IEEE 802.1Q YANG Interface Framework in support of Link Aggregation (802.1AX), Security (802.1X), and CFM (802.1ag)

Marc Holness
Version 1.3
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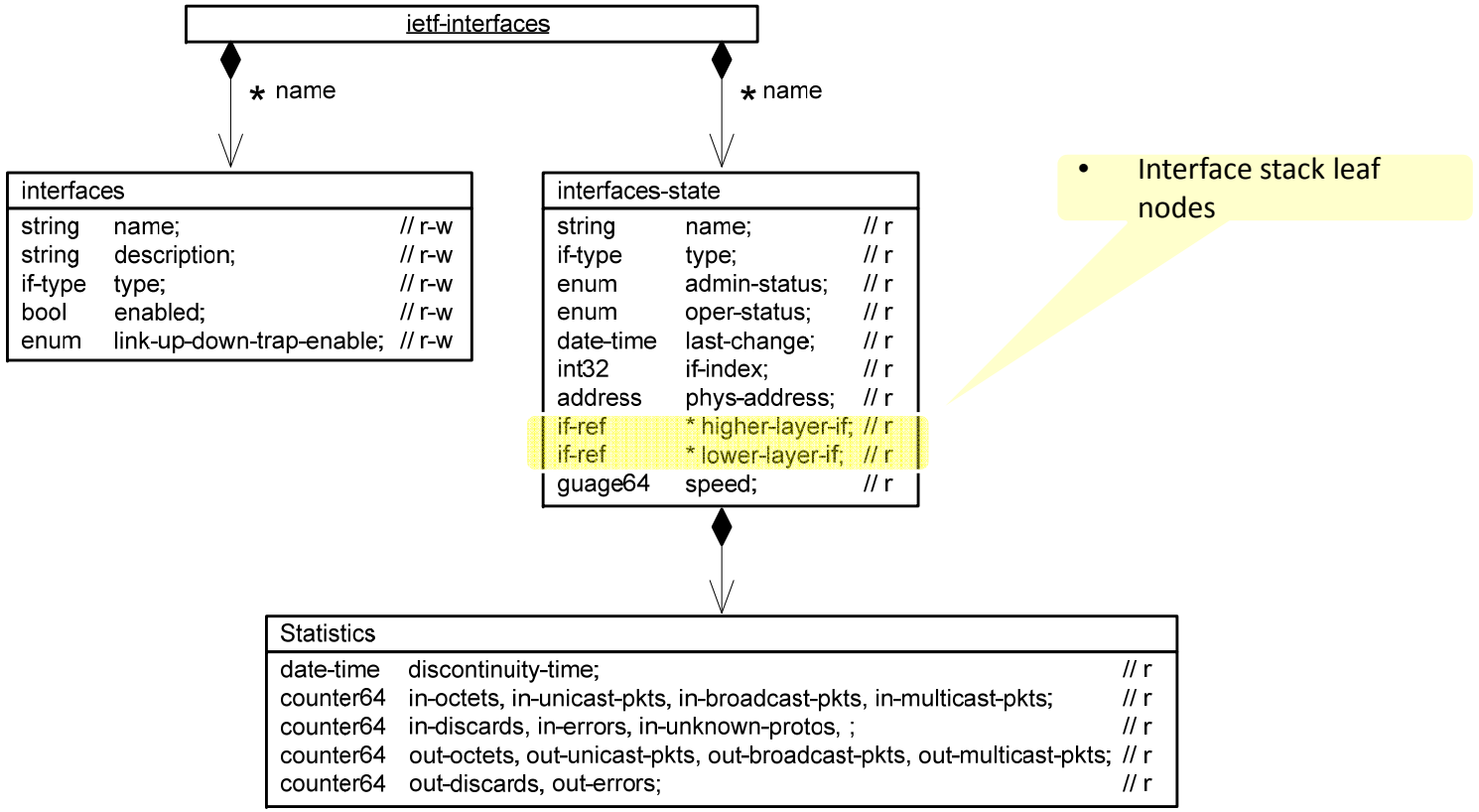
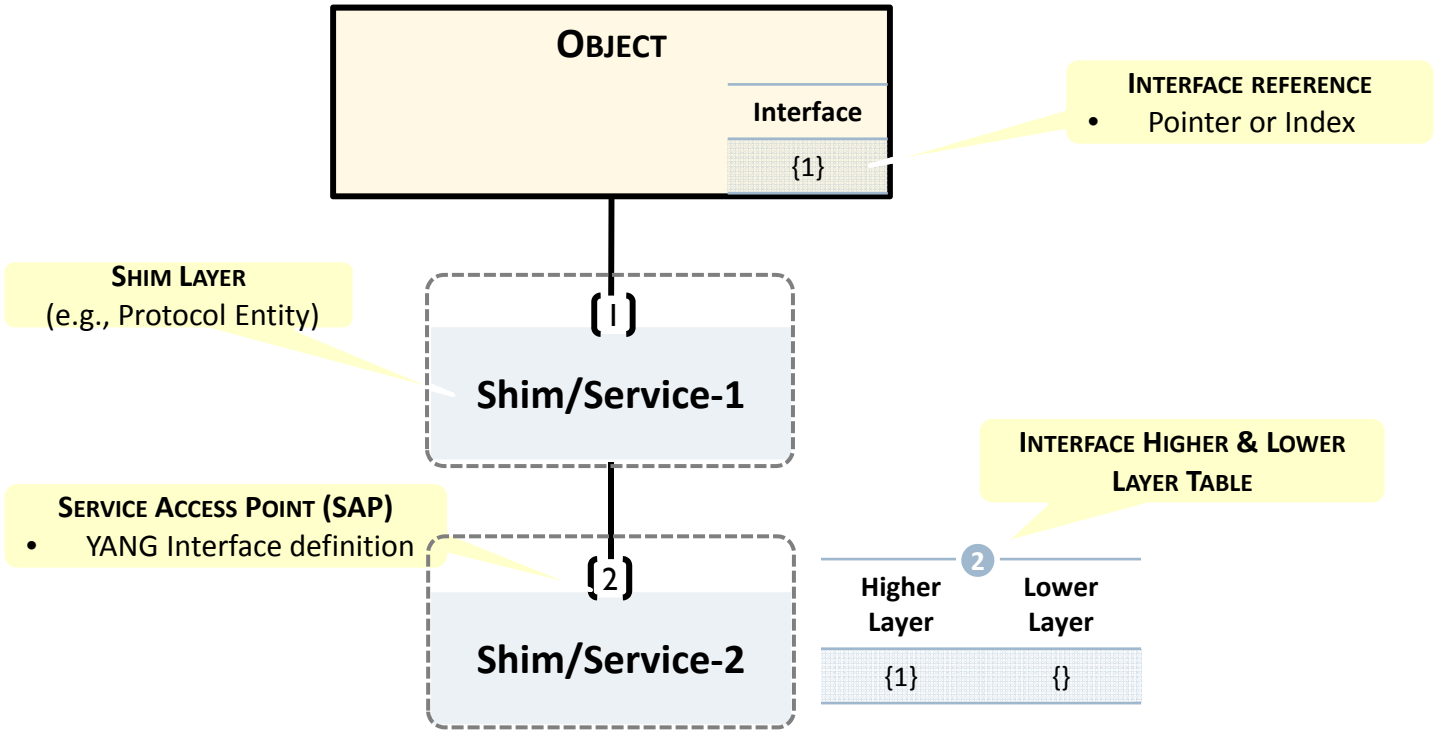
IETF Interface Management Model

- IETF Interface Management Model can be represented as shown below
  - UML-ized depiction of YANG model specified in RFC 7223

