PRELIMINARY DESIGN OF REMOTE SENSING GROUND STATION SYSTEM FOR THE JPSS-1 (JOINT POLAR SATELLITE SYSTEM) DATA ACQUISITION AND PROCESSING

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Abstract. One of the global polar orbit satellites for the Earth and the environment monitoring is S-NPP (Suomi National Polar-Orbiting) was launched in 2011 and will be finished in operation soon. S-NPP carries five primary sensors for earth monitoring i.e. VIIRS (Visible Infrared Imaging Radiometer Suite), CrIS (Cross-track Infrared Sounder), ATMS (Advanced Technology Microwave Sounder), OMPS (Ozone Mapping and Profiler Suite), and CERES (Clouds and the Earth's Radiant Energy System). While, JPSS-1 (Joint Polar Satellite System) polar satellites was planned tobe launched in 2017 to continuing the mission of earth monitoring similar with S-NPP. JPSS-1 also carries five primary sensors are similar with the S-NPP sensors, i.e. VIIRS, CrIS, ATMS, OMPS and CERES. VIIRS data is currently widely used in LAPAN for monitoring applications such as hotspot/fire detection, phase of rice plant growth monitoring (with NDVI/Normalized Difference Vegetation Index parameter), potential fishing zones determination (with SST/Sea Surface Temperature parameter) and many more. With so many benefits to use low resolution satellite data for the environmental monitoring purposes such as S-NPP, in order to ensure the continuity of S-NPP polar satellite data reception is necessary to assess the readiness of polar satellite data JPSS-1 reception as a S-NPP mission continuation. This paper focused on the preliminary design of the remote sensing ground stations system for future JPSS-1 satellite data acquisition and data processing system.

Keywords: JPSS-1, remote sensing, receiver ground station, acquisition, pre-processing

1. Introduction

JPSS (Joint Polar Satellite System)is one of the Earth monitoring and global environment polar orbit satellite. JPSS-1 is a part of collaboration between NOAA and NASA that represent the technological development of environmental monitoring and weather prediction. As soon as the S-NPP (Suomi-National Polar Orbiting) satellite operation that will be expire, JPSS-1 is scheduled to be launched in 2017 to continue the earth monitoring mission as well asconducted by S-NPP. JPSS-1 also carries five primary sensorsare similar with S-NPP i.e VIIRS (Visible Infrared Imaging Radiometer Suite), CrIS (Cross-track Infrared Sounder), ATMS (Advanced Technology Microwave Sounder), OMPS (Ozone Mapping and Profiler Suite), and CERES (Clouds and the Earth's Radiant Energy System). One of the data products that can be obtained from JPSS-1 for example are VIIRS and CrIS/ATMSdata.VIIRS data is currently widely used in LAPAN for monitoring applications such as hotspot/fire detection, phase of rice plant growth monitoring (with NDVI/Normalized Difference Vegetation Indexparameter), potential fishing zones determination (with SST/Sea Surface Temperatureparameter), etc.While ATMS data (together with data CrIS) are widely used for weather forecasts purposes such as temperature and moisture monitoring information. With so many benefits to use low resolution satellite data for theenvironmental monitoring purposes such as S-NPP, in order to ensure the continuity of S-NPP polar satellite data reception is necessary to assess the readiness of polar satellite data JPSS-1 reception as a S-NPP mission continuation. This paper focused on the preliminary design of the remote sensing ground stations system for future JPSS-1 satellite data acquisition and data processingsystem.

This paper studies JPSS-1 satellite system (spacecraft and sensors) and preliminary design architecture ofremote sensing ground station system for the JPSS-1 satellite data acquisition includes antenna receiver and data recording system (ingest, demodulator) and data processing system. The satellite data acquisition studies related to the antennaneedsparameters, demodulator and ingestsystem, the wiring system, and antenna protection system. While, the study of the data processing system takes implementation of data processing systems is performed on S-NPP satellite. It related to hardware and software to process the satellite data after acquisition.

2. JPSS-1 overview

From the S-NPP polar satellite towards JPSS-1. JPSS is the next generation of polar orbit environmental satellites. JPSS is a partnership between NOAA and NASA, and represent advances in technology and the development of scientific observations and data products for weather forecasting and environmental monitoring. Information from JPSS support each field mission of NOAA, to help further ensure the weather conditions, the condition of a healthy coast, coastal communities, as well as adaptation and mitigation to climate change (Cikanek, 2014). Figure 1 shows JPSS-1 satellite and its sensors.

The polar satellites circle the earth 14 times a day and is considered as the backbone of the global monitoring system. JPSS includes three satellites in polar orbit, the five instruments/main payload. The satellites are S-NPP which launched in 2011, JPSS-1 and JPSS-2, with a launch date scheduled respectively in 2017 and 2021. Immediately after the satellite S-NPP launched in 2011 expired operation, JPSS-1 (Joint Polar Satellite System) is scheduled to be launched in 2017 to continue the mission of earth monitoring conducted by S-NPP (Cikanek 2014).

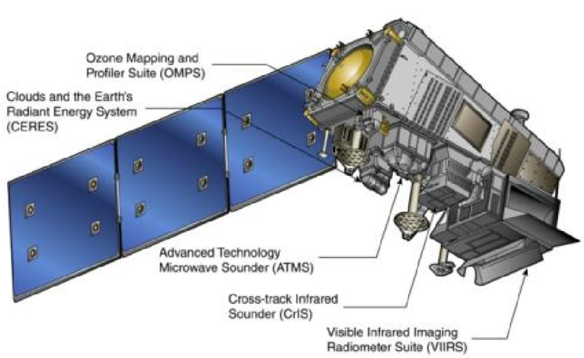

Figure 1. The primary sensors on the JPSS-1 satellite as well as S-NPP. (Source: JPSS-NOAA 2015)

VIIRS (22 Bands): albedo (surface), Cloud Base Height, Cloud Cover/Layers, Cloud Effective Part Size, Cloud Optical Thickness, Cloud Top Height, Cloud Top Pressure, Cloud Top Temperature, Ice Surface Temperature, Ocean Color/Chlorophyll, Suspended Matter Vegetation Index, Fraction, Health, Aerosol Optical Thickness, Aerosol Particle Size, Active Fires, Polar Winds, Imagery, Sea Ice characterization, Snow Cover, Sea Surface Temperature, Land Surface Temp, Surface Type

ATMS (22 Bands): Cloud Liquid Water, Precipitation Rate, precipitable Water, Land Surface Emissivity, Ice Water Path, Land Surface Temperature, Sea Ice Concentration, Snow Cover, Snow Water Equivalent, Atm Vert Temperature Profile, Atm Vert Moisture Profile

CrIS/ATMS (3 Bands): Moist Profile Atm Vert, Vert Temp Atm Profile, Carbon (CO_2, CH_4, CO)

OMPS (2 Bands): O_3 Total Column, Profile Nadir O_3, SO_2 and Aerosol Index

CERES (2 Bands): Reflected Solar Radiation (TOA), LW Outgoing Radiation (TOA)

As well as S-NPP, JPSS-1 satellite constellation will perform global measurements of the atmosphere, land and sea conditions including atmospheric temperature, the intensity of the storm, clouds, rain and thick fog with some of the terms. This will be done by five instrument sensors i.e. VIIRS, CrIS, ATMS, OMPS, and CERES (Cikanek 2014). Each sensor in the JPSS-1 consists of many spectral bands with different functions. VIIRS Sensor consists of 22 spectral bands, CrIS/ATMS consists of three spectral bands, ATMS consists of 22 spectral bands, OMPS consists of two spectral bands, CERES consists of two spectral bands as shown in Figure 1 (Goldberg2014).

Compared with the previous environmental monitoring satellites such as NOAA and Terra/Aqua, JPSS promised benefits are better able to provide higher spatial resolution by extending radiometric resolution that allows for users to obtain environmental object information to be observed more detailed. VIIRS data products from JPSS will have spatial and radiometric resolution higher than MODIS-Terra/Aqua or AVHRR-NOAA data as shown in Table 1.

