Yang Data Model for TE Topologies

draft-ietf-teas-yang-te-topo-04

Github: https://github.com/ietf-mpls-yang/te/blob/master/ietf-te-topology.yang

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Summary of Changes

- Alignment with new I2RS network topology model (version 2015-12-09).

- Submitted separate draft for schedule.

- Split the packet attributes to an augmentation module.

- In node, added alt-information-sources.

- Support for request containing multiple topologies from client to provider. Added an attribute "preference" in topology.

- Alignment with L3 network topology model.

- Worked with TE Yang model DT to align TE Tunnel modeling.

- Added support for tunnel termination point.

Alignment with New I2RS
Network Topology Model

```
module: ietf-network
   +--rw networks
   |  +--rw network* [network-id]
   |     +--rw network-types
   |     +--rw network-id           network-id
   |     +--rw supporting-network* [network-ref]
   |     |  +--rw network-ref    leafref
   |     +--rw node* [node-id]
   |        +--rw node-id           node-id
   |        +--rw supporting-node* [network-ref node-ref]
   |           +--rw network-ref    leafref
   |           +--rw node-ref       leafref
```

```
augment /nw:networks:
   +--rw te!
      +--rw templates
augment /nw:networks/nw:network:
   +--rw te!
      +--rw provider-id      te-global-id
      +--rw client-id        te-global-id
      +--rw te-topology-id    te-topology-id
      +--rw config
      +--ro state
augment /nw:networks/nw:network/nw:node:
   +--rw te!
      +--rw te-node-id              te-node-id
      +--rw config
      +--ro state
augment /nw:networks/nw:network/nt:link:
   +--rw te!
      +--rw config
      +--ro state
```

Submitted Separate Draft for Schedule

- Submitted draft-liu-netmod-yang-schedule-00
  - Has wider applicability.
  - Will present it to Netmod working group.

Split the Packet Attributes to an Augmentation Module

- Base TE Topology Model Is Technology Agnostic
  - Packet switching model augments base model.
  - Packet switching model covers packet switch attributes.

```
module: ietf-te-topology-psc
Augment /nw:networks/nw:network/nt:link/tet:te/tet:config/tet:te-link-
attributes/tet:interface-switching-capability:
   +--rw packet-switch-capable
      +--rw minimum-lsp-bandwidth?   decimal64
      +--rw interface-mtu?           Uint16
augment /nw:networks/nw:network/nt:link/tet:te/tet:state/tet:te-link-
attributes/tet:interface-switching-capability:
   +--ro packet-switch-capable
      +--ro minimum-lsp-bandwidth?   decimal64
      +--ro interface-mtu?           Uint16
augment /nw:networks/nw:network/nt:link/tet:te/tet:state/tet:alt-information-
sources/tet:interface-switching-capability:
   +--ro packet-switch-capable
      +--ro minimum-lsp-bandwidth?   decimal64
      +--ro interface-mtu?           uint16
augment /tet:te-link-event/tet:te-link-attributes/tet:interface-switching-capability:
   +---- packet-switch-capable
      +---- minimum-lsp-bandwidth?   decimal64
      +---- interface-mtu?           uint16
```

In Node, Added alt-information-sources

```
augment /nw:networks/nw:network/nw:node:
   +--rw te!
      +--ro state
      |  +--ro information-source?         enumeration
      |  +--ro information-source-state
      |  |  +--ro credibility-preference?   uint16
      |  |  +--ro topology
      |  |  |  +--ro provider-id-ref?      leafref
      |  |  |  +--ro client-id-ref?        leafref
      |  |  |  +--ro te-topology-id-ref?   leafref
      |  |  |  +--ro network-id-ref?       leafref
      |  |  +--ro routing-instance?         string
      |  +--ro alt-information-sources* [information-source]
```

Support for Request Containing Multiple Topologies from Client to Provider

▪ Added an attribute "preference" in topology.

```
module: ietf-te-topology
augment /nw:networks/nw:network:
   +--rw te!
      +--rw config
      |  +--rw preference?   uint8
```

Alignment with L3 Network Topology Model

- Submitted separate draft
  draft-liu-teas-yang-l3-te-topo-00.

```
module: ietf-l3-te-topology
augment /nw:networks/nw:network/nw:network-types/l3t:l3-unicast-igp-
topology:
   +--rw l3-te!
augment /nw:networks/nw:network/l3t:igp-topology-attributes:
   +--rw l3-te-topology-attributes
      +--rw network-ref?   leafref
augment /nw:networks/nw:network/nw:node/l3t:igp-node-attributes:
   +--rw l3-te-node-attributes
      +--rw node-ref?      leafref
      +--rw network-ref?   leafref
augment /nw:networks/nw:network/nw:node/nt:termination-point/l3t:igp-
termination-point-attributes:
   +--rw l3-te-tp-attributes
      +--rw tp-ref?        leafref
      +--rw node-ref?      leafref
      +--rw network-ref?   leafref
augment /nw:networks/nw:network/nt:link/l3t:igp-link-attributes:
   +--rw l3-te-link-attributes
      +--rw link-ref?      leafref
      +--rw network-ref?   leafref
```

Worked with TE Yang Model DT to Align TE Tunnel Modeling

- Both models can be on either device or controller.

- Both models share the same terminologies and types.

