Composing Business Solutions using SCA

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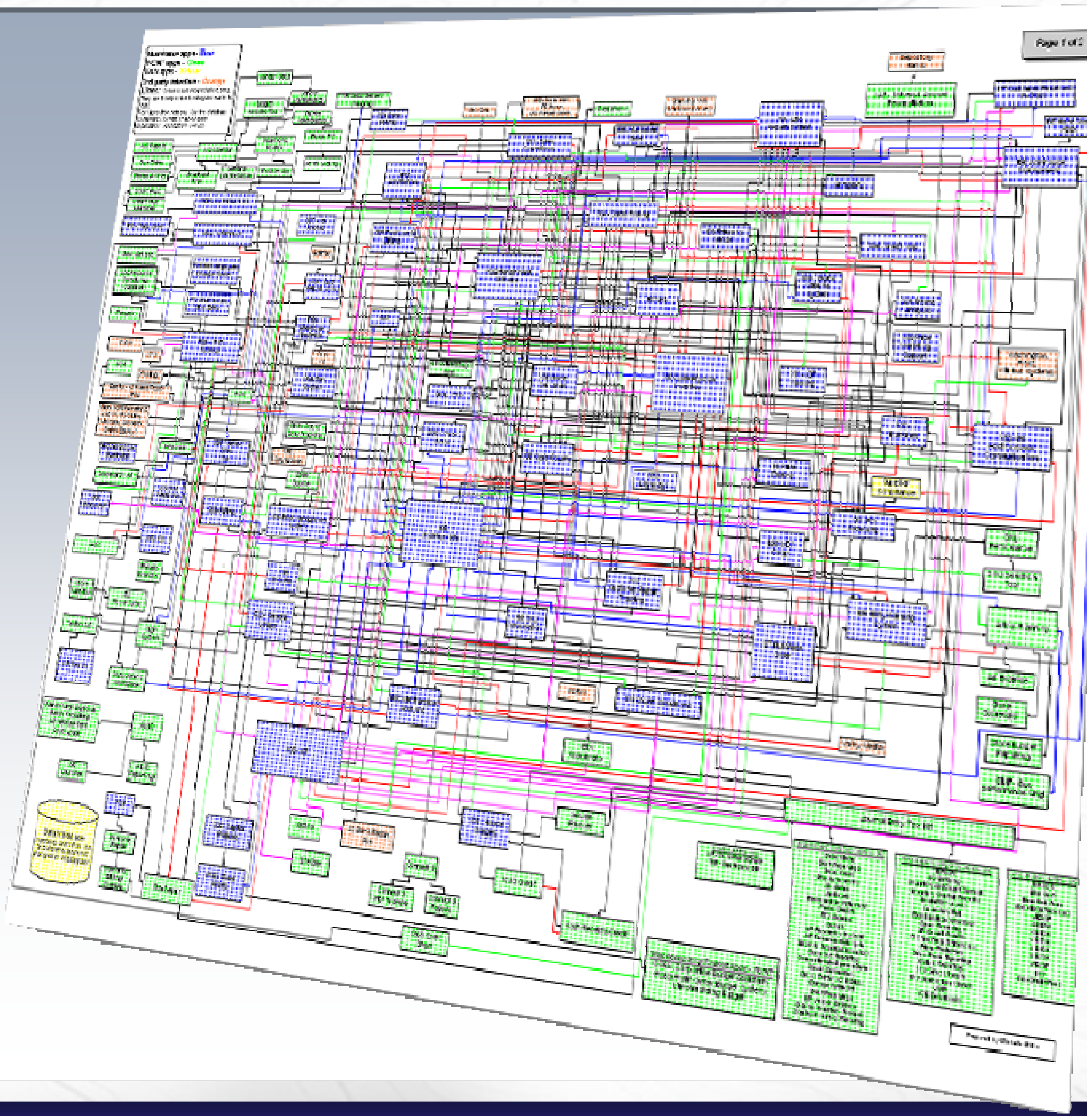
Service Component Architecture (SCA):

A model for the creation of business systems
using Service-Oriented Architecture
by the composition and deployment
of new and existing service components

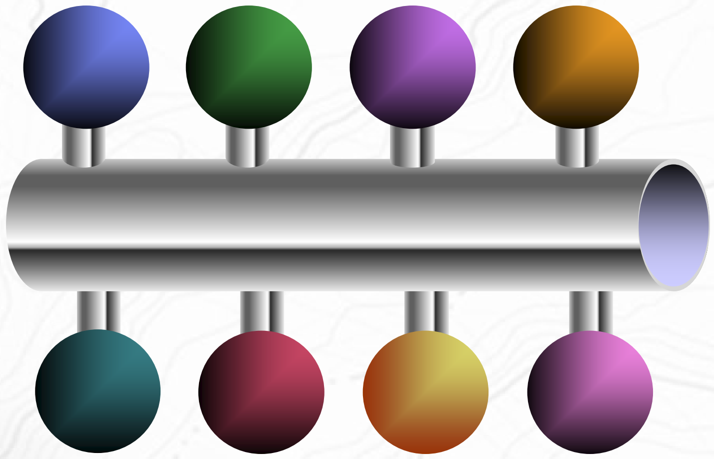
- **SCA: Why**
- **SCA: Scenarios**
- **SCA: Details**
- **SCA: Specifications, Standardization and Industry Support**

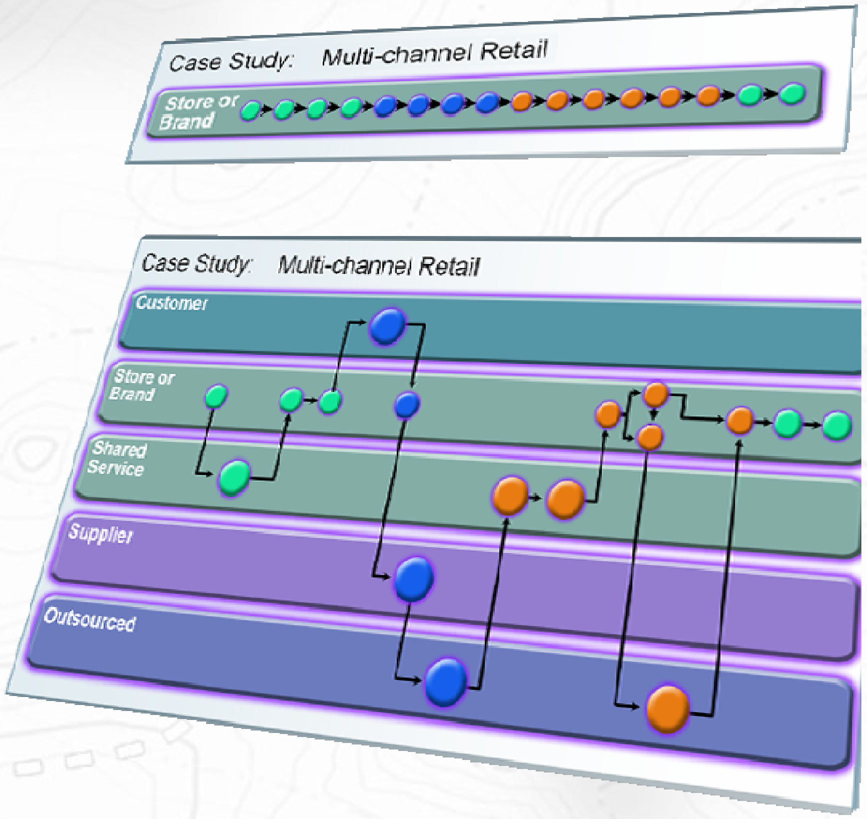
What We have Today

- Complexity
- Rigid, brittle architectures
- Inability to evolve



What we want to get to





- Well-defined interfaces with business-level semantics
- Standardized communication protocols
- Flexible recombination of services to enhance software flexibility

Service-Oriented Architecture is one of the key technologies to enable flexibility and reduce complexity

SOA Programming Model (1)

- SOA Programming Model derives from the basic concept of a *service*:
  - A service is an abstraction that encapsulates a software function.
  - *Developers* build services, use services and develop solutions that aggregate services.
  - *Composition* of services into integrated *solutions* is a key activity

SOA Programming Model (2)

- Core Elements:
  - ***Service Assembly***
    - technology- and language- independent representation of composition of services
  - ***Service Components***
    - technology- and language-independent representation of composable service implementation
  - ***Service Data Objects***
    - technology- and language-Independent representation of service data entity

What are SCA and SDO?

