stc Saudi Arabia

Cloud Infrastructure Department

Automated Orchestration for SDWAN use case

Dec, 2022

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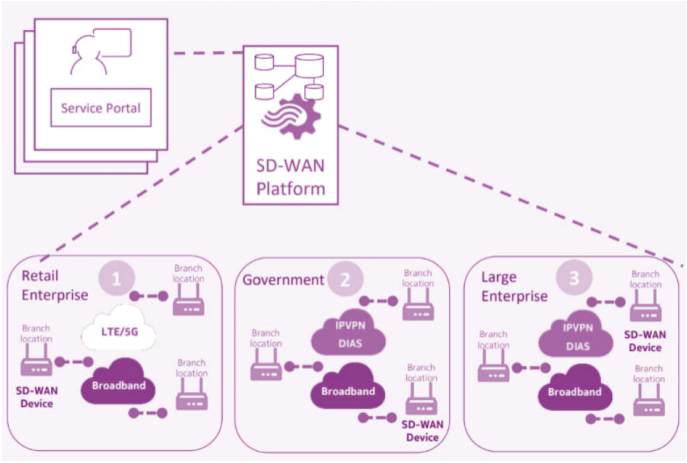
Executive Summary

Digital transformation is a crucial enabler for realizing Saudi Arabia's Vision 2030 and is geared toward creating a vibrant society, a thriving economy under the UN's Sustainable Development Goals (SDGs), and an ambitious nation by building a digital community, digital economy and a digital nation. It is about technology in data, process enhancement, and innovation as the main ingredient of the digital transformation strategy, which is the plan of describing how a business must strategically reposition itself in the digital economy. In a similar context, stc launched agile WAN in collaboration with Nokia Nuage Networks offerings a complete managed Software-Defined Wide Area Network (SD-WAN) services, in which stc plan to innovate, change operating process, and business models, and also leverage emerging technologies. stc SDWAN service designed from the creative industry perspective to connects with stc's digital transformation strategy through complete the change the customer experience (CX) and user experience (UX), in which stc Customers can find and select the products and services that match their needs.
stc is a world-class digital leader, supporting its business customers to go onboard on the existing journey of digital transformation. stc SD-WAN services bring agility as a service that will provide the required elasticity, visibility, self-control, and security to the path customers connect their network to the vital sites or cloud resources. stc agility in the area of SDWAN, business customers will benefit from a multitude of features to have optimized network performance, enhanced and enrich feature set of Cybersecurity tools to stay secure, and efficient management of their application along with ensuring end-to-end visibility and control.



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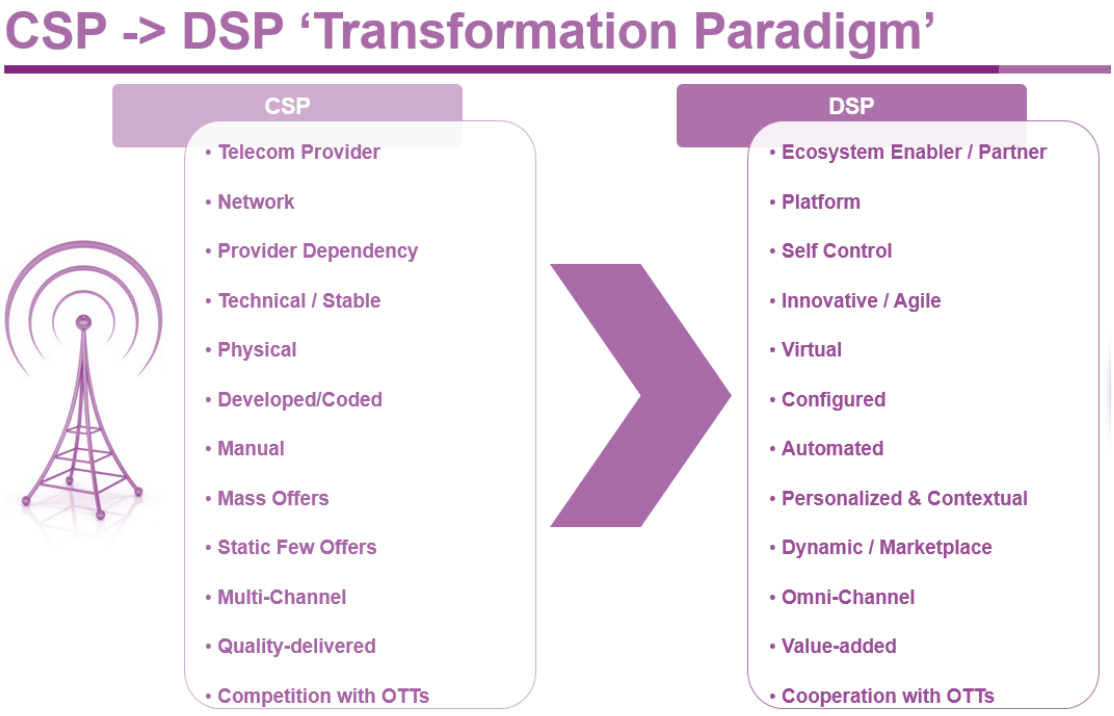
Digital Transformation Paradigm – Challenges and Opportunities

Digital disruption has undoubtedly touched, rather transformed many facets of human life over the recent years. On one hand, the digital age allows humans at large to become more productive and efficient in their work and personal life making use of the easy access to information and advanced services on the go. While on the other hand, digital technologies and processes are enabling businesses, whether small or big, to innovate and deliver value to their consumers at an unprecedented pace. Better customer experience, higher operational efficiencies, reduced costs, and increased agility are among the top benefits that digital transformation offers to businesses as well as governments across the globe.

Almost each and every industry on the planet has undergone a major transformation leveraging digital technologies and tools over the recent period. Service Providers (SP) are naturally the front-runners in this race owing to the critical role they play in this increasingly hyper-connected world. Like all other industries, the digital transformation at a SP is not limited to the Technology landscape alone; Culture, People, and Organization aspects are truly important as well. However, the Network and BSS/OSS Transformation do play a pivotal role in delivering the most innovative and cutting-edge services in a self-service and on-demand fashion, both to individuals and enterprises.



