Recommended Technical Framework Document

Version 1.0

Recommended technologies for an end-to-end system model for streaming media over wireless networks

Stardust.com, Inc.
15575 Los Gatos Blvd., Suite C
Los Gatos, California 95032
Phone: 408-402-0566
Fax: 408-402-0567

www.wmmforum.com

Charter Members


Executive Members

www.hantro.com


General Members

www.hutchison3G.com

www.neomagic.com

Content Members

www.warnerbros.com

Managing Member

Wireless Multimedia Forum
Technical Working Group

Recommended Technical Framework Document (RTFD)

Version 1.0

January 2001

Table of Contents

List of Figures

List of Tables

1 Scope

This document is a product of the WMF Technical Working Group, and its purpose is to describe an end-to-end system model that can be used for multimedia streaming and communication over wireless networks, and to recommend the formats, protocols, and APIs which will ensure interoperability among different vendors' implementations.

2 Document Status

This document has been approved for public release by the Wireless Multimedia Forum. Any comments should be submitted to wmmforum@stardust.com.

3 Introduction

3.1 Purpose

The Wireless Multimedia Forum was established to ensure interoperability of content, services and devices for multimedia streaming and communication over wireless networks.

3.2 Applications

The following areas are the target applications (wireless multimedia services) that will be supported under the technical framework:

1) SMM: Streaming multimedia (on-demand/live/scheduled)
2) DMM: Downloading multimedia
3) UMM: Uploading multimedia
4) MMM: Multimedia messaging (e.g. video email)
5) WVS: Wireless Video Surveillance (e.g. wireless video camera)
6) MMC: Real-time multimedia communication (e.g. videophone, videoconferencing)
7) IMG: Interactive multimedia games

Some of these applications, such as video communication, might already have a technical framework that is completely defined by some standards body, such as 3GPP or ITU. If this is the case, this document will reference the relevant standard(s) for the specific application(s). Other applications, such as SMM, may not yet be completely defined by existing standards, in which case this document will reference standard(s) that comprise the appropriate portions of the technical framework, and describe the means of ensuring interoperability between such standards.

In order to reduce the complexity and focus the scope of the Technical Working Group, the applications have been ordered according to their priority. The Recommended Technical Framework Document (RTFD) Version 1.0 will address the first application (SMM).

4 References

4.1 Normative references

1. Information Technology – Coding of audio-visual objects – Part 2: Visual, ISO/IEC FDIS 14496-2

2. Information Technology – Coding of audio-visual objects – Part 3: Audio, ISO/IEC FDIS 14496-3

3. Text for ISO/IEC 14496-1/PDAM1 (MPEG-4 version 2 Intermedia Format -MP4), David Singer/Apple Computer & William Belknap/IBM, July 1999, MPEG Committee Document N2801 subpart 4.

4. Request for Comments: 1889 - RTP: A Transport Protocol for Real-Time Applications, H. Schulzrinne, S. Casner, R. Frederick and V. Jacobson.

5. Request for Comments: 2326 – Real Time Streaming Protocol (RTSP), H. Schulzrinne/Columbia U., A. Rao/Netscape, R. Lanphier/RealNetworks, April 1998.

6. Request for Comments: 2327 – Session Description Protocol (SDP), M. Handley/ACIRI, V. Jacobson/LBNL, April 1998.

7. Apple Computer Inc., The QuickTime File Format, June 28, 2000.

8. Request for Comments: 2429 - RTP Payload Format for the 1998 Version of ITU-T Rec. H.263 Video (H.263+), C. Bormann/ Univ. Bremen, L. Cline/Intel, G. Deisher/Intel, T. Gardos/Intel, C. Maciocco/Intel, D. Newell/Intel, J. Ott/Univ. Bremen, G. Sullivan/PictureTel, S. Wenger/TU Berlin, C. Zhu/Intel, October 1998

9. Request for Comments: 3016 - RTP Payload Format for MPEG-4 Audio/Visual Streams, Y. Kikuchi, Y. Kikuchi/Toshiba, T. Nomura/NEC, S. Fukunaga/Oki, Y. Matsui/Matsushita, H. Kimata/NTT, November 2000.

10. 3GPP, “Mandatory Speech Codec speech processing functions- AMR Speech Codec; General Description,” document 3G TS 26.071, V.3.0.1, 1999-08.

