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Multi-Mission Satellite Processing Segment (MMSPS)

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2017 CSPP/IMAPP Users' Group Meeting

Overview

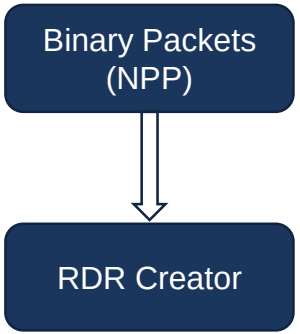
- MMSPS System Processing Flow (Binary Packets to Environmental Data Records (EDRs))
- Binary Packet Structure
- RDR Layout
- Global Composites (EDRs)
- Future Work

System Processing Flow

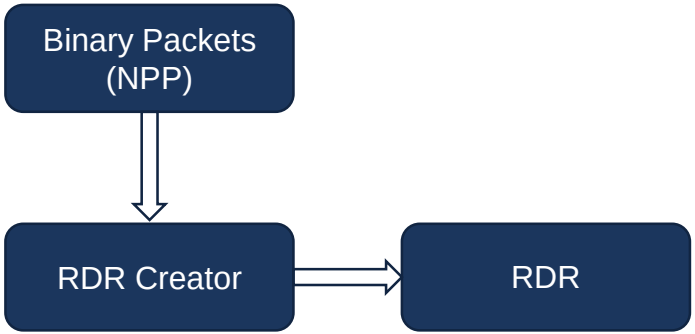
Binary Packets (NPP)

Binary Packets are Extended Application Files (EAPs)

