WinGD X-Type Training

WiDE - WinGD Integrated Digital Expert

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WIDE

Aim of Training

- Understand the philosopy of WIDE
- Understand DCM overview.
- Understand EDS overview.
- Understand the function of the FSM and FDA

WIDE

Introduction

- WiDE is standard for all new buildings contracted since 01.01.2018
- DCM is installed for the engine lifetime.
- EDS is only an engine diagnostics software and its free of charge during the first year from its installation onboard. After the trial period there is a license fee which is covered by the WiDE package subscription.

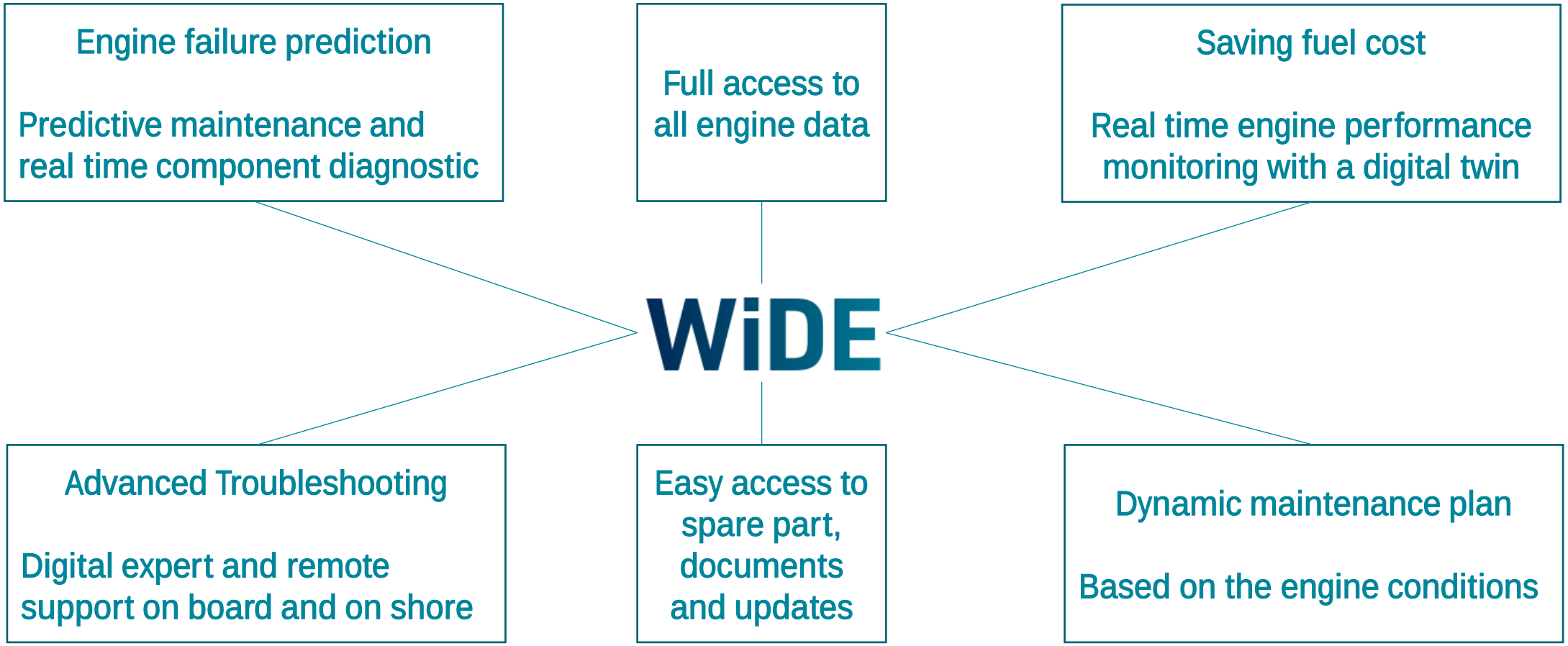
WIDE

Abbreviation

- WinGD Integrated Digital Expert
- Data Collection Monitoring
- Engine Diagnostic System
- Fast Signal Module
- Fast Data Acquisition

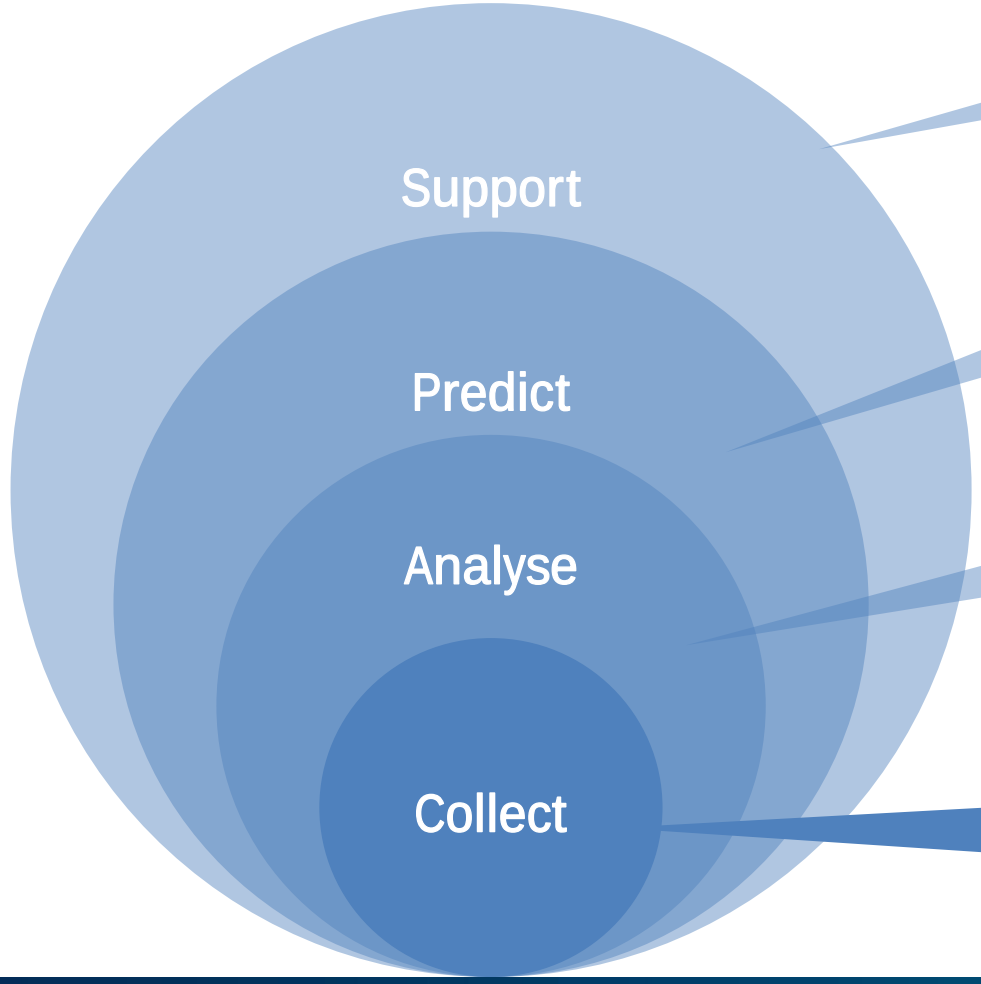
WIDE

Value to Operators



WiDE: WinGD Integrated Digital Expert

Creating Value from Engine and Ship Data



- Troubleshoot abnormalities
- Detailed information on key components
- Steps to fix the malfunction.

RS

- Prediction and diagnosis of component malfunction
- Extension of maintenance intervals

EDS

- Intelligently diagnose the engine status
- Performance information
- Sub-systems and components current behaviour

- Display trend of ship and machinery data
- Communicate engine data ashore to the ship owner
- Store data in a secured environment

DCM

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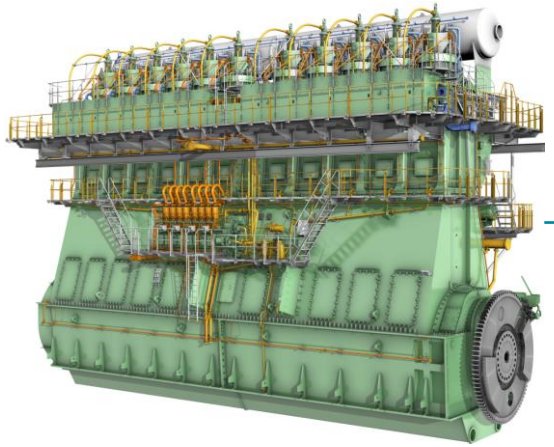
WinGD engines go online

