



# Topology Discovery and Changes

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# Auto-Topology Auto-Discovery

”the boot protocol”

- Topology detection
  - Ring/bus, number of rings, number of nodes
- MAC address to node number/ ring number detection
  - Facilitate multi-link routing
  - Addressing, routing, neighborhood is dynamically learned
- Link configuration parameter setting/verification

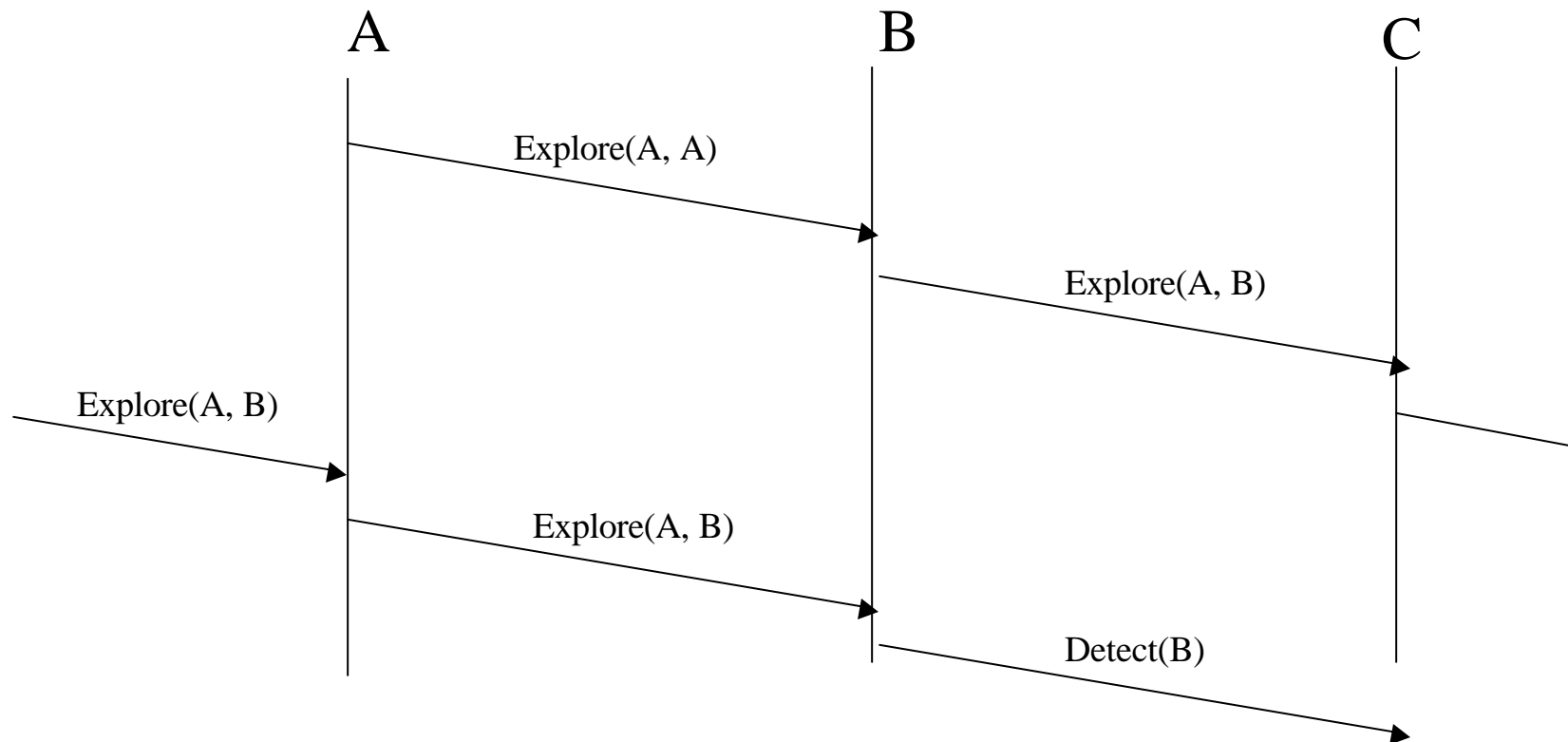


# Basic Model

- Every unidirectional fiber should be discovered
- Every node support passive bypass
- Ring topology with one designated "Topology discovery master" node
- Master in charge of discovery integrity
  - Link start-up time
  - Topology change (node addition/removal)
- Master circulates discovery messages around the ring
  - Insertion and removal of messages

