Interoperability Testing SDN Transport APIs

Update for OFC 2019

March 7

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Agenda

- 2018 Interop Demonstration
  - Objectives
  - Overview of Tests
  - Deep Dive into API messaging
  - Findings
- T-API Certification
- Summary

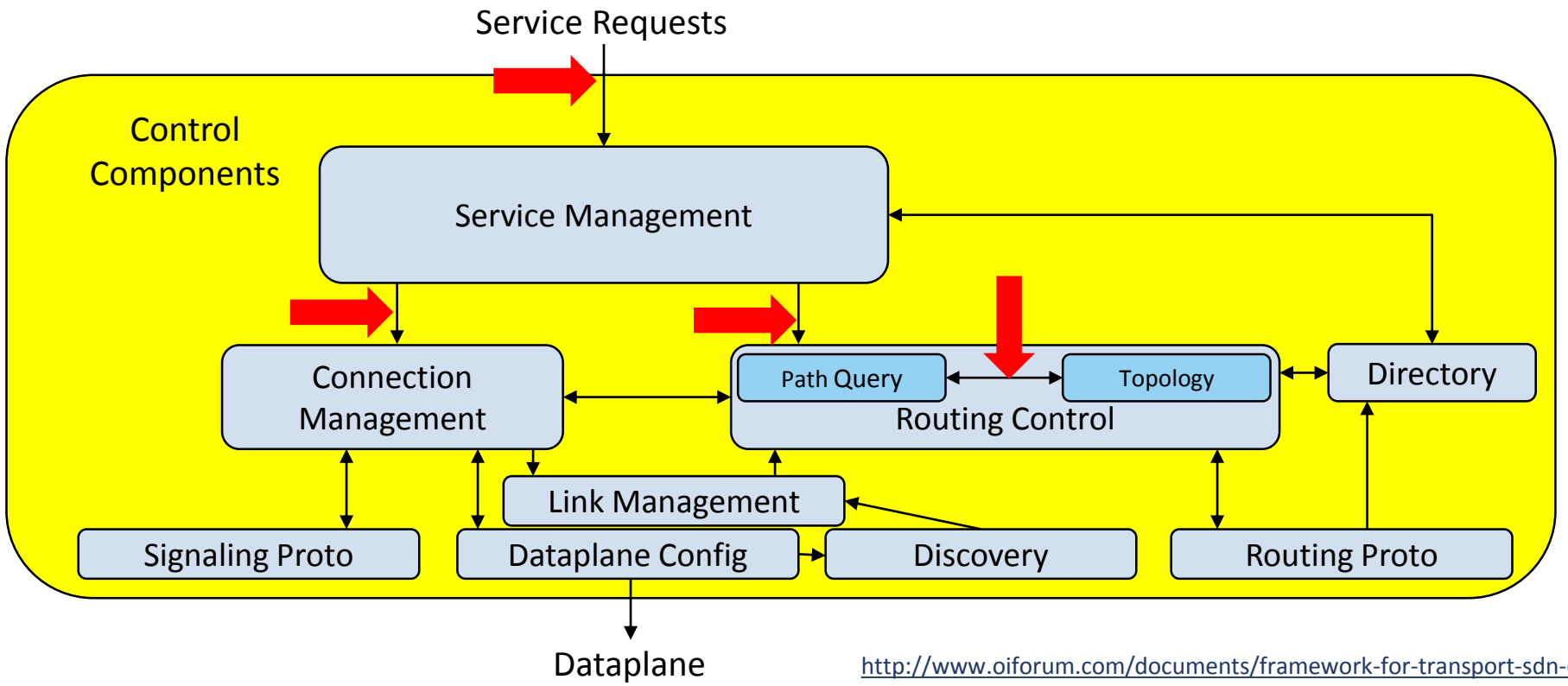
2018 OIF Interoperability Demonstration: SDN Transport APIs

- Collaboration between OIF, ONF and MEF
  - OIF – Optical and Transport Networks
    - API Framework
    - Prototype API experience – 2014 & 2016 Interop Demonstration events
  - ONF – SDN
    - SDN Architecture
    - Transport API Project
  - MEF – Service Management
    - Lifecycle Service Orchestration
    - Connectivity Service Specifications (Ethernet, Layer 1)

