REAL TIME SEA LEVEL MONITORING DATA COMMUNICATION USING VSAT

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Improving the GLOSS Contribution to Multi-Hazard Warning Systems
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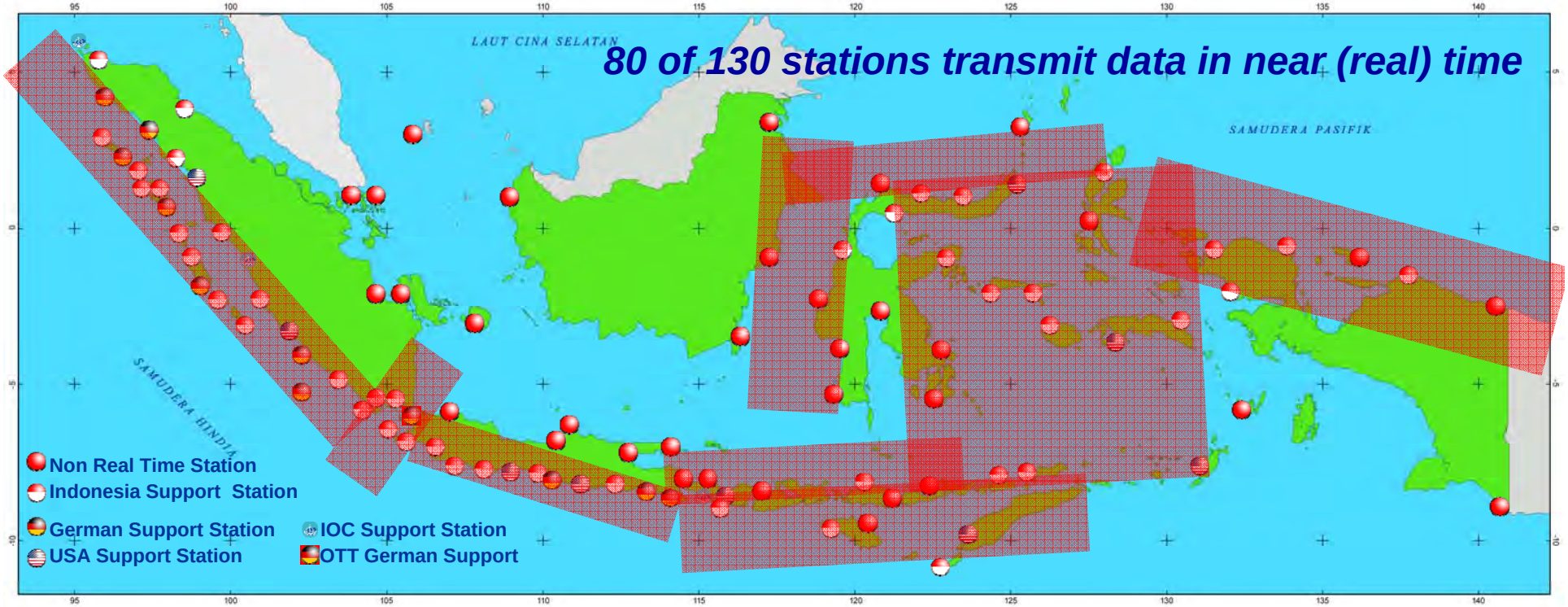
Outline

- The Indonesia TEWS (IdnTEWS) Sea Level Network Grand Design
- Why VSAT?
- The VSAT Sea Level Network Configuration
- VSAT in the Marine Environment
- Power budget with Solar Cell
- Reliability and Quick recovery
- Summary

The IdnTEWS Grand Design (1)



- Potential tsunami sources are very close to the Indonesia coastlines
- Tsunami wave arrival time: 15 minutes!
- Need a fast (real time) data communication

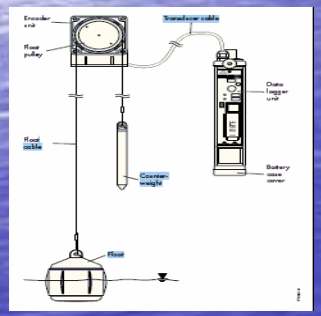
The IdnTEWS Grand Design (2)

