

# What CNN Can't Tell You: Maintaining Activity Awareness Through The Use Of Object-Specific RSS feeds

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## ABSTRACT

Pervasive access to networked computing enables a broad range of collaborative activities. But as we increase our frequency and varieties of computer-based collaborations, how do we stay aware of the status of our many activities? RSS feeds are increasingly used to support awareness: news-oriented websites broadcast RSS feeds and users subscribe to the feeds so that news updates can be delivered to them on a regular basis. In this paper we investigate the use of RSS feeds in maintaining activity awareness for projects that involve updates to more diverse types of objects. While we have found this application of RSS technology to be valuable, its effectiveness may be limited in RSS clients that were not designed with this use in mind.

## Author Keywords

computer supported collaborative work, CSCW, notification systems, activity awareness, RSS.

## ACM Classification Keywords

H.5.3 Group and Organization Interfaces

## INTRODUCTION

An important requirement for successful collaboration is to stay abreast of project activities — who is doing what, how far along they are and what remains to be done. This is *activity awareness* — awareness and coordination at the level of meaningful activities. Such activities are comprised of interleaved synchronous and asynchronous interactions that occur over an extended period of time [4, 11].

One technique for supporting activity awareness is to create a *notification system* that alerts project members of relevant status changes [3]. Several research projects have explored

notification systems, and researchers exploring such techniques have described many user interface design challenges related to the visual display and interaction with notifications [2, 5, 8, 9, 10].

In this paper, we report design work and some informal evaluations of a notification system for activity awareness. The questions we focus on concern the nature and amount of information a collaborator needs to maintain awareness of project activities. The project itself may involve many different types of content (text, images or drawings, datasets or analyses, meeting logs, and so on), as well as many kinds of interactions related to this content (meetings, email exchanges, chats, posting of documents or annotations, and so on). What project content and interactions do project members need to monitor? What updates are appropriate for different types of content? How do the notifications influence project members' work?

Our design experiments are directed at the development of a service that uses RSS technology [1] to support project activities such as those of our own work group. RSS (which stands for Rich Site Summary, RDF Site Summary, or Really Simple Syndication) is used to broadcast news updates. Each item in an RSS feed contains information such as a title, a brief textual description, and an associated date. It may also contain a link to the actual object that the item represents. Users can subscribe to an RSS feed, and periodically pull information from it, getting updates about new or changed items. They can do this using a variety of RSS clients, each with its own interface and notification styles. RSS has advantages over mailing lists in that it avoids the cost of moderation, and affords easy aggregation of information within and across feeds [7].

## A PROBLEM SCENARIO

In early 2005, a group in our department collaborated on a conference paper. Using their internal tools for collaboration, several web pages were created to hold notes and discussion among group members on aspects such as problem, general approach, methods, issues for discussion, conclusions, and so on. Over a two-week period, the team collaborated intensively, both as a group and as individuals, to share and refine ideas, and to turn these ideas into a well-

structured paper. However, team members found it difficult to stay on top of the paper's progress; in order to monitor progress they needed to either check with everyone else multiple times during the day, or open and scan the project documents. Team members making changes often did not highlight the most recent changes; nor did they leave an indication of who had made the change or when. When the team did meet in person, valuable time was spent bringing everyone to the same level of awareness.

This scenario motivates the goals of our notification system design, which are twofold. First, we want to provide an *activity summary*. Through concise but meaningful content, we hope to increase the overall awareness of a team member to the general status of a project. Users should gain useful knowledge of activity on a high level. Secondly, we want to *facilitate change inspection*. The content provided should be sufficient to indicate whether or not the change to an object is of interest. A user should then be able to access any such object and easily investigate the changes in detail.

### AN OBJECT-SPECIFIC RSS FEED

Our experiments with RSS technologies as a resource for activity awareness are situated within the BRIDGE tool set (Basic Resources for Integrated Distributed Group Environments; [6]). BRIDGE supports collaborative interaction through a variety of objects, including Web Pages, Calendars, Folders, Discussion Boards, Electronic Whiteboards, Charts, Maps and User Lists. BRIDGE users create and use such objects as needed by a project. They can use either a Java-based "full" client to collaborate synchronously with these objects, or a set of web views and wiki-style editors for asynchronous viewing of and interaction with the same objects.

When building the initial prototype of this project, we wanted to build RSS feeds for BRIDGE tools that are in common use, but also that differ significantly in their functionality. A focus on popular objects like Web Pages and Calendars increases the potential usefulness of the feeds. At the same time, these selections allow us to explore the role of updates for rather different collaborative actions (e.g., contrast the act of proposing a meeting vs. modifying text on a web page).