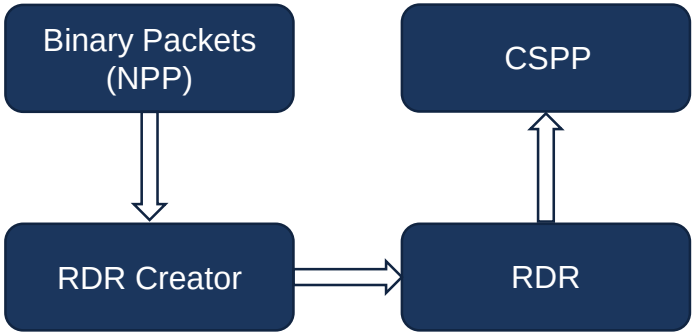
System Processing Flow



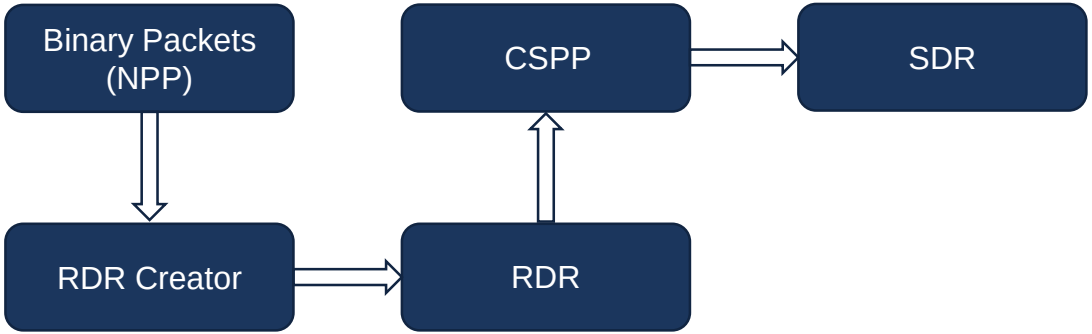
System Processing Flow



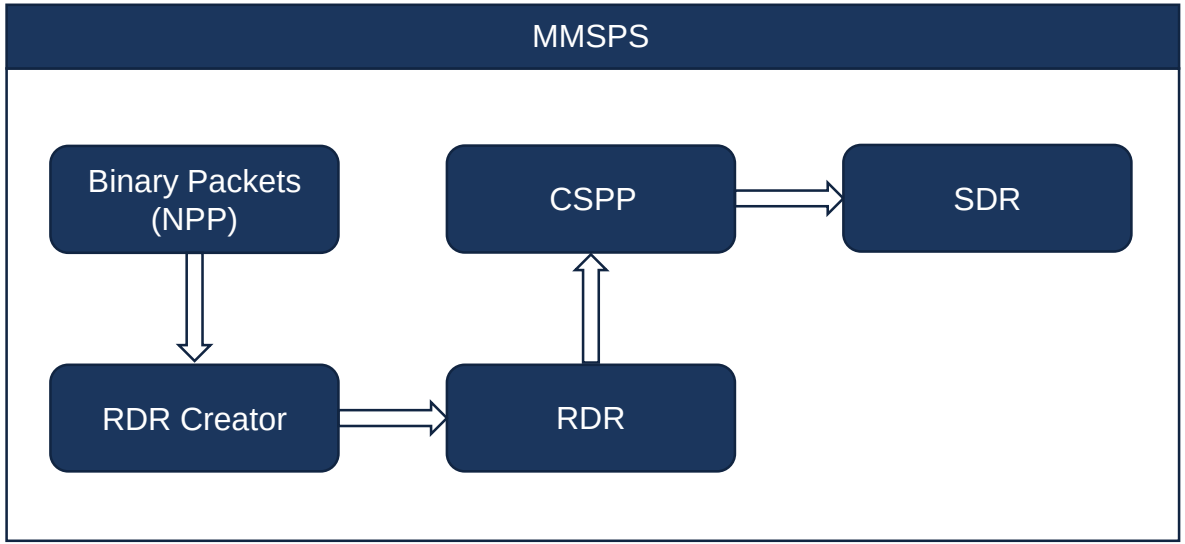
System Processing Flow



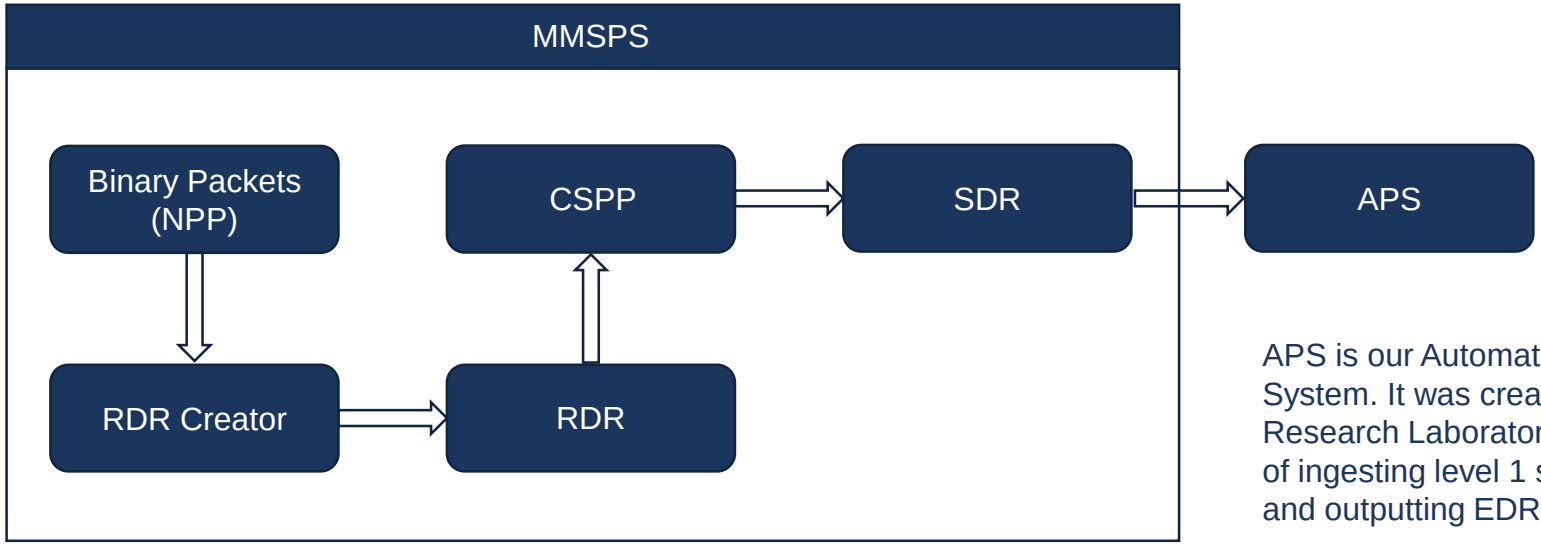
System Processing Flow



System Processing Flow