WiDE provides a constant support on board and on shore

Ship, navigation data



> 500 engine's signals continuously collected

On board

Onshore/ online

Remote Support

Ship owner
Engine diagnostics
Technical support

WinGD/ Service provider
Engine diagnostic
Troubleshooting

3rd party:
at owner preference

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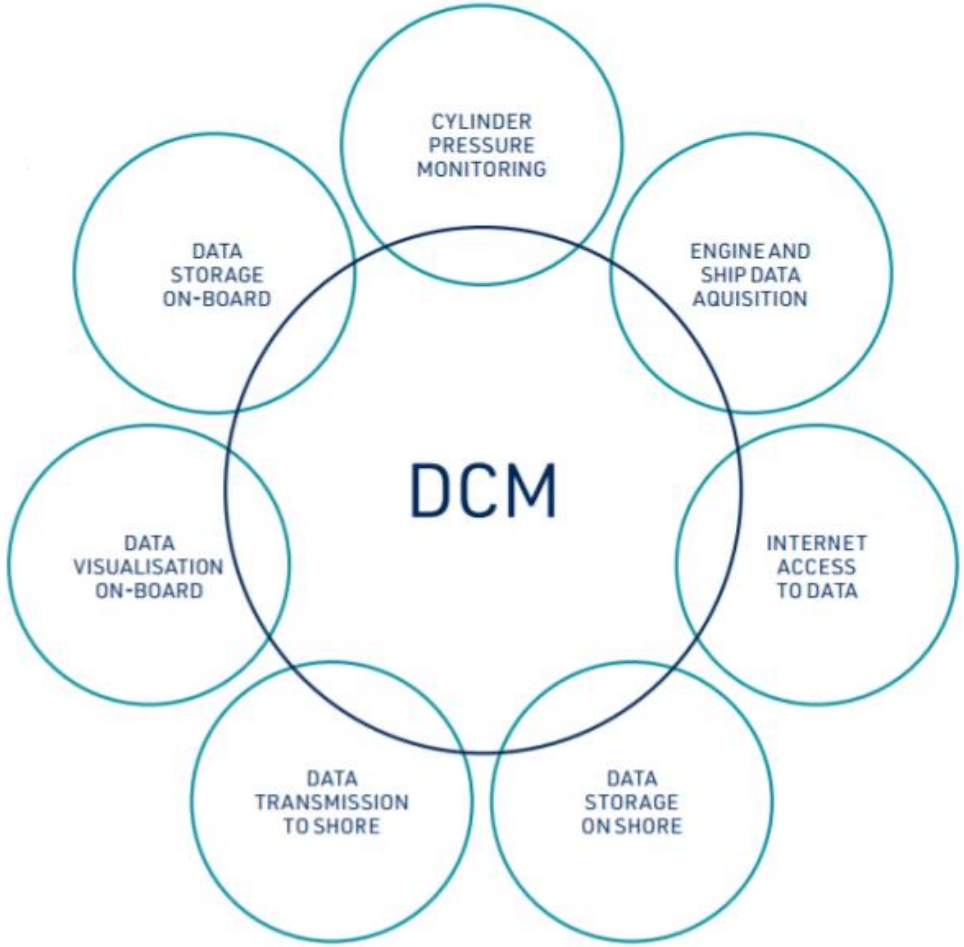
DCM: System Description

- Data Collection and Monitoring (DCM) is the system for collecting slow and fast data from the WinGD main engine and other machinery, both locally in the ship and remotely.

- DCM allows to send data to a secure external server with an encrypted communication and to visualize the data.



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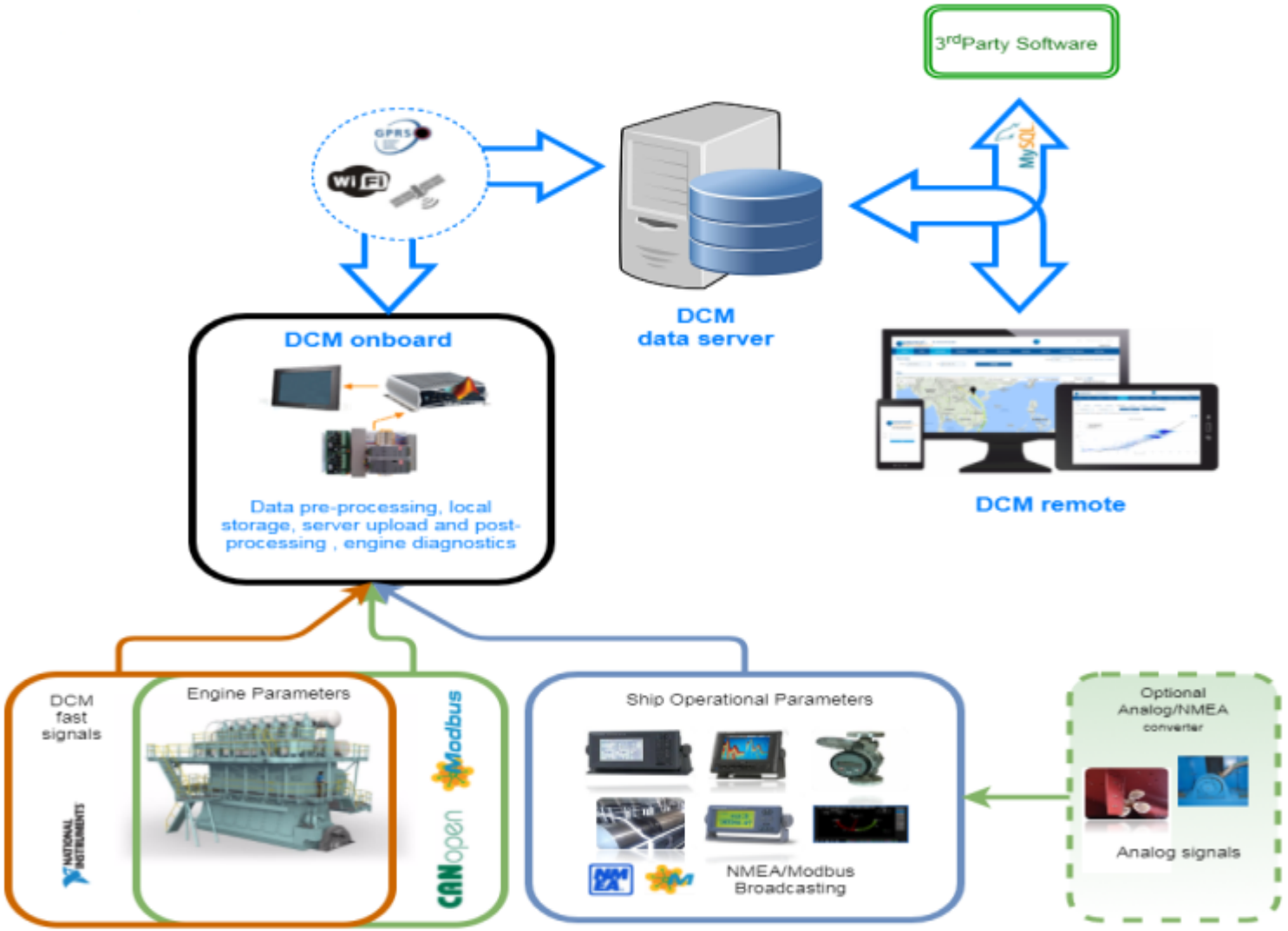
DCM: System Description

- The data collected by DCM can be used for data analytics and/or engine performance monitoring computed by the EDS
- In addition, DCM enables remote support collaboration between WinGD and the ship operators.



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DCM: Standard data collection

- DCM collects all main engine operational, diagnostic signals and failure codes.
- DCM allows to collect data from external navigational equipment and ship machinery.
- DCM communicate to almost every on-board equipment.
- Estimated requirement of disk space capacity 8-16GB per year, depending on installation.
  - **Data protocols:**

  System supports standard data exchange protocols
    - NMEA0183
    - Serial
    - Ethernet
    - Modbus
    - CANopen
    - Nonstandard signals and parallel use of protocols

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DCM: Safety of data storage and transfer

Data is pre-processed and saved to database as CSV file, all the exported files are zipped.
DCM sends the collected data on-board to the remote shore server by email via ship communication computer.

There is no direct connection to the Internet.

The system sends the data ashore in predefined intervals which can be changed.

Engine signals are collected every 0.1s (fast), 1s (medium) and 10s (slow) depending on the signal. Each 10s all signals are averaged and prepared for further upload to the DCM data server.

Navigation and operation signals are collected every 10s and averaged every 60s.

EMS raw data are stored for 5 days, records older than 5 days are removed from local (onboard) database.

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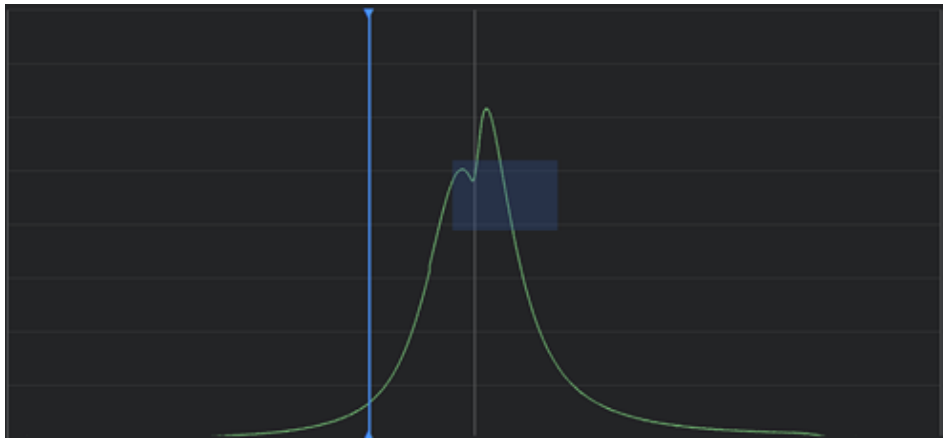
FDA: Fast Data Acquisition for WiCE controlled engines

FDA Client is an application designed with DCM system in order to process high frequency combustion signals. The NI cRIO hardware and additional cabling is not required anymore. It is developed to access signals provided by engine sensors, collected via WiCE control system, and distributed via GTU and FDA server application.

The working application delivers data in binary files format to the DCM. With the engine running amount of the binary data increases. When the engine is not running the FDA client does not produce any sort of data, it waits until the engine runs.



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Overview of DCM Hardware

DCM collects engine signals, machinery signals and navigational data.

