Son of SOA
Resource-Oriented Computing
Event-Driven Architecture

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pr3d4t0r @ irc://irc.freenode.net ##java, #esb, #awk, #security

About Eugene

- 15+ years of experience building mission-critical, high-availability systems infrastructure
- 12+ years of Java work
- Open-source evangelist
  - Official adoption of open-source / Linux at Wal-Mart Stores
  - State-of-the-art tech for main-line of business roll-outs
- Engaged by the largest companies in the world
  - Retail
  - Finance
  - Oil industry

What You Will Learn...

- How to develop complex apps within very tight deadlines
- Formalize integration around a resource-oriented model
- Develop event-driven apps based on existing production tech and services
- Turn SOA-based systems into callbacks as an evolution of the provider/consumer model
- Define application processing in terms of compositions and asynchronous sequences of resource requests

About LeapFrog Enterprises (NYSE: LF)

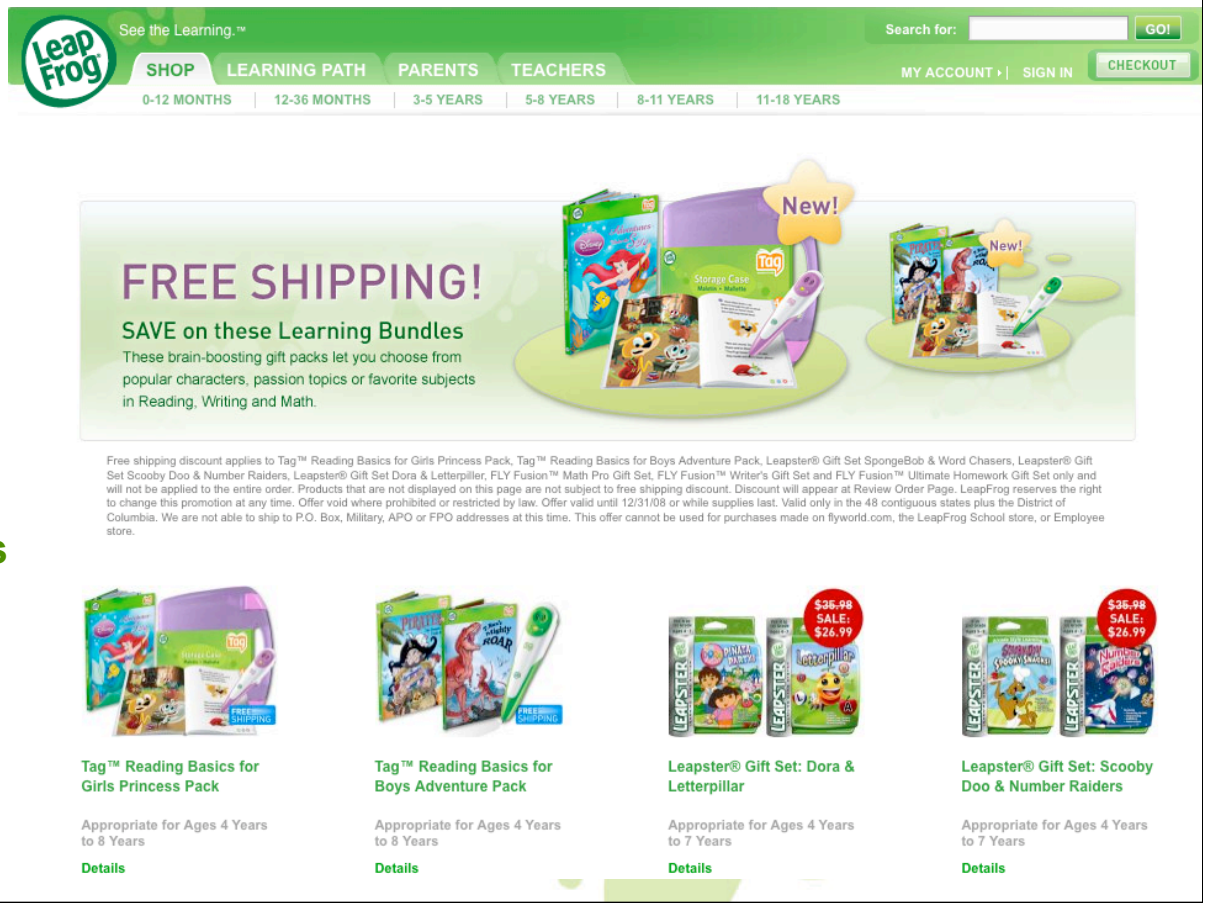
- The leading producer of innovative, technology-based learning products worldwide (six languages, 35 countries)
- At home and in schools (over 100,000 classrooms US)
- Titles: phonics, reading, writing, math, music, social studies, geography, spelling, vocabulary, science, more
- Millions of devices connected to our SOA infrastructure

