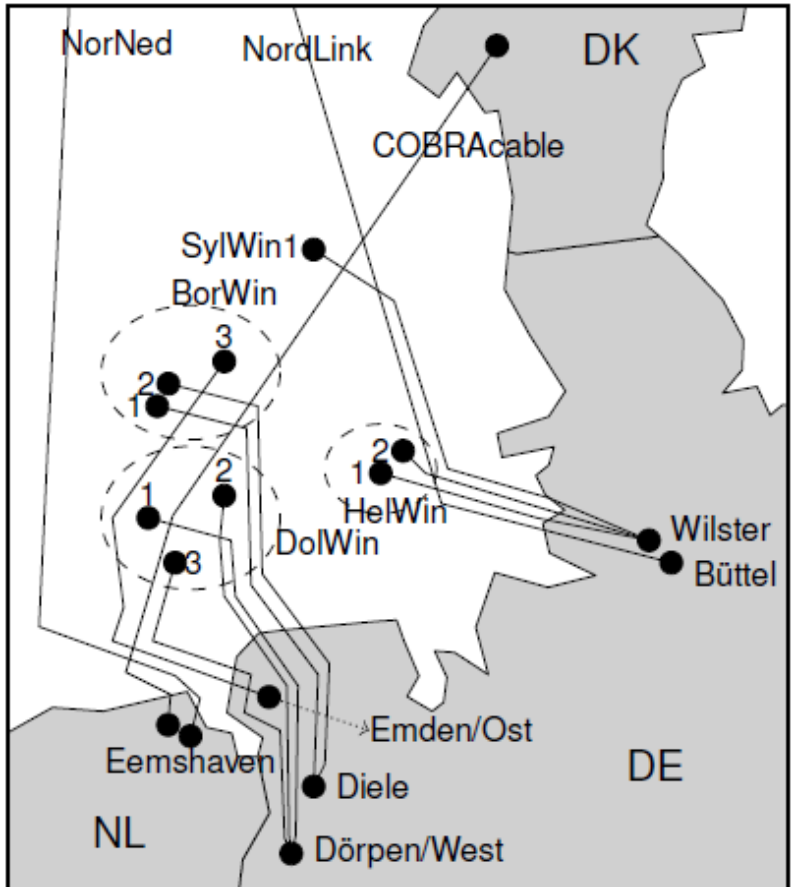
CONTROL CONCEPT FOR EXPANDABLE MULTI-TERMINAL HVDC TRANSMISSION SYSTEMS

FILIPE FARIA DA SILVA

The condition at North Sea



- Several HVDC links already in operation in the North Sea area:
  - Connecting two electricity areas
  - Importing offshore wind power
  - Powering an offshore oil/gas platform
- The North Sea has the highest concentration of HVDC links in the world
- All of these are point-to-point
- Supplied by various vendors

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The next step: to build multi-terminal systems

