

WARNING RECEIVER SYSTEM

FOR DISSEMINATION OF TSUNAMI WARNINGS
AT LOCAL LEVEL IN INDONESIA



**Warning Receiver System (WRS)
for Dissemination of Tsunami Warnings at Local Level in Indonesia**

August 2012

The book is translated from “Warning Receiver System dalam Penyebaran Peringatan Dini Tsunami di tingkat Daerah di Indonesia”, BMKG, August 2012

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Preface

Pursuant to Articles 46 and 47 of Law No. 24/ 2007 on Disaster Management, Article 19 of Government Regulation No. 21/ 2008 on Implementation of Disaster Management and Chapter 2 of Regulation No. 3/ 2008 by the Head of the National Disaster Mitigation Agency (BNPB) on the Guideline on the establishment of Local Disaster Mitigation Agency (BPBD), local governments have a responsibility to immediately and widely announce clear and instructive guidances to assist communities and visitors in their respective areas to react quickly and appropriately to tsunami threats. In order to carry out their responsibilities, local governments form a Local Disaster Management Agency (BPBD) with PUSDALOPS as one of its key components. In several regions that do not have a BPBD, this function is performed by the Civil Defense Agency (Kesbanglinmas). Regarding tsunami early warning, local PUSDALOPS have three main functions: to receive tsunami warnings from the Meteorology, Climatology and Geophysics Agency (BMKG), to make a decision to evacuate if necessary, and to disseminate tsunami warnings and guidances for evacuation to local communities.

The Warning Receiver System (WRS) is one of the “five-in-one” communications tools used by the Central BMKG to disseminate tsunami warnings to all interface institutions, with the local PUSDALOPS (Province or District) being one of them. The WRS equipment and programme that is installed by the Central BMKG in each PUSDALOPS can be used to carry out two of its three main functions, namely to receive tsunami warning messages and to disseminate these warnings and guidances to at-risk communities. Besides local PUSDALOPS offices, WRS equipment and programmes are also placed in other institutions, including the National Police Office and television stations.

This document is complementary to the Guidebook “Dissemination of Early Warning at the Local Level in Indonesia”, which was published by GTZ-IS GITEWS in 2010.

This revised document is the result of collaboration between the Central BMKG in Jakarta and GIZ-IS PROTECTS, and incorporates input based on the experiences of the PUSDALOPS offices in Bantul District and Bali Province, respectively.

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PERINGATAN DINI TSUNAMI



Berpotensi TSUNAMI untuk ditimbulkan pada Masyarakat

CCTV

1. Introduction

The Warning Receiver System (WRS) is one of the tools for the dissemination of earthquake information and tsunami early warnings along with other BMKG information that is used by the Central BMKG to disseminate information to interface institutions. These interface institutions include local governments (provincial or district), PUSDALOPS offices, media outlets (television and radio stations) and private organisations.

Based on its functions, the WRS is divided into two parts, namely a WRS Server and a WRS Client. The WRS Server is a computer-based dissemination application, which is used to send earthquake information, tsunami warnings and other BMKG information to the interface institutions. The WRS Server is installed in BMKG headquarters in Jakarta. The WRS Client is a computer-based dissemination application, which is used to receive the information sent from the WRS Server. This WRS Client application is installed in each of the interface institutions. The sending of information from the WRS Server to the WRS Client can be via: (a) Internet/VSAT, or (b) Digital Video Broadcasting (DVB). In a WRS context, Internet/VSAT is a form of two-way communication from IP to IP (the server can reach the client, and vice versa), whereas DVB is a form of one-way communication from the server to the client only (the server can reach the client, but not the other way around).

The diagram below illustrates the links between the BMKG and the interface institutions in disseminating earthquake information and tsunami warnings via WRS.