Table 1. Comparison of the spatial and radiometric resolution between VIIRS, MODIS and AVHRR (Source: Mitch Goldberg, JPSS Program Scientist - Satellite Proving Ground, June 2, 2014)

VIIRS			MODIS Equivalent			AVHRR-3 Equivalent			ABI		
Band	Range (um)	HSR (m)	Band	Range	HSR	Band	Range	HSR	Band	Range	HSR
DNB	0.500 - 0.900	750				Low light capabilities					
M1	0.402 - 0.422	750	8	0.405 - 0.420	1000	Ocean Color, Aerosol					
M2	0.436 - 0.454	750	9	0.438 - 0.448	1000						
M3	0.478 - 0.498	750	3 10	0.459 - 0.479 0.483 - 0.493	500 1000				1	0.45-0.49	1000
M4	0.545 - 0.565	750	4 12	0.545 - 0.565 0.546 - 0.556	500 1000						
I1	0.600 - 0.680	375	1	0.620 - 0.670	250	1	0.572 - 0.703	1100	2	0.59-0.69	500
M5	0.662 - 0.682	750	13 14	0.662 - 0.672 0.673 - 0.683	1000 1000	1	0.572 - 0.703	1100			
M6	0.739 - 0.754	750	15	0.743 - 0.753	1000	Atm Correction					
I2	0.846 - 0.885	375	2	0.841 - 0.876	250	2	0.720 - 1.000	1100			
M7	0.846 - 0.885	750	16	0.862 - 0.877	1000	2	0.720 - 1.000	1100	3	0.846-0.885	1000
M8	1.230 - 1.250	750	5	SAME	500	Cloud Particle Size					
M9	1.371 - 1.386	750	26	1.360 - 1.390	1000	Thin Cirrus			4	1.371-1.386	2000
I3	1.580 - 1.640	375	6	1.628 - 1.652	500	Snow Map			5	1.580-1.640	2000
M10	1.580 - 1.640	750	6	1.628 - 1.652	500	3a	SAME	1100			
M11	2.225 - 2.275	750	7	2.105 - 2.155	500	Cloud			6	2.225-2.275	2000
I4	3.550 - 3.930	375	20	3.660 - 3.840	1000	3b	SAME	1100			
M12	3.660 - 3.840	750	20	SAME	1000	3b	3.550 - 3.930	1100	7	3.80-4.00	2000
M13	3.973 - 4.128	750	21 22 23	3.929 - 3.989 3.929 - 3.989 4.020 - 4.080	1000 1000 1000	SST, Fire					
M14	8.400 - 8.700	750	29	SAME	1000	Cloud Top Properties			11	8.3-8.7	2000
M15	10.263 - 11.263	750	31	10.780 - 11.280	1000	4	10.300 - 11.300	1100	13	10.1-10.6	2000
I5	10.500 - 12.400	375	31 32	10.780 - 11.280 11.770 - 12.270	1000 1000	4 5	10.300 - 11.300 11.500 - 12.500	1100 1100	14	10.8-11.6	2000
M16	11.538 - 12.488	750	32	11.770 - 12.270	1000	5	11.500 - 12.500	1100	15	11.8-12.8	2000

Currently, data products that can be obtained from the S-NPP by LAPAN is VIIRS and CrIS/ATMSdata. In LAPAN, VIIRS data is currently widely used in LAPAN for monitoring applications such as hotspot/fire detection, phase of rice plant growth monitoring (with NDVIparameter), potential fishing zones determination (with SSTparameter)and many more. While ATMSdata (together with CRISdata) are widely used for temperature and moisture information for weather forecastspurposes. However, S-NPP has planned until 2016, and then remote sensing data from S-NPP will not acceptable after the time. And a continuation of S-NPP mission will be continued by JPSS-1 through five sensors that similar with S-NPP. JPSS-1 is planned to be launched in 2017.

Regarding to maintenance the acceptance of low resolution polar satellite data for environmental, especially for VIIRS and CRIS/ATMS data, in order to ensure the sustainability of S-NPP polar satellite data reception is necessary to study how to accept JPSS-1 satellite data include the acquisition and processing system, and JPSS-1 data utilization.

JPSS-1 sensor and data utilization. As shown in Figure 2, JPSS-1 also called NOAA-20 carries five primary similar sensor as S-NPP sensor i.e. VIIRS, CrIS, ATMS, OMPS, and CERES. Each sensor in JPSS-1 has the difference function and benefit and has capability increased when compared with the previous generation of environmental and weather monitoring satellites sensor. Here is an explanation of each sensor and the advantages that will be obtained from JPSS-1data:

VIIRS (visible infrared imaging radiometer suite). VIIRS sensor has a mission to collects visible and infrared imagery and radiometric data are used to provide information on the Earth's clouds, atmosphere, oceans and land surface. VIIRS consists 22 spectral bands with wavelengths between 412 nm - 12 μm. The spatial resolution on nadir direction is 400 m with a maximum swath width 3000 km and average data rate 7.674 Mbps.

VIIRS data extraction will produce information about snow and ice layer, clouds, smoke, fog, aerosols, fire, dust, plant health levels, availability of phytoplankton and chlorophyll, and so on. VIIRS is claiming better ability of sensor measurements when compared AVHRR-NOAA, MODIS-

Terra/Aqua and OLS (Linescan System Operator) to produce satellite images with higher spatial resolution (750 m) in the region with a wider swath width . VIIRS data is also available for monitoring both during the day or night, or also called "VIIRS Day/Night Band" or VIIRS DNB (Golberg 2014; JPSS-NOAA 2016). Figure 2 shows an example of image data used from VIIRS sensor for tropical storm monitoring.

CrIS (cross-track infrared sounder). CrIS Sensor has a mission to produce high resolution vertical temperature and water pavor information needed to maintain and improve weather forecast skill out from 5 to 7 days in advance. CrIS consists of 1305 spectral channels with wavelengths between 3.92 to 15.38 μm. The diameter horizontal spatial resolution is 14 km and vertical spatial resolution is 1 km with a maximum swath width 2200 km and average data rate 1.9 Mbps. CrIS is claiming better ability of sensor measurements that using infrared sounder when compared with HIRS sensor (High Resolution Infrared Radiation Sounders) on MetOp and NOAA satellites. CrIS produce water vapor and atmospheric temperature profiles information of the earth and tandem with the sensor ATMS (Advanced Technology Microwave Sounder) to produce high resolution information and three-dimensional (3D) atmospheric temperature, and also greenhouse gases information, especially in the middle and upper atmospheric layers (Golberg 2014; JPSS-NOAA 2016). Figure 3 shows an example of image data usedfrom CrIS data composite for 3 days monitoring vertical temperature and water vapor.

ATMS (advanced technology microwave sounder). ATMS sensor has a mission to provide microwave cross-track sounding profile from atmospheric temperature and humidity together with CrIS sensor for weather forecasting and climate applications. ATMS consists 22 spectral bands with wavelengths between 23-183 GHz. The spatial resolution on nadir direction between 15.8 to 74.8 km with a maximum average data rate 32 kbps. ATMS combines microwave sounder measurement capability on several sensors such as AMSU-A (Advanced Microwave Sounding Unit) and MHS (Microwave Humidity Sounders) at POEs-NOAA satellites. ATMS provide atmospheric temperature and humidity profiles with microwave sounders (Golberg 2014; JPSS-NOAA 2016). Figure 4 shows example of image data usedfrom channel-18 ATMS sensor for measuring atmospheric temperatures.

