Media Delivery to Remote Renderers Controlled by the Mobile Phone

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***Abstract*— In today's content delivery solutions, service delivery and control are still tightly coupled, a service typically being delivered to the same device that controls the session. We present a solution that was designed with the goal to decouple service control and delivery. Using our approach, multimedia streaming services can be delivered to off-the-shelf DLNA devices in visited networks. The service provider receives information about the remote media player and access environment via a mobile phone. Proximity technologies (e.g. barcodes, NFC) of the control device are used for the exchange of required credentials. This paper describes a typical scenario and our prototype implementation.**

Keywords- NGN, DLNA, remote media access, mobile phone control, QR-codes

I. INTRODUCTION

Entertainment devices, such as music players and cameras, nowadays come with networking capabilities that enable them to upload, download, and render media from other devices. The Digital Living Network Alliance (DLNA) [1], based on the Universal Plug and Play (UPnP) standards family [2], is now widely accepted in the consumer electronics industry. In parallel, fueled by rapidly growing mobile and fixed broadband penetration, consumers are increasingly using online media download and streaming services, such as music portals.

Network operators, on the other hand, have started to prepare for an increasing media mix by rolling out Next-Generation Network (NGN) infrastructures [3] and services based on IP Multimedia Subsystem (IMS) for service control and IP transport, based on standards of the 3rd Generation Partnership Project (3GPP) [4].

We envision an architecture that combines the benefits of operator-guaranteed trust, security, charging and quality of service (QoS) based on NGN technologies with the consumer electronics (CE) industry perspective of launching attractive end user devices.

II. DEMONSTRATION SCENARIO

A. Overview

The baseline scenario for our demonstration is depicted in Fig. 1 and described in the following:

Caroline is on a business trip, visiting a conference. In the taxi to the hotel she accesses the media portal of her service provider to listen to music with her mobile phone. After she has checked in, she decides to move the session to her hotel room, to enjoy the better sound quality of the hotel stereo system. Using her phone she connects to available media devices in the hotel room, with the stereo system and a TV set among them. Caroline selects the stereo as target device and her songs are immediately played out. With her phone, she can flip through her personalized playlist using trickplay controls such as pause, restart or forward.

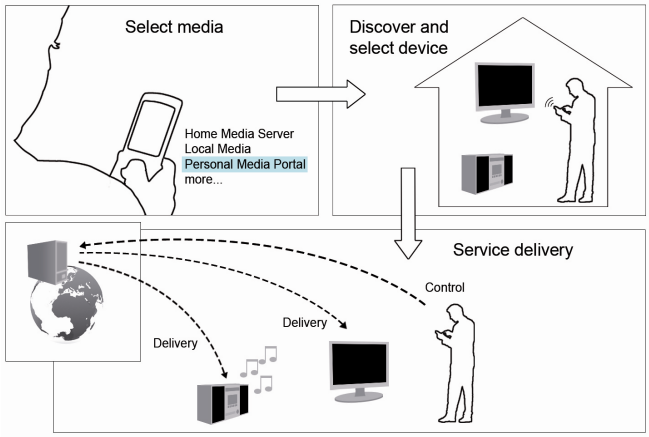

Fig. 1: Remote media access scenario

B. Relationship bootstrapping via barcodes

After the guest has checked in at the hotel reception, the residential control device creates a welcome message together with a 2D barcode (in our implementation we used the widely deployed QR code symbology). This barcode contains connectivity information about devices in the guest's room. The welcome message can for example be shown on the guest's TV or it can be handed out on paper. Prior to encoding, the barcode information can be optionally encrypted, i.e. requiring the user to enter an access code on the phone, to prevent malicious use of remote resources.

In their room, guests can use a media access client application on their phone to capture the barcode with the phone's camera. Thereafter, the client application launches the media portal in the web browser. During this process information from the barcode is passed to the media portal. The media portal offers personalized media content and a list of available media players. Guests can control the playout with their mobile phone through the media portal.

III. PROTOTYPE IMPLEMENTATION

Our demonstrator was developed in collaboration of Ericsson Research, University of Agder and RWTH Aachen. It is a simplification of our envisioned target architecture [7] and focuses on the separation of control signaling and media delivery to rendering devices.

