CloudCAP:
Case Study in Capacity Planning Using the Cloud

Joan A. Smith, PhD
Emory University
Atlanta, GA
mail@joanasmith.com

John F. Owen, MS-CS
Owenworks, Inc.
Blacksburg, VA
frank@owenworks.biz

James R. Gray, MS
Kronos, Inc.
Washington, DC
jim.gray@kronos.com

Background

- Commercial foundation:
  - Responsible for performance assurance of web-based employee time-tracker
  - Mission-critical US government software
  - Annual leave, hours worked, holidays, overtime, etc.
  - Many versions for special-case installations
- 1 Million+ Users
  - Majority of US government departments, bureaus
  - Agency-specific customizations
- Custom, local installations
  - Customer Data Center deployment (not Cloud – security regs)
  - Dedicated hardware purchased for each installation
  - High system performance requirements
  - Top-Quality software assurance essential

Problem Statement: Performance Tuning & Capacity Planning

- Ensure scalability & estimate deployment requirements given:
  - Frequent product releases
  - Multiple optional feature sets
  - Various deployment topologies
  - Installed-user base from 300 to 300,000+ users at any single site
- Detect & evaluate performance regressions
  - Determine resource constraints
  - Disk I/O, CPU usage, RAM usage, Network I/O
  - Correct & retest prior to release

Solution: CloudCAP

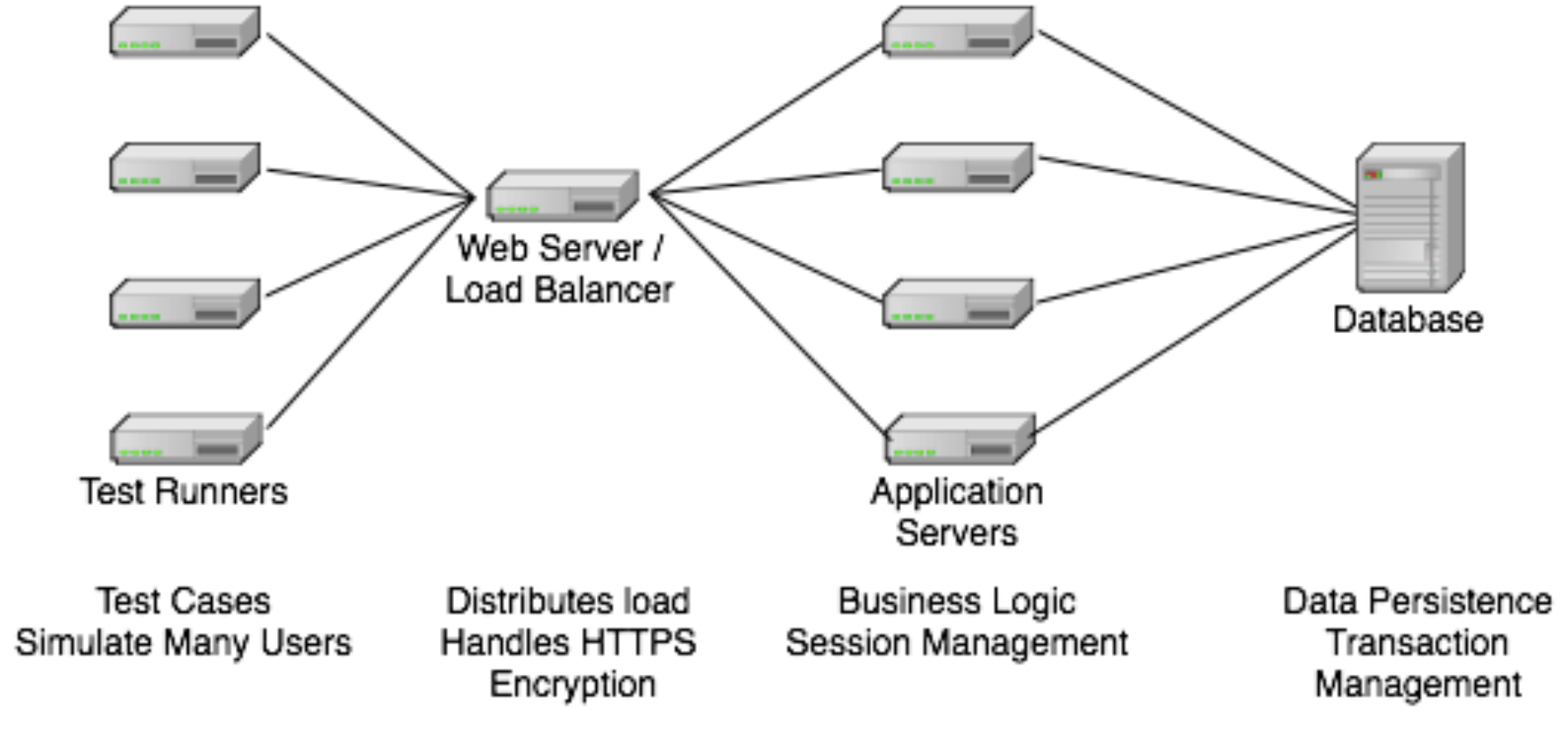
Two key innovations:

1. Web interface for cluster configuration & life-cycle management
   - Consolidates AWS hardware options
   - Streamlines host software installation, configuration (Oracle, Apache, Tomcat, JMeter, etc.)
   - Connects to version control repository for Product Release selection, auto-installation, & configuration
2. Auto-discovery & inter-nodal communication
   - Sequencing of node state transitions
   - Peer discovery: What is the topology of the cluster
   - Synchronization: App servers cannot start until database is servicing requests

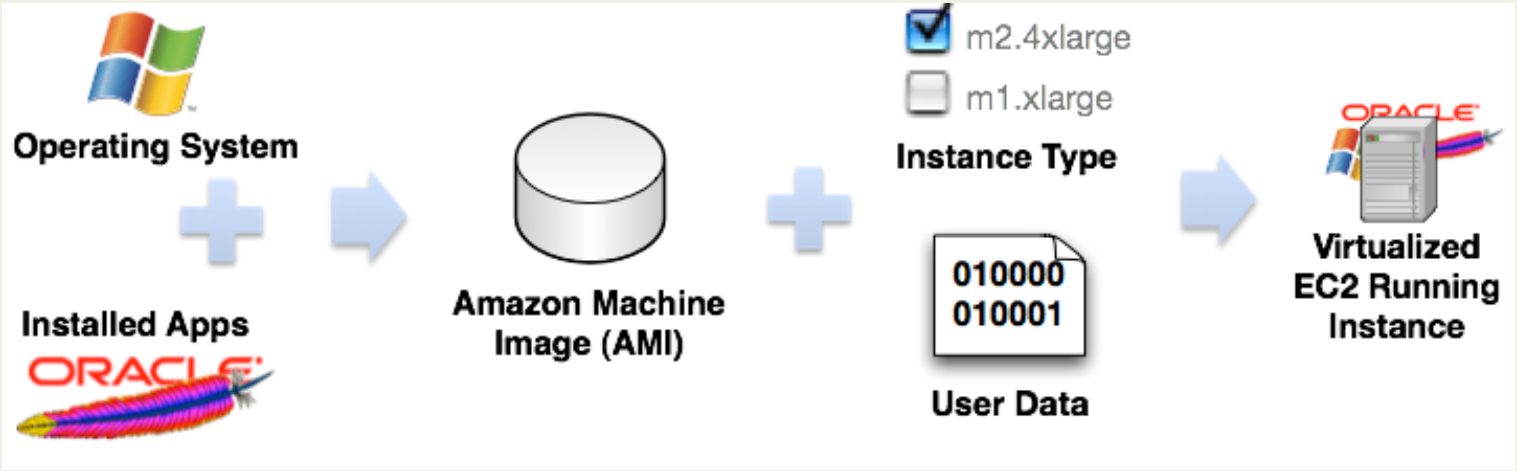
EC2: What it is & How it works

- EC2 = Elastic Compute Cloud
  - A virtual infrastructure
  - Highly configurable with OS, RAM, CPU features
- Instance Creation
  - Amazon Machine Image: Hard Drive image of an OS stored in Amazon Cloud (S3 or EBS)
  - Instance Type: Selectable Hardware
  - Running copy of an image on an instantiation of an instance type
  - Max 16K user data
- Costing
  - Cost begins upon powering up
  - Instance Price per Hour: $0.02-$2.48
  - Additional $$ for network, storage usage
- Management
  - Web interface for administration
  - Query API (URL based query strings)
  - SOAP API (Web Service)

