Interface Control Document for Monitor and Control System Data Recorder (MCS-DR) Ver. 1.0

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1 Description

1.1 Purpose

The purpose of this document is to define the interface between Monitor and Control System Data Recorder (MCS-DR) and other Long Wavelength Array (LWA) station subsystems. The MCS-DR subsystem records output of the Digital Processing (DP) subsystem and is controlled by the Monitor and Control System (MCS). Whereas station architecture and subsystem ICDs may refer to the MCS-DR as a whole, this ICD applies to a single MCS-DR PC.

1.2 Scope

This ICD shall describe the MCS-DR's physical and electrical connections, software interfacing and control methods.

1.3 Related Documents and Drawings

LWA Station Architecture [1]
MCS Architecture [2]
MCS Subsystem Definition [3]
MCS Common ICD [4]
DP ICD [5]
MCS - Data Recorder Preliminary Design & Verification [6]
MCS-DR Storage Unit [7]

2 Document Conventions

2.1 Abbreviations and Acronyms

DP	Digital Signal Processing
DRX	Digital Receiver
LWA	Long Wavelength Array
MIB	Management Information Base
MCS	Monitor and Control System
MCS-DR	Monitor and Control System - Data Recorder
TBN	Transient Narrowband Buffer
TBW	Transient Wideband Buffer
U	Rack Units (1.75 inches)

2.2 Command Parameter Types

uint8	unsigned integer, 8 bits
ASCII-XXX-#	An ASCII string exactly XXX characters in length which is interpreted as a number. Valid characters are numbers and right-padding spaces only.
ASCII-XXX-A	An ASCII string exactly XXX characters in length which is interpreted as a text string. Unless otherwise noted, valid characters are letters, numbers, the underscore character, and periods.

2.3 Mark-up Conventions

Symbol/Mark-up	Meaning	Example
italics	Italics indicate a variable, parameter, or response element name.	*Start MPM*
`Bold Fixed-width`	Text in this font indicates a particular parameter or response format. A single quote character appearing in a literal format should be interpreted as a space.	"`AB'_`" would indicate a literal "A" followed by a literal "B", followed by a space, followed by a literal "_".
`<...>`	Text appearing in these brackets indicates a parameter or variable substitution to a format specification. The brackets themselves are omitted from the format.	"`A<B>_`" would indicate a literal "A" followed by the variable *B*, followed by a literal "_".

2.4 Numeric Representation Convention

Numbers, units, and their associated prefixes and suffixes conform to the standard of IEC 60027-2 [8]. Specifically, the prefixes Ki, Mi, Gi, and Ti refer to 2^{10}, 2^{20}, 2^{30}, and 2^{40}, respectively. Likewise, the prefixes K, M, G, and T refer to 10^3, 10^6, 10^9, and 10^{12}, respectively. If a unit specifies a binary size or rate, an uppercase B represents a byte, whereas a lowercase b indicates an individual bit (i.e. MB = Megabyte, or 1,000,000 bytes, and Kb = kibibit or 1,024 bits).

3 Physical System Interfaces

3.1 Mechanical Interface

Figure 1 shows the MCS-DR mounted in one possible configuration. The MCS-DR consists of a PC and a RAID storage unit. The PC is mounted in a 6U EIA 19" shelf rack, and the storage unit requires 1U of rack space. The PC and storage unit may be mounted anywhere within the shelter so long as they are within cable's reach of each other (approx. 1 m). For more details on the 1U storage unit, see "MCS-DR Storage Unit" ([7]).

Figure 1: An MCS-DR PC and storage unit mounted on a 19" rack

3.2 Electrical and Electronic Interfaces

The PC will be powered by a 3-prong, grounded, 110 Volts RMS outlet, and power usage will not exceed 500 Watts. The storage unit will be powered by a 3-prong, grounded, 110 Volts RMS outlet, and power usage will not exceed 250W.

3.3 Electronic Interface

Figure 2 illustrates the electrical and electronic connections between the MCS-DR PC, MCS-DR storage unit, station power, and station subsystems. The insets of Figure 2 show expanded rear views of the MCS-DR PC and storage unit.

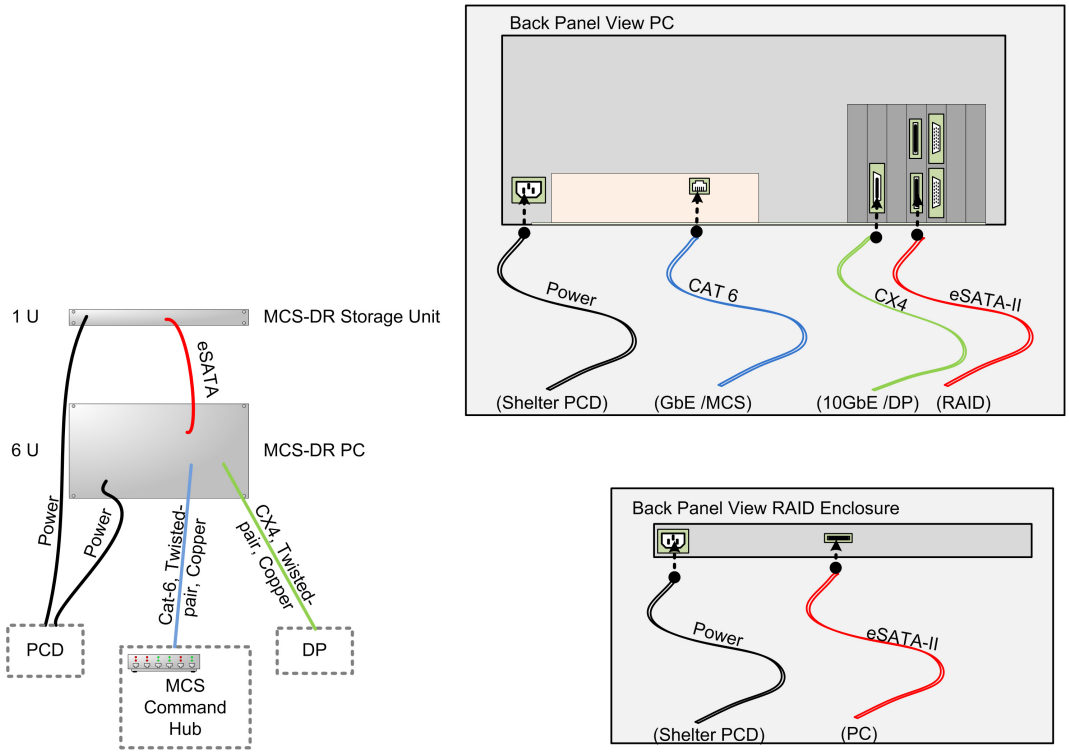


Figure 2: Diagram of electrical connections

4 Monitor and Control Interface

4.1 Overview

Control and monitoring of the MCS-DR is performed by the exchange of two different classes of messages. The first class of messages are monitoring messages which request system status information from the MCS-DR, while the second class of messages – command messages – request that the MCS-DR execute some action. The format of monitoring messages are all the same, while command messages may have formats that differ with respect to the specific command. Each monitoring message requests some part of the MCS-DR's Management Information Base (MIB). The following sections describe in detail each of the MIB entries and command actions that the MCS-DR supports, as well as the format of the response that the MCS-DR will return. If the MCS-DR cannot comply with the request, then a rejection response will be sent with an error message as defined in section 4.8.

4.2 Time Synchronization Considerations

MCS-DR does not use NTPD for time synchronization, but will synchronize its internal clock to station time each boot-up. Additionally, the SYN command (described in sec. 4.7.13), will explicitly synchronize time, as will the INI command (described in sec. 4.7.1). NTPD, while reliable in general, is overkill for the MCS-DR since explicit synchronizing is fast and cheap. Also, not using NTPD frees up memory and CPU time.

4.3 Timing Restrictions

The MCS-DR supports up to 100 commands per second. Commands which schedule recording must allow at least 5 seconds between the receipt of the command, and the start of recording. Additionally, recordings may not be scheduled to begin within 5 seconds of the termination of a prior recording session.

4.4 MIB

Index	Label	Description	Section
2	CURRENT-OPERATION		
2.1	OP-TYPE	Type of operation currently being performed by the MCS-DR.	4.5.1
2.2	OP-SCHEDULE		
2.2.1	OP-START	Start time of the current operation.	4.5.2
2.2.2	OP-STOP	Scheduled stop time of the current operation.	4.5.3
2.3	OP-REFERENCE	MCS-assigned reference number of the command message which initiated the current operation.	4.5.4
2.4	OP-FILEINFO-INTERNAL		
2.4.1	OP-TAG	Internal storage tag uniquely identifying the file in use by the current operation.	4.5.5
2.4.2	OP-FORMAT	Data format of the file in use by the current operation.	4.5.6
2.4.3	OP-POSITION	File position information of the internal file in use by the current operation.	4.5.7
2.5	OP-FILEINFO-EXTERNAL		
2.5.1	OP-FILENAME	File name and device id of the external storage file in use by the current operation.	4.5.8
2.5.2	OP-FILEINDEX	Indicates which file of a external storage file series is currently being written to.	4.5.9
3	SCHEDULE		
3.1	SCHEDULE-COUNT	A count of all scheduled recordings.	4.5.10
3.2	SCHEDULE-ENTRIES		
3.2.X	SCHEDULE-ENTRY-X	The X^{th} entry in the schedule of recordings with start time, durations, and data formats.	4.5.11
4	DIRECTORY		
4.1	DIRECTORY-COUNT	A count of recordings stored on internal storage.	4.5.12
4.2	DIRECTORY-ENTRIES		
4.2.X	DIRECTORY-ENTRY-X	The X^{th} entry in the list of recordings with pertinent data.	4.5.13
5	STORAGE-INFO		
5.1	TOTAL-STORAGE	Total storage capacity in bytes	4.5.14
5.2	REMAINING-STORAGE	Available storage capacity in bytes	4.5.15

