



# Med@Tel, Luxemburg, April 06-08 2005

HOME

KNOWLEDGE SHARING AND DECISION SUPPORT FOR HEALTHCARE PROFESSIONALS



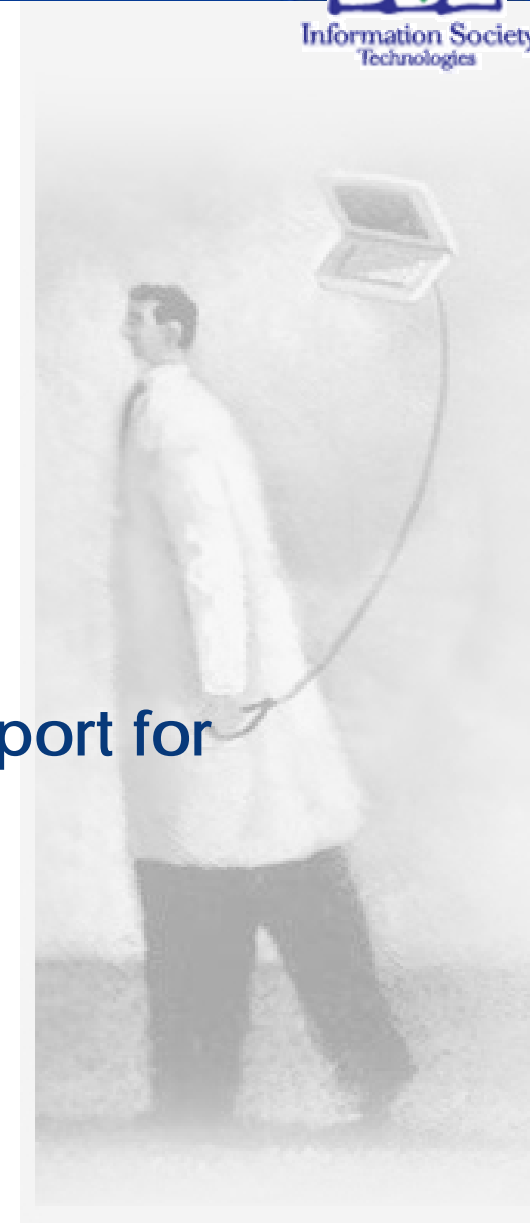
Information Society  
Technologies

DOC@HAND

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R&D Project Manager.  
Nomos Sistema S.p.A

