ONF Transport API
Opening up Disaggregated Optical Transport Applications *

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*animated slides
ONF TAPI

Introduction & Overview
ONF Transport API (TAPI): Functional Architecture

- Application
- SDN Controller

Transport API or Other NBIs

Topology Service
Connectivity Service
OAM Service
Path Computation Service
Virtual Network Service
Notification Service

Shared Network Information Context

Transport API or Other SBIs

Network Elements
SDN Controller
TAPI RI - Prototyping Controller-agnostic API

- TAPI Client (Python)
- Transport API
- ONOS NBI Mapper
- ODL NBI Mapper
- TAPI Server Backend
- TAPI Server (Python)
- Topology Service
- Connectivity Service
- OAM Service
- Path Computation Service
- Virtual Network Service
- Notification Service

Available / Shortly Available

- Network Domain (ODTN)
- Network Domain (UniMgr)
- TAPI Reference Network DB (JSON)
OIF Transport API Interop Demo (2014, 2016, 2018)
MEF 3.0 Optical Transport Implementation Project

- **L1** Service Attributes (MEF 63)
- **NRM** Network Resource Management IM (MEF 59)
- **NRP** Network Resource Provisioning IPS (MEF 60)

ONF Transport-API (TAPI)

MEF 3.0 Implementation project is underway to develop an orchestrated L1 Service Proof-of-Concept

Wide Area Network

- Optical Transport SDN Controller
- EMS/T-SDN Controller
- SDN Switch
- Data Center or Head End
- VNF

IM  Information Model
IPS  Interface Profile Specification
NBI  Northbound Interface

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ONAP

LSO Legato

Self-service Web Portal

Business Applications

LSO Presto

Amazon

Google

VNF
ONF ODTN (Open Disaggregated Transport) Architectures

With OLS Controller (Current Ph 1.5)

Without OLS Controller (Future Ph 2.0)
Confluence of Standards and Open Source

ONF OIMT
ONF Core Information Model
ONF Technology Specification Models

ONF OTCC
TAPI FRS
Use cases & Requirements

ONF TAPI SDK
TAPI UML Information Model
TAPI YANG Data Schema
OpenAPI (RESTConf) Schema
Python Reference Implementation

Open Model Profile
UML-YANG Generation Tool
YANG-OpenAPI Generation Tool
Python Stub Generation Tool
EAGLE Modeling Tools

Open Model
ONF TAPI Design Tools
ONF TAPI SDK

Python Reference Implementation
Python Stub Generation Tool

Optical Transport
Packet WAN

MEF
MEF 3.0 Implementations

MEF Models
NRM
NRP

MEF 3.0 Implementations
MEF Interop Implementations

Multi-carrier T-SDN Interop
Interop Implementations

OIF
Implementation Agreements & Certification

Technologies
OTN (ITU-T G.874.1)
ETH (ITU-T G.8052)
Photonic (ITU-T G.807.1)

Technology Generic Core Model (ITU-T G.7711)

ITU-T SG15

ITU-T SG15

ONF OIIMT
ONF Core Information Model
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Optical Transport
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MEF
MEF 3.0 Implementations

