
Artemis Project



A Semantic Web Service-based P2P
Infrastructure for the Interoperability of
Medical Information Systems
(IST-1-002103-STP)

Challenges of Healthcare Informatics



- Most of the health information systems today are proprietary
- They often only serve one specific department within a healthcare institute
- To complicate the matters worse, a patient's health information may be spread out over a number of different institutes which do not interoperate
- This makes it very difficult for clinicians to capture a complete clinical history of a patient

Electronic Healthcare Record (EHR) Architectures



The nice thing about standards is that there are so many to choose from 😊

- „Candidates“ of EHR architectures:
 - ❑ CEN ENV 13606 „EHR Communication“
 - ❑ Good Electronic Health Record (GEHR)
 - ❑ OpenEHR
 - ❑ CEN EN 13606 (draft)
 - ❑ HL7 Clinical Document Architecture
 - ❑ HL7 v2 Information Model (implicit)
 - ❑ HL7 v3 Reference Information Model (draft)

Artemis Architecture



- The Artemis project addresses the interoperability problem in the healthcare domain where organisations have proprietary application systems to access data

- To exchange information in an interoperable manner, the medical institutes:
 - Classify the Web services that they are providing through **Service Functionality Ontologies**
 - Determine the semantics of Service Messages through **Service Message Ontologies**

Semantic Mediation: Ontology Mapping



- The differences between disparate Service Functionality and Service Message Ontologies will be resolved through Ontology Mapping
- Although we propose to develop ontologies based on the prominent healthcare standards, **the ontologies we are proposing is just to facilitate ontology mediation**
- It realistic to expect healthcare institutes to conform to one global ontology

What kind of Semantics?



■ Service Functionality Semantics:

- HL7 Version 2.x has categorized the events in healthcare domain by considering service functionality which reflects the business logic in this domain
- This classification can be used as a basis for defining the service action semantics through a Service Functionality Ontology

■ Service Message Semantics:

- Electronic healthcare record (EHR) based standards like HL7 CDA (Clinical Document Architecture), GOM (GEHR Object Model), and CEN TC251's ENV 13606 define **meaningful components of EHR** so that when transferred, the receiving party can understand the record content better
- The **meaningful components** defined by these standards can be used in developing service message ontologies

