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WFCAM SOFTWARE FINAL REVIEW

Date: Monday 21 & 22 October 2002

Location: UK ATC, Edinburgh – Conference Centre

Present:	**External Reviews**		
	Nigel Dipper	Durham	ND
	Luc Simard	CADC	LS
	UK ATC		
	David Clark	Chair	DC
	David Atkinson	[part]	DA
	Alan Bridger		AB
	Mark Casali		MMC
	Martin Folger		MF
	Ken Laidlaw	[part]	KL
	Stewart McLay		SMcL
	Alan Pickup		AP
	Vicki Ramsay		VR
	Andy Vick		AJV
	JAC		
	Frossie Economu		FE
	Paul Hirst		PH
	Tim Jenness		TJ
	Nick Rees		NR
	Other Institutes		
	Steve Warren	UKIDSS	SW
	Mike Irwin	CASU	MI
	Jim Lewis	CASU	JL
	Simon Hodgkin	CASU	SH
	Nigel Hambly	WFAU [part]	NH
	Andy Lawrence	WFAU [part]	AL
	Ian Bond	WFAU [part]	
	Perdur Williams	WFAU [part]	PW
	Jim Emerson	Queen Mary [part]	JE

1. INTRODUCTION

DC gave a short introduction to describe how this review would be run. The main question is 'does this design meet the requirement' and includes 'what are the risks'. This meeting should identify risks, but should not be used to resolve them. He also stated that this meeting may be inclined to discuss VISTA items, but these will be noted and discussed outside this WFCAM review.

2. MECHANISMS & CRYOSTAT

The main issues for mechanical software and cryogenic services software were identified in SMcL's slide show to start discussions.

Input & output records (interface for selecting filter) are described in doc 5.2d001S. NR wished to know what the interference mechanisms were; AJV replied that it may occur that you can hit metal on glass, but Dave Montgomery is still to complete full

3D model. AJV went on to describe how these mechanisms work and how the 'step out' would work.

ND queried what happens with missed steps and NR stated that he felt there is not enough feedback from the system in this area. It was agreed that during use you can't tell positions, but these can be reset between each use. Encoders were not felt reliable enough to use and 'dead reckoning' is a better method. The filter mechanism that is currently being tested in the lab has proved to be reliable.

NR wished to know if switching off of datum switches was possible. This is not possible due to electronics interlocking system.

Action 1MMC to check that electronics interlocking 'plug' is fitted externally. [by end Nov]

Jumpers being used to select datum switch. NR stated datum switch selecton should be by an external switch.

Action 2AJV to speak with Electronics Group regarding alternative to jumpers for selecting datum switches. [by end Nov]

It was noted that it can take up to 20 mins to step all filter paddles back in place when at a worst case of all six being out of datum. A typical datum would take well under a minute.

Action 3SMcL to change mechanical digital output to analogue (EPICS records), as advised by NR. [by end Nov]

NR will forward JAC's output procedures to SMcL.

LS queried filter ID going into header and it was explained that this will be shown as a unique filter name and can be identified.

PH queried lack of filter between array and sky during day. However, tests on engineering device show that stellar flux is so out of focus to be negligible. Persistence of daytime light effect on WFCAM would take a few exposure cycles to clear but would not damage array.

NR asked whether the sequencing get so simple that S&L is not required? No, similar to UIST and is required.
NR noted motor control record not used at UKIRT presently. Reason for difference in WFCAM was discussed and accepted.
Temperature control was discussed. This currently does not have software connection and is simply set once and left.

Action 4KL/SMcL to look at temperature control linking to controllable software and monitoring. [by end Nov]

PH stated that, with input records, it would be beneficial to have datum then blank option.

Action 5AJV to speak to Engineering Group regarding 'datum then blank' filter option. [by end Nov]

NR stated that, historically, JAC have not used test scripts and may not use those provided with WFCAM. AJV stated these would be delivered and JAC can make the decision whether to use this or not.

3. AUTOGUIDER SOFTWARE

SMcL gave a short summary of the software that will be provided (SDSU controller based on Ultracam Realtime, but using VX Works). Main requirement is providing CAPI which JAC software expects.

With regards to control of rate of how chip is read out, NR wished to know if there was any way to change this readout speed and also speed of reverse clock. AJV replied JAC would have to rely on ATC to ensure system is cleared properly with respect to reverse clock. With regards to V & H clocks, DA will have to spend time optimising CCD to provide required latency and does not see a problem with adding JAC's requirements.

