OCEAN OBSERVING INFRASTRUCTURE AND SENSING TECHNICAL LESSONS LEARNED AND BEST PRACTICES

IMPROVED POWERING SOLUTIONS FOR SUBSEA CABLED OBSERVATORIES

Alcatel-Lucent Submarine Networks (ASN)

MBARI, Moss Landing, CA, September 24th, 2016

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IMPROVED POWERING SOLUTIONS FOR SUBSEA CABLED OBSERVATORIES
RELEVANT EXPERIENCE

ASN has contributed to the following projects:

- MARS (MBARI)
  - Cable, MVC
- NEPTUNE Canada (UVic/Ocean Networks Canada)
  - Installation, Cable, Repeaters, BUs, Subsea Node Elements (MVC, WDM, Routers…)
- NEMO (INFN)
  - Cable, MVC
- ANTARES (CPPM)
  - Cable
- MEUST (CPPM)
  - Cable

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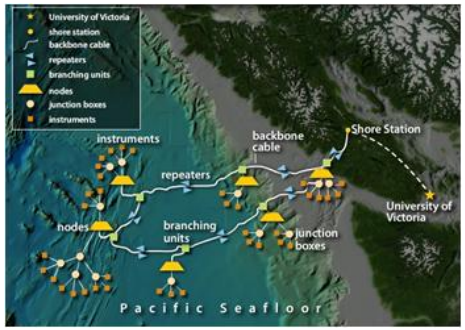
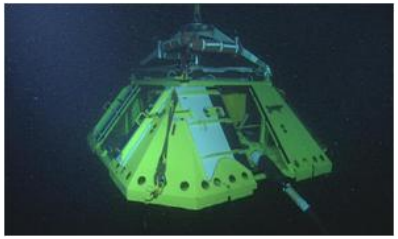
NEPTUNE CANADA

- 800 km subsea cabled infrastructure at water depth up to 2700 m with 6 subsea node locations supplying subsea power and communication connection points for scientific equipment (1GbE optical fiber and 400V DC interfaces)
- Cabled infrastructure powered from shore through 10kV DC on trunk, with 10kW maximum power supply capability per subsea node





System supplied and installed by ASN and partners

In operation since August 2009

IMPROVED POWERING SOLUTIONS FOR SUBSEA CABLED OBSERVATORIES
NEPTUNE CANADA (AND OTHERS) LESSONS LEARNED

- Parallel power feeding (grid mode) relative complexity
  - Local earths required for each MVC
  - Four state 10KV power switching BUs
  - Complex management of minimum current in all backbone cable sections (dummy loads)
  - Complex MVC design (individual converters synchronization, 10KV insulation constraints, coolant, bellows…)

- Node design
  - Serviceable node concept resulting in added complexity (foam, TRF…)
  - 10kV DC wet-mate connector

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MVC2 SOLUTION OVERVIEW

- A **simpler** and **more reliable** design based on **constant current**
- **No connector** on the upstream (HV DC) side (cable joints only)
- No **power switching** BU
- **Dual Conductor Cable** (no local electrodes, lower electrical field…)
- ASN **mechanical** node design
- Initiated by Statoil (Norway) for Oil & Gas Subsea Control (AKA DCFO)

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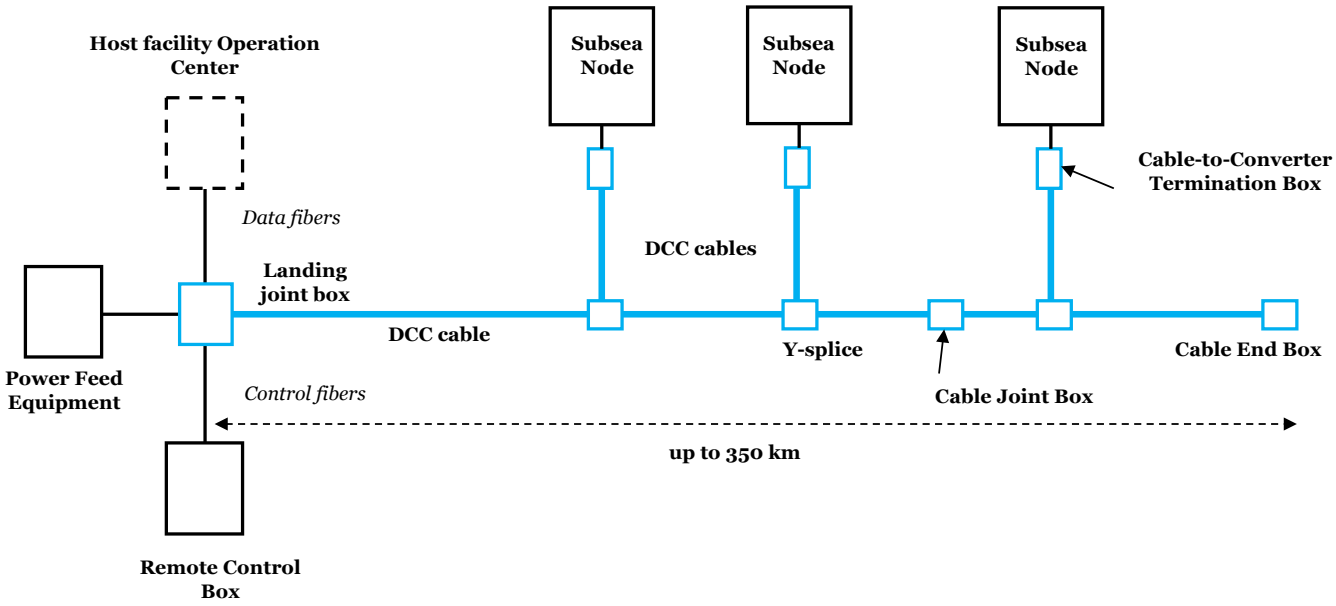
MVC2 SOLUTION DIAGRAM



