

Connection-Oriented Software-Defined Networking

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Re:

For P802.16r Project, IEEE 802.16 Session #85

Base Contribution:

[none]

Purpose:

To stimulate discussion regarding the implications to the P802.16r project of the integration of a connection-oriented transport like IEEE 802.16 into a software-defined network.

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Connection-Oriented Software-Defined Networking (COSDN)

This contribution is a followup to IEEE 802.16-13-0049 (“Integration of IEEE 802.16 and Carrier Ethernet”)

- proposed a switch-centric architecture with a switch in the BS
- switch is presumably based on 802.1Q functionality (learning, spanning tree, etc.)

This contribution is a companion to IEEE 802.16-13-0084 (“Integration of IEEE 802.16 with Software-Defined Network Control”)

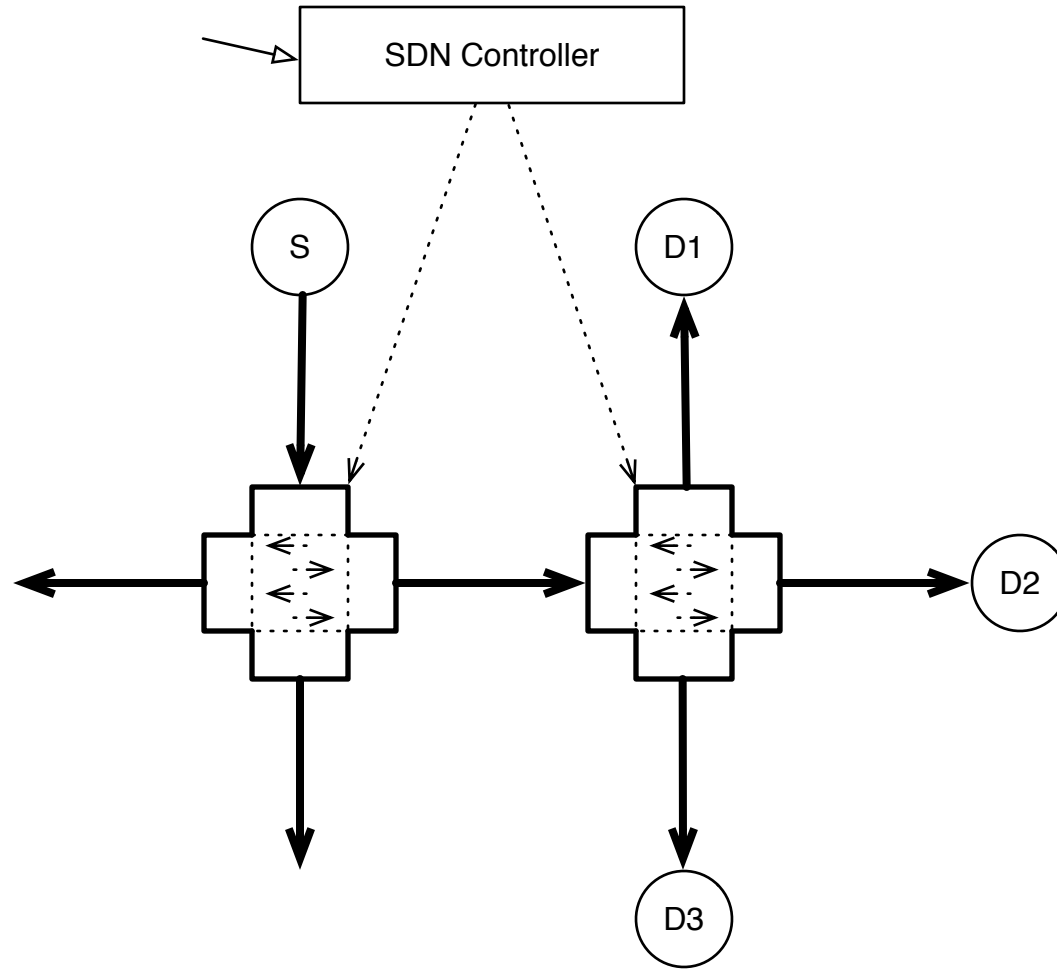
- followup to IEEE 802.16-13-0049, introducing SDN controller to program the switch and link connections, including QoS control, as an alternative to pure 802.1Q behavior.

