# Relationship Aggregation for Enhancing Enterprise Recommendations

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**ABSTRACT**
As social media and Web 2.0 sites are becoming ubiquitous, aggregation of social network information becomes valuable, building a more comprehensive and rich social graph. In this position paper we summarize our use of social relationship aggregation for recommendation of people and content within enterprise social software and draw future directions for recommender systems in the social media domain.

**Author Keywords**
Aggregation, social media, enterprise recommendation

**ACM Classification Keywords**
H.5.3 Information Interfaces and Presentation: Group and Organization Interfaces – Collaborative computing; H.3.3 Information Search and Retrieval – Information filtering.

**General Terms**
Algorithms, Design, Experimentation, Human Factors, Measurement

## INTRODUCTION

With the evolution of the social web (Web 2.0), people are leaving traces of relationships everywhere. From explicit connections in social network sites (SNSs), such as Facebbok and LinkedIn, to more implicit marks, such as co-editing a page in Wikipedia, commenting on a blog in WordPress, or using the same tag in Flickr. Following their counterparts on the Web, social media sites have emerged within large organizations, such as IBM, HP, and Microsoft. These enterprise social medial sites also unlock a lot of valuable information about relationships between employees.

## SOCIAL NETWORK AGGREGATION IN THE ENTERPRISE

Social Networks Architecture (SONAR) introduced an approach of aggregating people-to-people relationships across diverse data sources within the organization [5]. SONAR collects from each data source – be it a blogging system, a social network site, or the organizational chart – weighted relationships between employees. Each data source has its own weighting scheme, for example, a blogging system may weight a relationship between two users proportionally to the number of links, comments, and trackback between their blogs. The ultimate result is a rich weighted social graph, which maps relationships between employees in the organization based on various types of data.

An important concept in SONAR is "evidence" – as many of the data sources are public in nature, SONAR can provide an explanation for the weight of the relationship between two individuals. For example, it can be indicated that two individuals are related through 2 joint papers they have co-authored, 3 files they have shared, 5 blog comments they have made to each other, and so on. The aggregated social network information collected from public sources was found to be comparable, and often superior, to relationships extracted from email [4].

## PEOPLE RECOMMMENDATION

The introduction of the "Do You Know?" widget within the Fringe enterprise SNS site is described in detail in [6] and demonstrates how implicit relationship aggregation can be leveraged to encourage explicit connection. The widget suggests people to connect with in Fringe based on other implicit relationships that indicate familiarity. Its dramatic effect on the number of connections in the Fringe site, and the enthusiastic reaction in the blogosphere pointed at its effectiveness. The number of invitations sent through the widget was almost seven times larger than the number of invalidations sent through the regular profile-based mechanism during the inspected period of time (four months). Moreover, users who have never sent invitations to connect before, neither on Fringe nor on other SNSs, indicated the accurate recommendations prompted them to send invitations for the first time.

The widget also presented explanations for each recommended person through the SONAR "evidence" mechanism – for example, users of the widget could see that a person was recommended due to 3 common friends, 2 patents co-authored together, and a shared manager. Links to the specific common friends, patents, and manager were also provided on demand. This high level of transparency


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was indicated to be highly valuable by the widget's users, increasing trust in the system, helping to understand and justify recommendations and increasing usage in the long term.

Chen et al. [2] also studied people recommendation in an enterprise SNS called Beehive. They compared different algorithms for calculating recommendations, including content-matching, friend-of-a-friend, and a SONAR-based algorithm relying on aggregation, similarly to the one used in the "Do You Know?" Fringe widget. The SONAR algorithm was found to be the most effective, yielding the highest percentage of known people (over 85%), and highest percentage of recommendations rated "good" (over 80%).

Freyne at el. [3] use SONAR to recommend people to new users of the Beehive SNS. As an aggregation system collecting information from sources external to Beehive, SONAR allowed recommendation for brand new users in Beehive whose profile was completely blank. The SONAR-based people recommendations, especially when combined with recommendation for "about you" entry creation, were found to be highly effective in increasing user views and contributions over time. People recommendations were also found to significantly increase user retention rates over time. This work highlights the important capability of relationship aggregation to produce recommendations for new users of a social media application and increase adoption and engagement through these recommendations.

## CONTENT RECOMMMENDATION

The work in [7] introduced a system for recommending social media items, such as bookmarks, blog entries, and online communities. The recommendations were based solely on the user's social network, as harvested by SONAR. A key distinction was made between familiarity relationships (such as the ones used in the "Do You Know?" widget) and similarity relationships, which imply common social activity, such as co-usage of the same tags and co-commenting on the same blog entries. The familiarity network was found to be more effective in producing interesting recommendations, while the similarity network yielded more unexpected items.

Explanations were provided for each recommended item in the form of showing the people who are related to the recommended items (the "implicit recommenders"). The system could also show the "evidence" for the relationships between the user and the implicit recommenders. These explanations were found to increase interest in items, adding an instant value over the long-term value already shown in [6]. Overall, items recommended based on the familiarity network with explanations yielded a 57% interest ratio.

In another related work, Carmel et al. [1] studied personalized social search based on the user's social network as retrieved through SONAR. Personalization of the search results based on the user's social network was found to be effective, significantly improving over non-personalized results and over topic-based personalization.

## CONCLUSION AND FUTURE DIRECTIONS

We summarized several of our previous works that highlighted the value in aggregating social network information and its utilization for highly effective content and people recommendation within enterprise social media. Both people and content recommendations are characterized by a rich knowledge-base in the form of a social graph and a high level of transparency allowing to intuitively explain the recommendations.

Recently, we extended SONAR beyond people-to-people relationships to a new system called Social Networks and Discovery (SaND) [8], which aggregates all types of relationships among people, documents, and terms. SaND allows combing people-based and content-based analysis, which can enhance recommendation capabilities even further and allow recommendation in context. We also intend to explore recommendation of people who are not familiar to the user, to support extension of one's social capital. Finally, our challenge is to build an aggregation system outside the firewall, dealing with the challenges of scale and identity mapping.

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