Scan (and Frame) Pipeline Processing Flow: Instrumental Calibration

Version 1.5 (6 / 02 / 2008), F. Masci

1. Introduction

This document gives an overview of single frame processing, with particular emphasis on *instrumental image calibration*. This is defined as correcting the raw, "level-0" frames for instrumental signatures to generate calibrated, "level-1A" frames for use downstream. This excludes distortion correction in pixel space since there are plans to do this implicitly when re-projecting onto an up-sampled mosaic grid. An attempt is also made to accommodate this sub-system into an overall infrastructure. For details on overall processing, see the *WISE Science Data System Functional Design* document:
http://web.ipac.caltech.edu/staff/roc/wise/docs/WSDS_FDD_v1.pdf

2. Definitions and Assumptions

- **Frame:** image from a single stare pertaining to one WISE band: W1 – W4. Dimensions are 1024^2 for W1 – W3 and 512^2 for W4. These are referenced using some "frame index", probably tied to their location on the sky. We envisage there being five types of frames in the WSDS:
    i. level-0: raw frames as generated by ingest and archived for eternity. These are inputs for the instrumental calibration pipeline;
    ii. level-1A: after all instrumental calibration steps that lead to a modification of raw pixel values (but retaining distortion) have been performed;
    iii. level-1B: essentially the level-1A pixel data, but including photometric zero-points and a refined WCS in their headers. This follows from the first pass of single-frame source extraction, band-merging and pointing refinement. These frames will be inputs for the multi-frame coadder.
    iv. level-2A: same as ii but corrected for distortion (hence interpolated) in their native pixel coordinates. These are an intermediate product to support processing.
    v. level-2B: same as iii but corrected for distortion (hence interpolated) in their native pixel coordinates. These will facilitate QA and backtrack stacking analyses.

- **Scan:** basic unit of *N* frames, typically spanning half an orbit from N-pole—to—S-pole. This bisects the ecliptic equator and provides a natural unit from which calibrations can be generated in automated processing. In other words, variations from zodiacal gradients can be cancelled out (e.g., for *sky flats* and maybe *sky-offsets* if instrumental signatures are stable enough over such timescales). A scan is referenced using a "scan index". Every frame will therefore have an associated scan index.

- **On-orbit calibrations:** in the context of this document, these are for correcting instrumental-artifacts (*flats, sky-offset corrections, refined hot/dead pixel status, other?*). These will *not* always be generated using frames from single half-orbit scans. There may be a further sub-division, or, omission of frames that depend on the timing of transients, e.g., anneals and SAA recovery. Further filtering will also be necessary to exclude frames affected by unforeseen phenomena, e.g., bright objects and latents. If the detectors are stable enough, calibrations may also be constructed from multiple scans. On-orbit performance monitoring will tell us how to better fine-tune frame-calibration intervals. This will comprise the bulk of our preparation for 2nd pass (post-flight) processing. Prior to final reprocessing, all on-orbit calibrations will have been vetted by a QA process.

- **Calibration matching:** In the early phases of 1st pass processing, most calibrations will come from the ground. On-orbit calibrations will be created on an experimental basis and for performance monitoring. We may start with half-orbit scans as the basic unit, and then reprocess subsets of the science data to

find optimum windows. In general, if no *immediate* on-orbit calibrations from earlier scans can be "matched" to a scan of science data (e.g., due to highly unstable detectors), then they should default to ground based characterizations. Waiting for calibration products to be generated and then applied to the same scans in 1st pass processing puts an unnecessary lag in the system. It's important to keep in mind there will be a 2nd pass before which every scan is expected to be appropriately "calibration matched". Each on-orbit calibration product will be tagged with the scan index (or range of scan indices) from which it was created. This will facilitate frame-to-calibration matching and tracking.

3. General Scan-Pipeline Philosophy

Below we give an overview of the highly TBD scan/frame processing infrastructure. Specific Instrumental Calibration steps are described in Section 4.

