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Ultra-high availability in subsea cable networks

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Strategic competence and research manager

How can sub-sea fibre networks be designed for ultra-high availability?



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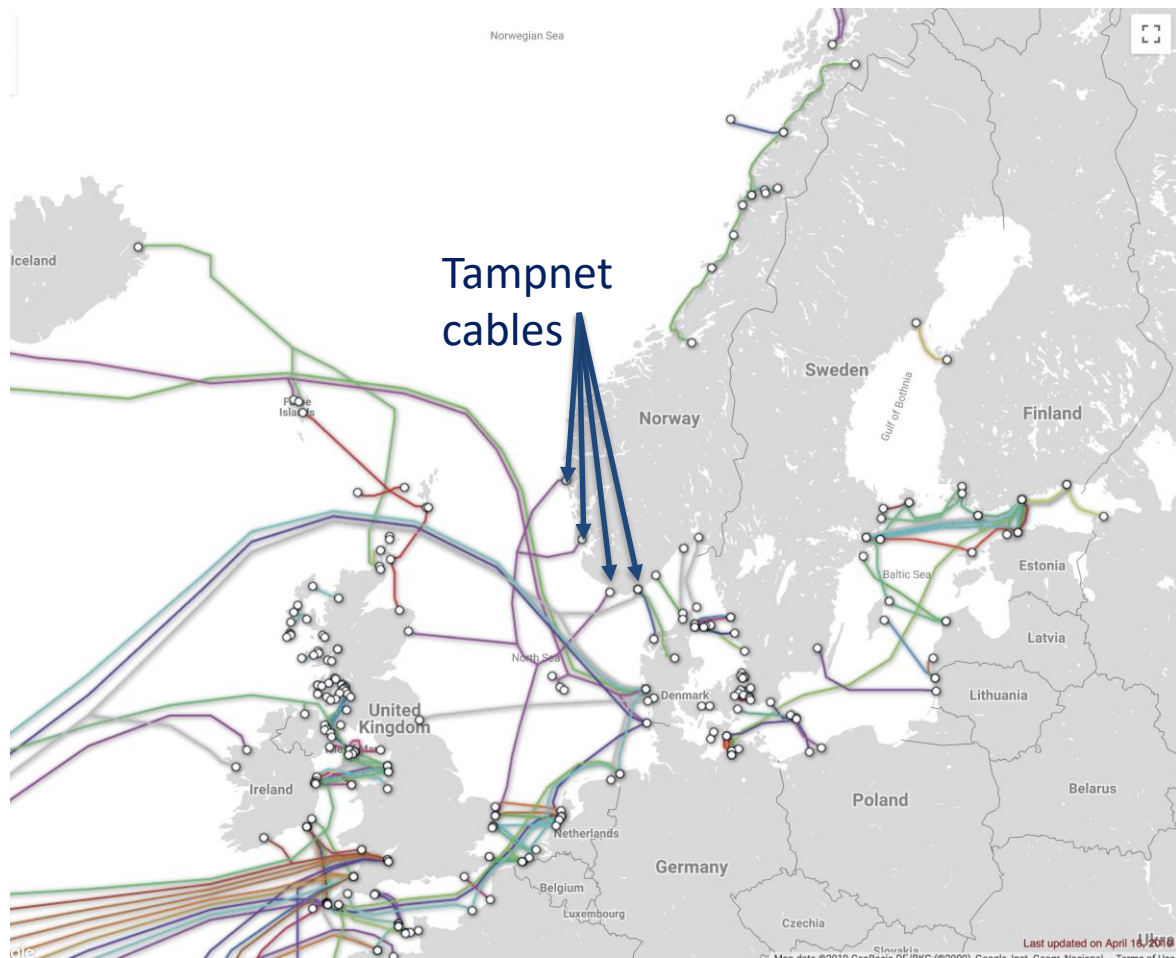
Outline

- Datacenters and diversity requirements
- Passive subsea fibre cables and offshore installations
 - Fibre-cable Installation
 - Optical amplifiers, optical switches, passive cables
- Availability
 - Stability of power source
 - Optical protection switching
- Tampnet sub-sea network key functionality



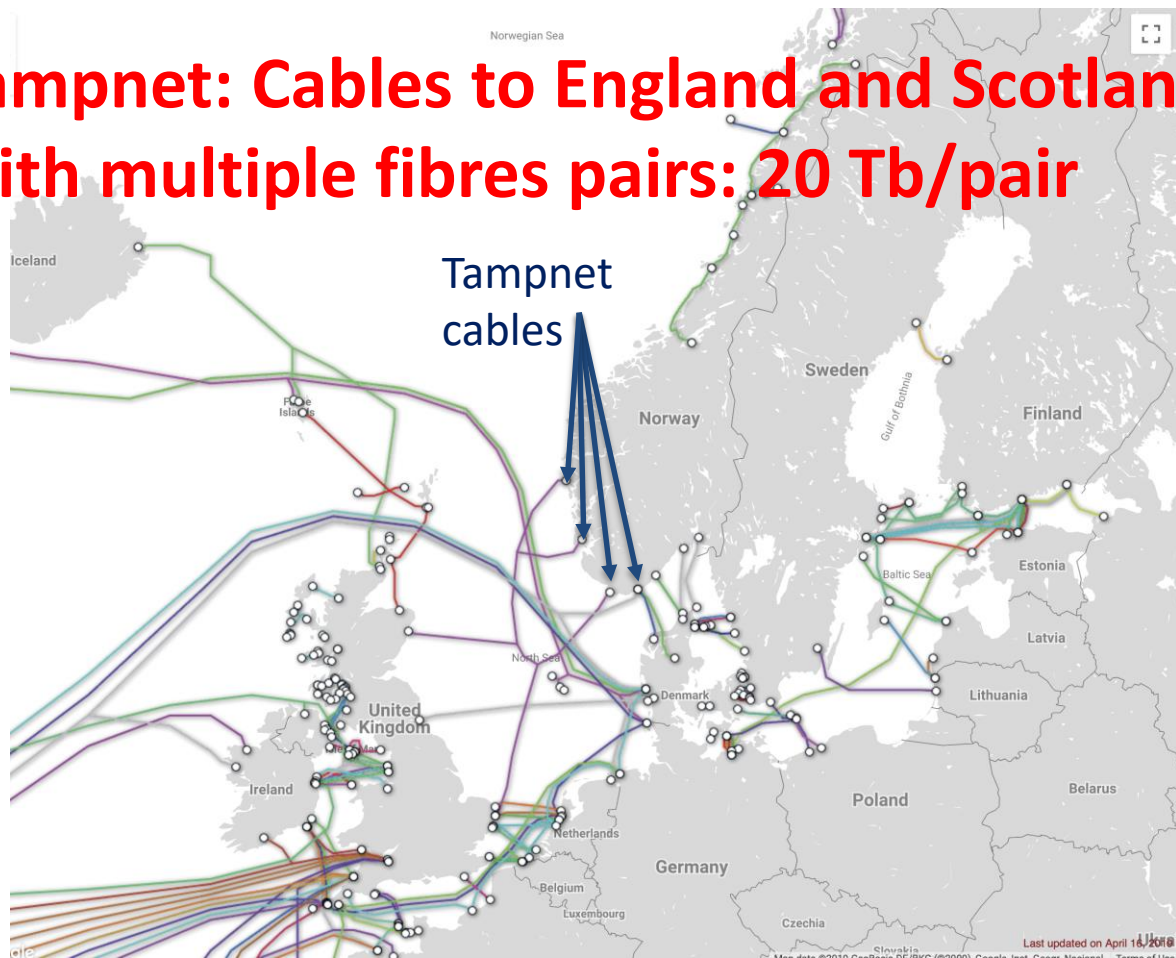
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Redundant fibre connectivity is key