This contribution takes a broader perspective than IEEE 802.16-13-0084 toward the general issue of Connection-Oriented Software-Defined Networking.

SDN

- SDN controller communicates with switches via control path
- SDN controller controls flow forwarding by managing flow tables
- limited QoS enables by associating a flow with a customized queue
 - Can schedule packets onto a link
 - Can't control what happens on the link

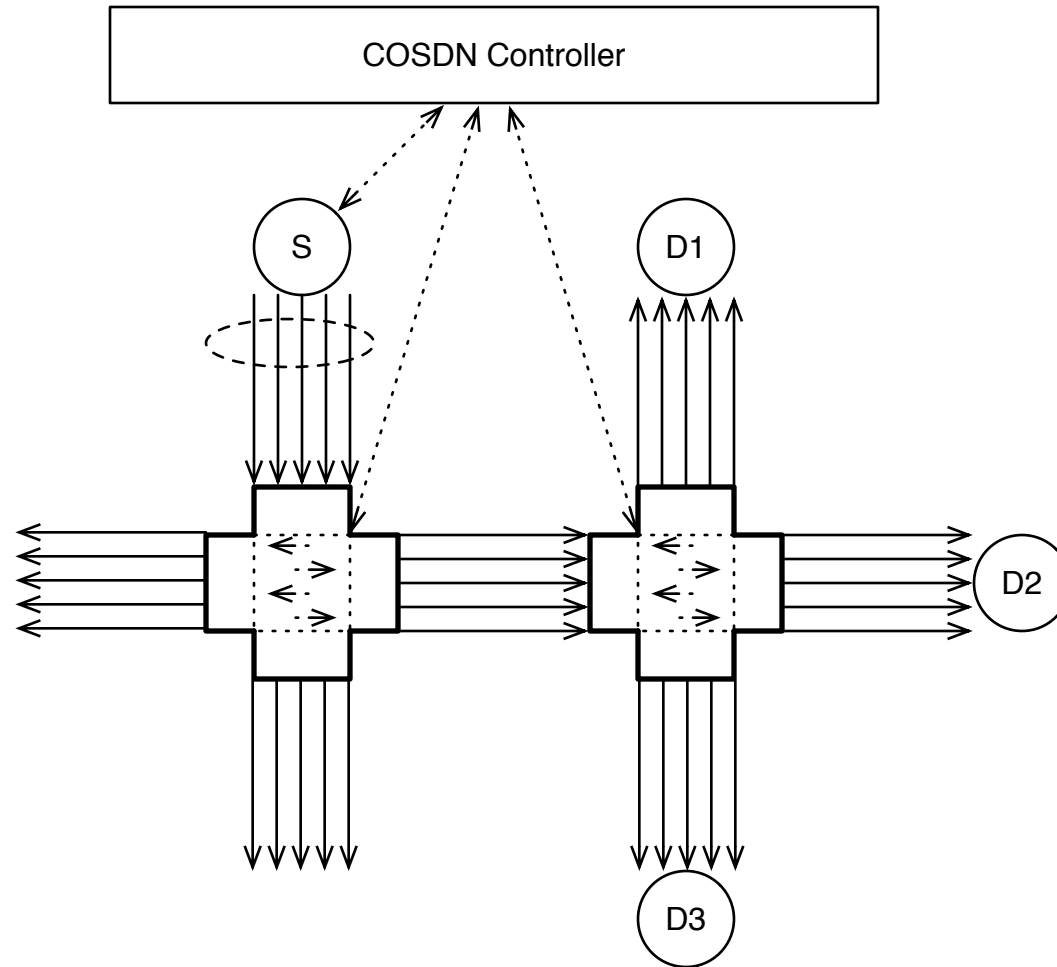
SDN



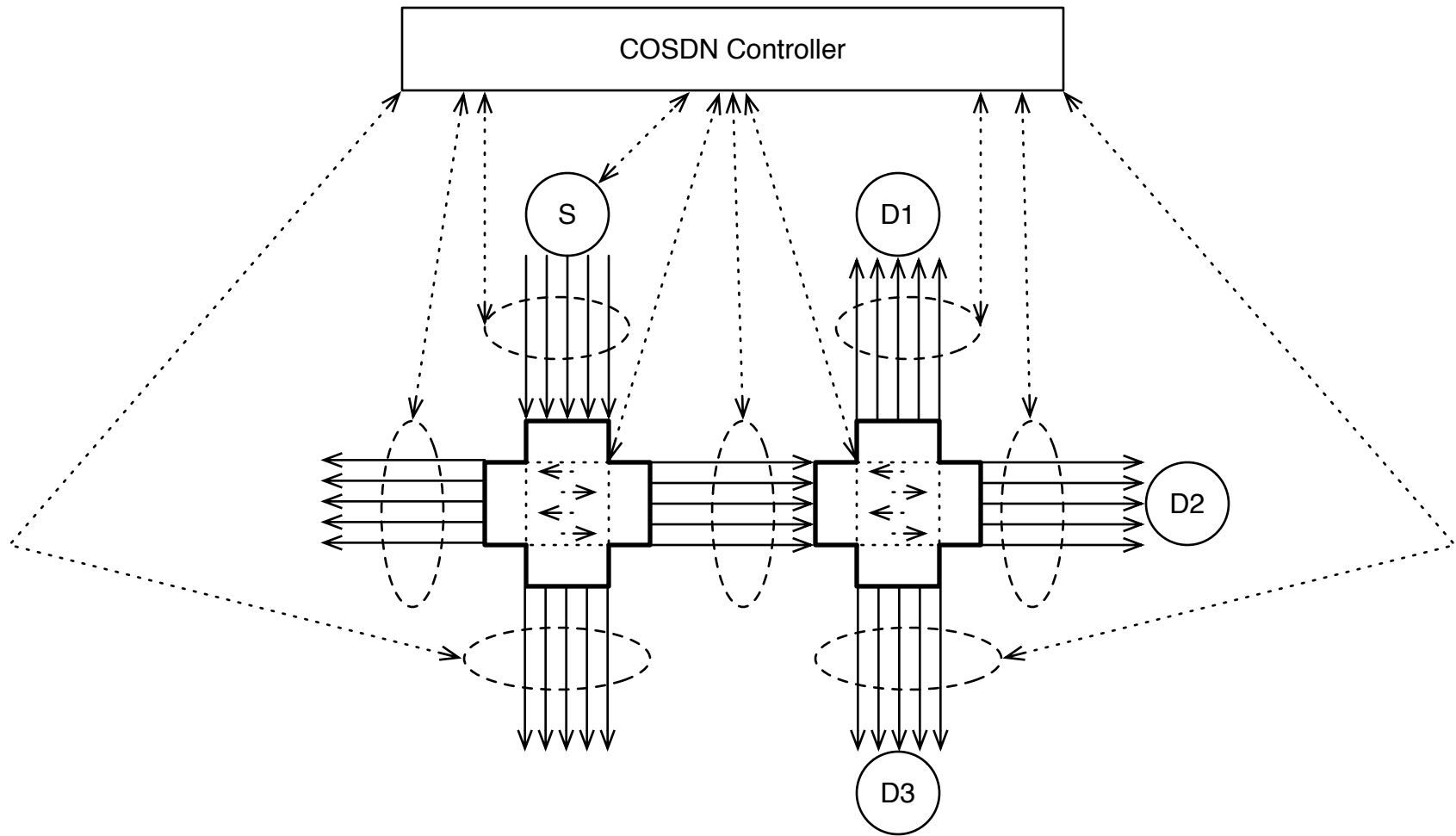
Connection-Oriented SDN (COSDN)

- Links are connection-oriented and managed
- COSDN controller manages not only switches but also
 - link connections
 - Connection setup, teardown, maintenance
 - packet classification
 - source ports for connection classification
- Links may be unmanaged
 - e.g. they may not be connection-oriented or may support only a single connection