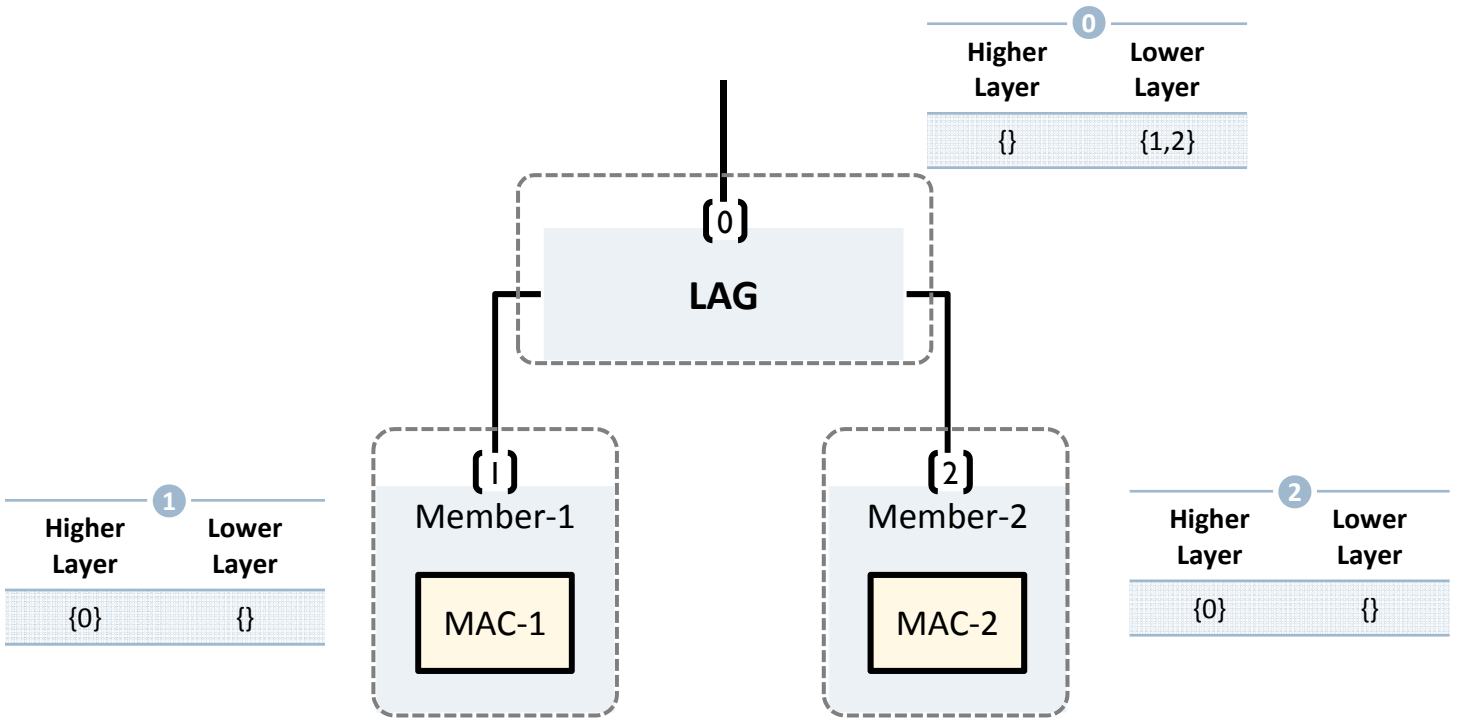


Interface Stack Diagram Representation

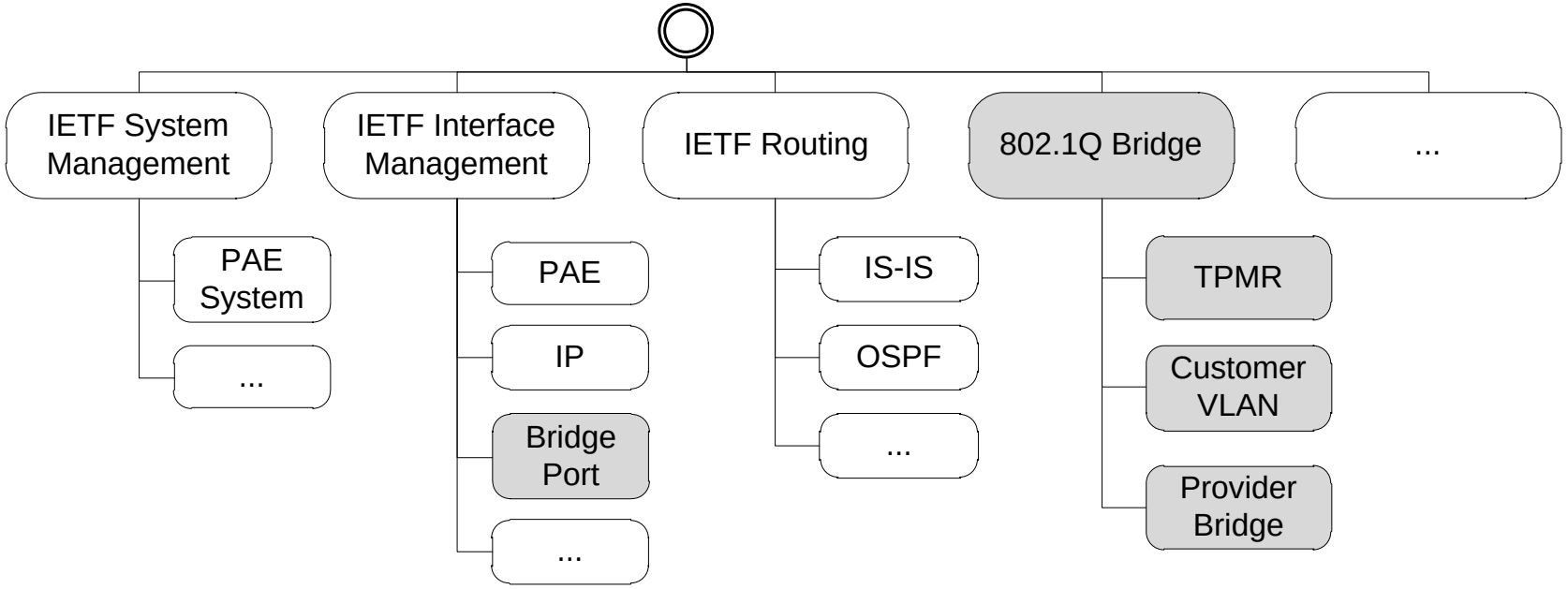
- A SAP is an abstraction and does not necessarily correspond to any concrete realization within a system
- The entities that support a particular SAP compose an interface stack
- Each YANG Interface definition contains an interface stack table



Interface Stack — LAG

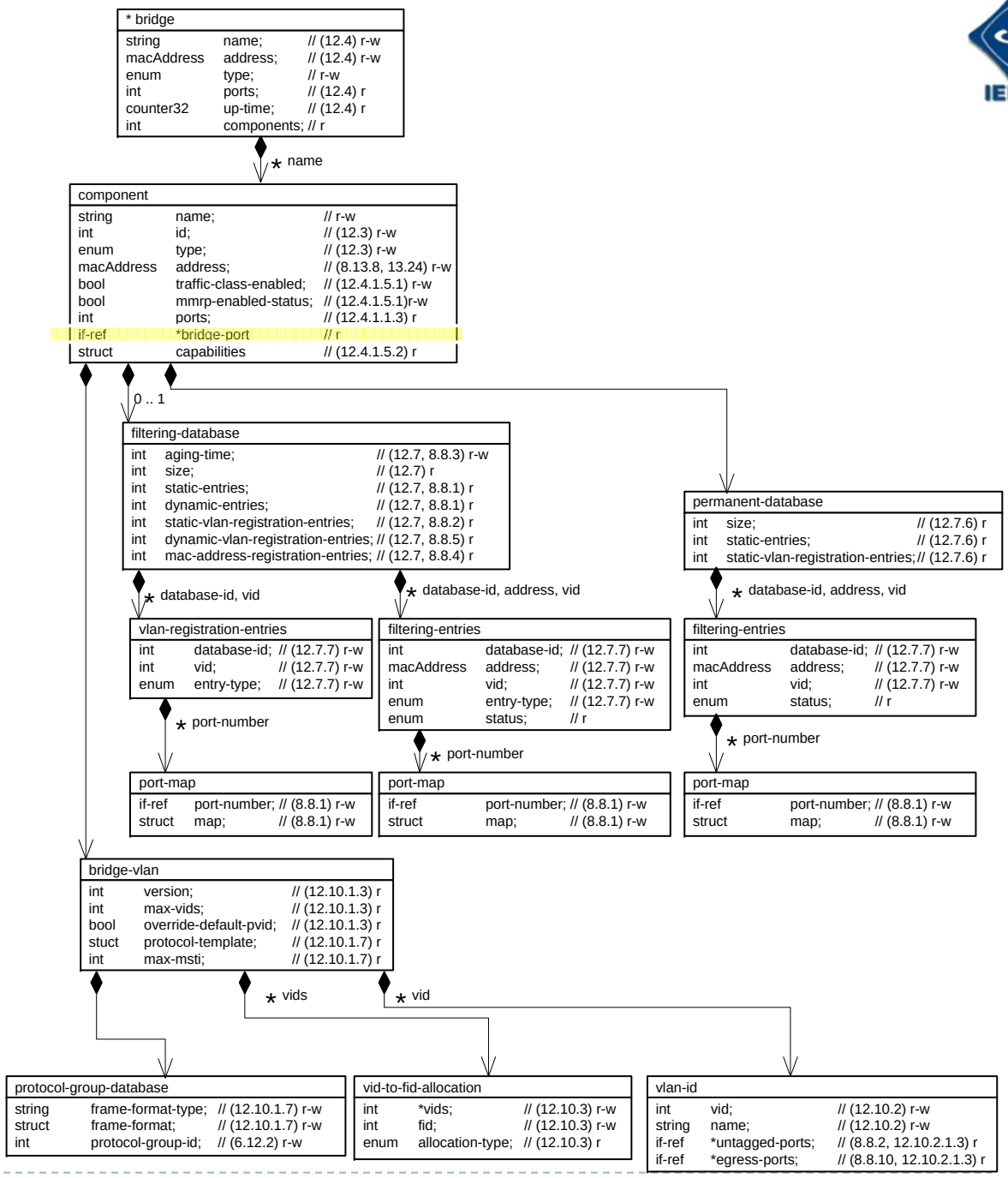


IEEE 802.1 Objects Within YANG Object Hierarchy



Introducing the [Generic] Bridge YANG Model

The list of Bridge Ports

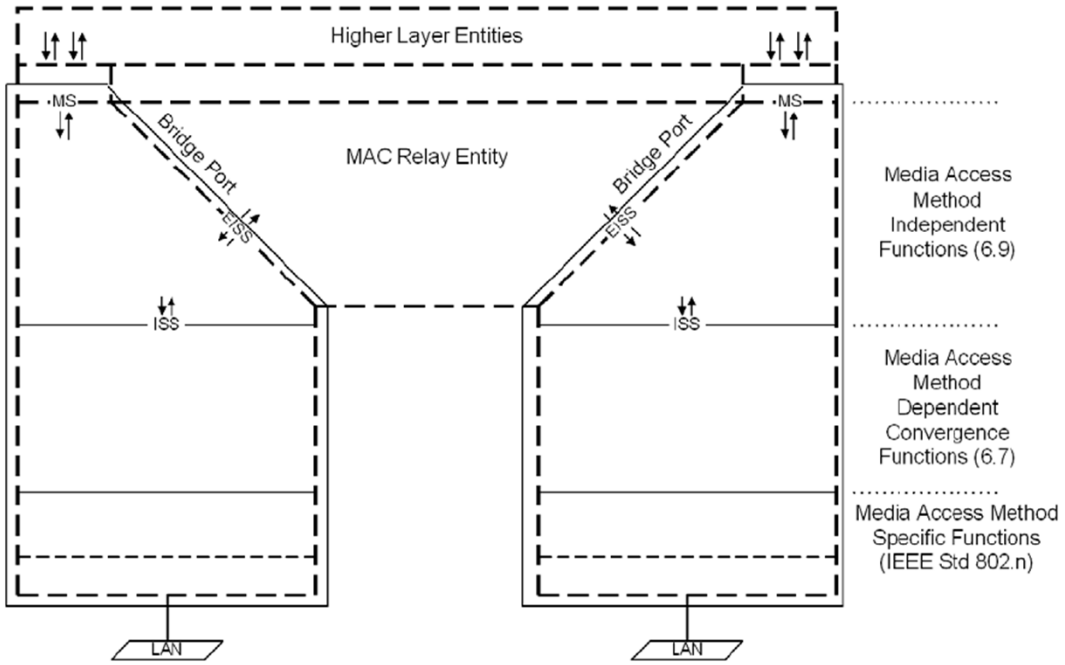


IEEE 802.1Q Bridge Port

- Each Bridge Port is associated with one Interface, and in most situations, each Bridge Port is associated with a different interface
- However, there are situations in which multiple Bridge Ports are associated with the same interface
  - For example, several Bridge Ports can each correspond one-to-one with several Ethernet private lines (or SDH virtual circuits) but all on the same Interface
  - Or multiple Bridge Ports can each correspond to a single internal LAN (I-LAN) port
- Alternatively, there is the Link Aggregation (IEEE Std 802.1AX) case where there are many physical Ports for one Bridge Port