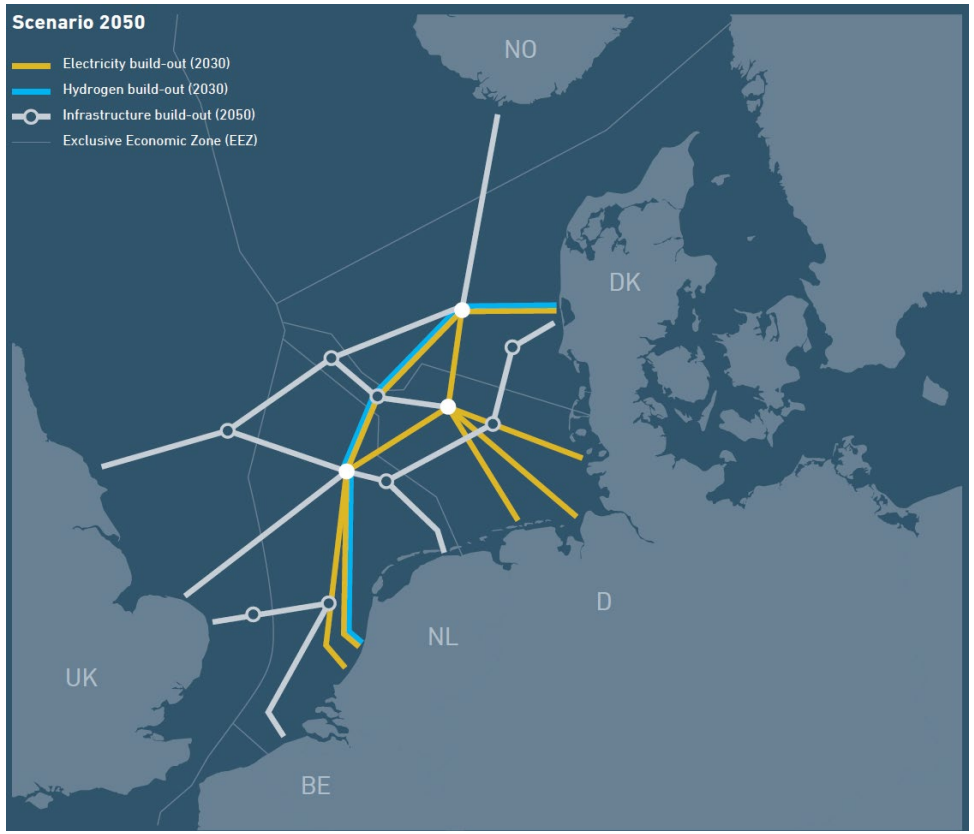

Figure Source: North Sea Wind Power Hub Programme
Unlocking the North Sea as a Green Powerplant

- Offshore wind targets for 6 North Sea Countries
  - 120 GW (2030)
  - 190 GW (2040)
- International electricity trading across North Sea
- Studies favour multi-terminal transmission systems
  - Improve flexibility
  - Increased security of supply
  - Better for environment
- An MTDC is expected to emerge:
  - Interconnecting two existing links or energy islands
  - Adding a new converter into an existing one

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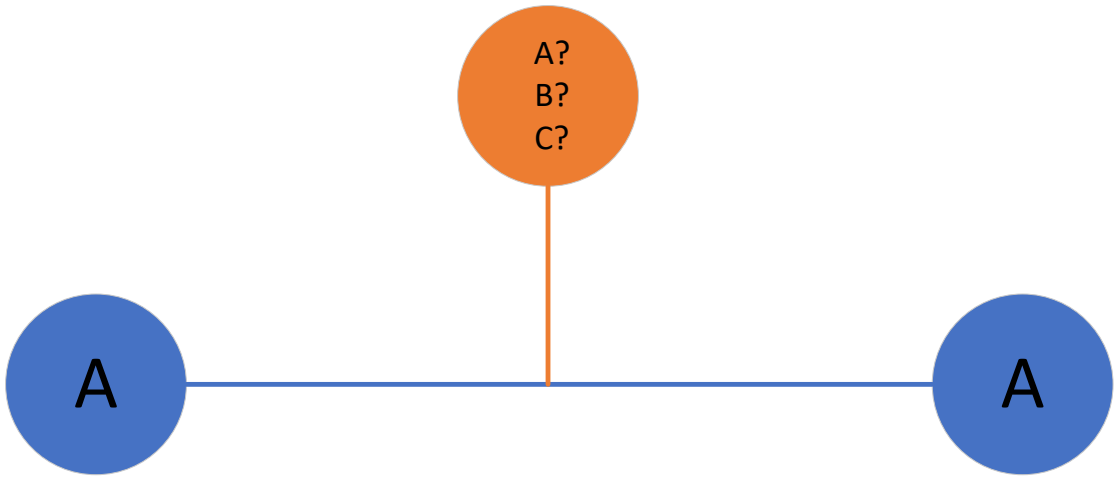
Challenges

- HVDC links will no longer remain as PtP links
- Even in built as MTDC, it should be possible to add new terminals

Challenges



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- Even in built as MTDC, it should be possible to add new terminals
- Expansions cannot be locked to the original technology vendor