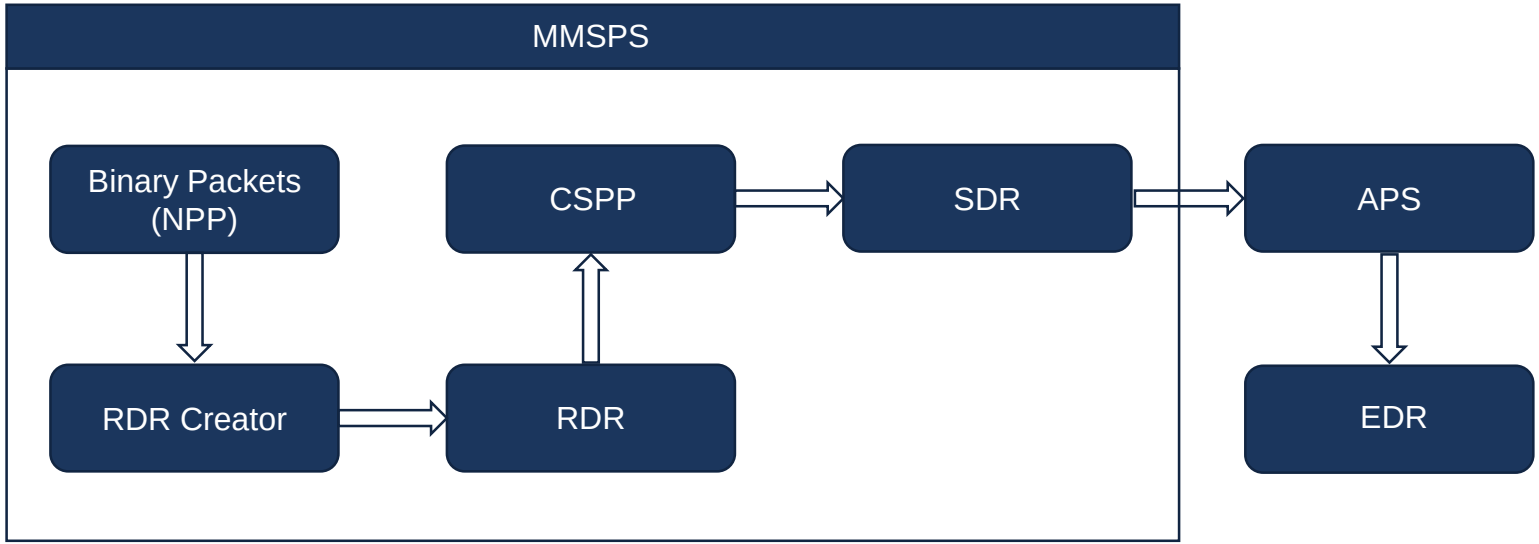


System Processing Flow

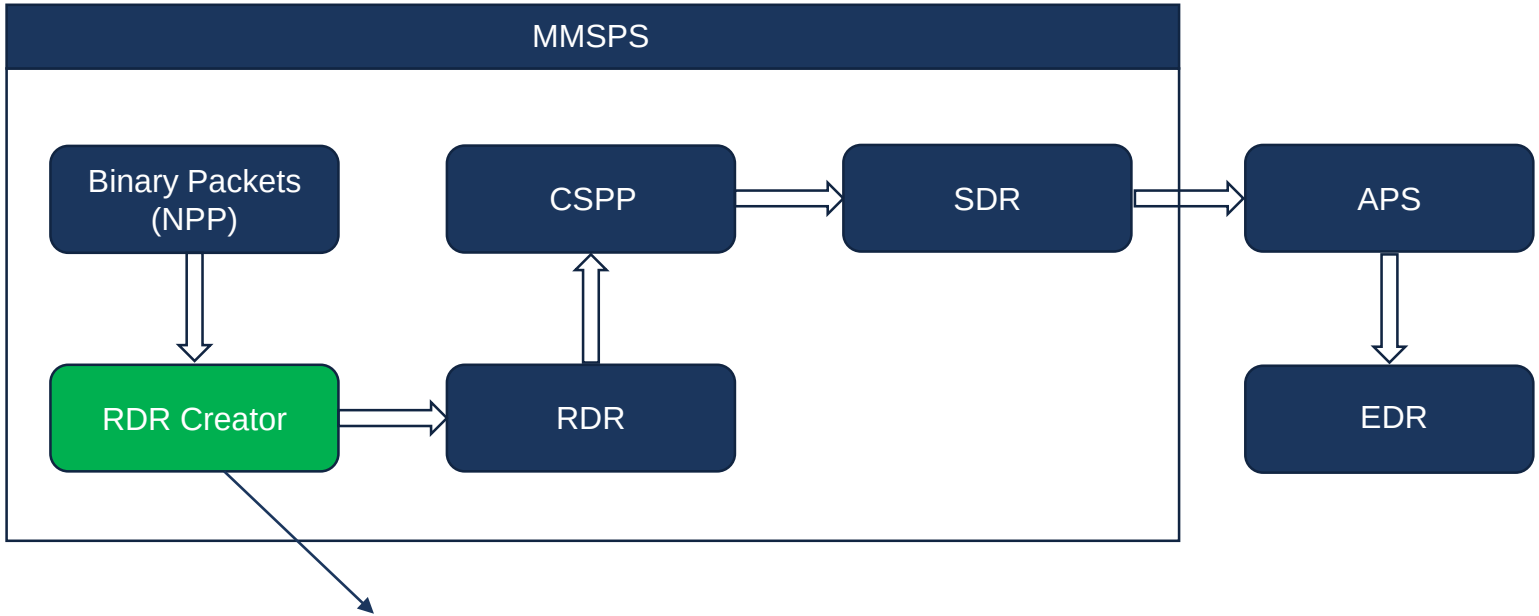


APS is our Automated Processing System. It was created by the Naval Research Laboratory and is capable of ingesting level 1 satellite imagery and outputting EDRs

