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System Architecture and Requirement Allocation Description for IPMS NavVision

Automation Competence Centre

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References

[A] System Requirement Specification IPMS NavVision
ACC-NAVVISION-SRS-R1.0

[B] ACC Documentation Guideline
ACC-GEN-DGL-R1.0

[C] IPMS NavVision solution roadmap
ACC-NAVVISION-xxx

[D] Interface Description Document
ACC-NAVVISION-ICD-R1.0

[E] Hardware catalogue
ACC-CATALOGUE

[F] Software installation and commissioning manual v1.9
FT-MANUAL

Abbreviations

AMCS	Alarm Monitoring and Control System
AP	Alarm Panel
CCTV	Closed-circuit television
FT	Free Technics
HMI	Human Machine Interface
IMO	Imtech Marine & Offshore
IPMS	Integrated Platform Management System
LPU	Local Processing Unit
MFW	Multi-Function Workstation
Nav.	Navigation
NAV System	Building block forming the bases of the integrated functionality.
OWS	Operator Workstation
PA	Personal Alarm
PCS	Propulsion Control System
PLC	Programmable Logic Controller
PMS	Power Management System
SE	System Element
UPS	Uninterruptible Power Supply

Definitions

Personnel Alarm	A personnel alarm provides a safety timer for personal protection, used when a single person works in an unattended area.
Duty Alarm System	The duty alarm system is used for the transfer of alarms to the technical crew in case of an unattended machinery space.
Local Processing Unit	Cabinet that contains hardware like one or more PLC's and serial interfaces and a switch.

Updates

Underneath are the updates indicated of those parts, which have been changed related to the previous release.

Issue:	Date:	Change:	Reason:
1.0.1	15 April 2010	Initial Issue	
1.0.2	1 July 2010	Added more detail information	Internal review
1.0.3	18 July 2013	Complete changeover	Verification issues

Table 0-1 Updates

1. Introduction

1.1 Purpose and scope

Within the Automation Competence Centre various solutions are being defined as a collection of one or more standardized System Elements (SE) which can be integrated (now or in the future) with each other. The decision to create a specific solution depends primarily on a customer demand for a predefined System Element, possibly integrated with other System Elements.

A solution has to be compliant with top level requirements (on ACC level) as stated in the ACC SRS. Requirements that apply to a specific solution will be derived from the ACC SRS and documented with further details in the Solution SRS, which will be created for each solution.

This document (SARAD) will subsequently define the system architecture for a specific solution by defining the hardware and software components for each System Element and assigns SRS based requirements to them, showing the degree of compliancy with the requirements.

The Integrated Platform Management System Solution consists of the following System Elements:

- Alarm Monitoring and Control System (AMCS);
- Duty Alarm System;
- Personnel Alarm System;
- Closed-circuit television (CCTV);
- Remote Diagnostics.

The IPMS NavVision Solution version 1.0 describes the AMCS of Free Technics, called NavVision. This document describes the stand-alone version.

The following figure identifies the core system (marked red) and the add-on System Elements (marked green) within the IPMS NavVision Solution.

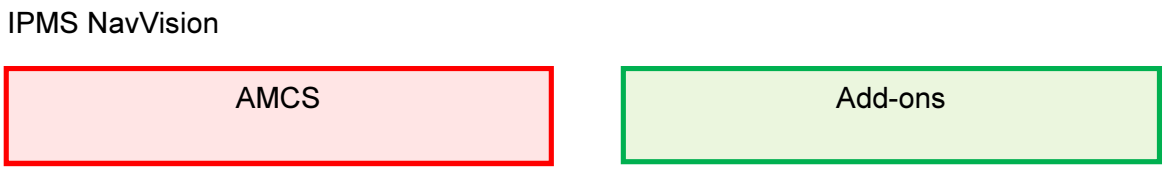


Figure 1-1: Solution scope

1.2 Content

Chapter two describes the collection of core and add-on system elements with their integrated functionality. Chapter three describes each system element with their specific functions. Chapter four identifies the interfaces between these system elements. Chapter five and six relate software and hardware items to each system element, followed by chapter seven identifying the cross relation between hardware and software items. Finally the appendices relate the SRS [A] requirements to system elements and items, indicate examples and refer to the hardware list.

