

Annex II.D

Report of the VMS Technical Specialist Group

Following are the conclusions of the VMS Technical Specialist Group. The Report is structured according to the four tasks of the group and split into numbered paragraphs accordingly. The Group has not met, there have only been exchange of E-mails and the report has been adjusted to reflect comments from the members of the group.

1. Identification of the possible advantages/disadvantages in the context of IWC to add VMS to vessels which have an international observer with GPS onboard

The possible advantages of a VMS in addition to an international observer equipped with a GPS could be the following:

- 1.1. An advantage of VMS in fisheries management is that it has the ability to give automatic near real time information regarding a vessel's position.
 - 1.1.1. An observer, with a hand-held GPS cannot supply near real time information and can only read and record the vessels position when above deck - unless connected to a fixed antenna onboard the vessel. Thus, unless they are above deck 24 hours a day and have access to communication equipment to transmit the information at regular intervals, it is not possible for an observer to provide the same service as a VMS.
- 1.2. The automatic position reporting, which is the main function of a VMS, can be routed to one or more recipients. This means that national monitoring centres, a centralised monitoring centre and any other addressee as necessary can be forwarded the reports simultaneously.
- 1.3. The automatic position reports can be forwarded to inspection and surveillance platforms as appropriate. For the purposes of inspection and surveillance it is essential to have accurate information regarding the location of vessels, in as close to real time as possible so that the location of the vessel can be verified. This can only be provided by automatic position reports generated by a VMS.
 - 1.3.1. Further verification can be done using satellite radar images. Whilst many inspection/surveillance agencies currently utilise these they are rather expensive.
- 1.4. A VMS also has the ability to provide the speed and heading of a vessel. In some fisheries, speed can give an indication of the activity of a vessel where the speed is not an important factor, but is more difficult in other types such as whaling.
- 1.5. VMS can be event driven, in that it is possible for the system to automatically send a predefined report and/or the position as a specific event occurs. For example: if a vessel crosses a sanctuary boundary or if another specific event occurs. This is achieved by connected sensors to the VMS unit on board the vessel.
- 1.6. Some VMS can provide a polling function, where an authorized operator, can instantly extract the vessels position as required. This can be very important where a vessel may be suspected of breaching the RMS. (Most VMS established for surveillance would have this capability.)
- 1.7. A VMS will allow for the independent verification and validation of vessel positions and movements against a common standard of monitoring.
- 1.8. Regular position reports are closely related to the vessels security.

- 1.8.1. Some VMS are mandatory equipment for the vessels safety and security. The regularity of the position reports, which for the smallest vessels can be as frequent as every few minutes, is monitored. If a vessel is not reporting according to the schedule and the system itself is not able to extract the vessels position, a warning is issued to the operator. This may lead to a full scale Search and Rescue operation. Where the safety and security aspect is regarded as one of the most important factors, the VMS, the FMC and the MRCC are all in the same operation centre

The possible disadvantages of a VMS in addition to an international observer equipped with a GPS could be the following:

- 1.9. The Vessel Monitoring System has its limitations. A regular VMS is not event driven. It means that the position is not automatically transmitted if a specific event occurs, only by time. For example not if the vessel has caught something. Some systems transmit with pre-set intervals, i.e. once every hour. Systems based on orbiting satellites only, receive the reports when the vessel's VMS transponder is within the satellite's footprint. The interval between satellite passes by polar orbiting satellites is shorter on high latitudes. Some systems using orbiting satellites do store tracking information until within the satellite's footprint. These systems do therefore not necessarily give an indication on the vessel's position at the time of an event or its activity at the time of transmission even though the speed and heading is included in the report unless a more complicated onboard system is used in addition. However, depending on circumstances a conclusion on the vessels activity may be drawn from the regular position reports. It should be noted, that these limitations of VMS are not seen as disadvantage by all.
- 1.10. Some nations may need to invest in VMS for those vessels which do not currently operate such a system, although most large vessels would have some form of Global Maritime Distress System which runs off Inmarsat units.
- 1.11. The automatic reports are charged and are either paid for by the vessel or by the recipient, but these are at a relatively low cost.

