

# Context-addressed communication dispatch

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## ABSTRACT

The goal of this thesis project is to find new, innovative uses of context information and to realize a novel approach to context-addressed communication dispatch, meaning that information is to be sent to a subset of users whose context matches the specified context. Therefore, the destinations will be identified by context - instead of by their network address (e.g., all people in a meeting room). Communication sessions can be triggered based upon context information, where this context information will be inferred rather than explicitly defined by the user. End users will be able to set their preferences regarding *whether & how* they want to receive information (e.g., as an instant message, an RSS feed, a VoIP call, or by file sharing) and on *which* device they would like to receive it (if they are using multiple devices). Their preferences can be context-based, so that the behavior will change as their current context changes. Entities called **communication dispatchers** will be responsible for establishing, maintaining, and terminating context sessions with the end user, as well as delivering content using the user's preferred communication means. An assumption is that a suitable means of content information collection & dissemination exists and that users will allow access to their context information to the appropriate communication dispatchers.

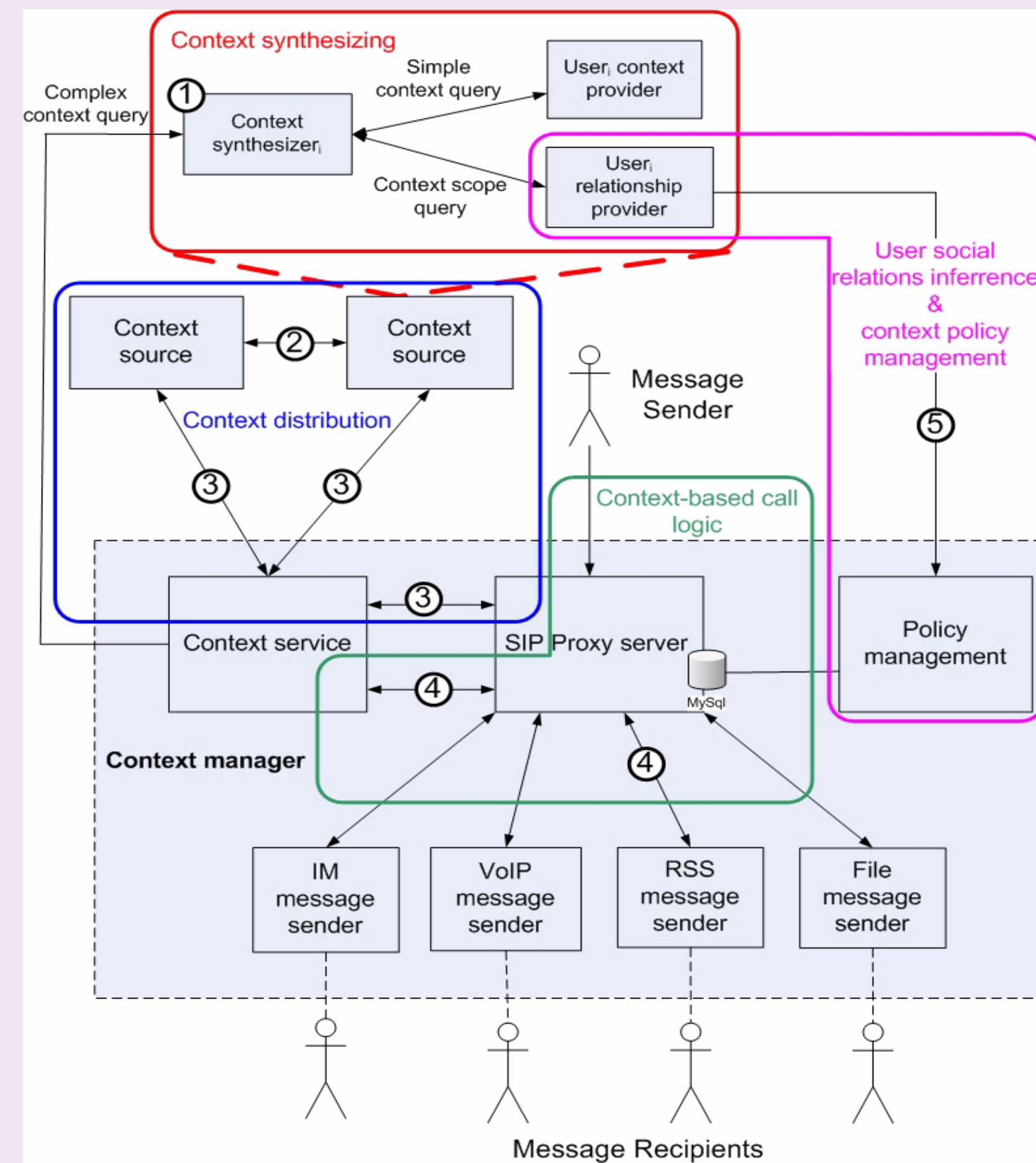
## 1. CONTEXT SYNTHESIZING

A context service forwards requests for context information to the relevant context sources. Context synthesizers provide high-level context as required by applications based on low-level context from context providers. As shown in the figure, if context service needs to resolve a complex context query, it relies on a **context synthesizer** to decompose the complex context query into several simpler queries, which are in turn forwarded to the relevant context providers. Otherwise, a simple context query will be directly sent to the correspondent context provider. An approach for context synthesis based on context operators is described in detail in [1] and evaluated in [2].

This approach was used to develop a set of sport applications and demonstrated at a live race (the Super Prestige Cyclocross in Gieten, Netherlands) in order to provide a nearly real-time virtual ranking service.

