Data Analytics Enables Advanced AIS Applications

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Abstract. The maritime Automatic Identification System (AIS) data is obtained from many different terrestrial and satellite sources. AIS data enables safety, security, environmental protection and the economic efficiency of the maritime sector. The quality of AIS receivers is not controlled in the same manner as AIS transmitters. This has led to a situation where AIS data is not as clean as it should/could be. Added to this is the lack of accuracy and standards in entering the voyage data by the mariners such as next port of call into the AIS equipment installed on vessels. By using analytics IMIS Global Limited has been able to process the AIS data stream to eliminate a large portion of the faulty data. This has allowed the resultant AIS data to be used for more accurate detailed analysis such as the long-term vessel track, port arrival events and port departure events. New data that is derived from processing AIS data has enhanced the information available to maritime authorities enabling a significant increase in safety, security, environmental protection and economic growth. The next generation of maritime data communications technology being based AIS. This is known as the VHF Data Exchange System (VDES) and this technology now enables further opportunities. The value from the large volumes of AIS data is extracted by visual, streaming, historical and prescriptive data analytics. The datAcron project is showing the way with regards to the processing and use of AIS and resultant trajectory data.

Keywords: AIS · VDES · datAcron

1 Introduction

When AIS was conceived in the mid-1990, those working in the maritime communications industry and on the associated standards, did not fully realise the future impact that AIS would have on the maritime safety, security, economics and environmental protection. The focus was primarily on maritime safety or accident prevention with AIS defined as an ‘aid to navigation’.

AIS uses a Self Organising Time Domain Multiple Access (SOTDMA) scheme in the VHF maritime band and transfers digital information from ship to shore, from ship to ship and from shore to ship, the so called 6S communication system. This uses 2 × 2,250 26.67 ms slots to transfer data in a range of messages with standard formats.

C. Doulkeridis et al. (Eds.): MATES 2017, LNCS 10731, pp. 22–35, 2018.
https://doi.org/10.1007/978-3-319-73521-4_2

AIS uses 27 standard format messages as described in the AIS standard, ITU-R M.1371-5 that include five basic message types:

1. Dynamic data
2. Static data
3. Safety Related Messages
4. Binary messages
5. System management messages

1.1 Dynamic Data

Dynamic data contains the position information of the GPS antenna connected to the AIS unit along with the Speed Over Ground (SOG), Course Over Ground (COG), Rate Of Turn (ROT) and True Heading (TH).

Along with this data, there is a Communication State parameter that adds value to understanding the AIS message and the temporal nature of the AIS dynamic messages.

1.2 Static Data

The static data concerns the ship on which the AIS unit is mounted and includes:

1. The precise location of the GPS antenna on the ship
2. The dimensions of the ship
3. The static draft of the ship
4. The name of the ship
5. The International Maritime Organisation (IMO) number of the ship (hull)
6. The call sign of the ship
7. The estimated time of arrival at the next port
8. The destination port name

Some of these data, such as the destination port, are entered by the mariner on the bridge.

1.3 Safety Related Messages

Safety Related Messages are text messages that are either broadcast and addressed to another ship or authority using the Maritime Mobile Service Identifier (MMSI) (a 9-digit identifier). The MMSI can also identify an authority or a service such as the local Coast Guard or the Maritime Rescue Coordination Centre (MRCC).

1.4 Binary Messages

Binary message can be broadcast or addressed and can contain any data to be sent between AIS units.

Binary messages are often used for telemetry or sensor data such as Internet of Things (IOT) data and includes meteorological and hydrological data.

1.5 System Management Messages

AIS system management messages are used to manage the VHF Data Link (VDL) layer load and access to it. These messages are normally under the control of the competent authority.

2 A Defining Moment for AIS

The events of the 9th of September 2001 in the United States of America added security to the maritime operations agenda and AIS was a good candidate to quickly satisfy this requirement. This need focused the global maritime sector on the identity of the vessel, its voyage history and its current location and navigational status.

