

# Web and Grid Services

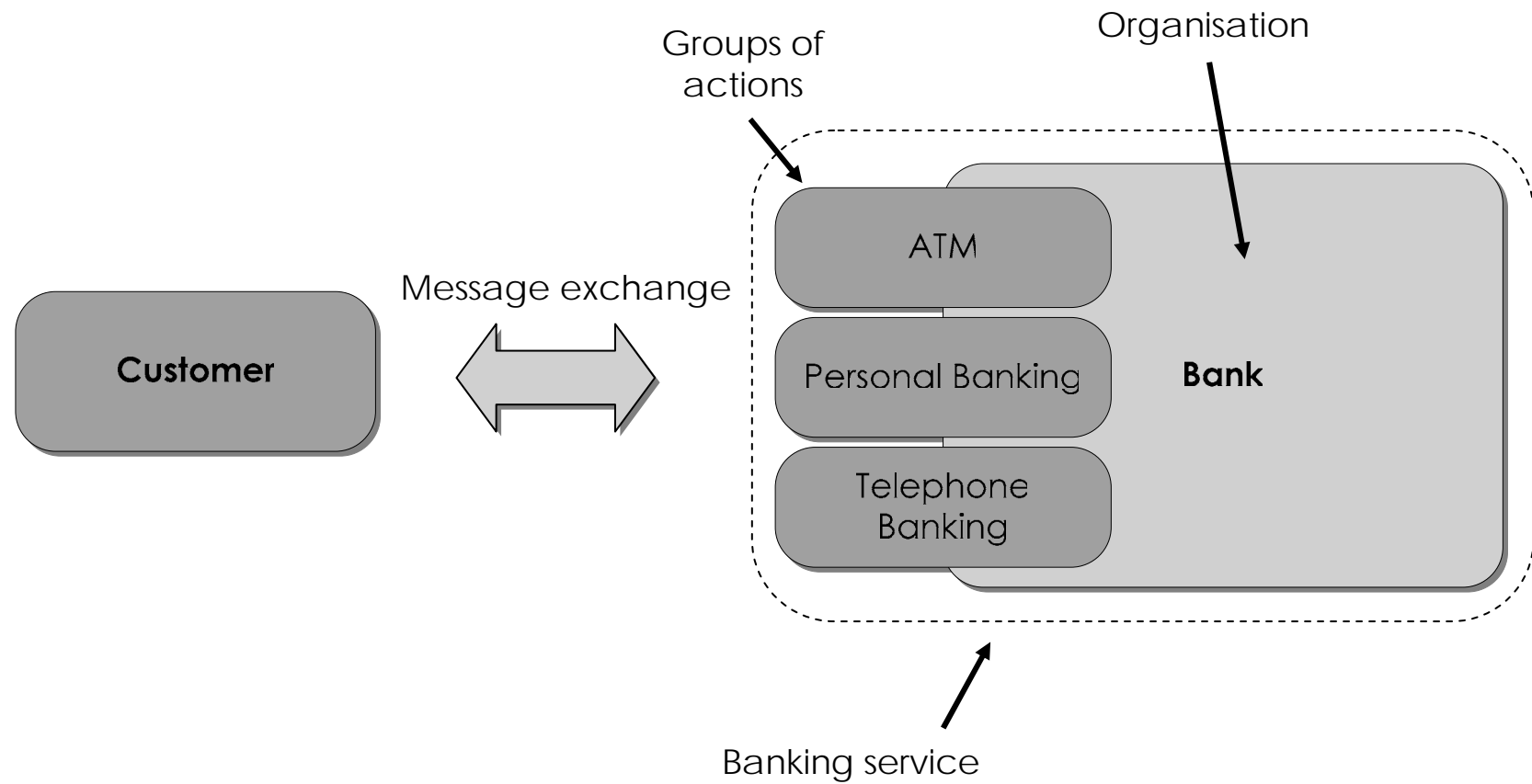
Architectures and Technologies

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- Service Orientation vs Object Orientation
- Web Services Architecture and Technologies
- Grid Services Architecture and Technologies
- Comparison
- Briefly what we are up to here
- References/Links

- Services Oriented Architecture (SOA)
  - Agents (software or human)
  - Emphasis on actions
  - Agent-to-agent interaction through message exchange
- *A service is a set of actions that form a coherent whole from the point of view of service providers and service requesters*

Source: W3C Web Services Architecture Document (Draft – 21/7/2003)