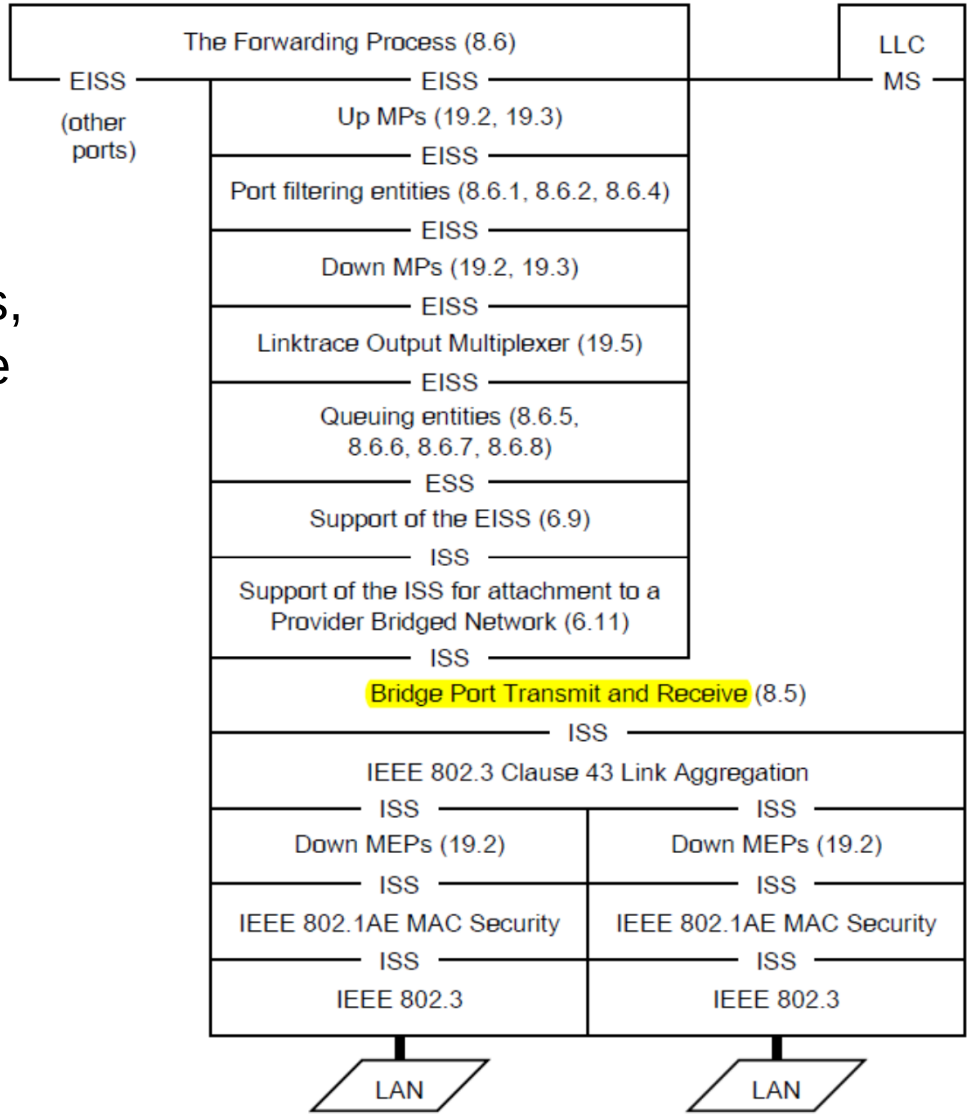
IEEE 802.1Q Bridge Port

- The MAC Relay Entity handles the media access method-independent functions of relaying frames among Bridge Ports. It uses the EISS (6.8, 6.9) provided by each Bridge Port
- Each Bridge Port also functions as an end station and shall provide the MAC Service to an LLC Entity that operates LLC Type 1 procedures to support protocol identification, multiplexing, and demultiplexing, for PDU transmission and reception by the Spanning Tree Protocol Entity and other higher layer entities

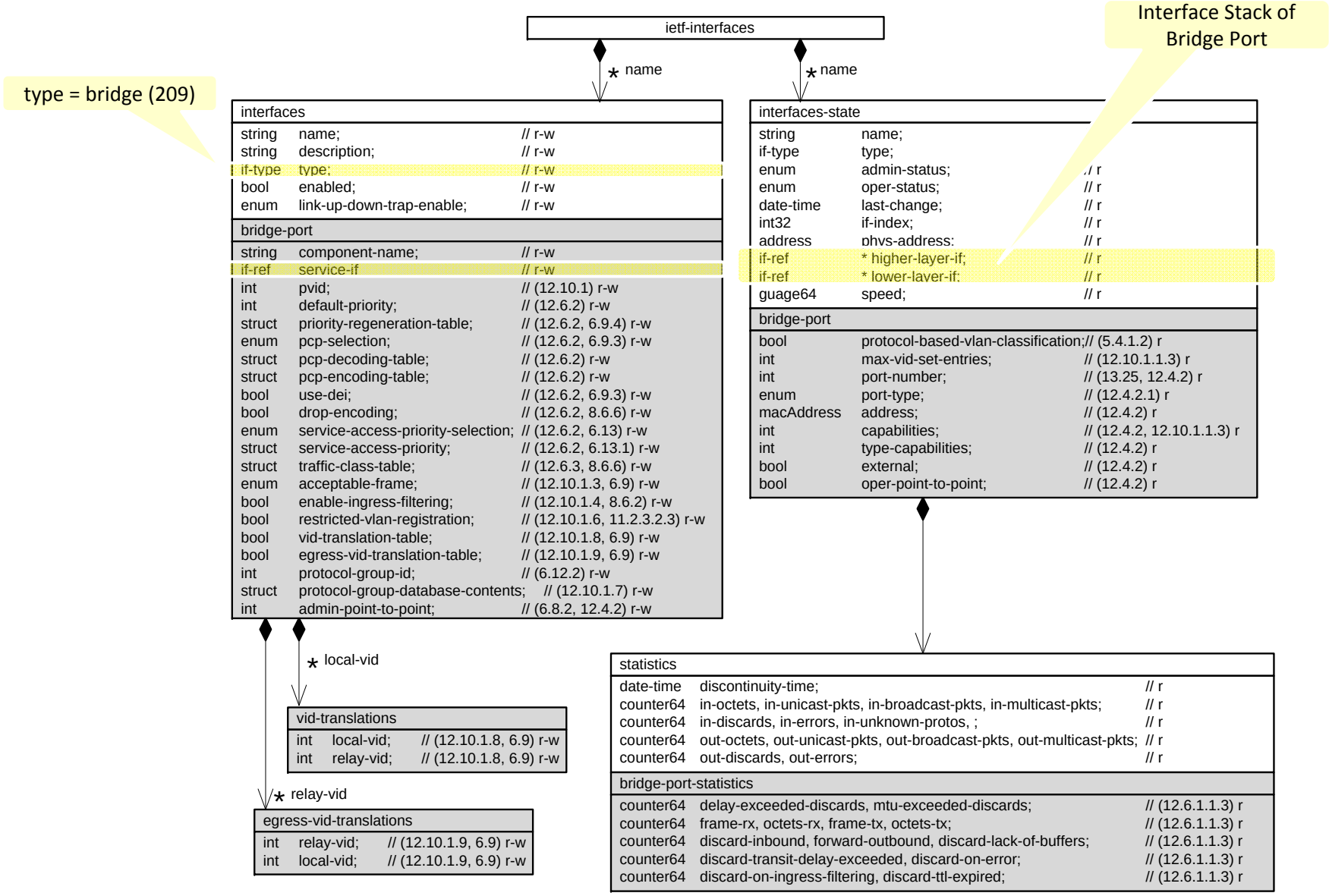


CFM Maintenance Point Placement

- CFM entities are specified as shims that make use of and provide the ISS or EISSS at SAPs within the network
- The relationships among MPs, and between the MPs and the other entities in a Bridge, are configurable



