

Open Source Teagle: A potential framework for GENI and FIRE experimental facility federation?

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www.fire-teagle.org

www.fokus.fraunhofer.de/go/ngn2fi

www.ngn2fi.org



Agenda

- European FIRE Projects and federation of experimental facilities
- Panlab II (PII) Project Overview
- Teagle as major Panlab II Achievement
- Teagle Open Source Plans
- Comparing Teagle and Planetlab SFA
- *Additional Information*
 - Teagle in Action

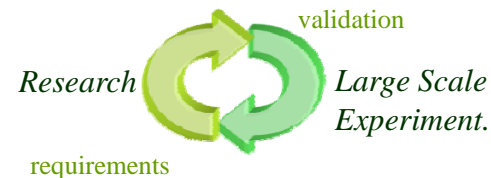




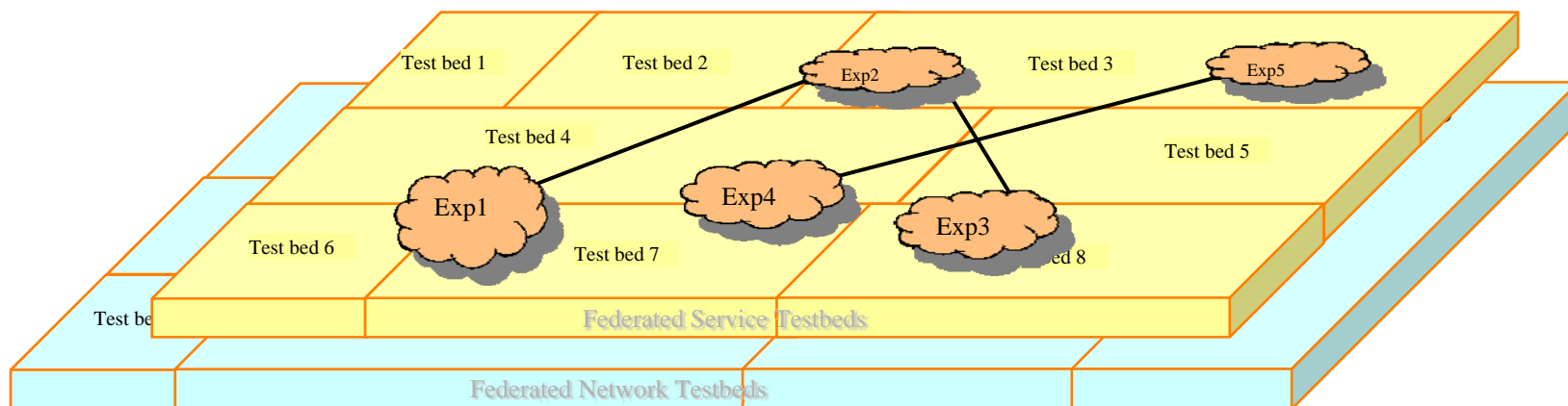
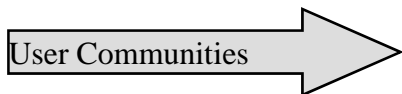
European FIRE Projects

- Supporting research and innovation on new network and service architectures
- Predict behaviour and assess non-technical impact: economic, societal, energy, environmental

FIRE Research



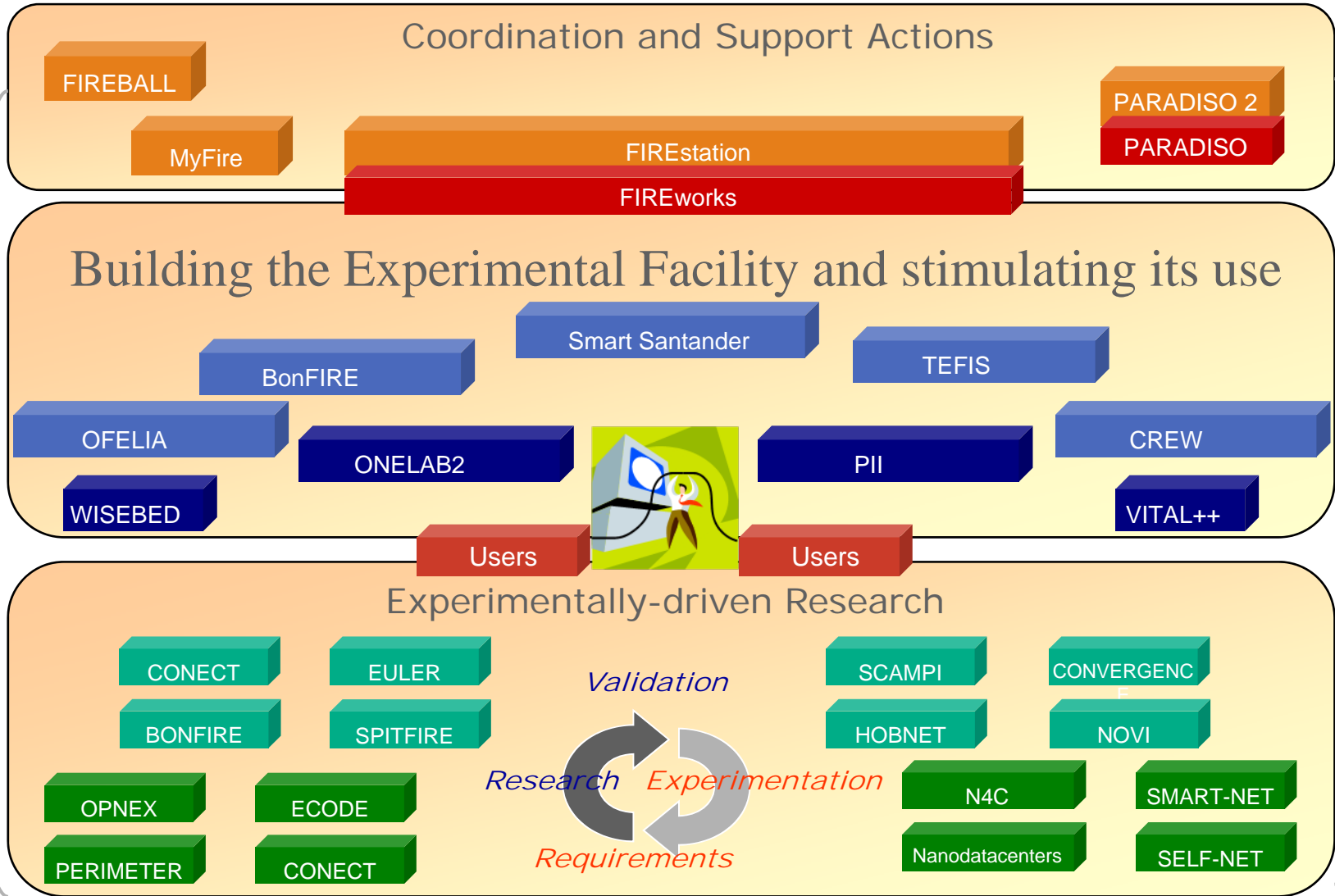
FIRE Experimental Facility



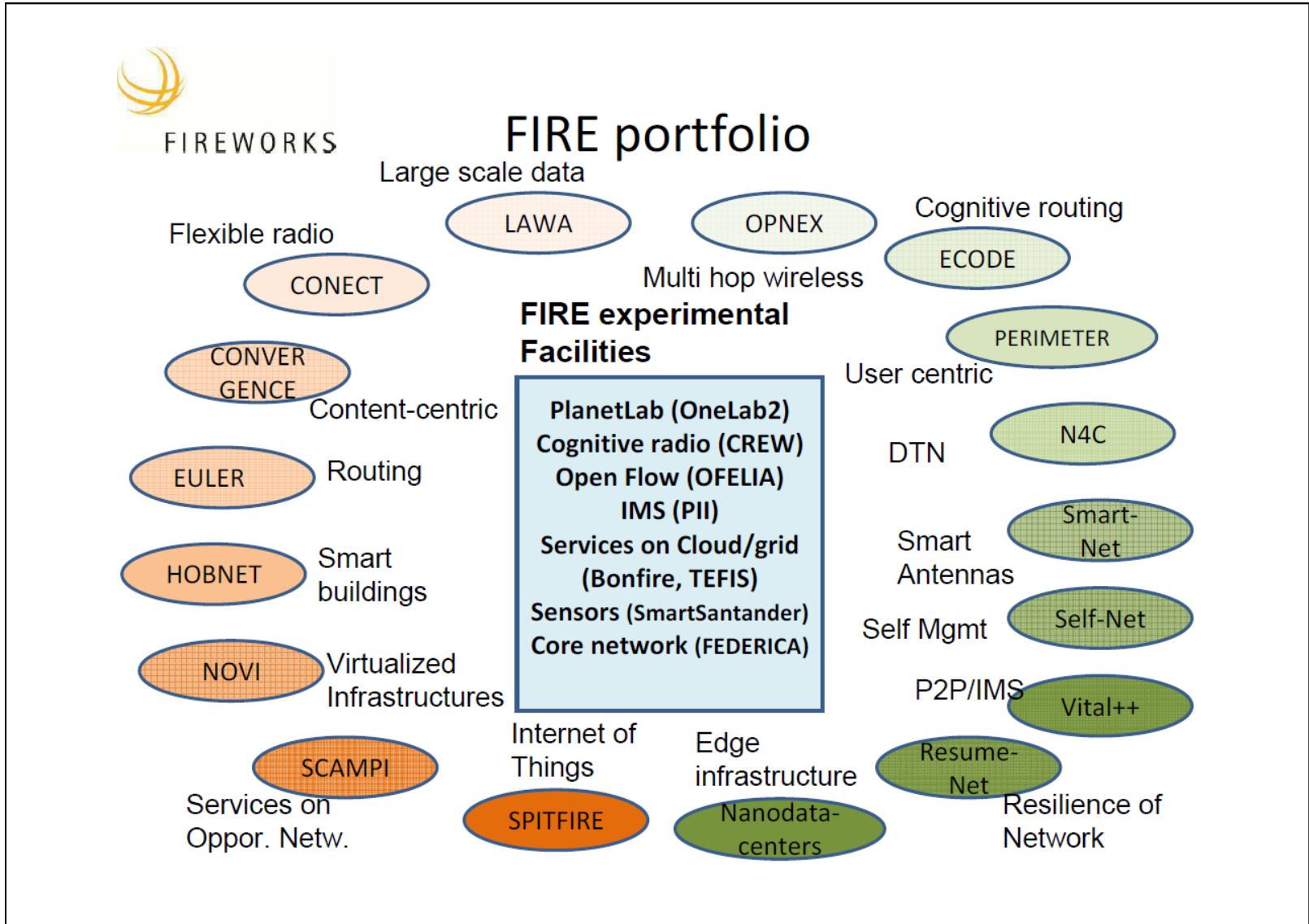
17 new projects, 50 M€ - Call 5 (tentative)



14 projects, 40 M€ - Call 2



- Facility Projects IPs Call 5
- Focused project Call 5 STREPs
- Coordination & support actions Call 5
- Facility projects IPs&STREPs Call 2
- Facility projects Call 2 STREPs
- Coordination & support actions Call 2



