

Proposal  
for  
IEEE 802.1  
Path Aggregation  
v1.3

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# Scope of this presentation

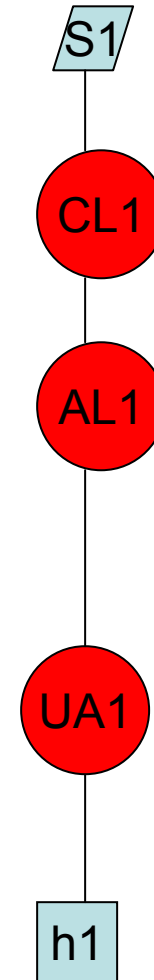
In response to positive end user feedback, this is a proposal for a path aggregation standard for dual-homed switches into a core switched L2 network. Much like the already well known point-to-point link aggregation (IEEE 802.3ad), however allowing to dual-home into a pair of switches.

This presentation depicts the problem areas and describes a potential solution approach.

Note: This presentation defines a specific solution focused on backward compatibility with installed 802.1 bridge and 802.3ad compliant devices. Other solutions may be possible.

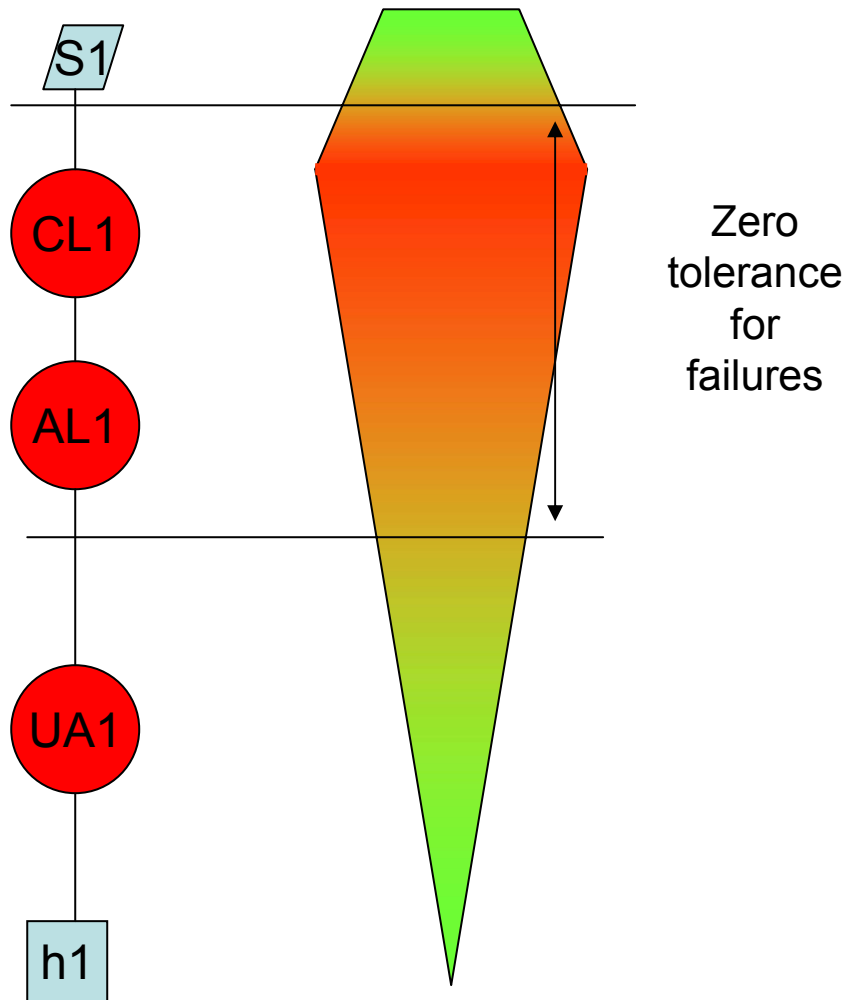
# Terminology

- User access layer, also known as wiring closets (UA)
- Building Aggregation Layer, also known as distribution layer (AL)
- Network Core Layer (CL)
- Server access layer (SA)



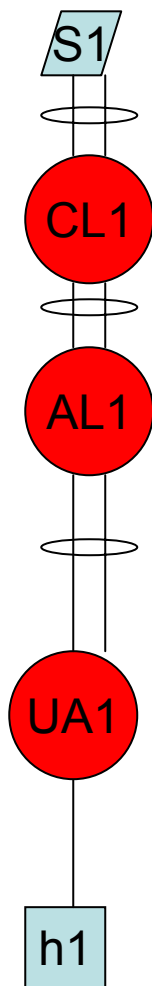
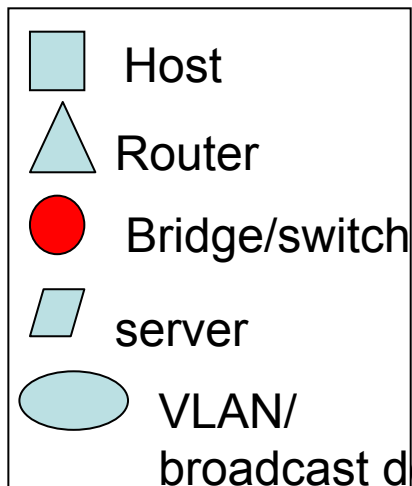
# Aggregation and Single Point failure effects

# of users affected by single point failure

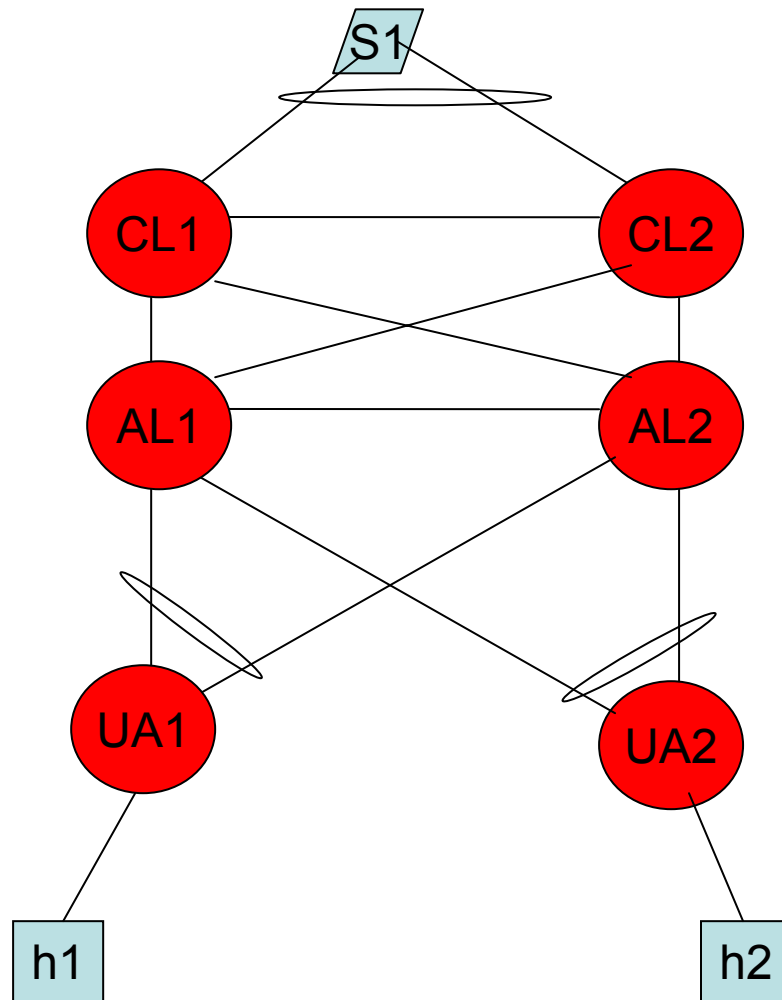


# Resilient networks

## link aggregation vs. dual-homing



Port/Module resiliency



1 + 1 device resiliency

# Problem in Campus

User Access aggregation in the Aggregation Layer

- Since a lot of UA devices are aggregated at the building AL, AL failures affect many users, device redundancy reduces this risk.
- Redundant devices introduce redundant links, which could be always active to leverage all investments.