HL7 Version 2.x and Web Services



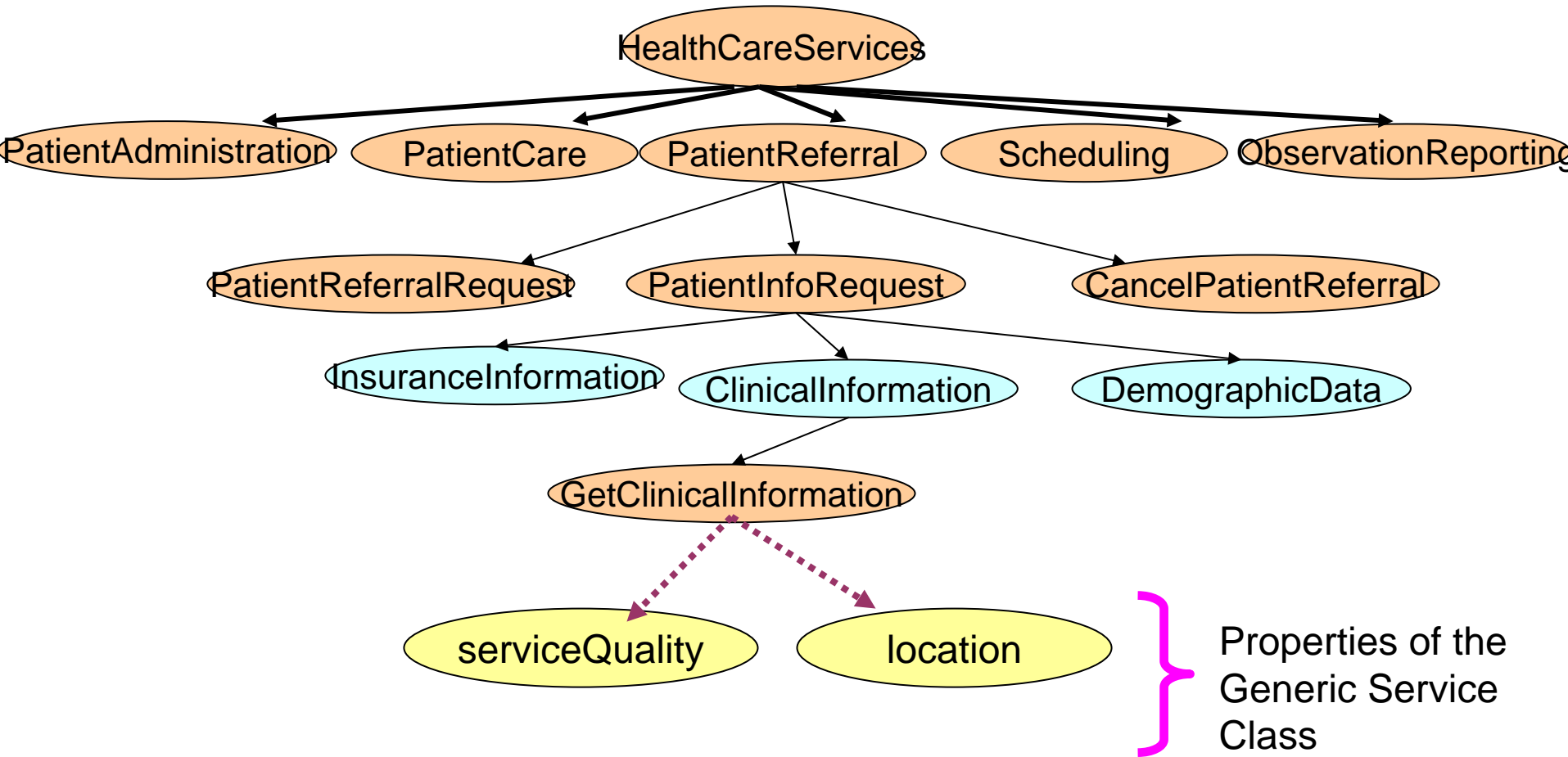
- The primary goal of HL7 is to provide standards for the exchange of data among healthcare computer applications
- An event in the healthcare world, called the trigger event, causes exchange of messages between a pair of applications
- When an event occurs in an HL7 compliant system, an HL7 message is prepared by collecting the necessary data from the underlying systems and it is passed to the requestor, usually as an EDI message
- Mapping HL7's message based events directly into Web services may result in several inefficiencies

HL7 Version 2.x and Web Services



- The input and output messages defined for HL7 events are usually very **complex containing innumerous segments of different types and optionality**
- Furthermore, **all the semantics about the business logic and the document structure are hard coded in the message**
- This implies that, the party invoking the Web service must be HL7 compliant to make any sense of the content of the output parameter(s) returned by the service
- Furthermore, the information contained in an **HL7 message may be coming from different systems either proprietary or complying to different standards**
- Hence, in Web services terminology, HL7 events correspond to **Composite services**, whereas more elementary services are needed

An Example Service Functionality Ontology based on HL7



Service Messages



- **A Web service in the healthcare domain usually accesses or updates a part of an electronic healthcare record, that is, parts of the EHR constitute the service parameters**
- An electronic healthcare record may get very complex with data coming from diverse systems such as lab tests, diagnosis, prescription of drugs which may be in different formats
- Electronic healthcare record (EHR) based standards like HL7 CDA, GOM and CEN's ENV 13606 aim to facilitate the interoperability between Medical Information Systems
- These standards provide **conceptual building blocks** or **meaningful components**
- We propose to use these standards as a basis for Service Message Ontology

