Adding P2P support to WengoPhone, an open-source VoIP and video conferencing application based on SIP

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February 16 2006

Motivation and Objectives

Nowadays, peer-to-peer (P2P) applications are in vogue everywhere. Business models have been defined and setup in order to take profit from their decentralized and low-cost architectures. One of the most promising revenue potential market is the sector of Voice over Internet Protocol (VoIP or Internet telephony) systems which have even brought telephone companies fright and concern. The successful story of Skype [1], the P2P VoIP software acquired by eBay for a few $US billion in September 2005[1] is an example which may not be the last. Skype is the current leader in the market with about 4.5 million distinct user profiles in October 2005 [2].

This kind of situation would be idyllic if only Skype and many others have not built their own proprietary and closed protocols. The lack of open standard support has conducted to serious questioning about the impossible interaction with their networks or security issues. Lately, it has even suffered restrictions through government regulations. In September 2005, the use of Skype in public research and higher education was disapproved by the French Ministry of Research for security and confidentiality issues... Unfortunately, this kind of decision looks more like a ban of P2P systems in general since they are often security holes in networks.

The objectives of this project is to provide P2P support to WengoPhone, an existing open-source application for VoIP and video conferencing. Since it is already a business model and a functional system based on the open standard Session Initiation Protocol (SIP) [3], there is just need to focus on the parts related to P2P. Furthermore, contrary to Skype, the protocol is thus open to everyone and its security level can be assessed for consideration. However the main idea remains the opportunity to have heterogenous networks (public phone, centralized VoIP and P2P VoIP networks) capable of communicating with each other with no or little cost.

Related work

The henceforth famous Skype provides Instant Messenging (IM), VoIP and video conferencing capabilities over a P2P network. Niklas Zennström and Janus Friis have created a proprietary and closed-source killer application from their file-sharing system KaZaA [4]. Therefore, there is little transparency around the communication protocol. Even though some technical studies have been conducted, it is still unclear how and what information is conveyed [5].

Of course, some very interesting work has also been done on the use of open standards as base infrastructure for decentralized communication systems. The Gizmo Project [6] is another P2P VoIP soft phone. Unlike Skype, it is based on SIP and thus can interoperate with other SIP-based software and hardware (compatible phones). David A. Bryan, Bruce B. Lowekamp and Cullen Jennings [7] have proposed SOSIMPLE which lays on the SIP/SIMPLE protocol. The

1The exact deal is $US 2.6 billion in cash and stock, plus an additional 1.5 billion in rewards if goals are met by 2008.

project consists in implementing Chord [8], a distributed lookup protocol using a distributed hash-table (DHT), with SIP messages. In a similar way, Kundan Singh and Henning Schulzrinne [9] have published papers about P2P-SIP, also built upon Chord and SIP. The main difference is that it uses an hybrid P2P/SIP architecture. A Web site has been created to promote P2P SIP [11]. It provides information about not only the IETF[2] [11] work (meetings and drafts) but also current research.

Open-source P2P applications for VoIP are not legion. To my knowledge, amiciPhone [12] is for now the only existing one in this category.[3] However it has its own solution: the Amicima protocol suite.[4] It appears that amiciPhone is also based on the DHT technology.

On the contrary, it is quite easy to find non-P2P VoIP programs with open source code. Ekiga [13] (formerly GnomeMeeting) and WengoPhone [14] are probably the most mature solutions. They are compatible with open standards (H.323 and/or SIP mostly), feature voice, video and chat, and are endowed with growing large communities of users and developers. The latter is even backed by French telco Neuf Cegetel. Hence adapting WengoPhone may be the easiest way to get a fully decentralized P2P software for VoIP and video conferencing.

Proposed work

The approach undertaken to achieve P2P support in WengoPhone is to implement a P2P-SIP like Chord DHT within a hierarchical architecture [9]: nodes are gathered around super-nodes; the latter are being interconnected via the DHT (illustration 1). The « buddy » search process is thus made with the Chord protocol which ensures that, in a *n*-node network, routing is done in log(*n*) (illustration 2). The payload transfer is still done via a classic SIP connection.

