Impact of Virtualization and SDN on Emerging Network Coding

Please send comments / suggestions to Bhumip (vumip1@gmail.com)

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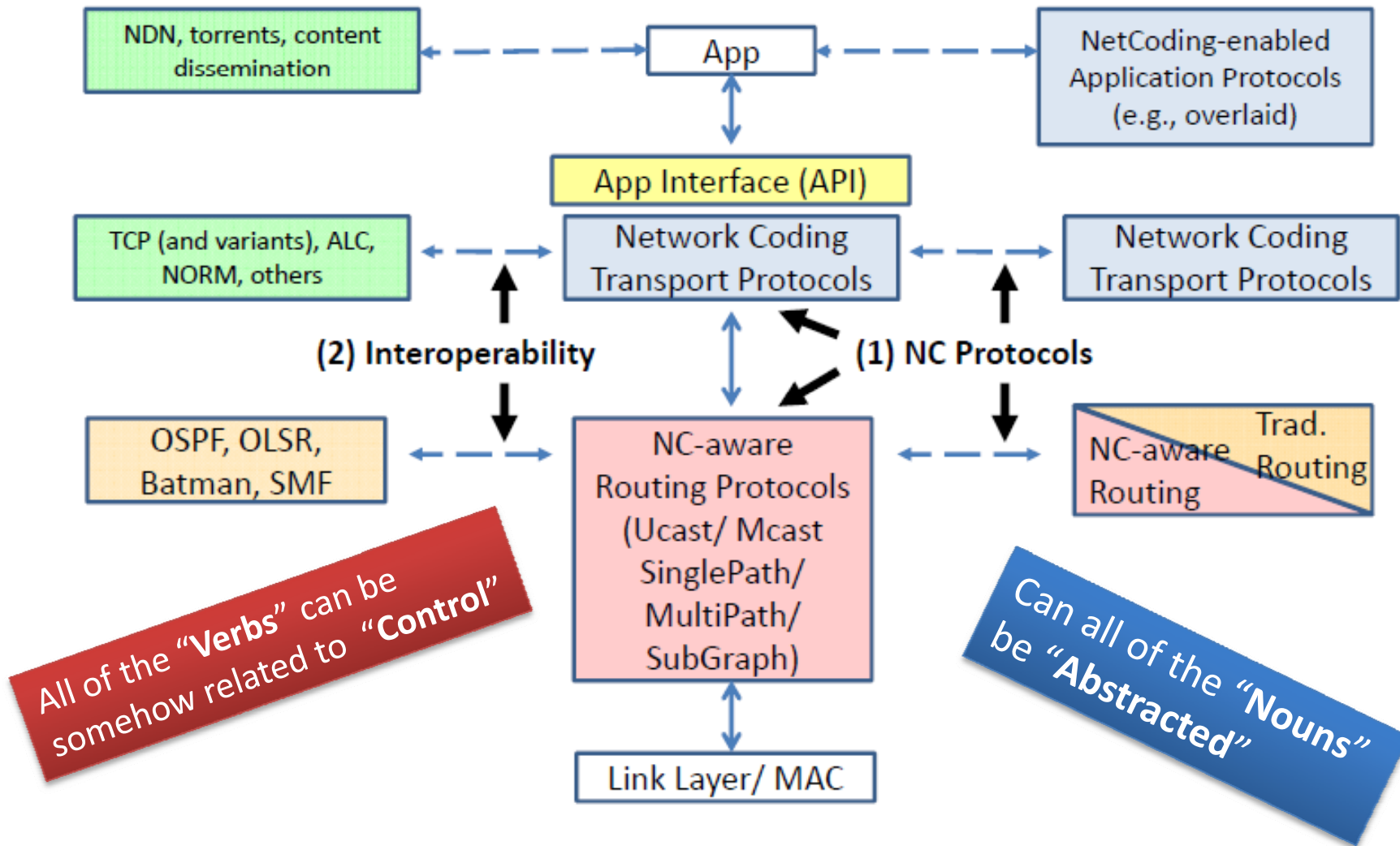225 Edgware Road, London, UK W2 1JU
Thursday, 06 March 2014

