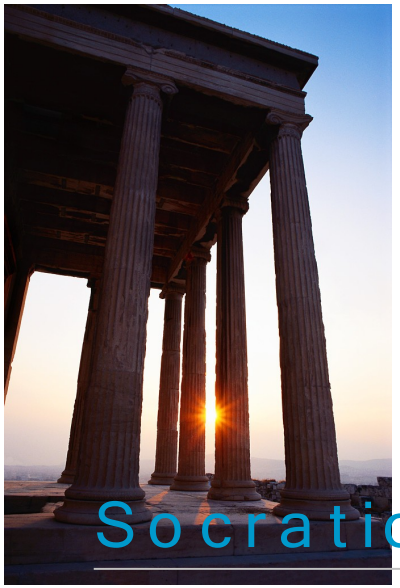

Socratic Grid Project

Syllògie
Intelligent Tools For Healthcare

Clinical Decision Support Subproject
Technical Overview

A Definition Of Quality Healthcare

- The consistent, timely and equitable delivery of evidence based medicine personalized to the individual, their cultural preferences, and the entirety of their medical record.
- Definition implies several things:
  - The "medical record" must collate data across facilities and systems.
  - Clinical data must be evaluated in near real-time without prejudice.
  - Medical treatment plans are appropriately conceived only within the context of a patient's ethical and cultural beliefs and must be articulated across time and place.
  - Quality healthcare can not depend exclusively on human initiated action.

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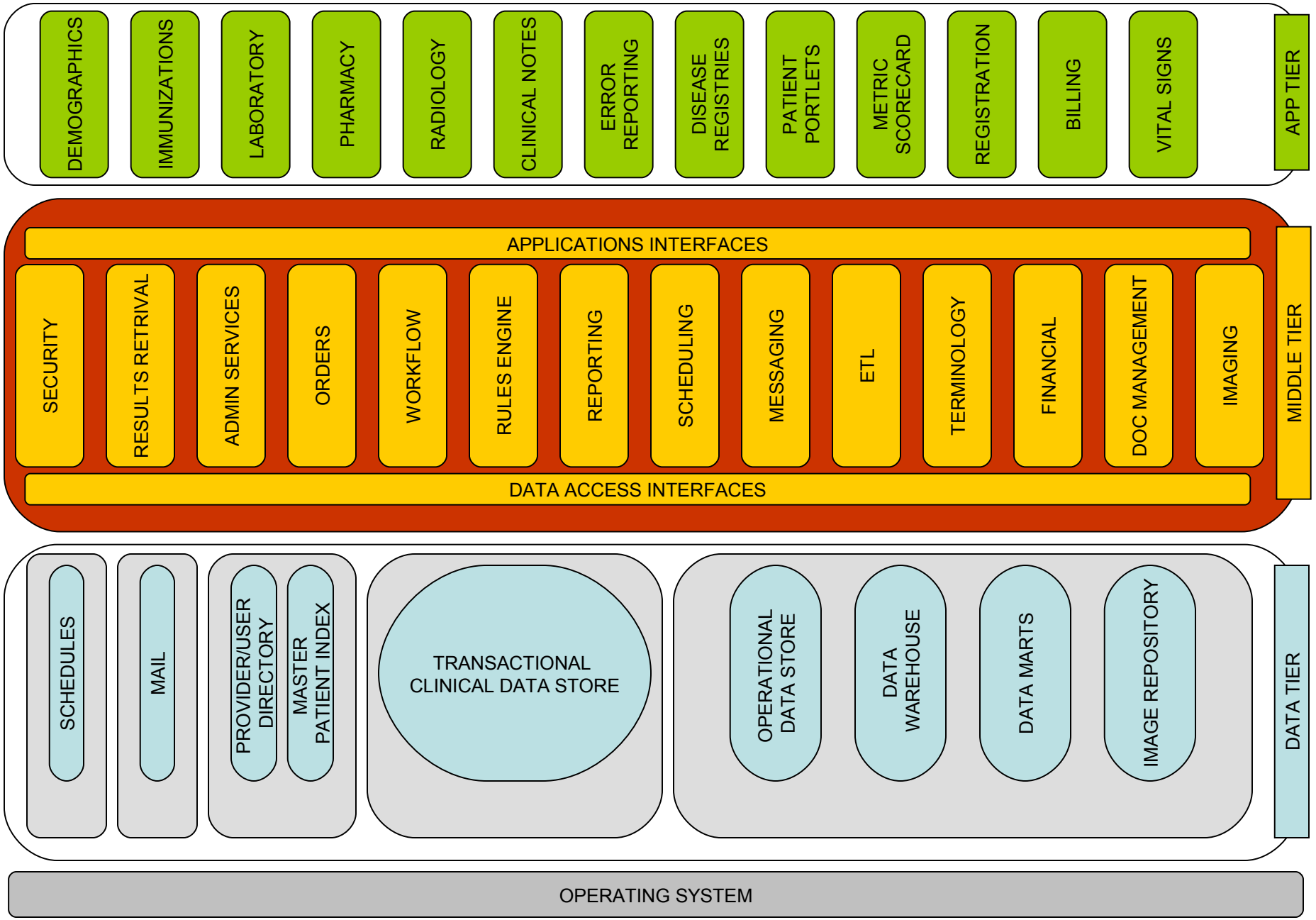
- Believes real-time clinical decision support (CDS) to be a fundamental requirement for delivery of quality healthcare to both individuals and populations.
- Developing a service-oriented healthcare enterprise bus with clinical decision support as a core capability, not an architectural afterthought.
- Uses open standards to increase interoperability and lower adoption costs.
- GPL licensed source code.
- 501(c)3 non-profit application pending.

What Might An Ideal SOA For Healthcare Look Like?