An example Service Message Ontology



DD02: Problem

DTC12: CarePlan

DF03: AllergyState

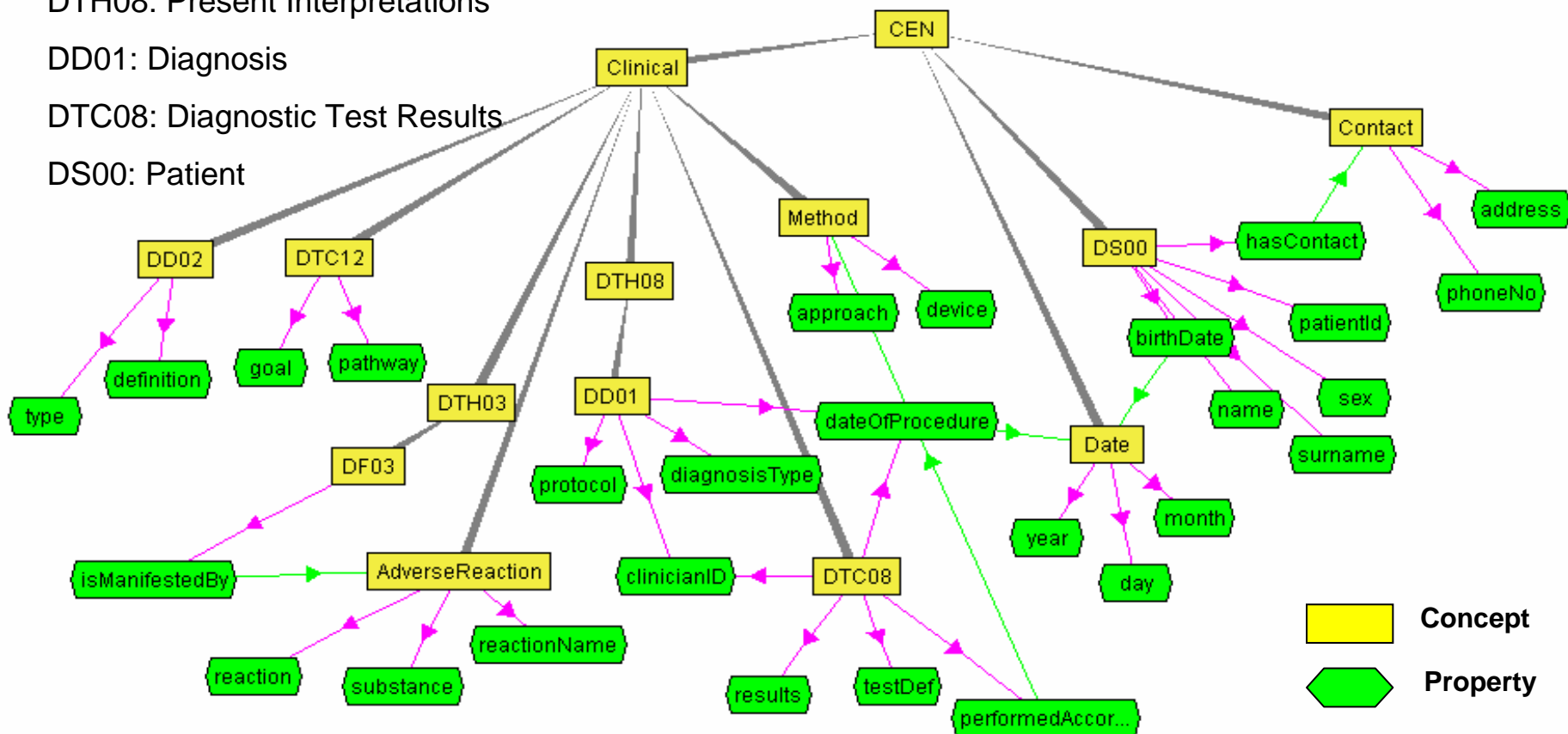
DTH03: Ongoing Problems

DTH08: Present Interpretations

DD01: Diagnosis

DTC08: Diagnostic Test Results

DS00: Patient

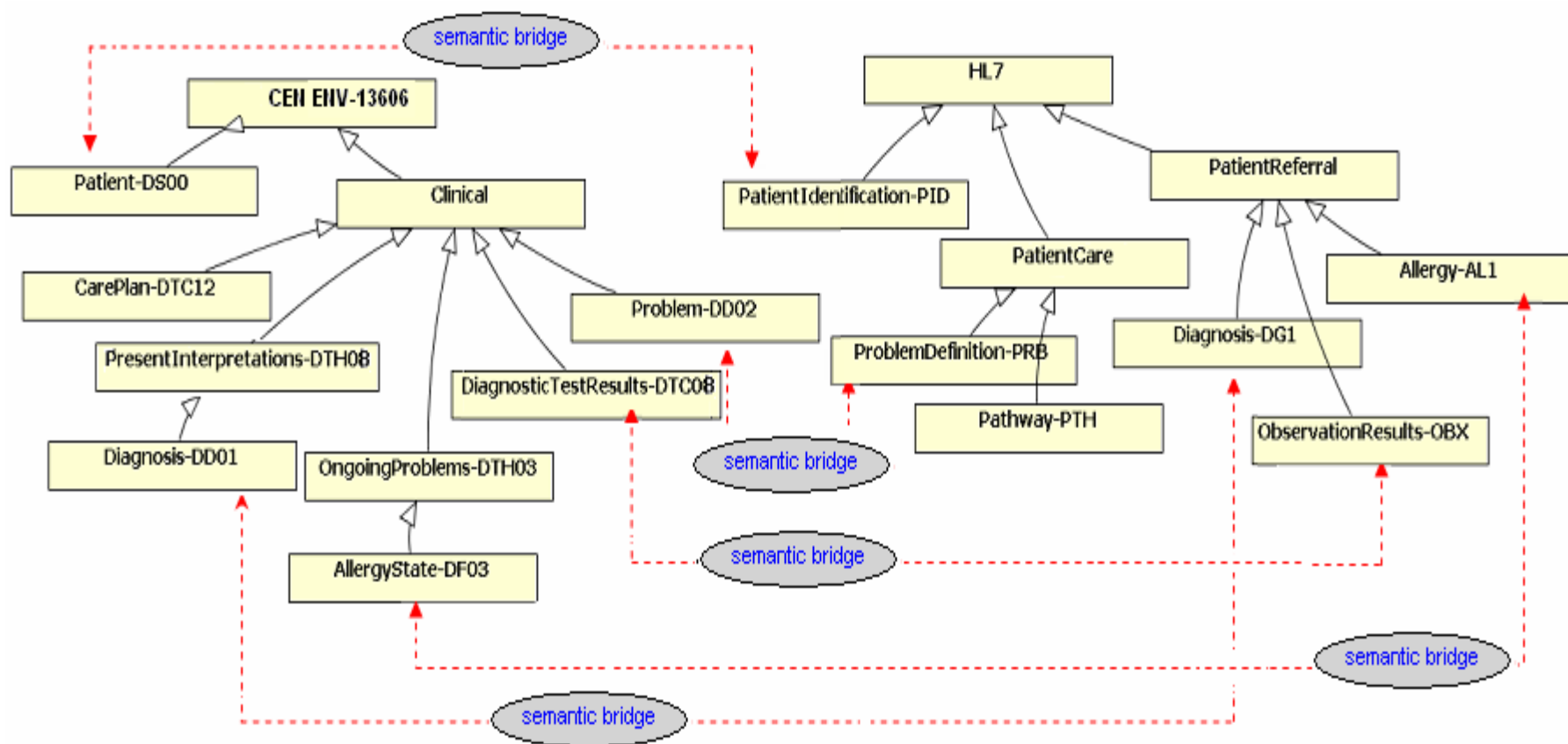


