



# **CLOUD NETWORKING**

## THE NEXT CHAPTER

FLORIN BALUS

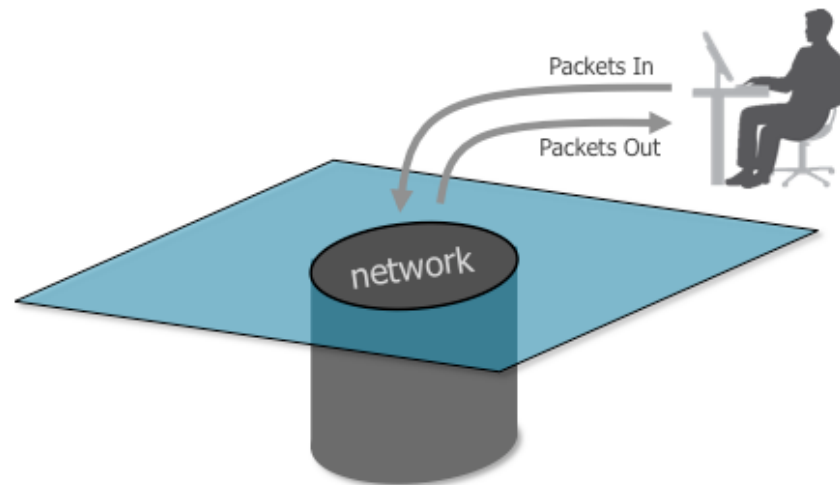


# COMMON APPLICATION VIEW OF THE NETWORK

## Fallacies of Distributed Computing

1. The network is reliable.
2. Latency is zero.
3. Bandwidth is infinite.
4. The network is secure.
5. Topology doesn't change.
6. There is one administrator.
7. Transport cost is zero.
8. The network is homogeneous.

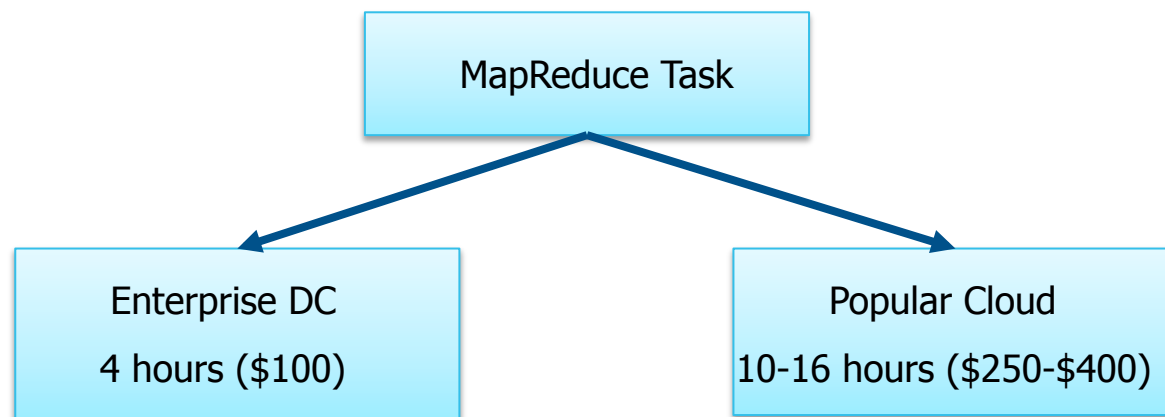
**Peter Deutsch - Sun Fellow, 1994**



net'wûrk': Unspeakably huge, complex, mysterious, stuffy network thing that nobody understands\*

# CLOUD NETWORK PERFORMANCE

*H. Ballani, P. Costa, T. Karagiannis, A. Rawstron, "Towards Predictable Datacenter Networks, Microsoft Research", ACM SIGCOMM 2011, MS Research*



