A Cloud based architecture for IPTV as a Service

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Abstract

Software Defined Networking (SDN) is a new and important approach in networking technology, designed to create high level abstractions on top of which hardware and software infrastructure can be built to support new cloud computing applications. SDN is also referred to as programmable network because it attempts to isolate control plane from data plane and provides an independent and centralized unit to control the network (this application unit is called Controller). These networks are implemented to support dynamic nature of the network functions and intelligent applications with low operating cost through simplified hardware, software and management. The aim of this paper is to implement and present a study of cloud based architecture for IPTV Service implemented inside SMC ISP data center (Software Media Communication ISP). SDN SMC Architecture is built in a simple concrete way involving Napster -3Protocol, NGNIX and SOAP Application Protocols achieving IPTV service in more secure, scalable and cost effective manner.

Keywords

SDN Approaches, Software Defined Networking, Virtualization, SDN SMC architecture, IPTV service

1. Introduction

Software defined networking (SDN) represents a fundamental advancement, revolutionizing the network industry [DOJDFCBMTR2014]. The difference between SDN and traditional networking consist: First, SDN separates the data plane, which forwards traffic at full speed, from the control plane, which makes decisions about how to forward traffic at longer time scales.

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Second, SDN provides a well-defined interface between the now-separated control and data planes, including a set of abstractions for network devices that hide the many of their details. Third, SDN migrate control plane logic to a logically centralized controller that exploits a global view of network resources and knowledge of application requirements to implement and optimize global policies.

Virtualization and abstraction [JP2013]: SDN defines open, standard abstractions for networks that hide the details of the underlying infrastructure, similar to how an operating system abstracts the complexity of underlying hardware by exporting common application programming interfaces (APIs) to services such as file systems, virtual memory, sockets, and threads. SDN offers the potential to reverse this trend by addressing these problems in the controller software running on commodity servers that programs network hardware using open protocols. The dominant use of SDN that enables solutions to these problems is network virtualization. Network virtualization involves abstracting the physical network in two ways: (i) isolating multiple tenants and giving them a view such that they are the only ones using the network and (ii) presenting an abstract topology that may differ from the physical topology, e.g., an abstract topology with all hosts attached to a single, large switch. A related concept is Network Functions Virtualization (NFV) [PH2013], which replaces specialized appliances such as firewalls, load balancers, and intrusion detection systems with virtual machines (VMs) running on conventional servers ([SERRS2013], [SERRS2011, SHC2013]) connected to the network. In the server world, virtualization has enabled new applications and revenue streams that would not have been technically possible or economically feasible otherwise. It is anticipated the same will be true for networking.

Splitting the data plane and the control plane: In conventional networks, each device implements both data and control plane functionality. Each device continues to forward packets at full speed on the basis of currently installed forwarding rules, but the distributed control plane is replaced with a logically centralized controller that programs the forwarding rules of each device in the network. The controller uses its global network view to create basic forwarding rules that are not limited to spanning trees and dovetail with higher-level functionalities such as Network Address Translation (NAT) and VLANs. The ability to control all aspects of the network results in flexibility and innovation.

Centralizing network control: Once the data and control planes are split, it is no longer necessary to have a distributed control plane. As a consequence most realizations of SDN migrates a substantial portion of network control functionality to a logically centralized SDN controller. The controller connects to every switch in the network, typically through a separate control network, which allows it to monitor and control each device. Though less common, the distributed management plane can also be replaced with a logically centralized management point, possibly the same controller, to enable network-wide monitoring, management, and policy enforcement While there are well-recognized trade-offs between distributed and centralized control, the advantages of centralization appear to greatly outweigh the disadvantages in the context of SDN. Most of the problems described earlier can be solved using SDN technology. For example, an SDN controller has global visibility into the current state of the network, e.g., link and buffer utilization, device failures, and where hosts are located, so it can implement end-to-end quality of service (QoS) and respond rapidly to failures ([FRRHV2010], [BAAZ2011]). However, SDN need not centralize control entirely. The rest of this paper is organized as follows: **Section II** describes our SDN Architecture implemented in SMC ISP data center. **Section III** describes the key benefits of implemented IPTV service on SMC ISP data center. In **Section IV** we have Conclusions and References

2. SDN Architecture based on IPTV Service implemented on SMC data center

Since managing the control of the networking part of the centre is a challenging task and keeping in view the advantages of Software Defined Networks, in this paper there is made an effort to propose architecture for the SDN based data centre providing IPTV service. The idea was to build a real network to provide IPTV, Video CLUB, AUDIO CLUB and Video on Demand services to clients using Software Cloud Networking for offering different Cloud applications as YouTube, Games, Browsers. To realize this, there is created a physical connection between Client and Cloud with Fiber. To enable a cost-efficient realization of user-defined virtual infrastructures in the cloud, there is proposed an architecture for Software-Defined Cloud Computing environments that is composed of four distinct layers:

The first layer, *user layer*, runs on user devices, such as mobile devices and browsers from workstations. It provides an interface between the end user and the resources on the cloud, forwarding requests to the latter to complete certain tasks that can be better completed in the cloud rather than in the device itself.

