Multi-layer Multi-domain Network Topology Abstractions Using ONF Transport API

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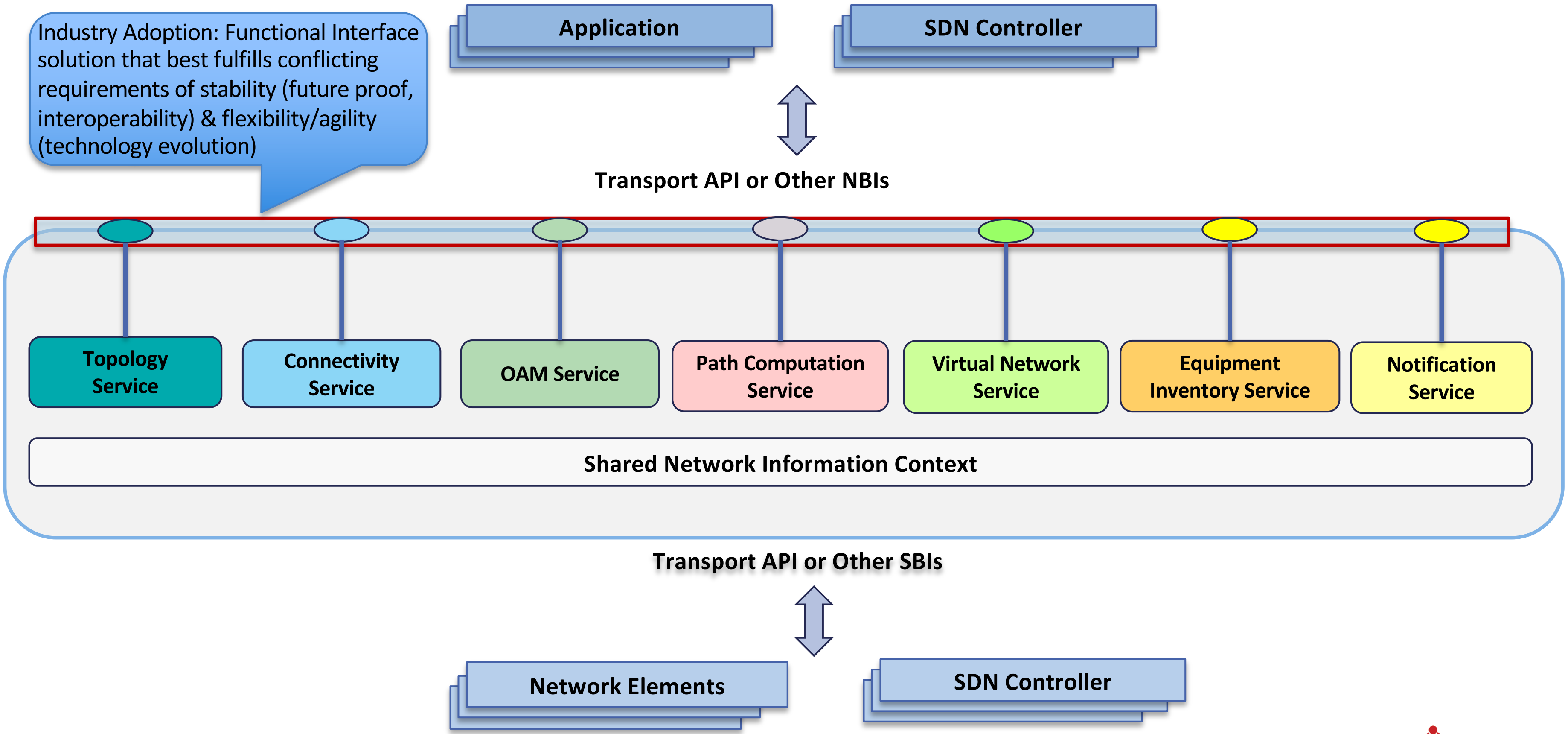
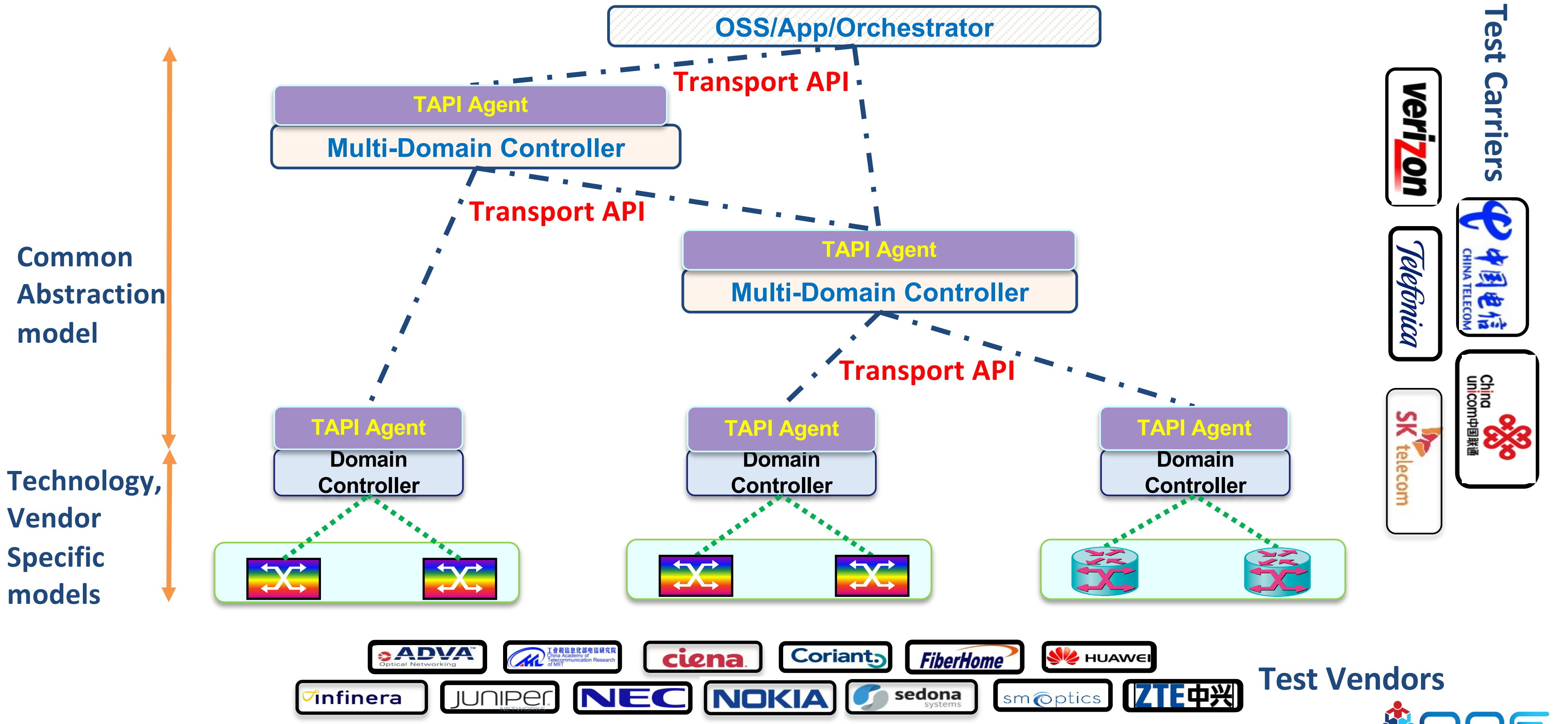
*animated slides

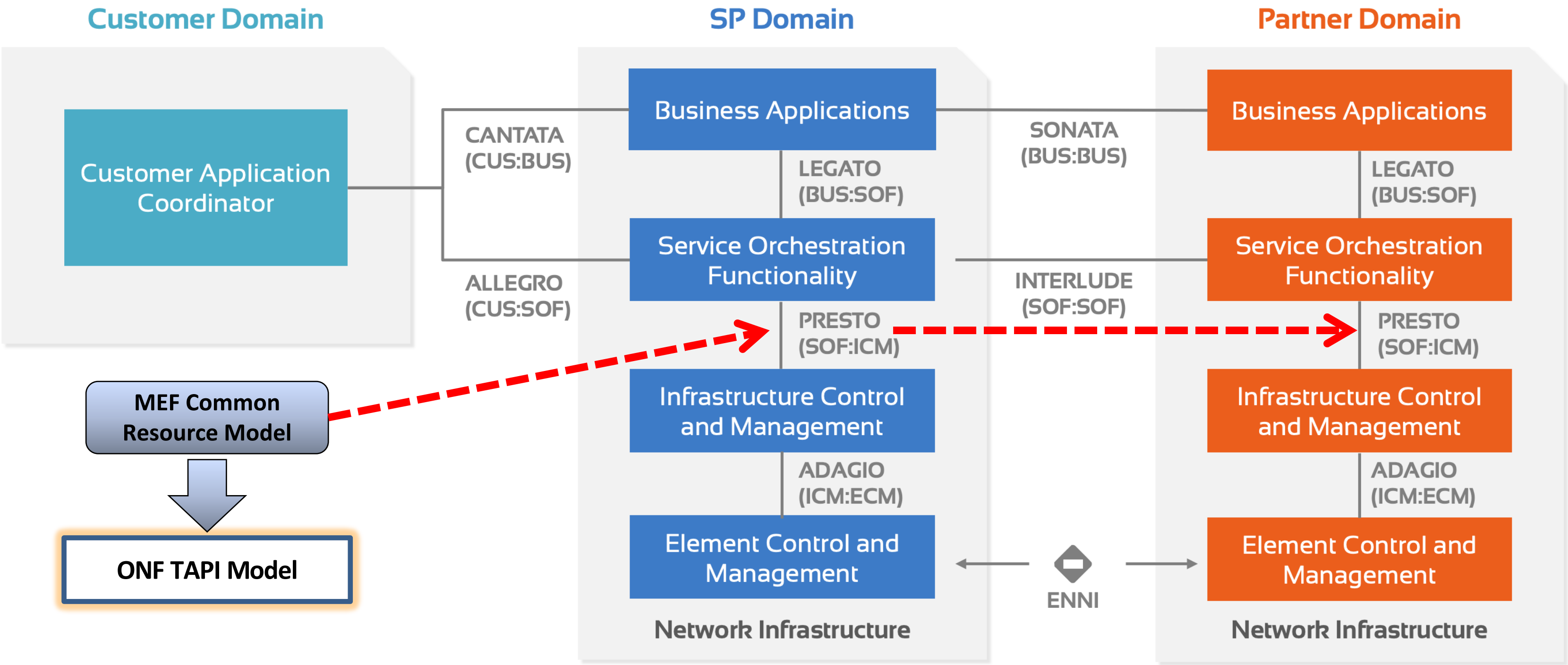
ONF Transport API (TAPI): Functional Architecture



OIF Transport API Interop Demo (2014, 2016, 2018)



