

# VNF Pool Use Cases

## Requirements and Use Cases for Virtual Network Functions

[draft-xia-vnfpool-use-cases-00](#)

## Virtualisation of Mobile Core Network Use Case

[draft-king-vnfpool-mobile-use-case-00](#)

### VNF Load Balancing

([Relates to all use case I-Ds](#))

## Virtualisation of Content Distribution Network Use Case

[draft-aranda-vnfpool-cdn-use-case-00](#)

## Use Cases for Resource Pools with Virtual Network Functions (VNFs)

[draft-hares-vnf-pool-use-case-01](#)

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# VNF Pool Use Case Overview

## 1. Requirements and Use Cases for Virtual Network Functions

Provides an analysis of the key reliability requirements for applications and functions that may be hosted within a virtualized network function (VNF).

**Presenter: Michiaki Hayashi, KDDI**

## 2. Virtualisation of Mobile Core Network Use Case

Use case document providing resiliency requirements for virtualization of the LTE mobile core network, known as virtualized EPC (vEPC).

**Presenter: Marco Liebsch, NEC**

## 3. Load Balancing between VNFs

**Presenter: Andy Reid, BT**

## 4. Virtualisation of Content Distribution Network Use Case

Use case document highlighting resiliency requirements for virtualization of the Content Distribution Network (vCDN).

**Presenter: Pedro Aranda, Telefonica**

## 5. Use Cases for Resource Pools with Virtual Network Functions (VNFs)

Use case document providing seven use cases the author has observed in demonstrations or deployments for the network function virtualization.

**Presenter: Susan Hares, Hickory Hill Consulting**

# draft-xia-vnfpool-use-cases-00

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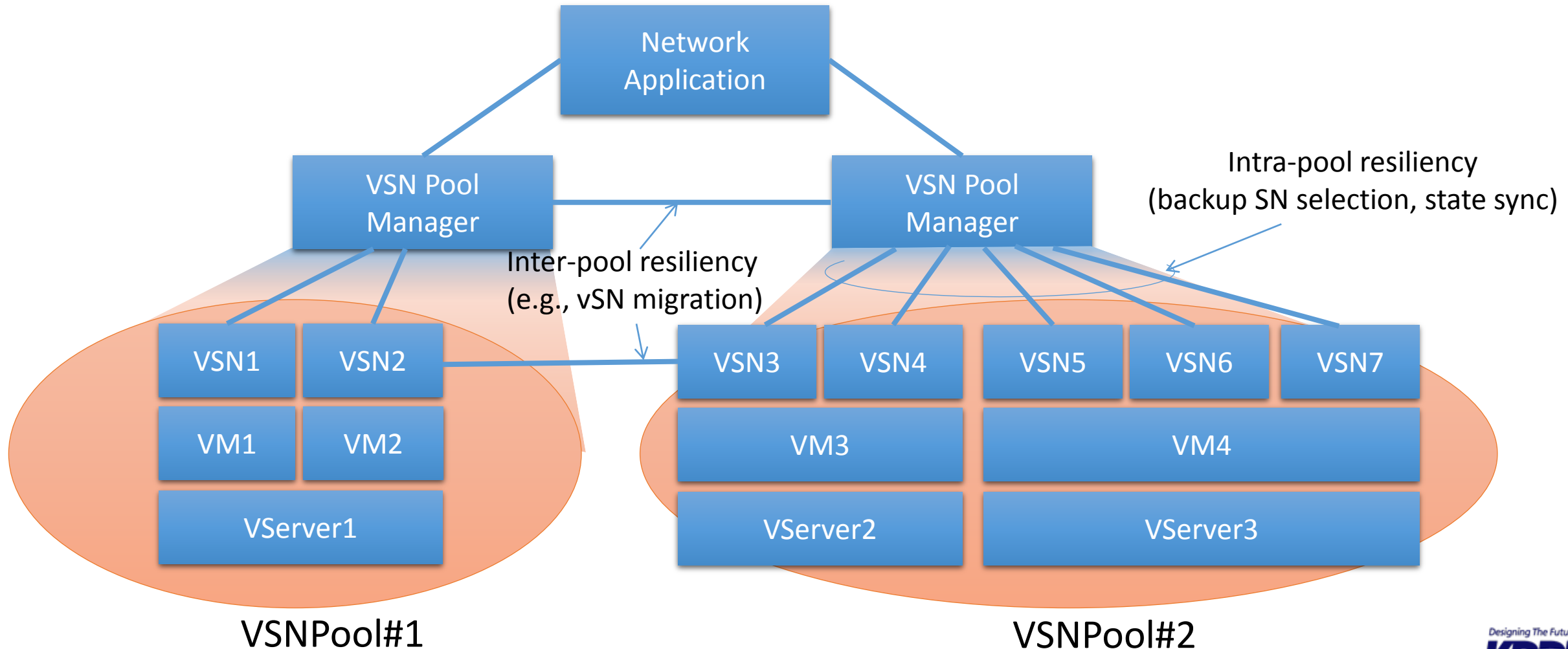


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- Introduction to VNF Pool Use Case Motivation
  - Includes general requirements and application specific scenario's (vEPC, vCDN, et al.)
- Hardware resilience does not scale for hosted functions on VNFs
  - Commodity hardware that supports resilience typically 2x more expensive
- Software resilience mechanisms and resource pooling mechanisms are required
- VNF Pool Resilience, includes:
  - **Reliable Virtual Network Functions (VNFs)**: critical to ensure that network functions are reliable and can recovery from a variety of failures.
  - **Ensure Service Continuity**: in the event failure support for seamless failover, when required, negate or minimize impact on end-to-end user services.
- General VNF Pool Function Components discussed in I-Ds
  - Virtual Network Function (VNF) Pool: a group of VNF instances providing same network function.
  - Virtual Service Node Pool (VSNP): # of virtualized servers supporting a variety of network functions.
  - Virtualized Service Node (VSN): a virtualized network function instance implemented in software on Virtualized Server.
  - Virtualized Server (VServer): a virtualized server runs a hypervisor supporting one or more Virtual Machine.

