White Paper

ZTE: Enabling CSP Digital Transformation to the Cloud Era

Sponsored by: ZTE

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IDC OPINION

The rapid pace of innovation in the ICT industry, changing customer demands, and ongoing digital transformation across industries and verticals, all requires important changes in the ways communication service providers (CSPs) operate. At the basis of CSP transformation into digital service providers capable of competing with over-the-top (OTT) providers is the transformation of CSPs' technological foundation – their networks.

- CSP network transformation will, in IDC's view, be based on the guiding principles of software-centricity and cloud, which will drive rapid adoption of technologies such as software-defined networking (SDN) and network function virtualization (NFV). CSPs will utilize these, and similar future technologies, not just to improve the way they operate traditional telecommunications technologies; the adoption of these technologies will trigger a qualitative change in CSP businesses.
- Through NFV and SDN, CSPs stand to gain unprecedented agility, flexibility, and efficiency, but only if the transformation of the way they develop their services, and conduct their business, goes hand in hand with that network transformation. To achieve excellence in service creation and customer engagement, CSPs need to reinvent their processes and organization along the transformational lines represented by Agile and DevOps services and software development methods.
- Another extremely important aspect of CSP digital transformation is the necessity for CSPs to adopt the mindset of cloud-scale service providers and large enterprise IT users. This is because most innovation and technologies that enable new competition to CSPs come from these areas. In other words, to survive in the world dominated by cloud players, telcos need to ***become*** cloud players, not trying to achieve parity in the services provided, but in adopting technologies and processes that enable cloud-like scale, agility, and efficiency.
- The changing nature of CSP operations will also lead to changes in the way that the market for CSP-oriented vendors operates. Networks will become truly multivendor, and the shift from selling "boxes" to solutions with a significant share of value residing in software and services, will be advantageous for vendors that can demonstrate software innovation and fluency in cloud technologies, and can provide customers with support beyond the solution itself, with consultative and co-development capabilities being key in this regard.
- In IDC's opinion, ZTE has built on its status as a major network equipment provider, to build a full ICT platform that incorporates cloud-native technologies while meeting the agility needs of its carrier customers. These characteristics make it particularly suited to playing an important role in digital transformation of their customers' networks and operations.

IN THIS WHITE PAPER

This White Paper focuses on assessing the ZTE solutions and services portfolio from the standpoint of CSP digital transformation, and associated technology and organizational trends. The White Paper is based on IDC's in-depth analysis of market trends driving the CSP market, and on detailed insight that IDC has been granted to ZTE's portfolio and strategy.

The document presents an overview of the current state of the communications services market, and its effects on CSP business. Furthermore, it assesses requirements that the current market conditions pose for CSP networks, and ZTE's portfolio, considering the current market conditions and associated trends driving CSP network development and business transformation.

Additionally, the document presents a future view of the CSP market development in the foreseeable future, along with IDC projections for market developments that will likely drive the development of network technologies in different domains of CSP activities. ZTE's current portfolio and roadmap plans are addressed in light of expected CSP network and business transformation development.

The paper concludes with IDC's view on challenges and opportunities that ZTE will face in the CSP ecosystem, and conclusions IDC draws from relevant market developments and ZTE's product portfolio, strategy, and development roadmap.

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SITUATION OVERVIEW

CSP Services Landscape is Transforming

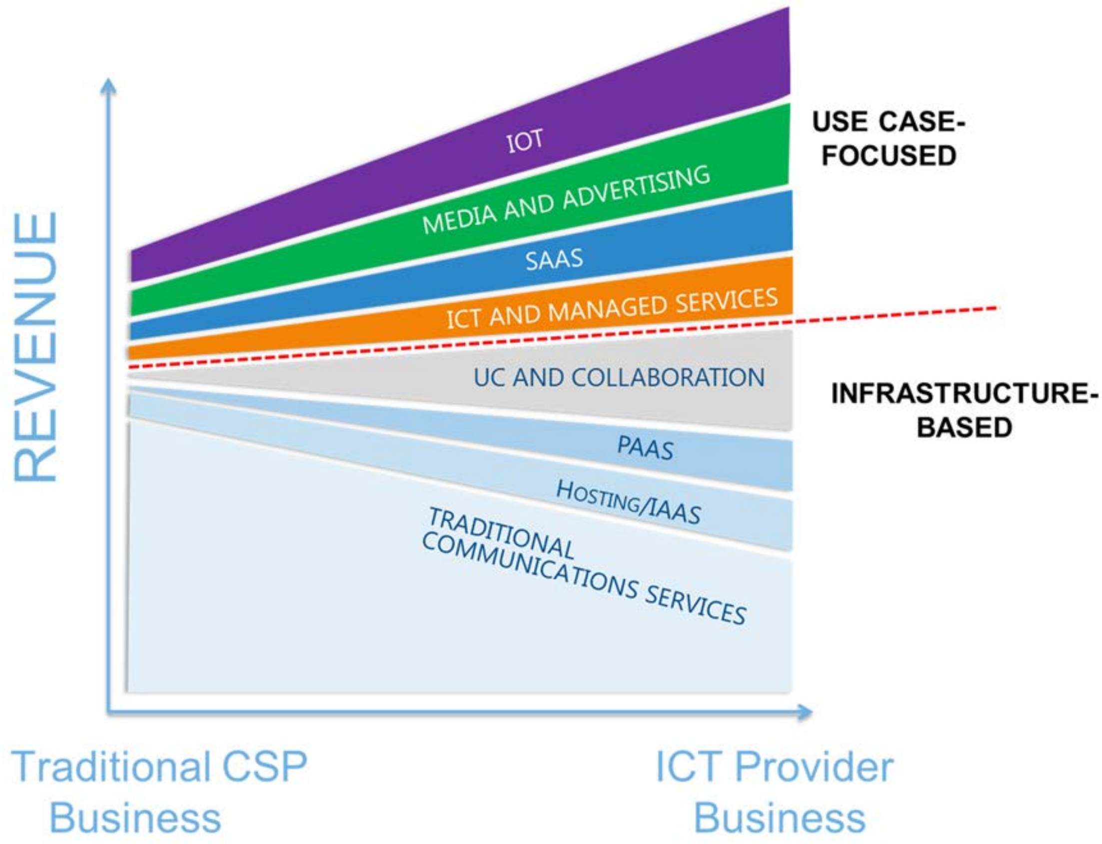
This is a time of tremendous disruption for communications services providers (CSPs). Consumers use ever-increasing amounts of data, and have an insatiable hunger for new digital services. Enterprises do as well, but beyond that, they demand ever-increasing service velocity, quality, security, and differentiation, in support of their own digital transformation efforts. These changing demands stem from fundamental transformation in the way enterprises do business – primarily the adoption of IoT and public cloud services, which are quickly changing enterprise traffic patterns, volume, and security requirements.

