



# Gearing up for transport-SDN deployment A starter kit for early adopters

## ECOC 2015 – Market Focus

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- section 1 Customer's and operator's expectations
- section 2 Why SDN for Transport networks now ?
- section 3 What is T-SDN ?
- section 4 Some T-SDN use cases





# What are the customer expectations for the network services ?

1

## Improve agility

- dynamic evolution of the new network services (Network on Demand)
- more « selfcare » to give the control to the customer on its network policies (QoS, routing, security)
- management of the network by the applications

2

## Reduce time to deliver

- towards a stronger automation of the internal processes
- towards more digital solutions which will give the control to the customer

3

## New innovative network products faster

- notion of “service chaining” which allows to dynamically apply a particular processing, in the transit traffic in the infrastructure





# What are the operator's expectations ?

1

## Reduce OPEX

- Introducing more and more automation in service delivery

2

## Optimize network resources

- Make the network smarter to dynamically adapt to conditions



3

## Develop new business and limit churn

- Make differentiation with competition

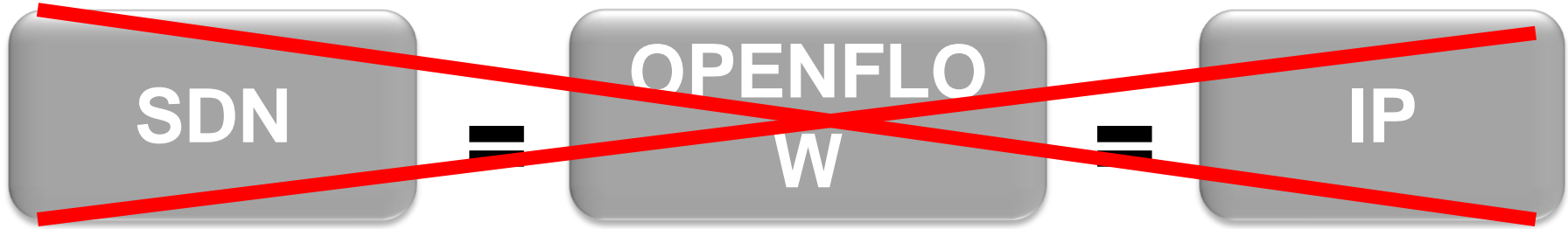


# Why SDN for Transport networks now?

- New services and applications (Computing, storage) are pushing traditional networks to their limits
  - Time to produce due to heavy manual operations
  - Cost effectiveness due to a poor flexibility and scalability
  - Capability to answer to new business use cases
- Work together with suppliers/SDOs to develop open based solutions with standardized interfaces/protocols
  - Facilitate application and service evolutions and innovations
  - Enable interworking between suppliers
  - Simplify network and system deployments or upgrades
- Evolution of operational scheme
  - Generate new revenues thanks to new business models as « Try & Buy »
  - OPEX reduction thanks to automation



## SDN for the Transport network : IP only ?



# Transport-SDN

- Optimizing IP layer without taking into account underlays is not enough

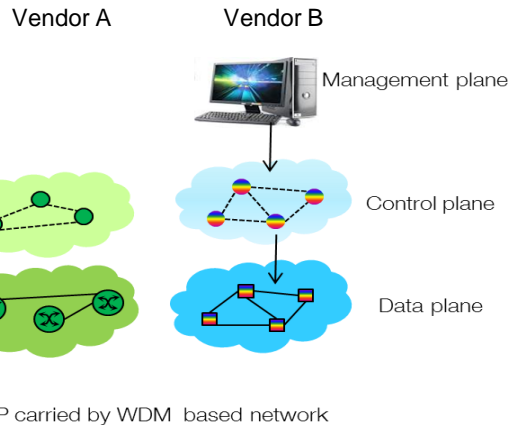


# Transport-SDN : how ?

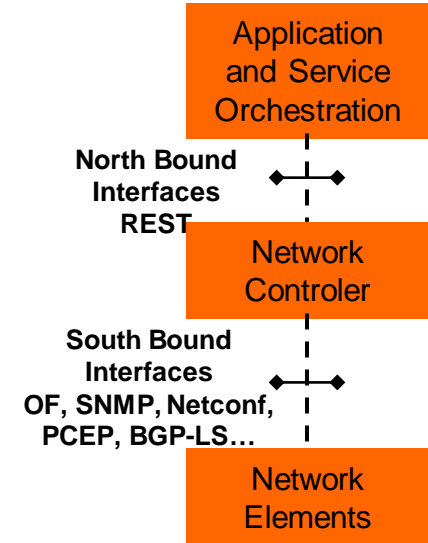
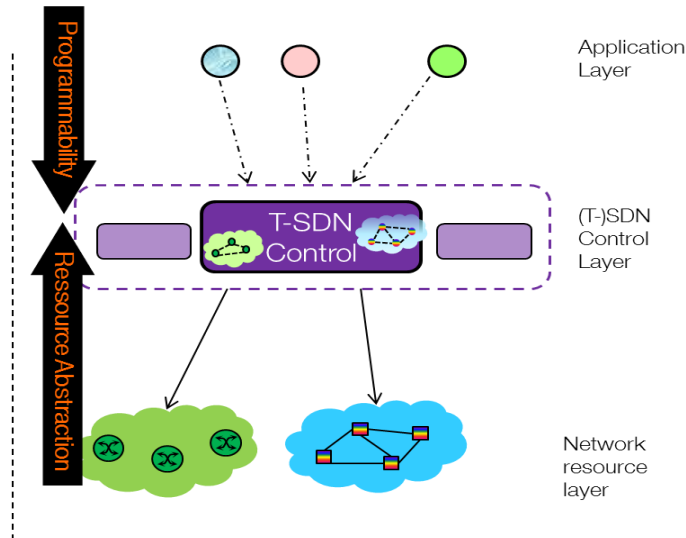
Dataplane separated from  
control/management

