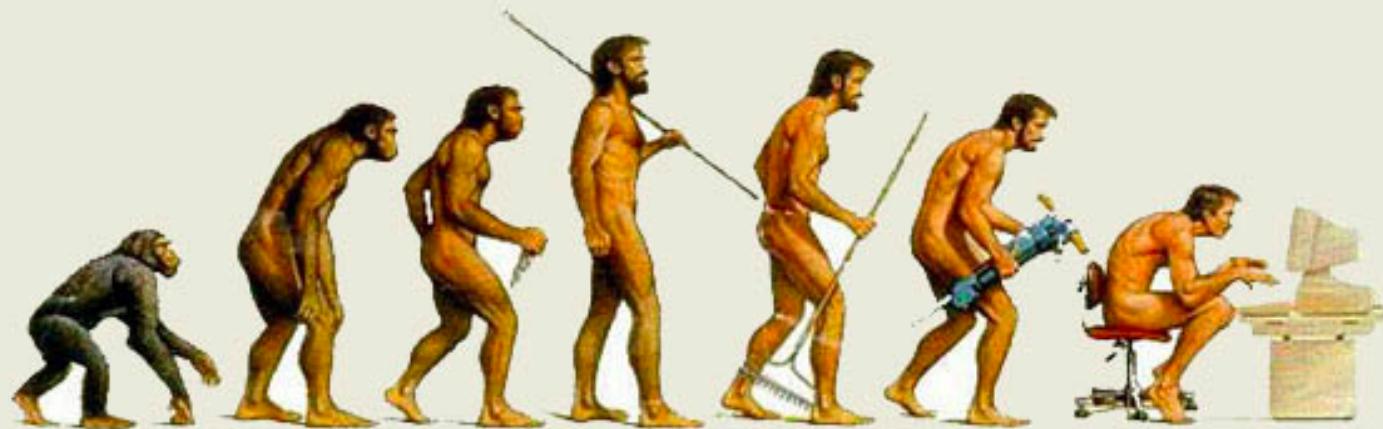


The Evolution of Distributed Computing and Integration

Oxford University
Software Engineering Programme
Dec 2014



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Distributed Computing



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Why is Distributed Computing important?

- Scale
- Evolution
- Integration
- Cross-boundary



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DCE

- Standardized remote procedure call model proposed in the 90s by the Open Software Foundation (OSF)
- Didn't succeed widely, except as part of Microsoft's DCOM

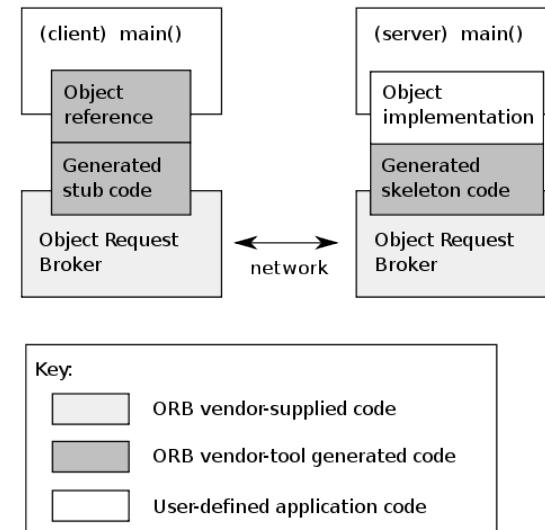


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CORBA

Common Object Request Broker Architecture

- An attempt to move DCE like distributed computing into the OO world
- Object Management Group (OMG)
- Still in some use today
- Stagnated/Deprecated



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SOAP

- XML approach to replace CORBA/DCE, etc
- Theoretically built to be transport independent and message oriented
- 97% of the time used over HTTP in RPC model
- We will cover in much more detail later



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REST

- Representational State Transfer
 - A model that influenced and was based on HTTP 1.1
- Web approach to distributed computing and integration
- We will cover in much more detail later



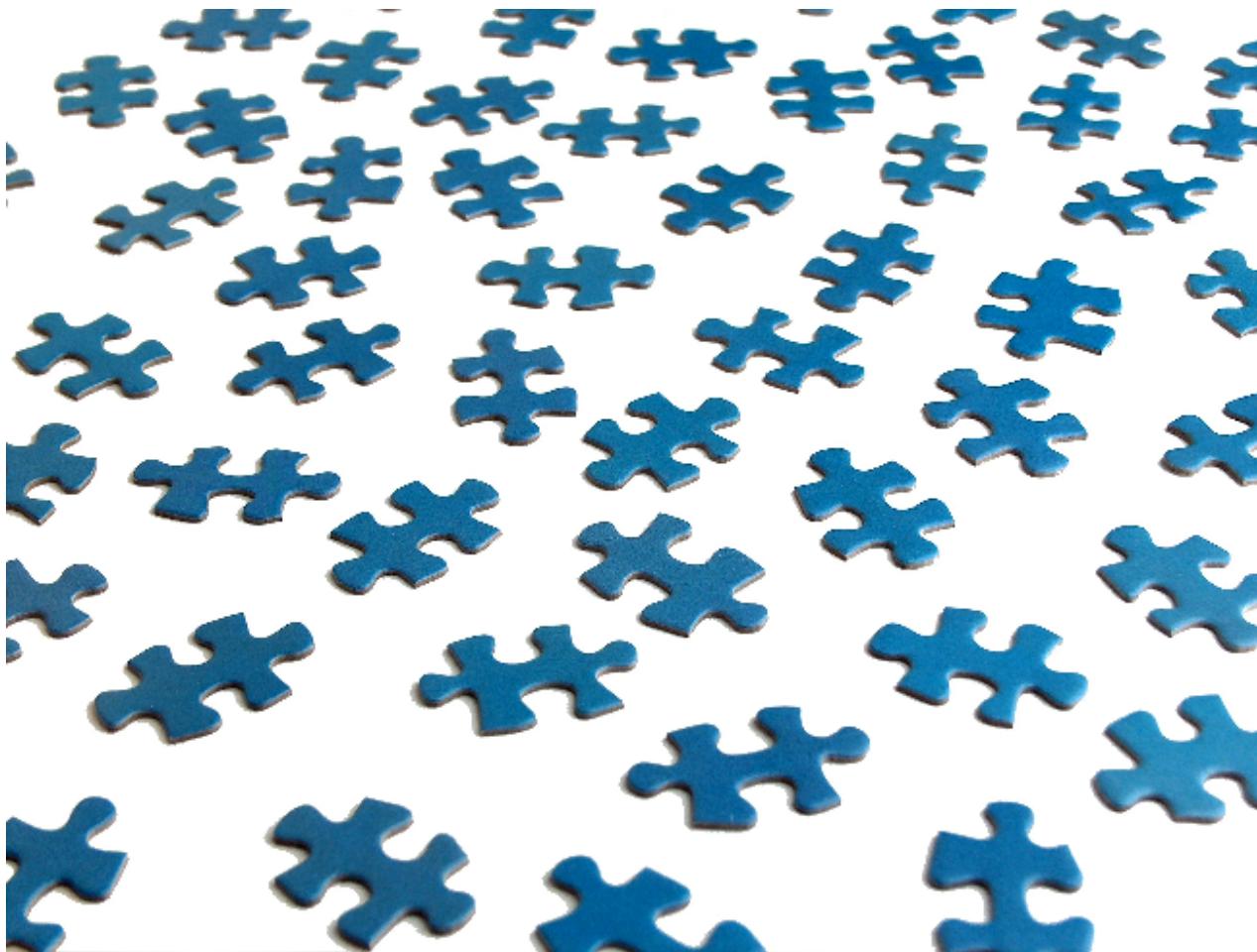
Next generation RPC

- Java RMI (Remote Method Invocation)
- Google Protocol Buffers
- Apache Thrift
- Apache Avro
- Kryo etc
- Twitter's Finagle



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Integration



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Integration

- It is unhelpful to consider Distributed Computing and SOA without considering Integration
- Integration is the problem of creating applications that incorporate existing as well as new logic
- Almost no system is standalone and does not need to evolve!
- Even embedded systems are now moving to incorporate Internet and Messaging



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Integration points

- Data
 - Integration in the database layer
- Application
 - Inter-application integration
- Web tier
 - Portal based integration
- On-the-glass
 - Cut and paste



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Tightly coupled

- Tightly coupled systems have significant problems:
 - Errors, delays and downtime spread through the system
 - The resilience of the whole system is based on the weakest part
 - Cost of upgrading or migrating spreads
 - Hard to evaluate the useful parts from the dead weight



