Subsea Controls Down Under 2016

Subsea and topsides controls integration: the new MDIS integration standard

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1. Overview
2. OPC-UA
3. Subsea Architecture and Functionality
4. MDIS
5. Summary

Overview

What is MDIS

- MCS DCS Interface Standardization
  - MCS = subsea Master Control Station
  - DCS = topsides Distributed Control System
- OPC-UA based protocol
- Vendor and platform independent
- Object (device) based

The Need For MDIS

- Currently no standardized approach to DCS/Subsea communications
- This means that there is risk associated with complexity, data mapping, communications compatibility, and misunderstanding in requirements between Subsea vendor, DCS vendor and client
- Communication is a significant aspect of a DCS/Subsea integration project

OPC-UA

OPC-UA

- Developed out of Microsoft OPC (classic):
  - Three different types: OPC-DA, OPC-AE, OPC-HDA
  - Platform dependent (Microsoft Windows)
  - Could not be used in control devices (because they do not use Windows)
  - Based on outdated Windows NT technology (OLE)

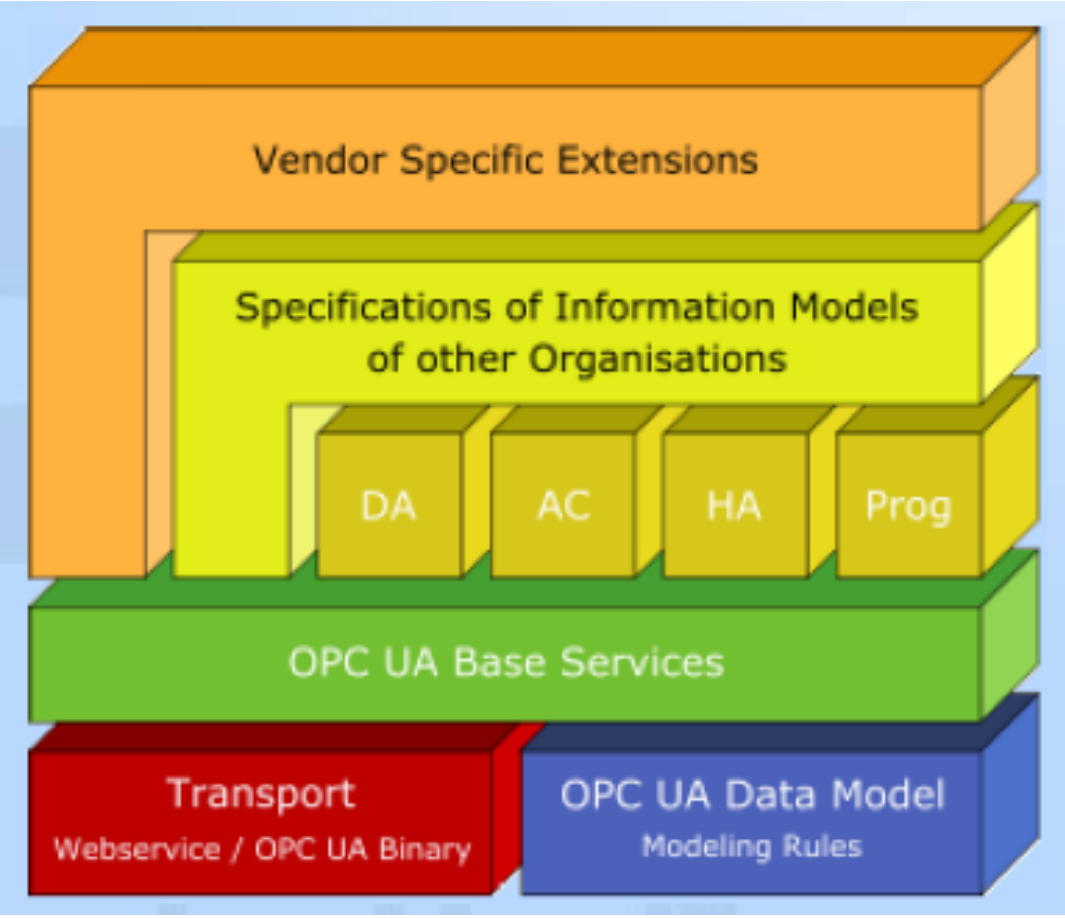
OPC-UA

- OPC-UA uses the good features of OPC:
  - Vendor independent – no knowledge of the subsystem required
  - Access to real time data, historical data and event messages but combined into a unified architecture
  - Object grouping
    - eg: SUBSEA.MANIFOLD01.WELL01.CV001

