Service and Content Metadata Systems in Interactive TV Domains

Mark Guelbahar[1] and Josip Zoric[2]

[1] Institut für Rundfunktechnik GmbH, Platforms for Broadcast Services, Munich, Germany
guelbahar@irt.de
[2] Telenor Research and Innovation and Norwegian University of Science and Technology, Trondheim, Norway
josip.zoric@telenor.com

Abstract. In this paper we discuss information interoperability, focusing on design and implementation of service and content metadata solutions for cross-domain IPTV services. We approach the problem by discussing *experience sharing* in interactive TV, and relate it to necessary service platform facilitators, such as: *interactive TV sessions*, *cross-domain service framework* and *metadata integration* (service, content and session metadata). We detail the design and an implementation of such *a metadata infrastructure*, and communicate our practical experiences.

Keywords: Networked electronic media, Cross Domain, Metadata, Service Discovery.

1 Introduction

We discuss the metadata functionality required for providing interactive TV services with enhanced cross-domain service support, where *cross-domain* can be described as "providing TV, Internet, Home-domain and Telco services as an integrated part of the user TV session". Cross-domain services cover user centric media discovery, delivery and consumption (with emphasis on social communities). Enabling interactive TV service maturity in an access- and network transparent manner is not a trivial task, and we will discuss why. The iNEM4U [1] vision of a networked electronic media framework enables individuals and groups of users to *share their interactive media experiences* in an intuitive and a seamless manner, regardless of their choice of service domains, networks, and devices. However, today's landscape of networked electronic media consists of a number of *non-interoperable technology islands* that were designed for different types of users, services, content, and devices. Examples are the consumer electronics devices in the home, and different kinds of network and service environments for mobile, IPTV, and broadcast usage.

The degree of connectedness within and outside of homes is improving significantly - however, available networks are still confronted with interoperability issues, regarding content and metadata formats, encodings and presentation (devices simply contain several network interfaces, but these as such don't make the contents interoperable and

P. Daras and O. Mayora (Eds.): UCMedia 2009, LNICST 40, pp. 141–150, 2010.
© Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering 2010

manageable via single points of access). The reason for this is quite obvious – within various domains, different content and metadata formats, distribution systems and standards are being used. Not only formats differ, but even similarity of metadata for the same content item offered by two different parties is not guaranteed.

Especially, when the Internet and the Web2.0 world is considered to play a new content provisioning role, things get even more complicated – the Web is in most cases totally unmanaged and un-standardised, especially regarding content and metadata formats. On top of that, the quality of content and metadata is not controlled, which makes good viewing experiences hard to find. Recommendations are one way out of this, where other projects try to manage these problems by using complex algorithms to allow separation of high and low quality offerings (although still in an early stage of development).

The iNEM4U [1] vision is accomplished by providing means to combine multiple service domains to offer services or content to end-users, allowing seamless integration of professional and user-generated content and services, and making the result accessible across terminals, locations and networks. Personalised interaction with services and content is supported, as well as synchronous community-based sharing of content and experiences. Interoperability is a major obstacle for such systems, spanning several dimensions, as network, and service interoperability, network and service roaming, as well as information interoperability, to which we dedicate this paper.

Metadata for services and enablers plays a crucial role in various service platform (SP) mechanisms, supporting the service delivery, e.g. service discovery (SD), composition, brokering and mediation - as already mentioned, various metadata formats and standards exist. DVB has adopted a profile of metadata defined by the TV-Anytime Forum (ETSI TS102323). TV-Anytime [2] is an XML-based solution, with the additional functionality to offer personalised recommendations on what to watch. It is a subset of MPEG-7 [3] and also an ETSI standard, which was included in several DVB standards, like DVB-IP, DVB-S/C/T and DVB-H.

