**SAP**™

# SAP ARCHITECTURE BLUEPRINT

# Galaxy

**PROJECT NAME/CPROJECT TITLE:    GALAXY**

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☐ Partner/ISV _____

## Document History

| Version | Date | Status (Comments) |
|---------|------|-------------------|
| 0.5 | 25.11.2007 | Initial Version by Franz Weber |
| 0.6 | 27.11.2007 | First feedback from Jochen Böder included |
| 0.7 | 28.11.2007 | Feedback of Ralf Schaub included |
| | | |

# I MARKET AND PRODUCT BACKGROUND OF PROJECT/PROGRAM

| Planned release date: | June 2008 | |
|---|---|---|
| Underlying SAP NetWeaver release: | CE 7.1.1 | |
| Used SAP NetWeaver stacks: | ☐ ABAP | X J2EE/Java EE 5 |

**Use cases targeted by the project/program:**

- Long term: comprehensive modeled business process, event and rules management layer on top of SAP platforms:
    - o Targeting business and IT roles
    - o Human and system centric processes composition
    - o Support ad hoc as well as predefined processes
- First Release:
    - o Developer role
    - o Human tasks combined with web service orchestration
    - o Well structured situations
    - o Process layer for CE (stakeholders e.g. ByDesign, iCOD, SCM)
    - o Support for Eventus and Rules scenarios probably as preview

**Strategic goals SAP wants to achieve with the project/program:**

- Long term:
    - o Empower SAP (Business Suite, AP and iCOD), ISVs and customers with world leading offering for modeled business process management on top of SAP platforms
    - o Protect and extend SAP Business Process Management (BPM) offering
    - o Extend the reach of SAP software through smart offerings for business end users
- First release:
    - o Market freeze: Support a model-driven approach to managing composite business processes throughout their life cycle. Provide a state of the art user experience for business process participants. Enable human centric processes composition with NetWeaver CE.

**Mandatory software capabilities to address goals, use cases, and target market:**

- Offer task management similar to SAP Business ByDesign Business Task Management (BTM)
- Be able to orchestrate SAP platform as well as standard web services
- Top class process modeler and debugger for developers based on Business Process Modeling Notation (BPMN) 1.0
- Integrate into universal worklist (UWL), offer end user UIs in Web Dynpro

## II. ARCHITECTURE

### Main Architecture Concepts and Decisions

To ensure flexibility, extensibility and scalability for Galaxy, the architectural decisions described in this section have been taken. The decisions however depend on portfolio decisions and supplies by components we depend on.

### Components

The main components of Galaxy as depicted in Figure 1 are real separately usable components. The only way to use them is via defined public APIs (Java or Web service facades). Each Galaxy 1.0 component will provide further componentization to have lean consumption for each of the components.

### Standards Based Metamodel and Modeling Infrastructure

The design tools and repositories for Galaxy are developed based on the standard metamodel language MOF [1] and SAP's Model Oriented Infrastructure MOIN..

### Multi-paradigm runtime kernel

Galaxy will provide a kernel architecture which is rehostable and scalable and can support multiple process paradigms (e.g. flow, events, reaction rules, state charts) in an interoperable way. This is necessary since Galaxy wants to support the whole BPM area containing several sub scenarios like:

- Procedural flow
- Event – condition – action rules
- State based approaches
- Human oriented workflow

### Kernel extension points

The kernel has several extensions points:

- Function and rules can be defined by an application via Java or as a web service.
- Systems can be integrated by exposing their data, methods and events to the kernel.
- Connectivity and UI unification: Galaxy will leverage the unification concepts of SAP NetWeaver Composition Environment (CE) to integrate arbitrary UI and connectivity components.

### Business context based human interaction management

Galaxy will provide a business context for human interaction management. The business context provides access to all resources (e.g. documents, data objects, roles …) needed for human interaction including collaboration concepts (for details see …). It will provide capabilities to make these resources actionable (view, edit …), to search for contexts or resources, to persist contexts as well as log all important actions done in a context.

