ATSC Mobile DTV Standard: A/153 Part 1, ATSC Mobile DTV System (A/153 Part 1:2013)

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Advanced Television Systems Committee
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The Advanced Television Systems Committee, Inc., is an international, non-profit organization developing voluntary standards for digital television. The ATSC member organizations represent the broadcast, broadcast equipment, motion picture, consumer electronics, computer, cable, satellite, and semiconductor industries.

Specifically, ATSC is working to coordinate television standards among different communications media focusing on digital television, interactive systems, and broadband multimedia communications. ATSC is also developing digital television implementation strategies and presenting educational seminars on the ATSC standards.

ATSC was formed in 1982 by the member organizations of the Joint Committee on InterSociety Coordination (JCIC): the Electronic Industries Association (EIA), the Institute of Electrical and Electronic Engineers (IEEE), the National Association of Broadcasters (NAB), the National Cable Telecommunications Association (NCTA), and the Society of Motion Picture and Television Engineers (SMPTE). Currently, there are approximately 150 members representing the broadcast, broadcast equipment, motion picture, consumer electronics, computer, cable, satellite, and semiconductor industries.

ATSC Digital TV Standards include digital high definition television (HDTV), standard definition television (SDTV), data broadcasting, multichannel surround-sound audio, and satellite direct-to-home broadcasting.

Note: The user's attention is called to the possibility that compliance with this standard may require use of an invention covered by patent rights. By publication of this standard, no position is taken with respect to the validity of this claim or of any patent rights in connection therewith. One or more patent holders have, however, filed a statement regarding the terms on which such patent holder(s) may be willing to grant a license under these rights to individuals or entities desiring to obtain such a license. Details may be obtained from the ATSC Secretary and the patent holder.

Revision History

Version	Date
Initial version approved (A/153 Part 1:2009)	15 October 2009
Revision 1 approved (A/153 Part 1:2011) Added the Scalable Full Channel Mobile Mode (SFCMM) through A/153 Part 9	1 June 2011
Revision 2 approved (A/153 Part 1:2013) Added Mobile Emergency Alerting System (M-EAS) through A/152 Part 10	11 March 2013

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1. SCOPE

This standard describes the ATSC Mobile DTV system, hereafter referred to as the ATSC mobile/handheld (M/H) system. The M/H system provides mobile/pedestrian/handheld broadcasting services using a portion of the ~19.39 Mbps ATSC 8-VSB payload, while the remainder is still available for HD and/or multiple SD television services. The M/H system is a dual-stream system—the ATSC service multiplex for existing digital television services and the M/H service multiplex for one or more mobile, pedestrian and handheld services.

This standard is divided into Parts, each of which describe elements of the ATSC Mobile DTV system.

1.1 Organization

This document is organized as follows:

- **Section 1** – Outlines the scope of this standard (Core Mobile Mode) and provides a general introduction
- **Section 2** – Lists references and applicable documents
- **Section 3** – Provides a definition of terms, acronyms, and abbreviations for this standard
- **Section 4** – ATSC-M/H system definition
- **Section 5** – ATSC-M/H system overview
- **Section 6** – System configuration signaling
- **Annex A** – Scalable Full Channel Mobile Mode

2. REFERENCES

All referenced documents are subject to revision. Users of this Standard are cautioned that newer editions might or might not be compatible.

2.1 Normative References

The following documents, in whole or in part, as referenced in this document, contain specific provisions that are to be followed strictly in order to implement a provision of this Standard.

[1] IEEE: "Use of the International Systems of Units (SI): The Modern Metric System," Doc. IEEE/ASTM SI 10-2002, Institute of Electrical and Electronics Engineers, New York, N.Y.

[2] ATSC: "ATSC Mobile DTV Standard, Part 2 – RF/Transmission System Characteristics," Doc. A/153 Part 2:2011, Advanced Television Systems Committee, Washington, D.C., 7 October 2011.

[3] ATSC: "ATSC Mobile DTV Standard A/153 Part 3, Service Multiplex and Transport Subsystem Characteristics," Doc. A/153 Part 3:2013, Advanced Television Systems Committee, Washington, D.C., [date].

[4] ATSC: "ATSC Mobile DTV Standard, Part 4 – Announcement," Doc. A/153 Part 4:2009, Advanced Television Systems Committee, Washington, D.C., 15 October 2009.

[5] ATSC: "ATSC Mobile DTV Standard, Part 5 – Application Framework," Doc. A/153 Part 5:2009, Advanced Television Systems Committee, Washington, D.C., 15 October 2009.

[6] ATSC: "ATSC Mobile DTV Standard, Part 6 – Service Protection," Doc. A/153 Part 6:2011, Advanced Television Systems Committee, Washington, D.C., 23 May 2011.

[7] ATSC: "ATSC Mobile DTV Standard A/153 Part 7 – AVC and SVC Video System Characteristics," Doc. A/153 Part 7:2012, Advanced Television Systems Committee, Washington, D.C., 4 July 2012.

[8] ATSC: "ATSC Standard A/153 Part 8 – HE AAC Audio System Characteristics," Doc. A/153 Part 8:2012, Advanced Television Systems Committee, Washington, D.C., 18 December 2012.

[9] ATSC: "ATSC Mobile DTV Standard A/153 Part 9, Scalable Full Channel Mobile Mode," Doc. A/153 Part 9:2013, Advanced Television Systems Committee, Washington, D.C., 11 March 2013.

[10] ATSC: "ATSC Mobile DTV Standard A/153 Part 10, Mobile Emergency Alert System," Doc. A/153 Part 10:2013, Advanced Television Systems Committee, Washington, D.C., 11 March 2013.

