♦ Community-Based Applications

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The WellCom platform enables the creation, delivery, and management of advanced personalized and interactive multimedia applications and services in a distributed home environment. End users obtain easy and seamless access to interactive and personalized television (TV) services as well as TV-related applications through their mobile terminals. The supporting devices and technologies include TV sets, mobile terminals for interaction with TV content and to deliver personalized services directly to the user; and near field communication (NFC)/Bluetooth technologies which combine with an "easy-pairing" mechanism for access to interactive programs and social applications. Individual interactivity opens up new possibilities for group experience of TV content. For example, users can themselves take part in a broadcast TV quiz or compete with friends. Personalization allows service providers to tap into new revenue streams such as targeted advertisements on mobile phones. © 2011 Alcatel-Lucent.

Introduction

Television (TV) screens are everywhere in public places (airports, restaurants, and shopping malls) as well as at home. At the same time, end users are increasingly bound to their mobile terminals, not only for phone usage, but also for applications and services. The mobile terminal becomes a personal agent of the user, containing personal data and applications. End users are also interested in community-based applications such as Web 2.0 applications [14]. A needs analysis for future TV content indicates a clear expectation from consumers for new personalized and interactive TV experiences [8, 11]. This allows consumers to be actively involved in a two-way dialogue that enables them to request specific personalized content based on their preferences while also being able to exchange information within their local and remote communities. We define the local community as a group of individuals watching the same TV content on the same TV screen (like a family in a living room), whereas the remote community corresponds to a distributed group of individuals watching the same TV content on different TV screens (like supporters of football teams in different locations).

In this context, the WellCom project was launched by Alcatel-Lucent Bell Labs with the objective of significantly improving interactive TV technologies in order to increase user experience and boost operator revenues. The intention was to bring together every entity on the value chain—end users, content providers, equipment manufacturers, telecom operators, and broadcasters, with the support of research organizations. Fifteen partners including Telenor, Telefonica, SES Astra, TF1, Pace, and NXP, across five European countries.

Bell Labs Technical Journal 15(4), 93–110 (2011) © 2011 Alcatel-Lucent. Published by Wiley Periodicals, Inc.
Published online in Wiley Online Library (wileyonlinelibrary.com) • DOI: 10.1002/bltj.20474

Panel 1. Abbreviations, Acronyms, and Terms

3G—Third generation
ad—Advertisement
ADSL—Asynchronous digital subscriber line
API—Application programming interface
BCAST—Mobile Broadcast Services Enabler Suite
CTIA—Cellular Telecommunications and Internet Association
DRM—Digital rights management
DVB—Digital video broadcasting
DVB-H—DVB-handheld
EPG—Electronic program guide
ESG—Electronic service guide
eTV—Enhanced television
GMB—Group model based
IMM—Interactive Media Manager
IP—Internet Protocol
IPTV—Internet Protocol television
IRM—Individual recommendation merging
ISP—Internet service provider
ITEA—Information Technology for European Advancement
iTV—Interactive television
MCM—Multimedia content management
MIDP—Mobile information device profile
MNO—Mobile network operator
MPEG7—Moving Picture Experts Group 7
MWC—Mobile World Congress
NDEF—NFC data exchange format
NFC—Near field communication
OMA—Open Mobile Alliance
OS—Operating system
PC—Personal computer
QoA—Quantity of affiliation
QoC—Quantity of consumption
QoI—Quantity of interest
SMS—Short message service
STB—Set-top box
TV—Television

France, Spain, Luxembourg, Norway, and Finland, were involved over a period of two and a half years.

The aim of the WellCom project is to bridge TV screens, mobile phones, broadband access, multimedia content, and community-based applications. This environment enables ergonomic, dynamic, and community-based applications for end users, based on a flexible architecture that optimally exploits access and resources—the convergence of broadcast and telecom. **Figure 1** presents the WellCom environment.

The available technologies for interacting in the home environment with multimedia content are mainly interactive television (iTV) and enhanced television (eTV) [12, 13]. Interactive television is a function/service which allows viewers to interact with television content in order to alter their viewing experience (e.g., choose at which angle to watch a football match), to send a request to the broadcaster (e.g., for additional information), or to express a choice or an opinion (e.g., a vote or a bet). This "return path" or "interactive channel" can be built upon a telephone line (short message service [SMS]), asynchronous digital subscriber line (ADSL), wireless, or cable). Enhanced TV is often used to describe "two-screen" services, e.g., content available through a personal computer (PC) synchronized with a TV show.

However, these current technologies are very limited compared to the scope of WellCom; they do not provide the experience of community or offer standard application programming interfaces (APIs) for third party service providers or interoperable equipment. The WellCom project tries to fulfill these needs by delivering not only interactive services and applications, but also several possible business models that bring a real added value to the interactive TV experience.

Overview of the WellCom Framework

The WellCom end user environment uses proximity-to-TV screen detection to create ad-hoc communities of individuals to serve as the foundation for new interactive, contextual, and community experiences [16]. It defines applications that bring synergies between the TV screen and mobile terminals.

The WellCom framework provides a distributed end-to-end environment for services and applications (**Figure 2**) which consists of three elements:

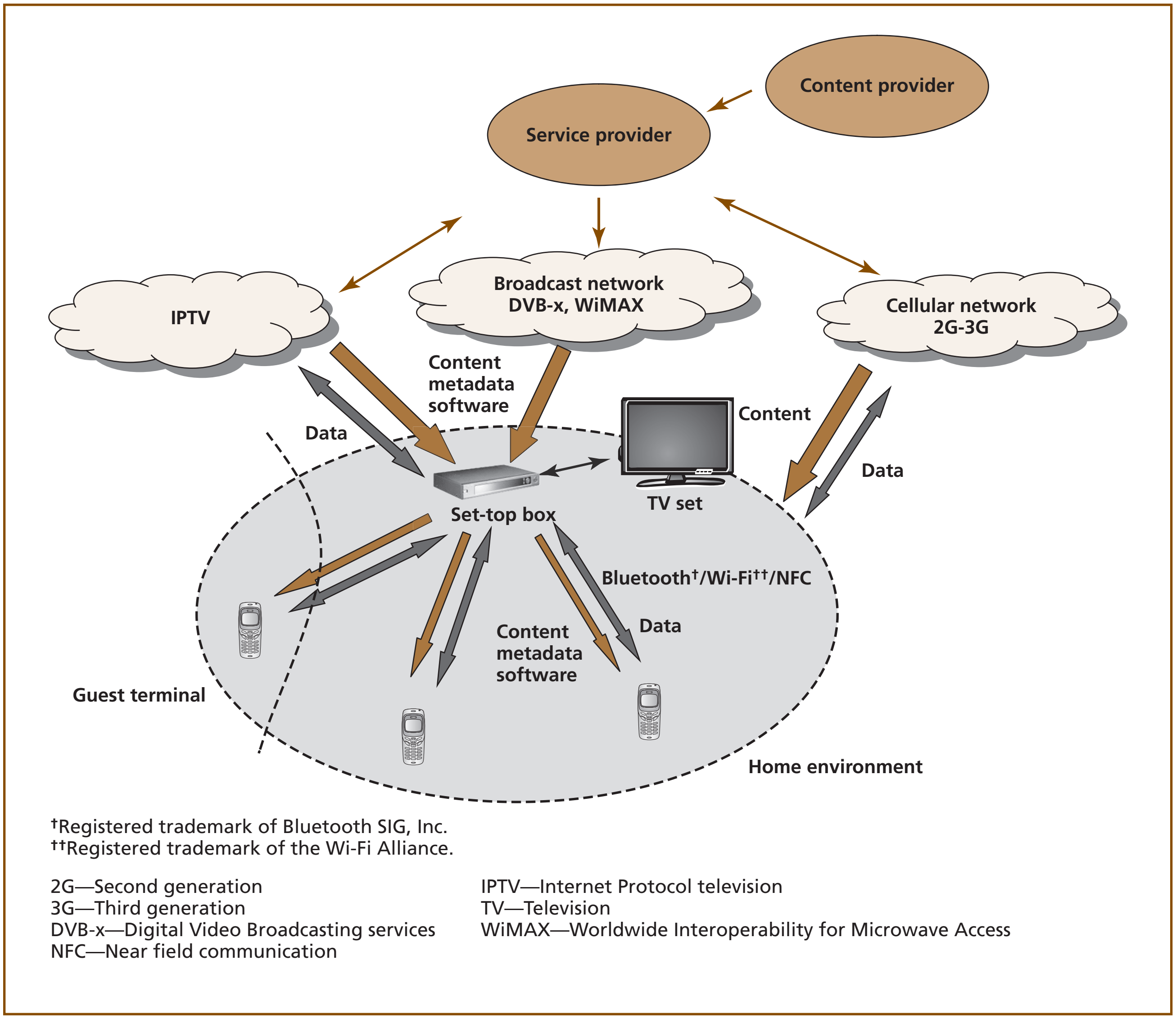

Figure 1.
WellCom environment.

- *Content and service delivery systems* that ensure end-to-end automated service provisioning and management mechanisms, and content distribution over heterogeneous network technologies and operating systems.
- *Media centers* (e.g., a home server or set-top box), where TV sets are used as community equipment for displaying or sharing the same content within a defined group of users.
- *Mobile terminals* that support interaction with TV content through the set-top box (STB), deliver personalized and interactive services directly to the user's terminal, and combine Wi-Fi*/Bluetooth* and near field communication (NFC) technologies for an "easy-pairing" mechanism that makes it easier for users to connect to interactive programs and social applications through their mobile phones. WellCom-enabled terminals also provide a clear identification of who is in front of the TV (essential for the community-based TV experience) and access to legacy networks such as Digital Video Broadcasting services (DVB-x), Internet Protocol television (IPTV), third generation (3G) mobile communications and other wireless