Redundant fibre connectivity is key

**Tampnet: Cables to England and Scotland
with multiple fibres pairs: 20 Tb/pair**



Tampnet business areas

We deliver unparalleled connectivity for your business critical operations.



Oil & Gas



Offshore Wind

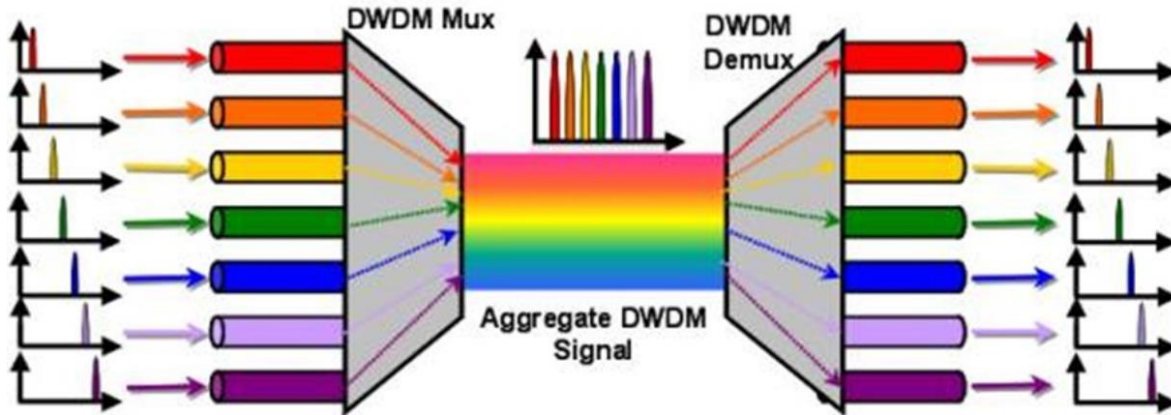
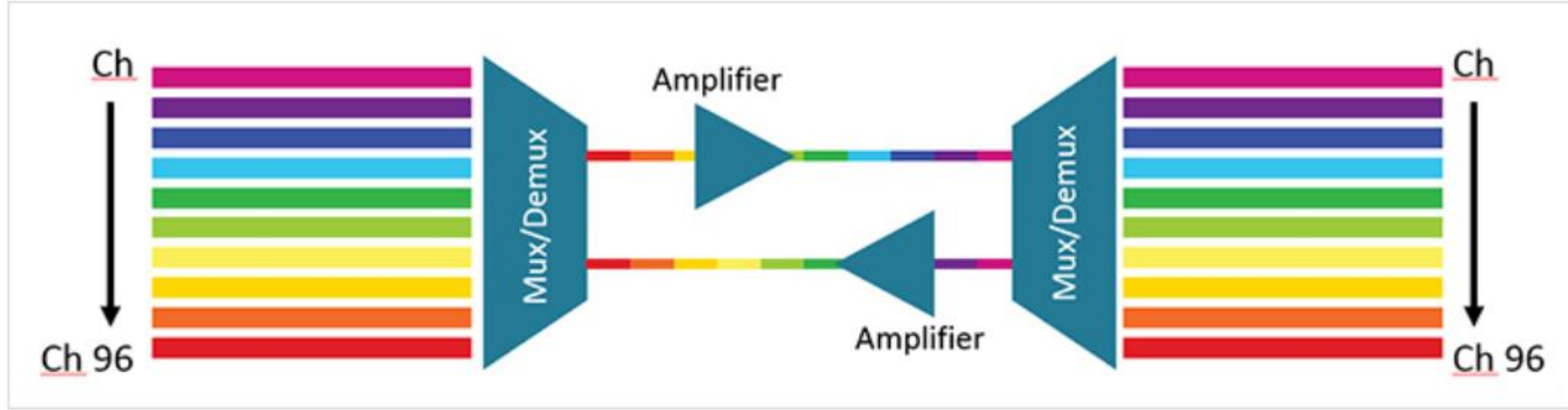