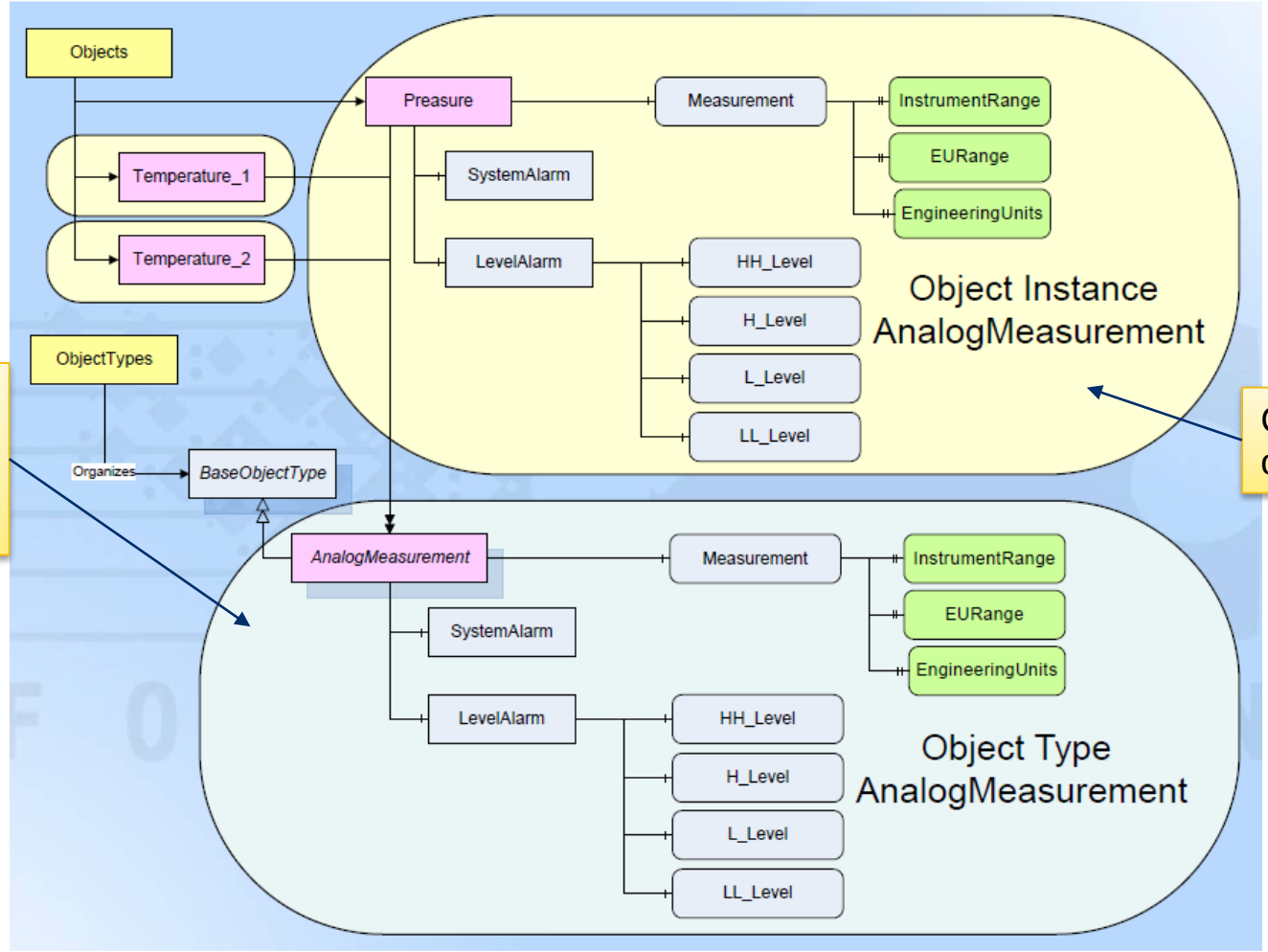
OPC-UA

- OPC-UA has added advantages:
  - Platform independent – does not require Windows and so can run on embedded devices
  - Object oriented – can create objects representing a device (such as a valve) and all data is encapsulated in the object (XML definitions). This is the basis for MDIS.
  - Secure – OPC-UA has been developed from the ground up for secure communications

OPC-UA Specification



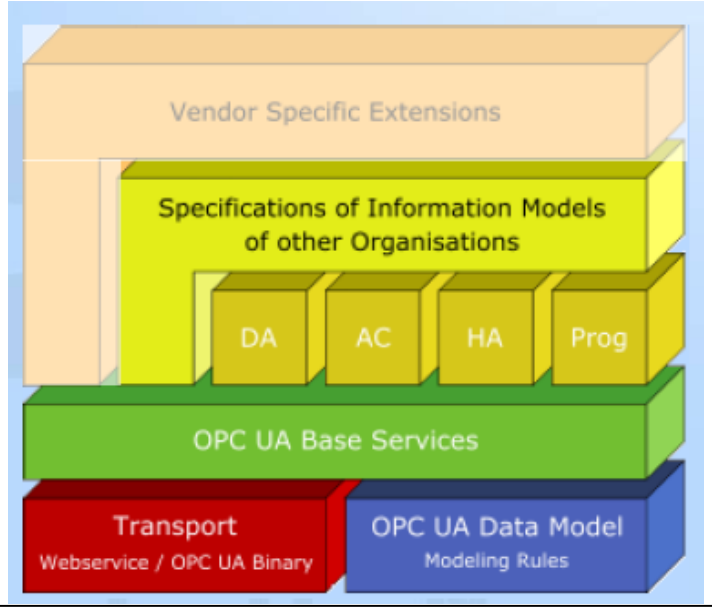
OPC-UA Data Model - Example



OPC-UA – External Information Models

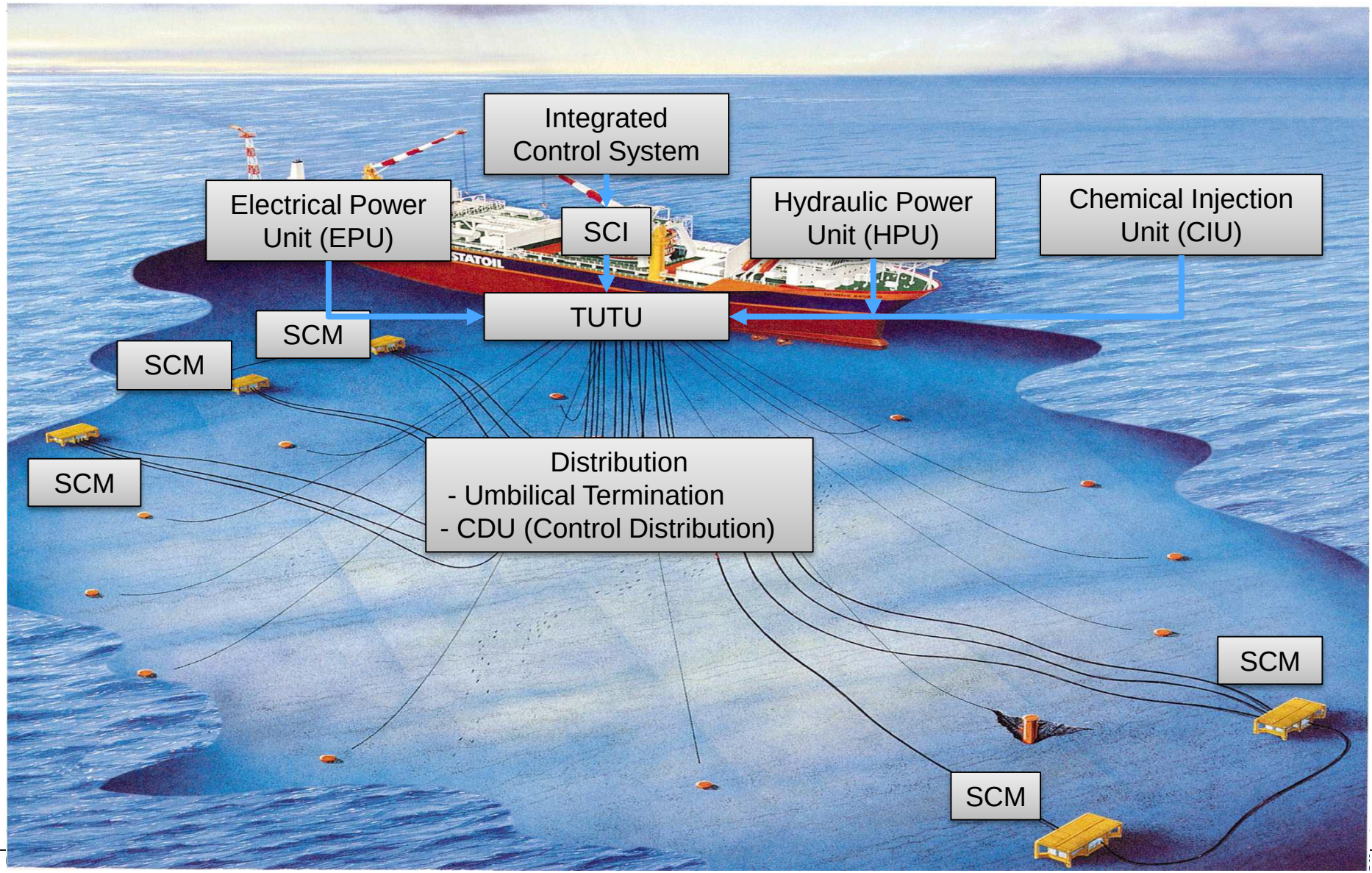
- Already available
  - IEC 61131-3 (PLCopen)
  - ISA-95 (Enterprise Information)
  - Many more……
- More planned
  - ISA-95 (Phase 2)
  - PRODML/WITSML
  - ……..