Action 6SMcL to add ability to change AG clocking readout speed (interactivity). (Re–establish items 20/21, section 5.2.2 in 5.2 d 002S)

Action 7MMC to add requirement for full array readout (AG) and also verify why 'in position' limit switch is needed in design.

NR asked if there were a flag to say AG is stopped by controller. MMC stated there is fallback that when science detectors are read out the AG can be switched off.

NR could add callback to API that could be called in AG is off to flag this.
Proposed Action: SMcL & NR to agree system to callback in AG (eg SMcL may alter software to take into account NR's callback sub–routine).

Note: this action was revisited later (for other reasons) and the action has been removed – the original idea (returning blank frames when the AG is switched off) was felt to be more useful to JAC.

With regards to Readout Performance, DA stated they had reached 75% duty cycle at worst case for readout (approx 6 ms using vertical clock of
3 Microsecs and horizontal of 0.8 Microsec). Should be able to improve on this with new, faster clocks. E2V stated science grade device has readout of 4 electrons. Clock swings have been reduced without affecting noise, and can transfer 1600 electrons and full well of 40%.

Guidestar acquisition was discussed. This will be identified in a later review. Martin Folger is writing requirements for Guidestar acquisition.

CASU representatives joined the meeting at this point.

4. UKIRT AG AND TCS MODIFICATIONS

NR presented a slide show, as a summary of his documentation.
This shows that either (a) the telescope meets the required requirements or (b) other areas cause the telescope to meet the requirements. He also showed the WFCAM specific requirements.

NR has a concern over the AG dynamic range that he will discuss with WFCAM team outside of this review.

The TCS block diagram was described and how this changes when WFCAM is installed. Presentation also covered proposed focussing and it was confirmed that focus method would take optical images.

AP asked if all the focus measurements would be classed as a single measurement

Action 8 Decide whether focus should be taken in optical (ie with AG) or in IR. (MMC/NR by end of Feb 03)

Action 9 Labelling and AG Data reduction pipeline to be discussed within separate meeting (who is processing and who will get info, what are the requirements of output. (MMC icw NR/AP)

Offset and microstepping with secondary were discussed. NR has put forward three proposals, including tilting the secondary to track the guide star and then putting back on AG to take up tilt in secondary (no more than 10 arc seconds) and bring all back in line.

MMC asked about the possibility of changing AG return speed (from current of 40Hz). NR stated it is JAC that set this guide frequency at operator level to suit image and there is no problem to them to change the speed.

The effects of differential atmospheric diffraction were queried. NR stated that this can be recalculated on each exposure (quantized in steps of .25 arc seconds).

5. SCIENCE ARRAY CONTROL SOFTWARE

AJV gave a summary presentation of the camera control system.

NR was unsure where XML file shown within the appendix fitted into the system. AJV replied this is what goes between the camera sequence and the rest of the system. This was felt to me of more detail than required and will probably be at a higher level in the final version.
At observation level, you can define your limiters and these would be the areas of this XML application that would run. The full requirements of this cannot be defined until after array testing. This is expected in January at which point electronics will be tied down to the system from that point.

NR stated there were no estimates of interfaces and felt they should be defined at least approximately at this stage. AJV replied that this development will be taking place from now until the array testing occurs. AP expressed his believe that this is an acceptable way to run this and should cause no problems.

Action 10 With respect to software interfaces, AJV to document what is known, what are the requirements at this stage and what are the risks of these changing following array tests. [end of Nov]

Action 11AJV to add linear look–up table to Science Array Control Software document.

TJ asked if frames stored rose from 2 bytes per pixel to 4 bytes per pixel, would memory would be sufficient. AJV stated this would be 128k when ATC commonly use 512k so, yes, memory would be sufficient.

It was confirmed that exposure rate is optimised at a minimum of 5 seconds. A quicker exposure is possible, but will not be efficient and cannot be maintained.

The quickest exposure actually possibly is .65 seconds, but the optimum gap is between is 5 seconds.

Movie mode was discussed, and displaying this is not believed to be a problem by either JAC or ATC. However, the actual use of movie mode was queried other than during commissioning. NR also requested that each array display points north in movie mode.