Maritime



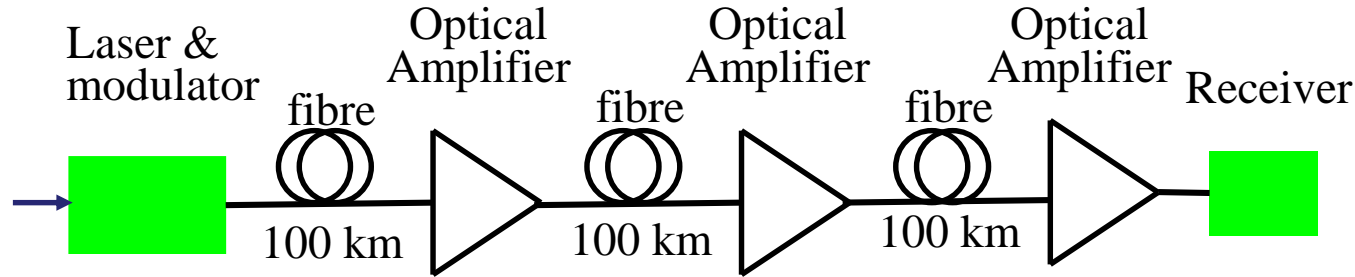
**International
Carrier**

Dense Wavelength Division Multiplexing (DWDM)