11. 3GPP, “Mandatory Speech Codec speech processing functions-AMR Speech Codec, Transcoding functions,” document 3G TS 26.090, V.3.1.0, 1999-12.

4.2 Informative references

1. Internet Draft: RTP payload format for AMR <draft-ietf-avt-rtp-amr-02.txt>, Johan Sjoberg/Ericsson, Magnus Westerlund/Ericsson, Ari Lakaniemi/Nokia, Petri Koskelainen/Nokia, Berhard Wimmer/Siemens, Tim Fingscheidt/Siemens, Qiaobing Xie, Motorola, Sanjay Gupta, Motorola, December 22, 2000.

2. Internet Draft : RTP Payload Format for EVRC <draft-mccann-avt-rtp-evrc-00.txt>, Tom Hiller, Peter J. McCann, Michael D. Turner, Ajay Rajkumar, Lucent Technologies, December 2000.

3. Internet Draft : RTP Profile for Audio and Video Conferences with Minimal Control < draft-ietf-avt-profile-new-09.txt>, Schulzrinne/Casner, Columbia U./Packet Design, July 14, 2000

5 Definitions

The words SHALL, MAY and SHOULD are defined according to IETF RFC 2119.

6 Abbreviations and symbols

6.1 Abbreviations

3GPP	3rd Generation Partnership Project
BIFS	BInary Format for Scenes
CCS	Content Creation Subsystem
CS	Content Stream
DMM	Downloading Multimedia
FFS	For Future Study
IMG	Interactive Multimedia Games
ITU	International Telecommunication Union
MDS	Multimedia Distribution Subsystem
MMC	Multimedia Communication
MMM	Multimedia Messaging
MPEG	Motion Pictures Expert Group
N/A	Not Applicable
RTCP	Real-Time Control Protocol
RTFD	Recommended Technical Framework Document
RTP	Real-Time Protocol
RTSP	Real-Time Streaming Protocol
SMIL	Synchronized Multimedia Integration Language
SMM	Streaming Multimedia
TBD	To Be Defined
TWG	Technical Working Group
UMM	Uploading Multimedia
WMF	Wireless Multimedia Forum
WMT	Wireless Multimedia Terminal
WS	Wireless stream
WVS	Wireless Video Surveillance

7 The WMF End-to-End System Model

The following diagram describes an end-to-end system model for supporting the SMM and DMM applications over wireless systems.

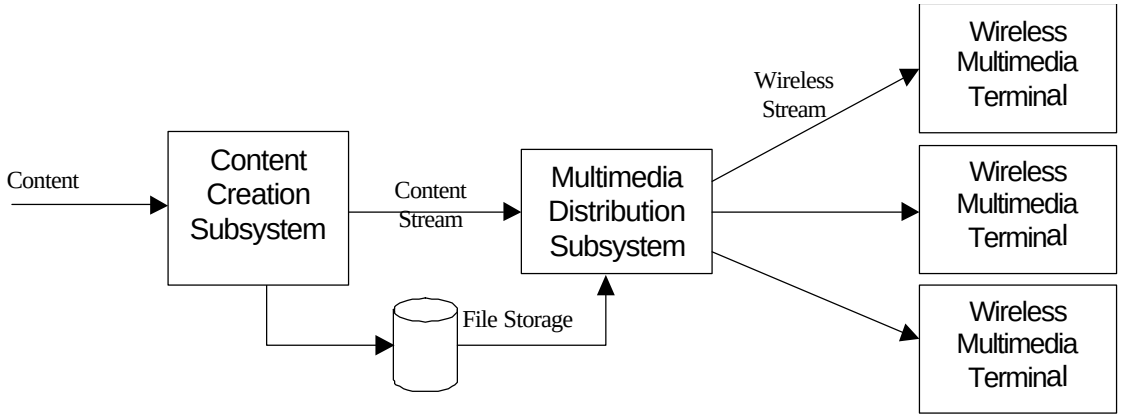

Figure 1 End-To-End SMM and DMM System Model

As shown in Figure 1, the content is created off-line or in real-time by the Content Creation Subsystem (CCS), delivered by the Multimedia Distribution Subsystem (MDS), and consumed or stored by the Wireless Multimedia Terminal (WMT).