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- Generalized Architecture Diagram



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We define key requirements for the VNF Pool architecture, based on generic use cases, including:

- VNF Resilience Classes
  - Application-based, priority, etc.
- VNF Resource Monitoring
  - Capacity (memory and CPU) limitations per instance to avoid overbooking, and failure of end-to-end services
- Automatic Detection of Application Failure, or Performance Degradation
  - Proactive health checking should also be supported
  - Isolation and reporting of failures
- Failover to another VServer or VSNP
  - Storage and transfer of state information within the VSN
  - Replication of state for active/standby network functions
- Resilience of VSN Network Connectivity
  - Automatic detection of link failure
  - Failover to another usable link
  - Automated routing recovery

# draft-king-vnfpool-mobile-use-case-00

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**NEC**

# VNF Pool in the view of mobile communication

## Preliminaries

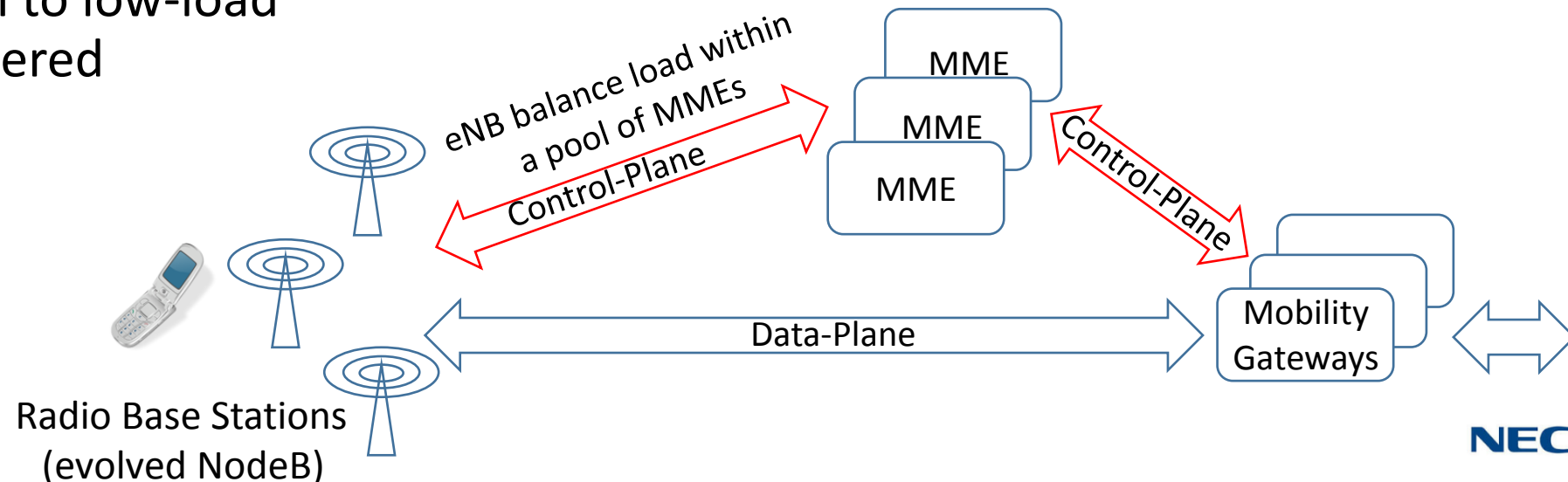
- Mobile communication
  - Evolution in terms of network usage
    - Increasing number of user equipment and devices' capability (data rate, processing power)
    - Increasing traffic volume (Data-Plane, Control-Plane)
  - High subscriber expectation on agreed service levels
    - Availability of resources (bandwidth, network functions)
  - Mandates thorough resources planning
    - Includes assessment of number of subscribers, active/idle ratio
- Major operator pain points: Unexpected traffic peaks & failure
  - Foreseen increase in traffic volume: Increasing number of devices/subscribers, scheduled events, ..
  - Unforeseen increase in traffic volume: Disaster events
  - Failure: small-scale (function, hardware), large scale (network, datacentre, geographic region)



# VNF Pool in the view of mobile communication

## The Evolved Packet Core (EPC) – Handling of Load and Failures

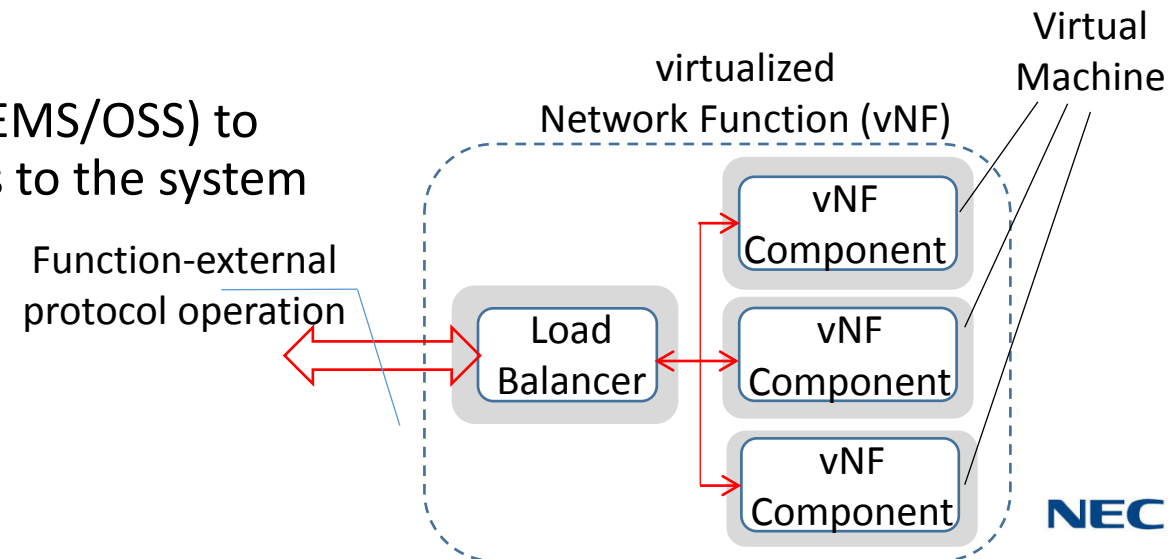
- Control Plane considers load balancing between logical network functions
  - Radio Base Stations select Mobility Management Entity (MME) from MME Pool based on load
- Proven vendor-specific solutions for redundancy management and failover handling within logical network function
- Adaptation to more load through planning and system dimensioning
- Dynamic adaptation to low-load situation not considered



