Landsat 7 Processing System CDR

Agenda

• Introduction	J. Henegar
• Design Overview	R. Schweiss T. Aslam
• LPS Hardware Architecture	C. Brambora
• LPS Operational Scenarios	R. Schweiss
• SWCI Detailed Design	J. Hosler D. Crehan
• System Testing	J. Henegar
• Acceptance Testing	EDC
• Facilities	EDC
• Conclusion	J. Henegar

Landsat 7 Processing System CDR

Studies Since PDR

Trade Studies

- Moving Window Display

Prototypes

- Moving Window Display
- Simultaneous Capabilities
- Raw Data Capture and Playback
- WRS Scene Algorithm

Technical Studies

- Data Quality Histogram
- Scene Accuracy
- Electronic Contact Schedules
- ACCA
- Partial Scenes
- Scene Corners

See Backup slides for a complete list.

Trade Studies

- Moving Window Display
  - **Objective**: Evaluate alternative implementations of the Moving Window Display
  - **Status**: Complete
  - **Results**:

    Four options were identified and studied:

    - **Option 1A, a software only solution, displays the multi band browse image on a scene basis during the Level 0R processing of the format 1 data only**
    - **Option 1B, a software only solution also, displays both format 1 and format 2 data concurrent with the Level 0R processing.**
    - **Option 2 utilizes added COTS hardware and displays the image in Real-Time**
    - **Option 3 utilizes added COTS hardware and displays the image post capture from the raw band files**

  Option 1B was selected because it is less costly the options 2 and 3 and more flexible then option 1.

  Total Cost: 1000DSI

See Backup slides for more details.

Prototypes Status and Results

- Simultaneous Capabilities
  - **Objective**: Determine the feasibility of simultaneous data capture, data transfer to the LP DAAC, and Level 0R Processing
  - **Status**: In Progress

- Raw Data Capture and Playback
  - **Objective**: Exercise NASA I/O Card's Receive and Playback capabilities
  - **Status**: Complete
  - **Results**:

Data Record	**82Mbps**
Data Playback	**80Mbps**

Prototypes Status and Results (cont.)

- Moving Window Display
  - **Objective:** Simulate a MWD to demonstrate the feasibilityof implementation and illuminate any derived requirements
  - **Status:** Complete
  - **Results:**
    - » Indy WS may need additional memory
    - » Display may pause between scenes
    - » Data compression is required to permit two MWD displays on one terminal

Technical Studies

- Data Quality Histogram
  - **Objective:** Assess Impacts of Generating Histogram-based WRS Scene Radiance Statistics on the LPS Design.
  - **Status:** Closed -- Pending Further Direction from Project
  - **Results:**
    - » **LPS Software Impact is Approximately 800 DSIs**
    - » **Hardware Impacts: Potential Increase in Memory Requirements**
- Scene Accuracy
  - **Objective:** Determine interpolation accuracy and benchmark WRS Algorithm for WRS Scene Center Accuracy
  - **Status:** Complete
  - **Results:**

Corrections Applied	WRS Center Accuracy
None	372 Meters
Time Coefficients Only	22 Meters
SLP Ephemeris & Time Coefficients (w/ 4 Points for Interpolation)	~ 15 Meters

  - Recommendation: Modify Scene Center Accuracy Requirement to 30 Meters (Equivalent to Nominal Spectral Band Pixel Size)

Technical Studies (cont.)

- Electronic Contact Schedules
  - **Objective:** Determine optimal manner to acquire L7 Contact schedules electrically
  - **Status:** Open
  - **Results:** Preliminary results indicate that acquiring schedules from the LGS is the least impact solution.
- ACCA
  - **Objective:** Improve Existing Automatic Cloud Cover Assessment Algorithm
  - **Status:** Completed by SSAI with support from the LPS.
  - **Results:**
    - » A Better ACCA Algorithm is possible
    - » LPS must perform Radiometric Corrections on the data
- Partial Scenes
  - **Objective:** Determine feasibility of producing metadata for partial scenes
  - **Status:** Open

Technical Studies (cont.)

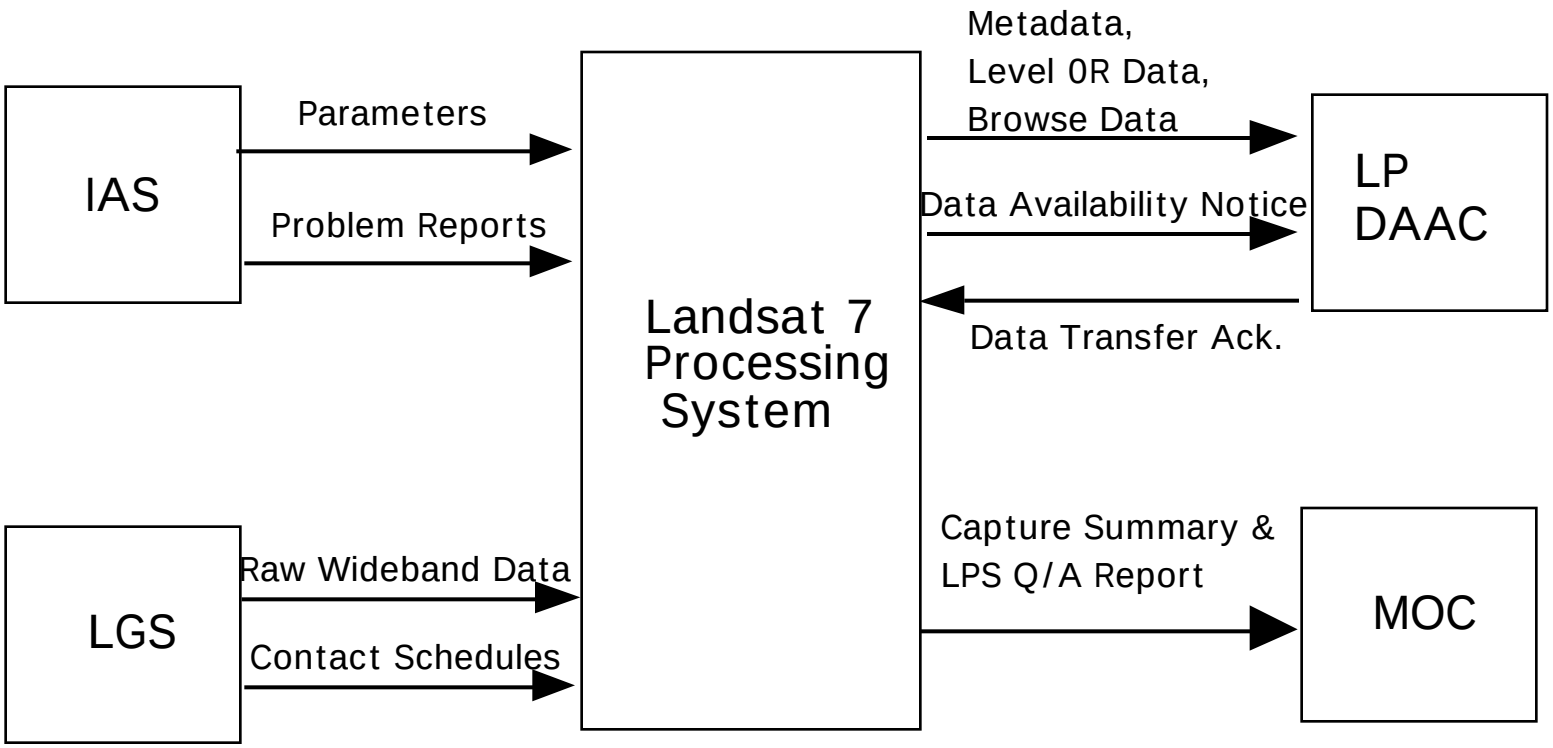
- Scene Corners
  - **Objective:** Determine an approach for identifying Nominal WRS Scene Corners
  - **Status:** In Progress
  - **Results:**
    - » Nominal WRS Scene Corners are not included in the Nominal WRS Scene Centers Identification Table
    - » Developed a preliminary algorithm for computing Nominal WRS Scene Corners and used EDC supplied software for computing WRS Scene Corners

