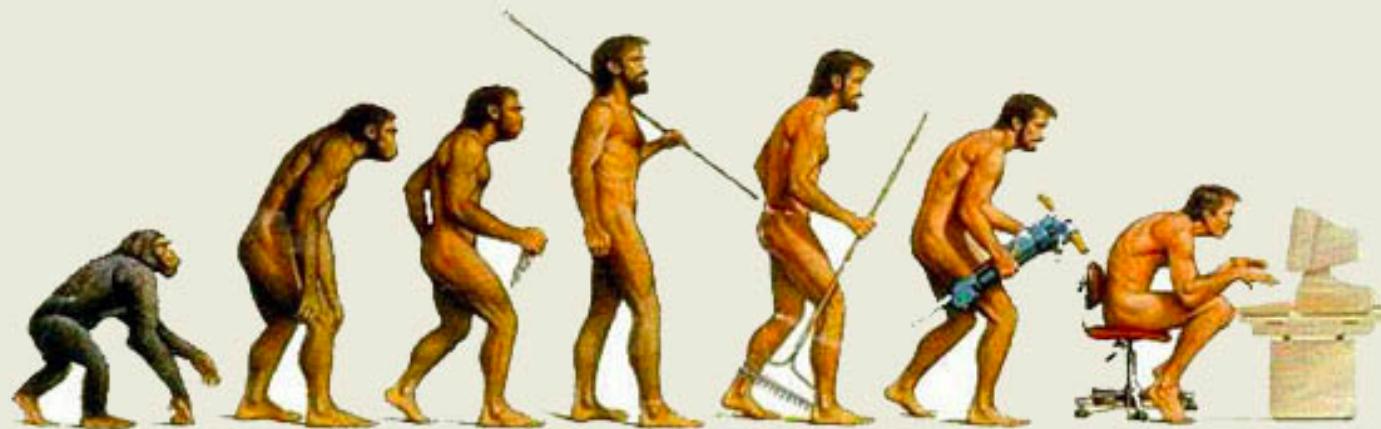


# The Evolution of Distributed Computing and Integration

Oxford University  
Software Engineering Programme  
Sep 2015



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# Distributed Computing



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# Why is Distributed Computing important?

- Scale
- Evolution
- Integration
- Cross-boundary
- Resilience



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# DCE

## Distributed Computing Environment

- 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

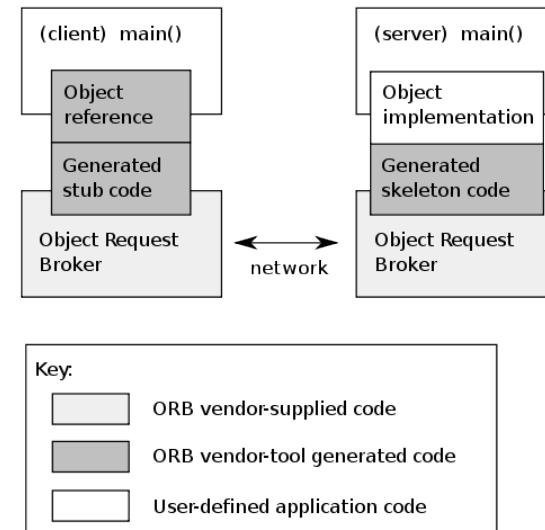


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# CORBA

## 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

Simple Object Access Protocol

- 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

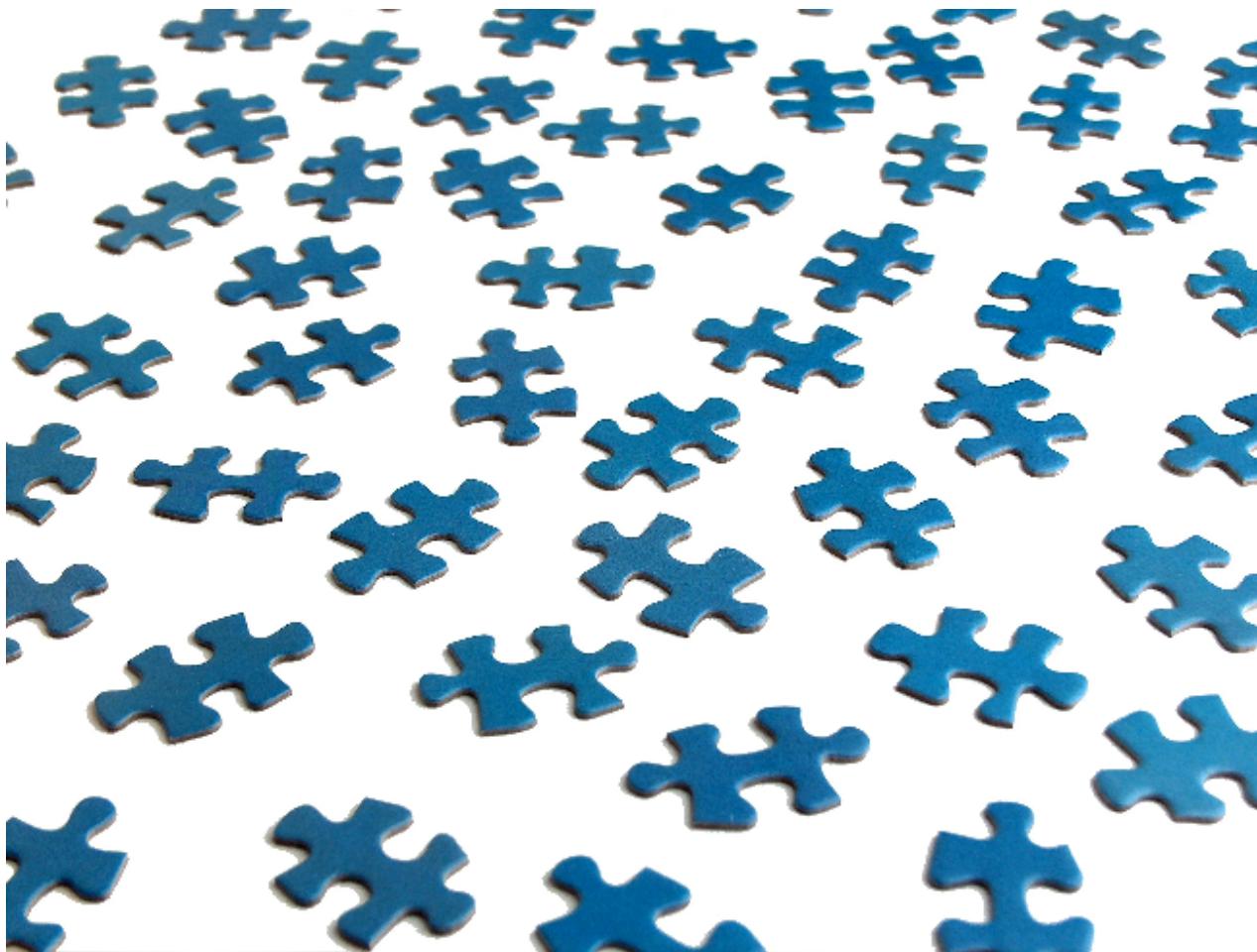
(Remote Procedure Call)

