

Enterprise Service Bus

Oxford University
Software Engineering Programme
Dec 2014



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Enterprise Service Bus (ESB)

- A software architecture
 - A logical intermediary through which every message flows
 - Offers a policy based approach to decide what to do to each message or interaction
- The benefits of the gateway model
 - Without a physical hub and spoke
- Many vendors offer ESB products
 - Often a layer over an existing messaging framework

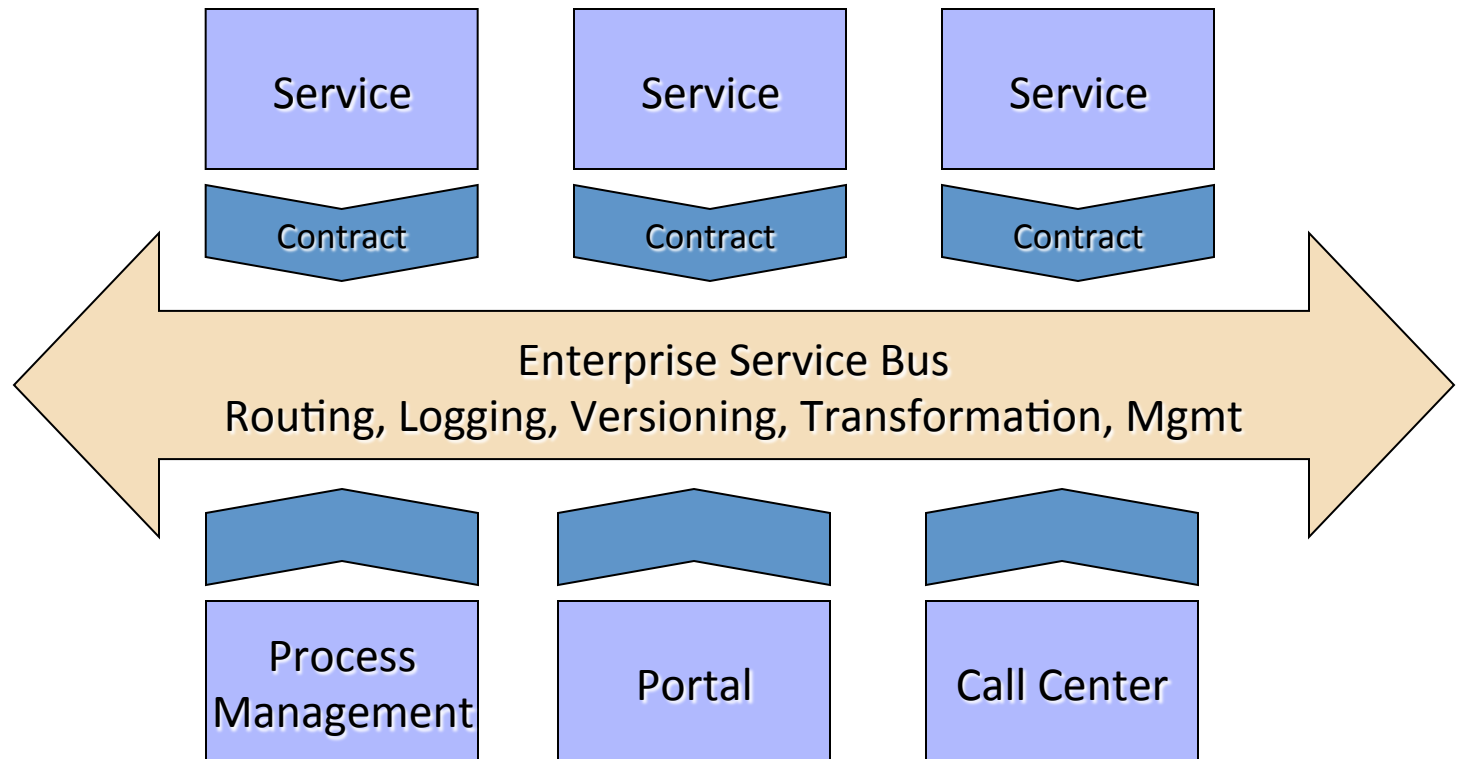


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ESB as the implementation of SOA



Different approaches

- Point to Point
- Traditional EAI
- ESB
- Event Driven Architecture



Pros and Cons of an ESB

Pros

- Faster and cheaper accommodation of existing systems
- Increased flexibility: easier to change as requirements change
- Standards-based
- Scales to enterprise wide deployment
- Configuration rather than coding
- No central broker

Cons

- May end up with a proprietary solution
 - no common standards for the overall config and policies yet
- Requires more hardware to run
- New skills to learn to configure ESB
- Hard to get ROI on a small number of projects



ESB options

- Proprietary
 - IBM, Oracle, Tibco, SAP
- Open Source
 - Mule, Fuse, WSO2
 - Apache ServiceMix, Apache Synapse, Apache Camel