Table 1: MCS-DR MIB structure

Index	Label	Description	Section
6	REMOVABLE-DEVICES		
6.1	DEVICE-COUNT	The number of additional storage devices which may be used in conjunction with commands to retrieve a recordings' contents.	4.5.16
6.2	DEVICE-IDS		
6.2.X	DEVICE-ID-X	The device id of the X^{th} discovered removable device.	4.5.17
6.3	DEVICE-STORAGES		
6.3.X	DEVICE-STORAGE-X	The remaining storage space on the X^{th} discovered removable device.	4.5.18
7	CPU-INFO		
7.1	CPU-COUNT	Number of CPU cores	4.5.19
7.2	CPUTEMPS		
7.2.X	CPU-TEMP-X	Temperature in degrees Celsius of CPU core X.	4.5.20
8	HDD-INFO		
8.1	HDD-COUNT	Number of hard drives comprising internal storage	4.5.21
8.2	HDD-TEMPS		
8.2.X	HDD-TEMP-X	Temperature in degrees Celsius of HDD X.	4.5.22
9	DATA-FORMATS		
9.1	FORMATS-COUNT	Count of available, configured data recording modes.	4.5.23
9.2	FORMAT-NAMES		
9.2.X	FORMAT-NAME-X	Name of the X^{th} data recording mode.	4.5.24
9.3	FORMAT-PAYLOADS		
9.3.X	FORMAT-PAYLOAD-X	UDP Payload Size of the X^{th} data recording mode.	4.5.25
9.4	FORMAT-RATES		
9.4.X	FORMAT-RATE-X	Rate of the X^{th} data recording mode.	4.5.26
9.5	FORMAT-SPECS		
9.5.X	FORMAT-SPEC-X	Format specification of the X^{th} data recording mode.	4.5.27
10	LOG		
10.1	LOG-COUNT	The number of entries in the system log.	4.5.28
10.2	LOG-ENTRIES		
10.2.X	LOG-ENTRY-X	The X^{th} entry in the system log.	4.5.29
11	LIVE-BUFFER		
11.1	BUFFER	Retrieve contents of live capture buffer.	4.5.30
11.2	BUFFER-RESTRICT	Retrieve contents of live capture buffer, one packet at-a-time.	4.5.31
12	DRSU STATUS		
12.1	DRSU-COUNT	The number of DRSUs detected.	4.5.32
12.2	DRSU-SELECTED	Report the currently selected DRSU.	4.5.33
12.3	DRSU-INFO		
12.2.X	DRSU-INFO-X	Report information regarding the X^{th} detected DRSU.	4.5.34

Table 2: MCS-DR MIB structure *(Continued)*

4.5 MIB Entries in Detail

4.5.1 OP-TYPE

MIB Entry:	Operation Type
Index:	2.1
Label:	OP-TYPE
Description:	OP-TYPE reports the current operation type. If no operation is in progress, it indicates the idle state.
Response Format:	`<Operation Type>`

Response Element	Type and Size	Description
Operation Type	(ASCII-11-A)	One of "Idle", "Initialize", "Record", "Copy", "Dump", "Down", "Synchronize".

Operation Type	Meaning
"Idle"	The system is not currently performing any operation.
"Initialize"	The system is currently being initialized.
"Record"	The system is currently recording data.
"Copy"	The system is currently offloading a single region of recorded data to external storage.
"Dump"	The system is currently offloading blocks of recorded data to external storage.
"Down"	Internal storage is currently offline due to a DWN command having been issued.
"Synchronize"	The system is currently synchronizing time with station NTP server time.

4.5.2 OP-START

MIB Entry:	Current Operation Start-time
Index:	2.2.1
Label:	OP-START
Description:	OP-START reports the time at which the current operation began. This MIB entry is not valid if the current operation (as reported by MIB 2.1 *Operation Type*) is "Idle", or "Down".
Response Format:	`<Start MJD>'<Start MPM>`

Response Element	Type and Size	Description
Start MJD	(ASCII-6-#)	MJD at which the operation began.
Start MPM	(ASCII-9-#)	MPM at which the operation began.

4.5.3 OP-STOP

MIB Entry: Current Operation Expected Stop-time
Index: 2.2.2
Label: OP-STOP
Description: OP-STOP reports the scheduled or expected end-time of the current operation. This MIB entry is not valid if the current operation (as reported by MIB 2.1 *Operation Type*) is "Idle", or "Down". If *Operation Type* is "Copy", or "Dump", this entry will represent an estimation of completion time, and as such may not be accurate until average transfer rates have been determined.
Response Format: `<Stop MJD>'<Stop MPM>`

Response Element	Type and Size	Description
Stop MJD	(ASCII-6-#)	MJD at which the operation will end.
Stop MPM	(ASCII-9-#)	MPM at which the operation will end.

4.5.4 OP-REFERENCE

MIB Entry: Current Operation Reference Number
Index: 2.3
Label: OP-REFERENCE
Description: OP-REFERENCE reports the reference number of the command message which initiated or scheduled the current operation. This MIB entry is not valid if the current operation (as reported by MIB 2.1 *Operation Type*) is "Idle".
Response Format: `<Reference Number>`

Response Element	Type and Size	Description
Reference Number	(ASCII-9-#)	Reference number of the command message which initiated or scheduled the current operation.

4.5.5 OP-TAG

MIB Entry: Current Operation File Tag
Index: 2.4.1
Label: OP-TAG
Description: OP-TAG reports the tag value used to identify the file in use by current operation. The file may be in read or write mode, depending on whether the current operation (as reported by MIB 2.1 *Operation Type*) is "Record", "Copy", or "Dump". This MIB entry is not valid if the current operation is "Idle", "Initialize", "Down", or "Synchronize".
Response Format: `<Tag>`

Response Element	Type and Size	Description
Tag	(ASCII-16-A)	Filename tag in use by the current operation; They are `<MJD>_<Reference Number>`–including the literal underscore.

4.5.6 OP-FORMAT

MIB Entry: Current Operation File Data Format
Index: 2.4.2
Label: OP-FORMAT
Description: OP-FORMAT reports the data format in use current operation. If the operation type as reported by MIB 2.1 *Operation Type* is "Record", then *Data Format* is the format which the MCS-DR is currently recording. If the operation type is "Copy", "Dump", then this MIB entry is the data format specified by the "REC" command which initiated or scheduled the recording. For all other operation types, this entry is invalid.
Response Format: `<Data Format>`

Response Element	Type and Size	Description
Data Format	(ASCII-32-A)	Data format in use. See the "REC" control command for more information on data formats.

4.5.7 OP-FILEPOSITION

MIB Entry: Current Operation File Position Information
Index: 2.4.3
Label: OP-FILEPOSITION
Description: OP-FILEPOSITION reports the start position, length, and current position of reading or writing with respect to the file in use by current operation (as reported by MIB 2.1 *Operation Type*). The *Current Position* value is always an offset relative to *Start Position*. This MIB entry is only valid if the current operation (as reported by MIB 2.1 *Operation Type*) is "Record", "Copy", or "Dump".
Response Format: `<Start Position>'<Length>'<Current Position>`

Response Element	Type and Size	Description
Start Position	(ASCII-15-#)	The position of the first byte to be copied or dumped to external storage; is always 0 for Recording operations.
Length	(ASCII-15-#)	Copy: The number of bytes to copy; Dump: Size of each file chunk. Record: The expected size of the file.
Current Position	(ASCII-15-#)	The position of the most recent byte to be copied, dumped, or recorded.

4.5.8 OP-FILENAME

MIB Entry:	Current Operation External File Information
Index:	2.5.1
Label:	OP-FILENAME
Description:	OP-FILENAME reports the file name and external storage device id in use by current operation. This MIB entry is only valid if the current operation (as reported by MIB 2.1 *Operation Type*) is "Copy" or "Dump". If the operation is "Dump", the returned file name is the name of the series, and individual files will be named as specified in the "DMP" command.
Response Format:	`<Storage ID>'<Filename>`

Response Element	Type and Size	Description
Storage ID	(ASCII-64-A)	Linux partition (e.g. /dev/sdf1) of an attached external storage device. The device/partition must be formatted with the ext2 file system to be properly recognized and usable.
Filename	(ASCII-128-A)	The name of a file or file series in use by the current operation. If the current operation is using a file series, then each file, including the first, will be named `<Filename>.X`, where X is a zero-padded serial identifier. The width – in characters – of X will be determined by the number of digits required to represent the largest id generated, and subject to the name length restriction of 128 characters.

4.5.9 OP-FILEINDEX

MIB Entry:	Current Operation
Index:	2.5.2
Label:	OP-FILEINDEX
Description:	OP-FILEINDEX reports the which file of the file series is being written to. This MIB entry is only valid if the current operation (as reported by MIB 2.1 *Operation Type*) is "Dump".
Response Format:	`<Storage ID>'<Filename>`

Response Element	Type and Size	Description
File index	(ASCII-9-#)	Indicates which file of the series is being dumped to.

4.5.10 SCHEDULE-COUNT

MIB Entry:	Schedule Count
Index:	3.1
Label:	SCHEDULE-COUNT
Description:	SCHEDULE-COUNT reports a count of all scheduled operations, including the current operation if one is in progress.
Response Format:	The output format is a comma separated list of: `<Count>`

Response Element	Type and Size	Description
Count	(ASCII-6-#)	The number of scheduled recordings.

