Building Services in WSRF

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GGF Summer School

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TODOs

- This should be a hidden slide

- Modify RP exercise to use Query not GMRP
- Interop slide
- 2 hours exercise = 60 slides = 15 slides per module

Module 1

- Overview
- WSRF
- Globus Alliance WSRF implementation

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Overview

- 4 modules
- Each module has:
  - Slides & talk
  - Hands on
- Covers:
  - WSRF specification
  - Globus Alliance implementation of WSRF

History and Motivation (1)

- Often we think we want standard APIs
  - Eg. MPI
- But on the grid, we actually want standard wire protocols
  - the API can be different on each system

History and Motivation (2)

- Open Grid Services Infrastructure (OGSI)
- GGF standard
- Identified a number of common 'building blocks' used in grid protocols
  - Inspecting state, creating and removing state, detecting changes in state, naming state
- Defined standard ways to do these things, based on web services (defined a thing called a Grid Service)

History and Motivation (3)

- But then…
- Realised that this was useful for web services in general, not just for the grid.
- Moved out of GGF, into OASIS
- Split the single OGSI specification into a number of other specifications called WSRF.

WSRF

WSRF is a framework consisting of a number of specifications.

- **WS-Resource Properties** *
- **WS-Resource Lifetime** *
- WS-Service Groups
- WS-Notification
- WS-BaseFaults
- WS-Renewable References (unpublished)

Other WS specifications such as:

- **WS-Addressing** *

* will be talked about in this tutorial

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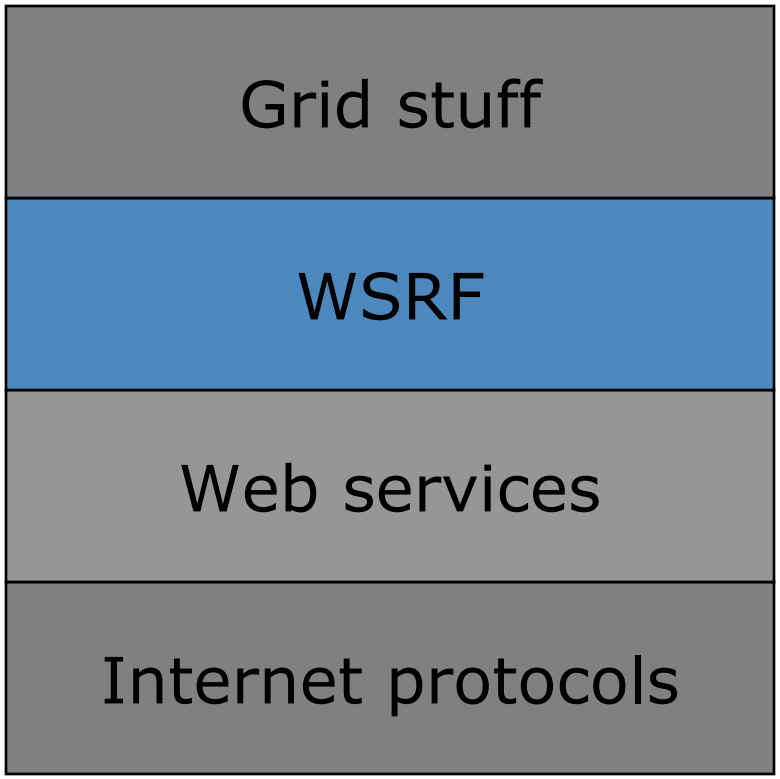
How WS-RF fits in with other standards, specifications and protocols.



Globus (GRAM, MDS)

WSDL, SOAP

HTTP, TCP/IP

WS-Resources

- Web services often provide access to state
  - Job submissions, databases
- A WS-Resource is standard way of representing that state.
- In this tutorial, we will be using ‘counter’ resources which are simple accumulators.

WS-Resources

- WSRF specifications provide:
  - XML-based Resource Properties
  - Lifetime management (creation/destruction) of resources
  - Servicegroups, which group together WS-Resources
  - Notification
    - (for example of changes in resource properties)
  - Faults
  - Renewable References

Examples of WS-Resources

- Files on a file server
- Rows in a database
- Jobs in a job submission system
- Accounts in a bank

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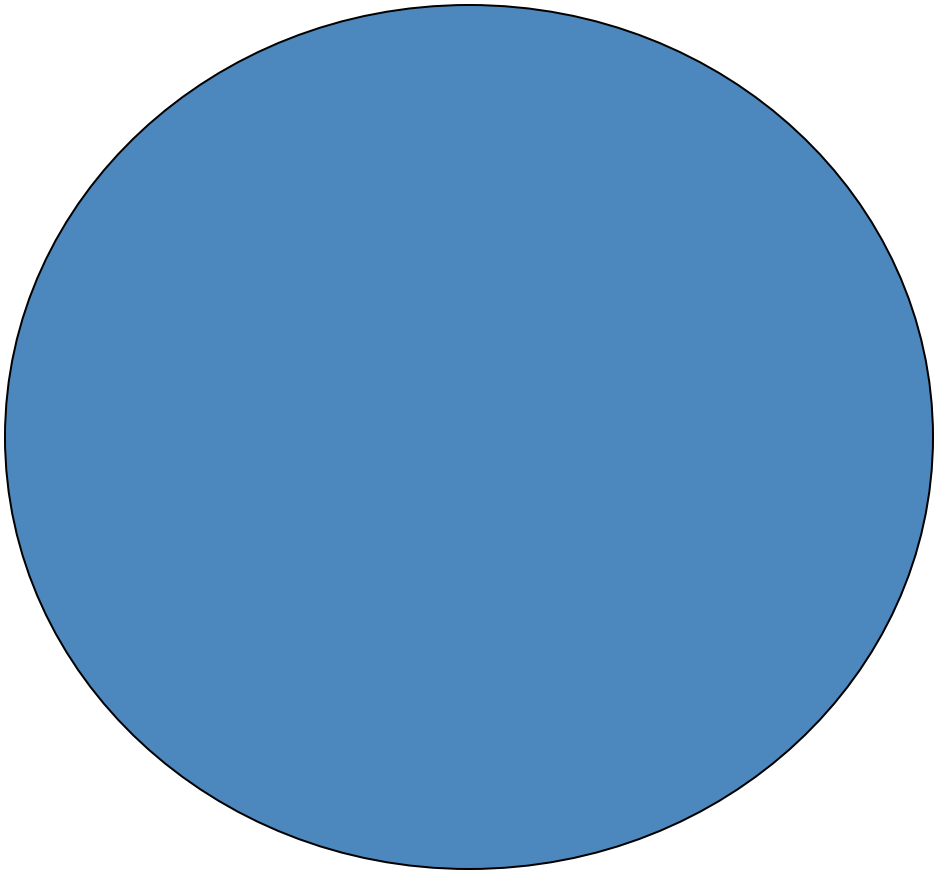
Web service