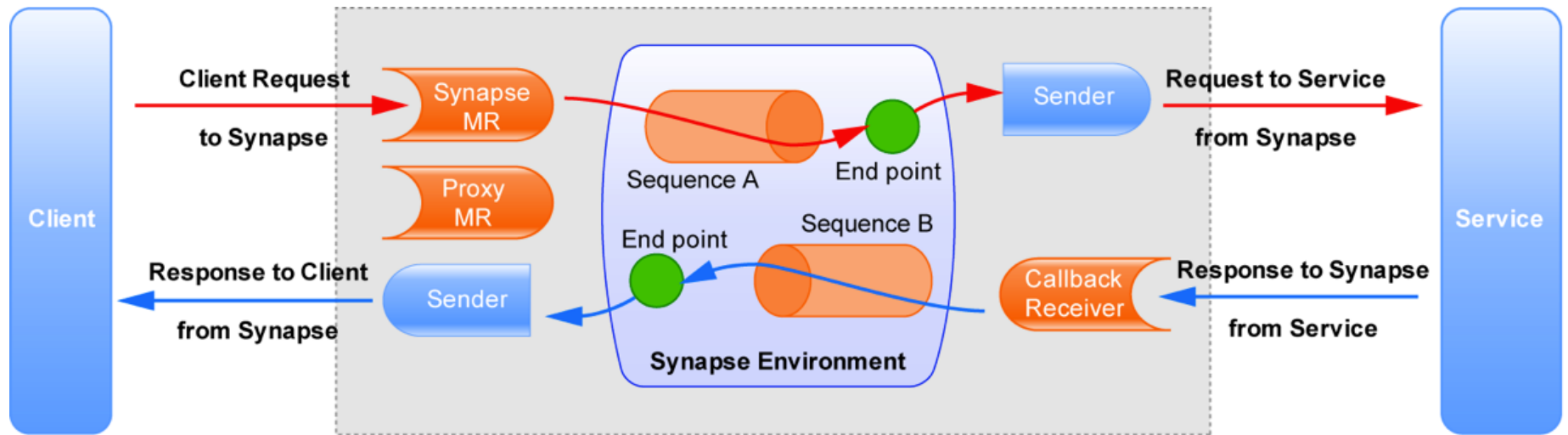
ESB models

- Almost all ESBs work on the same principle
- Message arrives
- Sequence of actions (Pipeline)
- Message is sent on

