Attention Metadata Visualizations: Plotting Attendance and Reuse

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ABSTRACT
Contextualized attention metadata can be used to visualize the attendance in online events and communities, as well as to indicate an online object's reuse. In this paper, we describe work in progress showing that attention metadata generated by desktop videoconferencing systems, such as FlashMeeting, can be used to plot community activity and to give some insights into a learning object's impact on a private community or worldwide. We report on results from a quantitative analysis using attention metadata visualizations in different datasets to demonstrate the FlashMeeting live and replay impact on specific communities or globally. Community participation is represented through live event attendance mapping, and learning object reuse through visualizing replay consumption. Future work directions focus on providing additional evidence regarding the extent to which plotting unique IPs on a geo-location map can be considered as an accurate method of measuring a learning object's impact.

Categories and Subject Descriptors
C.4 [**Computer Systems Organization**]: Performance of Systems - *measurement techniques*; [**Information Storage and Retrieval**] H.3.7 Digital Libraries - user issues; [**Information Systems Applications**]: H.4.3 Communications Applications – *videoconferencing*; [**Computers and Society**]: K.4.3 Organizational Impacts - *computer-supported collaborative work*

General Terms
Measurement, Performance

Keywords
FlashMeeting, contextualized attention metadata, metadata visualization, map, learning object, reuse, virtual communities

1. INTRODUCTION
Attention metadata refers to any content that a user pays attention to and consumes, from websites, wikis, blogs, text chats, emails etc. [3]. Attention metadata has been used to measure the impact of different online objects, such as in Amazon, or citations, such as CiteSeer, or popularity tags found in del.icio.us, where the number of users having bookmarked a page may be a valid measure for its overall significance. This metadata can be contextualized, taking into consideration the user, the content and the context, and used to rank and recommend resources and learning objects [4].

Aspects of the users' context may include their geo-locations or activities and community contributions. In collaborative scenarios, Contextualized Attention Metadata (CAM) can be used to map social proxies and collective activity. Visualizing social presence can stimulate group awareness and the building of collective knowledge in online communities. Presence has evolved from just being 'online' or 'offline' to a range of preferences such as availability, location, activity awareness and others [1], [2]. Geo-location maps are currently combined with a range of communication tools, such as instant messengers or activity awareness applications. Collective awareness can be enhanced with tools, such as TwitterVision or Google maps, representing the individuals' presence with icons on maps. Mapping individual attendance in collective events organized by communities of practice having a common knowledge objective is useful to visualize their evolution.

Visualizing attention metadata produced in online collaboration scenarios can be used on the one hand to map community activity and attendance and on the other to measure an online object's consumption. This paper presents work in progress on the attention metadata produced by videoconferencing interactions, showing what people are consuming when using online communication systems. We give some insights into how attention metadata visualizations can help represent community participation and activity and investigate whether attention metadata on IP logs can indicate the impact of learning objects in virtual communities worldwide.

2. FLASHMEETING METADATA
Initially developed to produce a useful in-house communication tool, FlashMeeting appears to currently have a global impact, used by over 33 European projects and numerous other communities of learners, educational practitioners and other professionals, counting over 4,000 naturalistic virtual meetings on its servers. FlashMeeting is a light-weight application, running on a web browser, as long as the Adobe Flash player plug-in (Version 7 and above) is installed (http://flashmeeting.open.ac.uk/). The meeting booker submits a form and the system generates a URL, which can be forwarded to other participants and clicked to access the meeting. The system favours simplex audio, allowing only one person to broadcast at

any one time, suitable for meetings with multiple participants. In order to broadcast, one has to push-to-talk, while attendees wishing to speak, raise a symbolic hand and queue until the current speaker stops broadcasting, or click on the 'interrupt' button. Other communication channels include text chat, voting, displaying mood indicators, URL firing and a whiteboard facility for uploaded slides and real-time annotations. One of the principal features of FlashMeeting is the ability to record meetings. These recordings form effectively a complete record of the event including the browsing of individual broadcasts by time code and participant name, text chat, voting, fired URLs, whiteboards etc.

