3 Data reduction and scientific analysis plans

3.1 Introduction

The FIRST Science Management Plan specifies that the PI should set up an Instrument Control Centre (ICC) for his/her instrument with the responsibilities, in the areas of data reduction and scientific analysis, to:

(i) generate and maintain all ground software and procedures needed for operating the instrument, and for performing monitoring and trend analysis;

(ii) provide all software and procedures required for error correction, calibration and generally for the scientific processing of the data from the instrument.

The ICC concept for SPIRE aims to maximise the use of the expertise spread across the consortium to develop and maintain the software required by the ICC whilst providing a single point of contact with the rest of the FIRST Ground Segment. This solution allows the involvement of instrument experts from the different institutes without incurring the additional cost of their relocation to a single site.

This discussion concentrates on the software used by the SPIRE ICC, and other Centres in the FIRST Ground Segment, during the Routine Operations Phase. This is described in section 3.2 under the heading of each of the functions performed by the ICC. Much of this software will be developed initially for use during the instrument AIV activities and upgraded and maintained throughout the Operations Phase. This process is described in section 3.3. Section 3.4 gives an overview of the infrastructure of the SPIRE ICC and environment in which the software will be developed and used. Section 3.5 gives a summary of the ICC management and work plans.

3.2 Functional description

Figure 1 shows the functions carried out by the ICC during the Routine Operations Phase. These fall under five main headings: monitoring of instrument operations, instrument calibration, quality monitoring, science data processing, and user support.

3.2.1 Monitoring instrument operations

Data from the instrument for each 22 hour Daily Prime Operational Phase (DPOP) is received on the ground, during the following 2 hour Daily Telecommunications Phase (DTCP). Initially, the ICC will provide 7 days a week operation (manned only during normal office hours) to allow it to monitor the instrument status daily. This will provide reaction to any instrument problems within 48 hrs of their occurrence. This may be relaxed as confidence in the instrument is gained.

The accumulated instrument science data will take, on average, 5-6 hrs to transmit from the MOC, through FINDAS, to the ICC (8 hrs of data @ 40 kbps through a 64-kbps link), with the time possibly extended if other FINDAS/ICC communications are taking place at the same time. The ICC cannot, therefore, monitor the instrument and take action in real time, based on the complete set of telemetry data available from the satellite. The monitoring activity will then be split into two stages; the first taking place during the DTCP when the possibility of commanding the instrument in real time is available; the second, after the DTCP when the full telemetry from the instrument is available.

3.2.1.1 During DTCP

The ICC instrument monitoring will take advantage of the ability of the satellite Data Handling Sub-System (DHSS) to transmit to the ground a mixture of real-time telemetry and selected data stored in the Solid State Recorder Mass Memory (SSR).

The ICC will receive, in parallel, the real-time instrument housekeeping telemetry and the "event packets" in the stored instrument housekeeping telemetry. These will be monitored for: parameters out of limits; unexpected instrument configurations; correct command execution and autonomous actions taken by the instrument On-Board Computer.