- Designed as self-support units:
  - Local infrastructure are susceptible to earthquake
  - Most sea level tsunami monitoring stations are located in the remote areas where local infrastructures are inadequate
- Use of multiple communication links
  - VSAT, GSM/GPRS, GTS/Meteosat, & PASTI/BGAN
- Use of solar cell for power supply

The IdnTEWS Grand Design (3)

- Use of multiple sea level gauges

- Radar gauge: direct measure to sea surface, data sampling 17 values in 40 seconds. The recorded value is the average of data in one minute interval, the remaining 20 seconds is time lag.



- Digital float gauge: data sampling of 1 second, the recorded value is the average of data in one minute interval

- Pressure gauge: 1 second data sampling, the recorded value is the average of data in one minute interval

IdnTEWS Data Work Flow (4)

OBSERVATION

VSAT

GSM

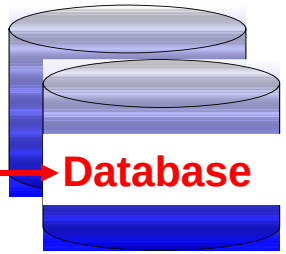
PASTI

GTS

PROCESSING CENTER

BAKOSURTANAL

Server

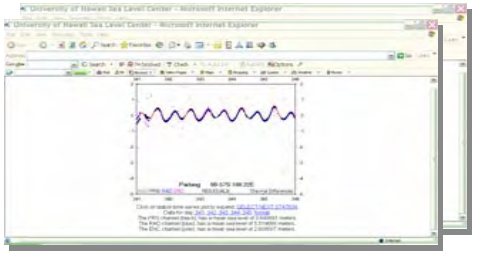


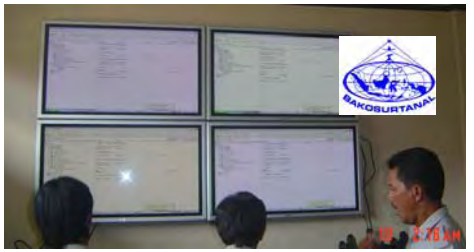
Database

DISPLAY

BMG

IdnTEWS Centre

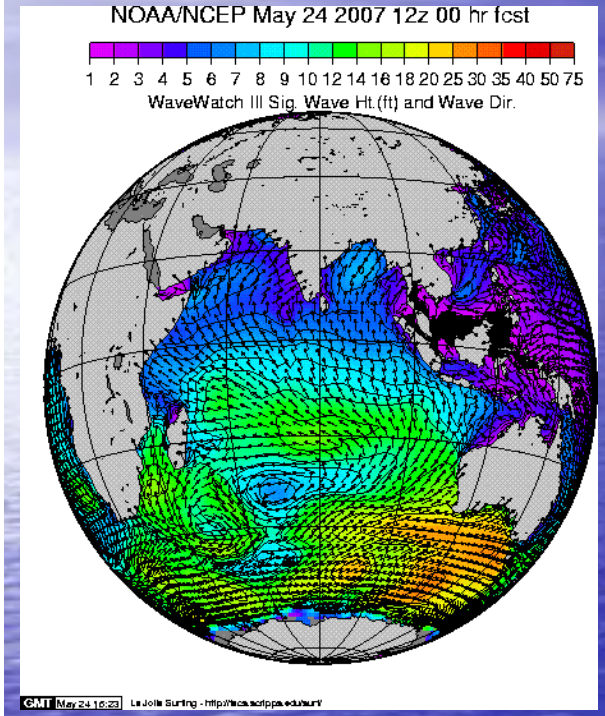


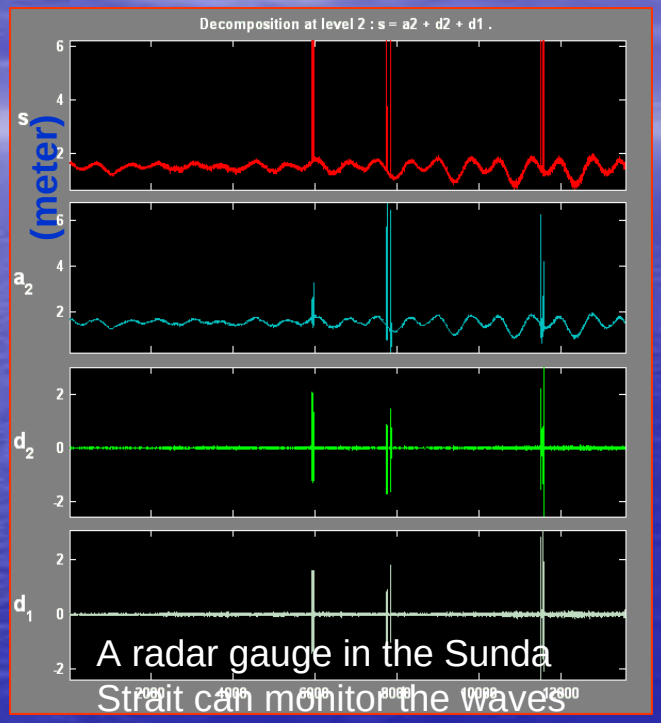


SMS Warning

Mobile access and monitoring

IdnTEWS Project Time Line (5)





A radar gauge in the Sunda Strait can monitor the waves

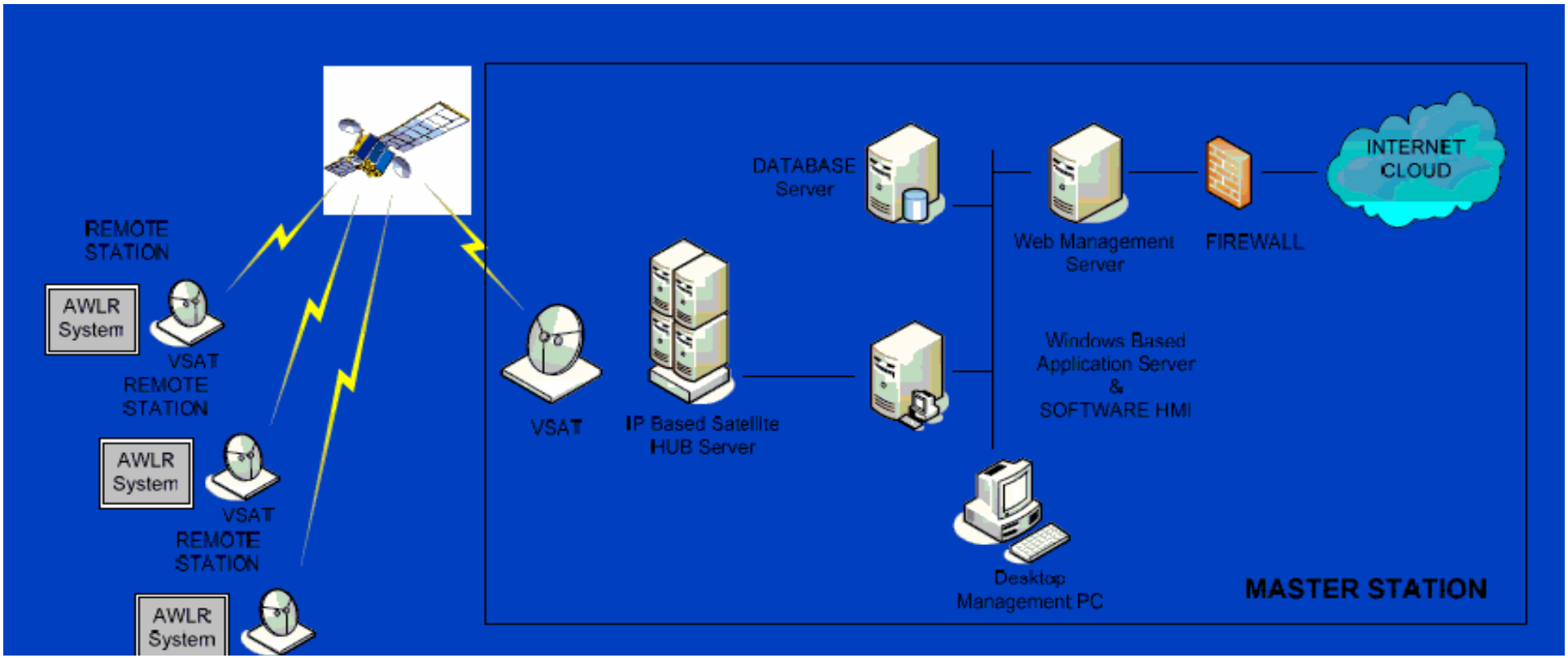
- From tsunami to multi hazard monitoring; a lesson learned from massive waves (strong swell) in Indian Ocean, 17-19 May 2007
- Our target in 2007: installation of 30 VSAT stations
- Our Target: **the IdnTEWS should be fully operational in Dec 2008**

