



Why Grid? The Middleware in Akogrimo

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Presentation outline



- Introduction
 - Grids and Mobile Grids
- Why Grid? ...and mobile Grid?
- OGSA based Grids
- How to build OGSA based Grids
 - WSRF overview
- The Akogrimo OGSA based approach
- The Akogrimo "vertical" example on middleware services

Introduction



- What is the Grid?
 - ✓ Many attempts have been made for the definition of the Grid
 - ✓ Example: the 3-point list by I.Foster
 - ✓ This is an indication that the diversity of the Grid functionality is difficult to be framed in a definition...
 - ✓ !!! Imagine what happens with Mobile Grid !!!

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Introduction



- What is the **Mobile Grid**?
 - ✓ Definition attempt is following:
 - ✓ It comprises of 2 things:
 - ✓ It is first a Grid and then
 - ✓ Mobile...

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Definition



- ✓ The **Grid** can be viewed as:
 - ✓ a distributed, high performance computing and data handling infrastructure,
 - ✓ incorporating geographically and organizationally dispersed, heterogeneous resources
 - ✓ providing common interfaces for all these resources, using standard, open, general-purpose protocols and interfaces .

- ✓ Recently it seems to form the basis and the enabling technology for pervasive and utility computing due to the ability of being open, highly heterogeneous and scalable

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Definition



- ✓ **Mobile** computing is:
 - ✓ application of small, portable, and wireless computing and communication devices
 - ✓ includes devices like Laptops with WLAN technology, mobile phones, PDAs with Bluetooth or IrDA interfaces
 - ✓ aims to provide access to information, communications and services everywhere, anytime and by any available means

- ✓ The mobility issue implies some constraints which limit the capability of its resources

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Definition

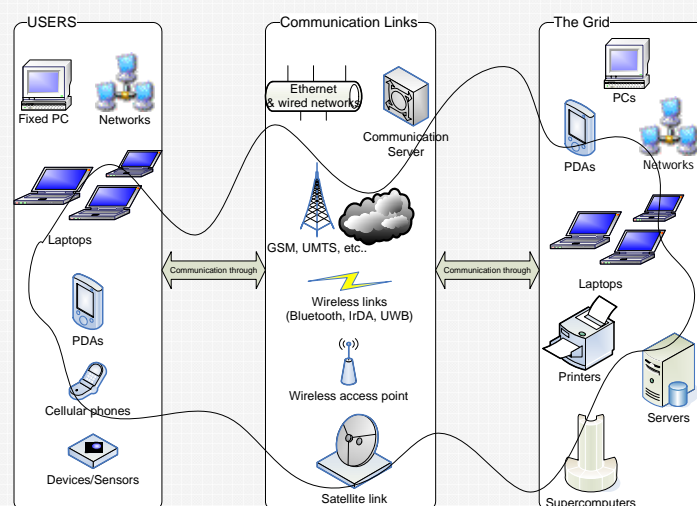


✓ **Mobile Grid:**

- ✓ is a full inheritor of Grid
- ✓ supporting mobile users and resources in a
 - ✓ seamless,
 - ✓ transparent,
 - ✓ secure and efficient way
- ✓ Ability to deploy ad-hoc networks (wireless links, arbitrary topologies)
 - and provide a self-configuring Grid system of mobile resources (hosts and users)
 - aware and adaptable to user's context (?)

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The Mobile Grid components



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What is mobile in a Mobile Grid?



- User mobility:
 - Nomadic users travel around, asking for session movement
- Terminal mobility:
 - Roaming users that have their own wireless devices and want to continue their session when they cross different localities
- Wireless Networking vs Mobile User i/f:
 - Wireless affects conditions in the QoS, pricing, reliability
 - Mobile i/f affect limitation of devices, adaptability of content...

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The 2-faces of Mobile Grid...



- *Mobile devices acting as **interfaces** to Grid*
 - Grid provides reliability, performance, cost efficiency
 - AAA
- ***"Grid-ifying"** mobile devices*
 - Current mobile devices have significant capabilities (PDAs, Laptops, with many interfaces)
 - Aggregated capabilities when in hotspots

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Why Mobile Grid??



- *The time has come!*
- *Grid has to reveal its capabilities and potentialities to a wider audience*
 - users with every day problems and requirements
 - gap between the needs of the scientific community and the ones of a citizen
 - big enough to justify an analysis of the motivation for the specific movement

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Why Mobile Grid??



- **Amount of** potential Grid users is really enormous
- Wireless devices (**laptops** and **PDA**s), with **limited resources** (low processing power, finite battery life and constrained storage space), would benefit from the **opportunity of using a considerable amount of resources** made available **by all the other devices** connected to the network
- Nomadic **users who travel** and work only **seldom at their offices**

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What will change?



- New **functionalities** will be needed:
 - ✓ End-2-end QoS, security, interoperability
- New values are in sight for revenue!
 - ✓ **Many users** holders of **devices** that have advanced capabilities:
 - ✓ PDAs and Laptops with storage and computing power
 - ✓ Many different interfaces
 - ✓ New **business models** and policy issues will be needed
 - ✓ Complex workflows for VOs
 - ✓ Service/Sharing level agreement have to be adapted
 - ✓ Conflict between public rights and viable business models

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But... why a Grid solution?

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The MDVO...