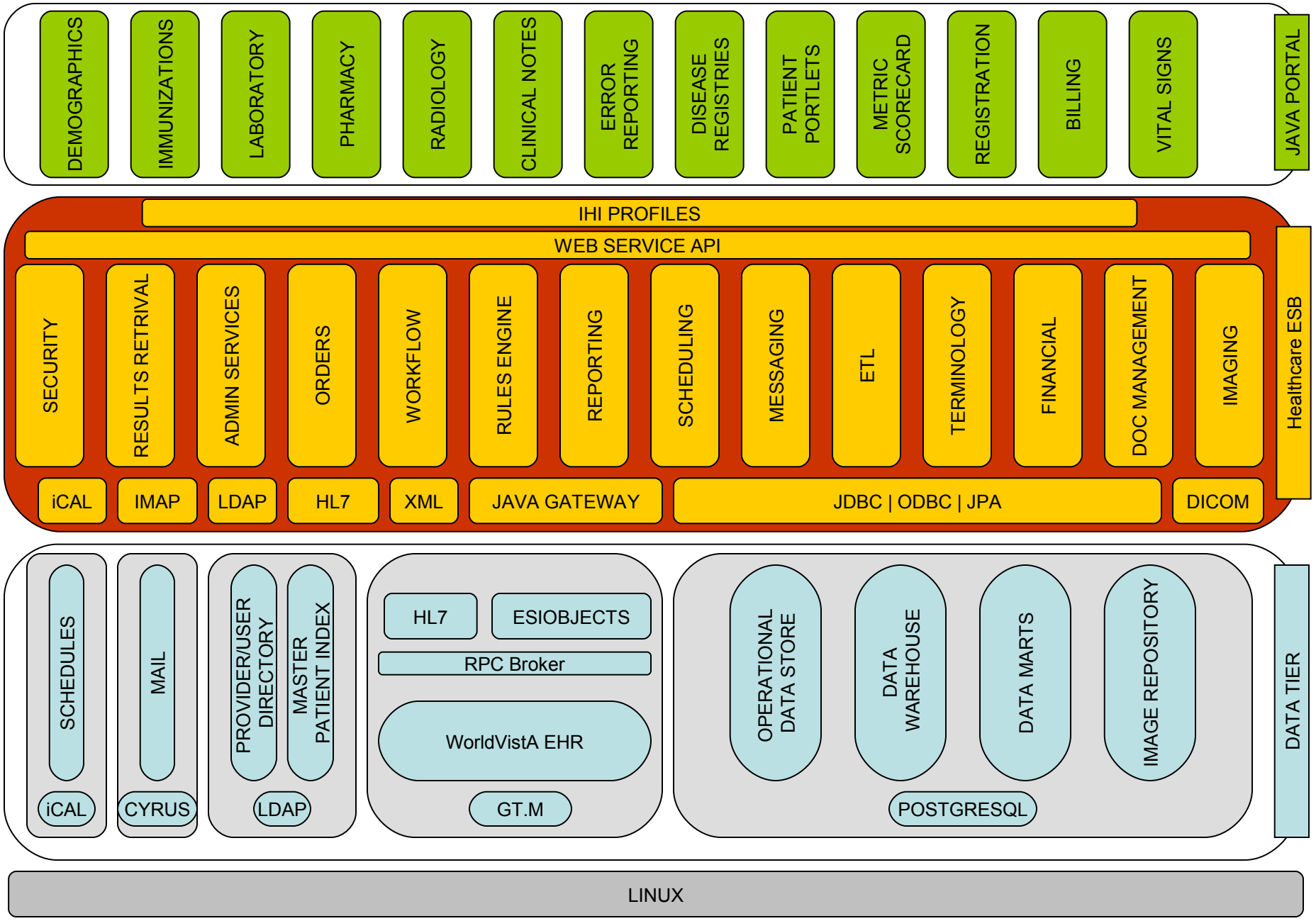
- Highly decoupled, modular components with interfaces modeled after IHE profiles and other applicable standards.
- Clinical data semantically constrained by appropriate domain terminologies and ontologies.
- Data structures conformant with an established reference information model.
- Application functionality exposed as reusable plugins within an open standard "harness"…in our case as portlets within a Java portal.
- Domain expertise and business logic managed with distributed real-time rule and workflow engines.

We call this idealized SOA the "Socratic Grid"

