CHINA TELECOM
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May 2017

A New Era for Enterprise WAN

China Telecom Global SD-WAN connects your business to growth opportunities

In this issue

Gartner®

China Telecom Global: Global SD-WAN Leadership On The Back Of An Integrated Network Services Giant

Introduction

We live in a world of great change. The fact is, we have in recent times arrived at the so-called "Fourth Industrial Revolution", one which extends upon the progress and achievements in mechanics, electronics and IT of the past. Artificial intelligence and big data have ushered in this new era. As a result, heterogeneous, self-aware communication technologies are fundamentally changing the way we communicate and relate to each other as humans.

The reality of billions of people connected via computers and mobile devices presents a unique but challenging opportunity for businesses. The explosion of data generated by businesses and individuals means that traditional methods of communication technology are no longer suited for business today. Which types of networking services are ideal and necessary? What are the enterprise network requirements of today's digital businesses? With so many devices and sensors connected to the Internet, how do you rationalize network infrastructure in order to minimize congestion and traffic instability?

Welcome to the world of the Software-Defined Wide Area Network, or SD-WAN.

Current Enterprise Service Offerings

To understand the impact of SD-WAN as a technology, it is useful to re-visit the history of enterprise WAN.

While current enterprise Wide Area Network (WAN) architecture has served the business world's needs well, little has changed in how the architecture itself was viewed and designed – especially over the past decade or so. WAN has always been about hardware. Starting from the 1970s, businesses had to use point-to-point leased lines, and through the years evolved to ISDN and T1/E1 connections. During that time, purchasing such services was incredibly expensive and difficult to maintain as companies had to purchase and manage many individual connections.

Many technology protocols subsequently followed and evolved the overall network experience; Multiprotocol Label Switching (MPLS) as well as ADSL and cable modems were prime examples of that. While many of these technologies achieved success in addressing connectivity, speed and cost requirements, the impact resulting from these enhancements were marginal from a company's standpoint.

Certainly, things like VoIP reduced voice latency, and MPLS delivered better QoS, but OpEx (i.e. networking and "people" costs) remained a barrier to entry. What's more, the rapid transformation of today's industries due to digitisation and globalisation has many companies wondering whether their current communication infrastructure approach will meet the increasing IT agility that is required for businesses to keep pace.

The Next Generation of WAN architecture: Cheaper, More Agile, More Open

In recent years, we have seen an undeniable shift to an evolved vision of enterprise WAN architecture. According to Gartner, currently close to 90% of enterprises prefer to use proprietary and standards-based offerings from traditional network operators. However, organisations are increasingly considering ways to change and improve the communication and collaboration between their IT operations and development.

Open network communities are in proliferation among core segments, from switching to routing and other network services. New solutions including software-defined networking (SDN) and network function virtualization (NFV) are also gaining momentum. The availability of these new technologies is allowing many forward-looking companies to transform their businesses – in order to remain agile, competitive and cost-effective. It is forecasted that by 2020, data center network spending on open networking and self-built "options" will replace at least 20% of enterprise spending on traditional network vendors.

This shift to a more open-sourced, virtualised approach to enterprise WAN architecture has inevitably led to the birth of the Software-Defined Wide Area Network.

SD-WAN: Addressing Your Data Needs In A New World Of Business

The explosion in data generation and usage, as well as the continued evolution of cloud-based technologies has resulted in the rapid adoption and interest in SD-WAN. As a specific application of SDN technology, SD-WAN technology is used to connect enterprise networks over large distances. Simply put, SD-WAN delivers secure, fast, cloud-enabled WAN connection with as much open and software-based technology as possible. The benefits of SD-WAN are multi-fold:

- Improve Internet connectivity – transmission speed, capacity and quality;

- Increase flexibility – control via the cloud allows customers to, as an example, scale up/down connectivity options based on the time of day;

CTG's network architecture enables enterprises of all sizes to re-architect their WAN and branch office networks through a carrier-grade backbone network and the latest SD-WAN technology.