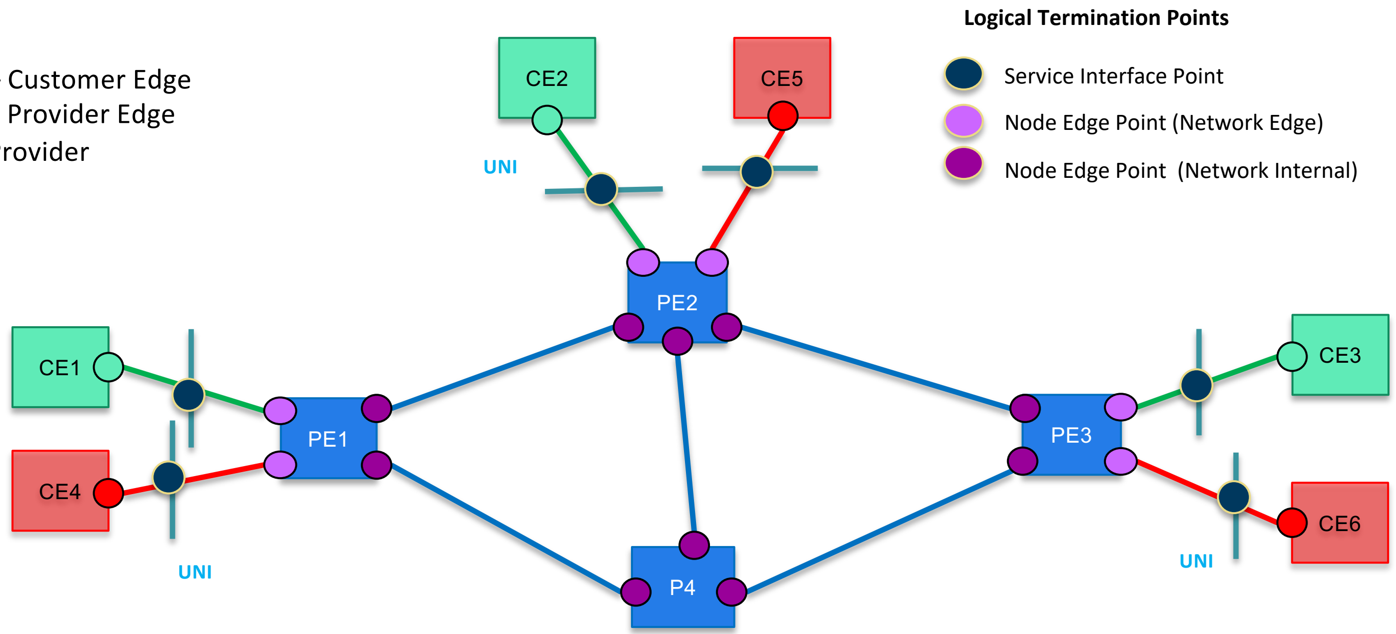
MEF: Lifecycle Service Orchestration Reference Architecture (LSO RA)



CUS: Customer Application Coordinator
BUS: Business Applications
SOF: Service Orchestration Functionality
ICM: Infrastructure Control and Management
ECM: Element Control and Management

Simple Physical Network Example to illustrate T-API

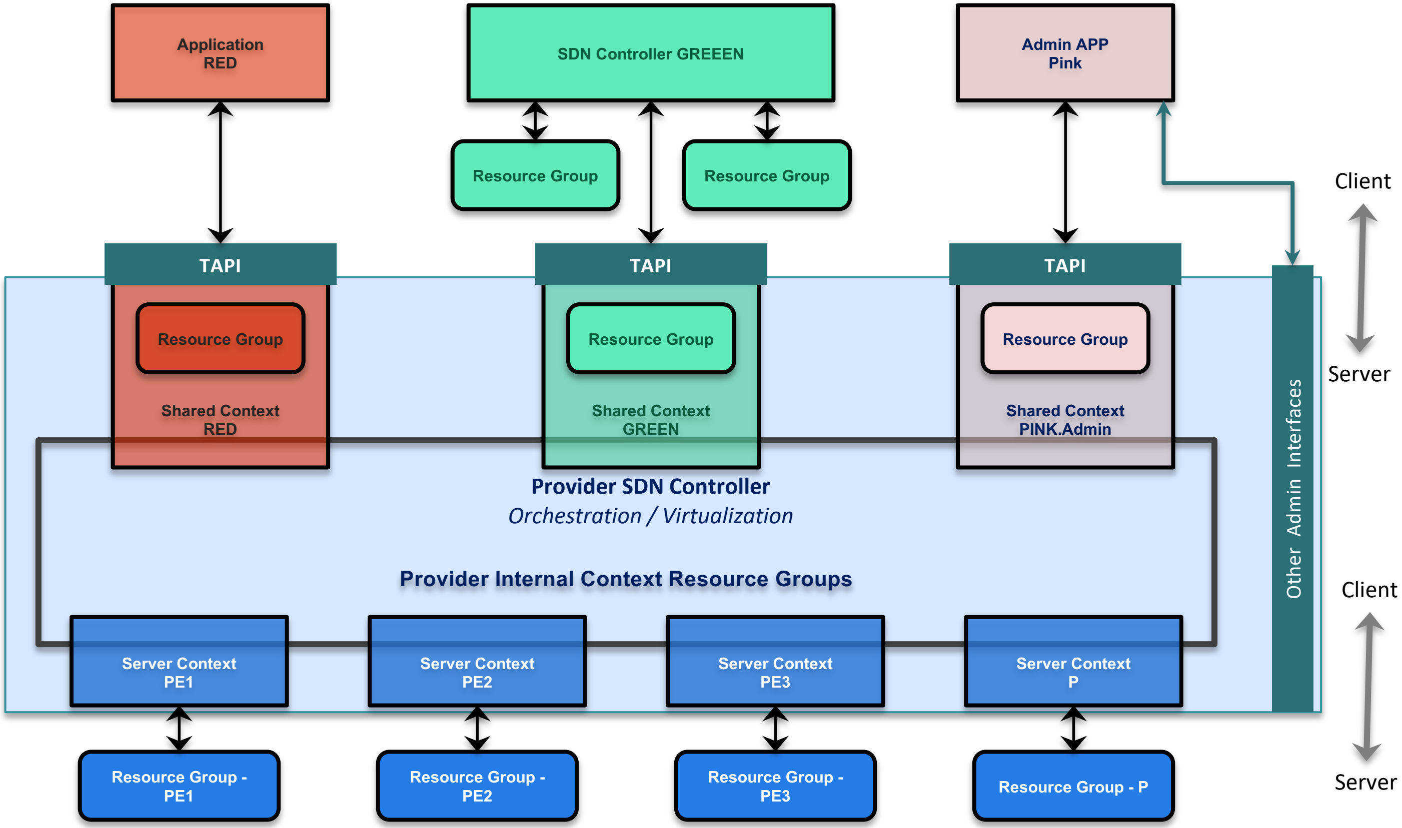
CE – Customer Edge
PE – Provider Edge
P - Provider



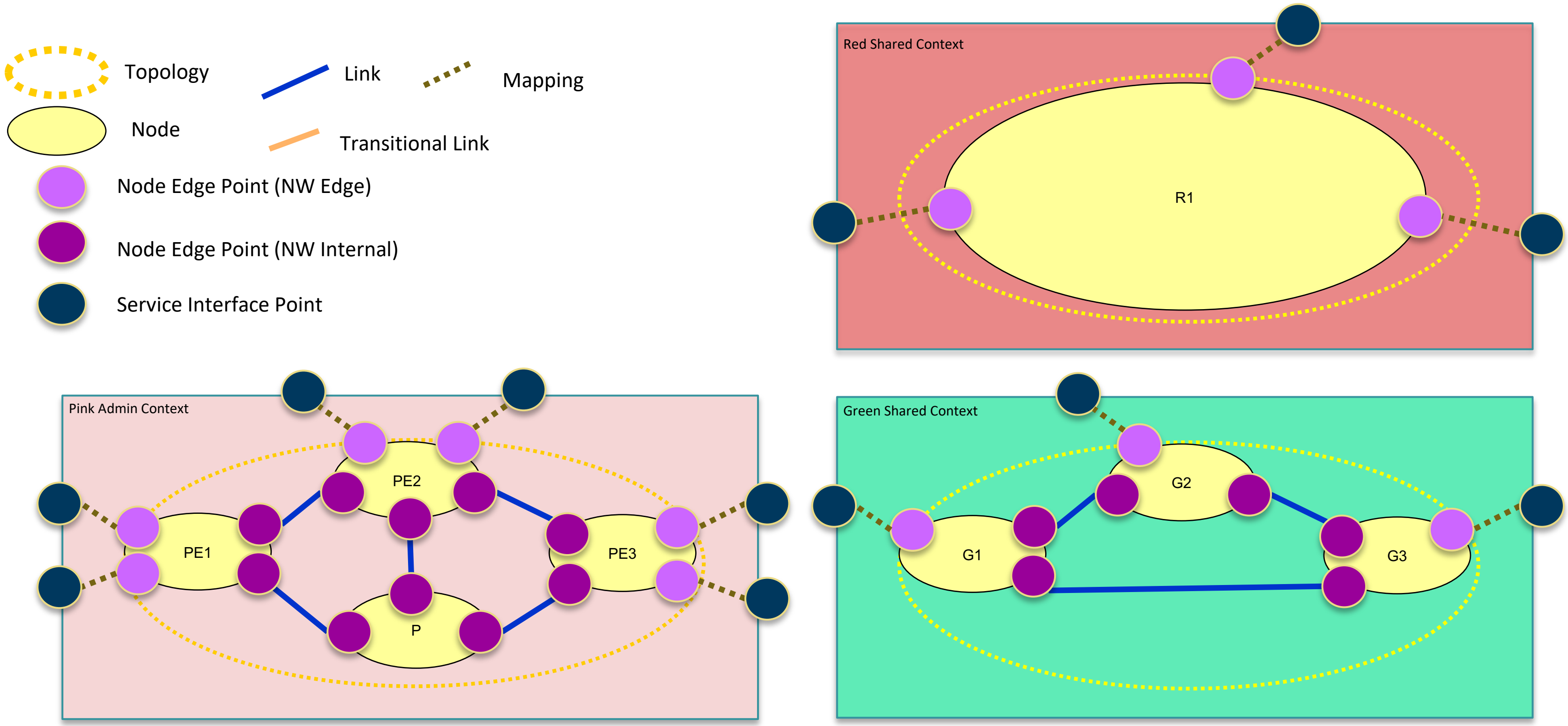
- A Network Provider (Blue) with two Customers (Red and Green)
- All UNI interfaces are ETH (e.g. 10GE), I-NNI interfaces are OTU (e.g. 100G OTN)
- All PE-NE are ODU/ETH switch capable, while P-NE is only ODU switch capable

T-API Contexts for the Simple Network Example

(based on ONF Architecture v1.1)

