

# Cover Page

**Title of submission:** Designing for Persistent Audio Conversations in the Enterprise

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# Designing for Persistent Audio Conversations in the Enterprise

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**Abstract**

Social media websites like flickr and del.icio.us enable collaboration by allowing users to easily share content on the web through tagging. To provide a similar advantage to the enterprise, we have designed a tagging system for audio conversations. We are developing telephonic interfaces, where participants of a spoken conversation can opt to archive and share it. We have also developed a web-based visual interface that enables annotation, search, and retrieval of archived conversations. In this interface, we have focused on visualizing relationships between users, tags and conversations, which will enable efficient searching and browsing, and more importantly, provide contextualized interaction histories. A pilot user study, conducted using simulated data, showed that our social network visualization was effective.

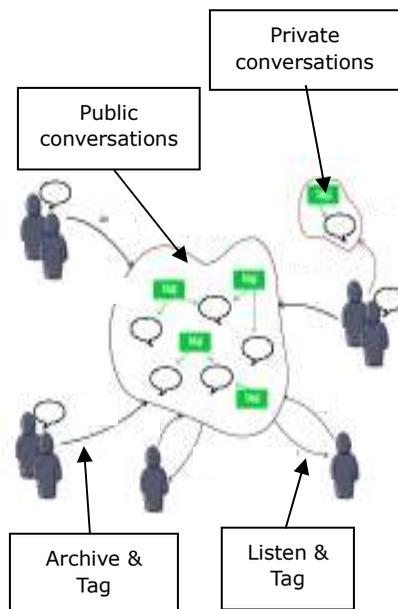
**Keywords**

Audio, Context-Aware Computing, Interaction Design, Social Media, User-Centered Design / Human-Centered Design, User Experience, User Interface Design, Visualization,

**Problem statement**

The paper focuses on the problem of enhancing conversations in the enterprise through social media. We have designed a system that *enables persistent (audio) conversations in the enterprise*, primarily by the

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**Figure 1:** Functional overview of archiving and tagging conversations.

use of the Web 2.0 technique of *tagging*. Tagging is widely used, as it generates folksonomies that describe, classify and distinguish the tagged content.

Persistent conversations can be stored, accessed and retrieved, due to which new possibilities for acting and doing arise, e.g., an individual can enhance his future conversations by being able to reflect on his past interactions and share his past conversations with other users. Persistence enables us to *search, browse, replay, annotate, visualize, restructure and recontextualize conversations* [2]. In particular, we have designed a visualization that allows users to search, browse, find, tag and listen to (stored) conversations and discover relevant communities, topics of discussion within communities, and relationships between people and communities.

### Background

The advent of social media under the umbrella of Web 2.0 and its enterprise counterpart Enterprise 2.0 [8] is breaking down perceived barriers to collaboration and the sharing of content (e.g. the sharing of personal photographs and video on Flickr and Youtube). With a view towards extending the kind of rich user experiences that social media have provided on the web to the enterprise, we have designed and implemented a system for users to store conversations, tag them and share them with other users. We use the Web 2.0 technology of “tagging” to do this because of the sheer number of ways in which tags can be used, e.g., as descriptors, opinions, reminders for action and even for mutual awareness [3,7].

In an enterprise, conversations are the most important resource for collaborative work. Through conversations,

knowledge is created and shared [9]. Team-members rely on a variety of channels to converse: face-to-face, email, IM, voice etc. While some of these channels such as email routinely provide for storage, retrieval, and sharing (through copying, forwarding etc.), others such as voice do not yet allow for these practices. Hence, we focus on audio conversations in our system.

In our system, participants of a (audio) conversation (over the phone) can choose to archive and tag it. Groups of users can be granted access to the conversation by the participants e.g. a meeting between a subset of people in a department may be deemed relevant to the rest of the department. A conversation deemed “public” can be listened to and tagged by others in the enterprise. **Figure 1** depicts the functionalities the system offers.

### Challenges

In this section, we give a brief idea of the long-term challenges that our system presents before proceeding to detail the immediate challenges that we propose to address in the current paper.