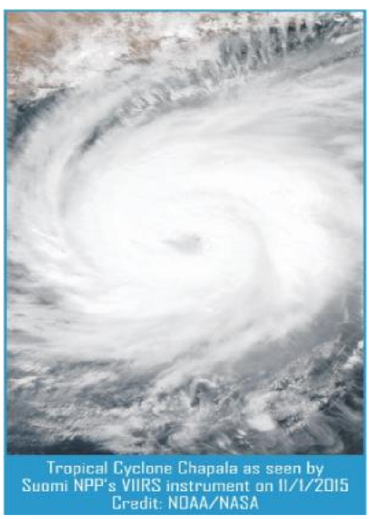

Figure 2. VIIRS image data for monitoring tropical storm example.

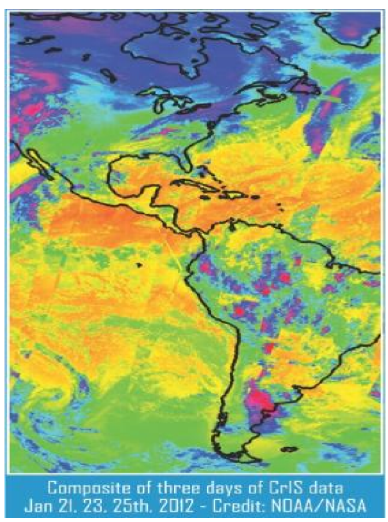

Figure 3. 3-days CrIS composite image data example.

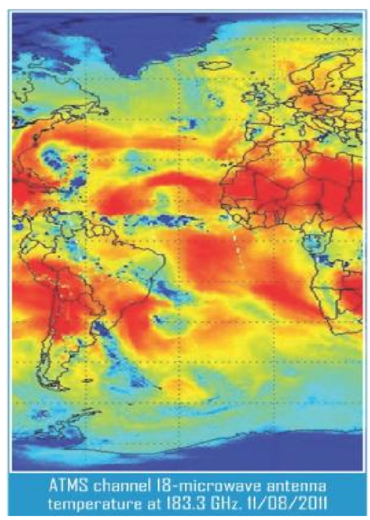

Figure 4. Channel-18 ATMS image data example to measurement atmospheric temperature.

OMPS (ozone mapping and profiler suite). OMPS Sensor has a mission to measure ozone concentration in the Earth's atmosphere and observes ozone health level in the atmosphere. OMPS has spectral wavelengths between 0.3 to 0.38 μm for mapper with a spatial resolution 50 km, while the profiler between 0.25 to 0.31 μm with a spatial resolution 250 km. OMPS has swath width 2800 km for mapper. OMPS consists three spectrometers i.e. downward-looking nadir mapper (OMPS suite), nadir profiler (OMPS-N), and limb profiler (OMPS-L). OMPS collect data and total vertical ozone profile in order to produce real-time ozone monitoring systems as well as SBUV/2 (Solar Backscatter Ultraviolet Radiometer) and TOMS (Total Ozone Mapping Spectrometer) on NOAA but with better skills and wider swath width. If OMPS data combines with cloud predictions, it will produce UV (ultraviolet) index value to give a warning of UV radiation dangers. In addition, OMPS data also can be used to measure the concentration of particles such as sulfur dioxide in the atmosphere due to volcanic eruption, which is useful for aviation safety warnings (Golberg 2014; JPSS-NOAA 2016). Figure 5 shows an example of image data usedfrom OMPS sensor for measuring cross-section of the Earth’s ozone layer.

CERES (clouds and the earth's radiant energy system). CERES sensor has a mission to measure the reflection of sunlight and thermal radiation emitted into the Earth's surface. CERES is composed of three spectral channels with a variety of wavelength coverage between 0.3 to 15.38 μm, 8-12 μm, and 0.3 to 50 μm. Spatial resolution is 20 km with average data rate 10.52 kbps. CERES FM5 satellite is currently operating at S-NPP while FM6 CERES satellite is planned to be carried on JPSS-1. CERES help provide spatial and temporal distribution measurements of the ERB (Earth radiation budget)components. ERB parameters will helps to understand the correlation between in and out coming energy from the earth and the atmosphere properties that affect the energy (Golberg 2014; JPSS-NOAA 2016). Figure 6 shows an example of image data usedfrom CERES sensorfor measurement of sunlight reflection to the Earth.

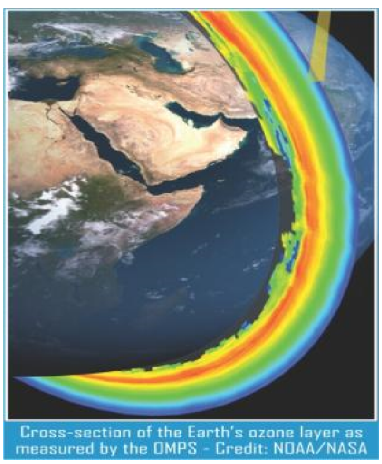

Figure 5. OMPS image data of a cross-section of the Earth's surface ozone layer example.

Figure 6. CERES image data for the measurement of reflected sunlight to the Earth example.

3. Methodology

Since May 2012, LAPAN has been receivingS-NPP satellite data with Direct Broadcast (DB). However, until now JPSS-1 has not been launched and released the information about data format anddata processing software. But, considering that JPSS-1 is the continuation of the S-NPP mission, and S-NPP data still receives and processes until today in LAPAN RSGS, the authors built an assumption that JPSS-1 satellite data will be able to received and processed by the similar processing system asS-NPP system relatively. So, the implementationof JPSS-1 satellite data acquisistion and processing systemin this case will be similar to the S-NPP.

The methodologiesthat used in this study are literature review about JPSS satellites and ground stations system of remote sensing from various sources on the internet (technical documents of satellites and ground stationssystem, scientific papers and proceedings, and other documents related) which explain aboutsensor satellites specifications, communication system and data transmission, and other parameters related to the JPSS satellite data reception. To get more practical information about how to receive JPSS satellite data, we have study the existing system implementation of LAPAN Remote Sensing Ground Stations (RSGS) Pare-Pare, South Sulawesi, especially for the S-NPP satellite acquisition and data processing system and another remote sensing data acquisition and processing system for environmental and weathermonitoring satellite. And then try to review the common existing parameters onLAPAN RSGS for S-NPP data reception, we have basic information about satellite data acquisition system (antenna, receiver, demodulator, ingestsystem, wiring and antenna protection) and satellite data processing system(hardware and software for data communication and processing). These information will be used to design the preliminary systems for JPSS-1 satellite data acquisition and processing system.

4. Results and discussion

4.1 Environment and weather satellite data acquisition by LAPAN

Since 1960, NOAA has operated the environmental monitoring and weather satellites generation, known as POEs (Polar-Orbiting Operational Satellite Environtment), with a series of satellites include the TIROS 1-10, ESSA 1-9, and ITOS 1-8 which bring two cameras and several radiometer. Then in 1978, NOAA has launched a series of satellites namely TIROS-N and NOAA 6-14 that first time brought AVHRR (Advanced Very High Resolution Radiometer) sensor and three sounders. Then in 1998, NOAA has launched the NOAA-15 satellite with new sensors addition such as AMSU (Advanced Microwave Sounding Units) which has been enhancedthan AVHRR. And then in 2005, NOAA-18 launched by addition a high resolution new sensor i.e. HIRS (High Resolution Infrared Radiation Sounder). After the operational of NOAA environmental satellitesgeneration, they was launched NPP (NPOESS Preparatory Project) satellite in 2011, now better known as Suomi-NPP or S-NPP which is part of collaboration between NOAA and NASA. POESS is a continuation of the National Polar-Orbiting Operational Environmental Satellite System. In the program, the S-NPP carries five latest sensor (VIIRS, OMPS, CERES, ATMS and CRIS) by increasing the radiometric resolution and spatial resolution and swath width coverage than the previous generation of environmental satellites belonging to NOAA. And as soon as S-NPP expired in operation in 2016, it will be followed by JPSS-1 (Joint Polar sateliite System) which carries the same mission sensors with S-NPP. JPSS-1, often called by the name NOAA-20, is planned for launch in 2017 (Cikanek 2015).

