ULSTEIN AUTOMATION, ALARM AND MONITORING

WWW.ULSTEIN.COM

ULSTEIN®

Prepare your ship for a digital future

New technologies can radically improve the efficiency of how a ship is operated. The future is about embracing these possibilities, developing products for safer and more efficient operations.

This is at the core of product and system development in Ulstein. With our effort on offering products and systems that utilize digital possibilities, you can offer ship intelligence that make your business smarter, safer and greener.

Prepare your ship with solutions utilizing digital opportunities.

Content

1 Prepared for the Scalable Future

In 2016 UPC released the new version of the Ulstein Integrated Automation System (ULSTEIN IAS®). This is a major release, where the previous system from 2006 is replaced by top modern technology based on ULSTEIN X-CONNECT™. The new product, which is first in its line with an Industrial Internet of Things (IIoT) backbone, has, among a range of different things and functionality, a new Graphical User Interface (GUI), segmented topology and is scalable in size and availability. The process of Configure To Order (CTO) makes it easier to embed changes and adapt the product to fit the customer's needs. SCADA, OPC DA and PLC's are replaced with configurable software running on Linux PC's, that are vendor independent and communicate on DDS (Data Distribution Service). DDS is one of the core technologies that enables us to easier integrate (and be integrated) and extend the product to fit the customer.

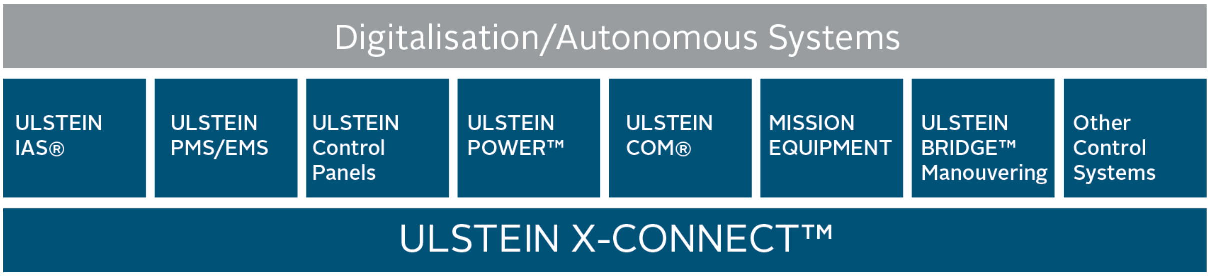

Figure 1: ULSTEIN X-CONNECT™ – the back-bone platform of Ulstein's new automation system.

1.1 Intuitive and easy to work with

The graphical user interface is easy to learn and efficient to work with. Fast, user-friendly and responsive views and representations of the system, make it easier for the personnel onboard to take the correct actions and to have full situation awareness, thus making the fault detection and correction processes more efficient. The design is adapted towards the skilled user, where fast search for information and visual representations enable the user to understand the status of the vessel. The modern and appealing design is also important for the user who monitors the screens for hours. Customized views are possible, with sidebars of frequently status and trend information.

1.2 Easy install and connect

The cabinets, operator stations, panels, displays, IOs and network are all built on standard type approved components. Each cabinet represents a connection hub with IOs, where different bus systems and Ethernet interfaces can be connected. The cabinets can be connected through a double Ethernet ring for increased reliability and availability. All parts of the standard software packages are configurable and can be automatically deployed.

1.3 Easy update and control

One of the main obstacles in such systems is the amount of late changes, altering components and systems. By having every aspect of the system available in the configuration and deployment tool, it is possible to minimize human errors to occur during manual updates. The process is also fast, and enable us to do remote updates. The existing configurations can be read back and compared, thus it is easier to identify changes in a life-cycle management perspective.

