Technical Manual

Creating Media for the Motorola C650 Handset

Version 1.1

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Overview

Welcome to the *Creating Media for the Motorola C650 Handset* guide. This guide contains all the information you need to get started developing pictures, animation, and sounds for the Motorola C650 handset.

The Motorola C650 Handset Guide covers the following areas:

- Display information, including size, color depth, and more
- Graphic support information
- Video support information
- Sound support information

This document assumes you are familiar with creating different media using the appropriate tools. This guide does not cover the tools required to create media, rather, it concentrates on the features and technical abilities of the handset when working with media.

Motorola recommends that if you are not the sole author or creator of the graphics, video, or sound, you obtain sufficient license rights, including the rights under all patents, trademarks, trade names, copyrights, and other third party proprietary rights.

Glossary

The following are definitions of common terms used in this guide:

Term	Definition
AMR	Adaptive Multi Rate
EMS	Enhanced Messaging Service
GIF	Graphics Interchange Format
iMelody	Infrared Data Association (IrDA) standard for the textual representation of a ring tone.
MIDI	Musical Instrument Digital Interface
MIDI Patch	One of the channels in a MIDI device, defined by the general MIDI standard
MPEG	Moving Pictures Experts Group
Pixel	One picture element on the display

Term	Definition
QCIF	Quarter Common Intermediate Format
WAP	Wireless Application Protocol
WBMP	Wireless Bitmap

References

The following references provide information related to developing media for the Motorola C650 handset:

Organization	URL
3GPP	http://www.3gpp.org
Infrared Data Association	http://www.irda.org
MIDI Manufacturers Association	http://www.midi.org
Motorola Developer Program	http://www.motocoder.com
Moving Pictures Experts Group	mpeg.telecomitalialab.com
WAP Forum	http://www.wapforum.org
World Wide Web Consortium	http://www.w3.org
Open Mobile Alliance	http://www.openmobilealliance.org

Display

This chapter describes the display characteristics for the Motorola C650 handset.

C650


Display Info

The physical internal display characteristics of the Motorola C650 handset are identical to each other and are the following:

Item	Description
Screen resolution	128w x 128h pixels
Screen dimensions	27.3 mm x 27.3 mm viewing area
Pixel pitch	.21 mm pitch, square
Color depth	16 bits
Maximum Colors	Up to 65535 colors
Text area	5 lines

Figure 1. **The Motorola C650 display.**

Note: Screen shot may not reflect actual display size.

Graphics & Video

This chapter describes the graphic environment available in the Motorola C650 handset. It includes information on picture and animation formats, size restrictions, pre-defined media, and more. Use this chapter as a reference when creating pictures or animations that support your products.

In general, file size is limited by available memory. All media (wallpaper, screensavers, ring tones, and themes), whether pre-loaded on the device or downloaded by the user, share the same storage area (total of 2.8 MB). The available memory for downloaded files will vary based on the media pre-loaded into the device. This pre-loaded media will vary from region to region and from carrier to carrier. Motorola recommends keeping all media files as small as possible to ensure the consumer has the ability to download and use a variety of files to enhance the user experience.

Supported Picture Formats

The Motorola C650 handset supports the following graphic and animation formats:

Type	Description
EMS 5.0 Bitmaps	Enhanced Messaging Service bitmap
GIF 87a	Graphics Interchange Format, a standard file format for lossless compression of still images. It is used to display static images and is the preferred format for pictures.
GIF 89a	The GIF 89a standard is a superset of the GIF 87a specification. It allows a sequence of GIF images to be displayed in succession that generates an animation.
JPEG	Joint Photography Expert Group standard. JPEG is designed for compressing either full-color or gray-scale images of natural, real-world scenes, not line art or lettering.
WBMP	Wireless Bitmap format described in the WAP specifications. It is an optimized bitmap format intended for use in portable devices with smaller screens and limited display capabilities.

Note: The maximum picture resolution is 640 x 480 (VGA). Any images with a higher resolution will not be displayed.

Supported Video Formats

The Motorola C650 handset supports the following video formats:

Type	Description
MPEG-4	The MPEG-4 format provides standardized technological elements that enable interactive multimedia (video/audio), interactive graphics, and digital television. Codec support includes: • MPEG simple profile Level 0 • SQCIF A maximum of 15 fps is available at a bit rate of 48Kbps when maximum size is 128x96.

