Virtual Communities on Stage: Supporting Chance Encounters, Communication and Awareness in a Theatre of Work

Tom Gross
Institute for Applied IT
Fraunhofer Gesellschaft
Birlinghoven
Schloss Birlinghoven
53754 St. Augustin
Germany
tom.gross@fit.fraunhofer.de

ABSTRACT
Virtual communities using various types of computer-mediated communication systems are spreading widely. These systems have several strengths: they support chance encounters and allow spontaneous and informal conversations, and they are easy to install, easy to use, have a huge number of existing users who new users can contact. However, they are, in general, stand-alone applications. In this paper we argue for the integration of virtual community support into groupware systems. We will discuss the characteristics of and requirements for virtual communities, present a virtual community system, and illustrate how it can be integrated into a shared workspace system.

INTRODUCTION
The idea of computer-mediated communication among geographically distributed users who exchange ideas and establish a shared space of information has been around since the 1960s. For instance, Joseph Licklider [8, 9] coined the metaphor of the computer as a communication device and aimed at supporting on-line communities of interest. In [9] Licklider writes:

But to communicate is more than to send and to receive. […] We believe that communicators have to do something nontrivial with the information they send and receive. And we believe that we are entering a technological age in which we will be able to interact with the richness of living information—not merely in the passive way that we have become accustomed to using books and libraries, but as active participants in an ongoing process […]

We want to emphasize something beyond its one-way transfer: the increasing significance of the jointly constructive, the mutually reinforcing aspect of communication—the part that transcends "now we both know a fact that only one of us knew before." When minds interact, new ideas emerge. We want to talk about the creative aspect of communication.

Today, virtual communities using various types of computer-mediated communication systems such as the Internet Relay Chat, Bulletin Board Systems, or instant messaging systems are spreading widely. These systems have several strengths: they support chance encounters and allow spontaneous and informal conversations, and they are easy to install, easy to use, have a huge number of existing users whom new users can contact. However, they are, in general, stand-alone applications. In this paper we argue for the integration of virtual community support into other groupware systems. We will discuss the characteristics of and requirements for virtual communities, present a virtual community system—the Theatre of Work Enabling Relationship environment—and illustrate how it can be integrated into a shared workspace system.

VIRTUAL COMMUNITIES
The notion of community became famous in the 19th century. Until the middle of the 19th century the focus of the people was the local community, they were living and working there and their social interaction took place within the borders of the local community. With the industrial revolution, and increasing mobility and tele-communication, people were able to bridge geographical distances. Consequently, they increasingly had remote family and friends. Toennis [14] argues that in the old communal societies (Gemeinschaft) personal relationships and face-to-face relations predominated, whereas in the society (Gesellschaft) rational will and carefully calculated conduct and behaviours are becoming increasingly dominant. In the communal societies understanding is a reciprocal sentiment, which binds the individual to a totality. In society individuals are basically alone and there is a tension between them; life is organised by regulations.

Today's online communities are somehow a mixture of Gemeinschaft and Gesellschaft; they are neither a familiar locale, nor an alienated metropolis [2, 6]. Nevertheless, they offer and stimulate types of exchange and altruism that were quite typical for the communal societies. Bowker and Star Star [3] point out that the vast spreading of base technology such as personal computers and Internet connection in private households are both important prerequisites and stimulus for fundamental changes in the way people use and exchange information. They emphasise that '[c]hanges in infrastructural networks such as transportation, information, and domestic technologies explain a great deal about other forms of social change and social relationships—they are not simply substrate, they are substance'. The term community is used in many different contexts with several different meaning, which more or less overlap. Bowker and Star [3, p. 11] point out that in literature the

exact definition of the term community is difficult and very controversy, but 'there is general agreement that the sense of community rests on nontrivial, ongoing relations among people; some degree of shared knowledge, understandings, material objects, or conventional practices; and the idea that these two are not independent'.

Virtual communities have several characteristics: they are technologically mediated and span traditional geographical limitations, they are persistent and exist for a mid- to long-term period, they offer multiple interaction styles such as informal and formal communication or peripheral and focused communication, they support some type of real-time interaction, and they support multi-users at the same time [5, 7, 11, 12]. As a prerequisite for chance encounters and spontaneous and informal communication, users need to have group awareness—information about the other persons they might want to talk to. They need information about the presence in the system and about their availability. Additionally, information on their current activity can help to decide if they want to start a conversation or try it later on. In the subsequent section we will present the TOWER environment.