- 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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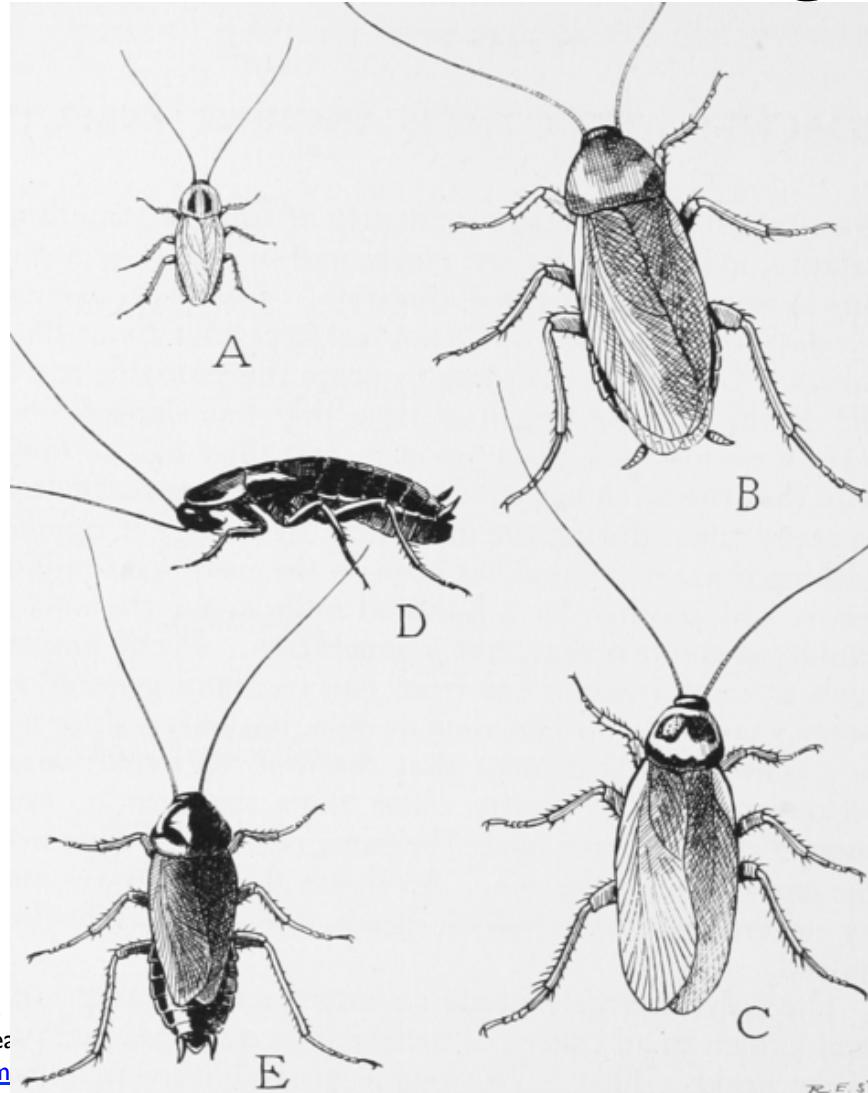
# “6 Degrees of Separation”

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



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# Batch file transfer - the cockroach of integration

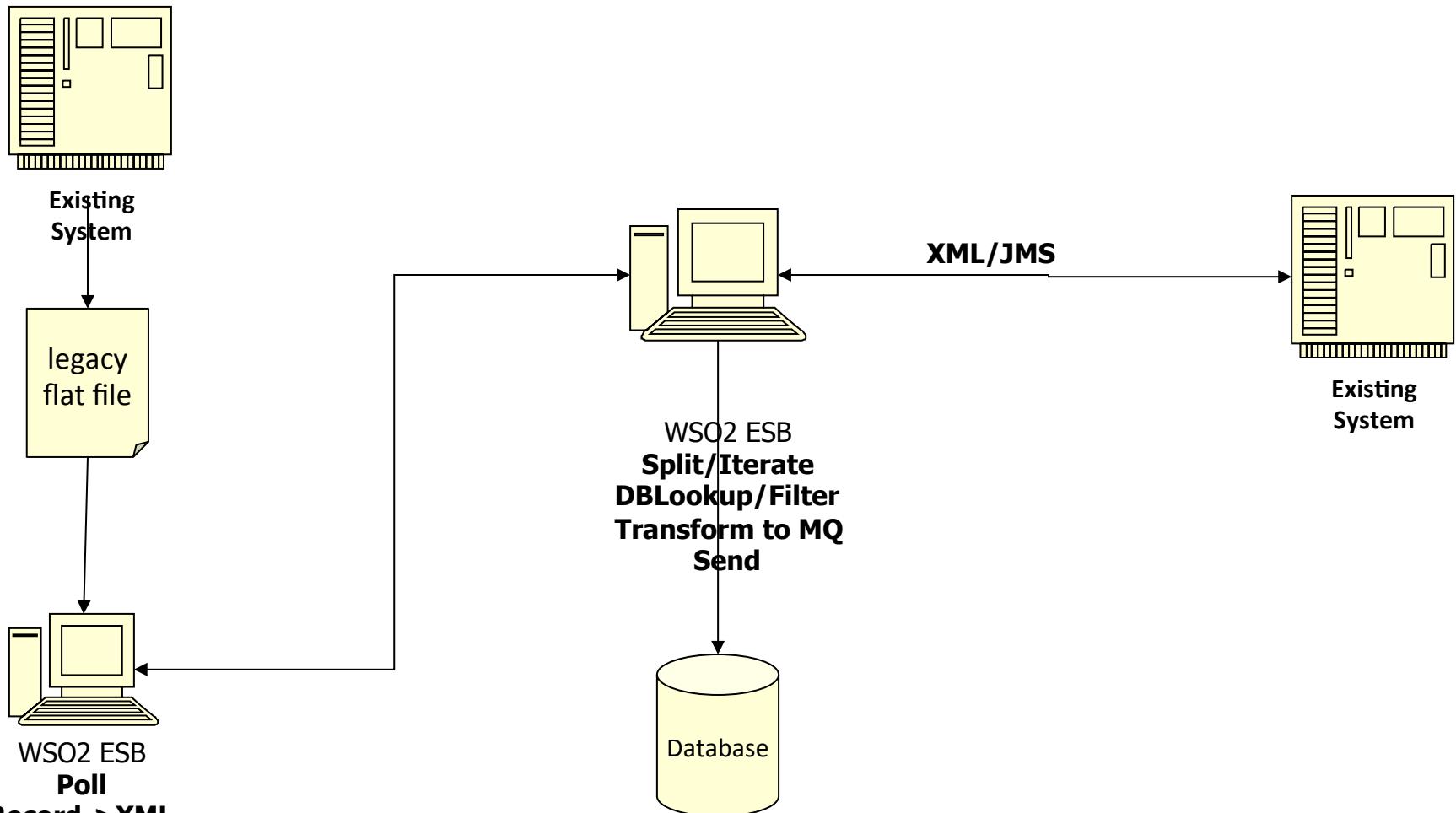


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# File transfer lives on



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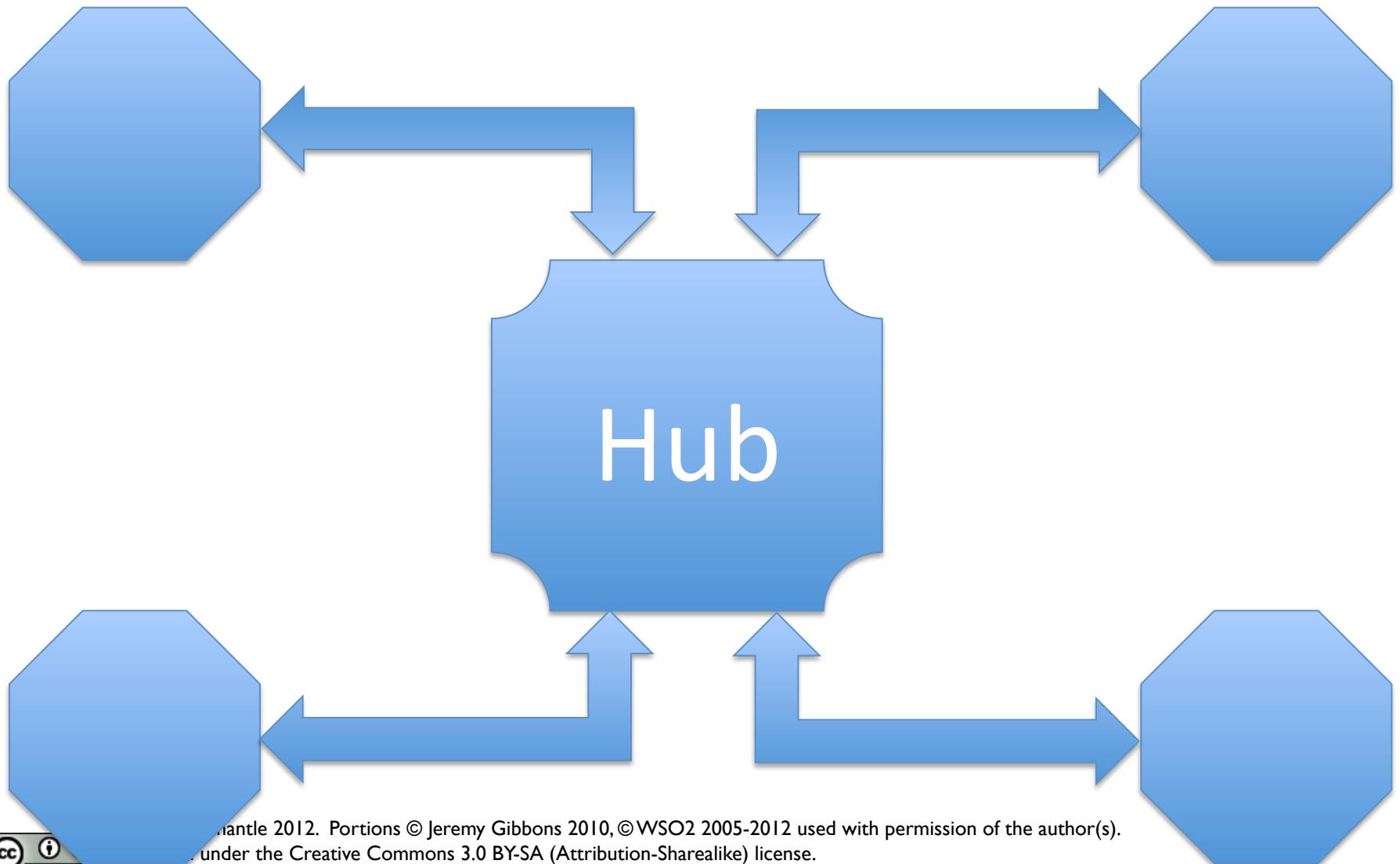
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NEW YORK

