Satellite based Mobile TV Services and overview of Digital Video Broadcasting Satellite Services to Handled (DVB-SH) Standard

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ABSTRACT

In this paper, we will discuss the DVB-SH standard and address the need for mobile TV reception via satellite. The advantage of a satellite based mobile TV service compared to terrestrial based mobile TV service is emphasized in this paper. The technical challenges of a satellite based mobile television reception technology are addressed. The salient features of the DVB-SH standard have been discussed and the features, which make the standard appropriate for mobile satellite networks, have been explained. Mobile Satellite Network requirements and how well DVB-SH handles those issues have been discussed. The paper also discusses the ongoing work in DVB-SH standard along with the inferences achieved from these experiments.

General Terms

Standards, Mobile TV, Satellite, Survey, Interleaver, Diversity

Keywords

DVB-SH, DVB-H, DMB-T, ISDB-T, S-DMB, CMMB, MPE, MPE-FEC, Turbo Codes

1. INTRODUCTION

The mobile communication taken has taken a revolution in the last decade and a large number of mobile communication devices are in use in all parts of the world. This not only includes the classical mobile phones and the Personal Digital Assistants (PDA) but also smart phones, which are exceedingly being used for the convenience of services customers achieve through their use. With the rising expectation of communication, anywhere and everywhere the mobile devices are becoming multi functional having built-in cameras, radio receivers, navigation hardware and various wireless communications systems. Television being the primary source of entertainment is certainly in the priority list of preferred services to be available on mobile devices of customers. These demands have huge financial implications and the competition in the mobile TV industry is going to be fierce. It was foreseen that Mobile TV could reach a market of up to € 20 billion by 2011, reaching some 500 million customers worldwide [22].

The technology for providing TV services on mobile devices is quite challenging and has been a major exciting research area in the mobile communication technology [25]. With the rising demand of communication everywhere and a drive to bridge the digital divide, Mobile TV services are also planned to be provided via satellite. In this paper, an attempt has been made to provide an overview of the satellite based mobile TV reception technology in general with all the existing international standards in this field. In Table1, the different technology in Mobile TV reception used in various countries from 2007 has been shown along with number of mobile TV receivers used in these countries. From this statistical data, it is quite evident that there is a growing demand in the Mobile TV technology [22].

Table 1 Mobile TV Usage Statistics

Country	Launched	MobileTV handsets end of 2007	MobileTV handsets end of 2009	Technology
Brazil	2008	0	150,000	ISDB-T
China	2008	0	5,000,000	CMMB
Germany	2008	0	50,000	DVB-T
Italy	2006	7,00,000	1,000,000	DVB-H
Japan	2006	25,000,000	60,000,000	ISDB-T
Netherlands	2008	0	180,000	DVB-H
Russia	2006	10,000	30,000	DVB-H
South Korea	2005	1,500,000	2,000,000	S-DMB
South Korea	2006	13,000,000	17,500,000	T-DMB
USA	2007	50.000	400,000	MediaFLo
Others		50,000	275,000	Various
		40,310,000	86,585,000	

1.1 Advantages of Satellite based Service

The use of satellites for the distribution of multimedia contents to mobile devices has certain advantages. The primary factor is the ability to cover a huge geographical area using a single geostationary satellite than could be possible using thousands of cellular towers if existing terrestrial cellular infrastructure is proposed to be used to provide the service. Secondly using a satellite-based service makes initial deployment of services targeting a large population easier. This leads to lesser network infrastructure development cost compared to purely terrestrial based infrastructure planning to provide the same coverage. Moreover, satellite based services has the advantage of providing services in places where establishing a terrestrial infrastructure is either not feasible or not economically viable. This includes services in ships and highly remote places with very sparse population.

1.2 History of Mobile TV Standards

Mobile TV systems using the UMTS 3G [12], [18], [19] systems were targeted but it was felt that with the increase in mobile television users there will be a shortage in the resources needed to cater telephony applications. Initially in many cases the terrestrial DVB-T [14], [17] standard was used because of the ability to receive broadcast services using portable terminals inside cars and high-speed trains. However it was felt that some new features were required considering the power saving and robust transmission for cellular environment. The DVB-T [17] standard later formed the basis for the DVB-H standard, which was a transition from the traditional broadcast system to cellular based transmission of television content. DVB-H the ETSI standard (EN 203 204) formulated in 2004 is based on the distribution of multimedia services using IP Encapsulation specifications of DVB [7] in the VHF band. The standard adds two new features in the link layer with the physical layer based on DVB-T [17].

A new technique called time slicing is implemented where receiver gets bursts of data periodically and power offs in between in order to achieve efficient power consumption at the battery-powered receivers. Challenges due to mobility of the user are overcome by the introduction of an additional forward error correction at the link layer.

DVB-IPDC [7], [8] was mainly intended to improve the IP data-cast standard as DVB-H was based on IP based data transfer. These specifications for IP Datacast are essential to the convergence of broadcast networks and cellular networks.

The DVB-T2 [17] standard is an evolution of the DVB-T and uses the concepts of DVB-S2 [15] to provide 30% enhancement on bandwidth utilization over DVB-T [17] with support of high-speed signal reception. Its main goal is to enable Multi Channel HDTV services [13].