Note: Maximum file sizes are determined by the handset's available memory

Enhanced Messaging Service (EMS) Support

The Motorola C650 handset supports use of the following animation settings:

Type	Description
Small	Color, 8 x 8 pixels (32 bytes = 256 bits)
Large	Color, 16 x 16 pixels (128 bytes = 1024 bits)
Frames	4 frames maximum (EMS animations only)
Rate	500 ms
Loop	Continuous

The Motorola C650 handset supports use of the following picture settings:

Type	Description

Type	Description
Small	16 x 16 pixels (32 bytes = 256 bits)
Large	32 x 32 pixels (128 bytes = 1024 bits)
Variable Size	255 x 255 pixels maximum

Note: All pictures will be in .bmp format and can be received in black and white, 2-bit grey scale, and 6-bit color.

The Motorola C650 handset supports use of the following audio settings:

Type	Description
Predefined	Supported as per the EMS standard
User-defined	iMelody format (max size 128 bytes)

Note: EMS messages can support up to 3Kb of inserted objects and 450 characters when sending a message.

Screensaver Support

The Motorola C650 handset support screensavers. **Screensavers** are animated or static images selected by the user that are shown full screen when the phone has been inactive for a period of time.

The recommended format for a screen saver is animated GIF (GIF 89a). Other file types also supported are the following: static GIF (GIF 87a), WBMP, and EMS 5.0 bitmaps.

Technical Specifications for Screen Savers:

- Dimensions: 128 x 128
- Recommended Number of Frames: 9-15
- Colors: Up to 65535
- Recommended File Size: up to 30kb

Screen savers are displayed using the entire screen. In the event an image is larger or smaller than the display, the following rules apply:

- **Image too small** – image is shown at actual size and centered on display.
- **Image too large** – image is resized to fill the display while keeping the original aspect ratio.

		
Image scaled to fit on the display while maintaining the original aspect ratio.	Original Image	Image scaled to fill the display while maintaining the original aspect ratio.

Figure 2. **How large screensaver images are displayed on the screen**

Note: Screen shot may not reflect actual display size.

Note: By default, bars may appear on the left/right or top/bottom of the image to fill the display

If the screensaver is an animation, it plays for one minute and then halts at the first animation frame. This first frame, or key frame, then remains on the screen. Please note when creating the animation, the first frame must be a key frame.

Wallpaper Support

Wallpaper images are static images that are shown on both the idle screen and the main menu screen. Wallpaper images can be tiled or centered as selected by the user; centered is the default setting.

The recommended format for wallpaper images is a static GIF (GIF87a) file. Other file types that can be used as wallpaper image are WBMP, EMS 5.0 bitmaps, and JPEG.

Technical Specifications for Wallpapers:

- Dimensions: 128 x 128
- Colors: Up to 65535
- Recommended File Size: up to 15kb

Wallpaper images are displayed on screen as shown below.

	
Wallpaper image. (example only)	Wallpaper images appear behind all screen elements on the menu screen.

Figure 3. **How wallpaper is displayed on the idle screen and main menu screen.**

Note: Screen shot may not reflect actual display size.

If the user has selected to tile the wallpaper, the image is tiled starting from the upper left hand corner of the working area. The image is tiled horizontally and vertically equal to the display size, as shown in Figure 3.

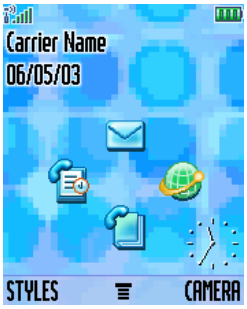
	
Original image	Image set to fill screen.

Figure 4. **A GIF Image as tiled wallpaper.**

Note: Screen shot may not reflect actual display size.

The user has the following options for wallpaper:

- **Center** – the image is resized to fit on the screen while keeping the aspect ratio.

- **Fit-to-screen** – the image is resized to fill the screen while keeping the original aspect ratio (refer to Figure 2).
- **Tile** – if the image is too large, it is resized to fit the display and tiled, if the image is too small, it tiles as displayed.

If the user selects an animated GIF image, the first frame of the animated GIF becomes the wallpaper image. It's important that the colors of the wallpaper image allow the text displayed on the screen to remain legible.

For more information, refer to "Screensaver Support".

Theme Support

The Motorola C650 handset support themes. A **theme** is a wallpaper, a screensaver, and a ring tone combined into a data set that enables users to customize their experience on the handset. Theme components are grouped together and downloaded to the handset as a bundle.