Requirement for openness and interoperability

▪ Now

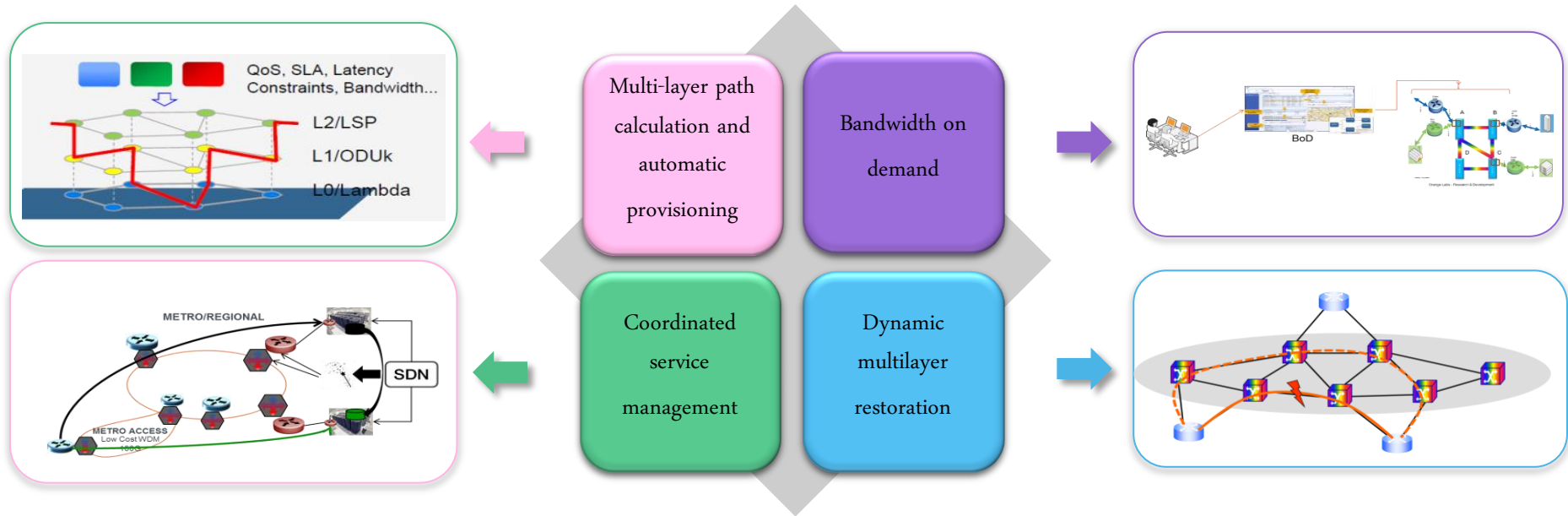


Tomorrow?





# Transport-SDN : use cases





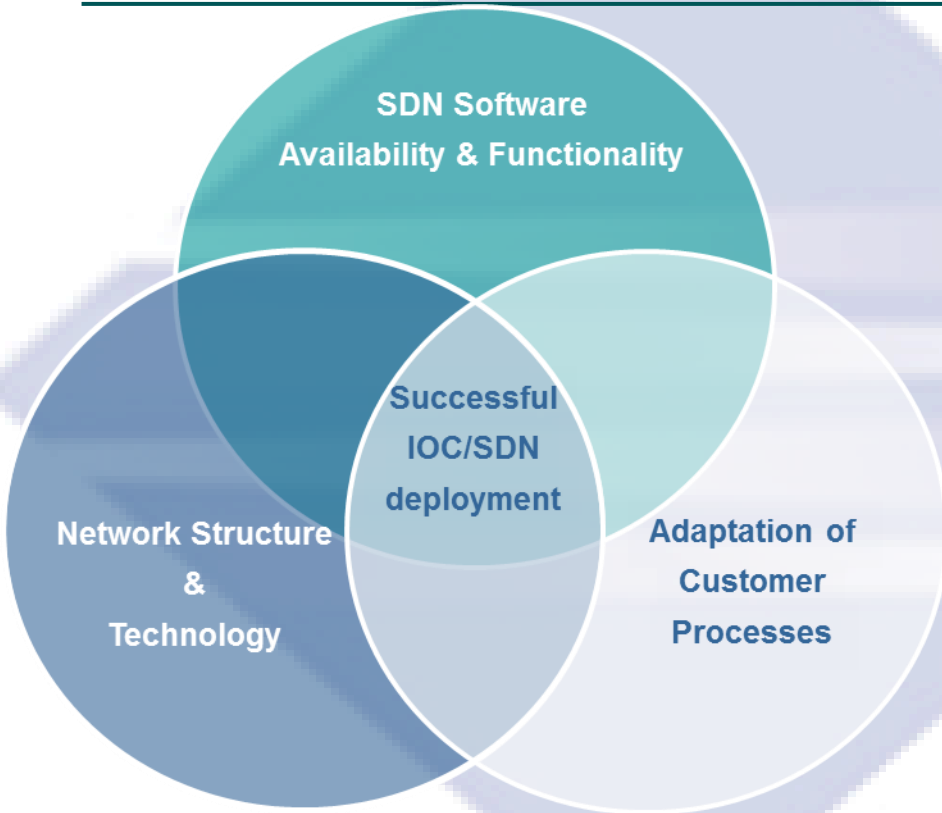


# Summary

- Dynamic services are a **win-win**
- SDN is **NOT** only for IP
- A lot of **use cases** for T-SDN
- **Need interoperability, openness and organization thoughts to make T-SDN real**



# SDN Deployment Challenges



## **Benefit:**

Totally automated, programmable, integrated and flexible network – leveraging the installed base in an optimized way.