- Minimise the purchase of expensive routing hardware, due to its migration of control to the cloud

With its lower cost commitment, SD-WAN is particularly attractive to companies in the SME sector which are looking for premium connectivity services without breaking their bank. In addition, lower cost implementation means that these SMEs can be more adventurous in their business planning, as exploring different offerings and expanding into new markets no longer means investing heavily in infrastructure and hardware.

China Telecom Global: A SD-WAN Pioneer With Global Network Support

China Telecom Global (CTG) is a unique leader and pioneer in SD-WAN and enterprise network technology. We are part of China Telecom, one of the world's largest wireline broadband and 4G LTE FDD mobile service providers with 123 million broadband subscribers and 215 million mobile subscribers (of which 122 million are 4G). This positions CTG as a strong competitor in the SD-WAN sector as it leverages on the strength of the Group's world-leading cable (and wireless) assets.

CTG's network architecture enables enterprises of all sizes to re-architect their WAN and branch office networks through a carrier-grade backbone network and the latest SD-WAN technology. We benefit from China Telecom's robust network, which allows CTG to offer their customers a competitive Service Level Objective.

China Telecom's multi-service enabled architecture includes a wide range of network and security functions that solves the primary use cases for next generation managed services –SD-WAN and bundle with vCPE function. This innovative feature enables the network to be serviced on demand, allowing enterprises to turn up or down its bandwidth according to traffic requirements. What this also implies is that the overall cost for network

maintenance decreases – a key target for financial budgeting and planning.

The carrier-grade solution is multi-tenanted, which allows China Telecom Global to centrally manage all its tenants while at the same time allow each tenant to manage its own WAN.

CTG's SD-WAN service elements all support networking function virtualization (NFV). This is important because with NFV, organizations can use standardised, commodity hardware while running software in a virtual machine to serve various functions. By de-coupling software from proprietary hardware, network and security functions can be designed to seamlessly interoperate with each another, and capital costs are significantly reduced through commodity appliances. This reduces the

Capex and Opex of the WAN, while increasing IT responsiveness to business needs as branch architecture is simplified and made highly agile. The time required to manage the network is minimised, and branch security is strengthened and expanded.

CTG has defined a plan for the initial launch of SD-WAN service. To date, CTG has selected Hong Kong, Tokyo, Los Angeles and Frankfurt as its initial deployment cities for SD-WAN POC; commencing exclusive invitation-only trials among enterprise users. By the 2nd quarter of 2017, CTG plans to build at least 4 SD-WAN sites across geographically strategic locations, including Singapore, Sydney, Paris and London.

Source: China Telecom Global Limited

Predicts 2017 – Enterprise Networks and Network Services

The performance requirements of digital business applications require that I&O leaders focused on enterprise networking transform their data center and wide-area network architecture and operations to optimize application performance and the end-user experience.

Key Findings

- Digital business requires faster delivery of services to the business, ultimately requiring enterprises to change network operations processes and tooling (for example, using open source and self-build versus current highly integrated appliances).

- While the CLI remains the dominant mechanism for more than 85% of system engineers to implement network changes, several alternatives are gaining popularity, including APIs, fabrics, and SD-WAN.

- Intent-based network technologies are emerging in support of automation of current manual operational processes.

- Branch office SD-WAN and vCPE solutions are maturing, and provide new alternatives for enterprises to connect their sites to the WAN in a simplified, cost-effective and agile manner.

- The proliferation of cloud computing continues to transform traditional application architectures and traffic patterns, including a need for many enterprises to rearchitect their WANs.

Recommendations

I&O leaders responsible for planning, sourcing and managing communications services:

- Mandate that network selection processes include evaluation of open-source software, and confirm alignment with business requirements.

- Deploy network solutions that reduce dependencies on the CLI, and require automation in all future network purchases/investments.

- Identify the personnel within your organization who can spearhead evaluations of new tools for intent-based networking.

- Include SD-WAN and vCPE on the shortlist when modernizing the WAN architecture, including when (re)negotiating with carriers and refreshing devices.

