NOKIA

Multi-layer Modelling with ACTN

Abstraction issues and architectural implications

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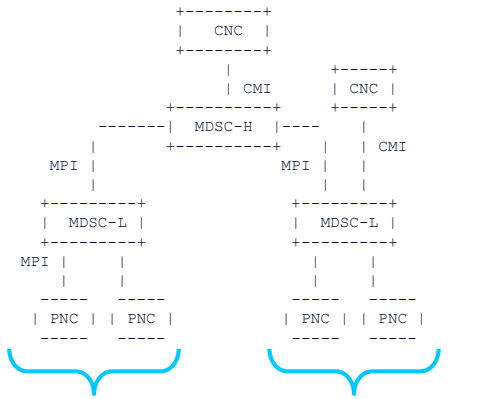
Introduction and problem statement
Applying the IETF ACTN framework to multiple technologies

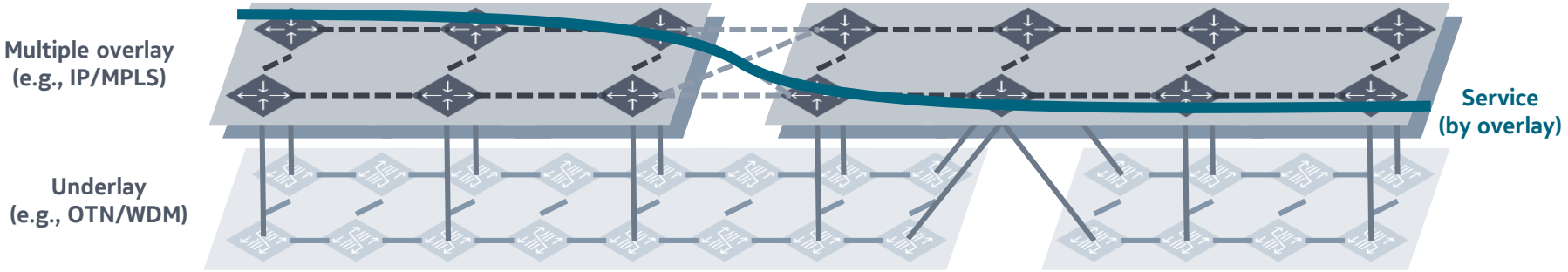
draft-ietf-teas-actn-framework-11

Another implementation choice could foresee the usage of an MDSC-L for all the PNCs related to a given technology (e.g. IP/MPLS) and a different MDSC-L for the PNCs related to another technology (e.g. OTN/WDM) and an MDSC-H to coordinate them.



- **Motivation**
  - Lots of existing analysis how to apply ACTN to single-technology transport networks
  - Discussions on how to apply ACTN to multiple transport technologies (e.g., IP/MPLS and OTN/WDM)
  - Architectures with a hierarchical coordinator (MDSC) for multiple technologies
- **Problem statement**
  - Multiple technologies can result in **multi-layer** traffic engineering (TE)
  - **Overlay/underlay mapping** to be analyzed
  - **For all customer-provider cases** (not only IP/MPLS over DWDM/OTN)