The purpose of this document is to provide technical recommendations to enable interoperability between the three different units (CCS, MDS and WMT). Recommendations will only be made for those parts of the system, and the related communication protocols, required to ensure such interoperability and allow a flexible framework for different applications and services.

7.1 Content Creation Subsystem

The Content Creation Subsystem (CCS) is responsible for taking raw or compressed media content, which is stored in a file or captured in real-time, converting it to a Content Stream (CS) that is suitable for delivery, and sending it to the MDS. The CS can also be stored in a file storage, from which the MDS reads the CS and distributes it to the WMT.

The following sections define the recommended standards for use by the CCS:

- Codecs: See section 8.3.
- File Format: See section 8.4.

7.2 Multimedia Distribution Subsystem

The Multimedia Distribution Subsystem (MDS) receives the multimedia content from the Content Creation Subsystem (CCS) and streams the content to Wireless Multimedia Terminals (WMT), live or with a delay. The MDS also can stream pre-stored content to different terminals and also manipulate and/or re-purpose the content according to the attributes and functions that are provided in the following sections. Note that the current version of the RTFD defines the exchange between CCS and MDS only through the file storage, and not the CS. Specifics of the CS will be defined in a future version of the RTFD.

The following sections define the recommended standards for use by the MDS:

- Session Initiation, Setup and Media Control: See section 8.1.1.
- Transport: 8.2.
- Codecs: See section 8.3.
- File Format: See section 8.4.

7.3 Wireless Multimedia Terminal

The Wireless Multimedia Terminal (WMT) receives the multimedia content from the Multimedia Distribution System, and displays it to the user. The content may be either live or on-demand streaming media for the SMM application, or a downloaded multimedia file for the DMM application. The content may be locally stored by the WMT, depending on the "wmf_allowrecord" attribute of SDP (see section 8.1.1).

The following sections define the recommended standards for use by the WMT:

- Session Initiation, Setup and Media Control: See section 8.1.1.
- Transport: 8.2.
- Codecs: See section 8.3.
- File Format: See section 8.4.

8 Recommended Standards

8.1 Setup and Control Protocols

8.1.1 Session Initiation, Setup and Media Control

Media control SHALL be implemented using RTSP over TCP/IP. The minimal RTSP implementation described in Appendix D of [RFC2326] SHALL be used, with the addition of the DESCRIBE method.

SDP SHALL be used as the format of the presentation description for both the MDS and the WMT. MDS SHALL send SDP data and the WMT SHALL interpret the SDP data according to SDP specification [RFC2327] and Appendix C, section 1.5 of [RFC2326].

The MDS SHALL signal if the WMT is allowed to store any media tracks through the SDP "wmf_allowrecord" attribute (see below). The WMT SHALL comply with this signal.

The specific SDP attributes are defined below:

8.1.1.1 SDP Internationalization

The SDP specification recommends the use of the ISO 10646 character sets in UTF-8 encoding (RFC 2044) to allow many different languages to be represented. However, to assist in compact representations, SDP also allows other character sets such as ISO 8859-1 to be used when desired. Internationalization only applies to free-text fields (session name and background information), and not to SDP as a whole.

8.1.1.2 The General SDP format tags

The same general format tags as defined in RFC 2327 SHALL be used.

8.1.1.3 WMF SDP specifications

This section provides a list of SDP tags and attributes for which this version of the WMF RTFD provides specific usage requirements. WMF systems SHALL use the specified tag arguments and attributes as described below. SDP tags, arguments, and attributes which are not specified below SHALL be used as defined in SDP (RFC 2327), with additions as defined below. WMF-specific attributes are identified by the "wmf_"prefix.

8.1.1.3.1 Session section

The a=range attribute SHALL be used as defined in RTSP (IETF RFC 2326) Appendix C section C.1.5.

Field name	Attribute – Minimal DRM control (WMF specific)
Format	a=wmf_allowrecord
WMF	This field is optional at the session level as well as the media level in order to control media recording at the stream/media level. If the wmf_allowrecord attribute occurs at the session level, then all streams in the session may be recorded at the WMT. If it is absent at the session level, then the ability to record shall be controlled by media-level occurrences of wmf_allowrecord. If the field does not exist, media recording at the WMT is not allowed.

Field name	Attribute – WMF Version
Format	a=wmf_version:<version_number>
WMF	version_number = 1.0 This attribute is required at the session level to a session which follows the WMF recommendation.