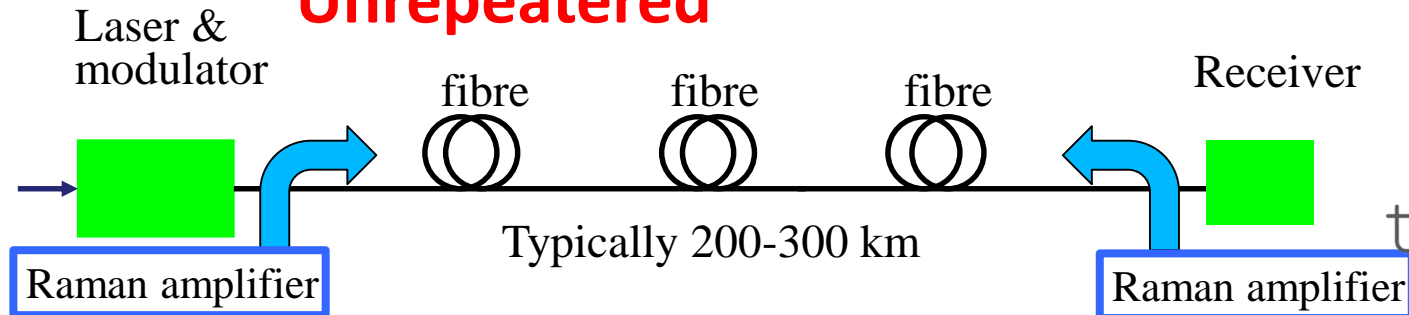


Repeated versus unrepeated

- Active amplifiers along the link:
Repeated

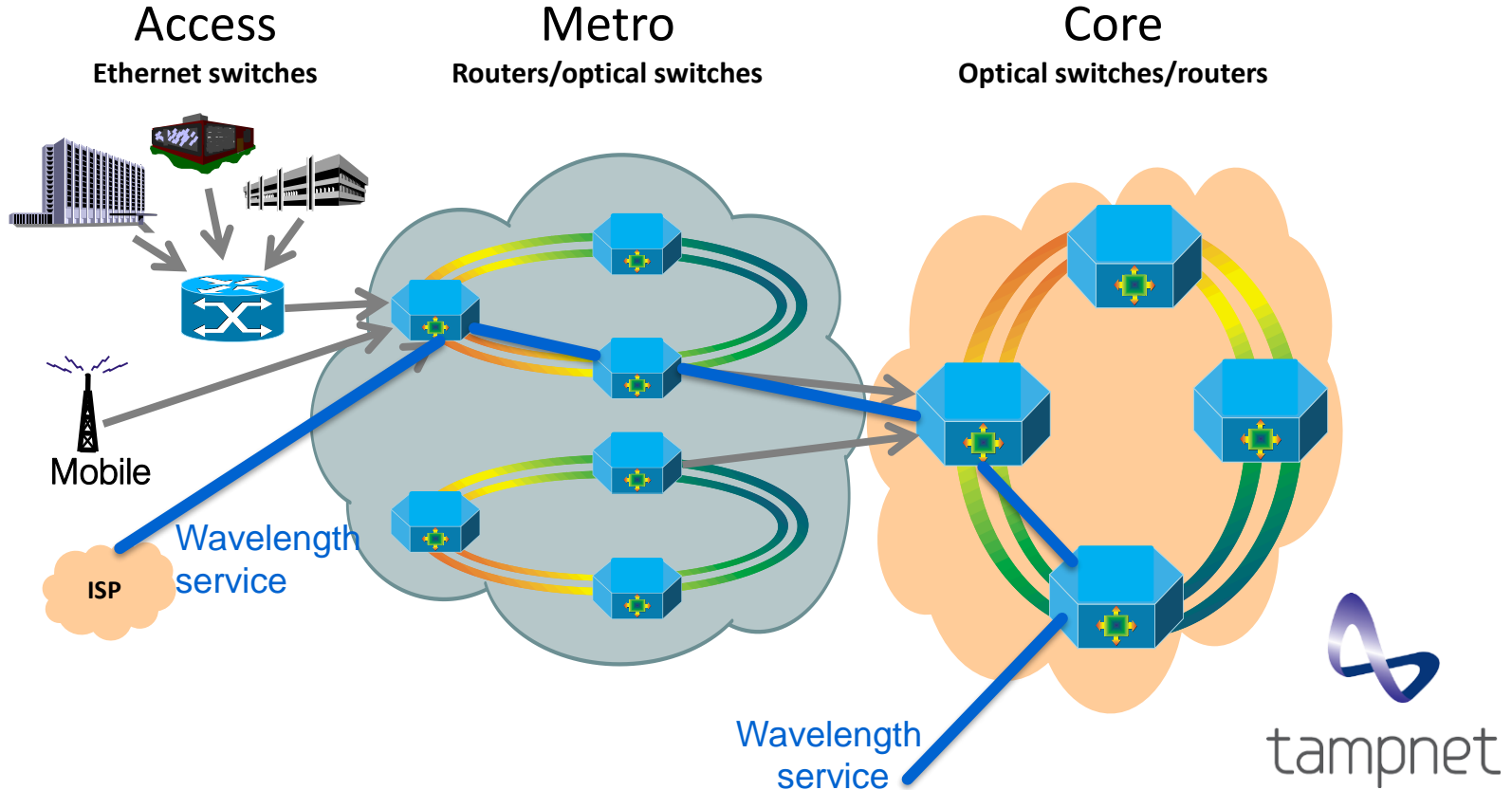


- Active amplifiers at end-points:
Unrepeated



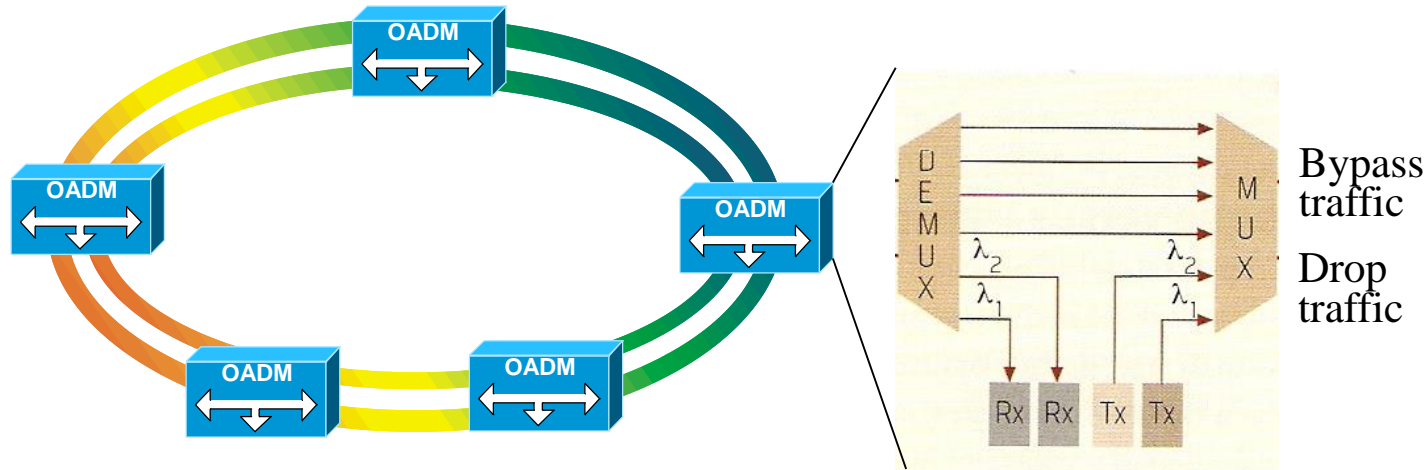
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WDM enables wavelength services



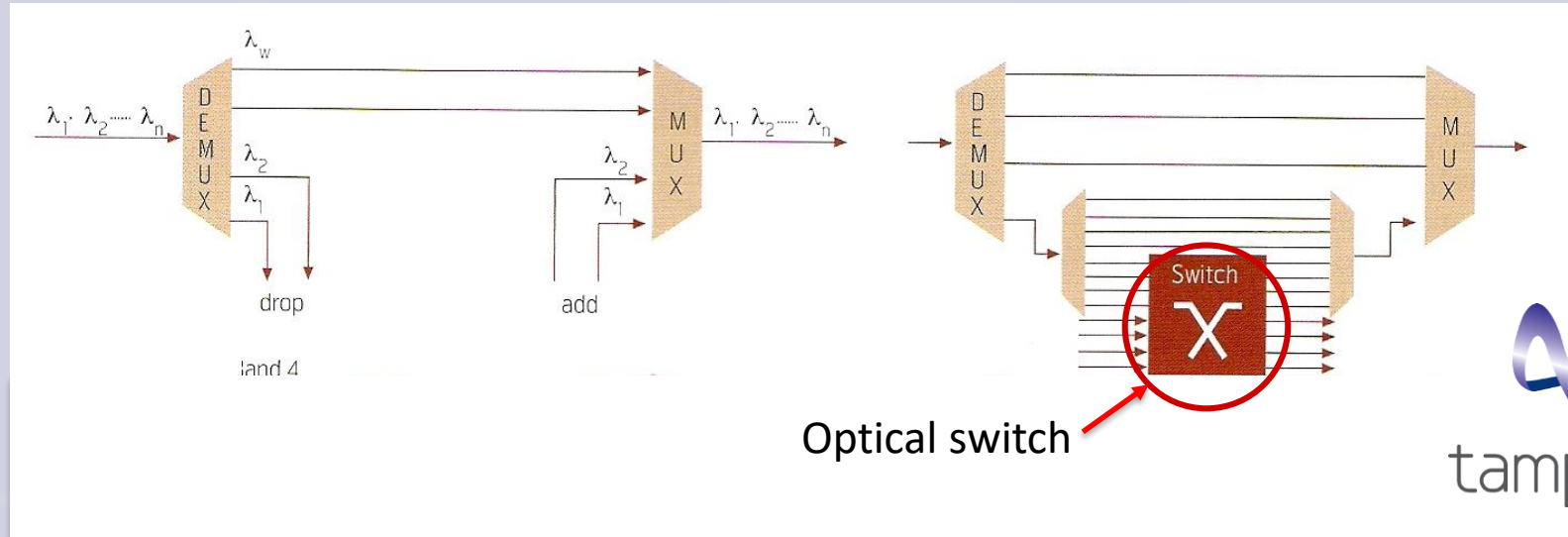
Optical add/drop multiplexer (OADM)

- Wavelength connectivity between network nodes can be created on top of e.g. a physical ring
- Bypass traffic is processed optically
- Specific wavelengths are added/dropped