2.2 Informative References

The following documents contain information that may be helpful in applying this Standard.

[11] ATSC: "ATSC Digital Television Standard, Part 3 – Service Multiplex and Transport Subsystem Characteristics," Doc. A/53 Part 3:2009, Advanced Television Systems Committee, Washington, D.C., 7 August 2009.

[12] ATSC: "Program and System Information Protocol for Terrestrial Broadcast and Cable," Doc. A/65:2009, Advanced Television Systems Committee, Washington, D.C., 14 April 2009.

[13] ATSC: "Content Identification and Labeling for ATSC Transport, Revision B," Doc. A/57B, Advanced Television Systems Committee, Washington D.C., May 2008.

3. DEFINITION OF TERMS

With respect to definition of terms, abbreviations, and units, the practice of the Institute of Electrical and Electronics Engineers (IEEE) as outlined in the Institute's published standards [1] shall be used. Where an abbreviation is not covered by IEEE practice or industry practice differs from IEEE practice, the abbreviation in question will be described in Section 3.3 of this document.

3.1 Compliance Notation

This section defines compliance terms for use by this document:

shall – This word indicates specific provisions that are to be followed strictly (no deviation is permitted).

shall not – This phrase indicates specific provisions that are absolutely prohibited.

should – This word indicates that a certain course of action is preferred but not necessarily required.

should not – This phrase means a certain possibility or course of action is undesirable but not prohibited.

3.2 Treatment of Syntactic Elements

This document contains symbolic references to syntactic elements used in the audio, video, and transport coding subsystems. These references are typographically distinguished by the use of a

different font (e.g., restricted), may contain the underscore character (e.g., sequence_end_code) and may consist of character strings that are not English words (e.g., dynrng).

3.2.1 Reserved Elements

One or more reserved bits, symbols, fields, or ranges of values (i.e., elements) may be present in this document. These are used primarily to enable adding new values to a syntactical structure without altering its syntax or causing a problem with backwards compatibility, but they also can be used for other reasons.

The ATSC default value for reserved bits is '1.' There is no default value for other reserved elements. Use of reserved elements except as defined in ATSC Standards or by an industry standards setting body is not permitted. See individual element semantics for mandatory settings and any additional use constraints. As currently-reserved elements may be assigned values and meanings in future versions of this Standard, receiving devices built to this version are expected to ignore all values appearing in currently-reserved elements to avoid possible future failure to function as intended.

3.3 Acronyms and Abbreviation

The following acronyms and abbreviations are used within this standard.

$\lfloor X \rfloor$ – The greatest integer less than or equal to X

AAC – Advanced Audio Coding
AES – Advanced Encryption Standard (AES may also refer to the Audio Engineering Society)
ALC – Asynchronous Layered Coding
AT – ATSC Time
ATSC – Advanced Television Systems Committee
ATSC-M/H – ATSC Mobile/Handheld Standard
AVC – Advanced Video Coding (ITU-T H.264 | ISO/IEC 14496-10)
B – SCCC output block length in symbols
BCRO – Broadcast Rights Object
BSD/A – Broadcast Service Distribution/Adaptation Center
bslbf – Bit string, left bit first
BSM – BCAST Subscription Management
CAP – Common Alerting Protocol
CIT-MH – Cell Information Table for ATSC-M/H
CRC – Cyclic Redundancy Check
CTA – Clear-to-Air
DIMS – Dynamic Interactive Multimedia Scenes
DNS – Domain Name System
DRM – Digital Rights Management
DTxA – Distributed transmission network adaptor
DTxN – Distributed transmission network
DVB – Digital Video Broadcasting
EAT-MH – Emergency Alert Table for ATSC-M/H
ESG – Electronic Service Guide
FDT – File Delivery Table

FEC – Forward Error Correction
FEMA – Federal Emergency Management Agency, an agency within the Department of Homeland Security within the United States
FET-MH – Future Event Table for ATSC-M/H
FIC – Fast Information Channel
FLUTE –File Delivery over Unidirectional Transport (RFC 3926)
FTA – Free-to-Air
GAT – Guide Access Table
GAT-MH – Guide Access Table for ATSC-M/H
GF – Galois field
GPS – Global Positioning System
HE AAC – High Efficiency Advanced Audio Coding
HE AAC v2 – High Efficiency Advanced Audio Coding version 2
HTTP – Hypertext Transfer Protocol
ID – Identification
IETF – Internet Engineering Task Force
IP – Internet Protocol
IPAWS – Integrated Public Alert and Warning System
IPsec – IP Security
ISAN – International Standard Audiovisual Number
JPG – A file extension label for the JPEG image file compression format developed by the Joint Photographic Experts Group
LASeR – Lightweight Application Scene Representation
LCT – Layered Coding Transport
LTKM – Long-Term Key Message
M-EAS – Mobile Emergency Alert Service
M/H – Mobile/pedestrian/handheld
MHE– M/H Encapsulation
MPEG– Moving Picture Experts Group
N – Number of columns in RS Frame payload
NoG – Number of M/H Groups per M/H Subframe
NTP – Network Time Protocol
OMA – Open Mobile Alliance
OMA-BCAST – Open Mobile Alliance Broadcast
P – Number of RS parity bytes per RS frame column
PCCC – Parallel concatenated convolutional code
PEK – Program Encryption Key
PL – RS frame portion length
PRC – Parade Repetition Cycle
PS – Parametric Stereo
R – the number of FIC Chunks per M/H Frame
RI – Rights Issuer

