Reference document: DRCU-SIM-dev_plan.1 (SO-2000-12-21)

Development Plan for the DRCU simulator (DRCU-SIM)

1a. Background.

The Stockholm Observatory has agreed to deliver a software simulator for the SPIRE that as far as possible shall mimic the behaviour of the real instrument. It is clear that this work cannot be carried out in full detail until SPIRE becomes fully characterised, but at that moment there will be very little time to construct a simulator. For this reason the construction of the real instrument and the simulator has to happen in parallel. When the need for a separate real time simulator of the SPIRE, less digital processor unit (DPU), appeared it was judged natural to regards this simulator as part of the development of the (full) SPIRE simulator.
As a result of further discussions, it has been agreed that the SPIRE simulator to be delivered to ESA will consist of a DPU (including software) delivered by IFSI and a simulator for SPIRE less the DPU delivered by the Stockholm Observatory.
In the following we use the following abbreviations:

DPU	Digital Processing Unit
DRCU	Detector Readout and Control Unit
DRCU-SIM	Simulator of SPIRE less the CPU
FPU	Focal Plane Unit
IFSI	Istituto di Fisica dello Spazio Interplanetrario
SO	Stockholm Observatory
SPIRE-SIM	Simulator of the SPIRE instrument (= DPU + DRCU-SIM)
WP	Work Package

1b. Purpose.

The DRCU-SIM will first be used for testing the DPU and later for replacing (at least partly) the DRCU+FPU in the AVM.

1c. Basic specifications

The DRCU-SIM shall interface to the DPU in the same way as the DRCU and react to commands in a similar way as the DRCU (+FPU). By ‘similar’ is understood the same data format and transmission details as a minimum. In addition, the DRCU-SIM shall have the capacity to produce realistic signal levels etc. when the behaviour of the SPIRE sub-systems become gradually better defined. It is understood, however, that the degree of sophistication will be limited by the capacity of a (fast) PC and (essentially) high level programming.

1d. Reference documents.

RD1 DPU Interface Control Document (SPIRE-IFS-DOC-22/11/2000)

RD2 DPU/DRCU Electrical Interface Control Document (Sap_SPIRE_Cca-24-00)

RD3 SPIRE Instrument Commands (SPIRE-RAL-DOC-000???, Issue 0.1)

RD4 Operating Modes for the SPIRE Instrument (Doc. No 000320, Issue 2.3)

2. Deliverables and Constraints

2a. Work packages

WP1. Communication board (PCboard-1)

The DRCU-SIM shall conform to the DPU/DRCU interface as defined in RD1. For this purpose, a communication board is developed to be used in a PCI slot of a PC. The board must be constructed in such a way that the communication can run without downloading the processor of the host computer.

WP2. Communication board (PCboard-2)

For development and test purposes of the DRCU-SIM, a communication board, similar to Pcboard1 but with reversed master/slave properties, is developed.

WP3. Windows-NT software drivers for PCboard-1&2, PCboard-drivers

To run the communication boards, software drivers are required. It should run under Windows-NT and be accessible for C-coding, specifically for Borland's 'C-Builder'

WP4. Power-on sensor and current drain device

To mimic the power-on procedure, a device is required that alerts the DRCU-SIM to start the simulations. This device connects to the 28V power line and it shall mimic the power consumption by the DRCU, if required, in a number of steps corresponding to power consumption of the sub-units.

WP5. Simulation software for basic performance tests, SIM-SOFT-1

SIM-SOFT-1 shall provide basic functions like continuously polling the slow port and respond by sending bit-coded data on the slow ports and test packages on the fast ports. It shall provide a test bench for the generation and transmission of data, and in particular it shall demonstrate the simultaneous transfer capacity of the communication channels.

WP6. Simulation software for real-time performance tests, SIM-SOFT-2

The SIM-SOFT-2 package shall provide means to investigate the limitations for real-time simulations, in particular the time-tagging possibilities. The outcome of these tests will tell whether the simulated data can be continuously generated (the most flexible solution) or have to be transferred from a library.