Multi-layer Traffic Engineering (TE) scenarios
Characteristics and use cases



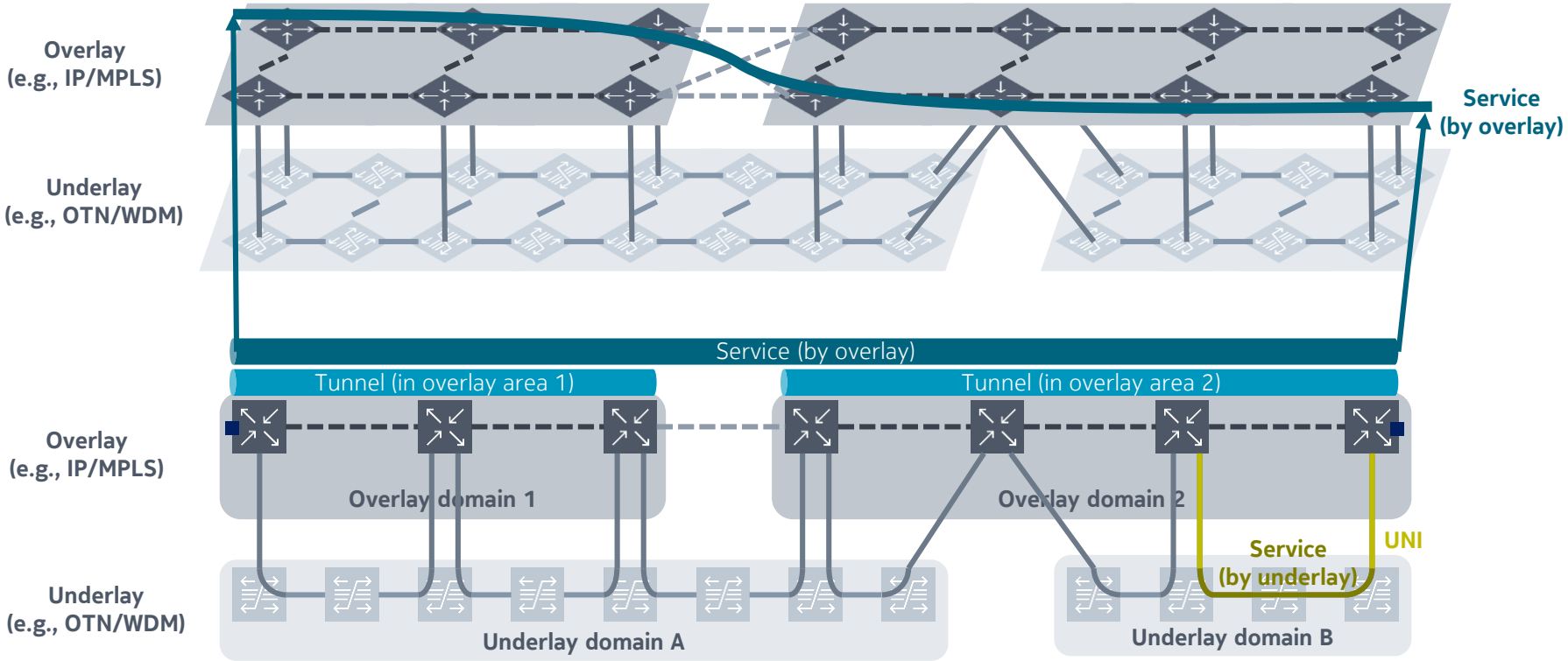
Typical multi-layer network characteristics

- A link in the overlay may be a path in the underlay (e.g., one IGP link can be an optical service over many ROADMs)
- Different area boundaries of overlays and underlay possible (e. g., one IP AS may use two different OTN/WDM networks)
- Overlay may be a “customer” of underlay (e.g., customer-provider relation between IP/MPLS and OTN/WDM)
- Underlay can be used by multiple overlays (not considered), and there can be underlay interconnections (not considered)

