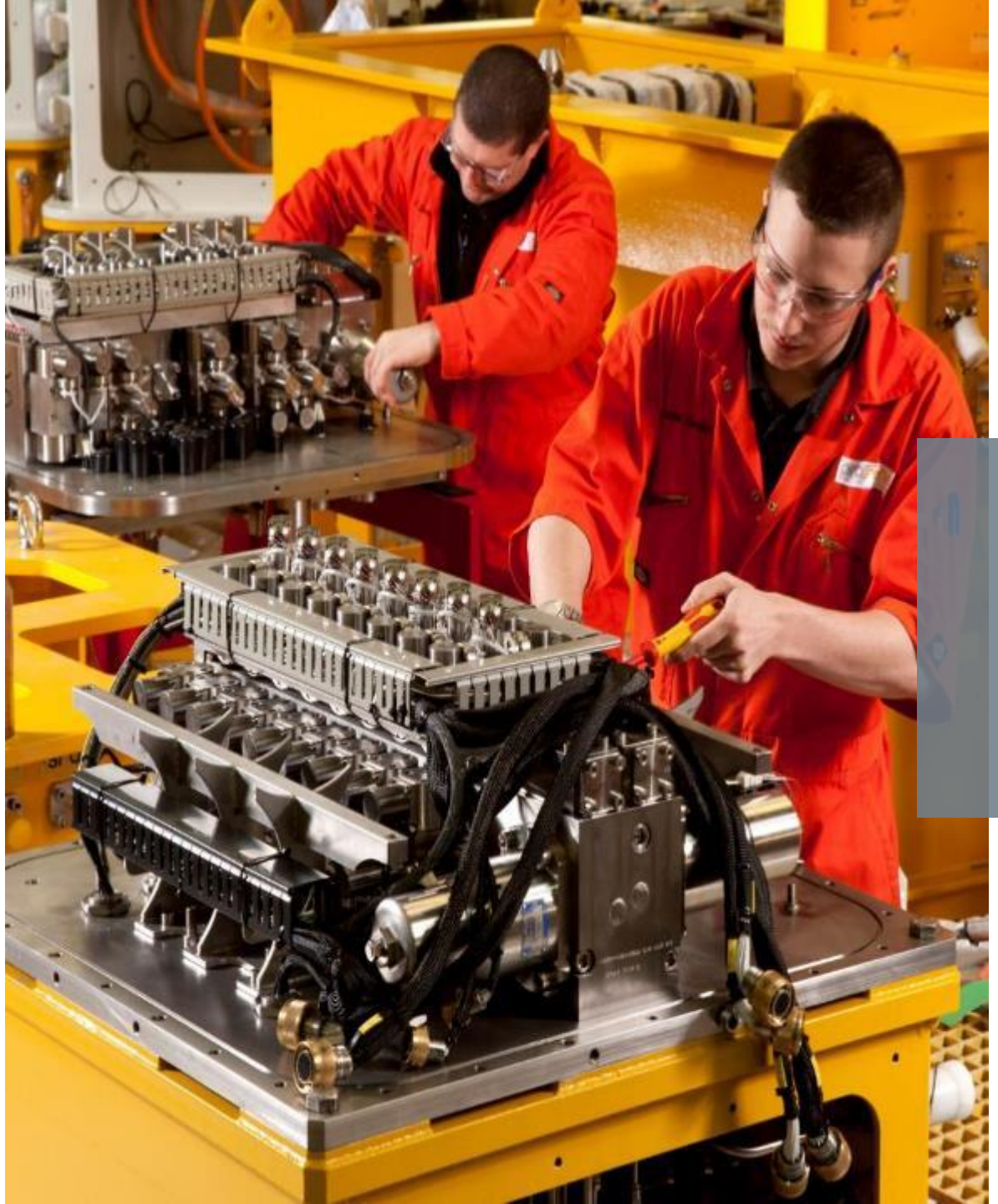


proserv

INGENIOUS SIMPLICITY

Extending life of brownfields and enabling new standards

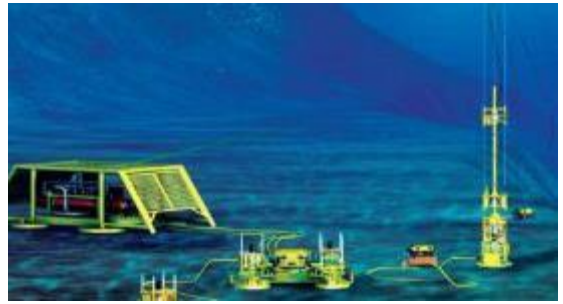
Tore Erntsen (presenter)

Vice President Technology, **Proserv**

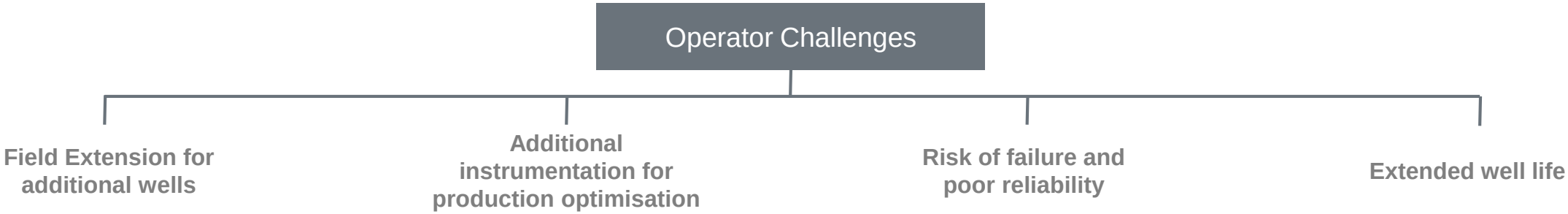
Why upgrade existing brownfield systems?