WP7. Simulation software for basic DPU tests, SIM-SOFT-3

The SIM-SOFT-3 package shall interpret DPU commands and respond as specified in terms of data formats (bit-coding and packages). Only test patterns are required.

WP8. Simulation software for advanced DPU tests, SIM-SOFT-4

The SIM-SOFT-4 package shall include the full command list and respond in the same speed and format as specified for the DRCU+FPU. It shall also control the ‘Power-on sensor and current drain device’.

WP9. Simulation software for the AVM, SIM-SOFT-AVM

The SIM-SOFT-AVM shall be based on SIM-SOFT-4 and it shall include specified error modes.

WP10. Simulation software for SPIRE-SIM, SIM-SOFT-SPIRE

The SIM-SOFT-SPIRE package shall be based on SIM-SOFT-AVM and it shall as closely as possible mimic the real instrument. It shall allow quick modifications in response to improving knowledge of the real instrument behaviour.

2b. Deliverables.

DEL1. PC computer with installed PCboard-1 and SIM-SOFT-3.

To be delivered to IFSI from SOS. (June 1, 2001)

DEL2. SIM-SOFT-4 and the ‘Power-on sensor and current drain device’.

To be delivered to IFSI from SO (Jan1, 2002)

DEL3. SIM-SOFT-AVM

To be delivered to IFSI from SO (Apr 1, 2002)

DEL4. PC computer with installed PCboard-1 and SIM-SOFT-AVM.

To be delivered to RAL (June 1, 2002)

DEL5. SIM-SOFT-SPIRE

To be delivered to RAL from SO (date, TBD)

2c. Interactions with other SPIRE groups.

The following input is required to develop the DRCU-SIM:

2c-1. The electrical interface DPU<--->DRCU

This item is defined in RD1 and RD2. These documents are labelled ‘Draft 1’ and ‘Issue 1.0’ and they are not fully convergent in one respect that influence **WP1&2,** namely the clock frequency of the slow speed interface. This point requires clarification a.s.a.p.

2c-2. The list of commands

Each sub-system requires a number of instructions and so far (Dec 00) it has been understood that the higher-level command structure briefly outlined in RD3, shall be broken down by the DPU software into elementary commands to the DRCU. The general structure of a command (address, identifier and data fields) are defined in RD1. The detailed structure for each elementary command has to be defined and it is assumed that the responsible parties for the sub-systems must define these commands.
It is assumed that the System Group (RAL) will compile the list and that the DRCU groups will define detailed structure of each command in collaboration with the DPU team.

2c-3. The anticipated response to each of these commands

Each command shall result in some sort of response, from a simple echo to a set of data words. This must obviously be defined, and the definition shall include:
- the format
- the timing
- typical values (test patterns)

As the responses to the commands are closely connected to the commands it is again assumed that the System Group (RAL) will compile this information and that the DRCU groups will define detailed format and timing in collaboration with the DPU team.

For the further development of DRCU-SIM, results from test bench runs of the different sub-systems should be communicated. The System Group should co-ordinate this transfer of information.

2c-4. The synchronisation

For the real instrument there must be a time tag on the position reading for the BSM, the FTS moving mirror and the array frames. The suggested solution is to use the 312.5 kHz clock signal (generated by the DPU), a synchronising command and distributed counters. The detailed solution of this synchronisation may have an impact on the basic design of the DRCU-SIM. It should therefore be defined a.s.a.p by the DPU and DRCU teams

2c-5. The modes of operation

Even though it is expected that the DRCU-SIM only shall react on elementary commands, the reaction shall depend on the active operating mode. The RD4, that describes the operating modes, needs to be more detailed. Again, it is assumed that the System Group will provide this information.