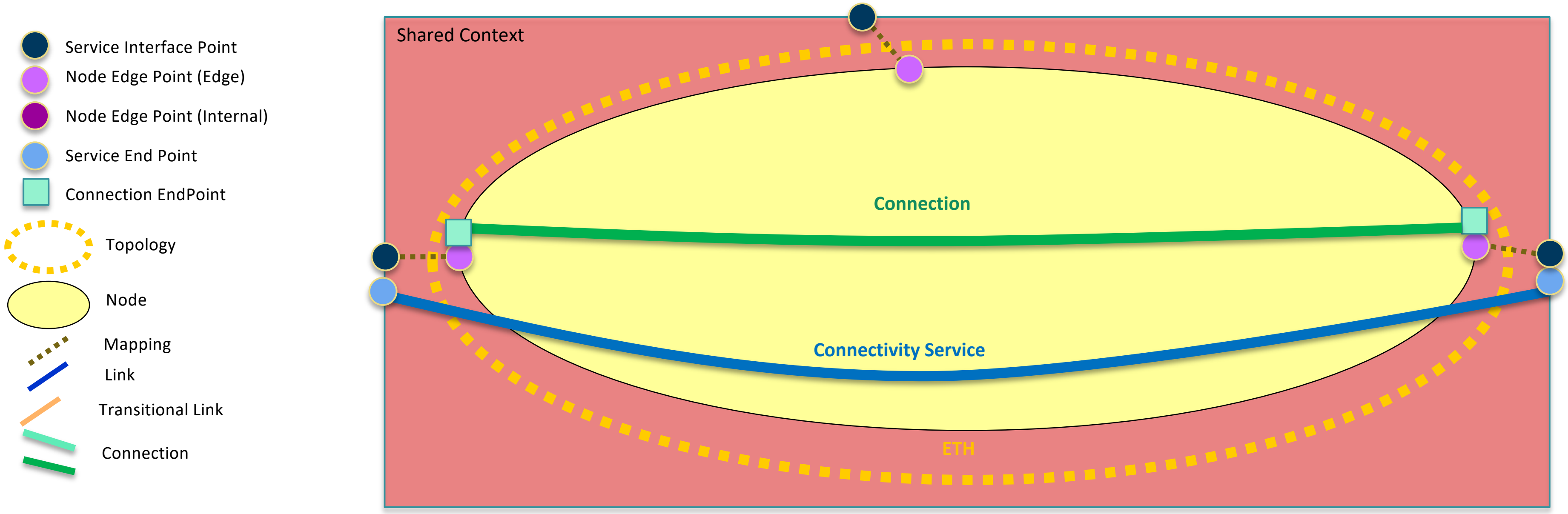


Example Topology Abstractions in the Shared Context



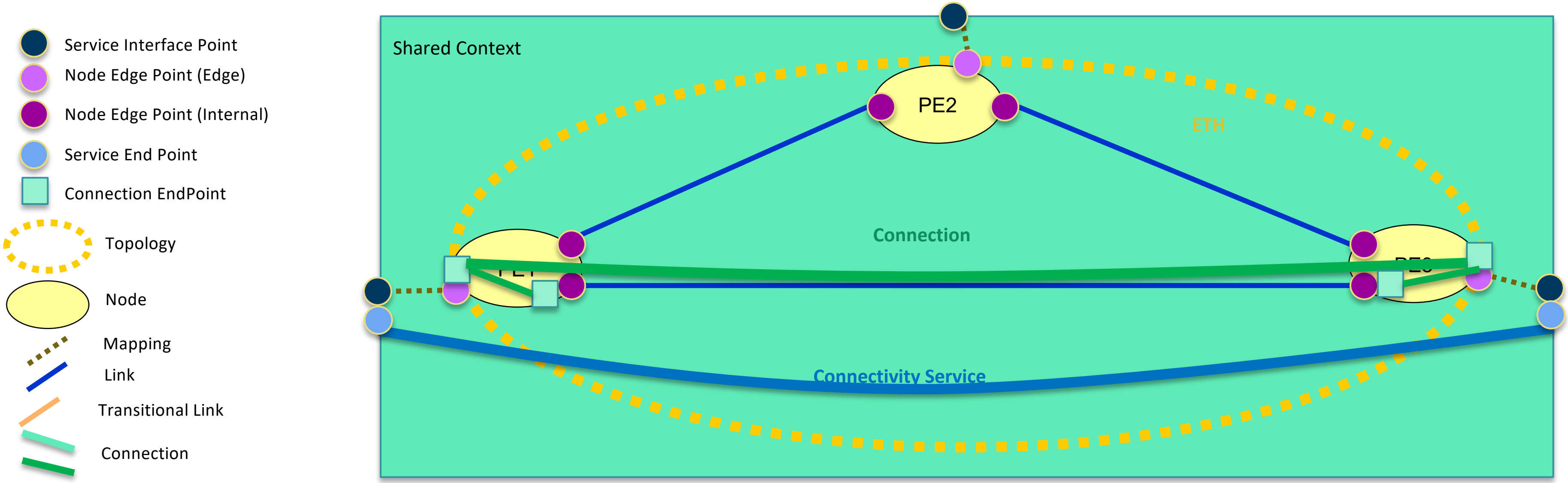
Client-1 (Red) Shared Context: Single Node Topology

- Single Node abstraction example
- *Node* and its *NodeEdgePoints* provide some approximation of the network capabilities
- *ConnectivityService* can be requested between *ServiceInterfacePoints*
- *Connections* appear as cross-connections across node, no visibility of underlying route



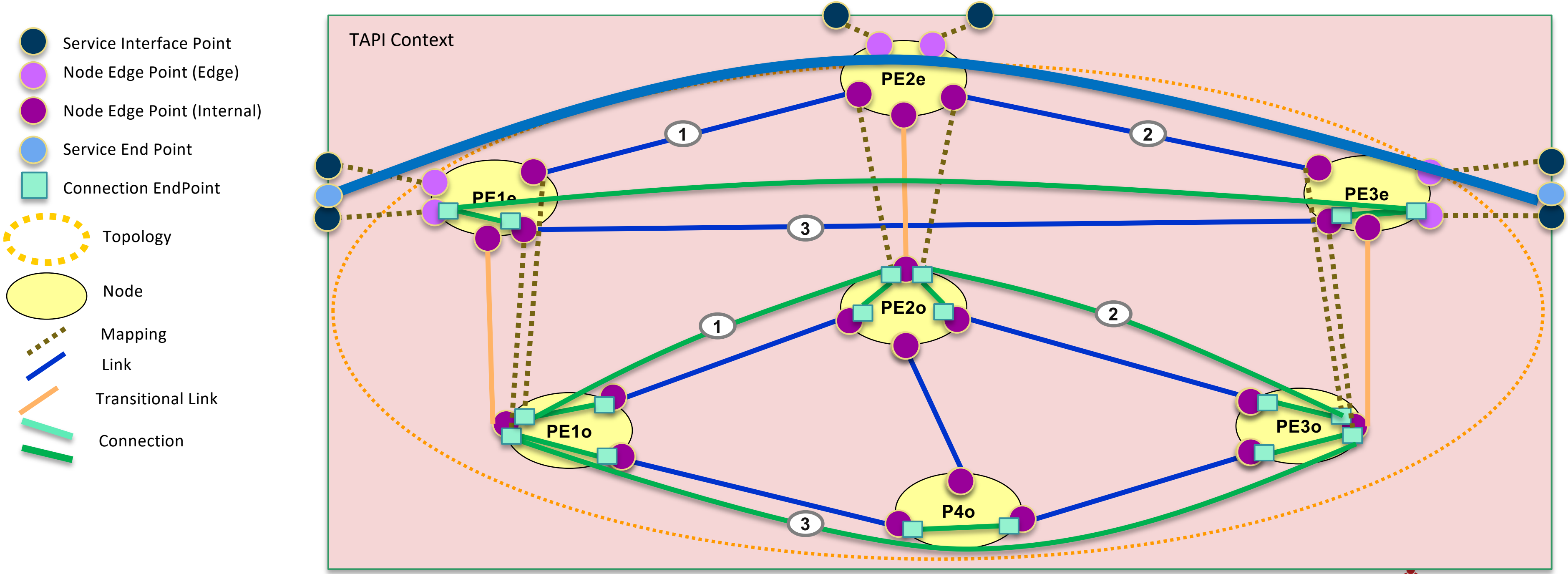
Client 2 (Green) Shared Context: Multi-Node Topology

- Multiple *Nodes* (PEs) *Topology* example
- *Node* and its *NodeEdgePoints* provide reasonable information of their capabilities
- *ConnectivityService* can be requested between *ServiceInterfacePoints*
- Top-level *Connection* is recursively decomposed into lower-level *Connections*, 1 per Node
- *Connection* route can be traced over the exposed *Topology*



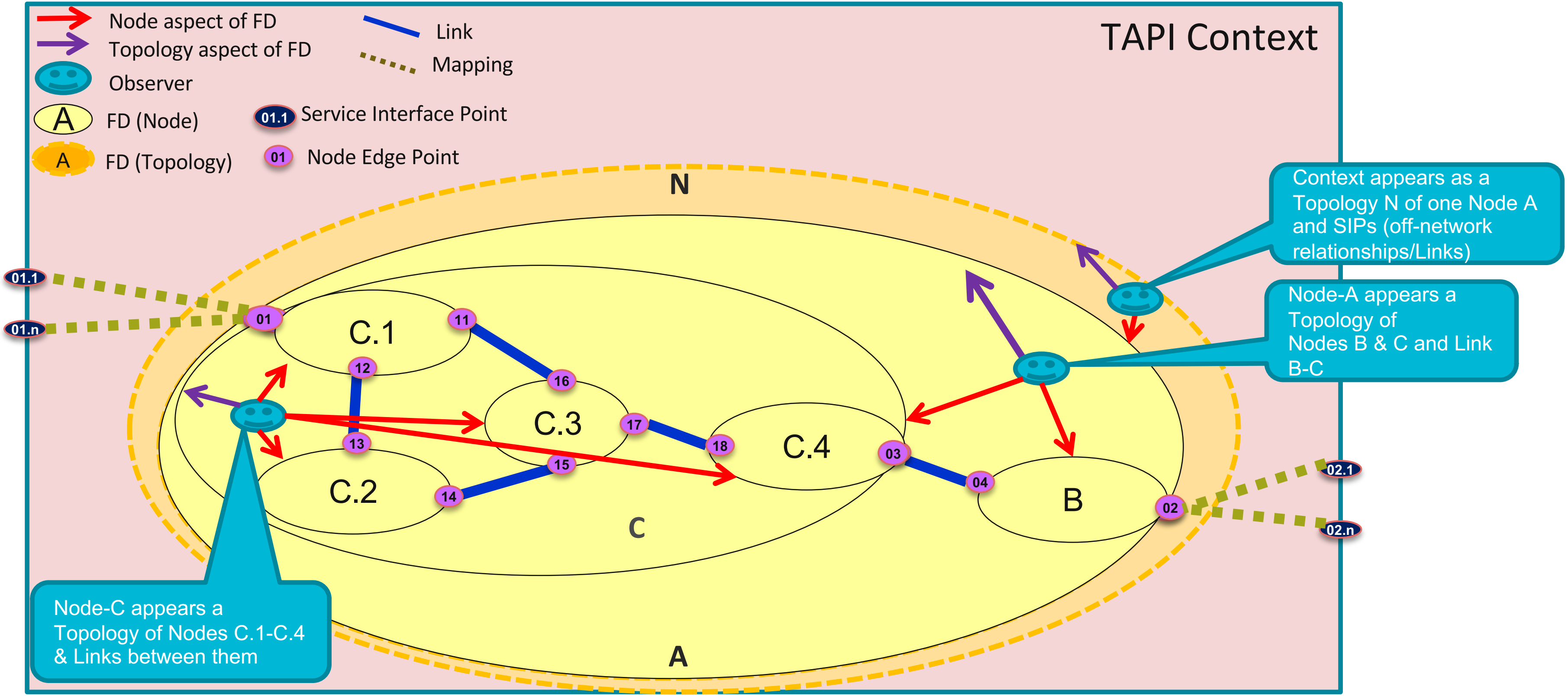
Admin (Pink) Shared Context: Multi-layer Topology

