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Ethernet Fabrics 101

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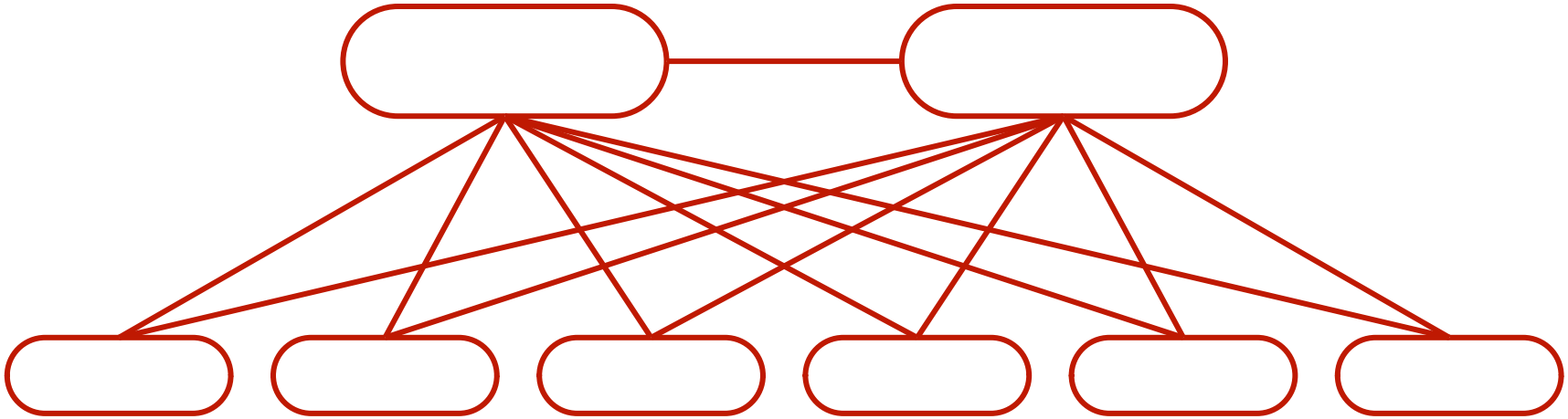
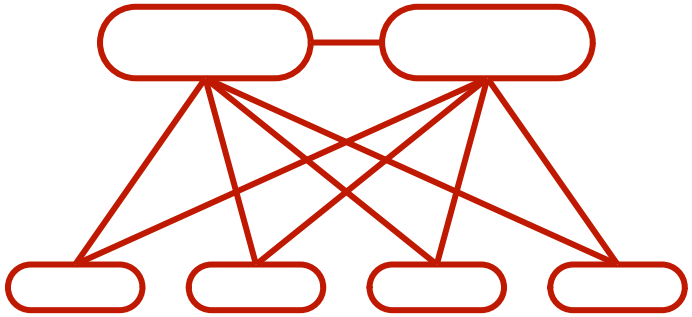
Networking is Evolving



What's this?

Network Characteristics

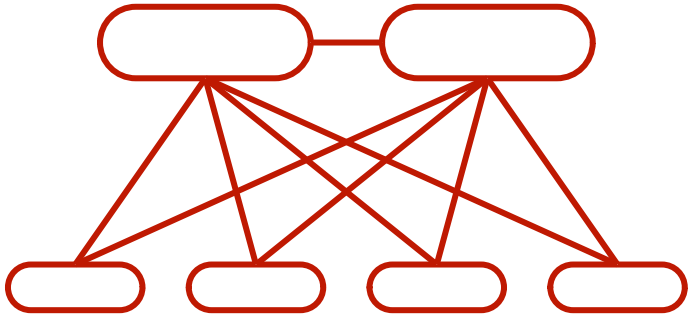
- Cost
- Link Redundancy
- Hardware Redundancy
- Software Redundancy
- Configuration Complexity



Is the traditional way still the right way?

Bisectional Flow Characteristics

- Bandwidth
- Latency
- Flow Size



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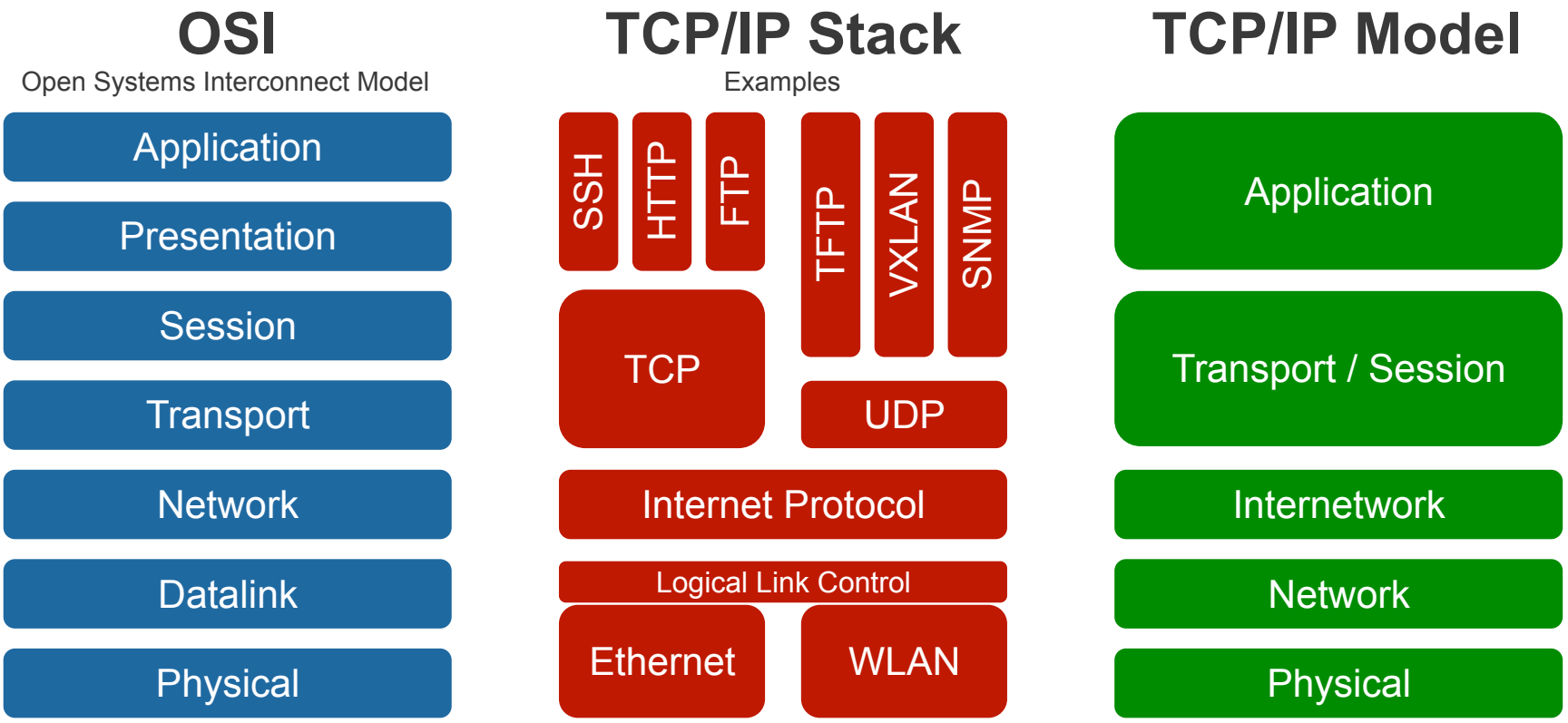
Networking 101



Three Key Terms

Router Switch Bridge

Let's define our terms!

Can we route at Layer-2?

RBridge

Hardware Overview

VDX Family of Switches

VDX 8770

VDX8770 Details

- Industry Leading Chassis
  - 4 I/O Slot Version
  - 8 I/O Slot Version
  - Redundant Management
    - With Hypervisor
  - N+N Fan Redundancy
  - N+N Power Redundancy
  - 3,000ns Latency***
- Available Modules
  - 48x1G SFP
  - 48x10G SFP+
  - 48x10GBaseT
  - 12x40G QSFP+
  - 27x40G QSFP+**
  - 6x100G CFP2

**THIS MODULE IS NOT LINE RATE

***NOT INCLUDING 10GBASE-T

VDX Family of Switches

VDX 6940

VDX8940 Details

- VDX6790-36Q
  - 36 QSFP+ Ports
    - Either 1x40 or 4x10
  - 1 Rack Units
  - 700ns Latency

- VDX6790-144S
  - 96x10G SFP+ Ports
  - 12x40G QSFP+ or 4x100G QSFP+
  - 2 Rack Units
  - 700ns Latency

**THIS MODULE IS NOT LINE RATE

VDX Family of Switches

VDX 6740

VDX6740 Details

- VDX6740
  - 48x10G SFP+
  - 4x40G QSFP+
  - 1 Rack Unit
  - 850ns Latency
- VDX6740T & VDX6740T-1G
  - 48x10GBaseT or 1GBaseT
  - 4x40G QSFP+
  - 1 Rack Unit
  - 3,000ns Latency

**THIS MODULE IS NOT LINE RATE

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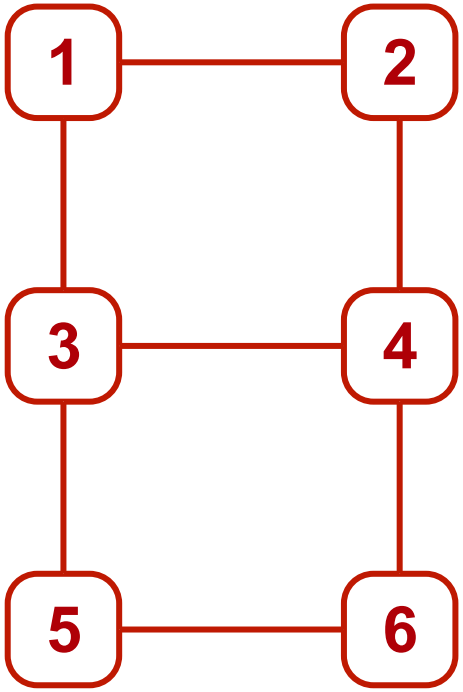
Intro to Ethernet Fabrics

Building a Useful Routed Topology

An Overview of Link State Routing

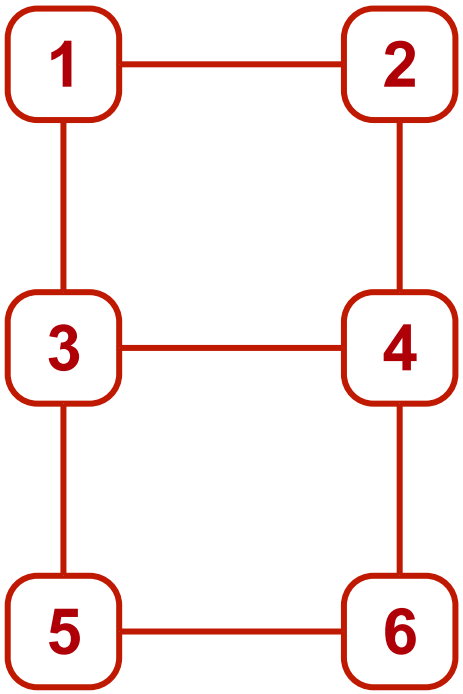
1. Identify each Node / Network
2. Form Adjacencies
3. Share Link-State Information
4. Run Dijkstra's Algorithm

Brocade's
Virtual Cluster Switching (VCS)
uses the
Fabric Shortest Path First (FSPF)
routing protocol.



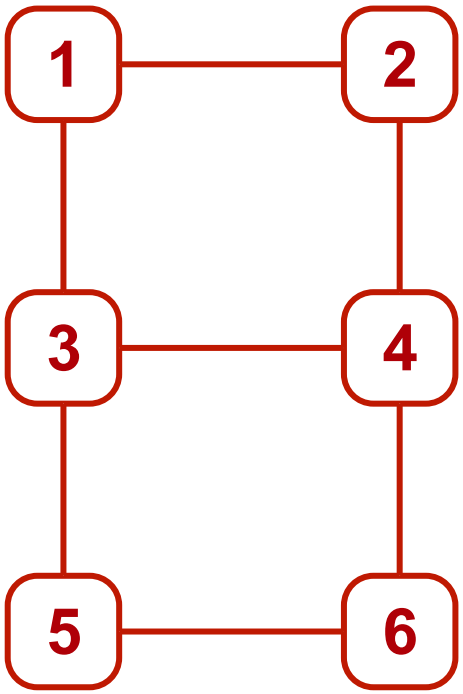
Node / Network Identification

- In Ethernet Fabrics, the terms “Node” and “Network” can be used interchangeably.
- In FSPF, each node has a unique “World Wide Name” or “WWN”.
  - Generally this is transparent to the operator.
  - FSPF was orginally designed for Fibre Channel Networks.
- Each node also gets an “RBridge ID” or “Nickname”.
  - This is configurable.
  - Used by TRILL



Forming Adjacencies

1. There are two types of ports:
   - Edge Ports
   - ISL Ports
2. ISL Characteristics
   - Must be Point-to-Point
   - Must have a link speed of 10G or greater
3. Connection Process
   - Primitives
   - Hellos
   - Fabric Joining



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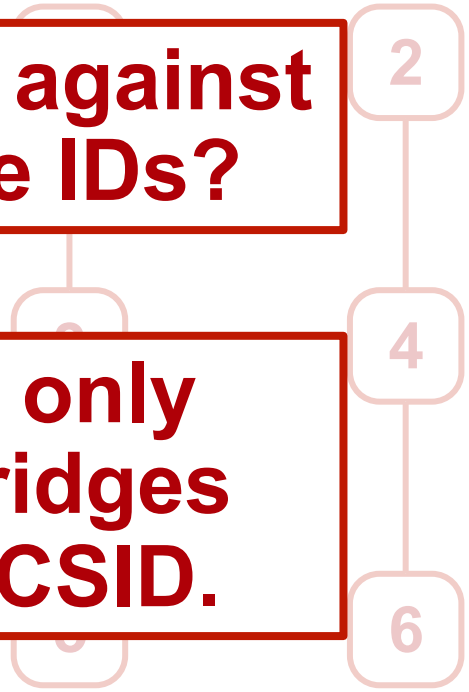
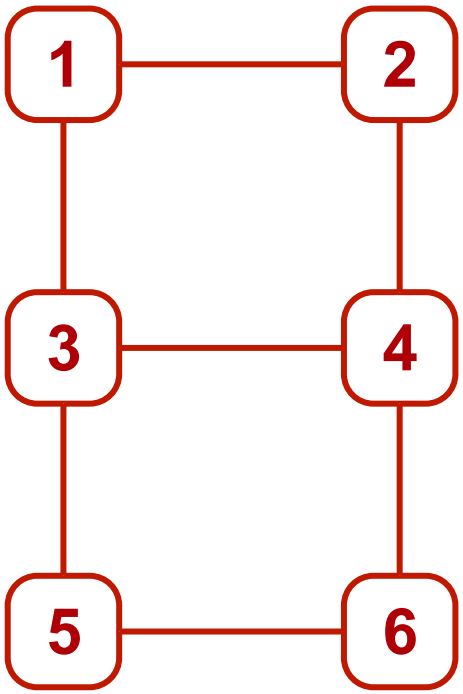
How do we protect against duplicate RBridge IDs?

Adjacencies are only formed if the RBridges have the same VCSID.



Sharing Link State Information

1. Each RBridge shares it's own link-state information with all the other Rbridges.
2. After synchronization, each RBridge has a full understanding of the Fabric topology.
3. Each link is assigned a cost, based on bandwidth.



Sharing Link State Information

1. Each RBridge shares it's own link-state information with all the other Rbridges.
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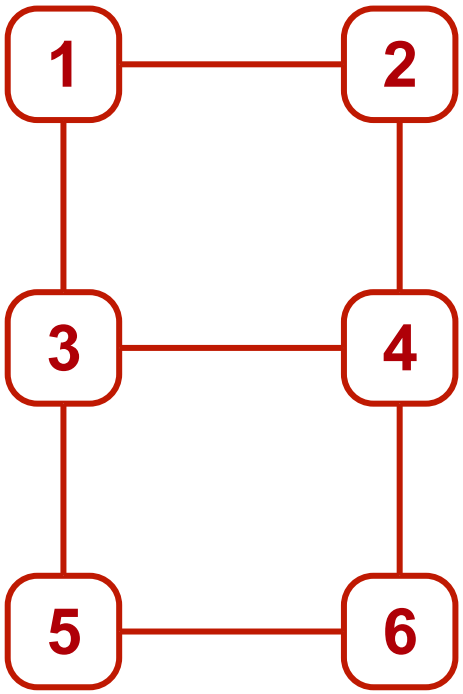
3. Dijkstra's algorithm is run
   – This algorithm is run every time a topology change occurs



Sharing Link State Information

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2. After synch
   a full unde
   topology.
3. Dijkstra's a
   – This algorithm is run every time a topology change occurs

We now know where the Rbridges are... how does this help us?

Some Useful FRP Commands

Configuring Fabric Routing Protocol

RBridge-5# **vcs vcsid 8192 rbridge-id 239 logical-chassis enable**

Configuring Fabric Routing Protocol

Viewing Inter-Switch Links

RBridge-5# **show fabric isl rbridge-id 3**

Rbridge-id: 3 #ISLs: 4

Src Index	Src Interface	Nbr Index	Nbr Interface	Nbr-WWN	BW	Trunk	Nbr-Name
105	Te 3/0/42	109	Te 7/0/46	10:00:50:EB:1A:61:5D:6A	40G	Yes	"RBridge-7"
108	Te 3/0/45	104	Te 101/0/41	10:00:50:EB:1A:A4:19:D8	30G	Yes	"RBridge-101"
112	Fo 3/0/49	113	Fo 13/0/50	10:00:50:EB:1A:AE:97:EC	40G	Yes	"RBridge-13"
113	Fo 3/0/50	112	Fo 17/0/49	10:00:50:EB:1A:E7:43:E8	40G	Yes	"RBridge-17"

RBridge-5#

```
RBridge-5# vcs vcsid 8192 rbridge-id 239 logical-chassis enable

RBridge-5# show fabric isl rbridge-id 4

Rbridge-id: 4   #ISLs: 3

 Src      Src          Nbr      Nbr
Index  Interface     Index  Interface           Nbr-WWN                BW   Trunk  Nbr-Name
-----------------------------------------------------------------------------------------
104    Te 4/0/41      108   Te 2/0/45     10:00:50:EB:1A:A4:29:AC   40G   Yes   "RBridge-2"
112    Fo 4/0/49      113   Fo 11/0/50    10:00:50:EB:1A:A4:2B:98   40G   Yes   "RBridge-11"
113    Fo 4/0/50      112   Fo 16/0/49    10:00:50:EB:1A:DE:35:08   40G   Yes   "RBridge-16"

RBridge-5# show fabric route topology dest-rbridge-id 101 src-rbridge-id 4
Src    Dst    Out    Out            ECMP             Nbr    Nbr
RB-ID  RB-ID  Index  Interface      Grp  Hops  Cost  Index  Interface      BW   Trunk
-----------------------------------------------------------------------------------
4      101    112    Fo 4/0/49      14   4     2000  113    Fo 11/0/50     40G   Yes
       101    104    Te 4/0/41      14   4     2000  108    Te 2/0/45      40G   Yes
RBridge-5#
```

Link State Routing - FAQ

- Does FSPF support Equal Cost Multi-Path?
- Is the FSPF protocol publically defined?
- Is the FSPF MIB publically defined?
- What configuration options are available to me?
- Can I change the WWN to RBridge ID mapping?

More Questions?

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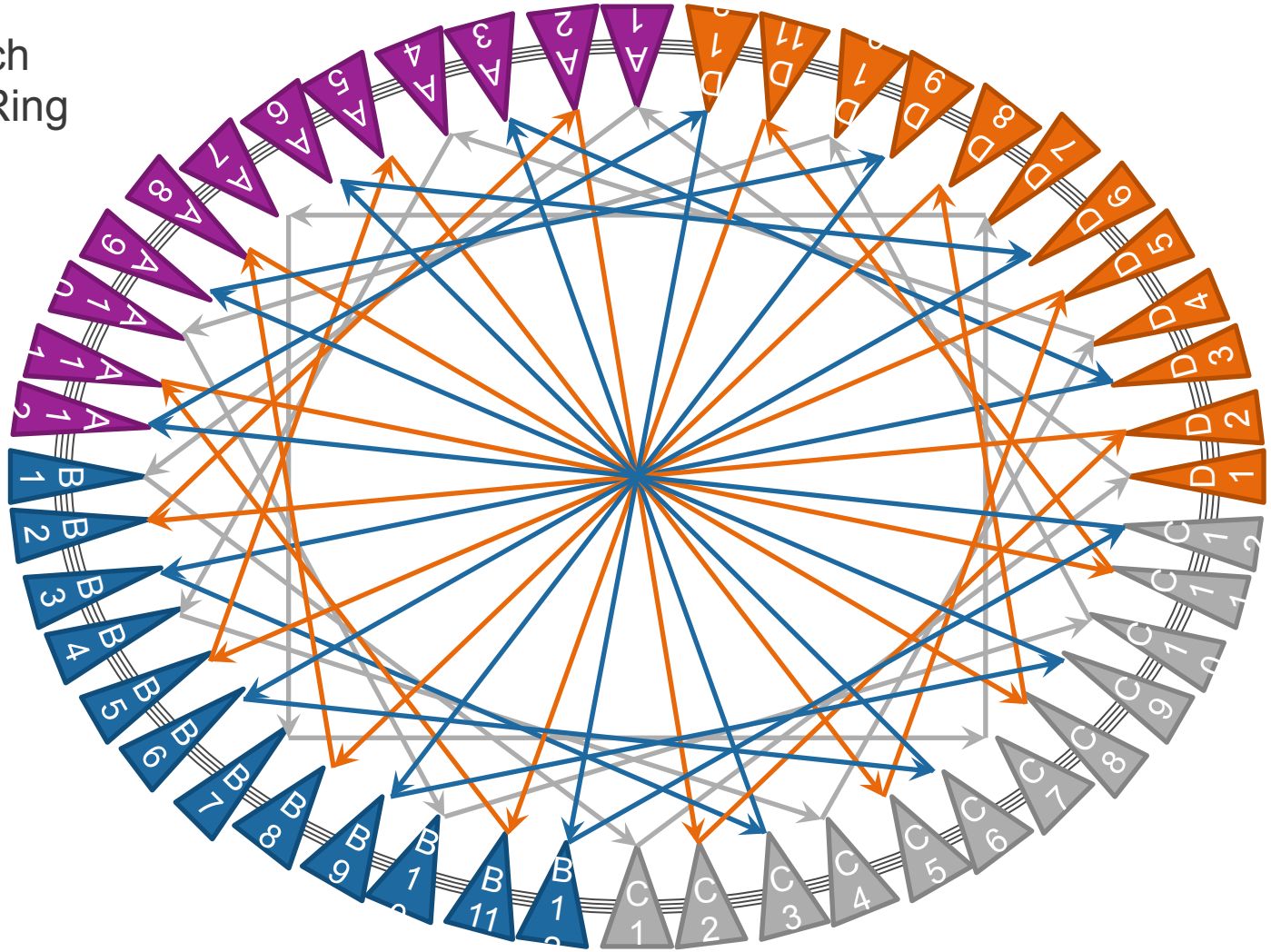
Bifurcated Ring Topology

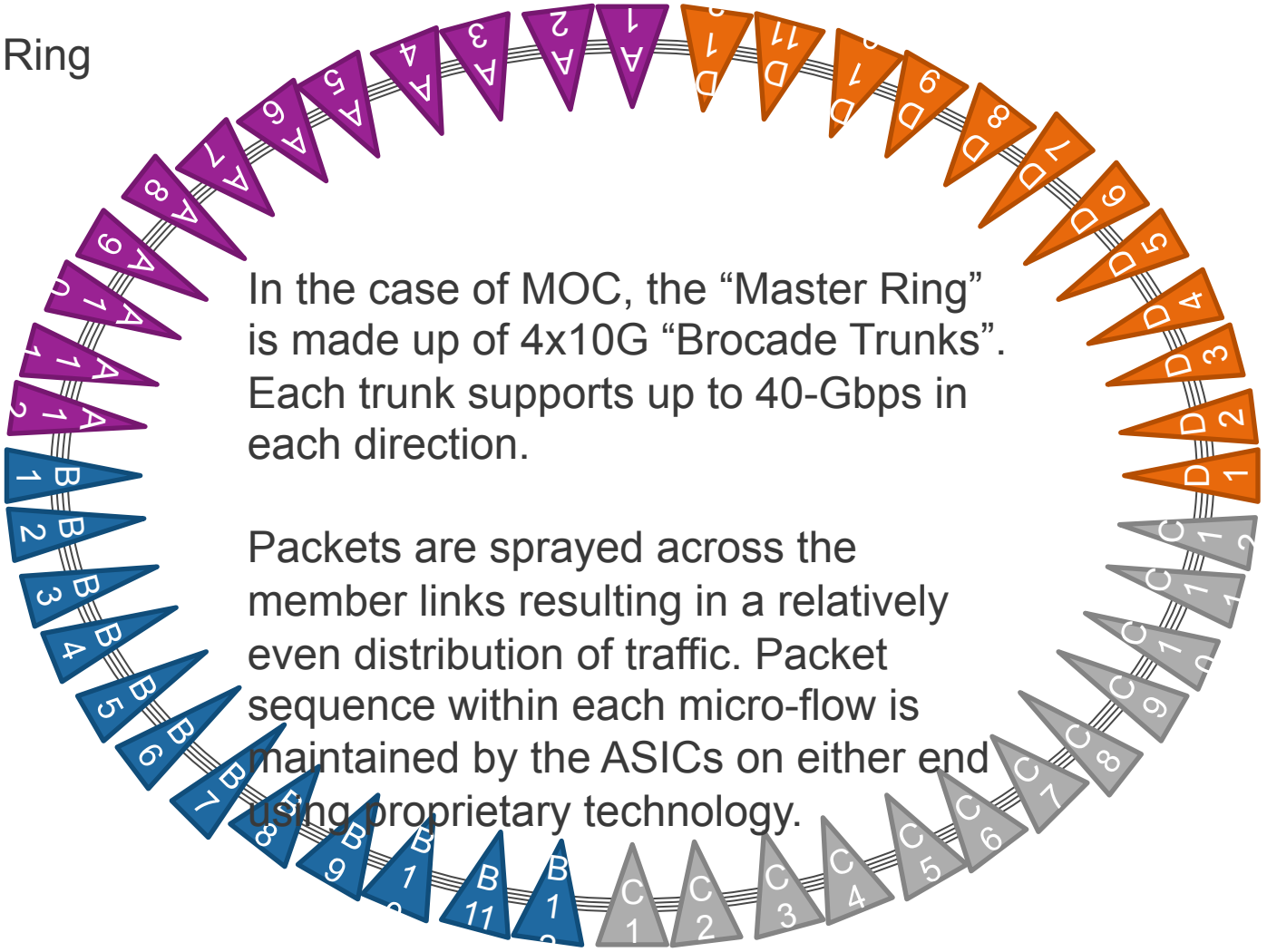
48-Switch
Bisected Ring



Bisected Ring Overview

- Theory
  - Essentially a two-dimensional torroidal mesh.
    - Includes a “Master Ring”, that connects all the switches.
    - Includes several “Shortcut Rings”, that bisect the “Master Ring”.
- Practical Application
  - The network is divided into four “Quadrants”.
    - A, B, C and D.
  - The “Quadrants” are deployed as evenly as possible.
    - No quadrant should ever have more than one more switch than any other quadrant.
  - “Peer” switches in each quadrant are interconnected with Shortcut Rings.
    - i.e. A1 connects to B1, C1 and D1.
    - There are three patterns for the Shortcut Rings.

