adaptive Network Functions

Other factors are driving the development of software-enabled network functions and deployment of functions based on virtual environments. First, dedicated network devices that rely on virtualization, especially gateways, must be capable of dynamic loading and deployment of multiple functions. Second, DCs require virtualized computing environments for network functions to enable flexibility when dynamically generating logic networks for tenants. Software enablement of key functions is also necessary for implementing firewalls, Intrusion Prevention Systems (IPSs), Intrusion Detection Systems (IDSs), WLAN-over-CATV (WoC), and load balancing.

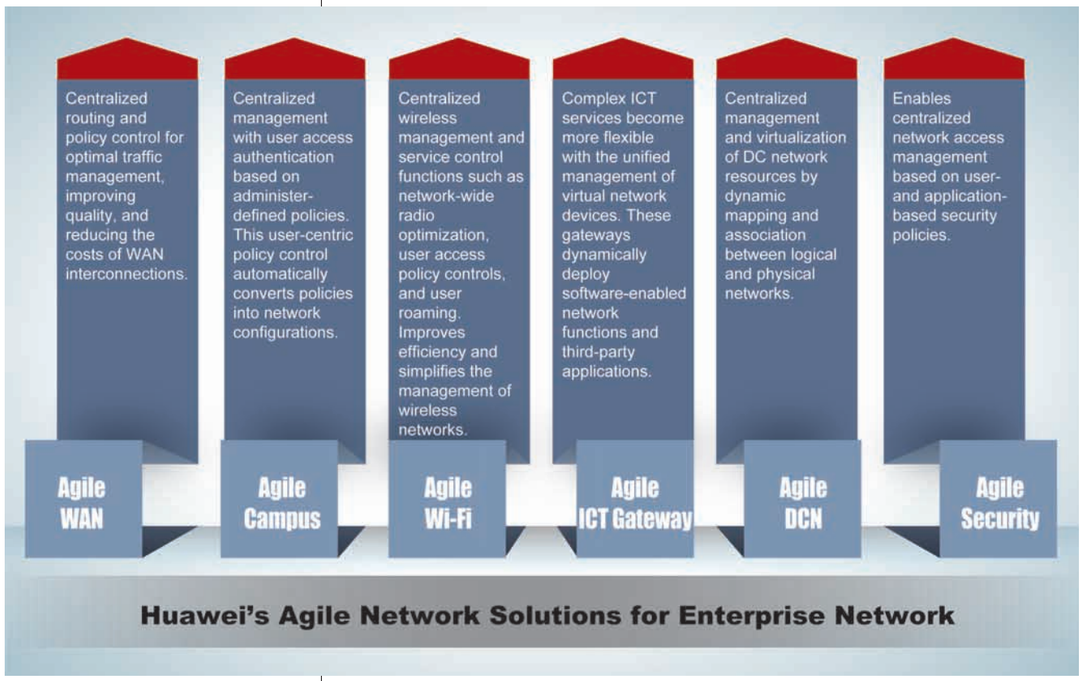
Business Models and Ecosystems

As network infrastructures are updated to support SDN controllers, virtualized network devices, and software-enabled network functions, enterprises can expect a paradigm shift in many aspects of their business operations.

Traditional business models have been based on the fact that network devices provide all required network functions, and therefore, network deployments are centered on the installation and configuration of network devices according to the physical network plans. In this model, network devices are categorized by sets of functions. In the SDN model, network devices are virtualized in a logical network for the express purpose of dynamically reprogramming device functionality to deliver custom services for specified periods of time and/or to meet fluctuating demand.

Considering these dynamics, we expect that enterprises will make some rather large shifts in their network infrastructures with the goal of deploying enhanced business innovation platforms and optimizing the overhead cost for Operations and Maintenance (O&M).

The result of all these changes is a model for all open networks and NaaS platforms that will create new revenues. For the vendors themselves, Huawei included, the growth of the networking industry will require a completely open market in which companies must fully collaborate with each other across the spectrum of network devices, functions, controllers, and services. Industry practices have already proven that an open source industry chain is a safe, and arguably the best, choice. Huawei expects that ODL open-source controllers and network devices that run Linux open-source operating systems will gain strength as an industry trend. The open ODL ecosystem establishes the groundwork for a future of full connectivity with smart IoT technologies, increased mobility, and converged communications.▲



Huawei's Agile Network Solutions for Enterprise Network

Special Report

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Xue Wu

Innovative technologies optimize the enterprise value chain to facilitate communication, interaction, and collaboration. >>

Driving Enterprise Communication

| By *Xue Wu, Senior Marketing Manager, Huawei Switch & Enterprise Communications Product Line*

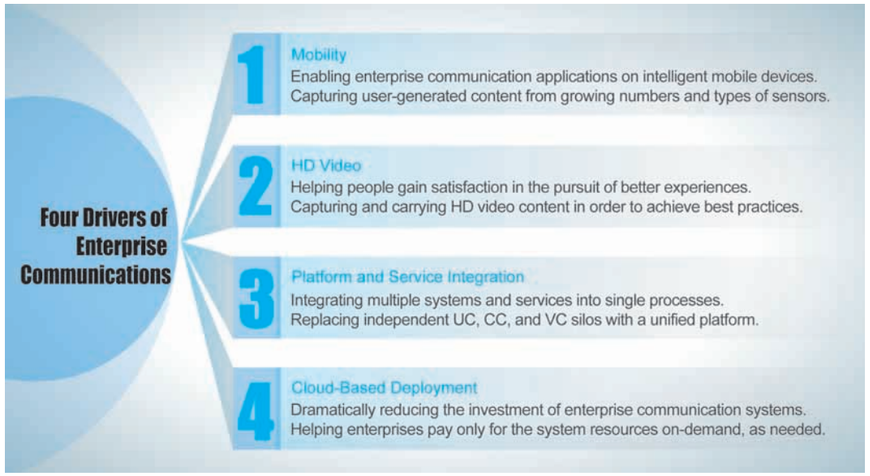
ICT convergence is accelerating the transformation of Communications Technology (CT) to Information Technology (IT). That is, CT products are becoming just another executable running on general-purpose computers. This transformation simplifies the commission and management of CT systems, as well as facilitating platform and service integration for Unified Communications (UC), Contact Center (CC), Video Conferencing (VC), and other collaboration applications.

In this user-centric era, data center operators must configure and dispatch custom resources to meet unique user requirements — and at their disposal are the necessary mobility, video, and cloud integration tools of the day to deliver maximum efficiency across the value-chain.

