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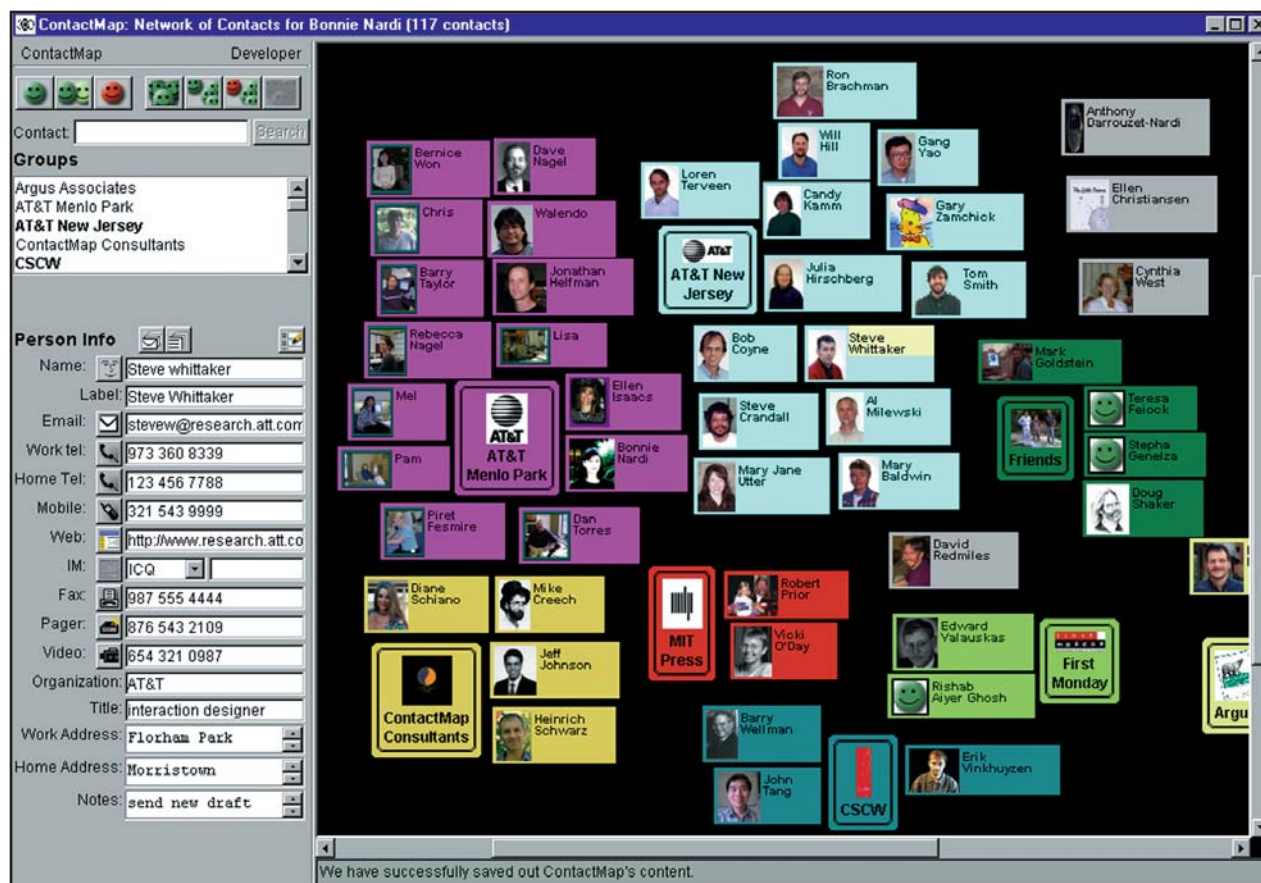and John Hainsworth

Integrating Communication and Information Through ContactMap

Visualizing personal social networks, the system allows
users to model and arrange their own in maps of individual contacts
and groups, along with the relationships among them.