System Processing Flow



System Processing Flow



Binary Packets (First Packet Structure)

	PACKET PRIMARY HEADER							SECONDARY HEADER			USER DATA FIELD					
	Version No.	Packet Identification			Packet Sequence Control (PSC)		Packet Length	Time of Day Start of Data [2]	Number of Packet Segments 1	Spare	VIIRS Packet ID		HR Format			HR Science Data	
		Type Indicator	Sec Hdr Flag	APID	Sequence Flags	Sequence Count	[1]				VIIRS Sequence Count	Packet Time [2]	Format Version	Instrument Number	Spare	HR Meta Data	Checksum
Bits	3	1	1	11	2	14	16	64	8	8	32	64	8	8	16	1168	16
Octets	2				2		2	8	1	1	4	8	1	1	2	146	2
Value	000	0	1	varies	01	varies	173	varies	varies	zeros	varies	varies	2	2	zeros	varies	varies

0 = Telemetry Packet

1 = Secondary Header Present

Segmented data, First packet. Definition per A.2.2

VIIRS Sequence Count is a running total count of all types of packets sent by VIIRS since power on or 32-bit rollover.

16-bit arithmetic Checksum of HR Meta Data Field. Filled with zeros if not used.

HR Meta Data														
	HAM Side	Scan Synch	Self Test Data Pattern	Reserved	Scan Number	Scan Terminus [2]	Sensor Mode	VIIRS Model	FSW Version	Band Control Word	Partial Start	No. of Samples	Sample Delay	Reserved
Bits	1	1	4	10	32	64	8	8	16	32	16	16	16	944
Octets			2		4	8	1	1	2	4	2	2	2	118
Value	varies	varies	varies	varies	varies	varies	varies	varies	varies	varies	varies	varies	varies	vareis

TOTAL
1168
146

0000 Live Data
0001-1111 Test Data Patterns

Filled with zeros if unused

Filled with zeros if unused

Notes:

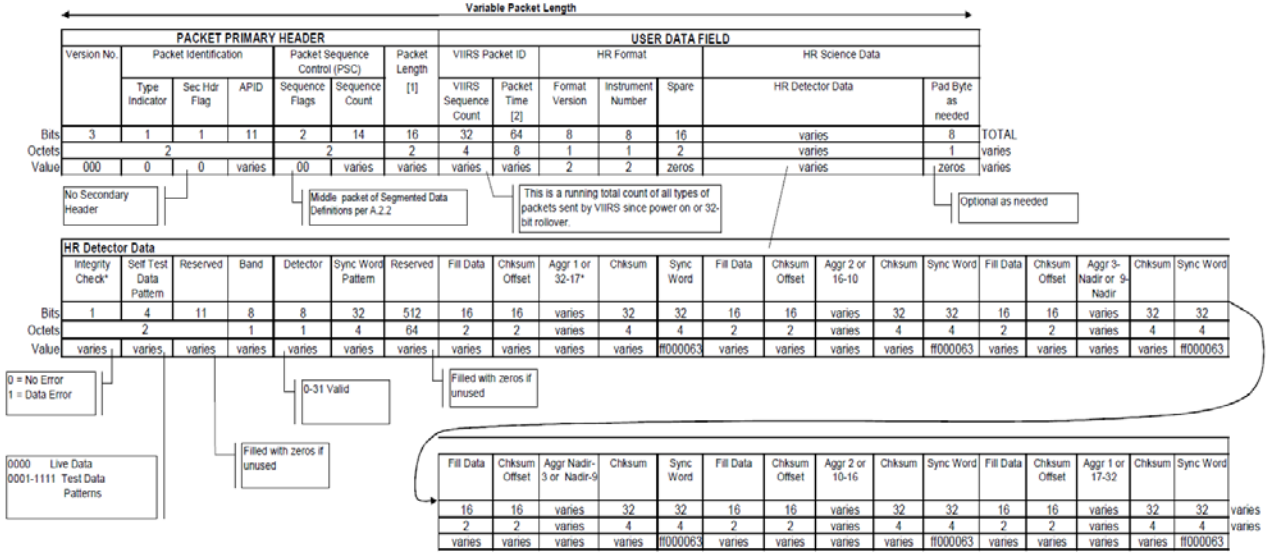
[1] Packet length is the number of bytes after the primary header minus one.

[2] "Time of Day Start of Data", "Packet Time", and "Scan Terminus" fields are 64-bit CCSDS Day Segmented Time Code format as defined in CCSDS 301.0-B-2 (1958 January 1 epoch, 16-bit day, 32-bit msec, 16-bit μsec). "Time of Day Start of Data" field is Start of Scan.