Semantic Mediation

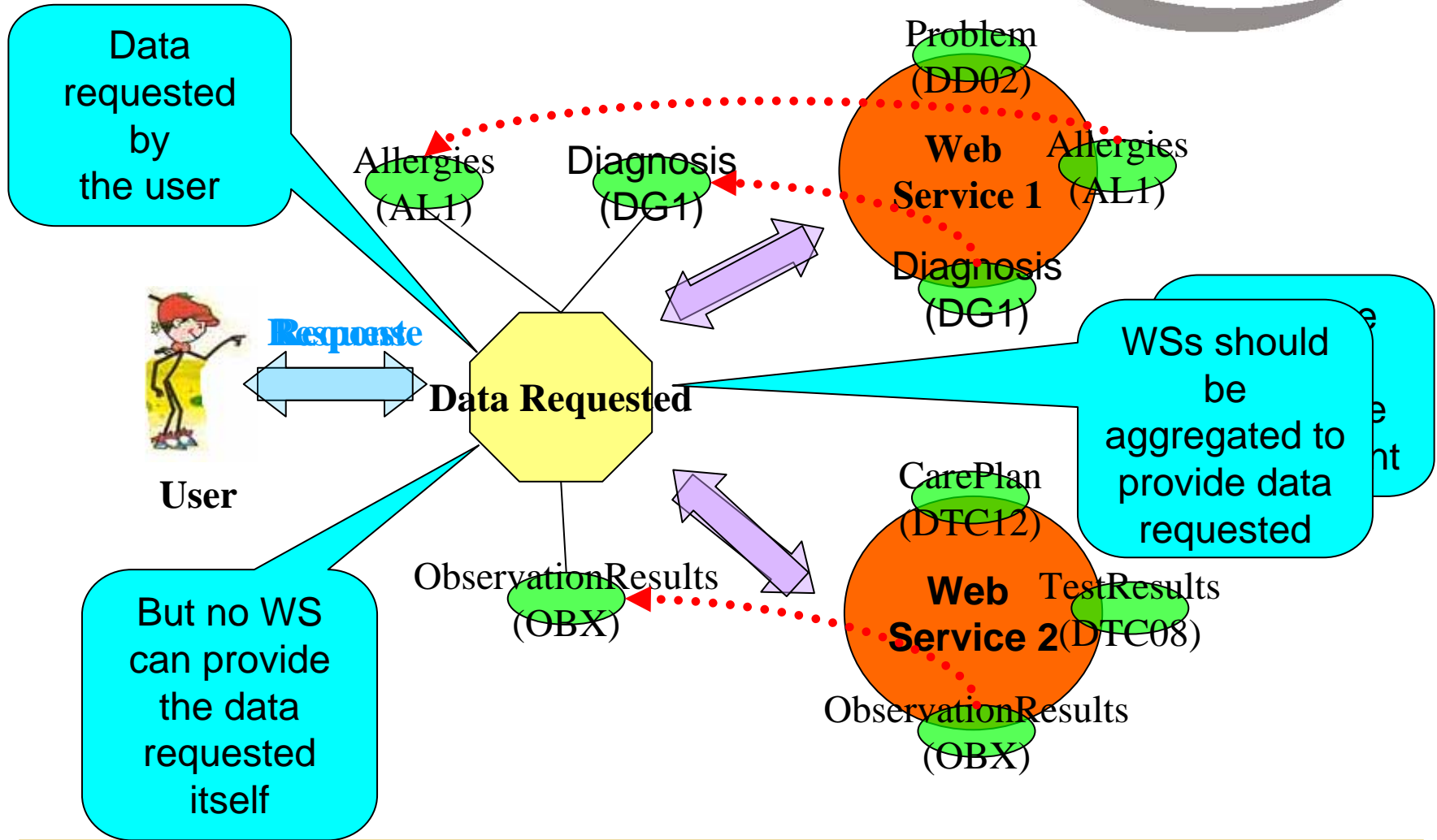


- In Artemis architecture, the healthcare institutes can develop their own ontologies
- However these ontologies are based on standards developed by the healthcare standardization bodies like CEN TC251, ISO TC215, GEHR or HL7