Beyond adapting to increasing complexity of customer requirements, CSPs face additional business challenges: OPEX growth; the advent of over-the-top digital giants, as well as cloud providers, as competitors; and new regulatory measures promoting additional competition.

These forces create a difficult challenge for CSPs. Revenues from traditional communication services are declining so steeply that no new service can reverse the trend on its own. Rather, it will take multiple additional services to return CSPs to reliable top-line growth (See Figure 1). To create, provision, and manage all of these services in a cost-effective way requires an integrated, virtualized ICT environment. Operators that try to enter these business lines with siloed, inefficient infrastructures will increasingly find themselves drowning in costs and falling behind their competitors. These issues thus represent not only an increasing impact on operators' profitability, but also a threat to their very sustainability.

FIGURE 1

Many New Services Must Make Up for the Declining Core Business



Source: IDC, 2017

Need for Digital Transformation and CSP Service Transformation

Overall, these changes in customer demand and market conditions affecting the CSP business are driving the transformation of CSPs into integrated digital service providers, capable of satisfying requirements of consumers and enterprises, while maintaining profitability and revenue growth.

Guiding Principles for Infrastructure Transformation

As a part of this fundamental evolution, CSPs are transforming the technical foundation of their business – their networks. This transformation is directed at satisfying the needs of the digital customer in a cost-effective and efficient manner, while reducing time to revenue. The driving principles that CSPs use to strategically direct their transformation efforts are:

- Efficiency. Legacy technologies only allow for relatively crude capacity planning in CSP networks. This has, in the past, led to solving all possible congestion problems with over-provisioning – the networks were dimensioned for the most adverse conditions, which seldom or never happened. This meant that large parts of installed network capacity were never actually used. Going forward, this situation is becoming unsustainable, due to costs related to acquiring and running the networks. Network capacity must become more dynamic, burstable, and flexible.

- **Time to market.** Service creation in legacy networks is often measured in months, due to tight integration of hardware, software, and service parameters. This is because the services available to customers were tightly defined by the network equipment itself, a situation that has led to the formation of inflexible network silos. With the advent of over-the-top, web-based services, these silos proved to be a major impediment to CSPs' ability to launch and sunset services quickly and in tune with changing market demands. New networks must enable CSPs to dramatically shorten time to market if they are to remain competitive.
- **Agility.** Like time to market, the capability of CSPs to react to market demands by differentiating and customizing their services is also limited by the characteristics of legacy networks. CSPs must adopt a fast-fail model, substantially reducing the opportunity cost of any one service so that they may innovate more freely. Their networks need to transform to enable cost-effective creation of diverse service portfolios, capable of serving the needs of a much wider spectrum of customer requirements, creating the capability to address the "long tail" of customer niches, primarily in the enterprise market.
- **Cost control.** In the past, CSP networks were built using predominantly proprietary, telco-grade technologies and hardware. In a time when the capacity of networks is expected to continually increase, keeping the cost of adding capacity under control is paramount. On the other hand, general IT technologies, such as x86-based servers, IP networking, and storage, are commoditized, and provide an opportunity for CSPs to reduce their TCO, both by controlling CAPEX and reducing OPEX through higher use of automation technologies invented for the purposes of cloud deployments in enterprises and cloud service provider datacenters.

While transformation is different for every CSP, there are common concerns: it will always affect the CSP's technical architecture as well as its business model.

Technical Foundations of the New Infrastructure

Guided by the principles above, CSPs are creating a new digital network, underpinned by the cloud, IT processes, SDN, and NFV. These technologies are, or will be, implemented throughout the network or more widely defined CSP infrastructure.