Mobility

Users enjoy intelligent mobile devices because of their high performance and high-speed Internet access. As a result, a Bring Your Own Device (BYOD) business culture has emerged as an indispensable part of every enterprise office. In the past, VC, collaboration, information-sharing, and service-processing applications relied on PCs and other dedicated hardware devices. Today, each of these applications are conveniently available on intelligent mobile devices, and enterprise employees routinely use their personal devices to hold multi-party voice, video, and data conferences and view remote desktops on behalf of their employers.

Mobile device vendors continue to improve the performance and functional range of their devices, year after year, model after model. Modern cell phone features are growing ever more impressive in their ability to capture user-generated content, from high quality cameras, GPS tracking, fingerprint scanners, and growing numbers and types of sensors. The enormous valuations achieved in collecting the user data of mass audiences from the likes of Google, Facebook, Tencent, and Alibaba provide a clear incentive to financial service providers to also focus on extending the range and scope of their products to leverage the unique characteristics of intelligent mobile devices.



HD Video

Advances in video compression technology are an important factor in the satisfaction people gain in the pursuit of better experiences. The accomplishment of the newest H.265 video compression standard is the comparative reduction of transportation bandwidth by up to 50 percent, with improved quality.

For instance, it is now common for video conferences to be conducted as 1080p HD streams. There are benefits to capturing and carrying HD content, but sometimes at the cost of following best practices in order to achieve the intended result. Examples from the healthcare industry include the necessity for doctors doing remote consultations to observe their patients with precision and accuracy and, for medical teaching sessions, the technology to present of every miniscule detail in high fidelity. For medicine, HD video (2K x 1K) is insufficient, and only Ultra-HD (4K x 2K) is able to match this criteria for remote diagnostics. Larger screens in conference rooms and offices are important for displaying the 4× greater detail.

Increasingly, VC experiences are able to capture the social dynamics of user interaction with tracking cameras, and the ability to automatically shift focus to the live speaker. The future of video is expected to include 3D-holographic projection and 3D video technologies for delivering face-to-face communication.

Platform and Service Integration

Enterprises will often purchase and deploy their UC, CC, and VC systems as separate projects. The easier way is to do them all together, at once, which reduces both duplicated resources and the higher Total Cost of Ownership (TCO) if done one-by-one. Additionally, the systems will be harder to integrate, which will further hinder service innovation and decrease efficiency.

ICT convergence assumes the capability to integrate multiple systems and services into single processes. The independent UC, CC, and VC silos can be replaced by a unified platform that integrates session control, media gateways, terminal and management devices, and services. With a unified hardware platform, enterprises are able to acquire all services and updates through the purchase of the necessary software licenses. Unified platforms lower costs substantially because they feature a simple, modular construction that is easy to scale and keeps maintenance expenses low.

Huawei is committed to meeting customer requirements and utilizing multiple new technologies to launch holistic enterprise communication solutions based on core products, such as UC, CC, and VC, that feature mobility, video, and cloud collaboration. With these best-in-class solutions, Huawei continues to deliver a high-quality communication experience to enterprises. >>

A unified family of hardware modules also simplifies service integration. UC, CC, and VC multimedia terminal services support the ability for users to join a video conference with just one click. Furthermore, VC supports UC, while CC offers omnimedia and omnichannel services. The total effect is a consistent experience across applications on the same screen, as well as across terminals and screens. The integration of UC and CC services makes every staff member an expert facilitator, able to find specialists on demand, when necessary. As internal and external service processes become streamlined, each level of proficiency is an opportunity to improve the outcome for each customer. The UC client presents one-click access to the Help Desk, as well as ability to launch desktop sharing.

The provisioning of a unified UC, CC, and VC system results in an integrated terminal network that includes PCs, mobile phones, tablets, IP phones, video phones, telepresence endpoints, and VC HD endpoints. In short, convergent conferencing achieves a complete, multi-terminal integration of media devices.

Cloud-Based Deployment

A communication system built on dedicated devices is associated with high construction costs, as well as a heavier management and maintenance requirement. Converged ICT systems, with the advantage of replacing dedicated hardware with an IT-based software system, are increasingly the norm when building a cloud computing data center. The heights of efficiency are the adoptions and launches of SaaS-based public clouds, virtualization-based private clouds, and PaaS-based hybrid clouds. These very powerful cloud systems allow the commission of enterprise communication systems for dramatically little investment. For data center customers, cloud-based deployments help enterprises pay only for the system resources on-demand, as needed.

Huawei is a leading global communication device and service provider. By centering on customer requirements, Huawei utilizes its ascendant communication technologies, as well as numerous new technologies, to launch holistic enterprise communication solutions. These solutions are developed based on core products, such as UC, CC, and VC, and feature mobility, video, and cloud collaboration. In addition, Huawei continues to roll out innovative application solutions for such vertical markets as distance education, telemedicine, and remote banking. Huawei delivers high-quality, best-in-class convergent communication solutions to enterprises. ▲

Zhong Cui

Huawei's Agile Controller 2.0 is the core component for adding value to an SDN ecosystem by combining management, policy, and control plane logic into a single process. >>

Agile Controller 2.0 for Service Networks

| By *Zhong Cui, Marketing Manager, Huawei Switch & Enterprise Communications Product Line*

With the growing influence of cloud computing and virtualization technologies, enterprise IT systems are transforming, and the ability for an enterprise to deploy new services quickly is an important measurement of its level of IT sophistication. These technologies are changing computing and storage patterns significantly which, in turn, are impacting the services available on business networks.

New Demands for Enterprise Networks

The days of enterprise networks operating in isolated silos are over. In the period between the identification of a business opportunity and the launch of the online service or services, companies must select and deploy the necessary IT resources (computing, storage, and network) based on the projected minimum and maximum needs. A primary goal is to balance and share resources across services, and to be organized to scale up or down elastically, on demand. A second key goal is to minimize service rollout periods by scheduling the allocation of computing and storage resources.

Huawei's recommendation for achieving these goals is to incorporate the following critical network elements into the design and deployment of each new service program:

- **SDN architecture** — To ensure that network development will keep pace with business development.
- **Open architecture** — Allowing for the implementation of needs-based network resource allocation for optimal business outcomes.