Web service

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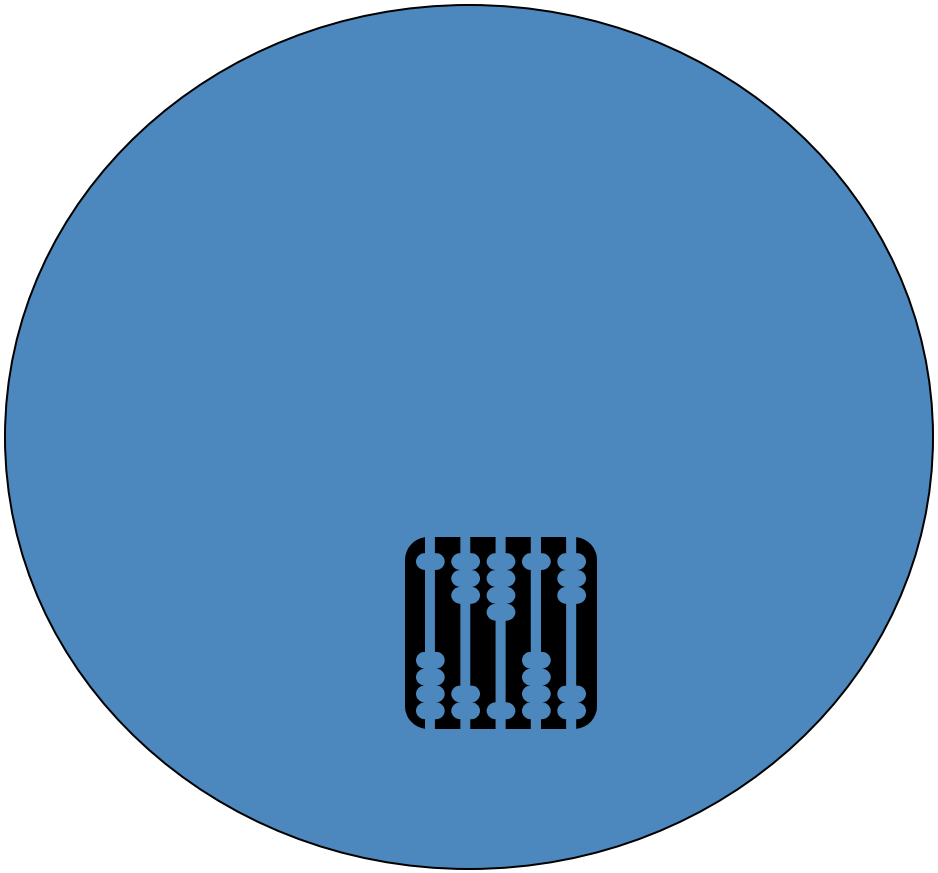
Web service with WS-Resource