8.1.1.3.2 Media section

8.1.1.3.2.1 Speech – GSM/AMR Narrowband

The SDP specifications, as defined in "RTP payload format for AMR" - draft-ietf-avt-rtp-amr-02.txt SHALL be used.
When this draft is approved by IETF as an RFC, this document will be updated.

8.1.1.3.2.2 Speech – EVRC

The SDP specifications, as defined in "RTP Payload Format for EVRC" - draft-mccann-avt-rtp-evrc-00.txt SHALL be used.
When this draft is approved by IETF as an RFC, this document will be updated.

8.1.1.3.2.3 Video – MPEG-4 Visual Simple Profile@Level 0

The SDP specifications, as defined in RFC 3016 - RTP Payload Format for MPEG-4 Audio/Visual Streams.txt SHALL be used.

8.1.1.3.2.4 Video – H.263 Baseline and H.263 Profile 3@Level 10 (optional CODEC)

The SDP specifications, as defined in "RTP Profile for Audio and Video Conferences with Minimal Control" - draft-ietf-avt-profile-new-09.txt SHALL be used.
When this draft is approved by IETF as an RFC, this document will be updated.

8.1.1.3.2.5 Additional WMF Video attributes

Field name	Attribute – format parameters
Format	a=fmtp:<format> <format specific parameters>
WMF	Format specific parameters = "wmf_framesize=<width>-<height>"

8.1.1.4 SDP Example

```
v=0
o=- 1 1 IN IP4 198.80.86.110
s=NewsHeadlines
c= IN IP4 0.0.0.0
t=0.000000 80.867000
a=range:npt=0 80.867000
a=wmf_allowrecord
m=audio 40 RTP/AVP 97
a=rtpmap:97 AMR/1000
a=fmtp:97 mode-set=0,2,5,7;maxframes=2
b=AS:4.3
m=video 50 RTP/AVP 98
a=rtpmap:98 MP4V-ES/1000
b=AS:56
a=fmtp:98 profile-level-id=8;wmf_framesize=176-144
```

8.2 Transport Protocols

RTP over UDP [RFC1889, RFC1890] SHALL be used as the means of transport for streaming multimedia content (speech, audio and video) from MDS to WMT.
The payload formats are defined as the following:

- Speech:
  - GSM-AMR: RTP Packetization of GSM-AMR is still in Internet Draft status. When the RTP packetization for GSM-AMR is approved by IETF as an RFC, this document will be updated.
  - EVRC: RTP Packetization of EVRC (3GPP2 Speech Codec) is still in Internet Draft status. When the RTP packetization for EVRC is approved by IETF as an RFC, this document will be updated
- Video:
  - MPEG-4 Visual: IETF RFC3016
  - H.263: IETF RFC 2429

8.3 Codecs

8.3.1 Speech

GSM-AMR speech codec SHALL be supported.
The EVRC speech codec (3GPP2 speech codec) MAY be supported.

8.3.2 Video

MPEG-4 Visual Simple Profile@Level 0 codec SHALL be supported.
ITU-T H.263 baseline also SHALL be supported.
ITU-T H.263 Profile 3@Level 10 MAY be supported.

8.4 File Storage Format

MPEG-4 File Format SHALL be used for transferring of the stored content between the content creation subsystem and the multimedia distribution subsystem. The specific parameters and restrictions on the MPEG-4 File Format are defined below.

8.4.1 WMF Set Atom

New atoms named WMF Set Session Atom ('wmfs') and WMF Set Media Atom ('wmfm') SHALL be introduced in User Data Atom ('udta') in order to indicate that the file is created under the restriction of WMF file format. The syntax and semantics of the WMF Set Atoms are defined below. The WMF Set Session Atom is defined at the movie level, and the WMF Set Media Atom is defined at the track level.

```
aligned(8) class WMFSetSessionAtom extends FullAtom (‘wmfs’, 0, 0){
        unsigned int(32)        major_version
        unsigned int(32)        minor_version
        bit(31)                 reserved
        bit(1)                  storable flag
}

aligned(8) class WMFSetMediaAtom extends FullAtom (‘wmfm’, 0, 0){
        bit(31)                 reserved
        bit(1)                  storable flag
        unsigned int(32)        codec-type
}
```

major_version, **minor_version**
: indicates the version of the WMF profile applied to this file. This is currently set to 1 and 0 respectively.