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)

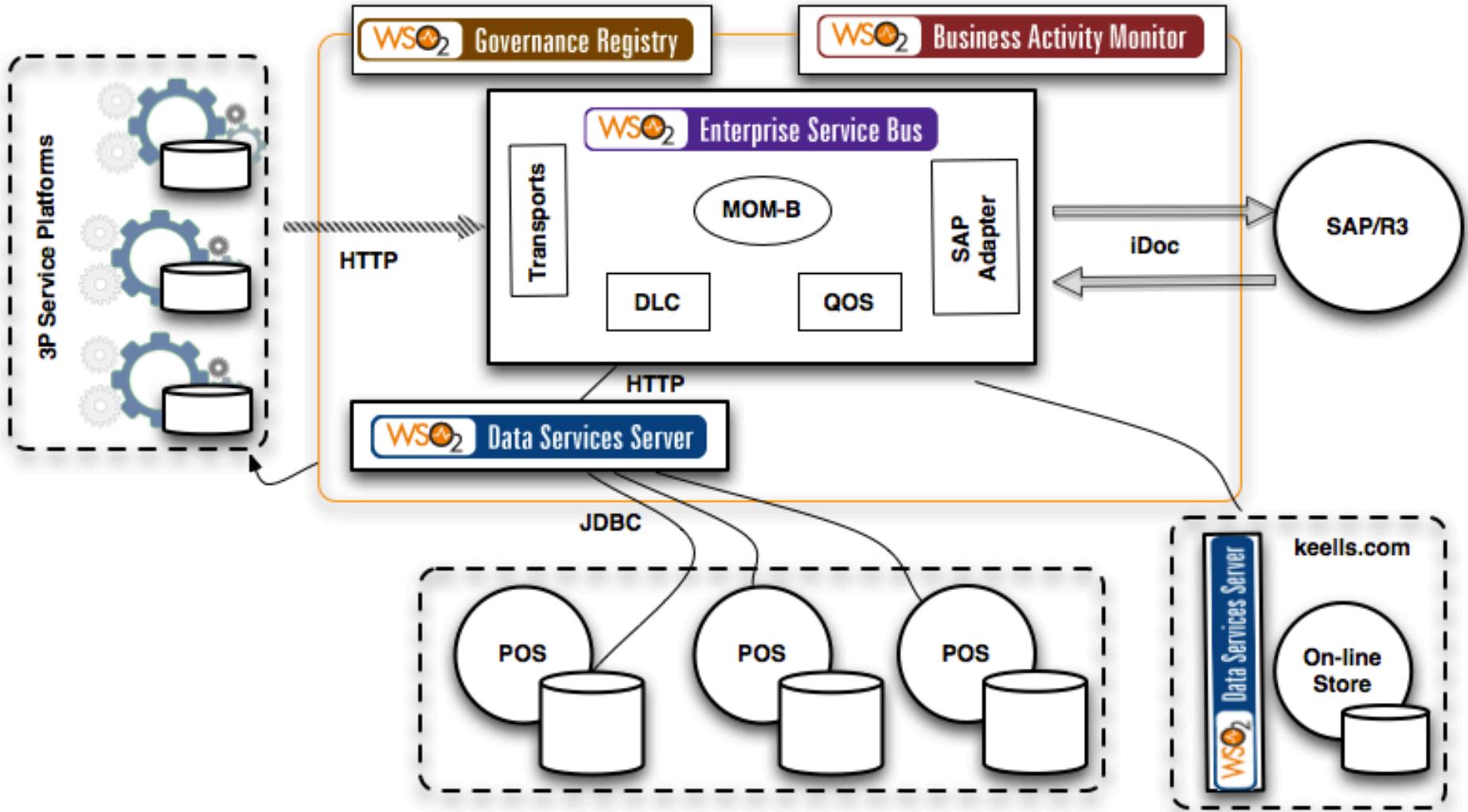


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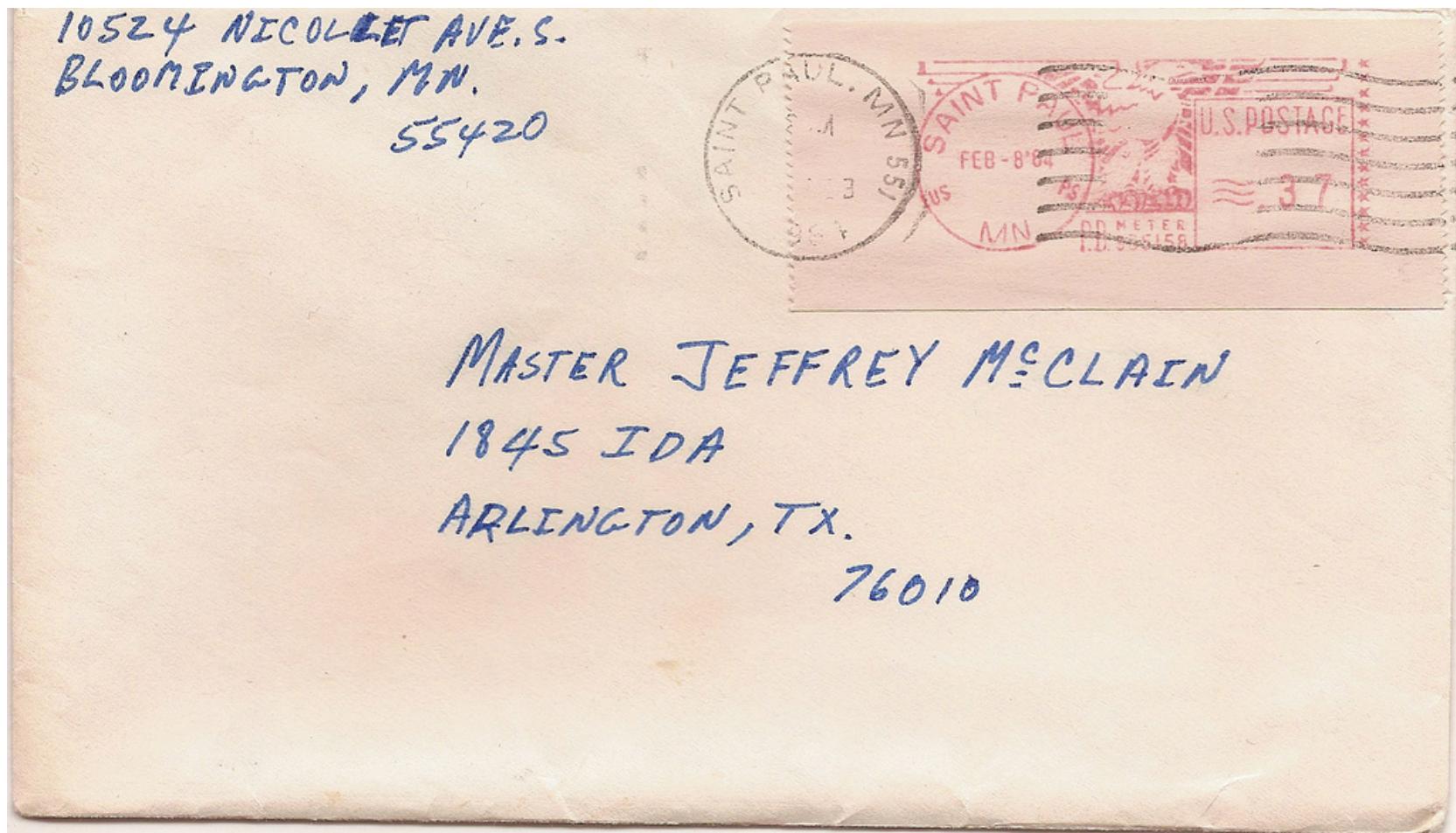
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# Hub approach with an ESB