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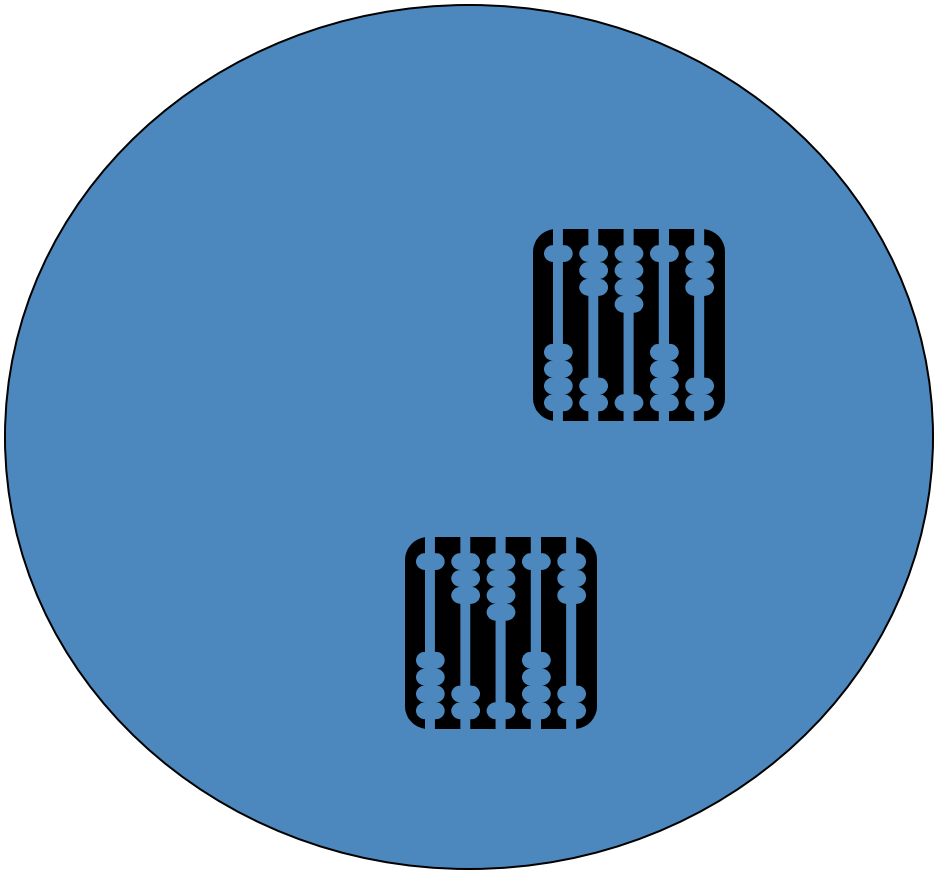
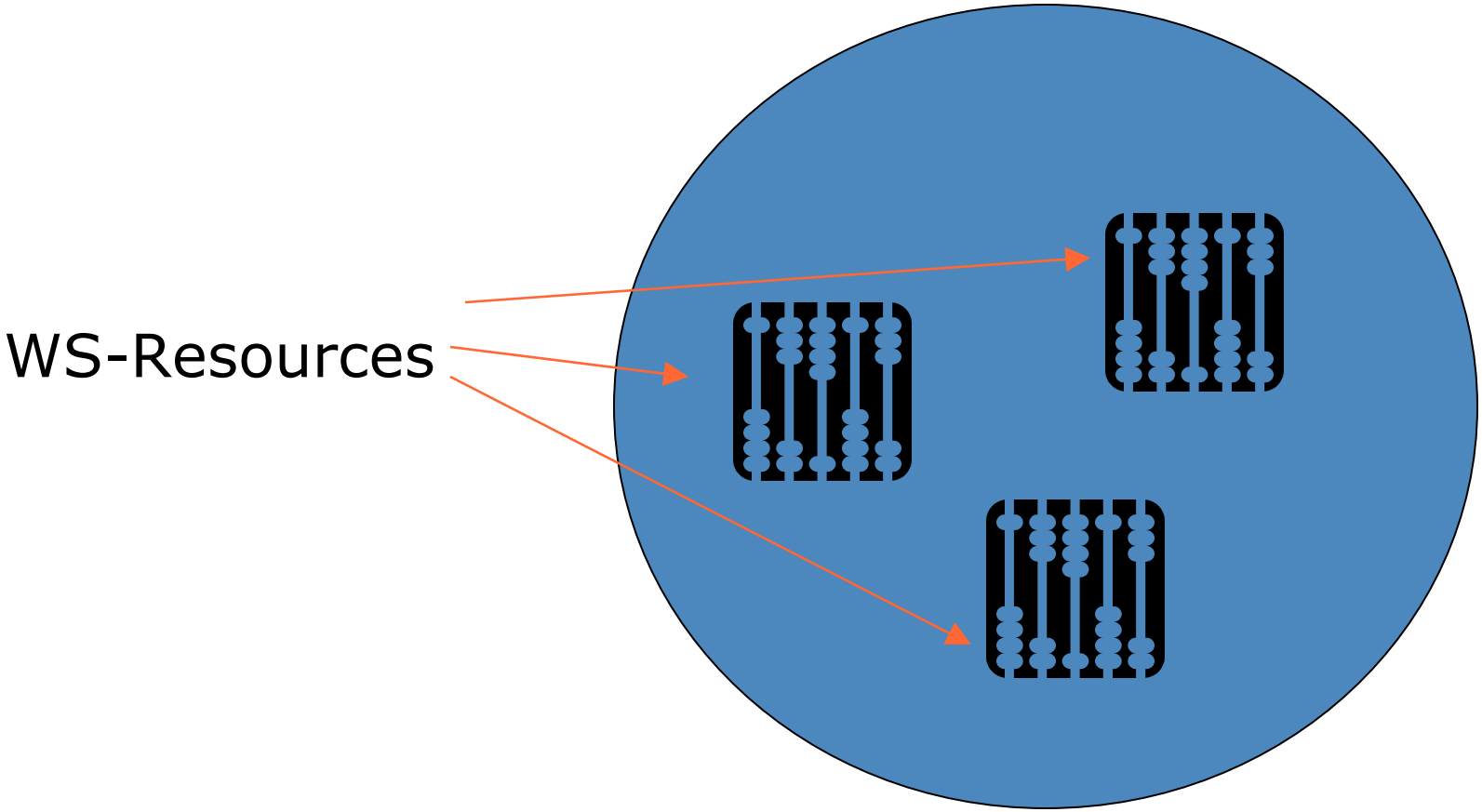
Web Service with WS-Resources



Web Service with WS-Resources



GT WSRF core

- Container
  - Hosts services
  - Built on top of Apache Axis
- Clients
  - Interact with services
- Build tools
  - For writing new services
  - Based around Apache Ant

Files used in the exercise

- WSDL and XML Schema:
  - counter_port_type.wsdl
- Java
  - Several Java source files
- Deployment information
  - deploy-server.wsdd
  - deploy-jndi-config.xml
- Build.xml
  - Tells Ant how to build and deploy the code

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Notes on the exercises

- Read notes.txt for information on each exercise.
- Only do one exercise at a time, then wait for next module.
- Each exercise consists of uncommenting code fragments. However, you should **READ AND UNDERSTAND** what you are uncommenting.
- If you are brave, you can make your own extra changes too – but be careful not to break anything!