2018 OIF Interoperability Demonstration: SDN Transport APIs

- Evaluate current state of SDN in Transport industry
  - Validate APIs in SDN Framework
    - Useful:
      - Do the defined APIs solve a business problem?
      - Is the API consistent with business structural boundaries?
    - Perform well:
      - Would a different API improve performance?
    - Can be implemented

OIF SDN Framework

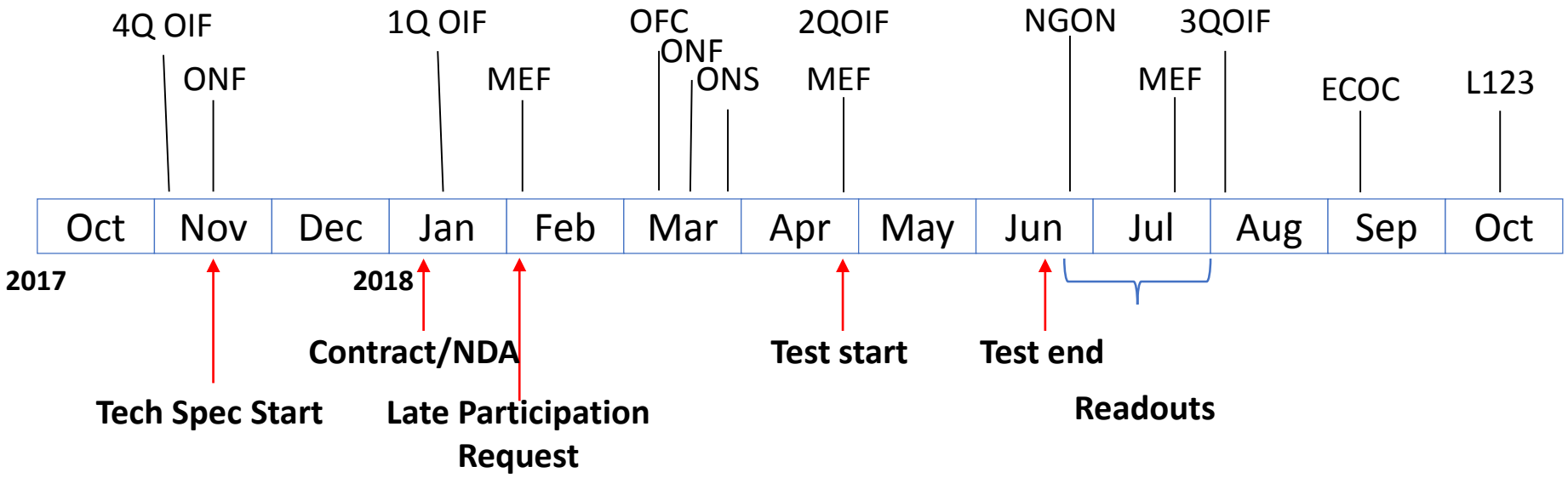


http://www.oiforum.com/documents/framework-for-transport-sdn-components-and-apis

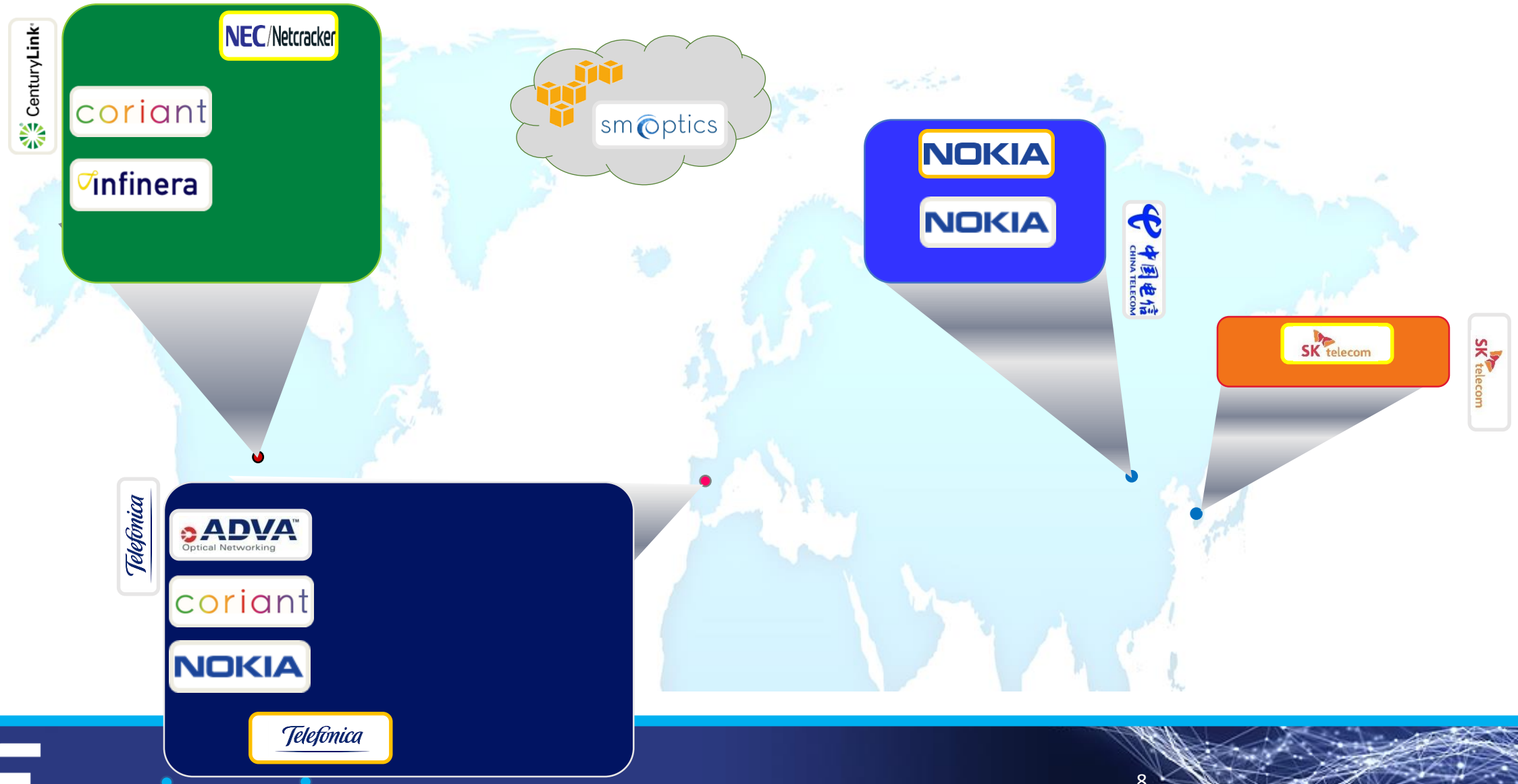
2018 OIF Interoperability Demonstration: SDN Transport APIs

- Participants from OIF, ONF and MEF
  - **OIF:** ADVA, CenturyLink, China Telecom, CTTC, Infinera/Coriant, NEC/Netcracker, Nokia, SK Telecom, SM Optics, Telefonica, Telus
  - **ONF:** China Telecom, CTTC, Infinera/Coriant, NEC/Netcracker, Nokia, SK Telecom, SMOptics, Telefonica, Telus
  - **MEF:** ADVA, CenturyLink, China Telecom, Infinera/Coriant, NEC/Netcracker, Nokia, SM Optics, Telefonica, Telus

Timeline


4Q OIF
ONF
1Q OIF
MEF
OFC
ONF
ONS
2QOIF
MEF
NGON
MEF
3QOIF
ECOC
L123
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
2017
2018
Contract/NDA
Test start
Test end
Tech Spec Start
Late Participation Request
Readouts