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Loose coupling



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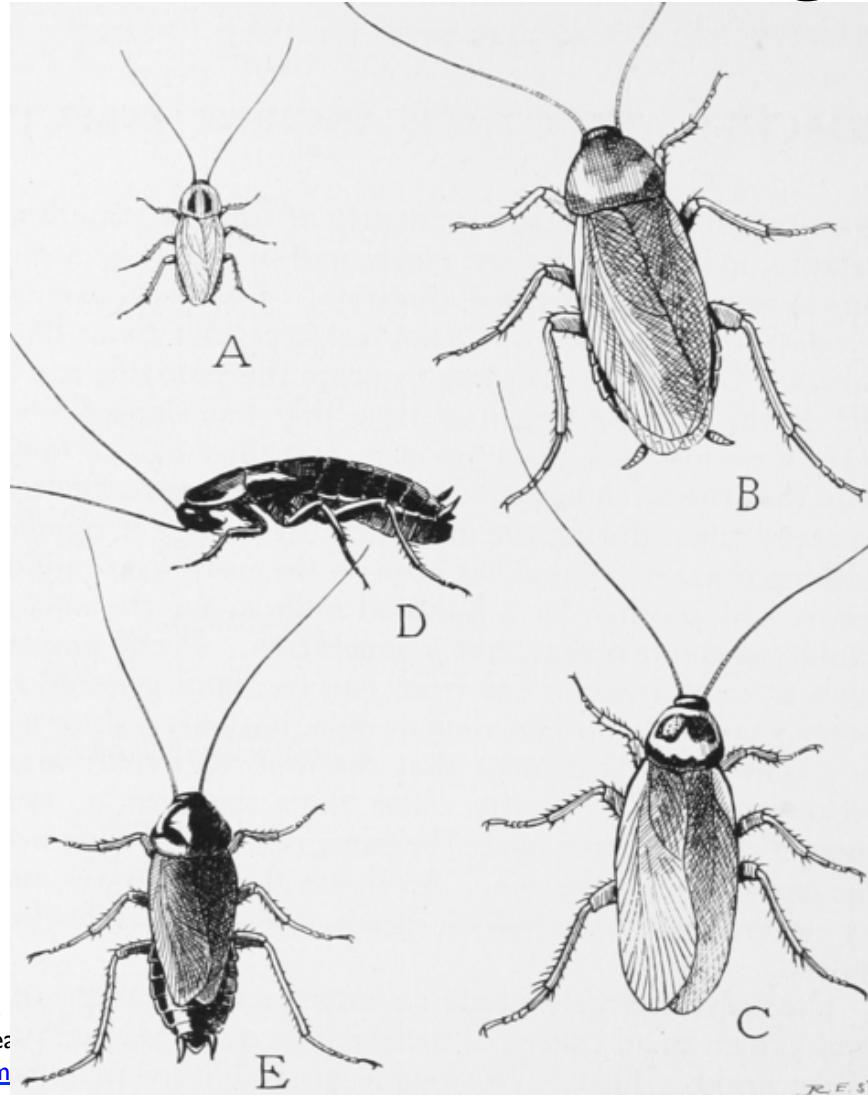
“6 Degrees of Separation”

- Location
- Access
- Programming Language
- Stack/Vendor
- Time
- Scalability



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Batch file transfer - the cockroach of integration

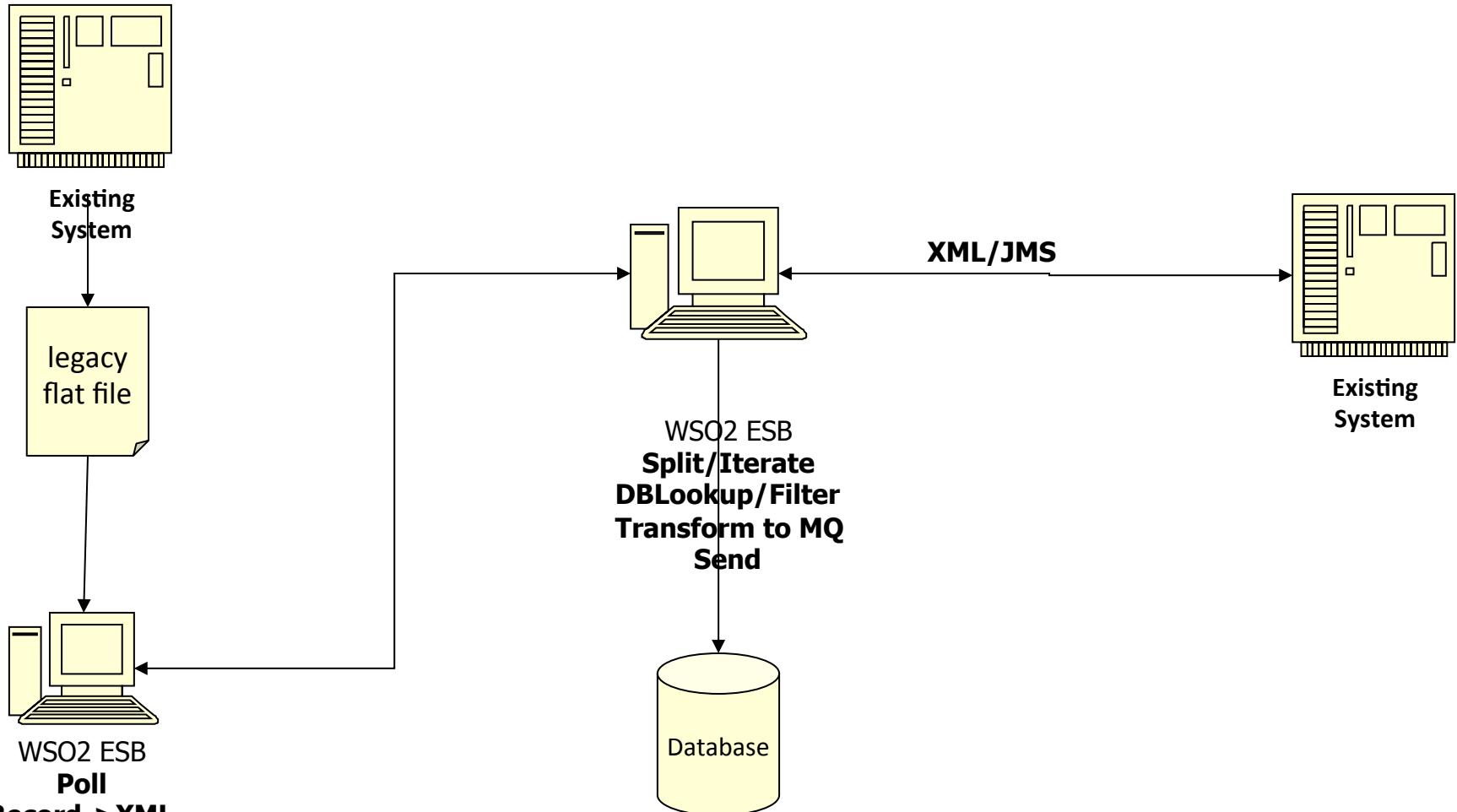


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File transfer lives on



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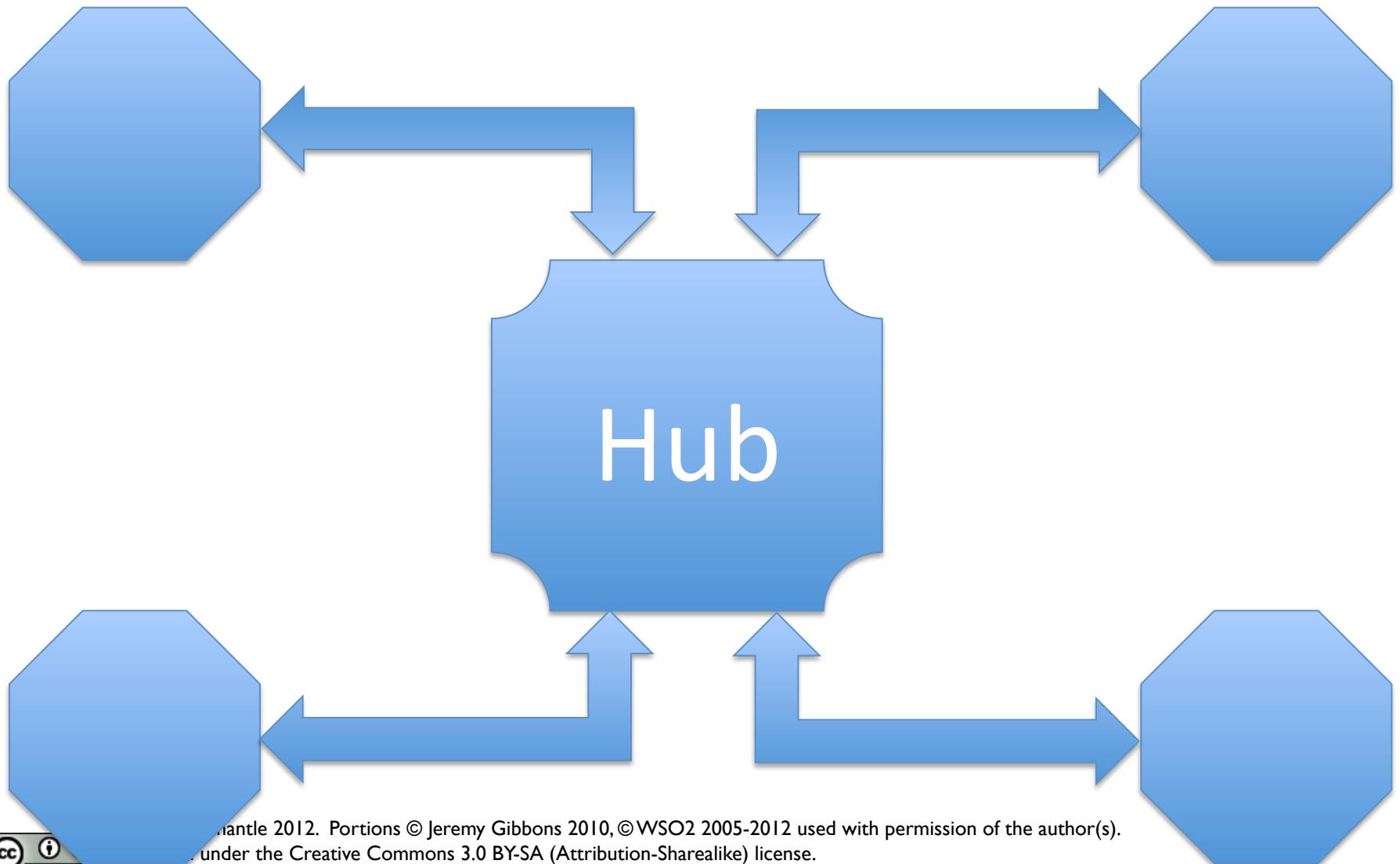
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NEW YORK