And since 1999, LAPAN RSGS has acquired a lot of environmental and weather data from MODIS Terra (1999) and Aqua (2002)satellite. Then since 2005, LAPAN also acquire NOAA-18 AVHRR (2005), MetOp-AAVHRR/3(2006), NOAA-19 (2009), MetOp-B (2012) data. Since 2011 and now,LAPAN RSGS received S-NPPVIIRS data. Furthermore,LAPANwill be planedtoacquireJPSS-1 or NOAA-20 VIIRS data as the S-NPP continuation mission which planned to be launched in 2017. Table 2 shows the environmental and weather satellite data that has been acquired by LAPAN RSGS since 1999 until today.

Table 2. Environments and weather satellites data acquired by LAPAN since 1999 until now (Source: LAPAN RSGS Pare-Pare, South Sulawesi)

Acquisition by LAPAN	TERRA	AQUA	NOAA-18	MetOp-A	NOAA-19	MetOp-B	SUOMI NPP	JPSS-1/ NOAA-20*
Launch Date	December 18, 1999	May 4, 2002	May 20, 2005	October 19, 2006	February 6, 2009	September 17, 2012	October 28, 2011	2017
sensors	MODIS (Moderate Resolution Imaging Spectroradiometer)	MODIS (Moderate Resolution Imaging Spectroradiometer)	AVHRR (Advanced Very High Resolution Radiometer)	AVHRR / 3 (Advanced Very High Resolution Radiometer)	AVHRR / 3 (Advanced Very High Resolution Radiometer)	AVHRR / 3 (Advanced Very High Resolution Radiometer)	VIIRS (Visible Infrared Imaging Radiometer Suite)	VIIRS (Visible Infrared Imaging Radiometer Suite)
	ASTER (Advanced Spaceborn Thermal Emission and Reflection Radiometer)	AMSR-E (Advnaced Microwave Scanning Radiometer-EOS)	HIRS (High Resolution Infrared Radiation Sounder)	HIRS / 4 (High Resolution Infrared Radiation Sounder)	HIRS / 4 (High Resolution Infrared Radiation Sounder)	HIRS / 4 (High Resolution Infrared Radiation Sounder)	ATMS (Advanced Technology Microwave Sounder)	ATMS (Advanced Technology Microwave Sounder)
	MISR (Multi-angle Imaging Spectro Radiometer)	AMSU-A (Advances in Microwave Sounding Unit)	AMSU-A (Advanced Microwave Sounding Units)	AMSU-A1 / A2 (Advanced Microwave Sounding Units)	AMSU-A1 / A2 (Advanced Microwave Sounding Units)	AMSU-A1 / A2 (Advanced Microwave Sounding Units)	CrIS (Cross-track Infrared Sounder)	CrIS (Cross-track Infrared Sounder)
	MOPITT (Measurements of Pollution in the Troposphere)	Airs (Atmosphere Infrared Sounder)	MHS (Microwave Humidity Sounder)	MHS (Microwave Humidity Sounder)	MHS (Microwave Humidity Sounder)	MHS (Microwave Humidity Sounder)	OMPS (Ozone Mapping and Profiler Suite)	OMPS (Ozone Mapping and Profiler Suite)
	CERES (Clouds and the Earth's Radiant Energy System)	CERES (Clouds and the Earth's Radiant Energy System)	SBUV (Solar Backscatter Ultraviolet Radiometer)	A-DCS (Advanced Data Collection System)	SBUV / 2 (Solar Backscatter Ultraviolet Radiometer)	A-DCS (Advanced Data Collection System)	CERES (Clouds and the Earth's Radiant Energy System)	CERES (Clouds and the Earth's Radiant Energy System)

*Note: The green color column is the primary sensor data from weather and environment satellites that has been acquired by LAPAN RSGS Pare Pare, while yellow color column is the VIIRS sensor data and other sensor data from JPSS-1 is planned to be acquired by LAPAN.

As previously explained, the current LAPAN RGSS has receive remote sensing satellite data for environmental and weather monitoring i.e. TERRA, AQUA, NOAA-18, NOAA-19, MetOp-A, MetOp-B and S-NPP. Therefore, one approach taken to research on satellite data acquisition JPSS-1 is reviewing basic parameters for the satellite data receiving and processing based on ground station operational implementation currently. By review the existing system we can get minimum standard parameters for receiving and processing JPSS-1data. And this parameters will be expected to make the preliminary design of JPSS-1 data receiving and processing system.

To determine the initial design of a JPSS-1 ground station system it required an analysis of the devices (hardware and software) needed. Analysis of necessary requirements include antenna system needs, demodulator and ingest system, coaxial cable and antenna protection system needs from overvoltage and lightning disturbances.

4.2 Antenna needs

To determinea receiver antenna type for JPSS-1satellite data acquisition, the first thing to do is determine the minimum G/T (Antenna Gain to Noise Temperature) antenna for JPSS-1satellite data acquisition. G/T is intended to determine the performance characteristics of the antenna (antenna sensitivity).

Based on the information contained in the technical document "JPSS-1 (Joint Polar Satellite System 1 (JPSS-1) Spacecraft High Rate Data (HRD) to Direct Broadcast Station (DBS) Radio Frequency (RF) Interface Control Document (ICD)" 11 December 2014, there are minimum standard parameters (JPSS-1 parameter link) required in a ground station antenna system to receive JPSS-1dataas follows: antenna with 3 meters diameter, at 5 degrees elevation and 15 Mbps data rate, the minimum G/T antenna about 22.70 db/K at 7812 MHz center frequency, RHCP (Right Hand Circular polarization) antenna polarization.The authors make a link budget analyisis calculation for these parameters. And these are results of the calculation as follows:

- *Total Transmited Power*(Pt), which power signal transmit from the satellite antenna toward the ground station antenna receiver on Earth (Wikipedia 2016). Pt value expressed by the equation:
  P = 10Log (p) + 30 = 10Log (8) + 30 = 9.03 + 30 = 39.03089 987 dBm (1)
  Where: p = transmitted power about 8 Watt (based on the link parameter JPSS-1 document)
- *Equivalent Isotropic Radiated Power* (EIRP), which is the amount of power from a theoretical isotropic antenna (which energy is distributed in all directions) emitted to produce peak power density observed in the direction of maximum antenna gain (Wikipedia 2016). EIRP values expressed by the equation:
  EIRP = Pt + Gt + Li = 39.03 + 5.87 + (-2) = 42.9 dBm (2)
  Where: Pt = Total Transmitted Power (results of calculations) the amount of 39.03089 987dBm
  gt = *antenna Gain* at ± 62 degrees (on the document link parameter JPSS-1) the amount of 5.87 dBi
  Li = *passive Loss* for cables, switches and filters (based on the link parameter JPSS-1document) the amount of -2.0 dBi
- *Free Space Loss Dispersion*(FSL), the loss of signal strength of the electromagnetic wave that would result from a line-of-sight through free space (usually air), with no nearby obstacles that could cause a reflection or diffraction (Wikipedia 2016). FSL value expressed by the equation:
  FSL = -92.45 - 20log (S) - 20log (f) (3)= -92.45 - 20log (2835) - 20log (7812) = -92.45 - 69051-17855 = -179.4 dB
  Where: S = distance to the satellite antenna (Propagation Path Length) is 2835 km
  f = Frequency satellite downlink amount of 7.812 GHz
- Receive Antenna Power SB/Total Received Power (Pr/T), which is the ability of an antenna receives signals from satellites in total (EIRP) and antenna gain after deducting the power loss due to the influence of the atmosphere, polarization, multipath, and so forth. Pr/T expressed in value to the equation:
  Pr/T = EIRP - (FSL + Lpol + La + Lc + Lr) + G/T (4)
  = 42.9 + (-179.4 - 0.2 - 3.65 - 0.2 - 1) + 22.7 = 42.9 - 22.7 = 185.45 + -118.85 dBm/K
  Where: EIRP = Equivalent Isotropic Radiated Power magnitude of 42.9 dBm
  FSL = Free Space Loss Dispersion amount of -179.4 dB
  Lpol = *Polarisation Loss*magnitude of -0.4 dB
  La = *Rain and Atmospheric Loss*the magnitude of -3.65 dB
  lc = *multipath Loss*magnitude of -0.2 dB
  lr = *Ground Antenna Pointing Loss* magnitude of -1.0 dB
  G/T = magnitude of 22.7 dB/K at an elevation of 5 degrees (based on the link parameter JPSS-1document)
- *Carrier to Noise Spectral Density Ratio*(C/No), which is the ratio between the modulated carrier signal power received against the received noise power (Wikipedia, 2016). C/No value expressed by the equation:
  C / No = Pr / T - k = -118.8 - (-198.6) = 79.8 dB-Hz (5)
  Where: Pr / T = Total Received Power magnitude -118.85 dB/K
  k = the Boltzmann constant (10 log (1.38x10-23)) the amount of -198.6 dBm/Hz-K

