TXMISSION

Software Defined Networks

Technology White Paper

Software Defined Networks (SDNs) use vendor-agnostic open protocols to provision services over a network of SDN-compliant devices from any number of vendors. This allows virtualisation of the network and makes the network infrastructure non-proprietary. As a result, control of the network can be unified and centralised by replacing proprietary management tools with a generic network management system that essentially controls everything in the network in the same way. TXMission is at the forefront of ensuring the benefits of seamless SDN integration are enjoyed by users as they roll out new smallsat and airborne communications networks.

Overview

The SDN bandwagon of recent years came about when the IT industry was confronted with the serious limitations of legacy networks, which were unable to readily meet the demands of modern user applications based in large part on dynamically changing cloud computing and mobile devices.

'... the technology that will define the future of the New Space industry can be succinctly described as Software Defined Everything ...'

A key issue was that different tools were required to control different vendor's equipment making control and expansion of networks difficult, time consuming and expensive. It was therefore inevitable that there would be a move to virtualise the underlying network infrastructure, allowing the creation of flexible, scalable networks that could adapt dynamically to changing demands.

By getting IT equipment vendors to support open command languages, such as OpenFlow, IT administrators could simplify and unify their network management systems, abstracting away the proprietary nature of the various devices in the network. SDNs are highly configurable, with a centralised control system that decouples high-level control from the more mundane task of forwarding specific user packets across the network. SDNs have fundamentally changed how networks are architected and how network services are delivered and are part of a wider move to virtualise services and applications, leading to the concept of software-defined everything.

Although SDNs took hold in the terrestrial world, by comparison, the satellite and airborne industries have been slower to adopt SDN technology - a situation that is now changing. Since a satellite modem performs similar packet processing functions to an Ethernet switch or router then supporting SDN protocols on the modems allows them to become an intrinsic part of the wider, homogenized network covering both terrestrial and non-terrestrial resources.

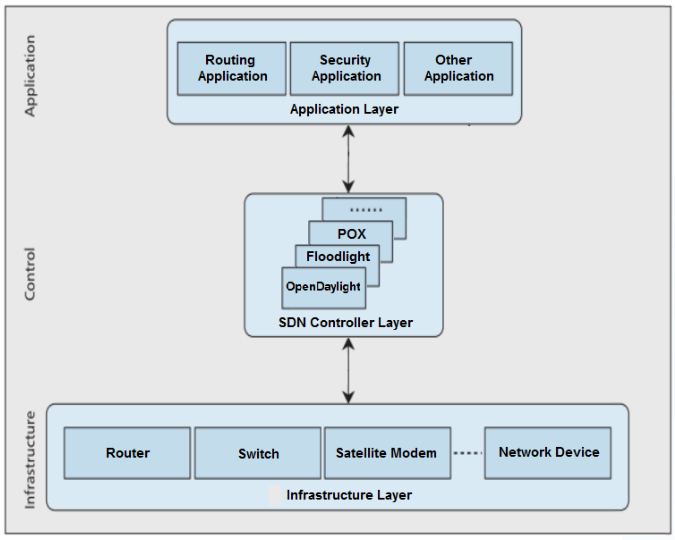
In this whitepaper, we describe how SDNs can be extended to the satellite and airborne portions of wide area networks and how TXMission is taking the concept of 'software defined' even further.

Separating Control and Data

SDN networks separate control of the network from the underlying data processing function. High-level network management includes tasks such as network discovery, the setting up of packet forwarding rules, computation of routes and collecting system metrics.

The data processing function requires the network devices to implement the instructions passed to them from the control system and to process data packets appropriately.

By logically separating control and data processing operations, a global view of the network becomes possible via the central control system. In the process, the network operator also gains vendor independence and the task of provisioning and deploying new services is vastly simplified.



Software Defined Network System Architecture

SDN Controller

Control of the network is provided by an SDN Controller, which is usually an open-source software application that runs on commodity hardware. The SDN controller can be programmed by higher level applications with business-level network policies (e.g. security, SLA requirements, access, etc.). The controller converts these policies into instructions for individual network appliances, such as satellite modems. All communication from the SDN controller to other applications and equipment uses open-standard protocols.

SDN OpenFlow Protocol

OpenFlow is a standardised SDN protocol that support the configuration of network equipment at Layer 2. It maintains flow tables containing flow entries that determine how packets belonging to a particular flow are processed and forwarded. A flow consists of rules that identify which of the incoming packets belong to the flow, throughput metrics to be applied to the flow and actions to be taken when a packet belonging to the flow is received. Another protocol called sFlow compliments OpenFlow and supports a standard way of collecting and analysing network metrics.

Software Defined Radios

Having standardized the command interface to network devices, Network Function Virtualization (NFV) was introduced to migrate the device functionality from proprietary hardware to commodity server hardware, greatly simplifying the provisioning of network services in the process.

The equivalent process is underway in smallsats, with dedicated communications hardware being replaced with Software Defined Radios (SDRs). SDRs are satellite modems that provide software programmable waveforms and transmission frequencies, meaning the hardware does not need to be changed when a different communications service is required.

SDRs can typically interface to a wide range of payload sensors and can transmit and/or receive at any data rate.

Application-specific Software

As smallsat hardware is becoming more pedestrian and off-the-shelf, the value add is increasingly in the software and specifically in the user's application.

There is a clear trend towards adding intelligence to satellites by way of software that allows the satellite's functionality to change over time to meet new requirements. This can include running onboard high-level software applications that are at the heart of the user's business model.

Often these can be run using the processor capabilities of the SDR, saving the extra cost involved in supporting a separate computer. In the process, this changes the SDR from a generic communications device to an application-aware processor that can be programmed with any number of apps or ***software personalities***. For example, you could create a 5G base station in space, or an IoT, cloud computing, edge computing or quantum cryptography application. Routine updates to applications can be scheduled and new applications installed, just like we do with our mobile phones.

The SDR then becomes an all-in-one processing solution that addresses all the onboard computing

requirements, from low-level housekeeping tasks up to and including the user's core business applications.

Summary

From proprietary, vendor-specific solutions we have evolved to fully software-defined satellites that are increasingly becoming vendor-neutral through the adoption of open standards.

The user's application is now the dominant part of the solution. TXMission SDRs are at the forefront of this revolution and can be personalized to do anything the user wants, just like we do with our phones. Software-defined innovations will continue to fuel the growth of the smallsat industry as part of the global journey to software-defined everything!

txmission.com +44 1923 889542