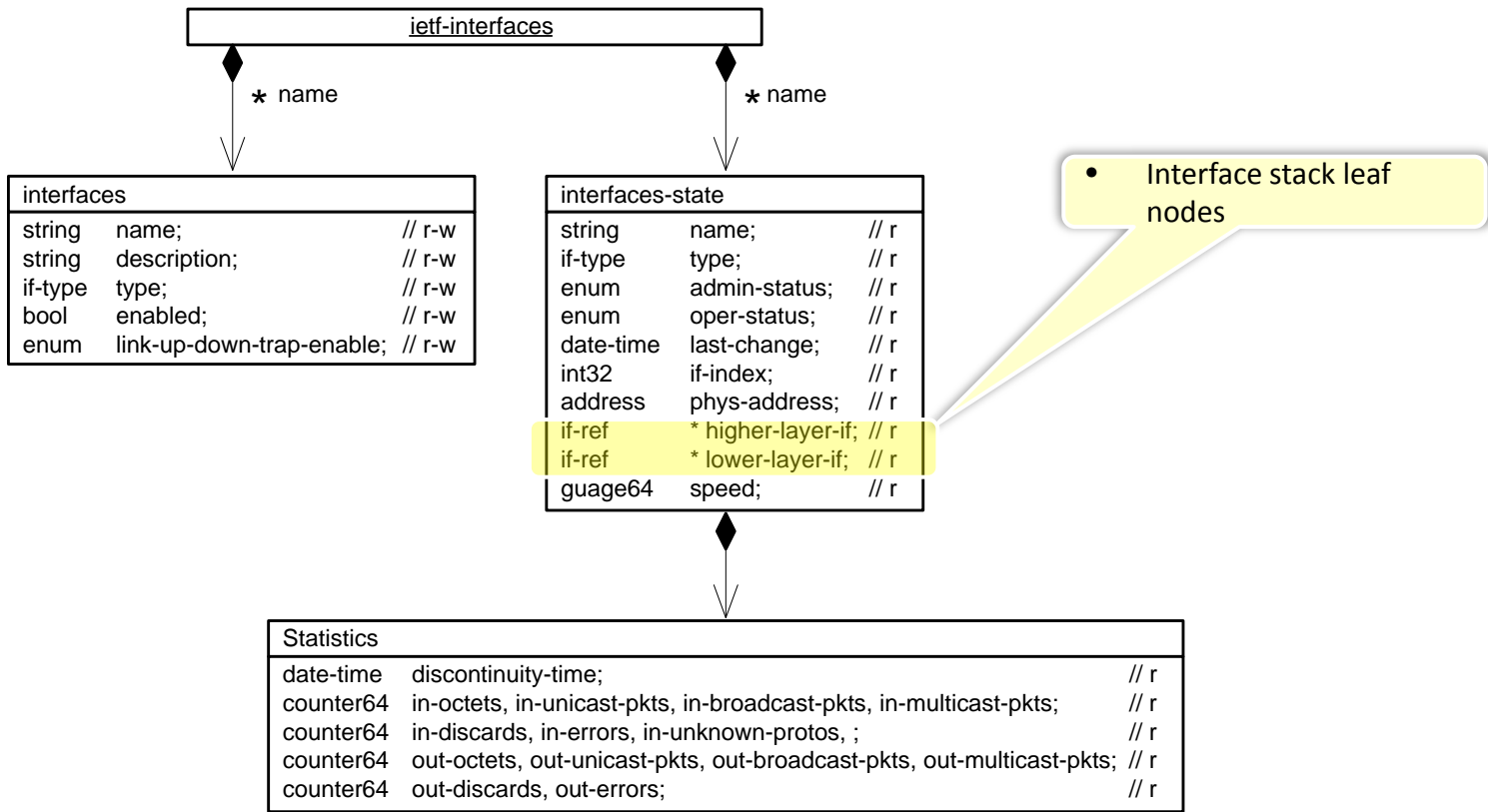


IEEE 802.1Q YANG Interface  
Framework in support of Link  
Aggregation (802.1AX), Security  
(802.1X), and CFM (802.1ag)

