EDUCAUSE
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#EDU16

Goodbye Datacenter

Choosing the Right Services to Migrate to the Cloud

Max Garrick • Bill Allison • Dana Watanabe

Who We Are

Max Garrick – Assistant Director, Executive Application Support, UC Irvine Office of Information Technology

Bill Allison – University Chief Technology Officer, UC Berkeley

Dana Watanabe – Application Architect, UC Irvine Office of Information Technology

Session Goal

To help others make effective decisions about which services to migrate to the cloud first.

Three different perspectives

Service provider for an enterprise web application used at 10 UC campuses

University CTO overseeing a diverse portfolio of services and a long history of cloud migrations

Application architecture lead and service provider for central identity management and single sign-on

If you're from a campus like ours…

1. You can't move all services to the cloud instantly
2. It may not make sense to move all services to the cloud
3. You have options: local datacenter, cloud, or hybrid

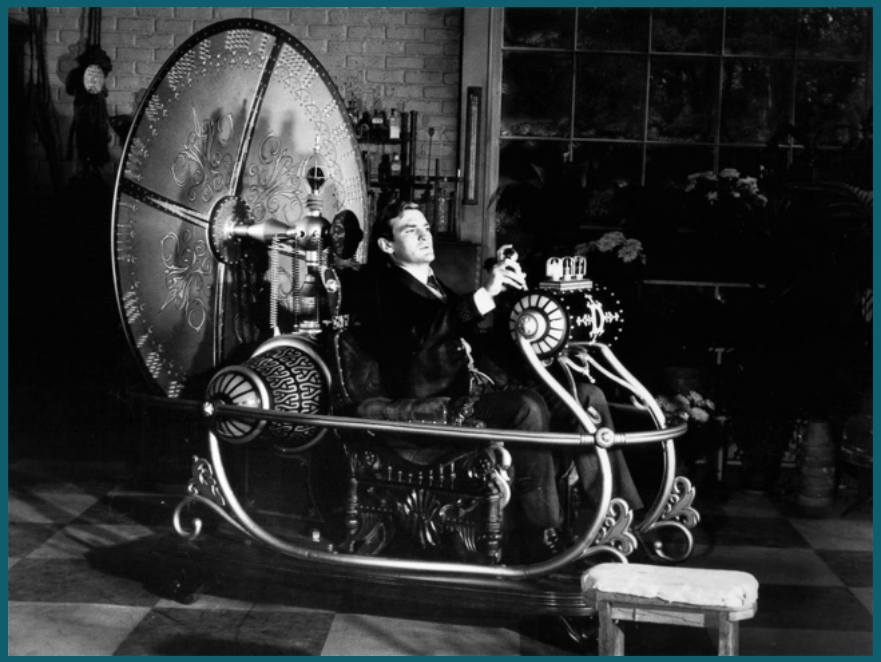
Our message

An effective cloud strategy requires a careful understanding of your goals, constraints, and priorities around cloud migrations.

In other words, one size does not fit all.