Anything that captures the user's attention and performance, during all videoconferencing interactions, from booking the meeting, to displaying an emoticon, is logged on the servers. The FlashMeeting client communicates via PHP scripts on the server to log all the data to MySQL database tables. The logged attention and performance metadata is then available for dynamic access and manipulation after the meeting. This metadata includes the booking logs, the unique IP logs of meeting attendees, the email addresses of signed-in users, the replay hits and the IP addresses of the replay viewers, the booking keywords, annotations, the participant names, the number and duration of broadcasts, the chat logs, the emoticons and URLs fired, interruptions, raised hands, and the voting and whiteboard logs. Such metadata produced in collaborative environments can be merged with additional attention metadata, e.g. from blog, in AttentionXML streams to feed personalization or recommender systems [3]. The IP logs can be used in a variety of ways to visualize for example live meeting attendance and replay reuse. A meetings' minutes' page shows representations of much of the metadata generated by a meeting and its subsequent reuse. The data has also been used by different systems for different applications, such as generating visualizations of the event shape to show user roles or event type. Other applications include linearly mapping the knowledge communicated in a virtual event or keyword search of replays (http://ariadne.cs.kuleuven.be/amg/SamgiFM/SamgiFM.html).

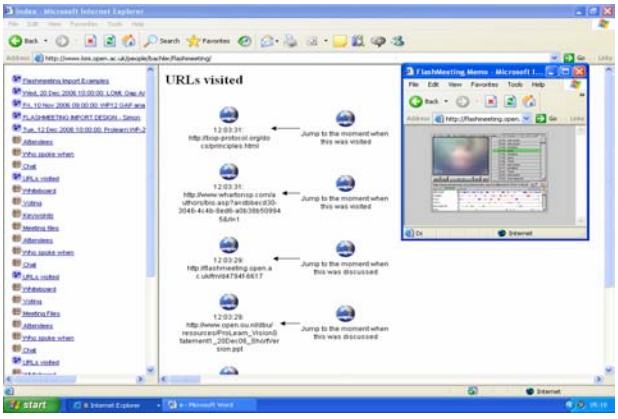

Figure 1. An example of integration of an XML FlashMeeting file with the Compendium knowledge mapping tool

Figure 1 presents the integration of the XML file generated by the FlashMeeting server for a public event replay with the Compendium system (http://www.compendiuminstitute.org/) for knowledge mapping, representing linearly the URLs exchanged in that meeting, linking them with the corresponding time-stamped video segment.

3. PLOTTING ATTENDANCE AND REUSE

In order to represent the FlashMeeting global impact on knowledge transfer communities, we indicate individual attendance by using attention metadata indicating user browser hits and plotting the geographical location of unique IPs on maps showing the participation in live events and the event replay reuse.

3.1 Live Event Attendance

Attention metadata produced by live logs can indicate the individual attendance in one meeting, or show the attendance of individuals in a virtual community holding a set of meetings. FlashMeeting CAM is also used to show pairs of individuals co-attending events, and generate contact lists. The extensive logging employed in FlashMeeting allows metadata based on a user's IP address to be collected and used to plot on a world map the location of people who have attended meetings. IP addresses are registered to physical postal addresses, and these can therefore be plotted to a map. For the majority of cases the registration address of an IP very closely matches that of the individual to which it has been issued (particularly within organizations and companies), however, occasionally there can be discrepancies, which can lead to an individual's location being incorrectly located. Additionally, as IP addresses are continually being registered, the database used to resolve IPs to geographical locations continually has to be updated (the database we have used is provided by Maxmind LLC, http://www.maxmind.com), and at the point of plotting a map it is possible that a few IPs may not yet exist in the database and so their locations will not be plotted.

Figure 2. The global impact of the live FlashMeeting system in April 2007

Figure 2 above is a plot of the attendees to meetings held in April 2007 on the research FlashMeeting server at the Knowledge Media Institute of the Open University, UK. It shows the location of the 900 unique IP addresses accessing meetings (7 IPs were not plotted because they were not in the IP database). People connecting to live meetings during this period are located throughout the world, most of them situated in Europe and North America.

Looking at the number of attendees of meetings against time (see figure 3), it can be observed that there is an upward trend in attendance in a 21-month period, starting with 300 attendees in August 2005, with peaks of around 900 unique IPs in March 2006 and more recently in April 2007. It seems that there is an established global community of an average of 600 users holding FlashMeeting events during a two-year period.