4.5.11 SCHEDULE-ENTRY-X

MIB Entry:	Schedule Entry X
Index:	3.2.X
Label:	SCHEDULE-ENTRY-X
Description:	SCHEDULE-ENTRY-X reports relevant information for the X^{th} scheduled operation.
Response Format:	`<Reference Number><Start MJD>'<Start MPM>'<Stop MJD>' <Stop MPM>'<Data Format>`

Response Element	Type and Size	Description
Reference Number	(ASCII-9-#)	Reference number of the command which scheduled the recording.
Start MJD	(ASCII-6-#)	MJD at which the recording will begin.
Start MPM	(ASCII-9-#)	MPM at which the recording will begin.
Stop MJD	(ASCII-6-#)	MJD at which the recording will end.
Stop MPM	(ASCII-9-#)	MPM at which the recording will end.
Format Name	(ASCII-32-A)	The data format of the scheduled operation. Must include only numbers, letters, and the underscore character.

4.5.12 DIRECTORY-COUNT

MIB Entry:	Directory File Count
Index:	4.1
Label:	DIRECTORY-COUNT
Description:	DIRECTORY-COUNT reports the number of recordings contained on internal storage.
Response Format:	`<Count>`

Response Element	Type and Size	Description
Count	(ASCII-6-#)	The number of recordings.

4.5.13 DIRECTORY-ENTRY-X

MIB Entry:	Directory Entry X
Index:	4.2.X
Label:	DIRECTORY-ENTRY-X
Description:	DIRECTORY-ENTRY-X reports pertinent information for the th recording contained on internal storage.
Response Format:	`<Tag>'<Start_MPM>'<Stop_MJD>'<Stop_MPM>'<Data Format>' <Size>'<Disk Usage>'<Complete>`

Response Element	Type and Size	Description
Tag	(ASCII-16-A)	Filename tag which uniquely identifies the file; They are of the form "`<MJD>_<Reference Number>`" – including the literal underscore, where MJD is the MJD when the recording began, and Reference Number is the Reference Number of the REC command which initiated/scheduled the recording.
Start MPM	(ASCII-9-#)	MPM at which the recording was started.
Stop MJD	(ASCII-6-#)	MJD at which the recording was stopped.
Stop MPM	(ASCII-9-#)	MPM at which the recording was stopped.
Data Format	(ASCII-32-A)	Data format which was used when the file was recorded. See the "REC" control commands for more information.
Size	(ASCII-15-#)	Size of the recording in bytes. This number reflects the actual number of bytes written to disk, but not the amount of space used by the file.
Disk Usage	(ASCII-15-#)	The total number of bytes occupied by the file on disk. Incomplete recordings will occupy an amount of space determined by the scheduled recording operation and data format. Bytes allocated in such a fashion will not be freed until the file is deleted.
Complete	(ASCII-3-A)	Either "YES" or "NO " depending on whether the recording completed without being interrupted or aborted.

4.5.14 TOTAL-STORAGE

MIB Entry:	Total Storage
Index:	5.1
Label:	TOTAL-STORAGE
Description:	TOTAL-STORAGE reports the total storage capacity of internal storage in bytes.
Response Format:	`<Size>`

Response Element	Type and Size	Description
Size	(ASCII-15#)	Total size of internal storage in bytes. This number does not reflect the number of bytes unavailable due to formatting and file system usage. This will be 0 when internal storage has been taken offline, or if a problem prevents the internal storage from being used.

4.5.15 REMAINING-STORAGE

MIB Entry: Remaining Storage
Index: 5.2
Label: REMAINING-STORAGE
Description: REMAINING-STORAGE reports the number of available bytes on internal storage.
Response Format: `<Available>`

Response Element	Type and Size	Description
Available	(ASCII-15#)	Total size of unused portion of internal storage in bytes. This number does not reflect the number of bytes unavailable due to formatting and file system usage. Each recording requires 4096 bytes in the file table, 512 kB of start and stop tags, and 256 kB of header information in addition to the actual file size, which is rounded up in units of 256 kB.

4.5.16 DEVICE-COUNT

MIB Entry: Removable Device Count
Index: 6.1
Label: DEVICE-COUNT
Description: DEVICE-COUNT reports a the number of available external storage devices.
Response Format: `<Count>`

Response Element	Type and Size	Description
Count	(ASCII-6-#)	The number of devices detected.

4.5.17 DEVICE-ID-X

MIB Entry: Removable Device ID X
Index: 6.2.X
Label: DEVICE-ID-X
Description: DEVICE-ID-X reports the device id of the X^{th} external storage device.
Response Format: `<Storage ID>`

Response Element	Type and Size	Description
Storage ID	(ASCII-64-A)	Linux partition (e.g. /dev/sdf1) of detected storage device. The device/partition must be formatted with the ext2 file system to be properly recognized and usable.

4.5.18 DEVICE-STORAGE-X

MIB Entry: Removable Device X Remaining Storage
Index: 6.3.X
Label: DEVICE-STORAGE-X
Description: DEVICE-STORAGE-X reports the free storage space on the Xth external storage device.
Response Format: `<Available>`

Response Element	Type and Size	Description
Available	(ASCII-15-#)	Total size of unused portion in bytes of external storage specified by *Storage ID* in MIB entry 6.2.X. This number does not reflect the number of bytes unavailable due to formatting and file system usage. If this number is 0, it indicates that a removable device was detected, but is not formatted properly, or contains an unsupported file system.

4.5.19 CPU-COUNT

MIB Entry: CPU Count
Index: 7.1
Label: CPU-COUNT
Description: CPU-COUNT reports the number of CPU cores present in the MCS DR. Typically this value will be 8, but to support the possibility of future hardware changes, this MIB entry is included.
Response Format: `<Count>`

Response Element	Type and Size	Description
Count	(ASCII-3-#)	The number of CPU cores.

4.5.20 CPU-TEMP-X

MIB Entry: CPU Temperatures
Index: 7.2.X
Label: CPU-TEMP-X
Description: CPU-TEMP-X reports temperature of the of core X.
Response Format: `<Core X Temp>`

Response Element	Type and Size	Description
Core X Temp	(ASCII-3-#)	Temperature in degrees Celsius of core X.

4.5.21 HDD-COUNT

MIB Entry: HDD Count
Index: 8.1
Label: HDD-COUNT
Description: HDD-COUNT reports the number of hard drives comprising internal storage. Typically this value will be 5, but to support the possibility of future hardware changes, this MIB entry is included.
Response Format: `<Count>`

Response Element	Type and Size	Description
Count	(ASCII-3-#)	The number of hard disk drives.

4.5.22 HDD-TEMP-X

MIB Entry: Hard Disk Drive Temperatures
Index: 8.X
Label: HDD-TEMP-X
Description: HDD-TEMP-X reports temperature of the X^{th} hard drive in the internal storage RAID array.
Response Format: `<HDD X Temp>`

Response Element	Type and Size	Description
HDD X Temp	(ASCII-3-#)	Temperature in degrees Celsius of drive X in the array.

4.5.23 FORMAT-COUNT

MIB Entry: Data Formats Count
Index: 9.1
Label: FORMAT-COUNT
Description: FORMAT-COUNT returns the number of recording formats supported.

Response Element	Type and Size	Description
Count	(ASCII-6-#)	The number of formats supported.

4.5.24 FORMAT-NAME-X

MIB Entry: Data Format X Name
Index: 9.2.X
Label: FORMAT-NAME-X
Description: FORMAT-NAME-X returns the name of the X^{th} recording format.

Response Element	Type and Size	Description
Format Name	(ASCII-32-A)	The name assigned to the format. Must include only numbers, letters, and the underscore character. Data formats should be named appropriately. e.g.: TBN_1024_112 for a TBN packet of 1024 bytes at a rate of 112 MiB/s.

4.5.25 FORMAT-PAYLOAD-X

MIB Entry: Data Format X UDP Packet Payload Size
Index: 9.3.X
Label: FORMAT-PAYLOAD-X
Description: FORMAT-PAYLOAD-X returns the UDP Packet Payload Size of the X^{th} recording format.

Response Element	Type and Size	Description
UDP Payload Size	(ASCII-4-#)	The size in bytes of the payload portion of UDP packets for this format. Typically this will be 1024 for TBN, 1224 for TBW, or 4128 for DRX. See the DP Common ICD ([5]) for more information.

4.5.26 FORMAT-RATE-X

MIB Entry: Data Format X Rate
Index: 9.4.X
Label: FORMAT-RATE-X
Description: FORMAT-RATE-X returns the data rate of the X^{th} recording format.

Response Element	Type and Size	Description
Rate	(ASCII-9-#)	Overall data rate once formatting has been taken into consideration. Specifically, this is the rate used in calculating the amount of space a recording will require on disk. If the entire UDP payload is recorded to disk, then this rate will equal the transmission rate. Likewise, if the format requires that portions of the payload will be discarded, then this number will be less than the actual transfer rate. Note that the MAC and UDP packet headers should not be considered in this rate as they are discarded automatically.

4.5.27 FORMAT-SPEC-X

MIB Entry: Data Format X specification
Index: 9.5.X
Label: FORMAT-SPEC-X
Description: FORMAT-SPEC-X returns the specification of the X^{th} recording format. This specification is an ordered list of Keep or Drop operations to be performed on portions of the received data packet. This feature's primary use is in conserving storage space by discarding portions of a packet that may not be needed before the packet is written to disk.