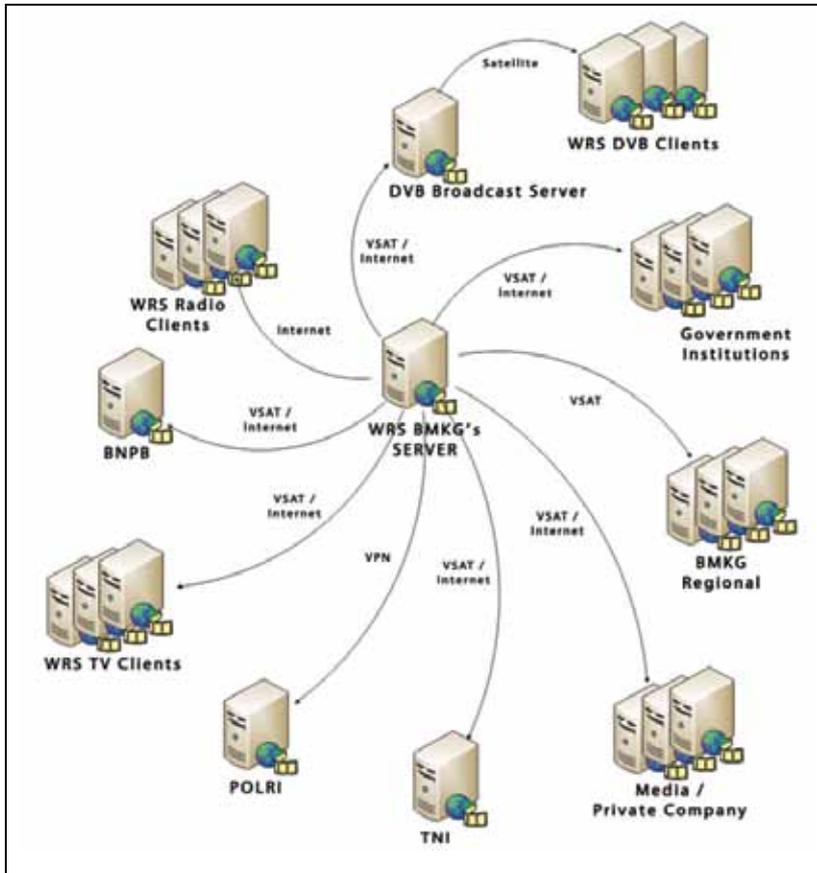


Figure 1: Inter-institutional relationships in WRS dissemination

2. Available Features of WRS Client

The WRS application has the following features:

- A special alarm tone is sounded the moment information is received about an earthquake or tsunami early warning;
- Automatic pop-up information appears via the browser as soon as earthquake and tsunami early warning information is received;
- An automatic SMS Forwarder, which forwards earthquake and tsunami early warning information to recipients via sms, and a manual SMS Forwarder, which allows messages to be sent from interface institutions;
- GIS-Website, which presents messages on earthquake information and tsunami warnings in the form of a map and text, and also presents historical data on the latest 60 events;
- BMKG information, such as weather and climate.

3. Equipment Required to Install a WRS Client Application

Necessary equipment for the WRS Client application includes both hardware and software. The hardware used for the WRS Client needs the following minimum specifications:

- A computer with a 2GB memory, 100GB hard disk and an Intel or dual Core 2 processor
- A 17-inch monitor, keyboard and mouse
- Active speakers
- A GSM modem for the SMS Server application (PCI GSM modem, or a GSM modem via computer USB)
- Ethernet card (if using an Internet connection or VSAT)
- A Solid Disc satellite antenna with LNB (Low Noise Block) and a World DVB Receiver (if using a DVB connection)
- UPS equipment.

Meanwhile, the minimum software specifications are:

- Windows XP Pro operating system
- Language Programmes: ASP, HTML, JavaScript
- IIS Webserver
- WRS Client application
- Local SMS Server application, to forward messages via SMS
- Browser (for instance: Internet Explorer, Mozilla Firefox).
- DVB-World application, to receive data via satellite (for a DVB connection)
- Multicast receiver application, to arrange folders for storing information that is received as well as to view signal status.

To meet the WRS Client requirements, InaTEWS Tsunami Early Warning Centre at the BMKG headquarters in Jakarta has prepared computers, with speakers, which are fitted with the WRS Client application. For connections via Internet or VSAT, interface institutions must prepare a public IP address or a VSAT IP address that can be reached by the BMKG. While for a DVB connection, all the necessary DVB tools are included in the computers that are made available by the BMKG. Interface institutions that require a WRS Client application can send an official request to the BMKG headquarters at the following address:

Head of the Earthquake and Tsunami Centre

Jl. Angkasa I no 2 Kemayoran Jakarta Pusat 10720

Fax 021 – 6546316

The availability of computers depends upon the BMKG's computer stock in a particular year. If the BMKG does not have any computers left in stock, a procurement of new computers will be proposed for the following financial year. A brief training on how to operate the system and basic troubleshooting will be given by staff from the BMKG or a partner organisation to those interface institutions that utilise the WRS Client application.

4. Information received by WRS Client

4.1 Automatic pop-up display

4.1.1 Information on earthquakes with no potential to cause a tsunami

The WRS Server at the BMKG sends information about earthquakes that have a magnitude greater than 5 on the Richter scale (RS) to the WRS Client. This information will then appear in a browser on the WRS Client computer in the form of an automatic pop-up on the monitor screen. This information will be sent within 5 minutes after an earthquake. The WRS Server sends information about earthquakes that occur throughout Indonesia. Earthquake information received by the WRS Client will be automatically forwarded by SMS to all those recipients who are registered in the WRS Client address book.

Below is a sample display of information concerning an earthquake without the potential to cause a tsunami, which occurred on December 11th, 2011.



Figure 2: Display of information about an earthquake without the potential to cause a tsunami

If interface institutions wish to limit the information received to include only those earthquakes that occur in and around their administrative districts, they need to set up a restriction zone in their WRS Client application. However, the restriction zone will not function if an earthquake occurs that has the potential to cause a tsunami. A zone's setting is carried out by entering a Longitude demarcation in the WRS Client application. This setting can be implemented either by staff from BMKG headquarters or by officials in an interface institution. The steps to establish a zone are as follows:

*Open and edit the File server.XML in the directory D:\DATA\wrsclient_psn\
Make changes only on the line*

*Longitude <lonclient>102.45</lonclient> and
Range Area <range>100</range>,*

To establish the Longitude, the respective longitudinal position of the WRS client locality needs to be filled in, while Range Area is established by entering the desired area's degree radius. For example, if the number 6 is entered, this means the DVB server will only forward earthquake SMS messages out within a 6° radius to the east, west, north and south from the longitudinal figure that is entered.

4.1.2 Information on earthquake with the potential to cause a tsunami (Tsunami Early Warning)

If an earthquake occurs that has the potential to cause a tsunami, the computer screen will display a pop up like the one shown here (example of a quake on April 11, 2012).