- Service Component Architecture
  - an executable model for building service-oriented applications as composed networks of service components
  - “how to build composite service applications”
- Service Data Objects
  - a unified model for the handling of (service) data irrespective of its source or target
  - “how to handle data in a services environment”

Service Component Architecture (SCA): Simplified Programming Model for SOA

- ***executable*** model for:
- ***building*** service components
- ***assembling*** components into applications
- ***deploying*** to (distributed) runtime environments
  - Service components built from ***new or existing code using SOA principles***
  - ***vendor-neutral*** – supported across the industry
  - ***language-neutral*** – components written using any language
  - ***technology-neutral*** – use any communication protocols and infrastructure to link components

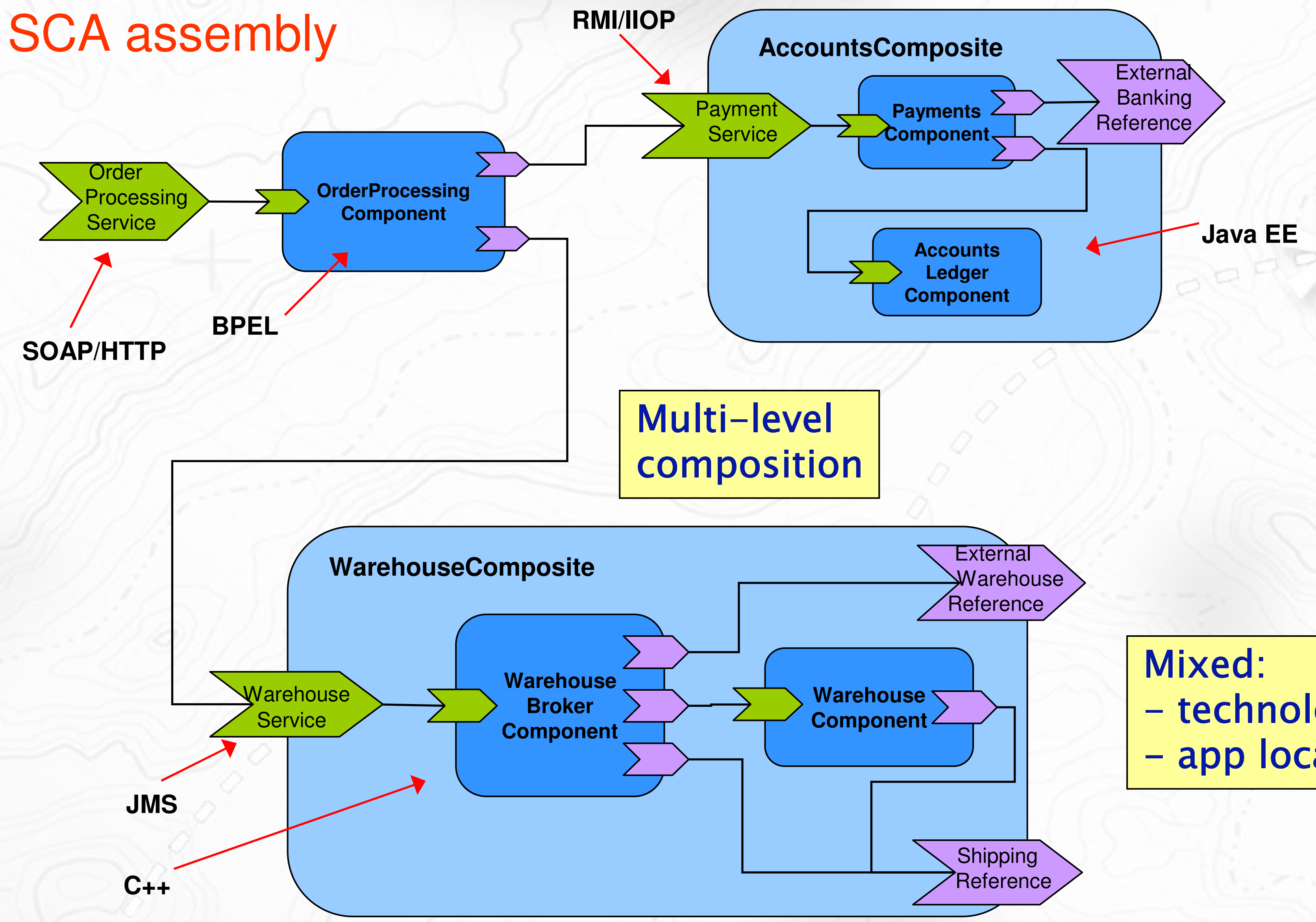
SCA: What is it NOT

- Does not model individual ***workflows***
  - use BPEL or other workflow languages
- Is not ***Web services***
  - SCA may use Web services, but can also build solutions with no Web services content
- Is not tied to a specific runtime environment
  - distributed, hetergeneous, large, small
- Does not force use of specific programming languages and technologies
  - aims to encompass many languages, technologies

Key benefits of SCA

- ***Loose Coupling***: components integrate without need to know how others are implemented
- ***Flexibility***: components can easily be replaced by other components
- ***Services*** can be *easily* invoked either synchronously or asynchronously
- ***Composition*** of solutions: clearly described
- ***Productivity***: easier to integrate components to form composite application
- ***Heterogeneity***: multiple implementation languages, communication mechanisms
- ***Declarative*** application of infrastructure services
- ***Simplification*** for **all** developers, integrators and application deployers

SCA assembly



Multi-level composition

Mixed:
- technologies
- app locations

Agenda

- ***SCA scenarios***

Bottom-up Composition

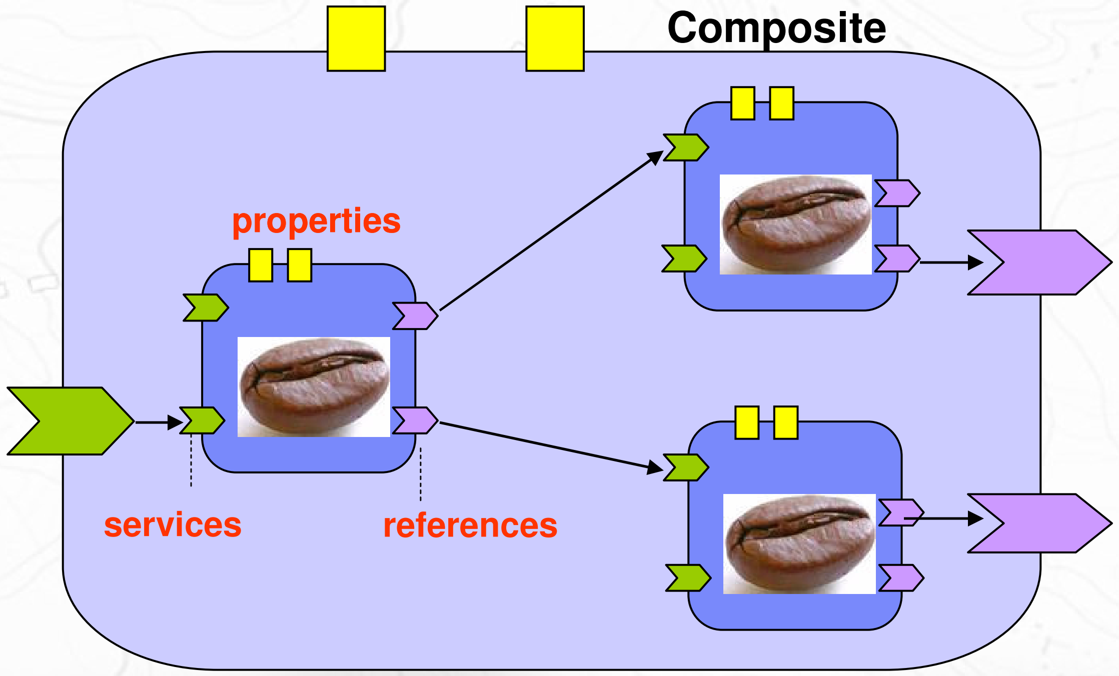
Select a set of existing component implementations for building the new composite