Response Element	Type and Size	Description
Format	(ASCII-256-A)	The format is defined as an ordered list of terms Kxxxx or Dyyyy where Kxxx means that xxxx bytes should be kept, and Dyyyy means that yyyy bytes should be dropped. For instance, the pattern "D0024K0512D0488" reads as "Drop the first 24 bytes, keep the next 512, and drop the 488 subsequent bytes. All xxxx and yyyy will add up to the specified UDP packet payload size, so for the example shown, the UDP packet payload size is 1024. These formats are predefined based on data formats specified in the DP ICD.

4.5.28 LOG-COUNT

MIB Entry: System Log Length
Index: 10.1
Label: LOG-COUNT
Description: LOG-COUNT reports the number of system log entries.
Response Format: `<Count>`

Response Element	Type and Size	Description
Count	(ASCII-6-#)	The number of entries in the system log.

4.5.29 LOG-ENTRY-X

MIB Entry: System Log Entry X
Index: 10.2.X
Label: LOG-ENTRY-X
Description: LOG-ENTRY-X reports the X^{th} entry in the system log.
Response Format: `<MJD>'<MPM>'<Message Class>'<Message>`

Response Element	Type and Size	Description
MJD	(ASCII-6-#)	MJD when the entry was logged.
MPM	(ASCII-9-#)	MPM when the entry was logged.
Message Class	(ASCII-7-A)	One of: "info...", "warning", or "error.." (periods indicate padding spaces)
Status	(ASCII-234-A)	A human readable string of at most 234 characters, padded with spaces, describing an event of interest.

4.5.30 BUFFER

MIB Entry:	Live Capture Buffer Retrieval
Index:	11.1
Label:	BUFFER
Description:	BUFFER returns contents of the live capture buffer. The live capture buffer captures DP output streams for periods up to 100ms. The live capture buffer is defined by issuing a BUF command (see sec. 4.7.12). The BUFFER MIB entry returns as many data packets as will fit in a single response message. The number returned depends on the data format of the recording; for TBN's 1024 byte packets, seven packets will fit in the response. The total size of the response's data field will be 55 ASCII bytes followed by (Size x Count) bytes of binary data.
Response Format:	`<Reference>'<MJD>'<MPM>'<Offset>'<Size>'<Count><<<Data>>>`

Response Element	Type and Size	Description
Reference	(ASCII-9-#)	Reference number of the recording whose data is in the buffer.
MJD	(ASCII-6-#)	MJD when the recording started.
MPM	(ASCII-9-#)	MPM when the recording started.
Offset	(ASCII-18-# *float*)	floating point offset in ms of the first packet returned. This is accurate to ±1 packet's period, but is based on the time the packet is received as opposed to the time slice that the sample corresponds to.
Size	(ASCII-4-#)	The size, in bytes, of each packet in the buffer
Count	(ASCII-4-#)	The number of packets returned in this response
Data	(Binary, variable length)	*Count* packets of binary data packed back to back

4.5.31 BUFFER-RESTRICT

MIB Entry:	Live Capture Buffer Retrieval, Restricted
Index:	11.2
Label:	BUFFER-RESTRICT
Description:	BUFFER-RESTRICT returns contents of the live capture buffer, but limits responses to one data packet. Otherwise, this behaves exactly as the BUFFER MIB entry (see sec. 4.5.30).
Response Format:	`<Reference>'<MJD>'<MPM>'<Offset>'<Size>'<Count><<<Data>>>`

Response Element	Type and Size	Description
Reference	(ASCII-9-#)	Reference number of the recording whose data is in the buffer.
MJD	(ASCII-6-#)	MJD when the recording started.
MPM	(ASCII-9-#)	MPM when the recording started.
Offset	(ASCII-18-# *float*)	floating point offset in ms of the first packet returned. This is accurate to ±1 packet's period, but is based on the time the packet is received as opposed to the time slice that the sample corresponds to.
Size	(ASCII-4-#)	The size, in bytes, of each packet in the buffer
Count	(ASCII-4-#)	Always 1
Data	(Binary, variable length)	*Count* packets of binary data packed back to back

4.5.32 DRSU-COUNT

MIB Entry: DRSU Count
Index: 12.1
Label: DRSU-COUNT
Description: DRSU-COUNT reports the number of detected DRSUs.
Response Format: `<Count>`

Response Element	Type and Size	Description
Count	(ASCII-2-#)	The number of detected DRSUs.

4.5.33 DRSU-SELECTED

MIB Entry: Currently Selected DRSU
Index: 12.2
Label: DRSU-SELECTED
Description: DRSU-SELECTED reports which DRSU is currently active. If internal storage is down, this will reflect the last valid selection.
Response Format: `<DRSU Number>`

Response Element	Type and Size	Description
DRSU Number	(ASCII-2-#)	The number of the selected DRSU.

4.5.34 DRSU-INFO-X

MIB Entry: DRSU info
Index: 12.3.X
Label: DRSU-INFO-X
Description: DRSU-INFO-X reports information on the X^{th} detected DRSU.
Response Format: `<Name>'<Partition>'<Unformatted Size>`

Response Element	Type and Size	Description
Name	(ASCII-6-A)	The DRSU's name (e.g. DRSU00, DRSU01, etc.).
Partition	(ASCII-64-A)	The multi-disk partition on which resides on the DRSU
Unformatted Size	(ASCII-16-#)	The size in bytes of the DRSU before formatting.

4.6 Control Commands

Command Name	Description	Section
INI	Initialize or restore the MCS-DR to its initial boot-up state.	4.7.1
REC	Schedule a recording operation with the start-time, duration, and data format specified.	4.7.2
DEL	Delete existing recording specified by a supplied tag-value	4.7.3
STP	Stop the recording specified by a supplied tag-value, halting if in-progress, and canceling if not yet begun.	4.7.4
GET	Retrieve a portion of the recording specified by a supplied tag-value, a byte-offset, and number of bytes.	4.7.5
CPY	Copy a portion of the recording specified by a supplied tag-value, a byte-offset, and number of bytes to a file on a removable storage device.	4.7.6
DMP	Dump a portion of the recording specified by a supplied tag-value, a byte-offset, and number of bytes to a series of files on a removable storage device.	4.7.7
FMT	Format internal or external storage device.	4.7.8
DWN	Bring internal storage to an offline state suitable for removal/replacement.	4.7.9
UP	Scan for internal storage and bring to an online state if possible.	4.7.10
SEL	Select DRSU to use as internal storage.	4.7.11
SYN	Synchronize MCS-DR with NTP server time.	4.7.13
TST	Perform a system self-test.	4.7.14
BUF	Prepare live capture buffer for on-the-fly packet capture.	4.7.12

Table 3: MCS-DR Commands

4.7 Control Commands in Detail

Each of the following commands specifies a list of arguments and their meanings, the response format returned if the command can be successfully executed. If the specification does not include a list of arguments, then none are required. If a description of the response format is not included, then the "R-COMMENT" field of the response shall be empty upon successful execution. In all commands below, the response format assumes the "R-RESPONSE" and "R-SUMMARY" as defined in the MCS Common ICD [4]. The response format listed for each command describes the contents of "R-COMMENT". Commands which cannot be executed will return a "R" in "R-RESPONSE", and "R-COMMENT" will be set to the corresponding error message. No commands will be rejected without returning a human-readable description of the reason in the "R-COMMENT" field. Possible error messages and their meanings are listed in section 4.8.

4.7.1 INI

Command: Initialize
Description: Initialize restores the MCS-DR to the initial boot-up state in all regards except for the system log and the contents of internal storage.
Argument Format: `<Flags>`

Argument	Type and Size	Description
Flags	(ASCII-256-A)	To force re-initialization of the system log, specify the flag "`--flush-log`" or "`-L`". To force re-initialization of internal RAID storage, specify the flag "`--flush-data`" or "`-D`". Field need not be padded with spaces, and order of flags appearance does not matter.

4.7.2 REC

Command: Record
Description: This command schedules or initiates a recording of output from the DP subsystem. Upon successful execution of the REC command, a tag value will be returned which will uniquely identify the file. A file will have been created on the file-system which is large enough to accommodate the recording. If an operation is in progress which prohibits writing to the disk, the file creation will only exist in memory until the disk is available for writing. A request to shutdown with the SCRAM option before such a file has been written to the drive will discard the file.
Argument Format: `<Start MJD>'<Start MPM>'<Length>'<Data Format>`
Response Format: `<Tag>`

Argument	Type and Size	Description
Start MJD	(ASCII-6-#)	Modified Julian Day to begin the recording. Must not be more than 24 hours into the future.
Start MPM	(ASCII-9-#)	Milliseconds Past Midnight to begin the recording. Must not be within 5 seconds of the termination of another operation.
Length	(ASCII-9-#)	The number of milliseconds to record. Must not terminate within 5 seconds of another scheduled operation, nor can any portion of the time period overlap any other scheduled operation. Note that the recording remains active for a short time afterwards to accommodate packets which have not been delivered yet. Consequently, additional data may be included past the end of the specified period. The length of this grace period is TBD.
Data Format	(ASCII-32-A)	The name of the pre-configured data format to use. See section 4.5.27 for details regarding data formats.

Response Element	Type and Size	Description
Tag	(ASCII-16-A)	A file name of the form `<MJD>_<Reference Number>`, where MJD is the MJD on which recording is scheduled to begin, and Reference number is the reference number of the command message which scheduled the recording.