Brownfield subsea fields are an important segment of global offshore oil and gas production.

With over **80%** of world energy use reliant on fossil fuels the maintenance and optimisation of these often aging subsea assets is an economic and moral necessity for the industry.



Subsea systems and services



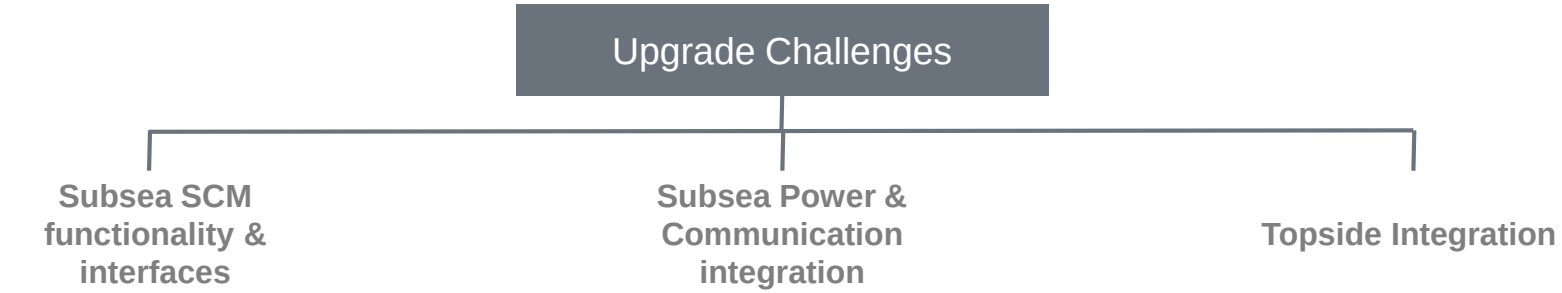
Adding wells to brownfield subsea systems requires interfacing with existing and often unsupported aging technology and experience both subsea and topside.

Instrumentation to provide essential information to maximise remaining production may not be supported by the existing control system.

Failed wells without adequate support from the OEM require an alternative control solution to reinstate well production without full system replacement.

Support for extended field life and even for original design life often limited due to obsolescence support and/or engineering support from the OEM.

Challenges for non-OEM subsea system upgrade

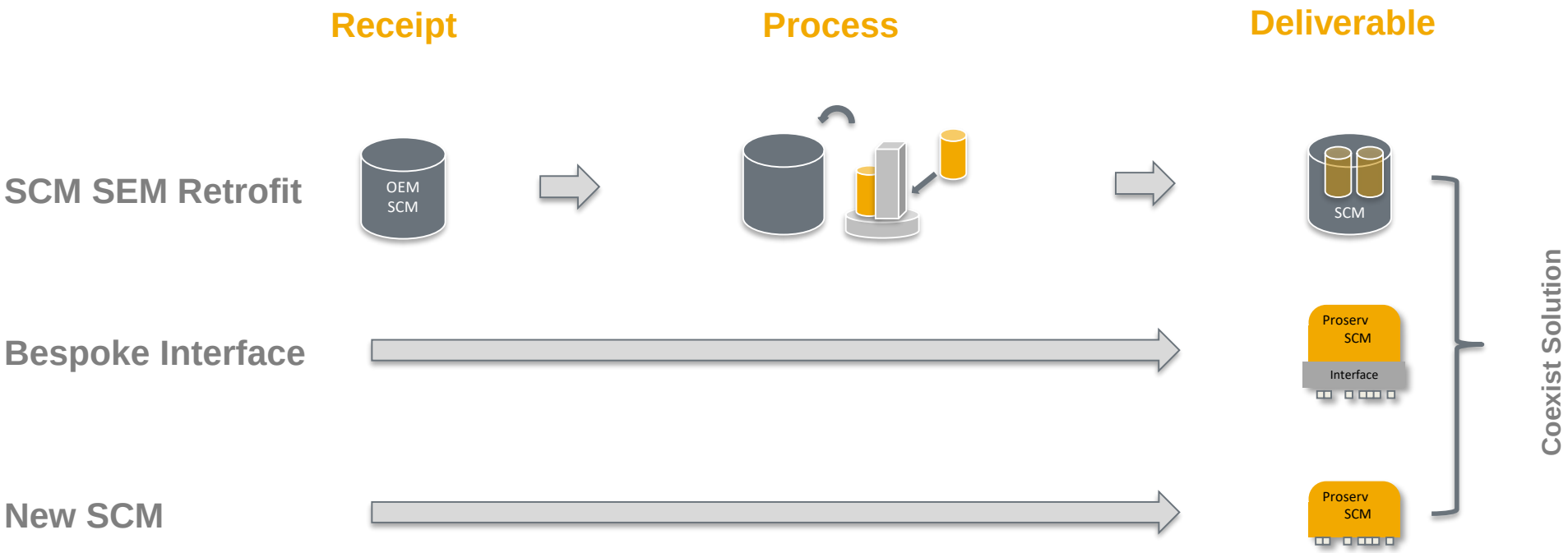


Upgrade should provide improved reliability and performance and functionality whilst providing compliant interfaces with existing system.