# Problem in Datacenter

## Server Aggregation

- Servers usually aggregate many end user sessions. Connectivity failures affect many users, server aggregation switch redundancy reduces this risk.
- Redundant devices introduce redundant links, which could be always active to leverage all investments.

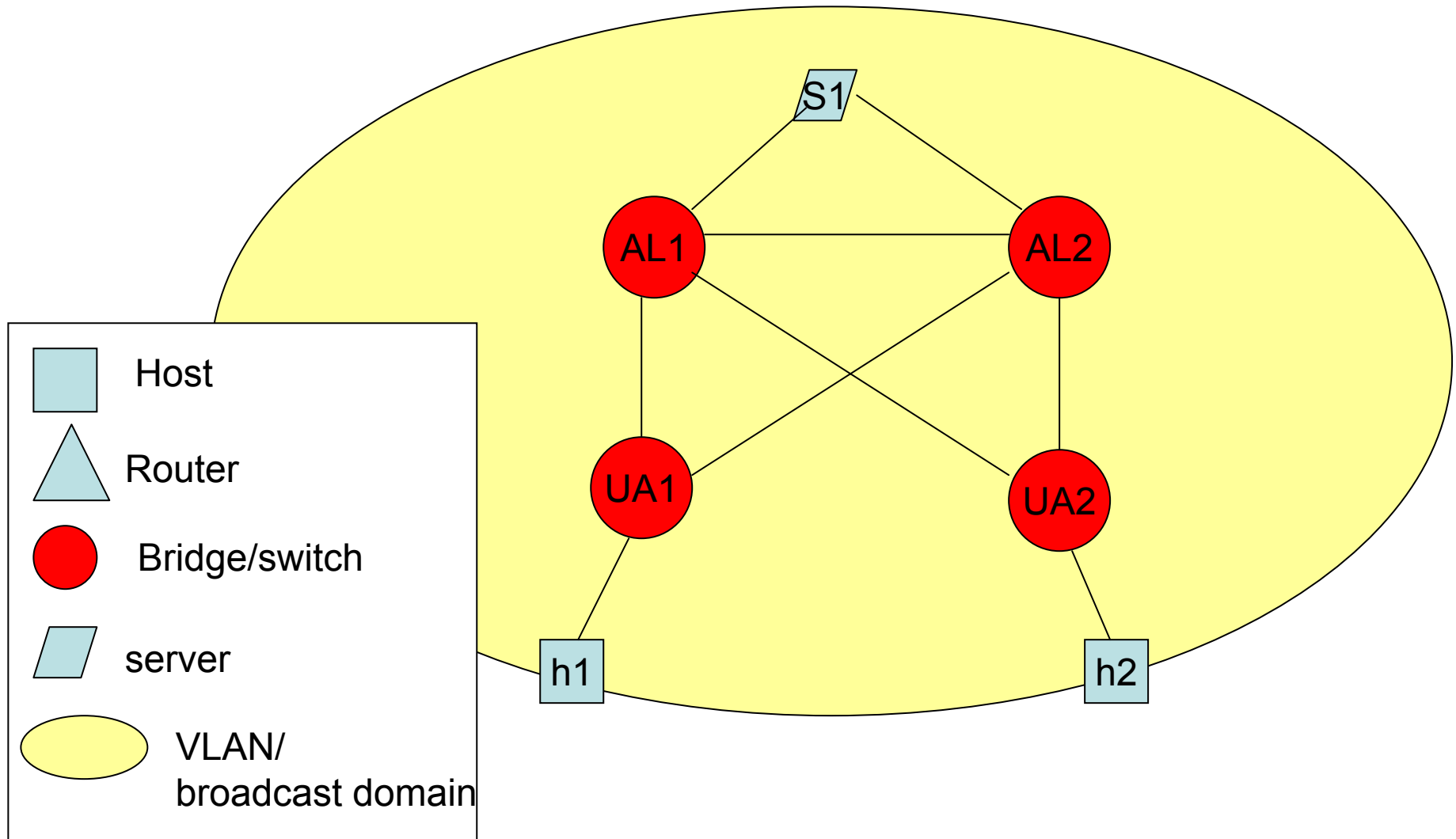
# Problem in Metro networks

## Redundant connections for CPEs to PEs

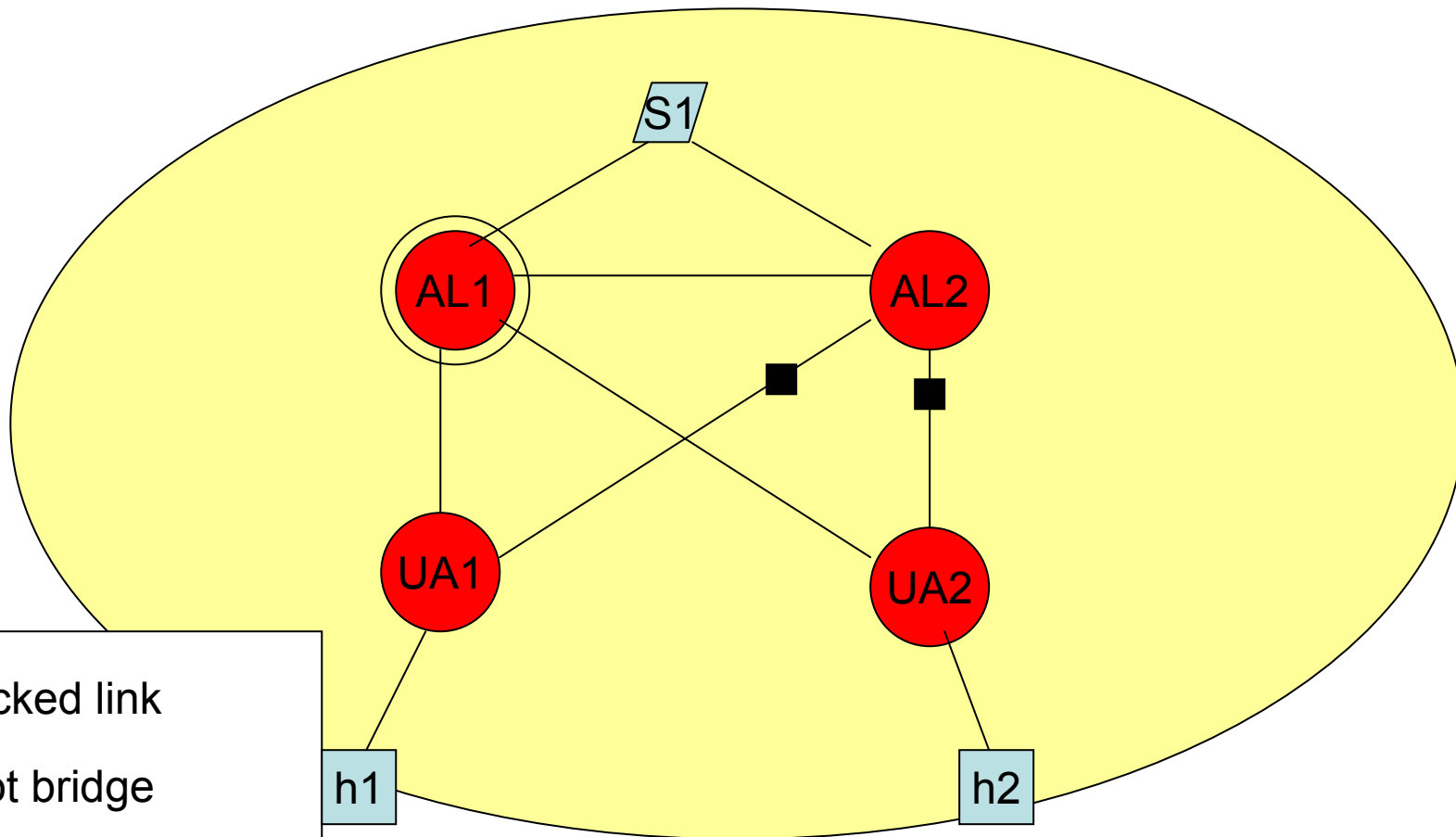
- PEs aggregate many CPEs. PE failure affects many customers. Dual-homing into two separate PE devices reduces this risk.
- Redundant devices introduce redundant links, which could be always active to leverage all investments.



