



SCUBA2 Data Reduction Software

Preliminary Design Review

Review Panel Report

Herzberg Institute of Astrophysics,
Victoria, September 24th, 2003

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Terms of Reference

The terms of reference of the review were defined as follows:

The purpose of the meeting is to review the preliminary design for the SCUBA-2 Data Reduction SW. The preliminary design review is intended to establish that all design requirements are defined, all major risks have been identified and development specifications (performance requirements and interfaces) have been produced for each sub-element of the Data Reduction SW before detailed design commences.

The review panel is asked to consider the following guidelines as a basis for the review:

1. Does the current Data Reduction SW design, as presented by the Project Team, comply with the relevant scientific and technical specifications?
2. Does the preliminary design address the required standards with respect to good engineering practices?
3. Are there any uncertainties in the preliminary design that need clarification before progress to detailed design can be made?
4. Are the relevant interfaces suitably identified and defined so as to minimise risk to the project?
5. Is the development and testing plan realistic to deliver a working data reduction SW ready for pipeline verification according to schedule?

Confirmation that the current design addresses the formal requirements and is sufficiently advanced to PDR stage is sought in order that the Project may proceed to the next stage of the SW development with confidence i.e. the detailed design can commence.

Documentation

The documentation provided for the SCUBA2 PDR is summarized in Table 1.

Table 1: SCUBA2 Data Reduction Preliminary Design Review Documentation

Section	Document title	Reference number
Introduction		
1.	Terms of reference for PDR	
Requirements		
2.	Data Reduction Software Requirements Document	SC2/SRE/S210/001 issue 1.21
Detailed design description		
3.	Data Acquisition/Data Reduction Pipeline Interface control Document	SC2/SOF/IC210/01 issue 1.18
4.	Pipeline Architecture	SC2/SOF/S210/001 issue 1.14
5.	SCUBA-2 Data Display System	SC2/SOF/S210/002 issue 1.20
6.	SCUBA-2 Data Simulation and Pipeline Testing	SC2/SOF/S210/003 issue 1.10
7.	SCUBA-2 Data Reduction Recipes and Primitives	SC2/SOF/S210/004 issue 1.14
Appendix 1: Supplementary requirements		
8.	Science Requirements for SCUBA-2	SC2/SRE/SC200/01

9.	Operational Concepts definition for	SCUBA-2 SC2/SRE/SC200/03
Appendix 2: Additional design documents		
8.	Software architectural design	SC2/ANA/S100/45
9.	SCUBA-2 Data Output	SC2/SOF/S200/007
10.	SCUBA-2 Data Acquisition to Data Processing Interface	SC2/SOF/S200/008
11.	SCUBA-2 data simulation.	SC2/SOF/S200/016
12.	Map making in different noise regimes.	SC2/ANA/S210/001
13.	Image processing and least-squares reconstructions.	SC2/SOF/S200/015
Appendix 4: Management documentation		
14.	SCUBA-2 Data Reduction SW Project Management Plan	SC2/SOF/PM210/01 issue 1.2
15.	SCUBA-2 Data Reduction SW Risk Assessment and Mitigation Plan	SC2/SOF/PM210/02 issue 1.1

Note: All documents are accessible through: <http://scuba2.jach.hawaii.edu/pdr.html>

Review Agenda

The review agenda was deliberately kept flexible so that sufficient time was spent on the areas of the review that were ultimately identified as needing the most attention. The approximate timetable that was ultimately adopted is given in Table 2, and reflects the areas of weakness identified by the reviewers in their pre-review comments. This resulted on an increased focus on requirements and management areas, at the expense of detailed review of the design.

Meeting Minutes

Detailed minutes were taken by the meeting secretary, Michael Peddle, and are included as Appendix A of this document.

Level of confidence in the design

This section outlines the basis on which confidence has been placed in the design.

The panel recognises that the project is complex and has both many external dependencies, and has to cope with unresolved technical issues outside of the team's control. In spite of this, the panel believes that the team has captured the essential elements of the design. However, some restructuring of the documents as well as additional information is required (see below).

Outstanding Actions from previous reviews

This section contains a record of any relevant outstanding actions from previous reviews.

None.

Table 2: SCUBA2 Data Reduction Software Preliminary Design Review Agenda

Date	Item
10-12 September 2003	Review documents made available to panel
19-23 September 2003	Panel and attendees provide written feedback on documents to chair
23 September 2003	13:00: SCUBA2 overview presentation (WSH)
	18:00: Chair provides summary of comments to project team.
24 September 2003	08:45: Coffee and pastries
	09:00: Introductory remarks
	09:10: Outline of SCUBA2 review process (WSH)
	09:20: Outline of SCUBA2 data acquisition system (BDK)
	10:00: Overview of data reduction requirements and expectations
	10:30: Break for coffee
	10:45: Detailed discussion of data reduction requirements
	12:30: Break for lunch
	13:00: Design review and discussion
	14:10: Management and Risk review and discussion
	15:15: Review panel's closed session
	16:40: Review panel's feedback to team

Recommendations on how to proceed

This section contains the review panels recommendations on how the design should be allowed to proceed to next stage.