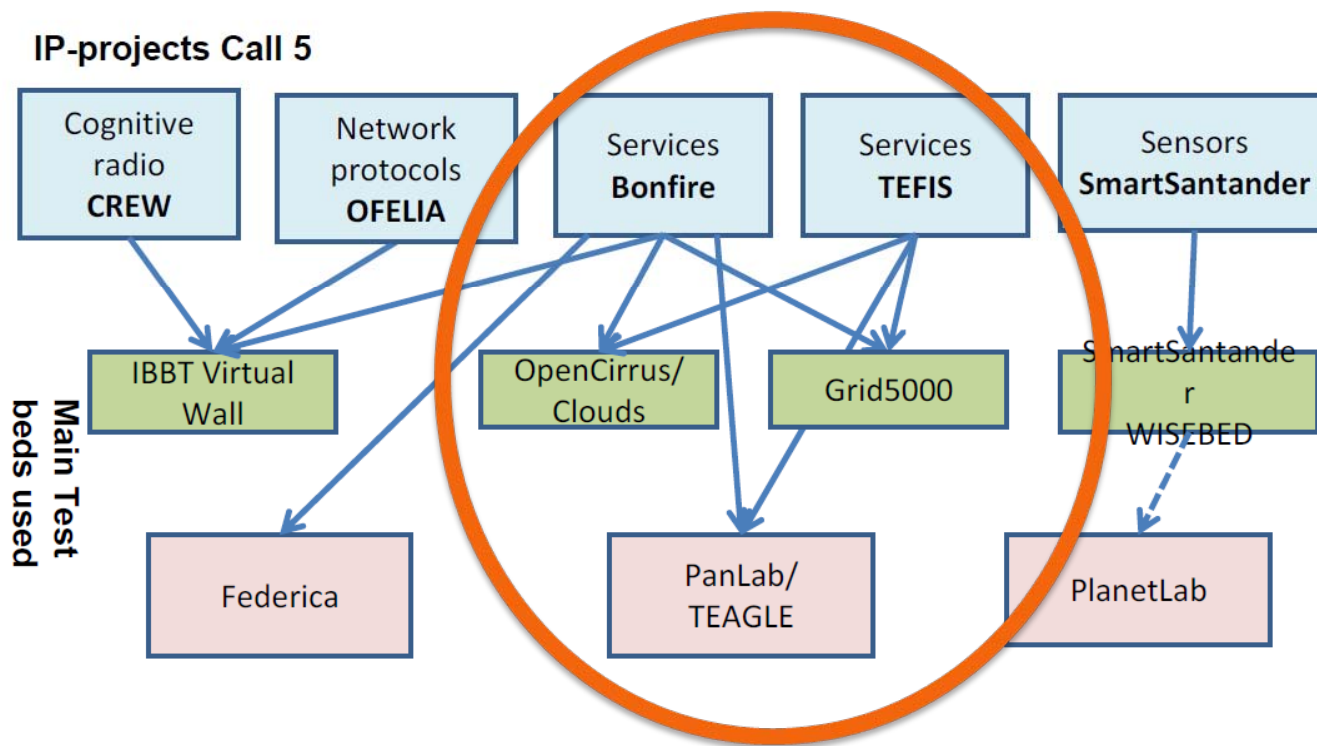
FIRE portfolio analysis June 2010. Scott Kirkpatrick, Jacques Magen, Dirk Trossen, Jerker Wilander





FIREWORKS FIRE Facility projects (call 5)

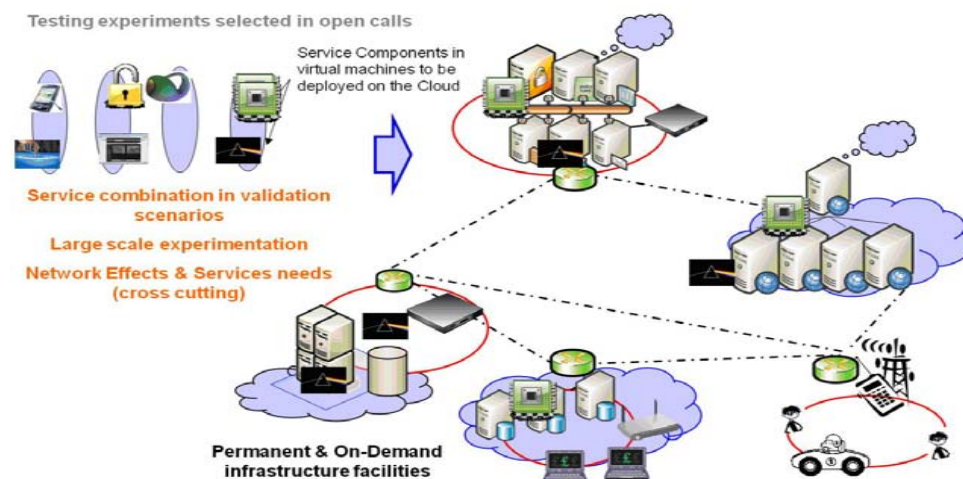
IP-projects Call 5



Building service testbeds for Future Internet Research and Experimentation



- *Multi site cloud facility to support applications, services and systems research targeting the FI Internet of Services.*
- *researchers access experimental facility which enables large scale experimentation of their systems and applications,*
- *the evaluation of cross-cutting effects of converged service and network infrastructures*
- *Makes use of Teagle*



TEFIS

Testbed for Future Internet Services



- *Open platform* able to integrate existing and next generation of testing and experimental facilities.
- *Connector model* that enables facilities to be accessed and used in a *unified manner using Web services*.
- The TEFIS platform *integrates 7 complementary experimental facilities, including network and software testing facilities, and user oriented living labs*.
- *Makes use of Teagle*
- ***www.tefis.hu***

The FIRE Project PII

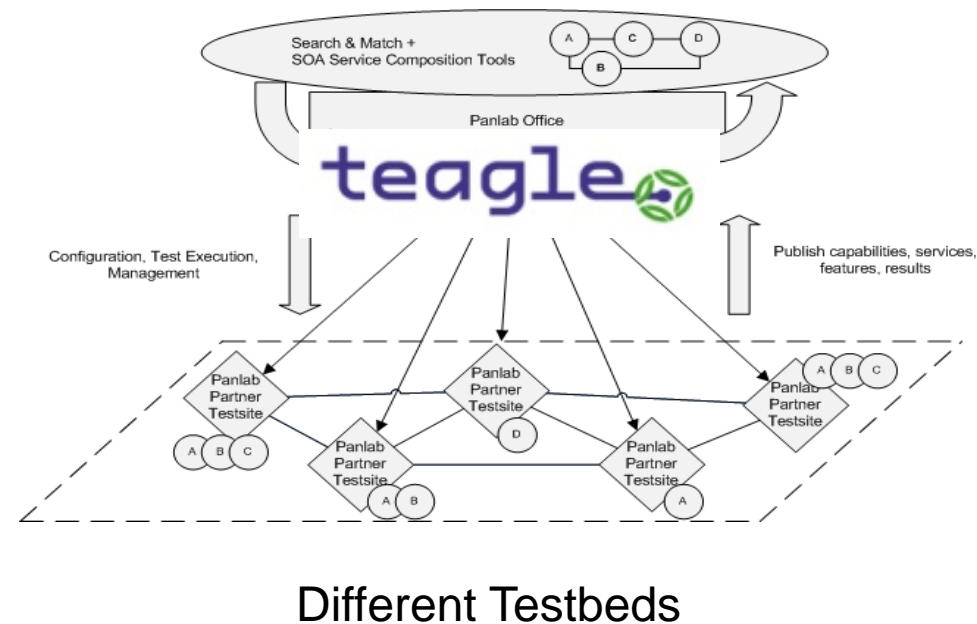
PanEuropean Laboratory II



Pan-European Laboratory Project (PII) develops SOA testbed federation tool Teagle

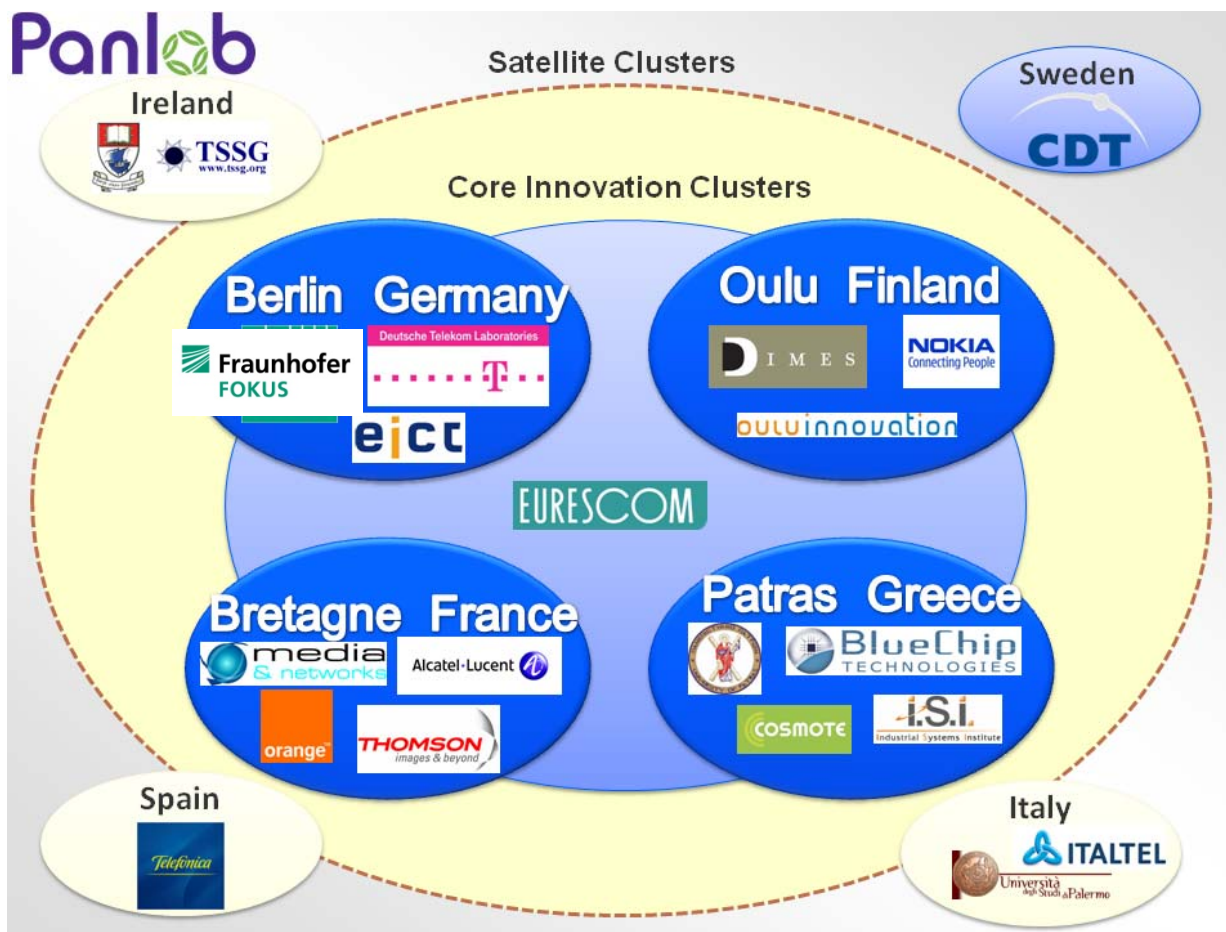
- Support life cycle of testbed federation management via common management plane
- Provides repositories for testbed and component descriptions (registration)
- Search available resources, i.e. infrastructure and services (discovery)
- Orchestrator of services and testing infrastructures
- Initiate automated deployment / provisioning
- Monitoring of federated resources (fault / performance) mgt
- More at → www.panlab.net

Federated Testbed View




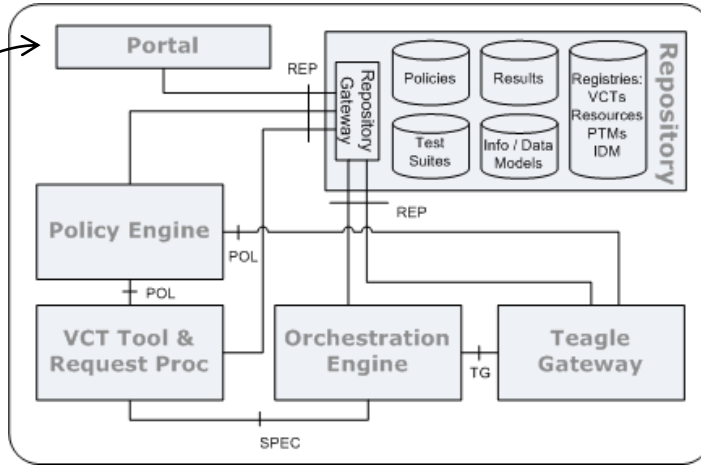
Pan-European Laboratory Infrastructure Implementation