- Both models cross reference each other whenever needed.
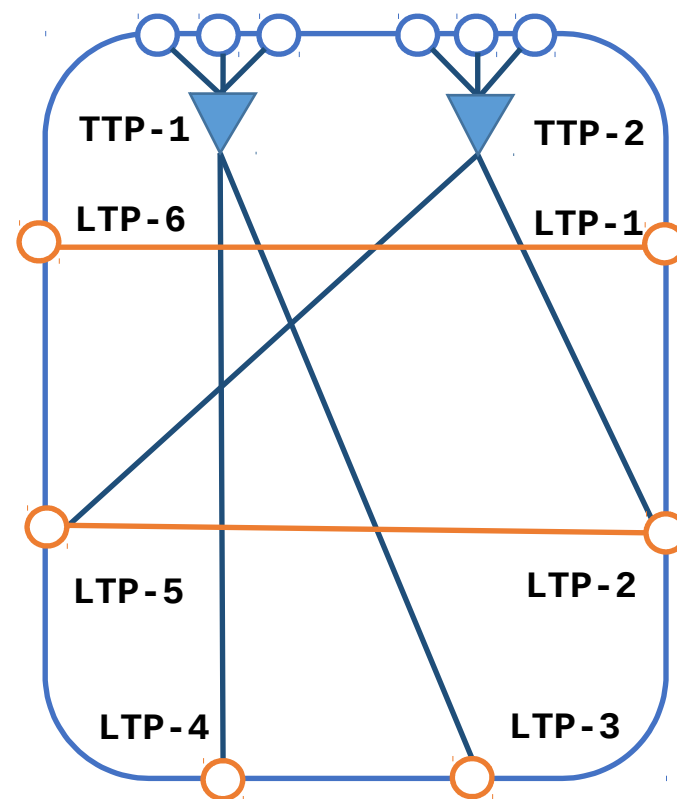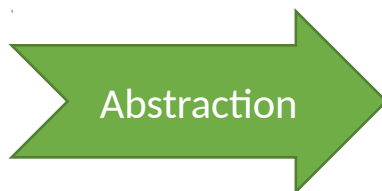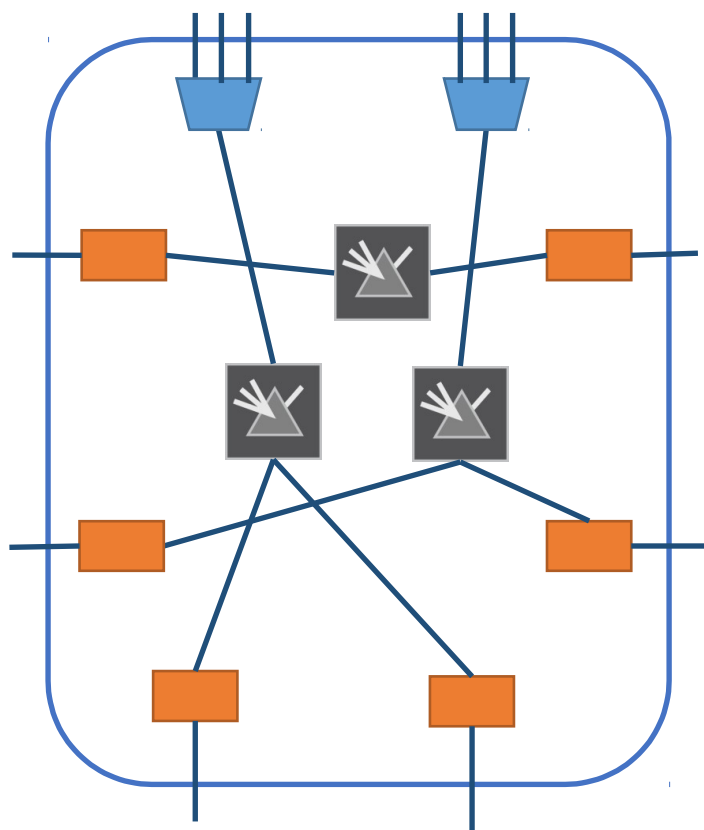
Support for Tunnel Termination Point

```
module: ietf-te-topology
augment /nw:networks/nw:network/nw:node:
   +--rw te!
      +--rw te-node-id                    te-node-id
      +--rw tunnel-termination-point* [tunnel-tp-id]
         +--rw tunnel-tp-id    binary
         +--ro state
            +--ro switching-capability?    identityref
            +--ro encoding?                identityref
            +--ro termination-capability* [link-tp]
               +--ro link-tp    leafref
```
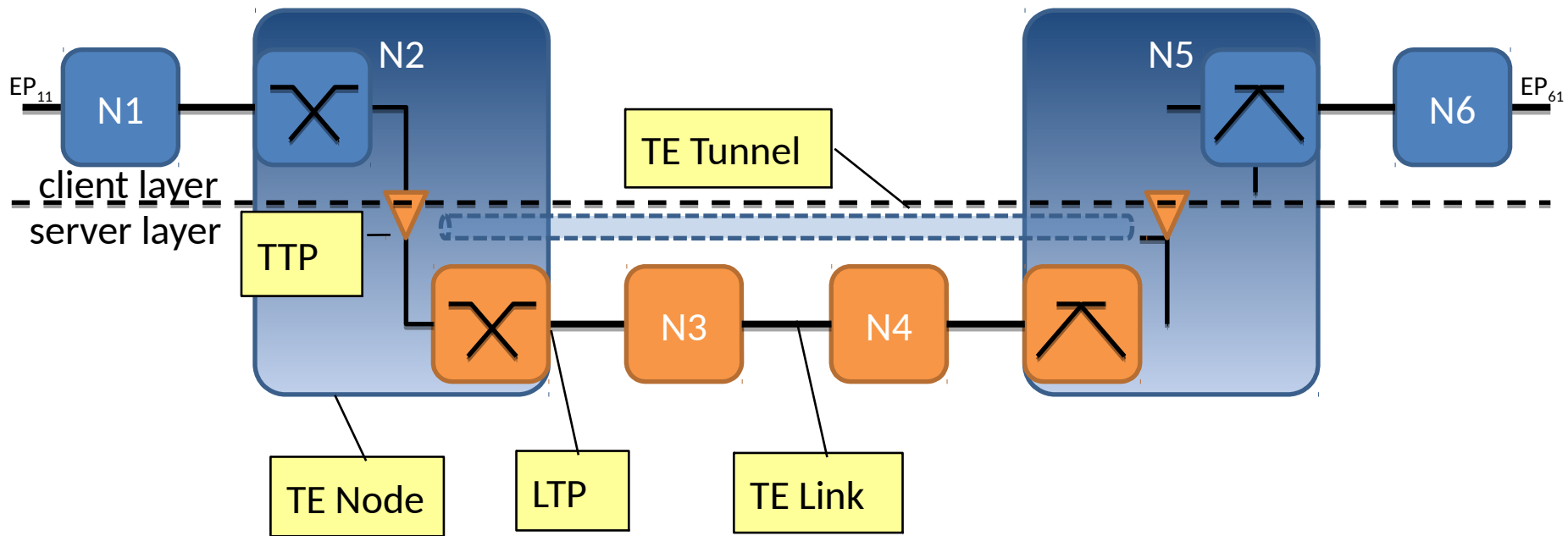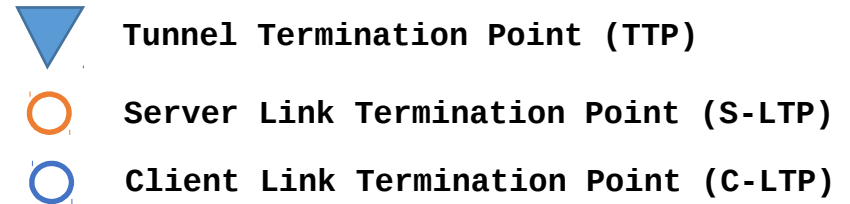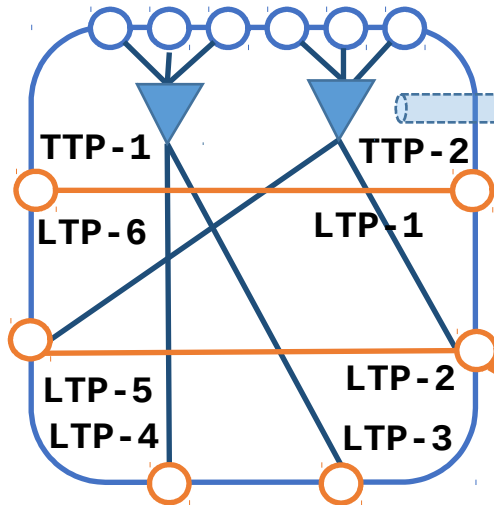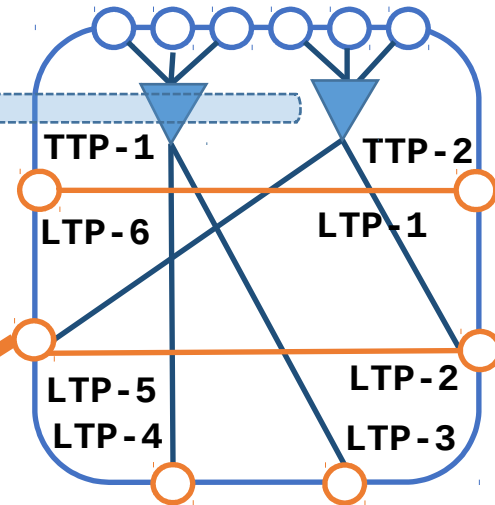
Modeling Abstractions