The Mobile TV services can be broadly divided into two categories. The Terrestrial Broadcast Standards below 1 GHz are as follows:

(i) T-DMB
(ii) ISDB-T
(iii) DVB-H
(iv) Media FLO
(v) ATSC M/H

The Terrestrial and Satellite Broadcast Hybrid Solution are:

(i) S-DMB
(ii) CMMB
(iii) DVB-SH

In the following sections a brief description of the entire satellite-based hybrid techniques available in this field are provided.

1.2.1 S-DMB

Mobile entertainment services are increasingly being provided using 3G networks to users mainly in South Korea, Japan and parts of Europe using T-DMB standard. The satellite version of T-DMB is the S-DMB [11], which allows the distribution of Multimedia Broadcast Multicast Service via satellite to users [23], [24]. Initially S-DMB was used in South Korea for providing satellite based digital radio services and later is used for video services. The S-DMB service uses a hybrid approach using GEO satellite for proving the national coverage and Intermediate Module Repeaters (IMR) used in 3G base stations to cope with the heavy shadowing in urban areas. It provides services in the VHF and L bands.

1.2.2 CMMB

China Mobile Multimedia Broadcast [11] an evolution of STiMi standard is a hybrid satellite/terrestrial broadcast system for audio/video and data services to handheld terminals [11]. Using the 2635 – 2660 MHz band the satellite and terrestrial network combines to create a Single Frequency Network (SFN). This is highly suitable for a country like China having a vast geographical span. CMMB [11] uses two channels for up linking, the Broadcast Uplink Channel and Distributing Uplink channel. The signals from the ground up linking stations are transmitted to the satellite using both these channels. The satellite broadcasts the received signal using the Broadcasting Downlink Channel and Distributing Downlink channel. The Distribution Downlink Channel signal received by the Complementary Ground Component and re-broadcast using the Broadcasting Retransmit Channel. The signals coming directly from the satellite using the Broadcasting Downlink Channel and signal from the complementary ground component in the Broadcast Retransmit Channel are synchronized in time and frequency. This ensures successful reception in the Single Frequency Network (SFN), which will be explained later in the paper. The system was envisaged to provide 25 video and 30 radio channels using a 25 MHz band. CMMB uses OFDM with 4K mode for 8MHz bandwidth and 1k mode for 2MHz bandwidth, RS outer coding and LDPC inner channel coding with rate ½ and ¾.

The input data stream from upper layer is processed by FEC, interleaving and constellation, and then multiplexed with Scatter Pilot and Continual Pilot. Afterwards, the data is processed by OFDM modulation, and then the frame headers are inserted to form the frame in the physical layer. Finally, after up converting, the signal is being transmitted.

1.2.3 DVB-SH

DVB-SH is an evolution from the DVB-H and the DVB-S2 [15] standard [1], [2], [3]. DVB-SH has considered a number of enhancements when compared to DVB-H. DVB-SH involved more alternative coding rates. It omitted the 64 QAM modulation scheme. It also included the 1.7MHz support and 1k FFT. It uses FEC using the Turbo Coding. There are improvements in the time-interleaver and support for diversity in terminals.

The details of the standard will be discussed in the subsequent sections, which is the main theme of this paper.

1.3 Challenges for Satellite based Mobile TV Reception

The main challenges, which need to be overcome for a satellite based mobile TV reception, are as follows:

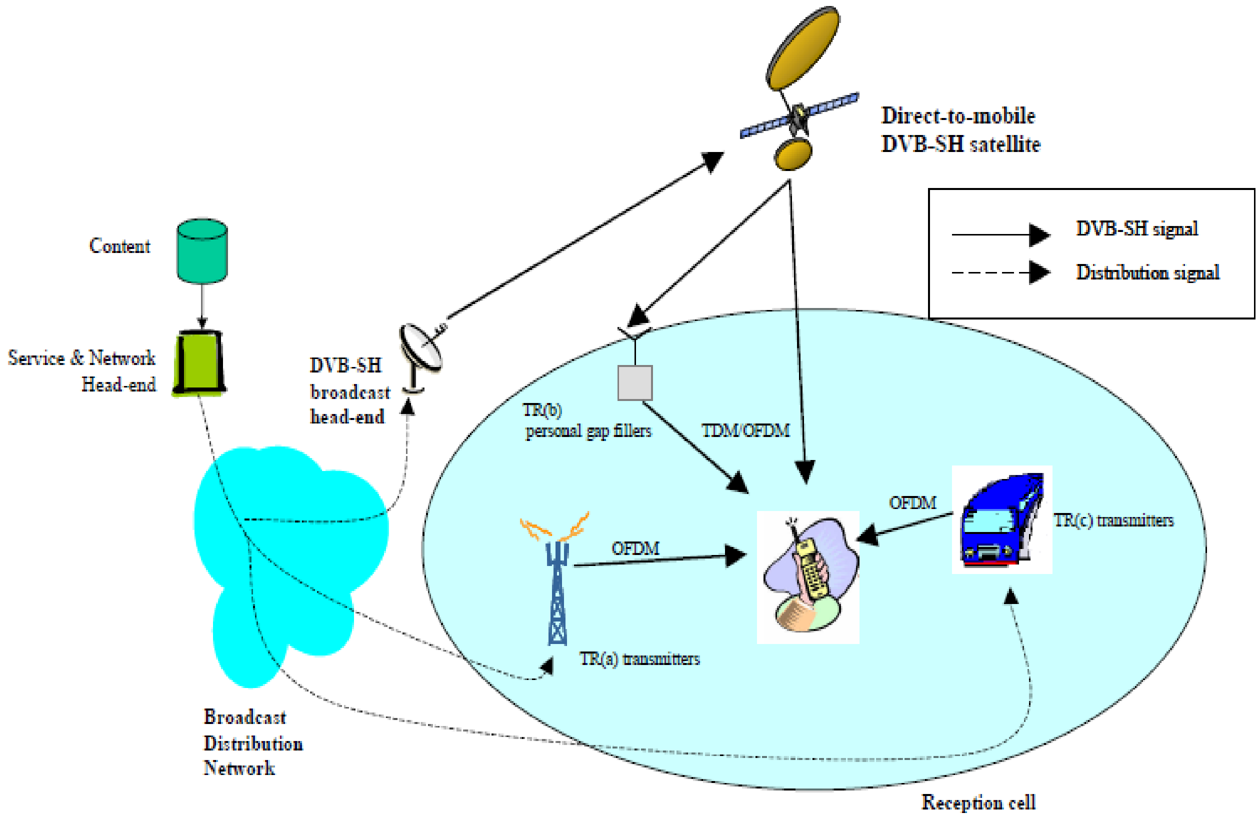

Fig.1 DVB-SH Architecture

Power Constraint: As the mobile devices are battery operated it should consume low power so that the terminal remains active for a long time.

Strong Signal: The mobile devices have very small antenna, which dictates the presence of a very strong signal from the satellite. This calls for the availability of high power satellites having multiple spot beams, which imposes the need for large antennas in the satellite.

Mobility: The mobile reception is generally characterized by period of shadowing where the line of sight of the terminal from the satellite is lost. Moreover, reception at high speed adds a high Doppler and frequent loss of LOS. The requirement for TV reception at very high speed combating the frequent link disruption is one of the main challenges of Mobile TV reception.

In section 2.0 an overview will be provided for the latest ETSI standard on satellite based hybrid mobile TV reception named DVB-SH. The salient features of the standard along with the advantages obtained in using this standard have been described.

2. OVERVIEW OF DVB-SH STANDARD

A brief description is provided in this section about the ETSI formulated Digital Video Broadcasting Satellite Services to Handheld (DVB-SH) standard which provide an efficient way of carrying multimedia services over hybrid satellite and terrestrial networks. This operates at frequencies below 3 GHz to a variety of mobile and fixed terminals having compact antennas with very limited directivity. All types of mobile terminals including handheld (PDAs, mobile phones, etc.), vehicle-mounted, nomadic (laptops, palmtops, etc.) and stationary terminals are targeted in this standard.

The specialty of the DVB-SH standard is that it provides a universal coverage by combining Satellite Component (SC), which caters a huge service area, and a Complementary Ground Component (CGC). The satellite component and the complementary ground component work in a cooperative mode. The standard envisages serving both outdoor and indoor environments. The satellite component can provide service directly after launch and the complementary ground infrastructure can be progressively realized mainly depending on the success of DVB-H [7], [8].

Fig1 describes a typical DVB-SH system combining a Satellite Component [12] and where necessary, a CGC consisting of terrestrial repeaters fed by a broadcast distribution network of various kinds.

The DVB-SH standard envisages three types of terrestrial repeaters providing the complementary ground service. First are broadcast infrastructure transmitters, which complement reception in areas where satellite reception is difficult, especially in urban areas. They may be collocated with mobile cell site or standalone. Using these repeaters local content insertion at that level is possible with adequate radio frequency planning and/or waveform optimizations.