The clusters and their partners



Panlab Overall Architecture


Experimenter



↕ interface

Panlab Testbed Manager

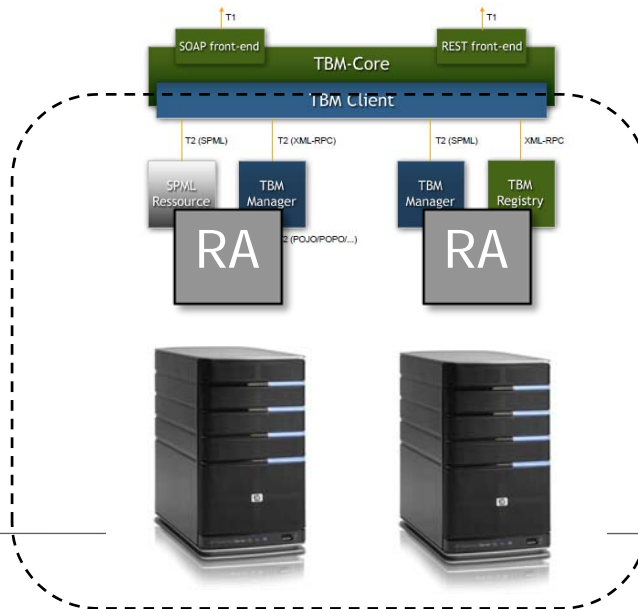
↕ interface

Resource Adaptor

↕ interface

Resource

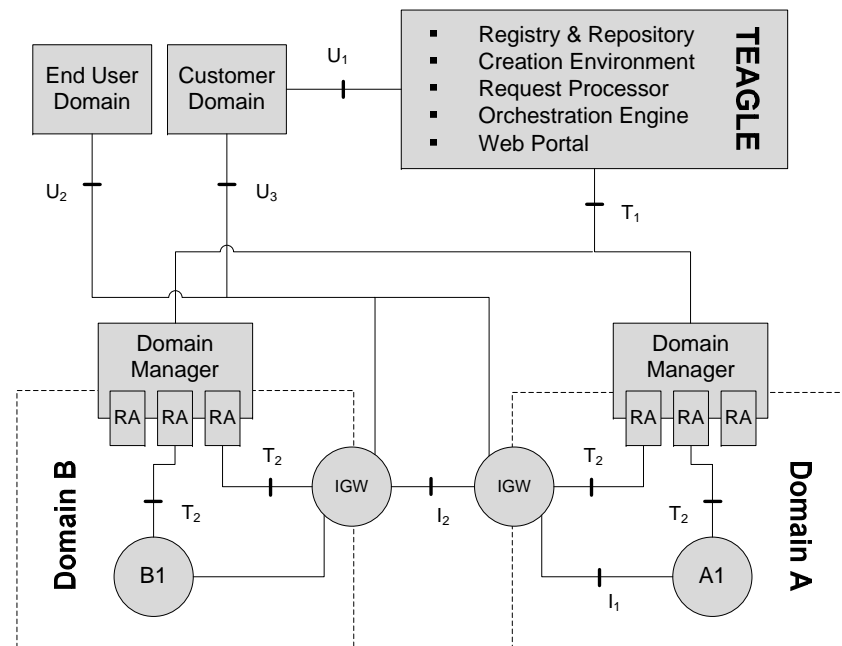
Partner Domain
(e.g. FIRE testbeds,
industrial and
academic testbeds,
GENI testbeds)



Teagle Interfaces

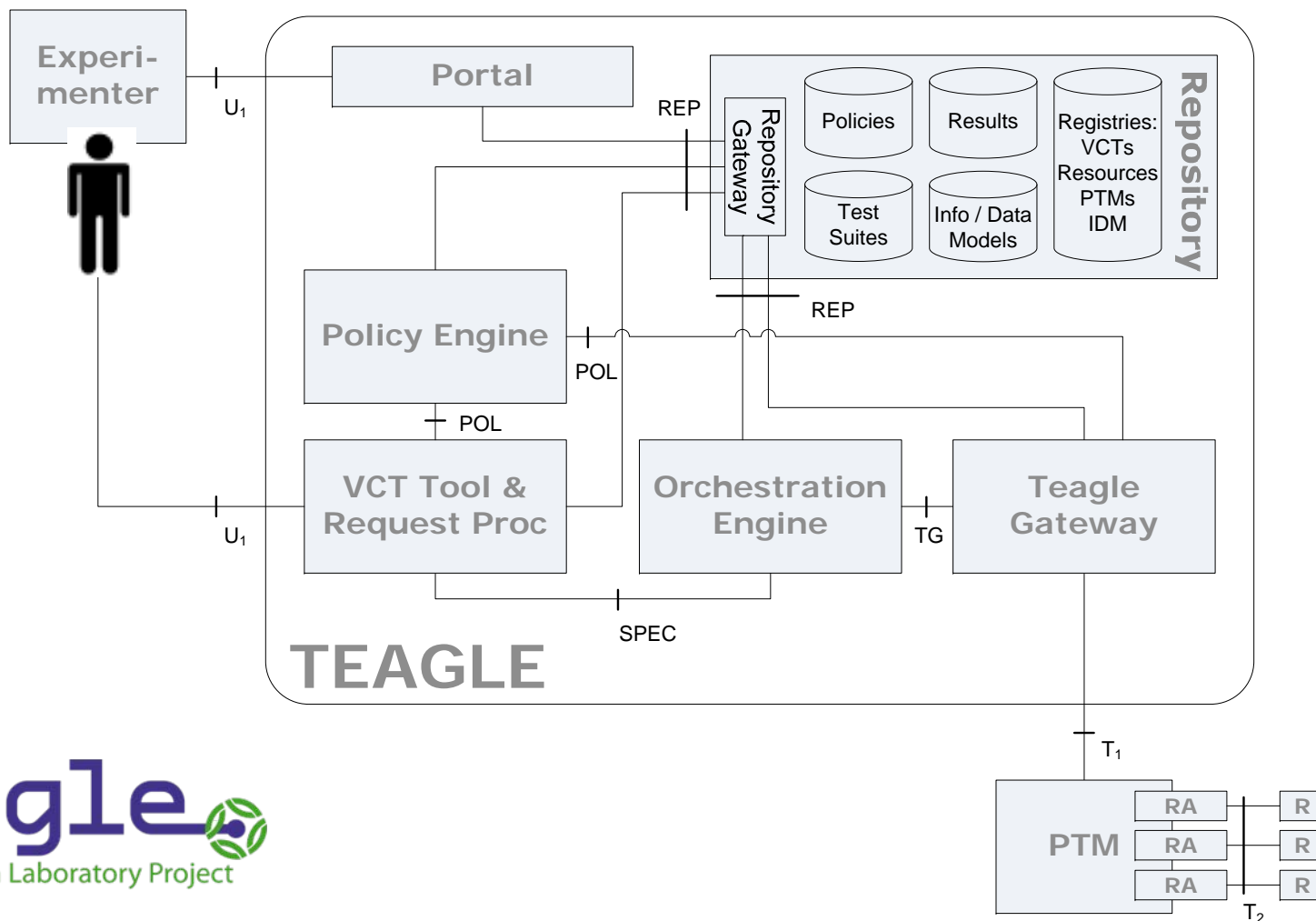
Heterogeneous Resources but a Common Control Framework

- Domain Managers control resources inside a partner domain
- Resource Adaptors (RA) are used like device drivers to translate federation level management commands to resource specific communication (e.g. SNMP, CLI, proprietary) on interface T2
- Teagle instructs domain managers via a common control framework on interface T1
 - Generic control framework
 - CRUD operations (create, read, update, delete)
- Teagle provides user interfaces for experimental facility configuration and deployment, provides registries, information- / data models, creation environment
- Domain interconnections are handled by gateways (IGW)



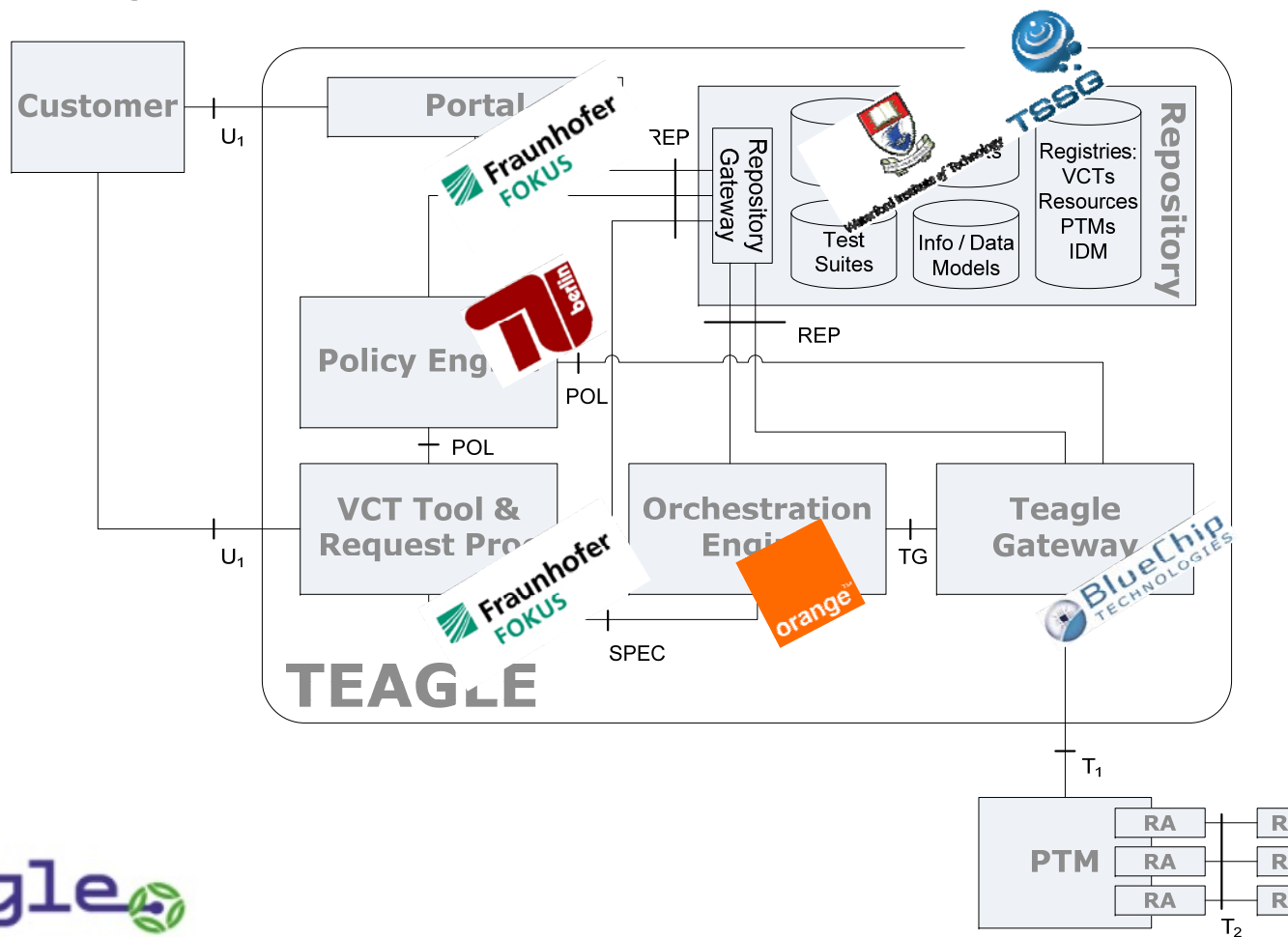
teagle 

Teagle Architecture



Teagle – a collaborative effort

Who is doing what



Teagle

Who is doing what

- Portal – Fraunhofer FOKUS, Germany
- Policy Engine – TU Berlin, Germany
- VCT Tool – Fraunhofer FOKUS, Germany
- Orchestration Engine – Orange, France
- Ressource Repository – TSSG, Ireland
- Teagle Gateway, BlueChip, Greece
- Panlab Resource Adaptor (PTM) – Fraunhofer FOKUS, Germany

Teagle goes Open Source

- Teagle is planned to be released as Open Source
- Currently different license options are evaluated
- Preferred option is to have one common license for all Teagle subcomponents
- Full code release is planned for Q4 2010 via BerliOS, <http://www.berlios.de/>
- Sandbox environment is planned allowing to test Teagle capabilities and allow for hands-on experience regarding resource adaptor development
- So far the following resource types have been federated (RAs exist)
 - Cloud resources (Amazon VM, OCCI compute, storage, network not yet fully done)
 - Optical network resources (e.g. Phosphorous testbed, inter-domain path can be reserved from Canada to Spain with specific bandwidth)
 - Telco Services (IMS & EPC core services, presence server, XDMS, MySQL, etc.)
 - PlanetLab nodes (no agreements with PLC, but prototypes exist for a private PlanetLab)
- Different usage strategies for Teagle OS software:
 - Use entire framework together with PTM
 - e.g. to control resources in single domain testbeds and allow third party access to resources
 - Use and enhance current capabilities of single components
 - e.g. enhance VCT Tool or Orchestration Engine to allow for runtime testing, NS3 mapping, VCT optimization, etc