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# “Message Oriented Middleware”



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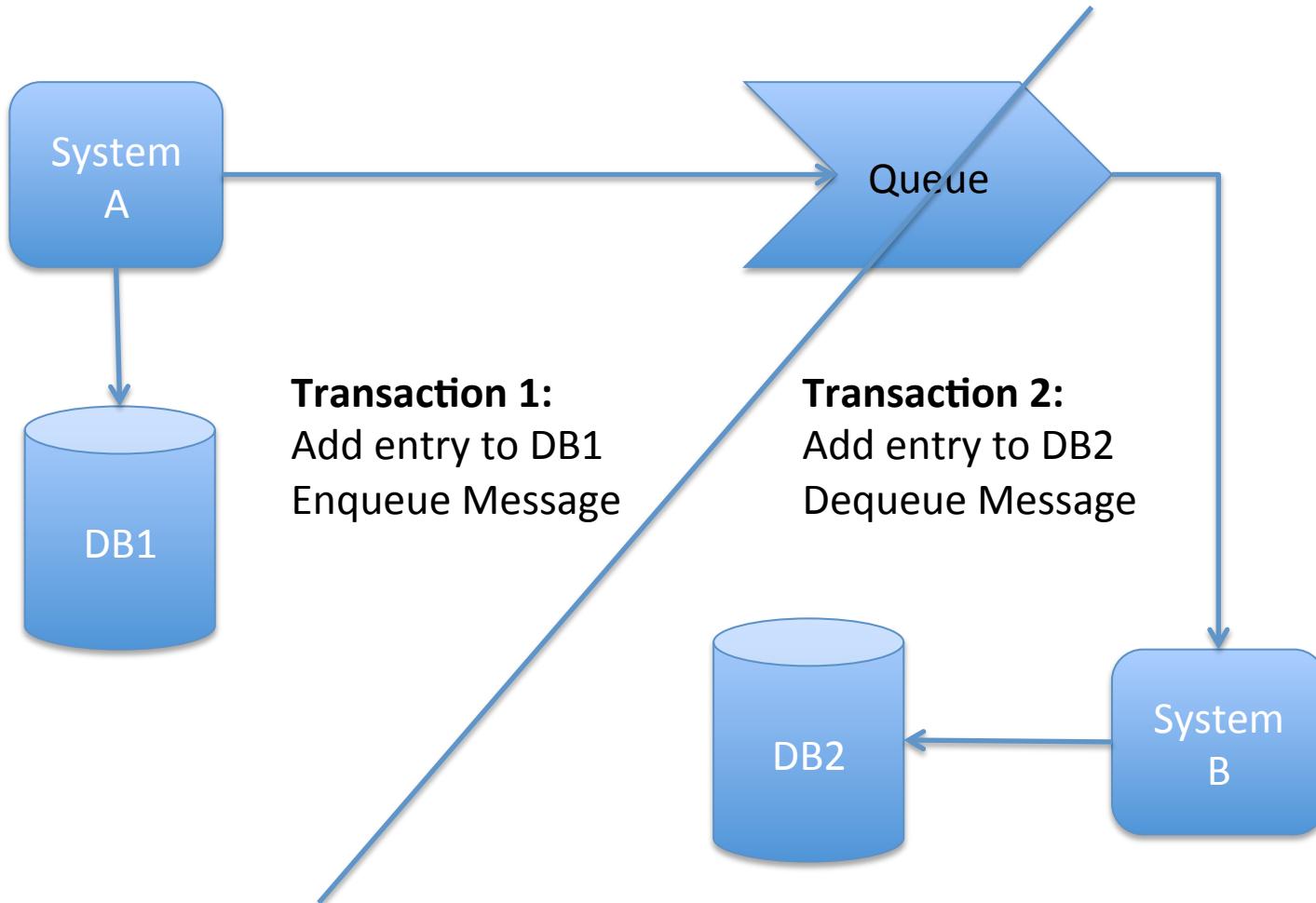
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# MOM model

- 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



# AMQP

## Advanced Message Queuing Protocol

- 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

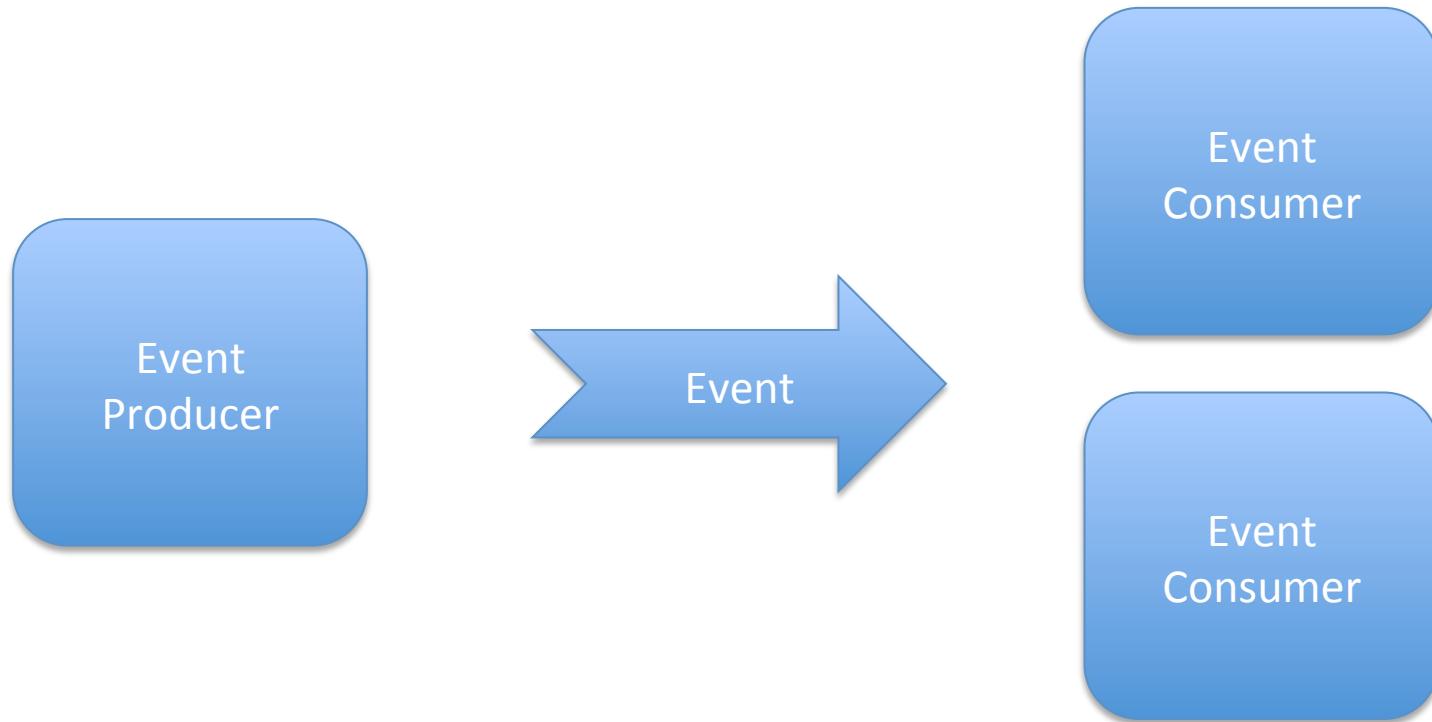
~~Message Queuing Telemetry Transport~~

- 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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# 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