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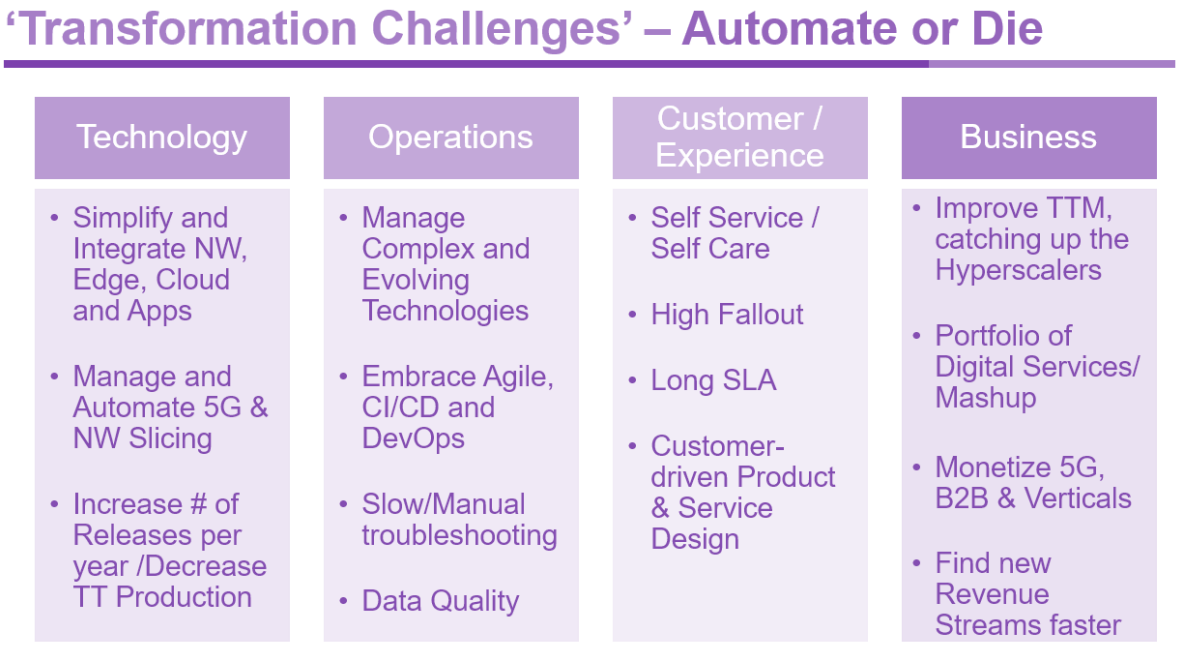
In the pursuit of becoming a truly digital service provider (DSP), operators have undergone a complete paradigm shift while embarking on an inward-out technology transformation journey that comes with its own unique challenges but also opens doors to a wide range of new opportunities. Moving away from the proprietary hardware and software across the network landscapes by virtue of Virtualization, Cloudification and Software-defined Networking capabilities had been at the heart of such a digitalization journey. However, reaping the actual benefits of such innovative technologies has only become possible by adopting the most advanced Automation and Service Orchestration tools across various layers of the increasingly complex, hybrid and multi-vendor network. By employing the right set of automation and orchestration capabilities in their technology architecture, a DSP can flexibly abstract and quickly provision and manage their virtual and physical network resources as necessary to deliver and assure the new breed of services in an agile and timely fashion.

Owing to the need for automation required to better manage the deployment of complex network technologies, optimize their operations and maintenance, simplify customer self-care and make the business operations agile, operators are faced with only two options, Automate or Die!



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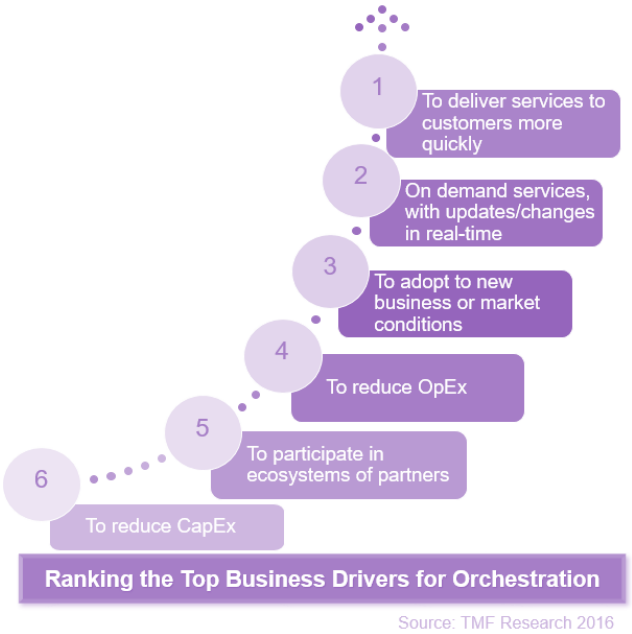
Automated Orchestration, drivers & value proposition for a DSP

Developing and managing digital services in this new era is challenging, mainly due to the convergence of Cloud, Smart Connectivity, Cyber Security, Internet of Things (IoT) and Artificial Intelligence (AI); all or most of which jointly make up an end product. Modernizing various business and network enablement platforms at a service provider (commonly known as OSS/BSS stack) is vital to achieving the intended state of an overall digital transformation program.

An end-to-end (E2E) Service Orchestration and Automation solution can help to accelerate a DSP's agility and innovation by providing a flexible and programmable framework to rapidly create, customize and roll-out such new services. Being able to design and provision a complex service in an automated fashion helps to reduce the Time-To-Market (TTM) and Time-To-Customer (TTC) from months to days and from weeks to hours/minutes. Further it can allow to manage the complete lifecycle of different types of services over multi-vendor physical, virtual or hybrid telecom networks, whether on-premise or hosted, and even across partners. An E2E Service Orchestration framework also targets to automate end-to-end service operations via a policy-based and near real-time closed-loop control approach in conjunction with Operator's assurance & analytics systems – thus greatly reducing the re-occurrence & time-to-resolve (TTR) of any service impacting incidents across the underlying complex infrastructure.