In the long term, our system must be integrated into conversational practices in the enterprise. These span several aspects, including, but not limited to, the actual role that conversations play in the accomplishment of work in the enterprise, the creation of a collective organizational memory [1] that a knowledge worker in the enterprise can draw upon and the issue of privacy. We concede that recording audio conversations presents a thorny privacy issue, despite the potential advantages of doing so. It is our belief that as users in enterprises begin to see the benefits of persistent audio conversations, any adverse reaction to recording

### **What are the potential benefits of collaborative tagging?**

- *Important conversations: Our system will highlight important conversations that may be useful to the enterprise.*
- *Expert Communities: If one thinks of tags as "topics", the analysis of people and tags gives an idea of expert communities, i.e. the networks of people that grow around a tag.*
- *We can validate imposed groups and hierarchies (e.g. sales, Human Resources) against real world conversational practices. One can study the how well these groups are functioning, or whether they are even required.*

conversations will be mitigated, provided, of course, that robust privacy safeguards are implemented. A full deployment of our system will include an authentication and authorization controls. Participants will control access to recorded conversations using privacy setting options.

We have identified the following immediate challenges that the interface must address.

- (1) Users must be able to query for conversations. Querying could be on the basis of people (i.e. users) or topics (i.e. tags, descriptions etc).
- (2) Users must be able to tag a conversation, a group of conversations or part of a conversation.
- (3) Users must be able to listen to a conversation as well as access all relevant information about it such as the names of the participants, tags, and people who used those tags.
- (4) Users must be able to use the interface to deduce histories and interactions between different participants, and their relationships with different topics, and with each other.

We have attempted to address the above challenges in our current visualization. We present our solution in detail in the next section.

### **Solution**

#### *A. Process:*

We have implemented the conferencing part of our preliminary system as a "meet me" type of conferencing bridge using an Avaya S8300 Media Server [10] and an Avaya Unified Communication Center (UCC) Speech Server [11]. These provide Automatic Speech Recognition (ASR) services, Text to Speech (TTS) services and H.323 call control

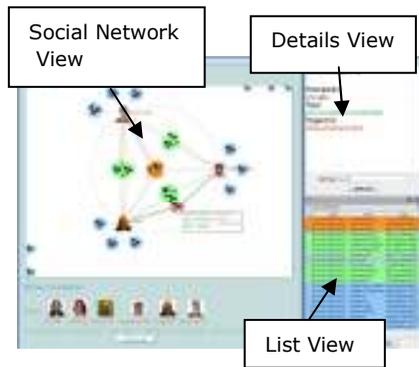
functionality. A registered user is assigned a host/participant code and can join a conference call using a single access number. We are enhancing the system with features such as allowing participants to turn the recording of the audio streams on/off throughout the conversation. As the system evolves, we plan to allow multiple users register through a code (to allow several users in a meeting room to join the conference as a group). This presents challenges such as identifying speakers to highlight speaker turns in the recordings.

This paper focuses on the web-based visual interface used to tag and retrieve conversations that have been conducted on the conference bridge.

The over-all visual interface is shown in **Figure 2**. It consists of three sub-views: (a) the Social Network View, (b) the Details View and (c) the Conversation List View. The Social Network View allows a user to figure out interaction histories. The Details View reveals details about a particular conversation, tag or user. The List View enables a user to view lists of conversations.

The rationale for these three views is as follows. People are familiar with 'Lists' in other persistent conversation channels such as emails and IM. Lists can be scanned quickly and can be sorted. The lower-right List View provides this functionality.

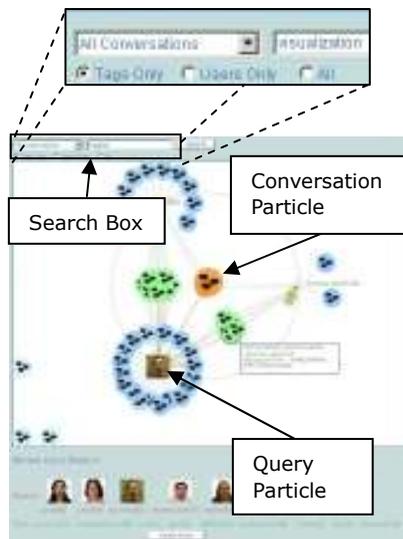
The upper-right Details View functions like the "preview" panel in email clients like Outlook. It provides the details of a selected conversation (in terms of participants, tags and taggers). The selected conversation can be tagged through the text field



**Figure 2:** Visual Interface and its three component views.

provided. The Details View also provides details for a selected Tag or User.

We attempt to do something slightly different in the Social Network View. The essential *content* of this view is the same as that of the List View: a set of conversations. However the *representation* is different: here, we attempt to show the relationships between various conversations, tags and users. We have suggested a computational model for tagged conversations in [5], which is reflected in the social network view. In the next section, we look at the Social Network View in detail and outline some scenarios where we think our visualization is useful.



