Building a Web of Needs
An Infrastructure for Mediating Resource Transfer

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Abstract. The Web as related to commerce suffers from a fundamental asymmetry. While there is a great number of commercial offers available, consumer needs are rarely represented explicitly. Thus, the most widely applied process of connecting the prospective consumer of a resource with its supplier is Web search. We challenge the Semantic Web community to develop an infrastructure that allows consumers to describe and publish their needs and have them interact with offers in a semi-automatic process, reducing the need for manual search and enabling a wide range of unprecedented applications.

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1 Introduction

In any society that is based on division of labour, the same principle is always present in one form or another: *Transfer of resources.* This transfer takes place when one actor has control over a resource she is prepared to give away and another feels a need that can be satisfied by obtaining the resource. Thus, these actors are connected by an asymmetric relationship between a *need* and an *offer*.

Offer and need differ substantially in their ontological status. Both are abstract notions, intentions of taking part in the transfer of the resource in question. However, and this is crucial, an offer can *appear as the thing being offered*, whereas a need always denotes the absence of something, so it can never appear as the thing that is required[1] until it is satisfied and has ceased to exist.

This difference leads to the form of the classical market, where physical objects are on display on different kiosks, representing offers, i.e., their owners' intentions to transfer them. Buyers must walk from kiosk to kiosk, searching for things that satisfy their needs, simply because the latter cannot be represented by any objects. Thus, buyers' needs are unknown to anyone else until negotiation about a transfer takes place.

[1] It can of course be represented by a description – which is exactly the case in point – but it cannot appear as the *thing actually required*.

The current state of the Web as related to e-commerce follows this form almost exactly, thereby perpetuating the asymmetry of need and offer: web sites offer goods for sale, amounting to a staggering number of distinct offers. On the other hand, users who want to satisfy a need have to perform Web search and peruse the results in order to find relevant offers. As in the classic market, the users' needs are unknown to anyone but themselves, and a lot of effort is spent in trying to guess them through the analysis of browsing or buying patterns and similar approaches.

We argue that this form of market is no longer the necessary form. Web technologies allow for needs as well as offers to be represented as documents of equal status, all published on the Web. Automatic matching services can find suitable pairs for a resource transfer. The transfer itself can be mediated by a simple protocol, reducing human interaction to a necessary minimum.

Stressing the fundamentally different status of needs in such a system we refer to it as a *web of needs*. By far exceeding the capacity of a single research group or company, building the required infrastructure could prove to be a worthy and fruitful challenge for the entire scientific community researching the Semantic Web as well as for bordering disciplines.

2 Outline of the Infrastructure

The primary element of the infrastructure is a common modeling language for specifying needs and offers along with a publishing mechanism. RDF as a basic technology and the principles of linked data publication are ideal for this purpose. Moreover, with the GoodRelations ontology[3], ground-breaking work has already been done with respect to the description of offers and needs.[2] For describing the resources being sought or offered themselves, however, no single language can be expected to fit all needs, so a multitude of different vocabularies would have to be used.

In a logical order, the next requirement is the existence of reliable matchmaking services for finding suitable need/offer pairs. These services are required to honor the description language specific to needs and offers; in addition to that, they must also be able to discover matches between resources described in different vocabularies. Ontology and instance matching tools[2] could be adapted to this problem domain and serve as starting points for building robust matchmaking services.

Finally, a protocol is required to allow for interested parties to agree on a transfer. The protocol should enable all parties interested in a transfer to determine the state of the transaction they share at any given point in time, and the effect of any action needs to be deterministic. For taking part in such a transaction, no more should be required than implementing the protocol correctly. Thus, transfers are not bound to any specific platform or website.

[2] A related approach is described by Abramovich and Sheu[1].

3 Use Cases

The more specific requirements for description, matching and protocol are given in the form of use cases that the infrastructure should allow.