Introducing the Bridge Port Interface Model

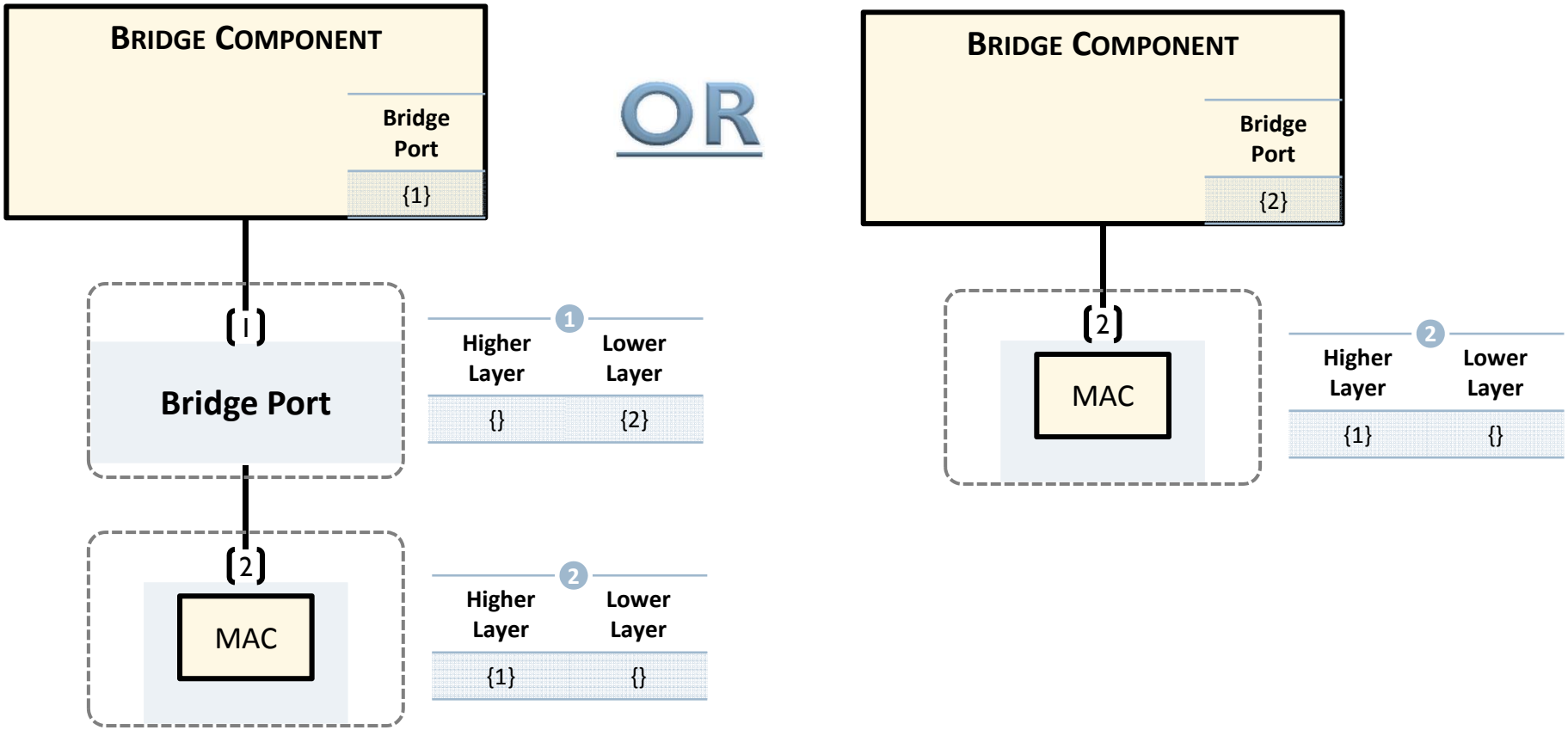


YANG Bridge Port Model Except

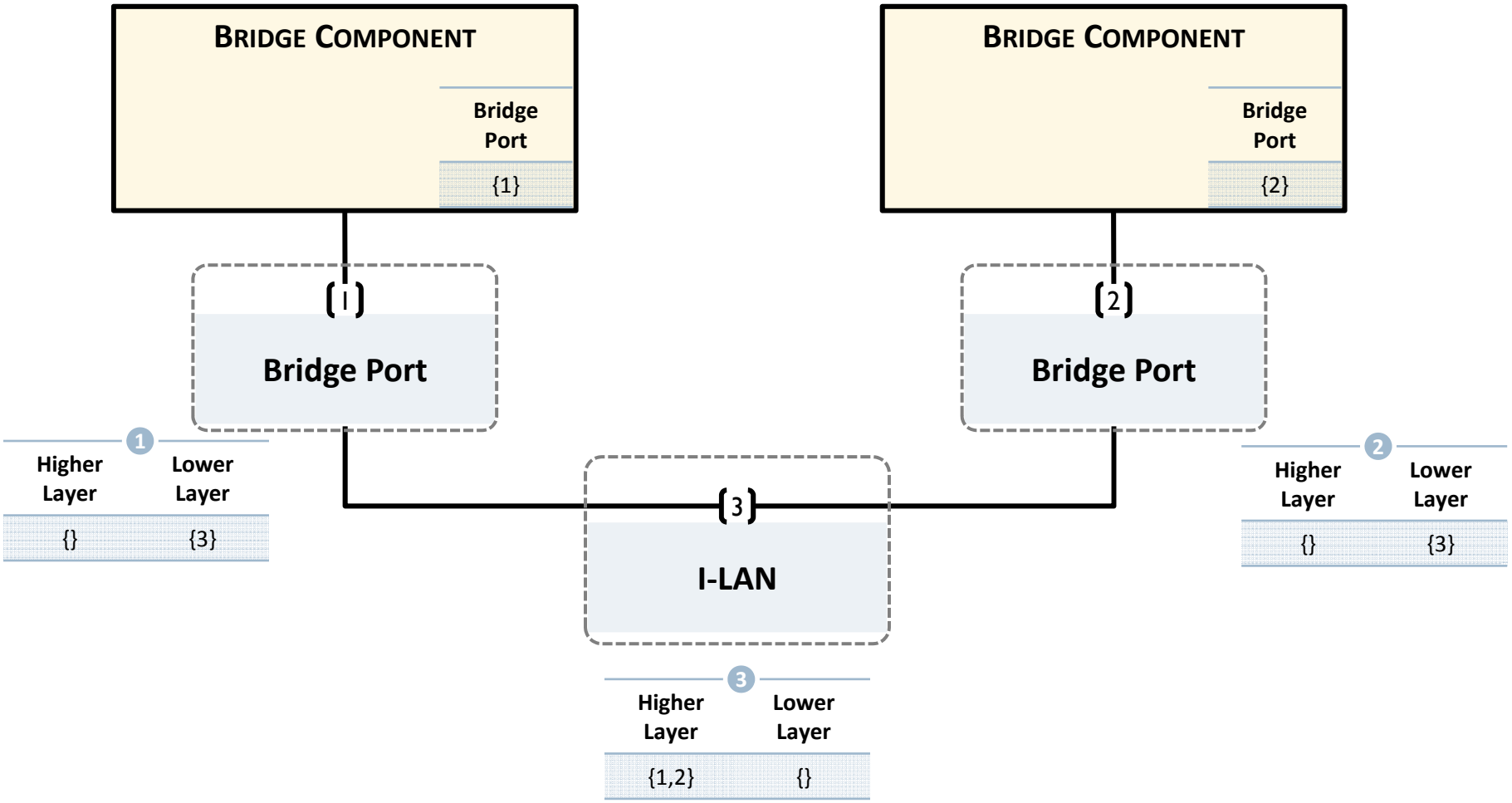
```
augment "/if:interfaces/if:interface" {
    when "/if:type = 'ianaif:bridge'{
      description
        "Applies when a Bridge interface";
    }
    description
      "Augment the interface model with the Bridge Port";
    container bridge-port {
      leaf component-name {
        type dot1qtypes:component-ref;
        description
          “Used to reference configured Component nodes.”;
      }
      :
      leaf service-if {
        type interface-ref;
        description
          “Reference to interfaces pointed to by the Bridge Port”;
      }
      :
    }
}
```

Interface Stack — Bridge Port

- The Bridge Port interface provides a pointer to a service interface
- The placement of CFM maintenance points (relative to other services) would suggest that a separate SAP between the Bridge Ports and actual interface is required