The second layer, *application layer*, is the level that decides whether requests can be executed or not and also schedules them.

The next layer is the control layer, where the logic that controls the SDC cloud is implemented.

The bottommost layer, the *infrastructure layer*, is the portion where the management actions from the layer above are applied, generating two distinct views: the physical plane, which contains the physical resources that compose the data center, and the virtual plane, where the virtual infrastructure defined by users is realized. In SDN SMC architecture, Infrastructure layer components are [LR2011]:

Infrastructure layer:

a) Physical plane**:**

1. A Mikrotik Router RB 1100 AH –performing routing of Clients request in Internet via PPOE Protocol

2. 1 Catalyst Cisco switch – which process 40 Gbps. This switch enables a good QoS in Multi cast Services

3. HP server DL 360 G5 with two processers Xeon Dual core 2.66 GHZ, 12 G RAM, 2X160 Giga HDD SAS Interface, Ride1

4. OLT ZTE C300 Equipment which offers GPON Technology with optical fiber. The most important feature of this equipment is to increase number of end users being connected only in a fiber thread using Passive Splitters. We are able to connect until 126 end-clients via 1 Gbit/s Interface.

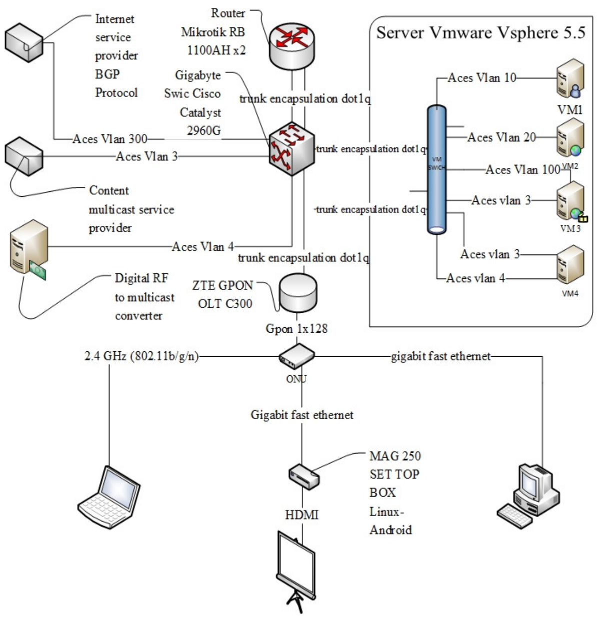


Figure 1: SDN SMC Architecture

5. ONU client ZTE F660 Router – This router is a Wireless Gigabit Router and operates as a Switch Layer 3 GPON.

6. Set box MAG 250 -The Set-Top Box is designed for ISPs, OTT-operators and content aggregators that provide services based on IPTV and VoD. MAG250 contains a whole set of functions that are in high demand with operators, such as playback of digital TV channels in high quality, streaming video support and video on demand. Stalker Middleware makes possible a fast and efficient launch of IP-network video services.

7. To receive Multicast services, there are used three methods:

a. Receiving Multicast Services directly by a certain content.

b. Receiving Multicast Services from a Multiplexed Content.

c. Receiving Multicast Services from a digital receiver RF (In SDN SMC Architecture, we have build an Ubuntu Server with a digital Receiver RF which perform conversion in IP multicast via proper helpful packages installed on it.

b) Virtual Plane:

As VMWare we have used VM Vsfere 5.5 server which provides the infrastructure of Virtual Machines built on it. This server gives the possibility to pool and manage the resources of multiple hosts and effectively monitor and manage physical and virtual infrastructure. We can manage resources for virtual machines, provision virtual machines, schedule tasks, collect Statistics logs, create templates, and more. Inside this server, there are created for VM's as follow:

