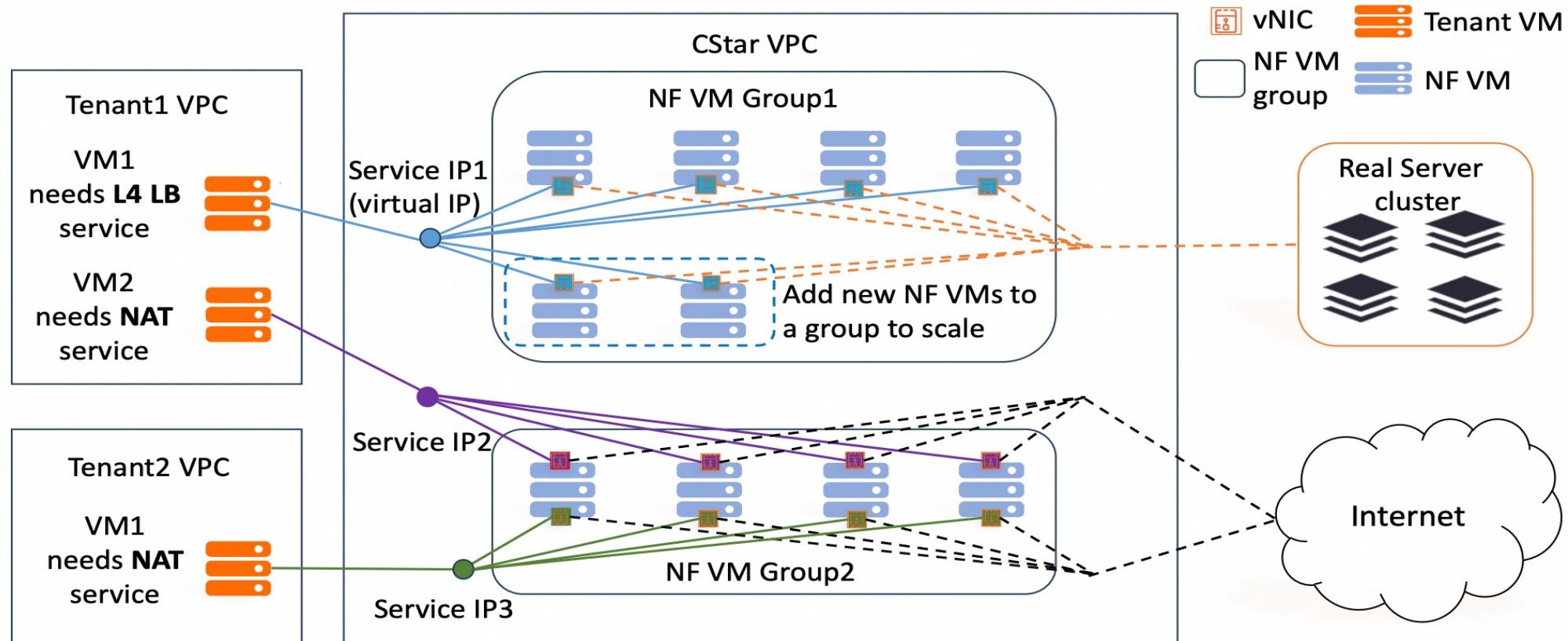


# Augmenting Public Cloud Infrastructure for Heterogeneous Network Function Virtualization

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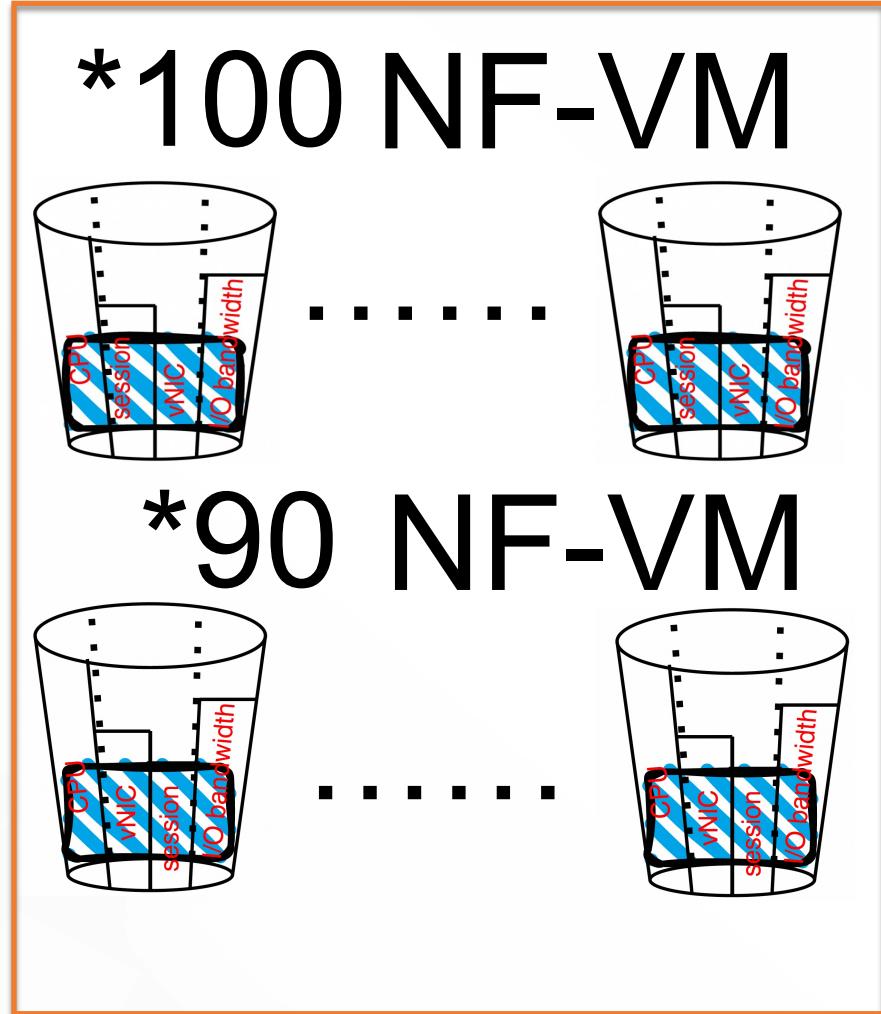