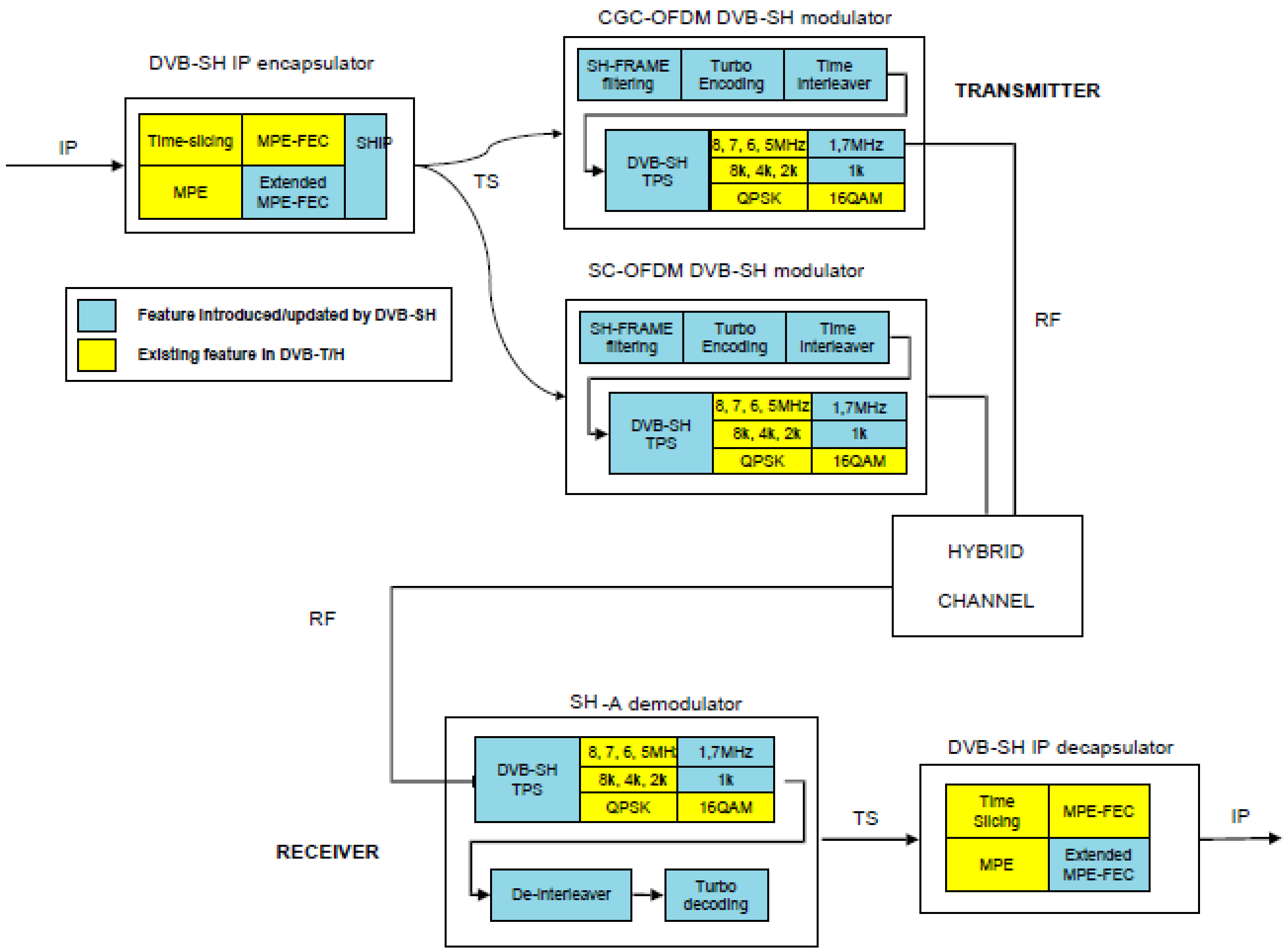

Fig2 DVB-SH A Architecture

Second type of repeaters are personal gap-fillers of limited coverage providing local on-frequency re-transmission and/or frequency conversion These repeaters does not allow local content insertion their primary goad is the enhancement of signal quality for indoor applications.

The third category of repeaters is the mobile broadcast infrastructure transmitters creating a moving complementary repeater facility. The provision for local content insertion exists in this case depending on waveform, configuration and radio frequency planning.

In the terrestrial network, OFDM is the natural choice for modulation, which has already been seen in earlier standards like those that the DVBT/H systems deployed over the past few years and in WiFi, WiMax and LTE [12].

The DVB-SH system can be designed using two modes depending on the type of modulation scheme used over the satellite link. The first is the SH-A for OFDM terrestrial and OFDM satellite transmission mode and secondly the SH-B for OFDM terrestrial and TDM satellite transmission mode being inspired from the successful DVB-S2 standard [15]. SH-B takes advantage of satellite transponders operated in full saturation while SH-A requires satellite transponders operated in a quasi-linear mode.

2.1 DVB-SH Architectures

In the following sections, a brief overview has been provided for both the DVB-SH A and DVB-SH B architectures. The general components of the DVB-SH based transmission system is composed of the DVB-SH Encapsulator and DVB-SH Modulator and up converter. The DVB-SH IP Encapsulator generates the forward link, which is fully compatible to DVB-SH standard and transfers data to the DVB-SH modulator.

Fig 2 depicts the DVB-SH A architecture with its fundamental building blocks of OFDM on the satellite part along with all the supported modulation techniques and code rates. Fig 3 shows the DVB-SH B architecture with TDM based satellite physical layer along with all modulation techniques and code rates. Both the architecture uses the OFDM on the complementary ground component. The figures also show the basic functionality of the DVB-SH IP Encapsulator which is described in the following section.