- *Bit Energy to Noise Ratio*(Eb / No), the SNR (signal to noise ratio) of the received signal, after the receiver filter but before entering bandwitdth in calculation (Wikipedia, 2016). Eb/No value expressed by the equation:
  Eb / No = C / No - R = 79.8 - (10Log (15000000)) = 79.8 - 71.76 = 8:04 dB (6)
  Where: C / No = Carrier to Noise Spectral Density Ratio magnitude of 79.8 dB-Hz
  R = Information Rate (10 log (15 Mbps)) magnitude = 71.76 dB-Hz
- *Fading Margin* (FM), which is the number of received signal level is reduced without causing system performance fall below the required threshold value (Wikipedia, 2016). FM stated value by the equation:
  FM = Eb / No - (Eb / No required) - Limp = 8:04 - 4.4 - 2.5 dB = 1:14 (7)
  Where: Eb / No = Energy Bit to Noise Ratio dB magnitude 8:04
  Eb / No required = Required Eb / No 10-5 BER from Viterbi (based on the link parameter JPSS-1document) = 4.4 dB magnitude
  Limp = *Implementation Loss*magnitude of -2.5 dB

In Table 3 below can be seen that by using an antenna that has a diameter of 3 meters and at an elevation of 5 degrees and a data rate of 15 Mbps, the minimum G / T that is required is equal to 22.70 db / K at the center frequency of 7812 MHz. In addition to the determination of G / T, which is otherwise necessary in determining the selection of the antenna to receive the satellite data is the type of antenna polarization, it is necessary that the acquisition activities receiving data on the antenna goes well. Polarization difference between the transmitter and the receiver antenna will cause reception of data acquisition activities may not run properly. Kind of polarization that are required in performing data reception JPSS-1 is RHCP (Right Hand Circular Polarization), so that the receiving antenna that is used should have a polarization RHCP antenna so that the receiver can receive the transmitted data. The main parameters of both the G / T and type of antenna polarization, can be a reference in the selection of the satellite data receiving antennas offered by the vendor antenna (Ball Aerospace 2015).
If the results of the analysis above link budget associated with the calculation based on conditions existing antenna systems for the reception of data S-NPP existing in SBPJ Pare-Pare, South Sulawesi (as shown in Table 3) would seem a small difference is not significant. This suggests that the existing system is currently (ie ground station receiver satellite data S-NPP) has good potential to be able to receive data JPSS-1 in accordance with the needs of minimal or ideal needs required by the technical documents data communication system on JPSS-1.

Table 3. Antenna Parameters Link from JPSS-1 Satellite & Existing System (5 degrees) at 15 Mbps (Source: Ball Aerospace, 2015 & RSGS Parepare)

	Parameter	Symbol	Value (JPSS)	Value (Pare Pare)	result Calculation (ideal)	unit	source
	Data Rate		15	15	15	Mbps	*Ball Aerospace*
	Polarization		RHCP	RHCP	RHCP		*Ball Aerospace*
input	*frequency*	f	7.812	7.812	7.812	GHz	*input parameters*
input	*Satellite Transmitter Power*	p	8	8	8	Watt	*Spec @ <45 degree C*
	Total transmit power	Pt	39.03	39.03	39.03089987	dBm	*P = 10 log (p) +30*
input	*S / C Antenna Gain*	gt	5.87	5.87	5.87	dBi	*Gain at ± 62 degree Worst case for ±* 1 Pointing
	passive Loss	Li	-2	-2	-2	dB	*7 ft Cable, Switch and Filter Loss*

	Equiv. Isotropic Radiated Power	EIRP	42.9	42.9	42.9	dBm	*EIRP = Pt + Gt + Li*
input	*Propagation Path Length*	S	2835	2835	2835	km	*input parameters (5 degree Elevation Angle)*
	Free Space Loss Dispersion	Ls	-179.4	-179.4	-179.346306	dB	*Ls = -92.44 - 20log (S) - 20log (f)*
	Polarization Loss	Lpol	-0.2	-0.2	-0.2	dB	*Pol loss in antenna gain measurements*
	Rain and Atmospheric Loss	La	-3.65	-3.65	-3.65	dB	*HRD IRD spec'd*
	multipath Loss	lc	-0.2	-0.2	-0.2	dB	*HRD IRD spec'd*
	Ground Antenna Pointing Loss	lr	-1	-1	-1	dB	*3 Meter Ground Antenna*
	IF Cable Loss			-8		dB	*100 Meters from Antenna to Demodulator*
from input	*Ground Station G / T*	G / T	22.7	22.7	22.7	dB / K	*HRD IRD G / T at 5 degree elevation angle*
	Total Received Power / T	Pr / T	-118.8	-117.093	-118.85	dBm / K	*Total Power From Space*
input	*Boltzmann's Constant*	k	-198.6	-198.6	-198.6	dBm / Hz-K	*k = 10 log (1.38 * 10-23)*
	Total Received Power / kT	C / No	79.8	81.5075	79.8	dB-Hz	*Total Power-K*
				Data Channel (QPSK)			
	Data Power / kT	C / No	79.8	79.8	79.8	dBm / Hz / KT	
input	*information Rate*	R	71.76	74.77121	71.76	dB-Hz	*10 log (15 Mbps)*
	Available Eb / No	Eb / No	8.04	6.736287	8.04	dB	*From Link Analysis Using Viterbi*
input	*Rqd Eb / No 10-5 BER from Viterbi*	Req Eb / No	4.4	4.4	4.4	dB	*HRD IRD spec'd*
	Implementation Loss	Limp	-2.5	-2.5	-2.5	dB	*IRD specified implementation loss*
	Available Signal Margin (Fading Margin)	FM	1.14	2.336287	1.14	dB	*1 dB Margin Required*

4.3 Demodulator and ingest system requirement

Another thing that is required to perform data reception JPSS-1 is a demodulator and ingest system. Once the signal is received by the receiving antenna further demodulator will perform data collection of the information signal received by the antenna by performing demodulation and decoding signals from the signal received by the antenna, and then signals the result of the demodulation and decoding will be done recording system using ingest, the data recording these will then be stored in storage media such as hard disks. From the data sheet published by Ball Aerospace on the type of modulation and encoding of data JPSS-1, it can be seen that the type of modulation used is QPSK with a Viterbi and Reed Solomon encoding. From this reference, the demodulator and ingest system that should be used in the data receiving ground station JPSS-1 has a QPSK modulation type and have the kind of Viterbi and Reed Solomon encoding (Hidayat 2015; Setyasaputra 2014).

4.4 Coaxial cable needs

Determination of the coaxial cable is also an important effect on the success or failure of data reception Satellite JPSS-1. The receiving antenna that has a quality G / T is good but when it does the data recording, data produced has a poor quality or can not be processed. This can happen because of the location of the antenna to the control room where demodulator attached has a remote location and the coaxial cable used has quality damping high so that the resulting signal is sent from the antenna to the demodulator many are lost in transit (Hidayat 2015; Setyasaputra 2014).