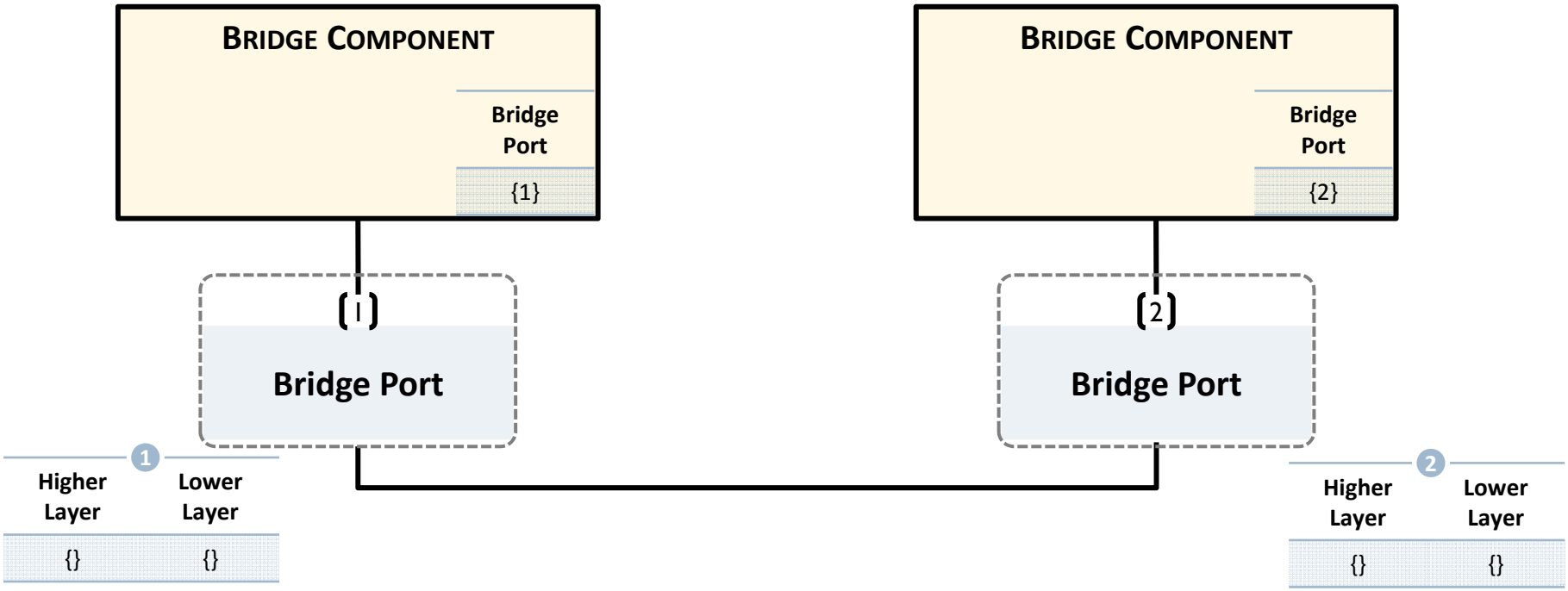


Interface Stack — Bridge Ports and Internal LAN

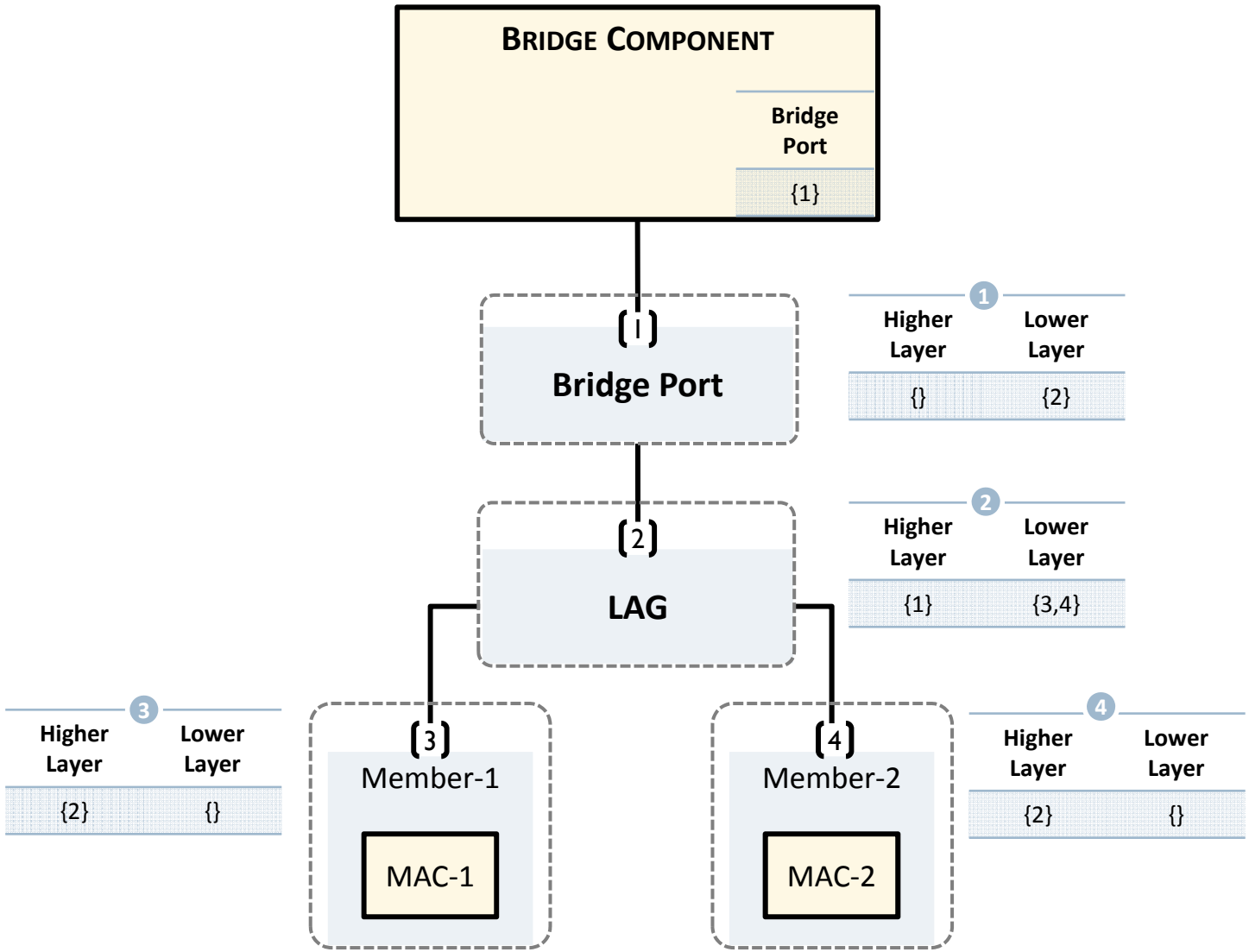


Interface Stack — Bridge Ports and Internal LAN

Alternative

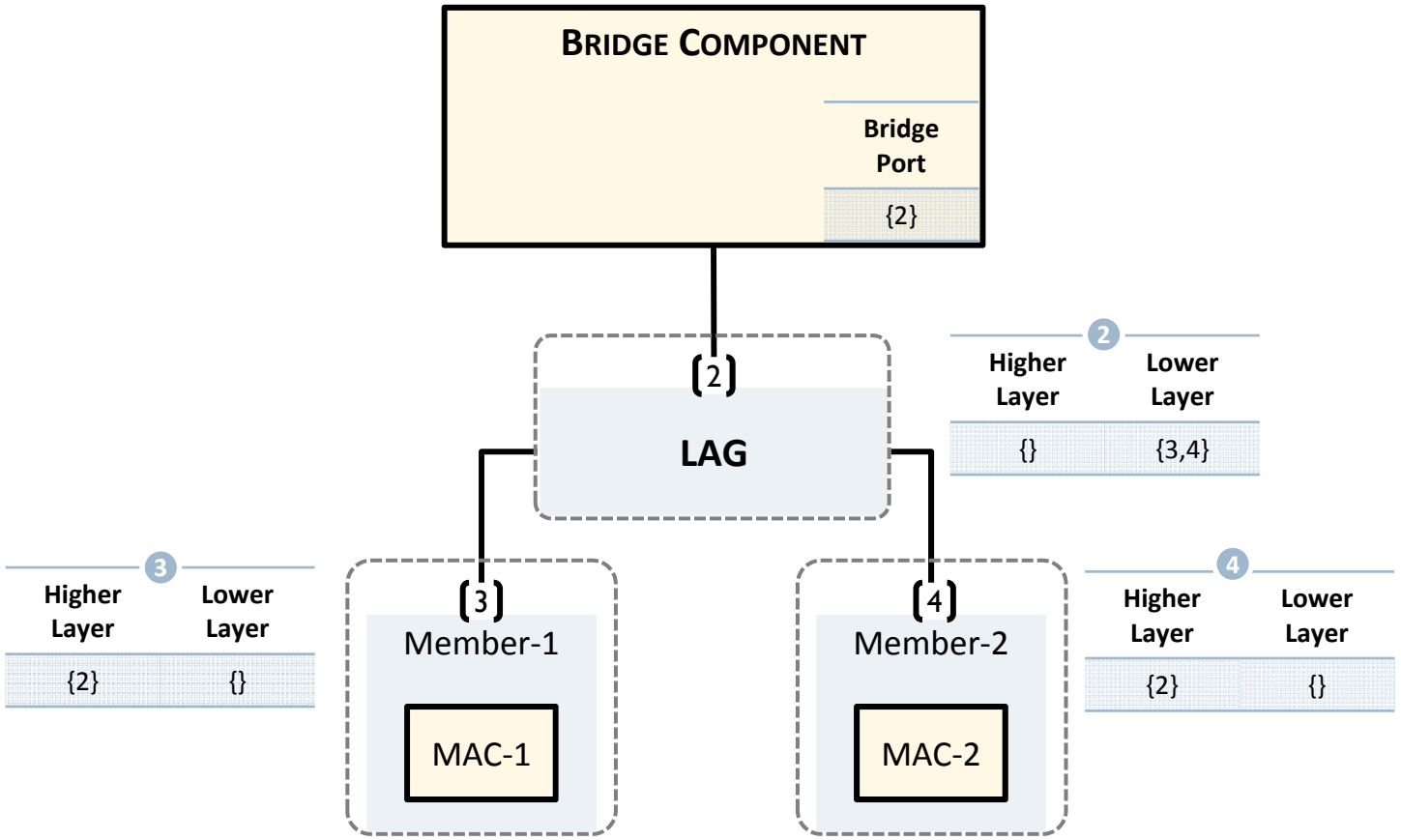


Interface Stack — Bridge Port (LAG)

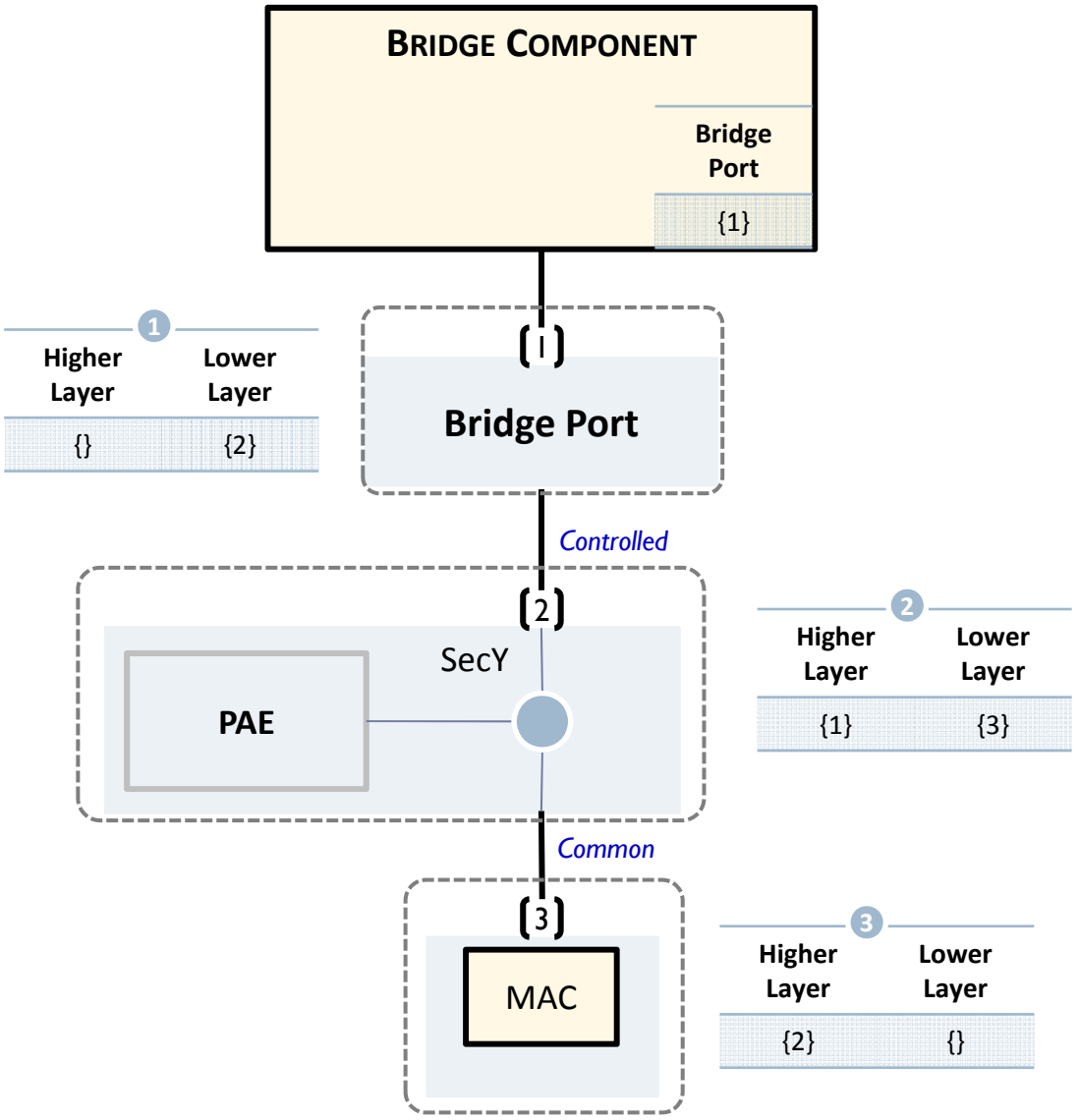


Interface Stack — Bridge Port (LAG)