We chose three types of BRIDGE objects for RSS support: the User List, the Calendar and the Web Page. A BRIDGE User List (see Figure 1) displays information regarding which users are logged in, when they logged in, whether they are active or idle, how long they have been idle if they are, and any status message they may have provided to indicate location or activity. Calendars (see Figure 3) contain calendar items that may be appointments, recurring events, or to-do lists. Web Pages (see Figure 5) can contain textual data, formatting tags, and links to other Web Pages (internal or external to BRIDGE). Other BRIDGE objects may also be embedded within a Web Page object.



**Figure 1: An example of a BRIDGE User List. (User names have been grayed out)**

These three objects contribute different sorts of awareness information: updates related to User Lists may aid social awareness, while knowledge of events on a Calendar, or of changes to a Web Page may facilitate action awareness.

### User Lists

Figure 1 shows a User List in BRIDGE, a tool similar to the Buddy Lists common in instant messaging applications. With respect to our goals for activity awareness, users need to know who is currently available for collaboration with others or for otherwise contributing to a project. Thus we reasoned that for our initial design, including information about whether or not another user is "active" should be more relevant than information about when s/he logged in. At the same time, some indication of how long a user has been available or unavailable might be useful. A user may use such information to infer how much activity one user has participated in comparison to others, or how likely it is that a user will soon become available.

Figure 2 shows an example of how a User List might be represented in an RSS feed as viewed by the Sharp Reader RSS client for Windows. The description for the item lists both active and idle users. Active users are ordered according to who has been active longest; similarly idle users are ordered according to who has been most recently active (i.e., "least idle" in some sense).



**Figure 2: Example representation of the status of a User List from an RSS feed, displayed with the Sharp Reader RSS client. (User names have been grayed out)**

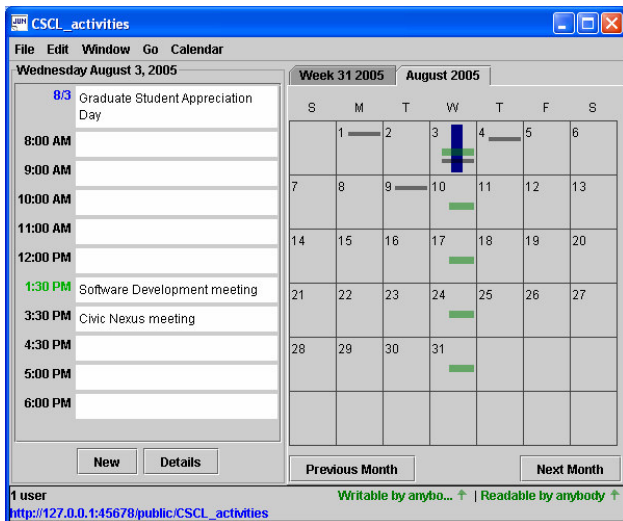


Figure 3: An example BRIDGE Calendar

### Calendars

Figure 3 shows a BRIDGE Calendar. On the left is a view of the selected day, displaying the titles of its items at their start times. All-day items are displayed at the top of the day view. On the right is a view of the month (a week view may be shown in its place). All-day items and items that belong to the recurring item list instead of any given month are displayed in different colors.

For objects dealing with social awareness, such as User Lists, it might be sufficient to convey key pieces of their status, but for a collection of events like a Calendar, we need a different summary. A list of all events in a Calendar might be very long, causing a user to be overwhelmed. It is likely to contain too much information, and a user would have to sift through all of the items to find ones that are relevant. With respect to activity awareness, Calendar users are most likely to be interested in recently added or modified events.

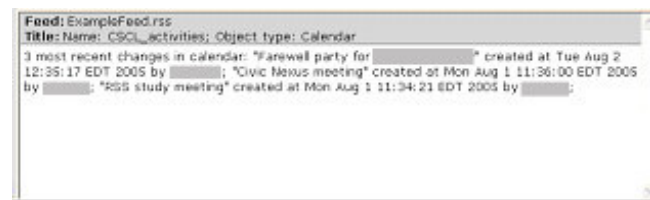
If users wish to be aware of “recent” events, do they wish to know about the last *X number* of items that have been added or changed? Or do they wish to know about the changes that have been made over the last *X number of days*? If recency is operationalized as a number of changes, users would be notified changes up to this threshold, regardless of how long ago the changes took place. In contrast, if recency is based on a period of time, they would be made aware of any changes occurring near in time, even when that number is quite large. Our initial design included both change descriptions. In choosing the threshold values for number and time period, we examined the use of Calendars in our work group, and decided to include information about the last 3 items and the last 7 days.