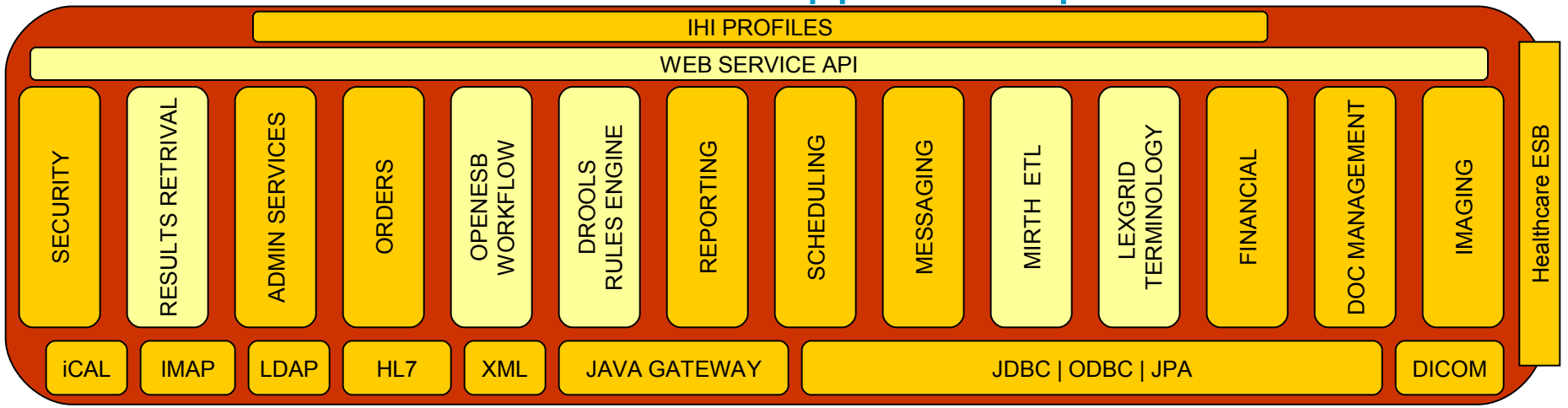
CONCEPTUAL SERVICE ORIENTED CARE FOE HEALTHCARE



SOCRATIC GRID IMPLEMENTATION CONCEPTS

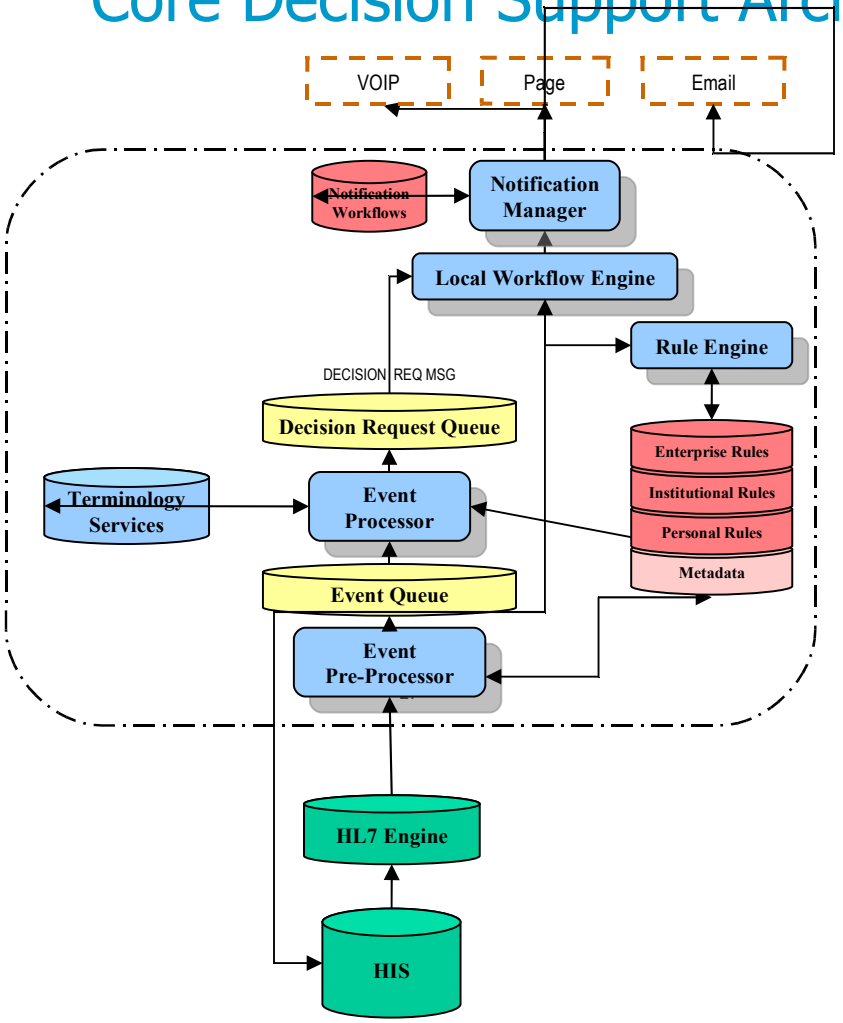


Core Middle Tier Decision Support Components



- Terminology services to semantically constrain clinical data
- Real-time rule and workflow engines to orchestrate clinical workflows across facilities and systems - create orders, consults, appointments, reports, identifies registry patients, etc
- Advanced result notification service includes fax, pager, email, voice, etc
- Background monitoring of computable clinical guidelines and care plans
- Provides the intelligence to transform the infrastructure into a “healthcare quality bus”.

Core Decision Support Architecture



MIRTH HL7 Engine

- Consumes real-time triggers (HL7, XML, etc) and transforms them into native RIM compliant XML messages.

Event Pre-Processor

- Filters inbound messages for which rules and workflows exist.

LexGrid Terminology Service Bureau

- Provides translation services between ICD9, LOINIC, SNOMED and custom terminologies.

Event Processor

- Uses terminology services to semantically constrain inbound triggers. Manages decision support request queue, execution priority, etc.

Drools Rule Engine & Repository

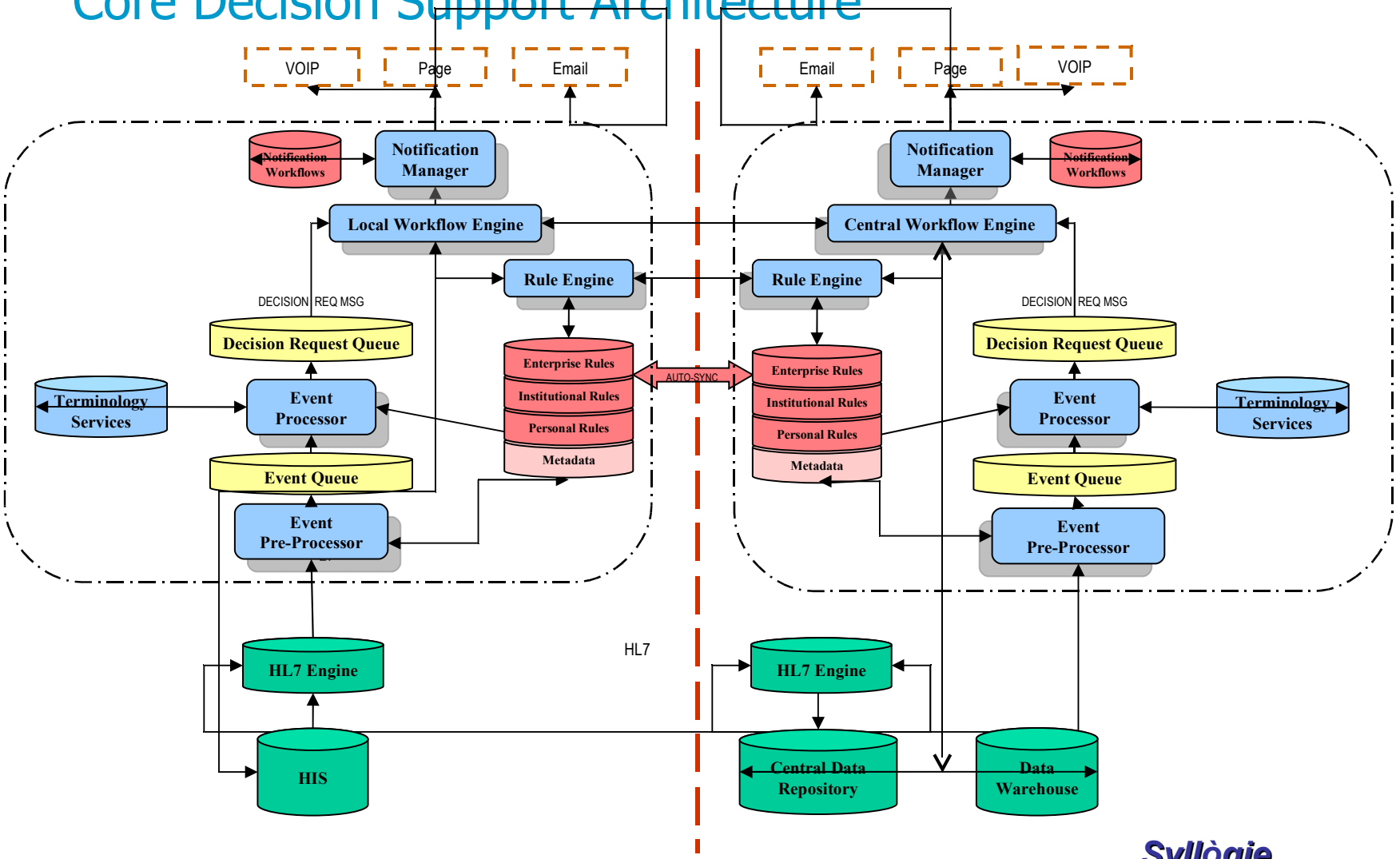
- Evaluates data using applicable rules and determines workflows to be executed.

OpenESB Workflow Engine & Repository

- Executes requested workflows resulting in notification messages to providers, disease registry enrollment, medication orders, etc.

Local Hospital

Core Decision Support Architecture



Local Hospital

Central Data Center

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Grid Administration Tools

Rule Workbench

- GUI tool to visually construct rules using a variety of clinical data elements and logical operators.