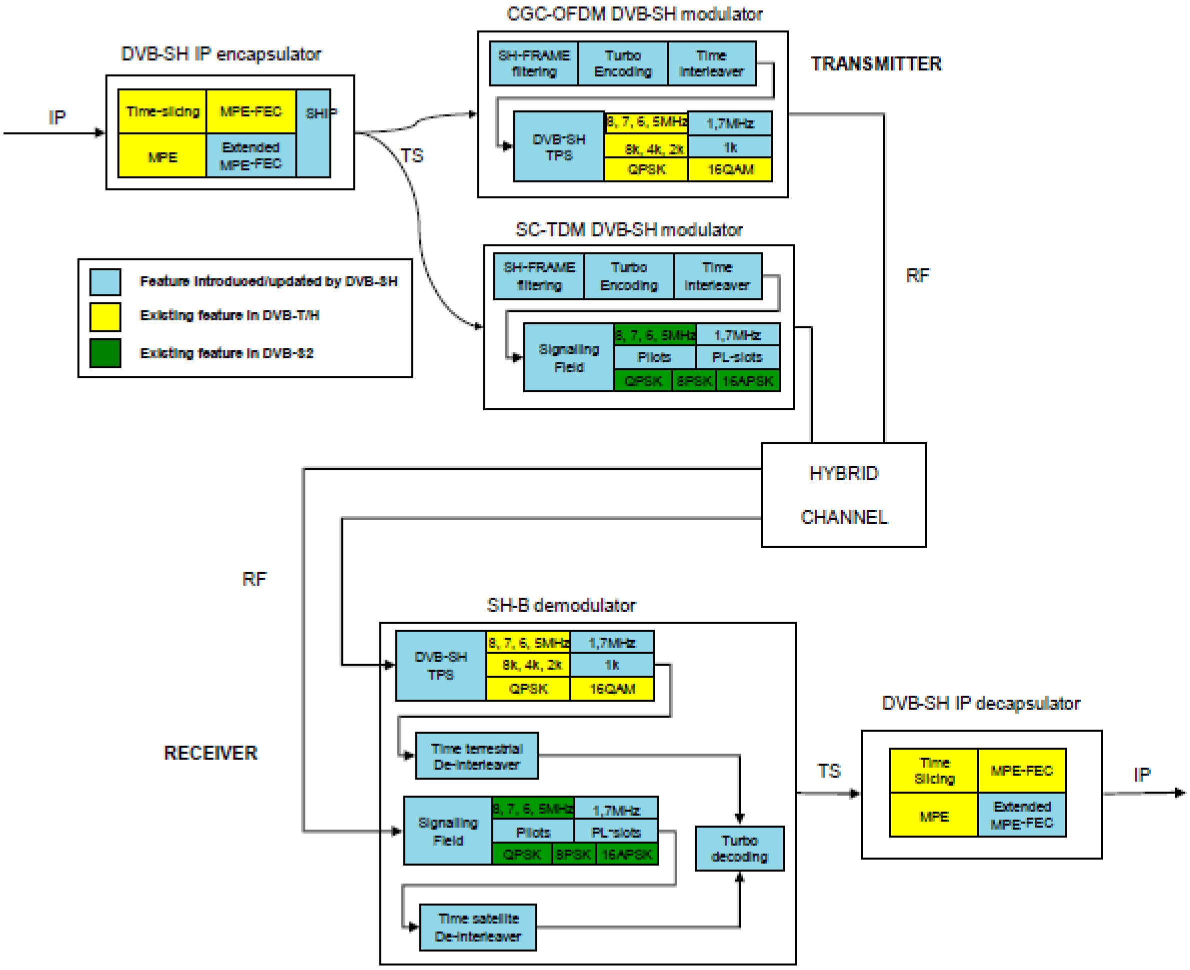

Fig.3. DVB-SH B Architecture

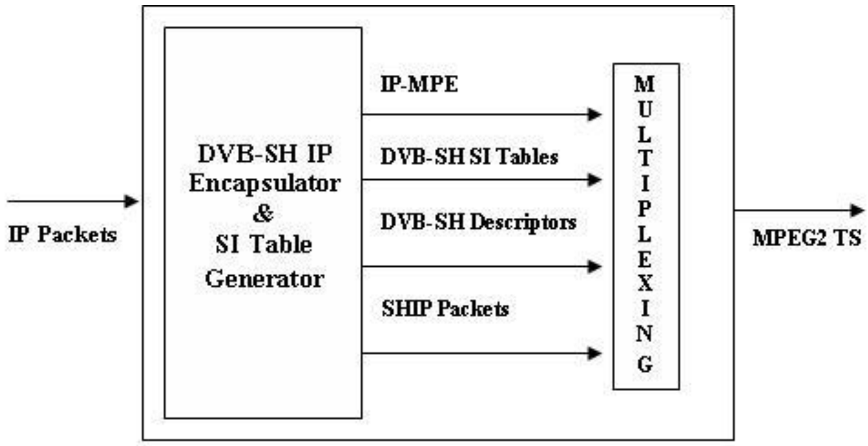

Fig.4 DVB-SH Forward Link Generator

2.2 DVB-SH IP Encapsulator

The DVB-SH IP Encapsulator is compliant to the ETSI DVB-SH international open standard. The DVB-SH IP Encapsulator is a critical network infrastructure element needed for the delivery of digital TV to mobile devices. In order to cost-effectively and reliably deliver content such as live television to a large number of mobile devices, service providers must address the issues of scalability and mobility. At the same time, device power consumption, as well as mobile and indoor reception issues are genuine concerns. The DVB-SH IP

Encapsulator addresses these issues in a shared infrastructure environment.