2. System Architecture

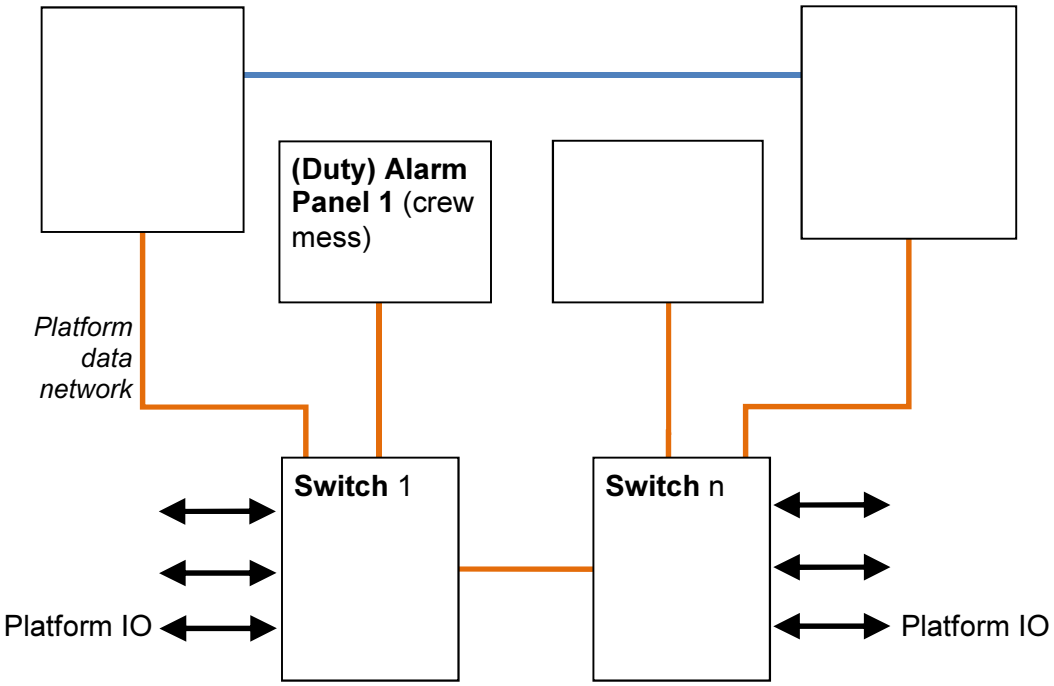
2.1 Basic system architecture

The Alarm, Monitoring and Control System is the Free Technics make FT NavVision® modular integral software solution for Maritime applications.

The system is an AMCS system based on Client-server architecture with redundant network topology, ruling out a single point of failure. The AMCS application can be software switched at the allocated workstation as per functionality matrix.

Full graphic Operator Workstations (OWS's) are used as HMI, with graphical mimics and text based messages. All OWS's are connected via Ethernet to the control positions of the vessel. The servers in the network collecting the sensor information and distributes the date to the connected OWS's. The OWS's are designed with a Windows Embedded Operating System. This in combination with the compact hardware, results in a reliable concept.

The basic standalone system consists of the following basic functional architecture, which will be present in every NavVision AMCS system.



The above mentioned system elements allow for functionality on different levels. These levels are described in this chapter. The following top level functionality (integrated functionality) is available:

a. sensor monitoring;
b. actuator control;
c. presentation of alarms;
d. presentation of platform data;
e. general engineers alarm (GEA);
f. system diagnostics functionality;
g. logging of platform data;

On the level below we identify functions that are present within system elements. These functions are considered a sub-set of the above mentioned integrated functionality.

2.2 Add-on system architecture

Depending on the functional options within the AMCS system architecture (see paragraph 2.1) and other functional options, the following add-on elements are required. These elements can be added to the system architecture.

Functional options	Add-on required
1. Unmanned Machinery Space (UMS)	Duty alarm system
2. Personnel Alarm System	Personnel Alarm (PA), consisting of one Release Station per machinery space and one or more Timer Reset Stations, depending on the size of the machinery space.
3. CCTV	CCTV interface, IP-camera's
4. Remote Diagnostics and support	Remote Diagnostics interface

Table 2-1: Required component add-ons

3. System elements

3.1 System element limitation

The following table indicates the system scale by stating the allowed minimal and maximal number of each element.

