

The Case for Enterprise Ready Virtual Private Clouds

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Cloud Computing

Rent computation and storage resources on demand

- Accessed by multiple enterprise sites

Cloud Platform types:

- Software as a Service
 - Hotmail, Google Docs
- Platform as a Service
 - Google App Engine, Microsoft Azure

- **Infrastructure as a Service**
 - Amazon EC2, VMware vCloud



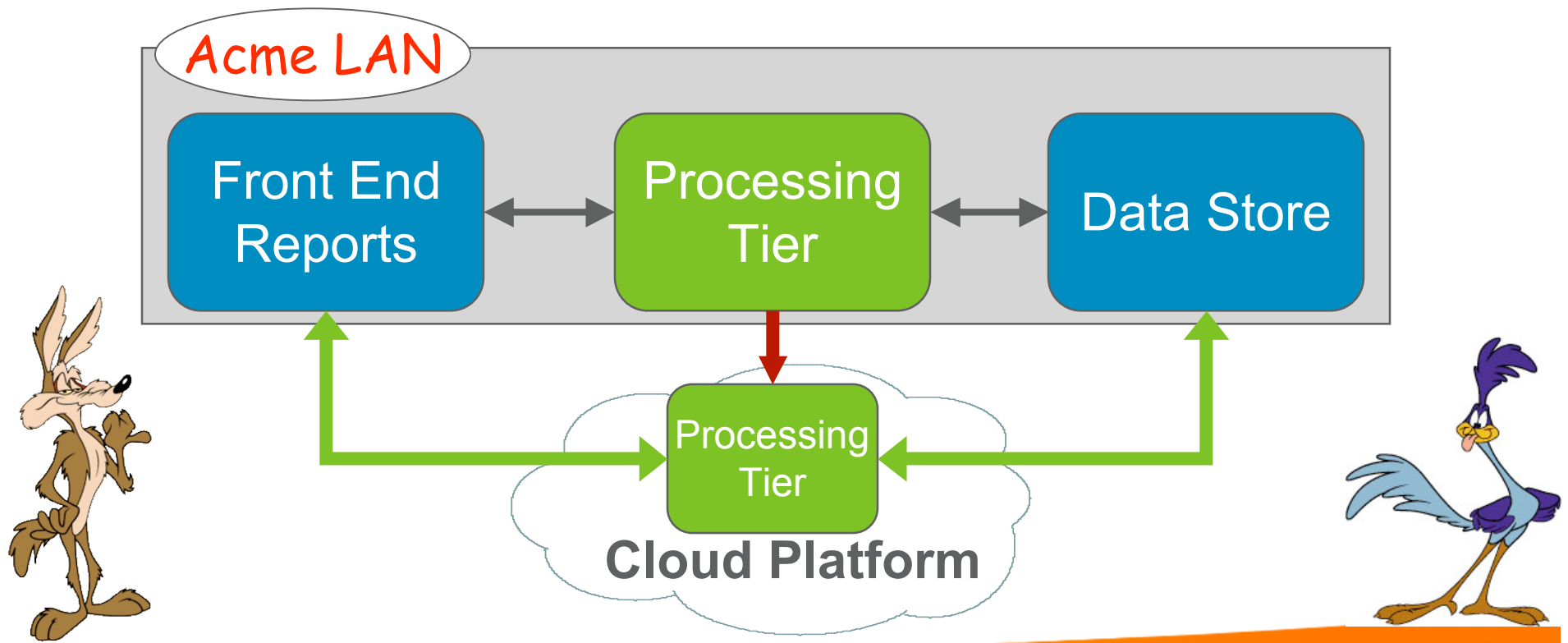
Enterprise Cloud Challenges

Existing platforms do not meet the needs of enterprise customers

- **Insufficient security controls**
 - Need isolation at server and network level
- **Deployment is difficult**
 - Cloud resources are completely separate from local ones
 - Can't make VMs look like part of existing LAN
- **Limited control over network resources**
 - Cannot specify network topology or IP addresses
 - Cannot reserve bandwidth or request QoS guarantees for network links

Moving to the Cloud

Acme wants to move part of its payroll app into the cloud
Should be easy, right...?