- **CSP Cloud.** IDC understands CSP cloud to be an umbrella term that describes the use of general IT hardware building blocks to establish a flexible foundation for different aspects of CSP operations. At present, there are three major types of cloud deployment within CSP networks: IT private cloud, supporting internal telco IT functions, including OSS and BSS; public or hybrid cloud infrastructure, supporting cloud XaaS services for clients; and NFV Infrastructure (NFVI), which supports the virtualization of core CSP functionality, used to support communications services provided to CSPs' customers. At present, very few CSPs build these cloud infrastructures on a common, shared infrastructure, not to mention one that can support each use case with an optimal set of performance characteristics. Going forward, to realize maximum efficiency, cloud domains within the telco needs to merge.
- **SDN.** Software-defined networking in the CSP domain is one of the necessary tools to enable cloud functionality in different aspects of CSP operations. Beyond the use of SDN in enabling the automation of datacenter networking, which is well understood from enterprise and cloud-centric datacenters, SDN is necessary to enable novel ways of providing wide area network (WAN) services to enterprise clients. This is best exemplified in the rapidly spreading concept of software-defined WAN (SD-WAN), which is bound to transform enterprise WAN services market. SDN has its uses in other domains of telco operations as well: use cases include automated provisioning of mobile backhaul links, or virtualizing consumer CPE for fixed-broadband services.
- **NFV.** Network function virtualization is the architecture that CSPs are predominantly using to drive the transformation of their networks from a collection of hardware-centric,

inflexible, predefined functions, to a common infrastructure based on general IT hardware, capable of supporting a multitude of current and yet undefined network functions. NFV intersects with cloud implementations, where its infrastructure part (NFVI) equals purpose-built datacenter infrastructure capable of supporting virtual network functions (VNFs). VNFs themselves represent the NFV software that enables communication service functionality. NFV MANO (management and orchestration) solutions support the deployment and operation of services defined in VNFs. Altogether, NFV provides a flexible and versatile framework to establish a flexible foundation for software-centric CSP operations.

Business Foundations of the New Infrastructure

Additionally, on this digital transformation journey, CSPs have developed a specific set of requirements governing their network transformation and implementation of software-centric technologies and architectures. The most important aspects of these requirements are the following:

- **Use of open source software.** CSPs have a lot of experience with CSP-specific vendor ecosystems. Although the symbiosis of CSPs and their vendors has been fruitful and has contributed to huge wealth generation, there is a feeling that in some aspects this cooperation is reaching its limits. In other words, CSPs need to diversify their software code base to be able to profit from fast pace of development in the open source communities, while keeping costs under control. The use of open source foundational technologies also helps CSPs to enroll new, smaller software vendors more quickly, or support custom software development better.
- **DevOps.** DevOps in the CSP space primarily refers to driving CSPs' speed and agility of service creation by adopting software development methodologies that promote these same qualities. Most CSP services will be defined in software, and that software will contain components that CSPs will source from vendors, open source communities, and their own development. CSP DevOps must tie all these aspects together.
- **Multivendor networks.** The close relationship between CSPs and their suppliers and proprietary nature of CSP network equipment usually led to CSP networks relying on a very limited number of vendors, resulting in the significant leverage vendors have over CSPs. This "vendor lock-in" is becoming an increasingly significant impediment for CSPs undergoing the process of digital transformation. In software-centric environments, leading CSPs expect a high level of standardization, commonality, and API-based interoperability, enabling them to use a much wider selection of vendors, either in parallel, or interchangeably.
- **Organizational changes.** Due to the highly siloed nature of legacy operations, many CSPs are organized into parallel divisions, interacting very little in their day-to-day activities. As general IT hardware starts to underpin an increasing number of communications services, the overlap in expertise between CTO and CIO organizations is becoming increasingly evident, and many CSPs have started merging these two functions. Also, sales and marketing functions within the CSPs are getting closer to CTO organizations, as service design becomes more flexible and adjusted to customer demands.

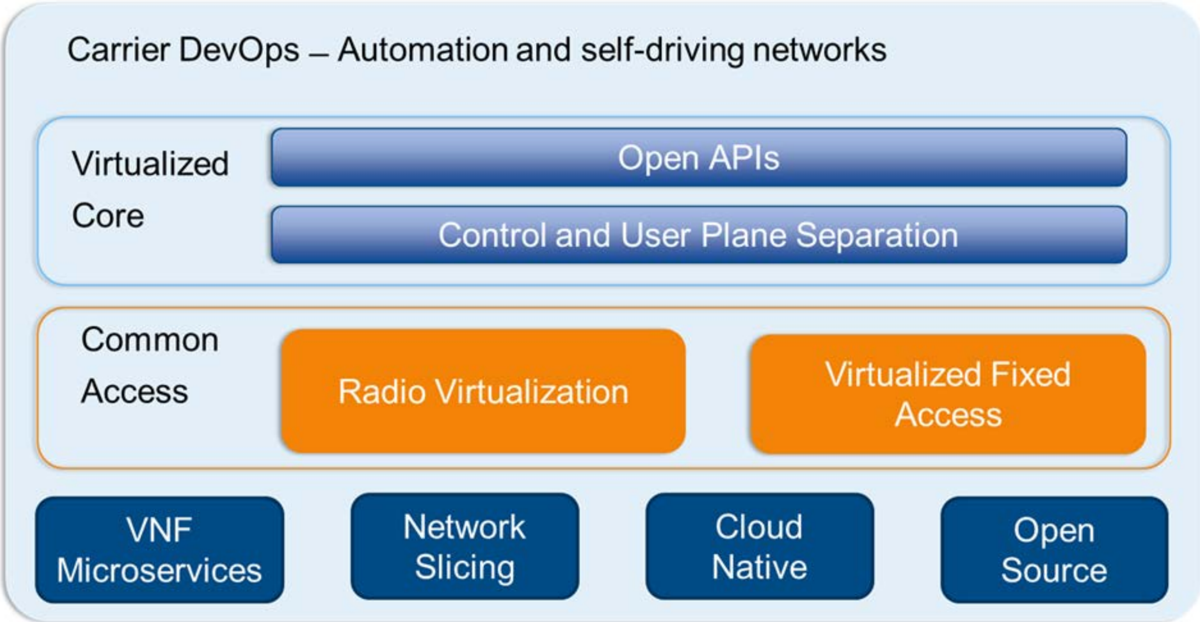
Together, the trends and requirements are parts of an extremely complex process, requiring CSP suppliers not only to have industry expertise that spans technology areas that are broader than the traditional telecoms sector, but also a high level of confidence in general IT technologies, along with the knowledge of specific issues accompanying general IT technology implementation in CSP infrastructures. The vendors serving the CSP markets also need to possess ecosystem relationships that enable next-generation services, networks, and operations, and must be able to support the co-development of solutions specific for each CSP's situation.