To overcome this, the consideration of cable used by the receiving antenna to the control room must be in accordance with the technical specifications of ground stations to receive satellite data is JPSS-1. Based on the reference link budget calculation of Ball Aerospace for data reception JPSS-1 satellite, cable loss is allowed only 8 dB per 100 meters. References obtained from the cable loss of some types of coaxial cable, coaxial cable types Heliax Andrew 0.5 cm has good quality because it has a cable loss / attenuation 6:01 dB per 100 meters. Details of the damping of each type of coaxial cable can be seen in the table below.

Table 4, Comparison Coaxial Cable Attenuation

No.	Cable Type	Attenuation per 100 meter (dB)
1	Andrew Heliax 0.5 cm	6:01
2	Belden Coaxial RG 8	11

4.5 Antenna system protection

Another thing that is important in building a data reception system JPSS-1 is the antenna protection system and devices from overvoltage and lightning disturbances. Satellite data receiving antenna is ideally mounted higher than the buildings nearby, so the chances of being struck by lightning is very large. Methods of protection to protect the antenna and device of interference overvoltage and lightning strikes using Faraday method, wherein the method uses copper wire that ran above the antenna. The copper wire is connected to the lightning protection system which has a barrier of land less than 1 ohm. So in case of a lightning strike on the antenna, the electric energy of the lightning strike results contained in the lightning protection system can be disposed of quickly. Earthing lightning rod with body grounding device should be separated so that if there is a lightning strike electrical energy results not me-looping into the attached device. At the point of electrical connection paneled box paired arrester and arrester is connected to earth, so that in the event of overvoltage on the device can be discarded (Setyasaputra 2014).

4.6 Preliminary design of JPSS-1 satellite data acquisition and recording

From the analysis of the needs of satellite data acquisition and recording based on the study of literature to be able to perform reception and recording of data Satellite JPSS-1, it can be described an initial design system for receiving and recording of data JPSS-1.

The details of the design / drafting initial reception system and data recording JPSS-1 can be seen in Figure 7. Overall, the design / drafting early to be able to receive and record data on JPSS-1 with a frequency of 7.812 GHz downlink then needed a receiver antenna system with a minimum diameter 3 meter, G / T> 22.70 dB / K (at an elevation of 5 degrees), the antenna polarization RHCP (Right Hand Circular polarized). Then also required a system acquisition and reception of data in the form of demodulator and ingest system with QPSK modulation (*Quadrature Phase Shift Keying*) And encoding using the Viterbi and Reed Solomon. It is also important cabling system with a distance of less than 100 meters at 6:01 dB attenuation coefficient, as well as the protection system in the form of a lightning rod antenna with Faraday methods which have barriers of land less than 1 Ohm.

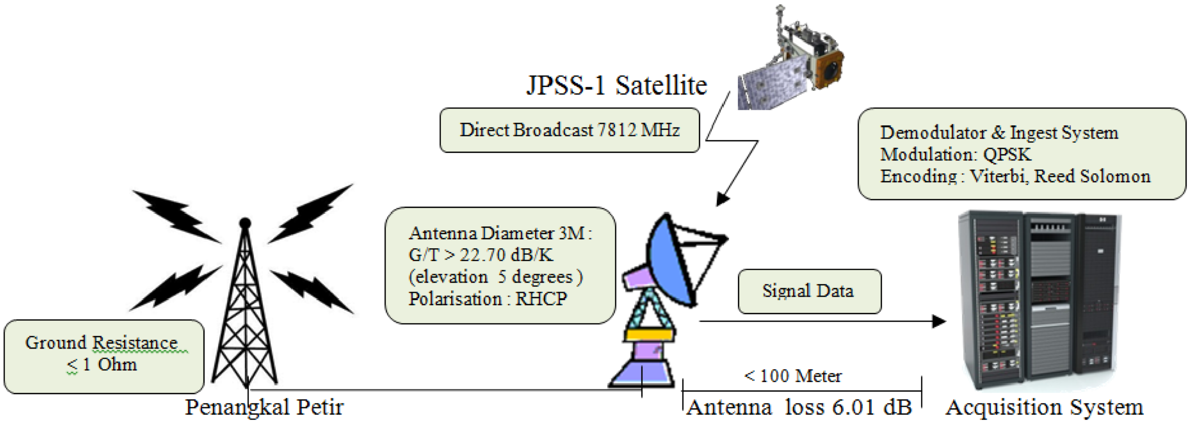

Figure 7. Architecture design for JPSS-1 signal acquisition system

4.7 Preliminary design of JPSS-1 satellite data processing

Since May 2012, S-NPP satellite data (Suomi National Polar-Orbiting) has accepted Direct Broadcast (DB) by remote sensing ground station National Institute of Aeronautics and Space (LAPAN) located in the town of Pare Pare, South Sulawesi. JPSS-1 (Joint Polar Satellite System) is scheduled to be launched in 2017 to continue the mission of earth monitoring conducted by S-NPP. As with S-NPP, JPSS-1 will also carry five main sensor is VIIRS (Visible Infrared Imaging Radiometer Suite), CrIS (Cross-track Infrared Sounder), ATMS (Advanced Technology Microwave Sounder), OMPS (Ozone Mapping and Profiler Suite) and CERES (Clouds and the Earth's Radiant Energy System). Keep in mind that until now JPSS-1 has not been released and has not released information regarding the format of the data and software for data processing. But considering that JPSS-1 is the continuation of the mission of the data reception S-NPP, and given the ability of the ground station remote sensing LAPAN Pare-Pare, South Sulawesi to receive and process data S-NPP since 2012 until today, the authors establish the assumption that in principle the data JPSS-1 will be able to be accepted and processed by the processing system that is relatively similar to the reception and processing of data on the S-NPP. So the assumption is that the data is built JPSS-1 received by the remote sensing ground station Pare-pare, South Sulawesi is the data format and data processing techniques similar to the data S-NPP. Therefore the design of the data processing system to be built is by adopting a data processing system implemented on the S-NPP.

To ongoing data processing system JPSS-1 required hardware and software. Hardware devices that are used in the system is designed using a processor with 24 cores with each core speed of 2.4 GHz and 64 GB of memory and communications network that connects computer servers in Pare Pare acquisition by computer processing server in Jakarta through a Virtual Private Network (VPN) with a capacity of 40 Mbps. Overall hardware used in the design of the data processing system of remote sensing satellites wherever possible JPSS-1 is designed to be able to meet the minimum specifications as required in the installation of technical documents and software operating system RT-STPS version 5.5. and the Internet as a communications network that connects computer servers Space Science and Engineering Center (SSEC) and processing systems for purposes ancillary data transfers required in the processing of 40 Mbps (shared). However, most hardware should get attention is the storage system. Limited capacity storage system will be directly related to one of the attributes most important quality of the system, namely keterawatan (maintainability) (Pahl et al. 2009). And for the purposes of sending rawdata to be processed the data processing storage systems are designed with a minimum capacity of 23 TB.

As shown in Figure 8, the draft system data processing JPSS-1 is done on a computer server in Jakarta after receiving the results data acquisition and recording satellite JPSS-1 in the level rawdata of aquisition server in Pare-pare, South Sulawesi over communications networks Virtual Private Network (VPN) to be immediately processed and distributed further.Sequence levels of satellite data JPSS-1 from its smallest to greatest level is rawdata, Raw Data Record (RDR), Sensor Data Record (SDR) / Temperature Data Record (TDR), Application Related Product (ARP) / Environmental Data Record (EDR), and the Climate Data Record (CDR). Data in the level rawdata must be processed into levels higher as Raw Data Record (RDR), Sensor Data Record (SDR), the Environmental Data Record (EDR), and the Climate Data Record (CDR) (Gustiandi et al. 2013).

