OPC UA Information modeling
For the Off Shore Platform Oil and Gas Industry

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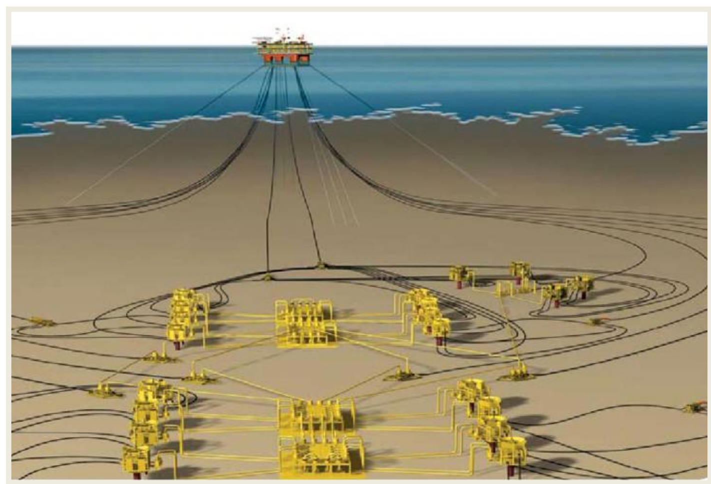
Introduction

In the oil and gas industry there is a push to try to minimize the cost associated with the engineering and validation of the control system. This is especially true for off shore platforms, where there are multiple companies that provide various aspects of these systems. These vendors specialize in topsides platform controls or subsea controls, but all of these systems must work together seamlessly. Since these controls are deployed in locations that at times are very hard to reach, making any changes after deployment can be very expensive. The engineering cost for these systems is often in excess of millions of dollars with project development beyond a year.



In general, component level development of these systems, whether it is topside control system or subsea control, is somewhat straightforward. The challenge is to effectively interface these different systems, and the interface level is where problems are most likely to occur. Many of the initial interface assumptions can prove to be incorrect only during factory acceptance or integration testing. A great deal of time and effort is then needed to rectify these issues; unfortunately, late in the project development with both time and cost impacts.

Many operating companies would like to see a standard communication interface between the subsea gateway, the MCS (Master Control Station) and the DCS (Distributed Control System). This standard interface would include the definition of a protocol for handling the communication. This protocol would need to be able to support functionality such as redundancy, robust communication and in this day and age security. Another key feature that is required and from which much of the cost savings would result is the development of a standardized information model.

Some operating companies have internally developed standardized models, which contribute to long term cost savings as well as reduced project development time. These initial models have provided valuable savings to the operating companies. The subsequent step to these initial standardized models was a standardized interface; which led to a joint industry organization to develop an industrial interface standard.

MDIS

The MCS-DCS Interface Standardization (MDIS) network was formed with involvement from key industry subsea equipment vendors, topsides DCS vendors and oil and gas operating companies. The list of current members is: ABB, Aker Solutions, BP, Chevron, ConocoPhillips, Dril-Quip, Emerson, ENGlobal, ExxonMobil, FMC, GE Oil and Gas, Honeywell, Invensys, Wood Group Kenny, Kongsberg, OneSubsea, Petrobras, Prediktor, Proserv, Rockwell Automation, Shell, Siemens, Statoil, Total, W-Industries, Woodside, Yokogawa. Using the network group as a collaborative resource to the industry, MDIS is able to facilitate information exchange in furthering development of the standard MCS-DCS interface The MDIS organization has selected following an evaluation of relevant industry protocols, the OPC UA protocol to provide this MCS to DCS communication link. In order to further realize savings from this standard protocol, it was also necessary to define standard objects models for commonly used equipment (e.g. valve, choke etc), which would be exchanged through the interface.

However, complicating the standardized information model development is the varying architectures of the MCS and DCS systems. Two major architectures, "Integrated" or "Interfaced", are typically used throughout the industry and the choice varies based on the players that are involved (see Figure 1).

