RP 163-1992

SMPTE RECOMMENDED PRACTICE

for Television — System Service Messages

1 Scope

This practice details and defines the control message subset for the system service level. System service messages are used to perform system functions within a general-purpose communications channel of an interface system. This interface system shall transport data and digital control signals between equipment utilized in the production, post-production, and/or transmission of visual and aural information.

2 Notation

This practice describes the coding of keywords and information fields (I/F) in the form shown below.

NN	KEYWORD or I/F NAME	Keyword or I/F descriptive text
[The coding NN represents the assigned keyword or I/F code in hexa-decimal format]		["trib-" Descriptive text: effect of message at tributary.] ["bc-" Descriptive text: effect of message at bus controller.] [Other comments ...]
	Format:	<COMMAND> <PARAMETER NAME 0> [Parameter description; ... Parameter value coding, scale or range; <PARAMETER NAME n> Parameter definitions and explanations]

In the practices listed in annex B, keywords are listed numerically in hexadecimal notation. Keyword numbers are reserved as follows:

— Keywords 00_h – $1F_h$: System service subset
— Keywords 20_h – $3F_h$: Common message subset
— Keywords 40_h – FF_h: Virtual machine type-specifc subset

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3 Summary of keywords, mnemonics and information field (I/F) names

Hex	Keyword	(mnemonic)	Hex	I/F name	(mnemonic)
00	SYSTEM SERVICE NO OPERATION	(SNOP)			
01	Reserved for BEGIN	(RBGN)			
02	Reserved for END	(REND)			
03	SYSTEM SERVICE RESET	(SRST)			
04	INITIAL SEGMENT	(ISGT)			
05	SUBSEQUENT SEGMENT	(SSGT)			
06	BLOCK	(BLCK)			
07	VIRTUAL MACHINE/GROUP SELECT	(VMGS)			
08	SYSTEM SERVICE ERROR	(SERR)			
09	VIRTUAL GROUP ATTACH	(VGAT)			
0A	VIRTUAL GROUP DISCONNECT	(VGDT)			
0B					
0C					
0D					
0E					
0F					
10	ASSIGN LINKAGE	(ALNK)	10	LINKAGE	(LINK)
11	DEASSIGN LINKAGE	(DLNK)	11	STATUS	(STAT)
12	ASSIGN SUPERVISORY LEVEL GROUP	(ASGP)	12	SUPERVISORY LEVEL GROUP	(SGRP)
13	DEASSIGN SUPERVISORY LEVEL GROUP	(DSGP)	13	VIRTUAL GROUP	(VGRP)
14	ASSIGN VIRTUAL GROUP	(AVGP)	14		
15	DEASSIGN VIRTUAL GROUP	(DVGP)	15		
16	BC READ	(BCRD)	16		
17	BC I/F ITEM RESPONSE	(BIRE)	17		
18	REQUEST TIME TRANSMISSION	(RQTT)	18		
19	BUS CONTROLLER USER DEFINED	(BCUD)	19		
1A			1A		
1B			1B		
1C			1C		
1D			1D		
1E			1E		
1F	EXTENSION	(SEXT)	FF	EXTENSION	(SIEX)

NOTES –
1 Information field names 03_h – $0F_h$ are reserved.
2 The following convention is used in all messages (system service, common, and type-specific):
– most-significant byte (MSB) is transmitted first;
– least-significant bit (lsb) is transmitted last.

4 Keywords

00 SYSTEM SERVICE NO OPERATION

trib- and bc- System service no operation.
Relayed by bc.

Format: <SYSTEM SERVICE NO OPERATION>

01 Reserved for BEGIN
02 Reserved for END

These codes are reserved for BEGIN and END delimiters. They are used in the form:
<BEGIN>
<command or I/F list>
<END>
Relayed by bc.

03 SYSTEM SERVICE RESET

trib- System service reset. Resets all system service level functions to the power-up default state:
Virtual machine select – 0
Virtual groups disconnected
Segmentation off.
bc- Select virtual circuit 0 for the addressed tributary.
Sent by bc.

Format: <SYSTEM SERVICE RESET>

04 INITIAL SEGMENT

trib- Directs the system service level to commence segment assembly.
bc- Do not parse message further.
Relayed by bc.

