A P2P Virtualization for Distributed Adaptive Conference Management*

Alexander Knauf[1] Gabriel Hege[1] Thomas C. Schmidt[1] Matthias Wählisch[2]
[1]HAW Hamburg, Dept. Informatik, Berliner Tor 7, D–20099 Hamburg, Germany
[2]Freie Universität Berlin, Inst. für Informatik, Takustr. 9, D–14195 Berlin, Germany
alexander.knauf@haw-hamburg.de hege@fhtw-berlin.de {t.schmidt,waehlisch}@ieee.org

ABSTRACT

An increasing number of popular conferencing applications operate in a lightweight, infrastructure-independent ad hoc fashion. These P2P-type systems raise the demand for scalable, adaptive self organization of conferencing in a standard-compliant way. We present a SIP-based approach to scalable distributed conference management in a Peer-to-Peer environment. The protocol distributes locators for a conference focus in a transparent fashion and makes use of the P2PSIP overlay to virtualize the focus identifier.

1. INTRODUCTION

Traditional two party telephone dialogs are challenged by an increasing popularity of instantaneous multi party voice and video chat opportunities. The Session Initiation Protocol (SIP) [1] is well suited to manage multi-point communication. However, established architectures for tightly coupled conferences with SIP rely on a single, central focus entity, that is responsible for media session parameter negotiations between the conference participants. These MCU-type devices are addressable by a globally routable conference URI [2] that attains the simultaneous role of an identifier of the conference and of its locator. Lightweight P2P conferences prefer to refrain from using such control infrastructure, but tend to distribute its function among participants. The major task in distributing this focus lies in splitting the functions of identifier and locator. Even though all conference members are required to logically join the same conference, they physically attach to different instances of the focus located at distinct peers. We solve this identifier-locator splitting with the help of source routing options available in SIP. Following this scheme, it is possible to distribute the tasks of session control and media distribution among multiple peers. Each focus peer is aware of the global conference state is kept permanently consisted by an synchronization mechanism using SIP subscription strategy [3].

The solution for this protocol scheme, relying on the dedicated registrar/proxies, does not allow complete infrastructure independence as desired. The currently increasing deployment of structured P2P overlays for data storage and retrieval is an adequate base for replacing traditional client-server models. REsource LOcation And Discover (RELOAD) [4] provides a solution for a P2PSIP service overlay by defining a protocol scheme for a SIP usage on distributed hash tables (DHTs) [5]. As this DHT provides proximity awareness, it can be used to optimize the underlying focus topology. In the following two sections we present the transparent focus distribution by separating its locator, and the virtualization of its identifier in a P2PSIP overlay.

*This work is supported by the German Bundesministerium für Bildung und Forschung within the project *Moviecast* (http://moviecast.realmv6.org).

2. TRANSPARENT FOCUS DISTRIBUTION BY ID-LOCATOR SPLIT

Our approach of Scalable Distributed Conferencing (SDCON) [6] assume that a conference controller is aware of its own capacity limits. The participant which initiated the multi-party session is called *primary focus*. When reaching its limits, the primary focus will require assistance by a so called *secondary focus*. The SDCON scheme provides means to iteratively discover potential focus candidates among other conference parties. A secondary focus is not functionally different from the primary focus. It will add, accept and manage calls from new participations and is able to discover other secondary focuses as well.

Participants do not need to be aware whether they are connected to a primary focus or a secondary focus. Calls that are addressed to the conference URI from outside the conference, will normally be routed to the primary focus. If it is fully booked, the primary focus will delegate these calls to remote secondary focus peers. Further operations from conferences members are addressed normally to the conference URI, but will be source routed to the focus who they are connected to. The source routing is implemented by an additional Record-Route header field directing to the corresponding focus peer included in all outgoing messages. The ID/locator split is realized by intercepting messages that belong to the secondary focus peer. The intercepted messages are processed and answered by the secondary focus which will immediately announce this change of conference state to the remote focus peers. The global conference state is kept in sync between the multiple focuses by subscribing to an extended conference-info [7] event package among each other.