6. SEQUENCING AND DATA HANDLING

AP presented system diagram of sequencing and data handling (as contained within his document).

To clarify DHSPool, AP described the heading definition tool. This system diagram was described and discussed in detail.

It was explained that during movie mode a series of exposure are taken but not saved.

Configuration file was raised. This will be simpler than the UIST file, which is preferable to JAC.

Action 12NR requested that five line configuration table be documented (AP by end of Jan).

AP wished to raise logging. Log will hold when only when the observation starts and when it is said to have stopped (when obs–end is entered).

NR queried what happened if SDSU controller were removed – could simulation be run? AJV replied there was no reason the system could not be configured to do this but would cause extra workload.
NR raised this as a formal request and stated this would be helpful for JAC and they would prefer to have this.

Action 13AJV to advise NR of extra workload required to configure system to test sequencing and DH software without SDSU controller in place.
Action 14AJV to look at worth of testing system in this way (following completion of Action 14 and icw JAC).

LS wished to warn ATC that data store is not a simple hardware issue and may require some software input.

Action 15AP to identify where DS requirement 5.13 originated as it no longer appears relevant and may be able to be removed. [Jan 03]

7. OBSERVING WITH WFCAM - OMP AND OCS MODS

Frossie displayed a 'road map of UKIRT observing' and explained that the only area in this that can be changed without affect other telescopes and systems is the translator. She then went on to discussion section 2.1.2 of her document (requirements that require further clarification).

"Good quality flat field" requirement – FE was not aware of this previously and wishes this to be clarified. MMC stated it relates to calibration procedures and will be discussed later in this review.

"Observations taken automatically" requirement is vague – taken from which level? FE stated that this has differing connotations for UKIRT depending on the level the observations is to be taken at. If no intervention is required between slews then up to a half hour of automatic work could be done with WFCAM, the level above this returns a list of options and would need intervention to carry on work. This level can be automated but Frossie does not recommend this and stated it would take some non–trivial work from JAC, but as there are always two people actually at the telescope there is no real reason to have this level of automation.

LS & SW stated that automation is better and a calibration program should be set up.

It was decided that the route to take was a low level of automation with a level of human input working to set out guidelines. This could be used for the first year until calibrations required are ascertained and then the situation can be revisited. Automatic Guidestar acquisition is still accepted as a requirement.

SW raised the possibility of building a scheduling simulator, but conceded that this may fall to UKIDSS to create as JAC do not have the effort for this. Either way, UKIDSS must provide scheduling constraints to JAC for observing.

Action 16 Steve Warren to look at a 'weighting' system for MSB's at observing and provide this to JAC. [June 03]

Action 17 Steve Warren to look at policies for observing priorities & rankings (eg PATT v UKIDSS and who can override observations). [following UKIRT board @ end Dec]

Following detector tests and meeting will be held to discuss how to implement observations (JAC/UKIDSS/ATC).

8. WFCAM OBSERVATION PREP AND SELECTION

Slide show summarising document was presented.

–– Observation Preparation: WFCAM is more simple that other instruments (Michelle & UIST)
–– Survey Definition: New requirements so more difficult that obs prep.

The observation screens were shown, and there are envisaged to be some modifications to these which will not take place until further along the project after various tests have taken place.

There were no issues raised specifically under observations preparation.

MMC raised the matter of flags to be used (Guidestar or telescope decoders to be used, and whether automatic or fixed exposure to be used), neither of these are within the documentation.
Fixed/optimised exposures where described and discussed and generally felt to be useful, although the method for this will require some work and will probably be via an engineering screen which AP would design.

Action 18 To specify what is possible in regards to optimised exposures and what would be required. MMC icw CASU/JAC/UKIDSS [following array tests, Feb 03]

Action 19 Document required to define readout modes (MMC).

SW raised dithering and it was explained that these could be set completely arbitrarily for each MSB as required and this is already within the UKIRT system.

There was a request for the survey definition tool to allow the tile of the arrays to be moved manually. It was explained that the tile grid can move in anyway as long as there are guidestars within it. It was further explained that the survey selection tool is an offline tool and can work out full pointings required when given two corners for a rectangle of sky.

Action 20MMC to find out the effect of the moon on guidestar selection. [end of Nov]

TJ asked if there was a requirement for skys to be generated as real skys?