Upgrade should operate over separate or existing umbilical cores / utilities. Support for additional instrumentation and field extensions should also be a goal.

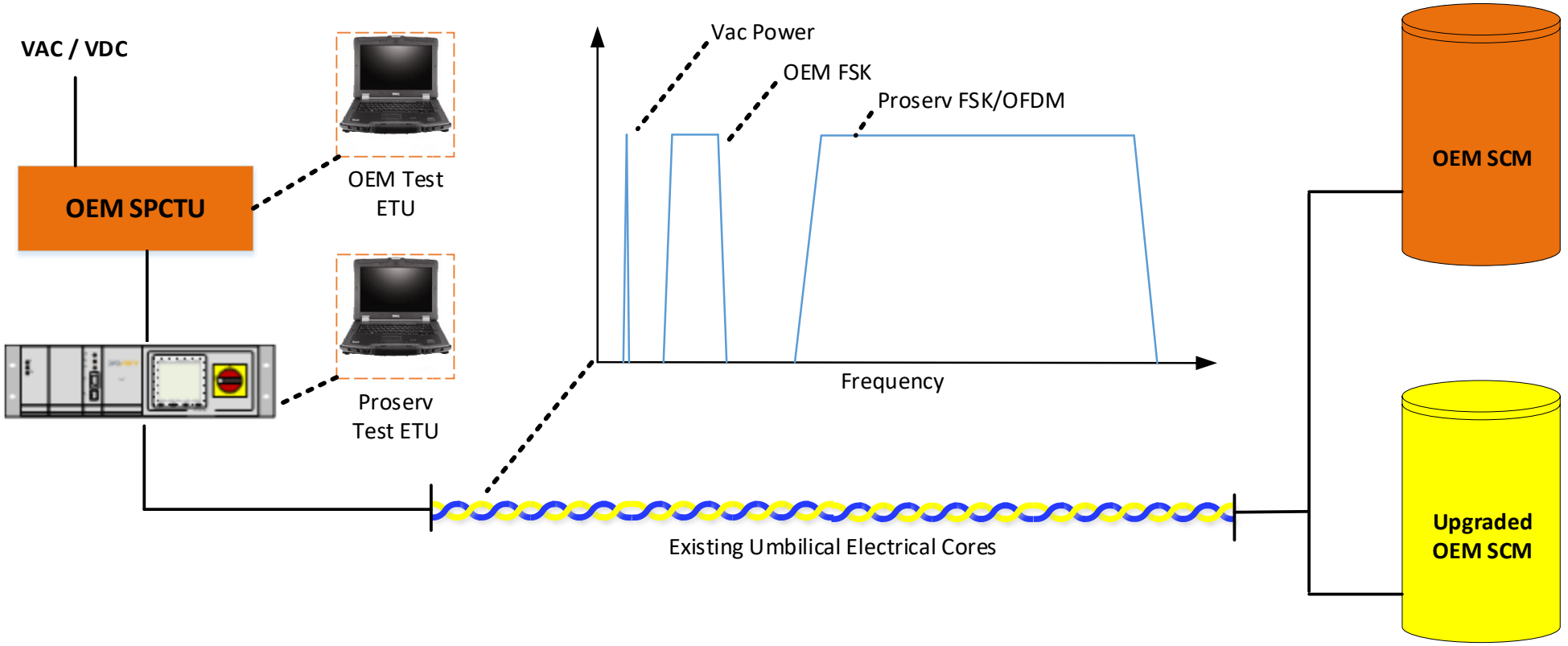
Upgrade should provide a flexible and reliable solution using industry standard interfaces.

Subsea upgrade of an SCM



Co-Exist Technology

Proserv Co-Exist Communication Technology operates concurrently with the existing subsea control system communications on the same OEM powerline or alternatively on separate conductors if available.

