Stitching in BEN/ORCA
Horizontally and Vertically

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Stitching Problem

- **Given:**
  - A set of domains connected
  - Each domain has an available label set (may not overlapping)
  - Just VLAN stitching between domains for now

- **Key Constraint**
  - Labels compatibility between domains
  - Label translation capability at boundaries

- **Solutions**
  - Routing
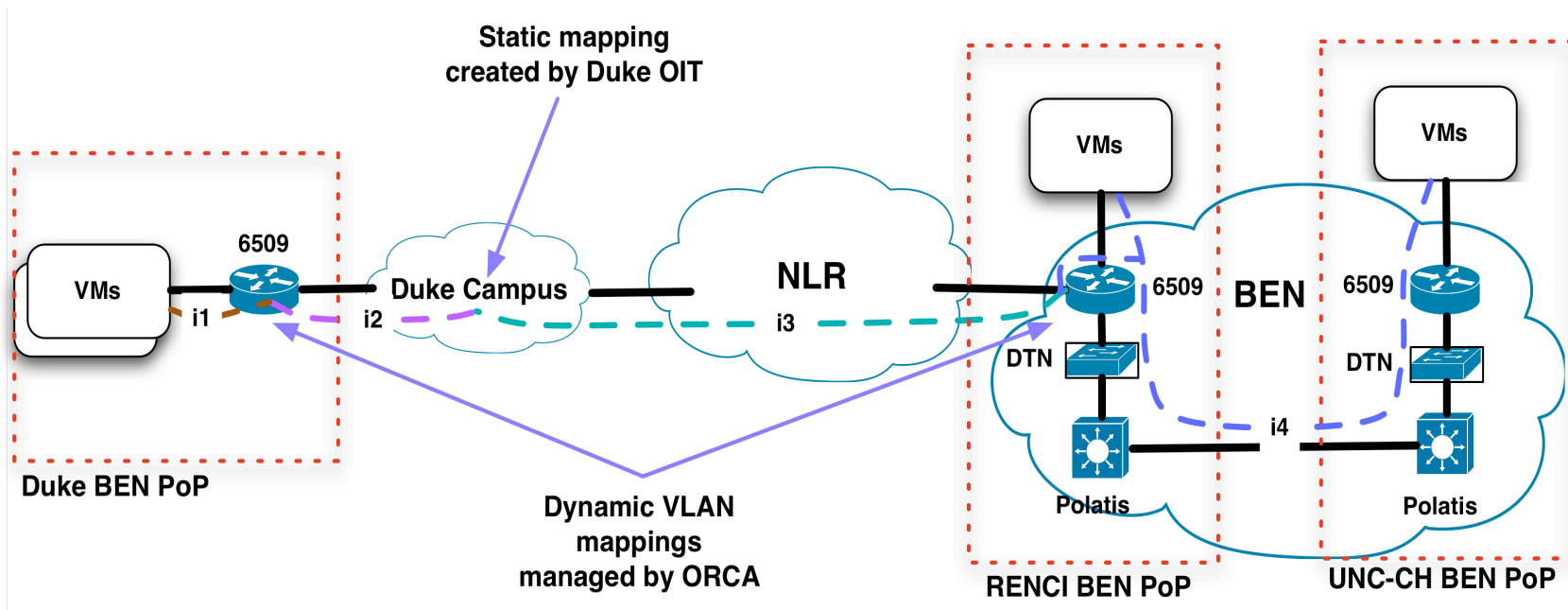 - Label Assignment
  - Configuration sequence

Solution options

- **No label translation (or label is global)**
  - Routing and label assignment is a hard problem due to the label continuity constraint
  - high blocking
  - Centralized vs. distributed