### Publications:

- [1] A. Devlic and E. Klintskog, "Context retrieval and distribution in a mobile distributed environment", Third Workshop on Context Awareness for Proactive Systems (CAPS2007), Guildford, UK, June 2007.
- [2] A. Devlic, M. Cossack, and W. Horsman, "Synthesizing context for a sports domain on a mobile device", Submitted to the 3rd IEEE European Conference on Smart Sensing and Context (EuroSSC 2008), Zurich, Switzerland, 29-31 October 2008.



## 2. CONTEXT DISTRIBUTION: BETWEEN CONTEXT SOURCES

A device can share its context knowledge (which it has discovered and acquired) with other geographically distant devices (which have done the same) in order to learn about potential new contexts in advance of arriving at a new location. Advance knowledge of context is powerful because it can reduce the delay or energy required by a device that will need to adapt to the new environment. Moreover, if the context information is distributed in advance, then the query can be answered locally. If the device is a user context provider, it will share its knowledge with other user context providers. Because there is a trade-off between the distribution of context data over a set of devices and the cost of this distribution versus its time-dependent value, we examined the battery power consumed by *context discovery* versus *context distribution*. The results of this evaluation, described in [3], show that it is more energy efficient to distribute (once discovered) context knowledge to other devices, rather than having each device discover this information itself. We also prove that WLAN multicast is more energy efficient than Bluetooth for this task, if the data is to be sent to more than three users at once.

### Publication:

- [3] A. Devlic, A. Graf, P. Barone, A. Mamelli, and A. Karapantelakis, "Evaluation of context distribution methods via Bluetooth and WLAN: Insights gained while examining Battery Power Consumption", Fifth Annual International Conference on Mobile and Ubiquitous Systems: Computing, Networking and Services (MobiQuitous 2008), July 21-15, 2008, Dublin, Ireland

## 3. CONTEXT DISTRIBUTION: BETWEEN CONTEXT SOURCES AND CONTEXT SERVER

Often context information needs to be transferred over *heterogeneous* networks. In [4] we examine the use of SIP/SIMPLE for context distribution. When a device needs to retrieve context from a remote device, it will establish a session with this remote device and retrieve the other device's context using SIP messages. We propose to use both the SIP request/response and subscription-based mechanism, because some information changes more frequently than other information; and this information needs to be available to multiple nodes. Moreover, different applications have different requirements for retrieving context information in terms of latency, frequency of updates, and network traffic. Based on these application requirements, the number of users interested in retrieving the information, the rate of context updates, and the user's mobility, the context distribution mode should be adapted in order to provide the relevant information to applications at the proper time. The recommendations for when it is better to use synchronous or asynchronous mode are given in [4][5] based on scalability and latency evaluation.

### Publication:

- [4] C. Angeles and A. Devlic, "Recommendations for Context Distribution based on evaluation of SIP/SIMPLE", Submitted to the 3rd IEEE European Conference on Smart Sensing and Context (EuroSSC 2008), to be held in Zurich, Switzerland, 29-31 October 2008.
- [5] Carlos Angeles Piña, "Distribution of Context Information Using SIP", Masters Thesis, Department of Communication Systems, School of Information and Communication Technology, Royal Institute of Technology (KTH), June 2008.

## 4. CONTEXT-BASED CALL LOGIC

An approach based upon exploiting context information to enhance the power of existing SIP call control services is presented in [6]. These services are implemented using Call Processing Language (CPL), a language to describe and control Internet telephony services. CPL was extended with context parameters to permit context-based decision making based on a context ontology. This work shows how easy it is to add new context parameters to the CPL and how complex criteria can be exploited using our solution.

### Publication:

- [6] A. Devlic, "Extending CPL with context ontology", Mobile Human Computer Interaction (Mobile HCI 2006) Conference Workshop on Innovative Mobile Applications of Context (IMAC), Espoo/Helsinki, Finland, September 2006.

## 5. USER SOCIAL RELATIONS INFERENCE AND CONTEXT POLICY MANAGEMENT

Since users are sensitive about sharing their context with other users, we have tried to make the context retrieval non-intrusive to the user. Therefore we propose to use a user's social relationships as a means to create user specific policies for granting access to a user's context information. This enables a user to specify different levels of access to his or her context information based on the relationship with another user (e.g. whether this other user is a family member, a friend, a colleague, business partner, or unknown). To address these issues we propose an approach to infer a user's social relationships to another user based upon available context data. Such derived social relationships are used to define a user's policies for context access control and to automatically form context groups in order to enable context-based addressing for communication. This idea and solution are described in [7].

### Publication:

- [7] A. Devlic, M. Wagner, R. Reiche, M. Valla, M. Kirsch Pinheiro, Y. Vanrompay, and Y. Berbers, "Context inference of users' social relationships for context policy management", Work in progress

## 6. CONCLUSIONS AND FUTURE WORK

We have investigated several areas targeting context-aware communication and have proposed an innovative way to synthesize context on a mobile device; as well as to exploit context information for designing context policies, enhancing call logic, and to enable context-addressed messaging.

We have learned that context knowledge (once discovered) should be distributed over via WLAN multicast (when possible), and that SIP/SIMPLE provides a suitable solution for context distribution. Additionally, context groups seem to be a powerful way to address users and for sharing context information. Thus, we plan to utilize SIP multicast for subscribing to and publishing context to the relevant context group(s). We plan to investigate the use of context operators for dynamically composing context groups. Finally, we will implement an intelligent layer on top of our context distribution which should adapt the context distribution **mode** based on the criteria and recommendations from our performance evaluation[4][5].

### Publication:

- A. Devlic, Licentiate thesis, KTH, planned for fall 2008.

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