1. delta PDR

The panel recommends that a delta PDR be held at date determined by the team with the agreement of the chair of the panel. The format of this review is TBD. In preparation for this review the team shall prepare:

- a) A new version of the requirements document showing: any additional requirements identified in the design documents and the review; separation of possible specifications into requirements, goals and items which are explicitly not addressed by the design. There should also be two compliance matrices for traceability. The first shows the source of each requirement, and the second shows, for each source, which requirements are relevant.
- b) A new document summarizing the design that, at a minimum, contains two compliance matrices. The first shows, for each requirement, which design elements (via a reference to the description of the design element in the design documents) satisfy each requirement. The second shows, for each design element, which requirements are addressed.
- c) A new version of the ICD document showing all interfaces.
- d) A new version of the risks document addressing:
 - Depth of personnel

- Location of work
 - Budget implications
 - Starlink support
- e) A new version of the management plan with:
- A list of tasks, showing derivation from design elements.
 - A management-level block diagram.
 - A list of external dependencies and dates.
 - A list of dependencies within the SCUBA2 DR project.
 - Resource allocations to tasks.
 - A Gantt chart summarizing all the above.
 - A true budget estimate based on the design.
 - Critical path analysis
2. It is the responsibility of the project manager to generate the project plan in consultation with the project team. The panel emphasises that the project manager has both the authority and the responsibility to ensure its successful execution.

Actions arising from the meeting

1. Team to prepare for a delta PDR covering the points raised in the previous section, to be conducted by videoconference between the panel and the team on 12 November 2003. The new documents should incorporate or address all the comments made both before and during the meeting and outlined in Appendix A.
2. The requirements document to refer to the source of each requirement.
3. The team needs to be explicit on the external requirements to and from other parts of the SCUBA2 project.
4. ATC and UBC to clarify which part of the SCUBA2 project is responsible for implementing dark frame subtraction.
5. ATC and JAC to discuss how pointing and the focus data frames will be generated.
6. Tim Jenness to write up a list outlining all the requirements of the pipeline (mostly deriving from ORACDR requirements).
7. Team to decide on whether there is a natural upper size to a mosaic.
8. Team to address a way to reduce the raw data file count, if possible.
9. Tim to clarify the use of the OBSMEM keyword.
10. Wayne to send Janos an example of block diagram.
11. UBC to purchase a Polycom Video over IP conferencing unit.

Recommendations for corrective actions

This section contains recommendations and reasons for corrective actions, if necessary.

None.

Members of review team and roles

The members of the review panel were:

1. Nick Rees (chair), Head of Software and Computer Services, Joint Astronomy Centre (n.rees@jach.hawaii.edu).
2. Séverin Gaudet, Project Manager/Software Engineer, Canadian Astronomical Data Centre (severin.gaudet@nrc-cnrc.gc.ca).
3. Kate Isaak Sub-mm scientist, Mullard Radio Astronomy Observatory (isaak@mrao.cam.ac.uk).

In addition, the panel invited the SCUBA2 project scientist, Wayne Holland, to act as a non-voting advisor.

Appendix A. Detailed Minutes of the Meeting

SCUBA 2 SOFTWARE PDR

Herzberg Institute of Astrophysics, Victoria, BC - September 24, 2003

Attendees: Brad Gom, Dennis Kelly, Douglas Scott, Frossie Economou, Gary Davis, Kate Isaak, Mike Fich, Nick Rees, Russell Redman, Séverin Gaudet, Janos Molnar, Tim Jenness, Michael Peddle, Dave Bohlender David Schade

A Note about the minutes:

To facilitate a more complete record of the meeting I have incorporated text from my notes, the list of pre-review comments and Nick's comments added to the pre-review comments. The rationale for this is to show context for the discussion and to include the comments recorded by Nick during the meeting. Here is a simple guide for the source within these minutes:

- These are from my notes taken during the meeting

Italicized text indicates text copied from the List of pre-review comments

- This bullet indicates Nick's comments in relation to the pre-review comments

Morning Session

Announcements and overview

- Nick congratulated the team on putting the necessary documentation together, especially given the distance between UBC and Hawaii
- Emphasized that the focus of the PDR and the main focus of this review is to make sure that the management plan is on the right path

Presentations

Wayne Holland

- Provided an overview of the SCUBA-2 project, timelines, financing, project development and staffing.
- Indicated that the JCMT Board is very supportive of the project
- Reviewed the design steps covered thus far
- SCUBA-2 CDR
- Optics PDR
- Systems Analysis PDR
- Detector Proof of Concept
- CFI funding approved June 2002 – money to arrive in 2003
- Confirmed PPARC funding and reviewed future project milestones
- Presented a summary of the instruments involved

- A short discussion on the number of sub array and the amount of pixel overlap is resolved with the idea that this will not be resolved until further development is undertaken.
- Doug Scott pointed out that, given the condensed timeframe of instrument Dennis Kelly reiterated that this is the reason for investigating a variety of modes. This will improve the chances of having a system that will work upon deployment.
- Development that we will not really know until the instrument is on the telescope.
- Nick summarized that, as all are aware, that this is a high-risk, high-reward endeavor
- Focused on the design of the data pipeline and emphasizing that the pipeline only transfers data – it does not manipulate data in any way

Dennis Kelly

- PowerPoint presentation on the data acquisition system

Requirements Document

- Séverin comments on the PDR Documents submitted.
- From this point forward the design should have an established scope
- Need to evaluate whether the design meets the requirements
- Current document makes the task difficult
- Cannot determine if the design meets the requirements
- Missing completeness and traceability (where does the requirement come from? [PDR, team, science documents])
- Important to show the traceability of design elements
- Makes the reviewers job easier and shows:
 - -that the team has met the requirements
 - shows where the requirements came from
 - concerned with the undefined parts of the design – this makes it difficult to determine whether you have met the task if you have nebulous tasks
 - e.g.: DA requirements – there should be explicit requirements – if it does not work, you know exactly where the problem is
- also important to note:
 - -attribution (where from)
 - -measurability (how measured)
- variety of sources and idea - use quantitative measures or if not available use best practices, however this needs to be documented clearly
- incumbent upon the team to suggest requirements and to point out any gaps in the requirements
- Nick noted that it is useful to have examples to work from and clear documentation (e.g.: tables clearly noting how each requirement is satisfied.) He noted that there were around 30 clear requirements from the Science Requirements document

ACTION: The requirements document to refer to the source of each requirement

- Dennis noted the difficulty in quantifying certain requirements (i.e.: ‘what is publication quality’?)