A second design task for the Calendar RSS feed was to analyze what a user might want to know about recent items. We decided that the title of the item was likely to be quite

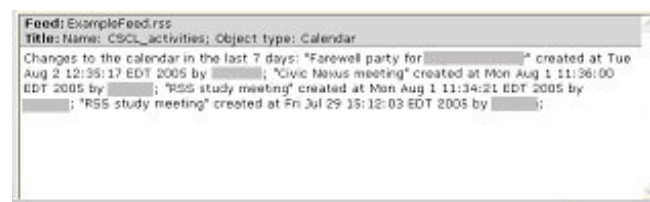
descriptive, and in fact might be the most useful thing for a user to know. Because activity involves both actions and people, we included with this descriptive title an indication of which user was involved in the creation or modification of the scheduled item.

In order to help users maintain awareness over time, we also included the date at which the item was added or last modified. We elected not to include the time at which an event was scheduled to occur, because items such as all-day events and to-do lists do not have start times. We felt that knowledge of what items were being added or changed, when and by whom, gave a good picture of overall activity. In particular, we felt that this would also be enough information for a user to determine if he/she was interested in a certain item, and thus whether to access the object to see all of its details.

Figure 4 shows the two alternatives for summarizing changes made to a Calendar in an RSS feed. Figure 4(a) shows a description containing the last 3 changes made to a Calendar. For each change it shows the title of the item, the date that each change was made, and the user who made the change. Figure 4(b) shows a description containing the changes made to a Calendar in the last 7 days. Each description also includes the title of the item, the date that each change was made, and the user who made the change.



(a)



(b)

Figure 4: Example representations of Calendar change information from an RSS feed, displayed with the Sharp Reader RSS client. (a) shows the 3 most recent changes, while (b) shows the changes made in the last week. (User names and names have been grayed out)

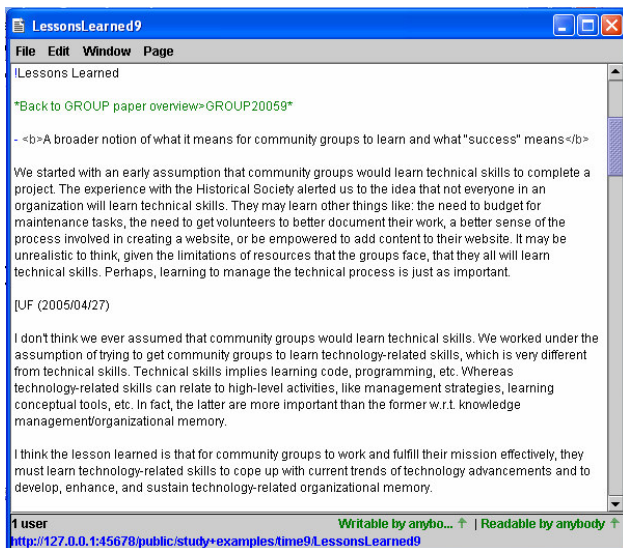


Figure 5: An example of a BRIDGE Web Page

### Web Pages

Figure 5 shows a Web Page in BRIDGE. A Web Page can contain several different types of information that may be of interest to a user. The example contains text with HTML as well as wiki formatting, as well as links to other Web Pages. Images and other embedded objects are not shown here, but are common in BRIDGE Web Pages.

Representing the current status of a Web Page in the feed, (as we did for User Lists) would not be very useful, for reasons similar to those considered for Calendars. As for Calendars, knowledge of changes made to Web Pages contributes to awareness of collaborators' actions. Thus we focused on how to represent recent changes to a Web Page.

However, even though Calendars and Web Pages are similar in some respects, they are rather different in what they represent, and their notifications must account for these differences. A Calendar can be understood as a collection of scheduled items. To say that a Calendar has been changed means that an item has been added or (less likely) changed. The essence of the change is the scheduled item. A Web Page, on the other hand, is not a simple container of items. It holds textual content and links to other material that can be browsed and edited in non-trivial ways. To say that a Web Page has been changed, is to say that additions, removals or modifications have been made to any or all of the pieces of information in its content. The change could be miniscule or enormous.

Given this line of thought, it seemed inappropriate to simply aggregate and summarize changes to a Web Page; the update would be much more useful if it summarizes one change at a time. This indeed makes more sense when one thinks about the editing of Calendars and Web Pages. To edit a Calendar, a user might take barely a minute to make the simple addition of an item. To edit a Web Page, a user

may work for several minutes or even hours. Each Web Page "edit" may include a multitude of changes. These are the changes that other team members want to know about.

Our task was then to analyze how a Web Page might be changed, and how these changes might affect the status of the document. The most obvious type of change is text. Knowing how much text was added, removed, or changed would certainly be useful in representing how much a Web Page has changed. The less obvious concern was finding the unit of text to use as a metric of change – a metric that would make the most sense to users in summary form.