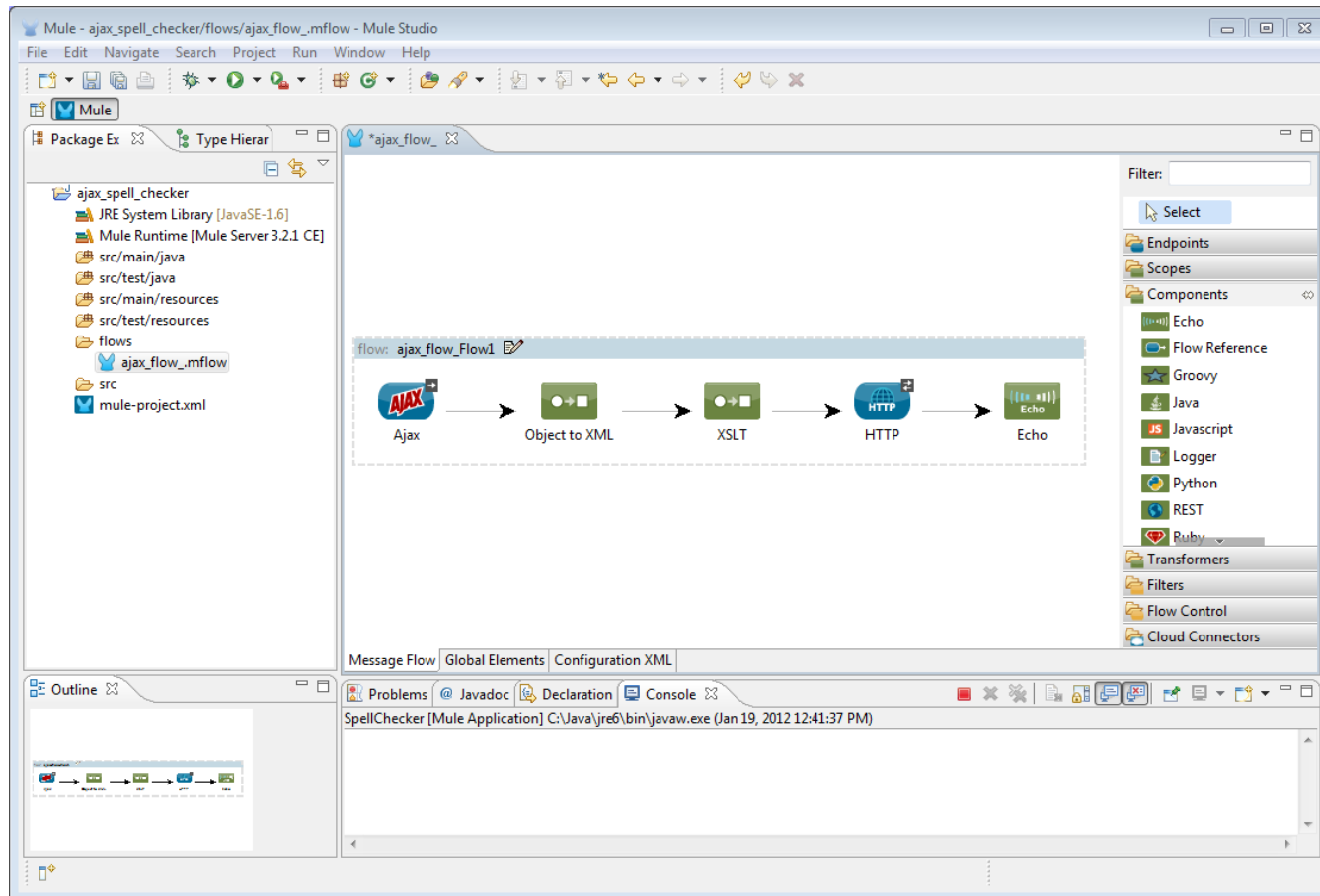


Graphically

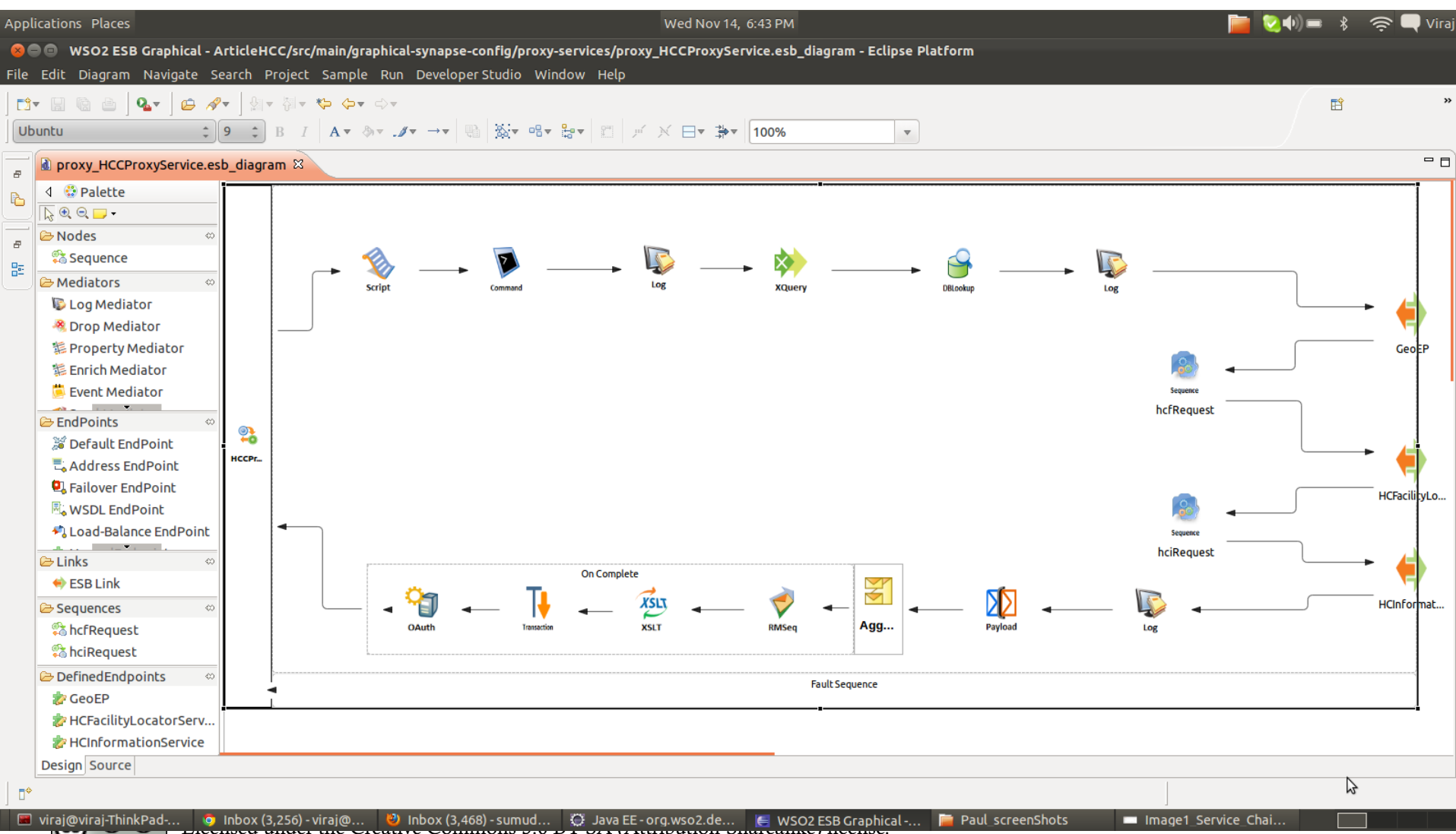
Apache Synapse terminology used



From some tooling



More Tooling



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FUSE - LoanBroker/eip/credit_response.eip_diagram - FUSE

File Edit Diagram Navigate Search Project Run Window Help

Segoe UI 9 B I A 100%

Project Explorer

- LoanBroker
 - Spring Elements
 - src
 - JRE System Library [jre1.6]
 - build
 - eip
 - credit_response.eip
 - credit_response.eip.d
 - null

credit_response.eip_diagram

```

graph LR
    Start(( )) --> Check[Check...]
    Check --> Decision{ }
    Decision -- Accept --> ProcessReq[Process Req]
    Decision -- Reject --> InvalidReq[Invalid Req]
    ProcessReq --> InformCust[Inform Cust]
    InformCust --> End(( ))
    InvalidReq --> End
  
```

Palette

- Patterns
 - Resequencer
 - Routing Slip
 - Splitter
 - Throttler
- Endpoints
 - CXF
 - Direct
 - File
 - Generic
- Camel Proces...
 - Bean
 - Catch
 - Convert Body To
 - Finally

Check Processor

Properties

General

Destination Parameters

*Type: queue

*Name: checkResponse



Enterprise Integration Patterns

Home - Enterprise Integratio x

www.eaipatterns.com

Offline Mail Inbox (124,820) - p 100+ WSO2 WSO2, Inc. - Calend + bitmark Shorten with bit.ly

**Enterprise
Integration
Patterns**

Home

[HOME](#) • [PATTERNS](#) • [RAMBLINGS](#) • [ARTICLES](#) • [TALKS](#) • [DOWNLOAD](#) • [LINKS](#) • [BOOKS](#) • [CONTACT](#)

 **Ramblings**

My ongoing thoughts about the present and future of integration, SOA and Web services. [\[see all\]](#)

[DDD - Diagram Driven Design](#)
(March 22, 2010)

[What Does It Mean to Use Messaging?](#)
(Feb 17, 2010)

[A Chapter a Day...](#)
(Feb 1, 2010)


 **Upcoming Events**

Articles & Interviews

[Conversations Between Loosely Coupled Services](#)
(Video on [InfoQ](#))

[Developing in a Service-oriented World](#)
(Video on [InfoQ](#))

[SOA Patterns - New Insights or Recycled Knowledge?](#)
(Whitepaper)



[Enterprise Integration Patterns](#)

Gregor Hohpe, Bobby Woolf

Best Price ~~\$23.99~~ or Buy New \$50.74

Patterns and Best Practices for Enterprise Integration

This site is dedicated to making the design and implementation of integration solutions easier. The solutions and approaches described here are relevant for integration tools and platforms such as IBM WebSphere MQ, TIBCO, Vitria, SeeBeyond, WebMethods, or BizTalk, messaging systems such as JMS, WCF, or MSMQ, ESB's such as Sonic, Fiorano, ServiceMix, Mule, Apache Synapse, or WSO2, and SOA and Web-service based solutions.

All content on this site is original and is maintained by [Gregor Hohpe](#). I have been building integration solutions for large clients for many years and enjoy sharing my findings with the community. I hope you find this material insightful and useful. Please [contact me](#) if you have suggestions or feedback.