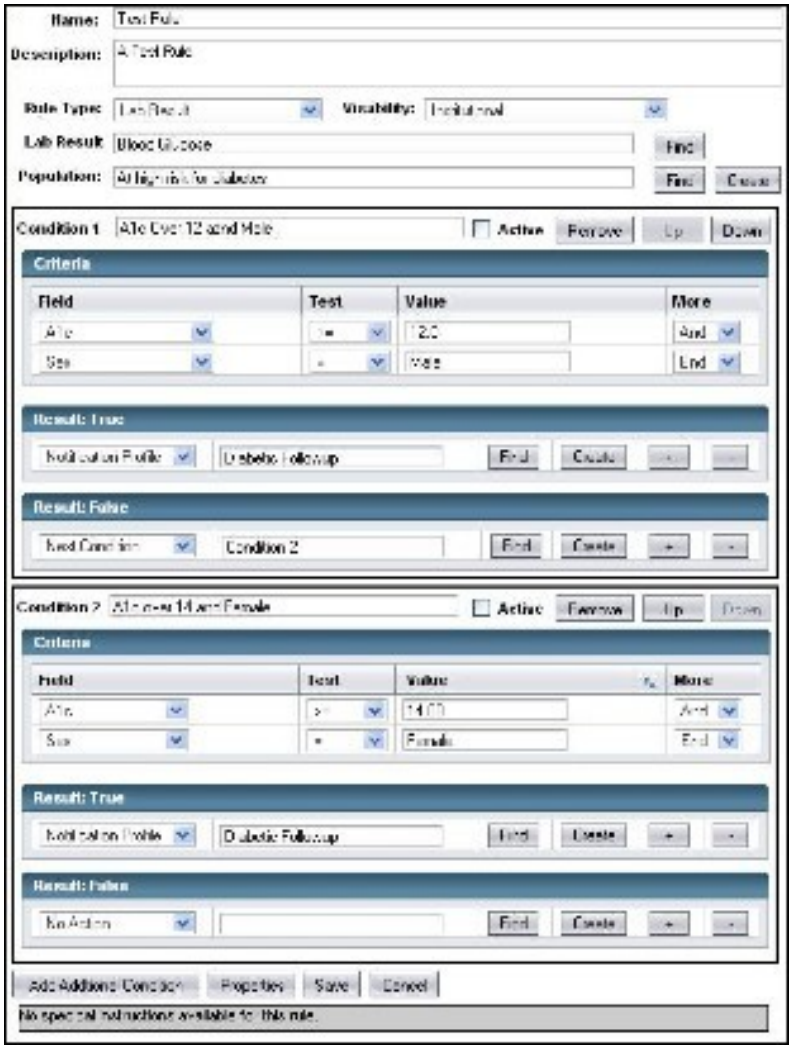
Notification Profile Workbench

- Tool to create profiles of who, how, and when others are told of the results from the rules execution. Recipients can be people, applications, or other services who can be notified by email, page, VOIP, etc.

System Test & Monitoring Harness

- Forensic tool to submit test data and analyze rule/workflow execution. Monitors state of rule engine working memory.