- Séverin responded that it is important to note these area of concern up front in order to either
 - reject this as a requirement
 - or indicate some indicator of measurement that can be used (e.g.: 90 % of observations result in publication in journals)
- Séverin also brought for the idea that it is very important to note which requirements are internal and which are external to the SW PDR

ACTION: The team needs to be explicit on the external requirements to and from other parts of the SCUBA2 project

- Nick directed the discussion towards the pre-review comments document
- Kate and Séverin brought forth their concerns with General Requirement 2. While the requirement is in the document, it is not explicitly stated what is required. Nick added that it is unclear who is writing the data acquisition system
- Tim said that Dennis and the ATC were writing up the software
- Séverin concluded that GR2 reflects a requirement to develop requirements and that this can be finalized in the future.

9. GR/MR. Presumably there is going to be some way in which users can put their own algorithms into the off-line pipeline? This is an important facility to have.

- Séverin inquired whether there was a specific requirement related to this comment.
- Russell suggested that, in agreement with Tim, that you do need to do this as part of the OIRAC DR

10. DR - need to be able to monitor FCFs, to include the last night's observing (Would also be extremely nice to be able to bring up calibration data for a given source to check variability...

- General agreement as noted by Nick and Doug Scott that the pipeline is a finite task that handles only one night's data.
- Séverin inquired where the requirement lies. Is it in DR-10 which suggests that "strip chart" would require the storage of data.
- Agreed that this lies outside the pipeline, but need a requirement that pipeline generates and stores this data
- The use of requirements and goals was suggested by Frossie, however Nick felt that while goals belong in the document, they are separate from requirements
- Doug stressed the importance of using explicit language
- PR2 and PR4 need to be rewritten as they are related according to Nick. Séverin added that PR needs to be quantified as in PR4

11. GR7. How is this (the publication quality) requirement to be measured?

- Some parameters can be quantified, but not all.
- Séverin noted that:
- GR8 – there are two requirements here.

12. GR9. It is not clear how this is a requirement on the SCUBA 2 DR. What does "can be found" mean - is it location data or is it location independent identified data?

- Frossie Economou noted the following:

- Found means selected. The first sentence of DR9 is actually a DA requirement. The rest is basically covered by the system being a closed, data driven system.

13. GR10. *It is not clear whether what system is doing the archiving. This requirement implies that it is the responsibility of the SCUBA-2 DR. In addition there seems to be several requirements here: one on header content and another on archiving SCUBA-2 DR products.*

- Tim noted that there is no archive requirement on the pipelines
- GR10 is not a DR requirement. There is a requirement on the DR to make processed data available, and an interface needs to be defined say what those data are (including header content of processed data).

14. GR11. *This requirement is puzzling. I can understand that it is necessary to draw boundaries in order to be able to design to a known context. But to make certain design decisions now could make the end result difficult to modify in the future is not an efficient use of the existing project resources. I think this requires further discussion. This also contradicts somewhat the statement in last paragraph of the "Responsibilities" section of the Project Management Plan document, page 4.*

- This is not a requirement. However, the requirements of the JCMT archive need to be clarified ASAP in case they add requirement upstream.

16. MR3-5. *Am I correct to interpret the use of the word "should" word in these 3 requirements as an indication that they are not mandatory requirements?*

- Correct. It is suggested that you use the terminology "requirements" and "goals".

17. *In the introduction to observing modes STARE and DREAM have standard jiggle patterns, not STARE and SCAN.*

- Correct

Also, in the next paragraph – who is responsible for dark frame subtraction (DA system or DR system)?

- It is not clear at this time who is responsible for dark frame subtraction. Needs to be made clear explicitly in the DA/DR interface. Preference is to do this in the DR. A dark needs to be a separate observation – this needs to be an explicit external requirement.

ACTION: ATC and UBC to clarify which part of the SCUBA2 project is responsible for implementing dark frame subtraction.

18. PR1. *Pointing and focus measurements, whilst not fed back to the DR system, should be able to be reduced by the DR system, so can be part of the loop.*

- This needs to be taken off line in discussions between ATC and JAC. Pointing and Focus is not a DR requirement.

ACTION: ATC and JAC to discuss how the pointing and focus data frames will be generated

19. PR4. *This is a complicated requirement and seems to be actually 3 requirements in one. There also needs to be a defined margins – 16 hours of data have to be reduced in < 16 hours. The comment about S/N being a flexible scheduling criteria needs to be thought about, in practice this is often difficult.*

- PR4 discussion focused on whether S/N issue is a requirement or goal. One option is to state that there is a requirement to display (strip chart), however the acquisition of S/N is not a software decision

- PR2 and PR4 need to be rewritten and clarified. The signal to noise sentence needs to be separately identified as a requirement (or goal) and also an additional requirement to generate catalogs as well as images.

21. *PR8. It is crucial to have warnings/flags regarding data quality, particularly as data mining is going to become more and more common. What the flags will be, will need to be discussed at some point later down the line - common flags for archives/VOs? (for example - we know where the telescope is pointing, and where the sun is, so could have a flag for SUN_ON_DISH? to warn dataminers of the possibility of a distorted dish). "Something bad is happening" is also far too vague for a requirement – be explicit - bad columns, noisy pixels.*

- Kate asked whether this information can flow back to the header. Tim felt it could in separate tables
- Bad observations are flagged by the OMP logging procedure. There must be an external interface that ensures that this information feeds back into the DR. There is also an internal requirement/interface to allow the DR to feedback into the database.