Several projects dealt with the cross domain metadata compatibility and provided the metadata entities, which might be partly reused in the interactive TV service platforms. Worth mentioning here are Daidalos [4], SPICE [5], Mobilife [6], NoTube [7] and SAVANT [8]. They all worked on metadata solutions, so they provide useful input for domain-specific solutions, e.g. Mobile service platforms, Web service platforms etc. But as none of them offers an approach that suits the cross-domain interactive service platform solutions, we only can take over fragments with metadata descriptions of service context, user profiles, service and enabler descriptions, and reuse them in our cross-domain framework.

This paper is organized in the following way: after having introduced the problem, its practical relevance and related work, we introduce the concepts of cross domain services and experience sharing in section 2. In section 3 we explain requirements and design issues related to cross-domain service architectures enabling interactive TV services, focusing on functionality for Metadata (MD) retrieval and management. Section 4 presents the iNEM4U service and content MD infrastructure, while section 5 communicates our implementation approach and practical experiences. Section 6 concludes this work.

2 Experience Sharing, Cross-Domain Services and Interactive Sessions

We dedicate this section to the iNEM4U approach towards cross-domain experience sharing. We start by *(1)* structuring the concept of experience sharing, considering simultaneously the user and the business aspects, *(2)* continue by relating the shared experience to the system entities which realize it, i.e. services and enablers, and finish by *(3)* detailing their composition and orchestration by introducing the concept of an interactive session.

2.1 Experience Sharing

The aim of the iNEM4U project is to enable individuals and groups of users to share interactive media experiences in an intuitive and seamless manner across domains and within cross-domain communities. *Sharing a live event experience*, such as a concert or a soccer match, with a group of people that have gathered in an ad-hoc way around that life event, contains the following business processes:

- *Sending recommendations* to *watch the concert* from various users' locations.
- Creating an iNEM4U sessions in order to *watch the event together*, in a synchronized way.
- *Opening up a synchronized video, voice or text chat session*, as an overlay video on top of the event broadcast.
- *Merging several user sessions* with the actual iNEM4U session.
- *Sharing notices and invitations across domains and devices.*
- *Watching* the event and sharing the experience with others.
- *Storing and replaying the sessions* (e.g. which consists of the broadcast video of the event and associated user generated content (UGC), comments, annotations and various service interactions) at any place and time, and making it available through information portals, community websites and other media channels.

2.2 Cross-Domain Services and Architectures

Above-mentioned business processes have to be mapped to their system counterparts, which specify the involved system platform functionality. System processes are realized by a composition and orchestration of service bundles, as discussed below.

iNEM4U enables both end-users and professional content providers to make use of interactive media services across domains, without the need to replicate the services that are currently provided by the existing infrastructures in these domains. Rather, iNEM4U uses these services to provide new "bundles" of services and applications, and adds new features such as cross-domain recommendations and experience sharing. These new services build upon the iNEM4U cross-domain service architecture, which forms a *convergence layer* on top of domain-specific ("native") service infrastructures. Service platforms, which offer interactive TV sessions, combine services, enabling technology, content and users in well-structured and synchronized service sessions. Such "iSessions" provide *experience sharing*, which facilitates both, on-line participation and

off-line retrieval, and the possibility to replay previous sessions. One key enabler for this (besides domain-independent synchronization functions and content formats) is the presence of a *well- defined and lightweight metadata system*. We will firstly define the above-mentioned service and platform entities, and secondly discuss their metadata descriptors and their retrieval and management techniques.

The key concept to deliver cross-domain services independent of the user's access network is based on the underlying assumption that all iNEM4U services are delivered using Internet Protocol (IP). This assumption implies they can be delivered using a variety of different networks and channels, as long as they support IP connectivity.

For example, services and applications that are residing:

- in the home (e.g. WiFi and UPnP devices),
- on the "open internet" (e.g. Web2.0 Web Sites/Applications)
- as IPTV services on set-top-boxes, IP-enabled TV's or PC hardware and
- within Mobile services (e.g. IMS-based multimedia services).