http://www.leapfrog.com/learningpath

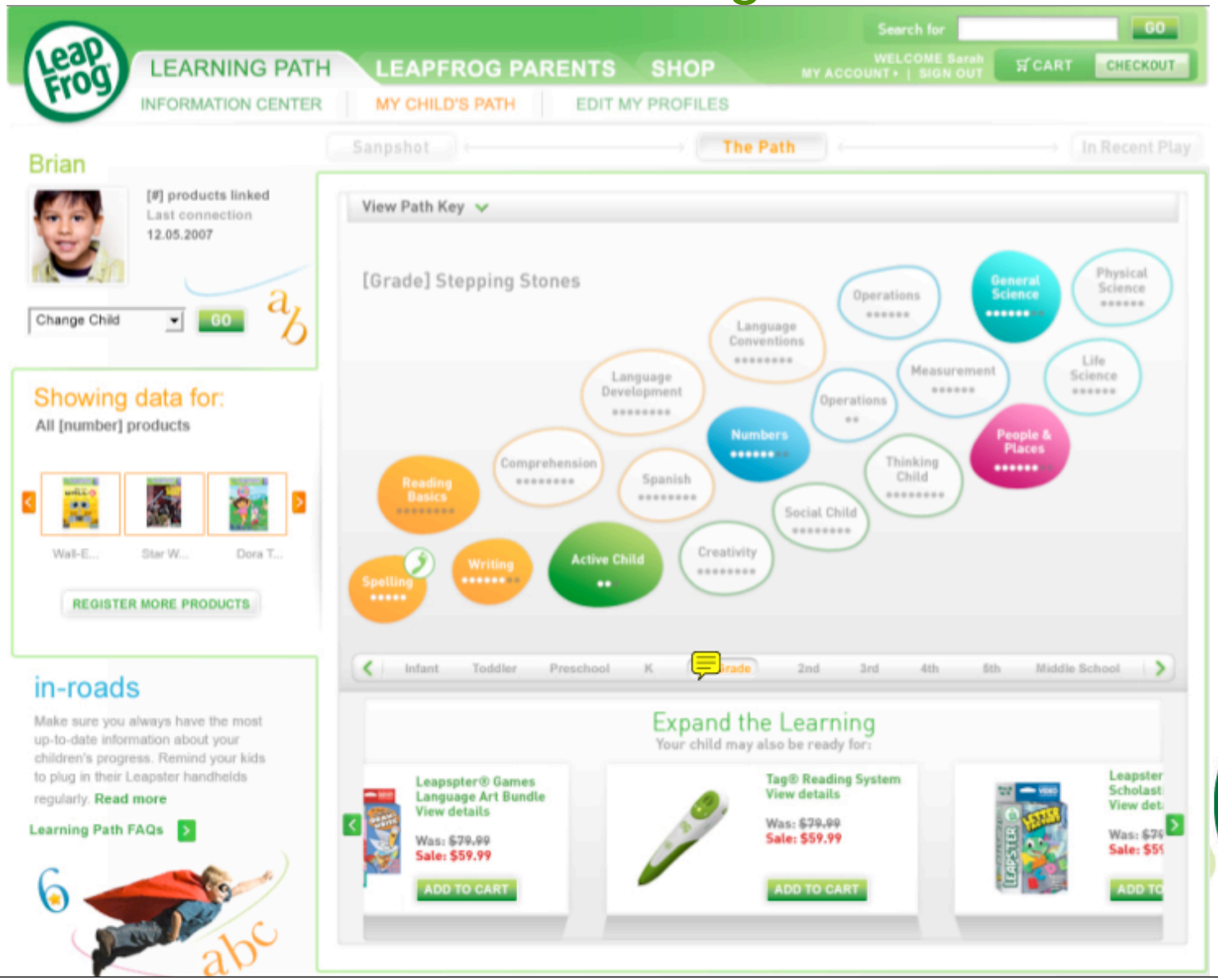
Environment: E-commerce

- **Web systems are divided in three broad categories for us**
  - **E-commerce and marketing**
  - **The LearningPath**
  - **Connected products**

E-commerce site problem domain:



Environment: The LearningPath



Environment: Connected Products

So... What is the Problem?

- Very tight deadlines
  - Typical 12-month project rolled out in 90 days
- Development team built at the same time as application design work
- No history of developing Web applications
- Rigid IT infrastructure and policies
  - SOX and other compliance issues
  - IT guys used to rule the world
- Integration with financial and other legacy systems is a must

Advantages

- Very tight deadlines!
  - We gotta do what we gotta do...
- Dev team grows at the same time as design work proceeds
  - Technology adoption driven by team member selection and viceversa
- Very few legacy issues to deal with in Web applications
  - Adoption of best-of-breed technology from open-source community
- IT doesn't do Web systems
  - Technology adoption policy evolves along with design and development
- No need to reinvent the wheel for existing systems
  - Financial, CRM model, etc.

Integration Through Services

- SOA = Services-Oriented Architecture
- Collection of services that communicate with one another
  - No dependencies on other services
  - Self-contained
- Messaging: mechanism for communication between two or more services
- Real-time, asynchronous, synchronous
  - May occur over different transports
    - HTTP, FTP, JMS, RMI, CORBA, etc.