3. CONFERENCE ID VIRTUALIZATION WITHIN AN P2PSIP OVERLAY

Using P2P-networks in the form of distributed hash tables for routing, data storage and error resilience is a consistent extension to our concept of distributing load over multiple peers. Error resilience against data loss is provided by replicating the stored information over multiple nodes. Instead of registering the conference URI at a registrar, the owner

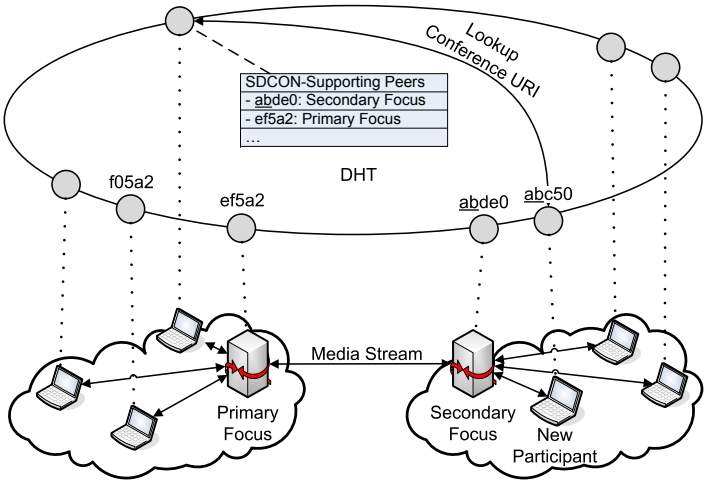

Figure 1: Discovery of a secondary focus using proximity information

that acts as the primary focus publishes the focus mapping in the P2PSIP service overlay. User agents attending to join the multi-party session can retrieve the contact information to the conference focus from the overlay to establish a SIP session. In that way it accomplishes a complete independence from server infrastructure.

Means for a scalable discovery for potential secondary focus peers can be implemented by the SDCON-enabled peers, that can advertise their capabilities in the P2PSIP overlay. A possible way to represent such an announcement can be done by storing this information under a well defined resource-ID dependent on the conference specific URI. A focus searching for a peer willing to act as a secondary focus, will generate the same resource-ID perform to retrieve the corresponding information about potential conference focuses from the overlay. Depending on whether the used topology plugin [4] in RELOAD supports underlay aware ID assignment (e.g. applying landmarking), this information can be used to optimize the underlying routing paths. In a conference scenario in which a focus peer needs assistance for handling a new participant, it could find a secondary focus topologically close to the latter. As the DHT establishes proximity awareness on the address space, a focus in the vicinity of the new participant can be selected based on overlay ID comparison as displayed in figure 1. We assume this provides a good heuristic for real conferencing scenarios in which participants appear regionally clustered.

P2P-networks face churn from the fact that nodes are joining and leaving frequently. In case of departure of a secondary focus, the remaining focuses re-INVITE the now disconnected participants. As a primary focus leaves the conference or fails, an election mechanism to select a new primary focus is executed. The selected focus than has to re-register for the conference URI to be globally accessible. In a traditional registrar/proxy environment this can cause problems in to obtain the requested SIP URI, because it could be not allowed to register at the conference URI's domain. To resolve this issue a way to reassign the resource-ID's conference URI to the elected focus could be defined in P2PSIP.

4. CONCLUSION AND FUTURE WORK

We presented an approach to virtualize a distributed conference management in a transparent, standard-compliant fashion. In its result, a fully infrastructure-independent conferencing solution arises that scales well for large conferences and achieves resilience against node failures. In future work we will adapt this to a P2PSIP service overlay using the advantages of distributed hash tables with proximity awareness to optimize the underlying focus topology.

References

[1] J. Rosenberg, H. Schulzrinne, G. Camarillo, A. Johnston, J. Peterson, R. Sparks, M. Handley, and E. Schooler, "SIP: Session Initiation Protocol," IETF, RFC 3261, Jun. 2002.

[2] J. Rosenberg, "A Framework for Conferencing with the Session Initiation Protocol (SIP)," IETF, RFC 4353, Feb. 2006.

[3] A. B. Roach, "Session Initiation Protocol (SIP)-Specific Event Notification," IETF, RFC 3265, Jun. 2002, updated by RFC 5367.

[4] C. Jennings, B. Lowekamp, E. Rescorla, S. Baset, and H. Schulzrinne, "REsource LOcation And Discovery (RELOAD) Base Protocol," IETF, Internet Draft – work in progress 01, Dec. 2008.

[5] R. Steinmetz and K. Wehrle, Eds., *Peer-to-Peer Systems and Applications*, ser. LNCS. Berlin Heidelberg: Springer-Verlag, 2005, vol. 3485.

[6] A. Knauf, T. C. Schmidt, and M. Wählisch, "Scalable, Distributed Conference Control in Heterogeneous Peer-to-Peer Scenarios with SIP," in *Proc. of the 5th ACM/ICST International Mobile Multimedia Communications Conference (MobiMedia)*, Brussels, Belgium: ICST, Sep. 2009.

[7] J. Rosenberg, H. Schulzrinne, and O. Levin, "A Session Initiation Protocol (SIP) Event Package for Conference State," IETF, RFC 4575, Aug. 2006.