**Doc@Hand:**

**Knowledge Sharing and Decision Support for  
Healthcare Professionals**





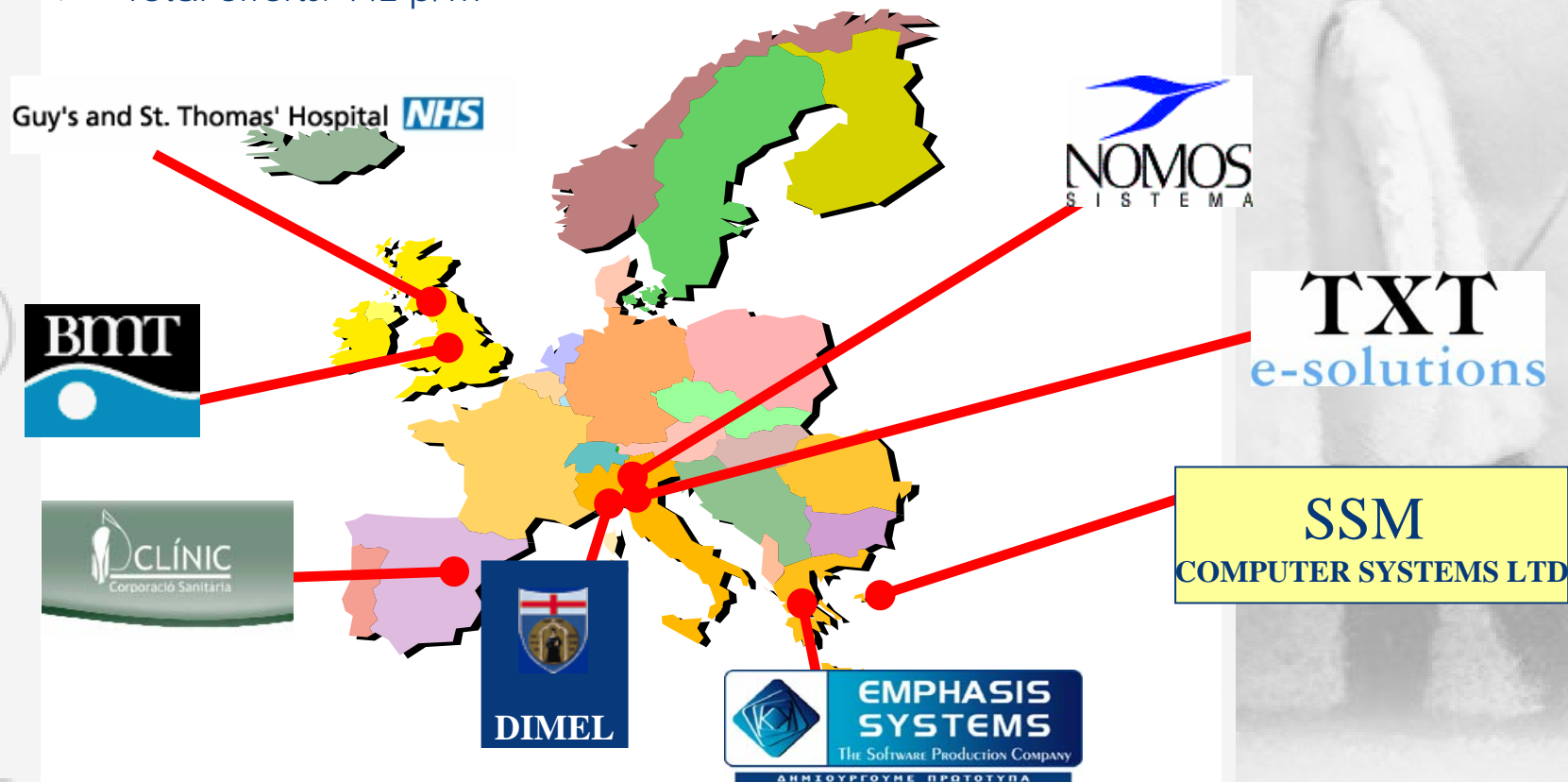
# Key project information

KNOWLEDGE SHARING AND DECISION SUPPORT FOR HEALTHCARE PROFESSIONALS



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- Project name: Doc@Hand
- Project type: STREP
- Consortium composition: 7 partners, 5 countries (4 IT Companies, 1 Academic, 2 Users)
- Project Coordination: TXT e-Solutions (I)
- Project duration: 30 months (1/1/2004 - 30/6/2006)
- Total efforts: 442 p/m





# The Healthcare Scenario

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## Demand Side

Wellness  
Quality  
Consistency  
Personalization



## Supply Side

Decentralization  
Multiple actors  
Cost reduction  
Resource shortage



**Increasing pressure on HealthCare Professionals**

Help needed in:

- Reducing the time spent in collecting the data they need
- Reducing the costs associated to the lack of timely information
- Increasing the quality of their decision making through prompt availability of relevant and complete data



# Doc@Hand mission

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## Our goals

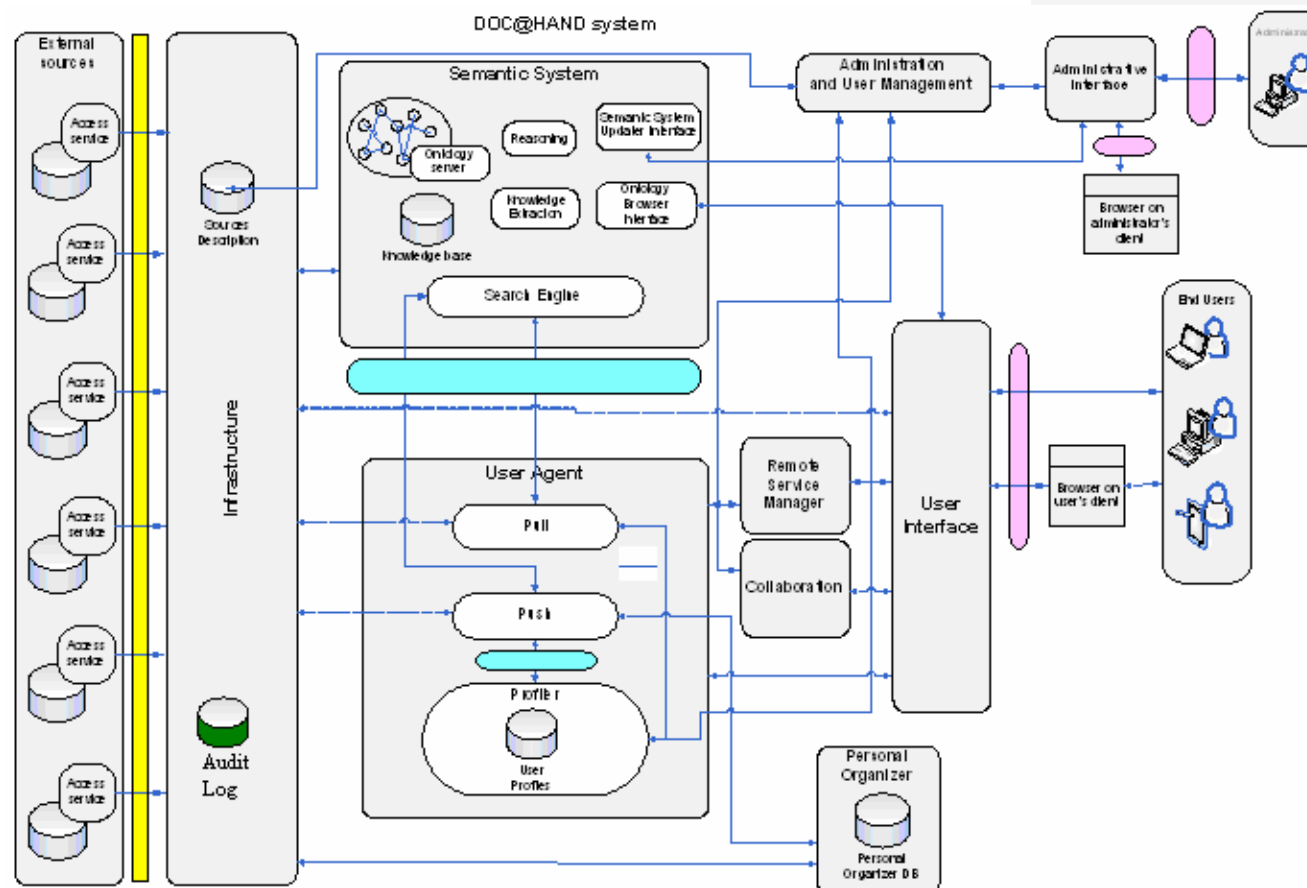
- To facilitate the retrieval and the understanding of knowledge and information geographically dispersed (indexing, knowledge elicitation)
- To interrogate the System through Natural Language queries (query-answering extended browsing and navigation)
- To improve health professionals quality of services
- To support health professionals in their day-by-day complex problem solving and decision making activities.