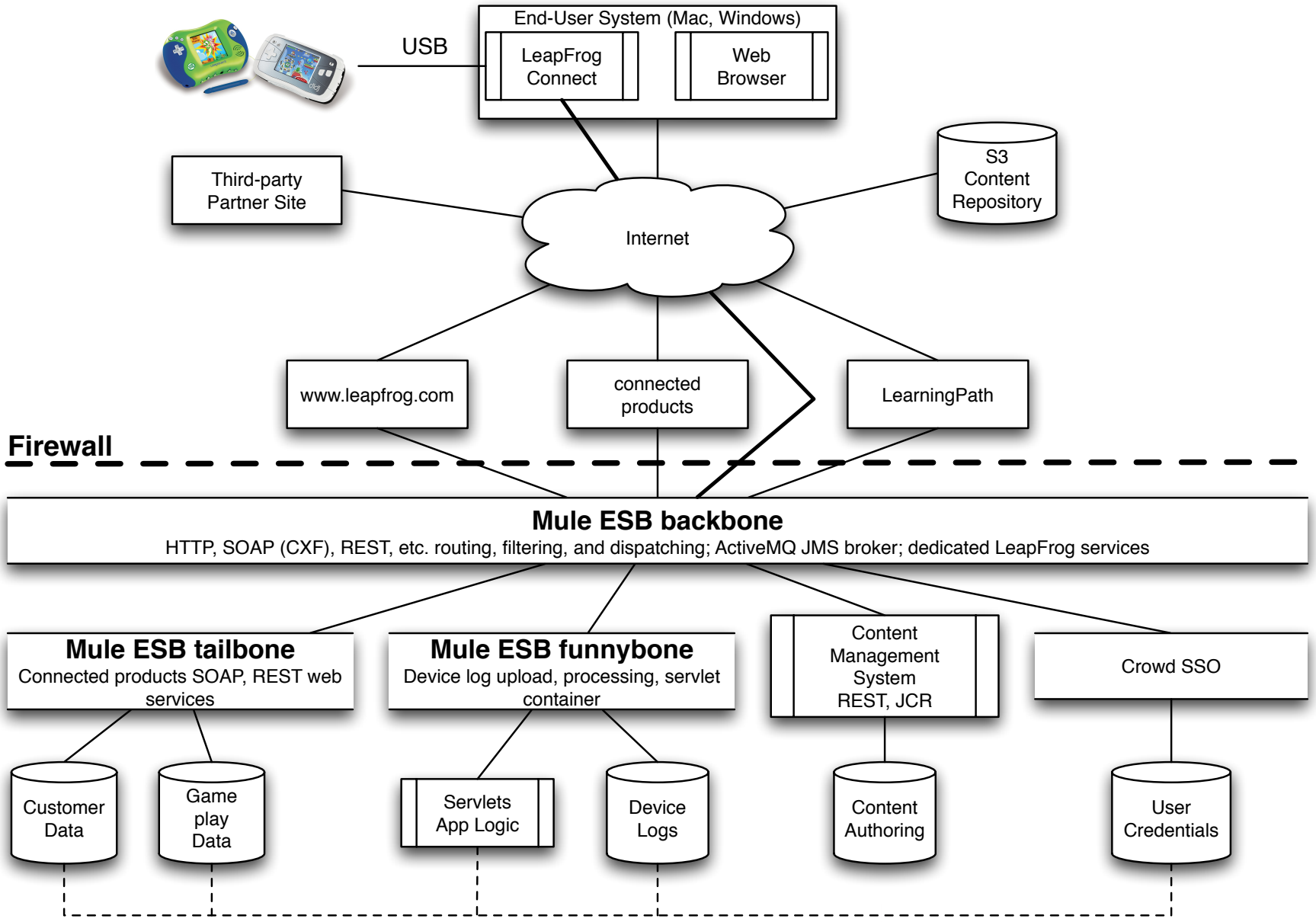
SOA Limitations

- Not all systems can be mapped as services
- Workflow issues
- Development team coordination
- Programmer skill levels
  - Do your programmers grok SOA?
- System coupling
  - System dependencies
  - Organizational dependencies