# Virtualization of the Evolved Packet Core (vEPC)

## Scaling the virtualized EPC – Some requirements

- Gain advantage from virtualization: Function Scaling
  - Instantiate additional **functions** and **function components** on demand
- Requires compatibility and transparency to the 3GPP Evolved Packet System
  - Identification of instantiated virtualized Network Functions
  - Announcement to the evolved Packet System
  - Load Balancing between vNFs and vNFCs
- Automation of scaling and simplified OAM
  - Inter-working with configuration management (EMS/OSS) to configure and announce new Network Functions to the system
- Scale-in support (adaptation to less load)



# Virtualization of the Evolved Packet Core (vEPC)

## Failover Handling – Some Requirements

- Support function-specific redundancy and failover management
- Support different kinds of redundancy for failover
  - state synchronization between vNFCs
  - state recovery at backup vNFC
  - state re-establishment at backup vNFC)
- Minimize state synchronization- and failover latency
- Detection of failure type and level (e.g. vNFC, hypervisor, hardware, network)
- Enforcement of failover strategy according to failure type
- Automated detection and failure handling

# Virtualization of the Evolved Packet Core (vEPC)

## Some VNF Pool considerations

- Complex system and problem space – where to position a generalized VNF Pool solution
  - Inter-working with vendor-specific solutions
- VNF Pool and Pool Elements (PE) – where to position vNFC instances of a single vNF
- VNF Pool Manager's role in load balancing in a macroscopic and microscopic view

# VNF Load Balancing

Andy Reid, BT

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# Load Balancing between VNFs

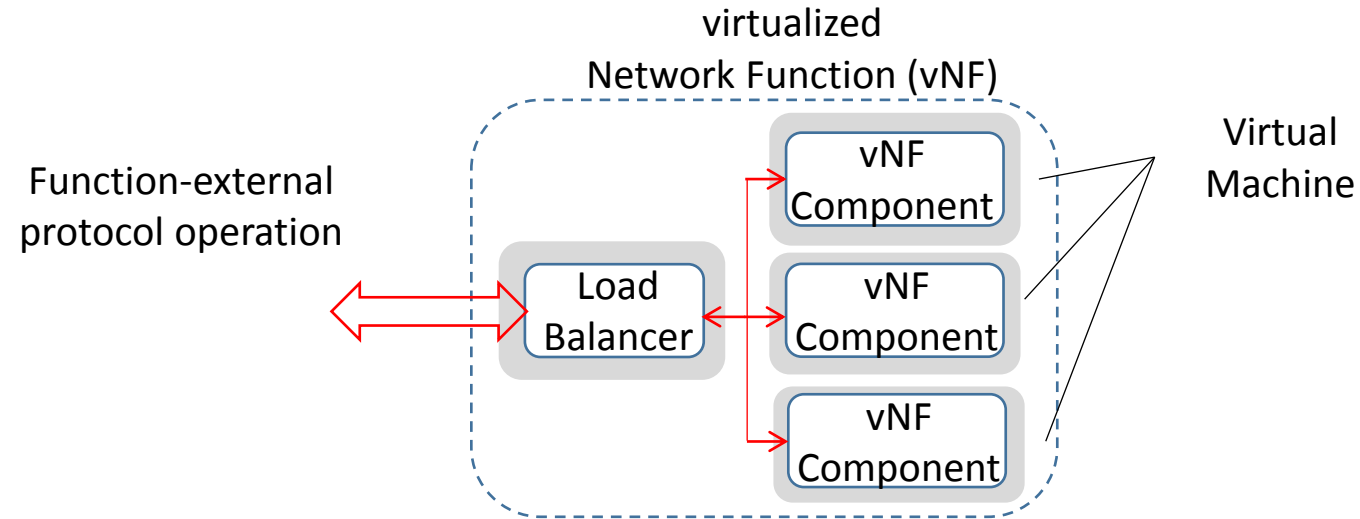
- Load balancing will be required for a variety of VNF-based applications based on load:
  - Edge: Firewall, DPI
  - CDN: Surrogate servers (mirrored web content servers)
  - EPC: Radio Base Stations select Mobility Management Entity (MME) from MME Pool based on load

# How do we scale?

***This is default solution***

***Issue:***

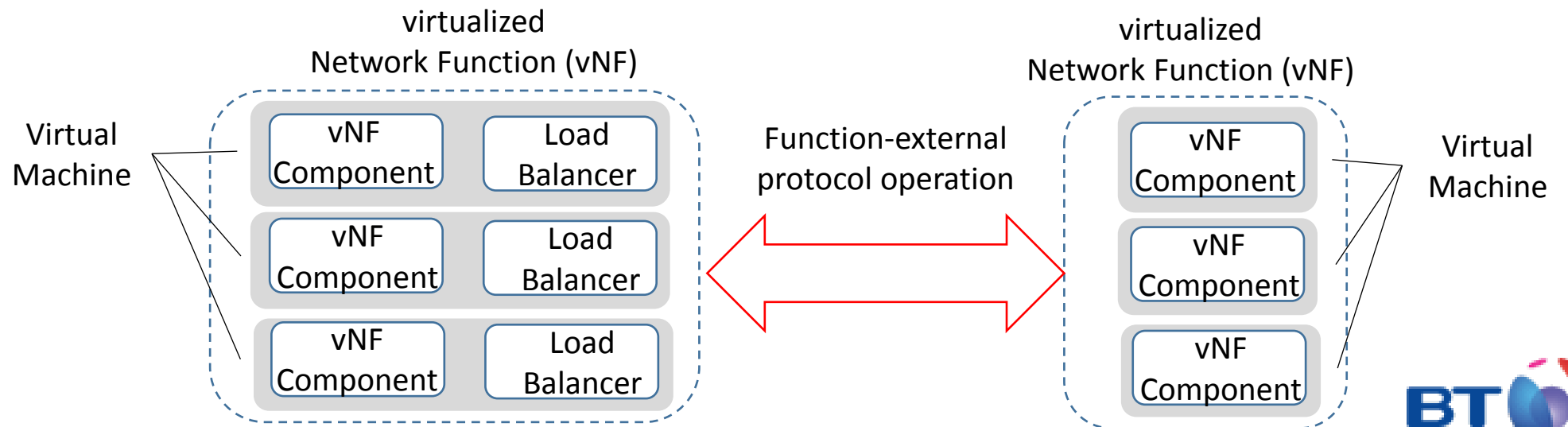
***The load balancer  
may be a non-  
scalable bottleneck***