Rule Workbench



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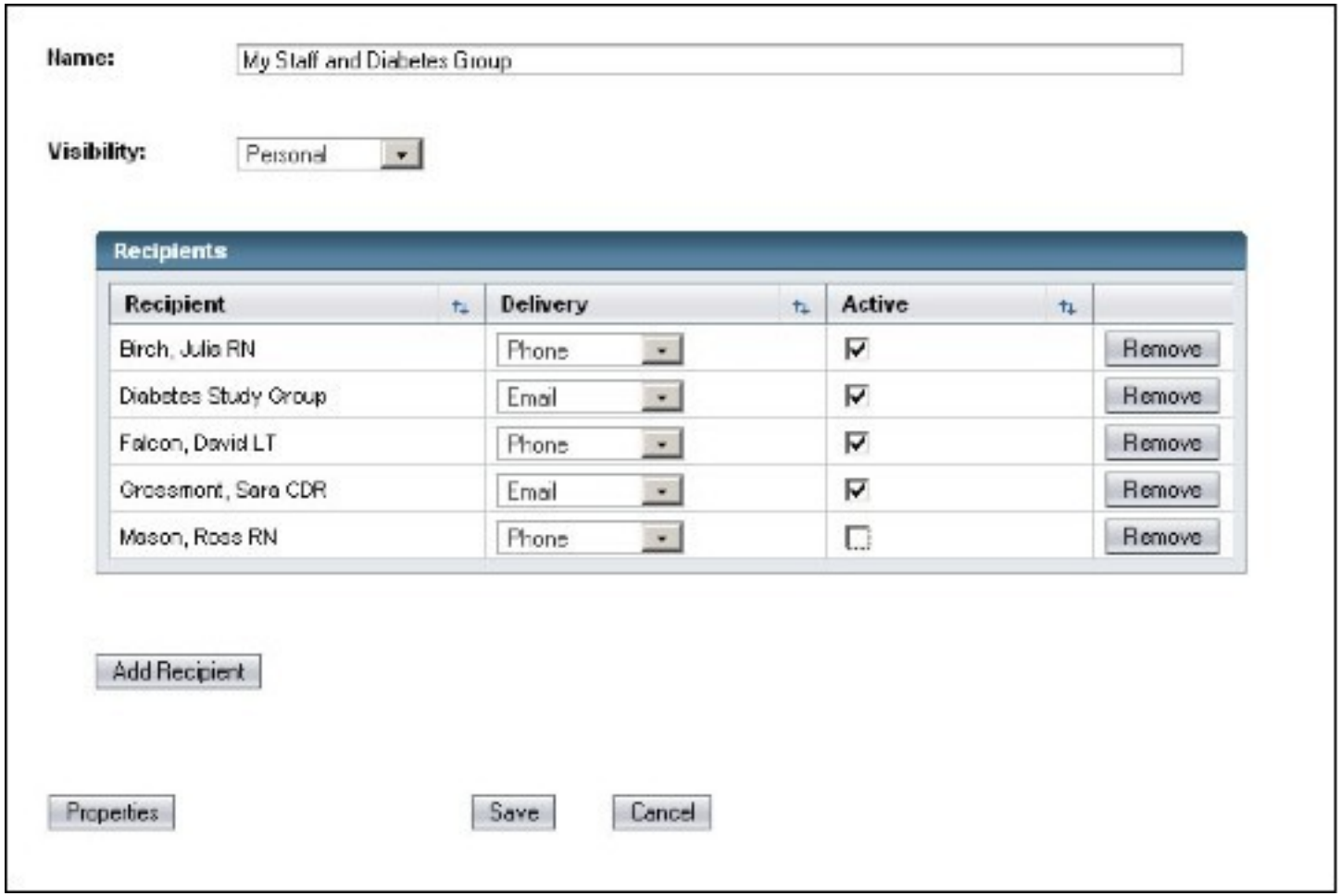
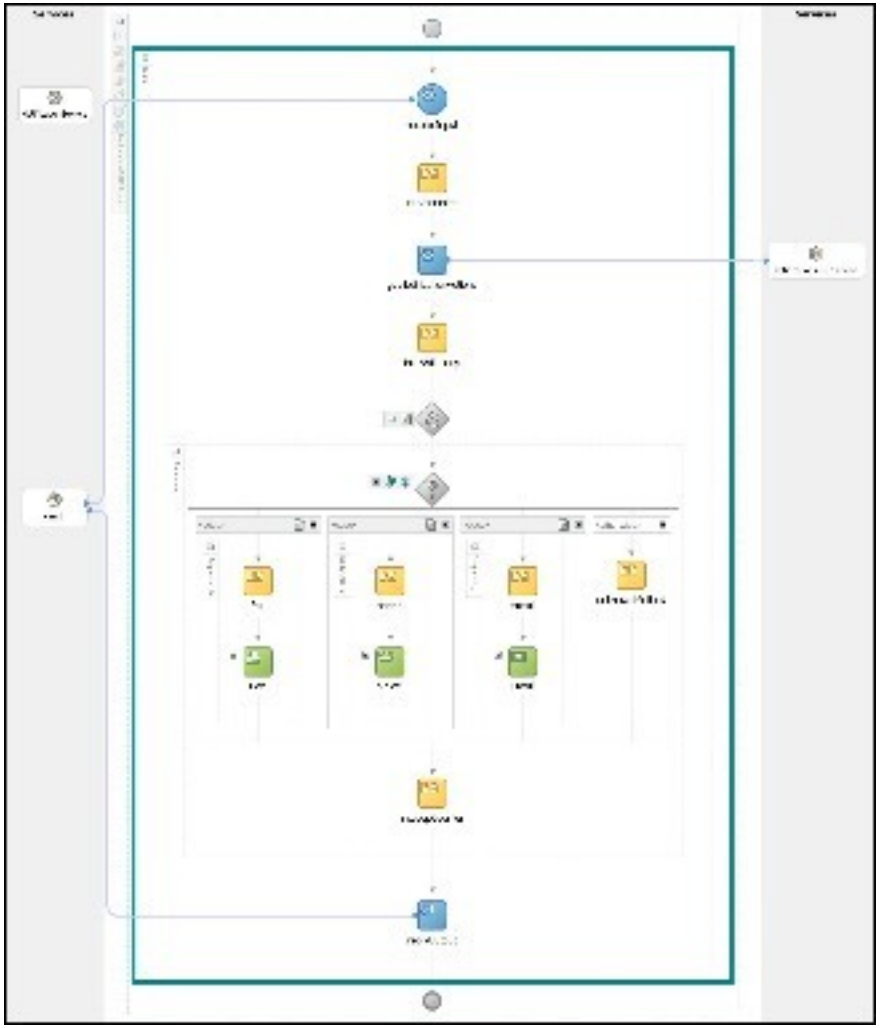
Repository Rule Generated Using Workbench

```
ruleset PERSONAL_1000_MenOver60_High_Weight1 {
  import mil.navy.med.nmcsd.pet.ws.objects.*;
  import mil.navy.med.nmcsd.dseworkbench.beans.*;
  import mil.med.ddss.rules.management.*;
  rule PERSONAL_1000_MenOver60_High_Weight1 {
    priority = 0;
   if ((fact mil.navy.med.nmcsd.pet.ws.objects.VitalsFact factObj && !factObj.isHistorical() &&  factObj.getVitalsNCID().equals("2178")) &&  fact
mil.navy.med.nmcsd.pet.ws.objects.PatientDemographicFact demoFactObj && fact ActionsList actionsList)   {
      String ruleName = "PERSONAL_1000_MenOver60_High_Weight1";
      String ruleSetName = "PERSONAL_1000_MenOver60_High_Weight1";
      if (Populations.PERSONAL_POP_1000_Men_Over_60(demoFactObj))  {  //Population check passed
        String VitalsValue = factObj.getVitalsValue();
        Calendar ValueDateTime = factObj.getValueDateTime();
        if ((Integer.valueOf(VitalsValue).intValue()>280) && (ValueDateTime.getTimeInMillis()>1191222000000L)) {  //// Condition True
          ContextBean contextT1 = DDSS_FUNCTIONS.setContextBean(ruleSetName, ruleName,         "Men over the age of 60 with a High Weight", "Weight over 280
lbs", "mil.navy.med.nmcsd.pet.ws.objects.VitalsFact", factObj.getVitalsNCID(), "FactName?", factObj.getVitalsValue() );
          ActionParameter actionParameterT1R1 =  DDSS_FUNCTIONS.setActionParameter("Email Kim","66");
          ActionParameter[] actionParameterT1R1s = new ActionParameter[] { actionParameterT1R1 };
          boolean status = DDSS_FUNCTIONS.addAction(1,"ActionT1R1",actionParameterT1R1s,contextT1,actionsList);
        }
      }  //End Population Check
    } //This is the Correct Fact
  } //End Rule
} //End RuleSet
```