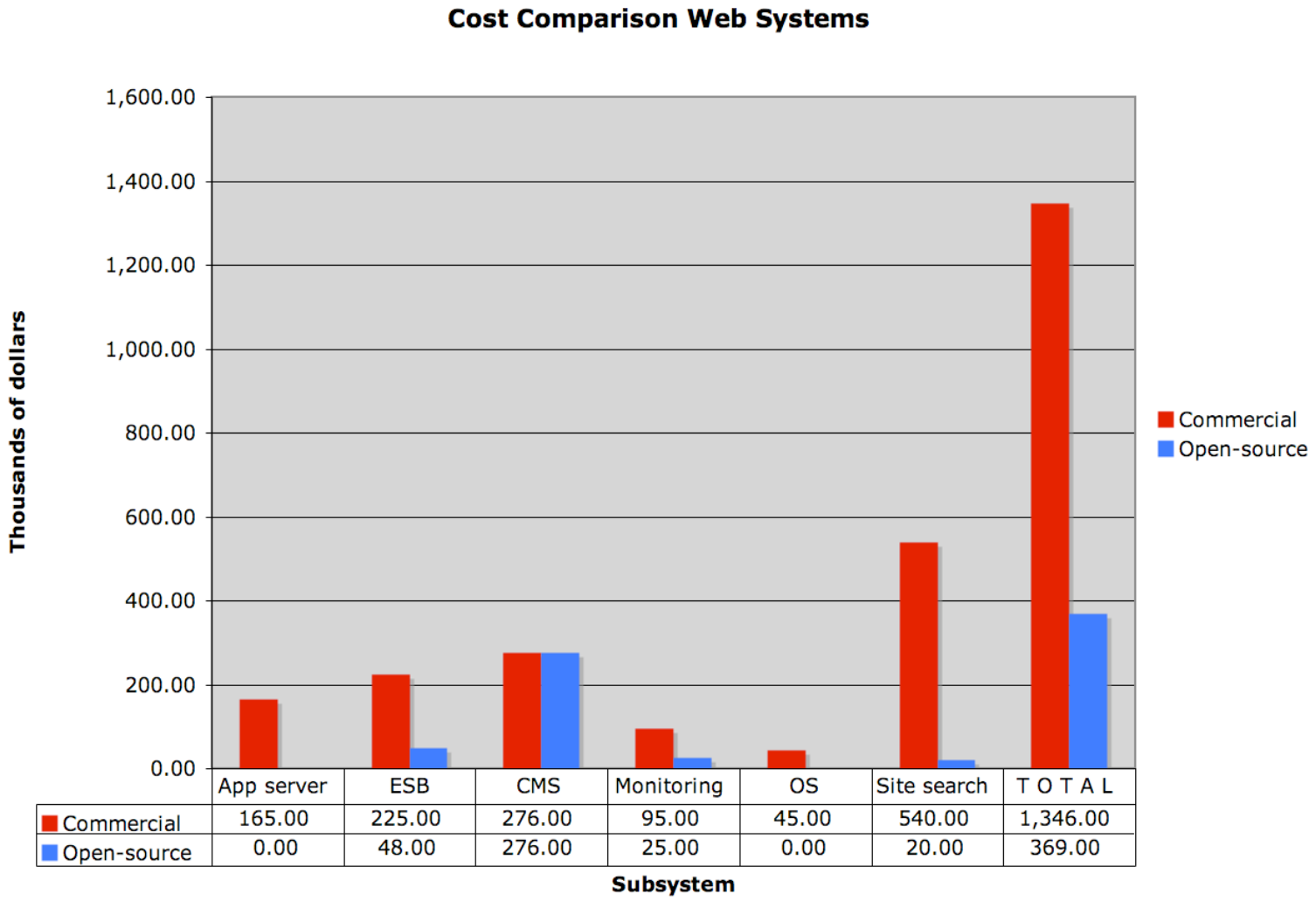
Technologies Deployed

- Best of Breed
- Mule ESB - the backbone
- ActiveMQ
- Crowd Single Sign-on
- GWT for front end AJAXy stuff
- Wicket for Web applications
- Day Communiqué / CRX for CMS
- All open-source development tools
- Java 5 and Java 6

Environment



How Well Did This Work?



	App server	ESB	CMS	Monitoring	OS	Site search	T O T A L
Commercial	165.00	225.00	276.00	95.00	45.00	540.00	1,346.00
Open-source	0.00	48.00	276.00	25.00	0.00	20.00	369.00

What's Next?

- Integration of third-party systems
  - 2007 - two
  - 2008 - ten or more
- International sites
- Real-time device data processing
- Multiple data sources
  - Databases
  - Financial systems
  - CRM
- Support for millions of devices "in the wild"

Shift Toward Consuming Resources

- Conscious decision to blur the distinction between "services" and "data sources"
- Everything is a STATELESS resource
  - SOAP, REST, JMS, files
  - Web apps back-end
  - Computational data
- Resources are available through a well-defined protocol
- Resources are always available through a common transport to simplify development and deployment
- Consumers implement workflow and keep state

What is Resource-Oriented Computing?

- All components of a system are viewed as resources to be consumed synchronously or asynchronously
- There is no distinction between “data”, “objects” or “services”
- There is no dependency on a programming language or framework
  - Mix and match is the reason why you want to move toward ROC
- Resources are located through URIs
- Software identifies resources through logical rather than physical mappings

What is Resource-Oriented Computing?

- Programs map logical and physical locations through identifiers in traditional computing models
  - String resource = “I am some useful, non-trivial text.”;
- ROC defines resources through verbs and logical identifiers
  - Yes, it sounds like REST
- An identifier ALWAYS returns the CURRENT representation of a resource
- Each logical identifier is resolved for every request
  - Resource implementations can change dynamically, resource consumers need not care about where or how a resource is implemented

Java vs. REST vs. ROC

	Java	REST	ROC
Identifier	private int nX;	URI	URI
Fetch	out.printf("nX = %d\n", nX);	Method GET URI	Protocol fetch + URI
Resolve	Compiler, reflection	DNS + app server	ROC kernel or backbone
Compute	Java Virtual Machine	App server	Endpoint and service object
Low-level operation	JVM, method, initializer	HTTP method + URI	Verb + URI pair