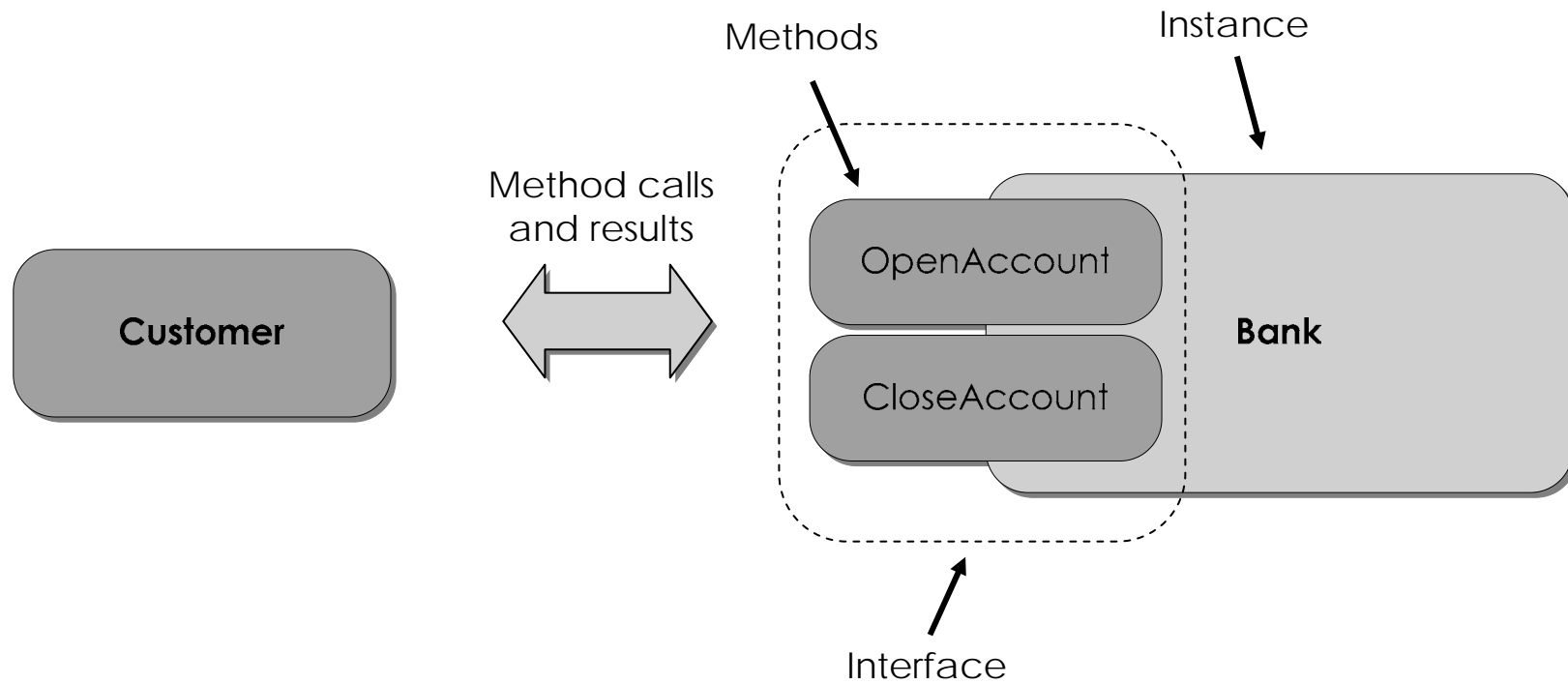


- Object-Orientation
  - Modelling of entities
  - Emphasis on state encapsulation, inheritance, interfaces
  - Object "id" important
- *An object has state, behaviour, and identity; the structure and behaviour of similar objects are defined in their common class; the terms instance and object are interchangeable*

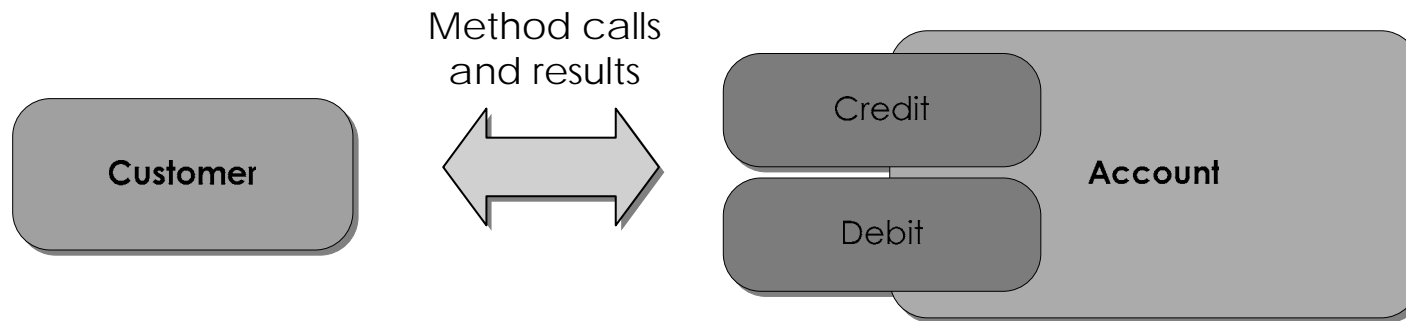
Source: Booch, Grady. Object-Oriented Design With Applications. Benjamin Cummings