FUTURE OUTLOOK

In addition to the trends that are currently driving CSP transformation, IDC expects the process to accelerate beyond the present stage soon, fueled by several important changes to the overall ICT environment.

FIGURE 2

Future CSP Network in a Software-Centric Environment



Source: IDC, 2017

IDC believes that the future of CSP digital transformation will primarily be driven by the following:

- **Implementation of microservices.** The current crop of NFV deployments is mostly based on software functions ported from ATCA platforms to x86 platforms. The main issue that CSPs face when deploying such functions is their poor cloud optimization and relatively low usage of truly virtualized underlying infrastructure. To tackle these issues, CSPs and their vendors are working on deconstructing network functions into components – microservices – that can be used to compose stateless network functions that take full advantage of cloudified network infrastructure.
- **Unified distributed cloud infrastructure**. The main trait of cloud infrastructure presently deployed in most CSP environments is its single purpose. Most clouds are deployed on purpose-built platforms, optimized for NFV, internal IT functions, or externally offered cloud services. Additionally, cloud infrastructures are usually highly centralized, and can support a limited number of functions that are suitable for centralized deployments. The way forward is unification of cloud infrastructure, with cloud capacity within the CSP organization shared between different IT and CT functions, and in a later stage, with clients as well. Additionally, CSP cloud infrastructure will be highly geographically distributed, with compute and storage capacity supporting VNFs across different sizes of the CSP's points of presence (POPs). The concept of a distributed datacenter is necessary to implement, to support capacity and performance requirements of network functions not suitable for centralized deployments, such as radio and fixed access, and vCPE.

- **Cloudification of NFV.** The early stages of NFV development consisted of rewriting hardware-based functions in software on a one-to-one basis. While a necessary step in the evolution of networks, this implementation still required dedicated hardware, and did not sufficiently support the burstable and shiftable capacity required by dynamic network usage. The industry is therefore quickly shifting to a cloud-native NFV model.
- **5G and Radio Virtualization.** The advent of 5G networks is often viewed as a process primarily affecting radio networks. In reality, true 5G networks will necessarily require highly distributed compute capacity throughout the network, robust and automated MANO, support for virtualized radio network elements, and highly automated virtualized core, to be able to support most commonly mentioned 5G use cases.
- **Open APIs.** As the complexity of service portfolios, network operations, and partner ecosystems explodes, and as CSPs work to dramatically reduce their time to market, they are increasingly relying on open APIs that expose their network and system capabilities to automated service composition and assurance, and to partners that use those APIs to incorporate CSP capabilities in their own services.
- **Network Slicing.** The ability to set up and tear down multiple virtualized network slices – logically autonomous virtualized networks – optimized for specific customer requirements tied to the use case in question, is one of the most important capabilities that CSPs will need to support various vertical IoT use cases. Such a network must be both virtualized and multitenant, with security microsegmentation implemented end-to-end.
- **Automation and self-driving networks.** Currently available automation solutions mainly rely on a "human-in-the-loop" concept, where operations personnel steer policies and templates that are implemented across different network domains. Future networks will need decision-making and adaptation to happen much closer to real time. With network slicing, the problem will be even more complicated, as the actual user of the network (for example an enterprise client) will not even have the resources available to manage network functionality. For such operations to be feasible, network operations need to utilize Big Data, analytics, and cognitive computing to enable the closure of the automation loop, in a concept sometimes called "self-driving networks."