Over the past few years, we've seen a massive uptake in the use of cell phones, personal digital assistants, and hybrid devices integrating phone, computer, and Internet services, communicating with one another, as well as with traditional computers. Along with the Internet, they are transforming our computational environments into communication spaces. In light of this transformation, our research has sought to seamlessly integrate communication with the traditional information functions of computational devices.

Which organizing principle might be adapted for designing and developing advanced user interfaces affording information and communication services in a single integrated system? Our research on communication patterns in the workplace points to models of personal social networks. We have found that people invest considerable effort in maintaining links with networks of colleagues, acquaintances, and friends, and that these networks are a significant organizing principle for work and information. Here, we outline and analyze a study of workplace communication that informs our development efforts, describing our evolving software prototype, ContactMap, as well as recent user experiments with the system.

Figure 1. Network of contacts for Bonnie Nardi. Steve Whittaker is selected, and his contact information appears in the pane to the left. A number of Nardi's groups are visible, including ContactMap Consultants and AT&T Menlo Park.

The netWORK Study

The new economy is characterized by unrelenting technical and organizational change. Workers acquire more and more new technology. Organizations experience a constant flux of downsizing, merging, splitting, partnering, reorganizing, and outsourcing. An increased focus on business relationships between companies leads to new kinds of alliances among them and with their suppliers and customers [1]. Relationships outside the organization, including those with government agencies and the press, are increasingly critical to many businesses. Within organizations, constant reorganization means frequent changes in workers' responsibilities, colleagues, and reporting relationships. One consequence is that many organizations operate in an increasingly distributed manner, with workers, contractors, consultants, and important contacts located not only in different parts of their home countries but around the world as well [10].

To understand the effects of this dynamic workplace, we conducted in-depth interviews and observations in a small sample—22 people in 12 organizations—working across organizational boundaries [7, 8]. All were experienced users of a variety of communication and information technologies. In four of the organizations, we studied two or more workers; the rest were individuals in various organizations. We recorded conversations in their workplaces and, in some cases, also observed them at work. Participants included public relations specialists working with the mass media, an executive transferring technology across corporate boundaries, an attorney appealing life-sentence cases, graphic artists, Web designers, software engineers, a consultant to nonprofit organizations, small business owners, executives at an Internet company, a secretary, and others. Some were independent contractors, some worked for a very large company, some for a mid-size company, and some for small companies of fewer than 100 people.

We were especially interested in the communication challenges faced by workers collaborating across organizational boundaries with customers, clients, colleagues, vendors, outsourced service providers, alliance partners in other companies, venture capitalists, funding agencies, the press, strategic peers, in-house experts, such as legal and human relations staff,

Figure 2. Selection of a group—ContactMap consultants—in the left pane.

and contractors and consultants. This communication differs in several notable ways from communication with close coworkers. For example, considerable effort is required to keep track of the whereabouts and circumstances of others. Communication preferences have to be learned and remembered. People often know each other less well and have to calibrate their interactions with more tact, delicacy, and restraint. They may be working at a distance and need awareness information about the availability of others. Moreover, many workers juggle multiple projects and need easy access to information about task status and documents sent to and from the distributed network of people they work with [9].

We found that people still rely heavily on their own personal social networks to do their work. At the organizational level, personal social networks are activated for labor recruitment, partnering, and information access, providing a rich conduit for vital sources of the labor and information needed by organizations. At the individual level, people exploit their networks to advance their careers by finding new job opportunities and gathering information. Hierarchical organizations are still important in the global economy but increasingly provide fewer of the resources workers need. People cross boundaries to get things done. We call the related communication work "netWORK" because people expend considerable energy and effort managing their own personal social networks.

The idea of networking is not new; Webster's dictionary dates the term to 1940. New is the intensity and necessity for today's workers. This emerging form of social and work interaction is characterized by two intersecting forms of social organization: the traditional hierarchical, role-based organization and fluid, weblike personal social networks. A key contrast between the two was noted by sociologist Carol Heimer when she wrote: "[The particularism] of social networks is expensive compared with the universalism [of preordained organizational roles] because it requires tracking individuals rather than categories and requires long relationships, extensive record keeping, and the like, all of which are expensive" [6].