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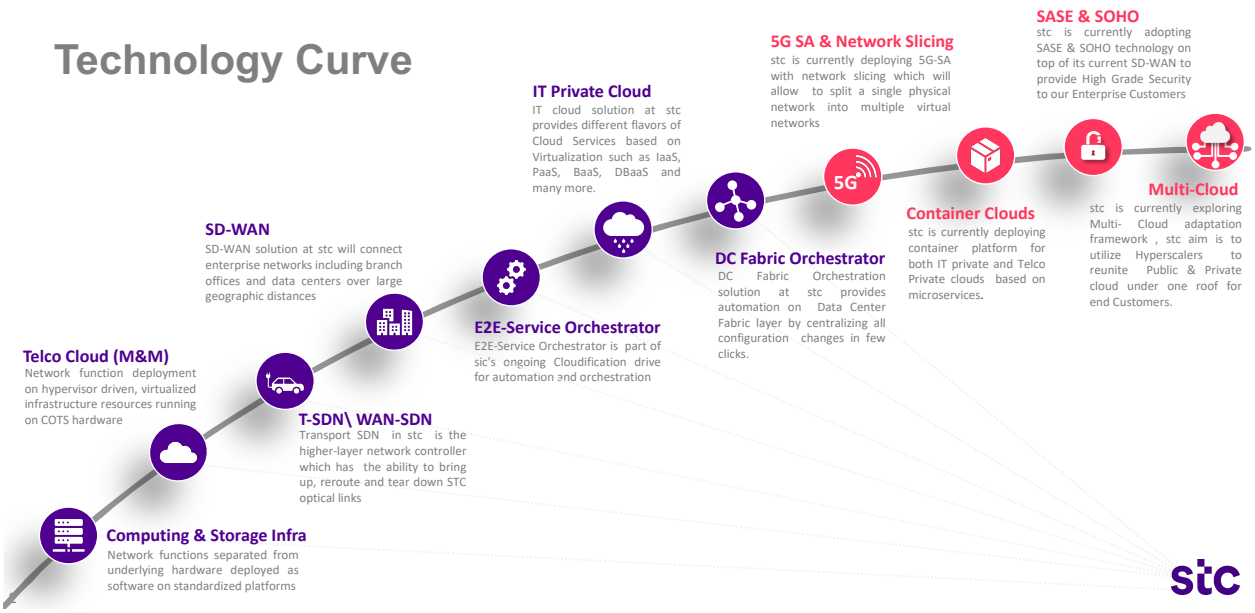
Among the key drivers of various automation and orchestration projects across the Telecom industry are Faster Innovation & Agility, Service & Product Evolution, and cost reductions both in terms of CAPEX and OPEX.

stc's journey into software defined networking and Telco cloud



Back in 2018, STC start to explore technological leaps from the standard IMPLS which was casting STC heavy OPEX, and wanted to diversify into Software Define connectivity rather than the legacy P2P connectivity. SDN was the solution for all STC problems. Based on SD-WAN the journey of assessing the vendor market to ascertain the availability of purpose-built and fit-for-its-purpose software defined WAN and Automation solutions, which eventually resulted in acquiring and implementing Nuage Networks from Nokia Virtualized Network Services (VNS) platform on top of the Nokia's Service Lifecycle Orchestration system (VNO). STC's SD-WAN solution is a key component of STC's cloud portfolio, providing enterprise customers with automated, dynamic, programmable, and more efficient network services.

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It will enable rapid ordering and automated configuration of network services, as well as increased visibility and control based on the enterprise's specific needs.

Stc is transforming its digital services infrastructure to support cloud services as enterprises embrace them. Stc launched SD-WAN services after recognizing the potential and benefits of cloud-based and software-defined technologies. The program aims to support its enterprise customers' digital transformation journeys and cloud transitions.

The initial scope was set to automate the fulfillment of STC's new SD-WAN basic and advanced connectivity services for the Enterprise and SME customer segments.

STC is acting as a leader in the provision of 5G services not only in KSA but Kuwait and Bahrain as a group subsidiary. keeping that in mind STC's approach of building a telco cloud that supports its digital transformation goal of becoming an agile Service Provider.

The backbone of STC Telco Cloud is based on ETSI Framework, in 2016 STC started to adopt by deploying a reference model but with a twist of mix and match approach. So, to get the best of bread STC started its Core functions to migrate from the traditional Network functions (PNF) to the new Virtual Network Functions (VNF). With the help of vendors Red Hat, Juniper, Huawei, Nokia, and Ericsson, STC build its first POD of Telco Cloud to onboard 1TB of throughput in the initial stage.

STC didn't stop at the first POD, recently two more PODs are been under deployment. Which is targeting to onboard all STC traffic throughputs by end of 2025 which will result in the decommissioning of the physical core and also be fully capable of hosting Virtual Network Functions (VNF), Container Network Functions (CNF), and any network workload.

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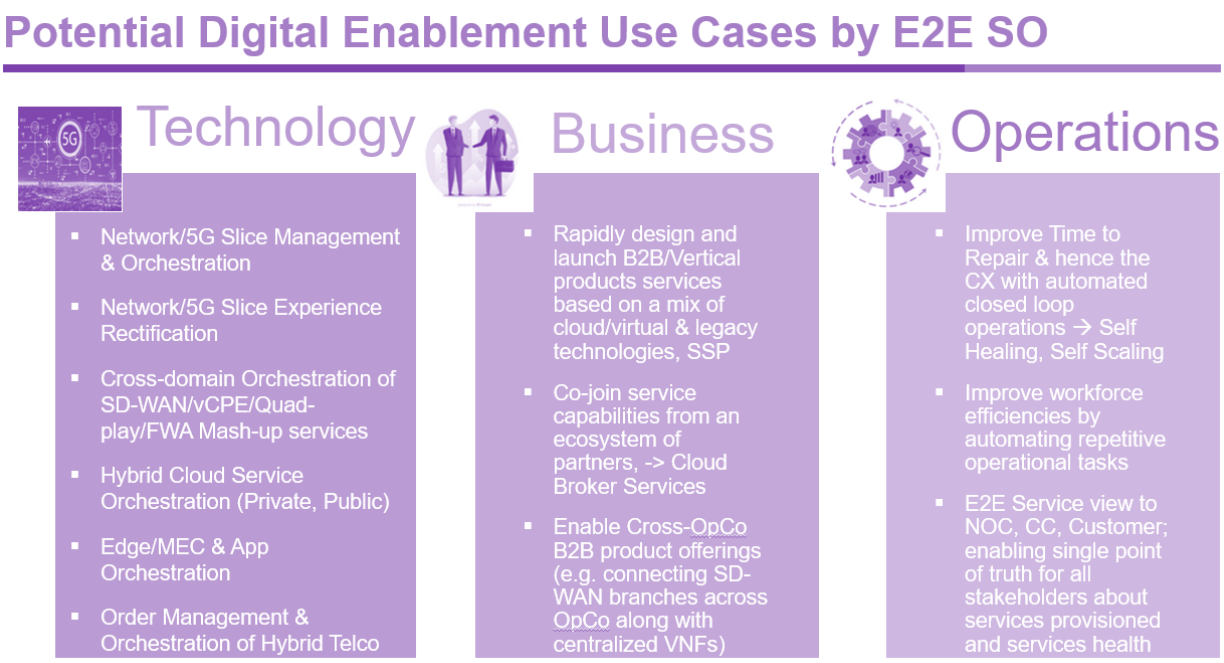
Critical role of Orchestration to fulfil the current SD-WAN & future use cases

Legacy tools and OSS/BSS applications in a typical operator's ecosystem do not offer the required features and flexibility as needed to dynamically decompose and orchestrate delivery of new type of digital services that span multiple technology domains. Most importantly, the legacy OSS/BSS tools do not have the required intelligence for the service placement and managing the entire lifecycle of cloud and software-defined applications in a hybrid environment. Legacy tools are very prescriptive in nature and do not allow combining the service fulfilment and assurance capabilities in order to achieve closed loop automation as necessary to move towards an autonomous network vision of digital service providers.