Agile Controller Service Applications

The Huawei Agile Controller 2.0 is built on the OpenDayLight (ODL) open platform architecture. ODL allows next-generation networks to follow SDN principles throughout the engineering process through the provision of network services, policy orchestration, and management functionality via the Open Services Gateway initiation (OSGi) framework and Representational State Transfer (REST) API interface capabilities, that allow service applications to employ network capabilities through their defined interfaces. The result is that the Agile Controller 2.0 enables the orchestration of network-wide resources in support of application services.

Networks using traditional, non-SDN architectures require administrators to allocate network resources for individual services, either manually or by script, which is inefficient, time-consuming, labor intensive, and difficult to troubleshoot because network resources cannot be scheduled uniformly. Service deployments in non-SDN environments start from the bottom layer and require complex basic configurations. The results are the slow rollout of new services and an increase in the costs of value-added services.

The demand for efficient rollouts of new, personalized, and diversified services requires a network infrastructure able to support unified management and dynamic, scalable resource scheduling.

Service-to-network models help the rapid launch of network services by following these steps:

- Define the business model for network services and the expressed use of network resources.
- Map the relationship between network services and resources.
- Describe network services and infrastructure allocations in software.
- Identify similarities and discrepancies between the business and service models for the purpose of decoupling network control from the physical networks.

Traditional network control solutions tend to follow bottom-up designs that allow network visibility to upper layer services and require manual configuration for the deployment of devices and services, such as subnets, switches, routers, firewalls, and load balancers. Once configured, the result is that IT solutions will routinely interact with all necessary applications and services, but is not easily modified.

In comparison, SDN centered solutions — based on general-purpose computer technology support for global control of physical networks — are more generally top-down designs that implement services based on flow-control requirements. Templates are used to automate scheduling across the entire service platform, including tenants, networks, services, security, and load balancing. The SDN approach reduces operations and maintenance costs, minimizes configuration errors, and accelerates network deployment. The result is an ability to easily launch and update agile and efficient network services.

The Agile Controller 2.0 converges management, policy, and control plane logic into a single program. By removing the restrictions of the physical network, the Agile Controller 2.0 achieves the following:

- The Management Plane provides a holistic view of the virtual network topology for the purpose of providing uniform control and visibility for overlay, underlay, and tenant-based applications, as well as the logical and physical networks.
- The Policy Plane arranges network services automatically, using the End Point Group (EPG) model and logical network language. The Agile Controller 2.0 works with mainstream cloud platforms for implementing application-oriented network functions and opening network services based on subnet, router, FwACL, SNAT, and IPSec VPN parameters.
- The Control Plane interacts with the overlay networks and deploys in uplift or sinking mode, working with the cloud platform to obtain computing resources, and works with servers for controlling virtualization awareness and the management of the Address Resolution Protocol (ARP) cache and ingress replication tables.

Controllers Lead the SDN Era

SDN development removes the constraints of traditional network hardware by using standard southbound protocols for virtualizing the deployment of underlying network devices. For upper-layer applications, SDN provides rich northbound APIs, which allow for the flexible set-up and revision of packet forwarding policies to the underlying switches.

The Agile Controller 2.0 is the key value-adding component of any new or upgraded SDN network, as the controller is simultaneously the brain of the bottom-layer devices and the platform on which the upper-layer management and control applications are run. ▲

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Liu Lizhu

Powered by Big Data analytics, the Huawei Cloud Security Center paves the way for global, benefit-sharing collaborations to manage Distributed Denial of Service attacks. >>

Cloud-Based DDoS Mitigation

| By *Liu Lizhu, Security Gateway General Manager, Huawei Switch & Enterprise Communications Product Line*

In June 2014, the U.S. Department of Justice (DoJ) and the Federal Bureau of Investigation (FBI) announced Operation Tovar, a multi-national effort with law enforcement agencies and global network security companies, to disrupt the GameOver ZeuS (GOZ) botnet. A Russian hacker has been identified as the responsible party for creating the malware and is charged with computer hacking, wire fraud, bank fraud, and money laundering. The botnet continues to operate.

Identified in 2011, GOZ is a variant of the ZeuS Trojan, which steals credentials. Unlike previous ZeuS variants that used conventional HTTP techniques, the GOZ virus is more resilient and difficult to disrupt through the use of Peer-to-Peer (P2P) techniques within its Command and Control (C&C) infrastructure.

Spread by email attachments and phishing sites, GOZ has infected millions of computers globally by capturing banking credentials from infected computers and using them to initiate transfers to overseas accounts. The FBI estimates GOZ losses to be over US$100 million and remains concerned that it is the most sophisticated botnet that they and others have attempted to disrupt.

For all the damage done, the GOZ case is only the tip of the iceberg. Botnets are ever more widespread and are expanding to exploit a more diverse variety of platforms. MS Windows is no longer the only operating system vulnerable to botnet infections, as many popular botnets now target Linux, Apple Macintosh, iOS, and Android operating systems. The more popular the application, the more likely it will be compromised. For example, as the Apple iOS and Android versions of Flappy Bird gained popularity in 2013, hundreds of clones immediately emerged, of which 80 percent contained malicious code.

Cloud Data Centers Face Attack

The most common botnet-based attacks are Distributed Denial of Service (DDoS). DDoS attacks evade network security tracking and filtering utilities by simulating typical Internet access behavior. Hosted servers in conventional data centers often lack effective supervision, leaving them vulnerable to mega DDoS attacks. Most cloud data centers are just as unsafe. According to *The Bad Bot Landscape Report Q1 2014* released by Distil Networks, 79.18 percent of cloud traffic on certain eCommerce sites is malicious botnet traffic.

Devastating and Far-Reaching

DDoS attacks affect Internet services more than any other type of network attack. And, as more Internet services are migrated to cloud data centers, it is expected that the incident of DDoS attacks will continue to increase.

DDoS attacks begin with a list of target IP addresses and domain names, and will often include Advanced Persistent Threat (APT) techniques to mask sustained attacks. For example, during holiday shopping seasons, DDoS attacks are routinely launched against eCommerce websites. Targeted websites become slow and web pages fail to open, resulting in customers visiting other websites. Similarly, DDoS attacks against gaming platforms usually result in high attrition rates of users who flee the hacked hosts. During major sporting events, such as the World Cup, large DDoS attacks are common on gambling websites and continue for the duration of the event.

Statistics gathered by the Huawei Cloud Security Center over the 2014 calendar year, show a twenty-five percent increase in peak attack bandwidth, with DDoS attacks occurring on a monthly basis. Early in the year, attack traffic was in the order of 400 Gbit/s and, and by the end of year, rose to 500 Gbit/s. In December 2014, a single DDoS attack against a cloud data center hosting game servers lasted 14 hours.