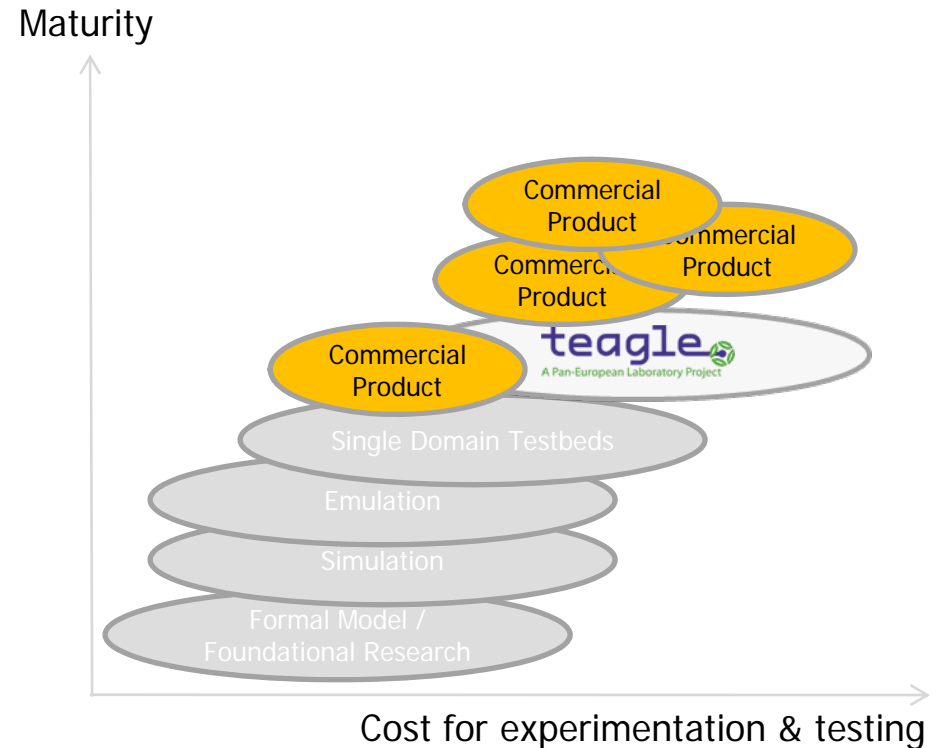


Teagle and Federation as a means for rapid prototyping and commercialization

- Teagle facilitates remote access to highly heterogeneous resources
- Various testing and experimentation needs and requirements can be met
- The closer to market, the higher the associated costs
- Teagle aims at closing this gap

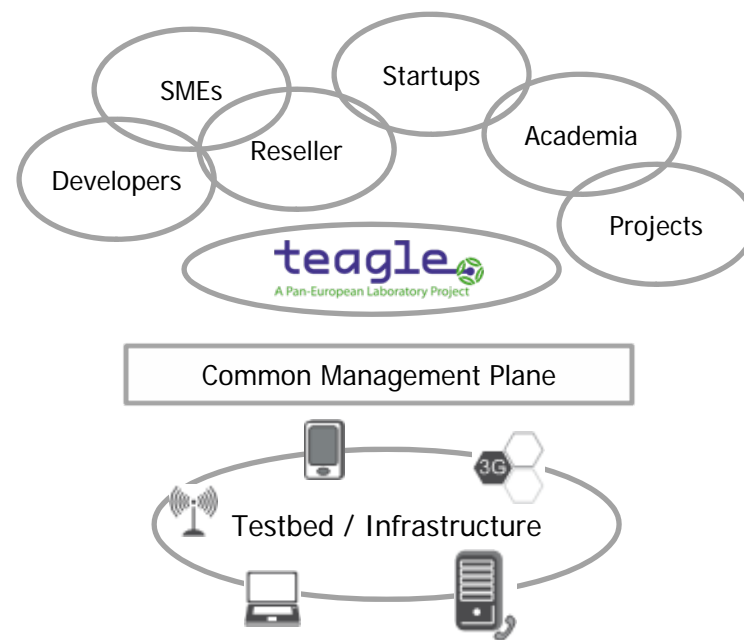


→ www.fire-teagle.org/tutorials.jsp

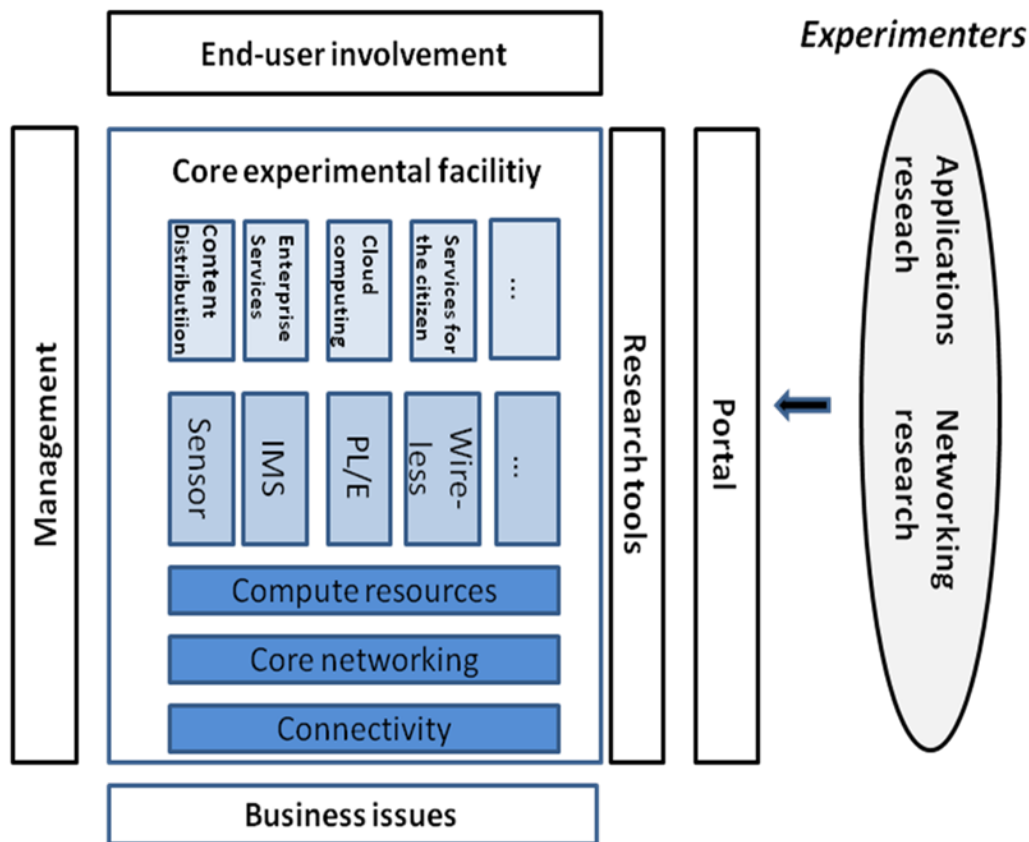


Intra-domain vs. Inter-domain Usage of Teagle

- Federation is great but also for intra-domain (single testbeds) scenarios, Teagle provides great tools to maximize testbed usage and benefit for all stakeholders
- Allow testbed customers to design desired testbed / infrastructure setups making use of remote testbed resources
- Testbed providers stay in full control of their resources but allow remote usage within defined constraints
- Use cases:
 - Third-party developers can use remote resources
 - Infrastructure providers offer services to SMEs and startups
 - IaaS, PaaS, and SaaS are possible
 - Easy testbed deployment and maintenance



Towards a collaboration and high level federation structure for the FIRE Facility

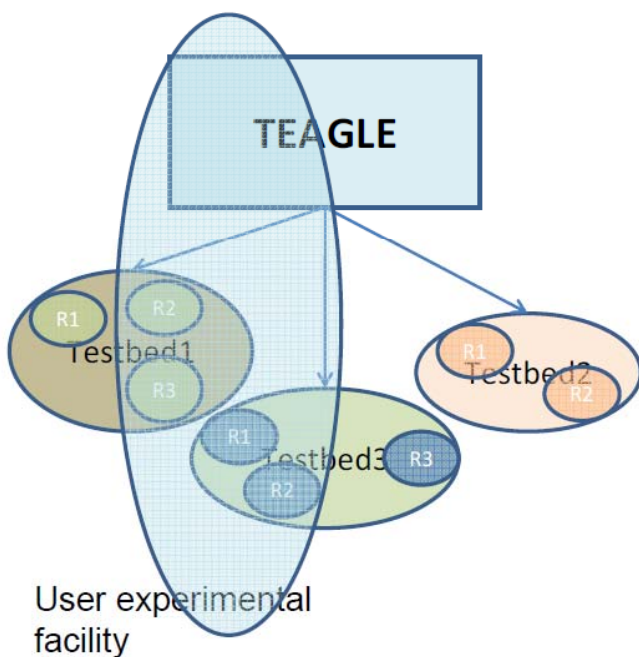




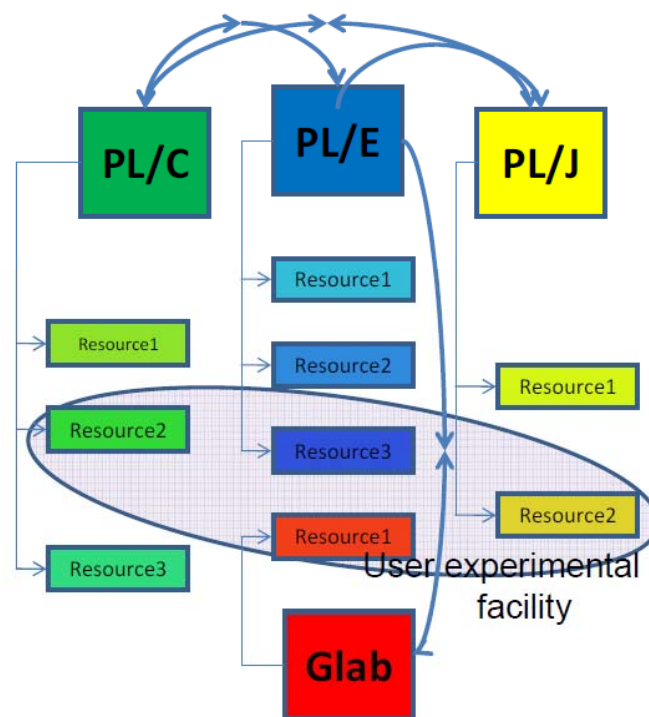
FIREWORKS

Federation models

PanLab Model



SFA/PlanetLab Model



Nomenclature

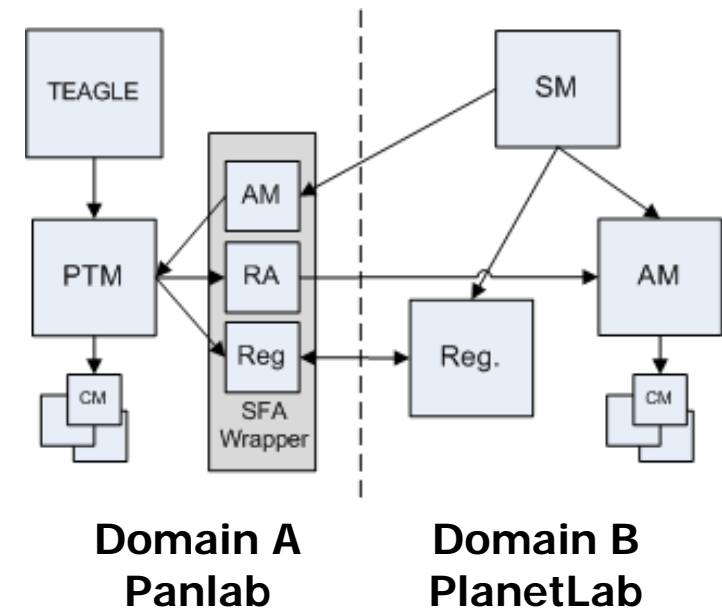
Panlab entities in GENI words

Panlab	GENI
Teagle	Clearinghouse + slice manager (SM)
Virtual Customer Testbed (VCT)	Slice
Resource	Component
Resource Adaptor (RA)	Component manager (CM)
Panlab Partner domain	Aggregate
Panlab Testbed Manager (PTM)	Aggregate manager (AM)
Panlab Partner	Management authority (MA)
Panlab Office	Slice authority (SA)
No equivalent entity as everything is treated as a resource / resource instance!	Sliver



Federation with PlanetLab

- Approach for federating Panlab with PlanetLab based on a full federation scenario
- This has been implemented as a prototype with a private PlanetLab installation by a so-called SFA wrapper that plugs into the Fraunhofer Domain Manager (PTM)
- No official agreement with PLC
- No operational, business, or legal aspects have been investigated as part of this activity



Konrad Campowsky, Thomas Magedanz, and Sebastian Wahle. Resource Management in Large Scale Experimental Facilities: Technical Approach to Federate Panlab and PlanetLab. In 12th IEEE/IFIP Network Operations and Management Symposium (NOMS 2010). IEEE/IFIP, April 2010.