- **Label translation is available**
  - Label assignment is a local decision
  - Neighbor relationship is important
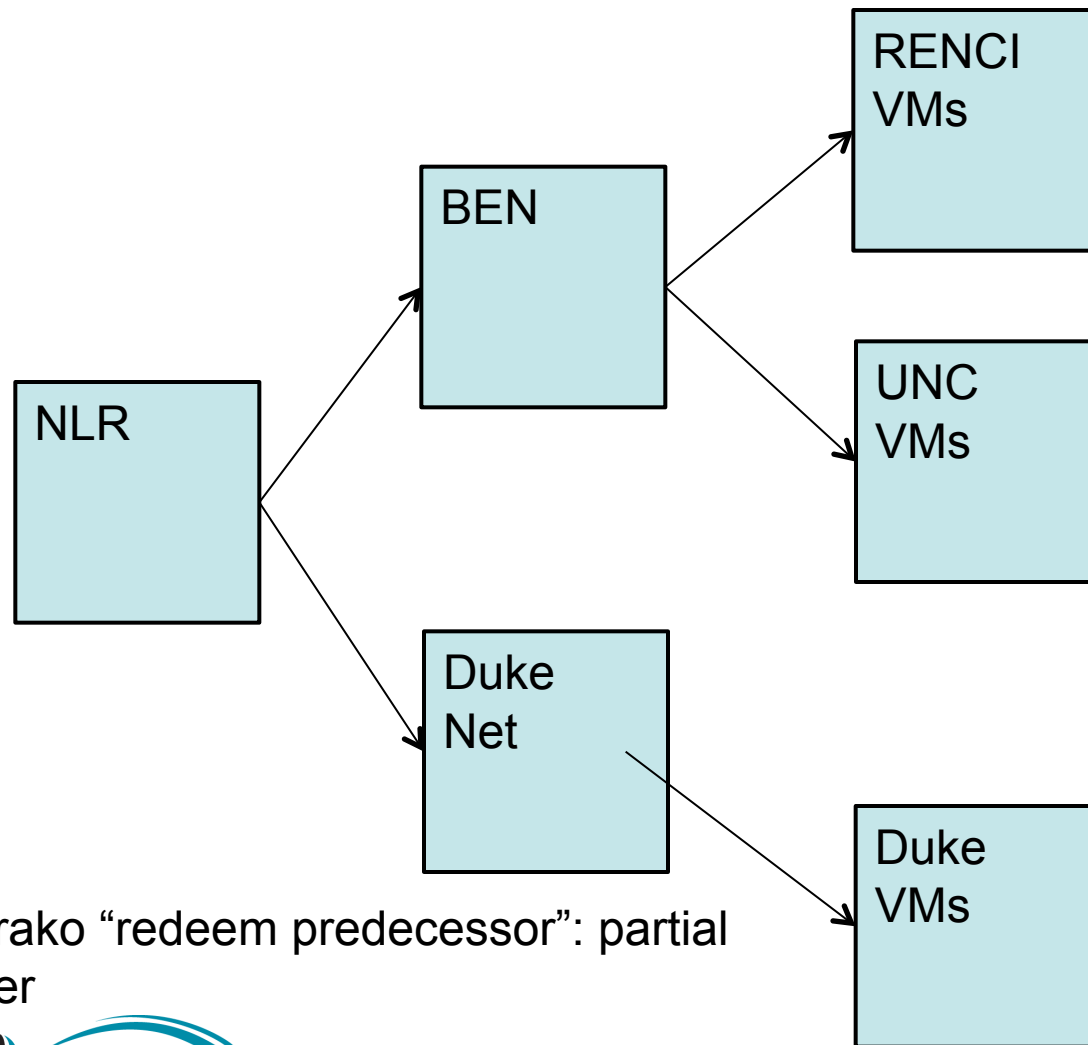 - Stitching becomes more interesting due to the relationship dependency

Label translation and stitching

- **Neighbor relationship**
  - **Peer relationship (BEN-Duke)**
    - In parallel, or RSVP
  - **Provider-customer relationship (NRL-BEN)**
    - Mapping at the customer
  - **Master-Slave relationship (BEN-VM sites)**
    - Slaves use the same label from the master
- **Stitching sequence**
  - **Find dependency tree**
- **Co-scheduling and Co-allocation problem**
  - **Centralized**
  - **(Semi-)Distributed**
    - Shared space
    - 2 step: label assignment+configuration
    - Sequence tree