RME – Rich Media Environment
RO – Right Object
ROT – Root Of Trust
RRT-MH – Rating Region Table for ATSC-M/H
RTP – Real-time Transport Protocol
RS – Reed-Solomon
S – Number of padding bytes
SBR – Spectral Band Replication
SCB1…SCB10 – SCCC (serial concatenated convolutional coding) blocks number 1 through number 10
SCCC – Serial concatenated convolutional code
SCR – Static Conformance Requirements
SDP – Session Description Protocol
SEK –Service Encryption Key
SFCMM – Scalable Full Channel Mobile Mode
SG – (Electronic) Service Guide
SGN – Starting group number
SIBL – SCCC input block length in bytes
signed int – signed integer
SLT-MH – Service Labeling Table for ATSC-M/H
SMT-MH – Service Map Table for ATSC-M/H
SOBL – SCCC output block length in bytes
SRTP – Secure Real Time Protocol
STKM – Short-Term Key Message
STT-MH – System Time Table for ATSC-M/H
SVC – Scalable Video Coding (Annex G of ITU-T rec. H.264 | ISO/IEC 14496-10)
SVG – Scalable Vector Graphics
TCP – Transmission Control Protocol
TEK – Traffic Encryption Key
TNoG – Total Number of M/H Groups including all the M/H Groups belonging to all M/H Parades in one M/H Subframe
TPC – Transmission parameter channel
TS – Transport Stream
TS-M – Transport Stream Main (defined in A/53 Part 3:2007 [11]).
TSI – Transport Session Identifier
UDP – User Datagram Protocol
uimsbf – Unsigned integer, most significant bit first
W3C – World Wide Web Consortium

3.4 Terms and Definitions

The following terms are used within this document.

Alert Aggregator – The functional system to collect and aggregate emergency alerts and provide a single feed of alerts to emergency alert distributors. FEMA has accepted this role in the United States.

Broadcast System – The collection of equipment necessary to transmit signals of a specified nature.

Canvas – The on-screen area in which OMA-RME user experience elements can be placed. Typically the canvas size will match that of the video layer.

Clear-to-Air service – A service that is sent unencrypted, and may be received via any suitable receiver with or without a subscription.

Event – A collection of associated media streams that have a common timeline for a defined period. An event is equivalent to the common industry usage of "television program."

Free-to-Air service – A service that is sent encrypted, and for which the keys for decryption are available free of charge.

Group Region – See M/H Group Region.

IP multicast stream – An IP stream in which the destination IP address is in the IP multicast address range.

IP stream – A sequence of IP datagrams with the same source IP address and the same destination IP address.

Local M/H Service – A Service which appears in one and only one M/H Broadcast. Typically this is a Service created by a local broadcaster which will not be transmitted by another broadcast facility other than a repeater.

M/H Block – A defined series of contiguous transmitted VSB data segments within an M/H Group, containing M/H data or a combination of main (legacy) and M/H data.

M/H Broadcast – The entire M/H portion of a physical transmission channel.

M/H Ensemble – A collection of consecutive RS Frames with the same FEC codes, where each RS Frame encapsulates a collection of IP streams.

M/H Frame – Time period that carries main ATSC data and M/H data (encapsulated as MHE packets) equal in duration of exactly 20 VSB data frames (~968 msec.).

M/H Group – At the MPEG-2 transport stream level, a collection of 118 MHE MPEG-2 transport packets delivering M/H service data; also, the corresponding data symbols in the 8-VSB signal after interleaving and trellis coding.

M/H Group Region (or simply "Group Region") – A defined set of M/H Blocks, designated as Region A, B, C, or D.

M/H Multiplex – A collection of M/H Ensembles in which the IP addresses of the IP streams in the M/H Services in the Ensembles have been coordinated to avoid any IP address collisions. A single M/H Multiplex may include one or more M/H Ensembles.

M/H Parade – A collection of M/H Groups that have the same M/H FEC parameters. Each M/H Parade carries one or two M/H Ensembles.

M/H Service – A package of packetized streams transmitted via an M/H Broadcast, which package is composed of a sequence of events which can be broadcast as part of a schedule.

M/H Service Signaling Channel – A single IP multicast stream incorporated within each M/H Ensemble, delivering M/H Service Signaling tables that include IP-level M/H Service access information.

M/H Slot – A portion of an M/H Sub-Frame consisting of 156 consecutive MPEG-2 transport packets. A Slot may consist solely of all TS-M (main) packets or may consist of 118 M/H packets and 38 TS-M packets. There are 16 M/H Slots per M/H Sub-Frame. Note: TS-M is Transport Stream Main as defined in A/53 Part 3:2007 [11].

M/H Sub-frame – One fifth of an M/H Frame; each M/H Sub-frame is equal in duration to 4 VSB data frames (8 VSB data fields).

M/H TP – The term "M/H Transport Packet (M/H TP)" is used to designate a row of an RS Frame with two bytes header included. Thus, each RS Frame is composed of 187 M/H TPs.

Mobile Emergency Alert System – A system to provide emergency alerts via ATSC-M/H services.

MPEG – Refers to standards developed by the ISO/IEC JTC1/SC29 WG11, Moving Picture Experts Group. MPEG may also refer to the Group.

Non-systematic – A property of a code in which the code word does not meet the definition of a systematic code, due to either re-ordering or substitution of data.

Number of Groups (NoG) – The number of M/H Groups per M/H Sub-Frame for a particular Ensemble.

Parade Repetition Cycle – A specification of the frequency of transmission of a Parade carrying a particular Ensemble. The Parade containing a particular Ensemble is transmitted in one M/H Frame per *PRC* M/H frames, e.g., PRC= 3 implies transmission in one M/H frame out of every three M/H frames.