- The ontology mappings are achieved through semantic mediation

Mapping Message Ontologies



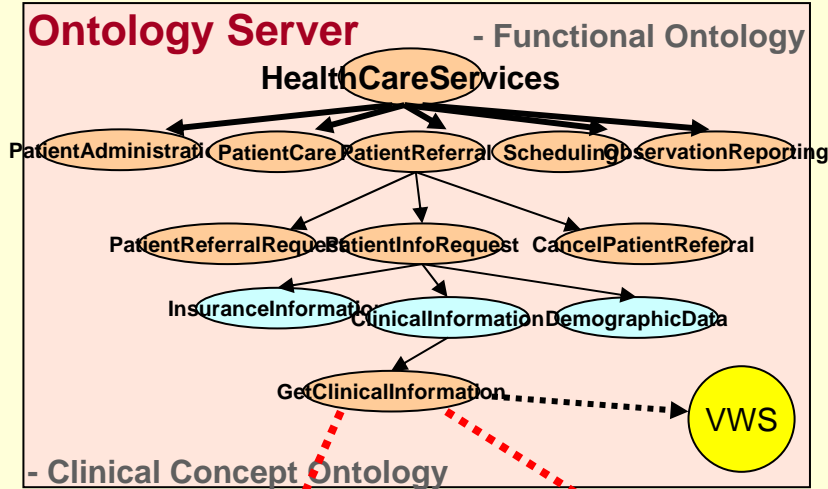
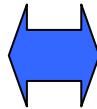
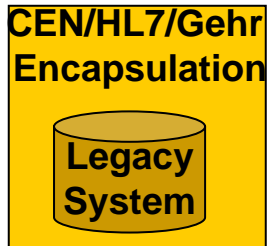
An Example to Service Aggregation