2018 Interoperability Demonstration: SDN Transport APIs



Pairings

- Lab A
  - Orchestrators: Vd
  - Dataplane: Vb1, Vb2, Vc

3 pairings

- Lab B
  - Orchestrators: Cb
  - Dataplane: Va, Vb, Ve

3 pairings

- Lab C
  - Orchestrators: Cd, Ve
  - Datraplane: Ve, Vf

4 pairings

Overall: 27 Pairs

Test Tracking

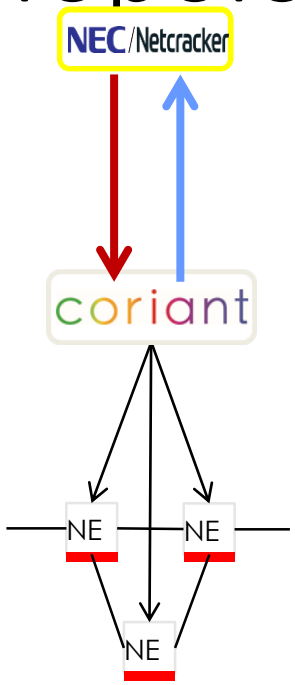
		Lab A			Lab B			Lab C			
		Vd-Vb1	Vd-Vb2	Vd-Vc	Cb-Va	Cb-Vb	Cb-Ve	Cd-Ve	Cd-Vf	Ve-Ve	Ve-Vf
Topology.1.1	Retrieval of Context Object-details										
Topology.1.2	Retrieval of collection of Topology object-references.										
Topology.1.3	Retrieval of Topology object-details.										
Topology.1.4	Retrieval of a collection of Link object-references contained in a specific Topology.										
Topology.1.5	Retrieval of a collection of Node object-references contained in a specific Topology.										
Topology.1.6	Retrieval of Link object-details.										
Topology.1.7	Retrieval of Node object-details.										
Topology.1.8	Retrieval of a collection of NodeEdgePoint object-references contained in specific Topology and Node.										
Topology.1.9	Retrieval of NodeEdgePoint object-details.										
ConnSvc.1.1	Retrieval of Service End Point List.										
ConnSvc.1.2	Retrieval of Service End Point Attributes.										
ConnSvc.1.3	Connectivity Service Activation.										
ConnSvc.1.4	Retrieval of Connectivity Service and Attributes.										
ConnSvc.1.5	Retrieval of Connection(s) and Connection attributes.										
ConnSvc.1.6	Update of Service Capacity.										
ConnSvc.1.7	Deletion of Connectivity Service.										
ConnSvc.1.8	Retrieval of Connection End-points and Attributes										

Changes since 2016 to be tested

- Alignment with updates to IETF RESTCONF Best Practices
  - Separation of config and operational data
- Further formalization of Notification
  - Prototype in T-API 1.0
- Addition of Ethernet Connectivity Service
  - Incorporation of MEF NRP
- Additional attributes for service requests
  - New resilience types (1+1 Protection, 1+1 w/ Reroute, etc.)
  - Additional constraints (SRG)

Interfaces In Action

Topology API Capture

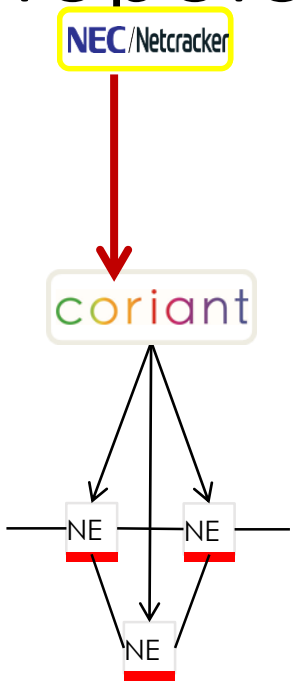


GET /restconf/config/context/topology HTTP/1.1
Accept: application/json
Accept-Encoding: gzip;q=1.0,deflate;q=0.6,identity;q=0.3

HTTP/1.1 200 OK
Server: Apache-Coyote/1.1
Content-Type: application/json
Date: Tue, 12 May 2018 4:41:37 GMT
Connection: close

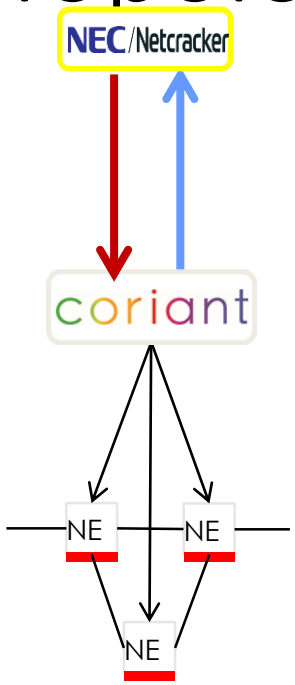

```
[
  "/restconf/config/context/topology/1e771577-25bb-3e60-b332-7942adf878db",
  "/restconf/config/context/topology/711ed90c-9360-3a51-8106-7099f0df8bad"
]
```

Topology API Capture



GET /restconf/config/context/topology/1e771577-25bb-3e60-b332-7942adf878db HTTP/1.1
Accept: application/json
Accept-Encoding: gzip;q=1.0,deflate;q=0.6,identity;q=0.3