- Each physical device is represented by a separate *Node* per supported layer (ETH & ODU)
- *Node* and its *NodeEdgePoints* provide information of their capabilities at that layer
- *Transitional Links* interconnect the *NodeEdgePoints* at different layers
- Top-level *Connection* is recursively decomposed into lower-level *Connections*, 1 per Node
- Top-level *Connections* at lower (server) layer result in *Links* at upper (client) layer

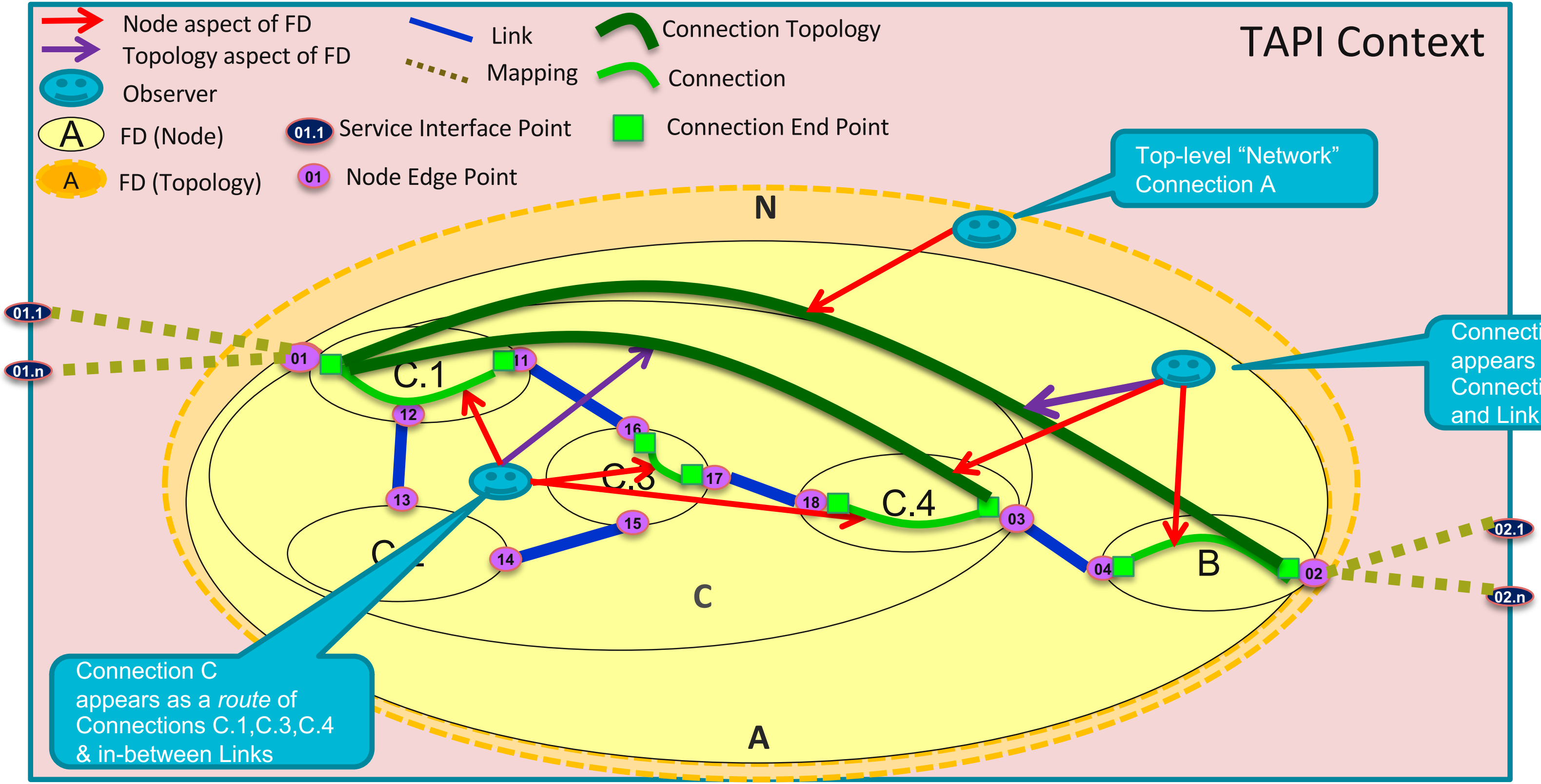


ONF CONNECT

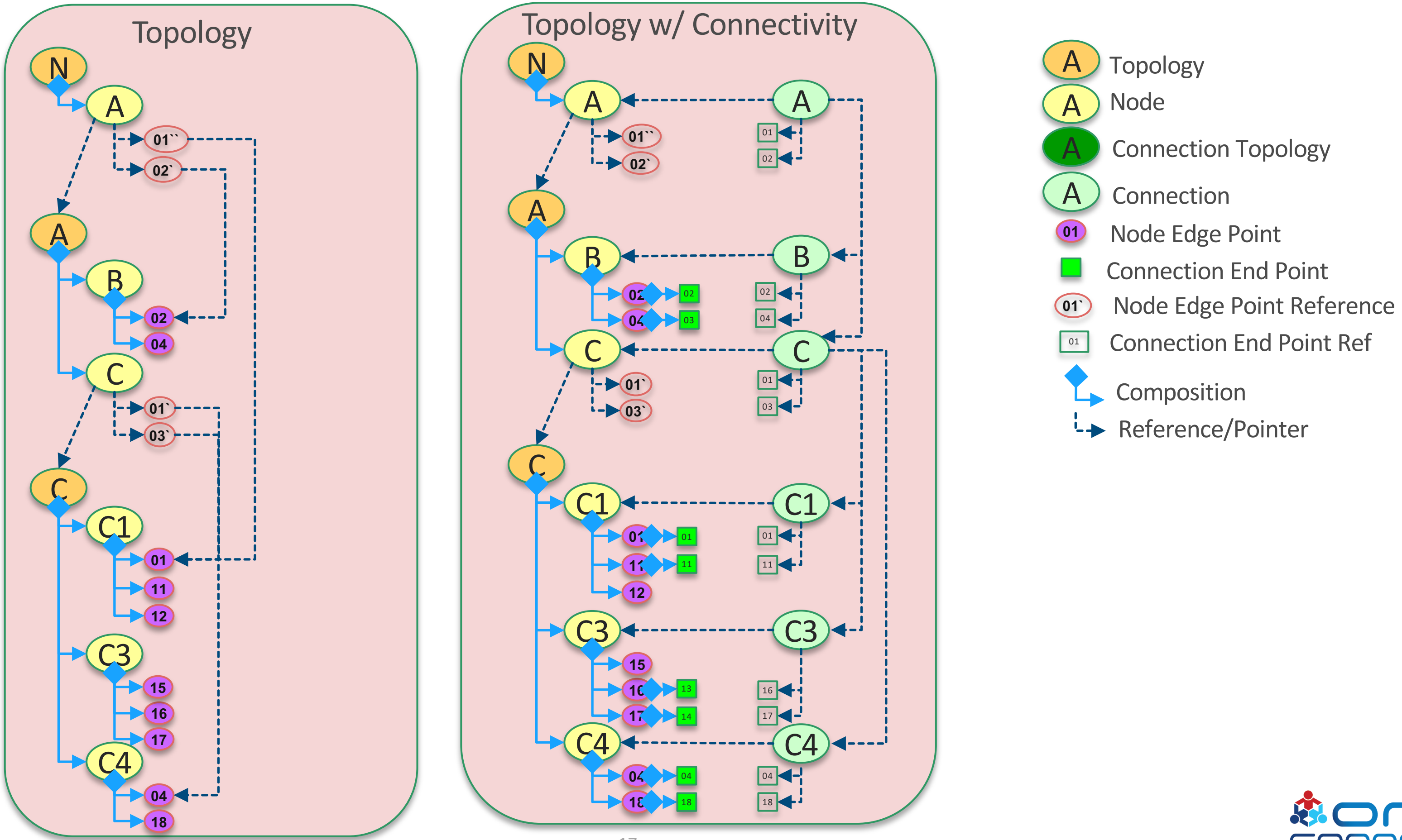
Recursive Node & Topology aspects of Forwarding Domain



Recursive Connectivity & Topology aspects of Forwarding

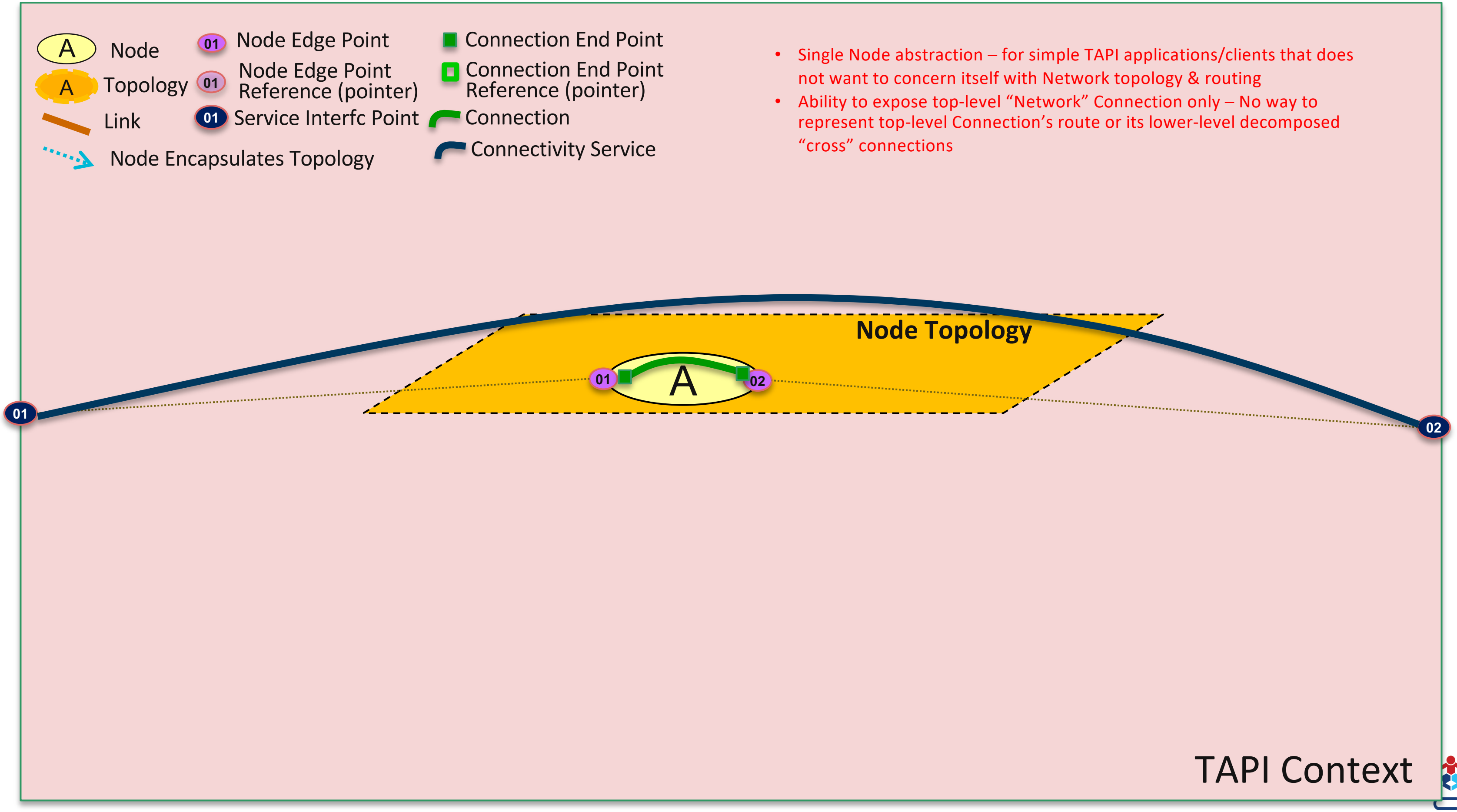


TAPI Topology & Connectivity Instances Tree view (example1)



