Subsea Down Under 2018

IoT and the Future of Subsea Controls

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Oct 2018

1. Overview of IoT Enabling Technologies
2. IoT Devices and Communications
3. Edge Computing
4. Analytics and Cloud Computing
5. Challenges and Benefits

Overview of IoT Enabling Technologies

Virtualisation

Industry 4.0

IIOT

OT

Factory of the Future

AI

SaaS

Big Data

Cloud

PaaS

IOT

Digital Transformation

Digital Twin

Digital Mine

Fog

IT

Edge

XaaS

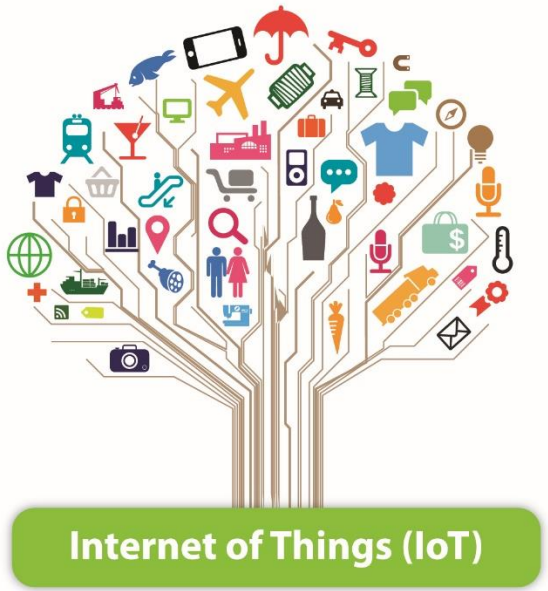
Convergence

Mirror Plant

Internet of Things

The Industrial Internet of Things (IIoT) refers to the application of IoT within an industrial environment.

The Internet of Things (IoT), is the network of physical objects or "things" embedded with electronics, software, sensors, and connectivity to enable objects to collect and exchange data.

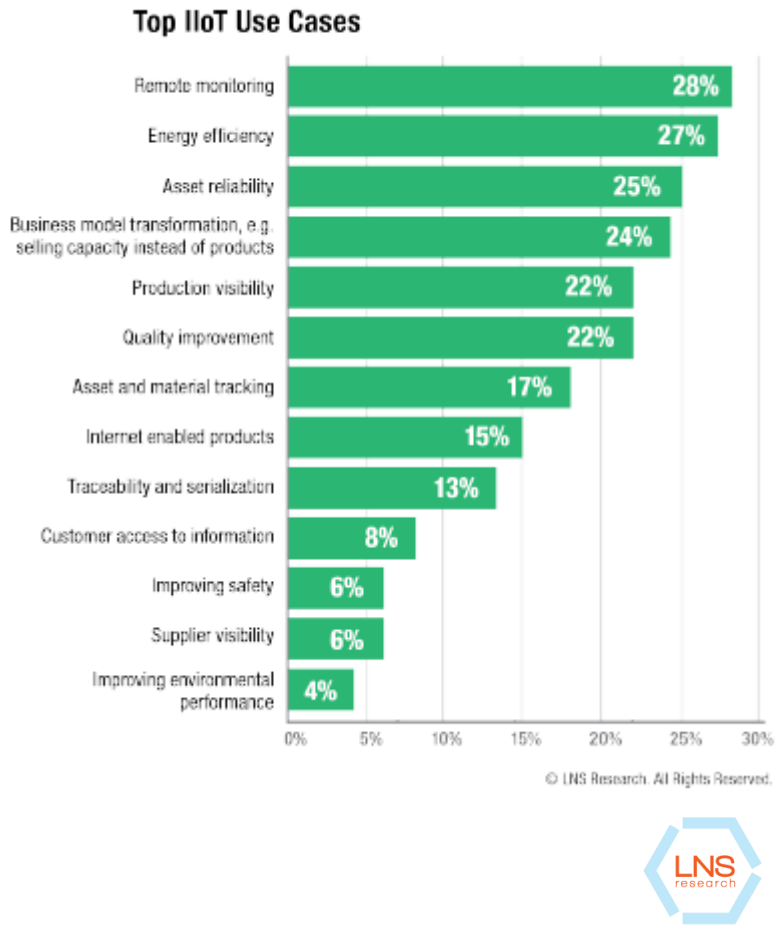


IIoT Technologies:

- *Edge Computing*
- *Cloud Computing*
- *Open Communications*

IIoT Use Cases

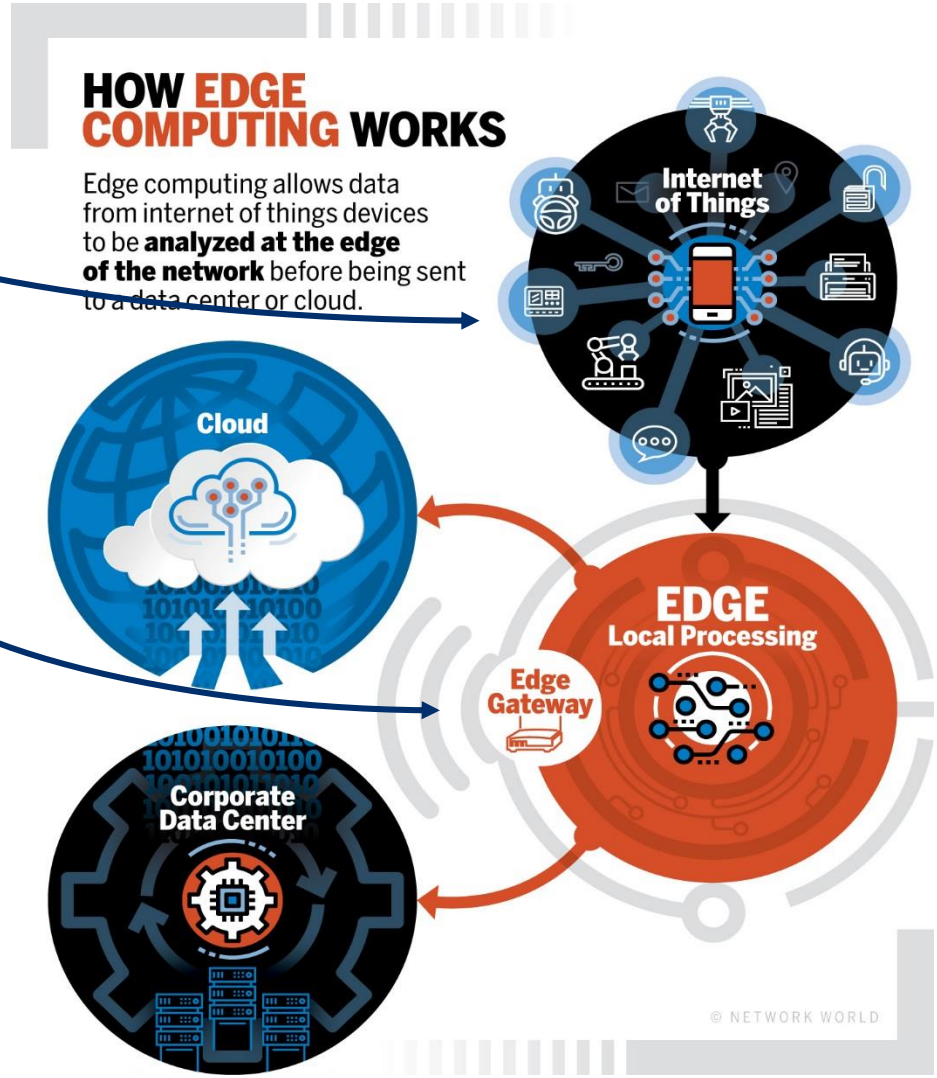
- Remote monitoring
- Energy efficiency
- Asset reliability
- Business model transformation
- Production visibility
- Quality improvement
- Asset and material tracking
- Internet enabled products
- Traceability and serialization
- Customer access to information
- Improving safety
- Supplier visibility
- Improving environmental performance