LONDON

EAI



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EAI hub

- Many integration models still uses the “hub model” today (even with an ESB)
 - Most vendors renamed their hub to ESB
- Why?
 - Well understood pattern
 - Easy to manage
- Why not?
 - Too many meetings with the “EAI Hub Team”
 - Too centrally managed (MQSI experiences)

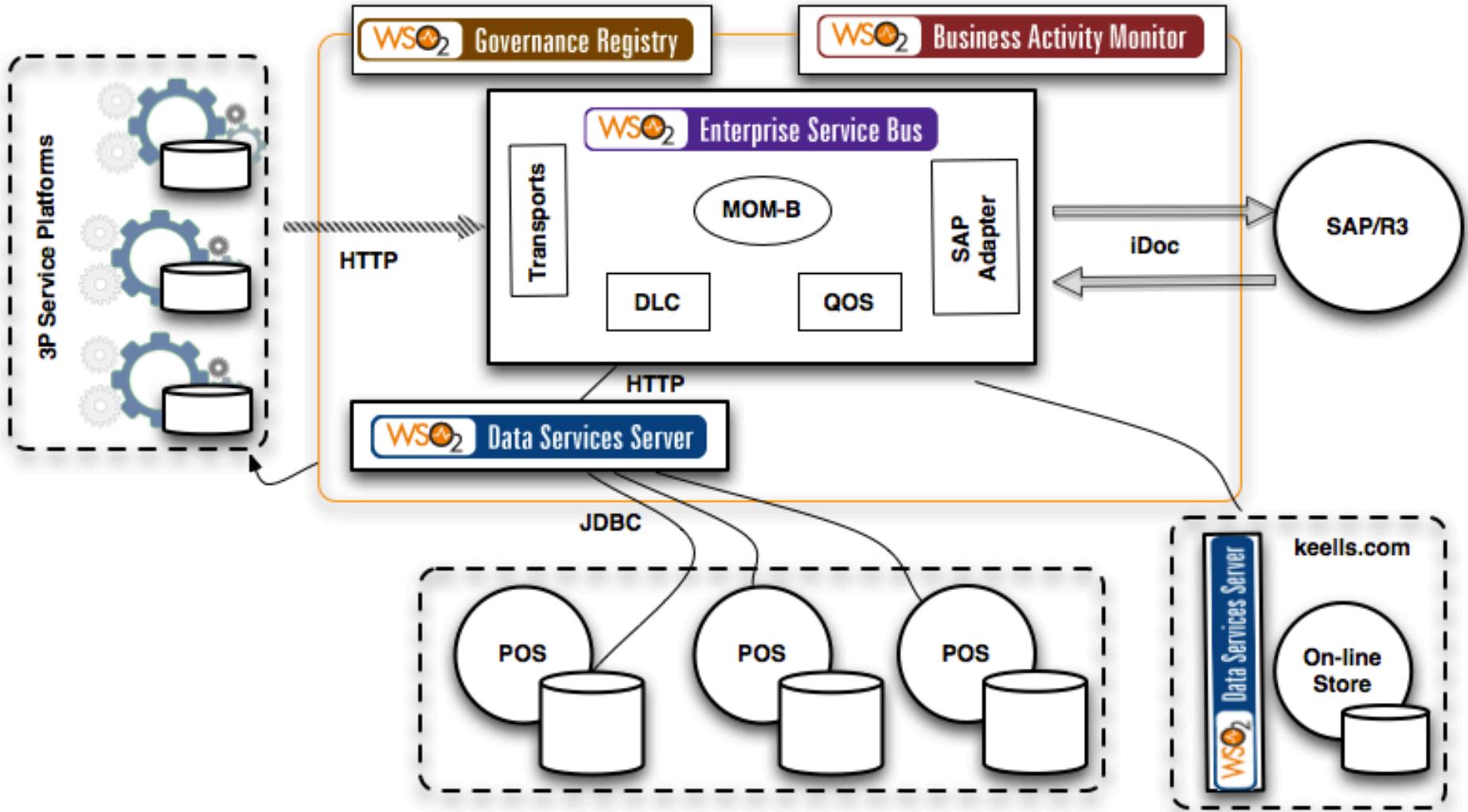


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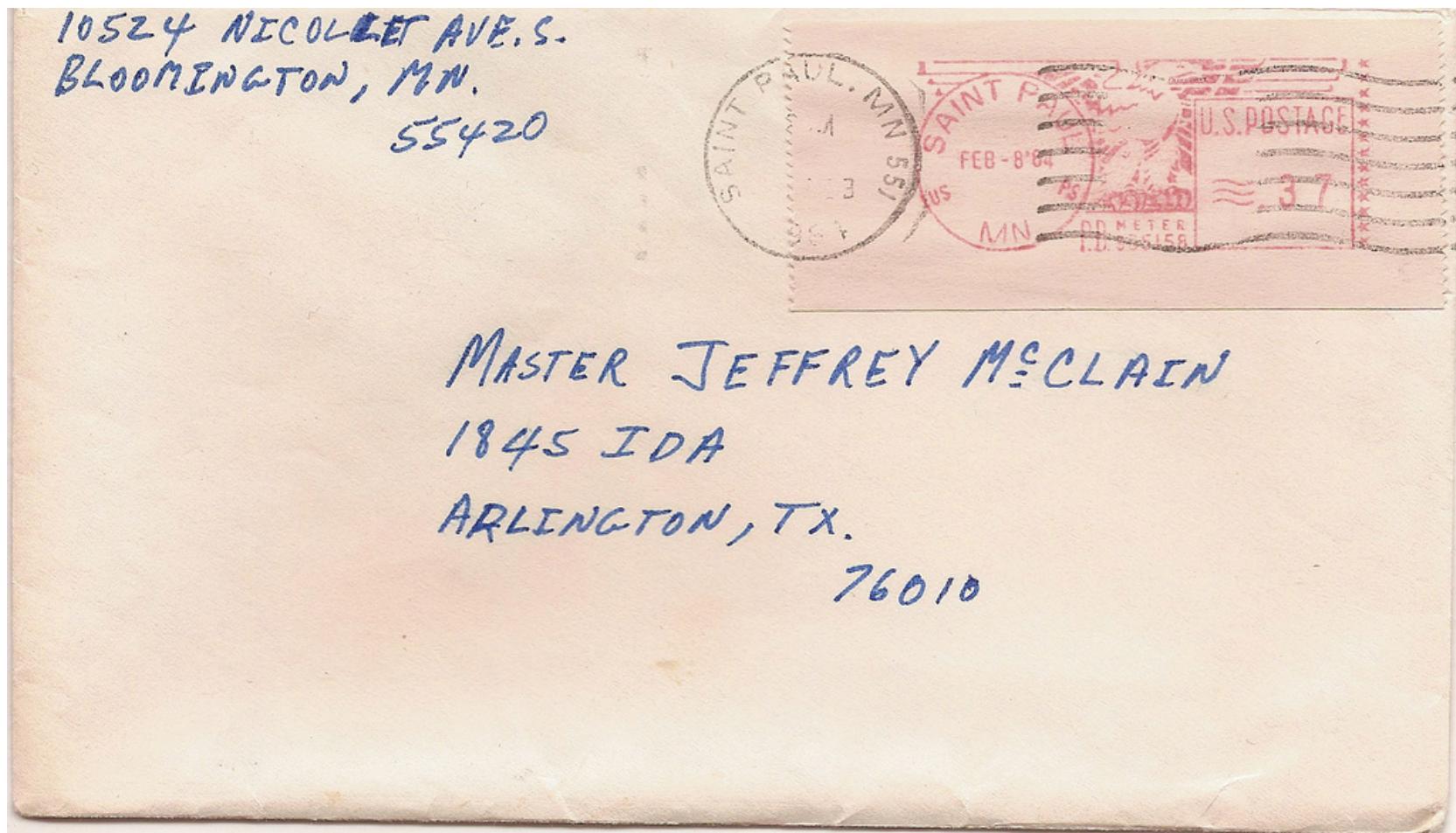
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Hub approach with an ESB



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“Message Oriented Middleware”