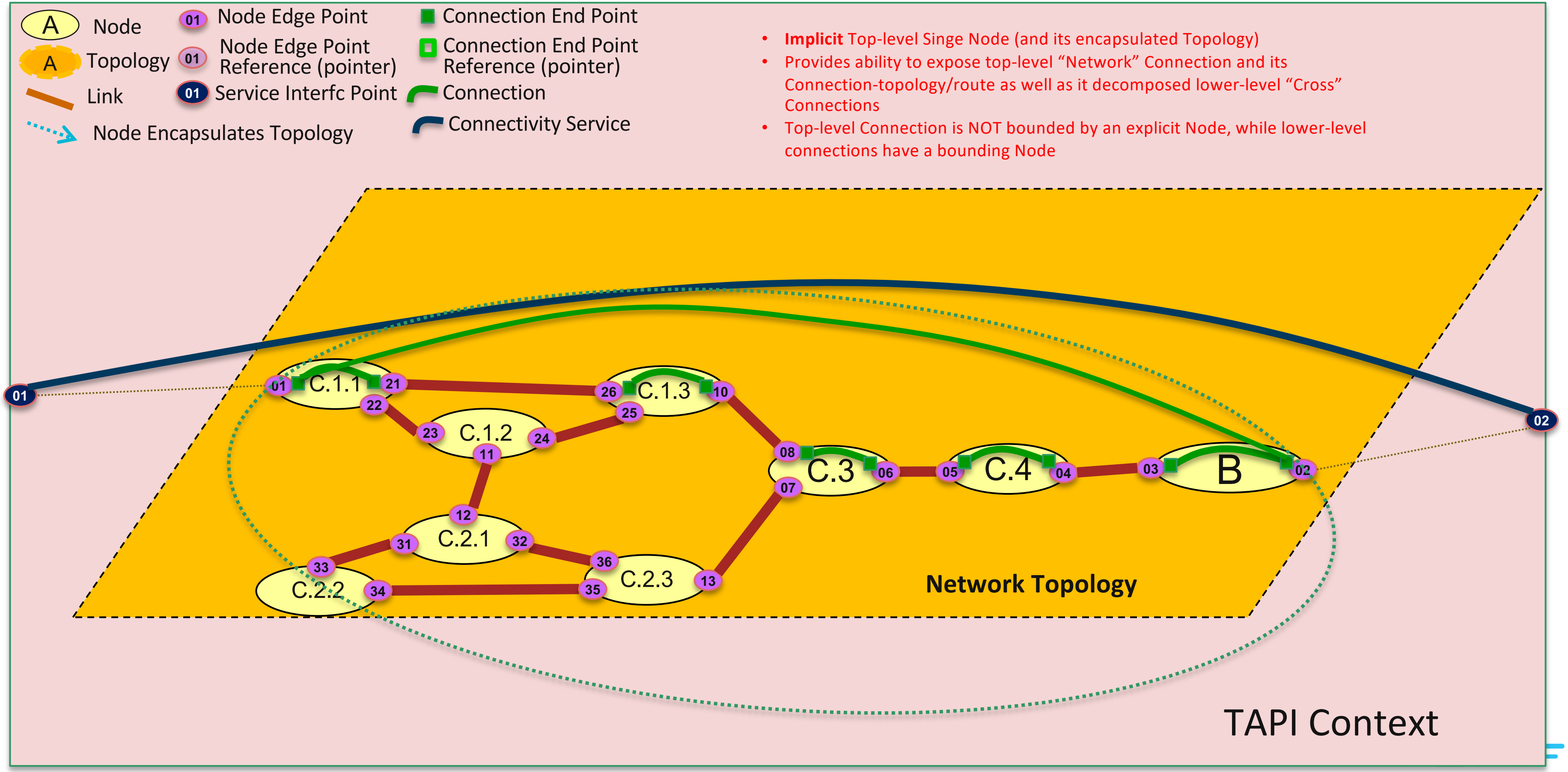
TAPI 2.2 Example 1: Single-level Topology, Network-Node (Single) abstraction

- Single Node abstraction – for simple TAPI applications/clients that does not want to concern itself with Network topology & routing
- Ability to expose top-level "Network" Connection only – No way to represent top-level Connection's route or its lower-level decomposed "cross" connections



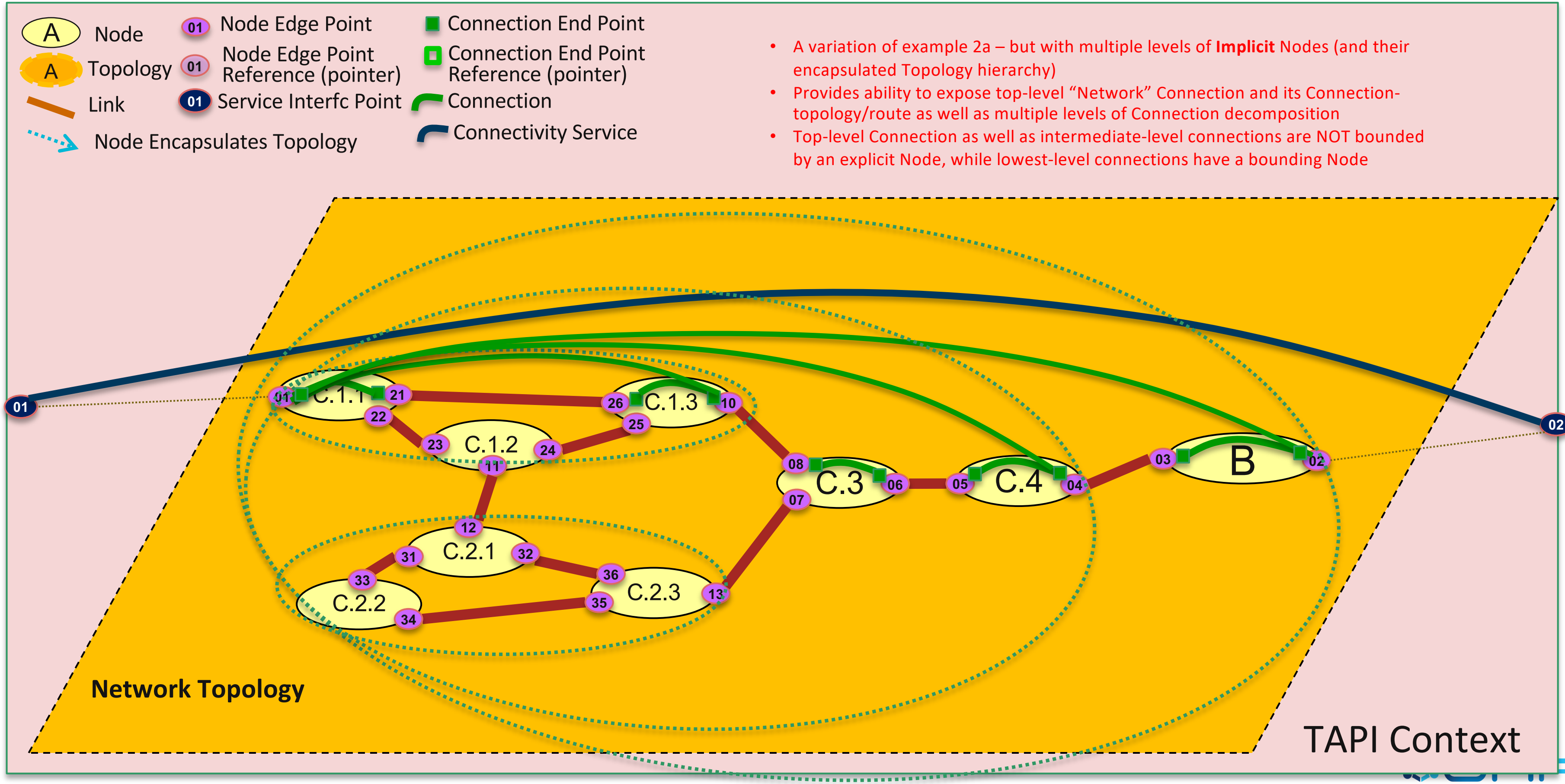
TAPI 2.2 Example 2a: Single-level Topology, Network abstraction w/ implicit Node

- **Implicit** Top-level Singe Node (and its encapsulated Topology)
- Provides ability to expose top-level "Network" Connection and its Connection-topology/route as well as it decomposed lower-level "Cross" Connections
- Top-level Connection is NOT bounded by an explicit Node, while lower-level connections have a bounding Node