PlanetLab View

- 2 nodes available
 - pln0.plc from the domain plc
 - pnode-0.ptm from the domain ptm
 - add both to a slice
- PlanetLab slice manager will contact the PTM's aggregate manager and request it to instantiate a sliver on pnode-0.ptm
- PTM contacts the appropriate resource adapter, orders it to set up a virtual node and to configure it to be PLC compatible
- To give rudimentary access to researches, this especially means installing respective user credentials and configuring the sliver's SSH server
- The researcher can now access the sliver and gain privileges in the same way he would access any other sliver:

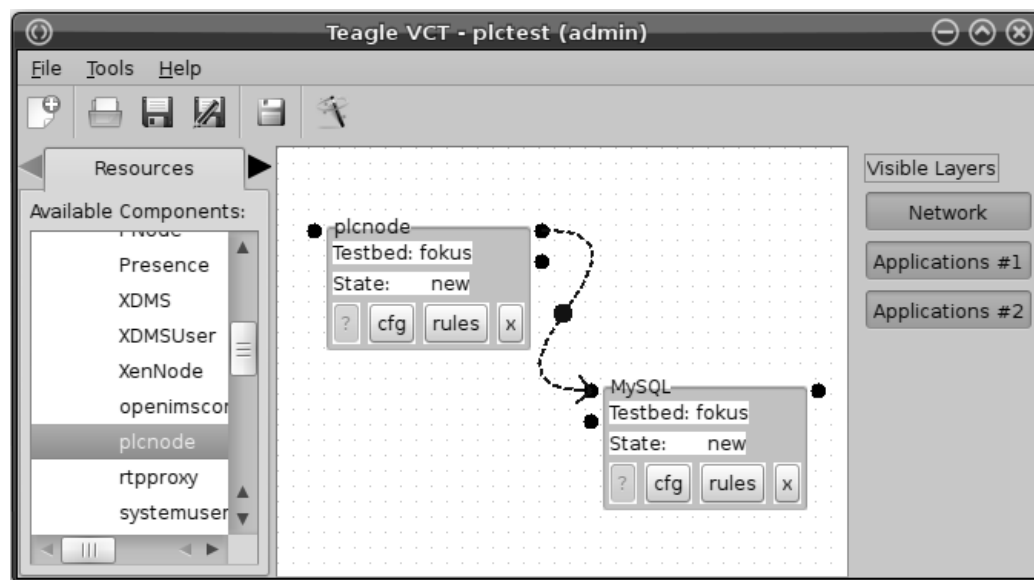
```
# ssh -i .ssh/id_rsa focus_s1@pnode-0.ptm \ sudo su -
```

```
<Rspec ...>  
  <networks>  
    <NetSpec name="ptm" ...>  
      <nodes>  
        <NodeSpec name="pnode-0.ptm">  
          <net_if>  
            <IfSpec addr="10.0.0.10" .../>  
          </net_if>  
        </NodeSpec>  
      </nodes>  
    </NetSpec>  
  </networks>  
  <networks>  
    <NetSpec name="plc" ...>  
      <nodes>  
        <NodeSpec name="pln0.plc">  
          <net_if>  
            <IfSpec addr="10.0.0.20" .../>  
          </net_if>  
        </NodeSpec>  
      </nodes>  
    </NetSpec>  
  </networks>  
</Rspec>
```



Panlab View

- Panlab Customer assembles new VCT containing an installation of a MySQL software package on PlanetLab node
- PTM contacts the SFA resource adapter which in turn will relay the request towards the aggregate manager on the PlanetLab side
- Slivers are added to the slice (must be created if not existent!)
- PTM can access the slice and install resource adapters, e.g. a SoftwareAdapter used to deploy the requested MySQL package
- Initial prototype demonstrates how PlanetLab resources could become available via Teagle to deploy VCTs/slices combining Panlab and PlanetLab resources
- Non-technical issues (e.g. operational & legal agreements) untouched!



3rd GI/ITG KuVS Fachgespräch on Next Generation SDPs: "Towards SDPs for the Future Internet" Berlin, Germany, October 14, 2010

- Hosted by:
Deutsche Telekom Laboratories
- Supported by:
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ICIN 2010 (www.icin.biz)
1st FOKUS FUSECO Forum (www.fuseco-forum.org)
- Coordinators:
Dr. Wolfgang Kellerer, DOCOMO Communications Labs Europe GmbH, Germany
Prof. Dr. Thomas Magedanz, Technische Universität Berlin, Germany
- Paper Submission to info@kuvs-ngsdp.org:
1-2 page short paper and 5-10 lines abstract for the Web by August 27th, 2010
Notification of acceptance by September 17th, 2010
- Free registration via info@kuvs-ngsdp.org
- Detailed Information under: www.kuvs-ngsdp.org/3rd_meeting

Deutsche Telekom Laboratories
An-Institut der Technischen Universität Berlin



Additional Information

Teagle Portal

- Primary contact point for customers and partners
- Customers can:
 - Launch the VCT tool to create VCTs
- Partners additionally can:
 - Manage their resources, VCTs, policies, and PTMs
- Tutorials section including videos and tutorial announcements
- News section

Panlab
Pan European Laboratory Infrastructure Implementation

Contact | Search | Sitemap

[back to Panlab](#) [Teagle Home](#)

You are Here: Teagle

Teagle

- Home
- News
- Results Repository
- Tutorials
- Members Area

Info

You are not logged in.
[Create account](#) or [login](#)

Welcome to the Teagle Portal. This is a project related to the [Panlab concept](#). The Teagle Portal provides information about our partner testbeds and allows you to manage your Private Virtual Test Lab.

[What is a Private Virtual Test Lab?](#)

[What is Teagle?](#)

[How to get started?](#)

hosted by
Fraunhofer FOKUS

supported by
AV
Next Generation Networks

News

2010-06-18
[PIL cluster training event in Barcelona](#)

1 July 2010: PIL cluster training event [more](#)

2010-06-14
[Teagle Tutorial at Tridentcom 2010](#)

Teagle Tutorial at Tridentcom 2010 [more](#)

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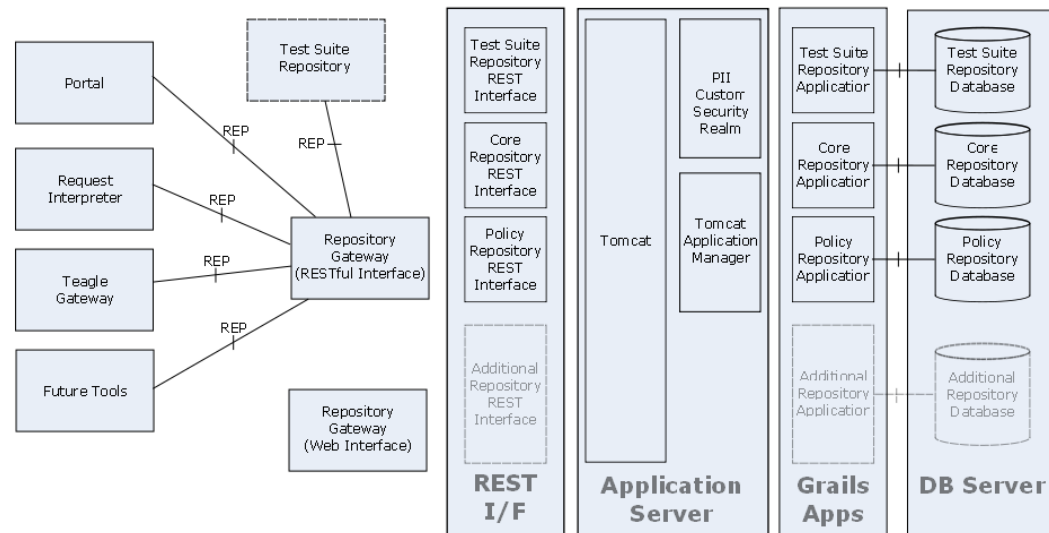
www.fire-teagle.org



Teagle Registry / Repository

Enabling common resource description

- Common Information Model for high-level agreement and resource descriptions across the federation
 - DEN-ng used for autonomic network management
 - Important Core Abstractions
 - Service/Resource description
 - Policy (and mediation)
 - User and Organization profiles
 - Test Suite Management
- Domain Specific Data Models for separation of concerns
 - Pick and group relevant pieces of the information model
 - Construct appropriate data models

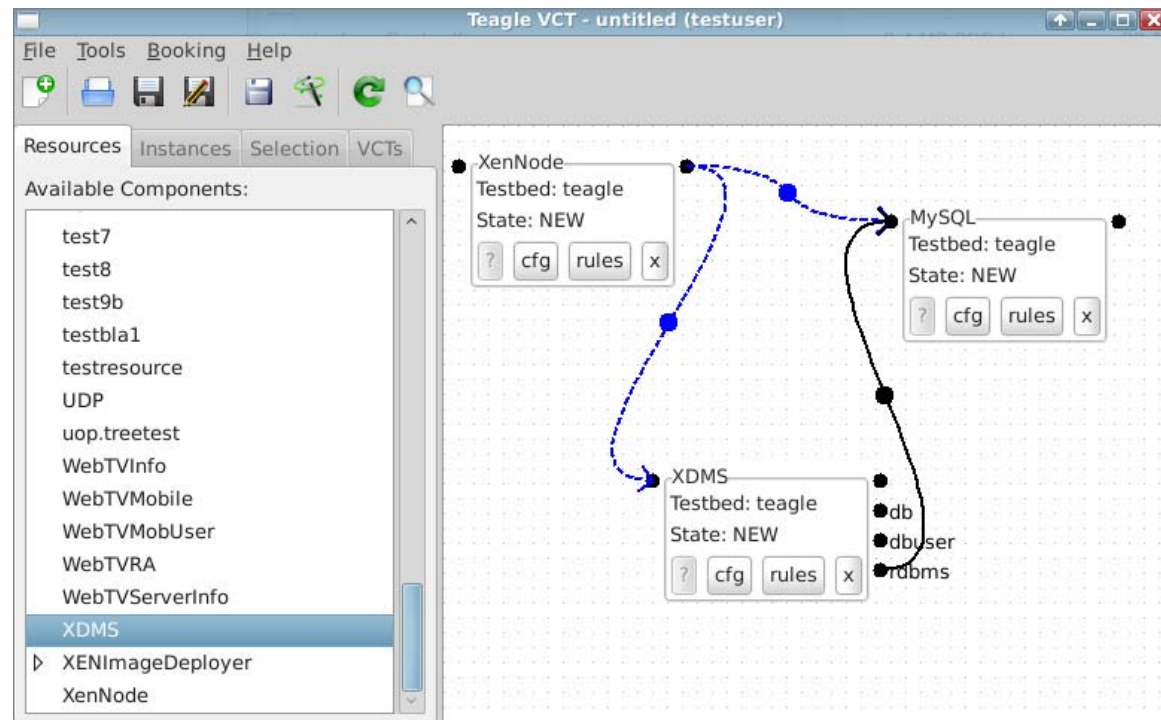


- Repository is made of several applications, each with its own storage and RESTful Interface
- Clean separation of concerns
- Communication is stateless

VCT Tool

Teagle Creation Environment

- Java Web Start application
- Enables configuration and deployment of VCTs
- communicates at startup and during runtime with the repository
 - User settings
 - Available resources
 - Saved testbeds from previous sessions
 - Bookings
- Communicates with policy engine, request processor, and OE via defined interfaces



Orchestration Engine

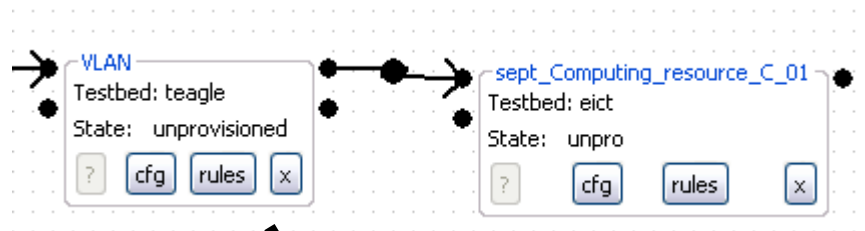
Overview

- The Orchestration Engine is in charge of controlling the sequencing of calls to testbeds to realize the booking of requested resources (cross-domain)
- Its role is:
 - To transform a topology-oriented VCT specification into an executable workflow script
 - To launch the execution of the scripts to realize the actual provisioning of resources, report on instantiated resources
- It is connected to:
 - VCT Tool (Request Processor) to receive the input VCT models
 - Teagle Gateway to access PTMs
- Exploits SOA (Booking requests become Services)



