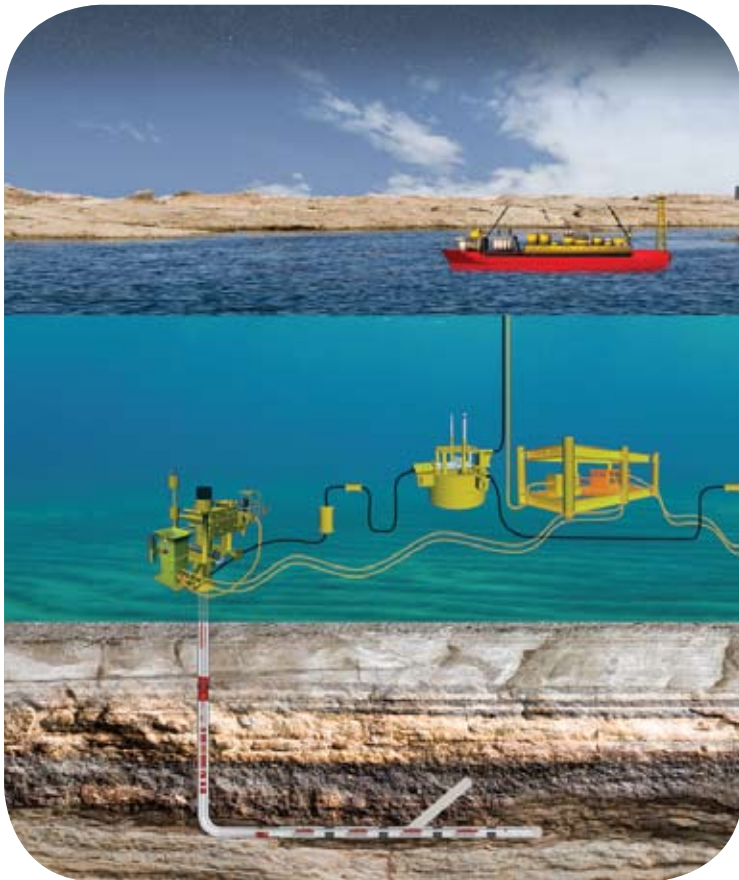




Subsea Production Control and Communication

Simplified and flexible installation and operation of subsea networks



Simplifying Subsea Production



Weatherford's system virtually brings the subsea network to the surface.

- Cost efficient
- Open wellhead control system
- Open communications
- Easily configurable
- Remote connectivity
- Fully expandable

Simplify and *subsea* are two terms that generally do not go together. Conventional wisdom would tell us that if you are going to operate and monitor subsea wells, you can expect long lead times, expensive processes and very complex communication systems.

Weatherford has once again challenged conventional wisdom. Our production system has simplified subsea operations by providing open systems for control, communications and data management. By making them open, operators are able to easily combine incompatible systems, increase options in expanding subsea fields and retrofit a large variety of designs into existing operations. Using open standards allows remote support and connectivity to any subsea installation worldwide where internet connectivity is available. This helps reduce downtime in production when support is required. Connection can be made using any standard web browser.

The system is ideal for upgrade of applications where data transmission requirements are increasing such as smart wells, video, riser or vibration monitoring, 4D seismic and multiphase measurements.

Open Control System

Weatherford's electro-hydraulic multiplex subsea control system is a modular design concept incorporating well established technology and qualified components to minimize both capital and operating expenditure costs. It is field proven with all major tree manufacturers and is adaptable to specific needs. The control system is used in subsea shallow and deep well locations around the world. The integrated system provides the requisite monitoring, control and shutdown functions by means of multiplexed electro-hydraulic control.



Open Communication System

The production system provides subsea communication via an industry proven open communications controller (OCC) which is protocol independent and supports many interface standards such as RS232, RS4xx and Ethernet. The system also complies with other open standards such as intelligent well interface standardization (IWIS), transmission control protocol/internet protocol (TCP/IP), Modbus®, Modbus TCP and production markup language (ProdML™).