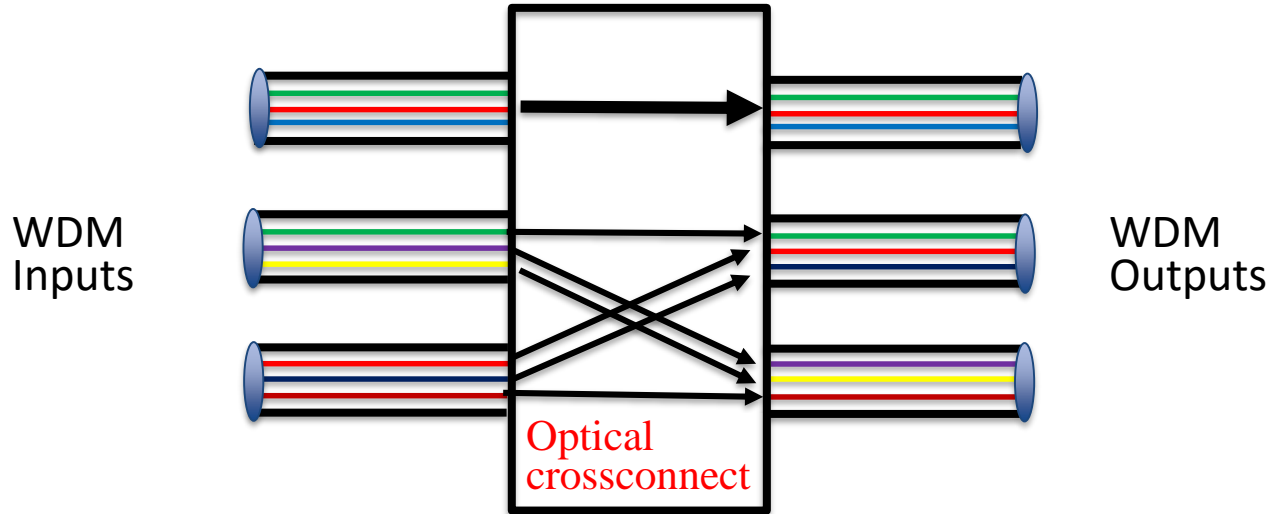
Reconfigurable (R-)OADM – optical switching

- A flexible and reconfigurable add-drop function
- Optical cross-connection of selected wavelengths
- Enables reconfigurable optical networks



Optical switching of wavelengths

- Wavelength Selective Switches (WSS): Cross-connection of wavelengths between several fibres
- Reconfiguration from a management system
- Optical protection switching



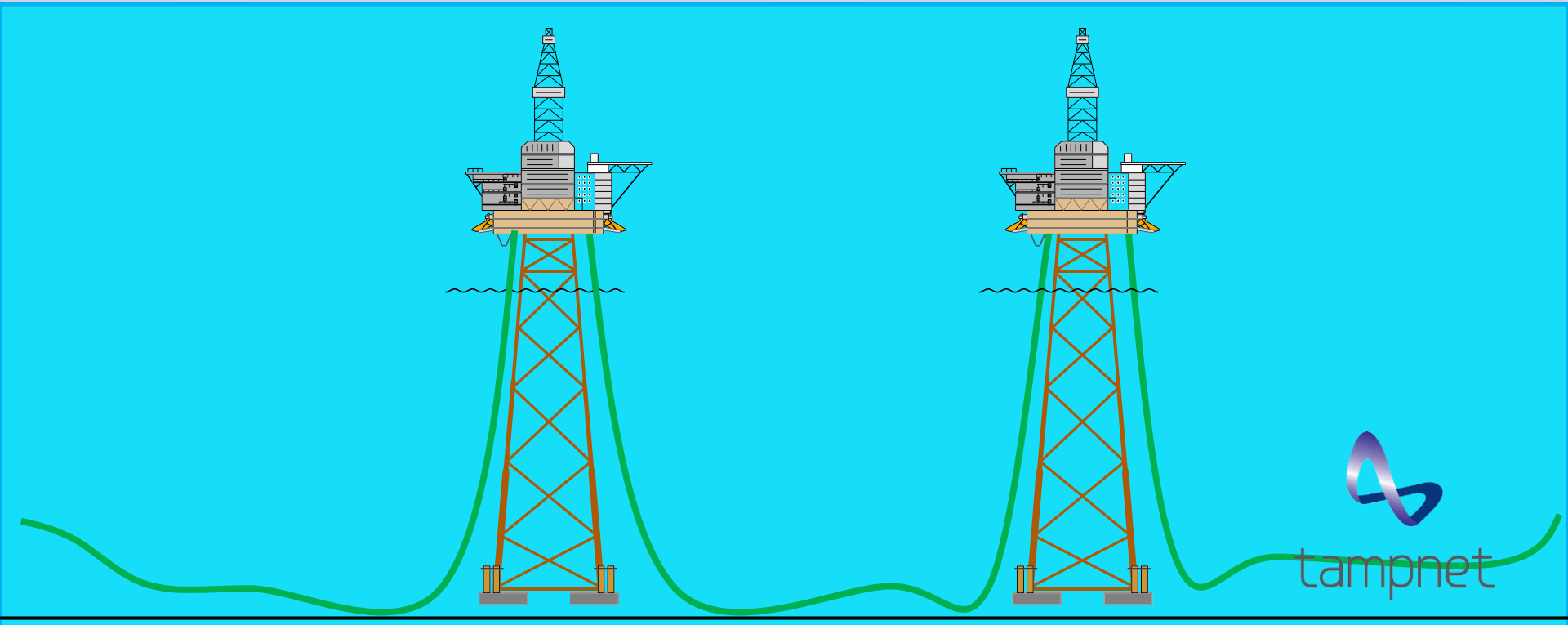
Passive subsea cables

- Fibre cable only – no power
- Long lifetime 35 years+
 - Lower complexity and cost: No active equipment on seafloor
 - No failures in electronics
 - Experience: No added attenuation after 20 year in the sea
 - No active equipment getting outdated
- Lower system cost than active cables