Format: <INITIAL SEGMENT>
<SEGMENT COUNT> 8-bit binary unsigned number; count zero is the final segment.
<SEGMENT DATA ...>

NOTE – The final byte of a data segment shall be the final byte of a supervisory level message block.

05 SUBSEQUENT SEGMENT

trib- Directs the system service level to continue segment assembly.
bc- Do not parse message further.
Relayed by bc.

Format: <SUBSEQUENT SEGMENT>
<SEGMENT COUNT> 8-bit binary unsigned number; count zero is the final segment.
<SEGMENT DATA> ...

NOTES –
1 The final byte of a data segment shall be the final byte of a supervisory level message block.
2 A tributary with multiple virtual machines attached must provide separate segmentation facilities for each virtual machine.

06 BLOCK

trib- Directs the system service level to disassemble messages which have been concatenated within a single supervisory level message block. The BLOCK command shall be employed to delimit messages on every occasion where message concatenation is employed.
bc- Looks at end of block for system service message. Relayed by bc.

Format: <BLOCK>
<BYTE COUNT> 8-bit binary unsigned number. Specifies the length of the individual blocked message, in bytes, not including the byte count.
<BLOCK DATA> ...

07 VIRTUAL MACHINE/GROUP SELECT

trib- Directs the system service level to select the specified virtual machine or group.
bc- Selects the virtual circuit linkage for the indicated virtual machine.

Format: <VIRTUAL MACHINE/GROUP SELECT>
<VIRTUAL MACHINE/GROUP NUMBER> 8-bit binary unsigned number in the range 00_h – EF_h (machine), $F0_h$ – FF_h (group). 00_h is default.

08 SYSTEM SERVICE ERROR

trib- and bc- Advises that the system service command in the last frame received had not been understood, or could not be performed. Following detection of a SYSTEM SERVICE ERROR condition, no further processing will take place on the supervisory level frame, although any virtual machine message(s) encountered up to that point will still be forwarded to their destinations.
Relayed by bc.

Format: <SYSTEM SERVICE ERROR>
<EXEC CODE> 8-bits
00 - parse error
01 - cannot do by design
02 - insufficiently equipped
03 - buffer overflow
04 - invalid keyword argument
05 - destination tributary unavailable
<BYTE COUNT> 8-bits; not including the byte count
<OFFENDING COMMAND>

09 VIRTUAL GROUP ATTACH

trib- Directs the system service level to attach the specified virtual machine to the specified virtual machine group.
bc- Never received.
Sent by bc.

Format: <VIRTUAL GROUP ATTACH>
<VIRTUAL MACHINE NUMBER> 8-bit binary unsigned number in the range 00_h to EF_h. 00_h is default.
<VIRTUAL GROUP NUMBER> 8-bit binary unsigned number in the range $F0_h$ to FF_h only.

0A VIRTUAL GROUP DISCONNECT

trib- Disconnects the specified virtual machine from the specified virtual machine group.
bc- Never received.
Sent by bc.

Format: as VIRTUAL GROUP ATTACH

00_h removes all group assignments for a particular virtual machine.

10 ASSIGN LINKAGE

trib- Never received.
bc- Directs the bus controller system service level to establish a unidirectional linkage.

Format: <ASSIGN LINKAGE>
<SOURCE>
<DESTINATION>

Where SOURCE = Supervisory level select address + virtual machine number (default is 00_h);
and DESTINATION = Supervisory level select address + virtual machine number or virtual group number (default is 00_h)
or DESTINATION = Supervisory level group select address + virtual group number (default is 00_h).

11 DEASSIGN LINKAGE

trib- Never received.
bc- Directs the system service level to terminate the specified unidirectional linkage.

Format: as ASSIGN LINKAGE

12 ASSIGN SUPERVISORY LEVEL GROUP

trib- Never received.
bc- Directs the bus controller to assign a tributary to the designated group.

Format: <ASSIGN SUPERVISORY LEVEL GROUP>
<TRIBUTARY SELECT ADDRESS>
<SUPERVISORY GROUP SELECT ADDRESS>

13 DEASSIGN SUPERVISORY LEVEL GROUP

trib- Never received.
bc- Directs the bus controller to remove a tributary from a designated group.

