Software-Defined Infrastructure Accelerates Digital Transformation

— A whitepaper on SDI development

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A long way to go for the digital transformation of enterprises

Digital transformation (DX) has become a shared target amongst today's organizations, driven by the rapid rise of digital economy. Numerous market research suggests that digital transformations are currently taking place throughout the business practices and operations in organizations, which are likely to have a profound impact on their future standing in the market. However, after embracing digital transformation to some degree, enterprises will face a range of challenges in terms of their business models, products, services, delivery capabilities and processes. This could hamper the process of transformation, decelerate its pace, and result in the benefits of the transformation becoming increasingly less visible.

IDC believes that the failure of organizations to establish a united transformation objective, flexible organizational structure and innovative corporate culture will be the macro factors that cause the transformation process to decelerate. The absence of strategies to track, evaluate and introduce new digital technologies and platforms are common weaknesses amongst enterprises at the execution level. Also, an inadequate understanding of the platform-based mindset can result in enterprises failing to create the most appropriate ecosystem for transformation, which will ultimately lead to a dilemma in which organizations are frustrated with their systems behind closed doors.

Making the right choices in terms of mindset, methodology and roadmaps toward digital transformation are deciding factors for enterprises looking to break through bottlenecks and reinvent themselves, while remaining proactive in an ever-changing market environment. This will not only put the rationality and determination of corporate decision makers to the test, it will also present each and every member of the enterprise with major challenges to overcome.

Focusing on use cases and platforms for digital transformation

Faced with several key challenges in the process of digital transformation, enterprises should form a clear understanding of their own situation through the means of scientific analytic models and examining their visions and objectives for achieving digital transformation development to in a holistic manner. This can be accomplished through identifying and categorizing various use cases in the development process. By doing so, enterprises can develop a phased roadmap to reach their digital transformation goals. During the process of transformation, the formation of a roadmap can be of extraordinary significance. It can help each member of the enterprise accurately understand corporate strategies, recognize development goals, and identify the use cases that they will be engaged with before they proceed with implementing the transformation.

As an instrument for implementing and interpreting the roadmap, enterprises should focus on building and leveraging on dynamic and advanced digital transformation platforms. These platforms can effectively support and provide navigation for the transformation of enterprises, while actively engaging, sharing and integrating with internal and external partners within the ecosystem.

The best digital transformation platforms should be agile, intelligent and secure. First, they must be able to be set up quickly, adjusted flexibly, and easily scaled up or down depending on the enterprise's future requirements and desire for efficient, easy and fast operations. Second, the platform should demonstrate considerable intelligence and autonomy throughout operations and maintenance processes, and be able to adapt to AI, edge computing and cloud native architectures in future. Ultimately, it should become an engine that can drive the coordinated development of new technologies and new architectures. Furthermore, built on a philosophy of openness and joint development, the platform can quickly leverage on consistent undertakings to meet with users' requirements for security and controllability.

SDI is ideal for digital transformation platforms

As opposed to traditional IT infrastructure and the embodiment of the next generation architectural philosophy, software-defined infrastructure (SDI) can meet with the most stringent enterprise requirements when it comes to delivering the fundamental capabilities for digital transformation platforms. Various applications of software-defined infrastructure in computing, storage, networking, and endpoints aptly demonstrate its symbiosis and superior performance in terms of control, interaction, and the acquisition of information. In terms of agility, intelligence, efficiency and security, it also delivers fitting performance for an enterprise's digital transformation.

In practical terms, there is plenty of proof that confirms that a software-defined infrastructure can provide speedy support to numerous business scenarios. As such, there is much room for growth across various industry markets thanks to its outstanding adaptability capabilities.

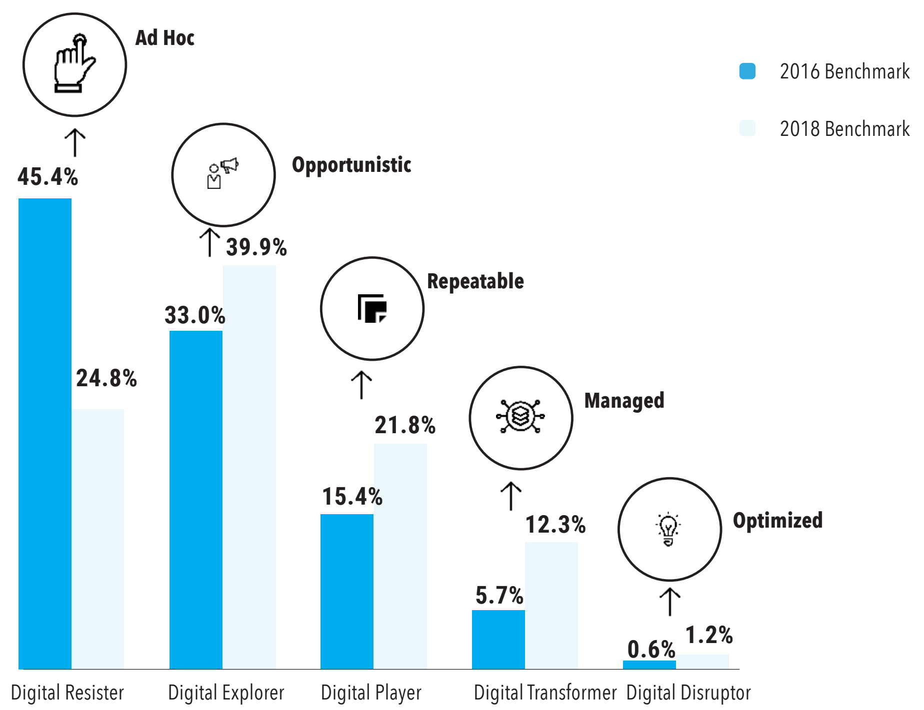
The development of technology and product matrix in the field of software-defined infrastructure can perfectly meet the diverse needs of enterprise digital transformation process in the foreseeable future and will integrate well with a large cluster of new technologies and scenarios to jointly build a software-defined world in the future.

Introduction: ***Challenges on the Road to Digital Transformation***

Thanks to constant developments and the progress achieved in the digital field, digital transformation is no longer just an option for enterprise decision-makers. An increasing number of organizations have come to realize that the digital transformation has become a must-have choice for their survival and development. They are now fully aware that it can help them improve on production, marketing and operations efficiency, and that it also has the capability to reshape the enterprises' core competitiveness from the inside out. As such, digital transformations are bound to have a profound effect on enterprises' performance across a wide range of functions going forward.

According to a CEO survey conducted by IDC, which covered 2,000 multinational enterprises, 67% of global 1000 companies and 50% of top 1000 companies in China placed digital transformation as their top strategic priority as of 2018.

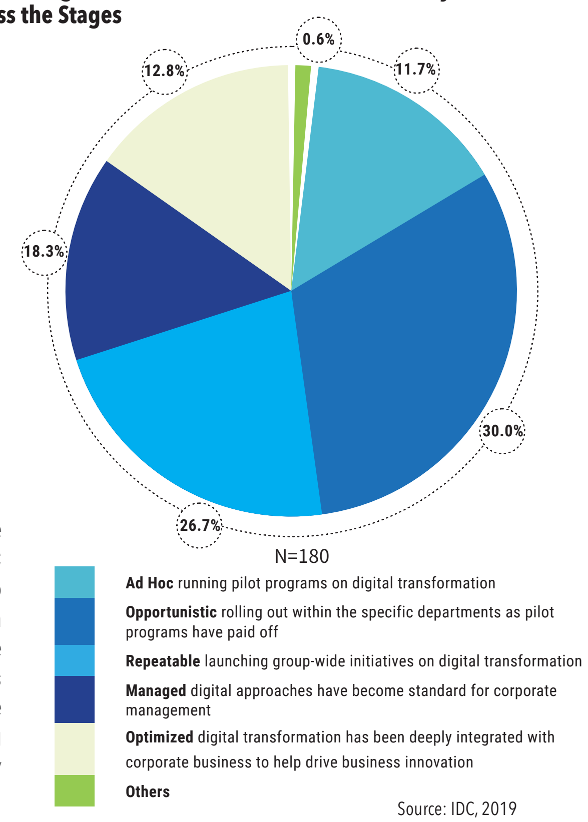
Figure 1 IDC Maturity Scape Benchmark: Digital Transformation in Asia/Pacific (Excluding Japan) – Maturity Distribution Across the Stages



Source: IDC, 2018

According to data from IDC's Digital Economy Market IT Spending Forecast, global IT spending for digital transformation will grow from $1.3 trillion in 2018 to $2.1 trillion by 2021. Of this, the Chinese proportion of the market will continue to increase, and its predicted compound annual growth rate will be much higher than the global average.

Figure 2 Digital Transformation in China – Maturity Distribution Across the Stages



Source: IDC, 2019

China has made strategic initiatives to build power in cyberspace and also called for building a "digital China" in the report at 19th CPC National Congress, demonstrating the country's determination to continue developing a digital economy. Digital transformation can improve the efficiency of social operations at large, promote the innovation of new business models, and drive the overall progress of society. In this context, methods with which to accelerate the digital transformation process and strengthen its effect on driving the capacity brought about by such processes have become key issues that every enterprise should address.

Despite many enterprises having focused on and invested heavily in technology and operations relating to digital transformation, most of them have been unable to achieve breakthroughs at the macro level, or address the challenges hampering their development, meaning that the benefits from the transformation process have fallen significantly short of their expectations. IDC research reveals that most enterprises are still in the second or third stages of digital transformation maturity. When examining the key issues during the process of digital transformation, the main concern is that it has been "slow", i.e. the improvements brought about by digital transformation have not been significant enough.

Business innovation needs to be sufficient

In terms of business innovation, while efforts to leverage on digital technology to provide innovation for products, services and deliveries have continued, the overall effect in terms of innovation has not been significant.

Process needs to be optimized

Process optimization is the digital transformation most enterprises refer to, and it is a key area almost all enterprises identify as being in need of improvement. In addition, it is the factor most executives point to for the pace and effect of optimization lagging behind their expectations.

Business models need to be restructured

A large number of enterprises, particularly non-digital organizations that make up the majority, have yet to foster a cognitive approach to restructuring their business models.

A growing number of Chinese enterprises are struggling with the uncertain association between input and effectiveness. For many enterprises, the challenge that needs to be addressed now is on how they can drive digital transformation and integrate digital approaches into their daily operations, management and business processes more effectively in order to stimulate business innovation.

01

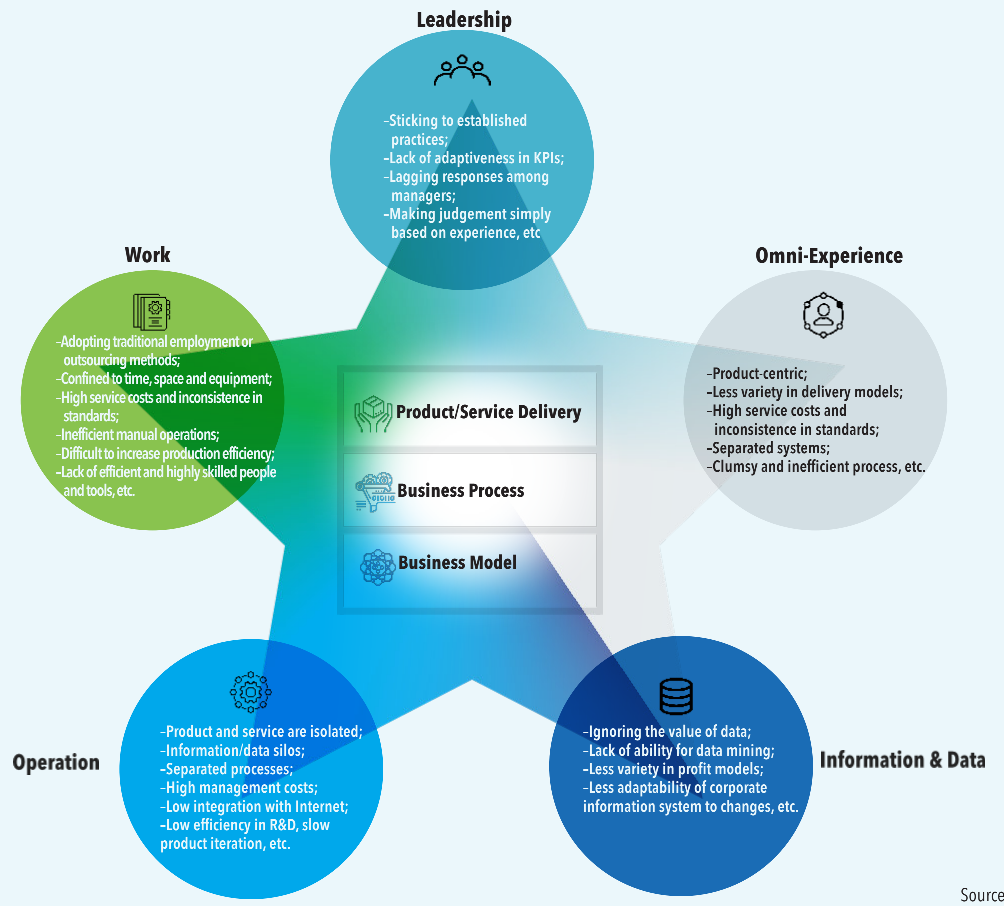
Root Causes
Hampering the Digital Transformation Process

> ***This whitepaper identifies five categories of constraints hampering the digital transformation processes of enterprises and explores how the three systemic factors of organizational management, technology platforms and external cooperation are affecting enterprises' DX process.***

How to identify the constraints that exist in the process of development and combat "slow" progress? By analyzing the various drivers and their effectiveness, IDC has broken digital transformation down into five categories: leadership, omni-experience, information and data, operation, and work. In each category, several actionable instructions have been specified. By cross-analyzing the three types of challenges previously mentioned – products, services and delivery, business processes as well as business models, it will help us generate constructive conclusions that will be beneficial to digital transformation.