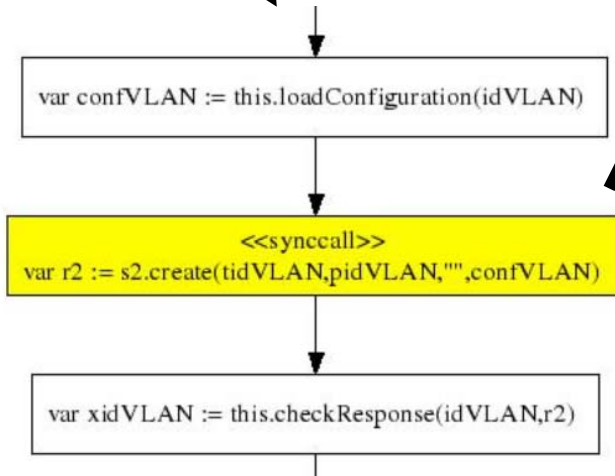
Orchestration Engine

Transforms VCT design into executable script



Transforming

Executing



```

***** PTM CALL *****
Date: Mon Sep 21 16:19:47 2009
ENDPOINT: http://62.38.216.70:9000/teaglew/share
POST /share.top-0
<vlan>
  <sept_computing_resource_b_1 type="reference">
    uop.sept_computing_resource_b_1-7
  </sept_computing_resource_b_1>
  <sept_asterisk_1 type="reference">
    uop.sept_asterisk_1-7
  </sept_asterisk_1>
</vlan>

200 OK
<?xml version="1.0" encoding="utf-8"?>
<vlan><uuid type="string">uop.vlan-8</uuid></vlan>
    
```

Transforming: Ordering create/update calls Based on ref/containments dependencies

Executing: Issuing HTTP Requests to PTMs Through TGW using REST approach



Teagle Gateway

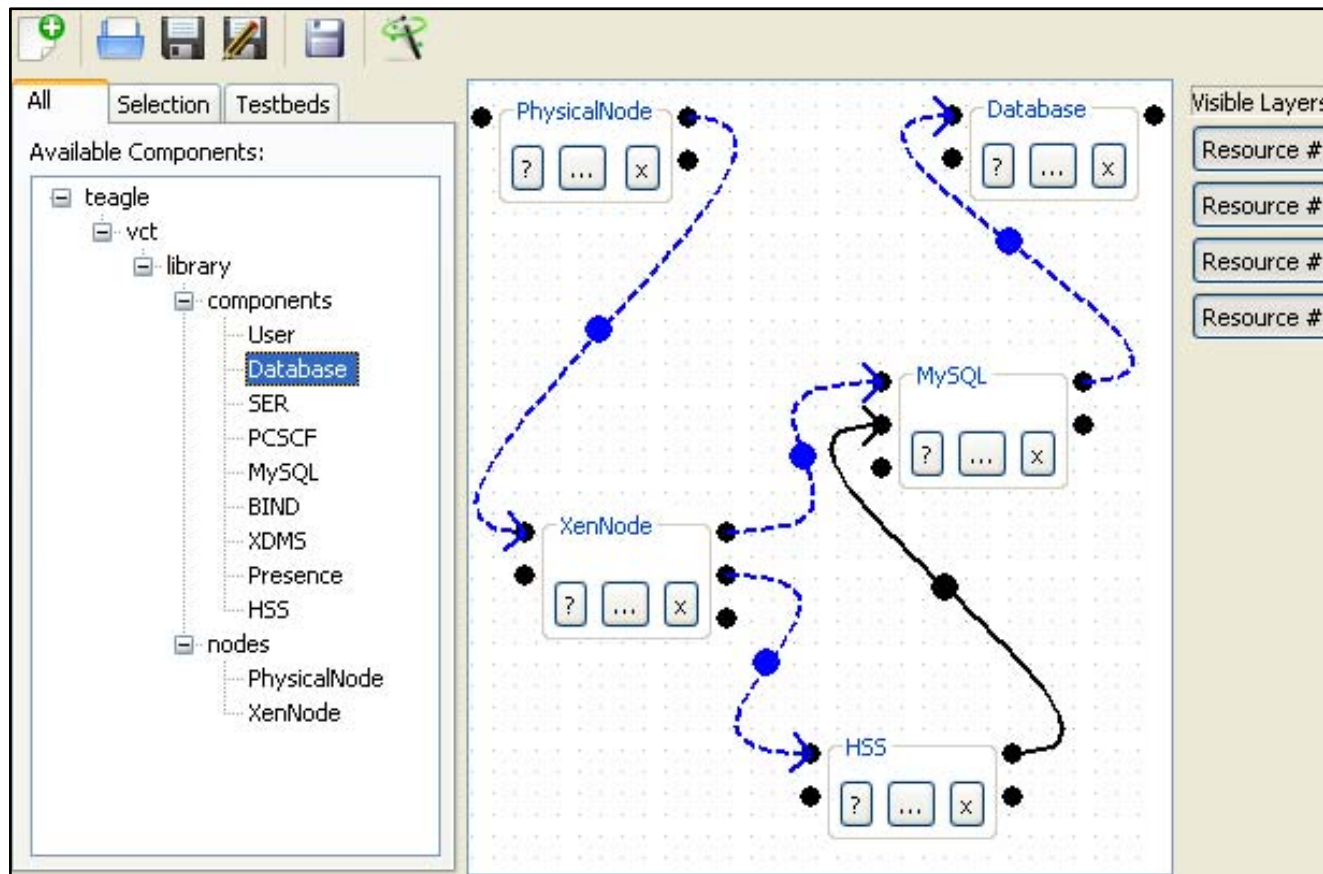
- Provides two interfaces:
 - TG (REST based) that is used by OE
 - T1 (SOAP-WS) that is used by the PTMs
- Communication over interface T1 has been enhanced and allows for
 - Establishment of SSL channels that require mutual authentication of TGW and PTMs
 - Notifications to be sent from the PTMs to TGW
 - Asynchronous requests from the OE can be supported, the immediate response acknowledges reception of the request and the actual outcome of a VCT booking is collected via a notification sent by the involved PTM
- Heartbeat monitoring of PTMs (status: OK, SSL Problem, PTM Offline, RAL Offline)
- Notifications from PTMs collected by the TGW:
 - Resource Adaptor Installation/Removal
 - Resource Instantiation/De-allocation
 - Availability of resource types



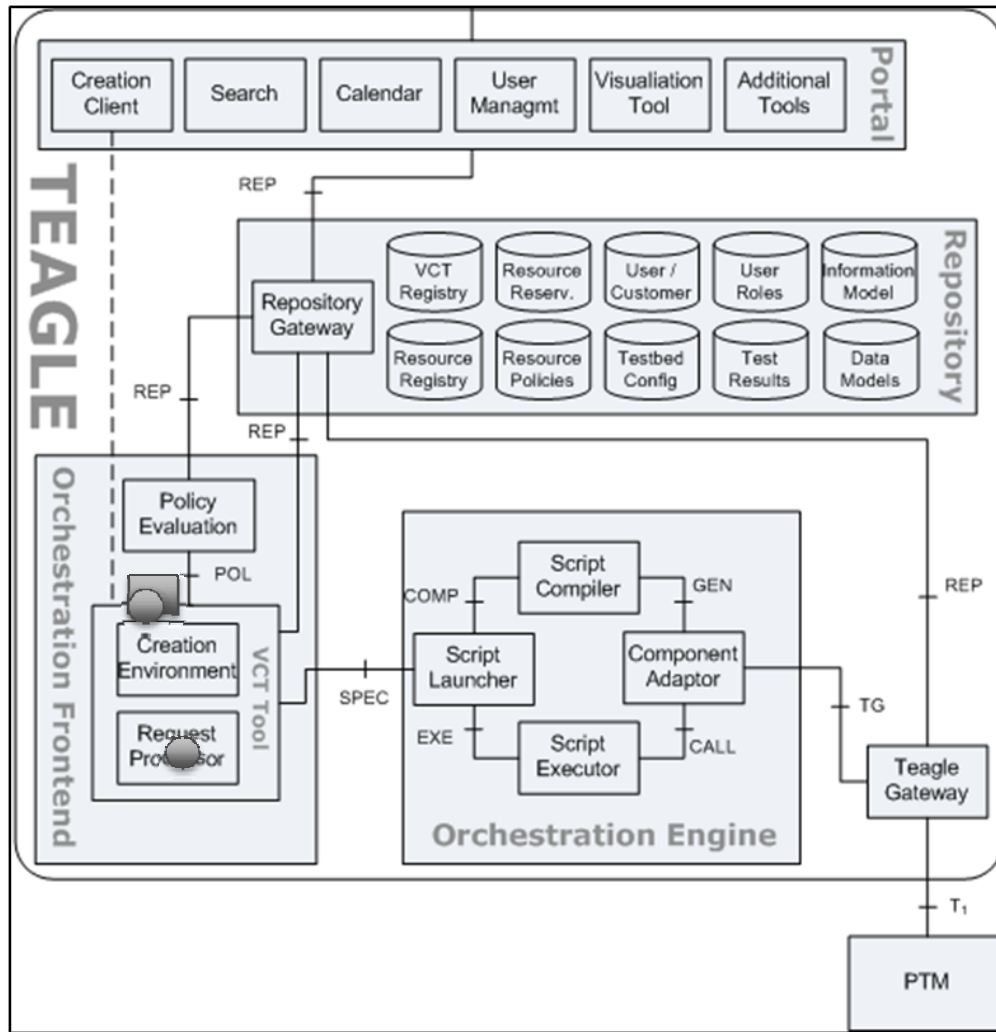
Policy Engine

- Implementation based on OMA PEEM specification. Policy language based on the Common Policy Format (RFC 4745).
- Policies represent a logical set of rules. Are identified by:
 - Identity (user, resource) or a group of identities (organization)
 - Scope of the identity relative to the operation(“originator” or “target”)
 - Operation that triggered the evaluation request (e.g. bookResource)
- A rule consists of :
 - conditions define the scope of the rule and constraints on the input data
 - actions define the behavior which should be enforced by requesting entities
- During the evaluation process, the rules of the associated policies are evaluated. The policy evaluation is explicitly triggered through the PEM1 interface
 - VCT Tool requests for policy evaluation and executes the result actions by:
 - Restricting display/booking of the resources
 - Restricting combinations of resources in a connection
 - PTM requests for policy evaluation and executes the result actions by setting firewall filters after provisioning resources (still on-going work)

How to Design and Book a VCT



Design the VCT
using the GUI
(VCT Tool)

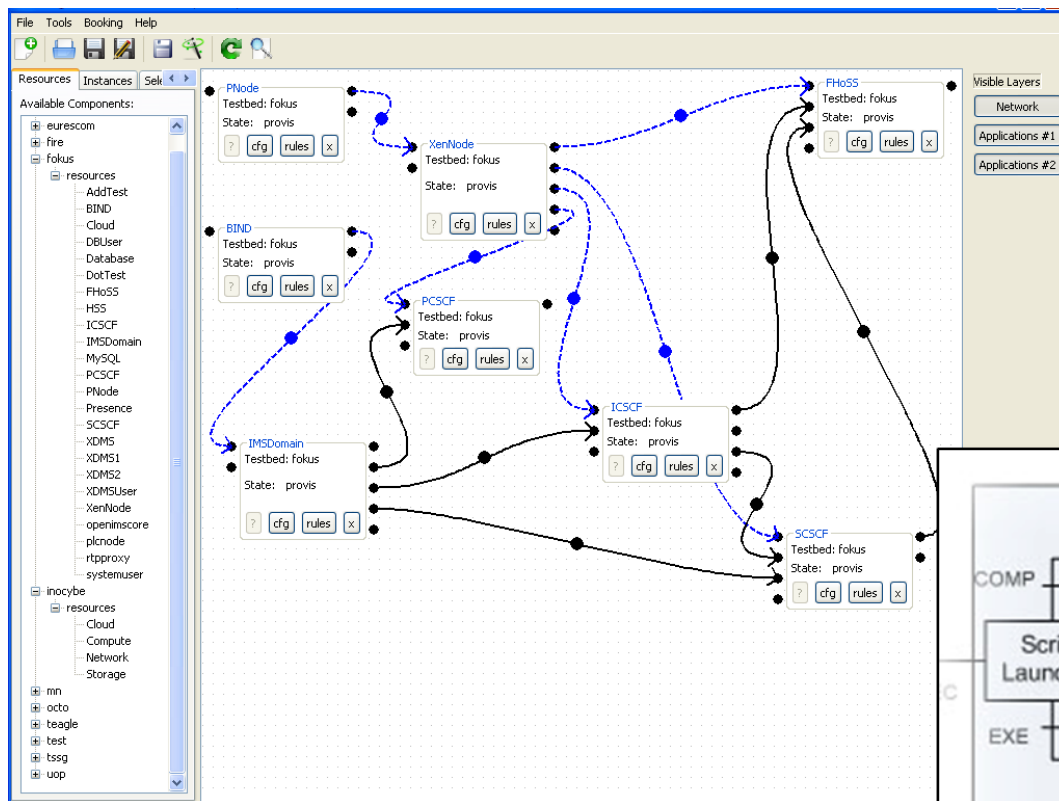


The VCT Tool allows configuring the testbed and deploying new resource instances.