AIS went from a ‘nice to have’ to a ‘have to have’ technology for all SOLAS vessels along with many work vessels within the port and off shore energy environments and vessels carrying paying passengers.

AIS receivers were installed in as many ports and waterways by various authorities. These AIS receivers were networked together and the data streamed into data processing and storage environments.

Data collected from AIS receivers started pouring into national authorities and a range of commercial terrestrial and space based services. Various commercial companies focused on getting an AIS receiver in every major port and then along most of the important waterways. The amount of AIS data increased significantly and the cost of collecting, processing and storing this data became higher than the apparent value.

The value to the users of the data was as simple as seeing ships fitted with AIS units moving on a chart. This supported Maritime Domain Awareness (MDA) initiative.

Many maritime administrations and commercial systems that were collecting AIS data started decimating data to try and reduce the amount of AIS data being streamed and stored. This reduced the amount of data being stored from one message per 5 s on average per sailing vessel to one message every few minutes.

This process continues to this day in some environments.

The decimation appeared to not have any negative impact on the services being used by the authorities and commercial sector at the time but data has been lost and some fidelity along with it.

Collecting AIS data, fusing it with any other available data and displaying this on a Common Operating Picture (COP) was the focus of many in the MDA environment.

Extracting further information from the data has now become a focus.

3 Maritime AIS Data Fidelity

Maritime data that has been decimated loses fidelity or accuracy. AIS data has spatial and temporal components. The AIS spatial components are accurate to approximately 10 m dependent on Global Navigation Satellite System (GNSS) accuracy and the availability and use of Differential GNSS. The AIS temporal components can be accurate to a single AIS slot which is 26.67 ms.

AIS data has two components:

1. TAG Block/Comment Block data/Meta Data
2. AIS message data

The TAG Block or Comment Block data is often not available in an AIS data stream or database or not considered important but this contains the source, destination and time of the message to an accuracy of one second. Depending on the system being used, additional data could be included that describes the AIS message status and quality. This has particular application in the collection and processing of satellite AIS data or so-called S-AIS data.

The TAG Block or Comment Blocks effectively doubles the amount of data that is received and processed for each AIS message transmitted from vessel. This therefore also increases the load on the data links, data processing and storage environment that use this data.

The AIS data, besides having the dynamic navigational detail of the vessel also includes some timing, slot and performance detail with regards to the AIS signal including:

1. The next slot to be transmitted in
2. The slot of the current message
3. The number of received AIS stations

Some of the AIS data is corrupted in the path between the transmitter and the Maritime Information System (MIS) that is receiving, storing, processing and disseminating the AIS data to third party applications. The performance of the MIS is described in the various international standards.

The corruption of AIS data has a number of causes which includes:

1. Substandard AIS receivers that corrupt the data
2. Substandard AIS receivers that cannot handle the load of AIS data in high traffic areas or under anomalous propagation conditions and lose data
3. Vessel Traffic Services (VTS) equipment that cannot handle the entire range of AIS messages and had to be modified to do this and corrupted AIS data in the process

There are other causes of AIS data errors and these include:

1. Incorrectly configured AIS units with primarily the type of ship, ship dimensions, GPS antenna position or MMSI being incorrect
2. Incorrectly installed AIS units which inhibits the AIS on the vessels from detecting ships in the local area and providing incorrect data
3. Mariners not updating the ETA and destination detail on a per voyage basis

With the availability of AIS data from various satellite service providers using Low Earth Orbiting (LEO) satellites, a global view was obtained of the entire maritime fleet. The increasing sophistication of the AIS receivers, associated antenna systems and the number of LEO satellites carrying AIS receivers is leading to significantly more AIS data being available to consumers of AIS data.

The issues with the security of AIS data was being highlighted by a number of entities and a widely distributed event where it was shown that it was possible to enter spoofed data into a Maritime Information System (MIS) and not have this event automatically detected but easily visible when shown on a chart.