- An object-centric (rather than class-centric) definition

# Objects

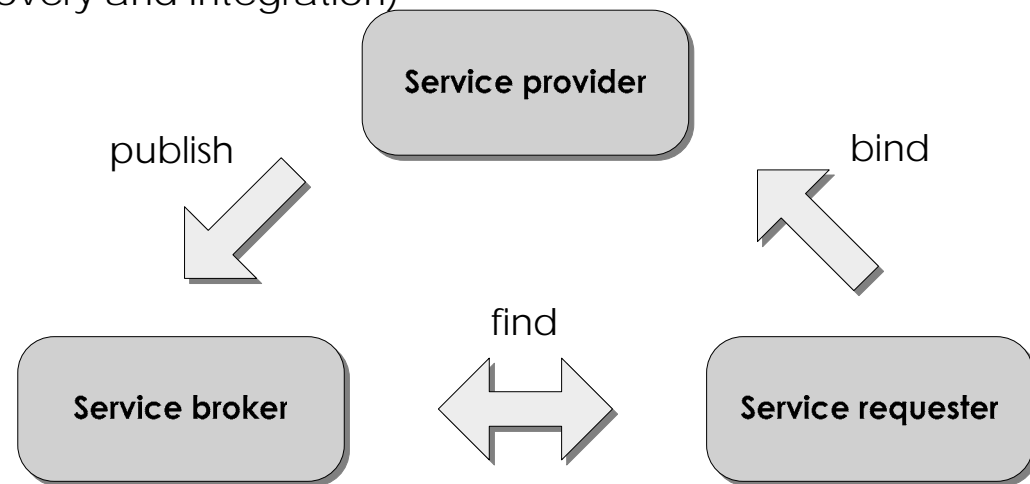


# Objects

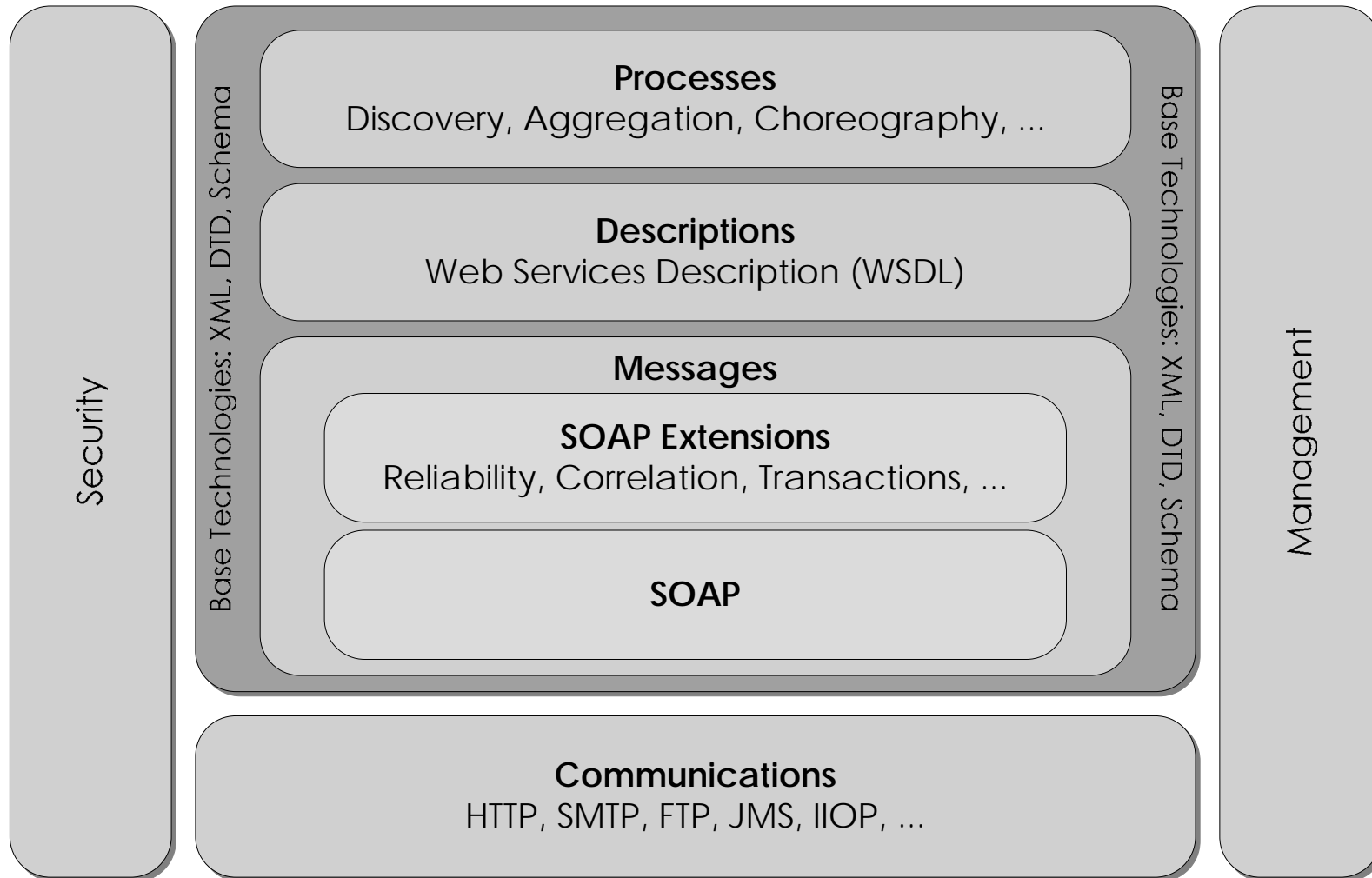


- Two different paradigms (?)
- Perhaps not widely-accepted statements...
  - Service-Oriented Architectures are more suitable for loosely coupled distributed applications (Web Services Architecture)
  - Object-Orientation encourages closely coupled distributed applications (i.e., CORBA, DCOM, etc.)
- Distinction not clear to some (especially to the CORBA and J2EE community)

- Follows the SOA concepts
- Emphasis on interoperability
  - XML, XML, XML
- Programming model, implementation technology, operating system unaware
- Originally three specifications were seen as the foundation of the architecture
  - SOAP – (Simple Object Access Protocol... well, not anymore!)
  - WSDL – (Web Services Description Language)
  - UDDI – (Universal Description, Discovery and Integration)
- SOAP and WSDL are the most important technologies but...



# Web Services Architecture

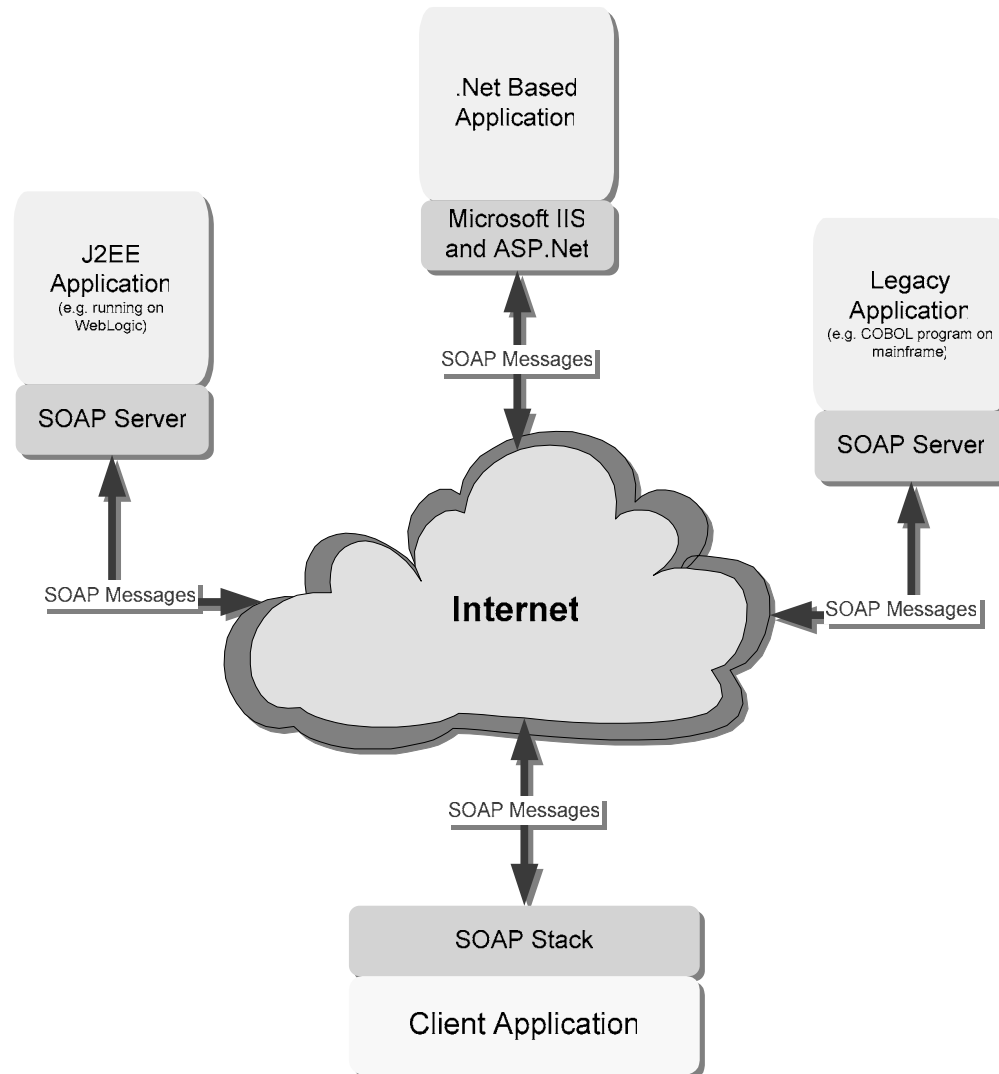


Source: W3C Web Services Architecture Document (Draft – 21/7/2003)