This display will continue to be shown on the monitor screen until officials at an interface institution close the screen. As long as the browser display on the monitor is not closed, earthquake information or subsequent tsunami warnings will automatically appear over (covering) the previous display. In this way, the information displayed on the monitor screen is always the most recent.

The upper part of the screen will show a map indicating the location of the earthquake as well as its parameter. To see the full information, the operator will need to scroll down the screen, which provides available information on warning levels, expected and / or observed wave heights and arrival times.



PERINGATAN DINI TSUNAMI
BADAN METEOROLOGI KLIMATOLOGI DAN GEOFISIKA



Magnitude

8,9

Waktu : 11-Apr-12 15:38:29 WIB

Lokasi : 2.31 LU - 92.67 BT

Kedalaman: 10 Km

Keterangan lokasi gempa bumi :

382 km BaratDaya KAB-SIMEULUE-NAD

431 km BaratDaya KAB-ACEHJAYA

453 km BaratDaya KAB-ACEHBARAT

460 km BaratDaya BANDAACEH-NAD

1829 km BaratLaut JAKARTA-INDONESIA

Berpotensi TSUNAMI untuk diteruskan pada Masyarakat

Berpotensi terjadi Tsunami di wilayah

BENGGULU	Bengkulu-Selatan	AWAS
BENGGULU	Bengkulu-Utara Bagian Utara	AWAS
BENGGULU	Bengkulu-Utara Pulau Enggano	AWAS
BENGGULU	Kaur	AWAS
BENGGULU	Kota-Bengkulu Pantai-Fanjang	AWAS
BENGGULU	Mukomuko	AWAS
BENGGULU	Seluma	AWAS
LAMPUNG	Lampung-Barat Pesisir-Selatan	AWAS

SUMBAR	Kota-Padang	SIAGA
SUMBAR	Kota-Padang Bagian Selatan	SIAGA
SUMBAR	Kota-Padang Bagian Utara	SIAGA
SUMBAR	Padang-Pariaman Bagian Selatan	SIAGA
SUMBAR	Padang-Pariaman Bagian Utara	SIAGA
SUMBAR	Pasaman-Barat	SIAGA
SUMBAR	Pesisir-Selatan Bagian Selatan	SIAGA
SUMBAR	Pesisir-Selatan Bagian Utara	SIAGA
BANTEN	Lebak	WASPADA
JABAR	Cianjur Sindangbarang	WASPADA
LAMPUNG	Lampung-Selatan Kep. Krakatau	WASPADA
LAMPUNG	Lampung-Selatan Kep. Sebuku	WASPADA

Keterangan Warna :

Awasi Tsunami ($h \geq 3m$)

Siaga Tsunami ($0.5m \leq h < 3m$)

Waspada Tsunami ($h < 0.5m$)

Warning 1 contains the earthquake parameters and, if available, information about the estimated impact of the tsunami reflected by a warning level (Major Warning – Awasi, Warning – Siaga or Advisory – Waspada)

Warning 1 will be issued at the latest 5 minutes after an earthquake.

Figure 3: Information display of Tsunami Warning 1



Warning 2 is issued to provide updated earthquake parameters and warning levels, and additional information about the tsunami's estimated time of arrival on shore.

Warning 2 can be expected approximately 10 minutes after an earthquake.

Figure 4: Information display of Tsunami Warning 2



Warning 3 contains tsunami observation and updated warning levels, which may be disseminated several times depending on the tsunami observations at the tide gauge stations and the buoys.

Warning 3 will be issued only if observation data from tide gauges and buoys are received, which confirms the arrival of tsunami on shore.

Warning 4 contains the announcement “The tsunami threat is over” and will be disseminated after the retrieval of supporting data from the tide gauges and/or information from the community.

If no tsunami was generated, Warning 4 will be issued minimum 120 minutes after the earthquake. If a tsunami had been generated, Warning 4 will be issued only after there is a certainty that the tsunami threat is over

Figure 5: Information display of Tsunami Warning 3



Figure 6: Information display of Tsunami Warning 4

4.2 Showing Stored Earthquake Information or Tsunami Warnings

Apart from pop ups, earthquake information and tsunami warnings can also be accessed from the main menu. Close all pop-up windows then double click on Server Application or open the following address: <http://localhost:8899/index.html>. The main menu will open as shown here:



Figure 7: Display of the main menu on the WRS Client web-based application

From the main menu, click on GEMPA or TSUNAMI to view historical information on earthquakes and tsunami warnings. The table will display information on the latest 60 earthquakes and/ or tsunami warnings.

DAFTAR INFORMASI 60 EVENT TERAKHIR

No.	Nama Event (yyyyymmddhhmmss.html)
1	Event_20091116083111.html
2	Event_20091116083123.html
2	Event_20090603144423.html
3	Event_20090603143221.html
4	Event_20090603143103.html
5	Event_20090603135537.html
6	Event_20090602095834.html warning
7	Event_20090525132340.html
8	Event_20090525131731.html
9	Event_20090525131306.html
10	Event_20090525131204.html warning
11	Event_20090525115328.html
12	Event_20090525115304.html warning
13	Event_20090525115143.html warning
14	Event_20090525114755.html warning
15	Event_20090525114734.html

Figure 8: Historical list of the latest 60 incidents

Black text without the additional word “warning” relates to information on earthquakes that did not have the potential to cause a tsunami (for example, numbers 1 to 5), while text that has the word “**warning**” written in red alongside it constitutes information about earthquakes that had the potential to cause a tsunami or other tsunami warning information (for example, numbers 6 and 10).