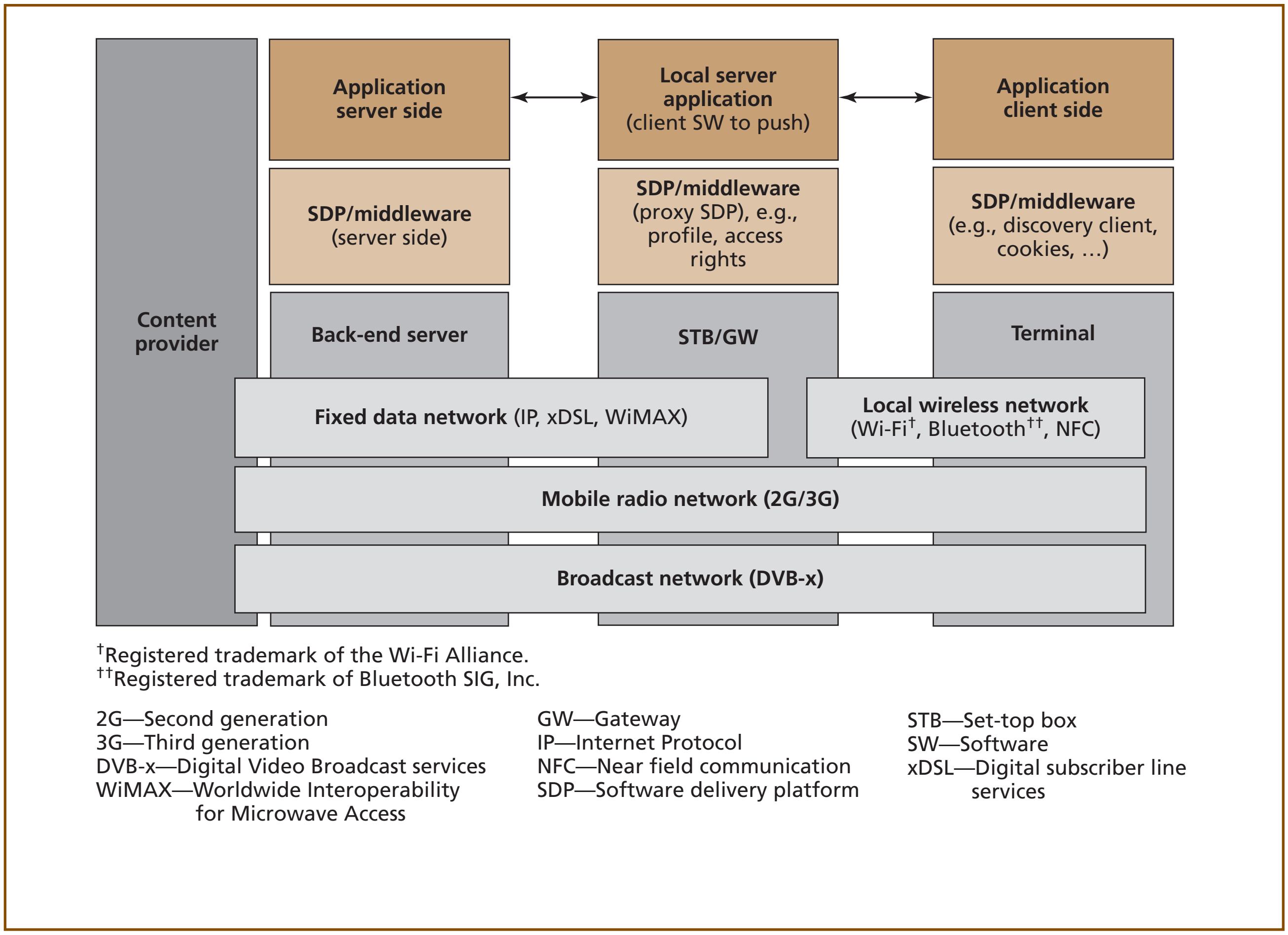

Figure 2.
WellCom global architecture.

media for delivery of enhanced content, services and applications.

In this context, the following challenges were addressed.

Cross-Media Applications

"Cross-media" refers to the management and use of applications, irrespective of location using heterogeneous communication networks such as fixed Internet Protocol (IP), DVB-x, and cellular telephony. Taking into account the WellCom architecture, services and applications are based on the interworking of heterogeneous communication technologies and customer premises equipment for the delivery and return channels.

Proximity and Ad-Hoc Communities

"Proximity" refers to the management of people in the same area. A group of people in close proximity (e.g., in a shop, a restaurant, or watching TV at home) usually shares a common interest or goal.

Supporting such an ad-hoc community requires managing the overall community profile as well as incoming, outgoing, active, and passive end users. The technical challenge for enabling an ad-hoc community lies in creating transparent mechanisms for subscription, security, transactions, user and community profiles, and management.

Contextual and Personalization Mechanisms

The WellCom project offers the possibility to go a step further in terms of personalization above and beyond mastering the knowledge of individual users. First and foremost, the WellCom service fosters a social activity where users view TV programs or services in small groups. To provide real added value in terms of service personalization for interactive TV,

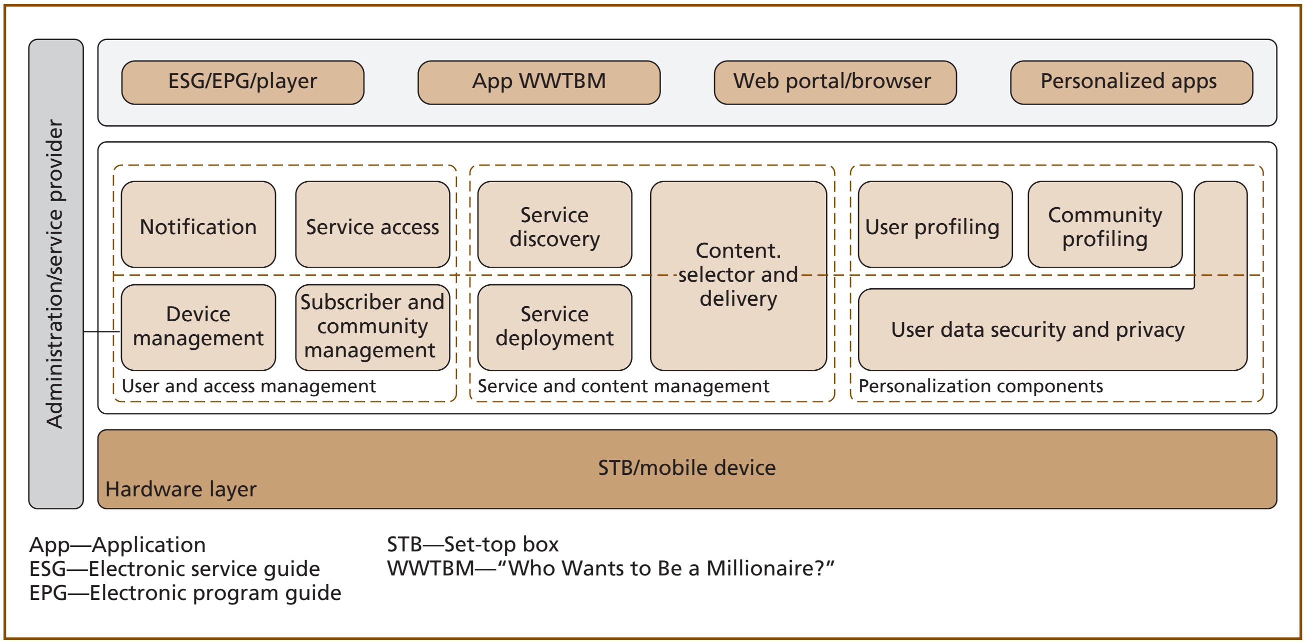

Figure 3.
Overview of the WellCom distributed service platform.

TV content needs to take into account the different tastes and preferences of all group viewers (household members **or** friends).

Detailed Description of the WellCom Framework

The WellCom project proposes a distributed service platform (see Figure 2) that enables allocation of resources in three separate venues, and services and applications based on a flexible infrastructure associating various modes of broadcasting and interactions. Based on the specification of these enablers, the WellCom framework is illustrated in **Figure 3**.

The enabler components correspond to the middle layer in Figure 3. In this layer, the enablers are gathered into three different groups according to their business logic:

- User and access management,
- Service and content management, and
- Personalization components.

Each group is divided in two sub-layers defined as follows:

- Components that are close to the hardware layer such as device management, subscriber and community management, and service deployment.
- Components that offer at least one external interface to the application layer such as notification, service access, service discovery, user profiling, and community profiling.

