Integration of IEEE 802.16 with OpenFlow Software-Defined Networking

Document Number:

IEEE 802.16-13-0084-00-000r

Date Submitted:

2013-04-17

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Re:

For P802.16r Project Telecon, 2013-04-17, 14:00 UTC <http://ieee802.org/16/scb/telecon.html>

Base Contribution:

[none]

Purpose:

To stimulate and support discussion within the P802.16r project regarding Software-Defined Network control architecture.

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Integration of IEEE 802.16 with Software-Defined Network Control

This contribution is a followup to:

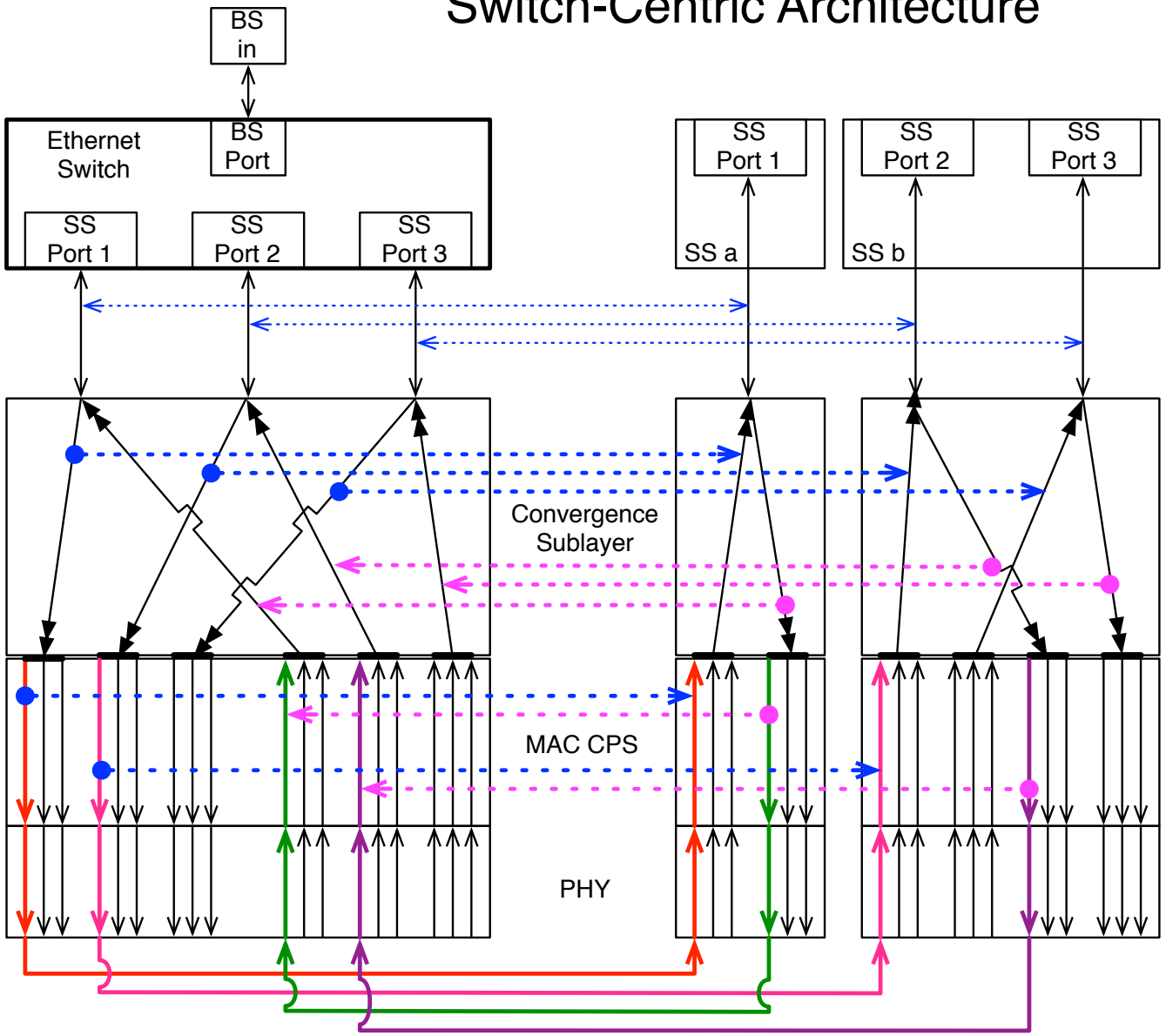
- IEEE 802.16-13-0049 (“Integration of IEEE 802.16 and Carrier Ethernet”)

