Sterlite Tech

Software Defined Access Solution: Key to Agile Access Network

Executive summary

- Exponential data growth has resulted in heterogeneous and extremely complex networks, making it more and more difficult for service providers to scale them. Moreover, these networks are mostly 'hardware defined', requiring service providers to configure myriad network-layer devices such as switches, firewalls and subnets, making the networks inefficient.

- This is especially complex in access networks because of the explosion of connected devices (25 bn 'things' are expected to be connected to the internet by 2020 – Gartner). At the same time, the last-mile connectivity for these devices is via multiple network platforms, viz, copper, fibre, microwave wireless.

- In this paper, we propose the approach of Software Defined Access Networks (SDAN) to integrate applications and heterogeneous networks. Some benefits of SDANs to network operators are:

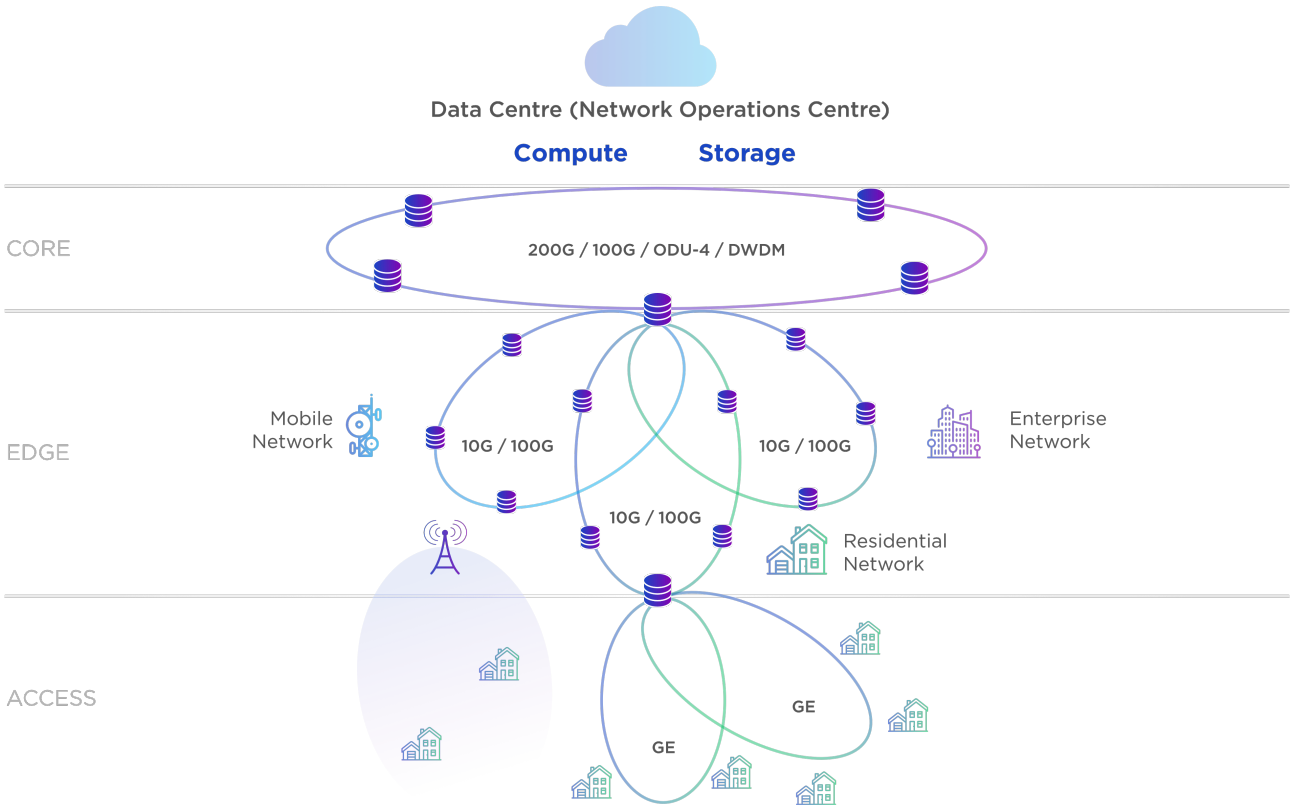
    - Enhanced FTTH customer satisfaction in multi-operator environment
    - Easy scalablity for future demand
    - High agility and responsiveness for dynamic networks
    - Reduced network provisioning time, from weeks to minutes
    - Simplified network due to multi-access convergence
    - Optimized operations due to virtualized access network control

Navigating network complexity

In today's zeta byte era, new services and innovation are resulting in accelerated data growth. With time, more subscribers with more devices are generating far more traffic than before, and service providers are demanding more agile access networks. To cater to such demands, fixed access networks need to be elastic to offer on-demand scalability.