Marc Holness  
Version 1.2  
10 July 2016

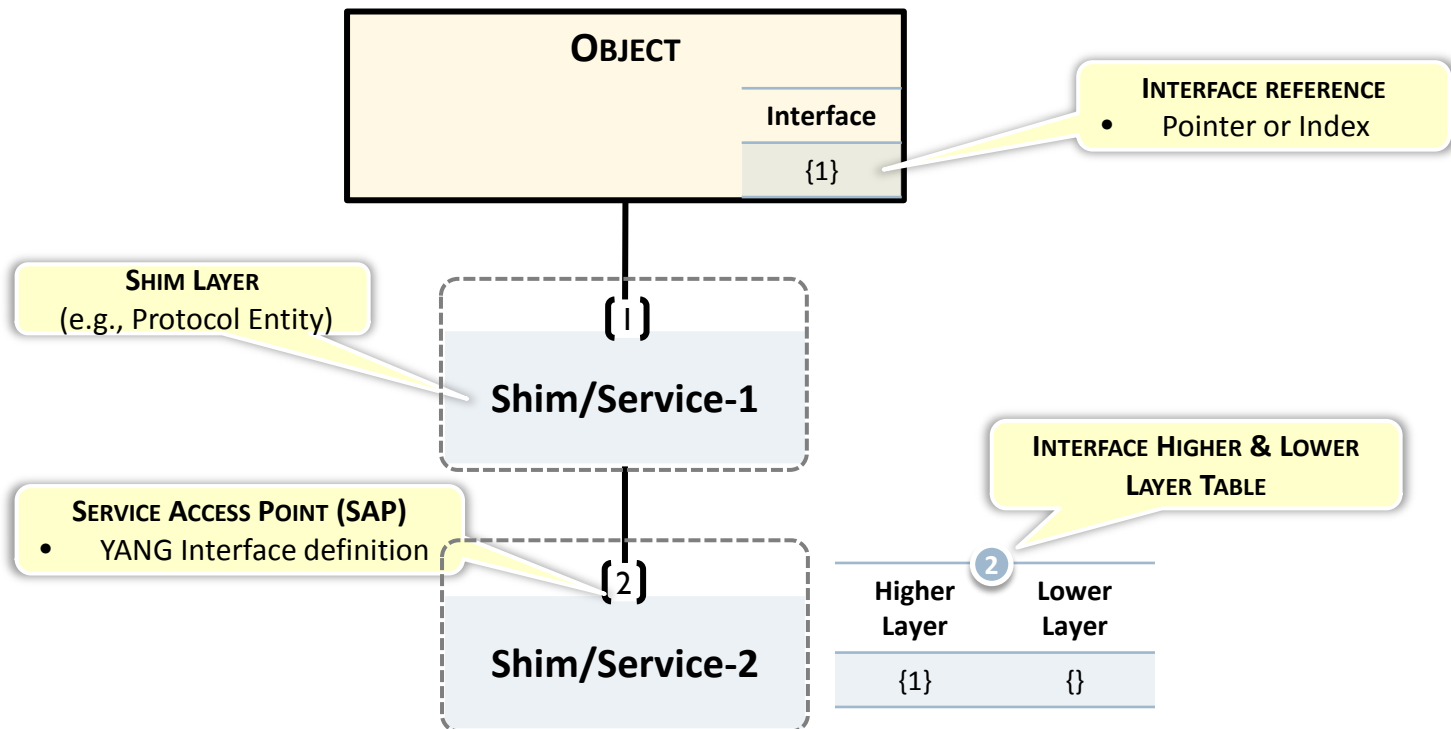
# IETF Interface Management Model

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

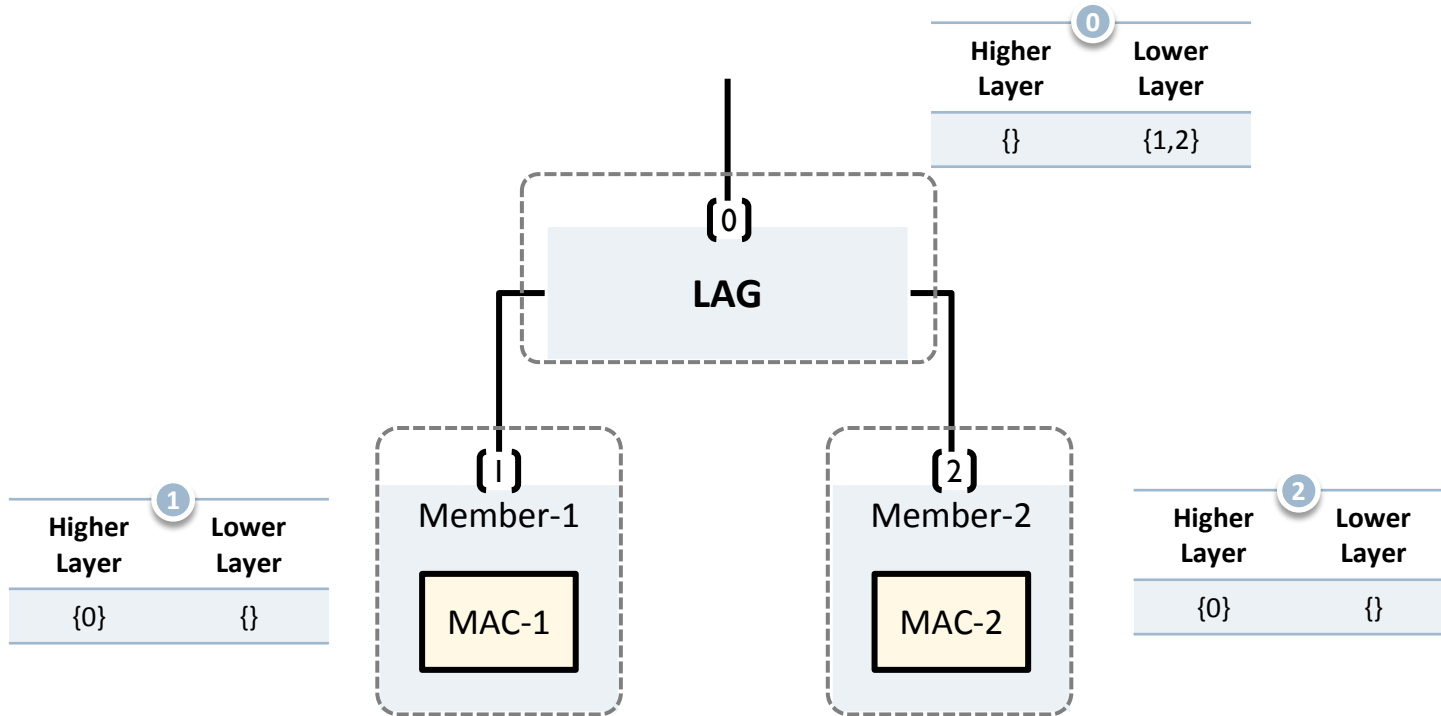


# Interface Stack Diagram Representation

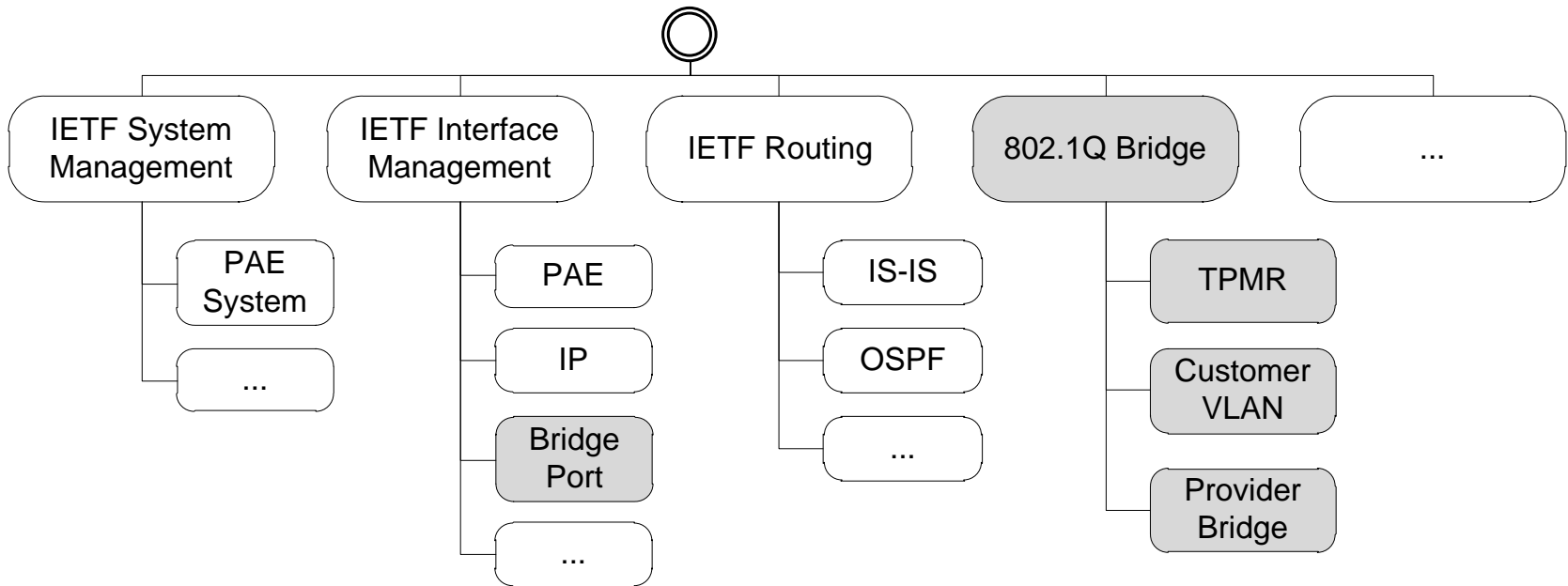
- A SAP is an abstraction and does not necessarily correspond to any concrete realization within a system
- The entities that support a particular SAP compose an interface stack
- Each YANG Interface definition contains an interface stack table



