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Red Hat Enterprise Linux Release 9.2 Manual Pages on 'sg_ses.8' command

$ man sg_ses.8

SG_SES(8) SG3_UTILS SG_SES(8)

NAME

sg_ses - access a SCSI Enclosure Services (SES) device

SYNOPSIS

sg_ses [--all] [--ALL] [--descriptor=DES] [--dev-slot-num=SN] [--ei?

ioe=A_F] [--filter] [--get=STR] [--hex] [--index=IIA | --index=TIA,II]

[--inner-hex] [--join] [--maxlen=LEN] [--page=PG] [--quiet] [--raw]

[--readonly] [--sas-addr=SA] [--status] [--verbose] [--warn] DEVICE

sg_ses --control [--byte1=B1] [--clear=STR] [--data=H,H...]

[--data=@FN] [--descriptor=DES] [--dev-slot-num=SN] [--index=IIA |

--index=TIA,II] [--mask] [--maxlen=LEN] [--nickname=SEN]

[--nickid=SEID] [--page=PG] [--readonly] [--sas-addr=SA] [--set=STR]

[--verbose] DEVICE

sg_ses --data=@FN --status [--raw --raw] [<all options from first

form>]

sg_ses --inhex=FN --status [--raw --raw] [<all options from first

form>]

sg_ses [--enumerate] [--index=IIA] [--list] [--help] [--version]

DESCRIPTION

Fetches management information from a SCSI Enclosure Service (SES) de?

vice. This utility can also modify the state of a SES device. The DE?

VICE should be a SES device which may be a dedicated enclosure services

processor in which case an INQUIRY response's Peripheral Device Type is

13 [0xd]. Alternatively it may be attached to another type of SCSI de?
vice (e.g. a disk) in which case the EncServ bit is set in its INQUIRY
response.

If the DEVICE argument is given with no options then the names of all
diagnostic pages (dpages) supported are listed. Most, but not necessar?
ily all, of the named dpages are defined in the SES standards and
drafts. The most recent reference for this utility is the draft SCSI
Enclosure Services 4 document T10/BSR INCITS 555 Revision 5 at
https://www.t10.org . Existing standards for SES, SES-2 and SES-3 are
ANSI INCITS 305-1998 and ANSI INCITS 448-2008 and ANSI INCITS 518-2017
respectively.

SAS expanders typically have a SES device attached via a virtual port.
Some HBAs (SCSI initiators) choose to expose a SES device internally.
That means the SCSI subsystem on the host machine can see the SES de?
vice, but devices connected to that HBA (e.g. a SAS expander) cannot
see the HBA's SES device. That internal SES device might report on the
temperature(s) of the HBA and whether anything is connected to its SCSI
ports.

The first form shown in the synopsis is for fetching and decoding
dpages or fields from the SES DEVICE. A SCSI RECEIVE DIAGNOSTIC RESULTS
command is sent to the DEVICE to obtain each dpage response. Rather
than decoding a fetched dpage, it may be output in hex or binary with
the --hex or --raw --raw options.

The second form in the synopsis is for modifying dpages or fields held
in the SES DEVICE. A SCSI SEND DIAGNOSTIC command containing a "con?
trol" dpage is sent to the DEVICE to cause changes. Changing the state
of an enclosure (e.g. requesting the "ident" (locate) LED to flash on a
disk carrier in an array) is typically done using a read-modify-write
cycle. See the section on CHANGING STATE below.

The third form in the synopsis has two equivalent invocations shown.
They decode the contents of a file (named FN) that holds a hexadecimal
or binary representation of one, or many, SES dpage responses. Typi?
cally an earlier invocation of the first form of this utility with the

'-HHHH' option would have generated that file. Since no SCSI commands are sent, the DEVICE argument if given will be ignored.

The last form in the synopsis shows the options for providing command line help (i.e. usage information), listing out dpage and field infor? mation tables held by the utility (--enumerate), or printing the ver? sion string of this utility.

There is a web page discussing this utility at https://sg.danny.cz/sg/sg_ses.html . Support for downloading microcode to a SES device has been placed in a separate utility called sg_ses_mi? crocode.

In the following sections "dpage" refers to a diagnostic page, either fetched with a SCSI RECEIVE DIAGNOSTIC RESULTS command, sent to the DE? VICE with a SCSI SEND DIAGNOSTIC command, or fetched from data supplied by the --data= option.

OPTIONS

Arguments to long options are mandatory for short options as well. The options are arranged in alphabetical order based on the long option name.