NOTE: The filenames used for screensavers, wallpapers, and ring tones used to create a theme files are limited to 32 characters each (excluding the dot and extension). Longer filenames are automatically truncated by the Media Manager (while retaining the extension) when it creates the theme file. Duplicate filenames are renamed by the phone to ensure they are unique. However, it is recommended you use unique filenames for each media element.

For more information on creating theme bundles, see the documentation that accompanies the Media Manager tools.

NOTE: Recommended file size for themes is 41 KB. The contents are as follows: Screensaver 30 kb, Wallpaper 5 kb, MIDI ringtone 6kb.

The following table describes the Motorola Theme File (.mtf):

Byte 0	3	4 . . .											. . . k
MTF Header	Version	Number of Fields	File Size 1	…	File Size N	Field Label 1	Filename 1 Variable UCS	Separator	...	Field Label N	Filename N Variable UCS	Separator	Checksum
3 Bytes	1 Byte	1 Byte	4 Bytes		4 Bytes	1 Byte	2 Bytes	2 Bytes		1 Byte	2 Bytes	2 Bytes	2 Bytes

K + 1 . . .		
File Contents 1 Variable Bytes	. . .	File Contents 1 Variable Bytes

The following definitions apply to the Motorola Theme File (.mtf):

- **MTF Header** – Contains the string “MTF”
- **Version** – $ 10 represents 1.0, $ 11 represents 1.1, etc
- **Number of Fields** – Denotes how many component files are inside the MTF file
- **File Size X** – Size of file X in bytes. For example, $00000020 equals 32 bytes file size
- **Field Label X** – Represents what type of component for the current file.
    - 0 – Wallpaper
    - 1 – Screensaver
    - 2 – Incoming Ringtone
- **Filename X** – Name of the file in UCS2 format. For example, “abc.def” is represented by $00 $61 $00 $62 $00 $63 $00 $2E $00 $64 $00 $65 $00 $66
- **Separator** – Used to denture end of current filename X. Value is $00 $00
- **Checksum** – Single byte addition from byte 0 to just before the checksum field. The last 2 bytes is then the checksum. For example, if calculated checksum is $ 1204AB, then the checksum will be $04AB
- **File Contents X** – Actual file contents

Sound

This chapter describes the sound environment available in the Motorola C650 handset. It includes information on sound formats and more. Use this chapter as a reference when creating sounds for your products.

In general, file size is limited by available memory. The available memory for downloaded files will vary based on the media that is pre-loaded into the device. This pre-loaded media will vary from region to region and from carrier to carrier. We recommend keeping all media files as small as possible to ensure the consumer has the ability to download and use a variety of files to enhance the user experience.

Alert Tone Support

Downloaded audio files can be applied to a number of alert tones on the device including Ringtones for incoming calls, Text Message, and Date Book Alarms.

Ring Tones

Ring tones should not exceed 30 seconds because most voice mail systems pick up after four rings (16-25 seconds depending on the system).

Supported Sound Formats

The Motorola C650 handset support the following sound formats:

Type	Description
iMelody	iMelody is the Infrared Data Association (IrDA) standard for the textual representation of a ring tone that can be used to transfer melodies between devices.
MIDI	The Motorola C650 handset are MIDI 1.0 compliant, and

Type	Description
	supports any data format described in *The Complete MIDI 1.0 Detailed Specification*, including: – MIDI, Type 0 – MIDI, Type 1 Scalable Polyphonic MIDI (SP-MIDI)
MP3	The MP3 format provides the coding of audio for digital storage.

MIDI Support

The Musical Instrument Digital Interface (MIDI) enables consumers to use multimedia computers and electronic musical instruments to create, enjoy and learn about music.

The MIDI protocol is a music description language in which every word describes an action of musical performance. Each action is stored as a binary word and when combined, store as MIDI files. These files can then be replayed by any electronic device that can read the MIDI file and recreate the performance using its available sound system.

Technical Specifications for MIDI:

- Recommended File Size: up to 15k
- MIDI Instruments: 128
- Maximum Polyphony: 24 voices
- Minimum Duration per note: 20ms
- Maximum Duration (NW dependent): 16-30 secs

MIDI Key Mapping

The Motorola C650 handset supports all 128 general MIDI instruments and the standard drum kit, but due to frequency limitations, not all MIDI notes are supported for all patches.