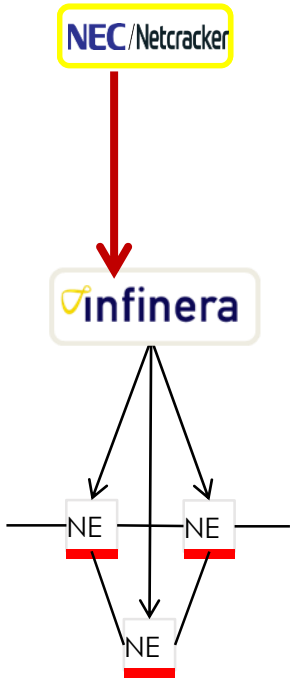
Topology API Capture




```
HTTP/1.1 200 OK
Content-Type: application/json
Server: Werkzeug/0.11.11 Python/2.7.5
Date: Tue, 12 May 2018 5:23:07 GMT

{
  "name": [
    {
      "value": "mTera_cluster“,
      "value-name": "DOMAIN_NAME",
    }
  ],
  "uuid":  "1e771577-25bb-3e60-b332-7942adf878db “,
  "layer-protocol-name": [
    "DSR",
    "ODU",
    "OTSiA",
  ],
  "link": [
   …   // 15 links reported
  ],
  “node": [
   …  // 4 nodes reported
  ]
}
```

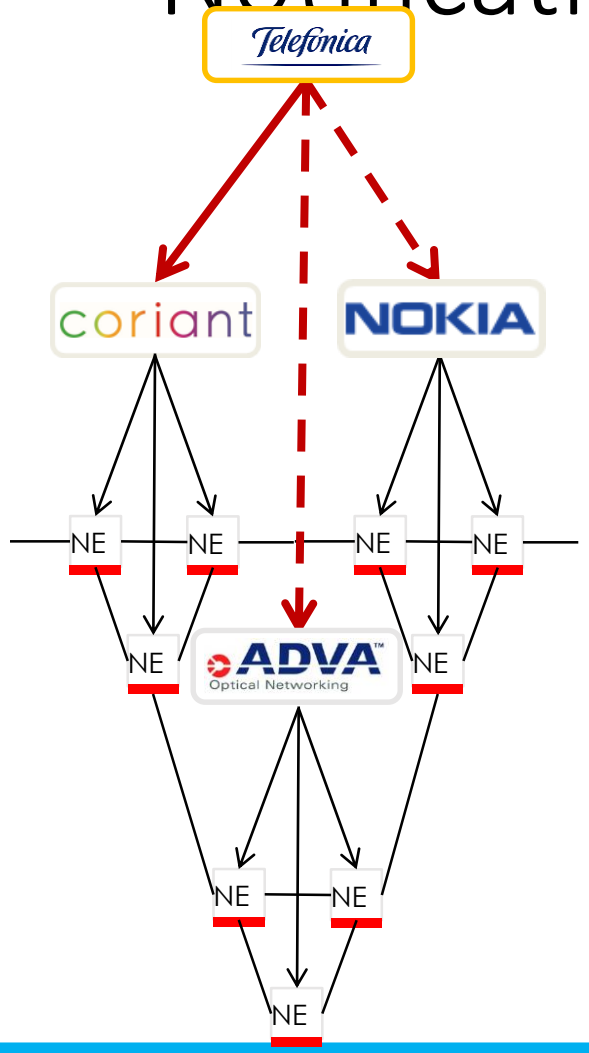
Service Invocation Flow




```
POST /restconf/config/Context/_connectivityService/ HTTP/1.1
Accept: application/json
Accept-Encoding: gzip;q=1.0,deflate;q=0.6,identity;q=0.3

{
 "uuid": "MEF_Prov_Test",
 "_connConstraint": {
  "requestedCapacity": {
   "totalSize": "10GBPS“
  },
  "serviceType": "POINT_TO_POINT_CONNECTIVITY",
  "serviceLayer": [
   "ODU“
  ]
 },
 "_servicePort": [
  {
   "localId": "sp1",
   "serviceLayer": "ODU",
   "direction": "BIDIRECTIONAL",
   "role": "SYMMETRIC",
   "_serviceEndPoint": "network=mynet-L1-test2:node=MA4513080110:ep=(type=ODU2&chassis=1&shelf=A&slot=2&subslot=T3&port=4)“
  },
  {
   "localId": "sp2",
   "serviceLayer": "ODU",
   "direction": "BIDIRECTIONAL",
   "role": "SYMMETRIC",
   "_serviceEndPoint": "network=mynet-L1-test2:node=MA4513120153:ep=(type=ODU2&chassis=1&shelf=A&slot=2&subslot=T3&port=4)“
  }
 ]
}
```