**Figure 3:** The features of the Social Network View

#### B. Solution details:

The Social Network View is shown in **Figure 2** (see **Figure 5** for a detailed view). On the top left, a user can submit keywords such as the names of users or tags. A set of conversations matching the keywords is retrieved and displayed.

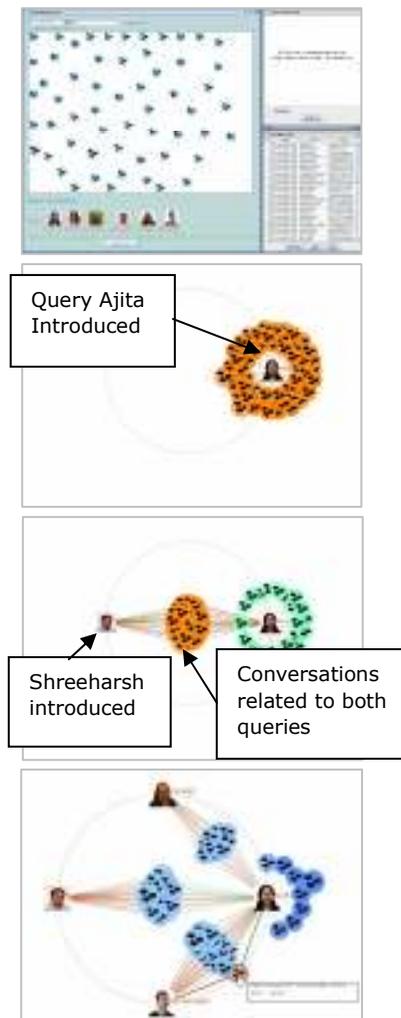
The conversations are represented as particles freely moving within the space, with variations in the color tint, indicating their “age”. Recent conversations are bolder while older conversations appear faded. Details of a conversation including the audio recording of the conversation can be easily obtained by clicking on a particle. The Details window (upper-right) refreshes when a particle is clicked, displaying the conversation details as well as playing the audio file associated with that conversation.

Along with the conversations, the Social Network View displays users and tags at the bottom: these users and tags are associated with the conversations returned by

the system in response to the query. When one of these users or tags is selected, a “query particle” is introduced into the search space (see Figure 3). Conversations that are associated with this query get attracted to it. A conversation is associated with a user if (a) she has participated in it, or (b) she has tagged it. In case (b) one or more tags also get associated with that conversation. Lines are drawn between queries and their associated conversations. To indicate different associations (i.e. participation and tagging) the lines are rendered in different colors. When multiple queries are introduced, the conversation particles re-arrange themselves so that they are closest to the queries they are related with. Conversations are color coded depending on how many queries they are related to (In Figure 3, blue, green, and orange particles are associated with 1 query, 2 queries, and 3 queries, respectively). Along with the re-arrangement of the conversations in the Social Network View, the List View also updates itself when queries are introduced. The conversations in the List View get sorted (conversations matching more queries appear earlier in the list) and color-coded depending on the number of queries they are associated with.

We now consider some scenarios to illustrate how users may utilize the visual interface. While these scenarios are not exhaustive with regards to the types of things that users may use the interface for, they will help put our visualization into perspective.

FINDING THE PEOPLE TO CONSULT ON A PARTICULAR TOPIC  
Adithya, a new employee, wants to find the identities of the important people working on social networks research in the enterprise. He types “social networks” and about 100 conversations appear in the search



**Figure 4:** Steps taken to refine a query. See (Figure 6) for a large-sized figure.

space. From the row of users at the bottom, he sees that Ajita is associated with more conversations than any other user. When he clicks on Ajita (see **Figure 4**), the user "Ajita" is introduced into the Social Network view and a large number of conversations cluster around her. To find out more, he adds two more people to the search space: Shreeharsh and Reinhard (two names he recognizes from his limited time working in the department). He now sees that most of the conversations that Shreeharsh has had on "Social Networks" are with Ajita and furthermore, Ajita and Reinhard seem to have a number of conversations between them. He adds user "Doree" into the search space and sees that Ajita has had conversations with Doree on Social Networks too. Adithya infers that Ajita is probably an authority on Social Networks. He listens to some of the conversations that Ajita has participated in and understands that other colleagues have consulted her for advice. He saves Ajita's contact (right-clicking on Ajita pulls up her contact information) for future use as he might need to discuss his research plans on Social Networks with her. He also notes that the best way to contact Ajita would be through Reinhard or Shreeharsh, whom he knows slightly. Note that the visualization can be enhanced with communication to allow Adithya to access interfaces to send Ajita an email/IM or call her through a softphone.