Objective	Target
Reduce time needed to search, filter and organize info & knowledge	Project target: -80% average
Ensure relevance of search results	Project target: 80%
Reduce noise (not relevant results)	Project target: -50%
Reduce costs for duplicate activities	Project target: -80%



# Doc@Hand Architecture

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- Authentication
- Access Right / Control
- Auditing
- Secure Networking



# Main features

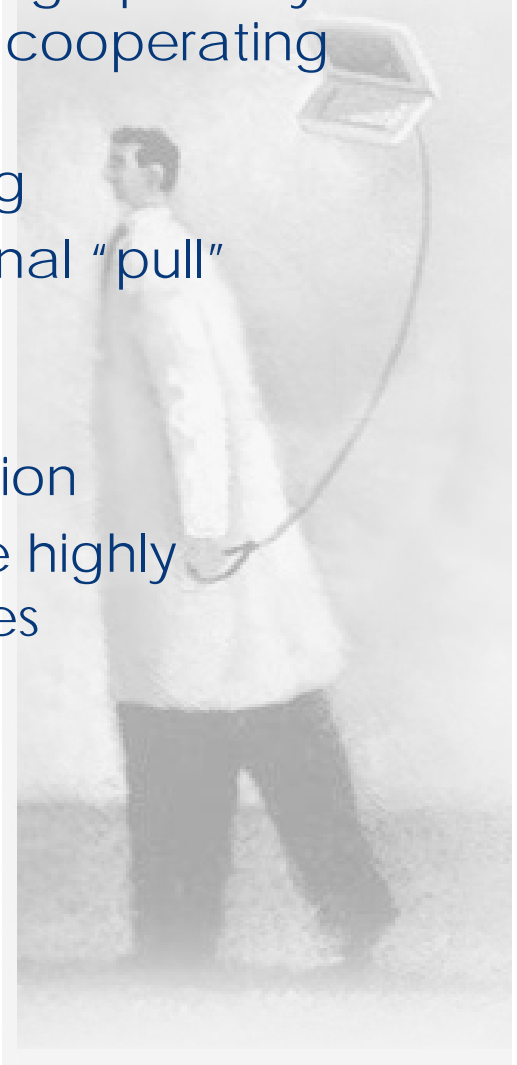
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- Transparent access to heterogeneous and geographically dispersed databases owned by separate, but cooperating organizations;
- Proactive search for relevant information, using
  - push technologies complementing traditional “pull” approach
  - domain ontology
- Collection of related knowledge and information
- Presentation through an intuitive user interface highly customized on user profile and current activities



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# Accessing Doc@Hand

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- ❖ Doc@Hand can be accessed by different terminals:  
Desktop, Laptop, Tablet PCs
- ❖ Wireless communication is supported:
  - WLAN
  - UMTS / GPRS
- ❖ Active connection dictates content selection
  - dynamically infer user's information needs  
(different context means different content)
  - reduce pushed content if running on limited or  
expensive bandwidth





# Doc@Hand interface

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## Doc@Hand Homepage



# Doc@Hand

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1. Neil Reasor
2. Kelly Dismukes
3. Fernando Leisinger
4. Darren Frew
5. [Hillary Staker](#)
6. Mathew Wason
7. Marylou Katon
8. Noemi Hoosier
9. Allan Harpole
10. Darren Frizell

### Hillary Staker

Woman 43 years with menstruation. Non toxic habits

Consults for an increased feeling of fatigue in the past three months. No suspicious family history. No other digestive symptoms. No medication.

Slightly distended, soft, non-tender abdomen with active bowel sounds.

### MEDLINE NEWS

#### Sunday, October 24

- o [Flu Vaccine Production System Shaky](#) (New York Times Syndicate)

#### Friday, October 22 [Return to top](#)

- o [Lipid Levels Vary by Race, Gender](#) (United Press International)
- o [Rural Veterans' Health is Poorer](#) (United Press International)
- o [Flu Vaccine Shortage Makes Watching Health Critical](#) (New York Times Syndicate)

### SEARCH ENGINES

Doc@Hand

Google





# Doc@Hand core – The Semantic Subsystem

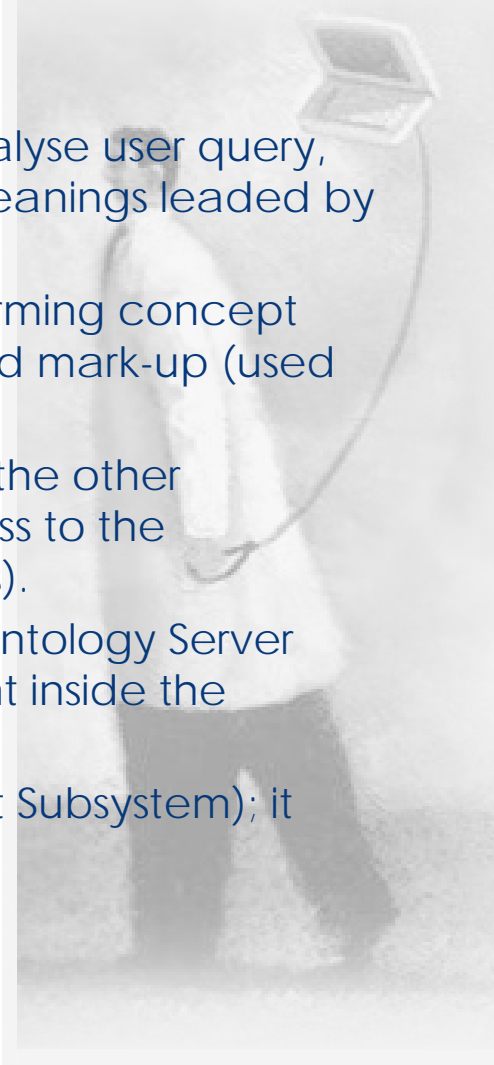
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The core Doc@Hand features are provided by the Semantic Subsystem, composed by:

- ❖ **Search engine** (based on Lucene) **Xml-based** able to analyse user query, to extract the main concepts, to expand the intended meanings leaded by semantic infrastructure (Dictionary and Ontologies).
- ❖ **Parser** (based on Gate); it analyses text documents performing concept extraction (used to enrich a Virtual Knowledge space) and mark-up (used for document indexing).
- ❖ **Ontology Server** (Protegè 2000): it communicates with all the other Semantic Subsystem tools in order to guarantee the access to the underlying information (Top Level and Domain Ontologies).
- ❖ **Dictionary Server** (Wordnet); it strictly interoperates with Ontology Server and it is used to provide additional information not present inside the Ontologies (plurals, synonyms and so on).
- ❖ **IRMS** (Information and Knowledge Retrieval Management Subsystem); it manages all documents submitted to Doc@Hand.



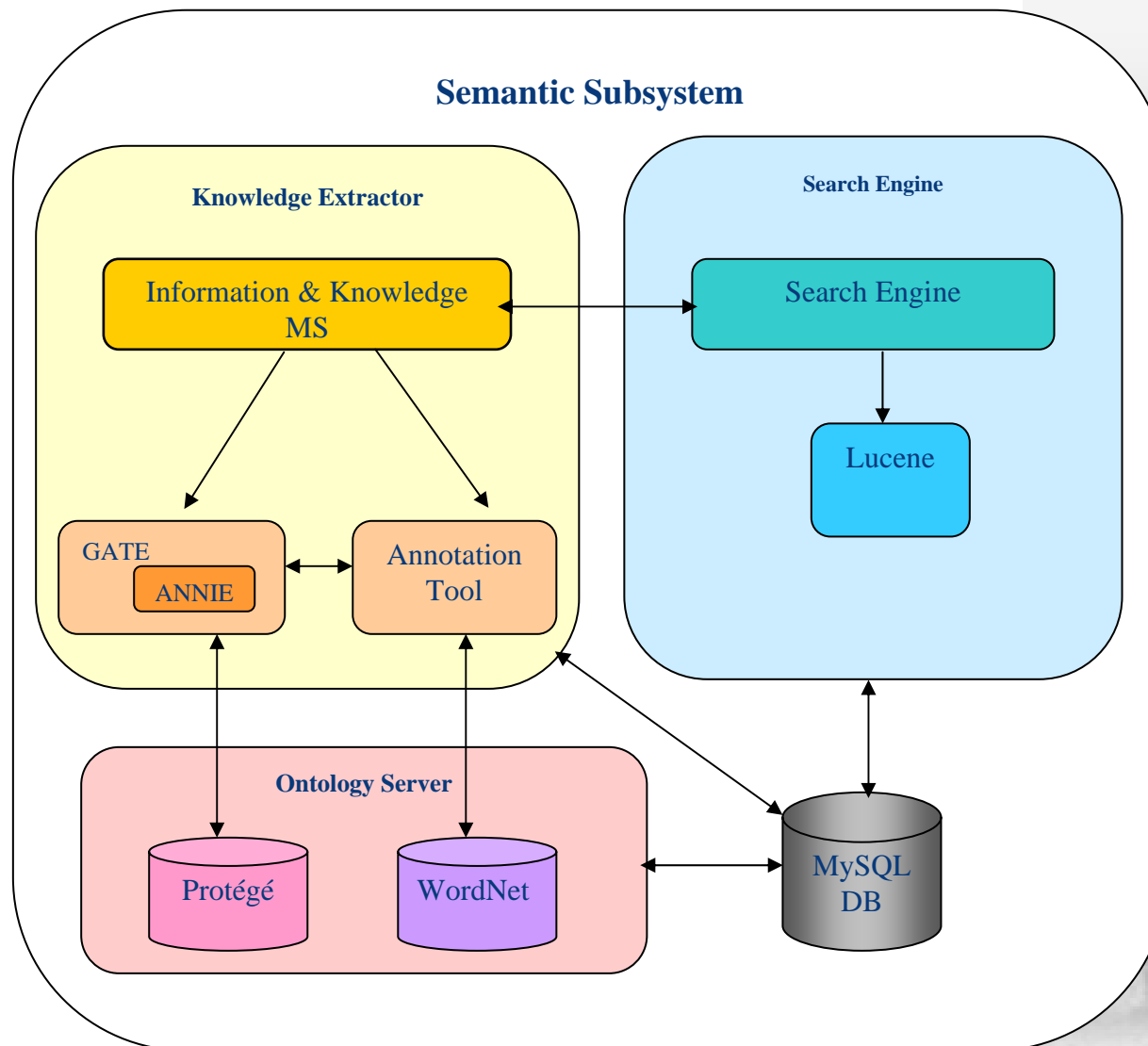


# Doc@Hand core – The Semantic Subsystem

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# Doc@Hand core – The Semantic Subsystem

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## Main Functions:

- binds terms, their definitions, and the explicit specification of relationships among them
- Allows concept and relation based searches (as opposed to just token-based search)
- Introduces a breakthrough in quality and effectiveness of the information search process
- Provides actors with a common representation of the domain (shared understanding)

## Main Benefits:

- Interoperability, and more effective use and re-use of knowledge resources.
- Ontology-based search
- Multi-lingual concept recognition
- Better recall
  - Hits results that would not have been found by using token-based searches
- Better precision
  - Avoids results that are not relevant (through matching the token provided)





# Semantic Subsystem Example (1/2)

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## Clinical Record (after parsing)

Woman 43 years with me

Non toxic habits

Consults for an increased **feeling of**

**fatigue** in the p

suspicious family

digestive sympto

Slightly distende

abdomen with active bowel sounds.