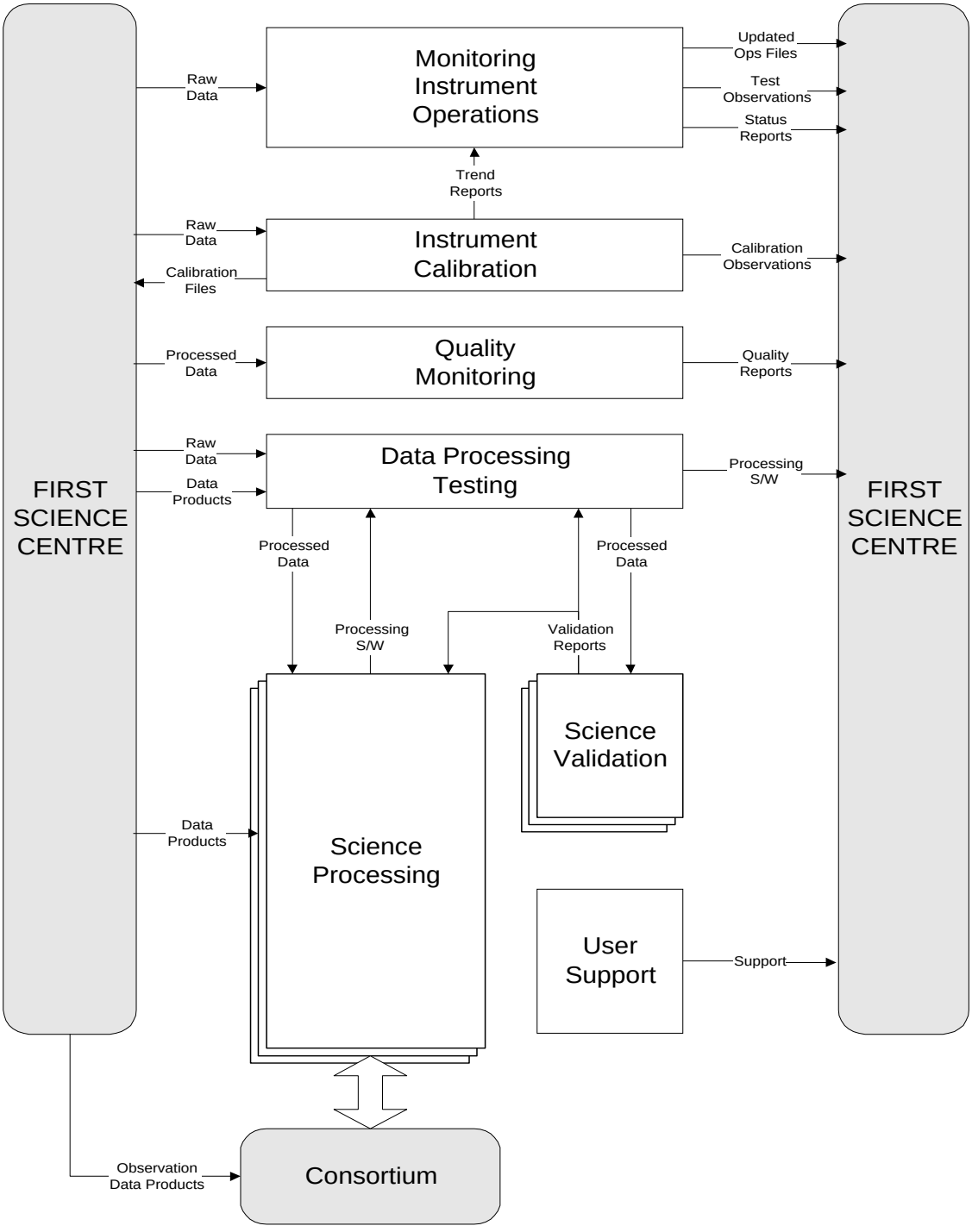


Figure 3.1: ICC Functional Overview

In the case of a serious problem, the ICC will have the option to execute any agreed contingency procedures (which may include real-time commanding of the instrument and require real-time instrument science data) in order to clarify, and possibly correct, the situation. The ICC may then take

the decision; to continue with the scheduled observations, to reset the instrument to its normal mode and continue with the schedule, or to suspend the schedule until the problem has been diagnosed. A report on the instrument health will be generated daily.

3.2.1.2 Post-DTCP

The ICC will request the complete instrument telemetry, both housekeeping and science data, from the previous DPOP and will monitor the instrument status information through that period. A report on the instrument status will be generated.

During this activity, data for the analysis of trends in instrument parameters, both housekeeping and science, will be generated and stored in Trend Data Files.

3.2.1.3 Trend analysis

Regularly (weekly, or as required) analysis of the Trend Data Files, produced during instrument monitoring and calibration activities, will be performed and a report on the instrument long-term status will be produced.

3.2.2 Instrument calibration

The results of instrument calibration activities will be placed in a Calibration Database held in the FINDAS. The initial database will be generated and populated during the AIV and Ground Calibration periods and will evolve throughout the mission as a result of regular Calibration Observations.

Calibration Observations will be carried out by execution of both standard Astronomical Observation Templates (AOTs) and custom written observations, using the common script language in which the AOTs will be implemented. The processing of both types of observation is likely to be non-standard and will be carried out by the ICC using calibration-specific software. This software is divided into two parts: the first will allow processing of individual Calibration Observations to provide data to be input into the Calibration Database, and the second will allow subsequent processing of the Database into the Calibration Files used by the uplink and downlink software.

Further processing of the Calibration Database will be made to provide Trend Data Files for calibration parameters. These are used to monitor instrument long term stability (see 3.2.1.3).