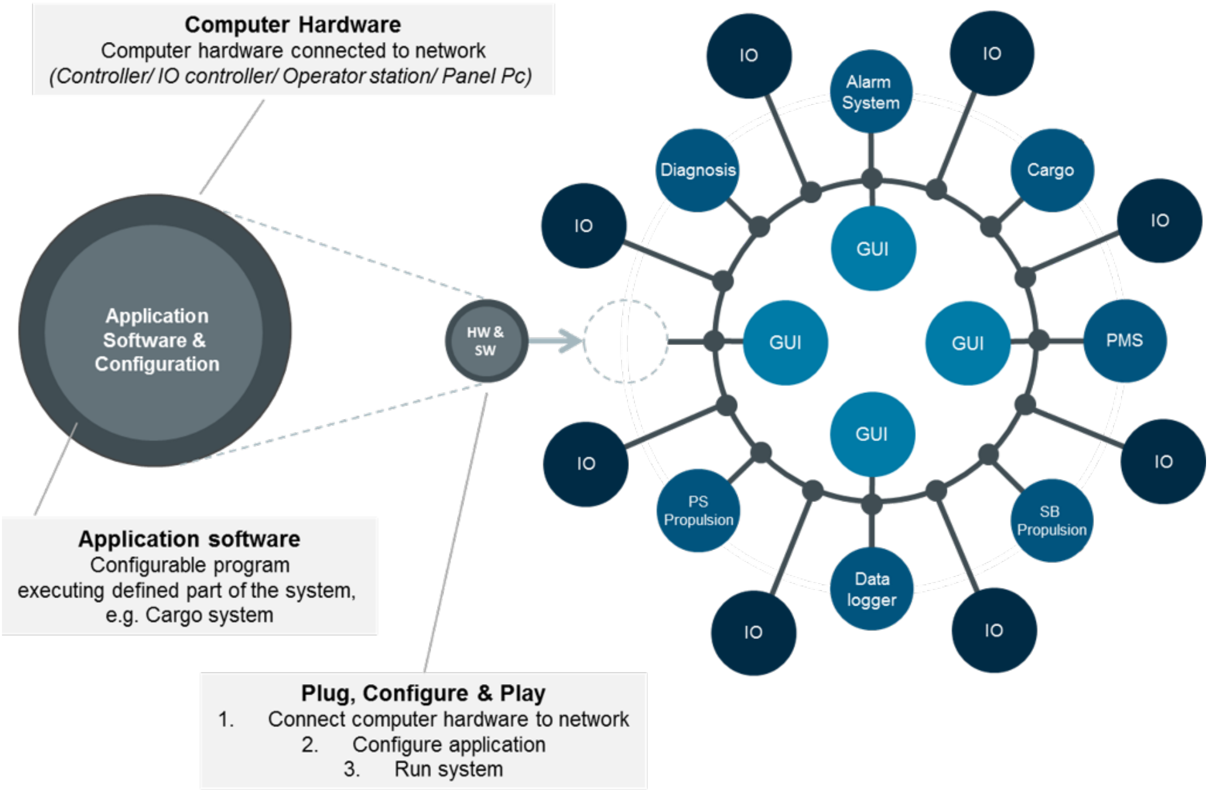

Figure 2: ULSTEIN IAS®, which is built on ULSTEIN X-CONNECT™, supports systems with different sizes. Adding, removing and replacing components to the system is made easy by using the configurator and deployment tools.

1.4 Scalable for different markets

The system can be available for most markets, as the simplest form can be a single cabinet with IO, controller and OS connected to it. In the other extreme we can provide a large system with >100k IOs connected with several OS's and controller segments. Our first delivery included 60 nodes (including IO Controllers, OS's and Segment Controllers). We have tested IO Nodes with 1000 IOs, thus this system has so far not experienced any real limitation in size and extent. In this way the hardware is flexible, and we can supply what is needed to the market depending on customer and class requirements.

1.5 Open technology and connectivity

One of the major strategic goals we achieved in ULSTEIN X-CONNECT™ was technology independence. In principle we do not rely on any single vendor. In a long term perspective, the form, fit and function requirements for all parts in the system also relate to software. Our technology takes this into account, and we are prepared for technical debt. Our system must