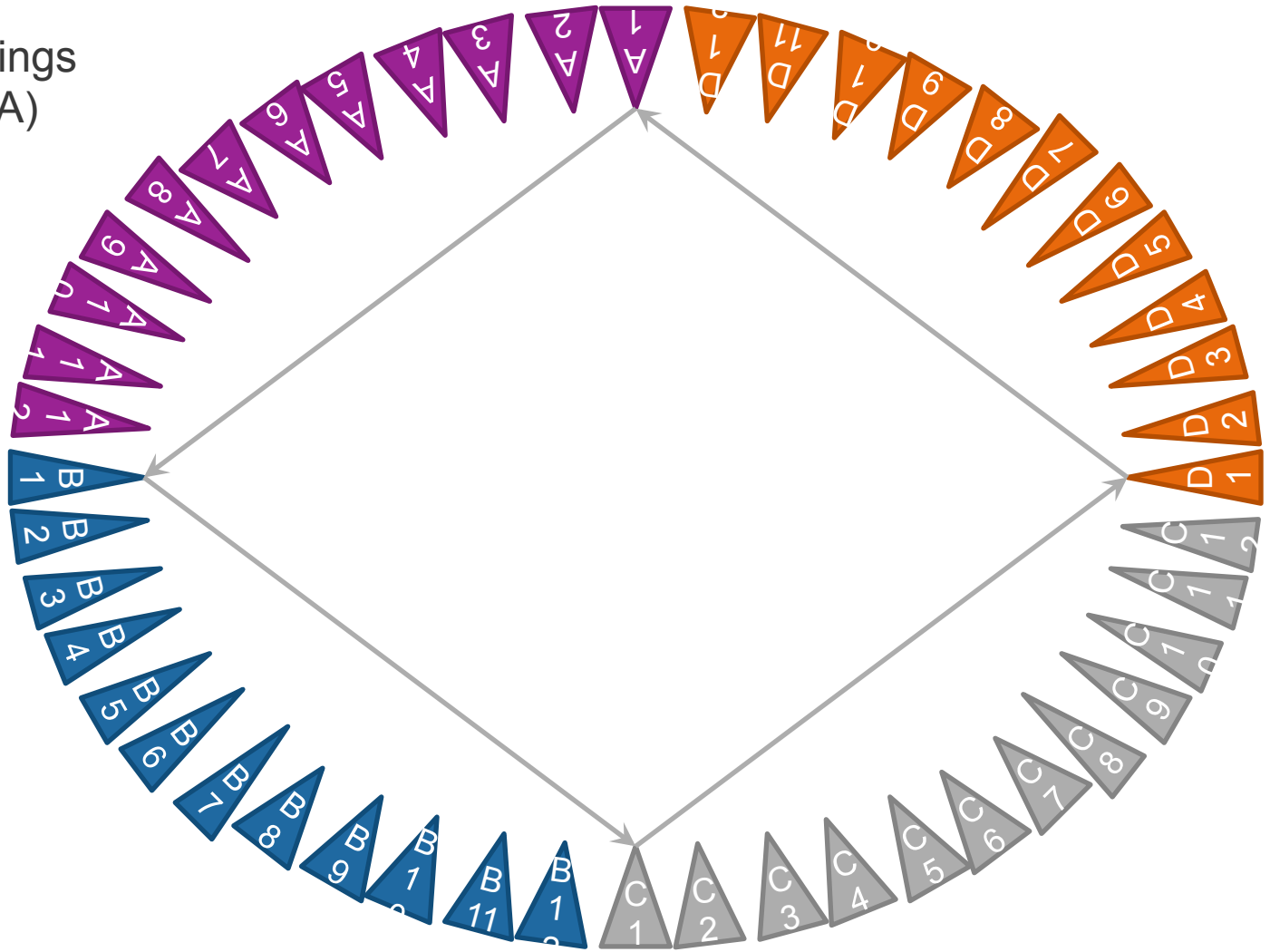
The Master Ring



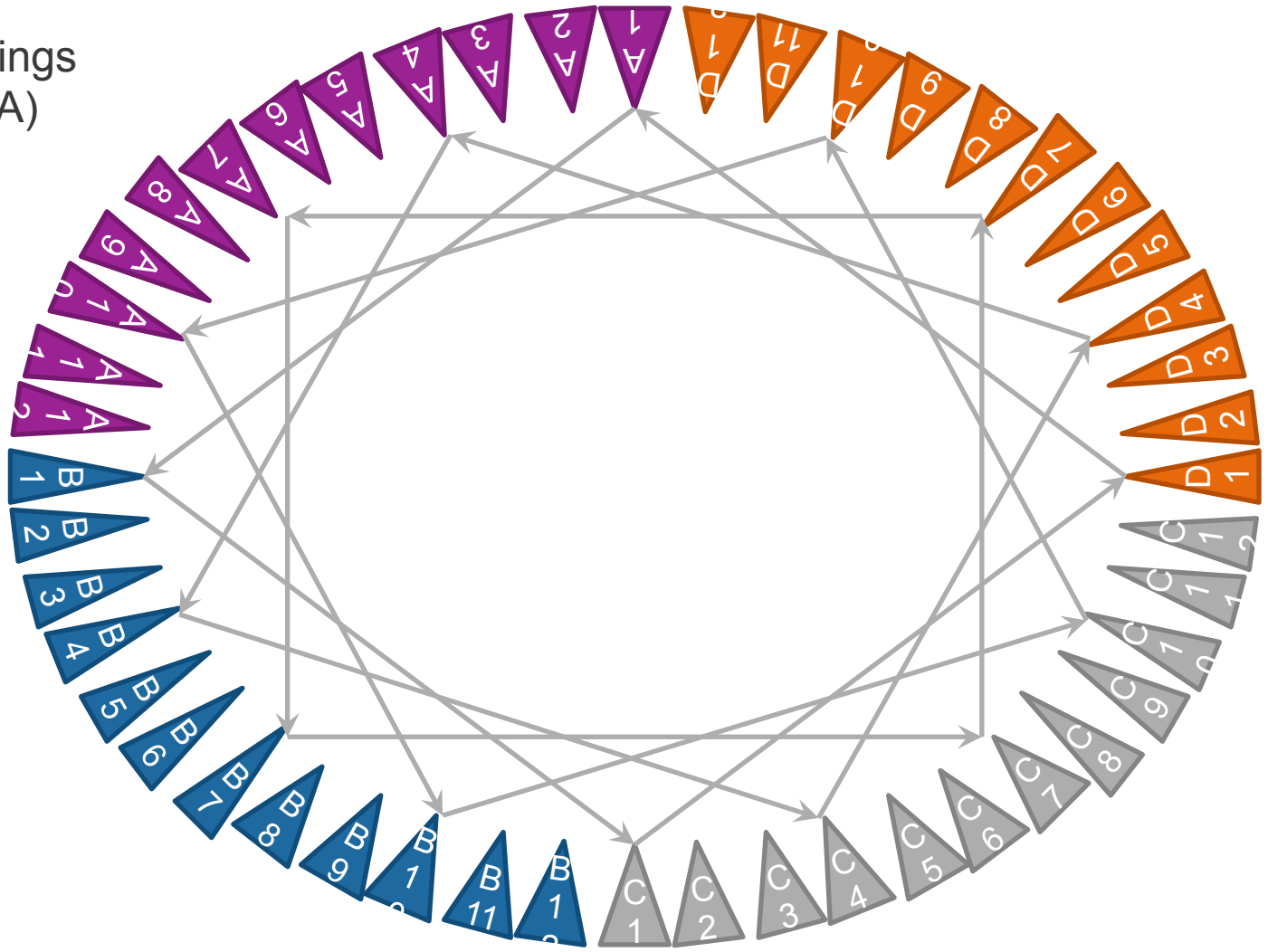
In the case of MOC, the “Master Ring” is made up of 4x10G “Brocade Trunks”. Each trunk supports up to 40-Gbps in each direction.

Packets are sprayed across the member links resulting in a relatively even distribution of traffic. Packet sequence within each micro-flow is maintained by the ASICs on either end using proprietary technology.

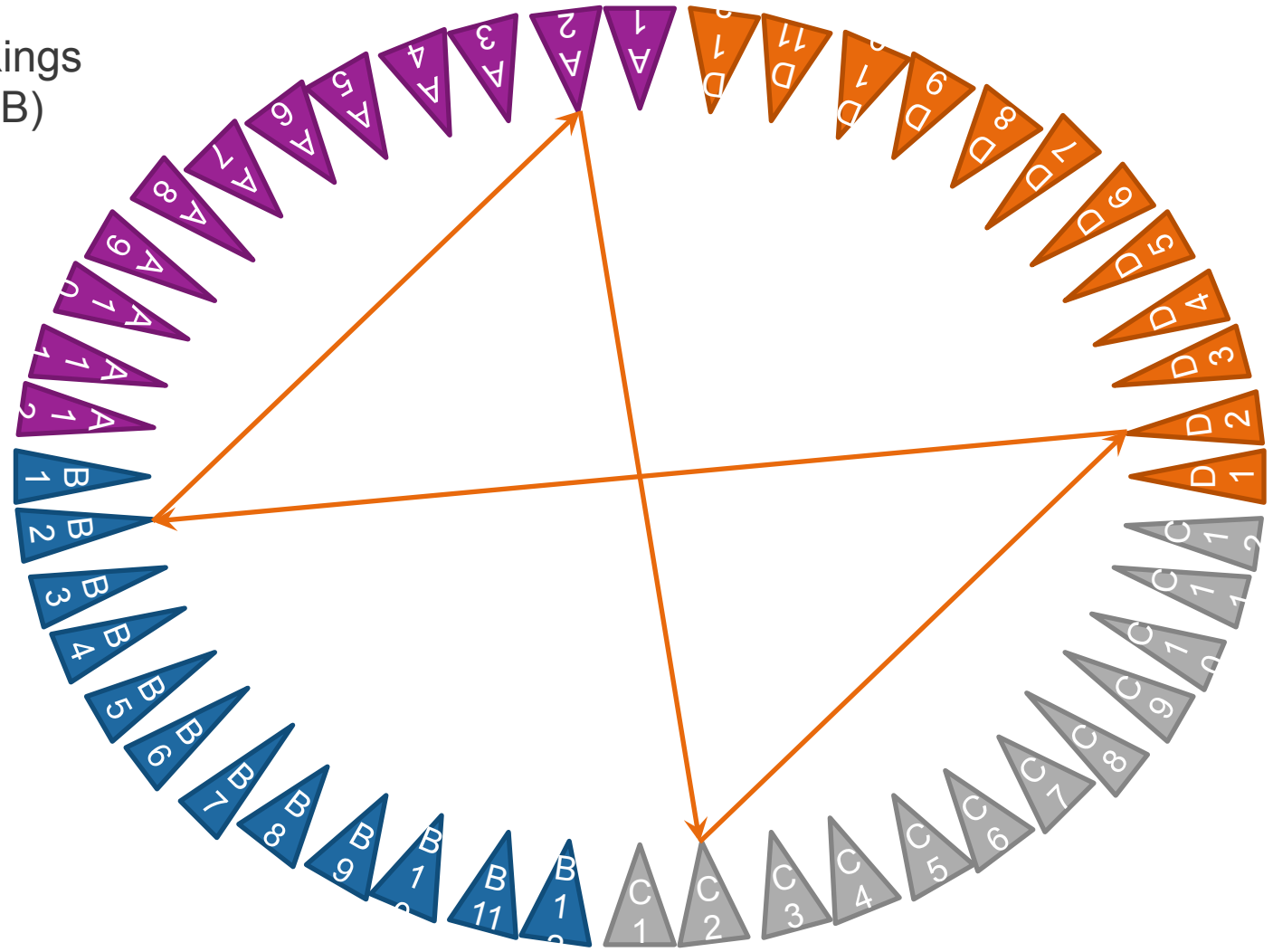
Shortcut Rings
(Pattern A)



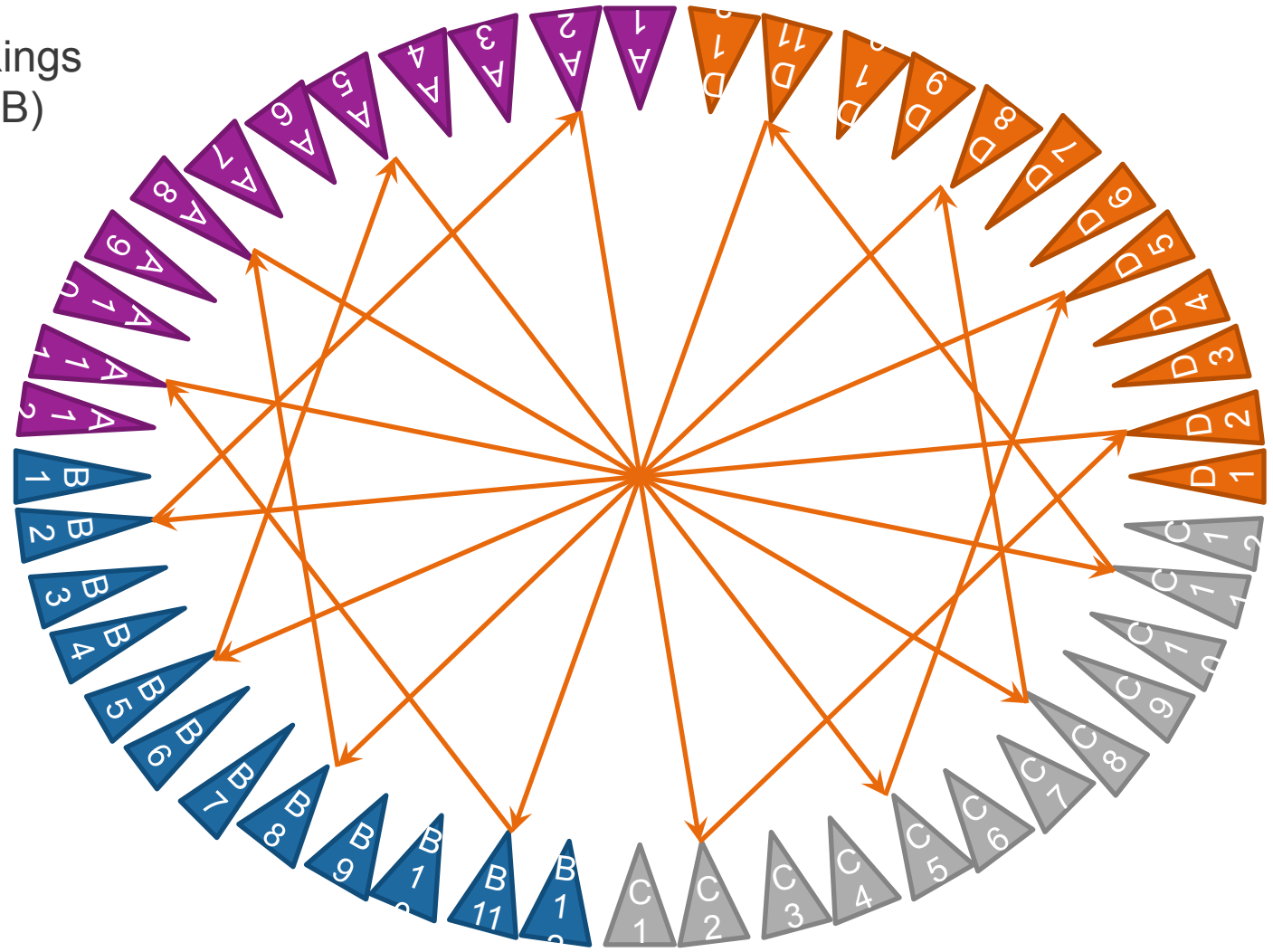
Shortcut Rings
(Pattern A)



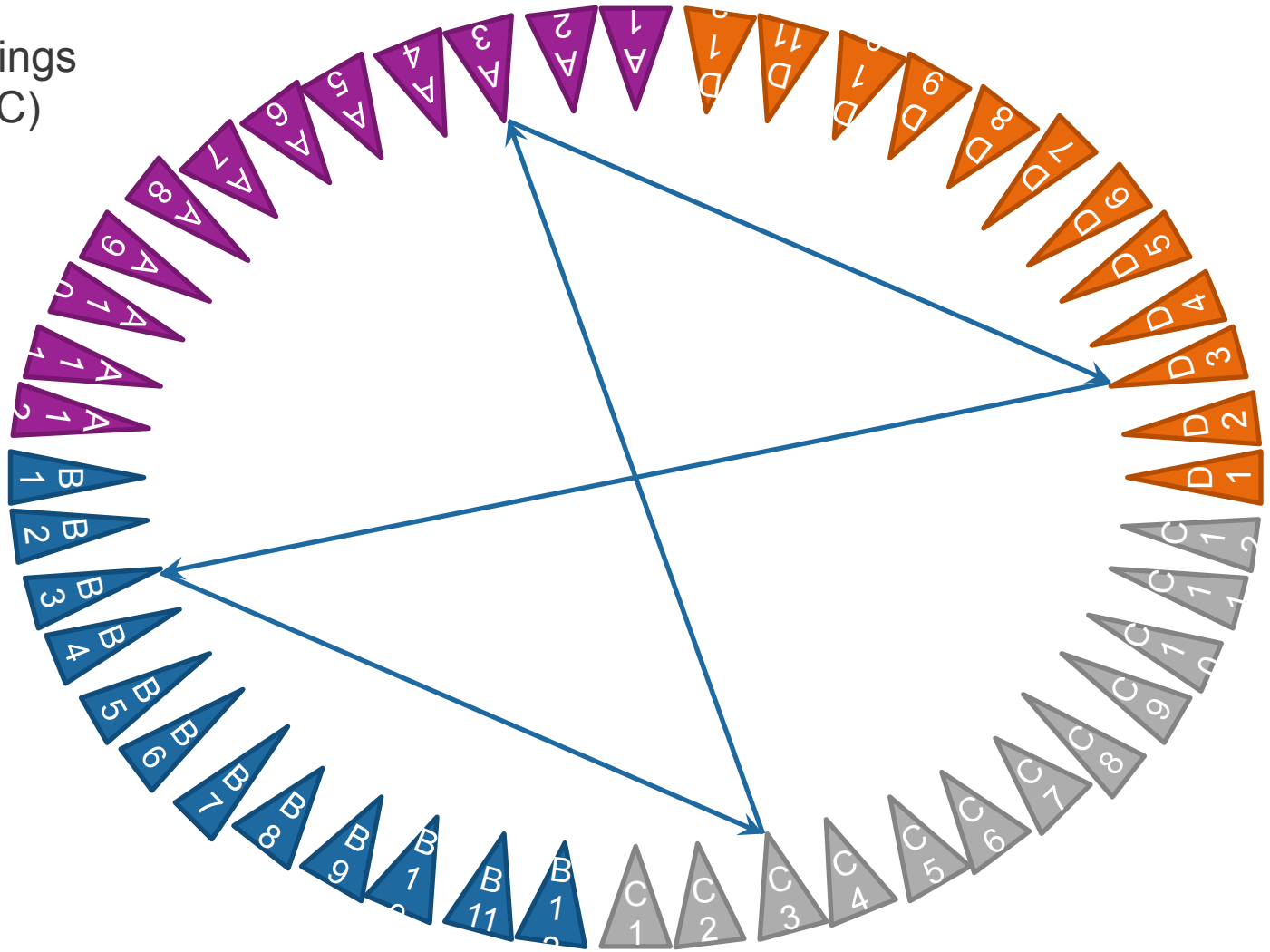
Shortcut Rings
(Pattern B)



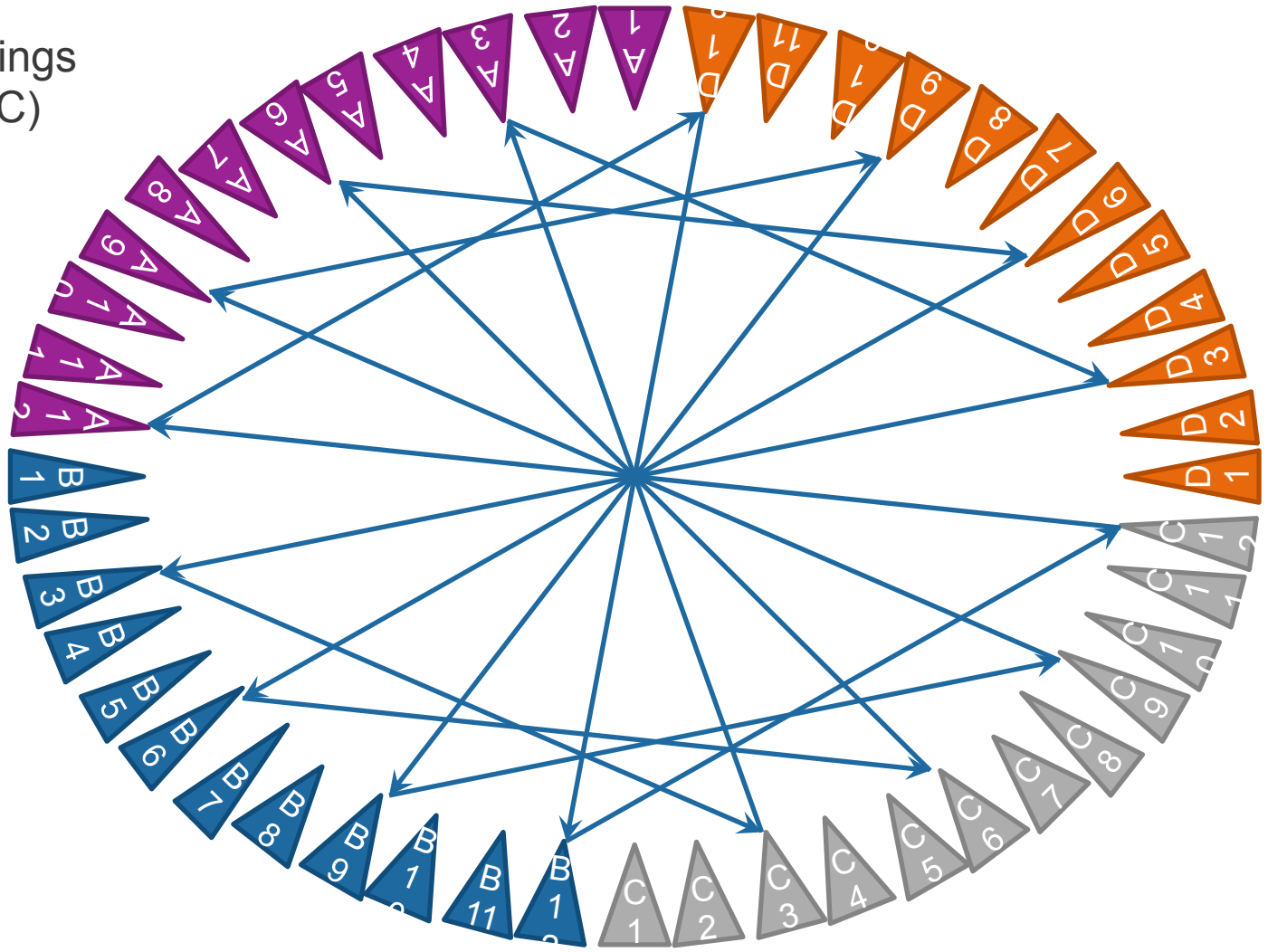
Shortcut Rings
(Pattern B)



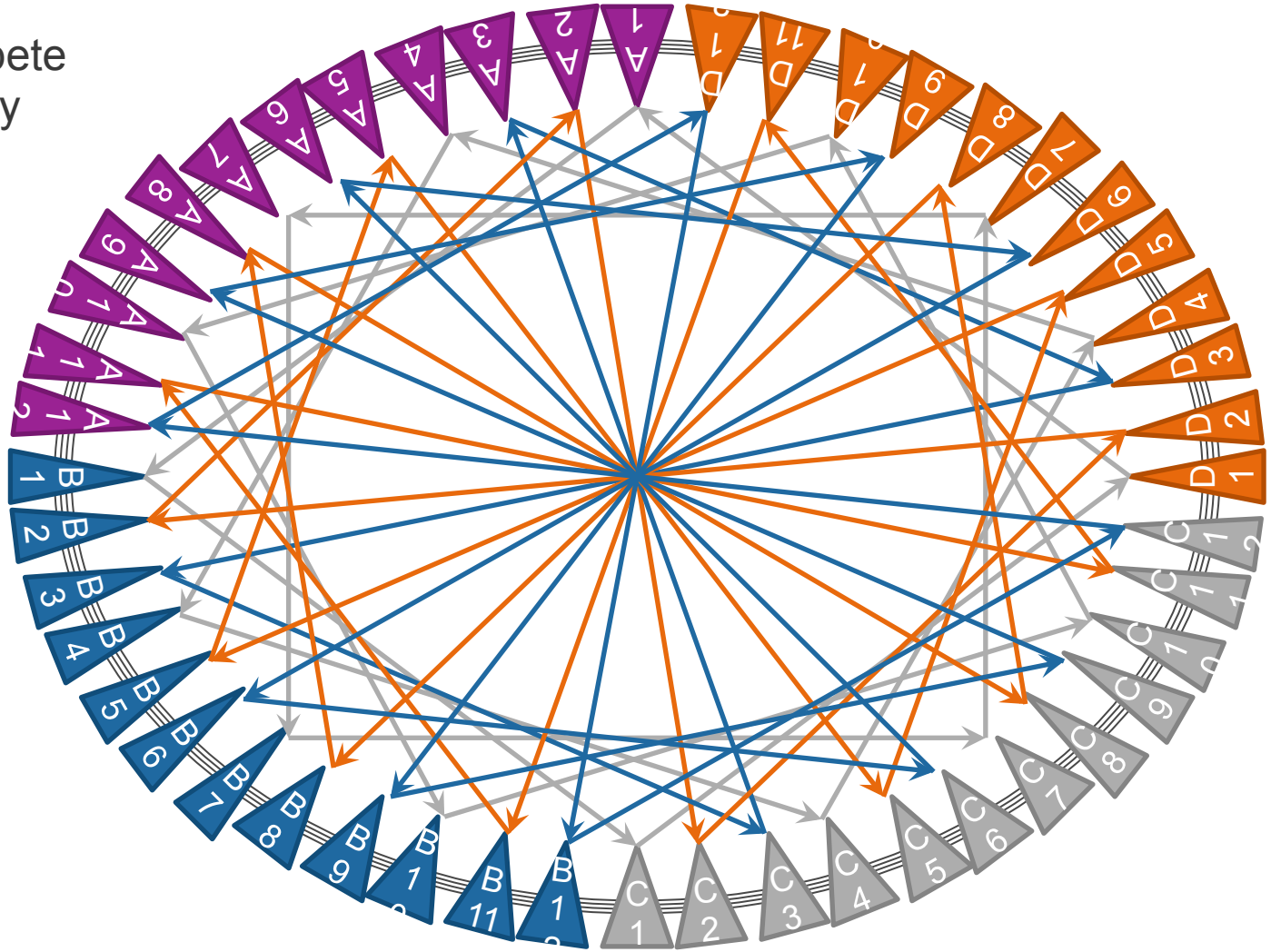
Shortcut Rings
(Pattern C)



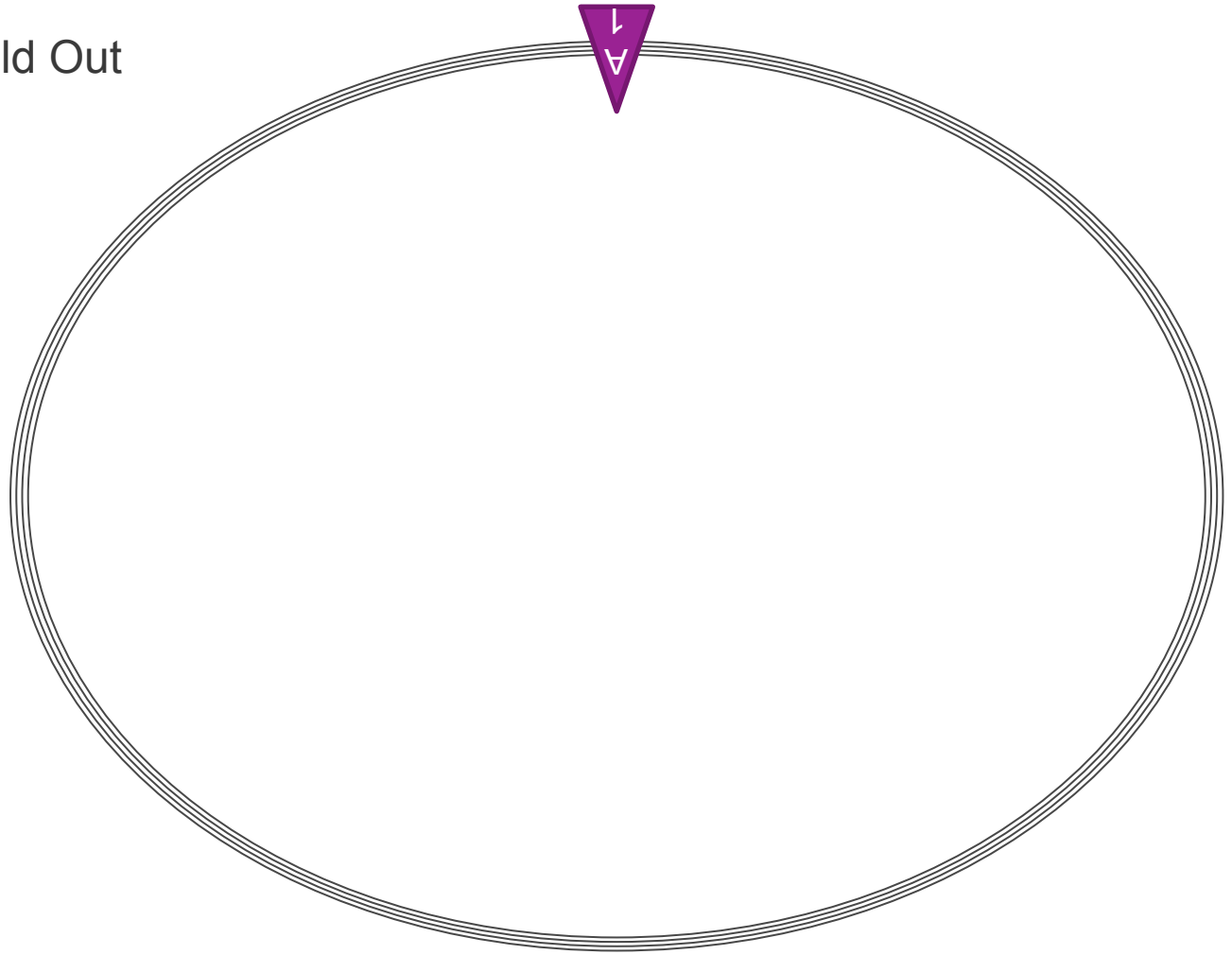
Shortcut Rings
(Pattern C)