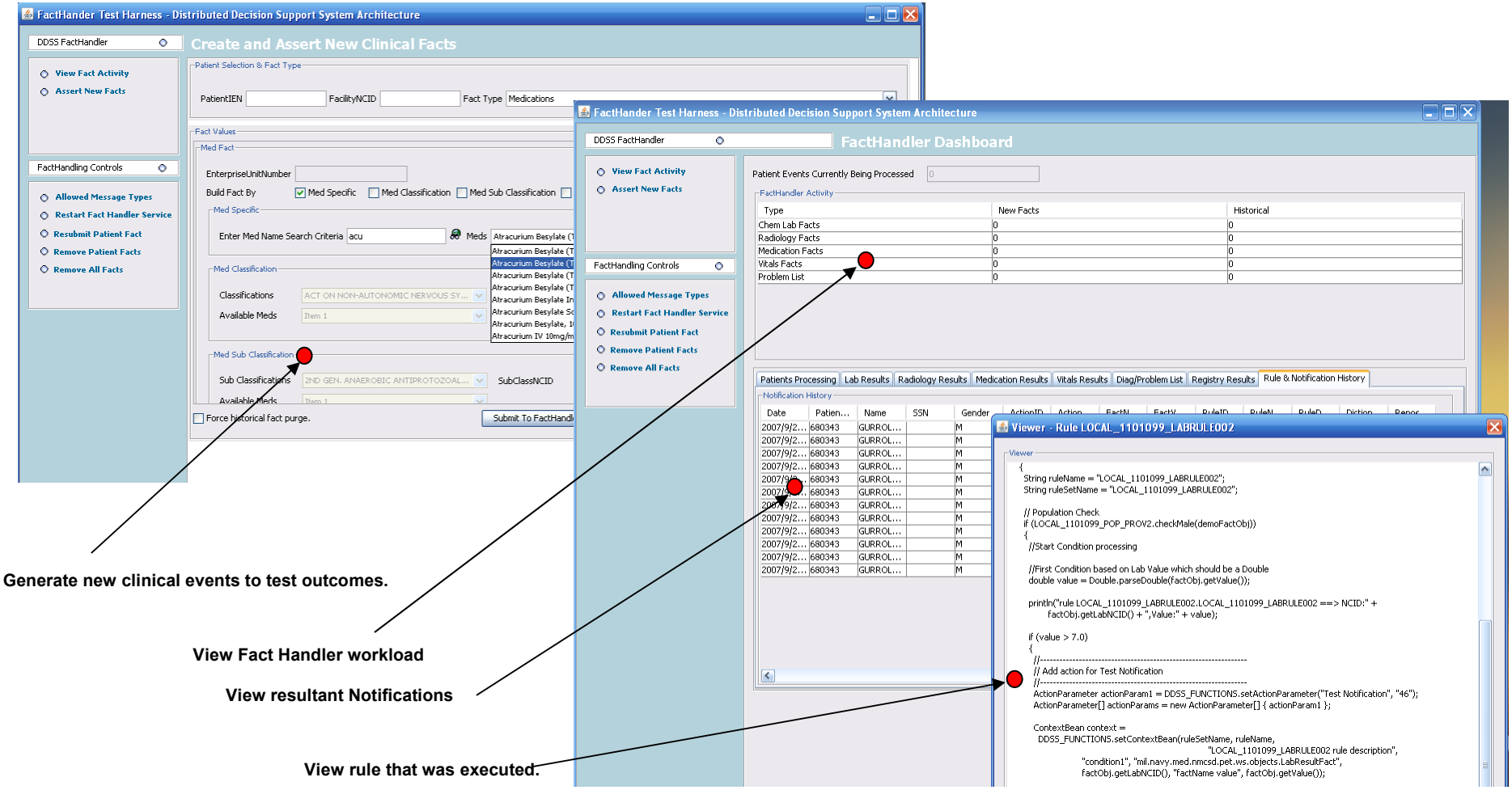
Notification Profile Workbench



Notification Profile BPEL Flow



System Test & Monitoring Harness



Generate new clinical events to test outcomes.

View Fact Handler workload

View resultant Notifications

View rule that was executed.

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Clinical Tools

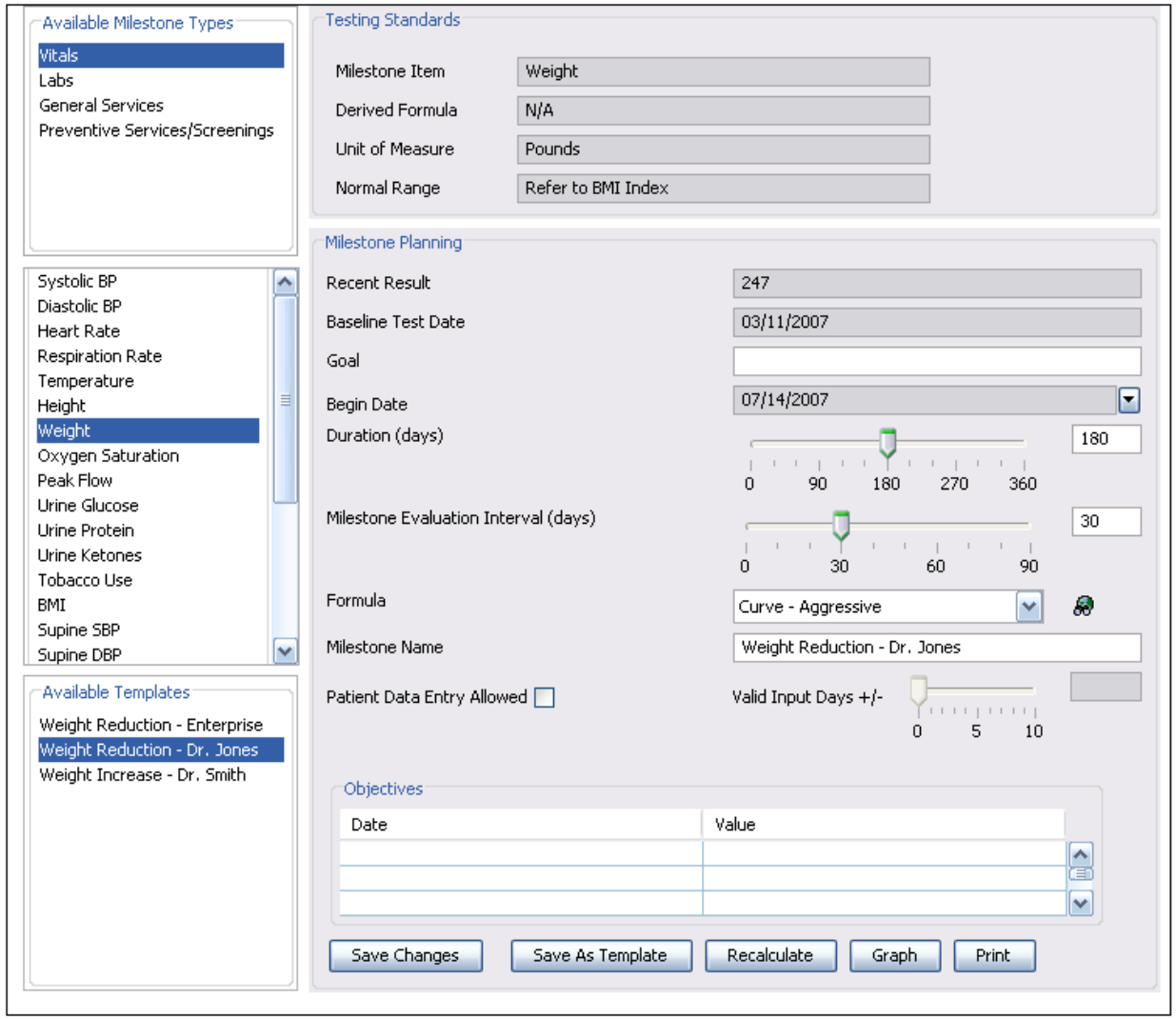
"Milestones to Health"

- Care plan editor to visually construct care plans using a variety of clinical data elements, logical operators, and workflow actions
- GUI tool to plot actual clinical data against care plan goals