Looking Ahead…

http://tinyurl.com/goodbyedatacenter

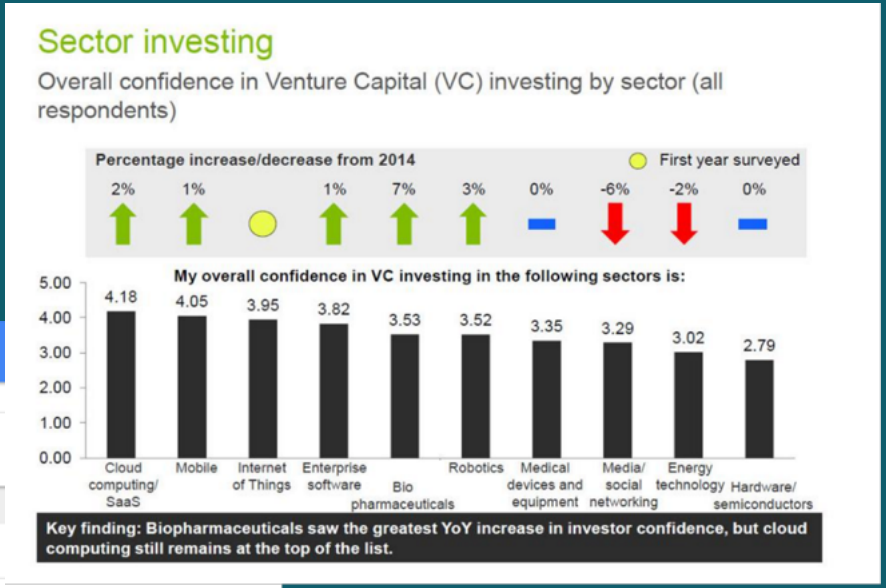


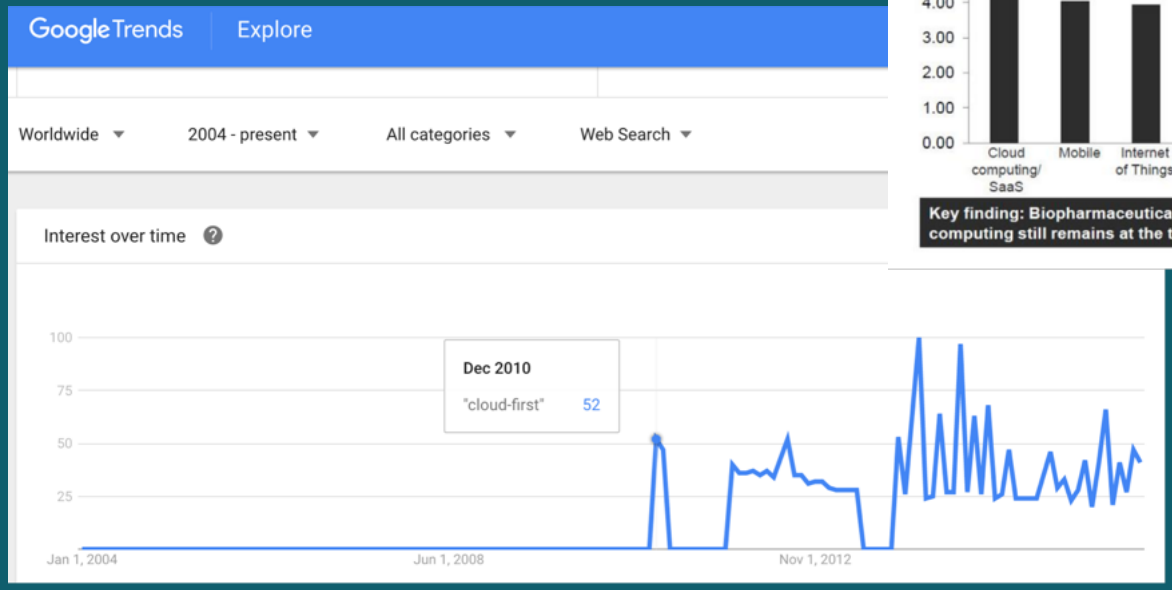
A Historical Fable…

Ice. It was a steady gig…

The Long Goodbye: Union Ice Co. in 2005

Industry Context





UC Berkeley Context

- Silicon Valley/SF metro labor pool
- 2004 Data center (69%-85% cap)*
- Large research university (decentralized)
- Financial Crisis (cloud strategy must bootstrap)

*

Cooling:

Facts

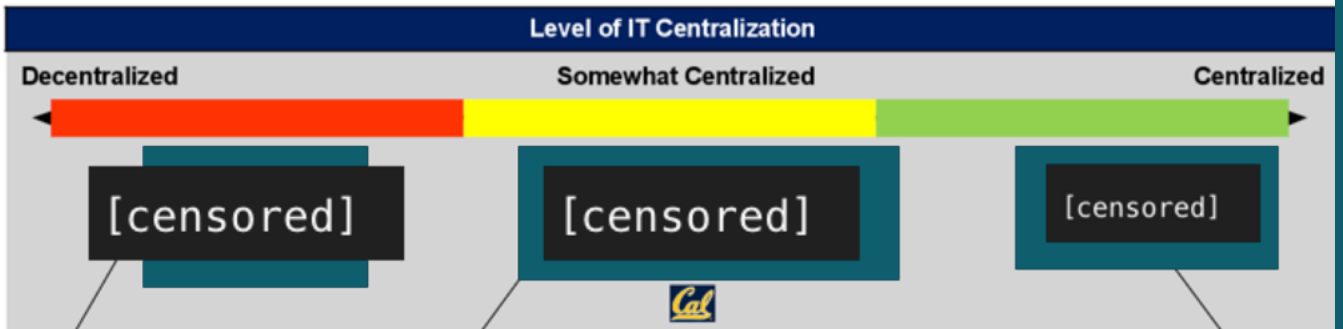
- 11 CRAC units support up to a total of 2,904,000 BTU's.
- Equipment load = 2,047,285 BTU's (88% of recommended max).

Critical Issues

The BRC computing cluster is expected to exhaust all of the remaining cooling capability of the data center. This project is anticipated to cause some of the older research clusters to be retired, however, so some cooling capacity is expected to be regained for future administrative computing needs.