Plans:

- » Modify Algorithm to Generate a Table of Nominal WRS Scene Corners
- » Validate Nominal Scene Corner Table

Landsat 7 Processing System CDR

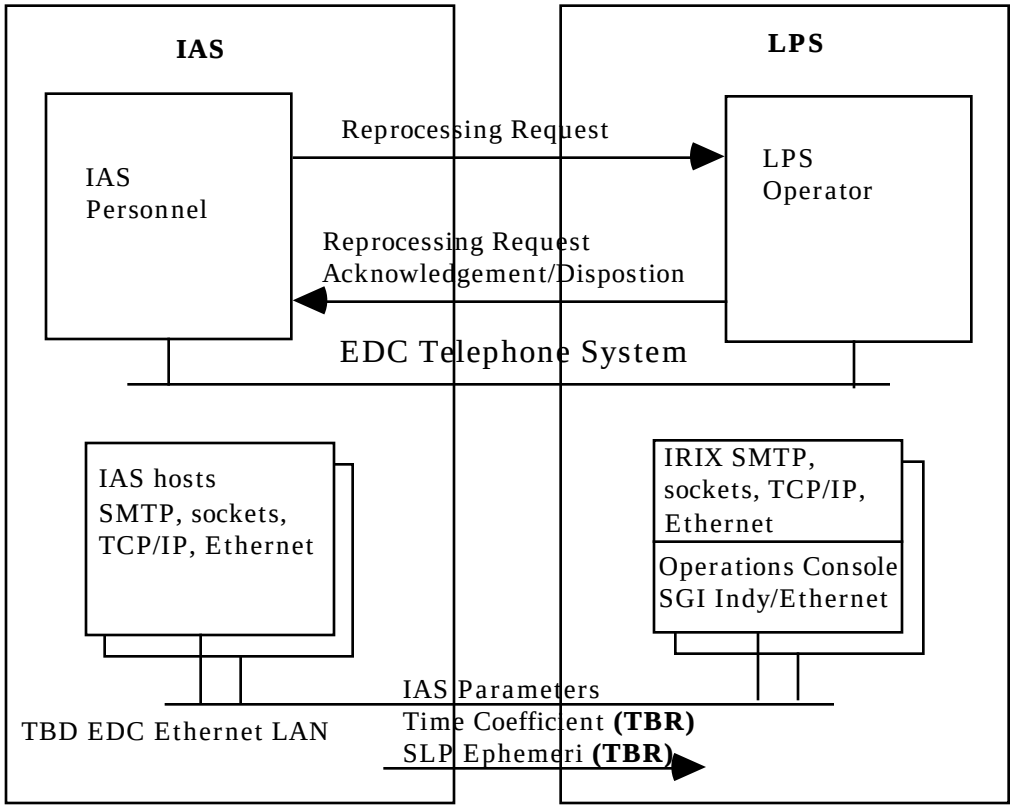
LPS Context Diagram



LPS External Interfaces

- LGS
  - » Receive Contact Period Schedules
  - » Coordinate with LGS to capture raw wideband data on contact basis
  - » Receive raw wideband data at 75 Mbps on four physical channels
- MOC
  - » Provide data receive summary report
  - » Provide non-nominal return link quality statistics
- LP DAAC
  - » Notify LP DAAC of data availability
  - » Receive Data Delivery Notice from the LP DAAC

Landsat 7 Processing System CDR



- IAS
  - » Receive Parameters for sensor alignment and scene identification
  - » Receive anomalous image quality statistics
  - » Receive Reprocessing Requests

Landsat 7 Processing System CDR

Product or Information Name -->	IAS Parameter File	Time Coefficient File (TBR)	SLP Ephemeris File (TBR)	Re-Processing Request	Re-Processing Request Disposition
From -> To Orgn.	IAS-to-LPS	IAS-to-LPS	IAS-to-LPS	IAS - LPS	IAS - LPS
Description / Purpose	Supplies Landsat processing parameters	Supplies UT1-UTC time differences for GHA calculations in WRS Scene Identification	Supplies nutation corrections for GHA calculations in WRS Scene Identification	Requests reprocessing of a Landsat 7 contact period	Advises IAS on the disposition of a reprocessing request
Mission Phase	All	All	All	All	All
Accuracy/ Completeness	Each version of the file contains complete set of parameters	Values maintained in FDF supplied format	Values maintained in FDF supplied format	Includes Contact period identification (from LPS Metadata)	Includes Contact period identification (from LPS metadata) and disposition
Delivery Schedule	Every 3 months (nominal)	Once per year (Nominal)	Once per year (Nominal)	One per day	One per day
Time Span	One week past Receip from IAS till replaced with the new one (nominal 3 months)	One Year	One Year	Not Applicable	Not Applicable
Transmission Medium/Protocol	File Transfer Protocol (FTP)	FTP	FTP	Voice / Paper	Voice /Paper
Volume Estimate	1 MBytes (with 100% overhead)	16 KBytes	5.8 MB	Not Applicable	Not Applicable