<http://www.flickr.com/photos/robeast/>



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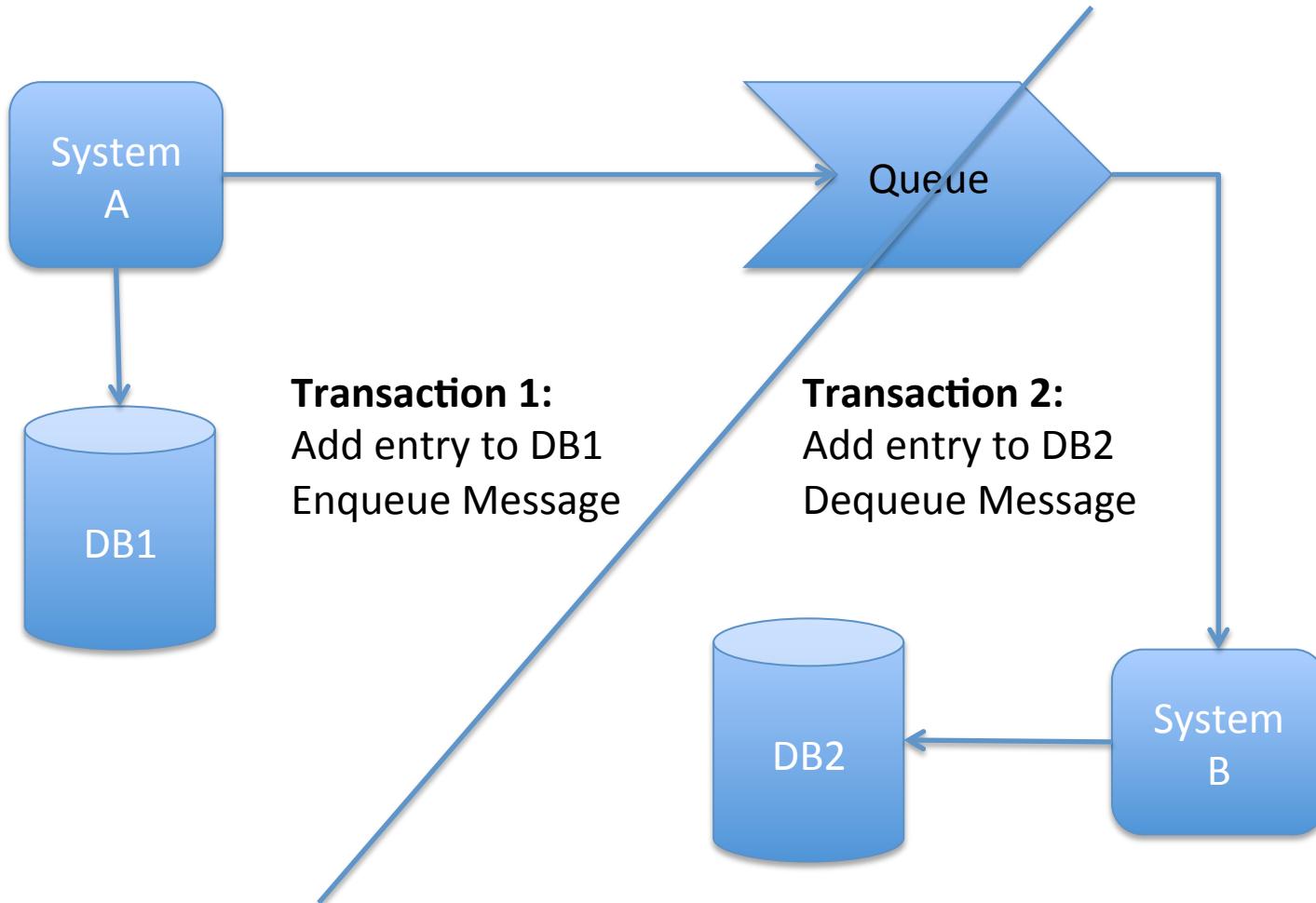
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MOM model

- Decouple message producers from consumers
 - Decoupled in addressing *and* in time
- Not inherently decoupled in message format
 - Though in many cases that too
- One-way asynchronous messages
 - But request-reply possible using “Reply Queues”
- Usually used with reliable delivery



Queued Transaction Processing



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AMQP



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AMQP

- Emerged out of JP Morgan
 - Wanted an open source/open standard alternative to proprietary (e.g. MQSeries)
 - Standardized at OASIS
 - Multiple Open Source implementations
 - RabbitMQ, Apache Qpid, WSO2 Message Broker, Apache Apollo, Apache ActiveMQ, etc
 - Used widely e.g. in OpenStack



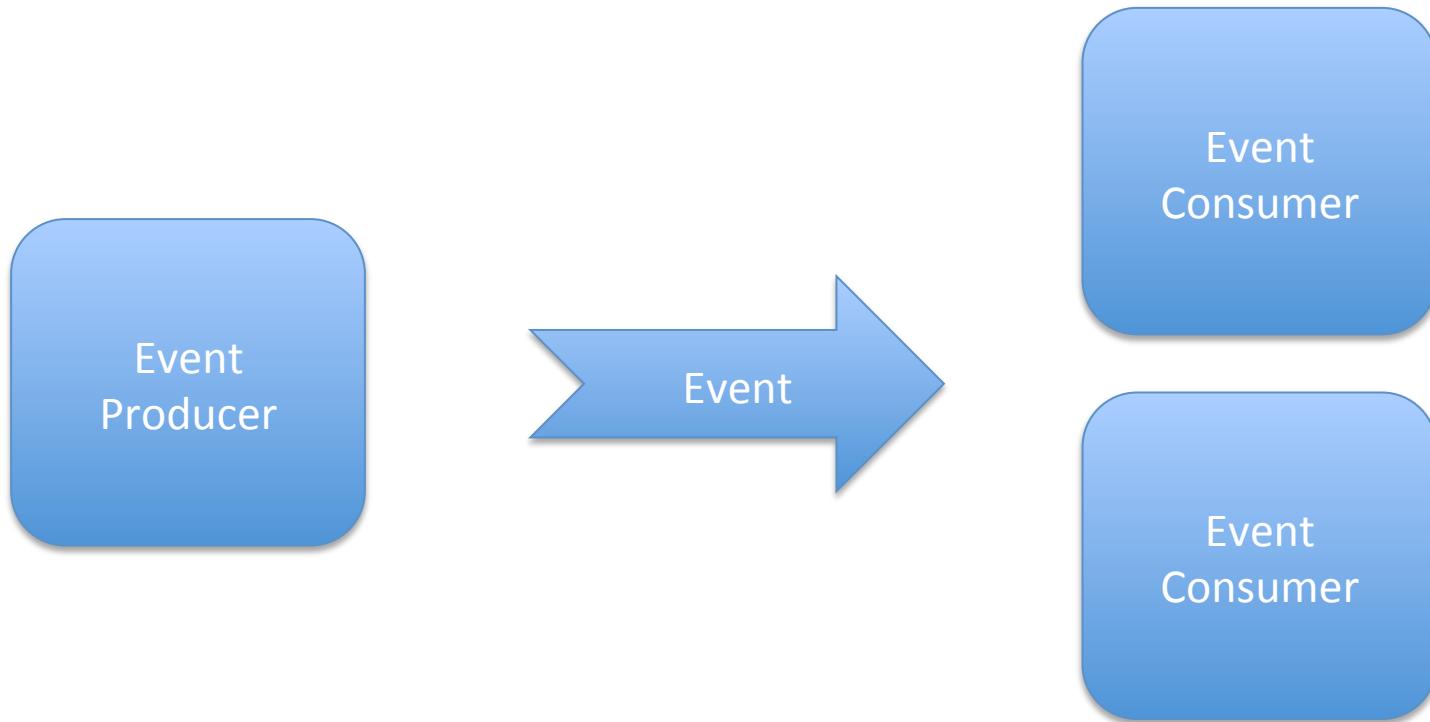
MQTT

- Very lightweight messaging pub/sub system
- Built for SCADA, M2M, IoT
- Being standardised at OASIS MQTT TC
 - Close to being done
 - No wire changes from 3.1
- Big effort in the Eclipse Paho / M2M project



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Event Driven Architecture



“Event Driven Architecture”

- Actually how Apache (and WSO2) work(s)
 - Mailing lists = topics
- Can be layered with reliable delivery
- Used a lot in high-volume logging, trading environments, fraud detection, etc
- *Requires a very different mindset*