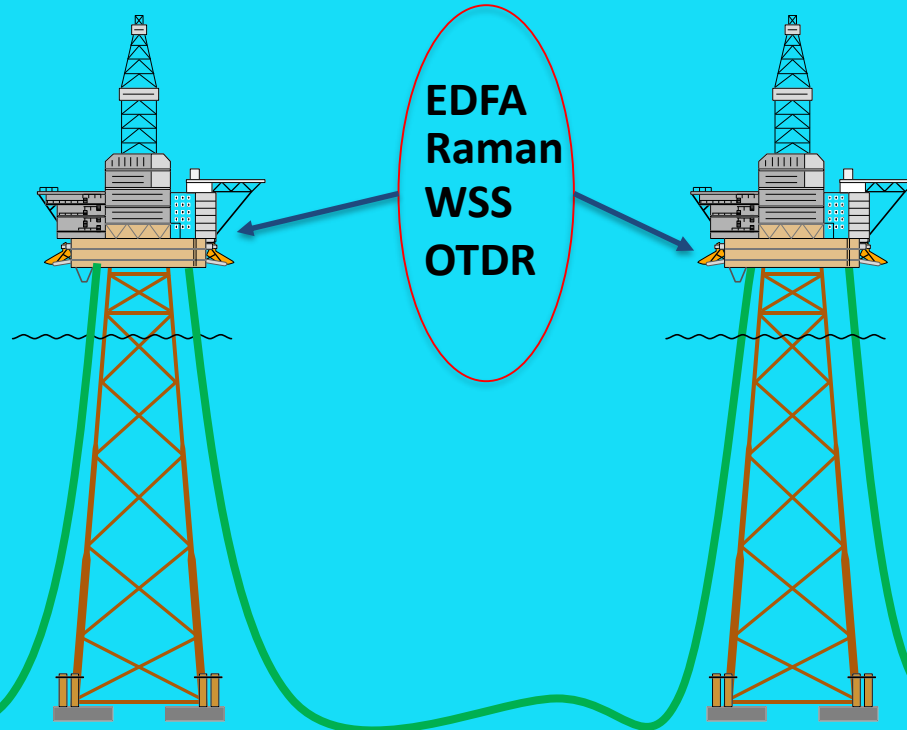


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Passive cables + offshore installations



Passive cables + offshore installations



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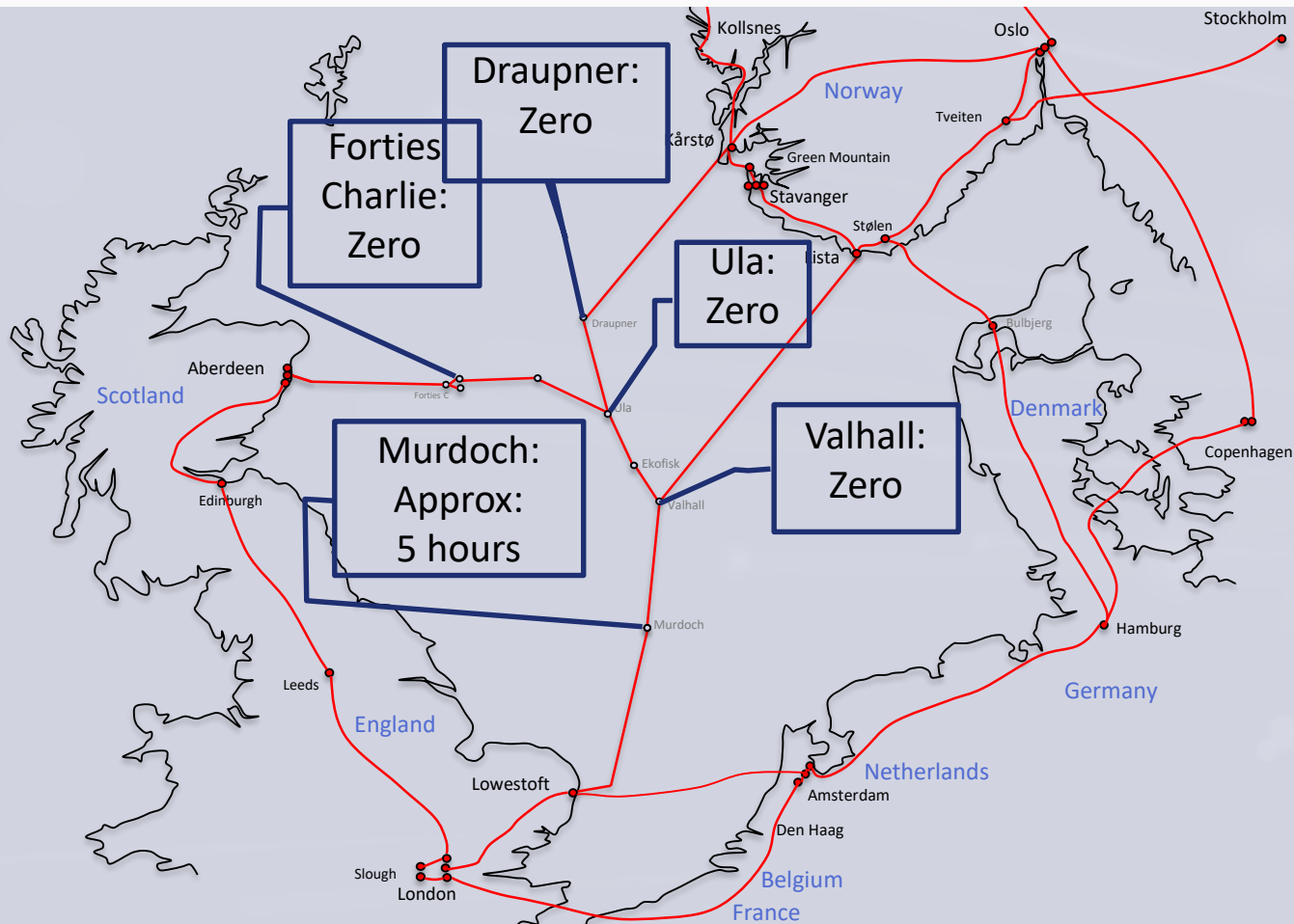
Passive cables + offshore installations

- Active equipment located in dry rooms at offshore installation
 - Deployment of up to date equipment when needed
 - Replaceable and upgradable active equipment
 - Limited span length enables capacity > 20 Tb/s per fibre pair
- Offshore installations have long lifetime
 - 35 years +
 - Floating installations may replace fixed installations
- Highly reliable power sources
 - Oil and gas are mission critical operations