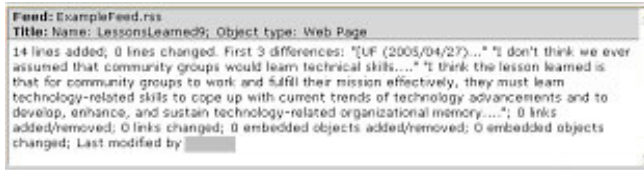
Expressing change in terms of page units might produce a summary that users can easily interpret, because we often speak of documents in terms of how many pages they contain. Unfortunately a page has no meaning for Web Pages. Based on a user's resolution or size of their browser window, a "page" could be a wide range of things. Should the change unit instead be "lines"? A line for the same reasons has no intrinsic meaning, because browser or screen size can lead to great variations. But what if we segmented the document by new line characters? This would essentially break a Web Page up into paragraphs. Would knowing that 1 "line" in this sense changed be useful enough? It could mean 1 sentence was changed or perhaps that 20 were. This could lead to information hiding. If in practice people put a new line after each separate thought/sentence, perhaps it could be useful.

Alternatively, we might use sentences as change units. This would involve segmenting the document by sentence-ending characters such as periods, question marks, exclamations signs and new lines. Such an approach might offer a more accurate view of how much has been changed, but presents a problem in that certain "sentence ending characters" may often arise *not* at the end of sentences. Perhaps we could be even more specific and use the unit of characters. This would leave no room for ambiguity. We would also be able to calculate things like percentage change. However this seems likely to be at such a low level that the summary content would mean nothing to most users. Based on this reasoning, our initial design included both sentences and lines as change units.

Web Pages often contain links to other pages; in BRIDGE they may also contain embedded BRIDGE objects. These contribute to the makeup of a Web Page, and it seems likely that changes to such links would also be of interest.



(a)



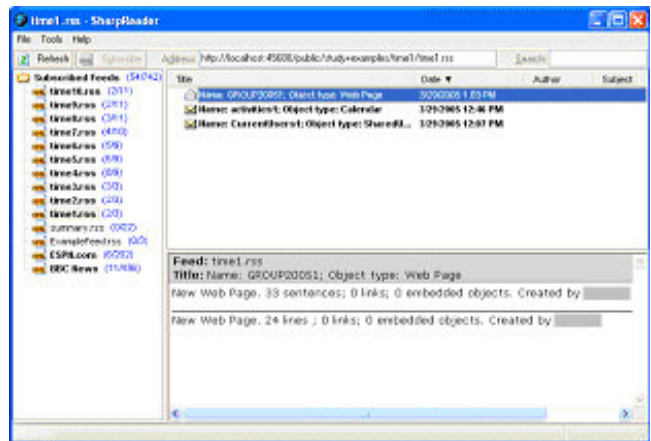
(b)

**Figure 6: Example representations of Web Page change information from an RSS feed, displayed with the Sharp Reader RSS client. (a) shows the changes on a sentence level, while (b) shows the changes on a line level. (User names have been grayed out)**

Figure 6 shows example descriptions for changes to a Web Page, displayed as an RSS feed. It includes the number of sentences/lines that have been added, removed or changed, to give a general picture of how much the page has changed overall. The first few changes are also reported, with the intention of indicating the nature of the changes, as well as providing a cue to use in locating the changes in the Web Page. The number of links and embedded objects added, removed or changed, and the first changed (not relevant in this example) are also shown. To better connect the change to the social context of the project, we again indicate which user made the change(s).

One issue that is specific to Web Pages is that they are at times updated very frequently with only minor changes. For instance, users may often proofread after saving, and iteratively return to make slight edits, such as fixing capitalization errors, adding punctuation, or adding or removing white space. We did not feel that these were significant contributions to activity, and notifications of such changes might annoy users rather than help them to maintain awareness.

It is relatively straightforward to build a difference algorithm that ignores changes involving capitalization, punctuation and white space, what of the fixing of typos? We considered having a threshold for change, for example only considering changes that impacted a certain number of words or sentences. This was not implemented because the size of a change is not always proportional to its significance. A few words could change the meaning of a sentence, paragraph or idea, and this cannot be easily distinguished from adjusting a typographical errors or introducing a slight rewording that does not affect meaning. We also considered a time threshold, where changes that occurred within a short time frame would not be considered. We chose to not implement this either because



**Figure 7: View of the description of changes to a Web Page as presented in the first study. (User names have been grayed out)**

it may only take a few seconds to delete a large chunk of a page, or paste a large chunk of information into a page.

#### USER TESTING AND DESIGN REFINEMENT

Our initial prototype was preliminary and included alternative designs for the Calendar and Web Page feeds. We carried out an informal user test aimed at 1) gauging the effectiveness of the RSS feeds in meeting our activity awareness goals; 2) exploring the alternative designs; and 3) uncovering and exploring other issues and user reactions that might arise through use.