IIoT Technologies:
- Edge Computing

Edge Computing

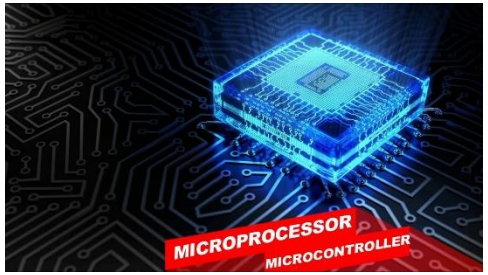
- Intelligent Sensors
  - Device diagnostics
  - Control capability
- Computing devices in the field
  - Enables raw data processing
  - Distribution of controls
- Subsea Applications:
  - Distributed Controls
  - Optical Fibre Data Analytics
  - Vibration Data Analytics



IoT Devices

- IoT Sensor – a networked sensor with local processing to provide a high level of information
  - Enabled by small, high speed, low power microprocessors
  - Now complex processing available at the sensor

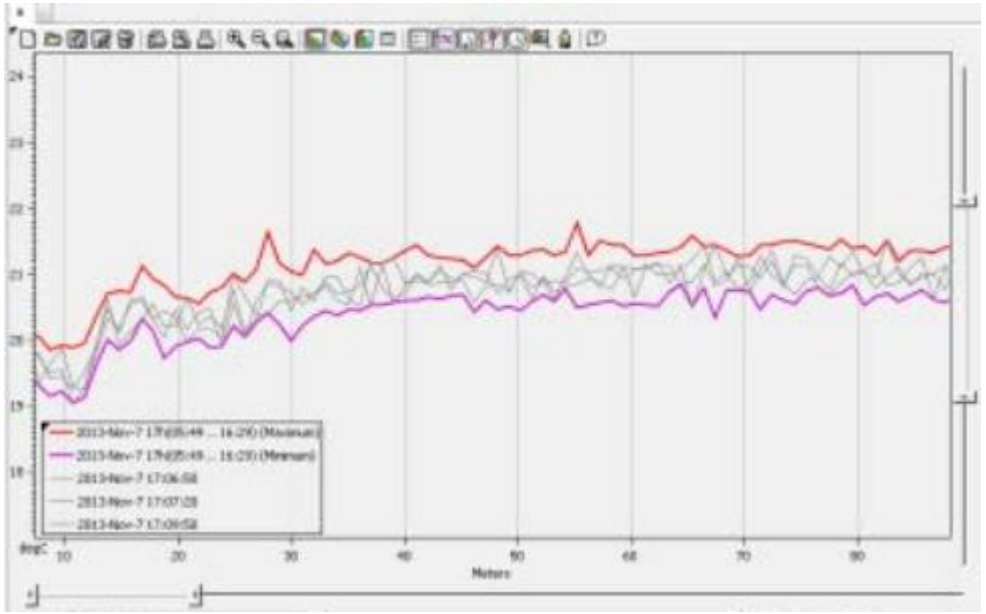
- Applications
  - Fibre Optic Sensing Technologies (Time Domain Reflectometry)
  - Vibration Sensing and Analysis (Fast Fourier Transforms)
  - Corrosion Sensing and Analysis (Magnetic flux analysis)



IoT Devices – Fibre Optic Sensing Technologies

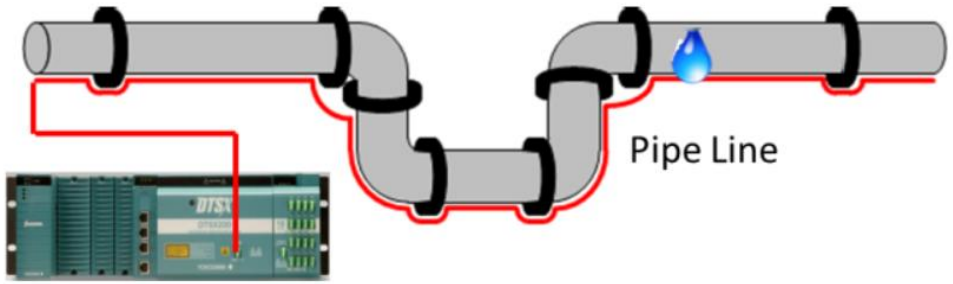
Fibre Optic Sensing Technologies

- TDR (time domain reflectometry) calculations at the sensor
- Accurate Temperature and Pressure/Stress Measurement
- Run optical fibre up to 50 km with measurement every 1m



Subsea Applications

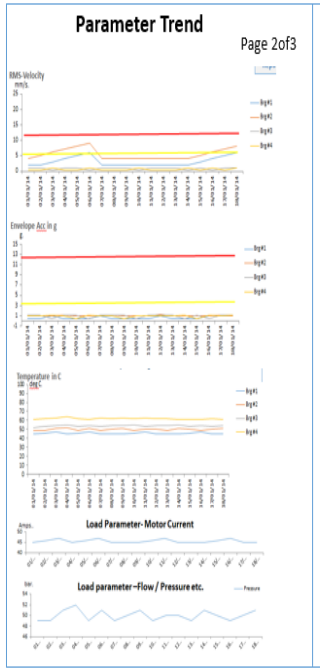
- Leak detection, hot spots and stress on pipelines & manifolds
- Downhole pressure and temperature monitoring

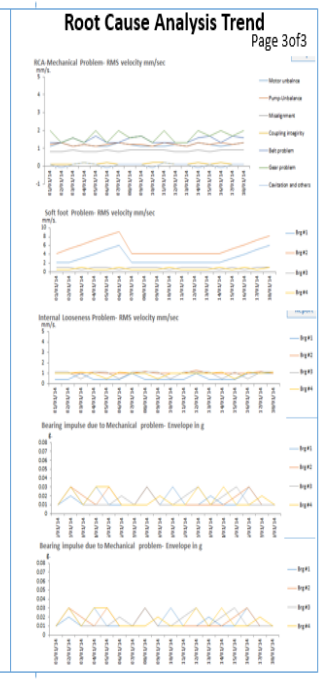


Vibration Sensing Technologies

Vibration Sensing Technologies

- Fast Fourier Transforms to analyse vibration data
- Different waveforms represent different issues:
  - Bearings
  - Cavitation
  - Lube oil contaminants
  - Impeller damage