Furthermore, it is also possible for services, content, sessions and applications to be provisioned via managed networks, for example, an end-to-end network managed by an operator using technologies such as Next Generation Networks or, more specifically, the IP Multimedia Subsystem (IMS [9]). Users of the iNEM4U system are not bound to specific delivery channels and are free to utilise applications that span the four main delivery channels outlined above and depicted in Figure 1. Services and enablers also hold important metadata, which is used by various service

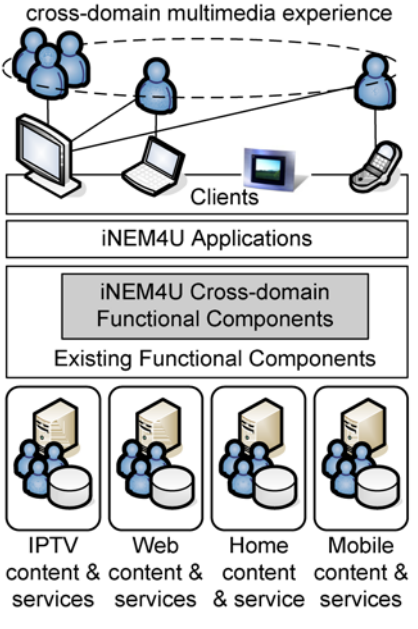

Fig. 1. iNEM4U High Level Architecture

platform mechanisms (service discovery, composition and brokering), and usually includes the information about the service and enabler capabilities, the type of the information / service they can deliver, the requirements / quality of service, the targeted terminals, where the services will be played etc.

2.3 Interactive TV Sessions

Let us now discuss interactive TV sessions (iSessions) as a way of bundling and synchronizing (spatially and temporarily) cross-domain services. iSessions can be used in nearly all situations where information has to be interchanged and a certain level of history should be tracked during the session lifetime (or even afterwards). We focus on sessions used to deliver multimedia content and related communication services in a synchronized manner to the end user. Metadata about sessions should include the metadata subtypes about content, services and enablers, applications, and users participating in sessions.

The iNEM4U iSession management, illustrated in Figure 2 is designed to be independent of the underlying domain technology. iSessions can be created either by users or by Service Providers, giving the possibility to create an iSession and to share it with others, i.e. via a community website or the users' buddy list. Users can discover sessions through invitation from other users, by subscribing to iSessions of specific types or genres, by selecting an iSession from an Electronic Program Guide (EPG) containing iSession information, or by downloading it from a web server. An overview of the basic iSession management architecture is given in [9]. In Figure 2, the session management architecture is illustrated in a simplified way as a single module in the server / backend side (the upper part of the architectural model). The *lifecycle actions* of an iSession include the following states: creation, initialization, running, pausing, resuming, stopping, storing. *The modification actions* on an iSession include: adding / removing content, adding / removing users, enabling / disabling content preview, modifying layout, modifying playlist, modifying session timing.

During the creation phase, the creator can add Content Sources [9] and users to a session and is able to define the layout and timing of the content within the session in one or more individual ways. During the initialization phase, the iSession description document is downloaded to one iNEM4U client. Once all Content Sources have been discovered, the iSession server notifies all of the other invited users and all iNEM4U clients can start to render the iSession content.

As stated, sessions can be paused, stored and *replayed at any later point in time*. One approach for storing an iSession is to store only the iSession description i.e. in a session repository, and there, Content Sources are just stored by reference - if they disappear (e.g. their URI changes or the source is going offline), the session cannot be played back any more, which is especially problematic whenever live content is part of the session. The extreme opposite of this approach is a complete recording of the session and all its involved Content Sources to ensure replay-ability of the complete session later. This involves the storage of all content items that form the session (including live broadcast content, video chats and text messages), as well as timing-related modifications during runtime (e.g. a content item has been added at a given time after the start of the session). This infers availability of huge data stores, but also could also enable new business models (i.e. the role of a "premium session provider").