# BACKGROUND: VM-based NFV Architecture

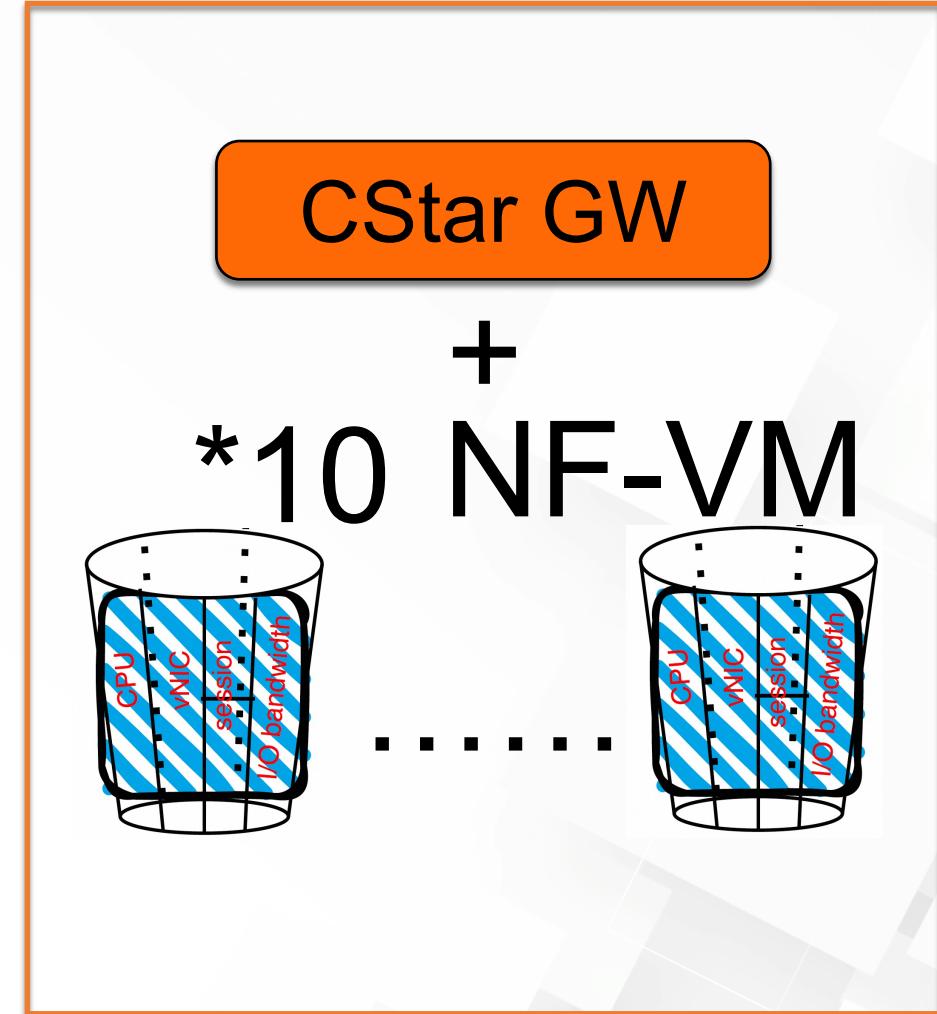


- Implementing network functions (e.g., LB, NAT) using **standard VMs**
- Allocate a **service IP** to the tenant to access the NF-VM
- Use **multiple** NF-VMs to form **a group** to handle traffic for a single tenant

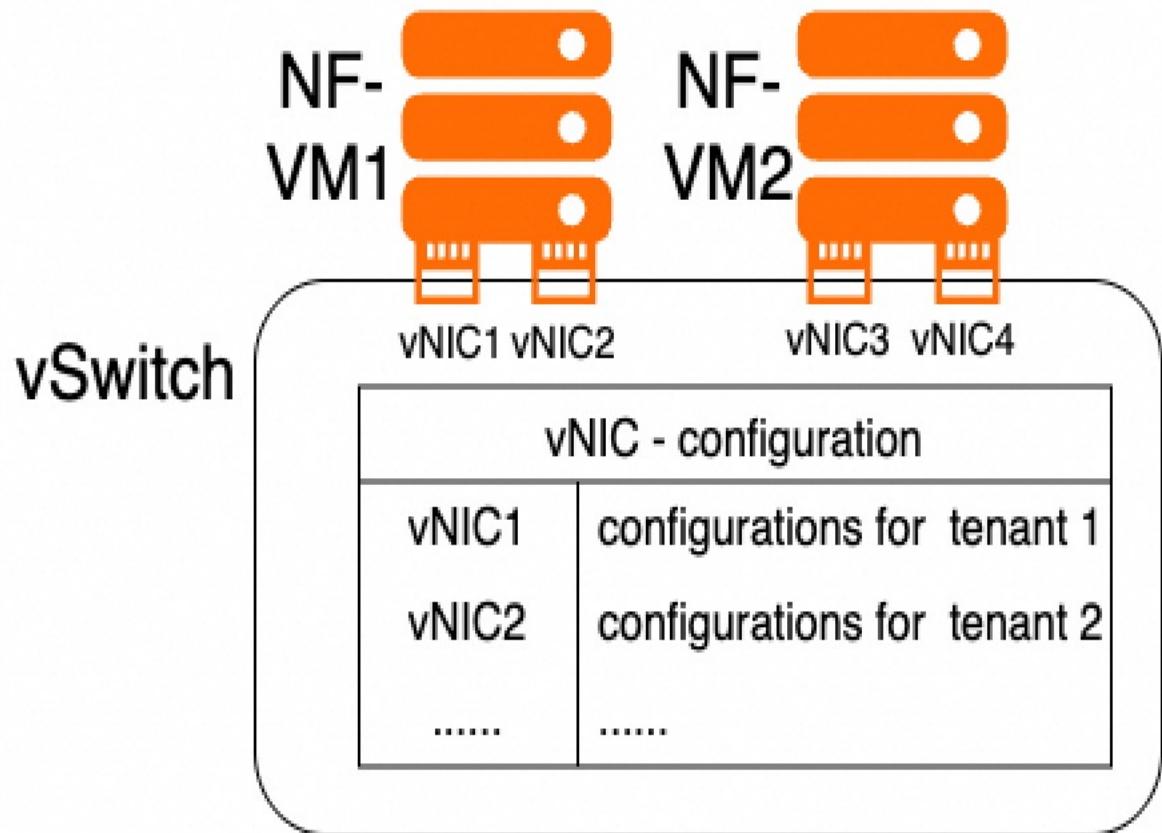
Resource limitations require us to allocate more VMs.



Use CStar GW to compensate for the resource shortcoming and reduce overhead.