In order to provide rich information and to stimulate the jointly constructive and mutually reinforcing aspect of communication virtual community systems, furthermore, have to extend the reach of the single user. So, the user can easily and flexibly contact other persons and share and exchange knowledge when needed. Technology needs to empower communities of users to establish a common knowledge base of living information over time—often called community memory. Marshall and associates [10] argue that 'when people work together—whether in designing a product, or creating training materials from video-based documentation, or writing a coherent analysis of a complex situation in the world—they require, and put effort into constructing and maintaining, shared understandings of what they are doing'. They define a community memory as an 'open-ended set of shared interpretations and understandings developed and maintained by the group'. In order to create, maintain, and increase community memory, systems have to support the acquisition and continual updates of the contents and the structure of the community memory and the identification of the relevancy of material found. As a result the community memory reflects the evolution of shared understanding.

THE THEATRE OF WORK ENABLING RELATIONSHIPS

The Theatre of Work Enabling Relationships (TOWER) environment aims at supporting virtual communities with functionality for communication and group awareness in their current work context. It offers an instant messenger showing a list of online users and allowing users to start a real-time text chat with any of the other online users. Additionally, it provides an infrastructure for facilitating chance encounters and spontaneous conversations among remote users. For this purpose, the infrastructure has various sensors capturing information about users and their activities and a range of indicators notifying users about the presence, availability, and current activities and tasks of the other users. Besides some lightweight indicators such as pop-up windows with pure text or tickertapes displaying messages about the other users and shared artefacts TOWER also offers the TowerWorld—a 3D virtual world—and the PResence, AVailability, and TAsk awareness (PRAVTA) client for mobile users.

The TowerWorld

The TowerWorld consists of a stage that is dynamically created by the space module based on shared information space such as BSCW workspaces [1] or the content of other document management systems and avatars navigating on this stage and performing symbolic actions [13]. Figure 1 shows screenshots of a TowerWorld: the left picture presents a view from the distance, where users can get a good overview of the whole stage with all its cubicles representing the documents; and the right picture shows a close-up of the same TowerWorld with more details (e.g., icons representing the file types, avatars positioned according to the current activities of the respective users).

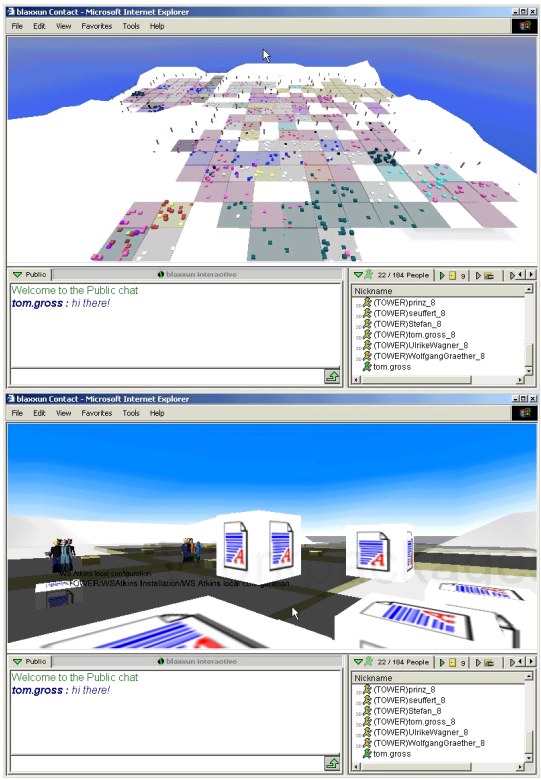

Figure 1. TowerWorld: (a) overview from a distance; (b) details in a close-up.

The stage evolves in response to the patterns of use in the shared information space. In this sense the TOWER environment develops a record of its own past history, which will in time act as a powerful asynchronous device, which will help users find their way and find each other. The stage is generated and adapted according to rules and semantic mappings that can be specified by the users. Various attributes of the documents in the shared information space can be visualised such as the type of a document, the size of a document, the frequency of manipulations to a document, the creator of a document, the similarity among documents, and so forth. These attributes can be mapped to the size of the cubicles in the TowerWorld, their shape, their colour, their position, their clustering, and so forth. Another criterion for the

stage creation is the granularity of the mapping of document sets into the stage. User workshops yielded different opinions whether a more detailed view or a more abstract overview provides better context for the visualisation of user activities. In the current implementation users can select between different worlds, each created by different selection criteria and rules for generation and mapping. In an overview world for example objects in the TowerWorld represent only folders of the shared information space, while the detailed TowerWorld provides a representation for each document. In the overview world activity spots are easier to recognise while in the detailed world clusters of objects with a similar semantic are easier to identified.

