Programmable FTTx

Virtualise Access Network for a Software-defined Future

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New digital use cases are shaping our lives in ways unimaginable. Users want more bandwidth, better speed, newer use cases and a great customer experience. This demands a massive change in the ecosystem. Service providers need to augment their networks to accommodate these needs as well as exert on-demand control over the entire network. Re-designing the last-mile network infrastructure will ensure convergence of network access technologies thereby making it easier to meet growing users demand.

The cost incurred for this transformation is one of the key roadblocks for the service providers. To ensure a seamless transition with minimum cost involvement, they need to build universal network access, with programmability at both hardware and software level, separating control plane functions from data plane functions and virtualising the functions to meet technology and network demands. An open and flexible architecture coupled with modularity and programmability, enhances user experience to a great degree and establishes maximum control for service providers.

Key challenges of service providers

The service providers are facing multiple technical and business challenges which needs to be considered while drafting the strategic solution. Some of the key challenges, which every service provider would want to solve are:

- How to deal with bandwidth explosion with increasing bit-rate and latency-sensitive data consumption?
- How can cost of last-mile connectivity be reduced?
- How to design and deploy integrated infrastructure for last mile connectivity including PON and Mobile RAN?
- How to effectively monetise the last-mile assets?
- How to seamlessly scale the last-mile performance and bandwidth with increasing subscriber base?
- How to address the front-haul challenges such as latency and synchronisation?
- How to minimise subscriber churn by enhancing the quality of experience with real time network performance monitoring?

Increasing need for disruptive solution

Telecom industry is going through a massive disruption both in terms of technology and also the way they look at their TCO models. While the TCO reduction always remains as one of the key objectives, service providers are realising that the programmable, open and disaggregated multi-access network helps them map their business requirements faster with their technical roadmap. The first step for this is to re-architect the service provider's central office through the disaggregation of hardware from software layer. The hardware abstraction layer with the profiles per subscriber along with SDN controller and open APIs will lead to following benefits:

- Clear delineation of control and data planes, wherein the control plane becomes an app on the SDN controller and the data plane gets offloaded on the RAN or OLT/switch hardware
- Software abstraction increases the agility thereby ensuring faster roll out of new services
- Flexible architecture deployment by creating mini central offices for MEC/OLT placements along with edge caching for enhancing the user experience
- Add and scale BNG software functions for wired access and EPC for wireless access

Programmable, open & disaggregated infrastructure at access layer – Need of the hour

The next-gen Passive Optical Network (PON) could function as the access backbone for any other last mile technology. The hardware MAC functions (OLT MAC) connect to the hardware abstraction layer (VOLTHA) which controls and manages the OLT and ONU hardware. VOLTHA retains the service provider's profiles and helps the SDN controller manage this abstraction layer over an open API viz. open config or gRPC.

The SDN controller hosts control plane functions (like vONU and vOLT) and this architecture helps in clear delineation of software and hardware layer. This controller can either be placed in a central office or a data centre and can have the white box hardware OLT and ONU located near the subscriber as per the optical distribution profile.

As this programmable and open infrastructure is extended till the last mile, the next step is to prepare for wireless technologies like 5G and ongoing capacity augmentation for 4G/LTE. With fibre available till the last mile, the network becomes ready for subsequent densification for 5G requirements.

Both 4G and 5G require significant front-haul architecture upgrade. These are primarily linked to latency (RTD `200 usec from RRH to BBU excluding processing time), frequency (16ppb/50ppb), phase (+/- 1.5 to 5 usec) and bandwidth requirements for front-haul. With cloud RAN architecture, the BBU clusters and DU can be moved to the cloud or data centre, and latency, frequency, phase and bandwidth have to be considered for the solution to work. The provisioning of dark fibre or having next-generation programmable PON can address 4G and 5G front-haul requirements and enable roll-out readiness.

Transition towards software-defined network

With vEPC, vBBU, vOLT, vONU and vBNG becoming software-defined; the control functions of these components are on the SDN controller. The forwarding on the switch fabric with the Programmable APIs viz. Netconf, gRPC, REST, P4 to program the FPGA or the chip silicon in the forwarding plane, while the switch fabric would be deployed over central offices or at the regional Data Center.