The figure below demonstrates a range of the root causes of stagnation in the process of enterprise digital transformation. Through systematic reviews of these issues, we can come to a clear understanding of the core of these causes.

Figure 3 Five Categories of Digital Transformation and Challenges Facing Enterprises



Source: IDC, 2019

From a macro perspective, various sub-categories relating to processing, assessment operations, and management styles reveal flaws in enterprises' organizational and management structures. At an operational level, these issues are mainly associated to slow progress and a lack of variety when it comes to technology, methodology and operating models. In addition, a lack of platforms, channels and integration capabilities have led to greater concerns: in modern society, the transformation and evolution of enterprises is closely related to collaborations throughout the ecosystem, while isolated and closed approaches will only lead to slower progress.

In addition, a survey on the digital transformation of Chinese enterprises conducted by IDC reveals that "insufficient collaboration in innovation" is most enterprises' key complaint when discussing the challenges associated with their digital transformation. On the other hand, "Collaboration in innovation" reflects the technological dependability of an enterprise, and its capabilities in regard to creating an ecosystem. Other concerns raised by the survey respondents were in relation to assessment systems, experience and skills, concept recognition and organizational structure, etc., all of which are mostly related to organizational development and overall technological improvements.

> ***The conclusions drawn from theoretical analysis and the survey are as follows: stagnation during the process of enterprise digital transformation can mainly be attributed to three systematic factors: organizational management, technology platforms, and external cooperation.***

1.1 Failure to set up clear objectives for transformation, organizational structures, and culture

Challenge

Among the five categories of digital transformation, the elements relating to leadership can be found at the top of the pyramid structure. Through cross-analysis, it can be discovered that for product/service delivery, business processes and business models, leadership issues such as sticking to established practices, deficient levels of KPI adaptability, and slow response actions from managers have generally been perceived to be the problem. In other categories, such as omni-experience and information and data, there are common glitches that have been observed at the macro level.

Analysis

To some extent, digital transformation has become an accepted obligation at the executive level, with business transformation and evolution being at the core of their ultimate objectives. The process of digital transformation will involve all the departments of an enterprise engaging. This will bring about organizational transformation and optimization, which will require the organization to coordinate its resources in a methodical manner.

The leadership is generally viewed to be reflective of any team's capabilities. A lack of leadership in digital transformation could result in there being a series of fundamental issues at a macro level. Enterprises that fail to set up clear objectives for transformation, organizational structures and their top-down corporate culture will find themselves in a situation whereby there is an inability to collaborate for innovation, the lack of a clear trajectory for strategic transformation and investment, an insulated organizational structure, and an absence of internally coordinated capabilities. Along with other unambiguous issues, enterprises in this situation could also find that their employees find it difficult to improve on their skills and experience, and that the KPI system could become outdated and ineffectual.

1.2 Scarcity of strategies for tracking, evaluating and introducing new digital technologies and platforms

Challenge

Next to transforming leadership functions, the most important factor to put into practice during transformation is the adoption of new digital technology and platform systems. Through cross-sectional analysis, we have identified issues at the operational level relating to roadmaps, approaches and models across all categories. This reveals an absence of strategies for tracking, evaluating and introducing new digital technologies and platforms with advanced capabilities among enterprises.

Through utilizing outdated digital technologies, there is the risk that the business created, and the operational management capabilities formed will become incompatible with the request of the times. Traditional IT infrastructure platform constraints affect data acquisition and analysis, the allocation of resources, and the ability to put in place efficient system controls. This has resulted in these types of platforms being unable to satisfy business development needs during the current era of cloud and big data. As such, the business entities these platforms support are unable to respond quickly to changes taking place in regard to products, the market and the supply chain, which in turn severely restricts the impact they can make through enterprise transformation and evolution.

Examples of the enterprise digital transformation process being hampered by an absence of strategies for tracking, evaluating and introducing new digital technologies and platforms are not uncommon. For example, on the one hand, at an IT infrastructure level, data center infrastructures that enterprises spent millions of dollars on may remain idle. On the other hand, these infrastructures may not be well coordinated across specific areas, such as computing, storage and networking, especially when there are particular workload demands, which may lead to a greater level of follow-up investment.

Analysis

Throughout the digital transformation process, new digital technologies and platforms should emerge as the enterprises develop, which will serve as a constant driving force for their continuing progress. For non-digital native traditional enterprises in particular, digital transformation platforms built on advanced digital technologies should always act as the key driver of enterprises' ongoing advancement. And this should stem from unremitting investment in and the dynamic creation of digital transformation platforms by enterprises from inside out and top down.

For enterprises, the creation of digital transformation platforms is a necessity when it comes to tracking and adopting a broad spectrum of digital technologies throughout the organization. A sophisticated, open and integrated technology platform can help enterprises establish interactive mechanisms from both a strategic and a business perspective. It should meet the needs of all parties involved and deliver collaborations and mutual benefits to organizations internally and externally. For any conflicts in traditional business processes that arise, the sophisticated nature of digital transformation platforms will ensure that enterprises can continuously streamline business relationships, identify problems at the core, and develop innovative models and processes. One of the main mechanisms to demonstrate this sophisticated approach is its ability to provide flexible, dynamic and constant updates at the infrastructure level of digital transformation platforms. By providing agility and adaptability, the platform can address the most common and complex issues in regard to resources, architectures, processes and various other functions within the organization.

1.3 Shortage of appropriate partners to conceive DX strategies and create corresponding ecosystems

Challenge

Analyses reveals that non-digital native enterprises need to procure a wide range of software and hardware system products in the process of building digital transformation platforms. More importantly, they should also appoint IT service providers with substantial industry experience to help navigate them through the process. A dearth in ecosystem partners would likely lead to the dilemma of enterprises pursuing digital transformation from behind closed doors, which would lower the chances of a successful transformation.

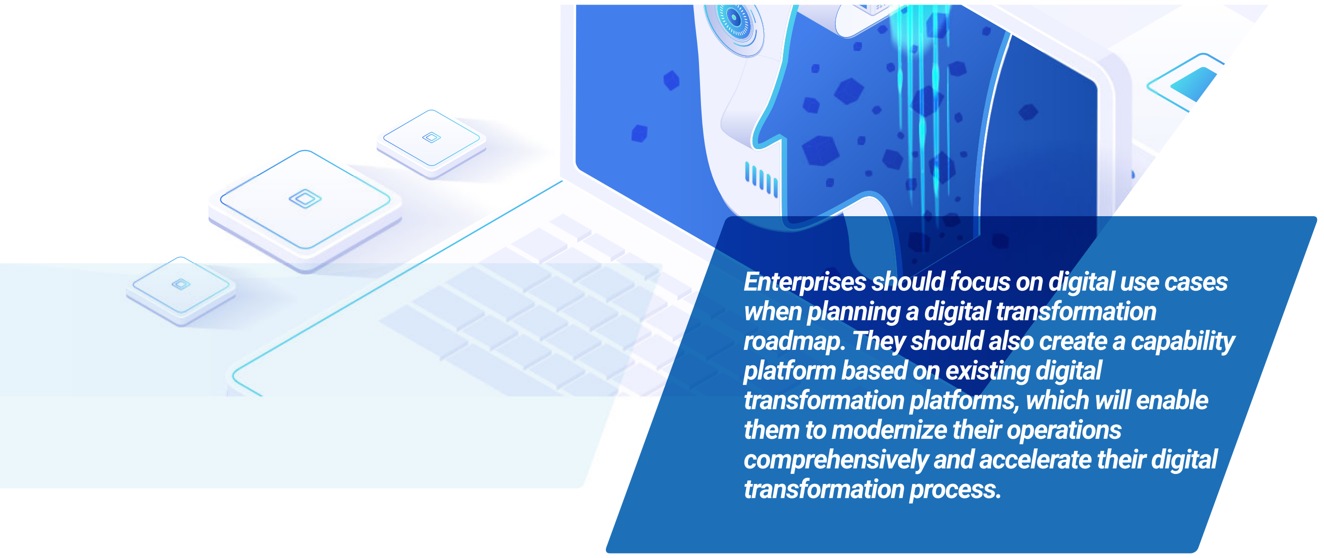
Analysis

To ensure a successful digital transformation, it is important that enterprises select the most suitable strategic partners. According to an IDC survey, the digital economy era will bring with it sweeping changes to society. These changes would affect policies, technology, competitiveness, cooperation, commercial practices, and user features. Amid dramatic market changes, every adjustment to the external competitive and cooperative landscape would have a profound impact on each particular enterprise in terms of time and space. Enterprises must unearth new partners as we enter this new environment in order to develop their own skillsets and forge an atmosphere in which they can collaborate. As part of this process, major manufacturers and industry operators will work to create a high-quality ecosystem, while small and medium-sized enterprises should join the community at the most appropriate juncture, to integrate themselves within the cooperation mechanism of the industrial chain.

For traditional enterprises, in addition to deciding upon the most appropriate means to becoming integrated in industrial cooperation mechanisms, selecting the best digital service provider should be at the top of their agenda when it comes to forming strategic alliances. First-rate IT service strategic partners will bring to enterprises advanced IT concepts and will continuously drive the transformation and evolution of these organizations. As such, the best digital service providers will always sit at the forefront of the digital market. And this is because they offer a wealth of leading-edge technologies and products in relation to digital transformation platforms and bring with them an abundance of industry-specific experience. This enables them to provide consulting services for enterprises on holistic design, master planning and action outlines around the digital transformation process. According to IDC's survey on the digital transformation of Chinese enterprises, almost one-third of respondents said that the most urgent requirement in regard to digital transformation was for the full backing of digital transformation partners.

02

Resolving the Dilemma
Focusing on DX Use Cases and Platforms



There are three root causes underpinning the stagnation of digital transformation processes, which illustrates that a large number of enterprises are simply not in a position to cope with the overall challenges the digital economy era presents. When dealing with issues relating directly to their survival and development, enterprises should develop core competences, set up clear objectives for their transformation, and make essential changes at an organizational and corporate culture level. For example, they may need to form a dedicated team to oversee the digital transformation, implement a new mechanism for assessment that is aligned with the transformation process, and create a continuous self-evaluation mechanism that enables it to adjust to the prerequisites of the transformation process. Enterprises should also foster a clear understanding of the importance of adhering to a precise methodology, roadmap, and technology matrix. They should also focus on creating a sophisticated, open, integrated and sustainable digital transformation platform in order to circumnavigate their business operations through these advanced technologies being introduced. In addition, enterprises should pay closer attention to aligning with the most suitable strategic partners and building a robust ecosystem. For every enterprise, the ecosystem will be the foundation for long-term development. Moreover, the digital transformation platform will serve as a facilitator for internal and external engagements during the process of ecosystem development.

To accomplish enterprise digital transformation at an execution level requires methods, routes and technical systems. Firstly, scientific methods should be implemented in order to devise a digital transformation strategy and development roadmap that suits their enterprise and function as a reliable base with which to put into practice the digital transformation. It will also incite them to attach importance to the use cases associated with digital transformation, and the various project operations arising from these use cases. Secondly, the construction of a digital transformation platform is of great importance. Enterprises can comprehensively interpret methods for digital transformation and a roadmap to achieving this via guidance from the platform's advanced technologies in regard to business operations and the practice of various business scenarios on the platform.

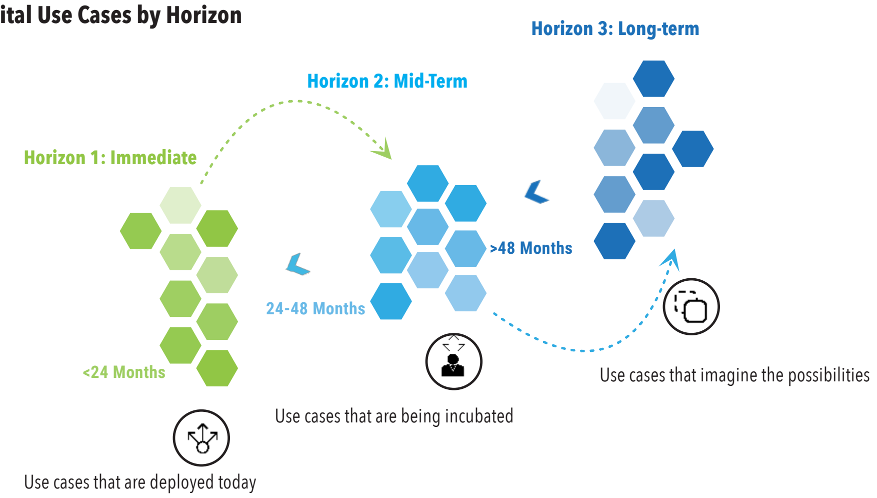
2.1 The establishment of a DX roadmap based on use cases

Digital transformation is an ongoing, systematic undertaking on a considerable scale. Enterprises often fail to have the proper procedures in place when looking to attain digital transformation, and it is usually the initiator displaying a lack of understanding during the construction process that can trigger potential problems.