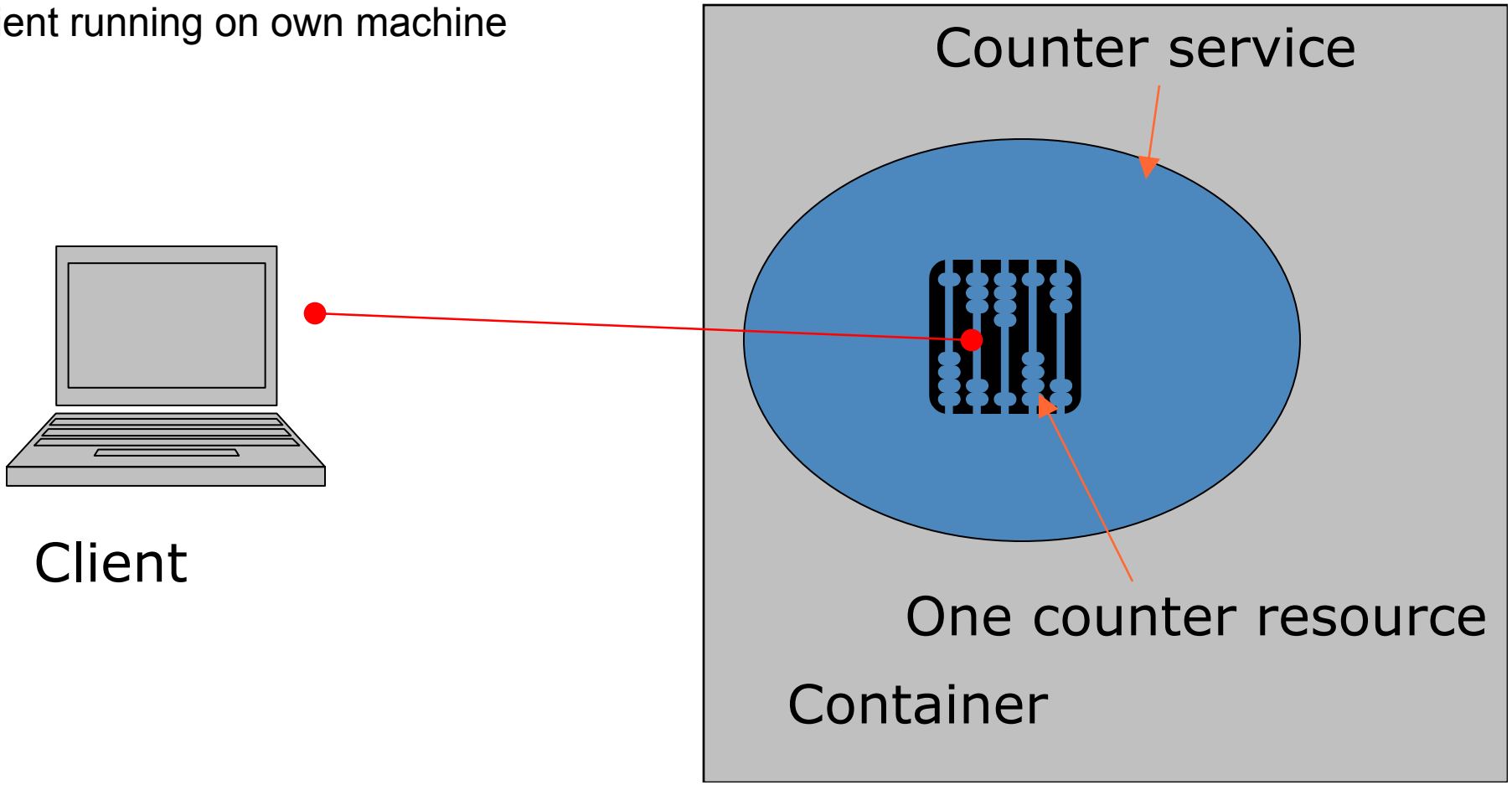
Exercise 1

- Exercise: stand up supplied installation and check it works.
- Install software
- Start the container
  - this will have a counter service and one counter resource.
- Interact with the counter resource

- Do the exercise now.

Exercise 1 overview

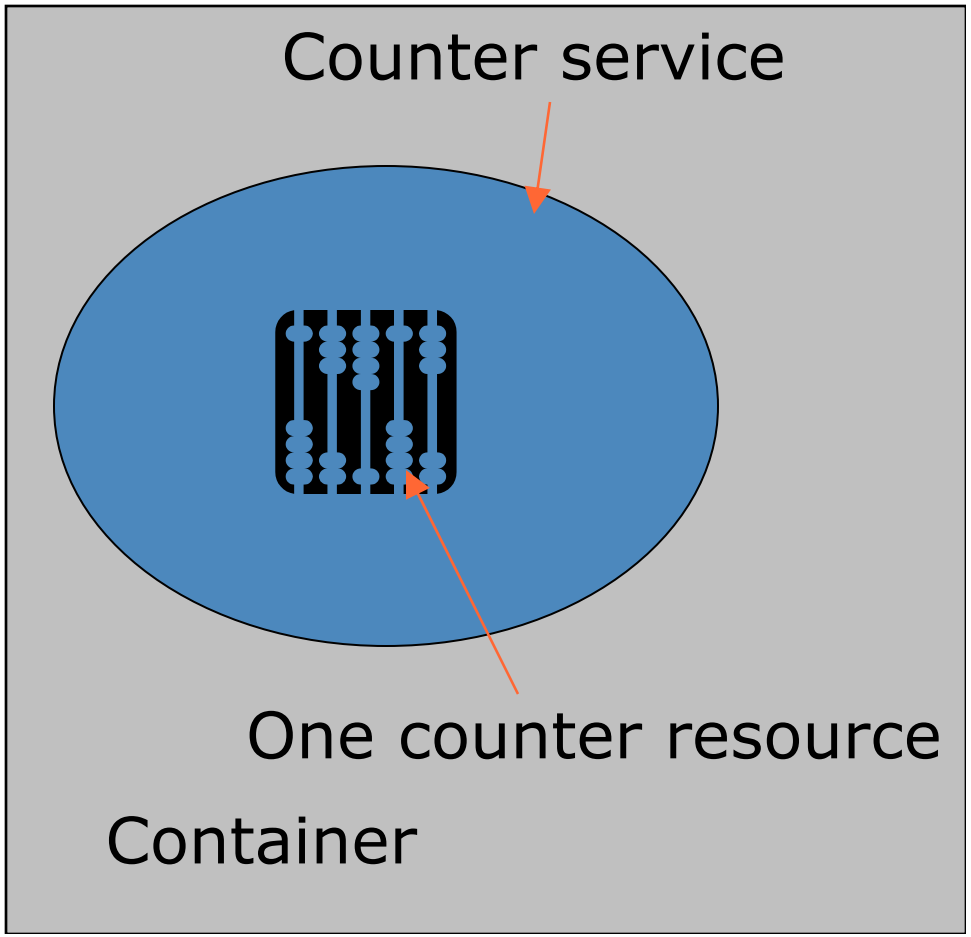
One host (your own machine)
One web service running on own machine
One counter resource, which will already exist
Client running on own machine