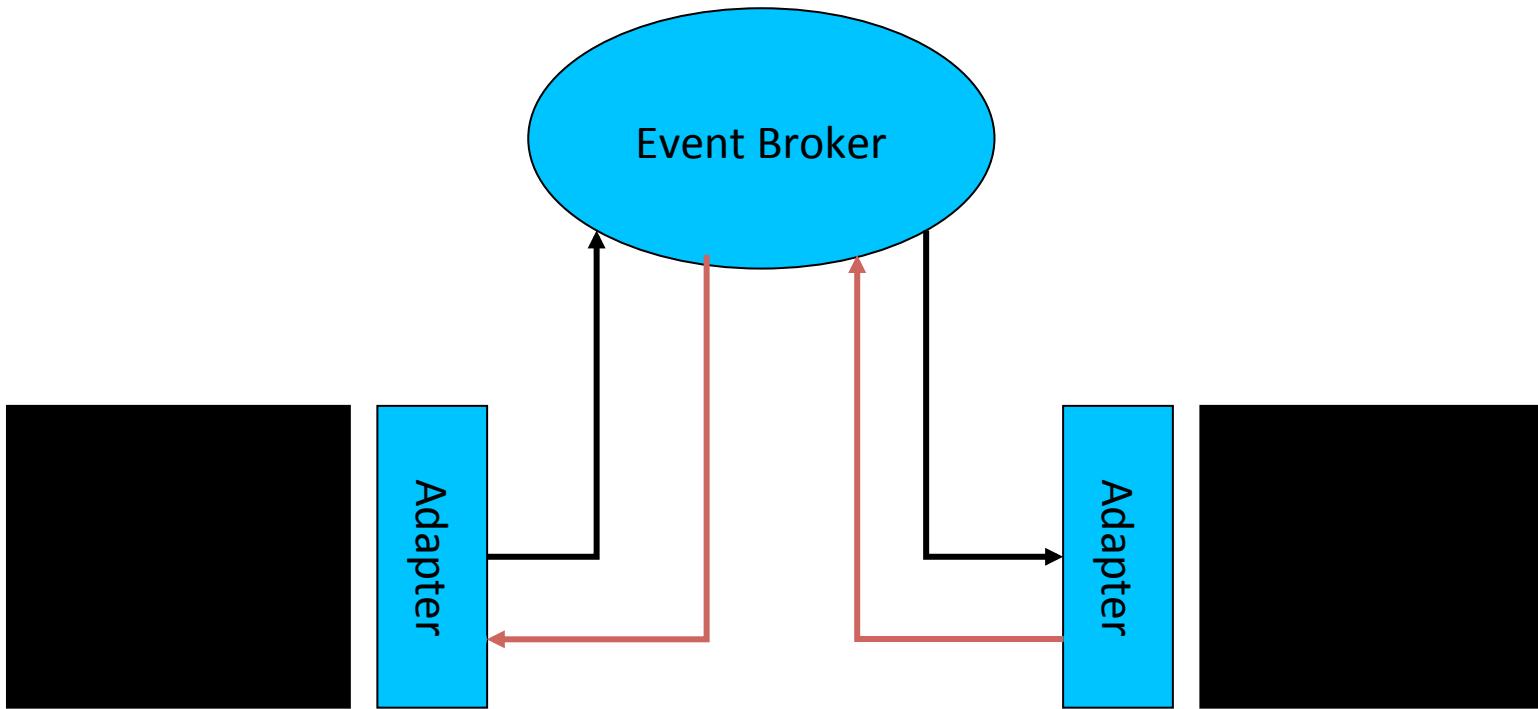


EDA



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Feedback loops

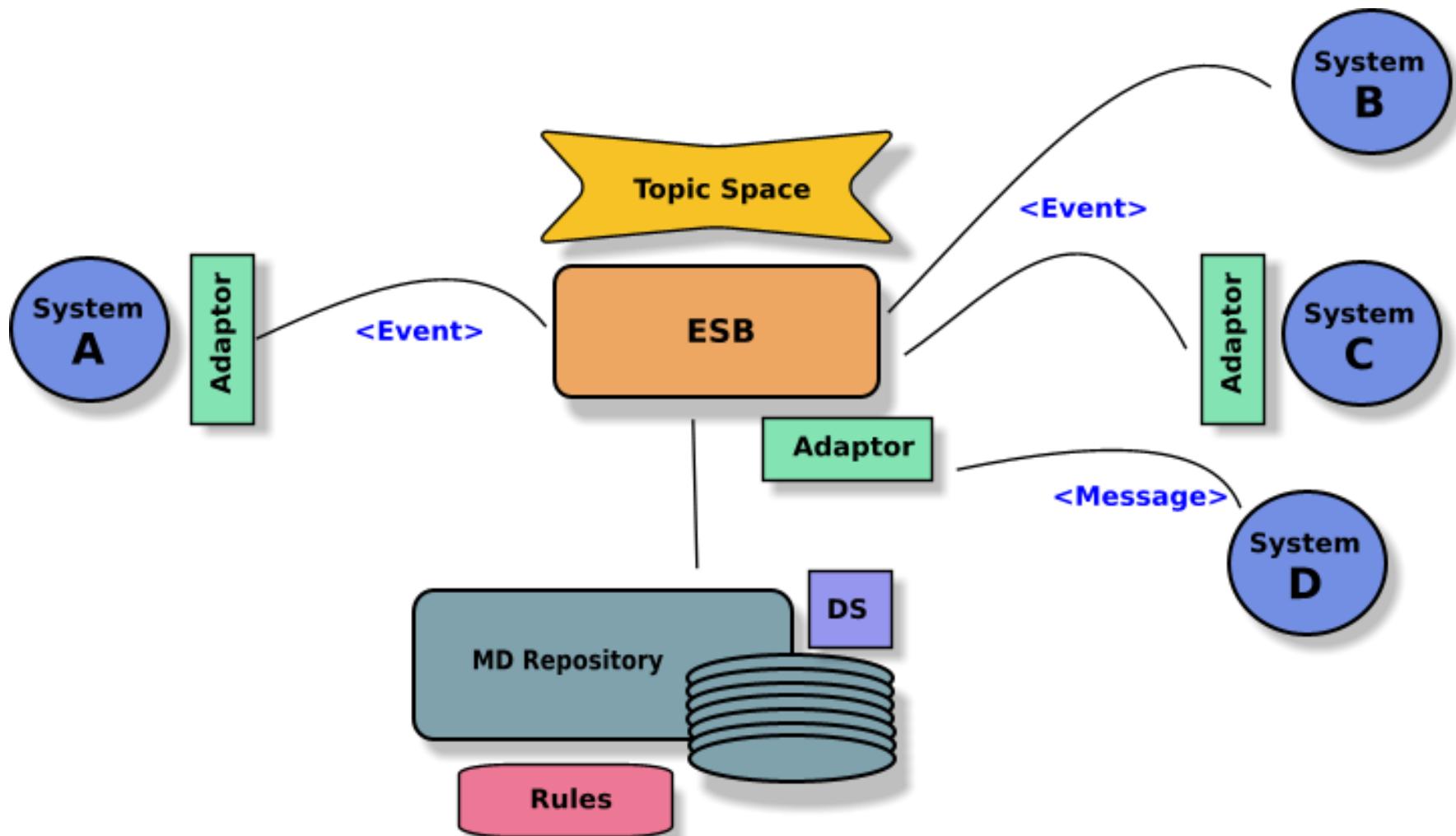


<http://pzf.fremantle.org/2008/09/interesting-problem-in-event-driven.html>



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Solution



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Why did SOA evolve?

- Directly came out of XML
 - Understanding the schema and structure of messages
 - Especially within the “fabric” not just at the endpoints
- What’s different?
 - Metadata
 - Policies
 - Security



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Service



<http://www.flickr.com/photos/yjv/>

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SOA failures

One consumer per service



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SOA failures

“Just buy an ESB from me”



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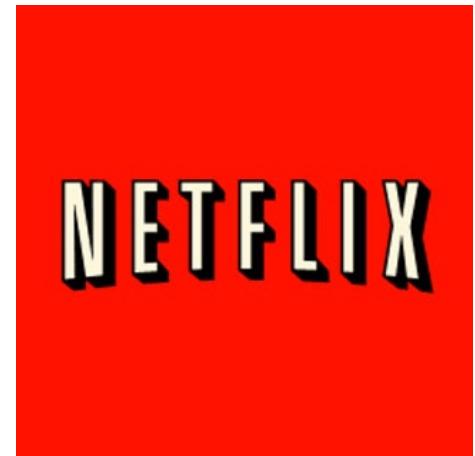
SOA failures

Vendor Driven Architecture



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“soa” successes



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Turmeric

[What is Turmeric?](#)

Turmeric is a comprehensive, policy-driven SOA platform that you can use to develop, deploy, secure, run and monitor SOA services and consumers. It is a Java based platform, follows the standards (SOAP, XML, JSON, XACML, etc.), and supports WSDL (SOAP style - Doc Lit wrapped mode and REST style). It supports a variety of protocols and data formats. Eclipse plugins help with the development of services and consumers. Other important features include:

- Various Quality of Service (QoS) features such as authentication, authorization, and rate limiting, which you control by defining respective policies.
- Monitoring capabilities.

Fork me on GitHub



Why ESB/SOA model isn't just EAI

- Policy based
 - XACML, Throttling Policy, etc
 - eBay's Internal Service Router
- Independent management
 - Loose coupling of configuration
 - Hot deploy / re-deploy / continuous delivery
- Governance
 - Lifecycle and Dependency management
 - Analysis and reporting on the meta-model
- Non-blocking asynchronous routing
- Distributed architecture



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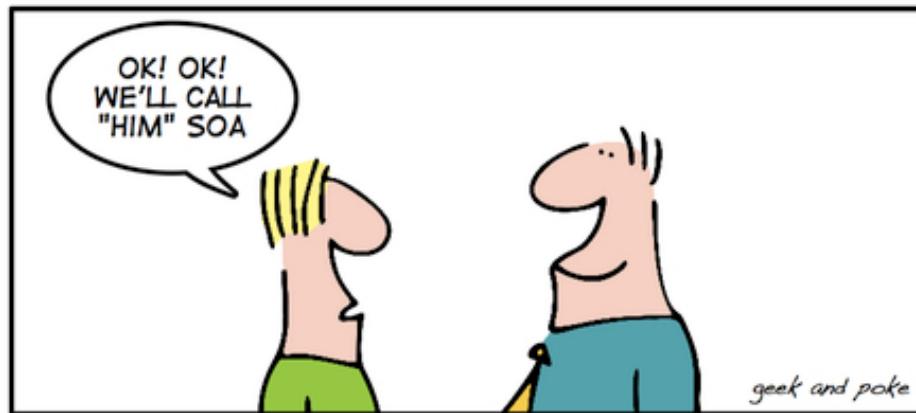
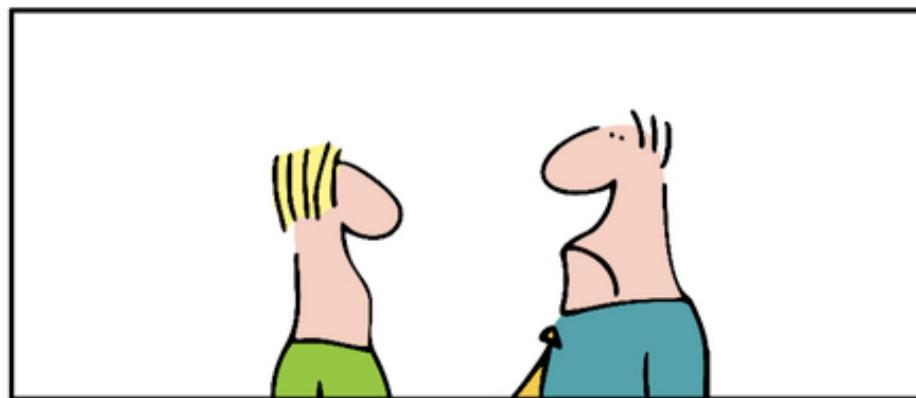
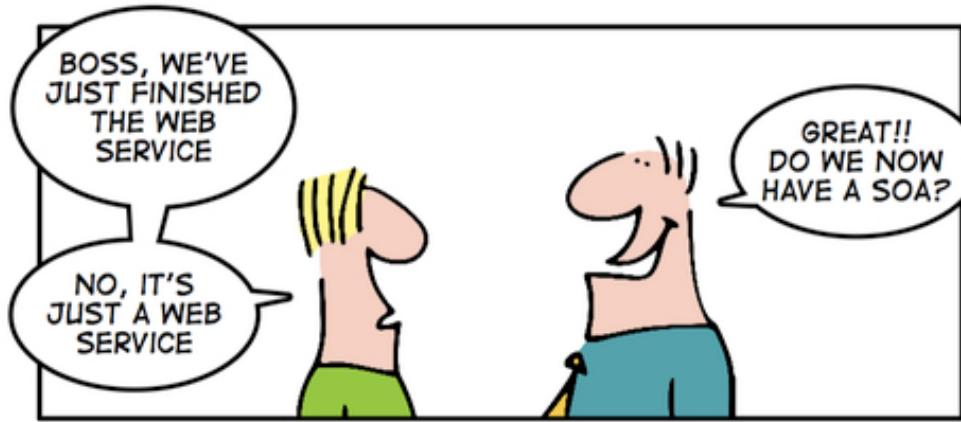
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Web Services != SOA