Very exciting – allows integration of controls and communications



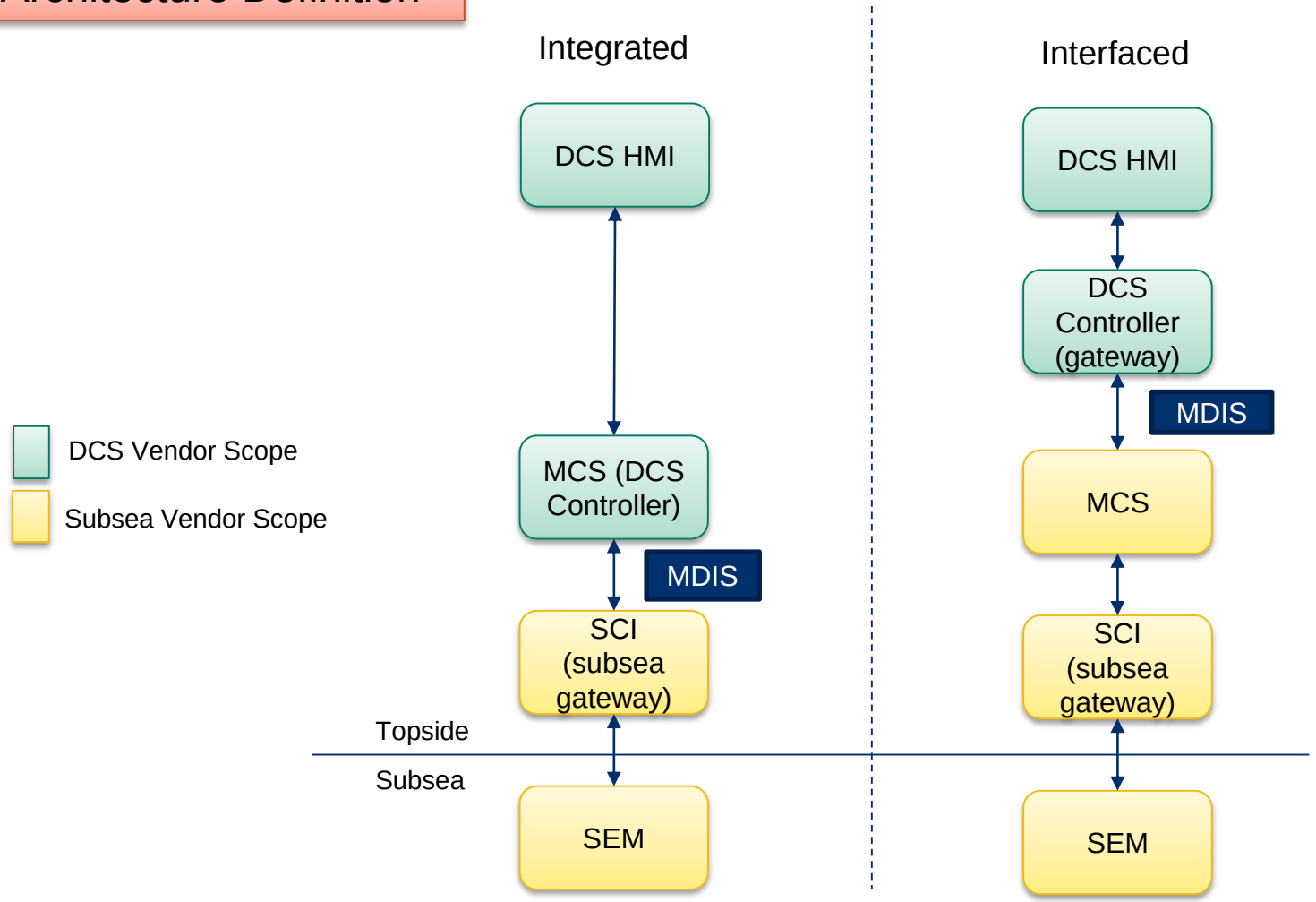
Subsea Architecture

Subsea Architecture

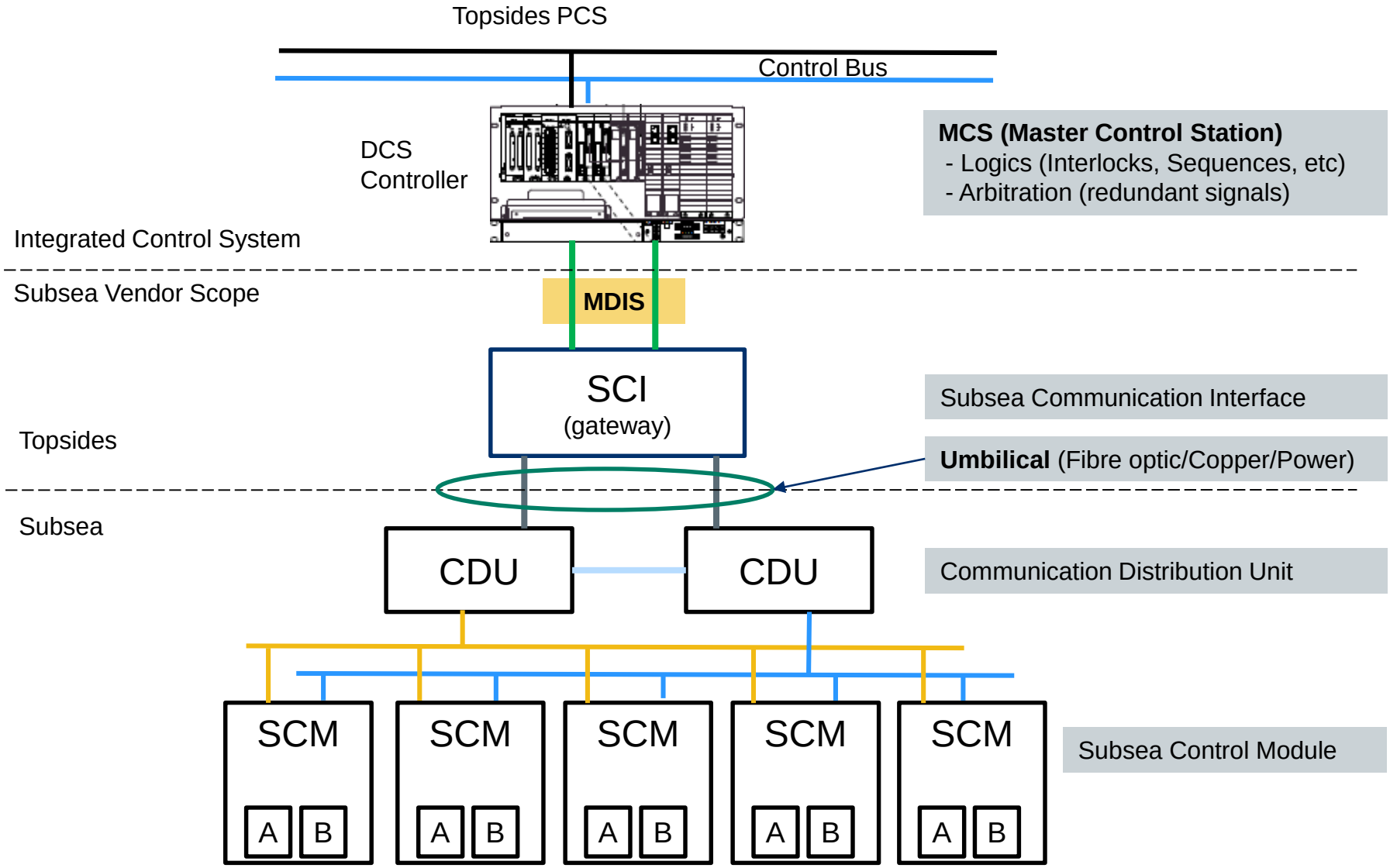


Subsea Controls Architecture

MDIS Architecture Definition



Architecture – Integrated System



Subsea Functionality

- The MDIS Standard defines the following minimum functionality:
  - Arbitration
  - Interlocks
  - Sequences
  - Valve Status Validation
  - Choke Position Validation
  - Interfacing with the HPU and CIS