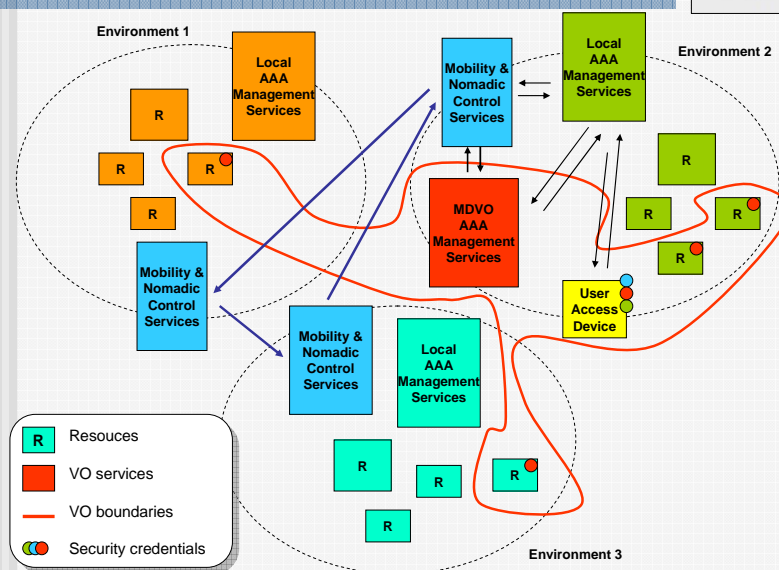


- A *Mobile Dynamic Virtual Organization (MDVO)* is a temporary or permanent coalition of geographically dispersed potentially mobile individuals, groups, organizational units or entire organizations that pool resources, capabilities and information, selected from the resources of an Enterprise Network, to contribute to the VO according to the dynamically established contracts typically driven by one or more business processes.
- Virtual Organizations can provide services and thus participate as a single entity in the formation of further Virtual Organizations. This enables the creation of recursive structures with multiple layers of "virtual" value-added service providers

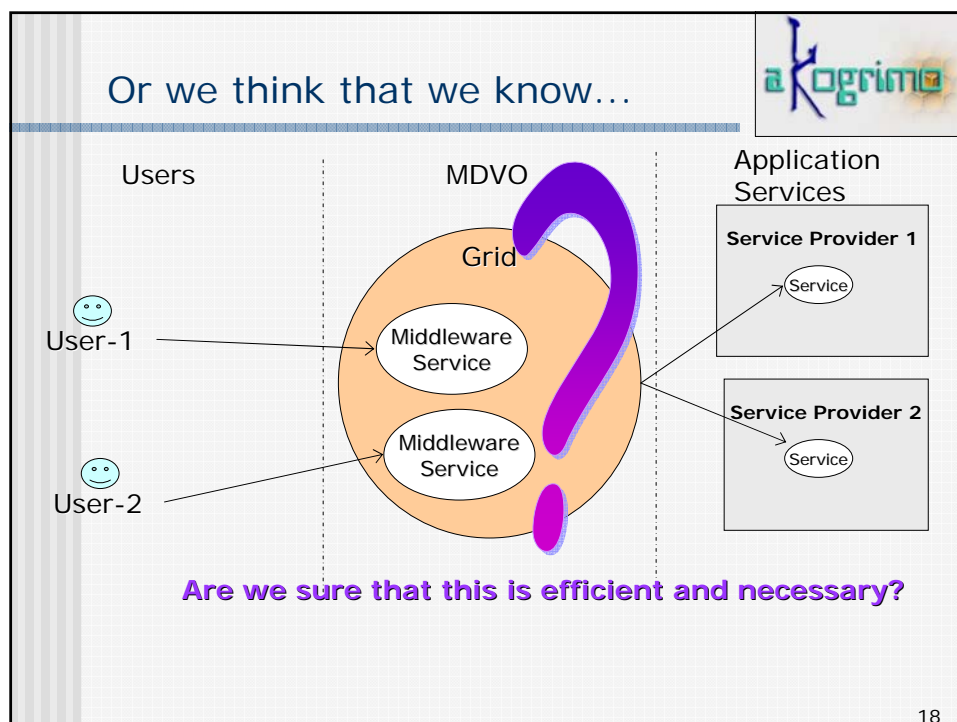
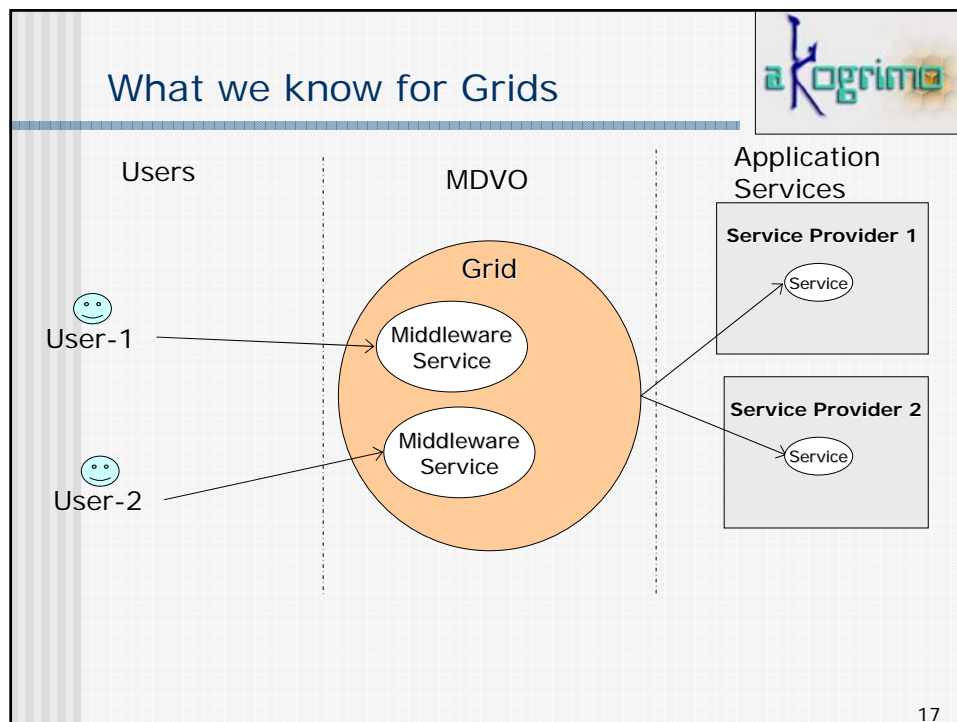
Difficult to follow??? ☺