Multi-layer TE use cases

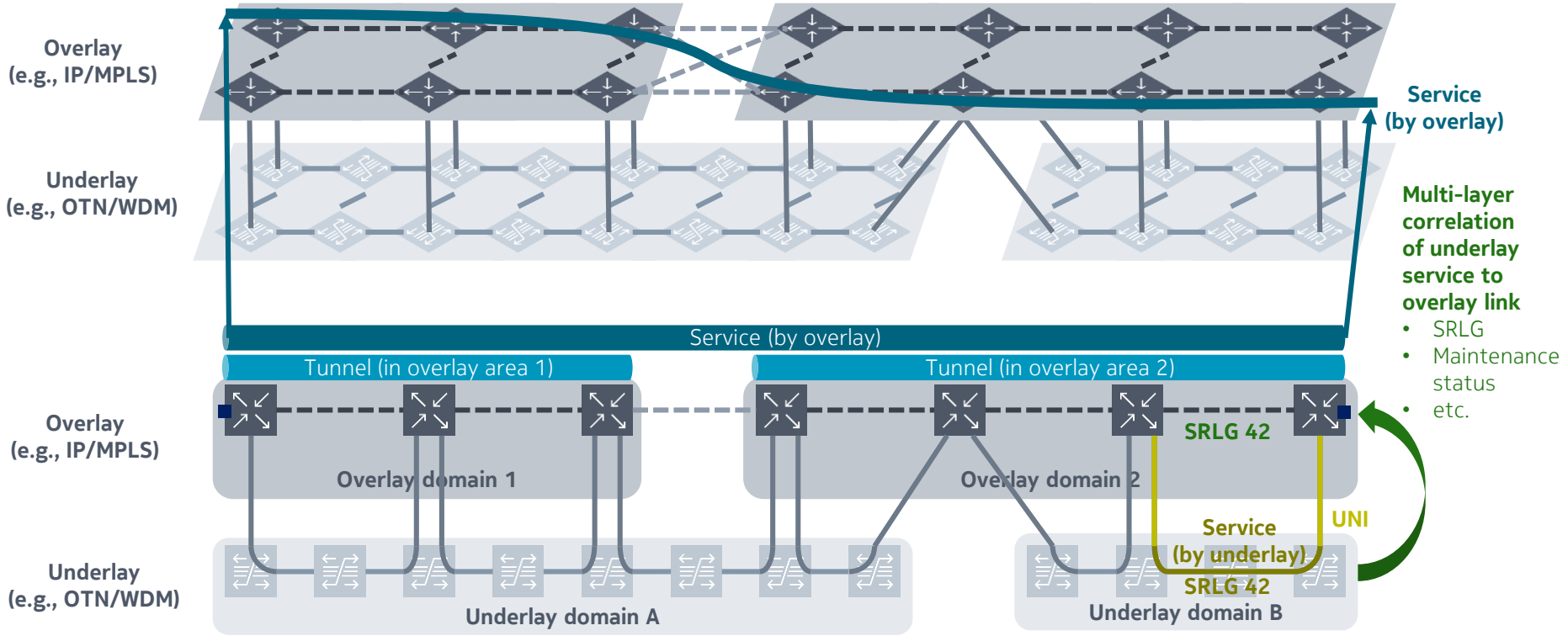
- Resiliency: Overlay paths should be disjoint in underlay (e.g., SRLG disjoint), possibly even after rerouting
- Maintenance coordination: No disruption in overlay by underlay maintenance, e.g., by pro-active measures
- Protection alignment: Overlay aware of underlay protection
- Bandwidth-on-demand: Request of underlay capacity if needed in the overlay
- … (more)

Multi-layer Traffic Engineering (TE) scenarios
Example for overlay service realization