However, new fixed access networks involve large numbers of small remote and distributed access nodes. These are constraining, and result in an overall complex network and sub-optimal service quality.

Service providers are increasingly taking initiatives to simplify their existing networks and plan for future. They want networks that allow them to continue adding bandwidth capacity with improved agility at minimal expenditure.



SD networks with virtualized controls

Network service providers – big or small – see the benefits of open, more agile, more programmable, and highly scalable networks. SDAN is gaining significant interest to service providers as it fulfils all these emerging requirements with an option to upgrade.

A typical SDAN can be described as separating the control and data forwarding functions of network equipment, and centralizing the control functions of multiple network elements. Generally, SDAN acts as a framework which facilitates automatic and active management of multiple network elements.

SDAN technology can be efficiently implemented with the help of Network Function Virtualization (NFV). NFV provides an innovative way to design, deploy and manage networking and carrier services. It leverages virtualisation technology to integrate network equipment using commercial off the-shelf servers with data-centres, network centres, and at the network terminal location.

Future Networks
Flexible and agile

Vendor neutral & Software Defined

Commodity and Virtualized Hardware

Fibre dominant

Network slicing approach

One approach to manage this challenge is to make a set of full-time networks, each dedicated to serve one type of customer. This approach, however, would be very expensive and time to market such services would be high. Enabling bandwidth on demand for individual consumer types is costly.

One of the most efficient and effective ways to implement SDAN/NFV is via network slicing, which allows multi-vendor participation in a shared virtual network. It enables the idea of operating multiple logical networks as independent virtual business operations on a shared platform. It can help simplify most parts of the network (such as terminal network, access network, core network and transport network).

A network slice can be designed based on the type of network function. Each network slice may consist of either exclusive or shared resources (such as storage resource, input power source). Every slice is completely separate and segregated from another network slice. Based on this approach, this paper presents three access network scenarios with varying level of virtualization.

A. No virtualization with advanced management control

This is the first scenario where a single Private IP service (PIP) provider serves customers. A single operator controls the outside infrastructure and access hardware, and acts as a network operator. Management functions, such as network analytics that drive maintenance operations and marketing campaigns, are more advanced compared to conventional networks. Centralising these functions helps in utilising analytics to derive advanced algorithms, delivering the highest gains. It also allows for homogeneous, vendor-agnostic management of the access hardware.

B. Regulated network virtualization

This scenario may have multiple Virtual Network Operators (VNO), delivering services to end users over a single infrastructure. Access hardware and outside infrastructure can be managed and controlled by one or more PIPs (or VNOs). This scenario is especially common in regions with facilities-based competition or where Layer 2 competition is mandated by regulators. Management or control of network is either at par or more advanced than mentioned in scenario 1.

C. SDAN with advanced management and control

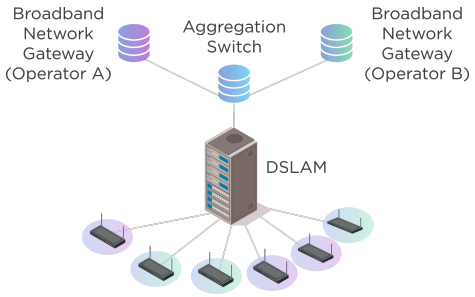
This is a full functional software defined access network which may extends beyond the access segment (in home network and possibly application platforms). A cloud based system enables an integrated edge network sending and receiving data on end-to-end broadband access and application performance. Data is collected on central databases at every data point in the network and is used by management to guide the optimization and diagnostic engines for efficient edge computing.

Network Scenario type	Suggestion for SD FTTH connection	Advantages of SD FTTH connection
Scenario 1: No virtualization with advanced management control	1. Centralised control using software based optimization tools. 2. Smart network diagnostics and recommendations by using software based frameworks 3. Multi-access roll-out at lower capex and opex 4. Scale layers when demand is needed	1. Multi-vendor support for hardware equipment 2. Enhanced experience with broadband line management capabilities for automated and fast optimization 3. Ability to translate low-level line data into network recommendations and analytics
Scenario 2: Regulated network virtualization	1. Multi VNO management platform to provide more flexibility compared to bit stream access 2. Smart network diagnostics and recommendations by using software based frameworks 3. High scalability and flexibility through dynamically expandable and programmable architecture	1. Network operators have more flexibility to introduce new and innovative services 2. Reduced pressure on PIP, predictive analytics at every network layer and component
Scenario 3: SDAN with advanced management and control	1. Plan in place for upgrade to newer network management paradigm 2. Unified network elements under common controller and orchestration layer	1. Future ready access network. Fulfils needs and requirements of both service providers and end-users 2. Provides high availability, high performance and scale-out