At this same time, some of the authorities were concerned about the exact location of ships being known and this information distributed publicly and in real time. This resulted in a design and sale of various devices that could be added to ships between the external GPS and the AIS that could spoof their position by a small distance (100's of meters) but not jeopardise the AIS as an 'aid to navigation' concept.

The question facing maritime authorities and systems suppliers alike was: Could this apparent security problem with AIS technology be overcome on both the vessel and on the shore side MDA applications?

4 Data Analytics

With the rapid improvements in computer hardware performance and the growth in data storage capability of database systems and technologies, it became economical to run all AIS data through high performance complex event applications and streaming analytics applications.

The first of these was to create an application that detected faulty AIS data. Faulty AIS data could have been overtly caused (spoofed vessels) or caused by the range of reasons already noted above.

The typical functions to filter out faulty or incorrect AIS data include the following:

1. Detect incorrectly formatted messages
2. Detect message with the incorrect temporal attributes
3. Detect messages with incoherent contents
4. Detect and eliminate duplicate MMSI
5. Detect changes in static data
6. Detect changes in the data that violate the hydrodynamic performance envelope of the vessel

AIS data is now often verified against message temporal attributes, message construction and ship hydrodynamic performance which flags approximately 10% of all AIS data from some sources as having some errors. Once flagged, the severity of the issue can be determined and the message eliminated or just flagged and processed further. This data can also be contributed to a vessel risk analysis that, in combination with other data, can lead to vessels being given special attention when entering the littoral state and the port.

The remaining 90% of the AIS data, although significantly decimated, is relatively clean and can be used by the data analytics applications and when used by third party applications, provides more reliable information/reports.

5 Event Management

An event manager, consumes clean AIS data and processes the data to detect a wide range of events and then generate one of a number of alerts.

AIS data along with a range of geospatial data can then be used with greater confidence in an event manager to generate a range of standard events that then leads to the generation of additional data and the associated alerts. These include:

1. Port entry and exit events
2. Closest Point of Approach (CPA) violation
3. Events as vessels approach hazardous objects and areas

Within some environments, the events become far more complex and includes:

1. Threat determination when vessels sail through sensitive areas
2. Threat determination when vessels enter sensitive areas
3. Vessels in dangerous or environmentally sensitive areas
4. Detecting the interaction between ships and work boats with a port such as pilot boats, tug boats and bunkering vessels
5. Detecting unusual activity of high risk vessels such as high-speed ferries within a port environment
6. Detecting the interaction between vessels of interest at sea

Each of these types of events need to deal with a sequence of sub-events to enable the detection of the desired event with a high level of confidence that the event took place and then generate the alert that enables the operator to take the correct action timeously for that event in that area.

The large volume of data that is now available along with the processing power to be able to process this data and deal with the described events allows authorities the unique capability to determine the performance of any port (number of ships arriving, in port and departing each day) or any ship (average sailing speed, acceleration, deceleration and port calls on any on voyage) that was fitted with a Class A AIS unit.

Where the AIS and event manager data is stored over long periods of time often approaching several years, using analytics, seasonal and yearly trends in ship activity, port activity and shipping routes can be detected.

The detection of routes can be used a predictor of the route to be followed by a particular vessel to the next known destination port. Where any particular vessel or fleet of vessels has been tracked over a number of years, the prediction may use this historical data to add to the accuracy of the destination port and the route used by that vessel or vessel fleet to that particular port.

6 Pattern Recognition

A large number of ships often sail a predetermined and often repeated route and thus the routes are often simpler to detect.

The sailing patterns that are of great interest to many are the fishing fleets. This data is becoming more widely available because more fishing vessels are being fitted with AIS units and the size of the vessels being fitted with AIS is decreasing. Smaller vessels tend to fish closer to their home port and these fishers are often dependent on their catch for food as well as income. The number of small fisher vessel in some countries is significant and can approach more than 500,000 small vessels in some Asian countries.