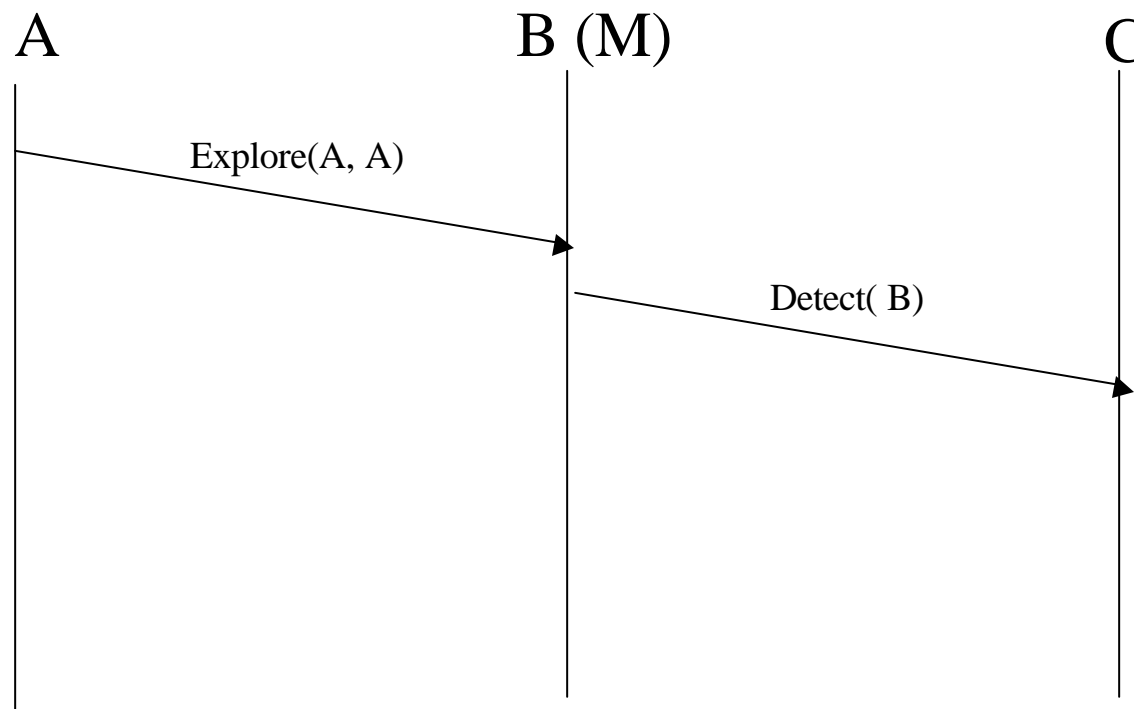
# Start—Initial Explore

- $B > A > C$



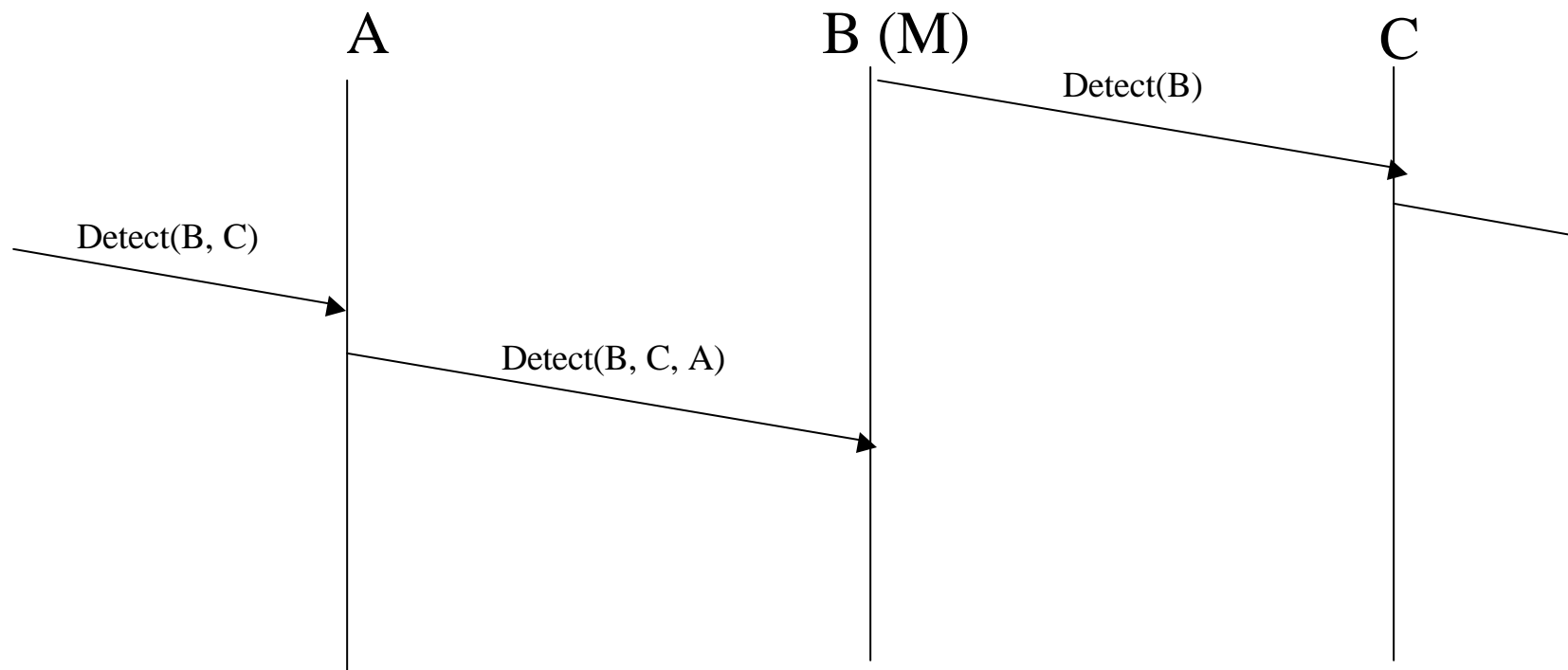