Usually, communication is through the power lines and is available to all channels and devices installed in the wells or on the seabed. The OCC is protocol independent and transmits each protocol transparently. This allows third party surface applications to directly communicate with their instruments using their native format. The systems architecture will allow any port at the topside to be connected to any port subsea—even Ethernet to serial. The flexibility allows nearly any combination of connectivity between topside and subsea.

Open Database Management

The subsea production system supports open database standards including object-linking and embedding (OLE) for process control (OPC) server compliance, open database connectivity (ODBC) and communications to surface applications. The topside information and control system (TIACS) provides the interface for applications to talk directly to end devices.

The open database structure allows the dissemination of data from all subsea devices to real-time, operational and historic databases. There is also a module for adding manual input to the databases.

The subsea industry jointly developed the open interface (mechanical, electrical and data communication) standard. IWIS provides a TCP/IP link to subsea electronics, and ensures interchangeability of downhole vendor equipment.



Modbus and ProdML are trademarks of their respective owners.



Products

SEM Product Line Benefits/Features

- IWIS compliant
- Compact and lightweight design
- Easily scalable for different project requirements
- Provides electrical and optical interfaces
- Both ROV- and diver-retrievable systems available



Subsea electronic module with open communication controller

Subsea Well Control Systems

An integrated system provides the requisite monitoring, control and shutdown functions by means of multiplexed electro-hydraulic control. Network connectivity uses communications on power lines between a surface master control station (MCS) and subsea control module (SCM) via a composite services umbilical and appropriate subsea distribution unit(s).

The subsea electronics module (SEM) is enclosed in a 1-atmosphere dry nitrogen purged housing located within the main SCM housing, with proprietary penetrators allowing connection to the SCM. Within the SEM housing ambient temperature and pressure are continually monitored and an alarm may be sent to the MCS should abnormal conditions arise.

The subsea control and communication is performed using the OCC and SEM inputs/outputs (I/O). Responses from the surface or subsea units are propagated back to the platform control system (PCS) via a Modbus compliant serial or TCP/IP channel from the MCS. The SEM also runs diagnostics showing the state of all power supplies and communications. Diagnostic tools and displays are available to the operators via the topside MCS.

The system is designed for deployment and intervention by means of a remotely operated vehicle (ROV) or diver intervention using a similar module. Assisted guideline and non-guideline running tools or funnels are available with ROV assistance in very deep water. These feature a simple sliding plate design lock down mechanism.