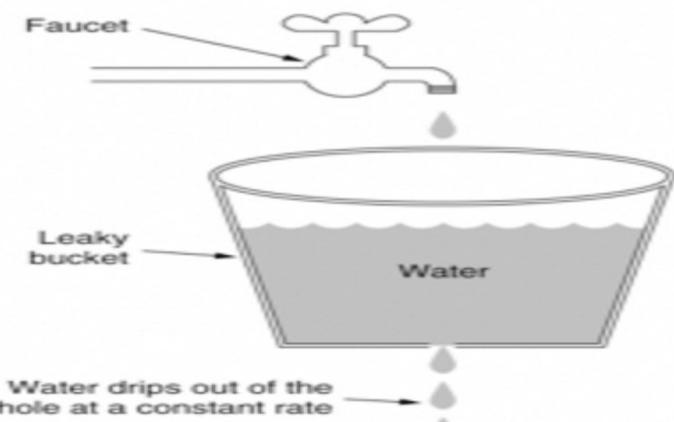


# BACKGROUND: vNIC

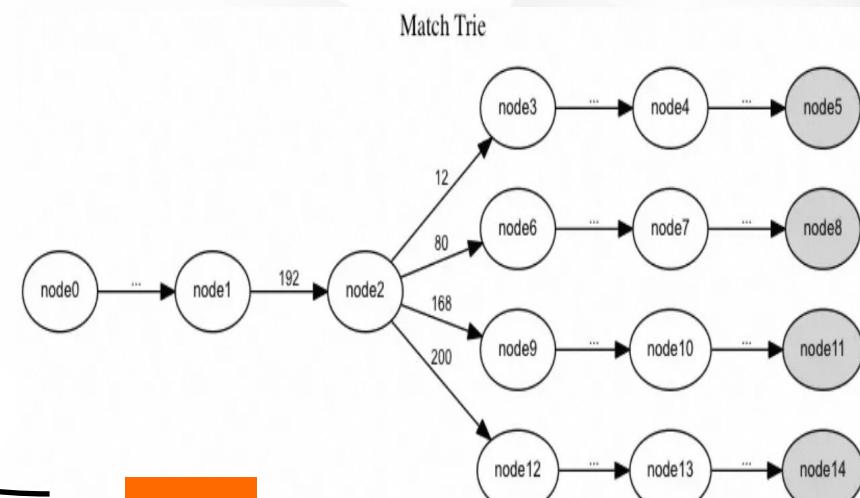


Tenant1's  
vNIC  
configurations

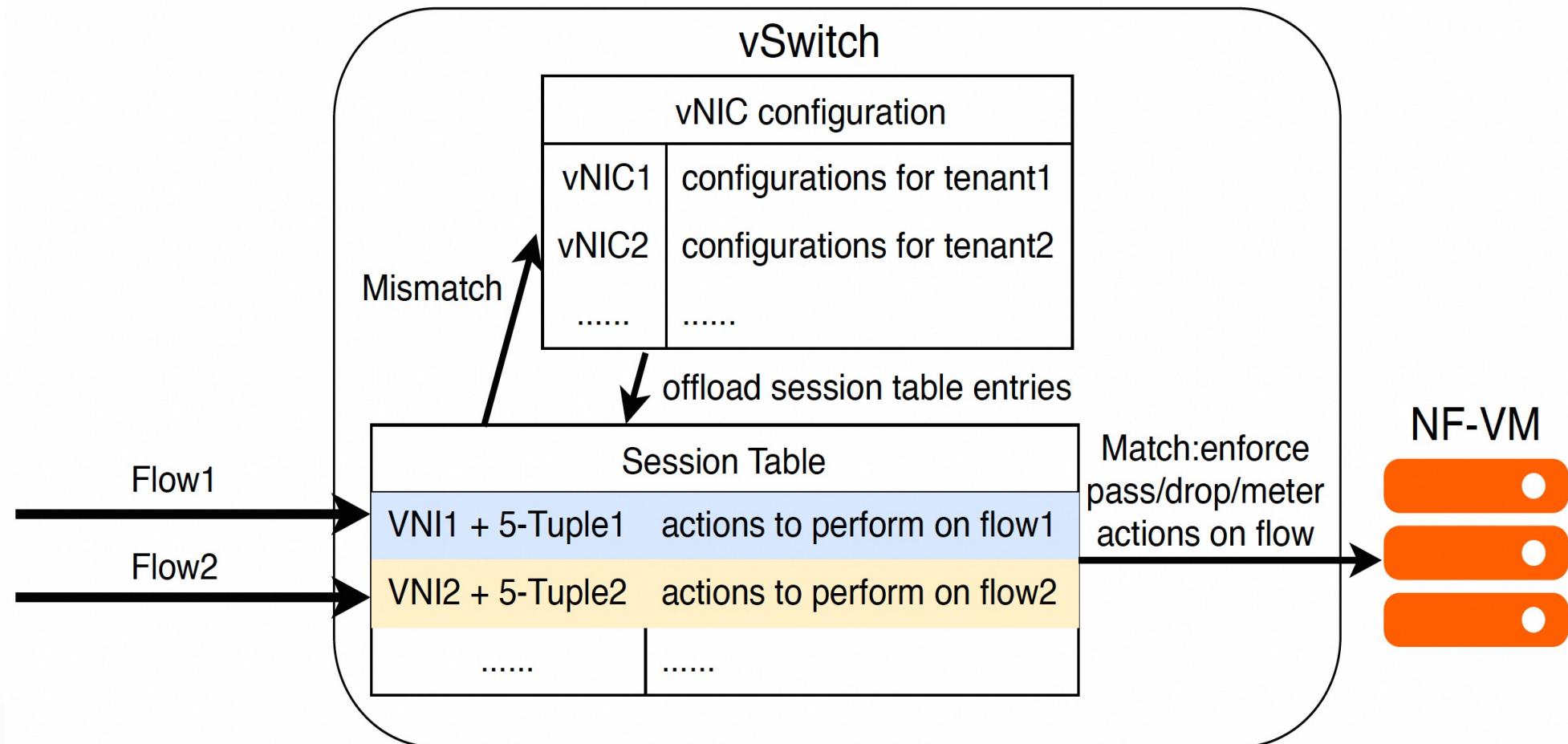
ACL based on  
the trie tree based security groups



Rate limiting based on  
the leaky bucket



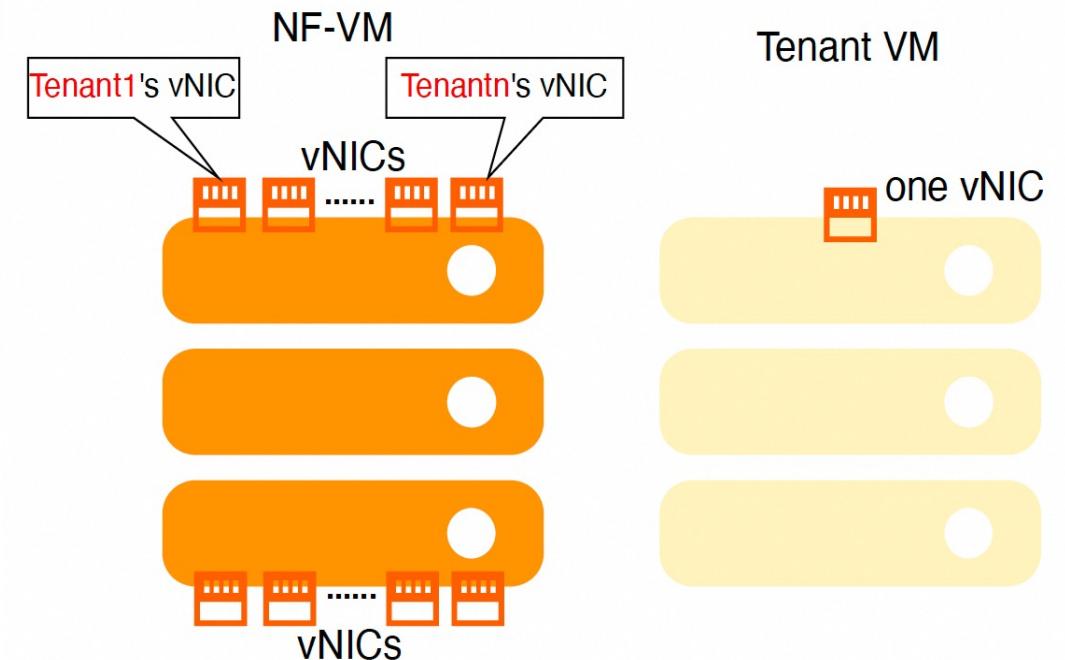
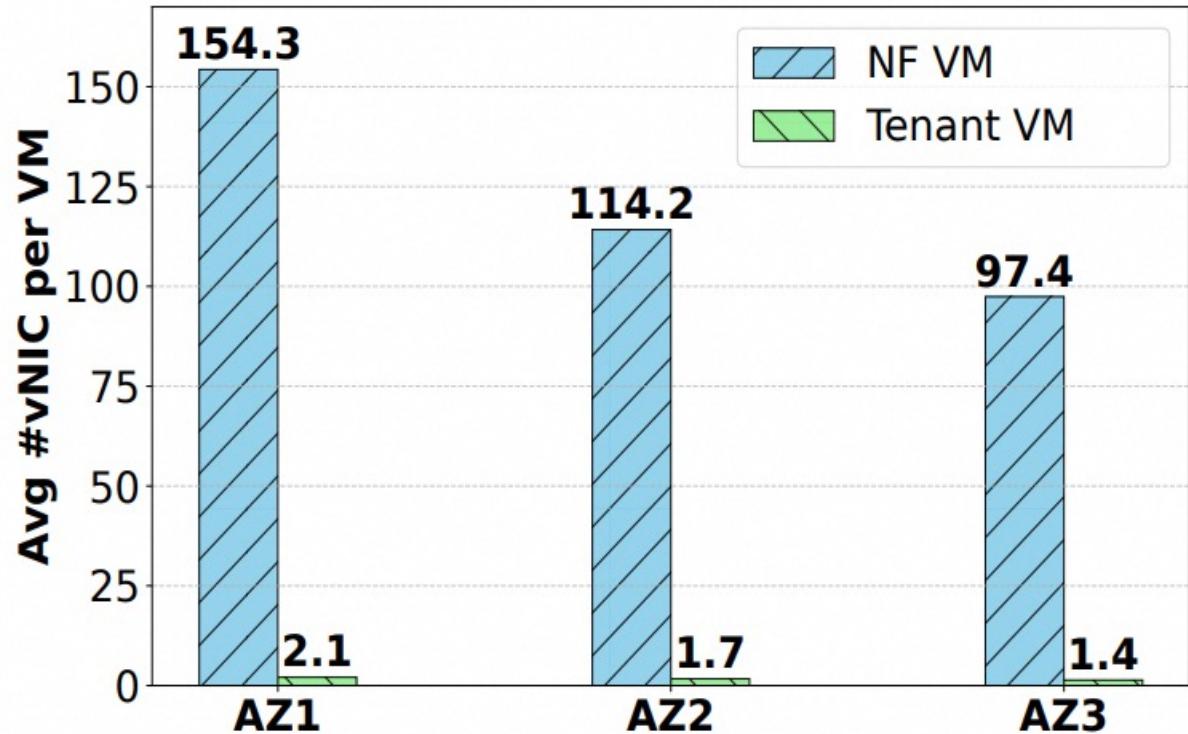
# BACKGROUND: Session



