An Open Grid Services Architecture for Mobile Network Operators

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Presentation Outline

OGSA-based Layered Architecture

Akogrimo Architecture

Grid Infrastructure Services Layer

Network QoS and Mobility

Application Services Layer

E-Health testbed

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OGSA-based Layered Architecture

An OGSA compliant architecture aims to

Manage resources across distributed heterogeneous platforms

Deliver seamless access control and quality of service

Provide a common base for autonomic management solutions
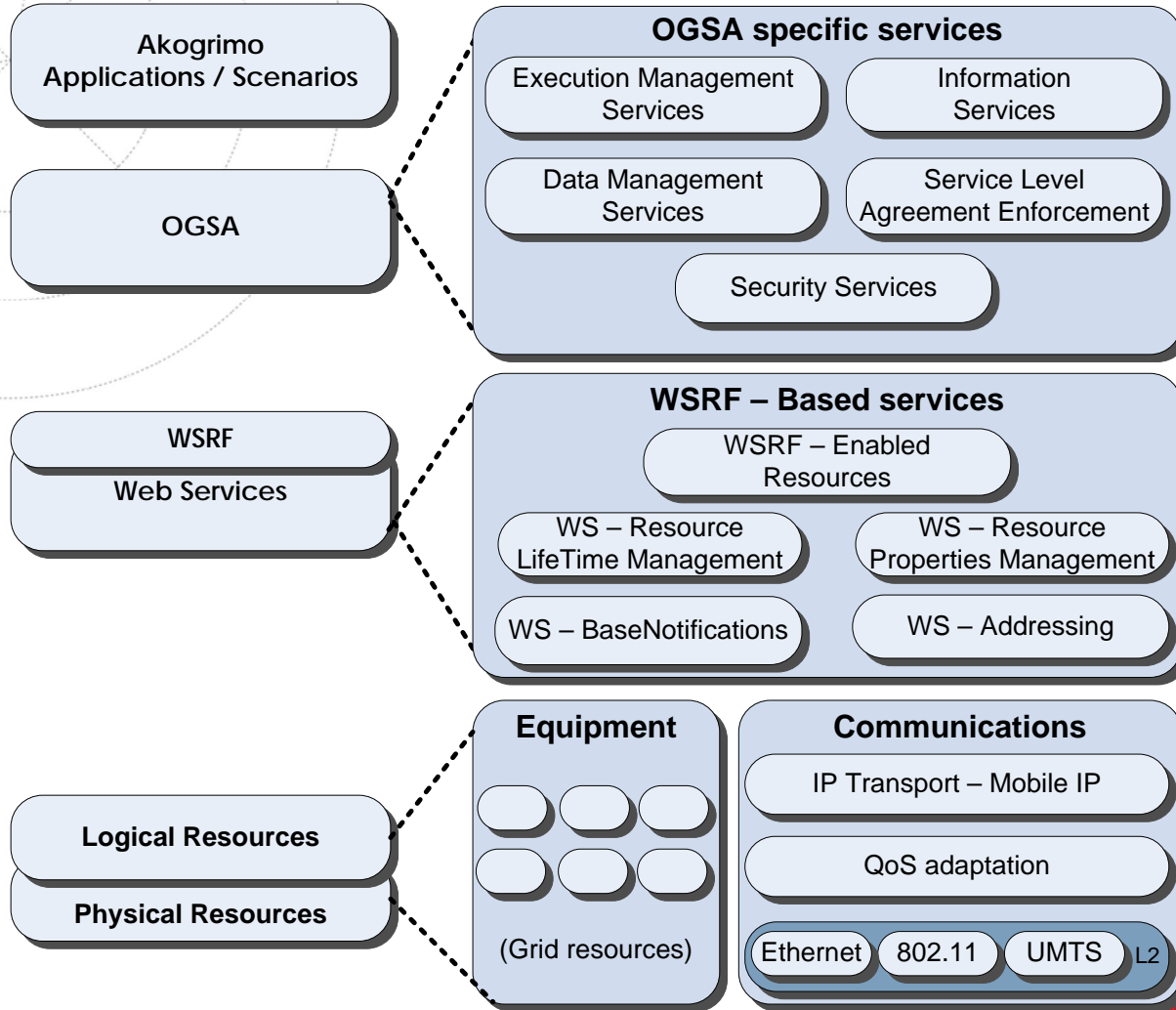
Define open, published interfaces

Akogrimo Architecture

Akogrimo Applications / Scenarios

OGSA

OGSA specific services

- Execution Management Services
- Information Services
- Data Management Services
- Service Level Agreement Enforcement
- Security Services

WSRF

Web Services

WSRF – Based services

- WSRF – Enabled Resources
- WS – Resource LifeTime Management
- WS – Resource Properties Management
- WS – BaseNotifications
- WS – Addressing