# Example 1: Resilient Network with Spanning Tree / one VLAN



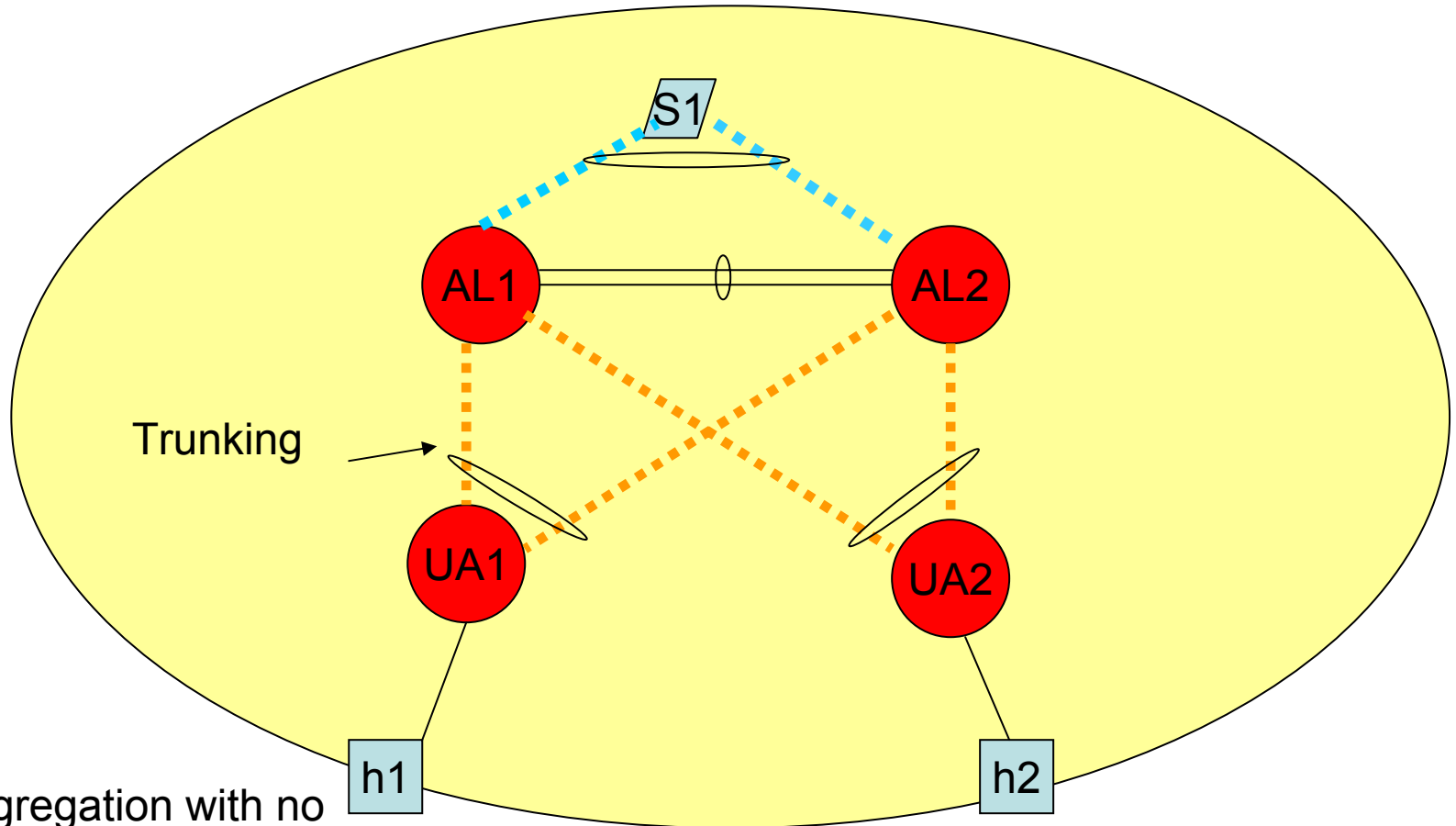
# Example 1: Resilient Networks with Spanning Tree / one VLAN



