Impact of Virtualization and SDN on Emerging Network Coding


(Current Version: draft-khasnabish-nwcrg-impact-of-vir-and-sdn-03.txt)

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Outline

• **Updates** since IETF 91 (Nov. 2014)
• **Plan** for next version (ver.-04) of the draft
• **Request** for further Comments, Thoughts, Suggestions, Guidance, Volunteers, etc.
• **Q & A, and THANKS!**
Plan for version 04

• In version 03:
  – We added what was presented last time related to:
    • Where to use SDN and NC?
    • Why use SDN and NC?
    • First steps of “How to implement SDN and NC?”

• Planned in version 04:
  – Further work on “How to implement SDN and NC?”
  – Consider the 5 use cases of “Network Coding Architecture – use cases protocols, and building blocks” in SDN context and consider “How to implement?”
    • E.g. NC shim through different layers of SDN architecture, etc.
Where to use SDN and NC?

• In version 03: some examples
  – SDN typical use in datacenters or in RAN (implies: subsets of use cases of NC)
    – Virtualization overlay, inter-data-center connectivity

• Example: in architectures such as NVO3, on inter-datacenter overlays

• (several) propositions of 60 GHz wireless data-centers

Example: In (specific) scenarios loosely related to RAN: wireless in datacenter (60 GHz)
Why use SDN and NC?

- In version 03:
  - Benefits from NC:
    - Reliability (multipath, inter-datacenters)
    - Performance in case of multicast (butterflies...)
  - SDN benefits for NC:
    - Central knowledge (controller)
    - Possible implementation without apps/stack modification
  - Open question: feasible/useful to use the reliability of network coding to improve latency (treat late packets as lost packets)

Open question: possibility of “cross-domain” routing e.g., mixing NC in storage and NC in the network.
How to implement NC?

- In order to support network coding, **one entity** has to code/decode somewhere, but who? (needs further investigations)

(Academic) proofs of concept of modification of SDN switches for NC


Can the coding/decoding function be implemented using a Virtual Network Function (NFV)?
(what are the impacts on overall performance?)

Any other approaches?
(what are the pros and cons?)

Source: [link to OpenFlow demo](http://gosp.lmit.tiny.hu/~gulyas/personal_page/openflow_demo.pdf)

How to implement NC?

- In order to support network coding, **multiple entities can co-operatively perform encoding/decoding** in different layers of SDN using virtualized components (needs further investigations).


http://opennf.cs.wisc.edu/overview
What’s Next?

- Comments
- Thoughts
- Suggestions
- Guidance
- Volunteers / Contributors / Reviewers,
- Anything else ?!
Q&A, and Discussion

THANKS!
Background Materials
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 ... Alien intelligence service*
  – South-East
    • Counter Surveillance Interface
  – South-West
    • *In progress ... Native Intelligence Service*
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, ...

Fri-27-Mar-2014

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Forwarding Plane API(s)
Next Steps

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


• Comments/Suggestions
Q & A,

THANKS.