REMOTE-CONTROL SYSTEMS FOR BROADCASTING PRODUCTION EQUIPMENT SYSTEM SERVICE AND COMMON MESSAGES

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CONTENTS

Introduction

Document Tech. 32 45 describes the specification of a digital remote control system for broadcasting production equipment. It defines completely the electrical/mechanical level (level 1) and the supervisory level (level 2) of the interface. The remaining two levels - the system service level (level 3) and the virtual machine level (level 4) - are defined in terms of function and control message syntax only.

Part 1 of this supplement to Tech. 3245 completes the definition of the system service level by detailing the system service messages. Part 2 defines those virtual machine messages which are common to all types of virtual machine - the common messages. Type-specific virtual machine messages are defined in other supplements to Tech. 3245.

In order to implement a complete network, the system designer therefore requires:

Document Tech. 3245: the general specification
Supplement 1: system service and common messages

and one or more other supplements appropriate to the category or categories of equipment to be used.

The specification described in this supplement has been developed jointly with the SMPTE, and is functionally identical to that to be published as an SMPTE Recommended Practice.

Part 1

System service messages

Chapter 1

General concepts

This chapter 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 specification in Chapter 2.

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 as 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 ATTACHE,
  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 or the tributary and the bus controller respectively, and give detailed information about their effect.

2. Blocking and segmenting

Detailed information about blocking and segmenting of virtual machine messages by the use of the corresponding system service messages is given in Tech. 3245, Chapter 4.

3. Addressing virtual machines

Since more than one virtual machine may be connected logically to a tributary, the address of every virtual machine to 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 (00h).

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, examples of tributary linkage, and a sample linkage directory are given in Tech. 3245, Chapter 4.

The linkage of groups is described below.

5. Assigning groups

The operational requirement for the grouping of virtual machines may come from 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.

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:

- to direct the bus controller to assign a linkage between the controlling virtual machine and the newly defined supervisory group;

- to 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 (00h).

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 massages 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.

7. Virtual groups

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

- to direct the bus controller to assign a linkage between the controlling virtual machine and the newly defined virtual group;

- to 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 SELECT 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 following 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.

8. Assignment messages overview

The following tables summarize all system service messages which are used for assigning/deassigning linkages and groups, together with their parameters and their effects.

8.1. Messages to bus controller

Message	Parameters		Action by bus controller
ASSIGN/ DEASSIGN LINKAGE	Source	tributary address	set up internal linkage directory
		virtual machine number	
	Destination	tributary address/group address	
		virtual machine number/ virtual group number	
ASSIGN/ DEASSIGN SUPERVISORY LEVE	Tributary address		Send supervisory level GROUP ASSIGN/DEASSIGN
	Supervisory level group address		
ASSIGN/ DEASSIGN VIRTUAL GROUP	Virtual machine	tributary address	send VIRTUAL GROUP ATTACH/ VIRTUAL GROUP DISCONNECT to appropriate virtual machine
		number	
	Virtual group number		

8.2. Messages from the bus controller

Message	Parameters	Action by tribut
VIRTUAL GROUP ATTACH/ DISCONNE	Virtual machine number	commence/cease to react to messages for the specified virtual group number
	Virtual group number	

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. Details are described in Tech. 3245, Chapter 4.

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

In a manner similar to virtual machines the bus controller contains information which is arranged in information fields (for details of the information field concept, see Part 2, Chapter 1 of this document).

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.

11. The bus clock

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 a 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:

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 ("ticks") common to all virtual machines.

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.

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 the 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.

Chapter 2

System service messages

1. Index of* keywords, mnemonics and information field names

Hex	Keyword	(mnemonic)	Hex	Information field 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 SEGM M	(SSGT)			
06	BLOCK	(BLCK)			
07	VIRTUAL MACHINE/GROUP SELECT	(VMGS)			
08	SYSTEM SERVICE ERROR	(SERR)			
09	VIRTUAL GROUP ATTACH	(VGAT)			
OA	VIRTUAL GROUP DISCONNECT	(VGDT)			
OB					
OC					
OD					
OE					
OF					
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 03h-0Fh 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 first.