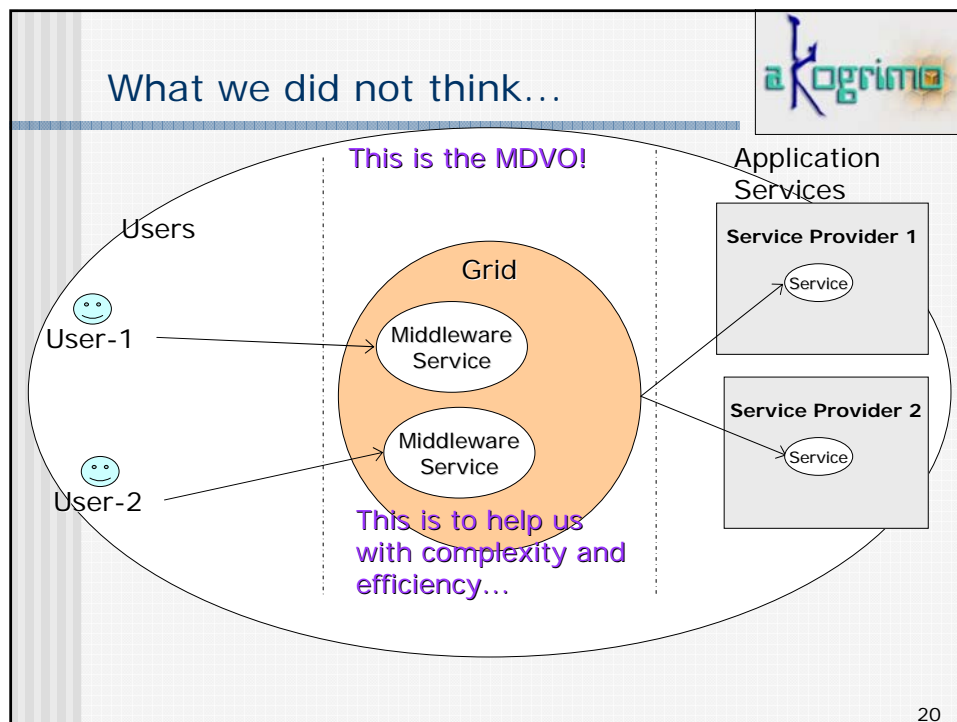
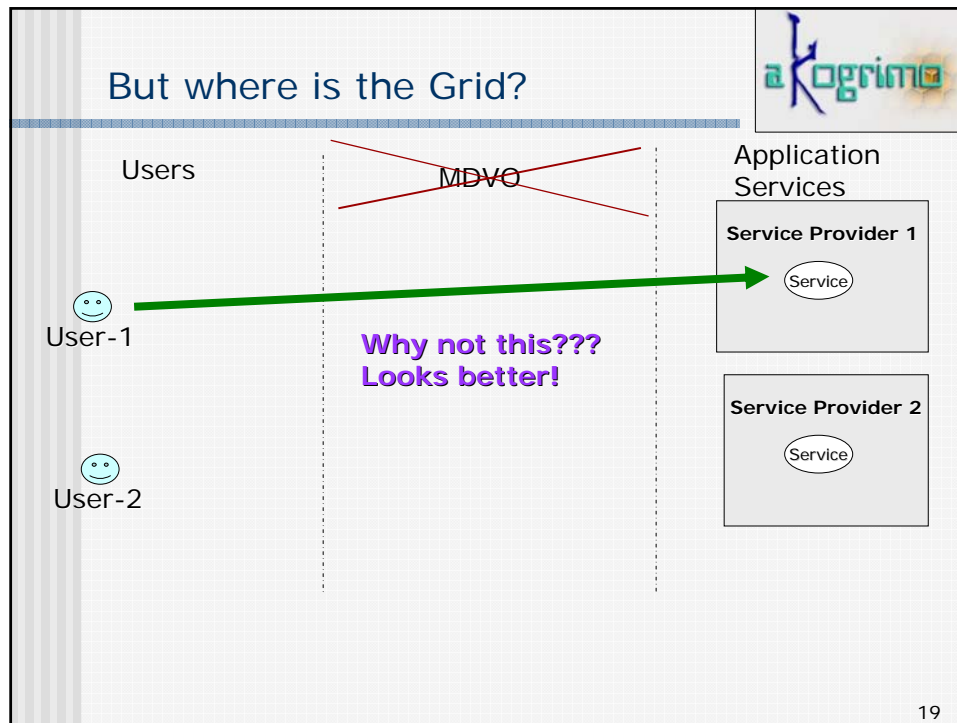
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The MDVO paradigm



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Would you like ... a **Grid** solution??