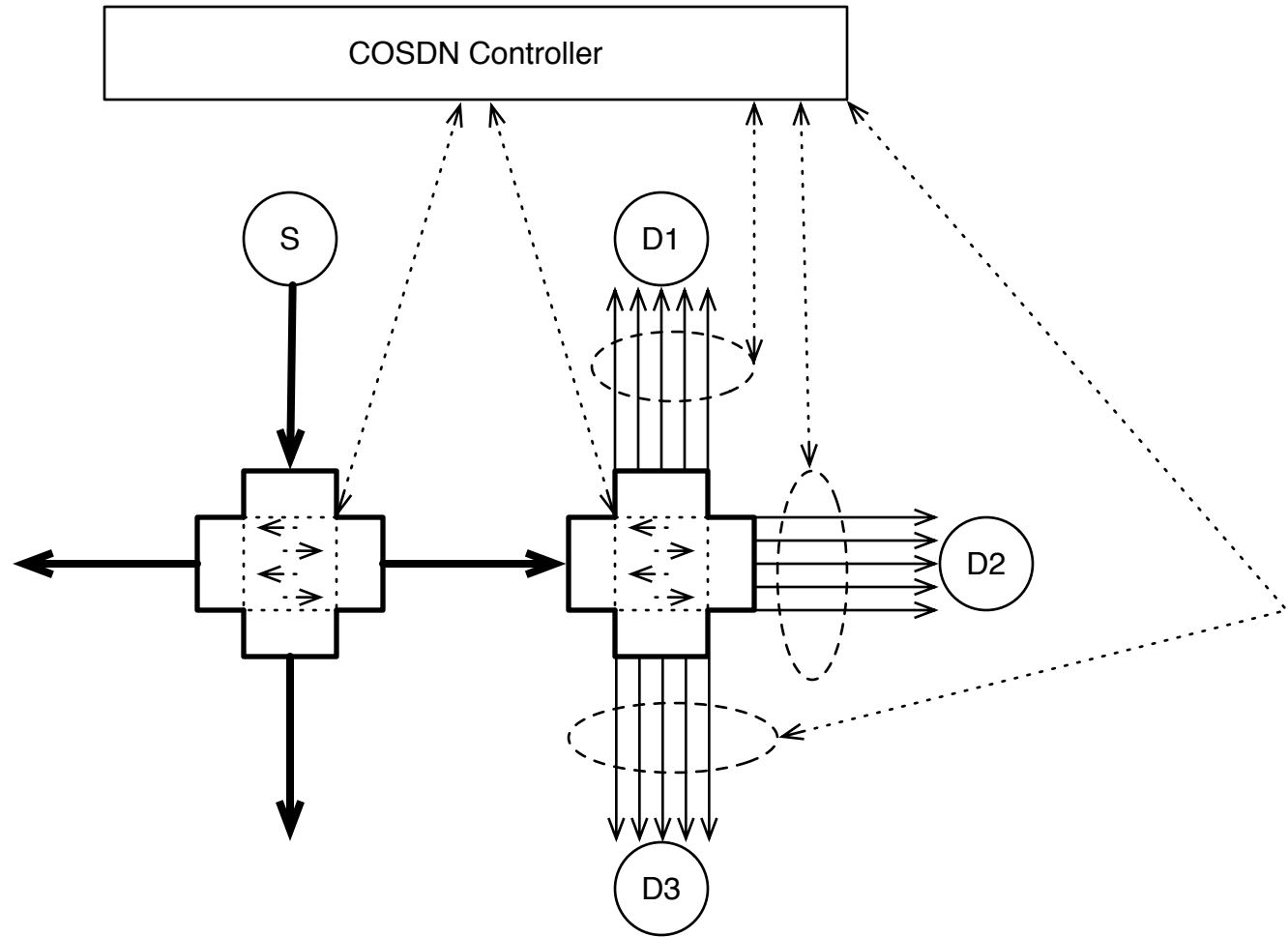
Connection-Oriented SDN



Connection-Oriented SDN Full Connection Control



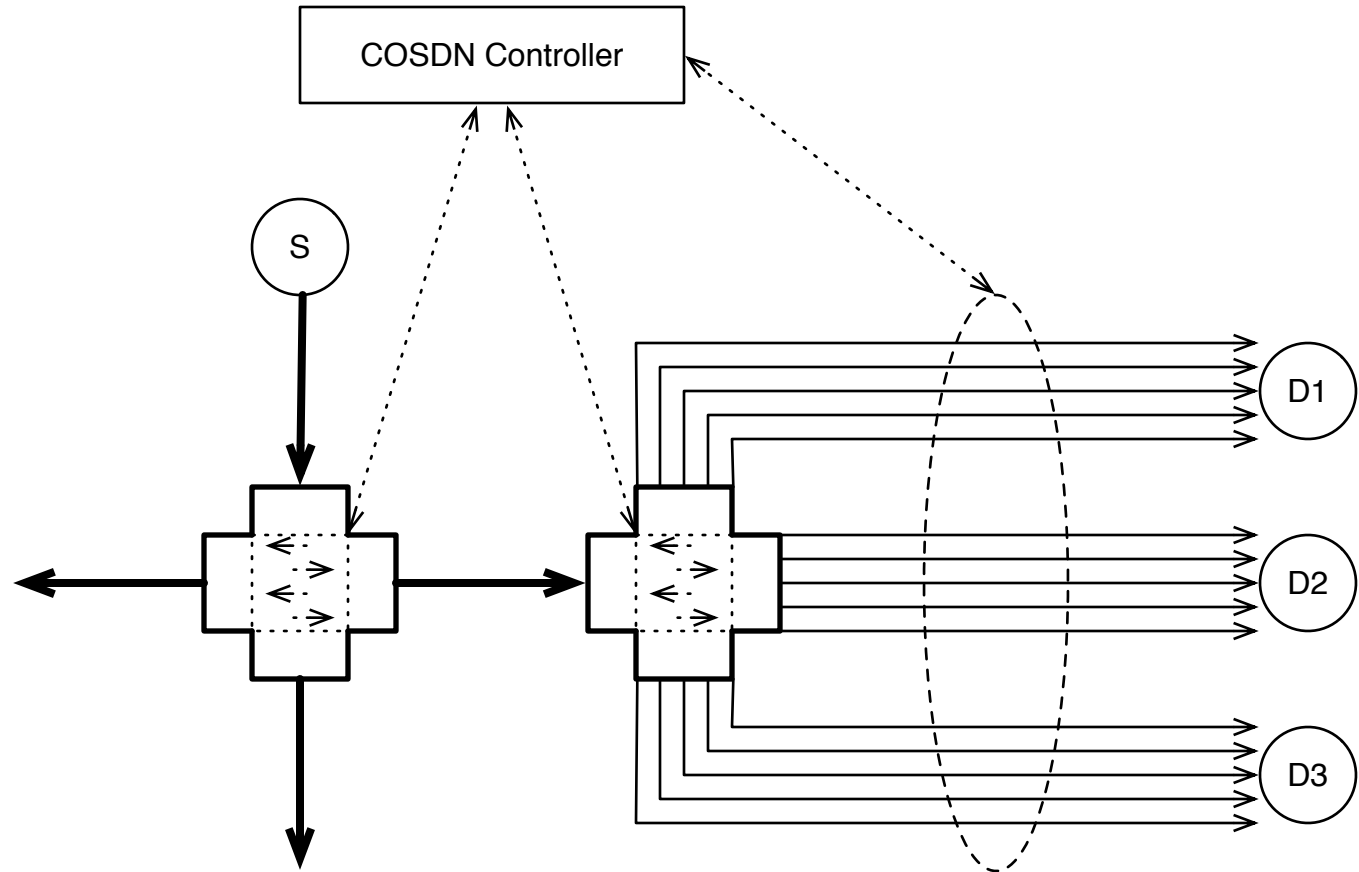
Connection-Oriented SDN Partial Connection Control



Connection-Oriented SDN with Shared Physical Medium

- Multiple Links may share a physical medium
- This points out a major limitation of queuing only on the link: if the link resource is shared, the entire shared resourced must be managed as a single resource, with scheduling to accommodate connection QoS requirements across all links.
- Example: Point-to-multipoint radio links, as in IEEE 802.16.
- Note: the switch ports are virtual, not physical.