Part – A Part is an independently-maintainable portion of an ATSC document. It shares a common root document number with other Parts of the document.

Primary DIMS Stream – A stream which defines the complete scene tree; i.e., in which all random access points are, or build, a complete DIMS Scene.

Primary Ensemble – An ensemble to be transmitted through a primary RS frame of a Parade.

Principal Broadcast Stream – The principal broadcast service is the current broadcast audio/video service being presented by the primary video and audio decoder.

Program – A collection of associated media streams that have a common timeline for a defined period. A program corresponds to the common industry usage of "television program."

Protected Content – Media Stream that is protected according to the requirements of A/153 Part 6.

Reference Receiver – A physical embodiment of hardware, operating system, and native applications of the manufacturer's choice, which collectively constitute a receiver for which specified transmissions are intended.

Regional M/H Service – A Service which appears in two or more M/H Broadcasts. Typically this is a Service transmitted by more than one broadcast facility.

reserved – Set aside for future use by a Standard.

RI Object – A binary coded Registration Layer message or LTKM Layer message.

RI Stream –A stream of UDP packets with the common source and destination IP addresses and UDP port, containing RI Objects.

Rights Issuer – An entity that issues Rights Objects to OMA DRM Conformant Devices.

Rights Issuer URI – A string that identifies the Rights Issuer issuing RI Objects and Service Encryption Keys (SEKs). Rights Issuer URI type is anyURI.

Rights Object – A collection of Permissions and other attributes which are linked to Protected Content.

RS Frame – Two-dimensional data frame by means of which an M/H Ensemble is RS CRC encoded. RS Frames are the output of the M/H physical layer subsystem. Generally, one RS Frame contains 187 rows of N bytes each, where the value of N is determined by the transmission mode of M/H physical layer subsystem, and carries data for one M/H Ensemble. RS Frames are defined in detail in Part 2.

RS Frame Portion Length – The number of SCCC payload bytes per Group.

Secondary DIMS Stream – A stream that manages only a portion of the scene tree.

Secondary Ensemble – An ensemble to be transmitted through a secondary RS frame of a Parade. Depending on RS Frame Mode, a Parade may or may not have the Secondary Ensemble and associated secondary RS Frame.

Starting Group Number – The Group Number assigned to the first Group in a Parade, which determines placement of the Parade into a particular series of M/H Slots.

Systematic – A property of a code in which the code word is composed of the original data in its sequential order followed by parity data for the codeword.

Total Number of Groups – The number of Groups per M/H Sub-Frame including all M/H Ensembles present in the Sub-Frame.

UDP Stream – A sequence of UDP/IP datagrams with the same destination IP address and the same destination UDP port number.

WAVE – (also WAV or .wav) File format for storing an audio bitstream, used as de facto standard for audio storage on PCs. Based on Resource Interchange File Format (RIFF), a generic meta-format for storing data in tagged “chunks”.

4. SYSTEM OVERVIEW

Documentation of the ATSC-M/H system has been organized into self-contained Parts. The Parts referenced below establish the characteristics of the subsystems necessary to accommodate the services envisioned:

1) The RF and transmission system of the ATSC-M/H system shall be as defined in A/153 Part 2 [2].
2) The service multiplex and transport subsystem characteristics of the ATSC-M/H system shall be as defined in A/153 Part 3 [3].
3) The announcement method of the ATSC-M/H system shall be as defined in A/153 Part 4 [4].
4) The presentation framework of the ATSC-M/H system shall be as defined in A/153 Part 5 [5].
5) Service Protection, when used, shall be as defined in the provisions of A/153 Part 6 [6].
6) Video coding in the ATSC-M/H system shall be as defined in A/153 Part 7 [7].
7) Audio coding in the ATSC-M/H system shall be as defined in A/153 Part 8 [8].
8) The emergency alerting method of the ATSC-M/H system shall be as defined in A/153 Part 10 [10]
9) Scalable Full Channel Mobile Mode (SFCMM), when used, shall be as defined in Annex A.

The Parts listed above contain the required elements and some optional elements. Additional ATSC standards may define other required and/or optional elements.

5. SYSTEM SPECIFICATIONS

The ATSC Mobile/Handheld service (M/H) shares the same RF channel as a standard ATSC broadcast service described in ATSC A/53 [11], also known as the "Main service" (or more precisely TS-M). M/H is enabled by using a portion of or the entire bandwidth of the total available ~19.39 Mbps bandwidth and utilizing delivery over IP transport. The overall ATSC broadcast system including standard (Main) and M/H systems is illustrated in Figure 5.1.