4.3 Additional BMKG Information

In addition to earthquake information and tsunami warnings, the WRS Client also provides other information relating to meteorology, climatology and geophysics. Click on Info BMKG on the main menu. The information displayed includes Meteorological Info (weather throughout Greater Jakarta, general weather and world weather), Maritime Info (Height of Sea Tides), Climate and Air Quality (Forest Fires), Geophysics Info (Earthquakes that have Occurred and Most Recent Earthquakes), and so on. Below is an example:

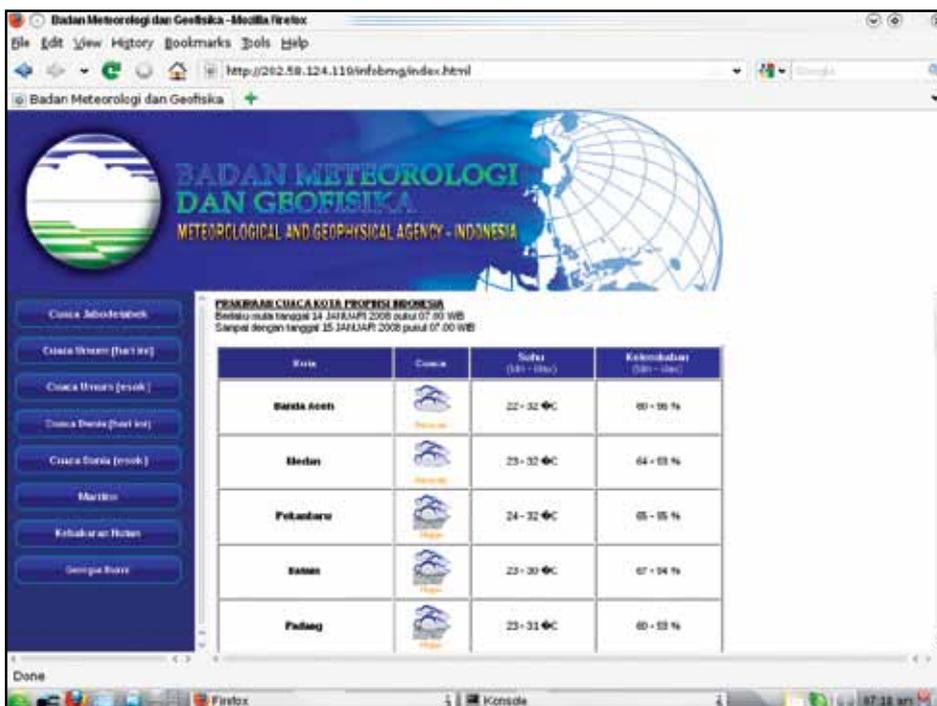


Figure 9: Additional BMKG Information

5. Information Dissemination from WRS Client

In addition to receiving information, the WRS Client can also be used to disseminate information regarding earthquakes and tsunami early warnings. This function is fulfilled by the SMS Forwarder feature, which is installed in the WRS Client programme. The SMS Forwarder consists of a local SMS Server application, which can forward earthquake information, tsunami early warnings and other messages to mobile phone numbers (cell phones) that are registered in the SMS Server. Registering a mobile phone number on a computer installed with WRS Client is carried out by an operator at the interface institution. There are two ways to send an SMS: (a) Automatic sending and (b) Manual sending.

5.1 Sending SMS Messages Automatically (SMS auto forwarder)

The WRS SMS Server address book contains two types of group: autobmg and bmgserver. The autobmg contains a list of previously registered mobile phone numbers belonging to recipients of WRS Client information, while the bmgserver contains numbers from BMKG headquarters in Jakarta.



Figure 10. Address book groups on the SMS Server

Every time a tsunami warning is received, the WRS Client automatically forwards the information in the form of an SMS (in standard BMKG format) to the recipients registered in the autobmg group. If the information received by the WRS Client pertains to an earthquake that does not have the potential to cause a tsunami, the SMS Forwarder will only forward it on by SMS if the quake's epicentre is within the restriction zone already determined according to the instructions in part 4.1.1. If a restriction zone has not been set, all earthquake information received by the WRS Client will be forwarded by the SMS Forwarder to all the numbers listed in the autobmg group.

The bmgserver group will forward all earthquake information regardless of zoning. This is carried out as a confirmation function back to BMKG headquarters in Jakarta that the WRS Client has already received the information from the BMKG in Jakarta.

This function is especially important for WRS Client applications that use a DVB connection, as the latter's identifying feature is uni-directional. Confirmation will ascertain:

1. The WRS Client receives messages from the WRS Server,
2. The SMS Forwarder application functions in sending SMS messages.

Below is a display of an **autobmg** group in the address book.