2. Identify the relevant benefits from a compliance point of view of national VMS systems and centralized system

2.1. What is VMS?

Vessel Monitoring Systems are used to track vessels by receiving automatic position data, via different satellite systems, via land-based VHF/UHF systems or any other communication network suitable for reliable communication. Most systems can be used to display vessel positions in a graphical environment, i.e. nautical charts. Some systems can also receive, store and forward messages concerning fishing vessels activity and catch. They can monitor the regularity of positional data from the vessels and warn the operator or any addressee if a vessel is not transmitting as scheduled. VMS can monitor fishing areas and issue a warning if a vessel activity does not conform to pre-set conditions for each area. Some VMS can poll (i.e. Inmarsat C) to start transmission, stop transmission or alter the frequency of transmission. VMS can be used to distribute data to other recipients via computer network. The system can be used to write reports for selected vessel or vessels, concerning their positions or other information which might be stored in the system.

2.2. Benefits of a national system only.

- 2.2.1. Vessels report direct to the national VMS monitoring centre. The national VMS monitoring centre can then distribute data to inspection platforms. This can be in near real time or close to near real time.
- 2.2.2. A number of nations have already established their national VMS and are involved in organisations where national VMS/FMC is a requirement.

- 2.2.3. Some of those are also involved in bilateral tracking agreements where the national VMS is mandatory.
- 2.2.4. In some cases, the national VMS is mandatory for the vessels safety and security and must therefore receive the data direct from the Land Earth Stations and/or its dedicated tracking system.
- 2.2.5. A national system can be used to distribute vessels positions to the IWC office or anyone else as a plain text with selectable frequency or upon request. By doing so IWC members can be assured that each member is fulfilling their VMS requirements.
- 2.2.6. The national VMS takes on the obligations to install vessels into the VMS and deal with the Land Earth Stations.
- 2.2.7. There would be no cost for the IWC office to establish and operate a centralized system and no need for additional staff with computer/VMS skill.

2.3. Benefits of a centralized system only.

- 2.3.1. A centralised system can have many of the same functions as a national system once vessels are installed into the central system.
- 2.3.2. IWC members can be assured that each member engaged in whaling activities is fulfilling their VMS requirements. Parties with an interest in management of whaling activities, including conservation groups, can be assured that the VMS requirements are being met.
- 2.3.3. The Commission can be assured that all whaling members' vessels are subject to the same monitoring standards, and at the same time confidentiality is maintained by providing for VMS access on a secure and "need to know" basis.
- 2.3.4. States which do not have an established VMS would not be required to establish a VMS in their country. Setting up one VMS monitoring centre would be more cost effective than setting up several.
- 2.3.5. Members States engaged in whaling activities would not need to monitor their vessels, rather one central monitoring centre (based at the Secretariat) would have this role. This would though only be applicable for those who do not have VMS or are not planning to do so.
- 2.3.6. A centralised VMS would enable States to verify the information on catch verification documents with greater confidence in the independence of the system.

2.4. Benefits of a combined national system and centralized system.

- 2.4.1. All the main benefits of both systems can be achieved by the combined solution, except that nations who do not already run their own national VMS would have to invest in such a system and the IWC office would need to install and operate a centralized system.
- 2.4.2. The centralized system would not need to take onboard the obligations of installing the vessels into the VMS.
- 2.4.3. The combined solution would simplify the administrative arrangements of the centralized system as all such work would be undertaken by the national system.
- 2.4.4. In the combined solution the national VMS would be primary recipient for VMS data and then this data is forwarded to Centralized system in a standardized format. This is the same procedure as already used in the NEAFC and NAFO systems.
- 2.4.5. The combined solution would solve any language problems of a centralized system.

2.4.6. The centralized system would still be able to record and verify all received data to secure compliance with the reporting standards.

2.4.7. The centralized system would not need to adjust to different tracking systems. The received data would always be in a standardized format, i.e. the North Atlantic Format (NAF).

2.5. Nations without VMS

2.5.1. It is possible for a state that does not have an established VMS to establish a contract with another state which has a VMS up and running to receive reports from its vessels and forward them as needed. The forwarding can be either in the form of computer data in case of forwarding to a centralized system or as a plain text either to the client and/or the IWC office. Such agreements may also be possible with private companies. Such companies may be able to run VMS for several different customers.