This first user test was formed around the group paper-writing project described earlier. The Web Pages that had been formed as this project progressed were recreated; Calendar and User List objects that may have represented events that occurred and users who were active at the time were simulated to create a more diverse set of test objects. Ten different feeds were created, from “time1” to “time10”, each representing the status of the project at a different point in time over a four-week period. The items in each feed described changes made to the content of Web Pages, a Calendar, and the User List as of the specified time.

Figure 7 shows the feeds as they were presented in the study, using the Sharp Reader client. Web Page and Calendar descriptions were both presented in a way that contrasted the design alternatives discussed earlier, divided by a line. From a description, a user could click on the title and view the object if he or she chose to.

Eight volunteers participated in the user study – four were members of the group that had created the pages for the actual paper, and four were not. Participants sat in front of a computer and were observed by the experimenter as they interacted with the RSS client. They were encouraged to communicate any thoughts they had to the experimenter throughout the study.

The participants were asked to examine each feed in chronological order, from the earliest (time1) to the latest (time10). After examining each feed, participants gave written answers to two questions, requiring them to interpret the information presented (for example how the state of the project had changed at that point and who contributed). They also completed a five question questionnaire at the end, which asked questions regarding the effectiveness of the feeds in terms of our goals and the usefulness of the design alternatives presented.

## Findings

### *...On summarizing activity*

When asked if they found the descriptions to be a reasonable high-level indicator of how much an object had changed, six out of eight users indicated that they did. For Web Pages, the quantitative measure of text, links and objects changed proved most useful to these users in determining this. The users who did not find the descriptions to be a reasonable indicator of change indicated that the information was not presented effectively. One user also added that it was difficult to gauge what a certain number of lines or sentences meant in terms of change, but felt that this would be a skill she would pick up through further use of the RSS feed.

### *...On facilitating change inspection*

Users were asked if in practice, the information in the descriptions would be enough to convey whether or not they needed to look at the actual object in detail. Seven of the eight users felt that the information would be enough to make that decision. Five of these users relied mainly on the number of lines/sentences that changed, and felt that changes over some number or number range would lead them to believe the change was significant and worth exploring. The other two felt that looking at the first three differences was more helpful in determining if they should look at the object. In addition, one user added that whether or not the links and embedded objects changed was also important, and another indicated that seeing which user made the change was also a helpful indicator as to the significance of the change. Five of the users also indicated that knowing that a page was new as opposed to just changed was important in determining its significance. One user added that the frequency of change of a page would push him to view a page even more than any information in the description. The user who felt that the descriptions were not helpful in determining whether or not he should look at a page, said that there was not enough information given, and that he would need to know the context of the differences and would hence have to look at each page anyway.

Users who said they viewed Calendar objects after reading their change descriptions were asked if the descriptions helped them to find the changes. There were five such users, and three of them felt that the name of the item

added/modified and the time at which that change was made was sufficient information for finding the event, but the other two users said that they needed the actual time the event was occurring at to find it easily. One of these two users pointed out that in practice events may be scheduled far in advance, unlike in this study, and knowing the creation date would not be helpful.

All eight users reported that they had followed the available links to view Web Pages after reading the change descriptions. When asked how helpful the descriptions were as they tried to find the changes on the actual pages, three of them indicated that the information in the descriptions was useful for this. They mentioned knowing where the changes began and roughly how much text had changed as useful. One user mentioned that Web Pages tend to be organized in sections with titles and bulleted lists, and that knowing actual lines that changed pointed her to the correct sections to begin looking. The other five users felt that knowing what a change was did not make them more likely to find it. One of these users, however, developed a strategy based on the browser's search tool; He copied information from the RSS to search for and locate the position of the change.

### *...On alternatives for representing change*

When asked if they found one alternative more useful than the other, five of the eight users indicated that displaying changes at a sentence level was more helpful than at a line level. They felt that there was too much variability in line length to be useful, that the concept of a "line" had no meaning, and that changes should be reported in sentences because we write in sentences. Two users felt that lines were more useful. One of these users felt that lines were less vague, and the other was used to the concept of lines from other software packages. The final user indicated no preference of lines or sentences.

When asked if one alternative for displaying calendar change information was more helpful, six of the users said that displaying the changes made in the last week was more useful. Their main concern seemed to be knowledge of current activity, and they did not like the other method as it sometimes displayed "old" activity. If a Calendar is not updated very often, the number-based threshold might give more information than collaborators want to see. For the time-based threshold, some users pointed out (and appreciated) that if no events were added or changed during a week, the time-based method would explicitly indicate that. One user found the 3 most recent changes method to be more useful; he suggested that if the time threshold had spanned 2 weeks, it would have been more useful. The final user said it depended a lot on how often changes were made. The main concern of these last two users seemed to be knowledge of what the most recent changes were.