**Pallor of skin** and mucosa.

Preliminary Diagnose: **Iron deficiency.**

### Concepts

**feeling of fatigue**

**pallor of skin**

**iron deficiency**

### Concepts

**feeling of fatigue**

**pallor of skin**

**iron deficiency**

**anemia**

**colon cancer**

## Ontology base

### Fatigue

CARRIED-BY-DISEASE Acromegaly

CARRIED-BY-DISEASE AIDS

CARRIED-BY-DISEASE Anemia

CARRIED-BY-DISEASE Anorexia Nervosa

CARRIED-BY-DISEASE Cancer

CARRIED-BY-DISEASE Diabetes

...

...

### Pallor

CARRIED-BY-DISEASE Anemia

CARRIED-BY-DISEASE Cancer

CARRIED-BY-DISEASE Hypoglycemia

### Iron deficiency

CARRIED-BY-DISEASE Anemia

CARRIED-BY-DISEASE Colon Cancer

CARRIED-BY-DISEASE Peptic Ulcer

CARRIED-BY-DISEASE Pica

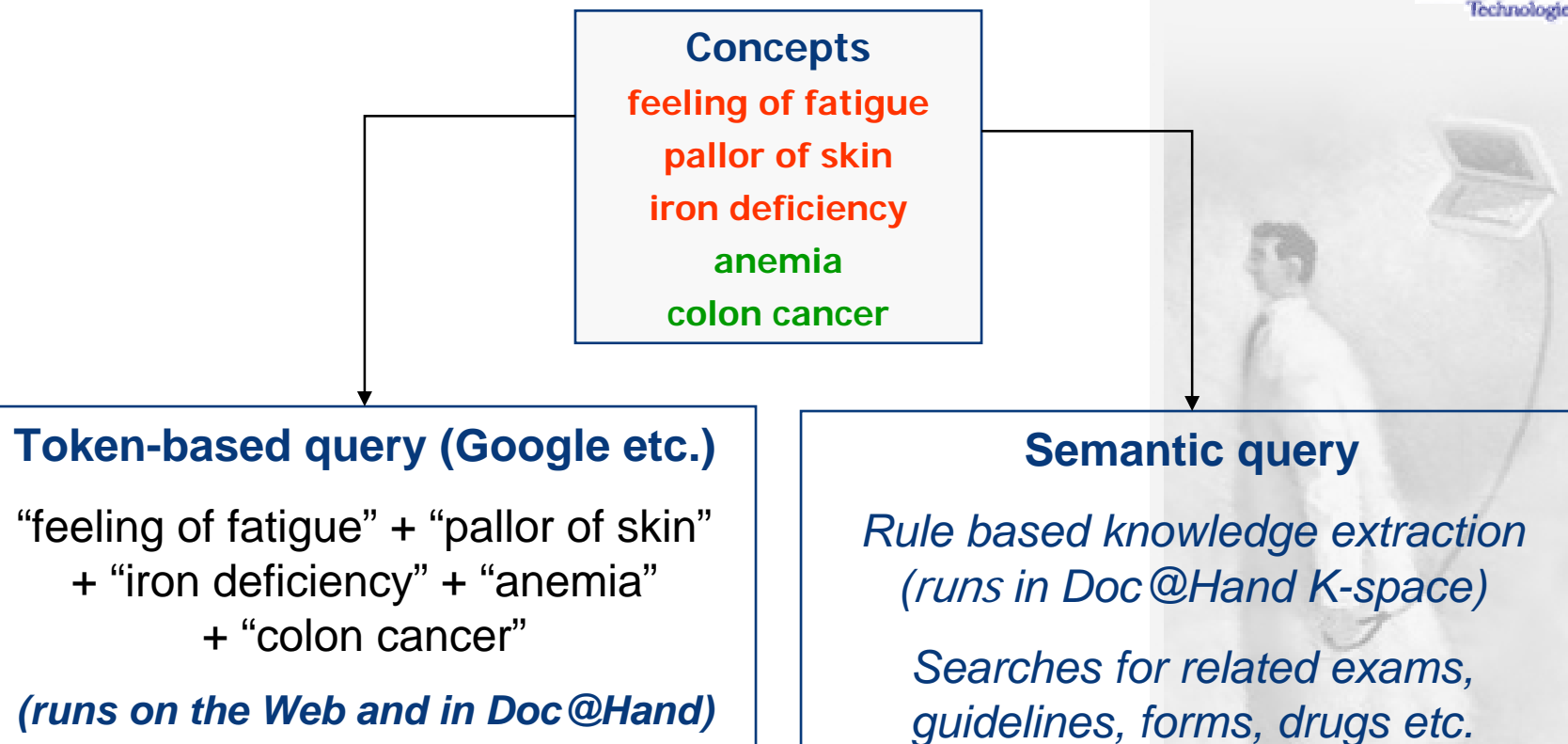


# Semantic Subsystem Example (2/2)

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Benefits:

- Generated automatically
- More precise (additional tokens)

Benefits:

- Extracts latent, correlated information
- Finds relevant documents even though they do not contain the original tokens





# Ontology building

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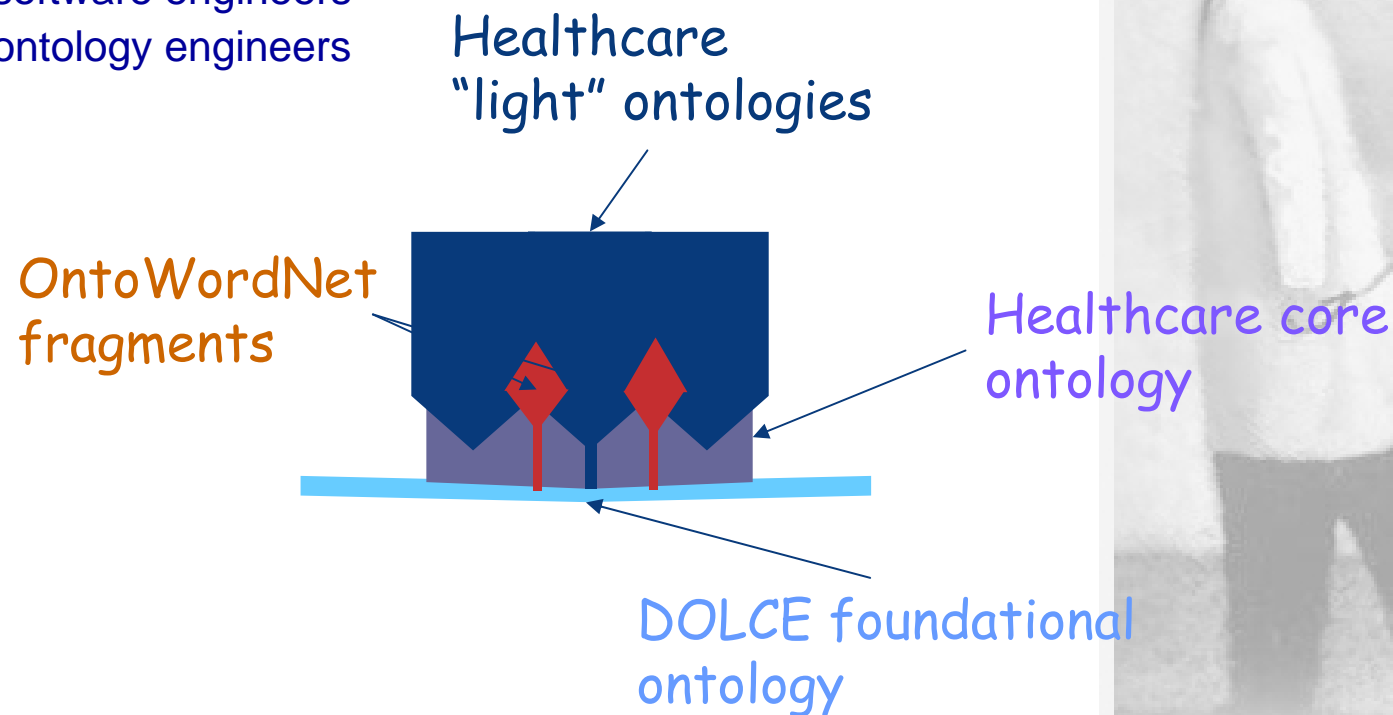
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## Formal ontologies have been reused

- DOLCE foundational ontology (WonderWeb project) 3.9, OWL encoding
- Description and Situations ontology design pattern

## A task force has been involved

- domain experts
- software engineers
- ontology engineers



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# Additional information

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- ❖ General Ontology is composed by about 350 concepts
- ❖ Specialization of the core ontology in the colon-cancer and haemo-cancer (still under building)
- ❖ Lexicalization of the ontology and link to the lexical repository
- ❖ Tuning of the semantic parser by adding ontology-driven functionality





# Doc@Hand Privacy & Security

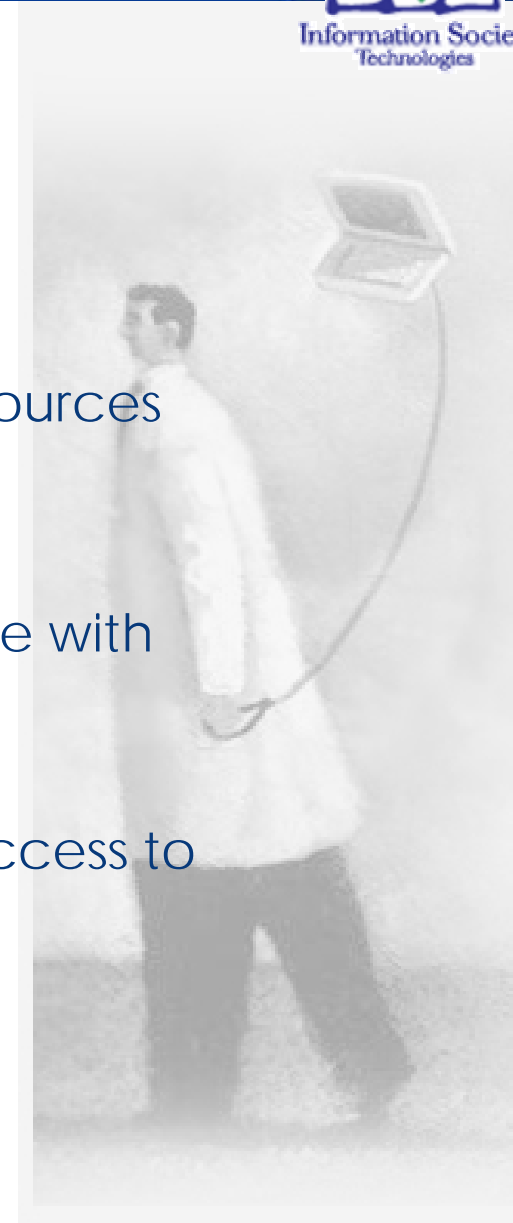
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- **User identification:**
  - Unique user identification
  - User authentication / authorization
  - Role based access on services and resources
  - Automatic logoff
- **Data Encryption:**
  - Secure connection and data exchange with external sources
- **Auditing/Logging**
  - Record and track of any interaction/access to clinical sensitive data