As for the operating system used by the computer processing server is Linux CentOS operating system version 6.3 (http://www.centos.org) and software Real-time Software Telemetry Processing System (RT-STPS) (http: //directreadout.sci .gsfc.nasa.gov) is used as the core of the system. RT-STPS is software to process satellite data S-NPP from level to level rawdata RDR. Bash shell scripting language used to integrate the software tools used in building systems and manufacture incident tracking program to generate the log file processing from level to level rawdata RDR. Consideration of the use of scripting languages is because the scripting language is a scripting language which is the most comprehensive to be used in a programming environment based on the Linux operating system (Parker 20111 Shoots Jr 2012). In addition, RT-STPS software which is the main processing software from level to level rawdata RDR will be built using the bash shell scripting language. Then the system to process data from RDR level to level as for the SDR VIIRS instrument, and so is the software integrating Community Satellite Processing Package (CSPP) Science Data Record (SDR) (http://cimss.ssec.wisc.edu/cspp /) (Indradjad and Gustiandi 2013). Furthermore, the software CSPP EDR will also be built to process data VIIRS instrument JPSS-1 satellite from level to level EDR SDR. This temporary system will be designed using the operating system and devices based on open source software that can be implemented on computers other servers without having constrained by the license.

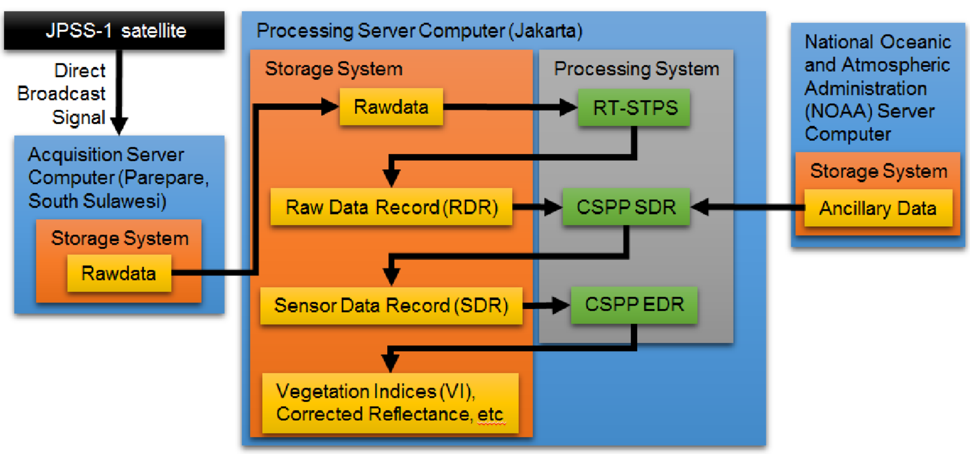

Figure 8. Architecture design for JPSS-1 data processing system

To produce a useful system, keterawatan attribute must be met by the system being developed. So that the capacity of storage systems available need to be evaluated in order to know whether these capacities can already accommodate the needs of satellite remote sensing data storage JPSS-1 as well as processed products both for now and until the age of satellite missions is expected to end. In addition it is necessary to evaluate also related to processing speed in relation to whether the development is done affect the nature of the systems that are already near real time.

4.8 General design of JPSS-1 satellite data reception and processing systems

In general, the initial design of the system for receiving and processing the data JPSS-1 can be seen in Figure 9. The figure shows that the design of the system to be able to receive and record data on

JPSS-1 with a frequency of 7.812 GHz downlink is a receiving antenna system with a minimum diameter of 3 meters, G / T> 22.70 dB / K (at an elevation of 5 degrees), the antenna polarization RHCP (Right Hand Circular polarized). Then also required a system acquisition and reception of data in the form of demodulator and ingest system with QPSK modulation (Quadrature Phase Shift Keying) and encoding using the Viterbi and Reed Solomon. It is also important cabling system with a distance of less than 100 meters at 6:01 dB attenuation coefficient, as well as the protection system in the form of a lightning rod antenna with Faraday methods which have barriers of land less than 1 Ohm.

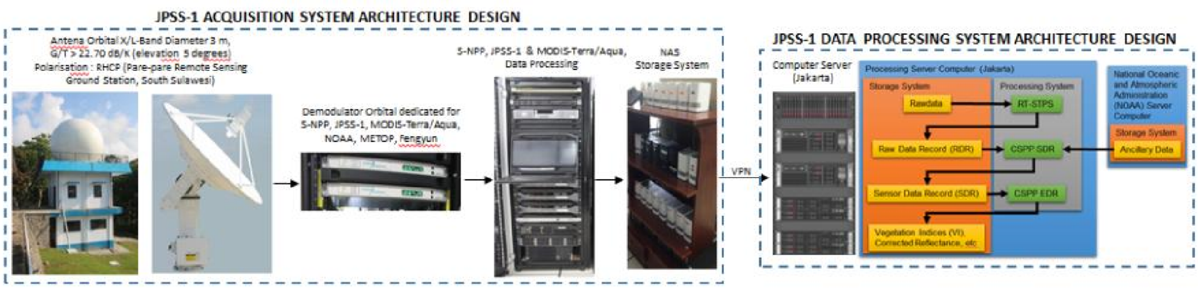

Figure 9. Architecture design for JPSS-1 signal acquisition and the data processing system

In terms of data processing, necessary hardware and software. Hardware devices aquisition server in Pare-pare, South Sulawesi used in the system is designed using a processor with 24 cores with each core speed of 2.4 GHz and 64 GB of memory and communications network that connects computer servers in Pare Pare acquisition with a computer server processing in Jakarta through a Virtual Private Network (VPN) with a capacity of 40 Mbps. Overall hardware used in the design of the data processing system of remote sensing satellites wherever possible JPSS-1 is designed to be able to meet the minimum specifications as required in the installation of technical documents and software operating system RT-STPS version 5.5. And for the purposes of sending rawdata to be processed the data processing storage systems are designed with a minimum capacity of 23 TB.

For data processing software JPSS-1 is done on a computer server in Jakarta after receiving the results data acquisition and recording satellite JPSS-1 in the level rawdata of aquisition server in Pare-pare, South Sulawesi over communications networks Virtual Private Network (VPN) that can be immediately processed and distributed further. Sequence levels of satellite data JPSS-1 from its smallest to greatest level is rawdata, Raw Data Record (RDR), Sensor Data Record (SDR)/Temperature Data Record (TDR), Application Related Product (ARP)/Environmental Data Record (EDR), and the Climate Data Record (CDR). Data in rawdata level must be processed into levels higher as Raw Data Record (RDR), Sensor Data Record (SDR), the Environmental Data Record (EDR), and the Climate Data Record (CDR). In this case the operating system used by the computer processing server is Linux CentOS operating system version 6.3 (http://www.centos.org) and software Real-time Software Telemetry Processing System (RT-STPS) (http: // directreadout .sci.gsfc.nasa.gov) is used as the core of the system. RT-STPS is software to process satellite data S-NPP from level to level rawdata RDR. Bash shell scripting language used to integrate the software tools used in building systems and manufacture incident tracking program to generate the log file processing from level to level rawdata RDR. Then the system to process data from RDR level to level as for the SDR VIIRS instrument, and so is the software integrating Community Satellite Processing Package (CSPP) Science Data Record (SDR) (http://cimss.ssec.wisc.edu/cspp/). Furthermore, the software CSPP EDR will also be built to process data VIIRS instrument JPSS-1 satellite from level to level EDR SDR. This temporary system will be designed using the operating system and devices based on open source software that can be implemented on computers other servers without having constrained by the license.