Defining Resources

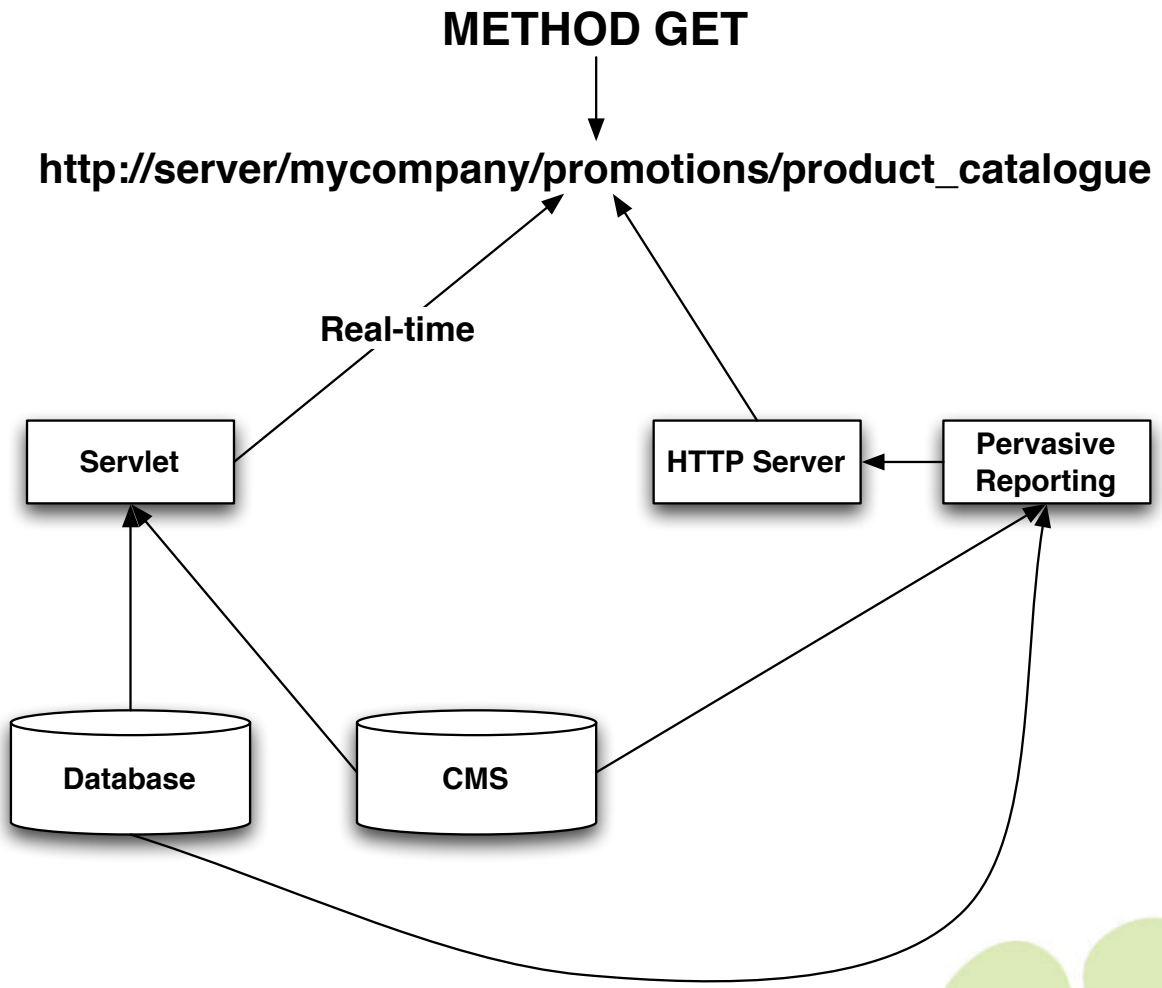
- Resources don't exist in the context of an application until they are requested
- Resources lack typing
  - Typing is relevant only to the consumer
- Endpoint URIs may convert types for individual data elements or complex data structures
- URIs may encode the desired operation to perform on the data
  - protocol://servername/subsystem/operation/resource

Resource Abstractions

http://server/mycompany/promotions/product_catalogue

- The promotions resources may be generated...
  - cron periodically
  - On-demand
  - Aggregated
- The promotions system of record is independent of the ROC platform or the consumer
- The “verb” here is “promotions”, when combined with a GET
- There may be two or more aggregators that produce the resource

Resource Abstractions



ROC Platforms

- Full ROC platform by 1060 Research
  - Custom distributed kernel
- GridGain, GigaSpaces
  - Distributed Computing
- Homebrew ROC
  - Are you in the business of building one from scratch?
- Off-the-shelf integration
  - Best-of-breed strategy: find the best components and integrate them

ROC Platforms

- VENDOR LOCK-IN!!!!
- Homebrew ROC
  - Are you in the business of building one from scratch?
- Off-the-shelf integration
  - Best-of-breed strategy: find the best components and integrate them

ROC Architecture

- The systems are built around a backbone that provides resources and routes requests as events via URI
- The backbone acts as a resource container or as a conduit between resources or resources and consumers
- URI is an abstraction - mapping is done by the backbone
- Resource containers can exist in the same memory space as the backbone or in a separate system
- Resource providers may be written in any programming language
- Resource providers are stateless

ROC Architecture

- Modularity is attained through logical separation of resources
  - Resource providers as .jar, .war, or other entity
  - Localized backbones
  - Localized resource providers
- Logical separation may obey organizational policy, technology policy, or both
- Implementation can be done with off-the-shelf components in any combination that makes sense, as long as the backbone is protocol-, language-, and vendor-independent

