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# An Integrated Platform for Location-based Services Built on Java Technologies

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## Centre Suisse d'Electronique et Microtechnique



Technologies for innovation

- High technology know-how transfer to the industry
- I am with the Advanced Systems Engineering Division

# Outline

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- Motivation
- PoLoS project
  - End-user perspective
  - Operator perspective
- PoLoS and J2EE (JBoss)

# Motivation

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Location-based services: quite promising, but their growth has been rather slow

- too complex (several fields, many actors)

Objective:

A tool for easy and low-cost development and provisioning of location-based services (LBS)

Use of open, standard technologies

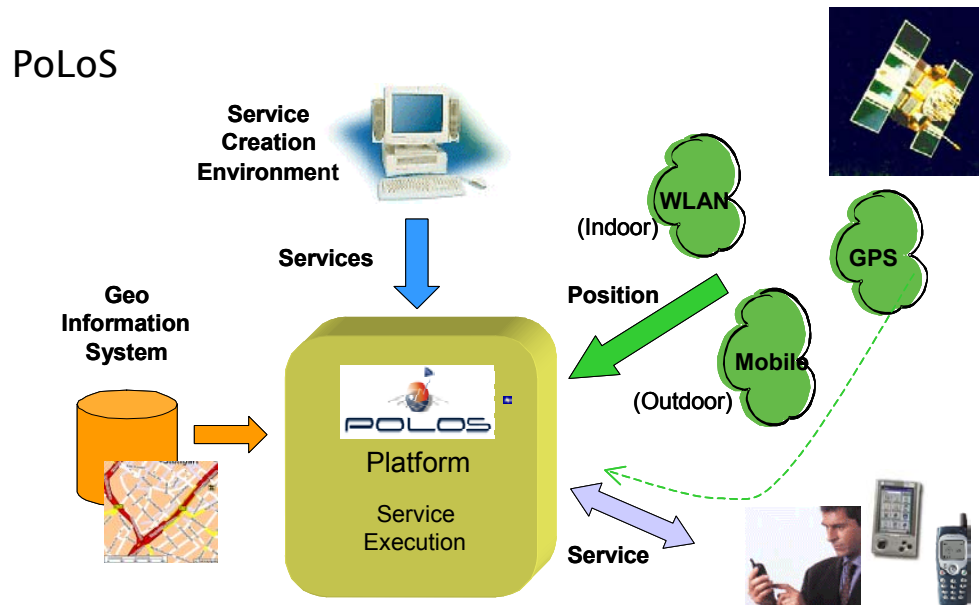
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# PoLoS (EU, IST project, 2002-2004)

## PoLoS: An integrated platform for the creation and provision of location-based services (LBS)



- an execution environment for LBS
- a development tool, for high-level specification, deployment and testing of new services

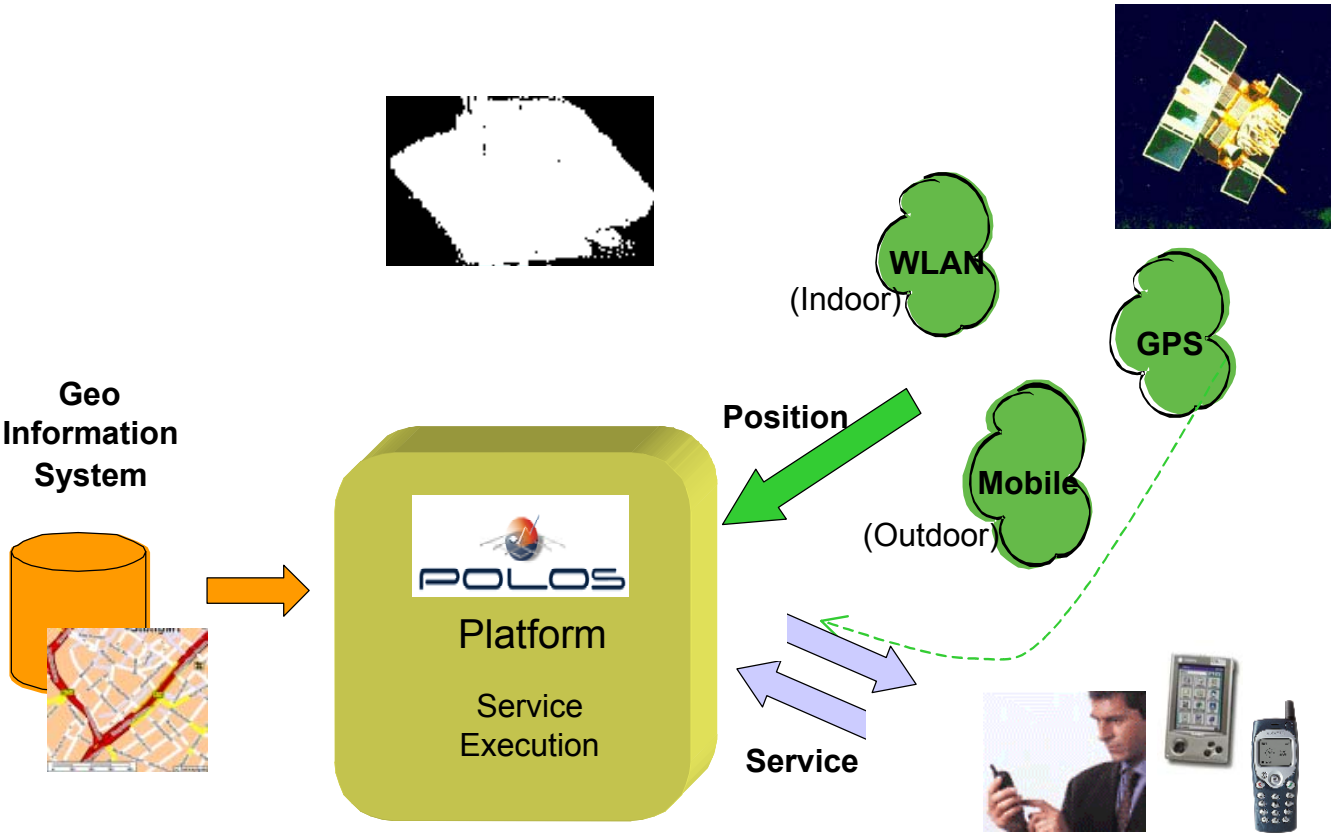
# Partners

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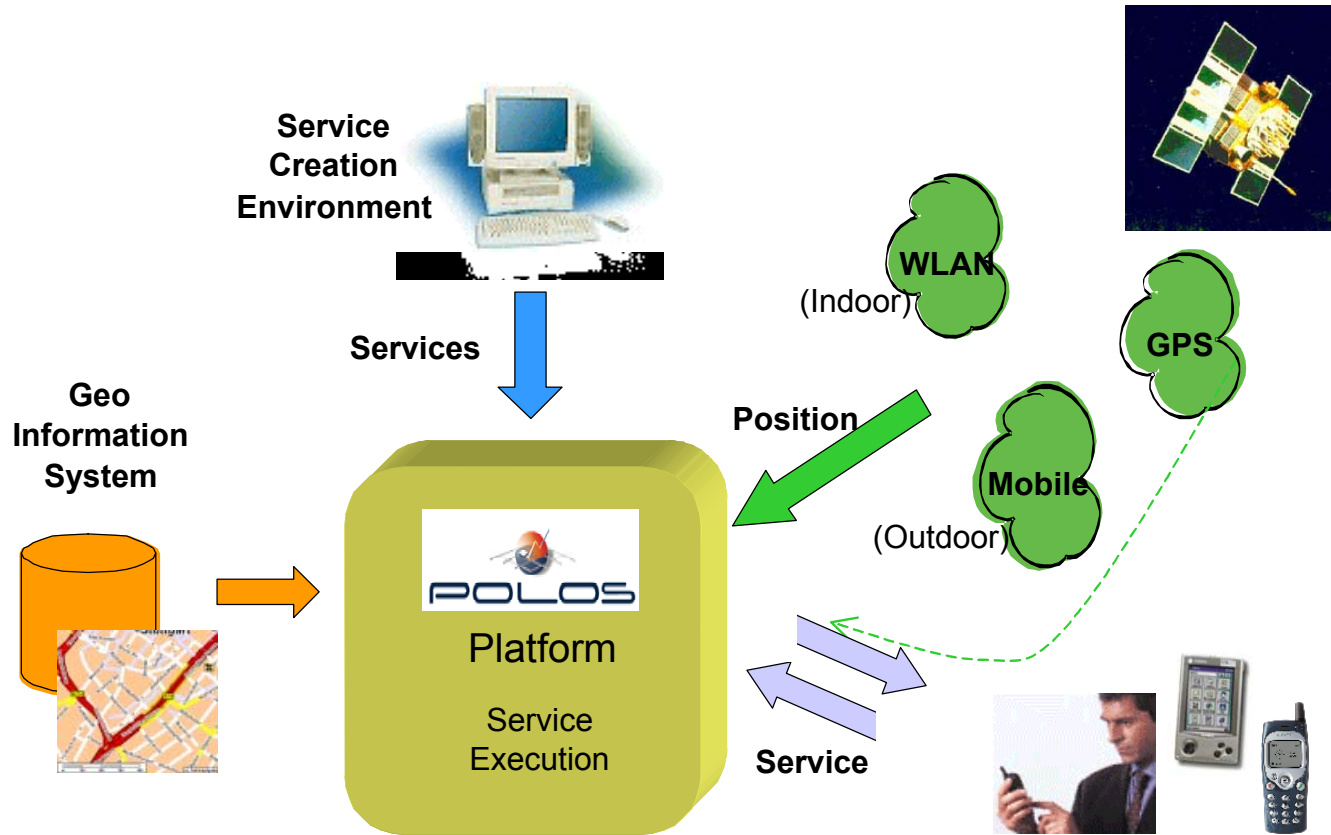
- University of Athens (GR)
- Alcatel SEL AG (DE)
- CSEM (CH)
- Intracom S.A. (GR)
- EPSILON S.A. (GR)
- Telefonica I+D (ES)
- Epsilon Consulting Ltd. (CY)