Participants in our study reported the following "expensive" tasks:

- Remembering the identities of the people in their social networks, particularly those who are important but are contacted infrequently;
- Remembering connections between different people in the network;

- Remembering or recording details about contacts, including current whereabouts and activities;
- Remembering which documents had been exchanged with whom and when;
- Remembering task status, such as that a report has to be finished by a certain date;
- Obtaining awareness information for distant contacts, such as whether they are available for a phone call; and
- Comfort using multiple communication media.

ContactMap Design

We've designed ContactMap to help users with these tasks by presenting a visual model of their personal social networks. Our overall research aim is to explore the viability of organizing the user interface to personal information and communications in terms of a social network of contacts. ContactMap allows users to arrange their individual social networks in a visual map of individual contacts and groups: each node affords a variety of communication functions enabling users to retrieve current and archived information associated with them.

Figure 1 shows part of a ContactMap and a selected contact. ContactMap models users' personal social networks, showing people who are literally central or peripheral to their work and personal lives. Each contact, represented by a picture and a label, is placed in a spatial position reflecting its relationship with both other contacts and the user. Contacts may be assigned to one or more groups (differentiated by color), resulting in a map resembling a geographic map. The groups themselves are arranged spatially to reflect their relationships with one another. Groups typically constitute social categories, such as friends, family, projects, and organizational affiliations. For the selected contact (Steve Whittaker) in Figure 1, the left side of the display shows group affiliations along with contact information, including email address, phone numbers, Web page, fax number, and pager number. Figure 2 shows a group selection. Clicking icons associated with communication functions activates the functions to, say, initiate a click-to-dial phone call, address an email message, or show the contact's Web page.

NetWORK study participants often discussed the care with which they chose specific media when communicating with a specific person in their social net-works. They accounted for such factors as the media preferences of the person being contacted and the nature of the communication. In ContactMap, the user chooses a medium through a single interface and need not remember or look up addressing information.

The social network map is also an index of users' information; each node provides access to documents, such as email messages and text files exchanged between user and contact, as well as access to Web pages associated with contacts (see Figure 3). We hope to integrate ContactMap with an instant messaging system indicating whether individual contacts are using their computers at the moment. ContactMap would then allow users to quickly initiate instant messages through the same integrated interface.

In order to "bootstrap" an individual's map of social networks, ContactMap takes advantage of the fact that personal social networks are built up through repeated interactions. It extracts personal networks by analyzing the history of the user's email interactions. New ContactMap users run an email analysis tool that provides a list of contacts from selected email folders, arranging the list according to a ranking based on interactivity (the extent the user replies to messages from the contact and vice versa) and frequency of interaction (number of messages). Users then choose which of the extracted contacts to include in their networks; ContactMap automatically creates a node with the email address for each individual. The user lays out the contacts on the screen, including an optional photo or other image, and assigns them to one or more groups. Contacts can be "cloned," and individuals can belong to more than one group. In future versions, we intend to extend the bootstrapping mechanism to other sources, including voicemail, phone logs, and existing electronic address books.

Personal social network structure. We recently conducted an experiment to evaluate the email analysis tool, studying the structure of personal social networks as they are modeled in ContactMap. The experiment taught us a great deal about the size and shape of personal social networks built in ContactMap, as well as how users view the dynamics of social networks in ways that might influence the system's future design.