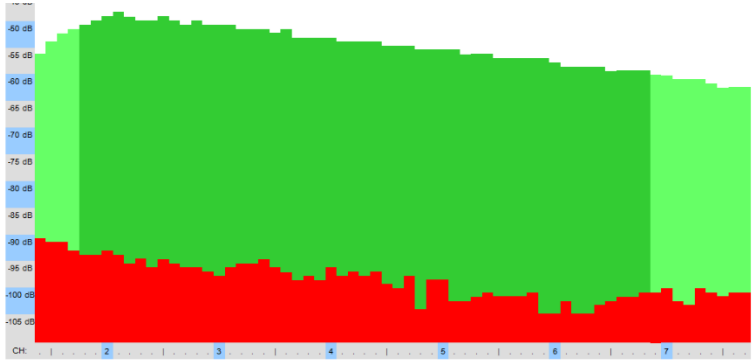


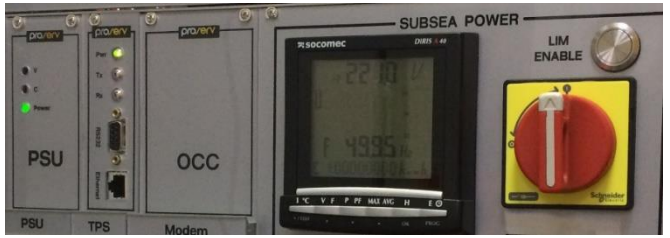
Co-Exist Technology

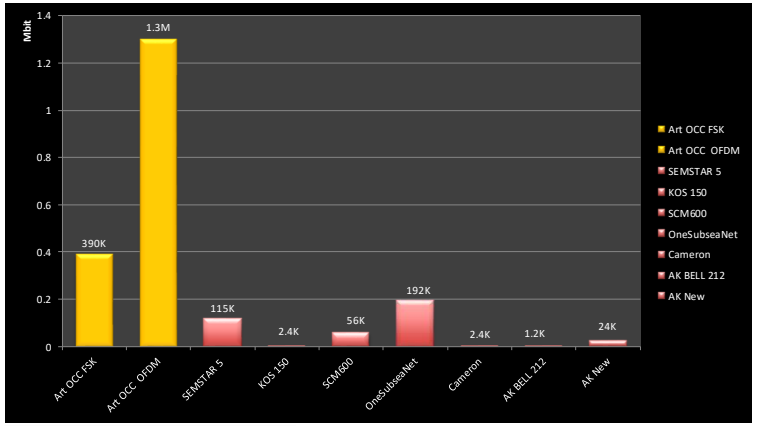
Multi-drop co-exist technology; provides a flexible solution to obsolesence / performance and reliability issues for OEM systems which compliments the older lower-speed modem technologies;

A flexible and transparent TCP/IP data network; aids the ease of integration and maintenance of industry standard and additionally non-standard devices.

Configuration and performance monitoring; a key benefit of modern digital technology is the ability to measure and configure to provide optimum flexibility for the configuration, diagnostic and performance data.







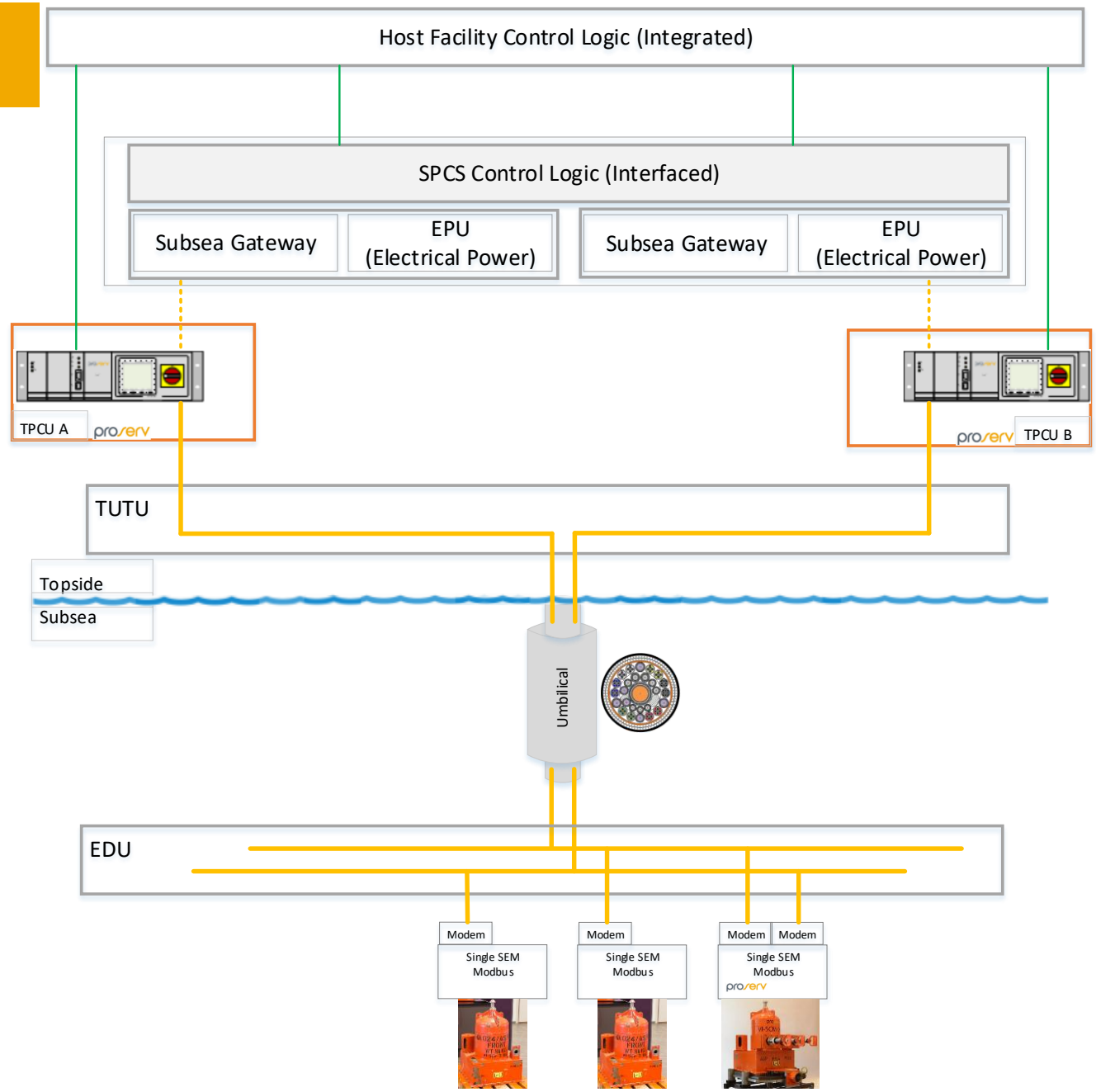
Manufacturer data taken from web source

The upgrade of the Topside System

The combination of proprietary protocols and vendor specific hardware / software solutions need to be addressed to assure reliable and efficient control and monitoring of the subsea solution.