# Service Execution Flow





# Service Creation



# Features (I)

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- Generic with respect to LBS types (no service-specific components)
- Portable: PoLoS is independent from specific hardware
- Independent from end-user terminal technologies: supports WAP, SMS, HTTP
- Multiple positioning techniques: GPS, GSM- and WLAN-based (simultaneously)
- Flexible with respect to external components

# Features (II)

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- Support for several LBS execution models: client pull, server push, time and event scheduling
- Service specification in a high-level, specially designed, XML-based language
- Easy service specification and handling using the Service Creation Environment (graphic and text edition, deployment, debugging)
- Service and user management.
- Optional access control at per user or per service basis.

# LBS Scenarios

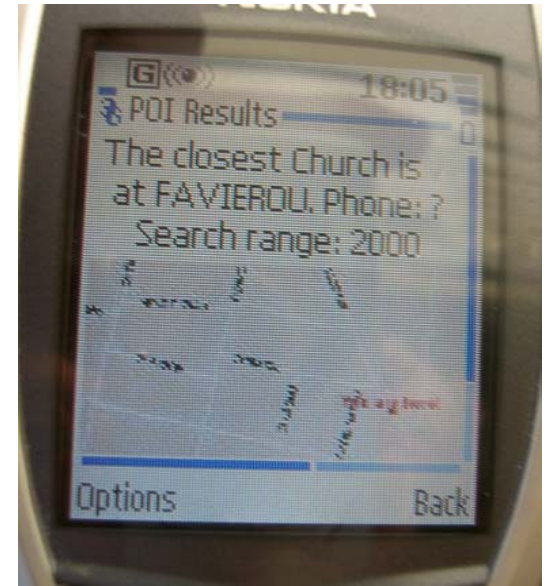
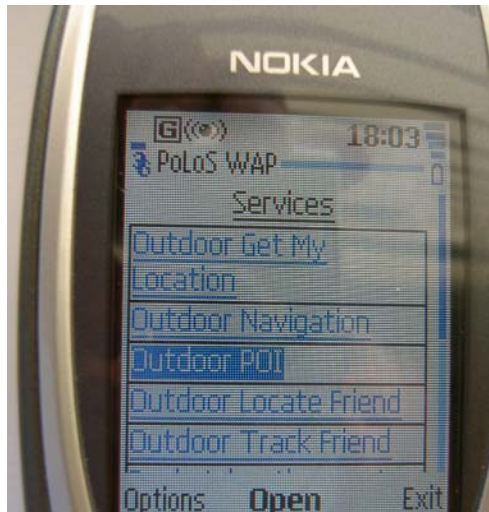
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## **Typical scenarios for LBS**

- getting the exact address of one's current location ("Where am I?"),
- finding a nearby point of interest ("What is the closest cinema?"),
- obtaining navigation directions ("How do I get there?"),
- tracking other users ("Where is my friend?", "Notify me when one of my friends is close"),
- fleet management applications,
- zone-based advertising ("Welcome to our site!"), etc

# PoLoS Use (1):

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Invocation and result of the proximity service using WAP

# PoLoS Use (2):

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Invocation and result of the proximity service using SMS

# PoLoS Use (3):

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INVOCATION (FROM THE SERVICE CUSTOM JSP):

Welcome to the indoor navigation service provided by UoA

Please select your destination:

Go!

- Ground floor, Room I9
- Ground floor, Room I9
- Ground floor, Conference Room
- Ground floor, Reception
- First floor, Room A31

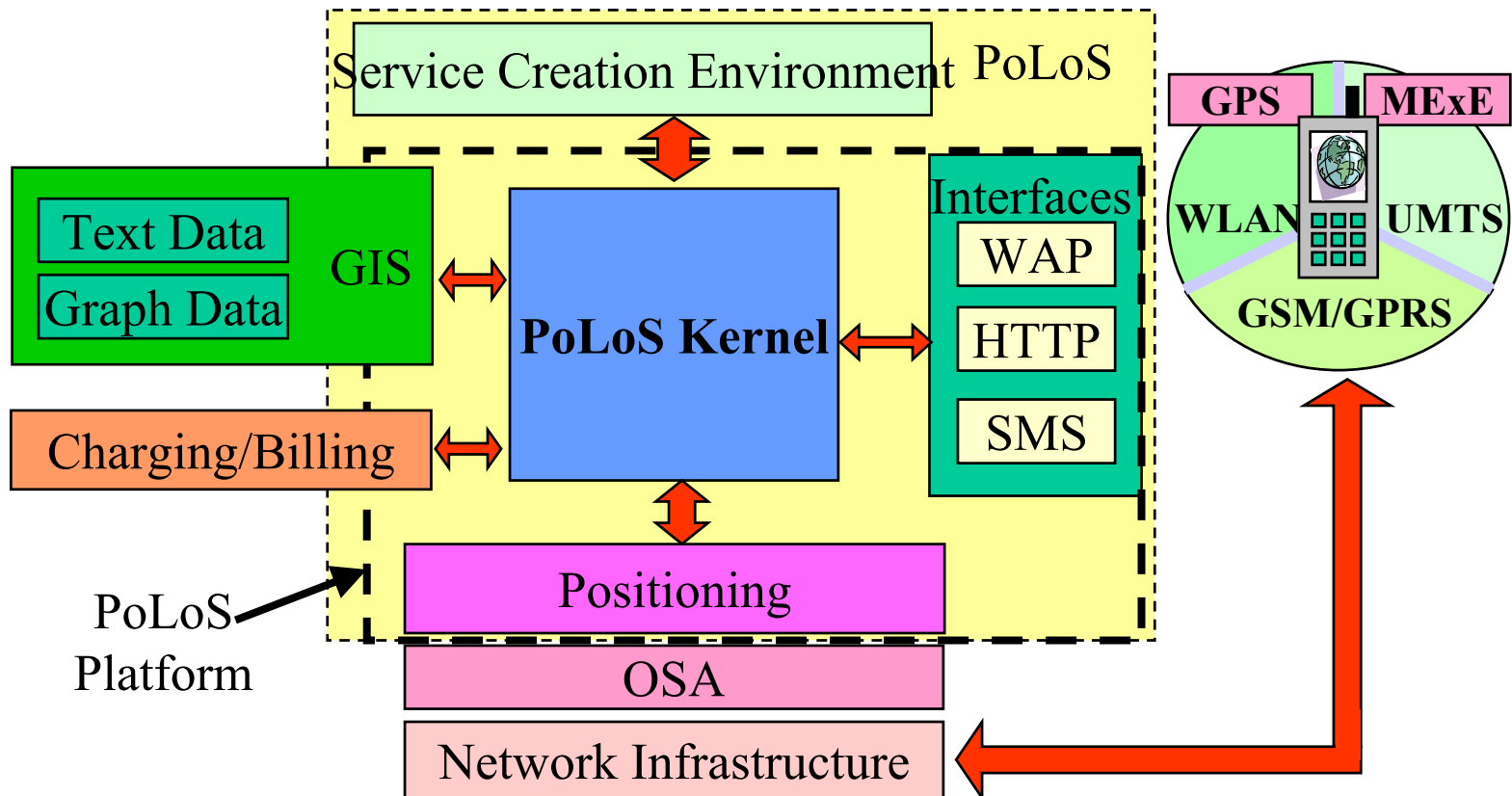
TEXT RESULT :