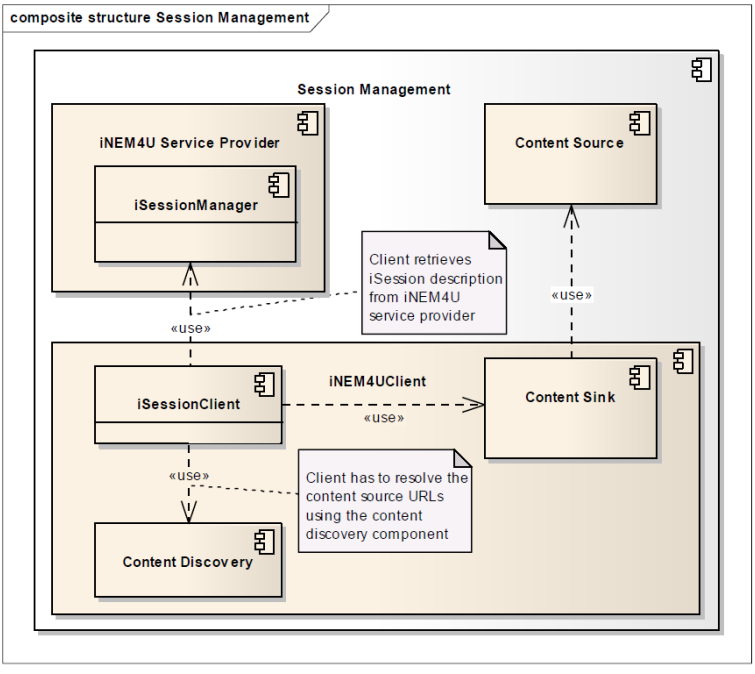

Fig. 2. Overview of Session Management

3 iNEM4U Cross-Domain Metadata Solution

As mentioned above, experience sharing is obtained by composing interactive TV sessions and orchestrating their cross-domain services. However, service and content interoperability require sharing of various metadata entities. We can identify the *need for a bridge* between those domain-specific implementations. In this section, we present both, design and implementation of the iNEM4U metadata solution.

The *iNEM4U metadata solution* bridges these differences in a way transparent to its clients and can handle proprietary formats as well as formats used for internal and external representation of multimedia content. As an internally used data format, we chose TV-Anytime Phase II [2], because it is an existing standard, and de facto the only reliable and most flexible one – it is even *by design* capable of describing applications and "iSessions". Since it is based on XML, TV-Anytime is also an extendable format, which is an important requirement to be able to support future metadata languages. Additionally and as already stated, TV-Anytime already *is* part of existing domains, and therefore, there's no need to create bridging modules to and in between those.

The interactive TV session infrastructure illustrated in Figure 2 requires support from several service platform mechanisms. We will outline just the ones related to retrieval and management of MD:

- SP functionality dedicated to metadata mapping,
- SP mechanisms for discovery of services and content,
- Notification systems for changes in content, services and sessions.

A precondition for efficient service composition, orchestration, and user interactivity, is the existence of simple and well structured metadata descriptions, as described in the following subsection.

Metadata Mapping

An important facilitator of knowledge/information exchange among domain-specific solutions is mapping the various MD formats/standards. Service domains live their own life, just slightly influence each other (e.g. broadcast and telecom service domain), so it is difficult to expect that they might comply with the same standard. Instead we can expect the coexistence of various MD standards.

The only solution to enable cross domain functionality thus is to build an extensible framework that allows for the translation of existing and future metadata models. If an application would want to provide i.e. a listing of available multimedia content across all those domains, it could – in the iNEM4U case, as depicted in Figure 3 - send a generic, TV-Anytime compliant query to the iNEM4U service discovery & metadata component. This component would then pass this query to the domain-specific implementation modules (i.e. a module managing YouTube MD, another module managing DVB-IP MD, etc), which translate it into domain-specific queries and execute it. The query results are then returned via the framework to the requesting application, combining the resulting content and iSession information from several domains in one smart overview.