- There are SOA's that don't use Web Services
 - We will see some in the case studies...
- There are systems that use Web Services that are not Service Oriented
 - e.g. Taking an existing text/TCP model and tunnelling over SOAP





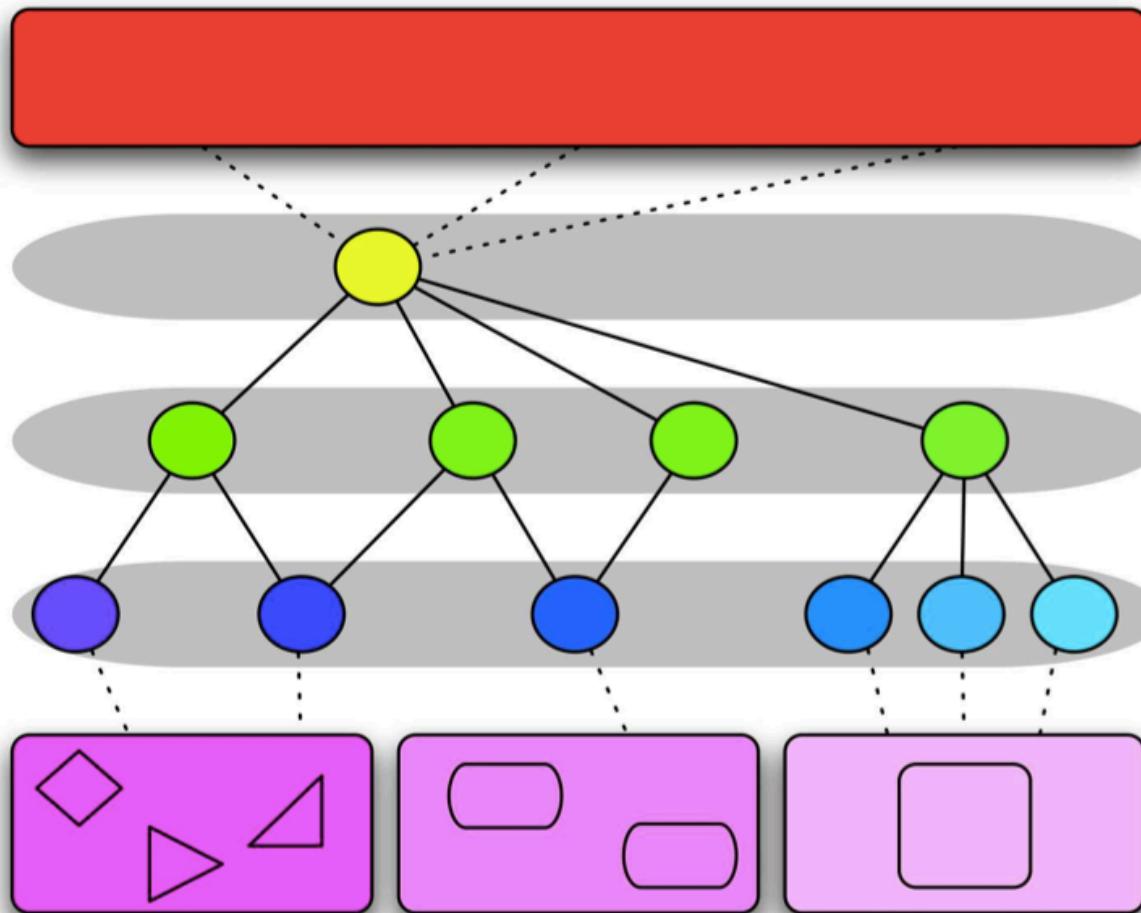
HOW TO GET A SOA



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or(s).