3.2.3 Quality monitoring

The purpose of this function is to assess the quality of the products being provided by the FSC through the use of the instrument science processing software. Products from selected observations will be requested, routinely, from the FSC (via FINDAS) and analysed to identify possible problems with the science processing. This will include analysis of the processing status reports (e.g. identification of failed processing steps, comparison of instrument science parameters (e.g., detector noise) with expected values, etc.) and analysis of the final products for obvious anomalies (e.g., zero detector output, negative fluxes, etc.). Status reports will be generated for each observation assessed.

Assessment of the scientific quality of the products from an observation cannot be made without the agreement of the PI for that observation. For this reason the members of the instrument consortium will be fully involved in the scientific quality assessment of their own guaranteed-time observations. They will make use of the instrument Interactive Analysis and Scientific Analysis software systems described below.

3.2.4 Science data processing

The Science Data Processing software is intended to process the scientific data from the instrument into a product that can be analysed by standard astronomical analysis packages. This takes place in the following stages; extraction, from FINDAS, of the raw scientific data and auxiliary data necessary for

the data reduction; removal of instrument effects (e.g., deglitching, decompression, correction for electronic gains, filtering, etc.) to produce an uncalibrated science product; calibration of the science data; and, possibly, further processing of the data into a scientifically useful product (e.g., flux calibration, Fourier transformation, co-addition of spectra and images, combining observations to make large maps, etc.). The development and maintenance of this software will depend on a wide range of expertise available throughout the SPIRE consortium and the ICC is organised to take advantage of this.

The Instrument Control Centre is not responsible for the processing of the science data for observers, but for providing the software which the FSC can use to carry this out. Three ICC functions are identified with this, as described below.

3.2.4.1 Data processing and science analysis software production

Initial versions of the data processing software will be produced during the development phase, based on requirements identified during the AIV and ground calibration activities. Subsequently, when operations begin, it will become necessary to upgrade the software to take account of anomalies and problems with the data processing and science analysis software identified during the execution of the above monitoring functions. Facilities to allow the development and testing of software modules and the analysis and investigation of their utility will be provided in an Interactive Analysis System.

The Interactive Analysis system will provide a user interface to allow users to process their data in several ways: to perform and control each step in the science data processing chain; to 'plug in' new modules to replace the current version at each step; and to display and/or modify the data at the end of each step before continuing with the processing. It is expected that initially some of the steps in the data processing chain will also require interactive input from the user and that several iterations round a series of steps may also be necessary. Later versions of the software will require less interaction. This system will provide the prime method of testing new data processing modules and their associated calibration files. These tested modules will form the basis of the data processing software provided to the FSC. (It is currently assumed that the SPIRE "pipeline" will be a cut-down version of the Interactive Analysis System, delivered to the FSC for processing of SPIRE observers' data. This may require the software to be run by the observer at their own institute, or be made available to be run by the observer at the FSC.)

New and updated processing algorithms will be prototyped and tested within this system by members of the consortium, particularly those with expertise related to instrument subsystems, until satisfactory performance is achieved. Subsequently, these algorithms will be converted into new modules following the ESA software development standards before submission to the FSC (see below).

3.2.4.2 Data-processing testing

It is assumed that a "cut-down" version (i.e., one which provides only the required facilities) of the Interactive Analysis system will be provided to the FSC as the instrument pipeline. Nevertheless it is probable that the environment in which the pipeline runs will be different to that under which the Interactive Analysis is supported (e.g., the data input interface may be different in the two cases: via FINDAS or via files). Therefore, a data processing test-bed will be required to emulate the processing environment in the FSC. It is expected that the FSC will provide access to such a "test pipeline" to be used by the ICC for testing prior to the formal delivery of the instrument software.
This test-bed will be used to acceptance test any proposed new science processing software delivery by processing a set of observations which will be selected to exercise all modules in the software. (This test-set will expand during the Operations Phase as new modules are produced and 'problem' observations are found.) The complete set of tests and expected results will be documented in an Acceptance Test Plan. The acceptance test results will be provided with the delivered software.

3.2.4.3 Science validation

After acceptance, an additional set of observations will be processed, selected to allow validation of the scientific results from the data processing. The products from these observations will be made available to the PI of the observation for them to report on the acceptability of the product. In general, these observations will be selected from the Guaranteed Time observations of the consortium, but they may include open-time observations if these are the only data available to validate parts of the data processing chain. Reports, and any caveats on the use of the data products produced, will be provided with the delivered software.