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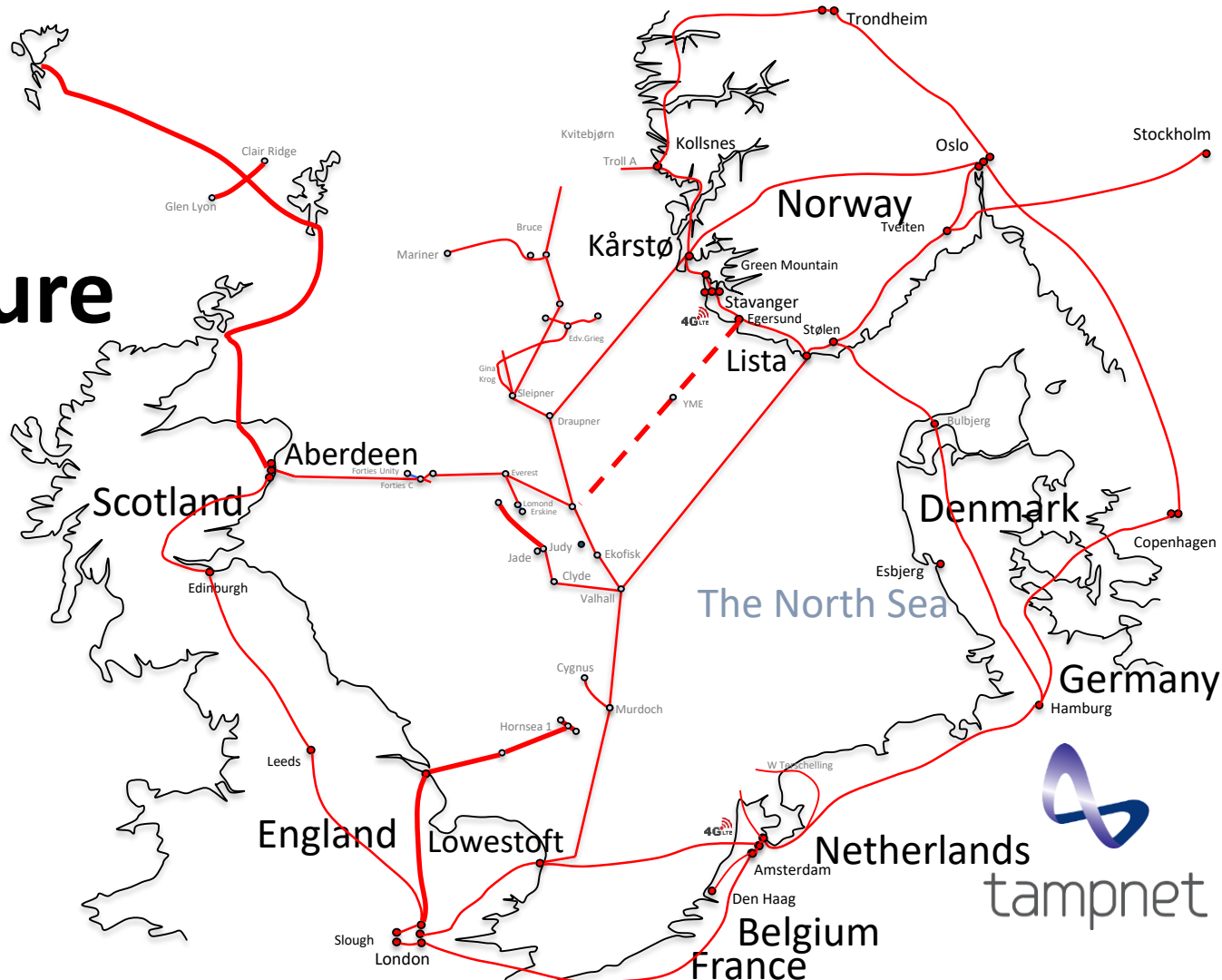
Unplanned power outages last 4 years



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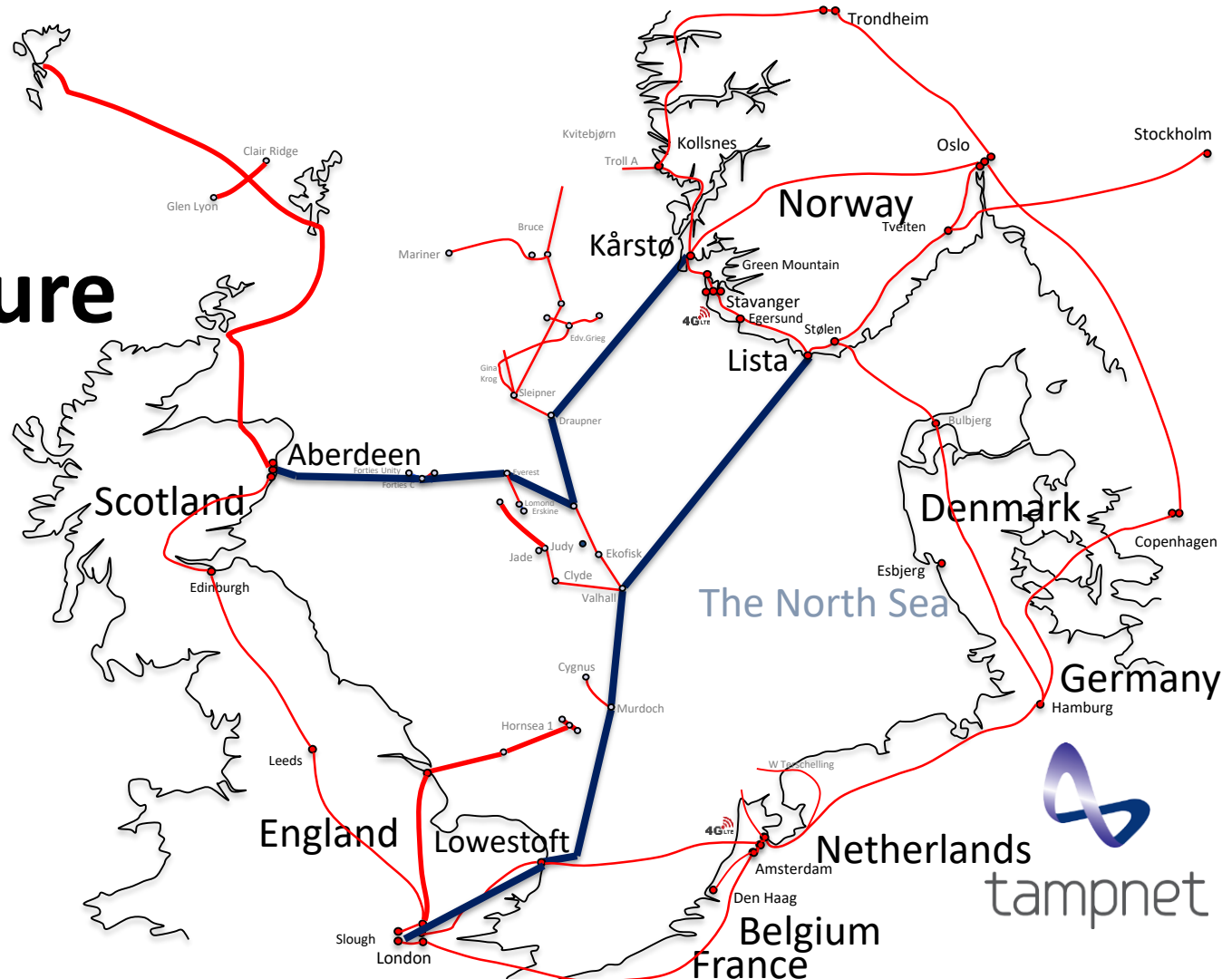
Tampnet Fibre Infrastructure