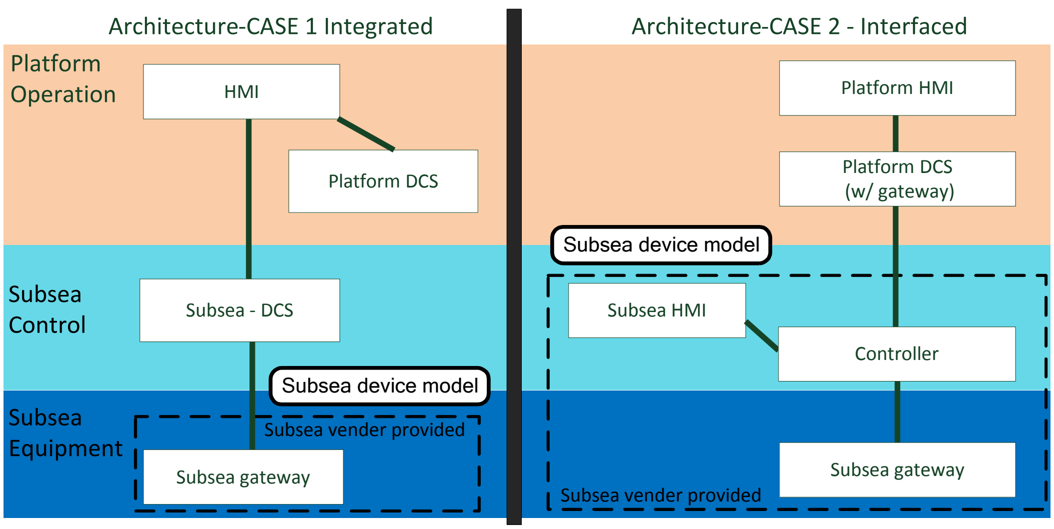


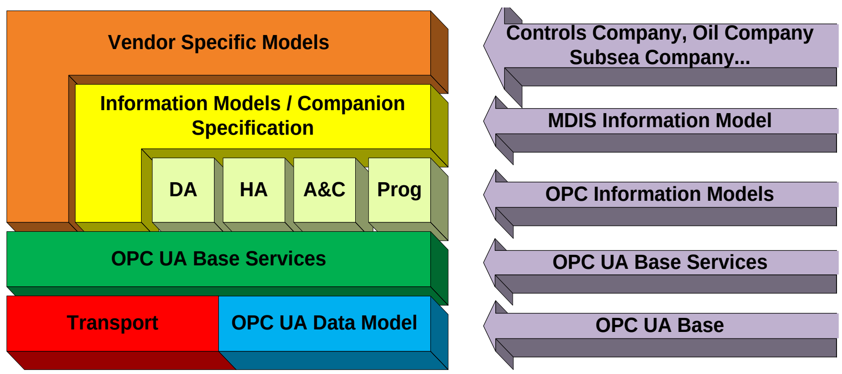
Figure 1 - Integrate vs Interface

Since the control aspects of the subsea system can be accomplished by both the DCS system or by the subsea system, the actual interface between the two systems may be different. In the Integrated architecture (Case 1), the controls system is an integrated system where all control is performed by the DCS vendor's hardware and the standard needs to support communication of all information between the subsea gateway and the DCS control system. This enables a single HMI (or set of HMIs) to control and monitor platform and subsea operations. In the Interfaced architecture (Case 2), the subsea vendor provides the controls for the subsea aspects of the system and the DCS system is used for monitoring and set point control purposes of the subsea system, along with topside controls. The MDIS information model has to be able to adapt to both of these architectures.

The MDIS companion standard includes developing information models to represent the common pieces of subsea equipment, such as valves, choke valves, instruments and discrete IO to name a few. This overall information model has to represent the information model required by each of the subsea vendors (Servers) and the information that they represent has to include all information required by the DCS systems (Clients). Furthermore the information model has to be able to support both of the architectures and account for any customized versions of the hardware components provided by the subsea vendors. These customized hardware components may have additional information that other comparable devices might not provide.