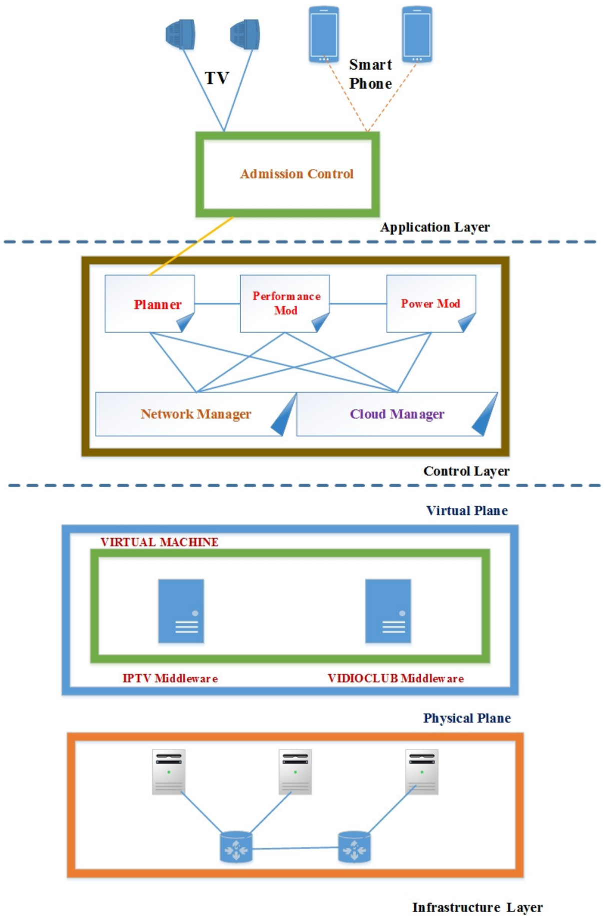


Figure 2: SDN SMC Layered architecture

VM1 is a Fedora System in which there is installed Radius Manager. The main function of Radius manager is authentication, Bandwidth control, Billing System and for all PPOE Users.

VM2 is a Centos 5.5 System in which we have installed Bind DNS Server.

VM3 is an Ubuntu server with 64 Bit which perform de-multiplexing of IP Multicast

Vm4 is an Ubuntu server with 64 Bit in which there is installed Stalker Portal Middleware and some helpful packages. Most important functionalities of this server are:

a. Conversion of Multi cast channels to Unicast that will be used to SET BOX

b. This server realizes all services and applications on Cloud such Video club, audio club, VoD services and YouTube, browsers etc application.

SDN SMC architecture above is a concrete architecture built with real hardware elements. A layered architecture is given in figure 2.

Security challenges on SDN SMC architecture based on IPTV services:

1. To protect data centre from threats that cannot be stopped by other security devices.

2. To secure the availability of the most important asset: the data centre services

3. To protect the data centre infrastructure and connectivity as well as customer services and data

4. To provide much needed visibility at the data centre edge and inside data centers

2.1 Application Protocols

Napster -3Protocol: - This Application protocol is a Complex client -server protocol with central site. Users can register, log in, etc and registration message includes age, income, and education. Central site which is service provider (Administrator) can allow or forbid the users to browsing/searching, uploading /downloading data. Process of Files transfer is direct and does not go through napster.com's site [Jay2012].

Operation Logic of this protocol:

a. Client sends search or browse requests to central site.

-Can browse some other user's files.

-Response comes back from central site.

b. Only explicitly-shared files should be retrievable.

c. Napster -3Protocol handles all file types (MP3, AUDIO, and VIDEO etc)

This protocol is much secure because it is much harder for clients to lie (Can't give fake IP addresses, port numbers etc). Administrator can exert much control. Using this protocol we decrease privacy issues because service provider or Administrator knows (almost) everything. In cloud network fake content and fake line speed attacks still apply but in theory, are more traceable through Napster -3protocol and this is the best feature protecting cloud data from attacks