## **Challenges:**

### **Technical:**

- Agree on standardized architectures and abstraction/virtualization models –
- Performance of centralized systems & OF

### **Commercial:**

- Open Source business models
- New business models leveraging SDN

### **Organizations:**

- Adapt processes to leverage SDN flexibility

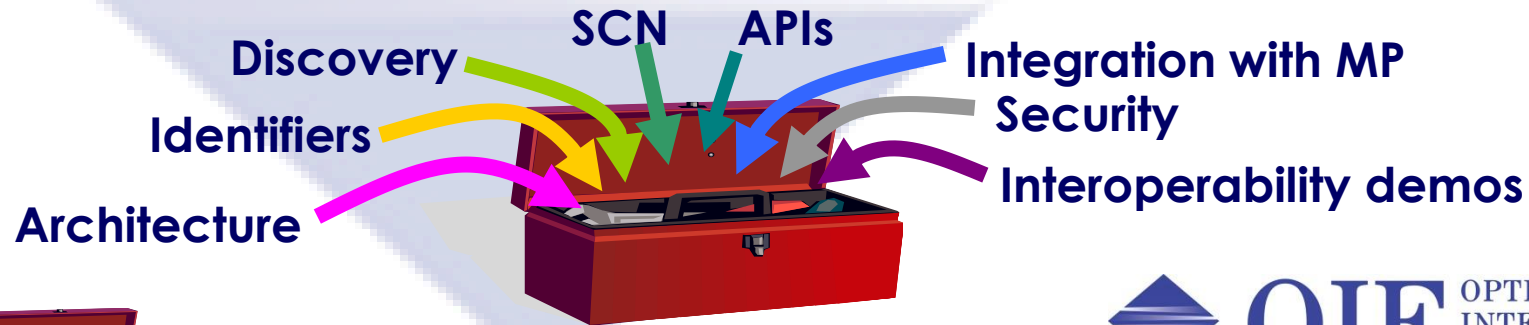
### **Availability:**

- Carrier grade SDN systems for field deployments
- Availability of new network technology in field deployments & legacy network

The SDN Deployment Toolbox

# Transport SDN Toolkit

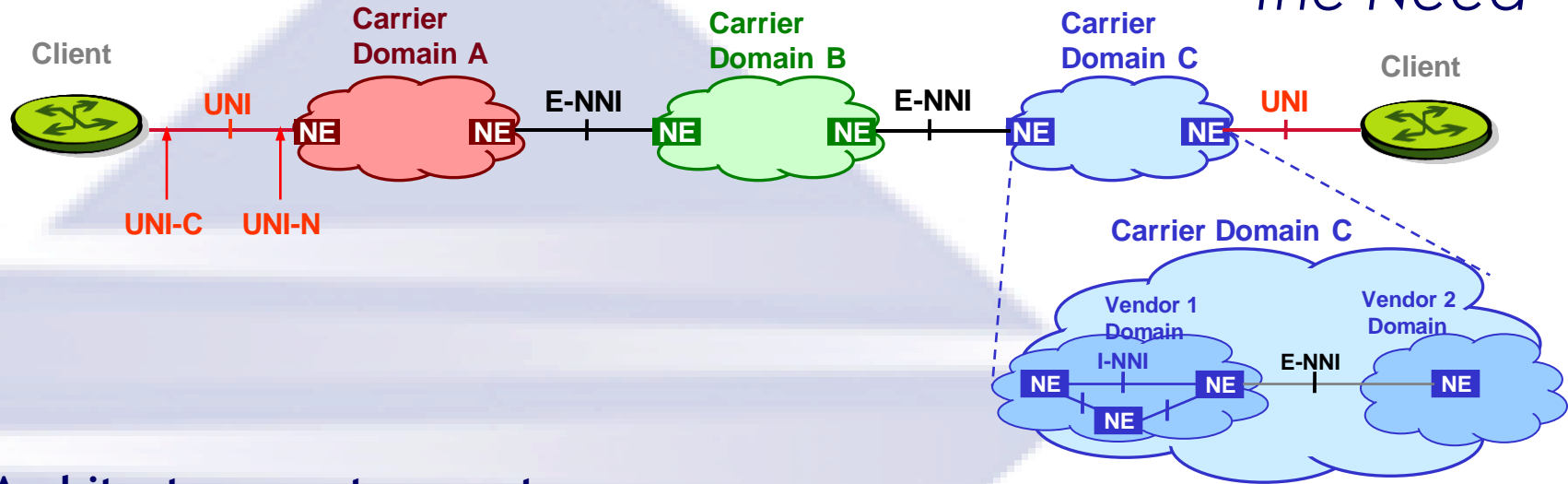
- **Providing carriers with essential tools in the Transport SDN toolkit**
  - How to apply SDN to a carrier's multi-domain, multi-layer transport network
  - Transport SDN API specifications to allow deployment of SDN applications
  - Prototyping and testing of real implementations for experience and interoperability