- Modernize WAN architectures to improve and secure internet connectivity to remote users.

Strategic Planning Assumptions

By 2020, open-source and self-build options will represent at least 20% of the data center network market, up from less than 2% at year-end (YE) 2016.

By 2020, only 30% of network operations teams will use the command line interface (CLI) as their primary interface, down from 85% at YE16.

By 2020, 10% of enterprises will use intent-driven network design and operation tools (up from 0% today), reducing their network outages by 65%.

By 2018, more than 40% of WAN edge infrastructure refresh initiatives will be based on software-defined WAN (SD-WAN) appliances and/or

x86-based virtualized customer premises equipment (vCPE) platforms versus traditional routers (up from less than 2% today).

By YE20, more than 60% of enterprises will have deployed direct internet access in their branch offices, up from less than 30% in 2016.

Analysis

We have created five predictions that represent fundamental changes that are emerging in key network domains, from branch offices to internal data centers and WAN services.

What You Need to Know

Digital business, such as the Internet of Things (IoT) or process integration with close partners, demands IT agility, and agility demands a new style of application development. One such style is the use of containers and microservices, which break applications into small components. These components can be updated individually and run across multiple servers. As such, they help high-performing data center networks to avoid application performance problems. Furthermore, they may link to external services. Conventional data center network architectures cannot accommodate the mix of transaction rate, diversity and bandwidth that will be needed. Simplification, automation and scale must all be proactively addressed so the network does not hinder the performance or reliability of digital business applications. Agility is key.

This year's predictions all focus on improving business agility via significant improvements in network operations, and how these enable clients' migration to both private and public cloud to support digital business applications. For example, we expect enterprise network leaders to continually move away from using device-by-device CLI-driven

configurations and increasingly move to centralized policy-based operations. This move is a required precursor for network teams to deal with increased scale requirements resulting from the use of microservices/containers and the proliferation of IoT devices. Similarly, SD-WAN has become a key vehicle to improve branch office WAN interconnect with public cloud offers.

Strategic Planning Assumptions

Strategic Planning Assumption: By 2020, open-source and self-build options will represent at least 20% of the data center network market, up from less than 2% at YE16.

Analysis by: Naresh Singh

Key Findings:

- Currently, close to 90% of enterprises prefer to use proprietary and standards-based offerings from traditional network vendors such as Cisco, Arista Networks, Juniper Networks, F5 and Brocade.

- DevOps organizations tend to prefer using open-source products for better control and flexibility, among other reasons. According to Gartner's 2015 DevOps adoption survey, 50% of organizations plan to use a DevOps approach in their IT by 2017.

- Although community-developed open-source network software, such as network monitoring and web cache/proxy, has been around for many years, it is only in the last two years that this trend has gained broad network momentum among enterprises.

- Open network communities now exist in core segments, such as Layer 2 and Layer 3 switching (Open Network Linux [ONL], OpenSwitch,

Software for Open Networking in the Cloud [SONiC], SnapRoute) and routing (Quagga), and extend to Layer 4 to Layer 7 network services (HAProxy, Nginx, ModSecurity, OpenDNS) and new solutions like software-defined networking (SDN) and network function virtualization (NFV; Open-O, Open Platform for NFV [OPNFV], OpenDaylight [ODL]).

- Large network operators and forward-leaning enterprises actively assert their stake and influence in the evolution of the network, taking a lead in adoption of open-source-based networks. Large and forward-leaning enterprises are also now increasingly looking toward such technologies to help transform their businesses to remain competitive.

Market Implications:

Enterprises such as DreamHost, American Fidelity and TIBCO are increasingly using open-source-based brite-box switches and open Ethernet fabric offerings to meet their data center network requirements. It is a trend among the self-consumption business user and DevOps teams to bypass traditional application delivery controller (ADC) solutions from vendors like F5 and Radware by using either cloud-based ADC services based on self-built components, or by directly using open-source offerings, such as Nginx and HAProxy. Significant drivers include meeting custom requirements and gaining back control from suppliers.

