

YANG models for Systems with Link Aggregation

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Introduction

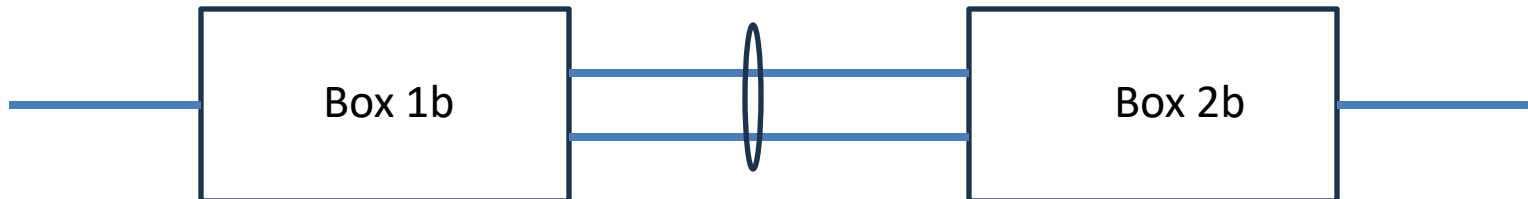
- This presentation provides a simple example of modifying the YANG model for a system without Link Aggregation to a system with Link Aggregation.
- A bridge is used as an example system, however adapting this to a system with different functionality simply involves replacing bridge-specific containers with appropriate containers for the other system functionality.
- YANG configuration files in JSON and XML are provided for the examples.

Simple Example

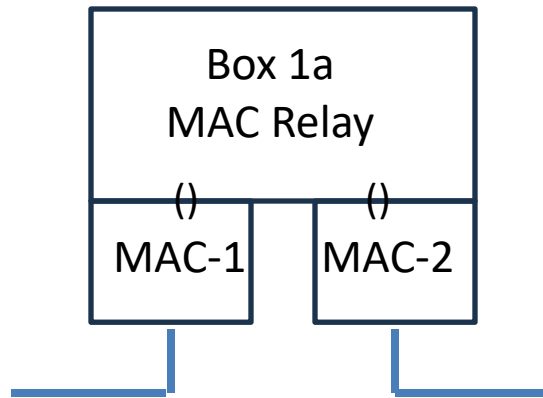
1. Connect two generic boxes with a single link



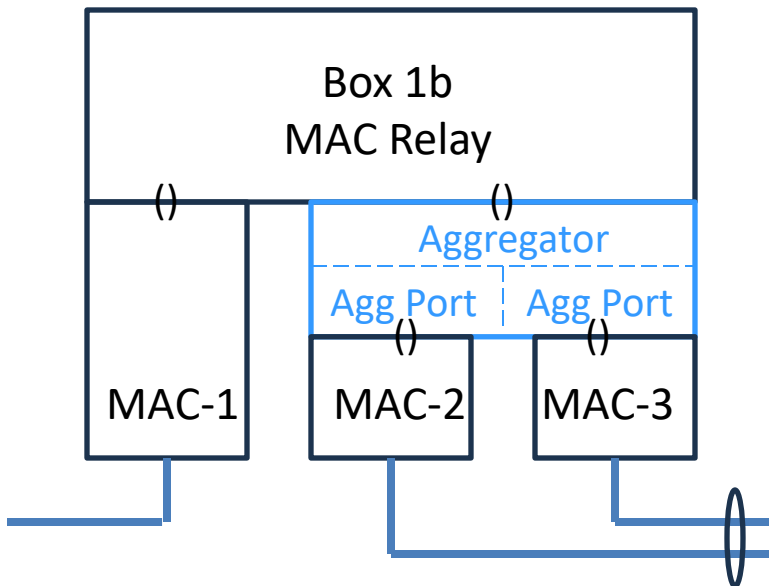
2. Convert the connection to a Link Aggregation Group (LAG)