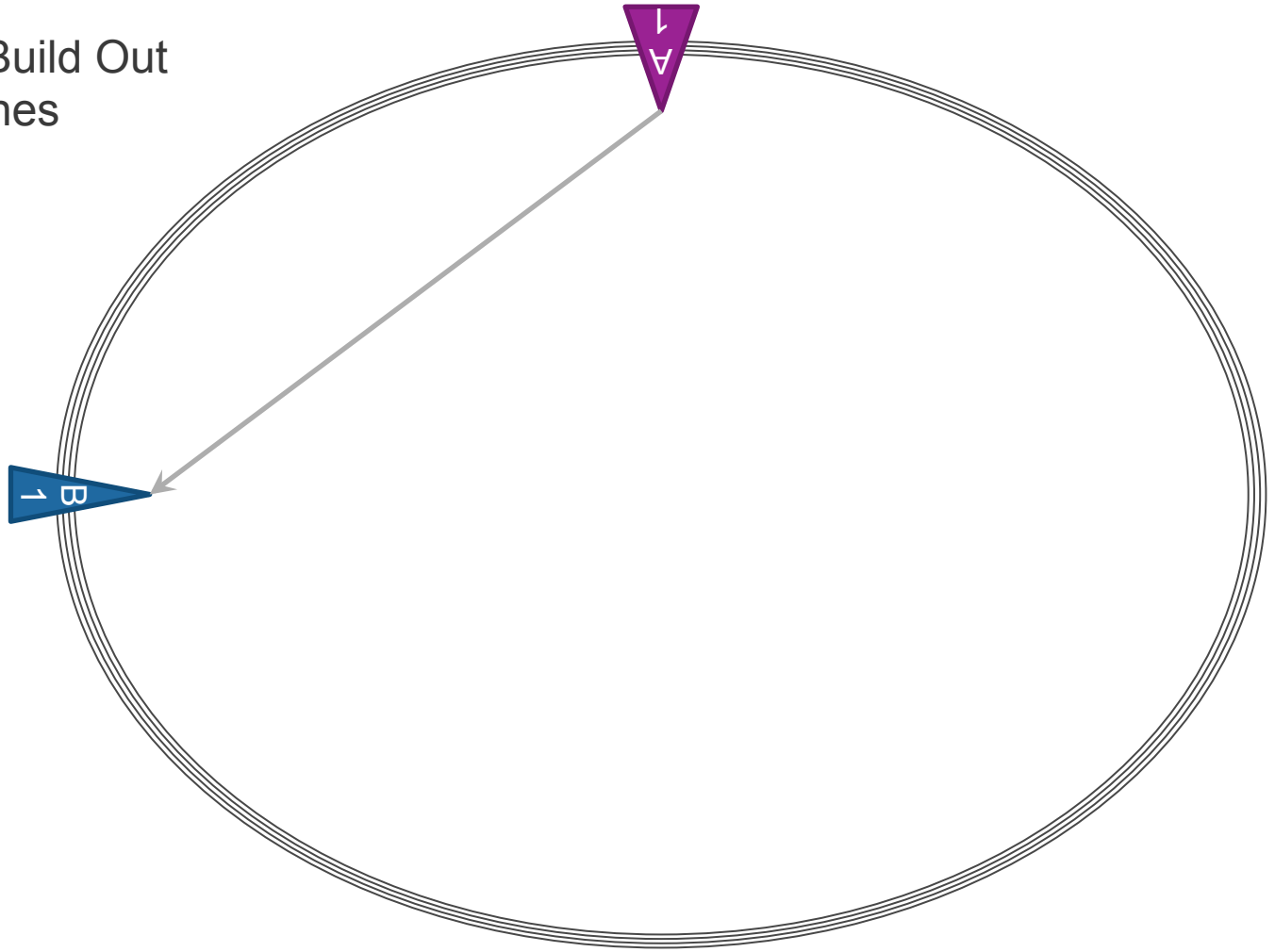
The Compete Topology



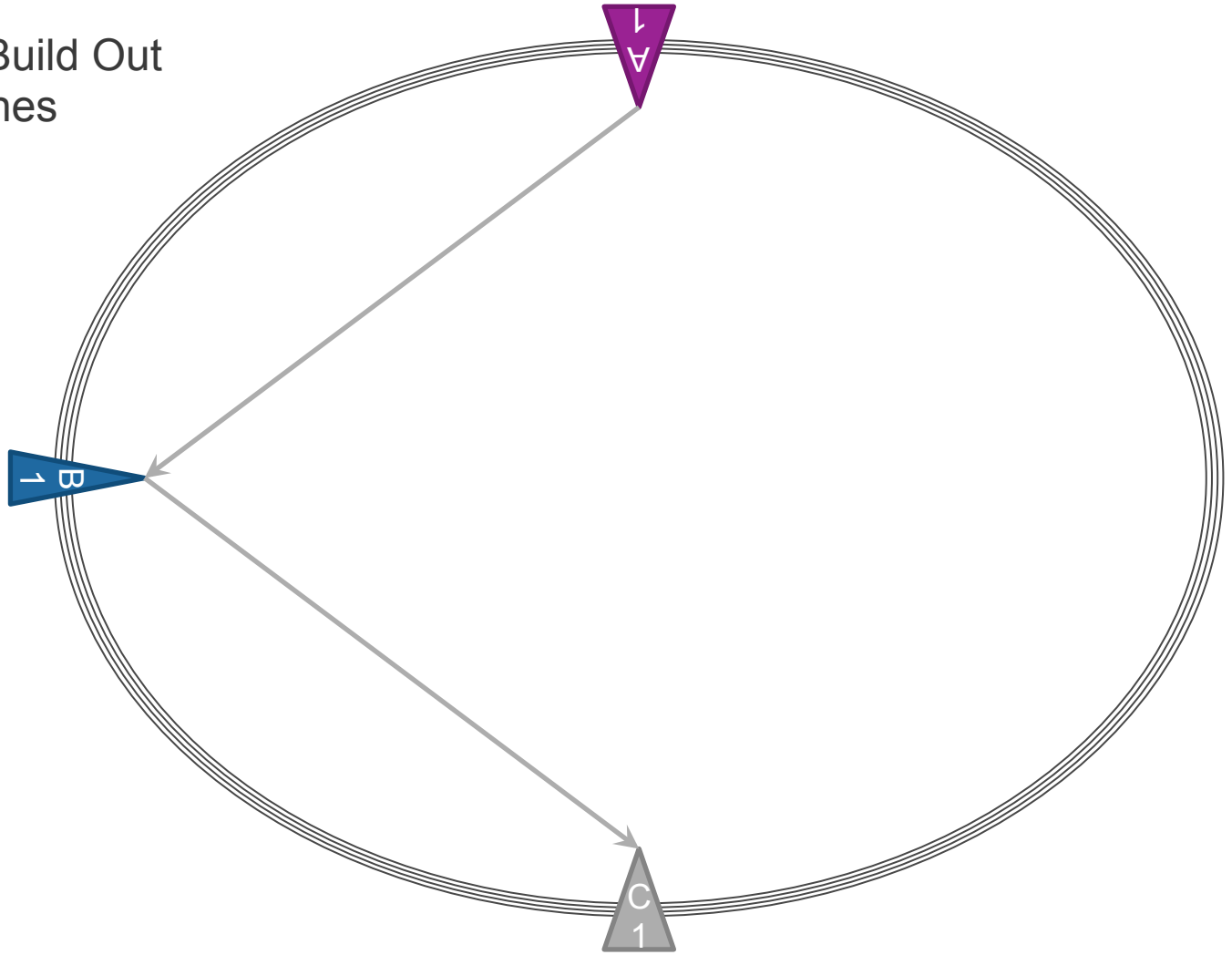
Incremental Build Out
1 Switch



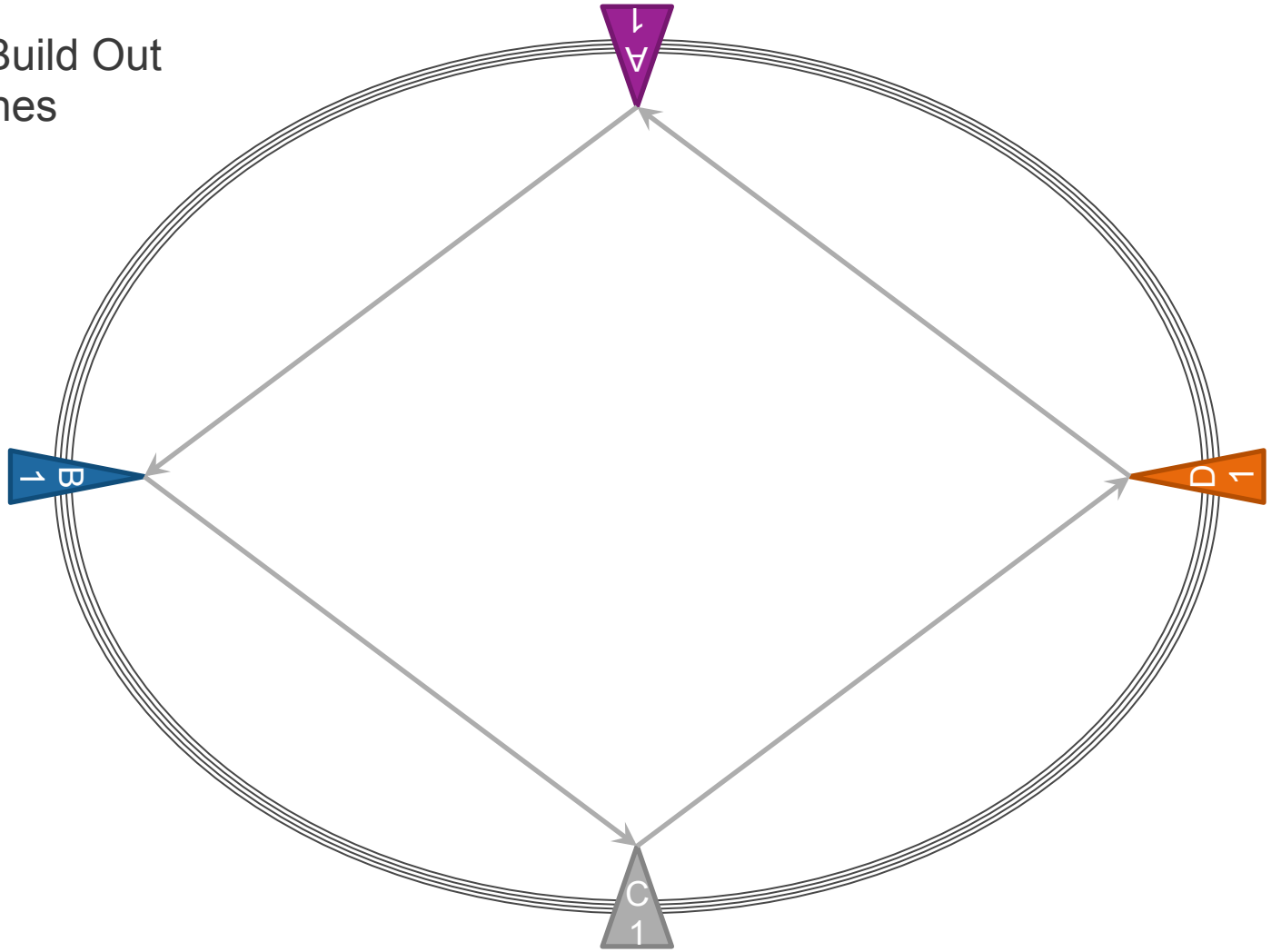
Incremental Build Out
2 Switches



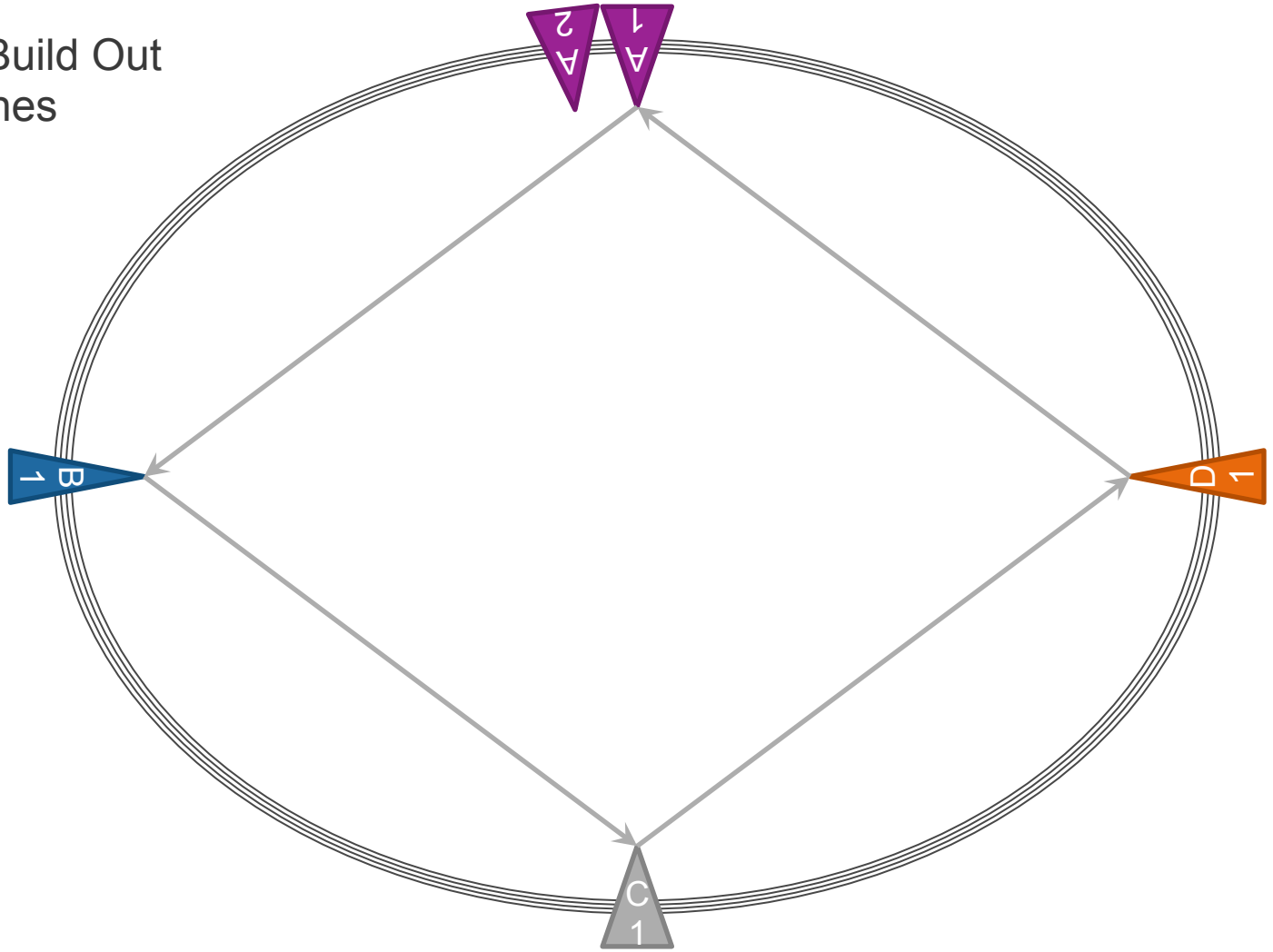
Incremental Build Out
3 Switches



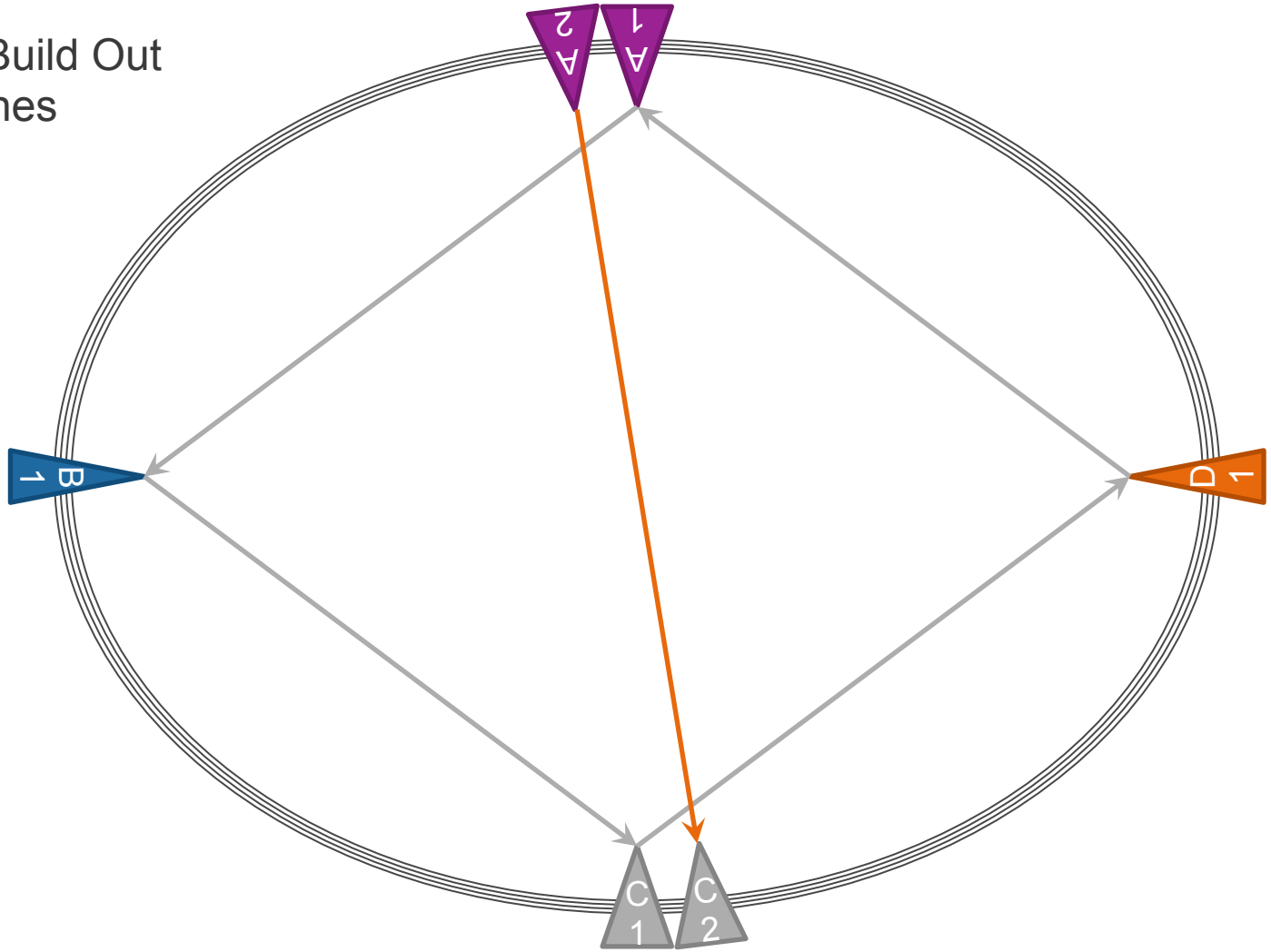
Incremental Build Out
4 Switches



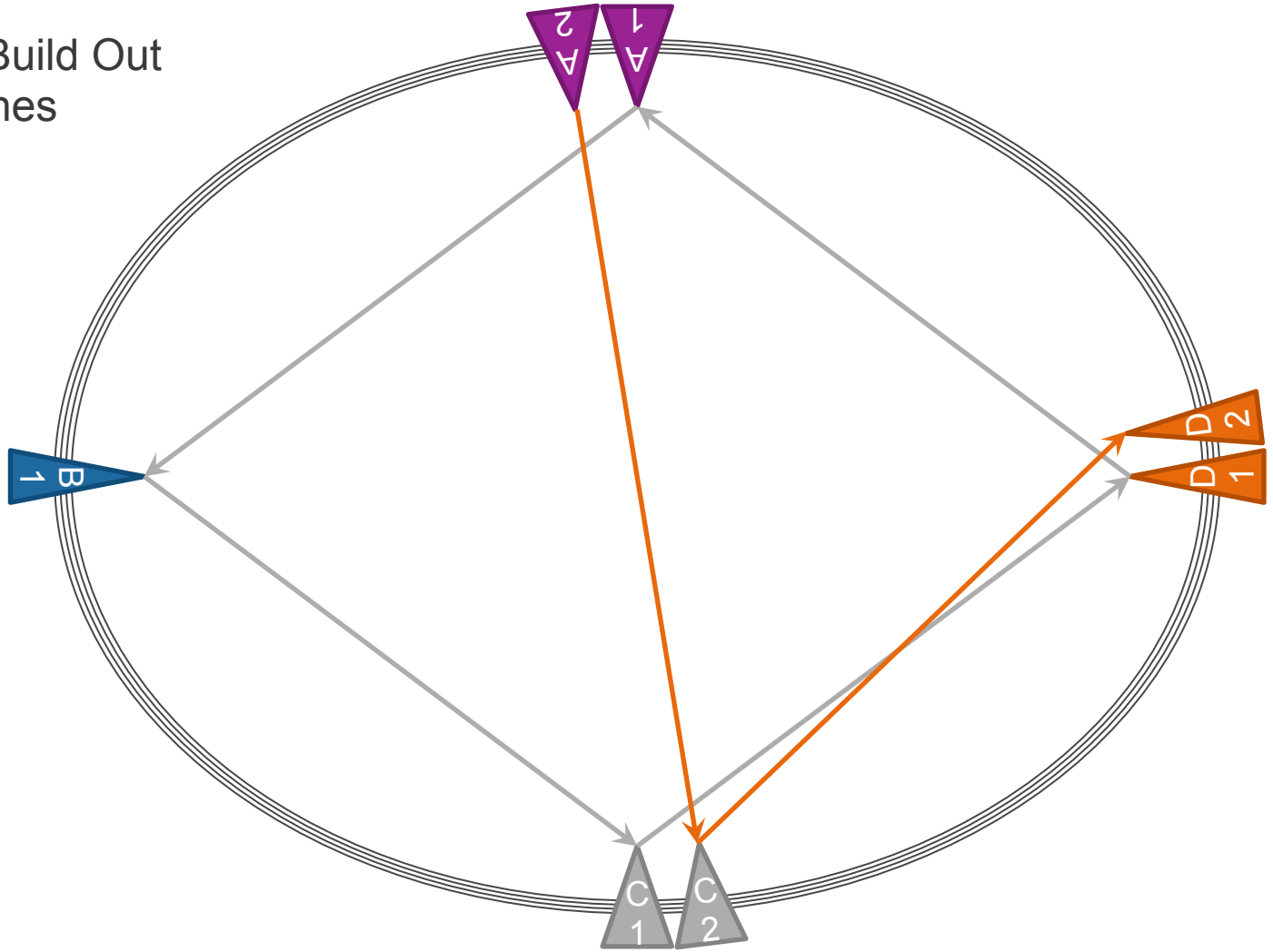
Incremental Build Out
5 Switches



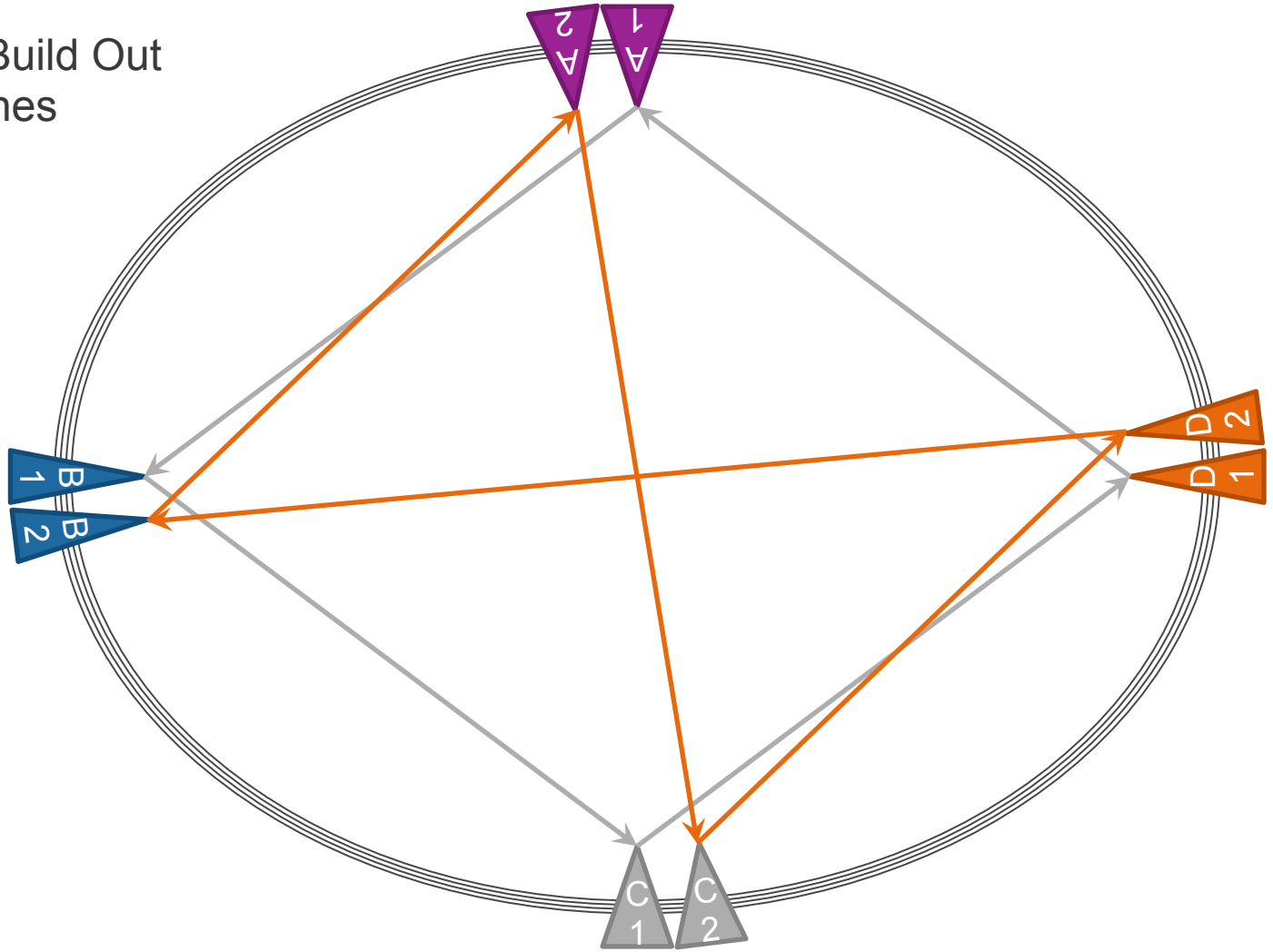
Incremental Build Out
6 Switches



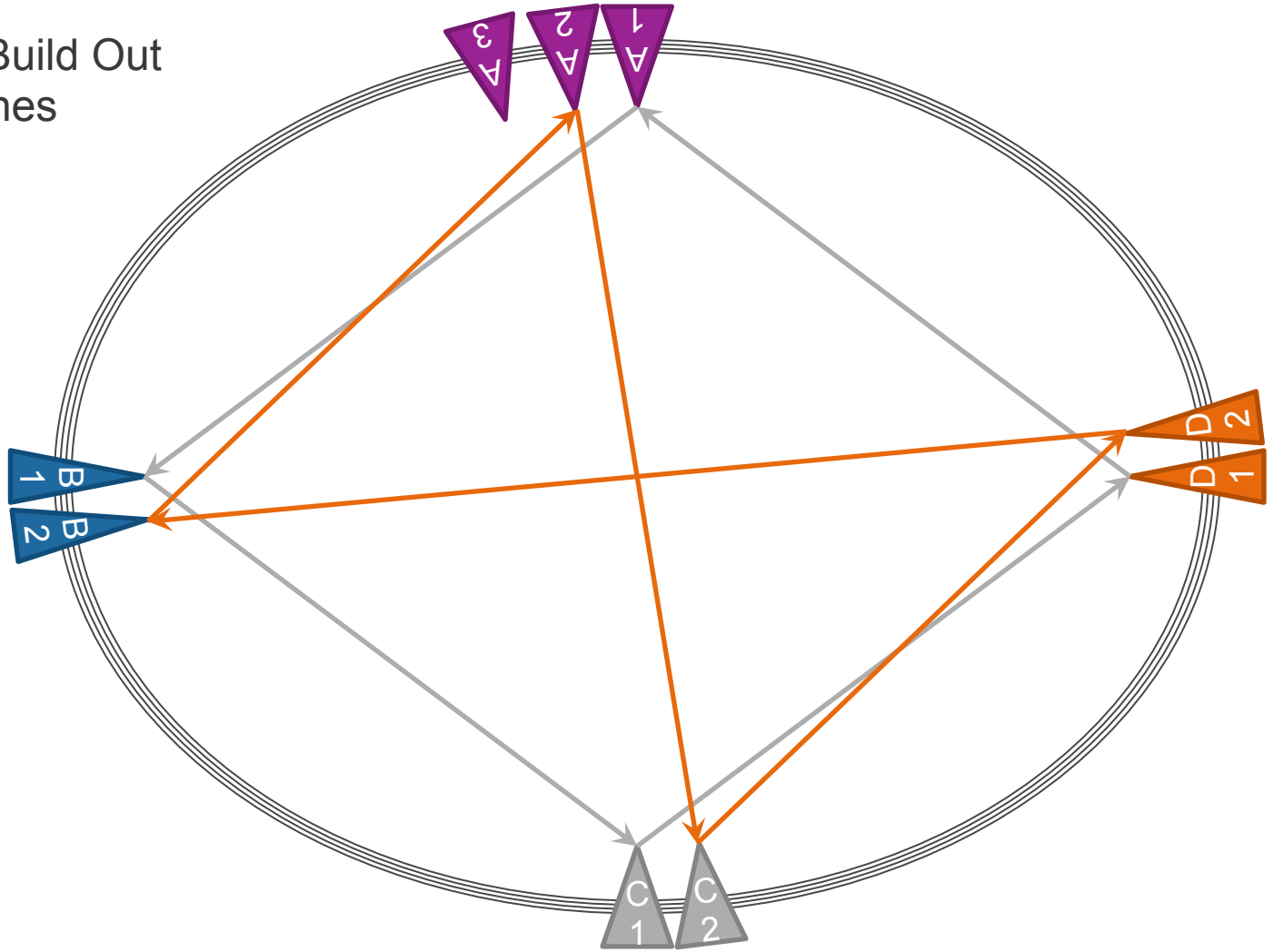