In Fig. 2 the main demonstration flow is shown. The residential gateway connects the hotel network to the Internet. In our prototype we use a commercial off-the-shelf device supporting NAT control through the UPnP Internet Gateway Device (IGD) profile [5]. As the hotel network uses private IP addresses the internal entities cannot be reached from external hosts, such as the media portal. Furthermore, due to UPnP restrictions the Digital Media Renderer (DMR) can not locate media on external hosts. Finally, a major design goal was to support standard feature phones without mandating availability of local WiFi connectivity. We therefore assume only a cellular communication interface that allows accessing the media portal over the air.

The residential control device is used in the hotel network to configure access to local target devices, such as a DMR. It is implemented as a standard Java application. It performs the discovery of DMR:s in the hotel network by means of UPnP and provides a web console for administration. The list of devices made available to the hotel guest can be pre-configured, together with a mapping between devices and the guest's hotel room. The control functionality then generates the personalized QR code and displays it on the guest room TV via the UPnP Audio/Video service. Encoded in this QR code is a room-specific URI that addresses the residential control device instance from where connectivity information and unique identifier of each available device in the hotel room can be retrieved.

On the mobile phone a Java MIDlet was implemented to capture and decode the barcodes. Information about available media renderers, as obtained from the QR codes, is submitted to the media portal when accessing the user's home page. The prototype supports UPnP compliant DMR:s located in the hotel network, such as a Zyxel DMA-1000.

The media portal offers a personalized menu for the content and media renderer selection. According to the user's trickplay requests on the media control page, UPnP control actions are delivered to the target device through a dedicated port mapping in the residential gateway.

IV. CONCLUSIONS

Using standard technologies available today, services can be delivered to off-the-shelf consumer devices in broadband-connected local network islands, with a user's phone staying in control of service access and delivery.

We have presented a proof-of-concept implementation that shows that the proposed mechanisms work as expected. Moreover, we have discovered some areas for improvement of the perceived usability that will be considered for the next evolution step of the prototype.

One area for improvement is system responsiveness. The recognition of QR codes by the camera and the decoding

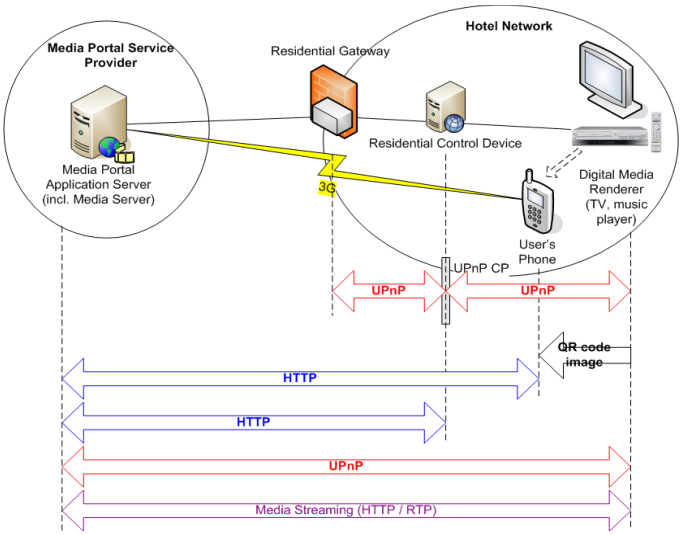

Fig. 2: High-level system architecture and signalling flows.

would be faster if implemented as a native application, as is the case with in most Japanese phones today. Latencies between issuing play commands and actual media playout can be improved by using RTP/RTSP for media delivery and by negotiating appropriate QoS settings for the signaling of UPnP actions. Here, the use of IMS would yield clear advantages.

In deployments where the residential RCD is not co-located with the gateway, the proposed solution requires support of UPnP IGD in order to establish port mappings. However, several gateway vendors and operators mandate i to be disabled by default for security reasons. The next version of the UPnP IGD specifications will provide secure default authentication and authorization mechanisms.

In line with our envisioned architecture, we are currently working on an enhanced version of the prototype, as outlined in [7]. This enhanced version utilizes IMS Presence Services [6] for remote service discovery and contains improvements addressing the aforementioned limitations.

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