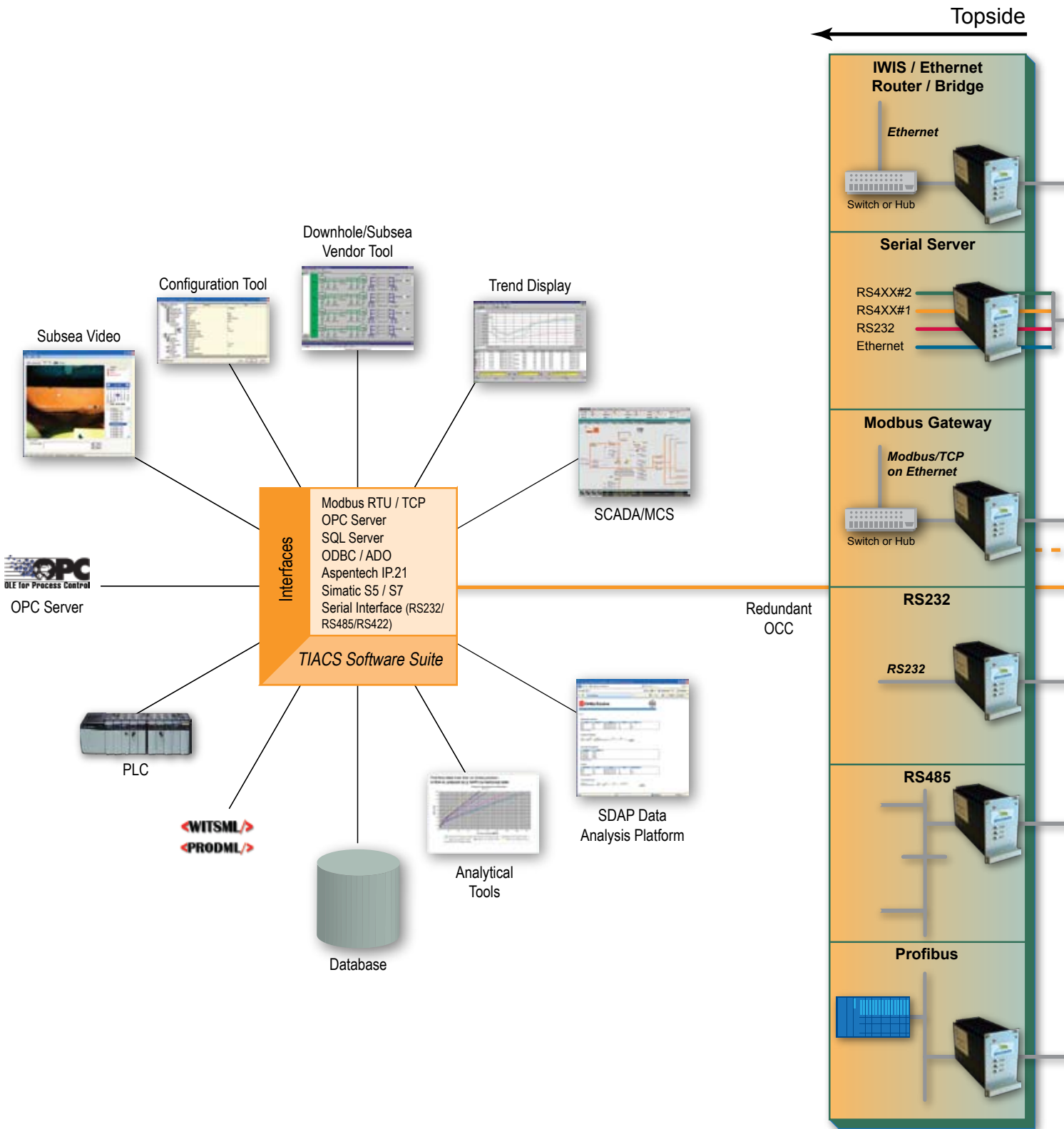


Topside Information and Control System

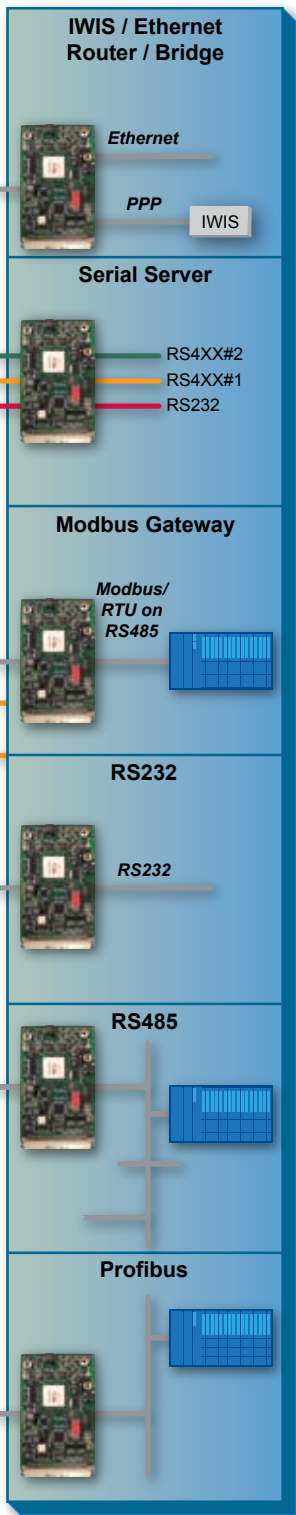
Weatherford's TIACS provides an open system with the ability to perform data collection, storage, presentation, aggregation and expert functionality. A new installation is only a matter of configuration because the software already supports a wide range of channels. Supporting all major SCADA systems, it uses one common infrastructure for integrating all downhole/subsea equipment. The common infrastructure supports OPC-DA (data access), OPC-UA (unified architecture), OPC-HDA (historical data access), Aspen InfoPlus.21® (IP21) through Aspen CIM-IO™, SQL Server™/Oracle, Simatic S5/S7, Teleperm, Modbus and extensible markup language (XML) [ProdML/wellsite information transfer standard markup language (WITSML)].