***This is a scalable  
solution***

***Issue:***

***existing  
functional block  
specification may  
not directly  
support this***



# Virtualization of Content Distribution Network

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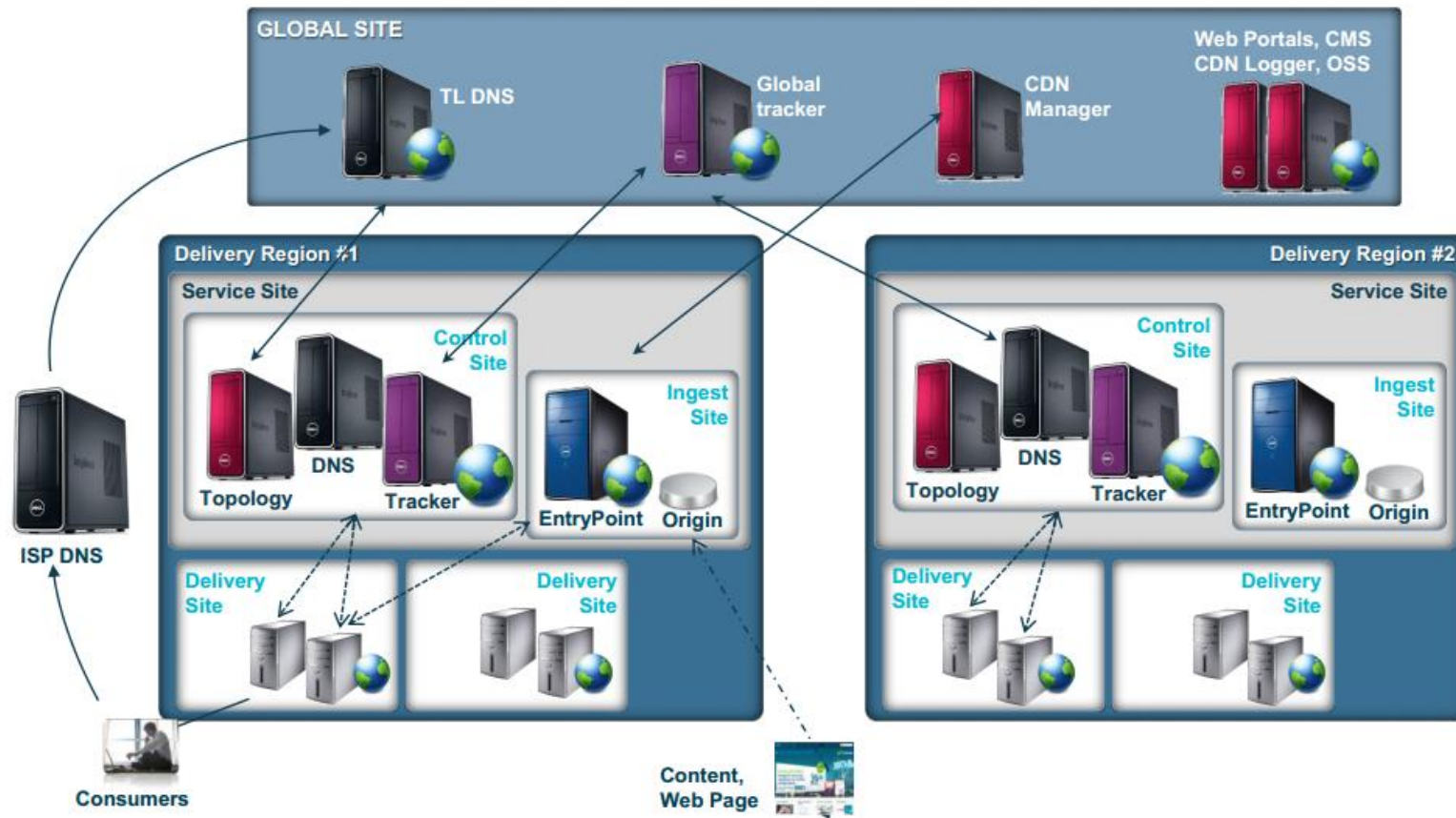
# Virtualization of Content Distribution Network

- Delivery of content, especially of video, is one of the major challenges of all operator networks due to massive growing amount of traffic.
  - Growth of video traffic is driven by the shift from broadcast media to unicast delivery via IP.
- Complementary to the growth of today's Video Traffic
  - On-demand Content Services to internet end-users, with similar quality constraints as for traditional TV Service of Network Operators
- Operators to deploy their proprietary cache nodes into the ISP network.
  - CDN cache nodes are dedicated physical appliances or software with specific requirements on standard but dedicated hardware.
- CDN controller objective is to select a cache node (or a pool of cache nodes) for answering to the end-user request, and then redirect the end-user to the selected Cache Node.
  - The Cache Node shall answer to the end-user request and deliver the requested content to the end user.
  - The CDN controller is a centralized component, and CDN cache nodes are distributed within the Network and in N-PoPs.