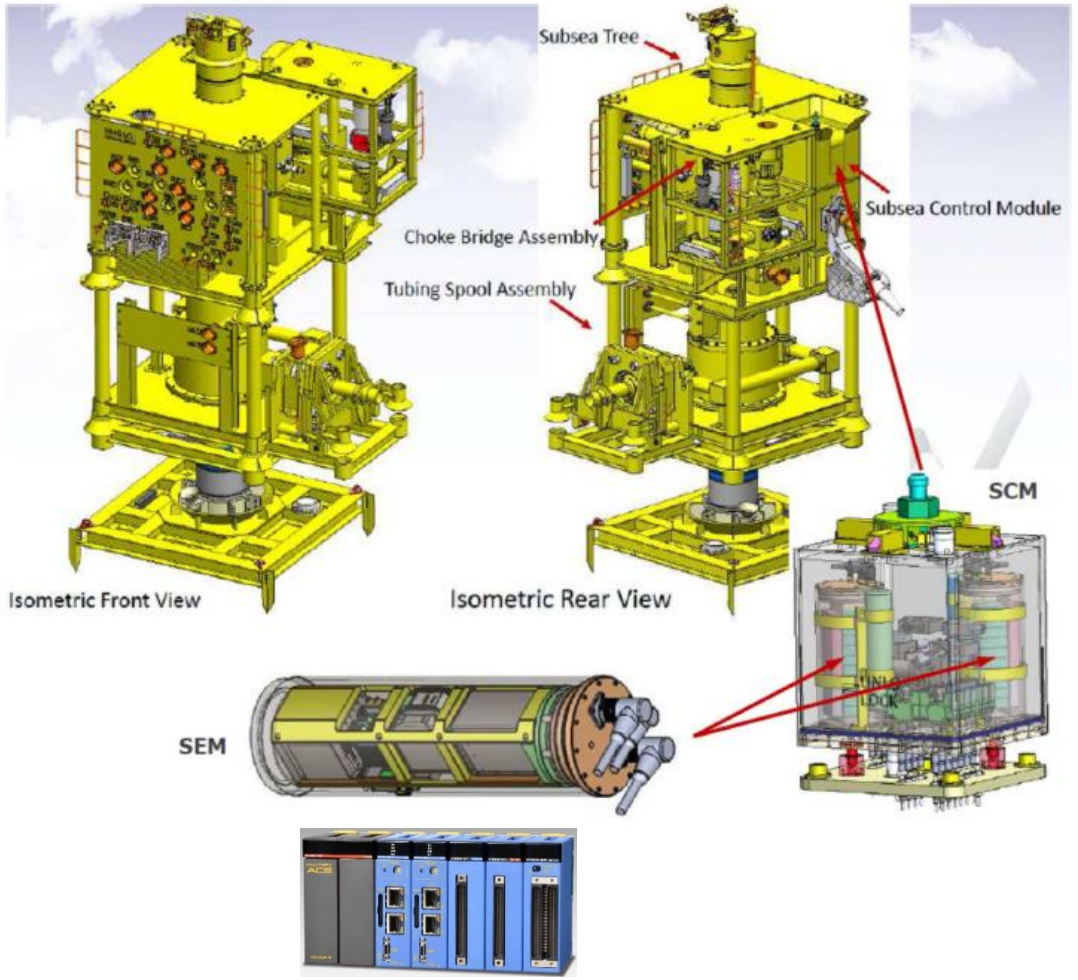


Subsea Applications

- Compressor monitoring
  - Enables predictive maintenance
  - Early warning of compressor problems

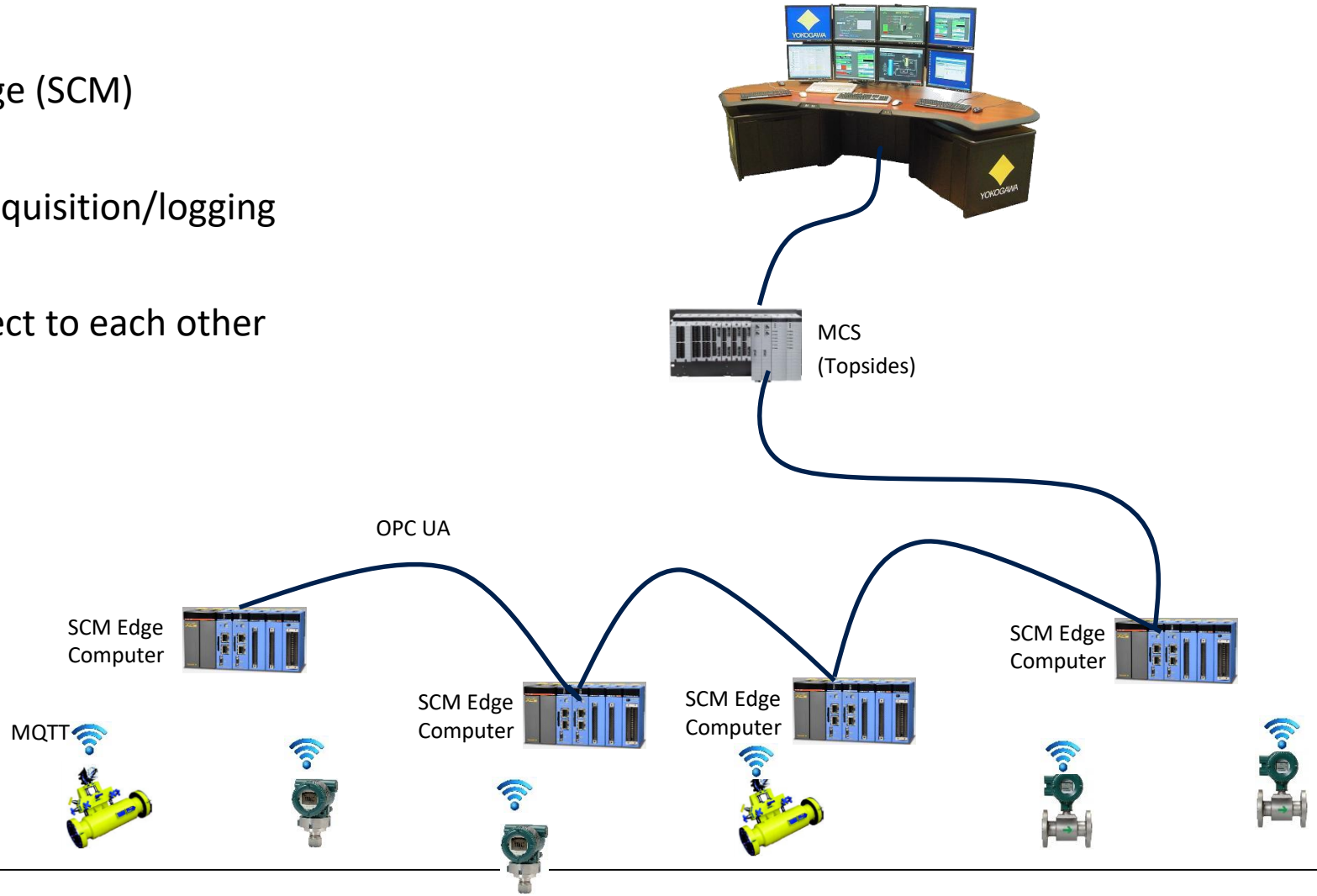
Subsea Controls

- Edge Computer Attributes
  - Large processing capacity
  - Low power consumption & heat load
  - Wide temperature range
  - Lightweight, real-time operating system
  - Built-in applications and APIs for fast deployment
    - IEC61131-3 control programming and libraries
    - Web services
    - I/O interfacing
    - SQL database
    - FFT libraries



