

# RSTP to MST Spanning Tree Migration in a Live Datacenter

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# Introductions

# What Is This Talk About?

- We found ourselves in the situation where we had to migrate from per-VLAN RSTP to MST due to high resource utilization at the network core
- Primary challenge: migrate with minimal impact to a live production network
- Secondary challenge: define best-practices for MST deployment that will yield maximal stability and future flexibility
- We had minimal reference material or previous experience (previous failures)

# What Isn't This Talk About?

- Not going to focus on the inner-workings of RSTP and MST
  - State machine
  - Topology change notifications
  - CST (common spanning tree)
  - IST (internal spanning tree)
  - CIST (common and internal spanning tree)
- Check vendor docs and whitepapers if you need to know about those, I'm just focusing on real-world migration experience

# Who May Be Interested?

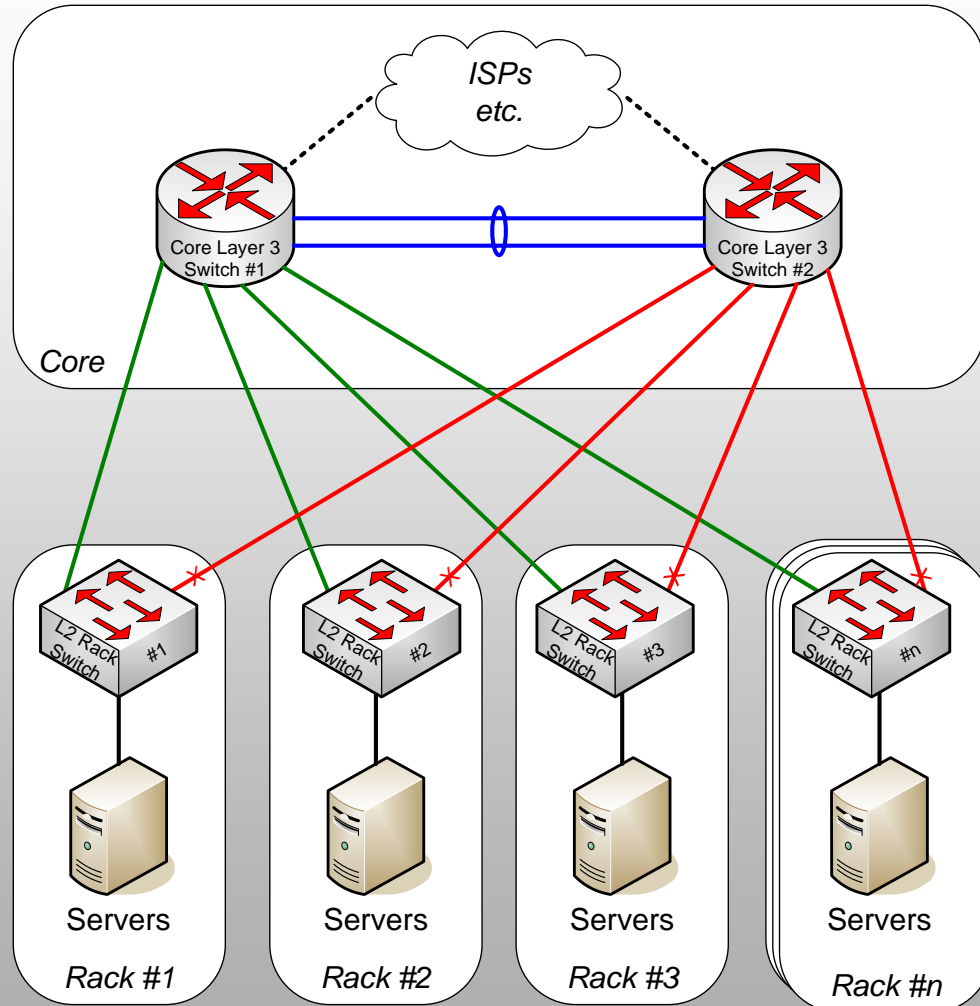
- Networks who run datacenters with a large number of VLANS
- Layer 2 connectivity to top-of-rack switches
- Folks experiencing scaling issues with large number of spanning tree instances
- Some vendor equipment runs in a default STP mode that needs to be adapted as the network grows