■ Blocked link

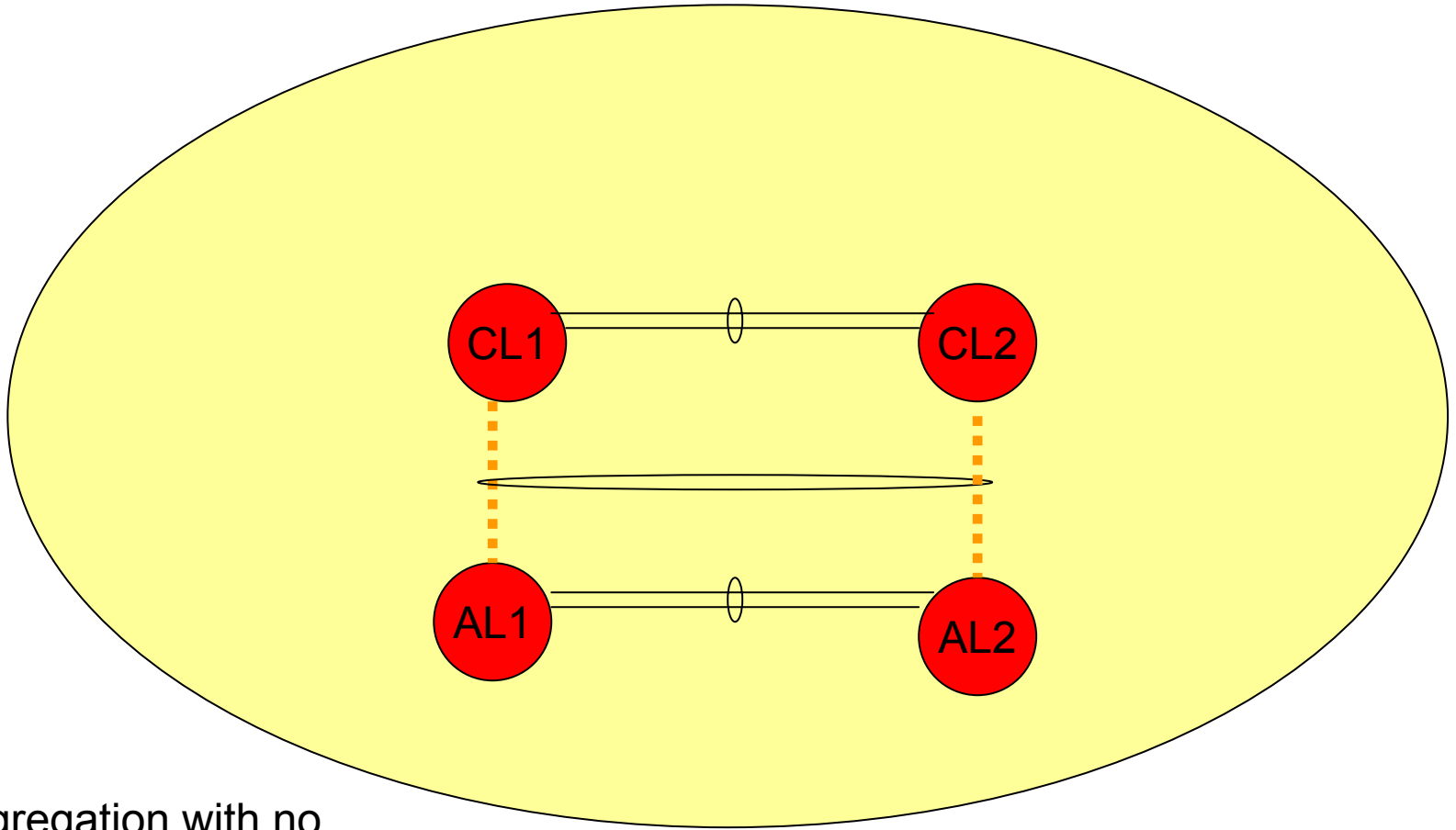
● Root bridge

# Proposed Solution - Triangle



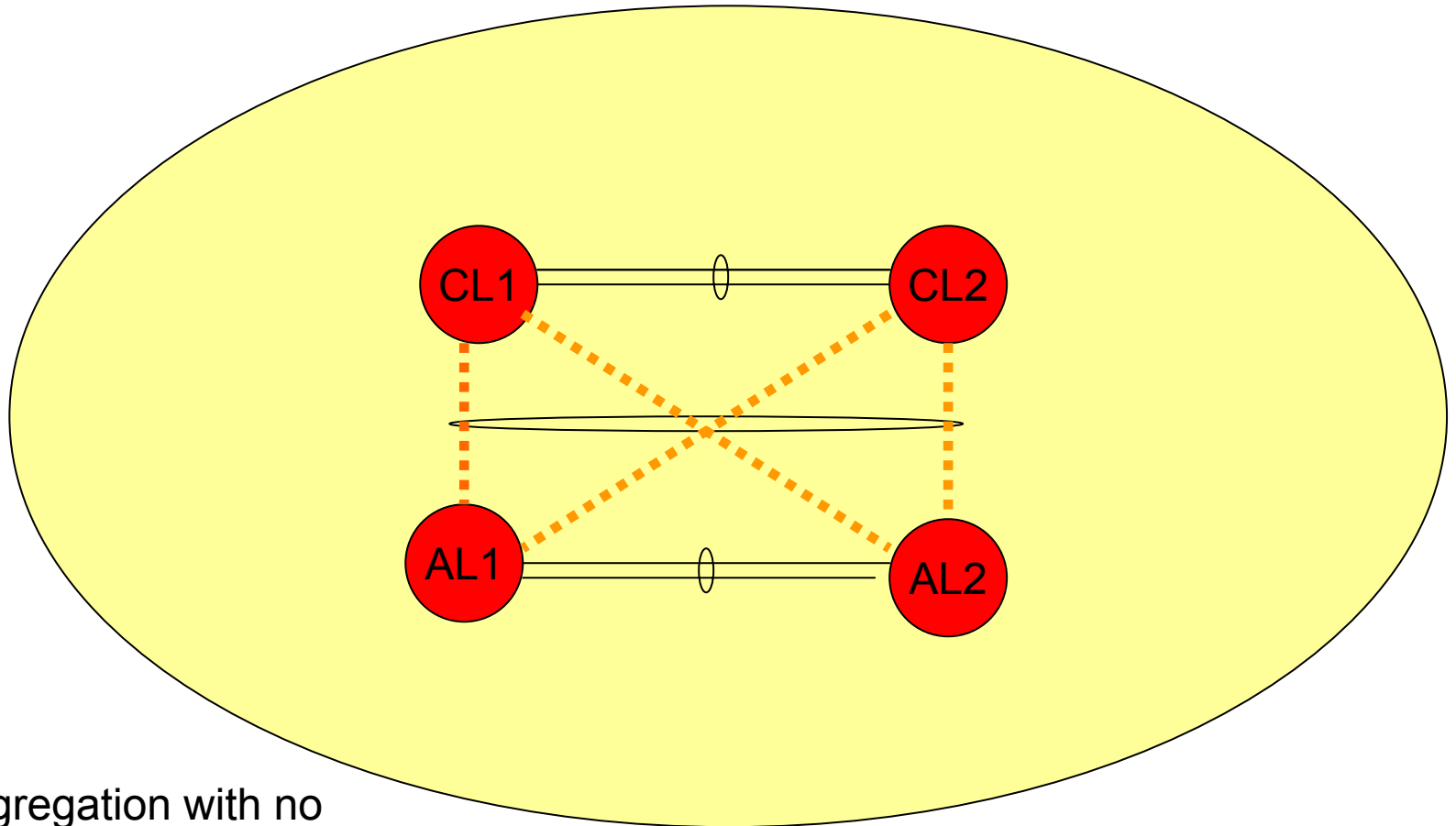
Path aggregation with no blocked links – loop protection through other means

