A comparison study of radio protocol AX.25 with Interchangeable data in VmeS (Vessel Messeging System) data communication and AIS (Automatic Identification System)

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Abstract—Indonesia is maritime country, inhabitant of Indonesia is fisherman large enough. Fishship makes up constribution widely, in general, Communication in the sea on a ship uses a satellite communication system, but the system requires a relatively large cost. For solving it, Vessel Messaging System (VmeS) is used as basis radio communication to send between ship terminal in the sea with gateway Vmes in the land, in addition with wide enough territorial water, it needs reliable keeping of maritime region of country. One of system at this time can be used to support all activities is Automatic Identification System (AIS). AIS is a system that can be used to help in tracking ship position which has used in all ports automatically to obeserve ship condition and to prevent crashing between ships. In this study a data format is suitable for VMeS will be designed so that the interchangeable process can be carried out to AIS so it can be read by AIS receivers intended for vessels below 30 GT (Gross Tonnage) using the AX.25 protocol.

Keywords—, VMeS; AIS; AX.25; interchangeable, ad hoc.

I. INTRODUCTION

Vmes (Vessel Messaging System) is communication which has a radio base to send the message between the ship terminal in the sea with gateway Vmes in the land. VmeS consist of two block system. There are Vmes gateway and terminal VmeS connected with radio waves to VHF channel.

X25 is layer protocol (refer to OSI Layer Reference) that is Layer Data Link. As layer protocol 2 AX25, it has responsible for building link connection, equiping logic procudure for information transfer, and link disconnection. So that AX.25 is complete enough to have been an example of protocol implementation.

Amateur Protocol X.25 (AX.25) is a derivative radio protocol from X.25 used in radio packet networks. To establish a relationship between two terminals through the physical layer and the data link layer. This protocol will work on two transmission conditions namely half duplex and full duplex. Furthermore, the two layers that exist in this protocol, namely the physical layer and the data link layer can be subdivided into several status states as shown in Figure 2.5. The intended situation is to define the state of a radio communication link for multi links.

AIS will be integrated with Vmes system so it can be conducted. Data on AIS will be adjusted with VmeS system so that it can be conducted reading and data conversion between AIS system and VmeS. Integerating system can be administrated specially to fisherman ship which will be sailed. This the best information is hoped that can helped fisherman and to make easy to communicate in the sea.

II. Related work

A. Vmes Technology

VMeS is a comprehensive communication system starting from the terminal, modem data communication in the HF / VHF line and power module [3]. VMeS devices have also been tested by fishermen in developing districts [2] [3]. VMeS research continues to increase bandwidth, improve routing [3], reduce errors in data transmission and improve system usability by updating terminal technology [2] Data communication using Radio (HF / VHF) is an answer to data communication needs other than using satellite communication [4].

In some case of military, using radio is as data communication to improve the safety of data tranmission.[1] Due to the limited distance (30 km on VHF), the concept of routing is needed to expand the scope of this HF / VHF-based network [2]. In addtion, the low of bandwith becomes a new problem so it is needed comfrey technic data to increase the capacity of data transmission [4]. Using radio (HF/VHF) is as part from data communication to have purpose connecting to computer network each place[1][3].

In shipping domain, computerization in ship is connected to command center which is in the land. Ad hoc technology network is the exact option in the node condition which is effected by the ship movement and there is no need the a stasion that controls the network system[3]. Ad-hoc network technology causes the routing to be spreadhead the success of communication data. Some ad-hoc network management technologies that have been studied, there are Selection Algorithm Nodes choose the best node propagation path to the destination node, Frequency Selection Algorithm selects available frequency, Link SheddingAlgorithm for selecting data priority, and Bandwidth Shedding Algorithm for managing bandwidth usage in data transmission. The four algorithms are used for the process of determining the order of sending data, priority, scheduling each node.

In constructing routing, the Ad-hoc On demand Distance Vector (AODV) algorithm [5] which is a renewal of Destination-Sequenced Distance Vector (DSDV) that uses the bruteforce technique in sending network definitions (network advertisement). Is the most widely used algorithm on ad-hoc systems. AODV works by means of nodes sending network advertisements if needed (there are route requests from other nodes with destinations outside the network), distinguishing local topologies and global topologies, sharing with surrounding networks if there are changes in the node in the local network of the node.

