Using IP Datacast Technology to Make TV Mobile

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Abstract: - : In this paper we explore the technology and business system which enables the mobile TV reality. This technology, a combination of digital broadcast and Internet protocol, is called IP Datacast over DVB-H, or simply IP Datacast. We shall show that, in addition to bringing a new form of multimedia enjoyment to the consumers, the proposed IP Datacast end-to-end solution also opens up new market opportunities for the telecommunications, broadcasting and media industries.

Key-Words: - Mobile TV, IP, Digital Broadcast, IP Datacast, DVB-H

1 Introduction

The face of mobile entertainment is rapidly changing with the advent of live digital TV (DTV) services for cellular phones. Thanks to advances in technology [1-21], consumers will have the opportunity to watch live television shows, get traffic reports or watch sporting events — all on the go. The real break-through has come from LIVE broadcast TV. Users will enjoy the same entertainment experience from the living room TV set, but delivered anywhere in real-time on the mobile phone.

Digital broadcast technology, such as the DVB-T standard (Digital Video Broadcasting – Terrestrial), moved TV broadcast into the digital age. Taking the concept one step further, the emerging DVB-H standard (Digital Video Broadcast – Handheld) is adding support to small handheld terminals like mobile phones for mobile broadcast reception [22]. DVB-H is an open standard specified by the DVB Organization and was created specifically for broadcasting TV content to handheld devices (Fig.1). The term handheld terminal includes multimedia mobile phones with colour displays as well as personal digital assistants (PDAs) and pocket PC types of equipment.

DVB-H overcomes two key limitations of the DVB-T standard when used for handheld devices — it lowers battery power consumption and improves robustness in the very difficult reception environments of indoor and outdoor portable use in devices with built-in antennas. DVB-H can be used alongside mobile telephone technology and thus benefit from access to a mobile telecom network as well as a broadcast network.

System	DVB-H
Region/Country deployment	Europe/US
Codec Video/Audio	H.264 MPEG-2 (BC)
Frequency/Channel Max bps	8 MHz 31 Mbps
Modulation	COFDM
Optimized Power Reduction for Handset	Time Slicing

Fig.1. DVB-H handset standard

When combined with IP, DVB-H can be used to distribute any kind of digital content including television broadcast, music, web pages and games. This combination of IP and DVB-H, or IP Datacast, broadens the types of content that can be broadcast and enables mobile reception of that content.

The development of digital content, the ability to broadcast and bill for that content and the growth of the number of mobile users — brings forward a natural evolution that converges the already familiar TV and mobile worlds and brings new, compelling services to the consumer. This paper addresses IP Datacasting over DVB-H, the key technology enabling this digital convergence, and its first application, Mobile TV.

2 IP Datacast over DVB-H Features

The mobile environment demands a different system respect to the DVB-T in order to support handheld receivers as these devices do not have an external antenna, large screens or continuous power supply. DVB-H uses an Orthogonal Frequency Division Multiplexing (OFDM) air interface technology, and includes a technique for power reduction in the tuner [23]. OFDM is a very good choice for a mobile TV air interface. It offers good spectral efficiency, immunity to multi-path, good mobile performance, and it works well in single-frequency networks such as those planned for mobile TV.

Savings in the power consumption of the receiver are achieved by the 'time-slicing' technology supported by DVB-H. In order to enable a longer battery lifetime for a mobile device, DVB-H receives the content in high speed bursts, which are buffered and played back over a longer period of time. Video and audio data (1-2 Mbits), generally representing between 1-5 seconds of the content arrives in the single burst. When the receiver is not receiving the wanted burst of data, the tuner contained in the handheld device is "inactive" and therefore using less power. While the receiver is "inactive" for periods of time, the broadcasting transmitter remains active at all times, sending a series of time-slice bursts for each service in sequence. In addition, time-sliced and non time-sliced services can be placed in the same multiplex. The user, however, does not notice the period of receiver activity or inactivity since the data bursts are stored in the receiver memory and played out continuously. Time-slicing could allow for up to a 95% reduction in power consumption compared to conventional and continuously operating DVB-T tuners. Of course, power is consumed continually by other parts of the receiver notably the video and audio decoders and the display.