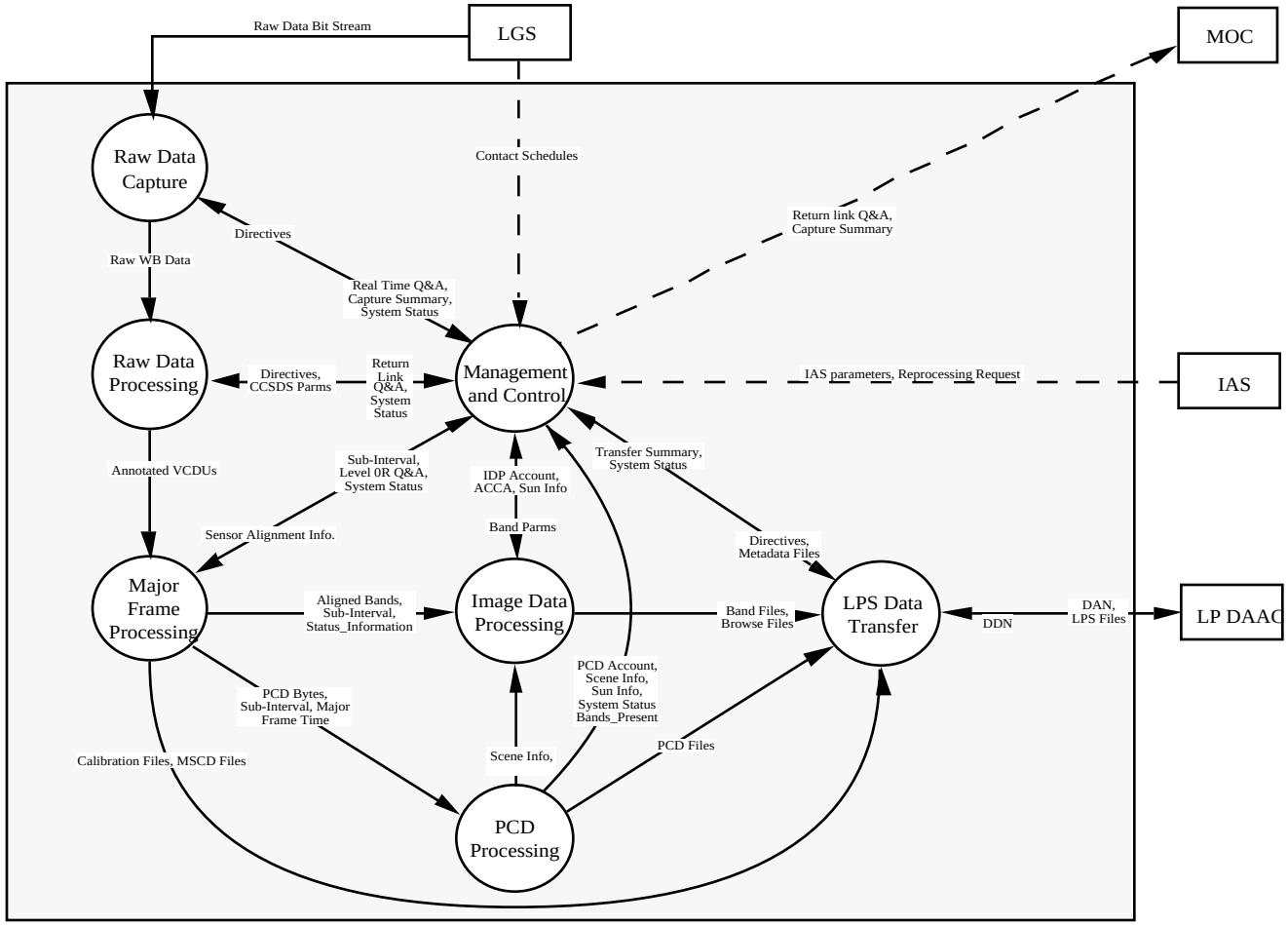
Interface Issues

- Receipt of Electronic Schedules from LGS or MOC

- IAS-LPS Interface details for receiving Time Coefficients file (required by LPS for meeting WRS Scene determination Accuracy)

Landsat 7 Processing System CDR

Level 0 DFD and System Element Functions



Landsat 7 Processing System CDR

System Element Functions

- Raw Data Capture Subsystem (RDCS)
  - Receive and record raw wideband data from LGS
  - Manage LPS 30 Day archive
  - Generate raw data capture summary and tape labels
  - Playback raw raw wideband data for testing
- Raw Data Processing Subsystem (RDPS)
  - Perform CCSDS Grade 3 Service
  - Perform BCH Error Detection and Correction
  - Generate quality and accounting information
- Major Frame Processing Subsystem (MFPS)
  - Process ETM+ major frames
  - Extract Payload Correction Data bytes and status information
  - Generate Mirror Scan Correction Data files and Calibration files
  - Determine Subintervals
  - Deinterleave/Reverse and Align bands
  - Generate Level 0R quality and accounting information

Landsat 7 Processing System CDR

System Element Functions (cont.)

- Payload Correction Data Processing Subsystem (PCDS)
  - Extract PCD Data
  - Determine scene identification
  - Produce PCD file
  - Produce PCD accounting information
- Image Data Processing Subsystem (IDPS)
  - Generate Browse Files
  - Generate Band Files
  - Produce Automatic Cloud Cover Assessment
  - Produce browse, band and cloud cover accounting information
  - Moving Window Display
- Management and Control Subsystem (MACS)
  - Control and Mange LPS top level process
  - Support LPS User Interface
  - Generate LPS metadata file
  - Generate LPS Level 0R Quality and Accounting Reports
  - Manage System start and shutdown

Landsat 7 Processing System CDR

System Element Functions (cont.)

- LPS Data Transfer Subsystem (LDTS)
  - Coordinate LPS file transfer to the LP DAAC
  - Provide network and communication support
  - Manages LPS output data store
  - Provide transfer summary information

Landsat 7 Processing System CDR

Major System Design Issues:

- None

Backup Slides

Landsat 7 Processing System CDR

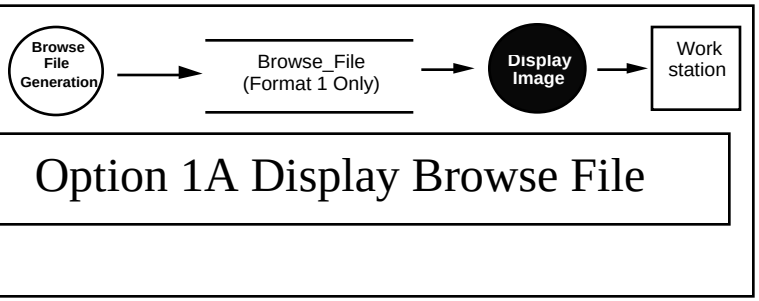
Complete list Studies to date

Basis of LPS System Design

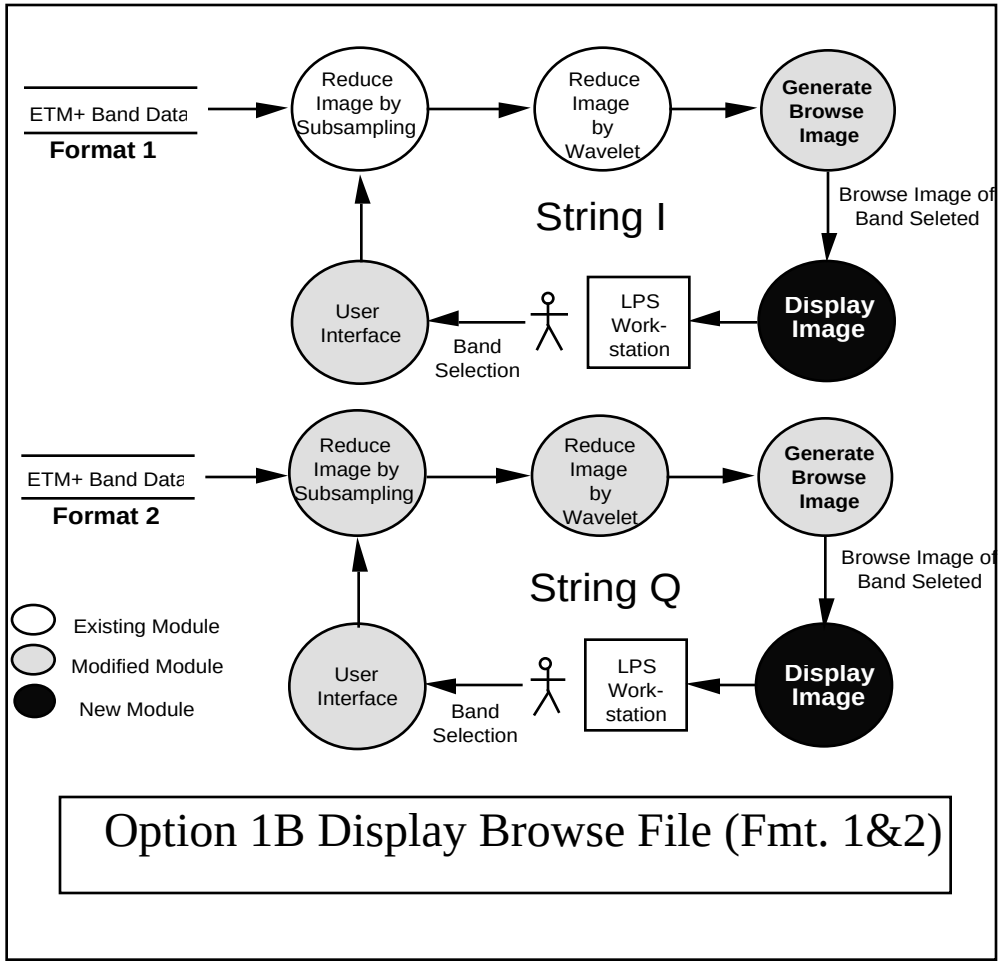
- Trade Studies
  - Raw Data Capture
  - Front-end
  - Compute processor
  - LPS Console
  - Back-End
  - Distributed vs. Centralized
  - Moving Window Display
- Prototype Studies
  - CCSDS Processing
  - BCH Error Detection and Correction
  - Band deinterleave
  - ETM+ major Frame Processing
  - Cloud Cover Assessment
  - Browse Generation
  - Raw Data Capture and Playback
  - Moving Window Display
  - Data Quality Histogram
  - Simultaneous Capabilities
- Technical Studies
  - RMA Analysis
  - Workload and Traffic (Sizing) Analysis
  - Performance (Response/Latency) Analysis
  - Operations
  - WRS Scene Identification
  - Sun Azimuth and Elevation Angle Determination
  - HDF Study
  - Re-use Analysis
  - LPS Testability Analysis
  - Data Quality Histogram

Landsat 7 Processing System CDR

Moving Window Trade Study



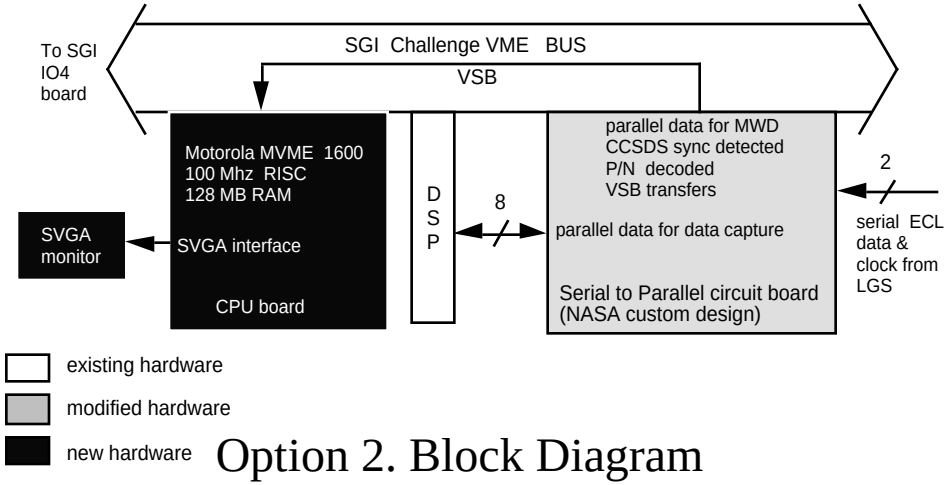
•MWD is derived from the browse images generated during Level 0R processing for format 1 data.



•Option 1B: The MWD is derived from a browse file process that is active during Level 0R processing, but is dedicated for the MWD on both the I and Q strings (Format 1 and 2).

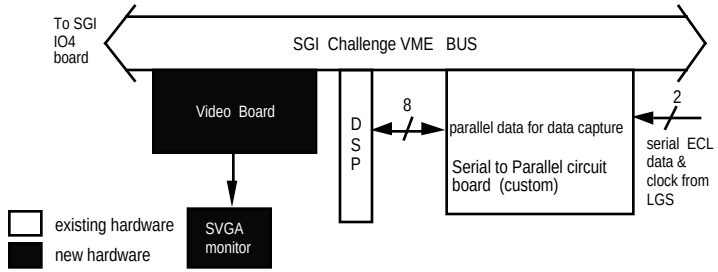
Landsat 7 Processing System CDR

Moving Window Trade Study (cont.)



Option 2. Block Diagram

- Displays MWD During data capture
- Utilizes a Hardware Approach.
- The MWD image is produced from the raw data during data capture. It is processed by COTS and custom hardware and displayed on a monitor.



Option 3. H/W Block Diagram

- Displays MWD Prior to Level 0R processing.
- Utilizes a Hardware Approach.
- The MWD image is produced from raw data on the RAID and displayed on a monitor using COTS VME graphics board.

Landsat 7 Processing System CDR

Moving Window Trade Study (cont.)

Advantages	Disadvantages
Option 1 A + Least software development + Visual QA of the Level 0R data during processing is available + Uses existing hardware	Option 1A - Increase CPU load (< 1%) - Some LAN impact - Slower image updates - Format 1 only - More screen real estate
Option 1 B + Visual QA of the Level 0R data during processing is available + Uses existing hardware + Both formats can be viewed	Option 1 B - More software development than Option 1A - More CPU load than 1A - Some LAN impact - Slower image updates - Requires more screen real estate
Option 2 + Provides display at real time rates + LAN loading is avoided + Software developed for LPS is modified and reused + Processing timeline not impacted	Option 2 - Higher cost then options 1 and 3 - Replays not available - MWD image is not Level 0R quality - Not representative of what is going to the DAAC
Option 3 + Faster display than Option 1A and 1B + Replays are readily available + Scenes from previous passes can be loaded and viewed more conveniently + LAN loading is avoided + Software developed for LPS is modified and reused	Option 3 - Higher cost then option 1 - Visual QA of the Level 0R data during processing is not available hence not representative of what is going to the LP DAAC - The processing timeline will be impacted - MWD image is not Level 0R quality

LPS Output File Formats

LPS Output Data Files

A. Level 0R Files

- Band Files
  - Bands 1 - 6 (Format 1 Data)
  - Bands 6 - 8 (Format 2 Data)

