

INDRIS, an Inland AIS Application on the European Waterways

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Introduction

The transport sector and in particular inland waterway transport, is increasing the use of information and communication technology (ICT). The use of ICT can improve this mode of transport eg efficiency and the competition with road transport. An ICT concept, called RIS, River Information Services, is developed during the last years for the exchange of information with inland vessels for a number of applications. To bring this concept alive, a research project, INDRIS (Inland Navigation Demonstrator for River Information Services), was defined to establish standards for the information flows in terms of data elements, protocols and communication means as well as to demonstrate the principles of the concept. INDRIS is carried out by governmental bodies, transport industry, shipping industry and research institutes in The Netherlands, Austria, Germany, Belgium and France.

The RIS concept covers navigation, safety and logistic applications. For this reason it was necessary to define data communication and communication systems for time critical applications (real time), such as navigation and safety related data exchange, and not time critical applications eg reporting, gathering fairway information, weather reports and planning.

For time critical data communication the Automatic Identification System, AIS, is chosen. This paper describes Inland AIS as demonstrated in INDRIS.

Why AIS?

The most important reason to use AIS for inland shipping is that it fulfils all requirements of the RIS concept for time critical information exchange. The following applications can be distinguished:

- automatic identification and reporting in VTS (or otherwise controlled) areas;
- completion of the traffic image on board on places where the shipborne radar fails (looking around the corner);
- identification of other vessels for navigation purposes on board;
- bringing navigational and safety related information on board;
- calculation and updating ETA's for planning purposes (logistic, locks, etc.).

Inland AIS must be, in a large extend, compliant with AIS for sea-going vessels falling under SOLAS chapter V, at least on VHF communication level. Advantage of this important choice is that vessels can 'see' each other, if they are sea going vessels or inland vessels. In areas with mixed traffic all vessels are behaving in only one common system. It is not necessary required that all category specific messages can be understood by the others but position and identification are the minimum common requirements. All participants should also understand safety related broadcast messages. In areas with sea-going and inland traffic, only one shore-based infrastructure is needed to communicate with all types of traffic.

AIS is a self-organising system following the SOTDMA (Self-Organising Time Domain Multiple Access) principle and can operate in different modes. In harbour areas with sea-going traffic there will be, at least in the future, a shore-based AIS infrastructure. Here AIS can operate in the 'assigned' mode or on bases of 'interrogation'. In other words the organisation of the communication can be managed from the shore (VTS station) but can be self organised as well. The same can apply for inland situations where dense traffic occurs or in complex river situations. However, on long stretches of rivers, without complex or dangerous situations, there will not be any shore-based infrastructure. The

traffic is self-organised, so the communication system must be self organised too and AIS facilitate this in the 'autonomous' mode.

Final reason to use AIS for inland applications is that AIS already is defined and there is some experience with the system. The development of a completely new communication system will be time consuming and very expensive. To get new frequencies for inland applications, besides the AIS frequencies, for international (or at least European) use can be very difficult or is probably impossible for a relative small group of users.

Development of Inland AIS

During the definition phase of the INDRIS project, only the ITU Recommendation M 1371 was available. Because the Recommendation is developed for sea-going vessels, for inland navigation some amendments were needed to implement all required functions. This resulted in separate specifications for Inland AIS. In particular in the 'Ship static and voyage related data' messages a number of changes were needed:

- The IMO number must be replaced by the OFS number (Official Shipping Number)
- A different 'type of ship' table was required using the 'DVK' code (European code for type of inland vessels)
- Actual draught must be defined in steps of 1/20 meter, total 12,75 meters
- Destination code will be the so called UN LOCODE (location code) list

Additionally a method was described to send VTS target information from shore-based stations to vessels, to complete the traffic image on board where the on-board radar system will not cover the whole area.

During the standardisation process in IEC and as result of the discussions within the IALA AIS Committee, some changes in the ITU Recommendation will be proposed. One of them includes the so-called 'local application' mode. The local application facilitates regional use of AIS other than required by IMO for sea-going vessels. This includes the use of AIS for inland navigation, broadcasting of special binary messages etc.