SOA



business processes

orchestration service layer

business service layer

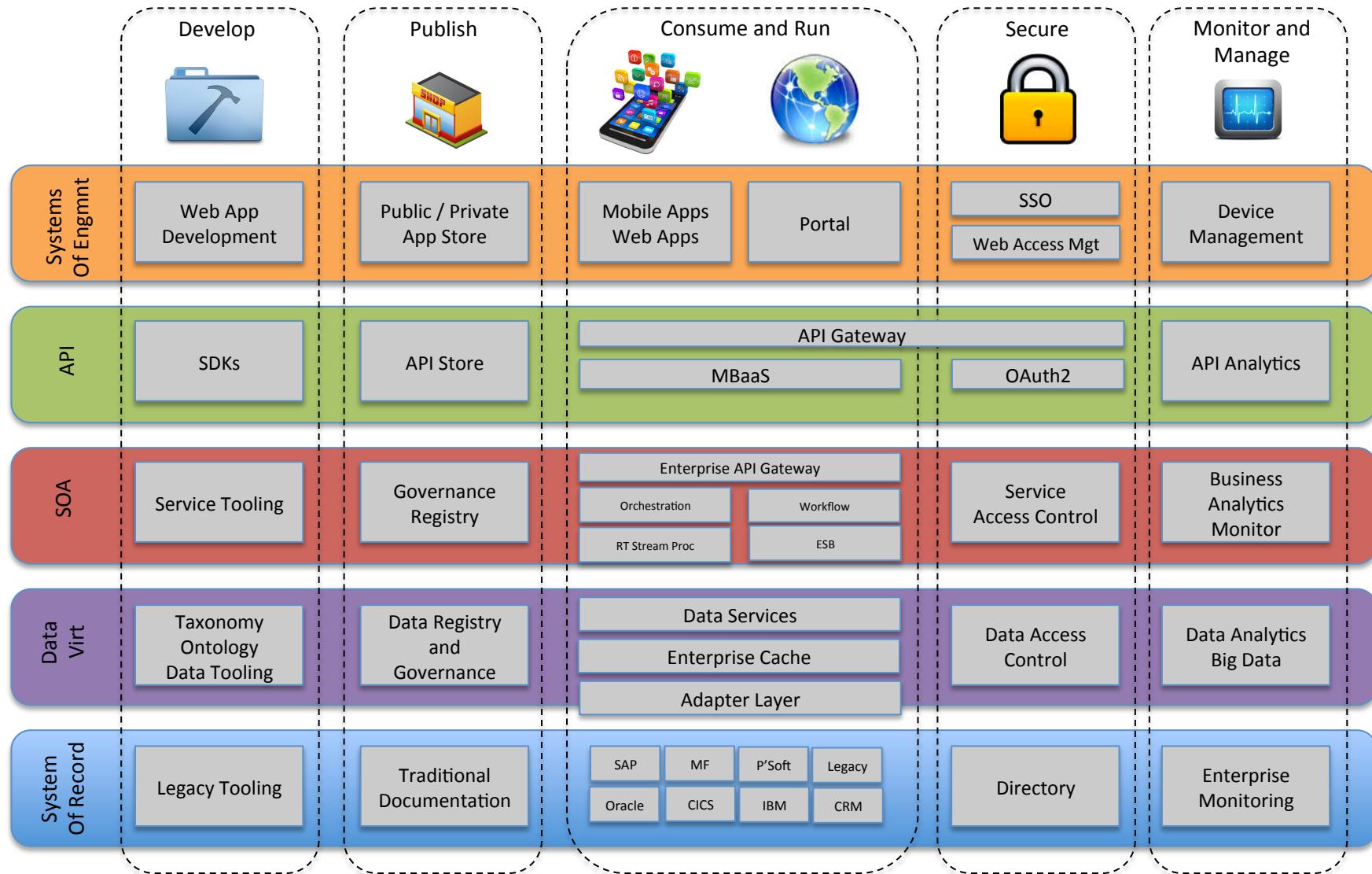
application service layer

application layer

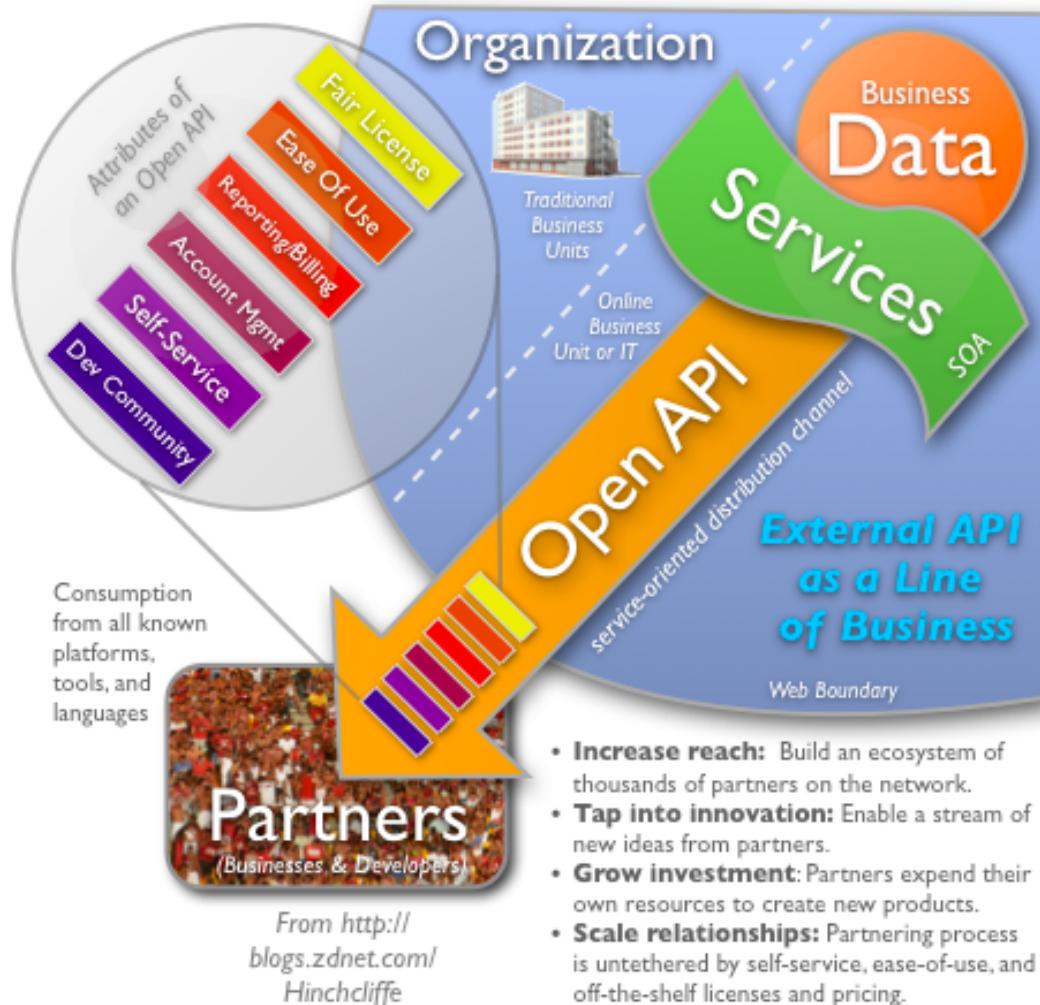


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End-to-End Architecture and Functional Requirements for a Connected Business



Running your SOA like a Web startup



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<http://www.zdnet.com/blog/hinchcliffe/running-your-soa-like-a-web-startup/525>

API

- **An API** is a business capability delivered over the Internet to internal or external consumers
 - Network accessible function
 - Available using standard web protocols
 - With well-defined interfaces
 - Designed for access by third-parties



What is different from an API and a Service?

- Publishing your API in a Portal
- Expecting people to use it without them having to meet with you
- Making it easy to consume (JSON? Ready built clients in Github?)
- Governance
 - Caring who uses it
 - Letting them know when you version it
 - Meeting an SLA



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Key API technologies

- json / rest
- OAuth / OAuth2 keys
- SLA management
- API portal / API Store
 - Catalogue, subscription/purchase
 - Monetization
 - Forum, Ratings, Social
- Analytics



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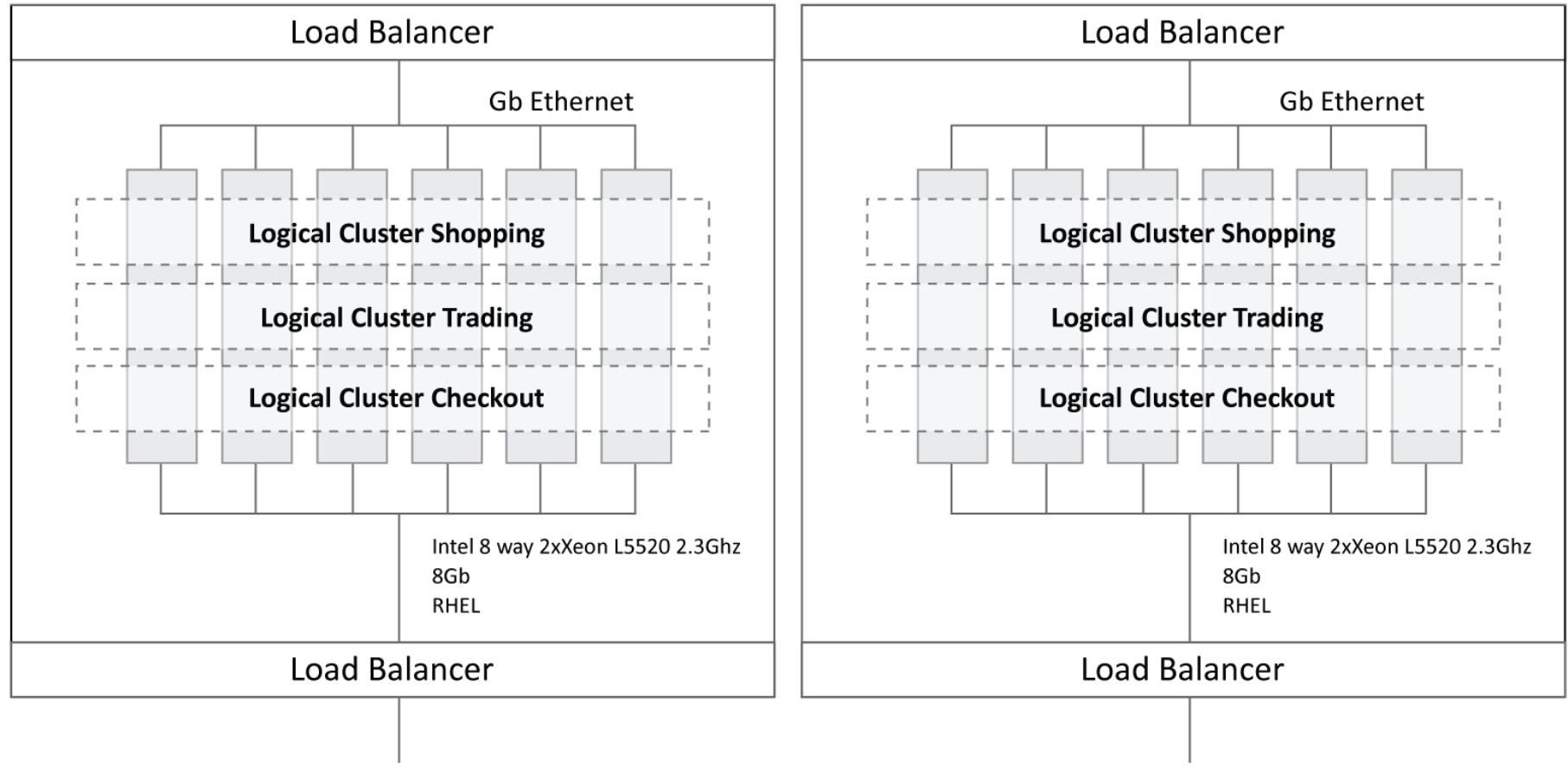
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High volume integration @ eBay



100's of service instances

Tomcat + Axis2

... <http://creativeservices.greenerbay.com>

Change in focus

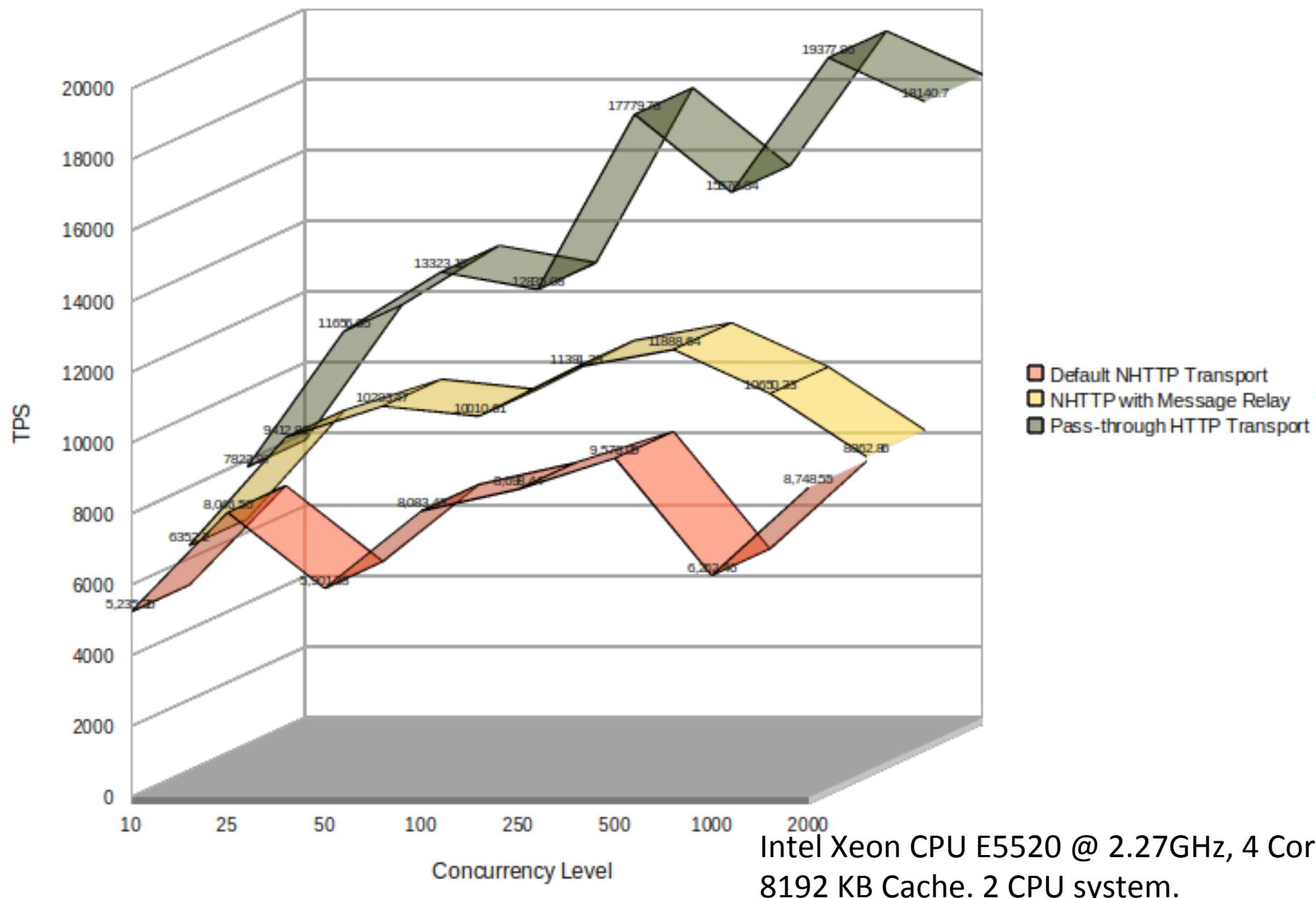
- Security, tokens, access control/entitlement
- Throttling, caching
- Latency and CPU usage
- Monitoring, BAM and CEP



