

C-Bus Application Messages & Behaviour

Chapter 21 – Media Transport Control

Document Number: CBUS-APP/21

Issue: 1.1

Date: 13 January 2010

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C-Bus Media Transport Control Application

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21 MEDIA TRANSPORT CONTROL APPLICATION

21.1 Default Application ID

\$C0

21.2 Description

The C-Bus Media Transport Control Application is used to control Audio and Video equipment attached to, or used with C-Bus equipment. This may include recorders, players, tuners, and other audio or video media equipment.

(Importantly, the Media Control Application does not control volume, bass, treble, etc. These attributes are controlled using the C-Bus Multi-Room Audio Application.)

21.2.1 Overview

The C-Bus Media Transport Control Application is used to transport commands between one or more control points, and a number of audio or video devices.

The **control point** might be, for example:

- a switch, knob or button being operated by a person;
- a programmed action from a soft button on something like a touchscreen; or
- a computer or other device, possibly reacting to a schedule, which requests an operation of an audio or video device.

The **audio or video device** might be a PVR, DVD player, media centre, MP3 streamer, or similar.

There will normally be a **translator**, which takes the C-Bus Media Transport Control commands and converts them in some form to drive the audio or video device. The translator may be built into the audio or video device, or may be separate.

The logical link between the control point and the device is called a **Media Link Group**.

The C-Bus Media Transport Control Application supports up to 255 Media Link Groups.

21.2.2 Terminology for Media Transport Control Devices

The devices participating in this Application are categorised as:

- a. **input units**, which perform the control point function of launching a control operation into a C-Bus network, often people interact with these devices; and these devices issue Media Transport Commands; and
- b. **output units**, which perform a function of taking a control operation from a C-Bus network and using it to perform specific functions on an A/V device. The output unit performs the function of the translator, taking the commands and converting them into a form that can be used to control and audio or video device.

21.2.3 Other Devices

Any device on a C-Bus network can issue Media Transport Control Application commands. If they do so, they must adopt the behaviour of Media Transport Control Application input units.

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21.2.4 Normal Configurations

A normal configuration will have, in a single Media Link Group, one or more input units and a single output unit.

Using more than one output unit in a single Media Link Group does not make sense and should not be done.

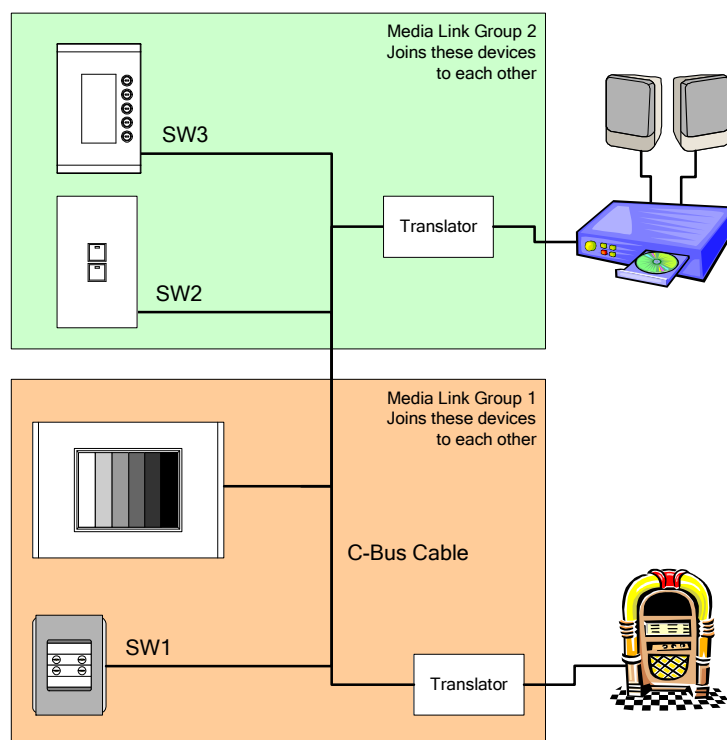
Using more than one Media Link Group in a single output device is possible, and may be required for some devices. In that case, the physical device is considered to be made up of several logical (and distinct) outputs devices – one in each Media Link Group.

21.2.5 Example of Media Link Groups with Input and Output Units

In the example shown below, a series of switches (SW1 .. SW3) and a touchscreen are on the same C-Bus as two translators attached to two different media sources.

Media Link Group 1 is used to make a logical association between the jukebox translator, SW1, and the touchscreen.

On the the same cable, Media Link Group 2 is used to make a different and separate logical association between a CD player translator, and SW2 and SW3.



The different media link group numbers allow different and separate relationships to exist on the same physical cable. In this example, SW2 and SW3 could control the jukebox, though using different buttons to those used to control the CD player.

21.3 Document Conventions

Numbers are shown in decimal (base ten) with no other special prefixes or indications.

Binary numbers (base 2) are shown with the prefix %.

Hexadecimal numbers (base 16) are shown with the prefix \$.

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Example: 157 = %10011101 = \$9D

21.4 Data Conventions

21.4.1 Media Link Group

A Media Link Group defines a logical linkage between an input unit and an output unit.

Commands and other information sent with a Link Group are used to convey a fixed state (Play, Stop, etc), **and also** trigger actions on the part of the output device (Next Track, Next Selection, etc).

The following convention is used:

Media Link Group:

Size:	8-bit byte
Range:	\$00 .. \$FF
Special Cases:	\$FF is reserved and indicates that the link group is unused.
Assignment:	The Media Link Group is assigned to a media input or output device. Each cluster of unrelated devices should use a unique Media Link Group.

21.4.2 Category

A Category defines the top level of control and choice of multimedia material (audio tracks, video titles, and so on). A Category is made up of a list of Selections. The meaning of a Category will depend on the output device being controlled, and might be used to select a (physical) source, a genre, an artist, and so on.

The following convention is used:

Category:

Size:	8-bit byte
Range:	\$00 .. \$7F
Special Cases:	Category numbers with the most significant bit set (numbers \$80 .. \$FF) are reserved and shall not be used.
Assignment:	The assignment, meaning and use of particular Category numbers depends on the media output device.

21.4.3 Selection

A Selection defines the middle level of control and choice of multimedia material. A Selection is made up of a list of Tracks, and exists inside a Category.