Ref.:
* Network Coding Taxonomy (Victor & Brian); www.ietf.org/proceedings/88/slides/slides-88-nwcrg-6.pdf
* JNSM SI on SDN Management (Bhumip et al); www.springer.com/journal/10922
* ZTE Comm. Mag., SI on Cloud Computing (Dec. 2013); wwwen.zte.com.cn/endata/magazine/ztecommunications/2013/4/

Outline

- Background
- Abstraction/Virtualization of the <elements> of Network (focus on *L3* entities only)
  - node, route, topology, RIB, service (policy, security, quality, etc.), address, transport, etc.
- Control of Network Coding
  - *Where* does it reside
  - How to *virtualize* and *centralize* logically
- APIs
  - Address, transport, routing, etc.
- Other thoughts/suggestions for discussion
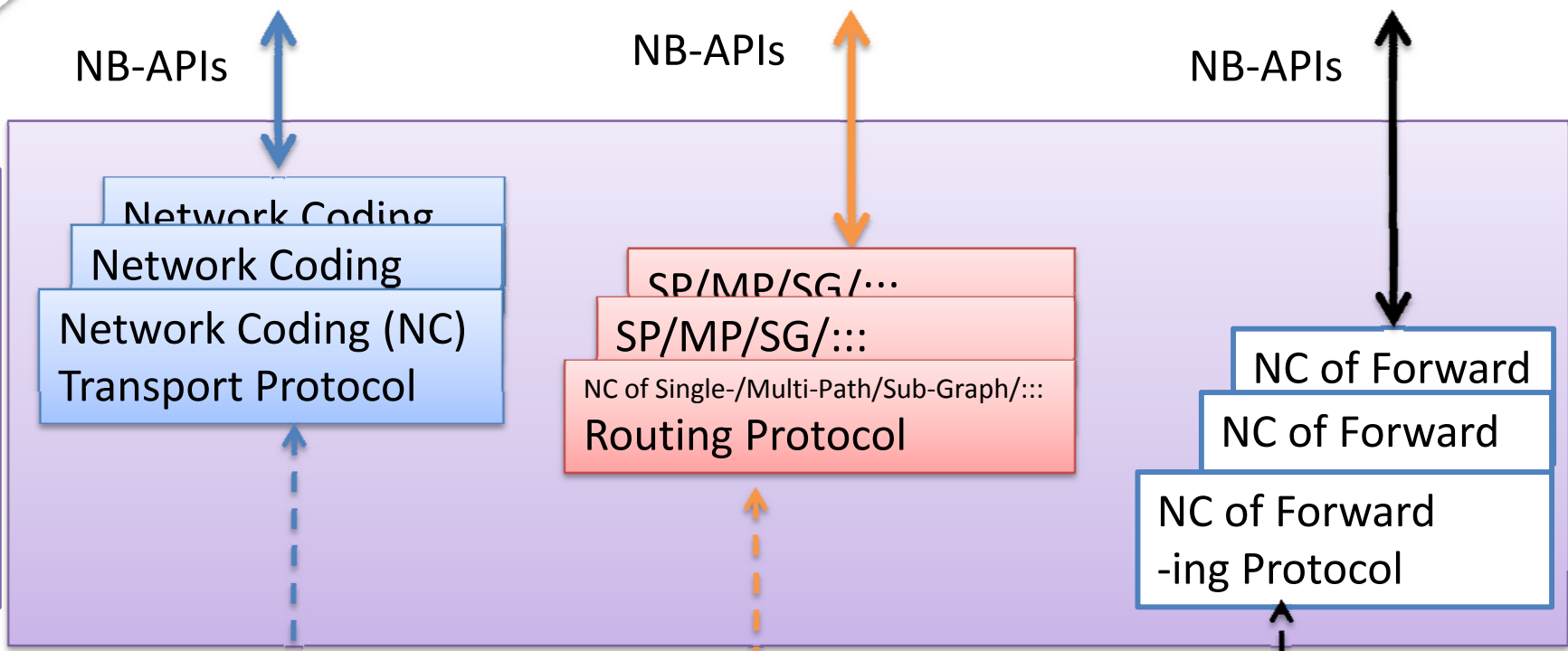
Notional Network Coding Architecture

| NDN, torrents, content dissemination | ← → | App | ← → | NetCoding-enabled Application Protocols (e.g., overlaid) |

App Interface (API)

| TCP (and variants), ALC, NORM, others | ← → | Network Coding Transport Protocols | ← → | Network Coding Transport Protocols |