- It is an agent, a software system, a component
- A possible definition
  - *A Web service is a software system identified by a URI, whose public interfaces are defined and described using XML. Other systems may interact with the Web service in a manner prescribed by its definition, using XML based messages conveyed by internet protocols.*  
Source: W3C Web Services Architecture Document (Draft – 21/7/2003)
- It is **NOT**
  - A web page
  - A web server
  - A Java Server Page
  - Related to Web browsers or portals
- Some more acronyms, protocols
  - W3C :-)
  - OASIS (Organisation for the Advancement of Structured Information Standards)
  - WS-I (Web Services Interoperability)
  - WS-Routing, WS-Referral, WS-Security, WS-Federation, WS-Coordination, WS-Transactions, WS-Choreography, WS-Policy, WS-ReliableMessaging, WS-Addressing, WS-Attachments, DIME, WS-Inspection, BPEL4WS

# The idea



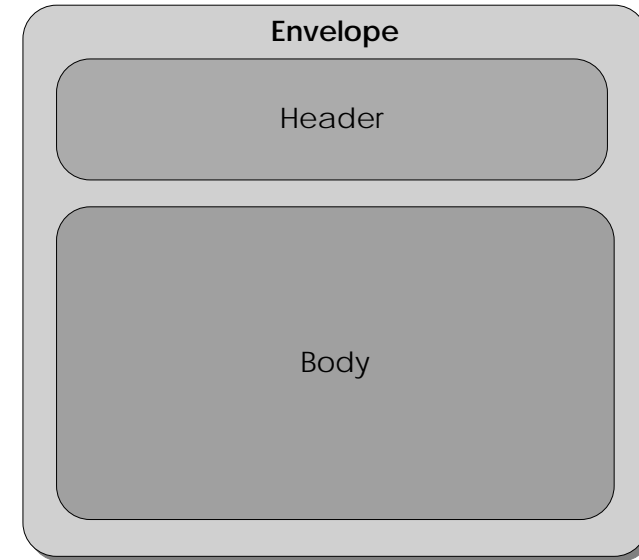
Source: Dr Jim Webber's NOOPS presentation on Advanced Web Services Development



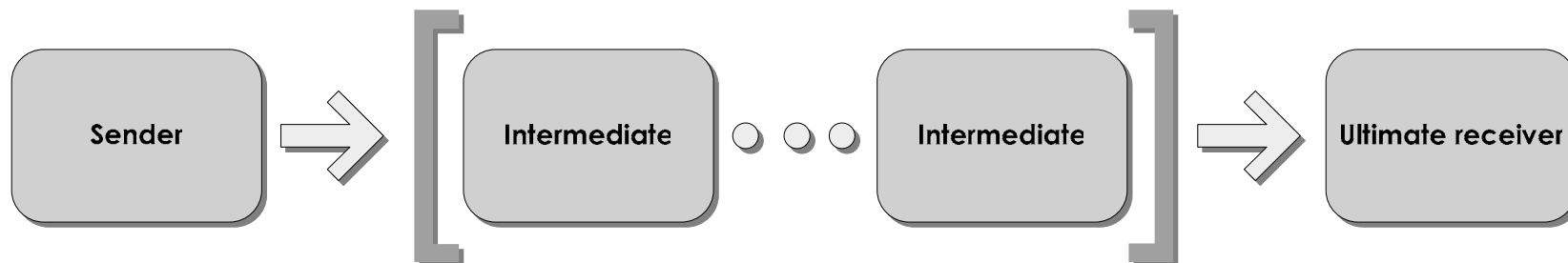
# The basics - SOAP



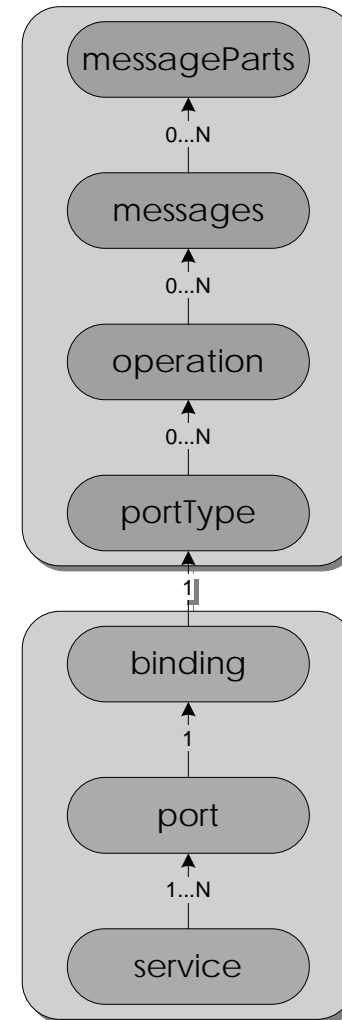
- An XML-based messaging format and framework
- The current choice of wire format
- Version 1.2



- Roles



- An XML-based interface description language for Web Services
- Protocol description – message exchanges
- Very important for interoperability
- Current version 1.1 (work on 1.2 or 2.0)



- Caution...
- ...you are about to enter the Grid

- In the beginning there was Globus for the Grid
- Then Web Services came along and everyone talked about them
- So the Globus team decided to create **Grid Services**
- The Global Grid Forum (GGF) was formed to standardise a services-based infrastructure for the Grid
  
- But first...