  - Validation of Valve Profiles/Signatures

Subsea Control Detail

- These are encapsulated in software modules designed for common devices in the SCMs
  - Arbitration
  - Valve Controls
  - Indicators
  - Start-up and Shutdown Sequences
  - MEG Sequence
- Modules expose data in MDIS format

MDIS

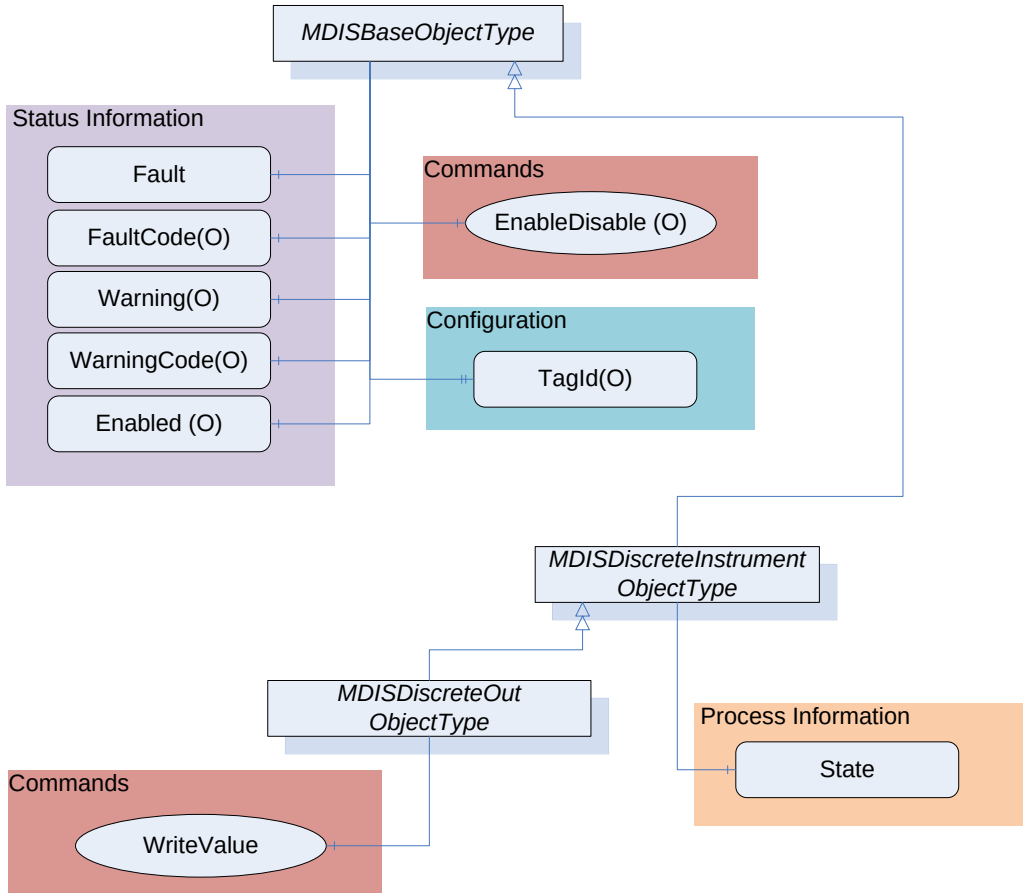
MDIS

- MDIS = MCS DCS Interface Standardization
  - An implementation of OPC-UA
  - Specifies a set of OPC-UA objects that are common to all subsea communications