2.5.2. It can also be an option in a combined system, that some nations have their vessels report direct to the centralized system. That would though place an extra burden on the staff of the centralized system. An example of such a facility can be found in the NEAFC Scheme. There is though **no** Contracting Party to that organisation doing so.

2.6. Compliance:

2.6.1. VMS is usually regarded as a system which increases the level of compliance, especially when the location of the vessel is an important factor. This is achieved by its deterrent effect. By adding external systems to the VMS to make it event driven, the increased level of compliance is not only concerning the position, but also the vessel's activity. Furthermore, a requirement for catch and activity reports to be transmitted via the VMS may be added.

2.6.2. The received information can be distributed to the relevant inspection/surveillance agencies for verification. That will further increase the level of compliance.

2.6.3. The same level of compliance should be achieved in all 3 options, given that the same standards are used and the received data can be verified.

3. Identify an appropriate system or systems and develop text for the technical document that would accompany the Schedule as described in (b)

3.1. Tracking systems:

3.1.1. There are several different tracking systems available on the market today. Some use orbiting satellites and other use geo-stationary satellites. Some systems can determine the vessels position on its own by calculation between two or more different satellites or by a Doppler effect but others use positioning from dedicated navigational systems such as GPS. Some systems using geo-stationary satellites have continuous global cover, except from the Polar Regions, while other systems have more limited coverage. Systems based on orbiting satellites can have global coverage, but not necessarily continuous coverage. As whaling are expected on high latitudes that may limit the choice of systems for those vessels.

3.2. Inmarsat C

3.2.1. Inmarsat is based on geo-stationary satellites, two over the Atlantic, one over the Pacific and one over the Indian Ocean. As the satellites are placed over the equator the Polar Regions are not visible north of 75° N or south of 75° S. In addition to the automatic position reporting feature, Inmarsat C is a two way messaging system. Inmarsat C is found onboard many vessels as a part of the GMDSS communication package and/or as a dedicated tracking device. Many VMS rely heavily on Inmarsat C.

3.3. Argos

3.3.1. The Argos system is based on polar orbiting satellites. This system currently only provides one way messaging. Argos is widely used in all kinds of tracking. Positioning can be either from inbuilt GPS or by calculation based on the Doppler shift technology. The coverage is not continuous as the vessel's transmitter must be within the satellites footprint and the satellite must also be visible from the ground receiving station. If the ground receiving station is not visible at the same time as the vessel's transponder is within the satellite's footprint the received data is stored until a ground station comes into the satellite's footprint.

3.4. BoaTrack – Euteltrack

3.4.1. These systems are based on geo-stationary satellites and have two way communication capabilities. The position can either be from an inbuilt GPS or can be determined by calculation from the satellites.

3.5 Other systems

3.5.1 There are a few other tracking systems available, some which may have better coverage in one part of the world but limited or none in other parts. It should be noted that VMS is not limited to one communication service provider or a single vessel system. In fact a sophisticated VMS should be able to communicate with and use position reports from any source which can fulfil the requirements of the relevant end user.

3.5.2 Some nations use dedicated VHF/UHF tracking systems for small vessels. These systems can be useful for coastal operations, where the vessels are not operating outside the VHF/UHF range. The range which is by theory line of sight increases by the height of the coastal installations.

3.6 General description of a VMS system.

3.6.1 A VMS system, in the context of the IWC, can be used to monitor the position of vessels in near real time or close to real time depending on the communication system used. The vessel's part of the system can, with external sensors installed, automatically transmit messages when an event occurs. Many VMS are also made to receive and process catch and activity reports and some send automatic reports to other systems/recipients as predefined circumstances are met. In some bilateral tracking agreements, as well as in the NEAFC and NAFO systems, this feature is used to send automatic Entry report upon detection by the national VMS of a vessel's position to be within a specific area and an Exit report upon exiting the area respectively.

3.6.1.1 Some systems are configured to automatically receive catch and activity reports direct from the vessels, process them and automatically distribute to the relevant recipients. Some using that feature have made specialised reporting software to be used onboard the vessels.