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[1] Meta object facility, defined by object management group (OMG) as part of the unified modeling language UML

## Task harmonization layer

Galaxy will start to implement the concept of the task harmonization layer. This will provide two extension/integration points:

1. Task providers can be added by an application. The first candidate for that is AP/SAP Business ByDesign BTM.

2. Task consumers can be added by an application. This opens up Galaxy to add new channels to the business users like Duet, Microsoft Office or Blackberries.

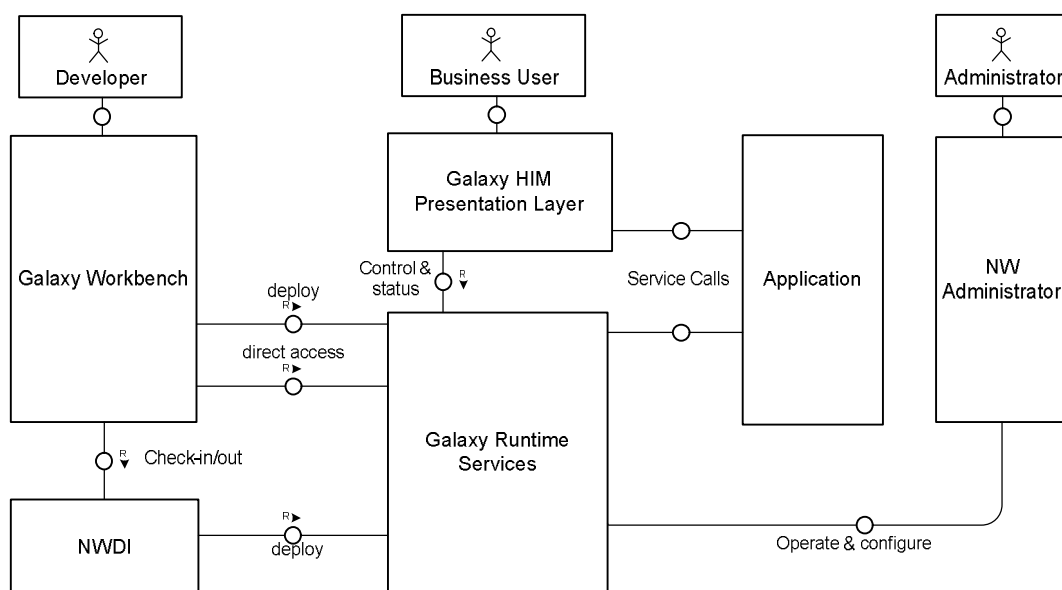## Architecture Landscape Overview



**Figure 1: Galaxy Landscape Overview**

The process life cycle has the following phases:

1. Design

2. Testing & Debugging

3. Deploy

4. Configuration

5. Control/Execute

6. Status/Monitor

These phases may overlap and occur in various orders. However, design, test, debugging, deploy and configuration are executed by a developer only. Monitoring will also be done partially by developers if necessary for debugging. The Galaxy Workbench provides a comprehensive tool for the developer to perform all of these tasks.

Design will not be carried out by single developers but in teams. The management of the artifacts (versioning, check-in, check-out, central build and deploy) will be done with the NetWeaver Development Infrastructure (NWDI). A single developer wanting to design, test, debug or monitor, checks out the necessary artifacts from the NWDI, manipulates them and checks them back in again (Check-in/Check-out interface). The final result will be in NWDI and be deployed from there. However, for testing and debugging purposes deployment may also be done directly from the Galaxy

Workbench (deploy interface). For debugging and monitoring a direct access to the control and status interface of the runtime services is used (direct access interface).

Execution is controlled by business users or applications. They may start or stop processes. Business users may interact with processes via tasks. Applications may interact with processes via services.

The business user may monitor the status of processes and tasks they are related to.