There may be some Categories for which the concept of a selection does not make sense, in which case the Selection does not exist, and by extension, the concept of a Track (in a Selection) does not make sense either.

The meaning of a Selection will depend on the output device being controlled, and might be used to select a playlist from amongst a series of playlists, or a radio station from a list of preset radio stations.

The following convention is used:

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Selection:

Size:	16-bits
Range:	\$0000 .. \$7FFF
Special Cases:	Selection numbers with the most significant bit set (numbers \$8000 .. \$FFFF) are reserved and shall not be used.
Assignment:	The assignment, meaning and use of particular Selection numbers depends on the media output device.

21.4.4 Track

A Track defines a single playable piece of media (MP3 file, internet radio station, etc) within a Selection, in a media output unit.

There will be some output units for which the concept of a Track has limited relevance – for example if a radio station is chosen as the Selection, then the concept of a Track in that (broadcast) radio station can not be controlled, so the not all Track related commands in that Selection would be implemented.

The following convention is used:

Track:

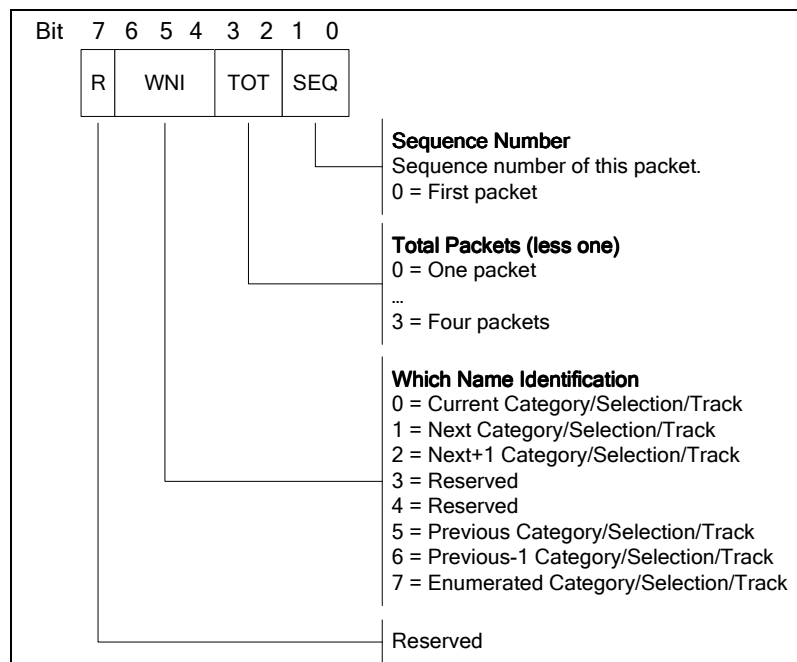
Size:	32-bits
Range:	\$00000000 .. \$FFFFFFFF
Special Cases:	Track numbers with the most significant bit set (numbers \$80000000 .. \$FFFFFFFF) are reserved and shall not be used.
Assignment:	The assignment, meaning and use of particular Track numbers depends on the media output device.

21.4.5 Text Name Header

A Text Name Header is used to allow a Text Name message to be transported as a number of separate packets over C-Bus, with reconstruction undertaken by the output devices. The packets are expected to be sent in order from first to last.

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The Text Name Header is a single byte with the structure:



Packets are sent beginning with a sequence number of 0, incrementing with subsequent packets. A Text Name message is always transmitted using the smallest possible number of packets.

The Text Name Header includes information in the <WNI> field to show if the message applies to the item (Category, Selection or Track) *currently* active in an output unit, the item which will follow (*next*), the item after the next (*next-next*), the item which preceded the current (*previous*), the item which preceded the previous (*previous-previous*), or if the name is part of a list (*enumerate*) operation.

21.4.6 Hierarchy of Control and Operations

Structure

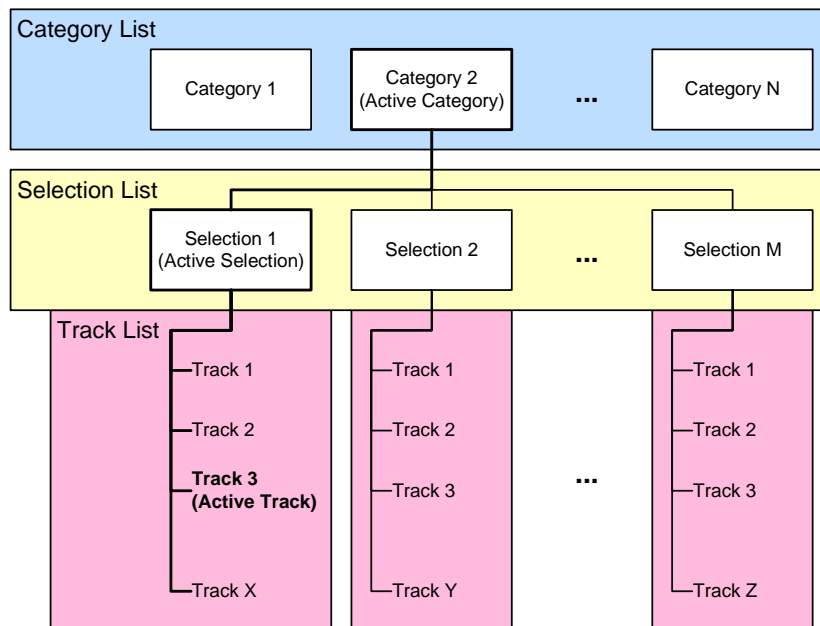
The Media Transport Control Application assumes a hierarchical structure used to determine which item from a media device is to be played / stopped / selected, etc.

The hierarchy comprises:

- A number of Categories which together make a Category List
- Within a Category, there may be a number of Selections which together make a Selection List
- Within a Selection, there may be a series of Tracks which together make a Track List

This is shown in the following diagram:

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The Active Track is the currently playing or controlled media item – it might be an audio track or a scene from a movie.

Example 1 :

An output device that streams audio from a digital music library might allow the contents of that library to be sorted in four different ways – Album, Artist, Year, Genre. These sorting options would correspond to Categories.