3.2.5 User support

The FSC has the responsibility for supporting the astronomical community in the use and exploitation of the FIRST instruments. The ICC will provide instrument-specific support to this work by offering training opportunities to personnel from the FSC during the Development Phase (it is hoped that FSC staff will take part in the AIV and Ground Calibration activities and Ground Segment tests) and by responding to questions during the Operations Phase.

3.3 Programme

The Instrument Control Centre is a concept designed to allow the maximum amount of the expertise gained during the design, manufacture, ground testing and calibration of the instrument hardware to be retained during the instrument operational phase. This requires making use of experienced staff, with directly relevant expertise, as much as possible. The concept is implemented by locating a SPIRE ICC Operations Centre at RAL, which also has the responsibility for the testing and calibration of the instrument, and by locating SPIRE ICC Data Processing and Science Analysis Software (DAPSAS) Centres at ICSTM (UK) and SAp, Saclay (France), both of which have significant relevant expertise in data processing software (e.g., from their involvement in ISO). The staff from these Centres will participate in the instrument development, AIV and calibration activities during the ICC development phase in order to build up expertise in the instrument and its operation.

The Operations Centre will be, primarily, responsible for maintaining the operational status and performance of the instrument. The centre will be staffed from personnel who have been involved in the development and testing of the instrument and its associated software and will be supported by the consortium members from other groups as and when necessary. This centre will also be the single interface between the ICC and the rest of the Ground Segment.

However, the scientific knowledge and experience which is essential for monitoring the scientific quality of the science products, and for designing the science processing and analysis software, is distributed through the whole SPIRE consortium and it is unrealistic to expect that Co-Is will relocate to a central ICC for the whole period of the development and operations phases. It is for this reason, that this work will be carried out by the two DAPSAS Centres. They will provide coordination of all the scientific data processing and analysis software development and maintenance activities.

The DAPSAS (UK) centre will additionally be responsible for the generation, to ESA standards, of each version of the ‘pipeline’ software. The Operations Centre will be responsible for its verification, configuration control and delivery to the FSC.

3.3.1 Development phase

Many of the activities of the ICC during the development phase are distributed amongst the groups contributing to the instrument hardware development, manufacture and testing as this is where the expertise resides. It is intended that those involved in this work will transfer to the ICC for the Operations Phase, bringing this expertise with them.

To coordinate the work amongst these groups an ICC Steering Group will be formed under the chairmanship of an ICC Scientist. This group will comprise the PI, the Co-PI, the Project Scientists, the Instrument Scientist, the Systems Engineer, the ICC Development Manager and the managers of the DAPSAS centres. This group will define and coordinate the work to be carried out and assign responsibilities to appropriate centres. The ICC Development Manager will be responsible for overseeing the implementation of these decisions, will be the formal interface between the ICC and ESA, and will attend all Ground Segment related meetings.

Development activities fall into three areas as outlined below.

3.3.1.1 Definition of and provision of instrument information

This includes:

1. **Provision of an Instrument Users Manual:** The Instrument Users Manual is a repository of information from many of the groups involved in the definition and manufacture of the instrument. The Instrument Scientist will be responsible for co-ordinating inputs from the other consortium members into a single coherent document.

2. **Provision of Instrument and Calibration Databases:** This information will be mostly generated as a direct result of data collected during the testing and calibration activities at RAL. The teams responsible for these activities will also generate the data required by the ICC.

3. **Definition of Instrument Operating Procedures:** These procedures (command sequences) will be defined as part of the preparation for the AIV and calibration activities. They are likely to be refined as these activities proceed.

4. **Definition of Instrument Observations:** The definition of the instrument modes of operation and the scientific definition of the AOTs will be co-ordinated by the Project Scientists. The definition and testing of the command sequences required will be the responsibility of the Instrument Scientist and will be done prior to and during the AIV and calibration activities, while the implementation of the AOTs in the script language will be carried out as part of the ICC work.

3.3.1.2 Software development

Responsibility for these activities will be distributed between the institutes housing the three ICC centres. The exact division will be determined by the ICC Steering Group. The following software has been identified:

(i) Real Time Assessment/Quick Look Analysis (RTA/QLA);
(ii) Trend Analysis;
(iii) Calibration Analysis;
(iv) Diagnostic Tools;
(v) Instrument Time Estimator;
(vi) Command Translator inputs;
(vii) Interactive Analysis System;
(viii) Data Processing and Science Analysis Modules.