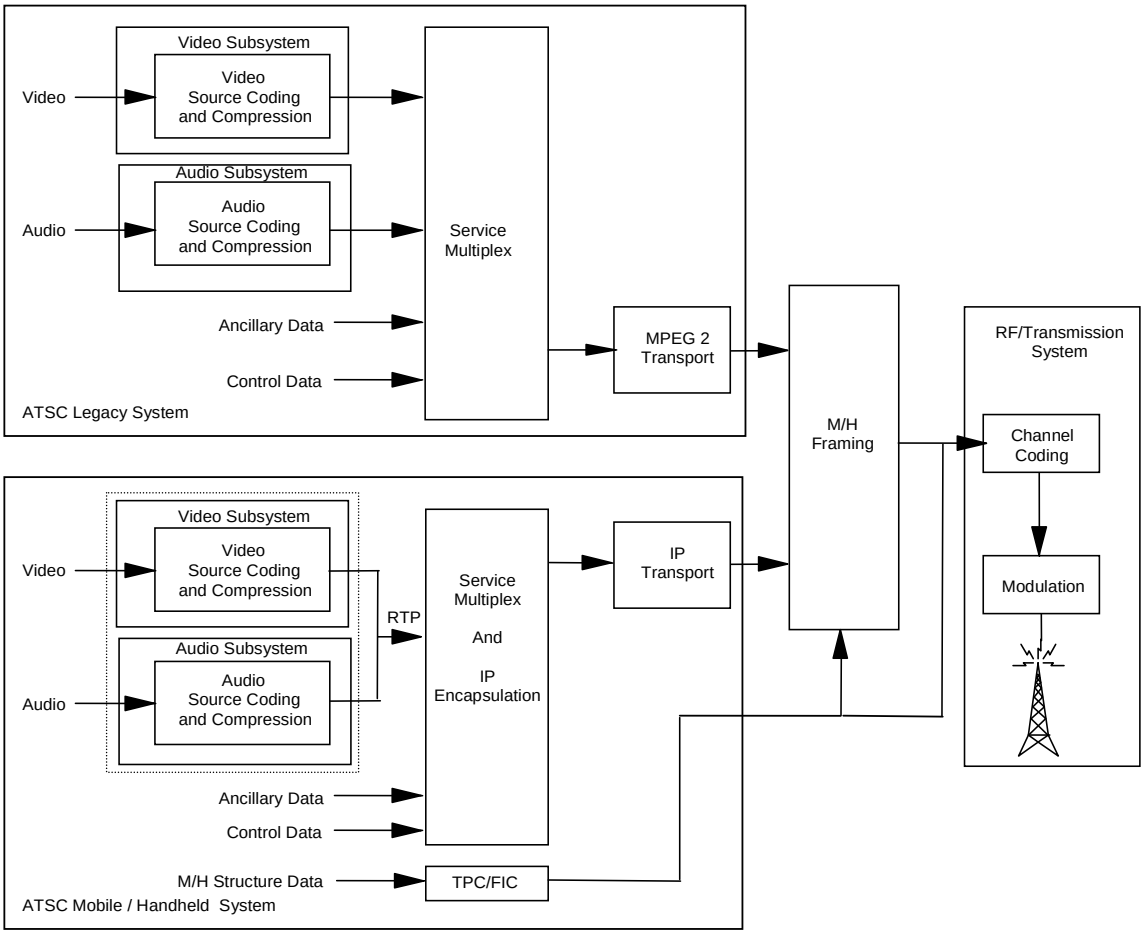

Figure 5.1 ATSC broadcast system with TS Main and M/H services.

Central to the M/H system are additions to the physical layer of the ATSC transmission system that are easily decodable under high Doppler rate conditions. Additional training sequences and additional forward error correction (FEC) assist reception of the enhanced stream(s). Consideration has also been given to the many system details that make such a signal compatible with legacy ATSC receivers, particularly audio decoder buffer constraints; but also such constraints as MPEG transport packet header standards, requirements for legacy PSIP carriage, etc. These changes do not alter the emitted spectral characteristics.

The ATSC-M/H system is separated into logical functional units corresponding to the protocol stack is illustrated in Figure 5.2.

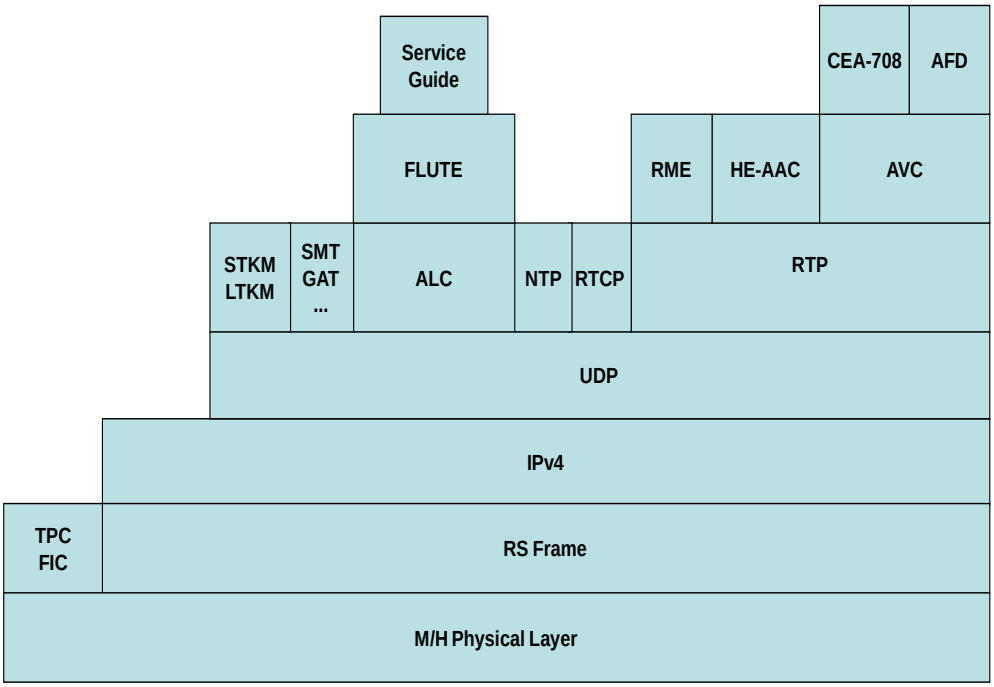

Figure 5.2 ATSC-M/H system protocol stack.