Configure the component properties

Draw internal wires

Wrap the components in a composite and configure external services/references

Hand off the composite to Deployer



Top-down Composition

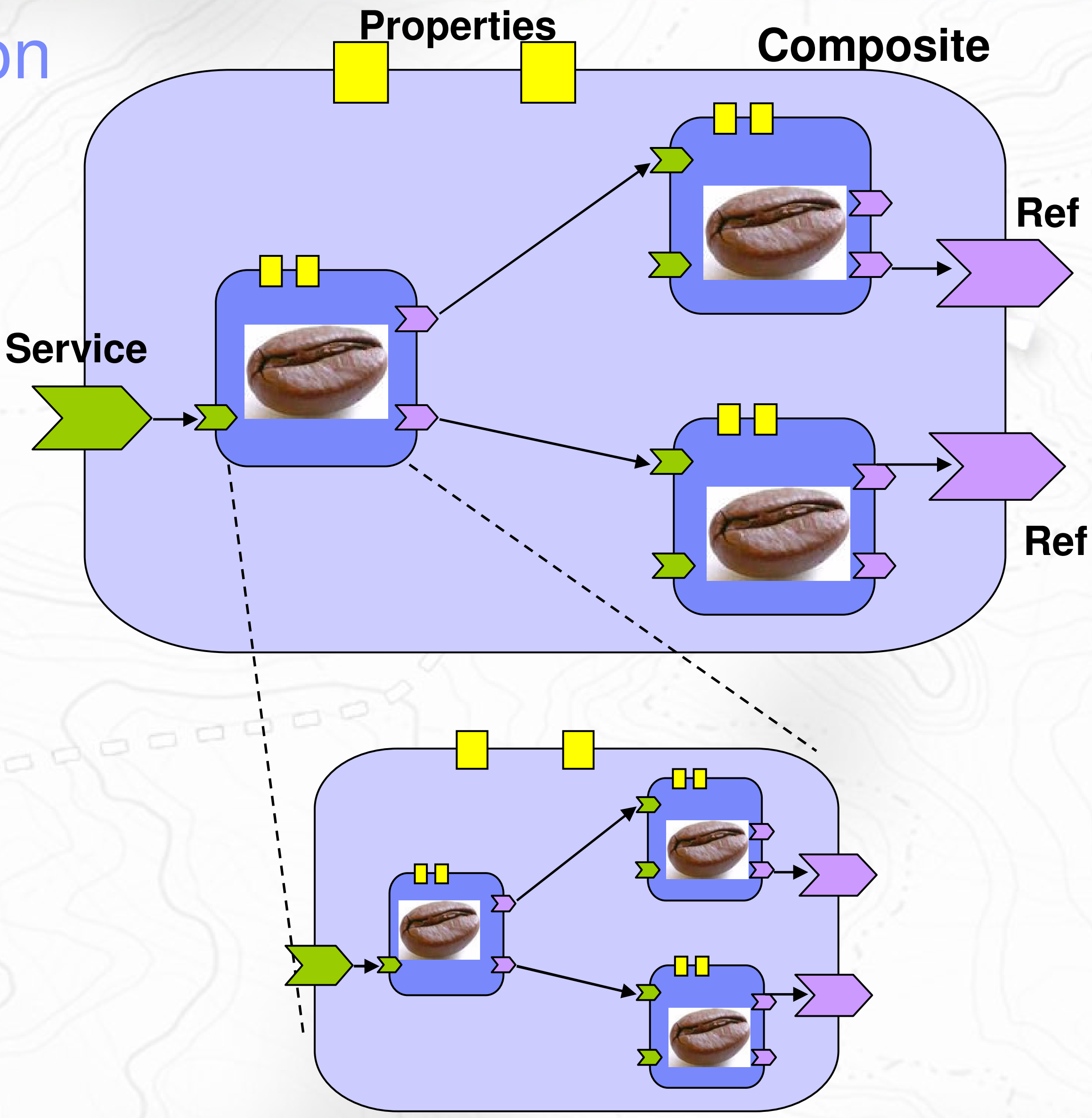
Start with gathering requirements for the top-level composite

Define the services/references and properties for the composite

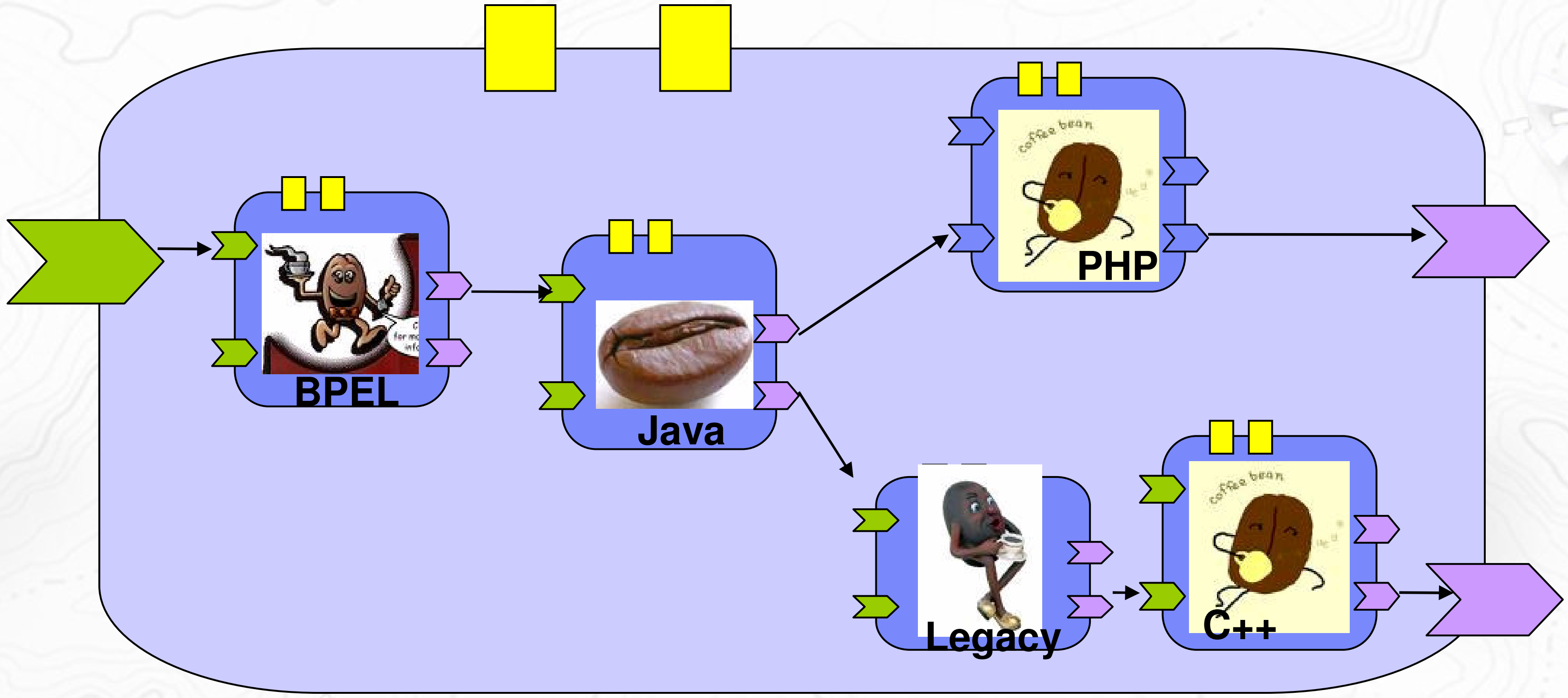
Break down the composite into individual components and wires between them

Recursively break down each component

Hand off the individual component contracts to developers for implementation



Heterogeneous Assembly



Components in the same composite share a common context for many aspects such as installation, deployment, security settings, logging behavior, etc.