The SDN Deployment Toolbox

# 1. Architecture

## *The Need*



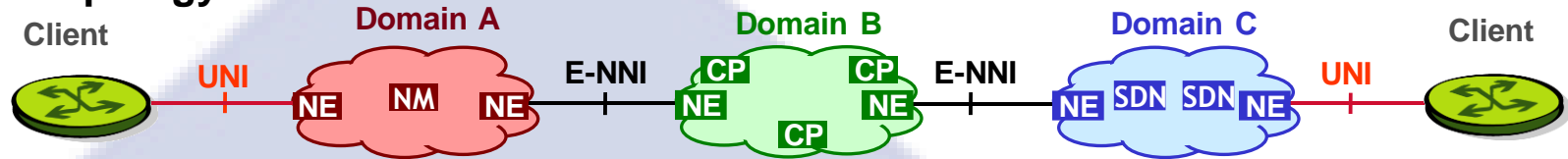
## Architecture must support

- Heterogeneous topologies, technologies, applications and trust relationships
- SDN-based, GMPLS-based or Management Plane (MP)-based subnetworks
- Boundaries of policy and information sharing/hiding
- Functional independence between SDN, GMPLS, MP, transport plane (TP) and SCN
- Any number of network layers with functional separation between them

# 1. Architecture

## Multi-layer OIF Control Model

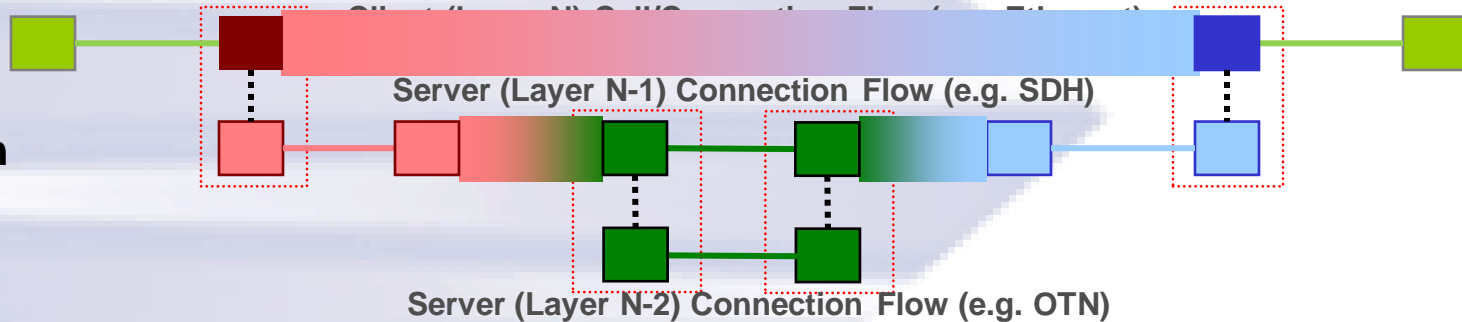
### Network Topology



### ControlTopology



### Connection Layering



- Edge nodes typically provide layer adaptation and multi-layer control plane
- Core nodes typically operate in single server layer
- Versatile - supports only layers needed (e.g Eth-VCAT-SDH, packet over OTN)
- Server layer signaling completes before client layer signaling does
- Supports BW modification by adjusting server layers to meet demands of client

# 1. Architecture

## *The Tools and Remaining Challenges*

### Existing Tools

- **ITU ASON architecture**
  - Enables value-added services over different transport technologies
  - Routing abstraction methods support domain models and multi-layer representations, to improve scalability and to control sharing of topology.
- **ONF SDN Architecture**
  - Discusses Client - Server relationship for Applications and Providers
- **OIF Framework for Transport SDN**
  - Identifies how ASON Functional model fits into ONF architecture

### Key challenges

- Historical limitations on how functions are realized

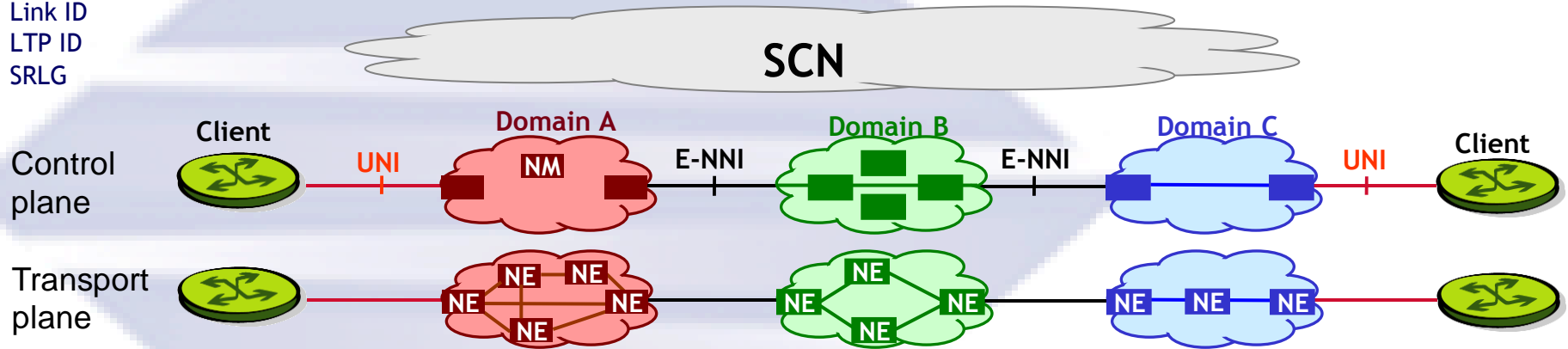
The SDN Deployment Toolbox



## 2. Identifiers *The Need*

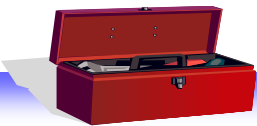
Transport Plane IDs  
(as viewed by the SDN Controller)

Forwarding Domain ID  
Logical Port ID  
Endpoint Name  
Routing Area IDs  
Link ID  
LTP ID  
SRLG



### Identifiers must provide

- An identity (name or address) for every entity visible to the SDN controller
- ID uniqueness and support for various formats (IPv4, IPv6, ...)
- Note: the SDN controller assigns other IDs dynamically (e.g. Service ID, Connection ID). The above list covers the IDs that need to be assigned for the SDN Controller to function.