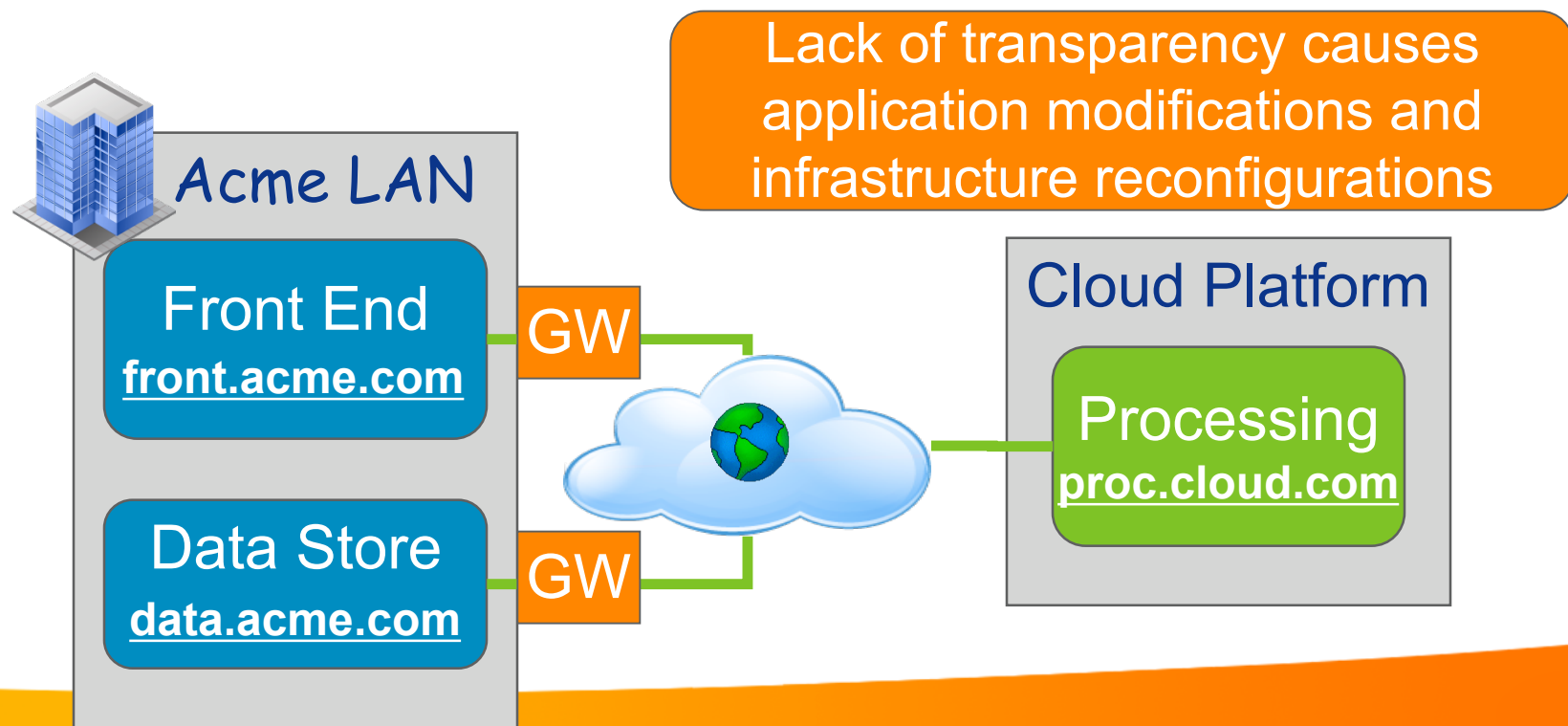
Problem #1: Transparency

Application may have been written for LAN environment

- Might utilize broadcast or LAN service discovery

Must add Internet gateways for apps previously only on LAN