Exercise 1 overview

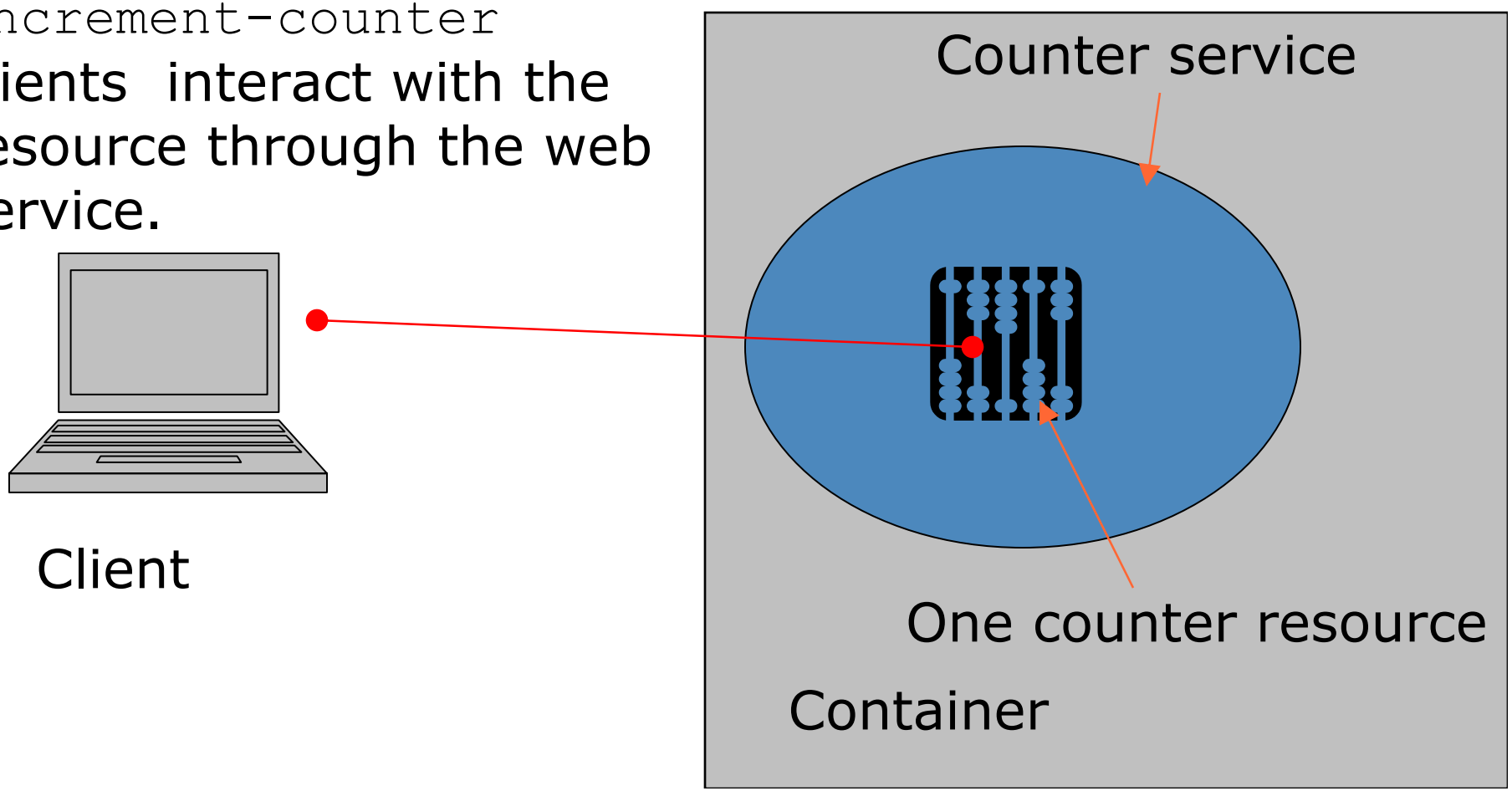
```
globus-start-container
```

Starts up container, with counter service and a single counter resource.