-a, --all

shows (almost) all status dpages, following references and pre? senting the information as a long list whose indentation indi? cates the level of nesting. This option is actually the same as --join, see its description for more information.

If used twice, adds threshold elements to output (if they are available). So it is the same as using --jointwice.

-z, --ALL

shows (almost) all status dpages, following references and pre? senting the information as a long list whose indentation indi? cates the level of nesting. Also shows the threshold elements if they are available. This option is the same as using --join rwice.

-b, --byte1=B1

some modifiable dpages may need byte 1 (i.e. the second byte)

set. In the Enclosure Control dpage, byte 1 contains the INFO, NON-CRIT, CRIT and UNRECOV bits. In the Subenclosure String Out, Subenclosure Nickname Control and Download Microcode Control dpages, byte 1 is the Subenclosure identifier. Active when the --control and --data=H,H... options are used and the default value is 0. If the --clear=STR or --set=STR option is used then the value read from byte 1 is written back to byte 1. B1 is in decimal unless it is prefixed by '0x' or '0X' (or has a trailing 'h' or 'H').

-C, --clear=STR

Used to clear an element field in the Enclosure Control or Threshold Out dpage. Must be used together with an indexing op? tion to specify which element is to be changed. The Enclosure Control dpage is assumed if the --page=PG option is not given. See the STR FORMAT and the CLEAR, GET, SET sections below.

-c, --control

will send control information to the DEVICE via a SCSI SEND DI? AGNOSTIC command. Cannot give both this option and --status. The Enclosure Control, String Out, Threshold Out, Array Control (obsolete in SES-2), Subenclosure String Out, Subenclosure Nick? name Control and Download Microcode dpages can be set currently. This option is assumed if either the --clear=STR or --set=STR option is given.

-d, --data=H,H...

permits a string of comma separated (ASCII) hex bytes to be specified (limit 1024). A (single) space separated string of hex bytes is also allowed but the list needs to be in quotes. This option allows the parameters to a control dpage to be specified. The string given should not include the first 4 bytes (i.e. page code and length). See the DATA SUPPLIED section below.

-d, --data=-

reads one or more data strings from stdin, limit almost 2**16 bytes. stdin may provide ASCII hex as a comma separated list

(i.e. as with the --data=H,H... option). Additionally spaces, tabs and line feeds are permitted as separators from stdin . Stops reading stdin when an EOF is detected. See the DATA SUP? PLIED section below.

-d, --data=@FN

reads one or more data strings from the file called FN, limit almost 2**16 bytes. The contents of the file is decoded in the same fashion as stdin described in the previous option. See the DATA SUPPLIED section below.

-D, --descriptor=DES

where DES is a descriptor name (string) as found in the Element Descriptor dpage. This is a medium level indexing alternative to the low level --index= options. If the descriptor name contains a space then DES needs to be surrounded by quotes (single or double) or the space escaped (e.g. preceded by a backslash). See the DESCRIPTOR NAME, DEVICE SLOT NUMBER AND SAS ADDRESS section below.

-x, --dev-slot-num=SN, --dsn=SN

where SN is a device slot number found in the Additional Element Status dpage. Only entries for FCP and SAS devices (with EIP=1) have device slot numbers. SN must be a number in the range 0 to 255 (inclusive). 255 is used to indicate there is no correspond? ing device slot. This is a medium level indexing alternative to the low level --index= options. See the DESCRIPTOR NAME, DEVICE SLOT NUMBER AND SAS ADDRESS section below.

-E, --eiioe=A_F

A_F is either the string 'auto' or 'force'. There was some fuzziness in the interpretation of the 'element index' field in the Additional Element Status (AES) dpage between SES-2 and SES-3. The EIIOE bit was introduced to resolve the problem but not all enclosures have caught up. In the SES-3 revision 12 draft the EIIOE bit was expanded to a 2 bit EIIOE field. Using '--eiioe=force' will decode the AES dpage as if the EIIOE field

is set to 1. Using '--eiioe=auto' will decode the AES dpage as if the EIIOE field is set to 1 if the first AES descriptor has its EIP bit set and its element index field is 1 (in other words a heuristic to guess whether the EIIOE field should be set to 1 or 0).

If the enclosure sets the actual EIIOE field to 1 or more then this option has no effect. It is recommended that HP JBOD users set --eiioe=auto .