(2) Interoperability   **(1) NC Protocols**

| OSPF, OLSR, Batman, SMF | ← → | NC-aware Routing Protocols (Ucast/ Mcast SinglePath/ MultiPath/ SubGraph) | ← → | NC-aware Routing / Trad. Routing |

Link Layer/ MAC

All of the "**Verbs**" can be somehow related to "**Control**"

Can all of the "**Nouns**" be "**Abstracted**"

Source: Network Coding Taxonomy (Victor & Brian);
http://www.ietf.org/proceedings/88/slides/slides-88-nwcrg-6.pdf

Separation of Control for Transport, Routing, Forwarding, etc.

Apps/Devices

Physical/Virtual NC Controller (NCC)

NB-APIs   NB-APIs   NB-APIs

Network Coding

Network Coding

Network Coding (NC)
Transport Protocol

SP/MP/SG/···

SP/MP/SG/:::

NC of Single-/Multi-Path/Sub-Graph/:::
Routing Protocol

NC of Forward

NC of Forward

NC of Forward
-ing Protocol

Coded and Controlled Network Service

SB-APIs   SB-APIs   SB-APIs

Transport(P/V)

Routing(Phy./Vir.)

Forwarding(P/V)

A High-Level Architecture for Network/Service Function Virtualization and Software-Defined Networking
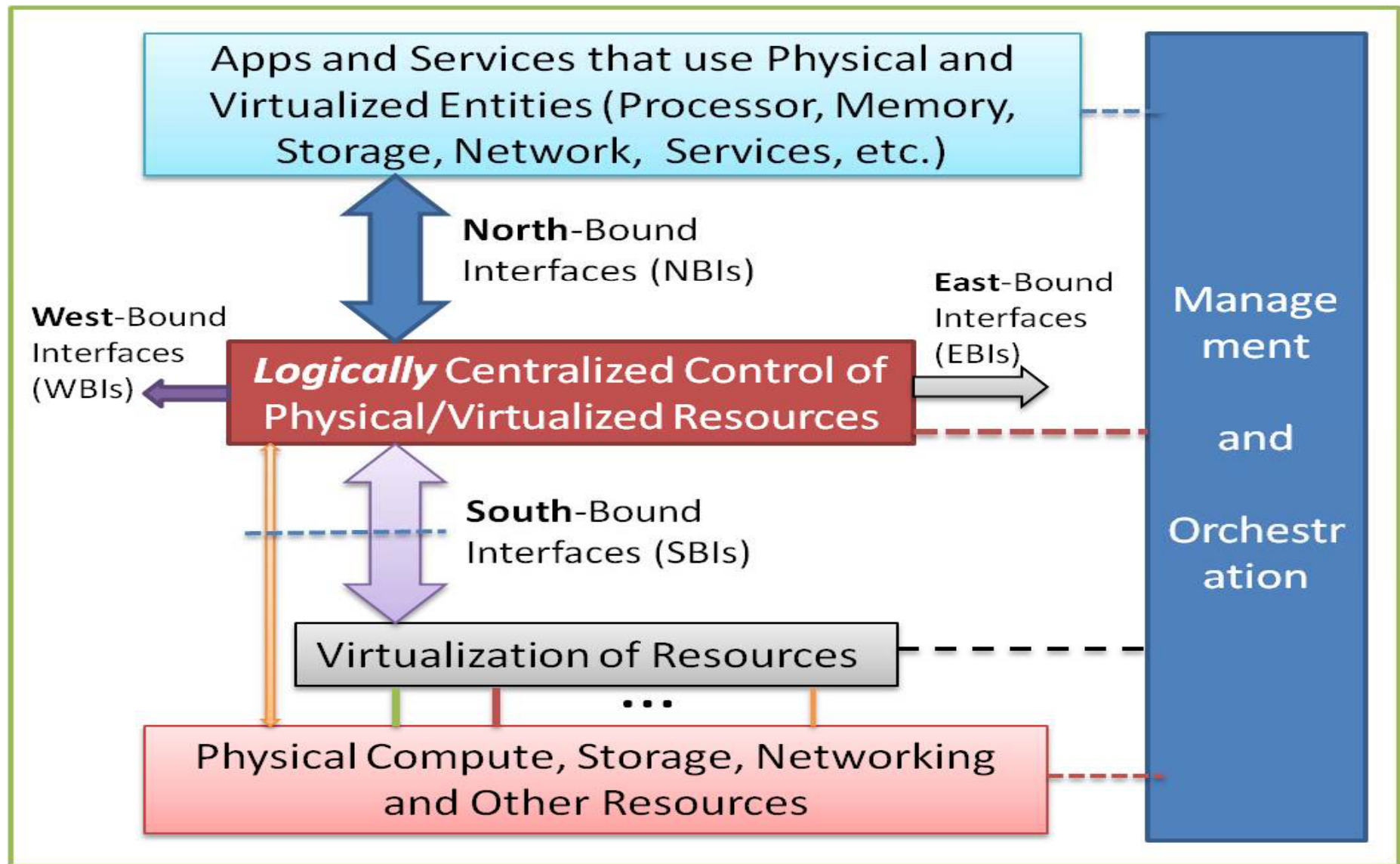
Virtualization