The Galaxy Runtime Services hold all the artifact definitions deployed into it and manage all instances created during execution. Amongst others the core of the runtime services is based on the RETE algorithm and main memory approach.

The Galaxy human interaction presentation layer provides services for single business users to interact with Galaxy from their perspective. It manages the access and interaction with the personal tasks via work lists. By executing a task an application defined UI connected to the task will be launched. This application UI will communicate with the application via services.

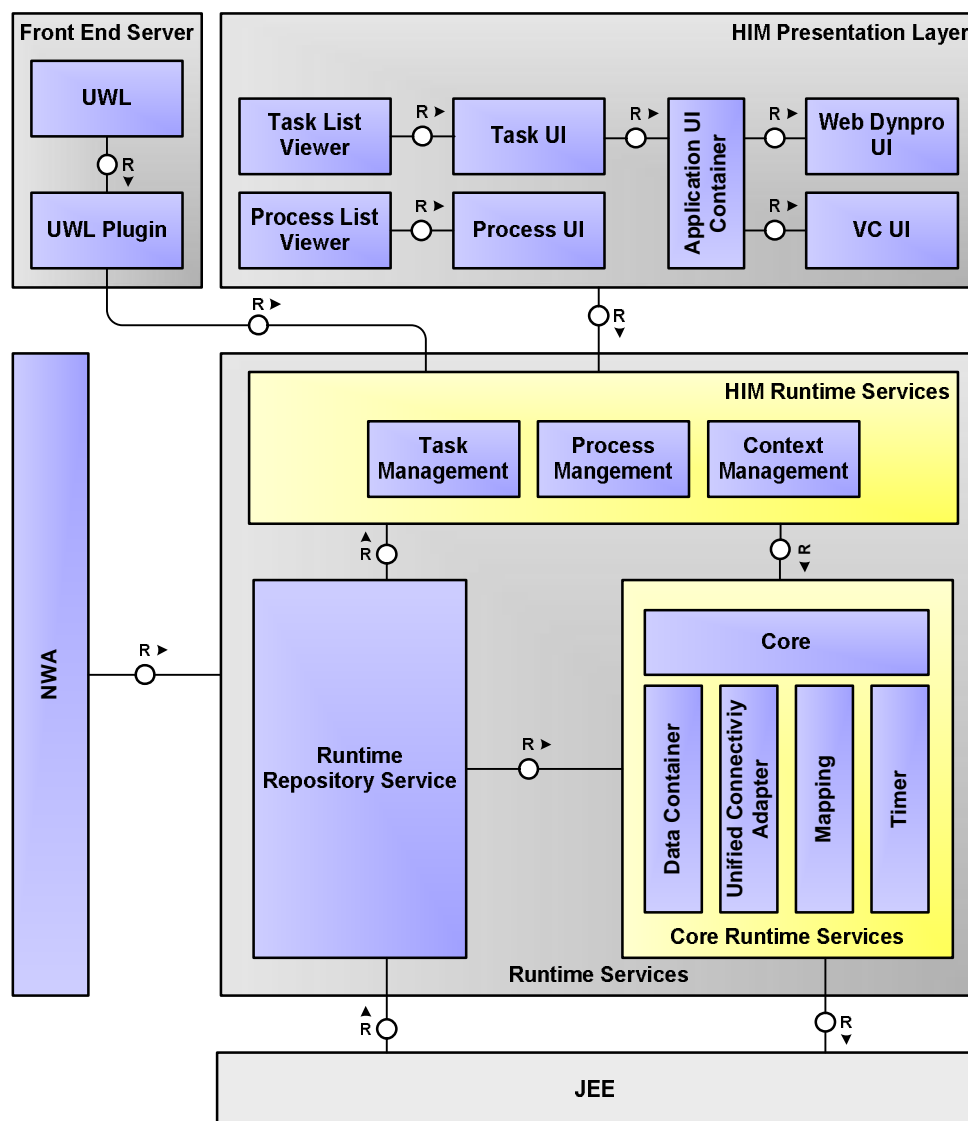## Main Architecture Concepts and Decisions (<u>Runtime</u>)



**Figure 2: Architecture Overview Diagram (Static Structure at Runtime)**

The Galaxy runtime is built on top of CE/JEE. It integrates into the **NetWeaver Administrator** (NWA) to provide the Galaxy management for system administrators for the different runtime components.