-e, --enumerate

enumerate all known diagnostic page (dpage) names and SES ele? ments that this utility recognizes plus the abbreviations ac? cepted by this utility. Ignores DEVICE if it is given. Essen? tially it is dumping out tables held internally by this utility.

If --enumerate is given twice, then the recognised acronyms for the --clear=STR, --get=STR and --set=STR options are listed. The utility exits after listing this information, so most other op? tions and DEVICE are ignored. Since there are many acronyms for the Enclosure Control/Status dpage then the output can be fur? ther restricted by giving the --index=IIA option (e.g. "sg_ses -ee -I ts" to only show the acronyms associated with the Enclo? sure Control/Status dpage's Temperature Sensor Element Type).

-f, --filter

cuts down on the amount of output from the Enclosure Status dpage and the Additional Element Status dpage. When this option is given, any line which has all its binary flags cleared (i.e. 0) is filtered out (i.e. ignored). If a line has some other value on it (e.g. a temperature) then it is output. When this option is used twice only elements associated with the "sta? tus=ok" field (in the Enclosure status dpage) are output. The --filter option is useful for reducing the amount of output gen? erated by the --join option.

-G, --get=STR

Used to read a field in a status element. Must be used together

with a an indexing option to specify which element is to be read. By default the Enclosure Status dpage is read, the only other dpages that can be read are the Threshold In and Addi? tional Element Status dpages. If a value is found it is output in decimal to stdout (by default) or in hexadecimal preceded by "0x" if the --hex option is also given. See the STR FORMAT and the CLEAR, GET, SET sections below.

-h, --help

output the usage message then exit. Since there is a lot of in? formation, it is split into two pages. The most important is shown on the first page. Use this option twice (e.g. '-hh') to output the second page. Note: the --enumerate option might also be viewed as a help or usage type option. And like this option it has a "given twice" form: '-ee'.

-H, --hex

If the --get=STR option is given then output the value found (if any) in hexadecimal, with a leading "0x". Otherwise output the response in hexadecimal; with trailing ASCII if given once, without it if given twice, and simple hex if given three or more times. Ignored when all elements from several dpages are being accessed (e.g. when the --join option is used). Also see the --raw option which may be used with this option.

To dump one of more dpage responses to stdout in ASCII parsable hexadecimal use -HHH or -HHHH. The triple H form only outputs hexadecimals which is fine for a single dpage response. When all dpages are dumped (e.g. with --page=all) then the quad H form adds the name of each dpage following a hash mark ('#'). The --data= option parser ignores everything from and including a hash mark to the end of the line. Hence the output of the quad H form is still parsable plus it is easier for users to view and possibly edit. -HHHHH (that is 5) adds the page code in hex af? ter the page's name in the comment.

-I, --index=IIA

where IIA is either an individual index (II) or an Element type abbreviation (A). See the INDEXES section below. If the --page=PG option is not given then the Enclosure Status (or Con? trol) dpage is assumed. May be used with the --join option or one of the --clear=STR, --get=STR or --set=STR options. To enu? merate the available Element type abbreviations use the --enu? merate option.

-I, --index=TIA,II

where TIA,II is an type header index (TI) or Element type abbre? viation (A) followed by an individual index (II). See the IN? DEXES section below. If the --page=PG option is not given then the Enclosure Status (or Control) dpage is assumed. May be used with the --join option or one of the --clear=STR, --get=STR or --set=STR options. To enumerate the available Element type ab? breviations use the --enumerate option.

-X, --inhex=FN

where FN is a filename. It has the equivalent action of the --data=@FN option. If FN is '-' then stdin is read. This option has been given for compatibility with other utilities in this package that use --inhex=FN (or --in=FN) is a similar way. See the "FORMAT OF FILES CONTAINING ASCII HEX" section in the sg3_utils manpage for more information.

-i, --inner-hex

the outer levels of a status dpage are decoded and printed out but the innermost level (e.g. the Element Status Descriptor) is output in hex. Also active with the Additional Element Status and Threshold In dpages. Can be used with an indexing option and/or --join options.

-j, --join

group elements from the Element Descriptor, Enclosure Status and Additional Element Status dpages. If this option is given twice then elements from the Threshold In dpage are also grouped. The order is dictated by the Configuration dpage.

There can be a bewildering amount of information in the "join" output. The default is to output everything. Several additional options are provided to cut down the amount displayed. If the indexing options is given, only the matching elements and their associated fields are output. The --filter option (see its de? scription) can be added to reduce the amount of output. Also "--page=aes" (or "-p 0xa") can be added to suppress the output of rows that don't have a "aes" dpage component. See the INDEXES and DESCRIPTOR NAME, DEVICE SLOT NUMBER AND SAS ADDRESS sections below.