2. Keywords

In the following definitions, the different effect of the message when received by a tributary, compared with the effect when received by a bus controller, is shown:

trib - (effect at tributary)
bc - (effect at bus controller).

Messages which are relayed by the bus controller are so indicated.

Hex Keyword

00 SYSTEM SERVICE NO OPERATION
trib - & - bc System service no operation

relayed by bc

Format: <SYSTEM SERVICE NO OPERATIN>

01 reserved for BEGIN These codes are reserved for BEGIN and
02 reserved for END 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 block.

05 SUBSEQUENT SEGMENT

trib - Directs the system service level to continue segment assembly.

bc - Do not parse massage further

relayed by bc

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

Note 1: The final byte of a data segment shall be the final byte of a supervisory 1evel block.
Note 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 virtual machine messages which have been concatenated within a single supervisory level frame. The BLOCK command shall be employed to delimit messages on every occasion where message concatenation is employed.

bc - Look 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 00h-EFh (machine), F0h-FFh, (group). 00h is default.

08 SYSTEM SERVICE ERROR

trib - & be - Advises that the system service command in the last frame received had not been understood, or could not be performed. Following receipt of a SYSTEM SERVICE ERROR, 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 destination(s).

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 trib. 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 00h to EFh. 00h is default.
<VIRTUAL GROUP NUMBER> 8-bit binary unsigned number In the range F0h to FFh 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. 00h 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 00h)

and: DESTINATION = Supervisory level select address + virtual machine number OR virtual group number (default is 00h)
or = Supervisory level group select address + virtual group number (default is 00h)

11 DEASSIGN LINKAGE
trib - Never received

bc - Directs the system service level to terminate 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 LEVEL 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 LEVEL 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>

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

be - 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 RESPONCE
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 wraped 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 TUM 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 - & 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)

3. 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 00h).
and DESTINATION = Supervisory level select address + virtual machine or group number (default is 00h)
or Supervisory level group select address + virtual group number (default is 00h)

When necessary, the linkage information may be segmented.

11 STATUS
Tallies the system service level status.

Format: <STATUS>
<STATUS REPORT> 00h Linkage directory established; clock available
01h No linkage directory; clock available
10h Linkage directory established; no clock available
11h No linkage directory: no clock available

12 SUPERVISORY LEVEL GROUP
Contains all active supervisory level (SIL) 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>
<S/L SELECT ADDRESS>
<S/L SELECT ADDRESS ... >
<END>

Multiple groups may be heated with BEGIN/END.

When necessary, the message may be segmented.

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

Format: <VIRTUAL GROUP>
<VIRTUAL GROUP NUMBER> 8-bit binary unsigned nunber in the range F0h to FFh.
<BEGIN>
<supervisory level select address>
<VIRTUAL MACHINE NUMBER> 8-bit binary unsigned number in the range 00h to EFh.
<supervisory level select address>
<VIRTUAL MACHINE NUMBER>
<supervisory level select address>
.
.
.
<END>

Multiple groups may be nested with BEGIN/END.

When necessary, the message may be segmented.

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

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

Part 2

Common messages

Chapter 1

General concepts

This chapter contains a general explanation of some of the concepts used in the formulation of the common message set. It constitutes tutorial information, and is intended to assist in the understanding of the specification in Chapter 2.

1. Commands and responses

The message language is subdivided into two types of message, which differ only in the direction of information flow between controlling and controlled virtual machines.

- COMMANDS are messages from a controlling to a controlled virtual machine;
- RESPONSES are messages from a controlled to a controlling virtual machine; responses are mostly transmitted in reaction to a command.

2. State machine and information transfer

The virtual machine controlled by the message language is considered as a STATE MACHINE. The message set can be regarded as being of two types:

- Messages which change the state of the virtual machine (e.g. the VTR messages STOP and PLAY). These commands reside mainly in the type-specific message set and comprise commands which are mutually exclusive (e.g. the tape motion commands (TMCs) in the VTR set).