The vSwitch records the flow's session at the granularity of the VXLAN layer VNI and the inner five-tuple.

## MISMATCH 1

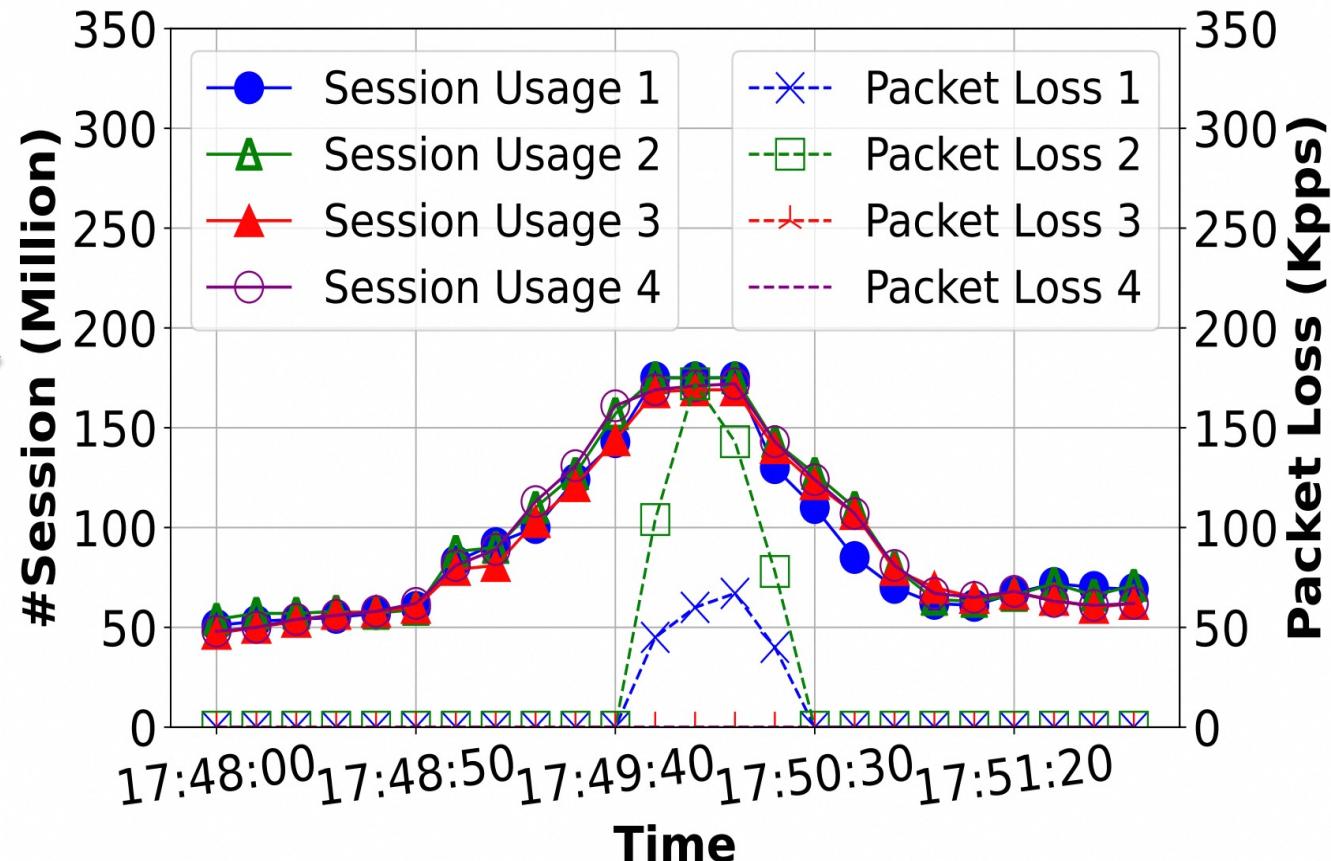
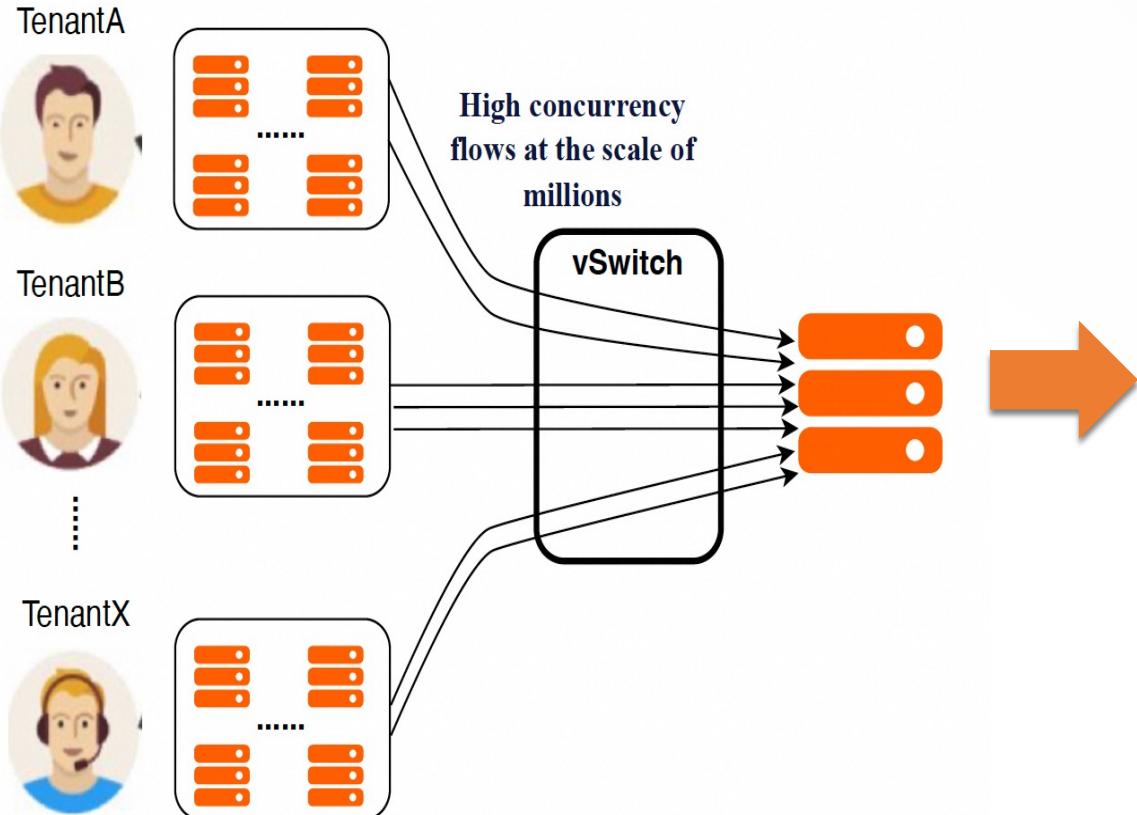
NF's massive occupation of vNICs provided by vSwitch.