Broadcasting VTS targets from the shore is now included in a special binary message in the AIS standard under development.

In the future the standard AIS specification can be used for inland traffic without special requirements for this application. Just the 'local application' must be described and registered by a competent authority.

Looking to the hardware of the AIS transponder one can conclude that some changes can be made to reduce the costs of a system on board. At least in Europe, the standard VHF maritime frequencies (channel 87 and 88) are available for AIS. There is no need for channel management via DSC. For inland navigation purposes the DSC facility (channel 70) will not be required because there will not be any shore-based station transmitting a DSC message.

An inland vessel is not to compare with a sea-going vessel falling under the IMO regulations concerning carriage requirements of navigational equipment. There is no gyro, no compass, no heading sensor and mostly no positioning system available. The traditional means of operation is just 'looking outside', many times completed with a simple river radar system.

The IMO-AIS includes a GPS receiver for time synchronisation only. Position, course and speed are delivered by the ships navigation system. For inland shipping, the built-in AIS-(D)GPS system must also be used for this kind of navigational information. No external navigational input will be required for this purpose.

Communication to and from other equipment on board can be done by the standard IEC 61162 standards eg to Inland ECDIS but an RS232 interface to a personal computer system (PC or laptop) is also recommended.

INDRIS Rhine-Scheldt Demonstrator

The following applications as part of the RIS concept will be realised and demonstrated in the Rhine-Scheldt INDRIS demonstrator in the Netherlands. Some of the applications are existing applications, adapted to the RIS concept eg Reporting Dangerous Goods, others are developed during the project to extend the functionality of RIS. In the following overview the role of AIS in that particular application is explained.

- Shore based traffic image on board. The position of VTS targets, as available in a VTS station, is broadcasted via AIS as far as it concerns targets without own AIS identity. Vessels equipped with AIS will be received on board of vessels via the regular AIS position reports. For the demonstrator the position will be broadcasted via normal 'binary messages', in the future IEC standard there is a 'VTS Targets' message doing the same functionality in a more efficient way. This application will include the 'looking around the corner' facility, useful in mountainous areas or in areas with poor radar coverage. Manned VTS station are not necessary needed to use this facility. In particular mountainous areas with sharp curves in the river, unmanned radar stations with some automatic processing tools, can provide information for this application.
- Traffic image in VTS. A real time traffic image will be maintained, normally by radar sensors, in each VTS station. Identification will take place by AIS without verbal communication. This will reduce workload of operators.
- Regional traffic overview. This will be used for planning and statistical purposes. AIS will supply positions and calculated ETA's.
- Voyage planning, reporting and monitoring. AIS will supply position for updating from voyage plan and calculated ETA. Automatic reporting to VTS stations or special reporting points eg locks and bridges will be given by AIS.
- Lock planning. For optimising lock planning, special tools are developed to calculate lock-ETA. After planning a feed-back to the vessel can be send to advise speed behaviour and to optimise the lock operation from both lock and vessels point of view.
- Terminal planning. Same as lock planning. Information will be used for a efficient dispatch of the vessel.
- Incident management. In case of incidents or accidents AIS will be used to inform traffic via broadcasted binary safety messages.
- Fairway information. This application will inform skippers about the actual fairway conditions eg water levels, ice condition during winter time, etc. This is part of RIS, however AIS will not play a role in this kind of information supply. It is not time critical.
- Electronic goods service. This trade in transport is one of the commercial services of RIS. Because the off-line character AIS will not play an active role.

Demonstrations will take place in the second half of May 2000. The AIS system keeps in operation at least in 2000 to built-up some practical experience with the system and to implement some new applications.

Figure 1 shows the area of interest of the Rhine-Scheldt demonstrator. The Netherlands part of the river Rhine will be covered by AIS shore-based stations. There are two VTS stations involved, the others are at reporting points as locks etc. The most imported VTS station is Dordrecht, a complex river situation with very dense traffic all over the day. The second VTS is Millingen, a junction of two main rivers. Figure 2 is the block diagram of the INDRIS AIS set-up. In total 30 vessels are equipped with AIS transponders and are participating the INDRIS trials.