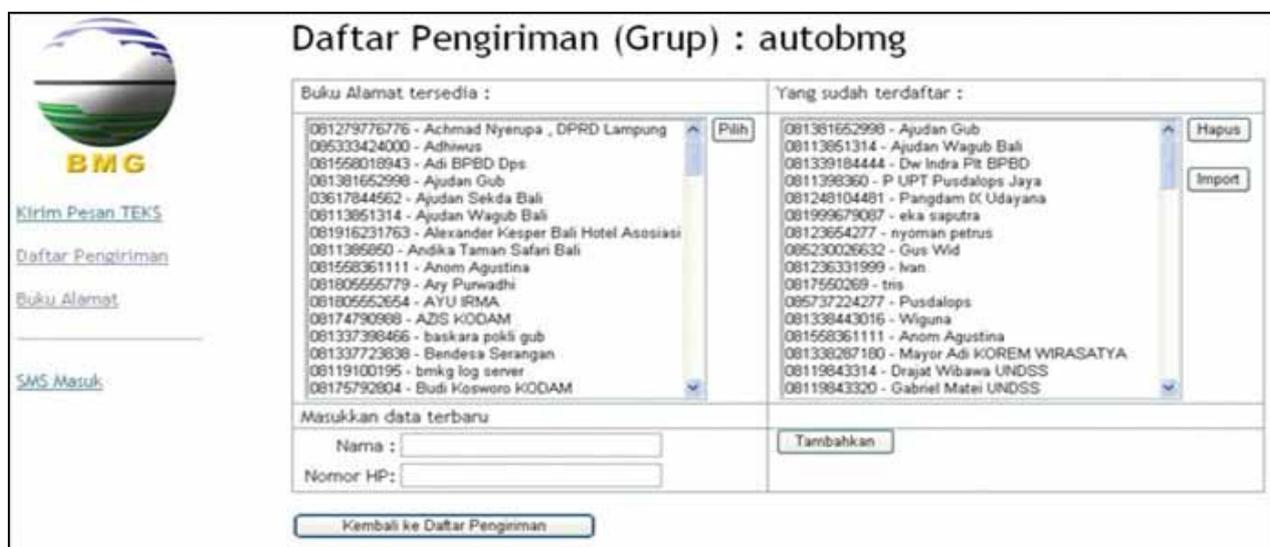


Figure 11: Mobile phone numbers in an **autobmg** group in the SMS Server

The order of the phone numbers displayed dictates the order in which SMS messages are sent out by the service provider, meaning that the display sequence needs to be compiled according to the priority of SMS recipients.

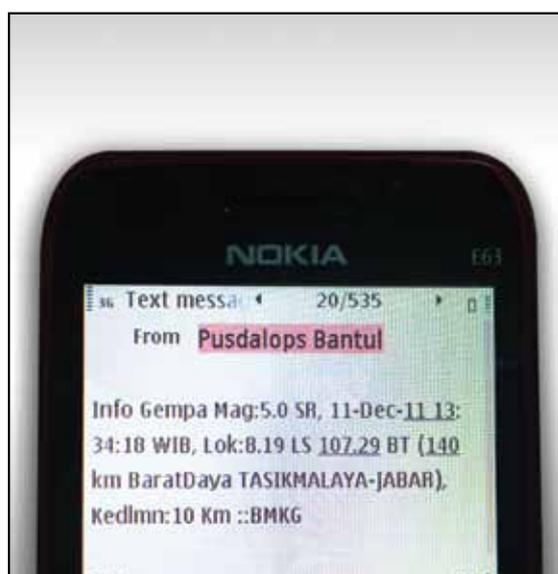


Figure 12: Example of message received from SMS auto forwarder

The listing of mobile phone numbers in an **autobmg** group is done by an officer at an interface institution that already has the WRS Client programme installed. The order of listings or display of mobile numbers relates to the order of priority for sending SMS messages.

5.2 Sending SMS Messages Manually

In addition to sending SMS messages automatically, the SMS Server can also send short text messages manually with interface institutions themselves determining the content of a message (for example, guiding an evacuation). The method of manually sending SMS messages is essentially the same as sending an SMS from a mobile phone, with the user establishing the number of the mobile phone due to receive the message and entering the message to be sent. The following illustration displays the page **Kirim Pesan TEKS (Send a Text Message)**:

The screenshot shows a web interface titled "Kirim Pesan TEKS". On the left side, there is a logo for "BMG" (Bureau of Meteorology and Geomatics) and a navigation menu with links: "Kirim Pesan TEKS", "Daftar Pengiriman", "Buku Alamat", and "SMS Masuk". The main content area is a form with the following fields and options:

Nomor Telepon Selular (HP)	<input type="text"/>	<input type="button" value="Buku Alamat"/>
Pesan SMS	<input type="text"/>	
Jenis Pesan	<input checked="" type="radio"/> Normal	
	Tipe: <input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7	
Klasifikasi SMS	<input checked="" type="radio"/> Normal <input type="radio"/> Class 0 (Flash) <input type="radio"/> Class 1 <input type="radio"/> Class 2 <input type="radio"/> Class 3	
<input type="button" value="Kirim Pesan SMS"/>		

Figure 13: Menu for sending a manual SMS on the local SMS Server

Besides the autobmg and bmgserver groups, interface institutions can also create other groups in the SMS Server's address book. These groups can be used when the manual SMS function is utilised.

In the column next to the list of Mobile Phone (HP) Numbers, the operator can choose from the menu:

1. Sending List for numbers that are already entered in a group,
2. Address Book for numbers that are already entered in the book but not yet entered in a group, or
3. Enter mobile phone number manually.



Figure 14: Mobile phone numbers displayed in address book

Type the content of the SMS message in the column next to Pesan SMS (SMS Message). After entering the recipient's mobile phone number and the content of the SMS Message, click Kirim Pesan SMS (Send SMS Message) on the tab underneath.

