ULSTEIN PRESENTATION
RTI CONNEXT CONFERENCE 2017

ULSTEIN®

OUTLINE

ULSTEIN INTRO

ULSTEIN X-CONNECT™

- **Background**
- **The platform**
- **Future**
- **Demo**

Jonas Wenström
Ulstein Power & Control

TURNING VISIONS INTO REALITY

ULSTEIN®

ULSTEIN GROUP

Ulstein is everything from Building ships, Designing ships, Outfitting ships, Integrating equipment and Operating ships

SHIP DESIGN & SOLUTIONS

SHIPBUILDING

POWER & CONTROL

SHIPPING

TURNING VISIONS INTO REALITY

BUSINESS

THE SEA

The sea that carries us forward	Raw materials Marine biotechnology The undiscovered
The sea that gives us prosperity	Oil and gas Renewables Bio marine
The sea that feeds us	Fisheries Aquaculture
The sea that takes us out into the world	Transport Recreation
The sea that binds us together	Communication Internet of things Big Data

ULSTEINVIK - NORWAY

GLOBAL

ULSTEIN POWER & CONTROL

ULSTEIN®

BRIDGE

COM

POWER
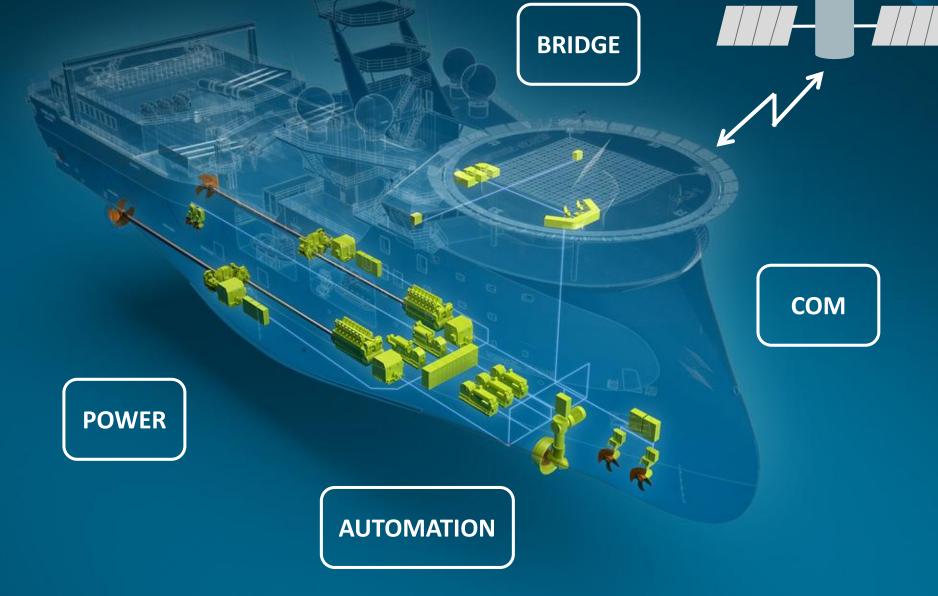
AUTOMATION

100 YEARS AND YOUNG AT HEART

100 years of experience in the maritime industry

Innovator in maritime equipment and ships

**TURNING VISIONS
INTO REALITY**

*We create tomorrow's solutions
for sustainable marine operations*

ULSTEIN®

INNOVATOR

X-BOW & X-STERN

BRIDGE VISION

X-CONNECT™

TURNING VISIONS INTO REALITY

2017: NEW SERIES OF BANK NOTES

TOPIC: THE SEA

FROM EQUIPMENT TO HUMAN CENTRIC

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CONNING	RADAR	ECDIS	
LIGHT	PMS	IAS	DP
	BNWAS	COM	RADAR

TRADITIONAL BRIDGE SYSTEMS

INTEGRATED BRIDGE (BRIDGE VISION)