4.7.3 DEL

Command: Delete
Description: This command deletes a recording from internal storage.
Argument Format: `<Tag>`

Argument	Type and Size	Description
Tag	(ASCII-16-A)	A file name of the form `<MJD>_<Reference Number>`. See section 4.7.2 for more information.

4.7.4 STP

Command: Stop
Description: This command halts or prevents the specified recording. If the recording is scheduled but not in-progress, it is deleted from the schedule and the corresponding hard drive space is freed. If the recording is in progress, it is halted and the corresponding file is closed, but not deleted.
Argument Format: `<Tag>`

Argument	Type and Size	Description
Tag	(ASCII-16-A)	A file name of the form `<MJD>_<Reference Number>`. See section 4.7.2 for more information.

4.7.5 GET

Command: Get
Description: The Get command retrieves a portion of a specified recording.
Argument Format: `<Tag>'<Start Byte>'<Length>`
Response Format: `<Data>`

Argument	Type and Size	Description
Tag	(ASCII-16-A)	A file name of the form `<MJD>_<Reference Number>`. See section 4.7.2 for more information.
Start Byte	(ASCII-15-#)	The byte offset within the file to start retrieval at.
Length	(ASCII-15-#)	The number of bytes to return. This is limited to the maximum size of a R-COMMENT field in a command response, or 8146 bytes.

Response Element	Type and Size	Description
Data	(uint8)x*Length*	On success, this field will contain *Length* bytes of data from the specified position in the file.

4.7.6 CPY

Command: Copy

Description: The Copy command copies portions of a recording to a file an external storage device. If the file already exists, it will be overwritten without warning or notification. The Copy and Dump commands are not available if there are any recordings scheduled.

Argument Format: `<Tag>'<Start Byte>'<Length>'<Device ID>'<Filename>`

Argument	Type and Size	Description
Tag	(ASCII-16-A)	A file name of the form `<MJD>_<Reference Number>`. See section 4.7.2 for more information.
Start Byte	(ASCII-15-#)	The byte offset within the file to start retrieval at.
Length	(ASCII-15-#)	The number of bytes to copy. This is limited to the free space on the target removable storage device.
Storage ID	(ASCII-64-A)	Linux partition (e.g. /dev/sdf1) of an attached external storage device. The device/partition must be formatted with the ext2 file system to be properly recognized and usable.
Filename	(ASCII-128-A)	The name of a file to create. Acceptable characters are letters, numbers, the underscore and period.

4.7.7 DMP

Command: Dump

Description: The Dump command copies blocks of data from a recording to a series of files on an external storage device. If any of the files already exist, they will be overwritten without warning or notification. The Copy and Dump commands are not available if there are any recordings scheduled.

Argument Format: `<Tag>'<Start Byte>'<Length>'<Block Size>'<Device ID>'<Filename>`

Argument	Type and Size	Description
Tag	(ASCII-16-A)	A file name of the form `<MJD>_<Reference Number>`. See section 4.7.2 for more information.
Start Byte	(ASCII-15-#)	The byte offset within the file to start retrieval at.
Length	(ASCII-15-#)	The number of bytes to copy. This is limited to the free space on the target removable storage device.
Block Size	(ASCII-15-#)	The number of bytes to copy before moving on to the next file. The files created by this command will be exactly Block Size bytes with the exception of the last, which will be determined by the *Length* specified.
Storage ID	(ASCII-64-A)	Linux partition (e.g. /dev/sdf1) of an attached external storage device. The device/partition must be formatted with the ext2 file system to be properly recognized and usable.
Filename	(ASCII-128-A)	The name of a file series to create. Acceptable characters are letters, numbers, the underscore and period. Each file, including the first, will be named `<Filename>.X`, where X is a zero-padded serial identifier. The width – in characters – of X will be determined by the number of digits required to represent the largest id generated, and subject to the name length restriction of 128 characters.

4.7.8 FMT

Command: Format

Description: This command formats either internal storage, or an attached external storage device. When formatting an external device, the operation can require a substantial amount of time, proportional to the size of the device. To determine whether a format command completed, poll the OP-INFO MIB entry until it no longer indicates that an operation is in progress, and then request the REMOVABLE-DEVICES MIB entry. If the command was successful, the available space on the device will reflect the formatted size. If unsuccessful, the reported size will be 0.

Argument Format: `<Storage ID>`*optional*

Argument	Type and Size	Description
Storage ID	(ASCII-64-A)	Optional argument specifying an external storage device's partition. If omitted, the command will format internal storage. In both cases, it is a destructive operation and all data on the target is erased. Formatting unpartitioned devices is not supported, though it may be in the future.

4.7.9 DWN

Command: Down (internal storage)

Description: This command prepares the MCS-DR's internal storage for removal/replacement. The command is executed immediately, but requires as much as 120 seconds to complete. Storage device must not be disconnected until a TOTAL-STORAGE request returns 0 as data may be lost.

4.7.10 UP

Command: Up (internal storage)

Description: This command brings internal storage back online, and reports the amount of free space if successful. If the MCS-DR cannot determine necessary file system information, no destructive changes will be made. To override this behavior and force a drive initialization, specify "-F" as an argument. Otherwise, this command has no arguments.

Response Format: `<Available>`

Response Element	Type and Size	Description
Available	(ASCII-15-#)	Total size of unused portion of internal storage in bytes. This number does not reflect the number of bytes unavailable due to formatting and file system usage.

4.7.11 SEL

Command: Select DRSU (internal storage)

Description: This command selects an alternate DRSU to use as internal storage. Current hardware limits the number of DRSUs to two. The MCS-DR must be idle with no scheduled operations, and the DRSU's must be previously prepared and detected by DROS. Detected DRSUs will have an MIB entry under DRSU-INFO-X.

Argument Format: `<DRSU Number>`

Argument	Type and Size	Description
DRSU Number	(ASCII-2-#)	Specifies which DRSU to activate. The first is 0, second is 1, etc. These numbers correspond to X in MIB entries DRSU-INFO-X.

4.7.12 BUF

Command: Live Capture Buffer Set-up

Description: The BUF command initializes the live capture buffer parameters to take effect at the start of the next recording. The live capture buffer can store upto 100ms of data and can be triggered once or periodically. The dimensions of the buffer can be specified in milliseconds or in integral packet increments. The parameters which define the buffer may be reused with subsequent recordings or may be tied to the length of the recording, as needed. The contents of the buffer are overwritten unless retrieval using the 'BUFFER' or 'BUFFER-RESTRICT' MIB entries. In this case, the contents are held until the entire buffer is retrieved, and captures triggered meanwhile are written to a shadow buffer.

Example: "`TTAAH 0000000000000021 0000000000000050 0000000000000500`" Buffer the first 50 ms of each 500 ms of data, starting 21 ms into the recording, and to hold the data until a new recording starts.

Argument Format: `<OffsetType><WidthType><Retrigger><Order>`
`<Behaviour>'<Offset>'<Width>'<Interval>`

Argument	Type and Size	Description
OffsetType	(ASCII-1-A)	Specifies whether *Offset* and *Interval* are measured in milliseconds or in packet counts. Either 'T' for millisedoncds or 'I' for packet count.
OffsetType	(ASCII-1-A)	Specifies whether *Offset* and *Interval* are measured in milliseconds ('T') or in packet counts ('I').
WidthType	(ASCII-1-A)	Specifies whether *Width* is measured in milliseconds ('T') or in packet counts ('I').
Retrigger	(ASCII-1-A)	Specifies whether capture is periodic ('A') or one-shot ('N'). If 'N' and settings are reused, then capture will trigger once each new recording.
Order	(ASCII-1-A)	Specifies whether packets are captured before ('B') data formatting is applied or after ('A'). See MIB branch 7 regarding data formats.
Behaviour	(ASCII-1-A)	Determines behaviour when a recording ends. There are three possibilities: 'D' - delete contents, reuse settings; 'H' - hold contents, reuse settings; and 'R' - hold contents, no reuse. The first deletes any buffered data between each recording and recreates/resizes the buffer for each subsequent recording. The second option holds the buffer's contents until a new recording is started. The last option hold's the buffer's contents indefinitely and stops live capture until a BUF command is issued.
Offset	(ASCII-16-#)	Offset from the beginning of the recording to trigger the first (and possibly only) capture. Indicates a number of milliseconds or number of packets, interpretation is determined by *OffsetType*.
Width	(ASCII-16-#)	Determines capture length in milliseconds or packets interpretation is determined by *WidthType*.
Interval	(ASCII-16-#)	Determines interval, in milliseconds or packets, between subsequent captures when *Retrigger* is set to always. Interpretation is determined by *OffsetType*. Must be much greater than *Width* to facilitate retrieval (preferably on the order of seconds or minutes).

4.7.13 SYN

Command:	Synchronize
Description:	This command explicitly synchronizes the MCS-DR with the station NTP time server. Executing this command while operations are scheduled or in progress may result in recording more or less data than desired, as well as shifting the times at which they occur. Such deviations should be minor, but no guarantees are made to that effect.