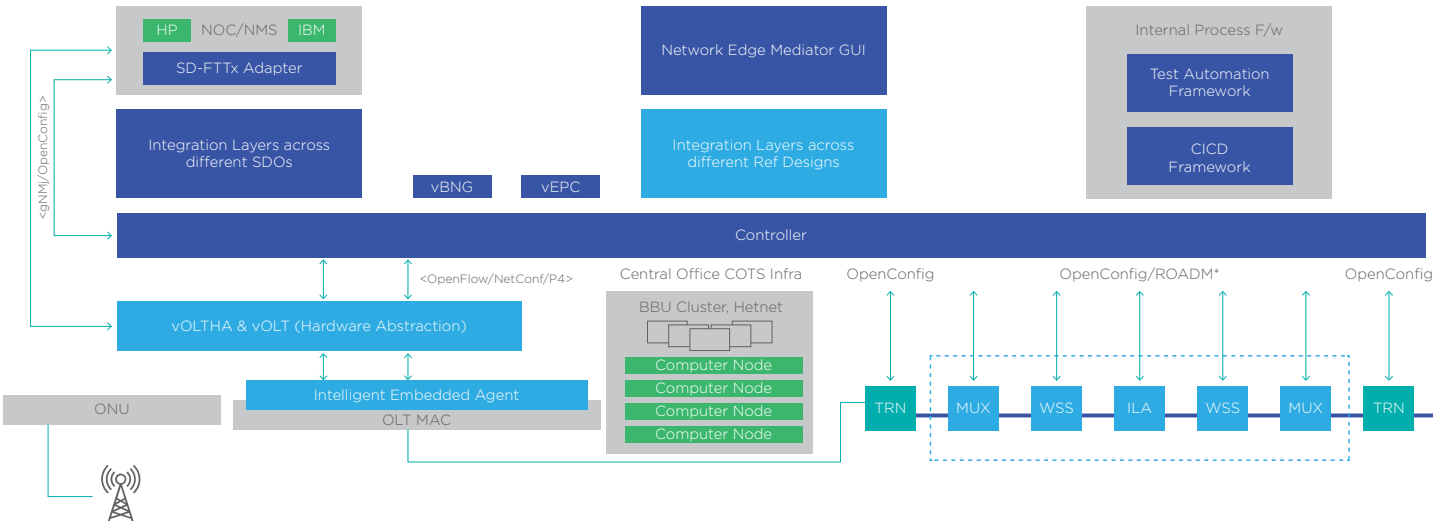
The implementation can further be extended to the transport domain with a programmable transport with DWDM (Metro and Long-haul) and MPLS using the software underlay network. The secure SD-WAN can be used for running application and can be initiated right from the uCPE and RAN nodes for better quality of experience, while continuing with the software-defined access backbone. Also with traffic encryption and secure tunnelling, SD-WAN can ensure that the traffic is well protected and it maximises the networking capabilities offered by the underlying layers.

STL's Programmable FTTx

Sterlite Technologies Limited (STL), a global leader in end-to-end data network solutions, is developing Programmable, Open and Disaggregated Solutions (PODS). With Programmable FTTx (pFTTx) and Programmable Radio (pRadio), we are addressing the key challenges of the service providers, while leveraging the ONF specifications like SEBA, Trellis and COMAC.

STL gives major focus on such cutting-edge virtualised and software-defined access in its production environment, while transforming its existing FTTx network to a Programmable FTTx network. The key principles of disaggregation, overlay, and chaining have helped in architecting the subsequent steps for modernisation of central offices, while integrating with the legacy GPON, legacy transport and with existing space, power and environmental requirements of central offices.

pFTTx Technical Architecture



Business benefits of pFTTx

- Reduction in hardware and software costs with white boxes at the edge for RAN, GPON/XGSPON/NG-PON2
- Service providers can have complete control over their own network and can solve their business problems and innovate as required
- With last-mile network becoming programmable and agile, and with the control over translating business requirements to technical features, the infrastructure of the service providers will become lock-in free
- Open infrastructure at the last mile significantly reduces the time-to-market and leads to revenue growth
- Faster roll-out of premium and innovative services lead to an increase in average revenue per user
- Programmable and agile network ensure better quality of experience, reducing subscriber churn

pFTTx – Way forward for Gigabit broadband

With innovations and disruptive technologies at the core, STL's pFTTx is an SDN (Software-defined Network), NFV (Network Function Virtualisation), micro-services oriented, cloud-based access and aggregation network solution that radically elevates the network service provider's business model. It drastically reduces time to market for new digital services, sets the ball rolling for edge computing by disaggregating broadband networks and re-architecting central offices. This technology will shape the future of broadband, while connecting millions of people and devices seamlessly.

About Sterlite Technologies Ltd

STL is a global leader in end-to-end data network solutions. We design and deploy high-capacity converged fibre and wireless networks. With expertise ranging from optical fibre and cables, hyper-scale network design, and deployment and network software, we are the industry's leading integrated solutions provider for global data networks. We partner with global telecom companies, cloud companies, citizen networks and large enterprises to design, build and manage such cloud-native software-defined networks.

STL has innovation at its core. With intense focus on end-to-end network solutions development, we conduct fundamental research in next-generation network applications at our Centres of Excellence. STL has strong global presence with next-gen optical preform, fibre and cable manufacturing facilities in India, Italy, China and Brazil and two software-development centres.