The **runtime repository service** handles the deployment and activation of Galaxy artifacts. It is triggered via the standard JEE Deploy Container. The runtime repository then handles versioning, text internationalization as well as transactional save deployment and activation in the different Galaxy components.

The **core runtime services** provide all capabilities necessary for building a process engine and end user or business user oriented services in the HIM (Human Interaction Management) layer. This includes a data container, a mapping engine on top of the data container, timer functionality a unified connectivity adapter and as a main component the kernel which provides the low level process execution for sequencing, control logic, state tracking and event correlation.

On top of the core runtime services the **HIM runtime services** provide management of tasks, processes and contexts. These services are provided to the end user via a set of Web Dynpro Uis in the **HIM presentation layer**. There is a UWL connector to be able to access Galaxy tasks from the UWL. Additionally there are UIs to see running process instances together with their context.

A central part is the **task UI**. It allows for the inclusion of application UI via an **application UI container**. It will allow for the integration of all UIs runable in a portal or Web Dynpro context (e.g. Web Dynpro Foundation and Web Dynpro for VC).

## Main Architecture Concepts and Decisions (<u>Design time</u>)
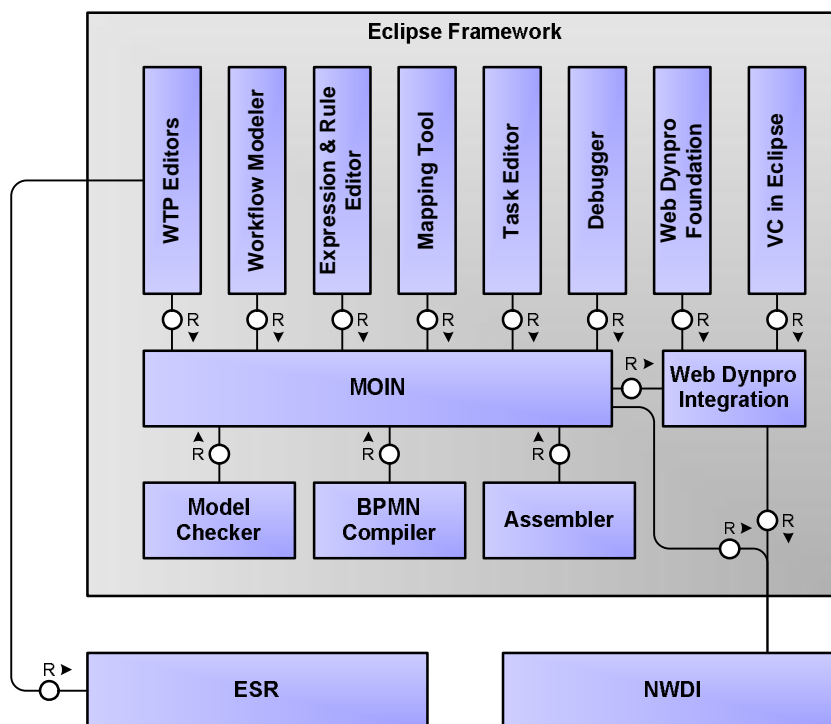


**Figure 3: Architecture Overview Diagram (Static Structure at Design Time)**

The block diagram above shows the overall architecture of the Galaxy Workbench.

### MOIN Repository

As mentioned before, all model data is stored using MOIN.