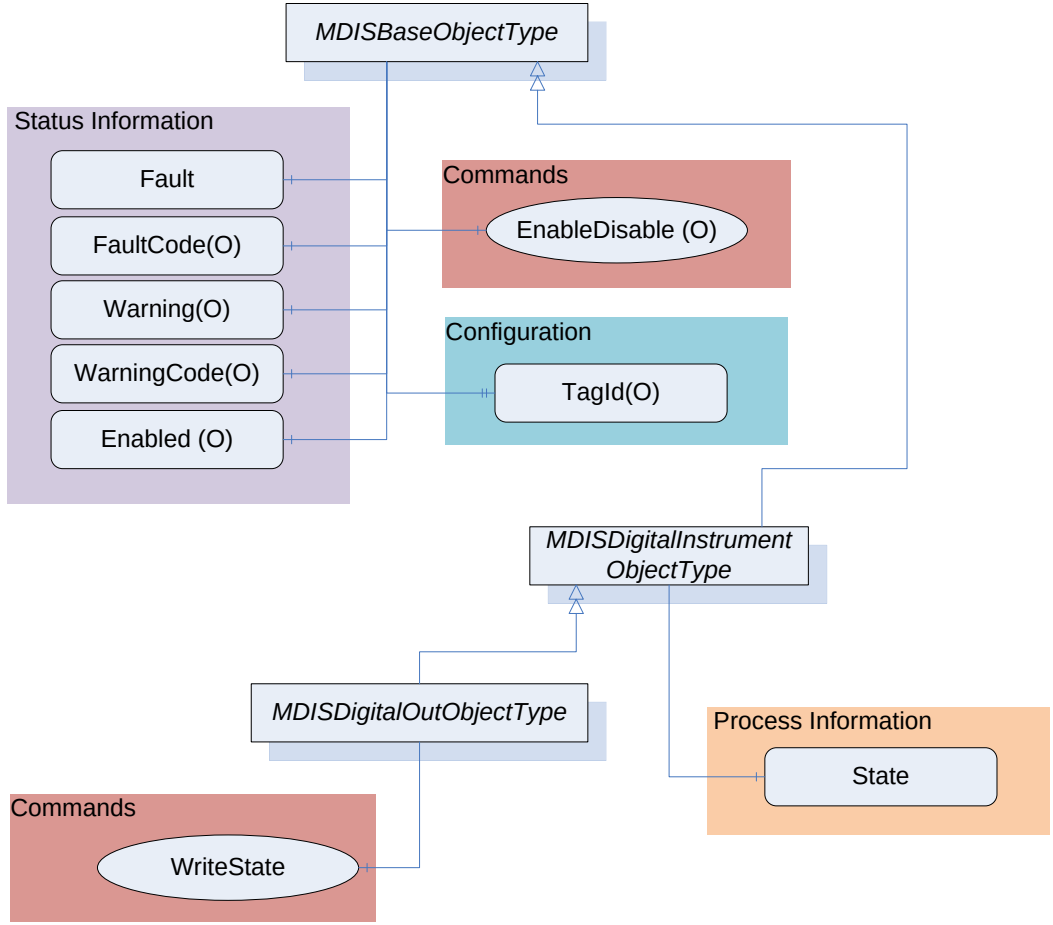
MDIS Object Types

MDIS Object	Description
Discrete Instrument	Multi-state type data (such as valve position – open/moving/closed)
Digital Instrument	On/Off functions
Instrument	For analogue data (eg, pressure, flow)
Choke	Choke Valves
Valve	All other valves

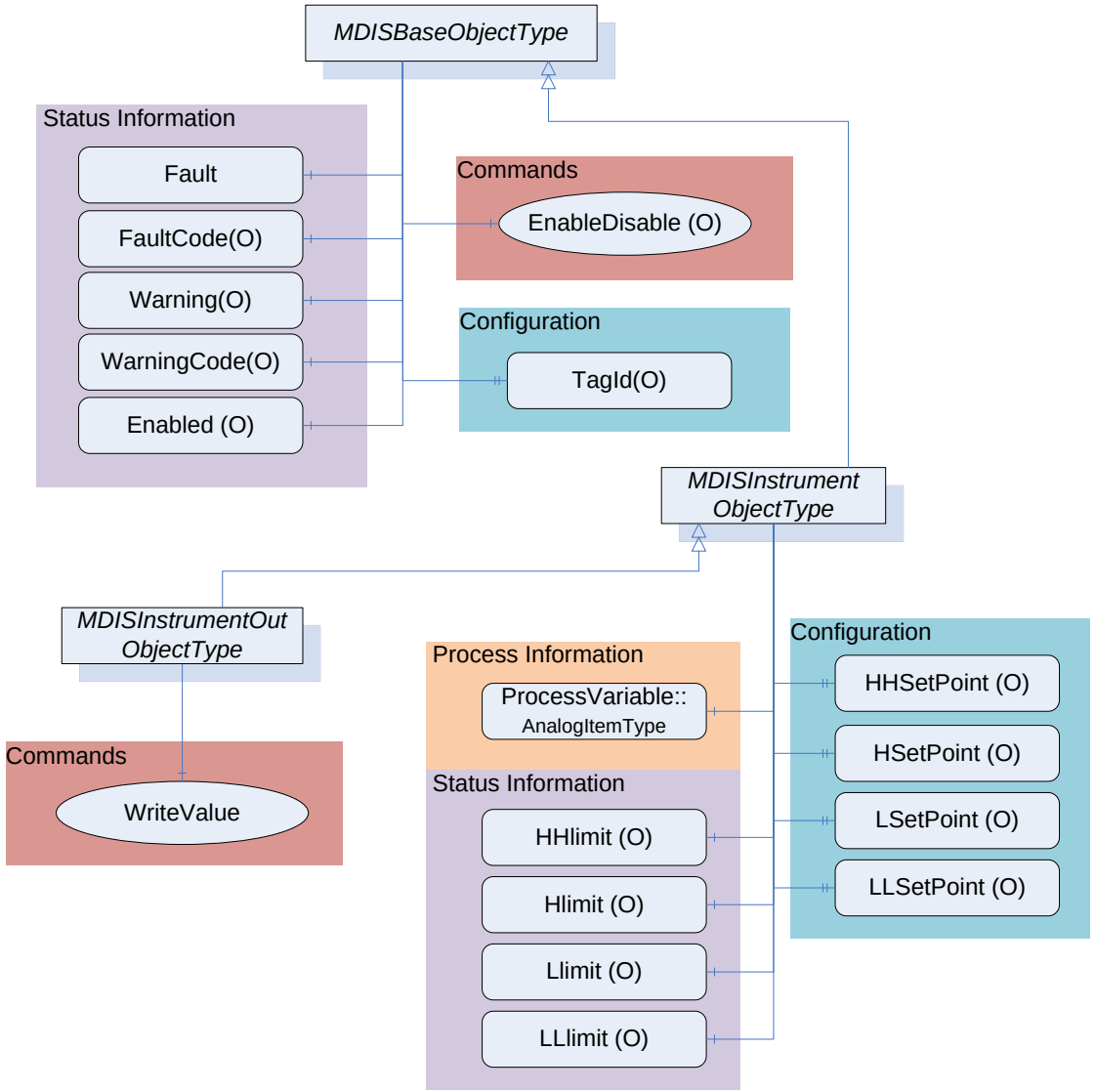
Discrete Instrument (Multistate Device)