# Virtualization of Content Distribution Network

- Functional Components
  - Content Distribution Management
    - Deploy content as close to each user as possible.
  - Content Routing
    - Route the users request for content to the closest available content store or content engine.
  - Content Switching & Load Balancing
    - Distribute user requests across one or multiple servers.
  - Surrogate servers
    - Mirrored web content servers
  - Content Proxies
    - Master proxy
    - Cache proxy
  - Content DNS servers
  - GeoIP information servers
  - Content Peering Gateways

# Virtualization of Content Distribution Network



# Virtualization of Content Distribution Network

- Investigation of problems & requirements include:
- Performance predictability
  - Performance: Mean Response Time, Latency, Hit Ratio Percentage, Number of Completed Requests, Rejection rate and Mean CDN load.
  - Dimensioning: remaining stable whatever the use of virtualized HW resources for CDN components
  - Resource management: allow the right balance of network i/o to CPU power to storage i/o performance (e.g., RAM and HDD).
- Flexibility of resources (storage)
  - Fulfil specific storage density requirements, e.g. to cache a large catalog of popular content.
- Deployment & Operational tools
  - Compliance of cache nodes with main monitoring and reporting requirements (e.g., SNMP, syslog, etc.) so that operator is able to manage different types of cache nodes together for a Delivery Service.
- Content Management
  - Ability to select specific cached content (e.g., video/HTTP) and replicate/duplicate these selected content items during delivery via virtual switching to a Quality of Experience (QoE) virtualized function without degrading the overall performance of the virtualized CDN function

# draft-hares-vnf-pool-use-case-01

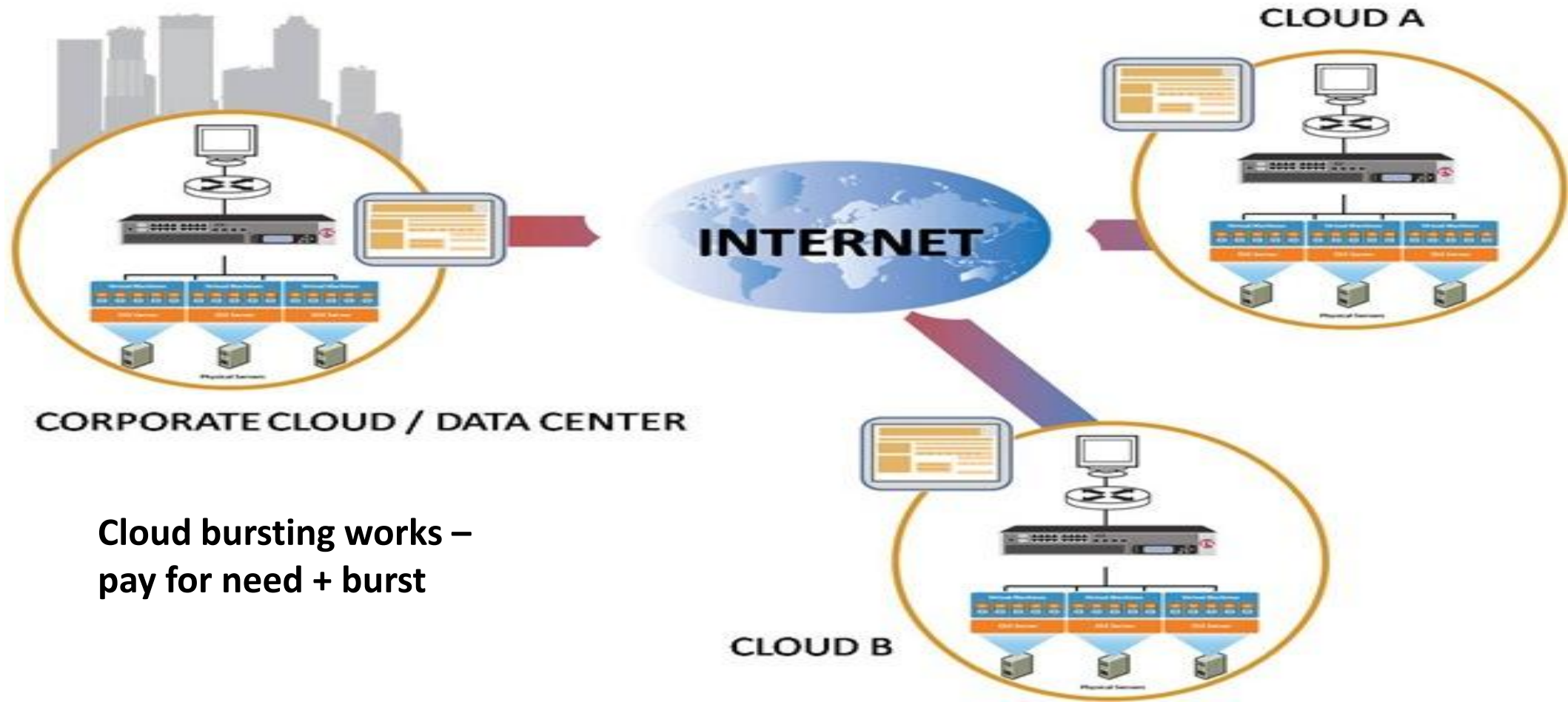
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# Use cases in draft-hares-vnf-pool-cases-01

- Cloud Bursting
- Stateful parental controls
- Load Balancer
- WAN optimization
  - Access nodes and Data Centers
  - Mobile phones to/from Data Centers
- Application placement
  - Using optimized DNS and DHCP
  - Using minimal data transfer

