Implications of Semantic Web Technology for Wireless Handheld Computing

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My interest in the semantic web is as a framework for facilitating exchange of data between wireless handheld computing devices and web-connected information repositories. In my view, it is important that the notion of "web" be broadly construed to include both the larger World Wide Web and local, "emergent" webs that ebb and flow in an addhoc fashion. That is, a web that exists for facilitating the exchange of information between handheld devices at a conference or concert – a web limited in time and space – is nevertheless the kind of web that will be of considerable important to users of handheld devices. In this paper, I will outline some of the challenges faced connecting handheld devices to webs, discuss some roles for semantic web technology in addressing these challenges, and discuss some work to be done.

The term "handheld computer" or "personal digital assistant" (pda) typically refers to PalmOS devices (e.g. Palm V, Sony Clie, etc.), PocketPC devices (e.g. Compaq ipaq), and RIMM Blackberry pager. This category of device is ever broadening to include so-called "smartphones" (e.g. Nokia Communicator,), and eBooks. These devices – my interest is in those with wireless connectivity – are thus being developed in a variety of form factors (from eBooks to wristwatch size devices) and are being developed with variety of targeted functionality (e.g. a Samsung smartphone supports web-browsing and MP3 playing). With a limited form factor comes the problem of presenting the range of web data on such devices. The proliferation of special function devices is another argument for on the fly content adaptation. For example, a document having multimedia content should be delivered differently to a smartphone than it would be to an eBook.

Semantic web technology has already been used -- albeit in a limited sense -- to address the "multiple device delivery" problem. Work on image and document transcoding for example, is relatively mature. Given a "desktop-viewable" document sufficiently annotated with semantic tags (e.g. DAML+OIL) it is possible to transform that document (e.g. assuming appropriate style sheets, or transformation rules) into a form viewable on a limited screen handheld device. A significant challenge remaining in this area is that of adoption: how do we facilitate the transition of existing repositories over to machine readable form; how to we enable users to develop new content using ontologies and other tools developed in support of the semantic web. Tools such as Annotea (http://www.w3.org/2001/Annotea/) and web data migration services such as those provided by 2Roam (http://www.2roam.com/) are a beginning.

The trends of increased processing and storage resources, and increased wireless connectivity options for handheld devices drive another important use for semantic web technology. Although the processing power and storage capacity of these devices lag those of desktop machines by an order of magnitude, the resources now available on high end handheld devices have scaled to support storage and manipulation of significant amounts of heterogeneous data. A number of wireless communication technologies have been adopted in these devices, making it possible to connect them to the larger web (e.g. a PalmOS device using the Omnisky service) or to add-hoc local networks (e.g. several PalmOS devices connected via Bluetooth radios and infrastructure). In either of these networking scenarios, the challenge of limited bandwidth and limited connectivity still remain. Most importantly, users of such devices will inevitably what to exchange data among each other.

For example, imagine a scenario in which a wireless local network has been setup to run during the course of a music concert. Assuming for a moment that the legal issues have been addressed, how is the exchange of information – anything from MP3s to videos to addresses -- among concert-goers using these devices – some having smartphones, some having Palm devices with 802.11b cards, others with different configurations – to be achieved? I think that semantic web technology can figure into the solutions.

I believe that one of the most important and interesting uses of semantic web technology for wireless handhelds will be in facilitating community in public spaces (e.g. libraries, concerts, sporting events.) How can users of such devices search for and make available large amounts and varieties of data in ways that construct and enhance communities of shared interest?

This raises three large problems for designers of such systems:

- Search: If I am a visitor to such a place, how do I locate information that I'm interested in? How do I locate people with similar interests?
- Broadcast: How do I make the information available on my device available to the right people in the local area? How do I control who can see it?
- Indexing: How do I maintain the information on my device so that I can make it intelligible, useful to others interested in the information?

To understand the tools necessary to support this functionality, I'll make the simplifying assumption that participants in a shared community will make use of ontologies developed by and for members of that community. Making this assumption, the following technologies still need to be developed:

- Adaptable search engines for semantic webs. What are the characteristics of search engine that would run in a library and

locate everyone having present in the library having similar research interests? or having a similar bibliographies stored on their devices. If we assume that the information on local information repositories follows consistent semantic organization, then the search task becomes easier. Efficiency tradeoffs between peer-to-peer and centralized search must also be explored.

- Tools for ontology construction. Assume that the users of such devices belong to communities that want to share information among one another. What are tools that allow them to construct ontologies useful for the members of that community.
- Indexing tools. Tools that allow information to contained on such devices to be easily indexed according to shared ontologies. How can index construction algorithms scale to the capabilities of such devices?

As these problems are addressed, I'm sure that new technologies and synergies will emerge.