# Proposed solution - Square



Path aggregation with no  
blocked links – loop protection  
through other means

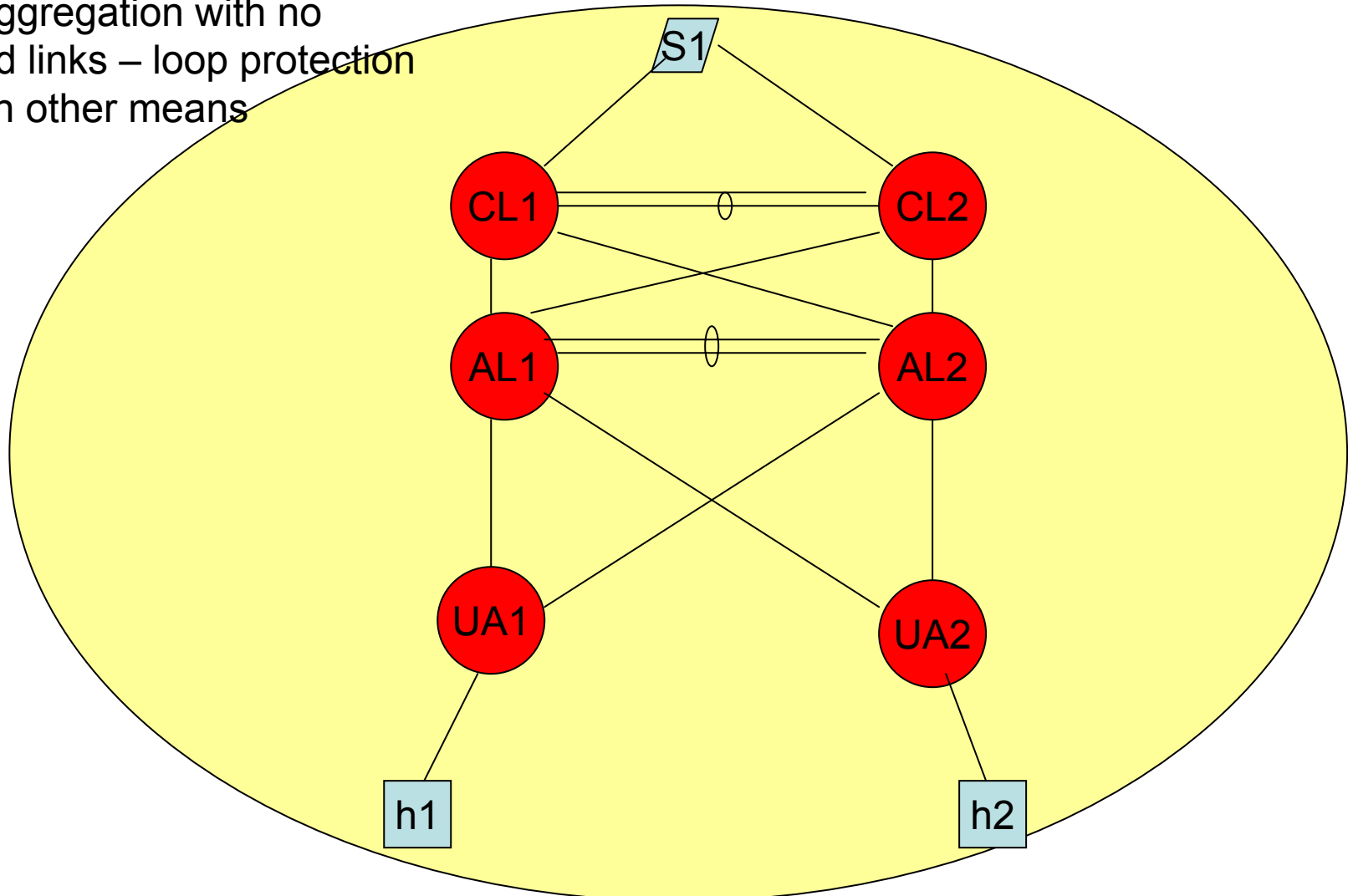
# Proposed Solution – full mesh



Path aggregation with no  
blocked links – loop protection  
through other means

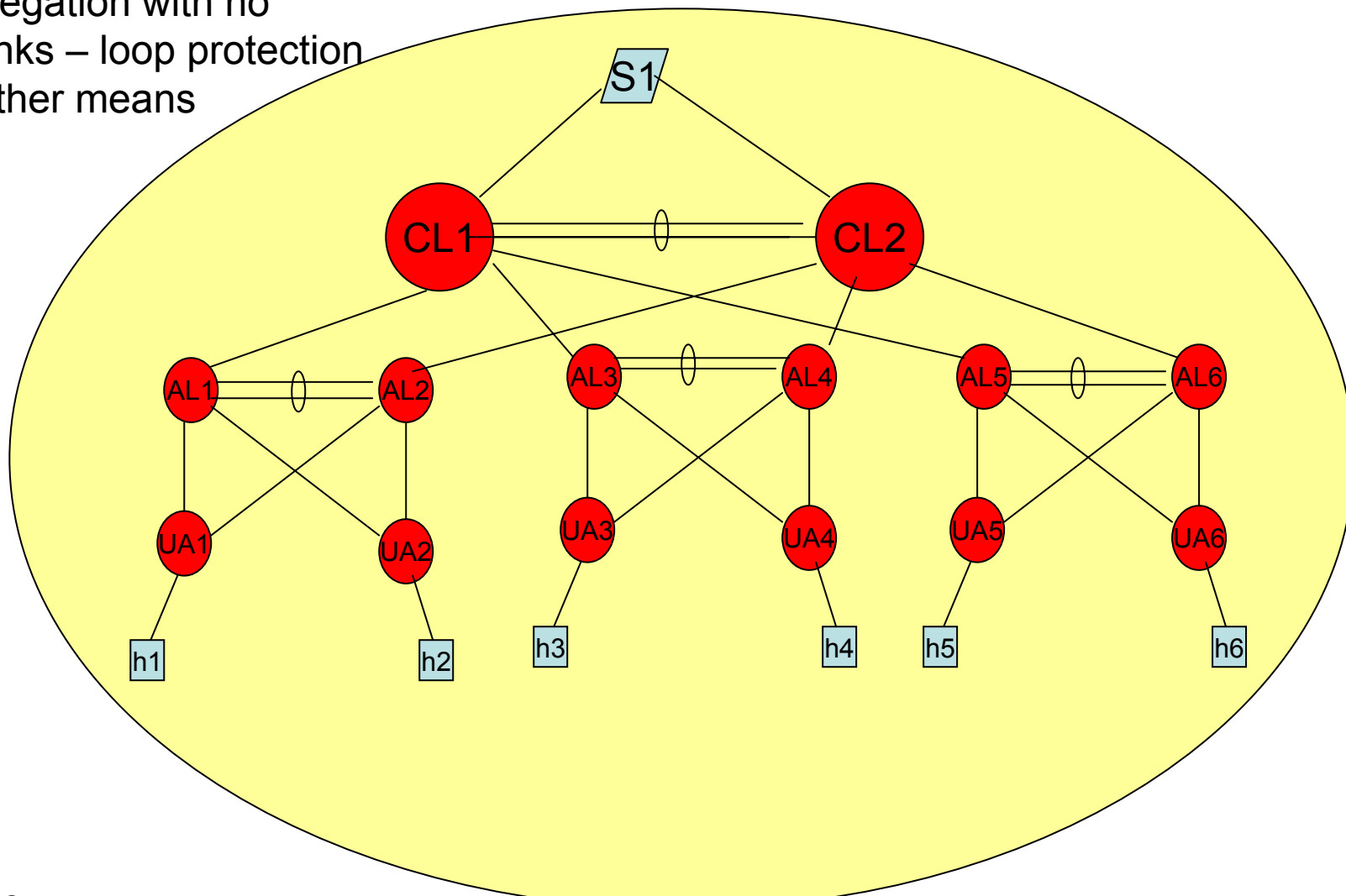
# Proposed Solution extended

Path aggregation with no blocked links – loop protection through other means



# Proposed Solution extended with hierarchy

Path aggregation with no blocked links – loop protection through other means



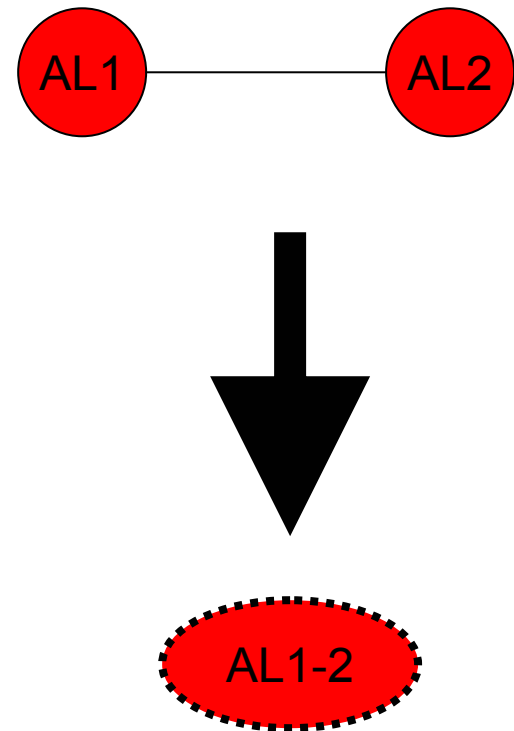
# Is it worth doing this?

- **Broad Market Potential**
  - Proprietary solution has gotten huge customer attention and has been widely deployed
- **Compatibility**
  - Proposed architecture is compatible if existing technologies: need to define 802.3ad interoperability and 802.1D/w support
- **Distinct Identity**
  - There is no comparable L2 solution available currently
- **Technical Feasibility**
  - Solution is implemented and widely deployed
- **Economic Feasibility**
  - Very minimal HW requirements, mostly software development



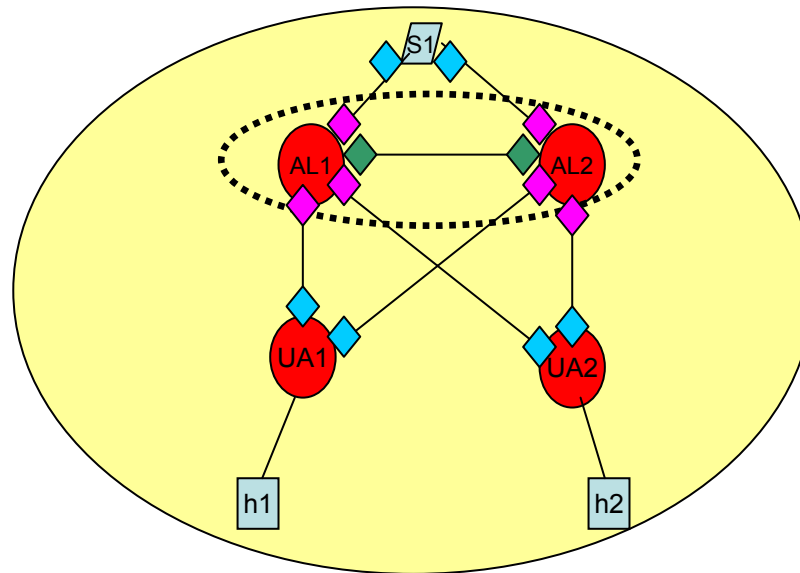
# Solution Proposal

- Provide Path aggregation by
  - Combining two ALs into one “logical entity” for the path aggregated links
  - Introduce protocol between ALs to exchange necessary information, or extend existing (potentially 802.3ad)
  - Introduce protocol between UA and AL, or leverage existing (potentially 802.3ad)
  - Define new port types to be path-aggregate-able, assign Id for aggregation-group (=set of ports that are path-aggregate-able)
  - Introduce status for path-aggregate-able links
    - path-aggregated true/false