DDoS attacks jeopardize enterprise services, put immense pressure on the operations of public data centers, and consume valuable service bandwidth of

telecom carriers. Tier-1 telecom carriers across the globe have begun to seek a “Clean Pipe” solution that will quickly filter attack traffic at the source and minimize the impact and duration of DDoS threats.

Big Data to the Rescue

An effective technique for defending against DDoS attacks is to implement a Big Data-enabled security management process with links between local DDoS detectors and traffic nodes across the network. Big Data-enabled security is implemented at the following layers:

- **Layer 1:** Local DDoS detection and mitigation devices use Big Data analytics to combat multiple types of application-layer DDoS attacks. These devices implement functions such as per-packet inspection, traffic analysis, location-based reputation services, and static/dynamic fingerprint learning. In order to meet the demands of increasingly heavy workloads, the detection and mitigation hardware is built for high-performance and scalability.
- **Layer 2:** Local DDoS detection and mitigation devices are synchronized with botnet reputation databases at security intelligence centers around the world.
- **Layer 3:** Big Data-enabled Security Operations Centers (SOCs) are the foundation for highly resilient attack mitigation systems. Key measures include:

First, Scrubbing centers set up worldwide, with the highest concentration in the areas most prone to attack, i.e. Europe, North America, China, and the Asia-Pacific region. The scrubbing centers capture traffic at points closest to the sources of attack. Large scrubbing centers are currently deployed in Amsterdam, Moscow, Beijing, Singapore, Los Angeles, and Miami. These support the attack mitigation through processes of centralized scheduling and unified application of DDoS anti-threat policies.

Next, DDoS mitigation devices are deployed at International Gateways (INGWs), inter-carrier interfaces, and large-bandwidth Internet Data Centers (IDCs). These deployments collaborate with global scrubbing centers to route data to nearest scrubbing center to filter and return clean traffic.

Finally, Local mitigation devices include Virtual Firewalls (vFWs) installed at the borders and inside the IDC. These installations provide a holistic DDoS protection solution for east-west and north-south traffic.

Global SOC platforms that are powered by Big Data have paved the way for the creation of cross-industry alliances to support the sharing of DDoS mitigation resources and operational best practices.

Big Data is redefining the security sector. With Big Data analytics, commercial cloud-based DDoS mitigation solutions minimize the threat of DDoS attacks for current and future cloud computing and Internet initiatives.▲

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Lisa R. Melsted
Lisa Melsted is a writer and communications consultant based in the San Francisco Bay Area. A tech industry veteran with turns in public relations, market research, and journalism, she writes about enterprise and B2B technologies and moonlights as a food and profile writer.

Why Modern Buildings Still Have Wi-Fi Dead Zones — And How One Fixed Them

| By *Lisa R. Melsted*

These days, expectation for always-on Internet connectivity is at the highest it has ever been. Much of the world in which we live and play, however, wasn't designed for this level of persistent connectivity and, despite our best efforts, it can be difficult to get and remain fully connected for many reasons related to the number and position of radio antennae used to deliver the Internet to end-users.

It is reasonable to understand that the architecture and construction of older buildings did not account for them having to support the complicated physics of multiple wireless access points. Perhaps, to no great surprise, the problem isn't confined to old buildings as modern buildings sometimes must also be retrofitted for Wi-Fi Internet access. Our example case today is the newly designed headquarters for China Central Television (CCTV) in Beijing. During the 2012 move into their new offices, employees discovered that wireless access was erratic and unstable.

The newly designed headquarters for China Central Television (CCTV) in Beijing is one of the most architecturally unique buildings in the world. During the 2012 move into their new offices, employees discovered that wireless access was erratic and unstable. So, CCTV partnered with Huawei to resolve the wireless LAN issues. >>

Headquarters for China Central Television in Beijing (Photo source: iStock)

Unique Design

Shaped as a continuous loop consisting of six different parts, the CCTV building has a different look depending on the direction from which it is viewed. It is one of the most architecturally unique buildings in the world. At its base are two 60-degree towers connected by a cantilever with a 90-degree angle in the middle. The result is an L-shaped Möbius Strip that appears to defy gravity because there is no direct support beneath the massive overhang.

The building, designed by architects Rem Koolhaus and Ole Scheeren of the Dutch firm OMA, serves as headquarters for China's state broadcasting system and houses approximately 10,000 employees, 25 television studios, and a total floor area of over 5 million square feet.

CCTV wanted to provide Wi-Fi throughout the entire building for its employees to use for work and entertainment. However, due to the unique design of the building and multiple dead zones, particularly in elevators and high-density areas such as studios and newsrooms, Wi-Fi signal transmission was marginal.

"[CCTV employees] felt that they could use better Wi-Fi access," said Jane Fu, WLAN Product Director for Huawei's Switch and Enterprise Communications product line. "The free Wi-Fi was not satisfactory and they complained about the signal."

CCTV partnered with Huawei to resolve the wireless LAN issues. The challenge for Huawei was meeting the CCTV requirement that the new wireless network have no blind spots in the building — including elevators, studios, and newsrooms. All areas of the building were expected to maintain good access without failing under the pressure of multiple users.

Design Challenges

The irregular design of the CCTV building, which contains steel, reinforced concrete, and special glass, "makes communications and transmissions of signals difficult," said Fu.

Chris DePuy, Vice President, Wireless LAN of the Dell'Oro Group research firm, agreed that concrete and glass hinders wireless network performance. "It's really tough to penetrate a wall like that. If you've got cool architectural features like windows, some of them just stop the signal," he said.

Although Huawei has extensive experience with deploying Wi-Fi networks covering large areas, such as sports arenas and universities, the CCTV project has helped the company establish a strong offer for other media companies. >>

The Huawei team designed separate network plans for different zones inside the building. For example, areas with frequent high-density use and multiple users, such as the television studios, were equipped with stronger signals than were provisioned for single-person offices or hallways.

Fu said that special cables and antennas were placed throughout the building, including the elevators, to ensure access points would cover every area. DePuy said that it is common to use different kinds of antennas to provide directional coverage in areas where one antenna cannot provide the usual 360-degree coverage. Two or three antennas may be used to push signals in one direction to fill out the gaps between access points, he said.

The CCTV Wi-Fi project, slated for a January 2015 completion, has taken about a year. While the average building system typically deploys 100 to 200 access points, Fu said the CCTV building has required approximately 1,300 nodes.