- Grid is **not** intended to be the '**panacea**' to the problems related to IT domain!
- It is a promising emerging technology aiming to enable
 - the 'connect and share' approach in the same manner as the current Internet search engines apply the 'connect and acquire information' concept
- Grids and mobile Grids can be the ideal solution for large scale, dynamic applications
 - increase the job throughput and performance
 - allow cooperative work, by integration of resources, data, services and ontologies in a transparent way

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Grids are here to:



- Provide dynamic and heterogeneous environments support
 - large-scale distributed computing among different environments and platforms (operating systems, networks, application frameworks...)
 - providing the application layer with standard services for resource virtualization, common management capabilities, resource discovery etc.

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Grids are here to:



- Allow Resource sharing across different organization and domains
 - support for standard protocols and schemas, global namespace handling, metadata services, site autonomy management.

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Grids are here to:



- Promote , advance and adopt common interfaces using standard, open, general-purpose protocols
 - Grid systems compliant with the OGSA architecture have component services and interfaces based on standard open and general-purpose protocols. This is for achieving modularity, scalability and interoperability in the context of complex and heterogeneous environments.

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Grids are here to:



- Enable coordinated administrative management
 - Grid applications can use the automation of common administrative operations to avoid human errors and manage very large-scale systems.

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Grids are here to:



- Provide multiple security infrastructure and policy exchange support
 - Distributed operation across different, independent domains need the support (and the coordination) of multiple security infrastructures. In a grid environment service requestors and providers can exchange security policy information to establish a negotiated security context between them.

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So...:



- If you are trying to solve the COMPLEX and LARGE problem ...

→Then...

You should consider a **Grid** solution!!

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OGSA based Grids

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OGSA



■ Open Grid Service Architecture

■ Service

- a function that can be invoked via a well-defined remote interface
- is used to represent the behaviour of any application, database, resource etc.

■ Why Service-Oriented Architecture?

- looser coupling among interacting systems

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OGSA: Key issues/requirements



■ Need for standard mechanisms that allow Grid Resources to be

- discovered
- accessed
- allocated
- monitored
- accounted
- billed

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The OGSA Services



- Execution Management Services
- Data Services
- Resource Management Services
- Security Services
- Self-Management Services
- Information Services

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Execution Management Services



- Objectives
 - where can a task execute
 - where should the task execute
 - prepare the task to execute
 - get the task executing
 - manage the executing task (monitor, restart, move, etc.)

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Data Services



- Objectives
 - move data to where it is needed
 - manage replicated copies
 - run queries and updates
 - transform data into new formats
 - manage the metadata
- Basic types of Data Resources
 - Flat Files
 - Streams
 - DBMS
 - Catalogues
 - Derivations
 - Data Services

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Resource Management Services



- Objectives
 - Management of the resources themselves (e.g. rebooting a host)
 - Management of the resources on Grid (e.g. resource reservation)
 - Management of the OGSA infrastructure (e.g. monitoring a registry service)

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Security Services



- Basic aspects:
 - Message integrity and confidentiality
 - Authentication of interacting entities
 - Intrusion detection
 - Authorization policy checks
 - Least privilege operations
 - Avoidance of DoS attacks

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Self-Management Services



- System components (both hardware and software) must be
 - self-configuring
 - self-healing
 - self-optimizing
- Service Level Managers (SLMs)
 - adjust policies to ensure overall compliance with business objectives
- Service level agreements (SLAs)

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Information Services



- Objectives
 - efficiently access and manipulate information about applications, resources and services
- possible models
 - consumer(s) wish to obtain information from producer(s)
 - producer(s) wish to send information to consumer(s)
 - pull information or use subscription mechanisms
- producers and consumers should not be required to have any prior knowledge of each other

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How to build OGSA based Grids

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The “tools”



- From OGSF to WSRF
- OGSF: July 2003
- WS-Resource Framework: January 2004
- WSRF: evolution of OGSF
 - exploit new Web Services standards (WS-Addressing - transport-neutral mechanisms to address Web Services)
 - exploit early implementation and application experiences
- changes mostly in syntax/terminology not in functionality

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Why change OGSF



- Critiques on OGSF
 - Too much stuff in one specification
 - Does not work well with existing Web services and XML tooling
 - Too object oriented
 - Introduction of forthcoming WSDL 2.0 capability as unsupported extensions to WSDL 1.1

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Why change OGSi



- WSRF approach
 - introduction of the WS-Resource concept
 - better separation of function and exploitation of other Web services specifications
 - a broader view of notification

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WSRF Objectives



- How to define the view of the state of the resource
- How to associate it with a Web Service description
- How to access it through a Web Service interface