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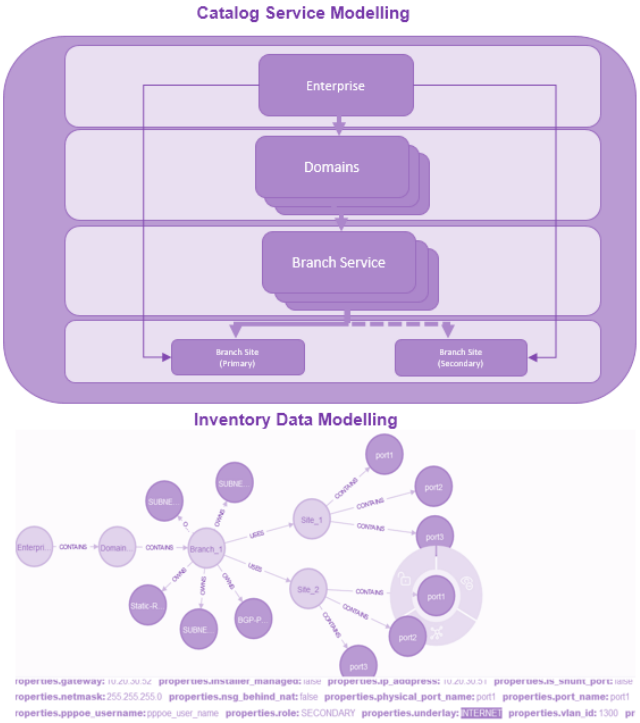
In addition to automating the fulfilment and delivery of new services in the shortest span of time and with no human intervention, E2E SO solution at stc also leverages its interworking with Assurance and Analytics platforms in order to automatically rectify the health of any faulty or malfunctioning services by either re-provisioning or restarting the failed service components and resources. This plays a vital role in improving the service uptime and guarantees a better customer experience, while also maximizing internal operations efficiencies. Assurance and fulfilment technologies work together seamlessly to achieve the ultimate zero-touch and closed loop automation vision that stc has put forward for the years to come.

While taking an agile approach towards the delivery of SD-WAN services for its enterprise customers, the orchestration logic and abstract APIs have been built incrementally to support the delivery of basic, advanced and premium SD-WAN service packages. By virtue of the latest orchestration technology at work across multiple layers of the stack, a new SD-WAN branch gets fulfilled and is ready for service within an hour, which is 98% quicker than the delivery of legacy branch services (IPVPN, DIA etc.) that took almost 3 days (72hrs) after the customer places an order. This drastic increase in TTM will help stc to survive and thrive in the digital age where customer expectations have sky-rocketed due the agility and speed offered by the Hyperscalers and other OTT players.



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E2E Orchestration solution will also allow to automate the delivery of hybrid connectivity and security services over the SD-WAN and SASE infrastructures provided by multiple technology vendors of stc.

Current implementation of E2E Service Orchestration solution has also provided a solid foundation for stc to quickly on-board and launch a variety of next generation services and uses cases, including but not limited to:

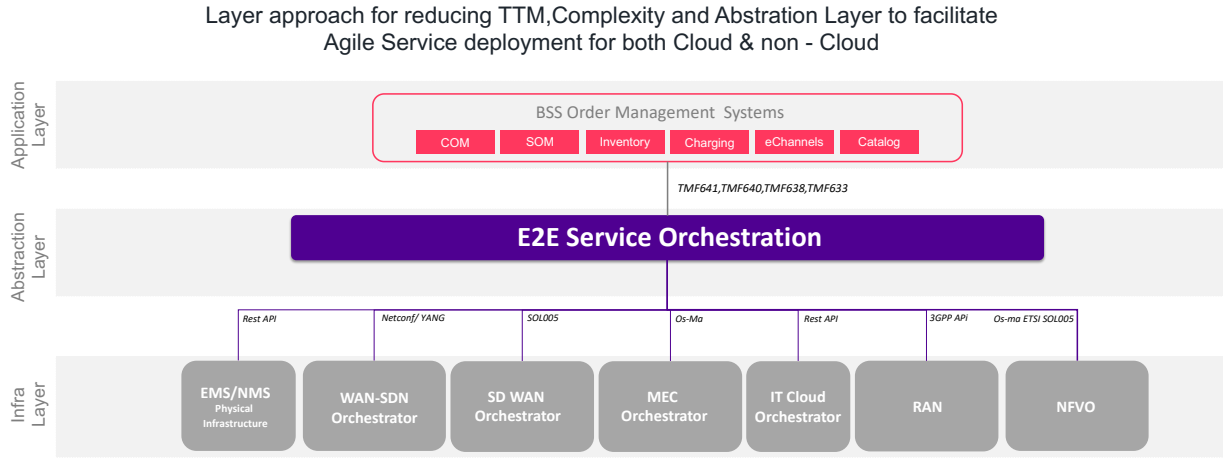
- 5G Slicing based vertical industry use cases, spanning across Core, Transport and RAN domains
- 5G Slice experience rectification to deliver premium SLAs to verticals
- Cross-domain Orchestration of SD-WAN/vCPE/SASE/MEC/FWA Mash-up services
- Automation of existing B2B/EBU services to remove any manual activities and the longer delivery times involved
- Multi/Hybrid Cloud Services Orchestration (Private, Public, Enterprise, Telco)
- Enable Cross-OpCo/Cross-Partner B2B product offerings

AUTOMATED ORCHESTRATION FOR SDWAN USE CASE

Stc Architecture blueprint for SD-WAN Infrastructure and STC Orchestration layers