IDC believes that enterprises should comprehensively review their visions and goals for digital transformation and transform their ultimate objective for digital transformation into tangible, achievable scenarios, which concurs with the characteristics of their own industries and the business functions within their organization's various departments. In addition, a medium and long-term digital transformation roadmap that can be followed methodically should be put in place during the different stages of implementing it.

The process of formulating a roadmap for digital transformation roadmap is based on researching and having knowledge of the environment in which it will take place. Typical factors identified by IDC include customer experience, finance, human resources, law and enterprise strategy, procurement, research and development, facilities and tools, information and data management, etc. Each area commands particular implementation requirements of its own. Based on an overall understanding of current market opportunities and the potential for future growth and innovation, enterprises can form target baselines at different stages of development – current, short-term and medium and long-term – for use cases.

Figure 4 Map Digital Use Cases by Horizon



Source: IDC, 2019

Taking **traditional manufacturing enterprises** as an example. Among the most pressing use cases currently are how to manage supply chains, logistics and marketing activities via the digital transformation platform amidst a fiercely competitive market backdrop. In order to optimize internal resources and management processes, big data analysis should be incorporated to processes as it can even help to predict management trends, supply chain developments and customer markets. Over the next three to four years, the development of "Internet Plus Smart Manufacturing" could change the configurations of many established manufacturers. Digital transformation platforms have been created to meet with web-based integration requirements. They also have a significant impact on design, manufacturing, supply chain and logistics processes, and can help shorten the product design and production cycle significantly. This will result in reduced costs while staying within regional limits, which will improve the competitiveness of enterprises and provide them with opportunities for growth. In the near future, manufacturing enterprises need to create a more flexible and rapid iterative testing and production environment and achieve more independent innovation through the combination of Internet of Things, AI and intelligent terminals.

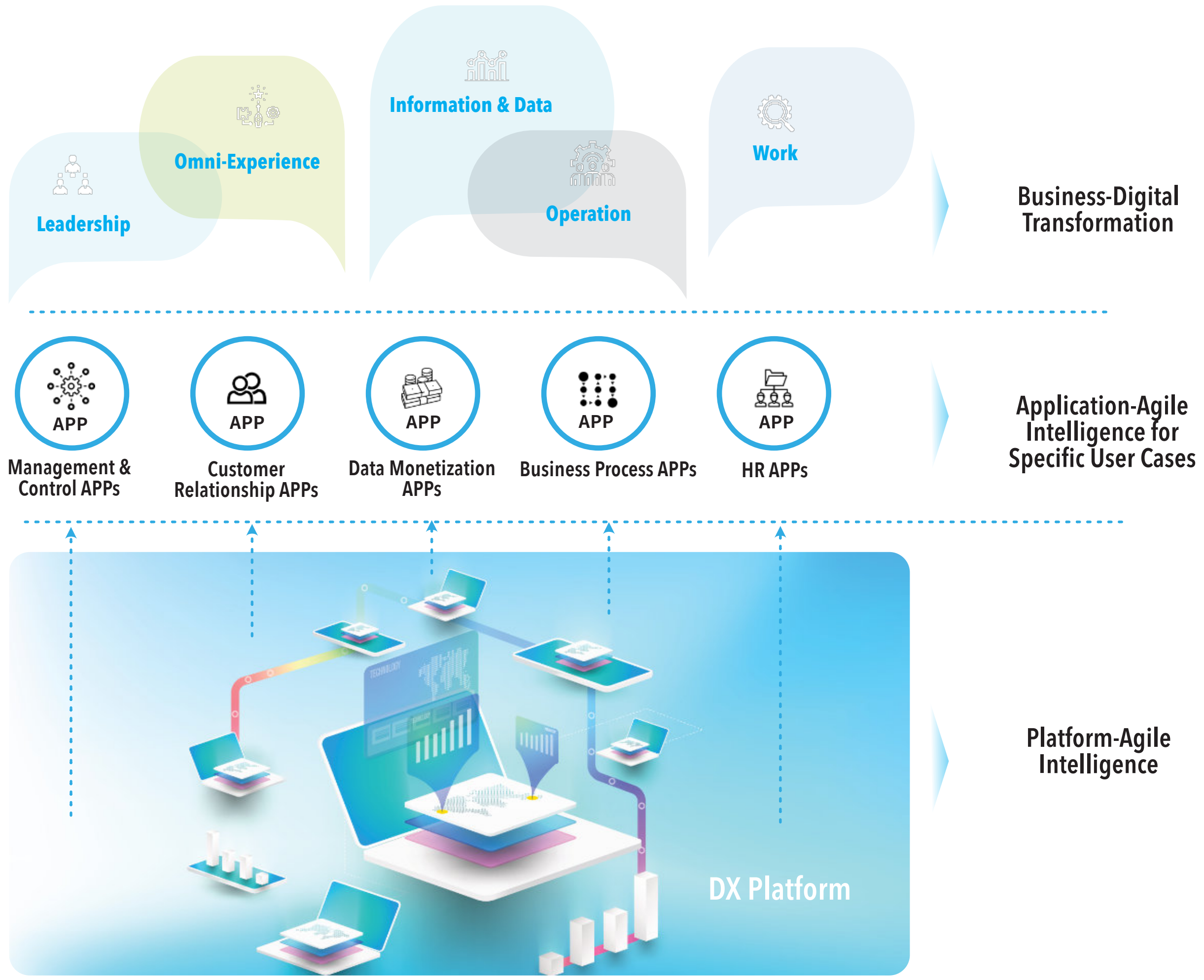
IDC's view: a digital transformation roadmap based on use cases is an important component of the enterprise transformation and upgrading process. Based on this, enterprises can rationally fathom out a corresponding relationship between current and future developments, input and output, whilst sustaining the driving force for transformation and upgrading, and benefiting from the consequent innovations at each and every stage of the digital transformation.

2.2 Accelerating the DX process with advanced platforms

It is the use cases that provide the impetus for the digital transformation at the business level. The **underlying support** for the use cases is provided via the digital transformation platform, which brings together and integrates the latest advanced digital technologies. Subsequently, the platform provides enterprises with extensive connectivity, an open ecology, and an agile digital infrastructure.This intensive business integration enables data sharing, while stimulating business collaboration and agile innovations, as well as accelerating their development.

A digital transformation platform is a capacity platform that supports the digital transformation of enterprises. Through building diversified new applications based on the digital transformation platform at the entry point of applications, it enables these enterprises to achieve a comprehensive transformation and upgrading of business operations.

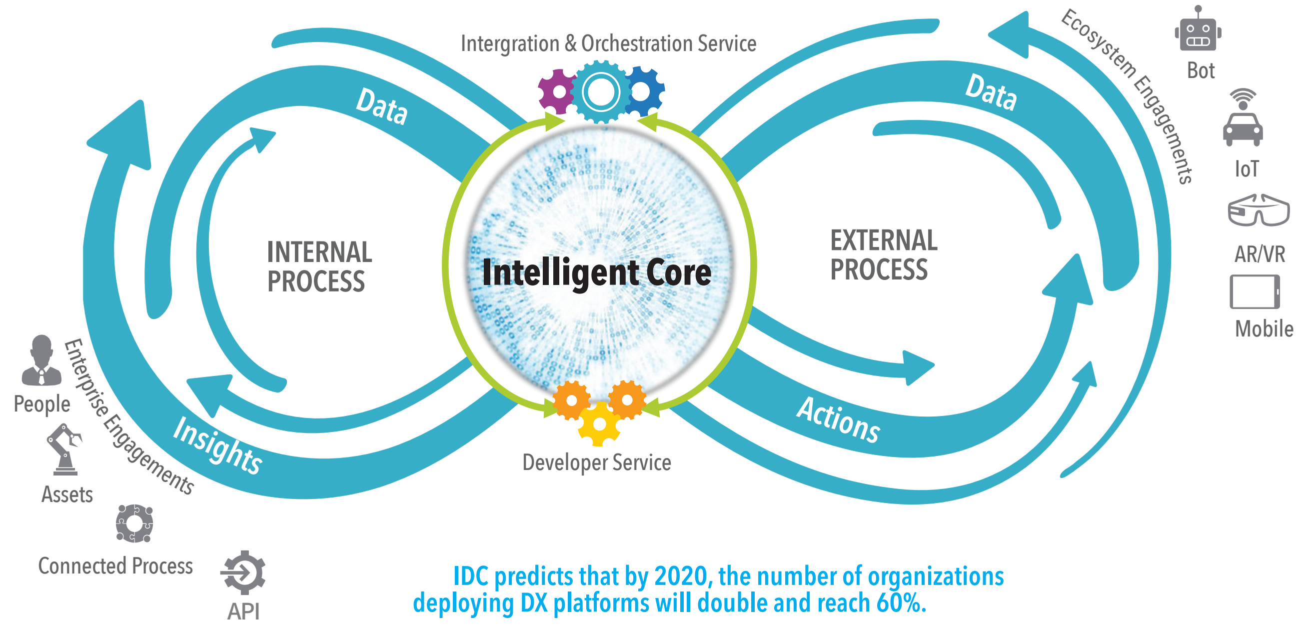
Figure 5 Enterprise Digital Transformation Empowered by DX Platform and Implemented through Use Cases



Source: IDC, 2019

An advanced digital transformation platform will typically deliver an agile infrastructure with an intelligent core, which will provide sustainable integrated services and better guarantee the security of the enterprise's operations, bringing enterprise users an extremely optimized experience. An ideal digital transformation platform should provide excellent execution efficiency, reasonable scale and sufficient agility. In order to achieve these goals, the platform should be able to integrate big data management, independent cognitive capabilities, artificial intelligence, and machine learning technology around the intelligent core. It should provide the enterprise with an agile application system hosted on PaaS that comprehends services and containers as the main elements. It should be based on an open architecture in order to produce a completely new ecosystem and customer experience.

Figure 6 DX Platform

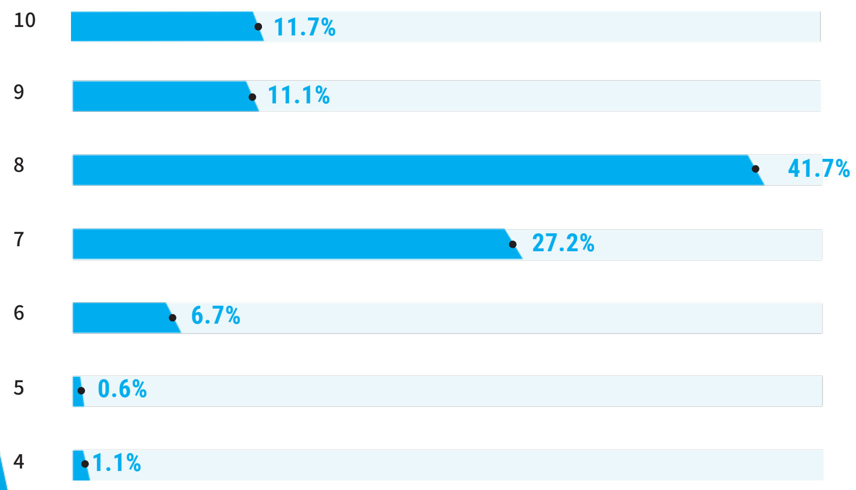


Source: IDC, 2019

Among them, the meaning of intelligent core is to possess active and concise cognitive abilities, which can be extended to the traditional artificial decision-making category by means of automatic decision-making. Concurrently, digital transformation platforms with intelligent cores must be able to meet the diverse needs of customers, partners and enterprises' own applications. To do so, they must possess the capacity for comprehensive information governance and powerful data management in order to enable the dynamic and organic integration of complex technologies and products. A digital transformation platform is not just an advanced technology platform; it also acts as an all-inclusive ecological construction platform. Through interacting, sharing and integrating with external resources, it will help enterprises to positively establish a functional ecological environment.

IDC' view: The successful application of digital platforms could help enterprises accelerate their processes of digitization. In turn, the enterprise's chances of survival and success would improve through being digitally enabled. This is mainly because it would significantly help improve the operational efficiency, customer experience, while enhancing their ability to innovate products and services. The DX platform would also empower the enterprises to optimize their business model, marketing capabilities, as well as their management structure and control systems. Finally, through IT and technical means, enterprises can overcome the challenges they encounter during digital transformation.