Enterprise Integration Patterns - The Book

Enterprise integration remains harder than it really should be. While integration is inherently complex, I felt that one of the major stumbling blocks is the lack of a common vocabulary and body of knowledge around asynchronous messaging architectures used to build integration solutions. Under the guidance of Martin Fowler and Kyle Brown, I teamed up with Bobby Woolf to create such a language in the form of 65 [integration patterns](#) (see the pattern links on the right).

The book [Enterprise Integration Patterns](#) provides a consistent vocabulary and visual notation to describe large

Integration Patterns

[Integration Patterns Overview](#)

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Integration Styles

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Messaging Systems

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[Message Channel](#)

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[Message Translator](#)

[Message Endpoint](#)

Messaging Channels

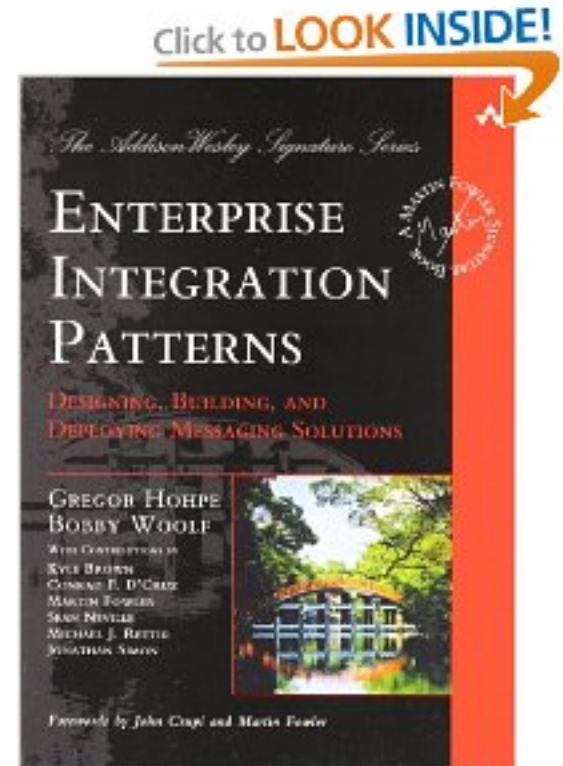
[Introduction](#)

[Point-to-Point Channel](#)



Enterprise Integration Patterns

- <http://www.eaipatterns.com/>
- The book
 - Enterprise Integration Patterns
 - Gregor Hohpe, Bobby Woolf



What actions

- The aim is to re-use existing adapters, transports and mediators/transformers
- Why?
 - Minimize custom coding
 - Utilize optimal components
 - e.g. streaming high-performance
 - Shorten test cycles
 - Be more agile



Common mediators

- Logging
- Routing
- Transformation
 - XSLT
 - Xquery
 - Template-ing
- Split/Aggregate
- Filter
- Clone/Tee
- Callout
- Enrich
- Drop
- Fault
- etc



Apache Synapse

- Designed to be simple to use and manage
 - XML configuration
 - No complex deployment
 - Hot deploy and update if needed
 - Separation of configs for different teams
 - Highly performant and scalable
 - Asynchronous core / non-blocking model