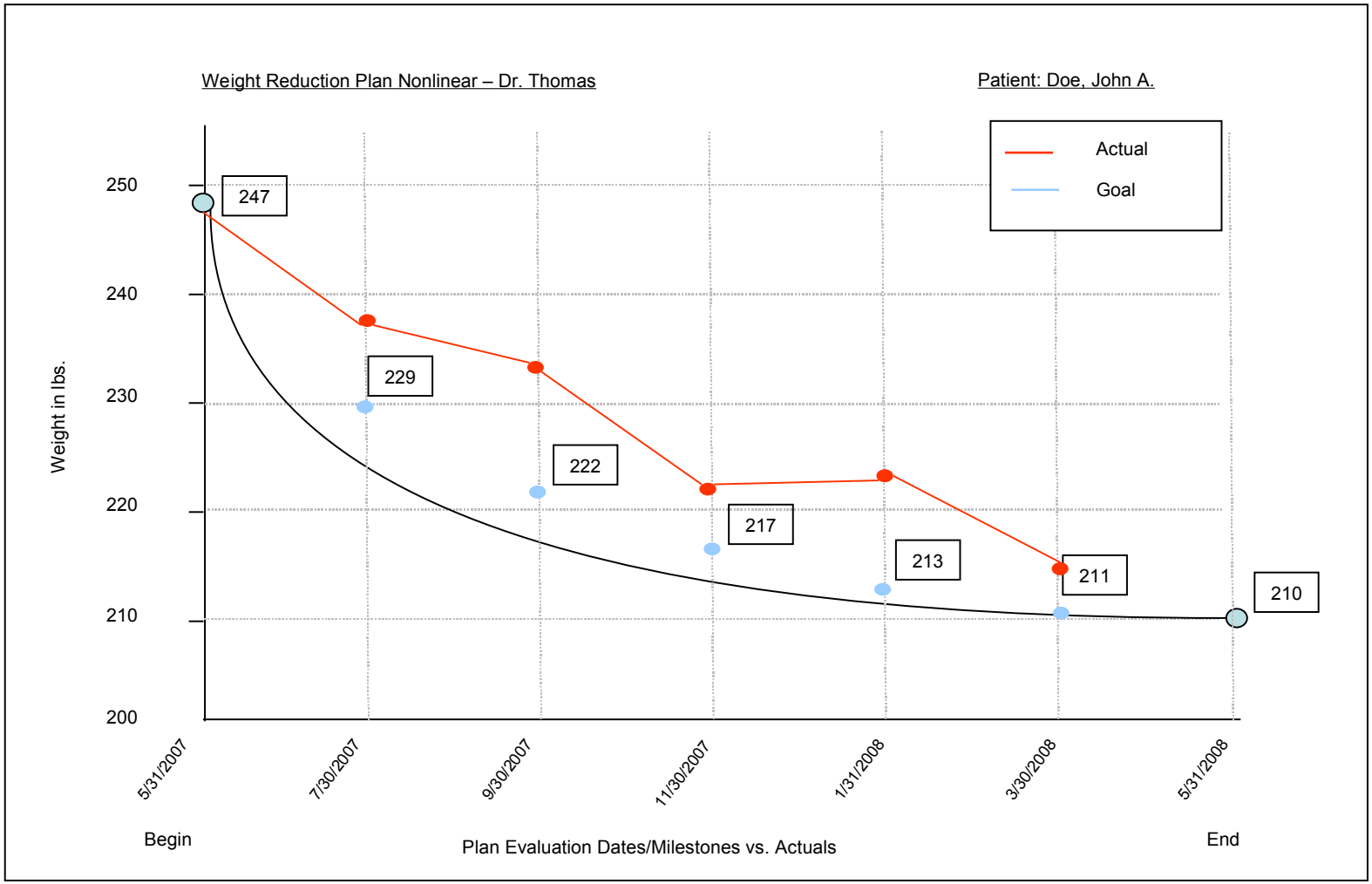
Provider Inbox

- Central workplace tool where provider receives "items" needing attention
  - Patient emails
  - Medical device data uploads from patients
  - Dictations to be edited and signed
  - Alerts and warnings