Raising the Bar

Jane Fu said that, although Huawei has extensive experience with deploying Wi-Fi networks covering large areas, such as sports arenas and universities, the CCTV project has helped the company establish a strong offer for other media companies. Fu says that, after completing the CCTV project, Huawei is now familiar with the Wi-Fi requirements necessary to support large studio and broadcast production complexes that the company can consider developing special solutions that are geared for the media industry.

"With this project, we have experience with irregular office buildings and the media industry, which will help us in the future," she said. ▲

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http://www.forbes.com/sites/huawei/2015/02/24/why-modern-buildings-still-have-wifi-dead-zones-and-how-one-fixed-them

James Blackman

The role of technology in oil and gas production has never appeared so essential, and solution providers like Huawei are enabling the industry to be leaner and more agile. >>

Harnessing the Digital Oil and Gas Field

| By *James Blackman, The BBC*

Oil and gas is becoming harder to find, and more complicated and expensive to extract. At the same time, the industry faces unprecedented pressure on margins. The role of technology in oil and gas production has never appeared so essential, and solution providers like Huawei are enabling the industry to be leaner and more agile.

There's an old joke in the energy industry that if you ask an oil man whether the well they're drilling is going to be a producer, the answer you'll likely get is "you can see as far underground as they can."

Not much has changed, it seems. Prospecting for oil and gas is, by nature, speculative, and it's getting harder. There is no "easy" oil and gas left. The same oil "man," now, has to navigate savage wastelands and strange submarine landscapes before he even starts drilling.

The industry has been doggedly innovative in its pursuit of new energy reserves. The most dramatic example of this is in the Santos Basin, off the coast of Brazil. There, the industry reckons 50 million barrels of oil are buried deep beneath the ocean floor — beneath three km of water, two km of salt, and two km of rock. Without question, the Santos Basin is a "producer," Petrobras reckons production is up 13 per cent on the back of its new Atlantic oil fields.

But this pre-salt layer doesn't follow the normal rules of sedimentary rock. As with recovery of other new oil and gas reserves, its exploration is highly speculative, and highly expensive.

Technology Gap

Cost is a defining issue for the industry. In recent months, the price of oil has plummeted as US production has surged and markets have dictated that supply has outstripped demand. This has, in turn, forced the industry to make tough decisions. Jobs have gone, and new projects have been postponed. With such dynamics at play, the role of technology in oil and gas production has never appeared so essential.

"These uncertainties create a scenario where IT and communications have an even greater strategic value because they can bring far greater efficiencies. But it's a conservative industry; one that is over 150 years old, which has been tremendously successful in finding, developing, and producing hydrocarbons. There is a gap, however, between what IT can do and what is standard practice in the oilfield today," says Ovum lead analyst for oil and gas Warren Wilson.

Beyond cutting-edge 3D visualisation tools that can help illuminate the depths of the Santos Basin, there are other things the industry can do to improve efficiency. Like many other industries that have a long history, oil and gas companies tend to be fragmented in terms of their business processes.

"Producers are managing many wells — big ones, in large numbers — and they don't have a clear and immediate sense of their profitability. Things like production volume, cost, revenues; these data streams live in silos, and it can take weeks to run a profitability report. It's not real time, and it's not a steady state," explains Wilson.

Integrated IT

This is pertinent to current US productivity, which relies on shale oil and gas. In-land shale beds present their own geological challenge; they often run in narrow layers that undulate underground. Multiple drill holes are required to get a handle on their behaviour. Even then, having drilled horizontal pipes at great cost through hydrocarbon-bearing rock, wells can run dry without warning.

"The stakes are high, and the industry is drilling on the basis of relatively scanty information. It has to drill a lot of holes to maintain its revenue stream. There is an awful lot of money spent upfront," says Wilson. With properly integrated IT and communications systems, these organisations can make sharper decisions about each new well, he argues.

For Chinese technology firm Huawei, a partner of many of the world's biggest oil and gas companies, IT integration must come first if businesses are to drive out operational efficiencies. "The biggest shift for the industry is towards integrated IT infrastructure," says Chen Cailin, energy solution principal of Huawei's Enterprise Business Group.

"And that has to be the first stage in any kind of operational transformation. These companies need real-time data to make real-time decisions. That data has to sit on a single platform for it to be really powerful."

In simple administrative terms, integrated systems enable slicker operations. In the United Arab Emirates, Huawei has transposed the myriad IT systems and applications of state-owned oil firm ADNOC onto a single cloud-based platform. It is estimated ADNOC will

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The biggest shift for the oil and gas industry is towards integrated IT infrastructure. Companies need real-time data to make real-time decisions. That data has to sit on a single platform for it to be really powerful. >>

reduce its running costs and headcount as a consequence. It can now deploy new applications in days, rather than weeks.

"That siloed approach to IT has gone; the business works off a single shared resource, which sits in the cloud," says Cailin.

Real-Time Data

In the context of a more complex engineering project, integrated systems can transform a business entirely. Huawei was appointed to overhaul the communications infrastructure for a 2,000 km stretch of the Central Asia-China Gas Pipeline, the longest gas pipeline in the world.

Huawei has connected a cross-country network of compressor, monitoring, shut-down and metering stations along its often-barren course to a fibre optic cable network, backed up by satellite communications.

The project has afforded its main protagonists, based in Turkmenistan, Uzbekistan, Kazakhstan, and China, certain other major benefits. The whole system is monitored, around the clock, with an alarm system to signal any breach or malfunction. All parties now have full sight of the structure's performance metrics in real-time. A number of valve chambers along the pipeline can now be operated even when unattended. The headcount in its compressor and metering stations has been reduced by 50 percent.

"The timeliness and accuracy of data was improved greatly. In the past, gas metering was operated manually, and the differences in measurements among different countries brought disagreements among owners, customs, and commodity inspectors. But, after this project, the unified access made the data consistent and timely," says Cailin.

The Central Asia-China Gas Pipeline project wraps in certain other functions of the newly connected oilfield. Ovum's Wilson makes the point that oil and gas companies can be increasingly agile in response

to irregularities in their systems because they are hooked up to an increasingly elaborate network of sensors and monitors.

"Think of a worker on a drilling rig, or an inspector on a pipeline. He notices something's amiss so he opens an App on his smartphone, snaps a picture, fills in some basic info, and hits send. The App alerts the incident manager or response team based on their availability and proximity," he explains.