Network performance can be a key obstacle to cloud adoption

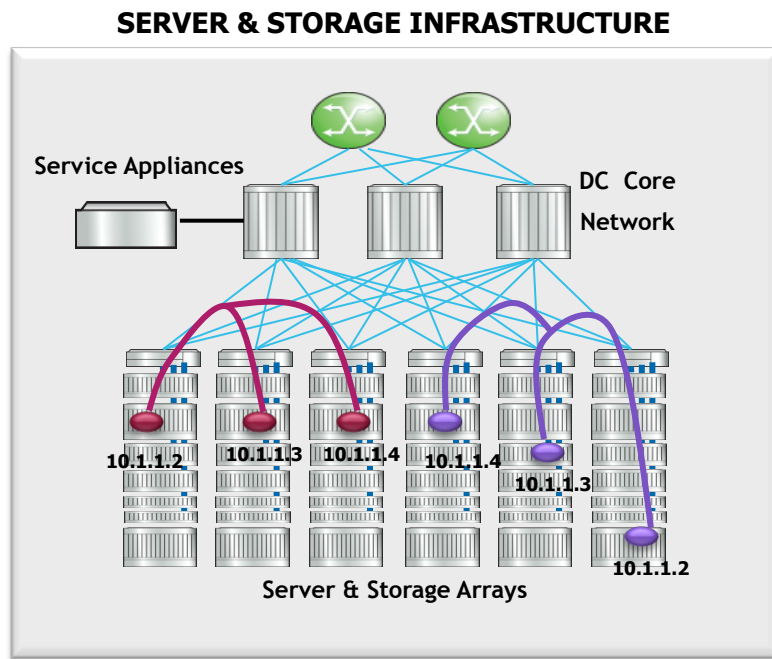
# DATA CENTER NETWORK VIRTUALIZATION



*The ..*

**Promise of Nirvana**

# 1<sup>st</sup> GENERATION – L2 SERVICE (VLANs)

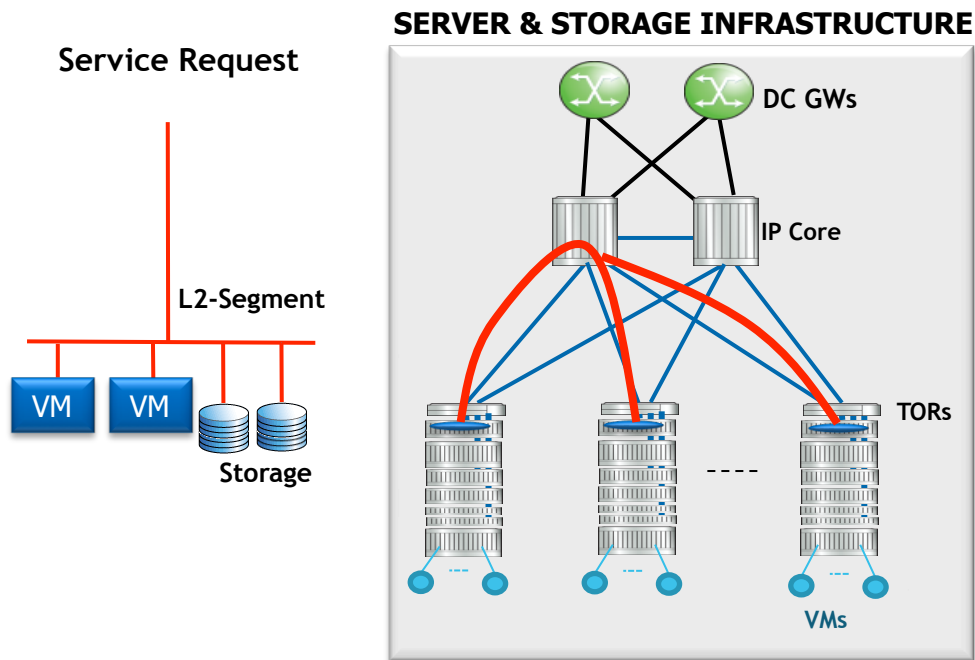


## ISSUES & LIMITATIONS

- VLAN scalability
- L2 core scaling issues
- Management complexity
- Network stability

# L2 NETWORK VIRTUALIZATION APPROACH

(L2 over IP tunnels: VXLAN/NVGRE)

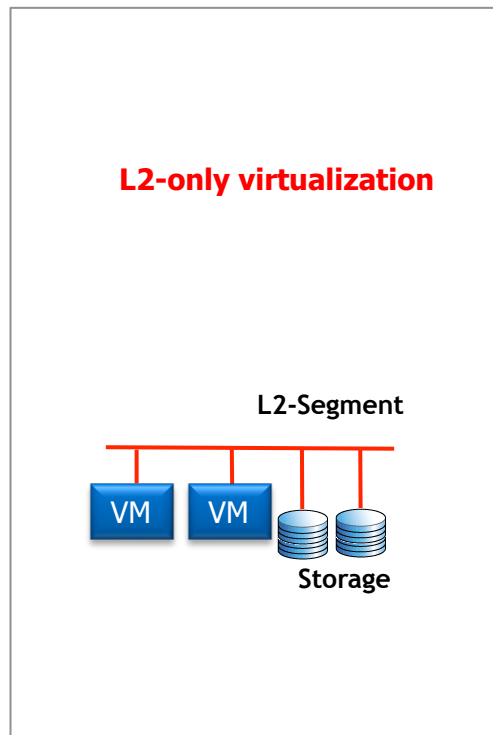


## ISSUES & LIMITATIONS

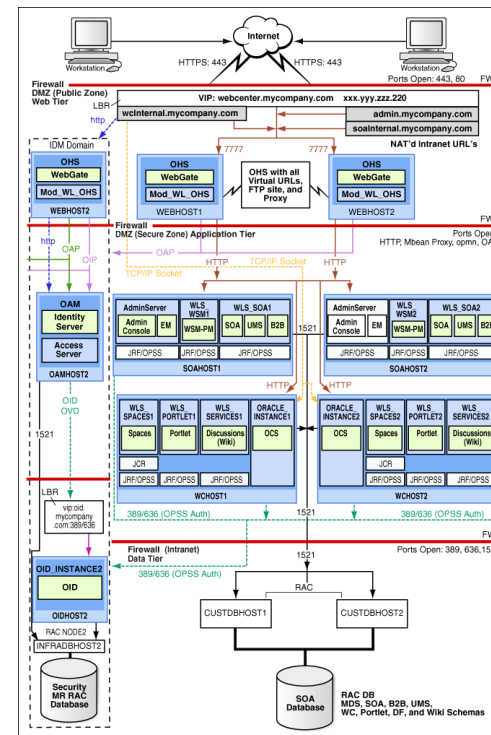
- Does not address enterprise use cases
- Bandwidth and routing inefficiencies
- Core network complexity
- Operational complexity