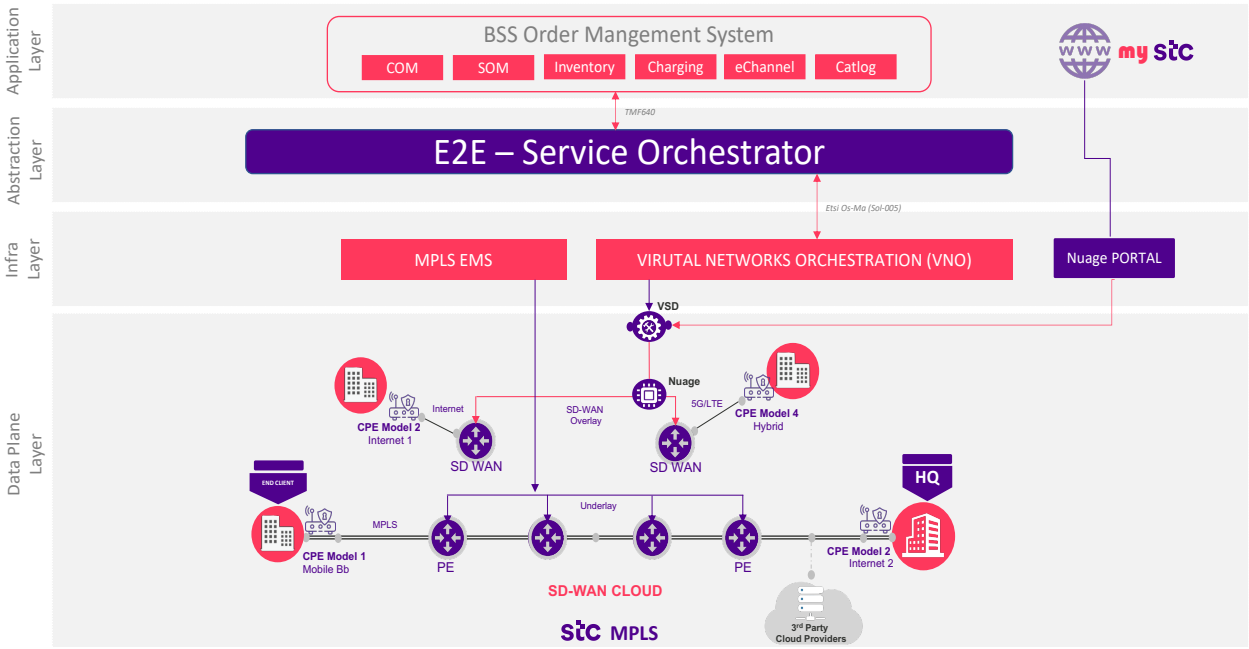
At STC, we opted for a layer orchestration architecture, E2E Service Orchestrator solution sits on top of all the newly established Cloud as an abstraction layer and other cloud-based technology domains which include SD-WAN, WAN-SDN, Telco Cloud/NFVO, 5G-SA Core, Edge/MEC, and ORAN. E2E SO layer thus acts both as a bridge between the existing BSS stack and the various SBI technology domains hiding their complexity for an intent-based fulfilment approach, and also helps to design and stitch multi-domain services across a massively transformed network landscape by adopting **Service Channing.**

E2E-SO per the current Strategic direction focuses on Cloud-based technologies to automate Digital Service traffic, but this does not limit it to acting as a Hybrid orchestrator as it has the full capacity of steering non-Cloud service of the physical world.



whereby SD-WAN as one of the technology domains has implemented its domain orchestrator (VNO) connected to VNS controller, which is further abstracted by the E2E Service Orchestrator solution. Using x86-based CPEs, Nokia VNS will provide the ideal enterprise branch service. It

provides fast, secure deployment of cloud-based WAN services with intelligent traffic steering, full application visibility, and end-to-end security and is Transport agnostic.



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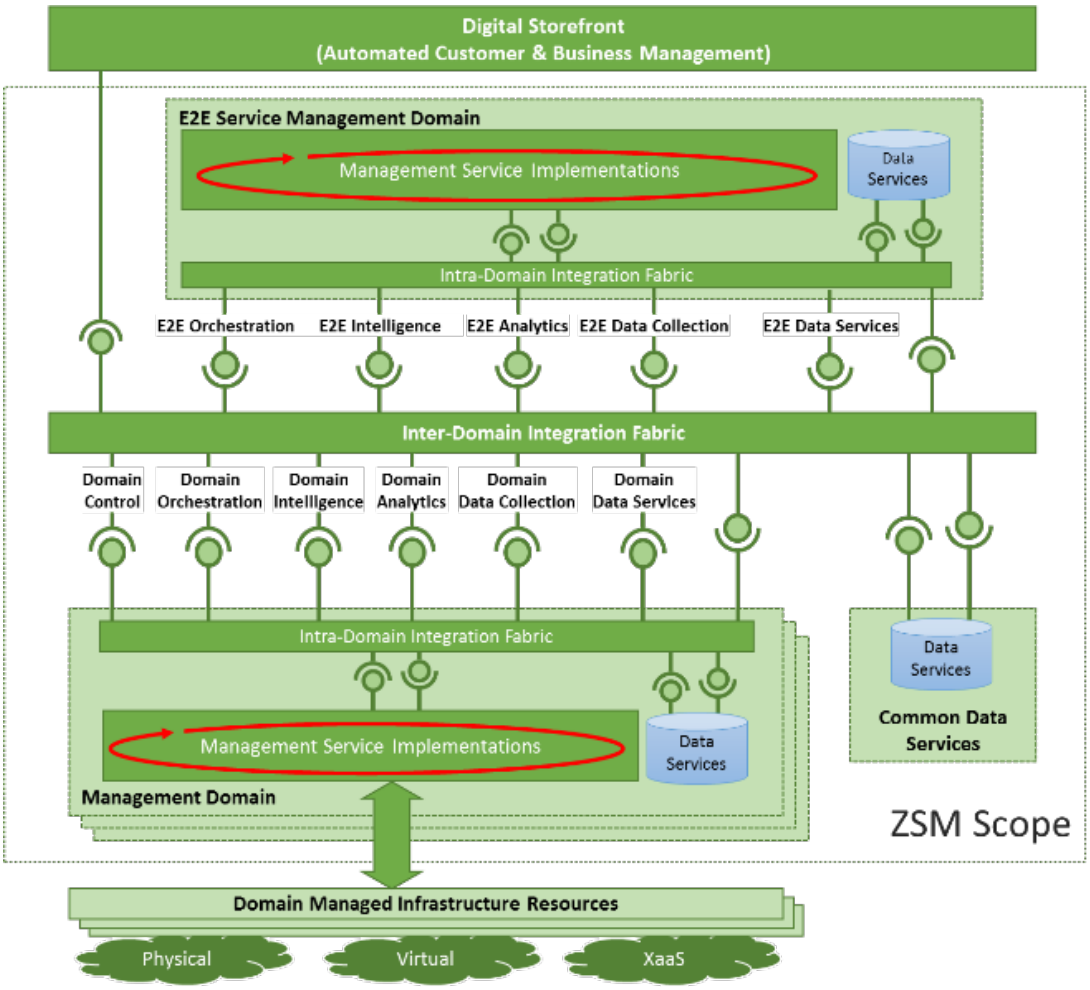
Orchestration's state of Industry Standardization

The architecture of stc's E2E Service Orchestration solution closely aligns with the most relevant industry reference frameworks and open-source projects like ETSI ZSM, MEF LSO, TMF ZOOM and LF ONAP.



