NFV Placement and Routing

HPNFV Tutorial

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Motivation

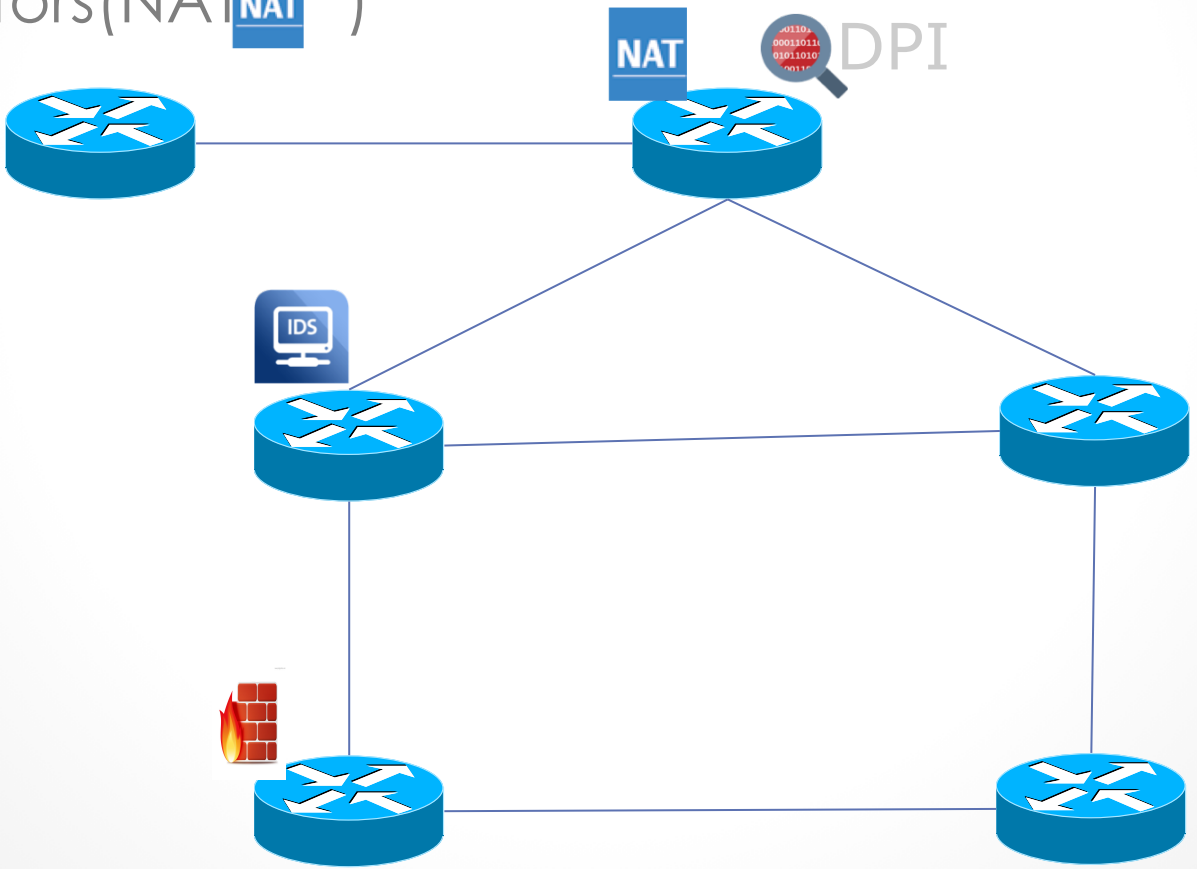
- Motivation for Middlebox NFV Placement and Routing:
  - Popularity of Cloud Computing and its benefits-like flexibility and agility brought about by virtualization- services that were previously run on dedicated hardware can be moved to the cloud or datacenters.
  - Middleboxes, such as firewall, DPI, IDS…,.
  - Middleboxes need to be placed on the route of a flow.
  - Currently this is done by physically placing the middlebox machines at the required positions.
  - It **is hard and/or complicated to manage** physically distributed middleboxes and is also **error prone**.

Details: Motivation

- By moving services to the cloud, the middleboxes can be run in a VM **when and where needed**. Which significantly **decreases CAPEX and OPEX**.
- Question that needs to be addressed:
  - How to decide the placement of VNF (Virtualized Network Function) middleboxes?
  - How to route the traffic between the VNF instances?
- A **dynamic**, **efficient**, and **multi-objective** resource allocation framework is required.

