S102252 – Technical Transformation in Higher Education at UNC-Chapel Hill

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The University of North Carolina at Chapel Hill

- Nation’s first public university
- 18.5k undergraduate students
- 11k graduate/professional students
- 12.5k faculty/staff
- $2.4B operating budget

IT Landscape

Central IT

- ~400 staff
- Networking
- Operations (servers/VMs, operating systems, data centers)
- Applications (web servers, J2EE, ERP)
- User Support
- Research Computing

Departments, Schools, Centers

- ~400 staff
- School of Medicine
- College of Arts and Sciences
- Business School
- Lineberger Cancer Center
- Specialized department systems

Other

Transiency of students

On Premise?

On-Premise Cloud Cheaper

- 2.5 existing data centers
- Networking is “free”
- Heating/cooling is “free”
- Power is “free”

Cost Comparison

- Onsite: $530,000/year ($100,000 cost recovered)
- AWS: $1.5M/year
- Azure: $1.3M/year

Virtualization at UNC

- 2006 – VMs at UNC began, in earnest
- 2007 – Data Center #1 uplift – VM was cost savings
- 2010 – Virtualization strategy – 80% solving – Xen backended
- 2012-2016 – 400% increase in VM usage
- 2014 – Cisco UCS backend – consolidate the consolidation
- 2014 – Standardize on VMWare hypervisor
- 2015 – Container strategy
- 2017 – Cloud strategy

Virtualization at UNC

Advantages

- More agile than bare metal
- Faster provisioning
- “Simplified” networking

Open questions?

- Customers expect push button *everything*
- Are resources being utilized optimally?
- Are users able to support full stack?

Problems we *were* trying to solve

- Server under desk
- Faster service provisioning, self-service fulfillment
- Who manages the managed LAMP stack?
- Campus customers using non-UNC IT resources
- Security/patching issues for out-of-band resources
- Optimize VM resource usage
- Decommission of legacy hosting services

Containers

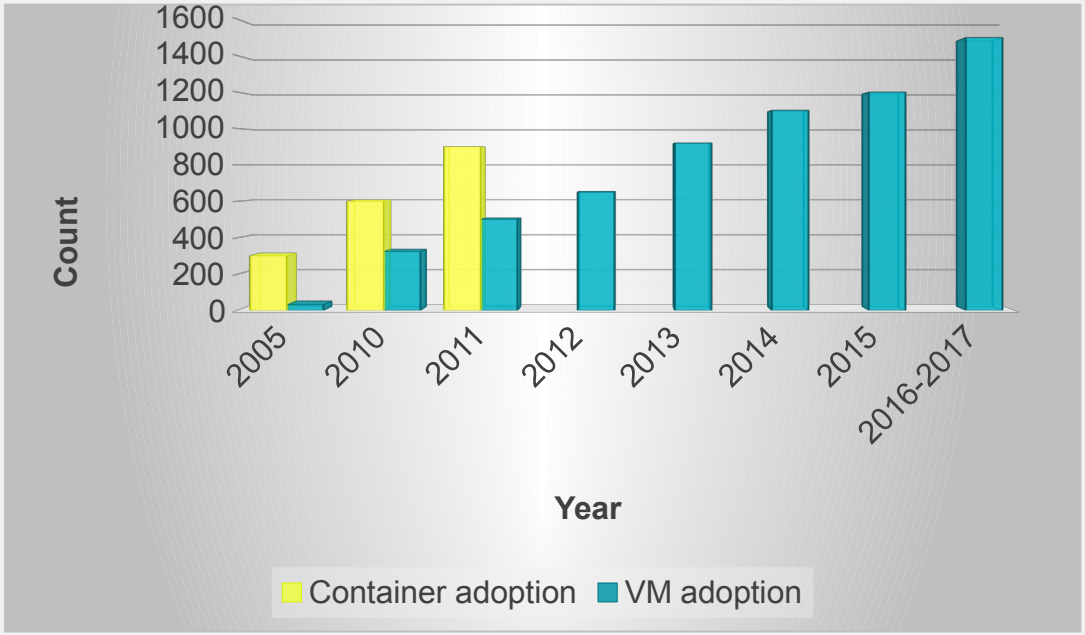
OpenShift v2

- 3-year front loaded cost for experiment
- $32k/year for hardware, software licensing
- Free to all students, faculty, and staff
- Oct 2014-Jan 2017 (27 months) – 650 applications – without sensitive data approval
- Creation of developer liaison role