- Mirror Scan Correction Data (MSCD)
- Payload Correction Data (PCD)
- Calibration Data

B. Metadata

C. Multibrowse Scene

Landsat 7 Processing System CDR

LPS Output File Formats - Summary

LPS File	ETM+ Format		Contents	HDF Structure
• Band 1 - 5 Image Data	1		Binary	Swath / SDS
• Band 6 Image Data	1		Binary	Swath / SDS
• Band 6 Image Data		2	Binary	Swath / SDS
• Band 7 & 8 Image Data		2	Binary	
• Mirror Scan Correction Data	1	2	Mixed	Vdata
• Payload Correction Data	1	2	Mixed	Vdata
• Calibration Data	1	2	Binary	Swath / SDS
• Metadata	1	2	ASCII Text	P=V (PVL)
- Subinterval Metadata	1	2		
- WRS Scene Metadata	1	2		
- ACCA Results	1	None		
- Level 0R Q&A	1	2		
• Browse Image Data (Band Sequential Orgn.)	1	None	Binary	RIS24

LPS File Naming Convention

File Name: L7XsssfnYYDOYHHuuv.xxx where:

L7 indicates the Landsat 7 mission
X = Landsat 7 X-bands 1, 2 or 3
sss Identifies a Landsat 7 ground station (e.g., sss = EDC)

f indicates ETM+ data format:
f = 1 for Format 1 data
f = 2 for Format 2 data
n indicates LPS processor number (1-9)

YYDOYHH: indicates Landsat 7 contact period receive date and time:
YY = Last two digit of year associated with a contact period
DOY = day of year (001 through 366) associated with contact period
HH = hour of the contact period within a 24 hour day (00-23)

uu indicates a Sub-interval number within this contact period (00- 99)
v indicates data set version number:
v = 0 For original / First time processed data
v = 1 - 9 for reprocessed data.

LPS File Naming Convention (Contd.)

File Name: L7XsssfnYYDOYHHuuv.xxx where:

xxx indicates the LPS File type:

xxx = Bis for band files where:

B indicates a "Band File",

i indicates Band IDs 1 - 7" for image bands 1 - 7, and
"P" for the Panchromatic Band 8

s indicates file segment number
s = 0 for "one segment file only",
s = 1 - 4 for Pan Band file segments

xxx = MSD for an MSCD file
xxx = PCD for a PCD file
xxx = CAL for a Calibration File
xxx = MTA for a Metadata File
xxx = Rnn for Multi-Browse Scene File nn (01-99)

Landsat 7 Processing System CDR

Band Data File Overview

File Descriptor

File Record No. File name **Creation Date/Time** Version No. **Source ID**

File Segments Segment No. S/W Version **IAS ParameterVersion No.**

Data Descriptor

File Record No. S/C ID Format 1 or 2 **Sub-Interval Start & Stop Times**

Total Scans **Bands Present** Detectors/Band **Scan Data Line Length** Total ScanLines

Band Data Records

Scan Data Information (Repeated for each Scan Data Line

- **File Record No.**
- **Scan No.**
- **Scan Direction**
- **Scan Start Time**
- **Band ID**
- **Detector ID**
- **Scan Data Line Count**
- **Scan Data Line Offset - LHS**
- **Scan Data Line Offset - RHS**

Scan Data Q &A (Repeated for each Scan Data Line):

- **Band Gain Status**
- **Band Gain Change Flag**
- **CADU Sync Flag**
- **Scan Sync Flag**
- **Scan Time Flag**
- **Scan End-of-Line Flag**
- **Minor Frame Fault Flag**
- **SLL/SD Fault Flag**

20 - 200 Byte Offset margin LHS

->Forward Scan Data Lines->

-> Band 2 Detector **16** Data Bytes (6313)->

-> Band 2 Detector **15** Data Bytes (6313)->

•

•

-> Band 2 Detector **02** Data Bytes (6313)->

-> Band 2 Detector **01** Data Bytes (6313)->

->Reversed Scan Data Lines->

-> Band 2 Detector **16** Data Bytes (6313)->

-> Band 2 Detector **15** Data Bytes (6313)->

•

•

-> Band 2 Detector **02** Data Bytes (6313)->

-> Band 2 Detector **01** Data Bytes (6313)->

-> Forward Scan Data Lines->

-> Band 2 Detector **16** Data Bytes (6313)->

-> Band 2 Detector **15** Data Bytes (6313)->

•

•

mnfm 1--->Forward Scan Data Line---> mnfm 6313

•

mnfm 6313--->Reversed Scan Data Lines--->mnfm 1

20 - 200 Byte Offset margin RHS

Min.3,000 Scan Lines (B6)

Max ~105,000 Scan lines

Per File Segment (B8)

Band Data File - Sizning Assumptions

- Subinterval Duration: 14 minutes - (Longest Possible Contact Period)
- Scene Duration: ~ 24 seconds
- Maximum Number of Scenes per Subinterval: ~ 35
- Scans per Scene: 375 (Maximum)
- ETM+ Scans per Subinterval: 375 x 35 = 13,125 (Maximum)
- Scan Data Lines per Scene:
  - Bands 1 - 5 and 7: 375 x 16 = 6,000
  - Band 6: 375 x 8 = 3,000
  - Band 8: 375 x 32 = 12,000 (Maximum)

Band Data File - Sizing Assumptions

- Scan Data Lines per Subinterval:
  - Bands 1 - 5 and 7: 6,000 x 35 = 210,000
  - Band 6: 3,000 x 35 = 105,000
  - Band 8: 12,000 x 35 = 420,000
    (Maximum - all 4 file segments)

  - Band 8: 12000 x 35 = 105,000
    (Maximum - 1 of 4 file segments)

- Scan Data Line Lengths:
  - Band 1 - 5 and 7: 6313 Bytes (Nominal, Minor Frames/Scan)
  - Band 6: 6313 / 2 = ~ 3,157 Bytes
  - Band 8: 6313 x 2 = ~ 12,626 Bytes

- Subinterval Sizes:
  - Band 1 - 5 and 7: 210,000 x 6313 = ~ 1.33 GB
  - Band 6: 105,000 x 3157 = ~ 0.33 GB
  - Band 8: 420,000 x 12,626 = ~ 5.33 GB
  - Band 8 Segment: = ~ 1.33 GB
    (Each of 4 FileSegments)

Landsat 7 Processing System CDR

MSCD File Overview

File Descriptor:	Record No., File Name, Date/Time, Version No. Source ID Total Segments, Segment No., S/W Ver. No, IAS Param Ver. No.
Data Descriptor:	Record No., S/C ID, ETM+ Format, Subinterval Start/Stop Times, Total Scans
Data Records:	Record No. **Scan No. 1,** Direction , Time, FHS ERR, SHSERR, Q&A: Sync, Time, EOL, MNFM Computed Line Length
	Scan No. 2
	Scan No. 3
	Scan No. 4
	⋮
	Scan No. N-2
	Scan No. N-1
	Scan No. N (where 325 < N < 13,125)