### *...On other issues and reactions*

One user who had been a part of the group that created the pages used in the study commented that some of those pages had been edited during meetings, where one user would log in, but another user (or several users) would edit the pages. The RSS feed gets information from BRIDGE, which maps the editor of the object to the user who logs in. Although our RSS technique is limited to the information we can get from the BRIDGE tools, perhaps the tools could allow multiple users to login for a session; another solution would be to employ group-based user accounts.

Another general question concerned the usefulness of the User List descriptions. A few users suggested that knowing who was online would better support activity awareness activity if they could see whether users are viewing objects related to the project. The BRIDGE User List displays users who are logged in anywhere in the system; it might be possible to elaborate this information to include open objects. If so, our RSS notification system could construct a more project-specific User List update.

In our first prototype, we only made use of the title, date and description fields for each item; these are the data that RSS clients support, although the RSS specification allows for other fields. One user pointed out the usefulness of knowing who edited an object without having to read the description, and suggested that we make use of the "creator" field. This would give users the advantage of being able to sort items by user, if their client supported it. However, not all clients support this field; its presence in the field may also be misleading if the author of the changes is interpreted as the author of the actual object.

Some users requested additional formatting in feeds to make pertinent information stand out (we had used a very simple format in the initial version because some clients are unable to render the formatting properly). Another user felt that both lines and sentences were too variable, and suggested a percentage change. However for a rather long page, a relatively large change might seem insignificant if presents as just a small percentage of the total Web Page.

Multiple users said that they would like the ability to go to a Web Page and see all the changes that were made highlighted. This feature is present in other software applications users might have used. This would undoubtedly be useful, but falls outside of the scope of this project. Perhaps the BRIDGE tools can be changed to allow for this; it seems clear that it would be a useful feature to use alongside the RSS technology.

### Redesign

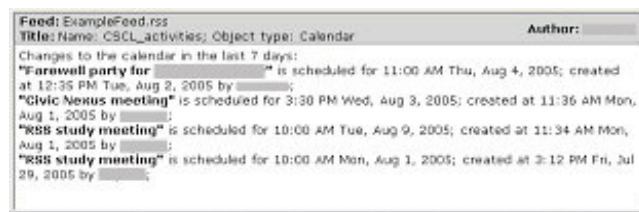
Our initial user test suggested that changes in a Web Page should be summarized at the sentence level. Sentences seemed to map more to people's mental models of textual data. For Calendars, we chose the time-period method, based on users' orientation toward recent activity. We decided to keep the summary period at one week, assuming

that users will check it at least that often if they wish to be current. A week is also a logical and meaningful chunk of time in the way we think about calendars. We also decided to include the start time of events (for those events with start times) in the Calendar description. The time in the time field for the RSS item was left as the time the Calendar was last modified, however. This means that a Calendar is reported as being updated when the event is created/changed, not when the event occurs. This is because our primary concern is still activity done to the Calendar, not activity that its content spawns.

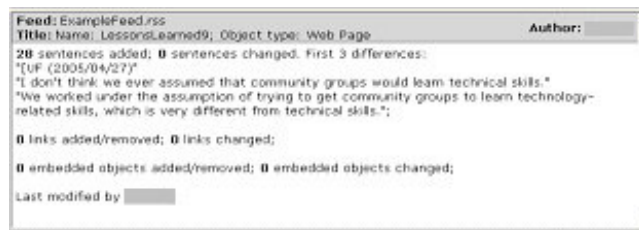
As the use of RSS becomes more widespread, RSS clients seem likely to become more advanced, such that they support all fields of the existing specifications. With this in mind, we added the creator field to the summaries. The descriptions for changes in Web Pages and Calendars were refined to make them more organized and readable (see figure 8). We wanted the most important information to be available at a glance, so we highlighted the quantitative measures of change for Web Pages, and the names of items added or modified for Calendars. We also simplified the time format in the Calendar and User List feeds.

### STUDYING OBJECT-SPECIFIC RSS FEEDS IN USE

Our first study helped us to refine our design, but we also wanted to evaluate the usefulness of the object-specific RSS summaries in a more realistic setting. After the redesign had been implemented, the technology was made generally available within the community of BRIDGE users. More specifically, an existing project group was invited to experiment with the RSS feeds over a week-long trial; a feed was set up for the BRIDGE objects comprising their project. Group members were emailed instructions about how to install an RSS reader (we recommended the Feed client for Macintosh OS/X), as well as how to subscribe to and monitor the RSS feed. The group consisted



(a)



(b)

Figure 8: (a) Redesigned Calendar description and (b) Redesigned Web Page description

of four collaborators who were co-located, one remote collaborator (three time zones away), and one member who was away on leave for half of the week-long trial.

At the end of each day, the six participants were emailed a short questionnaire asking them about a) their frequency of viewing the RSS feed; b) how informative they had found the descriptions; and c) what if any activity was initiated after viewing the feed. At the end of the study they were asked to complete a larger, more reflective set of questions, assessing how well the system achieved its goals, how they used it and what improvements they felt were necessary.