Patch Number	Patch Names	Valid MIDI Note Numbers
0	Acoustic Grand Piano	21-108
1	Bright Acoustic Piano	21-108
2	Electric Grand Piano	22-108
3	Honky-tonk Piano	21-108

Patch Number	Patch Names	Valid MIDI Note Numbers
4	Electric Piano 1	21-108
5	Electric Piano 2	24-103
6	Harpsichord	24-89
7	Clavinet	24-96
8	Celesta	48-108
9	Glockenspiel	65-108
10	Music Box	48-84
11	Vibraphone	48-96
12	Marimba	48-97
13	Xylophone	48-108
14	Tubular Bells	48-96
15	Dulcimer	48-96
16	Drawbar Organ	24-96
17	Percussive Organ	24-96
18	Rock Organ	24-96
19	Church Organ	21-96
20	Reed Organ	24-96
21	Accordion	48-89
22	Harmonica	48-84
23	Tango Accordion	48-89
24	Acoustic Guitar (nylon)	36-84
25	Acoustic Guitar (steel)	36-84
26	Electric Guitar (jazz)	36-86
27	Electric Guitar (clean)	36-86
28	Electric Guitar (muted)	36-86
29	Overdriven Guitar	36-96
30	Distortion Guitar	36-96
31	Guitar Harmonics	36-96
32	Acoustic Bass	24-72
33	Electric Bass (finger)	24-72
34	Electric Bass (pick)	24-72
35	Fretless Bass	24-72

Patch Number	Patch Names	Valid MIDI Note Numbers
36	Slap Bass 1	24-72
37	Slap Bass 2	24-72
38	Synth Bass 1	24-96
39	Synth Bass 2	24-96
40	Violin	48-96
41	Viola	48-96
42	Cello	36-96
43	Contrabass	24-96
44	Tremolo Strings	24-96
45	Pizzicato Strings	24-96
46	Orchestral Harp	21-103
47	Timpani	36-84
48	String Ensemble 1	24-96
49	String Ensemble 2	24-96
50	Synth Strings 1	24-96
51	Synth Strings 2	24-96
52	Choir Aahs	36-96
53	Voice Oohs	36-96
54	Synth Voice	36-96
55	Orchestra Hit	36-72
56	Trumpet	36-96
57	Trombone	36-96
58	Tuba	24-72
59	Muted Trumpet	48-84
60	French Horn	36-96
61	Brass Section	24-96
62	Synth Brass 1	24-96
63	Synth Brass 2	24-96
64	Soprano Sax	48-89
65	Alto Sax	48-84
66	Tenor Sax	36-84
67	Baritone Sax	24-84

Patch Number	Patch Names	Valid MIDI Note Numbers
68	Oboe	48-96
69	English Horn	48-96
70	Bassoon	24-84
71	Clarinet	48-96
72	Piccolo	60-108
73	Flute	48-96
74	Recorder	60-96
75	Pan Flute	48-96
76	Blown Bottle	48-96
77	Shakuhachi	48-96
78	Whistle	48-91
79	Ocarina	60-96
80	Lead 1 (square)	24-96
81	Lead 2 (sawtooth)	24-96
82	Lead 3 (calliope)	36-96
83	Lead 4 (chiff)	36-96
84	Lead 5 (charang)	36-96
85	Lead 6 (voice)	36-96
86	Lead 7 (fifths)	36-96
87	Lead 8 (bass+lead	24-96
88	Pad 1 (new age)	36-96
89	Pad 2 (warm)	36-96
90	Pad 3 (polysynth)	36-96
91	Pad 4 (choir)	36-96
92	Pad 5 (bowed)	36-96
93	Pad 6 (metallic)	36-96
94	Pad 7 (halo)	36-96
95	Pad 8 (sweep)	36-96
96	FX 1 (rain)	36-96
97	FX 2 (soundtrack)	36-96
98	FX 3 (crystal)	36-108
99	FX 4 (atmosphere)	36-96

Patch Number	Patch Names	Valid MIDI Note Numbers
100	FX 5 (brightness)	36-96
101	FX 6 (goblins)	36-96
102	FX 7 (echoes)	36-96
103	FX 8 (sci-fi)	36-96
104	Sitar	48-77
105	Banjo	48-84
106	Shamisen	48-79
107	Koto	48-96
108	Kalimba	48-96
109	Bagpipe	36-77
110	Fiddle	48-96
111	Shanai	48-96
112	Tinkle Bell	60-96
113	Agogo	48-72
114	Steel Drums	48-88
115	Woodblock	48-72
116	Tailo Drum	48-72
117	Melodic Drum	36-84
118	Synth Drum	36-84
119	Reverse Cymbal	48-72
120	Guitar Fret Noise	48-72
121	Breath Noise	48-72
122	Seashore	48-72
123	Bird Tweet	48-72
124	Telephone Ring	48-72
125	Helicopter	48-72
126	Applause	48-72
127	Gunshot	48-72
none	Drums	35-81

MIDI Audio Guidelines

The following are suggested guidelines to maximize sound quality while reducing the overall file size of a MIDI Ring Tone file for use with the Motorola C650 handset.