22. *PR12. Isn't this a design issue – why is in requirements.*

Frossie note that this is a boundary issue.

- This is really a design constraint so it is reasonable to state it up front.

23. *PR14. How do you quantify easily archived?*

Tim and Doug commented that the requirement should be modified as below:

- Maybe should say “generate images that can easily be used”.

24. *PR15/PR16 Should track pointing and focus offsets and display also?*

Tim noted that this is a display not a pipeline requirement.

- This should be a display requirement.

ACTION: Tim Jenness to write up a list outlining all the requirements of the pipeline (mostly deriving from ORACDR requirements).

25. *OR2 is actually 2 separate requirements.*

New Point Added

- OR3 is essentially a definition of data driven – does this mean it should be covered elsewhere?

26. *OR4 Is there a requirement on the maximum size of a mosaic. Are there problems which mean there are big problems beyond a certain size?*

- The consensus is that the data amount will be large (i.e.: SCAN map produces 125MB per ½ hour), however this is a hardware and not a software limit.
- Someone to think about this.

ACTION: Team to decide on whether there is a natural upper size to a mosaic.

27. *OR5. Are spectral index plots really a DR requirement?*

- No. This requirement should be implicit in the data products requirement.

28. *OR7 does this mean that the DR must handle multi-night data, or is this a science archive problem?*

- Frossie emphasized that this requirement has come from us and is not a requirement of the DR
- This is not a requirement on the DR. It [is] implicitly available from the data products.

New Points Added

- No external interface defined for source archive. [The] requirement [is] to be able to look up [the] catalog.
 - Need a requirement to be able to reduce moving targets.
29. *OR8 is not a requirement.*
- It would be good to have a section explicitly saying various things that have been thought about but will not do.
30. *DR8 How do you determine the noise – is it pixel variances, or is it image noise?*
- It should probably be both.
31. *XR3 describes implementation rather than a requirement. There are also 2 requirements here.*

New Points Added

- Need to add a few external requirements defining the FTS interface, and it should be in the ICD (which is probably just a reference to the ORACDR document). Should make clear that FTS SW is integrated into pipeline, but is provided externally. OTOH, it should be clear that polarimetry software is part of the DR package.
 - TR1 is really part of the management plan, not a technical requirement.
32. *Is TR2 a requirement on the DR to produce this simulator, or is it a requirement on ATC?*
- A cross package SCUBA2 simulation plan would be very useful – defining interfaces and products. There is an external requirement on the ATC SCUBA2 project is to provide the simulation package that generates simulated data to the DR work package.
33. *TR4 needs a lot of thought...*
- Séverin noted that the team will need to be clear on what are external requirements in this area
34. *Who is going to define the SCAN strategy – is it the DR project or the ATC.*
- It is a responsibility of the DR workpackage – the requirement for this should go in the observing modes... The external requirement from the TCS is that this pattern is simply parameterised (so it can be re-implemented).

New Point Added

- FTS should be added to acronyms.

The meeting broke for lunch

Afternoon Session

The group reconvened and Nick suggested that we spend an hour on design and then lay the floor open to discussion of the PDR document section by section.

DA/Pipeline ICD

- Tim began the discussion by noting that DA really refers to the DHS
 - Séverin brought forth his view that the DHS is for moving data through the system to the PI or an archive; essentially where you put your products.
2. *3600 files/hour in a single directory is a bit much... Possibly put each seconds worth of data in a monitored parameter, of have every observation in a separate directory.*

- Frossie asked the question whether this is workable. Séverin agreed that this is a concern. Nick noted that this was not a strong user requirement, however the team needs to look at this
- This is flagged as a concern and the team will address it.

ACTION: Team to address a way to reduce the raw data file count, if possible.

- The team discussed Section 4 of the DA/DR Pipeline ICD and the merits of the two options on how to make flat-field information available to the pipeline. It was agreed, as suggested by Nick, that at this point, the two options would remain open.

7. *Why can't the OBSMEM keyword be replaced by a rule saying that darks aren't members of the group?*

- There was some confusion here between the UKIRT and JCMT usage.

ACTION: Tim to clarify the use of the OBSMEM keyword.

8. *Doesn't the pipeline output somewhat contradict the requirement PR4?*

- Séverin questioned whether the FITS headers and CDR pipeline output required by DA was a contradiction to PR4. Frossie noted that this was not a software feedback loop but a human one.

New Points Added

- Need to mention the FTS DR interface via reference to ORACDR docs. Need to have a data output ICD – including catalog lists, as well as images.
- Details of the FITS headers will be defined well before CDR.
- It has to be obvious that flatfield and array setup data is being taken in engineering mode and feedback is via a human.

Pipeline Architecture

It was difficult to understand the need to specify the DRAMA messaging system for new developments. In reading the reference, I now understand where this decision comes from. But the proposal document contains recommendations. By what process did these recommendations become requirements? And if they are requirements, they should be listed in the requirements document.

- It is a JAC requirement that the DRAMA interface needs to be kept as simple as possible to allow porting to use different I/F software.
- Tim noted that the use of the DRAMA messaging system was related to the fact that it is a pre-existing system and that there is no obvious IRAF system.
- Séverin questioned the level of risk involved and whether this was a requirement and: if so, where does it come from.
- Tim acknowledged that there were risks involved and that they might be trading downstream flexibility, however Frossie pointed out that, from the JC end, this was not a concern.
- Séverin expanded on his concern about risk with the following general points on design:
 - It is difficult to pick out specific tasks from the ICD as it stands
 - What has to be done needs to be spelled out more clearly
 - What are the trade-offs for specific risks
 - It is important to give both options and rationales
 - There should be a high-level task list already prepared as it is difficult to pick this out from the documents

- In summary, this relates again to this issue of traceability. While ORACDR might be the baseline the team is working from, the way forward needs to have more clarity.