**NF-VM requires **multiple vNICs** to differentiate traffic among multiple tenants.**

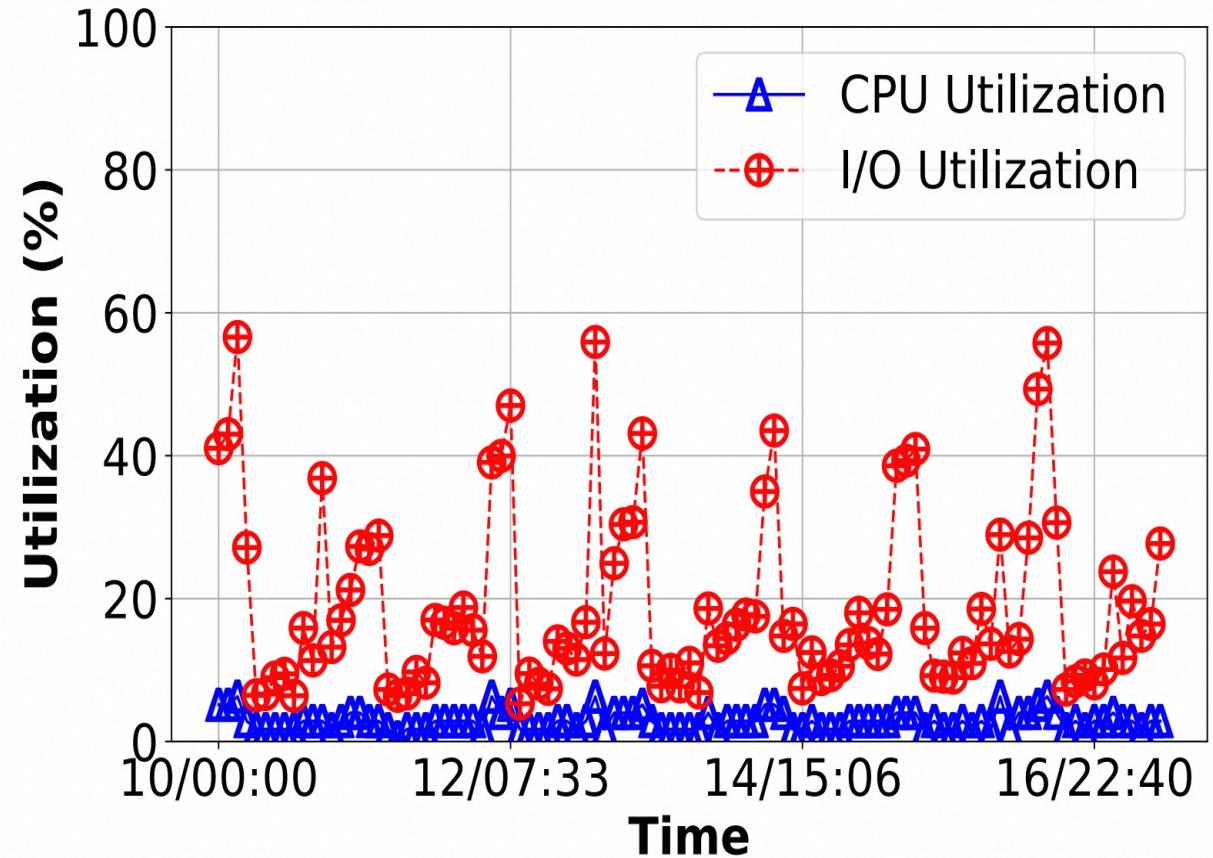
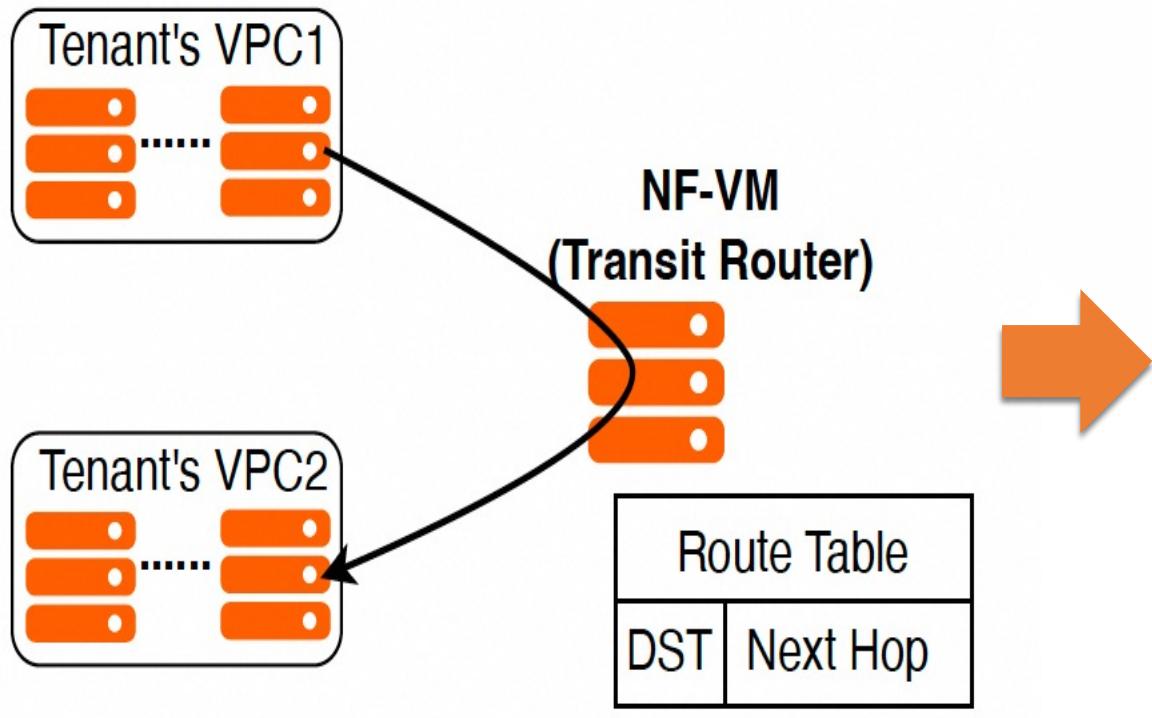
## MISMATCH 2

NF's massive occupation of sessions in vSwitch.