PCD File - File Descriptor Record

Field	Size (Bytes)	Remarks
File Record No. 1	6	
File Name	22	
File Creation Date & Time	16	
File Version No.	2	
File Source ID	12	
Total File Segments	1	
File Segment No.	1	(Used for Band 8 File only)
Software Version No.	4	
IAS Parameter Version No.	4	

PCD File - Data Descriptor Record

Field	Size (Bytes)	Remarks
File Record No. 2	6	
Spacecraft ID	8	
ETM+ Format	2	
ETM+ Sub-interval Start time	20	
ETM+ Sub-interval Stop Time	20	
Total ETM+ Scans	6	
PCD Sub-interval Start time	20	
PCD Sub-interval Stop Time	20	
Total PCD Major Frames	3	
PCD Record Length	5	
Spacecraft Orbit Number	5	

PCD File - Data Record

The Following Fields are Repeated for each PCD Major Frame:

Field	Size (Bytes)	Remarks
File Record No. 3	6	
PCD Cycle Count	2	
PCD Major Frame Count	3	
PCD Major Frame ID (0-3)	1	
Spacecraft ID - Major Frame(0)	1	
PCD Timecode - Major Frame(0)	20	
Bands Present	6	
ETM+ Last On Time	20	
ETM+ Last Off Time	20	
Full Aperture Cal. Flag	1	

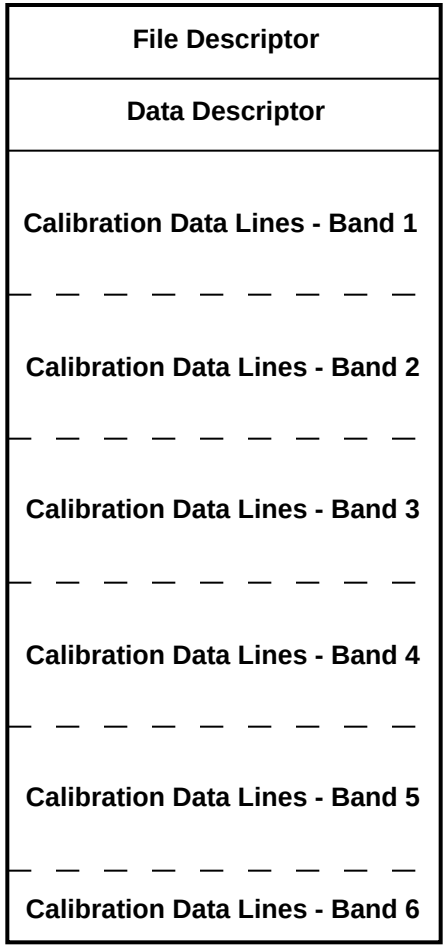
Landsat 7 Processing System CDR

PCD File - Data Record (Contd.)

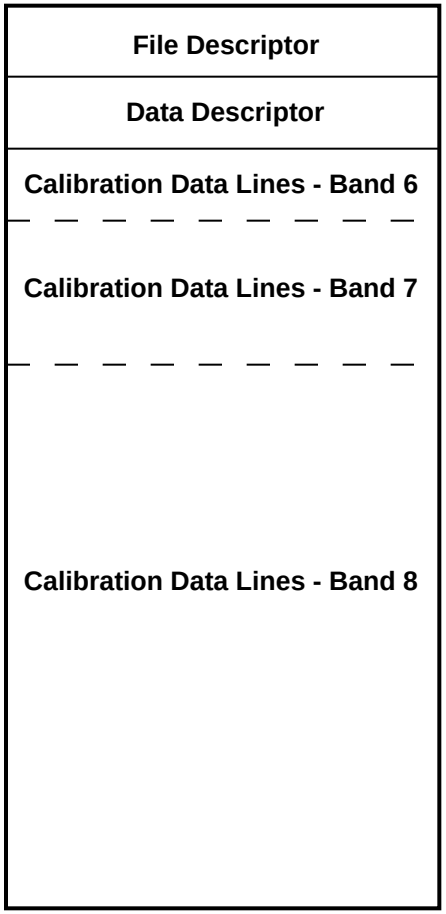
Field	Size (Bytes)	Remarks
Total PCD Bytes Received	8	
Total PCD Bytes Missing	8	
Total PCD Source VCDU Errors	7	
Total PCD Byte Voting Errors	7	
Total PCD MNFM Sync Errors	5	
Total PCD MNFM Counter Error	5	
Total PCD Minor Frames Filled	5	
Total PCD Major Frames Filled	3	
PCD Major Frame ID Flag	3	
PCD Timecode Flag	1	
PCD Major Frame Data	16384	One PCD Major Frame: 128 Minor Frames X 128 PCD Words (Bytes)

Landsat 7 Processing System CDR

Calibration Data File(s)



Format 1 File



Format 2 File

Landsat 7 Processing System CDR

Calibration File Overview

File Descriptor

File Record No. File name **Creation Date/Time** Version No. **Source ID**

File Segments Segment No. S/W Version **IAS ParameterVersion No.**

Data Descriptor

File Record No. S/C ID Format 1 or 2 **Sub-Interval Start & Stop Times**

Total Scans **Bands Present** Detectors/Band **Cal Data Line Length** Total Cal. Data Lines

Cal. Data Records

Scan/Cal. Data Information (Repeated for each Cal. Data Line

- **File Record No.**
- **Scan No.**
- **Scan Direction**
- **Scan Start Time**
- **Band ID**
- **Detector ID**
- **Cal. Data Line Count**
- **Cal. Data Line Offset - LHS**
- **Cal. Data Line Offset - RHS**

Scan/Cal. Data Q &A (Repeated for each Scan Data Line):

- **Band Gain Status**
- **Band Gain Change Flag**
- **CADU Sync Flag**
- **Scan Sync Flag**
- **Scan Time Flag**
- **Scan End-of-Line Flag**
- **Minor Frame Fault Flag**
- **SLL/SD Fault Flag**