Alternative

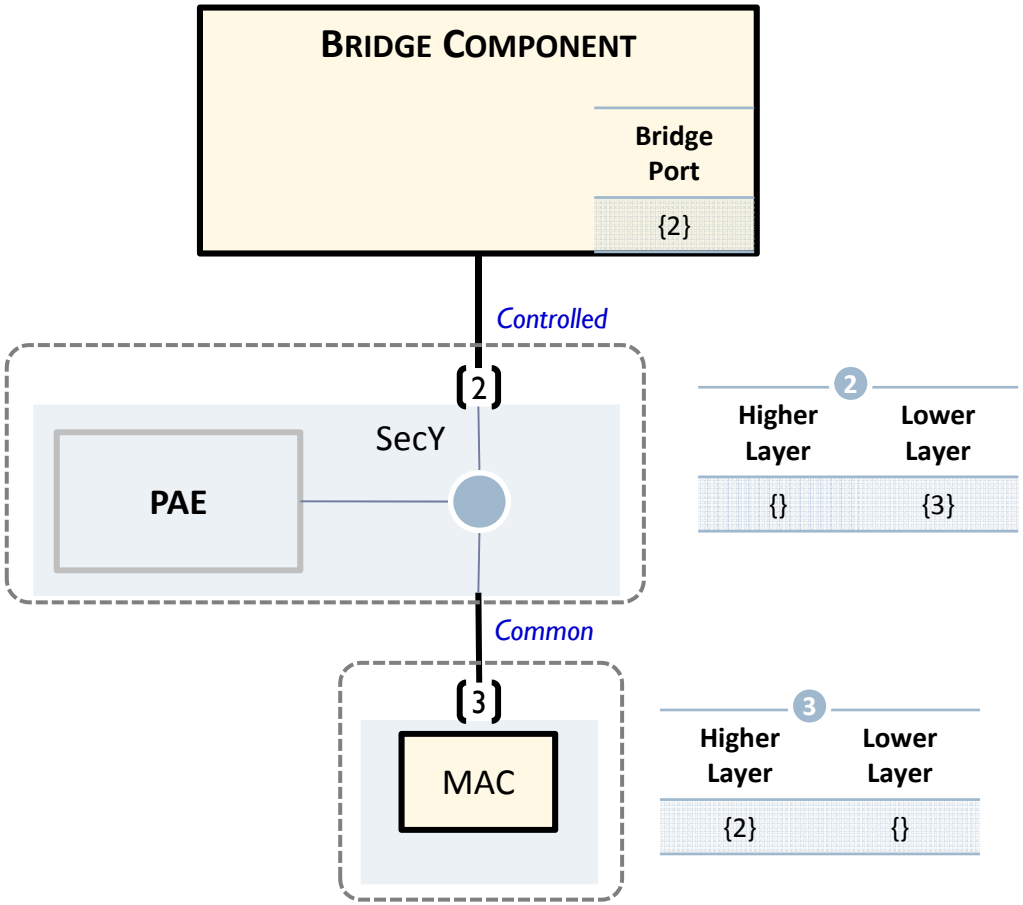


Interface Stack — Bridge Port with MACSec

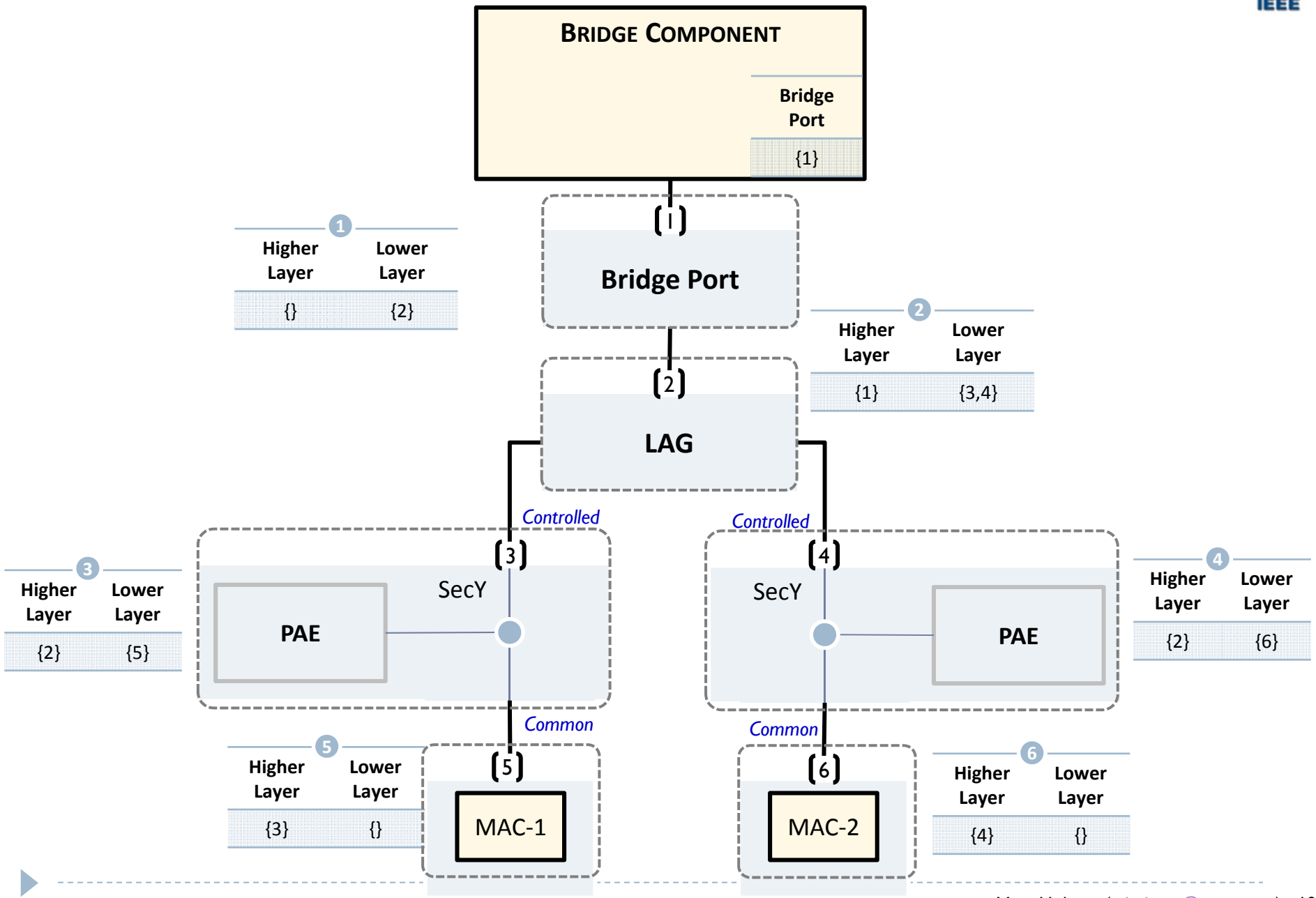


Interface Stack — Bridge Port with MACSec

Alternative

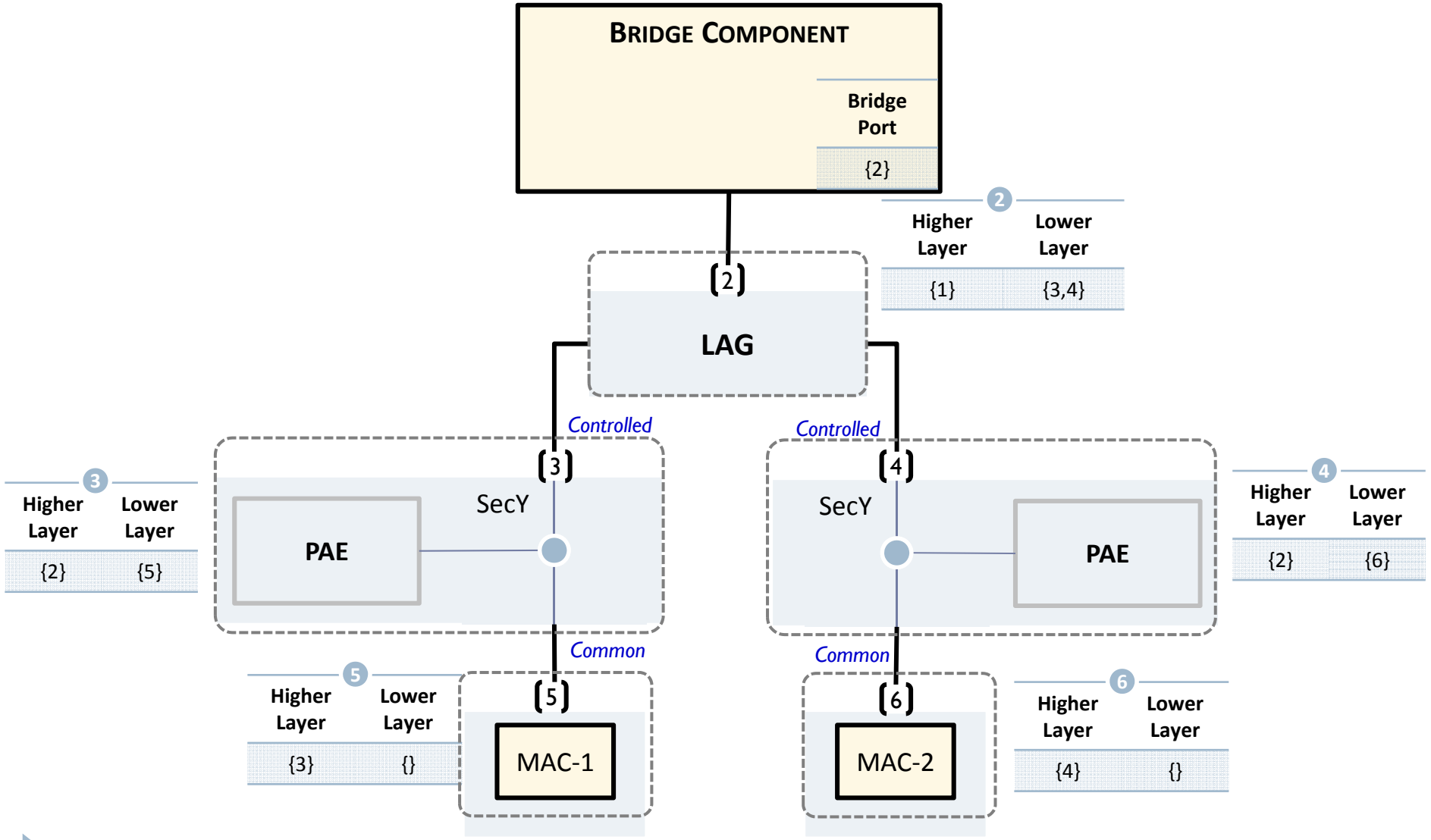


Interface Stack – Bridge Port (LAG) with MACSec

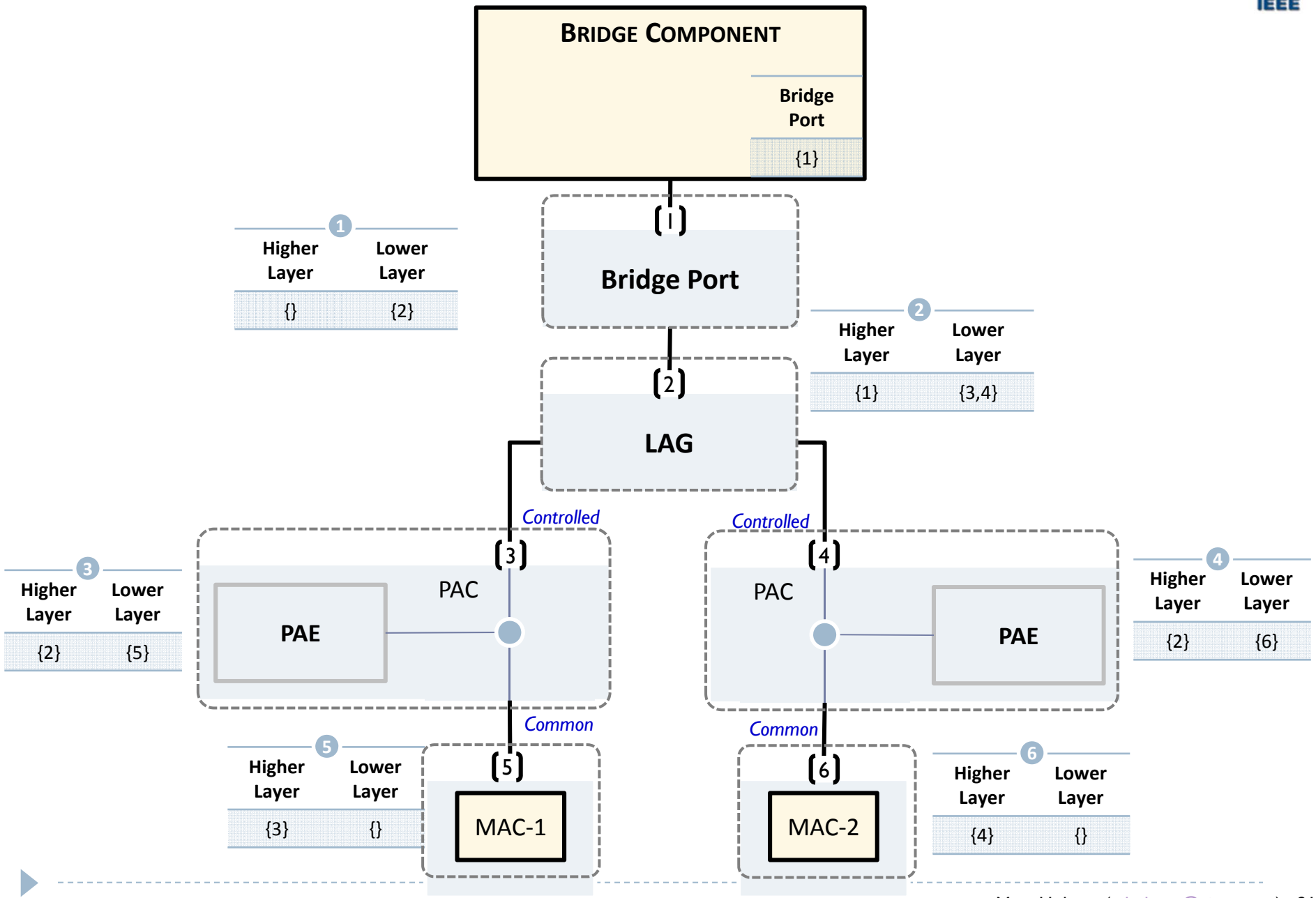


Interface Stack – Bridge Port (LAG) with MACSec

Alternative

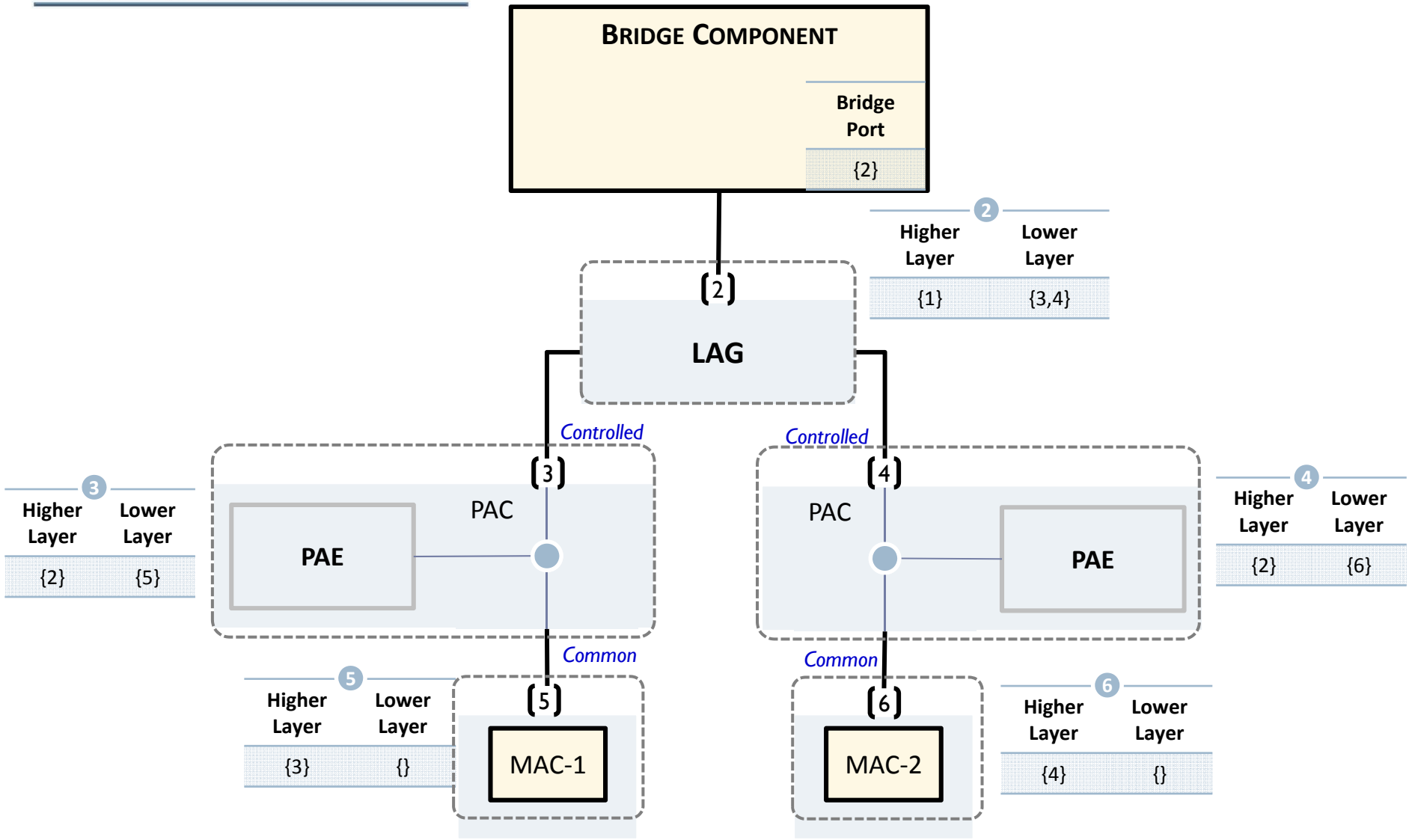


Interface Stack – Bridge Port (LAG) without MACSec



Interface Stack – Bridge Port (LAG) without MACSec

Alternative



NETCONF and YANG Example Configuration

Bridge Port

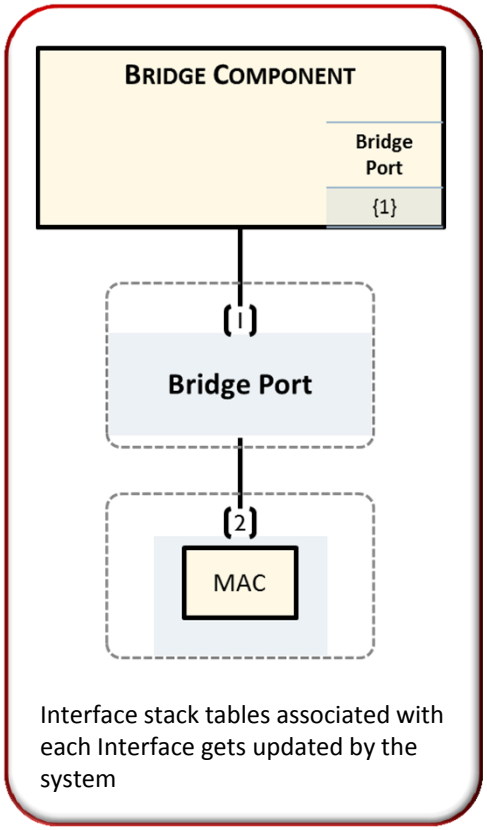
Bridge Port

```
<rpc message-id=”101” xmlns=”urn:ietf:params:xml:ns:yang:ietf-interfaces”>
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <top xmlns="http://example.com/schema/1.2/config">
        <interface xc:operation=“create”>
          <name>if-1</name>
          <type>bridge</type>
            :
        </interface>
        <interface xc:operation=“create”>
          <name>if-2</name>
          <type>ethernetCsmacd</type>
            :
        </interface>
      </top>
    </config>
  </edit-config>
</rpc>
```

- Interface specific configuration items

Bridge Port

```
<rpc message-id="101" xmlns="urn:ieee:params:xml:ns:yang:ieee-dot1q-bridge">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <top xmlns="http://example.com/schema/1.2/config">
        <bridges xc:operation="create">
          <bridge>
            <name>the-bridge</name>
              :
            <component>
              <name>the-component</name>
                :
            </component>
          </bridge>
          :
        </bridges>
        <interface>
          <name>if-1</name>
            :
          <bridge-port>
            <component-name>the-component</component-name>