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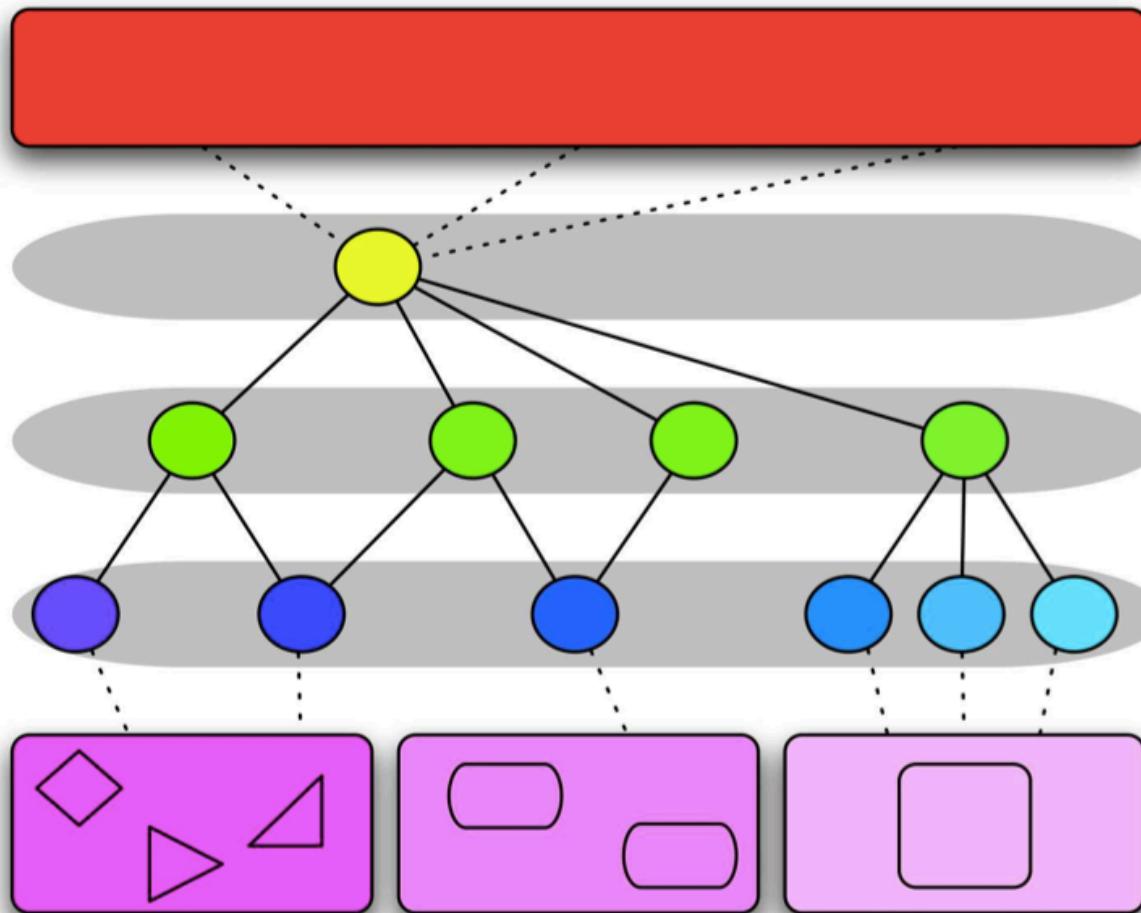
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# SOA



business processes

orchestration service layer

business service layer

application service layer

application layer

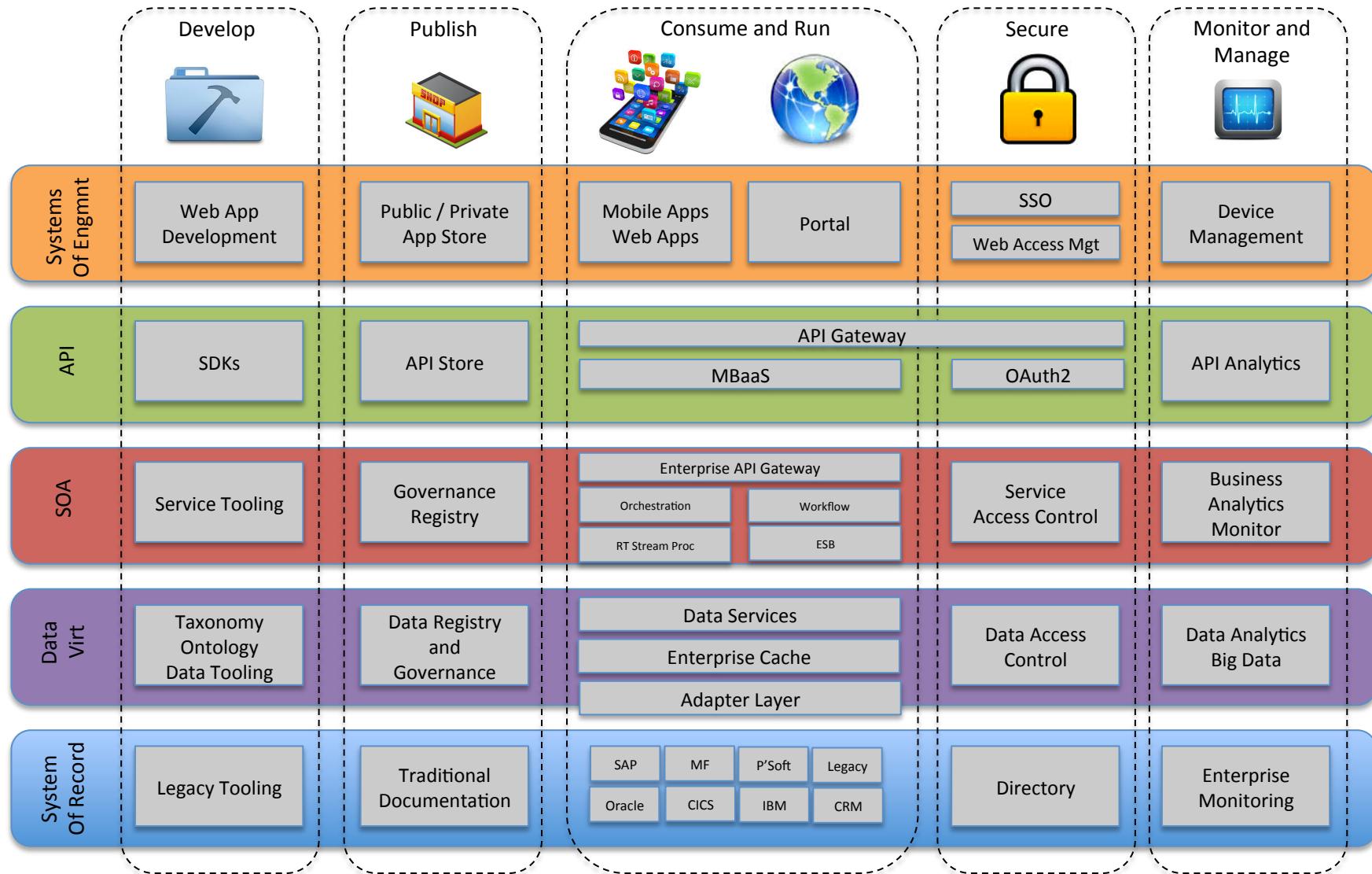


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# End-to-End Architecture and Functional Requirements for a Connected Business