When the “Album” Category is chosen, the Selections available under that Category would be the album titles. Under each of the Selections (albums), the Tracks available would be the tracks on that album.

When the “Year” category is chosen, the Selections available under that Category would be the different years. Under each of the Selections (years), the Tracks available would be all the tracks from that year.

Example 2 :

An digital radio tuner output device, which has a number of preset stations, and which provides the name of the currently playing track, where this information is broadcast by the station.

In this case there are really only two levels of the hierarchy that are relevant. The list of presets would be presented as Selections, and there would be a single Track under each of these Selections. The name of the currently playing song would be presented as a single Track Name. Some Track-related commands such as Stop, Pause, Play, and Reverse might be implemented, however others such as Shuffle, Repeat, Next/Previous Track, and Forward have no relevance and would have no effect.

Device Specifics

Some devices will not support multiple Categories, or multiple Selections, or even multiple Tracks. In these cases, these lists collapse to a single Category, Selection, or Track as appropriate.

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For example, a CD player is only a single Category (the CD), and there is only a single Selection (the contents of the CD). So in this case, telling the CD player to select its next Category, or next Selection, is meaningless.

For comparison, a plug-in to control iTunes might allow selection between the Internet Radio Category and a disc-based music collection Category. When the Category is set to Internet Radio, the Selection list might comprise some set of selected Internet Radio stations. When the Category is set to the disc-based music collection, the Selections could be playlists entered by a user in any form they choose.

In addition, not all devices need to support all levels of the hierarchy, nor do they need to support all commands for the levels of the hierarchy that they do support.

For example, for the digital radio tuner in Example 2 above, there is no level above the list of presets (Selections), so the Category level of the hierarchy would not be implemented. Furthermore, commands like "Next/Previous Track", and "Fast Forward" have no meaning to such a device, so would not be implemented.

21.4.7 Behaviour Modifiers: **SHUFFLE** and **REPEAT**

SHUFFLE and REPEAT are behaviour modifiers:

- When SHUFFLE is active it causes the Tracks in a Selection (ie the Track List) to be played in a random order.
- When REPEAT is active it causes either the currently playing Track to be repeated (REPEAT CURRENT) or the Tracks in a Selection (ie the Track List) to be played over again once the last Track of the list has been played (REPEAT TRACKS).

SHUFFLE can be used in conjunction with REPEAT TRACKS. SHUFFLE in conjunction with REPEAT CURRENT is possible but serves no useful purpose.

Shuffle and Track Names

When Shuffle is turned on or off, the "Next", "Next+1", "Previous" and "Previous-1" Track names that have previously been transmitted will be incorrect (because the play order changes).

Devices that receive and display should preferably clear the list of future track names, and may optionally repopulate that list by using a Get Status command. Preferably the status is refreshed after a short delay from the change of the shuffle state.

Preferred Behaviour

This is a preferred behaviour. Media output devices and/or translators can diverge from this behaviour, though such a divergence is discouraged.

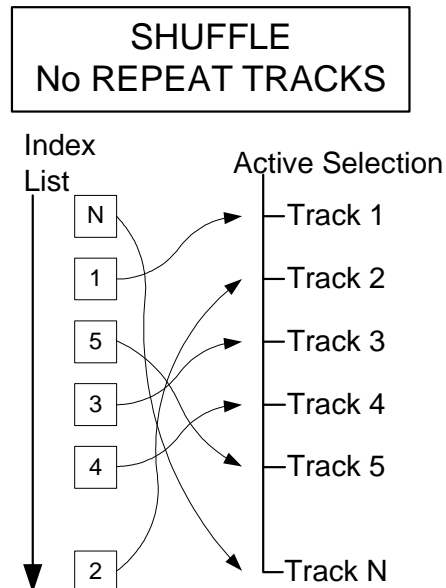
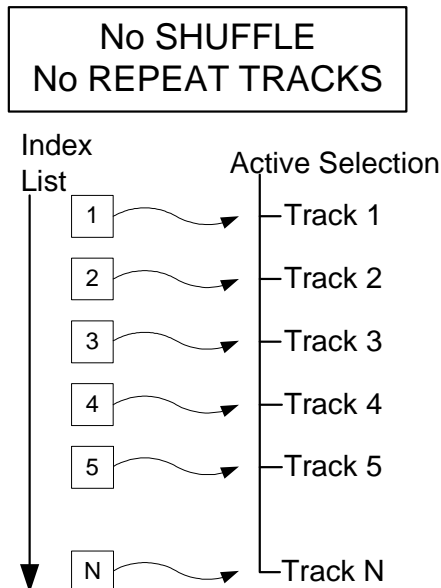
A consequence of SHUFFLE being used with REPEAT TRACKS is that if both SHUFFLE and REPEAT TRACKS are active, then once the Tracks in the Selection have all been played (in the random order), then the tracks will be played again, *in the same random order*.

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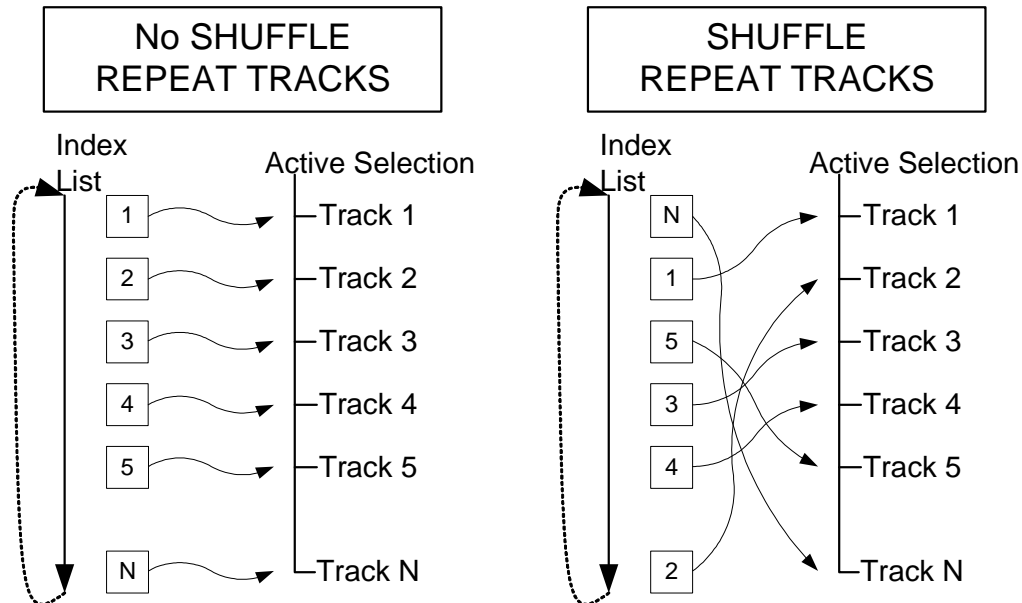
The SHUFFLE order should be calculated at the time, or shortly after, SHUFFLE is made active.