One of the uses of this manual SMS function is to coordinate internal communication between officials at the different interface institutions. Below is an example of a message received by a PUSDALOPS official:

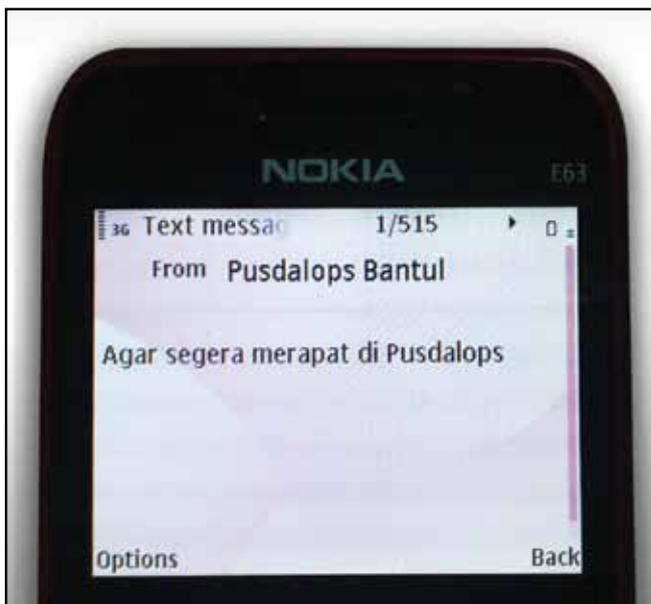


Figure 15: A manual SMS received for internal coordination from the local SMS Server

6. Important Issues Regarding WRS Client

6.1 Checking a Working Application

6.1.1 WRS Client with a DVB Connection

In order to see whether the WRS Client application is working or not, press Ctrl+Alt+Del to bring up Windows Task Manager. If the application is working well, the computer screen will show Windows Task Manager that includes the **BMKG_WRSclient** application as shown here:

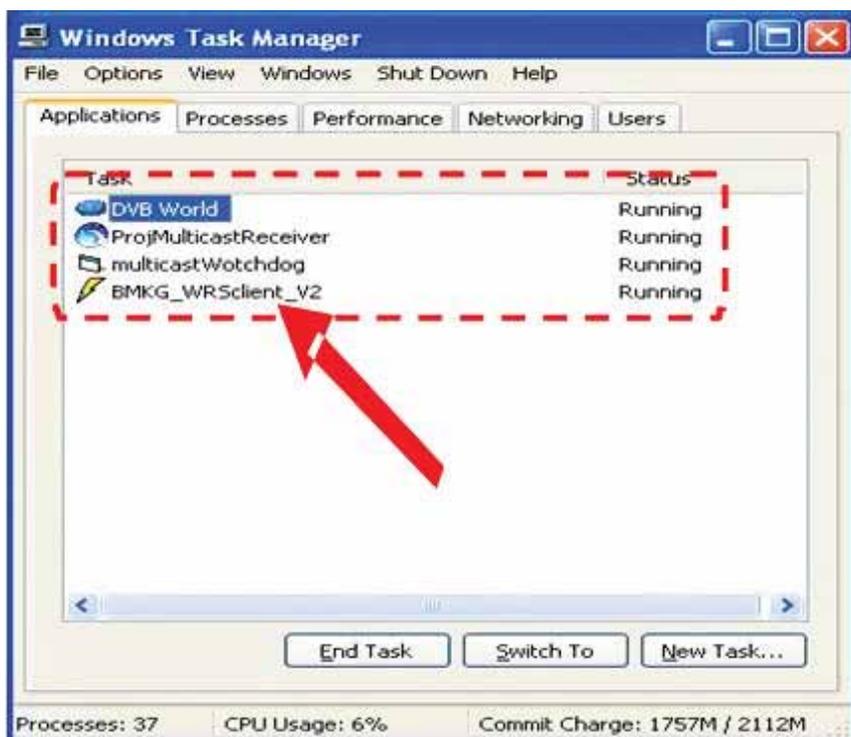


Figure 16: Checking the WRS application

If the **BMKG_WRSclient** application does not appear, double click on **Control System** on the desktop. In addition, the applications for the DVB connection should also be checked to ensure they are working properly, namely **DVBWorld**, **ProjMulticastReceiver**, and **MulticastWatchdog**. If these applications are not working, double click on **DVBWorld** on the desktop, and the **MulticastReceiver** in the taskbar at the bottom right-hand corner of the monitor (the blue shell).

For WRS Client that uses **Technisat 4PC (Technisat Digital PCI)** software, the application will only display **BMKG_WRSclient**, **ProjMulticastReceiver** and **MulticastWatchdog** in the list of working applications, as the Technisat 4PC (Technisat Digital PCI) remains hidden.