# Our Environment

# Network Overview

- Managed hosting facility needing flexibility of any VLAN to any server, in any rack
- Each customer has their own dedicated VLAN and subnet
- Layer 2 switches in racks, uplinks to Layer 3 collapsed core/distribution switches
- Need to have fault-tolerance, no SPoF, and therefore running STP to rack switches
- Supporting over 200 customers in the live datacenter, therefore over 200 live VLANs

# Reference: Sample Network





# Problem Seen

- High number of STP “logical port instances” using Cisco’s default per-VLAN RSTP (a.k.a. “rapid-pvst”) on the cores
- Multiply VLAN \* Interface count = logical port instances
- In short, too many spanning tree instances for the Layer 3 core switch
- Concerns include CPU utilization, memory, other resource exhaustion at the core

# Vendor Support: Per-VLAN STP

- Cisco: per-VLAN is the default configuration, actually can *not* switch to single-instance STP
- Foundry: offers per-VLAN mode to interoperate with Cisco
- Juniper MX and EX: offers VSTP to interoperate with Cisco in newer code versions
- Force10 FTOS and newer SFTOS: Offer PVST+ to interoperate with Cisco

# Looking Back

- Perhaps we're too spoiled with Cisco's default implementation of per-VLAN STP?
- Don't actually need per-VLAN STP, don't want to utilize alternate path during steady-state since we want to guarantee 100% capacity during failure scenario
- Just need Layer 2 redundant path to the rack, one primary link that will fail over to a backup link

# What Were Our Options?

- Simplest solution: collapse from per-VLAN to single-instance STP
- Since we were running a Cisco shop, the only way to reduce STP instances was to migrate to standards-based 802.1s MSTP
- Ironically, called “Multiple Spanning Trees” – however we were looking to collapse number of STP

# MST Solution Design

# MST Explained

- MST allows us to map multiple VLANs into a single instance of MST
- MST = IEEE 802.1s, developed as a standard to allow vendor interoperability for multiple spanning trees
- Typical use for non-Cisco equipment: load sharing by distributing VLANs across different path
- Driver for use on Cisco equipment: reducing the number of STP instances

# Problems with MST

- MST introduces a new configuration complexity: all switches within one “region” must contain identical VLAN-to-MST instance mapping
- This means that any VLAN or MST changes made must be updated universally throughout the datacenter
- Issue with change control: all rack switches must be touched whenever VLAN mappings are updated