Challenges

- Varying range of customer technical skills
- Customer documentation
- Development workflow change for customers
- Marketing
- Containers vs VMs

VM and Container Growth



- VM growth – 363% increase since 2010
- Container growth – 200% increase since Oct 2014

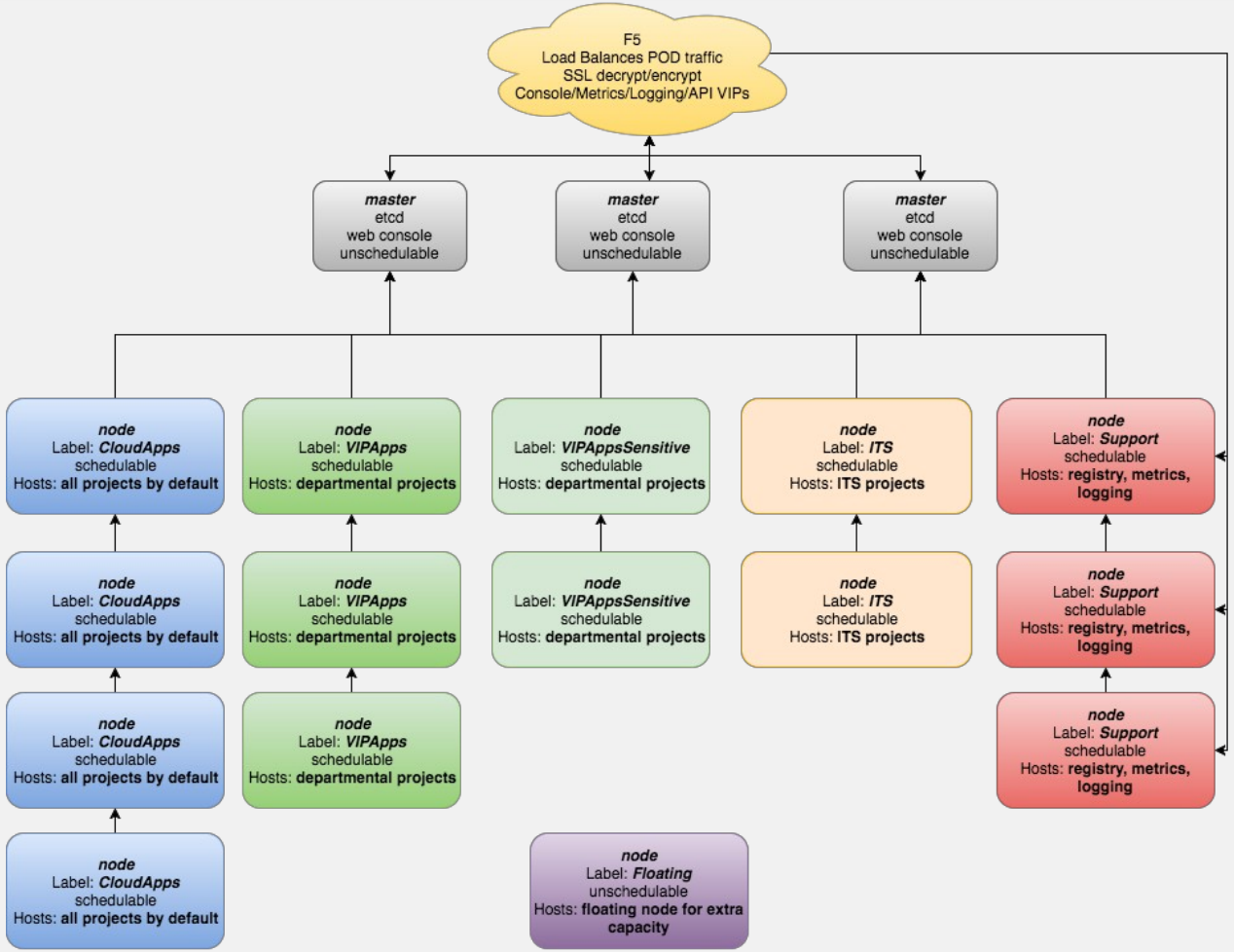
OpenShift v3

- Still in initial 3-year front loaded cost period through June 2017
- Jan 2017 – OCP 3.4 released
- Approved for sensitive data types – FERPA, HIPAA, PII
- Expanded developer liaison role
- Persistent volumes
- April 2017 ~400 applications