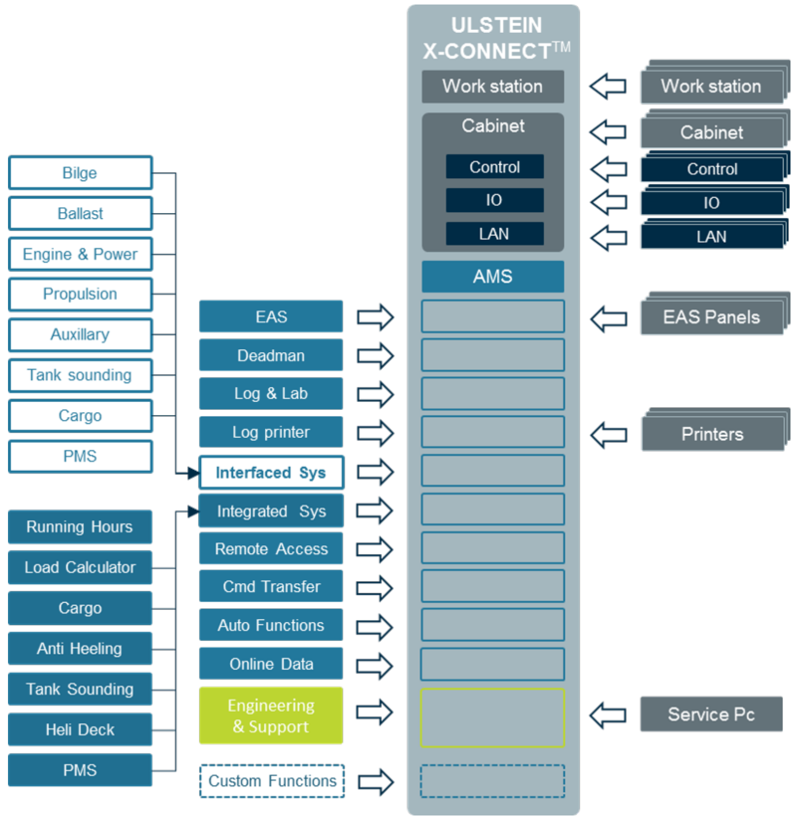

Figure 3: ULSTEIN IAS® based on ULSTEIN X-CONNECT™.

be open for new standards, and we integrate and connect through IO Controllers or through Ethernet interfaces.

1.6 Trusted technology

ULSTEIN X-CONNECT™and ULSTEIN IAS™ are programmed in C++11, use the Qt 5.x framework and run on Linux. There are many examples of industries using this combination. In addition we use RTI Connext DDS, which is applied and adopted in many safety critical systems used by NASA, NATO Naval ships, GE Medical etc[1].

1.7 Trusted delivery

Ulstein Power & Control AS has for more than 10 years supplied more than 100 ships with integrated automation systems, mostly Offshore Supply Vessels (OSV). A typical delivery has been offshore vessels with NAUT-OSV standard and 3000 hardware IO's.

1.8 Prepared for the future

DDS and IIoT (Industry 4.0) are implemented in this system. The connectivity and the number of data available will increase rapidly in the future. Data today can be an on/off digital input,

[1] www.rti.com

while in the future it might become an IoT Sensor with its own IP Stack containing 500 IO. This technology is built to handle such future demands.

1.9 Safety and reliability

Our novel technology depends on segmentation rather than controller redundancy. The reason is that we focus on least possible vulnerability in case of failure. In a dual redundant system it is not often stated what's happening in case of switching between Master and Slave. There are cases where such switching will not work properly. Segmentation is another way of solving redundancy, where we split the controllers into different segments. Each segment has its own controller communicating with other segments. If a segment controller fails, only the part of the system deployed on the faulty segment controller will fail. The controller can be replaced and restarted, in which brings the total system back to normal operation. During the fault, only a part of the system is not working. In this way we can design the system with as many segment controllers as the customer wants, depending on severity of failure, class- or customer requirements.

1.10 Remote operation

This system is made for remote operation, and we have several options. Remote Control can also be available, but we require encryption on remote operation. This is enabled by RTI Connext DDS.

2 System Architecture

ULSTEIN IAS® has a flexible architecture consisting of several nodes or units. A simplified schematic portraying the ULSTEIN IAS® main system architecture is portrayed in Figure 4. The solution flexibility enabled by ULSTEIN X-CONNECT™ is visualized in Figure 5. The main aspects of the system architecture will be treated separately the following subsections.