Figure 7 Evaluation of the Importance of Digital Transformation Platform for Enterprises

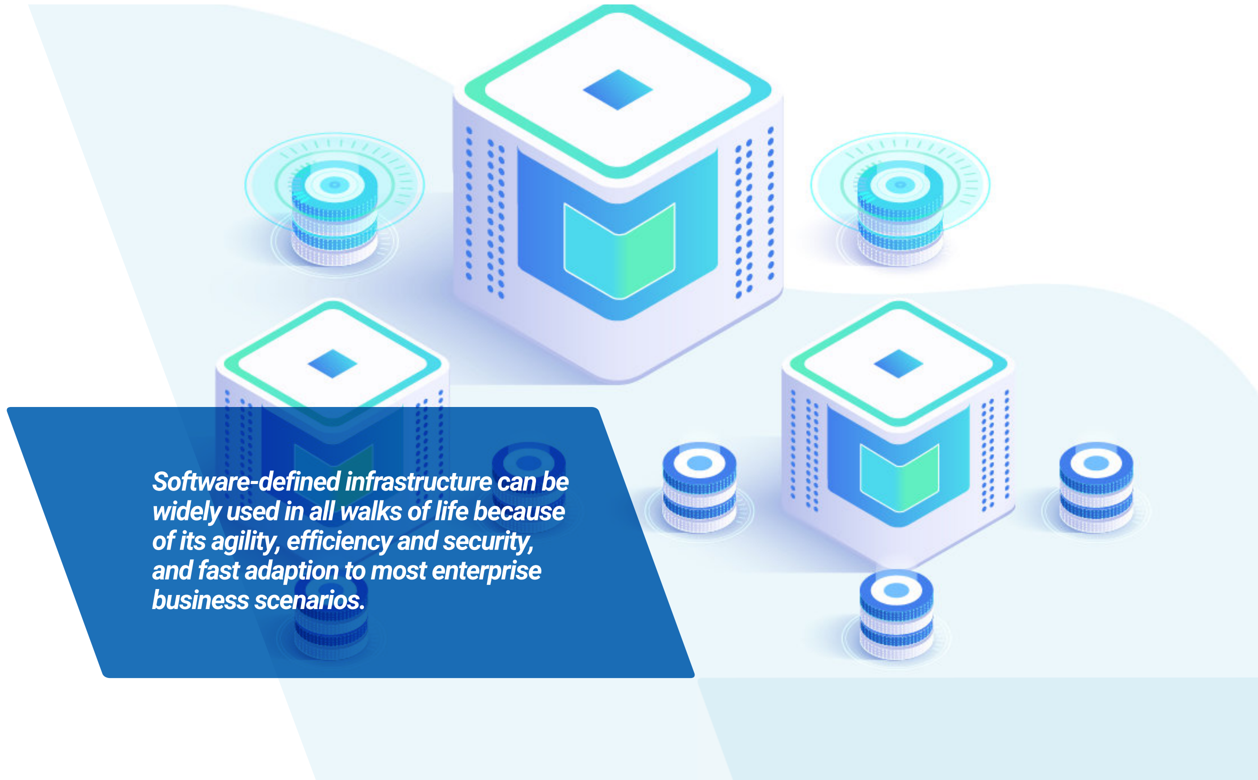


Note: 1 refers to not important, 5 refers to important, and 10 refers to very important
N=180

Source: IDC, 2019

03

SDI as an Ideal Choice **for Constructing the DX Platform**



Software-defined infrastructure can be widely used in all walks of life because of its agility, efficiency and security, and fast adaption to most enterprise business scenarios.

In order to meet the target requirements of the digital transformation platform and in order to achieve both current and future service adaptation capabilities for enterprises, it is necessary to establish an agile, intelligent, secure and controllable IT infrastructure environment. During this process, the idea of software-defined infrastructure design is put into practice and becomes an ideal choice for the near future. The way software is defined can bring about a more flexible, intelligent and resilient business application environment, which can meet the most demanding IT infrastructure construction requirements, for most users.

3.1 Introduction to software-defined infrastructure

According to IDC, software-defined infrastructure (SDI) refers to logically pooled computing, memory, storage and network resources, which are managed by software and require little human intervention. An SDI system is independent of the underlying hardware, as long as the hardware meets certain technical specifications. SDI supports policy-based automation of IT operations, such as monitoring, provisioning and configuration. Generally, SDI can be addressed and accessed through open API. The obvious benefits of SDI are that it is cheaper, more flexible and easier to deploy, scale and upgrade. The complete software-defined infrastructure architecture covers a set of software platforms, delivery modes, models, and architectural concepts. Among them, the software platform includes software-defined computing (SDC), software-defined storage (SDS), software-defined network (SDN) and other auxiliary infrastructure software. Delivery modes include integrated delivery, software-only delivery, and cloud delivery. The physical form of the infrastructure can be discrete, converged/hyperconverged, or assembled by components. Based on the categories mentioned above, a number of products and services have been available in the market, awaiting a large number of manufacturers to get involved.

Compared with traditional IT infrastructure, software-defined infrastructure products are of obvious advantages, as shown in the following table:

	Traditional infrastructure	Software-defined infrastructure
Computing platform	•Independent resource •Long resource expansion cycle •Huge resources waste •Depends on availability of the hardware	•Pooled resources •Rapid expansion on demand •Resources fully utilized •Availability improved by software vertex processing
Storage platform	•Centralized •High professional storage cost •Additional and complex constructed backup for disaster recovery is needed	•Distributed •Using cost-effective server storage •Improving disaster preparedness capability by multi-node distribution, strong self-recovery capability
Network platform	•High private network equipment cost •Difficult to manage and maintain •Poor agility and scalability	•Using general-purpose hardware •Easy to manage and maintain •Good agility and scalability
Management platform	•Hand-roll •Separately managed with complicated process	•Automatized and intelligentized •Unified control with simple interface
Expansion mode	•Vertical scaling, hardware upgrading is frequently needed, long time cycle and high investment	•Lateral spreading, fast dilatation by adding general-purpose hardware
Total cost of ownership	•High (both purchasing and maintenance cost)	•Low (reducing TCO by lower purchasing cost, maintenance cost and higher utilization
Appropriate business architecture	•Traditional business application architecture, centralized	•From traditional business to internet business, from centralized to distributed business

Source: IDC, 2019

Currently, the practical achievements of software-defined infrastructure are grouped mainly in the following forms:

Cloud computing platform: This embodies a very typical idea of software-defined infrastructure. The cloud computing platform uses software-defined technologies set to realize unified management, flexible distribution and on-demand expansion of computing, storage, network and network functional resources. From IaaS to PaaS, the cloud computing platform has applied virtualization, OpenStack, container and other software-defined computing technologies and frameworks. In the field of storage management, software-defined storage technologies such as Ceph are often used to build distributed storage environments. SDN/NFV software-defined network technology ensures the cloud computing platform network to be agile. In SaaS, new micro-service architecture and cloud native applications also the need strong support from the cloud computing platform built based on software-defined idea.

Converged/hyperconverged system: According to IDC's report on China's Software-defined Storage Market of 2018, the converged/hyperconverged system is the fastest growing product form in the software-defined storage market. It is also, proportionately, the largest product category. The converged/hyperconverged system is a set of equipment, integrating computing, storage, network, security, and other resources and technologies together and is able to realize virtualization. It introduces cache acceleration, data management, network aggregation and other technologies to realize a modular form of resource management and form a unified resource pool.

Software-defined network: There are two important systems in the software defined network market, SDN and NFV. Although they have different design goals and implementation methods, they both strive to be open, flexible and intelligent, decouple software from hardware and realize centralized network control. The software-defined network is an important direction of network evolution, which breaks the systematic monopoly of traditional network markets and introduces more competition, so as to reduce construction costs to users. The software-defined network significantly improves network agility by virtualizing and cloud-seeding network resources, thereby adapting better to changes in business and load. Software-defined WAN (SD-WAN) is a typical solution in the software defined network. Through the center controller, branch office box, security gateway, and other ancillary equipment edge products, the SD-WAN allocation scheme can realize network resource pool management and meet a series of goals, such as intelligent routing, priority management, dynamic optimization and channel control.

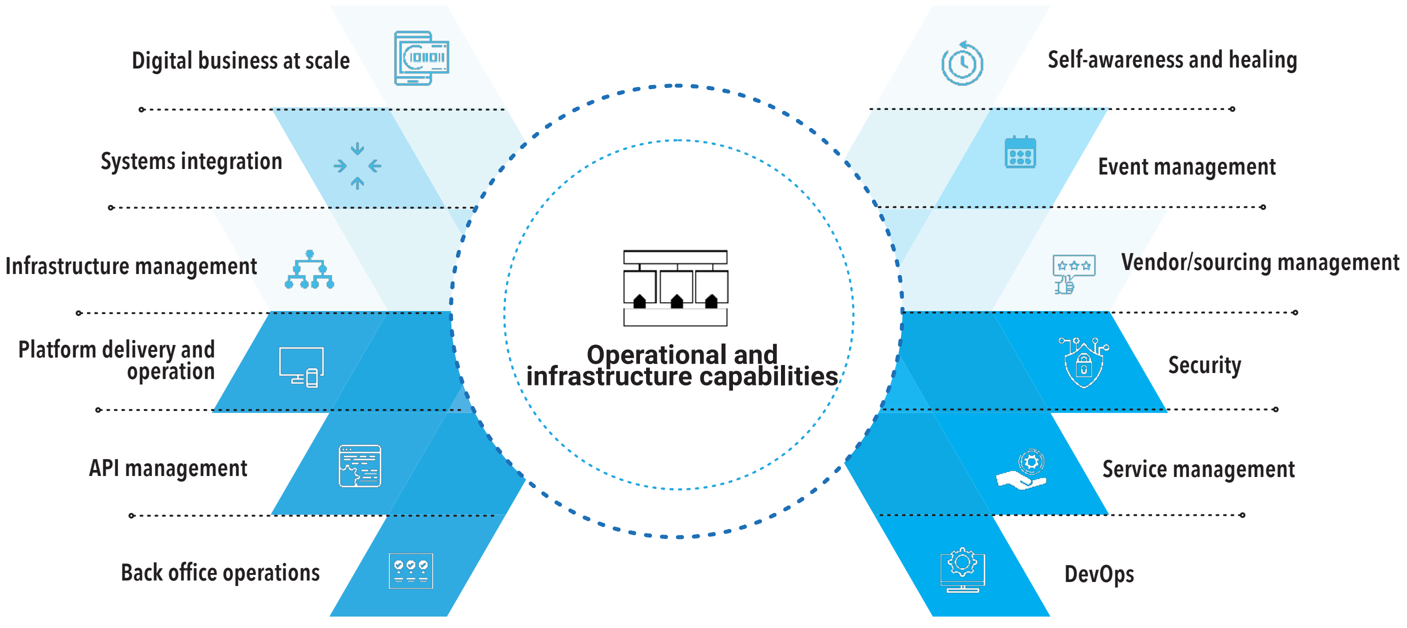
Moreover, as represented by the desktop cloud, new endpoint products put terminal computing power, storage resources, operating systems, drivers and applications in the cloud. This helps achieve a smoother, more stable, secure and efficient terminal experience through the extremely simplified terminal equipment, which overturns the traditional form of mobile office and terminal maintenance modes, to ensure individual users using anywhere on demand. In addition, this avoids PC system issues due to an easily damaged and failed and complicated updating process.

3.2 Software-defined infrastructure as a key factor to accelerate digital transformation

The advanced digital transformation platform is business-oriented and use cases-focused. Its business characteristics and application adaptability are core elements that CEOs and managers have long paid attention to. However, whether the business and application are efficient and operate in a benign environment depends fundamentally on the design level of the digital transformation platform infrastructure.

According to IDC, digital transformation creates systematic requirements in regard of infrastructure capability. The digital transformation platform capability reference model provided by IDC shows that, at the infrastructure level, platform capability concerns involve development, integration, delivery, management, security and other aspects.

Figure 8 Overview of IDC's DX Capabilities Reference Model: Operational and Infrastructure Capabilities



Source: IDC, 2019

We can also see the stringent requirements of enterprise for digital infrastructure, through the development of new and traditional applications.

For internet corporations, it is obvious that the rapidly changing market environment requires the business systems to be features with characteristics of fast construction, flexible expansion, upgrading at any time and easy maintenance.

However, the established telecom operators need to, on the one hand, constantly adjust the promotion and sales mechanism of the traditional voice/data market; and on the other hand, rapidly strengthen the key customer service capacity of cloud and network integration. Their requirements for the infrastructure of enterprise digital transformation platforms are consistently keeping up with those of internet enterprises.

In traditional industries, such as retail, education and manufacturing, one of the most important signs of digital transformation is breaking through traditional processes and geographical limitations, by pushing products, services and supply chain management into a broader space. As the complexity of business and a growing number of cross-regional integration activities grow, computing, storage, network and other infrastructure elements need to be adjusted, extended, and constantly updated. This is a novel situation that traditional IT security work has not previously faced.

For example, the market of some industries is changing quickly, which means there is a strong possibility for a huge-cost, front-end service system to change before it's put into use. **Large commercial retail institutions** are staking out territory in second-, third-, and fourth-tier cities in China, with supermarkets and convenience stores spreading into new areas. The entire organization's management structure of supply chain, logistics and outlets will face adjustment as the market develops. It will also manifest differences due to regional identities. This requires more flexible adjustment ability of a business system, as well as brings huge challenges to IT infrastructures. **Some traditional educational institutions** are rapidly transforming and entering into the online education market. This entails high demands on the agility of the IT infrastructure because of the operational mode of mixing both online and offline management, and construction investment mode to make ends meet. If the online experience is not satisfactory, the marketing process will be significantly slowed down. In addition, during the process of industrial Internet transformation and upgrading, **traditional manufacturing enterprises** will also face increasingly rapid market changes. Rigid thinking can easily formalize the construction achievements of the digital transformation platform.

IDC finds out that enterprises' IT infrastructure building practices requires the DX platform to be agile, efficient and secure, based on infrastructure, platform and business.

In contrast with the standard examples of traditional digital infrastructure, SDI almost perfectly meets those requirements. It is arguably the most ideal option for companies in DX to build their IT infrastructure.