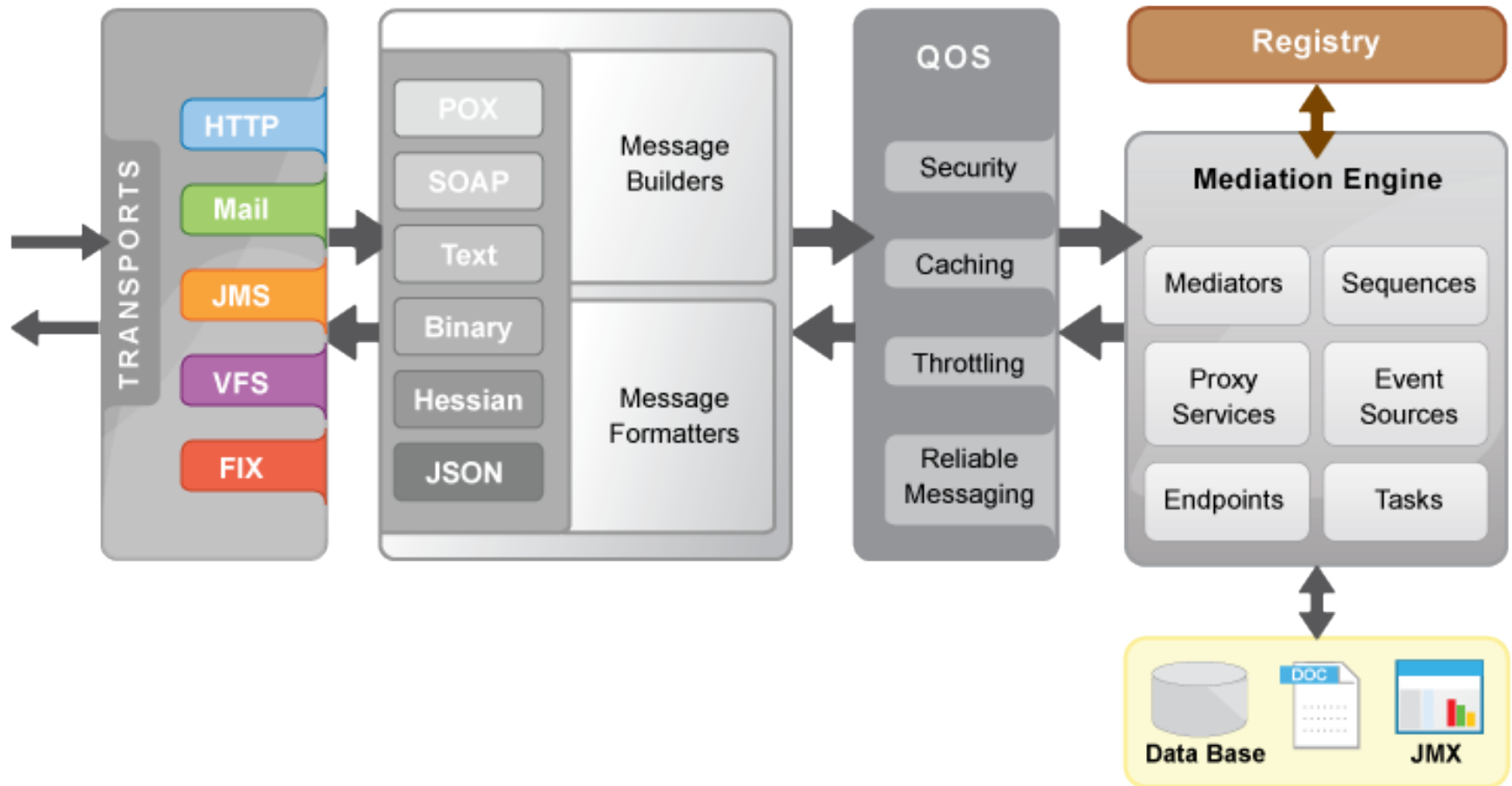


C10k Problem

- How to handle 10k concurrent requests
- Without 10k concurrent threads ☺
- Need to disassociate the socket from the thread
- Async handling
- Reactor pattern



Apache Synapse

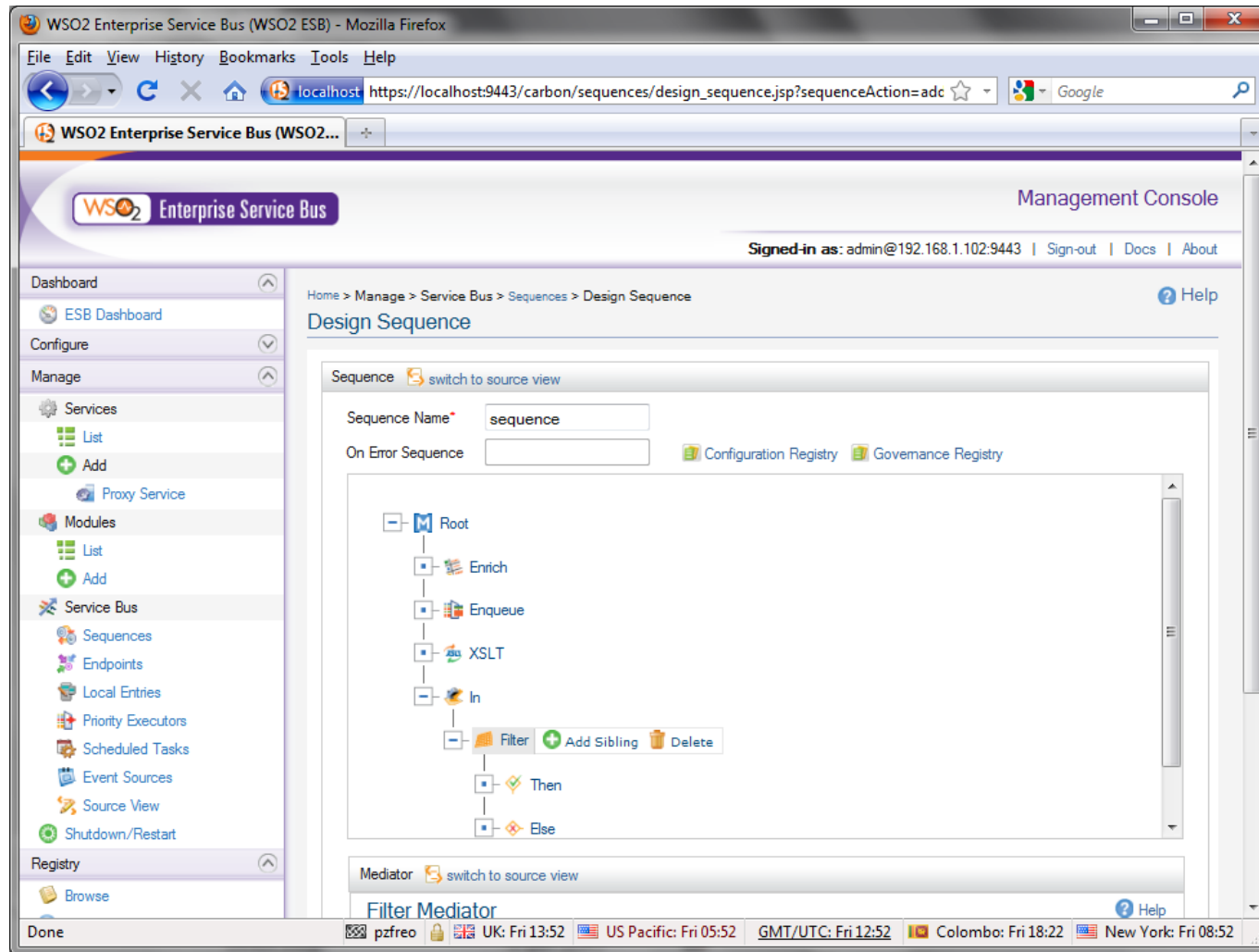


WSO2 ESB

- Also Apache License Open Source
- Adds a Graphical Web Interface
- Registry/Repository
- Deployment management/synchronization
- Other pluggable components











ESB UI



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Basic Mediators

Name		Description
Log Mediator		Logs full or part of the message, at various severity levels (Trace, Debug, etc)
Sequence Mediator		Invokes existing sequence - Sequence name can be static or dynamic
Send Mediator		Sends a message out, using static information or endpoint definition.
Callout Mediator		Performs a blocking external service invocation.
Switch Mediator		Evaluates messages contents against regular expression and invokes the corresponding mediator (switch-case-default)
Validate Mediator		Validates message or parts of message against XML schema (schema can be local or in registry)
Drop Mediator		Stops processing of current message
Fault Mediator		Transforms current message into custom Fault message