Many independent systems
with different GUI and handling

One system with uniform GUI
and handling

Complexity

Simplicity

Challenging and time consuming gathering of
ship information

User friendly aggregated and easy accessible
operation dependent information

TURNING VISION TO REALITY

The Bridge Vision project was finalised in 2013

To make Bridge Vision come true, «turning vision into reality»,

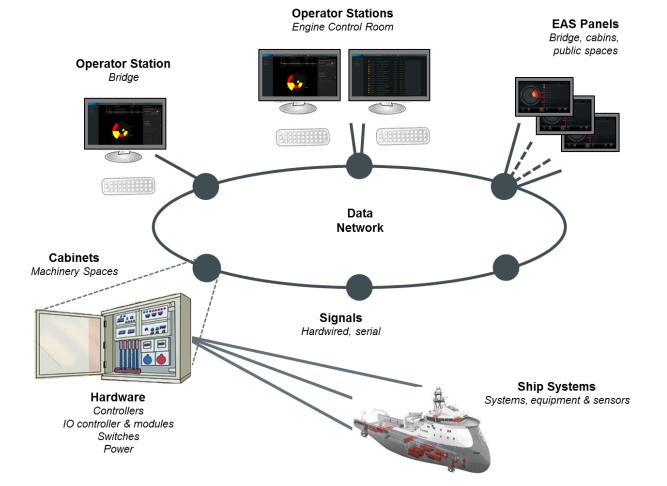**a data infrastructure to build it on is essential.**

Priority to build a platform

Ulstein X-CONNECT™

SHIP CONTROL & AUTOMATION

Operator Station
Bridge

Operator Stations
Engine Control Room

EAS Panels
Bridge, cabins, public spaces

Data Network

Cabinets
Machinery Spaces

Signals
Hardwired, serial

Hardware
Controllers
IO controller & modules
Switches
Power

Ship Systems
Systems, equipment & sensors

BACKGROUND

- **Platform with products based on Scada, PLC, client server technology, proprietary protocols, hardware and vendor dependent**

- **Unacceptable license costs, complex, costly maintenance costs, technical debt, high production costs**

- **Future oriented? No!**

- **Competitive? No!**

EVOLUTION START

❯ **Pre 2010**
  – Awareness of need

❯ **2010 - Develop requirement specification for all hardware and software for new platform, "Ulstein System Architecture" *<USA>***
  – Hardware criteria's:
    Maritime standards (IEC 60945), performance, form fit and function, life cycle aspects
  – Software criteria's:
    Independence of hardware, open OS, standard open software code,
  – Methods:
    Software and hardware configuration and software deployment

❯ **2011 – Implement and test components for new platform**
  – C++ & Qt, competence building
  – CDP middleware instead of PLC, Scada, OPC DA
  – Industrial pc instead of PLC

FIRST PRODUCT

> **2012**
> – UBAS

FIRST PRODUCT

> **2012**

– Bridge switch board and light control system

NEW AUTOMATION SYSTEM

- **2013 – Development of new automation system**
  - Configurable automation system
  - Configuration and deployment tools

- **2014 – Failures and Initial DDS testing**
  - Started with Prismtech and OpenSplice, found it easier to work with RTI Connext after evaluation
  - Easy migration from OpenSplice to RTI Connext
  - CDP scaling failure, need for middleware that solves scaleability and flexibility issues. CDP ok for UBAS with up to 1000 variables, but not for automation system with up to 10 000 variables
  - RTI Connext evaluation based on scaleability and performance, handling 100 000 alarms in avalanche

NEW AUTOMATION SYSTEM

- **2015 – Platform remake decision**
  - Buy or make self?
  - Decision to make own platform with RTI Connext DDS as communication layer
  - Available IO systems with open OS and API