UC Berkeley Context

1. Level of IT Centralization



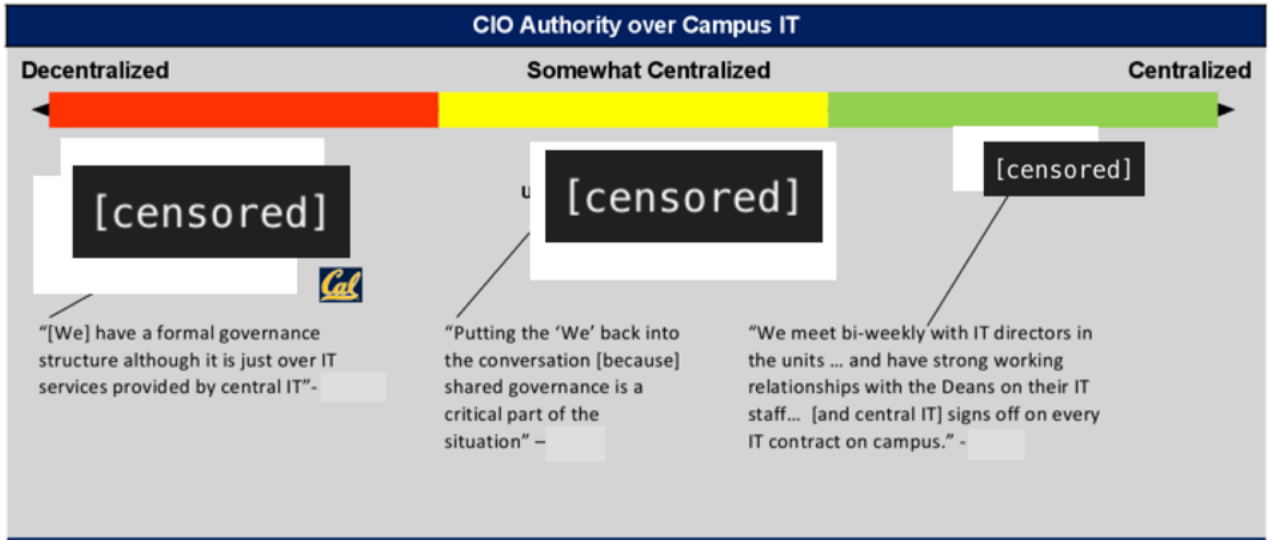
Key Observations

- Schools that are highly centralized are either private or relatively smaller (<15,000 students) compared to Berkeley
- The larger public schools similar to Berkeley in size/scale/academic standing range from Decentralized to Somewhat Centralized for common good IT services – primarily due to the culture of collaboration (vs. mandates) and the autonomy of individual academic units
- Large public schools like [censored] although not fully centralized, have effective IT governance models in place that limit IT sprawl of common good services

Berkeley
UNIVERSITY OF CALIFORNIA

UC Berkeley Context

2. CIO Authority Over Campus IT



Key Observations

- Most schools have a governance structure and process for central IT services
- Many mature schools have formal governance committees focused on areas like Research, Service Delivery, Security, Data, etc.
- Some schools like have a strong relationship with campus procurement where any IT purchase over $100k is flagged for central IT approval

Berkeley
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UC Berkeley's Cloud Strategy: *Emergent & Opportunistic*

SciQUEST

canvas BY INSTRUCTURE

Google Apps for Education

servicenow

druva

box

PANTHEON® Website Management Platform

amazon web services™

Cloud Readiness Considerations

Preparing the IT Organization for the Cloud

An Introduction

ECAR Working Group Paper | May 7, 2015

ECAR

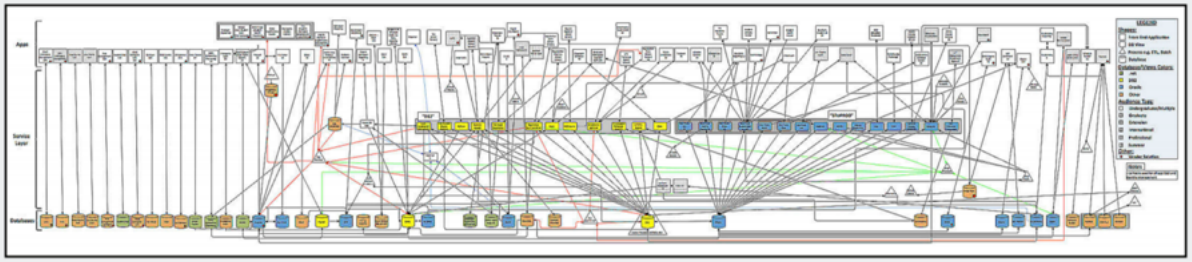
The IT organization is not the only part of the institution that needs to adapt to new ways of thinking in the cloud era. The cloud requires adjustment from procurement officers, legal counsel, risk management, and other business units. IT can help drive understanding of cloud models and work with colleagues across the institution to help make those adjustments.