DVB-H also provides improved error resilience compared to DVB-T using MPE-FEC (Multi-Protocol Encapsulation/Forward Error Correction). Because handheld devices have small antennas that require reception from many different locations, they necessitate a robust transmission system with solid error protection [24]. To better match the handheld environment, DVB-H offers improved transmission robustness through the use of an additional level of forward error correction (FEC) at the Multi Protocol Encapsulation (MPE) layer. The use of MPE-FEC is optional.

In IP Datacast over DVB-H, the DVB-H radio transmission technology is combined with Internet Protocol (IP). This combination makes it possible to broadcast any kind of digital content as IP packets, which is the same format used to transfer digital content on the Internet. IP Datacast offers the advantage that all existing IP-based digital content like video and audio streams, file delivery, web pages or game software, can be easily distributed over mobile broadcast [25].

The common IP layer means that applications, content formats, and middleware technologies developed within mainstream IT can be applied in IP Datacast terminals as well. From a product and service development point of view, this means that the use of Internet Protocol allows DVB-H to rely upon standard components and protocols for content manipulation, storage and transmission. As a result, the consumer can experience the best possible combination of broadcast and multimedia content with their mobile handset.

Another technical advantage is that IP Datacast can easily adapt to the smaller screen sizes of handheld terminals. Only 128 to 384 kbs per 'channel', per TV program, is required to deliver a high quality video experience on the smaller screen. This increases broadcasting efficiency and makes it possible to send 50 to 80 TV programs over one network. A conventional digital TV broadcast which is configured for a large screen and utilizes a wide bit stream of 3 to 5 Mbits/s delivers 3 to 5 programs over a similar network.

An integral part of the mobile IPDC (IP Datacast) concept is the availability of an interactive return channel. The broadcast content is delivered via the

broadcast channel, but the possible interactivity, such as content purchasing, voting or viewing additional on-line information, takes place via an interactive channel over the cellular network. The broadcast and cellular networks complement each other and can be used to create a wide range of new content and services for consumers — starting with Mobile TV [26].

IP Datacast builds on the concept that mobile TV-like content delivery is subscription-based and the service is protected with careful encryption. IP Datacast over DVB-H system specification defines an end-to-end solution that addresses the broadcast channel and its functions (IP encapsulation, Electronic Service Guide, service and content protection and QoS) as well as an interactivity channel (purchases, payment). As shown in Fig.2, there are several delivery methods. IP Formatted TV content can come directly from satellite to DTV towers (IPDC/DVB-H) and consumers would then receive the broadcasting content on their mobile phone terrestrially from the tower over regional specific DTV frequencies. Another option for a broadcast system is to use the terrestrial Internet infrastructure for scheduled delivery One-to-many. Complementarily, the 2G/3G cellular system can be used for On demand One-to-One streams.