3. All packet fields are big endian.

Figure 4.1.2-1, First Packet (metadata) in VIIRS Segmented Packet

Binary Packets (Middle Packet Structure)



Notes:

[1] Packet length is the number of bytes after the primary header minus one.
[2] "Packet Time" field is 64-bit CCSDS Day Segmented Time Code format as defined in CCSDS 301.0-B-2 (1958 January 1 epoch, 16-bit day, 32-bit msec, 16-bit μsec).
3. All packet fields are big endian.
4. Valid range for the detector field is 0-15 for Moderate Bands and 0-31 for Image Bands.

Figure 4.1.2-2, Middle Packet in VIIRS Segmented Packet

RDR Layout

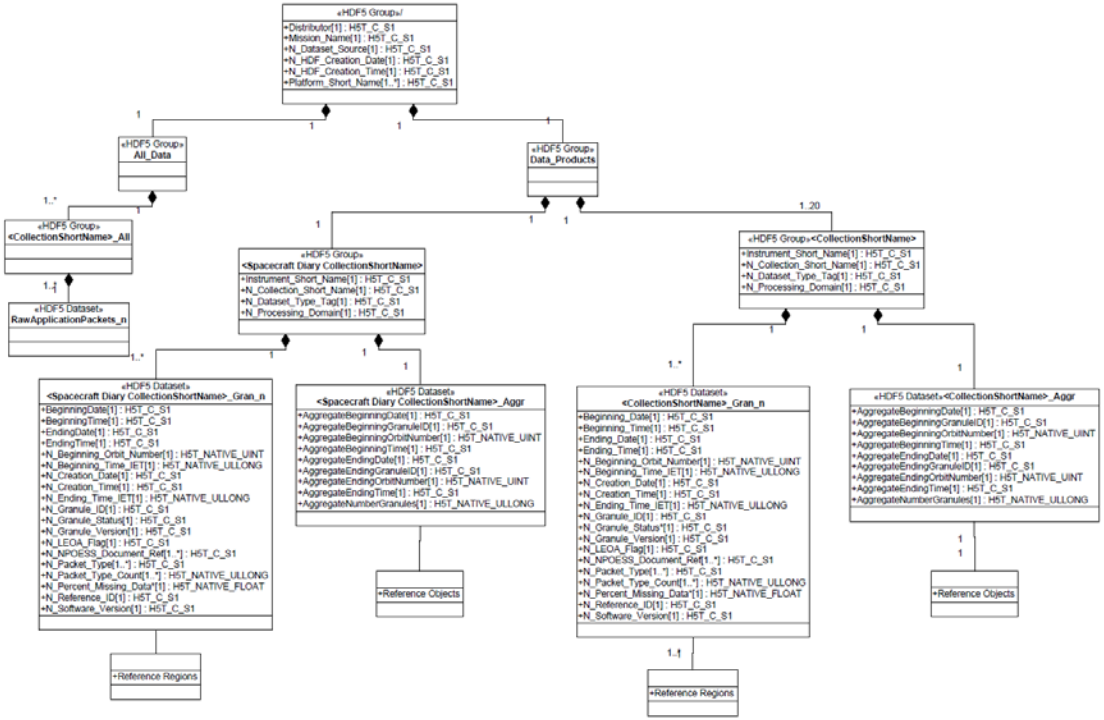


Figure 2.0-1, Science and Diagnostic RDR Generalized UML Diagram