Digital Instrument (On/Off Device)

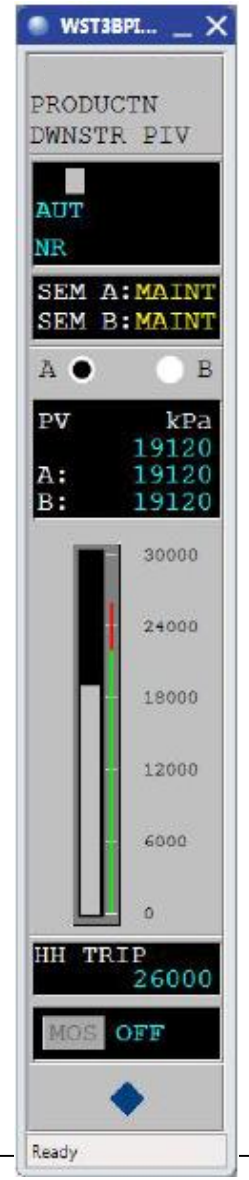


- Instrument


MDISBaseObjectType
Status Information
Fault
FaultCode(O)
Warning(O)
WarningCode(O)
Enabled (O)
Commands
EnableDisable (O)
Configuration
TagId(O)
MDISInstrument ObjectType
MDISInstrumentOut ObjectType
Commands
WriteValue
Process Information
ProcessVariable:: AnalogItemType
Status Information
HHlimit (O)
Hlimit (O)
Llimit (O)
LLlimit (O)
Configuration
HHSetPoint (O)
HSetPoint (O)
LSetPoint (O)
LLSetPoint (O)

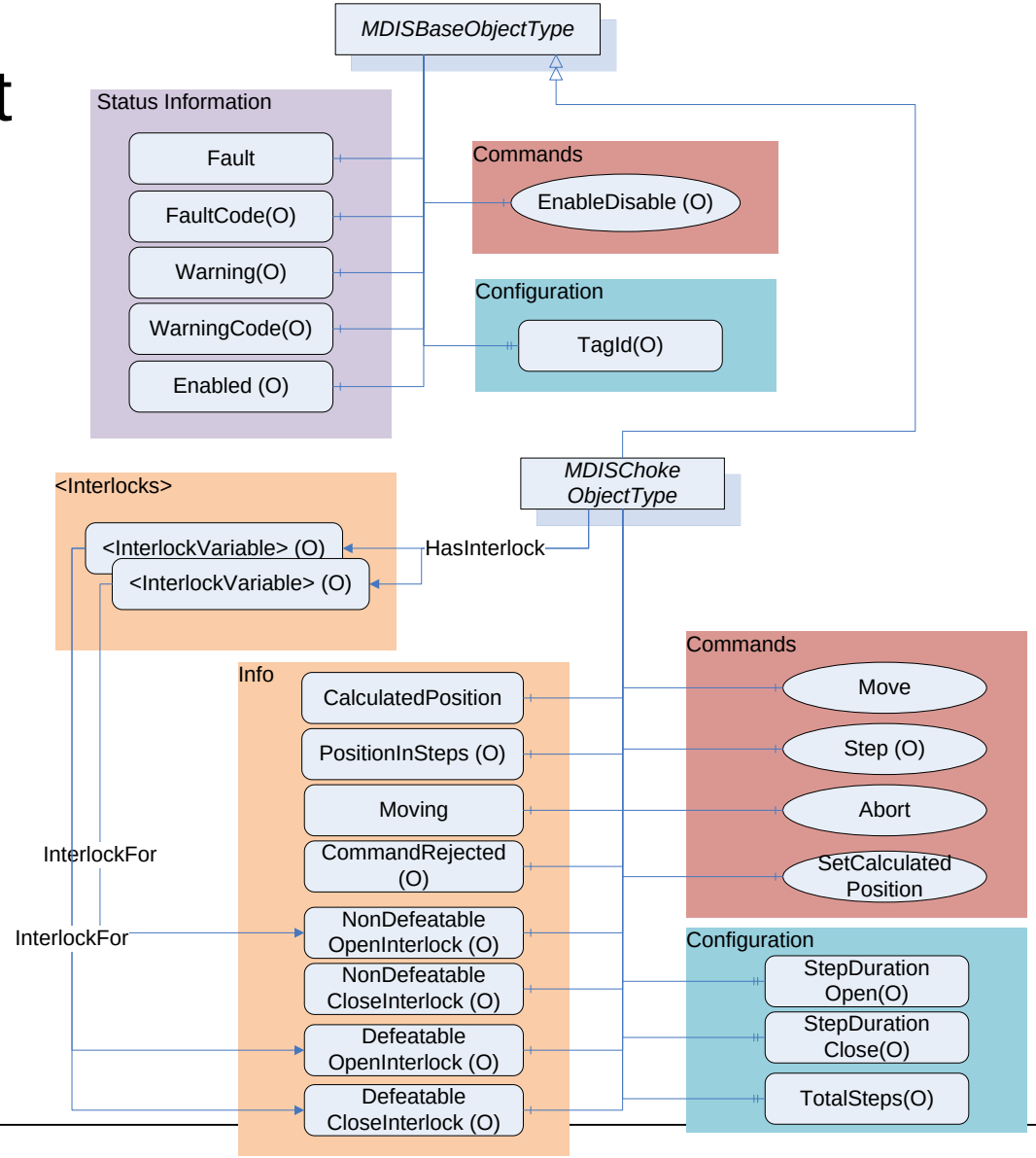
MDIS Analogue Instrument Example

- Analogue Indicators
  - Design based on MDIS Instrument Object
  - Arbitration built in to the functional design
  - Alarms and engineering range part of the MDIS Instrument object definition