# SOA failures

One consumer per service



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# SOA failures

“Just buy an ESB from me”



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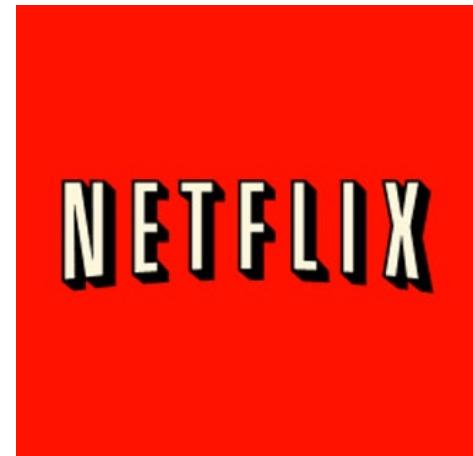
# SOA failures

## 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



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# 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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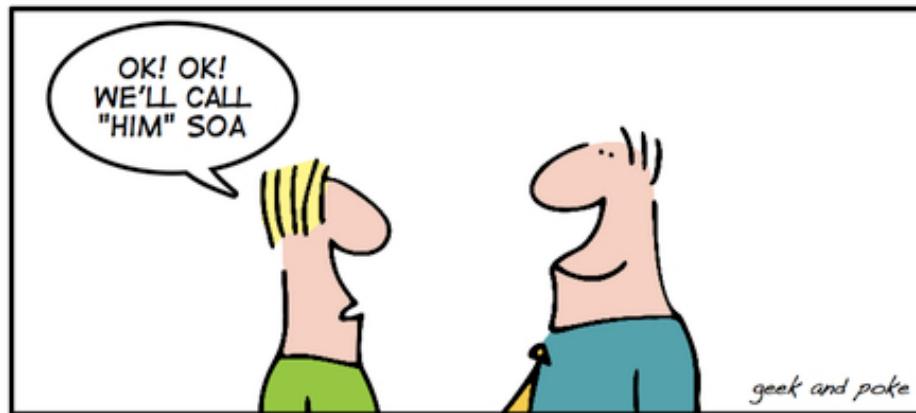
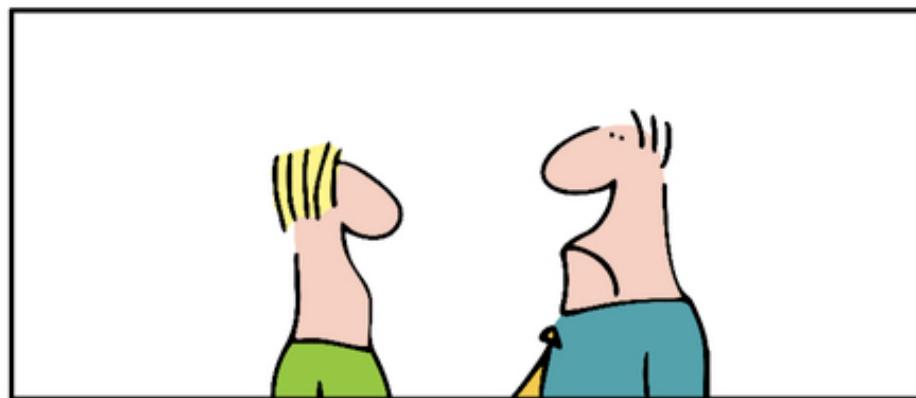
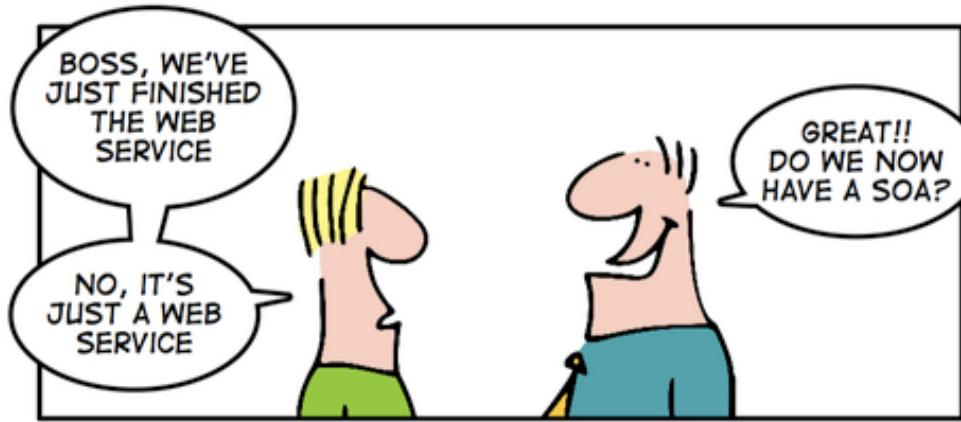
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# Web Services != SOA