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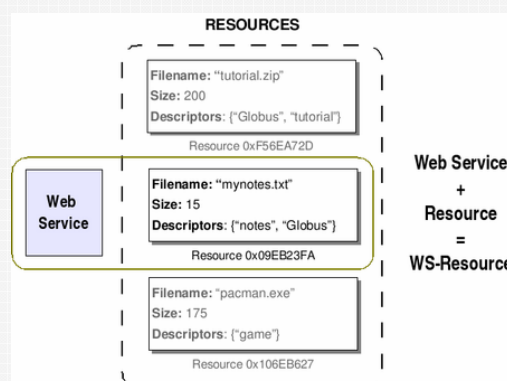
WS-Resource



- the composition of a stateful resource and a Web Service using the “implied resource pattern” (messages to a Web service may include a component that identifies a stateful resource to be used in the execution of the message)
- a Web Service can execute message exchanges against zero or more stateful resources
- an individual stateful resource may be associated with multiple Web Services

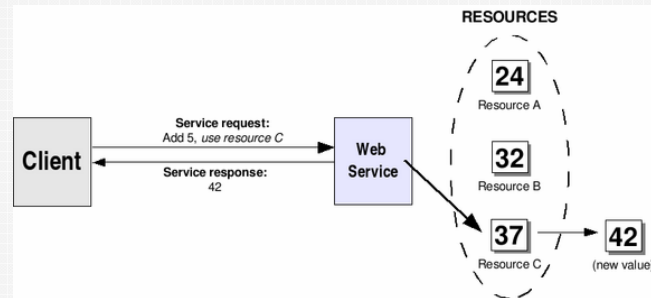
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WS-resource



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Stateful WS-resource



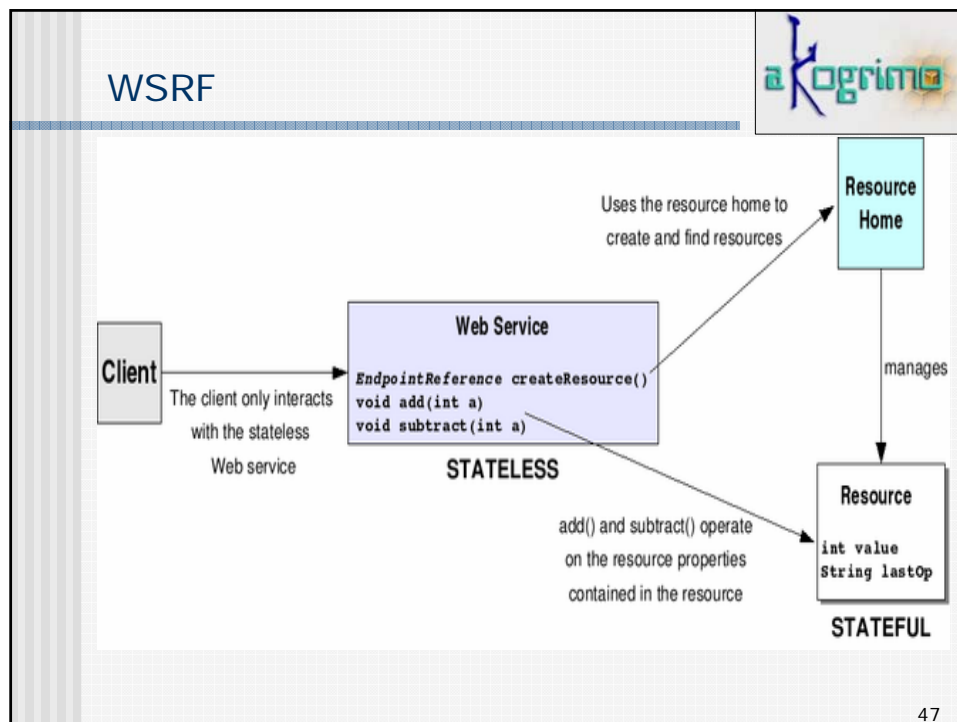
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WSRF Specifications



1. WS-ResourceProperties
 2. WS-ResourceLifetime
 3. WS-RenewableReferences
 4. WS-ServiceGroup
 5. WS-BaseFaults
- + WS-Notification family of specifications

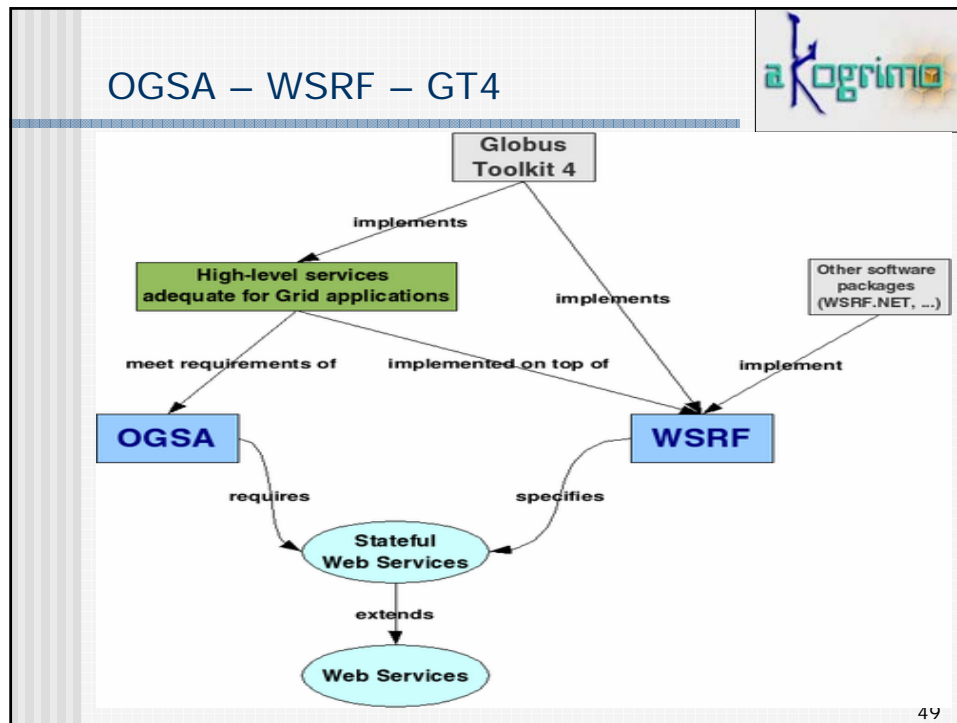
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WSRF Implementations - References