System element	Min	Max	Comment
AMCS server/client	2	8	Maximum of 8 servers or 50 workstations. Minimum of two servers required. In case more clients are required, add AMCS clients.
Switch	2	32	Indication
Alarm panel	2	30	Alarm panels can be replaced with DAP's when a Duty Alarm System is used.
Personnel Alarm System	*1*	*2*	*Optional. Consisting of one Release Station per machinery space entry and one or more Timer Reset Stations, depending on the size of the machinery space.*
Duty Alarm System	*1*	*10*	*Optional. In case of UMS notation. Maximum of 10 means 1 DAP in the crew mess (and other public areas) and 9 in engineer cabins.*
CCTV	*0*	*16*	*Optional. indication*
Remote Diagnostics	*0*	*1*	*Optional.*

Table 3-1: System element limitation

3.2 AMCS server/client

The AMCS server/client is the main system component for alarm, monitoring and control functions.
It provides the following features:

a. periodically gathering of platform data from each LPU via the Local Area Network (LAN);
b. distribution of platform data to all clients (Alarm Panel/AMCS client/DAP);
c. central alarm management and control;
d. store historical platform behavior;
e. color scheme;
f. system diagnostics functionality;
g. mimic presentation;
h. call function (engineers, bridge, etcetera);
i. Client functionality.

3.3 Alarm panel

The AP provides the following local or on duty features:

a. display of alarm status;
b. display of new alarms;
c. silencing alarms locally;

3.4 LPU

The Local Processing Unit is responsible for:

a. interfacing with platform sensors and actuators, hardwired or trough serial connections;
b. the network connection between LPU(‘s), NavVision server(s)/client(s),DAP’s and AP’s.

3.5 CCTV

CCTV video streams can be displayed on servers and/or clients by connecting these workstations to a separate CCTV Ethernet network interface. The workstations will connect to the CCTV video encoders over the Ethernet network.

3.6 Duty Alarm System

The duty alarm system is used for the transfer of alarms to the technical crew in case of an unattended machinery space. The duty alarm system can only be configured from a particular workstation in the machinery space.

The duty alarm system provides unambiguous audio (visual) annunciation of alarms and warnings through a dedicated banner located at the top of the alarm panel screen (in case DAP’s or clients are used) or through sound and alternating flashing LED lights in case of AP’s. A watch and call system extends the central alarm system to (Duty) Alarm Panels in engineers' cabins, other cabins and public areas when machinery spaces/control rooms are unattended.

The duty alarm system distinguishes two different alarm modes i.e.:

- attended;
- unattended.

Alarms will be distributed to all (Duty) Alarm Panels and servers/clients in a specific order, legislated by class rules and matrix settings (Reference [F]).

The On Duty selection and Engineers Calling functions are executed on a dedicated mimic on the workstations (AMCS server/client and DAPs).

3.7 Personnel Alarm System

A Personnel Alarm System provides a safety timer for personal protection, used when a single person works in an attended area. The personnel alarm consists of:

- a release station, used to switch between manned and unmanned and to enable of disable the watch timer;
- a timer reset station.

4. Interfaces

4.1 Interface limitations

This paragraph indicates the limitations of each external interface.

Interface	Min	Max	Comment
Moxa	1	2	A maximum of 2 serial I/O can be interfaced per Moxa
Wago	1	64	A maximum of 64-250 hardwired I/O can be interfaced per Wago PLC with a limitation of the “Total current for I/O modules”
Platform I/O	1	∞	Limited by Ethernet specifications
Internet	0	1	
CCTV	0	4	Axis video interface

Table 4-1: External interface limitations

4.2 Human machine interfaces

This paragraph describes the human machine interface of FT NavVision.

4.2.1 General

The human machine interface consists of two sections, as shown in the next picture.

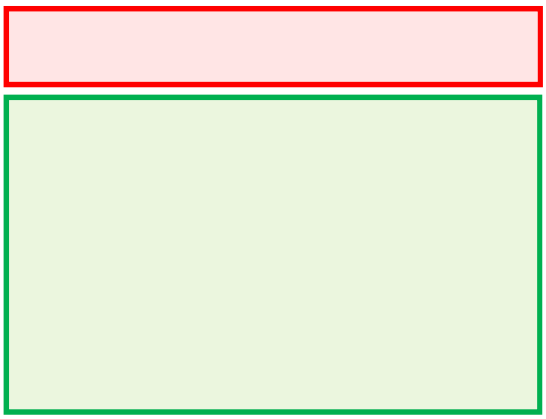


Figure 4-1: Human machine interface

4.2.2 Taskbar

FT NavVision® main User Interface (UI) element is the taskbar, positioned on top of the main screen. The taskbar is home to the shortcuts to various viewers and time.
In addition, whenever an alarm is registered, the right most portion of the taskbar turns a bright red and shows a list of the alarm(s) currently active. A single click on this portion links to the extensive alarm viewer showing the data belonging to each alarm item such as time, alarm group, status and duration.