# Design Ideas Considered

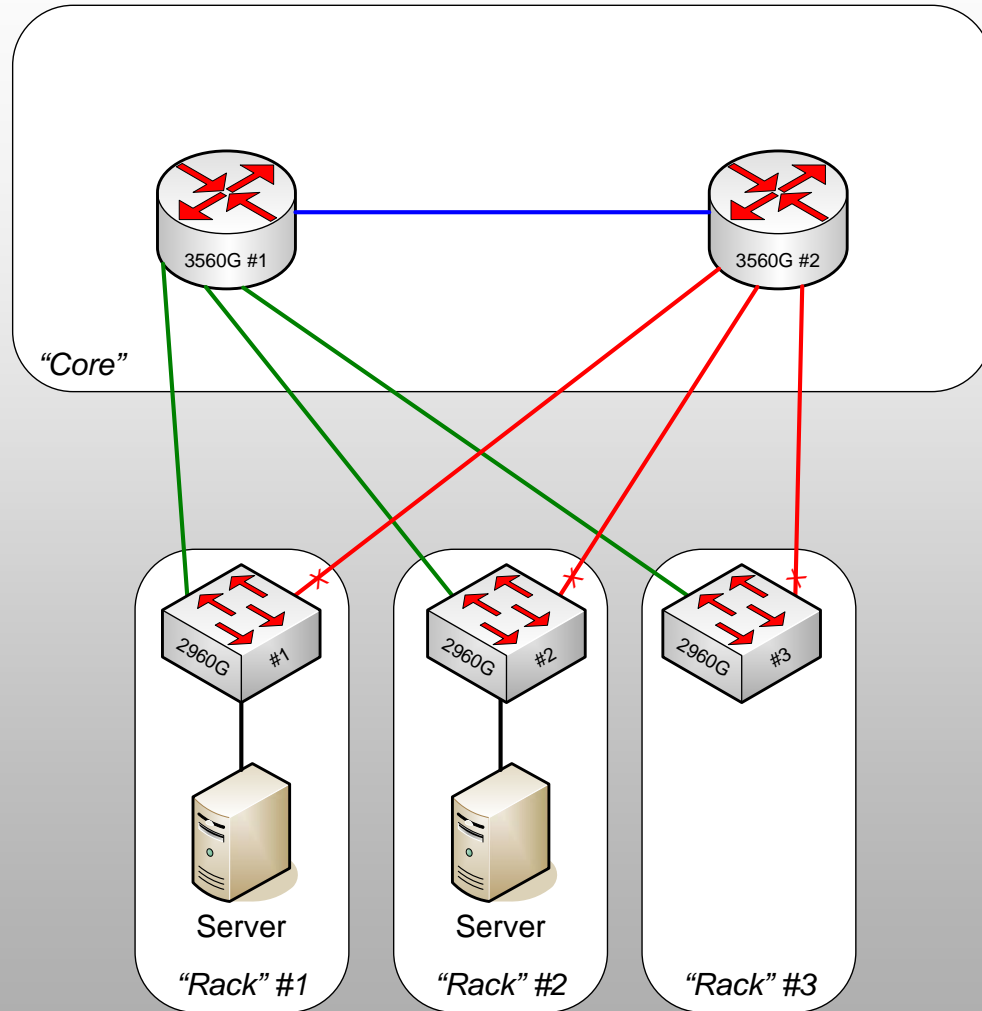
- Should we just go ahead and create a single MST instance that included all VLANs 1 – 4096
- Should we pre-create instances such as:
  - Instance 1: VLANs 1 – 99
  - Instance 100: VLANs 100 – 199
  - Instance 200: VLANs 200 – 299
  - Instance 300: VLANs 300 – 399
- Wait a moment, do all vendor equipment support large MST instance numbering?
- No! Some only support numbers 1 through 16



# Migration Challenges

- Had to migrate production network from per-VLAN RSTP to MST with zero down time if possible
- Used a Lab environment made up of core simulated with two Layer 3 switches and three rack Layer 2 switches
- We could not find a way with zero down time, so we had to find absolute minimal downtime
- We got this down to 45 seconds (one STP blocking → learning → forwarding cycle)

# Lab Network



# Migration Lab Key Notes

- Know your roots – set cores to “highest” STP priority (lowest numeric priority value)
- Set consistent root for all VLANs
- Set priority of rack switches to lower-than-default do ensure they do not become root
- Start from roots, then work your way “down”
- MSTP runs RSTP for backwards compatibility, making migration less painful if you’re already running RSTP (802.1w)
- Choose your VLAN ↔ Instance mapping carefully