# Interface Stack — LAG



# IEEE 802.1 Objects Within YANG Object Hierarchy

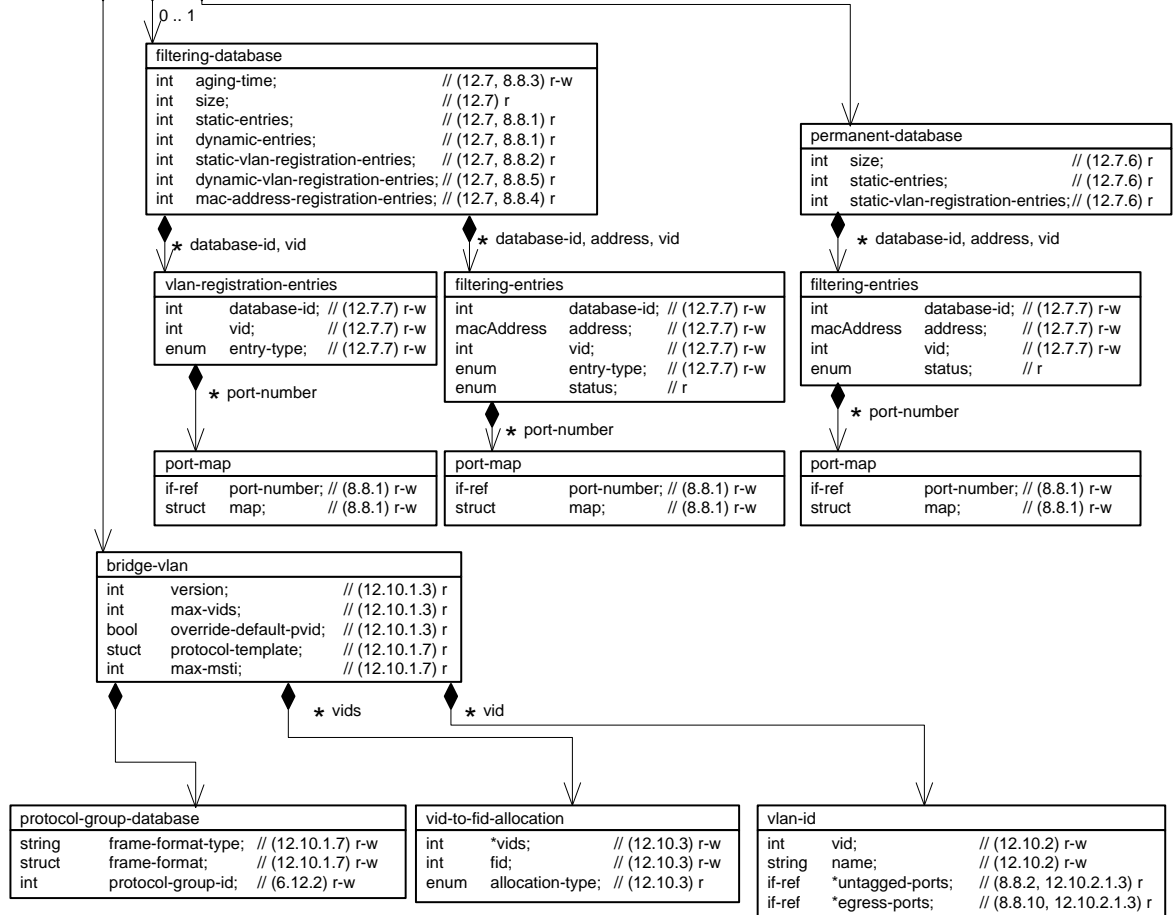


# Introducing the [Generic] Bridge YANG Model

* bridge		
string	name;	// (12.4) r-w
macAddress	address;	// (12.4) r-w
enum	type;	// r-w
int	ports;	// (12.4) r
counter32	up-time;	// (12.4) r
int	components;	// r

component		
string	name;	// r-w
int	id;	// (12.3) r-w
enum	type;	// (12.3) r-w
macAddress	address;	// (8.13.8, 13.24) r-w
bool	traffic-class-enabled;	// (12.4.1.5.1) r-w
bool	mrrp-enabled-status;	// (12.4.1.5.1)r-w
int	ports;	// (12.4.1.1.3) r
if-ref	*bridge-port	// r
struct	capabilities	// (12.4.1.5.2) r

The list of Bridge Ports



# IEEE 802.1Q Bridge Port

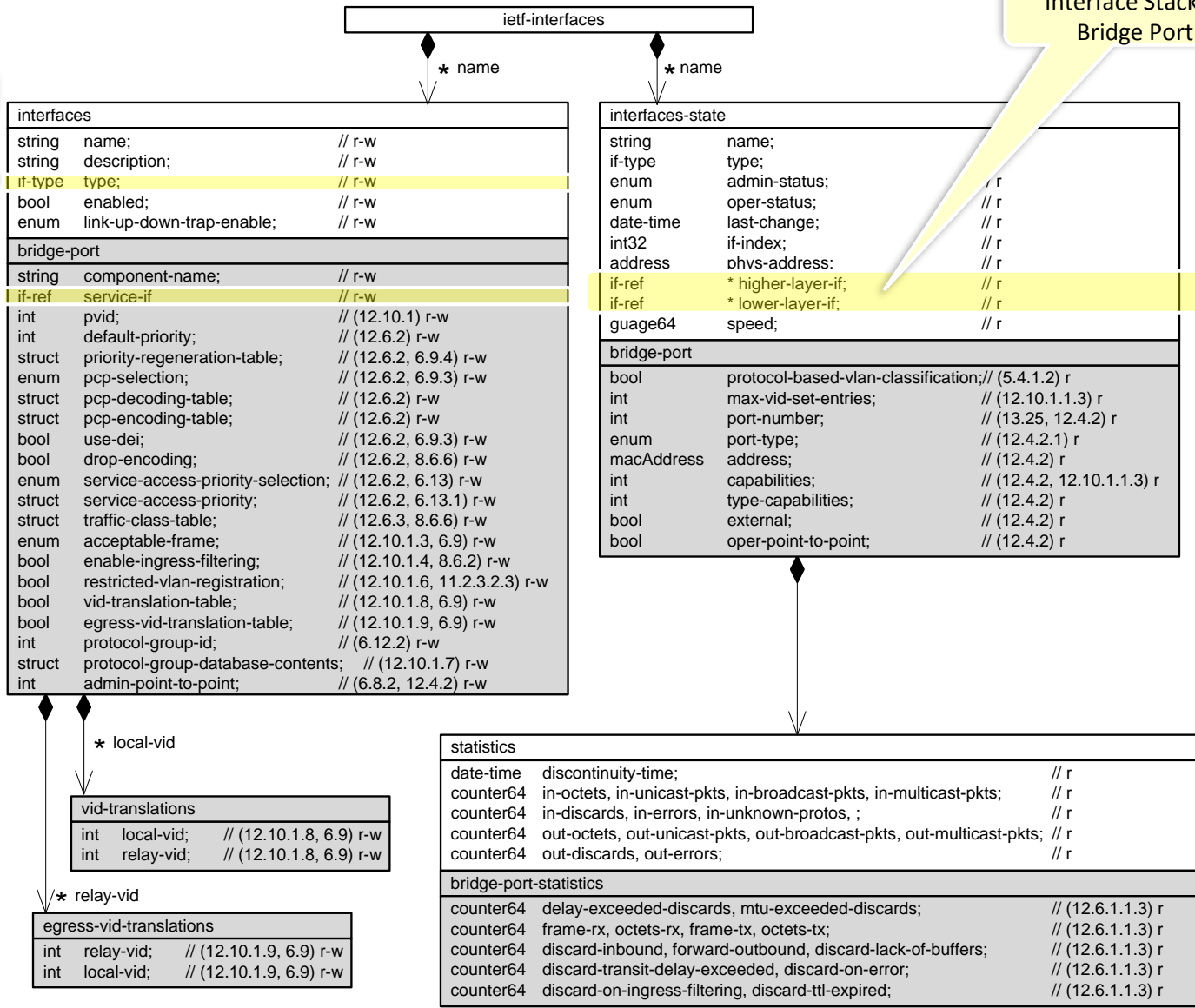
- Each Bridge Port is associated with one Interface, and in most situations, each Bridge Port is associated with a different interface
- However, there are situations in which multiple Bridge Ports are associated with the same interface
  - For example, several Bridge Ports can each correspond one-to-one 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