20 - 200 Byte Offset margin LHS

->Forward Cal. Data Lines->

-> Band 2 Detector **16** Data Bytes (960)->

-> Band 2 Detector **15** Data Bytes (960)->

•

•

-> Band 2 Detector **02** Data Bytes (960)->

-> Band 2 Detector **01** Data Bytes (960)->

->Reversed Cal. Data Lines->

-> Band 2 Detector **16** Data Bytes (960)->

-> Band 2 Detector **15** Data Bytes (960)->

•

•

-> Band 2 Detector **02** Data Bytes (960)->

-> Band 2 Detector **01** Data Bytes (960)->

-> Forward Cal. Data Lines->

-> Band 2 Detector **16** Data Bytes (960)->

-> Band 2 Detector **15** Data Bytes (960)->

•

•

mnfm 1--->Forward Cal. Data Line---> mnfm 960

•

mnfm 960--->Reversed Cal. Data Lines--->mnfm 1

20 - 200 Byte Offset margin RHS

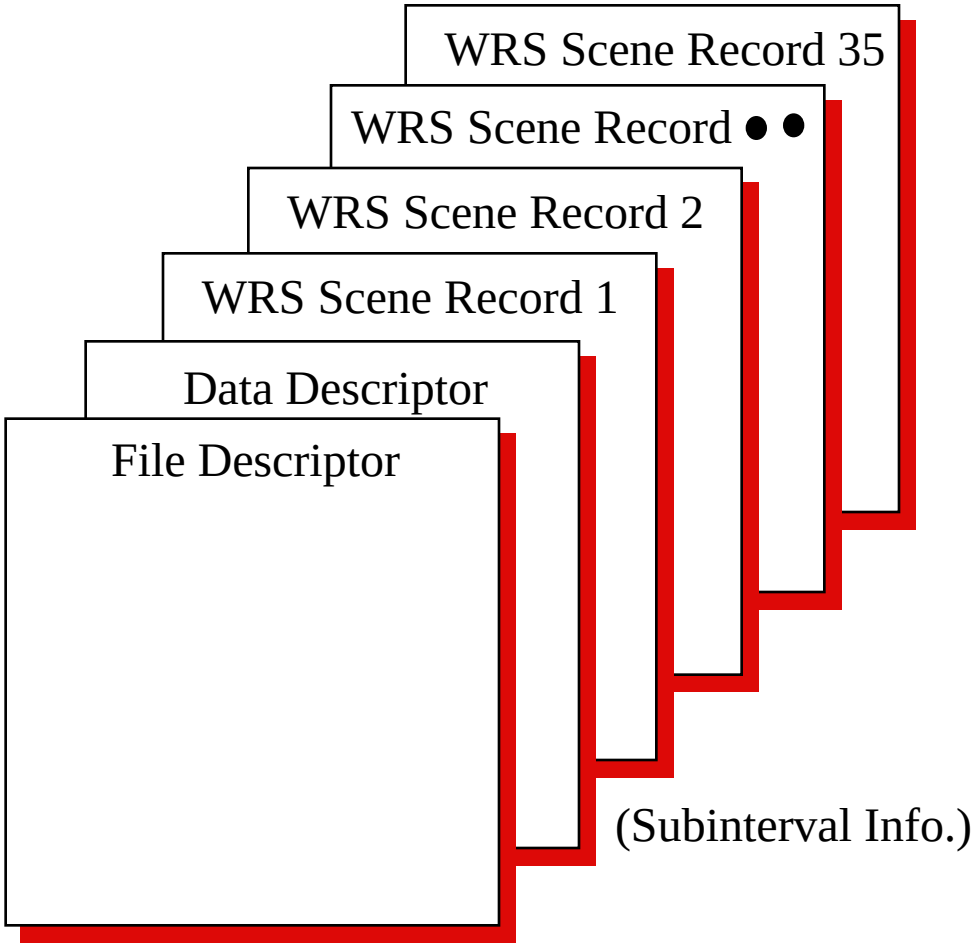
Min.3,000 Scan Lines (B6)

Max ~105,000 Scan lines

Per File Segment (B8)

Landsat 7 Processing System CDR

Metadata File Structure



Metadata File Descriptor - An HDF/PVL Example

```
BEGIN_GROUP = SUBINTERVAL_METADATA_FILE1;

        /* Metadata File Identification (File Descriptor) */

    BEGIN_GROUP = FILE_DESCRIPTOR;
        FILE_ Record_No = 000001;
        File_Name = L71EDC139813513011.MTA;
        File__Gen_ Date/Time = 1998-05-15T13:30:25ZZ;
        File_Version_No = 01;
        FILE_SOURCE_ID = USAEDC--LPS3;
        TOTAL_FILE_SEGMENTS = 0;
        FILE_SEGMENT_NO = 0
        SOFTWARE_VER_NO = 1.1;
        IAS_PARAM_FILE_VER_NO = 1.3;
    END_GROUP = FILE_DESCRIPTOR;
```

Metadata File Data Descriptor - An HDF/PVL Example

```
        FILE_RECORD_NO = 000002;

BEGIN_GROUP = SUBINTERVAL_METADATA;
        SPACECRAFT_ID = "Landsat 7";
        ETM+_FORMAT = 1;
        CONTACT_PERIOD_START_TIME = 1998-05-15T11:23:01;
        CONTACT_PERIOD_STOP_TIME = 1998-05-15T11:37:10;
        ORBIT_NO = 00003;
        WRS_PATH = 0029;
        STARTING_ROW = 0020;
        ENDING_ROW = 0045;
        SUBINTERVAL_START_TIME = 1998-05-15T11:25:01.350;
        SUBINTERVAL_STOP_TIME = 1998-05-15T11:35:05.650;
        TOTAL_ETM+_SCANS = 8853;
        PCD_START_TIME = 1998-05-15T11:25:01.250;
        PCD_STOP_TIME =1998-05-15T11:35:05.750;
        TOTAL_ PCD_MAJOR_FRAMES = 101;
        ETM+_LAST_ON_TIME = 1998-05-15T11:15:01.350;
        ETM+_LAST_OFF_TIME = 1998-05-15T09:25:01.350;
        BANDS_PRESENT = 123456;
        TOTAL_WRS_SCENES = 25;
        BAND_1_FILE_NAME = L71EDC139813513011.BB1;
        BAND_2_FILE_NAME = L71EDC139813513011.BB2;
                //
        BAND_6_FILE_NAME = L71EDC139813513011.BB6;
        MSCD_FILE_NAME = L71EDC139813513011.MSD;
        PCD_FILE_NAME = L71EDC139813513011.PCD;
        CAL_FILE_NAME = L71EDC139813513011.CAL;
        BROWSE_FILE_01 = L71EDC139813513011.R01;
                        //
        BROWSE_FILE_25 = L71EDC139813513011.R25;
END_GROUP = SUBINTERVAL_METADATA;
```

Landsat 7 Processing System CDR

Metadata File Scene Record - An HDF/PVL Example

```
BEGIN_GROUP = WRS_SCENE_01_METADATA;
        FILE_RECORD_NO = 000003;
        WRS_SCENE_NO = 0001;
        WRS_PATH = 0031;  /* SIOUX FALL, SD!>
        WRS_ROW = 0030;  /* SIOUX FALL, SD!>
        SCENE_CENTER_SCAN_NO = 000175;
        SCENE_CENTER_SCAN_TIME = 1998-05-15T11:37:05.450;
        SCENE_CENTER_LATTITUDE = +000042.1234567 <Degrees North>;
        SCENE_CENTER_LONGITUDE = -000096.7654321 <Degrees West>;
        HORIZONTAL_DISPLAY_SHIFT = 0275 <meters>;
        UPPER_LEFT_CORNER_LAT = +000041.5432176 <Degrees North>;
        UPPER_LEFT_CORNER_LONG = -000096.5432176 <Degrees West>;
        UPPER_RIGHT_CORNER_LAT = +000041.4321765  <Degrees North>;
        UPPER_RIGHT_CORNER_LONG = -000096.6543217 <Degrees West>;
        LOWER_LEFT_CORNER_LAT = +000041.6543217 <Degrees North>;
        LOWER_LEFT_CORNER_LONG = -000096.3543217 <Degrees West>;
        LOWER_RIGHT_CORNER_LAT = +000041.3432176  <Degrees North>;
        LOWER_RIGHT_CORNER_LONG = -000096.6543217 <Degrees West>;
        Full_SCENE_CCA = 020 <percent>;
        UPPER_LEFT_QUAD1_CCA = 001 <percent>;
        UPPER_RIGHT_QUAD2_CCA = 009 <percent>;
        LOWER_LEFT_QUAD3_CCA = 004 <percent>;
        LOWER_RIGHT_QUAD4_CCA = 006 <percent>;
        ACCA_ALGORITHM_ID_VER = "ACCA_11NOV95.ALG"
        SUN_AZIMUTH_ANGLE = 020.1234567 <degrees>;
        SUN_ELEVATION_ANGLE = 020.1234567 <degrees>;
        BAND_GAINS = HHHHLL;
        BAND_GAIN_CHANGES = NNNYNN;
        FULL_APERTURE_CAL_FLAG = N;
        PARTIAL_APERTURE_CAL_FLAG: D;      /*Day*/
END_GROUP = WRS_SCENE_01_METADATA;
```