Subsea Controls

- Edge Computer for Subsea Controls:
  - Devolved MCS controls to the edge (SCM)
  - Interlocks, sequences and data acquisition/logging
  - Network of controllers that connect to each other for integrated controls
  - Real-time analytics
    - Vibration
    - Cavitation
    - Corrosion

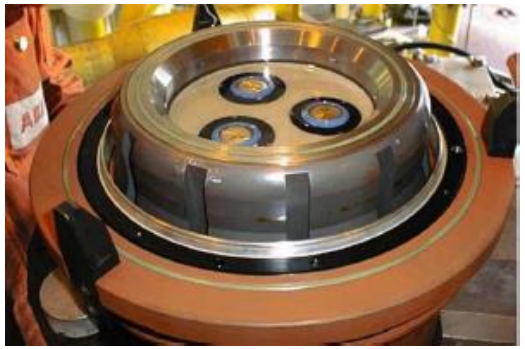


IIoT Technologies:
- IoT Communications

Communications

Wireless Communications

- Why wireless?
  - No physical connection required to device
  - Reduces installation cost
  - No “wet mate” connection, reducing incidence of leaks
  - Requires long battery life (10+ years) to be viable

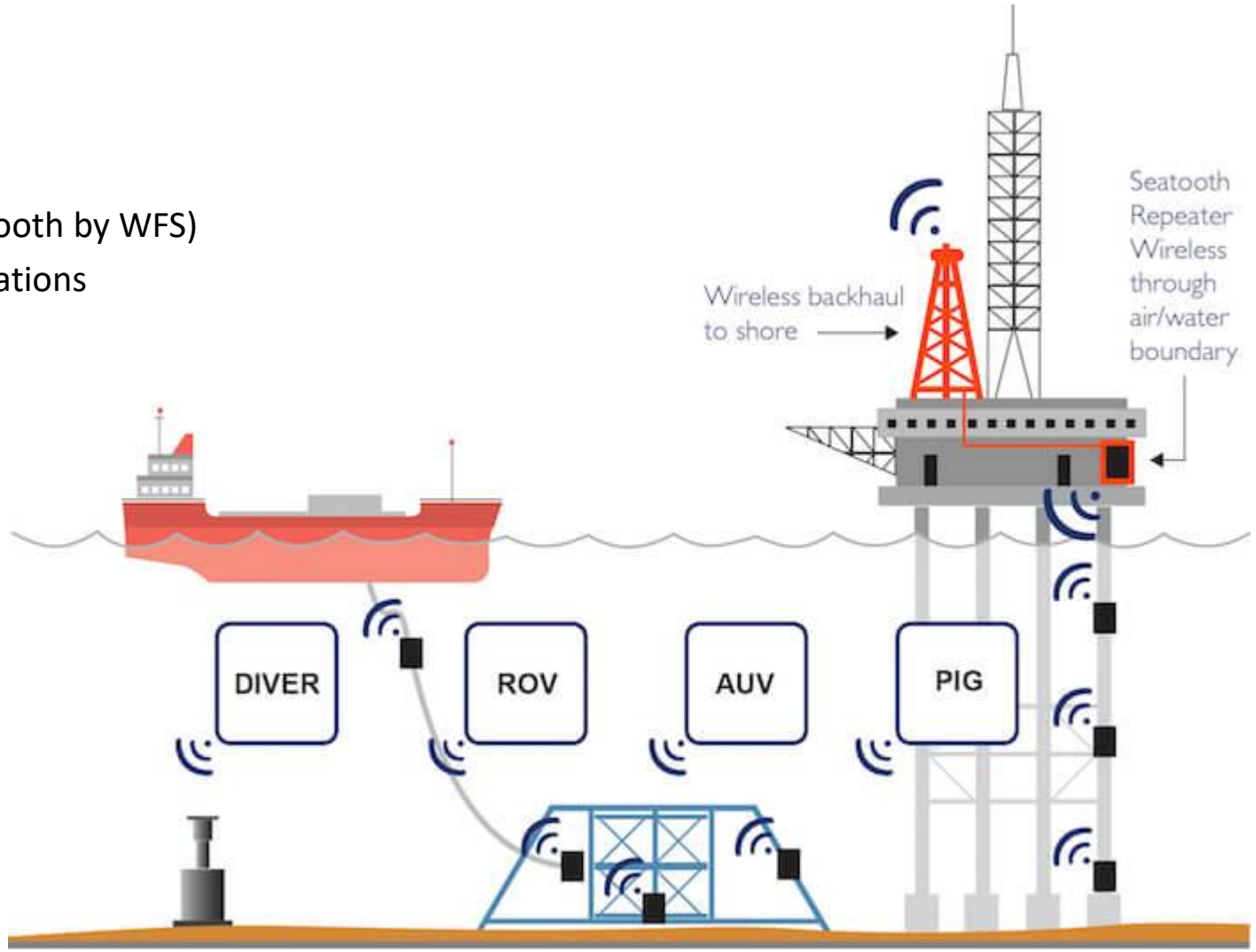


- Types:
  - Radio Telemetry
  - Sound (Sonar)
  - Light

Communication

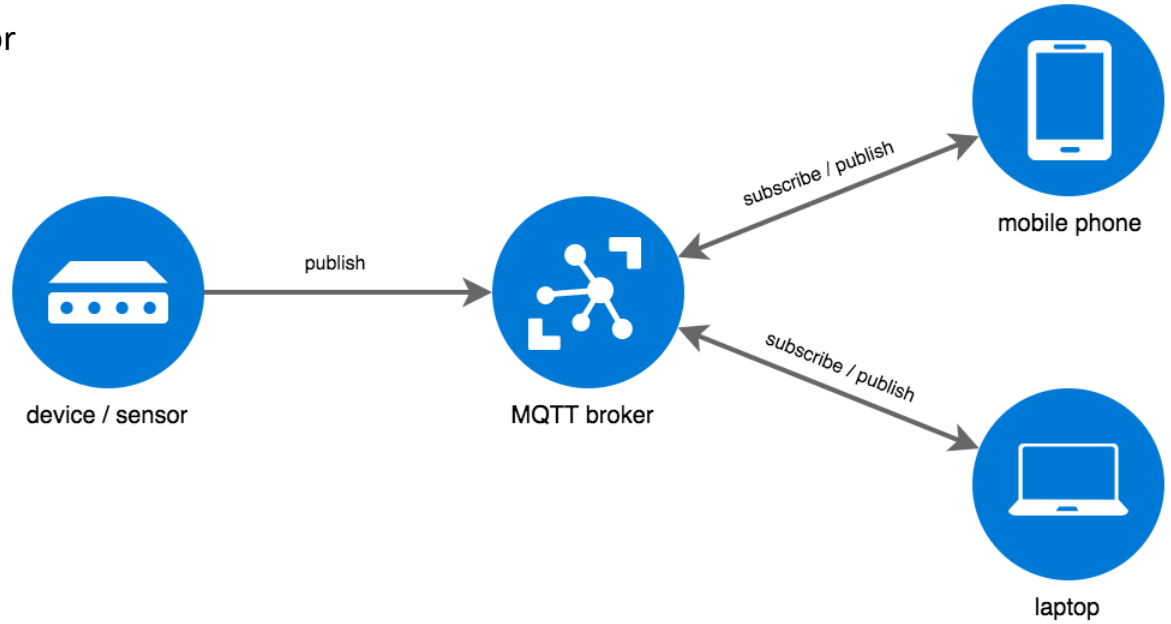
- Radio telemetry
  - 50m maximum range in shallow water
  - Bluetooth technologies now being utilized (Seatooth by WFS)
  - 5000 Bluetooth devices already in subsea applications
  - Can travel from above sea to subsea