Modeling Abstractions

Network Facing Line Card
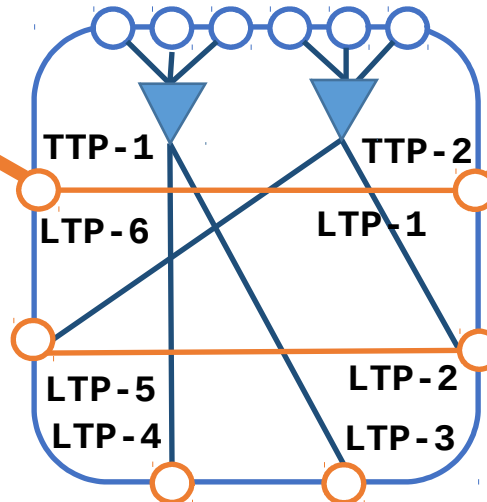
Termination Device with Client Ports

Blocking Switching component

Tunnel Termination Point (TTP)

Server Link Termination Point (S-LTP)

Client Link Termination Point (C-LTP)

Abstraction

TTP-1 **TTP-2**

LTP-6 **LTP-1**

LTP-5 **LTP-2**

LTP-4 **LTP-3**

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Modeling Abstractions

Tunnel Termination Point (TTP)

Server Link Termination Point (S-LTP)

Client Link Termination Point (C-LTP)