# Start —Discovery Master

- B is discovery master



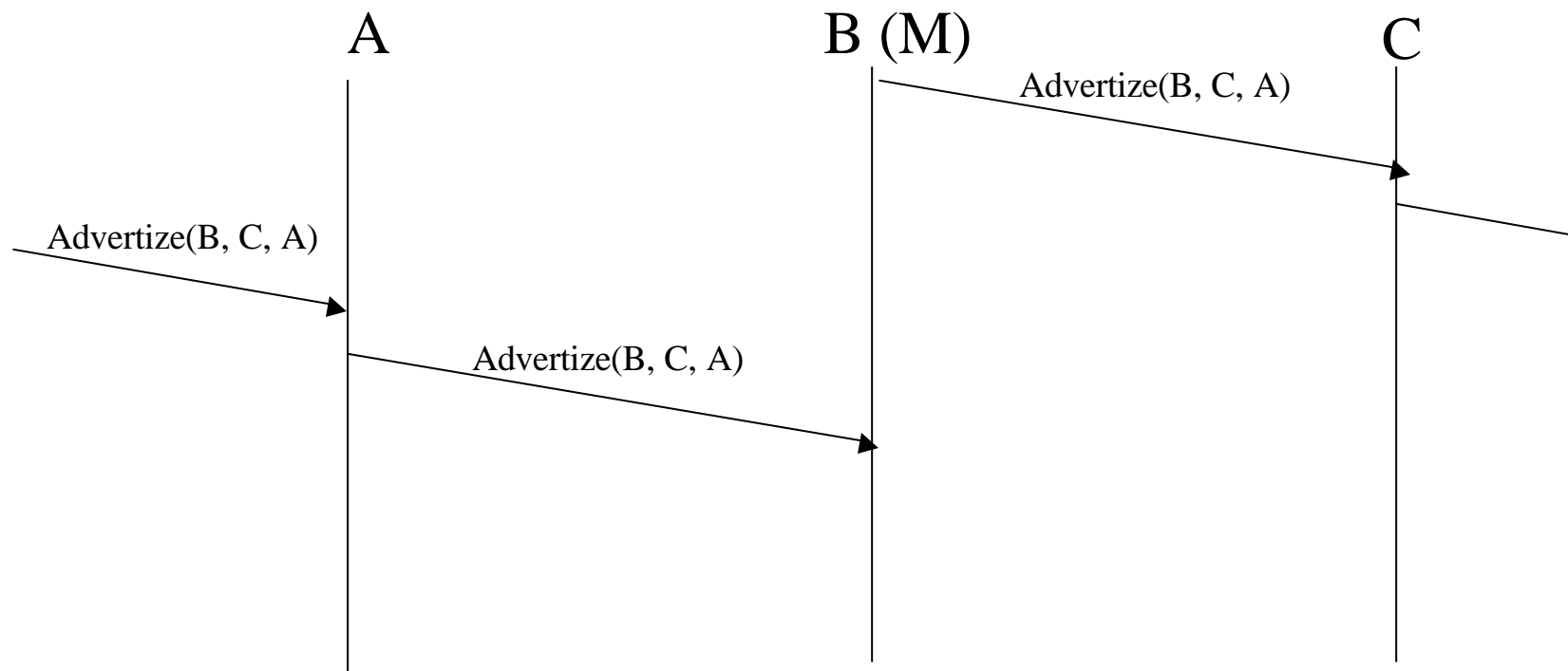