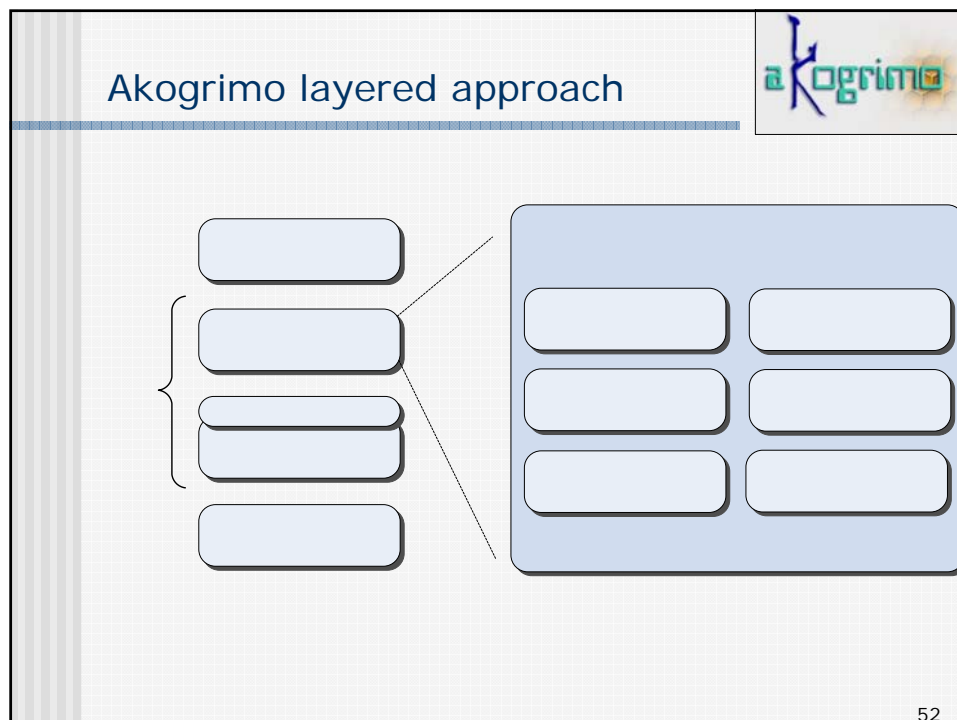
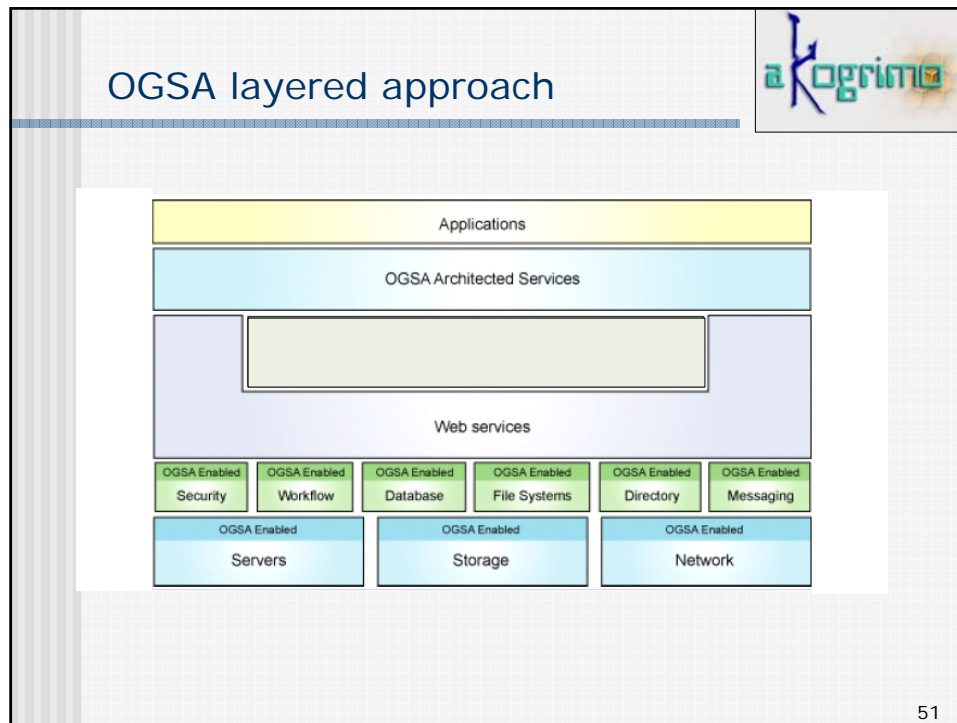
- **Globus Toolkit 4.0**
 - <http://www-unix.globus.org/toolkit/docs/development/4.0-drafts/GT4Facts/index.html>
- **WSRF .NET**
 - A set of software libraries, tools and applications which implement the WSRF and WSN families of specifications on top of .NET
 - <http://www.cs.virginia.edu/~gsw2c/wsrf.net.html>