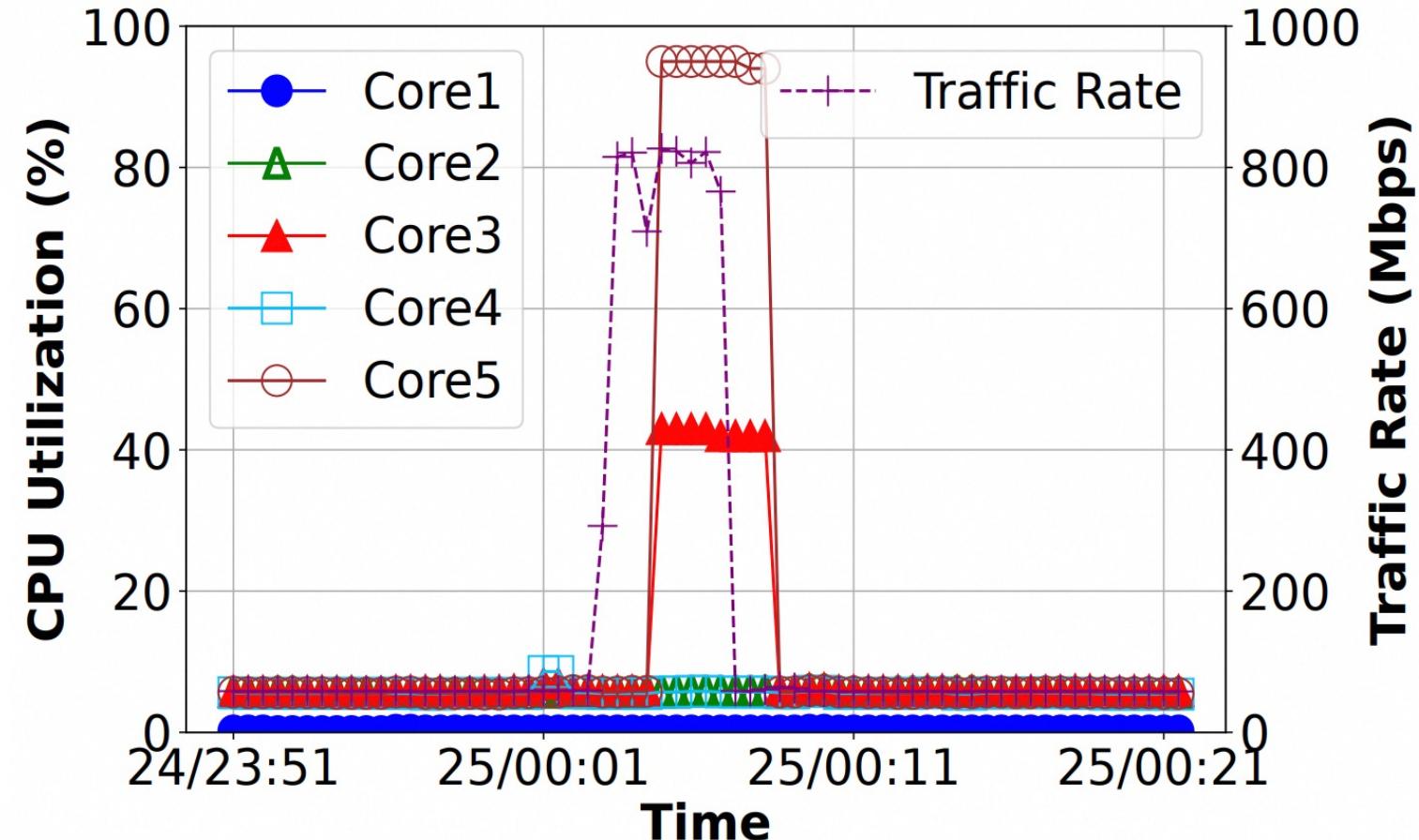
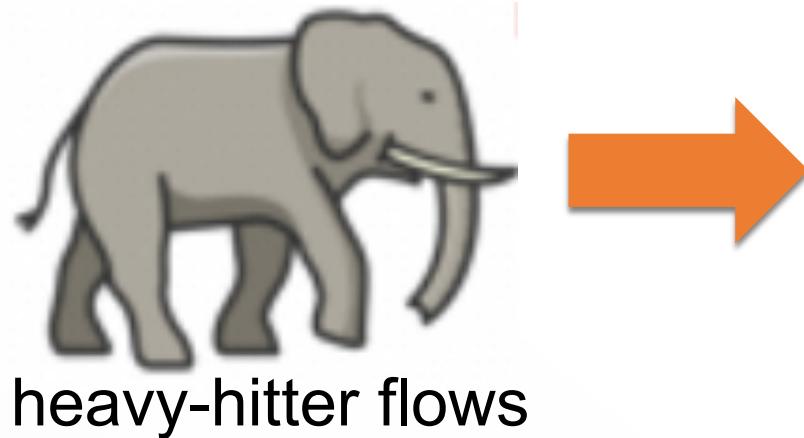


## MISMATCH 3

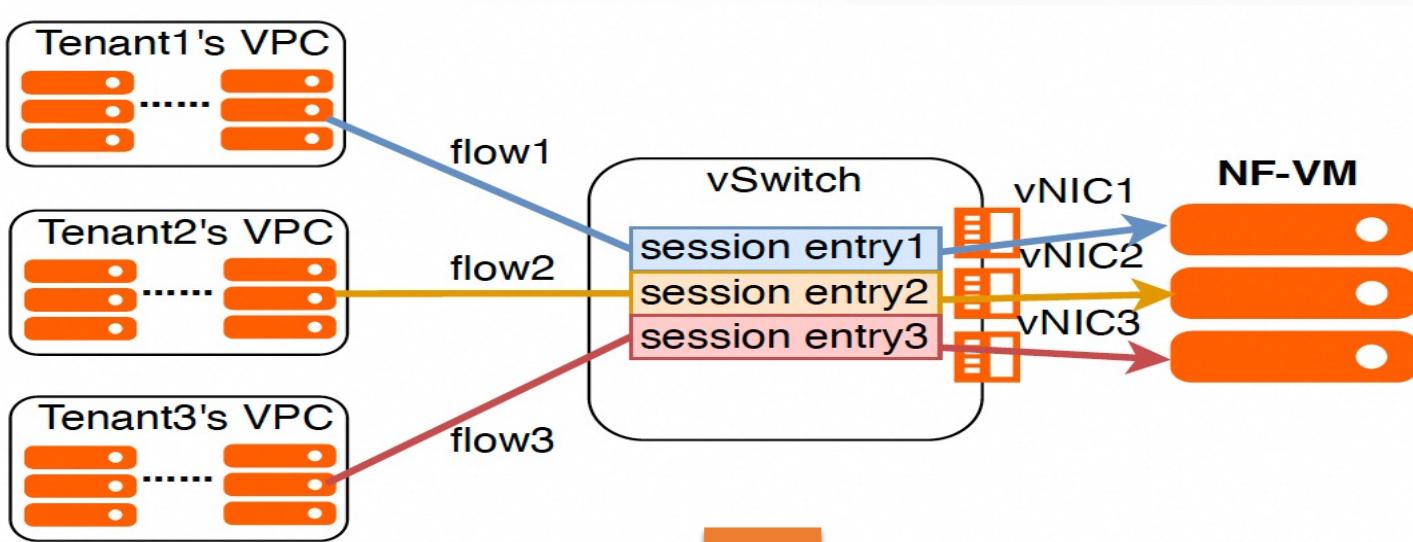
NF's I/O bandwidth can be saturated despite low CPU load.