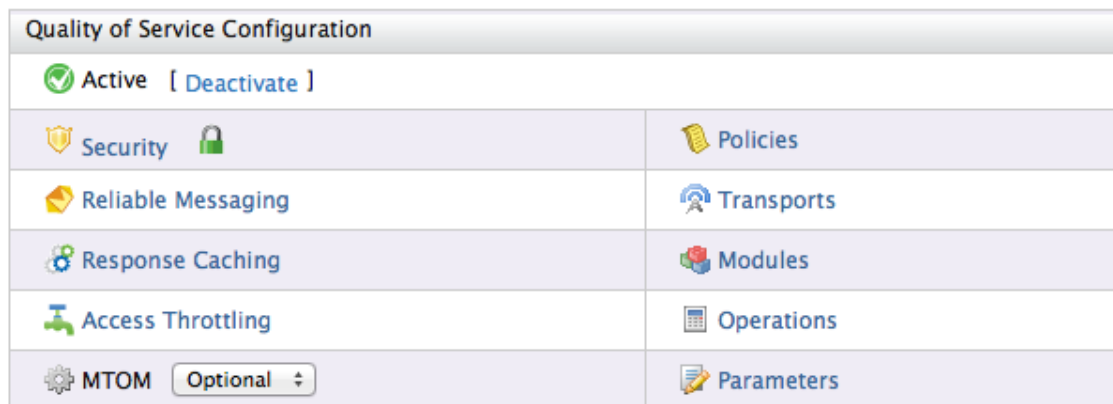
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Policy Driven

- Apply out-of-the-box policies to proxy services for
 - Security
 - Caching
 - Throttling
- Create and apply WS-Policies
- Apply Policies stored in Registry



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Transformation

- Transform via XSLT, XQuery, or Smooks
- Enrich via XPATH
- URL/Headers Management

Name		Description
XSLT Mediator		Invokes XSLT transformation on current message (v1.0 and v2.0 are supported)
XQuery Mediator		Invokes XQuery transformation on current message
Smooks Mediator		Invokes embedded Smooks Engine (v1.5) - Supports binary transformations (EDI, CSV, etc.)
Enrich Mediator		Enrich message contents using XPATH (replace, append, remove)
URL Rewrite Mediator		Rewrite protocol / URL contents
Header Mediator		Set / Remove Headers
Payload Factory		Override Message Contents

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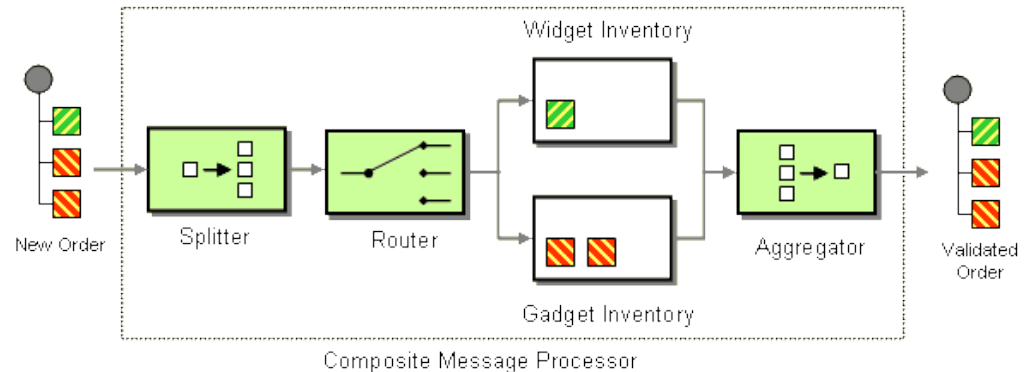


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Enterprise Integration Patterns

- Native Support for Common EIP
 - Content-based Router
 - Command Message
 - Message Filter
 - Message Splitter
 - Message Aggregator



Name		Description
Route Mediator		Routes message to given endpoint
POJOCommand		Creates instance of specific command class.
Iterate Mediator		Iterates over message and splits it into number of different messages derived from the parent message using XPATH.
Clone Mediator		Clones the entire message N times, each message is then treated in parallel
Aggregate		Aggregates multiple responses or messages, using XPATH.
Filter Mediator		Executes action based on evaluation of message contents against regular expression.

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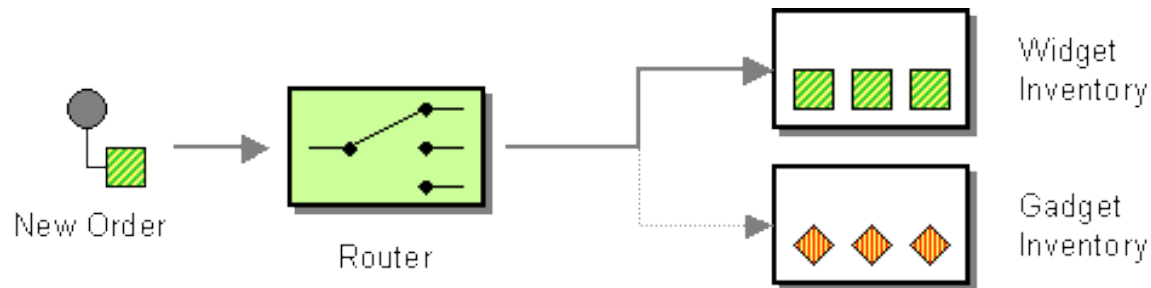


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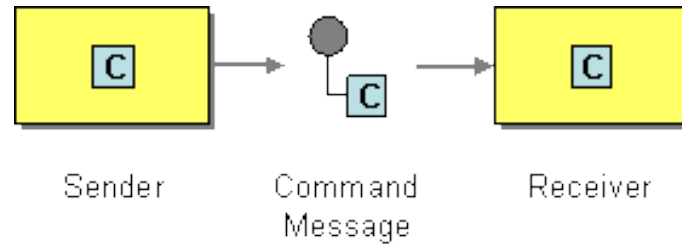
Content-Based Router