Additionally, the domain-handlers are triggered to subscribe to metadata updates, which results in the user automatically being informed whenever new services (with MD similar to queried one) are available and interesting content or iSession information has changed. Technically, this is realised by the use of XMPP [10] or JMS [11] (depending on the clients' capabilities) in an asynchronous way, and messages containing the changed information will be sent to the clients.

Cross-Domain Discovery and Notification

During interactions in iSessions we have to discover changes in content, users, services but also in iSessions. The discovery system has to be cross-domain - aware, which implies a federation of queries and subscription/notification mechanisms, as discussed in this subsection. In order to realize the system scenario presented in Figure 3, we have used the identical way to access all domains, namely through several interfaces:

- ***Cross-CRUD interface*** (create, retrieve, update, delete) and corresponding domain-specific CRUD interfaces, allowing the mapping of cross-domain retrieval and management functions to their domain-specific counterparts (Hierarchical multilayer-multistep search, i.e.: (i) a search for relevant sessions (a bundle of services and content), (ii) a search for services, which can provide a relevant content, and (iii) a retrieval of the content.
- ***Cross-SUBSCRIBE / NOTIFY interface*** and corresponding domain-specific SUBSCRIBE / NOTIFY interfaces, which are used for notification-based

interactions (notifications about new content, services, user who want to join or new sessions).

- ***Generic cross-domain metadata API***, which is mapped to domain-specific metadata standards.

Discovery and notification mechanisms can be used either during composition and initialization of sessions, or during their orchestration (when events and notifications give a chance to react on new content, users or services, as well as other changes in the service context). We are evaluating our design approach by implementation and usage tests, as discussed below.

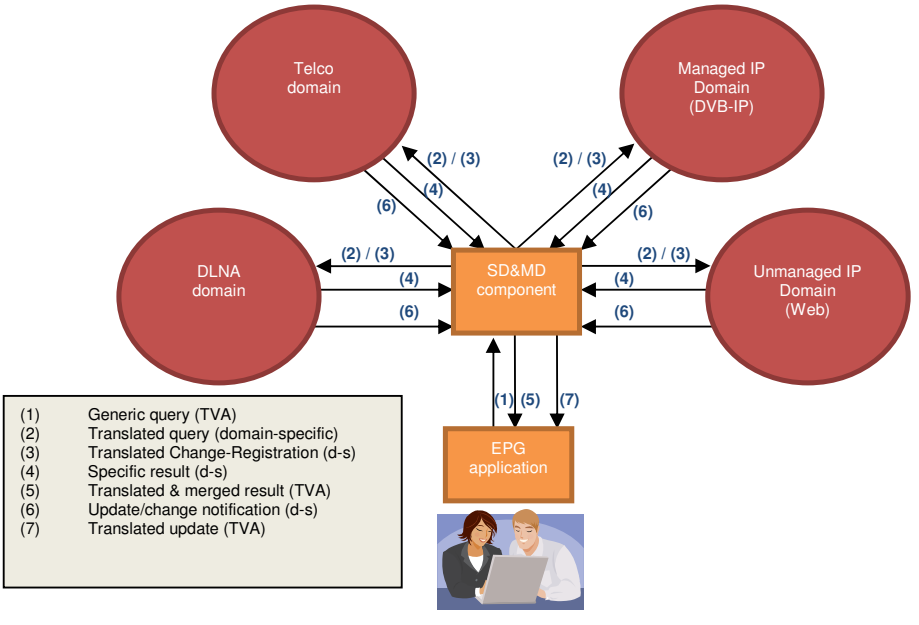

Fig. 3. Cross domain EPG scenario

4 Practical Experiences

The iNEM4U metadata *solution* has been implemented as a modular web service that can run in any technology domain, for instance within a home environment (e.g., on a DLNA gateway), or at a third-party service provider in the Web. Its implementation is Java-based, and uses JMS and XMPP for update notifications. Implementation of cross-domain service discovery and notification had a *cross-domain part* and a *domain-specific counterpart*, as well as a mapping between them. For querying we have used the web service technology, while for the notifications we have provided a XMPP - compatible solution in order to "attach" the SD/Notification to the technology used by the session management functionality. In such a way these service platform mechanisms can be used by any functional entity which subscribes to the information.