6.1.2 WRS Client with an IP/ VSAT Connection

To see whether **BMKG_WRSclient** is working or not, press Ctrl+Alt+Del to bring up Windows Task Manager. If the application is functioning properly, the computer screen will show Windows Task Manager that includes the **BMKG_WRSclient** application as shown here:

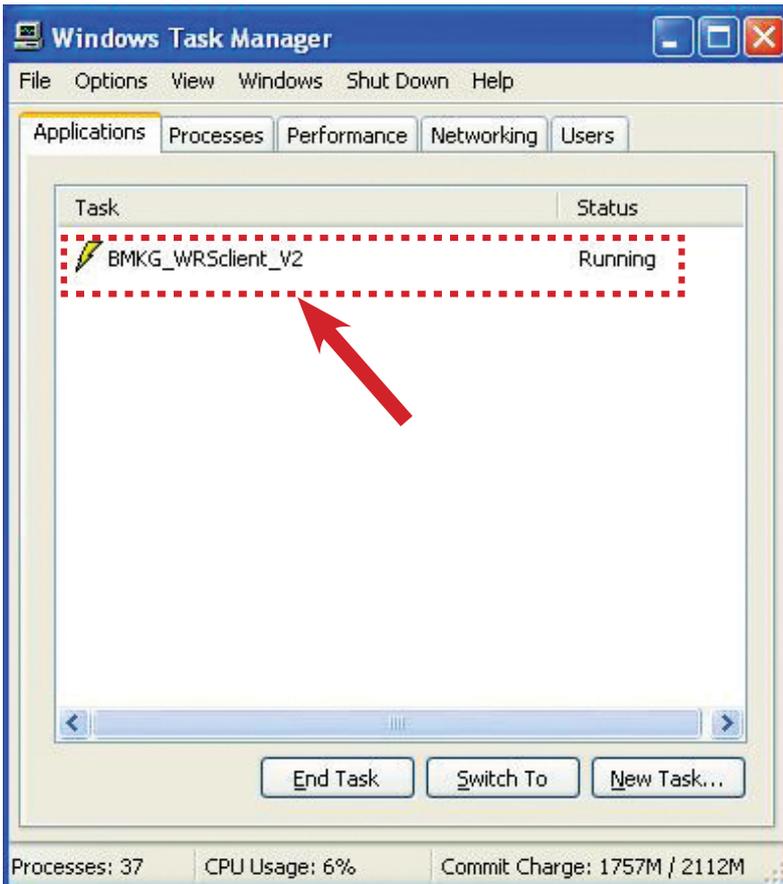


Figure 17: Checking the WRS-IP application

If the BMKG_WRSclient application does not appear, double click on the Control System icon on the desktop. To confirm that the line of communication is working, make sure the ethernet cable is properly fitted and check the network icon in the taskbar at the bottom right-hand corner of the screen.

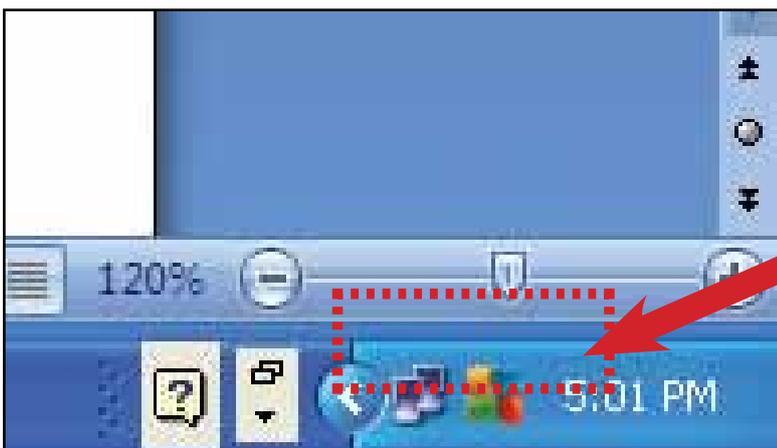
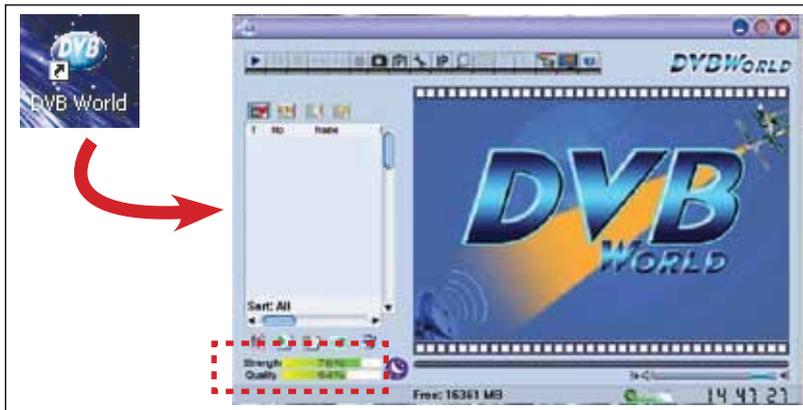


Figure 18: Checking the WRS-IP application

6. 2 Checking the Status of a DVB Signal

To determine whether data is received, double click on the DVBWorld icon and note the rate in the Strength and Quality section in the bottom left-hand corner. If it is green with a minimum Strength rate of 80% and a minimum Quality rate of 60%, this means a data packet is received. If, however, it is red, it means there is no data packet.