Located on the engine:

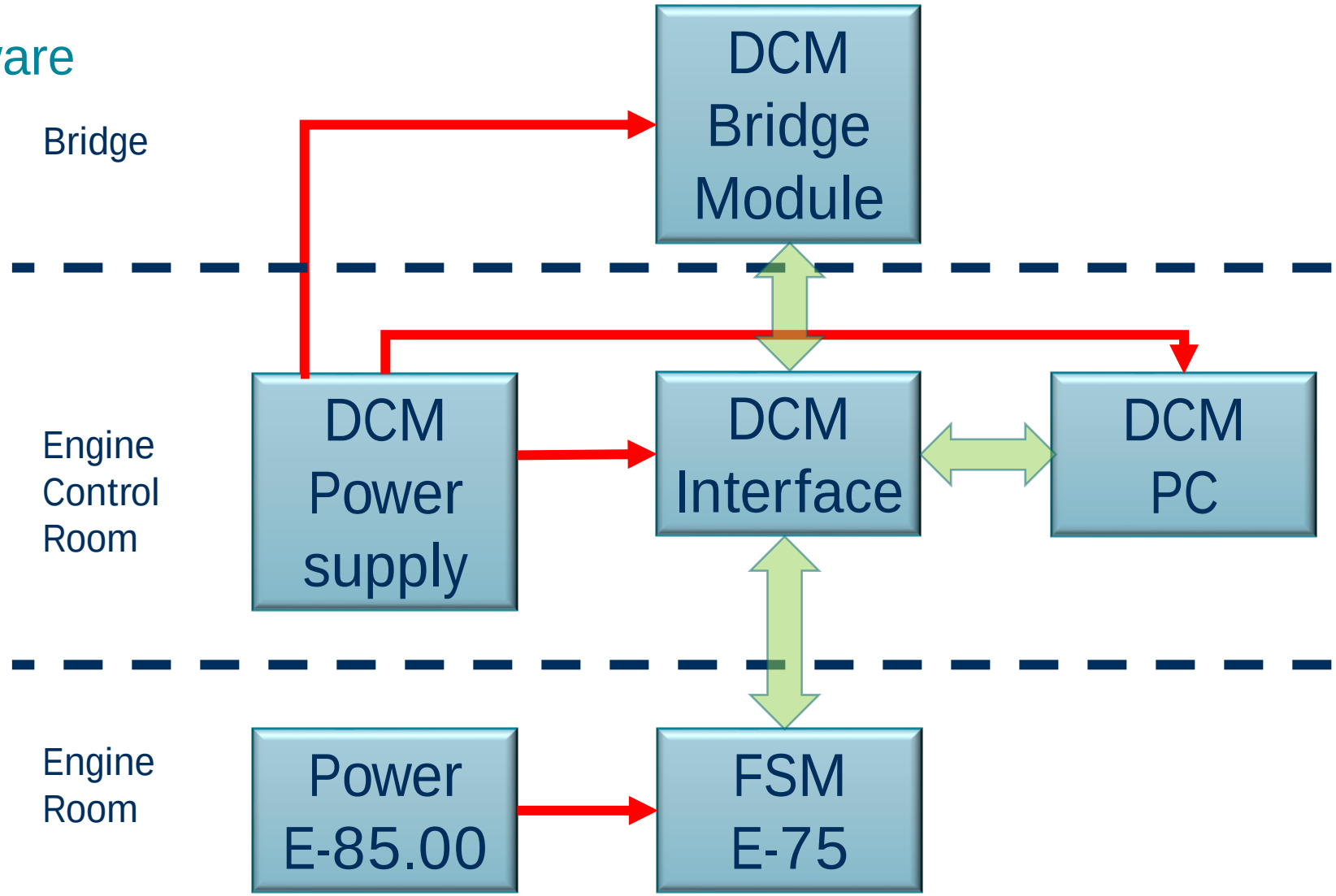
- FSM (E75 box)

Located in ECR

- DCM Power supply Unit
- DCM interface Unit
- DCM PC

Located on the bridge:

- DCM Bridge Unit



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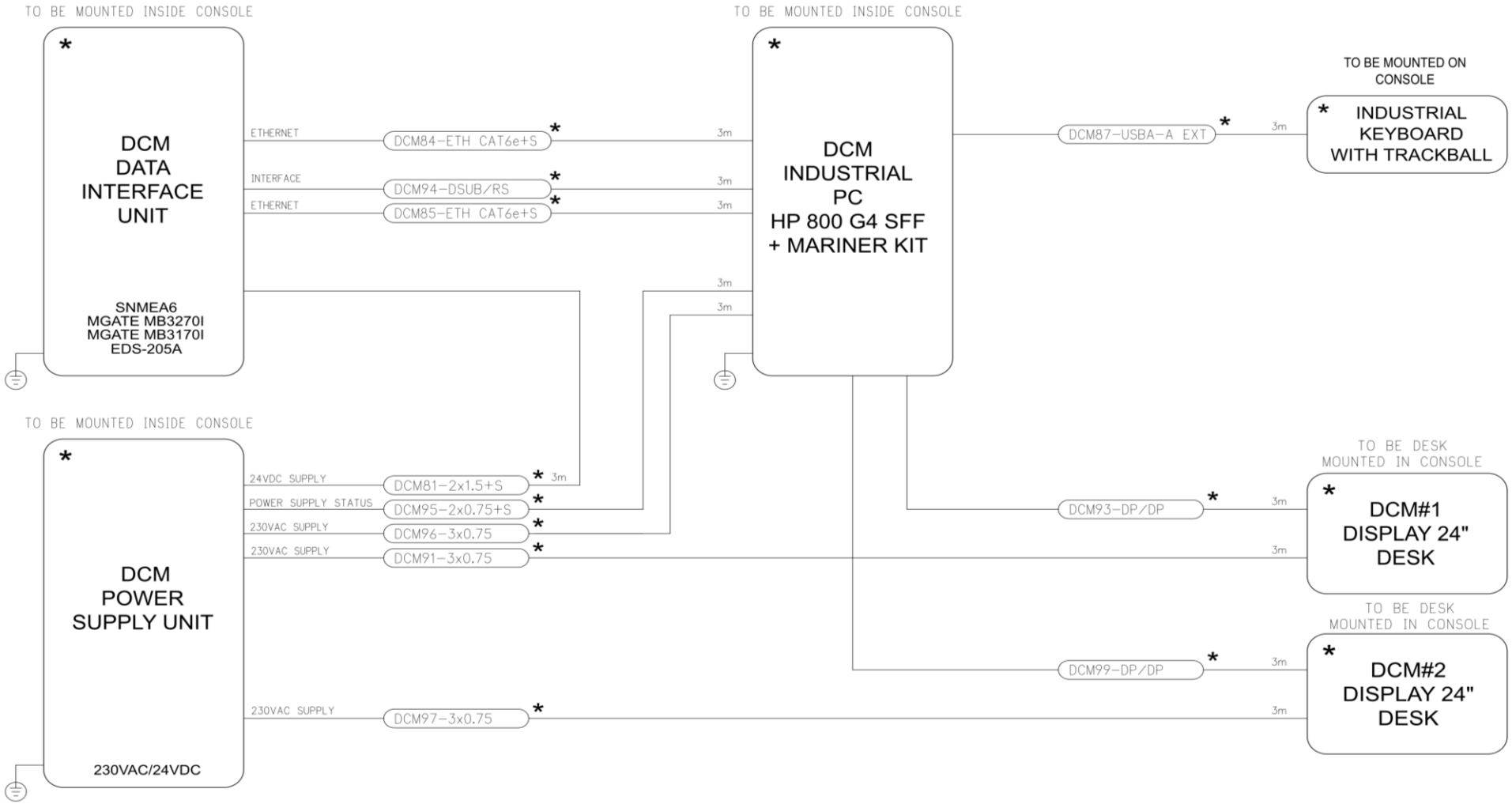
DCM Hardware in ECR



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Monitors for DCM and EDS Operation

- WinGD specifies two monitors for WIDE.
- The arrangement depends on the ECR Design.
- One monitor is dedicated for the DCM Software.
- One monitor is dedicated for the EDS Software.
- Both monitors are located in ECR.
- If flexView is installed we use second Monitor to display fV

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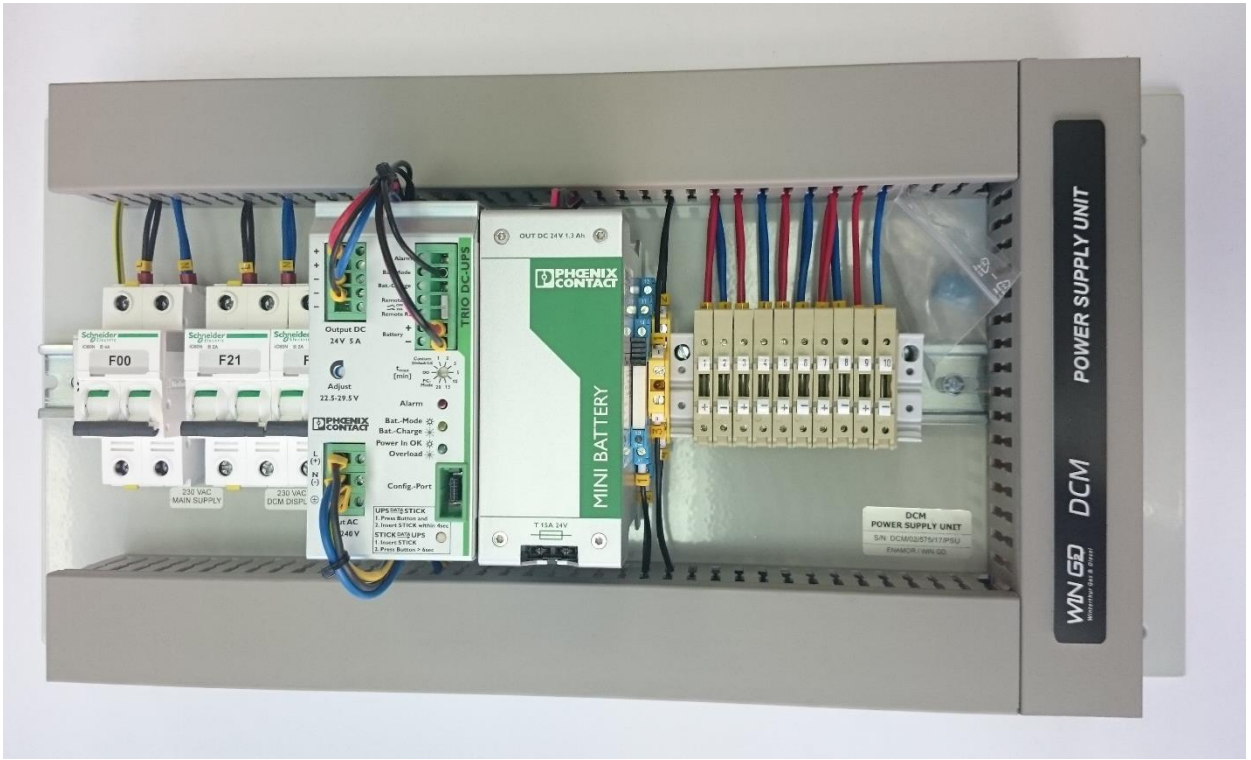
DCM Power supply Unit

DCM Power Supply Unit is located close to DCM interface Unit in Engine Control Room. It supplies 230VAC power to DCM elements like PC, Interfaces. It's equipped with :

- TRIO-UPS/1AC/24DC/5 Uninterruptible power supply 230 VAC / 24 VDC (5 A)
- TRIO- Mini Battery in TRIO-UPS (Phoenix Contact) offer guaranteed power protection for computers and other electronics.