Access network sharing: Traditional v/s SD network

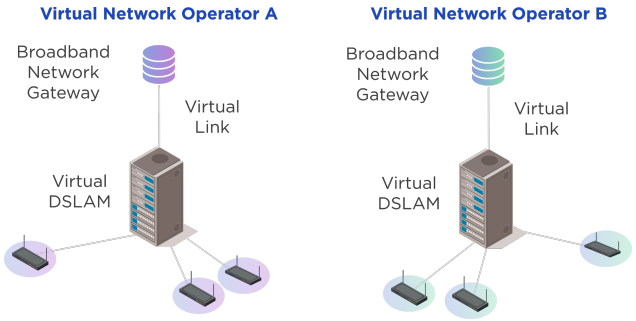
A number of broadband markets have access network sharing regulations such as Local loop unbundling (LLU), Sub-Loop Unbundling (SLU) and bit-stream access. In markets where access network in not very regulated voluntary operator collaboration also results in access network sharing.

Traditional network sharing[1]



- Regulated by LLU/SLU, most suitable for data cables
- Operator centric network segmentation
- Maximum network bundling level: Bit stream
- Physical layer control and firewall
- No direct access to functions or data

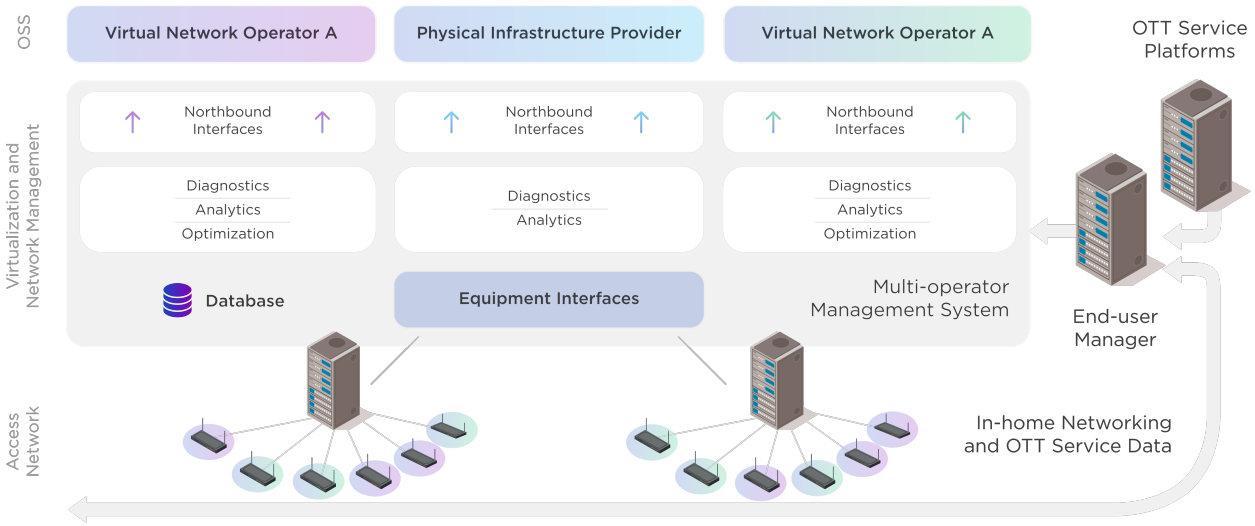
SD access network sharing[1]



- Minimal regulations, shared model
- Consumer usage centric network slicing
- Virtual network bundling with multiple VNO's at every level
- Data driven quality control, self-diagnosing and independent network management
- Innovative and purpose built applications

A step ahead: FTTH connection using SDAN

Traditionally, broadband access services have been largely limited to modem at the terminal points. This type of access system was adequate in homes as each line had one or two devices (such as desktop computers) connected via Ethernet cable. By 2021 it is estimated that each person will have more than 13 devices per connection in North America alone. Individual consumers and industries are adopting IoT enabled devices which would further increase number of devices per connection in coming future. Increased device density necessitates management of home network for better monitoring and improving overall broadband experience.