Tip 1: Use MIDI's running status feature

In the MIDI standard, a key-on or a key-off event will use, at most, three bytes each. However, when several key events occur on the same MIDI-channel, the running status feature can be used. In principle, running status means the first byte of a key-on event is omitted. In addition, the key-on event having a velocity of zero is equivalent to the key-off event. Thus, combining running status with key-on events that have zero velocity reduces the number of bytes needed to encode all key events.

EXAMPLE:

Without using the running status, features, the sequence

```
91 2E 23 8E, 91 2B 50 8E, 81 2E 64 00, 81 2B 64 00
```

represents "Key 2E ON" Velocity 23 MIDI Ch 1", "Key 2B ON Velocity 50 MIDI Ch 1", "Key 2E OFF Velocity 64 MIDI Ch 1", "Key 2B OFF Velocity 64 MIDI Ch 1". Using the running status feature reduces the sequence to:

```
91 2E 23 8E, 2B 50 8E, 2E 00 00, 2B 00 00,
```

That is, the command byte is omitted and velocity zero is used for key off.

Tip 2: Use Standard MIDI File (SMF) type 1

The MIDI content can be stored in a Standard MIDI File (SMF) of type 0 or type 1. In a type 0 SMF, the file format uses one header chunk with one-track chunk. In a type 1 SMF, the format uses one header chunk with several track chunks. SMF type 2 should not be used.

In general, it is more efficient to store the MIDI data as a type 1 file. The increased efficiency is achieved because each track contains only one MIDI channel and one instrument (often the case). The running status feature can be applied on each individual track, thereby reducing the track size. To reduce the size of the file even further, use one track per used MIDI channel. That is, if a temple/conductor track exists, merge it with the first instrument track and remove all unnecessary meta-events such as the "track name" and "lyric" meta-events.

To summarize, the following measures can be taken in order to reduce the SMF:

1. Use SMF type 1 (Or verify that a type 1 file is smaller than a type 0 file and use the smallest file).
2. Use running status.
3. One and only one instrument per track. Try not to change channels.
4. Do not change tempo in the middle of the music. That is, set the tempo once.
5. Use beat, instead of SMPTE, to set the tempo.
6. Do not use Copyright Text Fields.
7. Limit the use of continuous controller information such as pitch-bend and volume.

8. Turn off the options below:
    - Sequence Number - MIDI sequence ids
    - Text - embedded text for any optional fields
    - Sequence / Track Name
    - Instrument Name
    - Lyric
    - Marker - for synchronization purposes
    - Cue Point
    - Midi Channel Presix - associate channels with all events following
    - Sequencer-Specific settings

Items one through three above optimize the encoding of the notes, while items four to eight optimize the overall melody. The above measures provide an SMF file that is ready-made for compression. However, prior to compression, the composer/content author can add a few values for key velocity, thereby increasing the redundancy of the file.

Tip 3: Consider the Frequency Response

Even though the MIDI synthesizer is sampled at 22 KHz, the polyphonic speaker's frequency response is not as wide. Try to keep the majority of melodic information below 6000 Hz.

NOTE: The use of MIDI notes below 800 Hz may cause a decrease in volume when playing the note. Always test your audio on an actual device to ensure the accuracy of the sound you want to produce.

MP3 Audio Guidelines

MP3 (MPEG Audio Layer 3) is an audio compression technology that is part of the MPEG-1 and MPEG-2 specifications. Developed in Germany in 1991 by the Fraunhofer Institute, MP3 uses perceptual audio coding to compress CD-quality sound by a factor of 12, while providing almost the same fidelity. Because MP3 audio is digitized, not synthesized, reproduction (disregarding speaker quality) is identical on all devices. Therefore MP3 ring tones provide a near-CD quality audio experience for listeners as opposed to their MIDI counterparts which differ greatly from device to device.