Note that two of these components are spread over the two sub-layers: the content selector and delivery mechanism is linked both to streaming servers and to the electronic program guide/electronic service guide (ESG/EPG), and the user data security and privacy module offers interfaces both to the profiling engines and to end users for setting their own privacy policies [6].

Detailed descriptions of the ad-hoc community mechanisms, synchronization mechanisms, and personalization mechanisms are proposed below. These descriptions are related to the "game show" scenario described in the section titled WellCom Demonstrators.

Ad-Hoc Community Mechanisms

The set-top-box is charged with creating and locally managing the community (e.g., establishing/determining community members, their status, and the overall community profile). When a user connects to the system, he is automatically added to the community. Near-field communication [2, 21] coupled with Bluetooth or Wi-Fi allows the dynamic detection of an end user's proximity and connects him to the system, thus creating an ad-hoc community of individuals sharing the same broadcast content.

Proximity access network connection. In the context of WellCom, when the mobile terminal receives an NFC notification, it reads the NFC data exchange format (NDEF) information element and sends an interruption to the "interruption handler" in the mobile terminal core operating system (OS). Examples of interruption handling mechanisms can be found in the Mobile Information Device Profile (MIDP) push registry [26] or Microsoft radio interface layer notifications [20].

The WellCom bootstrap application is charged with retrieving information on the local hotspot from the NDEF information elements and then establishing connectivity to the local hotspot.

Community initialization. **Figure 4** illustrates the deployment of the WellCom service in a home environment. The mobile terminal is connected to the local STB via a residential hotspot using Bluetooth or Wi-Fi. The STB recognizes mobile terminal proximity by using contactless technologies (NFC) to detect, authenticate, and set up user connections automatically.

WellCom users are identified by means of their mobile phones. Set-top boxes relay community-related messages to a set of servers charged with managing roaming logistics, the community, and the game sessions. Back-end servers are mapped to several set-top boxes and to users. Each back-end server can play several roles depending on requests from users and set-top boxes:

- *Controlling server.* Each STB is connected to a single controlling server tasked with easing WellCom deployment for system users. The mapping between set-top boxes and their controlling servers is static and provisioned within the system.
- *Serving server.* A WellCom user is managed by the controlling server at his STB. This back-end server

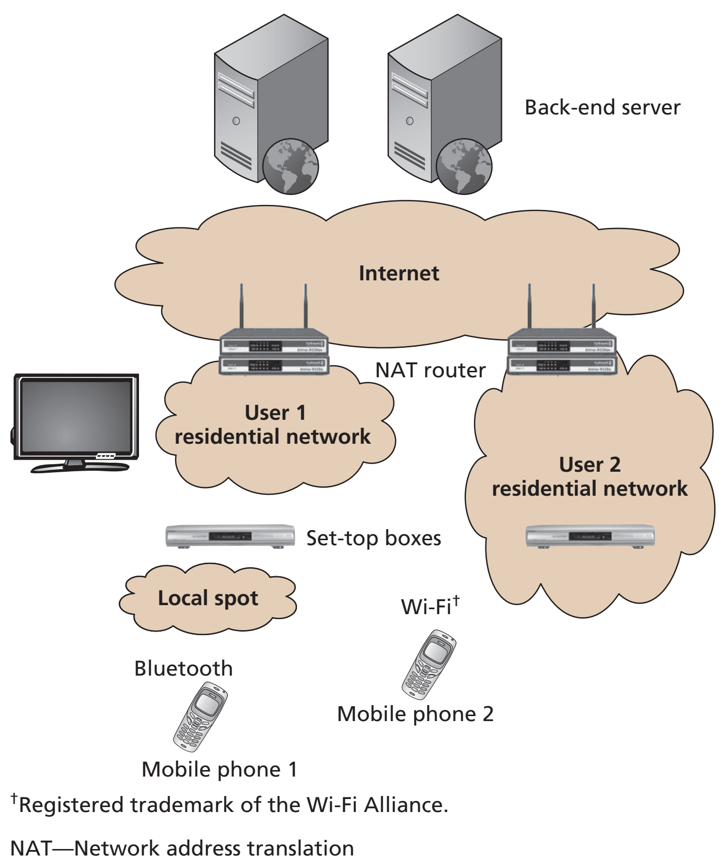

Figure 4.
Overall deployment of the WellCom framework.

is called the “serving back-end server” for that specific user. The serving back-end server handles the user’s WellCom context.

- *Game hosting server.* The WellCom framework manages user communities across the same game session independently of the location of each individual. The game-hosting server is charged with collecting all messages coming from the different players in the game session and managing them according to game rules that are specific to the TV show that the users are watching. This server is dedicated to the TV game scenarios.
- *Contact point server.* The contact point server enables content retrieval from the serving back-end server.

User registration and invitation. The WellCom framework has to be aware of the user’s location. The contact point server is used to track the location of the managed users and can provide this information to any other WellCom entity. SIP registration mechanisms are considered a good candidate for such an implementation, and WellCom has implemented a mechanism based on SIP registration to enable user location and community management.

In **Figure 5**, mobile phone 1 is automatically registered to its STB through contactless proximity detection. The STB relays that information to its controlling back-end server which then becomes the contact point server for that user.