- Subsea Applications
  - Wireless repeater at manifold or wellhead. All sensors on manifold/wellhead are wireless.
  - ROVs & AUVs collect data from sensors without requiring physical connection



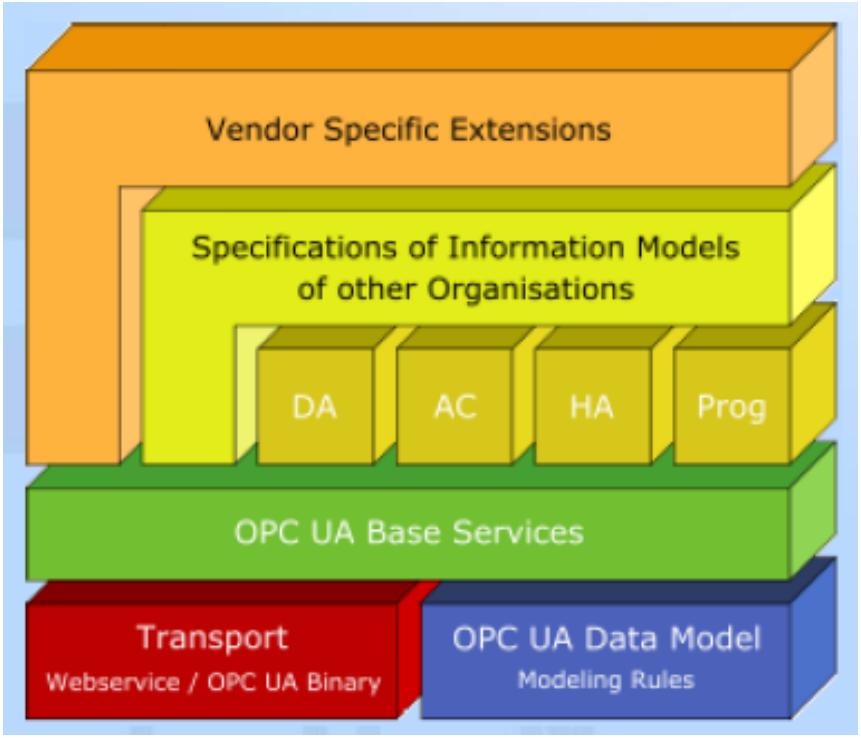
Communications

- MQTT – sensor level communications
  - Lightweight protocol designed for sensors
  - Publisher/Subscriber type (rather than polling)
    - Device sends data when there is data to be sent
    - A client subscribes to receive published messages from a sensor
  - Provides interoperability between devices and users



Communications

- OPC UA – control and information level communications
  - Significant advancement on traditional OPC
  - Platform independent
  - Object based (XML)
  - Allows vendor-independent integration



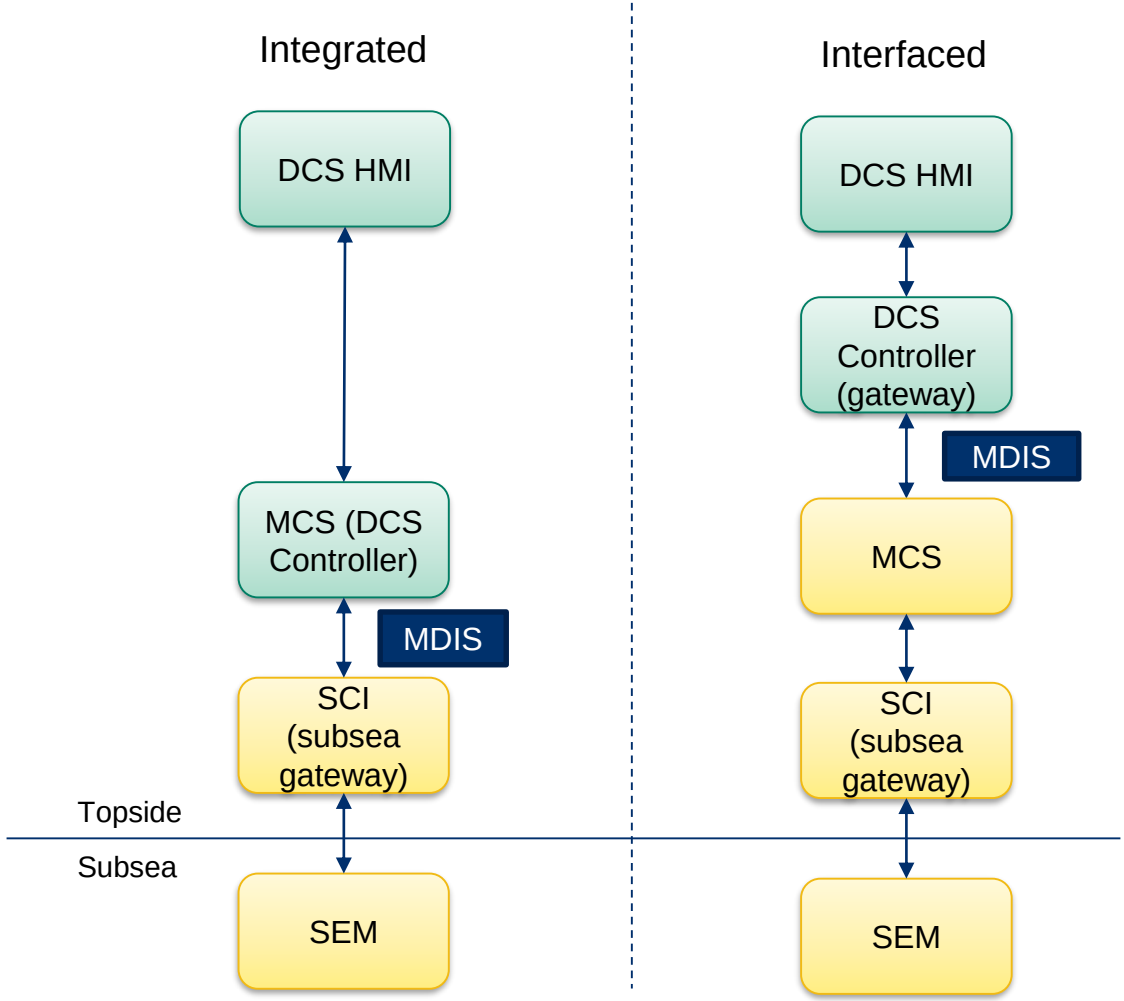
- Subsea Applications
  - MDIS subsea controls interface