Agility, efficiency and security are prominent features of SDI.

The standard model of building traditional IT infrastructure involves companies' planning and building various types of computing capabilities, storage, networks and platform service environments, which applies limited smart technology and requires considerable human efforts.

When planning for resource quantity, cloud center designers often fail to sufficiently coordinate the demands raised by business departments. In pursuit of stability and comprehensiveness, they may create redundancy, which can prolong the cycle of construction, while debugging impedes deployment on the business end. Once the infrastructure stabilizes, any readjustment or expansion of the various resources may require restructuring to some extent. This could mean reconfiguration and the need for new tests to be run on a variety of equipment, which leads to risks that cannot be controlled and have an impact on business stability. With the aggressive ramp-up of branches in modern enterprises, they all require the speedy deployment of IT facilities and seamless autonomous integration. In this respect, traditional IT infrastructure falls far behind demand.

Software-defined IT infrastructure shows its agility in terms of fast setup and flexible IT infrastructure expansion.

Agility

- By virtualizing and pooling resources, perfectly integrating resources through new technical controls, SDI decouples resources on all levels and creates new possibilities for agility in the infrastructure, which precisely meets the urgent need of enterprises for a fast launch and modification of their products;
- SDI can conveniently realize scale out with immediately visible, reliable and stable initial achievements in the IT environment setup;
- It also enables a degree of iteration in infrastructure construction, with a simultaneous return on investment.

The concept of efficiency is related to several aspects, such as ROI, operation efficiency, and so on.

Efficiency

- ROI: Given the reality of business development, enterprises have an increasing demand for efficient computing, massive storage and agile networks. However, a huge, one-time investment, combined with business growth uncertainties, impedes the development and innovative edge of enterprises. With a resource-optimized infrastructure, the company can not only reduce investment, but also accelerate the launch of the business to alleviate concerns regarding development and innovation.

- Operational efficiency: Traditional IT architecture features a degree of exclusiveness, such as the strong coupling between hardware and software of the network providers. To shift to a different network product requires deployment of the corresponding software for controlling and management. A company may typically maintain several sets of software platforms, which undoubtedly increases operational challenges and lowers operational efficiencies. The company then suffers the risk and trouble of being locked-in with the network providers.

SDI is an advanced architecture that delivers overall efficiency.

- Software-defined products emphasize the separation of control from function, enabling to significantly reduce the complexity of managing and controlling the IT infrastructure;

- Adopting the software-designed concept, building on virtualization and pooling management of universal equipment, the company will be able to improve utilization of computing, storage, networks, security resources and technologies, in addition to serving both internal and external users with agility;

- By introducing smart technology, big data and etc., the company will be more adept at constantly monitoring and analyzing the business system, so as to improve dynamic resource utilization, simplify the operation and maintenance processes. This will thereby enable the development of reasonable investment plans and a reduction in overall costs.

Security

The traditional concept of security domains subsides, while new security threats rapidly emerge. For example, major companies that operate in the cross-domain, cross-territory hybrid cloud environment, may have vulnerabilities at the branch ends that can easily be compromised by internal and external threats.

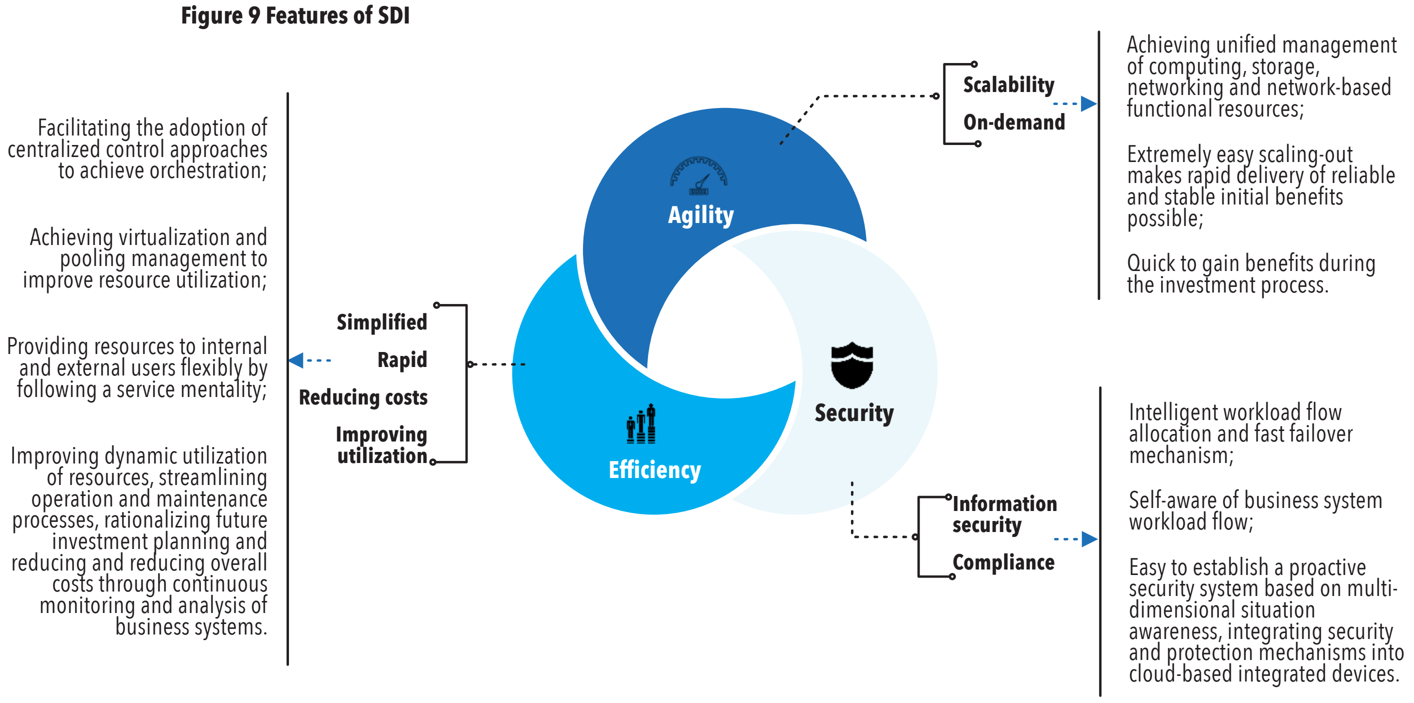
Safe cloud and network environments are intended to ensure the long-term stable operation of the system, while maintaining strict access control at the border, detecting threats in a timely manner and taking proactive defensive measures. This is manifested by fast malfunction fixes, layered management and control, active situational perception, and other technologies and mechanisms.

Centralized control of software-defined products enables the speedy application of standard templates and mature models for information safety and compliance. It avoids internal security defects caused by imperfections in the system setup.

- The software-defined network enables smart traffic distribution and a fast malfunction switch mechanism in the operational environment. It is safer and more reliable than traditional network architecture. Moreover, it is able to autonomously observe the characteristics of the system traffic and ensures the core business to meet high QoS requirements.

- SDI also helps build a multi-dimensional, situational perception-based active defense system and integrates the protection mechanism in the one-in-all cloud equipment. This enables dynamic adjustment of the network domain boundaries and constructs a multi-layered, comprehensive protection system with unified strategies.

Figure 9 Features of SDI



Source: IDC, 2019

One noteworthy fact is that agility, efficiency and security at the infrastructure level will also be manifested in business, with the further development of applications and practices to generate consistency from top to bottom.

- The agility of IT infrastructure provides greater flexibility and allowances in terms of business system deployment and provides an excellent service experience for rapidly expanding business departments.

- The efficiency of IT infrastructure can provide reassurance to managers and executives by giving an immediate sense of healthy change in terms of cost and efficiency.

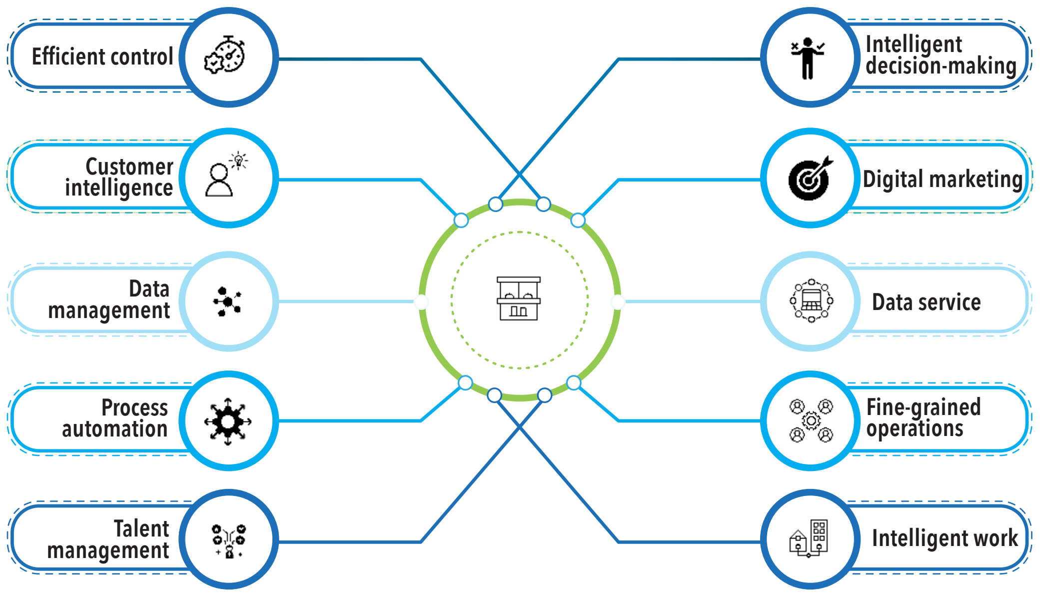
- The security of IT infrastructure plays a decisive role in the modern information system. Under the information safeguard framework, infrastructure is able to solve more security issues with a unified strategy. That means business system developers and maintenance staff can focus more on the applications and data required and build a more secure defense.

3.3 Quick adaptation to enterprise use cases with SDI

In terms of universal use cases, as opposed to traditional IT infrastructures, SDI can adapt quickly to typical use cases thanks to its agility, efficiency and safety. As such, it extends its capabilities to every facet of the business from the fundamental architecture.

The five key aspects of digital transformation (DX) – leadership, omni-experience, information and data, operation and work – include ten key enterprise use cases.

Figure 10 General Digitalization Use Cases for Enterprise



Source: IDC, 2019

In the DX root cause analysis mentioned previously, it is discovered that target audiences focus mainly on agility & speed, automation & intelligence, extraordinary experiences, reshaping sales models, and innovative products & services. These findings have enabled SDI to unleash its full potential and become the bedrock of enterprise infrastructures.

Software-defined products offer the advantage of distributed storage, particularly in the areas of **data storage and management.**

- Through the shared features of agility, intelligence and autonomy, software-defined products can minimalize the impact of intermediary processes on performance and consistency as the storage system develops and expands;
- Software-defined products meet the demands of clusterization through being able to store, manage and analyze massive amounts of non-structured data via an overall Input/Output Per Second (IOPS) framework;
- Software-defined products and network can collaborate during various massive data scenarios and adapt to distribute storage analysis and remote disaster recovery applications.

In endorsing its Safe City project, the Zhuhai Municipal Public Security Bureau employed AI technology. To ensure urban safety, it established a video data analysis platform based on video data and human facial data captured on surveillance cameras. As such, the back-end system storage had to be capable of handling massive quantities of video and image data generated from the surveillance cameras, whilst also supporting the platform's database. This presented the storage system with a huge challenge in terms of volumes of data and performance. The Zhuhai public security bureau incorporated a distributed storage software solution through utilizing a standard X86 server. In doing so, they constructed a unified storage resource pool to enable block, document and object storage. In Phase 1 of the implementation, the platform introduced almost 2,000 surveillance cameras, which will scale up into tens of thousands of surveillance points. The demand for data storage will reach dozens of PB, while the human facial recognition system could generate tens of billions of documents.

Fudan University Shanghai Cancer Center assembled its disaster recovery data center based on HCI technology. It recycled existing hardware resources and deployed 50C hyper-converged software to create a remote disaster recovery center and provide extremely cost-effective business protection. The solution didn't require any alterations to the main data center's existing architecture or business. While safeguarding the data center's network quality and enabling the HCI platform to manage its existing data center cluster, it enabled the CBT interface to support real-time conversions regarding the document types in data transmissions. As a result, it can ensure the quick recovery of the disaster recovery data center's operations in the unlikely event of a malfunction of the main data center.

In smart office scenarios, typical software-defined device solutions to have become popular in enterprise workplaces include desktop cloud architecture and desktop virtualization technology. As a universal software-defined device product, the desktop cloud has the benefit of being able to implement centralized management and smart operations & maintenance systems with a heightened level of reliability and security. In addition, the desktop cloud delivers the ultimate experience to mobility-focused customers. In particular, it offers incomparable relevance to business scenarios that involve frequent shifts between locations, occasions and ad-hoc situations.

The Ministry of Culture and Tourism of China endorsed a cloud transformation of the workplace. They created separate desktop clouds for cultural websites and the internet through making full use of existing servers and storage facilities. In doing so, it permitted separate access to cultural websites and the internet.