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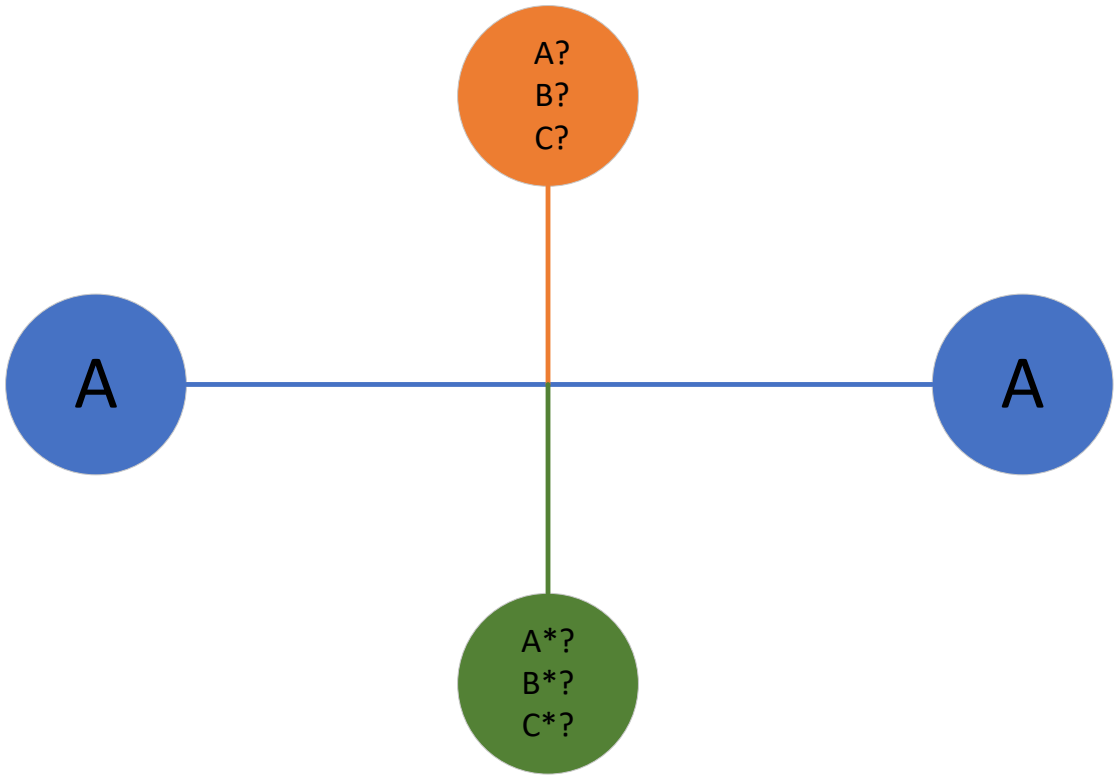
Challenges



- HVDC links will no longer remain as PtP links
- Even in built as MTDC, it should be possible to add new terminals
- Expansions cannot be locked to the original technology vendor
- It should be possible to integrate new HVDC solutions into the existing grid