Assume the boxes are bridges

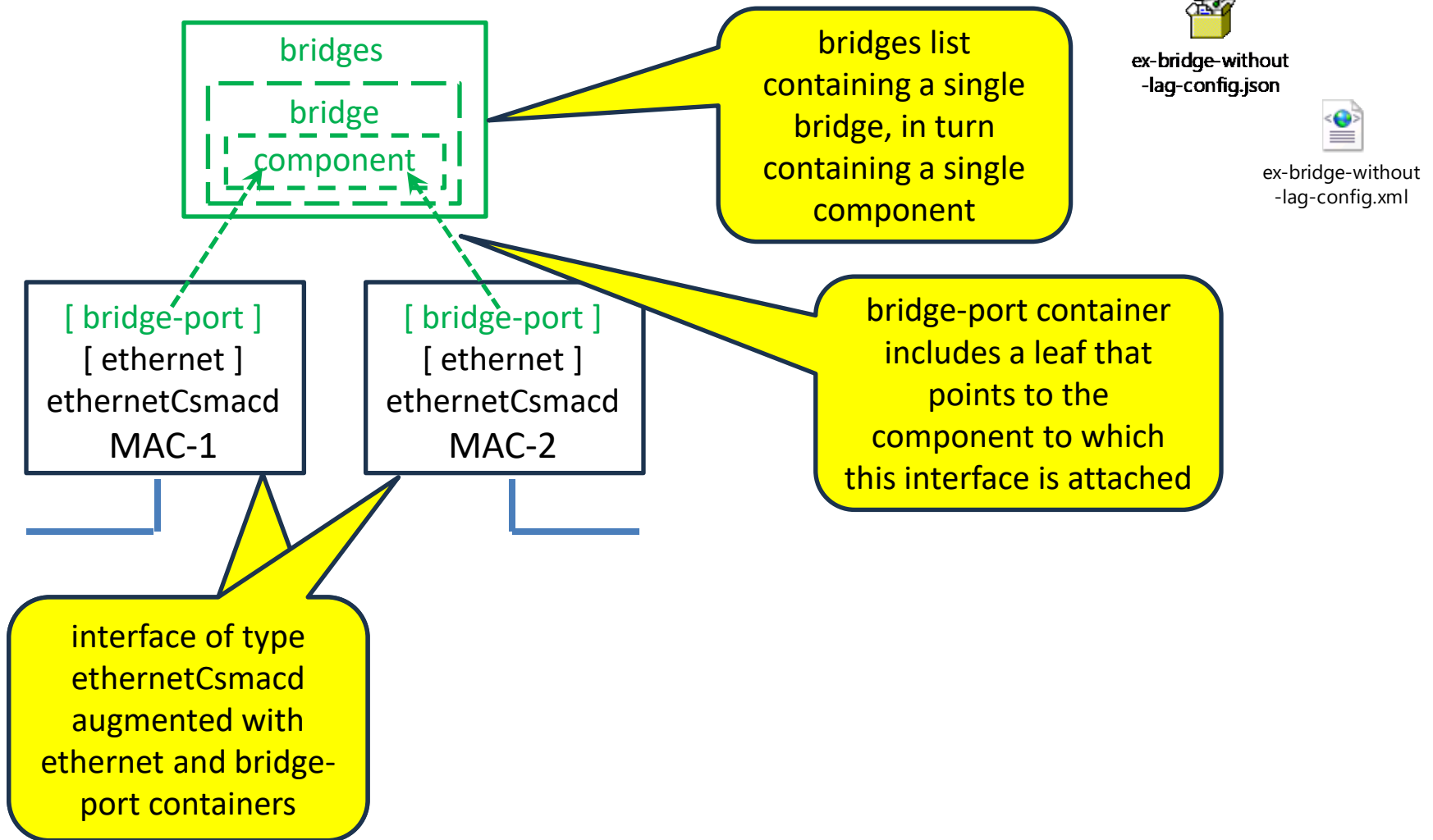


1. Box 1a “baggy pants” diagram
 - MAC Relay has two ports.
 - Each MAC attached to a port on the relay.



2. Box 1b “baggy pants” diagram
 - MAC Relay still has two ports.
 - MAC-1 attached directly to the relay.
 - MAC-2 and MAC-3 each attach to an Aggregation Port in a Link Aggregation Sublayer.
 - The Link Aggregation Sublayer has a single Aggregator that attaches to the relay.