The following recommendations should be used when designing MP3 audio clips for use in the phone:

Technical Specifications for MP3:

- Bit Rate: 64kbps recommended
- Recommended File Size: 30kb

- Maximum Duration (NW dependent): 16-30 secs

Available Sound Properties

The following table describes the available MP3 encoding properties on the C650 Platform.

File Type	*Sampling Frequency*	*Bit Depth*	*Mono/Stereo*	*Bit-rate (kbps)*
MP3	44.1kHz	16	Mono	64
MP3	24kHz	16	Mono	40
MP3	16kHz	16	Mono	32

*Overall bit-rate can exceed 64 kbps, but will not play in stereo.

Note: There is no stereo speaker support for the Motorola C650 handset. Stereo ring tones will be played in mono. If the handset supports a stereo file and a stereo headset is attached, the file will be played in stereo.

Depending of frequency content of the material the recommended properties for MP3 ring tones are:

MP3	44.1kHz	16	Mono	64
MP3	24kHz	16	Mono	40

Design Guidelines

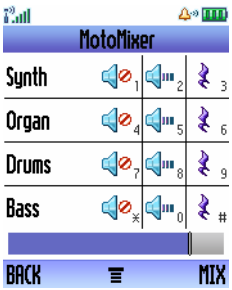
Since ring tones need to be at a consistent audible level, compressing the original content to reduce the peak-to-average ratio is necessary. After the audio is compressed it is advisable to re-normalize the audio to 0db before saving the compressed MP3 file.

Note: Ring tones are generally between 5 -10 seconds in length. Based on the recommended bit rates that would yield a file size of 30kb per tone. It is advisable to keep file size beneath 100K to allow the end-user to download multiple tones, but there is no file size limit except for total free memory available on the device.

MotoMixer

The Motorola MotoMixer feature allows users to mix a repeating “base track” directly on the Motorola C650 using the MotoMixer application. The base track consists of four parts: three content-specified instruments and a drum. Four variations are provided for each part in the base track file. Selecting one of the four variations for each of the parts at a specific point in time creates the mix. The mix created by the user can be saved in a file referred to as the “mix file” and can be recalled later to be used as a ringtone or sent to another mobile phone using SMS or email. The initial release of the Motorola C650 will not support mobile originated messages containing MIDI files.

The four variations defined for each part are referred to as “Variation A,” Variation B,” Variation A with effect,” and “Variation B with effect.” The user interface for the MotoMixer editor allows the user to modify three settings for each part: instrument on/off, which enables or disables the part entirely; variation A/B, which selects the variation played; and effect on/off, which enables and disables the effect. There are five valid combinations of these three settings: part turned off (muted) and the four variations listed at the beginning of this paragraph. The MotoMixer editor starts with all four parts muted as shown below.



NOTE: Screen shot may not reflect actual display size.

Changes made to the mix by the user will take effect only on 16th note boundaries. If a base track was written in 4/4 time (four quarter notes per measure), there would be 16 equally-spaced “sequence points” in the measure where changes by the user would take effect.

When played, the base track file is looped. Initial revisions of the MotoMixer feature will loop the base track four times. Future revisions may allow the number of loops to be configurable (with a default value of four) by the user on a per-mix file basis.

Base Track File Format

MotoMixer base tracks are required to be standard MIDI files stored in format 0 (i.e. data for all channels is stored in a single track). Base track files can be any length and be written any time and any key signature. MotoMixer base tracks should be saved with a .bas file extension.

Channels

The four variations for each part in the base track file are stored as separate channels. The mapping between part and variation and channel number is shown in the table below.

Part	Variation	MIDI Channel
Instrument 1	Variation A	1
	Variation B	2
	Variation A with effect	3
	Variation B with effect	4
Instrument 2	Variation A	5
	Variation B	6
	Variation A with effect	7
	Variation B with effect	8
Drums	Variation A	9
	Variation B	10
	Variation A with effect	11
	Variation B with effect	12
Instrument 3	Variation A	13
	Variation B	14
	Variation A with effect	15
	Variation B with effect	16

Instruments

The MotoMixer feature supports use of all 128 General MIDI instruments. Please note that not all phones are able to distinctly represent all of these instruments (e.g. all General MIDI piano-like instruments may be represented by a single piano sound – Acoustic Grand Piano may sound like Electric Piano 2). The Motorola C650 handset supports the full instrument set with very limited re-mapping. The General MIDI Percussion Map will be used for the drum part, so no instrument should be specified for the variations of the drum part.