The fishing community operates in a high-risk environment. In the short term, using pattern recognition techniques, the activity of ships and small craft fitted with AIS can be determined and measured against newly created models for safety, security, economic and environmental monitoring purposes.

The combination of catch data and voyage data allows the catch to be certified as being completed under the agreed terms and conditions applicable to that fisher or that fishing area and this, when attached to the catch can add economic value to the catch because of this catch source tracking capability.

7 Volume of Data

A typical national authority will monitor the activity of all 165,000 ships that can be detected by AIS in 2017. This monitoring is used to reduce the various risks when vessels enter the littoral state and national ports. These 165,000 vessels generated an estimated 19,000 AIS messages per second on a global basis resulting in 48 Mb/s data being transmitted in the two AIS channels. Many vessels are at sea and the transmitted AIS messages are not detected by terrestrial or satellite AIS receivers. About 8 million AIS messages are collected per day by space based AIS receiver systems with a revisit rates of about 15 min at some latitudes.

The number of vessels detected using AIS has increased by about 40% over the last 4 years due to the increased number of vessels fitted with AIS units, the improved performance of AIS receivers and antennas on the various satellite systems. This has increased the number of AIS messages received and the number of vessels.

In areas where the AIS population has increased significantly, techniques, such as coverage area sectorisation is being employed by terrestrial AIS receiver systems to gather more reliable data. A number of national authorities have now recognised that the monitoring of their entire coastline is important for safety, security, economic and environmental reasons and although not increasing the number of vessels being monitored, this activity is increasing the number of AIS messages for each vessel that are being collected, processed and stored on a daily basis.

AIS unit cost is decreasing and thus encouraging a large number of leisure and other small craft to fit AIS.

The following factors are expected to drive the amount of AIS data stored and available for analysis:

1. A decrease in AIS data decimation
2. The increasing number of satellites fitted with improved AIS receivers and antenna systems
3. The increasing number of work vessels, ferries, fishing and leisure craft being fitted with AIS
4. The integration of maritime locating systems and/or sensors to form an integrated system with a Common Operating Picture (COP) or Single Pane of Glass (SPG) operating environments

5. The growing AIS coverage of the various littoral states for safety, security, economic and environmental reasons
6. The inclusion of AIS as part the new and higher data bandwidth VHF Data Exchange System (VDES) technology
7. The sensorisation of ships and the cargo that is being carried by these ships (the Internet of Things (IoT))
8. The increase in applications that generate new data from the historical and real time AIS data available from various sources
9. Encouragement of the mechanised, artisanal and sport fishing environments to fit AIS for their own safety and protection

8 Satellite AIS

Satellite AIS was trialed as an experiment by ORBCOMM in the mid 2000's with a view to this being an opportunistic method of collecting AIS data on a global basis. This was proven to be a marginal but operational solution and since then, many satellites have been fitted with AIS receivers and placed in Low Earth Orbit (LEO) to collect AIS transmissions from ships, Aid to Navigation AIS and AIS shore stations.

AIS receivers that are used in space have become more sensitive and able to detect more AIS transmissions through deconflicting techniques. These orbiting LEO satellites have not provided simultaneous global coverage and use store and forward techniques leading to some system latency between when a ship transmitted the AIS message and the time this is made available to the consuming entity.

Various data processing and data analytic techniques have been used by the satellite service providers to extract and provide high quality data. This is then able to be used by their customers to enhance the national Maritime Domain Awareness (MDA) systems.

The pace of progress with regards to AIS receivers in space is not slowing down. Iridium are placing AIS receivers on more than 60 IridiumNext satellites and this system is expected to capture more than 50 million AIS messages per day with a revisit rate of less than 2 min on a global basis.

The near real-time availability of AIS data for all vessels fitted with AIS is driving new opportunities in port, berth and ship monitoring. The analysis of the ship voyage data is adding value to determining the risk that any vessel poses to a national authority or port and is also allowing those interested in the risk profile of any vessel or fleet of vessels to utilise the detailed spatiotemporal data that is now becoming available to re-evaluate and fine tune their risk models.