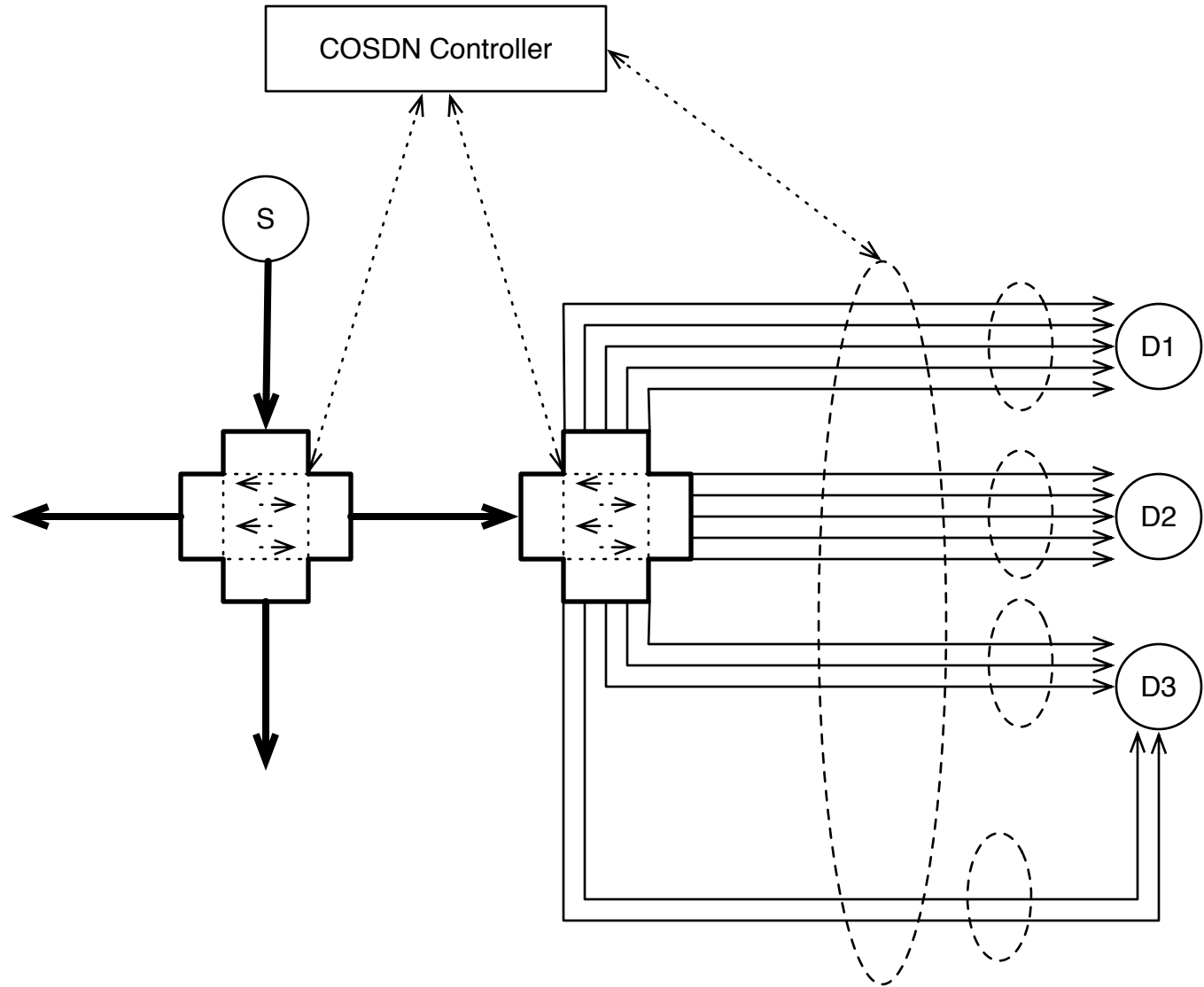
Connection-Oriented SDN Shared Physical Medium



Connection-Oriented SDN with Multiple Physical Media

- Connections need to deliver packets to ports. There are many ways to do so.
- Could separate link connections by physical media.
 - May require a physical switch, not just virtual
- Example: an edge device may support IEEE 802.16 and IEEE 802.11.
 - Provision some connections (e.g., QoS-sensitive ones) over 802.16.
 - Provision other connections (e.g., best-effort) over 802.11.
- Manage all connections in a coordinated fashion using COSDN.
- Enable cross-media handover.
 - Use link aggregation tricks (e.g. IEEE 802.1AX Marker Protocol) to speed transition while maintaining correct packet sequence.