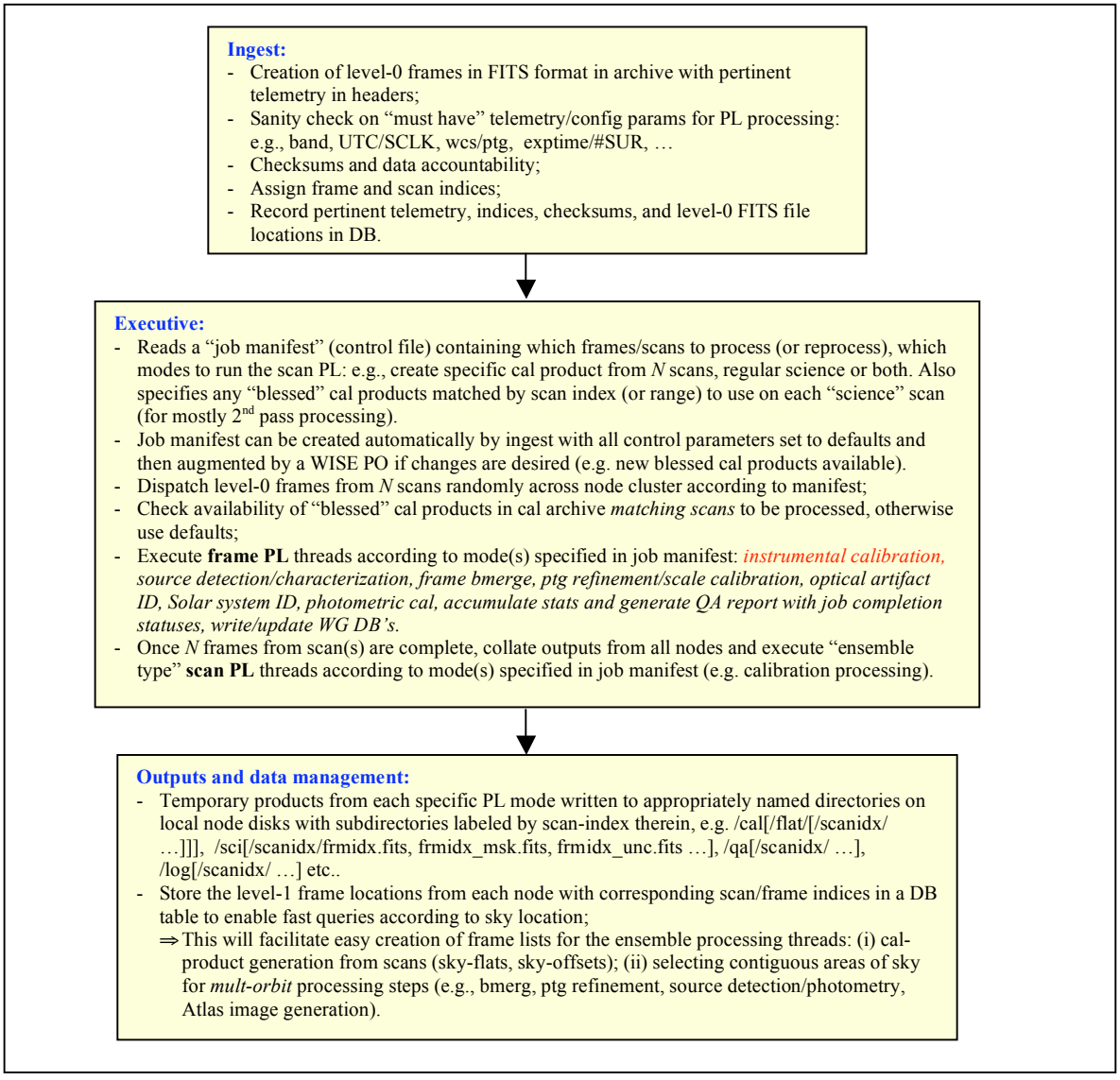

Figure 1: overall (scan/frame) processing flow

4. Instrumental Calibration

For more details on each planned step (module), see:
http://web.ipac.caltech.edu/staff/fmasci/home/wise/SingleOrbit_Cal.html