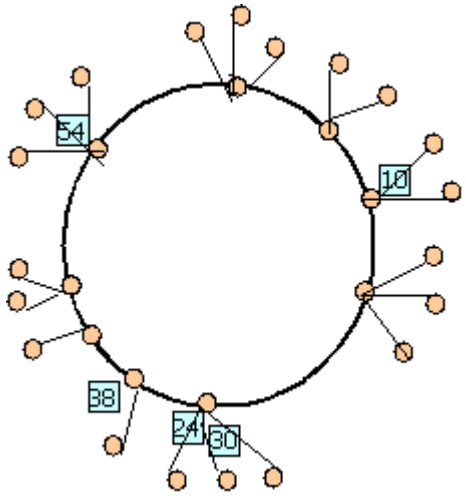

Illustration 1: Hierarchical architecture for lookup

In this project, I will try to contribute on the implementation, optimization and security issues:

- How can be integrated the P2P support to the SIP protocol stack?
- How can the locality and proximity be taken into consideration?
- What are the best options to protect the network and confidential data from attacks?

Chord can be implemented over the existing SIP layer used in WengoPhone (illustration 3). Super-nodes can be designated based on the locality and proximity of nodes with regard to the capability of each. Regarding the security, an evaluation of the potential attacks will be made.

2The Internet Engineering Task Force (IETF) works on Internet standards and specially those involving TCP/IP.
3For now, only the development libraries are available, the entire source code of the application will be released soon according to the Web site.
4The components are: the secure protocol MFP equivalent to TCP, the layers MFP and MFPNet, and the object library Mobj.

Counter ways will thus be provided, implemented and tested.

The success of the project will depend on the security level reached by the system and the effective P2P search process which is supposed to be fault-tolerant and scalable.