The industry is currently developing the MDIS interface based upon the OPC-UA protocol.

Subsea and DCS vendors are currently developing and validating the agreed MDIS interface. Thus providing potential support for a non-proprietary and flexible implementation for the upgrade solution.



Equinor Visund pilot

Refurbishment Aker 4G SCM

Visund field: brownfield upgrade introduction

Project background

Production within the Equinor Energy AS, Visund field was initiated in 1999; and substantial potential reserves remain to be recovered: -

NPD\'s CURRENT RESOURCE ESTIMATES

	Oil	Gas	NGL	Condensate	Sum
Original Recoverable Reserves	40.4	58.8	13.2	0	112.4
Remaining Reserves	8.5	43.4	11.2	0	63.1

Mill. Sm³.O.E. Source: - NorskPetroleum [2018]

As part of a strategy to recover these resources Equinor Energy AS had a requirement to refurbish older OEM SCM modules that had both obsolescence and reliability issues, particularly with the internal electronics (SEM).

The OEM for the existing system was unable to support the system nor deliver spare parts to assure system availability.

The old system was a single SEM SCM with only single power and communication and no downhole interface's. The proposed solution was to maximize reuse of hydraulic parts and sensors with only faulty parts being replaced.

The subsea power and communication system was a low-speed multi-drop copper modem technology running in a separate communication-and-power configuration.

The existing topside solution was Modbus® based, the existing DCS to MCS solution was highlighted as providing an opportunity to improve the performance for control and data monitoring of the system.

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Client: Equinor Energy AS

Location: Norwegian North Sea

Equipment: New SEM and Refurbished SCM

Existing SCM

Upgraded SCM

Visund field: brownfield SCM upgrade assessment

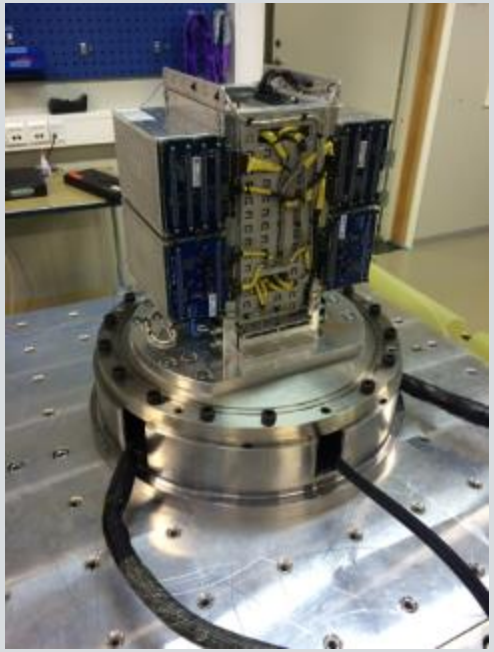
Subsea control module retrofit

Inspection and test is performed on received unit to establish serviceability and upgrade implementation