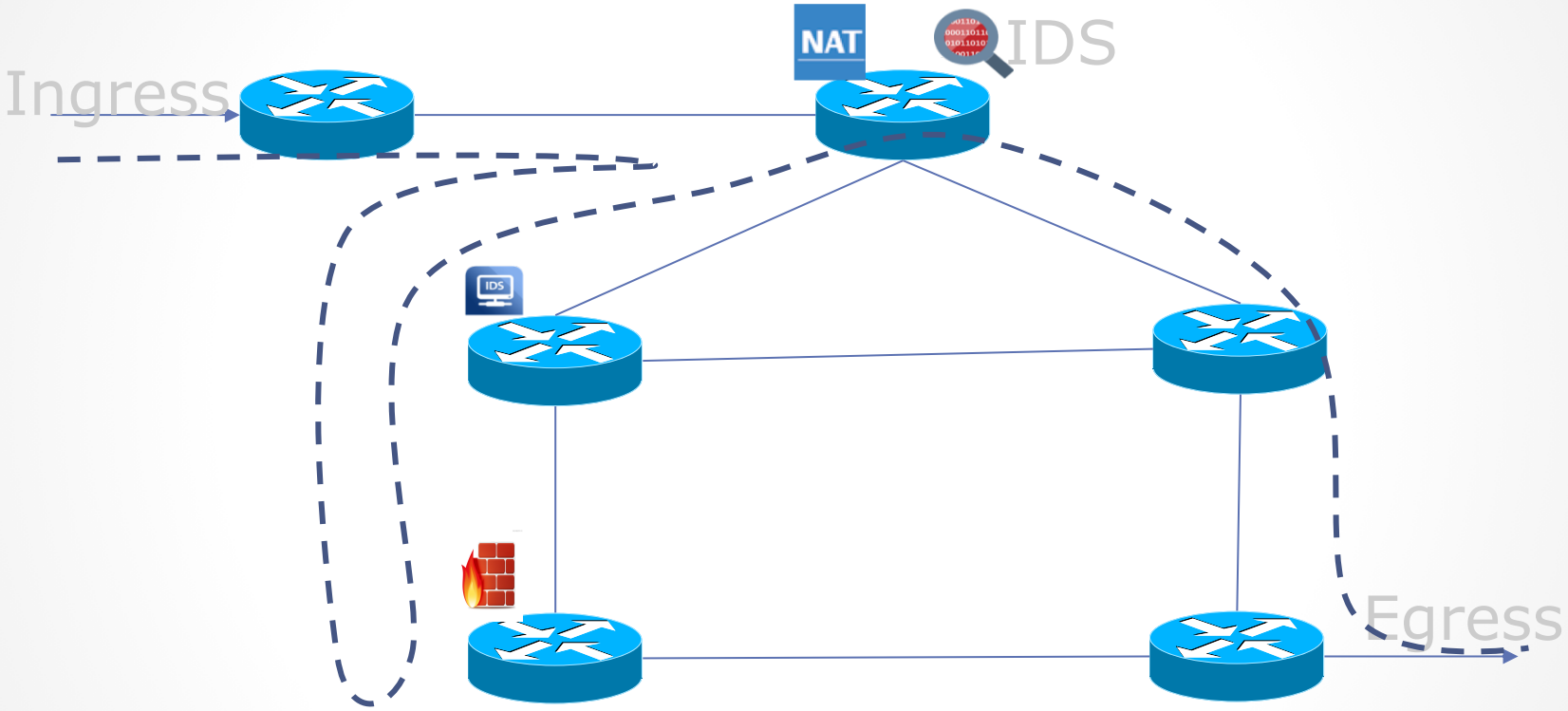
Details: Motivation

- VNF placement
- Firewall); - Deep Packet Inspection(DPI), Intrusion Detection System (IDS), Network Address Translators(NAT)