What data is acceptable for each collaboration tool?

PROTECTION LEVEL	ADVERSE IMPACT	SERVICE
PL2	High	Calshare
PL1	Moderate	bCourses, Box, Google Core Apps
PL0	Limited to None	Google Consumer Apps

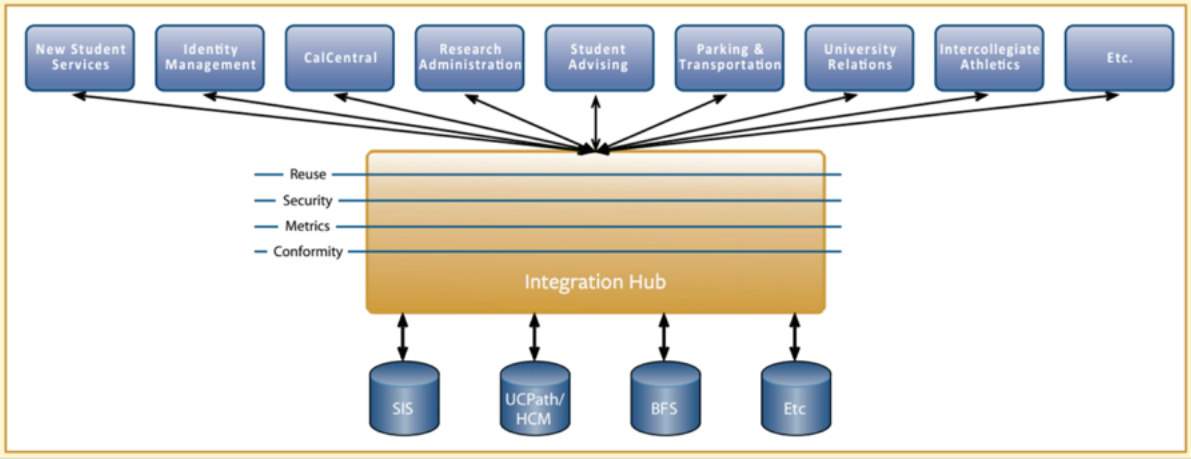
Focus on Cloud Readiness: Integration/API Strategy

THE OLD WAY (EXPENSIVE, FRAGILE): Pre-Enterprise Integration Services SIS Logical Architecture Model (LAMI)



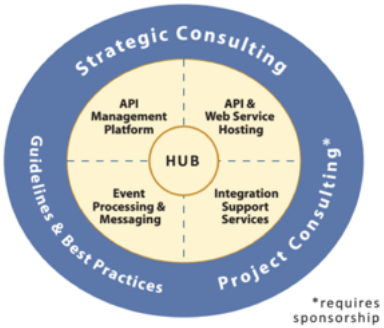
THE NEW WAY (AGILE, COST EFFECTIVE): IST Enterprise Integration Services Campus Integration Model

Featuring better code reuse, security and privacy, usage metrics, and data conformity transparently as part of every access.



THE INTEGRATION SERVICE MODEL

Our Integration Service Model will wrap consulting, guidelines, and best practices around our core hub/platform services.



INTEGRATION COMPETENCY CENTER

INTEGRATION HUB/PLATFORM

*requires sponsorship

API Service Case Study:
Metadata repository, hosted on AWS

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bMeta
The Enterprise Metadata Repository

- **Home**
  - Read Me
  - EDO Example
- **Common**
- **Student**
- **Research**
- **Human Resources**
- **Finance**

bMeta is Berkeley's repository for information about its Enterprise Data Objects.

The first step to developing a more manageable integrations environment is to decouple the data used within any particular application from that exchanged across the enterprise. This is accomplished by using "Enterprise Data Objects" or "EDOs" for all inter-system data exchange. Examples of EDOs are "Person," "Admissions Application," "Course," "Employee," "Financial Account," etc.

EDOs are designed not to fulfill the needs of any particular application, but instead to encompass the whole campus' notion of that information across all the business processes that use it. Because such notions change far less often than underlying process or technology, EDOs serve as a stable *lingua franca* that all applications use to communicate between themselves. EDOs are designed in close cooperation between enterprise architecture and business process owners.

bMeta will grow as more and more campus systems are redesigned to integrate using modern, message based methods based on EDOs.

See EDO Example for an example of how an EDO is represented here on bMeta.