Surface open communication controller

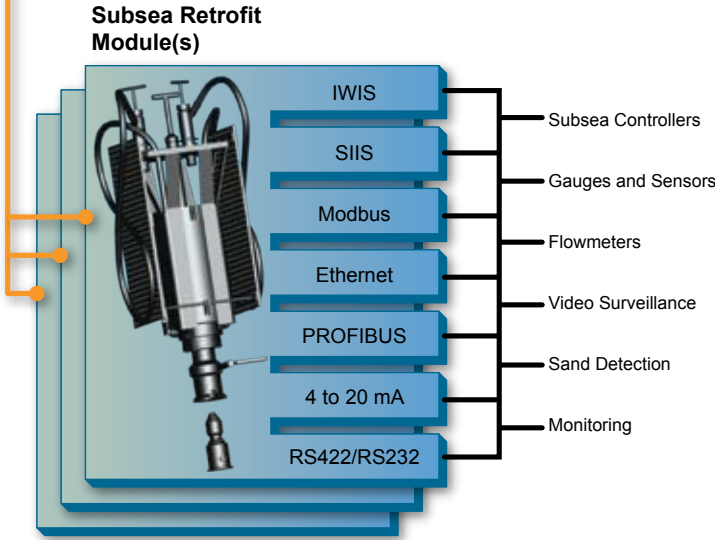
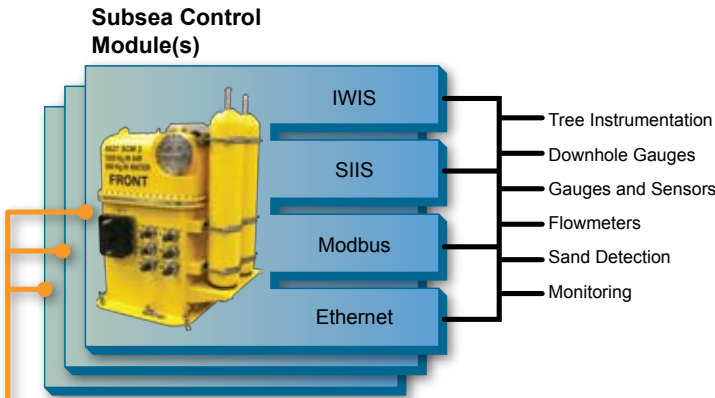


Subsea →



Serial server mode allows transparent communications between any topside and subsea interface (i.e. Ethernet to serial or RS232 to RS4XX, etc.)

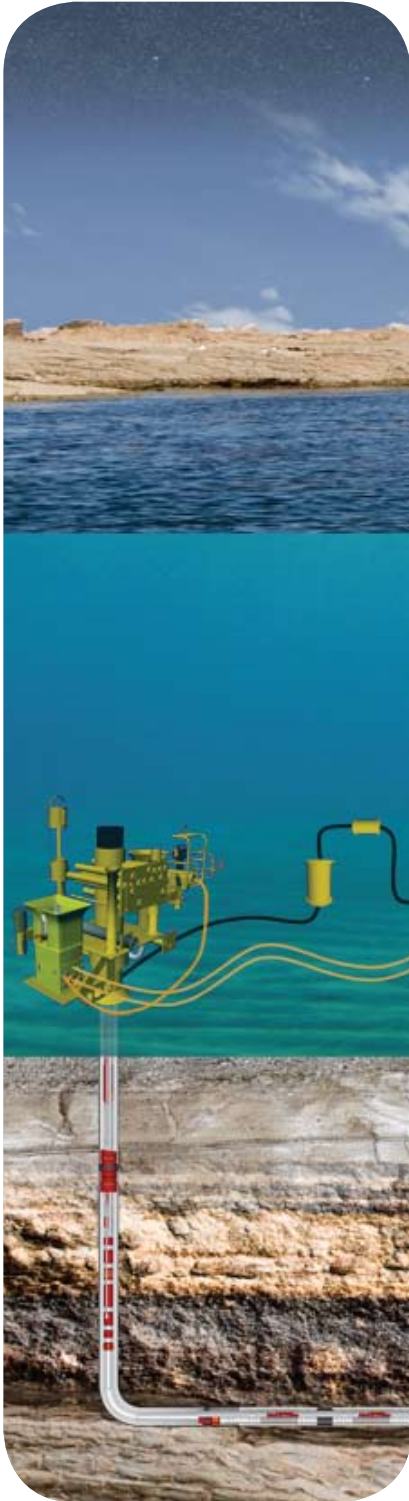
Redundant Path
Communications and Power Umbilical