Figure 3 is a block diagram of the Dordrecht VTS station. There is a chain of radar sensors along the whole area. A multi sensor fusion processor calculates a complete traffic image of the whole area. This is combined with AIS information of participating vessels as long as they are in this sector. Non AIS radar tracks are also transmitted by AIS.

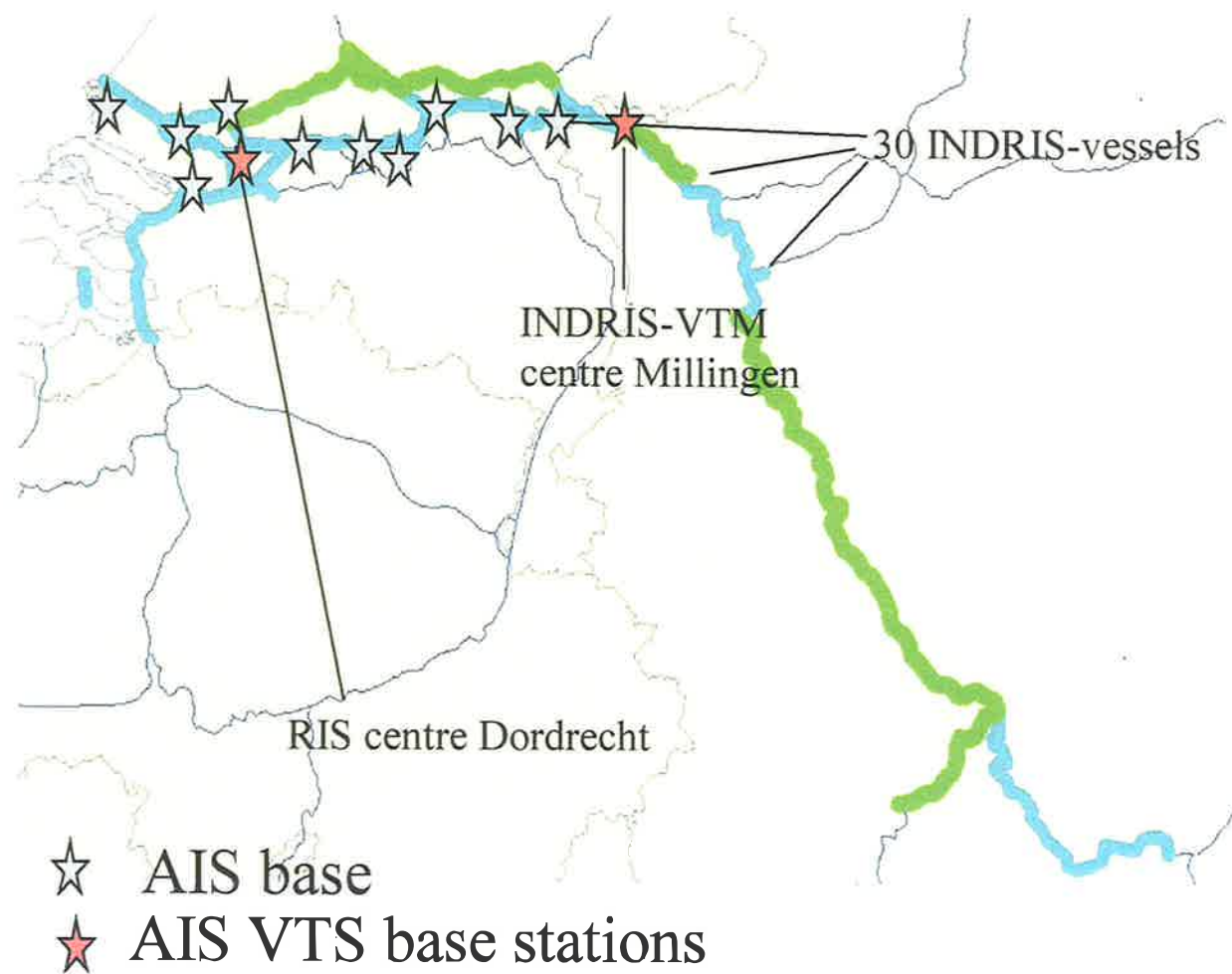


Fig 1. INDRIS Rhine-Scheldt demonstrator with AIS shore-based stations.