In another scenario, Mary is preparing for an important presentation to her new client, Ubiquity Inc. She wants to make her presentation more effective by aligning her points with her client's core business interests. She decides to search for a community that is interested in Ubiquity.

She types "ubiquity" in the main search text field; she sees that the tag has been used before by quite a few people. The Details View shows that the tag "ubiquity" has been used mainly by three people. She introduces them as queries in her search space and finds they have archived discussions related to their work with this client. Mary wonders if that they could give her some valuable feedback on her presentation and give insights that might help while working with Ubiquity. She requests a short meeting at the convenience of the three persons to discuss her work and presentation (see **Figure 8**).

#### DISCOVERING HIDDEN CONNECTIONS IN THE COMMUNITY

In another scenario, a user John, who has archived several conversations, types his own name in the keyword search to retrieve them. A row of associated people appears at the bottom of the search space. John sees the names of a few of his colleagues that he regularly meets. However, John notices a user – Lynne - whom he has never talked to. Curious to see what his relationship with Lynne is, he introduces two users into the search space, John (i.e. himself) and Lynne. A quick glance at the visualization tells him this: Lynne has been actively tagging several of his conversations (see **Figure 7**).

John finds out (from the tags) that these conversations are mainly regarding a problem John's group has been having with a recent Windows patch. Perhaps Lynne's development team has been having similar problems and could provide John with valuable input as well. John sends Lynne a short email and her reply confirms John's suspicion. They share their documentation and links and decide to arrange a joint group meeting between their respective groups to tackle the problem.

### *C. Results*

We conducted a small pilot study to test the effectiveness of our visual interface. Four subjects were asked to evaluate the interface. We simulated conversation data by constructing patterns of inter-communication and tagging between 6 hypothetical users. The questions in the study were about the relationships that our subjects were able to observe between users, tags and conversations. We were more interested in the methods used to arrive at the answers rather than the accuracy of the answers ( e.g. how they queried the conversations, what sub-queries did they use etc). For this reason we asked our subjects to provide an account of how they went about answering every question. To supplement this account, we also recorded their interactions with our system using a screen-capture program. We asked our subjects four sets of questions with 2 to 4 questions in each set. Questions ranged from simple ones like "How many conversations did Jane participate on 05/01/07?" to fairly difficult ones like "Can you estimate how many conversations Jack participated in between 05/10/07 and 05/15/07?"

The response we obtained from the study was extremely encouraging. The participants began to try and develop strategies while using a combination of sub-queries and search keywords to obtain appropriate conversations. What became clear was that many of our questions would have been difficult to answer without the Social Network View and our subjects tended to interact with this view the most. The "counting" questions (see above) were the hardest since some of them did not have obvious answers; in this case, our subjects tended to ask questions about some facet of the interface (what does this query do?

what does this line mean?), thus revealing their pre-conceptions about some aspect of the interface. This revealed to us which aspects of our design worked and which didn't.

More importantly, our subjects gave us valuable suggestions. In our interface, people are associated with conversations depending on whether they are taggers or participants, however the study showed that a clearer distinction (between a person who simply tagged a conversation versus someone who participated in it) was preferred. The study also showed that there is a need to emphasize who applied a tag rather than the tag alone, since the application of the tag indicates something of interest about the tagger. The feedback and the screen capture will help guide work in the future.

### **Conclusion and Future Work**

In this paper, we presented a visual interface that allows users to annotate, search, browse, and retrieve past conversations, to use as resources for individual and collaborative work. The visual interface, that depicts inter-relationships between users, tags and conversations, is part of a system that enables the archiving and tagging of audio conversations in the enterprise. We conducted a small pilot study to test the effectiveness of our social network visualization and to study how users utilize the resources provided by the interface (querying, browsing) to accomplish certain tasks.

A number of interface augmentations are currently being designed to aid functionality of the system. Some of these are the ability to initiate telephone conversations through the interface, define a list of

preferred/repeated users, and audio skim through long conversations. For the tagging system to be fully deployed, the telephonic interface should also contain features to set privacy for a conversation.

In the near future, we plan to actively deploy our system for persistent conversations. Particularly, we want to see how users adapt it to their use, to accomplish their day-to-day tasks. Feedback from the users can tell us how effective the system is and suggest pointers for improvement of its design. We also plan to work on a computational model for tagged conversations, which can help us compute aspects of conversations like relevance to a certain query, for a certain user or community and perhaps estimate how knowledge is created and distributed in the enterprise.