# ENTERPRISE APPLICATIONS

## CURRENT NETWORK VIEW



## REALITY

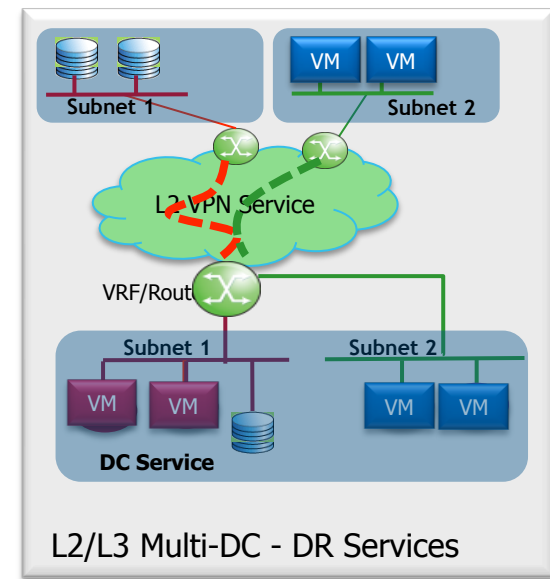
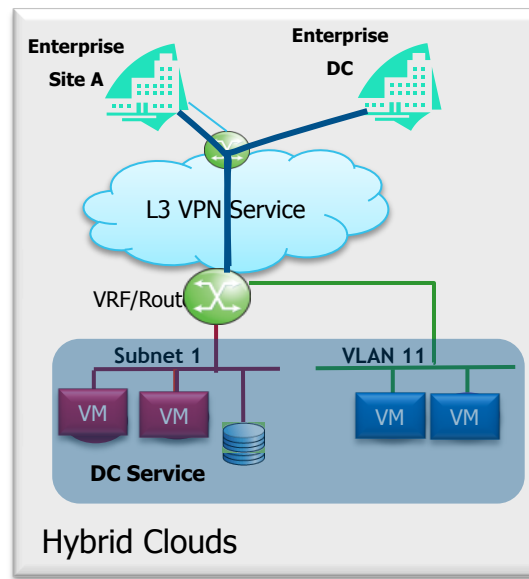
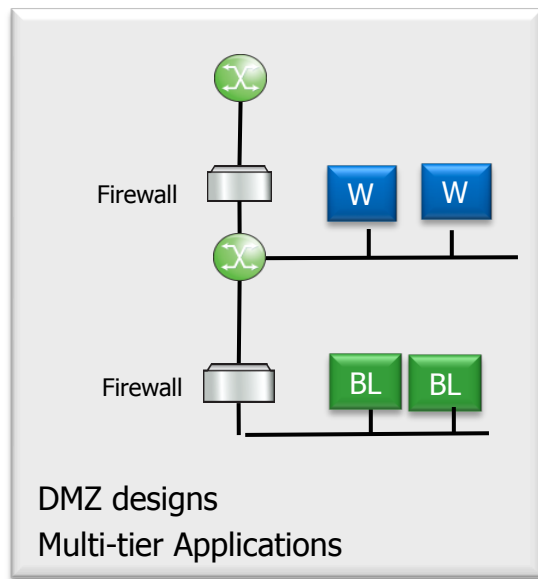


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Source: [http://docs.oracle.com/cd/E12839\\_01/core.1111/e12037/overview.htm](http://docs.oracle.com/cd/E12839_01/core.1111/e12037/overview.htm)

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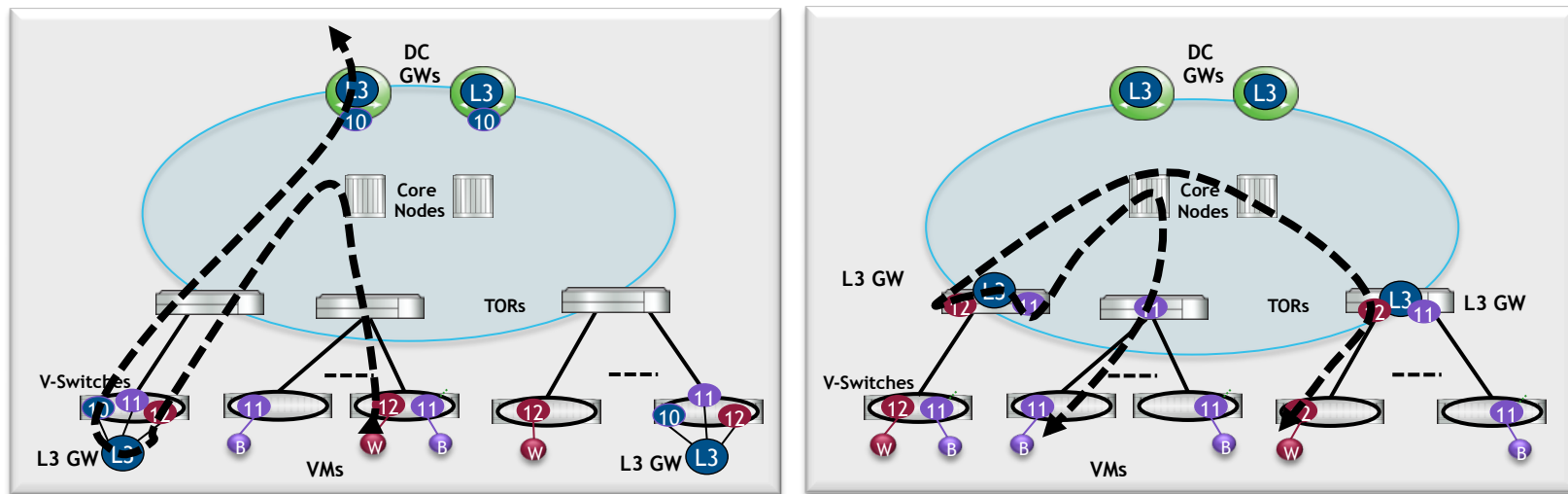
# 1. REAL ENTERPRISE USE CASES