A further consequence is that the sequence of operations PLAY, (allow some tracks to play), STOP, PLAY will mean that the second (and any subsequent) PLAY operations will play the Tracks in the same order as the first PLAY operation.

Another further consequence is that the operations PLAY, NEXT_TRACK, PREVIOUS_TRACK will result in the same track being played as the original PLAY operation. (For example, the tracks might be: PLAY (starts track 27). NEXT_TRACK (changes to play track 93). PREVIOUS_TRACK (goes back to track 27).



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REPEAT TRACKS and REPEAT CURRENT

Only one of these two repeat modes can be active at a single time.

21.4.8 PLAY, STOP and PAUSE/RESUME Commands

The PLAY, STOP, PAUSE and RESUME bus commands have associated states (Playing, Stopped, Paused).

PAUSE: Only has an effect in the Playing state.

Causes current play to suspend.

RESUME: Only has an effect in the Paused state.

Causes play to resume where it stopped on a previous PAUSE command.

STOP: Only has an effect in the Playing or Paused states.

Causes current play to cease.

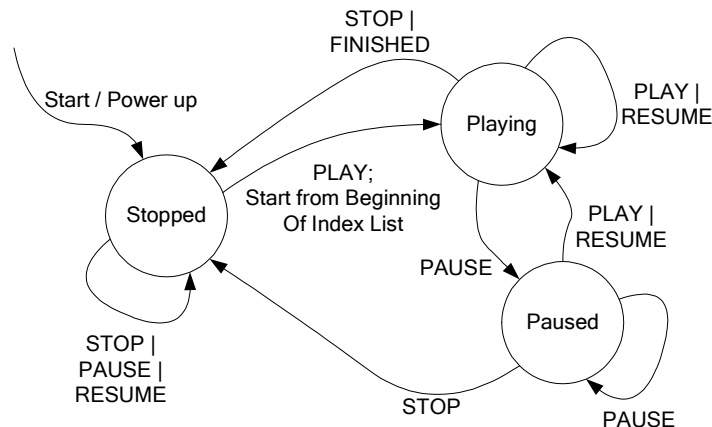
PLAY: Only has an effect in the Stopped or Paused states.

If stopped, causes play to begin from the start of the track looked up through the first entry of the shuffle index list. (In the diagram above, PLAY always begins playing through the topmost "Index List" entry, which then looks up the appropriate track.)

If paused, PLAY will resume from where it stopped on a previous PAUSE command.

The following state diagram shows this diagrammatically:

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[If a user interface device wants to have a behaviour where, when Paused, a press of a Pause button causes Playing (through associate transmission of a PLAY command), then that user interface device needs to know the state and issue either a PLAY or RESUME command at the appropriate time.]

21.4.9 Category, Selection and Track Text

The text of the Category, Selection or Track name is distributed as a sequence of characters. Each character is encoded using the UTF-8 coding system into one or more 8-bit bytes.

21.4.10 Listing (Enumerating) Category, Selection and Track Names

The protocol supports listing (enumerating) the Category, Selection or Track names known in an output device. ***This is a very bandwidth intensive operation, which should be used sparingly if at all.***

The enumeration uses a request message (please enumerate Category, Selection , or Tracks). When received, an output device which knows the names will send an enumeration size message (describing how many names follow), and then a series of up to 16 Category names, Selection names, or Track names (each of which may comprise one or more C-Bus messages).

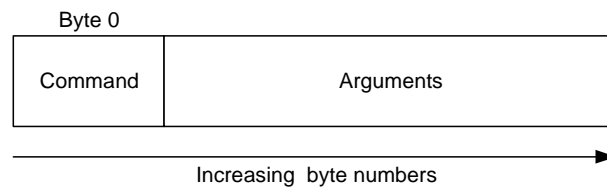
Each name returned is marked in the Text Name Header byte to indicate that it is an enumeration. This can be used to ensure that display devices which hold and display the current Track, Selection or Category name will not have those names changed during an enumeration operation.

21.5 Message Structure

Media Transport Application messages are between 1 and 21¹ bytes long, and have the form:

¹ Whilst the longest command into a local network can be 21 bytes long, the addition of network routing may reduce the available command to a maximum of 14 bytes in some cases. It is recommended that long commands be kept to a maximum of 14 bytes for greatest interoperability on complex network topologies.

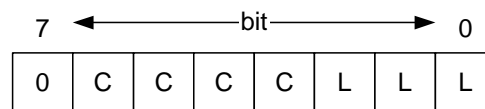
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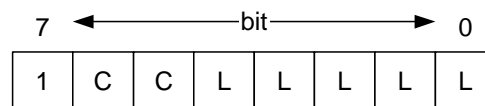
The format of the arguments portion is variable, and is dependent on the command.

The command byte is broken into bit-fields to support encoding of a command and the number of bytes following as parameters. There are two possible codings, to support a large number of commands with short arguments, and a small number of commands with long arguments.

The short argument command form is:



The long argument command form is:



Where “C” represents a bit of a command, and “L” represents a bit of the length.

21.5.1 Short Form Commands

Some of these commands are compatible in form and structure with the C-Bus Lighting Application, and can therefore be used for backward compatibility with older devices and interoperability with lighting units. Lighting compatibility is shown.