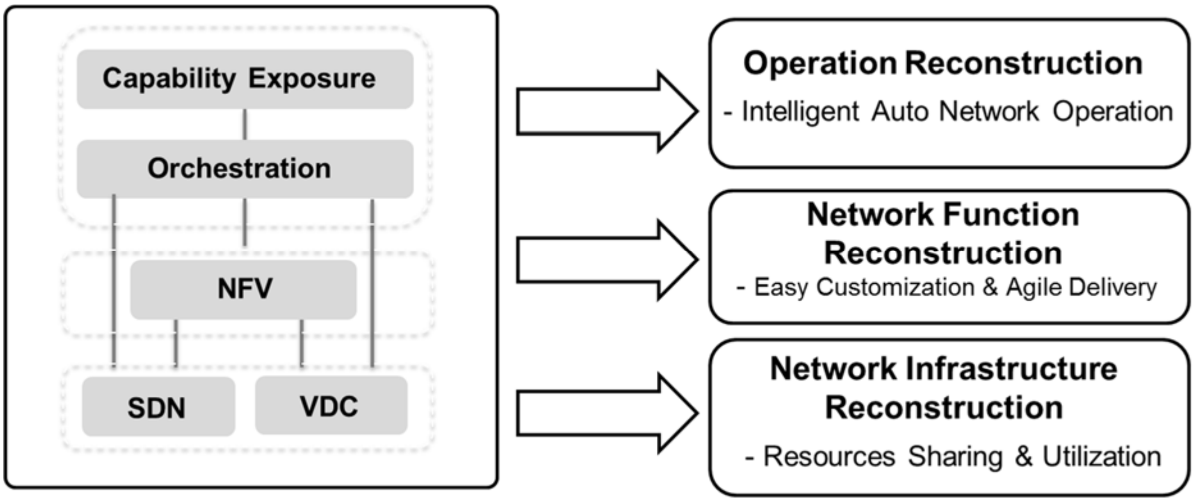
ZTE'S END-TO-END CLOUDIFICATION SOLUTION: ELASTICNET

ZTE is an experienced supplier of CSP infrastructure, with a wide portfolio of products supporting wireless and fixed access networks, transmission and IP networking, core networks, and cloud computing infrastructure. To support and encourage the digital transformation of CSPs, ZTE has established a full set of infrastructure, application, and professional services. The mainstay of ZTE's solution offering is its ElasticNet portfolio.

To enable cloudification of CSP networks, ZTE proposes a range of solutions within ElasticNet, divided into three reconstruction "levers" that enable transformation from traditional network infrastructure to the future evolution of cloud network. The three reconstructions support decoupling at all levels and follow ETSI NFV specifications, as well as other open communities such as OpenStack, ONAP, OPNFV, Open Daylight (ODL), and ONOS. They are Network Infrastructure Reconstruction, Network Function Reconstruction, and Operations Reconstruction.

FIGURE 3

ZTE's Cloudification Framework



Source: ZTE, 2017

Network Infrastructure Reconstruction

ZTE's approach to network reconstruction is to build open cloud ICT infrastructures, based on open source software and architectures, enhanced for carrier-grade volume and reliability. This infrastructure then forms a unified platform providing infrastructure as a service (IaaS)-like capabilities to communications functions within the CSP framework.

ZTE proposes a common, distributed DC infrastructure capable of supporting IT applications, VNFs, and the customer's industry-specific applications.

ZTE Tulip Elastic Cloud System – VIM & Hypervisor

ZTE Tulip Elastic Cloud System (TECS) is a KVM/OpenStack-based virtualization and virtual infrastructure management platform. TECS is an infrastructure as a service (IaaS) cloud computing and management platform in ZTE's ElasticNet solution, aiming to provide virtualized management for computing, storage, and network resources, rapidly build a cloud environment, and provide policy-based IaaS service and application deployment functions in the heterogeneous cloud environment of multiple datacenters. TECS also serves as ZTE's platform for interaction with the OpenStack, Ceph, and OPNFV communities. TECS can provide a virtual datacenter (vDC) service that can be flexibly deployed on a unified resource pool across physical datacenters, allowing customers to plan and manage cloud resources in the heterogeneous cloud environment in a unified manner.

ZTE E9000 — Commercial-Off-The-Shelf Hardware with Telco Acceleration

In addition to a series of standard commercial-off-the-shelf (COTS) servers, storage disk arrays and Open Flow capable Ethernet switches, ZTE also provides standard PCI-E interface network interconnect cards (NIC) which contain codecs and a field-programmable grid array (FPGA) that accelerates the forwarding capabilities of COTS infrastructure in line with CSP requirements.

ZTE ZENIC Elastic Network Intelligent Controller

ZTE ZENIC Elastic Network Intelligent Controller (SDN Controller), is a central SDN controller product that supports both the single-DC networking mode and multi-DC networking mode. In ZTE's architecture, ZENIC provides SDN control within the DC, and across the WAN, as well as over IP and optical domains.

Case Study: China Telecom

ZTE has implemented its network infrastructure reconstruction solution in China Telecom's operating unit Shanghai Telecom. It brings together substantial resources into a single logical system: 50 datacenters, 50,000 physical devices, and 1 million virtual machines. Even on the virtualized side, the environments that feed into the system are heterogeneous, requiring abstraction of the different environments into a single management system. ZTE's TECS open cloud platform enables unified management of five kinds of mainstream virtual resource pools, a multivendor SDN controller, and multivendor IT hardware support. The integrated management system enables resource sharing across formerly separate systems, producing an overall 40% improvement in resource utilization.

