Network service orchestration standardization: A technology survey — Summary

Ashwin Prasad S V

November 8, 2018

Abstract

This paper surveys the standardization attempts for orchestration from the operators perspective by showcasing various technologies and their intentions

1 Introduction

Network operators provide a myriad of services to the user, it's demand and adoption is raising exponentially[4]. The challenge for the operators is to maintain sufficient infrastructure to provide SLA guarantees while maintaining profitability. Manual management of network components is expensive and not flexible to changing requirements. On the other hand, independent advancement of technologies will lead to complicated interfaces between the offerings of different vendors.

Establishing a technical standard will enable easier integration and orchestration of services provided by the operators. This survey gives an overview of the efforts in the direction of standardization.

2 Terminology

Network Service (NS) is a high-level network functionality.

Network Function (NF) is a fundamental element of the network which performs a defined set of low level functionality on the traffic.

Service Orchestration (SO) is high-level automation of deployment, management and optimization of NS. It's the capability to plan and execute a deployment strategy that fulfills a NS request by dynamically adjusting network infrastructure configurations.

3 Need for orchestration

Coordination: The need to abstract the management and configuration of a wide array of resources and the coordination between them.

Automation: Vertical integration demands manual intervention and high operational costs. Primary goal is to reduce this by automating the deployment and management of NS

Resource provision and monitor NS will have QoS requirements which are hard to meet without dynamic control and monitoring of resources in all levels.

4 Network Services

This section discusses three popular NS as an example to realize SO's control requirements

Radio access network (RAN) is made of two functional blocks, Remote Radio Head (RRH) and Base Band Unit (BBU) which are housed together, however recent trends tend to separate the BBU to a centralized location to reduce costs and improve efficiency.

The challenge here is the variable bandwidth, strict latency and jitter requirements for the channel between RRH and BBU.[19] Orchestration is required to flexibly manage the resources on-demand across technologies. 5G Public Private Partnership (5G PPP) actually defines NS orchestration as a core design goal.[3]

Evolved packet core (EPC) is the architecture of 4G standard which unifies data and voice traffic on the IP architecture. EPC is made of multiple functional blocks which are delivered using specialized hardware from different vendors. Thus to ensure QoS on-demand, virtualization of the key EPC blocks becomes evident. "Network Slicing", a key function of 5G also demands virtualization.[5]

SoftAir[2] and Open5GCore[14] are works toward softwarization of EPC.

Content delivery network (CDN is used for low latency efficient distribution of stored content. It's a straight forward chaining of load balancing and caching NF, but the challenge is adopting to variations in traffic and provisioning resources dynamically. SO can enable flexible deployment plan based on network traffic.

5 Network orchestration standardization

Operator infrastructure is made of heterogeneous technologies and extensively depends on manual intervention in realizing high level goals into low level configuration. This survey looks into two architectures $\rightarrow$ SDN and ABNO, which enable flexibility and control over the resources using low level interfaces.

Name	**Description**
Path Computation	Proposes central way of switching
ONOS PCEP	Enables PCE, label switched paths (LSP) and MPLS-TE tunnels
ONOS/ODL BGP-LS[12]	Adds BGP-LS protocol support
Application Layer Traffic Optimization (ALTO)[18]	IETF WG proposes ease of access to network performance information
Virtual Tenant Networks (VTN)[16]	Logically separates network specification from network infrastructure
Locator/ID separation protocol (LISP)[7]	IETF WG proposes an alternative for IP architecture
Real time media[9]	Explores dynamic assignment of network flow to preserve QoS
Intent-based networking	Explores Domain specific language[13] to define network infrastructure and accepted states
Group-Based Policy	Alternative to intent based networking, based on promise theory.