5.1 Description of the A/153 Standard's Parts

The following sections provide an overview of the contents of the Parts that make up the ATSC-M/H Standard.

5.1.1 Part 2, RF/ Transmission

M/H data is partitioned into Ensembles, each of which contains one or more services. Each Ensemble uses an independent RS Frame (an FEC structure) and, furthermore, each Ensemble may be coded to a different level of error protection depending on the application. M/H encoding includes FEC at both the packet and trellis levels, plus the insertion of long and regularly spaced training sequences into the M/H data. Robust and reliable control data is also inserted for use by M/H receivers. The M/H system provides bursted transmission of the M/H data, which allows the M/H receiver to cycle power in the tuner and demodulator for energy saving.

5.1.2 Part 3, Service Multiplex and Transport Subsystem

The M/H data are transmitted within the 8-VSB signal on a time-slice basis, which facilitates burst-mode reception of just selected portions of the M/H data by an M/H receiver. Each M/H Frame time interval is divided into 5 sub-intervals of equal length, called M/H Subframes. Each M/H Subframe is in turn divided into 4 sub-divisions of length 48.4 ms, the time it takes to transmit one VSB frame. These VSB frame time intervals are in turn divided into 4 M/H Slots each (for a total of 16 M/H Slots in each M/H Subframe).

The M/H data to be transmitted is packaged into a set of consecutive RS Frames, where this set of RS Frames logically forms an M/H Ensemble. The data from each RS Frame to be transmitted during a single M/H Frame is split up into chunks called M/H Groups, and the M/H Groups are organized into M/H Parades. Each M/H Parade comprises the M/H Groups from either a single RS Frame or from both a primary RS Frame and a secondary RS Frame. The number of

M/H Groups belonging to an M/H Parade is always a multiple of 5, and the M/H Groups in the M/H Parade go into M/H Slots that are equally divided among the M/H Subframes of the M/H Frame.

The RS Frame is the basic data delivery unit, into which the datagrams in some defined structure are encapsulated (IP is the means defined currently). While an M/H Parade always is associated with a Primary RS Frame, it also may be associated with a Secondary RS Frame. The number of RS Frames and the size of each RS Frame are determined by the transmission mode of the M/H physical layer subsystem. Typically, the size of the Primary RS Frame is bigger than the size of Secondary RS Frame associated with the same M/H Parade.

The Fast Information Channel (FIC) is a separate data channel from the data channel delivered through RS Frames. The main purpose of the FIC is to efficiently deliver essential information for rapid M/H Service acquisition. This information primarily includes binding information between M/H Services and the M/H Ensembles carrying them, plus version information for the M/H Service Signaling Channel of each M/H Ensemble.

In ATSC-M/H, an "M/H Service" is similar in general concept to a virtual channel as defined in ATSC A/65 [12]. An M/H Service is currently defined[1] to be a package of IP streams transmitted through M/H Multiplex, which forms a sequence of programs under the control of a broadcaster which can be broadcast as part of a schedule. Typical examples of M/H Services include TV services and audio services. Collections of M/H Services are structured into M/H Ensembles, each of which consists of a set of successive RS Frames.

In general, there are two types of files that might be delivered using the methods described in this standard. The first of these is content files, such as music or video files. The second type of file that may be transmitted is a portion of the service guide. This includes long- and short-term keys for service protection, logos, and SDP files. In either case, the delivery mechanisms are the same and it is up to the terminal to resolve the purpose of the files.

5.1.3 Part 4, Announcement

In an M/H system, the Services available from a broadcaster (or another broadcaster) are announced via the Announcement subsystem. Services are announced using a Service Guide. A Service Guide is a special M/H Service that is declared in the Service Signaling subsystem. An M/H receiver determines available Service Guides by reading the Guide Access Table for M/H (GAT-MH). This table lists the Service Guides present in the M/H broadcast, gives information about the service provider for each guide, and gives access information for each guide.

The ATSC-M/H Service Guide is an OMA BCAST Service Guide, with constraints and extensions as specified in this standard. A Service Guide is delivered using one or more IP streams. The main stream delivers the Announcement Channel, and zero or more streams are used to deliver the guide data. If separate streams are not provided, guide data is carried in the Announcement Channel stream.

5.1.4 Part 5, Application Framework

The primary objective for the M/H platform is to deliver a set of audio and/or video services from a transmission site to mobile or portable devices. The Application Framework enables the

[1] The system design is independent of the choice of the protocol at this layer. MPEG-2 Transport Stream packets were supported in the original submission, IP was selected as the transport means for this release and others are supportable in the future via the means outlined in Section 6.

broadcaster of the audio-visual service to author and insert supplemental content to define and control various additional elements to be used in conjunction with the M/H audio-visual service. It enables definition of auxiliary (graphical) components, layout for the service, transitions between layouts and composition of audio-visual components with auxiliary data components. Furthermore, it enables the broadcaster to send remote events to modify the presentation and to control presentation timeline. The Application Framework further enables coherent rendering of the service and its layout on a variety of device classes and platforms, rendering of action buttons and input fields, and event handling and scripting associated with such buttons and fields.

5.1.5 Part 6, Service Protection

Service Protection refers to the protection of content, be that files or streams, during its delivery to a receiver. Service Protection is an access control mechanism intended for subscription management. It establishes no controls on content after delivery to the receiver.