IEEE 802.16-13-0049 proposed a bridge-centric architecture with a switch in the BS

Bridge (switch) is presumably based on 802.1Q functionality (learning, spanning tree, etc.)

Enhancement: Use of SDN controller to program the switch, in addition to 802.1Q behavior.

Switch-Centric Architecture



multiple SS Ports per SS
one SS per SS Port

One CS instance per SS
Port-aware CS

unidirectional
Connections

multiple Connections per SS Port
one SS Port per Connection
Connections labeled by SS Port

all Connections linked via PHY
[several examples highlighted]

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Switch Control

- Switching behavior per 802.1Q is required per IEEE 802.1Q
  - "The standard will comply with IEEE Std 802, IEEE Std 802.1D, and IEEE Std 802.1Q."
  - PAR P802.16r (IEEE 802.16-12-0587)
- It is also possible to allow other switch behavior.

OpenFlow

- *OpenFlow enables networks to evolve, by giving a remote controller the power to modify the behavior of network devices, through a well-defined "forwarding instruction set". The growing OpenFlow ecosystem now includes routers, switches, virtual switches, and access points from a range of vendors.*
- *The Open Networking Foundation (ONF) is now the home of the OpenFlow specification. We invite you to join the ONF and be part of the exciting standardization and commercial development and deployment of OpenFlow.*

  - <http://www.openflow.org>

Open Networking Foundation (ONF)

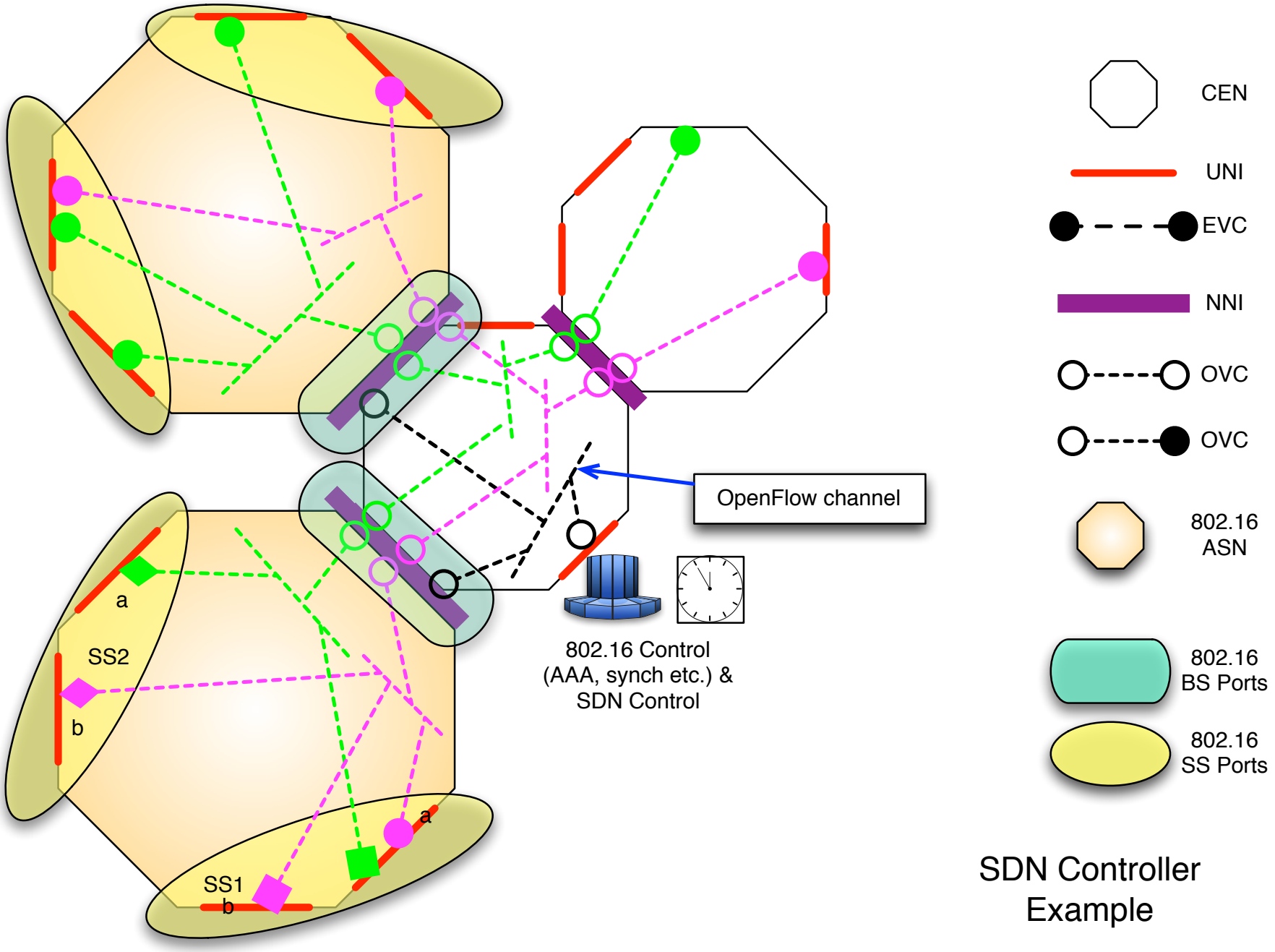
- *…a user-driven organization dedicated to the promotion and adoption of Software-Defined Networking (SDN) through open standards development.*
- *SDN is a new approach to networking in which network control is decoupled from the data forwarding function and is directly programmable*
- *Our signature accomplishment to date is introducing the OpenFlow™ Standard, which enables remote programming of the forwarding plane. The OpenFlow Standard is the first SDN standard and a vital element of an open software-defined network architecture.*

