Resilient Network Interconnect: D-LAG Models

Version 2

(added two new slides at the end)

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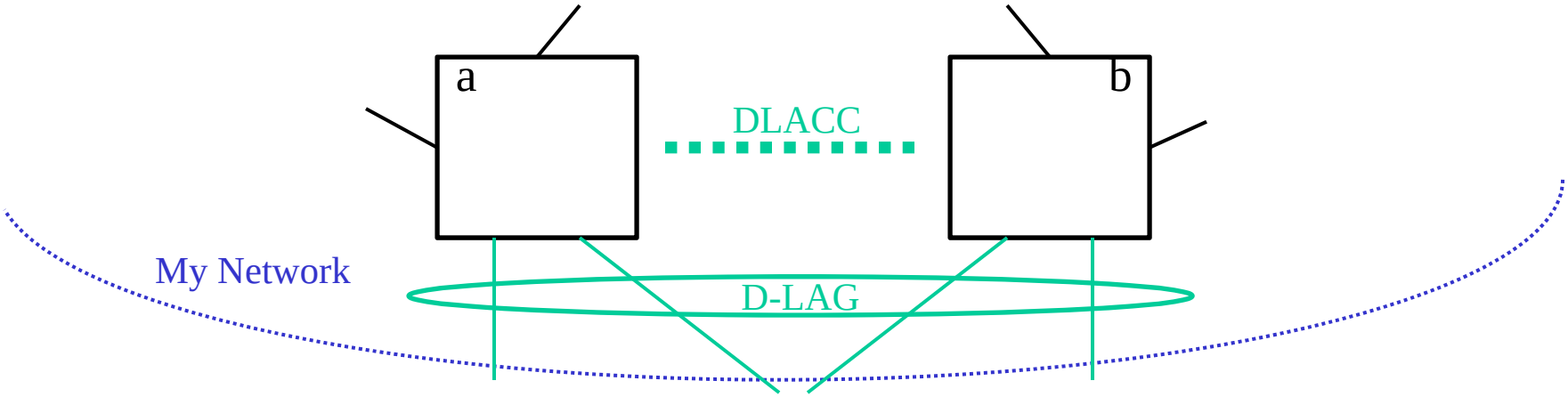
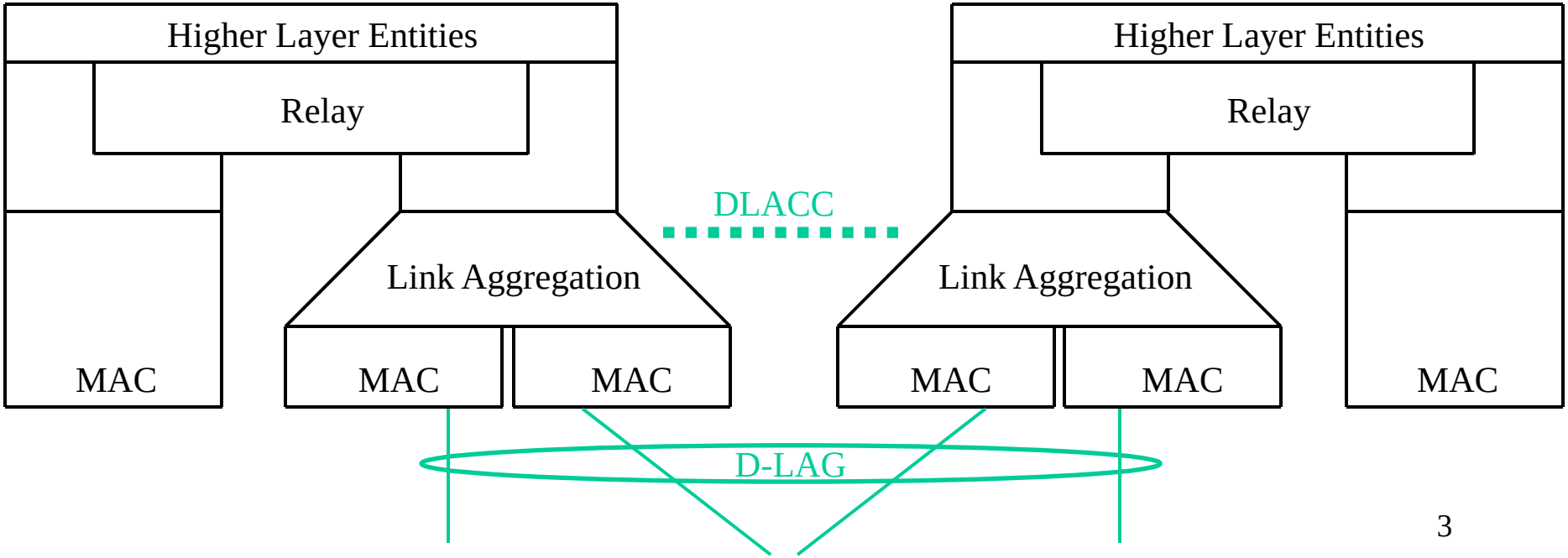
Introduction