at 0 meters Go Straight to I9 ;at 0 meters turn right to IHall 1 ;at 20 meters go straight to IS1 ;  
at 10 meters turn right to S1 ;at 0 meters turn left to 0 ;at 0 meters Go to end ;  
at 0 meters Go Straight to S1 ;at 0 meters go straight to AIS1 ;  
at 10 meters turn left to AHall 1 ;at 0 meters turn right to A22 ;

MAP RESULT :



# PoLoS Architecture



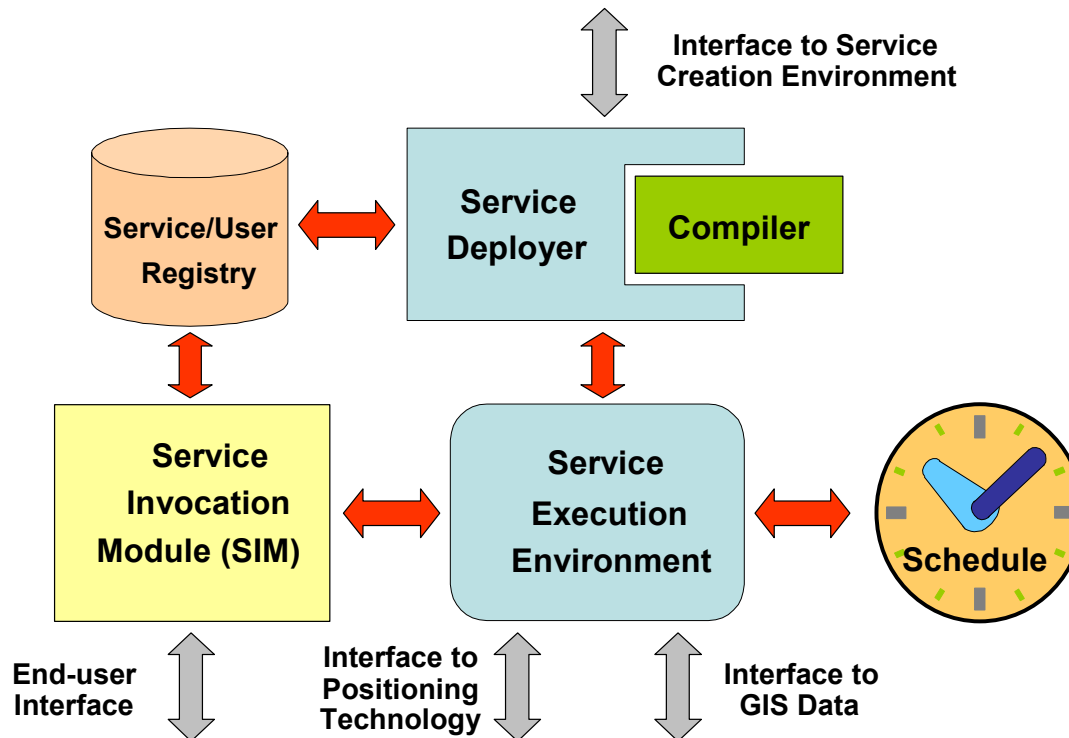


# PoLoS Kernel Functionality

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- Deployment of new services
- Service bookkeeping
- Invocation of services
- Execution of services
- Availability of peripheral components (POS, GIS, interfaces), task scheduling and other functions to service executables
- User registration
- Other (billing, ...)

# Kernel Architecture



# Technologies (1)

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- PoLoS platform: an application server, based on **Java 2 Enterprise Edition** technology (*jboss*)
- Services: instances of **Enterprise Java Beans**
- GIS, POS components: available to the services as **Enterprise Java Beans**
- New service deployment and debugging: **Web services** (*Apache axis*) offered by the platform
- GIS, POS underlying systems: **Web services** (*Axis*) invoked by the platform

# Technologies (2)

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- All data exchanged in **XML**, even between internal components to the platform (use of **SAX, DOM, XSLT** and **jdom**)
- Standardized access to underlying network infrastructures using **OSA**

# Positioning(I)

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- Three positioning systems:
  - GPS, GSM-based, WLAN-based
- When a service executes, the POS system used is
  - either specified in the service logic
  - or determined based on the end-user address type
- Types of requests:
  - Request/Reply
  - Generic Request
  - Event-triggered notification (GSM- and WLAN- based)
  - (Periodic Request not implemented; use of the kernel scheduler)

# Positioning(II)

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- GSM-based (outdoor):
  - emulated positioning (on a real GMLC system) (Alcatel)
  - positioning system by Telefonica Moviles (for authorized subscribers)
- WLAN-based (indoor):
  - Location detection based on Nibble system (symbolic coordinates) (UoA)
- GPS:
  - Requires a proxy software on user's GPS-enabled terminal
  - Location coordinates, piggybagged to the service invocation request, are stored to a repository

# Geographic Information Systems

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- GIS services (available to the platform as Web Services behind a session EJB):

GIS services	Description
Find Location (outdoor and indoor)	Location information corresponding to the supplied coordinates
Proximity (outdoor and indoor)	Information on the closest POI (theater, ...) to the supplied coordinates
Navigation (outdoor and indoor)	Navigation directions on how to go to a given point
Geocoding	Address to coordinates conversion

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# Service Specification

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- Through a script (XML-based)

```
<?xml version="1.0" encoding="UTF-8"?>
<PolosXML>
  <service name="serviceName" ...> } service logic
    ...
  </service>
  <configuration> } dependencies, parameters, security
    ...
  </configuration>
</PolosXML>
```

- Service logic control language (SCL) specially designed (usual programming language constructs and PoLoS specificities)

# Service Control Logic Language

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- Service entry points (->methods): **<entry>**
- Variables: **<set>**  
Support of usual arithmetic and logic expressions and string handling.  
Treelike variable structures through nested **<set>** elements.
- Invocation of platform components, other active services, native Java methods (attachments): **<invoke>**
- Control of logic flow: **<loop>**, **<break>**, **<if>**
- Error control: **<try>...<catch>**
- Persistent variables using repositories (service configuration (ro), service and service-user levels)
- Indirect addressing (based on variable names)