- Messages (commands and responses) which do not change the state, but which only carry information to or from the virtual machine. An Information-transfer is a general requirement of all types of virtual machine, general principles are applied to these tasks; these messages, therefore reside mainly in the common message set.

3. Information fields (I/F)

Items of information which are maintained by, and held within a controlled virtual machine, and which may be needed by its controlling virtual machine, are arranged in a virtual array of information fields, which is similar in concept to a data-base.

Each information field is identified by a unique descriptor called the information field name. This name, coded as a binary value, is used as an address within all commands referencing the field. The information field name is used, therefore, as a parameter name in these commands.

The format of information field data, within each message, as transmitted over the remote control system, is predefined for each item by the Information field now.

Each message set requires its own array of information fields; the complete field array of a specific virtual machine comprises the field array specified in the common message set, together with that of the type-specific message set.

A typical example of a command requiring an information field is READ, which directs the virtual machine to transmit the content of one or more information field(s), as specified within the command.

The SIMULTANEOUS READ command directs the virtual machine to read, simultaneously, the instantaneous values of a number of specified information fields. In response to this command, all the specified fields will be read as a "snapshot", and will be "locked", therefore, during the READ period.

It is essential to be able to PRESET the values of certain items held within information fields. However, since the preset function could (indirectly) change the state of the virtual machine (e.g. presetting a tape timer), the PRESET command is contained within the type-specific command set; information fields to which it relates are then individually specified.

4. Error and failure messages

An ERROR message advises a controlling virtual machine that the command, as identified, cannot be performed. The reason for the inability to perform the action is contained within an EXEC CODE transmitted as a parameter to the ERROR keyword.

The string which caused the error message is then appended to the EXEC CODE, preceded by a byte count.

In the event of failure of the specific machine (i.e. a failure requiring the attendance of an operator), a single byte FAILURE message is transmitted.

5. Enquiry concept

Although, ideally, every virtual machine should respond to the complete message set, it is the responsibility of each manufacturer to determine the degree of conformance of his product.

To enable a controlling virtual machine to determine the facilities supported by a remote-controlled virtual machine, two enquiry commands are provided:

- FUNCTION POLL to identify supported commands;
- FIELD POLL to identify supported information fields.

The associated responses are FUNCTION POLL RESPONSE and FIELD POLL RESPONSE.

Virtual machines that do not support these enquiry commands must respond to any unknown command with ERROR.

6. Standard and extension keywords

Due to the limited code-space available, each message set (system service, common, type-specific) contains an extension keyword, which opens an additional code space of 256 additional keywords.

Frequently used keywords will preferably reside in the standard set. For keywords that are used less frequently, the additional overhead of one byte is acceptable; such keywords have been put in the extension set from the beginning, thus leaving room in the standard set for future applications.

7. Procedures

A group of commands which are to be executed in sequence on one or more occasions may be combined into a procedure using the command DEFINE PROCEDURE.

Once defined, a procedure can be called simply by the command EXECUTE PROCEDURE, as often as wanted, until cancelled by the DELETE PROCEDURE command.

It is possible to define more than one procedure at a tine using different procedure names, coded as binary numbers.

The command RECALL PROCEDURE and the associated response PROCEDURE RESPONSE may be used to inspect currently-defined procedures.

8. The timeline concept

In order to allow for synchronous processes in and among several virtual machines, a time-scale common to all virtual machines is provided which my be referenced by certain commands. This time-scale is called TIMELINE.

The timeline may be derived externally by a locally-defined reference time (e.g. derived from a central timecode generator and distributed over separate lines), or it may be generated internally by a built-in clock, the "machine internal clock", that gets only its "ticks" from an external source available to all machine internal clocks of the system (e.g. the vertical pulse, in television applications).

Either of the two possibilities may be selected by the TIMELINE SOURCE command.