Node-1

Node-3

TE-Tunnel-1

Node-2

TTP-1 **TTP-2**

LTP-6 **LTP-1**

LTP-5 **LTP-2**

LTP-4 **LTP-3**

Link-12

Link-23

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Multi-layer Transformations

EP$_{11}$

N1

N2

client layer link
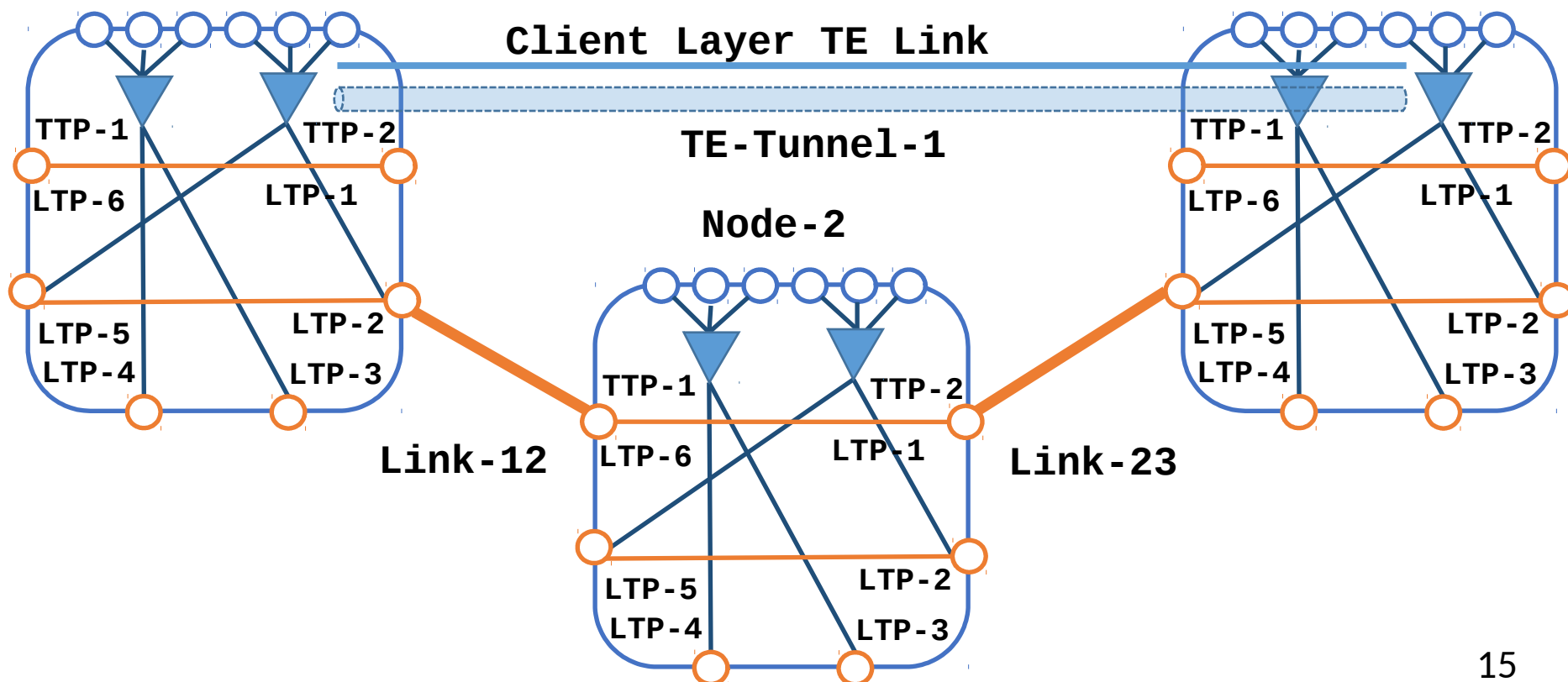
N5

N6

EP$_{61}$

client layer
server layer

TTP

N3
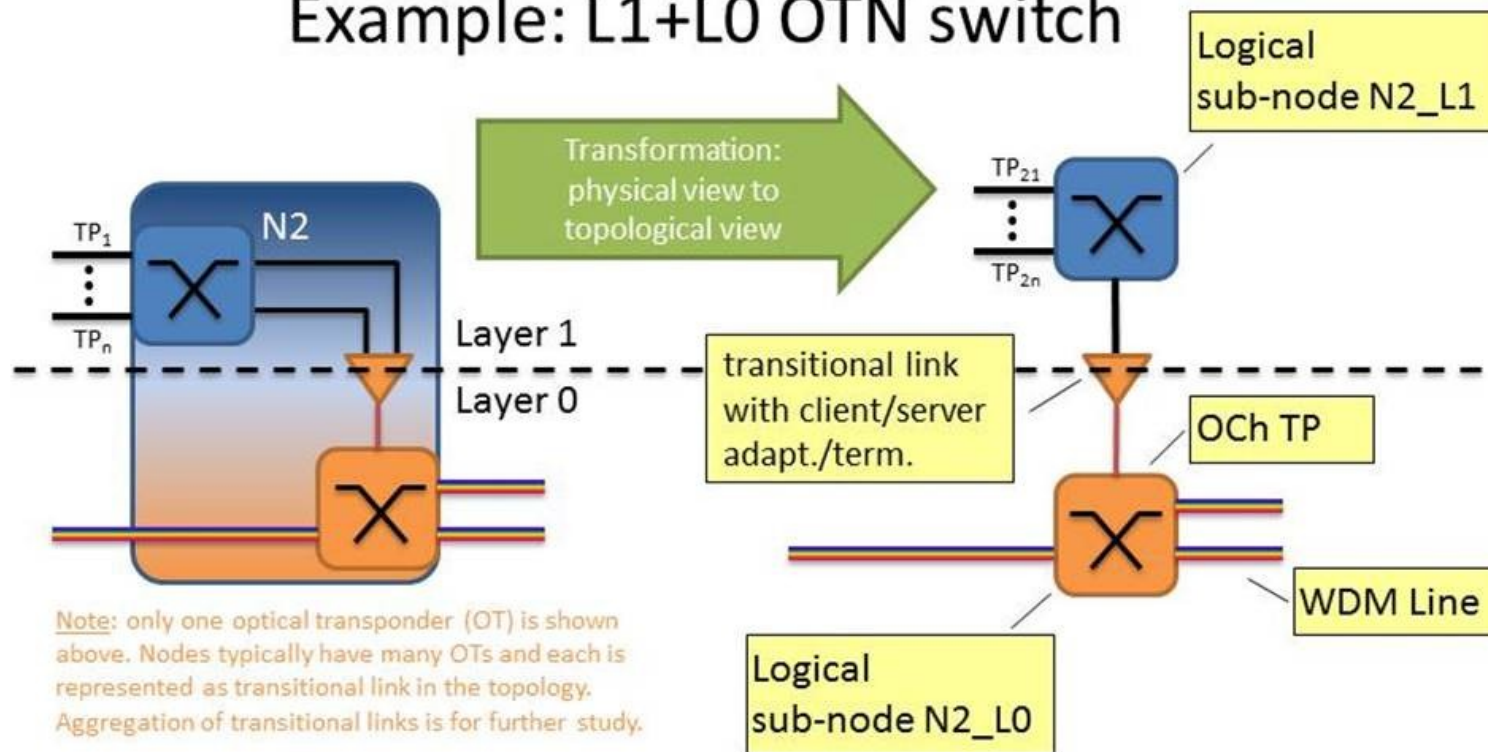
N4
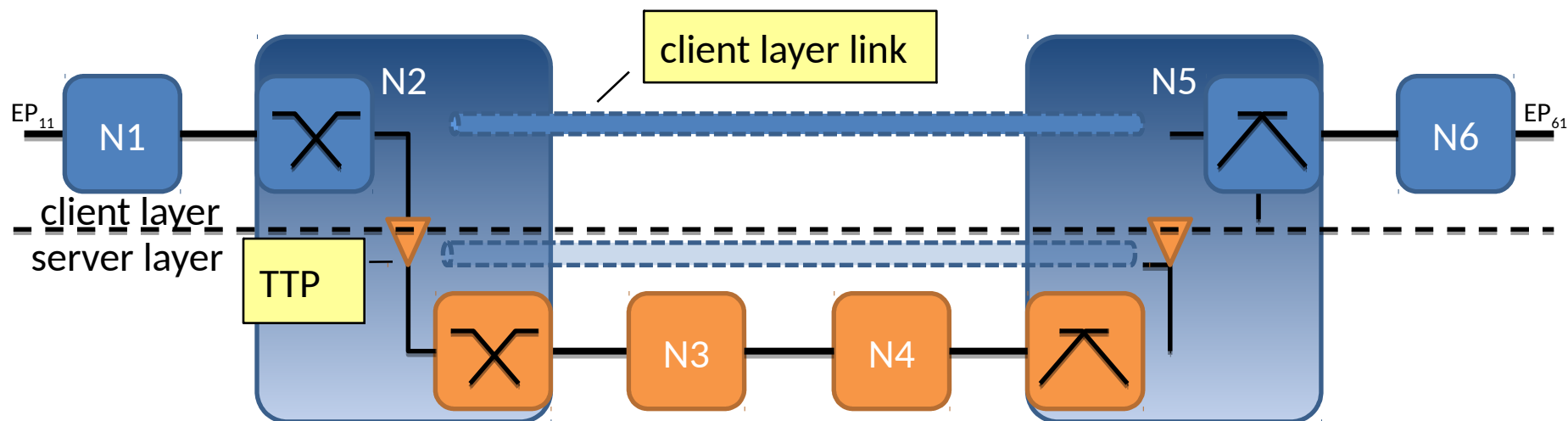
Multi-layer Transformations
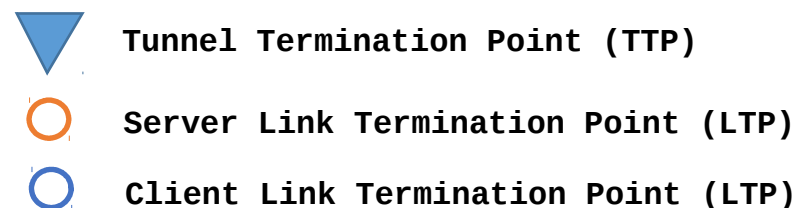
Option 1: Transitional Link

