

# WHAT WOULD SMART SERVICES LOOK LIKE?

And how can we build them  
on dumb infrastructure?

Keith Duddy ([keith.duddy@qut.edu.au](mailto:keith.duddy@qut.edu.au))

QUT/Smart Services CRC, WESOA Workshop, 1 Dec 2008



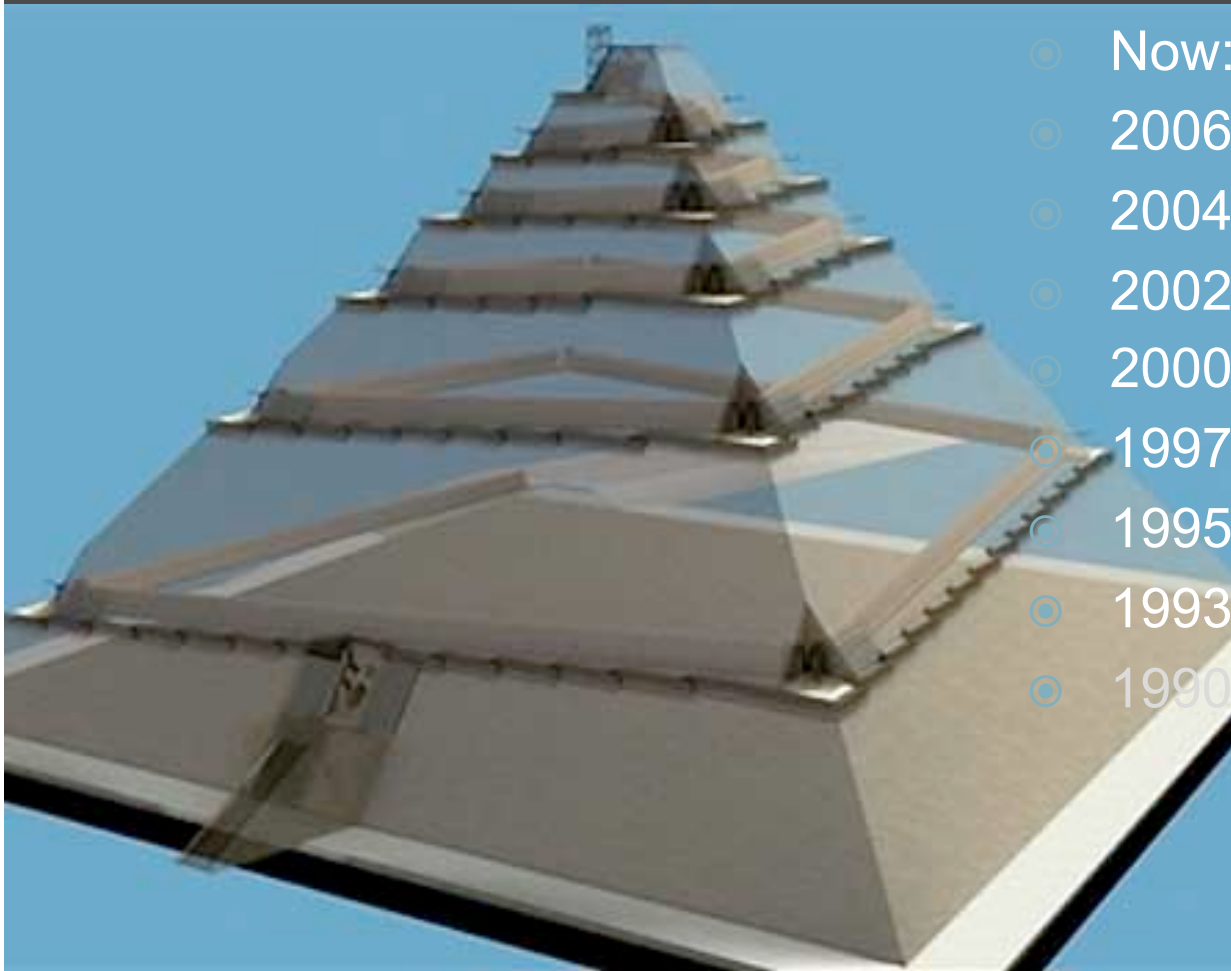
# Reconciliation

In keeping with the spirit of Reconciliation, I acknowledge the Cadigal people who are the traditional owners of the land on which we are meeting today, and acknowledge the important role Indigenous people continue to play within the QUT community.