When the machine internal clock is selected as the timeline source, the timeline may be stopped by the TIMELINE STOP command and restarted by the TIMELINE RUN command, which also specifies the start value.

The TIMELINE RUN command is also issued by the bus controller in response to the system service command REQUEST TIME TRANSMISSION; this allows for exact synchronization of all timelines of the system.

The current status of the timeline may be accessed through the Information field TIMELINE.

9. Events

An event specifies a command that will he executed on the occurrence of a specified trigger condition. The trigger condition arises when a specified trigger value coincides with the content of a specified trigger source. Any information field of the specific virtual machine may serve as a trigger source.

The most important trigger source, however, is the timeline. This allows for time-synchronous events in different virtual machines (e.g. synchronizing the transports of several VTRs).

The command DEFINE EVENT is used to specify an event. The event is cleared by the occurrence of the trigger condition, or by a CLEAR EVENT command.

The command RECALL EVENT and the associated response EVENT RESPONSE may be used to inspect pending events.

Using EXECUTE PROCEDURE as the command within an event specification allows for a sequence of commands to be programmed for execution on a trigger condition.

It is important to note that the controlled virtual machine, once programmed with an event, is responsible for taking care of all necessary actions for the correct execution of that event; even if actions have to be taken in advance of the occurrence of the trigger condition (e.g. in the case of an event that programs an edit entry on the timeline the virtual machine must apply the necessary switch commands for the erase head a certain number of frames in advance of the trigger time).

10. Tasks with repeated responses

In order to reduce overhead on the remote-control system, commands are provided which may be used to instruct a controlled virtual machine to transfer the content of an information field repeatedly; either whenever the content changes (UPDATE command), or when a specified time-period is over (CYCLE command).

Caution must be exercised, however, in the use of multiple UPDATE commands where the values of the specified information fields are changing rapidly; bus congestion may occur.

Additionally, where an information field value has changed a number of times in the period between bus controller polls, only the most recent value is transmitted at the next poll, in response to either the UPDATE or CYCLE commands; this will minimize the risk of bus congestion.

(Note: Repeated transmissions must be consistent with the requirements of the supervisory protocol, i.e. a transmission can take place only following a tributary poll and a subsequent service request to the bus controller.)

11. Dialect identification

The information field VIRTUAL MACHINE TYPE-of the common message set contains a code which defines the type of the type-specific message set. Every dialect has an associated code which is defined in the specification of that manage set.

The type of virtual machine, and the dialect understood by it, can be interrogated by READing this information field.

Chapter 2

Common messages

1. Index of keywords mnemonics and information field names

Hex	Keyword	(Mnemonic)	Hex	Information field name	(Mnemonic)
20	CNOP	(CNOP)	20		
21	CRESET	(CRST)	21	VIRTUAL MACHINE TYPE	(VTYP)
22	READ	(READ)	22	EQUIPMENT TYPE	(ETYP)
23	I/F ITEM RESPONSE	(IFRE)	23	TIME STANDARD	(TIME)
24	TIMELINE SOURCE	(TSCE)	24	TIMELINE TIME	(TTIM)
25			25		
26	EXECUTE PROCEDURE	(EXPR)	26	EVENT BUFFER STATUS	(EBST)
27	DEFINE EVENT	(DEEV)	27	VIRTUAL MACHINE STATUS	(VMST)
28	CLEAR EVENT	(CLEV)	28		
29	ERROR	(CERR)	29		
2A			2A		
2B			2B		
2C			2C		
2D	FAILURE	(FAIL)	2D		
2E			2E		
2F	TIMELINE STOP	(TSTP)	2F		
30	TIMELINE RUN	(TRUN)	30		
3E	USER DEFINED	(UDEF)	3E	USER DEFINED	(UDND)
3F	EXTENSION	(CEXT)	3F	EXTENSION	(CIEX)

Note: The ability to perform command 29h (ERROR), above, is mandatory for every virtual machine.