- **2016 – First delivery on new platform = X-CONNECT™**
  - System with 50 software's interconnected using DDS
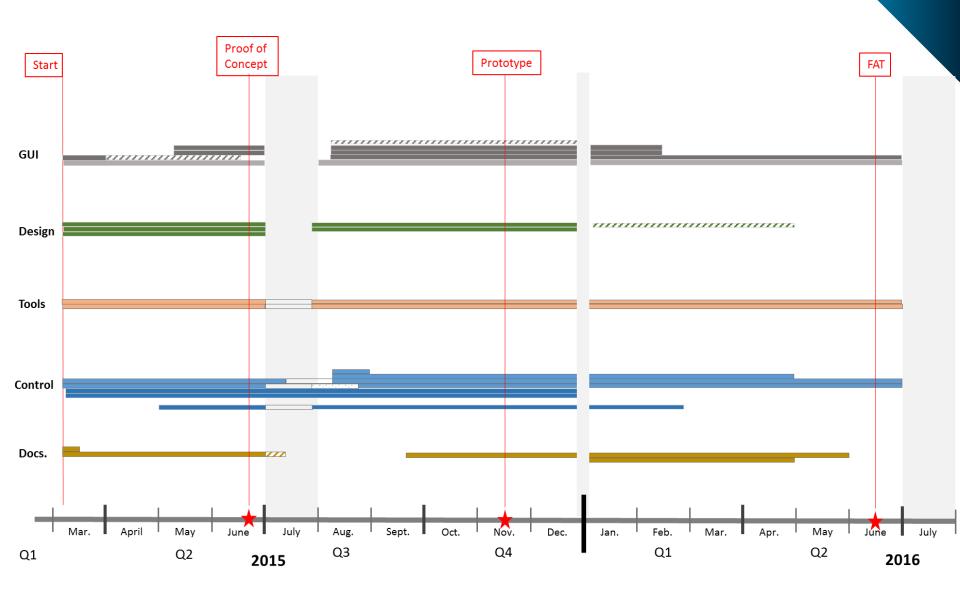 - One of the largest automation systems delivered by Ulstein, > 3000 variables, > 50 mimics, …

- **2017 – First ever delivery of AMS**
  - Small system with competitive pricing

TURNING VISIONS INTO REALITY

ULSTEIN X-CONNECT™

> **The integration platform**

> **Competitive**
- – Scalable
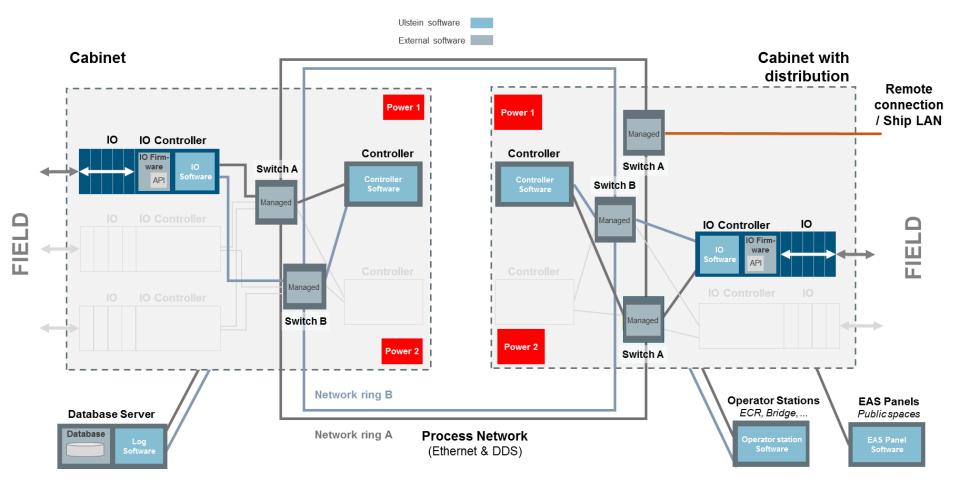- – Flexible
- – High grade of Independency
- – Cost effective

Digitalisation/ Autonomous Systems							
ULSTEIN IAS®	ULSTEIN PMS/ EMS	ULSTEIN POWER™	ULSTEIN COM®	ULSTEIN BRIDGE™ Manouvering	ULSTEIN Control Panels	MISSION EQUIPMENT	Other Control System

ULSTEIN X-CONNECT™

OVERVIEW

ULSTEIN X-CONNECT^{TM} is a combination of computer hardware, configurable software, network, efficient data communication, high definition monitors with rich graphical user interface and cabinets.