Driven by the Industry 4.0 strategy, manufacturing giant Foxconn has been endorsing the digitalization of industrial manufacturing processes in order to accomplish intelligent manufacturing. Foxconn has over 1.2 million employees globally; much of the production and/or management work relies on PCs. Increasing demand for Foxconn's employees to work remotely or partake in mobile office work has presented the organization with enormous challenges in terms of safety management and operations & maintenance arrangements. To combat this, Foxconn made the practical choice to deploy the desktop cloud system in six of its major plants. The system has dispatched cloud devices to approximately 10,000 clients. By doing so, it has greatly improved its centralized management and control capabilities, while responding to mobile office demands throughout the region.

As more companies attempt to bolster their capabilities through internet technology, Internet+ has become a hot topic. Many of those entities look to revive traditional businesses or establish new outlets for growth driven by means of transforming their current practices through Internet. The new internet capabilities that many traditional companies are focusing on deliver many new feature applications compared to their traditional operations, i.e. simultaneous access to systems, maximized peak and trough systems' accessing times, speedy launching and operations of systems, massive data storage, diversified storage capabilities, and a high emphasis on network speed and stability. These features all require the IT infrastructure to be with a more widely disseminated and more agile architecture.

Due to the impending impact of emerging internet financial models on traditional financial IT businesses and their operations, Haitong Futures upgraded its traditional IT infrastructure by installing an HCI enterprise-class cloud. The entire platform is comprised of multiple hyper-converged all-in-one devices that virtualize up to 100 virtual machines as needed. This not only meets with current business demands, but also provides adequate scalability for future platforms. Haitong Futures' cloud data center currently hosts a number of test systems (e.g. asset management platform, market maker simulation system, stock option simulation system), production systems (e.g. internet applications, fund sales, risk control), as well as core business systems such as a CRM portal and open architecture (OA).

The Ministry of Agriculture and Rural Affairs of China leveraged on HCI-enabled cloud computing technology when it created an information resource-sharing platform and a basic agricultural dynamic database. It has created an agricultural information resource catalog and enabled shared internal data within the agricultural system. It also provides for the centralized management and allocation of information resources, and access controls on shared departmental information resources. The cloud computing-based operation has enhanced the efficiency of the Ministry's information sharing and operations & maintenance systems considerably. Through adopting software-defined technology, it has helped the Ministry to optimize its utilization of resources and servers, thus reducing on energy consumption, and empowering its new hyper-converged cloud computing-based DX.

3.4 Wide application of SDI in various industries

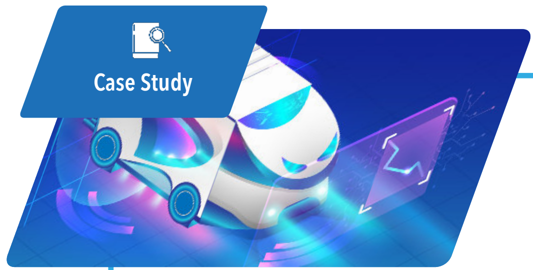
SDI technology and its associated products have broad application possibilities in various industries. This part will demonstrate how SDI can meet with the business needs of various industries through examples in the fields of finance, manufacturing and healthcare.

In the **financial industry**, more private commercial financial institutions are relying on IaaS, PaaS and SaaS's cloud service. These institutions tend to have numerous branches, an ongoing enlargement of networks, and extremely high requirement of business security. Intense market competition has driven banking and insurance companies to improve their services, which they have done through introducing new IT applications such as internet financial services, Apps, WeChat mini programs, etc. These can all present the firm with problems when it comes network domain management, network connectivity, bandwidth allocation, etc. SD-WAN, a conventional financial industry software-defined network, delivers a software-based overall network architecture that can interact with smart routers and security components by means of a central control terminal for all-in-one delivery. It enables seamless network expansions and business growth, while having virtually no impact on the operations of the financial institutions' existing systems. In addition, SD-WAN and the distributed software-defined storage is leveraged upon substantially during the construction of dual active data centers for one city and tri-active data centers for two cities in order to deliver flexibility and scalability.

China UnionPay's 29 subsidiaries have deployed SD-WAN security all-in-one devices to ensure secure network building and branch protection.

CITIC Futures have created an SD-WAN to cover its 43 branches across China. The SD-WAN security all-in-one devices ensure the secure integration of all its branches with its headquarters. Moreover, a centralized management platform has been created to provide access to its branches' main network components, which guarantees centralized secure operations and efficient branch maintenance.

The traditional manufacturing industry has embraced information technology to a much lesser extent, and its internal IT staff tend not to be as technically advanced as those in other industries. As well as focusing on leadership transformation and developing relationships with strategic partners, they should also be engaged in building a more convenient, reliable and easy-to-maintain IT infrastructure. Remarkably, the lack of information technology to-date could actually provide them with some late-mover advantages, as companies will not have to invest a lot in integrating their existing systems and resources with new ones. Therefore, traditional manufacturers should initiate a comprehensive SDI from the top down. This is particularly true in regard to cloud construction, as hyper-converged all-in-one devices can enable quick construction and launches while supporting long-term, stable operations. Therefore it is an optimal choice. HCI also provides for efficient maintenance, which alleviates the need for additional technology while easing non-digital native companies' budgetary pressures. The ever-evolving warehouse and logistics industry has also identified numerous opportunities associated with software-defined products, particularly for next-generation smart warehouses and logistics, thus providing an interesting comparison to the transformations taking place in the manufacturing industry.



CRRC Times Electric Vehicle Co., Ltd. announced a hyper-converged cloud data center. It began by incorporating software defined core capabilities into its data center, including computing, storage, networks, security, management, etc., which were assimilated into its existing server. It then went on to leverage on the stack mode of the X86 server to create a streamlined HCI cloud data center. The company is steadily migrating its core business systems to the cloud, such as MES, PLM, PDM, LIMES and other product configurators. Through this process, it has significantly accelerated the launch of its new systems while maintaining stable, fast business system operations and enjoying a sharp reduction in costs for server room operations& maintenance. In addition, five of its subsidiaries have replaced traditional PCs with a 700-node sized desktop cloud solution. This was in order to inaugurate a smart production and office platform, which accommodates a large number of enterprise applications including office automation (OA), financial systems, ERP systems, and office software. It has become a vital tool for the company as it facilitates it with efficient desktop operations& maintenance mechanisms as well as an effectual adaptation to the OA system.

The healthcare industry in China sees the continuous progress of medical reform and the application of DX in healthcare as two direct drivers behind the information technology transformation of the industry. Cloud computing platform will serve as the basis of the medical service system with Chinese characteristics while the overall medical information system will migrate to the cloud platform that supports the application of AI, VR and robot technologies in remote healthcare, remote operation, medical-nursing combined care, medicine R&D and health management. Thus, the smart healthcare will make a qualitative leap and shape the future healthcare service model. The hospitals currently have plenty of PCs and other specialized devices. As the scale of hospitals and the number of patients grow, the traditional PC that features low operation & maintenance efficiency and poor data security will weigh down on the IT staff and involve risks of medical data leakage. A cloud desktop application set up on the cloud offers an ideal solution to the problem. It will greatly enhance the efficiency of work for doctors and protect the rights of patients. The hospitals or any business organizations in the service industry have a huge potential of investing in DX. Their demands for internal process evolvement and integration of internal and external business provide broad space where SDI can make use of their unique advantages.

Wangjing Hospital of China Academy of Chinese Medical Sciences built a cloud-based data center with hyper-converged infrastructure. With the HCI one-in-all system and some switch hardware only, the hospital leveraged the software-defined technology to enable the total resource pooling in computing, storage, network and safety, replacing the cumbersome, complicated traditional cloud infrastructure and achieving minimalist, stable and high performance with the cloud architecture. It also enabled the safe migration of core business to the cloud.

The First Affiliated Hospital of Nanchang University established the new cloud office platform with the desktop cloud product. It deployed 7 desktop cloud all-in-one PCs and authorized 197 desktop cloud devices in the new site and deployed 5 desktop cloud all-in-one PCs and authorized 150 desktop cloud devices in the old site. The platform mainly operates on the HIS system to support the daily business of the whole hospital. Meanwhile, the desktop cloud system is compatible with various kinds of equipment in the hospital, including printers, medical insurance card readers, ID card readers, scanners, document scanners, cameras, etc. and thus meets all service needs of the hospital.

SDI's application in universal scenarios and industrial use cases are intertwined vertically and horizontally, depicting the whole picture of the SDI market. On the horizontal dimension, the users focus on the scale and resilience of their IT infrastructure, i.e. how to quantify the infrastructure resources they require. On the vertical dimension, the users pay attention to the effect of the whole solution, i.e. what improvements the SDI can achieve for the application. For a company in DX to make full use of the agility, resilience, smartness and integration advantages of software-defined design, it must build on typical scenarios and delve into the uniqueness of the industry.

04

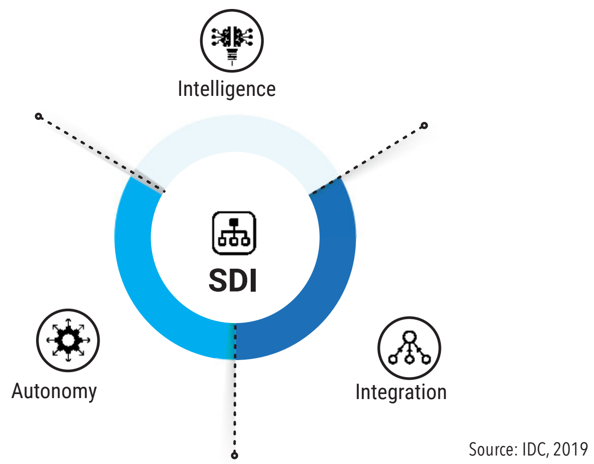
Outlook of ***SDI Development***

4.1 SDI technology and product development

Despite the diverse forms of appearances available, SDI technologies and products share some common features as they evolve. **Intelligence, integration and autonomy** are the typical examples of the shared features that will drive the potentially massive development of the SDI technology and product in the future.

According to IDC's Worldwide Enterprise Infrastructure 2019 Predictions, by 2021, spending on automated intelligent edge networking will yield a $4.5 billion SD-WAN infrastructure market. The network will not only meet the demand for end-to-end connectivity, but ultimately, with the emergence of cloud managed network, give rise to the concept of Network as a Service (NaaS).

Figure 11 Technical and Product Features of SDI



Source: IDC, 2019

Intelligence

The intelligent transformation of the SDI products is embodied in the fast on-demand service capability in building, scale-up and operation & maintenance. For example,

- With the software-defined network products, the control center is equipped with means of macro management over large-scale networks by separating controlling from forwarding. It enables scientific, dynamic planning of network paths based on the business and peak-and-trough statistic features of the network traffic on different paths. It thus coordinates and balances the needs of all business entities and guarantees the QoS of key business traffic.

- In the field of operation & maintenance automation, the software-defined environment further improves the comprehensive perception of the operation & maintenance center. The AI-empowered automated operation & maintenance platforms and tools can meet the daily needs of IT infrastructure for reliability and availability and to some extent ensures a robust upper-layer business system.

The integration of AI technology equips the operation & maintenance platform with a deeper perception and analysis of the characteristics in the operation of the business system. The platform is thus able to offer smart dynamic resource security solution.

Integration

The application of software-defined products will drive the integration of various kinds of IT infrastructure. For example, cloud network integration requires the two different systems of cloud and network to build in-depth mutual connections while keeping their own focus to meet the business needs of enterprises in the future. The coordination between the public, private and hybrid cloud requires a more powerful connectivity to provide all-around support. With the development of network, the concepts in cloud computing are constantly introduced to shape new forms similar to NaaS. With a closer integration in business, cloud network integration is able to create more industry-specific custom services.

Cloud network integration will be one of the major trends in the future service industry, where software-defined products are playing a crucial role. As one of the key engines behind cloud network integration, the telecommunication service provider leverages pool-based cloud resource management and massive application of SD-WAN and builds remarkably competitive enterprise IT service capabilities so that they may hope for a reclamation of the control over the digital service market in the future.

Autonomy

By introducing automation and intelligence capabilities into the SDI, the company will be able to accelerate the hardware configuration, improve the efficiency in building and operation, and reduce the cost. The key infrastructure in operation can detect hidden problems and raise early warnings on risks by collecting and analyzing key operational information. It may even allocate resources to resolve the hidden problems on its own, which enables a certain degree of self-governance and automation. IDC believes a lot of digital infrastructure may feature self-governance capabilities in varying degrees in the future. It can accelerate the improvement of business efficacy and reduce human error resulted from human intervention. That is also one of the key development goals of SDI.

4.2 SDI has the capacity to support future

SDI exhibits the capacity to support future. With outstanding advantages in agility, flexibility and smartness, it can quickly integrate with the existing and future new technologies and scenarios. Concepts and forms of AI, edge computing, cloud native may also be ideal partners to SDI.

The confidence in SDI's future lies in the open, integrated and forward-looking diverse support capacity that the new software-defined platform shows. First of all, SDI exhibits sufficient openness and inclusiveness. It on the one hand lays a ground that welcomes technologies like AI, big data and IoT and absorbs the latest research findings, and on the other keeps the door open for cloud native, multi-cloud architecture, edge computing and microservice based on the concepts like virtualization, pooling and modularization. Secondly, the software-defined platform effortlessly decouples the software and hardware. It loosens the stringent requirements of software and hardware compatibility and helps them break free to embrace more systematic evolvement. In addition, it is a proven fact that the software-defined concept enjoys a wide range of applications in cloud, network and device, and in the foreseeable future, technologies, products and services from different periods will be fully integrated by SDI for intensive use and to meet need of iterative development.