3.3.1.3 Preparation for operations

Approximately two years before launch, an Operations Manger will be appointed to carry out the preparations necessary to have the ICC Operations Centre available for the routine phase. This will involve:

(i) implementation of the ICC OperationsCentre infrastructure;
(ii) provision of the ICC OperationsCentre computer hardware;

(iii) provision of other ICC Operations Centre equipment (Quick Look Facility, Instrument Simulator, OBS Maintenance Facility, SPU S/W maintenance Facility);
(iv) definition of Operations Phase plans and procedures, including PV phase and routuine phase calibration observations;
(v) integration and test of the ICC hardware and interfaces;
(vi) set-up and training of the Operations Team;
(vii) participation in Ground Segment testing (SVTs, end-to-end tests).

3.3.2 Operations Phase

3.3.2.1 Operations Centre

The Operations Centre will consist of three teams;

The Operations Team will be responsible for:

(i) monitoring the status of the instrument;
(ii) trend data extraction and analysis;
(iii) calibration data extraction;
(iv) anomaly investigation (with help from instrument subsystem experts);
(v) generation of new observations (new calibration observations, investigative observations, etc.);
(vi) update of the AOT implementation;
(vii) generation of new and updated operations procedures.

The Operations Team will be available normally during office hours 5 days a week. However, the requirement to monitor the instrument status on a daily basis will mean that this function (probably taking one person a few hours) will be performed 7 days a week by rota. During the Commissioning and PV phases the Operations Centre will be staffed 7 days a week and the Operations Team will be augmented by visiting staff from other institutes.

The Software Team will be responsible for:

(i) maintenance of the ICC software;
(ii) maintenance of the On-Board Software;
(iii) acceptance testing of new science processing software and calibration files and their installation into the test-bed;
(iv) delivery of science processing software updates to the FSC after validation;
(v) Configuration Control of all deliverable software and data.

This team will operate during office hours 5 days a week.

The Facilities Team will be responsible for maintenance of the computer hardware and other equipment at the Operations Centre. They will operate during office hours for 5 days a week (being on call at weekends to support the Operations Team)

All Operations Centre staff will be encouraged to take part in data processing and scientific analysis activities in order to contribute to the software development work at the DAPSAS centres.

3.3.2.2 DAPSAS centres

During operations, these centres will be responsible for:

(i) monitoring the scientific quality of the processed data from the instrument and upgrading the data processing and science analysis software to reflect improved knowledge and experience of the instrument;

(ii) periodic reviews of the in-orbit calibration plan;
(iii) AOT optimisation in the light of in-flight instrument performance;
(iv) analysis of data from parallel and serendipity modes;
(v) providing support to the FSC (via the Operationscentre) in relation to these matters.

Coordination of this work will be through a Data Analysis and Calibration Group consisting of qualified people from across the consortium, which will meet regularly to review the quality of the scientific products, identify processing anomalies and effects and suggest ways of correcting these, devise improvements to the software, and to assign tasks for implementing them.

3.4 Infrastructure and hardware

3.4.1 Operations Centre

This centre is responsible for the routine operation and monitoring of the instrument on a day to day basis. It forms the single formal point of contact between the ICC and the FSC and MOC for deliveries of software, data files and other information identified in the ICC/FSC and ICC/MOC interface documents. The ESA-provided link to FINDAS will connect to this centre.

Facilities provided will include a Project Office for management, administrative and secretarial support, offices, meeting rooms and equipment for the Operations Centre teams and additional office space for visitors expected during the Instrument Commissioning and Performance Verification Phases and at other times.

The Operations Centre will be provided with the following computing hardware.

1. A Quick Look Facility (with redundancy), comprising a workstation plus additional displays running the RTA/QLA software developed during the AIV and Calibration activities, which will provide display and analysis facilities for monitoring of the instrument status. It is expected that this will be a copy of the Quick Look Facility used during the instrument testing and provided to the MOC for the Satellite Commissioning Phase with additional software for use in an operational environment.

2. An Operations Computer to support the work of the Operations Team in data processing and analysis. This machine will also have to be able to run software provided by ESA, such as time estimators, command translator, etc. A server-class machine is envisaged with large on-line disk space (for temporary storage of data under analysis) and peripherals (storage devices, printers, etc.) with terminals for each team.