The SDN Deployment Toolbox

## 2. Identifiers

### *The Tools and Remaining Challenges*

#### Existing Tools

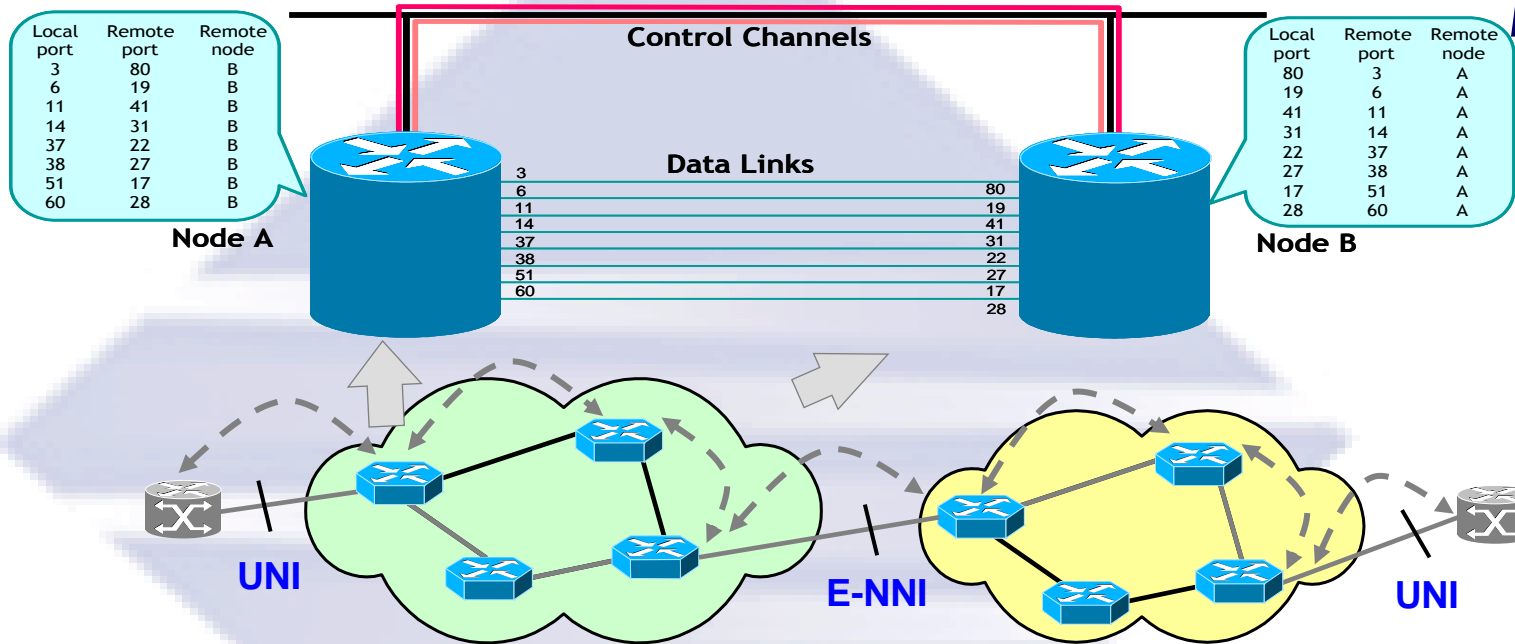
- OIF Carrier Requirements for SDN
  - Support for resource summarization, formatting, ID uniqueness
  - IDs primarily use IP addresses now, with ability to support other formats (e.g. URI)
- OIF TNA (Transport Network Assigned) Name for endpoints
  - Supports namespace separation and network growth/merges/splits

#### Key challenges remaining

- A naming authority may be needed to administer IDs, to ensure summarization and uniqueness
- Guidelines could help for mapping IDs that are commonly used by network operators into appropriate control identifiers



### 3. Discovery The Need



- The SDN controller must discover, or be provisioned with, the links to neighboring NEs. This can provide different types of information:
  - Remote link or end-point connectivity verification
  - Transport capability exchange (service discovery)
  - SDN domain identification

# 3. Discovery

## *The Tools and Remaining Challenges*

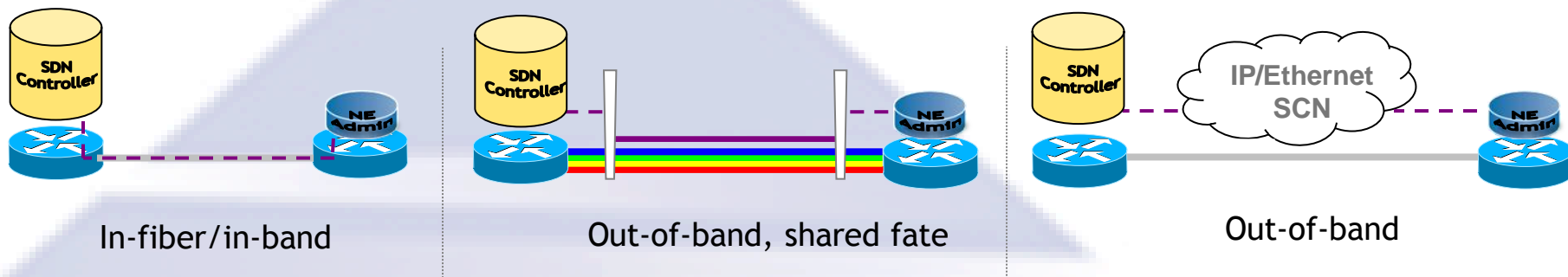
### Existing Tools

- Discovery mechanisms defined by ITU-T in G.7714 and other sources
  - **Defines discovery procedures for transport entities (SDH/SONET, OTN)**
- ONF Optical extensions to OpenFlow
- OIF Neighbor Discovery Implementation Agreement