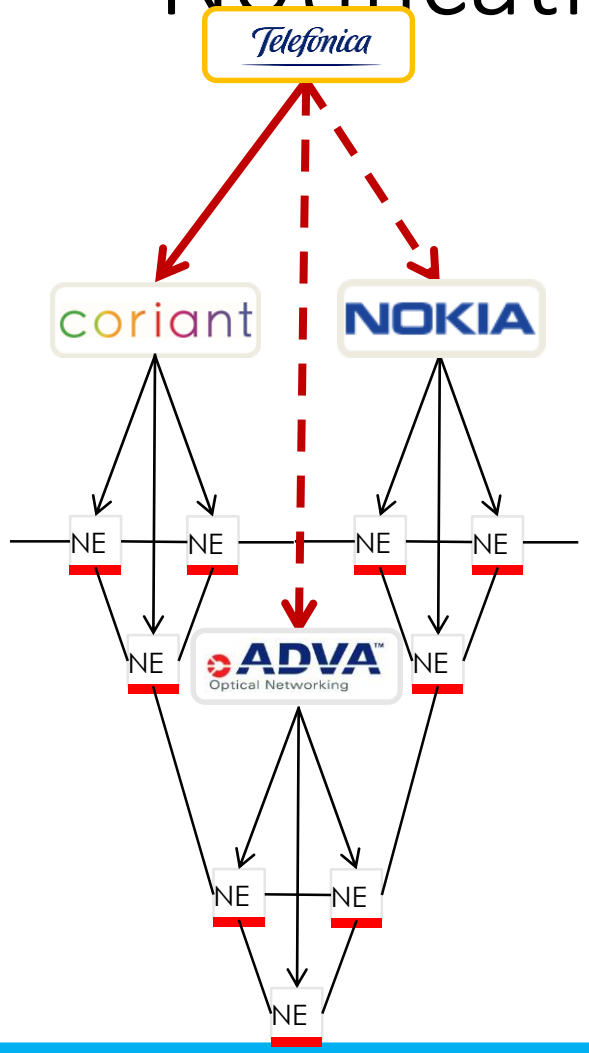
Notification Registrations



POST /restconf/config/context/notif-subscription
Accept: application/json
Accept-Encoding: gzip;q=1.0,deflate;q=0.6,identity;q=0.3

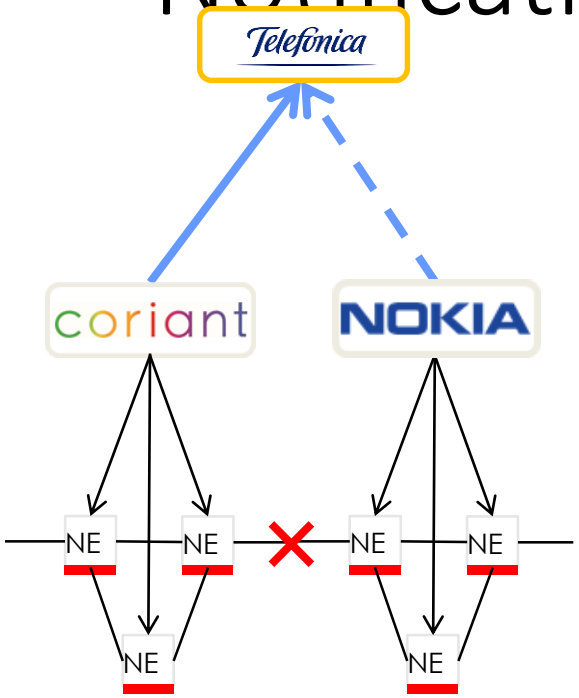

```
{
  "uuid": "171d1209-ed66-4f84-ab46-dd121ee05624",
  "notification-channel": {
    "next-sequence-no": 0,
    "stream-address": "wss://10.206.156.42:12443/tapi/restconf/streams/notification/171d1209-ed66-4f84-ab46-dd121ee05624"
  },
  "subscription-filter": {
    "name": [
      {
        "value": "AllNotifAndObjectTypes",
        "value-name": "NOTIF_SUBSCRIPTION_NAME"
      }
    ],
    "include-content": true,
    "requested-notification-types": [
      "OBJECT_CREATION", "OBJECT_DELETION", "ATTRIBUTE_VALUE_CHANGE"
    ],
    "requested-object-types": [
      "TOPOLOGY", "NODE", "LINK", "CONNECTION", "CONNECTIVITY_SERVICE", "NODE_EDGE_POINT", "SERVICE_INTERFACE_POINT"
    ]
  },
  "subscription-state": "ACTIVE",
...
```