# What is the Grid?



- *Neo, the Grid is everything you would like it to be*
- Just few...
  - Virtual organisations
  - Integration of distributed resources
  - Universal computer
  - Interconnection technologies for supercomputers
- Or... if you are a technologist
  - An application domain for the Web Services ideas and technologies
- Or... if you are a researcher/academic
  - A new set of interesting problems (at a global scale)
  - A (new?) paradigm for distributed computing
- Or... if you are a cynic
  - Another way for companies like IBM to sell you infrastructure solutions
  - A way for the globus team to get more publicity
  - A way for the main Grid people to get awards
  - A way for researchers to re-re-re-re-investigate the same ideas on distributed computing
  - A fantastic way to see the world (a lot of travelling for GGF meetings)



# A stack-based view



Grid Applications

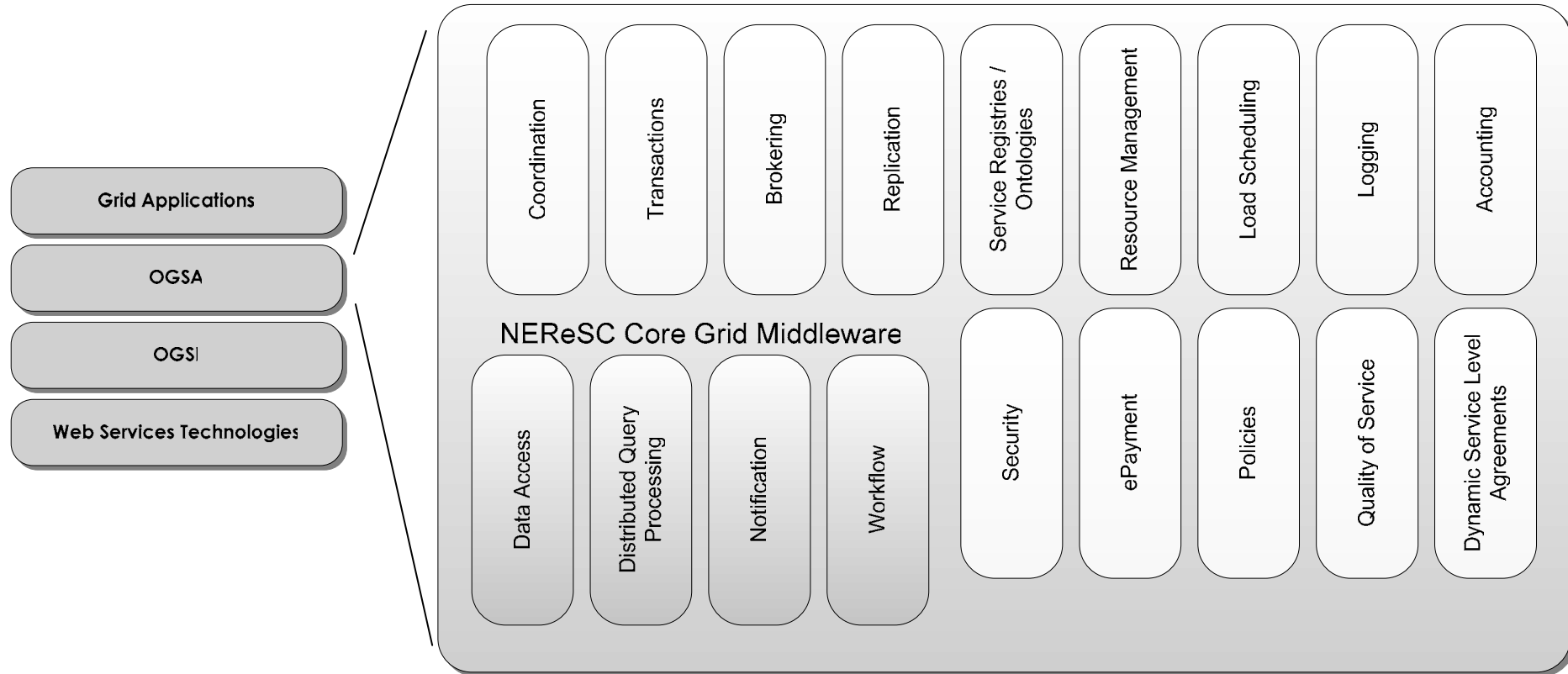
OGSA

OGSI

Web Services Technologies



# A stack-based view



- Open Grid Services Architecture
  - The “vision”
  - The collection of services
  - Does not create specifications, just talks about them
- How does one build all those services?
  - Use Web Servicesor
  - Identify Grid-specific problems that need to be addressed and then decide whether Web Services standards can provide the solution
- The Grid Architects decided that there were enough requirements in their services-oriented architecture that were not met by the Web Services standards
- They came up with OGSI
- A service is a “Grid Service” only if it adheres to the OGSI specification
- And the answer to the million dollar question...  
Grid Services **ARE** Web Services (well... it depends:-)

- Open Grid Services Infrastructure

- GWSDL (Grid WSDL)
- Introduces Service Data Elements (SDEs) (attributes in next version of WSDL)
- portType inheritance (next version of WSDL)
- Grid Service Handle (GSH)
- Grid Service Reference (GSR)
- Factory
- Handle resolver
- Notification
- Service groups (light-weight registries)

- **GRID SERVICE INSTANCES**

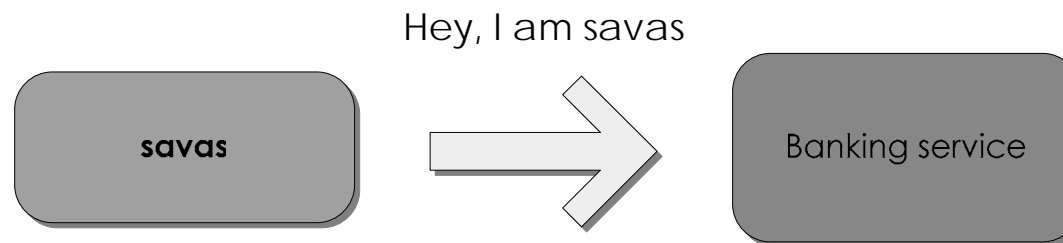


- Introduces semantics and capabilities to Web Services
  - Statefulness (SDEs)
  - Stateful interactions
  - Transient instances (Factories!!!)
  - Lifetime management
  - Introspection!!!
  - Notification on state changes

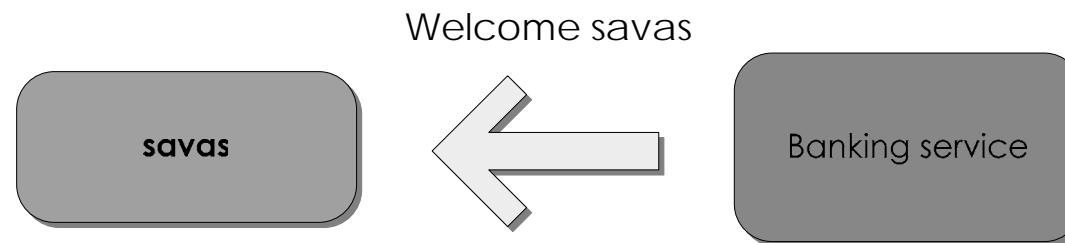
- You can use the Globus Toolkit 3
  - A reference implementation of OGSI (Globus Toolkit 3 Core)
  - "OGSA" services
    - GT2 services exposes as OGSI Services
  - WS-Security
- Or, you can use the Globus Toolkit 3
- Or even the Globus Toolkit 3
- Some other implementations
  - Fujitsu/Unicorn core implementation
  - OGSI.NET (University of Virginia)
  - MS.NETGrid (NeSC + EPCC)
  - Perl (University of Manchester)
  - Python coming? (Globus team)
- Interoperability concerns
  - Everyone is "interoperable" with GT3 (they are using the bindings that come with GT3)