Network Function Reconstruction

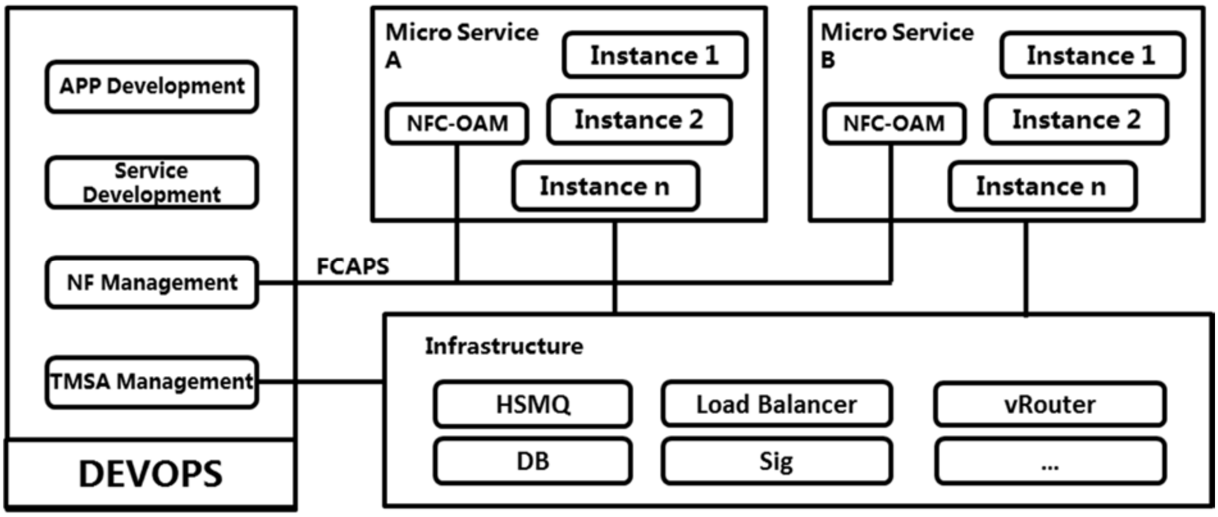
Instead of monolithic network functions, rewritten for general compute platforms (an approach that was characteristic of the first phase of NFV), ZTE proposes VNFs consisting of micro-service components, composed under automated management and orchestration. ZTE develops its network functions with a view of supporting on-demand network slicing, and layered deployment in distributed datacenters. Beyond the traditional 3GPP FE virtualization, ZTE adopted Open API for service architecture and container technology, building lightweight network components, while retaining openness of the network capabilities it provides. In practice, this enables ZTE to tailor its network function deployment strategy to different customer demands; for example, scaling its solutions to suit customers of different types and sizes.

CloudNative includes the following characteristics:

- Micro service architecture
- Stateless components
- Separated service logic processing from data storage
- Independent upgrade/scaling
- Lightweight container technology
- Self-healing
- Open API
- DevOps Support
- FCAPS (Fault, Configuration, Accounting, Performance, and Security)

FIGURE 4

ZTE CloudNative Software Architecture



Source: ZTE, 2017

ZTE vVoLTE, vEPC and cloud RAN solution are based on CloudNative software architecture.

Virtual Voice Over LTE

ZTE's Virtual Voice Over LTE (vVoLTE) solution includes virtualized instances of all core network elements (SBC, CSCF, TAS, HSS, MGCF, MRFP, ENUM, EMS, CG, and others). All components have been deployed commercially in operators of Telefonica Group, Telekom Austria Group, China Mobile, and other operators.

Virtual Evolved Packet Core

Using a data plane development kit (DPDK), FD.io (fast data input/output) and related NFV acceleration technologies, ZTE claims that its Virtual Evolved Packet Core (vEPC) has achieved the performance that allows it to fully replace traditional EPC. The solution allows for control/user plane split, the use of a distributed user plane, and provides an affordable way for CSPs to support IoT use cases, for example.

Virtualized RAN

In line with the technology trends it addresses with other parts of its portfolio, ZTE is proposing its 5G-ready radio access network (RAN) solution – ZTE Cloud RAN. The main principle of Cloud RAN is building a wireless network based on a cloud processing platform, allowing CSPs to achieve the performance and flexibility needed to serve the requirements of various future services.

ZTE Cloud RAN is based on a unified virtualization platform, and integrates multiple access modes (including 2G, 3G, 4G, WiFi, IoT, and 5G) with high connection density. The platform, based on platform-as-a-service (PaaS) architecture, provides open interfaces for third-party function vendors, which enables operators to rapidly deploy new services in changing business circumstances.

ZTE's Cloud RAN is a fully virtualized RAN including controller, base band unit (BBU), network management and related tools, based on the unified M-ICT platform which integrates IT and communication service requirements. The platform enables flexible architecture, allowing separate service and hardware deployment.

With regards to the network architecture, ZTE's Cloud RAN integrates existing RAN and transmission networks, enabling CSPs to enhance their network performance, and supports 5G-oriented Central Unit (CU) and Distributed Unit (DU) deployment.

Case Study: Vimpelcom (Now Veon)

Since 2015, ZTEs vEPC has been commercially deployed in five country operations of the VimpelCom (Now Veon) Group, along with the underlying NFVi. The datacenters in these five countries are linked into a single resource pool, and 500 test cases have been verified in six months. ZTE claims a 30% reduction in total cost of ownership, composed of drops in hardware, deployment, room rental, power, and maintenance costs. Building on this work, ZTE has just been awarded additional OpCos for its NFVi solution, making it the only NFVi vendor for Veon. The vendor believes that the scale of this deployment will make Veon the most virtualized operator upon completion.