2.1 Interface

Connectivity is fundamental for ULSTEIN IAS®. Depending on the level there are different options:

- Digital input/output (DI/DO)
- Analog input/output (AI/AO)
- Text signals (strings)
- Modbus serial
- Serial communication RS422, RS485, NMEA0183
- CAN communication
- Ethernet
  - Modbus Master and Slave

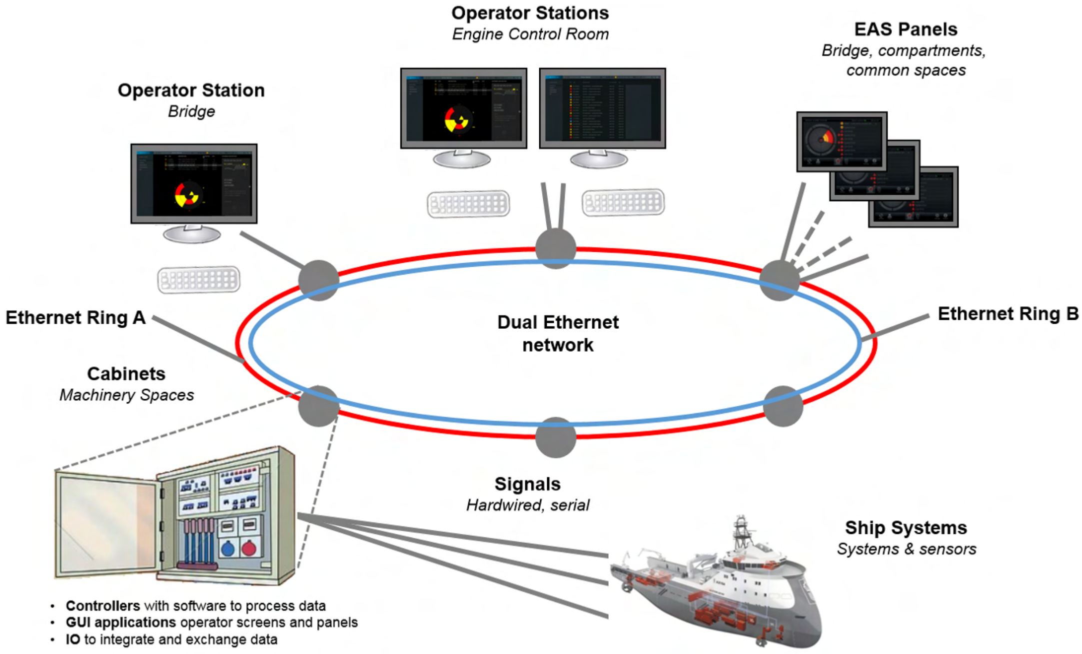

Figure 4: ULSTEIN IAS® system architecture.

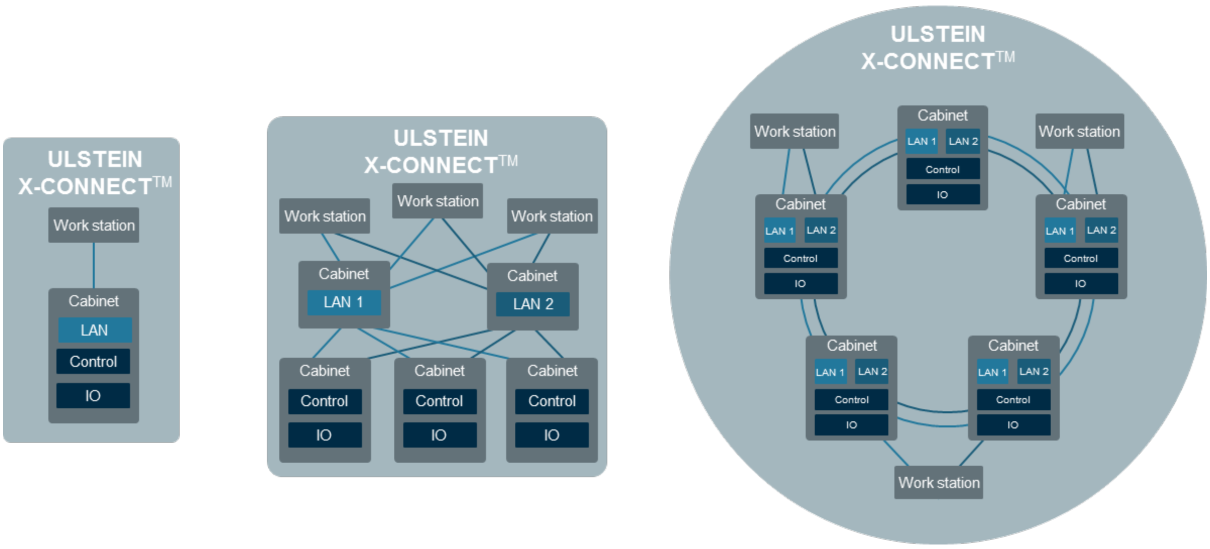

Figure 5: ULSTEIN X-CONNECT™ enables solution flexibility. Different system size and segments are supported.