# Introducing the Bridge Port Interface Model



type = bridge (209)

Interface Stack of Bridge Port





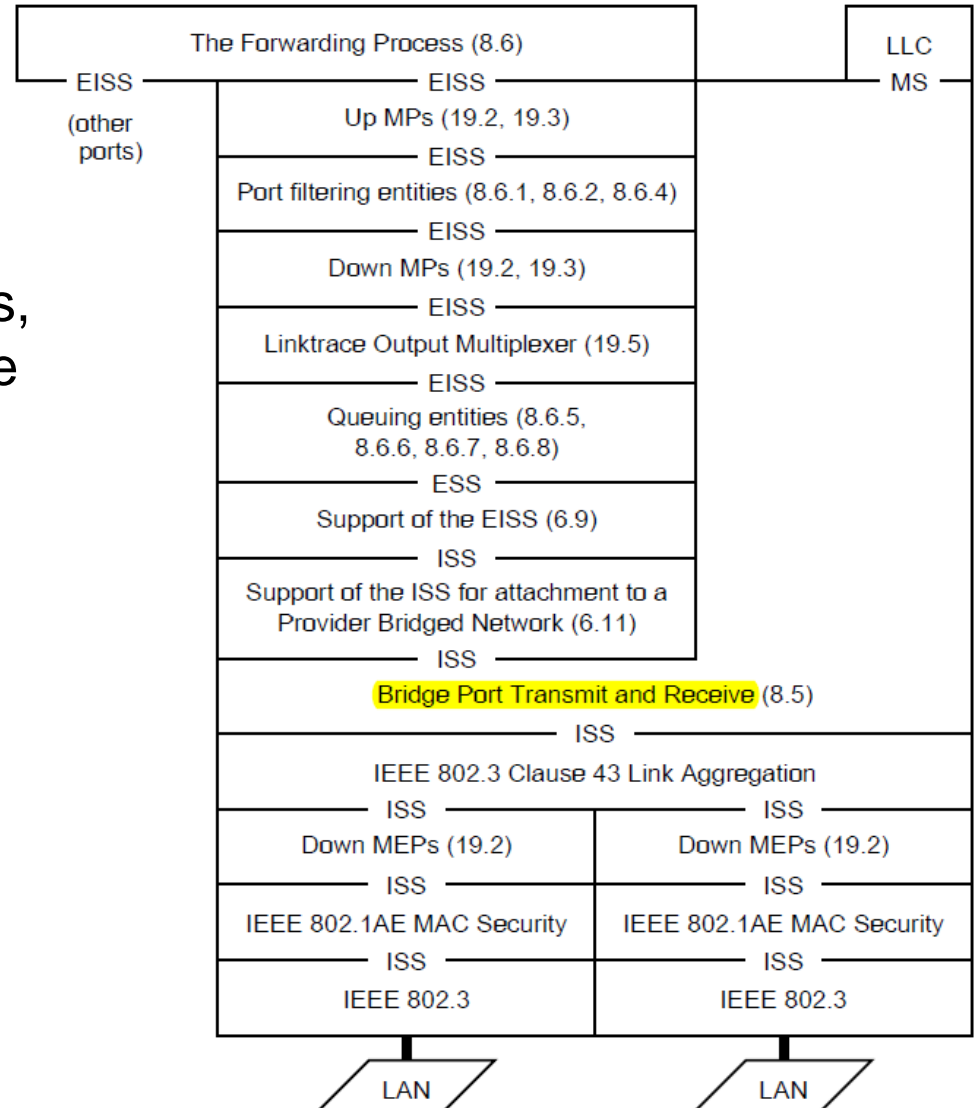
# YANG Bridge Port Model Except



```
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 dot1qt-types: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";
    }
    :
  }
}
```

# CFM Maintenance Point Placement

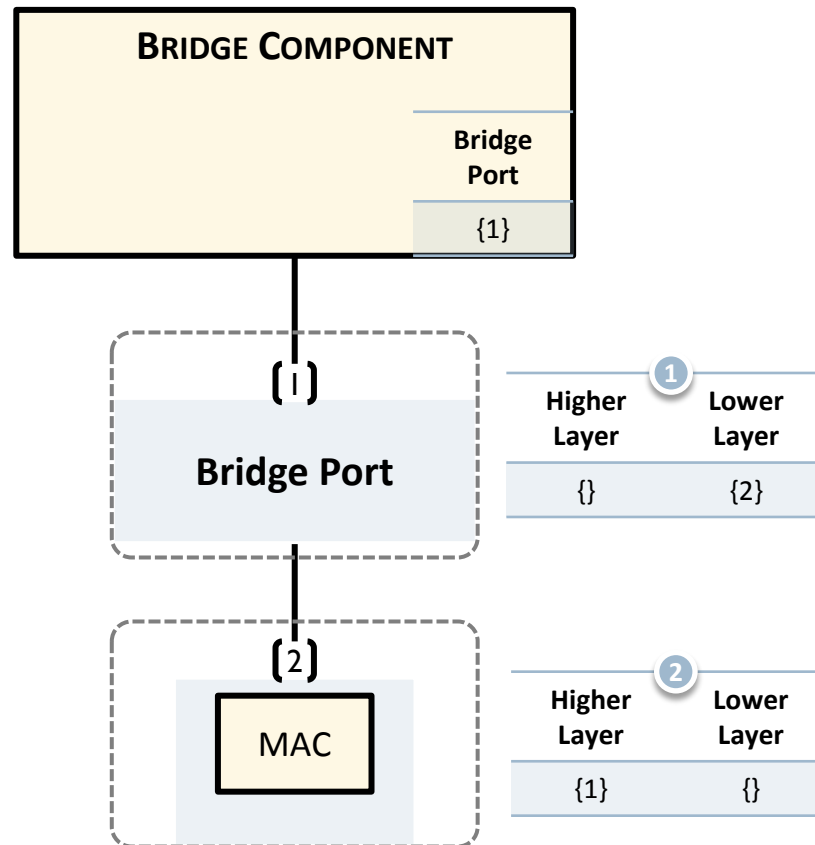
- CFM entities are specified as shims that make use of and provide the ISS or EISSS at SAPs within the network
- The relationships among MPs, and between the MPs and the other entities in a Bridge, are configurable