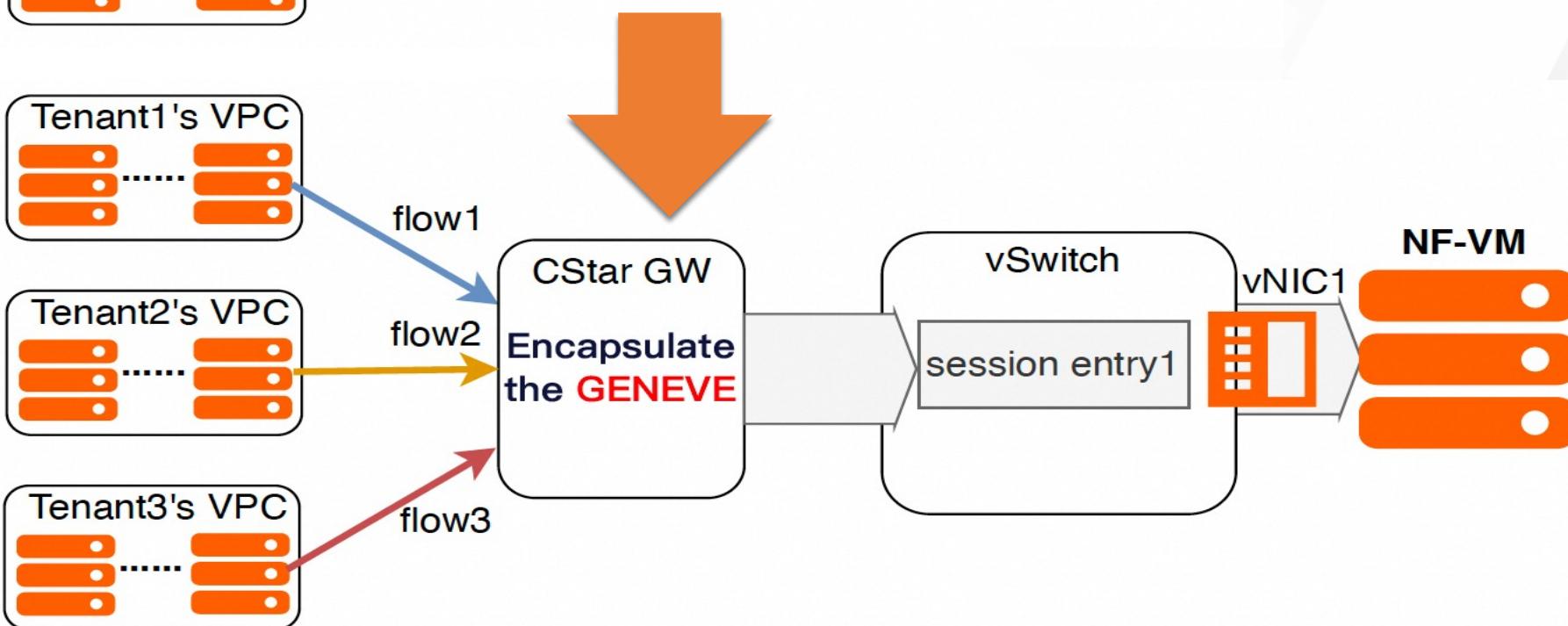
NF's CPU can be overloaded by heavy-hitter flows