News and updates:

- 10/20/2015 - Optional elements added to Common/Address component, and Academic Career added to Registration, see details
- 10/12/2015 - Work Experience EDO eliminated and subsumed as a component of Student EDO, see details
- 10/07/2015 - Athlete and Work Experience EDOs added, and updates to various "version 0" components, see details
- 10/01/2015 - Change data type of Applicant Rank element in Student/AdmissionApplication, see details
- 09/29/2015 - Standardized format of identifier types, affecting various examples, see details
- 09/23/2015 - Updates to various "version 0" components, see details
- 08/27/2015 - Updates to Student "version 0" components, see details
- 08/27/2015 - Student and Registration examples added
- 08/25/2015 - Student and Registration EDOs added
- 08/24/2015 - Updates to various "version 0" components, see details

Gene Kim
@RealGeneKim

Following

OH: "I love talking security w/cloud people, as opposed to talking cloud w/security people." Haha. @petecheslock @djetue #reinvent

RETWEETS 14 FAVORITES 11

1:51 PM - 12 Nov 2014

The Security Review Process:

https://security.berkeley.edu/data-classification

- Classify Data
- Architect system for actual security
- Review requirements for DPL
- Amend architecture
- Submit MSSEI Self-Assessment
- Iterate over concerns raised by ISP

Minimum Security Standards for Electronic Information (effective July 2014)

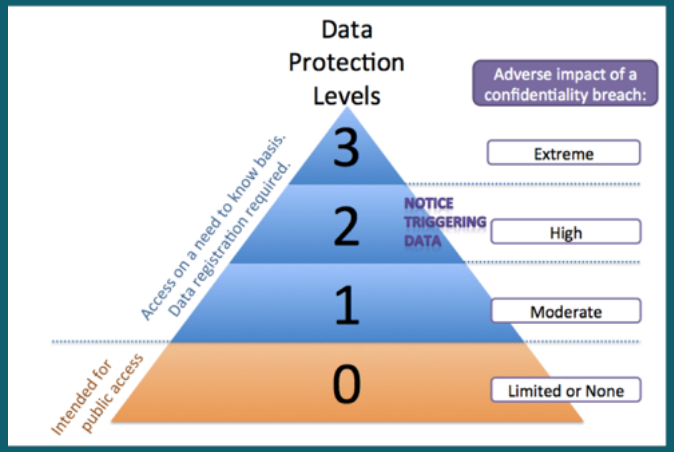
*The following **Minimum Security Standards for Electronic Information (MSSEI)** are issued under the authority vested in the UC Berkeley Chief Information Officer by the UC Business Finance Bulletin IS-3 Electronic Information Security: "All campuses shall establish an Information Security Program (Program) in conformance with the provisions in this bulletin. In order to achieve a secure information technology environment, the campus Program shall comprise a comprehensive set of strategies that include a range of related technical and non-technical measures." (Section III)*

Issue Date: April 23, 2013
Effective Date: July 1, 2014
Supersedes: Minimum Security Standard for Electronic Information (Issued: July 16, 2012/Effective: July 16, 2013)

Responsible Executive: Associate Vice Chancellor for Information Technology and Chief Information Officer
Responsible Office: IT Policy Office

Contact: IT Policy Manager, itpolicy@berkeley.edu

[Protection Profile Matrix by role pdf diagram - prints on legal-sized paper]



Data Classification Standard

http://security.berkeley.edu/data-classification

Data Protection Level	Adverse impact*	Sample Data Types (not an exhaustive list)
Level 3	Extreme	Data that creates extensive "shared-fate" risk between multiple sensitive systems, e.g., enterprise credential stores, backup data systems, and central system management consoles.
Level 2	High	Data elements with a statutory requirement for notification to affected parties in case of a confidentiality breach: • **Social security number** • **Driver's license number, California identification number** • **Financial account numbers, credit or debit card numbers; financial account security codes, access codes, or passwords** • **Personal medical information** • **Personal health insurance information**
Level 1	Moderate	Information intended for **release only on a need-to-know basis**, incl.: Personal information not otherwise classified as Level 0, 2 or 3, and Data protected or restricted by contract, grant, or other agreement terms and conditions, e.g.,: • FERPA student records (including Student ID) • Staff and academic personnel records (including Employee ID) • Licensed software/software license keys • Library paid subscription electronic resources
Level 0	Limited or None	Information **intended for public access**, e.g.,: Public websites, Course listings and pre-requisites, and Public directory data: **Staff:** Name, Date of hire, Current position title, Current salary, Organizational unit assignment, Date of separation, Office address, Office telephone number, Current job description, Full-time or part-time, and Appointment type **Students (unless the student has requested that information about them not be released as public information):** Name, Address, Telephone, Email, Dates of attendance, Number of course units in which enrolled, Class level, Major field of study, Last school attended, Degrees and honors received, Participation in official student activities, Weight/height (intercollegiate athletic team members only)

Public records requests, litigation or other legal obligations may require disclosure of information in any data class.