- At the September Interim two models for Distributed Link Aggregation were presented:
  - Distributed Bridge Model
  - Distributed Port Model
  - http://ieee802.org/1/files/public/docs2010/new-haddock-resilient-network-interconnect-LAG-0910-v3b.pdf
- Concerns were raised with respect to the Distributed Port model.
- This presentation modifies the model to address those concerns.

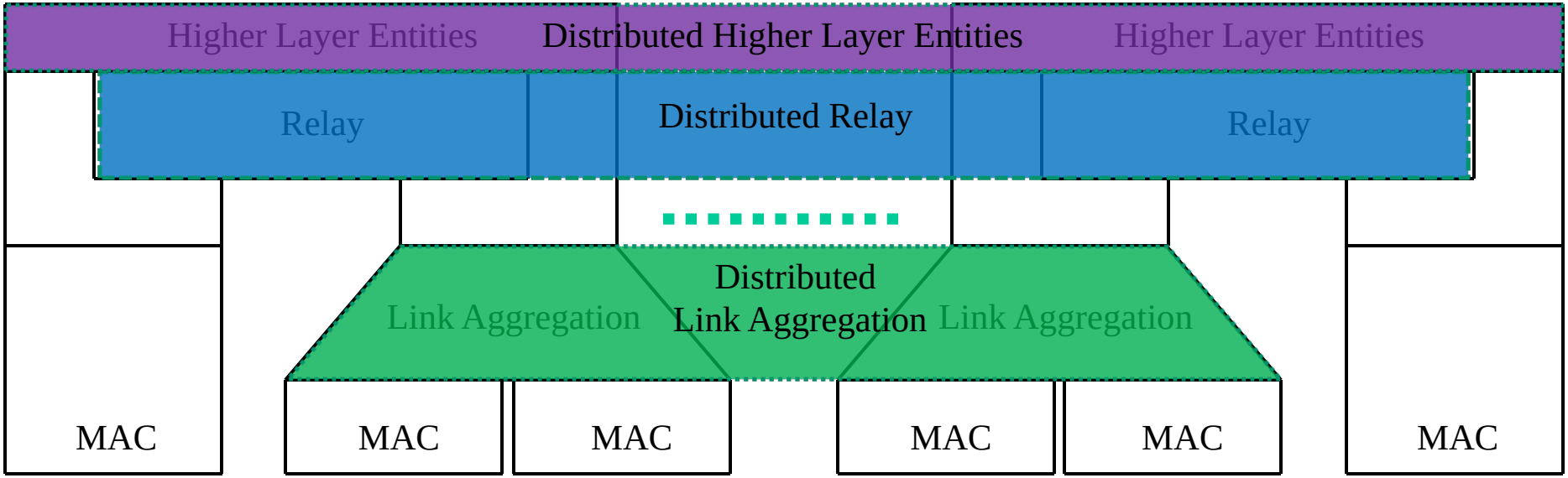
‘Baggy Pants’ Representation





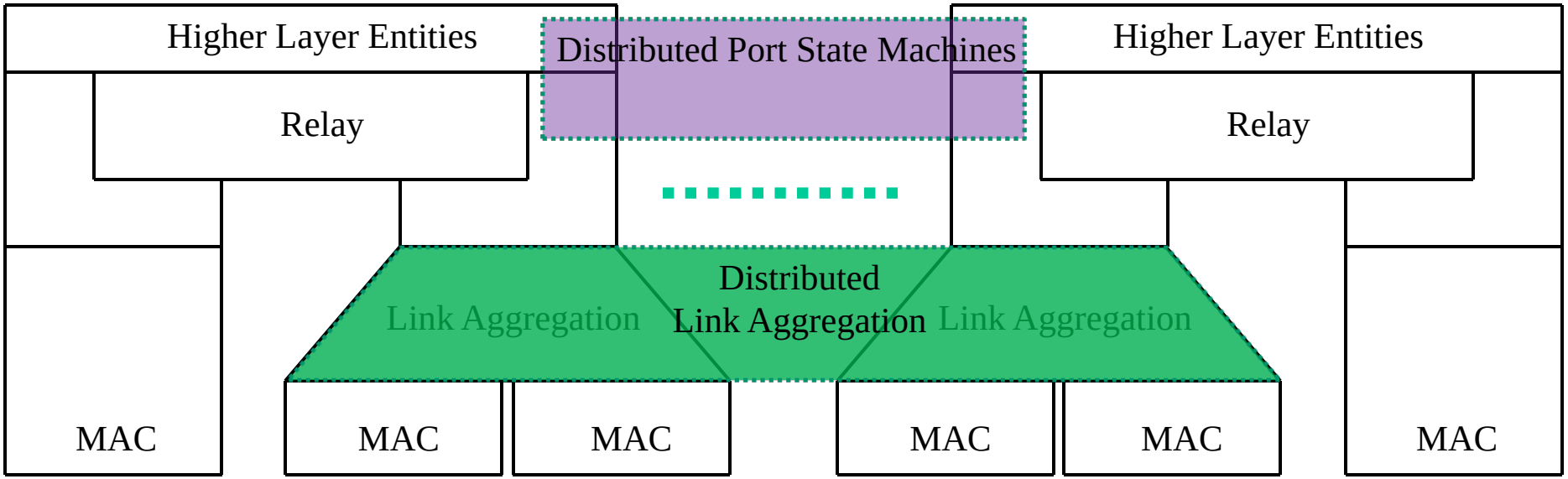
Distributed Bridge Model

- Emulate a single bridge
  - Create illusion that there is a single relay, single instance of all higher layer entities, and a single Bridge Port representing entire Distributed Link Aggregation Group.
- In normal operation neither the NNI nor My Network can distinguish this from a single bridge.
- Failure of the DLACC (“split brain” scenario) potentially causes a significant change in operation as viewed from My Network.



Distributed Port Model

- All unique behavior confined to the Ports that are part of the D-LAG.
  - Each Node operates as a separate bridge on all ports that are not part of the D-LAG.
- Distributed LAG creates a single Bridge Port on the Relay of each bridge.
  - LAG Distributor and Collector functions control frame forwarding between the D-LAG links and the Bridge Relays.
  - In some cases may require “tunneling” frames on the DLACC to the other Node.
- May need special behavior in port specific portions of some L2 protocols to maintain single Bridge Port illusion across D-LAG:
  - Probably xSTP and MxRP (if run these over D-LAG); maybe CFM LinkTrace