# Phase 1—Topology Detection





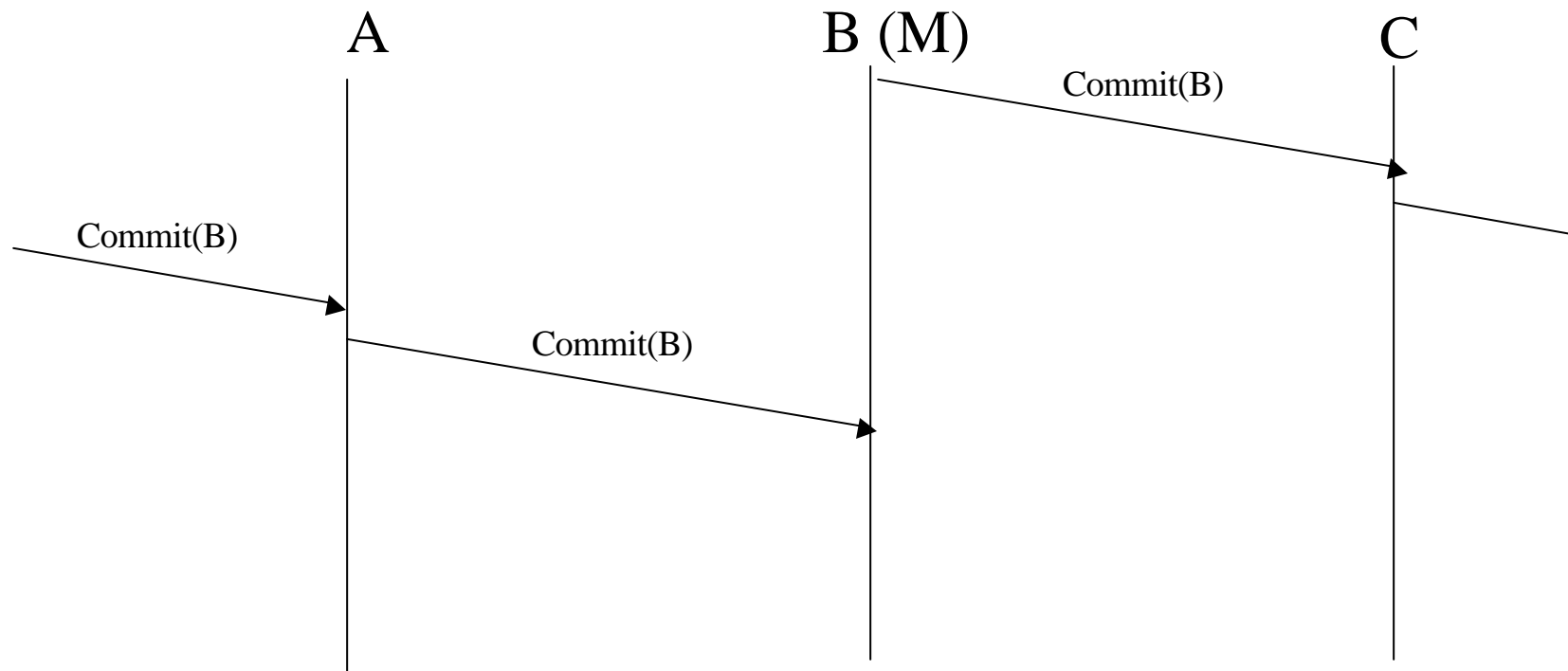
# Phase 2—Topology Advertisement





# Phase 