[www.reconciliation.qut.edu.au](http://www.reconciliation.qut.edu.au)

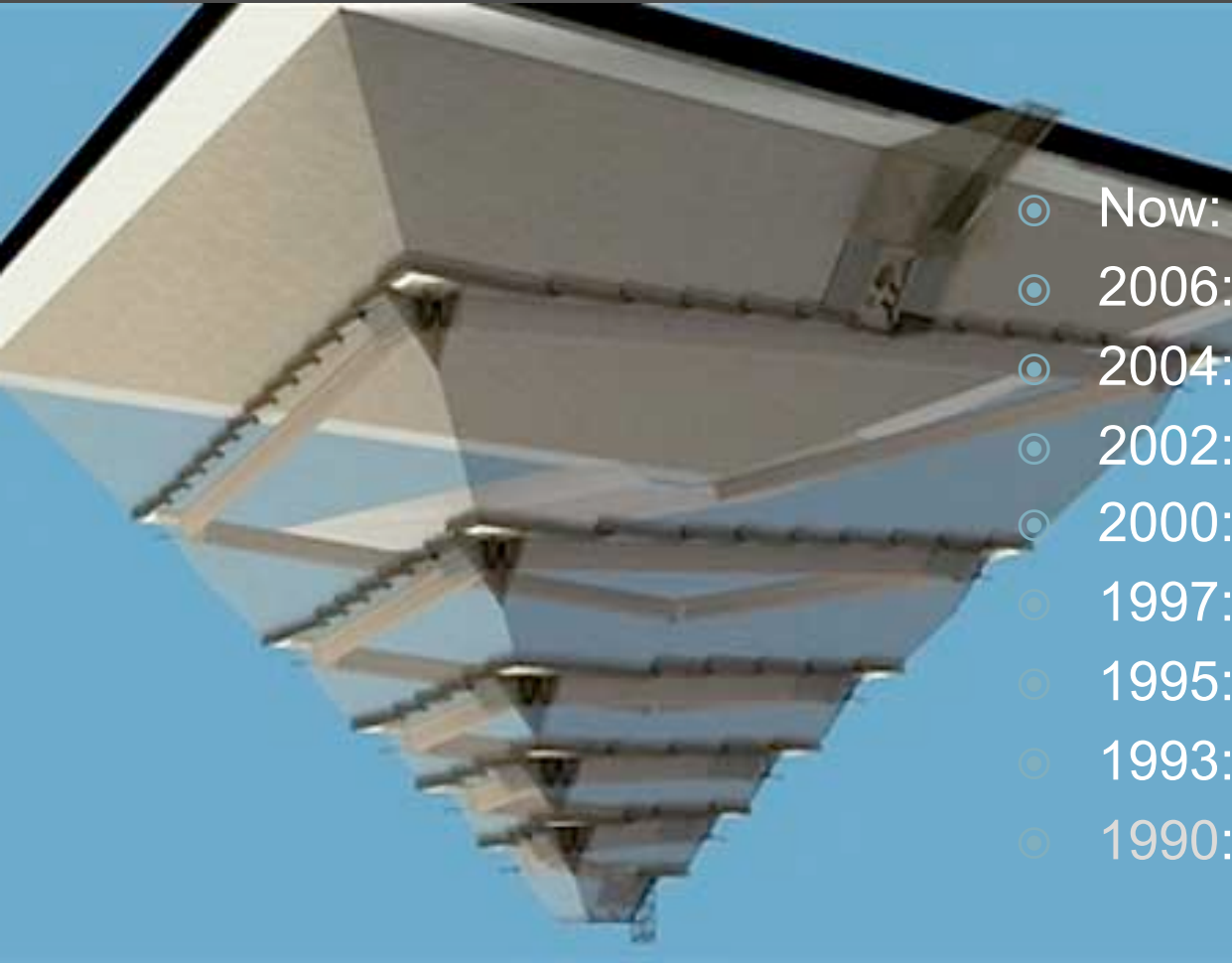


# A little about me



- Now: Smart Services CRC
- 2006: NEHTA
- 2004: Model Transformation
- 2002: Models of Enterprise Systems
- 2000: Metamodels & Repositories
- 1997: CORBA Components
- 1995: CORBA Trader & Notifications
- 1993: Network Protocol Drivers
- 1990: Operating Systems Drivers