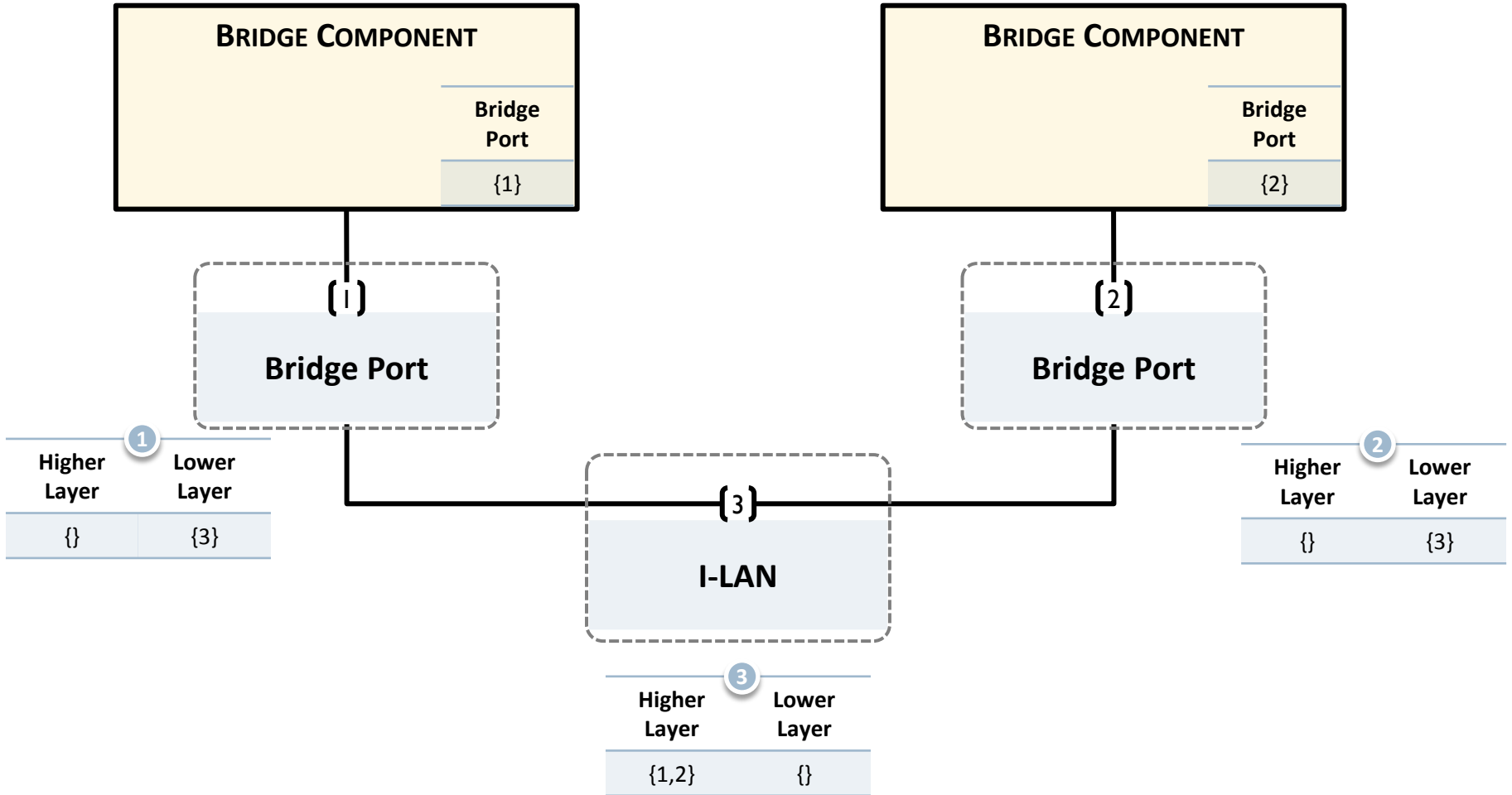
# Interface Stack — Bridge Port



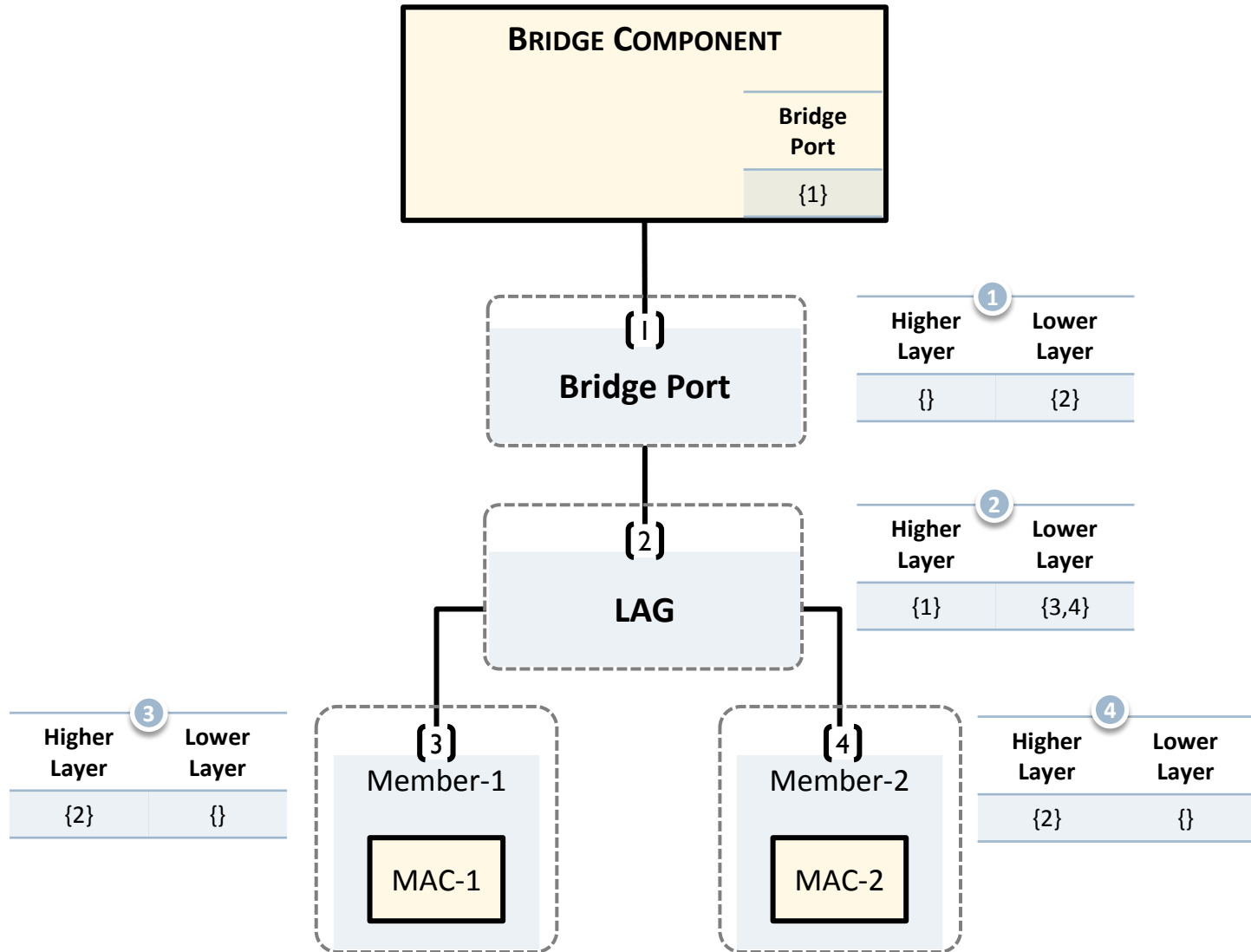
- The Bridge Port interface provides a pointer to a service interface
- The placement of CFM maintenance points (relative to other services) would suggest that a separate SAP between the Bridge Ports and actual interface is required