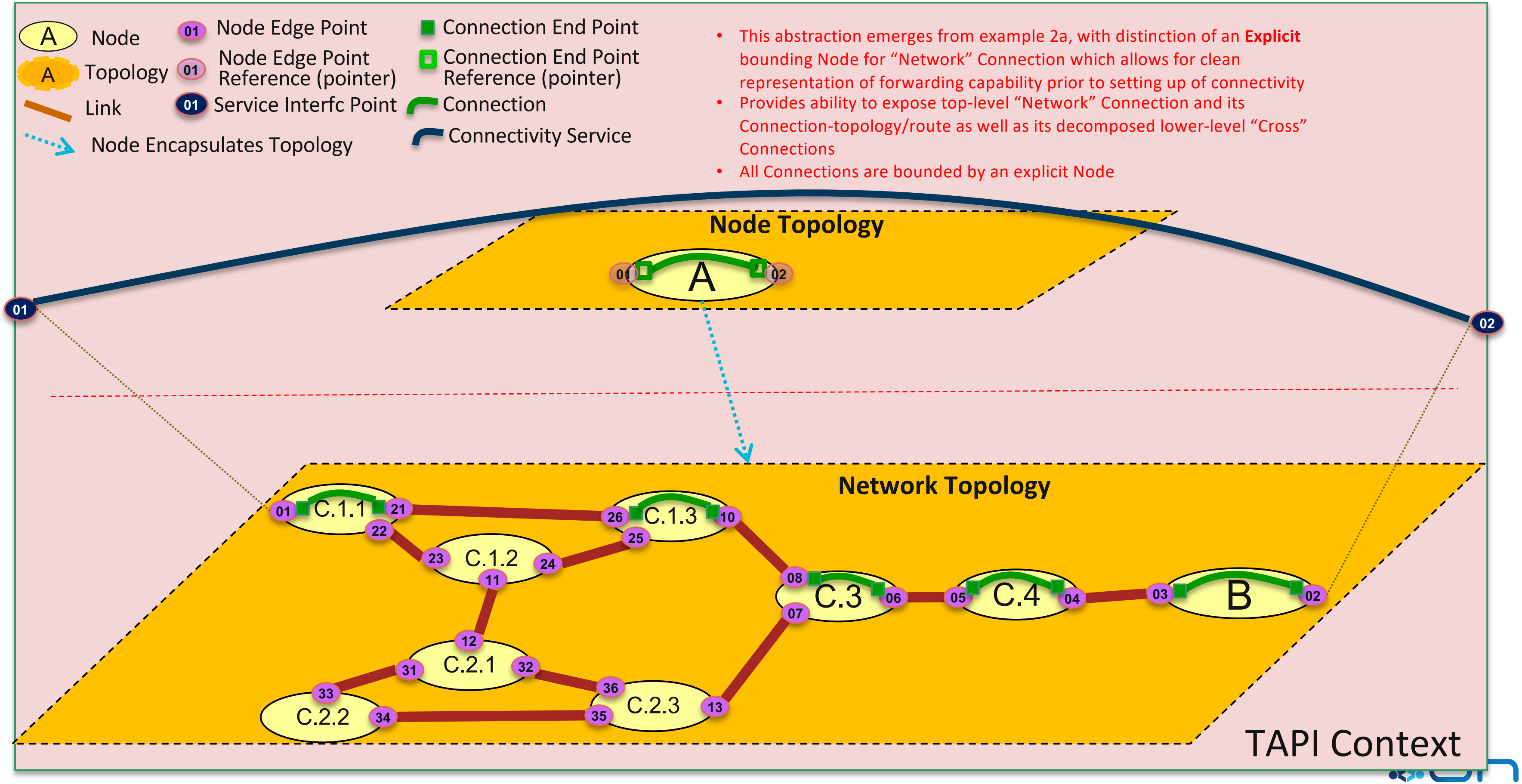


TAPI 2.2 Example 2b: Single-level Topology, Network abstraction /w multi-level implicit Nodes

- A variation of example 2a – but with multiple levels of **Implicit** Nodes (and their encapsulated Topology hierarchy)
- Provides ability to expose top-level "Network" Connection and its Connection-topology/route as well as multiple levels of Connection decomposition
- Top-level Connection as well as intermediate-level connections are NOT bounded by an explicit Node, while lowest-level connections have a bounding Node

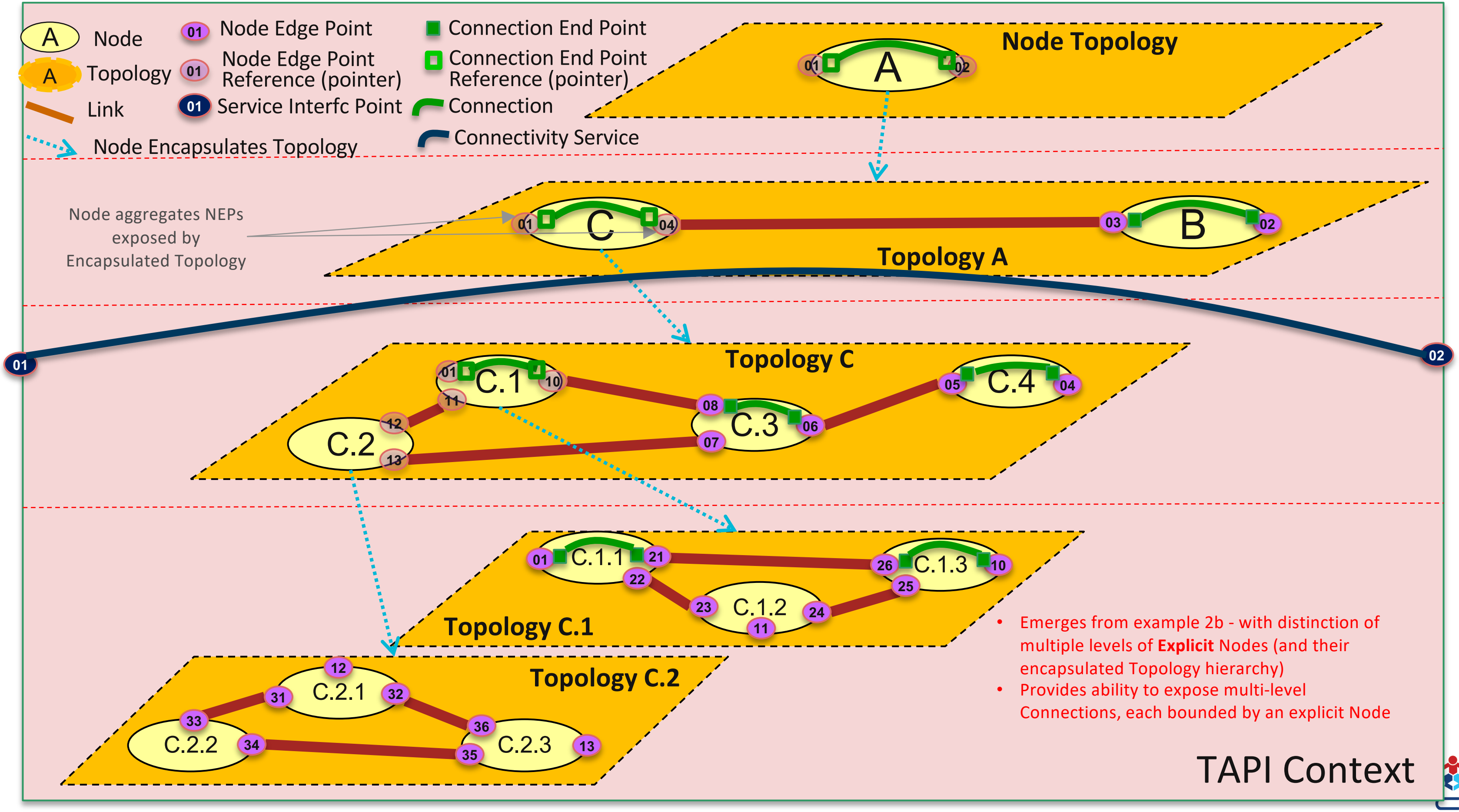


TAPI 2.2 Example 3: 2-level Topology, Network abstraction w/ Explicit Node



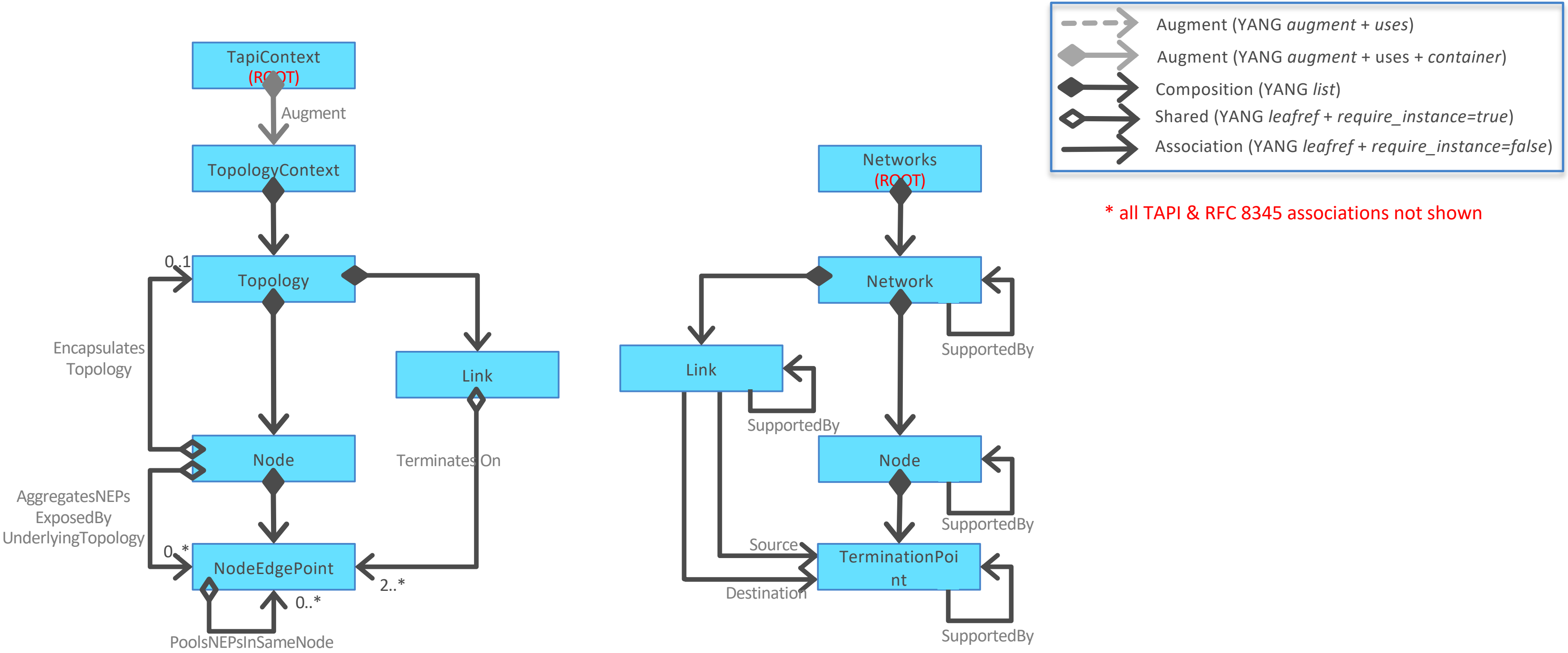
- This abstraction emerges from example 2a, with distinction of an **Explicit** bounding Node for "Network" Connection which allows for clean representation of forwarding capability prior to setting up of connectivity
- Provides ability to expose top-level "Network" Connection and its Connection-topology/route as well as its decomposed lower-level "Cross" Connections
- All Connections are bounded by an explicit Node

TAPI 2.2 Example 4: Multi-level Topology Partitioning abstraction



- Emerges from example 2b - with distinction of multiple levels of **Explicit** Nodes (and their encapsulated Topology hierarchy)
- Provides ability to expose multi-level Connections, each bounded by an explicit Node