Figure 4-2: Taskbar

4.2.3 Mimic

In the mimic section functions that can be selected from the taskbar, will be presented. This can be standard viewers (like the Generator Viewer) or customer specific mimics.

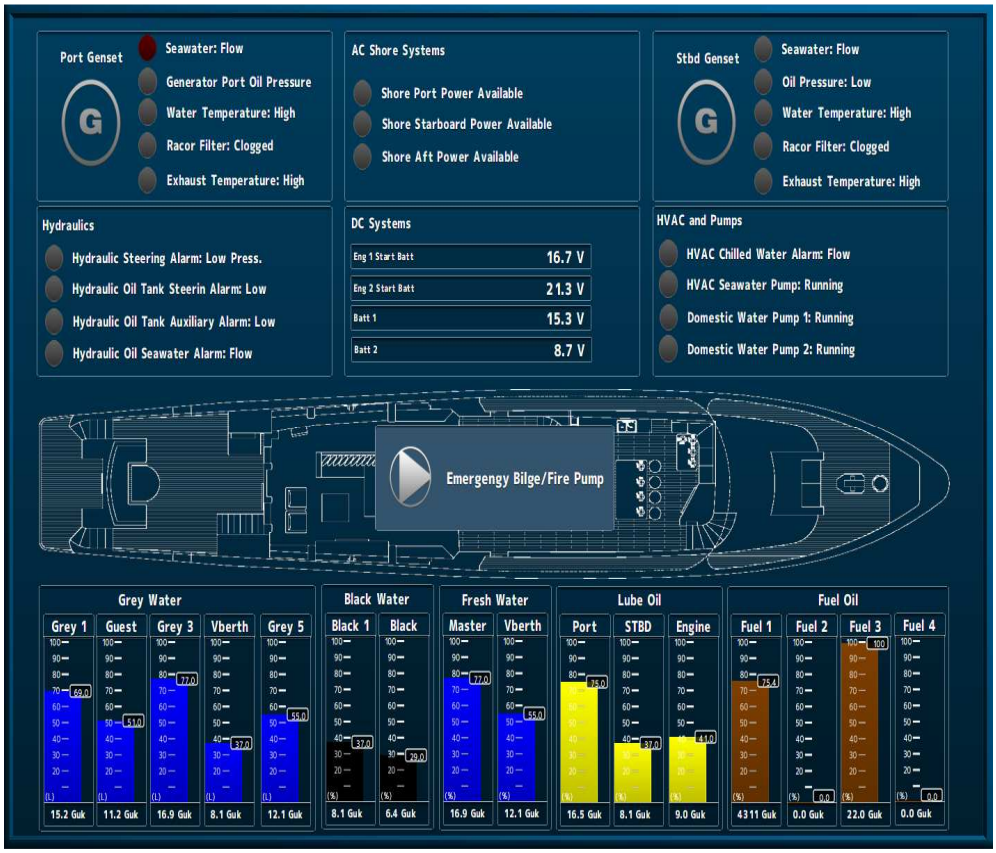


Figure 4-3: Mimic example

4.3 External interfaces

This paragraph describes the external interfaces, which are interfaces that are not an internal part of this solution.

4.3.1 PCS

See the external Interface Control Document for details on how NavVision interfaces with an external Propulsion Control System.

4.3.2 PMS

See the external Interface Control Document for details on how NavVision interfaces with an external Power management System.

4.3.3 Wago I/O

See the external Interface Control Document for details on how NavVision interfaces with a Wago I/O over a Wago connection.

For I/O interfacing with FT NavVision®, FT uses the modular and extendable I/Os (WAGO). These I/Os have been approved by organizations such as:

- Germanischer Lloyd (GL),
- Lloyds Register (LR),
- American Bureau of Shipping (ABS),
- Bureau Veritas (BV),
- Det Norske Veritas (DNV),
- Royal Institute of Naval Architects (RINA),
- Korean Certification (KR),
- Nippon Kodoshi Corporation (NKK).

4.3.3.1 Analogue sensors

The following analogue sensor module types are mostly used.

Sensor type	Description	Module series
Analogue input	0 - 20 mA and 4 - 20 mA	750-452 750-454
	± 10 VDC	750-485
	Resistance temperature device	750-461
Analogue output	0 - 20 mA	750-550
	0 - 10 V or ±10 V	750-585

Table 4-2: Analogue sensors

: basically every GL approved WAGO module may be used.