A key difference between the current open-source trend and previous open-source trends is the very active role of large customers and a broad-based user community. Open Compute Project (OCP)-based Layer 2/Layer 3 switching, for example, is led by several large influential customers, including Facebook, Goldman Sachs, Microsoft, Intel and Rackspace. Coming from OCP, tools like Open

Network Install Environment (ONIE) have enabled the disaggregation of Ethernet switches, thereby leveling the field for vendors and enabling new white-box and brite-box providers to create a niche to compete from. New startups, including Cumulus Networks, Big Switch Networks, Pluribus Networks and SnapRoute, have emerged as a result. Brite-box vendors like Dell and HPE have opened up a new chapter in their networking play as well. From the customer perspective, all this helps serve an important objective — gaining better leverage vis-à-vis vendors.

Projects like OpenSwitch, ODL, Open Network Operating System (ONOS), OpenNFV, Nginx and HAProxy have also attracted broad user and vendor participation, thus making their chances of mainstream enterprise adoption stronger. As these open-source efforts continue across different networking segments, a wide range of networking needs can be met today using open-source options.

By 2020, data center network spending on open networking and self-built options will replace at least 20% of enterprise spending on traditional network vendors. Enterprises that are looking at making strategic investments into networks need to use open-source-based networks to leverage the following benefits:

- A purpose-built product that meets specific requirements better than generic products

- Access to source codes to customize for individual needs and management

- Operational agility and flexibility

- Total cost of ownership (TCO) reduction

Recommendations:

- Mandate that every network selection include evaluation of open-source software (OSS) and confirm alignment with business requirements.

- Evaluate suppliers more on business requirements, such as agility and competitive capabilities, than on cost savings.

- Invest in skills development and cross-organization initiatives such as DevOps/NetOps, as open networks are disruptive, and require using new tools and components less familiar among network professionals.

Strategic Planning Assumption: By 2020, only 30% of network operations teams will use the CLI as their primary interface, which is down from 85% today.

Analysis by: Danilo Ciscato

Key Findings:

- To support digital business, organizations need to increase network agility by automating operational tasks; for example, reducing the reliance on manual service tickets with the network team for repetitive configuration changes.

- Enterprise leaders are looking for solutions to operate portions of the network as a whole, from a single control point, and not device by device.

- CLI is often associated with manual configuration changes, which are the main cause of network outages in the enterprise.

- A new wave of solutions that do not rely on a CLI as the primary way of configuring and operating

the network is gaining adoption in all segments (for example, Ethernet fabrics, SDN, SD-WAN and cloud-managed networks [CMN]) and will replace more than 50% of the installed base by 2020.

■ New network solutions leverage an API to enable integration with other infrastructure orchestration tools and automation of repetitive tasks.

Market Implications:

Major enterprise networking vendors are already offering solutions for the different network segments (such as Cisco Nexus Fabric Manager and Brocade Network Advisor) that do not rely on the CLI for initial deployment and ongoing operations. The CLI will not disappear completely; it can still be useful for in-depth troubleshooting or testing purposes, since it provides more nuanced functionality, but it will not represent the primary tool for network operators.

The CLI is vendor- and product-specific, and complex to master, which has limited the degree of multivendor automation tools that are on the market, increasing the cost and diminishing the functionality. Thus, a decreased reliance on CLI changes the skills required to configure and operate a network. In turn, we expect that proprietary network professional certifications, which put a strong focus on memorizing and mastering the CLI, will become less relevant and be replaced with architect-level skills that focus on network automation, API programming and integration with other infrastructure elements.

The greater ease of network deployment and operations achieved by reducing CLI dependence can facilitate changing vendors, since it reduces reskilling time and costs. At this time, most centrally operated network solutions, such as Ethernet fabrics, SD-WAN and CMN, are based on proprietary software, but solutions that disaggregate hardware and software (for example, SDN fabrics implemented on white-box switches or virtualized SD-WAN solutions that run on standard x86 platforms) provide enterprise buyers with a wider range of options for hardware selection.