Now must communicate via public IPs or configure DNS



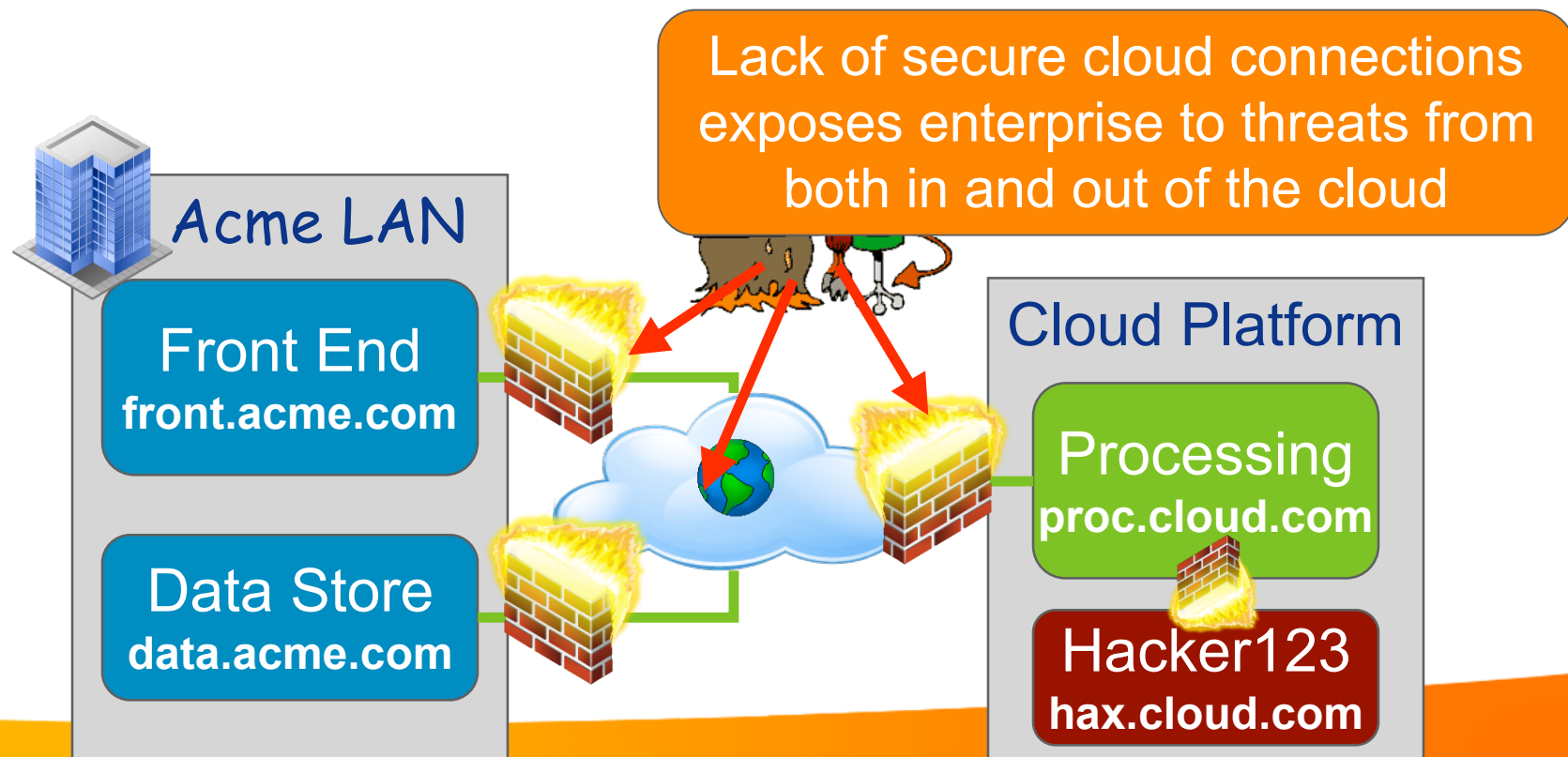
Problem #2: Security

Acme's servers are now accessible from the public internet!

