

Applications of an Advanced Peer-to-Peer Platform

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Abstract

This paper describes actual and trial applications on the SIONet (Semantic Information-Oriented Network) peer-to-peer (P2P) platform developed by NTT Labs. SIONet is a logical overlay network. Peers record semantic information on SIONet routers (SI switches), which use the information to guide the routing of packets. We have already developed on-line community systems, a storage system, integrated database systems, components for a software development environment, and a simple game. In this paper, we look at some of these applications.

1. Introduction

With the diffusion of broadband-communications environments and the growing importance of individually differentiated service-provision, peer-to-peer (P2P)-style applications are very much in the spotlight. The P2P model is expected to lead to solutions that are more cost-effective than functionally equivalent client-server systems and brand new applications that deliver unexpected value. We have developed an advanced general-purpose P2P platform, called SIONet (Semantic Information-Oriented Network), as a base for the development of such applications. This has included the development of middleware functions that support the easy creation of effective P2P applications and promote the spontaneous creation of communities by individuals.

2. SIONet

SIONet [1] forms a logical network on top of the transport network (Fig. 1). Routing within this logical network is handled by “semantic information switches” (SI switches) and is based on the matching of semantic information (meta-data).

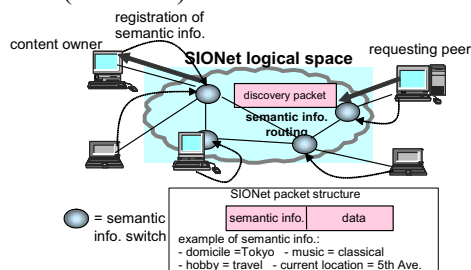


Figure 1. The Concept of SIONet.

This facilitates dynamic and precise discovery of peers that have shared interests, both by new arrivals and those already within communities. As is shown in Fig. 1, the SI-

switches set up a logical space (the event place, EP) within which they relay discovery packets that contain meta-data. Each peer in an EP registers meta-data indicating the properties and preferences of its user with the SI-switch. When a switch receives a discovery packet, it reads the metadata and then relays the packet to other switches and destination peers for which matching metadata is recorded. We used this mechanism as the basis for the various P2P applications described in the following sections.

3. Applications

3.1. Community-Support System

We have implemented a community-support system that allows individual users to set up communities that reflect particular interests (Fig. 2). Peers in a community exchange relevant information and files. The metadata routing capability of SIONet makes it easy for a peer to find appropriate content. The system is an effective application of the SIONet concept.

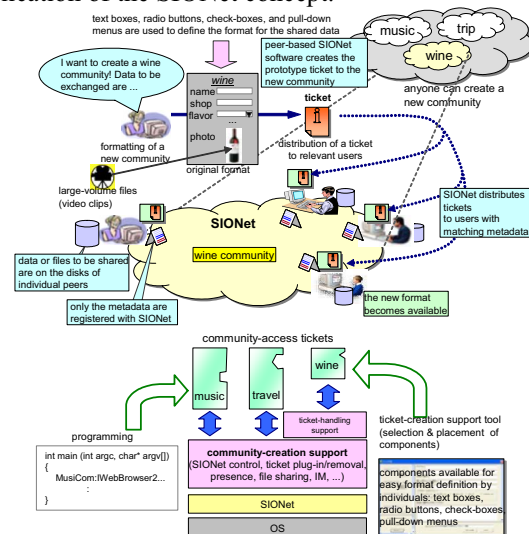


Figure 2. Setting up and Using SIONet-based Online Communities.

For example, a user who wants to share data to do with wine can define a “wine-community” ticket and distribute it to the other users of SIONet. The ticket is a kind of plug-in file that defines a user’s community in accordance with his or her preferences and is easily created by the selection and placement of basic GUI elements (text boxes, radio buttons, etc.). Tickets can also be created by using a high-level programming language. To support the

programming of SIONet applications, middleware provides control functions for the plugging-in and removal of tickets, presence management, file-sharing, instant-messaging, and other tasks.