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IMPROVED POWERING SOLUTIONS FOR SUBSEA CABLED OBSERVATORIES
MVC2 SOLUTION OVERVIEW

Main characteristics :

- Typically up to **eight** Subsea Nodes per submarine cable, fed from host facility with high voltage DC
- Subsea user connection points available at each Subsea Node:
  - **Two** optical fiber wetmate connectors
  - **Four** 400V DC (or **two** 220V, 400V or 500V AC) wetmate connectors

    (up to 4 x 2.5kW power supply capacity per Subsea Node)
- **Standardized** building blocks (one DCC cable design)
- Long **reach** (350km +), more with repeaters (similar to NEPTUNE Canada)
- Scalable, **extendable** and repairable, possibly in service
- High grade **reliability**

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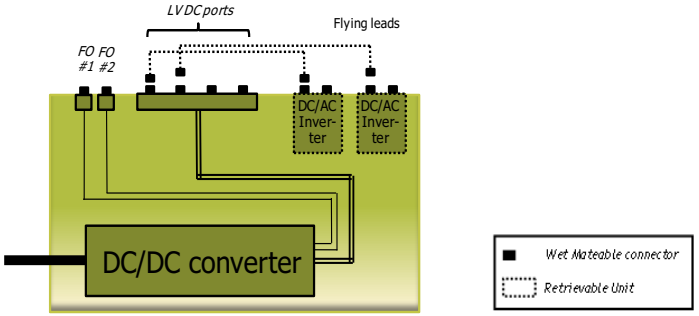
MVC2 SOLUTION OVERVIEW – SUBSEA NODE

- The **subsea node** is a subsea equipment delivering 4 x 2.5kW DC (or AC) and 8 optical fiber connection points with host facility, accessible through 2 wet mate connectors
- Sub-systems involved:
  - One High Voltage DC to Low Voltage DC converter
  - Two **optional** Low Voltage DC to Low Voltage AC inverters
  - Electrical & optical distributions
  - A mechanical frame with seabed interface (mudmat or other)



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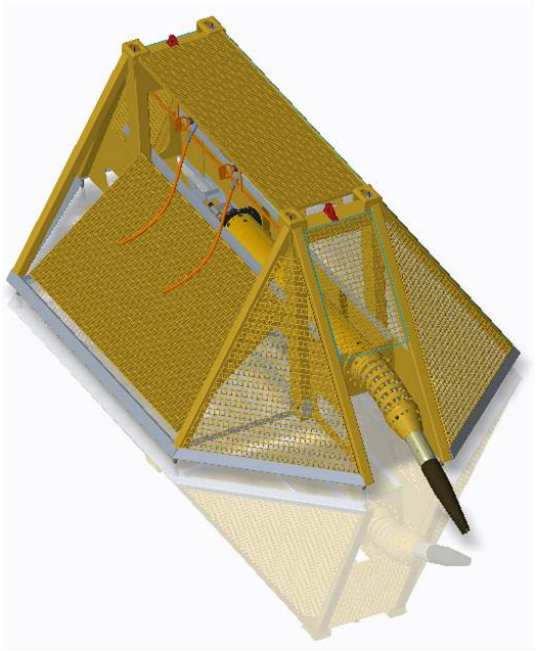
MVC2 SOLUTION OVERVIEW – SUBSEA NODE



Development/Qualification phase

- T0 in November 2011
- 1st model developed in 2012 to demonstrate feasibility and verify concept at system level
- Iterative development of models completed in 2013-2014 period (3 steps)
- Qualification started at the end of 2014
- End of qualification Q4 2016

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Every success has its network

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