RDR Layout

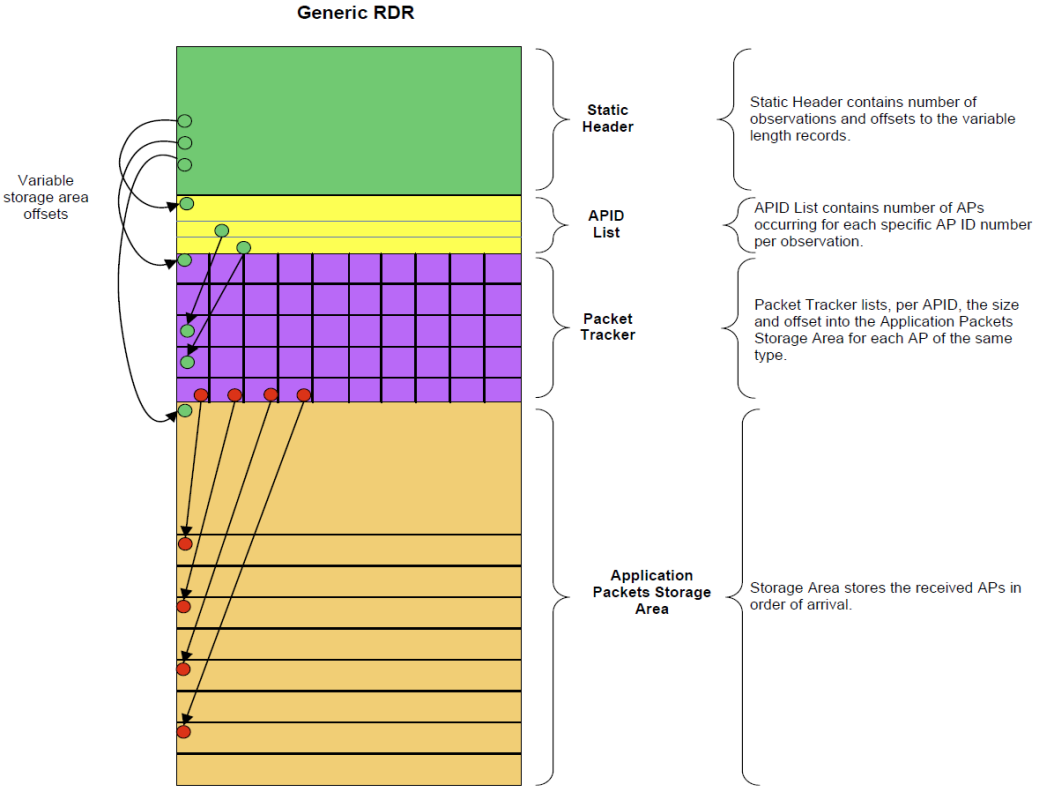


Figure 3.0-1, Common RDR Layout

RDR Layout

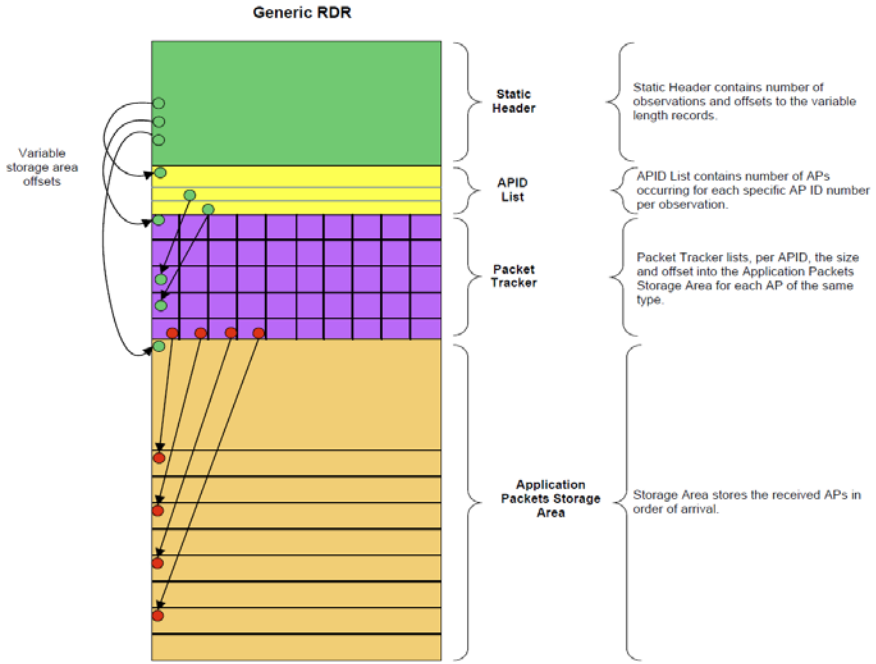


Figure 3.0-1, Common RDR Layout

APID

APID	Band	Wavelength (μm)*	Night
800	M4	0.555	No
801	M5	0.672	No
802	M3	0.488	No
803	M2	0.445	No
804	M1	0.412	No
805	M6	0.746	No
806	M7	0.865	Yes
807	M9	1.378	No
808	M10	1.610	Yes
809	M8	1.240	Yes
810	M11	2.250	No
811	M13	4.050	Yes
812	M12	3.700	Yes
813	I4	3.740	Yes
814	M16**	12.013	Yes
815	M15	10.763	Yes
816	M14	8.550	Yes
817	I5	11.450	Yes
818	I1	0.640	No
819	I2	0.865	No
820	I3	1.610	No
821	DNB	0.700	Yes
822	DNBMGS	0.700	Yes
823	DNBLGS	0.700	Yes

* Wavelength center frequencies are nominal.