Multiple Nodes with Multidrop Capability

Power Line Data Transmission Rate
1 to 390 kbps or 1 Gbps Distribution
and Ethernet 10/100 Mbps on Fiber Optic

Products *(continued)*



Open Communication Controller

The OCC provides the electrical and communications interface to the umbilical power line. Communication between the subsea network and surface equipment can be through power lines or optical cable using IWIS/RS422 or Ethernet. Interfaces to subsea devices include Fieldbus (Modbus, PROFIBUS and CANbus), Intelligent Information Systems (IIS), optical sensors, custom RS485/RS422/RS232 and vendor specified.

The controller is fully customizable and user specific features can be embedded into the firmware. It contains a built-in web server for setting parameters, diagnostics and firmware upgrades. A single topside unit can communicate with multiple subsea units all sharing a single power cable for communication (multi-drop).

The OCC provides multiple layers of communication and diagnosis as illustrated below. The controller performs the functions of a modem, plus control capabilities and diagnostics.

Diagnosis	4 to 20 mA	Control
	Modbus	
	IWIS-SIIS	
	TCP/IP	
	Ethernet	
	RS 422/RS485/RS232	
	Power line modem Fiber-optic modem	

Retrofit Capability

The open architecture of the OCC enables the system to share an existing subsea network. In most cases this allows installation of new technology instrumentation without having to replace the existing subsea infrastructure.



OCC Power Line Benefits/Features

- High speed—up to 390 kbps
- Mean time between failures > 25 years
- Power handling up to 500 VAC/1000 VDC
- Galvanically isolated dual RS422/RS485 and Ethernet ports
- IWIS compliant providing full Ethernet/IP transparency from topside to subsea
- Compact and versatile covering all main communication topologies including multi-drop
- Easy configuration using web browsers and configuration wizards
- Local I/O capabilities
- Full Modbus TCP/remote terminal unit (RTU) support

OCC Power Line Specifications

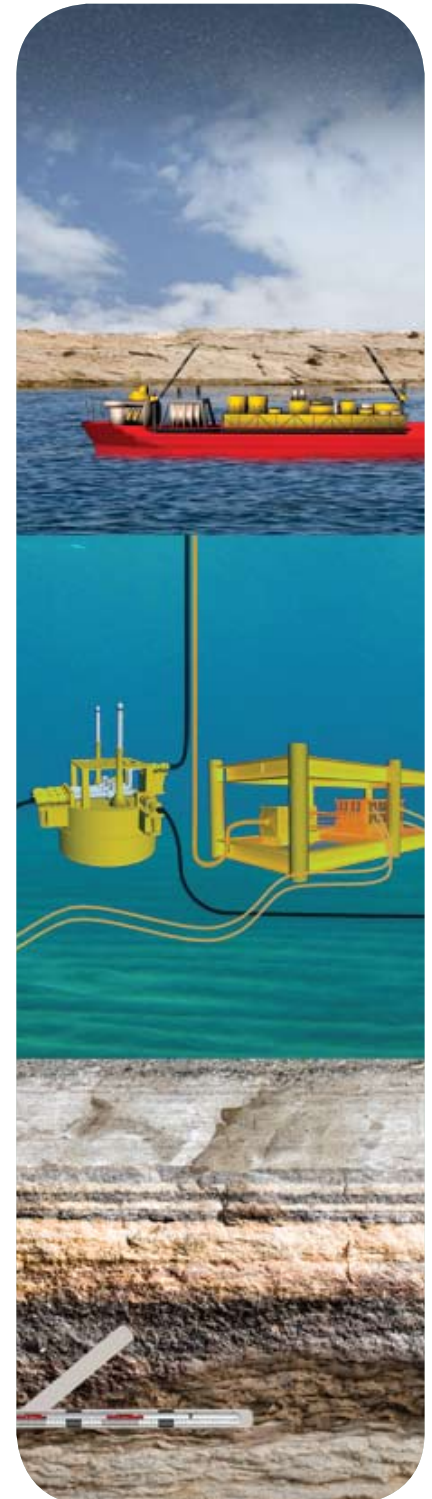
- Communication distances up to 100 km
- Selectable power line frequency from 50 to 630 kHz
- Electrical interfaces topside and subsea—RS232, RS4xx and Ethernet
- Auto recovery of subsea communications
- Transparent communications
- Supports Modbus, PROFIBUS and IWIS standards