The stage of the TowerWorld is populated with avatars representing users and representing their current activities as symbolic actions such as automatic navigation through the TowerWorld and gestures. The emphasis in symbolic acting is to show the contextual information telling users about where the other users are, who they are and what they are doing right now. With symbolic acting the context dependent actions of all users are shown at all times so the world can seem like a more active place as well as more closely reflecting the activities of a user group. We let the system do the walking–and the acting. This is a very powerful and engaging way of solving problems in mediated communication.

The PRAVTA Client

The PRAVTA client is a lightweight and mobile supplement to the TowerWorld and the other indicators that are very powerful and highly personalisable, but stationary [4]. In fact, it allows users to send messages to the tickertape of the online users, to actively query various types of awareness information, to enter und update awareness information about themselves anytime and anywhere. Being based on WAP [15], the PRAVTA prototype can be accessed from any mobile device that supports WAP such as mobile phones; palmtops; and SmartPhones.

After the users have authentified they can query information about the presence of other users resulting in a table with all online users. They can check the availability of others and get a table with the current availability. Figure 2 shows a mobile phone, and the login window and result of 'Who is online?', 'Check availability', and 'Check tasks'.

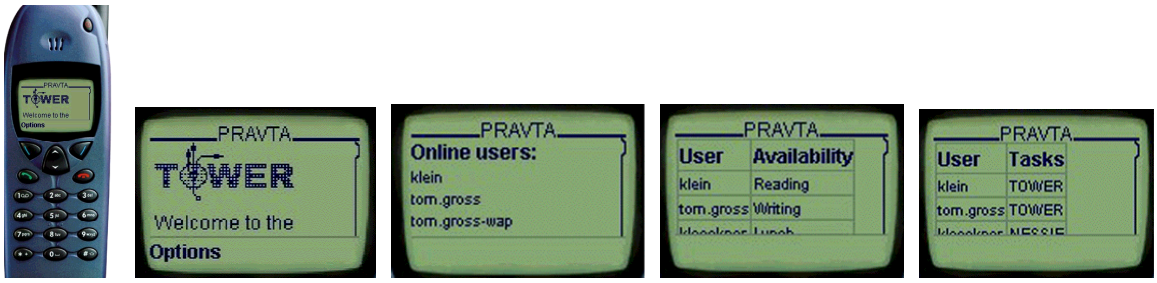

Figure 2. PRAVTA on a mobile phone: login window and the presentation of awareness information.

For users who are in their everyday work environment the TOWER sensors can capture information about their presence, availability, activities, and so forth. As PRAVTA can be used in any surrounding, the user has the possibility to manually update their status. .

Implementation

TOWER includes an infrastructure that is fully integrated with the Internet. This infrastructure provides a number of sensors that can be integrated with user applications using Internet protocols such as HTTP, which are available in almost all standard application nowadays. In addition, sensors are realised that observe information sources such as Web servers and shared information spaces. All sensors submit events that encapsulate activity information to the infrastructure. Tasks of the infrastructure are to store, aggregate, and forward the activity information to applications that have registered interest in the appropriate information. For the interaction with other applications push and pull methods are realised. Methods are developed to ensure restricted access to activity information access rights, and to provide reciprocity for ensuring transparency between producers and consumers of information.

The TOWER infrastructure (cf. Figure 3) consists of: (1) a number of different activity sensors that capture and recognise user activities in a real and virtual work environment and that submit appropriate events; (2) an Internet-based event & notification infrastructure (ENI) that receives events and forwards these events to interested and authorised users; (3) a space module that dynamically creates stages from shared information spaces and that adopts existing spaces to the actual usage and behaviour of the users that populate these spaces; (4) a symbolic acting module that transforms event notifications about user actions into symbolic actions, i.e. animated gestures of the avatars that represent users and their activities in the environment; (5) a 3D multi-user environment that interoperates with the symbolic acting and space module and manages the user interface and functionality of the TowerWorld; (6) the 3D visualisation is complemented by ambient interfaces integrated into the physical workplace providing activity visualisation beyond the standard desktop; and (7) a DocuDrama component that transforms sequences of event notifications and history information into a narrative of the past cooperative activities.