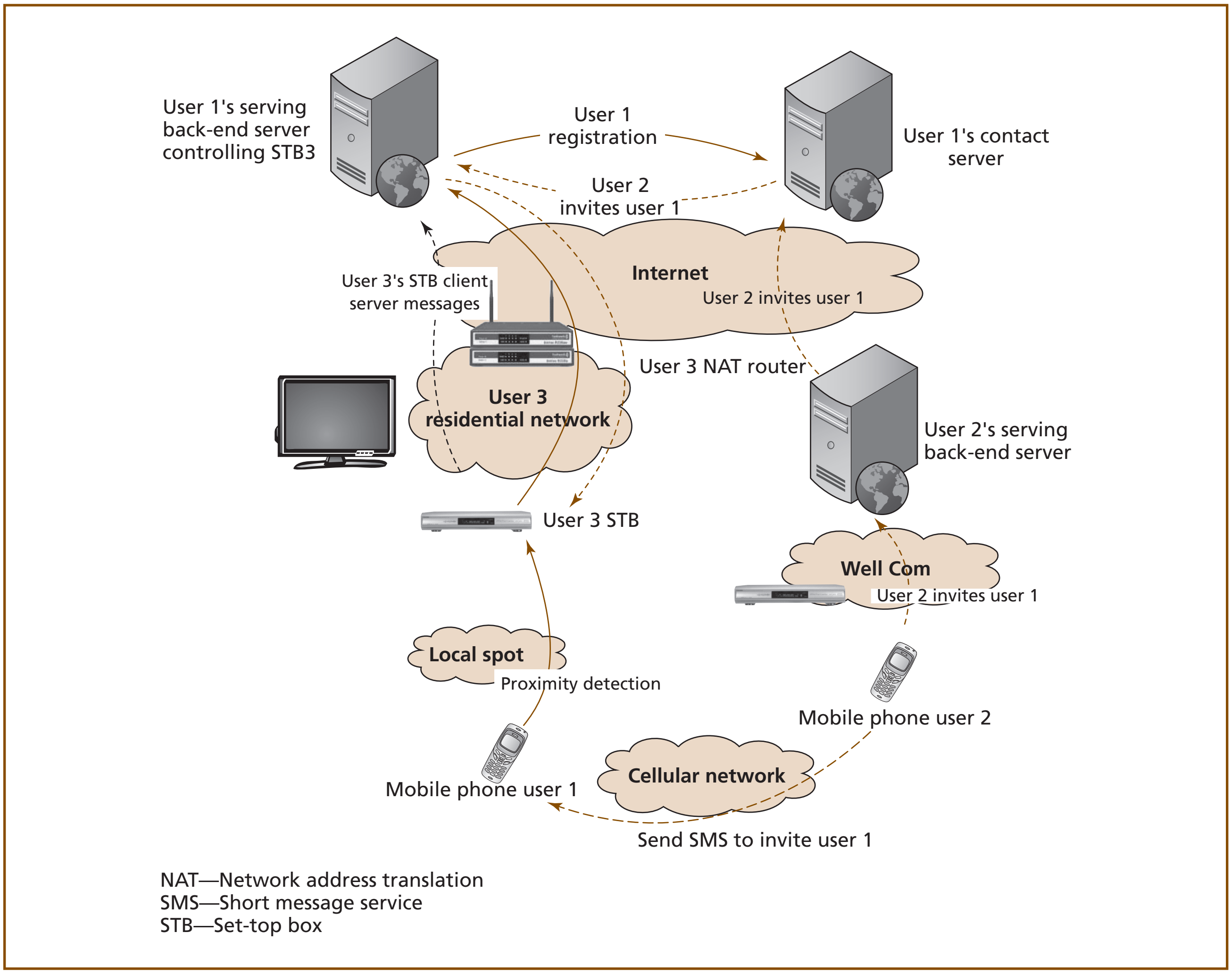

Figure 5.
User registration and invitation.

If user 1 is not connected to the WellCom framework but is invited by user 2 to join a game session, a specific request is sent by user 1's contact point server. This request indicates that invited user 1 is not connected to the WellCom system. User 2 can contact invited user 1 by sending an SMS over the cellular network to invite him to join the game session. This message is automatically sent by the WellCom mobile application when the user who sends an invitation receives a response from the contact servers of the invited users.

After receiving an invitation message, user 1 can connect and register his mobile phone with the WellCom system.

If user 1 is in a roaming situation and is not connected to his own STB, the contact point server for that user can be different than his serving server. In this situation, all invitation messages sent to user 1 are relayed via his contact point server. User 1's contact point server is aware of the user's location as a result of the registration message it received.

Synchronization Mechanisms

An important component of the WellCom architecture is the synchronization mechanism between content and applications, as well as between applications and users/communities [9]. The STB is used as an orchestrator for the synchronization mechanisms.

Interactivity features (voting, betting, advertisements, and other applications) imply that data has to be displayed to users according to a given timestamp. To enable this functionality, the system has to support a:

- Notification system, which indicates the metadata/data to be presented, and a
- Time synchronization system for sending events at the right time.

Several synchronization mechanisms have been established in the WellCom environment:

- *Time synchronization between the user terminal and the video*. Data sent to the user needs to be synchronized with the video context. Metadata content descriptors like those used in Moving Picture Experts Group 7 (MPEG7) [10] are used by the contextual synchronization mechanisms between content and application. Metadata is embedded within the content, and interpreted by the set-top box and the user terminal in order to keep the application state consistently updated.
- *Time synchronization between the TV display and the video*. The TV display needs to be synchronized with the context in order to retrieve data such as video duration or the time available to answer a question.
- *Time synchronization between the TV display and the user terminal*. The TV display and the user terminal must be time-synchronized to exchange information linked to the application.

Personalization

This section presents the main personalization scenarios that have been integrated within the WellCom environment as well as the basics of the user profiling approach. We also illustrate the group profiles and user group content-recommendation mechanism that constitutes the most innovative aspect of personalization in the scope of this project.

The context of the project allows us to introduce the following personalization use cases:

1. *TV program recommendation.* Via the EPG, users access services and content available on their TV. They can request recommendations for TV programs at any time.
2. *Targeted advertisement.* During commercial breaks, advertisements to be broadcast are selected based on all individual user profiles and additional criteria related to the current context (interrupted content or service, or current location) and the possible advertisements. In addition to the broadcast ads, additional advertising elements can be delivered directly to user mobile terminals.
3. *Community coupons.* After taking part in a given social TV program, service coupons can be sent to users based on their individual user profiles. A community coupon is an advertisement related to a special event where a group of people is involved, e.g., a concert, a sporting event, an exhibition, or a movie.

In order to implement these three use cases, the system should be able to address the two following questions:

- How to learn and update relevant individual user profiles.

- How to recommend appropriate content to a group of users.