From the VCT Tool requests are sent to the repository to update resource configurations and reservations.

The topology-oriented testbed design is sent to the Orchestration Engine by means of a XML document.

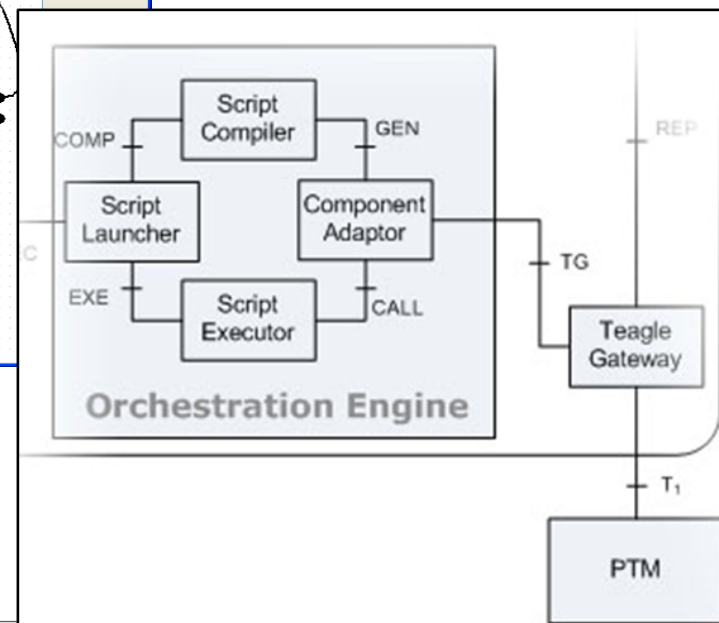




```

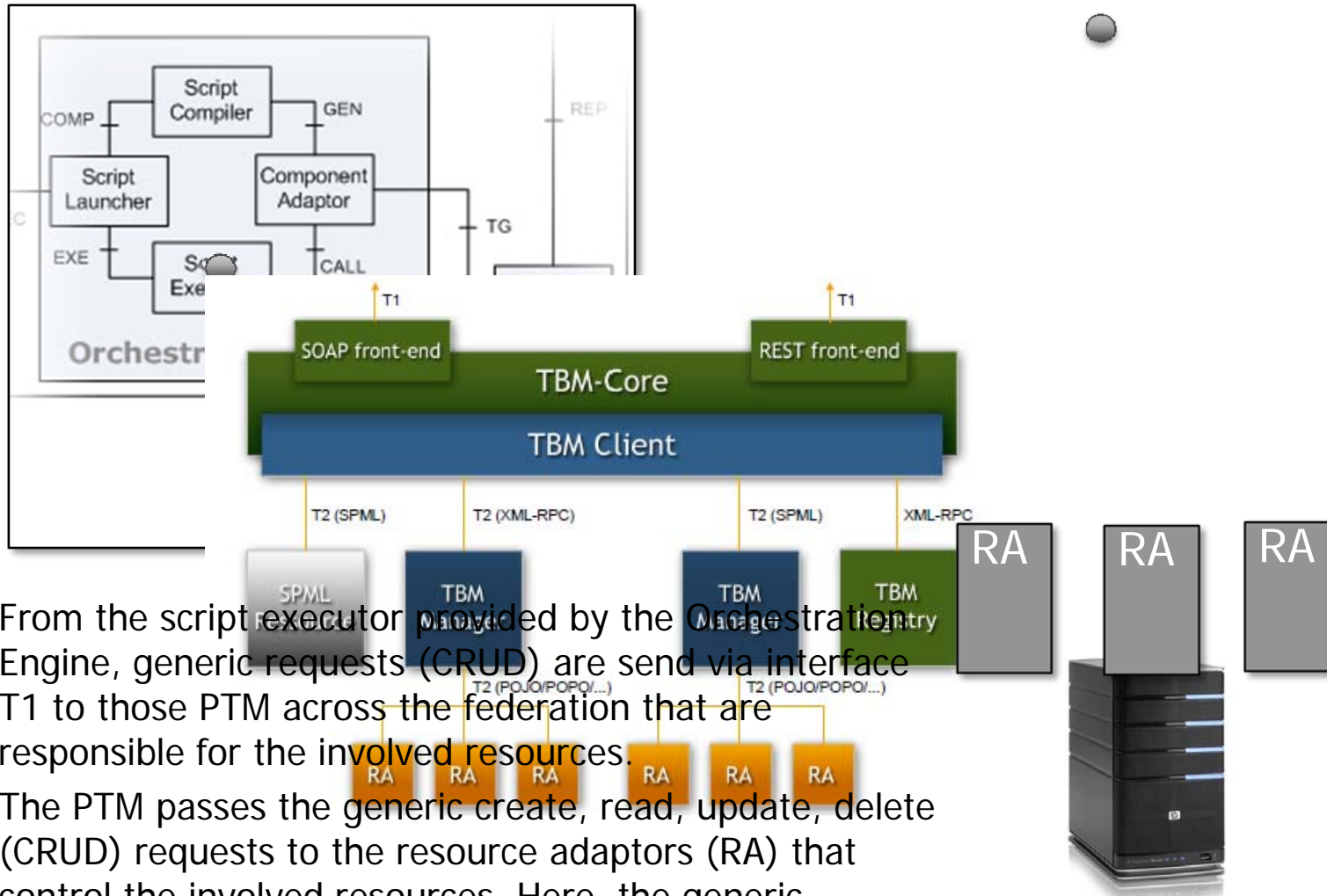
class HSSProvisioning01 (VBEntity):
  ## meta information
  META = {
    'orchestrate': {'args': ('userid',)},
  }

  def __init__(self, SESSION):
    self.SESSION = SESSION
    self.appld = PLUGINCONF.PLUGINID
    self.spatelsystem = SpatelSystem(
      SESSION, self.appld, "HSSProvisioning01")
  ## *** operation orchestrate ***
  def orchestrate(self, userid):
    ## in userid: String -> String
    from voicebench.com.m.VariantManager import invokeVariant
    return invokeVariant(self, 'orchestrate', userid)
  def orchestrate_v0(self, userid):
    ## in userid: String -> String
    ## use this for fake implementation
    result = "" ## default result
    return result
  ...
  ...
  
```



The Orchestration Engine transforms the VCT Tool output into an executable script and executes it (resolving dependencies, etc.)



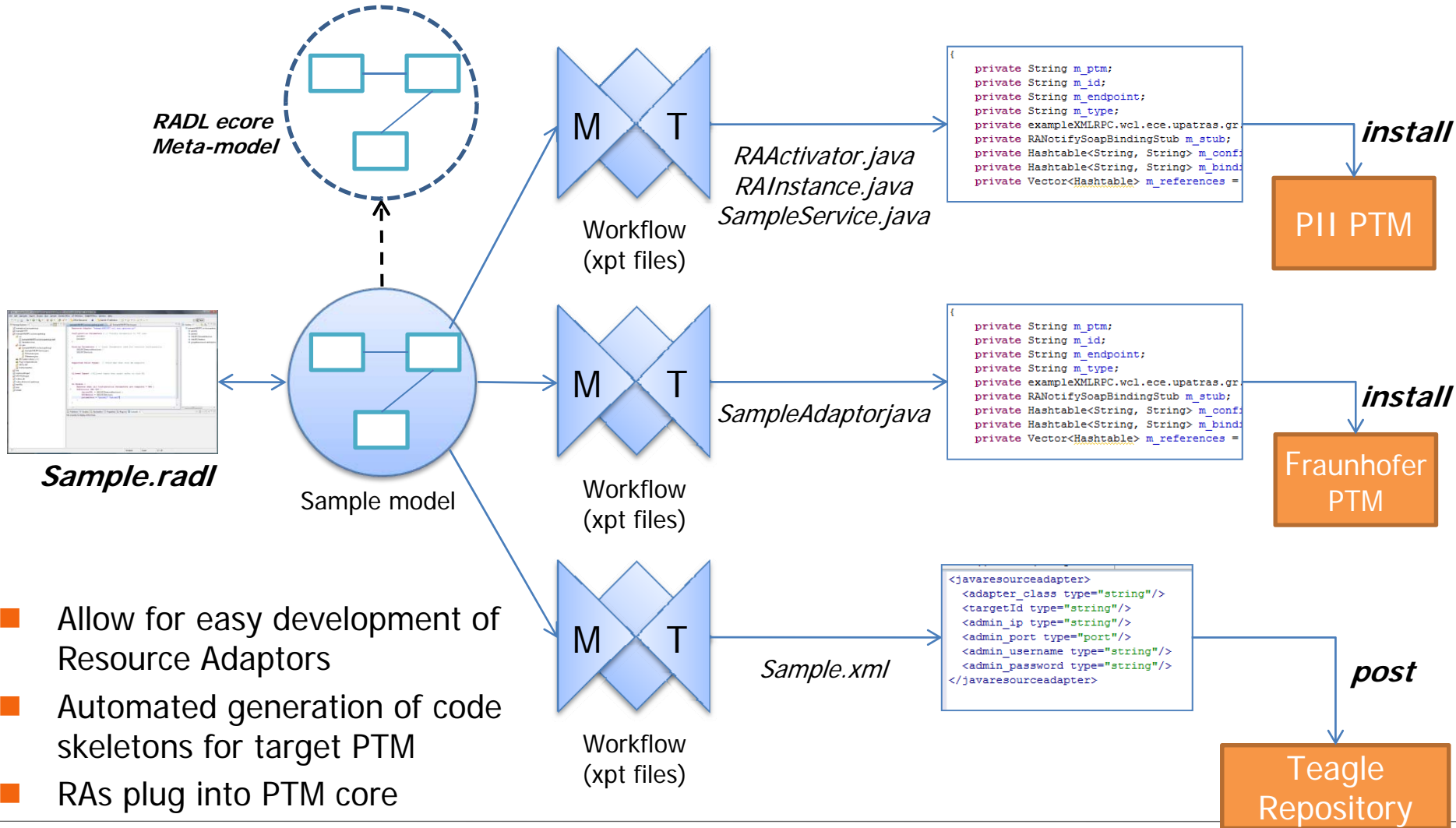


From the script executor provided by the Orchestration Engine, generic requests (CRUD) are sent via interface T1 to those PTM across the federation that are responsible for the involved resources.

The PTM passes the generic create, read, update, delete (CRUD) requests to the resource adaptors (RA) that control the involved resources. Here, the generic commands are translated into resources specific requests and actions.



Resource Adaptor Description Language (RADL)



- Allow for easy development of Resource Adaptors
- Automated generation of code skeletons for target PTM
- RAs plug into PTM core