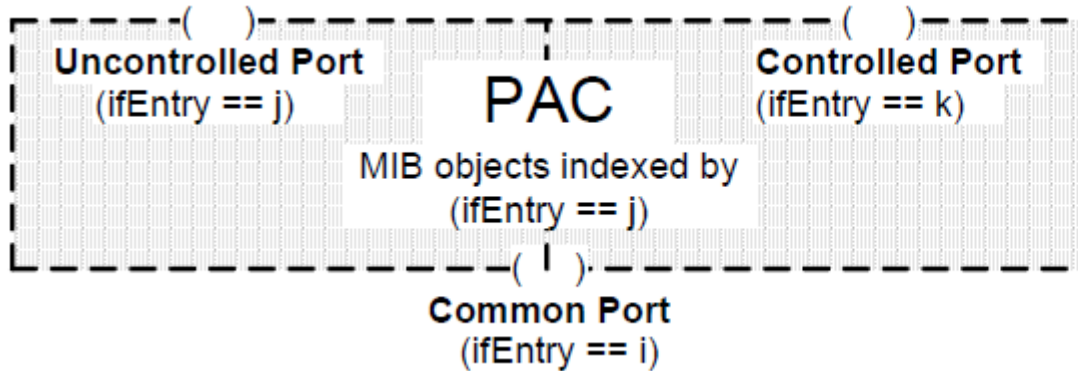
# Interface Stack — Bridge Ports and Internal LAN