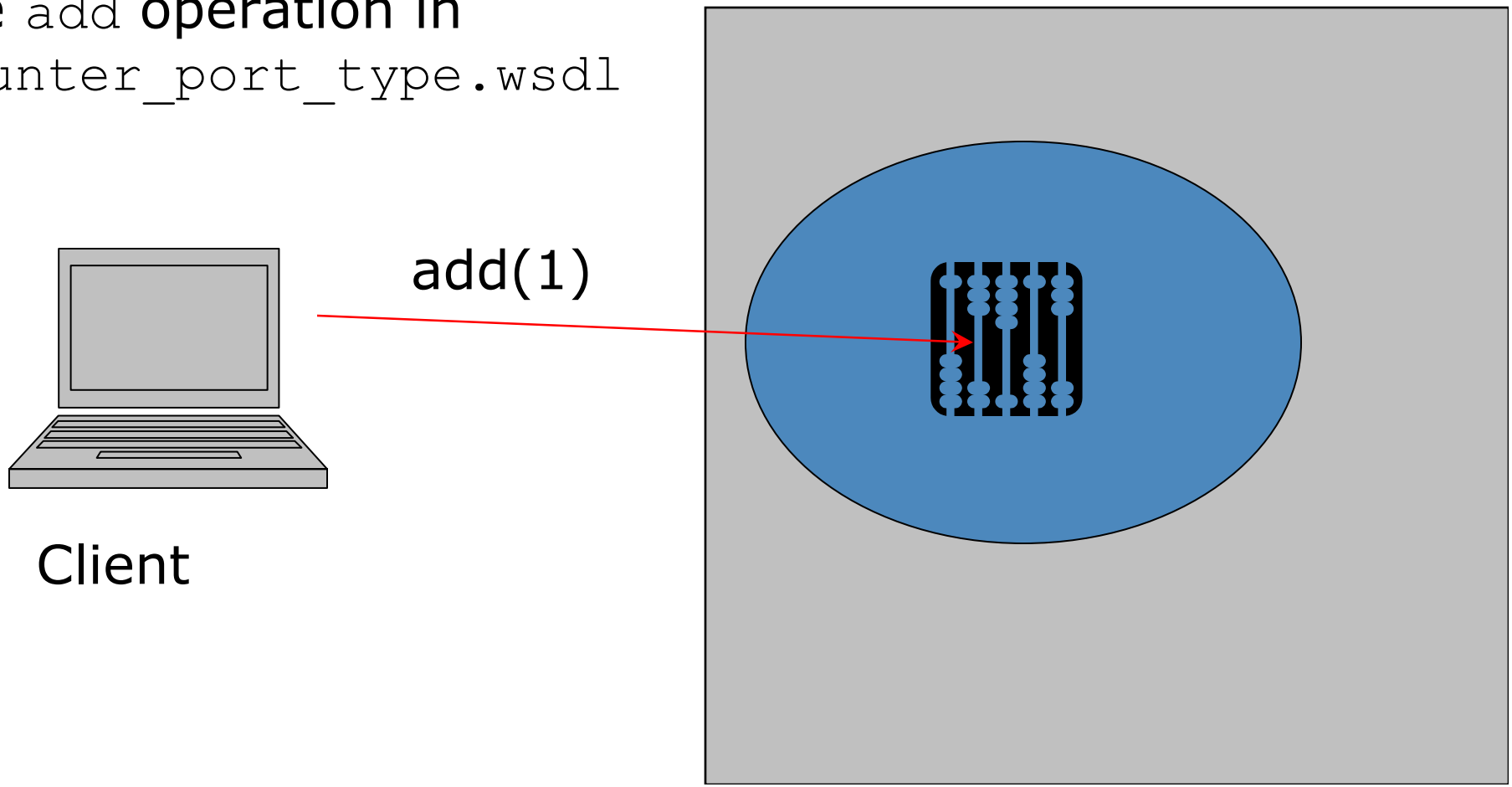
Exercise 1 overview

`show-counter` and `increment-counter` clients interact with the resource through the web service.



Exercise 1 overview

`increment-counter` invokes the `add` operation in `counter_port_type.wsdl`



Module 2 – Resource Addressing

- Endpoint References

Why?

- Need some way to refer to web services and WS-Resources from anywhere on the network.

Endpoint References

- WS-Addressing specification
- An **Endpoint Reference** (EPR) points to a web service by including a URL.

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Endpoint References

- WS-Addressing specification
- An Endpoint Reference (EPR) points to a web service by including a URL.

```
<EPR
xsi:type="ns2:EndpointReferenceType"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:ns2="http://schemas.xmlsoap.org/ws/2004/03/addressing”>
    <ns2:Address xsi:type="ns2:Address">
        http://localhost:8080/wsrf/services/CounterService
    </ns2:Address>
</EPR>
```

Endpoint References

- WS-Addressing specification
- An Endpoint Reference (EPR) points to a web service by including a URL.
- EPRs can also contain extra information
- For WSRF, can include **ReferenceProperties** that identify a resource – will see this later on.

Endpoint References

- WS-Addressing specification
- An Endpoint Reference (EPR) points to a web service by including a URL.
- EPRs can also contain extra information
- For WSRF, can include ReferenceProperties that identify a resource – will see this later on.
- Can also contain other information
  - Security
  - Renewable Refence information

Client code fragment

```
CounterServiceAddressingLocator locator =
        new CounterServiceAddressingLocator();
EndpointReferenceType endpoint;
        endpoint = EPRUtils.loadEPR(args);
CounterPortType counterPort =
  locator.getCounterPortTypePort(endpoint);
counterPort.add(1);
```

Automatically Generated types

```
CounterServiceAddressingLocator locator =
        new CounterServiceAddressingLocator();
EndpointReferenceType endpoint;
        endpoint = EPRUtils.loadEPR(args);
CounterPortType counterPort =
  locator.getCounterPortTypePort(endpoint);
counterPort.add(1);
```

Highlighted types are generated by the build system automatically, based on XSD and WSDL.

*AddressingLocator

- Every WSDL service has a corresponding AddressingLocator Java class automatically generated.
- For the CounterService, we get:
  - CounterServiceAddressingLocator
- An AddressingLocator knows how to take an EPR and return a java stub for the remote service:
  - CounterPortType counterPort = locator.getCounterPortTypePort(endpoint);

*PortType

- Every port type has a PortType Java interface automatically generated.
- For the counter port type, we have
  - CounterPortType
- The interface has a method for each operation on the port type:
  - counterPort.add(1);

Exercise 2

- Talk to someone else's service on a different laptop
- Modify clients to read an EPR file
- Should be able to run the clients against any machine in the room.

- Do the exercise now.