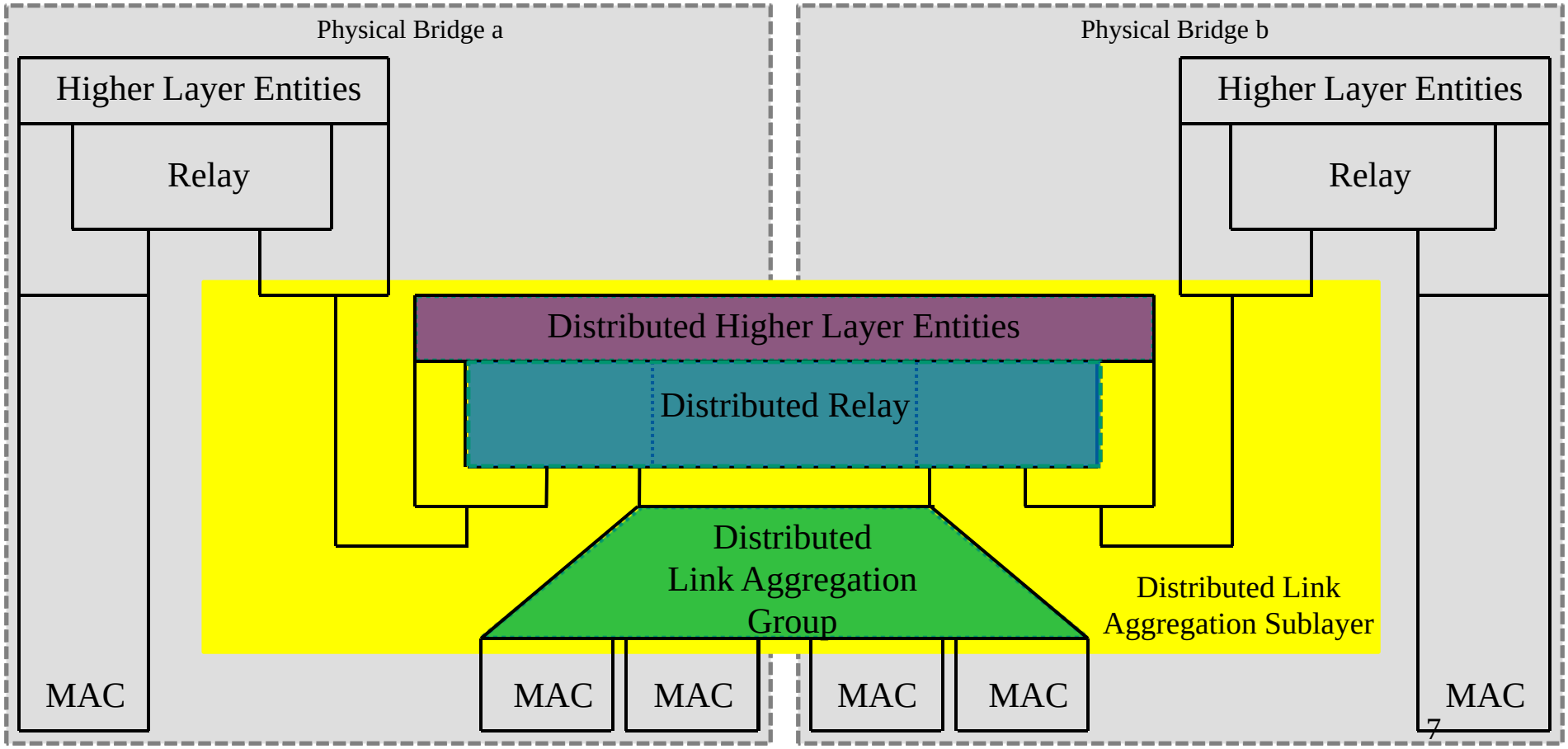


Concerns on Distributed Port Model

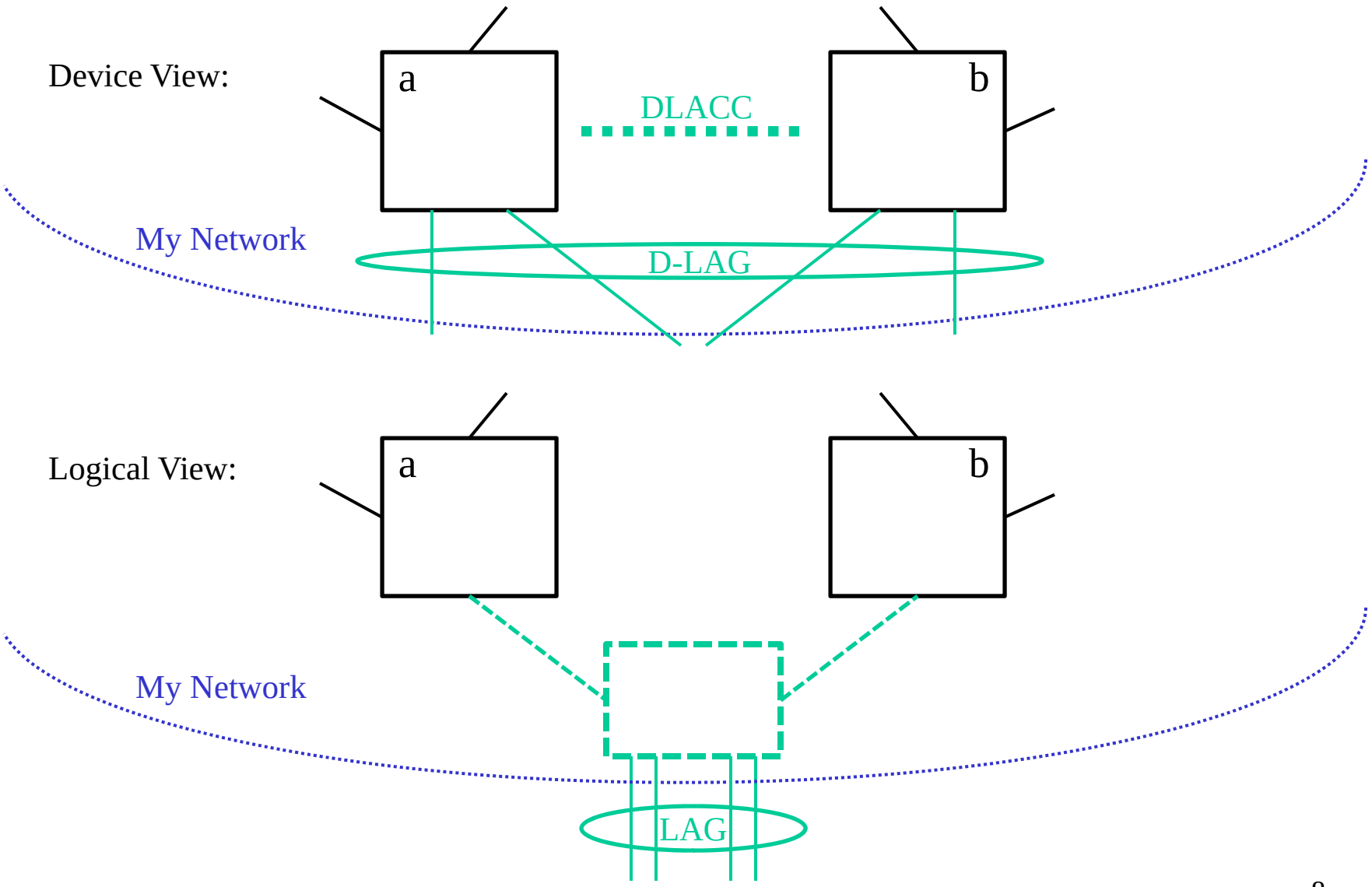
- Panos:
  - Generally uncomfortable with a single Link Aggregation Group looking like a Bridge Port on each of two distinct Bridges.
- Mick:
  - Specifically concerned with the idea that from the NNI the D-LAG looks like a single Bridge Port, while from My Network it looks like two distinct Bridge Ports, each on a distinct Bridge.
  - Means it is impossible for any control plane protocol operating over both My Network and the Other Network to have a consistent world view.
  - Presents an insoluble problem to any routing protocol (and perhaps to any control protocol?).
- Need a model where the D-LAG looks like a single Bridge Port from both the NNI and My Network.

Distributed Component Model

- Distributed LA Sublayer comprises a logical VLAN-aware component that:
  - Spans all physical bridges.
  - Has a single Bridge Port for all external links in the Distributed-LAG.
  - Has internal links/ports to the bridge component in each physical bridge.
  - Distributed Relay acts as a VLAN multiplexer (no MAC address learning).



Network Representation



Distributed Component Model: Data Plane

- FDB of Distributed Relay configured as a VLAN multiplexer.
  - Member set of an VID includes only the D-LAG Bridge Port and one of the internal Bridge Ports (same constraints as a PEB C-VLAN component).
  - No MAC address learning.
- Results in same behavior as the Gateway function described in the Distributed Port Model of http://ieee802.org/1/files/public/docs2010/new-haddock-resilient-network-interconnect-LAG-0910-v3b.pdf
- Network data flows are the same as those described in the Distributed Port Model.
- Still have situations where a frame needs to be transferred between physical bridges in the Distributed Link Aggregation Sublayer:
  - Frames received (or to be transmitted) on a D-LAG link terminating at one physical bridge, while the frame's VID is in the member set of a Bridge Port on another physical bridge.
  - Such frames may be transferred on a dedicated physical link, or tunneled on a physical link shared with the normal active topology.