Self Assessment – Step 1

WHAT IS IT? http://api-central.berkeley.edu

WHAT DOES IT DO? Together the Nginx Reverse Proxy Service and the 3Scale vendor product form a platform that enables APIs to be easily discoverable, well-documented, easy to use, secured, monitored, and metered. API consumers can find and explore APIs on the API Central portal, where reverse proxy simplifies and standardizes endpoint URIs. API providers and data stewards can control access to an API using the API Central Portal's credentialing service, and can limit usage and mitigate abuse using its metering service.

Risk Classification

"After consulting with others in Security, we will be classifying the 3Scale system as a PL3. The reason for the elevated classification is because having credentials (even for short time period of time) to multiple PL2 systems will create a "shared fate" and warrants the elevation."

Step 2 – Target Audience

Describe the users who will use and be affected by the application.

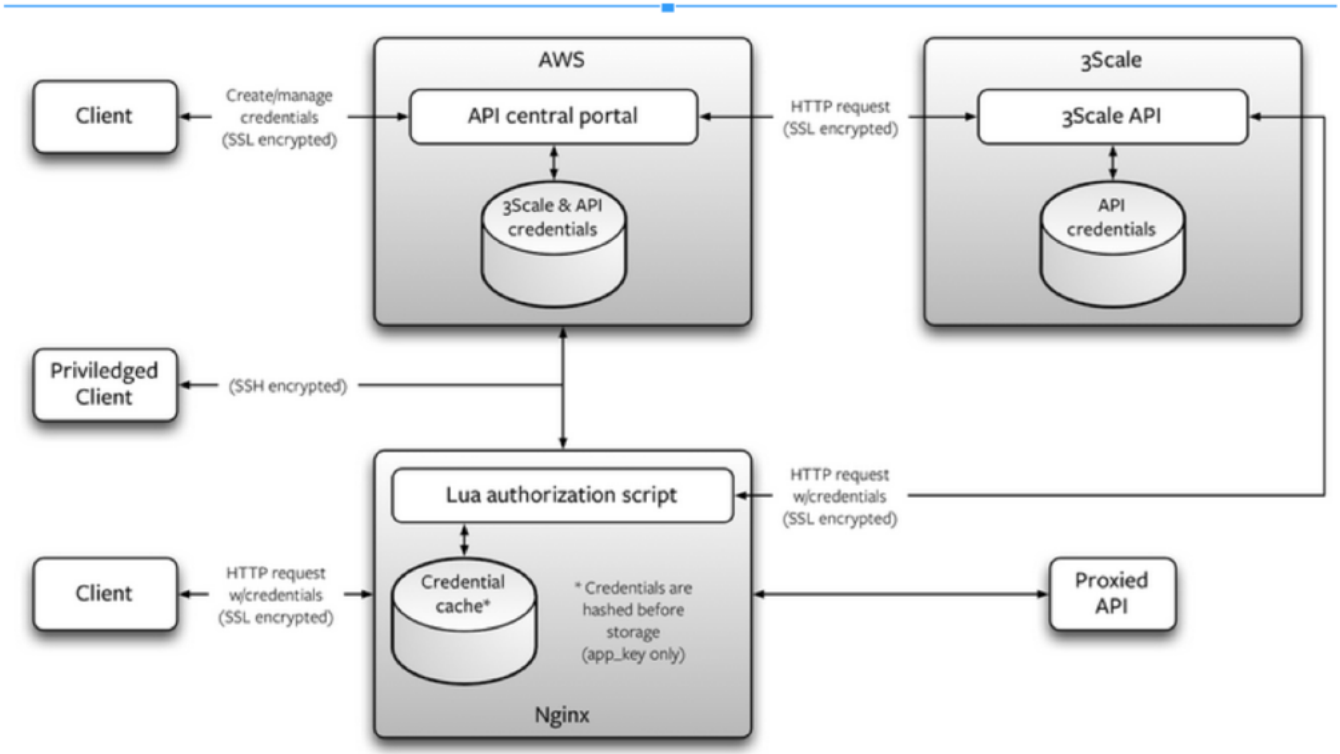
The customers for this API Management and Support Service are system-of-record stewards who provide APIs to access their data and developers who wish to call those APIs.
Currently the APIs are REST based, and are almost entirely read-only (using the http GET method). Requests that update data on the backend sources can be identified by use of the http methods POST, DELETE or PUT. They would however go through the same URL endpoints - this core to the semantics of REST APIs.

We are definitely planning to allow APIs that update state on the backend - what exactly gets updated depends on the the particular API involved.

Among the currently deployed APIs, only the Easy Messaging Service allows updating state via the PUT method. Performing a PUT doesn't update any system configuration, but does add an entry into an application message queue.