# MSTP Gotchas

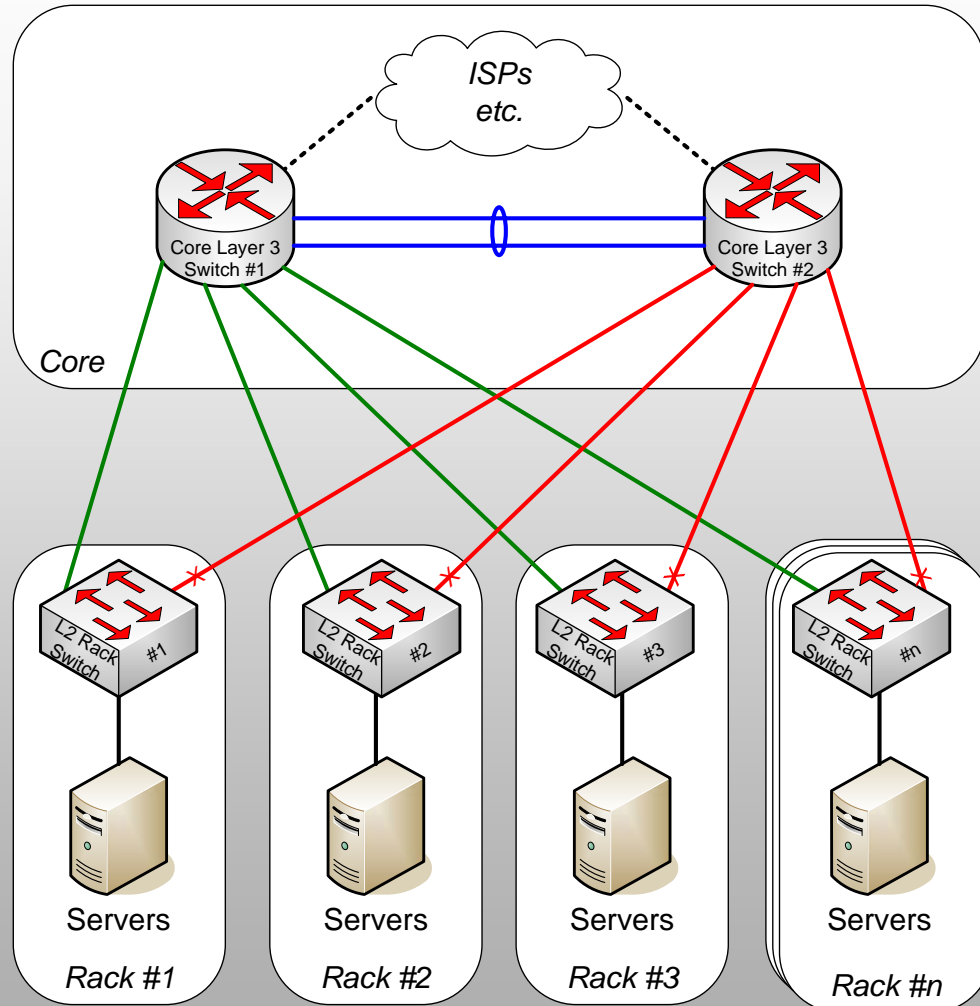
- Instance numbering
  - Some devices support arbitrarily numbered MSTP instances, e.g. 1, 100, 105, 3000
  - Some only support 1 through <maxN>, e.g. 1 through 16, 1 through 32, etc..
- MST config has got to match on all devices
  - Region name
  - Revision number
  - VLAN ⇔ Instance mapping for all VLANs, *even if there are no active ports in that VLAN on a given switch*

# Migration Example: Cisco Equipment

# Starting Point

- All devices running 802.1w (actually per-VLAN RSTP)
- Core 1: root with priority 8192 for all VLANs
- Core 2: secondary root with priority 16384 for all VLANs
- Rack Switches: blocking towards Core 2 with priority 40960 for all VLANs

# Reference: Sample Network



# Migration Walk-Through

- Base MSTP Configuration:

```
spanning-tree mst configuration
name DC1-MST
revision 1
instance 1 vlan 2-49 ! we don't use VLAN 1
instance 2 vlan 50-99
instance 3 vlan 100-199
instance 4 vlan 200-299
instance 5 vlan 300-399
instance 6 vlan 400-499
instance 7 vlan 500-1000
instance 8 vlan 2000 - 3999
```

- Specific to Core 1:

```
spanning-tree mst 0-8 priority 8192 ! don't forget MSTI 0
```

- Specific to Core 2:

```
spanning-tree mst 0-8 priority 16384 ! don't forget MSTI 0
```