4.7.14 TST

Command:	Self Test
Description:	Perform a system self-test. This command is used solely for development purposes and is not supported by this ICD. This command will be removed from release systems.
Argument Format:	`N/A`
Response Format:	`N/A`

4.8 Error Messages

Error Message	Error Description
Operation not permitted	Operations scheduled or in progress prevent the execution of this command.
Invalid Name	The specified *Format Name* contains illegal characters.
Format Already Defined	The specified *Format Name* is already in use.
Invalid Size	Specified *UDP Packet Payload Size* exceeds the maximum allowable size–determined by the Ethernet Jumbo Frames MTU less MAC, IP, and UDP header data. Specified limit is 8192 bytes.
Invalid Rate	The *Rate* specified exceeds the capabilities of the system, or the calculated actual rate exceeds the capabilities of the system. Currently this threshold is set at 120 MiB/s, and rates above 115 MiB/s are not supported and can not guarantee data will be recorded successfully.
Already Up	Internal storage is already online.
Not Detected	Internal storage was not detected.
Cannot Start	File system information was not detected on the device.
Already Down	Internal storage is already offline.
Invalid Storage ID	The *Storage ID* specified does not exist in the system.
File not found	The *Tag* value supplied does not refer to any file on internal storage.
Invalid Filename	The *Filename* specified contains illegal characters.
Invalid Position	The requested *Start Byte* and *Length* exceeds the size of the file.
Invalid Range	The requested *Length* exceeds response size limitations.
Not Scheduled	The specified *Tag* neither refers to any scheduled recording, nor to any existing recordings.
Already Stopped	The *Tag* value refers to a recording which has already completed.
Invalid Time	The requested time frame is either in the past or too far into the future.
Time Conflict: `<Operation>`	The requested time frame overlaps a scheduled operation. *Operation* lists the first scheduled operation which causes a conflict, and is formatted as with the SCHEDULE-ENTRY-X MIB entry (see section 4.5.11).
Unknown Format: `<Format>`	The specified *Format* has not been defined and cannot be used.
Insufficient Drive Space	The amount of storage space required for the requested recording exceeds the remaining space on internal storage, or it exceeds the amount of the largest contiguous block of free-space.
Component Not Available: `<X>`	Some internal component *X* of the MCS-DR is unavailable, unusable, or malfunctioning.

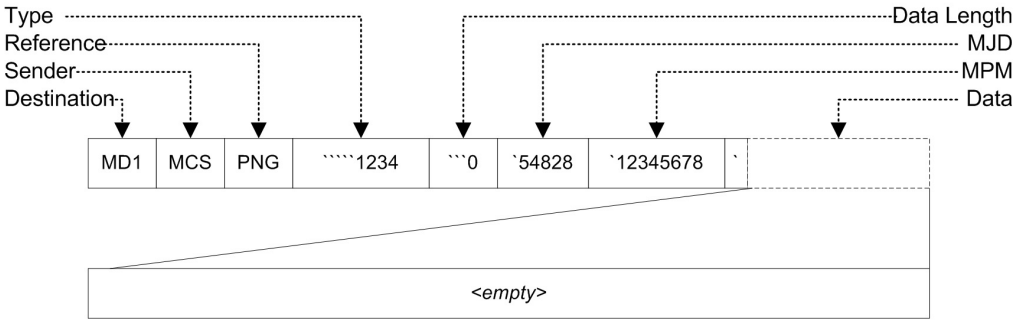
5 Control and Monitoring Session Examples

The following examples walk through a usage scenario and demonstrate the types of command and monitor messages needed to operate the MCS-DR as well as the responses and error messages that might be generated. It should be noted that the error conditions in the scenario are atypical, and are included for the sake of demonstrating the interface. In the following examples, a single quote is used to denote spaces appearing in arguments and responses. Subsystem ID is assumed to be "MD1" in these examples.

The example starts by checking system status to which the MCS-DR responds that it is booting. MCS then requests initialization but MCS-DR discovers that internal storage is missing and responds to that effect. MCS issues an UP command to bring storage online, and the MCS-DR is able to comply and fix the problem. MCS then schedules a recording and checks to verify that the recording was scheduled. Once the recording begins, the MCS checks the status of the operation. Once the operation is complete, MCS requests that the MCS-DR copy a portion of the new recording to an external storage device.

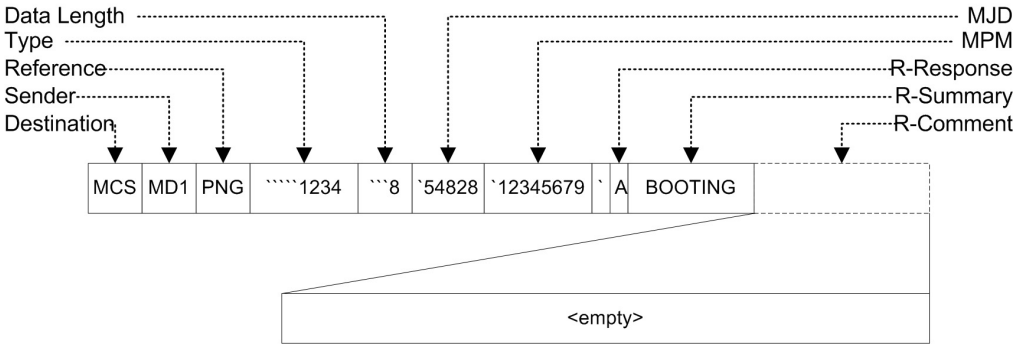
5.1 Checking System Status

Message:



Description: MCS sends a “PNG” request to MCS-DR PC #1 with reference designator “MD1”. The data field is empty and consequently, the Data Length field is set to 0.

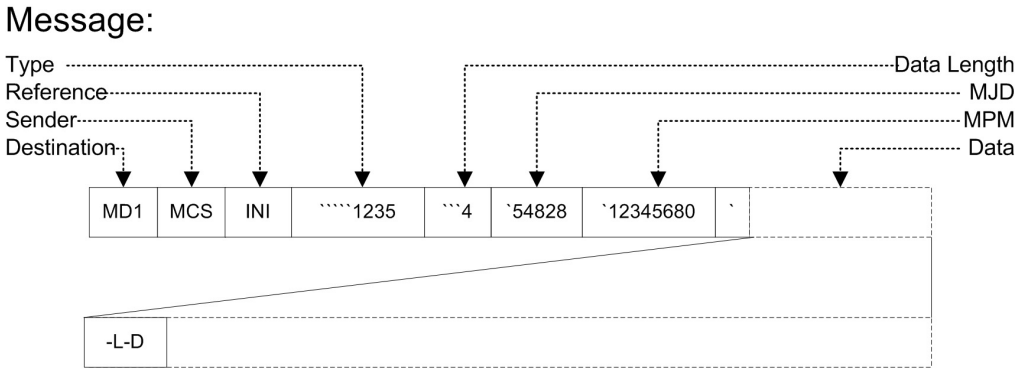
Response:



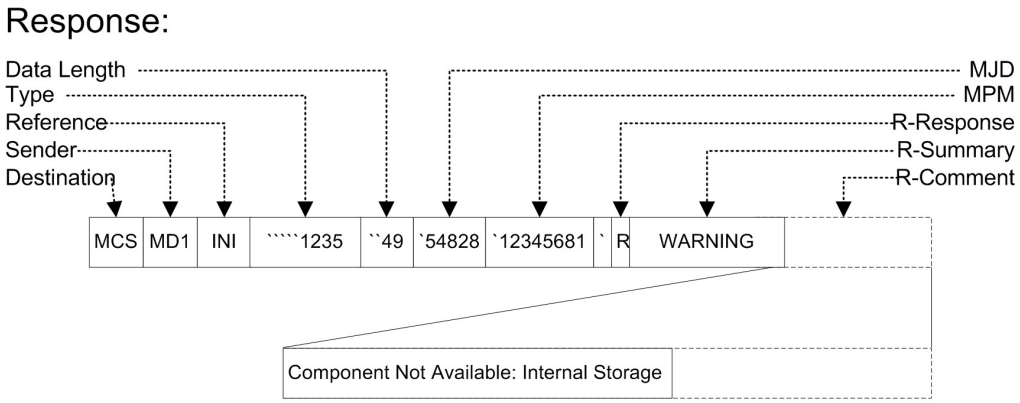
Description: MCS-DR PC #1 responds, acknowledging acceptance of the message, and with the status of “BOOTING”. R-Comment is empty, and thus the Data Length returned is 1+7, or 8.

Figure 3: Example of checking system status

5.2 Requesting Initialization (w/ Error Response)



Description: MCS requests initialization of the system with the “-L” and “-D” options. The options specified request that the MCS-DR clear its internal log and any previously recorded data.



Description: The MCS-DR is not able to comply with the request, and a rejection response is sent. In this scenario, previous commands had taken the internal storage offline for replacement. The storage had since been replaced, but no request to “UP” the storage had been made.