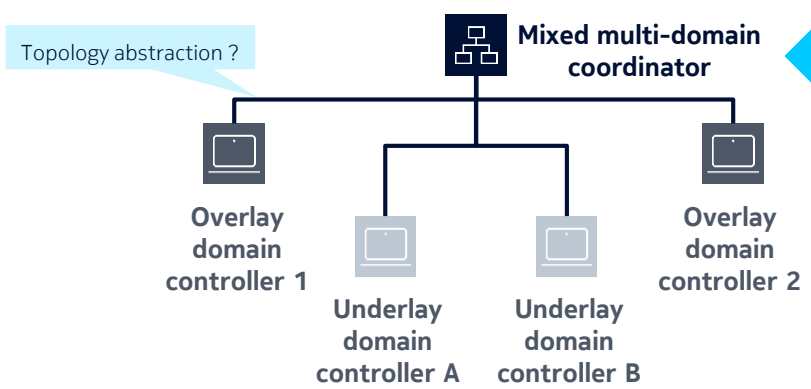


Multi-layer Traffic Engineering (TE) scenarios

Example for overlay service realization – with topology correlation

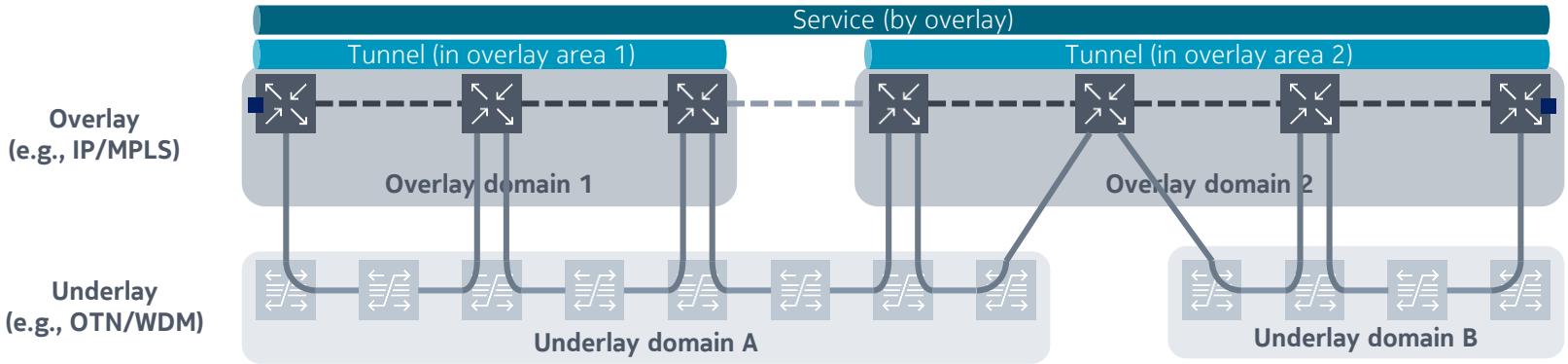


Multi-layer topology abstraction
Example for an hierarchical coordinator



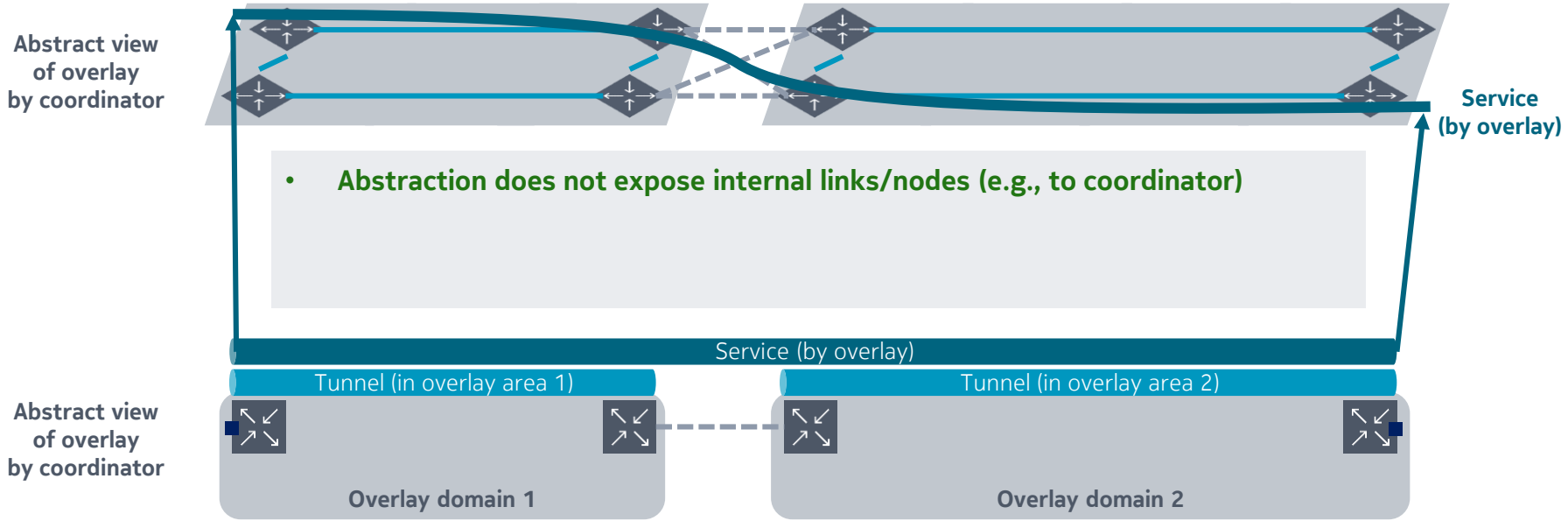
"Mixed" multi-domain coordinator

- **Multiple technologies** handled by same coordinator
- **Multi-layer correlation** by coordinator required
- **Topology abstraction** between domain controllers and coordinators**?**