Recommendations:

■ Require automated network solutions for new purchases of network infrastructure, and do not let your legacy CLI skills influence your decisions.

■ Move away from CLI operations; exploit APIs to achieve greater agility in your network modernization projects and to support broader infrastructure orchestration efforts.

■ Evaluate multiple vendors and score their architectures based on clear application requirements and business needs, not feature breadth or potential future benefits.

■ Refocus your training investments away from CLI and proprietary certifications, toward network programming tools and orchestration through APIs

Strategic Planning Assumption: By 2020, 10% of enterprises will use intent-driven network design and operation tools (up from 0% today), reducing their network outages by 65%.

Analysis by: Joe Skorupa

Key Findings:

■ "Intent" describes, in business terms, what services are required of the network, not how to configure individual parameters, and serves as the universal language for configuration. For example: "Provide a leaf/spine network with dual-homed 25 Gbps connections per server and

no more than 3:1 bandwidth oversubscription, even when one spine switch fails."

- Adoption of intent-based networking will be driven by digital business's requirements to deliver networking services faster and with greater reliability in a more complex environment.

- Intent-based networking is an early stage technology that will not be mainstream until 2020 to 2022, but early adopters can derive benefits today.

- Intent-based network technology will be delivered first by pure-play startups, and later by traditional network equipment vendors and network management vendors.

- Intent-based tools include an automation/orchestration capability to configure multiple device types in a vendor-agnostic manner.

- Intent-based networking reduces outages by validating the design before deployment, by preventing device configuration errors and by continuously monitoring the network to ensure the intent is being met. If intent is not being met, corrective action can be taken.

Market Implications:

Enterprise adoption of intent-based networking will be driven by a combination of:

- The requirements of digital business transformation to deliver networking services quicker and with greater reliability. Today's approaches often deliver network update cycles measured in days or weeks, rather than the required hours or minutes.

- The increasing need to apply uniform policy across heterogeneous (multicloud) infrastructures. As enterprises increasingly deploy applications in multiple environments (for example, on-premises, Amazon Web Services [AWS] and Microsoft Azure), consistent security and compliance must be maintained. Intent-driven systems provide a single, consistent, business-driven method to do so.

Network leaders will face the task of evaluating and integrating intent-based tools into their environments. Pressure from senior management to improve availability and agility while lowering costs will drive these efforts. Intent-based tools will reduce full-time equivalent (FTE) hours devoted to deployment and management, reduce downtime, and enable integration of multivendor (including OSS, white-box and brite-box) hardware and software.

We expect the move to intent-based tools to be driven by startups, because much of the underlying work is based upon university research on algorithmic approaches to proving network correctness. Incumbent vendors will incorporate intent-based capabilities into their portfolios, either through organic means, a hybrid approach that includes licensing core intellectual property from research organizations, or, in order to maintain account control, via resale or acquisition.

Mainstream enterprise network teams are highly risk-averse, and prefer incremental change to dramatic or radical shifts. Network designers will resist giving up direct control to algorithm-driven processes. These individuals are used to a very hands-on-the-devices approach, so any change to the status quo will be resisted. This reduces the likelihood of adoption of a technology like intent-based networking, which requires a change in thinking.

As a result, adoption will vary, based upon the capabilities of the offerings. Monitoring- and remediation-focused tools will see the greatest initial acceptance, because they are the easiest to integrate into existing production environments, and because they promise the quickest return on investment. Intent-networking-based design/build tools will initially focus on constrained problems, such as data center networking.

Recommendations:

Over the next six months, VPs of infrastructure and operations (I&O) at forward-leaning companies should:

- Identify members of your network teams that willingly embrace new modes of thinking and operations, and allocate them time to evaluate emerging offerings.

- Question incumbent networking and network management vendors, as intent-washing will be prevalent. Just as incumbents rebranded old products as "cloud," expect that they will claim that any policy-based tool is intent-based. Not all are; maintain skepticism.