# Interface Stack — Bridge Port (LAG)



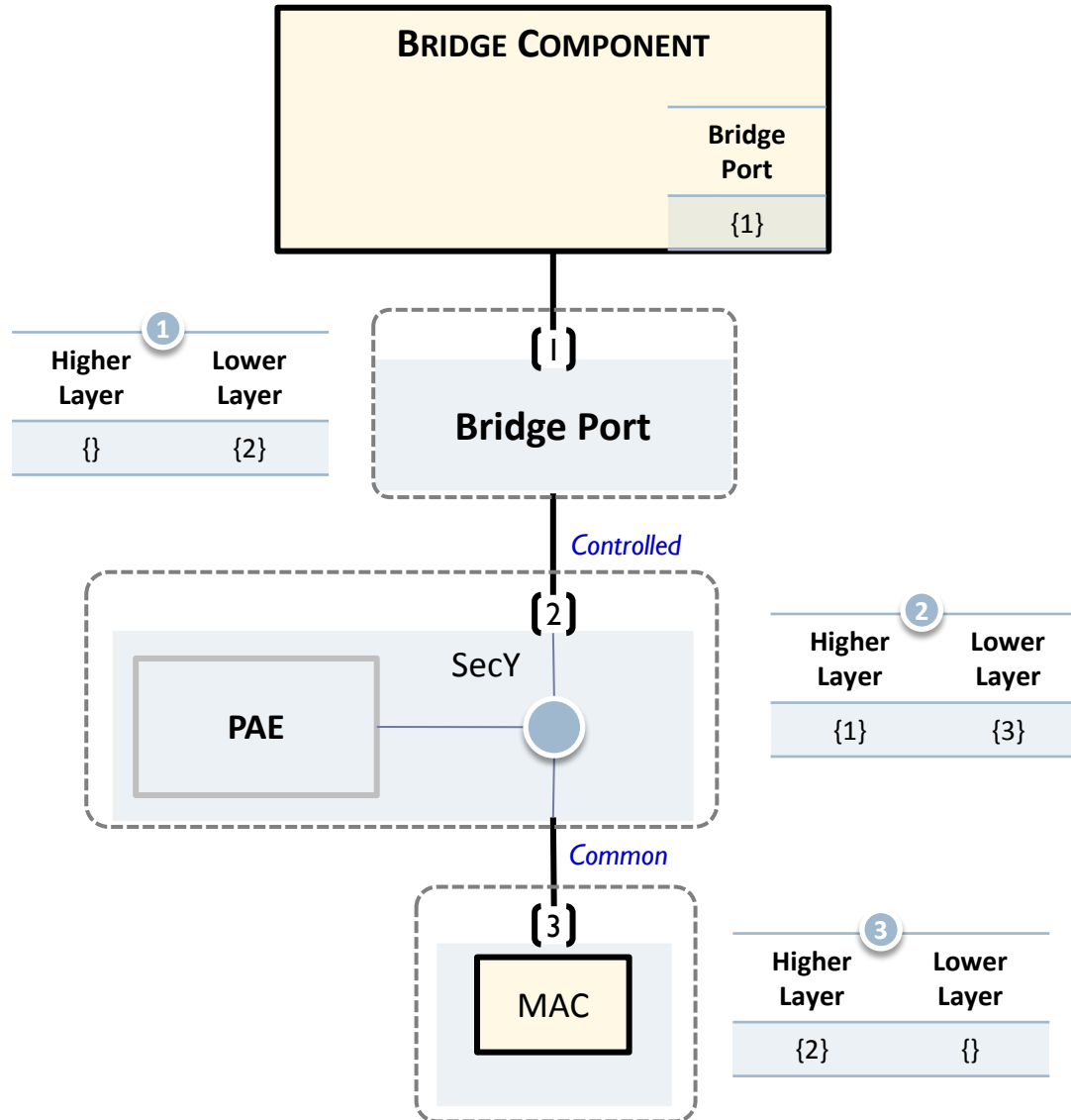
# MIB PAC/SecY Shim Layer



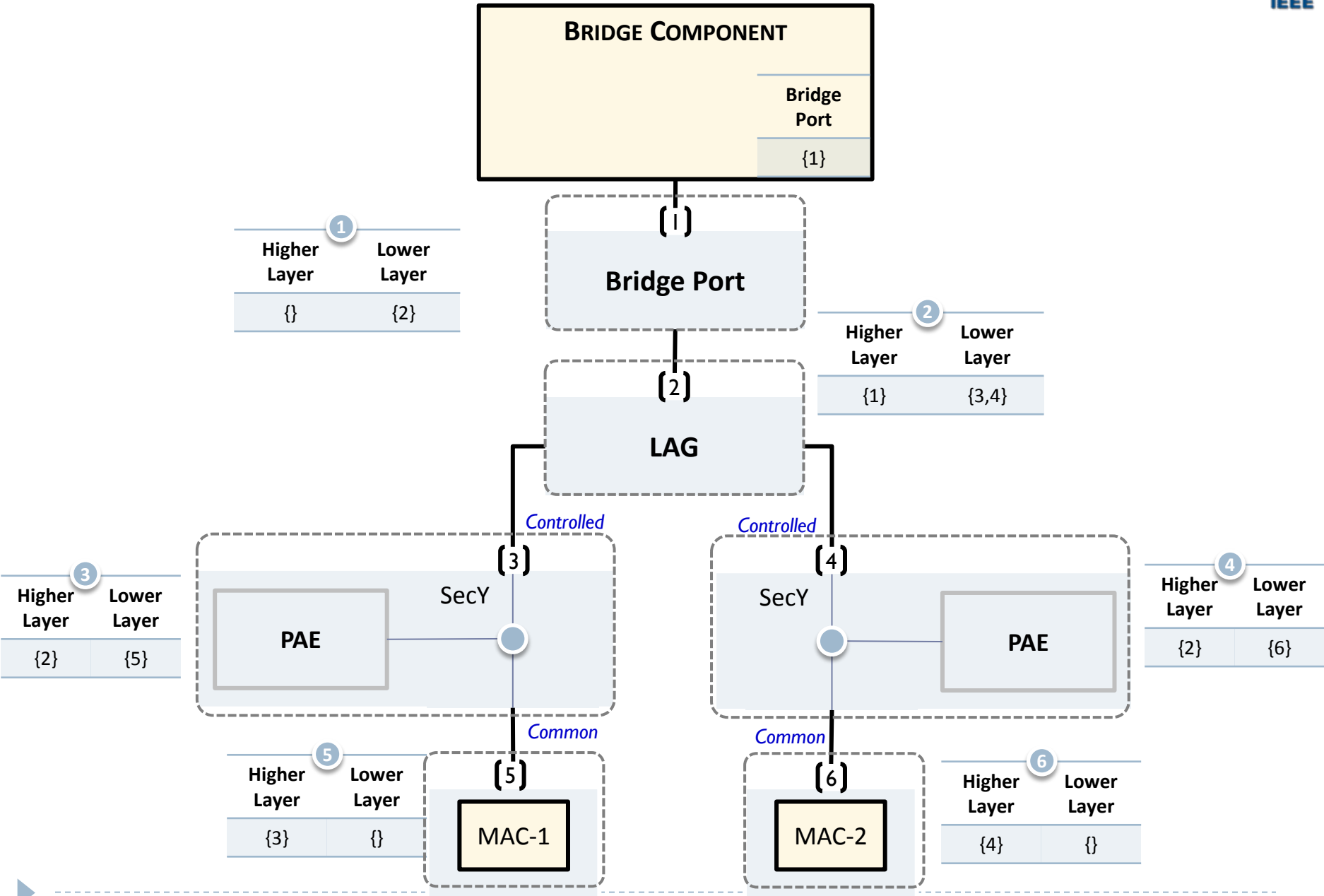
Higher Layer	Lower Layer
j	i
k	i

- Usage of the ifStackTable, as specified by IEEE 802.1X-2010
- The PAC (Protocol Access Controller), as well as SecY (MAC Security Entity), managed objects specify attributes of a shim in an interface stack