## Overview

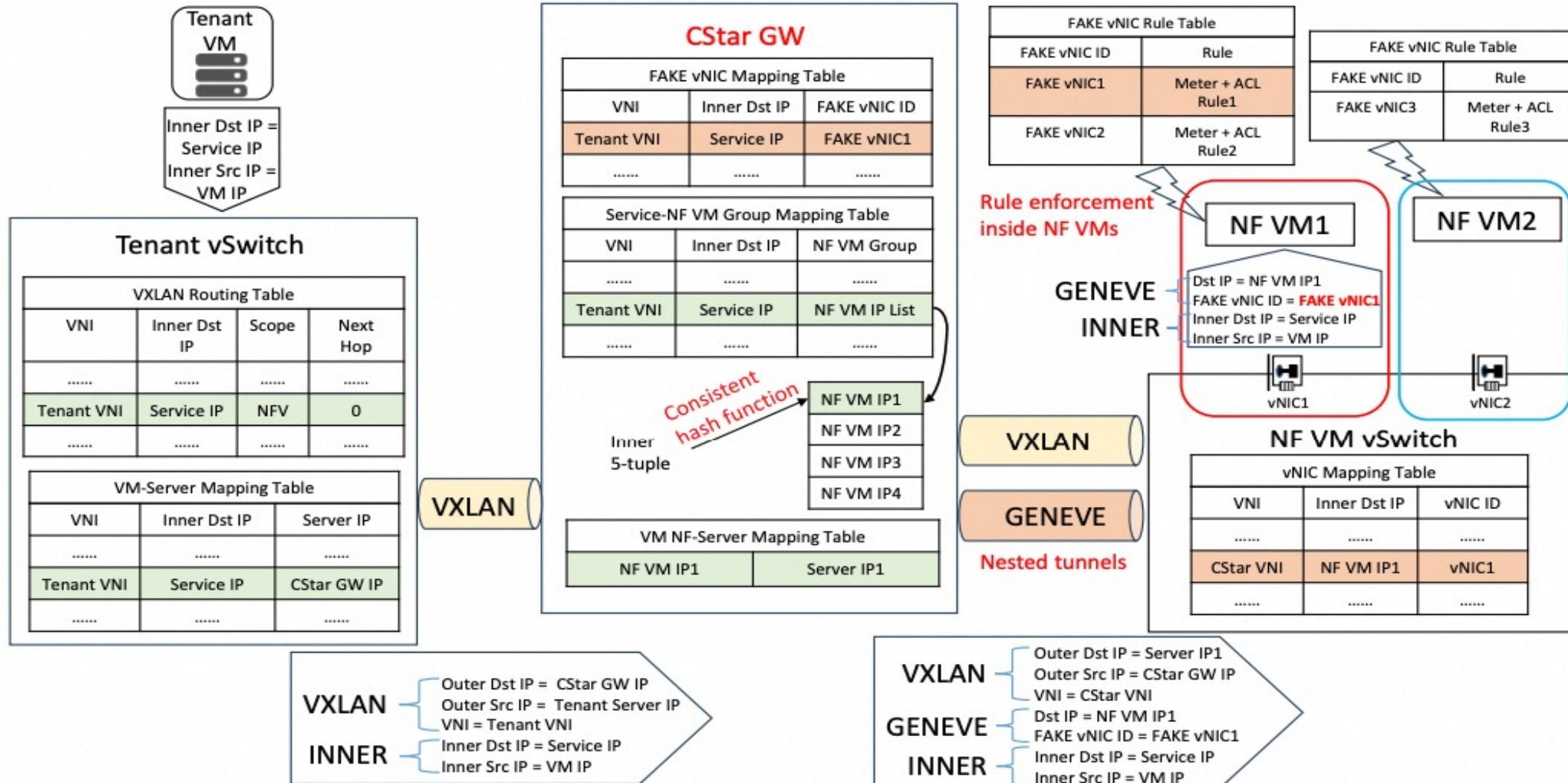


Without GW



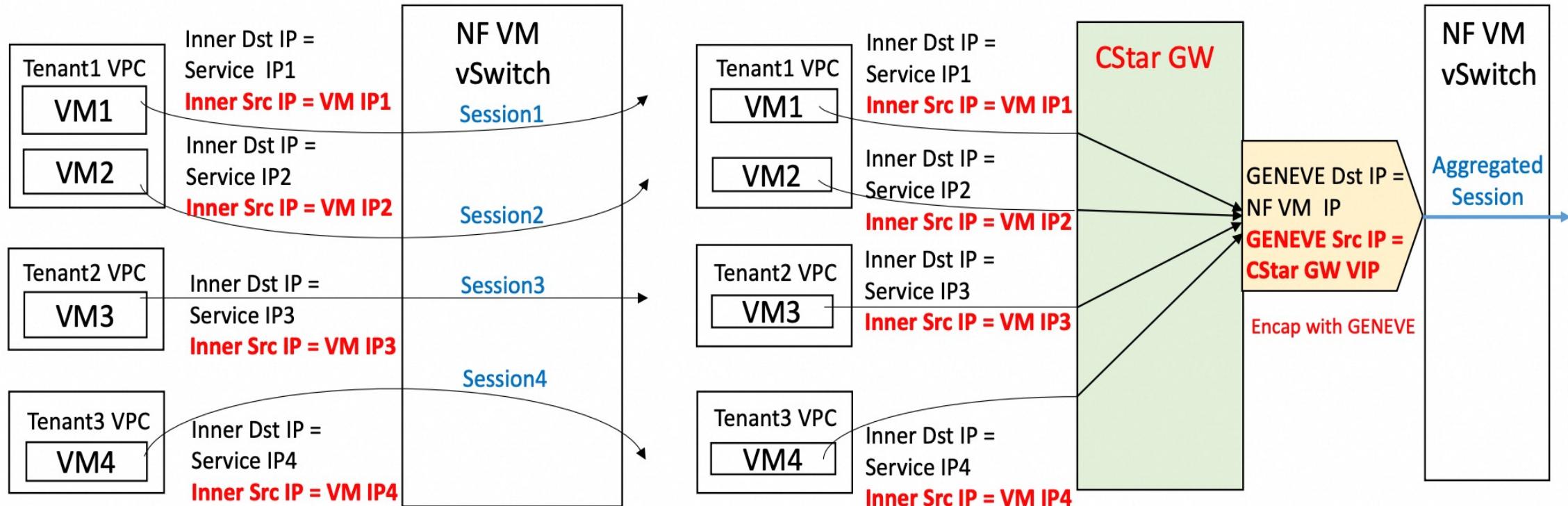
With GW

# vNIC overhead reduction through NF-specific configuration encapsulation in nested tunnels



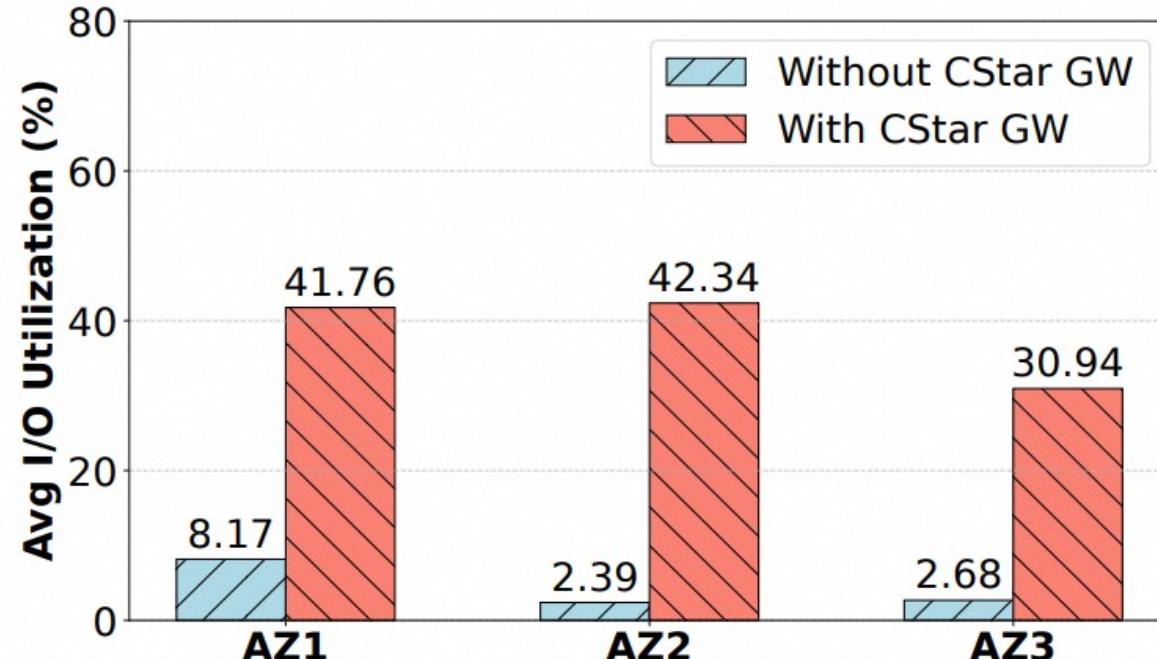
# DESIGN

## Session aggregation via tunnel encapsulation at the gateway



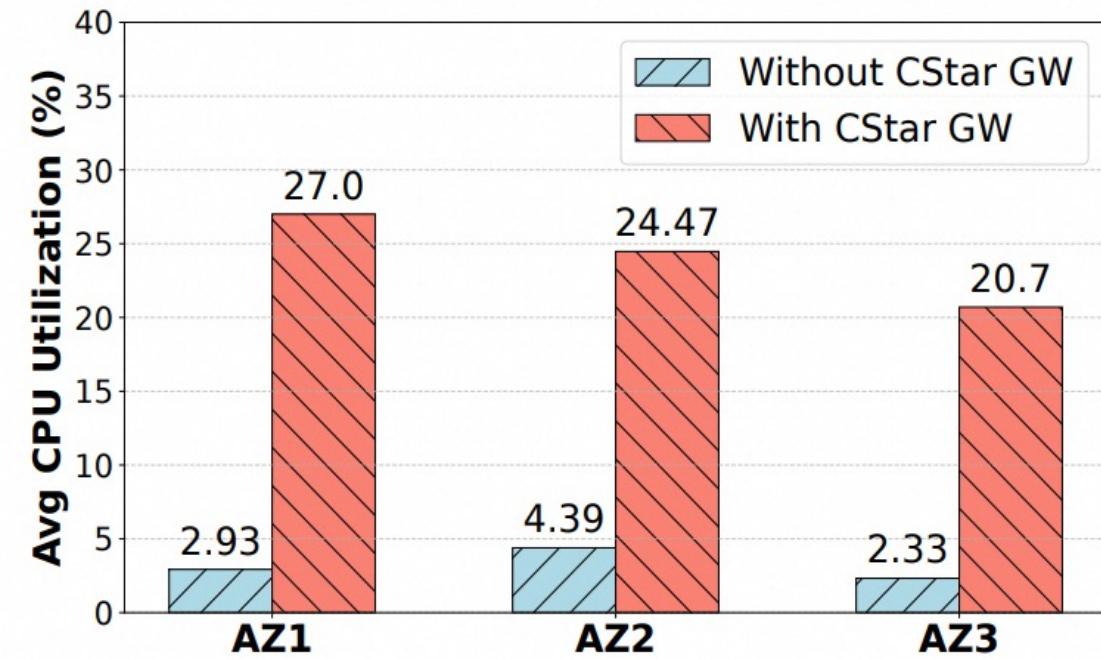
- The CStar GW **reduces the number of sessions** the vSwitch needs to track by adding an additional **GENEVE layer with a unified five-tuple** based on the inner layer.

# PRELIMINARY EVALUATION



I/O utilization improvement  
with CStar GW

After deploying the CStar GW, the average I/O and CPU utilization of VMs across the three AZs improved by **at least five times.**



CPU utilization improvement  
with CStar GW

## PRELIMINARY EVALUATION

The number of NF VMs allocated in the AZs before and after the deployment of CStar GW.

	AZ1	AZ2	AZ3
<b>Without CStar GW</b>	92	124	127
<b>With CStar GW</b>	18	7	11

In the three AZs, the number of NF-VMs used decreased by 80%, 94%, and 91%, respectively, after deploying the CStar GW compared to when it was not used.

It significantly reduces the cost of purchasing VMs, thereby increasing the cloud provider's profit.

In this work, we introduce the CStar GW and design a set of nested tunneling-based protocols to address the resource mismatch problems including limitations in vNICs and sessions for the vSwitch to host NF VMs when building scalable NFV products using standard VMs.

This solution significantly reduces the cost of deploying NFV systems on public clouds based on standard VMs, without requiring intrusive changes to the underlying cloud virtualization architecture. It offers a viable path for other cloud service providers seeking to deliver cost-effective, cloud-based NFV services.

# Augmenting Public Cloud Infrastructure for Heterogeneous Network Function Virtualization



Q & A