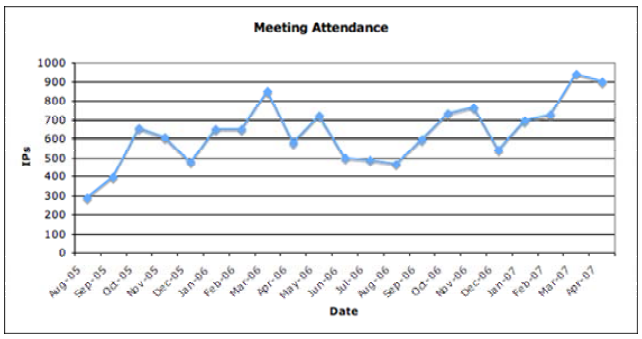

Figure 3. FlashMeeting attendance from August 05 to April 07

3.2 Replay Impact

The FlashMeeting recording facility reminds the live meeting attendees and informs community members that were unable to attend the meeting of what happened during the event, providing an auditable record of actions taken. It can also act as a reusable learning resource, either for a private community, or by making the resource available to the public.

The time-stamped logging of the IP addresses of people accessing all replays allows these 'hits' to be plotted on a world map. Figure 4 shows such a plot for April 2007 on the research Flashmeeting server at the Knowledge Media Institute, The Open University, UK. The map shows a plot of the 15,995 hits from 4,509 unique user IPs who reused the replays, showing the truly global use being made of FlashMeeting recordings (see figure 4).

Figure 4. Replay reuse in April 2007

Since March 2006, users have been encouraged to syndicate some of their meetings and share their experiences and events with the world. Several users syndicated some of their past events and continue to share their future ones. Public replays appear in a folksonomy of keywords added by the meeting bookers, which includes at the moment a variety of nearly 200 events: interviews, seminars, virtual lectures, web-casts of presentations, workshops or lectures, moderated project meetings, peer-to-peer support events in learning or counseling contexts and others [5]. Some types of syndicated replays, such as virtual seminars including experts from different parts of the world discussing a current research issue, appear to be rich sources of learning, being reused hundreds of times. As opposed to private replays, public replays are not only viewed by the live meeting attendees, but also by other people around the world, who may have never used the live system, but can learn from the replays, thanks to the value of syndication (http://flashmeeting.com/public).

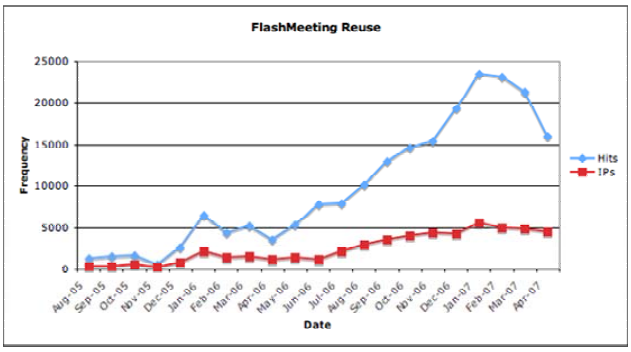

Figure 5. Replay reuse from August 05 to April 07

It is clear that the reuse of FlashMeeting recordings has increased significantly since 2005, with a peak in January 2007 reaching over 23,000 hits (see Fig. 5). This is being enhanced due to the public syndication of replays by users, released in March 2006, making replays publicly accessible to people who may never have participated in a live FlashMeeting.

3.3 Visualizing Community Activity

The attention metadata produced by live logs can be used to map the participation of individuals in a community and to portray a general view of the community activity. All logs of unique IPs of people who attended the meeting are recorded on the live attendance map of the event. Although these individuals may play different roles in the community, being more or less active than others, it is important to acknowledge their participation in the event, by clicking on the web page and accessing the meeting.

The FlashMeeting server hosts a series of public events, such as seminars on Learning Objects, Metadata and Interoperability (LOMI), starting in May 2005, seminars on Knowledge Mapping, starting in December 2006 and others, with experts in various research areas, discussing current topics of interest. Different communities hold their meetings via FlashMeeting, ranging from 'video-bloggers' and 'animation' students participating in peer-to-peer events, to e-learning communities holding project meetings, interviews and seminars.

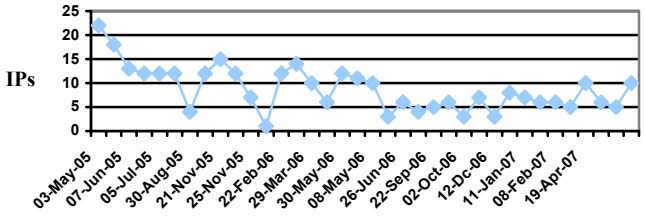

Figure 6. The attendance of LOMI seminars from May 2005 to March 2007

IP logs can be used to show the attendance in a series of events. In figure 6, we present the event attendance using the example of 34 LOMI seminars from May 2005 to present, each one including from 1 to 22 participants and a mean average of 9 participants per meeting. It seems that a stable community of around 10 individuals regularly attend LOMI events, while 22 attendees is the highest attendance number noted in these seminars.