The PRAVTA prototype is implemented on two layers: the PRAVTA Client that realises the user interface and the PRAVTA Communication Layer. The user interface at the PRAVTA Client is implemented in the wireless markup language (WML) [15]. WML is a tag-based browsing language that supports screen management with text and images; data input such as text or selection lists;

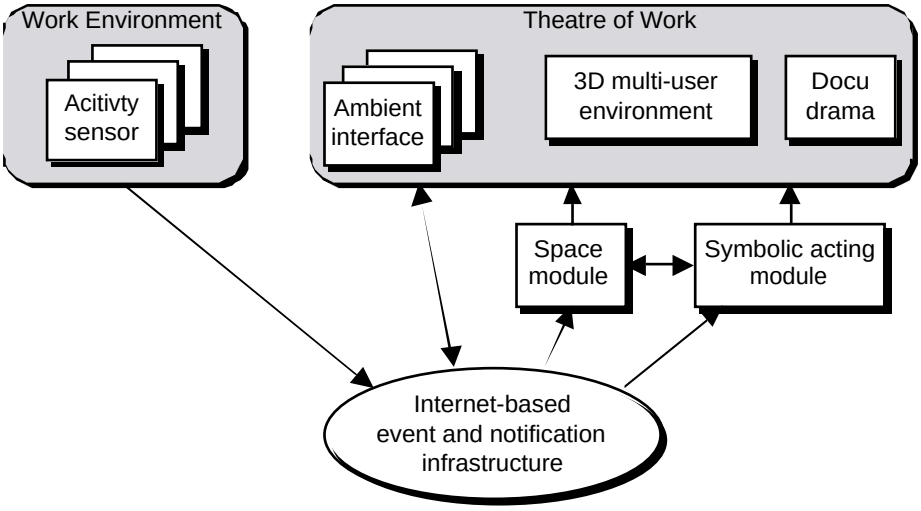

Figure 3. The TOWER infrastructure.

and hyperlinks and navigation support. It is, therefore, well suited as a platform for user interface design for mobile and ubiquitous applications. The wireless application protocol connects the user interface to the PRAVTA communication layer. The PRAVTA Communication Layer translates the data from the ENI server into PRAVTA format (i.e., WML and WMLScript) and translates the data from the PRAVTA client into ENI format. It provides mechanisms for login and access control, and so forth.

DISCUSSION

The TOWER environment has been used among the participants of the TOWER project for several months now. Some informal observations and discussions with people using them have revealed four challenges:

Privacy. Users want and need to know as much as possible about other users' presence, availability, tasks, and so forth. Yet, users have a legitimate wish for privacy of this kind of data. In our system one important feature with respect to privacy is that users are free to specify which information is captured about them. For instance, the system can capture the applications that a user is running, the documents that are opened in these applications. User can choose if everything should be captured, if only the applications should be captured, or if nothing should be captured.

Lurking. Users want information about other users, but sometimes do not want to provide information about themselves. In our system users have to log in before they can query for information about other users. So, users know who is logged in and who potentially gets information about them. All online users are listed in the instant messenger and are represented as avatars in the TowerWorld. However, users are free to choose their avatar (i.e., they can use an avatar they really characterises them and is recognisable or they can use a comic or other anonymous images).

Disturbance. Users want and need up-to-the-moment information about each other and yet do not want to be disturbed constantly. In our system users can choose from a number of indicators ranging from an instant messenger to the TowerWorld and the mobile PRAVTA client.

Distributed and replicated user interfaces. Users want to use several mobile, 2D and 3D indicators. Using these indicators in parallel entails a range of new challenges. In some occasions we realised that users do not always want and need the information displayed on more than one indicator at a time. For instance, when some users who were working in their offices on the PCs and who had some ambient indicators activated and were logged into the TowerWorld got notifications about the same event on several indicators they felt flooded by information. They argued that when logged into the TowerWorld and consequently capturing what is going on there, they do not want any kind of information presented on the other interfaces. For instance, they did not want to receive notifications in the form of short messages on their mobile phones in these situations.

BIOGRAPHICAL INFORMATION

Tom Gross holds a diploma and a doctorate degree in Applied Computer Science from the Johannes Kepler University Linz, Austria. He is a senior researcher in the Computer-Supported Cooperative Work research group of the Fraunhofer Institute for Applied Information Technology FIT (formerly known as GMD-FIT—German National Research Center for Information Technology). He is a member of the European IST-project TOWER and coordinates the activities of the European IST-project CYCLADES at FIT. His research interests include computer-supported cooperative work, human-computer interaction, and global information systems. He is teaching CSCW and HCI at the Johannes Kepler University Linz, Austria, and at the Technical University of Aachen, Germany.