Data Reduction Recipes and Primitives

- Tim commented that they would rather simplify recipes and that they can have recipes that have parameters for primitives. Frossie added that the number of recipes has not grown significantly.

Data Display System

“It will be possible for the movie system to combine multiple data files into a single movie” sounds like a requirement.

- General consensus is that this should be a requirement.

4.1.2 mentions a prototype system. It is not mentioned anywhere else.

- Tim informed the team that the prototype system will be the first system he will write. Frossie added that they expect to see a prototype by the CDR and to have had some feedback. She further noted that she will need to see Tim’s work and some simulation data
- By “prototype” – all Tim meant was that is was the first system he writes, not anything too deep. However, it needs to be clarified in the management plan. There will have to be a prototype by CDR.

(Last paragraphs of section 5). How likely is it that SPLAT will be supported.

Both Gary and Frossie mentioned that they will assume the risk of supporting Starlink and that part of Starlink’s mandate is to support JAC.

- The risk of Starlink software (and, in this case, SPLAT in particular) not being supported in the future is a risk JAC will assume.

Section 6 – Strip Charts. The strip chart section of the requirements document is much simpler than this. Are all of these requirements - especially the last one?

- The strip chart requirements in the design document need to be fed back into the requirements document.

Data simulation and pipeline testing

This is not clear who has the responsibility for developing simulators and simulated data. Is it the DR team, or other groups? This should describe what the DR team is going to produce and how it is going to produce it – i.e. a decent plan, reflecting the interdependencies, rather than just throwing hands in the air and saying it is difficult to be explicit about schedule. The BDK documents are obviously very relevant.

- The responsibility for developing simulators, and the interdependencies, all needs to be in the project management plan.
- In response to Doug’s question about how explicit a test plan is required, Séverin replied that the main purpose of a test plan is to prove that you met the requirements. In fact, as the project moves forward, the test plan should refer back directly to the requirements.
- Tim added that it will be ATC who will provide the simulation software which will simulate the instrument. They will provide an astronomical sky and earth atmosphere simulation.
- Kate added that ALMA and VLA have done quite a bit of simulation work already.

- ALMA (Francois Viallefont fviallef@maat.obspm.fr) in Meudon has done a large amount of atmospheric simulation, and it may be useful to contact him.

Management Plan

The lack of a task based Gantt chart is puzzling. At this stage of the project, there should be at least a high level breakdown of tasks, with resources and time allocated. This then drives the budget or is at least verified against the budget. There are many external dependencies mentioned throughout the documents. These dependencies and their due dates must be identified in the project plan (Gantt chart) as milestones. Examples of these dependencies are: new functionality in external software packages, functionality in other SCUBA-2 systems, instrument characterization and understanding, etc.

- The fact that the FTS work should not delay the rest of the project, should also be explicitly acknowledged.
 - A block diagram showing system outline, management responsibilities and interfaces would be extremely useful.
 - The development of a requirements analysis document outlining the most important requirements
 - Should be a single diagram (similar to Dennis' chart from his presentation
 - Importance of putting the software development on a timeline which can show what you can and cannot do with the available resources and timeframes
 - Séverin noted that once it is on paper, it is easier to produce and receive feedback which can easily result in new iterations.

ACTION: Wayne to send Janos an example of block diagram.

- Nick noted that there is a need to create a GANTT chart and a need to generate a list of tasks
- Doug felt this process could begin tomorrow morning with their scheduled meeting and would include a list of deliverables by date
- Project dependencies and milestones should be clearly identified
- Gary noted that the FTS and polarameter are funded through CFI but will be managed as separate projects and that because the full SCUBA-2 project is not fully funded, it would be prudent to identify descope options
- Nick noted that the only salary put forth towards FTS is Brad's and that the dependencies are vague—it would be wise not to work on FTS under we are sure we are moving forward with it.
- Doug also added that FTS and polarimeter work must not delay other tasks
- Séverin also felt it important to report delays that might be caused by such external influences
- UBC must purchase a Polycom Video over IP conferencing unit.

ACTION: UBC to purchase a Polycom Video over IP conferencing unit.

New Points Added

- The list of deliverables and dates is an requirement of the management plan, including ATC early deliverables.
- List of possible descopes should be part of the plan.

Risks

- Nick began the discussion by pointing out that there are a number of critical person dependencies

- Doug added that this was worse with some of the work being done in the university sector
- Frossie felt that there was strength at JAC and that ORAC-DR was no longer dependent upon Tim. Gary added that JAC was contributing Tim's time on a "best efforts" basis. Risk #3 may be too low as so much is happening at JAC that he "might" need Tim. Gary, at this time, did not anticipate having to use Tim
- Wayne would like to bring in new staff as soon as possible
- Kate suggested 1.5 FTE's to be located at UBC rather than JAC
- Nick inquired whether they might be more useful at JAC and Tim replied that perhaps their 1st 3 months could be JAC then move them to UBC. Nick noted that this was the model ESO used for their software personnel
- Séverin emphasized the necessity of reporting if staffing levels are adequate to meet the requirements. Nick added that it should be clear if budgets are sufficient to carry out tasks.
- In summary,
 - There should be a cost/benefit analysis of whether it is better to locate personnel at UBC or in HI
 - The development of a high-level plan needs to be clear what to do if there is a shortage of funds: a)descope or b)ask for more funds
- Mike Fich noted that CFI does not allow for contingency funds, however they did put in upper estimates for costing.
- Tim expressed a concern that we could end up with essentially SCUBA-1 software that needs 2 more years of development once the instrument is ready
- Frossie stated that JAC would not undertake survey work without an adequate pipeline
- Mike indicated 3 other possible sources of funding:
 - Ops costs moved to software
 - An Ontario Government program
 - NSERC
- Gary asked if there is a risk on us if FTS is not developed in time for SCUBA-2. Tim responded that it would have a direct impact on the pipeline, however this is an external dependency.
- DR_SW8 suggest that FTS be taken out of this risk since it is part of the FTS project.