DISTRIBUTED SYSTEM
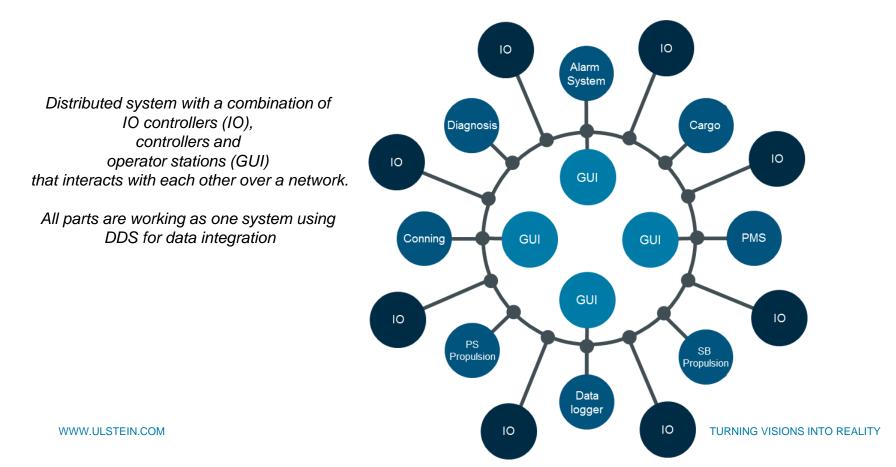
ULSTEIN X-CONNECT^{TM} is a distributed and decentralized software application platform enabling a lean system with robustness, scalability and flexibility.
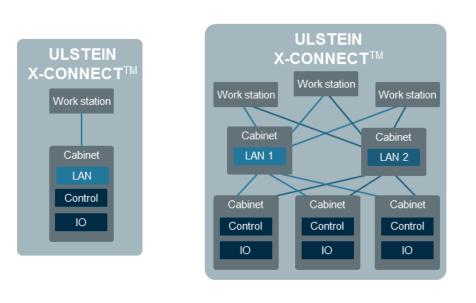
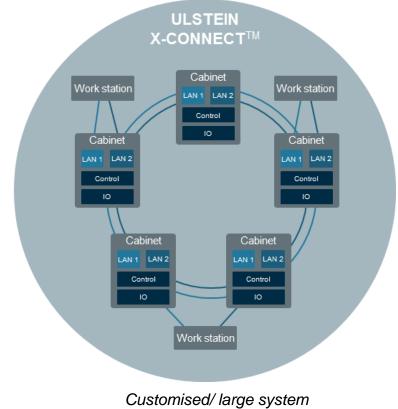*Workloads and tasks are partitioned between the different software applications.*

*Distributed system with a combination of
IO controllers (IO),
controllers and
operator stations (GUI)
that interacts with each other over a network.*

*All parts are working as one system using
DDS for data integration*

TURNING VISIONS INTO REALITY

FLEXIBLE

ULSTEIN X-CONNECT^{TM} enables solution flexibility.
Different system combinations, sizes and segments are supported

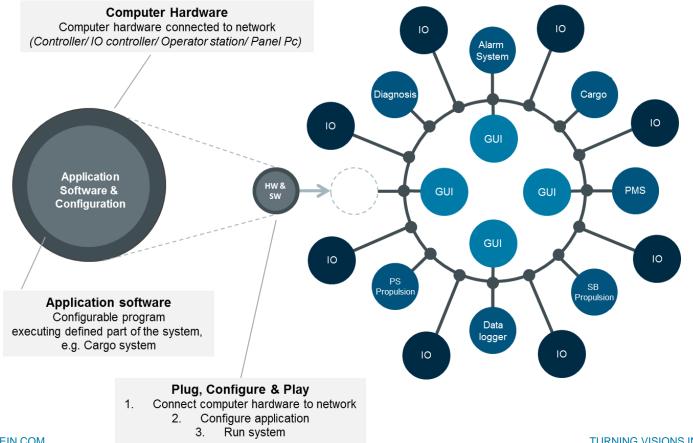Small system   Medium system   Customised/ large system

SCALEABLE

ULSTEIN X-CONNECT^{TM} supports systems with different sizes.