ACKNOWLEDGMENTS

The research presented here was carried out by the IST-10846 project TOWER, partly funded by the EC. I would like to thank all colleagues from the TOWER team at Aixonix, Atkins, blaxxun, BTexact, Fraunhofer FIT, and UCL.

REFERENCES

1. Bentley, R., Appelt, W., Busbach, U., Hinrichs, E., Kerr, D., Sikkel, K., Trevor, J. and Woetzel, G. Basic Support for Cooperative Work on the World-Wide Web. International Journal of Human Computer Studies: Special Issue on Novel Applications of the WWW, (Spring 1997).
2. Bishop, A., Neumann, L., Star, S.L., Merkel, C., Ignacio, E. and Sandusky, R. Digital Libraries: Situating Use in Changing Information Infrastructure. Journal of the American Society for Information Science 51, 4 (July 2000). pp. 394-413.
3. Bowker, G.C. and Star, S.L. Social Theoretical Issues in the Design of Collaboraties: Customised Software for Community Support versus Large-Scale Infrastructure. University of California at San Diego, http://weber.ucsd.edu/~gbowker/collab.pdf, 1995. (Accessed 16/6/2002).
4. Gross, T. Towards Ubiquitous Awareness: The PRAVTA Prototype. In Ninth Euromicro Workshop on Parallel and Distributed Processing - PDP 2001 (Feb. 7-9, Mantova, Italy). IEEE Computer Society Press, Los Alamitos, CA, 2001. pp. 139-146.
5. Gross, T. E-Democracy and Community Networks: Political Visions, Technological Opportunities, and Social Reality. In Groenlund, A., ed. Electronic Government: Design, Applications, and Management. Idea Group Publishing, London, UK, 2002. pp. 249-266.
6. Gross, T. CYCLADES: A Distributed System for Virtual Community Support Based on Open Archives. In Proceedings of the Euromicro Conference on Parallel, Distributed, and Network-Based Processing - PDP 2003 (Feb. 5-7, Genova, Italy). IEEE Computer Society Press, Los Alamitos, CA, (to appear).
7. Koch, M. and Woerndl, W. Community Support and Identity Management. In Proceedings of the Seventh European Conference on Computer-Supported Cooperative Work - ECSCW 2001 (Sept. 16-20, Bonn, Germany). Kluwer Academic Publishers, Dortrecht, NL, 2001. pp. 319-338.
8. Licklider, J.C.R. Man-Computer Symbiosis. IRE (now IEEE) Transactions on Human Factors in Electronics HFE-1 (Mar. 1960). pp. 4-11.
9. Licklider, J.C.R. The Computer as a Communication Device. Science and Technology, (Apr. 1968).
10. Marshall, C., Shipman, F.M. and McCall, R.J. Putting Digital Libraries to Work: Issues from Experience with Community Memories. In Proceedings of the Digital Libraries Workshop - DL'94 (May 19-20, Newark, NJ). Springer-Verlag, Heidelberg, 1994.
11. Miller, M. What is a Community Network? University of Michigan, School of Information, Community Networking Initiative, http://www.si.umich.edu/Community/faq/What.html, 2002. (Accessed 10/5/2002).
12. Mynatt, E.D., Adler, A., Ito, M. and O'Day, V.L. Design for Network Communities. In Proceedings of the Conference on Human Factors in Computing Systems - CHI'97 (Mar. 22-27, Atlanta, GA). ACM, N.Y., 1997. pp. 210-217.
13. Prinz, W. and Gross, T. Ubiquitous Awareness of Cooperative Activities in a Theatre of Work. In Proceedings of Fachtagung Arbeitsplatzcomputer: Pervasive Ubiquitous Computing - APC 2001 (Oct. 10-12, Munich, Germany). VDE Publisher, Berlin, Germany, 2001. pp. 135-144.
14. Toennies, F. Gemeinschaft und Gesellschaft (Community and Society; in German). Wissenschaftliche Buchgesellschaft, Darmstadt, 1963 (first appearance 1887).
15. WAP Forum. Wireless Application Protocol Forum Ltd. http://www.wapforum.org/, 2002. (Accessed 27/9/2002).