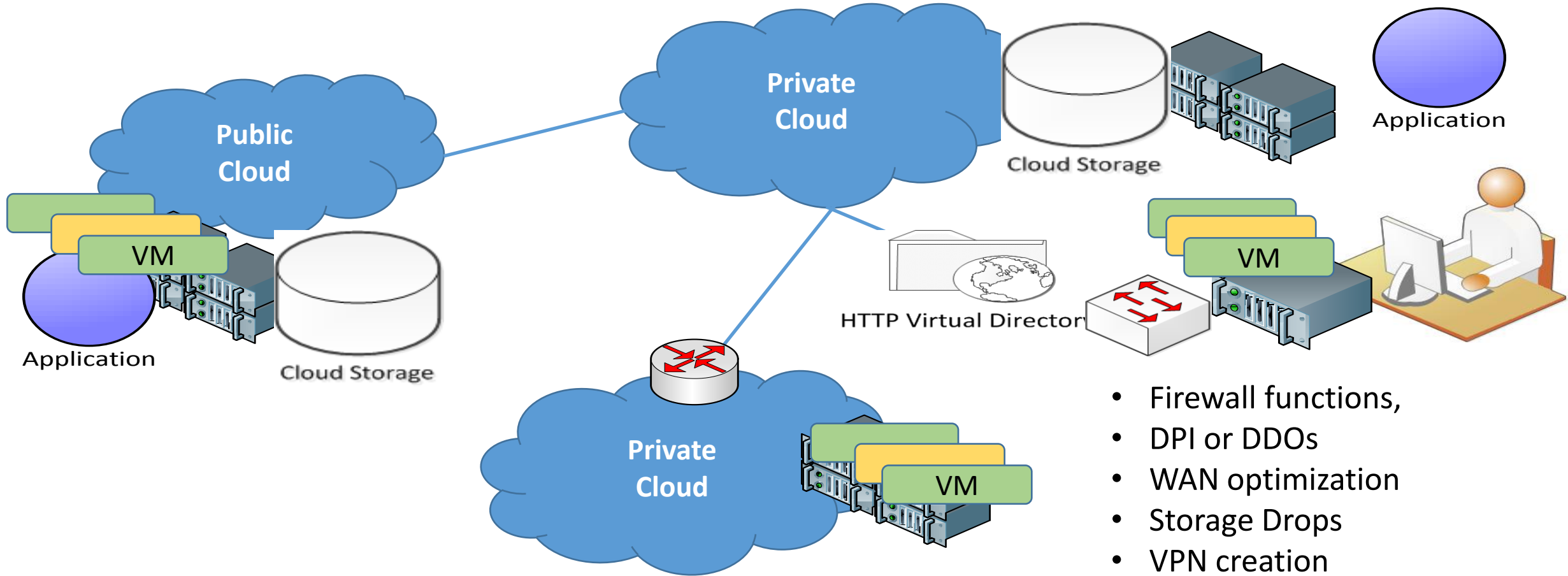
**This slide set provides one example case, please see draft for additional details**

# Cloud bursting



**Cloud bursting works –  
pay for need + burst**

# Virtualizing Networks Takes Pools



## Software Solution Augments Hardware

- Pools of VMs
- Support WAN optimization DPI, DOS, access nod, http virtualization (DNS) or DCHP/VPNs

- Firewall functions,
- DPI or DDOs
- WAN optimization
- Storage Drops
- VPN creation
- DHCP/DNS
- Private/Public cloud movement



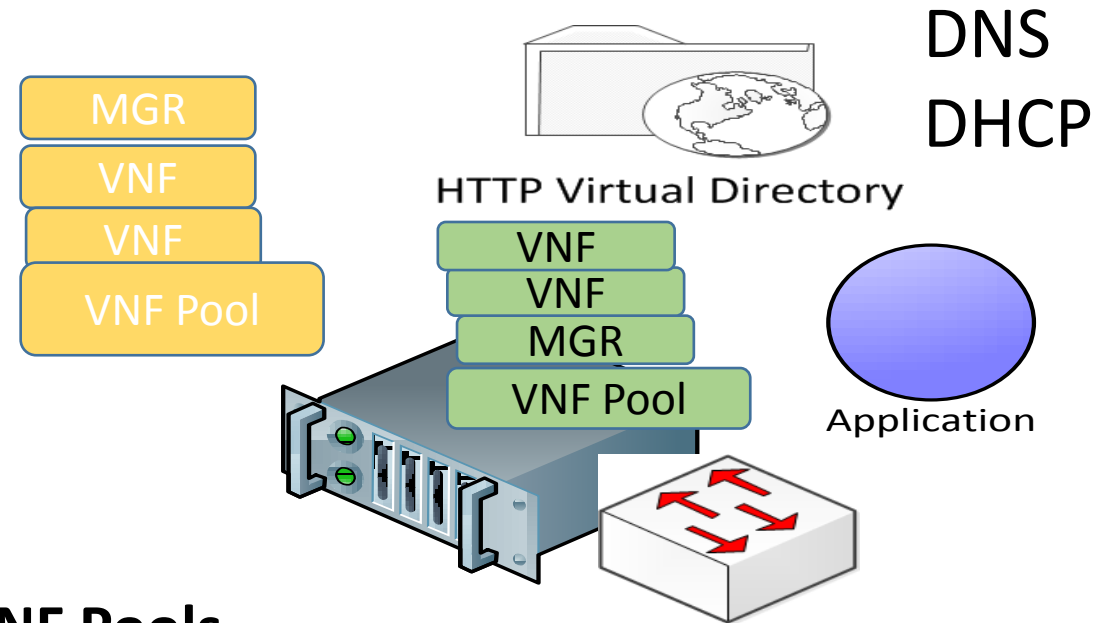
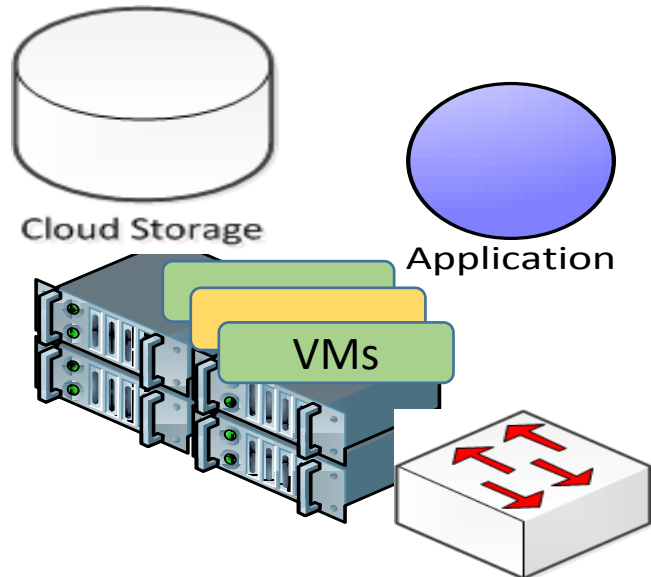
# VNF sets of VNF Pools