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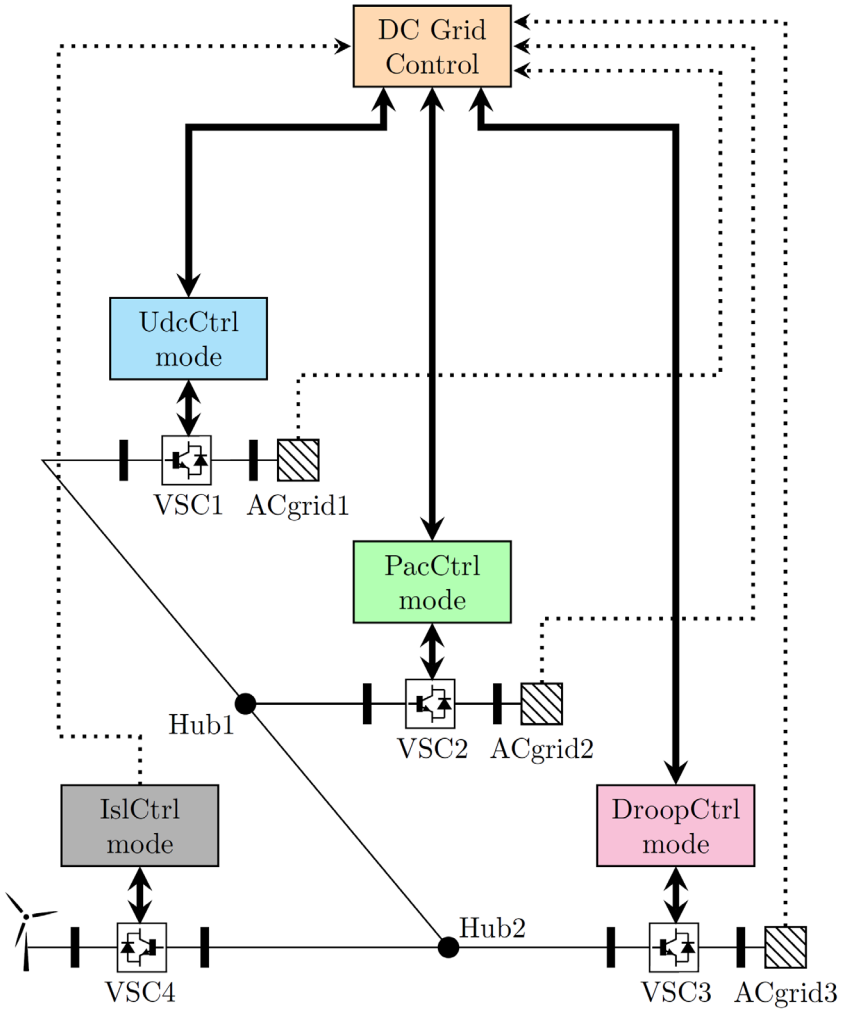
Challenges



- Standardize control system to enable the DC grid control is not yet available
- Each vendor has their own control approach
- The existing control system needs to be replaced to implement the DC grid control
- Studies cannot be performed, since the vendor specific models are black-boxed

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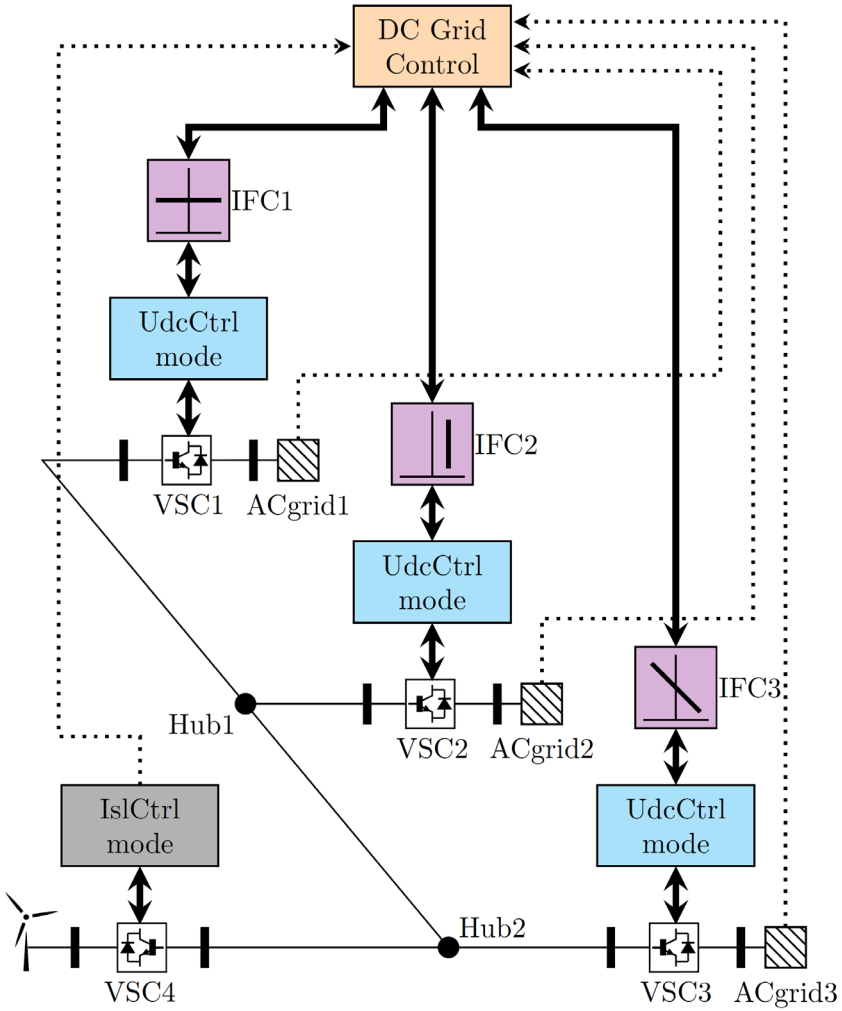
The primary control interface (IFC)