Client: Equinor Energy AS

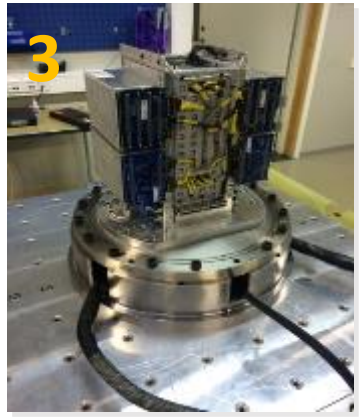
Location: Norwegian North Sea

Equipment: New SEM and Refurbished SCM



New SEM with A2G

Visund field: brownfield upgrade



Client: Equinor Energy AS

Location: Norwegian North Sea

Equipment: New SEM and Refurbished SCM

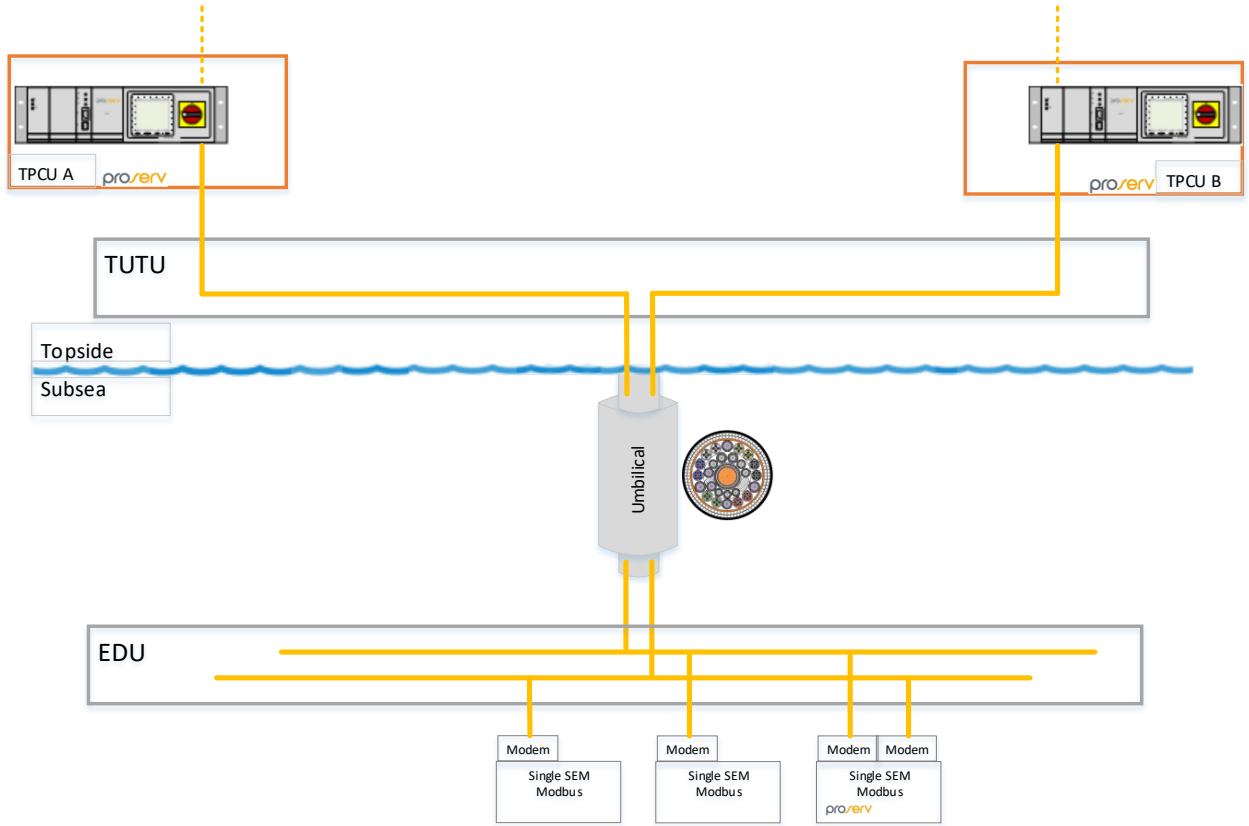
1. **FAT test SEM without hydraulics**
2. **FAT test SCM with hydraulics**
3. **SEM Vibration test**
4. **SEM Temp cycling**
5. **SEM hyperbaric test**

Visund Co-Exist Solution

The existing separate communication and power system provides multi-drop cluster architecture.

Evaluation of the system determined the optimum solution would be to implement a SEM upgrade using multi-drop 57,6 kbps powerline communication applied to the existing cluster power conductors.

Subsequent performance since the installation and commissioning has delivered reliable communications during more than 1million transactions with zero failures.