## 2. BANDWIDTH AND LATENCY ISSUES

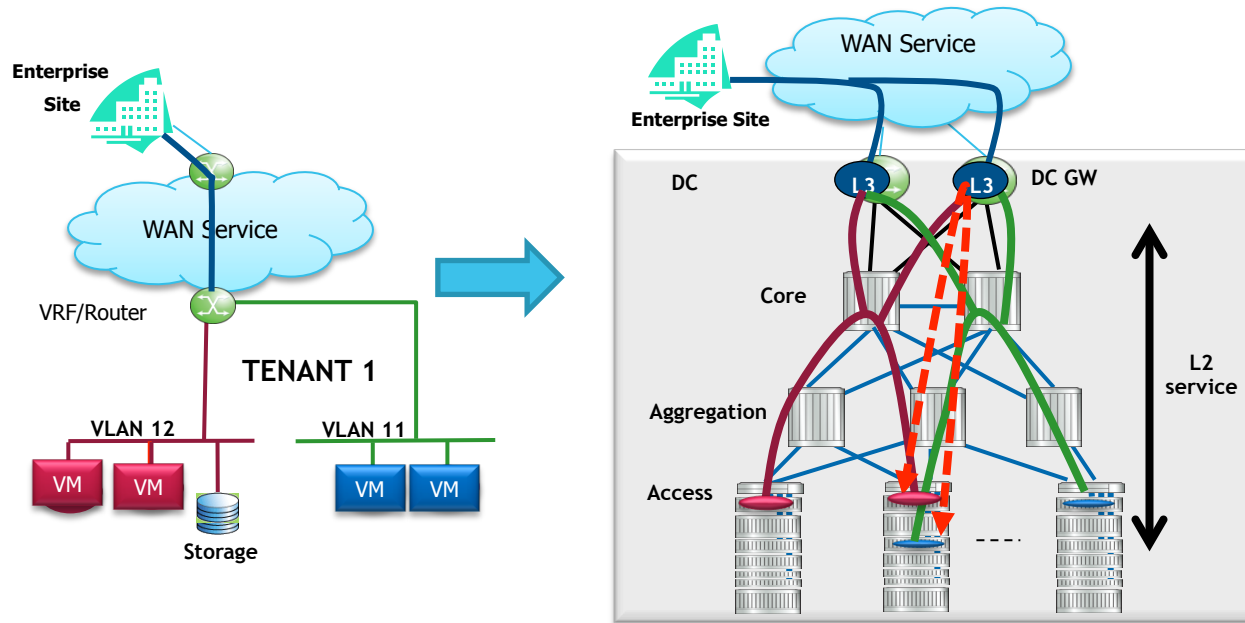
L3-L4 services only in certain locations (VMs or ToRs)



Centralized gateways result in sub-optimal bandwidth utilization, performance issues, and choke-points