Incremental Build Out
7 Switches



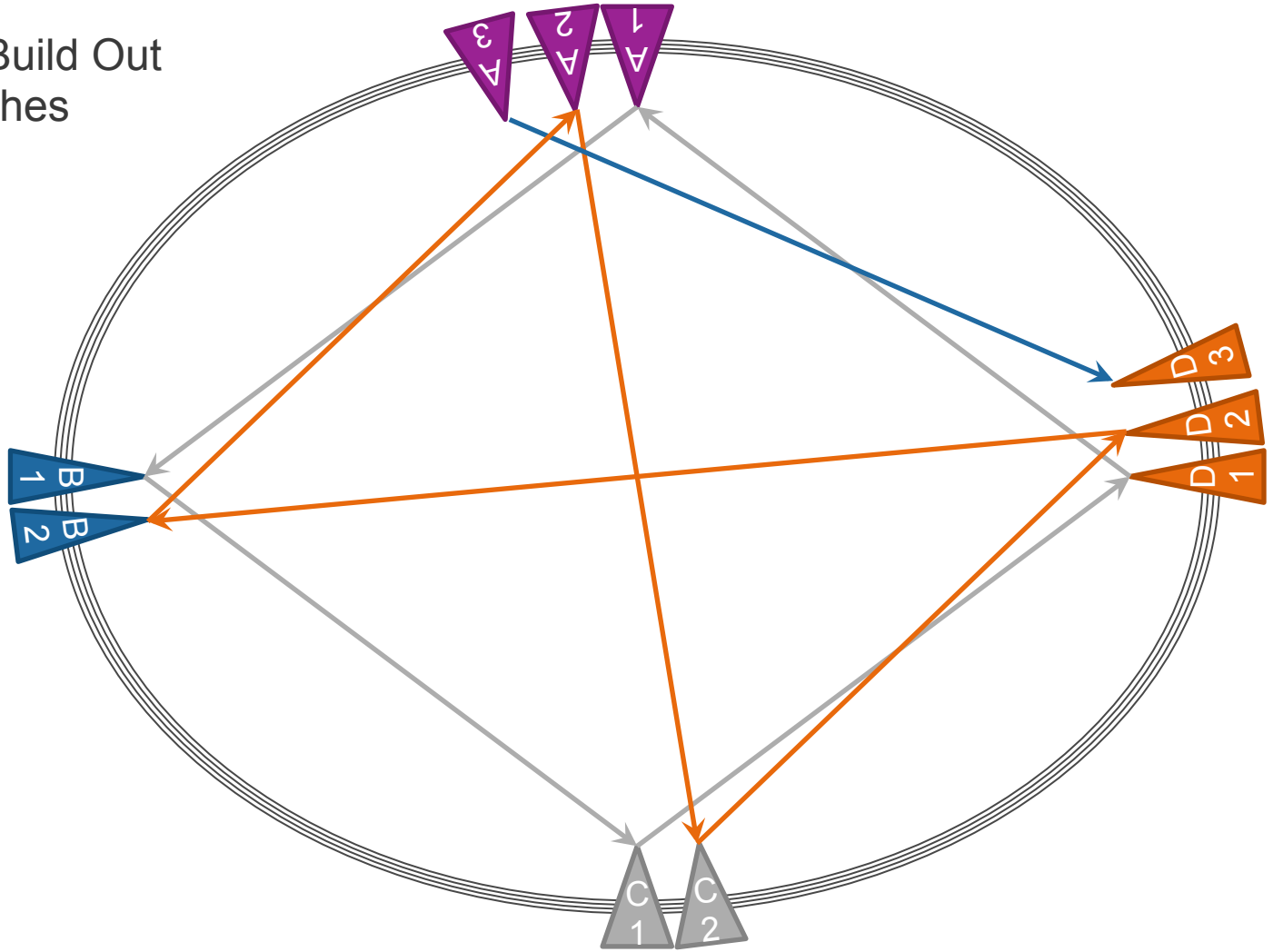
Incremental Build Out
8 Switches



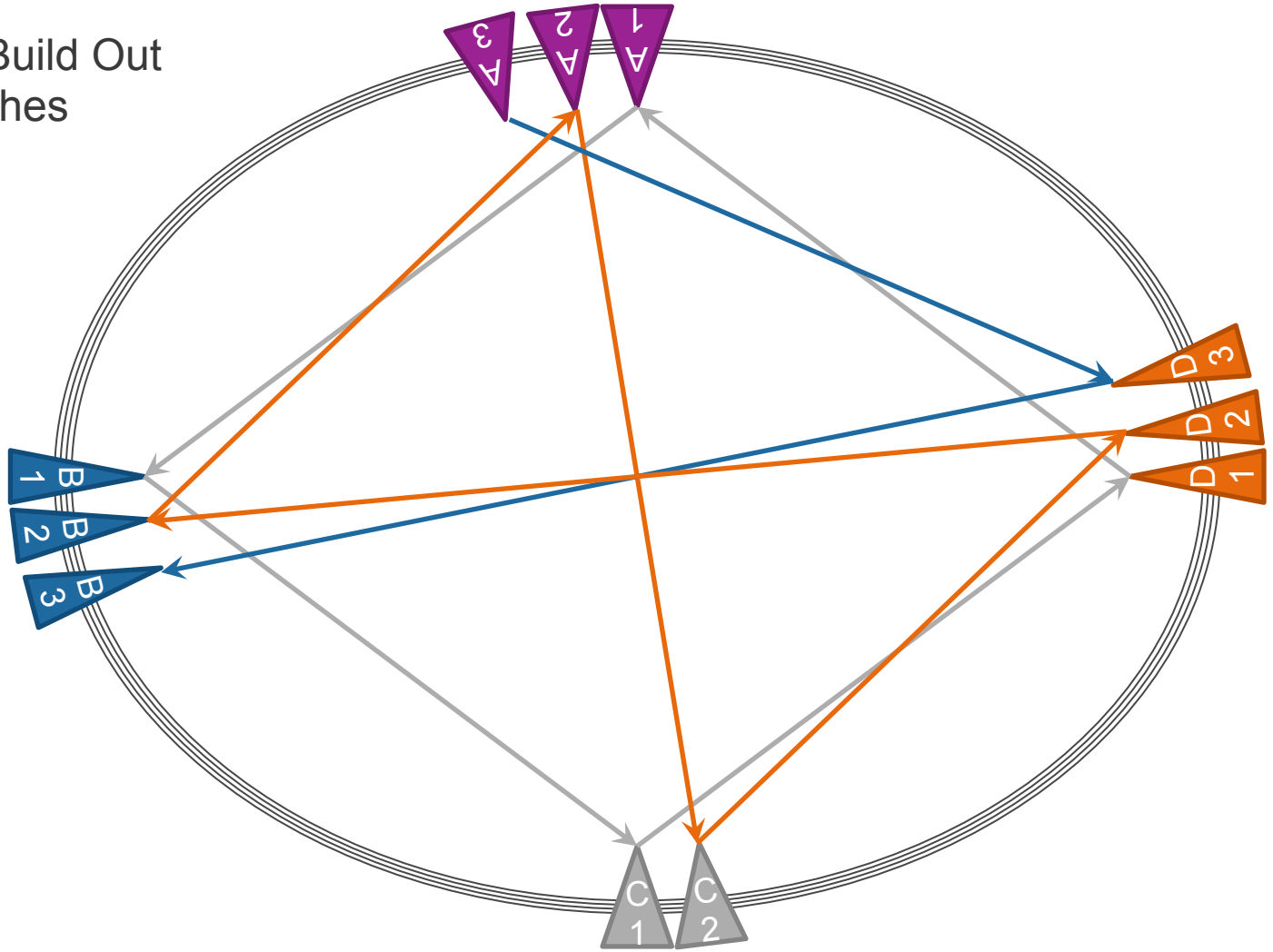
Incremental Build Out
9 Switches



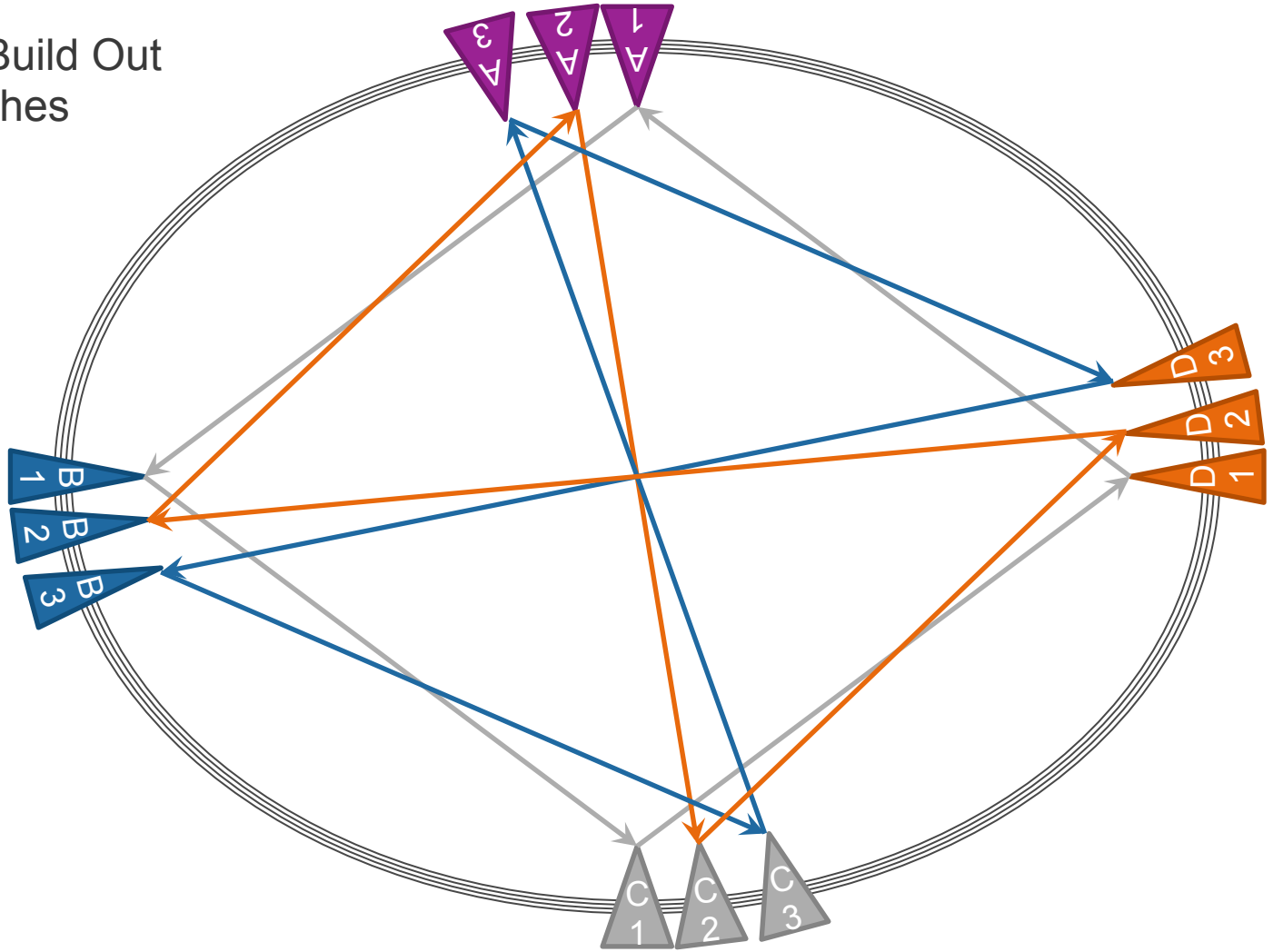
Incremental Build Out
10 Switches



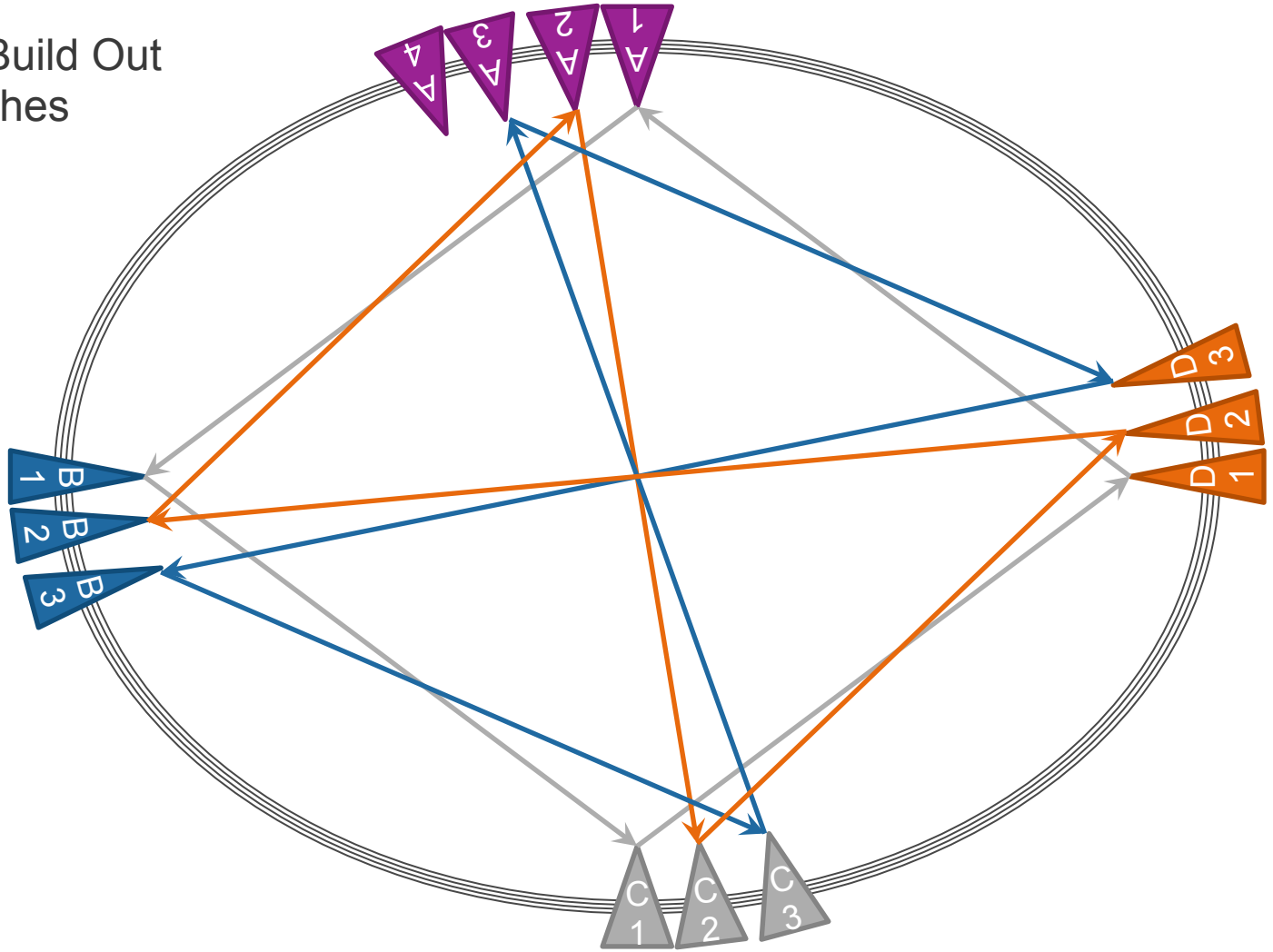
Incremental Build Out
11 Switches



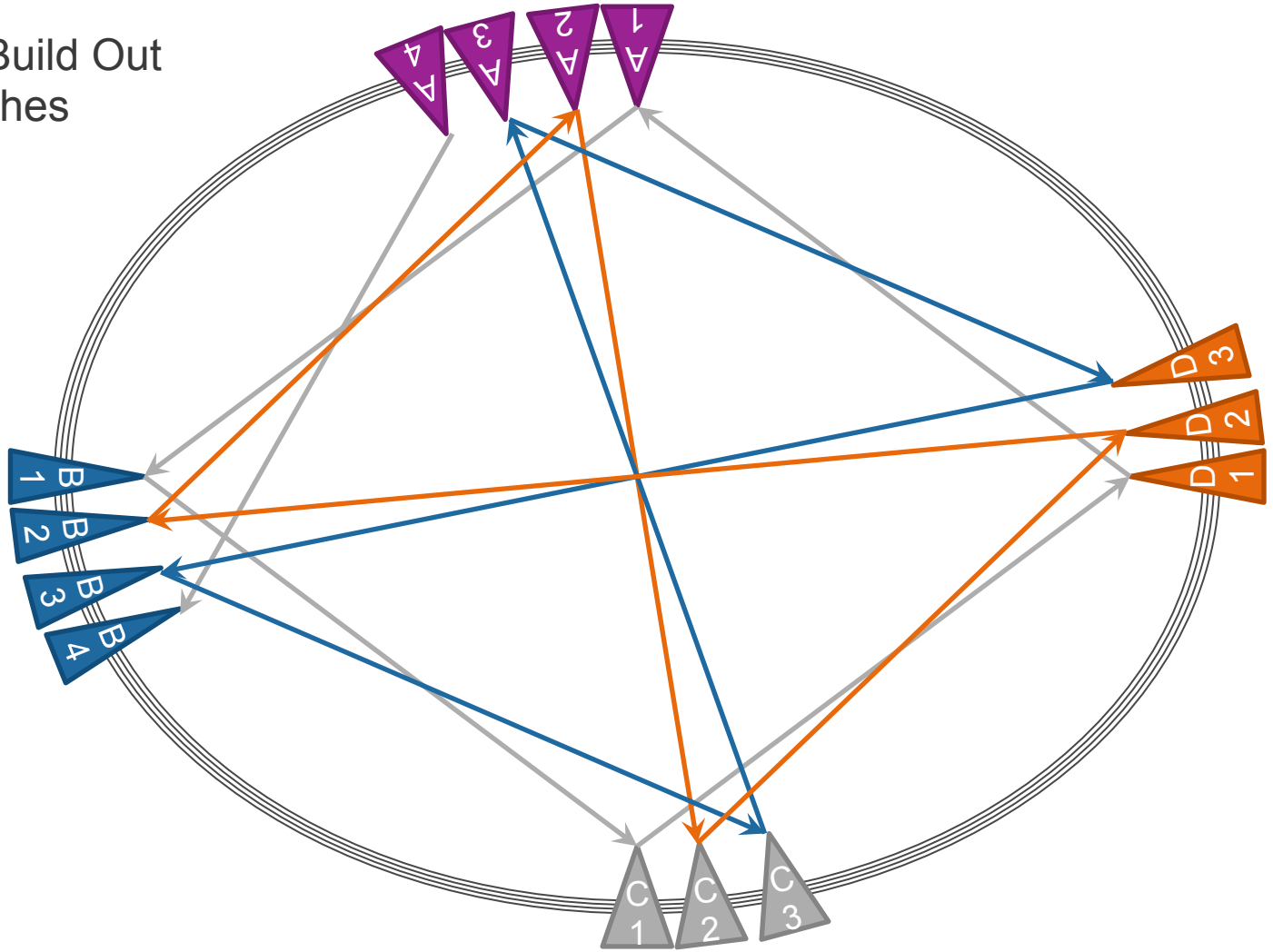
Incremental Build Out
12 Switches



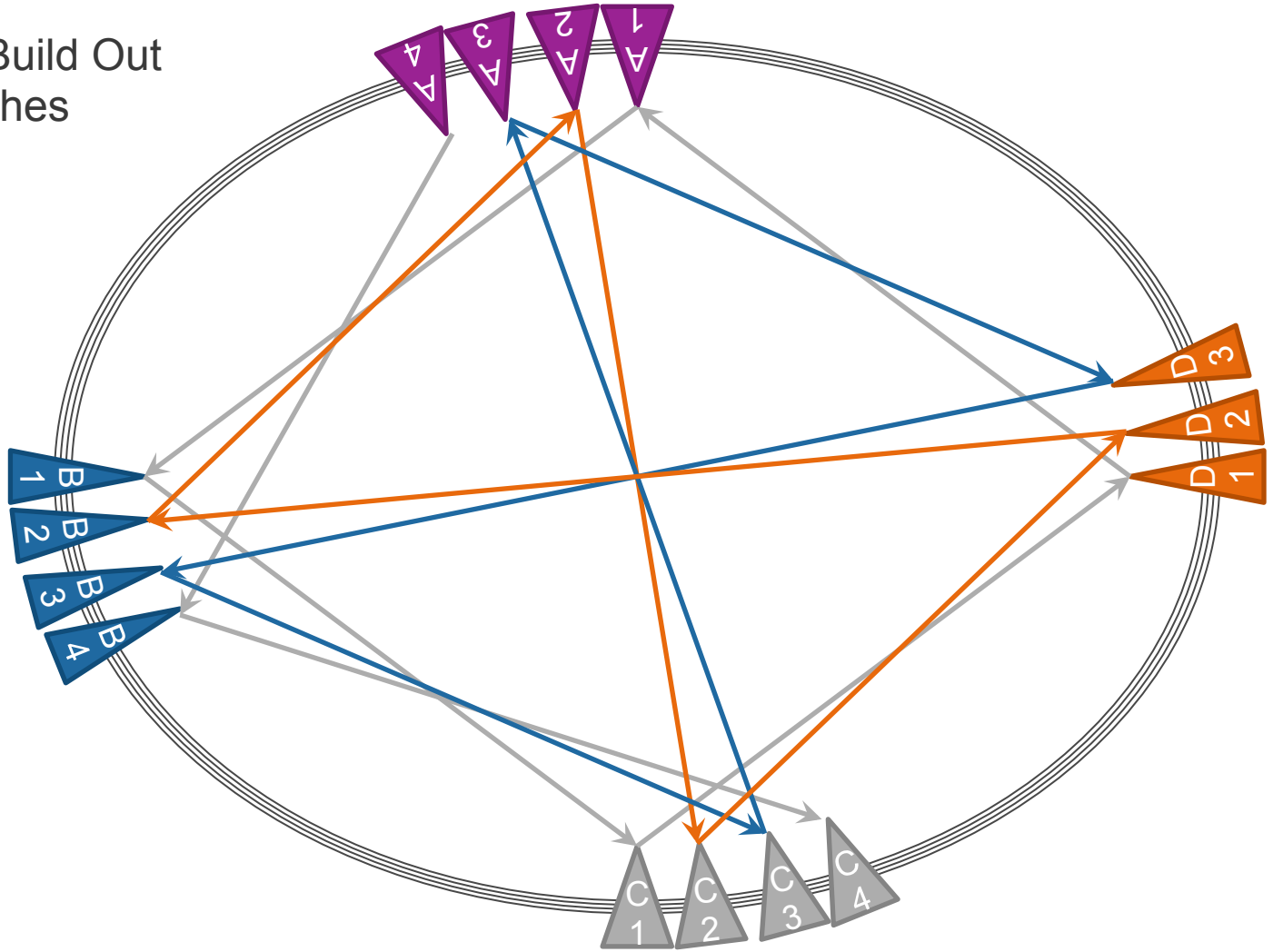
Incremental Build Out
13 Switches



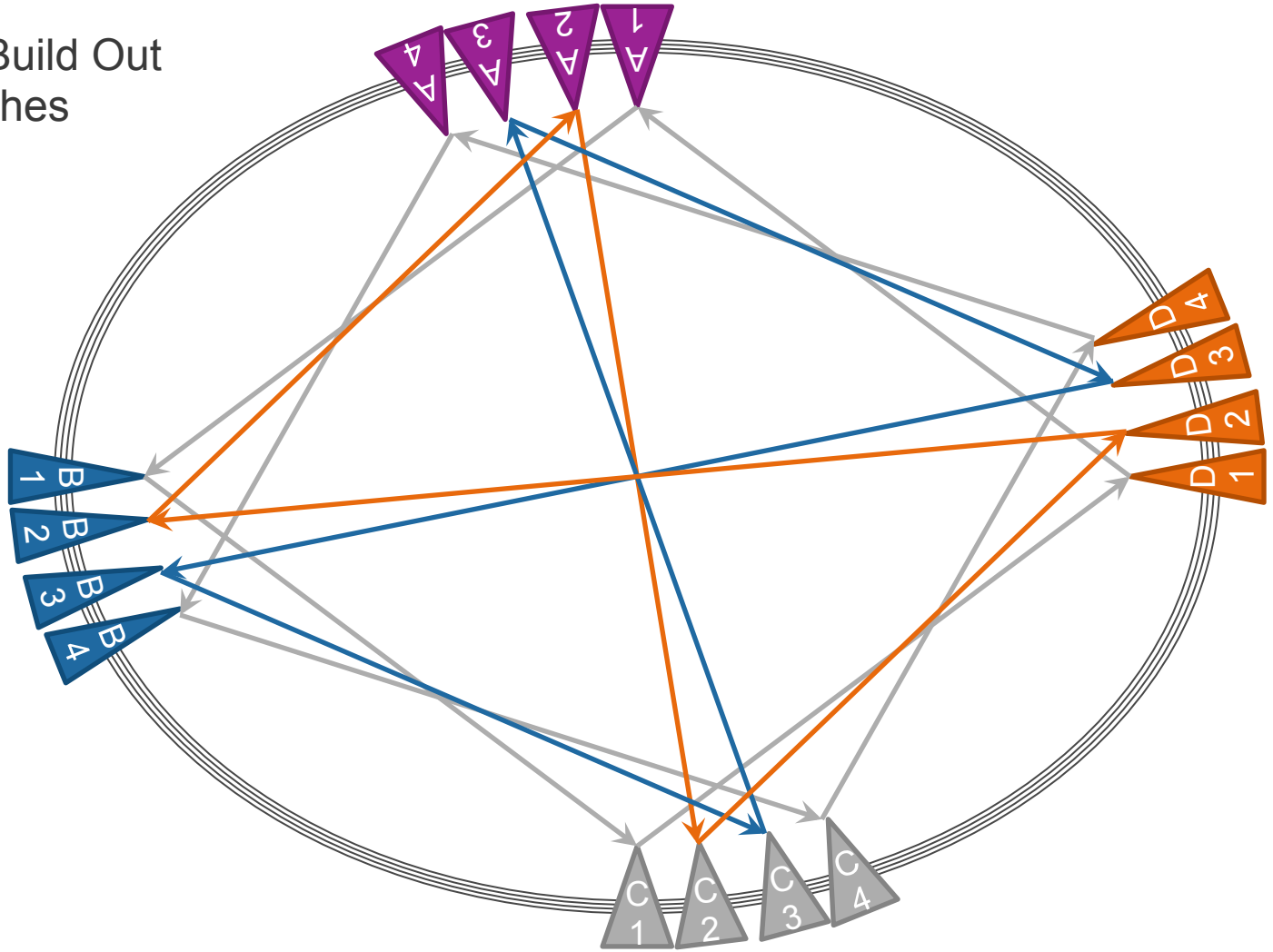
Incremental Build Out