4.3.4 Digital sensors

The following digital sensor module types are mostly used.

Sensor type	Description	Module series
Digital input	24 VDC	750-408 750-402 750-432
Digital output	24 VDC	750-504 750-532 750-517

Table 4-3: Digital sensors

 : *basically every GL approved WAGO module may be used.*

4.3.5 Serial I/O

See the external Interface Control Document for details on how NavVision interfaces with external I/O over a serial connection.

The following protocols are supported:

Option	Devicetype	Description
Adam	Serial	Advantech 4500/5000 series
AIS	Serial	AIS Data over Nmea
Algodue	Serial	Algodue AC monitoring module
Asea	Serial	Asea Shore converters
AutoAnchor601	Serial	Chaincounter
BMV501	Serial	Victron battery monitoring modules
BMV602	Serial	Victron battery monitoring modules
BTM1	Serial	Mastervolt battery monitoring modules
Can	I7540D	CAN bus
Cat	Serial	Caterpillar CAT-Link protocol. Link via CCM
CF Smartview	Serial	Broadband
Crompton	Serial	Crompton AC monitoring module
DssKeypad	Serial	CAN-based keypad
EM4000	Serial	ELEQ AC monitoring module
EmpirBus	Serial	power supply systems
Frigomar_626C	Serial	Airconditioning
FSI_2DACM	Serial	Current measurement sensors from Falmouth Scientific Instruments
Generic	Serial	Gen-set
Gensys	Serial	GenSYS power management system (PMS) monitoring
J1708	I7540D	SAE J1708

J1939	I7540D	SAE J1939
KiloPakIguard	Serial	Kilopak I-Guard Generators
Littau Anchor	Serial	Anchoring
Lutron	Serial	Lutron Light system
MalinDraught	Serial	Draft System
Masterbus Modbus	Serial	Mastervolt charger/inverter modules through Modbus
Mastervolt	Serial	Mastervolt charger/inverter modules
Mitsubishi_DMS_II	Serial	
ModBus	Serial/IP	Modbus ASCII/RTU Serial or TCP/IP
ModBus Slave	Serial/IP	Modbus ASCII/RTU Serial or TCP/IP
MPC30	Serial	Inkjet printer
MTU	Serial	MTU MCS-5 system. Connections to be made through LOP, PIM or PCS.
MVECP	Serial	PaxMAN Engine Control Unit
Nke	Serial	NKE Navigation Instruments and Autopilots
Nmea	Serial	NMEA 183
Nmea2000	I7540D	NMEA 2000 over CAN.
PC		Server or Client PC
PPM3	Serial	Deif power management system (PMS) monitoring
Printer	Serial	Printer
Sae	I7540D	SAE
SD41	Serial	
SMS	Serial	SMS Module (Tango blackbox modem)
Sounder	Serial	Black box video sounder
SygoDraft	Serial	Sygo Draft systems
TMA4S	Serial	Tank Gauging System
Vaisala_CL31	Serial	Vaisala cloud detection sensor
Vaisala_LT31	Serial	Vaisala LT series visibility sensor
Vaisala_PTB330	Serial	Vaisala Digital Barometer
Vaisala_PW	Serial	Vaisala PW series visibility sensor
VDR	Serial	VDR output connection (NMEA 183 based)
Victron	Serial	Victron charger/inverter modules
VictronVEBus	Serial	Victron BUS
VisiplexPaging	Serial	Alarm paging system

Table 4-4 Serial protocols

4.3.6 Internet (Remote Diagnostics)

See the external Interface Control Document for details on how NavVision connects to the Internet over an Ethernet connection to one of the NavVision servers.

4.3.7 CCTV

A maximum of 16 cameras can be interfaced.

4.4 Power supply configuration

This paragraph indicates how all system elements are connected to any available UPS or power supply.

Component	UPS 1a	UPS 1b
NavVision server/client	X	X
LPU 1…10	X	X
(Duty) Alarm Panel	X	X

Table 4-5 System element power arrangement

All components must have a redundant power supply. Class requirements do not apply.