MEF Models
NRM
NRP

MEF 3.0 Implementations
MEF Interop Implementations

Multi-carrier T-SDN Interop
Interop Implementations

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ITU-T SG15

ITU-T SG15
<table>
<thead>
<tr>
<th>TAPI Feature Set</th>
<th>TAPI SDK 1.x (H2 2016)</th>
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<tbody>
<tr>
<td><strong>Topology Service</strong></td>
<td>• Logical (abstract/virtual) Topology, Node, Link &amp; Edge-Point (Across all layers)</td>
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<tr>
<td><strong>Connectivity Service</strong></td>
<td>• Retrieve &amp; Request P2P, P2MP, MP2MP connectivity (Across all layers)</td>
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<td><strong>Path Computation Service</strong></td>
<td>• Request for Computation &amp; Optimization of paths</td>
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<td><strong>Virtual Network Service</strong></td>
<td>• Create, Update, Delete Virtual Network topologies</td>
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<tr>
<td><strong>Notification Framework</strong></td>
<td>• Subscription and filtering</td>
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<td></td>
<td>• Autonomous/Push mechanism</td>
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<th>TAPI SDK 2.x (H2 2018)</th>
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<tr>
<td><strong>Node Constraints</strong></td>
<td>• Ability to specify connectivity/blocking constraints</td>
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<tr>
<td><strong>Resilience &amp; Protection</strong></td>
<td>• Multi-layer, Multi-Domain</td>
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<td></td>
<td>• Based on use cases under discussion</td>
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<tr>
<td><strong>OAM/Monitoring/PM</strong></td>
<td>• Consistent Multi-layer abstraction and model – L0-L2</td>
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<td><strong>Alarm/TCA/Counter</strong></td>
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<td><strong>Multi-Technology</strong></td>
<td>• Photonic Media spec models</td>
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<tr>
<td></td>
<td>• ETH &amp; OTN enhancements</td>
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<td>• Microwave TBD</td>
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Transport API Summary

General Benefits

• Provides functions necessary for multi-domain orchestration
  – Topology view and abstraction
  – Connectivity establishment
  – Hierarchical Abstraction
  – Migration path for legacy systems
• Different types of topology abstraction
  – Abstract Node (single, edge, sliced, etc)
  – Abstract Link
  – Complete (1-to-1) internal topology
• Supports multiple transport technologies
  – Packet Transport (Ethernet, MPLS-TP)
  – Optical Transport (OTN, DWDM)
• Interoperability on North-South Orchestrator/Controller interface

TAPI Next Steps

• TAPI 2.x fixes & enhancements
  – Photonic Model updates based on ODTN feedback
  – ETH, L1 & OAM alignment due to interaction with MEF (NRM-OAM/SOAM, L1) projects
  – YANG & OpenAPI/RESTConf Best Practices
    – Based on MEF-PRESTO (ODL), ODTN (ONOS) and OIF (TAPI Interop) activity feedback
• TAPI 3.0 Items (Current)
  – Equipment Inventory & configuration
    – Equipment, Holders (Rack/Shelf, etc), Connectors, Fiber, etc
  – Topology Pacs/Datatypes (Capacity, Cost, Latency, Risk parameters) enhancements
  – Rationalize/tune the component-system pattern for Topology & Connectivity
ONF TAPI

Logical Topology & Forwarding Concepts with Photonic Example
Simple Physical Network Example to illustrate T-API

- A Network Provider with 2 operator domains:
  - Transponder domain
  - OLS/ROADM domain
- And with two Customers (Red and Green) connected to Transponders
- No Switching on TPD Nodes - DSRs are mapped into ODU into OTSi
- Only Photonic switching assumed on ROADMS

Abbreviations
TPD – Transponder Node
RDM – ROADM Node
UNI – User-Network Interface
NNI – Network-Network Interface
NMC – Network Media Channel
NMCA – NMC Assembly
OTSi – Optical Tributary Signal
OTSiA – OTSi Assembly

Logical Termination Points shown
- Service Interface Point
- Node Edge Point (Network Edge)
- Node Edge Point (Network Internal)
- Connectivity Service End Point
Example 1: Hierarchical TAPI Control Domains & Abstracted OLS Topology

Customer(s) view

Network Provider View

OLS Operator View

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Example 1: E2E Connectivity Request Flow (Omnipotent view)

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Example 1: E2E Connectivity Request Flow (actual TAPI Contexts view)

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Logical Termination Points shown
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Example 1: Connectivity Request Flow /w provisioned Connectivity

Customer(s) view
Network Provider View

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- Service Interface Point
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- Connectivity Service End Point

OLS Operator View
Example 2: Alternate TAPI Control Domains – Orchestration architecture