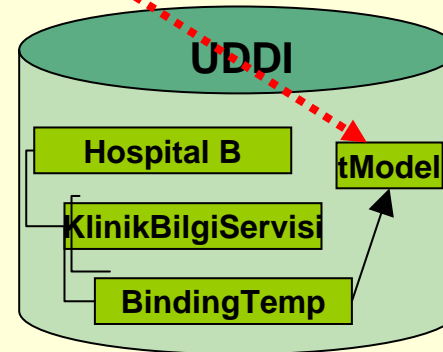
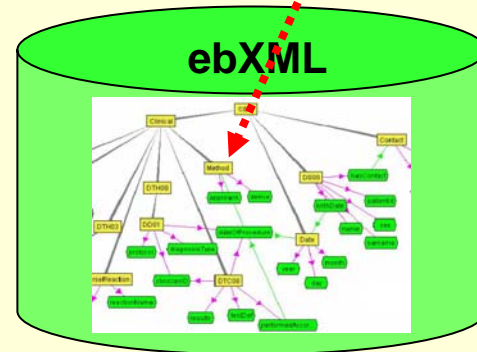
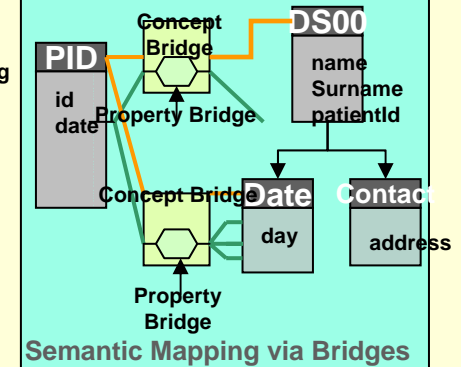
An Overview of a Mediator



Mediator Components



Semantic Mediator



Web Service Enactment

SuperPeer Services

Client Interface

Artemis Project: References



- <http://www.srdc.metu.edu.tr/artemis/>
- Dogac, A., [Laleci, G.](#), [Kirbas S.](#), [Kabak Y.](#), [Sinir S.](#), [Yildiz A.](#) Gurcan, Y., "Artemis: Deploying Semantically Enriched Web Services in the Healthcare Domain", Information Systems Journal (Elsevier), accepted for publication
<http://www.srdc.metu.edu.tr/webpage/publications/>

Current Artemis research...



- Mapping meaningful EHR components of one standard into another is not enough!
- To provide machine interoperability, we need more semantic details of meaningful components
- The solution seems to be in Archetypes: We are working on this issue

Archetypes



- An archetype is a reusable, formal expression of a distinct, domain-level concept, expressed in the form of constraints on data whose instances conform to a reference model
- Reference model could be CEN 13606, openEHR, the HL7 CDA schema, R-MIMs and HMDs

Artemis Contributions to Standards: Plans



- How to store archetypes (OWL versions) into ebXML registries?
- How to semantically annotate archetypes with ebXML classification hierarchies?
- How to access archetype metadata through ebXML query facilities?
- How to retrieve archetype data from medical information systems?

Artemis Contributions to Standards: Plans



- How to compose archetypes?
- How to map one template and archetype to another?
- How to federate ebXML registries and uniquely identify R-MIM Components?
- METU-SRDC is a member of **OASIS International Health Continuum Technical Committee**: We plan to submit this work to this committee

Artemis Contributions to Standards: Plans



- For ontology mapping, currently we are using an RDF based mapping tool called MAFRA (result of a previous IST project)
- We are working on a OWL based ontology mapping tool
- **Expected Result: Can be submitted to W3C if we are successful in contributing to OWL based ontology mapping field**

Artemis Contributions to Standards: Plans



- Integrating Healthcare Enterprise (IHE) has defined a few basic Web services
- Yet, since IHE does not address semantic issues: to use IHE Web services, it is necessary to conform to their specification exactly,
 - by calling the Web services with the names they have specified, and
 - providing the messages as instructed in its specification
- **We plan to contribute to IHE by semantically enriching the Web services they have defined**

Artemis Contributions to Standards: Plans



- Finally through all this work, we intend to contribute to:
 - CEN/TC251 “Health Informatics”

 - CEN/ISSS eHealth Focus Group

**Thank you very much for your
attention!**