5. Software items

5.1 Relationship system element and software items

System elements:	Software items:	Buy / make:
AMCS server/client	Windows XP embedded	Buy
	FT NavVision	Make
LPU	NavVision ACS (PLC)	Make
	Wago (PLC)	Buy
	NavVision Watchdog (PLC)	Make
	NavVision Gateway (Moxa)	Make
	Linux (Moxa)	buy
	NavVision serial-to-ethernet (Moxa)	make
	NavVision Watchdog (Moxa)	Make
Alarm Panel	Windows XP embedded	Buy
	FT NavVision	Make
Duty Alarm System	Windows XP embedded	Buy
	DAP client	Make
Personnel Alarm System	-	Make
CCTV	FT NavVision	Make

Table 5-1 Relationship system elements and software items

5.2 Software item description

Software item:	Description:
FT NavVision	Application for Alarm, Monitoring and operator control.
CCTV	Displaying of CCTV. Direct connection to the video encoder, so no recording and replay functionality.
Windows XP embedded	Operating system, supporting all other software items
DAP client	Client application to send requests from a DAP to the AMCS server and to display the server response on the DAP.
NavVision ACS (PLC)	Automatic control sequences (with more than one condition).
Wago (PLC)	Standard operating system for relay of sensor information or actuator commands and execution of control sequences.
NavVision Watchdog (PLC)	Checks status of PLC.
Linux (Moxa)	Standard operating system.
NavVision serial-to-ethernet (Moxa)	For conversion of serial input data to Ethernet and for conversion of output data from Ethernet to serial data.
NavVision Watchdog (Moxa)	Checks status of Moxa serial interface.

Table 5-2 Software item description

5.3 Software architecture

Three types of data can be distinguished:

1. Raw platform data (TCP/IP);
2. Processed platform data (TCP/IP);
3. Configuration data (TCP/IP).

Raw, unprocessed platform data is send from the LPU to both servers, with a rate of 10 times per second. The main server then processes the data and distributes the processed data over the network to the clients and servers and other LPU´s. This is done with a rate of 10 times per second, or once per 10 seconds when data is not changed in between.

Data synchronization of processed platform data between both servers takes place maximum 20 times per second.

Configuration data consist of alarm settings, calibration settings and other configuration settings. Configuration data will be distributed over the network in case of changes and when the system is activated.

The following diagram indicates the functional platform data flow within the basic architecture.

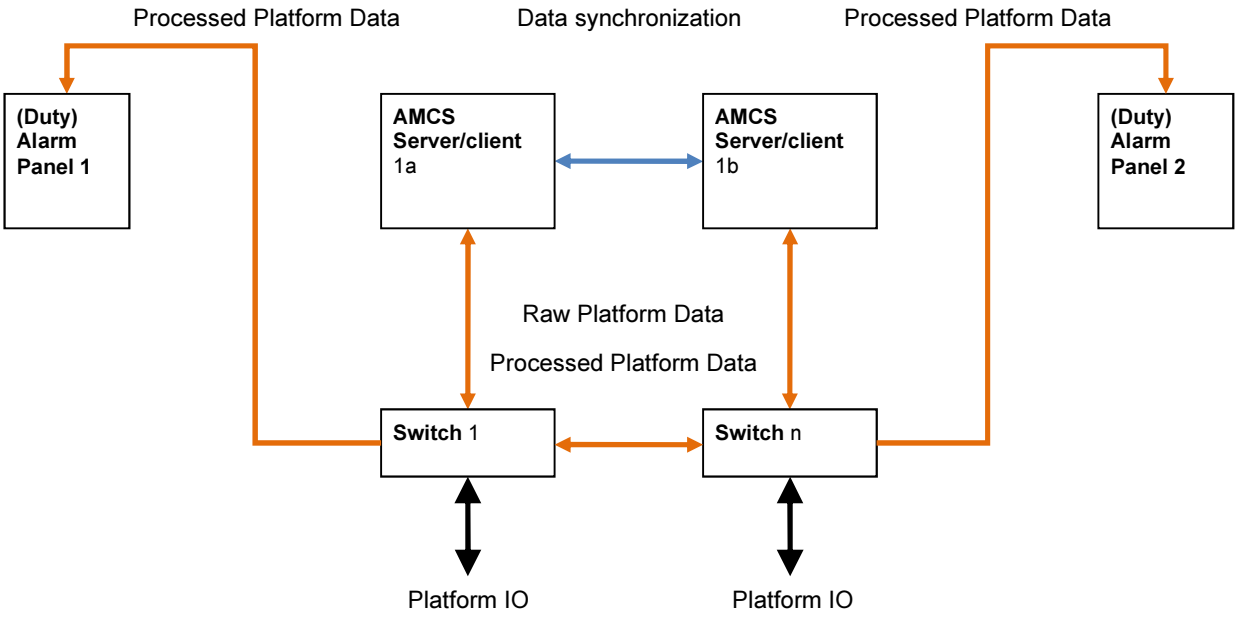


Figure 5-1 NavVision data flow

5.3.1 Distributed database

FT NavVision® uses a distributed database which is present in the memory of each Workstation which is configured as a server. All sensor data and settings are stored in this database. The database is continuously synchronized with other servers, with an update rate of 10 times per second.