New Point Added

- What about the risks of distributed development?
 - Team members left the meeting at this point to allow the Review Panel to conduct a session in camera.
 - The meeting resumed at 1630 to hear the Review Panel's initial comments:

Summary from the Review Panel

- This project is a high risk, high reward venture
- The panel is satisfied that assemble team can move forward with this project
- The panel, however recommends that a delta PDR take place to address some of the concerns raised in today's session. These include:
 - The addition of GANTT charts, task lists, milestone, and a compliance matrix
 - This may be done within the existing document or a full rewrite may be considered. This is up to the members of the team

- A more detailed and written report will be sent out by the review team

The meeting was adjourned.

Appendix B. List of pre-review comments

These are all included, unattributed, but drew from comments and discussions with the members of the panel, the Director of the JAC (Gary Davis), and the SCUBA2 project scientist (Wayne Holland) before the review. Most were sent to the project team before the review started.

Review Agenda

After reading the review documents, we would like to focus equally on three areas – the requirements, the design and the management plan. Looking at the timescale, this implies about one hour for each area, with another hour for introduction, Dennis' presentation and coffee – starting at 9, and finishing at 1. We invite the team to keep their presentations fairly short (say about 15 minutes) leaving about 45 minutes for general discussion. Whilst this is all very short notice, we believe that structuring the review in this way will yield a maximum benefit to all.

Requirements document

The requirements document is the foundation of the design process. In standard software engineering practices, a requirement must be simple, unambiguous and measurable. Comments such as “should be carried out”; “need to be investigated” are not terms that should be in a requirements document. In addition, whether a requirement is mandatory versus desirable should also be stated. This then guides the design process. The design documents and interface documents should also refer design choices back to requirements. To allow a review committee to answer "Does the current DR SW design, as presented by the Project Team, comply with the relevant scientific and technical specifications?" they need to see a cross-referenced list of requirements to design elements. In addition, the test plan should indicate how each the team would go about testing to see if each requirement is met.

In my opinion the requirements are not complete nor well described. Requirements also show up in at least one design document. There is no cross-referenced list of requirements to design elements. There I cannot say whether the design is good or not.

Specific points:

1. Where is the cross-reference table to indicate which parts of the design satisfy which requirements and conversely, which requirements are satisfied by which parts of the design?
2. What is the measure by which a requirement will judged to have been met?
3. Are all requirements mandatory or are some desirable? (What are goals, and what are requirements?).
4. There is no clear flow-down from scientific requirements.
5. It is difficult to determine requirements when all major modes have such severe reservations.
6. No mention of JAC Basic Software Requirements

7. No mention of supported O/S's and CPU architectures.
8. GR2. My understanding from reading through later documentation is that the off-line reduction pipeline will be the SAME as the on-line one, with switches for flexibility. Why not state this explicitly?
9. GR/MR. Presumably there is going to be some way in which users can put their own algorithms into the off-line pipeline? This is an important facility to have.
10. DR - need to be able to monitor FCFs, to include the last night's observing (Would also be extremely nice to be able to bring up calibration data for a given source to check variability...)
11. GR7. How is this (the publication quality) requirement to be measured?
12. GR9. It is not clear how this is a requirement on the SCUBA 2 DR. What does "can be found" mean - is it location data or is it location independent identified data?
13. GR10. It is not clear whether what system is doing the archiving. This requirement implies that it is the responsibility of the SCUBA-2 DR. In addition there seems to be several requirements here: one on header content and another on archiving SCUBA-2 DR products.
14. GR11. This requirement is puzzling. I can understand that it is necessary to draw boundaries in order to be able to design to a known context. But to make certain design decisions now could make the end result difficult to modify in the future is not an efficient use of the existing project resources. I think this requires further discussion. This also contradicts somewhat the statement in last paragraph of the "Responsibilities" section of the Project Management Plan document, page 4.
15. MR2. Where do these algorithms come from - the Data Acquisition system? There should be a discussion in the design on how these algorithms will be shared.
16. MR3-5. Am I correct to interpret the use of the word "should" word in these 3 requirements as an indication that they are not mandatory requirements?
17. In the introduction to observing modes STARE and DREAM have standard jiggle patterns, not STARE and SCAN. Also, in the next paragraph - who is responsible for dark frame subtraction (DA system or DR system)?
18. PR1. Pointing and focus measurements, whilst not fed back to the DR system, should be able to be reduced by the DR system, so can be part of the loop.
19. PR4. This is a complicated requirement and seems to be actually 3 requirements in one. There also needs to be a defined margin - 16 hours of data have to be reduced in < 16 hours. The comment about S/N being a flexible scheduling criteria needs to be thought about, in practice this is often difficult.
20. PR7. This needs to be quantifiable - not just robustly and accurately.
21. PR8. It is *crucial* to have warnings/flags regarding data quality, particularly as data mining is going to become more and more common. What the flags will be, will need to be discussed at some point later down the line - common flags for archives/VOs? (for example - we know where the telescope is pointing, and where the sun is, so

could have a flag for SUN_ON_DISH? to warn dataminers of the possibility of a distorted dish). “Something bad is happening” is also far too vague for a requirement – be explicit - bad columns, noisy pixels.