## 2. BANDWIDTH AND LATENCY ISSUES

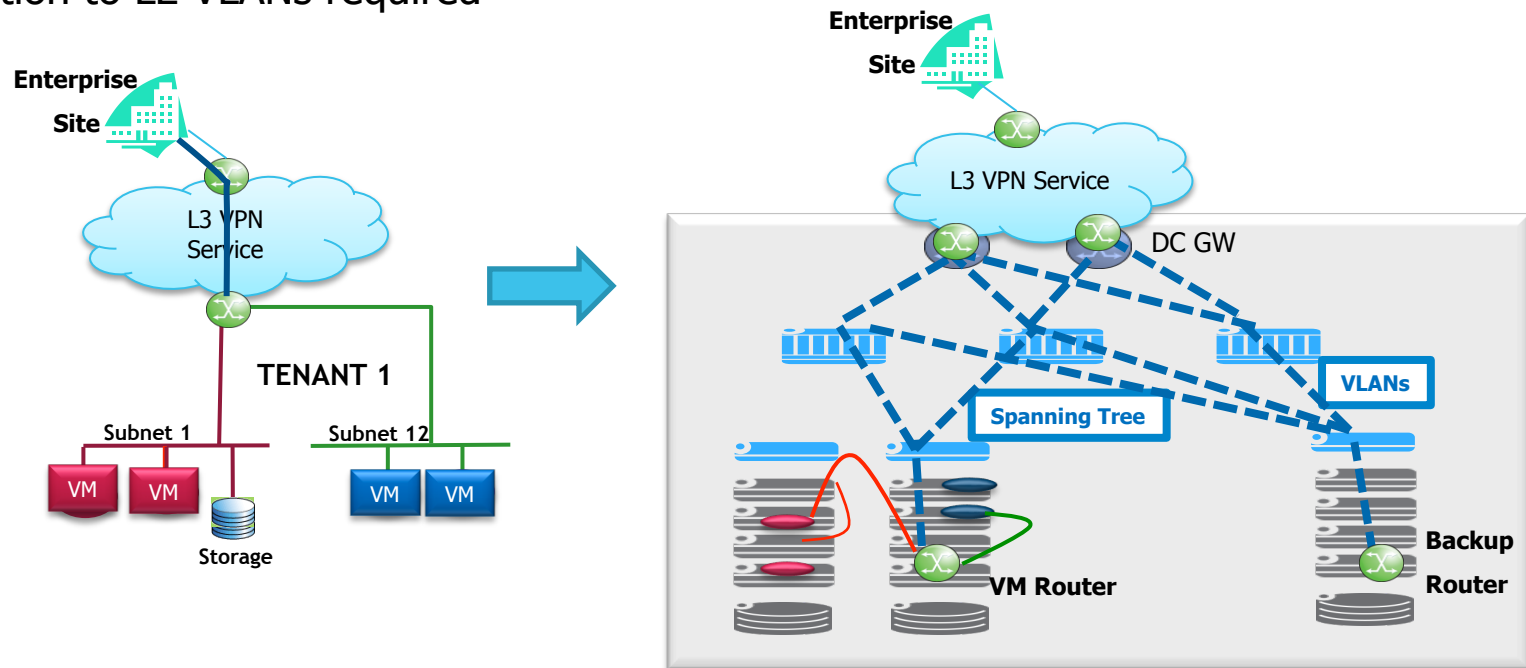
Using hardware-based routers



DC Gateways fail to solve the L3 service problem

### 3. NETWORK COMPLEXITY

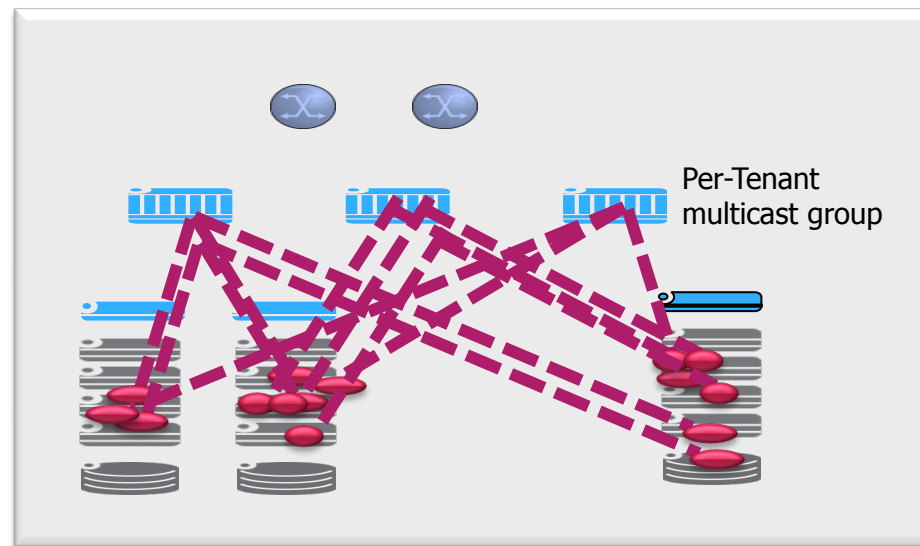
Translation to L2 VLANs required



External connectivity requires VLAN toolset and configuration

### 3. CORE NETWORK COMPLEXITY

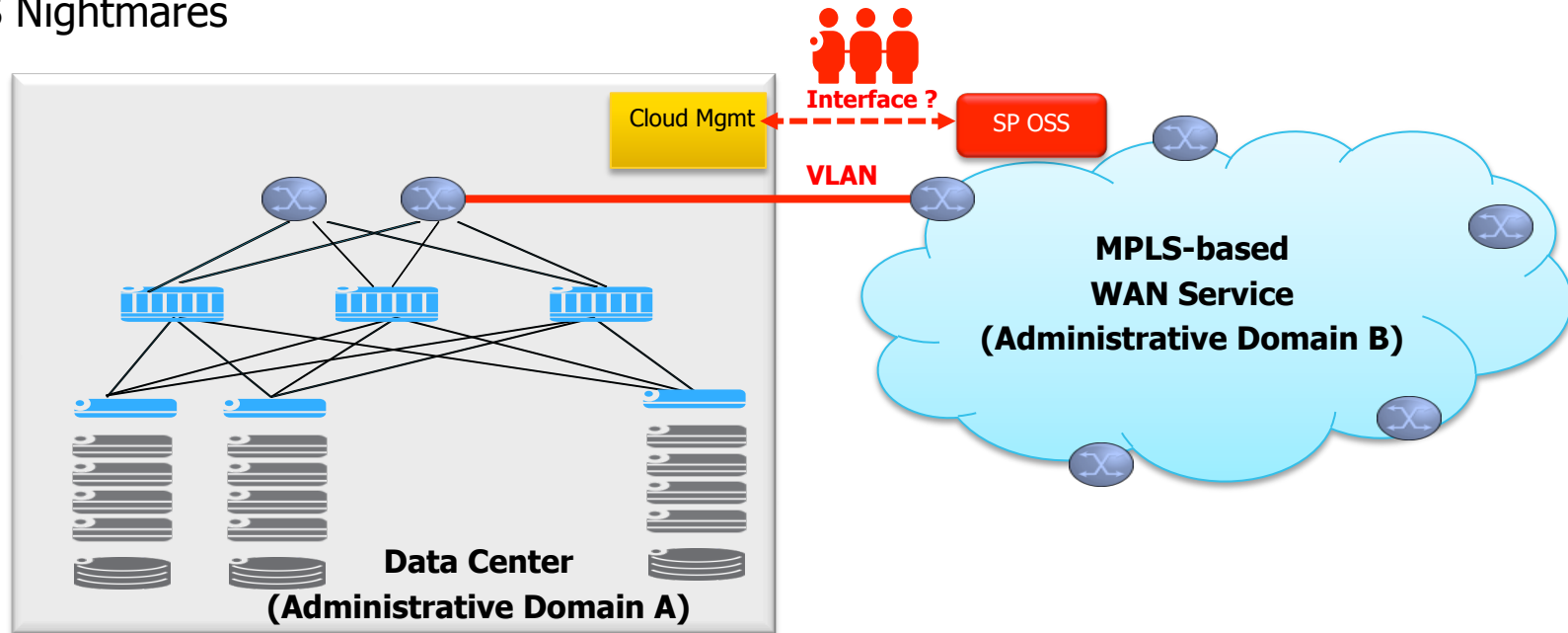
VXLAN Implementations require Multicast (PIM and IGMP) at the Core