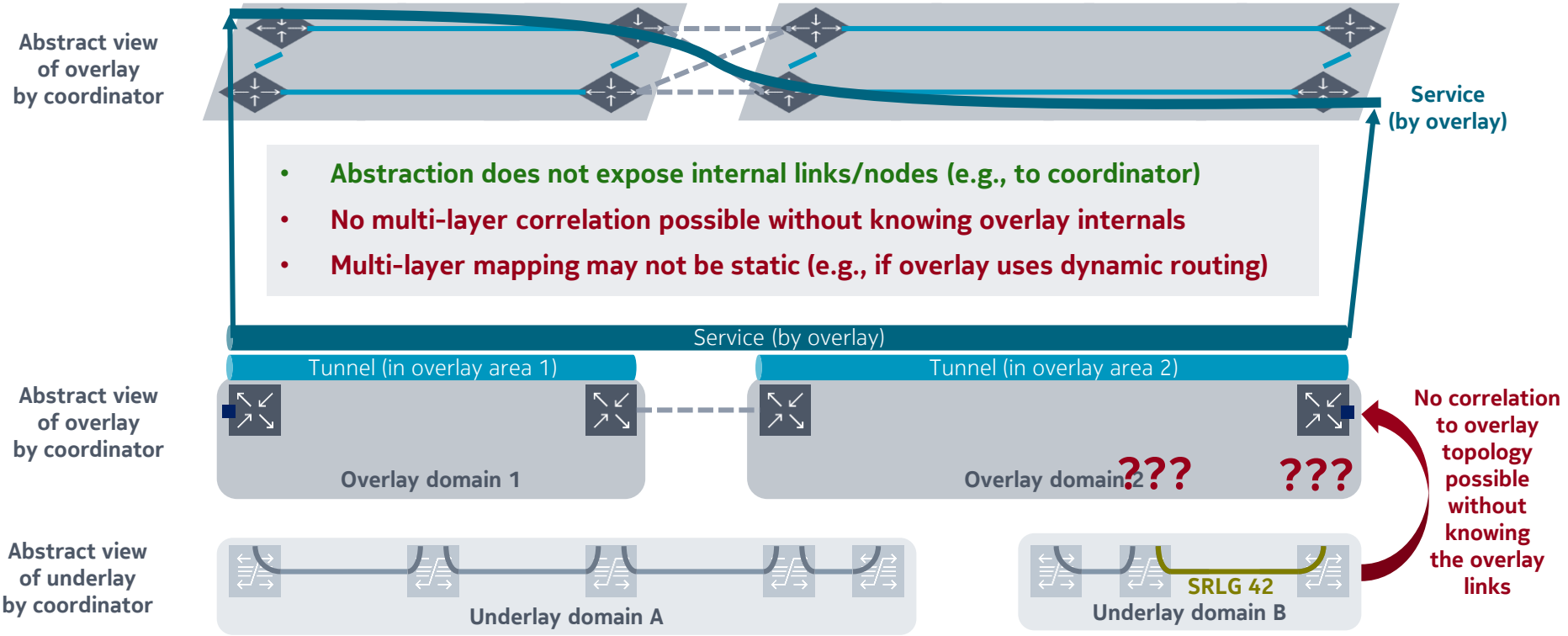
Multi-layer topology abstraction

Potential topology abstraction of overlay (“black abstraction”)



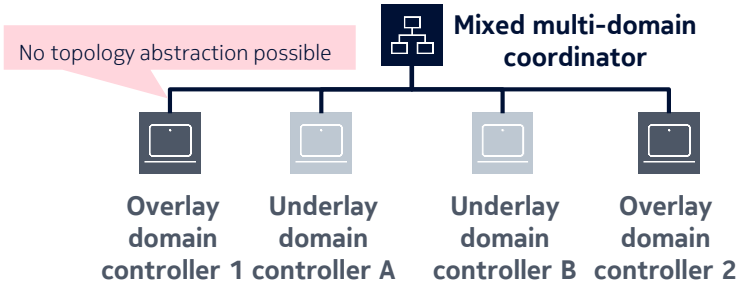
Multi-layer topology abstraction

Potential topology abstraction of overlay (“black abstraction”)



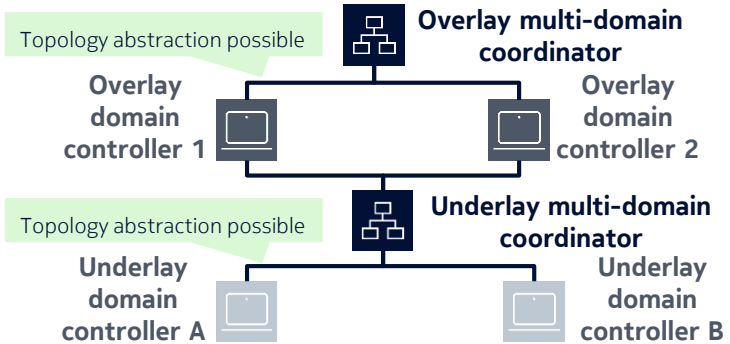
Architectural implications
Multi-domain coordination architectures

Mixed multi-domain coordination



- No topology abstraction between overlay controllers and coordinator possible
- Scalability issues for complex overlays
- Coordinator is basically a “god box”
- No customer/provider relation

Recursive multi-layer coordination



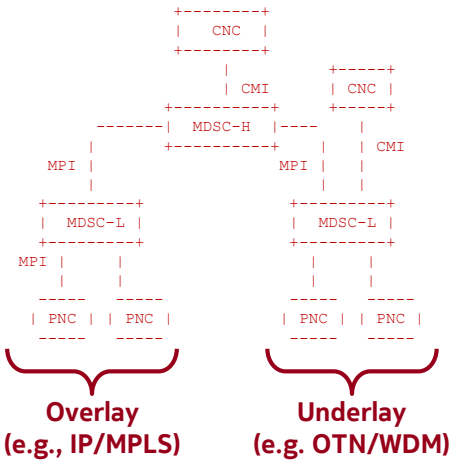
- Both topology abstraction and multi-layer correlation possible
- Scalable even for complex overlays
- Clear separation of layers and concerns
- Enables custom/provider relation

Architectural implications

Relation to draft-ietf-teas-actn-framework-11 (Section 4.1 and 5.5)