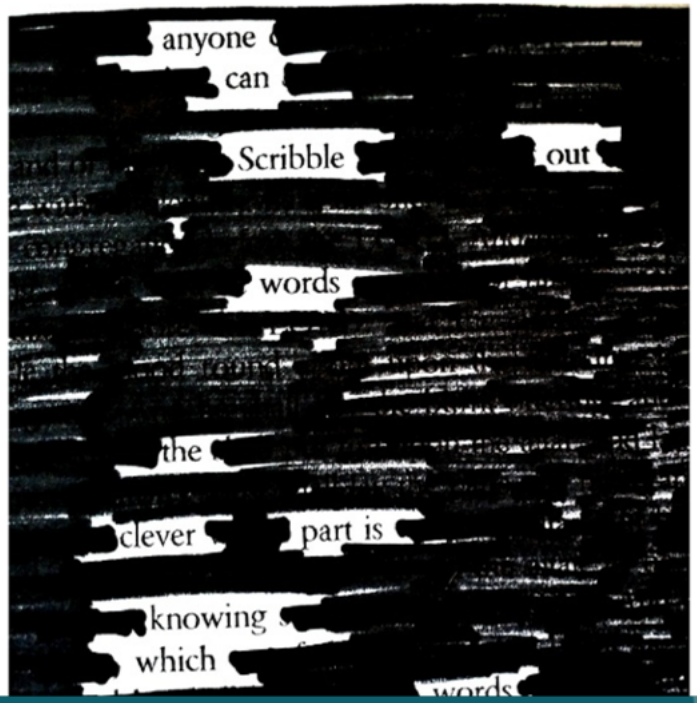
Step 3 – Architecture Model

Attach a high-level diagram of data flow and data storage, including all the interconnected system names and interfaces.



Step 4 – Data Flow Description

Provide description of data movement and data storage depicted in the architecture model. Please include brief description of how each component in the architecture model is being secured.



Step 5 - Support Model

Please list any support and development staff that have elevated privileges in the application or its underlying systems, including their roles and responsibilities in supporting/developing this application. In the responsibilities column, please make note if a role is temporary. Examples of temporary roles may include short-term contractors or support staff that will lose their elevated access to application in the near future (3 – 6 months). Elevated privileges in this case may mean permissions to change application configuration, bulk access to covered data, etc.

Name	Role	Application Responsibilities	Email Address
J	DevOps lead	permanent	
S	IT Manager	permanent	
K	Lead Developer	permanent	
M	Release Manager	permanent	

Step 6 -Meeting MSSEI Requirements

Derived from: https://www.sans.org/critical-security-controls/

The Minimum Security Standards for Electronic Information (MSSEI) define the minimum set of confidentiality controls required for Electronic Information as well as the device types for which these controls are applicable.
For each MSSEI standard (1.1 – 17.1), ***describe how compliance with the standard are achieved*** *for the device types listed with existing tools and practices. If a standard is recommended (o) on a device, indicate how the standard will be met or document the considerations for not meeting the control.*
Device type definitions, and detailed descriptions of each control *with links to implementation guidelines are available at: security.berkeley.edu/mssei.* ***Assessment questions are provided here as prompts, with the caveat that they are subject to change. They are not intended to be comprehensive and may not be applicable for all systems.*** *If compliant controls are not yet implemented, describe any future plans or proposal to meet applicable standard, and use "Progress" column to indicate whether implementation status of the security standard is "Not Started", "In Progress", "Fully Implemented".*

MSSEI 1.1 Removal of non-required covered data

- *What do you do with systems or storage media that are being*

Progress:
Fully Implemented

MSSEI Self Assessment Plan - High Level Requirements (small subset)

- Authenticated Scans
- Intrusion Detection
- Data flow and review
- Systems Inventory
- Build and Lifecycle
- Account Management
- “Hardware” Firewall
- Network Partitioning
- Audit Logging
- Encryption in Transit
- Secure Deletion

Appendix A – Hardware inventory

Host Name	IP address	Virtual ?	Managed By	OS/Software	Device Type[LW1]	Server Type
eas-api-prod-0	1	y	Unix Team, EIS	RHEL 5.1	Institutional	production API proxy accessible from off campus
eas-api-prod-0		y	Unix Team, EIS	RHEL 5.1	Institutional	production nginx proxy campus only
eas-api-prod-0		y	Unix	RHEL 5.1	Institutional	production