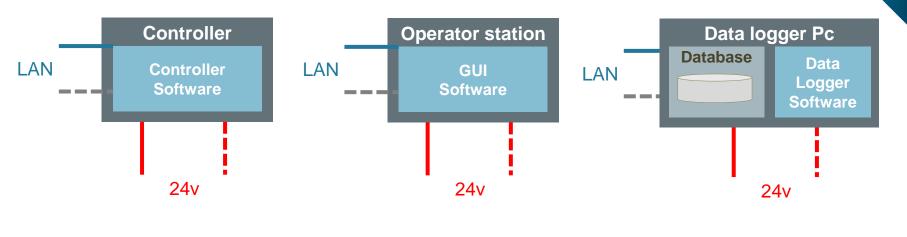*Adding, removing and replacing components to the system is made easy by using configurator and deployment tools*

Computer Hardware
Computer hardware connected to network
(Controller/ IO controller/ Operator station/ Panel Pc)

Application Software & Configuration

HW & SW

Application software
Configurable program
executing defined part of the system,
e.g. Cargo system

Plug, Configure & Play
1. Connect computer hardware to network
2. Configure application
3. Run system

IO · IO · Alarm System · Diagnosis · Cargo · IO · GUI · PMS · GUI · GUI · GUI · PS Propulsion · SB Propulsion · IO · Data logger · IO · IO

TURNING VISIONS INTO REALITY

LEAN SOFTWARE

Controller

Controller
Software

LAN

24v

Operator station

GUI
Software

LAN

24v

Data logger Pc

Database

Data
Logger
Software

LAN

24v

Linux/ VXWorx
C++
QML
DDS
SQL

Signals
Alarms
Components
Systems
Graphical User Interface

MODERN DATA DISTRIBUTION
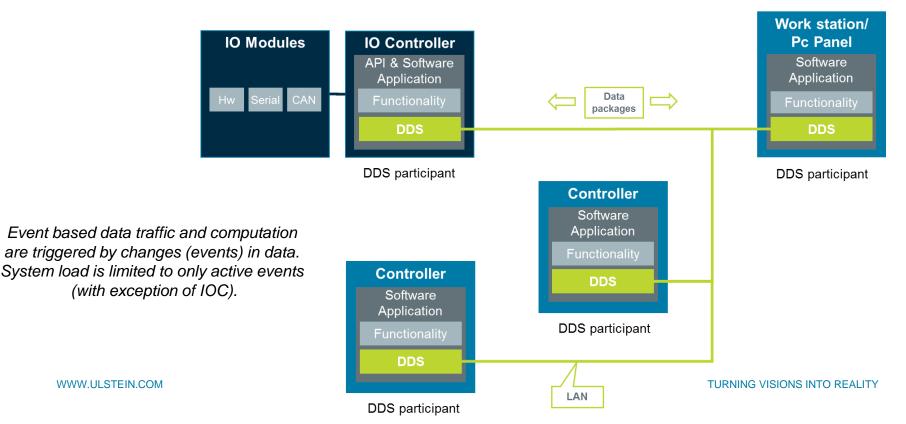
*All data communication within the system is based on
modern Ethernet network and DDS technology with event based data.*

*Software applications are DDS participants who cooperate with each other by
publishing data and subscribing to data*

The system is capable of handling huge amounts of data and at high speed.

*Event based data traffic and computation
are triggered by changes (events) in data.
System load is limited to only active events
(with exception of IOC).*