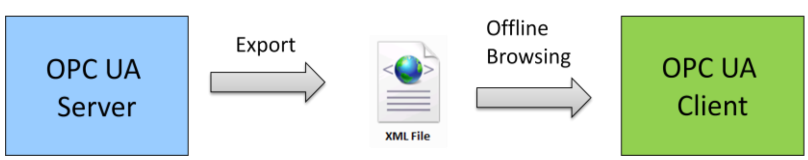
OPC UA

OPC UA's information modeling capabilities provide an excellent fit for these requirements. OPC UA supports the definition of complex or simple objects and variable types. It allows for these types to include optional components. These optional components need not be included in every instance of the given device. For example some valves may provide configuration information related to the time it takes to open or close, but in some cases a DCS may not be interested in this information from the subsea system. Valves also typically have a variety of interlocks associated with them. OPC UA provides the ability to have a custom list of interlocks associated with each instance of the valve. The client can easily obtain this list and provide standard functionality for these items.

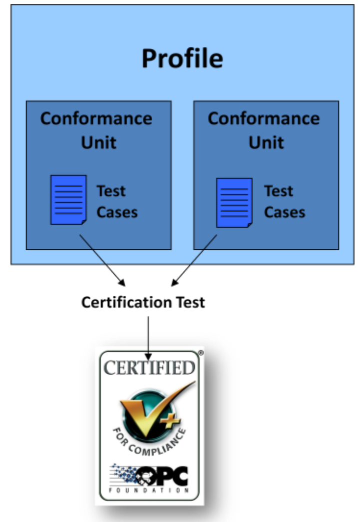


OPC UA support s subtyping of objects and variables. These subtypes can allow vendors to easily extend the information model to represent the custom information that they may provide in addition to the base information model. The subtypes allow clients to access the base type without having to understand the extension provided by the subtype. Clients may also be able to expose the additional information, since the meta-data associated with the types is also published. Clients can obtain the meta-data associated with the information model and determine what functionality the server is exposing, what customized versions of the various device models may exist.

The configuration information can be extracted directly from a server at run time, by simply browsing the address space. In many MDIS systems this may not be acceptable since the configuration would need to be verified and confirmed long before it is ever deployed to an off-shore site. To solve this OPC UA provides the capability to



export the configuration in a standard XML format. This configuration file can be used by the client to validate their configuration and to automate DCS configuration and testing.



OPC UA includes Profiles, which are different than a subsea profile. In the subsea environment a profile is associated with a Valve and is a collection of data that describe the latest move of a value. From this data it is possible to determine if the valve move encountered any issues. The data is usually compared to gold version[1] of the data. In OPC UA a Profile (OPC UA Profiles will be capitalized) is a collection of functionality. This functionality grouping is given a name and can be used by the end user to determine the functionality that is available in a product. Profiles are composed of Conformance Units and can be nested. A Conformance Unit describes a testable item. As part of the effort to define a companion specification, organizations define their own Profiles and Conformance Units. Usually they make use of existing Profiles and Conformance Units, only adding Conformance Units or Profiles specific to their information model. For a complete list of existing profile see https:/www.opcfoundation.org/profilereporting/index.htm

OPC UA provides conformance testing and tools to test both clients and servers. This compliance testing and certification allows operating companies to have some degree of certainty that a server vendor's or a client vendor's offering meets the requirements set forth in a standard. The tools allow a vendor to test their own systems, before taking the system to an OPC Certification Lab for formal testing and certification. As part of the MDIS companion standard, the list of required functionality and the list of required conformance tests are being specified. The list includes both custom test cases and functionality that is related to the MDIS information model (for both architectures) and the identification of the existing OPC UA functionality that all MDIS servers and clients must expose. For additional information related to the OPC certification labs see https://opcfoundation.org/certification/overview-benefits/

Summary

In summary, the use of a standardized protocol for interface communication allows for replication of models even within different systems; ultimately, reducing engineering costs and development for new systems. Using a standardized information model means a reduction in configuration efforts, testing and validation efforts and over all engineering. The MDIS organization is working on developing such an information model using the industry standard communication model provide by OPC UA. The MDIS Organization is also working on the required testing for MDIS certification.

[1] A gold version is a saved ideal operation of the valve. It may be set by engineering or by operation, but allows the operator to determine the current health status of the valve.

More Information

The MDIS network is run by OTM Consulting, a division of Sagentia Group who offer specialist technology consulting services to the oil and gas sectors. For more information regarding the MDIS network please refer to the MDIS website http://www.mdis-network.com/ or contact the MDIS network manager Rachael Mell mailto:Rachael.mell@otmconsulting.com

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