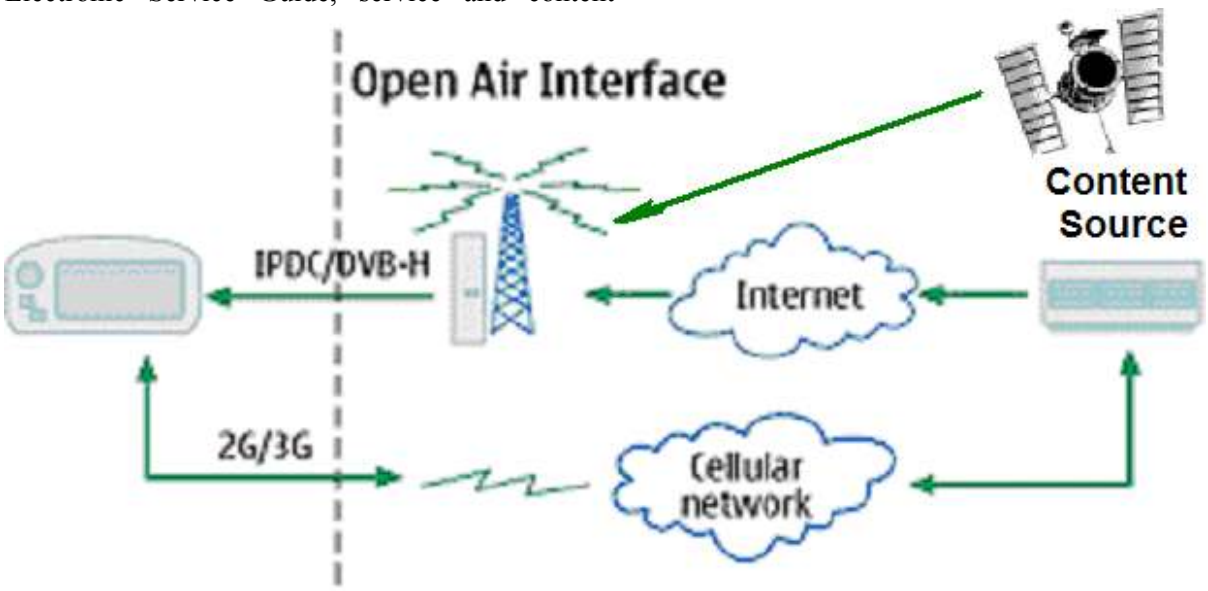

Fig.2. Options for Delivery

There are also other options for taped sitcom or show delivery where a provider can download the content ahead of time using satellite, Internet or other transmission means.

Regardless of delivery method, live broadcast TV will happen in real-time with only very slight delay — similar to how satellite feeds are received on a TV set today. Cellular operators will be able to bundle services to offer packages for various user interests, be it sports, entertainment and more.

3 Objective

Using IP Datacast technology to bring TV to mobile devices should provide extensive indoor coverage with a service level comparable to that of the modern cellular networks. In order to reach this level, a new network must be built, as the existing broadcast TV networks are not designed to provide indoor coverage to handheld devices. This new network would be financed with consumer subscriptions to the services. The suggested level of subscription fees could compare with the average amount spent on afternoon newspapers or between 10 and 20 € per month for unlimited access to TV-like services on the mobile phone.

The consumer experience must be similar to having digital cable or satellite quality programming on a mobile phone using a DTV broadcasting standard over a separate air interface. Users will be able to watch a variety of live television programs, traffic reports, movie clips, music videos, listen to digital music or view a variety of entertainment and content options. Mobile DTV solution must offer high quality live broadcast TV (20-30 frames per second) paired with full audio for a mobile viewing experience. In addition, other services will be available such as a menu/guide system and pay per view channels to enhance the viewing experience.

4 Requirements

The commercial requirements of designed IP Datacast system were determined, as follows:

- IP Datacast solution should offer broadcast services for portable and mobile usage, including audio and video streaming with acceptable quality. The data-rates feasible in practice have to be sufficient for this purpose. For the DVB-H system, a useful data-rate of up to 10 Mbit/s per channel is envisaged. Transmission channels will mostly be allocated in the regular UHF broadcasting band. VHF Band III may be used alternatively. Non-broadcast frequencies should be useable also.
- The typical user environment of a DVB-H handheld terminal is very much comparable to the mobile radio environment. Therefore, the IP Datacast system needs to provide the potential for similar geographic coverage.
- Mobility is an additional requirement, meaning that access to services shall be possible not only at almost all indoor and outdoor locations but also while moving in a vehicle at high speed. Also, the handover between adjacent DVB-H radio cells should happen imperceptibly when moving over larger distances.

5 IP Datacast End-to-End Solution

The solution (Fig.3) is comprised of three major integrated elements :

- The IP Encapsulators provide video/audio encapsulation and formatting for the mobile device, followed by stream multicasting to applicable transmitter sites. These are the gateways that enable broadcast delivery of IP content, e.g. Mobile TV.
- The Service System features service protection (end-to-end control of content encryption, generation of decryption keys and delivery of keys to consumers in billing-integrated manner) and generates the Electronic Service Guide (a broadcast of the service metadata alongside the content) which contains information on the available services and at what time they are offered.
- The E-Commerce System, which allows the user to buy rights to viewing protected content and produces charging data of the purchase transactions for billing purposes.

It has been envisaged that content aggregators purchase content from content providers and then they sell content through various channels, based on the distribution rights. Eventually, the content is delivered to consumers based on their subscriptions. For content aggregators, IP Datacast is a new media distribution channel that reaches mobile users while on the move.

The operator of the IP Datacast network owns and operates the digital broadcast infrastructure such as, transmitters, mast sites and the necessary connections to the site. That operator may also be the frequency license holder. Consequently, it sells broadcast capacity and coverage to those companies operating IP Datacast services. The IP Datacast system is cost efficient as several IP Datacast service operators can buy capacity from the same broadcast network operator.