VXLAN requires per-tenant state in the core network

## 4. INTERFACING TO EXISTING SERVICES

OSS Nightmares

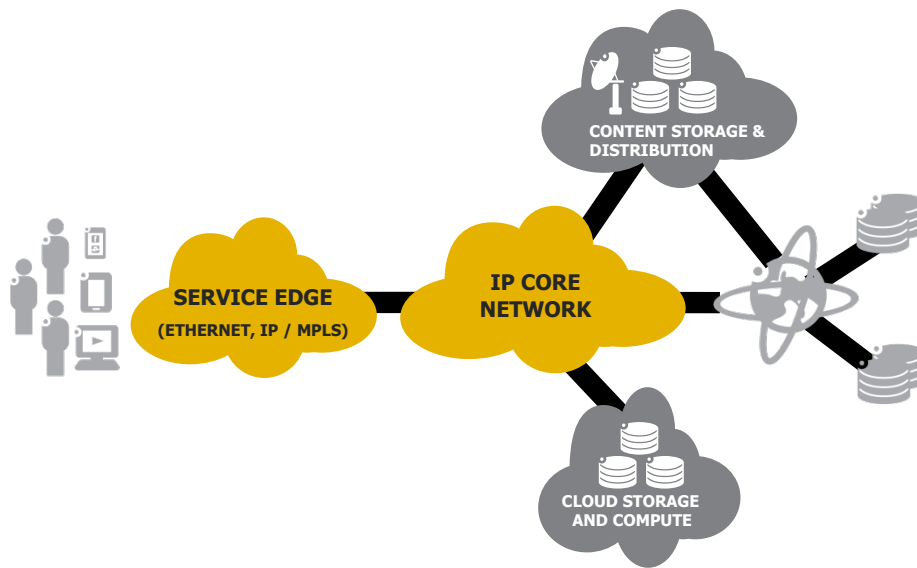


Significant costs and complexity in interfacing between different operational models and administrative domains

# NETWORK SERVICE REQUIREMENTS

L3 Scalability	<ul style="list-style-type: none"><li>• No per-tenant state</li></ul>
L2 Multi-tenancy	<ul style="list-style-type: none"><li>• Full tenant traffic isolation</li></ul>
L2 & L3 Services	<ul style="list-style-type: none"><li>• Support for real application topologies</li></ul>
VPN Service Extension	<ul style="list-style-type: none"><li>• Hybrid and extended clouds</li></ul>
SDN Programmability	<ul style="list-style-type: none"><li>• Rapid service deployment</li></ul>