9 The AIS Maritime Information System Infrastructure

This volume of AIS and associated data is driving the centralisation of AIS and associated data and services into cloud based systems and services offering a global service.

There are a number of standards that apply to AIS network infrastructure of which the Common Shore Side Architecture (CSSA) is the most well-known.

The CSSA does not however, deal with performance required to process the various AIS data streams and then provide the various topical data streams known in AIS as Logical Shore Stations (LSSs) and then analyse the real-time (real time analytics), historical (historical analytics) and actionable AIS data (prescriptive analytics) along with the many events that have resulted from the real-time processing of the AIS data.

The first challenge is to collect the data from the various sources to satisfy the demands of the end user. This could include AIS data that originates from:

1. AIS receivers in the area of interest
2. AIS shore stations in the area of interest
3. AIS Aids to Navigation devices in the area of interest
4. Satellite AIS data on a national, regional or global basis
5. Data from third party sources such as:
   a. Neighbouring countries
   b. Port Vessel Traffic Services
   c. Off shore energy platforms
   d. IALAnet
   e. Maritime Safety and Security Information System (MSSIS)

This data is cleaned using streaming analytics to remove any AIS data that is detected as being corrupt and then merged into a single temporally sequenced database which serves two primary purposes:

1. Store the received and cleaned AIS data
2. Provide an audit trial of all AIS data from source to customer

The AIS data is then streamed according to the LSS filtering and processing requirements. During this process, the data is processed in parallel by the event manager and the target trajectory extractor.

The stored data is made available for historical analytics. All data is made available on line for reporting via a Human Machine Interface (HMI)/query builder or by using a web service.

The performance demanded by users is often given in response time for a particular query on historical data such as:

1. A 10 s response time is required from a query to data result being available for download for all AIS data and trajectory data for one single vessel for one month from any month in the last 10 years of stored AIS data. The download of the result data is excluded.
2. A 10 s response time is required from a query to data result being available for download for all vessels that crossed a dynamically defined 100NM by 100NM bounding box in the selected one month from any month in the last 10 years of stored AIS data. The download of the result data is excluded.

To achieve the required performances demanded by users requires a range of techniques that includes:

1. Storing of the latest near real-time data in volatile Random Access Memory (RAM) database (i.e. x minutes)
2. Use of Solid State Disk (SSD) storage for some often-used short term data (i.e. x days)
3. The sharding of the database using various well-known techniques
4. Running multiple copies of the same database
5. Using a high performance, low latency LAN
6. Predefining a range of reports that are run in the background
7. Preparing the often-used AIS data in the database in a manner that is optimised for most standard reports

Historical analytics with the large volumes of AIS data available is becoming of interest to the fishing industry when combined with weather predictions, meteorological and hydrological data with water temperature.

10 VDES: A Step Change in Maritime Data Services?

A VDES unit includes AIS, Application Specific Message (ASM) + VHF Data Exchange (VDE) RF technologies. The AIS technology data rate is 9.6 Kbps, the AMS technology data rate is 19,2 Kbps and the VDE technology data rate is 308 Kbps.

A VDE capable unit has 32 times the bandwidth of an AIS capable unit.

The VDES specification, ITU-R M.2092-0 was published in 2016 for terrestrial services after the Radio Frequencies were approved for use at WRC-15. At WRC-19, an application is being made for Radio Frequencies (RF) to enable VDES satellite communications on a global basis.

VDES allows ship to ship, ship to shore, shore to ship and ship to satellite communication. The interface and the ship and the shore side are based on the same standards as was used for AIS. VDES has several unique technical features that includes:

1. Dynamic bandwidth allocation
2. Forward Error Correction (FEC)
3. Selected message authentication adding a level of cyber security
4. Backward compatible with AIS

VDES is one of a number of technologies that is increasing the bandwidth available to ships that includes satellite communication systems in the deep sea and LTE communication systems when close to the coastline and ports in some parts of the world.