The DVB-SH IP Encapsulator will generate the full DVB-SH complaint Forward Link. DVB-SH type of network is totally based on IP and in this type of network video, audio and data are communicated as IP packets. The audio video programs are sent in the payload of IP packets. DVB-SH network carries the IP packets in the form of DVB MPEG2 TS packets and uses the ETSI Specified Multi Protocol Encapsulation (MPE)[6] recommended technique (ETSI TS 101202) for converting IP packets into IP-MPE [6] and transferring it over DVB based networks.

The DVB-SH IP Encapsulator consisting of the DVB-SH Forward Link Generation software consists of DVB-SH Service Information Tables Generation as specified in ETSI Standard Document (A079 IP Datacast over DVB-SH) [3]. The Forward Link also includes the generation of DVB-SH Descriptors [6], which convey specific information to the receivers as specified in ETSI DVB-SH Standards. The Forward Link also includes the generation of SHIP packets (SH Initialization Packets) [5] and MPE-FEC [6] packets. All generated data including IP-MPE packets, SI Tables, Descriptors, SHIP packets have to be multiplexed using PID based multiplexing to generate the MPEG2 Transport Stream. This MPEG2 TS is transferred to the DVB-SH Modulator using a PCI based ASI (Asynchronous Serial Interface) Card using the interface modules of the DVB-SH Forward Link Generator. The DVB-SH IP Encapsulator takes input via LAN (Ethernet) and outputs using an ASI Card. The modulated signal is up-converted and up-linked to the satellite.

2.3 Class of Receivers

One of the design considerations of a DVB-SH network is the choice between physical layer or link layer techniques to combat long interruptions of the line of sight which is typical of satellite reception with mobile terminals, and resulting for instance from the shading by buildings, bridges and trees. This decision is influenced by the cost and required footprint of the memory to implement long interleaver at physical layer.

A combination of a short physical interleaver with a long link layer interleaver could be advantageous in the short term mainly considering handheld terminals. When targeting vehicular-mounted devices where there are no restrictions with battery-life, the long interleaver at physical layer might be preferable in difficult reception conditions [12].

The specific satellite channel impairments are addressed by DVB-SH through long time diversity protection. This temporary service disruption is handled in two approaches. The interleaver may be in the physical layer or in the data link layer. Depending on the type of interleaver, two types of receivers are defined.

The Class 1 receivers support short physical layer protection of the order of one burst. The link layer interleaver is long which complements this physical interleaver. The Class 2 receivers support long physical layer protection (in the order of 10 seconds) which is possible with the use of large on receiver memory chips. This protection managed at channel level can be complemented by same link layer protection as class 1 receivers. It is up to the service and network operators to allocate the protection between the different layers, depending on the targeted quality of service, service categories and commercialized classes of receivers.

The combination of different receiver types and system architecture makes four types of receiver configuration to be possible as shown in Table 2 below.

Table2 Receiver Configuration

Terminal Configuration	System Architecture	Receiver Class
A-1	SH-A	Class 1
A-2	SH-A	Class 2
B-1	SH-B	Class 1
B-2	SH-B	Class 2

2.4 Type of Modulation Supported

DVB-SH proposes OFDM modulation for the CGC, and either OFDM or TDM modulations for SC. The choice of a particular standard is dependent on the flexibility of network providers to choose according to satellite characteristics and regulatory considerations between SH-A and SH-B. The TDM transmission mode provides the choice of QPSK, 8PSK, 16APSK for power and spectral efficient modulation format in TDM transmission mode with a variety of roll-off factors (0.15, 0.25, and 0.35). QPSK, 16QAM and non-uniform 16QAM for OFDM transmission mode with support of hierarchical modulation on the other hand. Flexibility for network providers to choose, according to their transmission band (below 3 GHz), various channel bandwidths among 8 MHz, 7 MHz, 6 MHz, 5 MHz, 1,7 MHz, FFT length among existing 8k, 4k, 2k and an additional 1k directly scaled from the 2k mode.

2.5 Single Frequency Networks

Seamless reception of satellite and terrestrial signals using signal diversity either via single frequency network (SFN, SH-A only), maximal ratio combining (MRC, both SH-A and SH-B) or code diversity (complementary puncturing, SH-B only) techniques, the latter being possible via a common frame structure shared between TDM and OFDM modes. From the allocated spectrum for DVB-SH, the SH-B configuration needs a separate channel to be used in the complementary ground component than the frequency allocated for satellite broadcast. In SH-A the same frequency is used by the satellite as well as the complementary ground component as the time and frequency of the transmitted signal are highly synchronized. In SH-A SFN case, not only the OFDM modulation type is re-used between satellite and terrestrial links, but also the sub-carriers modulation and coding are strictly identical to allow a repetition at the same carrier frequency in an SFN mode. This is the concept of SFN networks, which is good in terms of bandwidth usage. In SH-B, the physical layer parameters used in the satellite and complementary ground component differs only the content remains same in both the satellite and ground component creating the MFN concept.

In [12], taking the example of a 6-beam, 3-color reuse system it has been shown that typical system capacity in 15MHz reaches 45Mbps with SH-A or SH-B MFN, and 60Mpbs with SH-A SFN.

3. FACTORS FOR ENHANCED DVB-SH PERFORMANCE

In the following section, we will try to bring out the factors, which make the DVB-SH standard suitable as a mobile broadcast standard.