Figure 4: Example of requesting initialization (w/ Error Response)

5.3 Up-ing Internal Storage

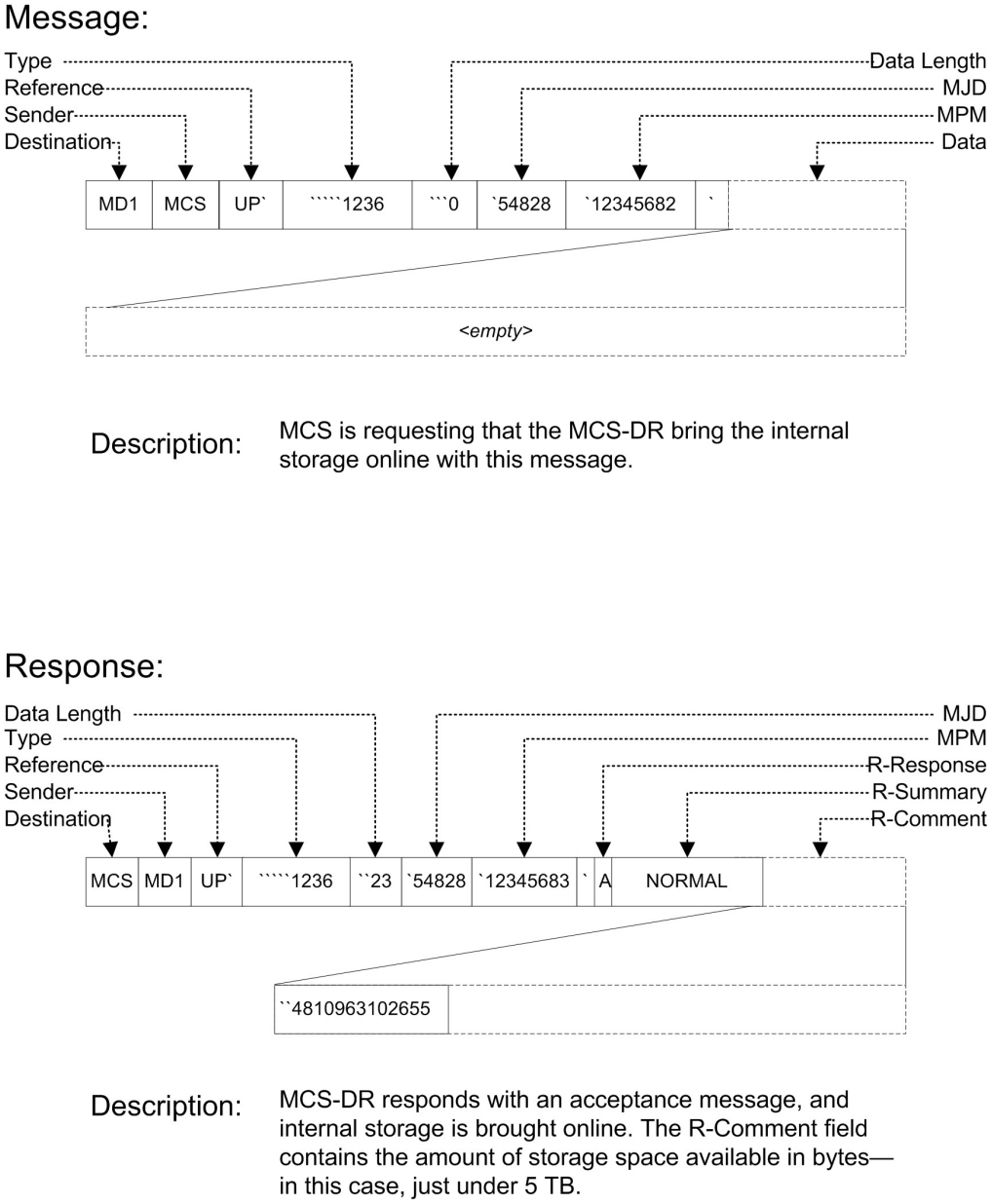
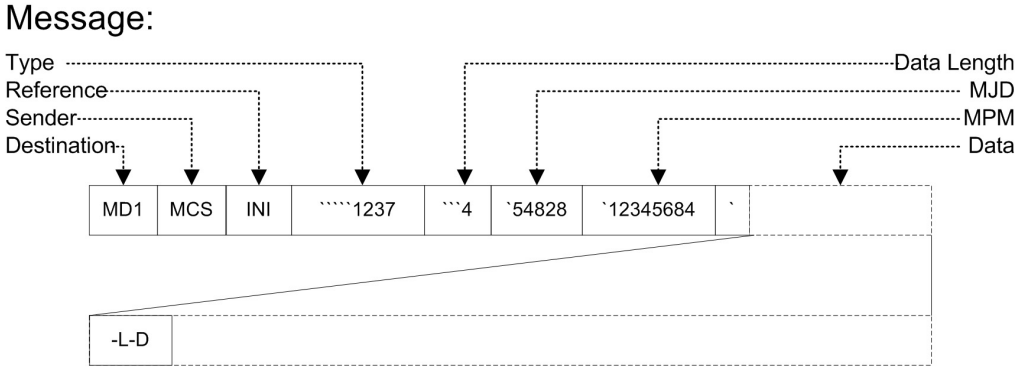
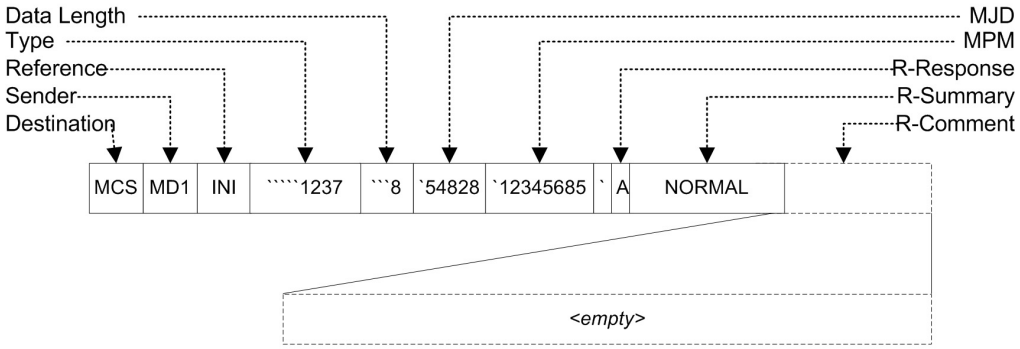


Figure 5: Example of bringing internal storage online

5.4 Requesting Initialization



Description: MCS requests initialization of the system with the "-L" and "-D" options. The options specified request that the MCS-DR clear its internal log and any previously recorded data.



Description: This time, the MCS-DR is able to comply, and has started the initialization process, responding with an acceptance message. The initialization process may take several minutes, and the status can be checked by requesting MIB entry 2.1 (not demonstrated in this scenario).

Figure 6: Example of requesting initialization

5.5 Scheduling a Recording

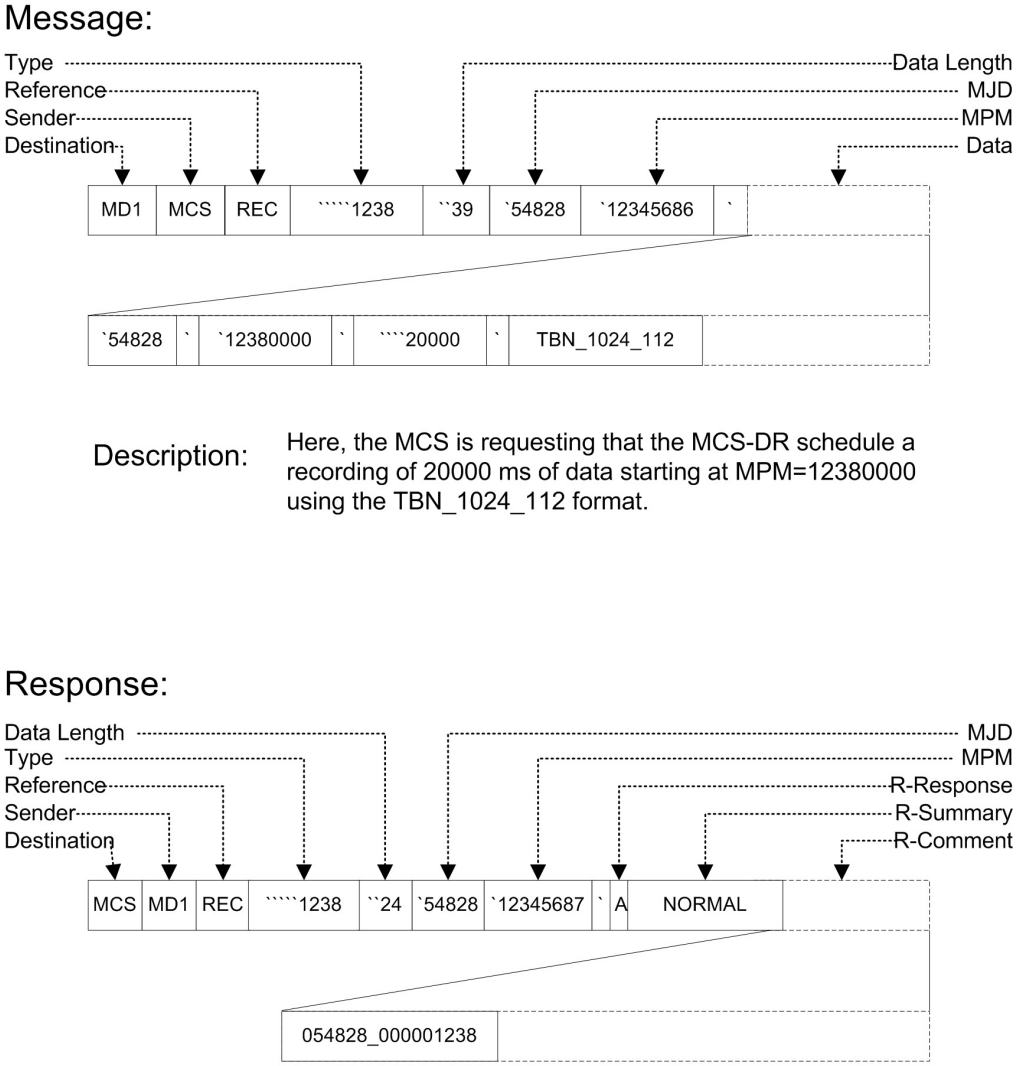
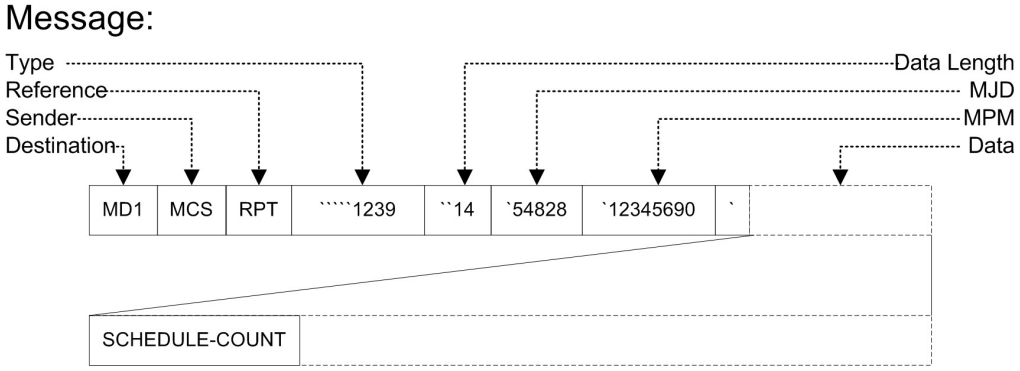
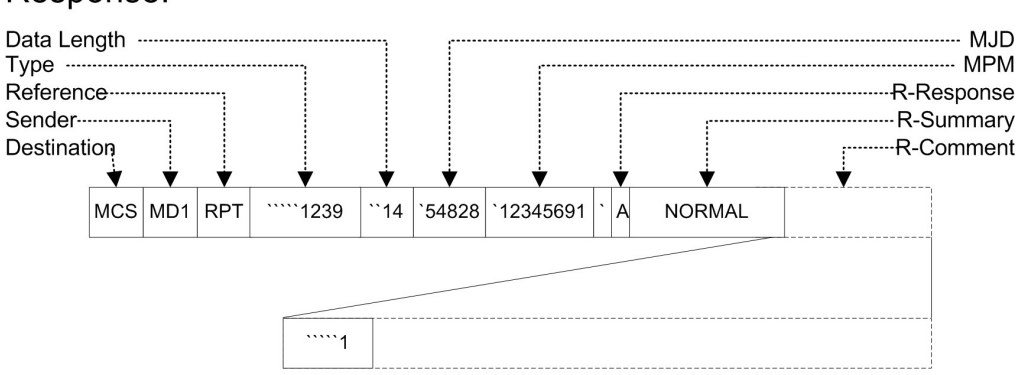