## Existing VM Interfaces

- Libvirt – VM manager probes
- REST, JASON

## Interfaces to Routing or Transport

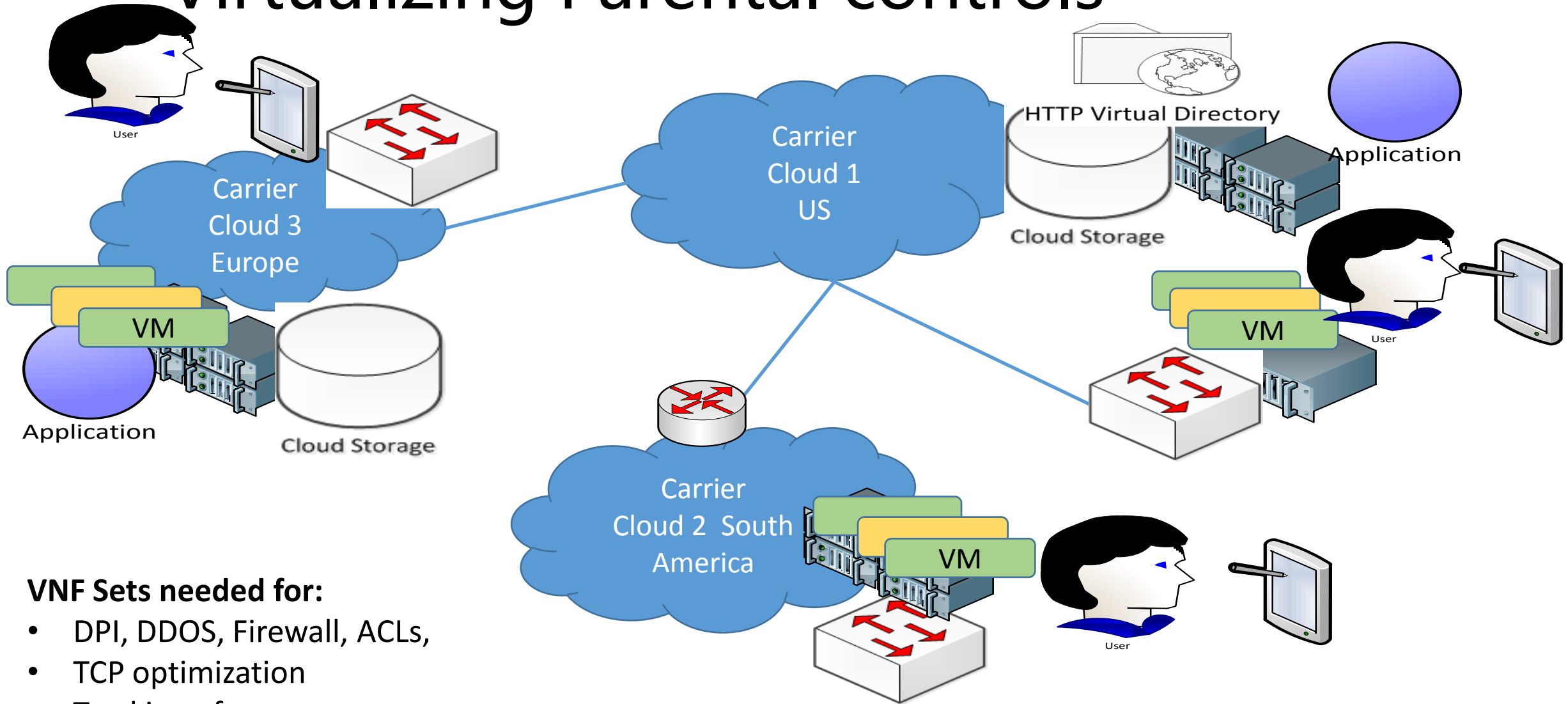
- CLI, NETCONF, I2RS



## VNF sets of VNF Pools

- Reliability and scaling out to more parallel processes rather than depth not needed at all times.
- Carrier grade reliability means multi-vendor interoperable scale-out of VNFs
- VNF may optimize to create best network function (Firewall, WAN Optimization)