– DDS
– OPC

2.2 IO Controller

The configurable IO Controller or IO Node represents a signal and alarm integrator, and handles data transport between the field and the automation system. We have made an integration

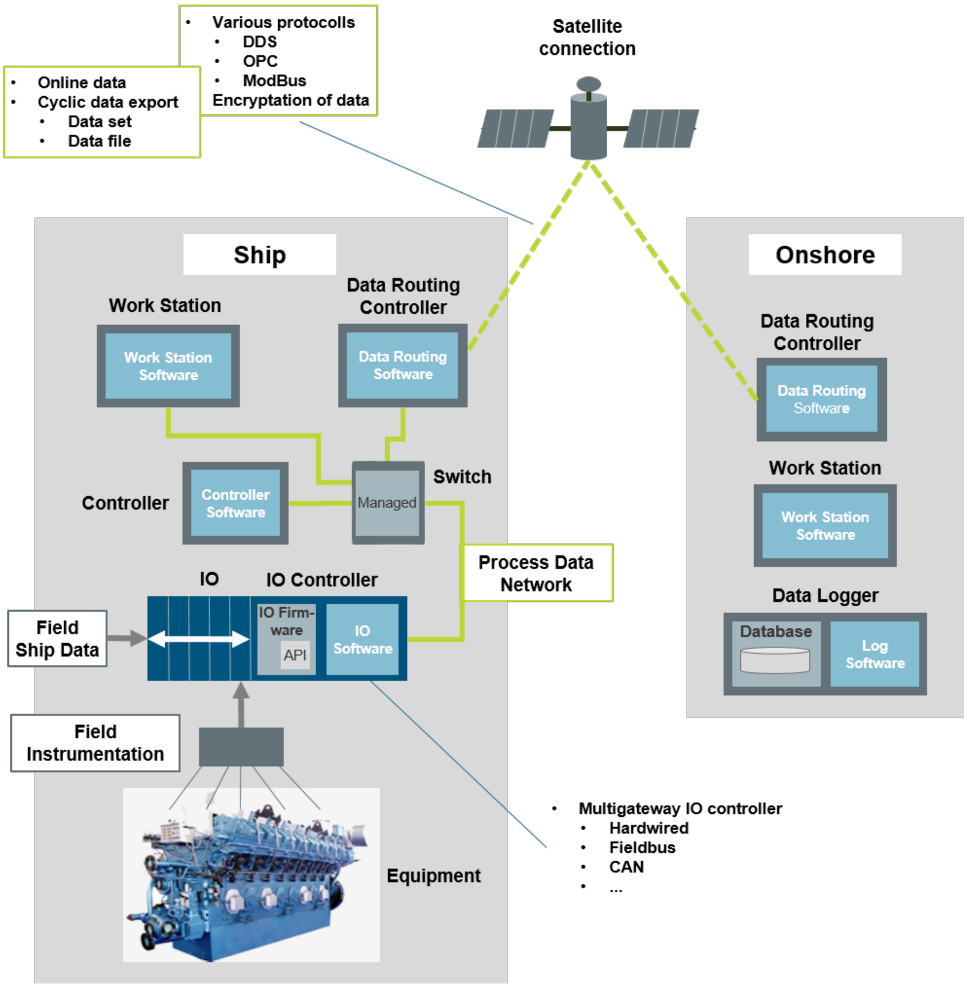

Figure 6: Ulstein X-CONNECT™ enables a streamlined interface from hardware, equipment and IO to higher level APIs.

between DDS and low level bus communication that easily extends and distributes logic and control. An IO Controller is basically a PC with IO functionality. Our configurator tool deploys the bus architecture for CAN, Serial and conventional IO and associates all values and IO channels to be used in the product. The IO Controller is a DDS participant or a node in the system, where data values (scaled/filtered/raw values) are exchanged on a regular basis. Although our product uses Bachmann IO, this is not applicable as we are only exchanging values through the API available on the IO Controller. Our solution is generic, and we are able to talk to other IO vendors providing API on a PC based platform.