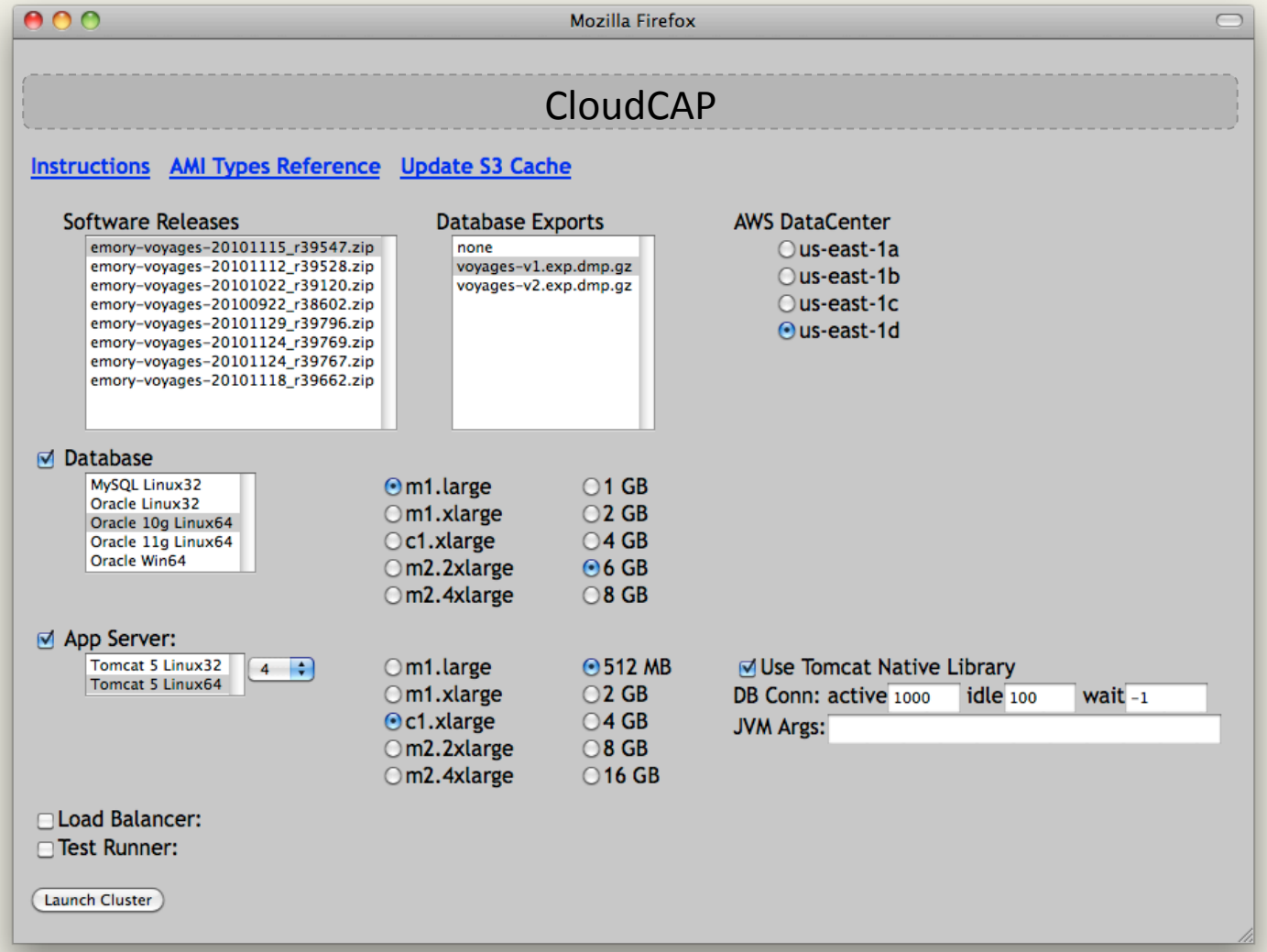
Typical large app cluster



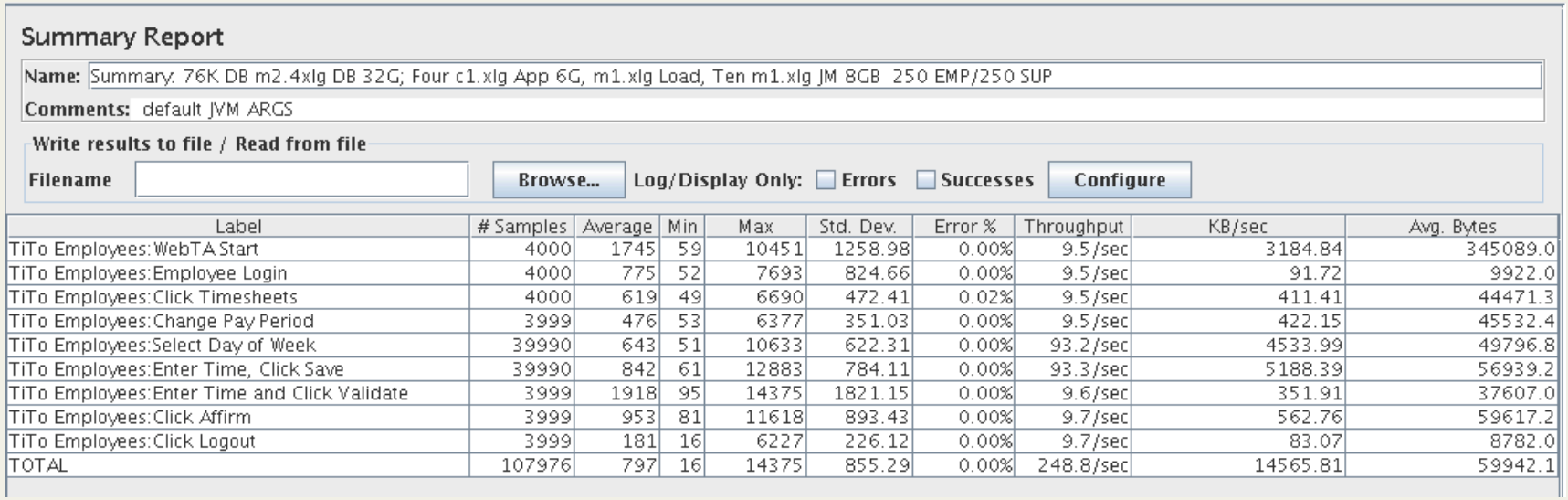
Launching a Virtual Instance



Cluster Management: Web UI



JMeter Report Example



Summary Report

Name: Summary: 76K DB m2.4xlg DB 32G; Four c1.xlg App 6G, m1.xlg Load, Ten m1.xlg JM 8GB 250 EMP/250 SUP