### Key challenges remaining

- In-band mechanisms require updates as new technologies emerge
- Identification of SDN information to be exchanged

## 4. Signaling Communications Network *The Need*



- A Signaling Communications Network (SCN) must be established to support secure communications between NEs and the SDN controllers
  - May be in-band or out-of-band
  - May consist of a single integrated SCN or multiple SCNs
  - SCNs may be partitioned by business, technology or layer boundaries
  - SCN resiliency is required



# 4. Signaling Communications Network

## *The Tools and Remaining Challenges*

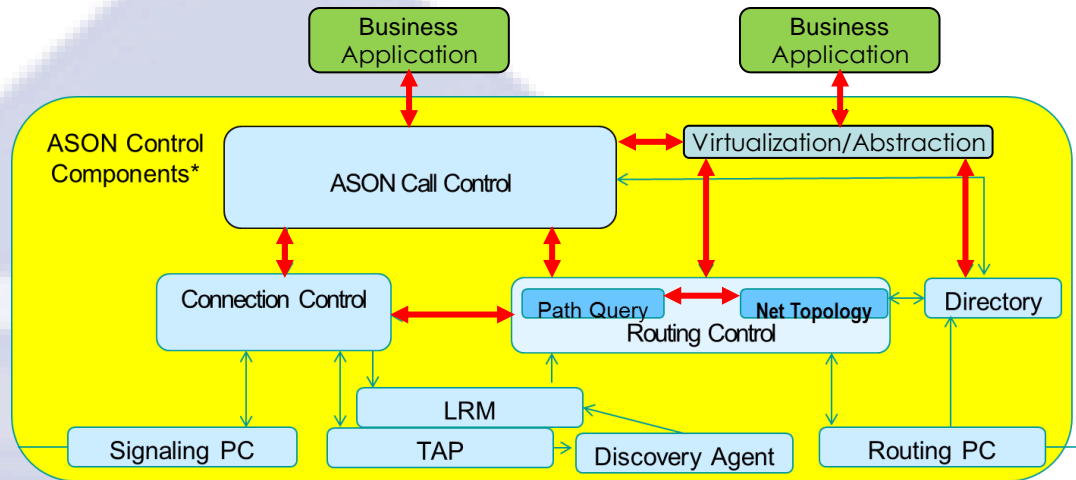
### Current CP Tools

- ITU-T G.7712 and other sources defining SCN functions
  - **Procedure, encapsulation and encryption methods defined**
- Carriers already have experience managing DCNs in MP-based networks

### Key challenges remaining

- Policy may limit scope of SCN across domain/carrier boundaries
- Multi-layer architecture requires SCN connectivity or forwarding gateway between remote nodes in client layer
- Use of a separate out-of-fiber IP SCN can impact the business case for deploying CP (i.e. why do I need a separate SCN for SDN when I'm trying to use SDN to simplify my transport network?)

## 5. APIs The Need



\* Figure does not imply specific distribution of components, e.g., centralized or distributed

- **Standard APIs must be defined for interfaces to functional entities**
  - In previous control systems APIs have been internal, proprietary interfaces
  - APIs enable functional blocks to be decoupled
  - Decoupling of functional blocks enables augmentation and/or replacement
    - Important for delivering new network behaviors
  - (Discussed further in the OIF Framework for Transport SDN)



The SDN Deployment Toolbox

# 5. APIs

## *The Tools and Remaining Challenges*

### Existing Tools

- Current API work is being done in fragmented silos
  - Applications may need to support 20+ definitions of the same API
- Some APIs are based on existing protocol specifications
  - Unclear if the APIs provide the correct capabilities to allow real innovation

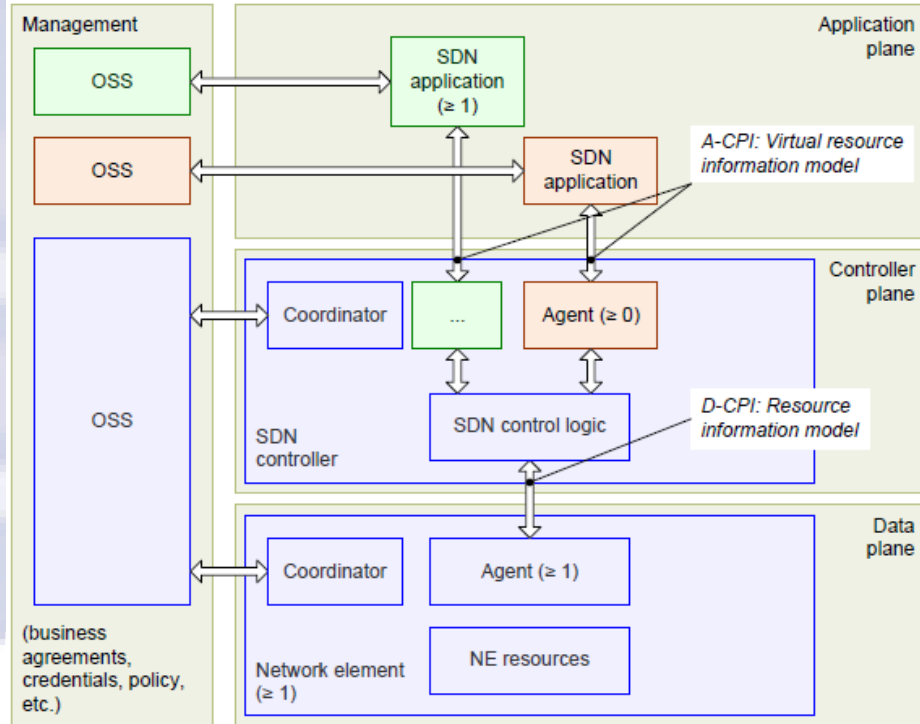
### Key challenges remaining

- Getting to a common Information Model and API specification
  - ONF Common Information Model is a start
- Verifying APIs provide the necessary functionality for applications
  - Use case review
  - Application development