22. PR12. Isn't this a design issue – why is it in requirements.
23. PR14. How do you quantify easily archived?
24. PR15/PR16 Should track pointing and focus offsets and display also?
25. OR2 is actually 2 separate requirements.
26. OR4 Is there a requirement on the maximum size of a mosaic. Are there problems which mean there are big problems beyond a certain size?
27. OR5. Are spectral index plots really a DR requirement?
28. OR7 does this mean that the DR must handle multi-night data, or is this a science archive problem?
29. OR8 is not a requirement.
30. DR8 How do you determine the noise – is it pixel variances, or is it image noise?
31. XR3 describes implementation rather than a requirement. There are also 2 requirements here.
32. Is TR2 a requirement on the DR to produce this simulator, or is it a requirement on ATC?
33. TR4 needs a lot of thought...

Who is going to define the SCAN strategy – is it the DR project or the ATC

DA/Pipeline ICD

1. FPGA data rate is now 20 kHz, not 5 kHz.
2. 3600 files/hour in a single directory is a bit much... Possibly put each second's worth of data in a monitored parameter, or have every observation in a separate directory.
3. If you want to collect data while turning around, we can define a separate observation area that handles this.
4. We need to allow simple asynchronous ending of sequences – so a sequence can “run until stopped” (by the TCS getting to the end of pattern).
5. There seems to be missing a Data Handling interface and an Archive interface.
6. How does the DR get the information on the number of sub-arrays? Can the DR adapt to a changing number of sub-arrays?
7. Why can't the OBSMEM keyword be replaced by a rule saying that darks aren't members of the group?
8. Doesn't the pipeline output somewhat contradict the requirement PR4?

9. The paragraphs in the pipeline output section discussing flat fields do not belong in this section. There are design issues relating to data handling, PI distribution and archiving.
10. FITS headers - There shouldn't be a TBD section in a final version of a document.
11. What is the tolerance on the array alignment before the idea of pixel coordinates needs to be dropped.
12. The DR will *have* to make use of data generated during array setup. Flat fielding will not be able to be generated from the nights data. The form of this data must be defined. However, the dark frame must be generated at the time of the observation, and so will be in the normal data flow.
13. Directories are /jcmtdata/raw/eng, not /jcmtdata/eng/raw. (... and the same for reduced directories).

Pipeline Architecture

It was difficult to understand the need to specify the DRAMA messaging system for new developments. In reading the reference, I now understand where this decision comes from. But the proposal document contains recommendations. By what process did these recommendations become requirements? And if they are requirements, they should be listed in the requirements document.

Is this stating that the project will undertake to develop a "C version" of Starlink HDX/NDX or is it a hope that such a version will be available? What are the risks? What is the requirement for it?

What are the consequences of limiting the ability to change the number of sub-arrays to editing a configuration file? Is it a limitation? Is it a design decision?

It sounds like one will have to maintain 2 -3 recipes that may be similar. Is this true? Can recipes not have flags to allow different parts to be executed?

Data Reduction Recipes and Primitives

The aside about shutter position being available in the data file should be explicit in the ICD.

3.12 - Is this a requirement that the instrument be shut down in an orderly manner while taking diagnostic frames. This point occurs neither in the pipeline document nor in the interface document.

Data Display System

3.

"It will be possible for the movie system to combine multiple data files into a single movie" sounds like a requirement.

Should the OpenDX decision already be made?

4.

There is no reference back to Section 6 of the requirements document. Are these new requirements or re-worded requirements?

The reference back to requirements in the last paragraph of section 4 is good but is it complete? Does GAIA provide all the required functionality?

4.1.2 mentions a prototype system. It is not mentioned anywhere else.

I do not understand the comment “We do not know how to apply the flat-field correction”. Surely it is just like all other flat-fields – it is a multiplication by a gain or, possibly, a polynomial correction for non-linearities. Do you mean “We do not know how to determine the sky subtraction” or “we do not know how to determine the flat field to be used in the flat field correction”? On the other hand, it is good to visually draw attention to gaps in the understanding of the problem like this. It is much better for the project for issues like this to be explicit rather than implicit by lack of description.

(Last paragraphs of section 5). How likely is it that SPLAT will be supported. Is there a requirement to do handle all display issues except FTS cubes? Is this the proposed solution? Can this be done?

Section 6 – Strip Charts. The strip chart section of the requirements document is much simpler than this. Are all of these requirements - especially the last one?

Data simulation and pipeline testing

This is not clear who has the responsibility for developing simulators and simulated data. Is it the DR team, or other groups? This should describe what the DR team is going to produce and how it is going to produce it – i.e. a decent plan, reflecting the interdependencies, rather than just throwing hands in the air and saying it is difficult to be explicit about schedule. The BDK documents are obviously very relevant.

This has to be the most sticky section of the document-pack. It is clear that *extensive* testing with simulated data will be required (on the critical path cf. what is said in the risk assessment/mitigation document)

How are the tests going to be made? What will be used as metrics to define successful data recovery.

I would like to flag this document and talk through the team's plans thoroughly. We need to question the team very carefully about the whole process - it is not going to be easy to realise. There is going to have to be very close interplay between the software group and the hardware

Management Plan

The lack of a task based Gantt chart is puzzling. At this stage of the project, there should be at least a high level breakdown of tasks, with resources and time allocated. This then drives the budget or is at least verified against the budget. There are many external dependencies mentioned throughout the documents. These dependencies and their due dates must be identified in the project plan (Gantt chart) as milestones. Examples of these dependencies are: new functionality in external software packages, functionality in other SCUBA-2 systems, instrument characterization and understanding, etc.