Format: as ASSIGN SUPERVISORY GROUP

14 ASSIGN VIRTUAL GROUP

trib- Never received.
bc- Directs the bus controller to assign a virtual machine to a virtual group.

Format: <ASSIGN VIRTUAL GROUP>
<MACHINE>
<VIRTUAL GROUP NUMBER>

Where MACHINE = Tributary select address + virtual machine number.

15 DEASSIGN VIRTUAL GROUP

trib- Never received.
bc- Directs the bus controller to remove a virtual machine from a virtual group.

Format: as ASSIGN VIRTUAL GROUP

16 BC READ

trib- Never received.
bc- Directs the bus controller to transmit the instantaneous contents of the information field.

Format: <BC READ>
<I/F NAME>

Note– The I/F NAME may be replaced by several names wrapped in a BEGIN/END construct.

17 BC I/F ITEM RESPONSE

trib- Contains the I/F data in response to a BC READ command.
bc- Never received.

Format: <BC I/F ITEM RESPONSE>
<I/F NAME>
<I/F VALUE>

Note– Several I/F NAMES/VALUES may be wrapped in a BEGIN/END construct.

18 REQUEST TIME TRANSMISSION

trib- Never received.
bc- Directs the bus controller to transmit the value of the master system clock to all virtual machines using the common message TIMELINE RUN.

Format: <REQUEST TIME TRANSMISSION>

19 BUS CONTROLLER USER DEFINED

trib- Never received.
bc- Directs the bus controller to enter the user defined command state. On entry to such a state the specific bus controller parses the data bytes which follow. This will be manufacturer-, operator-, and/or installation-dependent.

Format: <BUS CONTROLLER USER DEFINED>
<BYTE COUNT> 8-bit binary unsigned number. Specifies the length of the command in bytes, not including the byte count itself.
<RAW DATA>

1F EXTENSION

trib- and bc- Directs the tributary or bus controller to enter the extension command set for the following single command only. They shall then resume execution of the basic command set.

Format: <EXTENSION>
<EXTENSION SET COMMAND> (one or more bytes)

5 Information fields

10 LINKAGE

Contains all the linkage information.

Format: <LINKAGE>
<BEGIN>
<SOURCE>
<DESTINATION>
...
<SOURCE>
<DESTINATION>
<END>

Where SOURCE = Supervisory level select address + virtual machine number (default is 00_h);
and DESTINATION = Supervisory level select address + virtual machine number or virtual group number (default is 00_h)
or DESTINATION = Supervisory level group select address + virtual group number (default is 00_h).
When necessary, the linkage information may be segmented.

11 STATUS — Tallies the system service level status.

Format: <STATUS>
<STATUS REPORT>

00_h: Linkage directory established; clock available
01_h: No linkage directory; clock available
10_h: Linkage directory established; no clock available
11_h: No linkage directory; no clock available

12 SUPERVISORY LEVEL GROUP — Contains all active supervisory level (S/L) groups excluding All Call, with the associated tributary addresses.

Format: <SUPERVISORY LEVEL GROUP>
<S/L GROUP IDENTIFIER> — 16-bit binary unsigned number.
<BEGIN>
<S/L SELECT ADDRESS> — Multiple groups may be nested with BEGIN/END.
...
<S/L SELECT ADDRESS> — When necessary, the message may be segmented.
<END>

13 VIRTUAL GROUP — Contains all active virtual groups with the associated virtual machine identifiers.

Format: <VIRTUAL GROUP<
<VIRTUAL GROUP NUMBER> — 8-bit binary unsigned number in the range $F0_h$ to EF_h
<BEGIN>
<Supervisory level select address>
<VIRTUAL MACHINE NUMBER> — 8-bit binary unsigned number in the range 00_h to FF_h
...
<Supervisory level select address> — Multiple groups may be nested with BEGIN/END.
<VIRTUAL MACHINE NUMBER> — When necessary, the message may be segmented.
<END>

FF EXTENSION — Indicates that the next information field name is a member of the extension set.

Format: <EXTENSION>
<EXTENSION SET I/F NAME>

Annex A (informative)
General concepts

The following text contains a general explanation of some of the concepts used in the formulation of the system service message set. It constitutes tutorial information, and is intended to assist in the understanding of the specifications in previous portions of this practice.