Table 1: Summary of control interfaces discussed in the paper

Software defined networking (SDN)[10] is a network control architecture that aims for flexibility, openness and facilitates traffic engineering using high level interfaces for low level network components. SDN is separated into 3 functional blocks and they communicate using Southbound Interfaces (SBIs) or Northbound Interfaces (NBIs). NBIs are provided by Network Operating System (NOS) to the application plane for high level control. The authors focus on NBIs in this survey. Some of the interfaces discussed in the paper are detailed in Table 1

Application-based network operations (ABNO) enables network automation by embracing established protocols and includes orchestration in its core design. ABNO has 8 functional blocks with ABNO controller being the core, it primarily collects path requests and dynamically re-optimize the network based on further requests. Some real world implementations include iONE [11], Adaptive Network Manager [1] and two companies Infinera and Telefonica demonstrated "Network as a Service - NaaS" in a multi vendor environment [20].

6 Function orchestration standardization

Apart from achieving control over network connectivity, NFs also need to have interfaces to support service orchestration. Virtual network functions(VNF) and NFs working together in coherence will require careful planning. Authors discuss some NFV standardization efforts listed in the Table 2

Name	Description
NFV management and orchestration (NFV MANO)[6]	Encapsulates the control of VNFs to the outside world for easy management
MEF lifecycle service orchestration (LSO)[15]	Extends MANO and supports network infrastructure management
Service function chain (SFC)[17]	IETF WG aiming to standardize NF forwarding graphs
Segment routing (SR)[8]	A framework to instantiate service graphs over a network using source routing mechanism

Table 2: Summary of NFV standardization efforts discussed in the paper

References

[1] Alejandro Aguado, Víctor López, Jaume Marhuenda, Óscar González de Dios, and Juan Pedro Fernández-Palacios. Abno: A feasible sdn approach for multivendor ip and optical networks. *Journal of Optical Communications and Networking*, 7(2):A356–A362, 2015.

[2] Ian F Akyildiz, Pu Wang, and Shih-Chun Lin. Softair: A software defined networking architecture for 5g wireless systems. *Computer Networks*, 85:1–18, 2015.

[3] 5G Infrastructure Association et al. The 5g infrastructure public private partnership: The next generation of communication networks and services, 2015.

[4] I Cisco. Cisco visual networking index: Forecast and methodology, 2011–2016. *CISCO White paper*, 518, 2012.

[5] Ericsson. 5G systems: Enabling The Transformation of Industry And Society, 2017.

[6] GSNFV ETSI. 001:" network functions virtualisation (nfv). *Architectural framework*, 2013.

[7] Dino Farinacci, Vince Fuller, David Meyer, and Darrel Lewis. The locator/id separation protocol (lisp). Technical report, 2013.

[8] Clarence Filsfils, Nagendra Kumar Nainar, Carlos Pignataro, Juan Camilo Cardona, and Pierre Francois. The segment routing architecture. In *Global Communications Conference (GLOBECOM), 2015 IEEE*, pages 1–6. IEEE, 2015.

[9] Open Network Foundation. Onf tr-517: Real time media nbi rest specification.

[10] Open Network Foundation. Software-defined networking: The new norm for networks.

[11] Lluís Gifre, Nacho Navarro, Adrià Asensio, Marc Ruiz, and Luis Velasco. ione: An environment for experimentally assessing in-operation network planning algorithms. In *Transparent Optical Networks (ICTON), 2015 17th International Conference on*, pages 1–4. IEEE, 2015.

[12] H Gredler, J Medved, S Previdi, A Farrel, and S Ray. North-bound distribution of link-state and traffic engineering (te) information using bgp. Technical report, 2016.

[13] S. Hares. Intent-based nemo overview.

[14] http://www.open5gcore.org. The next mobile core network testbed platform.

[15] MEF. The third network: Lifecycle service orchestration vision.

[16] NEC. Programmableflow: Redefining cloud network virtualization with openflow.

[17] D. Zhou J. Li Yang R. Penno, P. Quinn. Data model for service function chaining, internet-draft , informational.

[18] Jan Seedorf and Eric Burger. Application-layer traffic optimization (alto) problem statement. Technical report, 2009.

[19] Interface Specification. Common public radio interface (cpri); interface specification. *version*, 6:128, 2004.

[20] Telefonica. ”telefonica and infinera network as a service (naas) demonstration using software defined networks”.