- Computing Resources Virtualization (*Software-defined Computing resources*)
  - *DMTF and Open Compute/Cloud/Stack Specs may be useful*
- Network Function Virtualization (*Software-defined Network functions*)
  - *ETSI/ISG NFV started developing the Requirements and gaps in the Industry and Standards*
- Storage Virtualization (*Software-defined Storage resources*)
  - *SNIA specs may be useful*
- Service Function Virtualization (*Software-defined Service function*)
  - *ETSI/ISG NFV started developing the Requirements and gaps in the Industry and Standards*

Virtualization of Network-Level Resources

- Network Node virtualization
  - *This refers to developing Templates for Deploying (Allocating, Managing, and Releasing the Functions that Reside in Network Nodes; the Functions may include Addressing, Forwarding, Monitoring, Management, etc.)*

- Router virtualization
  - *This refers to developing Templates for Deploying (Allocating, Managing, and Releasing the Functions that Reside in Routers; the Functions may include Route creation and management for packets/flows, etc.)*

- Network Topology virtualization
  - *This refers to developing Templates for physical (and virtual) interconnection among the network nodes (routers and others) and utilizing them for networked services*

- RIB/TIB (Routing /Topology information base) virtualization
  - *These refer to virtualizing (developing the templates and utilizing the instances) the databases that store Topology and Routing information*

- Network service (policy, security, quality, load-balancer , etc.) virtualization
  - *This refers to developing Templates for advanced network services and utilizing instances of those templates in general COTS servers for services*
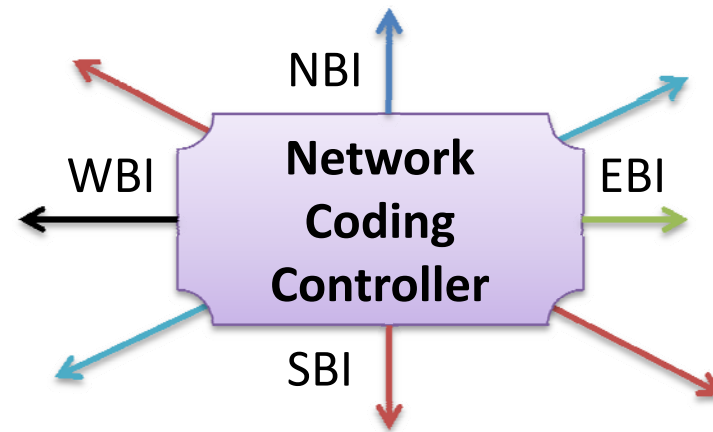
Virtualization of Network Coding

- Network Coding support of virtualization
  - *Network codes that can utilize both physical and virtual Transport, Routing, Forwarding, etc. entities*