  - <https://www.opennetworking.org/about/onf-overview>

OpenFlow separates control and data path

- *In a classical router or switch, the fast packet forwarding (data path) and the high level routing decisions (control path) occur on the same device. An OpenFlow Switch separates these two functions. The data path portion still resides on the switch, while high-level routing decisions are moved to a separate controller, typically a standard server. The OpenFlow Switch and Controller communicate via the OpenFlow protocol...*

  - <http://www.openflow.org/wp/learnmore/>



SDN Controller Example

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OpenFlow Hybrid Switch

OpenFlow-compliant switches come in two types: OpenFlow-only, and OpenFlow-hybrid.

- *OpenFlow-only switches support only OpenFlow operation.*
- *OpenFlow-hybrid switches support both OpenFlow operation and normal Ethernet switching operation, i.e. traditional L2 Ethernet switching, VLAN isolation, L3 routing, ACL and QoS processing. Those switches should provide a classification mechanism outside of OpenFlow that routes traffic to either the OpenFlow pipeline or the normal pipeline. For example, a switch may use the VLAN tag or input port of the packet to decide whether to process the packet using one pipeline or the other, or it may direct all packets to the OpenFlow pipeline…*

- **OpenFlow Switch Specification Version 1.1.0**

<http://www.openflow.org/documents/openflow-spec-v1.1.0.pdf>

Conclusions

- The architecture of IEEE 802.16-13-0049 can be easily extended to support SDN and OpenFlow
  - already based on Ethernet switch
  - separate control path links controller and switch
- Switch needs to support 802.1Q
- Switch should support the OpenFlow protocol
  - **OpenFlow Switch Specification Version 1.1.0**
- May need to specify a classification mechanism to distinguish the two switch modes

Proposal

- Modify IEEE 802.16-13-0074-02 (“Call for Contributions: IEEE Std 802.16 Amendment for Small Cell Backhaul”):
  - After “We would also like to call for contributions toward the development of this document.”, add a sentence:
  - “Contributions addressing the applicability of the project to software-defined networks are welcome.”