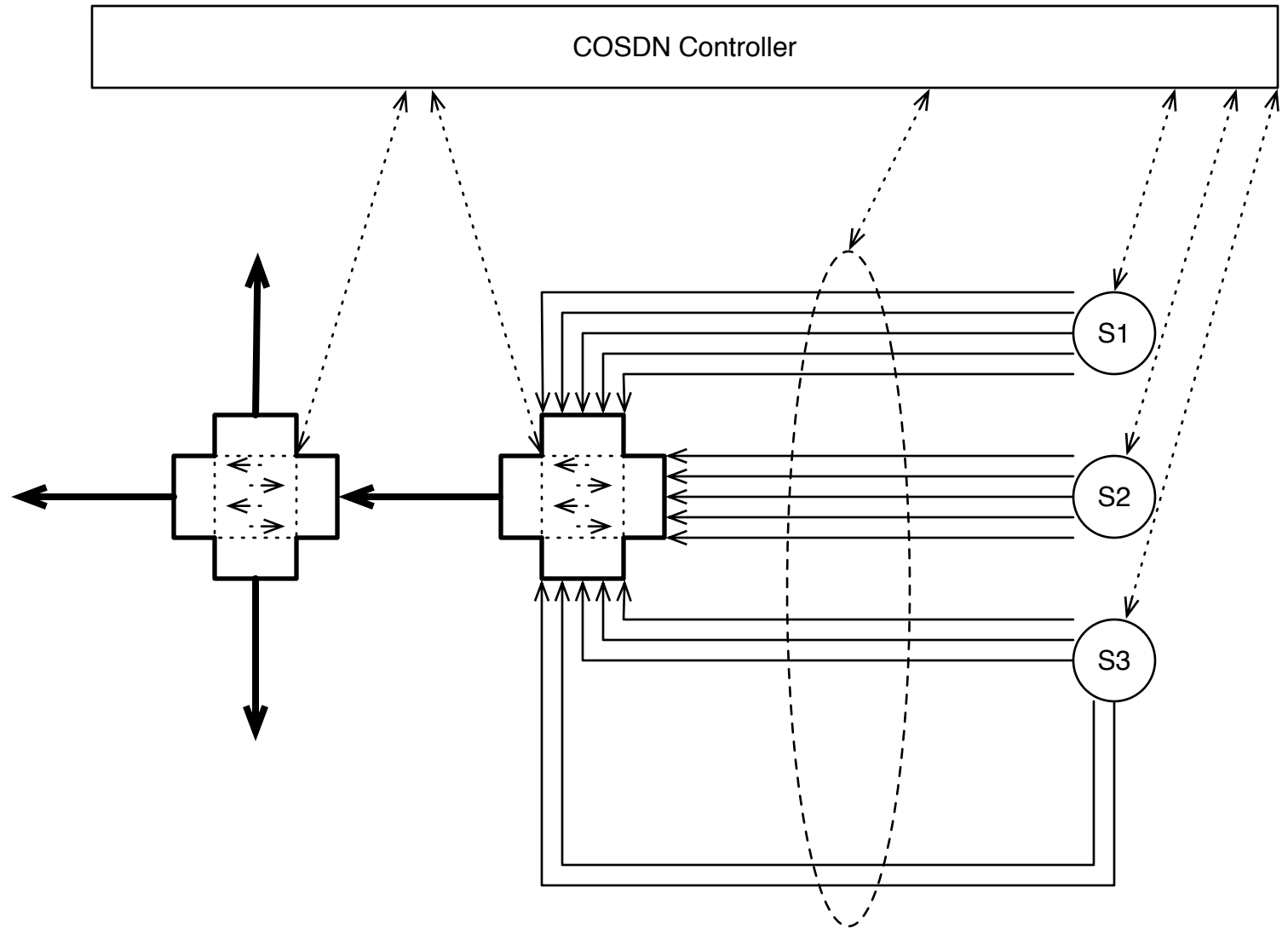
Connection-Oriented SDN Multiple Physical Media



Connection-Oriented SDN with Multiple Physical Media - Uplink

- The previous figures illustrates the “downlink” problem of a point-to-multipoint architecture.
- “Uplink” can be managed in a similar fashion.
- Source packets must be classified and assigned to flows that map to connections appropriate to their QoS requirements.
- COSDN Controller manages connections.
- COSDN Controller configures packet source flow tables
 - Not for switching but for QoS sorting and matching to appropriate connections.

Connection-Oriented SDN Multiple Physical Media - Uplink



Conclusions

- SDN manages switches but not links
- Connection-oriented transport networks, like IEEE 802.16 and others, provide QoS control by managing connections in a manner that is parallel to SDN switch management
- SDN can be extended to COSDN to allow control of the entire port-to-port network flow, including, switches and links.