- Virtualization Support in Network Coding
  - *Virtualization of Network codes for any combination of Transport, Routing, Forwarding, etc. entities*
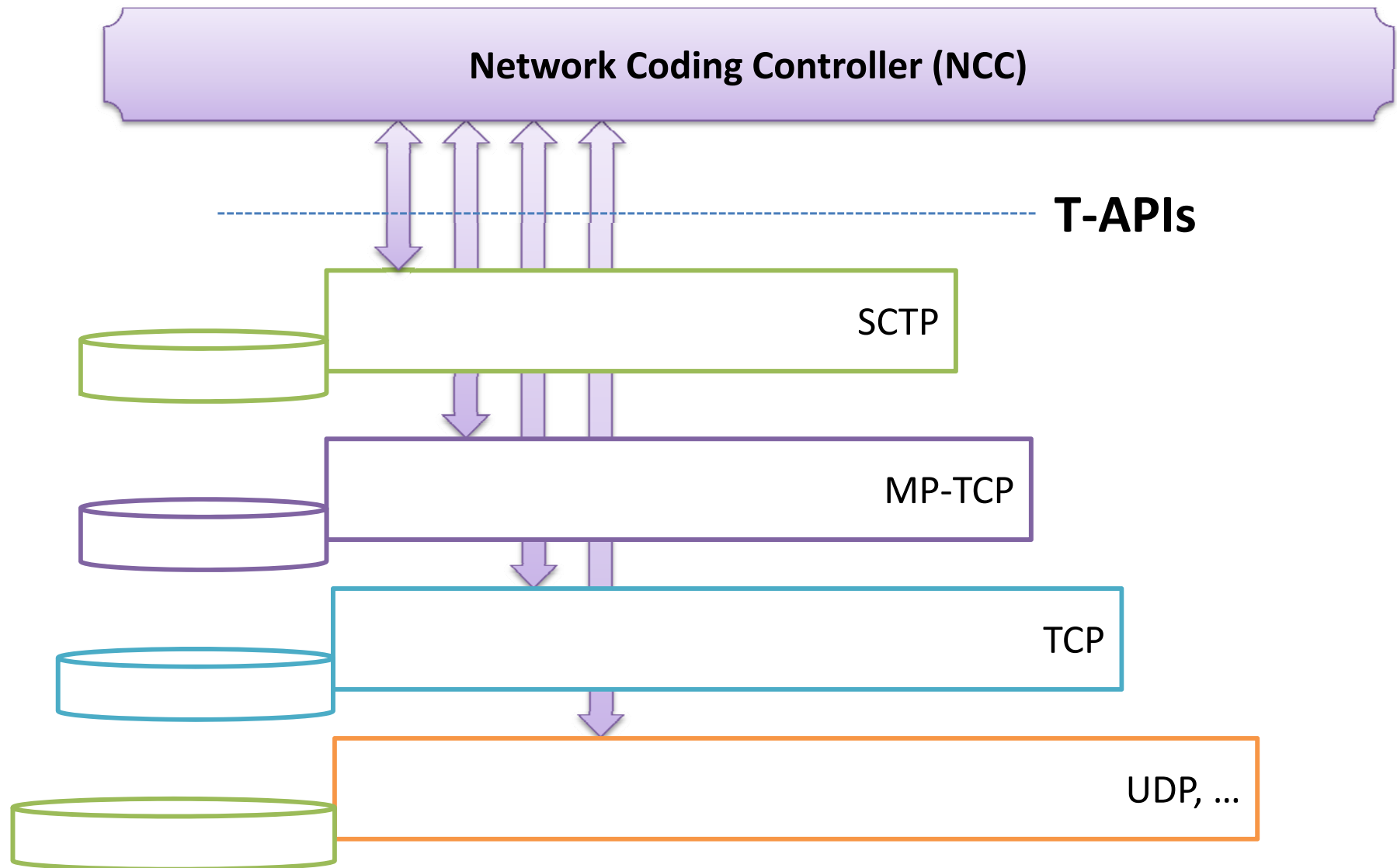
Network Coding Controller (NCC)

- Logically Centralized Physically Distributed
  - *Clustered or Hierarchically organized NCCs (physical and/or virtual)*