A block diagram showing system outline, management responsibilities and interfaces would be extremely useful.

Given that there are so many unknowns on how to process the data, it would be prudent to clearly identify all the components which are well understood so that they can be designed and developed independently of the instrument characterisation. This is especially true of the processing infrastructure (the system that executes recipes, provides for display, etc.) In other words, concentrate on understanding what you can do and plan for it well. For the other parts, create a time budget as one creates error budgets for instruments. The system is an implementor of other people's decisions on how to process and therefore must minimize the risks on the timing and scope of those decisions.

This is not a management plan. The review dates are plucked out of the air. There is no evidence they can be met. A list of tasks is needed, at a minimum.

Other general comments:

1. I would like to see a Gantt chart with tasks, estimated effort and assigned resources. This should include external dependencies.
2. Without 1 above, it is difficult to assess if the budget or the timeline are realistic.
3. The project needs to organise the work such that the design and development of well understood parts of the system can go ahead without waiting for external dependencies.
4. Is the distributed nature of the team was satisfactory? How do team members feel about this? It does not seem to be sufficient to integrate new team members and to encourage serendipitous discussions that are always important within a team environment.
5. There is an interface to the Data Reductions systems for the FTS and the Polarimeter. Whilst this is an interface to be defined, not an external interface that must be obeyed, this interface should still be identified.
6. In a similar vein, there are no interfaces acknowledged to the archive.

Risks

I think that the project is underestimating DR_SW/1 and DR_SW/2. What is the status of search for people to fill these two posts?

DR_SW/1. Owner should be DS, and date risk passed should be Dec 2003, not Dec 2004.

DR_SW/2 is crucial in terms of Tim. He and Frossie are pulled in many many other directions. There are undoubtedly others who fall into the same category. The cost to the software side of the project if either of these two people suffer from "burn-out" I would have thought would be significant. In this instance "mitigating action" proposed shouldn't really be referred to as such, rather included as good project practise with costs included in the overall project budget.

DR_SW/3 "...who lacks the above combination of skill sets might..." - no might, emphatically will. Also the date risk is passed should be after acceptance, and possible after commissioning – not Dec 2004.

DR_SW4/DR_SW5/DR_SW6 -- to be discussed after data taking modes have been explained in detail. No mention, apart from DR SW/6 SCAN matrix inversion, of risks arising from all the unresolved algorithm issues that surround all the observing modes not panning out. (i.e. Flat fields not being of sufficient accuracy, DREAM not working etc).

No mention of the risks of dependency on external software packages

Does JAC or UBC have the depth of personnel to be able to replace key members of the team if necessary? Is the probability of losing key staff really only a low level one (probability =1)?

What about the risk of Starlink software (or any other dependent software) not being supported in the future?

Appendix C. SCUBA2 Software Requirements from FPR

These are, I believe, the most relevant requirements from the SCUBA2 FPR.

- 67. FPR 3.6.3 Algorithms and software need to be developed for processing of engineering data
- 68. FPR 4.1 The observing efficiency (on-source time) target is $> 75\%$
- 69. FPR 4.2.1.1 SCUBA-2 should be capable of simple 'point-and-shoot' observations
- 70. FPR 4.2.1.2 The rms noise in an observation should integrate down with the square-root of the integration time for at least a period of 1 hour
- 71. FPR 4.2.1.3 Investigations must be carried out into alternatives for a stare-observing mode
- 72. FPR 4.2.2 Stare maps should be capable of being mosaiced to produce seamless images
- 73. FPR 4.2.3.1 Micro-stepping, using the secondary mirror, is needed to obtain fully-sampled images at 450m
- 74. FPR 4.2.3.2 Algorithms must be developed to cope with bad pixel groups and seams between the sub-arrays
- 75. FPR 4.3.1 SCUBA-2 must be capable of carrying out wide-field surveys >100 times faster than SCUBA to the same signal-to-noise
- 76. FPR 4.3.2 A series of optimum scan angles are required for survey scans
- 77. FPR 4.4 Serendipity mode should have negligible impact on the efficiency of "normal" observing programmes.
- 78. FPR 4.5.1 SCUBA-2 should be capable of carrying out skydips between airmasses 1 and 4
- 79. FPR 4.5.2 SCUBA-2 will need to carry out regular measurements during daytime periods using the flat-field source
- 81. FPR 4.6.1 Absolute photometric accuracy required is 15 and 10%, with a goal of <10 and $<5\%$ at 450 and 850m respectively.
- 82. FPR 4.6.2 Relative photometric accuracy required is 10 and 5%, with a goal of <10 and $<5\%$ at 450 and 850m respectively.
- 83. FPR 4.7 SCUBA-2 will require a pointing and focussing observing mode
- 92. FPR 5.2.2 Algorithms and software need to be developed to process astronomical frames
- 93. FPR 5.2.3 A data reduction pipeline for processing astronomical images, in near real-time, needs to be developed
- 94. FPR 5.2.4 Disk storage should be sufficient to handle a data rate of 200 frames/sec
- 95. FPR 5.2.5 SCUBA-2 must have a user-friendly computer interface
- 97. FPR 5.2.7 Recipes and software are required for the offline re-processing of images
- 98. FPR 5.2.8 Astronomers must have the necessary software tools to perform analyses on their SCUBA-2 data
- 99. FPR 6.1 SCUBA-2 will be delivered with documentation sufficient for effective operation, troubleshooting and maintenance