2.3 Controller

The controller code or functionality can run on different controllers. It can be run on the IO Controller (with some limitations), operator station or on separate controllers. We apply separate controllers for running the functionality by using the philosophy of segmentation, where each controller run parts of the control system.

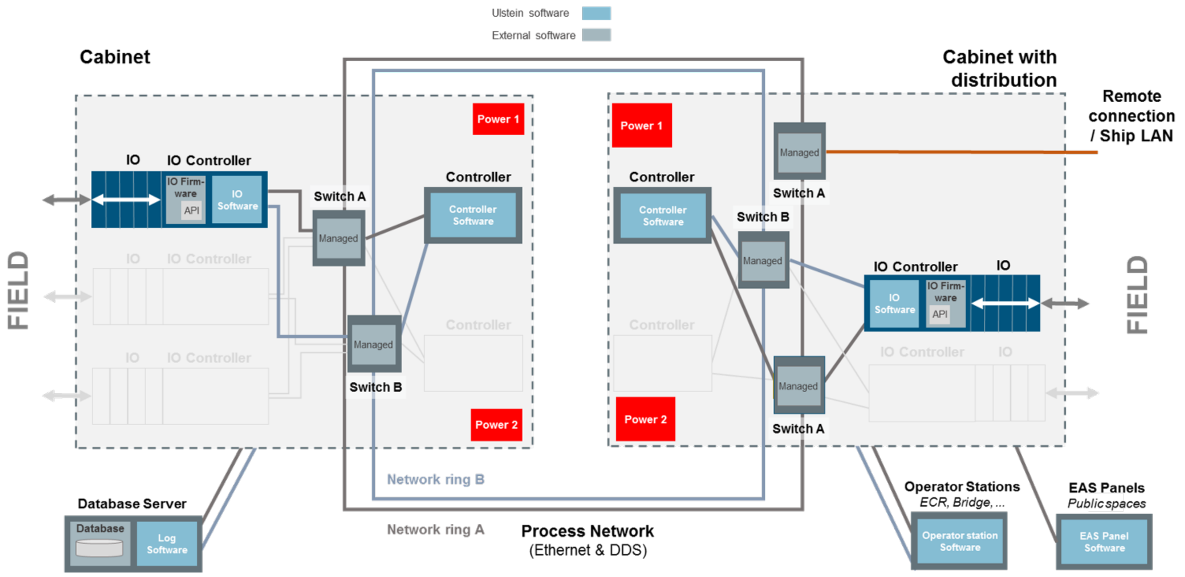

Figure 7: ULSTEIN X-CONNECT™ is a combination of computer hardware, configurable software, network, data communication, monitors with graphical user interface and cabinets.

2.4 Safety critical control

In safety critical control systems the issue is availability and reliability. There are several ways to handle this. The classical is dual redundancy in various forms or triple redundancy. Segmentation relies on distributed control. Rather than having one controller running it all, we split up the code and run parts on different segment controllers. That means if one segment controller fails, only the parts controlled by this segment controller will not be available until it is fixed and re-joined as a DDS participant. The control system will be split up into a number of segments according to class or customer requirements. It can even solve the issues regarding SIL requirements, where those associated signals are specially treated without consequences for the rest of the system. As all IO Controllers and segment controllers are communicating bi-directionally, the operating stations are subscribing to all these DDS participants and display their values accordingly in an integrated manner.

2.5 Operator station

The GUI application is also a DDS participant, which subscribes information from the segment controllers and IO Controllers directly.

2.6 Publish and subscribe

The DDS utilizes a Publish and Subscribe pattern. This is a communication pattern where each node publish on change and the subscriber receives the change. The subscriber only receives the data it subscribes to.

2.7 Scalable and flexible

The product can be both scalable and flexible in terms of the number of interfaces, IOs, operating stations (OS), segments and IO Controllers/nodes. This opportunity makes it both ideal to design the needed functionality for today, and it enables the end-user to upgrade at a later stage.

3 Functionality

This ULSTEIN IAS® supports a range of different functionality and subsystems. The standard basic functionality is an AMS (Alarm and Monitoring System). From this standard basic functionality, the customer can tailor the system solution by adding additional functionality.