End-to-End Slice "Stitching" Scenario

Sequenced Stitching

```
                              ┌──────────┐
                              │ RENCI    │
                              │ VMs      │
                  ┌──────┐ ──▶└──────────┘   Propagate VLAN tags to
                  │ BEN  │                    successors
                  │      │
                  │      │    ┌──────────┐
        ┌──────┐ ─┘      └──▶ │ UNC      │   As configuration properties
        │ NLR  │              │ VMs      │
        │      │              └──────────┘   Under SC control
        │      │ ──┐
        └──────┘   └─▶┌──────┐                Secure stitching?
                      │ Duke │
                      │ Net  │ ──┐
                      │      │   └─▶┌──────┐
                      └──────┘      │ Duke │
                                    │ VMs  │
                                    └──────┘
```
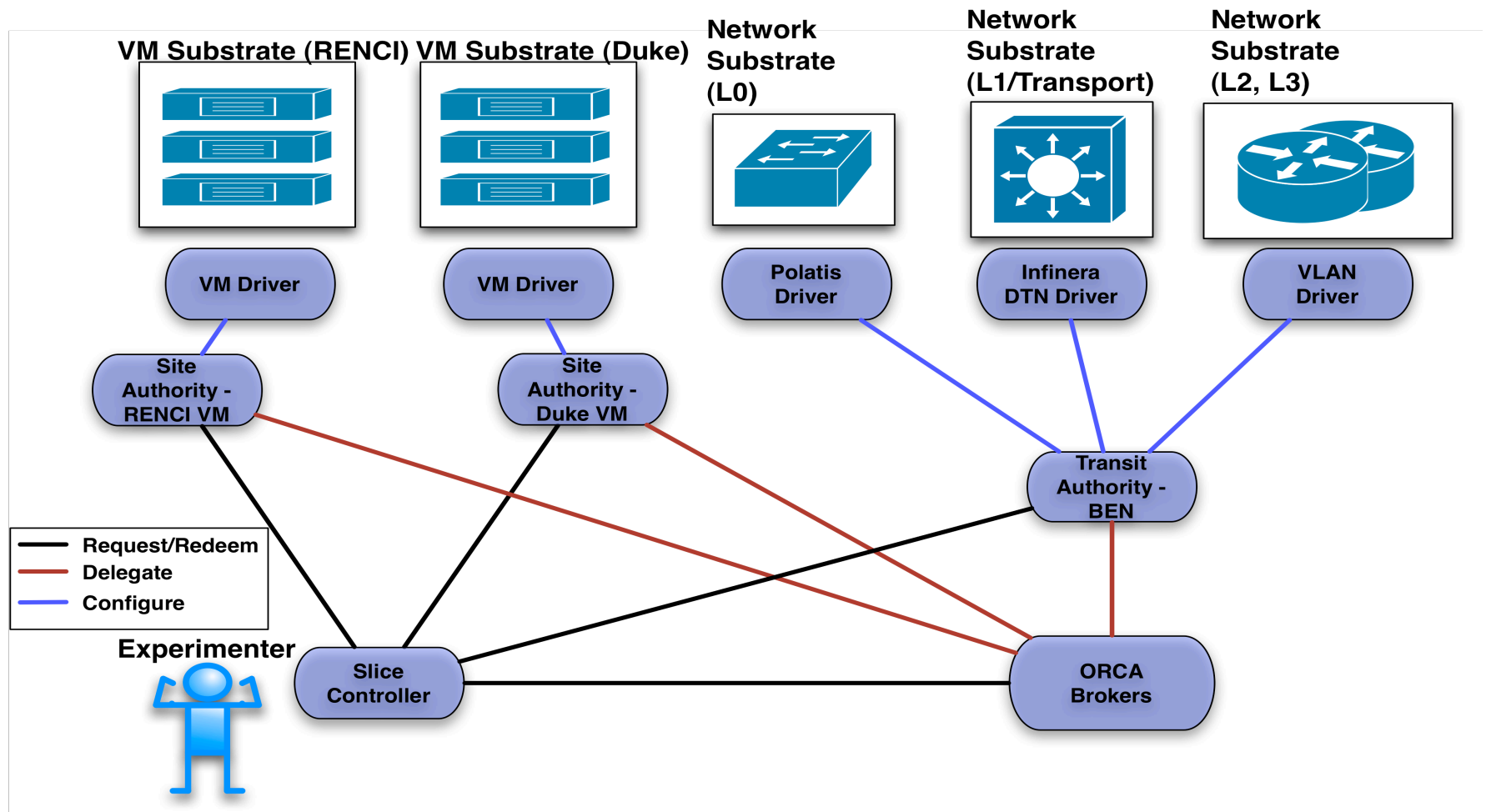
Shirako "redeem predecessor": partial
order