3.2. Storage Services (Enterprise Level)

A P2P-based storage service can reduce the cost and bandwidth requirements of large-scale file servers. A SIONet-based implementation (Fig. 3) allows office staff to share files directly in the pure-P2P mode over an intranet and use office-external storage when this is necessary for backing-up of files or sharing of files with staff members who are out of the office. Strict EP authentication protects illegal access, and finely grained matching of metadata provides an effective file-sharing capability. Also, the community-support functions described in the previous section enrich collaboration within the enterprise.

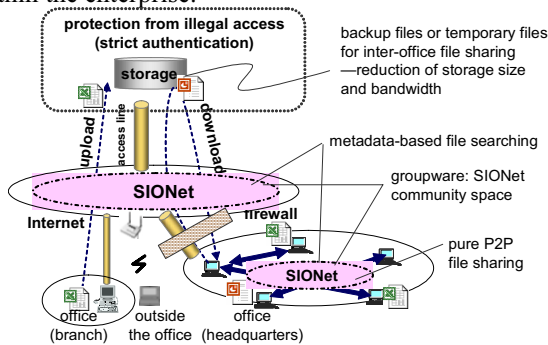


Figure 3. A P2P-style storage-service model.

3.3. Integration of Database Systems

The metadata-matching capability of SIONet can be used to share data across multiple database systems. Database users commonly want to connect to other database systems and exchange data, but they do not usually want all of their own data to be accessible. We have thus included a facility for limiting access to data in a SIONet-based system for the integration of multiple databases [2].

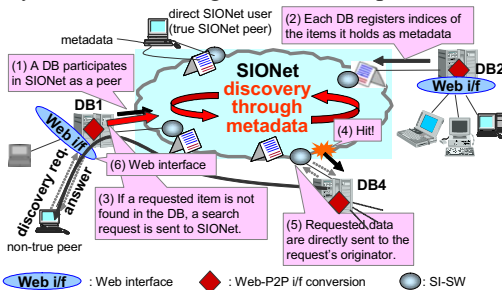


Figure 4. Applying SIONet to database integration.

For example, a user might allow other users to see the number of customers for a given service but not the names of the customers. The semantic information is, of course, open data; this allows the sharing of data across

multiple database systems. As shown in Fig. 4, the system also has a Web interface, so that users are able to access the system through a web browser.

3.4. Software Development Environment

P2P technology can be used in the management of software development. The complex interdependence among the huge numbers of development teams on a large software project often means that the right people are not informed of problems. To solve this problem, we set up a problem-reporting system where the semantic information consists of the names of people and branches responsible for software components. Testers and programmers include semantic information of this type in problem tickets, and SIONet then delivers them to the appropriate branches or people. Even when the main person responsible for a software component is out of the office, SIONet automatically delivers the problem ticket to someone else who is capable of handling the problem.

Like other P2P-style systems, no centralized servers are needed. We are now developing a trial system and verifying the feasibility of this model.

3.5. Others

As an evaluation experiment, we implemented a kind of multi-player Parcheesi game on three pure-P2P platforms (SIONet, JXTA, and the groove tool kit). In this system, the map is divided into small fragments, each of which is stored and managed on a different peer. The loose relationship between peers allowed easy handling of the entry and withdrawal of players. The SIONet implementation required the least programming effort because of the useful middleware functions for simple APIs that had already been developed.

We have also implemented a metadata-based application for news delivery over *ad-hoc* networks (.NET PDA) [3].

4. Conclusion

In this paper, we've introduced some prototype and actual applications implemented on SIONet. We are now using our experience in developing applications for new business fields.

5. References

- [1] Sunaga, H. et al., "Advanced Peer-to-Peer Network Platform for Various Services - SIONet (Semantic Information Oriented Network)," *Proc. of IEEE International Conference on Peer-to-Peer Computing*, Sept. 2002
- [2] Kimura, S. et al., "Software Configuration of P2P Application Controller," *Proc. of IEEE International Conference on Telecommunications*, June 2002
- [3] K. Ueda, et al., "Peer-to-Peer Network Topology Control within a Mobile Ad-hoc Network," *Proc. of Asia-Pacific Conference on Communications*, Sep. 2003 (in press)