3—Commit

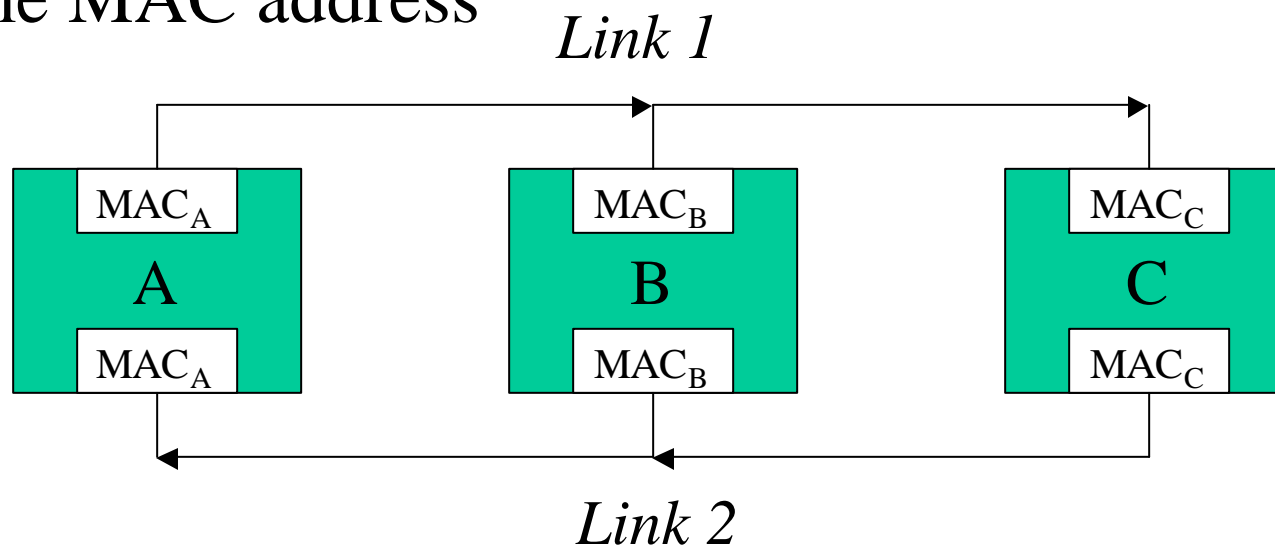
- Link may be inconsistent during advertizement
- "Freeze"