OCC Fiber-Optic Benefits/Features

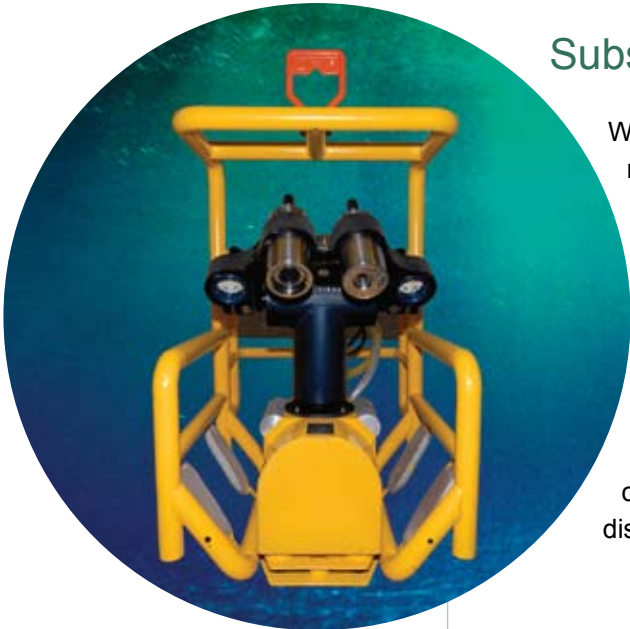
- Real-time performance using priority queing (QoS and CoS), IGMP filtering
- Supports fault tolerant loops or redundant rings using rapid spanning tree protocol (RSTP)
- SNMP version 3 for secure (authenticated encrypted) SNMP messaging

OCC Fiber-Optic Specifications

- Up to two uplinks @ 1 Gb each
- Up to 120 km without repeaters



Additional Applications



Subsea Video Surveillance System

Weatherford's subsea surveillance system provides video recording in presentation mode and transmission of real-time video. The system allows you to create a video history of installations, upgrades and repairs, or real-time viewing of system operations.

The camera system has user control to remotely pan, tilt and change the lighting. It is modular in design with a depth rating of 1000 m for aluminum housing or optional 3000 m for titanium housing. The system includes a complete web-based software suite for control, storage and display of image data.

Vibration Monitoring

The turnkey vibration monitoring system is for use on subsea rotating machinery. It consists of sensor assembly, subsea canister with controller electronics and topside software for presentation and analysis.

Acoustic Monitoring

The acoustic monitoring system provides gas leak detection or condition monitoring with acoustic sonar. The acoustic sonar instrument can detect leakages of both liquid and gas in subsea processing plants, pipeline systems and valves. The system provides instant recognition at the surface of a leak occurring subsea.



Sand Detection

Weatherford provides a complete retrofit system for real-time sand detection. Individual power and communication are provided to each sensor and the communication is consolidated with the OCC. The standard software suite (TIACS) provides the seamless interface for the sand applications.

The system is modular and can easily be extended to include complex sensors with high demands in power consumption and communication speed. The subsea solution allows for multiple modules stacked together, and includes parking positions for all jumpers.



Intelligent Wells

Weatherford's system provides a simple and robust solution for subsea intelligent wells. It makes it easy to instrument and control new intelligent wells and also provides a cost effective upgrade path when retrofitting existing wells with intelligent completions. The system is proven and in use in the world's largest smart well field in Norway.



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