# Or should it be...

- 
- Now: Smart Services CRC
  - 2006: NEHTA
  - 2004: Model Transformation
  - 2002: Models of Enterprise Systems
  - 2000: Metamodels & Repositories
  - 1997: CORBA Components
  - 1995: CORBA Trader & Notifications
  - 1993: Network Protocol Drivers
  - 1990: Operating Systems Drivers

# Outline

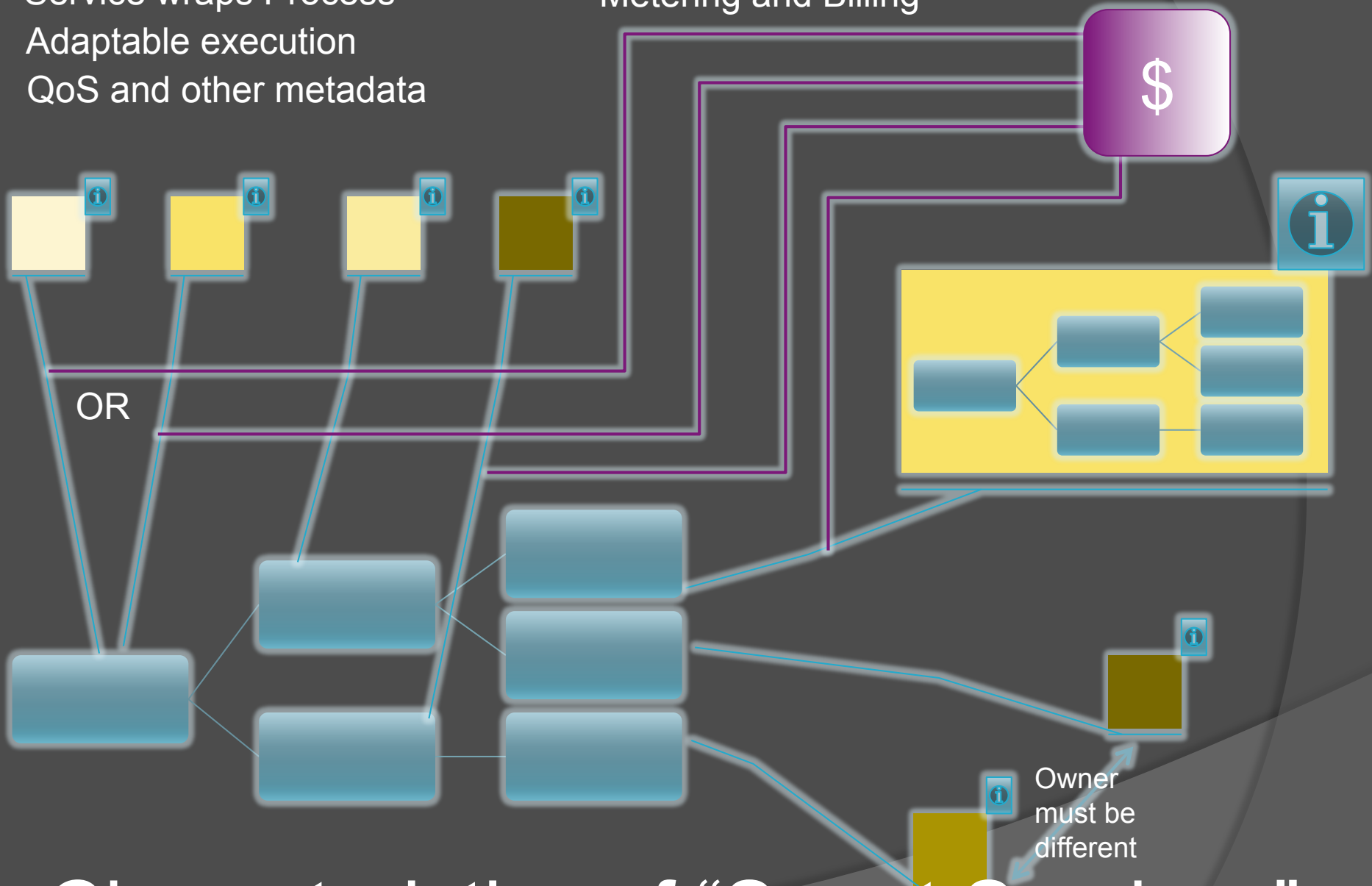
- ① What is a “Smart” Service?
- ② Overview of relevant Smart Services CRC projects
- ③ How does this relate to Web Services (WS\*)
- ④ What’s wrong with the WS\* & BP\* Platforms?
- ⑤ What other challenges do we face?
- ⑥ Some practical initiatives to overcome challenges

