Chair of Practical Computer Science
Cloud Native/Cloud Container Management/Kubernetes Eco-System

Network Functions: From Physical to Virtual to Cloud-native

19.07.2019

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Content

Network Functions - 4G Architecture

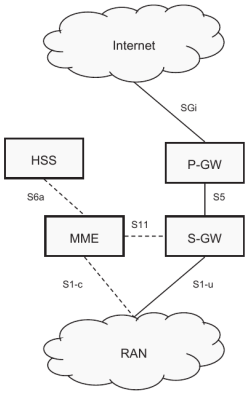

Figure 1: Evolved Packet Core architecture [1], Home Subscriber Service, Mobility Management Entity, Serving Gateway, Packet Data Network Gateway

Physical Network Service Composition

Numbers

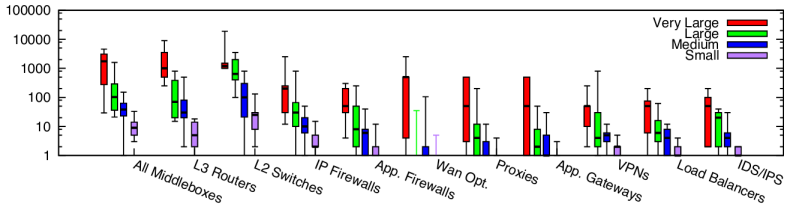

Figure 2: Number of physical middleboxes in enterprise and public networks [2]

Physical Network Service Composition

Cost

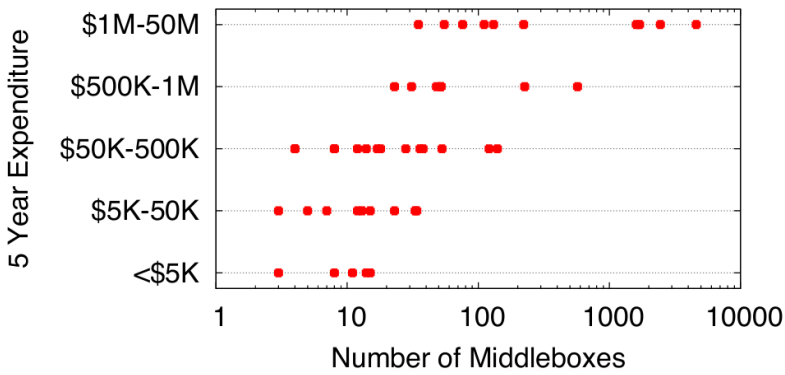

Figure 3: Cost of physical middleboxes [2]

Outline

Disadvantages of Physical Network Service Composition

- Physical appliances need physical processing (acquisition, deployment, setup...)
- Manual, vendor specific configuration
- Long time to market
- Inflexible service composition
- hard and costly maintenance

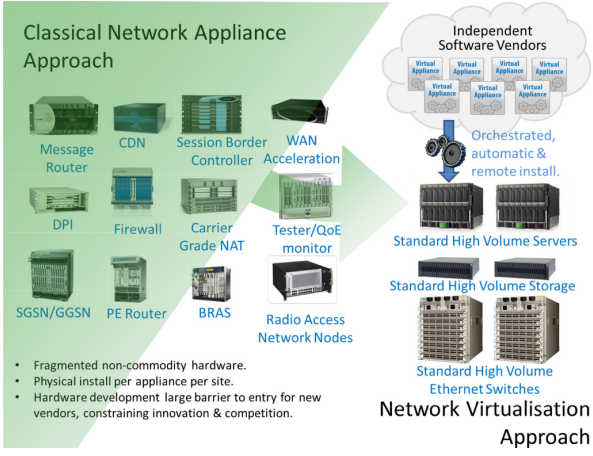

Figure 4: Traditional vs virtual network functions[3]

Outline

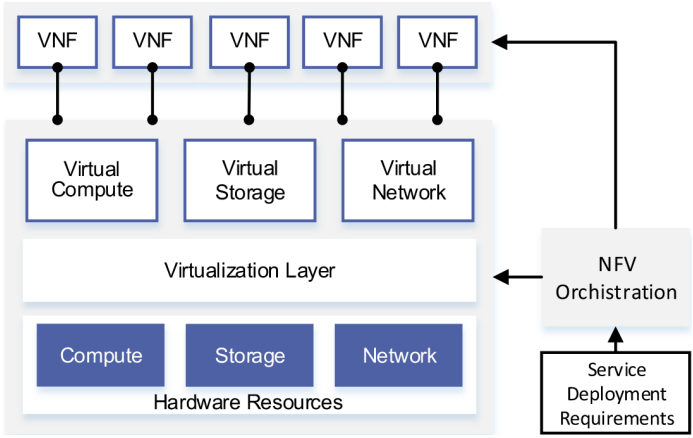

Figure 5: Network Function Virtualization Infrastructure [4]