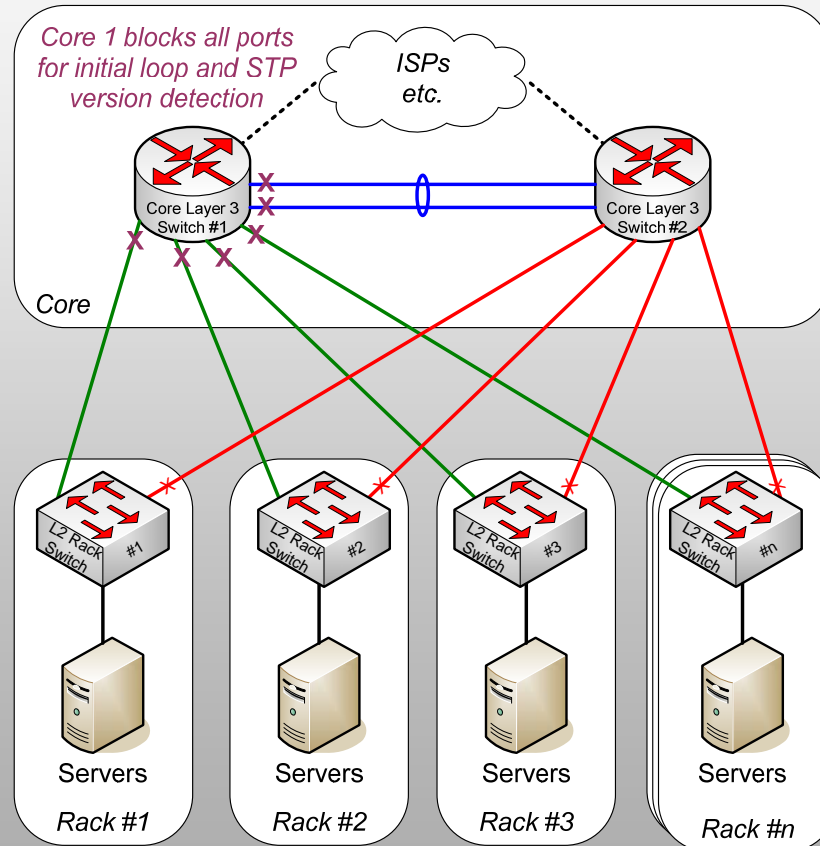
- Rack Switches:

```
spanning-tree mst 0-8 priority 40960 ! don't forget MSTI 0
```