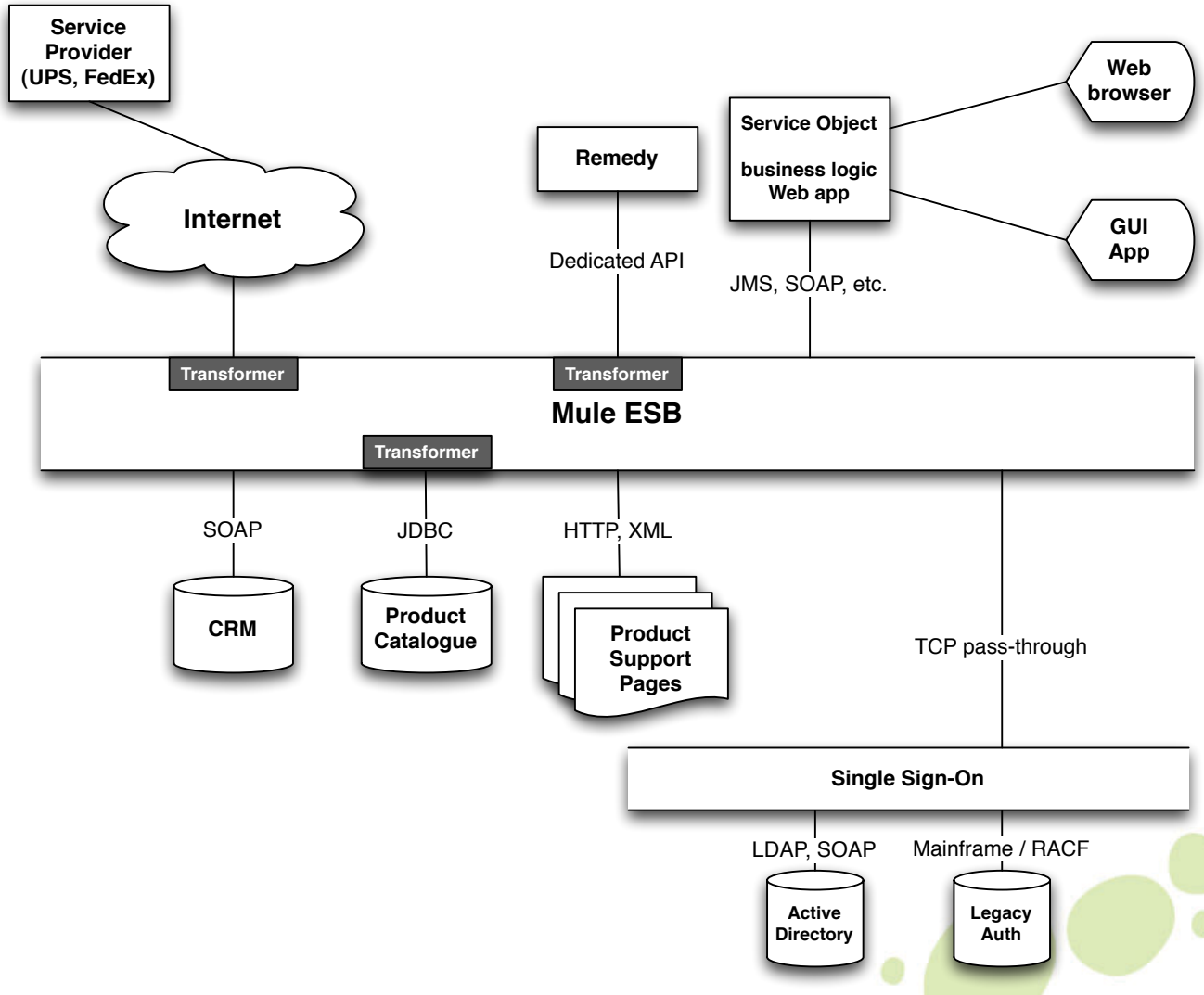
ROC Architecture

- **Backbone: Mule ESB**
  - Provides full independence from the kind of crap that vendors like to create lock-in for
  - Open-source
  - Workflow, transactions, transformations, logging, routing
- **Tailbone, funnybone: Mule ESB**
  - UMOs (service objects) implement business logic independently of protocol or data formats by design (think of them as protocol-independent servlets)
  - Transactional, app server and workflow logic built-in
  - UMOs are just POJOs
- **Synchronization**
  - In-memory endpoints

ROC Architecture

- Original architecture had lots of best-of-breed software
  - Tomcat
  - Dedicated application/service providers
  - Web servers
- ROC architecture only has two basic building blocks
  - Mule acting as a resource service provider (i.e. Mule is the application container)
  - UMOs as computationally active entities
- Existing and off-the-shelf systems plug into the architecture through SOAP, REST, JMS, etc.
- Mule allows us to define our own protocols, if necessary!

