

SE 4455 – Cloud Computing

# Cloud Enabling Technology

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# Cloud Enabling Technology

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- Data center technology
- Virtualization
- Web technology
- Service technology

# Data Center Technology

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1. Standardization and modularity
2. Automation
3. Remote operations and management
4. High availability
5. Security-aware design, operation and management
6. Facilities: power, cooling, access control, fire protection, backup power
7. Computing hardware
8. Storage hardware
9. Networking hardware

# Standardization and Modularity

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- Standardized commodity hardware
- Modular architectures
  - Aggregating multiple identical building blocks
  - Supports scalability, growth and quick replacement
- Enables economies of scale throughout
- Key to reducing cap-ex and op-ex
- Advances in capacity/performance of devices together with virtualization helps consolidation

# Data Center Automation

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- Automate provisioning, configuration, patching and monitoring
- Autonomic computing
  - Self-configuration
  - Self-healing – discovering and correcting faults
  - Self-optimization – monitoring and control
  - Self protection – identification and protection from cyber threats
- Software Defined Infrastructure (SDI)

# Tools for Automation

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- Open source tools
  - Puppet
  - Ansible
  - Chef
- Commercial tools
  - Orchestrator – Microsoft System Center
  - Data Center Automation Suite – HP
  - Tivoli – IBM

	Ansible	Puppet	Chef
Script Language	YAML	Custom DSL based on Ruby	Ruby
Infrastructure	Controller machine applies configuration on nodes via SSH	Puppet Master synchronizes configuration on Puppet Nodes	Chef Workstations push configuration to Chef Server, from which the Chef Nodes will be updated
Requires specialized software for nodes	No	Yes	Yes
Provides centralized point of control	No. Any computer can be a controller	Yes, via Puppet Master	Yes, via Chef Server
Script Terminology	Playbook / Roles	Manifests / Modules	Recipes / Cookbooks
Task Execution Order	Sequential	Non-Sequential	Sequential

Source: [www.digitalocean.com/community/tutorials/an-introduction-to-configuration-management](http://www.digitalocean.com/community/tutorials/an-introduction-to-configuration-management)

# Data Center Security

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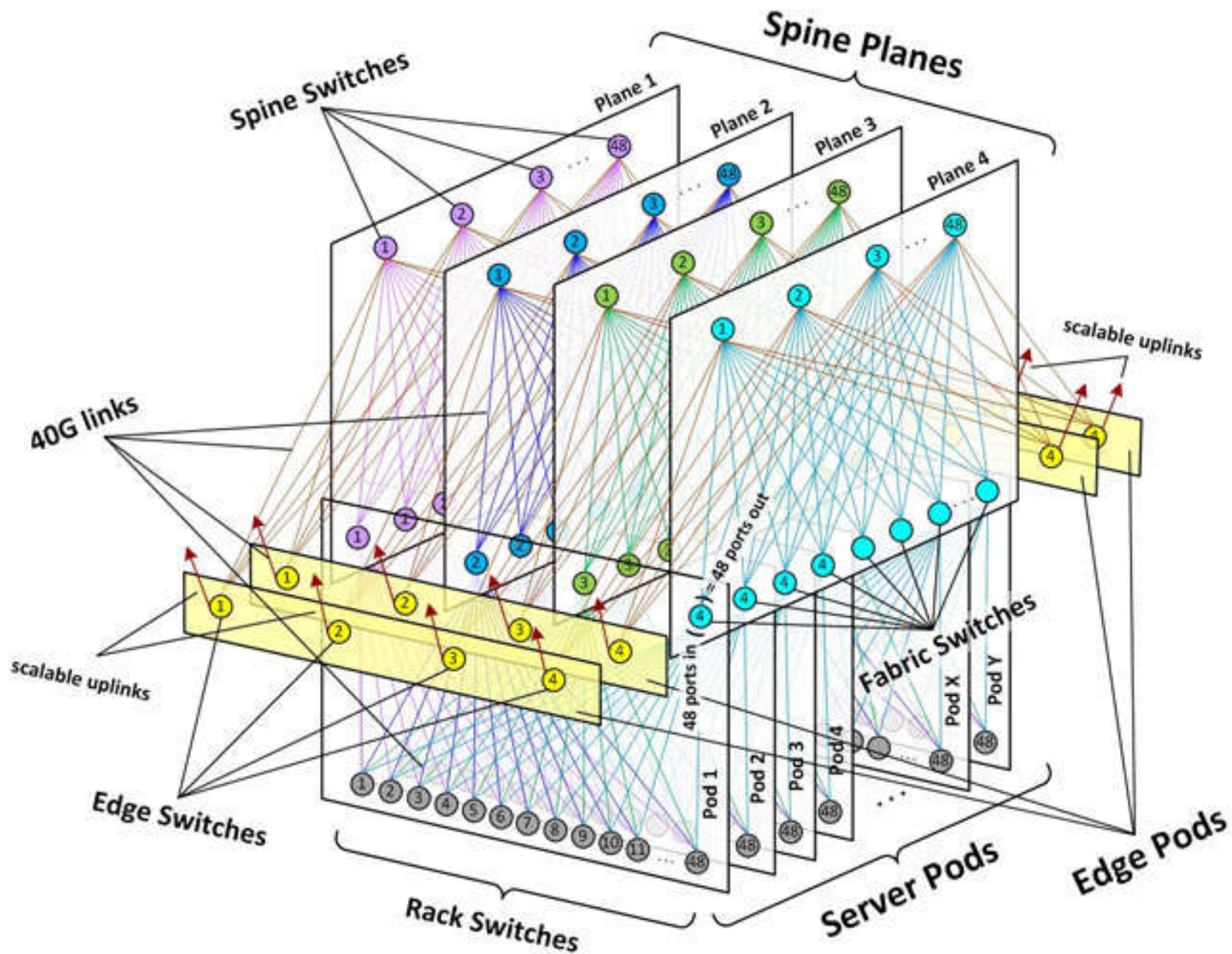
- Crucial aspect of a data center
- Can be prohibitively expensive to individual organizations
- Outsourcing may be done just for this