The following short form commands are defined:

Command	Lighting Compatible	Binary	Hex
Commands that convey an exact state or setting			
STOP	YES	%0 0000 001	\$01
PLAY	YES	%0 1111 001	\$79
PAUSE / RESUME	YES	%0 0001 010	\$0A
SELECT CATEGORY	NO	%0 0010 010	\$12
SELECT SELECTION	NO	%0 0011 011	\$1B

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Command	Lighting Compatible	Binary	Hex
SELECT TRACK	NO	%0 0100 101	\$25
Commands that convey the state of a modifier			
SHUFFLE ON / OFF	YES	%0 0101 010	\$2A
REPEAT ON / OFF	YES	%0 0110 010	\$32
Relative Operations (Triggers)			
NEXT / PREVIOUS CATEGORY	YES	%0 0111 010	\$3A
NEXT / PREVIOUS SELECTION	YES	%0 1000 010	\$42
NEXT / PREVIOUS TRACK	YES	%0 1001 010	\$4A
FAST FORWARD	YES	%0 1010 010	\$52
REWIND	YES	%0 1011 010	\$5A
Others			
SOURCE POWER CONTROL	YES	%0 1100 010	\$62
TOTAL TRACKS	NO	%0 1101 101	\$6D
STATUS REQUEST	NO	%0 1110 001	\$71
ENUMERATE (LIST) CATEGORIES / SELECTIONS / TRACKS	NO	%0 1110 011	\$73
ENUMERATION SIZE	NO	%0 1110 100	\$74

The (3 bit) length field reflects the number of arguments.

All other possible command encodings are reserved, and shall not be used.

21.5.2 Long form Commands

The following long form commands are supported:

Command	Lighting Compatible	Binary	Hex
Commands that convey an exact state or setting			
TRACK NAME	NO	%1 00 LLLLL	\$8x
SELECTION NAME	NO	%1 01 LLLLL	\$Ax
CATEGORY NAME	NO	%1 10 LLLLL	\$Cx

The (5 bit) length field reflects the number of arguments.

All other possible long form commands are reserved, and shall not be used.

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21.6 Defined Commands

The Media Transport Control Application commands are typically emitted by an input unit.

To maintain synchronisation of the network variables (the Track number, Selection number, playback state, etc), messages shall be received and processed by all units that use the Media Transport Control Application, for those Media Link Groups of interest to the unit.

Media Transport Control Application messages are C-Bus Specific Application Language (SAL) messages.

All messages listed are mandatory for C-Bus Media Control Application devices, unless explicitly stated otherwise. Deviation from these messages will cause C-Bus devices to be incompatible. Consult Clipsal Australia before deviating from these messages.

21.6.1 Stop

Command: \$01

Arguments: <Media Link Group>

Meaning: The output unit on the Media Link Group is to stop playing the Active Track

Origin: Anywhere (usually an input unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

The output unit is assumed to have a valid Active Category and Active Selection.

If an output unit is in the Stopped state, this command has no effect.

21.6.2 Play

Command: \$79

Arguments: <Media Link Group>

Meaning: The output unit on the Media Link Group is to play Tracks from the Active Selection

Originator: Anywhere (usually an input unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

The output unit is assumed to have a valid Active Category and Active Selection.

If the output unit is in the Playing state, this command has no effect, apart from setting the playback speed to normal (turning off any fast forward).

If the output unit is in the Stopped state, play will begin from the first track in the Active Selection and Category. The first track may be indirectly randomised if the SHUFFLE modifier is active.

If the output unit is in the Paused state, this command will cause play to resume where it left off at the time the transition to the Paused state was made.

Refer to section 21.4.8 for more information.

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21.6.3 *Pause/Resume*

Command: \$0A

Arguments: <Media Link Group><Operation>

Meaning: The output unit on the Media Link Group is to suspend or resume media playback

Originator: Anywhere (usually an input unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

If the output unit is in the Playing state, the PAUSE command will cause playing to suspend. If the output unit is in the Paused or Stopped states, a PAUSE command is ignored.

If the output unit is in the Paused state, a RESUME will cause play to resume where it left off at the time the transition to the Paused state was made. If the output unit is in the Stopped or Playing states, a RESUME command is ignored.

Refer to section 21.4.8 for more information.

<Operation> should be 0 to pause, and 255 to resume (which is equivalent to another PLAY command). Values 1..254 are reserved and must not be used.

21.6.4 *Set Category*

Command: \$12

Arguments: <Media Link Group>, <Category Number>

Meaning: The output unit on the Media Link Group is to set a numbered Category

Originator: Anywhere (usually an input unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

The interpretation of <Category Number> depends on the output unit and translator. It might for example be used to refer to a particular CD slot in a CD-stacker or similar. It might also change a media server device between several different feeds (for example, Internet Radio, hard drive MP3 collection, CD).

If the requested <Category Number> does not exist, no action is taken.

<Category Number> is a 0-based unsigned number in the range 0 .. 127.

21.6.5 *Set Selection*

Command: \$1B

Arguments: <Media Link Group>, <Selection Hi>, <Selection Lo>

Meaning: The output unit on the Media Link Group is to set a Selection, in its currently Active Category , by number

Originator: Anywhere (usually an input unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

<Selection Hi> is the most significant byte of the Selection number to select.

<Selection Lo> is the least significant byte of the Selection number to select.

The two bytes of the Selection number together are interpreted as a 0 based unsigned number in the range 0 .. 32767. (0 means the first Selection, 1 means the second, etc)

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If the Selection number does not exist in the Active Category , then the Active Selection is not changed.

21.6.6 Set Track

Command: \$25

Arguments: <Media Link Group>, <Track MSB>, <Track MMSB>, <Track MLSB>, <Track LSB>

Meaning: The output unit on the Media Link Group is to select a Track, in its currently Active Selection, by number

Originator: Anywhere (usually an input unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

<Track MSB> is the most significant byte of the Track number.

<Track MMSB> is the middle most significant byte of the Track number.

<Track MLSB> is the middle least significant byte of the Track number.

<Track LSB> is the least significant byte of the Track number.

The four bytes of the Track number together are interpreted as a 0-based unsigned 31-bit number, with 0 meaning the first Track (in the Active Selection), 1 meaning the second Track, and so on.

If the Track number does not exist in the Active Selection, the currently Active Track is not changed.

If the Track number does exist, the output unit will make that Track Active, and change to the Playing state, and start to play that track, and will then progress to subsequent tracks in the Selection. The order of subsequent Tracks is determined by the SHUFFLE modifier setting. THIS COMMAND IS ALSO AN IMPLICIT PLAY COMMAND.