SDI and artificial intelligence

> ***IDC predicts that by 2021, 50% of companies will be deploying cognitive and AI technologies in their infrastructures to stimulate productivity growth, manage operational risks and help further reduce operational costs.***

The introduction of AI and machine learning will increasingly transform operational infrastructures and business processes. Through autonomously learning and mastering the typical patterns in corporate networks, equipment and systems, it will enable the control center to detect the threat of malfunctions ahead of humans and achieve self-healing to a certain extent while significantly enhancing corporate IT infrastructure security. AI will be integrated into public and private cloud structures while machine learning will enable seamless data conversion. This will eliminate the need for any human intervention in the corporate infrastructure and cloud environment, while facilitating automated data migration across heterogeneous platforms.

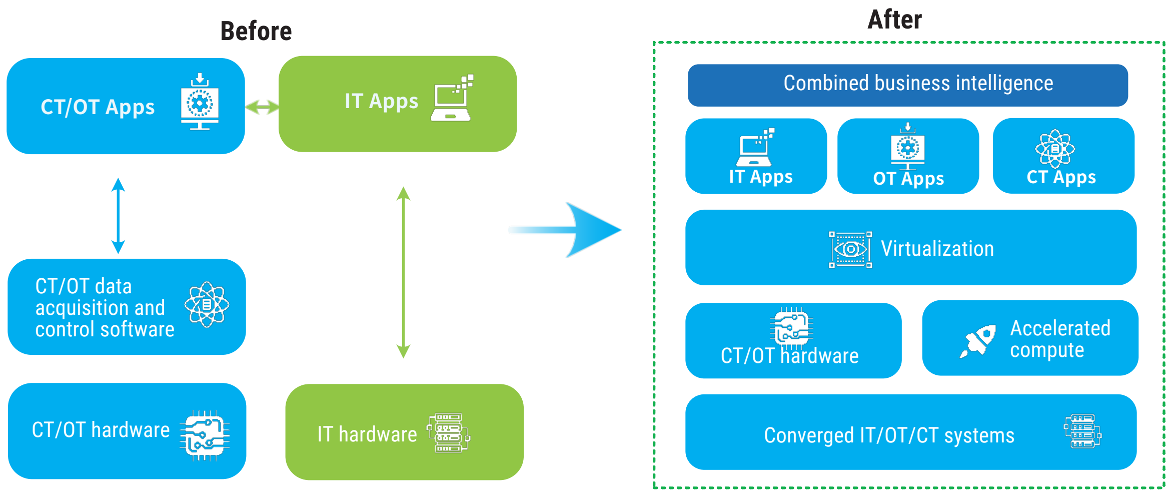
From a business perspective, AI can help detect and analyze market changes more efficiently and can therefore provide a targeted basis for decision-making. In terms of infrastructure, it helps with dynamic resource allocation and for optimizing business system performance.

SDI generates clear advantages for the application of AI technology. Through SDI's comprehensive information collection capability, AI enables a comprehensive understanding of all the information that has been collected. In addition, through software-enabled centralized management functions, it reaches every micro-operational aspect of the system for greater precision when it comes to adjustments and optimization.

SDI and edge computing

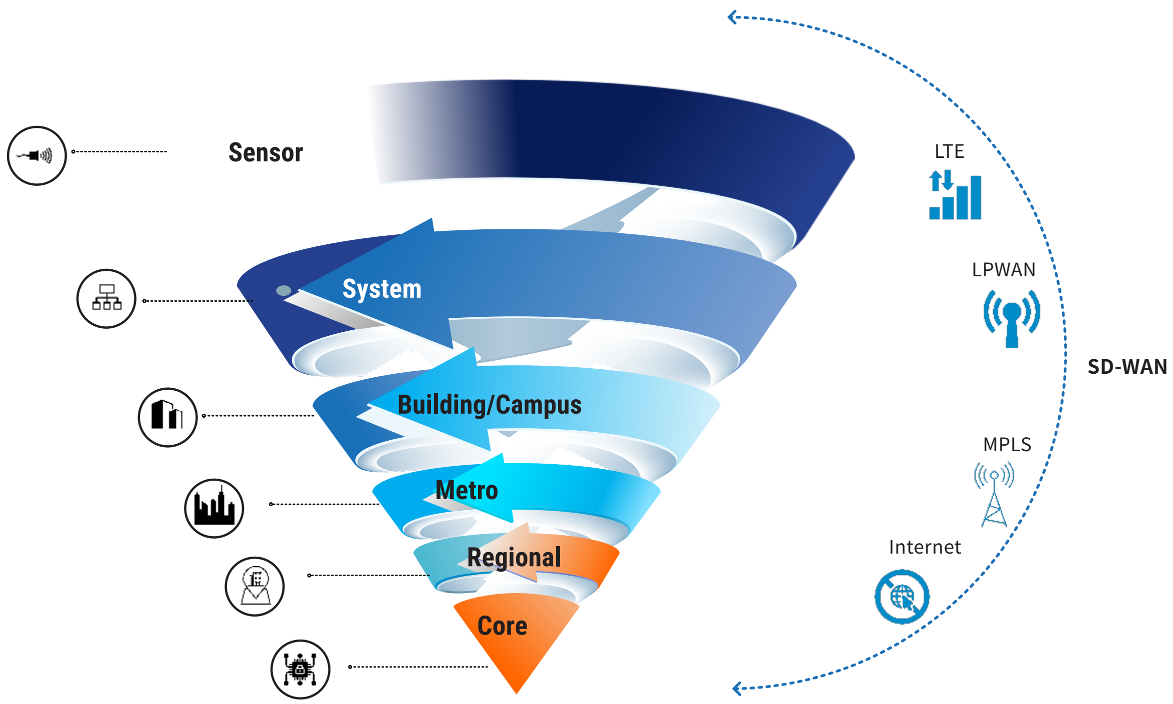
Traditional edges of IT, OT and CT systems feature separate infrastructures, which have been converged by the smart edge of the network for the seamless execution of IT, OT and CT functions. The smart edge enables the convergence of these three functions through affording a universal infrastructure. The converged smart IT/OT/CT edge can host IT applications, OT and CT systems, as well as software on the public infrastructure layer. It also delivers a seamless core-edge IT/OT/CT infrastructure. The software-defined design can transfer OT and CT functions to the converged layer, which means that OT/CT software can be run on servers or virtual machines in the same way that IT software can. More will utilize container technology, which can convert the specialized hardware-dependent development model to a universal hardware-based development model.

Figure 12 Software-Defined/Converged IT, OT, and CT Functions



Predictions from IDC show that by 2020, SD-WAN will be the main driver of edge computing. It is anticipated that SD-WAN will become the mainstream fundamental network technology, with an enormous potential market. Driven by increasing bandwidth demands, diversified Wide Area Network (WAN) connections, and cloud environment applications, enterprises are paying more attention to the cost effectiveness of their IT operations. Traditional WAN deployments are characterized by complexity and heterogeneity costs being high due to maintenance issues. As more companies become dependent on cloud and edge computing resources, which are accessible anywhere, anytime; SD-WAN has quickly risen to become the preferred solution of modern companies. This is because it can efficiently satisfy the WAN requirements for sustainable development, auto-configure the infrastructure, applications and services on the edge; and improve the execution efficiency of the diversified business structure.

Figure 13 Application Scenarios of SD-WAN



Source: IDC, 2019

SDI and cloud native

IDC is very positive on new frameworks such as cloud native, predicting that 70% of new company applications will be cloud native by 2021. On the framework front, cloud native has been designed more for microservice applications and is more appropriate for containerized use. Applications will feature on-demand scalability and loose coupling to adapt to the resilience required in the cloud environment.

In order to ensure cloud native is compatible with the reliability, stability and security delivered by the infrastructure, companies must also take into consideration the impact of containers, microservice feature designs, and unpredictable costs. As such, they must focus on software-defined development when it comes to infrastructure design and introduce more machine learning capabilities for the self-optimized management of virtual machines, containers and microservices in the cloud environment. These factors will play a critical role in controlling the costs associated with cloud native applications.

Similarly, SDI is of huge value in new scenarios such as mobile networks, IoT, multi-cloud frameworks, etc. Advanced IT frameworks are required to support, safeguard, empower and extend the value of new digital technologies and scenarios. With its open concept, ideal efficacy and powerful convergence capabilities, SDI will inevitably become the first choice for advanced IT infrastructures. It will make a profound impression on the industry through its continuous deployment and the evolution of new technologies and scenarios associated.

05

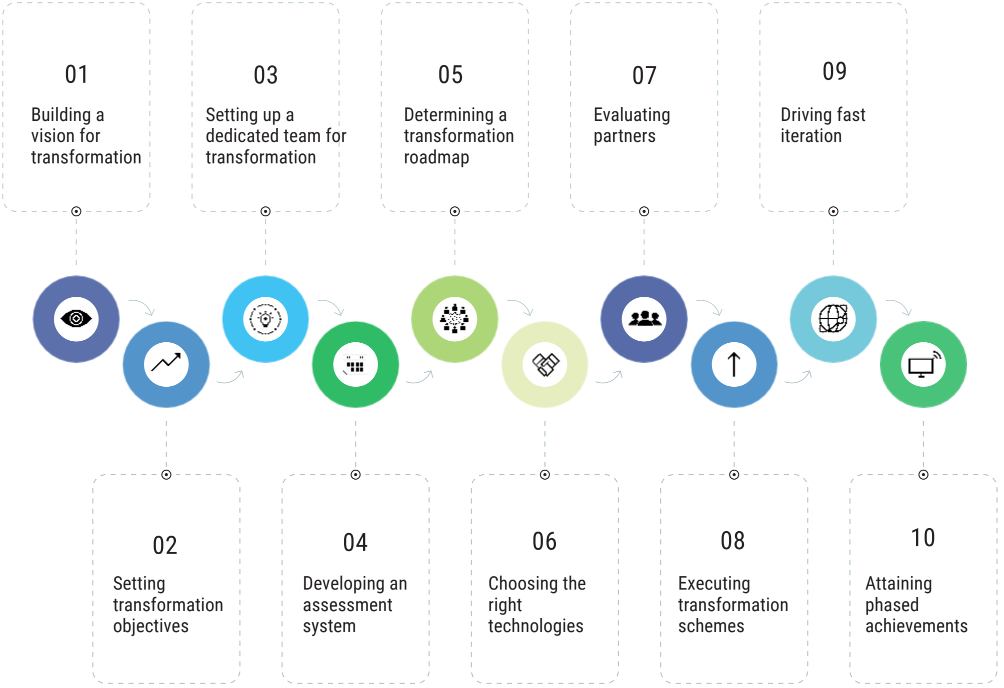
IDC ***User Advice***

5.1 Ten steps for DX driven by new technologies

As shown in the figure, IDC slices the new technology-driven DX into 10 segments, offering its experience on how to approach this new technology into a business. The 10 segments incorporate vision, goals, and organizations from a macro perspective, as well as operational issues such as transformation methods, technology selection, implementation and delivery. These steps stress the importance of the partner evaluation process, in particular, and the relevance of various other factors such as the industry chain, the ecosystem, technical transformation, etc.

As the foremost model of the new DX technology on the infrastructure front, SDI will continue to be the primary technical engine going forward. It is recommended that companies should strictly follow the approach by establishing visions, goals, and organizational and evaluation systems for DX in a scientific and rational manner. Based on comprehensive investigations and analysis, companies can integrate SDI as the core element of the DX roadmap, by following the relevant guidelines for implementation. Furthermore, they must develop a complete understanding of the importance of the system and its mechanisms in order to set the foundations for future development.