# Multi-link Topologies

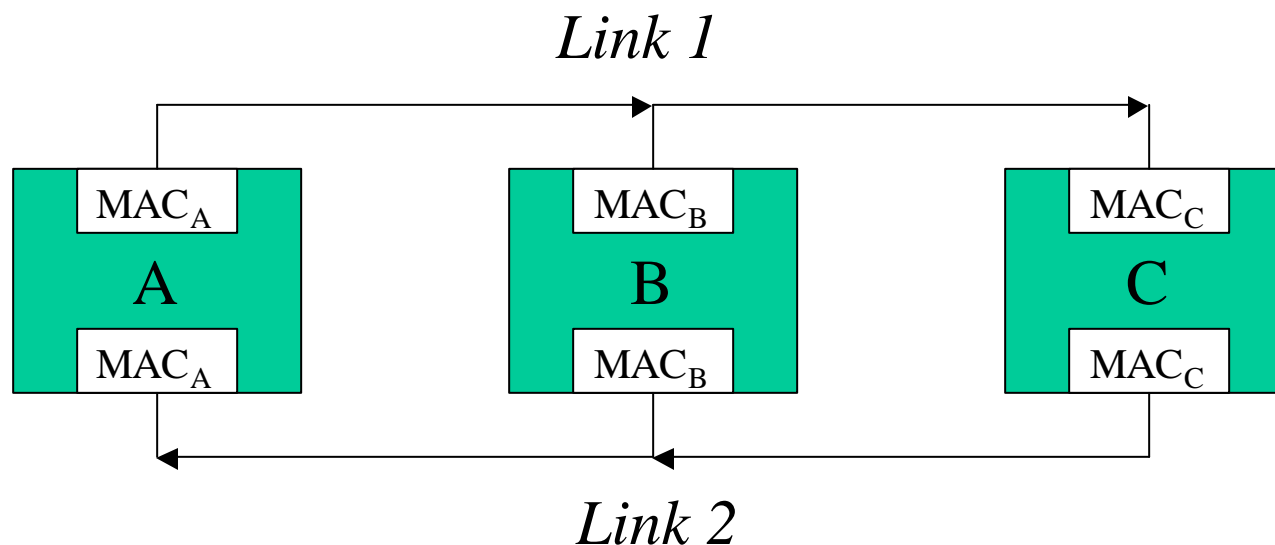
- Starting point: all (physical) interfaces in a node that belong to the same multi-link group have the same MAC address



# Node Maps

- Link routing: choose best interface to reach a node

MAC address	<i>Link 1</i>	<i>Link 2</i>
MAC <sub>A</sub>	0	2
MAC <sub>B</sub>	1	1
MAC <sub>C</sub>	2	0



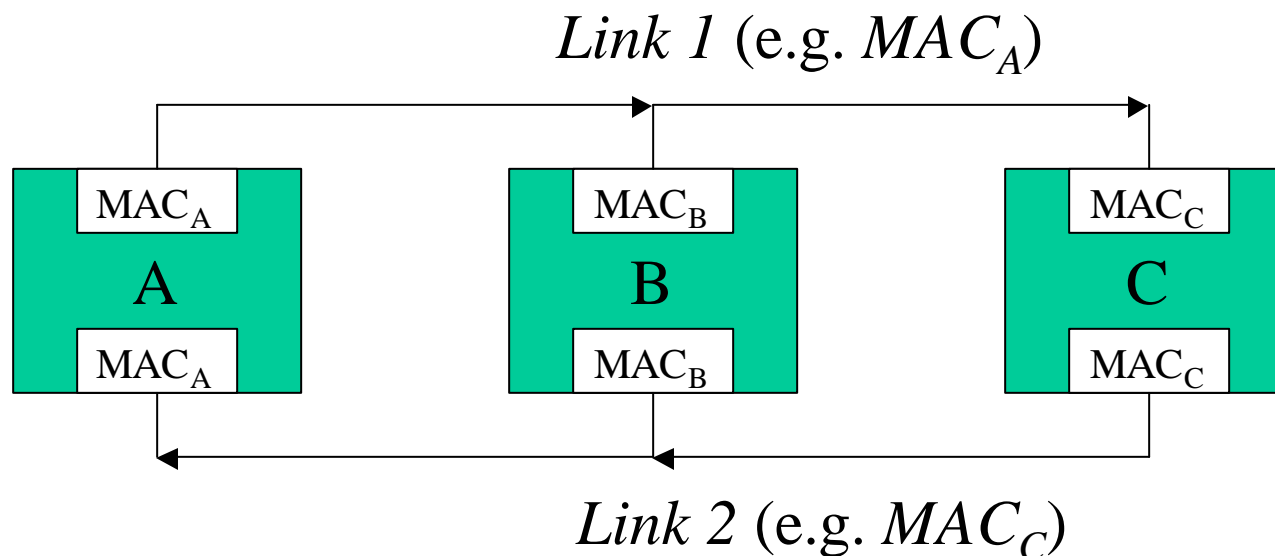


# Node Maps 2

- Collected in phase 1 (Detect)
  - A node appends MAC address and node number to Detect message
- Distributed in phase 2 (Advertize)
  - A node extracts node map information from Advertize message
  - Partial information: concerns current link only
  - Full node map is union of all advertized node maps

