

Who Shall I Ask?

A Discovery Engine for Booking a Meeting with the Right Specialist

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Searching everything everywhere is becoming our habit when we need to find something, but knowing who one shall ask for receiving advice on a given problem remains a hard job.

Most of us would certainly survive even if nobody comes up with such a tool, but in the healthcare sector this has been perceived as a problem long ago. A General Practitioner (GP) works in contact with a limited number of colleagues (either other GPs or specialists); therefore when a GP is seeking for a medical advice service, it may happen that he/she does not know the right colleague to contact or the suitable one is unavailable. This results either in more medical errors or in a larger amount of money spent in consulting the wrong specialist.

In order to cover this need, all over Europe, several National and Regional health care projects aim at building up directories of medical doctors willing to provide advice, second opinion and teaching services. For example, GPs can call a health care service center and they can explain to the call-center operators their medical issues. The operators use their *medical knowledge* to discover the best suitable specialists available according to the medical issues and they arrange a teleconsultation meeting for the GPs through a virtual collaboration platform. In this example, the call-center acts as a collection point for the available specialists. It continuously updates the list of expertises provided by each of the doctors and their nominal availability (e.g., Doctor J. Doe is a hypertension expert available on Monday morning and Friday afternoon). When a GP asks for advice about a problem, the call-center operator maps the medical problem to the needed expertises, checks the nominal availability and, if they both fit, tries to arrange the teleconsultation meeting.

But maintaining and updating a call-center can be very expensive; therefore, we can imagine automating the process of discovery of specialists.

Imagine if the mail client on the GPs'/specialists' machines (or the server they use) could expose the agenda of each GP/specialist as a Web Service and that a Discovery Engine could be used by a General Practitioner to arrange a meeting with the right specialist. Glue [1], a WSMO [2] based semantic discovery engine for Web Services, was deployed within the COCOON project [6] precisely for this goal.



Figure 1 The application of Glue Discovery Engine for General Practitioners to book a meeting with the right specialist.

In COCOON we deployed an integrated application¹ (see figure 1) in which the GP starts the discovery process by describing the problem of the patient and his/her preferred date-times to arrange the teleconsultation meeting (step A). Then, Glue performs the discovery by matching the problem expressed by the GP against the descriptions of the Web Services offered by each specialist, and it returns to the GP application a list of references to the agenda Web Services, ordered by decreasing relevance (step B). Finally, the GP interactively selects one of agendas exposed as Web Service to find a slot available for the teleconsultation meeting (step C).

Glue works similarly to a UDDI [3] registry: Web Services descriptions need to be *published* into Glue and then a client application can query it in order to *discover* the needed Web Services. But Glue is much more than a UDDI registry, since it uses ontologies to semantically enhance discovery. Glue is based on the notion of class of Goals and class of Web Services descriptions: those classes have to be modelled inside Glue during its *configuration*, as well as the ontologies. The instances of these classes represent the semantic descriptions of the actual GPs' needs and specialists' advice services.