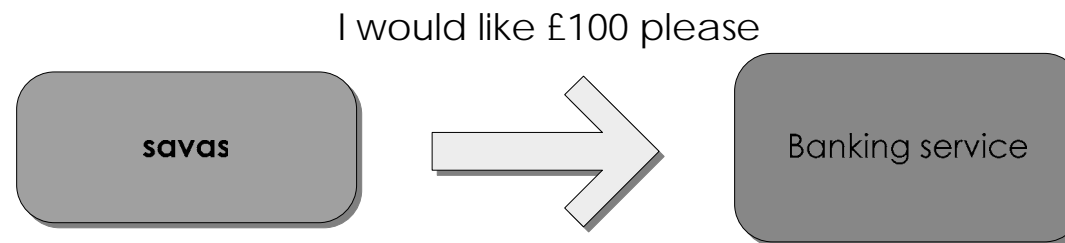
- Stateless interaction



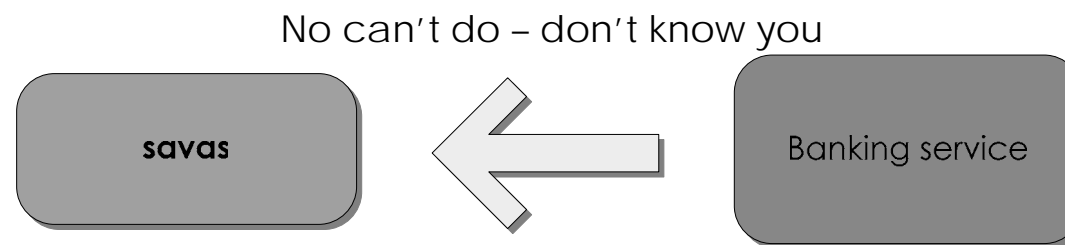
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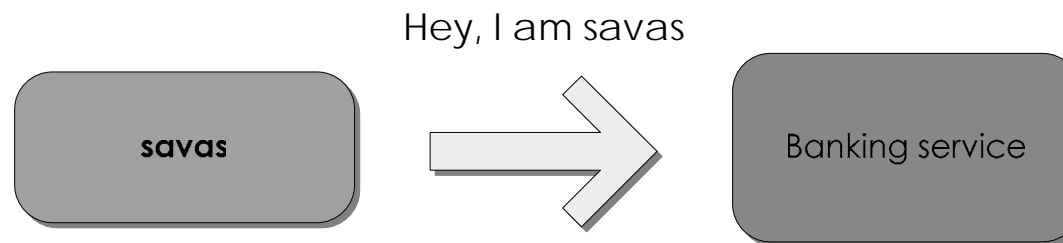
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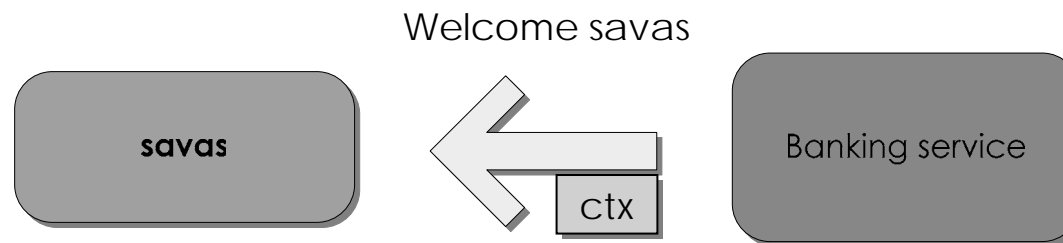
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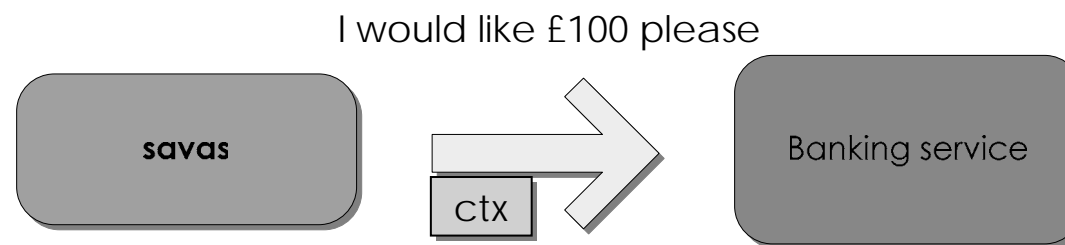
- Stateful interaction