Communications

- MDIS – MCS DCS Interface Standard
  - Based on OPC UA
  - Specifies object models relevant to subsea industry
  - Any subsea system can connect to any topsides system
  - Field device exists as an object model throughout the system

Choke Valve Object

- Valve position
- Enabled flag
- Fault status
- Interlocks
- Permissives
- Commands



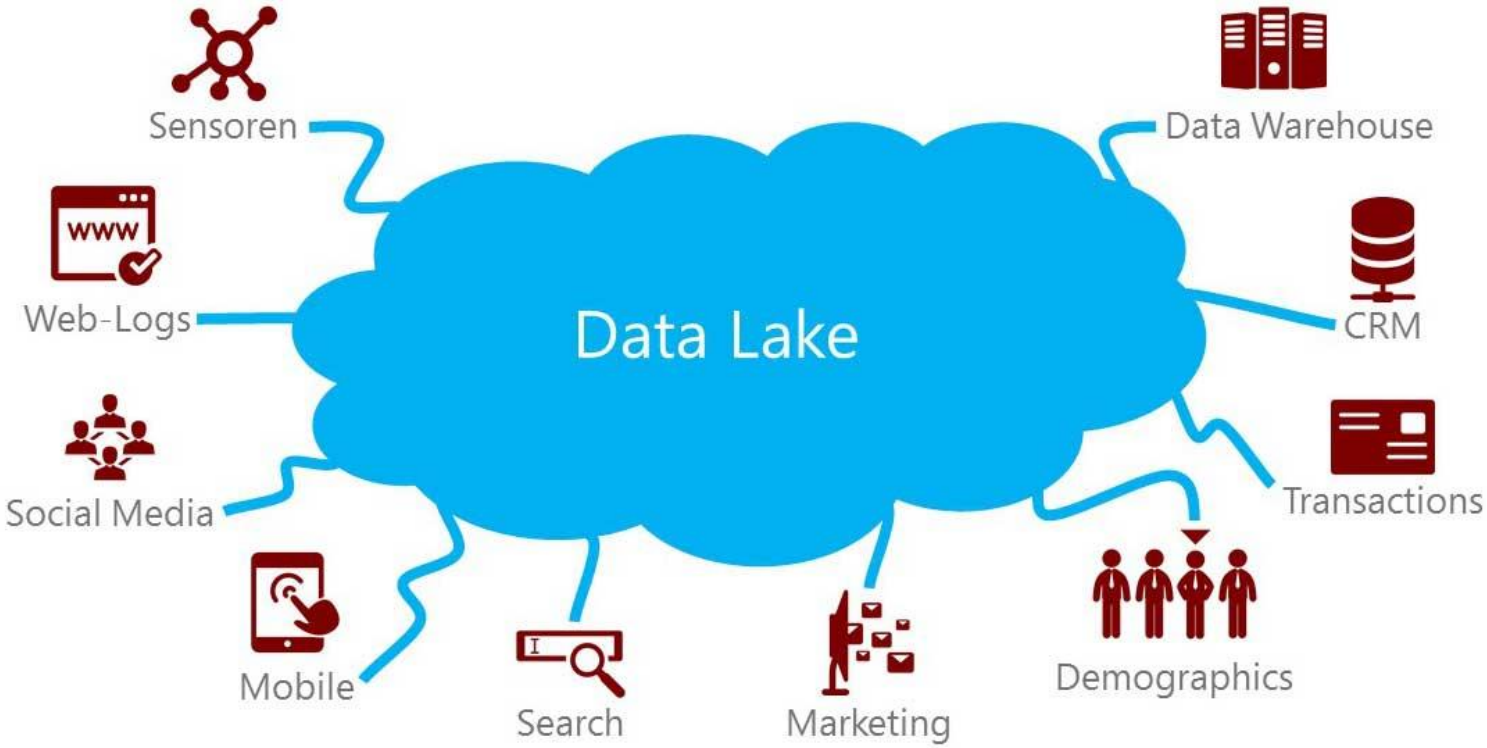
IIoT Technologies:
- Analytics and Cloud Computing

Cloud Computing

- All computer infrastructure on the internet
- Pay for what you use
- Unlimited storage and processing capability
- Access to high-powered analytics

Cloud Computing

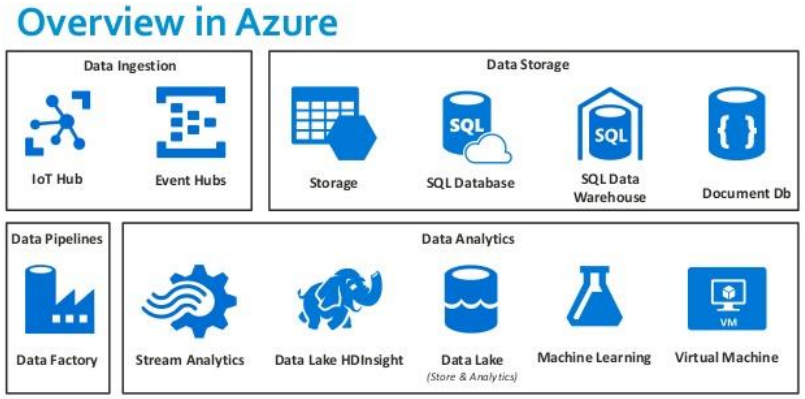
- Data Lakes
  - Massive data storage
  - Across multiple locations
  - From different users and devices