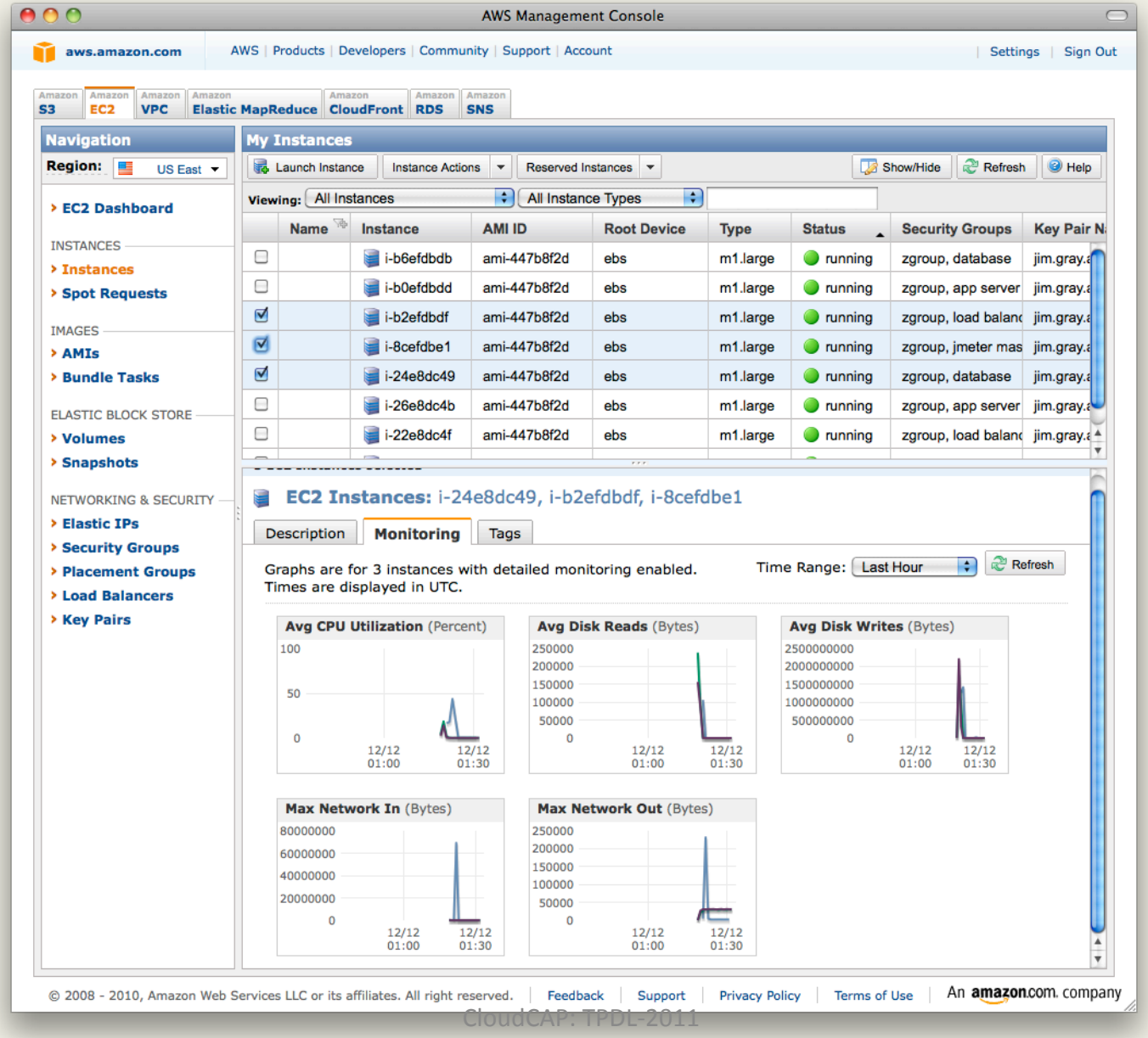
Comments: default JVM ARGS

Write results to file / Read from file