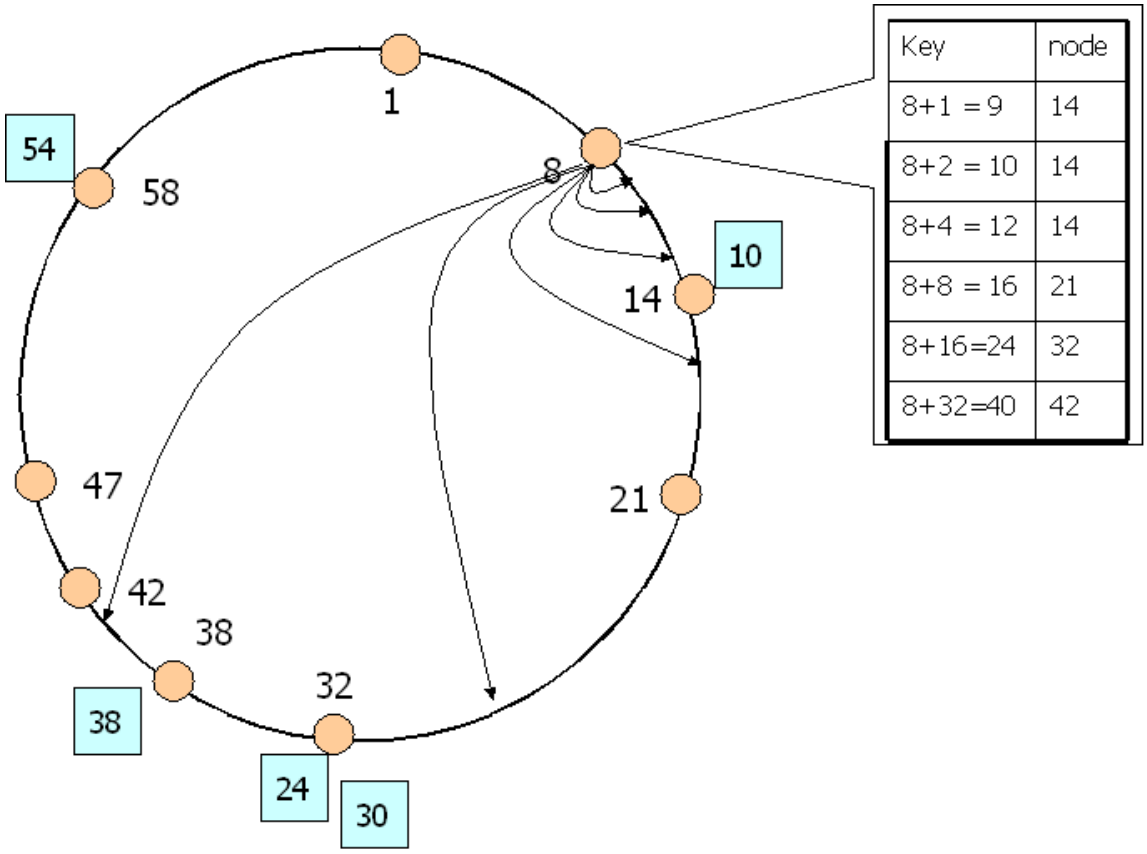

Illustration 2: Lookup process in a Chord DHT

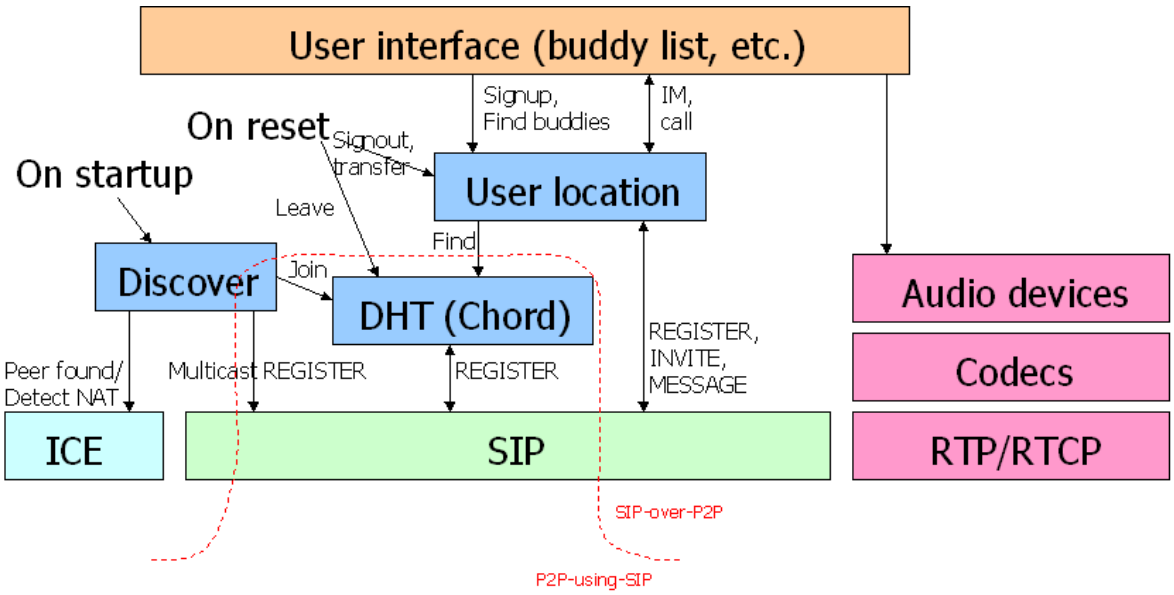

Illustration 3: P2P-SIP protocol architecture

Plan of action

The development of the program will be first done on my laptop (i386 architecture) but under a Windows platform (for hardware compatibility). It can be tested later under UNIX/Linux platforms on my computer or at the College of Computing.

For scalability test, I will try to deploy the software on numerous personal computers located in various place in the world for scalability and hierarchy testing.

Here is the schedule of the project:

02/23	WengoPhone architecture study
03/02	Design of P2P-SIP for WengoPhone
03/09	Implementation of Chord
03/16	Implementation of hierarchical architecture Add locality support
03/30	Scalability testing
04/06	Security level analysis
04/13	Setup of attacks and damage evaluation
04/20	Design and implementation of counter attack measures Replay of attacks and damage evaluation
04/27	Project demo and deliverable (report, documentation, results)

Evaluation and Testing Method

The evaluation of the new system will be made according to the following scheme:

- The system is scalable and the P2P layer is correctly functioning (lookup, hierarchy).
- Realisation of attacks scenarios (denial of service, malicious nodes, man-in-the-middle, etc.) and evaluation of damage.

Bibliography

1. Skype. http://www.skype.com/
2. SR Consulting. *Skype VoIP demographic research October 2005*. http://www.ruell-consulting.de/product_info.php/products_id/112
3. Session Initiation Protocol. http://en.wikipedia.org/wiki/Session_Initiation_Protocol
4. KaZaA. http://www.kazaa.com/
5. Salman A. Baset and Henning G. Schulzrinne. *An Analysis of the Skype Peer-to-Peer Internet Telephony Protocol,* 2006.
6. Gizmo Project. http://www.gizmoproject.com/
7. David A. Bryan, Bruce B. Lowekamp and Cullen Jennings. *SOSIMPLE: A Serverless, Standards-based P2P SIP Communication System*, 2005.
8. Ion Stoica et al. *Chord: A Scalable Peer-to-peer Lookup Protocol for Internet Applications*, 2004.
9. Kundan Singh and Henning Schulzrinne. *Peer-to-Peer Internet Telephony using SIP*, 2005.
10. P2P SIP. http://www.p2psip.org/
11. The Internet Engineering Task Force (IETF). http://www.ietf.org/
12. amiciPhone. http://www.amicima.com/
13. Ekiga. http://www.ekiga.org/
14. OpenWengo. http://www.openwengo.org/