The provision of e-commerce services has been deployed by operating an electronic shop that the mobile user can access and from which he can buy subscriptions for mobile TV content. The subscriptions may be for a longer period of time, e.g. one month, or of a pay-per-view nature. Consumer purchases are recorded in a customer database and fed into a billing system for collecting the content-related revenues. The provider of e-commerce services reimburses content aggregators their share of the revenue and provides data on content usage.

From a business perspective, proposed digital broadcasting system is attractive because it makes use of high bandwidth channels with high transmission speeds. This means that high quality and a wide selection of content such as TV services can be made available to consumers using mobile phones. Once some of this content is broadcast, there is no limit to how many people can receive the content within the coverage area. This makes broadcasting solution a very cost effective means to deliver media content to large audiences, when compared to the use of point-to-point connections and networks.

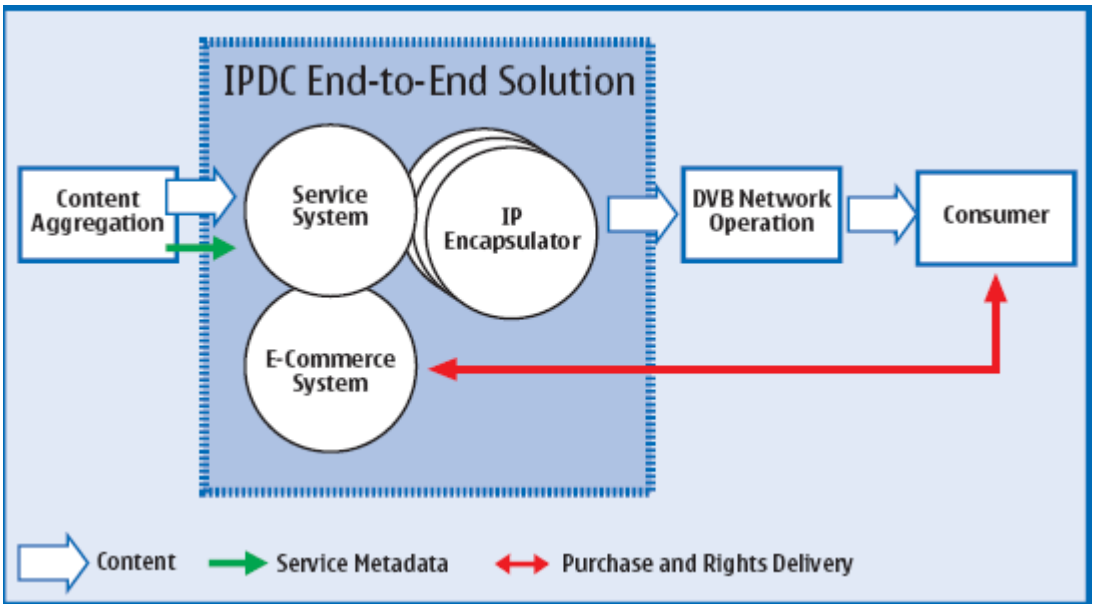

Fig.3. IP Datacast solution for the mobile environment

The end-to-end solution lowers the barrier for implementing IP Datacast services for all parties within the business system. For content aggregators it enables the use of the existing media production platforms. Network operators can leverage existing infrastructure to a maximum extent and consumers will find it easy to start experiencing compelling Mobile TV services.

6 Conclusion

The combination of IP and DVB-H, or IP Datacast, broadens the types of content that can be broadcast and enables mobile reception of that content. When combined with IP, DVB-H can be used to distribute any kind of digital content including television broadcast, music, web pages and games.

The proposed end-to-end solution with TV-like capabilities enabled by IP Datacast technology has brought a new, appealing feature to manufacturers' product lines while providing a new source of revenue. Consumers are sure to welcome the integration of the new features, thereby eliminating the need to carry numerous single-function devices. With reasonable cost, consumers now have a selection of TV-like services and other multimedia content brought directly into their mobile handsets.

Considering the popularity of TV, it is reasonable to assume that the benefits of mobile broadcast multimedia will be compelling. If approached in the right way, the combined effect of bringing mobility, extended capability and new forms of interactivity to the broadcast medium can be significant.

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