Distributed Component Model: Control Plane

- Distributed Component runs an instance of all supported control applications (e.g. RSTP/MSTP).
  - Since Bridge Port and VLAN configuration have same constraints as a PEB C-VLAN component, can use the RSTP enhancements described in 13.38. This allows the Distributed Component to have multiple Root Ports when the D-LAG Bridge Port is Designated.
  - Resolves the Distributed Port STP Problem (described on slide 33 of http://ieee802.org/1/files/public/docs2010/new-haddock-resilient-network-interconnect-LAG-0910-v3b.pdf
- As with Distributed Port Model, still need a Distributed Link Aggregation Communications Channel (DLACC):
  - to convey Distributed Link Aggregation Sublayer state and control information between physical devices.
  - to transfer data plane frames in the Distributed Link Aggregation Sublayer between physical devices.

Distributed Component Model: Observations

- Model presents D-LAG as supporting a single Bridge Port when viewed from NNI or My Network.
  - Provides a “consistent world view” from any point in network.
- Model provides clear behavioral reference for any higher layer application, control protocol, or protocol shim.
- Model easily accommodates more than two physical bridges in the D-LAG.
- Model easily accommodates bridges supporting multiple D-LAGs and overlapping D-LAGs.
- Model easily accommodates D-LAGs on bridges that are already multi-component.
  - E.g. Provider Edge Bridges and Backbone Edge Bridges

Some Thoughts on Standardizing Distributed Link Aggregation

Distributed Link Aggregation: Standardization 1

- Amendment to 802.1AX Link Aggregation
  - Add a new Distributed Link Aggregation Sublayer clause (or two)
  - Allow either Distributed Bridge or Distributed Component as conformant behavioral reference models.
- No changes to 802.1Q
  - Can just refer to 802.1Q for component definitions and specifications.
- Minimal specification if assume single vendor for all bridges in D-LAG:
  - Require that external behavior must match the Distributed Bridge or Distributed Component Model.
  - Specify constraints on VLAN configuration of Distributed Component Model.
  - All details of how to create Distributed Bridge or Distributed Component , including the DLACC, left to the implementer.
  - No standardized management model.
  - Will probably need to specify or constrain the uniqueness versus re-use of identifiers for logical ports and components.
  - Will need to specify what the model looks like when the DLACC fails.

Distributed Link Aggregation: Standardization 2

- Specification if do **NOT** assume single vendor for all bridges in D-LAG:
  - Specify how functionality is distributed between physical devices for Distributed Component Model only (not Distributed Bridge).
    - Distributed Relay probably best specified as a Gateway function in each device.
    - Specify whether control protocols are to be distributed , or run in a selected device with PDUs tunneled to/from Bridge Ports in other physical devices using the DLACC.
    - Specify Distributed Component management model, and which managed objects are implemented by which physical device.
      - Could follow 802.1ah precedent where all objects/parameters of a full-up component are specified, or 802.1ad precedent where only pertinent objects/parameters are specified.
  - Specify frame formats and protocol for the DLACC.

Distributed Link Aggregation: Standardization 3

- Specification of DLACC if do **NOT** assume single vendor for all bridges in D-LAG:
  - Define frame format and protocol for Distributed LACP.
  - Other control protocols
    - If select one physical bridge to run protocol, then need to define frame format to convey control protocol PDUs to and from that bridge.
    - If distribute protocol between physical bridges, then need to define frame formats to convey state and event information between bridges (potentially very complex).
  - Data frames on the DLACC
    - If have a directly connected link, dedicated for only DLACC traffic and only for one D-LAG, then don't need to encapsulate data frames. This would represent the minimum multi-vendor implementation.
    - We could specify an optional encapsulation that would allow a physical single link to carry frames for the normal network active topology as well as DLACC frames for any number of D-LAGs. Probably this would need to be implemented in a software path on existing bridges, but may someday be implemented in hardware.

Recommendations for Standardization

- Write amendment to 802.1AX as described on "Standardization 1" slide.
  - Assume single vendor, with descriptions of both the Distributed Bridge or Distributed Component models.
- Consider specifying the minimal multi-vendor behavior on "Standardization 2 and 3" slides.
  - Assume DLACC is a dedicated link for a single D-LAG, so no encapsulation of data frames is required.
  - Standardizing the control and management planes may be a challenge.
- If successfully specify the minimal multi-vendor behavior, then specify an optional DLACC data frame encapsulation.
  - Allows a single physical link to be shared between "normal" traffic and the DLACCs for multiple D-LAGs.