-l, --list

This option is equivalent to --enumerate. See that option.

-M, --mask

When modifying elements, the default action is a read (status element), mask, modify (based on --clear=STR or --set=STR) then write back as the control element. The mask step is new in sg_ses version 1.98 and is based on what is allowable (and in the same location) in draft SES-3 revision 6. Those masks may evolve, as they have in the past. This option re-instates the previous logic which was to ignore the mask step. The default action (i.e. without this option) is to perform the mask step in the read-mask-modify-write sequence.

-m, --maxlen=LEN

LEN is placed in the ALLOCATION LENGTH field of the SCSI RECEIVE DIAGNOSTIC RESULTS commands sent by the utility. It represents the maximum size of data the SES device can return (in bytes). It cannot exceed 65535 and defaults to 65532 (bytes). Some sys? tems may not permit such large sizes hence the need for this op? tion. If LEN is less than 0 or greater than 65535 then an error is generated. If LEN is 0 then the default value is used, other? wise if it is less than 4 then it is ignored (and a warning is sent to stderr).

-n, --nickname=SEN

where SEN is the new Subenclosure Nickname. Only the first 32 characters (bytes) of SEN are used, if more are given they are ignored. See the SETTING SUBENCLOSURE NICKNAME section below.

-N, --nickid=SEID

where SEID is the Subenclosure identifier that the new Nickname (SEN) will be applied to. So SEID must be an existing Subenclo? sure identifier. The default value is 0 which is the main enclo? sure.

-p, --page=PG

where PG is a dpage abbreviation or code (a number). If PG starts with a digit it is assumed to be in decimal unless pre? fixed by 0x for hex. Valid range is 0 to 255 (0x0 to 0xff) in? clusive. Default is dpage 'sdp' which is page_code 0 (i.e. "Sup? ported Diagnostic Pages") if no other options are given.

Page code 0xff or abbreviation "all" is not a real dpage (as the highest real dpage is 0x3f) but instead causes all dpages whose page code is 0x2f or less to be output. This can be used with either the -HHHH or -rr to send either hexadecimal ASCII or bi? nary respectively to stdout.

To list the available dpage abbreviations give "xxx" for PG; the same information can also be found with the --enumerate option.

-q, --quiet

this suppresses the number of warnings and messages output. The exit status of the utility is unaffected by this option.

-r, --raw

outputs the chosen status dpage in ASCII hex in a format suit? able for a later invocation using the --data= option. A dpage less its first 4 bytes (page code and length) is output. When used twice (e.g. -rr) the full dpage contents is output in bi? nary to stdout.

when -rr is used together with the --data=- or --data=@FN then stdin or file FN is decoded as a binary stream that continues to be read until an end of file (EOF). Once that data is read then

the internal raw option is cleared to 0 so the output is not ef?
fected. So the -rr option either changes how the input or output
is treated, but not both.

-R, --readonly

open the DEVICE read-only (e.g. in Unix with the O_RDONLY flag).
The default is to open it read-write.

-A, --sas-addr=SA

this is an indexing method for SAS end devices (e.g. SAS disks).
The utility will try to find the element or slot in the Addi?
tional Element Status dpage whose SAS address matches SA. For a
SAS disk or tape that SAS address is its target port identifier
for the port connected to that element or slot. Most SAS disks
and tapes have two such target ports, usually numbered consecu?
tively.
SATA devices in a SAS enclosure often receive "manufactured"
target port identifiers from a SAS expander; typically will have
a SAS address close to, but different from, the SAS address of
the expander itself. Note that this manufactured target port
identifier is different from a SATA disk's WWN.
SA is a hex number that is up to 8 digits long. It may have a
leading '0x' or '0X' or a trailing 'h' or 'H'. This option is a
medium level
indexing alternative to the low level --index= options. See
the DESCRIPTOR NAME, DEVICE SLOT NUMBER AND SAS ADDRESS section
below.

-S, --set=STR

Used to set an element field in the Enclosure Control or Thresh?
old Out dpage. Must be used together with an indexing option to
specify which element is to be changed. The Enclosure Control
dpage is assumed if the --page=PG option is not given. See the
STR FORMAT and CLEAR, GET, SET sections below.