# 6. Integration with the Management Plane

## The Need

- The SDN Controller must co-exist with - and be under the supervision of - the MP
  - Connections controlled by SDN Controller must co-exist with those controlled by MP
  - Connections may be migrated between MP, GMPLS & SDN Controller control without disruption
  - MP actions may trigger a SDN Controller connection setup (e.g. Soft Permanent Connection-SPC) or reroute an existing SDN Controller connection (Soft Reroute)
  - SDN Controller supports commands and queries from the MP and reports status to MP



## 6. Integration with the Management Plane

*Typical Work Split Between MP and SDN Controller*



The SDN Deployment Toolbox



# 6. Integration with the Management Plane

## *The Tools and Remaining Challenges*

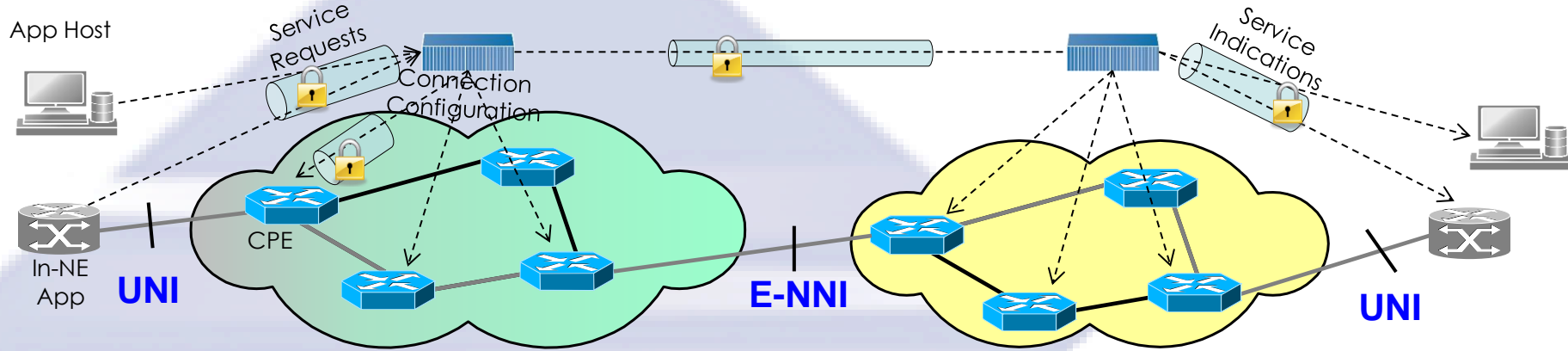
### Existing Tools

- ITU-T and TMF management functions including ITU-T M.3010, G.7718.x and TMF MTNM (TMF-513, TMF-608, TMF-814)
- IETF Management Information Base (MIBs)
- OIF Carrier Requirements specify allowing MP to initiate SDN Connections

### Key challenges remaining

- Develop Common Information Model that considers SDN management
  - **Liaison relationship from OIF to current project in ONF**
- Transitioning from mechanism-focused to service/policy (aka intent) driven management
- Carrier-specific OSS investments are needed to manage the SDN Controller
- MP/SDN integration, interworking and migration strategies are in work

# 7. Communications Security The Need



- **Communications between Applications, SDN Controllers and NEs must be secure to protect against various threats**
  - Communications must enforce carrier policy for revealing network resource details
  - Potential threats must be countered, including denial of service attacks, spoofing, eavesdropping, intrusion attempts, forgery and others
  - Security mechanisms should be tailorable and include auditing and logging features

# 7. Control Plane Security

## *The Tools and Remaining Challenges*

### Existing Tools

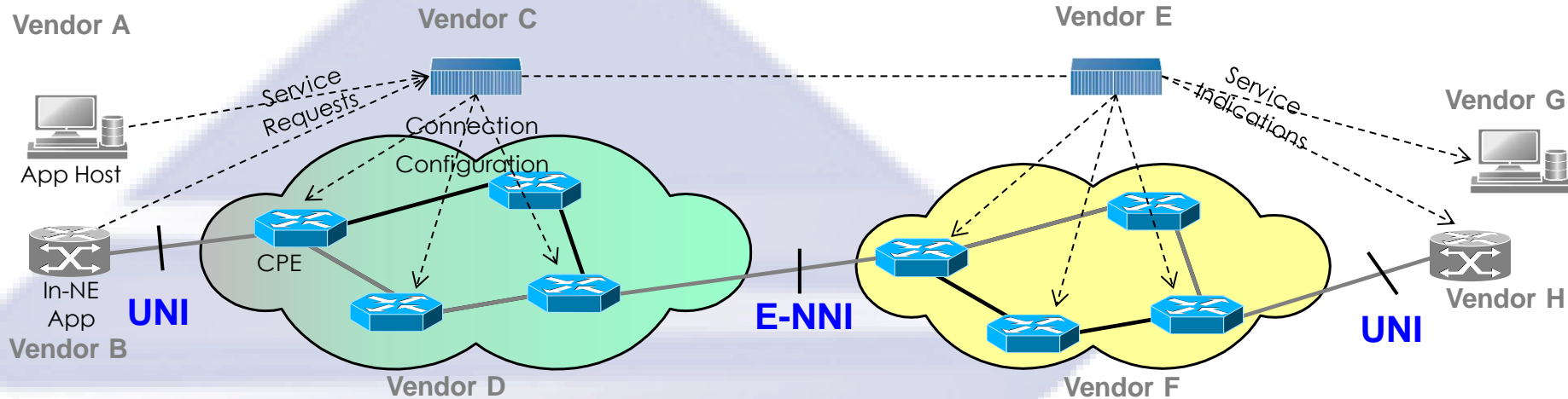
- OIF Security IAs, using the latest IETF RFCs tailored for the unique requirements of Dynamic Control Protocols
  - Security for Management Interfaces to Network Elements
  - Control Plane Logging and Auditing with Syslog