IO Modules
Hw | Serial | CAN

IO Controller
API & Software Application
Functionality
DDS

DDS participant

Data packages

Work station/ Pc Panel
Software Application
Functionality
DDS

DDS participant

Controller
Software Application
Functionality
DDS

DDS participant

Controller
Software Application
Functionality
DDS

DDS participant

LAN

TURNING VISIONS INTO REALITY

DDS ASPECTS

> **107 topics, static data types**

> **FUD and non FUD**

> **XML App creation**
> - Wire up topics and data types at startup

> **Mainly multi-cast groups, some uni-cast**

> **QoS, use of 4 predefined**
> - Keep last transient = Values to be persisted
> - Strict reliable = Commands
> - Best effort = Heartbeats
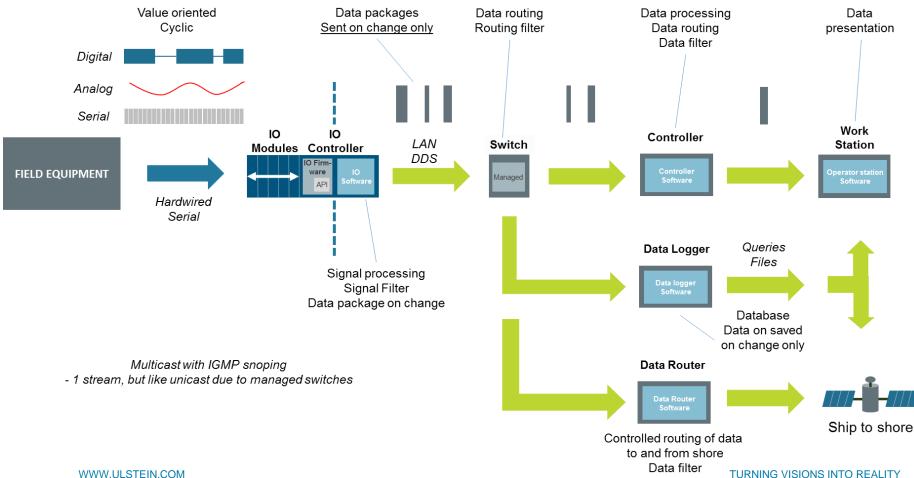> - HighThroughPut = Log reply

> **Cybersecurity**

> **DDS Routing service**

FROM SENSOR TO CONSUMER
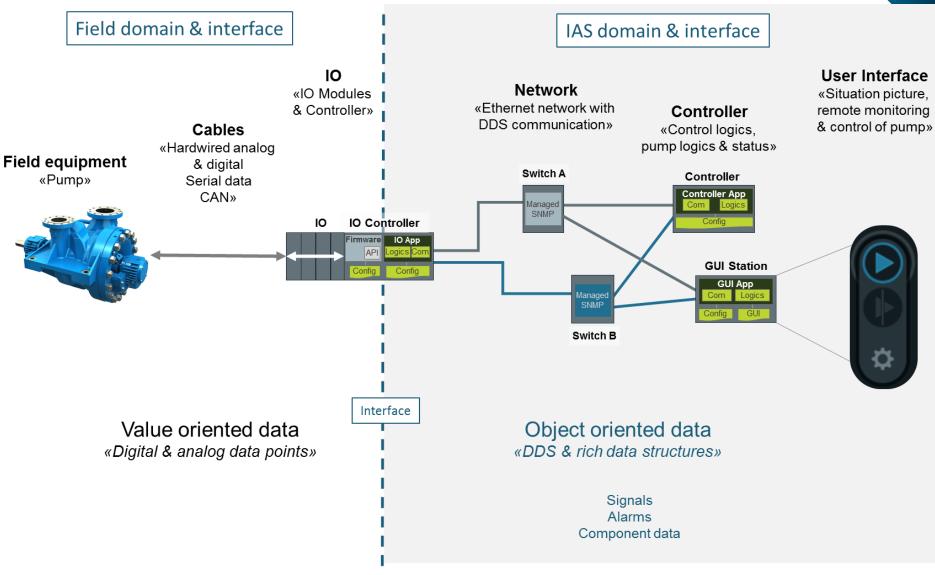
Event based and datacentric system makes more than 90% network load reduction possible compared to traditional systems

Value oriented
Cyclic

Digital

Analog

Serial

Data packages
Sent on change only

Data routing
Routing filter

Data processing
Data routing
Data filter

Data presentation

FIELD EQUIPMENT

Hardwired
Serial

IO Modules

IO Controller
IO Firm-ware
API
IO Software

LAN DDS

Switch
Managed

Controller
Controller Software

Work Station
Operator station Software

Signal processing
Signal Filter
Data package on change

Data Logger
Data logger Software

Queries Files

Database
Data on saved on change only

Multicast with IGMP snoping
- 1 stream, but like unicast due to managed switches

Data Router
Data Router Software

Ship to shore

Controlled routing of data
to and from shore
Data filter

TURNING VISIONS INTO REALITY

FROM FIELD TO USER

ULSTEIN®

Field domain & interface

IAS domain & interface

IO
«IO Modules & Controller»