Figure 13 Application Scenarios of SD-WAN

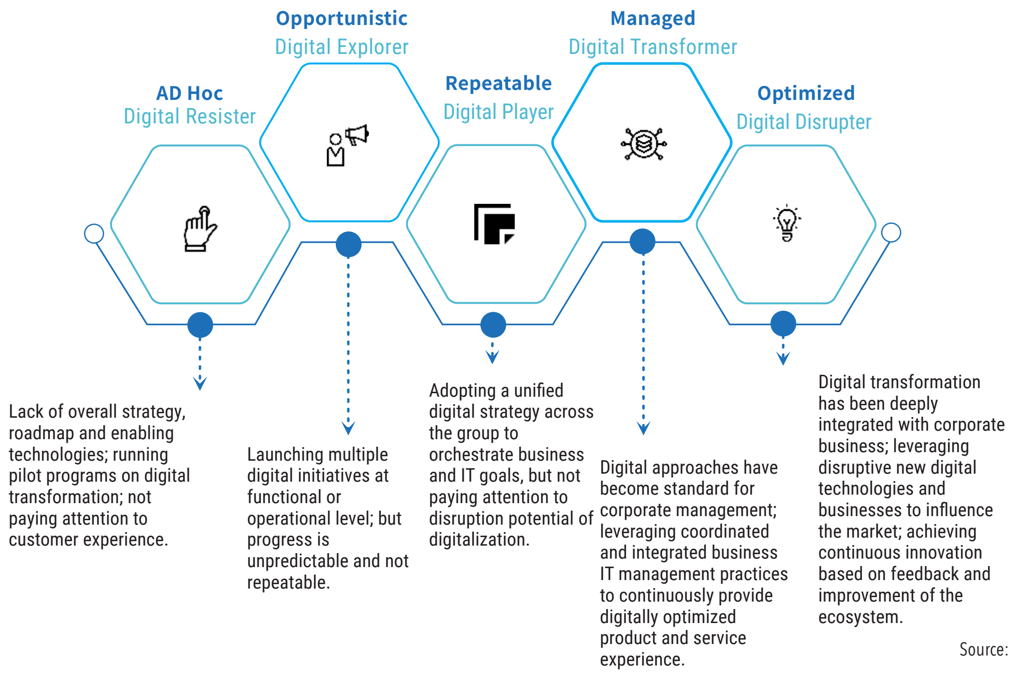


Source: IDC, 2019

5.2 Gain an accurate understanding of the organization with the maturity model

IDC has conducted research focused on the maturity models in fields related to corporate DX, including macro models for the transformation process, e.g. maturity in DX; and operational maturity models for specific platforms, e.g. network building maturity, wireless network maturity, etc. These maturity models provide systematic definitions and descriptions in a number of different areas, including infrastructure evaluation, the integration environment, control and management capabilities, organizational structures, technical structures, knowledge and skill management, leadership, corporate strategies, financial connotations, innovative systems, etc. They also identify specific areas the company needs to pay particular attention to and offer a thorough approach for the company's successful transformation.

Figure 15 Maturity Model of Enterprise Digital Transformation



Source: IDC, 2019

Using the macro DX maturity model as an example; a general evaluation identifies five key stages in the model's framework: ad hoc, opportunistic, repeatable, managed, and optimized. It goes on to elaborate on the characteristics, the key content, and sub-dimensions within each stage, as well as the actions and accomplishments required to reach each stage. During the DX process, it is vital that the company has a comprehensive understanding of each stage, as well as the content and sub-dimensions in the maturity model. This is to allow it to balance the processes and capabilities of each stage against the overall agenda and continuously discover business value.

According to IDC research, most companies are currently at the preliminary stages of the maturity model and are some way off the higher levels of maturity in all sub-dimensions. On the one hand, companies must have a forward-looking vision with an in-depth understanding of high maturity in specific areas; on the other, they must be aware of its current status and gap, and strive to establish process-based, systematic business and operation models for the continual improvement of all-around capabilities and operations.

5.3 The future of industry users

Looking ahead, the general consensus in the IT and tech industry is that we are quickly entering a software-defined era. It is widely acknowledged that companies must have an in-depth understanding of software-defined design concepts and goals during DX.

Based on recent IDC research, it is suggested for enterprise users to strictly adhere to the methodology provided and to establish the DX vision, goals, methods and route map suited to their own functional requirements. This should include near-term, mid-term and long-term development plans and execution guidelines. In regard to the integration of the new technology with their enterprise applications, the ten Steps for DX driven by new will serve as a powerful methodological reference for them to navigate. During the process of development, companies must frequently self-evaluate the maturity model and have a clear understanding of the tangibility of their executions and progress across all aspects of DX. They must also study the execution factors before moving onto the next stage.

By taking a broad view and adopting the correct concepts and scientific methods, companies are certain to benefit from the mainstream value and the advanced technology system provided via DX. Being an eminent part of the advanced technology system, SDI is expected to have a huge impact on the DX era.

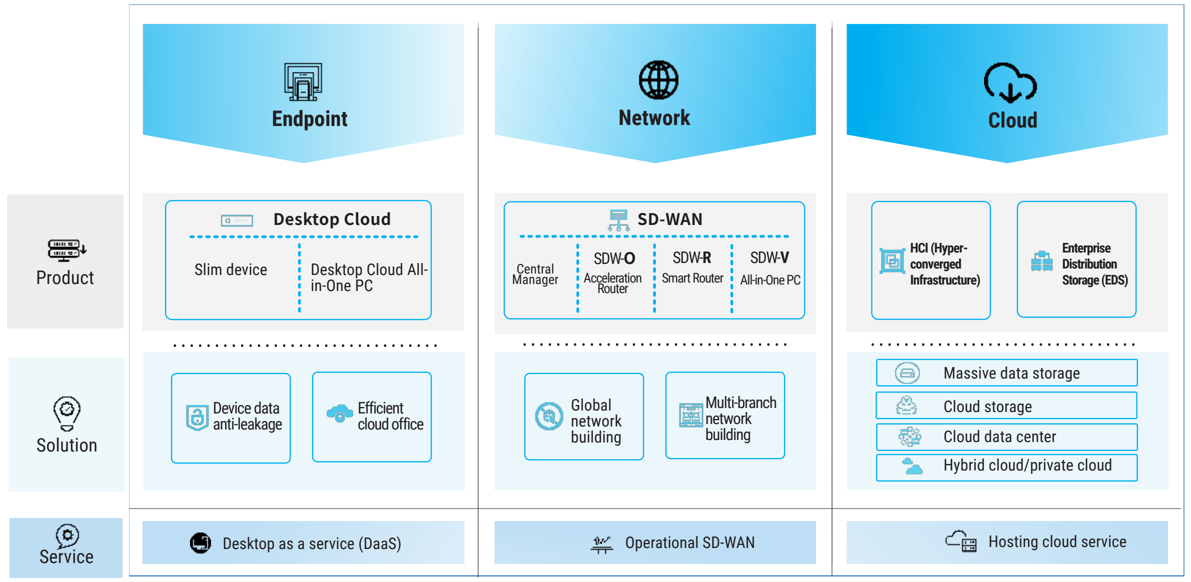
06

Sangfor's SDI
with Cloud-Network-Endpoint Integration

Sangfor Technologies is committed to laying solid foundations for customers' DX. The firm believes that the entire digital infrastructure should encompass software-defined modules ranging from the devices and the network through to the data center (cloud). Sangfor also recommends creating integrated mechanisms linking computing, networks, storage, security and management.

All software-defined modules

Figure 16 Sangfor's All Software-Defined Modules



Source: Sangfor, 2019

Endpoint: For PCs, as productivity tools, Sangfor focuses on efficiency and security. By disrupting the existing software and hardware tight coupling model and building a software-defined cloud office platform, Sangfor migrates all office desktops and data to the cloud. On the front end, the traditional PC is replaced with various streamlined devices, such as X86 and ARM, while the cloud adopts the boot-ready all-in-one solution with pre-installation and optimization from software to hardware to accelerate the DX delivery progress.

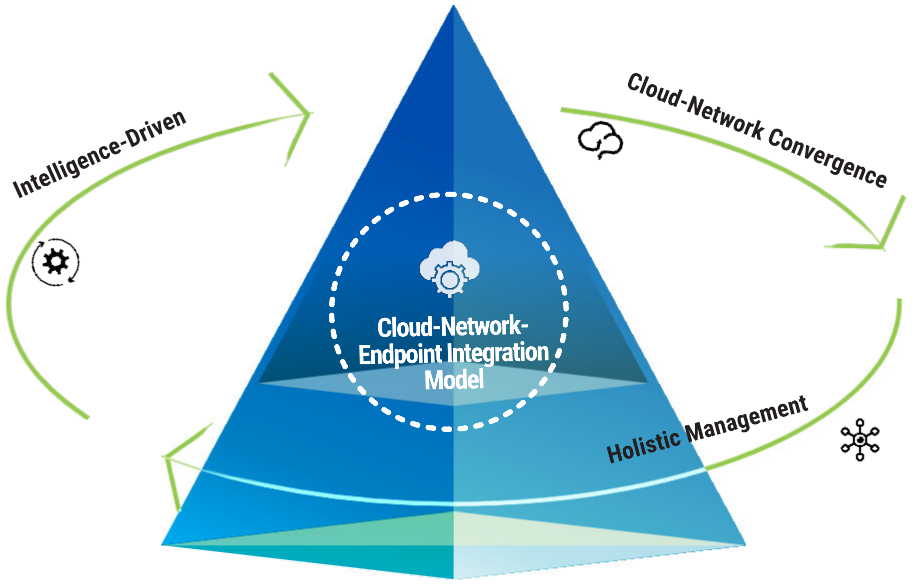
Network: Digital business operations require speedy synchronization and information feedback throughout the globe. That is where the network plays a vital role. SD-WAN is an ideal mode for remote communications, e.g. branch network building and cloud-network connectivity. SD-WAN facilitates the co-existence of Internet, dedicated networks and 4G and supports the virtual network feature. It converges the various channels into a bandwidth resource pool and introduces a centralized controller to enable the smart, optimal allocation of network resources based on the application status and SLA-configured strategy. It also offers zero deployment, all-network control and visualization, which reduces network costs and improves the access experience.

Data center and cloud are central to supporting digital business and massive data management. In regard to business support, companies should build software-defined source pools for computing, storage, network, security, etc., and move towards an integrated infrastructure merging HCI, private cloud, hosting cloud and hybrid cloud in order to meet the digital business development requirements in their various stages. As to substantial data management, a software-defined, all-in-one storage platform should be built to incorporate all structural, semi-structural and non-structural data services. It should also incorporate applications including production management, disaster recovery, document sharing, big data analysis, development and tests in order to cut management costs and improve flexibility.

Integration of cloud-network-endpoint

Independently operating different software-defined modules for computing, storage, network and security is unlikely to unleash the full value of SDI, i.e. agility, intelligence and security. Sangfor Technologies believes that companies should build coordinated mechanisms on every cloud level, network and endpoint to maximize connectivity and optimize each module.

Figure 17 Sangfor's Cloud-Network-Endpoint Integration



Source: Sangfor, 2019

Intelligence-driven: By introducing AI technology to the cloud, networks and endpoint respectively, and establishing a system incorporating data algorithms, data sampling, training models and predicative analyses, a company can accurately recognize risks, predict anomalies, evaluate functional bottlenecks, and adjust the overall strategy in an automated, smart manner, while controlling risks and the expansion of anomalies. For example, AI integration enables automatic resource releases and repurposing, and allows for the early detection of underperforming slow disks, etc., ensuring a positive and healthy software-defined ecosystem.

Holistic Management: Universally, traditional IT management endures a lack of coordination throughout business operations and specific management objectives. The solution is to build up a centralized management platform, which can make full use of the cloud capabilities by instituting an across-the-board risk monitor center and overall strategy management and control center. For example, the BBC cloud module, which is used for comprehensive network visualization; and the CMP cloud module, which is used for comprehensive resource monitoring and allocations. In this way, companies can operate cohesive standards, planning, deployment and management on all IT modules for complete cloud-network-endpoint connections and response management systems.

Cloud-network integration: With the cloud at the core, companies can support cloud-based business and enable cloud-based networks. It also facilitates cloud-driven networks and business-driven SDI, and delivers unified and automated cloud-network-endpoint connectivity. Take the hybrid cloud as an example, the company can build a multi-cloud network and unify connectivity, security strategies and management and control platforms. In a desktop cloud scenario, it can accomplish network protocol optimization and automatic bandwidth controls, and improve the cloud office user experience.

Apart from delivering cutting-edge, innovative products and technology, Sangfor Technologies has accumulated an abundance of industry experience. It works alongside its partners to create the ultimate ecosystem to drive its client's DX. Notably, it has enabled sectors including education, finance, government, large enterprise, and healthcare, to provide IT services to the clients in the corresponding industries. Sangfor's industry-specific business divisions focus on the study of innovation in various sectors, including Industry 4.0, smart city, digital campus, smart healthcare and other innovative initiatives. Sangfor ensures its products and services to correspond perfectly to the enterprises' DX and smart transformation needs, allowing for them to make forward-thinking, business-oriented innovations. While working with ISV in the industry, Sangfor also provides software with bottom-layer optimization and improved performance stability and security. By helping the clients solve business software bottom-layer support and security problems, Sangfor focuses explicitly on business innovation. Going forward, Sangfor will continue to innovate across three core business facets: security, cloud computing and infrastructure. This is to meet the increasing demand for DX acceleration and lay solid foundations for the enterprises' DX.

ABOUT SANGFOR

Sangfor Technologies is a leading global vendor of IT infrastructure solutions, specializing in cloud computing, network security and infrastructure with a wide range of products. Sangfor is committed to carrying the foundational work in the process of users' digital transformation in various industries, so as to make IT simpler, more secure and valuable. Sangfor now has over 4,500 employees with more than 50 branch offices around the world. The company has been awarded as a national high-tech enterprise and hosts the National and Local Joint Engineering Laboratory of Next-Generation Internet Information Security Technology, and Guangdong Research Center for Intelligent Cloud Computing Engineering.

Sangfor has adhered to the idea of continuous innovation to develop convenient products for users, winning wide recognition in the market and providing products to nearly 100,000 users.

About IDC

International Data Corporation (IDC) is the premier global provider of market intelligence, advisory services, and events for the information technology, telecommunications, and consumer technology markets. IDC helps IT professionals, business executives, and the investment community make fact-based decisions on technology purchases and business strategy. More than 1,100 IDC analysts provide global, regional, and local expertise on technology and industry opportunities and trends in over 110 countries worldwide. For 50 years, IDC has provided strategic insights to help our clients achieve their key business objectives. IDC is a subsidiary of IDG, the world's leading technology media, research, and events company.

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