EXTENSION SET

Hex	Keyword	(Mnemonic)
00		
01		
02		
03	FUNCTION POLL	(FNPL)
04	FUNCTION RESPONSE	(FNRE)
05	FIELD POLL	(FDPL)
06	FIELD RESPONSE	(FDRE)
07	UPDATE	(UDAT)
08	CYCLE	(CYCL)
09	MUTE	(MUTE)
OA	SIMULTANEOUS READ	(SIRD)
OB	DEFINE PROCEDURE	(DEPR)
OC	DELETE PROCEDURE	(DLPR)
OD	RECALL PROCEDURE	(REPR)
OE	PROCEDURE RESPONSE	(PRRE)
OF	RECALL EVENT	(REEV)
10	EVENT RESPONSE	(EVRE)
11	SIMULTANEOUS READ RESPONSE	(SRDR)
FF	EXTENSION	(EXEX)

2. Keywords

In the following definitions, parameter names and parameter values are 8-bit binary, unless otherwise noted.

Multi-byte values, where Used,are ordered with the most-significant byte first in the message; the least-significant bit ia transmitted first.

Hex Keywords

20 CNOP
Virtual machine no operation

Format: <CIROP>

21 CRESET
Directs the destination virtual machine to assume standard values of all preselectable functions. (Same status as power-up)

Format: <CRESET>

22 READ
Directs the virtual machine to transmit the instantaneous content of the specified information field

Format: <READ>
<I/F NAME>

Note. Several I/F NAMS may be wrapped in a BEGIN/END construct.

23 I/F ITEM RESPONSE
Response to READ, UPDATE or CYCLE commands

Format <117 ITEM RESPONSE>
<I/F NAME>
<I/F VALUE> (length varies according to the I/F NAME)
Note: Several I/F NAME and I/F VALUE pairs may be wrapped in a BEGIN/END construct.

24 TIMELINE SOURCE
Directs the virtual machine to select the source of the timeline

Format: <TIMELINE SOURCE>
<SOURCE IDENT> <00> INTERNAL - Internal clock Incremented by an unspecified source ("tick")
<0l> EXTERNAL - External reference time

26 EXECUTE PROCED
Directs the virtual machine toexecute immediately the procedure named.

Format: <EXECUTE PROCEDURE>
<PROCEDURE NAME> NAME is in the range 01h to FFh, 0h is reserved

27 DEFINE EVENT
Prepares an "event" i.e. a function which shall be executed at the Instant of coincidence of a specified trigger time with the content of a specified I/F time

Format: <DEFINE EVENT>
<EVENT NAME> 8 bits
<I/F NAME OF TRIGGER SOURCE>
<TRIGGER VALUE> (type TIME)
<COMMAND> specifies the function

Notes: 1. To implement a procedure in an event, "EXECUTE PROCEDURE" shall be used for the COMMAND, and the procedure shall have been pre-defined.
2. The TRIGGER SOURCE I/F NAME is a TIMELINE or a type-specific time information field.
3. All functions contained within a procedure defined as an event must be executed by the virtual machine at the trigger time specified by the event.
4. Events are limited to type-specific messages, and the common message READ.
5. The virtual machine shall clear an event on execution.
6. The EVENT NAME is unique for each event.
7. Where mutually exclusive commands are given inadvertently at the same time through the use of events constructs, such events shall be cleared by the virtual machine and an error message returned.

28 CLEAR EVENT
Clears one or all events previously established

Format: <CLEAR EVENT>
<EVENT NAME> (<00h> is all events)

29 ERROR

Advises the controlling virtual machine th&t7the previous string has not been understood by, or cannot be performed by the controlled virtual machine

Format: <MC CODE> 8 bits:

00	Parse error
01	Cannot do by design
02	Insufficiently equipped
03	Buffer overflow
04	Invalid keyword
05	Invalid keyword argument
FF	Unspecified

<BYTE COUNT> 8 bits, not including the byte count

<OFFENDING STRING> truncated not to exceed an overall message length of 256 bytes