1. *Simple resource transfer* – Actor A has control over a resource and is willing to pass it on and actor B needs the resource.
   Example: Sue would like to go kitesurfing but lacks the equipment. Carol is happy to give her her old kite.
2. *Conditional resource transfer* – Same as use case 1, with the addition that one (or both) of the actors only want to execute the transfer if some additional condition pertaining to the transaction is met.
   Example: Sue actually needs the kite within two weeks' time. She specifies this and requires that the date for the transfer must be fixed within 24 hours so that she has enough time to make alternative arrangements. Carol is fine with that – they close the deal by making an appointment.
3. *Combining multiple needs/offers* – Same as use case 1, with the addition that one (or both) of the actors only want to execute the transfer in connection with another transfer.
   Example: Sue actually also needs a kiteboard, so she issues two needs and states that she will only accept one if she can also get the other. Carol accepts these conditions, and so does Peter, who is willing to give Sue one of his old boards.
4. *Mutually constrained needs/offers* – Same as use case 1, with the addition that Actor A requires resources with properties that are logically linked to each other.
   Example: Sue wants to go on a kitesurfing holiday to Rhodes. She issues needs for a return flight to Rhodes and accommodation for two weeks, requiring that the dates of flights and accomodation correspond and fall in a specified period of time. Different airlines offer return flights two weeks apart, and different hotels and pensions offer accommodation. Sue chooses among the corresponding offers, which name conditions for payment.
5. *Production Offers* – Actor A requires a resource, actor B is able to produce it, but its production requires other resources.
   Example: At the kitebeach, Jill offers training for beginners, depending on someone lending her the equipment for this purpose. She issues an offer for training and a need for each piece of equipment a beginner needs. The offer is combined with the need, allowing her to fulfil the offer only when the needs are satisfied, and vice versa.

More use cases which are not elaborated on for brevity include: *Cooperation*, where Actors A and B both need to find a person to fulfil a certain task and find each other; *Needs for resources not yet offered*; and *Auctions* either from the buyer's side or from the seller's side.

4 Consequences and Benefit

Assuming for a moment the implementation of the infrastructure at hand at Web scale with a large user base, we see far-reaching potential consequences. To name a few, it could allow for markets currently fragmented in multiple dimensions, such as location, type of goods, customer segments, type of transfer (such as buying, rental, or barter), or simply by website (Amazon, Ebay, . . .) to amalgamate into one market, raising competition and lowering price dispersion. Moreover, consumers could have one interface to that market – their preferred need management service provider – and could get rid of the burden of Web search or search on different platforms. Need and offer descriptions being available even after a transaction has taken place, users could be enabled to formulate new ones based on past ones, making recurring tasks easier to perform. A publicly available history of needs and the offers they were satisfied by would represent an unprecedented resource for making informed political decisions or performing market research. Services could emerge that focus on needs instead of offers, e.g., allowing the re-use and guided improvement of need combinations that have already been used successfully by others, like the combination of needs for flights, hotel, kitesurfing training lessons, and car rental.

5 Challenges

Building the infrastructure outlined here requires solutions to a number of problems in addition to the design of a description language, a protocol and reliable matchmaking. For example, end users need to be provided with intuitive tools to enable them to formulate complex needs, offers, and combinations thereof correctly and with ease. Distribution models need to be devised for the timely transfer of new need or offer descriptions from their origin to the relevant matchmaking services. Moreover, security and trust issues need to be addressed, and privacy concerns have to be balanced with the benefits of openness. Finally, the infrastructure must be connected to existing payment solutions so as to enable serious trading and allow it to unfold its full potential.

References

[1] A. M. Abramovich and P. C.-Y. Sheu. Towards linked needs. In *Proceedings of the 2010 IEEE Fourth International Conference on Semantic Computing*, ICSC '10, pages 456–461, Washington, DC, USA, 2010. IEEE Computer Society.

[2] J. Euzenat, A. Ferrara, C. Meilicke, A. Nikolov, J. Pane, F. Scharffe, P. Shvaiko, H. Stuckenschmidt, O. Svb-Zamazal, V. Svtek, and C. Trojahn dos Santos. Results of the ontology alignment evaluation initiative 2010. In *Proc. 5th ISWC workshop on ontology matching (OM), Shanghai (CN)*, pages 85–117, 2010.

[3] M. Hepp. Goodrelations: An ontology for describing products and services offers on the web. In *Proc. of the 16th Int. Conf. on Knowledge Engineering and Knowledge Management (EKAW2008)*, volume 5268 of *Springer LNCS*, pages 332–347, Acitrezza, Italy, September 2008.