RDR Layout

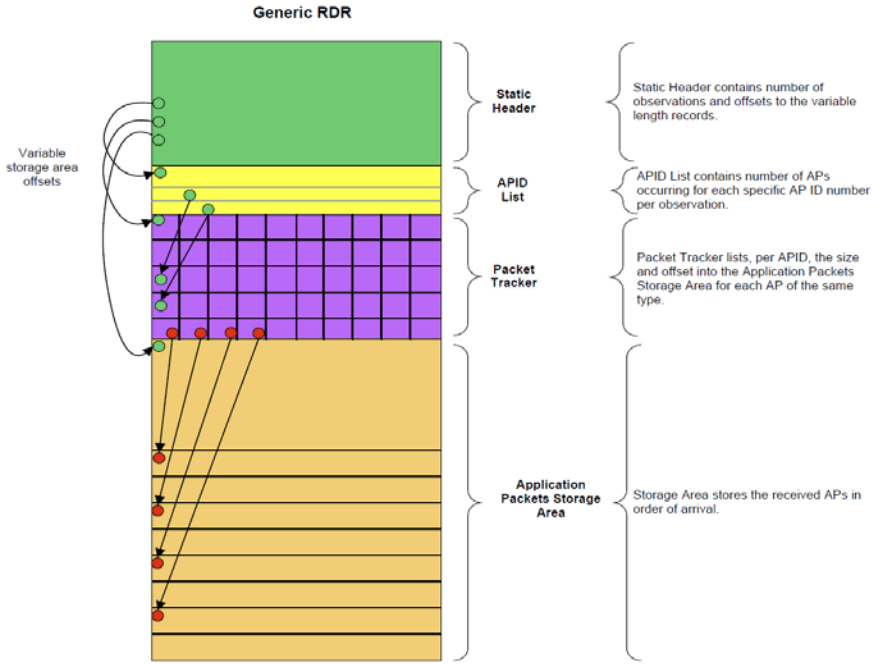


Figure 3.0-1, Common RDR Layout

Table: 4.3.2-3 VIIRS S-NPP Science RDR Structure

	Byte	Field	Type	Value
Static Header	0	satellite	char[4]	NPP
	4	sensor	char[16]	VIIRS
	20	typeID	char[16]	SCIENCE
	36	numAPIDs	Uint32	26
	40	apidListOffset	Uint32	72
	44	pktTrackerOffset	Uint32	904
	48	apStorageOffset	Uint32	591880
	52	nextPktPos	Uint32	Varies
	56	startBoundary	int64	Varies
	64	endBoundary	int64	Varies
Dynamic	72	APID List	IngSmdCommon_ApidDetailType[26]	Varies
	904	Pkt Tracker List	IngSmdCommon_PktTrackerType[24624]	Varies
	591880	AP storage area	Uint8[241965600]	Varies
File Size	**242,557,480 Bytes**			

RDR Layout

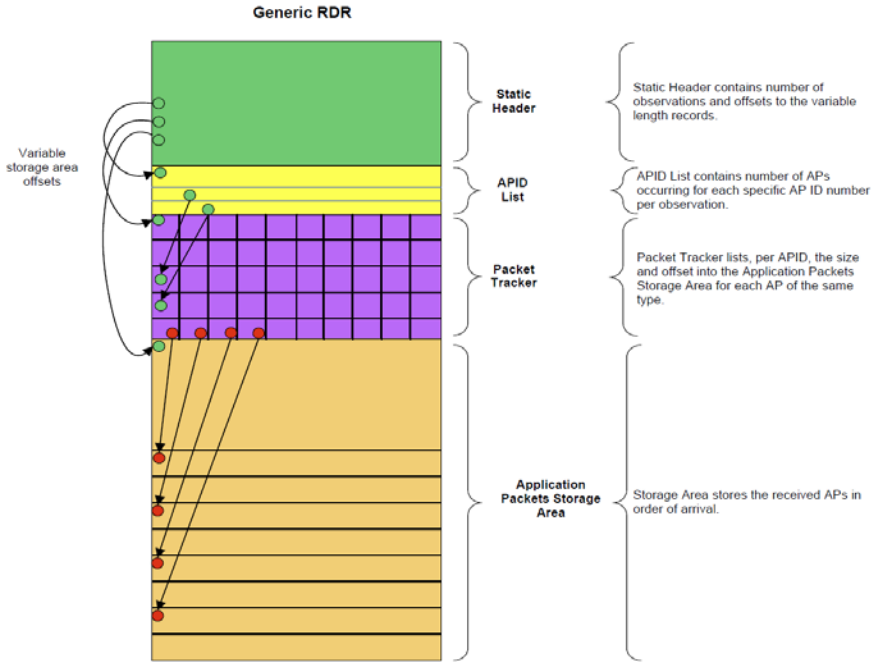


Figure 3.0-1, Common RDR Layout

Table: 4.2.3-2 S-NPP RDR Spacecraft Attitude and Ephemeris RDR Structure

	Byte	Field	Type	Value
Static Header	0	satellite	char[4]	'NPP'
	4	sensor	char[16]	'SPACECRAFT'
	20	typeID	char[16]	'DIARY'
	36	numAPIDs	Uint32	3
	40	apidListOffset	Uint32	72
	44	pktTrackerOffset	Uint32	168
	48	apStorageOffset	Uint32	1680
	52	nextPktPos	Uint32	varies
	56	startBoundary	int64	varies
	64	endBoundary	int64	varies
Dynamic	72	APID List	IngSmdCommon_ApidDetailType [3]	varies
	168	Pkt Tracker List	IngSmdCommon_PktTrackerType [63]	varies
	1440	AP storage area	Uint8[13293]	varies
		Total Size	14,973 Bytes	