Data is stored and used based on its timestamp. That means that FT NavVision® uses the data with the latest timestamp. If one server would fail, i.e. because of a broken network link, the newest data present across the network will be used.

5.3.2 Data flow

Each sensor read-out is connected to a so-called “Field” in the FT NavVision® software. Such a field is a collection of values (or data package) relating to the configuration & current status of the sensor readout.

Fields consist of both “Static data” and “Dynamic data”. Static data store the configuration of the sensor readout and is typically edited only once (during install), whereas the dynamic data is updated whenever the sensor readout changes.

Table 5-3 shows the values carried in each field data package.

Static data	Dynamic data
Timestamp	Sensor value
Range of value	Current value
Type of data (pressure, temperature, etc.)	Desired value
Filter time	High alarm status
Default value	Low alarm status
Default unit (mBar, °C, etc.)	Too high alarm status
Sensor calibration	Too low alarm status
Alarm levels (too low / low / high/ too high)	Defective status
Label	Available status
Comment	Low speed/high speed status Local status Remote status Auto status

Table 5-3: Static and dynamic data

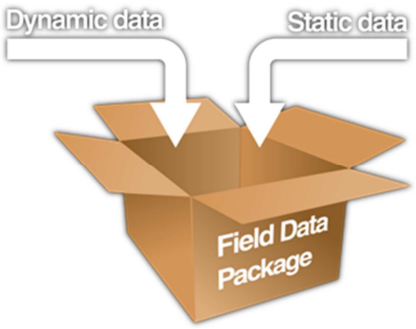


Figure 5-2: Field Data Package

: Each dynamic data value carries its own value, source, owner and timestamp.

Each time an item in the dynamic data changes (with interval dependent on protocol), the item is overwritten accordingly and distributed over the network ten times a second.
This updated data package is then compared with other versions of the same package on the network.

FT NavVision® uses timestamps & sources to compare the values in the various package-versions, and selects the highest priority value as new value. The source of the value determines which new value is selected, followed by the timestamp of the readout.
Note that the procedure above is also used for distributing & synchronizing configuration (i.e. the static data of a field) over the entire network.
This means that any adjustment to a field configuration can be performed on any alarm panel with sufficient rights, and is picked up by all FT NavVision® servers/clients.

After the current value is updated, it is compared with the alarm levels set in the static data of the same package. If the current value does not fall within the parameters set by these alarm levels, FT NavVision® registers an alarm by setting the corresponding status in the dynamic data (e.g. too low alarm status) to "True" (with "False" meaning this status is currently not applicable).
The data package is then again distributed over the network, and the cycle repeats itself.

5.3.3 Sensor priority

Sensor values will be processed according to a priority list. Main reason for this is that manually configured devices are more important than some NMEA data that is constantly present on the network.
Sensor values as indicated higher in the list (top) have a higher priority. If a sensor value is read twice by FT NavVision® (through different input sources), then the sensor type input with the highest priority will be used. When the sensor values from the device with highest priority is no longer available, sensor values with the lower priority will be automatically chosen.

Priority level	Device
1	WAGO inputs
2	Electrical systems
3	Tank monitor
4	Draft sensors
5	Generic engine data
6	NMEA
7	Misc. communication
8	WAGO output

Table 5-4: Sensor priority list

5.4 Built-in failure detection

The FT NavVision® system offers built-in test facilities for the hardware and software components. This means that when a fault is detected, the operator will be notified immediately.

5.5 Data logging

For the purpose of the technical monitoring of the installations on the ship, the condition of certain parts of the installation is recorded regularly. Owing to this it is possible to plan, for instance major, preventive repairs in periods that the ship is in the harbor.
On top of that, data recording can be the help for the planning of normal maintenance on board of the ship.

The following data types are logged with a predefined sampling rate or on event.