A.1 System service tasks

System service messages can affect all participants on the bus, tributaries as well as the bus controller; their effect, however, differs between tributaries and the bus controller.

Some system service messages address the bus controller only. These originate in a tributary and cause the bus controller to set up a new internal condition, or to originate further messages. Examples:

ASSIGN LINKAGE
DEASSIGN LINKAGE
ASSIGN SUPERVISORY LEVEL GROUP
DEASSIGN SUPERVISORY LEVEL GROUP
ASSIGN VIRTUAL GROUP
DEASSIGN VIRTUAL GROUP

Other system service messages are sent by the bus controller to accomplish linkage tasks in tributaries. Examples:

VIRTUAL GROUP ATTACH
VIRTUAL GROUP DISCONNECT
VIRTUAL MACHINE/GROUP SELECT

Finally there are system service messages which accompany virtual machine messages from source to destination and have no practical effect on the bus controller. These are simply relayed by the bus controller. Examples:

BLOCK
INITIAL SEGMENT
SUBSEQUENT SEGMENT

Notes in the system service message list indicate the effect of the messages on the tributary and the bus controller respectively, and give detailed information about their effect.

A.2 Blocking and segmenting

Information about blocking and segmenting of virtual machine messages by the use of the corresponding system service messages is given in SMPTE RP 139.

A.3 Addressing virtual machines

Since more than one virtual machine logically may be connected to a tributary, the address of every virtual machine is in two parts:

- the tributary address;
- the virtual machine number which identifies the virtual machine connected to this tributary.

Messages which specify a virtual machine must carry both tributary address and virtual machine number as joint parameters. When a single virtual machine only is attached to a tributary address, the virtual machine number defaults to zero (00_h).

A.4 Assigning linkages

In order to establish a linkage it is necessary to make an entry in the linkage directory of the bus controller. Unless the bus controller is very simple (setting up linkages by thumbwheels or a local keyboard only), system service messages originating in any tributary may be used to establish a linkage entry.

The relevant messages are:

ASSIGN LINKAGE and DEASSIGN LINKAGE

Either message carries parameters which specify the tributary address and virtual machine number of both source and destination; each such message assigns/deassigns a unidirectional linkage only, from one source to one destination.

In the assignment of groups the tributary address may be replaced by a supervisory level group address, and/or the virtual machine number may be replaced by a virtual group number.

Application details and examples of tributary linkage are given in SMPTE RP 139.

The linkage of groups is described below.

A.5 Assigning groups

The operational requirement for the grouping of virtual machines may come from any individual tributary, or from an assignment virtual machine. However, only the bus controller is able to establish groups, and system service messages are required, therefore, to instruct the bus controller to take the necessary actions.

A.6 Supervisory level groups

In order to set up a controlled supervisory level group, two actions need to be taken by the assigning virtual machine:

- direct the bus controller to assign a linkage between the controlling virtual machine and the newly defined supervisory group;
- direct the bus controller to assign all tributaries that are to be members of the new group.

Linkage assignment is initiated by an ASSIGN LINKAGE message to the bus controller as described above, but using the desired supervisory level group address and virtual group number instead of a tributary address and virtual machine number.

Where a single virtual machine only is attached to each and every tributary within a supervisory level group, the virtual group number defaults to zero (00_h).

Assignment of the required tributaries to the group is initiated by multiple system service messages, using the command

ASSIGN SUPERVISORY LEVEL GROUP

to the bus controller. In reaction to each of these messages the bus controller generates a supervisory level GROUP ASSIGN message for the appropriate tributary.

The ASSIGN SUPERVISORY LEVEL GROUP message carries two parameters:

- the tributary select address, which identifies the appropriate tributary;
- the desired supervisory level group select address.

Deassignment is performed similarly using the messages:

DEASSIGN LINKAGE and
DEASSIGN SUPERVISORY LEVEL GROUP.

A.7 Virtual groups

In order to set up a controlled virtual group, two actions need be taken by the assigning virtual machine:

- direct the bus controller to assign a linkage between the controlling virtual machine and the newly defined virtual group;
- direct the bus controller to assign all virtual machines that are to be members of the new group.