Logical Resources

Physical Resources

Equipment

(Grid resources)

Communications

- IP Transport – Mobile IP
- QoS adaptation
- Ethernet | 802.11 | UMTS | L2

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Akogrimo Architecture

- Physical and logical resources layer
  - Resources comprise each and every capability of the Grid
    - Physical resources, which include servers, storage, and network and Logical resources.
    - Logical resources are above the physical and provide additional functionality by virtualizing and aggregating the resources in the physical layer.
    - In Akogrimo communication resources are also incorporated in logical resources
- Web services layer
  - All Grid resources are modelled as services
  - Web Services Resource Framework (WSRF) defines a family of specifications for accessing stateful resources using Web services
- OGSA architected grid services layer
  - Overall grid management functionality
- Grid applications layer
  - High – level applications a client might require
  - For Akogrimo we have deployed an E – Health application offering a suite of E – Health services.
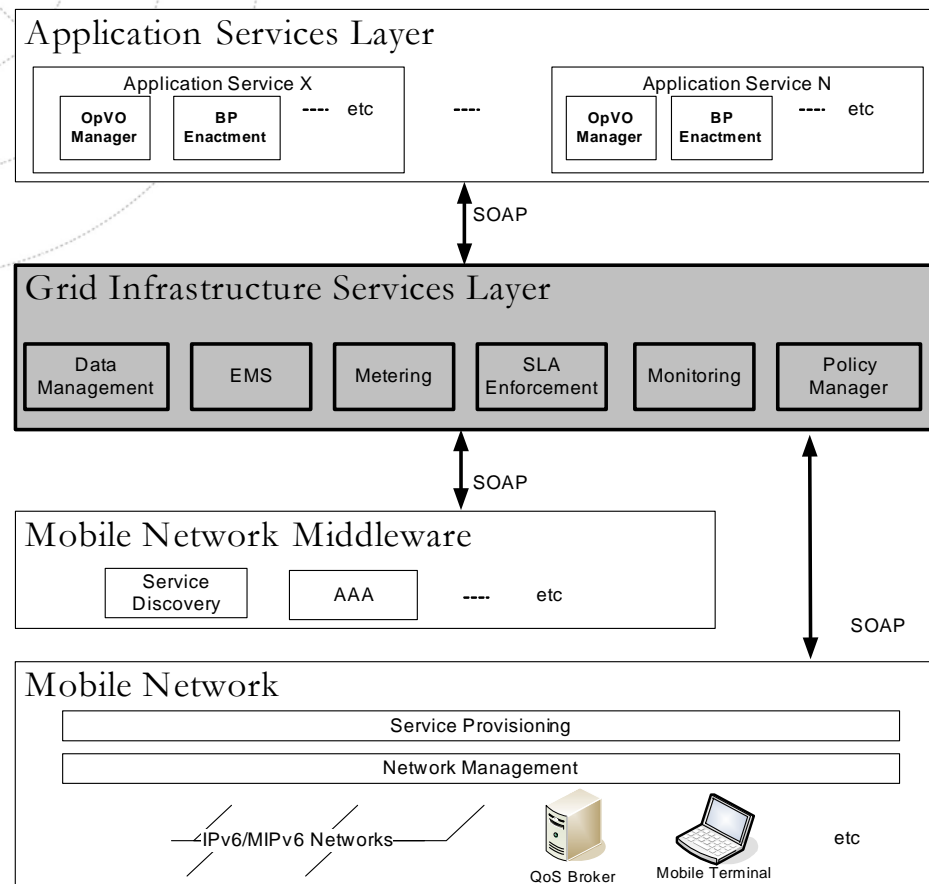
Grid Infrastructure Services Layer

Positioning of Grid Infrastructure Services Layer in Akogrimo architectural components

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Grid Infrastructure Services Layer

- Provides services to manage the execution of jobs coming from the Application Service Layer.
- Addresses the performance issues while conforming to the determined Service Level Agreement (SLA).
- Major interactions
  - Application Services layer
    - Receive the jobs to be executed
    - Identify the corresponding SLAs and Policies that will regulate and influence this execution.
  - Mobile Network Middleware layer
    - Discover services
    - Access to A4C.
  - Mobile Network layer
    - Network QoS reservation

Grid Infrastructure Services Layer - Categorization of functionality

- **Execution Management Services (EMS)**
  - Assigning jobs to resources
  - Creating an execution plan
  - Balancing the workload
  - Optimizing the performance
  - Replicating jobs to provide fault tolerance
- **Data Management**
  - Access to and movement of large data sets
  - Data sharing
  - Replication and archiving of data
- **Monitoring**
  - Monitoring and managing of the web services within the layer.
- **Service Level Agreement (SLA)**
  - Services related to the enforcement of the SLA contractual terms that especially influence the execution of jobs within the layer.
- **Metering**
  - Services supplementary to the monitoring and accounting services, dealing especially with the measurement of resource usage.
- **Policy management**
  - Management of rules and the policies which apply in the execution of services within the Akogrimo architecture.
- **Security**
  - Services that will deal with the confidentiality of the communications and the authorization for execution within the system.