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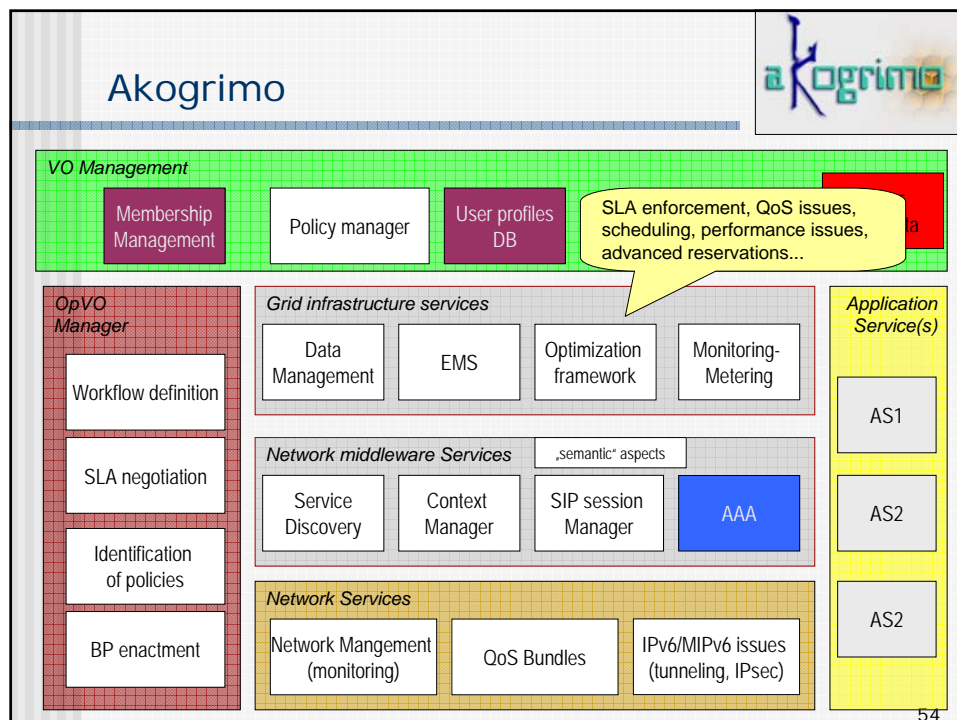
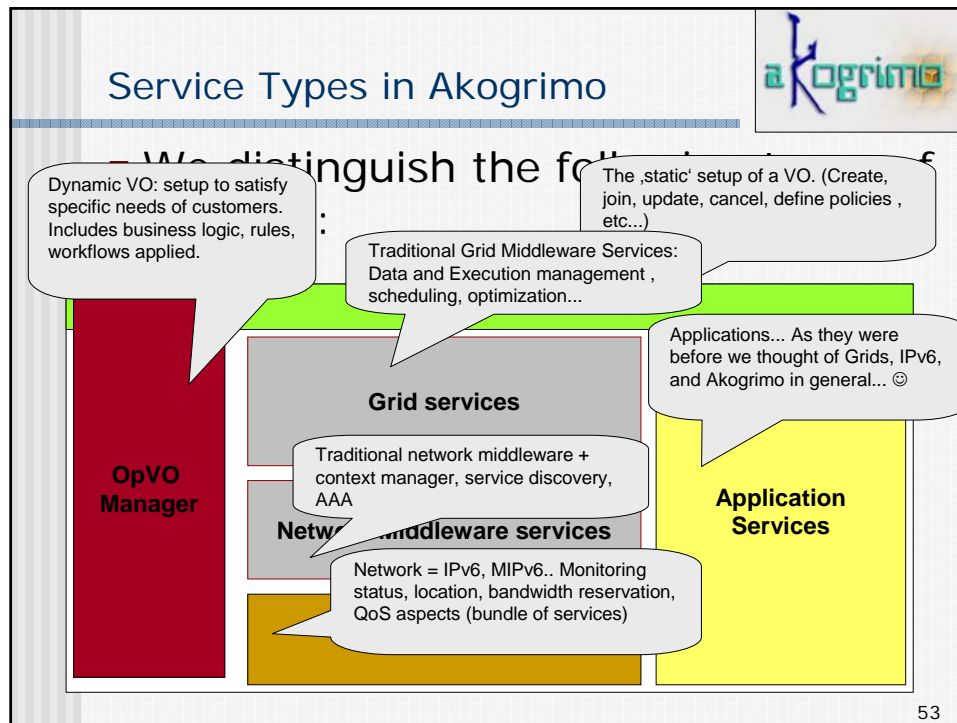