The device provide enough battery backup power so it is possible to work through short period of power outages. It protects equipment from damaging surge and spikes that travel along utility and data lines. In case of power break down longer than 1 minute computer shut downs and awake when power supply is back. This replaces the SIEMENS LOGO



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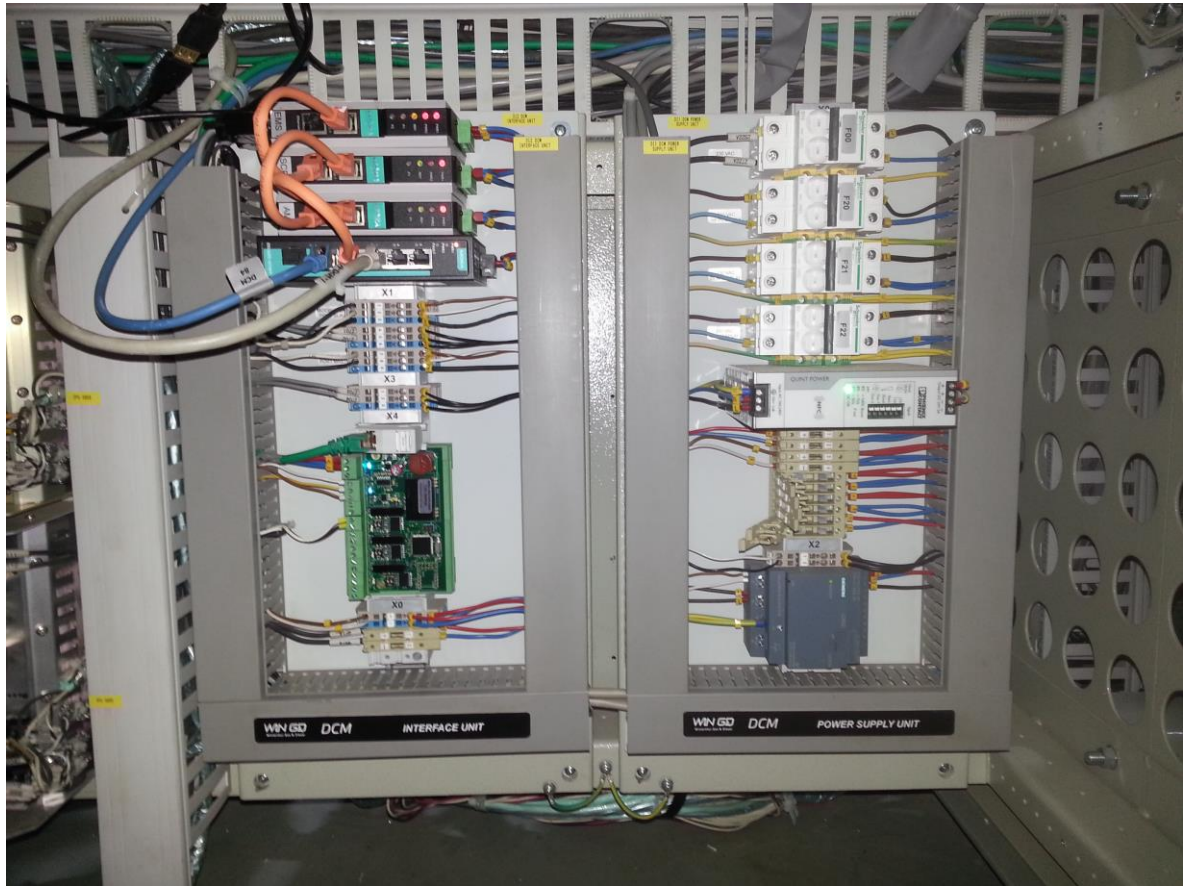
DCM Interface Unit ER

Data Interface Unit ER is responsible for Modbus or CAN Open data transfer from Engine Management System, Modbus data transfer from IAS/AMS and for NMEA data transfer via NMEA Multiplexer.

Interfaces:

- Interface 1: Modbus RTU Moxa interface for connection with WECS or UNIC
- Interface 2: Modbus RTU Moxa interface for connection with IAS/AMS
- Interface 3: NMEA interface for connection with up to 6 NMEA signals
- Interface 3: (Optional) CANOpen Interface for connection with WECS
- Option 1: Additional Modbus Interface for external systems
- WiCE is using Modbus TCP



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DCM Collecting Interface Unit Bridge

Data Collecting Interface Unit Bridge is responsible for NMEA data transfer from navigational equipment (GPS, Gyro, Speed Log, Echosounder, Weather station etc.). DCIU Bridge is also equipped with Ethernet switch used for communication with DCIU ER and access from external DCM station.

- Option 1: Analog to NMEA converter if signal is available in other standard than NMEA protocol (i.e. analog 0..10 VDC, 4..20 mA etc)
- Option 2: Additional NMEA Multiplexer if more NMEA protocols are necessary to be collected

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DCM Collecting Interface Unit Bridge

DCM Bridge Unit collects up to 23 Data signals from the available navigation equipment on the bridge via NMEA or VDR:

- GPS
- Loading Computer (ECR)
- Speed Log

Mandatory

- Digital Inclinometer
- Echo sounder
- GYRO
- Weather station
- Rudder
- Wave radar (manual)

Optional

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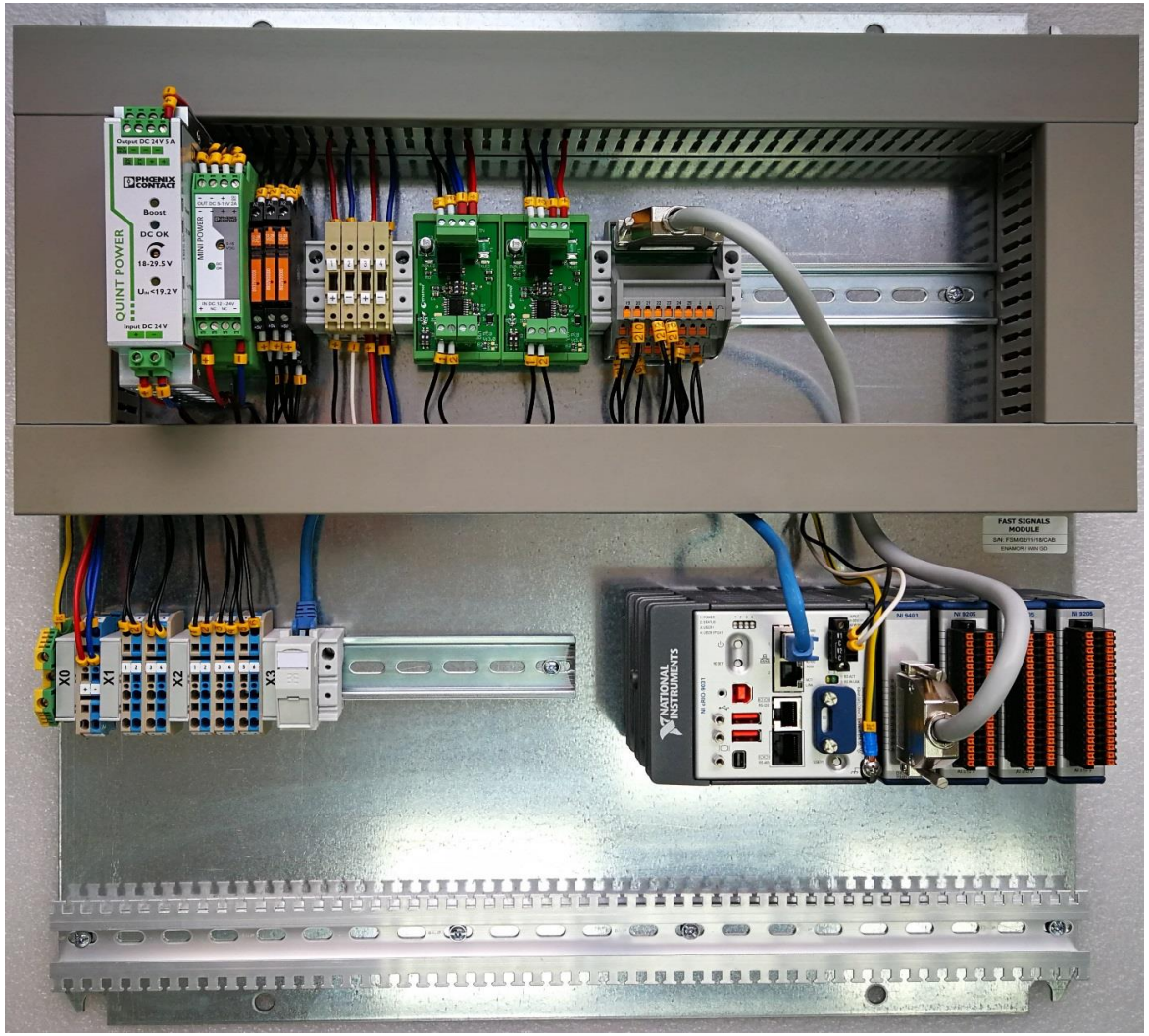
DCM FSM – Fast signal monitoring unit

Fast Signal Monitoring Unit is responsible for high frequency acquisition of cylinder related analogue signals. It allows the acquisition and visualisation of the following engine values:

- Crankshaft position
- Cylinder combustion pressure (CP), [bar] ,
- Exhaust valve position (EVP), [mm]
- Gas admission valve No. 1 position (GAV1), [mm]
- Gas admission valve No. 2 position (GAV2), [mm]
  Injection quantity sensor position (ICU), [mm]

Data acquisition in FSM is based on engine strokes (angular position of crankshaft).