- Servers formerly on secure LAN now exposed to malicious users

Must configure firewall rules to limit access

- Fine grain rules are difficult to manage in dynamic environments

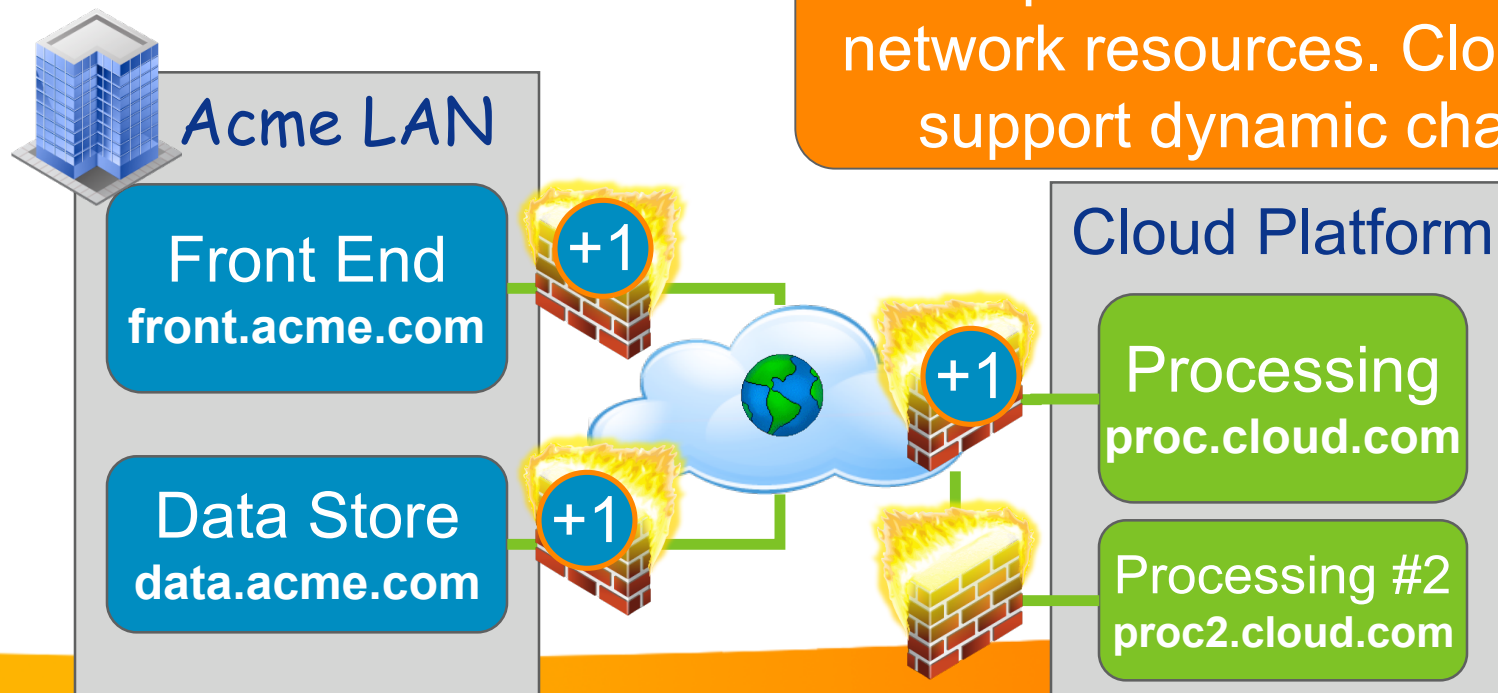


Problem #3: Flexible Resource Mgmt

Benefit of cloud computing: ability to easily adjust resource capacities and add new VMs