# DIDN'T WE SOLVE THIS PROBLEM BEFORE?



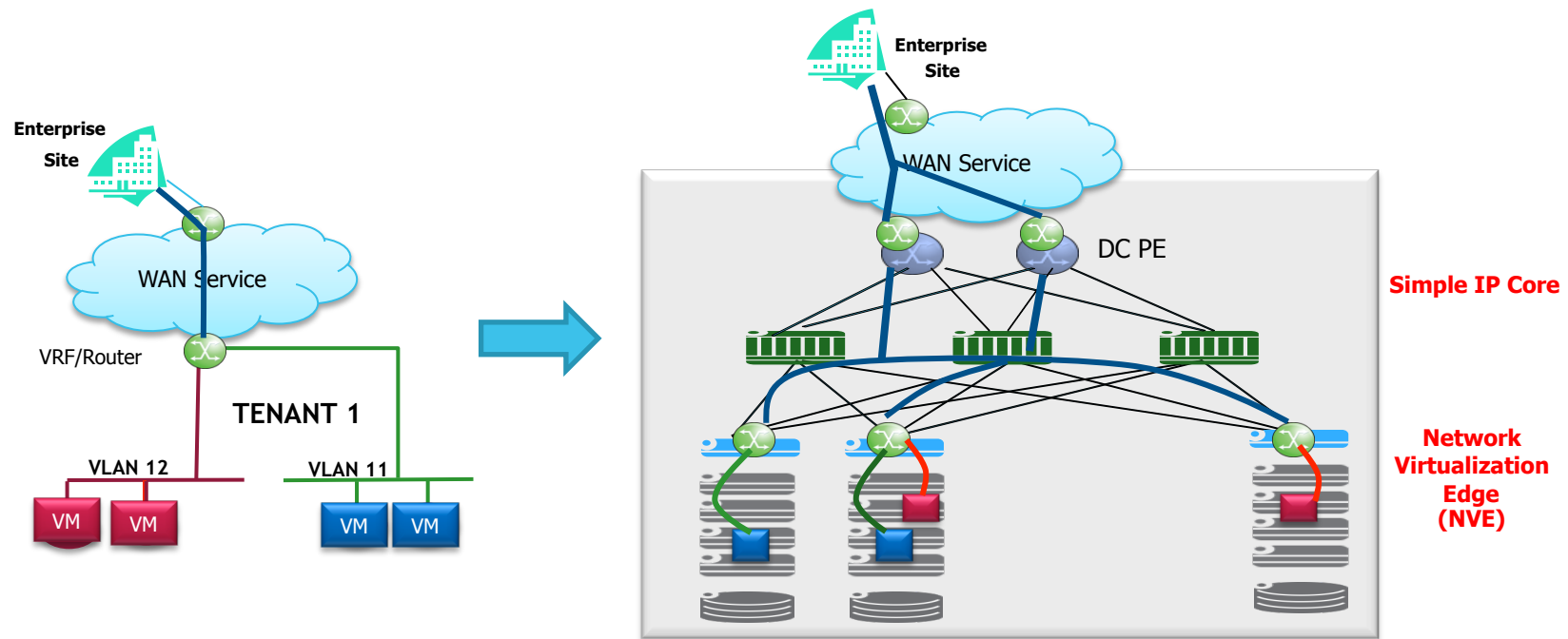
## Issues and Limitations

- Not optimized for data center designs
- Unfamiliar protocols for IT organizations