- 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





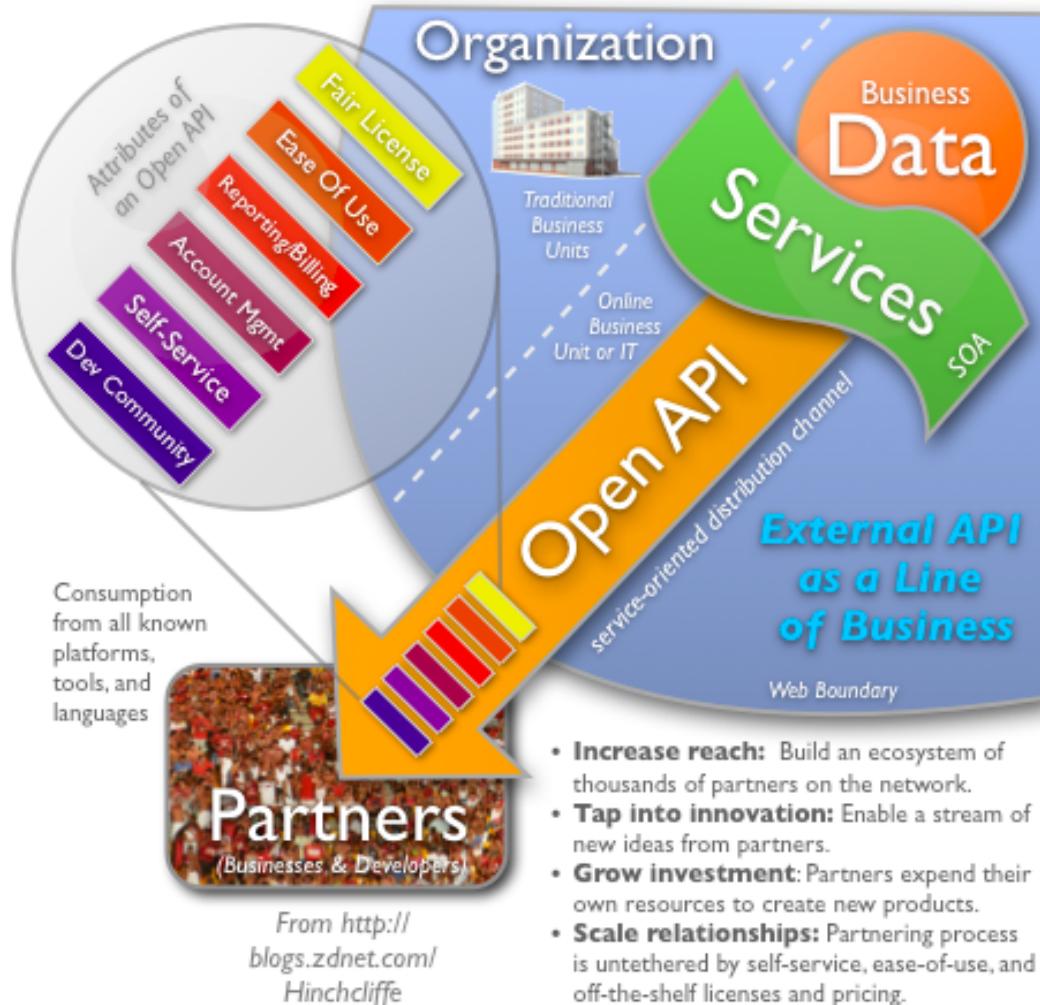
## HOW TO GET A SOA



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# 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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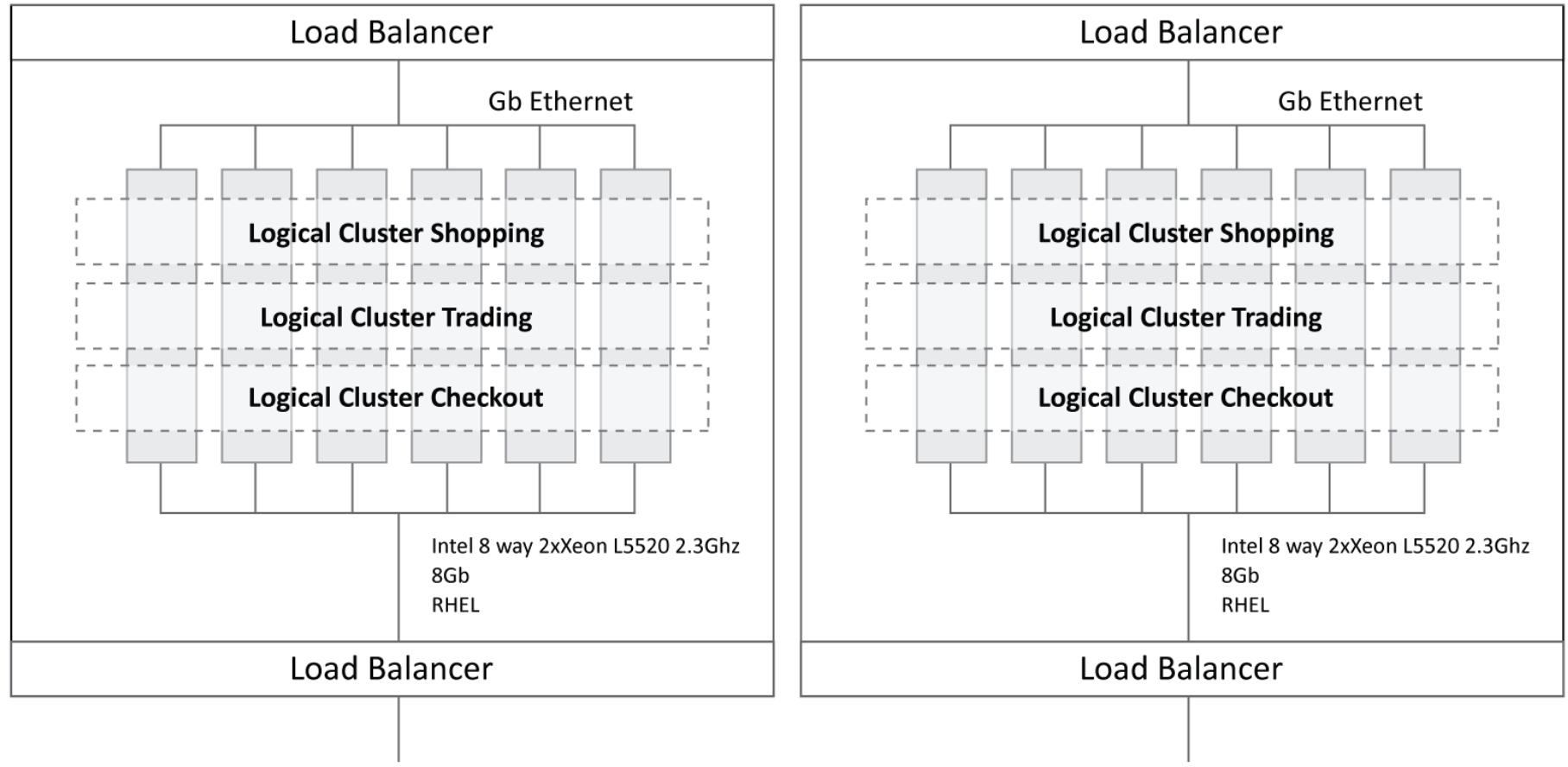
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# High volume integration @ eBay



100's of service instances

Tomcat + Axis2

... [http://creativeservices.ebay.com/service\\_center](http://creativeservices.ebay.com/service_center)

# Change in focus

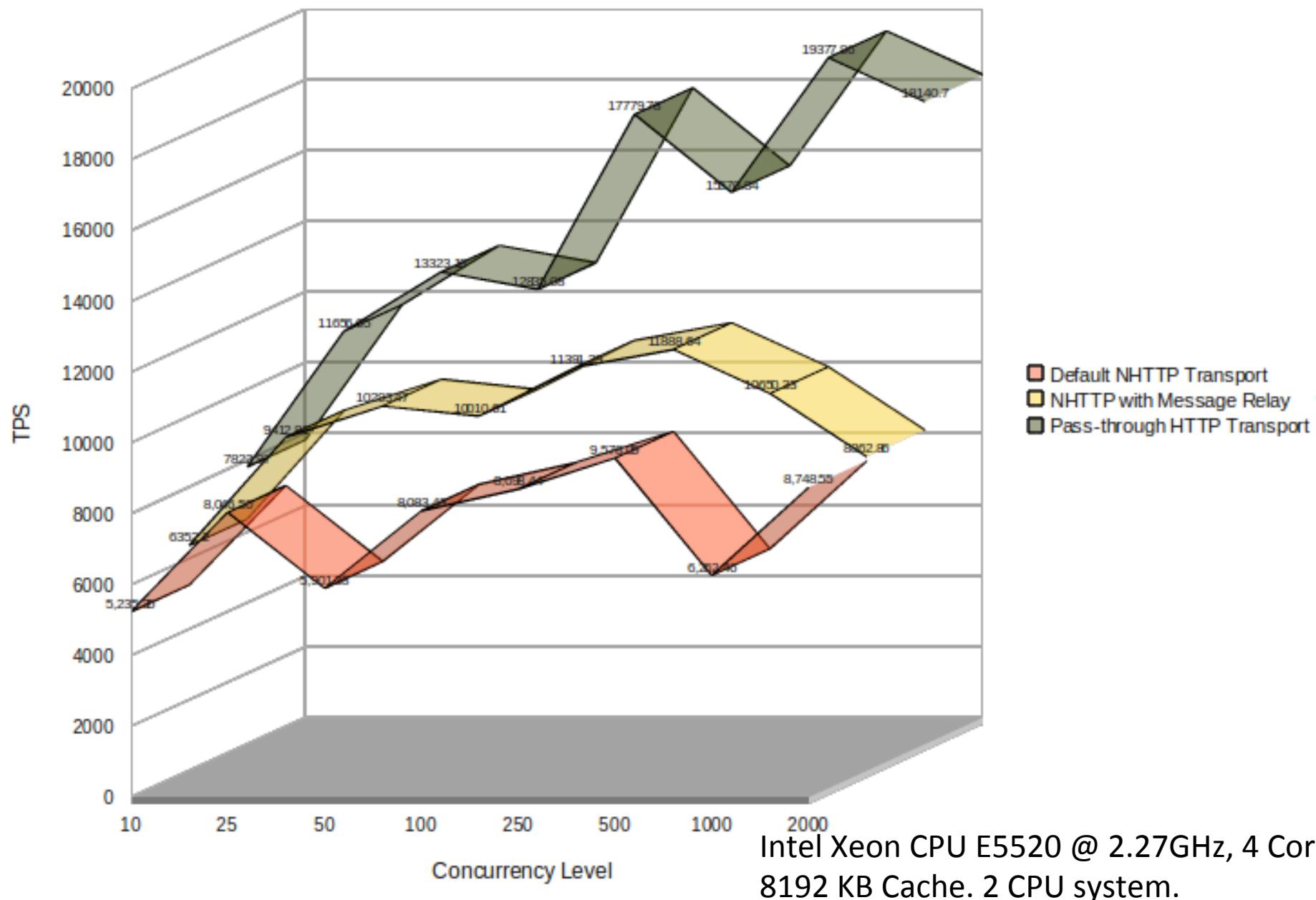
- Security, tokens, access control/entitlement
- Microservices
- Throttling, caching
- Latency and CPU usage
- Monitoring, BAM and CEP