14 Switches



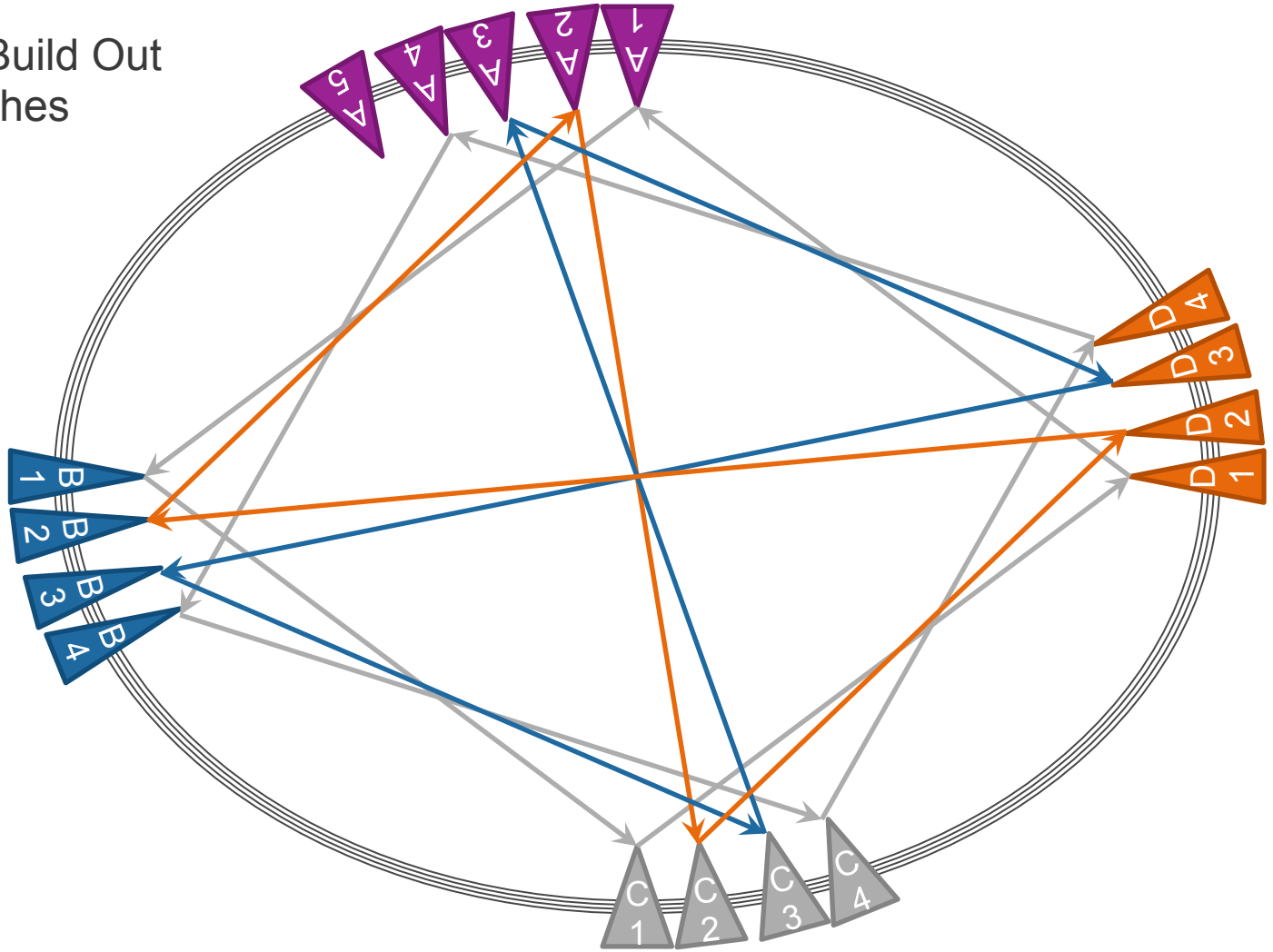
Incremental Build Out
15 Switches



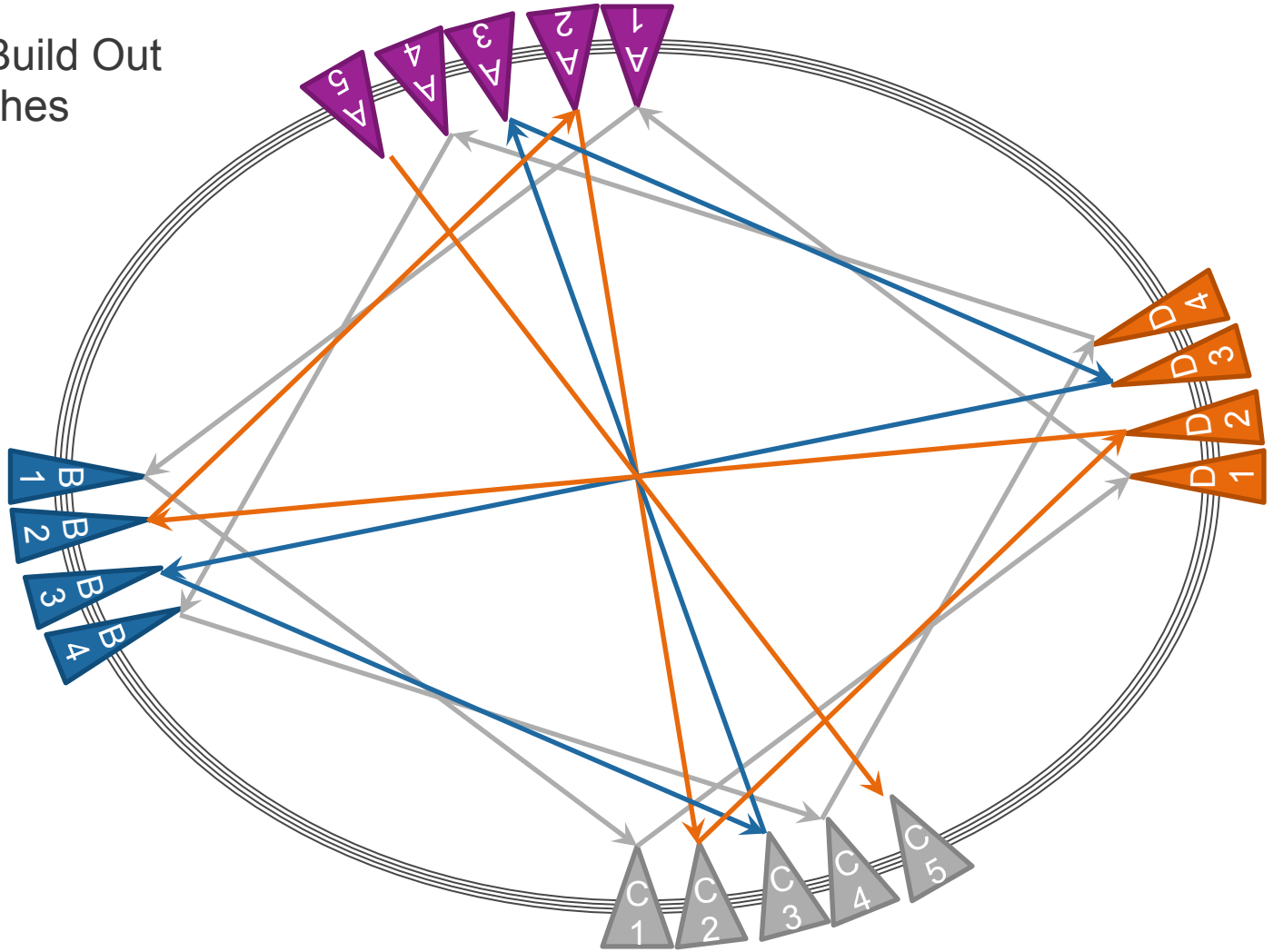
Incremental Build Out
16 Switches



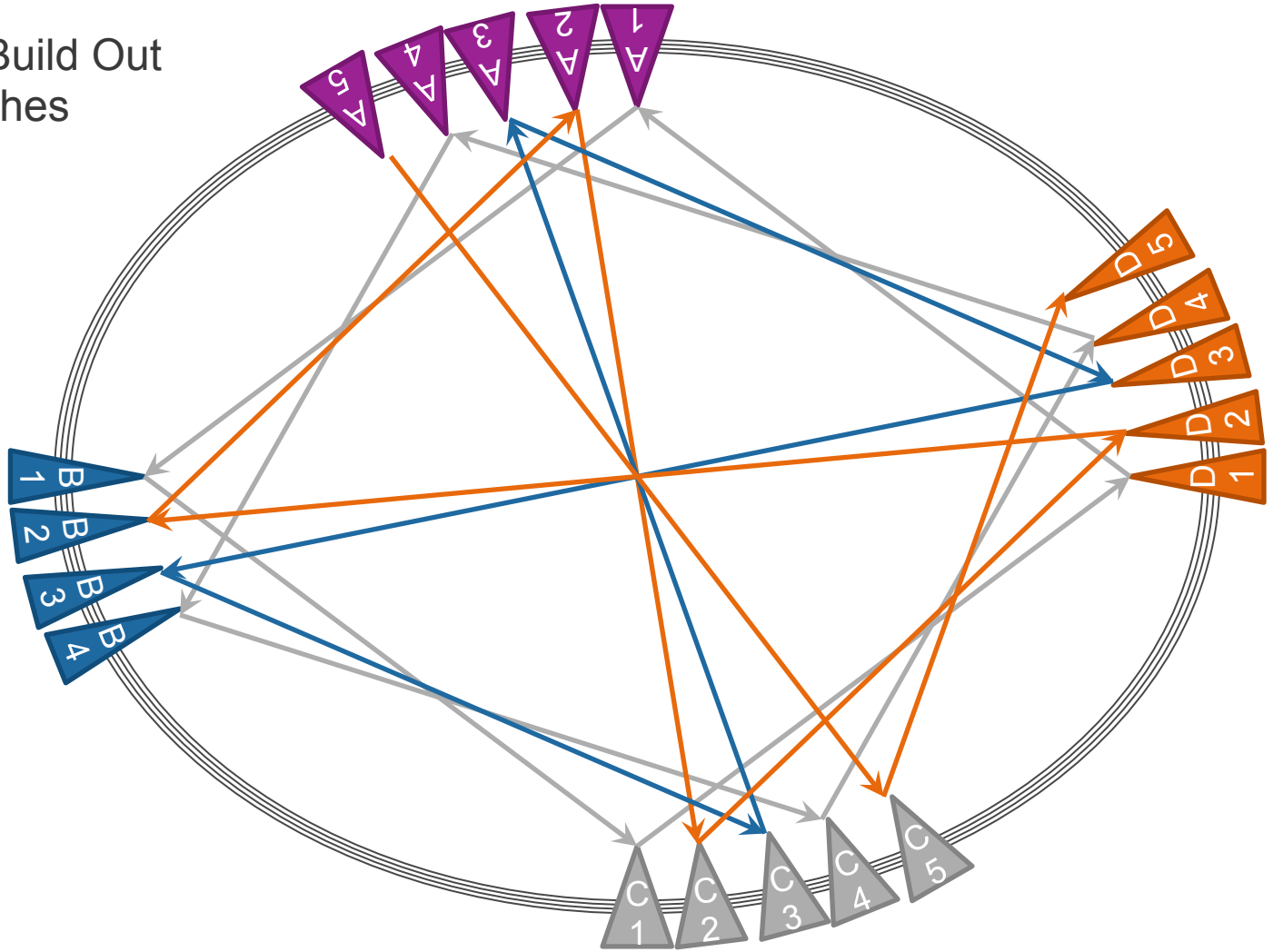
Incremental Build Out
17 Switches



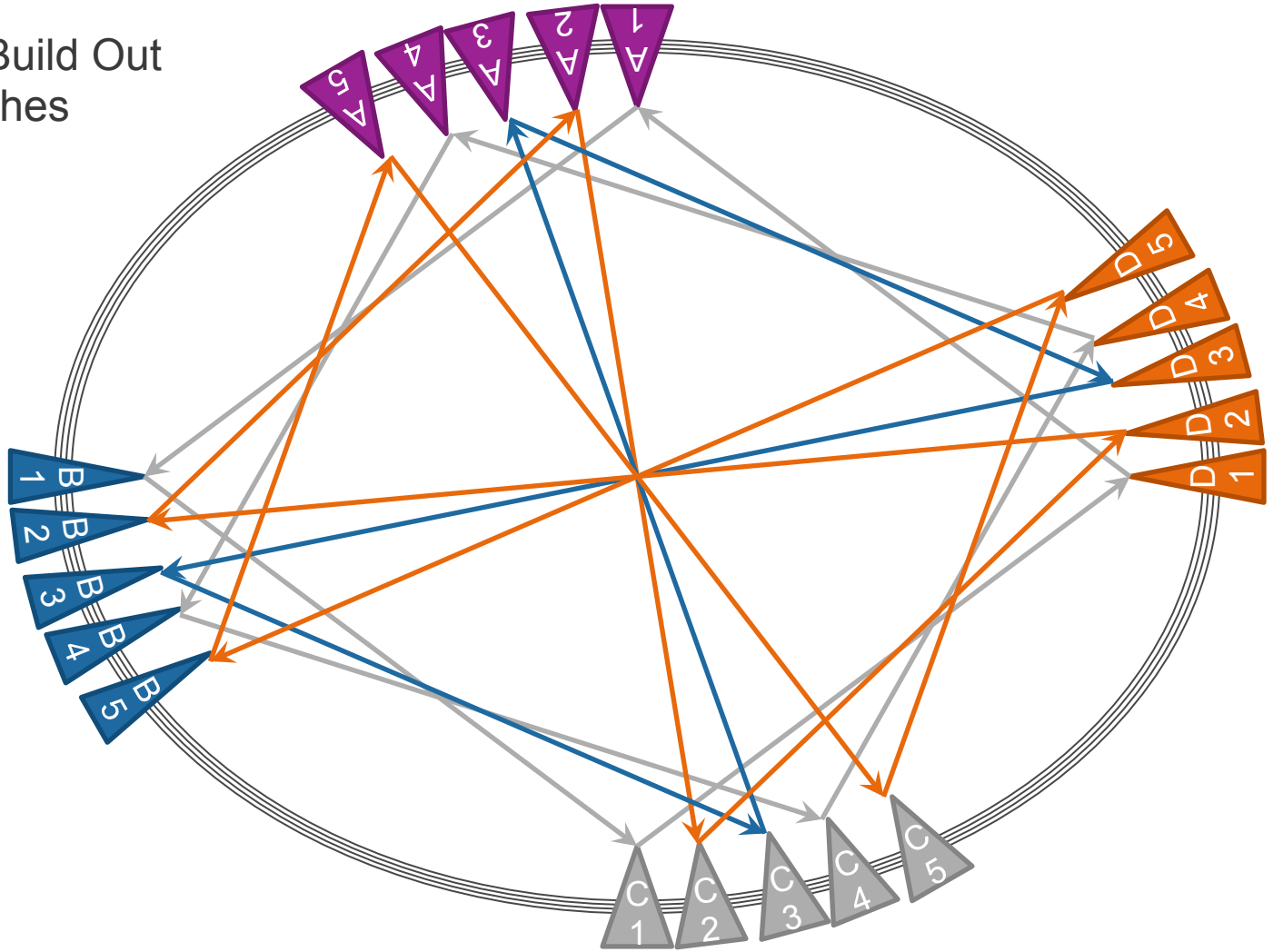
Incremental Build Out
18 Switches



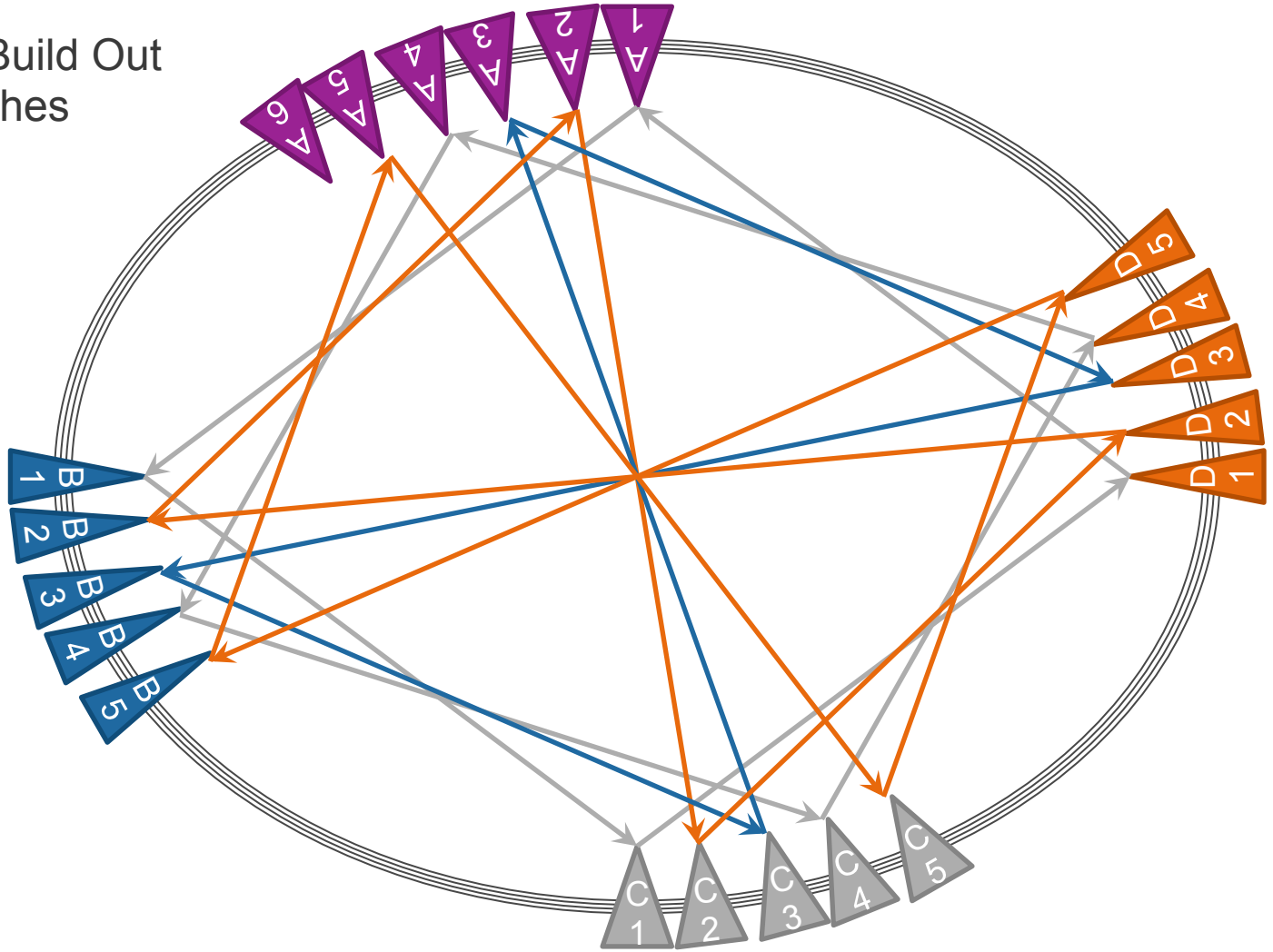
Incremental Build Out
19 Switches



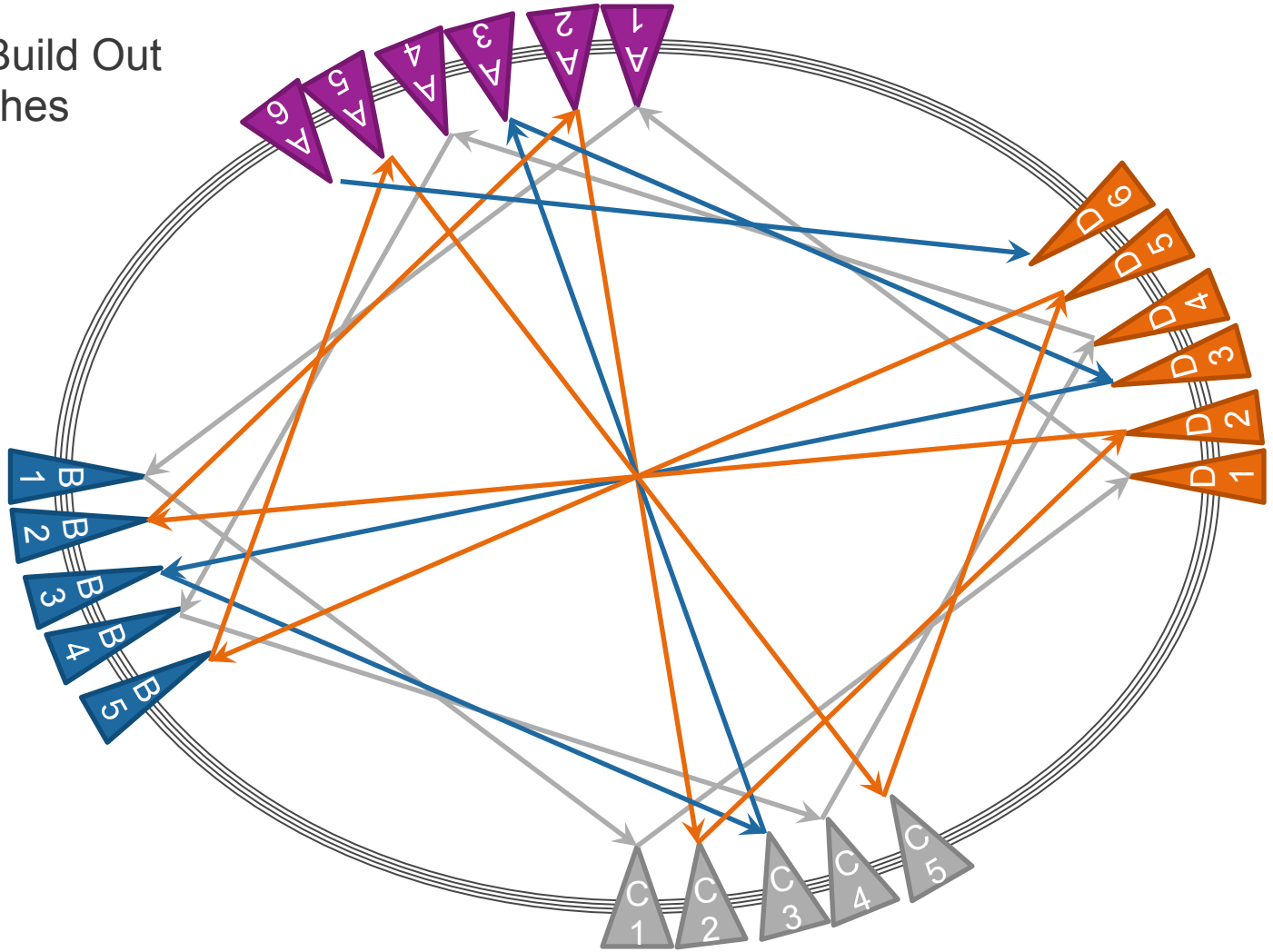
Incremental Build Out
20 Switches



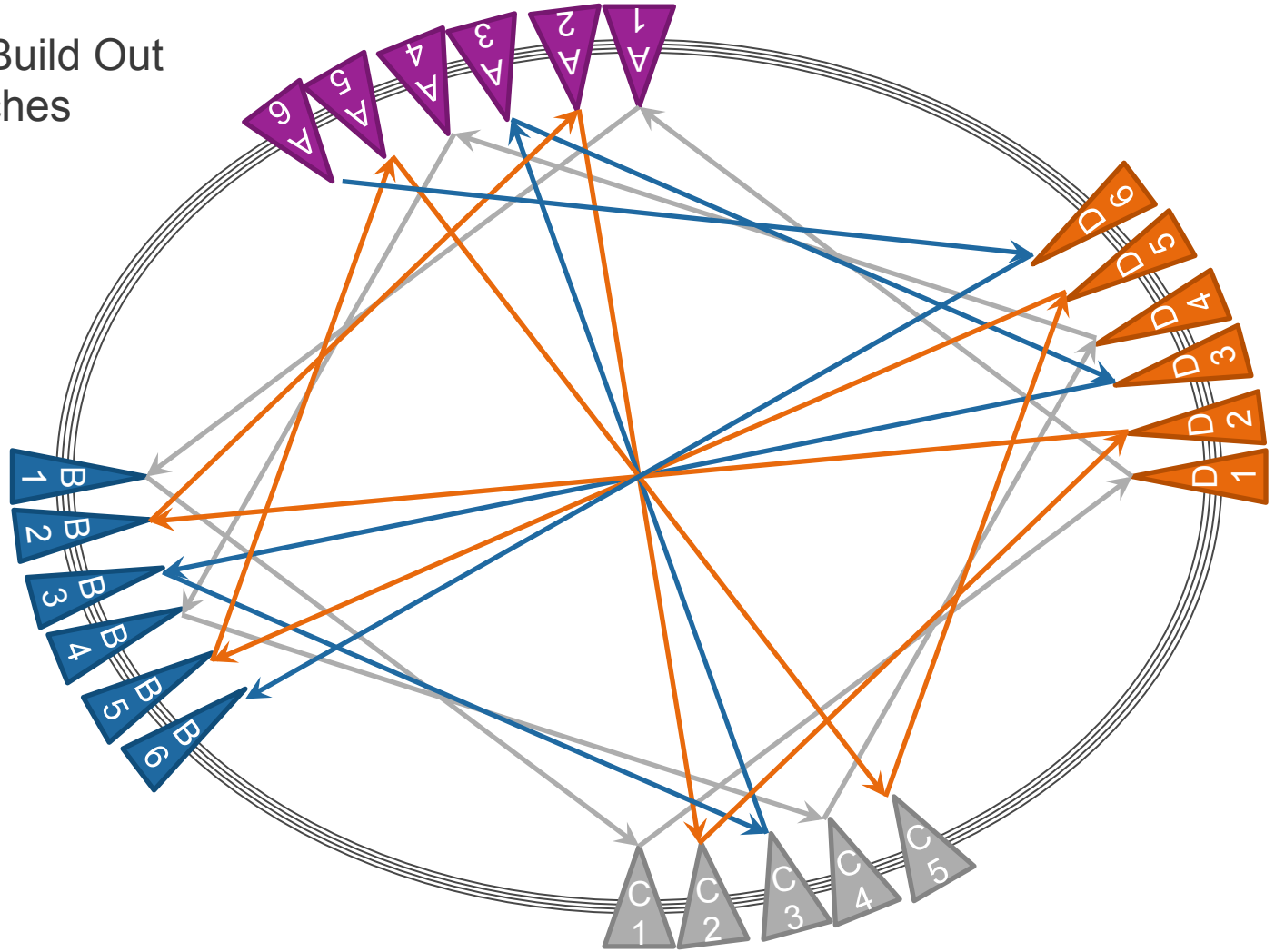
Incremental Build Out
21 Switches