Placement *and* Routing

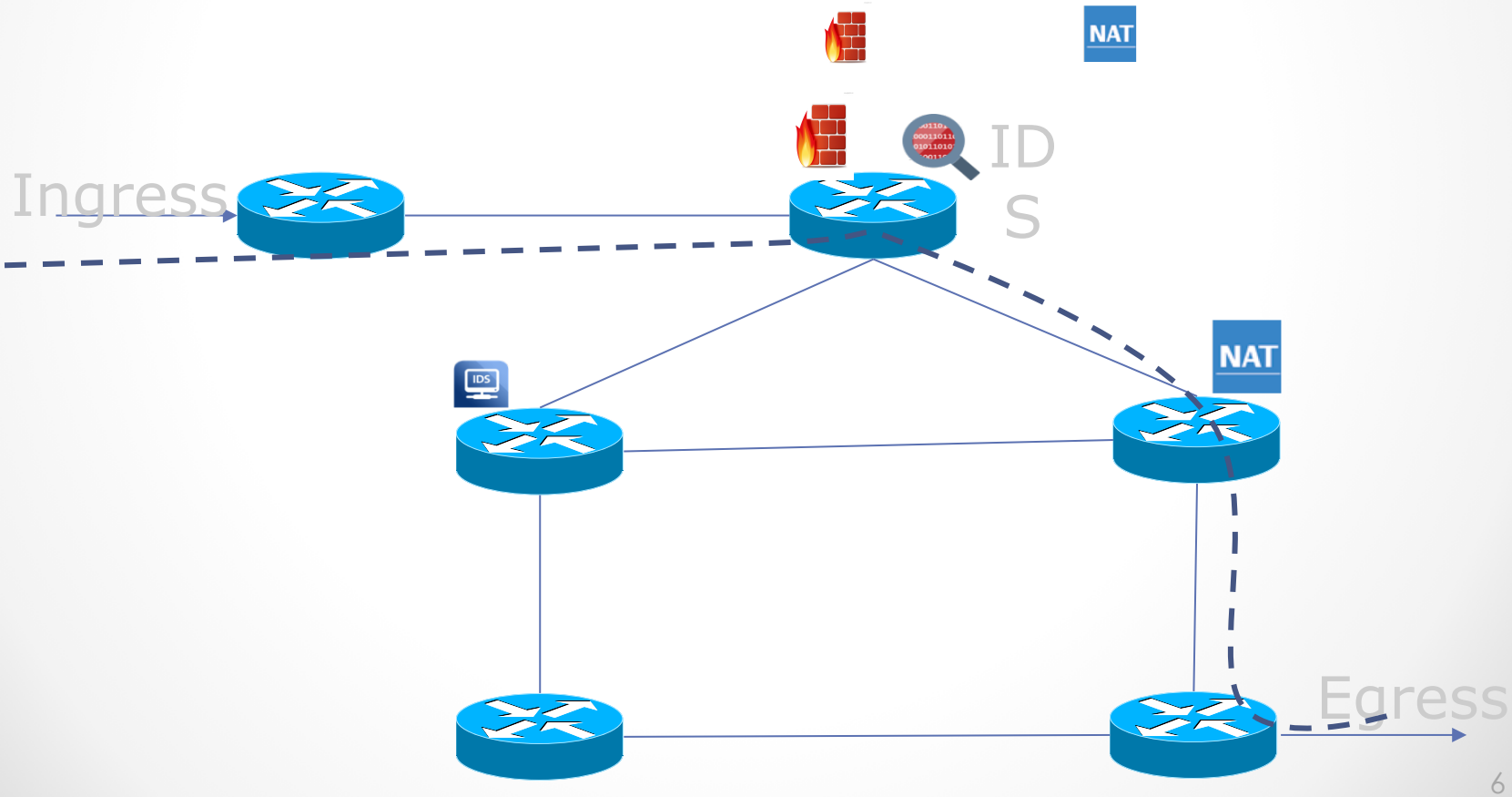
- Flow's service chain – firewall -> NAT



- Flow routing – Flow taking longer routes -> **Increased delay**
- VNF placement and flow routing need to be **optimized simultaneously**

Placement *and* Routing

- Simultaneous VNF placement and routing optimization.
  - leverage placement optimization to satisfy flows requirement.
- Flow's service chain – firewall -> NAT



Placement and Routing: Current State

- State-of-the-art & Related Work:
  - In most literature the VNF placement and flow routing are optimized independently. [1],[2]
  - In some cases, the VNF placement and routing are optimized simultaneously but the proposed algorithms are not scalable.
  - Other studies make unrealistic assumptions like homogeneity of flows in the problem formulation, as in[3] .
  - In addition, multi-objective optimization algorithms have not yet been developed.

1. Xia, Ming, et al. "Network function placement for NFV chaining in packet/optical data centers." *Optical Communication (ECOC), 2014 European Conference on*. IEEE, 2014.

2. ZafarAyyubQazi,Cheng-ChunTu,LuisChiang,RuiMiao,VyasSekar, and Minlan Yu. Simplefying middlebox policy enforcement using sdn. In *ACM SIGCOMM Computer Communication Review*, volume 43, pages 27–38. ACM, 2013 .

3. Tung-Wei Kuo, Bang Heng Liou, Kate Ching-Ju Lin, and MingJer Tsai "Deploying Chains of Virtual Network Functions: On the Relation Between Link and Server Usage" IEEE INFOCOM 2016 - The 35th Annual IEEE International Conference on Computer Communications

Details: The Problem

- Problem Statement:
  - For a given network topology, How many VNF instances to create in the network?
  - Where or in which of the nodes to place the VNF instances?
  - How to route a flow between VNF instances?

Needed

  - A **dynamic**, **efficient** and **scalable** optimization framework that is able to adapt to the dynamic nature of the traffic and instantiate VNF instances and steer the incoming flows between the required VNF instances.

Summary

- Networks are changing – moving to a software base - with SDN's centralized control and NFV's software based implementations
  - NFVs starting with middleboxes, moving to switching and routing in the future
- Our NetVM/OpenNetVM efforts enhance this industry direction to enable a more coherent and effective network architecture
  - Recognize the need for a smarter data plane that is capable to flow-level decision making and maintaining state
  - High performance forwarding on COTS hardware
  - Flexible, dynamic instantiation and management of NFs and flow routing

Getting OpenNetVM

- Source code and NSF CloudLab images at

  http://sdnfv.github.io/