# Interface Stack — Bridge Port with MACSec

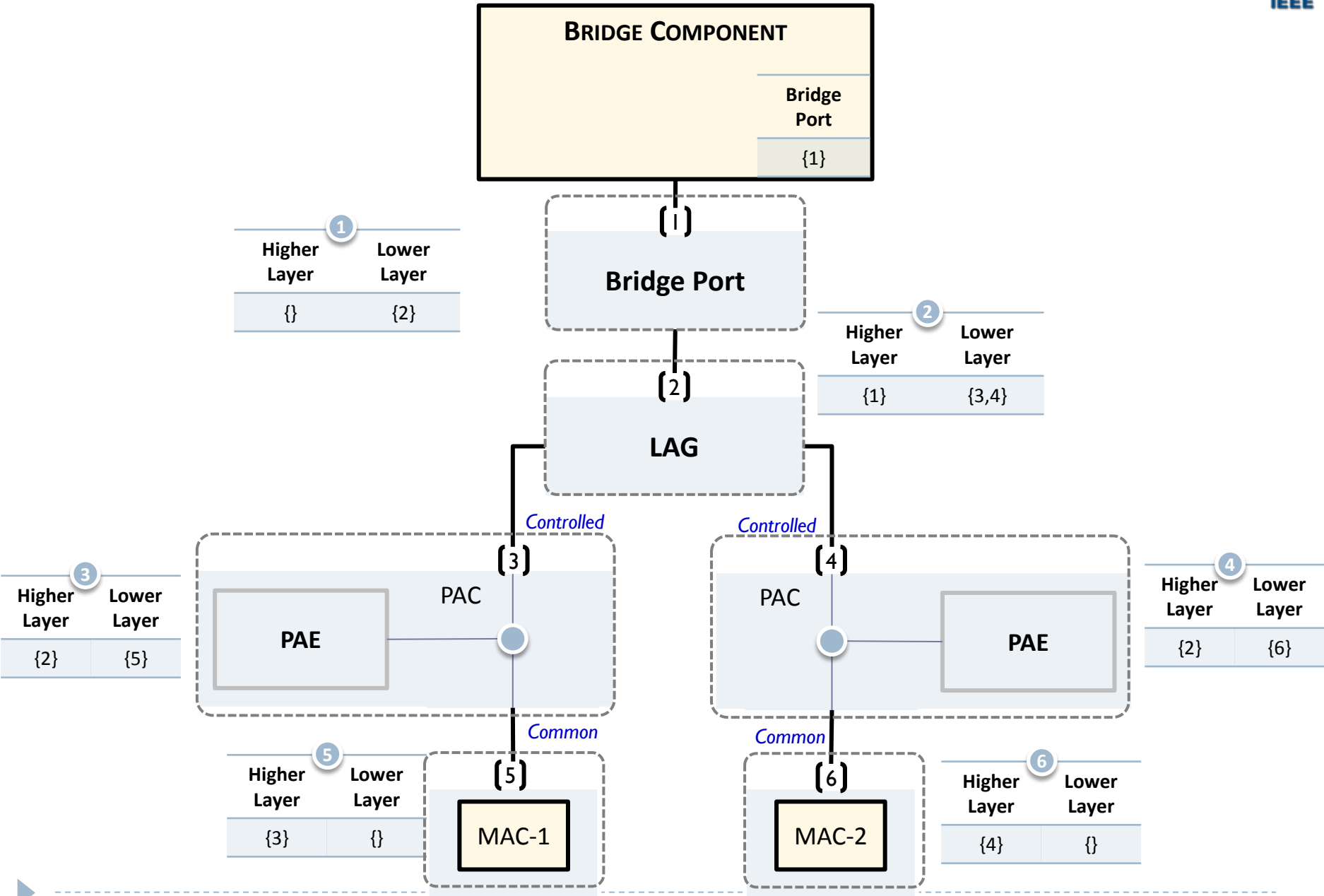


# Interface Stack – Bridge Port (LAG) with MACSec





# Interface Stack – Bridge Port (LAG) without MACSec



# NETCONF and YANG Example Configuration

Bridge Port

# Bridge Port



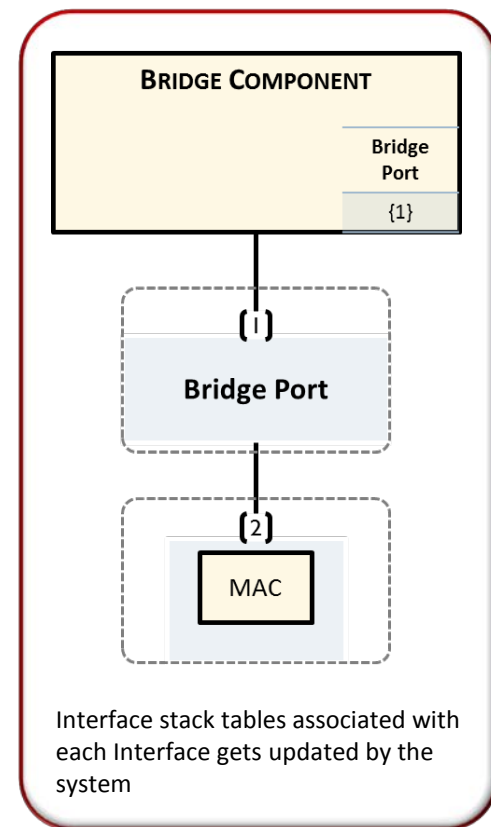
```
<rpc message-id="101" xmlns="urn:ietf:params:xml:ns:yang:ietf-interfaces">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <top xmlns="http://example.com/schema/1.2/config">
        <interface xc:operation="create">
          <name>if-1</name>
          <type>bridge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



# 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)

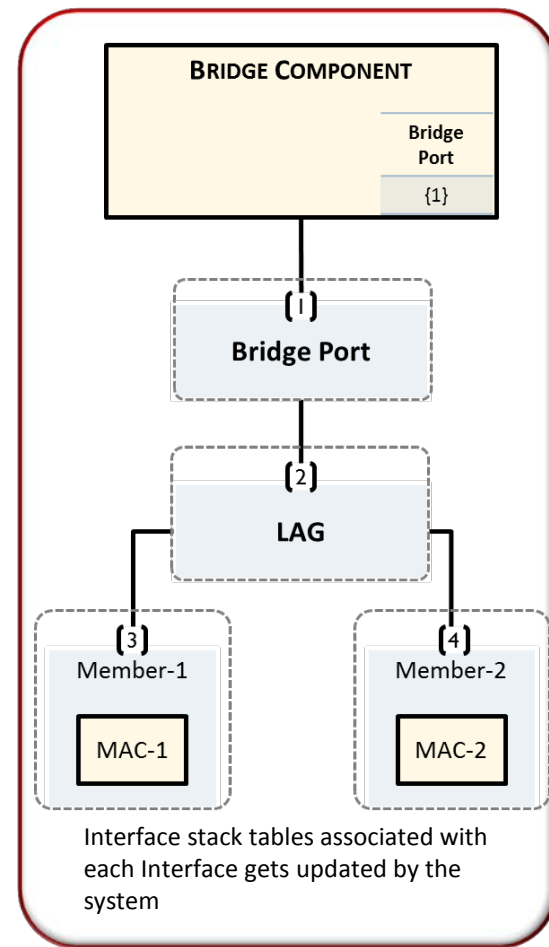
```
<rpc message-id="101" xmlns="urn:ieee:params:xml:ns:yang:ieee-dot1ax">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <top xmlns="http://example.com/schema/1.2/config">
        <interface>
          <name>if-3</name>
          :
        </interface>
        <interface>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

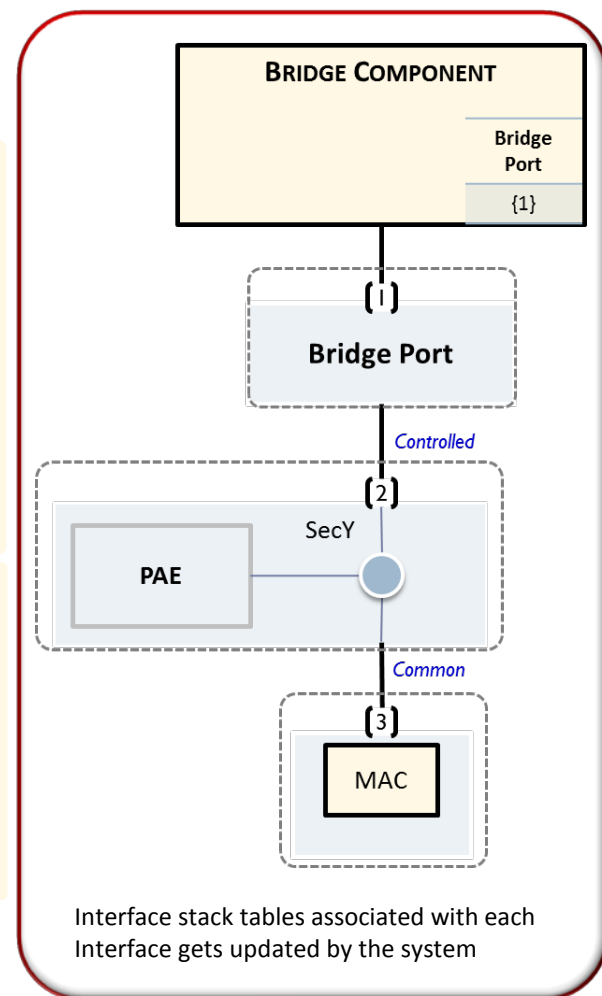
- PAE System specific configuration items

- 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>
```



# 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>
      </top>
    </config>
  </edit-config>
</rpc>
```

# 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>
          <pa-e-system>
            <name>my-pae-system</name>
            :
          </pa-e-system>
          :
        </system>
        <interface>
          <name>if-3</name>
          <pa-e-system>my-pae-system</pa-e-system>
          :
        </interface>
        <interface>
          <name>if-4</name>
          <pa-e-system>my-pae-system</pa-e-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-name>
```

```
            <service-if>if-2</service-if>
```

```
            :
```

```
          </bridge-port>
```

```
          :
```

```
        </interface>
```

```
      </top>
```

```
    </config>
```

```
  </edit-config>
```

```
</rpc>
```