- `<router>` mediator



Command Message

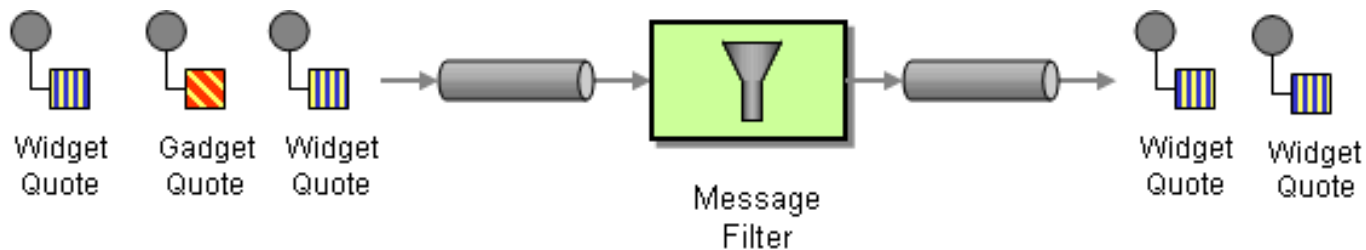
- <callout> mediator



`C = getLastTradePrice("DIS");`

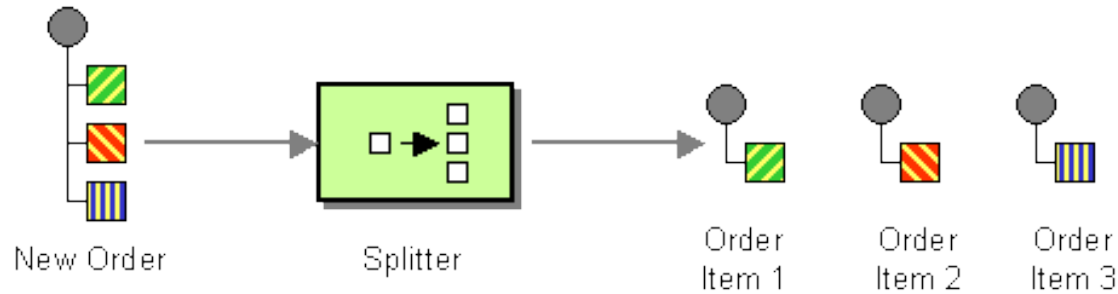
Message Filter

- <filter> mediator (with <drop> mediator)



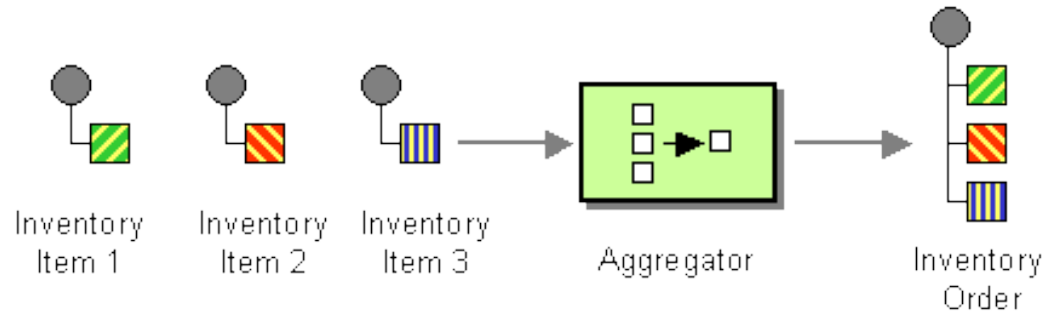
Splitter

- Iterate Mediator



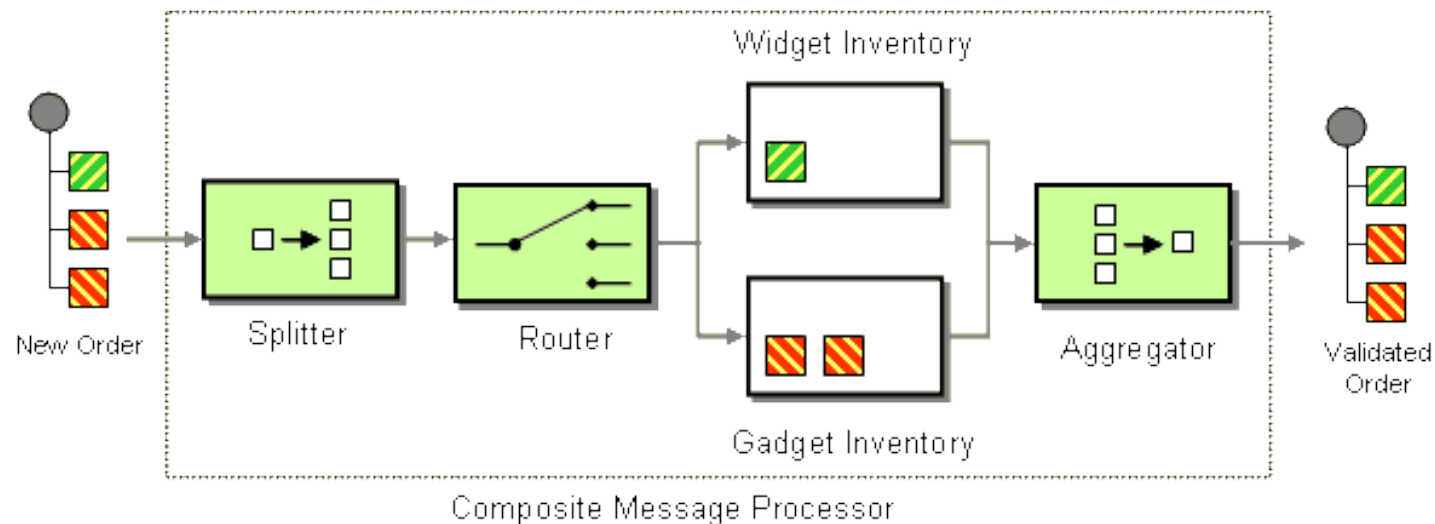
Aggregator

- Aggregate mediator



Composed Message Processor

- <sequence>



Security





- Supports Authentication via HTTP Basic, UserName Token, SSL, OAuth, Kerberos, OpenID, SAML
- Integration with various LDAP servers (OpenDS, Oracle, IBM..)
- XML Encryption, Digital Signatures, WS-Secure Conversations
- Acts as PEP for fined-grained authorization (entitlements) using XACML