Notification Registrations




```
    "supported-notification-types": [
      "OBJECT_CREATION", "OBJECT_DELETION", "ATTRIBUTE_VALUE_CHANGE"
    ],
    "supported-object-types": [
      "TOPOLOGY", "NODE", "LINK", "CONNECTION", "CONNECTIVITY_SERVICE", "NODE_EDGE_POINT", "SERVICE_INTERFACE_POINT"
    ]
  }
```

Notification Event




```
{
 "uuid": "75b95bcf-fc04-443f-807b-bb9f0e434404",
 "changed-attributes": [{
  "new-value": "DISABLED",
  "old-value": "ENABLED",
  "value-name": "operational-state"
 }],
 "event-time-stamp": "2018-06-10T10:09:28.014",
 "notification-type": "ATTRIBUTE_VALUE_CHANGE",
 "sequence-number": 1,
 "target-object-identifier": "/restconf/config/context/service-interface-point/adb8c5da-e0c5-36cb-ad5f-bd12144b82e0",
 "target-object-name": [{
  "value": "SIP_PTP_1_20150001",
  "value-name": "TRI"
 }, {
  "value": "10_GBE_LAN",
  "value-name": "SIGNAL_TYPE"
 }],
 "target-object-type": "SERVICE_INTERFACE_POINT"
}
```

Findings

Findings

- ONF's alignment of T-API with IETF RESTCONF is a good start
  - Provides developers access to RESTCONF tool environment
  - Additional alignment addressed in T-API 2.1
- MEF's extensions to T-API for LSO Presto and Ethernet are necessary extensions to meet operator requirements for T-API
- Additional use cases are supported by the formalized notifications interface
  - Multi-domain/Multi-layer Reroute
  - Network reoptimization
- Swagger definitions can aid automated testing
  - Specifies behavior of request and response

Findings

- Controllers abstract the network in different ways
  - E.g. Unidirectional vs Bidirectional links
- Controllers provide/report different capabilities
  - E.g. Connectivity restrictions
- Division of responsibility between controllers unclear
  - E.g. Multi-domain Path Computation
- Additional use cases exist and need to validated
  - Use of topology interface for Path Computation
  - Service Management interface

Findings

- Restoration control evolution required
  - Need extensions for operations control for rerouted services
    (Forced reroute, Freeze, Make Permanent, Restoration scheduling)

- T-API evolution is required to increase performance
  - Reduce number of API operations required when following relations between tables
  - Remove need for bulk retrieval to follow some relations
  - Architecture description for notification hub

- Better error reporting required across interface
  - HTTP result codes (e.g. 20x, 40x) do not provide enough clarity

Certification

The Need

- Interoperability events are great as leading-edge demonstrations, but can't be specified in a Carrier RFx
  - One time events, every two years
  - Test plans focused on new capabilities
- Certification facilitates long term interoperability
  - Test-fixture based testing as well as multi-vendor tests
  - Continuous test bed enables vendors to test as they need

OIF T-API Certification

- Certification program under development
  - Under guidance of Network Operator Advisory Group (NOAG)
  - Use case / scenario based
  - Leverages OIF 2014, 2016 and 2018 test plans

- Opportunity exists for Network Operators to join NOAG
  - Not limited to OIF membership
  - Discussion via conference calls, workshops

Summary

- 2018 Interop Demonstration shows:
  - 12 cooperating companies (5 Network Operators, 6 Vendors, 1 Research)
  - Transport SDN APIs are evolving
    - Additional capability added to APIs meeting additional service provider requirements
- Next steps:
  - Continued Evolution of T-API
  - OIF T-API Certification Program
    - Let us know if you would like to participate!