User Profile and Preference Learning Algorithm

Several approaches for building and modeling user profiles have been widely discussed in the literature, e.g., [1, 15, 22]. In the scope of the WellCom project, a content-based approach has been applied which assumes that content characteristics and user preferences (inferred or declared explicitly) will form the basis of a decision as to which content is appropriate for which user. The user profile is basically represented by a set of <concept, value> pairs, in which each value is taken from the interval [0,1] and reflects the level of interest in a given semantic concept (item category). The concepts can be structured into a taxonomy that reflects hierarchical relations between them, see, e.g., [7]. More generally, the profiling engine manipulates three important types of information:

- *Quantity of affiliation (QoA)* characterizes the degree of affiliation of a content item to a given semantic concept. Each content item is characterized by a QoA set, e.g., the film "Shrek" is described by {Animation = 0.9, Comedy = 0.8}.
- *Quantity of consumption (QoC)* characterizes the degree of intensity of a consumption act with respect to a given semantic concept. For example, the longer the movie (e.g., "Shrek") is viewed by the user, the higher his interest in the semantic concepts of animation and comedy. Thus, each act of consumption can be characterized by a QoC set.
- *Quantity of interest (QoI)* characterizes the degree of user interest in a given semantic concept. The user profile is composed of a QoI set.

The QoAs can be retrieved from a back-end content manager or directly on the STB from the video stream where the EPG metadata are embedded (e.g., TV program genre). The profiling algorithm consists first in computing the QoCs for each user consumption or interaction trace, and then in iteratively updating the QoIs. An example of such an update function is the sigmoid-based approach as described in [1]. In addition, a decay function is applied at fixed periods of time in order to account for a non-consumption effect on the interest categories depending on the frequency or recentness of respective consumptions.

Group Profile and Recommendation

In order to provide relevant recommendations to a group of users, a group profile has been built so that it reflects the preferences and tastes of all group members.

The group profile can be built by using two different approaches:

1. *Building local profile*: by profiling the STB like a user in different contexts. Each context corresponds to a group of users connected to the STB. In this case, a given group profile can be seen as an STB profile in a given context.
2. *Aggregating individual user data*: by applying an appropriate aggregation strategy [18, 19] over the individual data (profiles or usage history) to directly obtain a group profile or a group recommendation list.

The first approach has two drawbacks. The first drawback is the generation of redundant information due to the fact that some applications such as targeted ads on a mobile device need to compute their own individual user profiles. The second drawback is the recurrent cold start problem: it can often happen that the number of consumption events in each particular group is too small to build a reliable group profile from group consumption alone. Due to this shortcoming, a second approach has been considered, which consists of merging of individual data for generating the group profile or recommendation list.

To recommend content items to groups, two families of algorithms relying on different aggregation strategies exist: 1) individual recommendation merging (IRM) and 2) group model based (GMB)-recommendation (which is explained in [3]). The IRM approach consists in merging individual recommendation lists obtained by classical methods [4, 23, 24], e.g., collaborative filtering based on a user's consumption/interaction history, or content-based recommendation exploiting content metadata and user interest categories. The GMB approach consists in aggregating individual profiles into a group profile and then applying a classical recommendation method to this group profile. Here, the content-based approaches are more suitable because of the difficulty in obtaining group consumption histories for ephemeral entities such as unstable ad hoc communities. The group profile (in terms of interest categories) can be computed by applying different aggregation strategies based on individual user profiles, as detailed in [5].

Even if the IRM approach promises a more flexible adaptation to group needs, the GMB approach could be preferred for its scalability with respect to the number of items. Computing individual recommendations may require significant processing capabilities.

Group Aggregation Strategies

Three main categories of group recommendation strategies can be defined based on the principles adopted for conciliation of individual preferences, regardless of the algorithmic family that applies each strategy. We use the term *user preference* to reflect both a preferred content item in the IRM and an interest category in the GMB approach.

- *Majority-based strategies* use the most popular/shared interest categories or preferred items between group members. These include plurality voting, Borda count, Copeland rule, or approval voting as outlined in [5]. For example, with the plurality voting strategy, at first each member (implicitly) votes for his most preferred item/interest category and those with the highest votes are selected. The method is then reiterated for the remaining preferences to obtain a ranked list.
- *Consensus-based strategies* consider the preferences of all group members and average all users' preferences for each item/concept (utilitarian strategy). Examples include average without misery, fairness, or satisfaction alternated [5].
- *Borderline strategies* consider only a subset of interest categories/items belonging to a member or members of a group or subgroup, based on the roles or other criteria identified within the group. These strategies include the least misery, most pleasure, strongly/weakly support, grumpiest, dictatorship or privileged sub-group strategies [5]. For example, the least misery strategy retains the minimum weight for each preference; thus, a single member can impose his choices on the group.
- *Hybrid strategies* aim to combine different principles described above. Namely, the advanced utilitarian could be combined with the no misery strategy to avoid recommending contents displeasing to at least one group member.

The WellCom Personalization Infrastructure

The personalization system implemented in WellCom relies on the following components, which are illustrated in **Figure 6**.

User traces acquisition through remote profiling proxies. A profiling proxy is installed on each user's set-top box which collects user traces logged by means of JavaScript* pages embedded within the set-top box browser. The traces reflect TV program consumption (program viewing along with duration) or interaction (zapping or specific service activity) either by individual user or by group. Users are identified via an identification client relying on an NFC proximity detection mechanism. The traces are then computed into *QoC* values reflecting the intensity degree of the consumption.

Individual profile update. Due to the lack of computing resources available on the STB, all profiling work is done through a centralized component in a back-end server called the profiling engine. Each user individual profile is periodically updated via the learning algorithm described above, according to the traces collected on the STB by the profiling proxy.

Group profile builder. The aggregation algorithm we used is the GMB which builds group profiles for a given group by aggregating the individual profiles of identified members composing the groups.

Due to the specificity of the WellCom project (interactive TV at home, i.e., people sitting in front of a TV set), WellCom group characteristics by default consist of small groups, usually between two and six, mainly composed of a family or friends with a strong degree of cohesiveness.

Existing user studies conducted by Masthoff [17] and on an offline evaluation over a real large-scale dataset of TV viewings [25] show that for groups of this type the best strategy to use is a consensus-based strategy, and a utilitarian one if possible. We have applied a utilitarian aggregation strategy for building the group profiles.