Multi-layer node decomposition
Example: L1+L0 OTN switch

Note: only one optical transponder (OT) is shown above. Nodes typically have many OTs and each is represented as transitional link in the topology. Aggregation of transitional links is for further study.
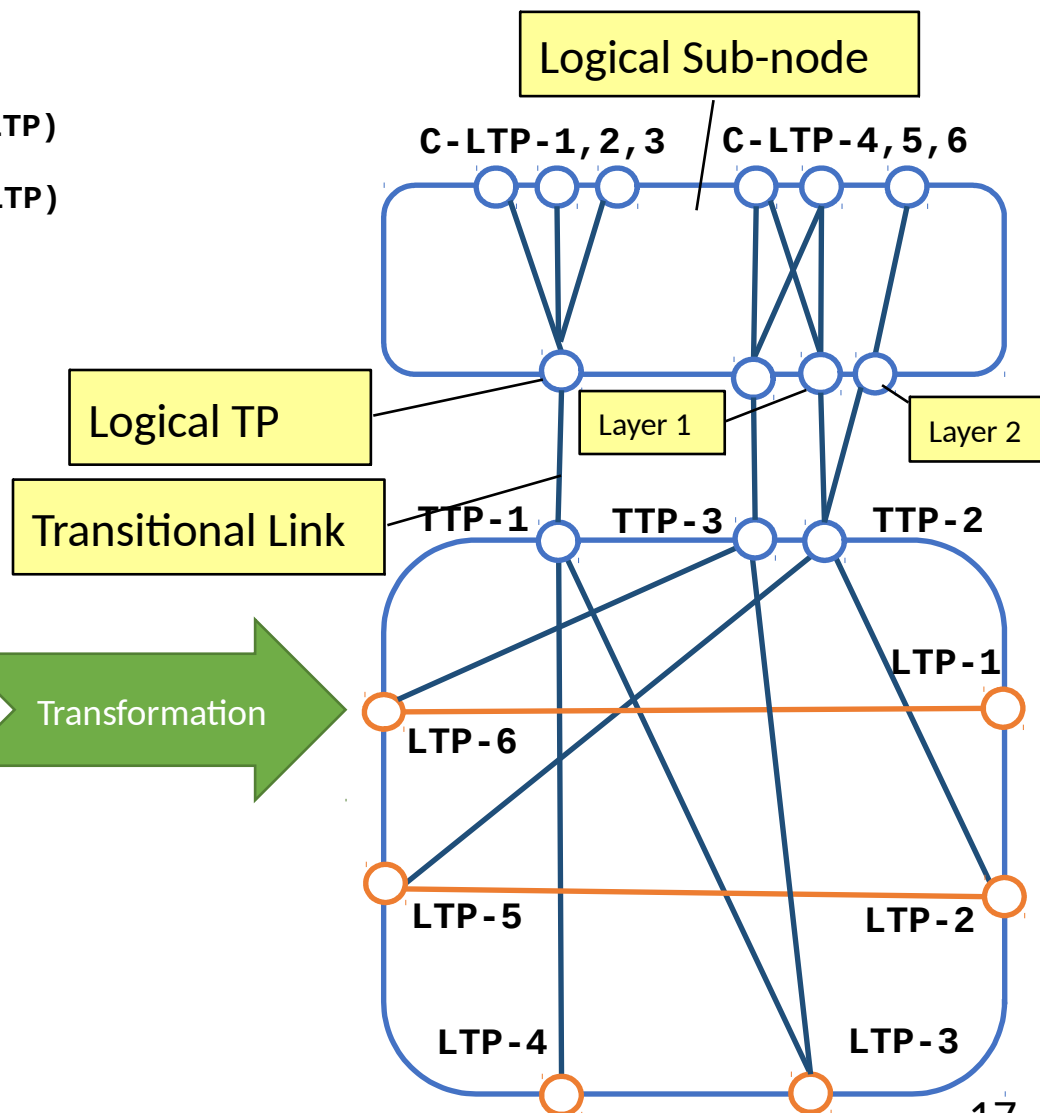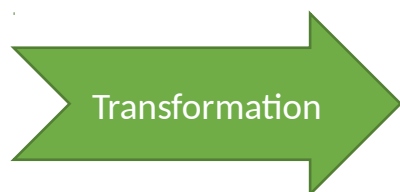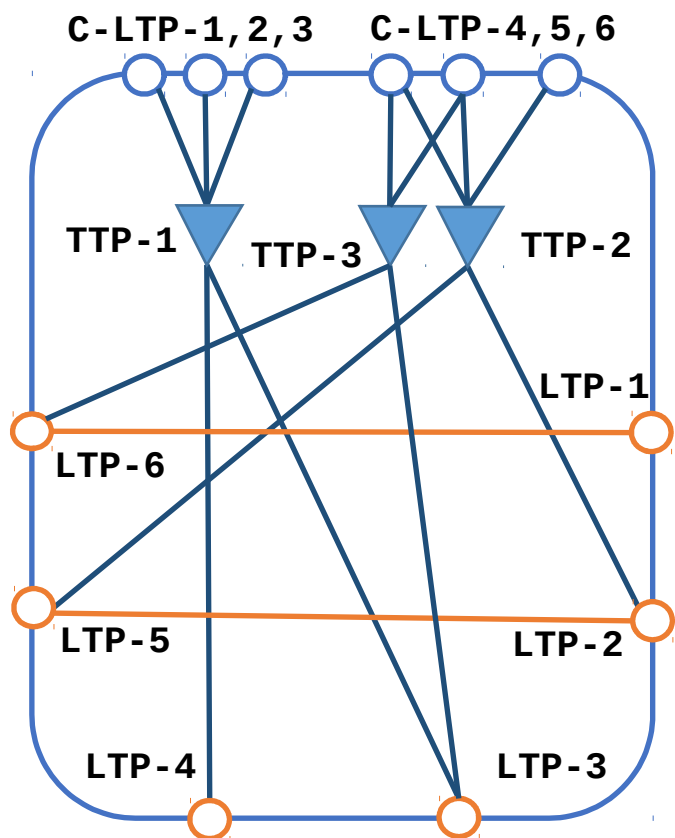
Dual-layer node N2 is decomposed into 2 logical sub-nodes: N2_L1 and N2_L0
Transitional link between N2_L1 and N2_L0 with following TPs on the link ends:
N2_L1 side: set of ODUk TPs, N2_L0 side: single OCh TP
Example: 100G OCh TP → ODUk TPs {80 x ODU0, 40 x ODU1, 10 x ODU2, 2 x ODU3, 1 x ODU4}

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Option 1: Transitional Link

▼ Tunnel Termination Point (TTP)

◯ Server Link Termination Point (S-LTP)

◯ Client Link Termination Point (C-LTP)

Logical Sub-node

C-LTP-1,2,3   C-LTP-4,5,6

Logical TP

Transitional Link

Layer 1

Layer 2

C-LTP-1,2,3   C-LTP-4,5,6

TTP-1   TTP-3   TTP-2

LTP-1

LTP-6

LTP-5   LTP-2

LTP-4   LTP-3

Transformation

TTP-1   TTP-3   TTP-2

LTP-1

LTP-6

LTP-5   LTP-2

LTP-4   LTP-3

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Option 1: Transitional Link

▪ Decompose one node into two logical nodes.

▪ Treat Tunnel TP the same as Link TP.

▪ Modeling changes:
  - ▪ On Link TP: need to have an attribute for switch-layer.
  - ▪ On Link: have a flag to indicate the link is transitional.

Option 1: Transitional Link

- Transition links are going across layers, asking path computations on both layer to be aware.

- Causing a more complex topology, because the additional nodes and links, in mixed layers.

- Need a mechanism to decompose nodes, generate links and assign attributes.

- Existing TE link attributes are not applicable to transition links.