Mobility

- Terminal mobility
  - Allows a mobile terminal to maintain its connection to the network when it changes access points
  - Provided by the Mobile IPv6 protocol; enhanced with fast mobility mechanisms
- User mobility
  - Allows the user access to personalized services independently of the user's device
  - Provided by a user-oriented security and authentication framework
  - Having performed his registration in the network, the user is associated with the terminal
- Session mobility
  - Enables the transfer of application sessions between different devices without interruption
  - Achieved with the SIP protocol
  - SIP can be used both by the user, and by the Grid infrastructure, to redirect communications (e.g. image display) to different devices, retaining the user association mentioned above.

Network QoS

ᗧThe Mobile Network Layer implements end-to-end Quality of Service, for all types of mobility
- Make an effective use of network resources
- Assure that a user can utilize the services he is entitled to without disruptions

ᗧThe QoS implementation
- Allows fine-grained QoS control at the access networks
- Aggregates different flows with the same QoS requirements in the core network

ᗧThe network supports well defined QoS bundles

Bundle 1 Mix audio + data	Bundle 2 High data + video	Bundle 3 Mostly voice
10 – Interactive	20 – Interactive	10 – Interactive
100 – Data	1000 – Data	1 – Priority
1 – Priority	200 – Priority	1 – Signalling
1 – Signalling	1 – Signalling	250 – Best Effort
250 – Best Effort		

Cross-layer network QoS

- QoS Broker handles Quality of Service
  - Has information about the user,
  - and about the current status of the network
- For receiving QoS requests from EMS, the QoS Broker will have an interface designed specifically for interaction with it.
  - Cross-layer interface
  - Based on Web Services and OGSA standards
  - Network services become part of the workflow
    - Defined both according to the user profile (and subscribed services)
    - and according to its current operations (e.g. emergency life support overrides contractual user capabilities).
- After receiving instructions from the grid layer,
  - The network layer handles mobility, session movement and QoS independently
  - If non-expected changes happen (e.g. session mobility from a cell phone to a high-quality display) the network layer requests and receives (again) instructions about how to handle them from the workflow manager

Application Services Layer

- Each application service requested by a client is modeled as a business process
- Workflows represent the automation of the business process
  - Each workflow coordinates and manages component services or entities involved into the automation of business process
  - This coordination procedure is called Business Process Enactment
- A Virtual Organization (VO) provides services and the means to manage and coordinate Business Processes
- In Akogrimo we consider the VO as a Mobile Dynamic Virtual Organization (MDVO)
- Implementation of a Business Process implies
  - Creation of an Operational Virtual Organisation (OpVO) out of a base VO.

E-Health testbed

- The Akogrimo consortium has deployed a suite of e–Health application services
- The organizational framework where the process is executed consists of
    - a university hospital
    - regional hospitals
    - medical specialists
    - general practitioners
    - emergency medical services
    - emergency dispatch center
- This regional health network collaborates with a health service provider (HSP) and a network operator (NO)
- The NO hosts an infrastructure to provide telemedicine services over its network
    - Computational
    - network
    - and data collection services
- The HSP
    - distributes the telemedicine equipment
    - provides advanced medical analysis services
    - configures application services specific to the health network's needs
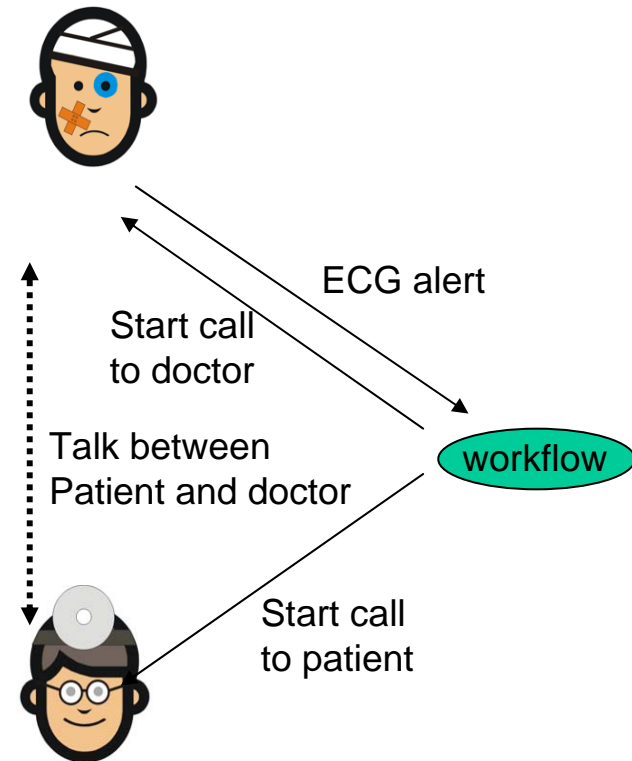   - responsible of the patient-side accounting and billing