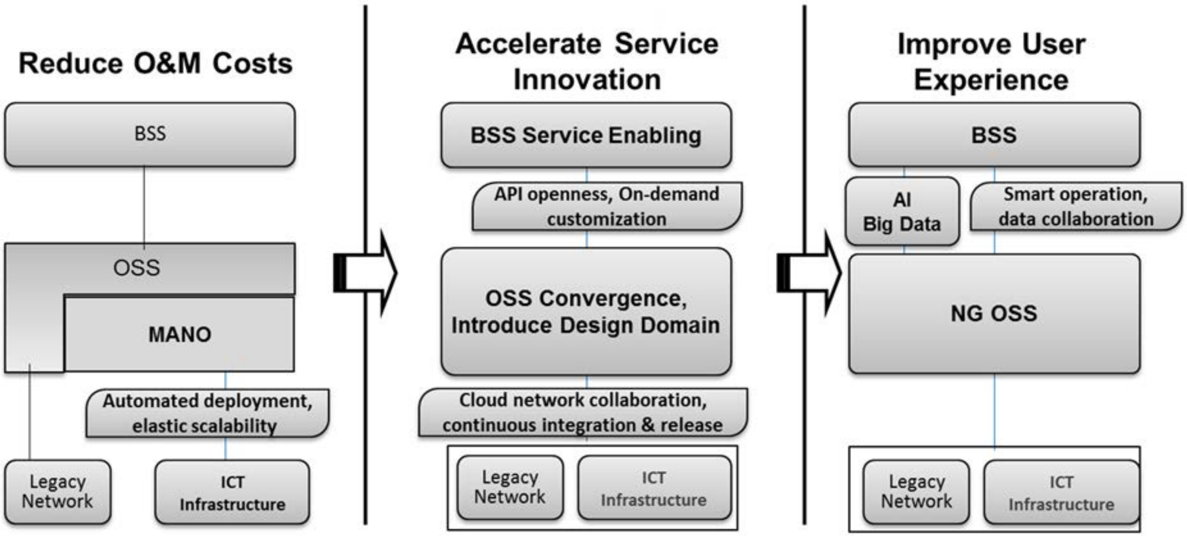
Operations Reconstruction

One of the biggest problems that CSPs face in transformation is the necessity of gradual change: they must continue to serve their customers with their legacy environment while implementing their new environment and providing services on that infrastructure as well. To address the transformation needs of carriers with significant legacy infrastructure, ZTE has outlined a plan for architectural transition, and has established professional services support not only to integrate systems but also to assist its customers with both technological and business transformation. Different carriers have different approaches to combining the two infrastructures or leaving them separate.

ZTE designed the transformation process to enable increasing amounts of automation by adding analytics and artificial intelligence, and by converging OSS and BSS functions until they reach the target unified service creation and orchestration capability. Open APIs are also progressively added to support a platform ecosystem in which partners can create services using the carrier's capabilities, and to onboard these services automatically.

FIGURE 5

ZTE's Operation Reconstruction Approach



Source: ZTE, 2017

ZTE MICT-OS

ZTE MICT-OS is a customer-facing product and solution development platform, operation platform, and ecosystem platform that integrates CSP's network resources, IT resources, user resources, third-party contents, and applications, which would gradually become an operating system for CSPs. ZTE's MICT-OS is a management and orchestration (MANO) layer designed to address that issue, enabling end-to-end service orchestration across virtualized elements and legacy, hardware-based elements. MICT-OS integrates the three domains of "Design domain + O&M domain + Operation domain," uses global orchestration as the core engine, accelerates service innovation with the agile DevOps mode, and saves OPEX with intelligent and automatic O&M. This solution accelerates operation transformation in the aspects of fulfillment, assurance, and service capabilities, and makes it possible to achieve end-to-end orchestration and management cross-domain, cross-network, multi-VIM, multi-DC, and multi-vDC.

ZTE Cloudworks (Carrier DevOps)

To address the requirements for on-demand service customization, quick service delivery, and healthy innovation, ZTE has established an NFV-oriented DevOps platform for CSPs. Based on open microservices components, automatic tool and container deployment, the platform enables on-demand customization and quick delivery of network services for different scenarios. Cloudworks provides an online function and performance verification environment, as well as an automated simulation tool for designing network slice function and performance verification. It also enables automated deployment and lifecycle management of certified network slice designs. The end-to-end status of each instantiated slice is made available to the slice manager for further optimization or trouble shooting.

ZTE's approach to DevOps incorporates the following characteristics:

- Closed-loop, automated DevOps infrastructure support for agile service and application development

- Modular design of component services assembly, designed to enable more convenient plug and play service customization
- Microservice components with open APIs for telecom capabilities
- One-touch automatic deployment incorporating on-demand application resources, and concurrent deployment of multiple VNFs
- Closed-loop control based on Big Data-enabled policy, enabling automatic maintenance and hosting
- Enhanced carrier-grade Docker technology to meet NFV performance, networking, and automation requirements.
- Full lifecycle services including VNF and network service design, application and infrastructure management, and automatic hosting

Professional Services Support (Training and Consulting)

ZTE provides telecom cloud training courses to its customers. Additionally, ZTE has a consulting practice that can assist CSPs in network restructuring or building greenfield cloud-based network infrastructures.