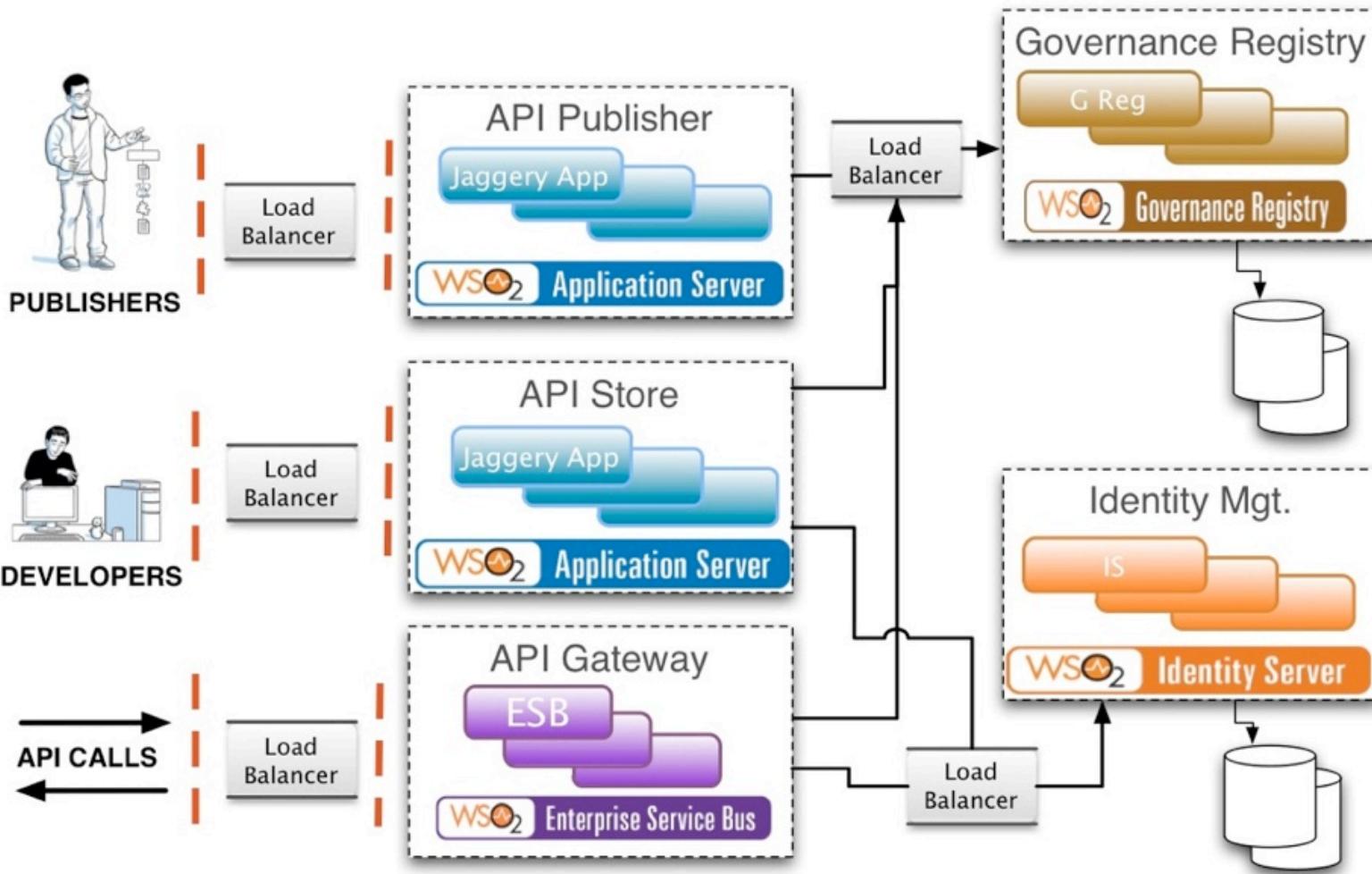
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# Pass-through Proxying

Message Size 0.5K



# API management



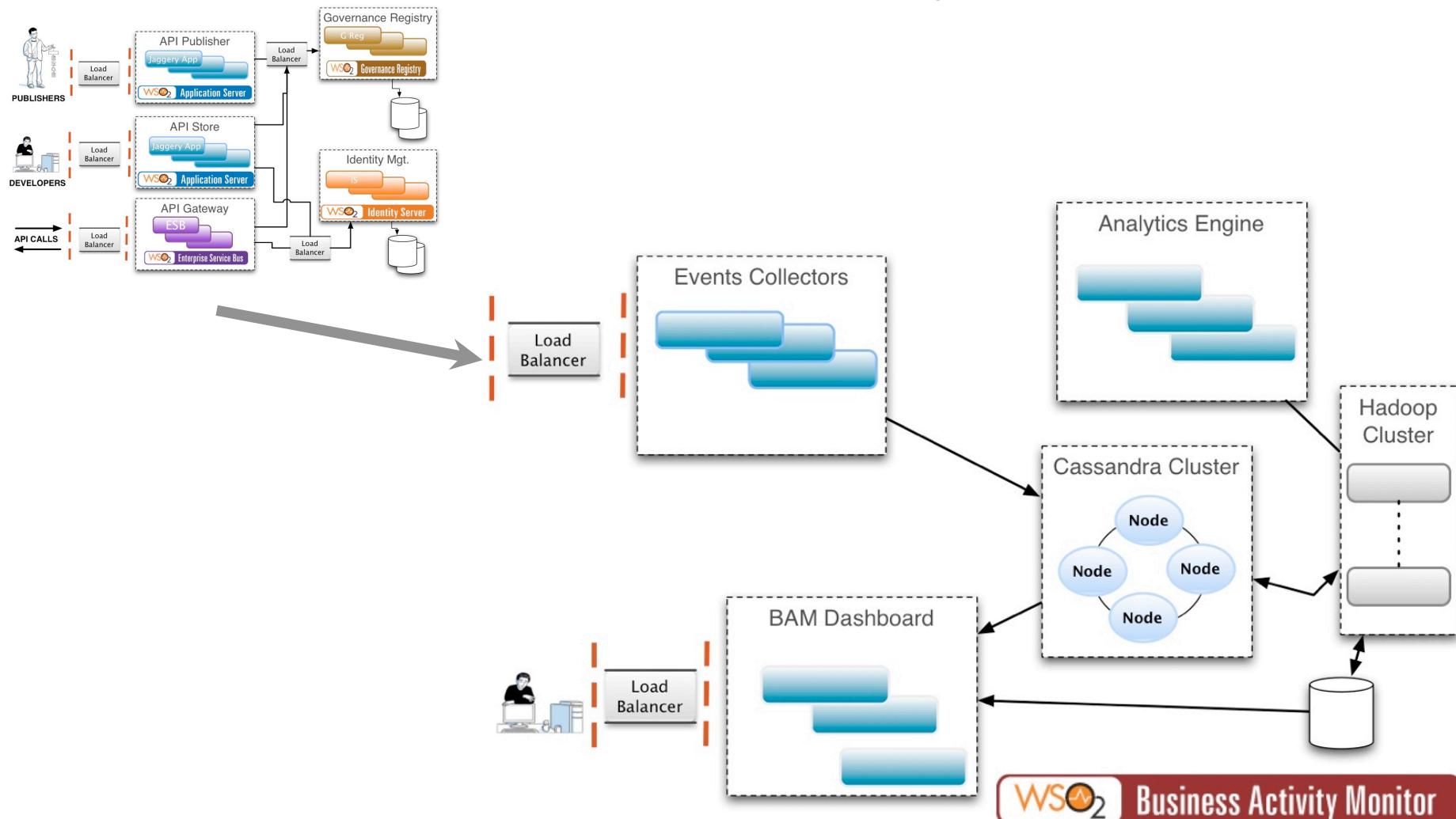
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# Scalable analytics



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# Cloud integration



salesforce.com



Google™ Docs



Cloud Service Gateway



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# Microservices

- Lots more later..



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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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