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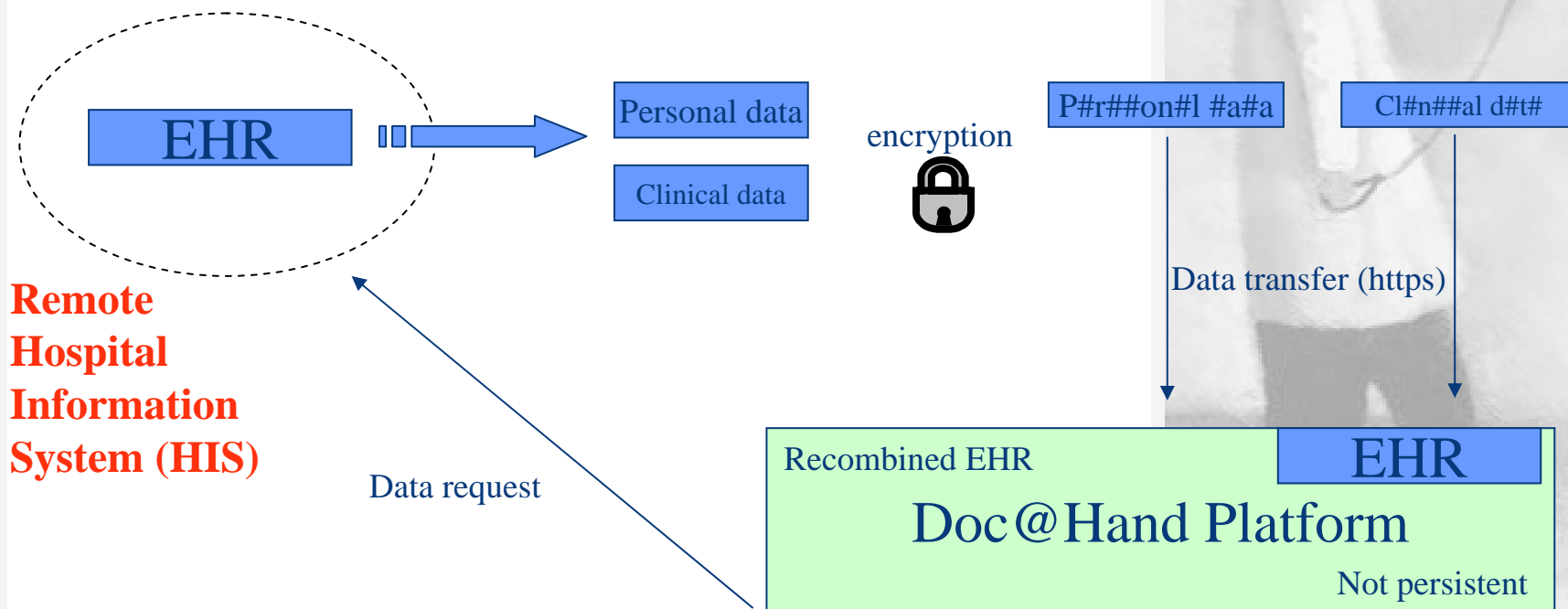
# Data communication security

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- ❖ EHR is first splitted in two distinct packages; personal data e clinical data
- ❖ Unique Id has been assigned to EHR and added to each packages header information
- ❖ Each package is crypted and submitted separately via https
- ❖ Doc@Hand receives both distinct packages and recombines the original EHR; such data will then be managed entirely in memory. Packages are sent separately





# EHR Example

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```
<?xml version="1.0" encoding="utf-8" ?>
```

```
<Patient>
```

```
<PatientDemographics> <!-- Personal data Area -->
```

```
<PatientNumber></PatientNumber>
```

```
<CIP></CIP>
```

```
<Surname></Surname>
```

```
<Name></Name>
```

```
<BirthDate></BirthDate>
```

```
<Gender></Gender>
```

```
...
```

```
<HCA></HCA> <!-- Health Care Area -->
```

```
<RelativeContact>
```

```
<RelName></RelName>
```

```
<RelSurname></RelSurname>
```

```
<RelAddress></RelAddress>
```

```
<Relation></Relation>
```

```
</RelativeContact>
```

```
</PatientDemographics>
```

```
<Episode> > <!-- Clinical data Area -->
```

```
<EpiNumber></EpiNumber>
```

```
<HCC></HCC> <!-- Health Care Center -->
```

```
<EpiClass></EpiClass>
```

```
<EpiType></EpiType>
```

```
<AdmissionClass></AdmissionClass>
```

```
<AdmissionDate></AdmissionDate>
```

```
<EndDate></EndDate> <!-- The date the episode ends -->
```

```
<UomedUnit></UomedUnit> <!-- Professional Organisational unit = service -->
```