# Service Logic Specification Example

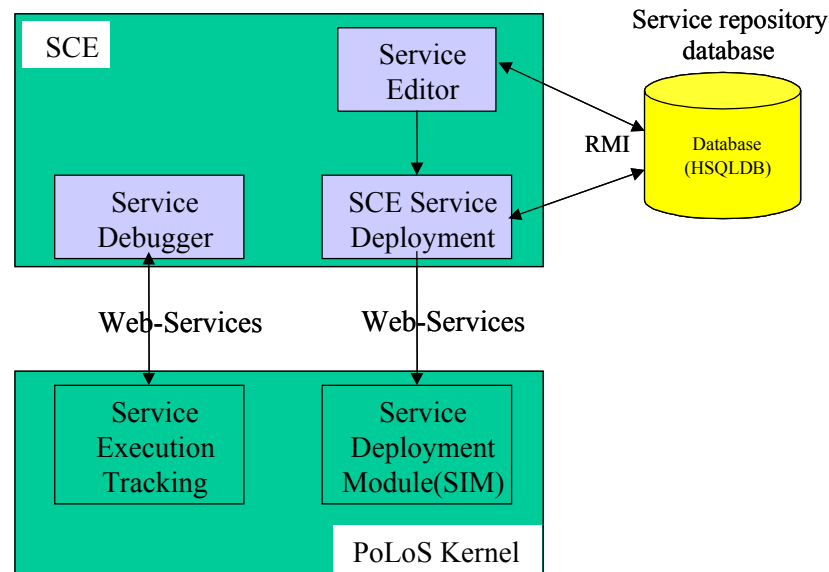
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```
<service name="GetMyLocation" >
  <entry label="main">
    <set name="userpos">
      <invoke component="POS">
        <set name="userid" value="parameters.userId" />
      </invoke>
    </set>
    <set name="useraddress">
      <invoke component="GIS">
        <set name="coordinates.north" value="userpos.latitude"/>
        <set name="coordinates.east" value="userpos.longitude"/>
      </invoke>
    </set>
    <set name="result.location" value="useraddress.textposition"/>
  </entry>
</service>
```

# Service Creation Environment

An IDE for:

- Edition of LBS scripts
- Deployment on the PoLoS platform (securely)
- Testing of new services (tracing)

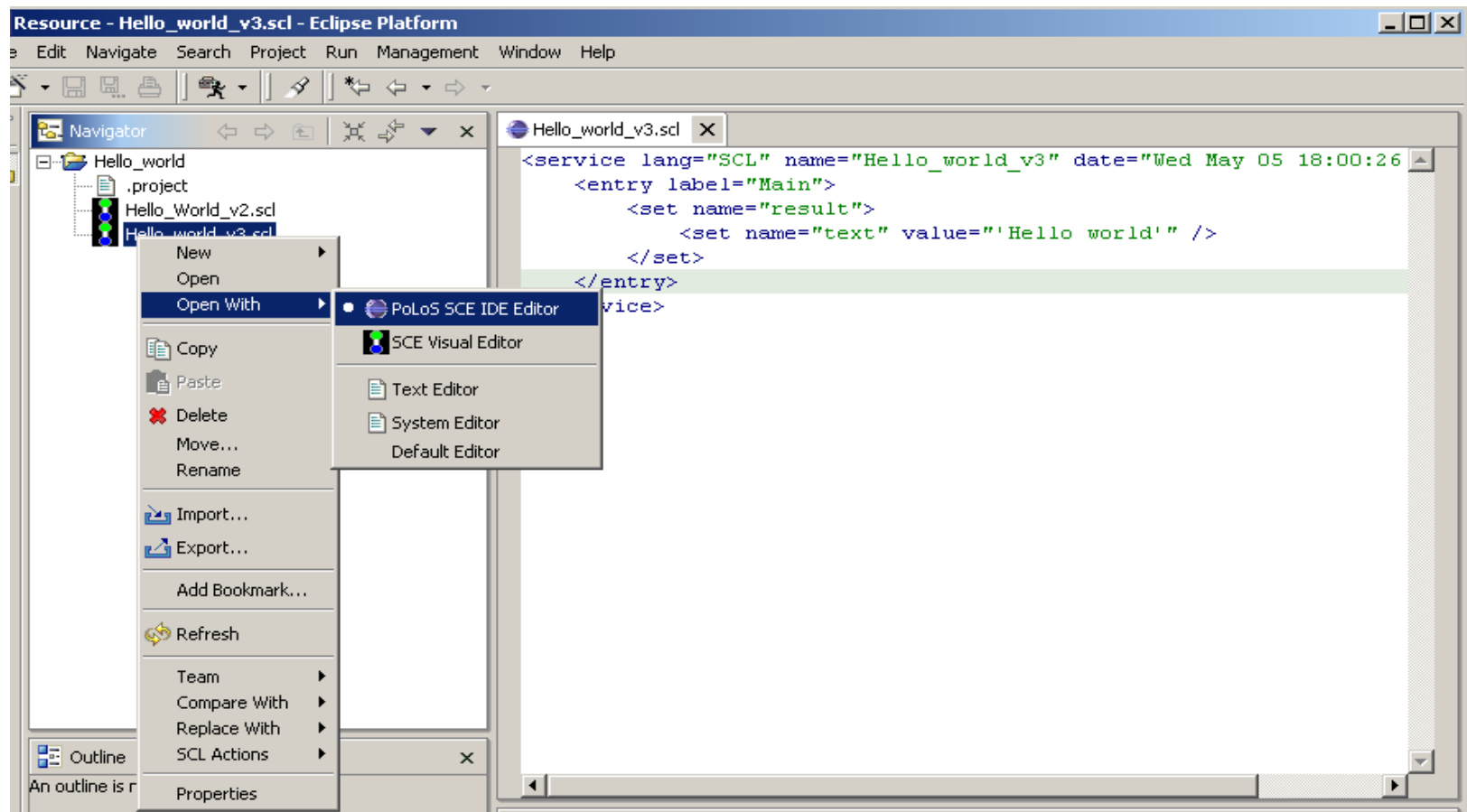


# Technology

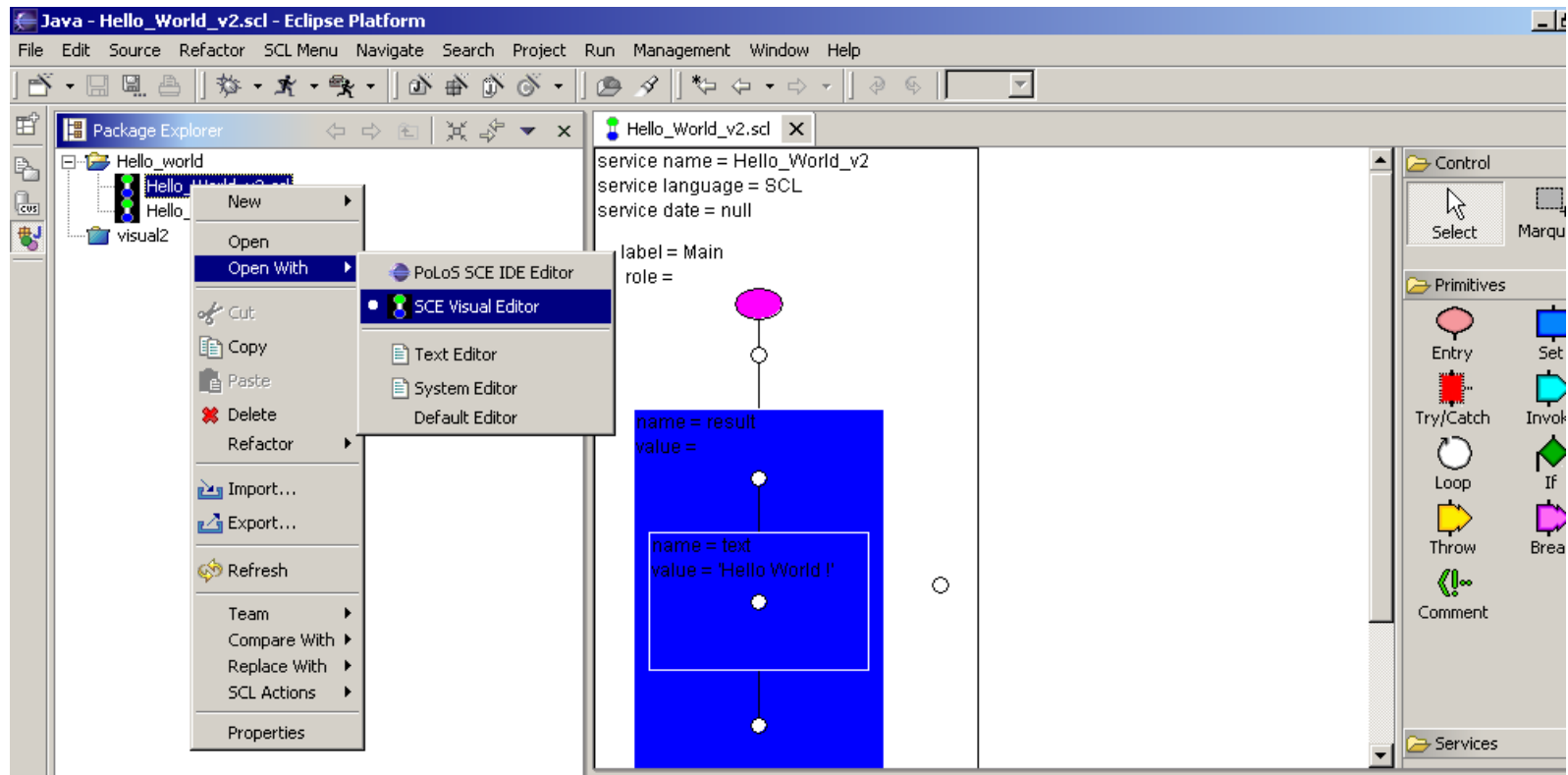
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- Service Creation Environment based on **Eclipse SDK**.
- PoLoS menus, views and operations defined and implemented as **plugins** (service logic text edition and service deployment, graphic edition, debugging)