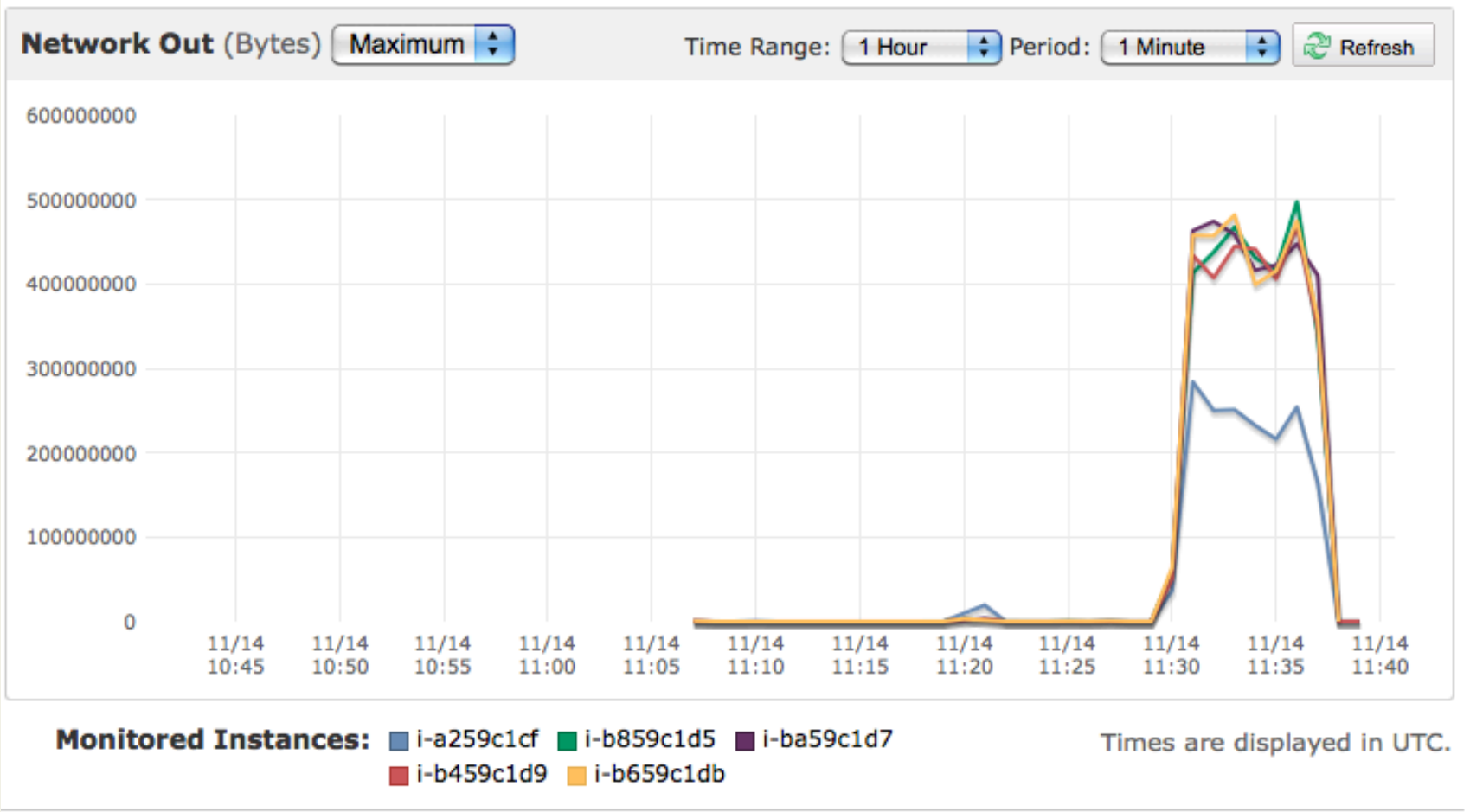
Filename | Browse... | Log/Display Only: Errors Successes | Configure