Problems we are *now* trying to solve

- Server/VM gluttony – collapse downstream
- Continued optimization of computing resources (VM + container)
- Patching time/impact
- Software license savings (migrating J2EE to EAP)
- Growth
- Security
- Consolidate sensitive data applications

Implementation Details


F5
Load Balances POD traffic
SSL decrypt/encrypt
Console/Metrics/Logging/API VIPs
master
etcd
web console
unschedulable
master
etcd
web console
unschedulable
master
etcd
web console
unschedulable
node
Label: CloudApps
schedulable
Hosts: all projects by default
node
Label: CloudApps
schedulable
Hosts: all projects by default
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Label: CloudApps
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Hosts: all projects by default
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Label: CloudApps
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Hosts: all projects by default
node
Label: VIPApps
schedulable
Hosts: departmental projects
node
Label: VIPApps
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Label: VIPApps
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Hosts: departmental projects
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Label: VIPAppsSensitive
schedulable
Hosts: departmental projects
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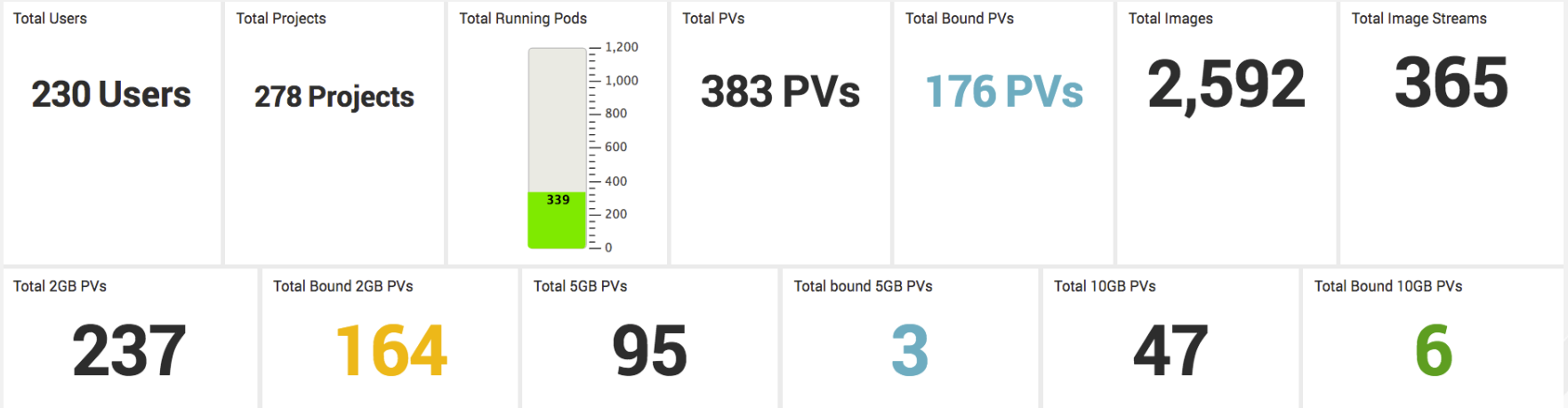
Label: VIPAppsSensitive
schedulable
Hosts: departmental projects
node
Label: ITS
schedulable
Hosts: ITS projects
node
Label: ITS
schedulable
Hosts: ITS projects
node
Label: Support
schedulable
Hosts: registry, metrics, logging
node
Label: Support
schedulable
Hosts: registry, metrics, logging
node
Label: Support
schedulable
Hosts: registry, metrics, logging
node
Label: Floating
unschedulable
Hosts: floating node for extra capacity