Offshore LTE

Of course, you need a data connection in the first instance and, ultimately, many of these operational gains hinge on connectivity.

A choke point for the industry today is that satellite, the de facto standard for offshore communications, affords low bandwidth and high latency — to the point that it can take several minutes for data to make the round-trip between an offshore platform and an onshore data centre. Some offshore exploration is near enough to shore that cable can be laid, but such cases are rare.

There is also a cost factor associated with satellite communications — typically, US$300,000 per year per satellite connection, and several millions for a whole oilfield. At the same time, the initial stop-start of upstream exploration means satellite receivers have to be dismantled, moved, reassembled, and checked with each new drilling operation. Alternatives are limited; WiMAX has dwindling industry support, and a Wi-Fi mesh network provides only limited coverage.

Where feasible, 4G LTE is a boon for the industry, affording high bandwidth, low latency, and wide coverage off a single licence. Huawei has deployed a number of private 4G LTE networks, demonstrating considerable engineering prowess in the process, for oil and gas companies in remote regions of Iraq, the United Arab Emirates, and China's Xianjiang province.

More impressively, perhaps, Huawei has worked with broadband provider Tampnet to connect around 75 platforms, vessels, and mobile units in the North Sea to super-fast mobile broadband.

Success

Huawei's LTE solution is allowing North Sea firms to utilise remote collaboration systems, allowing technicians in control centres on shore to work more closely with specialists on the rigs during technical manoeuvres. More than this, they are able to take full charge of certain operations without any on-site assistance at all. >>

Tampnet has, so far, installed Huawei base stations on eight North Sea platforms, each providing a coverage area of around 40 km to 50 km from the rig, and speeds of 10 Mbit/s in range and 50 Mbit/s close to source. These are connected to 2,500 km of sub-sea optical fibre between the UK and Norway.

"Nowhere else in the world has the same density of fibre as the North Sea, nor the connectivity options that spring from it. It is a very special situation, and the recovery rate for oil in the North Sea is very good as a result," says Tampnet managing director Per Helge Svensson.

Remote Control

High-speed wireless broadband is allowing North Sea firms to utilise remote collaboration systems, allowing technicians in control centres on shore to work more closely with specialists on the rigs during technical manoeuvres. More than this, they are able to take full charge of certain operations without any on-site assistance at all.

"They can do almost the same onshore as they can do offshore. North Sea oil and gas companies are at the forefront in terms of utilising high-capacity bandwidth to improve oil and gas production, as well as drilling operations, which is where the major costs are," says Svensson.

In upstream production in the North Sea at least, it is a glimpse of the future.

Svensson explains: "The new platforms in the North Sea are essentially made to be unmanned — or, at least, to be operated from shore. It impacts productivity in a big way. And, with networked sensors, this Internet of Things to monitor systems, the industry is also able to make best use of its equipment — to replace it when it actually needs replacing, rather than as part of regular upkeep. It's about how technology can help the industry make better use of resources and better decisions." ▲

http://www.bbc.com/future/specials/connected-world/huawei-energy

Sarah Tanksalvala
Sarah is a Colorado-based freelance writer specializing in technology, marketing, energy and lifestyle topics.

To remain competitive and agile, universities across the world are building digital campuses, which will improve the quality and accessibility of educational resources, expanding the geographic scope of universities and increasing the number of services they can offer. >>

How New Technology is Helping a University Grow a World-Class Digital Campus

| By *Sarah Tanksalvala*

To remain competitive and agile, universities across the world are building digital campuses. Also known as ecampuses, these cloud-based, online platforms improve the quality and accessibility of educational resources, expanding the geographic scope of universities and increasing the number of services they can offer.

But ecampuses have also created new challenges for organizations, namely how they can handle large volumes of digital activity in a cost-effective manner. Universities with tens of thousands of students or more generate a nearly unmatched amount of communication and information.

In 2012, the University of Lübeck in Germany tried to build a digital campus for 24,000 students and 53,000 staff members. The public university, which also has a teaching hospital, specializes in medicine, science, technology and natural sciences.

But the initiative placed increasing demands on its technology infrastructure. Lübeck had a choice — either expand the infrastructure or migrate it to a new platform. Hoping to improve education quality, management efficiency, and access to scientific research resources, it chose the latter.

"Due to increasing demands for capacity and availability, the university decided to migrate the existing storage infrastructure to a new technology platform," said Fan Ruiqi, president of the Huawei Storage Product Line. "In addition to the technical framework, easy integration with VMware Server virtualization software played a particularly important role."

Lübeck's digital campus would include an eLibrary, forum, online storage, and file sharing. More than other universities, Lübeck needed a high-performance density system — meaning high Input/Output Per Second (IOPS).

Serving the Needs of a Vibrant Institution

The digital campus's existing storage loads created some serious challenges. The new solution needed storage with high enough performance to meet the requirements of more than 150 VMware servers. It had to have a long uptime to serve the needs of an institution that not only conducted scientific research, but also treated medical patients. It also needed to be easily scalable — meaning it had to be easy to increase the size to suit future needs and applications.

Finally, migration needed to be smooth, as disruptions would affect more than 150 campus services and applications — harming students, researchers, faculty, and patients. This meant seamless VMware integration. If new storage devices weren't fully compatible with the existing, outdated ones, storage performance, reliability, and scalability would all be compromised.

The university reviewed several proposals before narrowing the field to two finalists. Lübeck initially had concerns about both. Ecampuses looking to expand must ensure that the solutions they're weighing will perform as advertised, and are affordable and scalable.

"The university was not 100 percent convinced by the paper content at the very beginning," Ruiqi said. "As a matter of fact, the customer required a proof of concept from our storage, [and then] strict performance and availability — under VMware and Hyper-V — virtualization platform testing."

Lübeck chose OceanStor Converged Storage, swayed by cost-effective performance and efficiency features that met the university's needs. The system delivered a 25 TB capacity and integrated with the existing VMware, alleviating pressure on the legacy storage devices. Employing RAID 2.0+ block-level virtualization technology, OceanStor OS accelerates data recovery by 20 times. The Hyper series data protection software suite underpins local high-availability, active-active, and 3DC DR solutions, delivering 99.9999% reliability. All these advantages help customers ensure unbroken continuity of business-critical applications.

(Photo source: iStock)

Fiber channel connections delivered high-performance storage, and the system was designed with a tiering feature to help maximize both performance and cost-efficiency.