storable flag
: indicates if the media data contained in this file is storable at the WMT.
0: not storable, 1: storable.

codec-type

indicates the media codec in this file. This field consists of four 8-bit segments. The first segment indicates the media type (audio=0 or video=1), and the next 3 segments indicate codec, profile and level respectively, as follows:

```
aligned(8) class codec-type() {
    unsigned int(8)     media-type;
    unsigned int(8)     codec;
    unsigned int(8)     profile;
    unsigned int(8)     level;
}
```

The actual values of codec-type are shown in Table 1 below.

Table 1 codec-type

codec-type				Description
Media-type	Codec	profile	Level	
0	1	0	0	AMR
0	2	0	0	EVRC
1	1	1	0	MPEG-4 Simple Profile@Level 0
1	2	0	10	H.263 baseline
1	2	3	10	H.263 Profile 3@Level 10
-	255	-	-	unspecified

The two variants of WMF Set Atom are used as follows: The 'wmfs' variant is used at the movie level to signal that the file complies with the WMF file format definition. It also conveys the RTFD version number as well as the session-level storability information. The 'wmfm' variant is used at the track level to indicate the codec-type and storability information corresponding to each track.

8.4.2 Hint track

The hint track serves information to describe to a MDS how to deliver media streams in the WMF file to a WMT over the network. Hint tracks are used only at the MDS to construct RTP packets, and are not delivered to the WMTs.

The hint sample data format defined in Chapter 3 of the QuickTime File Format [7] SHOULD be supported by the MDS. Other hint data formats MAY be defined outside of WMF, however these SHOULD be ignored by any WMF server which does not recognize them. The data format field in the hint sample description atom SHALL be used to identify the hint data format. Data format 'wmfr' is currently defined for the WMF hint data format.

The WMF hint sample data format is based on the QuickTime hint track defined in Chapter 3 of the QuickTime File Format [7] with some additions and restrictions as listed below. The WMF hint data format SHOULD be supported by the MDS. The use of the WMF hint sample data format SHALL be signaled in the WMF file format by a <protocol> value of 'wmfr' in the

HintSampleEntry that is contained within the SampleDescriptionAtom inside the hint track.[1]
Other hint data formats with other protocol values MAY be defined outside of WMF.
However, these SHOULD be ignored by any WMF server which does not recognize them.

8.4.2.1 Default Hint Track Sample

When the RTP hint media data of the QuickTime is used, the following restrictions apply:

1) The 'X' value of the RTP header information in the packet table SHALL be set to 0.
2) The 'R' value of the flags in the packet table SHALL be set to 0.
3) The value of data source of the data table in the packet table SHALL be set to 1 or 2.
4) When the value of the data source in the data table is 2, the value of 0x00 is forbidden for the track_reference_index.
5) When the value of the data source in the data table is 2, the bytes per compression block and the sample per compression block SHALL be set to 0.

8.4.2.1.1 Extra Information TLV

The QuickTime hint track format allows for user-defined extensions, which are specified in terms of Type-Length-Value (TLV). WMF defines a set of TLVs that indicate a priority per packet basis. TLVs of the Delay Preference and Drop Preference MAY be used by the MDS or the subsequent network system as a hint on how this packet should be handled. The syntax and semantics of TLV are defined in QuickTime File Format [7].

For the Delay Preference TLV, the following semantics SHALL apply.

Size	always set to 12
Type	'dely' SHALL be used
Data	A single 32-bit integer which indicates the delay preference value.

For the Drop Preference TLV, the following semantics SHALL apply.

Size	always set to 12
Type	'drop' SHALL be used
Data	A single 32-bit integer which indicates the drop preference value.

If the MDS finds any other types of TLV, MDS SHALL ignore and skip them if they are not understandable.