In approximately 8 months, the 'video-blogging' community members have drawn their attention to 36 videoconferencing events from September 2006 to May 2007. The event frequency in such a short period of time shows the engagement of a very active community, holding social events that tend to happen during weekdays, as well as on weekends. In Figure 7, we have plotted the date of the event and the number of unique IPs, showing a stable community attending events in a two-year period, while the number of attendees per meeting may range from 3 to 21.

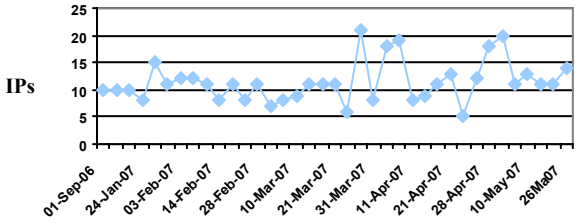

Figure 7. The attendance of 'videoblogging' events from September 2006 to present

3.4 Visualizing Learning Object's Reuse

The public replay hits can show the reuse of the meeting by the people who attended the event and by other people who may have not attended the specific event or any live FlashMeeting. Several FlashMeeting replays can be considered as learning objects. For example, the series of LOMI seminars can be reused to learn about learning objects and metadata, while there are other series of events, seminars, lectures or presentations, with a goal to transfer knowledge. The FlashMeeting folksonomy of public meetings is based on the metadata produced by keywords added when booking or editing the meeting. It is possible to give insights into a learning object's impact, by taking into consideration the hits and unique IPs of users who paid attention to its resources.

The most popular replays relate to a series of presentations called 'Historic Homeworks' showing a range of house renovation activities from window repairs to floor planing. From March 2006 until May 2007 there had been 36 of these events. The replays of 7 of these presentations had been each viewed more than 3,500 times and the replay of one of the presentations from October 2006 included the highest number of viewings, counting 6,012 hits from 2,437 unique IPs.

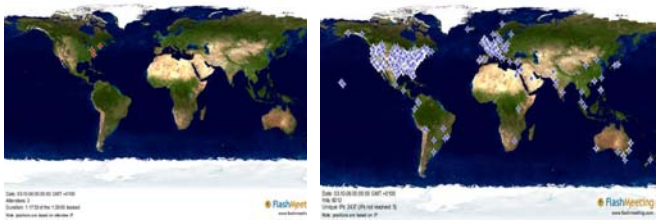

Figure 8. The live attendance and replay maps of the most popular recording on the FlashMeeting server, counting 6,015 hits

The comparison of the live attendance and replay maps shows that users outside of the presenter's community have accessed the replays, as there were 3 live meeting participants in North America but 2,437 resolved IP addresses of replay 're-users' spread all over the world, with many of them located in Europe and North America (see figure 8). The replay map produced is impressive, showing more than 2,000 of people located in parts of the world different from the location of the live meeting attendees, who have consequently learned from the recording.

4. DISCUSSION AND FUTURE WORK

Can attention metadata based on IP logs be a reliable measure of the impact of an online resource? In the different datasets discussed here, there was a number of IPs not resolved, for example 46 IPs were not resolved in the 4,509 user sample of the April 2007 replay viewers. In addition, some IPs may have been erroneously plotted. The accuracy of IP resolution is an issue, but works quite well for the majority of user locations with a few exceptions. Another issue affecting the objectivity of counting on browser hits may be the demonstration of example replays by certain groups. For example, the highest number of hits in one LOMI seminar (1,170) with experts discussing 'open content' may have been boosted by its inclusion in an online article linked by a prestigious website. There may be occasions when one replay is viewed thousands of times, due to its featuring as an example in demos and linked from several other web sources.

It would be useful to locate in the future how the users arrived at a certain replay. Popular replays may have been linked in forums or blogs, or just contain keywords attracting the reader's attention, or including popular keywords, searched by users in search engines and pointed to their FlashMeeting replay. Knowing how the users arrived at the replay URL will give more insights into the reason of attention to the specific event replay, e.g. it was linked in a forum, or in another website where the community of interest drew their attention to, or syndicated and appearing in the FlashMeeting folksonomy with an interesting keyword choice, or advertised in online news stories or shown in demos. This will lead to contextualized recommendations of attention resources.

5. ACKNOWLEDGMENTS

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