- New service deployment and debugging: **Web services (*Apache axis*)** offered by the PoLoS platform
- Service testing based on **Apache log4j**.

# Text Editor



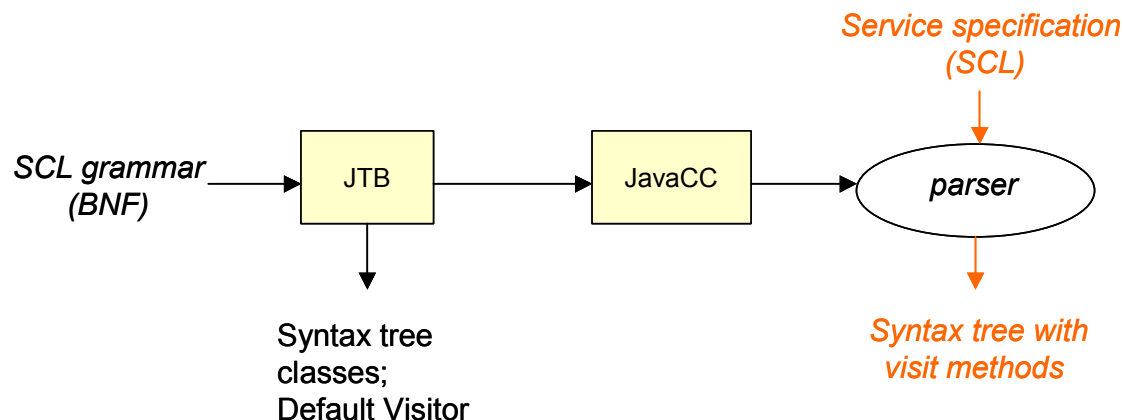
# Visual Editor



# Service Logic into an EJB

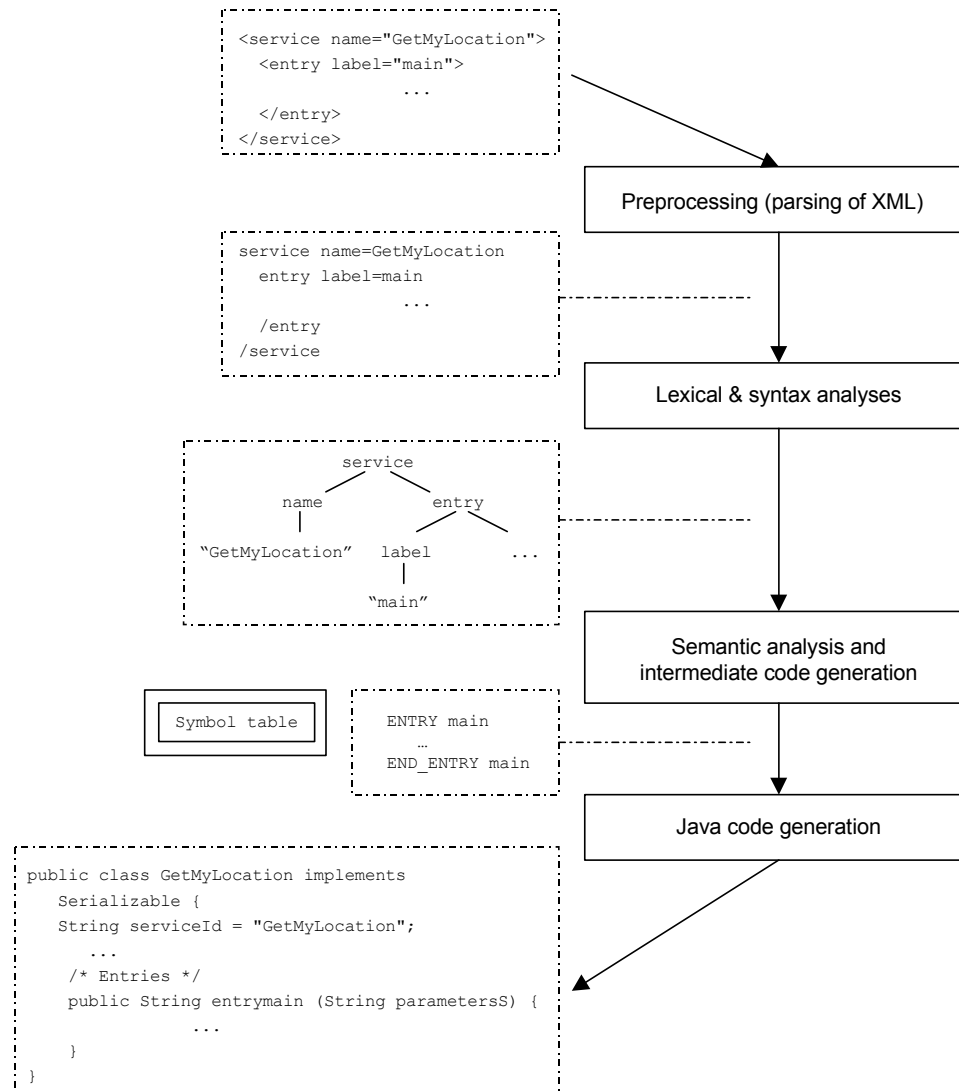
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- Translation of service logic (in SCL) into a Java class, which is encapsulated into a stateless session EJB.
- Translator SCL->Java based on **JavaCC** and **JTB**





# Translation phases



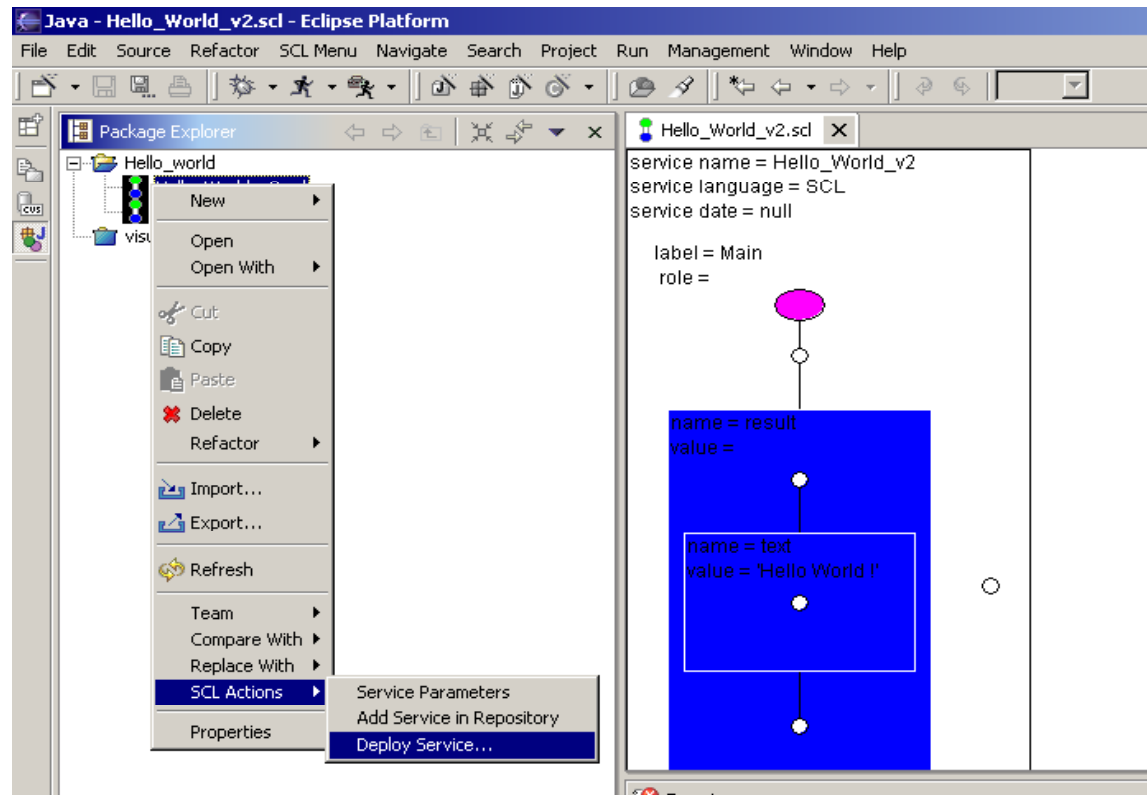
# EJB Class of a LBS service

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```
public class GetMyLocationEJB implements SessionBean {
    ...
    public void ejbCreate() throws RemoteException
    {...};
    public void setSessionContext(SessionContext sc)
    ...{};
    public void ejbActivate() ...{}; // Stateful
    public void ejbPassivate() ...{}; // Stateful
    public void ejbRemove() {...};
    public String entryMain(String XMLInputParameters)
    ...{ ...};
    public String entryInit(String XMLInputParameters)
    ...{...};
    ...
}
```

