AppNote 5 - Spinnaker Command Protocol (SCP) Specification

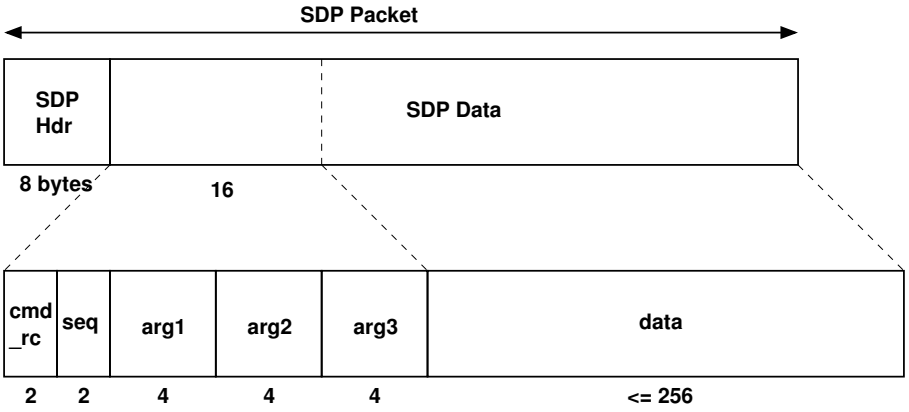
SpiNNaker Group, School of Computer Science, University of Manchester
Steve Temple - 16 Mar 2016 - Version 2.0.0

Introduction

The SpiNNaker Command Protocol is a data format imposed on the data field of an SDP packet. It consists of a fixed-length header followed by a variable sized data field. It is used for low-level interactions with SpiNNaker systems for program loading and debugging. It is suggested that it also be used in applications wherever a similar facility is needed in order to facilitate code re-use. It is frequently used to carry a command to a SpiNNaker core and then to convey a response from that command back to the originator.

The following C struct definition describes the layout of SCP data.

```
typedef struct
{
  ushort cmd_rc;            // Command/Return Code
  ushort seq;               // Sequence number
  uint arg1;                // Arg 1
  uint arg2;                // Arg 2
  uint arg3;                // Arg 3
  uchar data[SDP_BUF_SIZE]; // User data (256 bytes)
} sdp_cmd_t;
```



The 16-bit *cmd_rc* field is a code indicating the command that is being specified in the case of a packet conveying a command. Where the packet is a response to a command, the *cmd_rc* field indicates a return code following execution of the command.

The 16-bit *seq* field may be used for error checking to detect lost packets and to allow for a retry mechanism. If the field is not being used it should be set to zero.

The fields *arg1*, *arg2* and *arg3* are provided to allow 32-bit arguments or return values to be transported while the *data* field allows arbitrary data structures to be conveyed. At present, this field is limited to 256 bytes.

In common with the rest of SpiNNaker, data in the header is stored in Little Endian Format.

Where not all of the *arg1-3* fields are used, it is acceptable, for reasons of efficiency, to start the data field 'early' (ie to occupy space unused by *arg1-3*) but the *cmd_rc* and *seq* fields must always be present.

Kernel Commands

SpiNNaker is controlled initially by commands sent from a host system using SCP. Kernel software running on every active core in the system accepts and acts upon these commands which are typically used to download application programs and perform other low-level functions. At present, the kernel software is *SC&MP* on Monitor Processors and *SARK* on Application processors. *SARK* responds to a small set of commands while *SC&MP* responds to a larger set. A command is directed to a particular core by means of the addressing field in the SDP header of the SDP packet which carries the command. The 3-bit *dest_port* field in the SDP header must be set to zero so that the command is interpreted by *SC&MP* or *SARK*.

When a core receives one of the kernel commands it attempts to carry out the requested command and then send back a response packet. The response may carry some data or it may merely carry a return code, indicating success or failure of the command. The *seq* field from the incoming packet is copied in the reply so that the sender of commands can detect packet loss. The packet is returned by swapping over the *Srce* and *Dest* fields in the SDP header. If an error is detected in the processing of the command, a response packet is sent with an appropriate error code in the *cmd_rc* field. The kernel checks all of the arguments in the command packet for validity and may also detect errors during the execution of the command. The three commands which are currently implemented by all cores are documented below.

Version Command (*CMD_VER*)

The Version command is a request for the core to return some information about itself and the kernel which is running there. There are two variants of this command, depending on the version number of the software tools which are running. The command and response packets are shown in the diagram below.