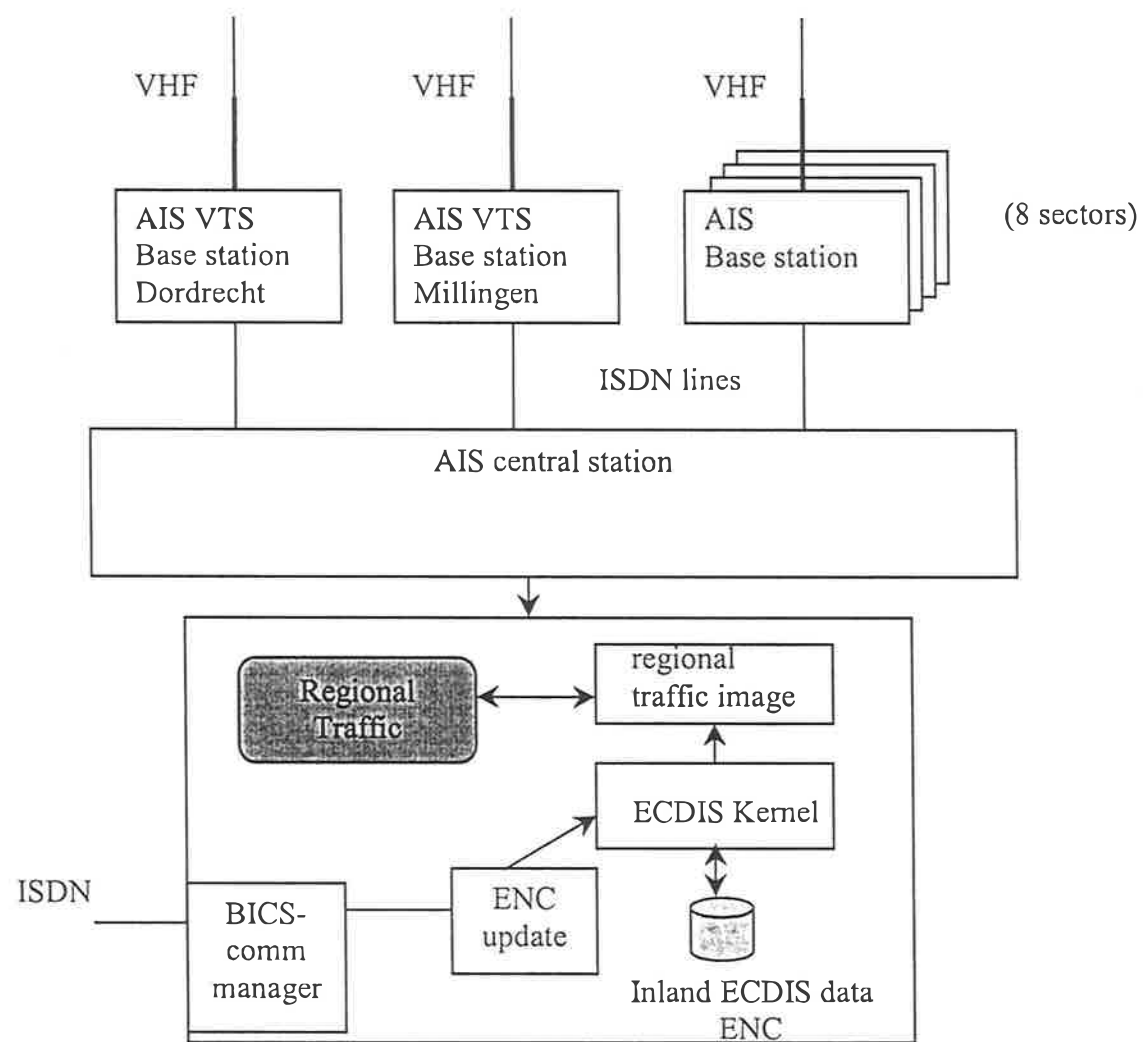


Fig 2. INDRIS AIS configuration

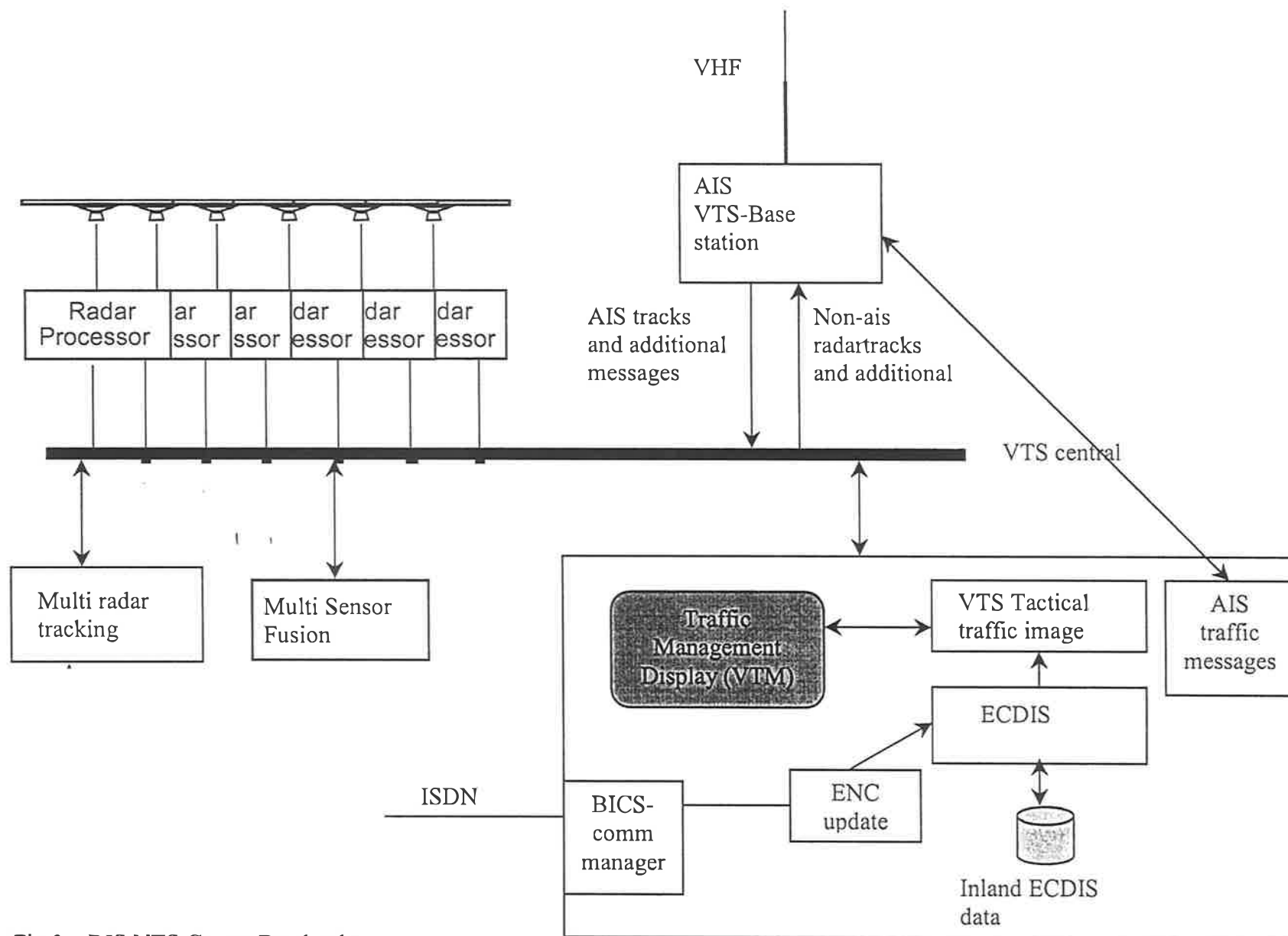


Fig 3. RIS VTS Centre Dordrecht



Meeting Program

**2000 Annual Assembly Meeting
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**May 7-13, 2000
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