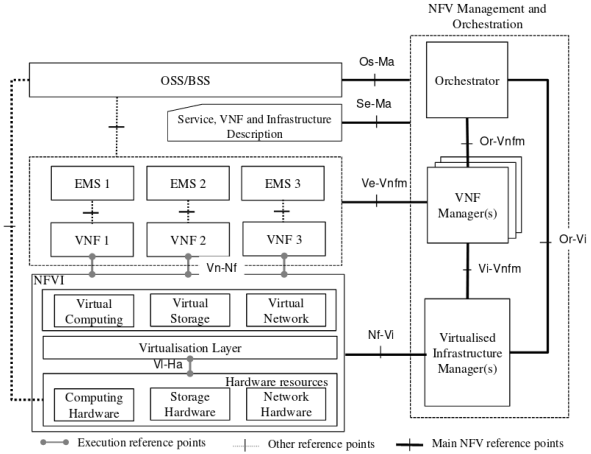

Figure 6: The ETSI NFV Reference Architecture [5]

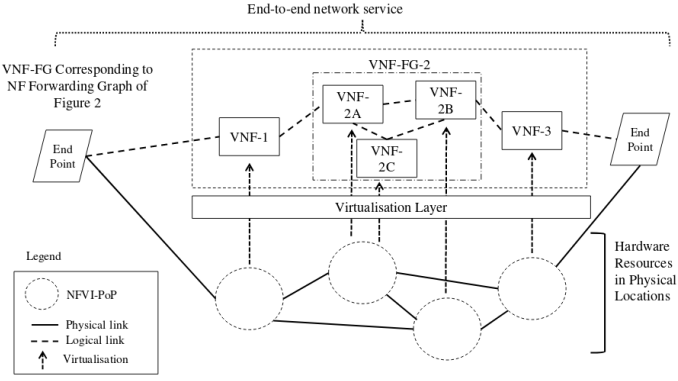

Figure 7: NFV forwarding to establish end-to-end connections [5]

Outline

Cloud-native Network Function Virtualization

Evolution

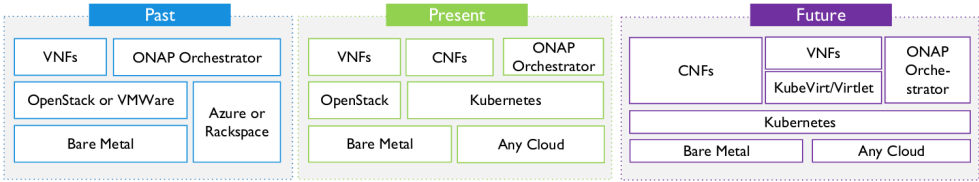

Figure 8: Evolution from VNF to CNF architecture [1]

[1] https://community.infoblox.com/t5/Cloud-Native/En-Route-to-Cloud-Native-Network-Functions/ba-p/16311

CNF Example Architecture

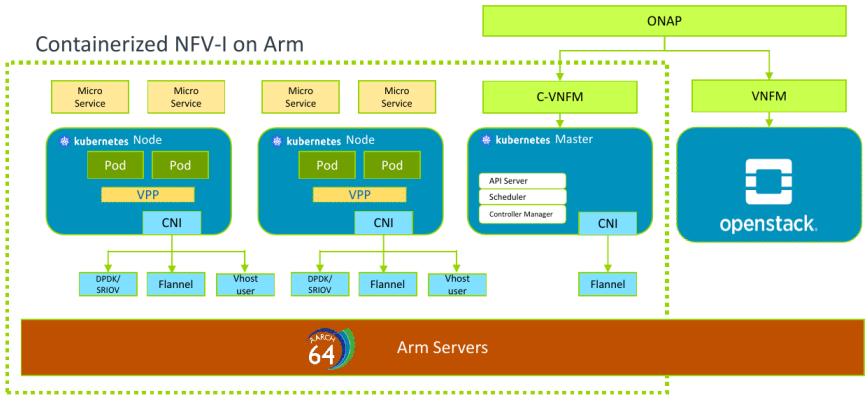

Figure 9: Example architecture using Kubernetes to provide an NFV Infrastructure on ARM devices [6]