Home > Manage > Web Services > List > Service Dashboard > Security for the service Help

Security for the service

The service "StockQuoteService" is secured using "UsernameToken"

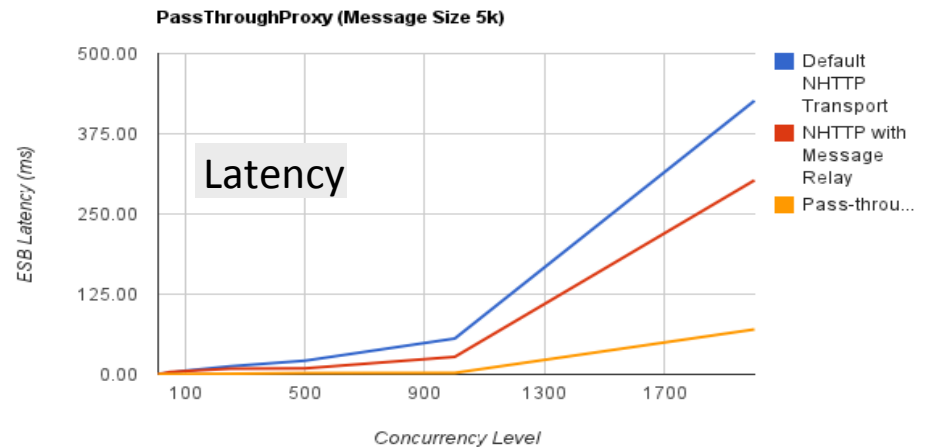
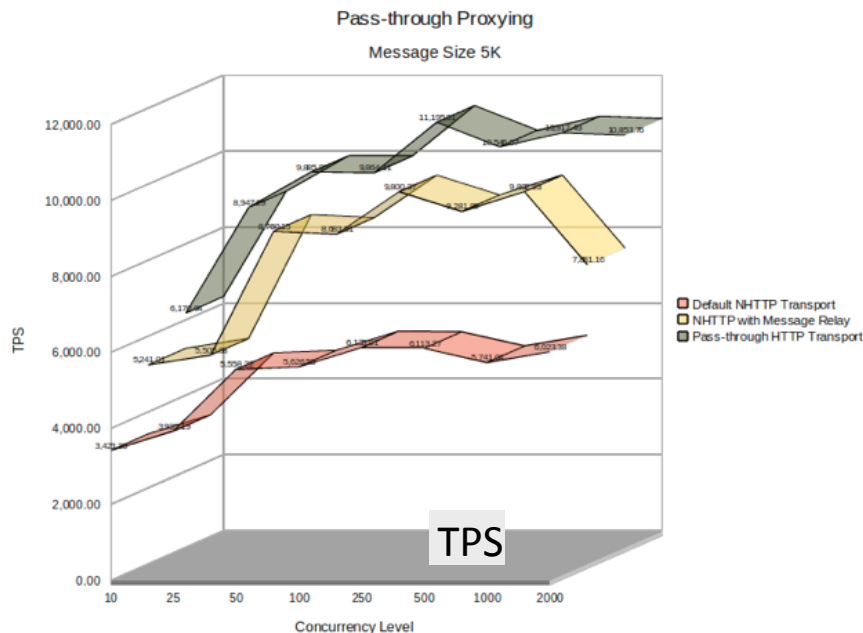
Enable Security?

Basic Scenarios			
1.	<input checked="" type="radio"/>	UsernameToken	 Provides Authentication. Clients have Username Tokens
2.	<input type="radio"/>	Non-repudiation	 Provides Authentication and Integrity. Clients have X509 certificates
3.	<input type="radio"/>	Integrity	 Provides Integrity. Clients do not have X509 certificates
4.	<input type="radio"/>	Confidentiality	 Provides Confidentiality. Clients do not have X509 certificates



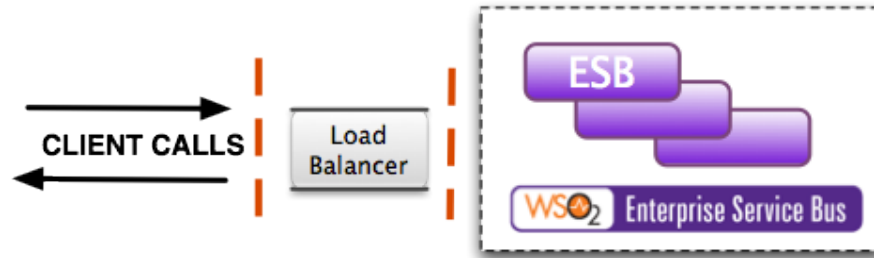
High Performance and Stability

- Supports 1000s of concurrent non-blocking HTTP transaction per server
- Pure streaming and Optimization using Message relay (on-demand processing of messages)
- Very Low latency (0.5 ms for Non-Blocking IO transport)
- Long Term Execution Stability with Low Resources Utilization
- Response Caching



High Availability and Scalability

- Supports Active/Active, Active/Passive Scenarios





- ESB itself can act as load-balancer.
- Auto-scaling using Load Balancer component
- Deployment Synchronizer can be used to maintain configuration across clusters.



Extensibility

- Supports Scripting Language (JavaScript, JRuby, Groovy)
- Java extension via POJO calls
- Can be extended via custom mediators

Name		Description
Script Mediator		Calls scripts via Bean Scripting Framework (Java, JRuby, Groovy)
Class Mediator		Invoke your own mediator

- Extend configuration vocabulary with custom domain-specific languages via **templates**.



Resources

- Wikipedia!
 - http://en.wikipedia.org/wiki/Enterprise_service_bus
- Books
 - David Chappell: ESB
 - Open Source ESBs in Action
- Open Source
 - synapse.apache.org
 - wso2.com/products/enterprise-service-bus
 - servicemix.apache.org