Customer(s) view

Network Provider View

Operators View

Service Orchestrator
Abstraction & Orchestration

TAPI Context-G
UNI 1
UNI 3

TAPI Context-R
UNI 2

Abstraction & Orchestration

UNI 1
UNI 2
UNI 3
UNI 4

TPD Domain Controller

TPD TAPI Context

RDM1
RDM2
RDM3
RDM4
RDM5

UNI 1
UNI 2
UNI 3
UNI 4

OLS TAPI Context

OLSDomain Controller

OLS Domain

UNI 1
UNI 2
UNI 3
UNI 4

TPD Domain

UNI 1
UNI 2
UNI 3
UNI 4

TPD TAPI Context

RDM1
RDM2
RDM3
RDM4
RDM5

UNI 1
UNI 2
UNI 3
UNI 4

Operators View

Customer(s) view

Network Provider View

Service Orchestrator
Abstraction & Orchestration

TAPI Context-G
UNI 1
UNI 3

TAPI Context-R
UNI 2

Abstraction & Orchestration

UNI 1
UNI 2
UNI 3
UNI 4

TPD Domain Controller

TPD TAPI Context

RDM1
RDM2
RDM3
RDM4
RDM5

UNI 1
UNI 2
UNI 3
UNI 4

OLS TAPI Context

OLSDomain Controller

OLS Domain

UNI 1
UNI 2
UNI 3
UNI 4

TPD Domain

UNI 1
UNI 2
UNI 3
UNI 4
Example 2: Alternate TAPI Control Domains – E2E Connectivity Request
Recursive Node & Topology aspects of TAPI Forwarding Domain

TAPI Context → Network Domain View

- Node aspect of the FD
- Topology aspect of the FD
- Observer
- FD (Node)
- FD (Topology)

Node aspect of the FD:
- Observer
- FD (Node)
- FD (Topology)

Topology aspect of the FD:
- Link
- Mapping

Context appears as a Topology of one Node B and SIPs (off-network relationships/Links)

Node-B appears a Topology of Nodes A & C and Link A-C

Node-C appears as a Topology with NULL elements

Node-A appears a Topology of Nodes A.1 - A.5 & Links between them
Recursive Connectivity decomposition of TAPI Forwarding Construct

Node aspect of the FD ➔ Topology aspect of the FD

Observer ➔ Node-B appears a Topology of Nodes A & C and Link A-C.

Connection (01-02) decomposes into 2 lower-level Connections (01-04) & (03-02).

Context appears as a Topology of one Node B and a Connection (01-02).

Node-A appears a Topology of Nodes A.1 - A.5 & Connection (01-04) further decomposes into 3 lowest-level connections (01-12), (17-18) & (20, 04).

Observer ➔ Network Domain View

Node-A aspect of the FD ➔ Topology aspect of the FD

Link ➔ LTP (Service Interface Point)

Mapping ➔ LTP (Node Edge Point)
TAPI 2.1 Photonic LTP Model (still under review for 2.2)
References

Thank you 😊
Links:

- TAPI Wiki: https://wiki.opennetworking.org/display/OTCC/TAPI
- TAPI SDK: https://github.com/OpenNetworkingFoundation/tapi
- Core model: TR-512 V1.4 (November 2018)
  - https://3vf60mmveq1g8vzn48q2o71a-wpengine.netdna-ssl.com/wp-content/uploads/2018/12/TR-512_v1.4_OnfCorelm-info.zip
- UML, Papyrus, YANG Guidelines TR 514/515 (July 2018)
  - Last published version → https://www.opennetworking.org/software-defined-standards/models-apis/
  - Latest working draft
    - https://wiki.opennetworking.org/display/OIMT/Infrastructure+Sub-team+Guidelines
    - https://wiki.opennetworking.org/display/OIMT/UML++YANG+Guidelines
- UML to YANG & YAMG-OpenAPI Mapping Tools
  - Github repository: https://github.com/OpenNetworkingFoundation/EagleUmlYang
  - Github repository: https://github.com/OpenNetworkingFoundation/EagleYangOpenApi