When an output unit is playing through a Selection, each time the Active Track changes (simply by advancing through the Selection or the shuffled Selection), the output unit must transmit a SET TRACK command. This ensures all other units in the Media Link Group know the Active Track.

21.6.7 Shuffle On/Off

Command: \$2A

Arguments: <Media Link Group><State>

Meaning: Set the SHUFFLE modifier of the Media Link Group either ON or OFF

Originator: Anywhere (usually an input unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

Refer to section 21.4.7 for the definitions of the SHUFFLE behaviour modifier.

<State> codes the Shuffle state:

0:	Shuffle is OFF.
1 .. 254:	Reserved, do not use.
255:	Shuffle is ON.

The SHUFFLE modifier can be changed at any time.

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21.6.8 Repeat On/Off

Command: \$32

Arguments: <Media Link Group><Type>

Meaning: Set the REPEAT modifier of the Media Link Group to OFF, REPEAT TRACKS or REPEAT CURRENT

Originator: Anywhere (usually an input unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.
Refer to section 21.4.7 for the definitions of the REPEAT behaviour modifier.
<Type> codes the Repeat state:

0:	Repeat is OFF
1 .. 254:	REPEAT CURRENT
255:	REPEAT TRACKS

The REPEAT modifier can be changed at any time.

21.6.9 Next/Previous Category

Command: \$3A

Arguments: <Media Link Group><Operation>

Meaning: Requests the output unit on the Media Link Group change to the next or previous Category

Originator: Anywhere (usually an input unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.
<Operation> determines the operation performed:

0:	Set the previous Category
Non-0:	Set the next Category

After receipt of a Next / Previous Category command, the output unit must issue a "SET CATEGORY" command containing the actual Category number that has been selected, even if that Category did not change.

When the end of a Category List is reached, the output unit should "wrap around". For example, with 3 Categories and a series of Next commands, the Categories would go 0, 1, 2, 0, 1, etc. Similarly for Previous commands, the Categories would go 0, 2, 1, 0, 2, etc.

21.6.10 Next/Previous Selection

Command: \$42

Arguments: <Media Link Group><Operation>

Meaning: Requests the output unit on a Media Link Group change to the next or previous Selection in its Active Category

Originator: Anywhere (usually an input unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.
<Operation> determines the operation performed:

0:	Set the previous Selection
----	----------------------------

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Non-0: Set the next Selection

After receipt of a Next / Previous Selection command, the output unit must issue a "SET SELECTION" command containing the actual Selection number that has been selected, even if that Selection did not change.

When the end of a Selection List is reached, the output unit should "wrap around". For example, with 4 Selections and a series of Next commands, the Selections would go 0, 1, 2, 3, 0, 1, etc. Similarly for Previous commands, the Selections would go 0, 3, 2, 1, 0, 3, etc.

21.6.11 *Next/Previous Track*

Command: \$4A

Arguments: <Media Link Group><Operation>

Meaning: Requests the output unit change to the next or previous Track in the Active Selection

Originator: Anywhere (usually an input unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

<Operation> determines the operation performed:

0: Set the previous Track
Non-0: Set the next Track

After receipt of a Next / Previous Track command, the output unit must issue a "SET TRACK" command containing the actual Track number that has been selected, even if that Track did not change.

When the end of a Track List is reached, the output unit should "wrap around". For example, with 10 Tracks and a series of Next commands, the Tracks selected might be 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, etc. Similarly for Previous commands, the Tracks selected might be 0, 9, 8, 7, 6, 5, 4, 3, 2, 1, 0, 9, etc.

(If SHUFFLE is turned on, the forward Track order might, for example, be 5, 1, 6, 4, 2, 9, 3, 8, 7, 0, 5, 1, 6, 4, etc. Similarly the reverse Track order might be (If 5, 0, 7, 8, 3, 9, 2, 4, 6, 1, 5, 0, 7, etc)

21.6.12 *Forward*

Command: \$52

Arguments: <Media Link Group>, <Operation>

Meaning: The output unit in Media Link Group is to Fast forward the current Track being played

Originator: Anywhere (usually an input unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

<Operation> determines the operation performed:

0: Cease fast forward – play at normal speed
1: Reserved
2: Fast forward at 2x speed
3: Reserved
4: Fast forward at 4x speed
5: Reserved

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6:	Fast forward at 8x speed
7:	Reserved
8:	Fast forward at 16x speed
9:	Reserved
10:	Fast forward at 32x speed
11:	Reserved
12:	Fast forward at 64x speed
13 .. 255:	Reserved

If the output unit on the Media Link Group is not in the Playing state, this command is ignored.

If the output unit on the Media Link Group supports only one fast forward speed, then it should use that speed for Operation codes 2, 4, 6, 8, 10 and 12.

When playing, and after receipt of a Forward command, the output unit continues playing but at a faster speed.

If the Active Track finishes, and Forward is still active, then the next Track is also played at the higher speed. If the track changes during Forward, the output unit must transmit a SET TRACK command.

To stop the Forward operation, transmit a Forward or Rewind command with an Operation 0 (zero). Alternatively, a PLAY command may be used.

21.6.13 **Rewind**

Command: \$5A

Arguments: <Media Link Group>, <Operation>

Meaning: The output unit in Media Link Group is to play the current Track but in reverse

Originator: Anywhere (usually an input unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

<Operation> determines the operation performed:

0:	Cease rewind – play at normal speed
1:	Reserved
2:	Rewind at 2x speed
3:	Reserved
4:	Rewind at 4x speed
5:	Reserved
6:	Rewind at 8x speed
7:	Reserved
8:	Rewind at 16x speed
9:	Reserved
10:	Rewind at 32x speed
11:	Reserved
12:	Rewind at 64x speed
13 .. 255:	Reserved

If the output unit on the Media Link Group is not in the Playing state, this command is ignored.

If the output unit on the Media Link Group supports only one rewind speed, then it should use that speed for Operation codes 2, 4, 6, 8, 10 and 12.

When playing, and after receipt of a Rewind command, the output unit continues

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playing but (if it supports it), going backwards and at a faster speed.