# Computing Hardware

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- Standardized racks
- Dense CPUs and server boards
  - Intel Xeon Phi – up to 72 cores/CPU
  - Arm TILE-Mx100 – 100 cores/CPU
- OpenCompute initiative for data center specific designs and standardizing
- Storage Area Networks (SAN)
- Network fabrics



Facebook's data center fabric design

# Data Center Classification

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- ANSI/TIA-942 defines 4 tiers
  1. Basic site
  2. Redundant Capacity Component Site
  3. Concurrently maintainable site
  4. Fault Tolerant Site Infrastructure
- Uptime Institute defines 4 similar tiers
  - Adds specific uptime requirements

# Tiers Defined by Uptime Institute

Rank	
1	<ul style="list-style-type: none"><li>• Single non-redundant distribution path serving the IT equipment</li><li>• Non-redundant capacity components</li><li>• Basic site infrastructure with expected availability of 99.671% (28.817 hrs)</li></ul>
2	<ul style="list-style-type: none"><li>• Meets or exceeds all Tier 1 requirements</li><li>• Redundant site infrastructure capacity components with expected availability of 99.741% (22.688 hrs)</li></ul>
3	<ul style="list-style-type: none"><li>• Meets or exceeds all Tier 2 requirements</li><li>• Multiple independent distribution paths serving the IT equipment</li><li>• All IT equipment must be dual-powered and fully compatible with the topology of a site's architecture</li><li>• Concurrently maintainable site infrastructure with expected availability of 99.982% (1.5768 hours)</li></ul>
4	<ul style="list-style-type: none"><li>• Meets or exceeds all Tier 3 requirements</li><li>• All cooling equipment is independently dual-powered, including chillers and heating, ventilating and air-conditioning (HVAC) systems</li><li>• Fault-tolerant site infrastructure with electrical power storage and distribution facilities with expected availability of 99.995% (0.438 hours)</li></ul>

# Cloud Enabling Technology

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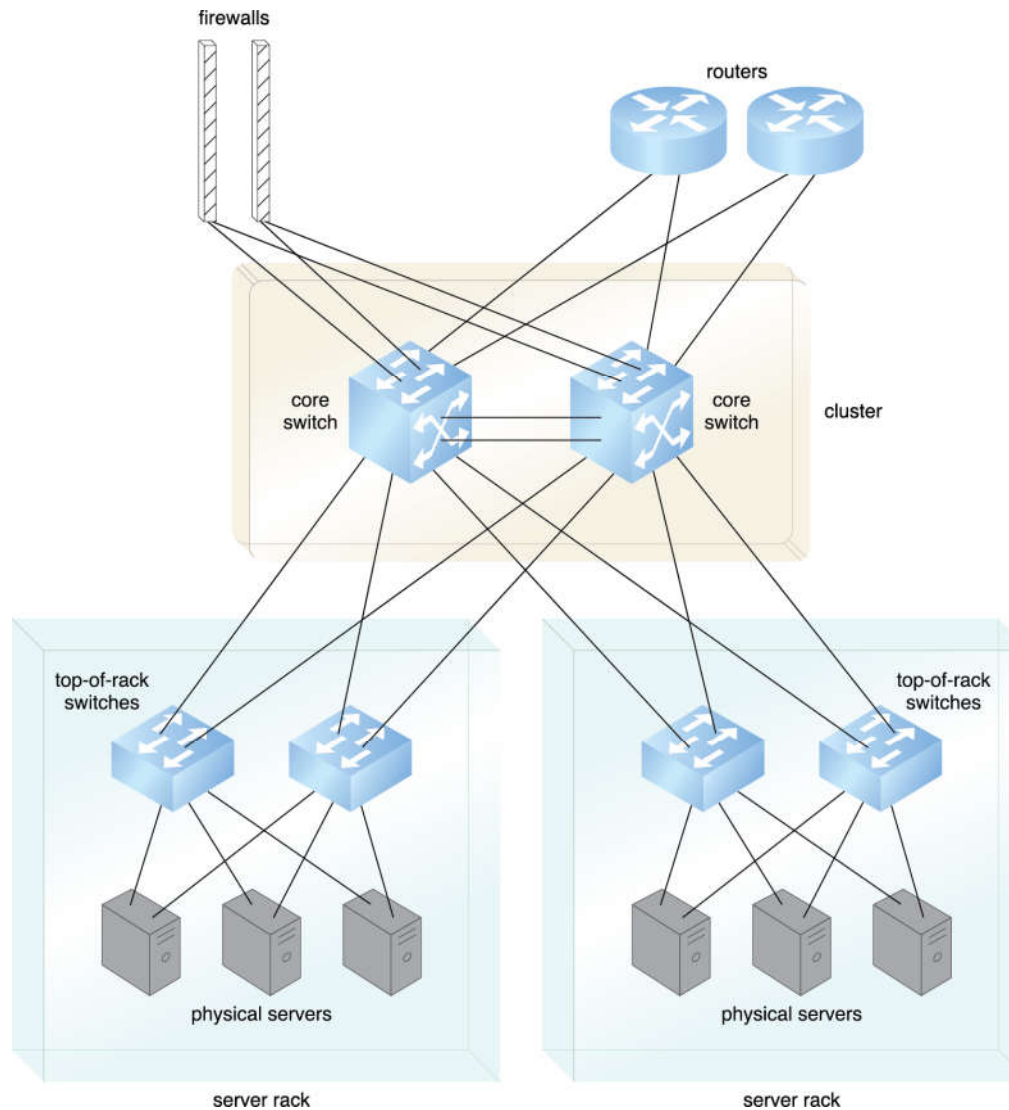
- Data center technology ✓
- Virtualization – covered later
- Web technology – SE 3316!
  - Web applications
- Service technology – SE 3316!
  - ReST style web services
  - Service Agents
  - Service middleware