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FSM cabinet (E75) location on the engine

- Depending on the engine type E75 (FSM cabinet) for example on X92DF it will be located on the driving end of the engine. Below the E27 box

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FSM E75 module

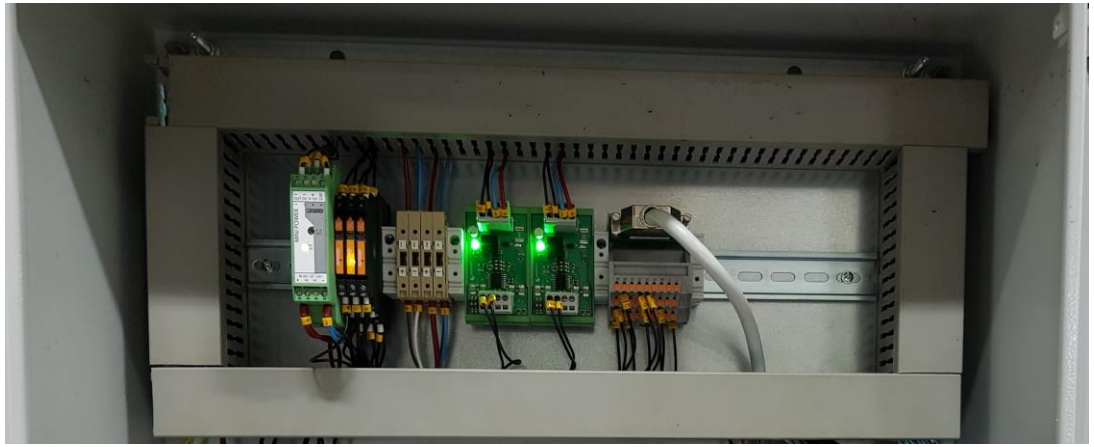
The Crank angle is used by FSM internal calculations and is displayed as a Graph on DCM UI

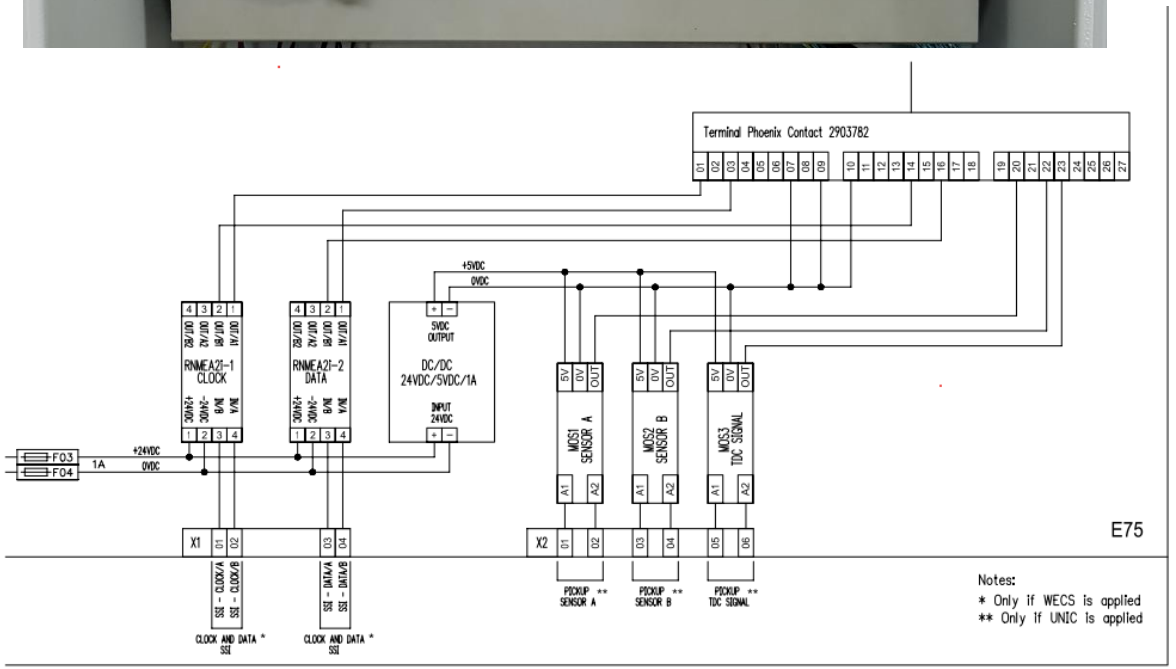
In Case of UNIC we read:

- Sensor A
- Sensor B
- TDC Signal

In Case of WECS and WiCE we read SSI:

- CLOCK 1
- DATA 1





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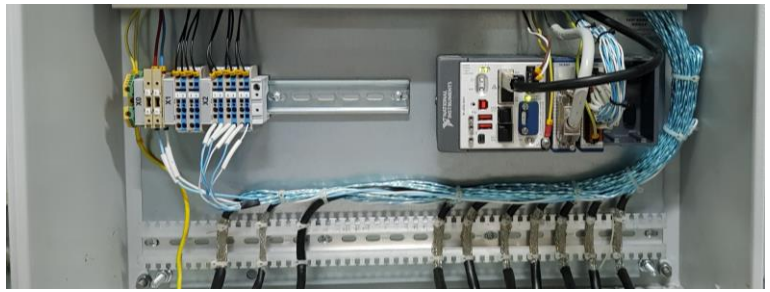
FSM E75 module

FSM collects following signals from all Units:

Ethernet 1 on the NI cRIO is connected to DCM Interface in the ECR

The cRIO does not have a own Hard disk, it use a 64GB SD Card.

DO NOT REMOVE THE SD CARD



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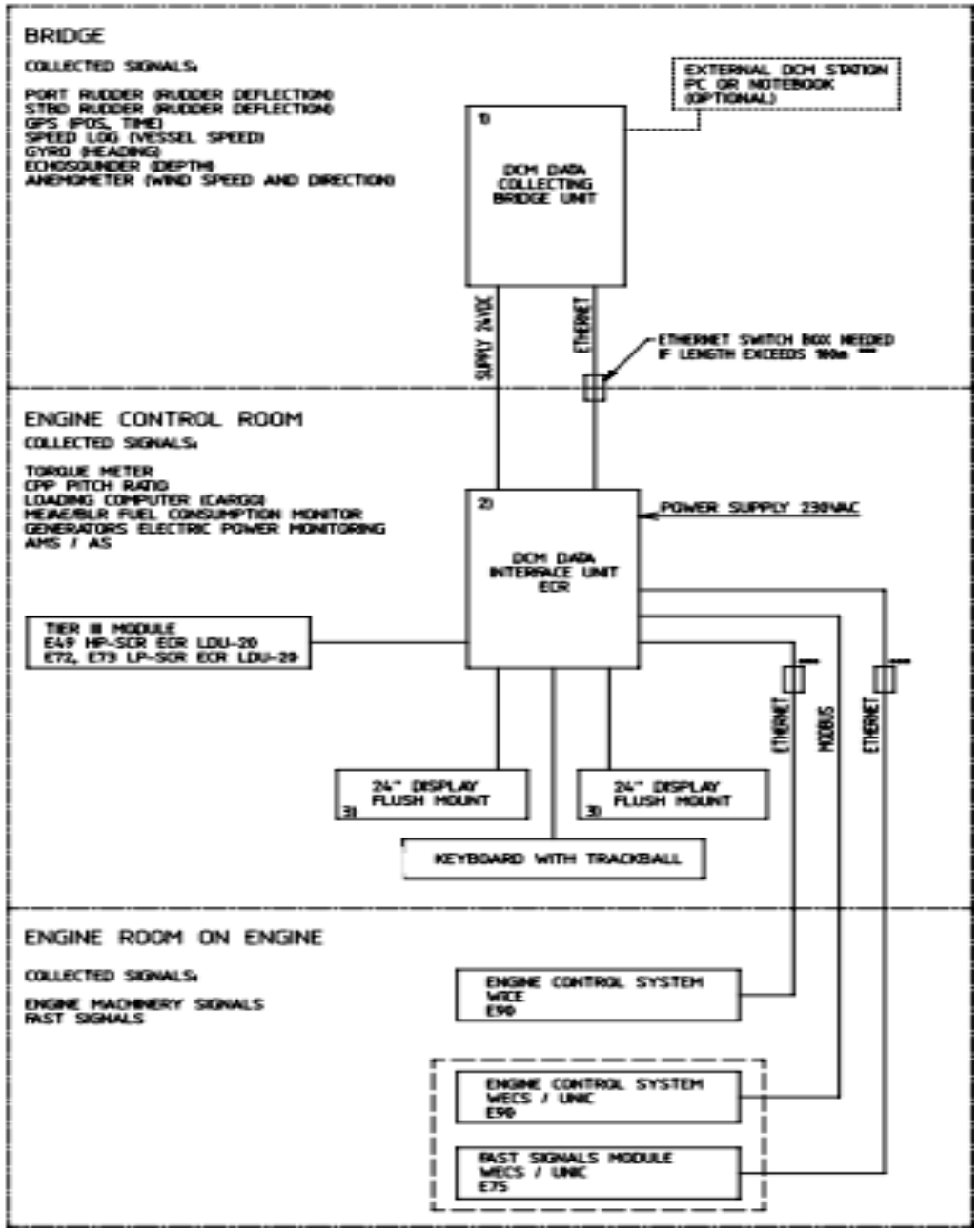
DCM Communication