2D FAILURE

Warns of a catastrophic failure of the specific machine; i.e. a failure which requires intervention by the local operator

Format: <FAILURE>

2F TIMELINE STOP

If the timeline is internal, stops the timeline from increment

Format: <TIMELINE STOP>

30 TIMELINE RUN

If the timeline is internal, starts the timeline incrementing from the time indicated

Format: <TIMELINE RM

<TIMELINE VALUE> (type TIME)

3E USER,DEFINED

Identifies USER DEFINED commands

Format: <USER DEFINED>

<BYTE COUNT> 16-bit~binary unsigned number. Specifies the length of the command, in bytes, not including the byte count itself.

<RAW DATA> (length varies according to the byte count)

3F EXTENSION

Directs the virtual machine to enter the common message extens on act following single command only. The virtual machine shall then resume execution of the basic command set.

Format: <EXTENSION>

<EXTENSION SET COMMAND> (one or more bytes)

EXTENSION SET

00 ⎫
01 ⎬ RESERVED
02 ⎭

03 FUNCTION POLL
Directs the virtual machine to indicate which of the keywords contained in the command set are supported by its type-specific machine. BEGIN and END are excluded from the keywords. The existence of the function poll command assumes the existence of the BEGIN/END construct.
5

Format: <FUNCTION POLL>
<BEGIN>
<KEYWORD l>
<KEYWORD 2>
<KEYWORD . . .>
<END>

04 FUNCTION RESPONSE
Contains the list of supported keywords in response to a FUNC

Format: <FUNCTION REPONSE>
<BEGM
<KEYWORD l>
<KEYWORD 2>
<KEYWORD . . .>
<END>

05 FIELD POLL
Directs the virtual m~chine to indicate which I/F names contained in the parameter list are supported by the type-specific machine information field

Format: <FIELD POLL>
<BEGIN>
<I/F NAME l>
<I/F NAME 2>
<I/F NAME . . .>
<END>

06 FIELD RESPONSE
Contains the list of supported I/F names from those indicated by a FIELD POLL command

Format: <FIELD RESPONSE>
<BEGIN>
<I/F NAME l>
<I/F NAME 2>
<I/F NAME . . .>
<END>

07 UPDATE
Directs the virtual machine to respond immediately with the contents of the information field, and then, automatically, whenever its contents change.

Format: <UPDAATE>
<I/F NAME> (Hex,)

Notes: 1 The single I/F NAME may be replaced by several names wrapped in a BEGIN/END construct.
2. The default condition is MUTEd.
3. Where an information field value has changed a number of times in the period between bus-controller polls, only the most recent value is transmitted at the next poll.

08 CYCLE
Directs the virtual machine to transmit periodically, as specified, the instantaneous contents of the specified information field.

Format: <CYCLE>
<TIME INTERVAL> (type TIME)
<I/F NAME> (Hex)

Notes: 1. The single I/F NAME may be replaced by several names wrapped In a BEGIN/END construct.
2. The default condition is MUTEd.
3. Where an information field value has changed a number of times in the period between bus-controller polls, only the most recent value Is transmitted at the next poll.

09 MUTE
Directs the virtual machine to switch off all responses previously initiated by CYCLE or UPDATE commands

Format: <MUTE>

0A SIMULTANEOUS READ
Directs the virtual machine to read simultaneously the contents of the specified information fields

Format: <SIMULTANEOUS READ>
<BEGIN>
<I/F NAME>
<I/F NAME>
<END>

0B DEFINE PROCEDURE
Directs the virtual machine to assemble a block of virtual machine commands for subsequent execution

Format: <DEFINE PROCEDURE>
<PROCEDURE NAME> (Hex) in the range 0lh-FFh. 00h is reserved.
<BYTE COUNT> 16 bits; not including the byte count
<COMMAND l> ⎫
<COMMAND 2> ⎬ The procedure
<COMMAND . . .> ⎭

Notes: 1. All functions contained within a procedure which is used within an event must be executed by the virtual machine at the trigger time specified by the event, even if actions must be taken in advance.