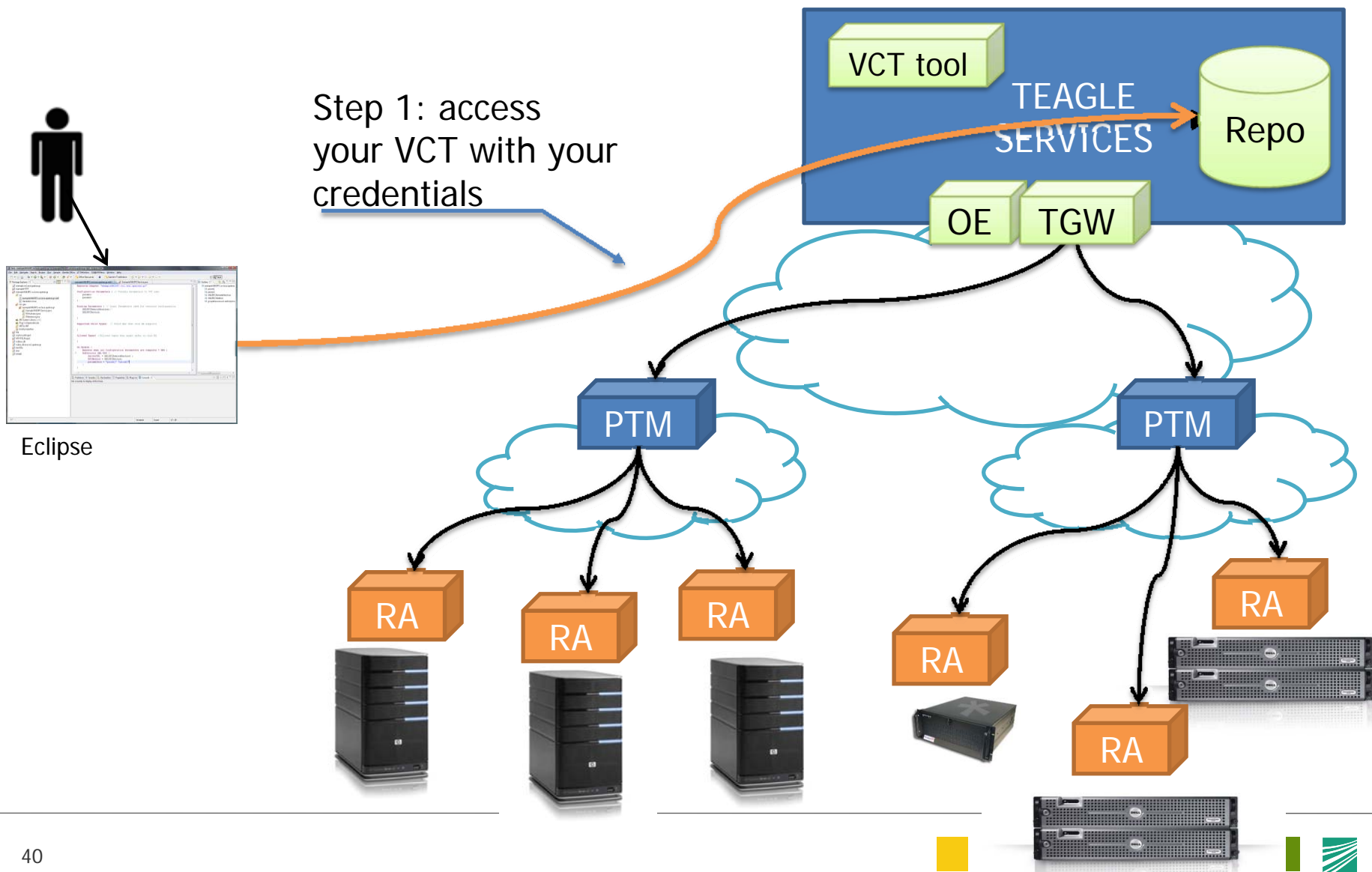
Federation Computing Interface (FCI)

An API for accessing resources in the federation

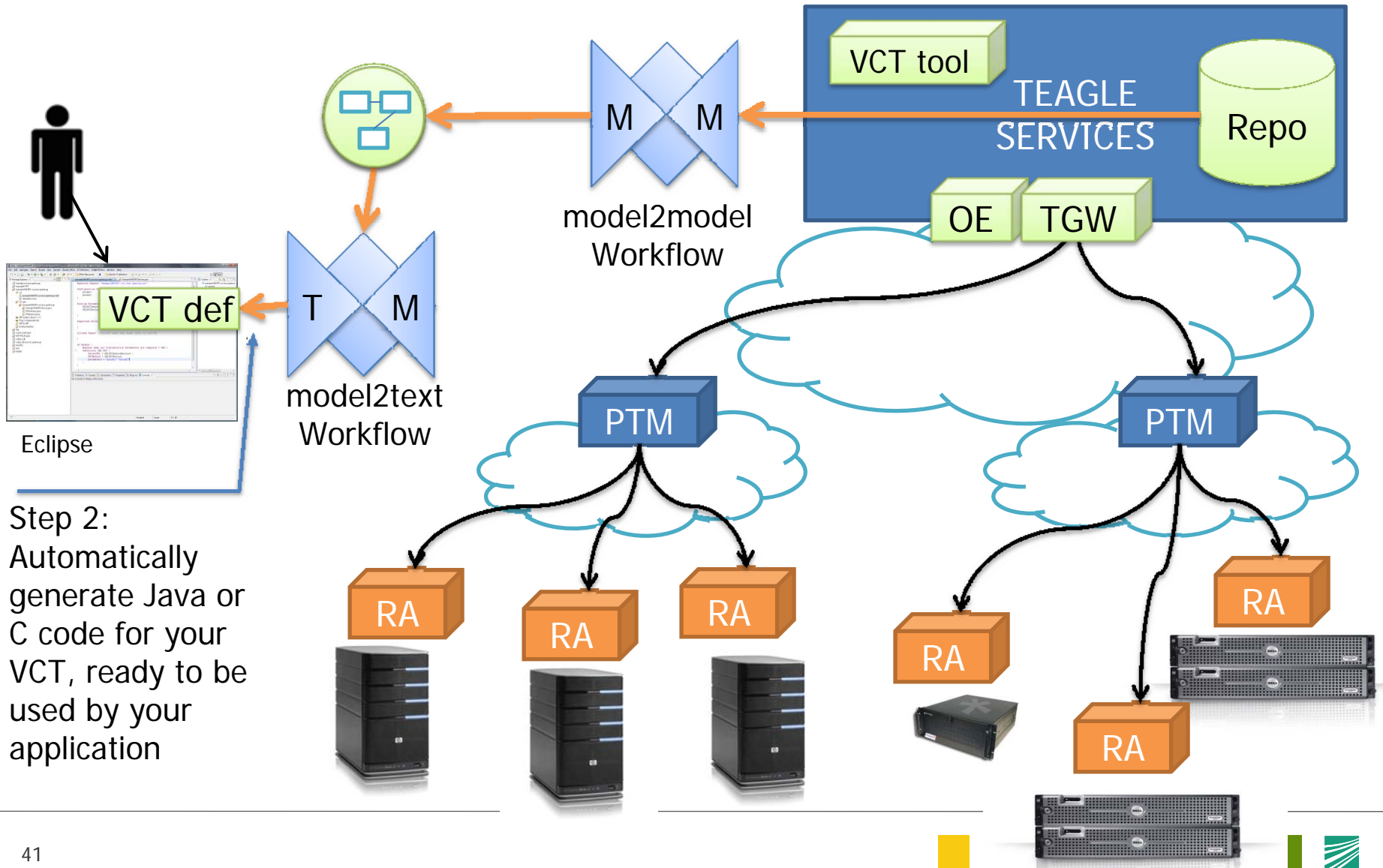
- Users reported that they would need an SDK for developing applications that access requested resources in a VCT through the Panlab office during operation of testing
- The Federation Computing Interface (FCI) is an Eclipse based SDK
- Allows to access resources in a specific VCT through Eclipse
- Easy execution of experiments and application development/testing
- Developed by University of Patras <http://trac.panlab.net/trac/wiki/FCI>



Federation Computing Interface



Federation Computing Interface

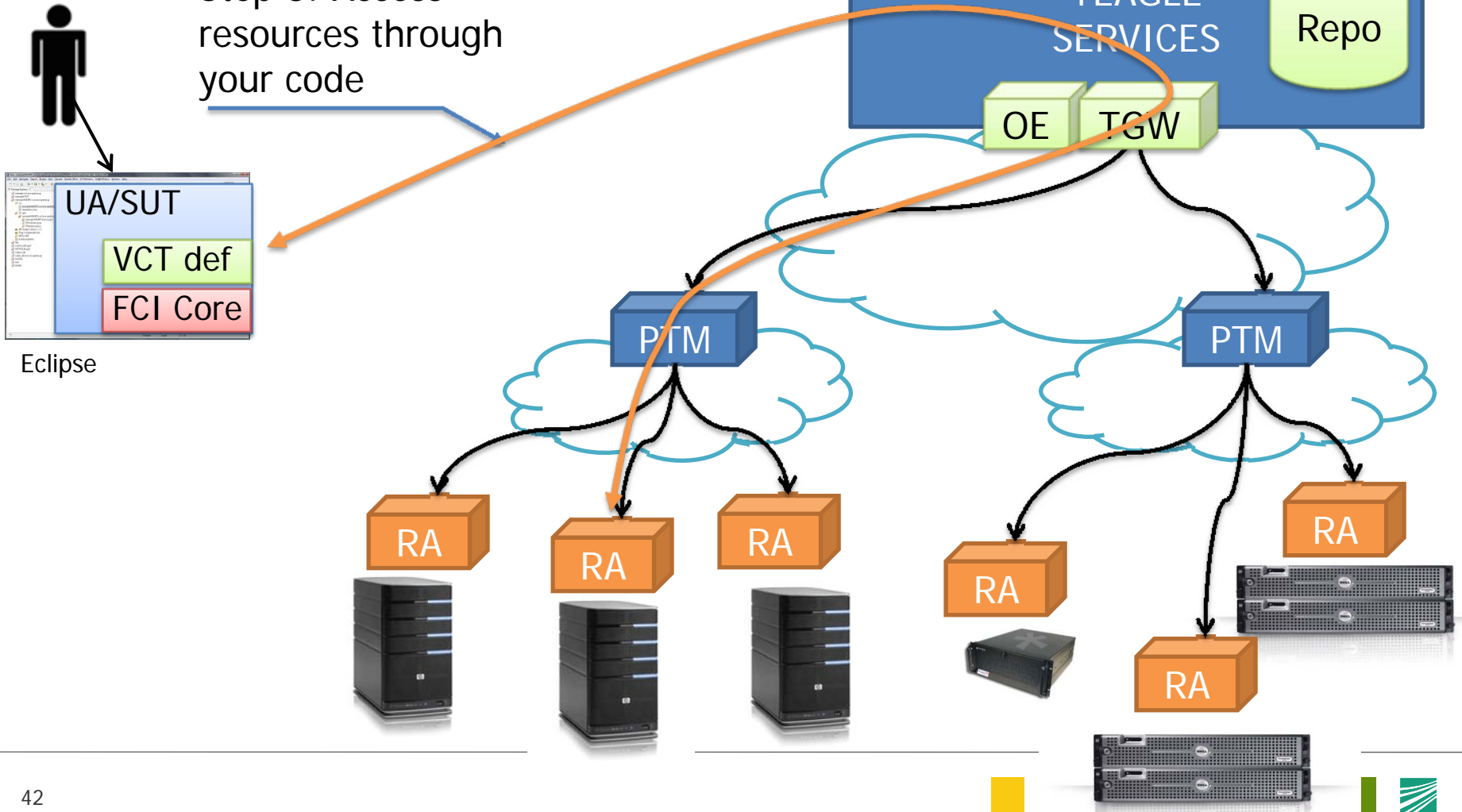


Step 2:
Automatically
generate Java or
C code for your
VCT, ready to be
used by your
application



Federation Computing Interface

Step 3: Access resources through your code



FOKUS is participating in major NGN and FI Testbed Initiatives



- Deep-G Project
 - Work on FI Security
- www.g-lab-deep.de



- Lead in Teagle development
 - Testbed management
- www.panlab.net



- Open FI Testbed
- Work on FI Security, Monitoring, Service Composition, Federation

→ www.fokus.fraunhofer.de/go/fi-lab



FIREWORKS

- Fireworks Expert Meetings
- Official multiplier
- Several workshops

→ www.ict-fireworks.eu



- Call 5 projects
- Building FIRE the facility



- Development of AC testbed
- www.onelab.eu



Recent Publications

- Sebastian Wahle, Thomas Magedanz, and Anastasius Gavras. Towards the Future Internet - Emerging Trends from European Research, chapter Conceptual Design and Use Cases for a FIRE Resource Federation Framework, pages 51-62. IOS Press, April 2010. ISBN: 978-1-60750-538-9 (print), 978-1-60750-539-6 (online).
<http://www.booksonline.iospress.nl/Content/View.aspx?piid=16471>
- Konrad Campowsky, Thomas Magedanz, and Sebastian Wahle. Resource Management in Large Scale Experimental Facilities: Technical Approach to Federate Panlab and PlanetLab. In 12th IEEE/IFIP Network Operations and Management Symposium (NOMS 2010). IEEE/IFIP, April 2010.
- Sebastian Wahle, Thomas Magedanz, and Konrad Campowsky. Interoperability in Heterogeneous Resource Federations. In International Conference on Testbeds and Research Infrastructures for the Development of Networks and Communities (TRIDENTCOM 2010). ICST/Springer, May 2010.
- Sebastian Wahle and Anastasius Gavras. Federation interoperability – dealing with heterogeneity. Position paper at NSF/FIRE Workshop on Federating Computing Resources, May 2010.
<http://svn.planet-lab.org/wiki/FederationWorkshop>
- Sebastian Wahle, Bogdan Harjoc, Konrad Campowsky, Thomas Magedanz, and Anastasius Gavras. Pan-European testbed and experimental facility federation – architecture refinement and implementation. Inderscience International Journal of Communication Networks and Distributed Systems (IJCND), Special Issue: Recent Advances in Test-bed Driven Networking Research, 5(1/2):67-87, June 2010. ISSN (Online): 1754-3924 - ISSN (Print): 1754-3916.



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