ROC Architecture



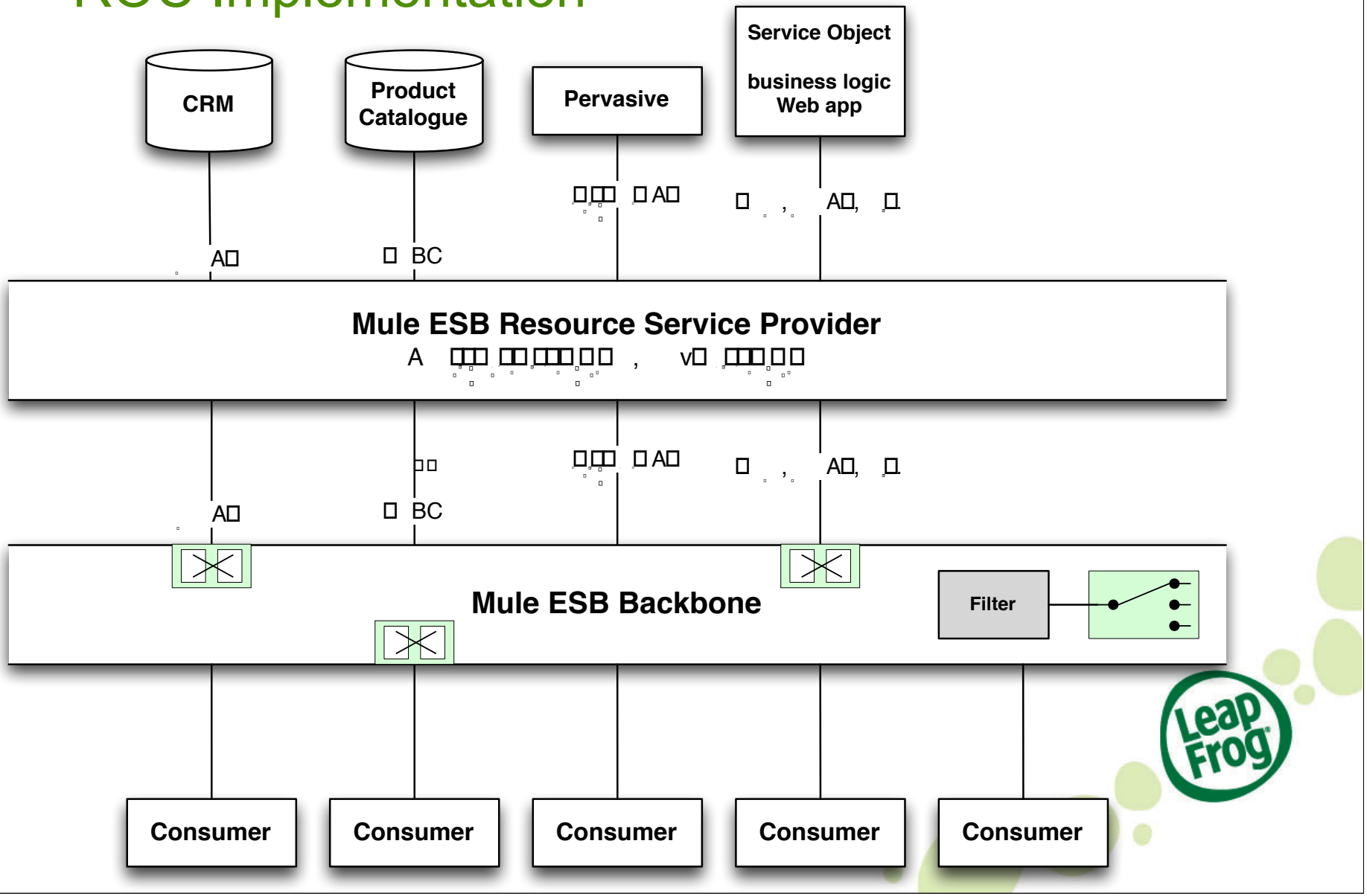
ROC Implementation

- Dedicated protocols
  - vm://mycompany/subsystem/resource_name
  - http://mycompany/subsystem/resource_name
- Easy to extend to handle ROC:

verb:protocol://mycompany:port/organization/subsystem/resource_name

- Easy to implement!

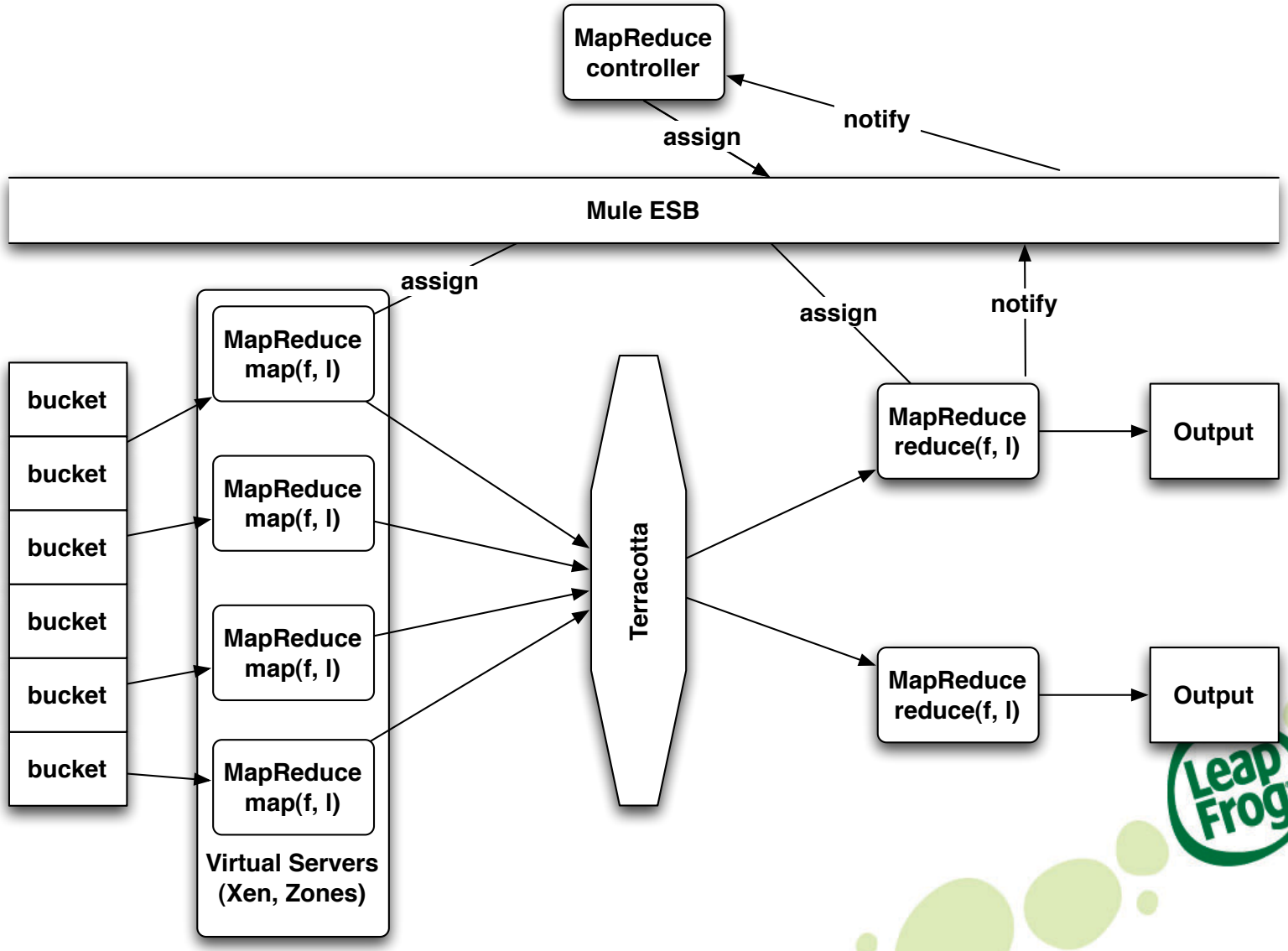
ROC Implementation



ROC Implementation

- Resource providers
  - SOAP API to CRM
  - Abstracted JMS API to transactional pieces
  - Download app repository
- Interfaces to existing systems
  - Epsilon direct mail interfaces
  - FTP, sftp, other data transfer
- Computational resources for ad hoc new functionality
  - Device log processing
  - MapReducers (2008, 2009)