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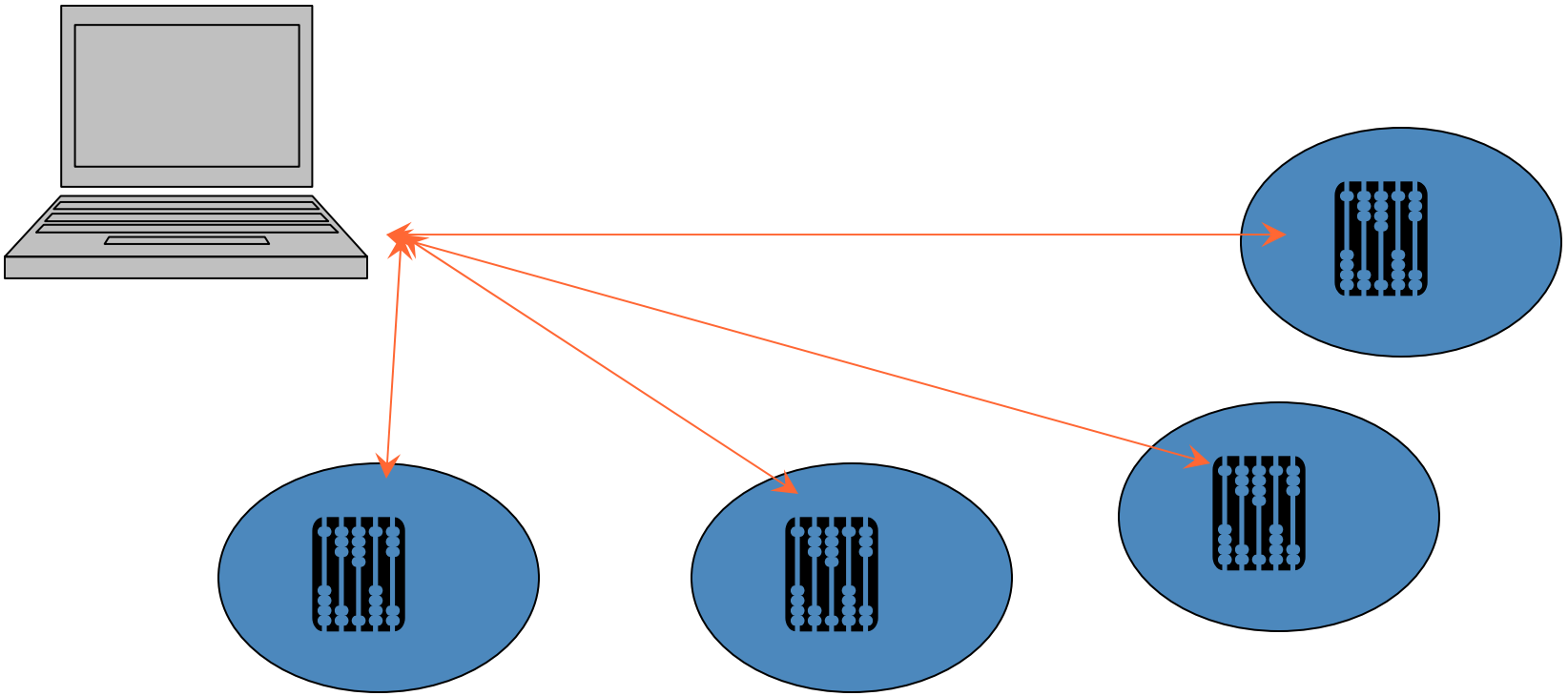
Exercise 2 scenario

Two hosts (your own machine and your friend's machine)
One web service running on friend's machine
One counter resource on friend's machine
Client running on your own machine

Exercise 2 scenario

Client can talk to everyone's servers – so the situation in this room looks more like this.



Module 3 – Resource Properties

- Resources have Resource Properties
- Defined in XML
- Resource Properties document in portType
- Querying Resource Properties

Why?

- Resources represent state
- Often we want to inspect that state

- In this tutorial, we want to know the value stored in each counter
  - show-counter client

XML based

- Each resource has a **Resource Properties document**.
- Defined in XML schema
- Each element in the Resource Properties document is a **Resource Property (RP)**.

Ways to access RPs

- Pull
  - Client can query the RP document
    - `GetResourceProperty`
    - `GetMultipleResourceProperties`
    - `QueryResourceProperties`
- Push
  - Allows services to send changes in their resources' RPs to interested parties.
    - WS-Notification
    - Not covered in this tutorial

Pull operations

- GetResourceProperty
  - Requests a single resource property by name
- GetMultipleResourceProperties
  - Requests several resource properties (from the same resource) by name
- QueryResourceProperties
  - More advanced queries against RP document.
  - eg. XPath

Counter example

- The counter service's Resource Property Document is defined in
  `schema/core/samples/counter/counter_port_type.wsdl`

-
```
<xsd:element name="CounterRP">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element ref="tns:Value"
                   minOccurs="1" maxOccurs="1"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
```

Operation Providers

- WSRF Core allows operations to be implemented by Operation Providers.
- Service writers can include these in WSDD, rather than writing Java code.
- Exercise will involve adding operation provider to support QueryResourceProperties operation

Exercise 3

- Exercise: add a resource property to the service to give 'last incremented time'. New client to query this RP.
- Query own counters and query other peoples' counters.

- Do the exercise now.

Module 4 – Resource Lifetime

- Creating new resources
- Destroying old resources
- Soft-state lifetime management

Why?

- Resources come and go
- For example:
  - jobs in a batch submission system could be represented as resources
  - submitting a new job causes a new resource to be created
  - when the job is completed, the resource goes away

Creating new resources

- Factory pattern
- A web service operation causes a new resource to come into existence.

- For example, in job submission:
  - submit(JobDescription)

Destroying resources

- Two ways:
  - Immediate Destruction
  - Scheduled Destruction

Immediate destruction

- Destroy the resource now!
- `Destroy` operation

Scheduled Destruction

- Scheduled destruction allows soft management of state.
- `TerminationTime` RP
- Keep state alive for as long as we need it, by calling `SetTerminationTime` operation periodically.

Scheduled Destruction

- Remote service is 'self-cleaning'
  - old unwanted state gets cleaned up automatically if no-one keeps it alive
- Problem: if interested party is disconnected from network for a long time, then it cannot extend lifetime and state may be cleaned up prematurely.

EPRs with ReferenceProperties

- If there are several counters accessible through a service, we need some way to tell them apart when making calls.
- Add ReferenceProperties to EPR with a key that identifies counter.