# Protocol Interactions

New path-aggregation protocol on  
“logical-entity” side and 802.3ad  
on single-homed side



802.3ad LACP

New path aggregation link protocol/interoperable with 802.3ad

New path aggregation “logical entity”  
protocol



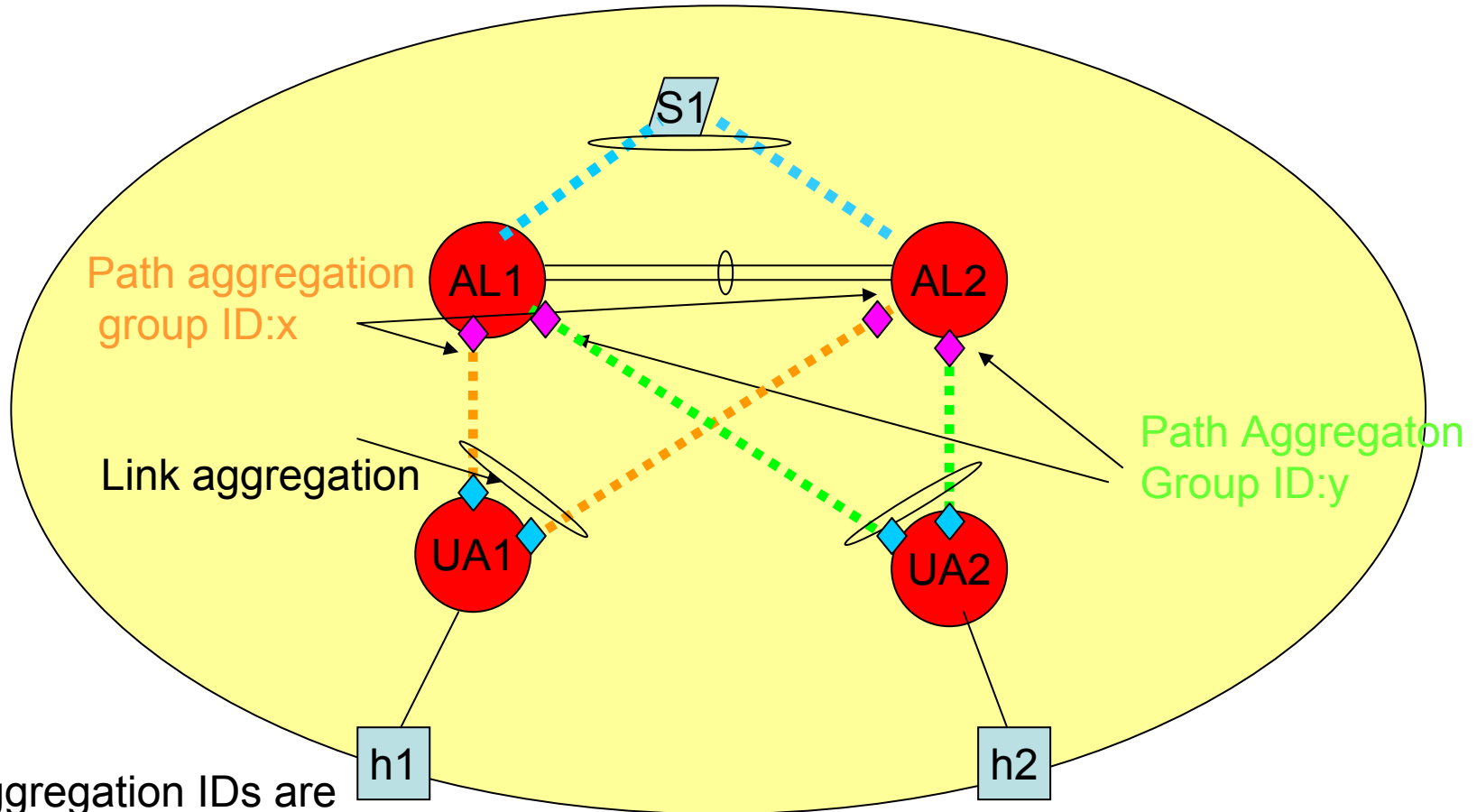
# Advantages, Disadvantages

New path-aggregation protocol on logical switch side and 802.3ad on single-homed side

- Advantage:
  - Installed based of 802.3ad installations would be compatible to new path aggregation solution
- Disadvantage
  - 802.3ad adjustments might be required
  - 802.3ad would not be a “point-to-point-only” protocol anymore

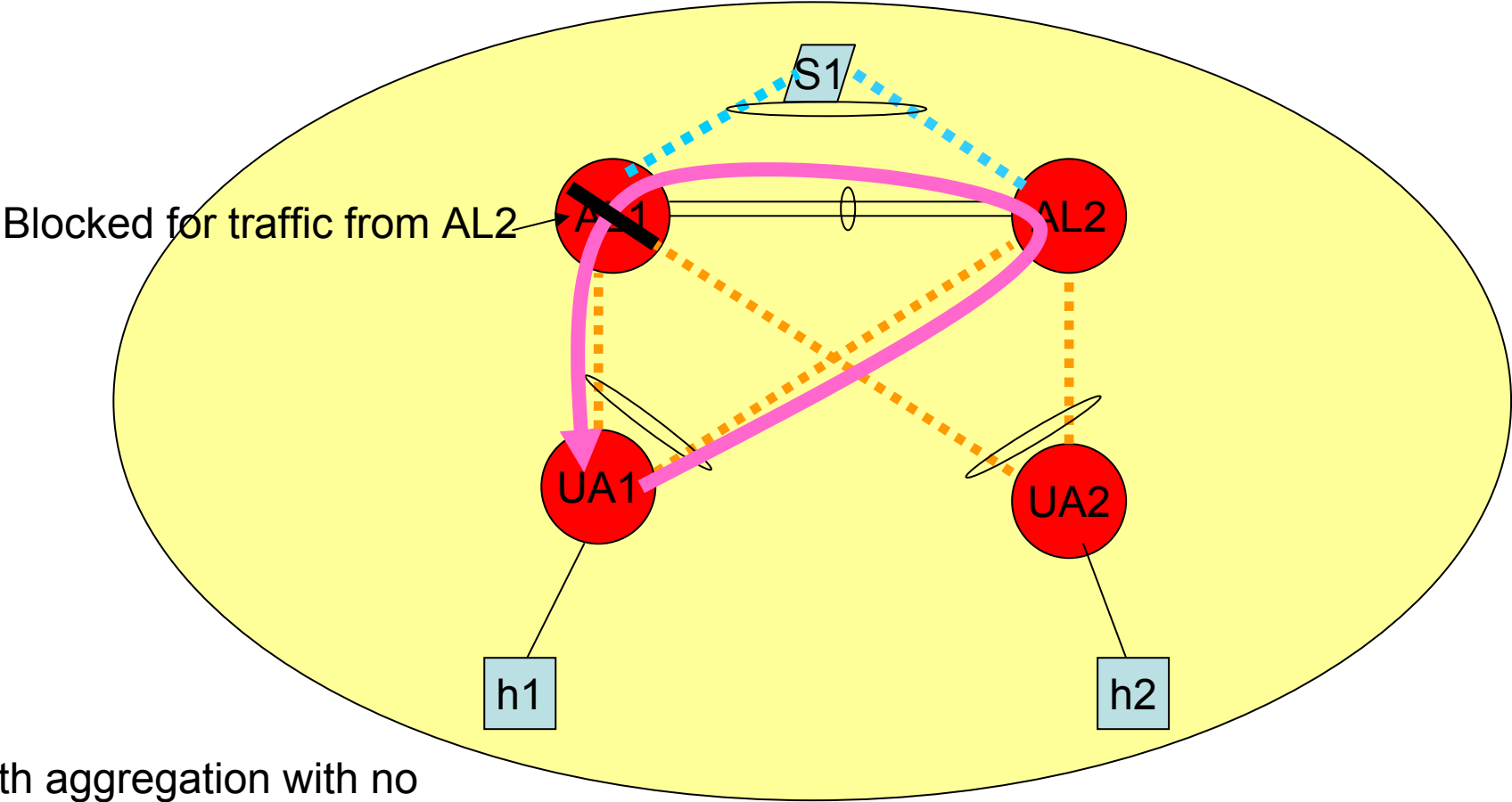
# Proposed Solution

## Path Aggregation ID



Path aggregation IDs are  
Used to identify a group of “bundled/multi-homed”  
Links.