## Findings

### *...On usage*

Of the six users invited to participate, four reported that they used the RSS feed. They were asked questions about when and how they used the feed, and any usage patterns they developed. These users said that they checked the feed daily, typically 2 or 3 times per day; they reported that this was more often than they generally check RSS feeds (e.g. from news sites). Users seemed to check at roughly equal intervals throughout the day. Some users mentioned that they checked the feed specifically before meetings, not just to see if there was any new information, but also to reacquaint themselves with the current status of the project. The user who was away for the first half of the week reported checking the feed before speaking with any of her collaborators, and found it very useful in getting up to date on the changes that had occurred in her absence.

Some users reported that they kept their RSS readers open throughout the day, so that checking the RSS feed consisted of just a quick glance to the reader to see whether new or updated items had appeared. One user described an episode at a meeting, where he and another user were discussing something the other user had posted to a Web Page, and he began searching his inbox for the e-mail message containing the URL of the page she had changed. He soon realized that she had not sent him an email, but he had seen the information in the feed. He was relying on an existing practice whereby collaborators email their changes to each other. These emergent changes in practices suggest an interesting shift in the workplace culture in our lab. It may be that RSS technology can be used to replace some of the functions of email (those involving change notification).

We observed three levels of notification awareness in people's use of our RSS system. Firstly, users must notice that updates have been broadcast. Users working with the Safari web browser's built in RSS reader were able to track the number of unread items (this indication can be permanently displayed on the browser's toolbar). Having this notification constantly in peripheral vision saved these users the effort of looking at the actual feed to know when there was something new. Detecting the presence of changes sometimes prompted users to examine the feed, or

served as a reminder to check the feed later if they did not have time to or did not wish to do so then.

A second level of awareness occurred when users read the descriptions in the feed. This high-level awareness often prompted users to investigate actual changes in the objects themselves, as described later. The third level of awareness comprised viewing the changes in context.

Users often reported that being notified of changes reminded them of changes they themselves needed to make in the project, and often prompted them to do so. There is also the social aspect of recognition to consider, in that some of the activity may have been encouraged by the desire of users to see their names in the feed.

One study participant who reported not using the RSS feed had been a participant in the first study, and had concluded that the information given in the descriptions was not enough for him to be able to find changes in Web Pages. He felt that for an RSS feed to be usable, it had to be used in conjunction with a mechanism that could highlight changes on the actual page. He chose not to participate in the study because we had not implemented such a system (for reasons described earlier).

Some of the users who did use the RSS feed also offered reasons why others might not use it. Some users mentioned client usability issues; another felt that the information in the feed might be too overwhelming for users who were more ancillary to a project. Other than that, they felt that this RSS notification system was something that could be successfully accepted into general use. On completion of the study, one user even expressed an immediate desire to begin setting up her own feeds to watch all the BRIDGE objects that were of interest to her.

### *...On summarizing activity*

Users were again asked if they found the descriptions in the feed to be good high-level indicators of change, and in practice, most of them felt that they were. One user relied not on the item descriptions, but the simple appearance of new items as an indicator of change. Two users mentioned that while they found all of the aspects of Web Pages mentioned (sentences, links and embedded objects) to be important, they often only looked at how many sentences were different, as they felt this was a good enough indication of change and that the rest of the information made the description too long. Another user mentioned that he would find the descriptions to be a better summary of activity if he knew not just how many sentences were different, but how many sentences were present, so as to infer the relative size of the change.

When asked whether the feed helped to maintain awareness of the contributions of each user, all users said that knowing which users made changes (included in the description as well as in the creator field of the item) was useful for this. From browsing the feed, users could see

who was participating in the project and how, and how active other users were in relation to each other.

For Web Pages that had not been updated recently, users found their existence in the feed to be useful in that they could see when they were last updated. Interestingly, even when they had viewed those changes in the past, they liked being aware of the *inactivity* of certain project elements.

*...On facilitating change inspection*

Users were asked if reading the descriptions helped them to decide whether or not to inspect an actual object, and again they answered affirmatively. They mentioned that knowing which user made a change was useful for this purpose, as it provided general knowledge about which areas of the project were being edited by which users. One user suggested reorganizing the descriptions to first list what actually had actually been changed. However, users in general reported that no huge changes were made to objects during the one-week span of this study, and there were not many objects that they needed to inspect. There were also three meetings during the course of the study, and one user (in a supervisory position) indicated that she was unlikely to investigate the actual changes, because progress updates would be given at the meeting. The amount of time she had often dictated whether or not she chose to view the changes made to an object.