# Link Identifiers

- Same format as MAC address (48 bits)
- Assigned by master
  - Recommendation is to use physical MAC address of master's interface on that link

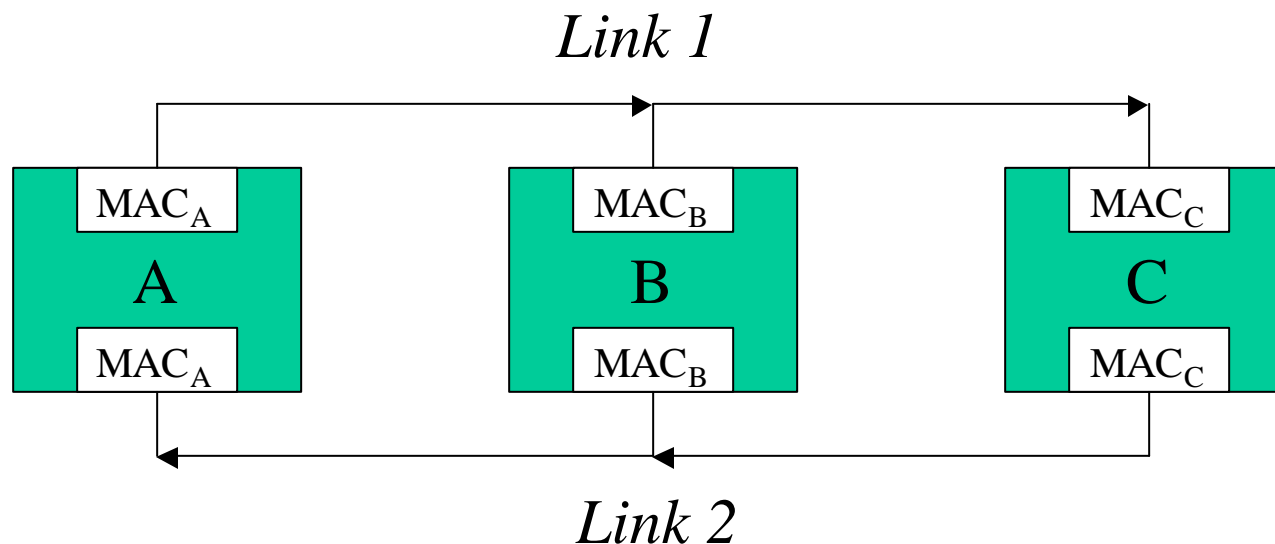




# Link Maps

- Mapping from link identifier to RingID
  - Scope of RingID is current link

Link ID	<i>Link 1</i>	<i>Link 2</i>
<i>Link 1</i>	0	1
<i>Link 2</i>	1	0





# Constructing a Link Map

- Master constructs initial link map
  - contains all links the master *knows*
  - A node  $n$  knows a link  $l$  if  $n$  is master on  $l$ , or if  $n$  has received an Advertizement for  $l$
- If a node receives in a Detect message a link map that does not contain a link known by that node:
  - Allocate RingID
  - Append new link map entry to link map
- Master distributes full link map in Advertizement messages
  - Will contain all links known on the link



# Link Configuration Parameters

- Values need to be consistent among the nodes
  - Total bandwidth/resources available
  - resources reallocation (enabled/disabled)
  - Initial resources distribution (centralized/distributed)
  - bandwidth reuse (enabled/disabled)
  - Link MTU



# Parameter Negotiation

- Master distributed proposed setting
  - Piggybacked on Advertisement message
- Nodes reject/accept proposed setting
  - Reject flag associated with each parameter
  - Note: node may not change proposed setting
- If proposed setting rejected, Topology Discovery does not proceed to phase 3