Box 1a YANG Model



Box 1b YANG Model

Still have two interfaces with bridge-port containers pointing to the bridge component

Add linkagg container with a single agg-system and, in this case, a single key-group

Add interface of type ieee8023adLag augmented with lag and bridge-port containers

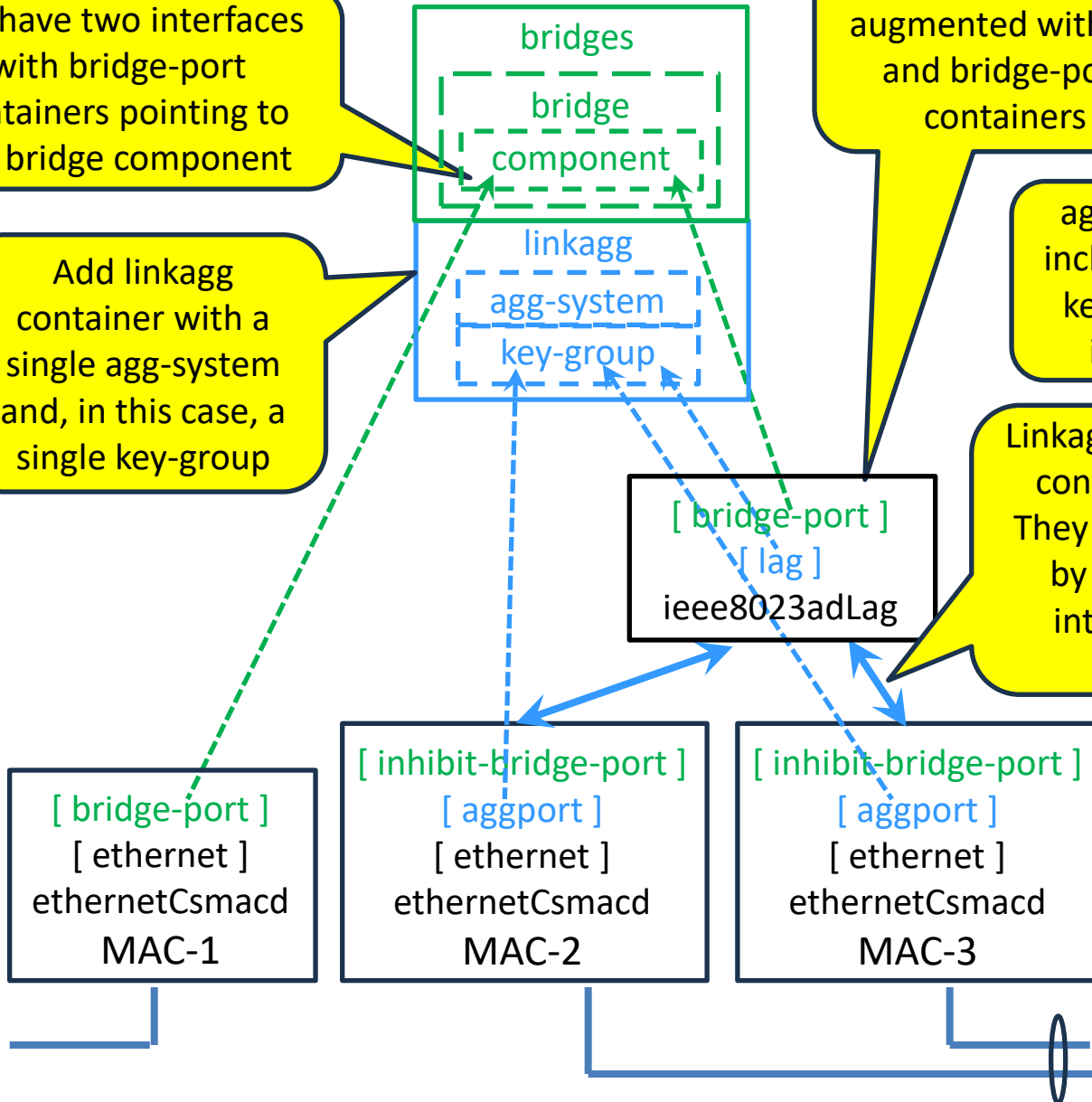

ex-bridge-with-lag-config.json


ex-bridge-with-lag-config.xml

aggport and lag containers include a leaf pointing to the key-group to which these interfaces are assigned

Linkages between aggport and lag containers are not configured. They are established dynamically by LACP, and readable in the interface higher-layer-if and lower-layer-if lists.