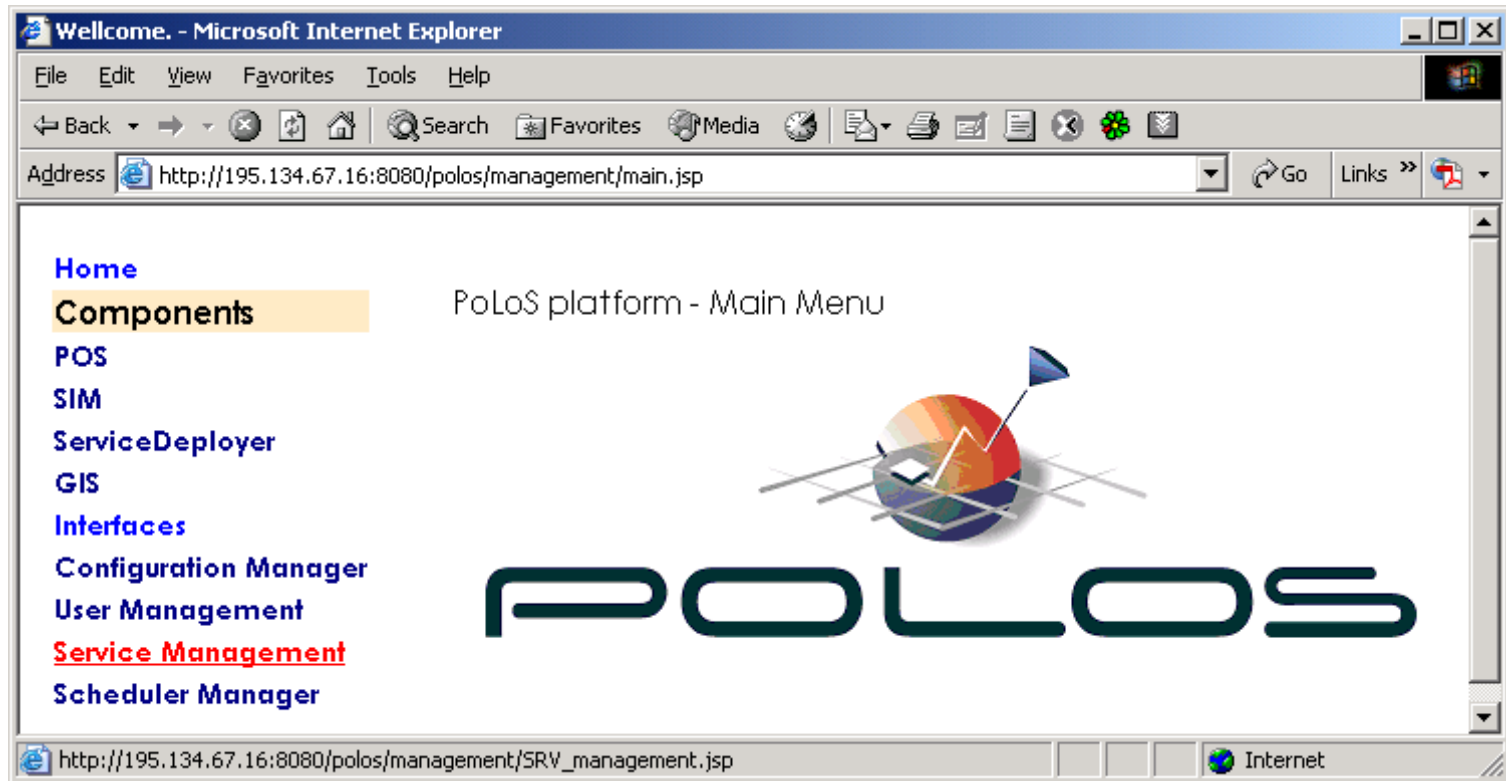
# Service Deployment on PoLoS

- Invocation of a secure Web Service (SOAP over HTTPS) exported by PoLoS platform



# PoLoS Platform Management

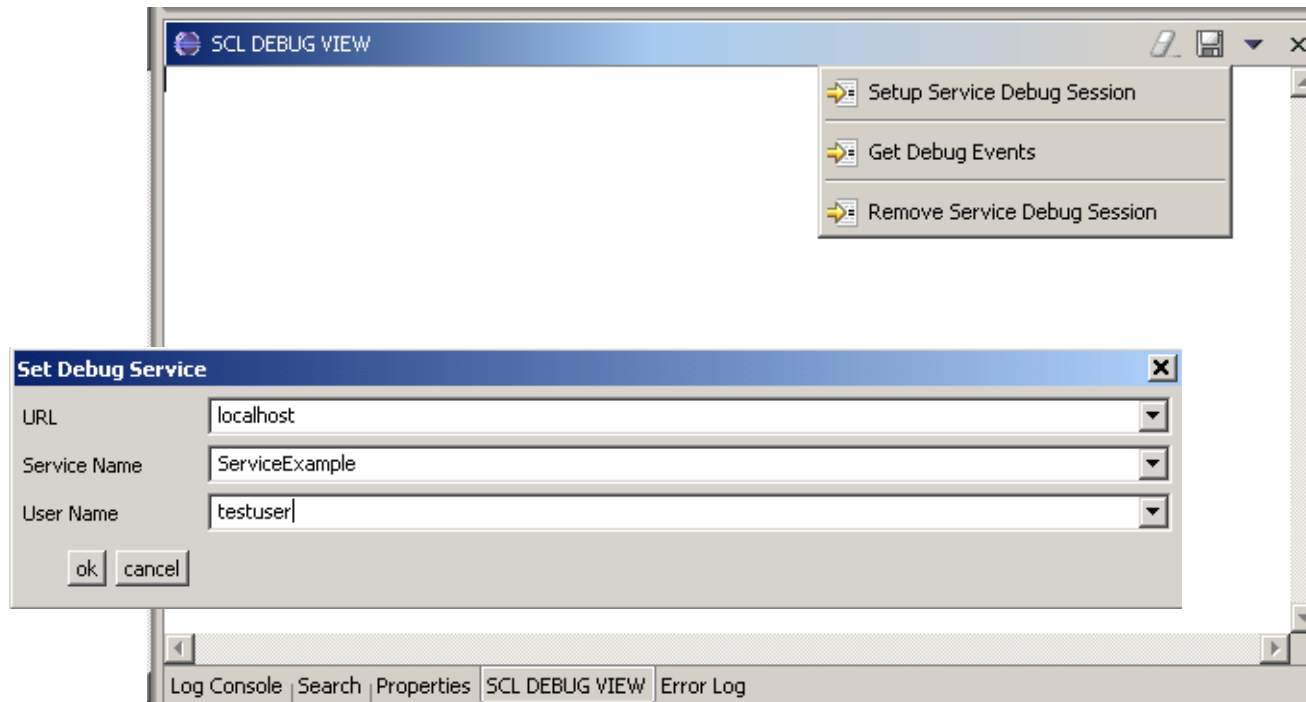
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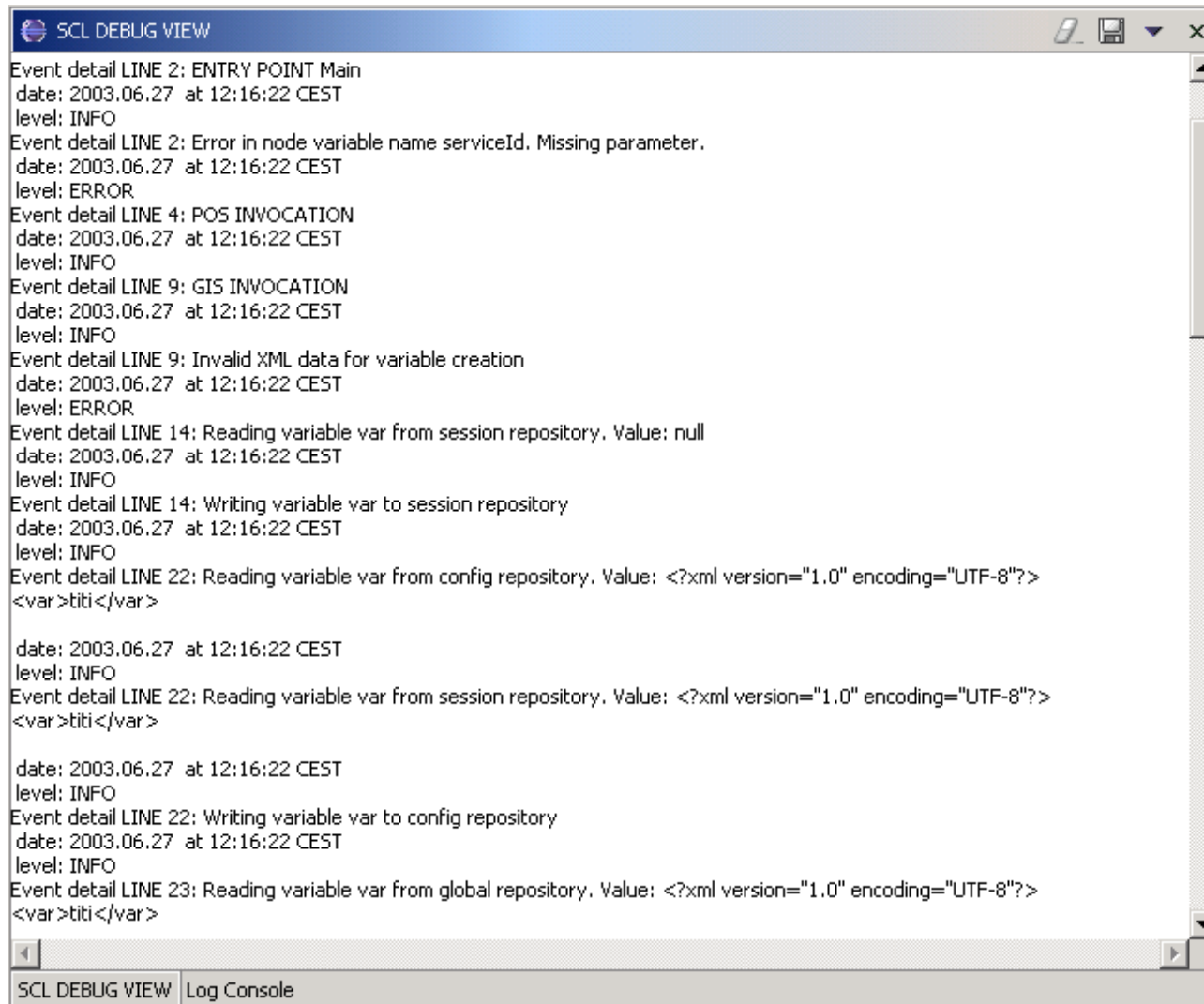
# Service Testing(I)