Cloud Computing

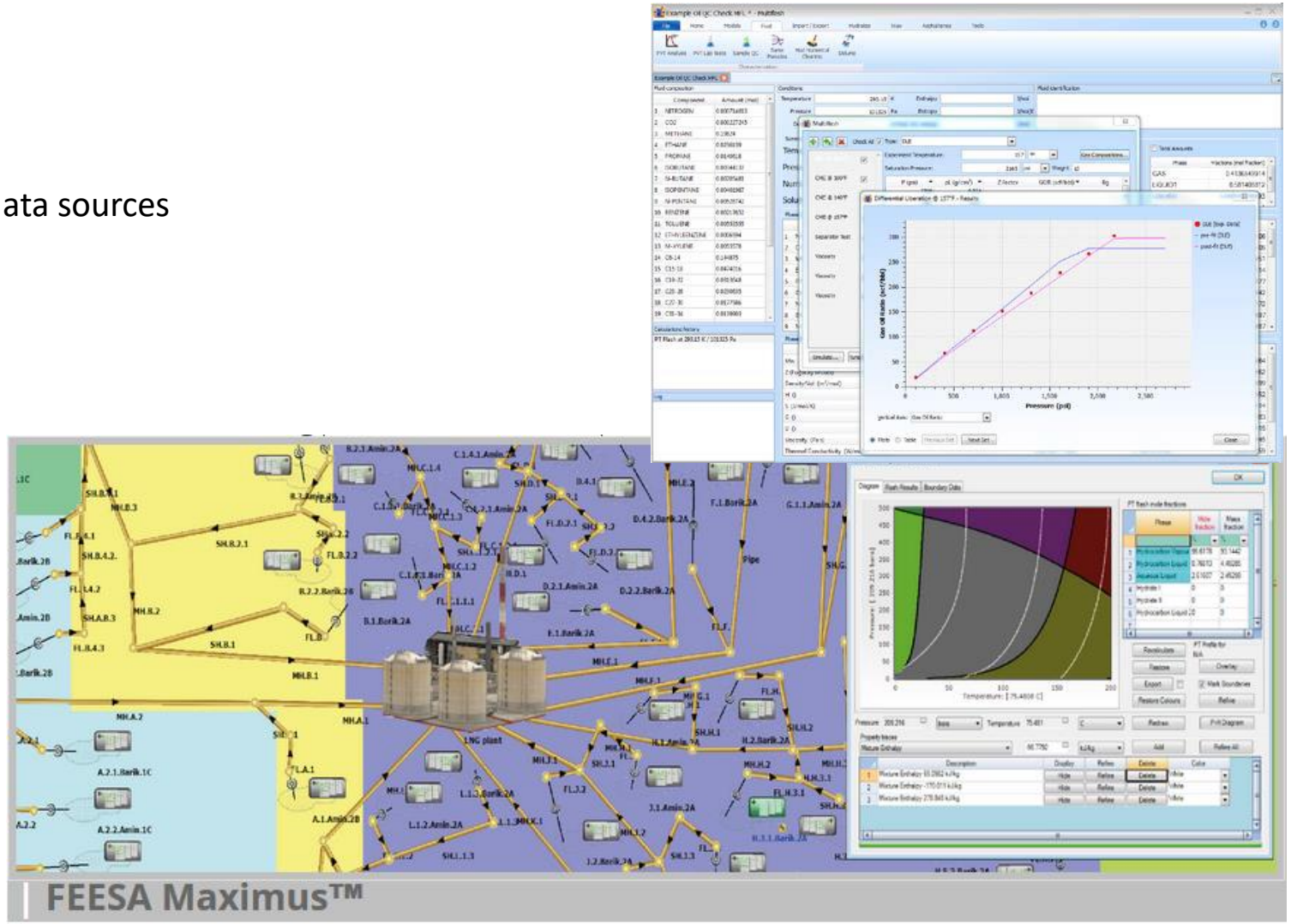
- Data Analytics
  - Converts data to information … and information to knowledge
  - Analyses large amounts of data and data profiles
  - Correlates different types of data and information

- Platform providers
  - Microsoft Azure
  - Google Analytics
  - Amazon AWS

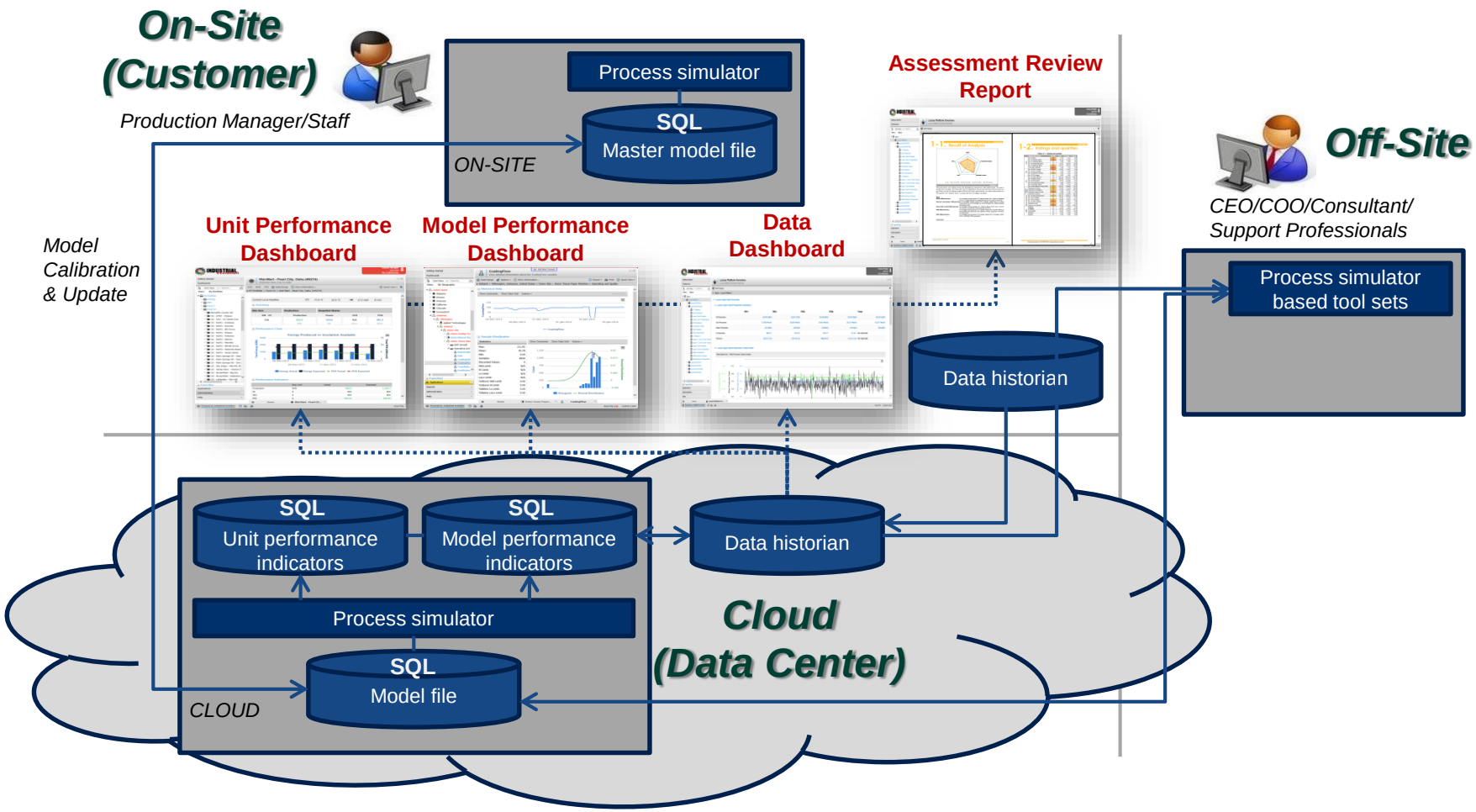


Cloud based modelling

- Subsea Applications
  - Model well performance
  - Knowledge based system based on multiple data sources
  - Compare against actual
  - Predict well life
  - Identify areas for optimisation