E-Health scenario

- A patient on holidays in a foreign country carries a wearable ECG device that forwards data to his mobile phone
- The device detects an anomaly and starts the workflow
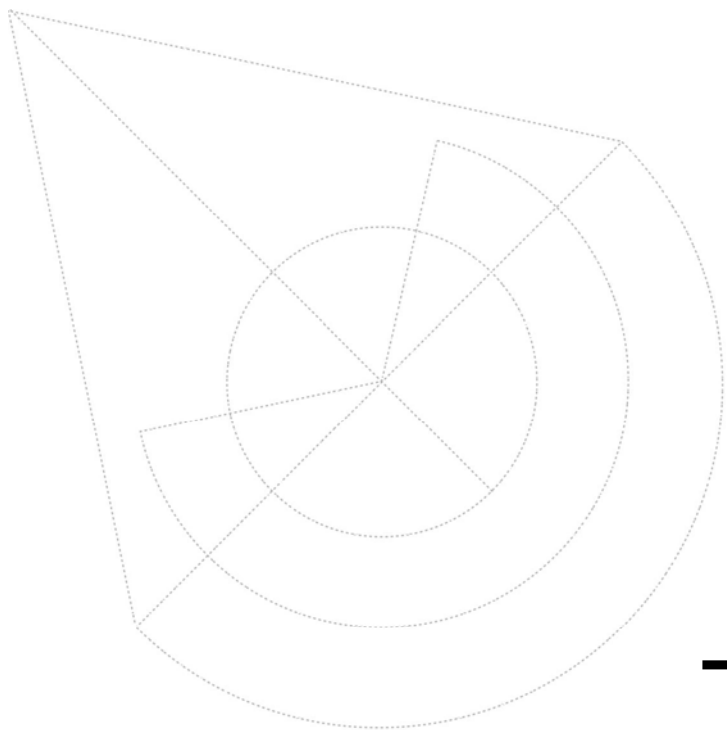- A SIP call is established between the patient and his doctor

ECG alert

Start call to doctor

Talk between Patient and doctor

workflow

Start call to patient

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E-Health scenario

- After talking to the patient, the doctor requests ECG data
- The workflow process is informed by the Context Manager that a big display is available to the doctor
- ECG data is retrieved and sent to the doctor's big display
- The doctor analyses the data and makes his diagnosis

Request ECG data

Send data

workflow

Doctor is near
A big display

Process data

Context mgr
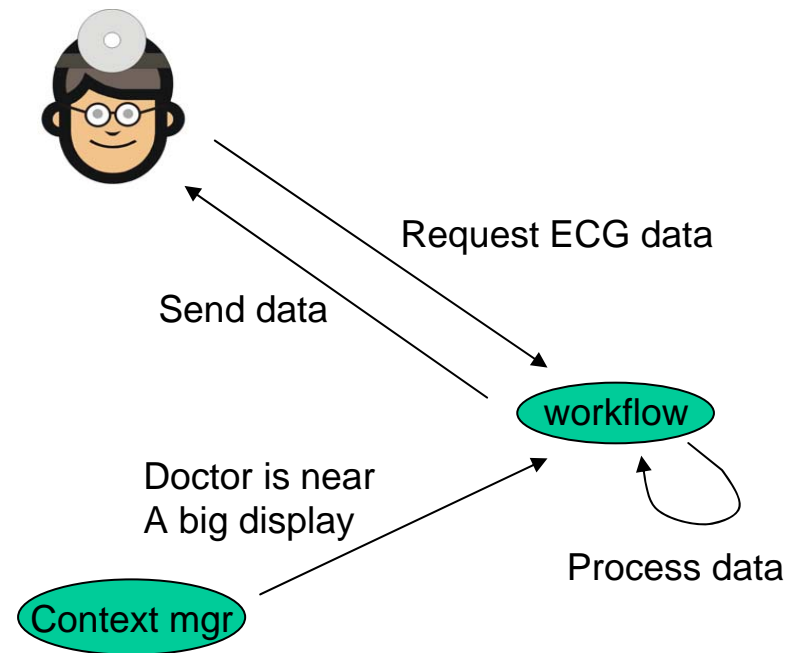
Conclusion

- We presented an architecture to integrate network aspects in the traditional OGSA environment
  - Based on interactions with QoSBrokers
- This provides the capability to deploy mobile-oriented grid services
  - demonstrated in a simple e-Health scenario.
- Work still with large potential to improvement!!

Thank you!