3.6.2 General requirements

- 3.6.2.1 The VMS shall be able to receive and transmit reports via common communication protocols, preferably using the Internet based secure communication protocol HTTPS. It shall be able to communicate with different tracking systems.
- 3.6.2.2 The system shall be able to receive and transmit reports in the North Atlantic Format (NAF) for exchange of information with other systems. (The data communicated can be position reports and activity messages.)
- 3.6.2.3 The system must have user interface for input of data regarding the vessels being tracked as well as access to communication parameters.
- 3.6.2.4 There shall be a Graphical User Interface where vessels positions are displayed in a map. There should be a selection of different maps and nautical charts.
- 3.6.2.5 There shall be a Database where all information can be stored in a constructive manner, making it easy to extract information based on various criteria.
- 3.6.2.6 The system shall be able to automatically distribute data according to predefined parameters.
- 3.6.2.7 The system shall be able to automatically generate and transmit relevant reports if a vessel enters a predefined area.
- 3.6.2.8 There shall be automatic warnings if a vessel is not reporting according to schedule and if a vessel's activity does not conform to pre-set conditions.
- 3.6.2.9 There shall be a polling function for the communication systems where that is applicable.
- 3.6.2.10 There shall be a selection of printing selected data, display it on screen or store it in a file.
- 3.6.2.11 Security is of high importance. There should be strict rules, based on already recognised standards for data security. Such rules shall apply to handling of the data, its exchange between systems as well as physical access to the VMS. A model of rules for security and confidentiality can be found in the NEAFC Scheme for Control and Enforcement and in the NAFO Control and Enforcement Measures.
- 3.6.2.12 It is possible to let the system register and transmit information concerning tampering. This can be information regarding blocking the antenna, cutting off the power etc. This is available in some systems.
- 3.6.2.13 There should be standards for the approved vessel equipment. Number of nations has already established such standards.

4. Develop cost estimates for the option(s) developed in (3) above

4.1 Hardware cost:

4.1.1 Monitoring centre:

4.1.1.1 Centralized system will require a PC or Unix computer, depending on the type of system. Number of computers depends on the complexity of the system and how many workstations are required. In some cases a regular PC will be sufficient but in other systems a number of computers connected in a network may be needed. The basic VMS will also require a modem and/or an Internet connection with firewall. In addition a printer is needed. This can be in the range of 6.000 USD and upwards.

4.1.1.2 National system will require more or less the same hardware as a centralized system and the cost estimate is therefore the same given the assumption that a rather small system is to be installed.

4.1.2 Vessel:

4.1.2.1 Cost of a tracking device for a vessel depends on the type of system to be used. It should though not exceed 5.000 USD but can be considerably cheaper.

4.2 Software cost:

4.2.1 Software cost for a VMS system can vary considerably. Starting price can be around 30.000 USD for the system itself. An additional cost for installation and training should be expected as well as for licences.

4.3 Communication cost:

4.3.1 Vessel:

4.3.1.1 Cost per report from vessels depends on the different tracking systems. In Inmarsat C cost of a single position report can be around 0,07 USD for the position and including the speed and heading the cost can be around 0,15 USD

4.3.1.2 The total communication cost for the vessel depends on the frequency of reports. Given that there is a requirement for an hourly report the cost pr. day can be from 1,70 USD up to 3,60 USD if speed and heading is included. It should be noted that NEAFC and NAFO require 12 reports pr. day but many nations require once every hour.

4.3.2 Monitoring centre:

4.3.2.1 The communication cost for the basic connection in monitoring centres can vary between systems as well as between individual service providers and nations. These connections have nevertheless become cheaper, especially if based on the Internet technology. A VMS must though have a fixed high speed connection such as ADSL. An average cost pr. month for an ADSL connection can be around 40 USD.

4.3.2.1.1 To inspection platforms:

4.3.2.1.1.1 Distribution of information to inspection platforms depend on the volume and frequency as well on different systems. In the case of E-mail via the Inmarsat C system the cost could be something like 1,20 USD for 1 kbit of data, which is equivalent to about 127 characters. One position report including speed and heading can be

around 45 characters for the data itself but additional cost for overhead in the messages should be expected. That is though only a small part of the message and becomes proportionally smaller with larger messages. However, it should be noted that information to inspection platforms may be included in transmission of other information of data from the relevant authorities and therefore not necessarily of additional cost for a centralized system.

4.3.2.1.2 To organisations:

- 4.3.2.1.2.1 Distribution of information on HTTPS over the Internet is usually not of a significant cost. In fact very cheap. Can be compared with normal E-mail cost.