3. A Software Development Computer (identical to the Operations Computer, to provide redundancy in the case of failure of the prime machine) used by the software maintenance team for its tasks.

4. A copy of the instrument software simulator to allow testing of updated instrument command sequences, AOTs, etc.

5. An On-Board Software Maintenance Facility, to allow generation and testing of updates to the on-board software.

6. A Signal Processing Unit Software Maintenance Facility (TBC), to allow generation and testing of updates to the SPU software.

7. A substantial data storage facility (TBC) to provide storage for large amounts of data used in testing and validation of data processing software. (With the link rate available (64 kbps) it would take a long time to extract all the data needed for a validation exercise from FINDAS every time.)

In addition the Operations Centre will retain the Flight Spare Model of the instrument and the calibration and test facilities which will be available, at short notice, to support any necessary investigations of instrument anomalies or to test new command sequences during the routine phase.

3.4.2 DAPSAS centres

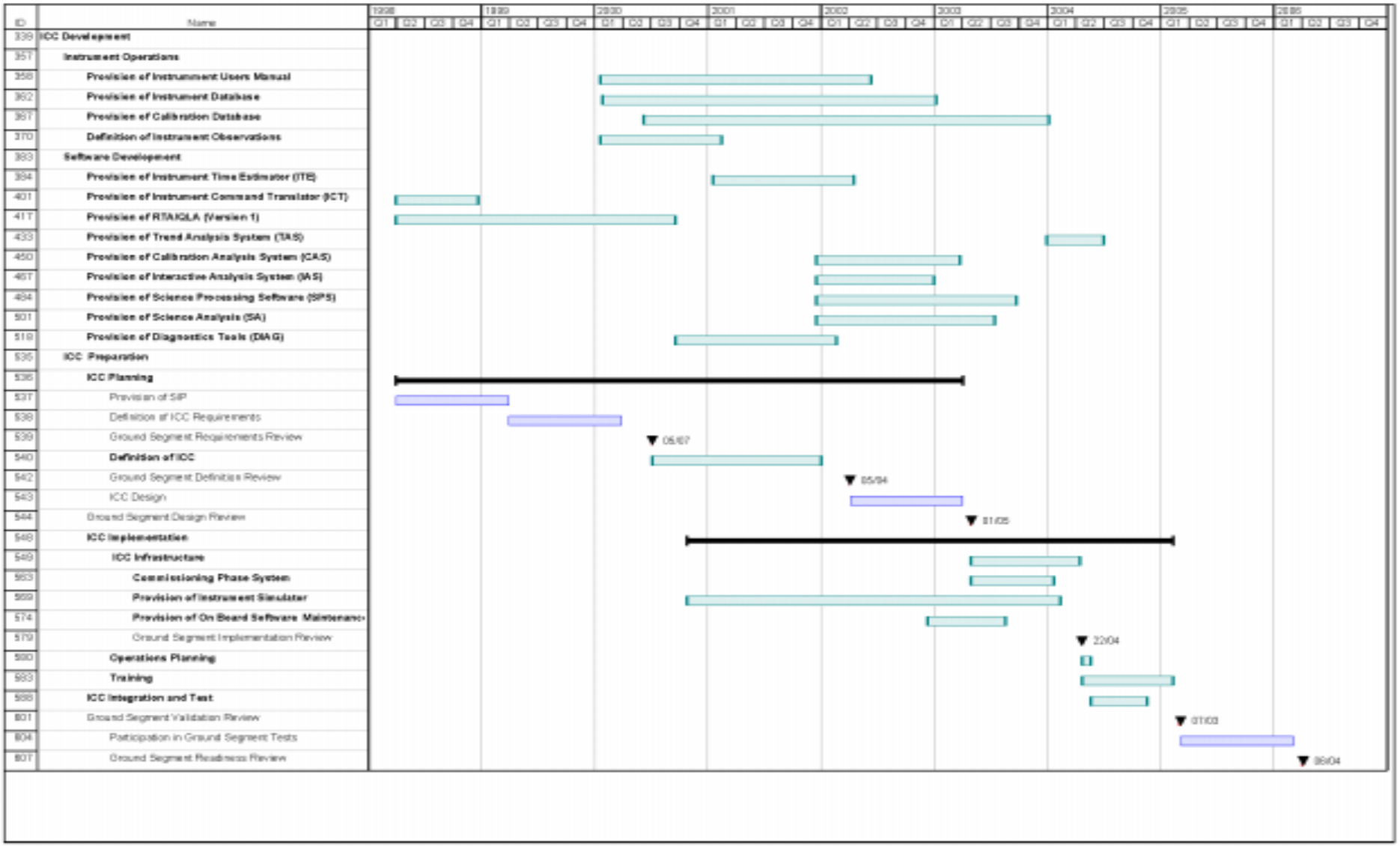
The Data Processing and Science Analysis Software centres will be responsible for the development and maintenance of the data processing and science analysis software systems.