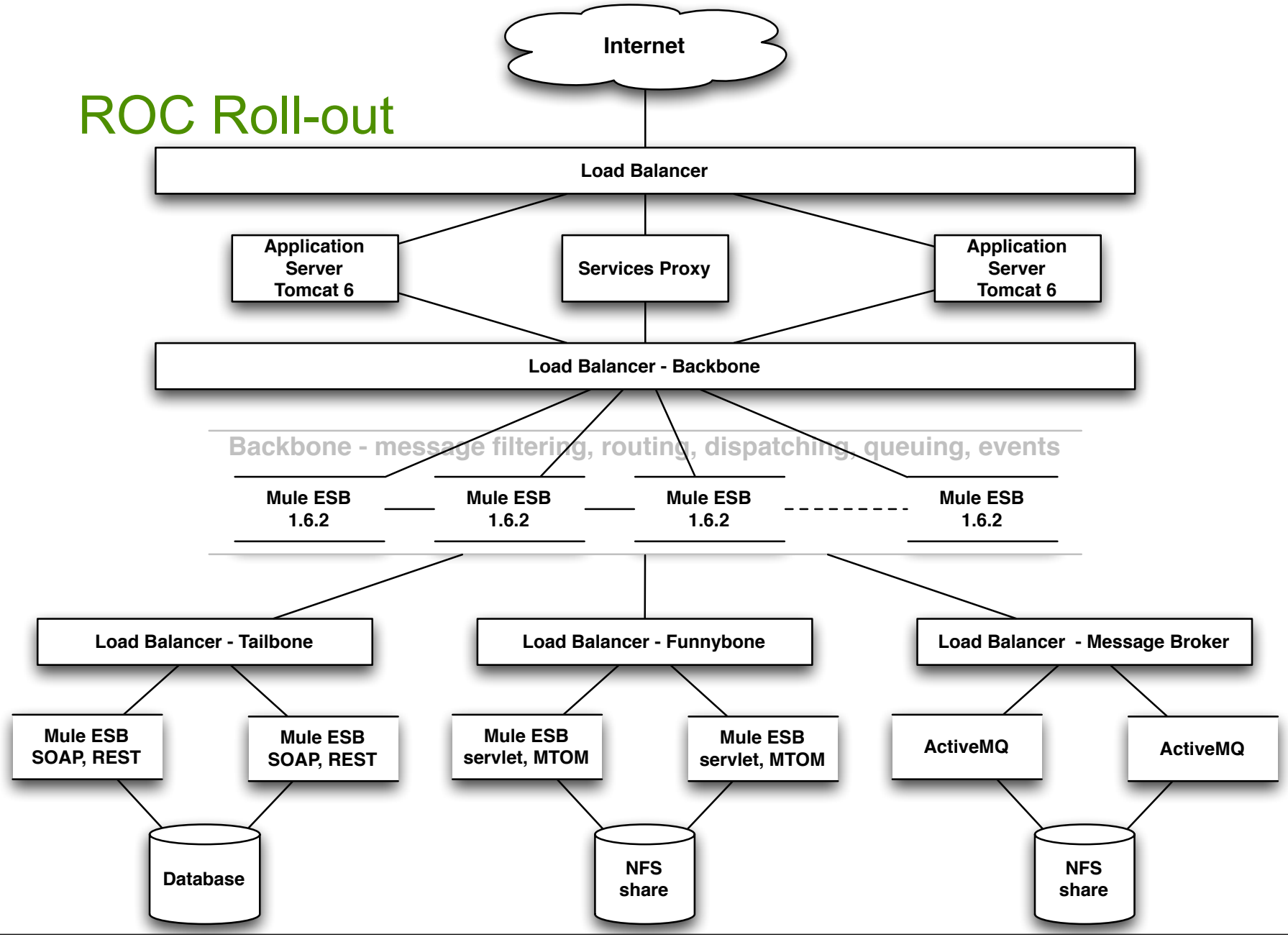
ROC Implementation



ROC Roll-out

- Quick, turnkey roll-out
- The fewer systems to maintain, the better
- Use Java or JVM-hosted languages wherever possible
- Integrate with third-party or non-Java systems over standard or custom protocols with as quick a turnaround as possible
- EASY TO SCALE QUICKLY!!!!

ROC Roll-out


Internet
Load Balancer
Application Server Tomcat 6
Services Proxy
Application Server Tomcat 6
Load Balancer - Backbone
Backbone - message filtering, routing, dispatching, queuing, events
Mule ESB 1.6.2
Mule ESB 1.6.2
Mule ESB 1.6.2
Mule ESB 1.6.2
Load Balancer - Tailbone
Load Balancer - Funnybone
Load Balancer - Message Broker
Mule ESB SOAP, REST
Mule ESB SOAP, REST
Mule ESB servlet, MTOM
Mule ESB servlet, MTOM
ActiveMQ
ActiveMQ
Database
NFS share
NFS share

Conclusions

- Complex systems are easier to code and maintain if implemented as small blocks
- Small blocks can be mapped as resources that can be consumed in a stateless fashion
- Applications can be built as an aggregation of resources
- ROC techniques improve time-to-market
- ROC techniques combined with open-source offerings can reduce deployment costs by 70%, and ongoing maintenance by 30-40%
- Complex systems can be integrated as a combination of best-of-breed software whether commercial, open-source, or homebrew
- ROC is the logical evolution of applied SOA

Q&A

Thanks for coming!

This presentation is at:
http://eugeneciurana.com/JavaZone2008/ROC.pdf

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