The VDES technology is being propelled by the communication demands of e-Navigation. VDES with associated data collection, data processing, data storage, event management and data analytic engines is expected to enable a wide range of new maritime e-Navigation centric services such as the Sea Traffic Management (STM) and Port Collaborative Decision Making (PCDM) systems that could be supported by a wide range of localised applications that could run on any number of portable communication devices within the maritime domain.

There are large numbers of sensors and applications that are expected to be accommodated on the new VDES system starting from early 2018 onwards.

11 Future Opportunities

Autonomous ships are now being considered and along with e-Navigation and the drive to sensorise ships and port environment. This results in significantly more location based and contextual data going to be available via the increasing data bandwidth to authorities and commercial companies that will drive a wide variety maritime centric safety, security, economic and environmental agendas. The availability of this increased volume of data along with an analytics capability will increase the view of the logistics chain from manufacturer in one part of the world to consumer in another.

With more finely grained AIS data becoming available due to the reduction in decimation and with AIS data being integrated with a wide range of IoT sensors in ports, on ships and fitted to cargo, weather data, radar data and data from other geospatial and imaging sensors, the volume and breadth of data to be collected, processed stored, analysed and reported on is growing and creating new insights into the maritime environment resulting in new commercial opportunities.

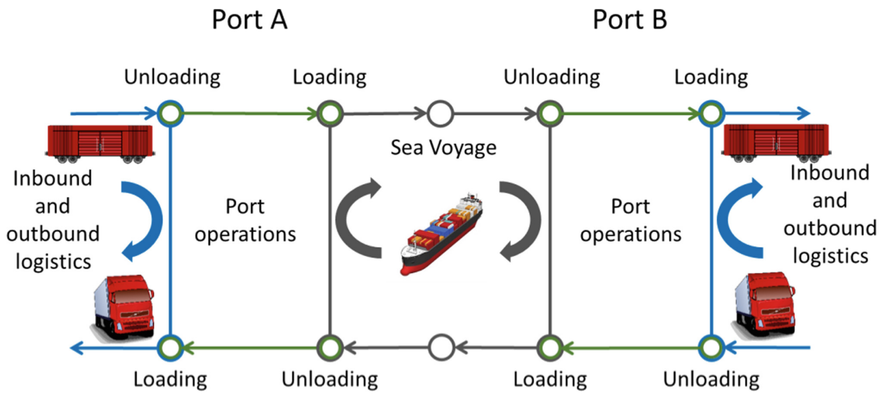
These new commercial opportunities include:

1. Streaming analytics to clean AIS data providing real time insight into vessel activities with complex events adding new data and new insights
2. Historical analytics allow the development of contextual models and patterns to provide insight and support the streaming analytics and allows the development of prescriptive analytics applications
3. Detection of complex events adding data and information available to support the maritime operator environment
4. The integration of IoT sensors on the ship and shore will support the improvement in efficiencies and lead to further gains in safety, security and improve the economic viability and the environmental protection in this domain

All changes, disruptions and enhancements to the operational maritime environment need to have a compelling moral, legal and/or commercial imperative or they will not take hold.

12 An Example That Demonstrates the Potential

We are going to work through an example that comes from the European Union H2020 EfficienSea2 project. This example follows a vessel from Port A to sea and from sea to Port B.



1. The vessel is berthed at Berth A1 in Port A its location is determined by two components:
   a. The size of the berth – this can be made available from the port database or determined from the historical data for vessels that have berthed in the same/similar position.
   b. The size of the vessel.
2. The vessel is being loaded with cargo as part of port operations.
3. The cargo will be in line with the ship and cargo type (i.e. Cargo vessel Carrying DG, HS, or MP, IMO hazard or pollutant category X).
4. The vessel has an estimated date and time of departure 3 h in the future. History indicates that this vessel leaves on time.
5. The master of the vessel obtains the best passage optimised for vessel type, predicted weather and sea state 4 days ahead.
6. The route is loaded onto the Electronic Chart System (ECS) and transmitted to the port control of the port, the vessel operator, the destination port and any Vessel Traffic System (VTS) in between the departure and destination port using the port data service (VDES, WiFi or LTE).
7. The port VTS is notified.
8. The tug boat operator is notified.
9. The pilot is notified.
10. The linesman is notified.
11. The loading is completed and port operations notified.
12. The ships agent is provided with a status update transferred to the shore using VDES or LTE.
13. The pilot boards and his costs start increasing.
14. The tug boat arrives and ties up and its costs start increasing.