Back-end and local recommenders. The content recommender is designed to evaluate the semantic

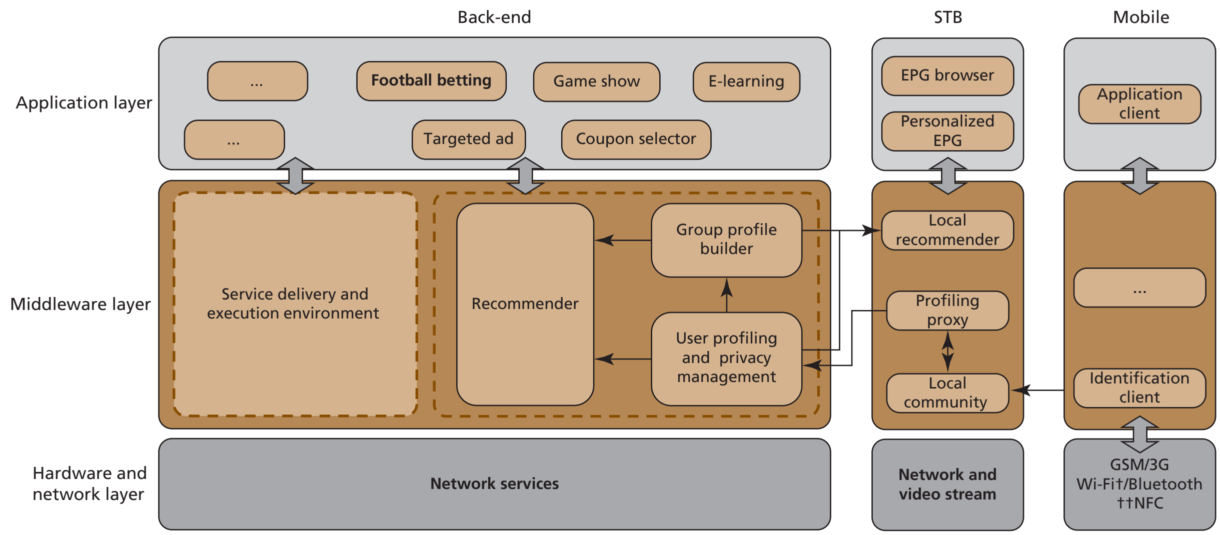

Figure 6.
Integration of the personalization component within the WellCom architecture.

proximity between a set of *QoI* that can represent either a user or a group profile and a set of *QoA* describing content. For computing the proximity value between those two entities, we use classical similarity measures such as the cosine similarity, thus, the higher the value, the closer the similarity. Additional constraints are obviously taken into account when computing the proximity value according to the business logic of the personalization feature. For instance, the following constraints are also considered by the system during the selection process for targeted advertising: 1) the history of previously selected ads, 2) the current TV program description, 3) demographic user data (e.g., age, gender, and other parameters), and 4) the price paid by the advertiser for displaying his ad. The final selection of the best ad among all those available is made by a multi-criteria decision mechanism relying on a Pareto ordering.

Content recommendations are made locally on the STB, and content descriptions are extracted from the EPG stream and converted into QoA format. Before each recommendation, a profile is retrieved from the back-end components. This may be an individual profile or a group profile, depending on the number of people connected. To conserve network resources, the first step in the recommendation process is the filtering of content items based on static profile data (language, age, and other criteria). Then, the semantic proximity between the resulting subset and the profile is computed.

In addition to the three use cases, privacy and explicit (declarative) user preference collection mechanisms have also been developed but are not detailed in this paper. The privacy mechanism will provide the end user with a web-based portal to identify authorized applications (e.g., TV recommendation, targeted ads, coupons) or forbidden profiling actions (e.g., which categories of interests can be learned by the systems, for use in which applications) at different levels of granularity.

WellCom Services and Business Opportunities

This section aims at shedding light on possible business models for WellCom services. Such technology may be brought to customers in multiple ways and forms.

WellCom Demonstrators

Several ambitious TV programs mixing interactivity and personalization were developed within the project to demonstrate the feasibility and the value of the WellCom approach. The demonstrations, shown in **Figure 7**, included:

- *Game show* based on the well-known "Who Wants to Be a Millionaire?" TV quiz show, which allows users to play interactively along while receiving personalized information and advertisements.
- *Dynamic music channel,* which proposes a shared community experience either at home or in public places, where people rate, vote, suggest music videos and share their tastes with others.
- *Betting* on football matches, where users can play along with a live TV sports program and bet on future events (e.g., goals) using their mobile phones.
- *E-learning application,* a personalized quiz game based on user and community preferences.
- *Home shopping scenario,* where during a program's commercial breaks, personal commercial offers are uploaded to each user's mobile device based on his/her preferences. When he/she is on the move, offers for local shops can be activated via a geolocation utility.

WellCom generates a high social impact as it transforms traditional "passive" TV consumption into an interactive experience. The personalized interactivity provided through the distributed infrastructure opens up the possibility of a new social TV experience. For example, users can take part in a broadcast

†Registered trademark of the Wi-Fi Alliance.
††Registered trademark of Bluetooth SIG, Inc.

3G—Third generation
BT—Bluetooth††
NFC—Near field communication

Figure 7.
WellCom demonstrators: betting, game show, dynamic music channel.

TV quiz and compete with friends—or a user can invite a friend to take part in a personalized quiz. The distributed infrastructure is a key point for system scalability in real world deployments.

Value Chain and Business Models

Based on the WellCom technology, scenarios, and demonstrators, business plans and studies have been conducted by the WellCom consortium to leverage/monetize the added value of such a service. The objective of these studies was to identify new business opportunities along the value chain. The WellCom value chain integrates TV's traditional value chain with that of mobile services, as shown in **Figure 8**.

The main business roles of the value chain actors include the:

- *Editor,* the entity that provides content to the community terminals. Editors can include the content broadcaster, content aggregator, end user service provider, or an advertiser. In terms of monetization, the editor handles billing and sells sponsorships or ads.
- *WellCom service provider*, which creates and delivers interactive community applications to end users. The service provider either serves directly as the content producer, or it obtains multimedia content from another actor, such as the content provider.
- *Network operator*, which provides specific services such as user profiles, billing, or specific localization services. Common services like network connections or SMS have to be transparent within the WellCom offering.
- *TV/STB/mobile phone provider*, which distributes devices allowing access to WellCom services.
- *End user,* an entity that uses the WellCom application. The end user may be a private individual who uses different kinds of personal mobile terminals, or a shop or restaurant owner who uses different kinds of community terminals such as a TV monitor or a public display.