The Akogrimo OGSA based middleware

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WSR



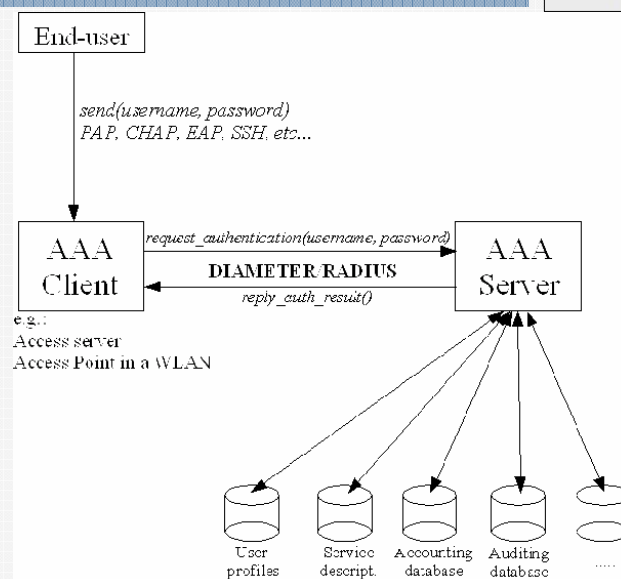
Akogrimo vertical (example)



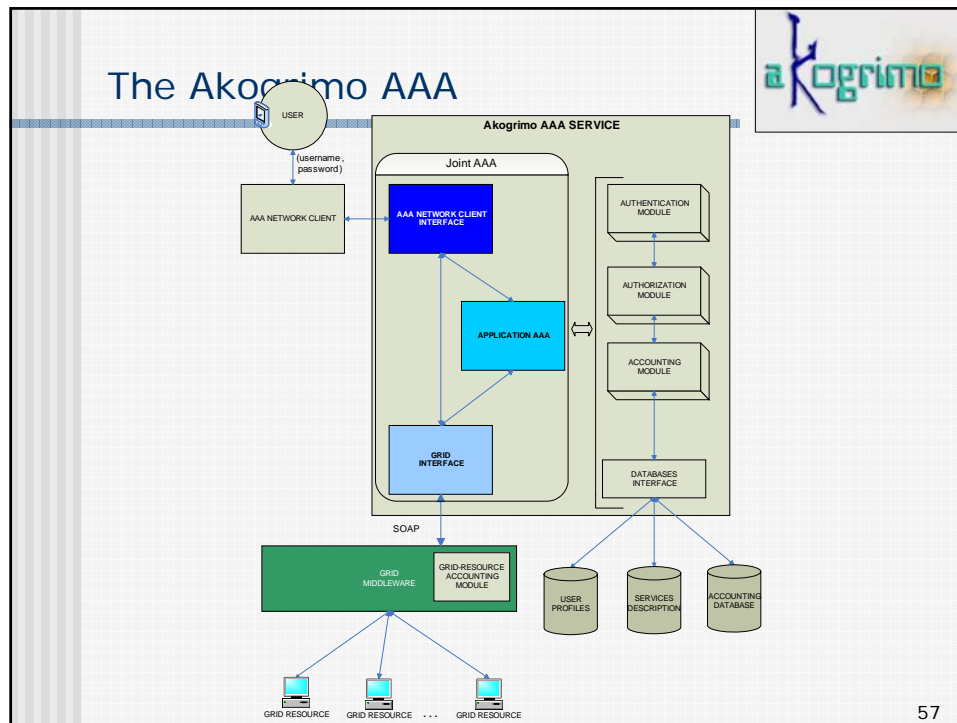
- What we have is:
 - Network middleware AAA servers (RADIUS, Diameter)
 - Grid middleware
 - Mandatory for performing actions like resource brokering, scheduling, distributed execution, etc.
 - Has to perform also AAA independently from the network layer (wrt Grid specific parameters)
- What we want is:
 - Vertical approach
 - Merging of the functionalities
 - Transparent to the users
 - In an efficient way

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Network AAA



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The Akogrimo AAA

- A user logs in to the network via a (mobile) device
 - (mainly using username and password)
- The AAA service is being initiated from the AAA Network Client towards the Authentication and Authorization Modules

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The Akogrimo AAA



- The user requests a service through an application
 - for example runs an e-health application
- Application AAA communicates with the Grid Interface in order to check for the available resources of the Grid Infrastructure and to conclude to the accounting parameters that will be metered for the specific execution

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The Akogrimo AAA



- The Grid Middleware includes :
 - Grid Resources Accounting Module in order to:
 - keep accounting information for the utilization of the resources used in the Grid infrastructure
 - taking into account the defined parameters such as wall-clock time, CPU time etc...

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The Akogrimo AAA



- The Databases Interface is being used in order to
 - check the User Profiles (following the Authorization Module),
 - provide the Services Descriptions
 - communicate with the Accounting Database
 - (update the account information from the Network AAA Client, the Application AAA and the Grid Accounting Module)

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Conclusions



- The **Mobile Grid** is here bringing new challenges for QoS, Security, Interoperability, Business models etc.
- Grids and mobile Grids **can be the ideal solution** for large scale, dynamic applications... (if the requirements for the application can be met by providing Grid services)
- OGSA based grids can provide a good solution for forming VOs and MDVOs
- OGSA based Grids can be built with WSRF technology (GT4 or WSRF.net)
- The Akogrimo project is a live paradigm for addressing these issues.

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References



- For further reading please visit the site of the project:

"Access to Knowledge through the
Grid in a Mobile World"

AKOGRIMO

www.akogrimo.org

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Thank you!

Questions ???

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