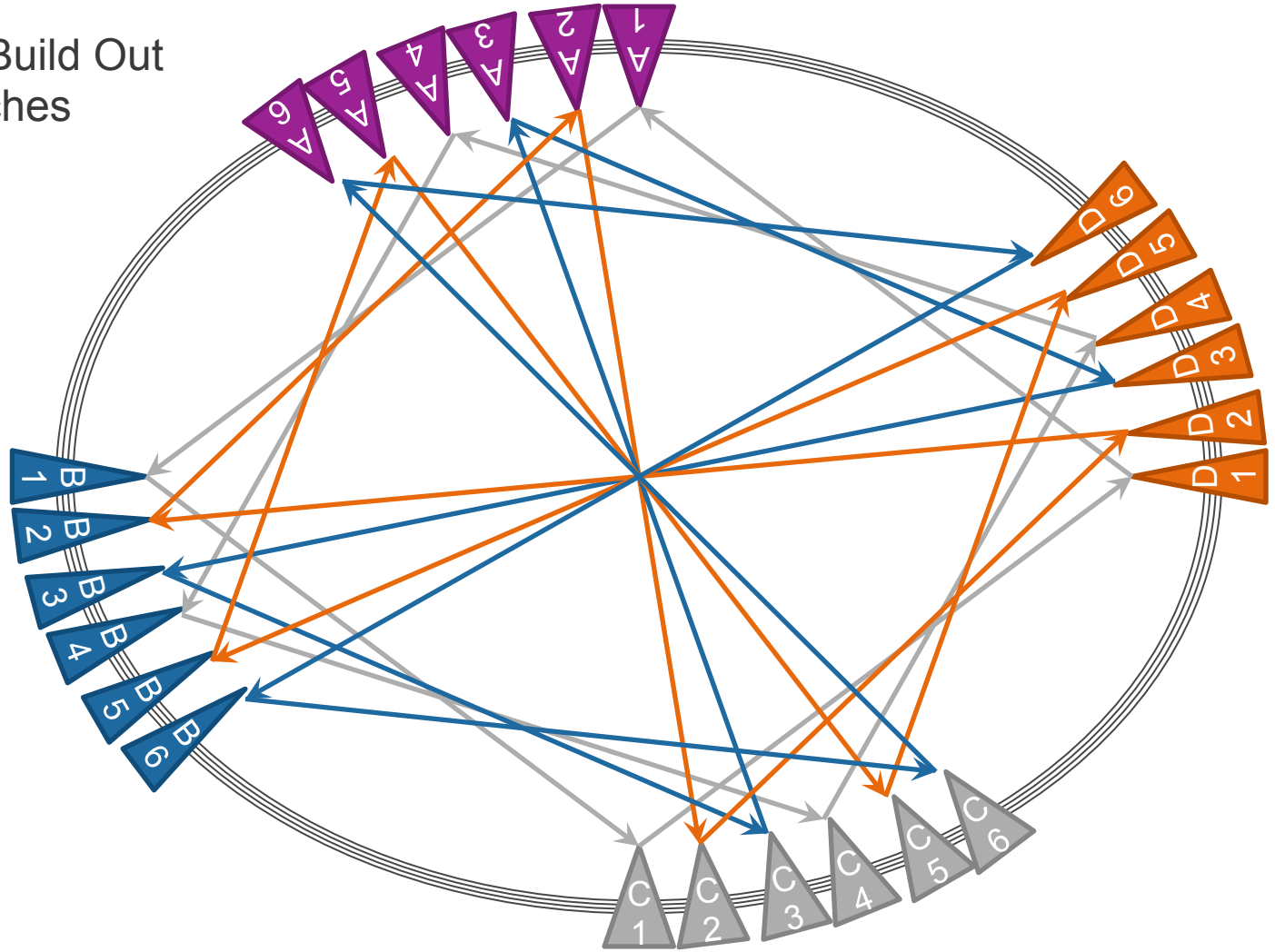
Incremental Build Out
22 Switches



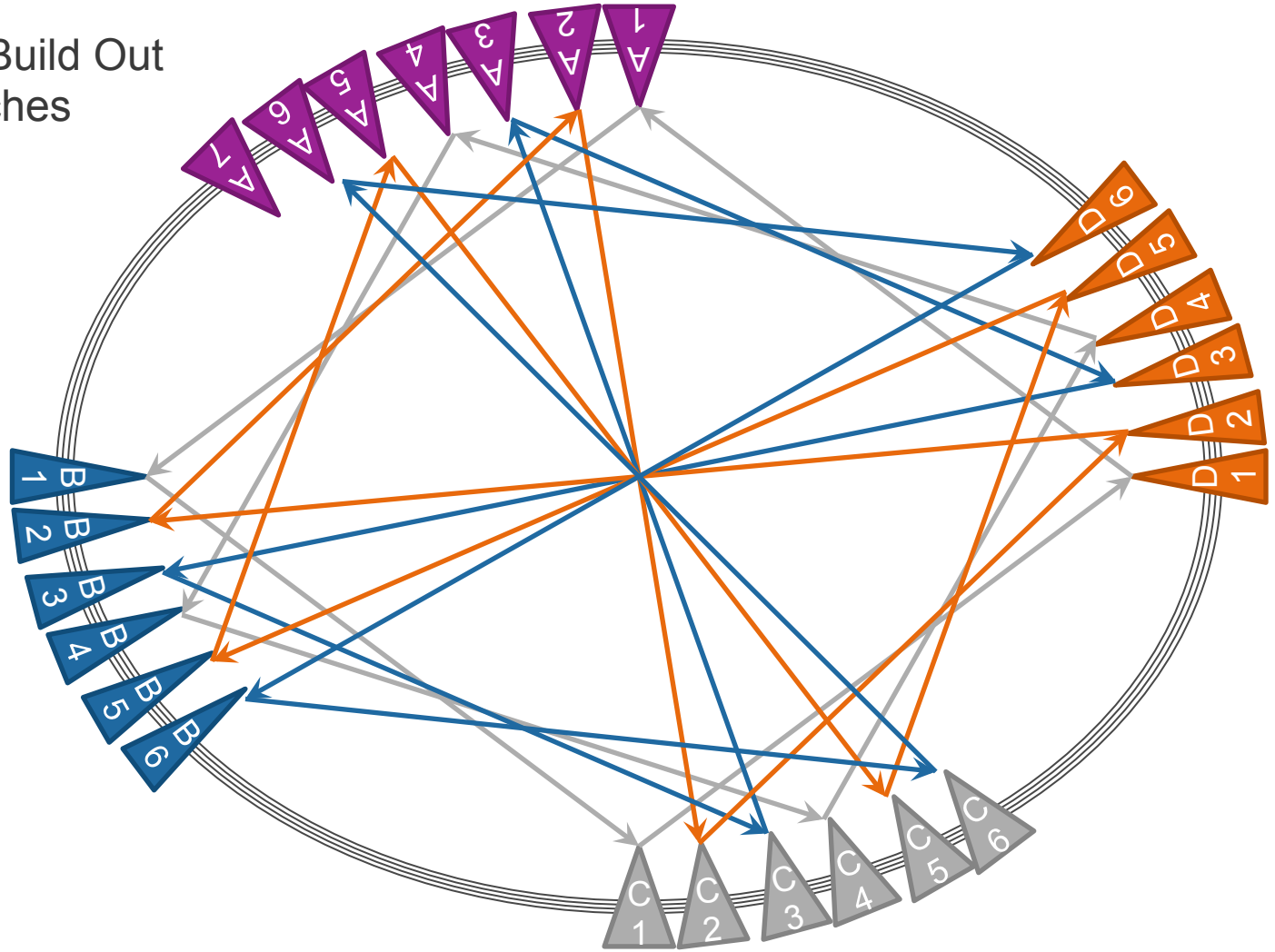
Incremental Build Out
23 Switches



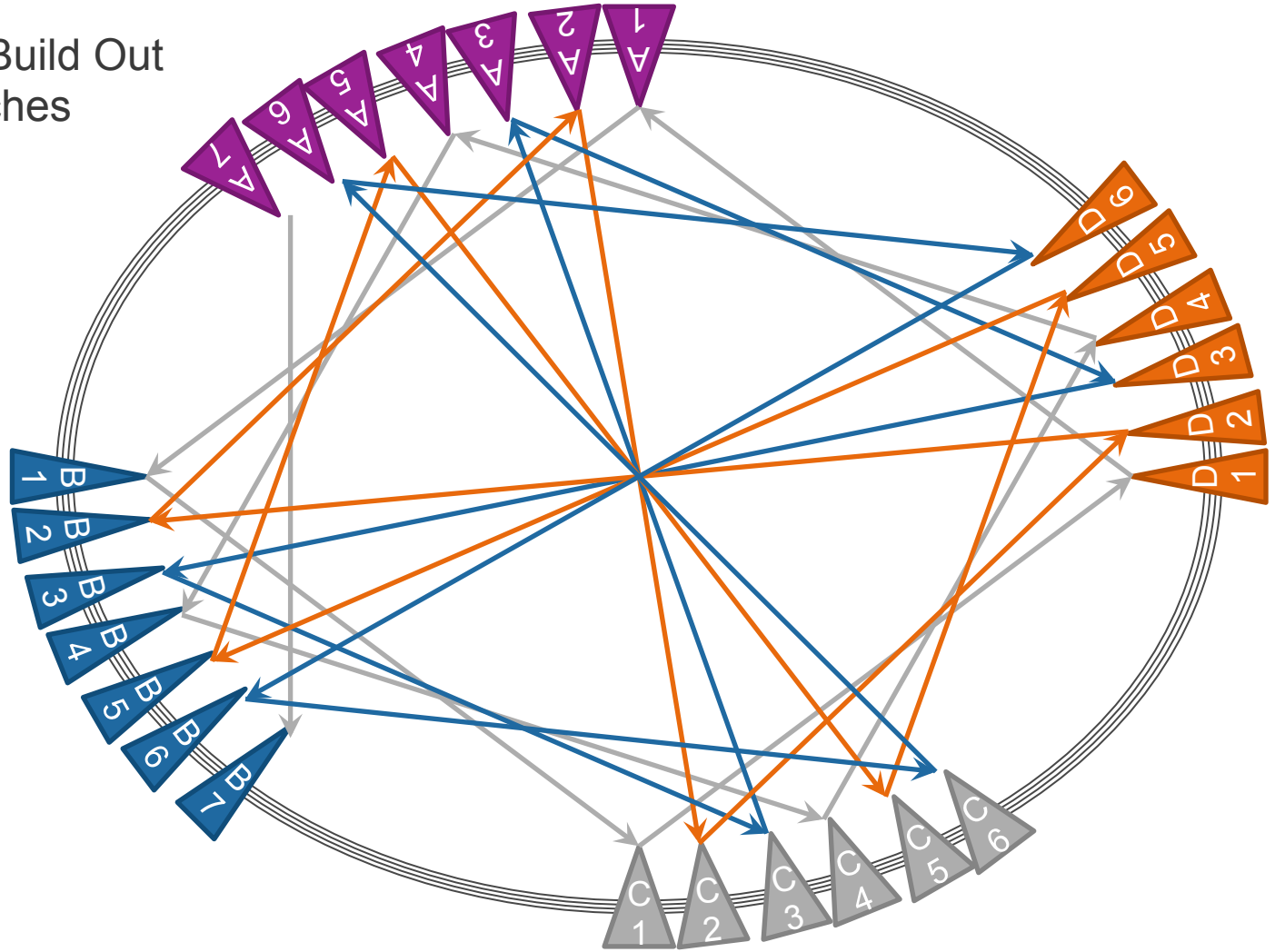
Incremental Build Out
24 Switches



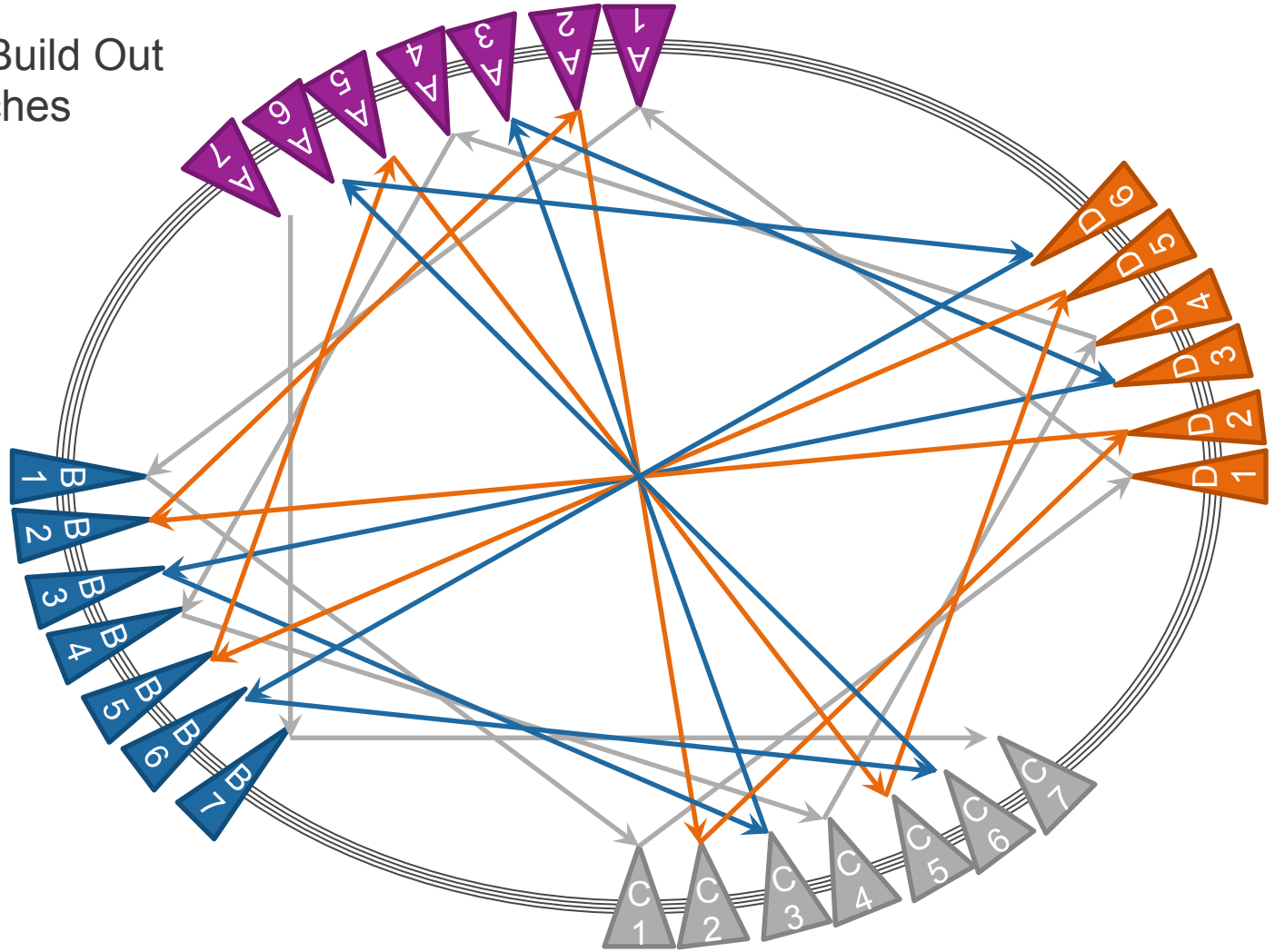
Incremental Build Out
25 Switches



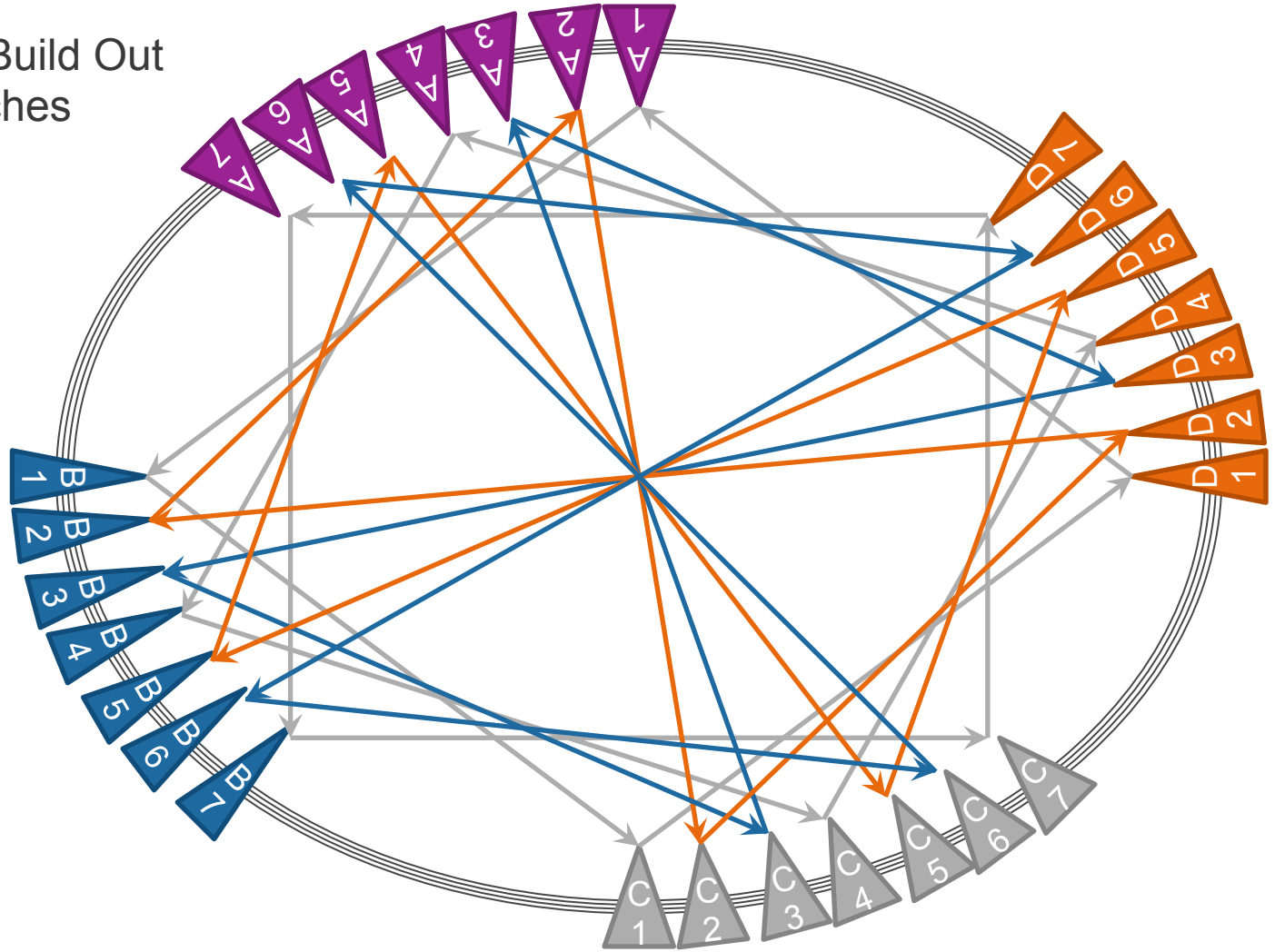
Incremental Build Out
26 Switches



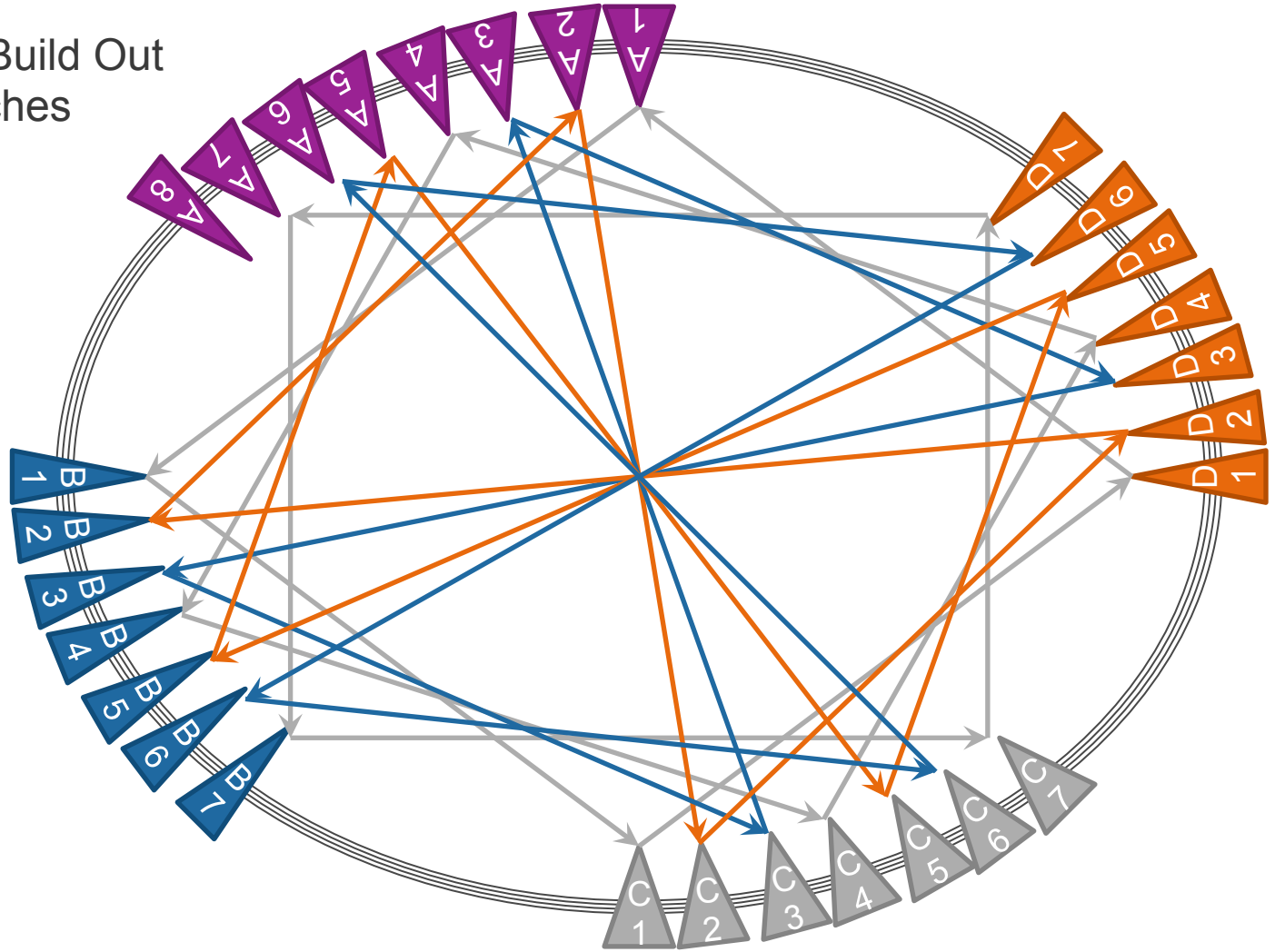
Incremental Build Out
27 Switches



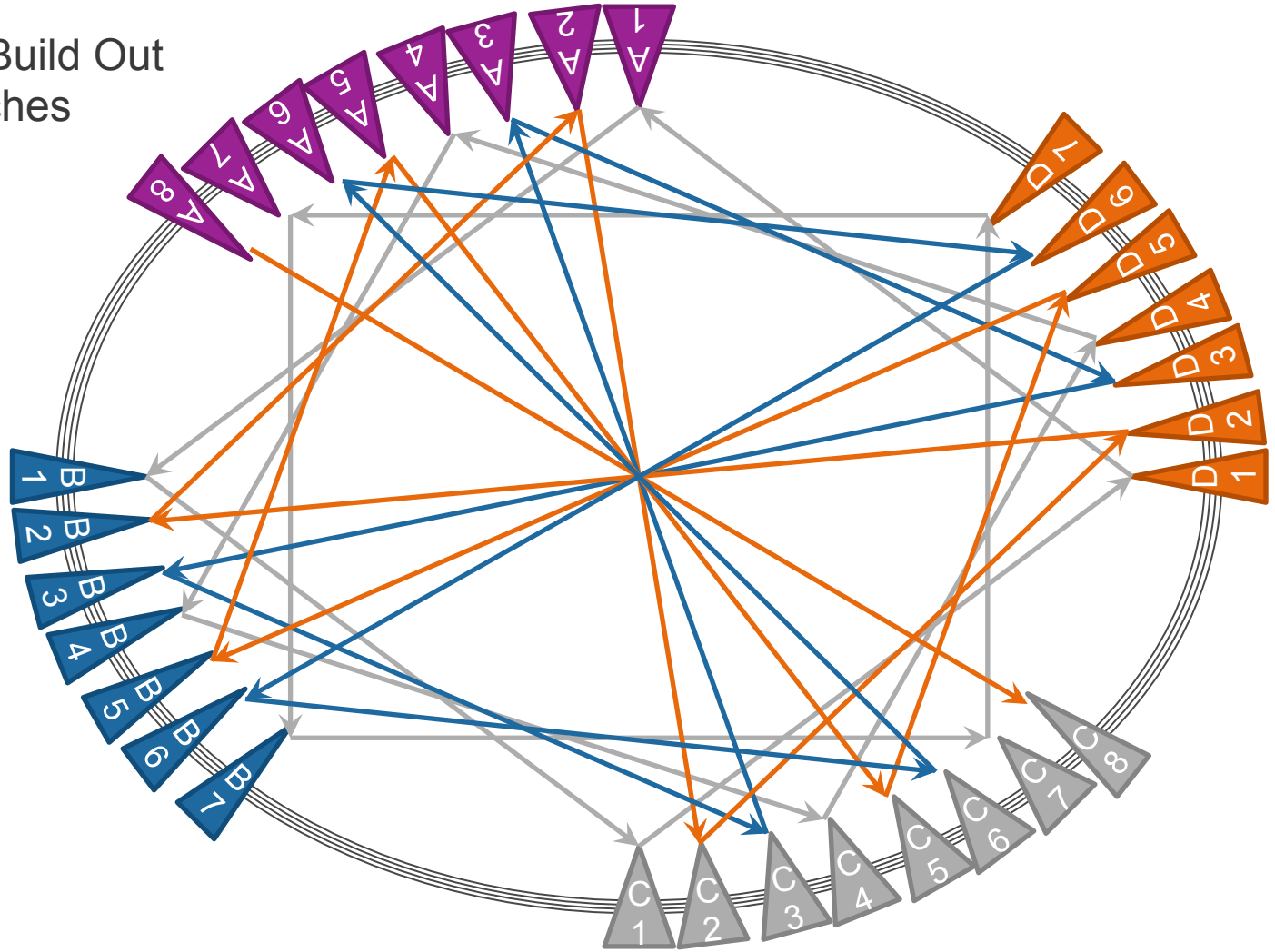
Incremental Build Out
28 Switches



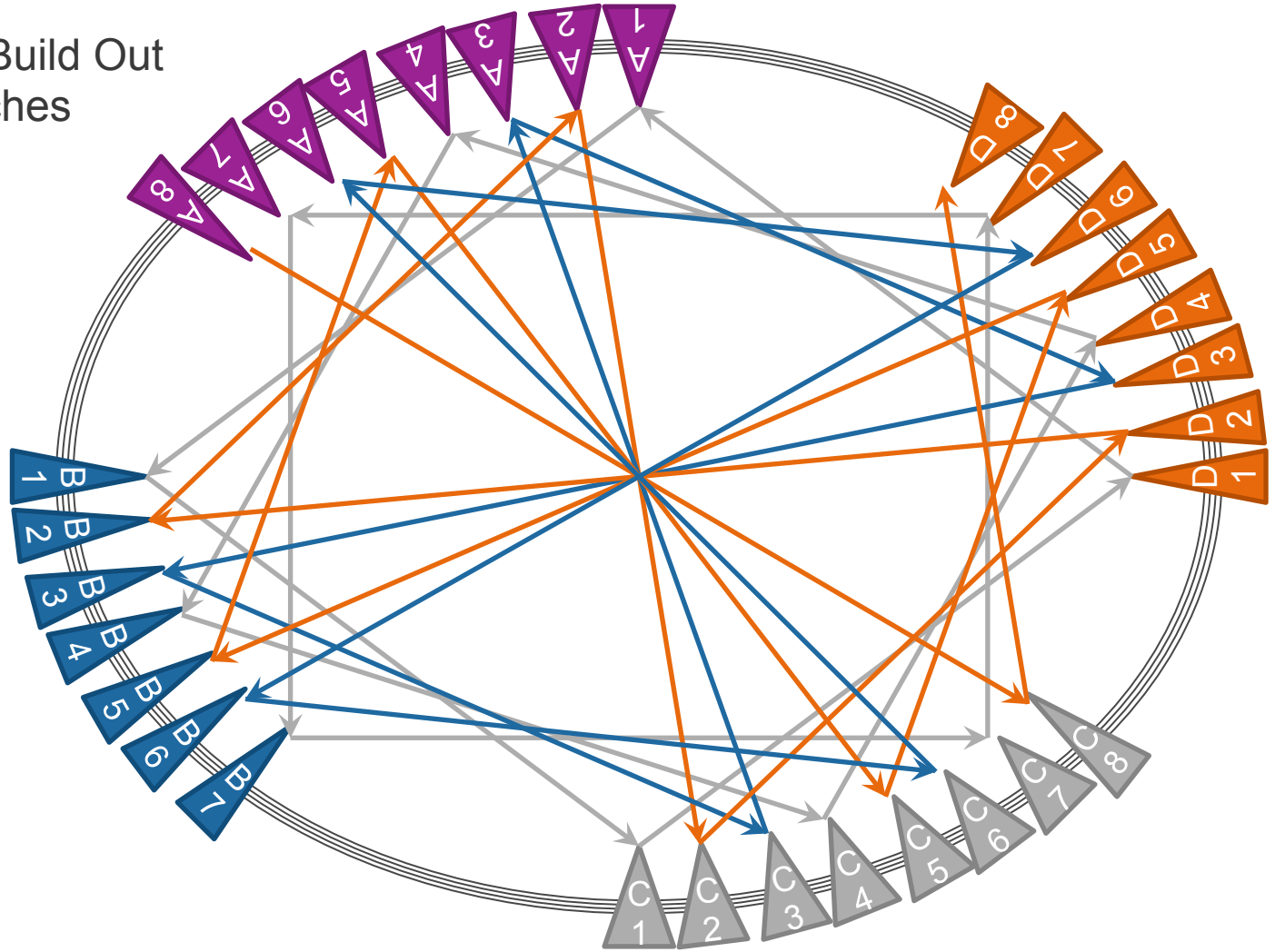