The command packet contains only the command *CMD_VER* (0) in the *cmd_rc* field and a sequence number in the *seq* field. The other fields are unused and may be omitted from the SDP packet if desired.

Command Packet

cmd_rc	seq	arg1	arg2	arg3	data
CMD_VER (0)	SeqNo	<Don't Care>	<Don't Care>	<Don't Care>	<Don't Care>
2 bytes	2	4	4	4	

Response Packet (pre 2.0.0)

cmd_rc	seq	arg1			arg2		arg3	data
RC_OK (128)	SeqNo	P2P Addr	Phys CPU	Virt CPU	Version Number	Buffer Size	Build date	ID String (NULL terminated)

Response Packet (2.0.0 onwards)

cmd_rc	seq	arg1			arg2		arg3	data	
RC_OK (128)	SeqNo	P2P Addr	Phys CPU	Virt CPU	Version Number	Buffer Size	Build date	ID String	Version String

The response packet contains several pieces of information packed into the *arg1-3* fields and one or two NULL-terminated text strings in the data field. *arg1* contains the point-to-point address of the node (if set) in the top 16 bits. It contains the physical CPU number of the core in bits 15:8 and the virtual CPU number in bits 7:0. *arg2* contains the version number of the kernel

software running on the core in the upper 16 bits and the size of the SCP data buffer in the lower 16 bits. The buffer size is the number of bytes that can be carried in the data portion of a packet carrying SCP. An SDP packet can hold this number plus 16 (the size of the SCP header).

In versions of the software tools prior to release 2.0.0 the version number is the major number multiplied by 100 plus the minor number (eg version 1.29 is represented as 129). In versions from 2.0.0 onwards the version number is 65535 and an extended version number of the form "major.minor.patch" is present as an ASCII string in the data field (see diagram)

arg3 contains the build date of the kernel software as a Unix time (ie seconds since 1970) or zero if this value is not set. The *data* field contains a NULL-terminated ASCII ID string which consists of two fields separated by a "/". The first field is the name of the kernel (eg *SC&MP* or *SARK*) and the second field is the name of the hardware platform, currently *SpiNNaker*. In versions of the tools from 2.0.0 onwards, a second (version) string is present which is also NULL-terminated and located directly after the ID string.

Read Command (*CMD_READ*)

The Read command is implemented by all cores. It is used to request the core to read memory from its address space and return the data which was read. Up to 256 bytes may be requested in current kernels (the size may be obtained via the *CMD_VER* command). The core can be asked to read the memory either as bytes, halfwords (16 bits) or words (32 bits). For halfwords and words, the size should be a multiple of 2 or 4 respectively. The command and response packets are shown in the diagram below.

Command Packet

cmd_rc	seq	arg1	arg2	arg3
CMD_READ (2)	SeqNo	Address	Length (bytes) 0 <= Length <= 256	Type 0=Byte, 1=Short, 2=Word

Response Packet

cmd_rc	seq	data
RC_OK (128)	SeqNo	Read data (<= 256 bytes)

In the request, *arg1* is the address of the beginning of the read data. It should be correctly aligned for the data type which is being specified. *arg2* is the number of bytes to be read and *arg3* specifies whether bytes, halfwords or words are being read. Note that in the response packet, the data immediately follows the *cmd_rc* and *seq* fields as there is no use for the *arg1-3* fields in this case.

Write Command (*CMD_WRITE*)

The Write command is implemented by all cores. It is used to request that a core writes some data to its address space. The parameters are similar to the Read command in that up to 256 bytes may be written as either bytes, halfwords or words. The command packet also carries the data to be written and the response packet carries no data other than the return code and sequence number. The command and response packets are shown in the diagram below.

The write command is used extensively to download code and data to SpiNNaker cores prior to application execution.

Command Packet

cmd_rc	seq	arg1	arg2	arg3	data
CMD_WRITE (3)	SeqNo	Address	Length (bytes) 0 <= Length <= 256	Type 0=Byte, 1=Short, 2=Word	Write data (<= 256 bytes)

Response Packet

cmd_rc	seq
RC_OK (128)	SeqNo

Change log:

- *1.00 - 28nov11- ST* - initial release - comments to *steven.temple@manchester.ac.uk*
- *2.0.0 - 16mar16 - ST* - update for 2.0.0 tools release. Amended VER, removed RUN and APLX commands.