

# Share it! by bringing P2P into the TV-domain

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## Abstract

*Share it! is a European project with a focus on developing concepts and solutions for interconnecting digital TV set-top boxes that enable users to share TV-programmes. One important goal of the project is to set future standards, e.g. in content management and rights management, for broadband connected digital television.*

*This paper introduces the project objectives and the consortium, and then focuses on how P2P technology and JXTA platform are used in solving various important issues that help to achieve the project goals.*

## 1. INTRODUCTION

Recent developments in digital television and the increasing computational capabilities of set top boxes, enhanced with hard discs and broadband connections, bring new possibilities for products and services. Share it! is an IST project with the aim to develop concepts and prototypes for a network of set-top boxes, and contribute with the results to the standardization work of TV-Anytime [4] and DVB [5]. The project covers aspects from user benefits, business possibilities, and available technologies. After a thorough study of possible applications [1], the project is developing four prototype scenarios: sharing TV-programmes by user groups, audience research which involves collecting information about user behavior, remote storage for users at a storage provider, and user creation and publishing of own content.

An early design decision was to use the peer-to-peer technology to enable scalable and decentralized network organization, as well as content exchange.

The project consortium represents different interests in a future infrastructure. Philips and NDS have hardware and software interests, BBC and NOB are broadcasters. TNO and Elisa have interests in networks and telecommunications. There are also three research partners: Linköping University provides expertise in peer-to-peer technology and security, University of Ljubljana has a focus on broadband communication and peer-to-peer solutions, and Fraunhofer Focus specializes in multimedia applications.

In this paper we point out some of the problems to be addressed for bringing peer-to-peer technology to the TV-domain and shortly describe the solutions under development using the JXTA framework [3].

## 2. P2P TECHNOLOGY WITHIN *Share it!*

The *Share it!* network of connected set-top boxes represents a distributed, peer-to-peer environment with no central point of control. One of the main goals of the project has been to offer users the possibility to organize themselves in communities and groups according to their interests and to be able to share and exchange content, e.g. user-created videos. Below we present three problem areas and the approaches taken in the project, together with related issues that still remain to be addressed and need further analysis and working solutions.

**Network organization and management.** The first group of problems is directly related to peer-to-peer network specifics and includes naming and resource identifiers, resource discovery, peer bootstrapping, and message routing among others. These issues have been tackled by using the JXTA framework and JXTA protocol stack with built-in mechanisms for P2P network organization.

**Content management.** The application domain of the *Share it!* network allows a variety of media content such as broadcasted TV programs, user-created videos, music, photos, etc. to be recorded, stored, published, and shared among users. Taking into account the open and distributed character of the *Share it!* network, content management is a hard problem to solve. How, for example, should content be identified assuming several instances of the same program from different sources, in different recordings and different versions? Where should the metadata for a particular piece of content be stored? How should we locate the content? And, of course, Digital Rights Management (DRM) is a major concern for content providers.

**Security-related issues.** Various security aspects have to be addressed in *Share it!*, as is the case with any distributed and open network. Questions such as group creation and management, group membership, user authentication and access control, content authentication and integrity verification have to be dealt with in order to provide a secure platform for future *Share it!* applications.

Next we present some of the *Share it!* services, implemented as JXTA services, that are closely related and provide solutions to the problems mentioned above.

## 3. *Share it!* SERVICES AND JXTA

The concept of *Share it!* service is inspired by JXTA's definition of services [3]. Services can be regarded as

building blocks that each provides part of the functionality of the application. Services are always associated with a group and are accessible only for valid members of that group. The *Share it!* prototype uses the JXTA framework and follows the JXTA concepts and architecture. *Share it!* uses some of JXTA core services that implement the JXTA protocol stack and also has custom services that provide additional functionality specific to *Share it!* application domain. The following are the main services in *Share it!*:

- ***Share it!* basic services.**

The *Share it!* basic services are oriented toward solving the network organization and management issues stated in the previous section. The *Share it!* network uses the JXTA core services that implement the built-in protocols for P2P network organization, resource discovery and transparent communication between peers. Each peer in the network is uniquely identified and provides certain services to other peers. Peers can organize themselves in groups that share common interests and agree on a common set of services. A group is a key element in *Share it!*, as it is in JXTA, acting as a boundary within which services run.

The root group in JXTA is the NetPeerGroup, which in the project is renamed to ShareIt group. It contains all the existent and connected JXTA peers and has a null membership policy (see Membership service). Inside the root group users can create their own groups, resulting in a tree hierarchy. In *Share it!* users can specify three basic attributes that determine the activity type of the group: visibility (visible vs. hidden), membership (private vs. public) and control (moderated vs. unmoderated).

When a *Share it!* peer bootstraps it is configured in a similar way to a peer in the JXTA reference implementation, indicating gateways, rendezvous peers and proxies that are all part of the JXTA peer-to-peer network organization. The built-in discovery service is used for *Share it!* resource discovery. By resources we mean peers, groups, services, etc. and all the associated advertisements that are needed for network organization and for the invocation of available services.

- ***Share it!* Publish service**

The *Share it!* Publish service is a custom service implemented as a JXTA peer group service. It works within the boundaries of a group and an instance exists for every member (peer) in the group. The Publish service provides the main operations needed for the content management issues mentioned in section 2. The service contains four basic functions – content search, publishing, recommendation and announcement. Publishing involves the creation of a Content Advertisement that can later be sent as a search result to a query, as a content recommendation message (to a particular user) or a content announcement message (to the whole group). The content advertisement itself is an XML document that contains metadata about the shared content and its location, as specified by the TV-Anytime standard [6]. The Publish service advertisements are embedded within JXTA

Resolver messages and are distributed using the built-in Resolver protocol facilities.

The *Share it!* Publish service is integrated with the *Share it!* Membership service and allows for fine grained control over the four basic operations described above.

- ***Share it!* Membership service**

The *Share it!* Membership service is an extension to the JXTA core membership service that has “null” credentials. When a new group is created, it replaces the default JXTA membership service if the creator sets the membership attribute to “private”. The “null” credentials are replaced with one or several username/password pairs, which serve as authentication information when entering the group. The credentials also contain a set of services the user can invoke within the context of that group. All the other *Share it!* services can be integrated with the Membership service and check the credentials to allow or deny access to the service. The Membership service acts as a guard that grants or denies user access to groups and related services. It is responsible for some of the security aspects mentioned in section 2, whereas other issues were left for future work.

- ***Share it!* Rights Negotiation service**

The *Share it!* Rights Negotiation service is a custom JXTA group service that addresses DRM issues. For each piece of content a set of usage rules and a set of sharing rules are generated during the rights negotiation process. Two rights negotiation models have been designed to allow for different applications and business models to be built – “light touch” and “heavy touch”. The former allows the rights to be negotiated only between the requesting and responding peers. The latter involves a third entity – a rights negotiation broker. The detailed description of the DRM architecture is outside the scope of this paper. For the prototype the “light touch” model has been implemented as a JXTA peer group service and using JXTA pipes. The service is also integrated with *Share it!* Membership service for user authentication during rights negotiation process.

#### 4. CURRENT STATUS OF THE PROJECT

The project started in December 2001 and expects to demonstrate the main functionality of the system on exhibitions during the autumn of 2003 and early 2004

#### References

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