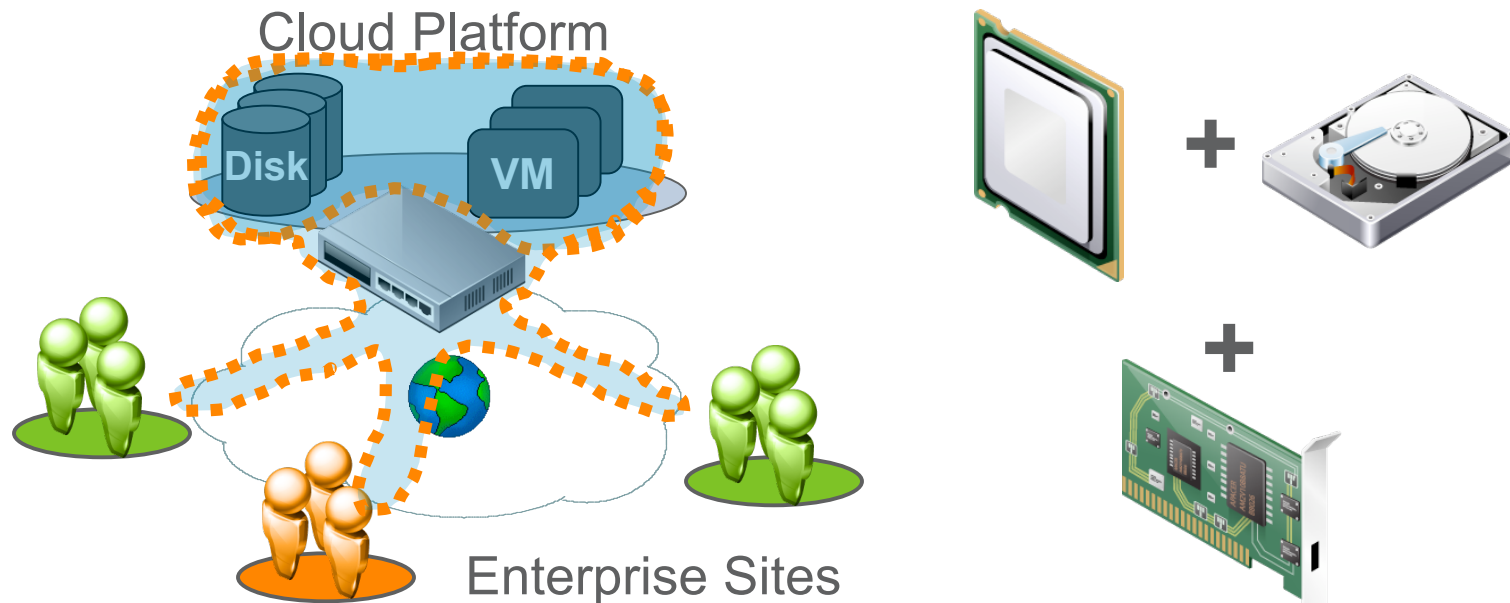
- After a change must deal with transparency and security issues all over again!
- Current platforms do not support network resource reservation (Bandwidth/QoS guarantees)

Enterprises want control over network resources. Cloud must support dynamic changes



Key Observation

Existing cloud platforms only cover storage and computation

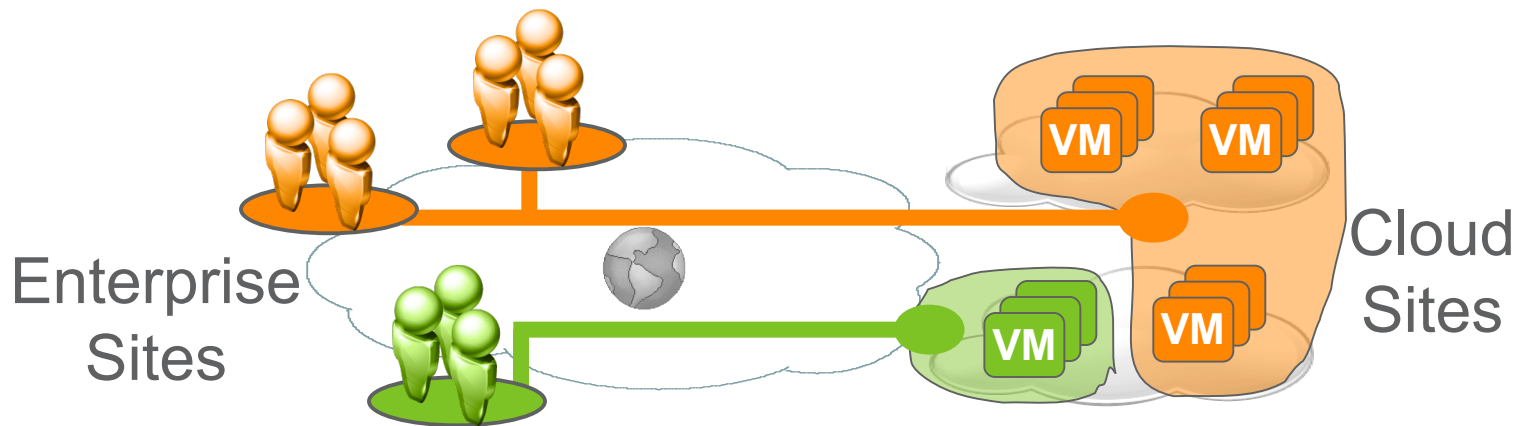


Enterprise Clouds need control over the network as well

Virtual Private Clouds

A Virtual Private Cloud is...

