Interpersonal Network Awareness for Mobile Knowledge Workers

Richard Beales, David De Roure, Nigel Shadbolt
Intelligence, Agents and Multimedia Group,
Department of Electronics and Computer Science,
University of Southampton, Southampton, SO17 1BJ, UK
{rmb00r, dder, nrs}@ecs.soton.ac.uk

ABSTRACT

Knowledge-led organisations increasingly recognise the commercial value of personal, or tacit, knowledge. Although intrinsically difficult to manage, it is possible to expedite the flow of tacit knowledge, within and between organisations, indirectly, by supporting the interpersonal interactions through which it is transferred. We advocate enhanced interpersonal network awareness as a means to promote this transfer and present a mobile platform, *aware*, which provides an individual with a dynamic, contextually tailored model of their interpersonal network. An example application, *aware.twentyfour*, is also described.

INTRODUCTION

We live in a knowledge age, members of a knowledge society, contributing to a knowledge economy [Brodner00]. According to Peter Drucker, management guru and Harvard Business Review columnist, knowledge is now "the basic economic resource". Knowledge, this basic economic resource, sits atop a conceptual pyramid, the foundation of which is *data* - raw symbols, sequences of numbers, characters on a page. Data is devoid of any context – it "says nothing about its own importance or irrelevance" [Davenport98]. The opportunities for software processing of data are limited: input, do math, store, output. *Information* is data organised, to give meaning; data with added value. It exerts influence (literally, it *gives shape*). Information, then, is 'more than' data. *Knowledge*, in turn, is more than information. It is information interpreted through human experience. You may be *informed* that a person is in two places at once, but you *know* this cannot be true.

Nonaka and Takeuchi [Skyrme99] subdivide knowledge into two categories. *Explicit* knowledge is that that can be "expressed in words and numbers and can be easily communicated and shared in the form of hard data, scientific formulae, codified procedures or universal principles". Explicit knowledge lends itself to direct manipulation by software tools. *Tacit* knowledge, on the other hand, is "highly personal and hard to formalise". It includes "subjective insights, intuitions and hunches" – the collective expertise of an organisation [Lutters00]. Acquisition and exchange of tacit knowledge takes place through ever-changing networks of people and organisations.

INTERPERSONAL NETWORKS

Once, if you wanted to understand the relationships between employees in an organisation, you would visit its personnel department and ask to see their organisation chart. This chart showed who worked with whom, in what team, under which manager (organisational charts are nothing if not hierarchical). More than that, it was a tool for planning, for control [Krebs02]. Relationships were made and unmade not by the employees themselves, but by a personnel manager drawing and rubbing out lines of ink, sticking on labels and peeling them off again. At least that was the theory. Ethnographic workplace studies [Orr96] showed that those lines and labels only told part of the story, that in reality, many workers relied heavily on their own self-initiated relationship networks.

Now, in today's fast moving, fluid business environment, informal self-managed relationships have gained even greater importance. One of the most comprehensive surveys of the modern workplace [Nardi02] illustrates a world in which employees pass back and forth across employment boundaries, in which freelancers rub shoulders with salaried staff, in which employees work multiple jobs *with the approval of their employers*, in which employees dictate their own work, eschewing traditional management structures. Individuals manage their own workplace relationships, maintaining dynamic personal networks, drawing on expertise from individuals similarly skilled to themselves, who they locate through more formal communities of practice.

A PLATFORM FOR NETWORK AWARENESS

Inter-Personal Awareness Devices (IPADs) have been promoted by the CSCW and Ubiquitous Computing communities as a means to instantiate and strengthen social relationships. Current IPAD research, however, is strongly focussed on discrete, one to one, physical meetings. Shared-aura interaction models are used that preclude both continuing awareness of contacts when they are not physically or virtually co-located and awareness of virtual contacts such as electronic mail exchange, telephone conversation or videoconference. Furthermore, as contacts are treated as isolated entities, the real-life interpersonal relationships that link them are not represented.

The *aware* platform is intended to address these limitations. *aware* is a lightweight, agent-like platform to support interpersonal network awareness on mobile devices. It is built around a 'world model' of two self-managing, ontologically principled knowledge bases. One contains the *nodes* in the user's interpersonal network – people, documents, projects, etc.; the other the *relationships* between them. To allow live, continual awareness, each instance in the world model is an active information object - a Java Bean representation of a class defined in the AKT[1] ontology. Each Bean includes the capability to register with the originating device and receive updates regarding its properties and relationships, when wireless LAN connectivity is available. This will also facilitate on-demand community based messaging between *aware* devices.

Traditionally IPADs exchange individual personal contacts. In order that *aware* can build a more rich interpersonal network model, neighbouring devices instead exchange *social network sub-models* up to 3 degrees of separation in scope (the 3 degrees limit was chosen because this was felt to be the largest distance that a person can meaningfully relate to; it is "*a colleague knows someone who used to work with*").