The ATSC-M/H Service Protection system is based on the OMA BCAST DRM Profile. It consists of the following components:

- Key provisioning
- Layer 1 registration
- Long-Term Key Message (LTKM), including the use of Broadcast Rights Objects (BCROs) to deliver LTKMs
- Short-Term Key Messages (STKM)
- Traffic encryption

The system relies on the following encryption standards:

- Advanced Encryption Standard (AES)
- Secure Internet Protocol (IPsec)
- Traffic Encryption Key (TEK)

In the OMA BCAST DRM Profile there are two modes for Service Protection—interactive and broadcast-only mode. In interactive mode, the receiver supports an interaction channel to communicate with a service provider, in order to receive Service and/or Content Protection rights. In broadcast-only mode, the receiver does not use an interaction channel to communicate with a service provider. Requests are made by the user through some out-of-band mechanism to the service provider, such as calling a service provider phone number or accessing the service provider website.

5.1.6 Part 7, AVC and SVC Video System

The M/H system uses MPEG-4 Part 10 AVC and SVC video coding as described in ITU-T Rec. H.264 | ISO/IEC 14496-10, with certain constraints.

5.1.7 Part 8, HE AAC Audio System

The M/H system uses MPEG-4 Part 3 HE AAC v2 audio coding as described in ISO/IEC 14496-3 (with Amendment 2), with certain constraints. HE AAC v2 is used to code mono or stereo audio and is a combination of three specific audio coding tools, MPEG-4 AAC, Spectral Band Replication (SBR) and Parametric Stereo (PS).

5.1.8 Part 9, SFCMM

Part 9 describes the Scalable Full Channel Mobile Mode (SFCMM) of the ATSC Mobile DTV system, consisting of capabilities compatible with A/53 receivers, extended scalable capabilities compatible with ATSC M/H receivers, and an incompatible extension capable of using the full 6

MHz channel. The SFCMM system provides mobile/pedestrian/handheld broadcasting services using a portion of or the whole of the ~19.39 Mbps ATSC 8-VSB payload, while the remainder is still available for HD and/or multiple SD television services. Annex A of this Part 1 contains the normative references to the Parts (of A/153) that comprise SFCMM.

5.1.9 Part 10, M-EAS

Part 10 describes the Mobile Emergency Alert System (M-EAS) of the ATSC Mobile DTV system, consisting of the emergency alert tables, signaling for wake-up, automatic tuning, and additions for non-real-time transmission.

6. SYSTEM CONFIGURATION SIGNALING

To enable future development of the M/H system, the many system elements are grouped into functional units called elementary subsystems. These elementary subsystems generally correspond to the M/H protocol stack shown in Figure 5.2. Recognizing that the mobile technology is subject to rapid change, the requirements on the system to respond to these changes were formalized. The syntax and semantics to implement these requirements are distributed throughout the Parts.

6.1 Signaling Capabilities

The M/H signaling system enables the following capabilities:

- Capable of signaling the addition of a new elementary subsystem. For example, a Digital Rights Management capability may be added.
- Capable of signaling the removal of an elementary subsystem. For example, service protection is removed and replaced with functionality that resides outside of the ATSC system; i.e., an out-of-band method.
- Capable of signaling the replacement of an elementary subsystem. For example, one encryption is replaced with another encryption—the black box operation is equivalent.
- Capable of signaling service compatibility in an expedient manner, where the receiver is able to determine if it can support a service within one complete M/H frame time.
- Capable of signaling all functionality needed to support service correctly (i.e., transport, file management, SVC sync, and so on).
- Capable of enabling the ESG subsystem to avoid display of an event choice that cannot be provided to the user.
- Capable of signaling of the elementary subsystem functions completely enough for the receiver to determine whether or not it can process the content that it receives.
- Capable of signaling multiple generations of service carried concurrently, in the same ATSC M/H emission.
- Capable of signaling services that are intended for the equivalent of a multicast group (target is subset of receivers grouped by activity).
- Capable of signaling legacy services with optional extensions, such that the legacy receiver ignores the optional functionality signaling, and supports the legacy portion of the service.
- Capable of changing the System Configuration Signaling system protocol without adversely affecting products built to the original signaling protocol.
- Capable of supporting a receiver determining a channel is out of service.
- Capable of signaling that the protocol version of a single elementary subsystem has changed.

- Capable of communicating a code for the version of each elementary subsystem required to decode and correctly display the services offered.

6.2 Signaling Approach

The M/H signaling approach is hierarchical with the physical RF layer being considered the bottom of the stack (see Figure 5.2). Much of the signaling for the RF layer is defined as integral parts of the data structure in the other Parts of the M/H standard. At the bottom-most layer is a simple (one-bit) signaling method. A major change of the entire physical layer can be signaled by use of another such bit. Other signaling for the RF layer is implemented with a simple version field in key data structures, each of which enables signaling of changes in higher data structures.

In general, at higher layers more signaling capability is established reflecting the increasing likelihood of change in those layers as time progresses.

Annex A: Scalable Full Channel Mobile Mode (Normative)

A.1 INTRODUCTION

This annex describes the Scalable Full Channel Mode (SFCMM) of the ATSC Mobile DTV system, hereafter referred to as the ATSC mobile/handheld (M/H) system.

SFCMM increases the capacity of the ATSC-M/H system in a scalable manner up to full utilization of the channel. To distinguish this new mode from the original mode described in the body of this document, the original mode has been named "Core Mobile Mode."

A.2 DEFINITION OF TERMS

A.2.1 Acronyms and Abbreviations

In addition to the acronyms and abbreviations defined in Section 3.3, the following acronyms and abbreviations are used within Scalable Full Channel Mobile Mode.

BEM – SCCC Block Extension Mode

CMM – Core Mobile Mode

SCB1…SCB11 – SCCC (serial concatenated convolutional coding) blocks number 1 through number 11

SFCMM – Scalable Full Channel Mobile Mode

SM – Scalable Mode

A.2.2 Terms

In addition to the terms defined in Section 3.4, the following terms are used within Scalable Full Channel Mobile Mode.