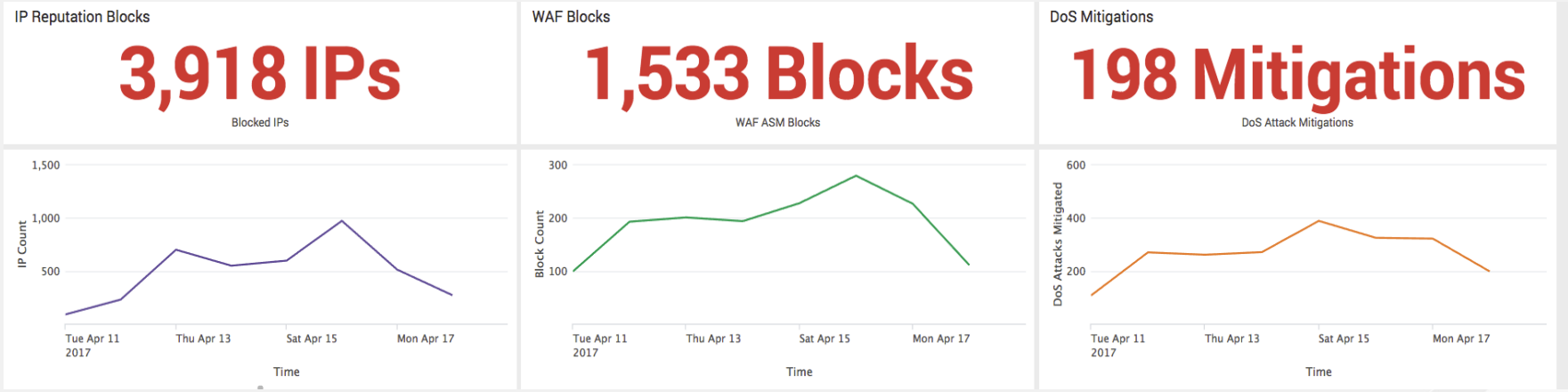
Splunk Integration

- Push ES logs to Splunk – SIEM integration
- Splunk dashboards for operations reporting and KPIs



F5 Security Controls Integration

- Web Application Firewall
- Denial of Service protection
- IP address reputation
- Border protection tools



Customizations

Custom Content

- Campus customers have business needs for alternative options
- Custom images for Drupal and WordPress
- Custom PHP images – Oracle database driver, mcrypt, Microsoft SQL Server driver
- Shibboleth Single Sign-On image

xPaaS Integration

- Red Hat SSO – integrate Shibboleth with OCP console

Legacy J2EE Environment

Legacy Environment

- Oracle GlassFish – extended support
- 13 clusters, by business line (HR, Finance, etc)
- 101 applications
- 24 hosts (app + web)

Problems

- Not current Java/J2EE
- Tuning shared JVMs is problematic
- No access control for segregation of duties
- Operations has to manage configuration and deployments
- Expensive licensing costs

J2EE Environment in OCP

Red Hat JBoss EAP

- DevOps model – let developers do what they need to, quickly
- Existing clusters split to 22 smaller “clusters”
- 2 hosts to support all environments
- EAP for stateful, mission critical services

Benefits

- Fits into our container strategy
- Agility for developers and operations teams
- Cluster access is finely grained to “librarian” role
- Better JVM tuning possible
- Transparent maintenance

Density

Current

- 277 servers, 29 service lines (OCP one service line)

Future

- J2EE – 22 hosts
- WordPress SaaS – 12 hosts
- PHP development – 10 hosts
- Atlassian stack – 2 hosts
- Learning Management System – 23 hosts

Potential decrease of 69 hosts, 25% of our host total

Next Big Opportunity

Research

- ~$850M/year in research
- Research Computing Division – provides computing infrastructure and technology tools to support research at university
- Integrate with OCP – frontend to HPC nodes, mounting mass storage systems
- Pilot project to deploy research tools in Docker

What's Next?

- Academic use cases – Computer Science, School of Media and Journalism, Friday Center for Continuing Education
- Administrative Uses – School of Pharmacy, School of Media and Journalism
- Training/videos
- Advanced OCP features

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