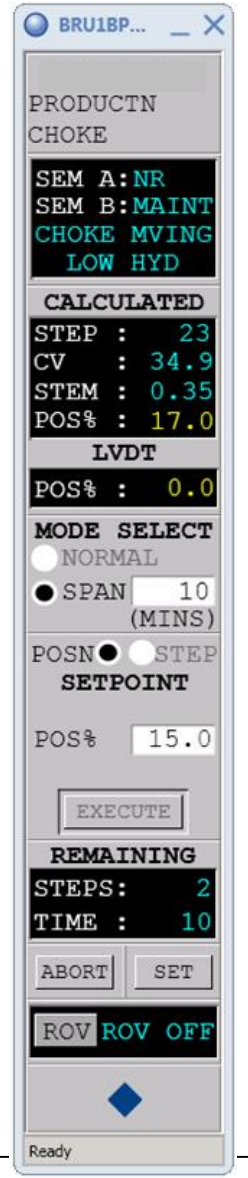
MDIS Choke Valve

- Choke Valve Object



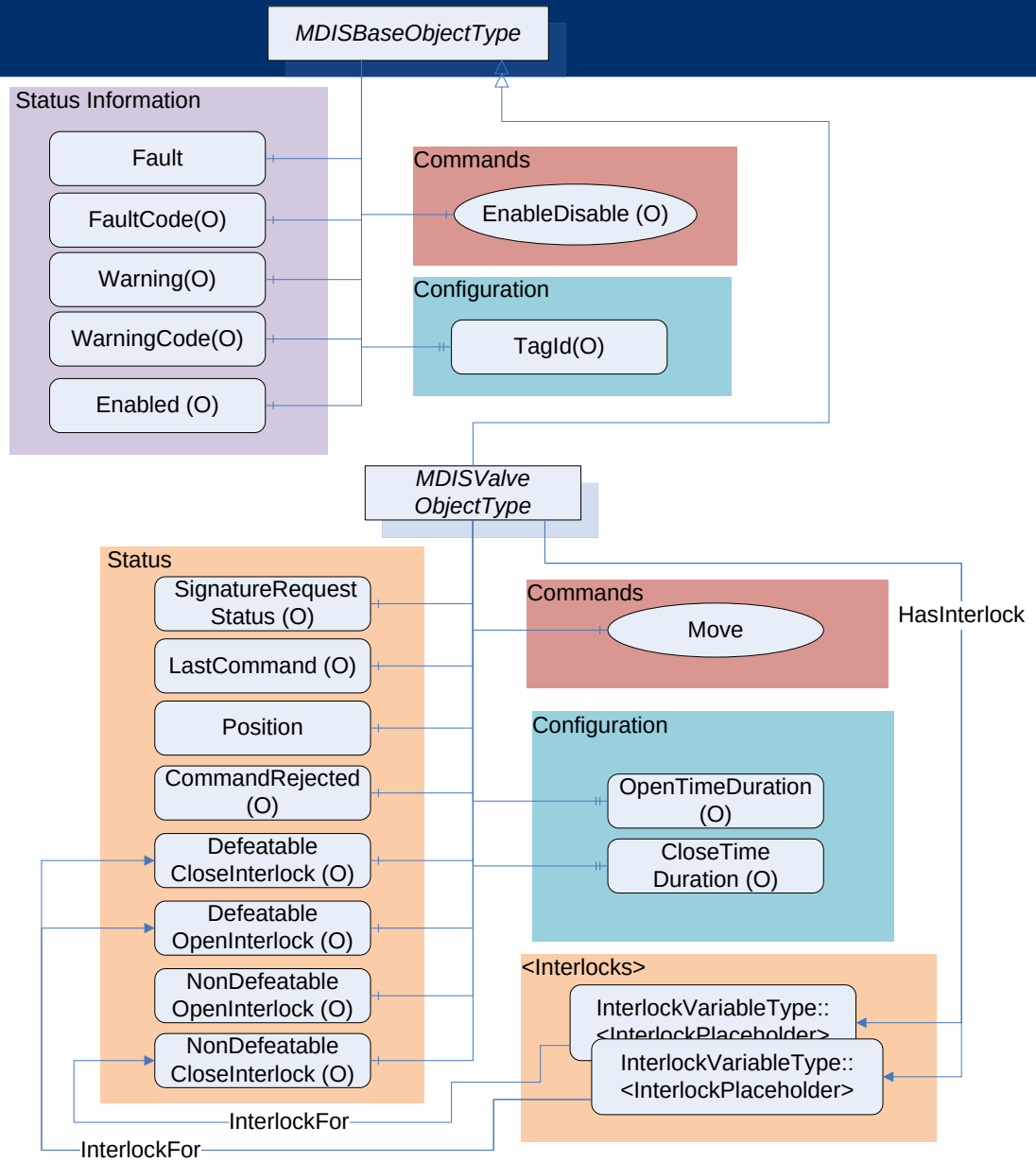
MDIS Choke Valve Example

- Production Choke Valves
  - Can be a complex device depending on operator requirements
  - Hydraulically stepped to open and close
  - Different modes of operation
    - Step open/close
    - move to a percentage
    - Calculated within the MCS
  - Product interlocks (Hydraulic and Electric)
  - Data and command structure in MDIS format