Communication between DCM Interface and
- Bridge Unit
- FSM

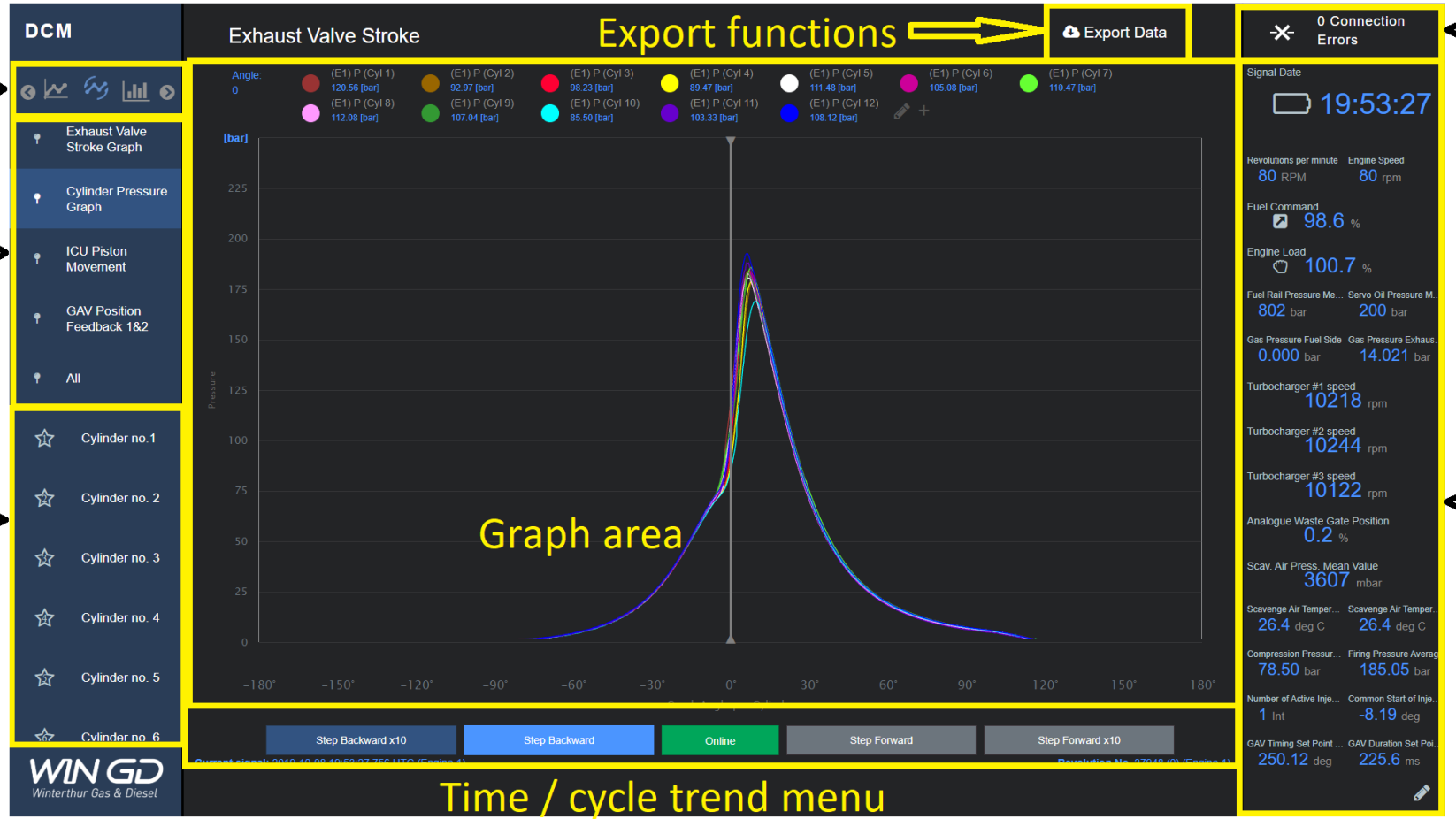
Is Ethernet and to
- SCR Box
- AMS

Modbus is used



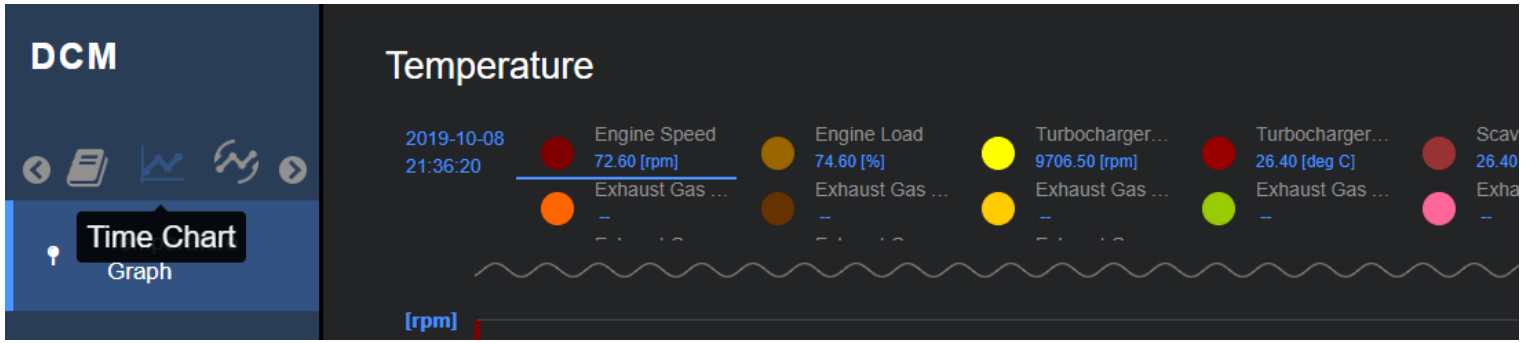
DCM - User interface

General view



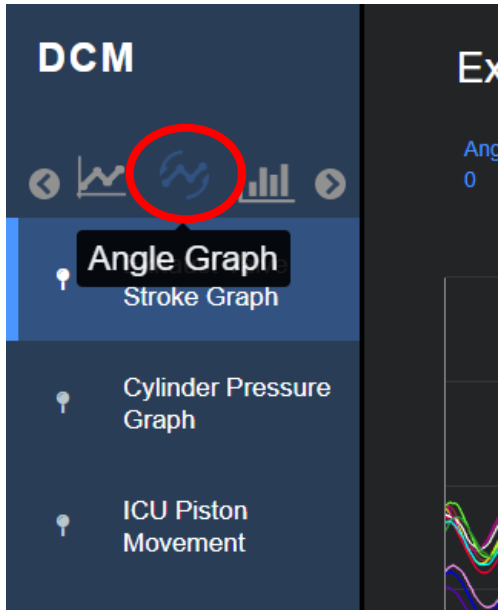
Time-based graphs

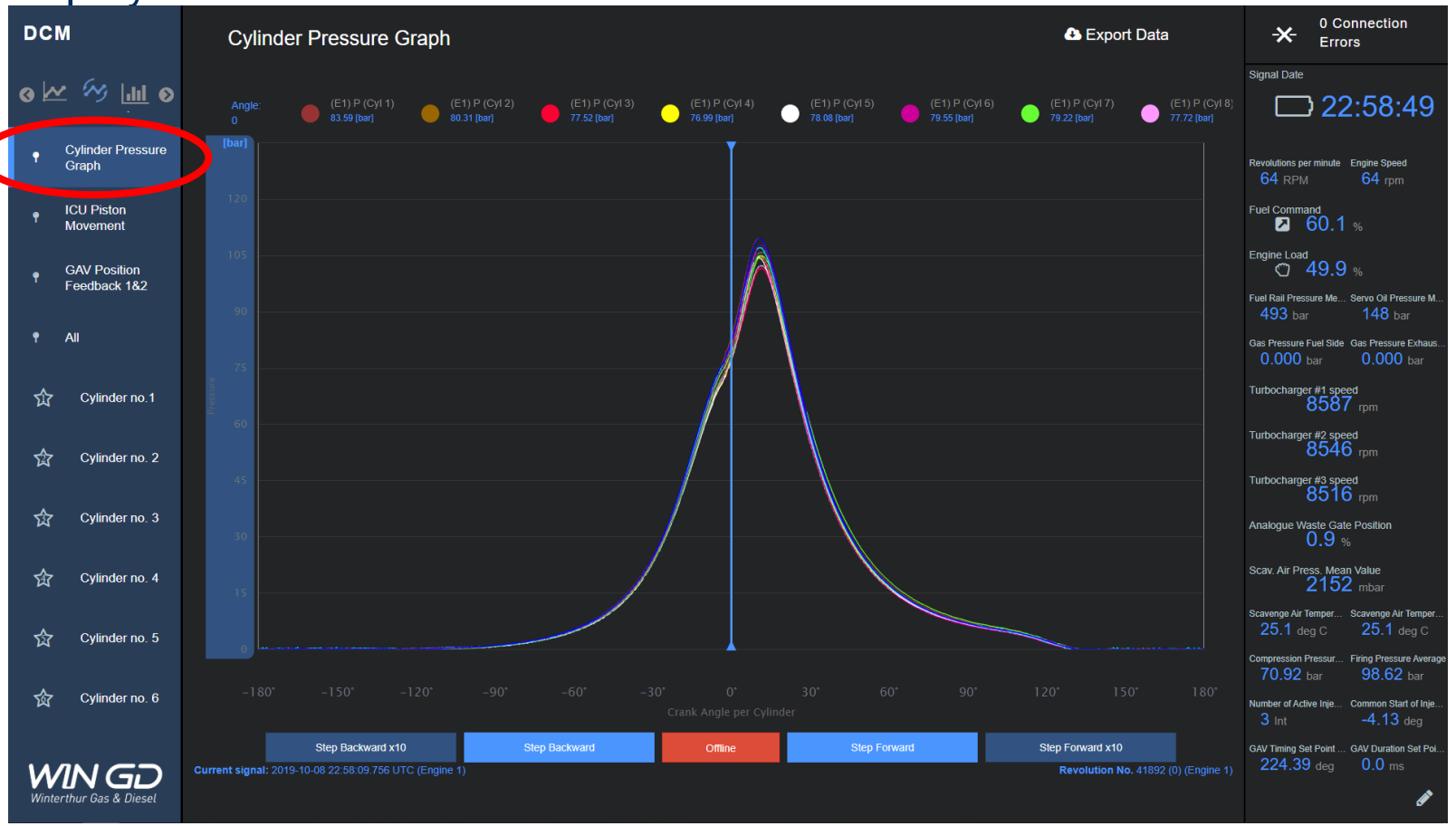
- To open the group of time-based trends the operator must choose from Main Menu “Time Chart” icon. By default DCM is opening in Time Chart mode
- To open requested trend operator must click on the title on the left side and requested graph will be displayed.



Angle-based graphs

- To open the group of time-based trends the operator must choose from Main Menu “Angle Graph” icon. To open requested trend operator must click on the title on the left side and requested graph will be displayed.





Angle-based graphs

- For CA based trends it is possible to zoom the graph area and keep the trend running online.
- The ruler is always showing value at 0° of the stroke.

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DCM Software

- DCM Software allows user to monitor real time data from the engine and display it on the time based trends, additionally fast signals collected from the engine will be displayed crank angle based domain.