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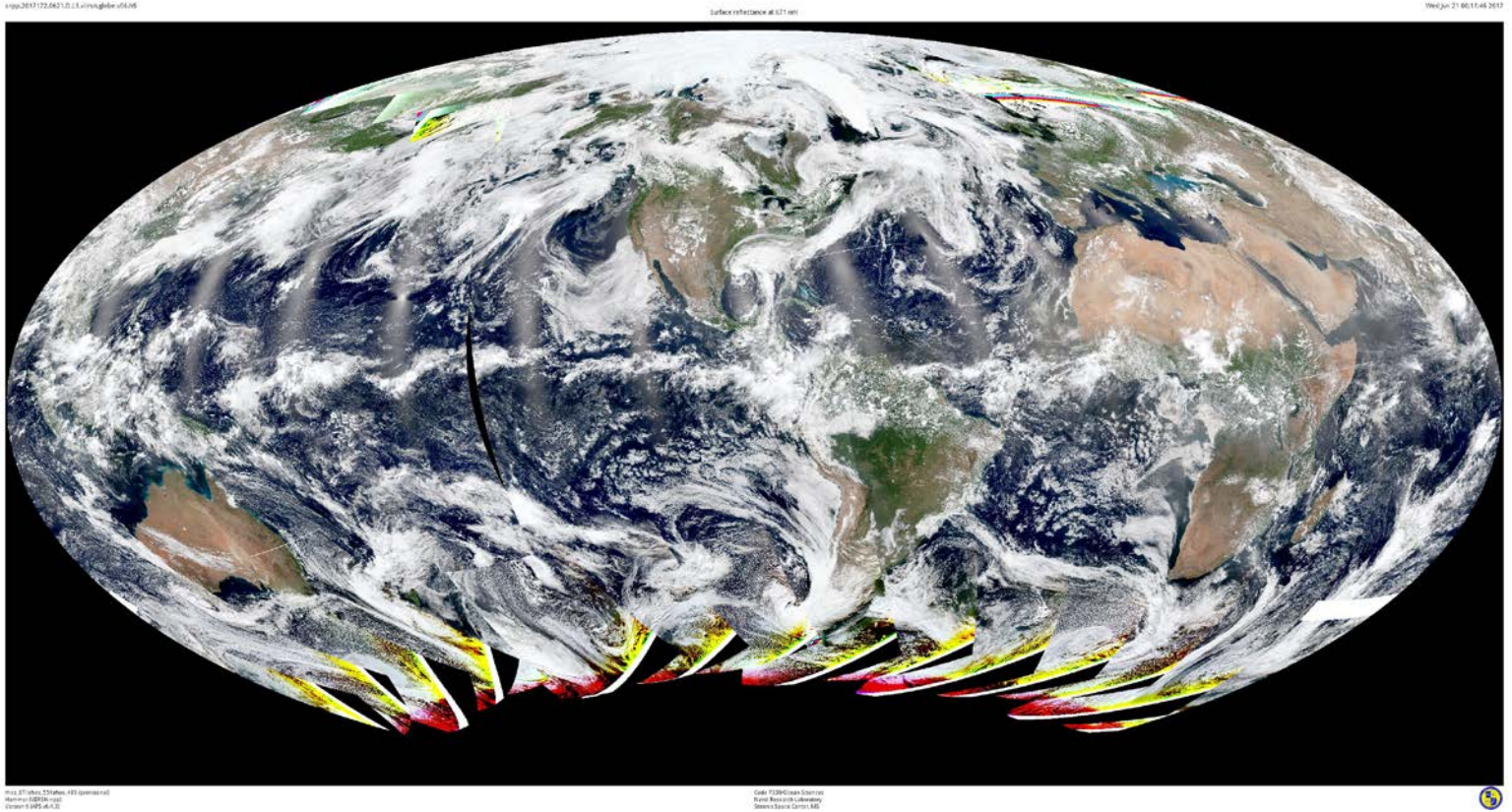
Global Composite (True Color Image from 6-21-17)



Future Work

- Extend MMSPS to include ATMS and J01 data
- Enhance MMSPS to be more robust and fault tolerant
  - Check for missing packet data throughout the day
  - Provide email notifications to developers when errors are found
  - Restart the system if needed

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Acknowledgements

We would like to thank Kathy Strabala and Scott Mindock for always being very responsive and answering a ton of our emails regarding all things CSPP.

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