The display screen on a computer using a DVB Receiver USB:



Gambar 19. Tampilan status sinyal DVB (DVB Receiver USB)

For a computer that uses Technisat 4PC software, double click on the Technisat icon on the taskbar in the bottom right-hand corner of the screen. Thereafter, press the Status key. The following information will then appear:

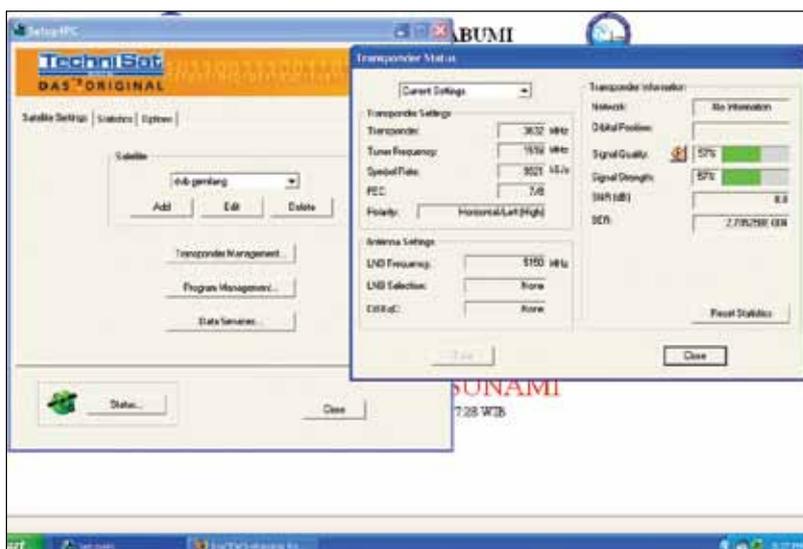


Figure 20: Status of DVB Signal (Technisat 4PC)

The loss of a DVB signal can be caused by several things, including:

- The position of the antenna has moved
- The adaptor from the DVB receiver is not fully inserted
- The USB cable from the DVB receiver is not inserted correctly

6.3 The Computer Must Operate 24 / 7

A WRS Client computer is in operation 24 hours-a-day, seven days-a-week so as to receive and forward information from the WRS Server in the most efficient way. In order to ensure that the computer functions around the clock, an Uninterrupted Power Supply (UPS) is needed to enable the computer to be on, even when there is an electricity outage. If there is an electricity cut, before the power in the UPS runs out (± 20 minutes, depending on the UPS voltage level), switch off the computer as normal and then reboot it when the electricity supply comes back on. In case the computer is off due to power failure, remember to switch it back on as soon as electricity is available.

6.4 Concise Operational Guidelines

The following points should also be observed in order that WRS Client functions properly:

- **Available credit:** If a mobile phone number used by the SMS Server is a post-paid number, ensure that payments are made on time so that the number is not blocked by the service operator. If the mobile phone number in question is a pre-paid number, check the available credit on the phone and its validity period regularly. Verification can be carried out by sending an SMS to a mobile phone belonging to a PUSDALOPS official.
- **Guard against viruses:** A computer that is installed with a WRS Client programme should not under any circumstances be used for anything other than WRS. In order to prevent a virus from infecting the computer, do not introduce any stored media (via USB flash disk or CD) into the computer.
- **Rebooting the computer:** A computer that is used for WRS needs to be rebooted once-a-month.
- **Modem:** Do not take out the simcard while the computer is in operation. To remove the simcard, switch off the computer and then take the simcard out of the modem. If the simcard is removed from the modem while the computer is switched on, the driver for the SMS Server may have to be reinstalled.

If a problem occurs, contact officials at BMKG headquarters for technical assistance or the DVB Service Centre about any disruption to the DVB and signal on the following numbers:

Nurpujiono – BMKG (081546094757)

M. Luqman H – BMKG (087780841091)

Cucu - DVB Service Centre, Hunting: 085214110712 / 021-89900333

Technical Terminology

Desktop	computer homepage when the computer is switched on; usually displays programmes that are often used or that need to be accessed quickly
Directory or folder	a virtual container within a digital system, in which groups of computer files and possibly other folders can be kept and organized
DVB (Digital Video Broadcasting)	suite of internationally accepted open standards for digital television
Recipient group	a group in a mobile phone address book (or sms server) containing mobile phone numbers that are set to receive information
InaTEWS (Indonesian Tsunami Early Warning System)	tsunami early warning system that was established by the Government of Indonesia with the involvement of government institutions along with financial and technological support from various countries
IP (Internet Protocol) Public	numerical address assigned to each device (e.g., computer, printer) participating in a computer network that uses the Internet Protocol for communication
Pop up	window/display that automatically appears on a computer screen and which usually continues to be displayed until it is manually closed. In the context of WRS, the display of earthquake information or tsunami early warnings will automatically appear on the computer screen when a message is received from the WRS Server
Shortcut	a small file that stores the target location of a file that it represents, or starts running a programme that it represents. It is usually located on the desktop or start menu
Simcard (Subscriber identity module card)	a circuit that stores the identity of a mobile phone number and associated code so that it can be identified by other mobile-phone equipment
SMS Server	computer programme that performs the SMS function on a computer
UPS (uninterrupted power supply)	electronic instrument that offers reserve electrical power when the main electricity supply fails, offering enough time to shut down the computer normally so as to avoid the risk of damage or loss of data
USB Flash disk	data storage instrument that is integrated with a USB interface. Physically smaller than a floppy disk, a flash disk's storage capacity varies. Stored data can be deleted or added to and resaved
VSAT (very small aperture terminal)	satellite with a two-directional ground station, which has a disc-shaped antenna with a diameter of less than three metres; generally used to send narrowband data (for example, a credit card transaction) or broadband (for example, Internet or VoIP)



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