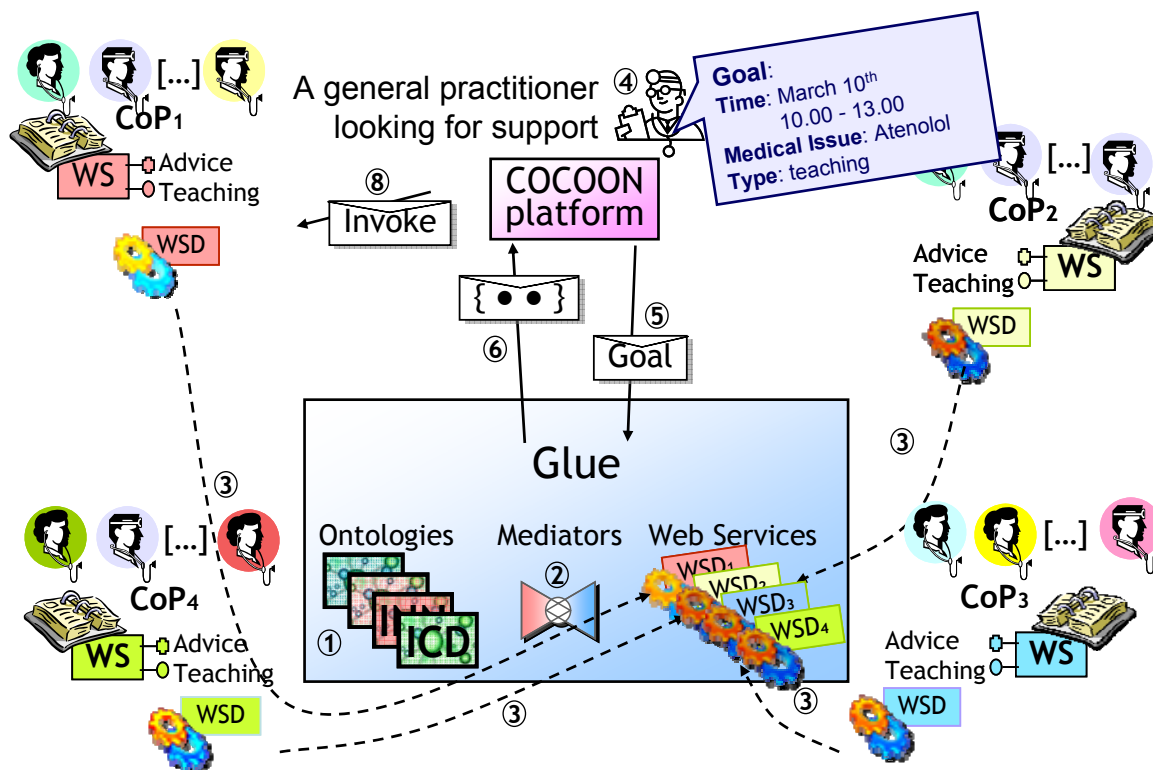


Figure 2 The application of Glue Discovery Engine for General Practitioners to book a meeting with the right specialist

Hereafter, we provide a description of the entire process (see figure 2):

Set up time:

1. an agreement on the ontologies to use for modeling pathologies (e.g. International Code of Disease ICD), drugs (e.g. International Nonproprietary Names for Pharmaceutical Substances INN), date-time, is reached
2. if an agreement cannot be reached on the use of a specific set of common ontologies, the use of mediators is required. In the COCOON scenario, the Specialists and the GPs cannot agree on the use of a common date-time ontology. The Specialists provider entities prefer to express the nominal availability of each Specialist using a week-based calendar (e.g. the advice service is available on Thursday afternoon and Friday morning), whereas the requester entity prefers to express users' preferences using a Gregorian calendar (e.g. is the service available on April, 9th from 10.00 to 12.00?);

Publishing time:

3. each specialist publishes inside Glue its Web Service descriptions for arranging a meeting, describing his/her clinical capabilities and the date-time intervals he/she is normally available (the nominal

¹ For a demo please visit <http://glue.cefrieli.it/glueclient>

availability for advice and teaching may differ). For instance, a Specialist may register saying “*I can give advice on the use of alpha and beta blockers with nominal availability on Monday, Tuesday and Friday in the afternoon*”;

Discovery time:

4. similarly, a GP can discover the most suitable Specialist by using our GUI (see figure 1) in order to express his/her goal in term of the available ontologies. For instance the GP asks “*an advice on the use of Atenolol, preferring the meeting to be arranged on June 8th from 10.00 to 13.00 or on June 9th from 13.00 to 16.00*”;
5. COCOON application submits the goal to Glue;
6. Glue performs discovery matching the GP goal against the descriptions of the advice/teaching services offered by each specialist; then it returns a list of references to Web Services for arranging a meeting, ordered by decreasing relevance;
7. the results list is displayed to the GP;
8. the GP interactively selects one of specialist until he/she finds one to arrange a meeting with.

What make Glue different from other discovery engines is that it allows for coding the similarity in a wgMediator (for details see [1]). For instance, in the case of COCOON, the rule that performs an exact match between what the GP is asking for and the medical capabilities of a Specialist says that there is an exact matching when:

- the GP is asking for a specialist and
 - the specialist has that clinical specialty,
 - or the specialist manages a disease that affects a body part dealt by the specialist the GP is asking for,
 - or the specialist delivers an intervention that controls one of diseases treated by the specialist the GP is asking for,
- the GP is asking for a disease and
 - the specialist has a clinical specialty that deals with a body part affected by the disease the GP is asking for,
 - or the specialist manages the disease that the GP is asking for,
 - or the specialist delivers an intervention that controls the disease the GP is asking for,
- the GP is asking for an intervention and
 - the specialist has a clinical specialty that deals with a body part affected by a disease controlled by the intervention the GP is asking for,
 - or the specialist manages a disease controlled by the intervention the GP is asking for,
 - or the specialist delivers the intervention that the GP is asking for.

We believe that this approach, which was successfully tested in COCOON, could be extended outside the healthcare boundaries and become of use of everybody. Ontologies like FOAF and SIOC could become the basic way for modeling a profile that is subsequently extended with domain specific description of interest and capabilities. When agreement on using the same ontologies won't be found, the mediator centric approach to discovery of Glue could be the work around.

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