# Case Study – DTGOV Data Center

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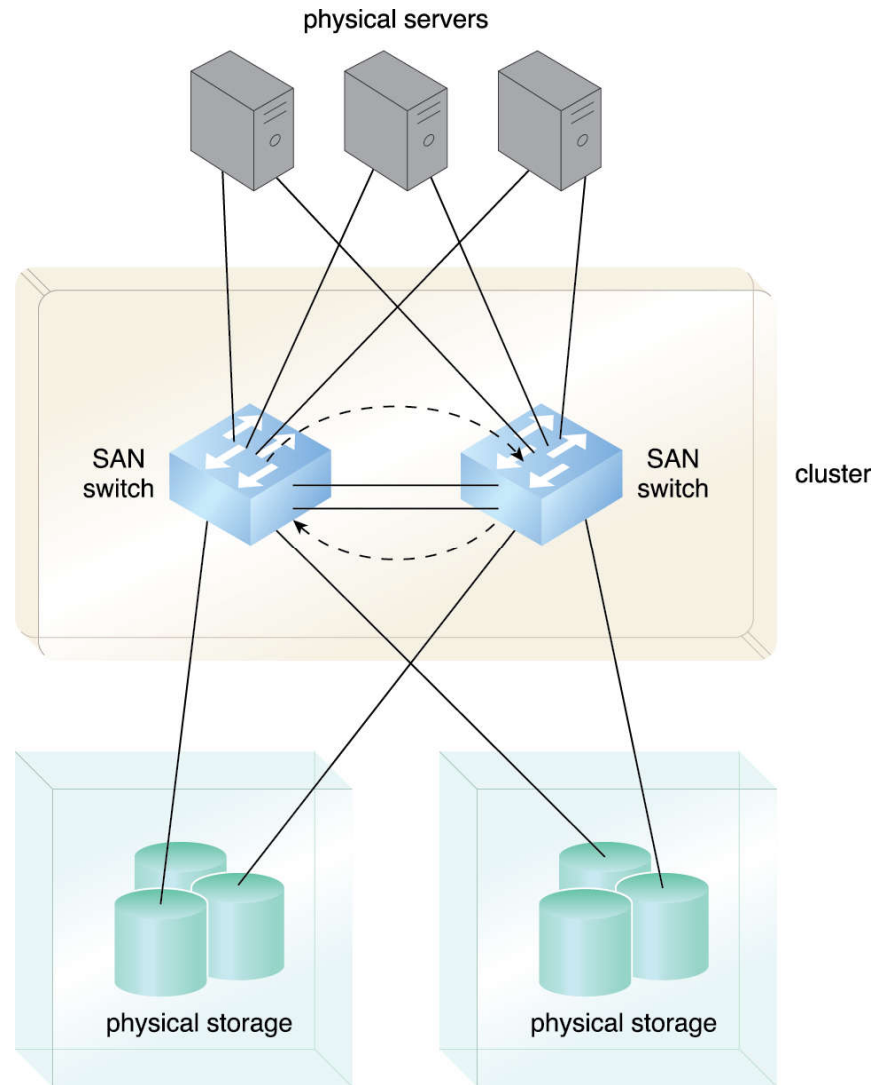
- DTGOV is a US public company created by Ministry of Social Security
- Processing social security benefits in US
- 3000 employees, branches in 300 localities
- 3 data centers

# Server Network Connections - DTGOV



# Storage Network Connections - DTGOV

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# Internet Setup - DTGOV