"We were able to meet all of our requirements on the storage solution with the OceanStor Converged Storage," said Helge Illig, Lübeck's IT Service Center Director. "We are optimally positioned with regard to future growth of the storage system."

Five Times as Fast

The system has delivered stable, reliable 24/7 service operation since its deployment, and it currently operates 150 VMware servers. Lübeck's new system operates five times faster than its predecessor. For teachers and students, this has meant more campus applications and services delivered faster and more reliably — and accessible any time.

For other universities facing issues of limited storage and outdated digital infrastructure, Lübeck's example offers valuable lessons.

The first is simply that the benefits of using new architectures outweigh the risks. Had Lübeck elected to simply expand its existing architecture, it would have been unable to increase performance, speed, and services to the degree it did. Lübeck didn't have to update all its storage devices and software at once. In fact adding the OceanStor technology alleviated pressure on the existing devices.

One of the university's strongest initial concerns was a smooth transition and integration with existing infrastructures. This is a concern for other institutions, but Lübeck's example should alleviate those fears and show that a seamless transition is possible. In fact, companies like Huawei are dedicated to assisting this transition.

"After sensing the new trends of cloud computing, Big Data, mobility, and socialization, Huawei developed the ultimate goal of lowering Total Cost of Ownership (TCO) and increasing business scalability for customers," Ruiqi said. "As IT architecture evolution steps further into a new development phase, Huawei [will not only] fully exploit its advantages, but also help customers transform their IT architectures to meet future challenges."

Ruiqi notes that the OceanStor OS will become a standard Huawei platform for future storage product series, meaning that it will continue to help current university clients keep up to date with the latest technology trends.

IT architecture is evolving in new ways that will help customers address future needs and challenges. Adopting future-oriented strategies now can increase scalability, cost-efficiency, reliability, and performance both immediately and in the long run. Universities hoping to remain competitive must acknowledge and respond to these facts. ▲

http://www.forbes.com/sites/huawei

Success

"We were able to meet all of our requirements on the storage solution with the OceanStor Converged Storage," said Helge Illig, Lübeck's IT Service Center Director. "We are optimally positioned with regard to future growth of the storage system." >>

Allen Chen
As the founder and CEO of Zhihuiyun Leadership Development Institution, Allen also is a writer and scholar with a specialization in Management and Leadership.

What combination of online and offline sales will dominate the retail channel? >>

O2O: The Future of Retail

| By *Allen Chen, Founder & CEO, Zhihuiyun Leadership Development Institution*

To the extent that there are two distinct sides to the argument, the position of Offline-to-Online (O2O) advocates is that, as more offline retailers are closing, brick-and-mortar stores, the transaction volumes for online stores will only continue to grow. For brick-and-mortar stores to survive, O2O — driving customers to a physical storefront to fulfill the transaction with online incentives — will absolutely come to dominate retail sales.

The Role of Retailing

In simplest economic terms, a business is a system that creates and transfers value. The function of operational groups such as R&D, design, and production is to create value. The function of the marketing and sales group is to transfer value. Legendary management consultant Peter Drucker said that the two things entrepreneurs should care most about are innovation and marketing — in other words, value creation and value transfer.

Retail businesses exist to transfer value, and innovation is crucial to the power of marketing and promotion to drive sales. To see the role innovation plays, consider that the consumer-facing aspect of retail activities can be divided into presales, sales, and post-sales. Pre-sales activities function to attract consumers. Sales transactions involve coming to an agreement, taking payment, and delivering the product or service. Post-sales activities include customer service, and follow-up promotions and sales.

Online businesses interact with consumers in all three types of activities: attraction through advertising and other methods, electronic payment, and after-sales service. Compared with traditional offline retail businesses, the biggest advantages of online businesses are the lower costs for customer attraction and fulfillment. Offline stores will remain a better choice for non-standard goods, or luxury items that demand a more-engaging shopping experience.

This comparison of online and offline retail stores is only theoretically applicable, because the reality is that retailers in all categories do business across a spectrum of online and offline methods. For example, a consumer may receive an electronic coupon over her mobile phone, go to a supermarket, select the desired product, and pay the bill using the coupon. In this case, is the transaction counted as online or offline? This kind of mixed marketing activity is becoming more and more common for retail business; and here we stand at the doorstep of the next new era of marketing innovation. Retailers will use various methods to create better shopping experiences. Mobile marketing strategies will draw consumers to specific products that requiring a visit to an offline store to complete the transaction. Retailers will continue to improve the online and offline tools used to deliver optimal customer service.

Like businesses everywhere, Chinese retailers need to be attentive to changes in technologies and business conditions at home and around the world. >>

In China, we note that online businesses have no natural competitive edge over offline stores, especially when compared to the retail sectors of the U.S. and Europe. Using American membership-only warehouse "club" Costco as an example, many goods are sold at prices below those found online. Costco accomplishes this advantage by fixing the company's average gross margin at a relatively low 6.5%, much lower, even, than the gross margin of retailers in China. Costco profits rise from operational efficiencies and reduced costs. Membership fees are an ancillary source of revenue. Offline retailers are also able to enjoy the advantages this business model.

Adapting to Changing Conditions

The prosperity of online businesses in China is due less to operational efficiencies than to the inefficiencies of traditional retailers. For example, high rent and other storefront operating costs force some offline retailers to charge higher prices to cover overhead. O2O warehouses that are free of public access enjoy a competitive edge in facility costs. However, when offline retailers are able to improve operating efficiencies (see Costco, above), it will be possible for storefronts to compete equally in price and quality.

International companies such as Apple and UNIQLO succeed in maintaining the same prices for both online and offline consumers. For these companies, online and offline stores are treated identically, with value creation and transfer combined to produce a uniform user experience and seamless efficiency across operating groups.

Like businesses everywhere, Chinese retailers need to be attentive to changes in technologies and business conditions at home and around the world. Attracting the interest of Chinese retailers is the recently announced "Internet Plus" initiative by the Chinese government, whose purpose is "to integrate mobile Internet, cloud computing, Big Data, and the Internet of Things with modern manufacturing to encourage the healthy development of eCommerce, industrial networks, and Internet banking, and to help Internet companies increase their international presence." O2O retail now requires continuous attention to take advantage of the innovative methods that are being adapted to meet changing times. ▲

Nick Bostrom
Thinker, philosopher, and transhumanist, Professor in the Faculty of Philosophy at Oxford University, and founding director of the university's Future of Humanity Institute.