# What is a “Smart” Service?

- ◎ Better to think of infrastructure to enable “smarts” of regular web services
  - Selection of “best fit” services
    - based on QoS, context or policy
    - dynamic and static selection
  - Support for service meta-data to allow fitness to be discovered
  - Aggregation of services within Business Processes
    - Allowing the BP to be the context for selection
    - Exposure of aggregations as first class services
  - Integration with payment, logging & auditing
  - Replacement of services with “similar” services
    - Using ontologies, AI, other approaches

Process Tasks invoke Services  
Service wraps Process  
Adaptable execution  
QoS and other metadata

Constraint enforcement  
Metering and Billing



# Characteristics of "Smart Services"

# Overview of relevant Smart Services CRC projects (Year 1)

- ◎ Service Delivery Framework
  - Architecture & Vision
  - Service Delivery Use Cases from industry/govt
  - Service Broker
- ◎ Service Aggregation
  - Architecture & Vision
  - Service Aggregation Use Cases
  - BPM-based Service Aggregation Engine(s)
    - QoS and Constraint aware
    - Adaptive to changing environment
    - Range of enactment optimisations
  - Lightweight (Web UI-based) Aggregations

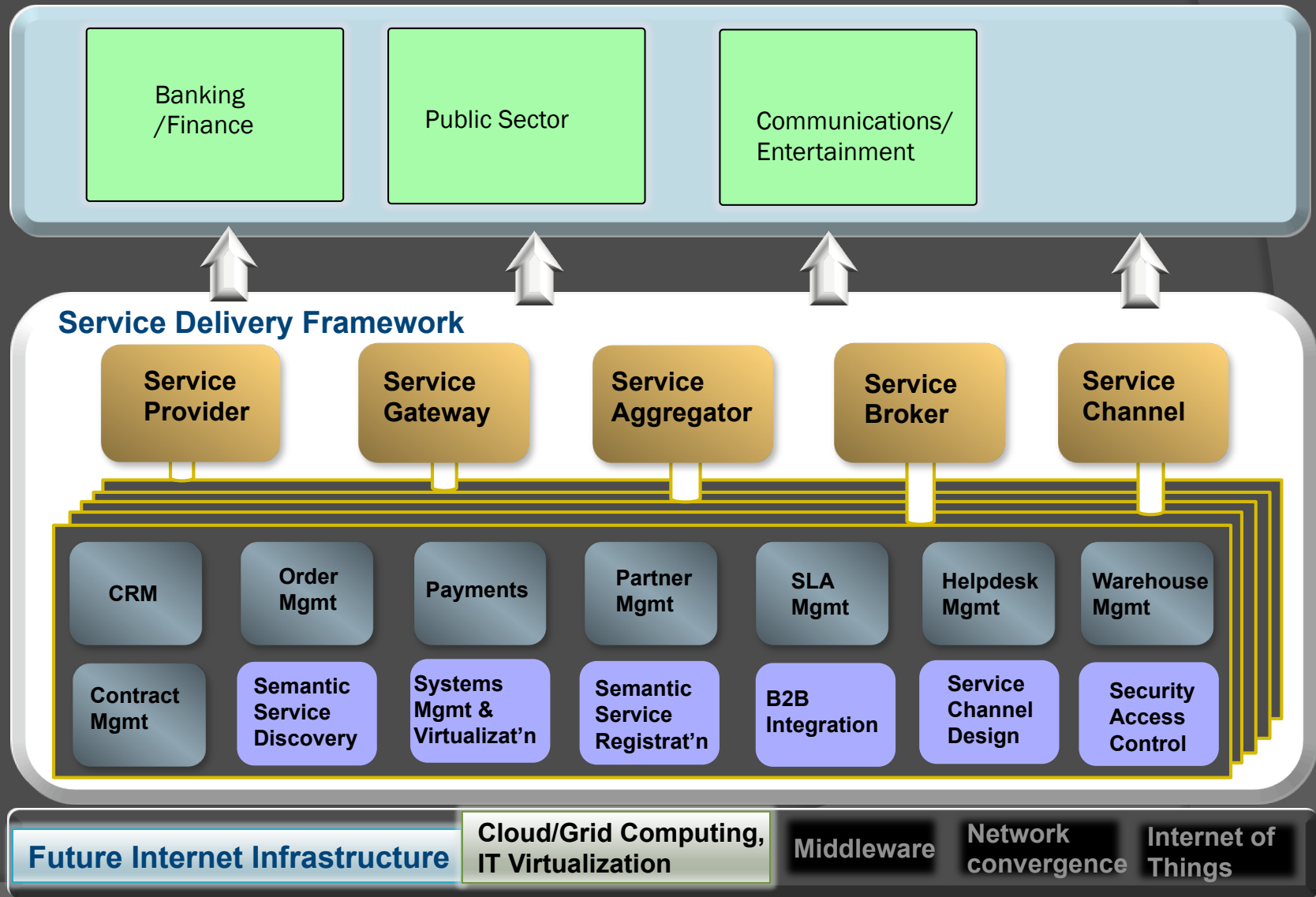


# Enterprise SOA Big Picture

Diagram © SAP 2008

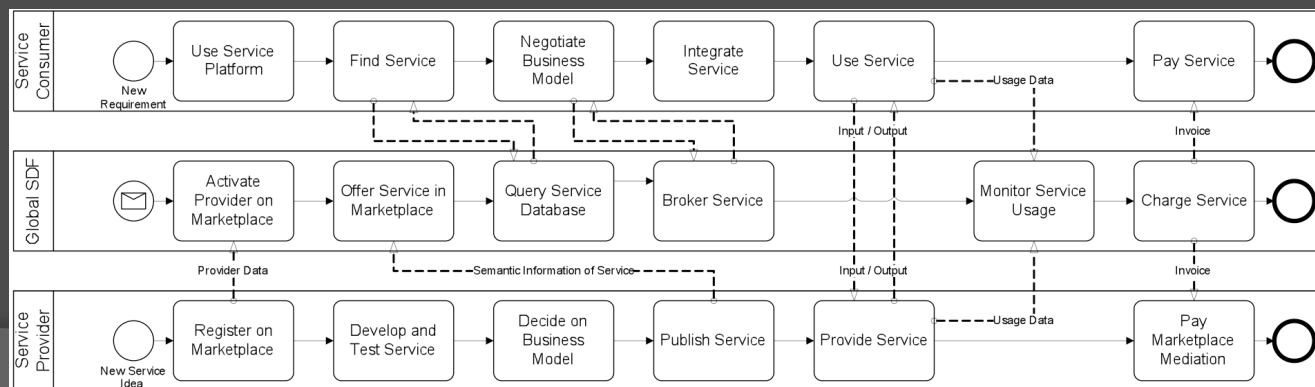
Target industries: First loS apps.

Enterprise SOA 2.0



# Service Broker

- Mediates Access to Web Services
  - Deployment
  - Metering/Payment
  - Discovery
  - Security/Trust
- Acts as a Marketplace of Services in some domain



# Déjà Vu

- ◎ Open Services Marketplaces have been promised since the early 90s
  - CORBA/ODP Trader (1995)
    - Stored standard metadata on services
    - Allowed selection based on query language
    - Federated model
  - UDDI (2001)
    - Stored standard metadata on services
    - Allowed selection based on criteria
    - Federated model
    - Global deployment by SAP, IBM & Microsoft until plug pulled in 2005
- ◎ Has anything changed?
  - Web Services have have gained critical mass?

# How does this relate to WS\* ?

- ◎ SOAP and WSDL are assumed
  - But what style? RPC, Literal, Wrapped, Document? Any XML?
- ◎ WS Addressing is well supported by vendors
- ◎ WS Security is implemented, but divergent
- ◎ WS Reliable Messaging ??
- ◎ WS Policy ??
- ◎ WSFL, WS-Coordination, WS-Transactions, ...