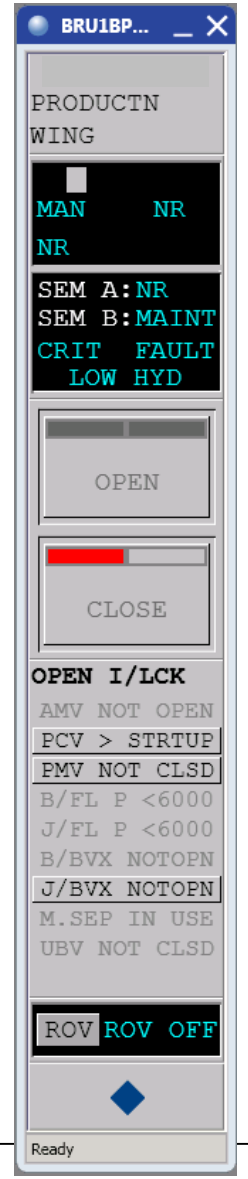
MDIS Valve Object

- Valve Object



MDIS Valve Object Example

- Single Actuated Valves
  - Design based on MDIS valve object
  - Arbitration built in to the functional design
  - Product interlocks and process interlocks as defined in the MDIS specification
  - Customised faceplate includes diagnostic information and detailed feedback information via pop-ups



MDIS Creating a Chemical Injection Valve

Creating new objects (Aggregation)

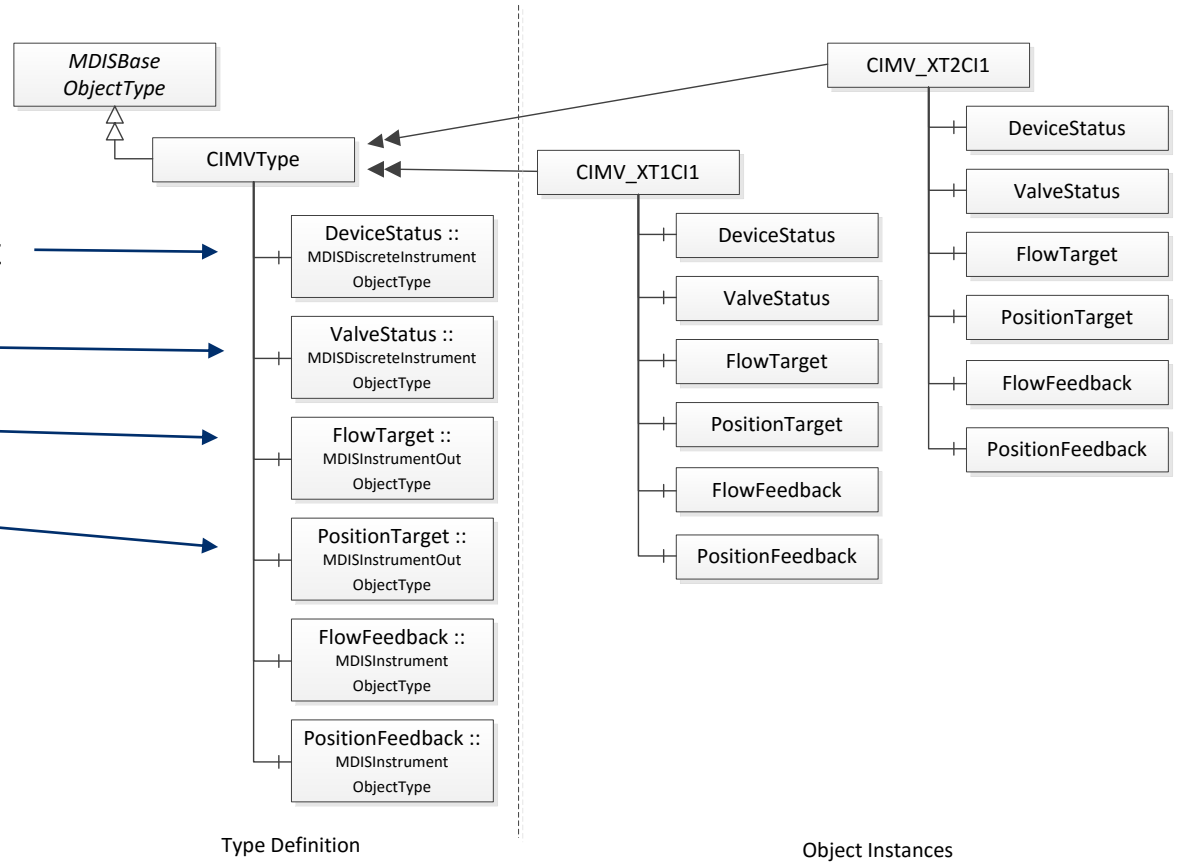
Example for creating an aggregated model of a simple CIMV object. A generic model of a CIMV has the following items:

Valve Device State – Discrete Instrument

Valve Status – Discrete Instrument

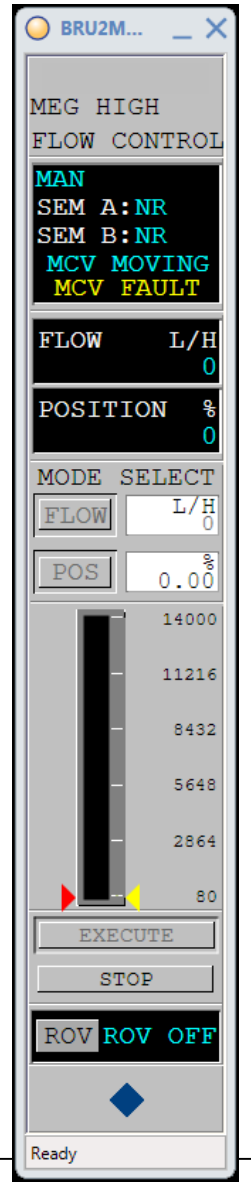
Valve Flow Target - Instrument

Valve Position Target - Instrument



MDIS Aggregated Object – CIV Example

- Chemical/MEG Control Valves
  - Complex device with many diagnostic values
  - Different modes of operation
  - Usually electrically controlled (no hydraulic restrictions)
  - Data and command structure in MDIS format



MDIS – Controls Integration

- MDIS enables the integration of communications and controls
  - Linked to IEC61131-3 (PLCOpen – XML based)
  - Function Blocks in IEC61131-3 can mirror MDIS blocks
  - Control functionality and communications are therefore defined at the same time

Summary

Summary

- MDIS provides a standardized approach to DCS/Subsea communications
  - Reduces engineering effort
  - Reduces risk
  - Provides DCS and Subsea system independence
  - Integrates with control standards (IEC 61131-3)

References

- MDIS Network: http://www.mdis-network.com/
- OPC UA: https://opcfoundation.org/about/opc-technologies/opc-ua/

Any questions?