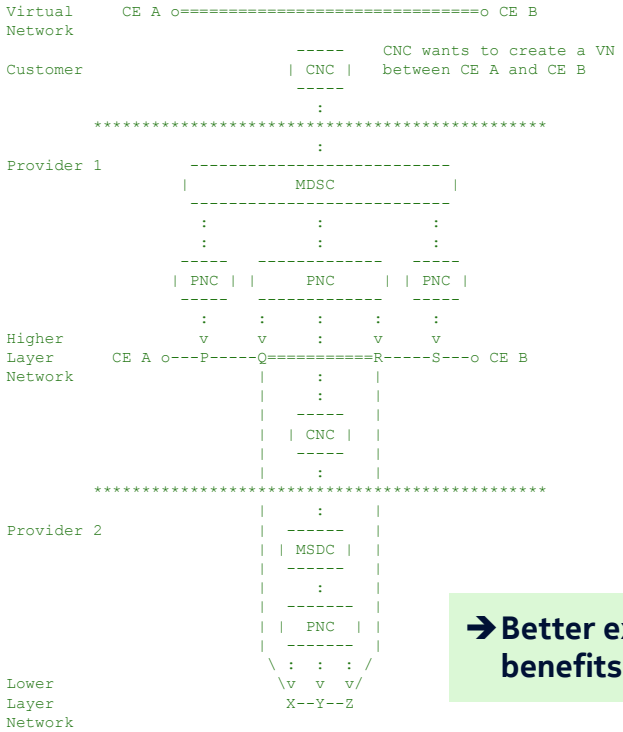
Mixed multi-domain coordination

Another implementation choice could foresee the usage of an MDSC-L for all the PNCs related to a given technology (e.g. IP/MPLS) and a different MDSC-L for the PNCs related to another technology (e.g. OTN/WDM) and an MDSC-H to coordinate them.



➔ **Unaddressed issues for multi-layer use cases?**

Recursive multi-layer coordination



➔ **Better explanation of benefits and use cases?**

  Public

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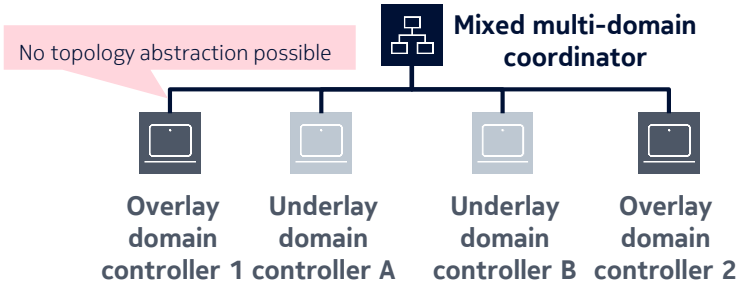
Backup slides

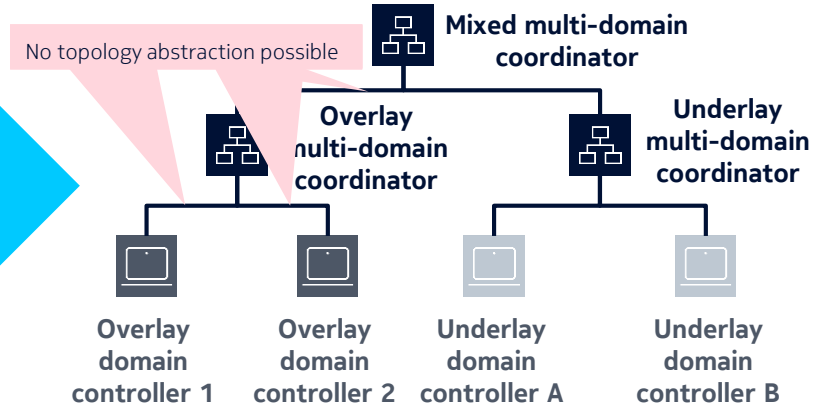
Other variants for mixed multi-domain coordination

Mixed multi-domain coordination



Same issues

Mixed multi-domain coordination (variant)



- **No abstraction for overlay in all “tree” architectures with mixed multi-domain coordinators**
- **No improvement by additional hierarchy levels**