Data	Sampling rate	Event	Data storage time
Alarm events	-	Generate, acknowledge reset and rectify	Typically 180 days
Analogue values	3 seconds	-	Infinite
Platform commands	-	On command	Typically 180 days
Platform parameters	-	On change	Typically 180 days
Running hours	3 seconds	-	Infinite
Function group allocation	-	On change	Typically 180 days
Ship's trip data	3 seconds	-	Infinite

Table 5-5: Data logging

Sampled platform data is stored for an infinite period of time. The data storage time is only limited by hard disk size of the server.
Event data, such as alarm events and platform commands and settings, is saved with a maximum of one million records (one record per event or change). When the maximum number of records is reached, FT NavVision® will start overwriting the log starting with the first record.

Figure 5-3: Logbook

To distinguish the display information, different colours are used.

Colour	Detail
White	Reports to indicate the system is busy processing data
Green	Reports to confirm a certain system task is successfully completed
Red	Reports to indicate a system error has occurred or an alarm is set off
Orange	Reports to indicate a red report has been confirmed or that a white or green report has been interrupted
Blue	Reports to indicate that parts of the system have been initialized.

Table 5-6: Display information colors

The different parts of the log-book are:

Button	Detail
Navigation	With the scroll buttons you can navigate through the logbook. Via the upper scroll button the report-list automatically scrolls with every new incoming report (e.g. item 4). When this button is not activated, the list will freeze. With the 4 other buttons you can scroll up and down through the report-list. With the single arrow button you can shift one line at the time; with the double arrow scroll button you can shift a full page.
Alarm display	With the alarm buttons you can switch the reports regarding alarm warnings on or off. With the top button the reports regarding alarm stations can be turned on or off. With the lower button the reports regarding individual alarms can be turned on or off.
Communication & system display	With these buttons it is possible to turn on or off various reports in the report-list. The upper button controls the reports concerning the network connection. The second, centre button the reports regarding the serial connection are either switched on or off. The lower button is for turning on or off the reports regarding system in general.
Report list	This is the core of the logbook module. Here all system reports are being displayed. The latest reports are at the top of the list. The layout is identical to an actual log-book.

Table 5-7: Logbook buttons

Report information is displayed as follows (from left to right):

- Date
- Time
- Group
- Message
- Report status.

6. Hardware items

6.1 Relationship system element and hardware items

System elements:	Hardware items:	Buy / make:
AMCS server/client	AMCS PC	Buy
	Trackball	Buy
	Display (optional: touch screen)	Buy
	Option: Keyboard	*Buy*
Alarm panel	Panel plate	Buy
	Alarm buttons	Buy
LPU	Wago PLC controller	Buy
	I/O modules	Buy
	Redundant power supply	Buy
	Network switch	Buy
	Serial to network interface	Buy
Duty Alarm System	Duty Alarm Panel	Buy
	Alarm buttons	Buy
Personnel Alarm System	Release station	Buy
	Timer reset station	Buy
CCTV	*Network Interface Axis server*	*Buy*
Remote diagnostics	*Network Interface Moxa*	*Buy*

Table 6-1 Relationship system elements and hardware items

6.2 Hardware item description

Hardware item:	Description:
AMCS PC	• Product approved PC • Dual network • Solid state disk • Fan-less • RS232 interface
Trackball	Keytouch trackball
Display	Hatteland/Conrac/Lauer/KEP
Option: keyboard	*Keytouch keyboard*
Panel PC	• Product approved PC • Integrated touch screen • Single Ethernet interface
Alarm buttons	Free Technics make
PLC controller	WAGO 750-series
IO modules	WAGO 750-series
Network switch	Phoenix Contact SFNT 5TX of SFNT 8TX
Serial to LAN converter	The Serial to LAN Converters enable the serial data coming from all kinds of equipment to be transferred over the network. These converters have two serial ports and redundant network port per unit. Moxa U7110-x

Table 6-2 Hardware item description

7. Relation software / hardware items

Hardware:	Windows XP embedded	FT NavVision	NavVision ACS (PLC)	Wago (PLC)	NavVision Watchdog (PLC)	NavVision Gateway (Moxa)	Linux (Moxa)	NavVision serial-to-ethernet (Moxa)	NavVision Watchdog (Moxa)	DAP client
AMCS PC	Y	Y								
Trackball										
Display (optional: touch screen)										
Option: Keyboard										
Panel PC	Y	O								Y
Alarm buttons										
PLC controller			O	Y	Y					
I/O modules										
Network switch										
Serial to network interface						Y	Y	Y	Y	
Alarm buzzer										
Release station										
Timer reset station										

Table 7-1 Relation software / hardware items

Y: Yes
O: Option