-s, --status

will fetch dpage from the DEVICE via a SCSI RECEIVE DIAGNOSTIC

RESULTS command (or from --data=@FN). In the absence of other options that imply modifying a dpage (e.g. --control or --set=STR) then --status is assumed, except when the --data= op? tion is given. When the --data= option is given there is no de? fault action: either the --control or this option must be given to distinguish between the two different ways that data will be treated.

-v, --verbose

increase the level of verbosity. For example when this option is given four times (in which case the short form is more conve? nient: '-vvvv') then if the internal join array has been gener? ated then it is output to stderr in a form suitable for debug? ging.

-V, --version

print the version string and then exit.

-w, --warn

warn about certain irregularities with warnings sent to stderr. The join is a complex operation that relies on information from several dpages to be synchronized. The quality of SES devices vary and to be fair, the descriptions from T10 drafts and stan? dards have been tweaked several times (see the EIIOE field) in order to clear up confusion.

INDEXES

An enclosure can have information about its disk and tape drives plus other supporting components like power supplies spread across several dpages. Addressing a specific element (overall or individual) within a dpage is complicated. This section describes low level indexing (i.e. choosing a single element (or a group of related elements) from a large number of elements). If available, the medium level indexing described in the following section (DESCRIPTOR NAME, DEVICE SLOT NUMBER AND SAS ADDRESS) might be simpler to use.

The Configuration dpage is key to low level indexing: it contains a list of "type headers", each of which contains an Element type (e.g.

Array Device Slot), a Subenclosure identifier (0 for the primary enclo? sure) and a "Number of possible elements". Corresponding to each type header, the Enclosure Status dpage has one "overall" element plus "Num? ber of possible elements" individual elements all of which have the given Element type. For some Element types the "Number of possible ele? ments" will be 0 so the Enclosure Status dpage has only one "overall" element corresponding to that type header. The Element Descriptor dpage and the Threshold (In and Out) dpages follow the same pattern as the Enclosure Status dpage.

The numeric index corresponding to the overall element is "-1". If the Configuration dpage indicates a particular element type has "n" ele? ments and n is greater than 0 then its indexes range from 0 to n-1 .

The Additional Element Status dpage is a bit more complicated. It has entries for "Number of possible elements" of certain Element types. It does not have entries corresponding to the "overall" elements. To make the correspondence a little clearer each descriptor in this dpage op? tionally contains an "Element Index Present" (EIP) indicator. If EIP is set then each element's "Element Index" field refers to the position of the corresponding element in the Enclosure Status dpage.

Addressing a single overall element or a single individual element is done with two indexes: TI and II. Both are origin 0. TI=0 corresponds to the first type header entry which must be a Device Slot or Array De? vice Slot Element type (according to the SES-2 standard). To address the corresponding overall instance, II is set to -1, otherwise II can be set to the individual instance index. As an alternative to the type header index (TI), an Element type abbreviation (A) optionally followed by a number (e.g. "ps" refers to the first Power Supply Element type; "ps1" refers to the second) can be given.

One of two command lines variants can be used to specify indexes: --in? dex=TIA,II where TIA is either an type header index (TI) or an Element type abbreviation (A) (e.g. "ps" or "ps1"). II is either an individual index or "-1" to specify the overall element. The second variant is --index=IIA where IIA is either an individual index (II) or an Element

type abbreviation (A). When IIA is an individual index then the option is equivalent to --index=0,II. When IIA is an Element type abbreviation then the option is equivalent to --index=A,-1.

Wherever an individual index is applicable, it can be replaced by an individual index range. It has the form: <first_ii>-<last_ii>. For ex? ample: '3-5' will select individual indexes 3, 4 and 5 .

To cope with vendor specific Element types (whose type codes should be in the range 128 to 255) the Element type code can be given as a number with a leading underscore. For example these are equivalent: --in? dex=arr and --index=_23 since the Array Device Slot Element type code is 23. Also --index=ps1 and --index=_2_1 are equivalent.

Another example: if the first type header in the Configuration dpage has has Array Device Slot Element type then --index=0,-1 is equivalent to --index=arr. Also --index=arr,3 is equivalent to --index=3.

The --index= options can be used to reduce the amount of output (e.g. only showing the element associated with the second 12 volt power sup? ply). They may also be used together with with the --clear=STR, --get=STR and --set=STR options which are described in the STR section below.