8.4.2.2 Hint Information Atom

When the hint track for a media is used, the hint track MAY contain the hint information atom ('hinf'). The syntax and semantics of the hint information atom are defined in QuickTime File Format [7]. WMF defines the following two child atoms that indicate the default value when no Delay Preference TLV nor Drop Preference TLV is present in the packet table entry of the hint samples.

```
aligned (8) class DelayPreferenceChildAtom extends Atom ('dely') {
        unsigned int (32)       delay_preference;
}

aligned (8) class DropPreferenceChildAtom extends Atom ('drop') {
```

[1] The <protocol> field is described here in terms of MPEG-4 File Format terminology. In QuickTime terms, it corresponds to the « data format » field in the hint sample description atom [7].

```
        unsigned int (32)       drop_preference;
}
```

8.4.2.3 SDP Atom

WMF files SHOULD contain SDP atoms. Session-level SDP information SHOULD be placed in a movie-level sdp atom, and media-level SDP information SHOULD be placed in track-level sdp atoms as described in Chapter 3 of the QuickTime File Format [7].

8.4.3 IOD Atom

The codec type and profile/level information corresponding to each media track SHALL be specified using fields within the WMF Set Atom as described earlier. Because these fields may not be available to a non-WMF server, a WMF file SHOULD also set the ProfileLevelIndication fields in the 'iods' atom and the objectTypeIndication in the 'esds' atom. These fields SHOULD be set to the appropriate values for the required MPEG-4 codec and profile/level. For non-MPEG-4 codecs such as AMR, the following values SHOULD be used:

videoProfileLevelIndication = 0x80 (user private)
audioProfileLevelIndication = 0x80 (user private)
objectTypeIndication = 0xC0 (user private)

A WMF-compliant MPEG-4 file does not require object-descriptor (OD) tracks or scene description (BIFS) tracks. A WMF-compliant server SHOULD ignore any such tracks and instead deduce the simple audio/visual scene description by parsing the meta-data and 'trak' atoms present at the movie level. For this reason, ES_Descriptors present in the 'iods' atom may be safely ignored by a WMF-compliant server. A WMF file MAY contain ES_Descriptors as well as a BIFS and/or OD track if these are required for operation with non-WMF servers.

8.4.4 Supported Atoms

The MDS SHALL support all atoms that are MP4 mandatory as defined in [3]. Table 2 contains a list of additional atoms in order to indicate WMF-specific requirements. The atoms indicated in the column "WMF Mandatory" are atoms that SHALL appear in all WMF-compliant MP4 files and SHALL be supported by the MDS. The atoms indicated in the column "MDS Recommended" are atoms that MAY appear in WMF-compliant MP4 files. Support for these atoms is recommended for the MDS. Unsupported or unknown atoms should be ignored at the MDS.

Table 2 WMF Atoms for MDS

Type	Atom Name	Mandatory	Recommended
'tref'	Track Reference[1]		X
'edts'	Edit[2]		X
'elst'	Edit List[2]		X
'stss'	Sync Sample[3]		X
'mdat'	Media Data[4]	X	
'udta'	User Data	X	
'wmfs'	WMF Set Atom (Session)	X	
'wmfm'	WMF Set Atom (Media)	X	
'hnti'	Hint Information Atom[1]		X
'sdp '	SDP Atom[1]		X

1. The Track Reference Atom SHALL be present when hint tracks are used. The Hint Information and SDP Atoms MAY be present when hint tracks are used. The 'tref' atom is used by the hint track to indicate which track(s) it is providing hint information for. The 'hnti' and 'sdp ' atoms provide the SDP data at the movie level as well as within the actual hint track.
2. These atoms MAY be present in a WMF-compliant MP4 file and are used to synchronize the playback of the separate audio and video streams.
3. This atom is used when random access to the media stream is requested. This atom contains a table of all the samples within the track that are random access points within the stream (i.e. the I-frames). If this atom is not present, all samples are taken to be random access points.
4. This atom becomes mandatory because of the restriction that all the media in the MP4 file is self-contained. This imposes a restriction on the Data Reference Atom ('dref') in that the entry-flags field shall always be '1', which means that no external data reference is used.

8.4.5 Media Data Format

The following sections define the format of media data within the MP4 file. Note that the media data stored in the MP4 file is stored without pre-packetization.

8.4.5.1 MPEG-4 Visual

MPEG-4 Visual bitstreams SHALL be stored in MP4 files as described in [ISO 14496-1] and [ISO 14496-2]. Note that the mode of Decoder Configuration Information transmission when used with Systems is defined in Annex K to [ISO 14496-2].

8.4.5.2 H.263

When H.263 bitstream is stored into MP4 files, one picture frame SHALL be mapped into one sample of an MP4 file.