Network
«Ethernet network with DDS communication»

Controller
«Control logics, pump logics & status»

User Interface
«Situation picture, remote monitoring & control of pump»

Cables
«Hardwired analog & digital Serial data CAN»

Field equipment
«Pump»

Switch A
Managed SNMP

Controller
Controller App
Com | Logics
Config

IO | **IO Controller**
Firmware | **IO App**
API | Logics | Com
Config | Config

GUI Station
GUI App
Com | Logics
Config | GUI

Managed SNMP

Switch B

Interface

Value oriented data
«Digital & analog data points»

Object oriented data
«DDS & rich data structures»

Signals
Alarms
Component data

HARDWARE

Controller
- Industrial Pc

Operator station
- Industrial Pc

EAS panel
- Industrial Pc panels

Monitors
- Full HD 1080p (1920x1080)

IO system
- Multigateway IO controllers
- Hardwired
- Serial IO: ModBus, NMEA
- Ethernet: NMEA 450, ModBus
- CAN

Network Switches
- Managed, with SNMP

Network
- Ethernet
- 100Mb/ 1Gb
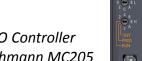
Marine approved in accordance with IEC 60945

Controller Pc
Marine Grade Fanless
DIN Rail computer.

GUI controller Pc
Matrix Krypton
6311 Fanless computer

IO Controller
Bachmann MC205

DATA LOGGER
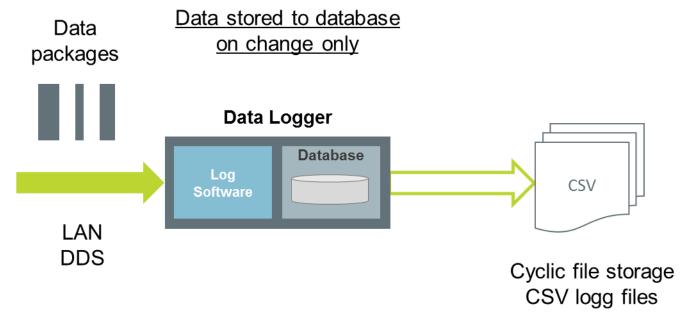
All system data can be logged to database and be used for different purposes such as data trending and playback

DDS and event based data helps saving space and enhancing length of data time span.
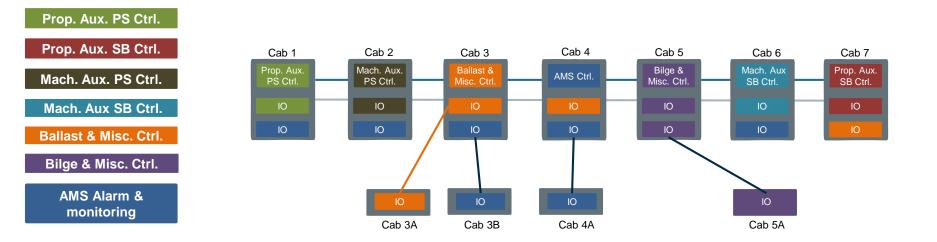
SEGMENTATION

Distributed system enables segmentation meeting class requirements as well as increasing flexibility, reliability and accessibility

Typical IAS segments (Offshore vessel):
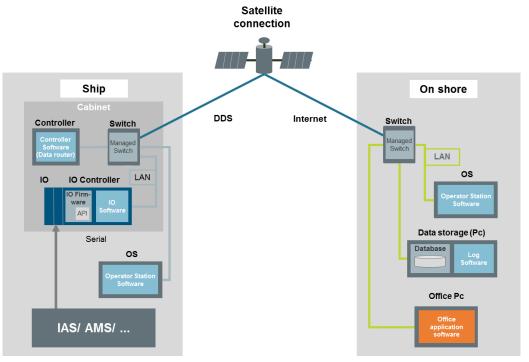
DATA EXPORT & SHIP TO SHORE

*Different ways of exporting data from the system is provided
such as interface to OPC and sending data ship to shore via satellite connection.*

Use of DDS and event based data enables low and efficient transmission

TURNING VISIONS INTO REALITY

GRAPHICAL USER INTERFACE

«A user centric and consistent user interface design that supports efficient use of the system.