            <service-if>if-2</service-if>
            :
          </bridge-port>
            :
        </interface>
      </top>
    </config>
  </edit-config>
</rpc>
```



Interface stack tables associated with each Interface gets updated by the system

NETCONF and YANG Example Configuration

Bridge Port (with 2 member LAG)

Bridge Port (with LAG)

```
<rpc message-id="101" xmlns="urn:ietf:params:xml:ns:yang:ietf-interfaces">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <top xmlns="http://example.com/schema/1.2/config">
        <interface xc:operation="create">
          <name>if-1</name>
          <type>bridge</type>
            :
        </interface>
        <interface xc:operation="create">
          <name>if-2</name>
          <type>ieee8023adLag</type>
            :
        </interface>
        <interface xc:operation="create">
          <name>if-3</name>
          <type>ethernetCsmacd</type>
            :
        </interface>
        <interface xc:operation="create">
          <name>if-4</name>
          <type>ethernetCsmacd</type>
            :
        </interface>
      </top>
    </config>
  </edit-config>
</rpc>
```

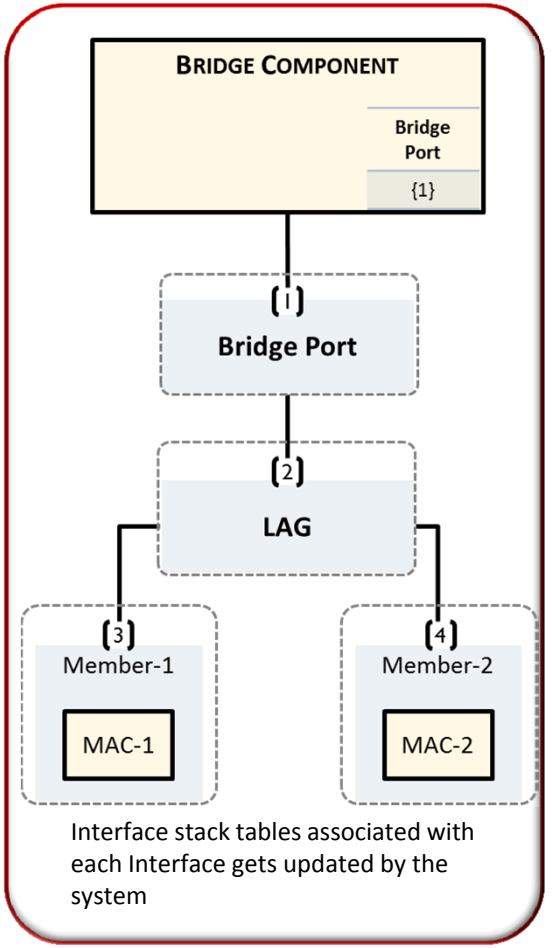
Bridge Port (with LAG)

```
<rpc message-id="101" xmlns="urn:ieee:params:xml:ns:yang:ieee-dot1ax">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <top xmlns="http://example.com/schema/1.2/config">
        <interface>
          <name>if-3</name>
          :
        </interface>
        <interface>
          <name>if-4</name>
          :
        </interface>
        <interface>
          <name>if-2</name>
          <members>
            <member>if-3</member>
            <member>if-4</member>
          </members>
          :
        </interface>
      </top>
    </config>
  </edit-config>
</rpc>
```