Our work differs from traditional social network analysis that collects data on who communicates with whom and then generates network graphs based on
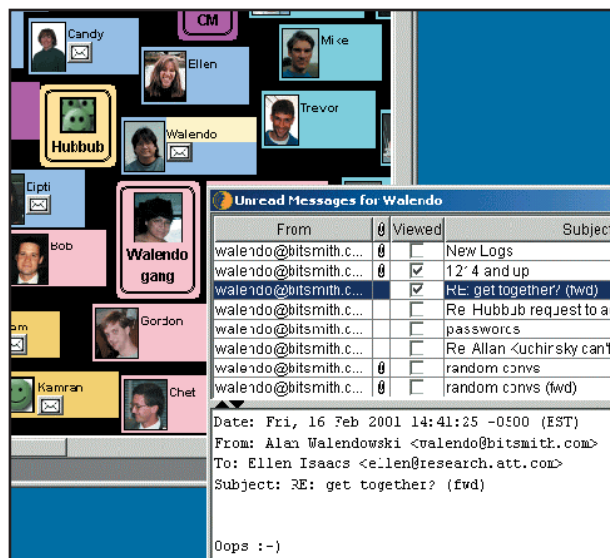
Figure 3. Selection of unread email messages for Ellen Isaacs' map, along with one message she has selected to read. ContactMap indexes email and other documents by contact.

the data [4, 5]. We are interested in how users themselves construe their personal social networks from a subjective ego-centered point of view, rather than from an objective research perspective. For us, the social network is a working tool for users, not an objective representation of sociologically verifiable communication patterns. ContactMap users include in their networks only the contacts with whom they wish to communicate or keep track of. They group them according to personal-use criteria. In contrast, a sociological network graph creates groups based on some objective measure of contact, such as number of conversations held, email messages exchanged, or references cited.

We collected qualitative and quantitative data addressing questions of personal social network structure by having 10 users (researchers, marketing specialists, engineers, and public relations consultants) manipulate and comment on a seed personal network constructed automatically from both their email and their own groupings of their contacts. We first explained the general purpose of ContactMap, then ran the email analysis program over each of their email archives to extract contacts; ContactMap can be configured to analyze specific folders in an email archive, including the Inbox. The contact-extraction procedure generated large numbers of contacts that were then ordered by an importance-ranking algorithm. Users inspected the initial ordered set of contacts and selected a subset to include in their networks. They then grouped the contacts according to their own categories.

We interviewed each user at each step of the

process to elicit personal motivations for constructing their networks as they did, including their reasons for including various contacts and groups and for excluding others, as well as their reactions to the importance-ranking process and how they laid out their networks.

We found significant individual differences in the character of each network. For example, the median number of selected contacts was 107, with a maximum of 233 and a minimum of 23. Original sets of contacts extracted from email ranged from 211 to 1,435. Both the number of groups created and the size of the groups also varied. The median numbers of groups was 10, with 22 the maximum and five the minimum.

We also investigated the common types of groups constructed. We found remarkable homogeneity, as all users but one organized their social networks into workgroups, work projects, friends, family, and special interests. (One had only workgroups and work projects, as she kept all her personal information on a separate computer.) For example, "Carl" grouped his network of 43 contacts into his immediate workgroup, another workgroup, a cross-organizational project, professional colleagues he considered friends, friends in his home state (where he no longer lived), friends in other states, family, and his rock band. We found the "work-friends" category interesting, as many users' friends included people they formerly worked with at other companies—a symptom of the economic flux we pointed to earlier. These networks represented contacts affiliated with personal special interests, including stock clubs, PTAs, and small businesses they ran on the side.

The reasons they cited for including or excluding contacts were consistent with our initial hypotheses about the communication functions of the network and about the importance of the network for managing communications. A key reason for including contacts was just to keep track of them. Being motivated to include a particular contact occurred for positive reasons ("Herbert is a good person to keep track of"; "Sue is someone whose name I might forget"), as well as negative reasons ("I hoped Smith would just disappear, but he's not going to"). Contacts were also included in the network in order to manage related communication tasks: "The only reason Maria is there is because I'm supposed to send her something back." Reasons for excluding contacts were that the user hadn't communicated with that person in a long time or where there was no immediate prospect of communication ("I'm not going to deal with Fred in the future").