TAPI 2.2 v/s RFC8345 Topology Models: Simplified View

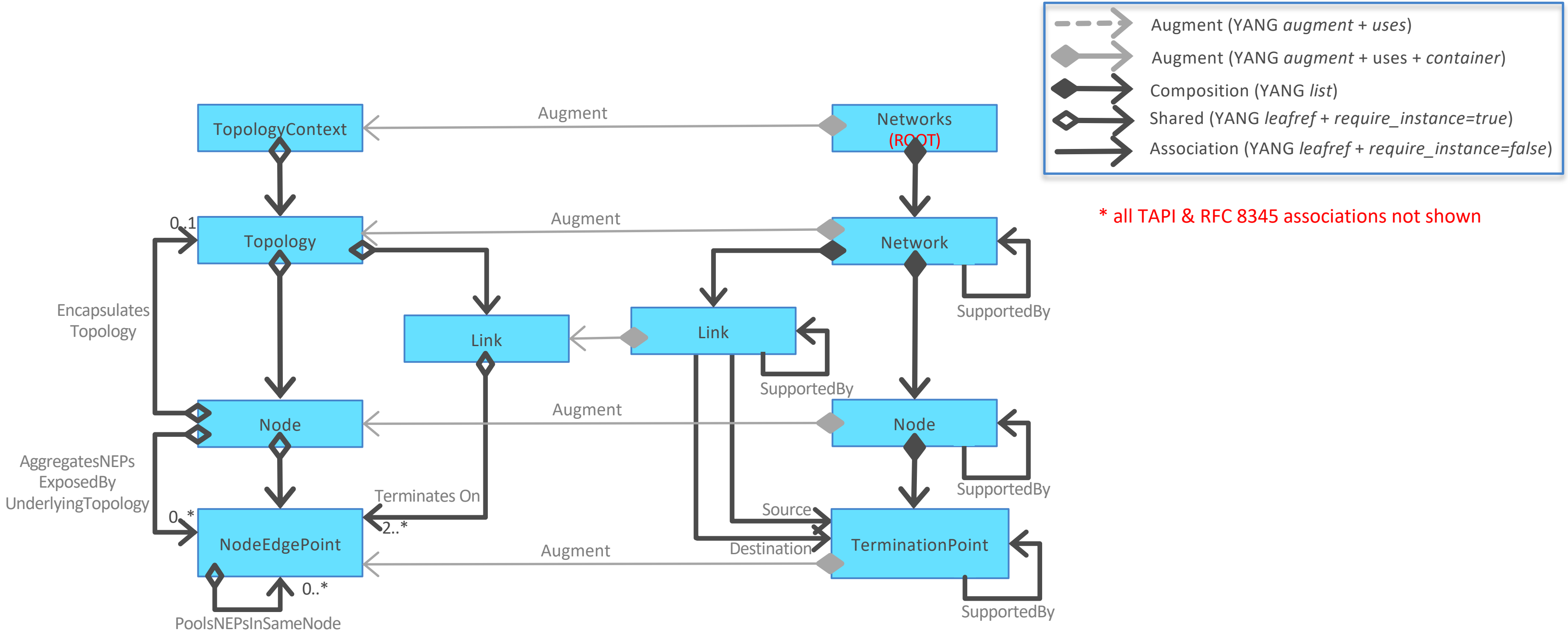


* all TAPI & RFC 8345 associations not shown

Tapi 2.2 Topology (Partitioning & Layering)

RFC 8345 Topology (View mapping)

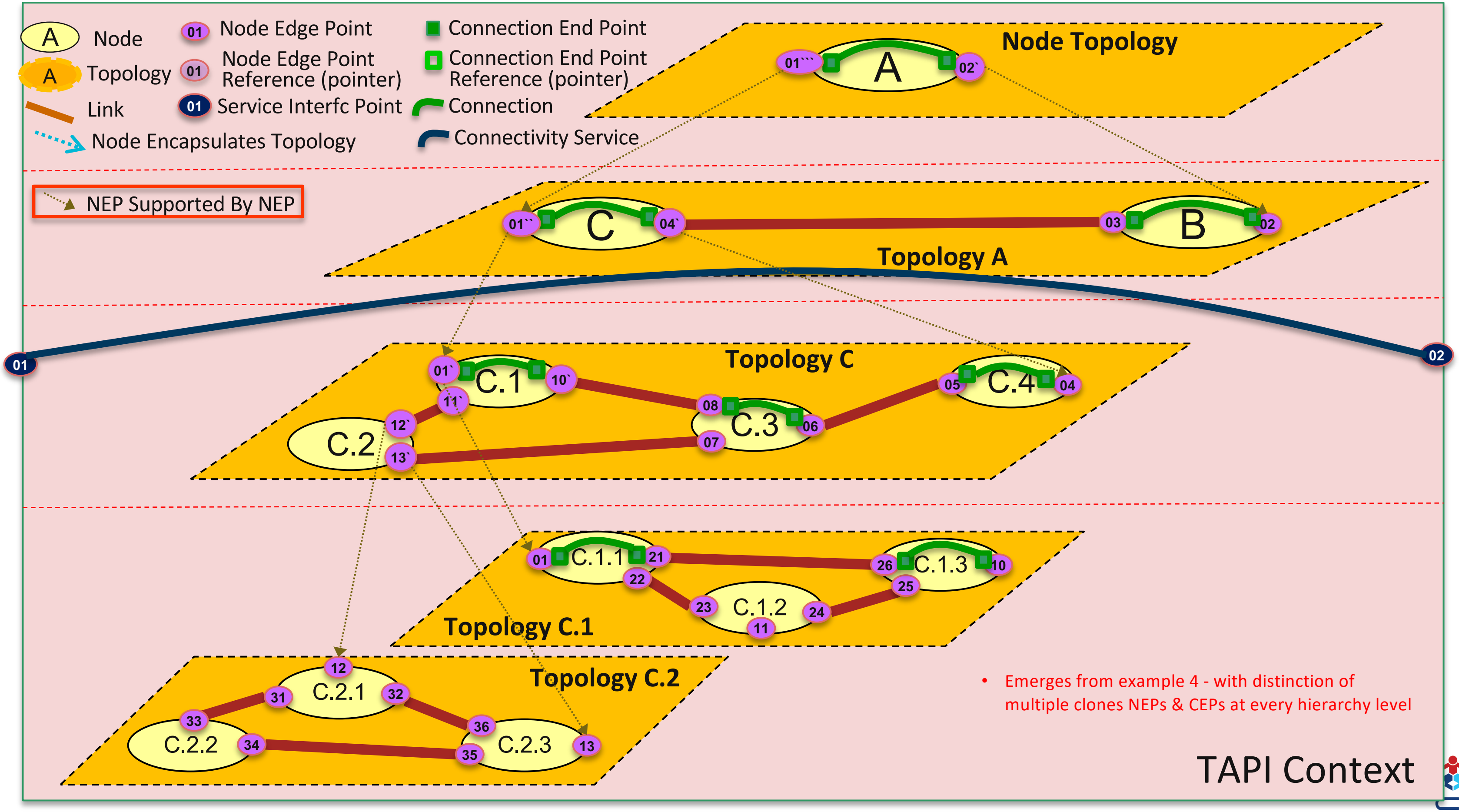
TAPI 3.0 augments RFC8345 Topology Model (under discussion)



Tapi 2.2 Topology (Partitioning & Layering)

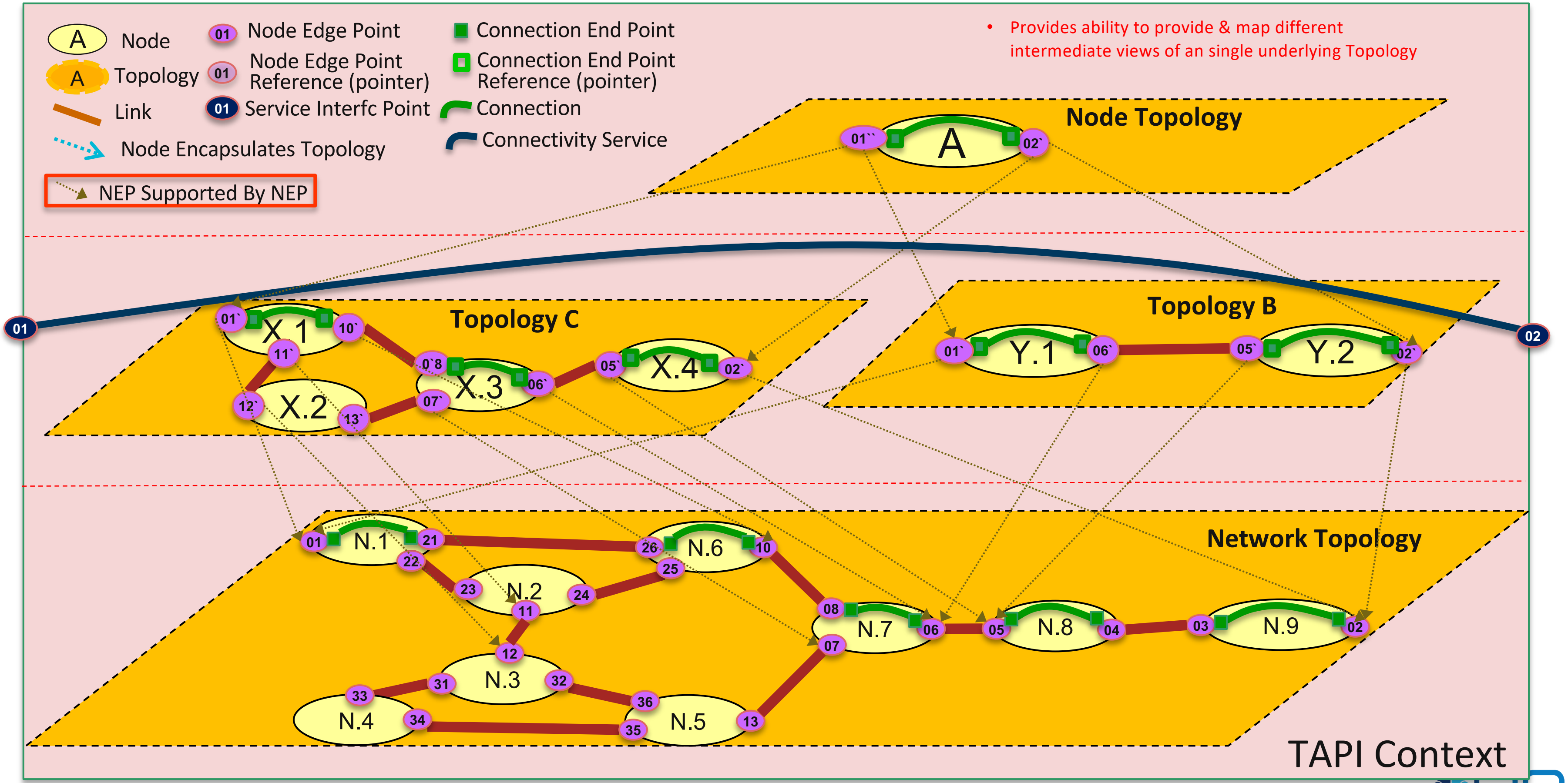
RFC 8345 Topology (View mapping)