5. Conclusion

Based on the analysis of the results of the literature study found some important points in planning the ground station satellite data reception JPSS-1. On the side of the receiving antenna, the antenna is required which has a G / T over 22.70 dB / K at an elevation of 5 degrees with the polarization RHCP, on the side of the demodulator and ingest system that has the required demodulator QPSK modulation with Viterbi and Reed Solomon encoding. In addition to consider is the distance between the receiver antenna to the demodulator stored in the control room should not be more than 100 meters, because will cause power losses are high if the location of the receiving antenna to the control room of more than 100 meters. To overcome the power losses that arise as a result of the cable used, it is recommended to use a coaxial cable with a 0.5 cm Andrew Heliax kind, because it has good quality with 6:01 dB attenuation per 100 meters. Apart from the reception and recording of data, it is no less important in planning the construction of a data recording system for receiving satellite data is useful building protection system to protect the antenna and the device from over voltage disturbances and lightning strikes.

In terms of data processing, necessary hardware and software. Hardware devices aquisition server in Pare-pare, South Sulawesi used in the system is designed using a processor with 24 cores with each core speed of 2.4 GHz and 64 GB of memory and communications network that connects computer servers in Pare Pare acquisition with a computer server processing in Jakarta through a Virtual Private Network (VPN) with a capacity of 40 Mbps. And for the purposes of sending rawdata to be processed the data processing storage systems are designed with a minimum capacity of 23 TB. As for the data processing software JPSS-1 is done on a computer server in Jakarta after receiving the results data acquisition and recording satellite JPSS-1 in the level rawdata of aquisition server in Pare-pare, South Sulawesi over communications networks Virtual Private Network (VPN) in order to immediately processed and distributed further. Sequence levels of satellite data JPSS-1 from its smallest to greatest level is rawdata, Raw Data Record (RDR), Sensor Data Record (SDR)/Temperature Data Record (TDR), Application Related Product (ARP)/Environmental Data Record (EDR), and the Climate Data Record (CDR). Data in rawdata level must be processed into levels higher as Raw Data Record (RDR), Sensor Data Record (SDR), the Environmental Data Record (EDR), and the Climate Data Record (CDR). In this case the operating system used by the computer processing server is Linux CentOS operating system version 6.3 (http://www.centos.org) and software Real-time Software Telemetry Processing System (RT-STPS) (http://directreadout .sci.gsfc.nasa.gov) is used as the core of the system. RT-STPS is software to process satellite data S-NPP from level to level rawdata RDR. Then the system to process data from RDR level to level as for the SDR VIIRS instrument, and so is the software integrating Community Satellite Processing Package (CSPP) Science Data Record (SDR) (http://cimss.ssec.wisc.edu/cspp /). Furthermore, the software CSPP EDR will also be built to process data VIIRS instrument JPSS-1 satellite from level to level EDR SDR. This temporary system will be designed using the operating system and devices based on open source software that can be implemented on computers other servers without having constrained by license.

Acknowledgement

The authors thank the LAPAN, especially Remote Sensing Ground Stations (LAPAN RSGS) Pare Pare who have provided input in the form of documents related to the existing condition of the ground station as study materials understanding of the implementation of the system ground station for receiving and recording satellite remote sensing data JPSS-1, as well as research groups, development and engineering (poklitbangyasa) acquisition technology and remote sensing ground station and the technology Center of remote sensing Data LAPAN Jakarta who have provided information and documents related to satellite data processing system S-NPP as a material for designing a data processing system JPSS-1 satellite.

References

Ball Aerospace 2015 Interface Control Document, NPP Spacecraft High Rate Data (HRD) RFICD to the Direct-Downlink Stations. Ball Aerospace & Technologies Corp.

Cikanek, Harry 2014. JPSS: An Overview. JPSS Newsletter 1st Quarter January - March 2014 Issue 1, April 4, 2014, March 10, 2016 downloaded from http://www.jpss.noaa.gov/pdf/JPSS_Newsletter_1Q14-1.pdf

Cikanek, Harry2015 NOAA Polar Orbiting Satellites, From POEs to JPSS: New Capabilities in Satellite Observations. NOAA Satellite Conference 2015, Greenbelt, MD

Gustiandi B, Indradjad A, Bagdja IW 2013Design of Satellite Data Processing System Suomi National Polar-Orbiting Partnership (S-NPP) of Rawdata to Raw Data Record (RDR).Sensing magazine **6**6 10-14

Gustiandi B, Indradjad A. (2013), Satellite Data Processing System Based S-NPP CSPP: RDR to the SDR. Proceedings of the National Seminar and Expo in Electrical Engineering (SNETE), 56-62

Goldberg, Mitch 2014 Joint Polar Satellite System. JPSS Program Scientist - Satellite Proving Ground, June 2 2014

Goldberg, Mitch 2014 JPSS Overview. JPSS Program Scientist - Joint Polar Satellite System, NESDIS - NOAA, 30 September 2014 WGCV

Hidayat, A., Munawar, STA, Suprijanto, A. and Setyasaputra, N 2014 Integration Receiving and Recording System for NPP Satellite Data at Remote Sensing Ground Station. Proceedings of the IEEE-2014 Makassar International Conference on Electrical Engineering and Informatics (MICEEI). UNHAS. Makassar

Indradjad A, Gustiandi B, Bagdja IW 2013 S-NPP Satellite Automatic Data Processing System: Rawdata to RDR, Proceedings of the National Seminar Pengaplikasi Telematics (SINAPTIKA) 7-12

JPSS-NOAA 2016 What Is This ?, ATMS downloaded February 16, 2016 from http://www.jpss.noaa.gov/ATMS.html.

JPSS-NOAA 2016 What is VIIRS ? downloaded February 16, 2016 from http://www.jpss.noaa.gov/viirs.html.

JPSS-NOAA 2016 What is OMPS ? downloaded February 16, 2016 from http://www.jpss.noaa.gov/omps.html.

JPSS-NOAA 2016 What is CRIS ? downloaded February 16, 2016 from http://www.jpss.noaa.gov/CrIS.html.

JPSS-NOAA 2016 What is CERES ? downloaded February 16, 2016 from http://www.jpss.noaa.gov/ceres.html.

NASA 2014 Joint Polar Satellite System 1 (JPSS-1) Spacecraft High Rate Data (HRD) to Direct Broadcast Station (DBS) Radio Frequency (RF) Interface Control Document (ICD). National Aeronautics and Space Administration (NASA), December 11, 2014

Pahl C, Boskovic M, Barrett R, Hasselbring W. 2009 Quality-Aware Model-Driven Service Engineering.in: Rech J and Bunse C, ed. Model-Driven Software Development: Integrating QualityAssurance. New York: Information Science Reference

Parker S 2011 Shell Scripting: Expert Recipes for Linux, Bash, and More, Indianapolis: John Wiley & Sons, Inc

Setyasaputra, N., Hidayat, A., Hadiyanto, AL, and Munawar, STA 2015 Orbital Antenna Integration Needs Analysis 3.0 with System Has Been Operating at Ground station Ground station Remote Sensing Pare Pare. National Seminar on Remote Sensing (Sinasinderaja) in 2015, the IICC Bogor, Indonesia

Shoots Jr WE 2012 The Linux® Command Line: A Complete Introduction, California: No Starch Press

Wikipedia 2016 Free-space path loss defenition, March 3, 2016 downloaded from https://en.wikipedia.org/wiki/Free-space_path_loss

Wikipedia 2016 *Equivalent Isotropic Radiated Power* (EIRP) defenition, March 3, 2016 downloaded from https://en.wikipedia.org/wiki/Equivalent_isotropically_radiated_power

Wikipedia 2016 Transfer *power output*defenition, March 3, 2016 downloaded from https://en.wikipedia.org/wiki/Transmitter_power_output

Wikipedia 2016 Carrier to Noise Ratio defenition, March 3, 2016 downloaded from https://en.wikipedia.org/wiki/Carrier-to-noise_ratio

Wikipedia 2016 *Energy Per Bit To Noise Power Spectral Density Ratio* defenition, March 3, 2016 downloaded from https://en.wikipedia.org/wiki/Eb/N0

Wikipedia 2016 *Fade Margin* defenition, March 3, 2016 downloaded from https://en.wikipedia.org/wiki/Fade_margin