MACs in LAG are interfaces of type ethernetCsmacd augmented with ethernet, aggport, and inhibit-bridge-port containers



Bridge Notes

- These examples use a version of the standard `ieee-dot1q-bridge.yang` module modified to include edits from:
 - Maintenance Item 0370 which introduces the “inhibit-bridge-port” presence container to allow ethernetCsmacd interfaces to prevent automatic augmentation with a “bridge-port” container.
 - The proposed solution in Maintenance Item 0370 uses the name “no-bridge-port” for the presence container that inhibits automatic augmentation. Ideally this can be changed to “inhibit-bridge-port” when put into 802.1Q-2022-Rev.
 - Maintenance Item 0383 which allows the system to provide the unique MAC address to be used as a bridge identifier, rather than requiring it to be explicitly configured in a YANG model.



ieee802-dot1q-bridge.yang

Link Aggregation in other Systems

- These models can be adapted to systems that are not bridges (e.g., routers, servers, firewalls, ...).
 - Replace “bridges” container with container(s) that include per-system configuration and status values for the core functionality of the system.
 - Replace “bridge-port” container with container(s) that include port-specific configuration and status values for the functionality of the system.

Details and Variations

Link Aggregation variation 1

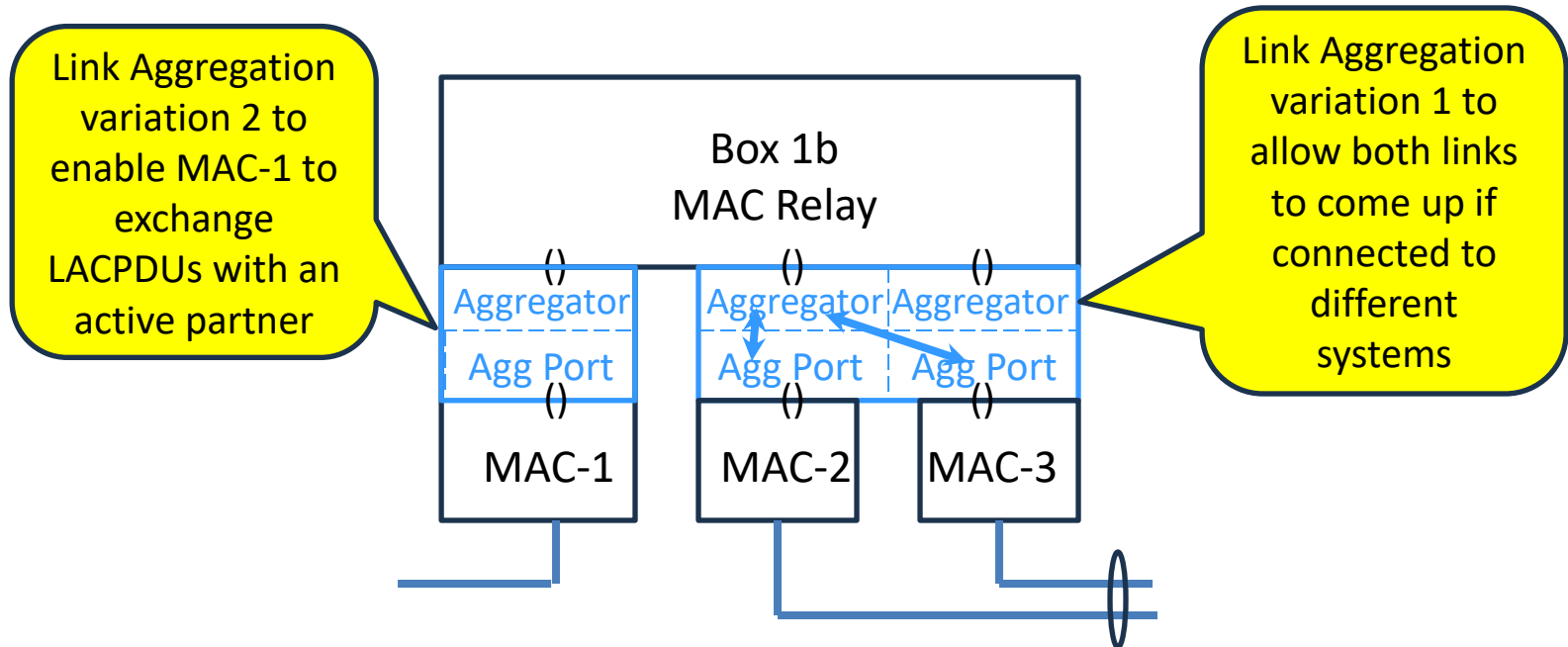
- If MAC-2 and MAC-3 are connected to different systems, only one will attach to the Aggregator (ieee8023adLag interface).
 - Which MAC attaches is system implementation dependent.
 - The link on the MAC not attached to the Aggregator will be operational but will not pass any frames because it is not attached to a higher layer.
 - This may be appropriate ...
 - If there is specific functionality configured on just this bridge-port, regardless of whether that bridge-port is supported by a LAG or a solitary link, and cannot be supported on an additional bridge-port.
 - This may be intentional ...
 - This configuration supports the “dual-homed” topology, where only one link is active at a time, but the other will become active if the first fails.
 - Particularly useful when attached to MC-LAG, DRNI, or other high availability dual-system function, because it can help prevent loops in case of a “split-brain” condition.
- Alternatively ...
 - If the functionality on this bridge-port is generic, and the bridge can support another bridge-port, then can add another ieee8023adLag interface to the key-group which would allow the MACs to either come up as two solitary links, or come up together as a LAG.