2c-6. The start-up and close down procedures

These procedures can be regarded as transitions between modes of operation, but in addition to the functional steps involved, information on the timing and the corresponding current drain is required to simulate these transitions. The DRCU groups are expected to provide this information.

2d. Interactions with commercial companies

Communication boards and software drivers.

The work packages **WP1-3** is contracted to ABNW-Polska. Prototypes have been delivered (Sept 00) and are being tested (Dec 00). Final versions of boards and drivers shall be defined in collaboration between SO and ABNW-Polska (Jan01) and produced by ABNW-Polska (March01).

3. Verification Plan

3a. Verification of the communication boards and software drivers (WP1-3)

3a-1. The signal characteristics shall conform to RD1. The tests and documentation shall be provided by ABNW-Polska.

3a-2 The software drivers shall allow simultaneous transmitting and receiving on all channels. The tests and verifications shall be the responsibility of SO.

3a-3 The software drivers shall not down-load the host processor during transmission and reception of data/commands. SO is responsible for the tests and verifications.

3b. Verification of Power-on sensor and current drain device (WP4).

SO shall test, verify and document the performance of this device.

3c. Simulation software (WP5-9).

In order to verify the simulation software, separate software, run on a separate computer, shall be developed that allow complete monitoring (and/or logging) of the simulator response to all defined modes and commands. This separate test software shall be developed in parallel to the simulation software. Graphical tools shall be developed to facilitate the tests and verifications.
It is realised that it is hard to achieve a full proof verification of the simulation software, in particular as there is never any guaranty that the operation system of the computer and the compiler are free from bugs. For operation modes that are considered as particularly critical, extensive testing is foreseen. Clearly, the simulation software cannot mimic instrumental properties that are unknown to the part responsible for the coding (SO). *Therefore, to avoid unnecessary inconsistencies, it is important that known changes of the real instrument are reported.*

4.

Work Breakdown

4a. Work packages.

The work packages are defined in section 2a

4b. Scope and responsibilities.

The scope is described in section 1. SO is responsible to the development of the DRCU-SIM, including subcontracted work packages. It is, however, understood that the conditions are on a best effort.

4c. Work flow.

The interaction with other SPIRE groups are described in 2b and 2c. In summary it concerns the following:

Documentation	**from -> to**	**date (TBC) yyyy-mm-dd**
Confirmation of slow channel Frequency	IFSI -> SO	2001-01-15
Synchronisation definition	IFSI -> SO	2001-01-15
List of commands (including format)	RAL+CEA->SO	2001-03-01
List of responses (including formats)	RAL+CEA->SO	2001-03-01
Modes of operation	RAL -> SO	2001-06-01
Star-up/close-down procedures	CEA -> SO	2001-06-01
Deliverables		
DEL1 (see section 2b)	SO -> IFSI	2001-06-01
DEL2	SO -> IFSI	2002-01-01
DEL3	SO -> IFSI	2002-04-01
DEL4	SO -> RAL	2002-06-01
DEL5	SO -> RAL	(TBD)

Note: The (preliminary) dates for the deliverables are coupled to the availability of the listed documentation at the proposed dates.

5.

Organisational and Cost Breakdown

The organisation at SO for constructing the DRCU-SIM is simple: H-G Florén (local manager) and G. Olofsson (SPIRE Co-I) are in charge. Financial resources are provided by the SNSB (Swedish National Space Board (in a contract to Olofsson as the PI). Apart from travel and hardware expenses, this grant allow external consultance to the estimated extent. Both SO and SNSB have endorsed the project.

6. Risk plan

The main risk is connected to the continuity of personnel. If, for some reason, Florén and/or Olofsson must leave the project this would cause difficulties, in particular if it would happen with short notice. It is realised that the safest solution would be to involve more people, but this would require an expansion of the required resources that at present (end 2000) would be hard to achieve. In any case, the documentation practice shall be such that it would be feasible to continue the work for new personnel.