B. Protocol X.25

AX.25 is the layer 2 protocol (referring to the OSI Layer Reference), which is the Data Link Layer. As a layer 2 protocol AX.25 is responsible for establishing connection links, providing logic procedures for information transfers, and link disconnections. So AX.25 is complete enough to be an example of implementing a protocol [11]. Amateur Protocol X.25 (AX.25) is a derivative radio protocol from X.25 used in radio packet networks. To establish a relationship between two terminals through the physical layer and the data link layer. This protocol will work on two transmission conditions namely half duplex and full duplex. Furthermore, the two layers that exist in this protocol, namely the physical layer and the data link layer can be subdivided into several status states as shown in Figure 2.5. The intended situation is to define the state of a radio communication link for multi links [1].

C. *AIS Technology*

AIS is an automatic tracking system used on ships and with ship traffic services (VTS) to identify and locate ships by electronically exchanging data with other nearby vessels, AIS

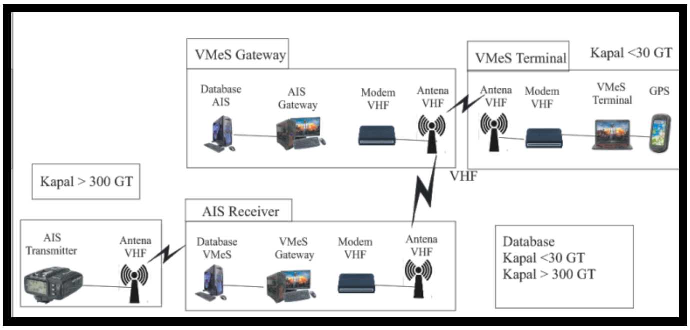
BTS, and satellites. When satellites are used to detect AIS signatures, the term Satellite-AIS (S-AIS) is used. Information AIS complements marine radar, which continues to be the main method of avoiding collisions for water transportation. Information provided by AIS equipment, such as unique identification, position, direction and speed, can be displayed on the screen or ECDIS.

AIS is intended to help ship watchstanding officers and allow maritime authorities to track and monitor ship movements. AIS integrates standard VHF transceivers with positioning systems such as GPS or LORAN-C receivers, with other electronic navigation sensors, such as the gyrocompass or turn indicator level. Ships equipped with AIS transceivers and transponders can be tracked by AIS BTS located along the coastline or, when out of reach of terrestrial networks, through more and more satellites equipped with special AIS receivers that are able to deconfliction deconflicting a large number of signatures [1].

III. Scenario and methodology

A. Design system interchangeable

Design system of interchangeable can be seen on picture 1.



Picture 1. architecture system interchangeable

VMeS Gateway functions conduct interchangeable data processes from VMeS data to AIS data. VMeS data received in VMeS Gateway or VMeS BS will be examined the type of VMeS message sent. If the message sent is VMES type 1 or position data, then the data will be changed directly to AIS type 1. VMeS type 1 Data is a real time data. VMeS type 2 data is only intended for ship information and is not interchangeable to AIS.Whereas for VMeS type 3 it is directly interchangeable data to AIS type 8, all data received by VMeS BS will be saved in database.

B. Format of VMeS data.

Previousresearchof VMeS has defined several format data for communication system of VMeS namely format data position, message and SMS (short message service) [6]. Based on the needs of vessels under the size of 30 GT, this research assigned 3 types payload VMeS consisting of position type message (type 1) vessel information (type 2) and data (type 3). The VMeS data format is designed almost the same as AIS only using encoding 7 bits. The reason for choosing 7 bits is because 6 bits it is still limited to large alphabet characters and a few additional characters.

C. Interchangeable format data

Payload VMeS type 1 is designed based on type 1 and 4 so this type can have interchangeable data between AIS type 1 or 4. Payload VMeS type 8 is designed to transmit data with maximum length of 256, where the data is interchangeable with AIS type 8. Payload VMeS type 1 will be converted into 2 kinds namely AIS type 1 and 4 on AIS type 1 sent data (SOG, longitude and latitude) and AIS type 4 sent data (*year, month, day, hour, minute, second, longitude, and latitude*). While on payload VMeS type 2 data just sent to VMeS BS and become local database of vessel information, in practice the interchange is automatically only carried out for type 1 VMeS payload data.

D. AIS format data

IALA has described the AIS type 1-24 message where the binary message has defined by IMO, message 25 and 26 based on vendor transceiver AIS. Message 27 has been described on ITU1371-4. This study will be used 3 types of AIS message, there is message type 1,4, and 8, message type 1 monitoring vessel in real time, message type 2 for communicating between BS, while type 8 for communication data. Detail content of AIS message type 1 can be seen on table 1 [4].