### Key challenges remaining

- Continue regular updates to IAs, to keep pace with evolving threats and updates in foundation RFCs

# 8. Interoperability Demos

## *The Need*



- **Interoperability testing is needed to evaluate multi-vendor interop and advance maturity**
  - Essential stepping-stone to move CP from research labs to live networks
  - Initial exposure and feasibility demo, feedback into standards process
  - Critical tool for early detection and correction of interoperability issues - in specifications, vendor implementations and operations concepts

# 8. Interoperability Demos

## *The Tools and Remaining Challenges*

### Existing Tools

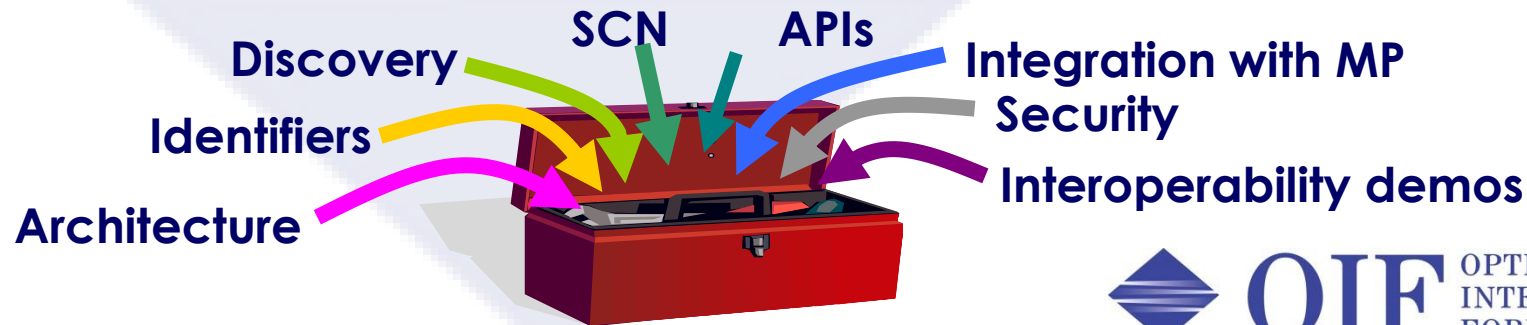
- Experience from 7 OIF Interop events - control and transport plane test methods, global SCN, test findings
- Continued planning for next OIF interop event
- Test efforts of groups including EANTC, MEF, ONF and others

### Key challenges remaining

- Planning of future interop test efforts, with finite resources
- Focus on proving out new features in definition phase or IAs near completion?
- On-going smaller-scale tests or less frequent large event?
  - **Many candidate features and technologies are on the horizon - which ones to test?**

# Control Plane Toolbox Summary

- Operationalizing SDN (deploying SDN as a business process at the operations level) requires a full set of tools
  - A set of tools exist today from ITU-T, MEF, OIF, ONF, TMF, MEF
  - Additional work is needed to continue advancing SDN - both in feature content and operational aspects
  - Future development of SDN and related tools must align with business needs and operational realities of service providers





thank you

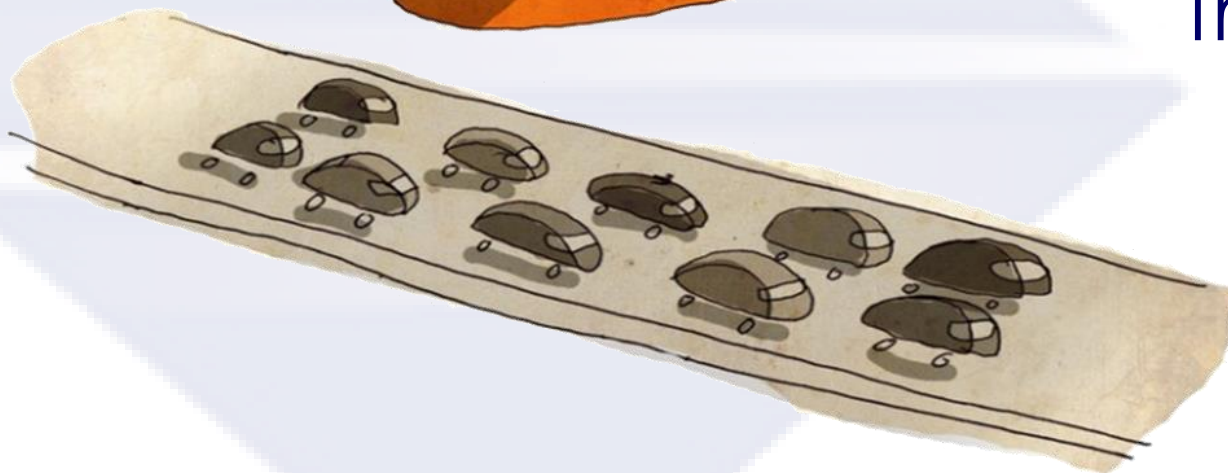


Image by Ben Scurton for VCN.



**OIF** OPTICAL  
INTERNETWORKING  
FORUM