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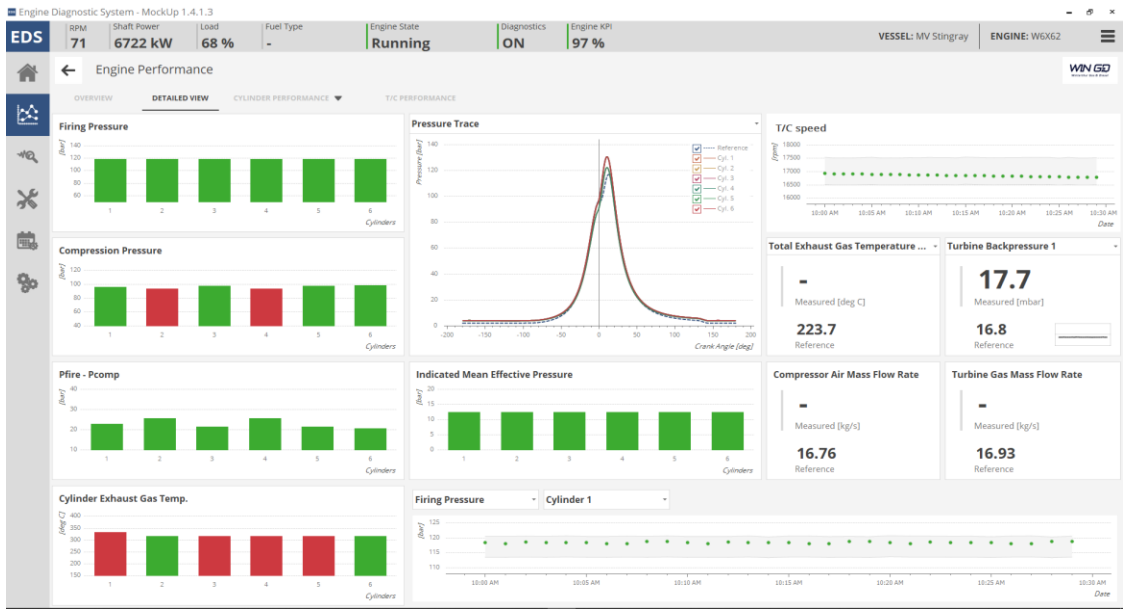
EDS and DCM Software

- Both systems are running on the DCM PC. DCM software is prepared and commissioned after sea trial. EDS software require preparation of engine digital twin with data collected during shop test and sea trials.



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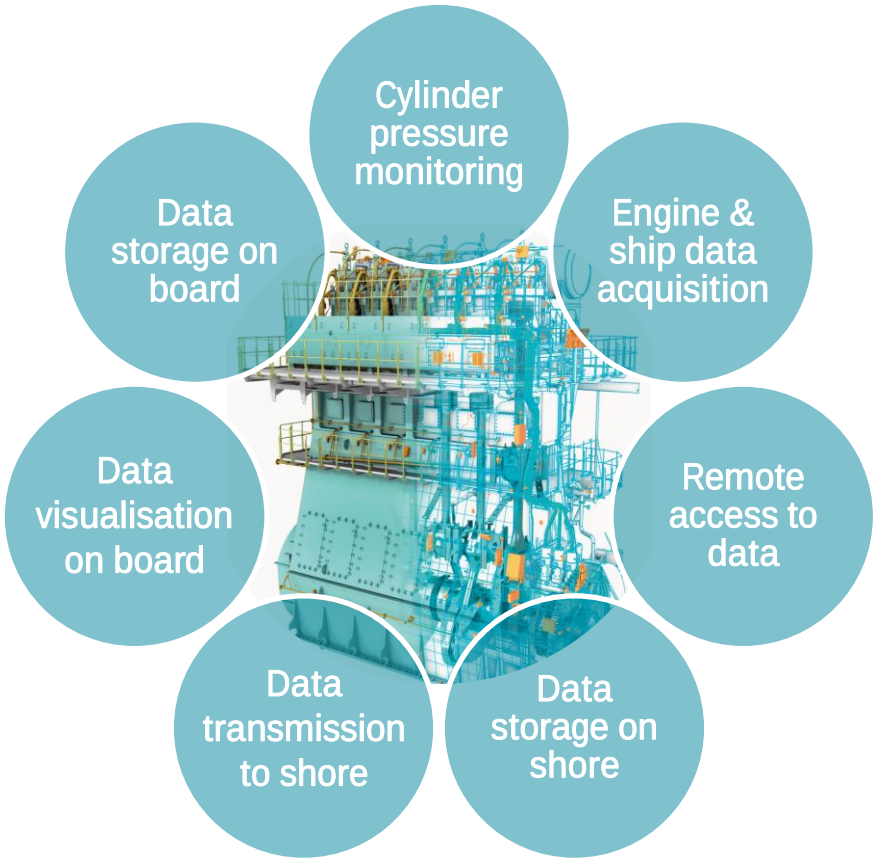
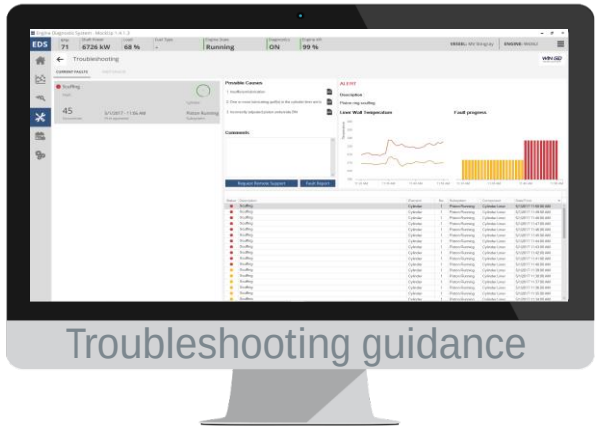
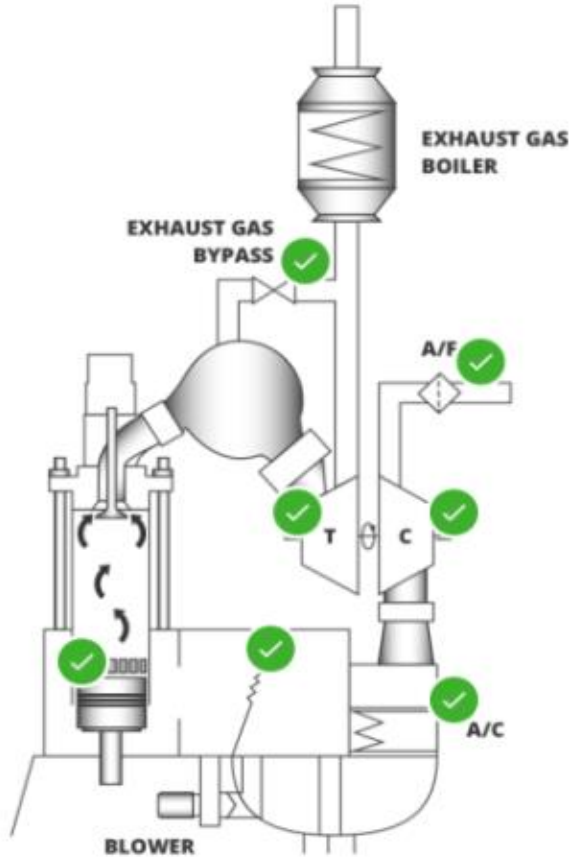
EDS mechanism

Data Collection → **Advance Analytics & Actions** → **Outcomes**







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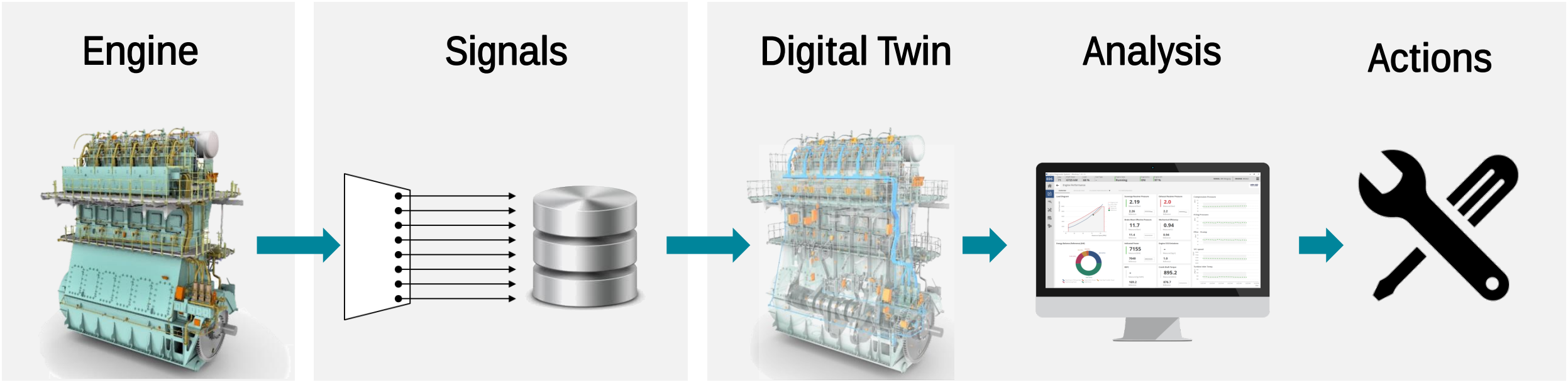
An Advanced real time diagnostic system at the core of WiDE



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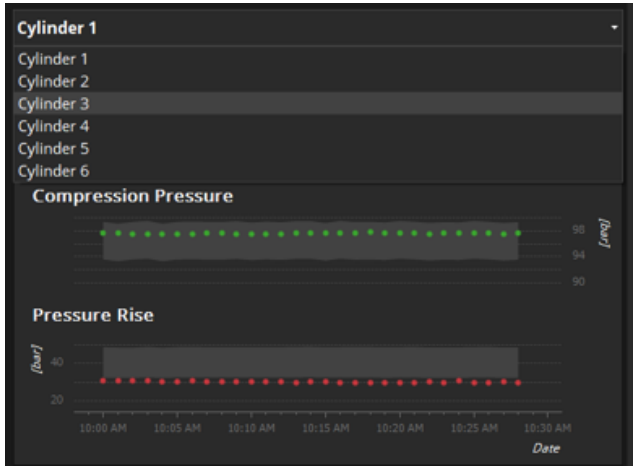
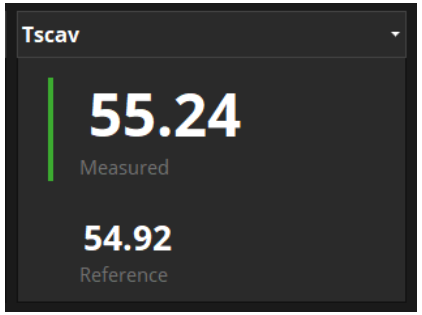
EDS software