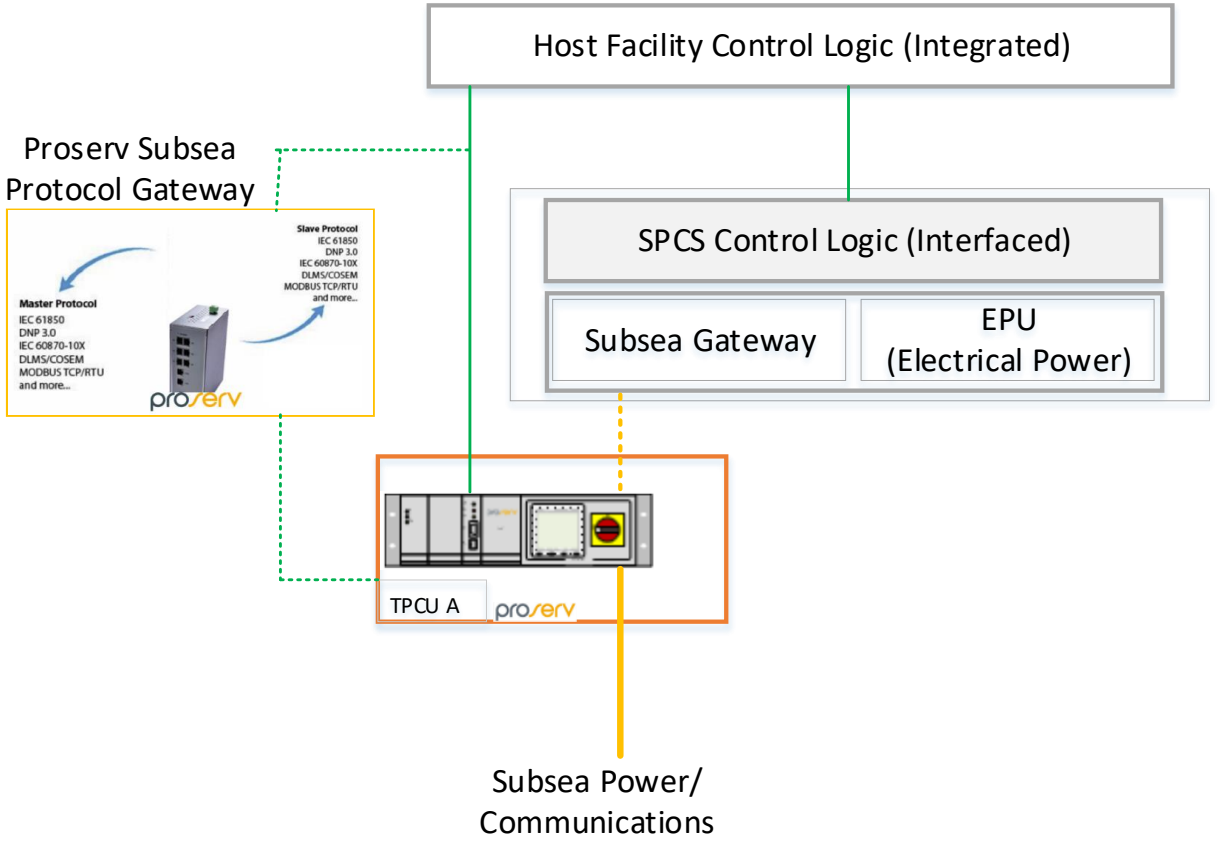


The upgrade of the Visund Topside System

Evaluation of the existing topside interface identified opportunities to simplify the subsea / topside interface at the same time improving the performance and reliability.

Subsea and DCS vendors are currently developing and validating the agreed MDIS interface. Using the MDIS principle of an 'Integrated Solution' enabled the DCS to efficiently effect control and data monitoring.

Whilst generally conceived for new system implementations MDIS potentially offers support for providing a flexible and non-proprietary upgrade solution. On this occasion ModbusTCP® was the preferred industry protocol. Siemens was the DCS vendor at Visund.



The upgrade of the Visund Topside System

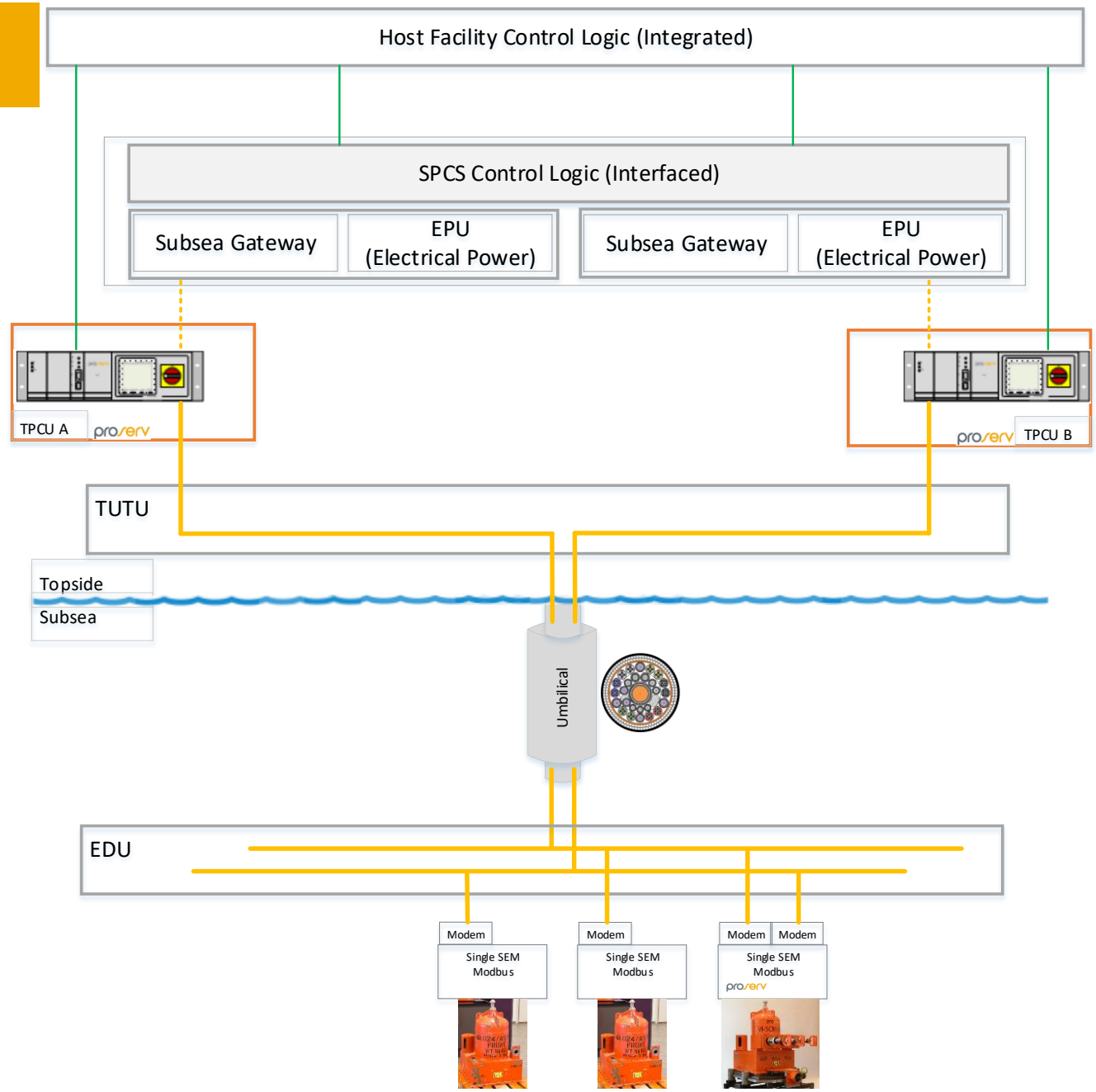
The simplification of the control and monitoring interface provided: -