- A *secure* collection of server, storage, and network resources spanning one or more cloud data centers
- That is *seamlessly* connected to one or more enterprise sites



Virtual Private Networks (VPNs)

- Layer 2 and 3 MPLS based VPNs
- Created by network provider with no end host configuration
- Already used by many businesses!




VPC Benefits

For the customer:

- Isolates network & compute resources
 - Cloud resources are only accessible through VPN
- Simplifies deployment since cloud looks same as local resources

For the service provider:

- Provides mechanism for control over resource reservation within provider network
 - Simplifies management of multiple data centers by combining them into large resource pools
- 

VPC Challenges & Solutions

Existing cloud platforms do not integrate with network service providers

- Must coordinate with ISP to create VPN endpoints
- VPN endpoints must be linked to VLANs within the cloud data center

VPN endpoints are traditionally static

- Utilize virtual routers with programmable interfaces to rapidly create and reconfigure routers
- Use BGP signaling to dynamically adjust VPN topology

CloudNet

Cloud Manager

- Allocates computation and storage resources
- Manages VLAN assignment within cloud network

Network Manager

- Creates and configure VPN endpoints
- Reserves network resources

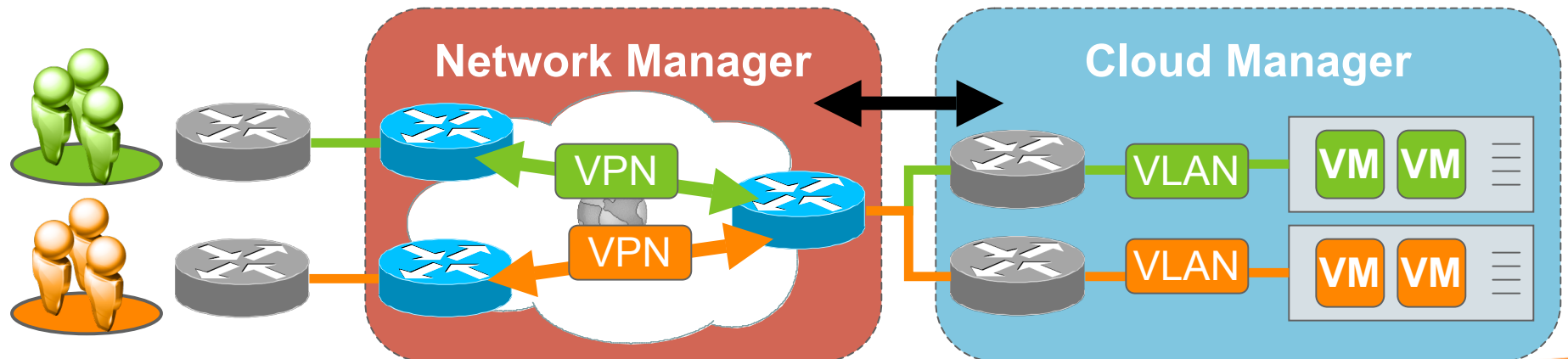
Routers



Customer Edge



Provider Edge



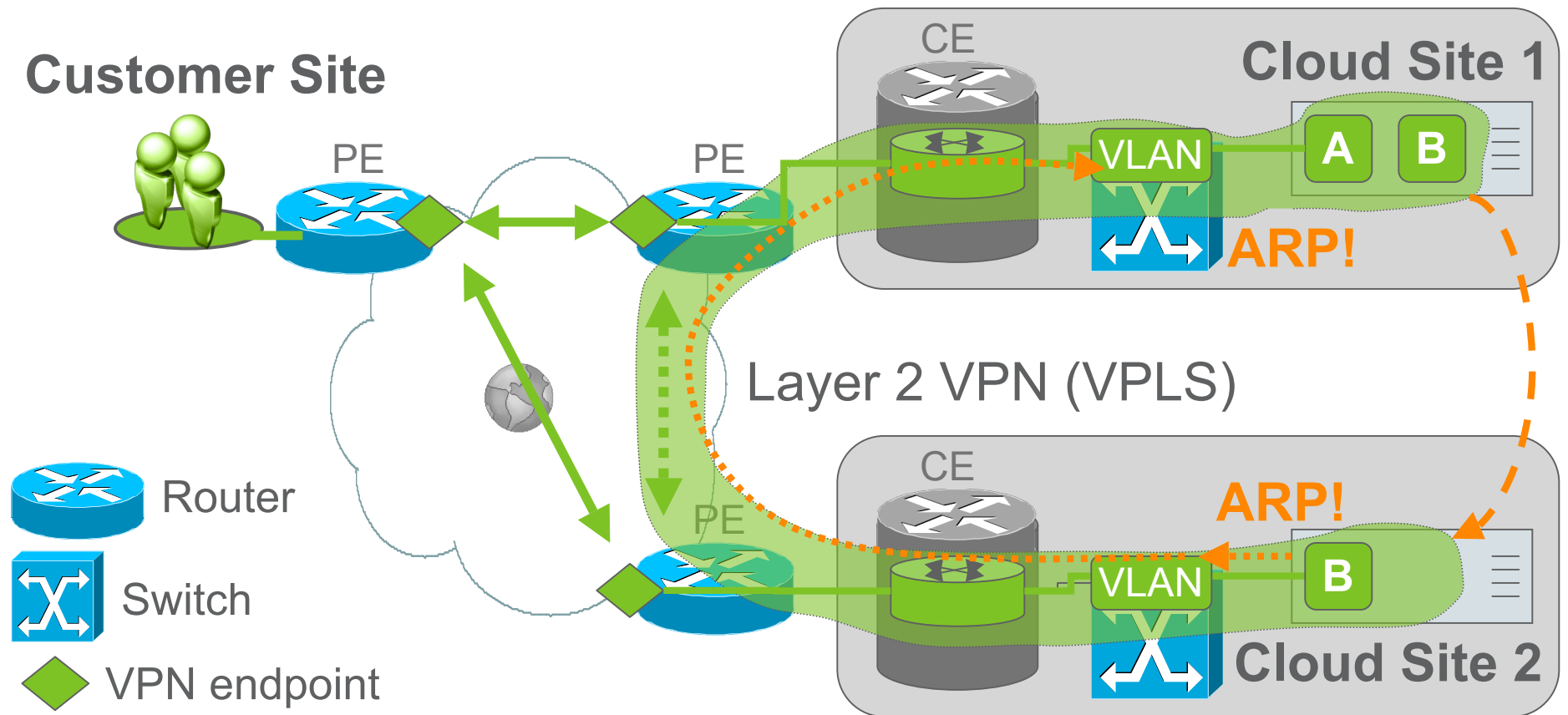
WAN Migration

Layer 2 VPNs make WAN act like a LAN

Can use existing LAN migration techniques to move across WAN

WAN Migration

Layer 2 VPNs make WAN act like a LAN



Can use existing LAN migration techniques to move across WAN

Summary

Cloud Computing for enterprises requires:

- Security
- Transparency
- Flexibility

CloudNet can help provide these features

- Defines interface between cloud platform and network provider
- Uses VPNs for secure, seamless connections
- Employs virtualization at server, router, and network levels to improve agility and efficiency

Future Work

- Network optimizations to reduce latency of WAN migration
- Utilize VPLS to simplify deployment of high availability services across WAN

Questions?

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Extra slides



WAN Migration

LAN migration already supported by Xen, VMware, etc

- Transparently move a VM between two hosts
- Useful for load balancing, maintenance, etc
- Only works on LAN because of need for network reconfiguration

Layer 2 VPNs make WAN act like a LAN

- Lets VPN endpoints across WAN act as a single LAN segment
- Allows for WAN migration without modifying VM platform!

Storage migration still must be handled by other means