In the MotoMixer editor, the parts are named by the General MIDI instrument used by the first note of the “Variation A” variation of the part. That is, if the first note in “Variation A” for a part is played with the “Whistle” instrument, the part is labeled in the user interface as “Whistle”. The different variations for a part can be implemented using different

General MIDI instruments, but the part name displayed to the user will never change. The drum part will always be named “Drums” regardless of the drum sounds used in the part.

The results of changing instrument mapping for a variation in the middle of the variation are unpredictable and should be avoided.

Base tracks may use up to four different drum instruments from the General MIDI Percussion Map. For example, a base track may decide to use drum instruments 36, 40, 42, and 45 (Bass Drum 1, Electric Snare, Closed Hi Hat, and Low Tom). No additional drum instruments can be used. If other drum instruments are used, only the first four that are specified in the base track will be heard. This applies across all variations of the drum part – only the four selected drum instruments can be used in the entire base track.

Tempo

The tempo of the base track must be specified at a time 0 of the base track file. Tempo is specified in microseconds per quarter note in a standard MIDI “Set Tempo” meta-event. If the tempo is not set in the MIDI file, or is not set at time 0, the tempo will default to 500,000 microseconds per quarter note (120 beats per minute). Tempo changes in the middle of the base track file will be ignored.

The MotoMixer user interface provides the user with an option to adjust the tempo of the base track. This user-specified tempo is saved as part of the mix file. The user is allowed to adjust the tempo on a scale of 0-7. Setting 3 is the default value and will be equal to the tempo specified in the base track file. Setting 0 is approximately equal to half of the default temp. Setting 7 is more than double the default tempo.

Restrictions

The implementation of the MotoMixer feature uses a MIDI Text Event containing the text “\!” (backslash exclamation mark) in the form:

FF 01 02 5C 21

Base tracks will not contain text events matching this format. Text events that contain other text can be included at any point in the base track file.

In addition, files should be created to allow for a maximum polyphony of 16 simultaneous notes when all tracks and effects are active.

Design Recommendations

Individual instruments’ variations should be varied greatly to allow for an easily discernable difference between variation 1 and 2. This can be accomplished by using different rhythmic, harmonic, and melodic structures. One possible recommendation is to use a more basic structure for variation 1 and a more complex one for variation two (steady rhythm vs. syncopation). There must be an easily recognizable differentiation between each of the variations.

With regards to variations with effect, these tracks can be used in a multitude of ways. One possibility is to use the effect track to add harmony to a melody of an associated track. Additionally, the effect track can be used to add musical substance such as arpeggiations or figured basses. Lastly, the effect track can be used to add delay effects such as echo by copying all musical events and pasting them at a short (1/32) offset. Overall, the effect track should be used to add rhythmic, harmonic, or acoustical depth to the associated variation track.

Appendix A: DRM

Digital Rights Management

Digital Rights Management (DRM) is a method of protecting content from illegal distribution by embedding the content into an encrypted package along with rules dictating its use. Using a set of keys and a license for the specific file, a DRM application is required to decrypt the content for playback. The DRM application will be transparent to the user except for the cases where the user acquires a file without a proper license. Applications that will interact with DRM encoded files include the following:

- Media Center
- MMS
- EMS
- Browser
- Email
- KJava

For more information, refer to the following references found at http://www.openmobilealliance.org :

- OMA-Download-DRM-v1_0-20020905-C
- OMA-Download-DRMREL-v1_0-20030801-C
- OMA-Download-DRMCF-v1_0-20030801-C

Supported DRM Solutions

Two DRM solutions are supported by Motorola handsets. The solutions are the following:

- Forward Locking – Forward locking construct defined by the OMA DRM specification. Similar to NDIS implementation in MMS/EMS.
- Combined Delivery – The OMA Combined Delivery mechanism is an extension of OMA forward locking. The Combined Delivery mechanism differs by including a rights object within the DRM message which govern the consumption of the

content included along with the rights object. A handset that supports Combined Delivery will support OMA forward locking.

Download

Forward Lock files will be downloaded within a DRM message. The download manager will recognize the DRM message of MIME type ‘application/ vnd.oma.drm.message’ as a valid file type.

The download manager will discard any DRM message that contains more than one media object within the DRM message.

OMA Combined Delivery will be downloaded within a DRM message and will consist of a media object and a rights object. The download manager will recognize the DRM message MIME type and the MIME type ‘application/vnd.oma.drm.rights+xml’ as a valid file type. A single media object in the body of the DRM message, that is encoded in the following identity transfer encoding ‘7bit’, ‘8 bit’, and ‘binary,’ will be accepted by the download manager.