Why VSAT?

Platform	Transmission rate	Coverage in Indonesia	Com. direction	Power Consumption	Cost/yr (USD)
VSAT IP C-band	flexible	good	2-ways	high	8,000
GTS/Meteosat	15' (5'?)	good	1-way	low	free
PASTI/BGAN	flexible	good	2-ways	low	> 20,000
GSM/GPRS	flexible	none in remote	2-ways	low	> 20,000
PSTN	flexible	none in remote	2-ways	low	6000
Radio	flexible	inter visibility	2-ways	high	No air time cost

- VSAT is currently the best choice for a real time data transmission and its flexibility to add data transmission of other sensors: GPS and Meteo Sensor
- PASTI/BGAN would be the most preferable if a special rate is available
- Radio requires tower due to inter station visibility

VSAT Configuration



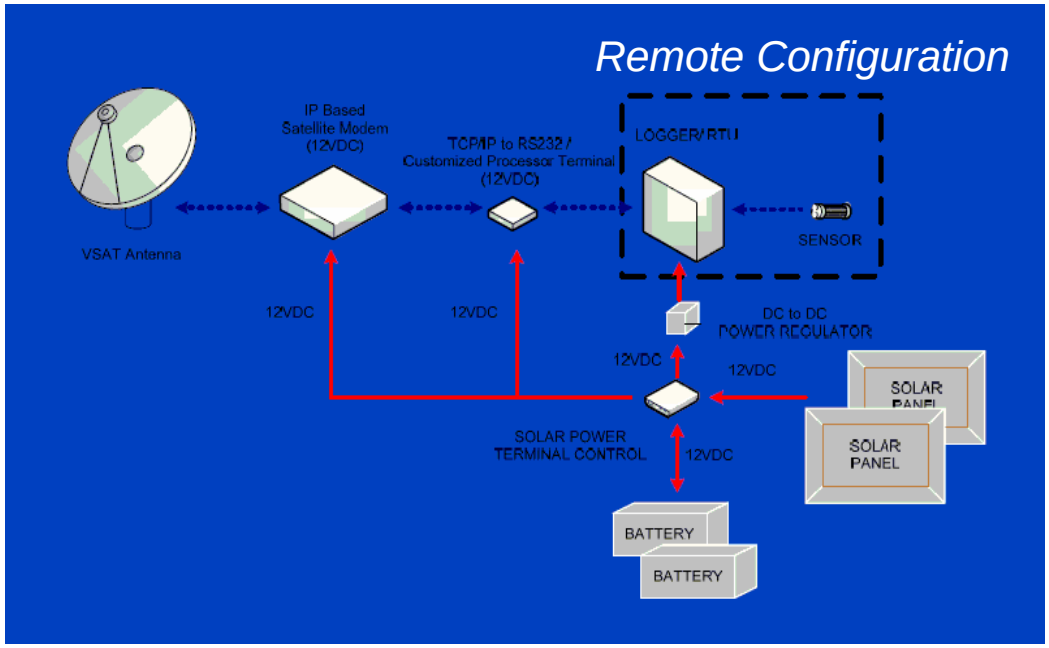
Components:

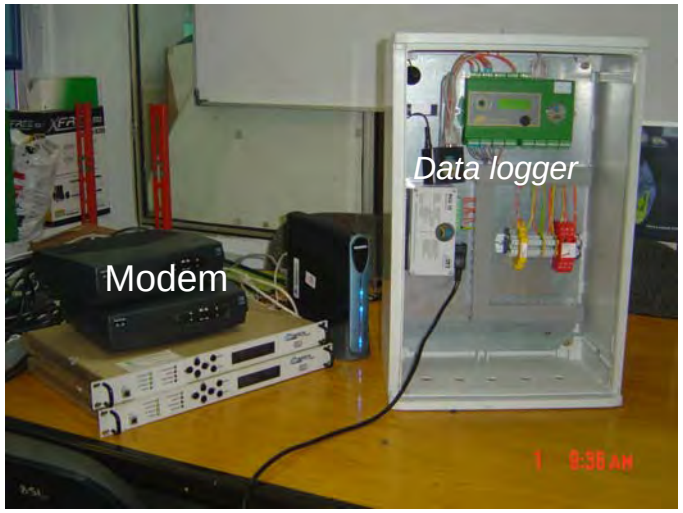
- Master station (The VSAT Provider office)
- Sea Level Processing Center (BAKOSURTANAL) is connected to the master via a fiber optic line.
- Remote sites consists of 30 sea level stations, each 3 sensors

The Master Station

- **Communication link** from all the remote stations is managed by the satellite hub server using IP-based address of the stations.
- **Application Server:** Hydrass software (serial-based with 10 communication ports) will control the remote station acquisition. One PC pools max 8 remote stations per minute
- **VSAT IP bandwidth is 32 kbps** with transmission latency of less than 600 mili seconds.
- **Database Server:** all data will be saved in a database server for data historical check-up, technical administration and data service.
- **Web Management Server:** the web management server will be a stand alone server to get data from the database server for on-line data dissemination.

The Remote Stations





- **Modem** uses TCP/IP protocol to data logger
- **Logger** (serial basis) converts physical unit to data stream and controls data protocol to modem
- **Converter** maps the serial port number to IP address and convert the serial data to TCP/IP format.

A documentation of a trial test carried out by a VSAT Provider , requested before proceeding to the bidding process

Power Budget with Solar Cell

Components	Requirement
VSAT IP terminal	30.0 W
Data logger for sea level sensor	2.0 W
Sensors: float, radar, and pressure gauges	10.0 W
Interface serial to TCP/IP	4.0 W
Power consumption per hour (12 VDC)	44.0 W (3.67 A)
Power consumption per day (44 W x 24 hours)	1056 Wh (88.1 Ah)
Solar cell charging: 4 peaces, @100 Watt (5.83 A), 4 hours/day effective sun shine in the equator	1119 Wh (93.28 Ah)
Usage of batteries: 12 VDC (20 hours)	880 Wh (73.3Ah)
Max charge during sun shine: (73.3 Ah, 4 cells x 5.83 A)	3.73 h
Battery charging per-hour (4 batteries)	19.65 Ah
No sun shine (solar energy charge): 5 days x 88.1 Ah	440.5 Ah
Battery used: 4 units x 150 Ah	600Ah

VSAT in the Marine Environment

A special care and protection:

- Marine environment: high humidity and salinity
- All connectors should be hermetically sealed and no direct contact of the electronic components to the out side air
- The electronic components should be covered with a stainless steel casing and use of a non-air circulation cooler

The Sadeng Station in Java

Reliability and Quick Recovery

- To provide a reliable multi-hazard monitoring system, a quick recovery is a must
- The VSAT providers can guarantee minimum 99.5% operational status per year
- Some challenges for a quick recovery in the vast archipelago:
  - the use of multiple communications can help to ensure which components should need to repair
  - no voice communication to the remote station operators,
  - Handling logistics and traveling to the sites
- The recovery of the system should be done after the earthquake or tsunami hit the stations

Summary

- VSAT is the current best solution for continuous data transmission with a cost effective budget
- The VSAT operation in marine environment should require a special casing and cooler for protecting the instrumentation from damage resulting from high salinity
- A quick recovery of stations from damage and malfunction is a great challenge for the system located in a vast archipelagic condition with difficult access to some sites

thank you .....