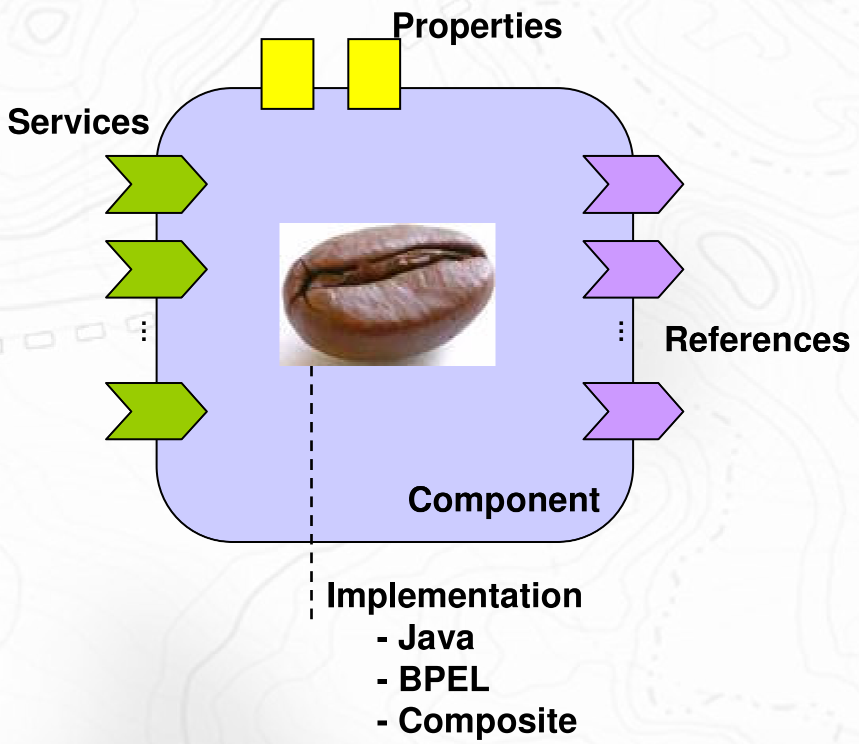
Implementation Reuse – By Configuration

Select an existing component implementation

Configure its behavior (via setting props, refs) to match the current requirements

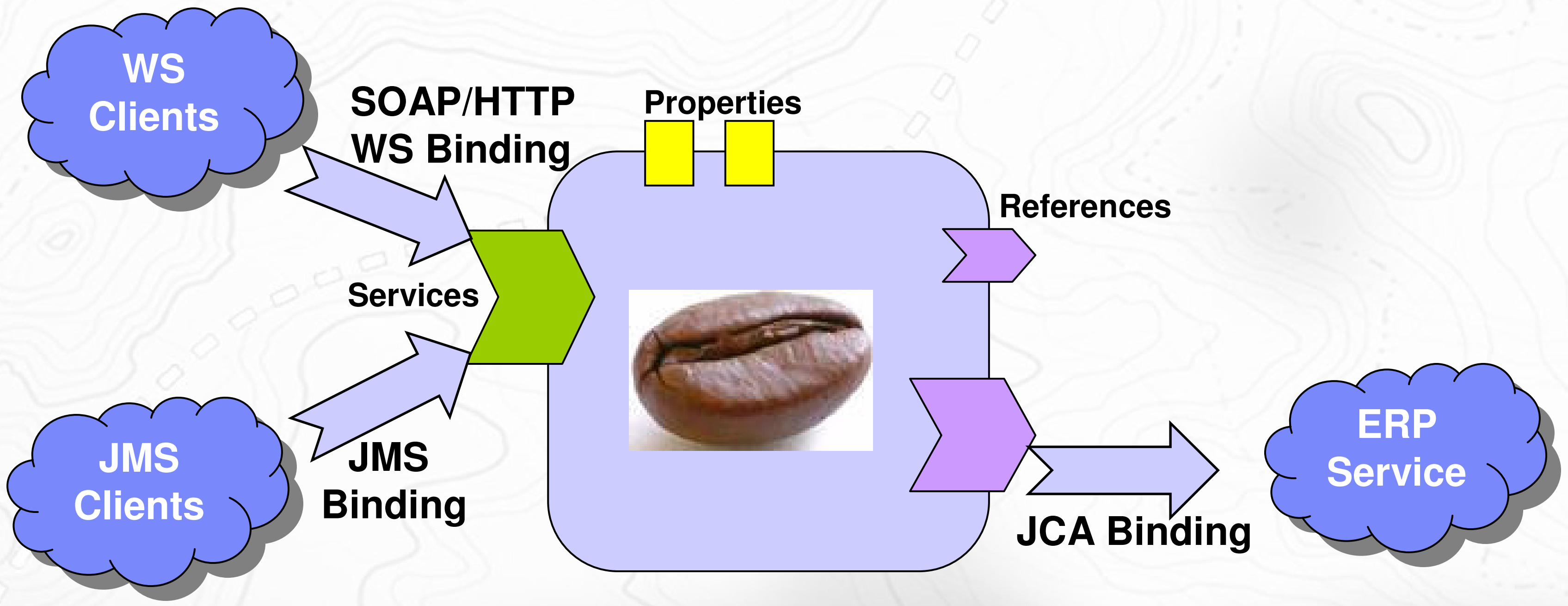
E.g. Configure multiple instances of product pricing component, each with different currency, tax rate, discount charts, etc.

Deploy the component implementation
- Multiple instances of the same implementation may be running simultaneously

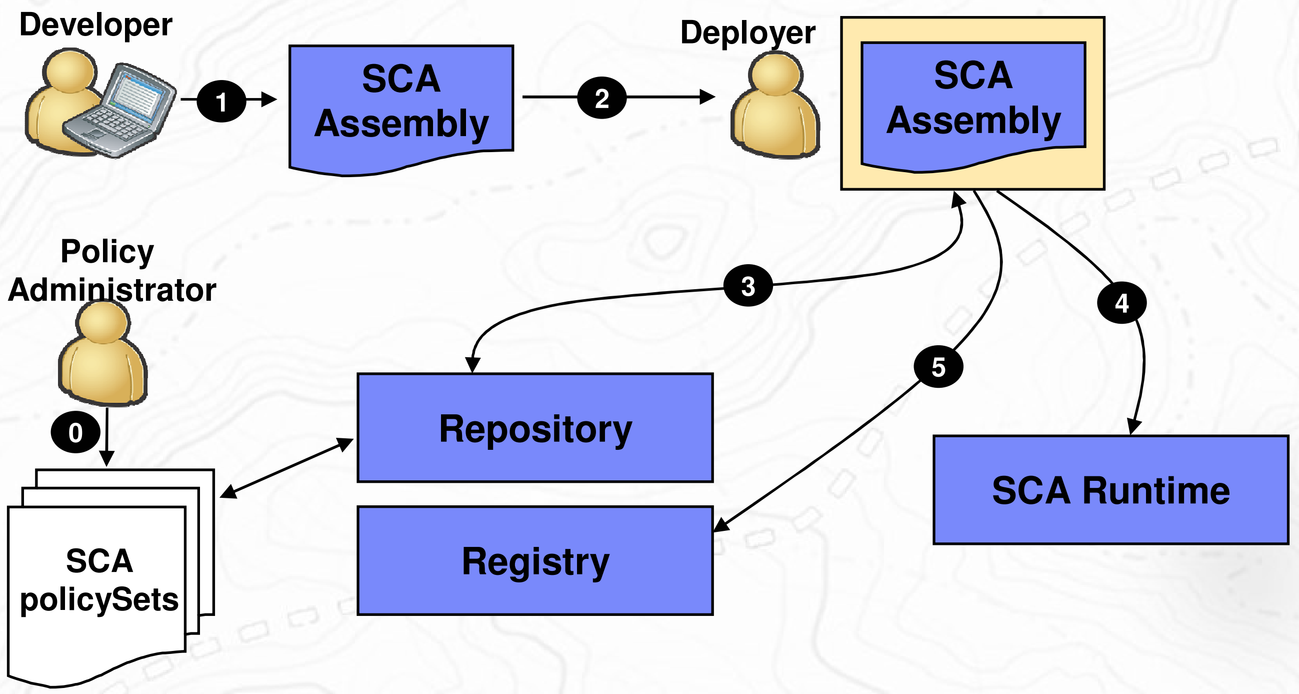


Deployment Flexibility

Deployer chooses and configures communication mechanisms for services/references without having to modify the component implementation