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- Post-mortem debugging (trace on service execution) based on log4j



# Service Testing(II)



The screenshot shows a window titled "SCL DEBUG VIEW" with a standard Windows-style title bar (minimize, maximize, close buttons). The main area contains a log of events with the following text:

```
Event detail LINE 2: ENTRY POINT Main
date: 2003.06.27 at 12:16:22 CEST
level: INFO
Event detail LINE 2: Error in node variable name serviceId. Missing parameter.
date: 2003.06.27 at 12:16:22 CEST
level: ERROR
Event detail LINE 4: POS INVOCATION
date: 2003.06.27 at 12:16:22 CEST
level: INFO
Event detail LINE 9: GIS INVOCATION
date: 2003.06.27 at 12:16:22 CEST
level: INFO
Event detail LINE 9: Invalid XML data for variable creation
date: 2003.06.27 at 12:16:22 CEST
level: ERROR
Event detail LINE 14: Reading variable var from session repository. Value: null
date: 2003.06.27 at 12:16:22 CEST
level: INFO
Event detail LINE 14: Writing variable var to session repository
date: 2003.06.27 at 12:16:22 CEST
level: INFO
Event detail LINE 22: Reading variable var from config repository. Value: <?xml version="1.0" encoding="UTF-8"?>
<var>titi</var>

date: 2003.06.27 at 12:16:22 CEST
level: INFO
Event detail LINE 22: Reading variable var from session repository. Value: <?xml version="1.0" encoding="UTF-8"?>
<var>titi</var>

date: 2003.06.27 at 12:16:22 CEST
level: INFO
Event detail LINE 22: Writing variable var to config repository
date: 2003.06.27 at 12:16:22 CEST
level: INFO
Event detail LINE 23: Reading variable var from global repository. Value: <?xml version="1.0" encoding="UTF-8"?>
<var>titi</var>
```

At the bottom of the window, there is a tab labeled "SCL DEBUG VIEW" and a button labeled "Log Console".

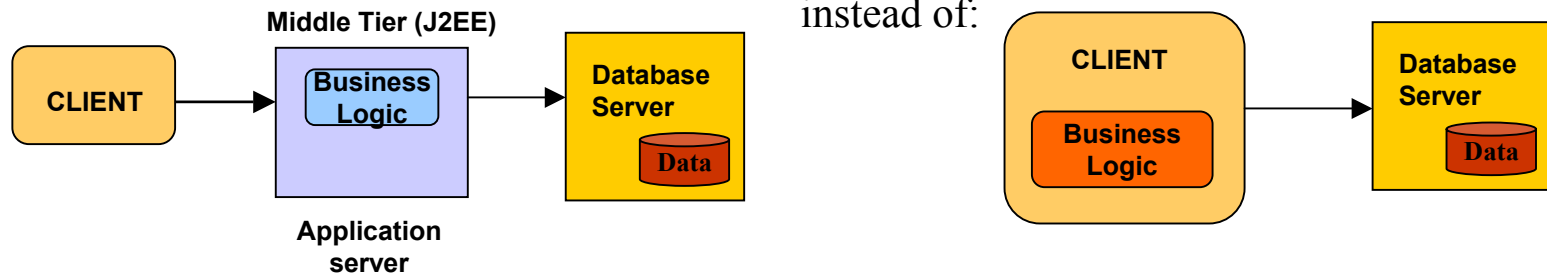
# Outline

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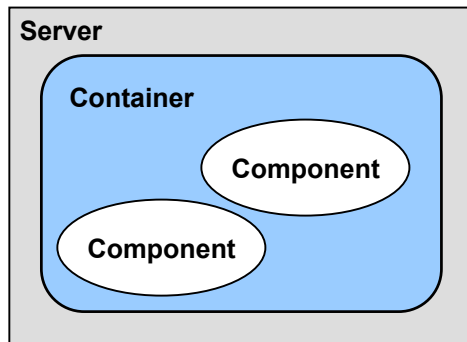
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# J2EE Basic Ideas