- Physical NCC
  - *A Physical device/host that contains the NCC functions*

- Virtual NCC
  - *A virtual machine that hosts/contains an instance of the NCC function*
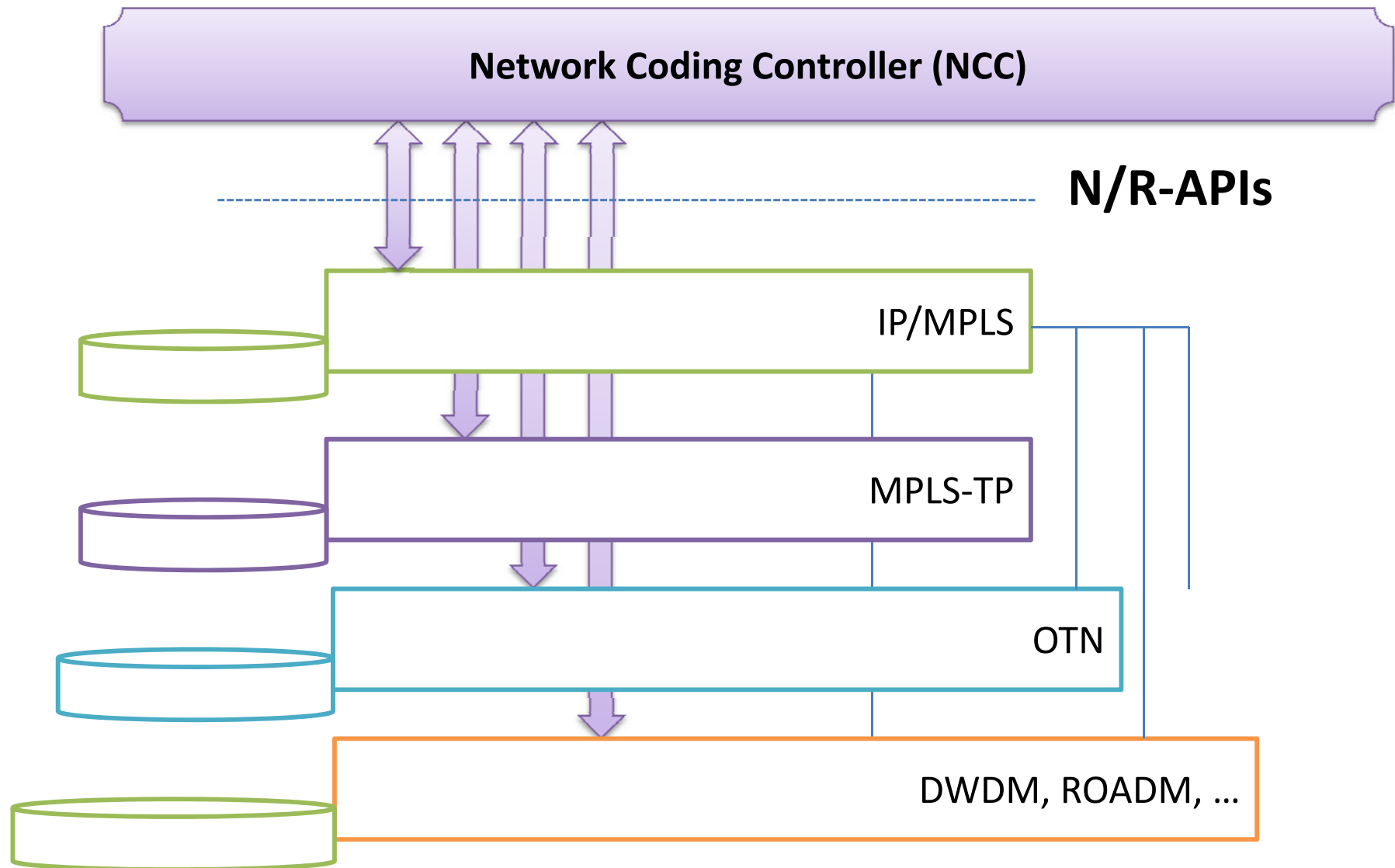
APIs

- North-Bound APIs (NBIs)
  - *Interfaces to/from Applications and Services*

- South-Bound APIs (SBIs)
  - *Interfaces to/from {Transport, Network, Forwarding, Physical Devices/Links, Location, etc.}*

- East-Bound APIs (EBIs)
  - *Interfaces to/from Management and Orchestration*

- West-Bound APIs (WBIs)
  - *Interfaces to/from Access-Network (Consumer Device)*