When asked whether or not the descriptions from the feed helped them to find the changes made when they were viewing an object, users gave mixed opinions. One user found that this task was what the descriptions accomplished best. For Web Pages, even just the name of the user who made changes was enough for her to infer the nature of the changes and easily find them on the page. In contrast, another user indicated that she did not find the descriptions to be helpful in this respect, and that she often relied on her memory and familiarity with a Web Page to spot the differences.

*...On client issues*

Users reported instances in which their RSS readers did not behave in an expected way. In some clients, when an item was updated a notification was given but the date associated with it did not change within the client - the date shown always reflected the date at which the object was initially created. Since users tended to have items in the feed sorted by date, new items were not readily visible, because they did not always appear at the top/bottom of the list. Sorting by date itself also lost its meaning. Another client adjusts the date to indicate when an item is updated, but only gives notifications when an item appears in the feed for the first time. Because the conventional use of RSS feeds is to send information about news stories, users are not likely to experience such problems—news stories are generally not edited, but rather new articles are created. This may also suggest a deficiency in the RSS protocol; it is described as a means of providing change information

about websites, but does not define the uniqueness of feed items or the meaning of date information within each item.

Some users do a lot of work in their web browsers and thus constantly have them open on their desktops. A browser-based RSS is ideal for such users, because any visual notifications displayed in the browser are readily available. However one user commented that her “default” working space centered around her email communication activities, and that because she uses a standalone email client, her web browser is not a part of this space. Both browser-based and standalone RSS clients would be out of this default working space, and unless she set up an auditory alert, she might not become aware of change notifications. For communication-centered users such as this, an email client that integrates RSS support could be very valuable.

Some projects in BRIDGE involve Web Pages with information that only authorized users can access. One user voiced concern about this, wondering how this would be regulated when using an RSS feed. Some RSS clients support HTTP authentication to handle this issue. Some however — including the client she was using — do not, thus restricting her from viewing such pages.

Another issue concerned the tradeoff between screen real estate and the amount of information provided. The RSS readers that were integrated into web browsers generally did not occupy much screen space, but required extra effort to get to the actual descriptions in the feed, while the standalone clients put all the information in front of a user right away, but take up considerable screen real estate.

*...On suggestions for improvement*

A simple suggestion for improving our RSS notification system was to include more objects. The existing project included many Web Pages, but also many Uploaded File objects. The feed for these objects (and all objects not analyzed in the initial design) was a default, listing the name and type of object, who made changes to or created it, and when they did so. Users suggested that the design be expanded to give more detail about these objects.

In one situation during the study, one collaborator missed a meeting — he had not been checking the feed and was not aware of a meeting time that had been added to the Calendar. The group was not otherwise notified of the meeting time; the creator assumed that everyone would be checking the feed for new information. Afterward, the user who had scheduled the meeting expressed the desire to know which users had viewed which objects.

**CONCLUSION**

Our design experiment and associated user reactions and comments suggest that our RSS notification system is reasonably successful at accomplishing its goals. It proved quite useful as an activity summary, both providing notification of and letting users see at a glance which

objects were being changed as well as how “big” these changes were. The functionality appeared to be particularly useful to users in supervisory positions; it may be that their main concerns are with their subordinates’ general level of activity, and they may not be interested in the specific content of the changes. In terms of facilitating change inspection, our technique may be of more limited use. The quantitative measures of change were valuable indicators to users in determining that a change to an object was significant and worthy of inspection, and having a direct link to the object in question was useful and time saving. The RSS feed itself, however, did not always prove helpful when trying to find the changes on a page.

This new application of the RSS technology appears to have caught on quickly in our lab. There were signs of users developing usage patterns, and it began to replace old practices. We plan to address the issues brought up in our studies, as well as expand our system to describe changes to other objects for the next version of our system. We hope to thus make it more effective and widely used. Until RSS readers are designed to with uses like ours in mind, however, our system will remain somewhat limited in its effectiveness.

As RSS use becomes more widespread, we hope that more people will take advantage of its capability to do more than just report news headlines. Our design experiments suggest that even providing an indication that changes have occurred—along with information regarding the nature, timing, and author—can be quite useful on its own. However, it is also clear that to support the investigation of particularly “interesting” changes, the RSS feeds should be combined with other awareness techniques that highlight or otherwise indicate the location of the changes summarized in the update. Unlike a news story from CNN, the “news” about a project object is often a refinement or elaboration buried deep within an existing object.

#### ACKNOWLEDGEMENTS

A short preliminary report of this work has been accepted for publication in ACM’s student magazine *Crossroads*. We would like to thank the Computing Research Association’s Committee on the Status of Women in Computing Research for supporting this research during the summer of 2005.

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**Contribution and benefits statement**

Presents a design experiment and informal evaluation of content type-specific RSS feeds. Researchers working on techniques for activity awareness within group projects can learn from our experiences.