```
<UoNurse></UoNurse> <!-- Nurse organisational unit -->
```

```
<Room></Room>
```

```
<LEI></LEI> <!-- Legal episode indicator -->
```

```
<ProfAdm></ProfAdm> <!-- Professional for admission -->
```

```
<ProfDis></ProfDis> <!-- Professional for discharge -->
```

```
<ProfTreat></ProfTreat> <!-- Professional for treatment -->
```

```
<ProfExt></ProfExt> <!-- External professional -->
```

```
<GProf></GProf> <!-- General Professional -->
```

```
<DDATA> <!-- Episode Diagnostic Data -->
```

```
<DCode></DCode>
```

```
<DCatalog></DCatalog>
```

```
<DText></DText>
```

```
<DDate></DDate>
```

```
<DTime></DTime>
```

```
<DFreeText></DFreeText>
```

```
</DDATA>
```

```
</Episode>
```

```
</Patient>
```







# HCPB case

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## Primary Care

Home  
care



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Management  
Centre



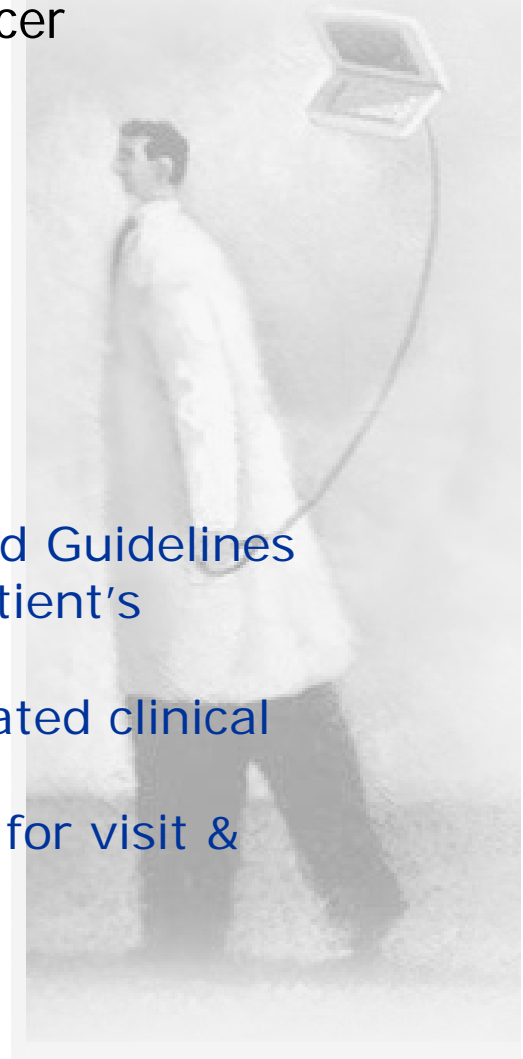
Patient's  
home

Early diagnosis and referral  
of colon cancer

## Hospital



- Evidence Based Guidelines
- Distributed patient's clinical data
- Access to updated clinical knowledge
- Booking plans for visit & testing





# GST case

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Primary Care

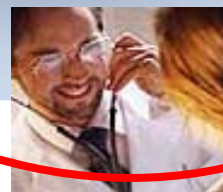
Hospital



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Hospital



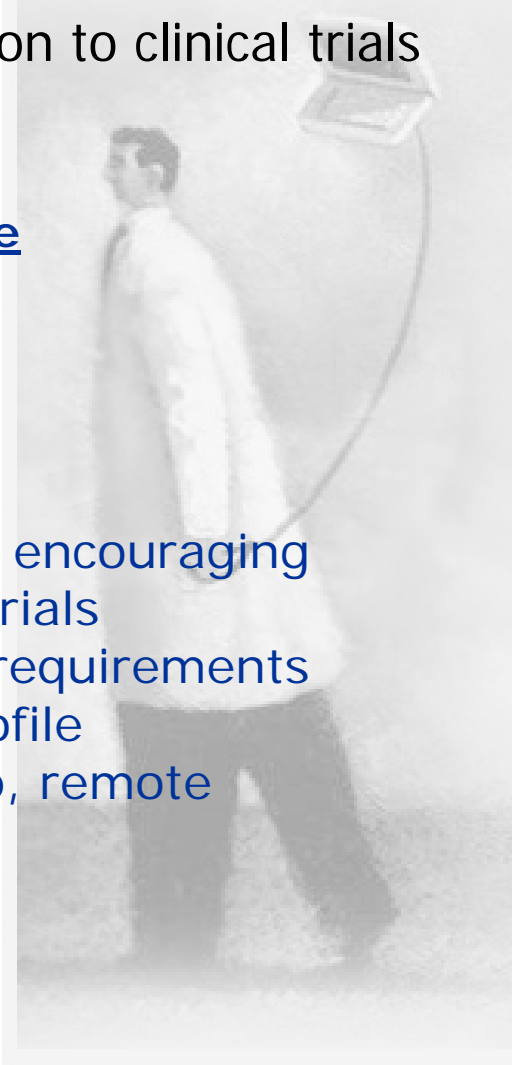
Hospital

Patient allocation to clinical trials

Primary Care



- National policy encouraging enrollment in trials
- Matching trial requirements to patient's profile
- Local follow-up, remote monitoring



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# Conclusion

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**Thank you.**

**Any questions?**

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<http://www.doc-at-hand.org/>



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