Link Aggregation variation 2

- MAC-1 does not run LACP
 - Why enable LACP on this MAC?
 - Allows it to participate as a passive partner, rather than a silent partner, when connected to another system that would allow the link to be in an aggregation with other links.
 - Enabling LACP entails:
 1. Creating another key-group configured so that any member of this key group is limited to being a solitary link (the aggregation bit of the actor-admin-state is clear).
 2. Augmenting the MAC-1 interface with an aggport and inhibit-bridge-port containers instead of a bridge-port container.
 3. Adding an ieee8023adLag interface augmented with lag and bridge-port containers.
 - Multiple MACs can reference the same key-group, and each will be a solitary (non-aggregated) link.

Box 1b variations 1 and 2

“baggy pants” diagram



The diagram illustrates the relationship between various components in a network architecture. It is divided into two main sections: a green section at the top and a blue section at the bottom.

- Green Section:** Contains the text "bridges" at the top. Below it is a dashed green box labeled "bridge component". Three green arrows point from the "bridge component" box to the "linkagg" text in the blue section.
- Blue Section:** Contains the text "linkagg" at the top. Below it is a dashed blue box labeled "agg-system". Underneath "agg-system" are two more dashed blue boxes: "key-group-2and3" and "key-group-1".
 - Four blue arrows point from "key-group-1" to "key-group-2and3".
 - Four blue arrows point from "key-group-2and3" to "agg-system".
 - Four blue arrows point from "agg-system" to "linkagg".

A black arrow points from the left edge of the diagram towards the "key-group-1" box.

- Link Aggregation variation 1:
 - When MAC-2 and MAC-3 form a LAG, this interface will not be operational (oper-status = down)
 - When MAC-2 and MAC-3 connect to different systems, one MAC will attach to this Aggregator and this interface will be operational (oper-status = up).

