Towards Management of Software-Driven Networks

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Content List

- SDN Context and Advances – A view point
- Self-Management Functionality in SDN
- An SDN management testbed
- Concluding Remarks
Some current SDN’s Systemic Limits

- Networks are becoming both a connectivity and service execution environment
  -> Work towards a service and management aware connectivity infrastructure

  - Computation, storage and connectivity Virtualised separately (but not in an integrated way)
  -> Work towards a flexible and cost effective integrated virtual infrastructure with elastic usage and sharing resources
    - Silos and disparate systems with limited extensibilities which created a segmentation of networking & computation

-> Programmability: dynamic and autonomic activation of network and service functions
  - Need for Software driven features:

  - Programmability and Elasticity
  - Integrated Virtualisation of Connectivity Storage and Processing Resources
  - In-Network Management
  - Service awareness

  - Energy awareness
  - Content awareness
  - Knowledge awareness
  - Economic awareness
  - Extensibility with new features
  - ............
SDN Evolution - Conceptual Networked Systems

SDNs Architecture
Connectivity & Computation Infrastructure
Status in the early 2000+
( active & programmable networks)
SDN Evolution - Conceptual Networked Systems (continuation)

**SDNs Architecture**
Connectivity Only Infrastructure
Status in the 2010+
(ONF – Open Networking Foundation)

**Physical Infrastructure**
Network Device

**Control Infrastructure**
SDN Connectivity Control Software
Control APIs (e.g. OpenFlow)

**Application Infrastructure**
Application Layer
Northbound APIs
Business Applications

**Network API**
Node API
Network API
Applications
Execution Environments
Node OS
Node
Router

**SDNs Architecture**
Connectivity & Computation Infrastructure
Status in the early 2000+
(active & programmable networks)
Revised SDN Architecture –> Service-aware Networked Systems

Network Apps – Service-aware Control and Self-management

SDN-aware Network Cloud Programmability Control
CEs: Deployment, execution and self-management of SDN-aware Network Clouds
(e.g. Management OpenStack Apps)

Virtual Network Service-aware Control and Self-Management
CEs: Resources Virtualisation Functions, VM management, Service-awareness Enablers, Execution Environments Management, Network Services, Self-management Functions

Virtual Resources Service-aware Control and Self Management
CEs: firewall, routing, connectivity

Configurations

Protocols

Physical Resources Control

Network (C) I/Fs

Network (B) I/Fs

Network (A) I/Fs

Services and Network Services Orchestration and Programmability

Federation & Multi-operator Protocols

3rd Party Service Providers

3rd Party Service Providers

3rd Party Service Providers

Physical Infrastructure

Network Device

Network Device

Mobile Device

Smart Objects
New Management & Control Functionality: SDN as Service-aware Networked Systems

**New Managed Entities:**
- Integrated Virtual Resources - dynamically created groups of physical resources need to be managed in an autonomous or cooperative way
- Groups of Virtual Machines, Virtual Machines - representing service components and virtual routers, network attachments, domains, smart objects

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**Established Managed Entities:** Service Components, Networks, Resources, Domains
Key:
PS - Publication /Subscription Sources/Clients  VR – Virtual Router  MI – Monitoring Instrumentation
(probes, control points, data sources, filtering, data structures)
UCL SDN Management TestBed

Placement Optimization

Timeline Viewer

REST Interface

Reorganize communicating nodes

Information Sharing or Publishing

Virtual Infrastructure Management

Lookup with pull or pub/sub

Knowledge Block

Network Viewer

Real-time Updates in the Virtual Infrastructure

Web Browser

Real-time Updates in the Virtual Infrastructure

Virtual network
Demo Screen – Visualization of Virtual Network

Initial design, demos & results where the basis of 3 papers:

- “Self Management for Inter-Connected Smart Objects”- S. Clayman and A. Galis: ACM CoNEXT 2011, December 2011, Tokyo, Japan
Thank You

Concluding Remark: (Self)Management and Control would represent nearly 100% of the Future SDN functionality !!!