If the Active Track finishes, and Rewind is still active, then the previous Track is also played in rewind. If the Track changes during rewind, the output unit must transmit a SET TRACK command.

To stop the Rewind operation, transmit a Rewind or Forward command with an Operation 0 (zero). Alternatively, a PLAY command may be used.

21.6.14 Source Power Control

Command: \$62

Arguments: <Media Link Group>, <State >

Meaning: The output unit in <Media Link Group> has its power on/off state set

Originator: Anywhere (usually an input unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

<State> determines the power up state:

0: The output unit or device should power off

Non-0: The output unit or device should power on

If the output unit does not have power control abilities, this command is ignored.

21.6.15 Total Tracks

Command: \$6D

Arguments: <Media Link Group>, <Total_Tracks MSB>, <Total_Tracks MMSB>, <Total_Tracks MLSB>, <Total_Tracks LSB>

Meaning: The output unit on the Media Link Group is describing how many Tracks are available in the currently selected Category and Selection.

Originator: Anywhere (usually an output unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

<Total_Tracks MSB> is the most significant byte of the Track number.

<Total_Tracks MMSB> is the middle most significant byte of the Track number.

<Total_Tracks MLSB> is the middle least significant byte of the Track number.

<Total_Tracks LSB> is the least significant byte of the Track number.

The four bytes of the Total_Tracks number together are interpreted as a 0-based unsigned 31-bit number, with 0 meaning no Tracks, 1 meaning 1 Track, and so on.

21.6.16 Status Request

Command: \$71

Arguments: <Media Link Group>

Meaning: The unit issuing this command is requesting the current status of the output unit in <Media Link Group>

Originator: Anywhere (usually an input unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

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The output unit in this Media Link must emit the following commands, in the following order, to convey its current status to the network:

- SET CATEGORY to convey the Active Category number*;
- SET SELECTION to convey the Active Selection number*;
- SET TRACK to convey the Active Track number*;
- TOTAL TRACKS*;
- One of STOP, PLAY or PAUSE, depending on the playback state (but not RESUME);
- SHUFFLE ON/OFF* to convey the Shuffle Modifier state; and then
- REPEAT TRACKS / REPEAT CURRENT / REPEAT OFF to convey the Repeat Modifier state*.

The output unit must then issue names, as follows:

- Current Track Name**;
- Current Selection Name**;
- Current Category Name**;
- Next Track Name**;
- Next Selection Name**;
- Next Category Name;

And then, Previous Track, Selection, Category names, followed by Next+1 names, followed by previous-1 names.

* The command listed should only be sent by devices where that command is meaningful. For example, a Radio device should not transmit SET CATEGORY, SET TRACK, TOTAL TRACKS, SHUFFLE, REPEAT because these are meaningless

** Only names that are meaningful should be transmitted. Again, for the example of a radio device the category and track names are not meaningful, so these should not be transmitted. Transmission of Current and Next names are mandatory, the remainder are optional.

21.6.17 Enumerate Categories / Selections / Tracks

Command: \$73

Arguments: <Media Link Group><Type><Start>

Meaning: The unit issuing this command is requesting a dump of the names of the first 16 Categories / Selections / Tracks in <Media Link Group>

Originator: Anywhere (usually an input unit)

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

The output unit in this Media Link must emit an ENUMERATION SIZE message, and then up to 16 (or less, if there are less than 16 available) Categories, Selections, or Tracks; as specified by <Type> and starting from entry <Start>.

<Type> has the following meanings:

<Type> = 0 – list Categories

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<Type> = 1 – list Selections

<Type> = 2 – list Tracks

All other values of <Type> are reserved and must be ignored if received.

When an output unit emits the list of Category names, Selection names, or Track names, they must be sent in the order from first to last.

<Start> = the number at which the enumeration should begin, 0-based.

21.6.18 Enumeration Size

Command: \$74

Arguments: <Media Link Group><Type><Start><Size>

Meaning: The unit issuing this command is describing the number of entries that it is about to send as part of a previous enumeration on <Media Link Group>

Originator: Usually an output unit

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

In response to an Enumerate Categories / Selections / Tracks command, the output unit in this Media Link will emit this command, which describes how many Track, Selection or Category names will follow.

<Type> and <Start> are the values of the Enumerate command to which this enumeration applies (see 21.6.17.)

<Size> is the number of entries that will be produced, in the range 0 .. 15.

This command will be followed by 0 to 15 Track Names, Selection Names, or Category Names (each of which might comprise one or more C-Bus messages).

21.6.19 Track Name

Command: %100LLLLL

Arguments: <Media Link Group>, <Text Name Header>, <Text> ... <Text>

Meaning: The name, in characters, of the track being played (or to be played) by the output device in <Media Link Group>

Originator: Usually an output unit.

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

Track Names are only applied by units with capabilities to display Track names. All other units shall receive and discard this message.

Track names are transmitted in one of more such Track Name messages, and receiving units are responsible for reconstructing the name.

Units that transmit Track names always transmit the packets in order of increasing sequence number.

Track Name commands should be limited to 14 bytes total length (including the command) to ensure the message can be routed through at most 6 bridges.

Specific unit behaviour when transmitting Track Names is described in section 21.9.4.

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21.6.20 Selection Name

Command: %101LLLLL

Arguments: <Media Link Group>, <Text Name Header>, <Text> ... <Text>

Meaning: The name, in characters, of the Selection currently active (or to be active) in the output device in <Media Link Group>

Originator: Usually an output unit.

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

Selection Names are only applied by units with capabilities to display textual Selection names. All other units shall receive and discard this message.

Selection names are transmitted in one of more such Selection Name messages, and receiving units are responsible for reconstructing the name.

Units that transmit Selection names always transmit the packets in order of increasing sequence number.

Selection Name commands should be limited to 14 bytes total length (including the command) to ensure the message can be routed through at most 6 bridges.

Specific unit behaviour when transmitting Selection Names is described in section 21.9.4.

21.6.21 Category Name

Command: %110LLLLL

Arguments: <Media Link Group>, <Text Name Header>, <Text> ... <Text>

Meaning: The name, in characters, of the Category currently active (or to be active) in the output device in <Media Link Group>

Originator: Usually an output unit.

Notes: Refer to section 21.4.1 for the conventions used for Media Link Groups.