EPRs with ReferenceProperties

```
<EPR
   xsi:type="ns2:EndpointReferenceType"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xmlns:ns2="http://schemas.xmlsoap.org/ws/2004/03/addressing">
   <ns2:Address xsi:type="ns2:Address">
      http://localhost:8080/wsrf/services/CounterService
   </ns2:Address>
   <ns2:ReferenceProperties xsi:type="ns2:ReferencePropertiesType">
      <ns3:CounterKey
    xmlns:ns3="http://counter.com">42</ns3:CounterKey>
   </ns2:ReferenceProperties>
</EPR>
```

- Note that the CounterKey field is meaningless to everyone apart from the service.

EPRs with ReferenceProperties

```
<EPR
   xsi:type="ns2:EndpointReferenceType"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xmlns:ns2="http://schemas.xmlsoap.org/ws/2004/03/addressing">
   <ns2:Address xsi:type="ns2:Address">
      http://localhost:8080/wsrf/services/CounterService
   </ns2:Address>
   <ns2:ReferenceProperties xsi:type="ns2:ReferencePropertiesType">
      <ns3:CounterKey
    xmlns:ns3="http://counter.com">42</ns3:CounterKey>
   </ns2:ReferenceProperties>
</EPR>
```

- Note that the CounterKey field is meaningless to everyone apart from the service.

EPRs with ReferenceProperties

```
<EPR
   xsi:type="ns2:EndpointReferenceType"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xmlns:ns2="http://schemas.xmlsoap.org/ws/2004/03/addressing">
   <ns2:Address xsi:type="ns2:Address">
      http://localhost:8080/wsrf/services/CounterService
   </ns2:Address>
   <ns2:ReferenceProperties xsi:type="ns2:ReferencePropertiesType">
      <ns3:CounterKey
    xmlns:ns3="http://counter.com">42</ns3:CounterKey>
   </ns2:ReferenceProperties>
</EPR>
```

- Note that the CounterKey field is meaningless to everyone apart from the service.

Resource Homes

- Resource Homes map from key in EPR to a resource object
- So far, CounterService has used SingletonResorceHome.
  - Always returns the same single resource
  - So CounterService only provides access to one resource
  - No key needed in EPR
- Will now use ResourceHomeImpl
  - Allows creation of new resource objects
  - Maps from key in EPR to resource objects
  - Counter service will provide access to many resource objects

Exercise 4

- Exercise: create new counters. Destroy old counters.
- Two new clients:
  - create-counter
  - destroy-counter

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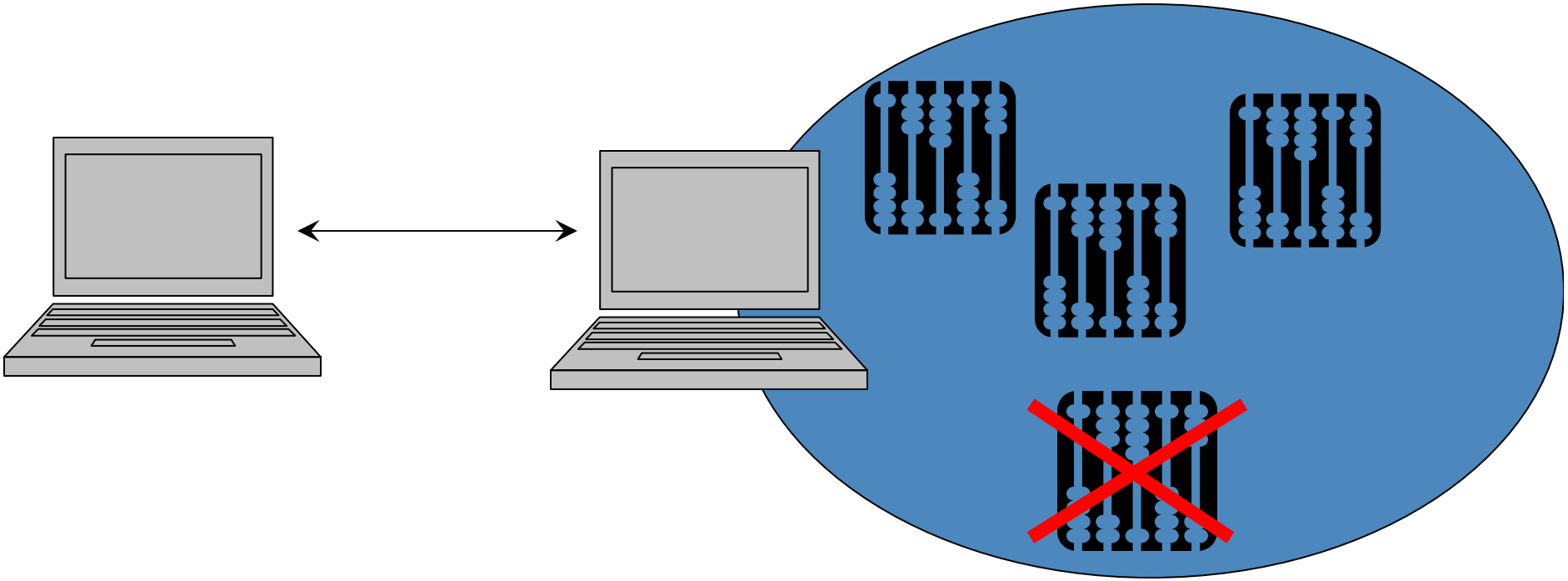
Exercise 4 scenario

Created new counters
Destroyed existing counters



The rest of WSRF

- WS-Resource Properties
- WS-Resource Lifetime
- WS-Servicegroups
- WS-BaseFaults
- WS-Renewable References
- WS-Notification

WS-ServiceGroups

- Form groups of services and/or resources
- Represent those groups as Resources.
- Registries etc

WS-BaseFaults

- Standard datatype for transmitting webservice faults
  - Originator
  - Timestamp
  - Etc…

WS-Renewable References

- EPRs can become stale
  - Service might move to a different host
- Renewable References provide a way to take a stale reference and try to a fresh one.

WS-Notification

- A group of 3 standards
- Deliver notifications of events
- For example, change in value of a resource property
- Started as one WSRF standard, but split off into three separate standards.

Fin