Source: 1. http://www.assia-inc.com/

As suggested in the figure[1] above SDAN provides a conducive framework for integration of service performance data, vertically and horizontally across all layers. This setup also leverages end user network diagnostics data to build predictive characteristics in the access network. It facilitates in sharing performance and diagnostics data from multiple access management platforms via secure and publically available APIs.

Conclusion

In terms of delivery of services to end users access network acts as a crucial component. The current and future industry insights and technology enablers indicate that network is continuously developing in terms of sophistication and simplicity. In light of significant increase in IoT enabled devices and its data production, need for uninterrupted and dependable network access is of high priority.

Challenge	SDAN features	Benefits
Network expansion	Execution of network functions from cloud	Increased network mobility and deployment
Operations expansion	Network control and automation in software defined framework	Streamline network administration, monitoring and troubleshooting
Business expansion	Open network ecosystem	Smoother consolidation and faster service rollout

Abbreviations

API	Application Programming Interface
CPE	Consumer Premises Equipment
DSL	Digital Subscriber Line
DSLAM	DSL Access Multiplexer
FTTH	Fibre To The Home
FTTN	Fibre To The Node
LLU	Local Loop Unbundling
OLT	Optical Line Terminal
ONT	Optical Network Terminal
OSS	Operations Support System
SD	Software Defined
SDN	Software Defined Network
SDAN	Software Defined Access Network
SLU	Sub-Loop Unbundling
VDSL	Very High Speed Digital Subscriber Line
VNF	Virtualized Network Function
VNO	Virtual Network Operator
VULA	Virtual Unbundled Local Access
WiFi	802.11 family of IEEE standards

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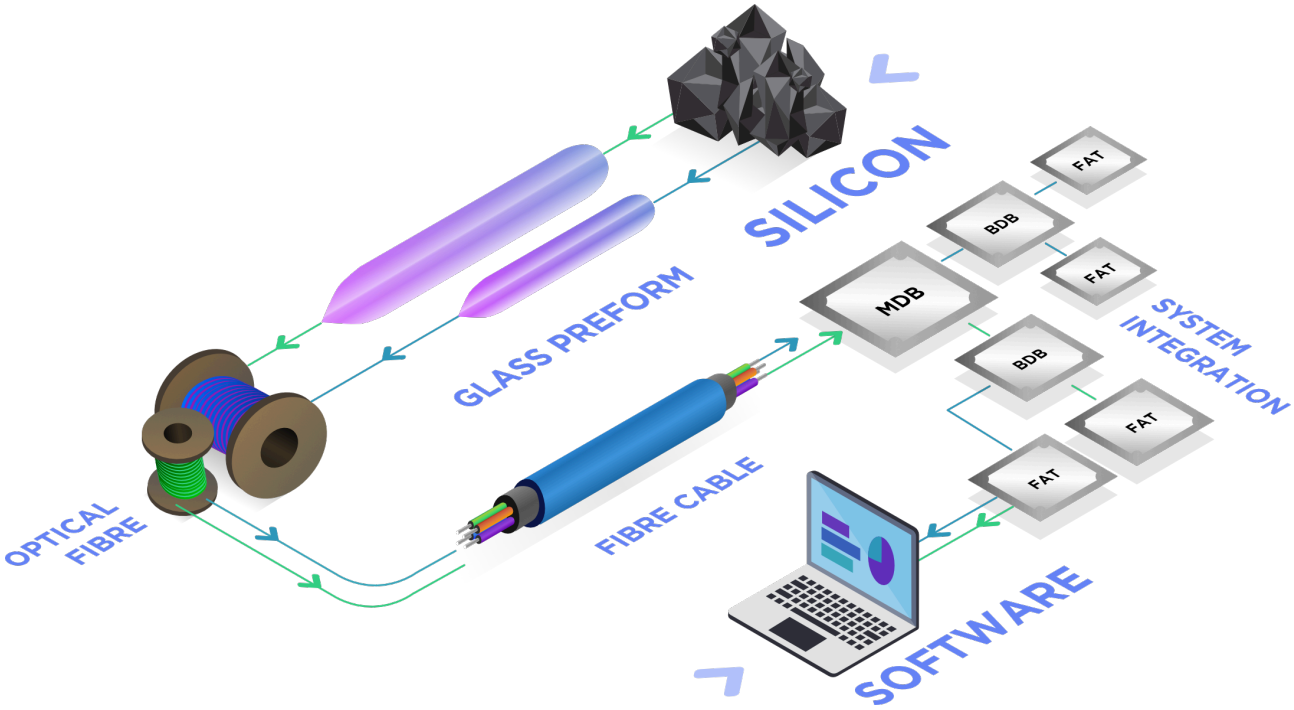

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