Figure 7: Example of scheduling a recording

5.6 Checking Scheduled Operations



Description: Here, the MCS is making sure the recording is scheduled by checking the number of scheduled recordings (MIB entry 3.1).

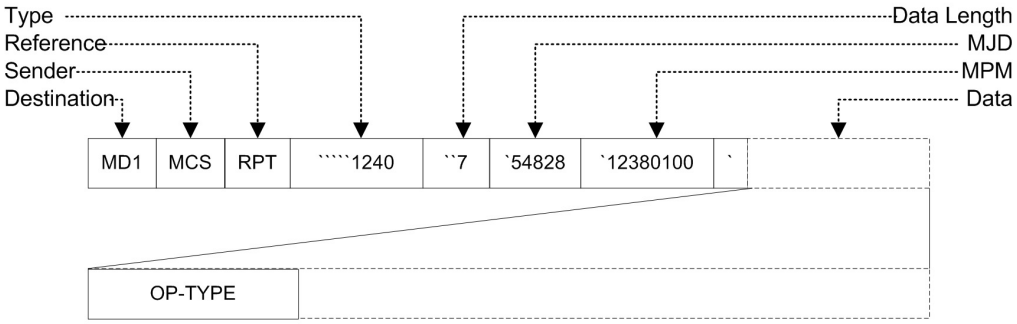


Description: MCS-DR reports that there are 1 operations scheduled. Requesting additional MIB entries under the SCHEDULE branch will provide details of the specific operation, but that is not demonstrated in this scenario.

Figure 8: Example of checking the recording schedule

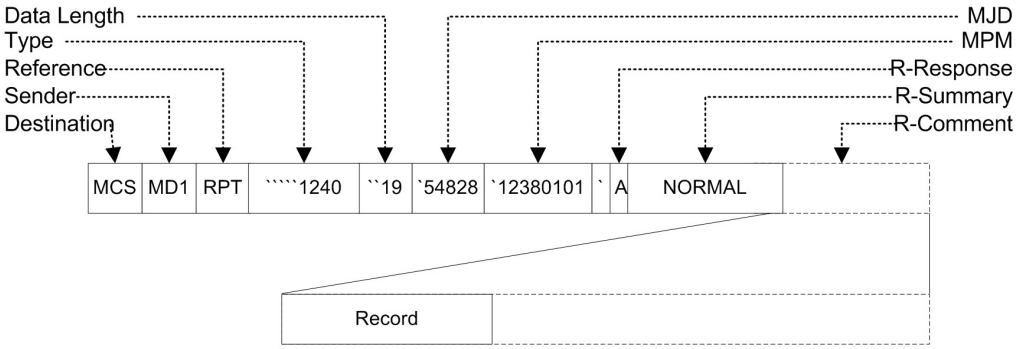
5.7 Checking An Operation's Progress

Message:



Description: While the recording is running, MCS verifies that the MCS-DR is recording by requesting MIB entry 2.1, expecting the response "Record".

Response:

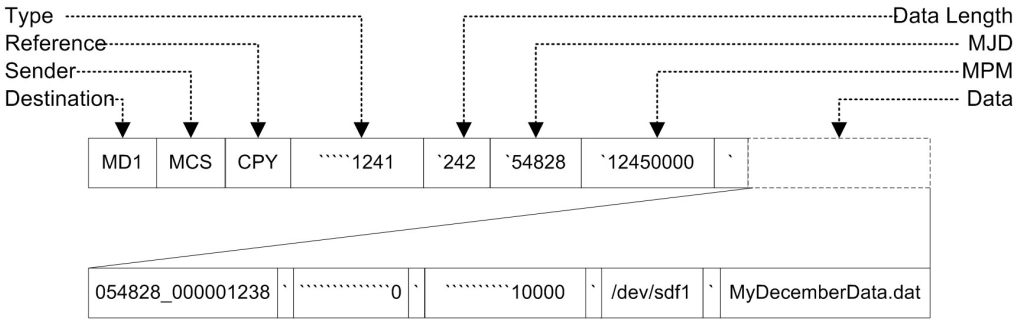


Description: MCS-DR responds with "Record" indicating that an operation is in progress, and it is a recording operation. More information regarding the current operation can be retrieved by requesting other branch 2 MIB entries, but they are not shown in this scenario.

Figure 9: Example of checking that an operation is in progress as scheduled

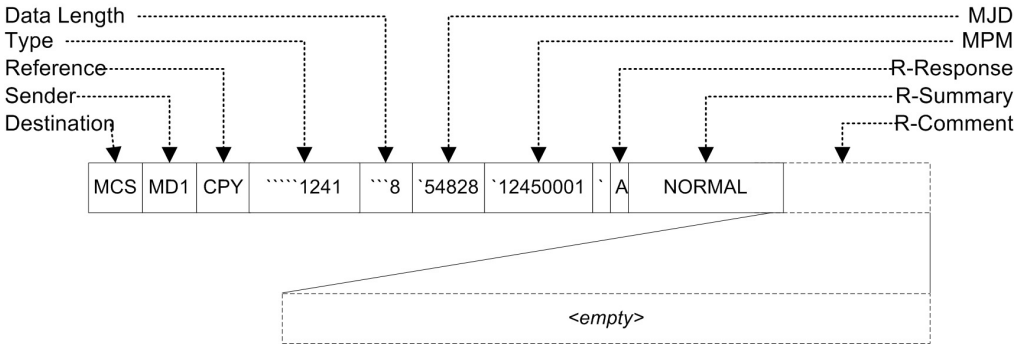
5.8 Retrieving Recorded Data

Message:



Description: Here, the MCS is requesting that data be copied from recording 054828_000001238 to "/dev/sdf1/ MyDecemberData.dat" starting with the first byte and continuing for 10000 bytes. *Note that padding spaces are not shown for Storage ID and Filename, but either left or right padding spaces are fine.* Spaces contained between the first and last non-space character are interpreted as part of the filename or storage id. Rules and semantics concerning such spaces are defined by the Ubuntu Linux operating system.

Response:



Description: The MCS-DR returns an acceptance response and begins copying the data.

Figure 10: Example of using the copy command to retrieve data

6 Change Record

Version	Date	Affected Section(s)	Reason/Description
1.0	2010-02-21	MIB, MIB Detail, Command, Command Detail	Added commands: 'BUF', 'SEL'. Added MIB entries: 'DRSU-COUNT', 'DRSU-SELECTED', 'DRSU-INFO-X', 'BUFFER', 'BUFFER-RESTRICT'. Added description of NTP synching behaviour. Fixed couple of formatting issues.
0.5	2010-01-28	MIB, MIB Detail, Command, Command Detail	Final draft of document, removed EJT command and OP-ERROR.
0.4	2009-10-10	All	Fourth draft of document, removed image matte, removed references to development-stage diagnostics except "TST", revised electrical connections view to not imply a specific mounting requirement, updated argument and response formats to separate all parameters with spaces, updated use-case example to reflect new formats, rewrote FORMAT-SPEC-X description to remove ambiguity.
0.3	2009-10-04	All	Third draft of document, restructured MIB to remove the "MORE" entry. Removed the "DFD" command. Added mechanical and electrical figures and use-case scenario examples.
0.2	2009-09-24	All	Second draft of document, corrected typos and removed extraneous material.
0.1	2009-09-12	All	Initial draft of document.

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