15. The lineman arrives.
16. The port control gives permission for the vessel to leave.
17. The lineman releases the ship.
18. The tugs pull the ship from the berth.
19. The berth is now empty and can be used for another vessel.
20. All billing for berth services (communications, shore power and water services) cease.
21. The vessels moves through Port A and through the port channels towards the Port A departure pilot station.
22. The tugs drop the lines as soon as it is safe to do so.
23. The pilot stays onboard until the pilot station is reached.
24. The pilot disembarks.
25. The vessel sails along the path to the destination port.
26. The optimised route is updated on the vessel with the actual route detail using VDES, LTE or satellite communications (lowest cost communications service routing).
27. An updated weather forecast is obtained from the local service provided using an application provided by the service provider.
28. A new route is required to avoid local traffic and is provided by the local VTS office.
29. A new optimised route is constructed on the ship or by a service provider and sent to the vessel operator, the destination port and all VTS offices between the vessel and the destination port.
30. The destination port ETA data is entered into the destination Port Collaborative Decision Making (PCDM) system.
31. The vessel, if it maintains its current sailing speed, is going to arrive 3 h too early and an optimised route is sent back to the vessel to allow it to 'green steam' to the destination port saving fuel and reducing pollution.
32. Work flow systems provides the port operations with the list of actions to take to ensure all operational arrangements are completed.
33. The destination port VTS is notified.
34. The vessel arrives at the approach to the destination port, Port B.
35. The ships agent, pilot and tug boats are all notified and ready for the vessels arrival.
36. The pilot boards at the pilot stations.
37. The tugs tie up to the vessel at the designated point.
38. The tugs take the vessel to the designated berth at which the linesman is ready to secure the ship.
39. The ship enters the berth and the required services are made available (water, shore power and communications services).
40. The berth is marked as being occupied.
41. The linesman secures the ship.
42. The tugs depart.
43. The ships agent is provided with a status update of all tracked cargo using IoT and transferred to the shore using VDES or LTE.
44. The unloading operations begin.

45. The vessel has an estimated date and time of departure 3 h in the future. History indicates that this vessel leaves on time.
46. The master of the vessel obtains the best passage optimised for vessel type, predicted weather and sea state 4 days ahead.

….. and so on.

13 Summary

Data Analytics enables advanced AIS applications and the associated safety, security, economic and environmental protection applications through:

1. Ensuring that AIS data that is collected processed and stored is clean
2. Creating visual reports that can easily be viewed, interpreted and used by the operator
3. Using an event manager to generate new data from a wide range of preconfigured and operator configurable events
4. Allowing the operator to create reports that combine data from the AIS Comment Blocks, static, dynamic and communication state data
5. Take the load from the operator by implementing prescriptive analytics that uses all received and generated data
6. Including the Sea Traffic Management (STM) and the port operations Port Collaborative Decision Making (PCDM) applications
7. IMIS Global is a datAcron partner and is focused on the maritime domain using AIS data and the implementation of event management, data compression and analytics in the maritime domain.

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Mobility Analytics for Spatio-Temporal and Social Data
First International Workshop, MATES 2017, Munich, Germany, September 1, 2017, Revised Selected Papers
Doulkeridis, C.; Vouros, G.A.; Qu, Q.; Wang, S. (Eds.)
2018, IX, 177 p. 60 illus., Softcover
ISBN: 978-3-319-73520-7