8.4.5.3 AMR

When an AMR bitstream is stored in a WMF-compliant MP4 file, each audio frame SHALL be mapped into one sample of the MP4 file.

Annex A - System Attributes beyond version 1.0

The following system components are out of the scope of RTFD 1.0. Standards listed in this section should be treated as working assumptions, and may change in the future. These sections will move to the body of the RTFD document after they are finalized.

1. Audio

[MPEG-4 AAC audio codec SHALL be supported for high quality audiovisual streaming applications.
Editor: the profile/level of support AAC to be defined. A new profile for AAC need to be defined by MPEG-4. Will be discussed on email reflector based on radio experts opinion on ER behavior and submit to the next possible MPEG meeting as liaison, and M4IF for AAC IPR issue]
MPEG-1 Layer 3 (MP3) codec MAY be supported for audio-only downloading applications.

2. Video

The issues of extension to Simple Scaleable Profile will be discussed in future versions of this document.

3. Still Natural Image

JPEG still image codec SHALL be supported with the following restrictions:
Baseline DCT, non-differential, Huffman coding, as defined in Table B.1, Symbol 'SOF0'
[under consideration: Progressive DCT, non-differential, as defined in Table B.1, Symbol 'SOF2']

4. Bitmap Graphics

[GIF SHALL be supported, modes to be defined]

5. Text

FFS.

6. Scene Description and Multimedia Synchronization

SMIL and BIFS are the candidate standards for scene description and multimedia synchronization. A recommendation on how one of both of these standards should be used in the context of the RTFD will be included in a future version of this document.

7. Quality of Service Attributes

FFS.

8. Digital Rights Management

V 1.0 allows MDS to limit the usage of the content at WMT for streaming [Session initiation and File storage format sections]. More comprehensive DRM tools will be provided in future versions.

9. Usage tracking, reporting and provisioning for recording purposes

FFS.

10. Personalization

FFS.

Annex B - Evaluation Criteria

The following is a list of evaluation criteria for evaluating standard candidates or technology proposals put forward to the WMF in the July meeting at Yokohama, Japan.

TBD = to be decided.

1. Features/Suitability to requirements

Evaluation of the features provided in a proposed technology/standard candidate against the application requirements and usage domain to the requirements put forward in WMF RTFD.

***Note**: for any proposals, please list clearly the features and how the features can be used to support one or multiple application and technical requirements, and the advantages and disadvantages (suitability) of such.*

2. Cost

This is the aggregate cost that will be directly or indirectly incurred by one or a set of proposed technical or standard features, in the three subsystems – the content creation subsystem, the distribution subsystem, and the wireless terminal subsystem.

a. Complexity/Performance/Footprint
TBD.

b. Development/implementation cost
TBD.

c. Others
TBD.

3. Security

Evaluation against the ease of attacks, existence and impact of such attacks - if any - to any proposed features, malicious or not.

4. Bandwidth consumption

The bit-rates required for the end-to-end system to incorporate the standard candidates or support features.

5. Delay

Estimate the delay of the system, or any subsystem, directly or indirectly impacted by one or a set of proposed features/standards. For example, delay can be a combination of various factors, including computation complexity, channel codes/error resiliency, bit-rate requirement (bandwidth consumption), complexity of security features imposed, and others.

6. Adaptability to channel conditions/different terminals:

One evaluation key factor is how adaptive and scalable is the particular (set of) standard/features across various channel conditions, and different types of wireless terminal devices.

a. Channel Conditions under consideration for evaluation

b. Terminal types under consideration for evaluation

7. Availability/Maturity/Industry acceptance of standards

One evaluation area is the availability of tools and wide acceptance of a set of standards under consideration for developers to build applications, or for users to simply play the audio or video.

a. editing/development tools

b. media players

8. IP/Royalty issues

A factor to be considered is the intellectual property issues surrounding one or a set of standard features under consideration, the pending/potential litigation, and royalty fees if any. (For example, MPEG-4 IP and royalty issues are not resolved and still under discussion and that may impose some uncertainty for adoption of the standard.)

9. Error Resilience

Define the robustness requirements of the transmission/transport under different channel conditions to evaluate the set of candidates under consideration.

10. Scalability

TBD.

11. Extensibility

TBD.