ETSI GS ZSM 002 V1.1.1 (2019-08)

Among all these, ETSI is probably the top organization involved in the standardization work related to virtualized network technologies. While already known for their NFV MANO architecture and OSM project, in August 2019 ETSI published v1.0 of their Zero Touch Service Management (ZSM) requirements and reference architecture specification.

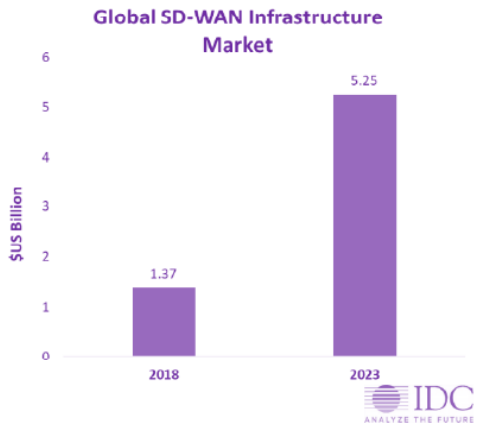
Among the ZSM highlights are:

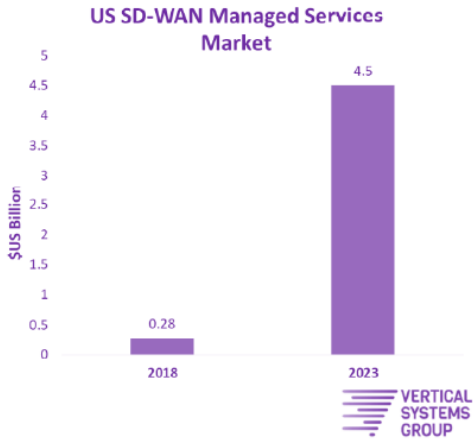
- A Service-based, modular, and extensible Architecture
- Separation of management and automation into different areas of concern, i.e., network management domains & E2E cross-domain service management
- An integration fabric for integration and composition of management services
- Decoupled domains with own Fulfilment (orchestration and control) and Assurance (data collection, analytics and intelligent automation)

5G slicing automation framework envisioned by stc also closely aligns with the key approaches proposed by both ETSI ZSM GS 003 and GS 008. On top of 3GPP Network Slicing architecture & references definition.

SD-WAN's state of Industry Standardization

The SDWAN market is one of the rapidly growing sectors in the telecommunications industry, projected to generate billions of dollars of revenue over the next five years. According to the Metro Ethernet Forum (MEF3.0, 2019), IDC estimates that the worldwide SDWAN infrastructure market will reach $US 5.3 Billion by 2023 at 30.8% CAGR. The United States managed SDWAN services market independently reaches $US 4.5 Billion by 2023 at 74% CAGR. The leading drivers of this market growth are enterprises seeking (1) better support for SaaS applications and hybrid cloud and multi-cloud usability, (2) easier management of WAN connectivity to improve user experience and application performance.





However, today's SDWAN market shares many resemblances to the early days of today's Carrier Ethernet services and technology market before standardization and services. Nowadays, the standardization of SDWAN technology and services certification are available, which led to adopting the standardized SDWAN services over the service provider network and unified the framework across the vendors that are involved in the development of SDWAN technologies and services. This essential and fast-growing SDWAN services market is therefore attracting many new service providers and technology vendors that attach the term 'SDWAN' to their product offerings. Moreover, SDWAN service standardization has been conducted within the context of the MEF 3.0 Global Services Framework. It is part of a digital transformational initiative to define, deliver, and certify a family of Carrier Ethernet (CE), IP, Optical Transport, SDWAN, and security services orchestrated across the automated networks using Life-Cycle Orchestration (LSO) APIs.

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The SD-WAN vendor market is like the wild west, with over numerous vendors with widely different approaches and starting points. The industry organization, MEF, a nonprofit industry forum of network, cloud & technology providers, has developed standards and certification called MEF 3.0 (MEF 70/70.1). It sets forth what counts as SD-WAN, the basic terms and component parts of an SD-WAN solution, and the critical attributes of an SD-WAN service that is provided by service providers to enterprises with an SLA.

Although MEF 3.0 covers the basic capabilities of SD-WAN, it makes it easier for enterprises to understand, evaluate and choose SD-WAN services. The planned evolution of standards will ultimately ensure interoperability between different SD-WAN services, orchestration of these services, and required security and SLA framework.

"Customers know what to expect when selecting SD-WAN managed services from a provider, and providers have the tools needed to deliver secure SD-WAN services that drive customer satisfaction," Pascal Menezes (MEF, 2021)

MEF 3.0 SDWAN SERVICES

MEF-defined SDWAN services are provided global SDWAN services framework that includes:

1- Optical Transport services
2- Carrier Ethernet services
3- IP services

MEF 3.0 services in a consistent way to, among other objectives, maximize the ability to use a single orchestration approach for all data connectivity services, as well as to reuse concepts in all the services standardization work. MEF generally defines a service that can be offered as part of its product offerings by a service provider, including prescribed Service Level Agreements. MEF 2.0 Service framework provides enough information, which leads to the service provider being free to choose the most suitable technology vendors and design the most appropriate implementations while conforming to the SLA agreed upon with the enterprise customer.

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The MEF 70 (MEF3.0, 2019) standard describes SDWAN services requirements mainly for an application-aware, overlay WAN connectivity service that uses policies and procedures to determine how the application flows directed over multiple underlay networks irrespective of the underlay technologies or the service providers who deliver them

The MEF 70 defines as:

- **Service attributes** describe the externally visible behavior of SDWAN services as experienced by the subscriber
- **Rules** associated with the traffic and how it handled
- **The Key technical concepts and definitions** like an SDWAN UNI, the SDWAN Edge, Tunnel Virtual Connections, SDWAN Virtual Connection End Points, and Underlay Connectivity Services.