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All Conversations visualization  
 Tags Only  Users Only  All

**Figure 5a:** Details of the Search Options

**Figure 5b:** Information displayed upon 'mouseover' action on a conversation

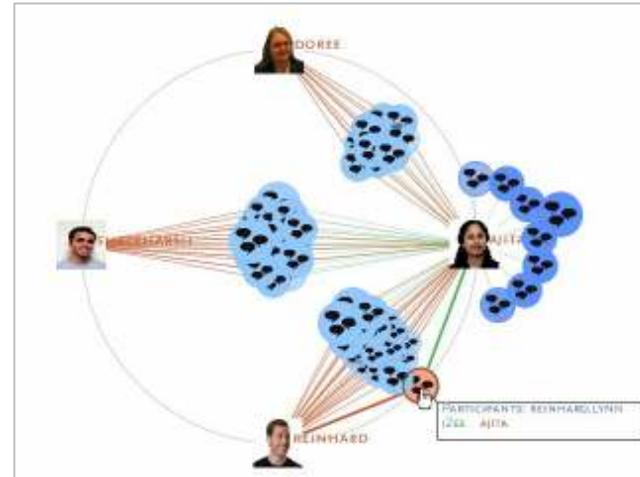
Add Tags (dur: 07)

**Figure 5c:** Details of the Tag Field and Audio player

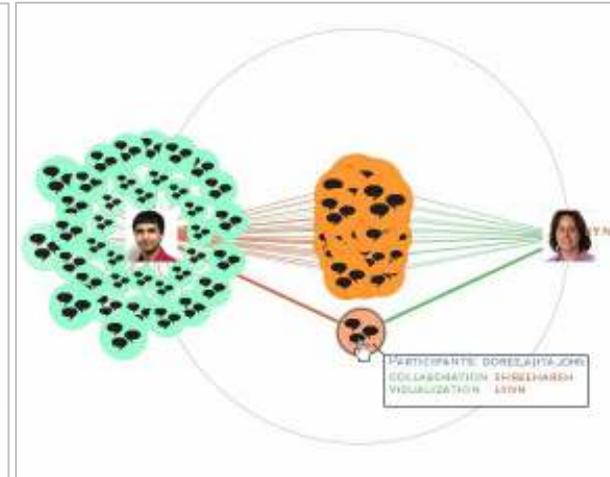
List of Clickable People and Tags

**Figure 5:** The full screenshot of the interface. The Social Network View is on the left, the Details View of the selected conversation (orange in the Social Network View) on the top right, and the List View is on the bottom right. The conversations in the Social Network and the List views are the result of the search query. The conversations are color-coded in both views. Conversations with the most associations with the queries are orange, while those with fewer associations are blue.

ID	Label	Users	Tags
3	Conversation200...	beinhard,doree	visualization
4	Conversation200...	beinhard,lynn	visualization,MAC
20	Conversation200...	ajita,beinhard	MAC OS,visualization
8	Conversation200...	beinhard,doree	j2ee,visualization
5	Conversation200...	shreeharsh,ajita	fun,j2ee,visualization
6	Conversation200...	adithya,shreeharsh	visualization,toggle
7	Conversation200...	lynn,shreeharsh	duration,visualization
9	Conversation200...	adithya,ajita	MAC OS,visualization
11	Conversation200...	lynn,ajita	j2ee,visualization
12	Conversation200...	lynn,beinhard	collaboration,you
13	Conversation200...	beinhard,doree	MAC OS,tagging,you
18	Conversation200...	beinhard,ajita	visualization,j2ee
19	Conversation200...	ajita,doree	collaboration,you
1	Conversation200...	shreeharsh,adithya	visualization,MAC
2	Conversation200...	adithya,shreeharsh	tagging,MAC OS,you
9	Conversation200...	ajita,lynn	visualization,MAC
10	Conversation200...	doree,lynn	visualization,collab
14	Conversation200...	adithya,ajita	collaboration,you
15	Conversation200...	beinhard,ajita	visualization,MAC
16	Conversation200...	ajita,lynn	tagging,collaborat
17	Conversation200...	doree,lynn	tagging,MAC OS,you
21	Conversation200...	lynn,beinhard	visualization,MAC



**Figure 6:** Social Network View indicating that the user Ajita may be an authority on the topic “Social Networks” as three other users converse with her regularly on that topic.



**Figure 7:** Social Network View showing Lynne has tagged many of John’s conversations, indicating that they may have common interests.

**Figure 8:** Details View and Social Network View depicting top users who are associated with the tag “ubiquity”.