Option 2: Inter-layer Locks

Tunnel Termination Point (TTP)

Server Link Termination Point (S-LTP)

Client Link Termination Point (C-LTP)
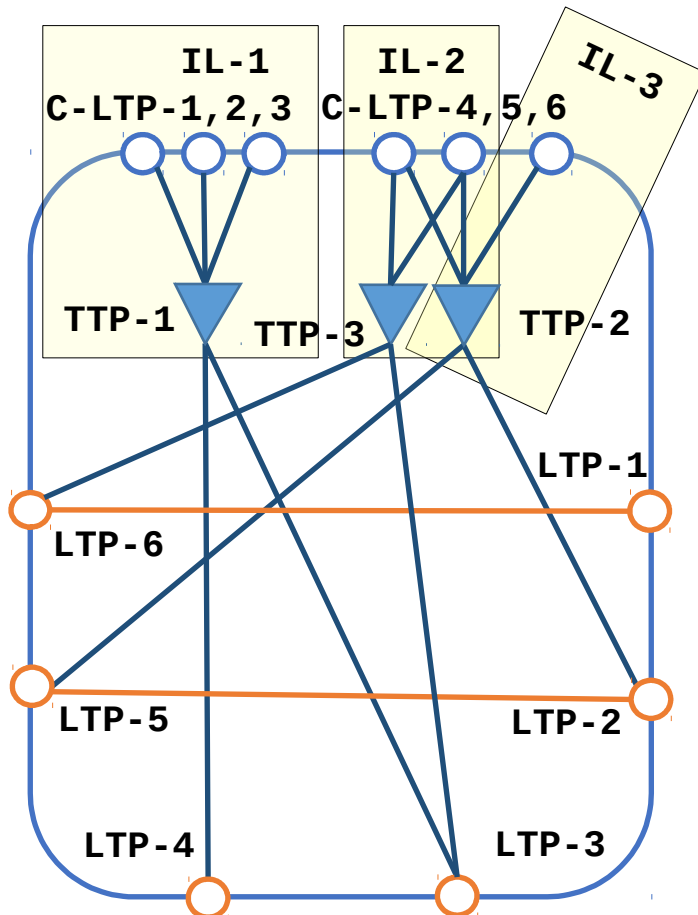
- Describe client-server layer adaptation relationship.
- It is an association of M client layer LTPs and N server layer TTPs.
- Each association is uniquely identified by an inter-layer lock ID.

TTP1	IL-1	C-LTP-1	IL-1
TTP2	IL-2, IL-3	C-LTP-2	IL-1
TTP3	IL-2	C-LTP-3	IL-1
		C-LTP-4	IL-2
		C-LTP-5	IL-2
		C-LTP-6	IL-3

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Option 2: Inter-layer Locks

- Do not decompose nodes.

- Modeling changes:
  - On Link TP and TTP: add an attribute for inter-layer-lock-id.

- Inter-layer properties are separate and independent from TE links, having different attributes from TE link attributes.

- Inter-layer properties are used only for multi-layer, not for single layer cases.
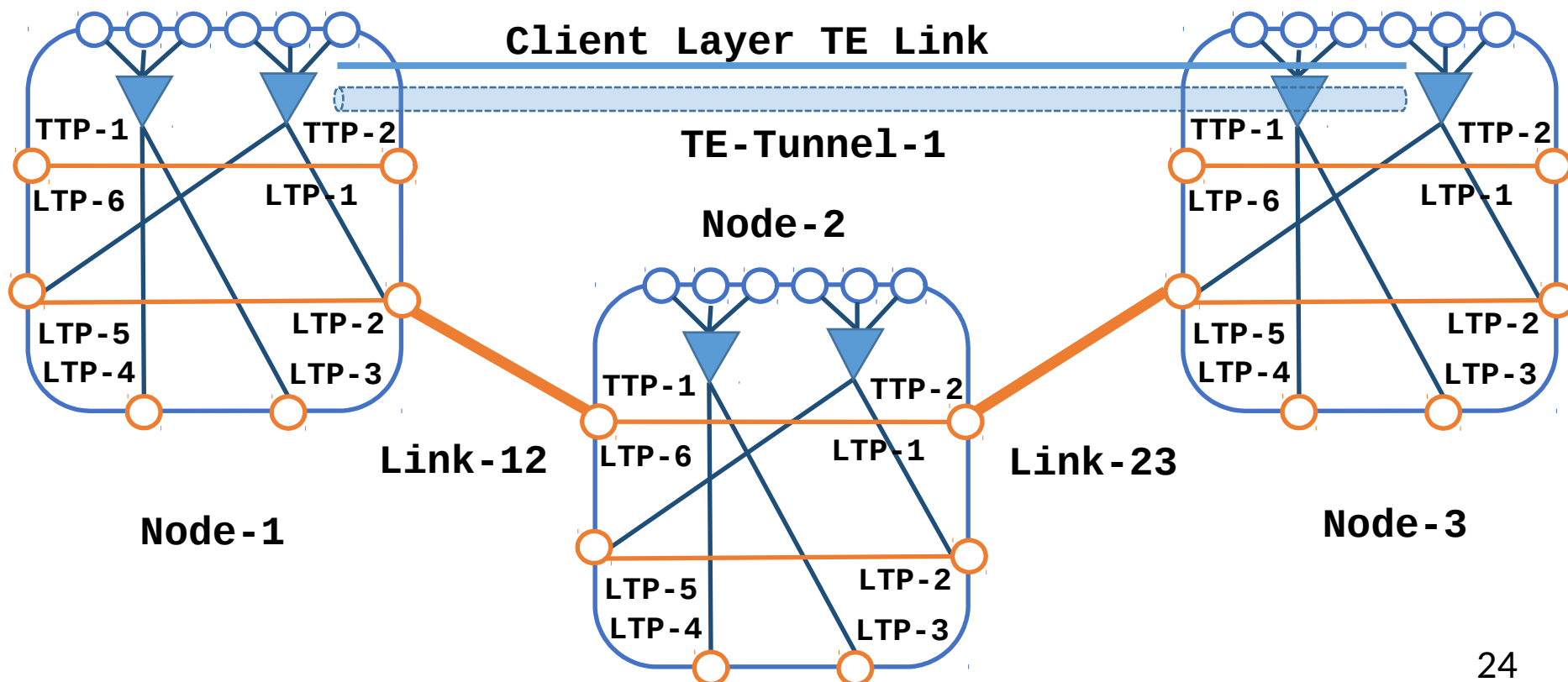
Modeling Considerations

- The inter-layer lock approach and transition-link approach can both be supported at the same time.