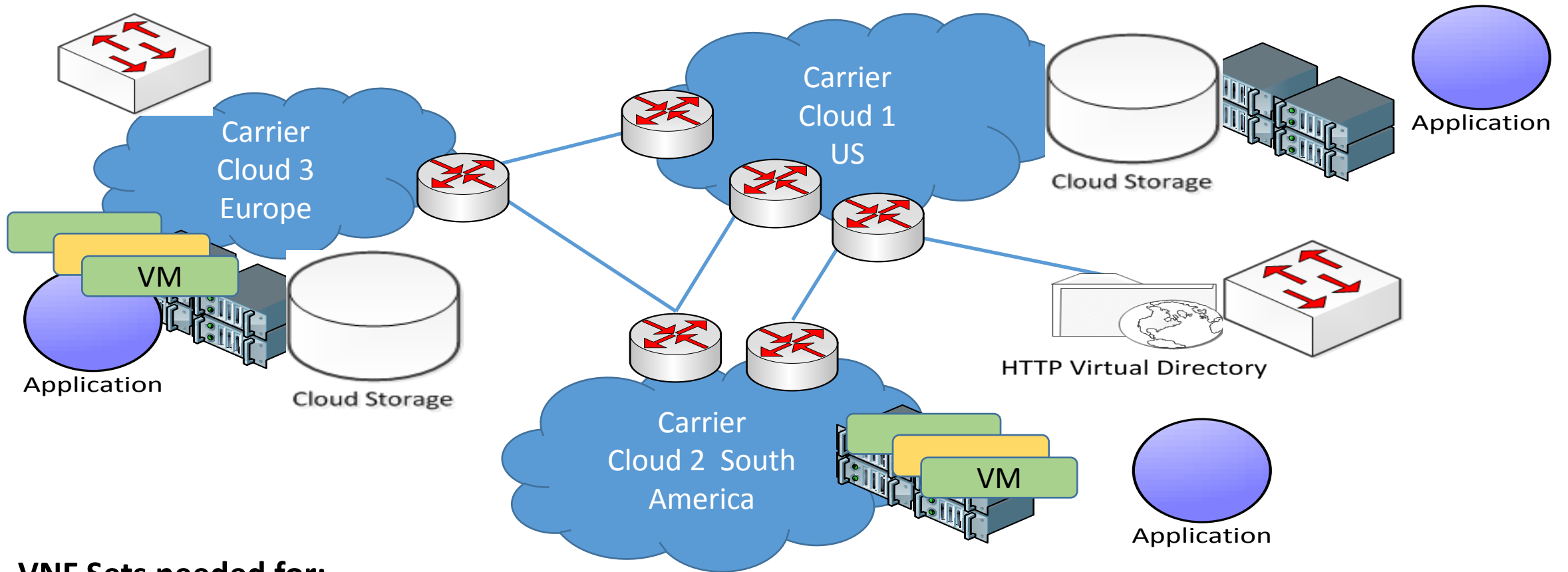
# Virtualizing Parental controls



## VNF Sets needed for:

- DPI, DDOS, Firewall, ACLs,
- TCP optimization
- Tracking of access
- Switching/routing of packets, WAN optimized
- User or role Base usage for mobile application

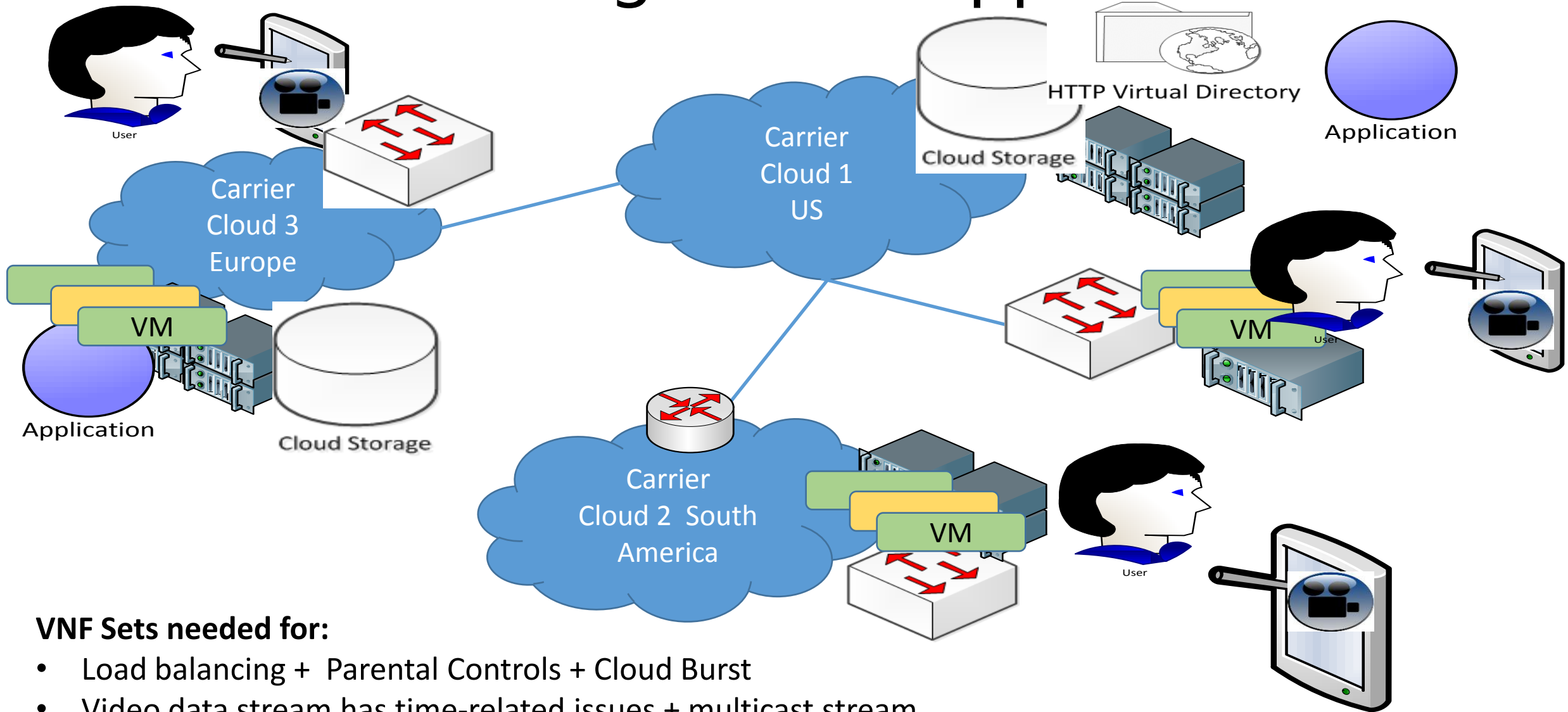
# Load Balancing L1-L7



## VNF Sets needed for:

- Load Balancing at Switch, Routing, Application at L1-L7
- Tracking of different storage/access needs
- Switching/routing of packets, WAN optimized
- User or role Base usage for mobile application

# Load balancing Mobile Applications



## VNF Sets needed for:

- Load balancing + Parental Controls + Cloud Burst
- Video data stream has time-related issues + multicast stream
- De-duplicate streams of web service or video
- Wifi vs LTE with SOHO and office optimization

# Questions?



Operators actively investigating and deploying Virtual Network Function (VNF) based services.

# VNF Pool Use Cases – Next Steps

- Continue to define VNF Pool technical requirements via use cases.
- What is required, nice to have, or out of scope (currently)?
  - We know many requirements still need to be defined for specific use cases. For instance:
    - Control and orchestration of reliable VNFs, is automation also required?
    - What does security look like for reliable VNFs?
  - We can look to polish I-Ds to ensure we do not “boil the ocean”. For instance:
    - Auto Scale of Virtual Network Function Instances?
    - Reliable Traffic Steering of Network Function Chains?
- Consolidation and summarisation of use case requirements.
  - New VNF Pool Requirements I-D, when needed.