DESCRIPTOR NAME, DEVICE SLOT NUMBER AND SAS ADDRESS

The three options: --descriptor=DES, --dev-slot-num=SN and --sas-addr=SA allow medium level indexing, as an alternative to the low level --index= options. Only one of the three options can be used in an invocation. Each of the three options implicitly set the --join option since they need either the Element Descriptor dpage or the Additional Element Status dpage as well as the dpages needed by the --index= op? tion.

These medium level indexing options need support from the SES device and that support is optional. For example the --descriptor=DES needs the Element Descriptor dpage provided by the SES device however that is optional. Also the provided descriptor names need to be useful, and having descriptor names which are all "0" is not very useful. Also some elements (e.g. overall elements) may not have descriptor names.

These medium level indexing options can be used to reduce the amount of output (e.g. only showing the elements related to device slot number 3). They may also be used together with with the --clear=STR, --get=STR and --set=STR options which are described in the following section. Note that even if a field can be set (e.g. "do not remove" (dnr)) and that field can be read back with --get=STR confirming that change, the disk array may still ignore it (e.g. because it does not have the mechanism to lock the disk drawer).

STR FORMAT

The STR operands of the --clear=STR, --get=STR and --set=STR options all have the same structure. There are two forms:

<acronym>[=<value>]

<start_byte>:<start_bit>[:<num_bits>][=<value>]

The <acronym> is one of a list of common fields (e.g. "ident" and "fault") that the utility converts internally into the second form. The <start_byte> is usually in the range 0 to 3, the <start_bit> must be in the range 0 to 7 and the <num_bits> must be in the range 1 to 64 (de? fault 1). The number of bits are read in the left to right sense of the element tables shown in the various SES draft documents. For example the 8 bits of byte 2 would be represented as 2:7:8 with the most sig? nificant bit being 2:7 and the least significant bit being 2:0 .

The <value> is optional but is ignored if provided to --get=STR. For --set=STR the default <value> is 1 while for --clear=STR the default value is 0 . <value> is assumed to be decimal, hexadecimal values can be given in the normal fashion.

The supported list of <acronym>s can be viewed by using the --enumerate option twice (or "-ee").

CLEAR, GET, SET

The --clear=STR, --get=STR and --set=STR options can be used up to 8 times in the same invocation. Any <acronym>s used in the STR operands must refer to the same dpage.

When multiple of these options are used (maximum: 8), they are applied in the order in which they appear on the command line. So if options

contradict each other, the last one appearing on the command line will be enforced. When there are multiple --clear=STR and --set=STR options, then the dpage they refer to is only written after the last one.

DATA SUPPLIED

This section describes the two scenarios that can occur when the --data= option is given. These scenarios are the same irrespective of whether the argument to the --data= option is a string of hex bytes on the command line, stdin (indicated by --data=-) or names a file (e.g. --data=@thresh_in_dpage.hex).

The first scenario is flagged by the --control option. It uses the sup? plied data to build a 'control' dpage that will be sent to the DEVICE using the SCSI SCSI SEND DIAGNOSTIC command. The supplied dpage data should not include its first 4 bytes. Those 4 bytes are added by this utility using the --page=PG option with PG placed at byte offset 0). If needed, the --byte1=B1 option sets byte offset 1, else 0 is placed in that position. The number of bytes decoded from the data provided (i.e. its length) goes into byte offsets 2 and 3.

The second scenario is flagged by the --status option. It decodes the supplied data assuming that it represents the response to one or more SCSI RECEIVE DIAGNOSTIC RESULTS commands. Those responses have typi? cally been captured from some earlier invocation(s) of this utility.

Those earlier invocations could use the '-HHH' or '-HHHH' option and file redirection to capture that response (or responses) in hexadeci? mal. The supplied dpage response data is decoded according to the other command line options. For example the --join option could be given and that would require the data from multiple dpages typically: Configura? tion, Enclosure status, Element descriptor and Additional element sta? tus dpages. If in doubt use --page=all in the capture phase; having more dpages than needed is not a problem.

By default the user supplied data is assumed to be ASCII hexadecimal in lines that don't exceed 512 characters. Anything on a line from and in? cluding a hash mark ('#') to the end of line is ignored. An end of line can be a LF or CR,LF and blank lines are ignored. Each separated pair

(or single) hexadecimal digits represent a byte (and neither a leading '0x' nor a trailing 'h' should be given). Separators are either space, tab, comma or end of line.

Alternatively binary can be used and this is flagged by the '-rr' op? tion. The --data=H,H... form cannot use binary values for the 'H's, only ASCII hexadecimal. The other two forms (--data=- and --data=@FN) may contain binary data. Note that when the '-rr' option is used with --data=@FN that it only changes the interpretation of the input data, it does not change the decoding and output representation.