The Cross-Domain Personal EPG *application* is a lightweight, browser-based Java-Servlet application that can be used on any device providing (CE-) HTML support and IP connectivity. There, a profile- and context- based cross-domain EPG is realised and presented to the user, showing a personalised guide to content from broadcast, web, and mobile domains. It typically provides functions allowing a viewer to discover, navigate, and select services, content and iSessions, filtered by time, title, channel, genre etc. The users can control the application via their remote control, a keyboard, or other input devices such as a phone keypad. The implementation of the EPG has shown that the iNEM4U Metadata API allows application developers to create a cross domain application in a quick and easy manner, as in example it took the developers less than 15 lines of code to get a list of available EPG items, covering 3 different domains. Presenting this EPG in a graphical way requires much more work, especially in the Java Servlet case, but retrieval of cross domain metadata is very much simplified.

User tests and open demos at exhibitions (i.e. IBC 2009) have shown that the broad mass welcomes the domain-transparent way of content representation, and especially younger people tend to demand exactly for this network and source abstraction, as they grow up with a high degree of connectedness to several networks and content sources, and they don't care *where* the content they're actually interested in comes from, as long as they can get it.

5 Conclusion

Interactive cross-domain TV sessions require robust and efficient metadata support. We believe in the coexistence of domain-specific solutions, integrated by cross-domain service platform mechanisms, while the metadata interoperability gets ensured by metadata mapping techniques. A combination of several functional entities is required for the information interoperability in interactive TV, at least: (a) interactive session entities, (b) cross-domain session / service / content search and retrieval mechanisms, and (c) metadata mappings. We are continuing design improvements and implementation tests, the results of which we will communicate in the close future.

Acknowledgements

This work was partially funded by the EU FP7 grant (FP7/2007-2013), agreement no. 216647. We thank our colleagues within iNEM4U project for their support and insights. Authors are grateful to task workforce for all the input and suggestions they received, especially from D.Goergen, J.O'Connell and O.Friedrich.

References

1. iNEM4U, EU FP7 project - Interactive new experiences in multimedia for you, `http://www.inem4u.eu`
2. TVAnytime Forum, `http://www.tv-anytime.org`

3. MPEG, MPEG-7 Overview (2004), http://www.chiariglione.org/mpeg/standards/mpeg-7/mpeg-7.htm
4. Daidalos I and II, EU IST – FP6 project, http://www.ist-daidalos.org/
5. SPICE, European IST-FP6 project - Service Platform for Innovative Communication Environment, http://www.ist-spice.org/
6. Mobilife, EU IST – FP6 project, Services and applications from the user and terminal perspective, http://www.ist-mobilife.org/
7. NoTube, EU FP7 project, http://www.notube.tv/
8. SAVANT, EU FP5 project, http://www.ist-world.org/ProjectDetails.aspx?ProjectId=cf85b5506fde4e5697cdbaa5184364fb
9. Friedrich, et al.: Deliverable: D1.3, Overall Architecture of the iNEM4U Platform, iNEM4U, EU STREP project, FP7-ICT-2007-1-216647 (2008), https://doc.telin.nl/dsweb/Get/Document-95057
10. XMPP: Extensible Messaging and Presence Protocol (XMPP), http://xmpp.org
11. JMS: Java Message Service, http://java.sun.com/products/jms