Action 21MF to add option of flagging 'sky' to headers of tools. These areas would also require to be autoguided. [end of Nov]

PH raised WFCAM working when one or more of the arrays stop working. Is there a follow up requirement to re–tile if this happens? There is the ability to regenerate the tiles in another pattern, but this would not be automated. Anything further would be done only if an array were to fail.

Action 22MF to allow tiles the ability to fill areas assuming one of the arrays fails to work. [end of Nov]
Action 23MMC to add ability to re–tile if array fails as a requirement. [end of Nov]

MF took on board the ability to look at surveys that have already taken place and to ensure that enough past pointing information is saved.

9. DATA REDUCTION PIPELINE

Jim Lewis presented a summary of the documentation provide, including data flow diagram.

CASU's impression of the pipeline was described. They will also catalogue at the summit as well as a Cambridge. Both sets will be compared to ensure the results are the same.

CASU have a number of concerns:

1. FITS headers (esp who is defining them)
   Action 24 Paul Hirst nominated to find out what is happening with FITS headers (who is defining them, what they should contain etc) and also with regards to grouping arrangement for data products. [end Nov]
2. Flat Fielding and how this is done. Once lab results are in, meeting will take place to discuss this matter further and define this area.
   Action 25 Simulations for flat fielding to be investigated (MMC).
3. Bad Pixels & bad rows: Can't be determined until after array tests, but information will be sent to CASU as soon as possible to discuss further.
4. Dark correction: Effect may not actually be noticeable, so will have to be revisited after detector results.
5. Image retention & cross talk: These will be on final system at some level but, again, cannot be ascertained until later in the project.

A numbers of these items cannot be settled until early next year, and another meeting will take place then to further discuss these.

ATC will provide CASU with array detector test information as soon as possible to ascertain what can be dealt with in data reduction and what needs to be looked at further.

LS stated that, on pipeline architecture, grouping criteria should be thought about carefully as it cannot be changed. He also stated that with regards to messaging system, it would be difficult to correct things in headers so, in his experience, this was put into database.

CASU currently do not have Validation agents and these and will be examined manually. CASU will be keeping historical data from this for their own use.

SW asked if there is an action to identify data points? Also, there is no timescale on these actions so is a schedule of work required?

Action 26CASU to provide document to identify data points and the output of the data pipeline. icw UKIDSS, WFAU etc.

UKIDSS working group will have request for data products from basic pipeline by 25 Nov and the data products definition document to be agreed by January with UKIDSS and WFAU (CASU will also attend this meeting).

Hardware and storage issues will be defined at a separate review to take place early next year.

10. WFCAM ARCHIVE AND ARCHIVE PROCESSING

Nigel Hambly started by saying that document in pack shows that development in archive are not as developed as other software, but this is expected as a number of matters cannot be agreed until further along project lifetime.

WFAU are working towards solution to data volume problem of WFCAM output and the grant application which went out recently for next four years includes WFCAM requirements. Archive will not be a simple repository but an archive where you can 'do' your science using specific database functions.

FE expressed concern that 12 months before delivery there is no architecture on software design for this. Document provided was not at CDR level. There was also no milestone for an external review on project plan in this area.

Action 27NH to add software CDR for archiving to his project plan.

LS stated that, from experience, he worries about the timeframes for the on-line data services that are planned believes a one year timescale for this level of analysis is very optimistic. It may be best to focus on getting the pixel order correct in pipeline first before working on advanced queries.

Action 28NH to provide work breakdown of what must be produced before delivery and what would be the scale up. (cannot take place until other information has been provided but will be part of CDR documentation).

With regards to detailed requirements, AJV asked how much of this had been signed off. NH replied that this is in process and should be complete by the end of the year and will be fixed from this point (only changeable via change request).

Ian Bond presented a "use case" overview of how the archive system would be used and also UML data models.

It is expected that this whole program will not be re-written but will more likely be a program that does much of what is required and is simply 'tweaked' to suite WFCAM.

It was discovered that there are a few issues that have not been strictly documented but it is accepted that WFAU have taken account of these within their design.

11. AOB

NR stated a lot of work has been done towards this review and he had found the review to be very beneficial (had never held specific software CDRs on other instruments before).

He thanked externals and chair for input.

NR finished by adding that WFCAM approach is better than any other instrument and should be a good instrument. Should save trouble down the line.

12. SUMMARY OF ACTIONS