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BEN/ORCA Vertical View

BEN/ORCA Horizontal View
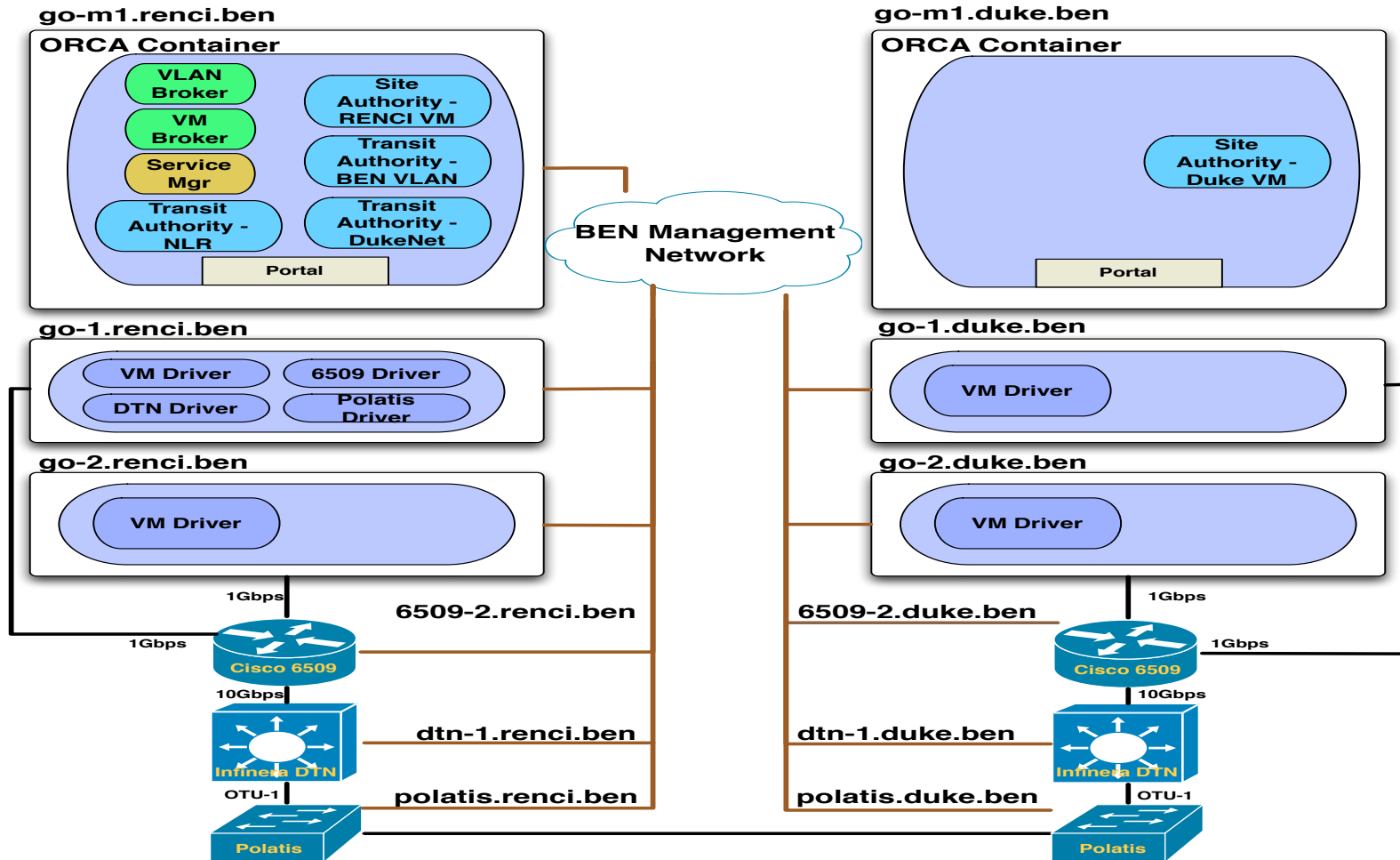
BEN Slicing Technique

- **VLAN as the universal stitching vehicle for now**
  - **Discover the domain dependency**
  - **Define the stitching sequence tree**

- **Hide layer adaptation and configuration details within the site**
  - **NDL-OWL for BEN now**
  - **Dynamic cross-layer path and configuration computation**
  - **Developed universal driver framework for network elements and driver implementation for 6509, DTN and Polatis)**

- **Future work**
  - **Replace ORCA resource model with NDL/OWL ontology-based one**
    - Describe inter-domain compatibility and dependency
    - QoS support
  - **Enhance supporting DTN platforms : GMPLS, etc.**
  - **Advanced cross-layer and inter-domain path validation, computation, stitching**
  - **VM substrate**
    - Eucalyptus/EC2
    - VMWare