# Web Services Standards Overview

## Interoperability Issues

**Basic Profile**  
1.0  
Final Specification

**Basic Profile**  
1.2  
Working Draft

**Basic Profile**  
1.3  
Working Draft

**Basic Profile**  
1.3  
Working Draft

**Basic Profile**  
1.3  
Working Draft

**Attachment Profile**  
1.0  
Final Specification

**Simple SOAP Binding Profile**  
1.0  
Final Specification

**Basic Security Profile**  
1.0  
Draft Proposed

**REL Token Profile**  
1.0  
Working Draft

**SAML Token Profile**  
1.0  
Working Draft

**Conformance Claim Attachment Mechanism**  
1.0  
Final Specification

**Reliable Asynchronous Messaging Profile**  
1.0  
Working Draft

## Standards Bodies

**OASIS** - Open Architecture and Standards Institute  
**ISO** - International Organization for Standardization  
**W3C** - World Wide Web Consortium  
**ECMA** - European Committee for Standardization  
**IEEE** - Institute of Electrical and Electronics Engineers  
**ANSI** - American National Standards Institute  
**IEC** - International Electrotechnical Commission  
**ITU-T** - International Telecommunication Union - Telecommunication Standardization Sector  
**ISO/IEC JTC 1** - Joint Technical Committee 1  
**ISO/IEC JTC 2** - Joint Technical Committee 2  
**ISO/IEC JTC 3** - Joint Technical Committee 3  
**ISO/IEC JTC 4** - Joint Technical Committee 4  
**ISO/IEC JTC 5** - Joint Technical Committee 5  
**ISO/IEC JTC 6** - Joint Technical Committee 6  
**ISO/IEC JTC 7** - Joint Technical Committee 7  
**ISO/IEC JTC 8** - Joint Technical Committee 8  
**ISO/IEC JTC 9** - Joint Technical Committee 9  
**ISO/IEC JTC 10** - Joint Technical Committee 10  
**ISO/IEC JTC 11** - Joint Technical Committee 11  
**ISO/IEC JTC 12** - Joint Technical Committee 12  
**ISO/IEC JTC 13** - Joint Technical Committee 13  
**ISO/IEC JTC 14** - Joint Technical Committee 14  
**ISO/IEC JTC 15** - Joint Technical Committee 15  
**ISO/IEC JTC 16** - Joint Technical Committee 16  
**ISO/IEC JTC 17** - Joint Technical Committee 17  
**ISO/IEC JTC 18** - Joint Technical Committee 18  
**ISO/IEC JTC 19** - Joint Technical Committee 19  
**ISO/IEC JTC 20** - Joint Technical Committee 20  
**ISO/IEC JTC 21** - Joint Technical Committee 21  
**ISO/IEC JTC 22** - Joint Technical Committee 22  
**ISO/IEC JTC 23** - Joint Technical Committee 23  
**ISO/IEC JTC 24** - Joint Technical Committee 24  
**ISO/IEC JTC 25** - Joint Technical Committee 25  
**ISO/IEC JTC 26** - Joint Technical Committee 26  
**ISO/IEC JTC 27** - Joint Technical Committee 27  
**ISO/IEC JTC 28** - Joint Technical Committee 28  
**ISO/IEC JTC 29** - Joint Technical Committee 29  
**ISO/IEC JTC 30** - Joint Technical Committee 30  
**ISO/IEC JTC 31** - Joint Technical Committee 31  
**ISO/IEC JTC 32** - Joint Technical Committee 32  
**ISO/IEC JTC 33** - Joint Technical Committee 33  
**ISO/IEC JTC 34** - Joint Technical Committee 34  
**ISO/IEC JTC 35** - Joint Technical Committee 35  
**ISO/IEC JTC 36** - Joint Technical Committee 36  
**ISO/IEC JTC 37** - Joint Technical Committee 37  
**ISO/IEC JTC 38** - Joint Technical Committee 38  
**ISO/IEC JTC 39** - Joint Technical Committee 39  
**ISO/IEC JTC 40** - Joint Technical Committee 40  
**ISO/IEC JTC 41** - Joint Technical Committee 41  
**ISO/IEC JTC 42** - Joint Technical Committee 42  
**ISO/IEC JTC 43** - Joint Technical Committee 43  
**ISO/IEC JTC 44** - Joint Technical Committee 44  
**ISO/IEC JTC 45** - Joint Technical Committee 45  
**ISO/IEC JTC 46** - Joint Technical Committee 46  
**ISO/IEC JTC 47** - Joint Technical Committee 47  
**ISO/IEC JTC 48** - Joint Technical Committee 48  
**ISO/IEC JTC 49** - Joint Technical Committee 49  
**ISO/IEC JTC 50** - Joint Technical Committee 50