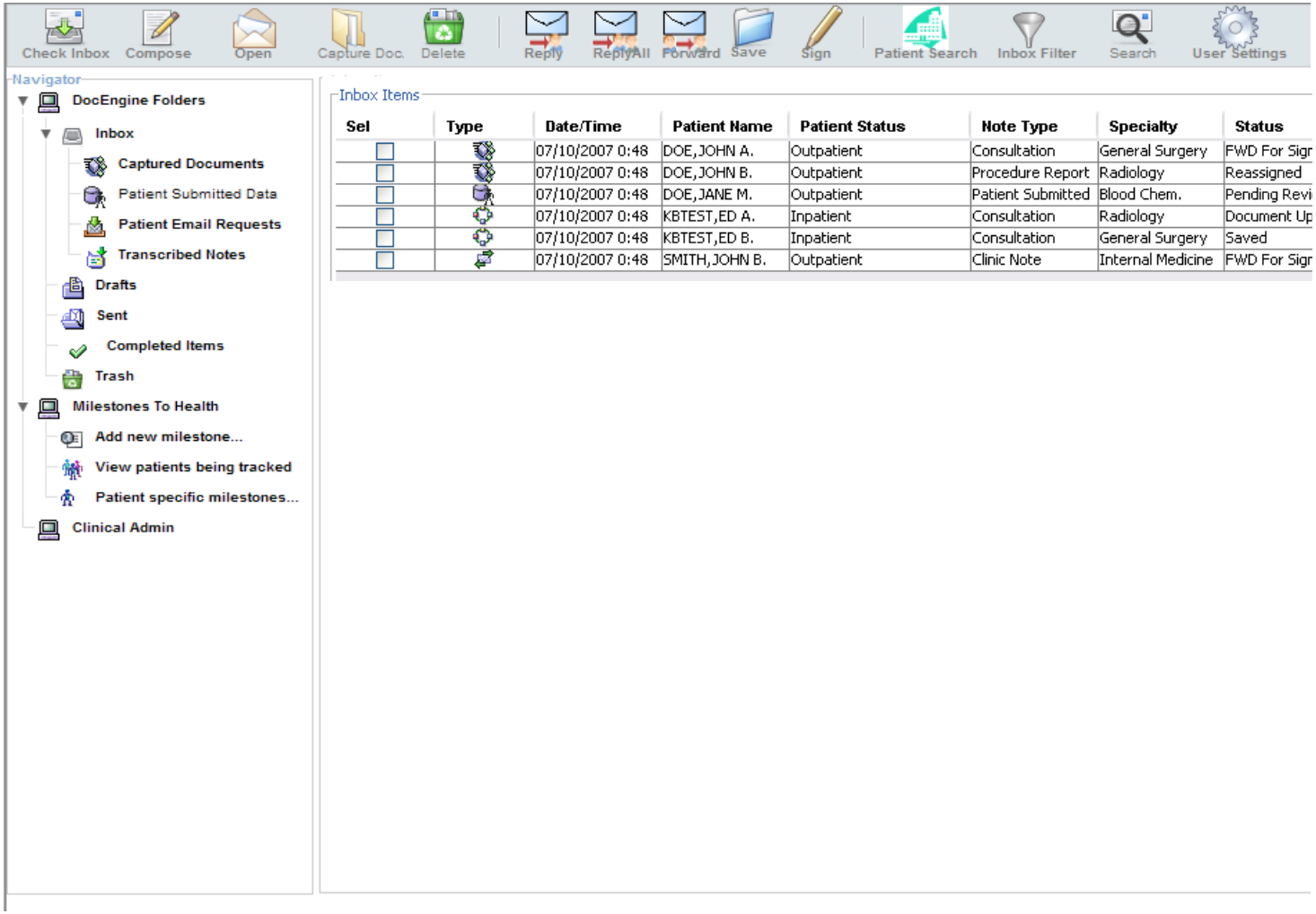
Milestones to Health – Care Plan Editor



Milestones to Health – Progress Review

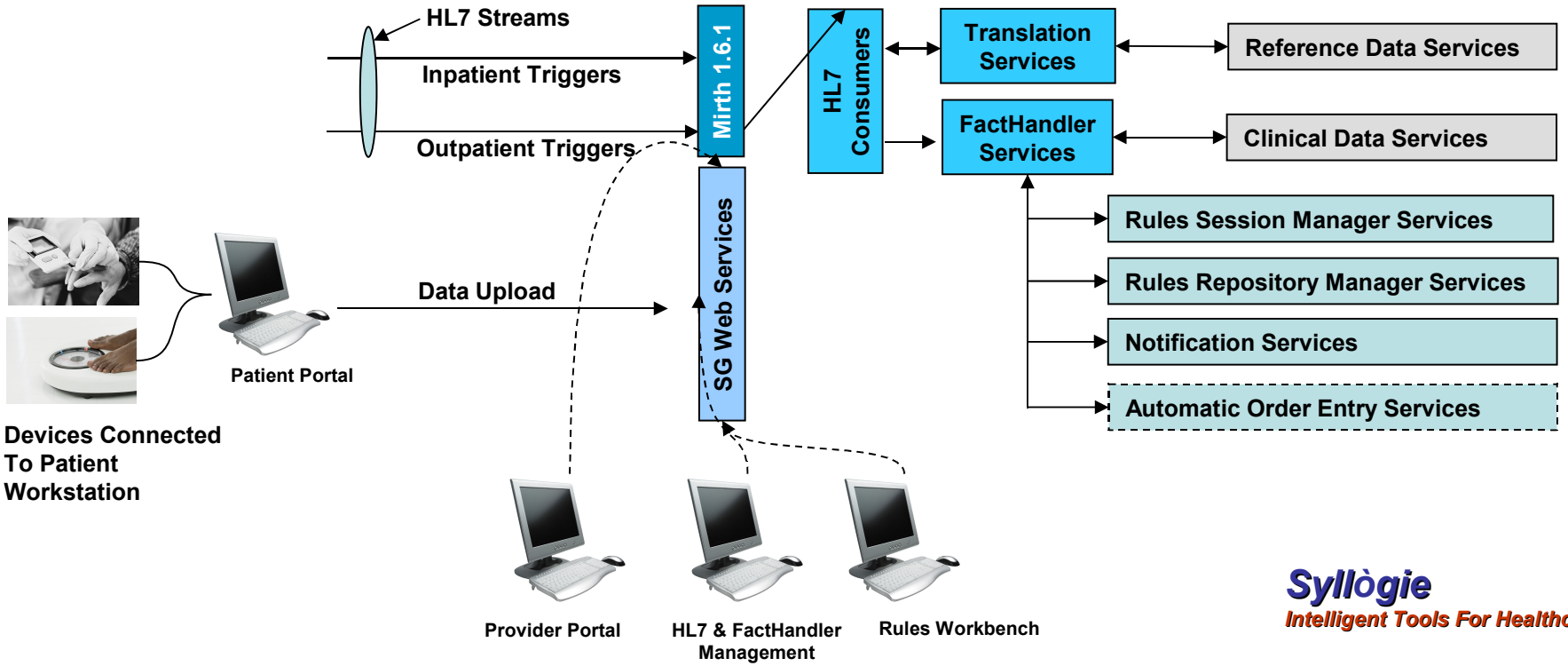


Provider Inbox



Clinical Use Case

- A congestive heart failure patient weighs himself at home and transmits that data to his HMO through a patient portal . The new weight is up 4 lbs from yesterday's weigh in. The patient's provider is automatically notified by email that the recommended intervention is to increase the diuretic and that an order for the new dosage is awaiting their signature.



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Project Status

- Project prototype completed and demonstrable on deployed DOD enterprise architecture.
- Currently implemented using Sun e-Gate Integration Engine, Oracle 10g, Oracle 11g AS, and Oracle Fusion middleware to process HL7 messages from 105 hosts.
- Uses a proprietary Terminology Service Bureau specific to DOD whose meta-dictionary includes MEDCIN, 3M HDD, ICD and CPT.
- Clinical data assessors are web services retrieving data from the central clinical data repository.

Remaining Tasks For Open Source Implementation

- Refactor Translation Services using LexGrid.
- Refactor Clinical Data Accessors to talk to WorldVistA EHR web services.
- Validate all services to perform outside of Oracle environment – container of choice is Glassfish.
- Refactor workbench, repository, and session managers to utilize a JBOSS Drools rule engine and OpenESB workflow engines.

- Develop WorldVistA/Open VistA triggering mechanism.

WorldVistA Triggering Possibilities

- HL7 Triggers
  - No single repository for HL7 message definitions.
  - HL7 generation application centric not system based.
  - Current messages highly customized and conformant to a variety of standards (2.4, 2.5, etc).
- Journal File Extracts
  - GTM uses journal file for disaster recovery.
  - Routine exists to create journal file extracts.
  - Strategy is to modify code to send XML extract to Socratic Grid.
  - Translation Services will access Fileman data dictionary and LexGrid terminologies to transform data elements to a semantically constrained 'fact'.
- Other community generated concepts are welcome.

Next Steps….

- Launch project @ www.socraticgrid.org so interested parties can participate.
- Publish detailed roadmap and project requirements.
- Scope final Release 1.0 tasks.
- Develop detailed test and validation plan.
- Pilot implementation – identify organization for real-world pilot evaluation.