2. Procedures are retained until receipt of a DELETE PROCEDURE or CRESET command.

0C DELETE PROCEDURE

Directs the virtual machine to delete a command block previously defined

Format: <DELETE PROCEDURE>
<PROCEDURE NAME> (<00h> deletes all procedures)

0D RECALL PROCEDURE

Directs the virtual machine to transmit, but not execute or delete, the specified procedure for checking

Format: <RECALL PROCEDURE>
<PROCEDURE NAME> (<00h> recalls all procedures)

0E PRECEDURE RESPONSE

Response to RECALL PROCEDURE command

Format: <PROCEDURE RESPONSE>
<PROCEDURE NAMW
<BYTE COUNT> 16 bits not including the byte count
<C011MAND l>
<COMMAND 2>
<COMMAND . . .>

0F RECALL EVENT

Causes an EVENT RESPONSE from the controlled virtual machine containing the data of an event already established

Format: <RECALL EVENT>
<EVENT NAME> (<00h> recalls all events)

10 EVENT RESPONSE

Contains the data of an event already established

Format: <EVENT RESPONSE>
<EVENT NAME>
<I/F NAME of TRIGGER SOURCE>
<TRIGGER VALUE> (type TIME)
<COMMAND> function caused by trigger condition

11 SIMULTANEOUS READ RESPONSE 5,2

Response to SIMULTANEOUS READ with all specified information fields

Format: <SIMULTANEOUS READ RESPONSE>,
<BEGIN>
<I/F NAME l>
<I/F VALUE l>
<I/F NAME 2>
<I/F VALUE 2>
.
.
<END>

FF EXTENSION

Directs the virtual machine to enter the further extension sat for the following single command only. The virtual machine shall then resume execution of the basic set.

Format: <EXTENSION>
<EXTENSION SET COM~

3. Information fields

20 Not used

21 VIRTUAL MACHINE TYPE

Contains the virtual machine name and hence defines the type specific machine command set

Format: <VIRTUAL MACHINE TYPE>
<VIRTUAL MACHINE NAME> (8-bit binary unsigned number)

The content of VIRTUAL MACHINE NAME shall be defined explicitly in each virtual machine dialect; the virtual machine name for a wholly USER DEFINED virtual 01h.

22 EQUIPMENT TYPE

Contains the data to identify the specific product, including hardware/software revision level

Format: <EQUIPMENT TYPE>
<BYTE COUNT> 8 bits, not including the byte count itself
<ISO 646 printing characters>

Note: The ISO characters shall contain three fields, namely:
1. Manufacturer Identification
2. Product identification
3. Revision level
in that order. Each field shall be terminated by <0Dh>.

23 TIME STANDARD

Contains the nominal field rate to be used, or in use

Format: <TIME STANDARD>
<NAME> 8-bit binary unsigned number
<00h> is undefined
<01h> is "48
<02h> is "50"
<03h> is "60"

24 TIMELINE TIME

Contains the timeline time value

Format: <TIMELINE TIME>
<TIMELINE TIME VALUE> the resolution shall be consistent with the timecode in use.

26 EVENT BUFFER STATUS

Tallies the event buffer status

Format:	<EVENT BUFFER STATUS>	
	<STATUS REPORT>	Space remaining In bytes 16-bit number

27 VIRTUAL MACHINE STATUS

Tallies the virtual machine status

Format:	<VIRTUAL MACHINE STATUS>	
	<STATUS REPORT>	<00h> off <0lh> not available <02h> available

3E USER DEFINED

Identifies USER DEFINED information fields

Format:	<USER DEFINED>	
	<BYTE COUNT>	16-bit binary unsigned number. Specifies the length of the information field in bytes, not including the byte count itself
	<RAW DATA>	(Length varies according to the byte count)

3F EXTENSION

Directs the virtual machine to enter the common message I/F name extension set for the following single I/F name only. The virtual machine shall then resume access to the basic I/F name set

Format: <EXTENSION>