Core Mobile Mode – A mode in which Mobile DTV services are transmitted while reserving at least 38 of the 156 packets in an M/H Slot for Main A/53-compatible services. Modes in A/153 are scoped to Slots; thus this definition is applicable on a Slot by Slot basis.

M/H Ensemble (or simply "Ensemble") – A collection of consecutive RS Frames with the same FEC codes, where each RS Frame encapsulates a collection of IP streams.

- **CMM Ensemble**[2] – A Primary or Secondary Ensemble as defined in ATSC A/153 Part 2 [2].
- **SFCMM Ensemble** – A Primary or Secondary Ensemble that carries a collection of SFCMM Services and is backwards compatible with, but not recognizable by, a CMM receiver/decoder.

M/H Group – At the MPEG-2 transport stream level, a collection of 118 MHE MPEG-2 transport packets + x additional MHE-encapsulated transport packets delivering M/H service data(x<=38 TS packets); also, the corresponding data symbols in the 8-VSB signal after interleaving and trellis coding.

M/H Group Region (or simply "Group Region") – A defined set of M/H Blocks, designated as Region A, B, C, D or E.

[2] M/H Ensemble is categorized into a number of types in a hierarchical manner.

M/H Parade[3] (or simply "Parade") – A collection of M/H Groups that have the same M/H FEC parameters. Each M/H Parade carries one or two M/H Ensembles.

- **CMM Parade** – An M/H Parade that is compatible with the CMM system. A CMM Parade consists of M/H Groups, where each M/H Group does not include the Group Region E and carries an entire RS Frame belonging to the corresponding CMM Ensemble.
- **SFCMM Parade** – An M/H Parade consisting of M/H Groups, where each M/H Group contains the Group Region E and carries an entire RS Frame belonging to the corresponding SFCMM Ensemble. An SFCMM Parade may consist solely of SFCMM content or may contain content that is recognizable by a CMM system receiver/decoder.

M/H Service – A package of packetized streams transmitted via an M/H Broadcast, which package is composed of a sequence of events which can be broadcast as part of a schedule.

- **CMM Service** – An M/H Service as defined in ATSC A/153 Part 2 [2].
- **SFCMM Service** – An M/H Service that is delivered through an SFCMM Ensemble and therefore is not recognizable by a CMM receiver/decoder.

M/H Slot[4] (or simply "Slot") – A portion of an M/H Sub-Frame consisting of 156 consecutive MPEG-2 transport packets. A Slot may consist solely of all TS-M (main) packets or may consist of 118 M/H packets and 38 TS-M packets or may consist of 118 + x M/H packets and y TS-M packets (x+y=38 TS packets). There are 16 M/H Slots per M/H Sub-Frame. Note: TS-M is Transport Stream Main as defined in A/53 Part 3 [3].

- **CMM Slot** – A CMM slot shall be an M/H Slot as defined in ATSC A/153 Part 2 [2] (which consists of 118 M/H packets and 38 TS-M packets). Modes are defined to be scoped to Slots by ATSC A/153 Part 2 [2]; thus this definition is applicable on a Slot by Slot basis.
- **SFCMM Slot** – A Slot that shall consist of 118 + x M/H packets and y TS-M packets (x+y=38 TS packets). Modes in A/153 are scoped to Slots by Section 5.3 of ATSC A/153 Part 2 [2]); thus this definition is applicable on a Slot by Slot basis.

Scalable Full Channel Mobile Mode – A mode in which Mobile DTV services are transmitted while reserving fewer than 38 of the 156 packets in an M/H Slot for Main A/53-compatible services. Modes in A/153 are scoped to Slots; thus this definition is applicable on a Slot by Slot basis. Scalable Full Channel Mobile Mode may apply to some or all of the Slots in a Mobile DTV transmission.

A.3 ATSC-M/H SFCMM DEFINITION

Documentation of the ATSC-M/H SFCMM has been organized into self-contained Parts. The Parts referenced below establish the characteristics of the subsystems necessary to accommodate the services envisioned:

1) When SFCMM is added to the ATSC-M/H system, the RF and transmission system shall be as defined in A/153 Part 9 [9].
2) When SFCMM is added to the ATSC-M/H system, the service multiplex and transport subsystem characteristics shall be as defined in the A/153 Part 9 [9].

[3] M/H Parade is categorized into a number of types in a hierarchical manner.

[4] The definition of M/H Slot in ATSC A/153 Part 2 [2] is expanded in this Part to incorporate the newly introduced M/H Group Region E and Group formats.

3) When SFCMM added to the ATSC-M/H system, the announcement method shall be as defined in A/153 Part 4 [4].
4) When SFCMM is added to the ATSC-M/H system, the presentation framework shall be as defined in A/153 Part 5 [5].
5) When SFCMM is used with Service Protection, it shall be as defined in the provisions of A/153 Part 6 [6].
6) When SFCMM is added to the ATSC-M/H system, video coding shall be as defined in A/153 Part 7 [7].
7) When SFCMM is added to the ATSC-M/H system, audio coding shall be as defined in A/153 Part 8 [8].
8) When SCFMM is added to the ATSC-M/H system, emergency alerting shall be as defined in A/153 Part 10 [10].

The Parts listed above, taken together with requirements 1–8 of Section 4, totally define all of the aspects when SFCMM is used. The Parts listed above contain the required elements and some optional elements. Additional ATSC standards may define other required and/or optional elements.