## Business Process Specifications

**Business Process Execution Language for Web Services 1.1**  
1.0  
Final Specification

**WS-Choreography Model Overview**  
1.0  
Working Draft

**Web Service Choreography Interface**  
1.0  
Working Draft

**Web Service Choreography Description Language**  
1.0  
Working Draft

**Business Process Execution Language for Web Services 2.0**  
1.0  
Final Specification

**Business Process Management Language**  
1.0  
Working Draft

**XML Process Definition Language**  
1.0  
Working Draft

## Metadata Specifications

**WS-Policy**  
1.0  
Working Draft

**WS-PolicyAssertions**  
1.0  
Working Draft

**WS-PolicyAttachment**  
1.0  
Working Draft

**WS-Discovery**  
1.0  
Working Draft

**WS-MetadataExchange**  
1.0  
Working Draft

**Universal Description, Discovery and Ingestion 1.0**  
1.0  
Working Draft

**Web Service Description Language 2.0**  
1.0  
Working Draft

**Web Service Description Language 2.0 Core**  
1.0  
Working Draft

**Web Service Description Language 1.1**  
1.0  
Working Draft

**Web Service Description Language 1.0**  
1.0  
Working Draft

## Reliability Specifications

**WS-ReliableMessaging**  
1.0  
Working Draft

**WS-ReliableMessaging Policy Assertion (part 1)**  
1.0  
Working Draft

**WS-ReliableMessaging Policy Assertion (part 2)**  
1.0  
Working Draft

**WS-Reliability**  
1.0  
Working Draft

## Security Specifications

**WS-Security**  
1.0  
Working Draft

**WS-SecurityPolicy**  
1.0  
Working Draft

**WS-Security: Kerberos Binding**  
1.0  
Working Draft

**WS-Security: SOAP Message Security**  
1.0  
Working Draft

**WS-Security: Username Token Profile**  
1.0  
Working Draft

**WS-Security: SAML Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

**WS-Security: X.509 Certificate Token Profile**  
1.0  
Working Draft

## Management Specifications

**Management Using Web Services (part 1)**  
1.0  
Working Draft

**Management Of Web Services (part 1)**  
1.0  
Working Draft

**WS-Management**  
1.0  
Working Draft

**Service Modeling Language**  
1.0  
Working Draft

## Transaction Specifications

**WS-Coordination**  
1.0  
Working Draft

**WS-Business Activity**  
1.0  
Working Draft

**WS-Atomic Transaction**  
1.0  
Working Draft

**WS-Composite Application Framework**  
1.0  
Working Draft

**WS-Contract**  
1.0  
Working Draft

**WS-Transaction Framework**  
1.0  
Working Draft

**WS-Transaction Framework (part 1)**  
1.0  
Working Draft

**WS-Transaction Framework (part 2)**  
1.0  
Working Draft

**WS-Transaction Management (part 1)**  
1.0  
Working Draft

**WS-Transaction Management (part 2)**  
1.0  
Working Draft

**WS-Transaction Management (part 3)**  
1.0  
Working Draft

**WS-Transaction Management (part 4)**  
1.0  
Working Draft

**WS-Transaction Management (part 5)**  
1.0  
Working Draft

**WS-Transaction Management (part 6)**  
1.0  
Working Draft

**WS-Transaction Management (part 7)**  
1.0  
Working Draft

**WS-Transaction Management (part 8)**  
1.0  
Working Draft

**WS-Transaction Management (part 9)**  
1.0  
Working Draft

**WS-Transaction Management (part 10)**  
1.0  
Working Draft

**WS-Transaction Management (part 11)**  
1.0  
Working Draft

**WS-Transaction Management (part 12)**  
1.0  
Working Draft

**WS-Transaction Management (part 13)**  
1.0  
Working Draft

**WS-Transaction Management (part 14)**  
1.0  
Working Draft

**WS-Transaction Management (part 15)**  
1.0  
Working Draft

**WS-Transaction Management (part 16)**  
1.0  
Working Draft

**WS-Transaction Management (part 17)**  
1.0  
Working Draft

**WS-Transaction Management (part 18)**  
1.0  
Working Draft

**WS-Transaction Management (part 19)**  
1.0  
Working Draft

**WS-Transaction Management (part 20)**  
1.0  
Working Draft

**WS-Transaction Management (part 21)**  
1.0  
Working Draft

**WS-Transaction Management (part 22)**  
1.0  
Working Draft

**WS-Transaction Management (part 23)**  
1.0  
Working Draft

## Presentation Specifications

**Web Services for Remote Formats (part 1)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 2)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 3)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 4)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 5)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 6)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 7)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 8)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 9)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 10)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 11)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 12)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 13)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 14)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 15)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 16)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 17)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 18)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 19)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 20)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 21)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 22)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 23)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 24)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 25)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 26)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 27)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 28)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 29)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 30)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 31)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 32)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 33)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 34)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 35)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 36)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 37)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 38)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 39)**  
1.0  
Working Draft