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### WTP Editors and WSDL/XSD Importers

All data types and service interfaces are edited with Eclipse Web Tool Platform (WTP) editors and stored in the Galaxy project as XML schema and WSDL files. This persistence is implemented with Eclipse Modeling Framework (EMF). The WSDL importer will read the files and propagate the content to the corresponding MOIN models. The WTP tools offer a capability to browse the ESR for web services and to import them.

### Graphical Workflow Modeler

The "heart" of the Galaxy Workbench is the process designer (graphical workflow modeler). It is built on top of the grafix framework of MOIN.

### Expressions and Rules Editor

In many places the Galaxy workbench and runtime deals with expressions that calculate a value from a scope of variables. A reusable expression editor is being implemented that can be "plugged in" wherever an expression is used in the Galaxy workbench.

### Mapping Tool

An important aspect of each business process is data flow. The heart of data flow is mapping data from one context (or scope) to another. In Galaxy workflows, there will be for each activity at least an input mapping, which maps from the process context to the activity's input parameters and an output mapping, which maps the activity's result parameters back to the process context. The mapping is considered useful outside its use in the Galaxy Workflow modeler and hence built as a component reusable also in other contexts than Galaxy.

### Task Editor

Tasks (also called Task Types or Task Definitions) contain the metadata necessary to control a human work item. They are instantiated in Human Activities, but could be also used outside of a workflow. Galaxy tasks are aligned with WS Human Task and ByDesign Business Task Management.

### Web Dynpro Foundation UI Integration

The contract for data flow from a task to the UI and back is based purely on a WSDL service interface in Galaxy. Therefore the data interface of the Web Dynpro component that implements the UI has to be imported as WSDL into the enterprise service model (ESM) used by Galaxy.

### Model Checker

When model elements are entered using an editor, they may contain inconsistencies or violate constraints and checks. The checking could be done while editing or later, e.g. on save.

### BPMN Compiler and Triggernet Assembler

The graphical debugger allows visual debugging of business processes on the level of BPMN diagrams. It will be cleanly integrated with the Eclipse debugger framework.

### Debugger

The graphical debugger allows visually debugging of BPMN diagrams. It will be cleanly integrated with the Eclipse debugger framework.

**Total Cost of Ownership**

Galaxy is integrated into the standard CE installation with a zero admin template. It adds of course resource requirements at runtime and requires some system administration of task and process management. It adheres to the lean consumption requirements of CE.

**Deployment**

### *Runtime Versioning*

In order to guarantee stable execution of a started process, the version active at process start must be available throughout the entire life of the process (and even longer for archiving reasons). Therefore a versioning runtime repository is required.

### *Build & Deploy*

With CE, deployable results can be created using a command line tool, from the NetWeaver developer Studio or in the ComponentBuildServer (CBS) of the NWDI. To support these scenarios, a Galaxy build plugin has to be provided. Galaxy content is deployed as standard software delivery archives (SDA). They are passed to the Galaxy runtime repository through the standard JEE deploy container. The Galaxy runtime repository handles deploy transactionality, versions, texts and the further distribution of the different artifacts to the different Galaxy components.

### *Debugging*

Debugging a process instance consists of the following steps:

- From the Galaxy workbench, identify the process template (development component, workflow), then identify the process instance

- In Eclipse, a new development configuration is created for debugging the process

- The process instance identifies the key of the development component the process is defined in, and the corresponding model sources may be downloaded from the runtime repository.

- After the sources are downloaded, the process state may be debugged

**Architecture Documentation**

Further architecture documentation may be found under Architecture - Wiki@SAP

Especially the Galaxy ERD explains the topics of this document in much more detail.

## III. OPEN ISSUES, OUTLOOK AND RISKS

### Open Issues and Outlook

In this section we discuss the main architectural directions in which Galaxy will be developed further after Galaxy 1.0. Of course the actual roadmap is subject to portfolio management and is not handled in this section.