Each will provide infrastructure and computing facilities for their expected staff, plus visitors, and will be linked via the internet (using ISDN, TBC) to the Operations Centre. They will also provide internet access for remote log-in by consortium members not located at a DAPSAS Centre to allow their participation in the software development and maintenance.

3.5 Management

The ICC management will be under the direction of an ICC Steering Group, chaired by the ICC Scientist, and comprising the PI, the Co-PI, the Project Scientists, the Instrument Scientist, the Systems Engineer and the managers of the ICC centres. It shall define the policies for ICC development and the tasks to be carried out by the two DAPSASCs. These policies will be implemented by the ICC Development Manager during the Development Phase and by the Operations Manager after the launch of FIRST.

3.5.1 Schedule



3.5.2 Resources

ICC Development (WBS 3)

WBS	Task Name	1998	1999	2000	2001	2002	2003	2004	2005	SY	Eqpmnt	SIRD Requirement(s)
											£K	
3.1	**Management**											
3.1.1	Support to Ground Segment Meetings	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	**0.80**		ICCF-030,035,MNGT-022,023
3.1.2	Conrol and Maintenance of ICC Schedule	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	**1.60**		ICCF-020,MNGT-024
3.1.3	Product/Quality Assurance	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	**1.20**		ICCF-180,185,190,PAQA-001,002,030,032,033
3.1.4	Team Setup and Management		0.02	0.02	0.05	0.05	0.40	0.80	1.00	**2.34**		ICCF-015,ICCO-005
3.2	**Instrument Operations**											
3.2.1	Provision of Instrument Users' Manual					0.25	0.50	0.50		**1.25**		ICF-090
3.2.2	Provision of Instrument Database			0.50	0.10	0.10	0.10	0.30	0.10	**1.20**		ICCF-050,070,085,160
3.2.3	Provision of Calibration Database		0.40	0.10	0.10	0.10	0.10	0.50	0.50	**1.80**		ICCF-135,140,145
3.2.4	Definition of Instrument Observations			0.35	0.55	0.95	1.10	1.20	0.65	**4.80**		ICCF-055,060,070,080
3.2.5	Definition of Operating Procedures					0.25	0.50	0.50	0.50	**1.75**		ICCF-065,095,100
3.3	**Software Development**											
3.3.1	Provision of Instrument Time Estimator			0.10	0.30	0.30	0.45	0.20	0.20	**1.55**		ICCF-105,PAQA-011
3.3.2	Provision of Instrument Command Translator	0.10	0.50	0.50	0.10	0.10	0.10	0.10	0.10	**1.60**		ICCF-110
3.3.3	Provision of RTA/QLA	0.30	1.00	1.00	0.50	0.50	0.50	0.50	1.00	**5.30**		ICCF-130,PAQA-011
3.3.4	Provision of Trend Analysis				0.25	0.25	0.10	0.10	0.10	**0.80**		ICCF-130,PAQA-011
3.3.5	Provision of Calibration Analysis		0.10	0.10	1.00	1.50	1.50	1.50	1.50	**7.20**		ICCF-130,PAQA-011
3.3.6	Provision of Interactive Analysis		0.25	0.25	1.00	1.00	1.00	1.00	1.00	**5.50**		
3.3.7	Provision of Science Processing Software				0.50	0.50	1.50	1.50	1.50	**5.50**		
3.3.8	Provision of Science Analysis Software					0.25	0.70	1.50	1.50	**3.95**		ICCF-130,PAQA-011
3.3.9	Provision of Diagnostic Tools			0.10	0.10	0.20	0.35	0.20	0.20	**1.15**		ICCF-130,PAQA-011
3.4	**ICC Preparation**											
3.4.1	ICC Planning	0.40	0.20	0.10	0.10	0.10	0.10	0.10	0.10	**1.20**		ICCF-005,010,025,040,PAQA-010,MNGT-010,011,025
3.4.2	Facilities											
3.4.2.1	Provision of ICC Infrastructure							0.10	0.10	**0.20**	70	ICCF-045
3.4.2.2	ICC Hardware		0.60	0.15	0.15	0.15	0.15	0.25	0.25	**1.70**	225	
3.4.2.3	Commissioning Phase System						0.20	0.20	0.25	**0.65**	10	ICCF-205
3.4.2.4	Provision of Instrument Simulator		0.20	0.20	0.40	1.50	0.50	0.25	0.25	**3.30**		ICCF-150
3.4.2.5	Provision of On Board Software Maintenance Facility						0.40	0.35	0.10	**0.85**	5	ICCF-155
3.4.3	Integration and Test						1.00	2.00	4.00	**7.00**		ICCF-195,200,PAQA-020,022,023,024,025,026
3.4.4	FINDAS Support		0.10	0.10	0.10	0.10	0.10	0.10	0.10	**0.70**		ICCF-120,125,175
3.4.5	Operations Planning				0.10	0.10	0.25	0.25	0.50	**1.20**		ICCF-115,165,170
3.4.6	Training							0.10	0.40	**0.50**		ICCO-005,010
	Totals	**1.25**	**3.82**	**4.02**	**5.85**	**8.70**	**12.05**	**14.55**	**16.35**	**66.59**	**310**	