## Distributed Application Model:



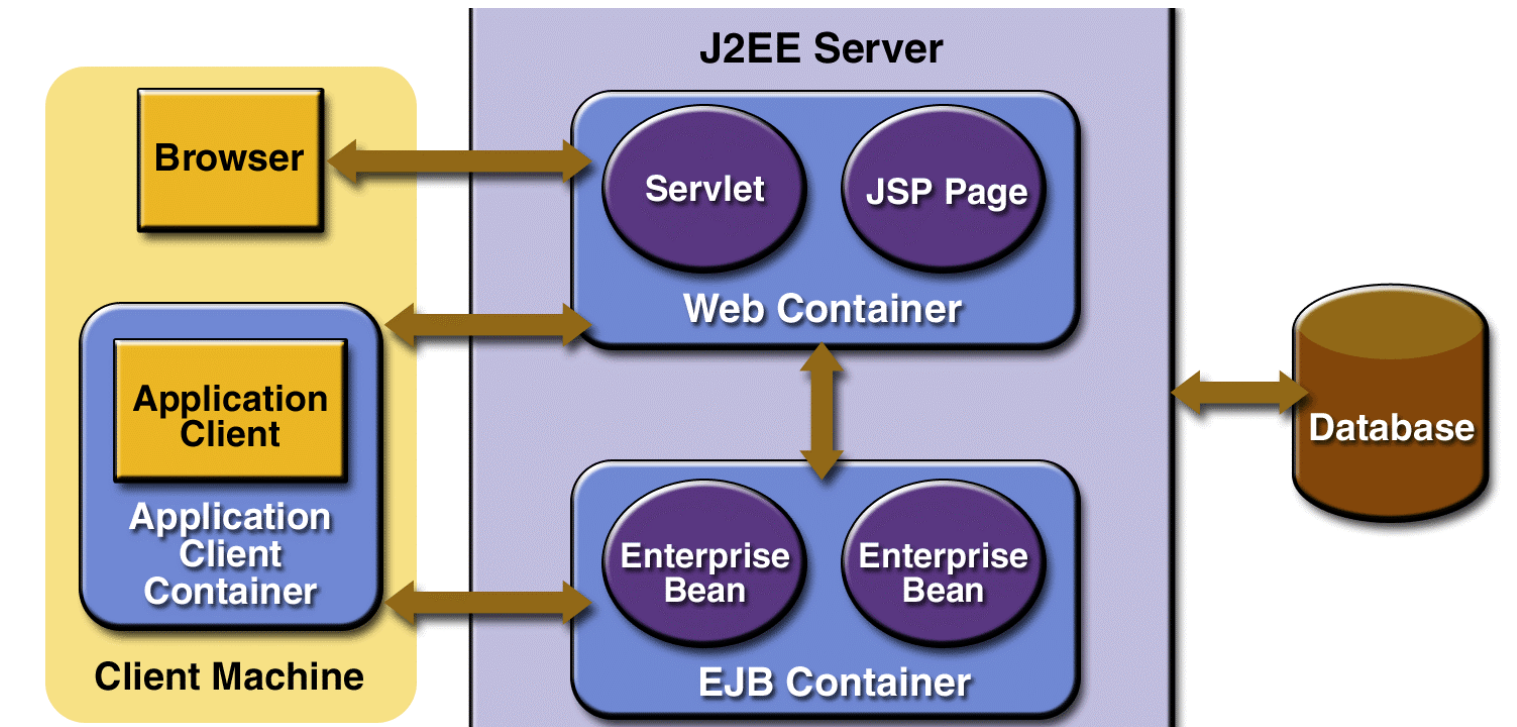
## Components in containers:



Separation of business logic, held in components, from implementation details, provided by containers

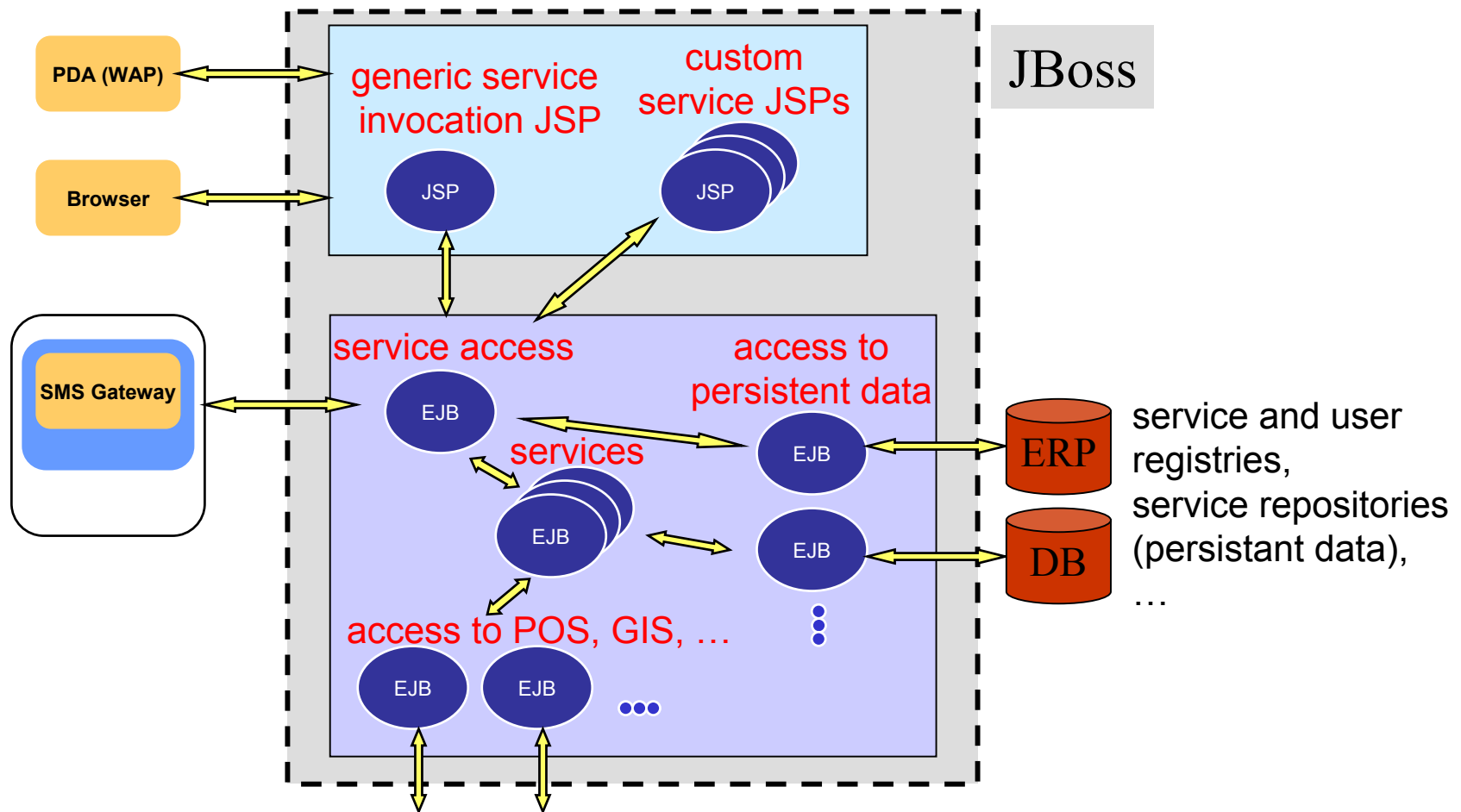
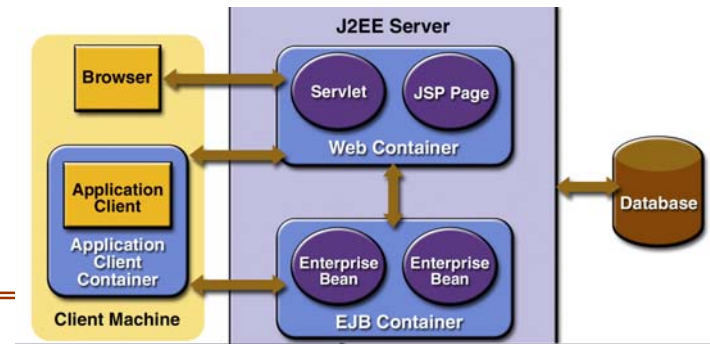


# J2EE Architecture



Three types of EJB: Session, Entity and Message-driven

# PoLoS on Jboss (service execution)



# Web Services

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Cross-platform, cross-language, distributed computing applications

- SOAP/ HTTP message exchange
- WSDL: XML-based language for service endpoint description

Axis: A SOAP engine

- Plugs into servlet engines (Tomcat)
- Extensive support for WSDL,
- generation of Java classes from WSDL

# Conclusion

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- PoLoS has been successfully demonstrated
- Extensive use of open and open-source technologies
- A very positive experience
  - Easy development, re-usability
  - Portability, scalability

# References

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## PoLoS

- [www.polos.org](http://www.polos.org)

## J2EE

- [www.jboss.org](http://www.jboss.org) (open-source J2EE platform)
- [www.java.sun.com/j2ee](http://www.java.sun.com/j2ee) (doc, tutorial and open-source J2EE platform)

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Thank you!