### Business Analyst Role

The business analyst role is not included in Galaxy so far. After Galaxy 1.0 we will build a variant of the Galaxy Workbench to support the business analyst throughout the complete lifecycle of a process.

### Design Collaboration

We will build support for design collaboration in teams with homogenous and heterogeneous skill sets. A special focus will be on the collaboration between business analysts and developers. Business analysts will be able to make incomplete designs as well as sandbox designs.

### Integration with AP/SAP Business ByDesign concepts

AP/SAP BusinessByDesign and Galaxy have already established a task force to align Galaxy and AP/SAP BusinessByDesign concepts with the goal of having one comprehensive development method for all kinds of business processes. This will minimize the efforts of understanding the SAP process development method as will as the integration efforts.

Besides aligning the concepts, three obstacles have to be overcome to make this vision true:

1.  Migration of the Enterprise Service Repository to MOIN: currently all artifacts and tools for AP/SAP BusinessByDesign are based on the current ESR version, which is not integrated with MOIN. Galaxy repositories and tools are based on MOIN.

2.  Ensure alignment of metamodels. AP/SAP BusinessByDesign started development earlier and independently of CE and Galaxy. Thus there are some areas where the alignment of the metamodel has to be ensured: BTM, Expressions and Rules, Service Composition and BO.

### Leverage Galaxy in SAP NetWeaver PI

The Galaxy runtime services may provide new features and better scalability to the orchestration engine in SAP NetWeaver PI called ccBPM.

### High volume/low latency scalability

Although the Galaxy architecture is designed to support high volume and low latency scalability from the very start, it will exhibit this capability in an incremental manner.

### Ad hoc and collaboration user experience

We will extend the capabilities of the HIM services to support ad hoc and collaboration for business users. Our support and participation for Eventus is the major effort we spend here at the moment. Also activity central is a potential candidate to go into that direction.

### Integration of user channels

Although Galaxy 1.0 only supports Web Dynpro as a user channel, the architecture allows for plugging in arbitrary user channels for tasks and contexts. The prerequisite for this to work is an aligned task abstraction API suitable for mobile applications and Duet but also the integration of other user channels like Microsoft Office and Sharepoint. The goal is to extend the reach of SAP solutions as far as possible on the users desktop.

## Rules

Galaxy will support the usage of business rules. Work on integration of the Quickrules Rule Engine from Yasu has been started already.

## Information worker support

Galaxy will provide extended human interaction services (e.g. Enterprise Search integration and enhancements, ad hoc capabilities, collaborative practices, resource networks...) as kind of mash-up to serve a comprehensive information worker story.

The topic is an important contribution to Eventus, for which the planning for a potential Eventus productization has started.

## Extensibility Patterns support

Galaxy has to provide support for the various extensibility patterns needed as part of composition. Prominent examples are field extensibility and the interface delegation of CE. Field extensibility could in turn pose further requirements to service data objects (SDO )(to be able to transport additional metadata)

## Risks

We see the following risks for Galaxy 1.0:

1.  Resources. All teams are staffed very tightly and very late. The project plan depends on new hires. The majority of the team joined or will join this year.

1.  Inclusion of several new concepts:

    a.  Unified connectivity

    b.  Unified UI

    c.  SDO

    d.  MOIN and all technologies based on that

    e.  RETE / main memory based kernel design

2.  Unclear whether Unified connectivity will reach necessary KPIs.

3.  Galaxy is a 1.0 development. Only limited stakeholder feedback may be included in the last project phase.

4.  Dependencies: Galaxy depends on delivery commitments in the CE stack which in turn have tight resources and timelines.

5.  MOIN EMF bridge will not come. Currently the impacts are unclear. The risk is that we really break an appropriate user experience if the WTP editors for WSDL and XSD are not integrated smoothly. If we do not solve the integration of MOIN and EMF smoothly we should make a decision at SAP to use only one of the approaches. The results will otherwise be highly unprofessional.