1. A reduced update time of 10 to 1 Second; giving the user a more responsive solution.

2. Reduced complexity resulted in removal of failed read / write actions performed by the DCS.

3. Compliant data mapping within Proserv upgrade eased integration into existing DCS functionality.

4. Freedom and flexibility to locate and interchange OEM and upgraded SCMs provided



Visund field: brownfield upgrade

Operator Challenges

- Extend field for additional wells
- Additional instrumentation for production optimisation
- Risk of failure and poor reliability
- Extended well life

Proserv Solutions

- Co-exist
- SEM Retrofit
- SCM Refurbishment
- Topside Upgrade

Proserv Toolkit


OCC

OCH

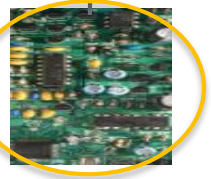

A2G

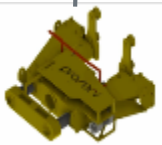

SCM


TIACS


Subsea Interfaces


Monitoring SeaHawk


Topside Protocols


ROV Tooling


Hydraulics

Responsibility and sustainability

Proserv is committed to making a positive contribution to society and the **environment.**

On the current modules we reuse up to **80%** of the mechanical components on the refurbished SCM.

Condition monitoring - allowing continued operation on old subsea installations and equipment with lowered risk of pollution

- Refurbishment
- Upgrade
- Integrate new technology on existing infrastructure
- Bundled services

Award winning energy efficient equipment

Conclusion

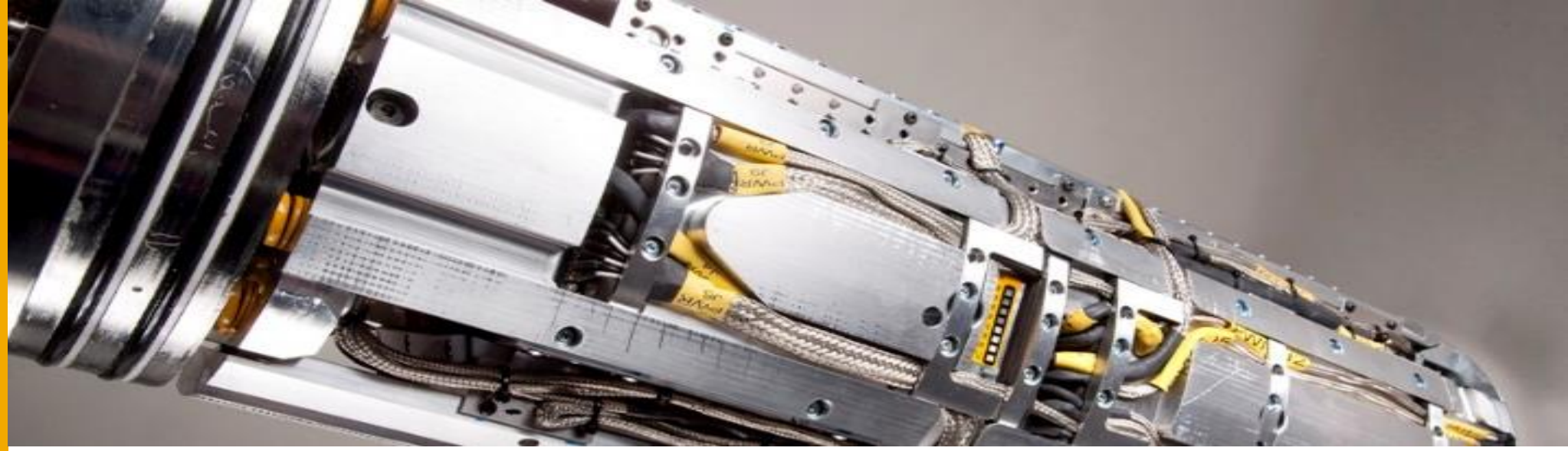
Equinor Energy AS challenged the market by performing a refurbishment with a new vendor. The price, quality and reliability of the technology has shown this to be a **truly viable** solution.

Compelling solution:
Proserv ACT initiative showed together with Equinor that refurbishing older modules is a good business case. Additionally they achieved: -

1. an open communication solution exceeding existing system speed many times.
2. Improved topside performance and reliability with flexibility to respond to operational requirements with ease.

"To maximise on the advantage of this technology, we need to start thinking a bit less conventionally and employ some of the practices which are common in other areas of the energy and manufacturing industry."

Paul Hunter, CNR International



Using co-exist and a proven open and modular system approach with standardised interfaces, the operational **‘life of field’** can be more than just ‘existence’.

Industry JIP to Standard

IWIS – assist the integration of downhole power and communication architectures, subsea control systems and topsides [*Intelligent Well Interface Standardisation*]

SIIS – defines three instrument interface protocols for communication between subsea control modules and subsea sensors [*Subsea Instrument Interface Standardisation*]

MDIS – to develop a standard interface to facilitate the development of applications by multiple vendors that shall inter-operate seamlessly together [*MCS DCS Interface Standardisation*]

SEAFOM™ – facilitate the growth of fibre optic monitoring system installations in the upstream oil and gas industry

SWiG - promotes interoperability for subsea wireless communications (radio frequency, acoustics and free space optics) [*Subsea Wireless Group*]

Several standardization initiatives are now ongoing to help the industry to reduce cost, lead time and improve quality.

Thank You

Any Questions?