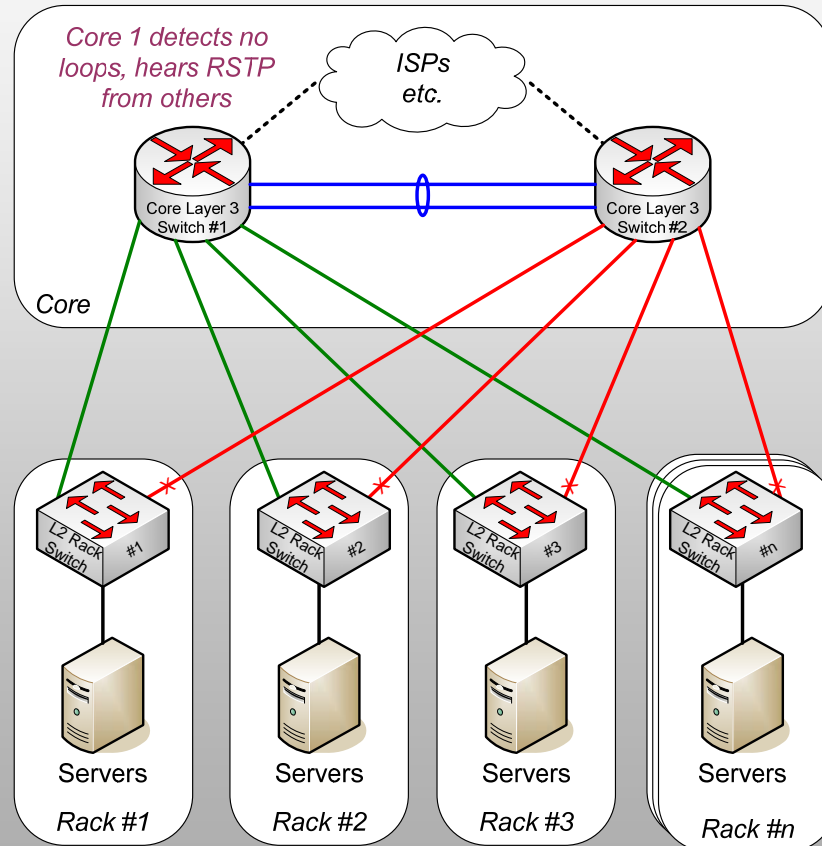
# Migration Step 1: Network Hit

- Core 1: Activate MSTP  
spanning-tree mode mst



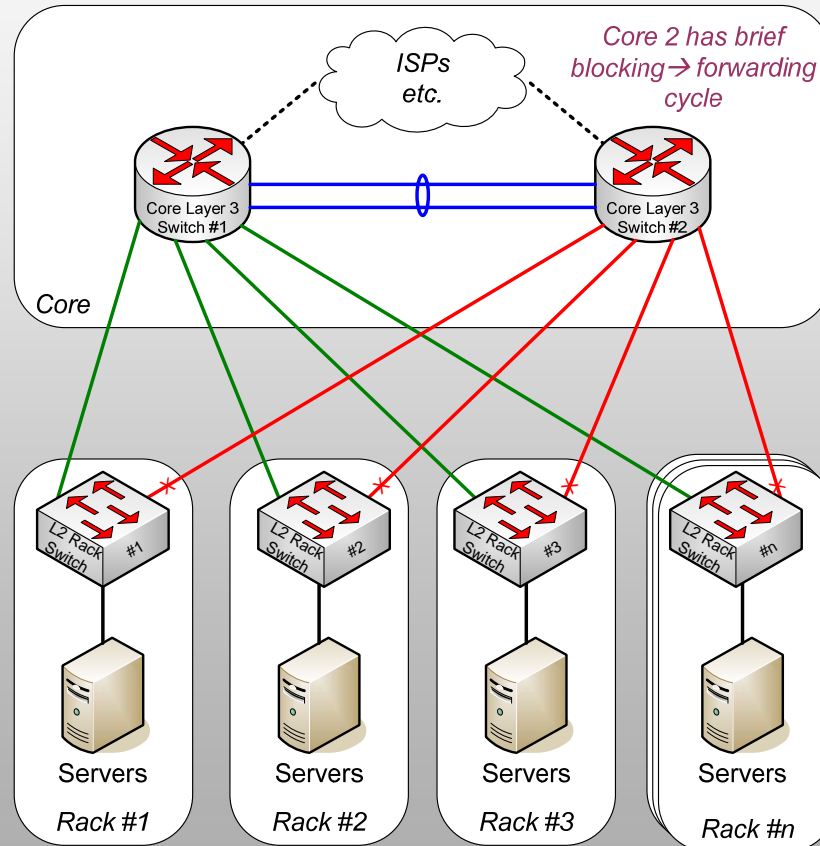
# 45 Sec. Later: Network Restored

- Wait patiently...