Incremental Build Out
29 Switches



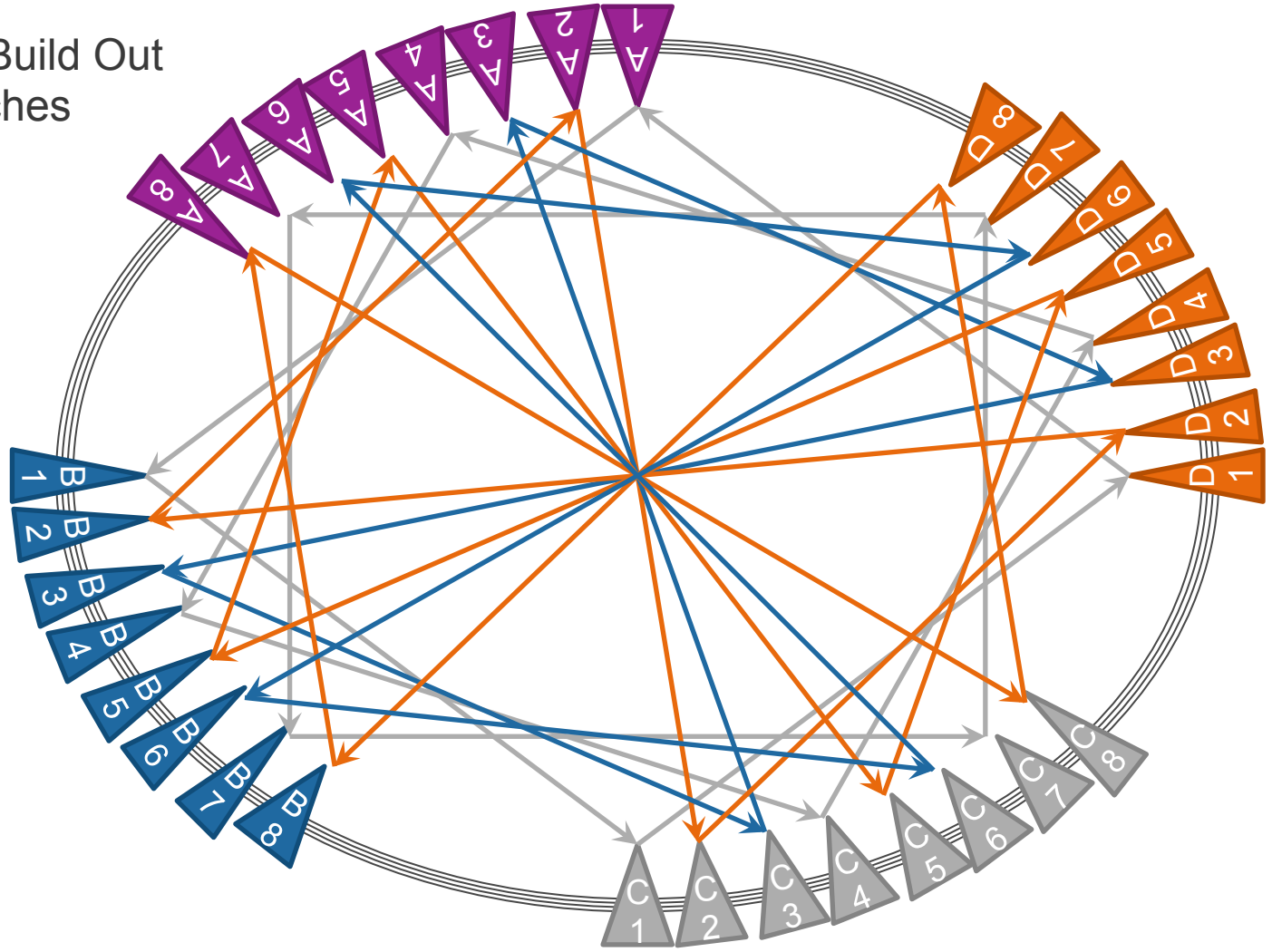
Incremental Build Out
30 Switches



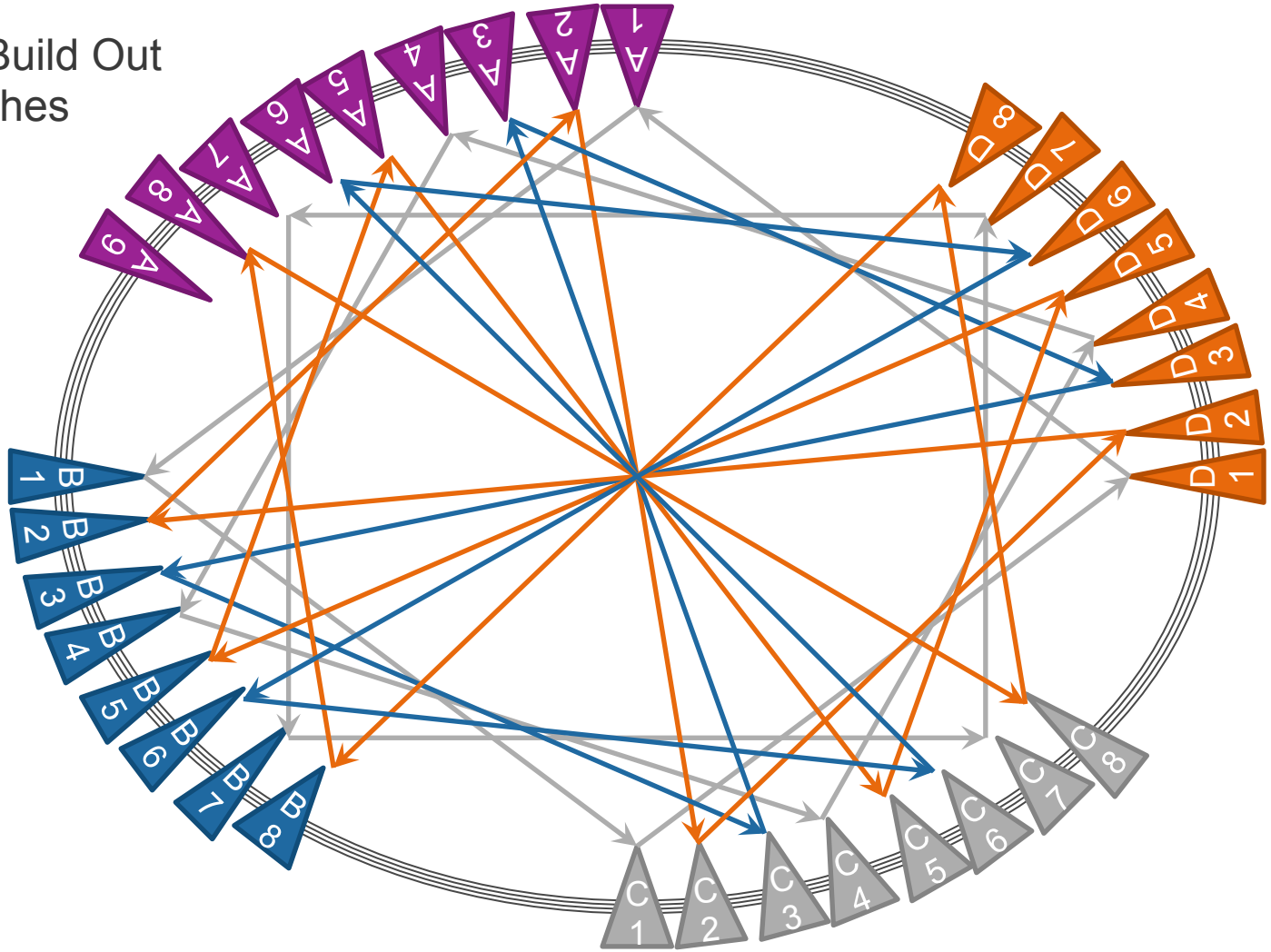
Incremental Build Out
31 Switches



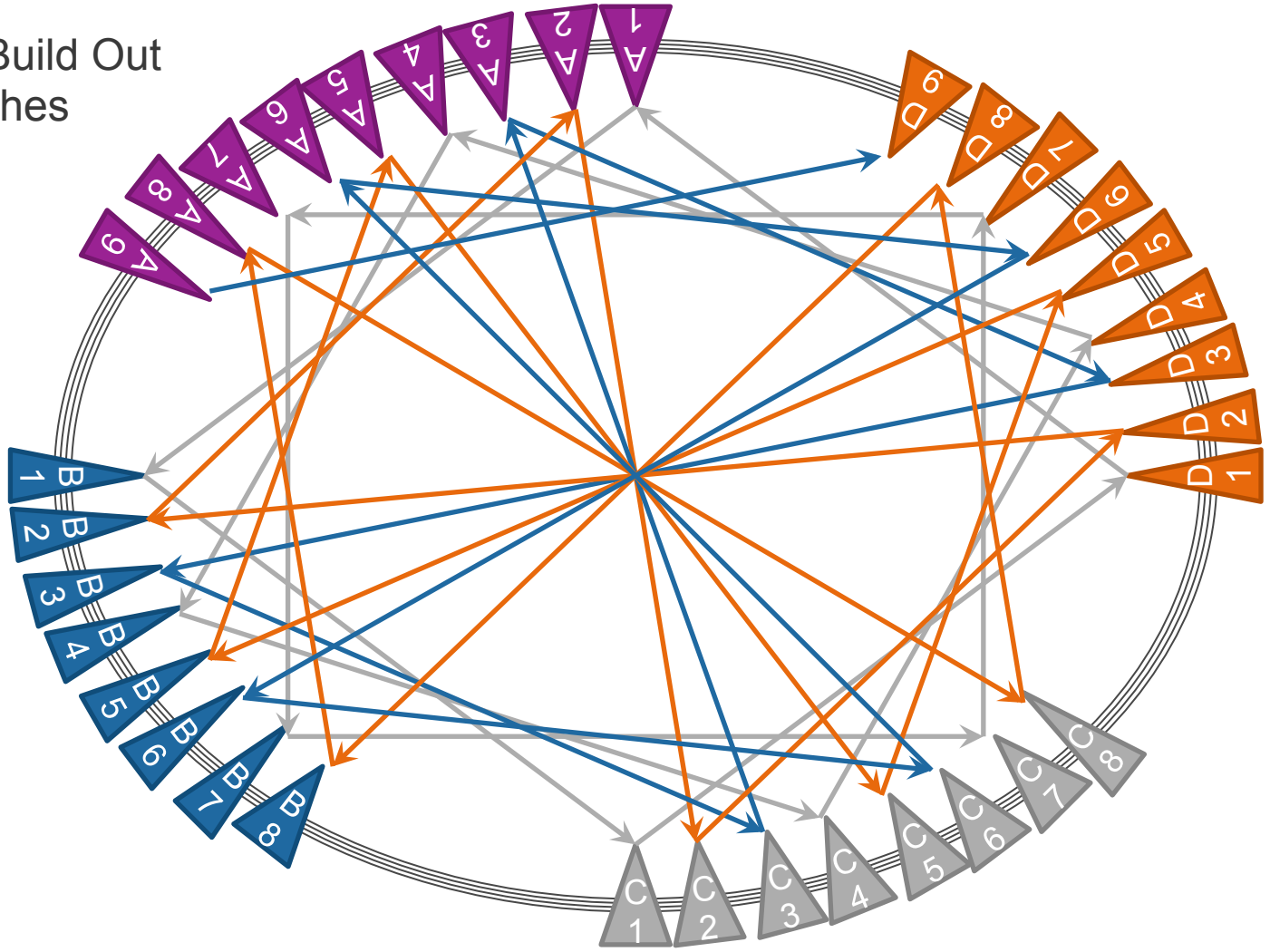
Incremental Build Out
32 Switches



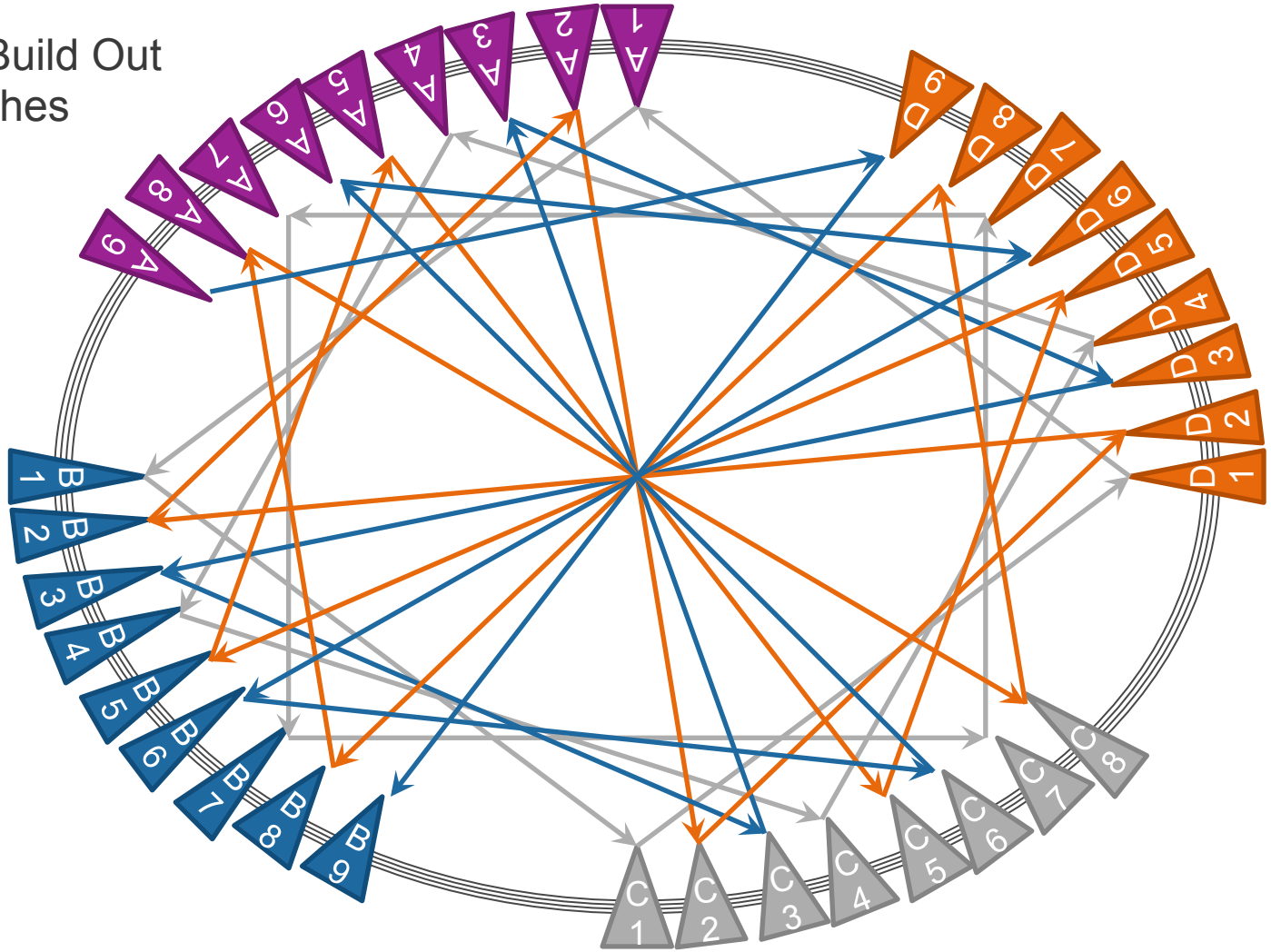
Incremental Build Out
33 Switches



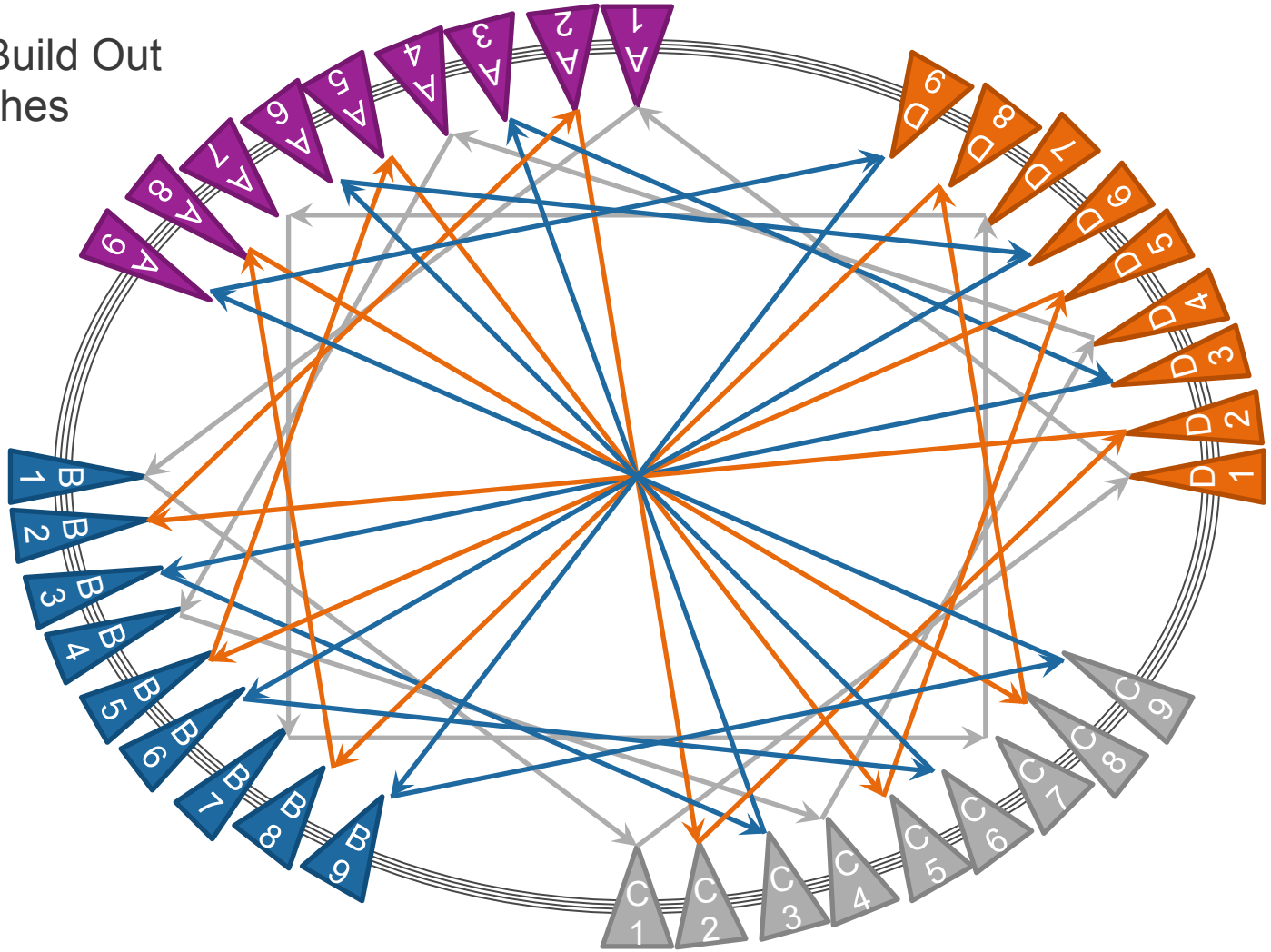
Incremental Build Out
34 Switches



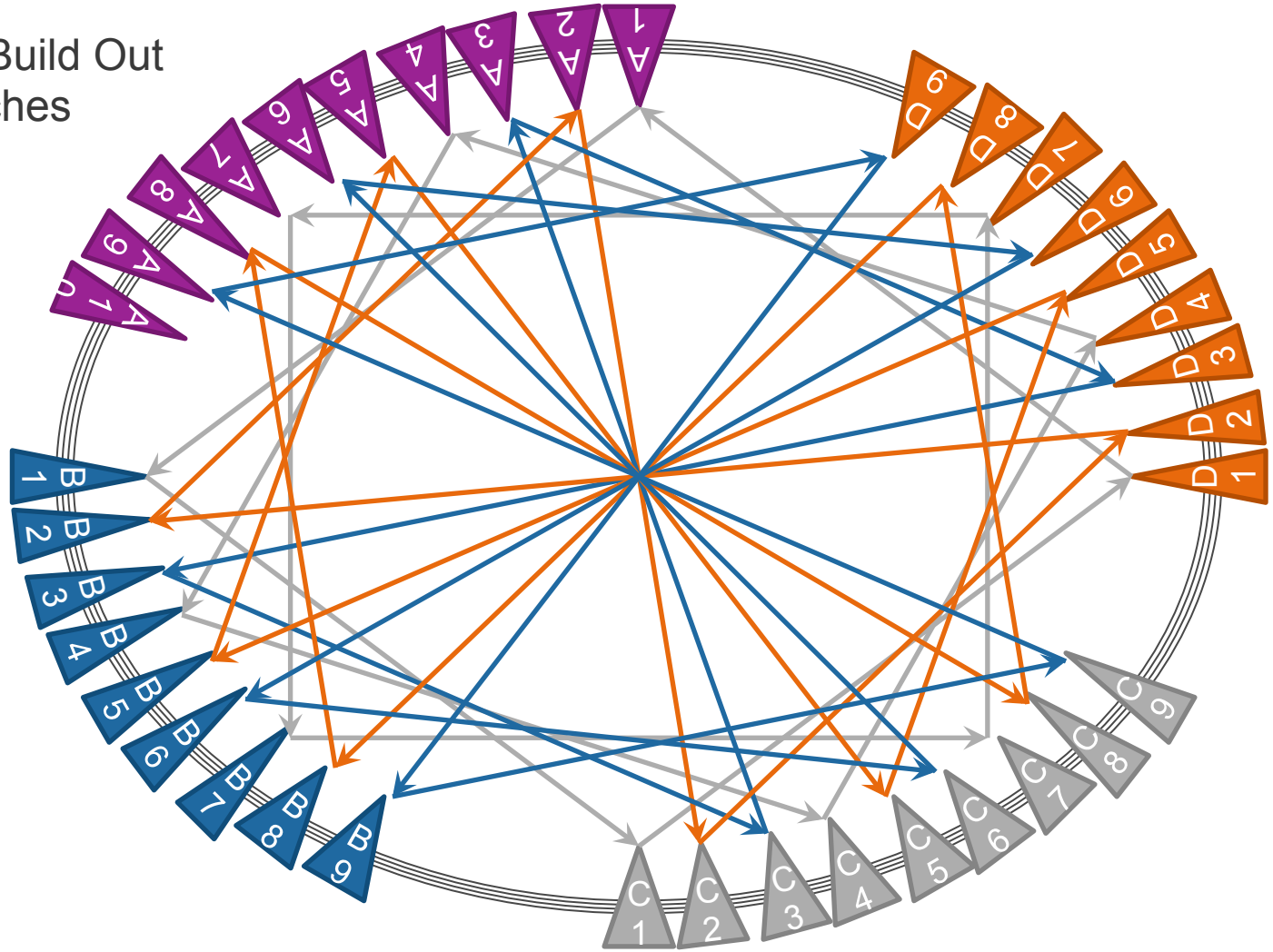
Incremental Build Out
35 Switches



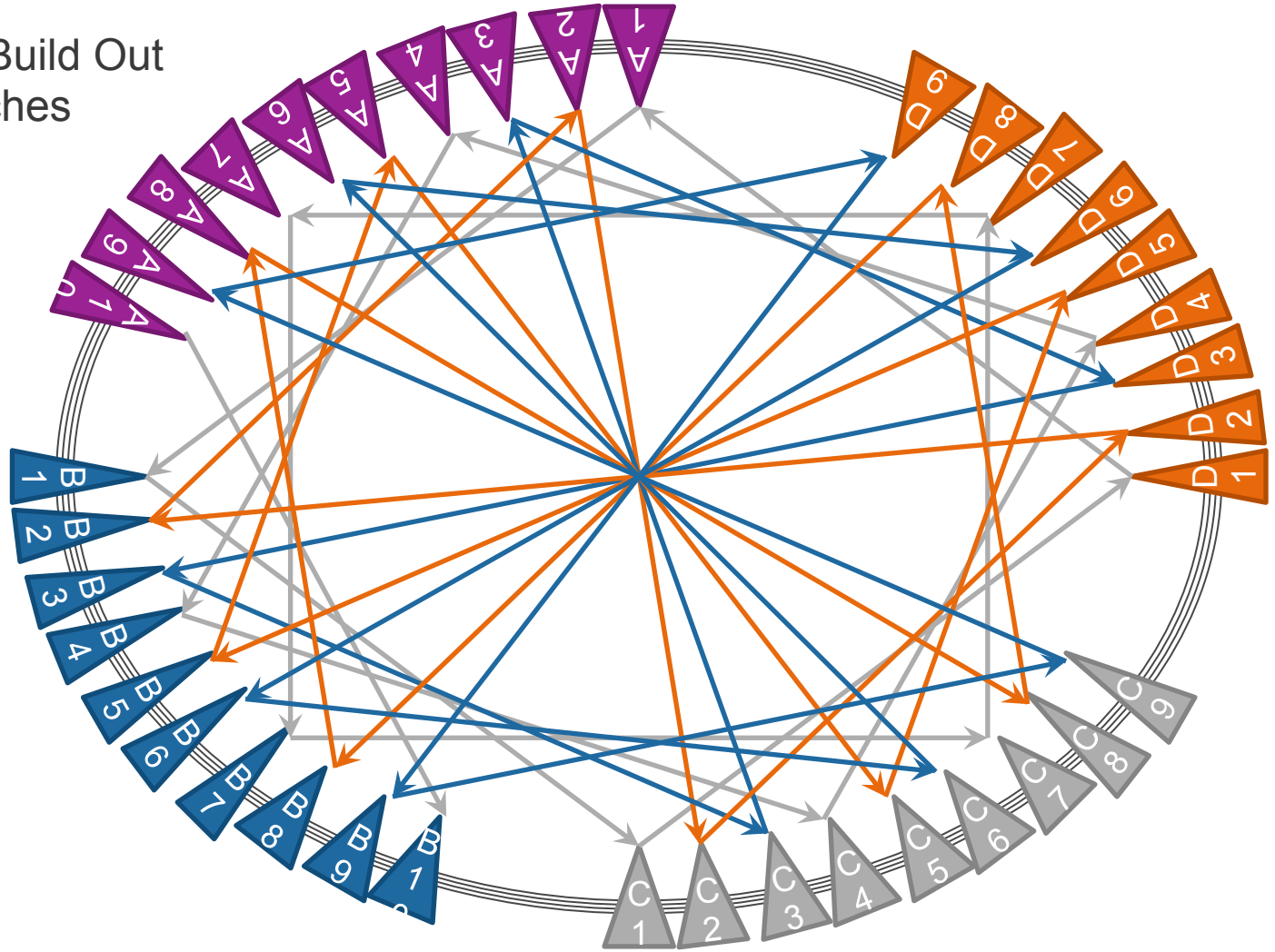
Incremental Build Out