Metadata File Scene Record - HDF/PVL Example (Contd.)

```
/*Scene Image Data Quality and Accounting Data */

BEGIN_GROUP = SCENE_01_ETM+_Q&A;
        TOTAL_CADUS/VCDUS = 05439266;
        FLYWHEEL_CADUS = 1<percent>;
        R-S_ERR_VCDUS = 1<percent>;
        BCH_CORRECTED_VCDUS = 1<percent>;
        BCH_UNCORRECTED_VCDUS = 0<percent>;
        BIT_ERR_RATE = 0.1e-6;
        ETM+_TIMECODE_ERRORS = 0<percent>;
        ENTIRELY_FILLED_SCANS = 0<percent>;
        PARTIALLY_FILLED_SCANS = 1<percent>;
END_GROUP = SCENE_01_ETM+_Q&A;

/*Scene PCD Quality and Accounting Information */

BEGIN_GROUP = SCENE_01_PCD_Q&A;
        PCD_WORDS_RECEIVED = 2470070;
        PCD_BYTE_VOTING_ERR = 5<percent>;
        TOTAL_PCD_MINOR_FRAMES = 19297;
        PCD_MINOR_FRAME_ERR = 3<percent>;
        FILLED_PCD_MINOR_FRMAES = 2<percent>;
        FILLED_PCD_MAJOR_FRAMES = 1<percent>;
END_GROUP = SCENE_01_PCD_Q&A;
```

Metadata File Scene Record - HDF/PVL Example (Contd.)

/Scene Processes PCD Quality and Accounting Info.*/

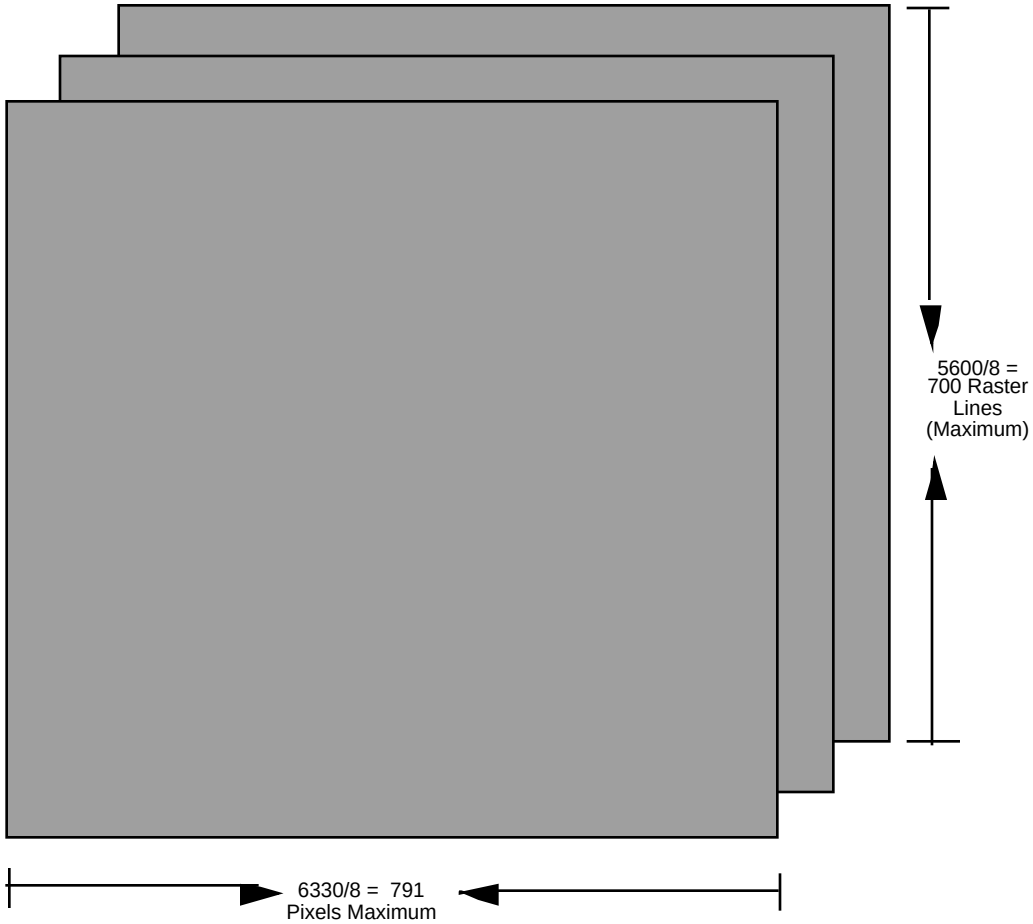
BEGIN_GROUP = PROCEESED_PCD_01_Q&A;
TOTAL_ATTITUDE_POINTS = 0037;
REJECTED_ATTITUDE_POINTS = 0002 <percent>;
MISSING_ATTITUDE_POINTS = 0001 <percent>;
TOTAL_EPHEMERIS__ POINTS = 0037;
REJECTED_EPHEMERIS_POINTS = 0000 <percent>;
MISSING_EPHEMERIS_POINTS = 0001 <percent>;
WRS_SCENES_NOT_CALCULATED = 0;
END_GROUP = PROCEESED_PCD_01_Q&A;

END_GROUP = SCENE_RECORD_1;

Landsat 7 Processing System CDR

Multibrowse Scene Data File

Multibrowse 24 bit Raster Image (3 8-bit Planes - TBR)



Multibrowse Image Object Before JPEG Compression

- **Format 1 Only: Bands 1, 2,3, 4 & 5**
- **Inputs Bands: 3 Selected Bands**
- **Each Band Data Size: 6330 x 5600**
- **Data Reduction Factor: 8 X 8 = 64 (1 Subsample & 2 Wavelet Runs)**
- **Data Reduction Ouput: 791 x 700 (Each Band)**
- **Reduced Data Volume: 1.6 MB (All 3 Bands in a Single File)**
- **HDF RIS24 - Interleave by Plane**
- **JPEG Compression: 60%**
- **Multibrowse Output File: <1.0 MB**

Aspect Ratio: Same as Input Bands