CHANGING STATE

This utility has various techniques for changing the state of a SES de? vice. As noted above this is typically a read-modify-write type opera? tion. Most modifiable dpages have a "status" (or "in") page that can be read, and a corresponding "control" (or "out") dpage that can be written back to change the state of the enclosure.

The lower level technique provided by this utility involves outputting a "status" dpage in hex with --raw. Then a text editor can be used to edit the hex (note: to change an Enclosure Control descriptor the SE? LECT bit needs to be set). Next the control dpage data can fed back with the --data=H,H... option together with the --control option; the --byte1=B1 option may need to be given as well.

Changes to the Enclosure Control dpage (and the Threshold Out dpage) can be done at a higher level. This involves choosing a dpage (the de? fault in this case is the Enclosure Control dpage). Next choose an in? dividual or overall element index (or name it with its Element Descrip? tor string). Then give the element's name (e.g. "ident" for RQST IDENT) or its position within that element (e.g. in an Array Device Slot Con? trol element RQST IDENT is byte 2, bit 1 and 1 bit long ("2:1:1")). Fi? nally a value can be given, if not the value for --set=STR defaults to 1 and for --clear=STR defaults to 0.

SETTING SUBENCLOSURE NICKNAME

The format of the Subenclosure Nickname control dpage is different from its corresponding status dpage. The status dpage reports all Subenclo?

sure Nicknames (and Subenclosure identifier 0 is the main enclosure) while the control dpage allows only one of them to be changed. There? fore using the --data option technique to change a Subenclosure nick? name is difficult (but still possible).

To simplify changing a Subenclosure nickname the --nickname=SEN and --nickid=SEID options have been added. If the SEN string contains spa? ces or other punctuation, it should be quoted: surrounded by single or double quotes (or the offending characters escaped). If the --nickid=SEID is not given then a Subenclosure identifier of 0 is as? sumed. As a guard the --control option must also be given. If the --page=PG option is not given then --page=snic is assumed.

When --nickname=SEN is given then the Subenclosure Nickname Status dpage is read to obtain the Generation Code field. That Generation Code together with no more than 32 bytes from the Nickname (SEN) and the Subenclosure Identifier (SEID) are written to the Subenclosure Nickname Control dpage.

There is an example of changing a nickname in the EXAMPLES section be? low.

NVME ENCLOSURES

Support has been added to sg_ses (actually, its underlying library) for NVMe (also known as NVM Express) Enclosures. It can be considered ex? perimental in sg3_utils package version 1.43 and sg_ses version 2.34 .

This support is based on a decision by NVME-MI (Management Interface) developers to support the SES-3 standard. This was facilitated by adding NVME-MI SES Send and SES Receive commands that tunnel dpage con? tents as used by SES.

NOTES

This utility can be used to fetch arbitrary (i.e. non SES) dpages (us? ing the SCSI READ DIAGNOSTIC command). To this end the --page=PG and --hex options would be appropriate. Non-SES dpages can be sent to a de? vice with the sg_senddiag utility.

The most troublesome part of the join operation is associating Addi? tional Element Status descriptors correctly. At least one SES device

vendor has misinterpreted the SES-2 standard, specifically with its "element index" field interpretation. The code in this utility inter? prets the "element index" field as per the SES-2 standard and if that yields an inappropriate Element type, adjusts its indexing to follow that vendor's misinterpretation. The SES-3 drafts have introduced the EIIOE (Element Index Includes Overall Elements) bit which later became a 2 bit field to resolve this ambiguity. See the --eiioe=A_F option.

In draft SES-3 revision 5 the "Door Lock" element name was changed to the "Door" (and an OPEN field was added to the status element). As a consequence the former 'dl' element type abbreviation has been changed to 'do'.

Some RAID controllers hide SES device nodes from the host Operating System. It has been reported that some MegaRAID controllers do this and the following command is needed to expose them:

```
perccli /cx set backplane expose=<on/off>
```

where perccli is Dell's version of BroadCom's (LSI) storcli utility.

There is a related command set called SAF-TE (SCSI attached fault-tol? erant enclosure) for enclosure (including RAID) status and control. SCSI devices that support SAF-TE report "Processor" peripheral device type (0x3) in their INQUIRY response. See the sg_safte utility in this package or the safte-monitor utility on the Internet.