Abstract policy decleration



0. Policy Administrator authors SCA policySets with concrete policies
1. Developer specifies intents on SCA assembly
2. Developer hands over SCA assembly to Deployer
3. Deployer configures SCA assembly by assigning SCA policySets (could be automated)
4. Deployer deploys configured SCA Assembly to SCA Runtime
5. Deployer updates Registry

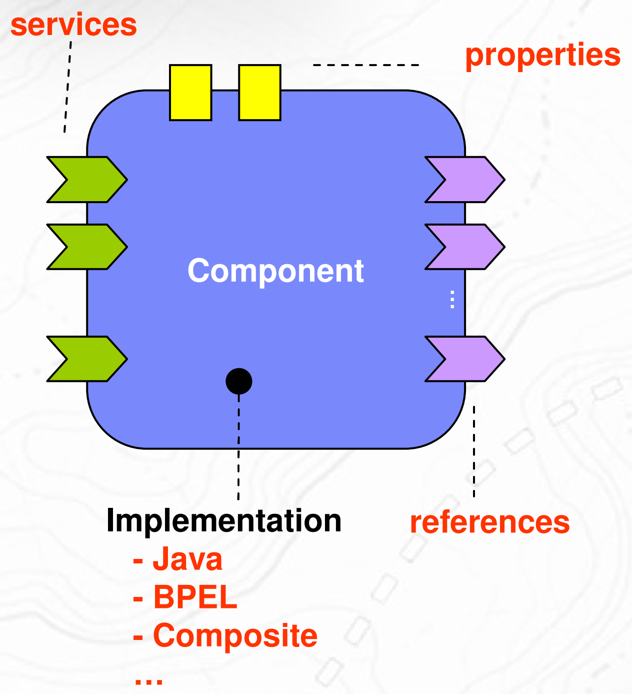
Agenda

- ***SCA details***

SCA Elements

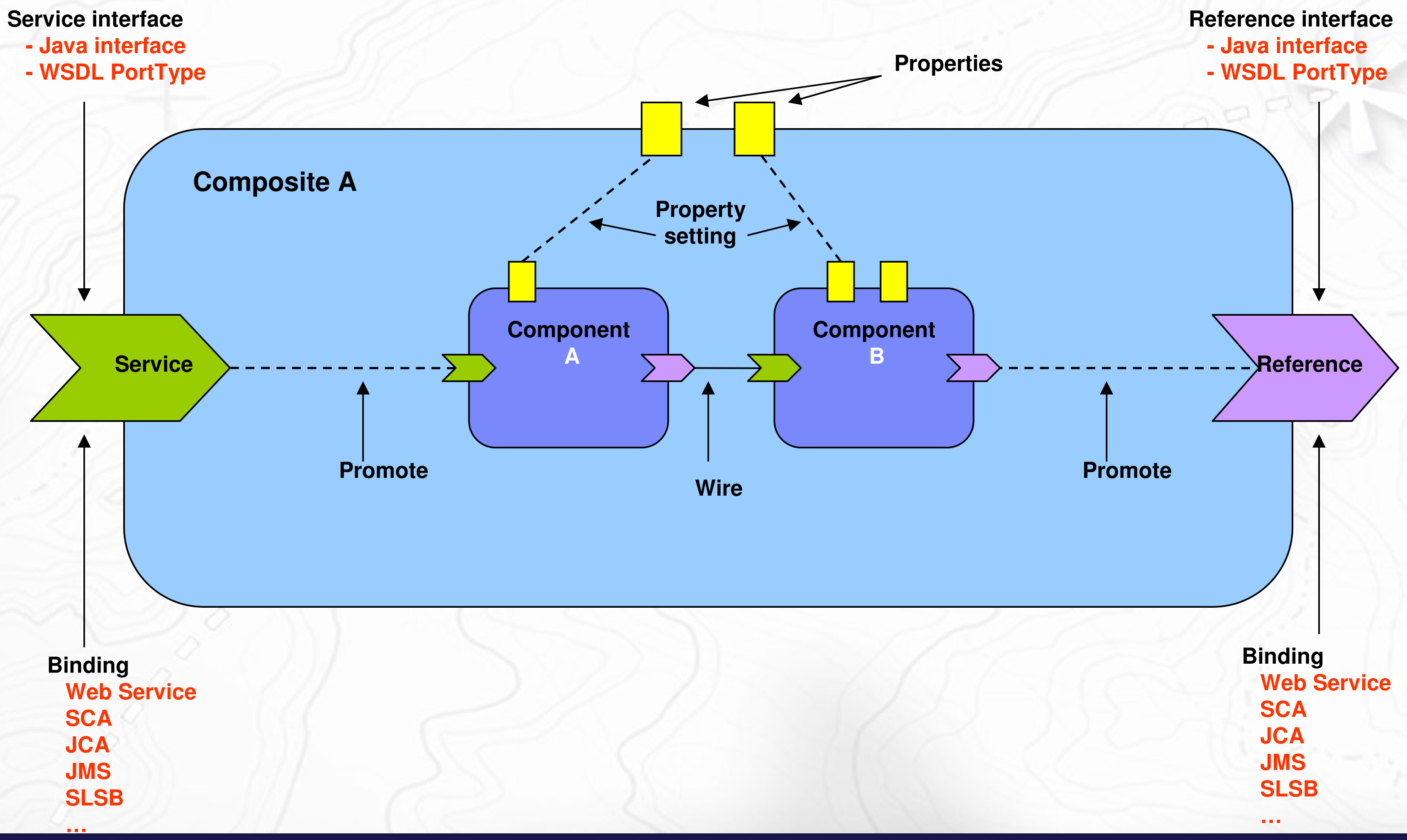
- ***Assembly*** Model
  - how to define structure of composite applications
- ***Client & Implementation*** specifications
  - how to write business services in particular languages
  - Java, C++, BPEL, PHP….
- ***Binding*** specifications
  - how to use access methods
  - Web services, JMS, RMI-IIOP, REST…
- ***Policy Framework***
  - Security, Transactions, Reliable messaging…