- Identify a pilot project for the evaluation and possible introduction of intent-based networking tools. These projects should focus on identifying the business value of the use of these new tools, and should not just focus on the technological aspects. For example, look to intent-based networking tools if you struggle with providing consistent network policies across heterogeneous infrastructures at scale.

- Take a measured approach to intent-based networking if you are in a mainstream organization. Perform the steps listed above, but perform the steps over the next 12 to 18 months.

Strategic Planning Assumption: By 2018, more than 40% of WAN edge infrastructure refresh initiatives will be based on SD-WAN appliances and/or x86-based vCPE platforms versus traditional routers (up from less than 2% today).

Analysis by: Andrew Lerner

Key Findings:

- Many enterprises are struggling with the cost, performance and flexibility of their traditional WANs, further exacerbated by the proliferation of public cloud applications.

- SD-WAN is gaining momentum, as it provides a very tangible ROI affiliated with the technology, often saving 40% or more compared to traditional WAN approaches.

- Many networking vendors now offer SD-WAN functionality products, while carriers and management service providers (MSPs) are beginning to launch and roll out managed SD-WAN services as an alternative to managed routers.

- Global SD-WAN adoption has grown from a handful of paying customers in June 2014 to more than 2,000, as of September 2016.

- Virtualized CPE increases the agility of enterprise networks, enabling them to respond to changing needs more rapidly, while simultaneously reducing the costs of adding additional functions at the WAN edge.

- Network service providers (NSPs) are starting to roll out and pilot their vCPE solutions, including AT&T, Orange and Verizon.

- SD-WAN and vCPE can be deployed by the enterprise, or by NSPs as a managed service. Further, they can be used in conjunction with one another, namely with SD-WAN as a virtualized network function residing inside a vCPE server/appliance.

- Major WAN decisions are made by 31% to 47% of enterprises each year, including equipment refresh or carrier renegotiations (assuming the refresh cycle on routers is six years, and the average enterprise WAN services contract is three years).

Market Implications:

Over the next two years, adoption of hybrid WANs will increasingly be driven by workloads continuing to shift to the public cloud. Thus, we anticipate rapid adoption of SD-WAN and vCPE solutions in the enterprise, driven by the following considerations:

- SD-WAN solutions are much better aligned with hybrid WAN architectures from cost and operational perspectives, compared to traditional routers, and are increasingly available from many networking vendors.

- The cost, agility and operational simplicity benefits are significant for vCPE, combined with carriers leading with vCPE as flagship offerings.

- Both vCPE and SD-WAN can be deployed directly by the enterprise or consumed as a managed service.

Recommendations:

- Include SD-WAN and vCPE offerings on procurement shortlists when moving to hybrid WAN architectures and/or refreshing branch WAN equipment.

- Pilot SD-WAN solutions for branch offices to redress device complexity and/or high WAN transport or equipment costs.

- Use vCPE offerings as an alternative to traditional, mission-specific appliances when refreshing network edge devices or renewing managed network service deals, or to reduce branch appliance sprawl.

Replay Prediction

The replay prediction is a prediction from a previously published report that is so significant that it is being republished here.

Strategic Planning Assumption: By year-end 2020, more than 60% of enterprises will have deployed direct internet access in their branch offices, up from less than 30% in 2016.

Analysis by: Bjarne Munch

Key Findings:

- Enterprises that have moved their applications to external cloud services while backhauling internet traffic to a central data center internet gateway often experience degraded application performance due to increased network latency.

- Continued expansion in enterprise use of cloud services requires a redesign of branch office internet access to improve cloud connectivity.

Market Implications:

Enterprises moving applications into public cloud services (that is, internet-based cloud services) continue to report application performance issues. We continue to see that traditional centralized internet access solutions are a major cause of

these performance issues, because they lead to suboptimal traffic routing and subsequently too much network latency. Enterprise network leaders have multiple options to create an internet access solution, and the choice of an internet access solution will be dictated by the broader enterprise cloud strategy. Gartner's 2015 Cloud Planning and Adoption Survey showed that 82% of organizations plan to use public cloud services by end of 2017, up from 45% by the end of 2015, while 88% of these organizations have a cloud-first strategy.