SDWAN standardization brings numerous benefits that help the industry to accelerate the SDWAN market growth while improving overall user and customer experience with hybrid networking solutions

Essential Strategic Benefits include:

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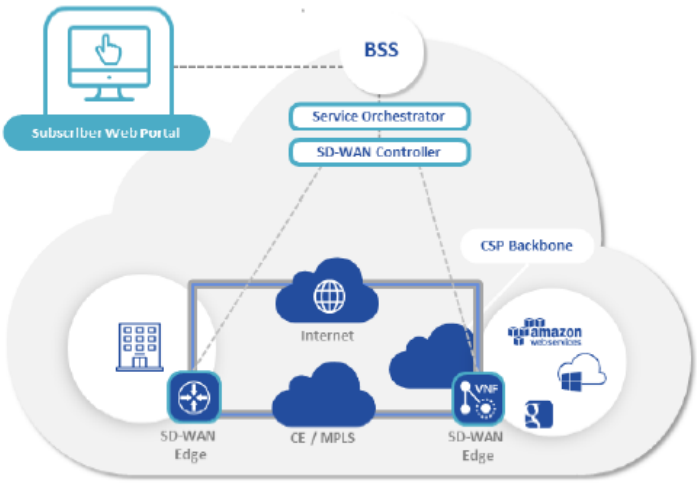
- ✓ Enabling the broad range of ecosystem of stakeholders for the use of the SDWAN technology while selling, accessing, deploying, and delivering SDWAN services.
- ✓ Underlay connectivity service intelligently to provide a better application experience with guaranteed service resiliency.
- ✓ Facilitate including SDWAN in Life Cycle Orchestration architecture to automate MEF 3.0 SDWAN services for agility.
- ✓ Providing the foundation for developing SDWAN APIs to support the multidisciplinary interfaces in the MEF LSO architecture.
- ✓ Concreting the way for creating and implementing the MEF 3.0 SDWAN services, which helps to provide users confidence that a service meets the fundamental set of requirements.
- ✓



There are four different aspects of the SDWAN services as defined in MEF 70.1 (MEF70.1, 2021):

- The SDWAN Service Provider and SDWAN subscriber
- The main component involves in SDWAN service provider describing and building the SDWAN service
- The attributes of SDWAN services, including Service Level Agreements SLAs experienced by the user of the service
- The overlay nature of the SDWAN service

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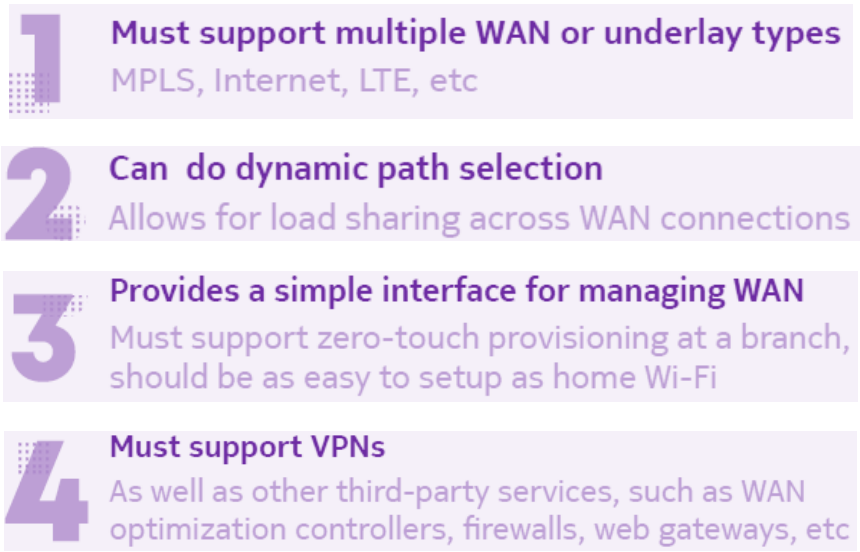
stc's way forward with SD WAN 2.0 and SASE

A software-defined approach to managing wide-area networks, SD-WAN offers improved connectivity to branch offices and the cloud. End users are excited about SD-WAN because it enables them to manage and add network functionality using a cloud-based software model, which eases deployment, enables central manageability, and reduces costs. As compute resources and associated cloud services have exploded, the traditional enterprise network boundaries have expanded into the public cloud, branch locations, and intelligent edges. Service providers are increasingly providing managed SD-WAN services to enterprises, and the number of enterprise SD-WAN deployments is growing rapidly.

The four main characteristics of SDWAN specified by Gartner (Gartner, n.d.)



WHAT PROBLEM IS BEING SOLVED BY SASE?

As cloud becomes pervasive and driven by digital transformation of enterprises, the networking and security needs of an enterprise are evolving. The traditional enterprise network and security paradigm was centered around applications in private data centers. Although networking was

complex, the security risk profile was well-defined. The migration of applications to the cloud has redefined networking and security. Many companies use SD-WAN to securely connect branch offices to their corporate networks instead of relying on traditional and expensive MPLS links. SD-WAN also facilitates direct access by corporate branch offices to the public clouds and SaaS applications. This creates stringent security requirements from the branch to the cloud.

Gartner observed this trend of security and networking requirements and has recently defined a new framework that converges network (SD-WAN) and security into a single cloud-based service: Secure Access Service Edge (SASE).

The term SASE was first coined in 2019 and the original definition of SASE was the integration of networking and network security as a single unified, cloud-delivered service. SASE experienced a massive hype cycle in 2020, leading to customer confusion, massively inflated expectations, and suboptimal approaches.

Vendors tried to bundle their disparate products or service offerings as an all-in-one SASE solution. However, this led to suboptimal offerings and frustration for the buyers.

However, the industry has settled at this point where Networking & Security are seen as a separate part of the SASE architecture. This also aligns with enterprises having separate decision-makers, requirements, and budgets for these areas.

Branches or sites require connections that are reliable and performant. Enterprises want granular policy control and application insight; all are managed centrally. This is provided by SD-WAN.

The Security Service Edge (SSE) is seen as a way to efficiently deliver advanced security services. Traditionally these functions would have lived in the DC, but to move the security services closest to the users, the user traffic is steered to the nearest cloud POP of a security provider. Services offered here include CASB, SWG, FWaaS & ZTNA. Other optional services include RBI (Remote Browser Isolation) and DLP.