Appendix B – Software Inventory

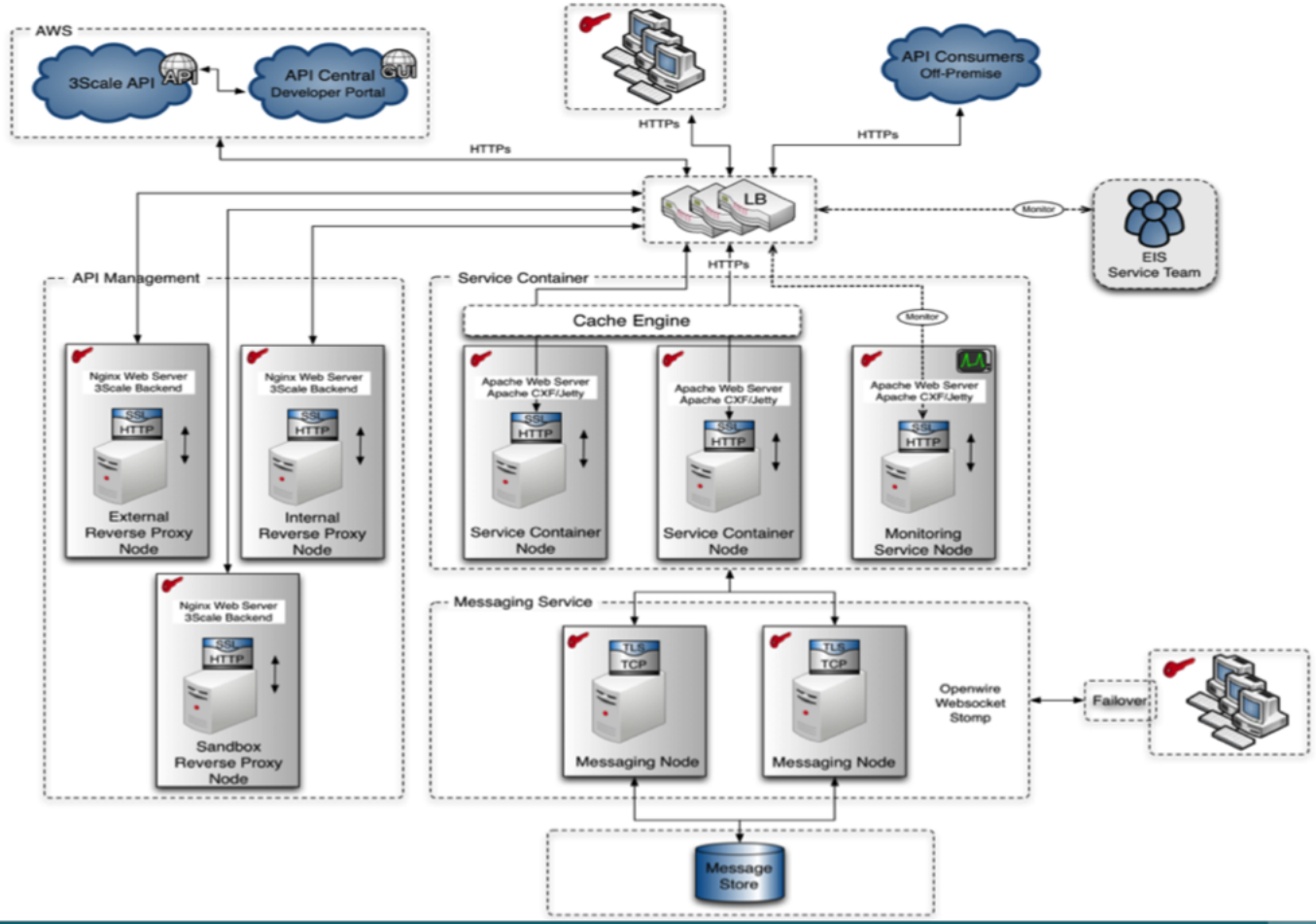
Software	Version	Source	Purpose
e.g., Windows server *Oracle* *Eclipse* *JDK* *Gnu Privacy Guard*	*2008* *11g* *1.6*	*www.eclipse.org* *www.oracle.com* *www.gpg.org*	*Operating System* *Database* *Integrated Development Environment* *Java Libraries* *Encryption Too*
Nginx Openresty	1.4.3.6	http://openresty.org/	Reverse-proxy server
Luarocks	2.1.2	RHEL5 package	Lua package manager

Baseline

http://aws.amazon.com/whitepapers/aws-security-best-practices/

- 2 Factor authentication for AWS Console
- CF defined IAM Roles for all Instances
- Encryption for all comms in and out of VPCs
- Patching of security packages via yum-cron
- Identify credentials and their lifecycle
- Minimal (if any) data on EBS
- Minimal software deployment

API Service – On premises architecture



API Service – Application stack

Management software stack

API Service – Security architecture

Suricata
Open Source IDS / IPS / NSM engine

http://suricata-ids.org/

AppScan
IBM. Rational.

EMERGING THREATS

http://emergingthreats.net/products/etpro-ruleset/

Site24x7

elasticsearch

http://www.elasticsearch.org/overview/kibana/

SALTSTACK