The on-board EDS is, at a high level, designed so that:

- The engine will be running in the most efficient way possible.
- Downtime will be avoided/minimized through early detection or prediction of component failure.
- Customers will be supported for troubleshooting.
- In order to address the above high-level specifications, the system encompasses the following pillars:
- Data Acquisition (through DCM system)
- Data Processing and Analysis (within EDS)
- Troubleshooting recommendations
- Maintenance and Spare parts support (in development)





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EDS Dashboard

The EDS dashboard allows the user to:

- view all key issues and core parameters analyzed within EDS
- have a quick check of the status of the engine operation
- track the health of the various subsystems (servo oil, fuel injection etc.)
- track the health of its core elements/parts (cylinders, turbochargers, etc.)
- track the evolution of some key engine parameters

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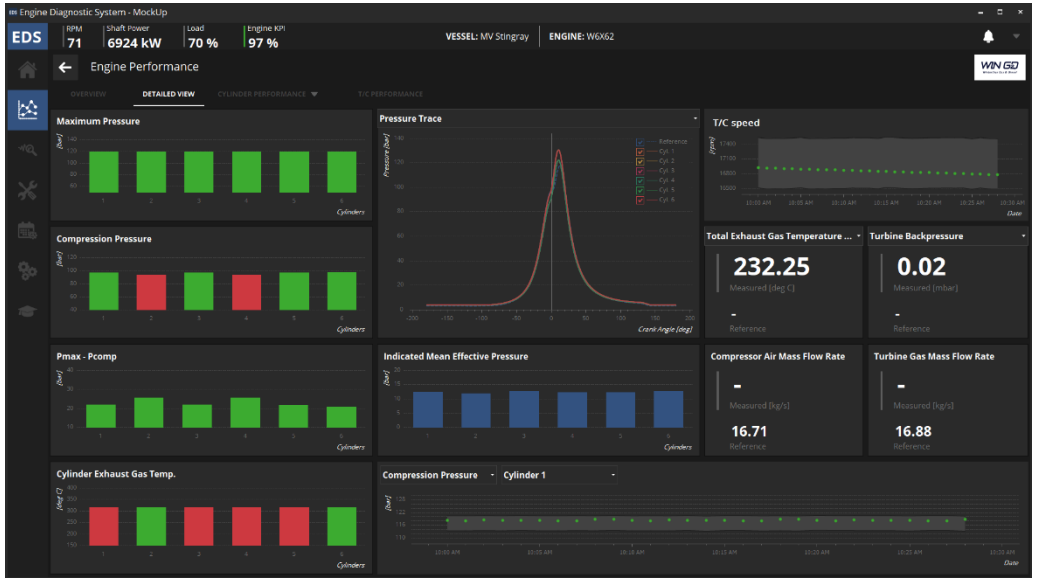
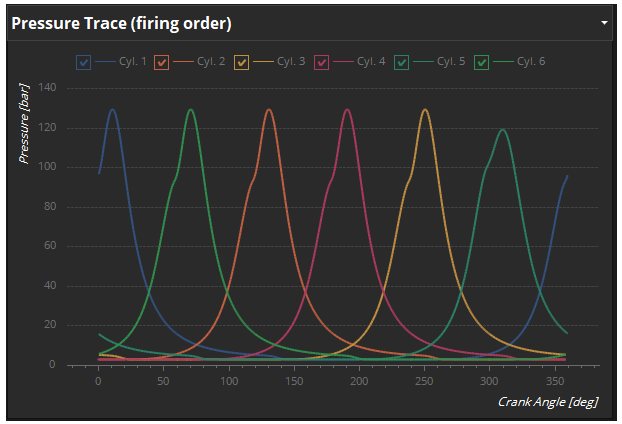
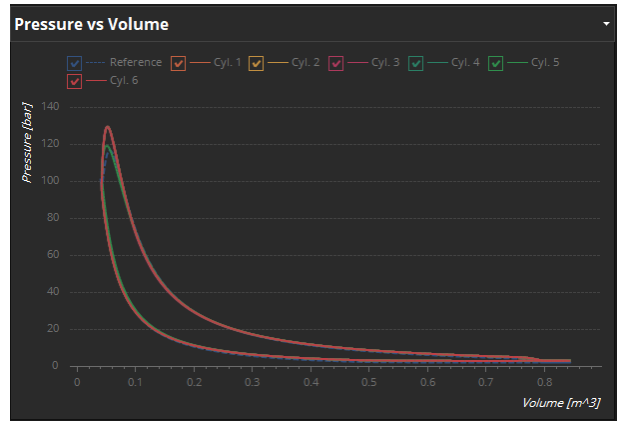
EDS Performance

- One parameter is shown in bar chart for all performance elements (compression, firing, pressure rise, Indicated Mean Effective Pressure, exhaust gas temperature for cylinders, pressure trace for cylinders as well as speed, turbine inlet temperature and mass flow rates for turbochargers). Pressure trace has two additional views: firing order view with the consecutive pressure traces for all cylinders during one crankshaft revolution and pressure vs. volume (the so-called “closed” pressure trace) allowing to visually estimate indicated power differences.







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EDS Troubleshooting

The Troubleshooting module gathers all faults with the accompanied detailed information and provides a list of possible causes as well as recommended actions assisting the user to handle the issue. The recommended actions are provided through direct reference to the specific section of the operation or the maintenance manual of the engine.

The EDS Troubleshooting Module collects all EDS-diagnosed faults, together with accompanied detailed information, and provides a list of possible causes as well as recommended actions assisting the user to handle the issue. The recommended actions are provided through direct reference to the specific section of the engine user manual. EDS Troubleshooting module is designed in order to achieve the following:

- Organize and display the content in a self-explanatory way.
- Make clear which are the current issues (active) that need the user’s attention.
- Consolidate multiple instances (events) of the same fault identified on a specific subsystem
- Create an archive of faults that have been reported in the past

The module has two parts (Current Faults and Past Faults) represented by equivalent pages:

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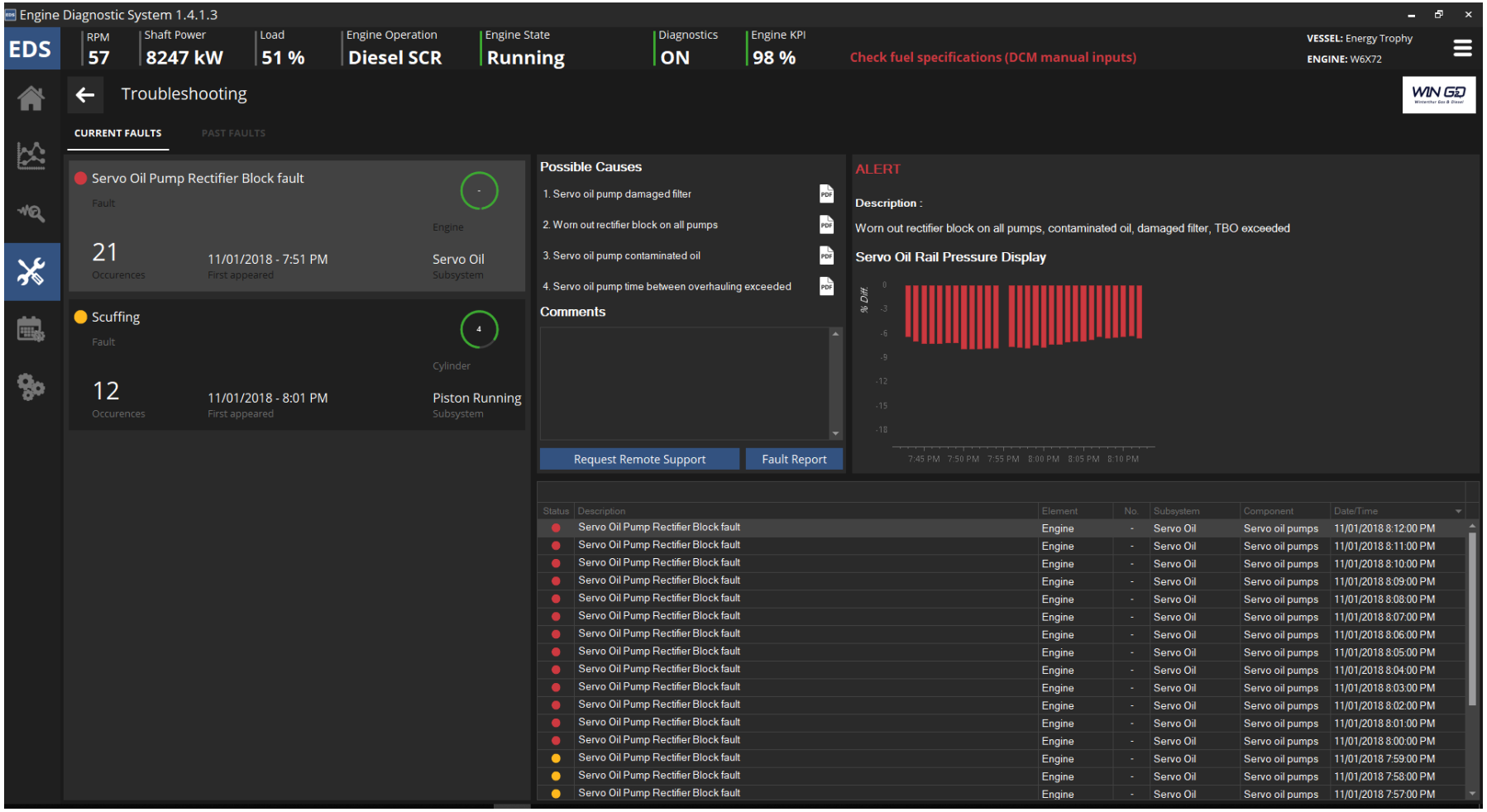
EDS Troubleshooting



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DCM

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