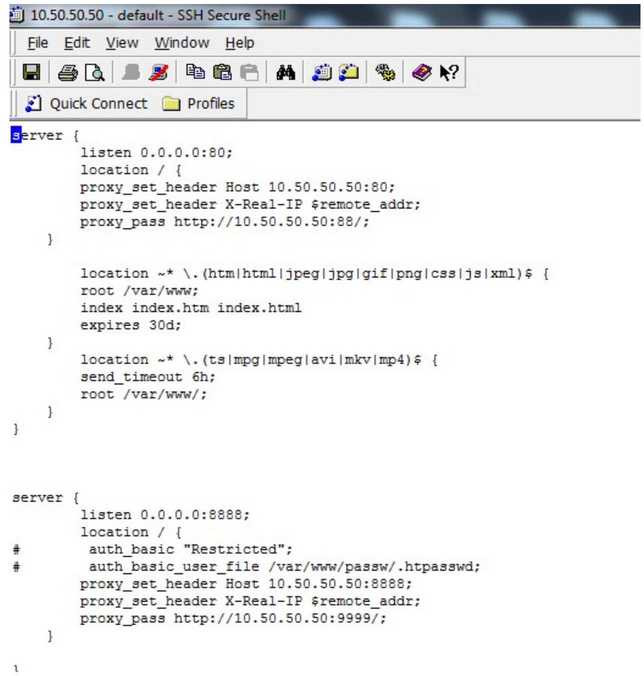
SOAP Protocol (Simple Object access protocol) [W3C2007]*:* SOAP allows you to build interoperable software and allows others to take advantage of your software over a network. It defines rules for sending and receiving Remote Procedure Calls (RPC) such as the structure of the request and responses. Therefore, SOAP is not tied to any specific operating system or programming language. As that matters is someone can formulate and parse a SOAP message in their chosen language

NGNIX protocol: NGINX Protocol is acting as reverse proxy protocol [Kol2015]. This protocol can load balance HTTP/HTTPS traffic specifically, or it can load balance straight TCP traffic without regard to the protocol. Referring to our architecture, NGINX is configured in VM4. In the configuration file displayed in figure 3, there are two virtual servers where virtual server 1listen on port 80 and second virtual server listen on port 8888. When a request comes from client, NGNIX first decides which server should process the request. In our configuration NGNIX tests only the requests header field "Host" to determine which server the request should be routed to. If its value does not match any server name, or the request does not contain this header field at all, then NGNIX will route the request to the default server for this port. In our configuration, NGNIX accept proxy protocols headers on two ports for each server:

Server 1: port 80 and 88

Server 2: port 8888 and 9999

Using NGNIX we can retrieve resources on behalf of a client from the application servers.




```
server {
        listen 0.0.0.0:80;
        location / {
        proxy_set_header Host 10.50.50.50:80;
        proxy_set_header X-Real-IP $remote_addr;
        proxy_pass http://10.50.50.50:88/;
    }

        location ~* \.(htm|html|jpeg|jpg|gif|png|css|js|xml)$ {
        root /var/www;
        index index.htm index.html
        expires 30d;
    }
        location ~* \.(ts|mpg|mpeg|avi|mkv|mp4)$ {
        send_timeout 6h;
        root /var/www/;
    }
}


server {
        listen 0.0.0.0:8888;
        location / {
#        auth_basic "Restricted";
#        auth_basic_user_file /var/www/passw/.htpasswd;
        proxy_set_header Host 10.50.50.50:8888;
        proxy_set_header X-Real-IP $remote_addr;
        proxy_pass http://10.50.50.50:9999/;
    }

}
```

Figure 3: NGNIX Configuration file in VM4

3. Key benefits of implemented IPTV service on SMC ISP data center

The following are some of the other benefits arising out of using SDN in SMC ISP for implementing IPTV service:

1. It can improve network management efficiency because it does not require continuous upgrades.

2. It integrates the department LANs with different policies and reduces installation costs.

3. It provides stable networks and reduces time and costs for the operation management and configuration modifications.

4. It reduces installation costs

In SDN SMC data center, legacy networks are difficult to automate as the control plane intelligence is distributed. SDN promises an easier, more dynamic interaction with the network through abstraction of the control plane. This reduces the complexity of managing, provisioning, and changing the network.

4. Conclusions

Software-Defined Cloud Computing is emerging as a result of advances in the areas of cloud computing, system virtualization, software-defined networks, software-defined middleboxes networking, and network virtualization. Before SDCs become a reality, however, many challenges need to be overcome. SDN architectures will end up taking many approaches, and each vendor will have a different way of developing its SDN solution. In this paper is presented a concrete architecture enabling IPTV Services in SDN. This architecture is deployed in a more secure, scalable and cost effective manner using Napster -3Protocol, SOAP and NGNIX Application Protocol for retrieving media DATA (Video, Audio etc.) and the main purpose of building it is to implement in SDN an effective IPTV Service. As SDCs and the enabling technologies progress, we expect new challenges to arise and new application scenarios to emerge that will make SDC a *lively* mainstream technology with applications in all the industry sectors.

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