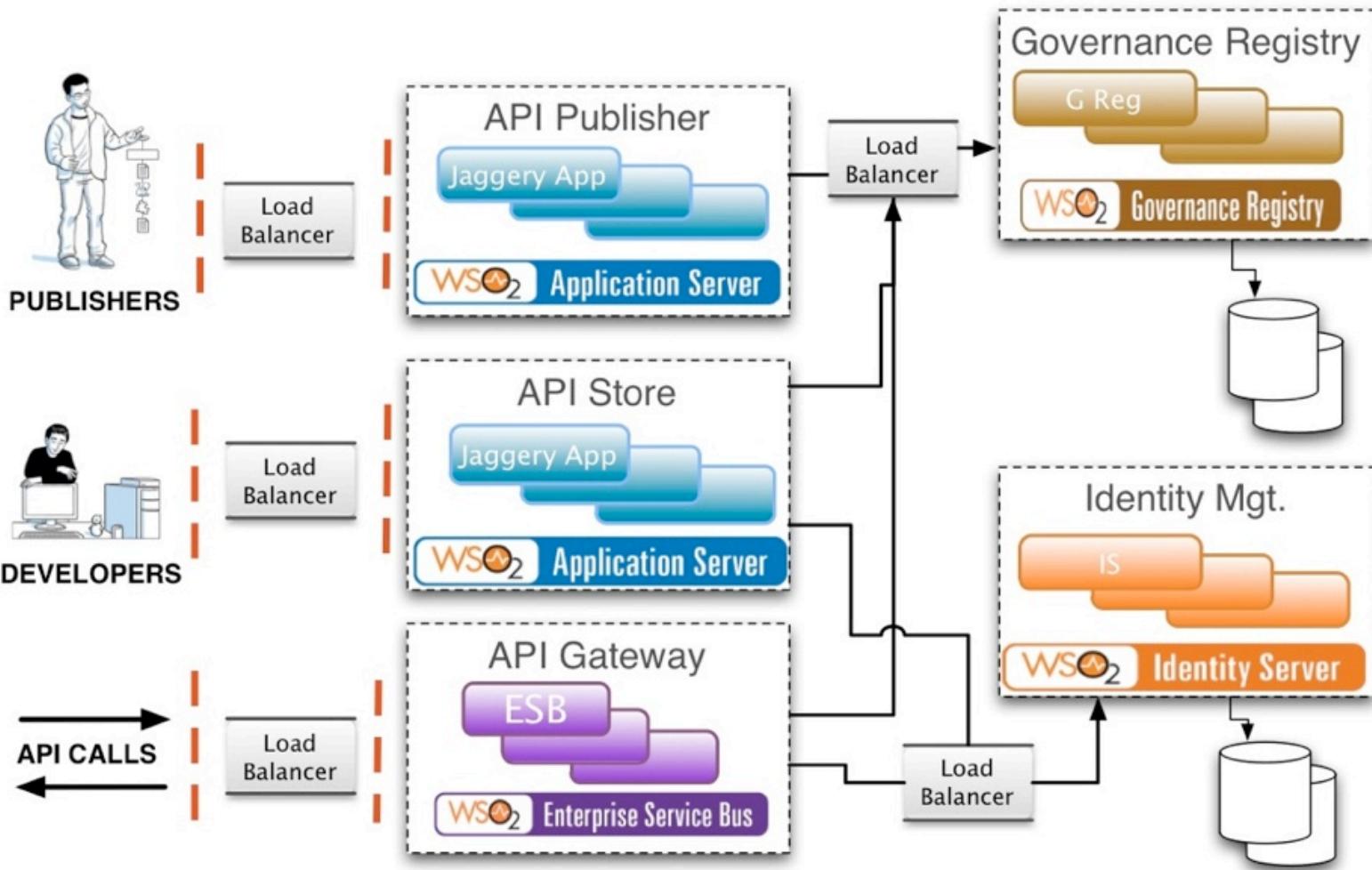
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Pass-through Proxying

Message Size 0.5K



API management



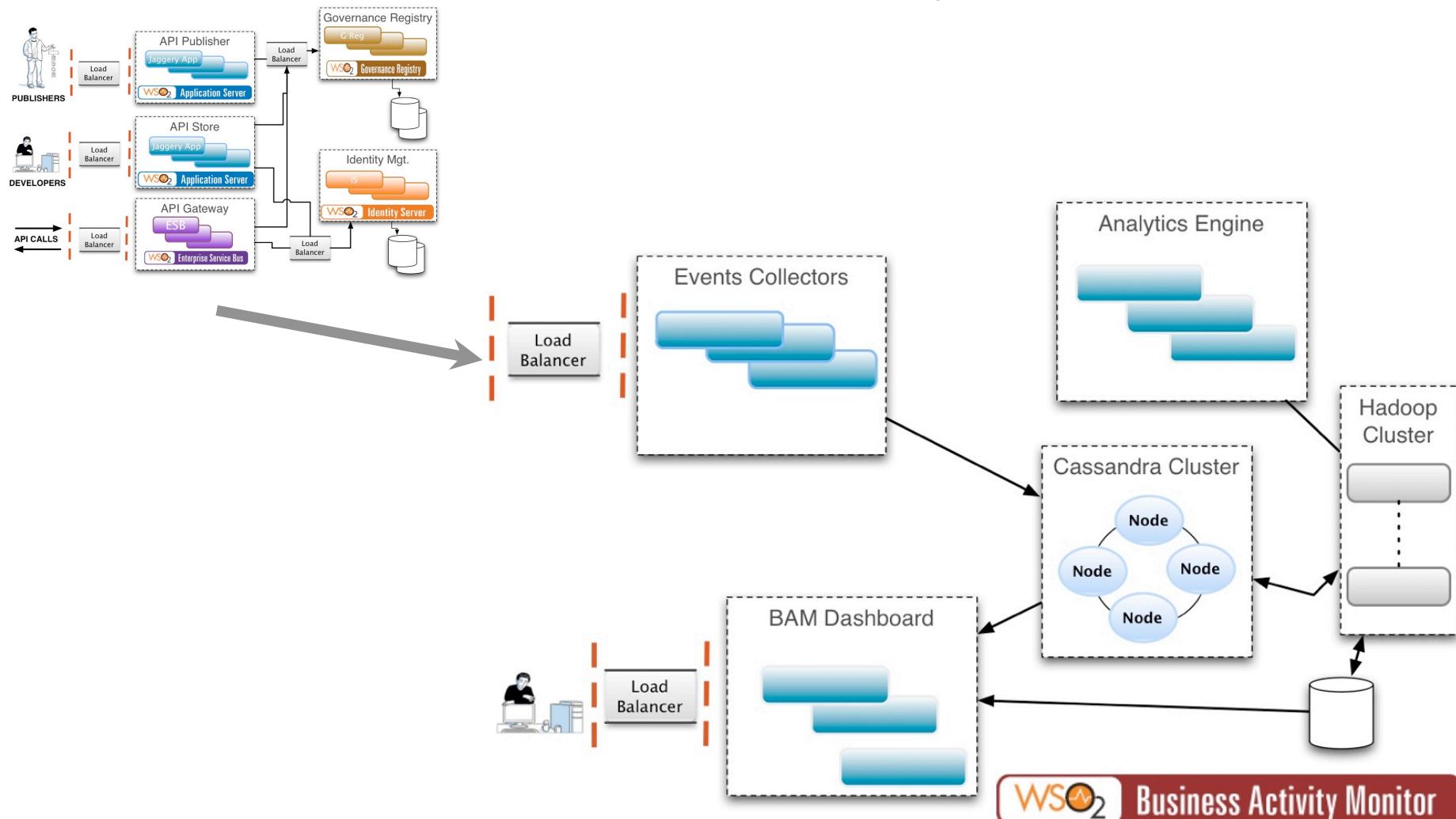
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Scalable analytics



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WSO₂ Business Activity Monitor

Cloud integration



salesforce.com



Google™ Docs



Cloud Service Gateway



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Cloud integration

- APIs are the right approach
 - Use a “cloud gateway” to bridge into internal systems
- “Push-me pull-you” pattern
 - Use an active ESB in the cloud
- Analytics
 - See what is happening



What's next?

- Still a long way from canonical models
- Successful systems are using “soa” and “rest” at scale
 - Architecture is more important than dogma
- Governance sounds boring but is key
- Applying monetization approaches and “API Economy” models
- Analytics and feedback loops



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Summary

- Integration has evolved in some interesting ways
 - Async messaging, EDA, APIs, High Volume
- Evolution isn't monotonic
- Doing APIs right is about the mindset as much as the technology



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