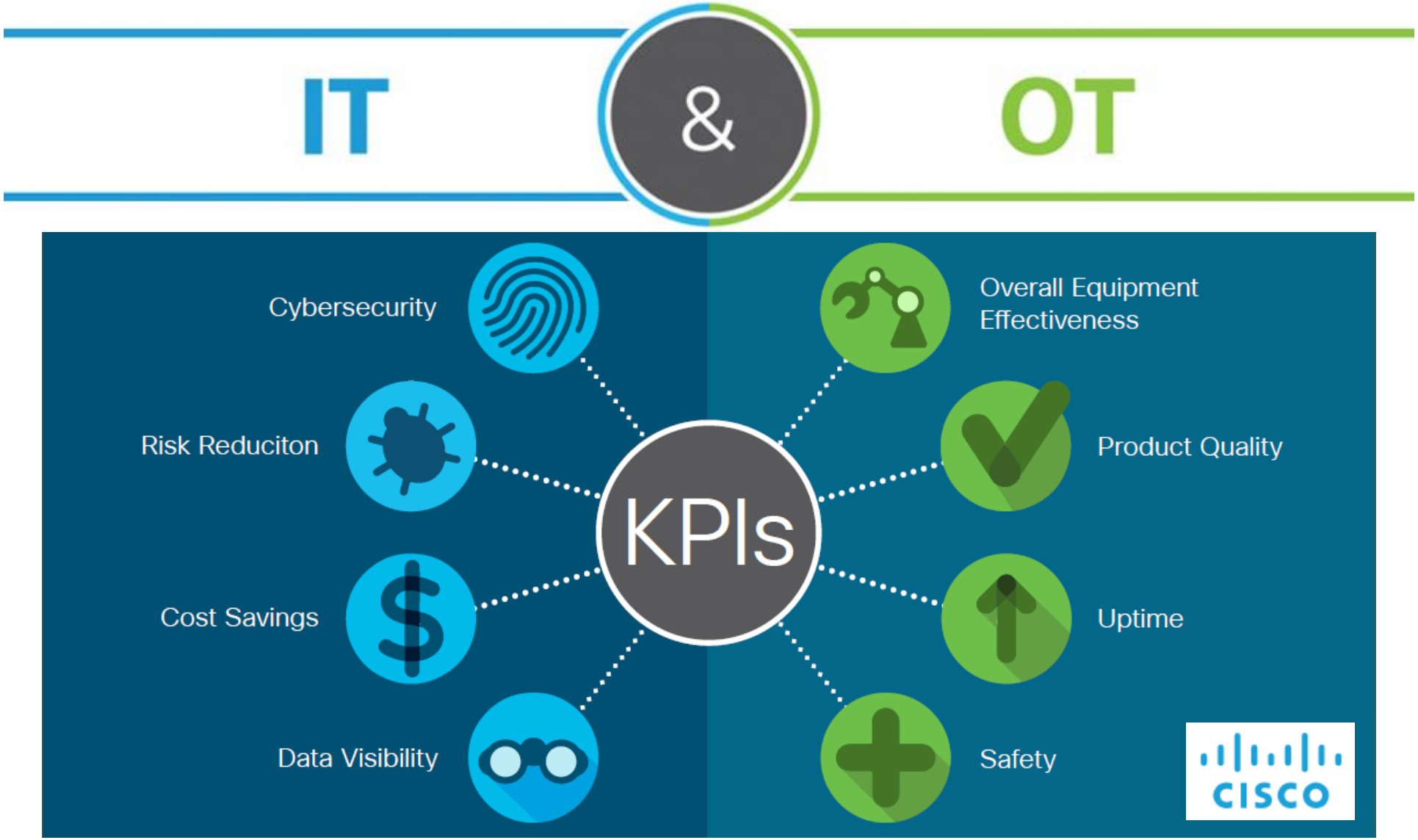


Example of a closed loop cloud-based system



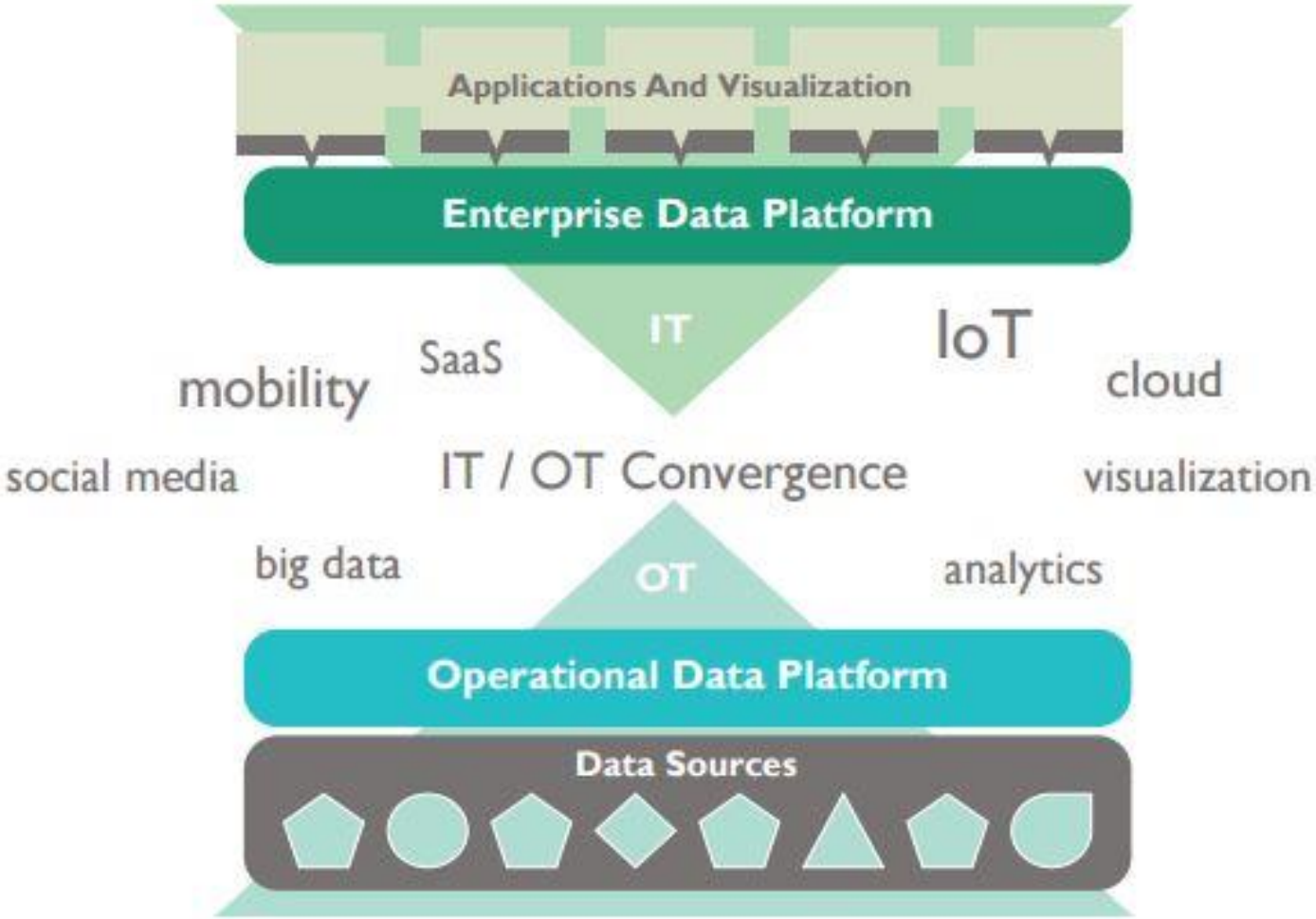
Challenges and Benefits

IT/OT Convergence – Different Priorities



Benefits

- Improved asset management
- Greater insight into well performance
- Better integration between systems and information
- Wireless – fewer subsea connections
- Improved reliability
- Opportunities for optimisation



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