- The two approaches can co-exist, with some parts of the system modeled by one approach and other parts modeled by another approach.
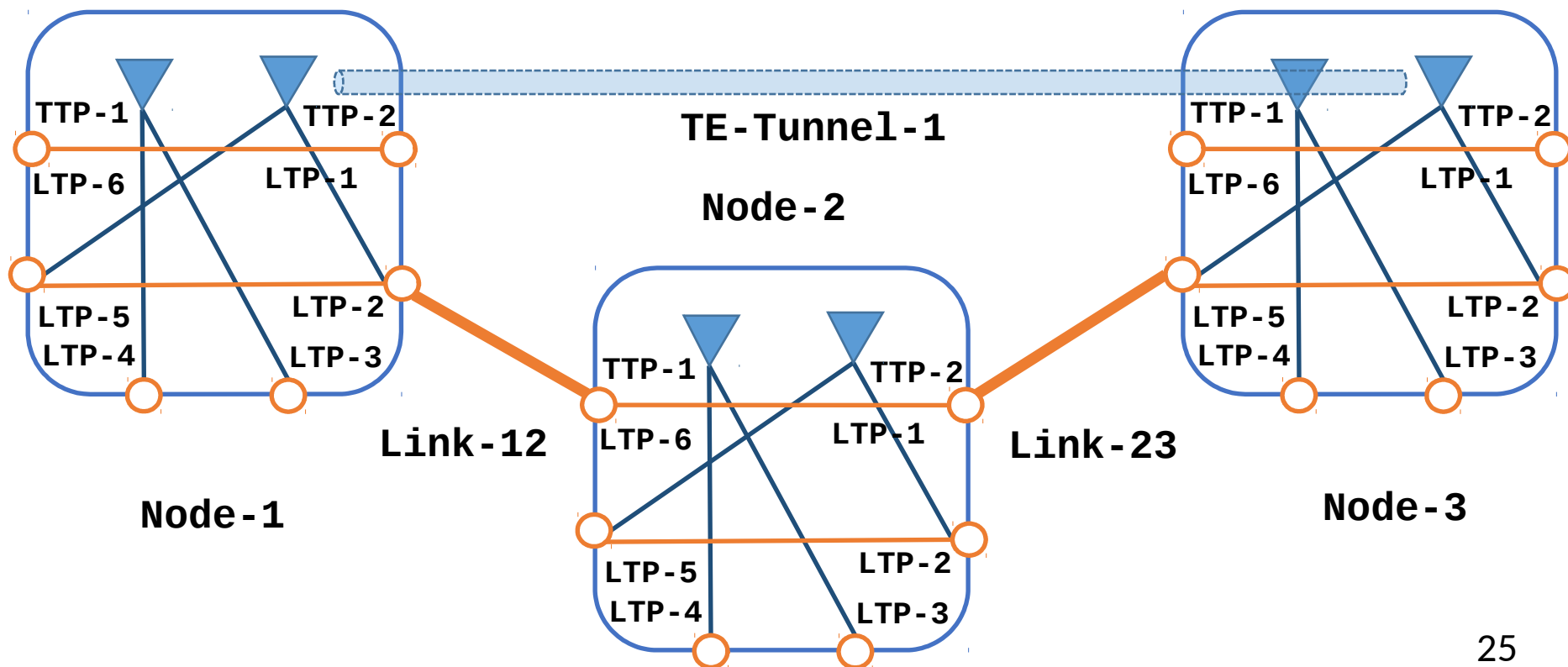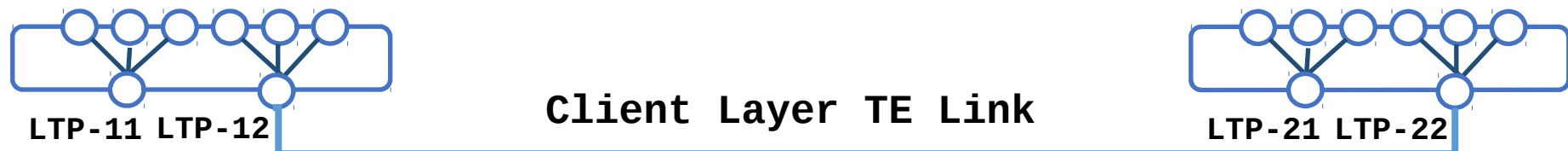
Topology Layer Separation

- Besides putting multiple layers into one topology, TE topology model allows to separate server and client layer networks into two independent TE topologies.

Topology Layer Separation

Topology Layer Separation

LTP-11 LTP-12

Client Layer TE Link

LTP-21 LTP-22

TTP-1

TTP-2

LTP-6

LTP-1

TE-Tunnel-1

Node-2

TTP-1

TTP-2

LTP-6

LTP-1

LTP-5

LTP-2

LTP-4

LTP-3

LTP-5

LTP-2

LTP-4

LTP-3

TTP-1

TTP-2

LTP-6

LTP-1

Link-12

Link-23

Node-1

Node-3

LTP-5

LTP-2

LTP-4

LTP-3

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Topology Layer Separation

- In such a case, a transitional link cannot be used between LTP-11 and TTP-1.

Next Steps

- Address review comments.
  - To Do List:
    - https://github.com/ietf-mpls-yang/te/blob/master/ietf-te-topology-todo-list.txt
- Request further review.