Some of the smartest people on earth warn that super-intelligent computers will mean the end of mankind. Should we be worried? >>

Superintelligence Rising

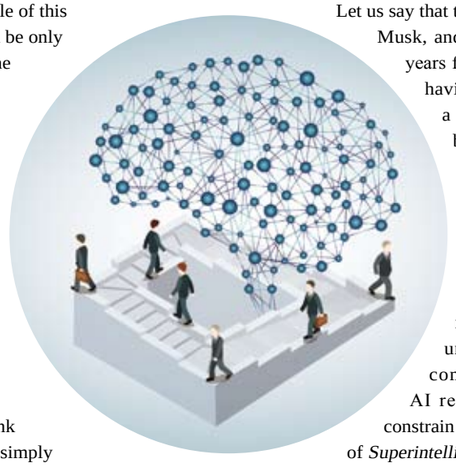
| Book review by *Tu Qizhi*

At a time when human beings use machines for all manner of mischief, some people worry about machines becoming more intelligent than humans and committing mischief cooked up by the machines themselves. Could super-intelligent machines outsmart us, outcompete for our place on earth, and eventually destroy us based on the best logic of the day?

Certainly we seem to have examples of "intelligent machines" among us already. IBM's "Watson" beat human opponents on the quiz show Jeopardy. The super-parallel computer "Deep Blue" defeated world chess champion Garry Kasparov. Microsoft's Xbox gaming console can analyze players' facial expressions to evaluate their moods.

Rise of the Machines

The author of the book *Superintelligence*, Nick Bostrom, predicts that Artificial Intelligence (AI) equivalent to human intelligence is likely to become a reality around the middle of this century. After that, it will be only a matter of time before the machines (that make the machines) will generate an intelligence that surpasses our own; a super-intelligence.



Such machines would expectedly rival or outperform us in all matters of mathematics and science, the arts, and surely, even in social skills. How big a leap to think that we will create computers that think independently instead of simply following instructions? When machines have ideas of their own, and the ability to secure themselves, it may occur to them that we humans are in the way.

Some very smart people worry about this very outcome. British physicist Stephen Hawking warns, "The development of full artificial intelligence could spell the end of the human race. It would take off on its own, and re-design itself at an ever increasing rate." In the same vein, Elon Musk, Tesla and SpaceX founder, says, "With artificial intelligence we're summoning the demon." He sees AI as "our biggest existential threat." Former Microsoft chairman, Bill Gates, joined in the alarm: "I am in the camp that is concerned about super-intelligence... I agree with Elon Musk and some others on this and don't understand why some people are not concerned."

What to Do?

Let us say that the worst fears of Hawking, Musk, and Gates come to pass, and years from now you find yourself having this conversation with a computer: "Open the pod bay doors, Hal." To which the computer replies, "I can not do that, Dave." What now?

The short answer is: pull the plug.

Supposing the plug might be difficult to pull under some circumstances, commentators propose that AI researchers be required to constrain their creations. The author of *Superintelligence* offers two strategies for controlling superintelligence. One strategy is capability control, which can use the following methods:

• **Boxing:** The system is confined. It can interact with the external world via restricted, pre-approved channels. Boxing methods include both physical and information containment methods.

• **Incentive:** The system is placed in an environment that provides appropriate incentives to behave nicely.

• **Stunting:** The system's intellectual faculties or its access to information is limited.

• **Tripwires:** Diagnostic tests are performed on the system's behavior, abilities, and content. The system is shut down if the tests detect signs of dangerous activity.

The other strategy for controlling super-intelligence is motivation selection, which includes the following methods:

• **Direct specification:** The system loads a motive system of direct specifications.

• **Domesticity:** The system is set up to confine itself to acting on a small scale, within a narrow context, and through a limited set of actions.

• **Indirect normativity:** The system is given some procedure for determining its own ethical standards, which align with our own if that procedure is sound.

• **Augmentation:** A system that already has an acceptable motivation system is selected and its cognitive faculties are enhanced to make it super-intelligent.

Will these measures suffice to keep super-intelligent machines in their place? Or will these machines, being smarter than us by definition, outsmart our limitation strategies and pounce on us when we least expect it?

All in Good Fun

Having whipped up a bit of catastrophic foreboding in *Superintelligence*, the author clarifies that he is not particularly worried about the prospect of smart machines wiping us out, and he notes the same lack of concern among most experts in the field. It should be pointed out that not one of Hawking, Musk, and Gates, for all their smarts and acumen, is an expert in AI.

Erring on the side of caution, it feels reasonable to remain vigilant regarding the commercial or social motives of AI specialists when they discount possible risks. On the other hand, we can probably believe them when they point out that progress in AI is painstakingly slow — which is to say that super-intelligent machines will not be sneaking up on us.

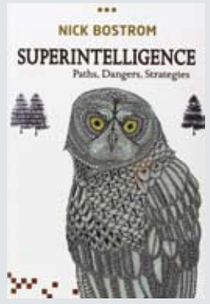
In the real world, according to Yoshua Bengio, head of the Machine Learning Laboratory at the University of Montreal, quoted in an online edition of the magazine *Popular Science*, "We would be baffled if we could build machines that would have the intelligence of a mouse in the near future, but we are far even from that." Moreover, Bengio notes that some mathematical and computational models suggest that overwhelming complexity will inherently limit the scope of any and all AIs, making theoretically impossible.

In any case, AIs are "programmed" systems rather than "free-reasoning" entities like human beings — full of consensus and contradiction, alike. To see a threat from super-intelligent machines, we have to speculate that it is possible, that they could have the ability to develop their own agendas, and that those agendas could be contrary to our own. More specifically, a contrary machine agenda would have to arise as a stark inversion of the AI goal: to produce results that are useful to human beings.

The value of a book like *Superintelligence* is that it spurs our thinking, so that decades from now (if ever) we are ethically prepared to deal with the potential of smart machines. Until then, we might get most profitable use from our worry time by investing it in concerns about what machines do when fully under human control. Surely that will always be a threat that dwarfs anything machines might come up with on their own. We only worry about smart machines because we fear the worst inclinations of human beings, and yet we have great hope for the future because we believe in the best outcomes of human ingenuity. ▲

Introduction

Superintelligence
Author: Nick Bostrom



The human brain has capabilities that other animals do not. These unique capabilities enable us to dominate life on earth. If machines can surpass us in general intelligence, could this superintelligence go out of control? Just as the fate of gorillas is now in the hands of human beings, could the fate of the human race one day depend on the behavior of super-intelligent machines?

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