— Current fibre
- - - Ready Sept. 2019



Tampnet Fibre Infrastructure

— Routes across
the North-sea



Protection switching off-shore

— Routes across
the North-sea



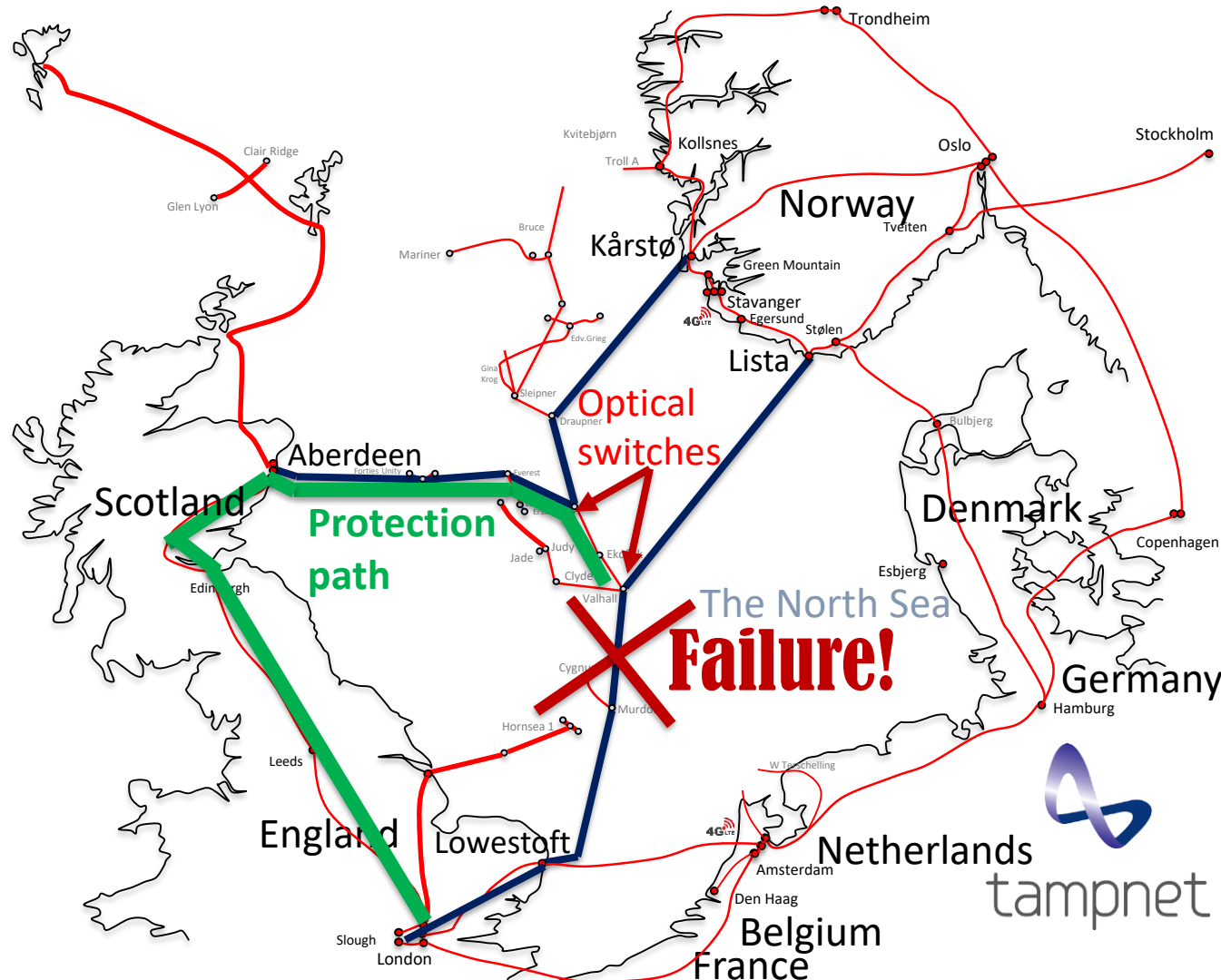
Protection switching off-shore

— Routes across the North-sea



Protection switching off-shore

— Routes across the North-sea



Network key functionality

- Off-shore optical protection switching
- Low latency routes across the North-sea
- Continuous OTDR monitoring on vacant fibre pairs
 - Attenuation
 - Potential damage/cut of cable
- Any new beneficial technology may be installed when becoming available
- Dark fibre offering: Different types of active equipment may be collocated offshore



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Summary

- Passive optical sub-sea cables and offshore installations
 - Deploy or upgrade to latest technology
 - > 20 Tb/s fibre capacity
 - Advanced monitoring
 - Power supply availability typically higher than onshore
- Ultra-high availability through optical protection switching
- Tampnet carries low-latency datacentre traffic to the Nordics



**Passive sub-sea fibre cables
combined with offshore
installations enables ultra-high
availability in sub-sea networks**



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