**But,**

Rich toolkit of technologies and lessons learned

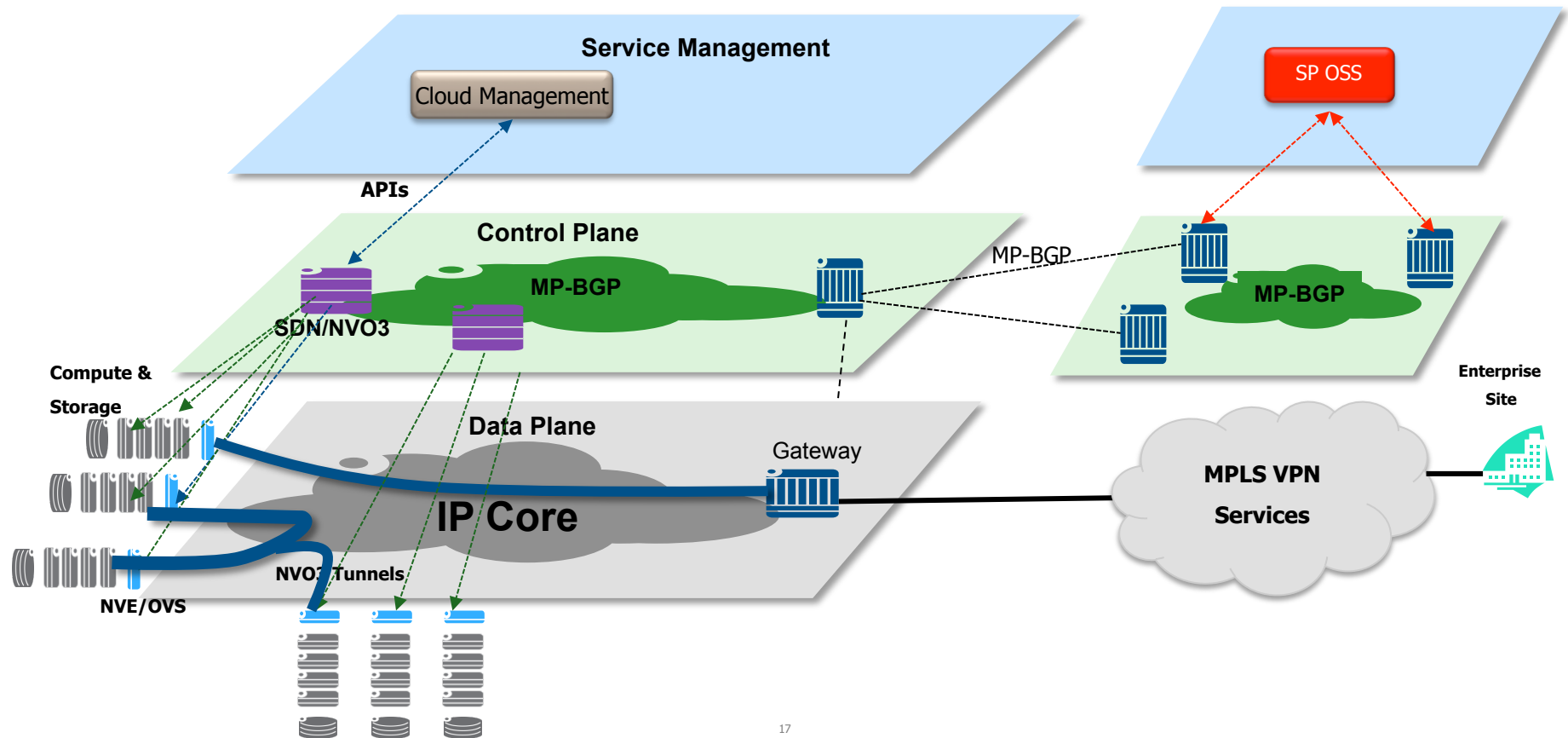
# SOLUTION: DISTRIBUTED L2-L4 SERVICES



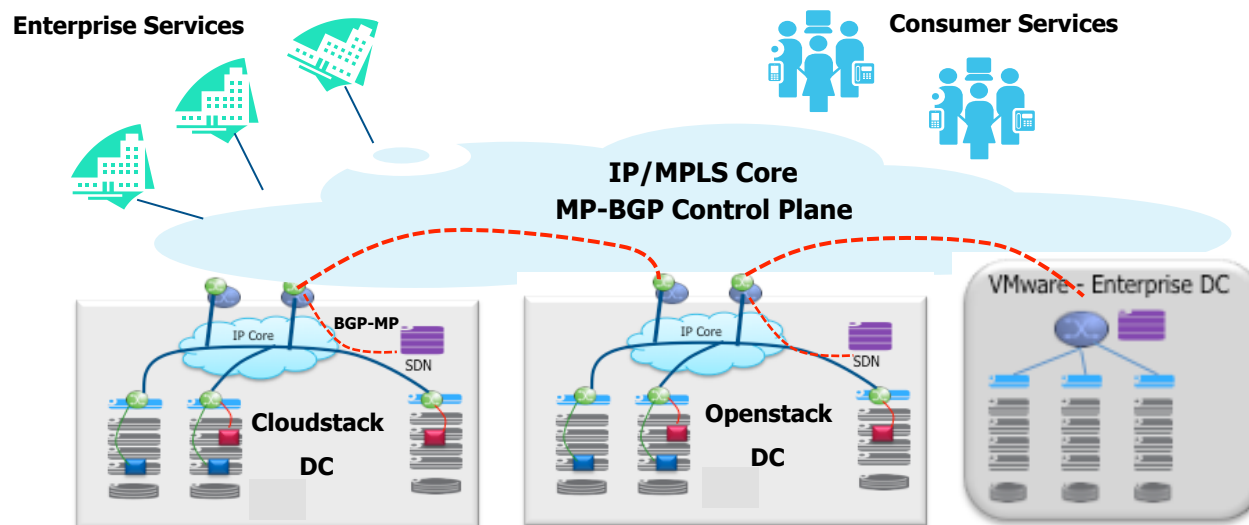
L2-L4 Services Distributed on all Edge Forwarding Elements of the DC



# CONTROL AND DATA PLANE INTERACTIONS



# MULTI-DC AND MULTI-VENDOR SERVICES



BGP interoperability enables federation of multi-vendor cloud services

# DRIVING TOWARD INTEROPERABILITY



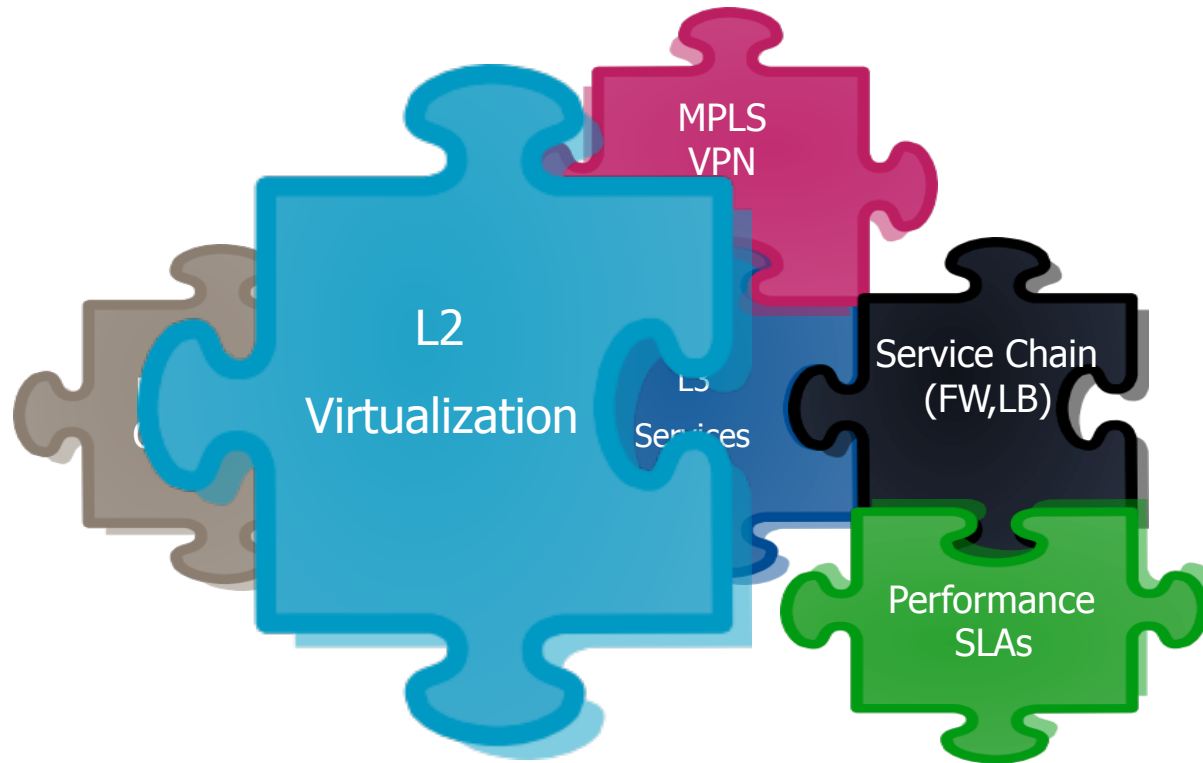
- IETF – NVO3 Working Group

- Problem statement
  - [draft-ietf-nvo3-problem-statement](#)
- Framework
  - [draft-ietf-nv03-framework](#)
- Data plane requirements
  - [draft-bl-nvo0-dataplane-requirements](#)
- Control plane requirements
  - [draft-drake-nvo3-evpn-control-plane](#)
- Federation of SDN Controller
  - [draft-sb-nv03-sdn-federation](#)



- Openflow Specification 1.3

# CLOUD NETWORK SERVICES RAPIDLY EVOLVING TO MEET ENTERPRISE NEEDS





# Nuage Networks

[www.nuagenetworks.net](http://www.nuagenetworks.net)