- LAG member specific configuration items
- Link Aggregation Group specific configuration items

Bridge Port (with LAG)

```
<rpc message-id="101" xmlns="urn:ieee:params:xml:ns:yang:ieee-dot1q-bridge">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <top xmlns="http://example.com/schema/1.2/config">
        <bridges xc:operation="create">
          <bridge>
            <name>my-bridge</name>
              :
            <component>
              <name>the-component</name>
                :
            </component>
          </bridge>
          :
        </bridges>
        <interface>
          <name>if-1</name>
            :
          <bridge-port>
            <component-name>the-component</component-name>
            <service-if>if-2</service-if>
            :
          </bridge-port>
            :
        </interface>
      </top>
    </config>
  </edit-config>
</rpc>
```



NETCONF and YANG Example Configuration

Bridge Port (with MACSec)

Bridge Port (with MACSec)

```
<rpc message-id="101" xmlns="urn:ietf:params:xml:ns:yang:ietf-interfaces">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <top xmlns="http://example.com/schema/1.2/config">
        <interface xc:operation="create">
          <name>if-1</name>
          <type>bridge</type>
            :
        </interface>
        <interface xc:operation="create">
          <name>if-2</name>
          <type>macSecControlledIF</type>
            :
        </interface>
        <interface xc:operation="create">
          <name>if-3</name>
          <type>ethernetCsmacd</type>
            :
        </interface>
      </top>
    </config>
  </edit-config>
</rpc>
```

Bridge Port (with MACSec)

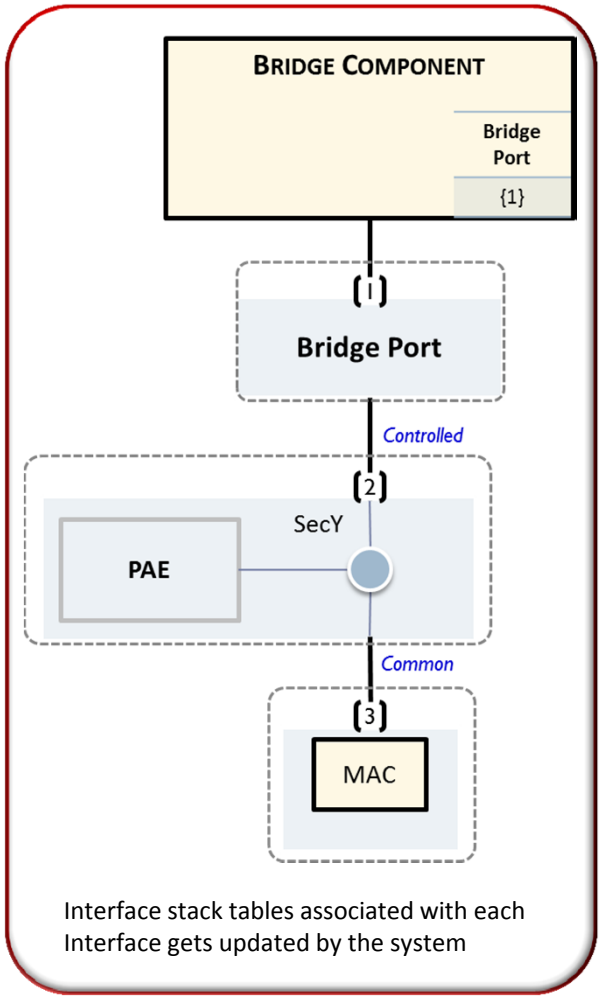
```
<rpc message-id="101" xmlns="urn:ieee:params:xml:ns:yang:ieee-dot1x">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <top xmlns="http://example.com/schema/1.2/config">
        <system>
          <pae-system>
            <name>my-pae-system</name>
            :
          </pae-system>
          :
        </system>
        <interface>
          <name>if-2</name>
          <pae-system>my-pae-system</pae-system>
          :
        </interface>
      </top>
    </config>
  </edit-config>
</rpc>
```

- PAE System specific configuration items

- PAE specific configuration items

Bridge Port (with MACSec)

```
<rpc message-id="101" xmlns="urn:ieee:params:xml:ns:yang:ieee-dot1q-bridge">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <top xmlns="http://example.com/schema/1.2/config">
        <bridges xc:operation="create">
          <bridge>
            <name>the-bridge</name>
              :
            <component>
              <name>the-component</name>
                :
            </component>
          </bridge>
          :
        </bridges>
        <interface>
          <name>if-1</name>
            :
          <bridge-port>
            <component-name>the-component</component-name>
            <service-if>if-2</service-if>
            :
          </bridge-port>
            :
        </interface>
      </top>
    </config>
  </edit-config>
</rpc>
```



Interface stack tables associated with each Interface gets updated by the system

NETCONF and YANG Example Configuration

Bridge Port (with 2 member LAG and MACSec)

Bridge Port (with LAG plus MACSec)

```
<rpc message-id="101" xmlns="urn:ietf:params:xml:ns:yang:ietf-interfaces">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <top xmlns="http://example.com/schema/1.2/config">
        <interface xc:operation="create">
          <name>if-1</name>
          <type>bridge</type>
            :
        </interface>
        <interface xc:operation="create">
          <name>if-2</name>
          <type>ieee8023adLag</type>
            :
        </interface>
        <interface xc:operation="create">
          <name>if-3</name>
          <type>macSecControlledIF</type>
            :
        </interface>
        <interface xc:operation="create">
          <name>if-4</name>
          <type>macSecControlledIF</type>
            :
        </interface>
```

Bridge Port (with LAG plus MACSec)

```
        <interface xc:operation="create">
          <name>if-5</name>
          <type>ethernetCsmacd</type>
            :
        </interface>
        <interface xc:operation="create">
          <name>if-6</name>
          <type>ieee8023adLag</type>
            :
        </interface>
      </top>
    </config>
  </edit-config>
</rpc>
```

Bridge Port (with LAG plus MACSec)

```
<rpc message-id="101" xmlns="urn:ieee:params:xml:ns:yang:ieee-dot1ax">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <top xmlns="http://example.com/schema/1.2/config">
        <interface>
          <name>if-3</name>
          :
        </interface>
        <interface>
          <name>if-4</name>
          :
        </interface>
        <interface>
          <name>if-2</name>
          <members>
            <member>if-3</member>
            <member>if-4</member>
          </members>
          :
        </interface>
      </top>
    </config>
  </edit-config>
</rpc>
```

- LAG member specific configuration items

- Link Aggregation Group specific configuration items

Bridge Port (with LAG plus MACSec)

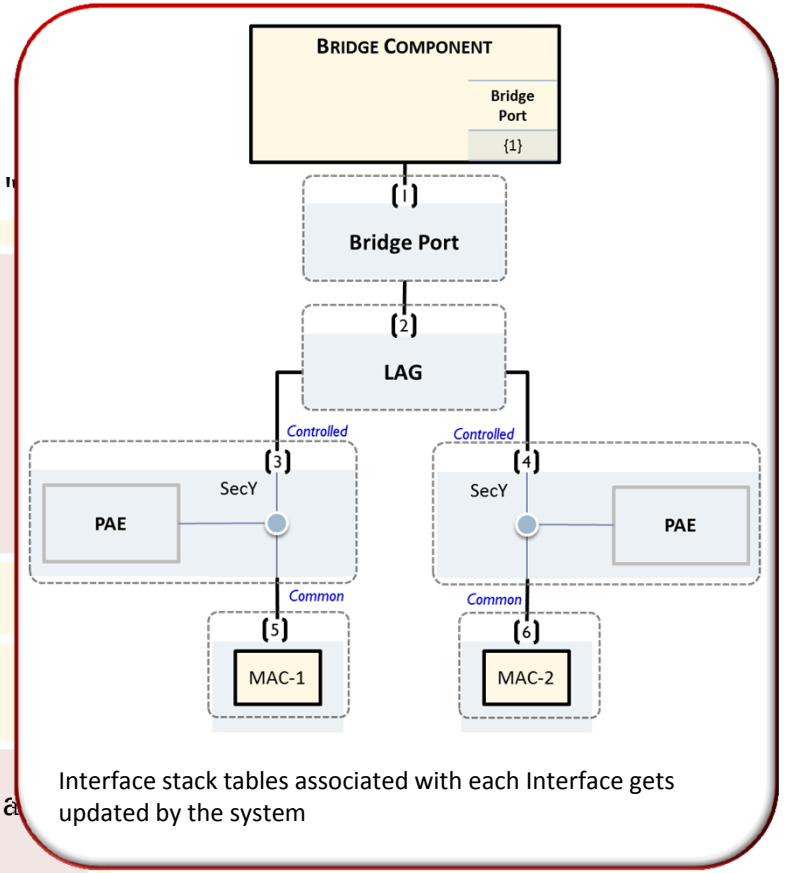
```
<rpc message-id="101" xmlns="urn:ieee:params:xml:ns:yang:ieee-dot1x">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <top xmlns="http://example.com/schema/1.2/config">
        <system>
          <pae-system>
            <name>my-pae-system</name>
            :
          </pae-system>
          :
        </system>
        <interface>
          <name>if-3</name>
          <pae-system>my-pae-system</pae-system>
          :
        </interface>
        <interface>
          <name>if-4</name>
          <pae-system>my-pae-system</pae-system>
          :
        </interface>
      </top>
    </config>
  </edit-config>
</rpc>
```

- PAE System specific configuration items

- PAE specific configuration items

Bridge Port (with LAG plus MACSec)

```
<rpc message-id="101" xmlns="urn:ieee:params:xml:ns:yang:ieee-dot1q-bridge">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <top xmlns="http://example.com/schema/1.2/config"
        <bridges xc:operation="create">
          <bridge>
            <name>my-bridge</name>
              :
            <component>
              <name>the-component</name>
                :
            </component>
          </bridge>
          :
        </bridges>
        <interface>
          <name>if-1</name>
            :
          <bridge-port>
            <component-name>the-component</component-na
            <service-if>if-2</service-if>
            :
          </bridge-port>
            :
        </interface>
      </top>
    </config>
  </edit-config>
</rpc>
```



Interface stack tables associated with each Interface gets updated by the system