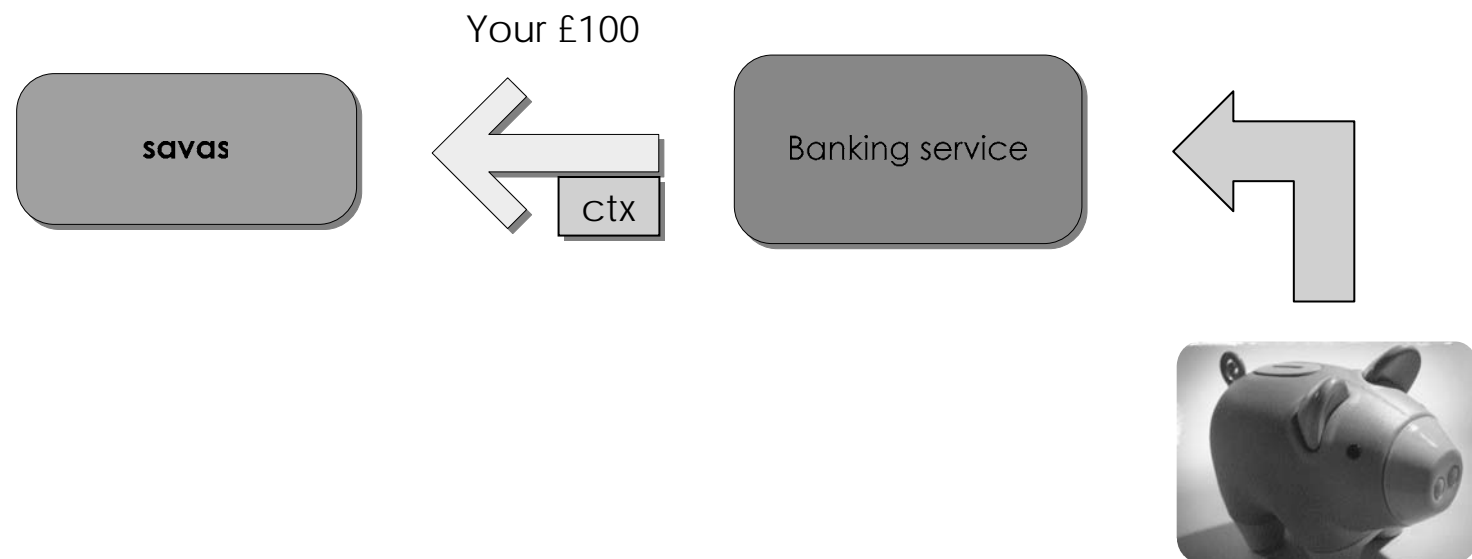
- Stateful interaction



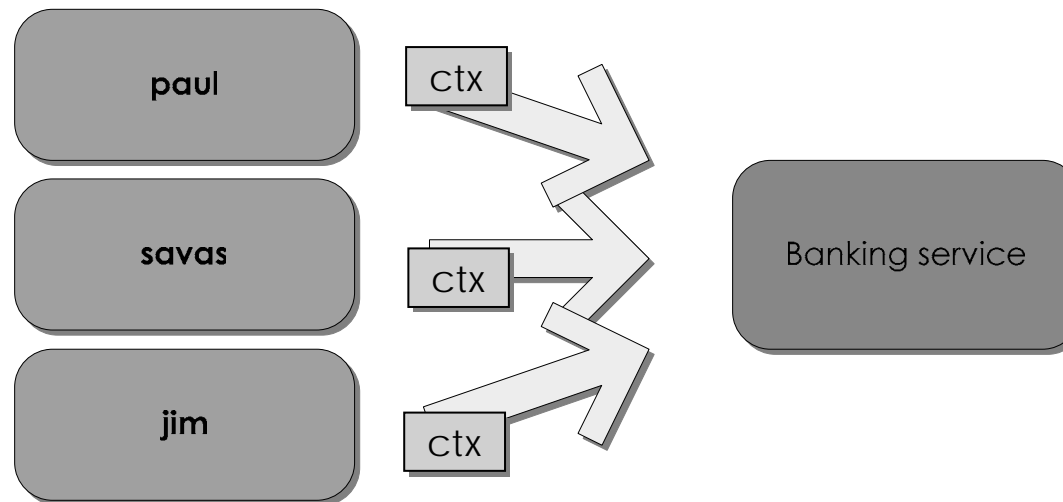
- Stateful interaction



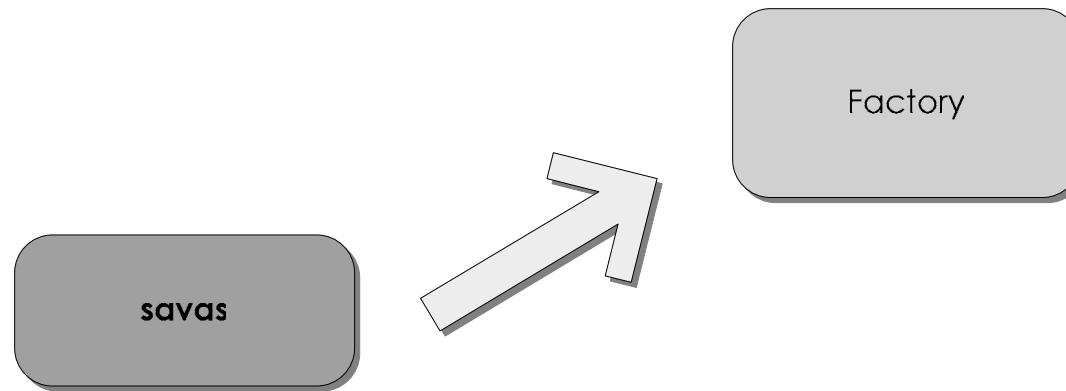
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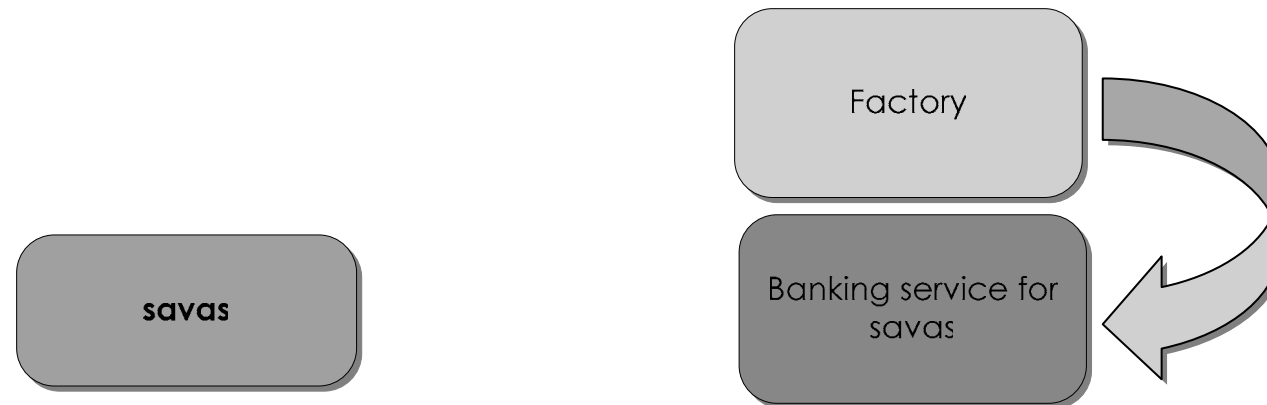
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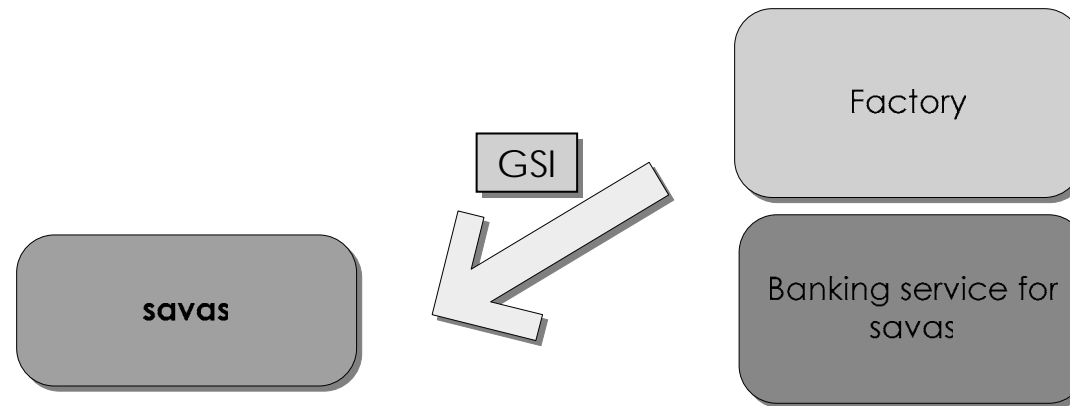
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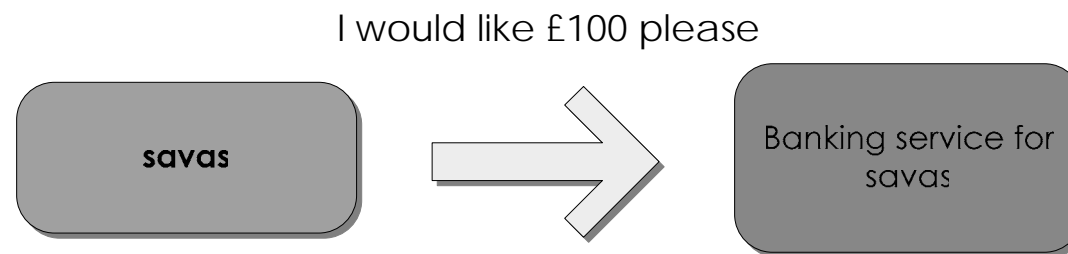
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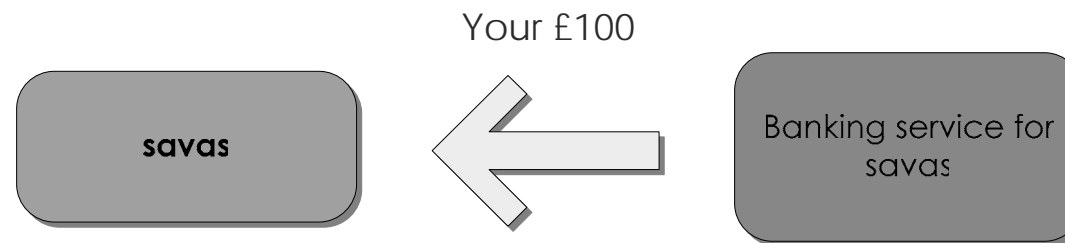
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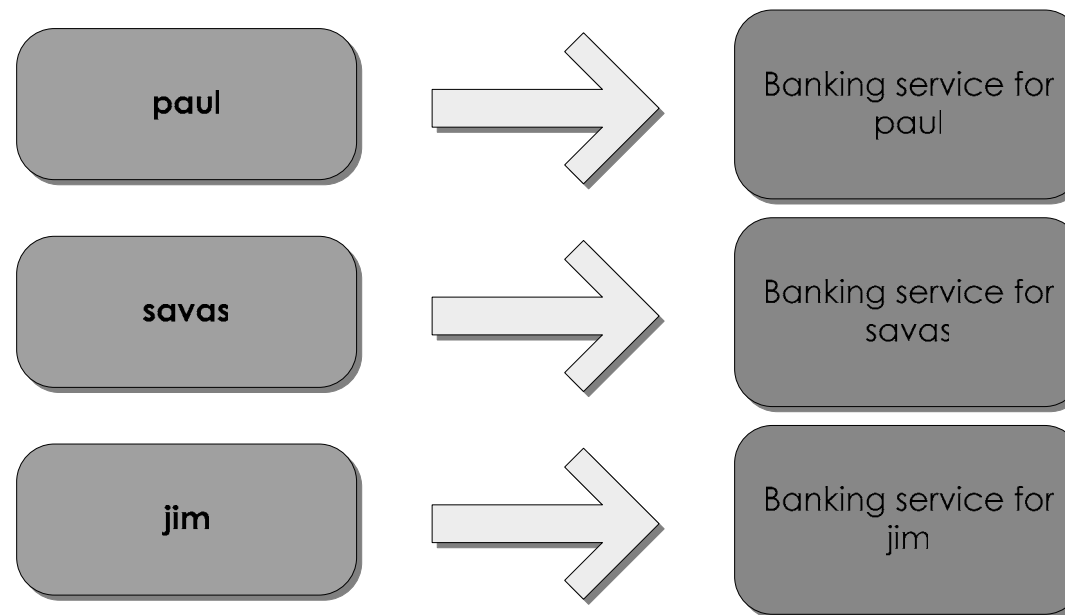
- Stateful interaction



- Stateful interaction



- Stateful interaction



SOAP and WSDL  Web services

The central text of the slide, "SOAP and WSDL Web services", is separated by a circular icon containing a stylized arrow pointing right, crossed out with a diagonal slash.

- Web Services
  - Messages exchange
  - Documents
  - No notion of "pointer"
  - Service orientation?
- Grid Services
  - The architecture encourages everything to be exposed through an interface rather than being sent as a document
  - GSH is the "pointer"
  - Object orientation? (CORBA?)

- Proposals for discussion
- Make OGSi an application framework that uses Web services concepts and technologies
- No changes/additions/extensions to specifications
- Utilise existing/upcoming Web services tools
- One should be able to build a services-based infrastructure for the Grid by picking and mixing tools

- XML
- XML
- XML
  
- XML Schema
- WSDL
- SOAP
  
- OGSi specification and primer

- W3C – <http://www.w3c.org>
- OASIS – <http://www.oasis-open.org>
- Microsoft – <http://msdn.microsoft.com/webservices>
- IBM - <http://www-106.ibm.com/developerworks/webservices/>
- GGF – <http://www.gridforum.org>
- OGSF WG – <https://forge.gridforum.org/projects/ogsf-wg>
- OGSA WG – <https://forge.gridforum.org/projects/ogsa-wg>
  
- NEReSC – <http://www.neresc.ac.uk> (to be updated soon)
  
- Please do contact me: [Savas.Parastatidis@newcastle.ac.uk](mailto:Savas.Parastatidis@newcastle.ac.uk)