Component

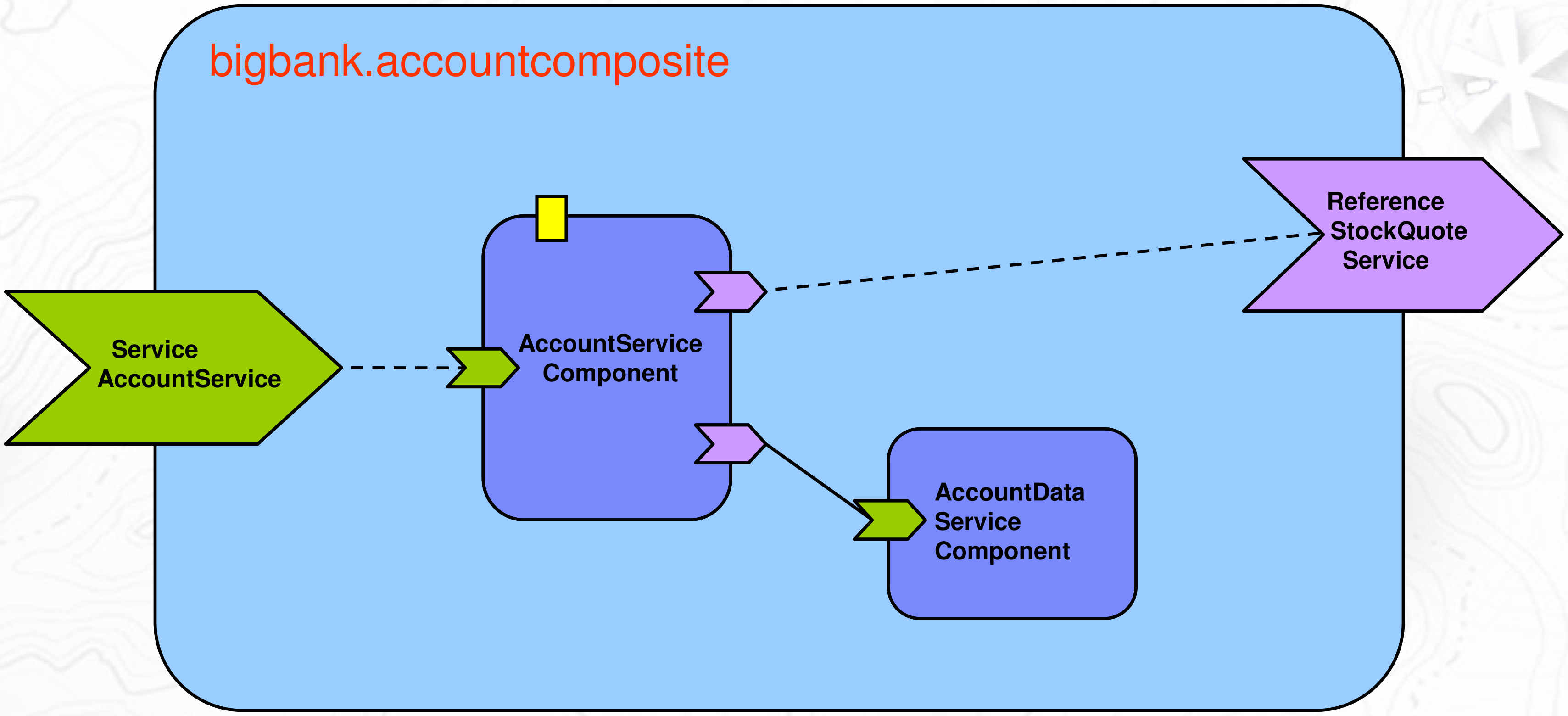


- ***configured*** instance of ***implementation***
  - more than one component can use same implementation
- ***provides*** and ***consumes services***
- Sets ***values*** for implementation ***properties***
- Sets service ***references*** by ***wiring*** them to services

Composite


Service interface
- Java interface
- WSDL PortType
Properties
Reference interface
- Java interface
- WSDL PortType
Composite A
Property setting
Component A
Component B
Service
Reference
Promote
Wire
Promote
Binding
Web Service
SCA
JCA
JMS
SLSB
...
Binding
Web Service
SCA
JCA
JMS
SLSB
...

Simple Example



SCA

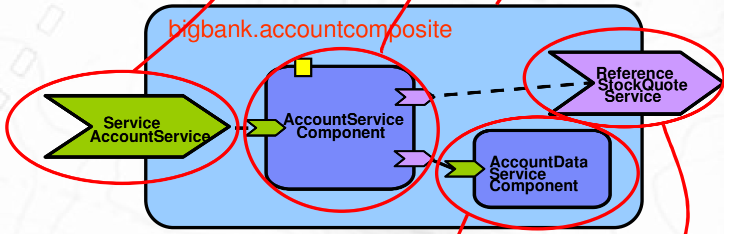
```
<composite xmlns="http://www.osoa.org/xmlns/sca/1.0"
           name="bigbank.accountcomposite" >

    <service name="AccountService" promote="AccountServiceComponent">
        <interface.java interface="services.account.AccountService"/>
        <binding.ws port="http://www.example.org/AccountService#
          wsdl.endpoint(AccountService/AccountServiceSOAP)"/>
    </service>

    <component name="AccountServiceComponent">
        <implementation.java class="services.account.AccountServiceImpl"/>
        <reference name="StockQuoteService"/>
        <reference name="AccountDataService"
                   target="AccountDataServiceComponent/AccountDataService"/>
        <property name="currency">EURO</property>
    </component>

    <component name="AccountDataServiceComponent">
        <implementation.bpel process="QName"/>
        <service name="AccountDataService">
            <interface.java interface="services.accountdata.AccountDataService"/>
        </service>
    </component>

    <reference name="StockQuoteService" promote="AccountServiceComponent/StockQuoteService">
        <interface.java interface="services.stockquote.StockQuoteService"/>
        <binding.ws port="http://example.org/StockQuoteService#
          wsdl.endpoint(StockQuoteService/StockQuoteServiceSOAP)"/>
    </reference>
<composite>
```



Java Implementation Example: Service Interface

```
package org.example.services.account;

@Remotable
public interface AccountService {

   public AccountReport getAccountReport(String customerID);
}
```

Interface is callable remotely
eg. as a Web service

Java Implementation Example – Implementation (part 1)

```
package org.example.services.account;

import org.osoa.sca.annotations.*;

@Service(interfaces = AccountService.class)
public class AccountServiceImpl implements AccountService {

    private String currency = "USD";
    private AccountDataService accountDataService;
    private StockQuoteService stockQuoteService;

    public AccountServiceImpl(
            @Property("currency") String currency,
            @Reference("accountDataService") AccountDataService dataService
            @Reference("stockQuoteService") StockQuoteService stockService) {
       this.currency           = currency;
       this.accountDataService = dataService;
       this.stockQuoteService  = stockService;
    }
```

Annotation for the service offered by this class

Constructor with annotations for injected property and references

Java Implementation Example – Implementation (part 2)

```
public AccountReport getAccountReport(int customerID)
       throws AccountDataUnavailableException {

       AccountReport accountReport =
          accountDataService.getAccountReport(customerID);
       List<Stock> stocks = accountReport.getStocks();

       List<StockValues> stockValues =
          stockQuoteService.getValues( stocks, currency );

       accountReport.setStockValues( stockValues );

       return accountReport;
    }
} // end class
```

Get the basic account report using the account data service

Obtain up to date stock values using the stock quote service

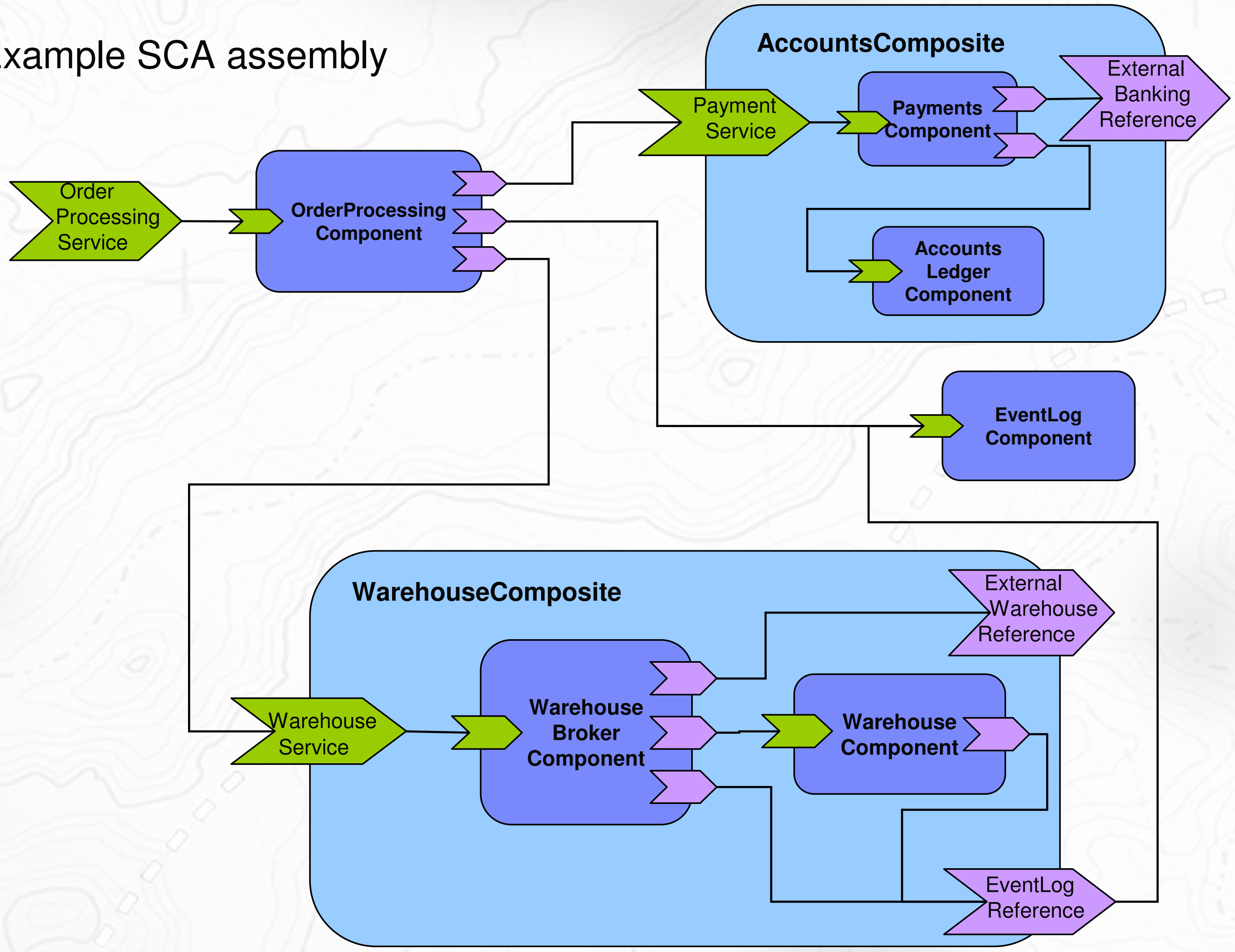
Update the account report with the latest stock values