4.4 Staffing of monitoring centres:

- 4.4.1 National monitoring centres are in many instances already up and running and taking onboard additional vessels is not necessarily reflected in increased staff. It should however be recognised that additional vessels means an additional work load which needs to be dealt with. New systems will, however require staff, unless they can be operated by other centres like Coast Guard and/or Maritime Traffic Centres.
- 4.4.2 For a centralized system the staffing depends on the current manpower at the relevant organisation together with the volume of traffic and the complexity of the system. Given that automatic procedures are utilised as far as possible a simple system could more or less work on its own. However, additional staff with some computer/VMS skill will be needed if not already present.
- 4.4.3 Some national systems are open 24 hours a day, 7 days a week. These are sometimes included in larger operation centres. For centralized systems the need for extended opening hours is not foreseen. This is based on the fact that a centralized system like NEAFC in London does not require extended opening hours, as the system works automatically.

4.5 Operating cost of VMS system:

- 4.5.1 Yearly maintenance of the system will always be a factor. This can be in the range of 15 – 20 % of the total cost of the system.
- 4.5.2 Hardware should be expected to be renewed every 3 years if regular PC is used.
- 4.5.3 Consumables and other costs should not be of any significance. This can be expected to be power consumption, paper, etc.

29th March 2005

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Attachment I, Comparison of different systems
Attachment II, Cost estimates
Attachment III, The NEAFC system

Attachment I, Comparison of different systems

System	Main characteristics	Area of coverage	Two way	General remarks
Inmarsat C	Based on geo-stationary satellites over the equator. Two satellites over the Atlantic, one over the Pacific and one over the Indian Ocean	Global except from polar regions above 75°	Yes	Inmarsat C is often found onboard vessels as part of the GMDSS communication package and/or as a tracking device. Positioning is usually done by an internal GPS. Inmarsat C is heavily used in VMS today. Some whaling operations could be conducted in and close to the polar regions. This might affect the use of Inmarsat C.
Argos	Based on polar orbiting satellites	Global.	No	Argos transponders must be within the satellite's footprint. Therefore the connection is not continuous, but the interval between satellite passes is shorter on high latitudes. Widely used in all kinds of tracking. Also used to track animals. Positioning can either be from an internal GPS or by calculation from the satellite using the Doppler effect.
BoaTrack - Euteltrack	Based on geo-stationary satellites.	Beamed system	Yes	Widely used in many types of tracking, i.e. monitoring boats and trucks. Positioning can be either from an internal GPS or by calculation from the satellites.
Coastal VHF/UHF system	Based on coastal repeater system	Line of sight from the coastal repeater	Yes / No	There are some such systems being used today. This however requires considerable infrastructure cost if being installed for a large coastal area.

Attachment II, Cost estimates

tem	Basic cost in USD	Yearly operating cost in USD	Remarks
Base Station:			
PC Computer and accessories	6,000	2,000	Complete renewal of hardware should be expected up to every 36 months.
ADSL connection	100	500	
VMS Software	30,000	4,500	Maintenance cost should be expected every year.
Licences	5,000	16,000	Monthly fee for licences should be expected, i.e. database, operating system, security measures, etc.
Consumables		1,000	
Communication cost		3,000	This can vary a lot depending on volume of data. This figure should be regarded as a pure estimate.
Staff		60,000	Some set-ups may need additional staff and some not. The figure depends also on the normal wages in different countries. This is an estimate for one person.
Totals	41,100	87,000	

Vessels:			
Possible cost for one vessel:			
VMS equipment	4,000	400	Inmarsat C solution. Mini C is though as low as 2.000 USD
Communication		720	Based on hourly reports in Inmarsat C, including speed and heading for 200 days a year. The cost will however depend on agreements between the different service providers and the customers.
Totals	4,000	1,120	

The basic security is included in the estimate, such as firewalls etc. It should be noted that the above figures are only estimates which can cange to both sides when making a contract with a vendor.

Attachment III

The NEAFC system which is very similar to the NAFO system. These systems are based on the combined solution and are in fact not only tracking system. They do also handle catch and activity reports and distribute information to Contracting Parties with an active inspection Presence in their Regulatory Areas.