Installation

Forward Lock

After the download of a DRM message has been completed, the download manager will strip out the media object that is encapsulated within the DRM message prior to dispatching the object for preview. The MIME type associated with the encapsulated media object will be used to verify that the OMA download descriptor ‘type’ meta data field matches the MIME type of the media object within the DRM message.

Once the media object has been extracted from the DRM message, the original DRM message can be discarded. Along with passing the media object to the content dispatcher for preview, the download manager shall indicate to the content dispatcher that the media object is ‘forward locked’.

The mechanism for indicating a ‘forward locked’ status is to set the NDIS bit for the file within the file system.

Combined Delivery

After the download of a DRM message has been completed, the handset will strip out the media object and the rights object that are encapsulated within the DRM message prior to dispatching the object for preview. If the DRM message is received without a descriptor file, the MIME type associated with the encapsulated media object should be used to verify that the OMA download descriptor ‘type’ meta data field matches the MIME type of the media object within the DRM message.

Once the media object has been extracted from the DRM message, the original DRM message can be discarded. Along with passing the media object to the content dispatcher

for preview, the handset shall indicate to the content dispatcher that the media object is ‘forward locked’.

- If the user selects to store the content from the preview: The media shall be stored in the appropriate file directory and shall be marked as ‘forward-locked’ using the NDIS bit. The rights object shall be stored in a protected portion of the file system. Rights objects are NEVER to be forwarded. Association between the rights object and the media MUST be maintained while stored in the file system.

Right Object

Forward Lock files do not have Right Objects associated with the content. The user has unlimited usage. The handset will mark the file as "do not forward" and the user will be able to consume the content as a normal file. The only limitation is the handset will not allow the user to send the file via any transfer method.

In the case of Combined Delivery there is a Right Object associated with the content. The Right Object will be stored in a secure area and the user will not have access to it. The handset will not allow the user to send it via any delivery method. The Right Object will define the constraints for content usage. This Right Object can have count, time, date, or interval constraints. The application will check the Right Object before consuming the content.

File Types

DRM solutions apply to all file formats. The OMA DRM solution is content agnostic and can be used for any type of content that the handset supports. Individual files are handled in the same manner as a DRM file would be handled. Files downloaded using OMA Combined Delivery will be downloaded within a DRM message and will consist of a media object and a rights object. The download manager will recognize the DRM message MIME type and the MIME type ‘application/vnd.oma.drm.rights+xml’ as a valid file type. A single media object in the body of the DRM message that is encoded in the following identity transfer encoding ‘7bit’, ‘8 bit’, and ‘binary’ will be accepted by the download manager.

Appendix B: MIME Types

This appendix provides a list of common MIME types used on various Motorola handsets. The list is sorted by category and provides file type descriptions, as well as the MIME types used to download different media files.

NOTE: The file and MIME types shown below are not supported by all Motorola handsets. Please refer to the handset's media guide to determine what file types a particular handset supports.

Category	Description	MIME Type
Audio	iMelody	`audio/imelody x-imelody imy x-imy`
	MIDI	`audio/midi x-midi mid x-mid sp-midi`
	WAV	`audio/wav x-wav`
	MP3	`audio/mp3 x-mp3 mpeg3 x-mpeg3 mpeg x-mpeg`
	AMR/MP4	`audio/amr x-amr mp4 x-mp4`
Image	GIF	`image/gif gif`
	JPEG	`image/jpeg jpeg jpg jpe`
	PNG	`image/png png`
	TIFF	`image/tiff tiff tif`
	WBMP	`image/vnd.wap.wbmp wbmp`
	MPEG	`video/mpeg mpeg mpg mpe`
	WAV	`video/wav wav`
Motorola	MotoMixer	`audio/bas bas`
	Theme	`application/mtf mtf`

Note: Tone Sequence as defined in JSR-135 is equal to the following: audio/x-tone-seq Different strings in the same group are synonyms and are equally applicable for the corresponding media type.

Please note the following when mapping MIME types to a server:

- A MIME type can be mapped to zero or more file extensions
- Extension mapping is case insensitive

For information on configuring servers to deploy programs or files over-the-air, or to determine which MIME types are supported by a particular handset, download the *Basic Over-the-Air Server Configuration* whitepaper from the Motocoder website (http://www.motocoder.com).

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