Linkage assignment is initiated by an ASSIGN LINKAGE message to the bus controller as described above, but using the desired virtual group number instead of the virtual machine number following the tributary supervisory level SELECT or GROUP address.

Assignment of the required virtual machines to the group is initiated by multiple system service messages using the command ASSIGN VIRTUAL GROUP to the bus controller.

In reaction to each of these messages the bus controller generates the system service message VIRTUAL GROUP ATTACH and sends it to the system service level of the tributary serving the required virtual machine.

Where a virtual group comprises virtual machines spread across several tributaries, it is the responsibility of the assigning station to direct the bus controller to construct the appropriate supervisory level group using the ASSIGN SUPERVISORY LEVEL GROUP command.

Each ASSIGN VIRTUAL GROUP message carries the parameters:

- the tributary select address and virtual machine number of the virtual machine;
- the desired virtual group number.

Deassignment is performed similarly using the messages DEASSIGN LINKAGE and DEASSIGN VIRTUAL GROUP. The message used by the bus controller to cancel the group assignment of an individual virtual machine is VIRTUAL GROUP DISCONNECT.

A.8 Assignment messages overview

Tables A.1 and A.2 summarize all system service messages which are used for assigning/deassigning linkages and groups, along with their parameters and their effects.

Table A.1 — Messages to the bus controller

Message	Parameters		Action by bus controller
ASSIGN/DEASSIGN LINKAGE	Source	tributary address virtual machine number	Set up internal linkage directory
	Destination	tributary address/group address virtual machine number virtual group number	
ASSIGN/DEASSIGN SUPERVISORY LEVEL GROUP	Tributary address Supervisory level group address		Send supervisory level GROUP ASSIGN/DEASSIGN to appropriate tributary

Table A.2 – Messages from the bus controller

Message	Parameters	Action by tributary
VIRTUAL GROUP ATTACH/ DISCONNECT	Virtual machine number Virtual group number	Commence/cease to react to messages for the specified virtual group number

A.9 Selecting virtual machines/groups

To switch the data flow path to a specified virtual machine/group within the system service level of the tributary; or to select the correct virtual circuit linkage for the indicated virtual machine, within the bus controller, VIRTUAL MACHINE/GROUP SELECT is used. Further details are given in SMPTE RP 139.

A.10 Information fields (I/F) within the bus controller

In a manner similar to virtual machines, the bus controller contains information fields.

The bus controller information field comprises:

- a table of all linkages currently established;
- a table of all supervisory level groups;
- a table of all virtual groups;
- status information for the bus controller.

A.11 Clocks

Many applications require a common time scale across several virtual machines. This is usually implemented as a (software) clock, the machine internal clock, which must be synchronized by a simultaneous command to all appropriate virtual machines.

Of all the bus participants only the bus controller can guarantee simultaneous transmission of a preset command for those clocks.

Therefore the bus controller is designated as the keeper of a bus clock that is used to synchronize the timelines in all appropriate tributaries.

To support this general concept, the following assumptions are made:

A.11.1 Bus clock

If present in the system, the bus clock is resident in the bus controller.

The bus clock is set by means external to the control bus.

The bus clock is incremented by an external, unspecified signal (tick) common to all virtual machines.

A.11.2 Machine internal clock

The machine internal clock is resident in the virtual machine level of the tributary.

The machine internal clock is preset by messages carried on the control bus.

The machine internal clock is incremented by the same external, unspecified signal (ticks) as the bus clock.

The machine internal clock may be selected as the source of the machine TIMELINE.

A.11.3 Time synchronization

Machine internal clocks are preset by the bus controller.

The bus controller, using the supervisory level message GROUP SELECT ALL CALL, transmits to all virtual machines connected to the bus, the common message TIMELINE RUN, with the time value from the bus clock.

The bus controller is responsible for transmitting the time consistent with the common external tick signal and intended use of time in the system.

The bus controller performs synchronization of the system in response to the system service message REQUEST TIME TRANSMISSION.

Annex B (informative)
Bibliography

ANSI/SMPTE 207M-1992, Television -- Digital Control Interface -- Electrical and Mechanical Characteristics

SMPTE RP 113-1992, Supervisory Protocol for Digital Control Interface

SMPTE RP 138-1992, Control Message Architecture

SMPTE RP 139-1992, Tributary Interconnection