Managed Services Capabilities

ZTE operates six technical support centers and four OpenLab co-development centers in Asia, Europe, and Latin America. This infrastructure provides cloud hosting operations, maintenance, and joint innovation for CSPs.

CHALLENGES/OPPORTUNITIES

In IDC's view, the main challenges ZTE faces in addressing CSP network transformation can roughly be divided into three categories:

- **Coping with intensifying and diversified competition.** In the past few years, the CSP supplier ecosystem has been going through a consolidation, as R&D costs and price competition continue to reduce margins in an already stagnating traditional CSP supplier market. ZTE has weathered these years fairly well, and remains one of the main traditional CSP suppliers. However, with the advent of NFV and digital transformation in the telecommunications industry, the number of competitors capable of serving CSP needs has increased significantly, with general IT hardware vendors and software solution providers gaining much higher profiles and relevance. Likewise, when looking purely at network functions, the move from physical network functions to virtualized ones has increased the number of players in this market as well. Finally, the use of open source software puts emphasis on ecosystem cooperation, rather than the no-holds-barred competition that was the characteristic of the CSP vendor ecosystem in the past. ZTE will need to adjust to these conditions, mainly by emphasizing its agility and R&D prowess, along with its understanding of CSP environment specifics.
- **Value transition from appliances to software and services.** Traditional CSP vendors have long relied on predominantly addressing CSP CAPEX as their main source of revenue. As more value moves to software and services, appliances usually comprising most CSP CAPEX spend will give way to software solutions, coupled with general IT hardware expenditure. Both spending categories are increasingly moving towards perpetual, "pay-as-you-go" or "pay-as-you-grow" revenue models. This will inevitably mean a significant transformation of how traditional CSP suppliers like ZTE do their business, and will reflect on the composition of their revenue. Deftly managing this transition while retaining revenue and profitability is paramount, and ZTE needs to choose carefully where it can extract the most value, and where it is more profitable to partner than to compete.

- **Managing technology partnerships.** In the past, the main method CSP suppliers deferred to when faced with market transitions was to try to steer the market their way, by increasing scale, primarily by addressing adjacent technology markets through M&A activity. This process has left a relatively small number of traditional CSP vendors in the marketplace, but, as noted before, market disruption stemming from software-centricity has cracked this status quo wide open. To succeed, any vendor supplying solutions and services to CSPs needs to be a part of an ecosystem, and managing that ecosystem will become a necessary precondition for success in the CSP market. CSP vendors such as ZTE need to focus their efforts and R&D on areas where they can provide the most value, both to their clients and their shareholders. In other areas, they need to evolve close partnerships that can complement ZTE's solutions seamlessly, and to the customers' benefit.

IDC believes that ZTE, due to its firm R&D and innovation focus, is well equipped to tackle them, and explore opportunities that CSP ecosystem provides. The traditional CSP role of providing communication services to consumers and enterprises alike is more crucial than ever. These services will continue to provide the bulk of CSP revenue in the future, and facilitating migration of communication services onto new software-based platforms remains a sizeable revenue opportunity. CSP investment in the new cloud platforms will also grow. ZTE has an advantage here of understanding the specifics of CSP environments and focusing its R&D on key innovation designed to help the CSPs transform swiftly and efficiently.

CONCLUSION

Evolving and transforming the CSP businesses is a tremendously demanding and complicated task that needs to consider both the legacy state of the business and its technical foundation, and the future end-state that CSPs are striving to achieve. Along that transformation journey, CSPs need their technology suppliers to evolve as well. CSPs need their suppliers to evolve as well, and become more than vendors of services and technology. Instead, during the transformation phase, CSPs need a much higher level of support than was previously the case. Their suppliers need to become co-developers of the future state of CSPs' networks, supplementing client capabilities where needed, while building customers' internal capacities with the future state of their business in mind.

At the current stage of transformation, CSPs primarily require support in managing the transition from legacy, appliance-focused environments, to new software-centric NFV systems, capable of supporting both IT and communications functions at maximum efficiency. The legacy and new network elements will be operated in parallel for a long time, and a clear path for migration between the two states is also required. But, to achieve maximum benefits from deploying NFV and cloud solutions, IDC believes that CSPs need to move quickly in the direction of the ideal end-state – unified cloud infrastructure, supporting composable, disaggregated functions and microservices. ZTE has proven that it can deliver just that, together with a roadmap opening up new business opportunities for CSPs, enabling network slicing and CSP DevOps.

CSPs also need to view the network much more holistically, and be aware that they will only realize the full benefits of incorporating general IT technologies when they change their internal organization and their operations to match the transformation of their network foundation. Based on its experience in telecoms infrastructure in general, and the newer area of virtualization, ZTE has designed a powerful, integrated telco cloud infrastructure and accompanying service portfolio to enable this transformation. It already has several large NFV projects in production at clients, especially elements such as vEPC, vIMS and vSDM, ranking it among the leaders of NFV commercialization. At Mobile World Congress 2017, ZTE also became one of the first companies to demonstrate that it had extended the DevOps paradigm to closed-loop, automated CSP operations, with particular emphasis on empowering CSPs to become, in effect, PaaS providers, using their networks as a platform for the services and underlying network slices that will be necessary for 5G. This approach is a very good fit to future needs of CSPs as they transform their infrastructure and business models in preparation for 5G IoT-centric use cases.

About IDC

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