SCA (Java) Implementation principles

- Code only to business interfaces
  - “Don’t program ***to SCA***, just program…”
  - Use Java idioms
  - Minimal middleware APIs used only in special cases
- Components declare both the ***services*** they offer and ***references*** to other services they need
- Injection of required service References and Property values
  - via constructor / via setter methods / via direct field injection
- Java annotations for SCA elements
  - services, references, properties
  - + more advanced features such as intents, bindings
- Principles apply to other languages

SCA

Example SCA assembly



Significant features of SCA Composites

- Distributed
  - each component can exist on a different system/process in a network
- Heterogeneous
  - assemblies can contain components of mixed implementation types
- Recursive or Nested
  - component in a composite can itself be implemented as a composite
- Model existing applications/systems
  - either as components or as composites
- Declarative application of infrastructure services

- “keep APIs out of the business logic”
  - philosophy for component implementation

SCA Implementation Types: Client & Implementation Specifications

- Specify how service components and service clients are built
- Specific to particular language, framework or language/ framework-specific APIs
- Extensible – more languages/frameworks can be added
- Currently defined C&I specifications:
  - BPEL
  - Java POJO
  - Spring Framework
  - C++
  - EJB (in preparation)

Example Implementation Types

```
<component name="ComponentA">
    <implementation.bpel process="foo:Process/Example/processA"/>
    ...
</component>
```

BPEL

```
<component name="ComponentB">
    <implementation.java name="com.foo.ImplementationB"/>
    ...
</component>
```

Java POJO

```
<component name="ComponentC">
    <implementation.spring location="SpringApplicationC.jar"/>
    ...
</component>
```

Spring

```
<component name="ComponentD">
    <implementation.cpp library="libraryD" header="ServiceDImpl.h"/>
    ...
</component>
```

C++

SCA Interaction Model

- ***Synchronous*** & ***Asynchronous*** service relationships

- ***Conversational*** services
  - stateful service interactions

- Asynchronous support
  - “non-blocking” invocation
  - asynchronous client to synchronous service
  - ***callbacks***

Bidirectional Interfaces (Callbacks)

- Used for for asynchronous messaging
- Unifies the provider (service) interface with callback interface

- Support for callbacks using Java interfaces

```
<interface.java interface="services.invoicing.ComputePrice"
       callbackInterface="services.invoicing.InvoiceCallback"/>
```

- Support for callbacks using WSDL portTypes/interfaces

```
<interface.wsdl
  interface="http://example.org/inv#wsdl.interface(ComputePrice)"
  callbackInterface="http://example.org/inv#wsdl.interface(InvoiceCallback)"/>
```

Conversational Interfaces

- Model stateful service interactions
- Frees application programmer from conversation/correlation management
- Imposes requirements on bindings

- Specific operations can be marked as “endsConversation”
- WSDL extensions for “conversational” and “endsConversation”

```
<portType name="LoanService" sca:requires="conversational" >
       <operation name="apply">
          <input message="tns:ApplicationInput"/>
          <output message="tns:ApplicationOutput"/>
       </operation>
       <operation name="cancel" sca:endsConversation="true" >
       </operation>
       ...
</portType>
```

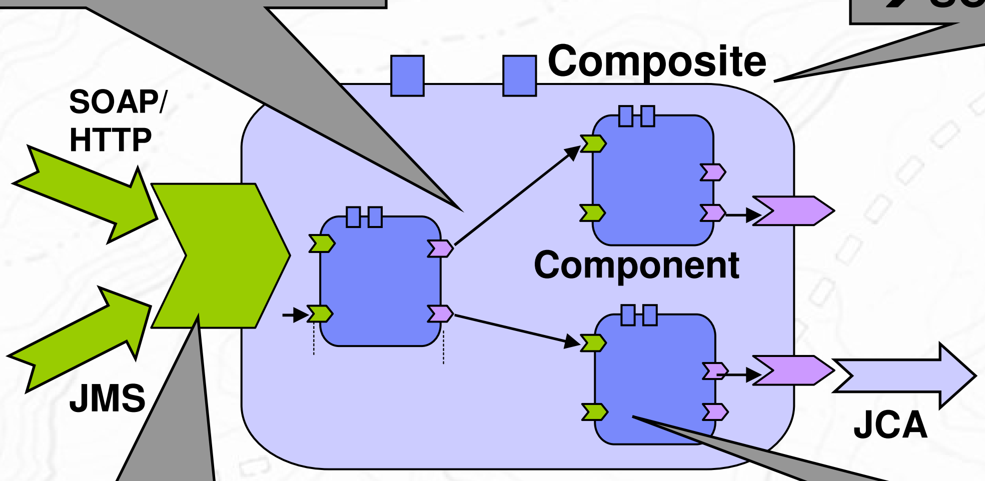
Agenda

- ***SCA Specifications, Standardization and Industry Support***

SCA Technology

How do I define, use and administer policies for non-functional aspects (QoS, etc)?
➔ SCA Policy Framework Spec