# Proposed Solution – Loop avoidance



Path aggregation with no blocked links – loop protection through other means

# Proposed solution

## “logical-entity” message exchange 1/3

- **Hello message**

- Each AL periodically transmits and listens for this message. If for certain time interval the AL doesn't receive this message, it will assume the other AL or the inter-AL-trunk is down. It will change the PA ports status to “non-path-aggregate-able”, clean up the communication channel, and modify the forwarding database.

- **Learn MAC Address**

- When an AL learns a new MAC address on any of its ports, it notifies the other AL about the MAC address.

- **MAC Address Age out**

- When an AL ages out a MAC address, it will notify the other AL.

# Proposed solution

## “logical-entity” message exchange 2/3

- **Delete MAC Address**
  - When an AL deletes a MAC address, it will notify the other AL.
- **MAC Address Table exchange**
  - Each AL periodically transmits its MAC Address database for synchronization purpose.

# Proposed solution

## “logical-entity” message exchange 3/3

- **PA-link Down**

- When the last port in PA group goes down, the AL will notify the other AL. When an AL receives this message, it will change the corresponding PA-link to status “path-aggregated”.

- **PA-link Up**

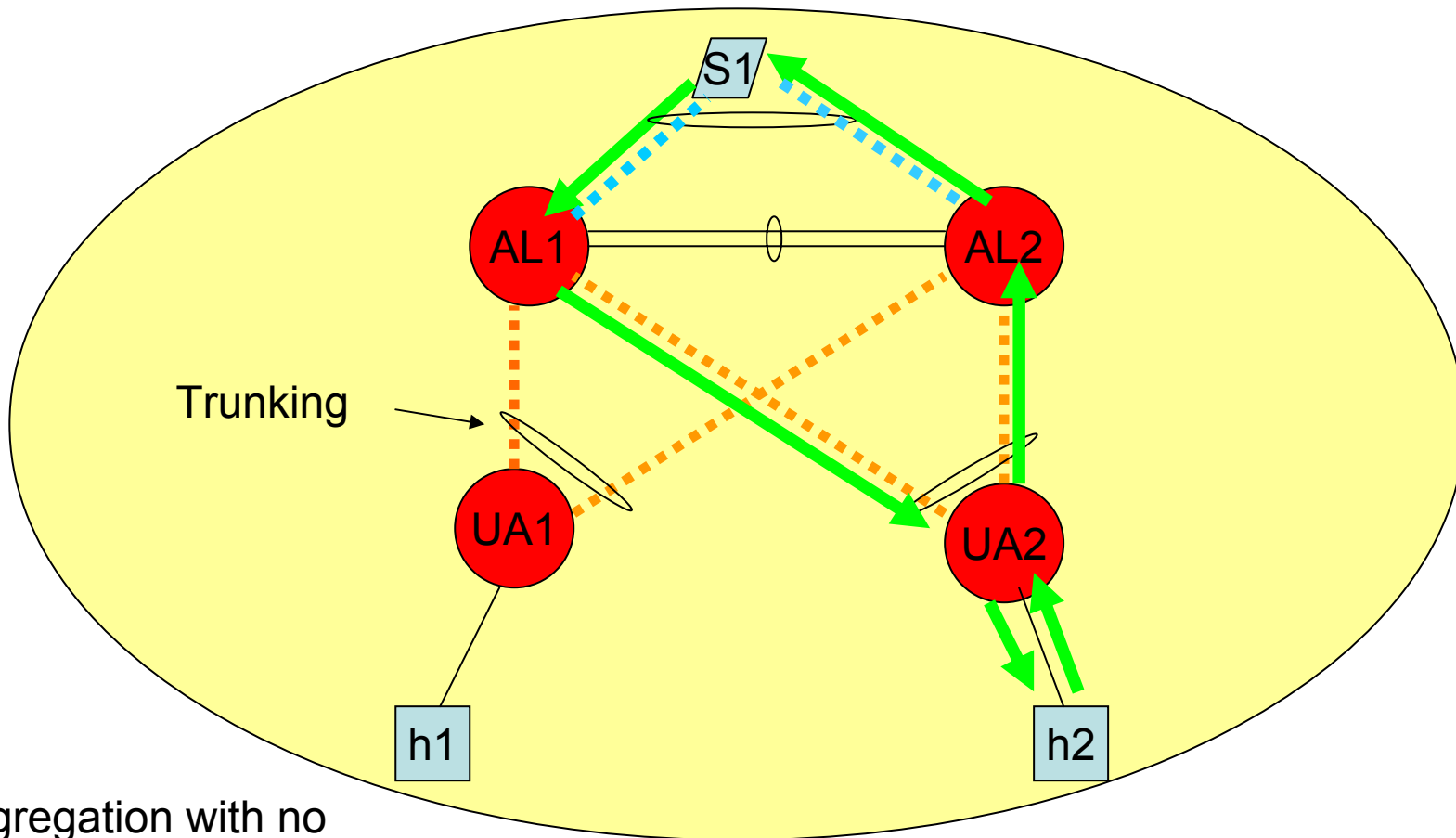
- When the first port in PA group goes up, the AL will notify the other AL. When an AL receives this message, it will check the same PA group ports, if there is a port up, it will change the corresponding PA group status from path-aggregated: false to status path-aggregated true.

- **Port Down**

- When a port with type non-PA goes down, the AL will notify the other AL. When an AL receives this message, it will clean up all the MAC address learned on this remote port.