SIMPLE, EASY TO GET OVERVIEW
- Minimize visual interruptions
- Maximize available workspace
- Information on-demand before always visible

SERVE THE EXPERT USER
- Efficiency before over-clarity
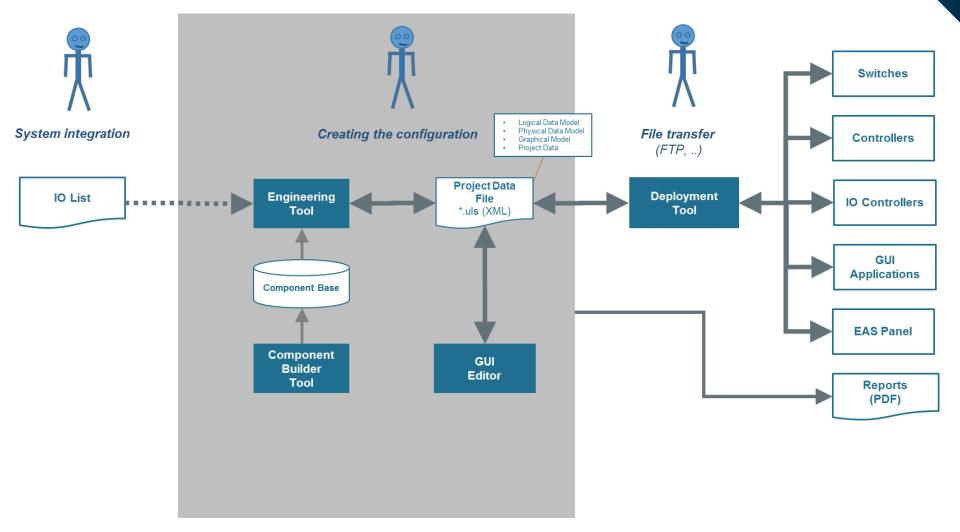
FLEXIBLE
- Modular
- Components for re-use

TURNING VISIONS INTO REALITY

CONFIGURE TO ORDER

TURNING VISIONS INTO REALITY

FUTURE
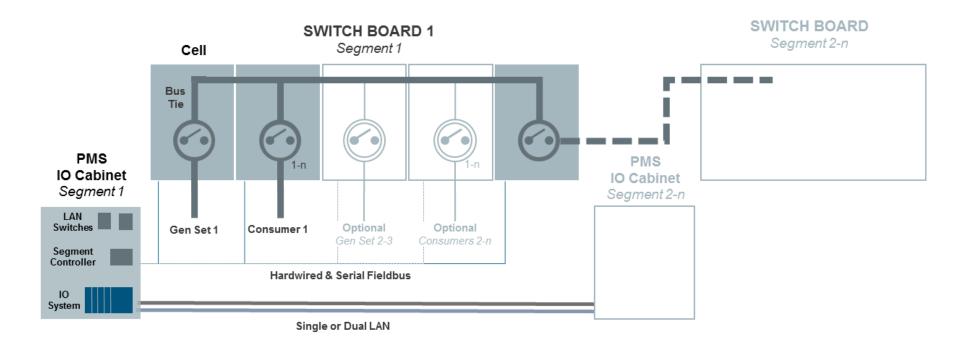
> ## 2017 – Power Management System (PMS)

– Managing power generation on ship

FUTURE

- **2018 – Energy Management System (EMS)**

- **Further – Controlling ship operations**
  - Communication & Entertainment System

  - Vessel Performance System
    - Data collection and aggregation
    - Decision support
    - Condition based monitoring (prediction, maintenance)

  - Data analytics
    - Collect
    - Analyze
    - Improve solutions

  - New Bridge System

  - Mission Equipment Systems

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TURNING VISIONS INTO REALITY

SIGNAL LAB – SIGNAL DATA ANALYSIS

ALARM LAB – ALARM ANALYSIS

SYSTEM DIAGNOSTICS

CARGO SYSTEM

THRUSTER MIMIC

PMS CONTROL MIMIC

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