TAPI 3.0 Example 5: Multi-level Topology Partitioning via Mapping abstraction



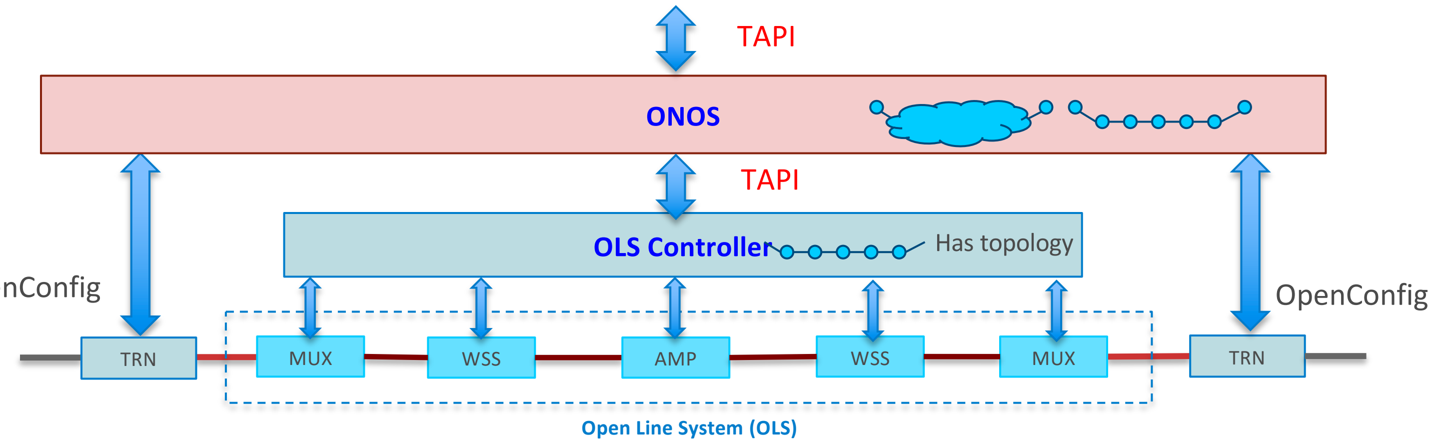
- Emerges from example 4 - with distinction of multiple clones NEPs & CEPs at every hierarchy level

TAPI 3.0 Example 6: Multiple Topology Views via Mapping abstraction



ONF ODTN (Open Disaggregated Transport) Architecture

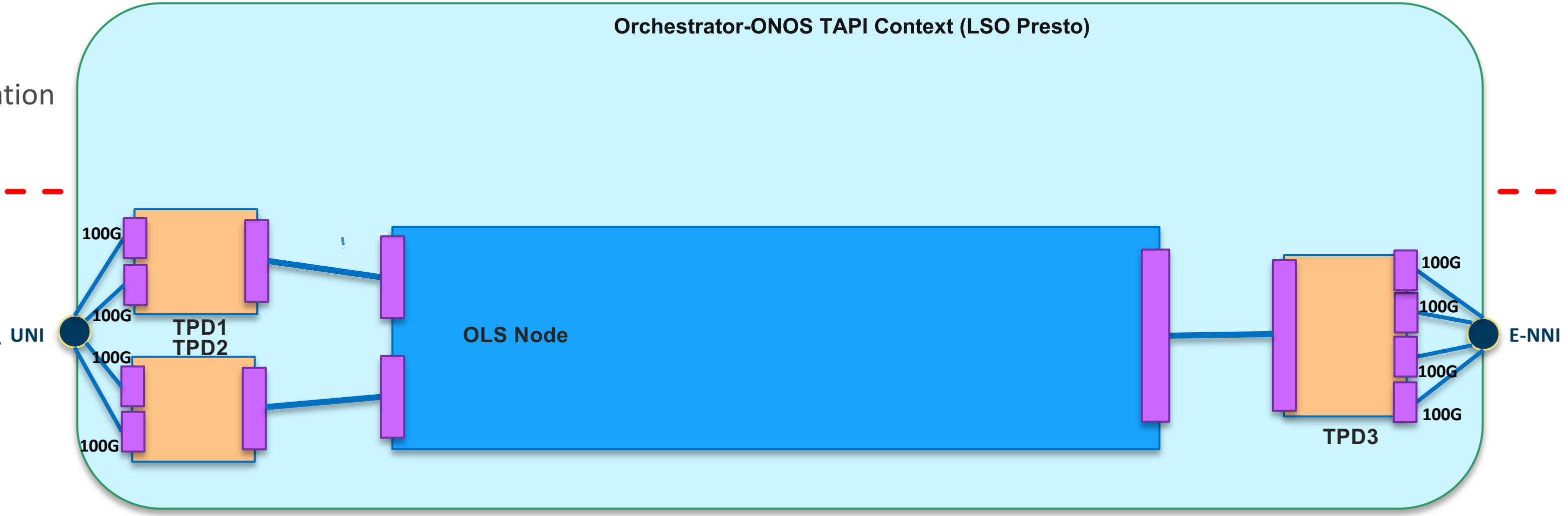
With OLS Controller



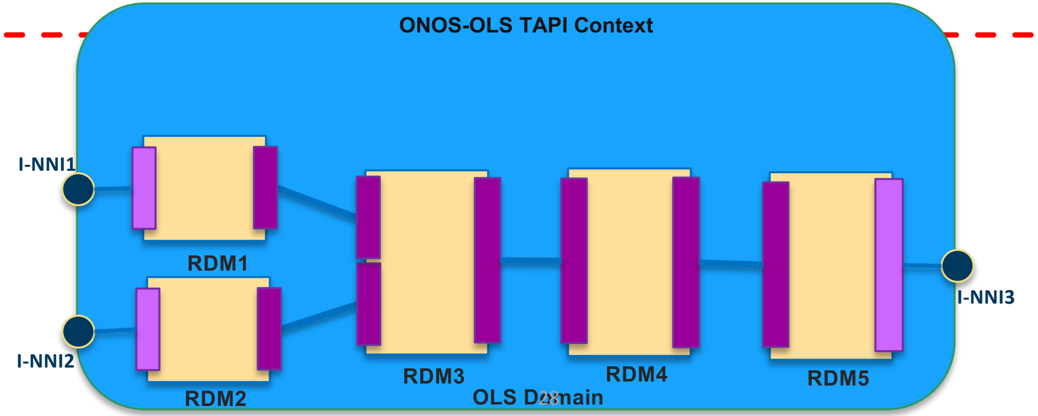
Operator Domain Topology – Partitioning to abstract layer network

Orchestration view

ONOS Controller View



OLS Controller View



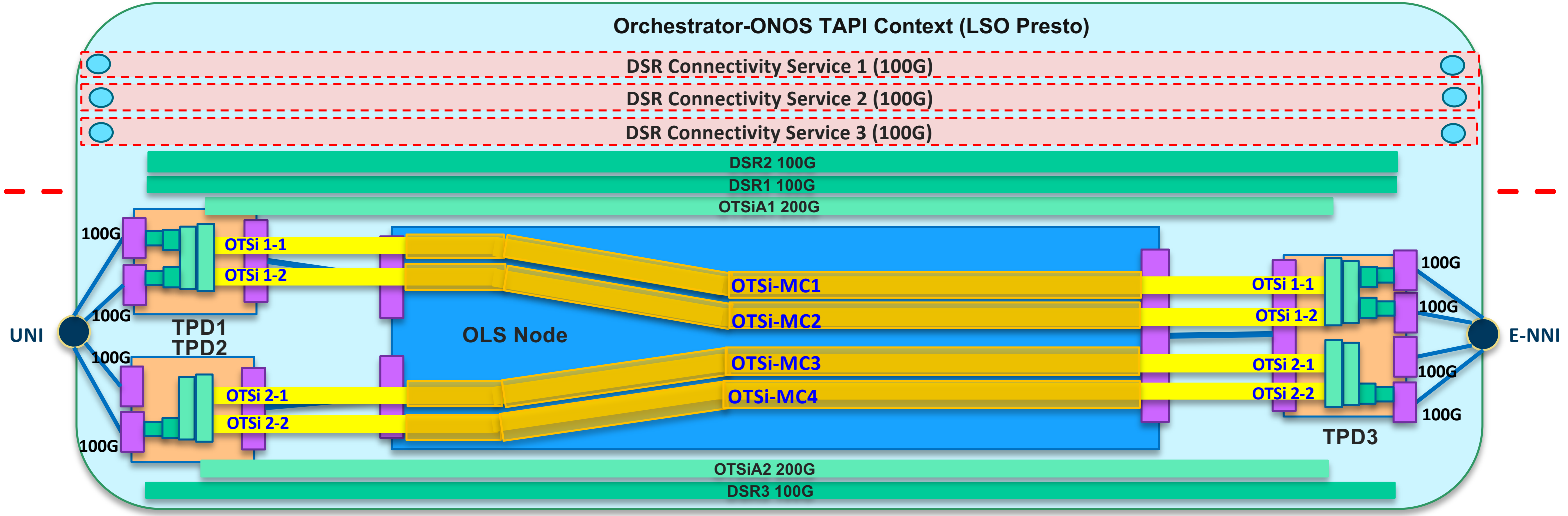
Abbreviations

TPD – Transponder Node
RDM – ROADM Node
UNI – User-Network Interface
NNI – Network-Network Interface
DSR – Digital Signal Rate
OTSi – Optical Tributary Signal
OTSiA – OTSi Assembly
MC – Media Channel

Logical Termination Points shown

- Service Interface Point
- Node Edge Point (Network Edge)
- Node Edge Point (Network Internal)
- Connectivity Service End Point
- Connection / Connection End Point
- Photonic Connection
- Photonic Media Channel

Operator Domain Connectivity Service & Resources



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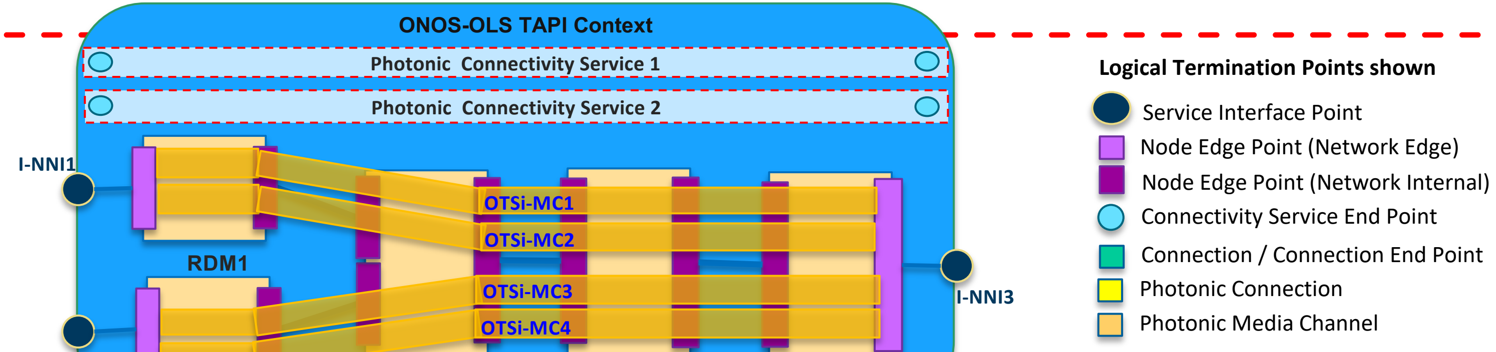

Thank You

Follow Up Links:

https://wiki.opennetworking.org/display/OTCC/TAPI