Category Names are only applied by units with capabilities to display textual Category names. All other units shall receive and discard this message.

Category names are transmitted in one of more such Category Name messages, and receiving units are responsible for reconstructing the name.

Units that transmit Category names always transmit the packets in order of increasing sequence number.

Category Name commands should be limited to 14 bytes total length (including the command) to ensure the message can be routed through at most 6 bridges.

Specific unit behaviour when transmitting Category Names is described in section 21.9.4.

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21.7 Message Priority

C-Bus Transport Control Application messages that are initiated by human events (for example, key press) are transmitted at Class 3 (medium low) priority.

Transport Control Application messages generated by complex software controlled systems (for example, a scheduling system or a security system) are transmitted at Class 4 (low) priority.

Message priority is part of the C-Bus message header (refer to the C-Bus PC Interface documentation), and is set by the two most significant bits of the C-Bus header field, as follows:

- 00 = Class 4, lowest priority
- 01 = Class 3, Medium low priority
- 10 = Class 2, Medium high priority
- 11 = Class 1, High priority

Thus, to send a Class 3 message, use a message header of (for example) \$45 instead of \$05 for a Class 4 message.

21.8 Internetwork Routing

C-Bus Transport Control Application devices (Clipsal key input units) never generate messages routed through bridges. (To extend range or node capacity, two adjacent networks can be linked by a bridge in "Application Connect" mode, which makes the bridge appear transparent).

Other devices participating in the Transport Control Application can generate messages routed through one or more C-Bus bridges. Clipsal C-Bus input and output units will correctly receive and interpret such messages. The Network routing information will be discarded.

21.9 Application Behaviour

21.9.1 Concatenated Commands

An Transport Control Application device may receive a message containing more bytes than a single command. This permits a single C-Bus transmission to contain multiple commands for a single application.

Devices using C-Bus Transport Control Application messages must process all received bytes. This is achieved by placing the received bytes in a buffer, and using the following simple algorithm:

```
WHILE the buffer contains bytes LOOP

    The first byte defines the command type and argument
    count (refer section 21.4).

    Process the first (command) byte and its arguments

    Once processed, remove the command and argument bytes
    from the buffer

END LOOP
```

21.9.2 Channels and Media Transport Control Output Units

Media Transport Control output units are typically media players such as Audio and/or Video streamers.

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Each unit may contain one or more **channels**. A channel is an individually switchable or controllable output.

21.9.3 Number of Media Link Groups

Media Transport Control units shall support at least one Media Link Group per device.

Use of more than one Media Link Group in an output device is possible but unusual. All such Media Link Groups are considered to be logically separated.

21.9.4 Category , Selection and Track Names

Category , Selection and Track Names can be transmitted into C-Bus, from output units, for use by input units. Names have the following importance, which in turn determines how they should be handled:

- | | |
|--------------------|---|
| (most important): | Current Category, Selection, or Track Name |
| | Next Category, Selection, or Track Name |
| | Previous Category, Selection, or Track Name |
| | Next + 1 Category, Selection, or Track Name |
| (least important): | Previous - 1 Category, Selection, or Track Name |

Encoding System

Names are encoded for transmission using the UTF-8 coding system with no Byte Order Marker. Where multiple bytes are used to encode a character, the byte will be transmitted in natural order (first byte of the encoded character first).

Output Devices Transmitting New Names

Category Names

Output devices should transmit the current Category name as soon as possible after a Category has been selected (whether by a SET CATEGORY, NEXT CATEGORY, or PREVIOUS CATEGORY command).

Output devices should transmit the Next Category name, or Next+1 Category name some time later, a delay of up to a second is acceptable.

Selection Names

Output devices should transmit the current Selection name as soon as possible after a Selection has been selected (whether by a Set Selection, Next Selection, or Previous Selection command).

Output devices should transmit the Next Selection name, or Next+1 Selection name some time later, a delay of up to a second is acceptable.

Track Names

When an output device finishes a track, and starts playing a new track, it should always transmit the new track name as soon as possible. If the new track name can be transmitted fractionally before the new track begins playing this is preferred.

Output devices should not transmit the Next Track name, or Next+1 Track Name until the new track has been playing for several seconds.

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Past History of Names

Output devices may or may not transmit a past history of Category, Selection, or Track names, using the Previous and Previous-1 Name commands.

If this information is required by an input device, it is recommended that that device collect a running history of Category, Selection, or Track names that have been played, for retention and display as appropriate to that input device. If the output device does send this information, the input device can simply overwrite its locally collected history of this information if and when it is received.

For example, small simple display devices with constrained resources might display no past history at all, or perhaps only 1, 2 or 5 previous track names.

Behaviour When Category , Selection or Track Is Changing Rapidly

If an output device detects a number of Media Transport Control commands arriving rapidly (for example, if a series of "Next Track" or "Next Category" commands arrive before the current Track Name has completed transmission), then the transmission of all Names should cease until the new commands stop arriving.

The period with no commands arriving is suggested as 2 seconds, though a range of 1 to 5 seconds is acceptable.

[This is to handle the case of a human user pressing "Next Category " or "Next Track" over and over again. We don't want a large queue with a backlog of out-of-date Track names to be sent into the bus. We have to send the first, detect that multiple commands are arriving, and so don't send any further updates until stability is reached. This runs counter to the need to send new names as quickly as possible – but is needed to ensure that silly behaviour by an operator does not lead to even more silly information display, such as name updates arriving for many seconds after the user stops pressing buttons.]

Display of Names on Input Devices

The display method, and number of Category, Selection or Track names displayed on an input device, is at the discretion of the input device designer.

For small input devices that cannot support a full UTF-8 character encoding, the non-displayable characters (generally those bytes with a most significant bit set) can be displayed as an open square box or "?". Whilst permitted, this should be avoided wherever possible.

Text Name Length Limit

A Text Name is limited to 40 bytes in total, irrespective of the number of packets used to transport the name. Because UTF-8 encoding is used, there may be less than 40 displayable characters if the transmitted message made use of multi-byte characters. (For information, the average track name is 23 characters.)

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Order of Operations

In order for a client device to build a suitable history of previous Track / Selection / Category names, the current Track / Selection / Category number ***must always*** be transmitted before the names are transmitted.

21.10 Notes

None.