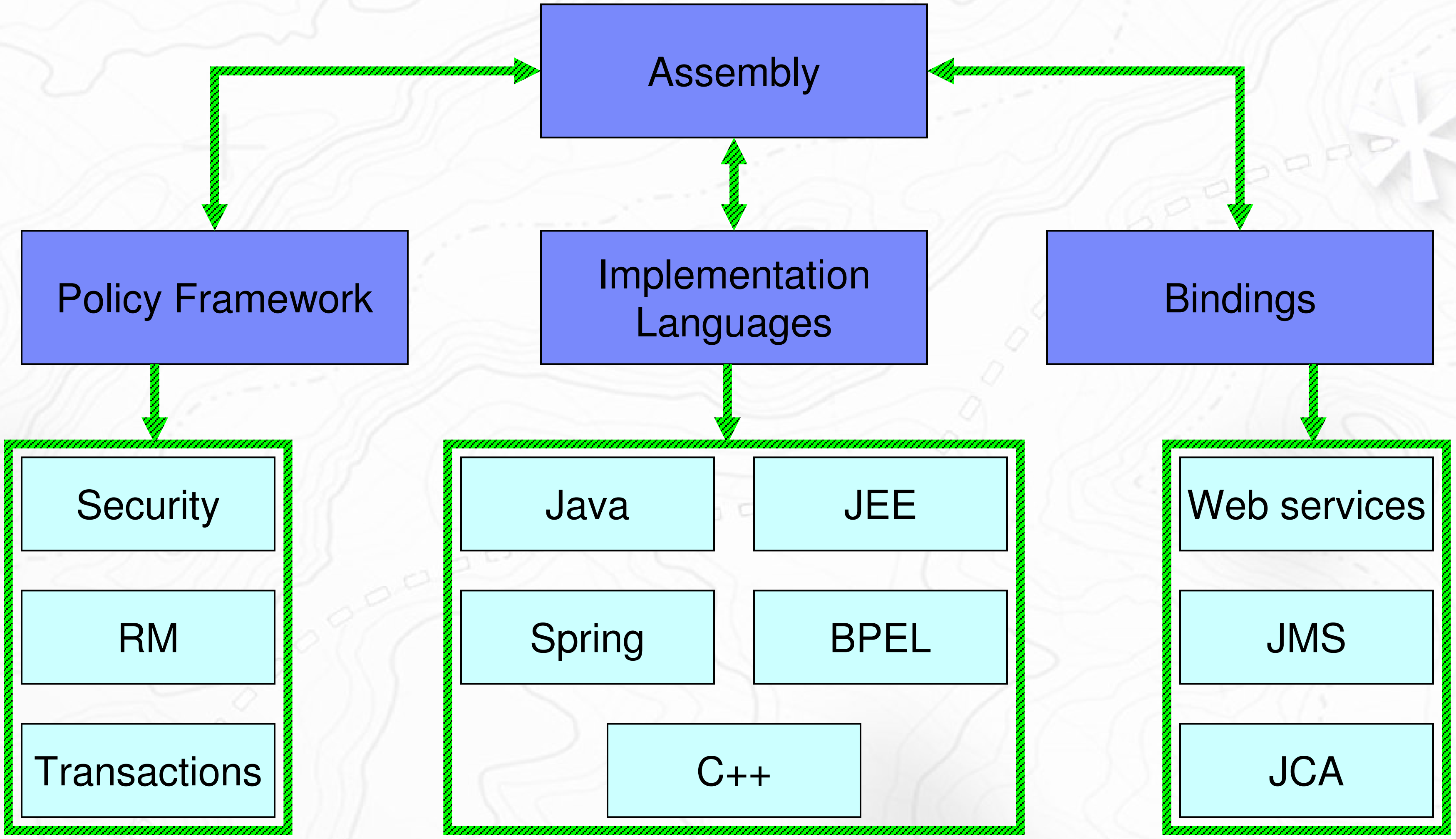
How do I define, configure and assemble components to create composites?
➔ SCA Assembly Spec

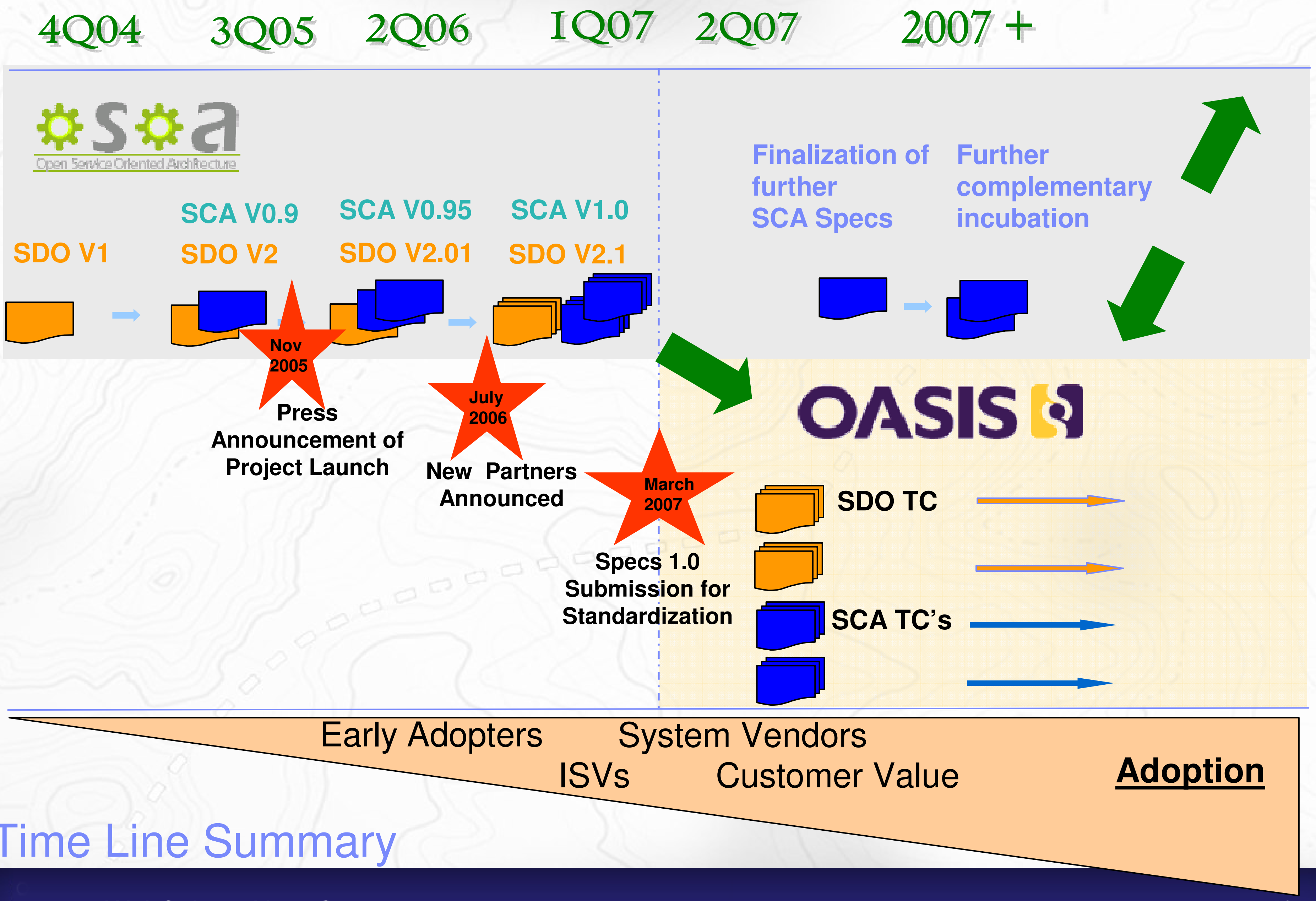


How do I configure SCA services/references to use SOAP/HTTP or JMS or JCA, …
➔ SCA WS Binding Spec, …

How do I develop SCA components in BPEL? Or in Java? Or C++, PHP,…
➔ SCA BPEL Client & Impl Spec, …

The SCA Specifications





Time Line Summary

Open Source Projects and Implementations

- Apache Tuscany Incubator Project
  - Provides SOA programming runtime based on SCA, SDO
  - Java™ & C++ implementations today
  - Aim to support several runtimes (eg Tomcat) and protocols
  - Associated PHP implementation on PECL site
  - http://incubator.apache.org/tuscany
- Eclipse SOA Tools Project
  - Eclipse-based tooling for SOA applications and systems
  - Based on SCA as model for solutions built using SOA
  - Target range of systems including SCA runtimes such as Tuscany
  - http://www.eclipse.org/stp/
- Several vendor implementations
  - IBM WebSphere, Oracle Fabric, BEA, RogueWave, TIBCO

Summary

- SCA is an agile approach to developing systems using a service-oriented architecture
  - wide industry support
  - standardization taking place at OASIS
- SCA is being implemented in Open Source at Apache and at Eclipse
- SCA is implemented in WebSphere
  - WebSphere Application Server 6.1 SOA Feature Pack
  - WebSphere Process Server, WebSphere ESB

Useful links…

- OASIS Open CSA
  http://www.oasis-opencsa.org/
- OASIS SCA Technical Committees
  http://www.oasis-opencsa.org/committees
- Open SOA Collaboration
  http://osoa.org/display/Main/Home
- V1 level of SCA specifications
  http://osoa.org/display/Main/Service+Component+Architecture+Specifications
- Useful papers and interesting SCA information:
  http://osoa.org/display/Main/SCA+Resources
- OASIS Webinar downloads:
  http://www.oasis-opencsa.org/resources

Questions
and
Answers

SCA