The internal join array is statically allocated and its size is con? trolled by the MX_JOIN_ROWS define. Its current value is 520.

EXAMPLES

Examples can also be found at https://sg.danny.cz/sg/sg_ses.html

The following examples use Linux device names. For suitable device names in other supported Operating Systems see the sg3_utils(8) man page.

To view the supported dpages:

```
sg_ses /dev/bsg/6:0:2:0
```

To view the Configuration Diagnostic dpage:

```
sg_ses --page=cf /dev/bsg/6:0:2:0
```

To view the Enclosure Status dpage:

sg_ses --page=es /dev/bsg/6:0:2:0

To get the (attached) SAS address of that device (which is held in the Additional Element Sense dpage (dpage 10)) printed on hex:

sg_ses -p aes -D ArrayDevice07 -G at_sas_addr -H /dev/sg3

To collate the information in the Enclosure Status, Element Descriptor and Additional Element Status dpages the --join option can be used:

sg_ses --join /dev/sg3

This will produce a lot of output. To filter out lines that don't con? tain much information add the --filter option:

sg_ses --join --filter /dev/sg3

Fields in the various elements of the Enclosure Control and Threshold dpages can be changed with the --clear=STR and --set=STR options. [All modifiable dpages can be changed with the --raw and --data=H,H... op? tions.] The following example looks at making the "ident" LED (also called "locate") flash on "ArrayDevice07" which is a disk (or more pre? cisely the carrier drawer the disk is in):

sg_ses --index=7 --set=2:1:1 /dev/sg3

If the Element Descriptor diagnostic dpage shows that "ArrayDevice07" is the descriptor name associated with element index 7 then this invo? cation is equivalent to the previous one:

sg_ses --descriptor=ArrayDevice07 --set=2:1:1 /dev/sg3

Further the byte 2, bit 1 (for 1 bit) field in the Array Device Slot Control element is RQST IDENT for asking a disk carrier to flash a LED so it can be located. In this case "ident" (or "locate") is accepted as an acronym for that field:

sg_ses --descriptor=ArrayDevice07 --set=ident /dev/sg3

To stop that LED flashing:

sg_ses --dev-slot-num=7 --clear=ident /dev/sg3

The above assumes the descriptor name 'ArrayDevice07' corresponds to device slot number 7.

Now for an example of a more general but lower level technique for changing a modifiable diagnostic dpage. The String (In and Out) diag? nostics dpage is relatively simple (compared with the Enclosure Sta?

tus/Control dpage). However the use of this lower level technique is awkward involving three steps: read, modify then write. First check the current String (In) dpage contents:

```
sg_ses --page=str /dev/bsg/6:0:2:0
```

Now the "read" step. The following command will send the contents of the String dpage (from byte 4 onwards) to stdout. The output will be in ASCII hex with pairs of hex digits representing a byte, 16 pairs per line, space separated. The redirection puts stdout in a file called "t":

```
sg_ses --page=str --raw /dev/bsg/6:0:2:0 > t
```

Then with the aid of the SES-3 document (in revision 3: section 6.1.6) use your favourite editor to change t. The changes can be sent to the device with:

```
sg_ses --page=str --control --data=- /dev/bsg/6:0:2:0 < t
```

If the above is successful, the String dpage should have been changed. To check try:

```
sg_ses --page=str /dev/bsg/6:0:2:0
```

To change the nickname on the main enclosure:

```
sg_ses --nickname='1st enclosure' --control /dev/bsg/6:0:2:0
```

To capture the whole state of an enclosure (from a SES perspective) for later analysis, this can be done:

```
sg_ses --page=all -HHHH /dev/sg5 > enc_sg5_all.hex
```

Note that if there are errors or warnings they will be sent to stderr so they will appear on the command line (since only stdout is redi? rected). A text editor could be used to inspect enc_sg5_all.hex . If all looks in order at some later time, potentially on a different ma? chine where enc_sg5_all.hex has been copied, a "join" could be done. Note that join reflects the state of the enclosure when the capture was done.

```
sg_ses --data=@enc_sg5_all.hex --status --join
```

EXIT STATUS

The exit status of sg_ses is 0 when it is successful. Otherwise see the sg3_utils(8) man page.

AUTHORS

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REPORTING BUGS

Report bugs to <dgilbert at interlog dot com>.

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SEE ALSO

sg_inq, sg_safte, sg_senddiag, sg_ses_microcode, sg3_utils (sg3_utils);

safte-monitor (Internet)