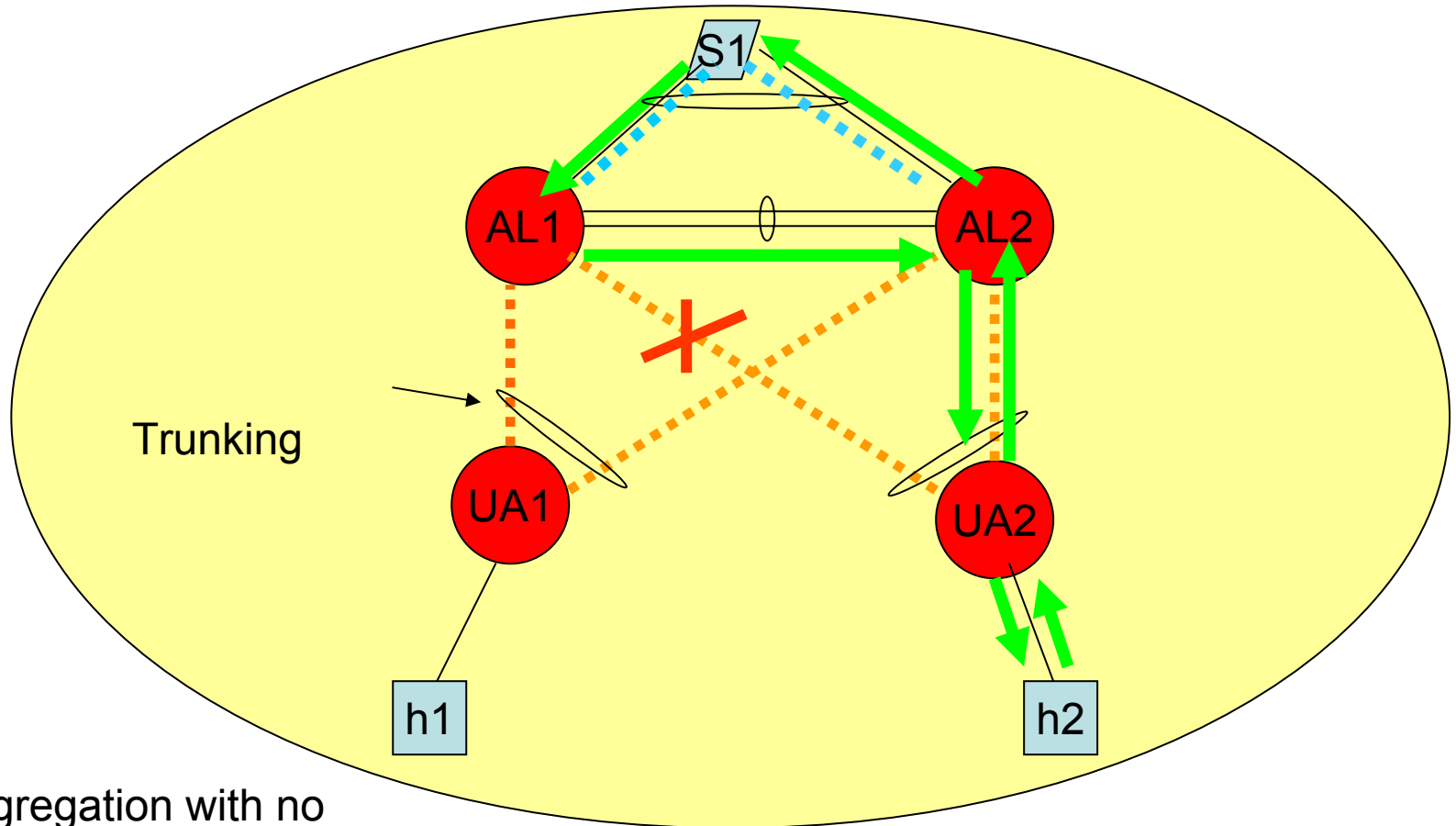


# Proposed Solution – packet flow 1/2



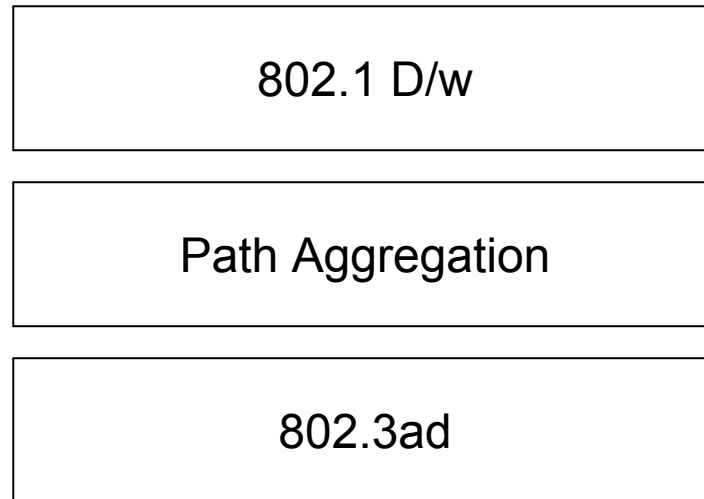
Path aggregation with no blocked links – loop protection through other means

# Proposed Solution – packet flow 2/2

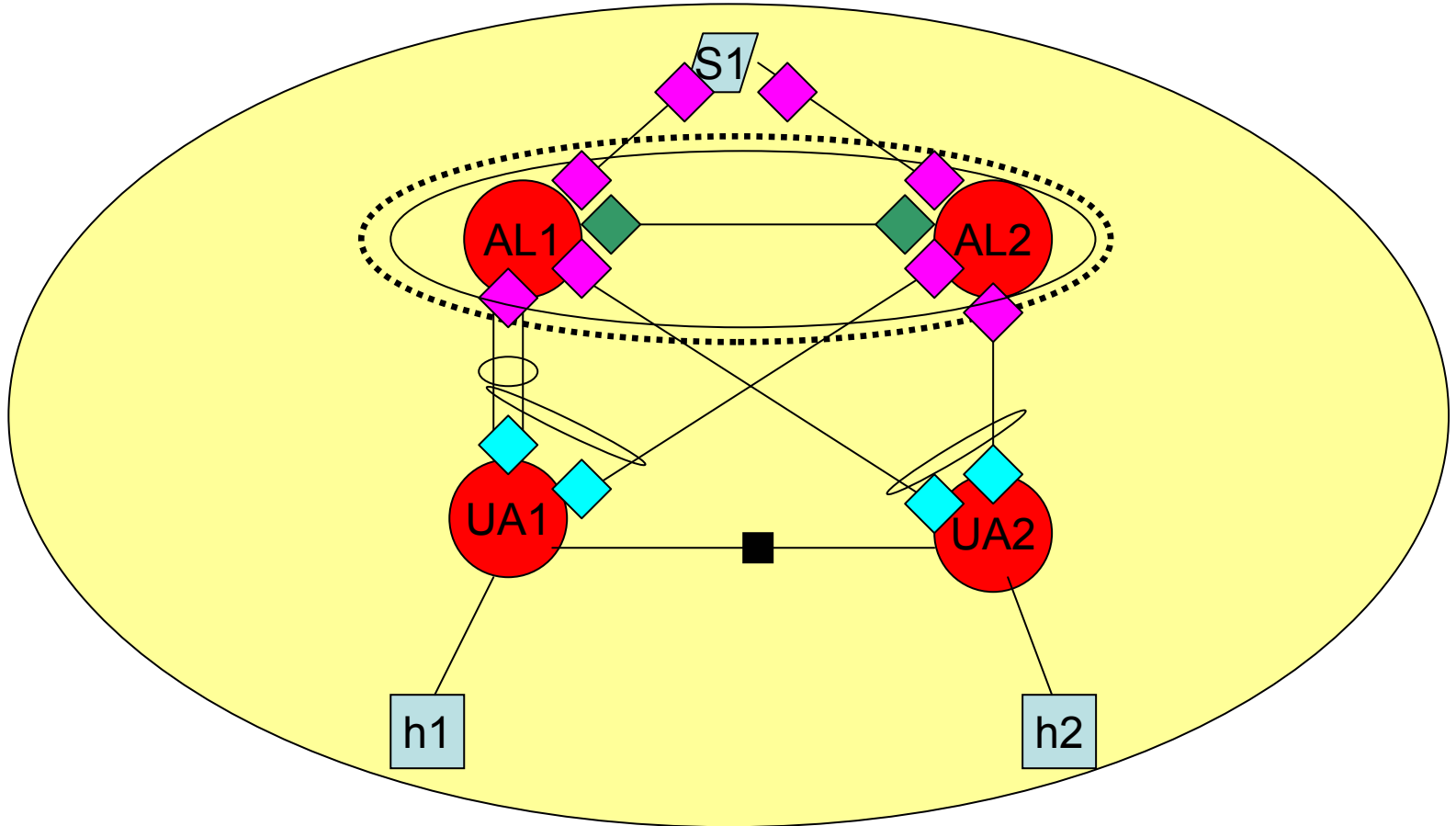


Path aggregation with no blocked links – loop protection through other means

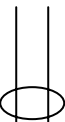
# Path Aggregation and 802.3ad, 802.1D/w



# Path Aggregation and 802.3ad, 802.1D/w 2)



Link aggregation 802.3ad:



Thank you