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	KB/sec	Avg. Bytes
TiTo Employees:WebTA Start	4000	1745	59	10451	1258.98	0.00%	9.5/sec	3184.84	345089.0
TiTo Employees:Employee Login	4000	775	52	7693	824.66	0.00%	9.5/sec	91.72	9922.0
TiTo Employees:Click Timesheets	4000	619	49	6690	472.41	0.02%	9.5/sec	411.41	44471.3
TiTo Employees:Change Pay Period	3999	476	53	6377	351.03	0.00%	9.5/sec	422.15	45532.4
TiTo Employees:Select Day of Week	39990	643	51	10633	622.31	0.00%	93.2/sec	4533.99	49796.8
TiTo Employees:Enter Time, Click Save	39990	842	61	12883	784.11	0.00%	93.3/sec	5188.39	56939.2
TiTo Employees:Enter Time and Click Validate	3999	1918	95	14375	1821.15	0.00%	9.6/sec	351.91	37607.0
TiTo Employees:Click Affirm	3999	953	81	11618	893.43	0.00%	9.7/sec	562.76	59617.2
TiTo Employees:Click Logout	3999	181	16	6227	226.12	0.00%	9.7/sec	83.07	8782.0
TOTAL	107976	797	16	14375	855.29	0.00%	248.8/sec	14565.81	59942.1

Amazon Management Console Example



Amazon CloudWatch: Example Graph Detail



Challenges: Results Analysis

- Instance types are ***approximate***
  - Need multiple runs to even out results
  - *Cluster Luck:*
    The likelihood Amazon EC2 gives you a fast set of machines.
- Mapping test results to real hardware is difficult
  - How much CPU is a CU worth?
  - Close approximations are possible
- EC2 network topology differs from deployment topology
- Disk I/O performance is poor on EC2
  - Disk bound apps not a good match for EC2 testing
  - But: Few apps these days are disk bound
- Lack of comparable historical data from similar sites

Problem Statement: Academic Library

- Peak user loads at launch, tapers off rapidly
  - Typical scenario: 100+ users/month
  - Rare scenario: 10,000+ users/month
  - No good predictors for launch-time load
  - Few academic sites hit the user jack-pot
- Infrequent releases
  - Unique digital scholarship projects
  - Relatively static content
  - Usually one-off: Not baseline for other projects
- Performance regressions are unlikely to be caught before deployment
  - Little QA performed
  - Deadline/research driven, not QA/customer driven

Adapting CloudCAP to Library Web

- Some Reusable Parts
  - *Reuse:* Web UI/node lifecycle management
  - *Reuse:* Startup state management
  - *Reuse:* Peer discovery, registration, interaction
- Several New Parts
  - *New:* Application-specific configuration
  - *New:* Application-specific load scripts/test scripts
  - *New:* Application-specific performance settings
  - *New:* Application-specific tuning parameters

Cost-Benefit Comparison

- Commercial App:
  - + High reusability
  - + Risk-justified (high cost of software failure)
  - + Regression-testing produces critical information
  - + Cost amortized through reduced deployment expenses, increased sales, customer satisfaction

- Academic Scholarly App:
  - – Limited reusability
  - – Risk-unjustified (low cost of software failure)
  - – Regression-testing uninformative or not critical
  - – Cost not recoverable in sales, license fees
- BUT:
  - + Potentially useful for university-wide IT App deployments where risk of failure is high

QUESTIONS & ANSWERS

Thank you for attending our presentation.

Joan A. Smith, PhD
Emory University
Math & CS Dept.
Atlanta, GA 30322
mail@joanasmith.com

John F. Owen, MS-CS
Owenworks, Inc.
Blacksburg, VA
frank@owenworks.biz