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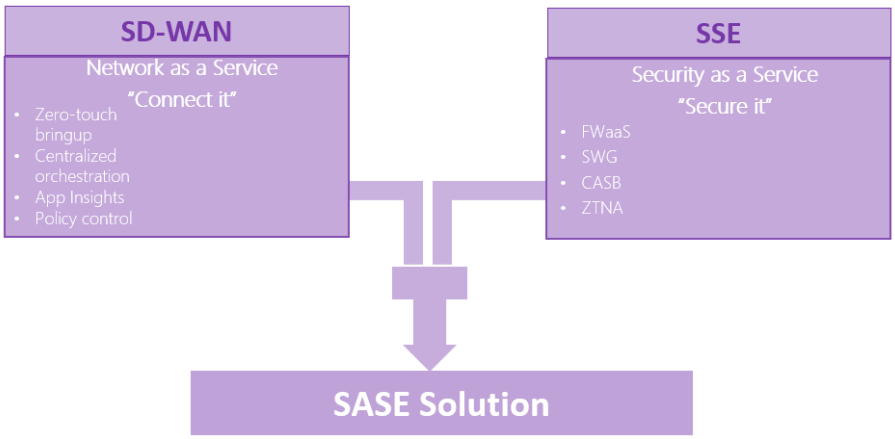
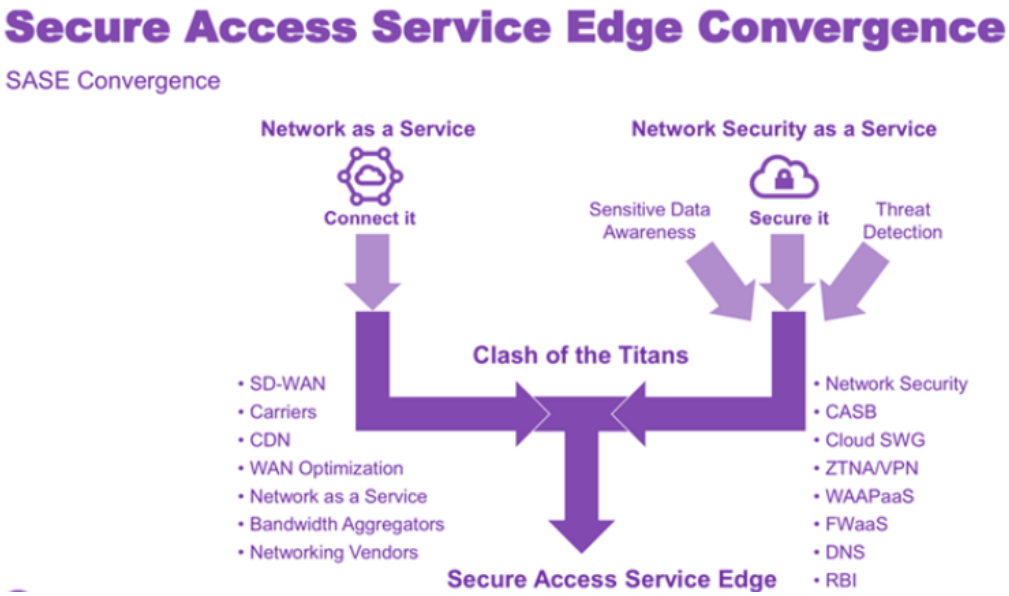


SASE AND ITS KEY REQUIREMENTS

SASE framework that gives simultaneously networking and security services in one unified solution designed to deliver security for applications in the cloud delivered as a service. It is not an RFC or a static architecture but rather a recommendation and a framework.

SASE has two major functional blocks – Networking (SD-WAN) and Security, as shown in the figure below. SD-WAN is the foundation of SASE, and security features are offered on and beyond SD-WAN.



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SASE NETWORKING (SD-WAN) – FEATURES AND BENEFITS

SASE networking capabilities offer the following benefits and capabilities:

- Network Agility – Flexibility and choice of MPLS, broadband, or LTE.
- Multi-Cloud and SaaS Connectivity without the need for backhauling.
- Network Management and Automation - Real-time network monitoring, analytics, and reports.
- Application Performance Assurance – Business-policy-based application prioritization.

stc SDWAN Challenges

Challenge No. 1 - Complex Network Management

Description:

- Inefficient hub and spoke network model with lower bandwidth and higher exposure to cyber threats
- Manual and complex process of configuring routers and networks across branches, resulting in unscalable networks

How stc SDWAN helps:

- ✓ Provides a centralized design, automatically routing traffic from site to site
- ✓ Enables centralized network policy control and management

Challenge No. 2 - Lack of Application Control & Visibility

Description:

- Lack of application-level visibility and control over the network, impacting troubleshooting, network efficiency, security, and planning

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How stc SDWAN helps:

- ✓ Allows application performance monitoring and ensures prioritized network routing for critical applications

Challenge No. 3 - Distributed Vendor Management

Description:

- Presence of multiple service providers across branches, resulting in higher costs and misaligned SLAs

How stc SDWAN helps:

- ✓ Supports management of the entire network through a single vendor

Challenge No. 4 - Inefficient Access to Cloud

Description:

- Traditional WAN architectures based on MPLS currently backhaul traffic from the branches to headquarters/ centralized data center when accessing cloud applications, resulting in slower internet due to higher latency

How stc SDWAN helps:

- ✓ Enables seamless and highly secure compatibility with public and private clouds

Conclusion

The MEF standardizing SDWAN services led the industry to define the standards of SDWAN services and its attributes which help for the adoption of SDWAN across the enterprises and service providers to build and offer the SDWAN and SASE technologies-based products and services. It also helps to unify the understanding of SDWAN and SASE across the vendors and reduces the confusion around SDWAN. It creates simplicity among the vendors, service providers, and enterprises to choose the SDWAN solutions for their offerings.

Life-cycle service orchestration (LSO) of SDWAN is a significant next step to enable multi vendor solution to be offered to SDWAN service providers, and MEF work on information and data models based upon the MEF 70 will significantly enhance the capabilities of the resulting APIs needed for such orchestration

SDWAN is following in the footsteps of the rest of our world, becoming cloud-native and cloud-deployed. Given the cloud's numerous capabilities, including performance, economy, reliability, security, and scalability, multi-cloud & SASE is likely to be key destination for SD-WAN. As more enterprises adopt a hybrid or remote workplace model, cloud-native technology will become standard; it will be powered by 5G, a major mobility driver that will connect users to overlays and hyperscalers via the cloud.

Digital transformation is a crucial enabler for realizing Saudi Arabia’s Vision 2030 and is geared toward creating a vibrant society, a thriving economy under the UN’s Sustainable Development Goals (SDGs), and an ambitious nation by building a digital community, a digital economy, and a digital nation. It is about technology in data, process enhancement, and innovation as the main ingredient of the digital transformation strategy, In a similar context, stc launched an agile SDWAN service in a complete managed portfolio where stc continuous innovate and continuously develops the SDWAN service and change operating process, and business models to leverage emerging technologies. The stc SDWAN service is designed from the creative industry perspective to connect with stc's digital transformation strategy through completing the change in the customer experience (CX) and user experience (UX), in which STC Customers can find and select the products and services that match their needs.

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