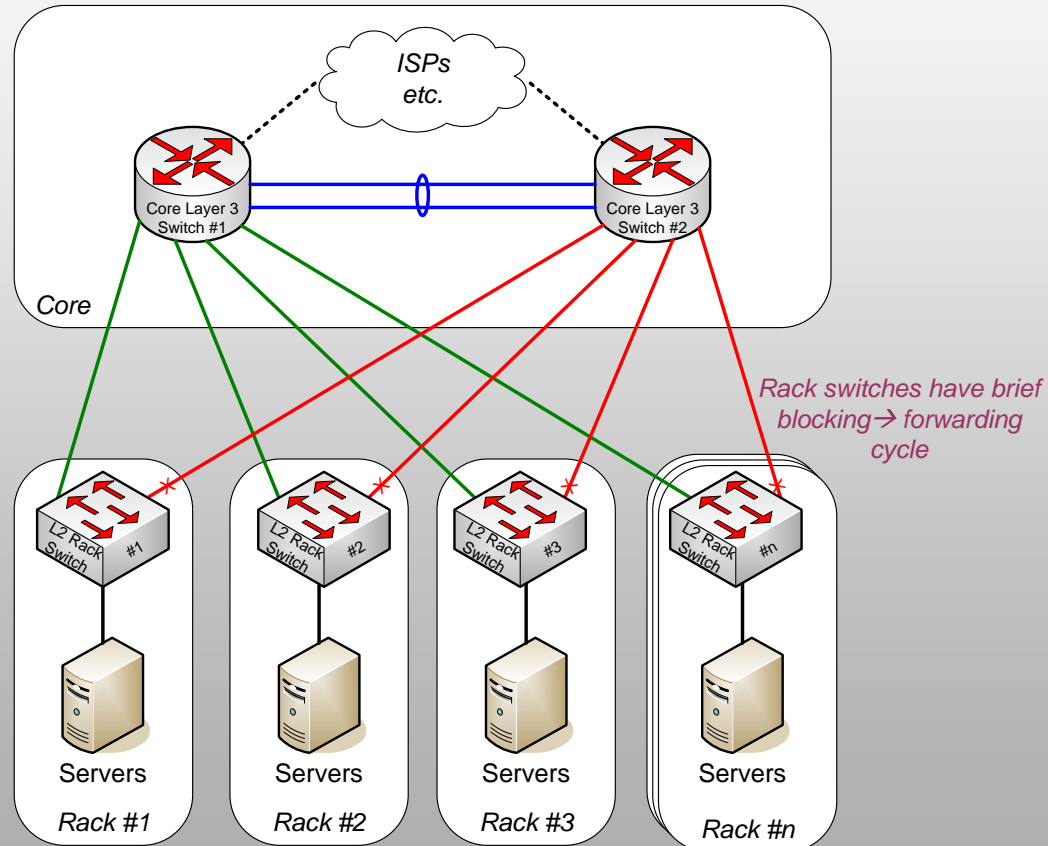
# Migration Step 2: Core 2

- Core 2: Activate MSTP  
spanning-tree mode mst



# Migration Step 3: Rack Switches

- All Rack Switches: Activate MSTP  
spanning-tree mode mst



# Ongoing Maintenance

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- Once MST is deployed, a few things must be kept in mind:
  - All new devices should be pre-configured with identical MST parameters before being deployed on the network
  - Any VLAN  $\leftrightarrow$  Instance mapping changes should be made on the root, then pushed to secondary root, then to rack switches
- Currently there is no widespread protocol for automatic propagation of MST configuration
  - Maybe VTPv3? (though Cisco only)
  - Anyone else?

# Summary

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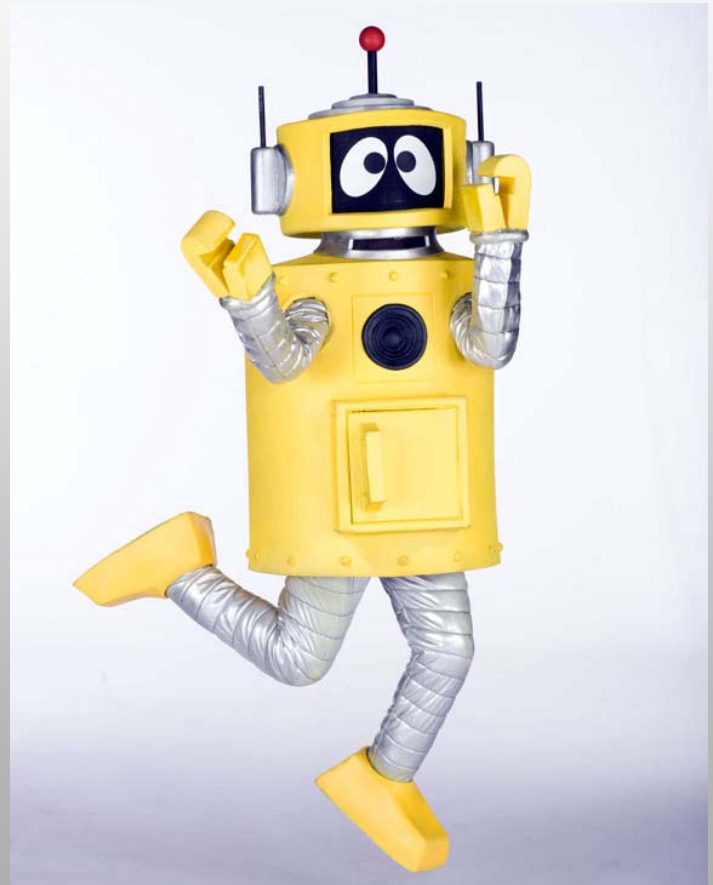
- MST adds configuration complexity, so stay on your toes
- While not covered in this talk, MST allows for great multi-vendor interoperability in a Layer 2 datacenter network
- We've only deployed this solution a few times, I'm interested in hearing feedback and experience from others in similar situations
- Anybody know how to configure Cisco Layer 3 switches for single-instance RSTP?



# Any Questions?

***Thank you for listening***

***Peak Web Consulting  
is available to assist***



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