3.1 Use of 3GPP2 Turbo Codes

State-of-the-art and field-proven FEC (3GPP2 Turbo code) supporting several coding rates is used in DVB-SH. This gives a high benefit to the mobile terminals using the DVB-SH standard when receiving signals of low strength. The strength of the signal available at the receiver input drops to very low levels when the receiver is faced with obstruction in the signal path because of tress or tunnels. For the operation of the receiver at low signal levels, there is a need for a very efficient coding technique, which can compensate the degradation in signal loss. From a series of simulation [21] conducted using standard models (LMS) [13] it has been seen that use of 3GPP2 Turbo gives a high benefit. Turbo based decoders give 3 db gain in DVB-SH.

3.2 Use of Interleaver

The highly flexible channel time interleaver that offers time diversity from about one hundred milliseconds to several seconds depending on the targeted service level and corresponding capabilities of Terminal Class provides the enhancement. The same interleaver allows Class 1 receivers to co-exist with Class 2 receivers, within the same network. The interleaver can be set to either a common configuration (SH-A) or two specialized configurations (SH-B: one for the TDM SC and one for the OFDM CGC).

3.3 Use of Pilot Symbols

Pilot symbols to make robust signal estimation and fast re-acquisition after a deep and long shadowing/blockage event for both TDM and OFDM modes.

3.4 MPE Time Slicing

DVB-H [7] first introduced the concept of time slicing where the real-time parameters, specifically the Delta-t information, conveyed within MPE [4] and MPE-FEC [6] headers are used in order to inform the start of the next burst. DVB-SH re-uses this concept and each MPE, MPE-FEC and MPE-IFEC [20] section carried by the MPEG2 TS over DVB-SH physical layer includes the same Delta-t information. By using this mechanism enables to power off the terminal during periods where no relevant bursts for this service are transmitted. This also enables hand-over even for receivers with a single demodulator in case the infrastructure provisions to synchronize the transmitted TS. Moreover, time slicing enables the efficient support of variable bit rate services since Delta-t can be adapted for each burst size.

3.5 MPE-FEC and iFEC

DVB-H [7] permits the use of link layer protection by applying MPE-FEC to counteract terrestrial fading. DVB-SH also supports the use of MPE-FEC [6]. Alternatively, DVB-SH provides a multi burst MPE-IFEC protection [3], better adapted to satellite coverage, especially with Class1 receivers.

With link layer protection, individual protection for each service is enabled. Depending on the service requirements and the physical layer performance, the transmitter can select from a variety of link layer parameters, e.g. using single burst MPE-FEC or multi burst MPE-IFEC [20]. Each FEC protection scheme can be fully configured to the service requirements thanks to a number of parameters.

Several simulations showed that the new mechanism of MPE-FEC was offering a gain of about 3–4 dB compared with DVB-T [17] in the presence of mobile channels and was offering a greater robustness against Doppler Effect degradation without the need for diversity antennas [7]. The MPE-FEC, while correcting errors at a higher layer than the lower layer FEC (Viterbi1Reed-Solomon), did offer a significant gain over DVB-T without the need for a significantly larger buffer memory.

MPE-iFEC (Interleaved FEC) [20] is a completely new concept, which has been introduced within DVB-SH. The main objective of it is to counteract relatively long satellite signal dropouts due to tunnels, bridges, foliage and other signal blockages.

MPE-iFEC is introduced to support reception in situations of long duration erasure on the MPE section level spanning several consecutive time slice bursts. Such erasure situations may for example occur on satellite mobile channels (LMS: land mobile satellite) [16] without any terrestrial repeaters in the vicinity. Obstacles may hinder direct satellite reception and induce losses of several successive bursts. For example, with an MPE-iFEC [20] protection where about 30% of TS data are allocated to parity overhead computed over 10 successive bursts, it is possible to compensate up to three successive complete burst losses, whereas recovery of a complete burst loss with DVB-H MPE-FEC protection would not be possible. Such erasure situations may also occur in terrestrial networks so that MPE-iFEC may be useful in other channels than LMS [12], [16].

3.6 IP Datacast

DVB-H provides an IP multicast transport on top of MPEG2 TS. To encapsulate the IP datagram over MPEG2 TS, multi protocol encapsulation is applied. As the DVB-SH physical layer is also MPEG2 TS based, DVB-SH reuses MPE for the transport of IP datagram over DVB-SH physical layers. MPEG2 TS based transport and MPE [6] enable to reuse most signaling concept of DVB-H also for DVB-SH.

DVB-SH is fully compatible with the DVB IPDC specifications [3], including ESG [10], Content Delivery Protocols [9] and Service purchase and Protection [8]. This enables the fast deployment of services on top of DVB-SH physical and link layers through the reuse of the IPDC protocol stack [5], [6], [7].

DVB-SH uses updated PSI/SI [3], [4] to convey system and program parameters. This enables smooth transition scenarios between DVB-SH and DVB-H networks, in particular, for handovers: dual-mode receivers may receive content on one or the other technique seamlessly.