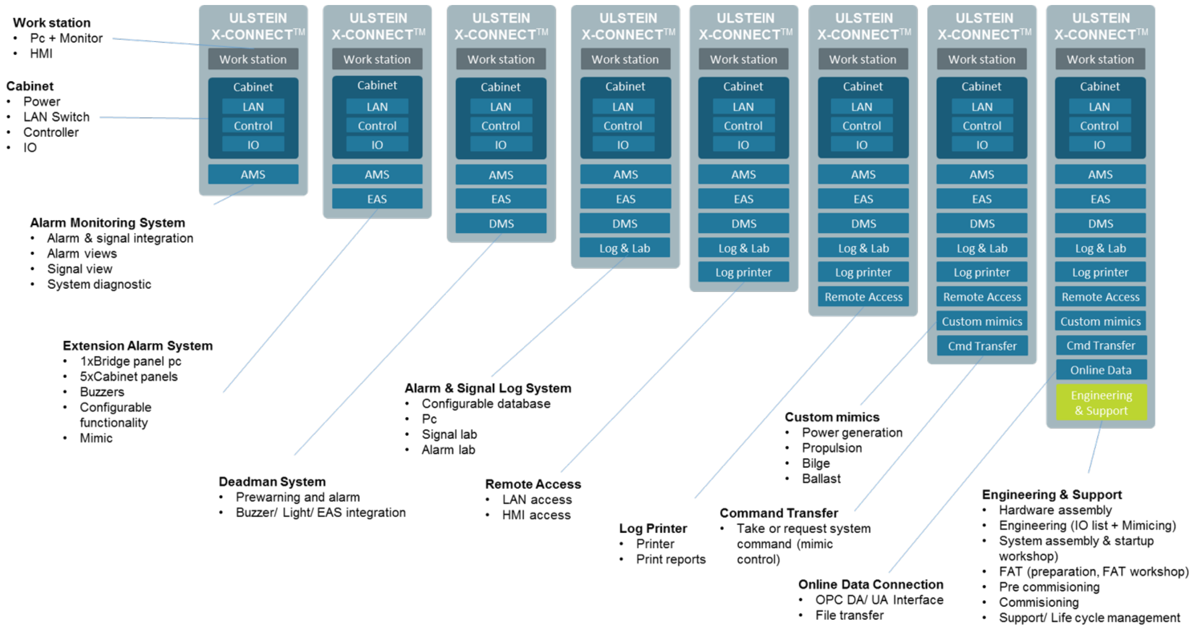

Figure 8: ULSTEIN IAS® functionality.

3.1 Common supported functionality

- Alarm and Monitoring System (AMS)
  - Alarm and signal integration with definitions and properties
  - Current alarm list
  - Alarm filtering
- System diagnostics
  - Alarming on com errors between software entities
  - Alarm on lost IAS controller in network
  - Controller hardware failure (FAT)

  - Controller software failure
  - Alarm on network com when excessive traffic
  - Alarm on network malfunction and degraded capacity
  - Cabinet switch fault (FAT)
  - Network communication performance (FAT)
- Extended Alarm System (EAS)
  - Standard (Panel PCs on bridge, diode panels in cabins and public spaces)
  - Premium (Panel PCs on bridge, in cabins and public spaces)
- Dead Man System (DMS)
  - Automatic and manual operation
  - EAS integration
- Command Transfer
- Alarm Lab
  - Alarm logging and alarm database
  - Log printer
- Signal Lab
  - Signal logging and signal database
  - Log printer
- Remote data communication (Ship-to-ship/ship-to-shore)
  - OPC/ DDS
  - File export/ transfer
- Service PC
- Engine overview and diagnostics
- Propulsion overview and diagnostics
- Power Management System (PMS)
- Bilge system
- Ballast system
- Auxiliary systems, e.g.
  - lubrication oil
  - air
  - water cooling
  - fuel oil

- Cargo systems with mimics
  - Starters (pump, compressor, agitator, etc.)
  - Valves
  - Tanks
  - Flow meters
  - Tank summary
- Cargo transfer
- Tank sounding
- Anti-heeling system
- Running hours calculation
- Auto functions
  - Components
  - Custom (macro)
- Interfaced customer-specific third-party systems with mimics
  - Ventilation
  - Fire
  - Hydrophore
  - Ship motion/ Roll damping
  - PMS

ULSTEIN®

turning visions into reality

ULSTEIN POWER & CONTROL AS
P.O. Box 278
NO-6067 Ulsteinvik, Norway
upc.sales@ulstein.com
Tel.: +47 7000 8000

WWW.ULSTEIN.COM