We also observed that contacts could be relevant to multiple groups, but users often found it difficult to

arrange their groups so their contacts would straddle several groups. Several users wanted duplicates of the same contact (clones) in multiple clusters, to avoid this complex layout problem. This feedback has since prompted us to add a clone feature. To help users avoid cluttering their maps, a single contact can also belong to multiple groups, even if it is not cloned. When a group is selected, all its members are highlighted in that group's color regardless of their spatial positions, enabling users to position a contact within a primary group but still see it light up when selecting other groups.

Users commented about network growth, saying they need methods to update their networks as new contacts come into their lives. The system now allows them to easily add new contacts manually, one at a time. Users also suggested that any automatic updates be incremental and preserve the spatial relations among preexisting contacts. They viewed ContactMap as a visual workspace where spatial position represents an important memory cue. Today, ContactMap allows users to run the mail analysis tool whenever they want to find and add new contacts not already in a map. In the future, closer integration with email programs will allow them to add new contacts one at a time, as they receive email—rather than running the entire program over a set of folders or manually creating new contacts from within ContactMap, as in the current version. We hope to discover how social networks expand over time, or perhaps whether people tend to maintain their networks at a relatively constant size, removing older contacts as they add new ones.

Users with large maps proposed mechanisms for hiding more peripheral contacts from view; fisheye views might be appropriate here. Some users also talked about the visual complexity of the network when executing specific tasks, suggesting ContactMap construct task-specific views where relevant parts of the network are highlighted and others hidden when they execute certain tasks. These suggestions will be taken up in future versions.

Finally, we noticed that photographs of contacts had a positive effect on bringing a map to life for users. Those taking the time to replace the generic contact icon with a picture of a contact (or of something reminding them of the person) seemed to have a stronger sense that the map reflected their personal social networks. They collected images in various ways: downloading pictures of colleagues from internal organizational Web sites; requesting online photos from contacts; and scanning in personal photos. These methods are time consuming, though often amusing. While ContactMap sizes images to fit its requirements, we would like to find a way to ease the process of obtaining and incorporating the photos.

Compared to related systems. Traditional corporate tools, including organizational charts, are intended to support many netWORK-type functions, including tracking contact details and providing information about affiliations, roles, and expertise. However, organization charts are specific to particular organizations and are updated infrequently. Moreover, they do not reflect an individual's perception of the relationships among people. The networks described to us by ContactMap users changed constantly while spanning multiple organizations. A number of software programs support personal contact management, though they require extensive data entry and maintenance and do not reflect each contact's relationship to the others. They are also poorly integrated with file systems and email, so do not allow users to readily retrieve information or prior interactions associated with a contact. Moreover, these programs do not support communication functions, such as placing phone calls or finding Web pages within a single user interface, that is, an interface that does not require clicking one's way through multiple windows to do something as simple as open a Web page.

Conclusion

Our results suggest the potential utility of social networks as a new principle for organizing work on the computer desktop. Other research has identified the limitations of the current desktop metaphor of files and folders and proposed methods for personal data organization based on new arrangements of documents [2, 3]. For example, TheBrain (www.thebrain.com) and other systems allow highly flexible visualization and organization of personal information. However, they are information-oriented, lacking the communication functions necessary for all kinds of workers. ContactMap integrates both information and communication capabilities in a single user interface.

Future ContactMap research questions we hope to address include: How will people use this social desktop for everyday work to manage communications with their contacts and organize their data?; How might it support network growth and complexity, preserving the overall spatial consistency and spatial workspace users want?; How might it support task-specific views of the network, along with the ability to hide more peripheral contacts from default views?; How far might it push the communication-centric model to include information?; How might it accommodate information users not associated with a specific person or group?; How might it make it easier

for people to get access to one another's photos so they more easily bring their contact maps to life?; How should we evolve ContactMap so it can be used on cell phones and personal digital assistants?; How might it subsume information in personal information manager software?; and, How might it enable the sharing of contact information so users readily share their contacts (while addressing related privacy concerns)?

By giving users straightforward methods for extracting and visualizing personal social networks we hope to integrate access to information and communication with the demands of today's economy. ⓒ

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