- Other APIs
  - North-East
    - Surveillance Interface
  - North-West
    - *In progress …*
  - South-East
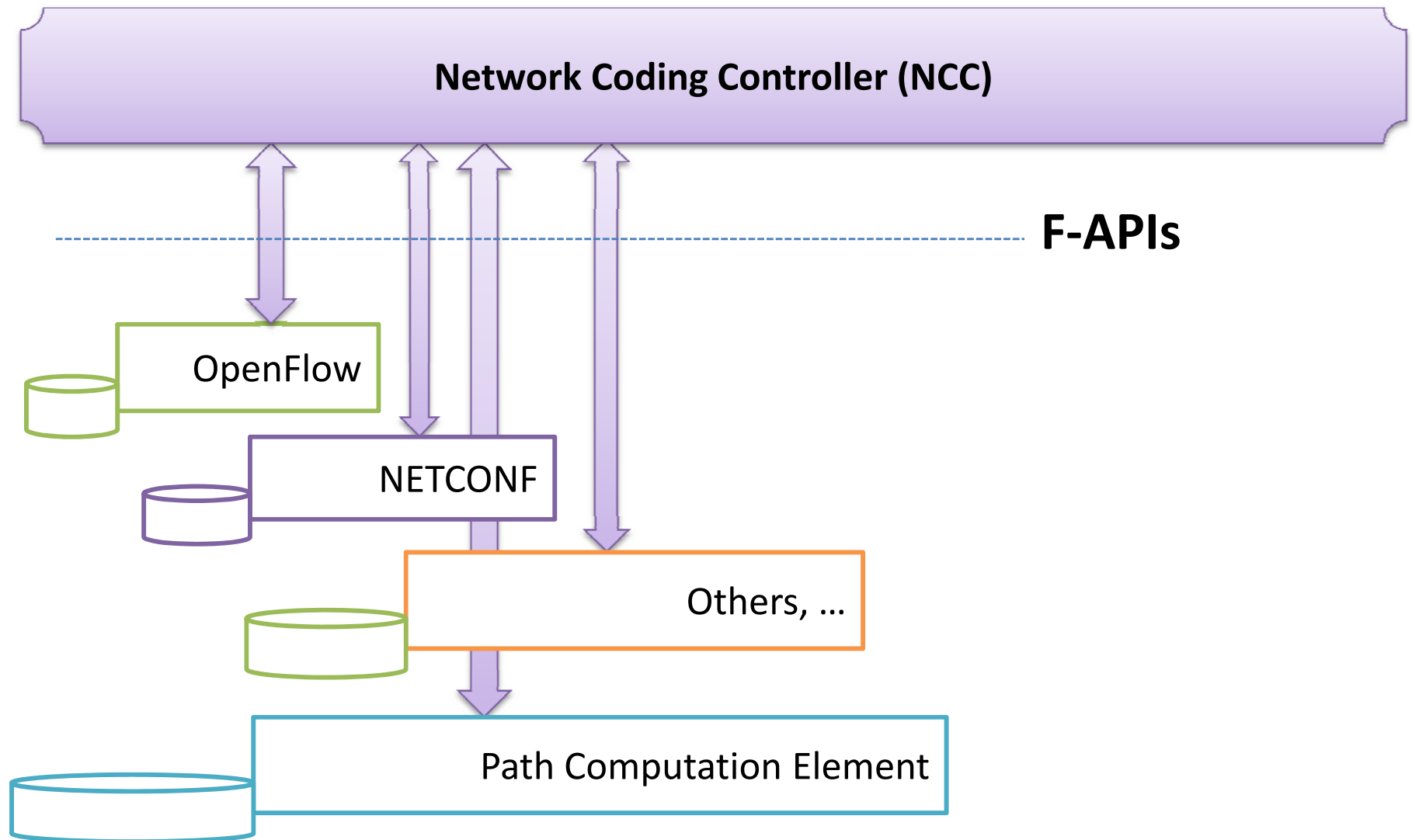   - Counter Surveillance Interface
  - South-West
    - *In progress …*

Transport Plane API(s)

Network Coding Controller (NCC)

T-APIs

SCTP

MP-TCP

TCP

UDP, ...

Network/Routing Plane API(s)

Network Coding Controller (NCC)

N/R-APIs

IP/MPLS

MPLS-TP

OTN

DWDM, ROADM, …

Forwarding Plane API(s)

Network Coding Controller (NCC)

F-APIs

OpenFlow

NETCONF

Others, …

Path Computation Element

Next Steps

- Initiate a draft, and Invite others to Contribute/Participate

http://datatracker.ietf.org/doc/draft-khasnabish-nwcrg-impact-of-vir-and-sdn/

- **Comments/Suggestions**

Q&A, and Discussion

THANKS!