- A new interface (IFC) is proposed as an additional module to the existing control system
- Uses the existing DC voltage controller found in every link
- The IFC adjusts the reference such that the converter follows a specific characteristic
- Hence, no need to replace the existing system
- Simplifies the realization of a multi-vendor multi-terminal HVDC transmission system

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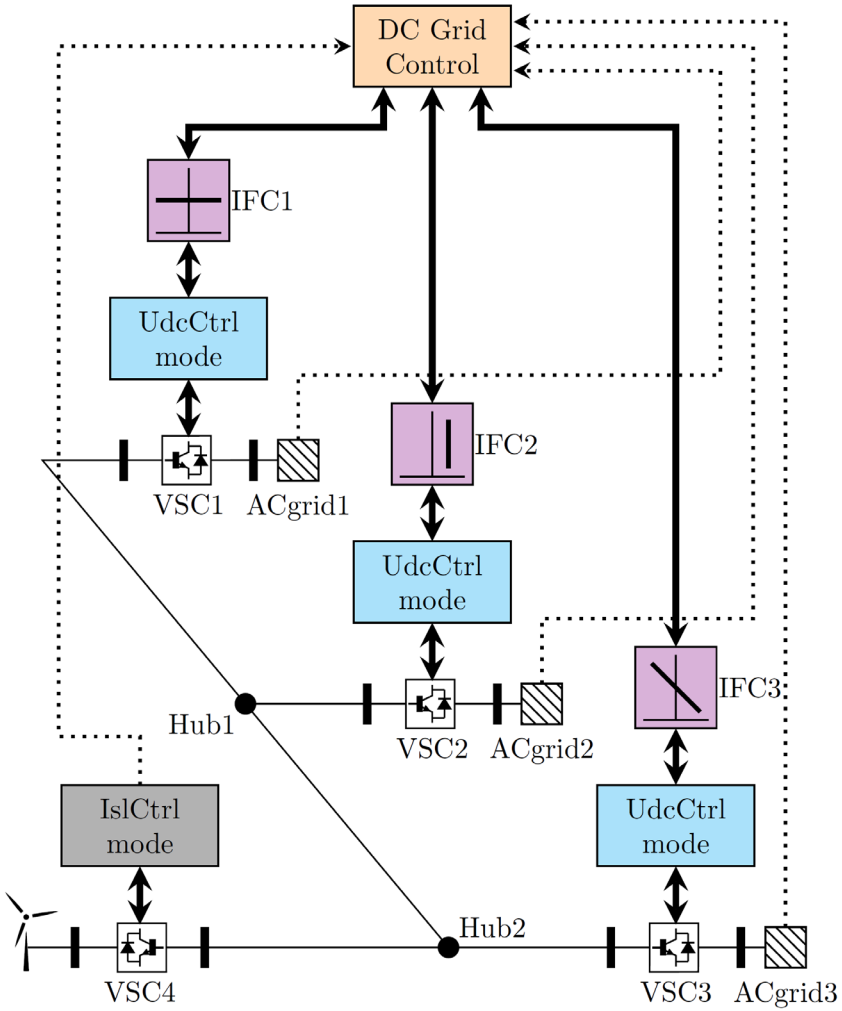
Implementation of the IFC



- The IFC has been implemented as an additional software
- It is expected to be used directly with the black-box models
- It has been proven with a vendor-specific black-box model

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