We believe that the majority of enterprises must adopt an internet access solution that provides good connectivity to a broad range of cloud services, and direct internet access from enterprise branch offices offer the most flexible connectivity to any internet-based cloud service, with the most direct network path.

Recommendations:

■ In scenarios where network teams are involved prior to public cloud service being selected, ensure that the new location of the applications will not introduce significant additional latency through the network.

■ Enterprises with significant use of cloud services from a range of cloud providers should choose branch office direct internet connectivity because it offers the best flexibility for most direct connections.

■ Enterprises that need guaranteed performance and privacy for specific business-critical applications should complement branch-office-based solutions with hub-based solutions.

A Look Back

In response to your requests, we are taking a look back at some key predictions from previous years. We have intentionally selected predictions from opposite ends of the scale — one where we were wholly or largely on target, as well as one we missed.

On Target: 2015 Prediction — By year-end 2017, at least five national carriers will have incorporated SD-WAN as a key component of their managed service design, up from zero today.

This prediction has already become a reality, since at least seven vendors now offer managed SD-WAN

services as of September 2016. Since we made this prediction, carriers around the world have been busy launching various types of managed hybrid WAN services, and we have also seen at least five carriers, such as AT&T, BT, CenturyLink, Interoute, Masergy, Singtel and Verizon, launch SD-WAN-based services.

Missed: 2014 Prediction — By 2016, 50% of enterprises will choose to overbuild the WAN versus tightly managing bandwidth, up from less than 15% today.

This is an example of where Gartner's prediction was too aggressive, but was directionally correct. While we have identified a strong trend in the rapidly declining bandwidth pricing, we overstated the actual adoption by enterprises. We do see the cost of bandwidth being significantly reduced when enterprises migrate their WAN access from a leased line or broadband access to a fiber-based Ethernet service; however, the slow rate of WAN contract refresh with many enterprises just renewing/extending existing contracts hampers adoption of fiber-based access. We also see that, in many countries, fiber-based access has limited availability outside of metro areas. For this reason, a more correct statement is that more than 50% of enterprises overbuild their WAN access in select areas, where fiber connectivity is available.

About China Telecom Global Limited

China Telecommunications Corporation ("China Telecom"), one of the world's largest providers of integrated telecommunication services, keeps pace with the times and it has a long-standing commitment to the development of our global operations and capabilities. In November 2000, China Telecom took the first step to realize that commitment by establishing a representative office in America. Over the next decade and more, China Telecom's international footprint grew rapidly with the establishment of China Telecom (Hong Kong) International Limited, China Telecom Americas Corporation, China Telecom (Europe) Limited and China Telecom (Africa and Middle East) Limited. China Telecom set up subsidiaries in 27 countries and regions, as well as 68 overseas POPs, and owns more than 20T capacities in international connectivity bandwidth and intercontinental capacity. China Telecom also has resources on 38 submarine cables, while participating in the construction of more than 10. With direct connections to more than 10 neighbouring countries and regions via terrestrial cables, China Telecom has primarily forged its global layout of service network and network capacity.

Driven by our determination to serve the ever growing demands from integrated operation of international telecommunication business, and to enhance our global serving quality as well as to accelerate the overseas business expansion, in 2012, China Telecom resolved to integrate our international business resources and human resources to found China Telecom Global Limited ("CTG") which is headquartered in Hong Kong.

Leveraging on its abundant resources in Mainland China, CTG bridges the Asia Pacific region and connects the world. It has gradually become a world-class integrated provider of communications services including network deployment, service support and product supply. Targeting international carriers, multinational corporation clients and overseas Chinese, CTG provides customised and economical integrated communication solutions and diversified telecom services to cater for their global business needs. Its services include internet direct access, internet transit, broadband, unified communications, cloud computing, ICT, fixed and mobile voice and value added services, professional services and industry solutions, operation consultancy, outsourcing, etc.

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