Link Aggregation
variation 2



ex-bridge-lag-var.
json

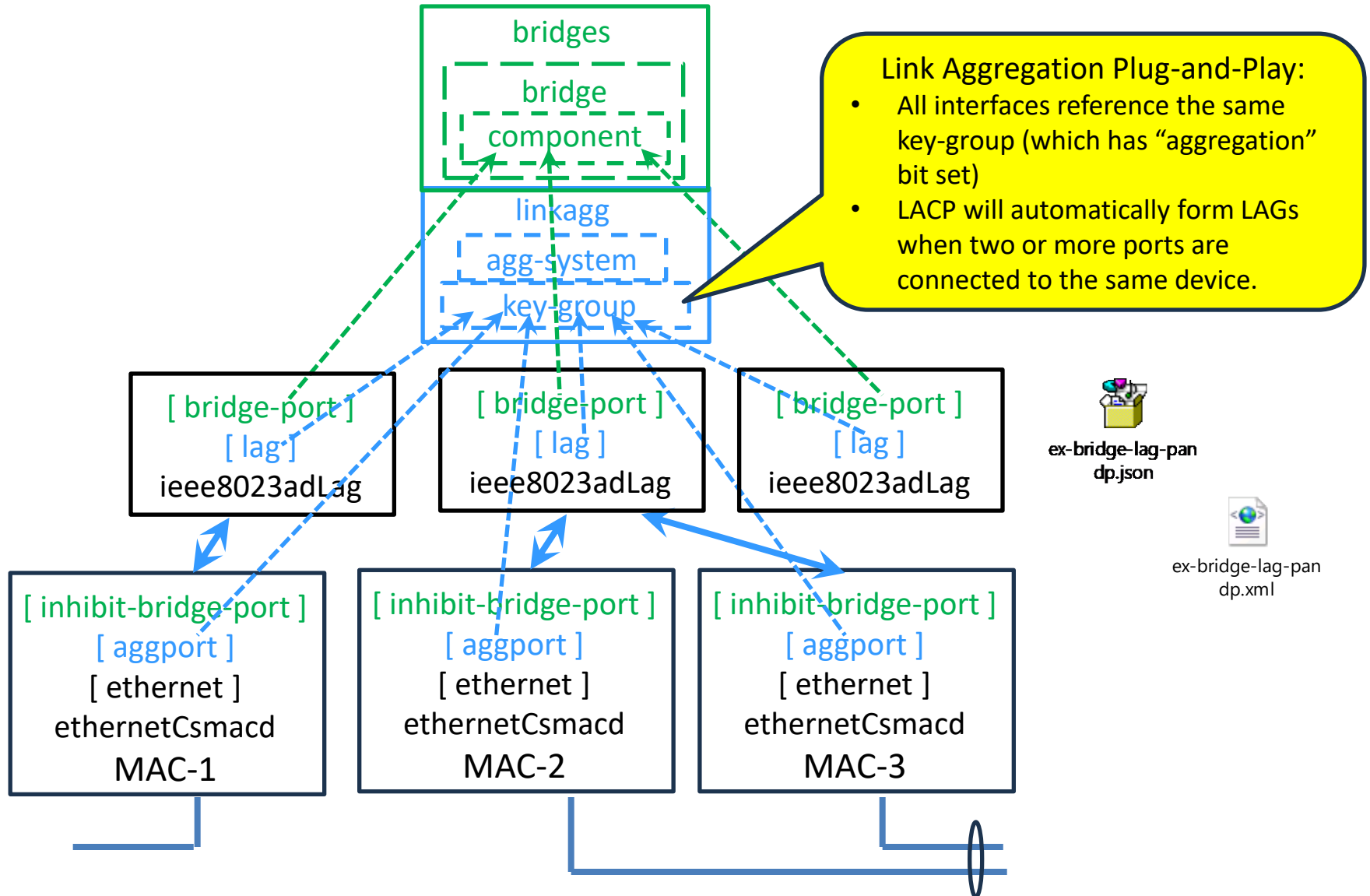


ex-bridge-lag-var.
xml

Plug-and-Play Link Aggregation

- Allow the configuration to adapt to the cabling, rather than requiring the cabling to conform to the configuration.
 - Use when ports are functionally equivalent.
 - This is often the case with bridges, and for at least a subset of ports on other devices.
 - LACP automatically forms a LAG when two or more ports are connected to the same device (and that device allows aggregation).
 - Simplifies configuration.
 - Reduces issues with mis-cabling.
- All interfaces (that are augmented with “aggport” or “lag” containers) reference the same key-group.
 - That key-group has the “aggregation” bit in the “actor-admin-state” set.
 - This bit is set by default, so no explicit configuration is required.

Box 1b YANG Model Plug-and-Play variation



Back-up slides

Non-standard variation 2 – Implicit Aggregators

- The standard way to enable LACP on MAC-1 involves adding an ieee8023adLag interface
 - because the Link Aggregation standard only specifies attaching an Aggregation Port to higher layers through an intervening Aggregator.
 - When this is a solitary link, the Aggregator is basically a pass-through layer.
- The YANG models will support a non-standard configuration short-cut:
 1. Configure a key-group that only allows solitary links.
 2. Do not introduce any Aggregators as members of this key-group.
 3. Any MACs using this short-cut to enable LACP are augmented with both aggport and bridge-port containers.
 - The aggport container references the key-group that only allows solitary links.
- Caveat:
 - The system must recognize this configuration and implement non-standard modifications to LACP that allow a solitary Aggregation Port to attach to higher-layer functionality without an intervening Aggregator.
- Risks!
 - The YANG model will not prevent an aggport in this configuration from referencing a key-group that allows aggregation. If this happens there is a possibility this port will end up in a LAG with one or more other ports. This would create two paths between the MAC and the MAC Relay, through two different bridge-ports, that are both operational at the same time. Since this is a non-standard implementation, the resulting behavior is unspecified and system-dependent, but unlikely to be desirable and likely to be very disruptive to the network!

Thank You