Table 1. AIS class A message type 1,2,3 [4]

Parameter	Panjang (Bit)
Message ID	6
Repeat indicator	2
User ID	30
Navigational status	4
Rate of turn ROTAIS	8
SOG	10
Position accuracy	1
Longitude	28
Latitude	27
COG	12
True Heading	9
Time stamp	6
Special manuvre indicator	2
Spare	3
RAIM-flag	1
Communication state	12
Total of bits	168

IV. Data Analysis

A. VMeS communication using AX.25 protocol

1. Comparison of bit error rate (BER) and packet loss distance of 40.50.60 meters.

The measurement of BER value is carried out outside the room with a Line of Sight (LoS) condition is the condition between the terminal transmitter and terminal receiver has no obstacle at all. The scenario was performed by changing the distance between terminal transmitter and terminal receiver with 3 different distances. Frist trials between terminal transmitter and terminal receiver is 40 meters distance, next trials was carried out with a distance between terminal transmitter and terminal receiver is as far as 50 meters distance and the last trials is done with a distance between terminal transmitter and terminal receiver 60 meters distance. Data sent from terminal transmitter is in the form of text datathat is character "a" total 50 characters. At each trial data collection was carried out 5 times.

Table 2 value of BER (bit error rate) and packet loss on scenario 1, 2, 3.

Trials	Distance between RX and TX	*Bit Error Rate* (BER)	Paket loss
1	40 meters	0	0%
	50 meters	0	0%
	60 meters	0	20%
2	40 meters	0	0%
	50 meters	0	20%
	60 meters	0	20%
3	40 meters	0	0%
	50 meters	0	20%
	60 meters	0	40%
4	40 meters	0	0%

	50 meters	0	0%
	60 meters	0	20%
5	40 meters	0	0%
	50 meters	0	0%
	60 meters	0	0%

The results from 3 scenarios trials with a distance between the transmitter and receiver terminals as far as 40 meters, 50 meters and 60 meters, data obtained with distance of 40 meters that terminal data communication can work properly without any error and packet loss. Whereas at a distance 50 meters terminal data communication can still work properly without any error but pocket loss begins, then at a distance 60 meters data communication terminal can still work properly without any error but always appear pocket loss with big value. Thus the maximum coverage area or range from data communication terminalprototypes is designed ± 60 meters because when the data communication terminal is tested with a range above 60 meters the terminal performance is not optimal because of large packet loss.

B. Interchangeable data protocol on VmeS and AIS.

It can be concluded from the result that power level is inversely proportional to the packet loss that occurs. Modem has reception sensitivity of -112 dBm. Low level power received will affect pocket loss because data is not well received. This research untilthe maximum message length of 255 characters do not occur packet loss. Damaged packages can be caused by NLOS reception conditions accordingly the level of received power is low and cause packet loss. In general, the quality of interchangeable system has been built that has quite good quality with the success rate of interchangeable process above 71.875%. Interchangeable system is not good enough to be applied on land because of affected by environmental attenuation can reduce power received.

C. AX.25 protocol in VMeS communication

The AX.25 protocol in radio data communication facilitates users to communicate data directly using a hyper-terminal program and users do not have to deal with acknowledgment problems because it has been handled by the terminal node controller (TNC).

Communication data is controlled directly by more flexible software when using the lowest layer protocol. Mostly, TNC supports the use of keep it simple and stupid (KISS) as a protocol at the bottom layer to send datagrams directly from a computer / microcontroller.

KISS frame has been completed with error detection process and also used for direct data communication using the TCP / IP protocol. On high speed sending data and TCP/IP application have several changes in sending more than 256 bytes of data in one frame.

From both implemented techniques concludes that the technique is good used for VMeS communication. for further research a comparison will be examined between VMeS and AIS communication using the AX.25 protocol.

V. CONCLUSIONS

The results of a comparative study between VMeS technology using the AX.25 protocol and interchangeable VMeS communication protocol and AISare obtained several conclusions, namely.

1. VMeS techniques Using AX.25 is good for distance ± 60 meters because when the terminal data communication is tested with a range above 60 meters the terminal performance is not optimal because of large packet loss.
2. Interchangeable VMeS communication protocol and AIS Message delivery period in every 1 second have 128 total messages sent with a success rate of 71.875%.Message delivery period has the highest message sent at 5 period of 30 message with a success rate 96,67%.The longer the period of sending messages can affect the channel conditions better for communicationthus the success rate of sending messages increases. While the lowest packet loss level occurs at 5 second message period.

3. VMeS technology using AX.25 protocol of data communication terminal can work both as a sender and as a recipient.

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