3.7 DVB-SH Signaling

DVB-SH signaling is done via a combination of TPS bits (OFDM part), and a Signaling Field (TDM part). They allow together the various parameters of both components to be controlled, in particular when common operation of both different components is required in SH-B.

3.8 DVB-SH PSI/SI

The organization of the DVB-SH network follows the DVB-S legacy and uses the Program Specific Information (PSI) [4] and Service Information (SI) Tables [6] to convey to the terminals about the organization of the network. These tables are broadcast to the terminals and are differentiated using MPEG2 PIDs, which are carried in the header of the MPEG2 TS packets. In terms of PSI/SI, DVB-SH is fully compatible with references [1] and [2].

The PSI tables include the Program Association Table (PAT) [4], Program Map Table (PMT) [4], Conditional Access Table (CAT) [4] and the Transport Stream Description Table (TSDT) [4].

Generally, SI tables include the Network Information Table (NIT), BAT, SDT, EIT, RST, TDT, TOT, ST, and INT [3], [4]. In DVB-SH in some implementations EIT, RST, ST is sometimes not included. Among the PSI and SI tables the Program Association Table (PAT), Program Map Table (PMT) and Network Information Table (NIT) are mandatory tables, which must be present in the DVB-SH Transport Stream.

The Network Information Table contains the bare minimum information necessary for the receiver to decode the streams being broadcast. Generally, the information related to the physical layer of the transmission as the modulation used, symbol rate and frequency in which signals are transmitted appears in NIT.

In DVB-SH, the NIT contains descriptors, which provide the additional information like the SH Delivery System Descriptor [26], Time Slice FEC Descriptor [6], Cell List descriptor [26], Cell Frequency Link Descriptor [26], Linkage Descriptor [4] and the Network Name Descriptor [4]. These descriptors combined convey all the important physical layer parameters in which the signals are broadcast.

The Program Association Table (PAT) [7] conveys the PIDs in which the Program Map Table (PMT) [7] for all the respective programs is being sent. The Program Map Table (PMT) contains the PIDs in which the respective programs are being broadcast. The receiver decodes these tables in order to find out the PIDs in which the program for which the receiver is interested is broadcast. Further information is decoded from the information available in these tables.

3.10 SH Initialization Packet

The SHIP packets [5] are used to provide the time synchronization between the different transmitters. If a separate channel from the satellite channel is available for terrestrial use, the satellite signal may be repeated terrestrially on that channel. In this case, SH-B architecture should be preferred since TDM modulation optimizes satellite power resource and allows the use of code diversity. TDM and OFDM modulators are synchronized by time alignment of TDM and OFDM SH-frames and absolute reference given by SH-Initialization Packet specified in annex A of reference [3]. When it is preferred or necessary to repeat terrestrially the satellite signal on the same frequency, OFDM modulation shall be used by the satellite component to constitute a Single Frequency Network (SFN) between SC and its CGC using SH-A architecture. OFDM modulators are time synchronized by the absolute reference given by SH initialization packet.

4. SATELLITE POWER REQUIREMENTS

In the DVB-SH Implementation Guidelines [3], an in-depth analysis has been provided about the required power requirements in the space segment to cater to the services envisaged in DVB-SH standard. From the analysis the following main conclusions has been inferred which is also discussed by Almanac et al in [13].

An EIRP of 59dBW per spot beam can guarantee the required service availability when the satellite is designed to reach only Class 2 vehicular terminals assuming that the other terminals to be served by the terrestrial repeaters. This is considering QPSK ½ and LL FEC 2/3 for Class 1 Receivers and QPSK 1/3 considering Class 2 Receivers. With 63dBW per spot beam, an interleaver length of 10 s at PL can provide excellent QoS for vehicular or palmtop terminals in open, rural and suburban environments. In this case, the achieved bit rate in 5MHz is in the range of 2.2–2.6 Mbps.

An EIRP of 68dBW would allow closing the link in direct LOS in open areas (AWGN channel) for all Class 1 (QPSK code rate 1/2) handheld terminals considered. High ESR5 (20) availability for vehicular terminals in mobility conditions will also be guaranteed. This satellite power would therefore comply with all satellite-only reception cases addressed in the SH system.

An extra increase of the EIRP would offer the possibility to increase the satellite capacity of the system. With 72dBW per spot beam, an enhanced QoS is obtained for handheld terminals or alternatively a 50% capacity increase compared with the 68dBW case can be achieved.

5. CONCLUSION

In this paper, an overview has been provided about Mobile TV reception via satellite. The advantages of a satellite based mobile TV reception along with the associated challenges the technology brings have been discussed. An attempt has been made to cover the important international standards in this field. A detailed description has been provided for the DVB-SH standard along with the factors, which makes it so suitable for Mobile TV. It has been seen that DVB-SH provides a number of facility over its traditional counterparts. DVB-SH single antenna reception exhibits 5-8 dB over DVB-T [17], [13] while the Dual Antenna reception exhibits 9-13 dB over the native DVB-T. DVB-SH diversity antenna mode offers an additional improvement of about 4–5 dB compared with DVB-SH single antenna mode. This makes the DVB-SH the most appropriate standard for satellite based Mobile TV reception. This paper will be useful for people interested to work in the filed of satellite based mobile television.

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