Summary & Future Work

Summary

- Large-scale networks have long used middleboxes
- Breaking up vertical integration to enable flexibility and reduce cost
- NFV concept and architectures have been introduced
- SDN for programmable networks
- CNF to enable unprecedented automation

Future Work

- Explore technical details of networking of Docker and K8 (dpdk, ovs, etc)
- Investigate real life adaption (Orange indicates ~ 50 % virtualization)
- Explore realization of DevOps for CNF

Thanks for your attention!

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References - Selection I

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[2] J. M. Sherry, "Middleboxes as a cloud service," Ph.D. dissertation, UC Berkeley, 2016.

[3] NFV White Paper, "Network Functions Virtualisation: An Introduction, Benefits, Enablers, Challenges & Call for Action. Issue 1," ETSI, Tech. Rep., Oct. 2012.

[4] Y. Li and M. Chen, "Software-defined network function virtualization: A survey," *IEEE Access*, vol. 3, pp. 2542–2553, 2015.

[5] N. ETSI, "ETSI GS NFV 002: Network Functions Virtualisation (NFV); Architectural Framework," ETSI, Tech. Rep. GS NFV 002, Tech. Rep.

[6] T. T. Tina Tsou, "Building container-based NFV solutions with OPNFV, ONAP and VPP on Arm platform," https://wiki.lfnetworking.org/display/LN/LFN+Developer+Forum+Presentations, accessed: July 18, 2019.

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[11] Y. Jia, C. Wu, Z. Li, F. Le, A. Liu, Z. Li, Y. Jia, C. Wu, F. Le, and A. Liu, "Online scaling of nfv service chains across geo-distributed datacenters," *IEEE/ACM Transactions on Networking (TON)*, vol. 26, no. 2, pp. 699–710, 2018.

[12] R. Mijumbi, J. Serrat, J.-L. Gorricho, N. Bouten, F. De Turck, and R. Boutaba, "Network function virtualization: State-of-the-art and research challenges," *IEEE Communications Surveys & Tutorials*, vol. 18, no. 1, pp. 236–262, 2016.

Software Defined Networking

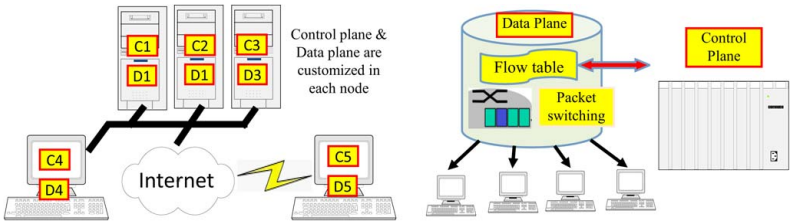

Figure 10: Separation of the data/control planes [4]

Software Defined Networking

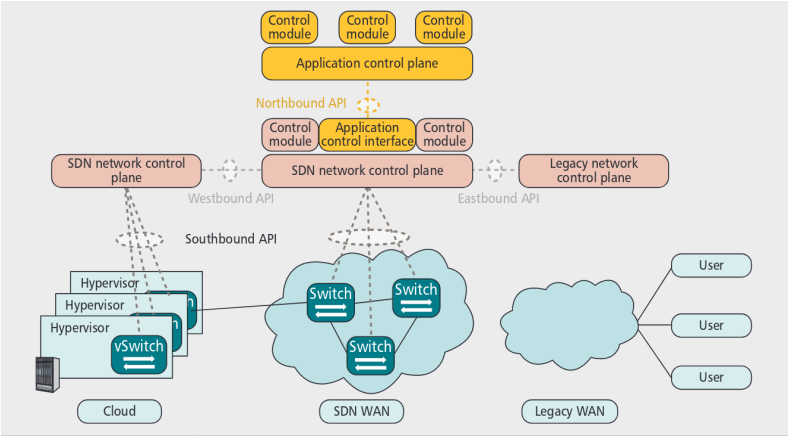

Figure 11: SDN controller APIs [7]