Obviously *aware* requires some means of detecting when an interpersonal contact takes place. Manual contact addition by the user would rapidly become tedious, particularly if brief 'chats in the corridor' are to be captured. However if manual contact addition can piggyback on an established conversational gesture, no additional overhead will be required, while the potential errors that any automatic detection technique would introduce are avoided. *aware* makes use of low frequency Body Area Network technology pioneered by Zimmerman [Zimmerman96], to exchange personal numeric identifiers whenever individuals shake hands. 802.11b wireless networking is then used to exchange the individuals' personal network models. If a meeting occurs in an area with no wireless connectivity, these identifiers are cached and the information exchanged later when connectivity is regained.

aware.twentyfour

One of the most appealing aspects of current IPADs is the relevance of their display to the user's current task. However this can also be seen as a shortcoming, as most people do not spend their working day performing a linear sequence of unrelated tasks. *aware.twentyfour* is an *aware* application intended to combine the immediacy of current IPADs with a longer-term awareness that better reflects real work. The aware.twentyfour user interface includes a scrollable 24 hour timeline, above which is a live network visualisation showing a contextually relevant version of the relationships of the people the user met around the chosen time. The network visualisation adopts the same 'ball and chain' technique used by commercial desktop Organisational Network Analysis tools, such as InFlow[2], but while these provide a organisation-centric snapshot view of the strength of manually selected relationships between manually selected individuals, the aware.twentyfour display adapts dynamically to present a view relevant to an individual's current context.

aware.twentyfour is being implemented as a lightweight Java application layer above aware with a Macromedia Flash GUI, interfaced with the application layer using a persistent TCP/IP connection. The authors envisage that further such thin-client applications of *aware* will be developed.

[1] www.aktors.org

[2] www.orgnet.com/index.html

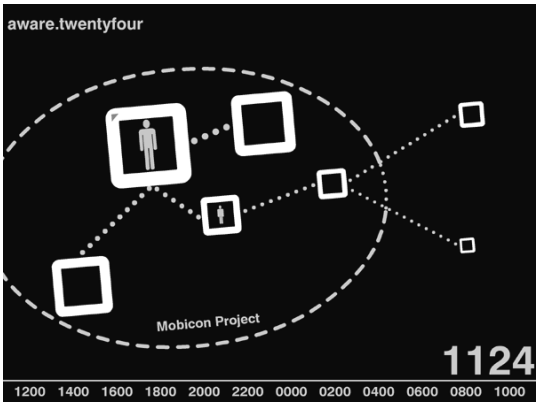

Fig.1 The *aware.twentyfour* user interface.

FUTURE WORK

The ontologically principled nature of *aware*'s world model will enable the addition of intelligent reasoning capability. Three areas have been identified where this will be of benefit:

- Smart management of the network model garbage collection, to achieve as compact (fast) a network model as possible, while ensuring that non-redundant nodes and structural-hole relationships are not discarded.
- Determination of which nodes and relationships should be included in the sub-network exchanged with a particular neighbour device
- Subsetting of nodes and relationships for a particular context, to maximise the usefulness of the information presented to the user, while minimising, as far as possible, the number of objects displayed to maintain the clarity of the visualisation.

ACKNOWLEDGEMENTS

This work is supported under the Advanced Knowledge Technologies (AKT) Interdisciplinary Research Collaboration (IRC), which is sponsored by the UK Engineering and Physical Sciences Research Council under grant number GR/N15764/01.

REFERENCES

[Brodner00] Brodner, P. *The Future of Work in a Knowledge-based Economy*, ICT / CIREM Int. Seminar on "Economy and Work in the Knowledge Society", Barcelona (Spain), February 24 - 25, 2000

[Davenport98] Davenport, T.H., Prusak, L. *Working Knowledge*, Harvard Business School Press, 1998.

[Krebs02] Krebs, V. Knowledge Networks. *Mapping and Measuring Knowledge Creation and Re-Use*, orgnet, 2002. (online at www.orgnet.com/IHRIM.html)

[Lutters00] Lutters, W.G., Ackerman, M.S., Boster, J., McDonald, D.W. *Mapping Knowledge Networks in Organizations: Creating a Knowledge Mapping Instrumen* in *Proceedings of the 2000 Americas Conference on Information Systems (AMCIS '00)*, 2014—2018, 2000.

[Nardi02] Nardi, B., Whittaker, S., Schwarz, H. *NetWORKers and their Activity in Intensional Networks.* Journal of Computer-supported Cooperative Work. Special issue on activity theory and design. Vol. 11, Nos. 1-2. 2002.

[Orr96] Orr, J. *Talking About Machines: An Ethnography of a Modern Job*, Cornell University Press, 1996.

[Skyrme99] Skyrme, D.J. *Knowledge Networking. Creating the Collaborative Enterprise*, Butterworth Heinemann 1999.

[Zimmerman96] Zimmerman, T. *Personal area networks (PAN): Near-field intra-body communication.* IBM Systems Journal, vol. 35, 609—618, 1996.