ICC Operations (WBS 4)

WBS	Task Name	2006	2007	2008	2009	2010	SY	Eqpmnt	SIRD Requirement(s)
								£K	
4.1	**Management**								
4.1.1	Operations Management	1.00	1.00	1.00	1.00	1.00	**5.00**		MNGT-024
4.1.2	Product/Quality Assurance	0.70	0.70	0.70	0.70	0.70	**3.50**		PAQA-002,030
4.2	**Software Maintenance**								
4.2.1	OBS Maintenance	0.20	0.20	0.20	0.20	0.20	**1.00**		ICCO-020
4.2.2	ICC Software Maintenance	1.50	1.50	1.50	1.20	1.20	**6.90**		ICCO-080
4.2.3	Science Processing Software Maintenance	1.50	1.50	1.50	1.50	1.50	**7.50**		ICCO-065
4.2.4	Science Analysis Software Maintenance	0.50	0.50	0.50	0.50	0.50	**2.50**		ICCO-065
4.3	**ICC Operations**								
4.3.1	Support to MOC	1.00					**1.00**		ICCO-015
4.3.2	Support to FSC	0.30	0.30	0.30	0.30	0.30	**1.50**		ICCO-025
4.3.3	Health and Status Monitoring	1.20	1.20	1.00	1.00	1.00	**5.40**		ICCO-035
4.3.4	Performance Monitoring and Diagnostics	1.50	1.20	1.20	1.20	1.20	**6.30**		ICCO-040,045
4.3.5	Calibration	2.50	2.50	2.00	2.00	2.00	**11.00**		ICCO-050
4.3.6	Trend Analysis	0.50	0.50	0.50	0.50	0.50	**2.50**		ICCO-050
4.3.7	Science Quality Checking	1.00	1.00	1.00	1.00	1.00	**5.00**		ICCO-070
4.3.8	Performance Maintenance	0.25	0.25	0.25	0.25	0.25	**1.25**		ICCO-055,075
4.3.9	Ground Segment Interaction	0.50	0.50	0.50	0.50	0.50	**2.50**		ICCO-030,085
4.3.10	Parallel Mode Analysis	0.50	0.50	0.50	0.50	0.50	**2.50**		
4.3.11	Serendipity Mode Analysis	0.50	0.50	0.50	0.50	0.50	**2.50**		
4.3.12	Support to the Community	1.50	1.50	1.50	1.50	1.50	**7.50**		
4.3.13	Consortium Support to the ICC	2.00	2.00	2.00	2.00	2.00	**10.00**		ICCO-065,070
4.4	**Facilities maintenance**	1.00	1.00	1.00	1.00	1.00	**5.00**	70	ICCO-080
	Totals	**19.65**	**18.35**	**17.65**	**17.35**	**17.35**	**90.35**	**70**	