In a case where the WellCom platform is managed by a mobile network operator/Internet service provider (MNO/ISP), the operator assumes three roles within the value chain described above: WellCom operator, TV/STB/mobile provider, and mobile phone and home equipment provider.

Finally, the WellCom project also studied opportunities for monetization of the service. Three opportunities for monetization can be put forward:

- *Direct billing to end user*. End users pay directly to access the service. For instance, they pay each time they use the service or pay a flat fee for unlimited use during a given period. The payment system can be handled directly by the WellCom operator or use a system implemented by TV or mobile operator.
- *Sponsoring/advertising*. End users access the service for free. The service is supported by sponsorship or advertising, e.g., commercial breaks in full screen video, or targeted advertisements.

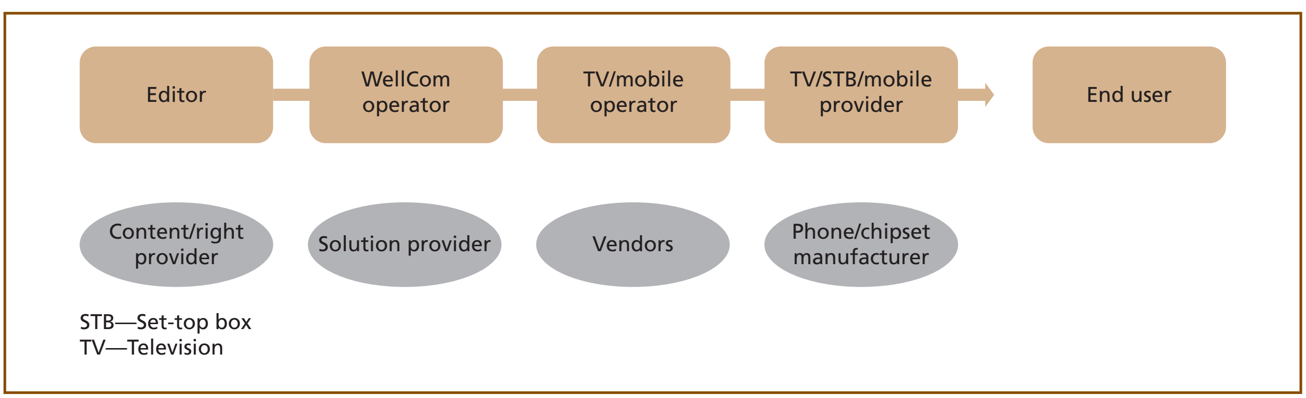

Figure 8.
WellCom value chain.

- *Support from operators and STB providers*. The service is supported by a TV or mobile operator for the purpose of distribution. The service is sold as a pay option added to the monthly subscription already paid by the end user.

Obviously these options are not mutually exclusive. They can—and are likely to—coexist.

Conclusions

By providing a new dimension of interactivity within a personalized content and service environment, project results show that Wellcom can both enhance the TV experience for the user and open up innovative revenue models for operators and service and content providers. This work and results were possible thanks to the open innovation process and the collaboration between different companies sharing their skills and competencies.

Six demonstrators were developed to showcase different aspects of the WellCom theme, with a strong focus on interactive access to media and leveraging the user's mobile phone and/or the home STB for user identification or personalization, and use of a common underlying architecture, which takes advantage of an intelligent distribution of the components. Several innovative functions were also developed within WellCom: Bluetooth pairing via NFC on the mobile phone, geolocalization coupled to personal preferences and interests, content recommendations to groups, use of the home STB as a gateway to WellCom services, and combining different broadcast means such as DVB-handheld (DVB-H) and Open Mobile Alliance Mobile Broadcast Services Enabler Suite (OMA-BCAST). Further research is still required in the following domains: precise and consistent synchronization of additional content with broadcast transmissions, small device (mobile/remote control) user interfaces, and secure integration with existing solutions, to enable support for confidentiality, intrusion prevention, and digital rights management (DRM).

A user study of one WellCom application concept (the dynamic music channel) was carried out with a group of users with the help of a Human Factors lab. The main result of this study was that the service is easy to understand and to use. Only the registration phase posed any usability problems. Ninety percent of users had difficulties in waving their NFC mobile phone close to an STB-mounted NFC reader due to its non-intuitive gesture. The problem was solved by replacing the NFC technology with 3G femto technology that provides a more transparent mechanism for registration and presence.

The WellCom concept for a "dynamic music channel" has been adapted to the 3G femto context to highlight the Alcatel-Lucent 9365 Base Station Router Femto capabilities to offer personalized interactive service on a TV screen through mobile phones. A part of the personalization technology used in WellCom was integrated within a personalized content and advertising demonstration led by the Alcatel-Lucent Solutions and Marketing Group. For the purpose of the demonstration, the personalization components were integrated with various Alcatel-Lucent products such as Multimedia Content Management (MCM), Geopepper, IMM (Interactive Media Manager), and MiTV (mobile TV), and presented at key telecom conferences including the Mobile World Congress (MWC) and Cellular Telecommunications and Internet Association (CTIA).

Future directions emerging for the WellCom project are numerous, and depending on the actors involved, the following subjects are undergoing exploration:

- TV distribution platform upgrade with interactive content, personalized content, and targeted advertising,
- Open platforms to service editors,
- Convergence of IP services with broadcast TV,
- Application toolboxes to enrich proposed services, and
- Multi-device services and STB/mobile-client solutions.

Acknowledgements

This work was carried out within the framework of the Eureka-ITEA 2 WellCom project. It is supported in part by the French Ministry of Industry. The work benefits from the valuable exchanges between all the members of the WellCom consortium, which includes Activa Multimedia, Alcatel-Lucent, Expway, FTA-Inverto Digital Labs, Inverto - Deciphering Broadcast

Technology, Centre de Recherche Public Henri Tudor, InOut TV, NXP Semiconductors, Pace, Prewise, SES Astra, Telefonica I+D, Telenor, TF1, UNIK, and the University of Evry.

***Trademarks**

Bluetooth is a registered trademark of Bluetooth SIG, Inc.
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(Manuscript approved August 2010)

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