**Web Services for Remote Formats (part 40)**  
1.0  
Working Draft

## Messaging Specifications

**WS-Notification**  
1.0  
Working Draft

**WS-Eventing**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

**WS-Eventing - WSDL Binding**  
1.0  
Working Draft

# What's wrong with WS-\* ?

- ⦿ “We don't support WSDL-first development – you need to design your operations in C# first and export”

Microsoft .Net Web Services Toolkit Support

- Visual Studio/.Net currently doesn't support various WSDL Fault types or XML payloads
- Jax-WS has problems with Canonicalization, which is required for WS-Security
- And that's just the big 2
- ⦿ WS-I “Basic” profile has 3 variants which are supported inconsistently by toolkits
  - The other WSI profiles are only implemented by a handful of toolkits
- ⦿ In short – Interoperability is a farce
- ⦿ So how can the pundits claim WS is the only viable distributed solution?

# Whose Fault is the WS Mess?

- ⦿ The vendors?
  - They do tend to propose overlapping WS standards to do the same thing
  - They implement convenient subsets of the standards
    - to deliberately thwart interop?
- ⦿ The standards bodies?
  - W3C is notorious for slow process that leaves standards at “recommendation” status for too long
  - OASIS has little editorial or architectural quality control
  - WS-I has failed to fix the ambiguities that W3C and OASIS have allowed to pass
- ⦿ In the end the contributors (mostly vendors) write, submit and vote on the standards
- ⦿ We are seeing “Browser Wars” develop into “Service Wars”
  - At least HTTP & TLS work 😊

# WS Success Stories

- ⦿ Reardon Commerce (Axiom Travel Service)
  - SOA platform with user profiles & WS integration
- ⦿ RightNow (Enterprise CRM)
  - WS in the background
- ⦿ Salesforce.com (Smaller Business CRM)
  - WS in the background
- ⦿ Amazon.com
  - Partner integration using WS
- ⦿ **Not** Google
  - They use HTTP & proprietary messages and platform toolkits
  - Indicator that WS is not ready for prime time



# What do the “successes” have in common?

- ⦿ “Walled Garden”
  - Control over who uses what and how
- ⦿ Minimal use of WS\*
  - WSDL only (maybe WS Addressing)
  - Transport level security rather than WS-Security
- ⦿ Controlled interface types
  - Simple payloads - no complex XML
  - Restricted subset of WSDL
- ⦿ Integration behind a slick user interface
- ⦿ Hosted platform in bespoke environment
  - User Profiles
  - Events/Notifications
  - Charging and Payment

# What's wrong with BPM?

- ⦿ The execution semantics of the popular BPM languages is incompatible:
  - BPMN is a pretty diagram format with no formal semantics
    - XPDL can represent BPMN, but with no more formality
  - UML Activity Graphs have a novel token passing semantics (with “semantic variations”)
  - BPEL is based on Pi-Calculus, but with no formal mapping and no graphical syntax
  - YAWL is formally based on Petri Nets, but only has open source implementation
- ⦿ Therefore, no semantic mappings are possible between the languages

# What about QoS?

- ⦿ Do we mean QoS of the service provision OR QoS of the service application?
  - Execution time – is this end-to-end, or just at the server? Average, or Max? Measured by whom?
  - Price – is this access price (search the books), or price of service (buy a book). Is Price even a QoS?
  - Reputation & Trust – who rates this? Who stores it? Is the number of reviews, etc., revealed?
- ⦿ Who stores the QoS properties, and in what format?

# Some practical initiatives to overcome challenges

- ◎ Service Description metamodels
  - Covers many of the questions asked about QoS
  - <http://service-description.com/>
- ◎ SDLs to raise the level of abstraction
  - Maturity of MDA, MDE by discarding the hype
  - Allows Code generation OR Runtimes from Software Factories
- ◎ KISS (Knowledge Industry Survival Strategy) Initiative
  - Modelling Tool Interoperability Manifesto & Projects
  - Workshop Series at major conferences
  - <http://www.industrialized-software.org/kiss-initiative>

# To Wrap Up

- ◎ Smart Services will combine
  - Web Services (where viable)
  - BPM (several variants)
  - QoS and other service properties
  - Metering and Billing
  - Service Discovery, Substitution and Variability
- ◎ Standards have hit an all time quality low
  - Interoperability is compromised
  - We will need lots of duct tape & ticky-tacky
  - Model interoperability gives us a chance to abstract away from the ugly realities
  - Contributions to Open Source allow us to provide reference implementations and bottom-up interop