36 Switches



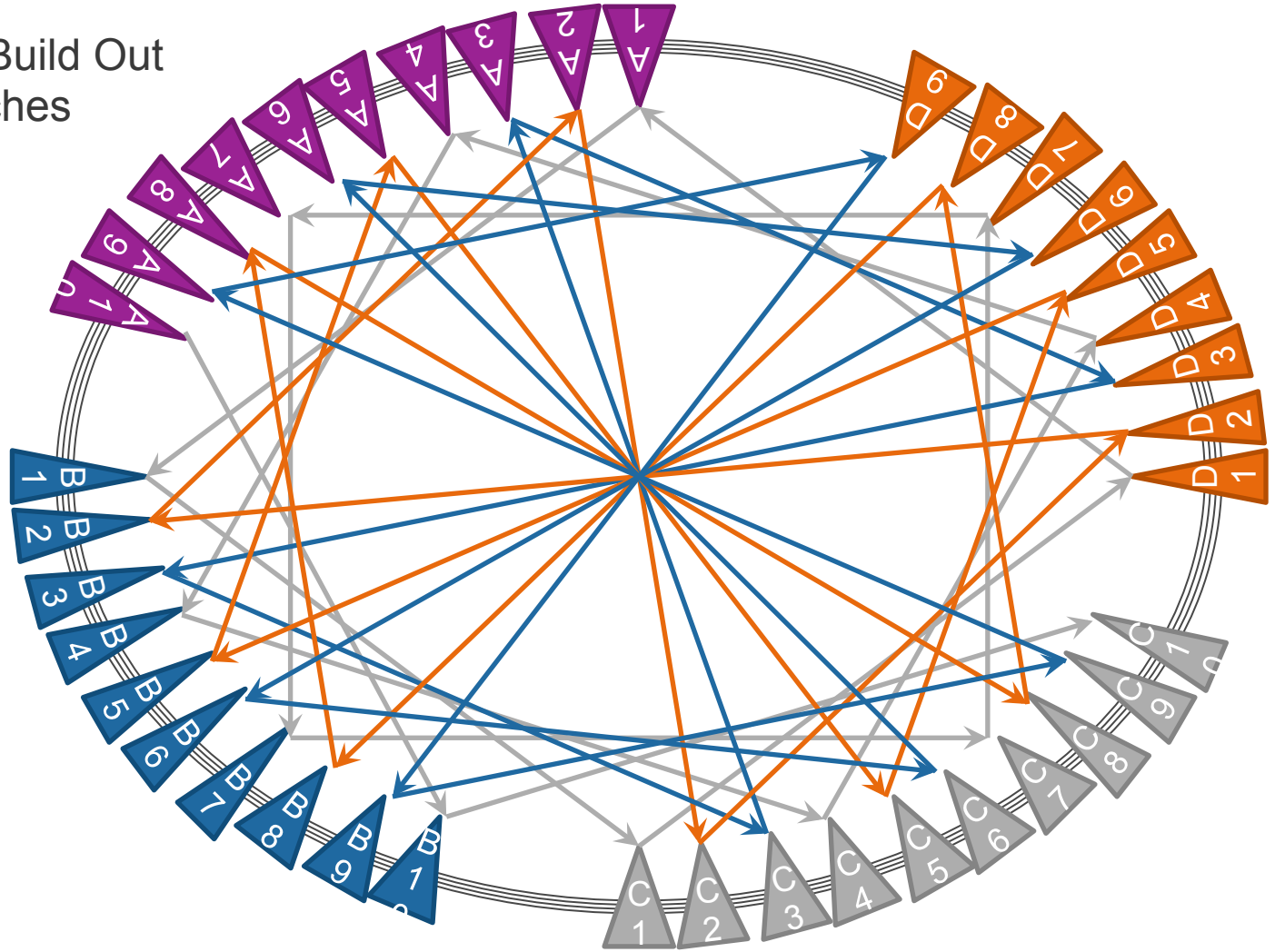
Incremental Build Out
37 Switches



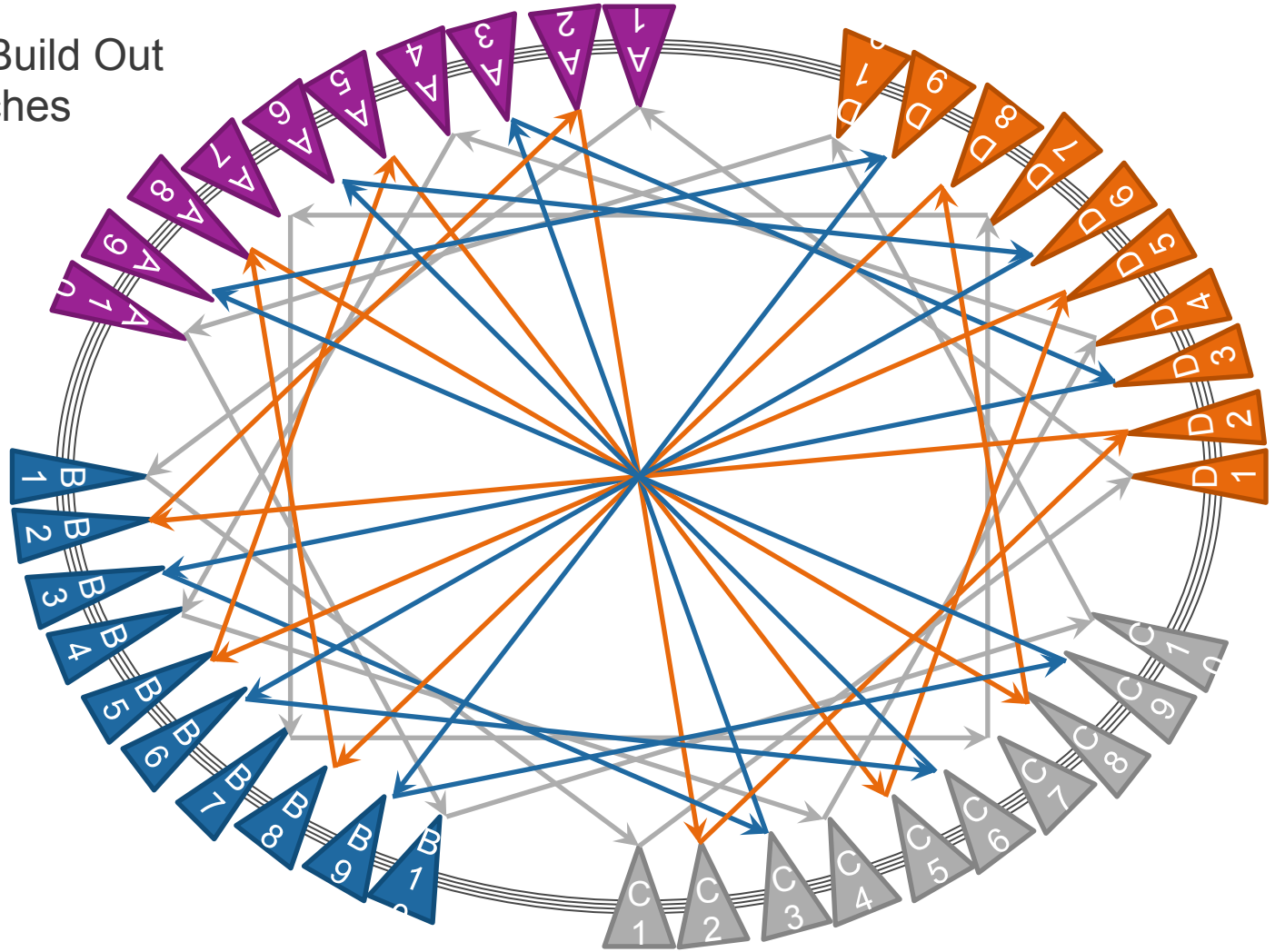
Incremental Build Out
38 Switches



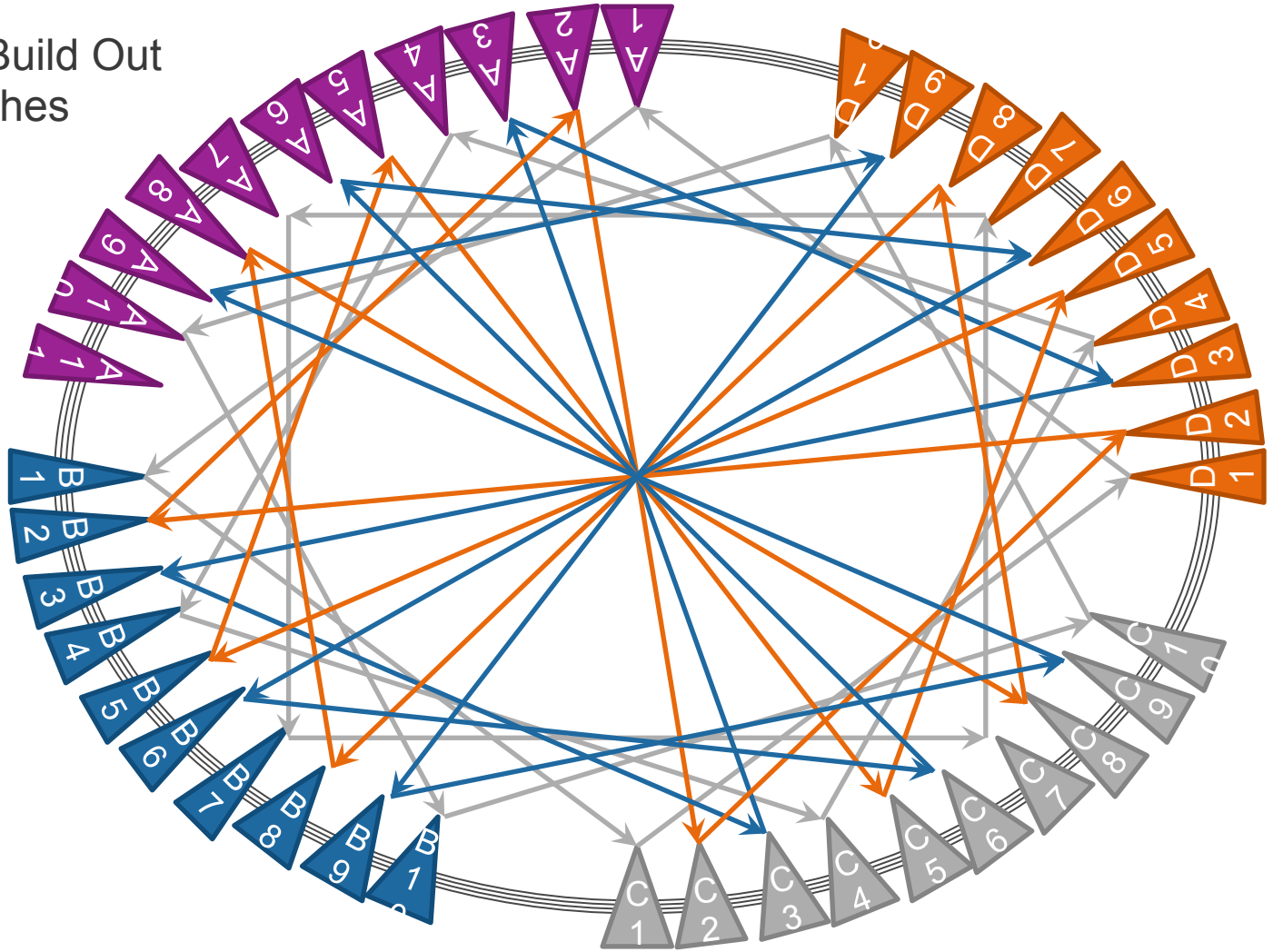
Incremental Build Out
39 Switches



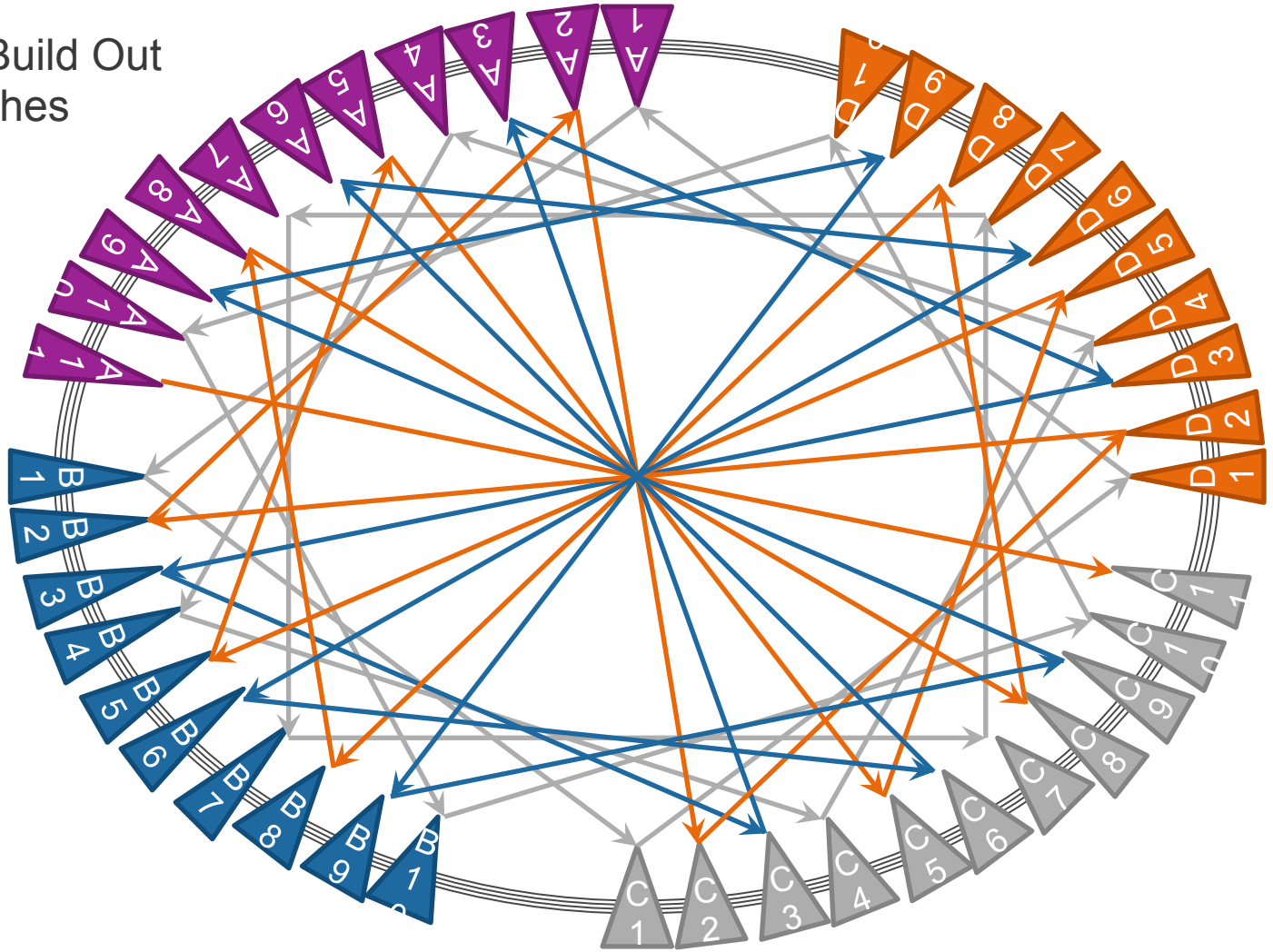
Incremental Build Out
40 Switches



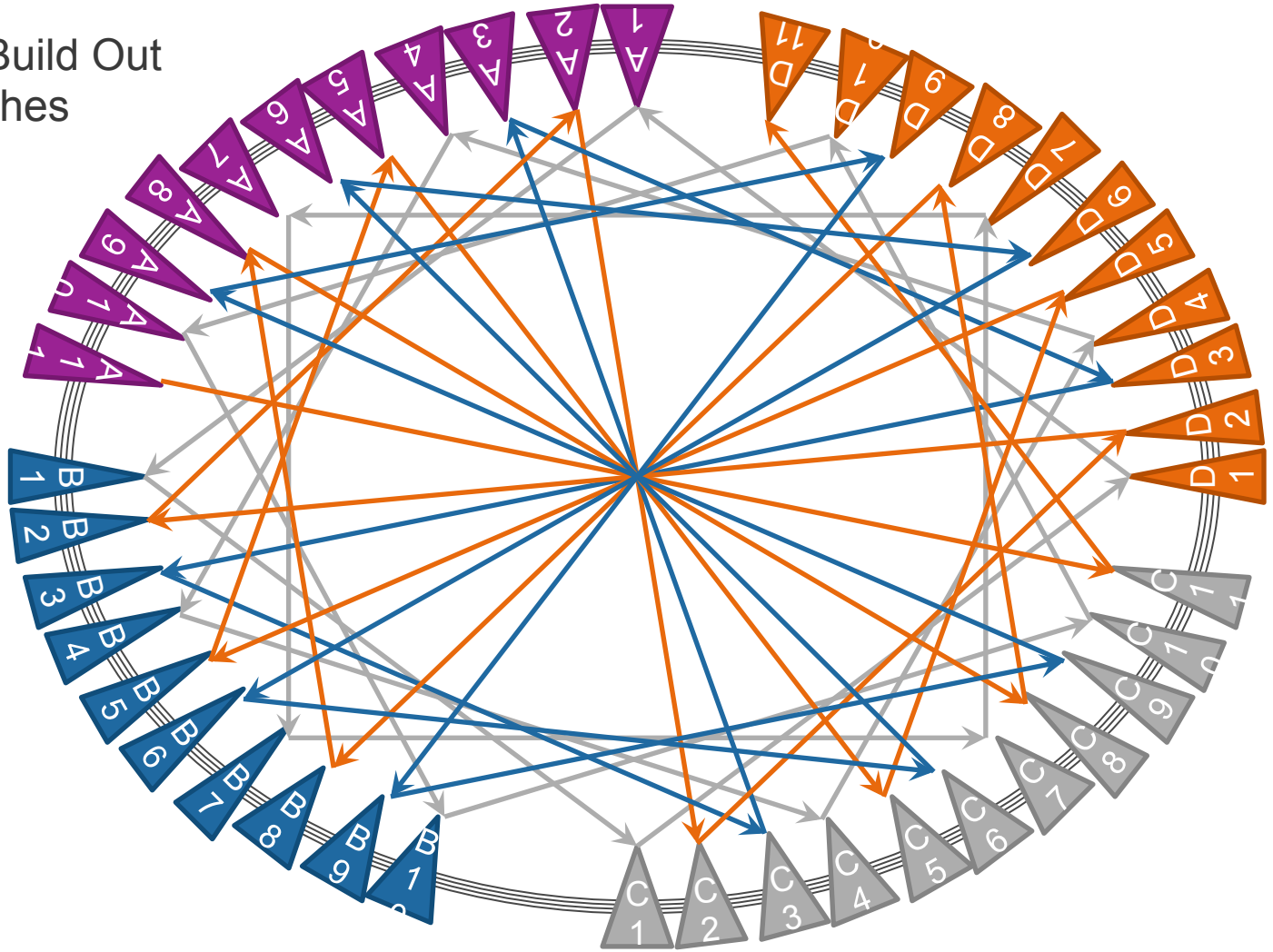
Incremental Build Out
41 Switches



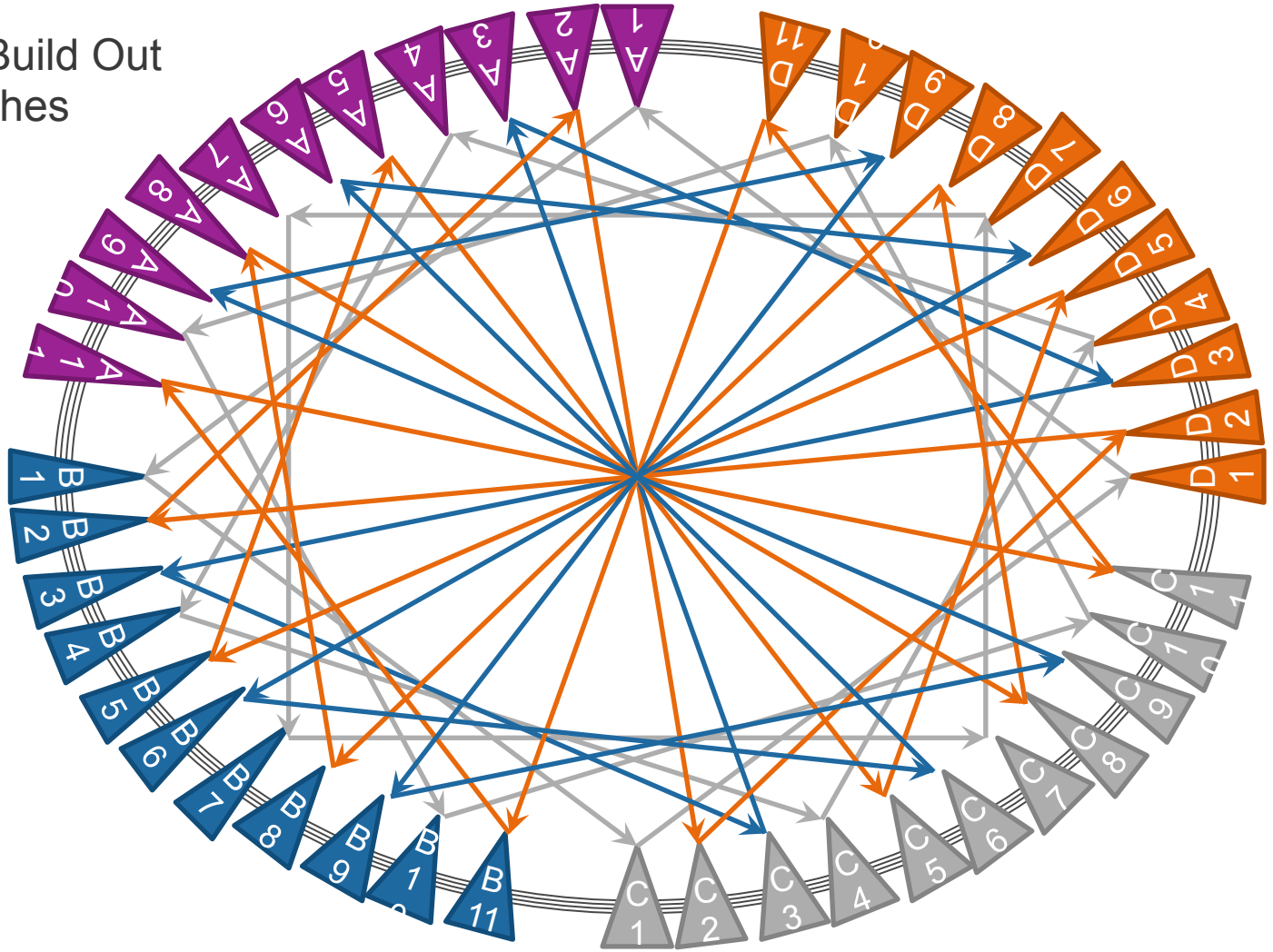
Incremental Build Out
42 Switches



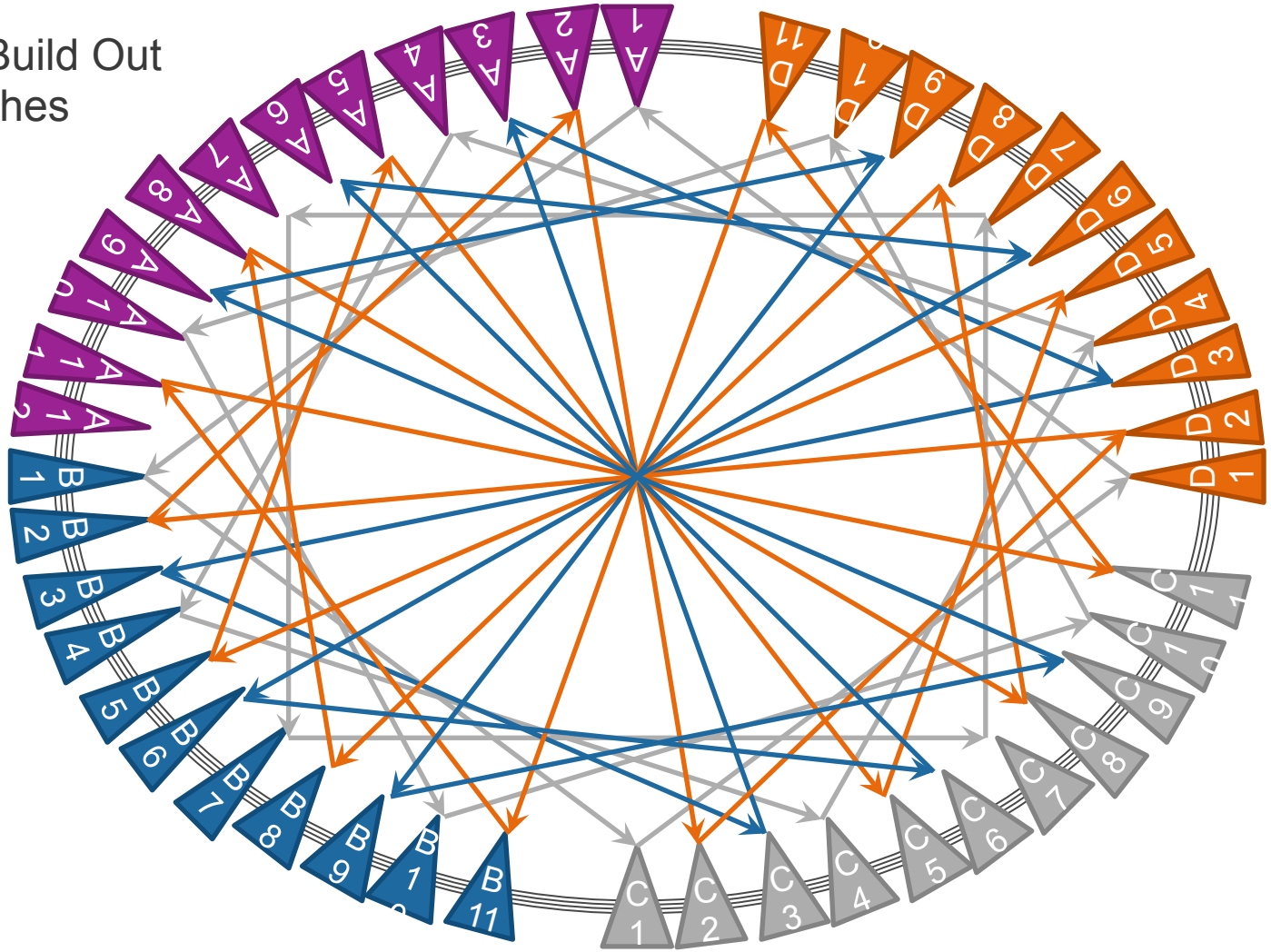
Incremental Build Out
43 Switches



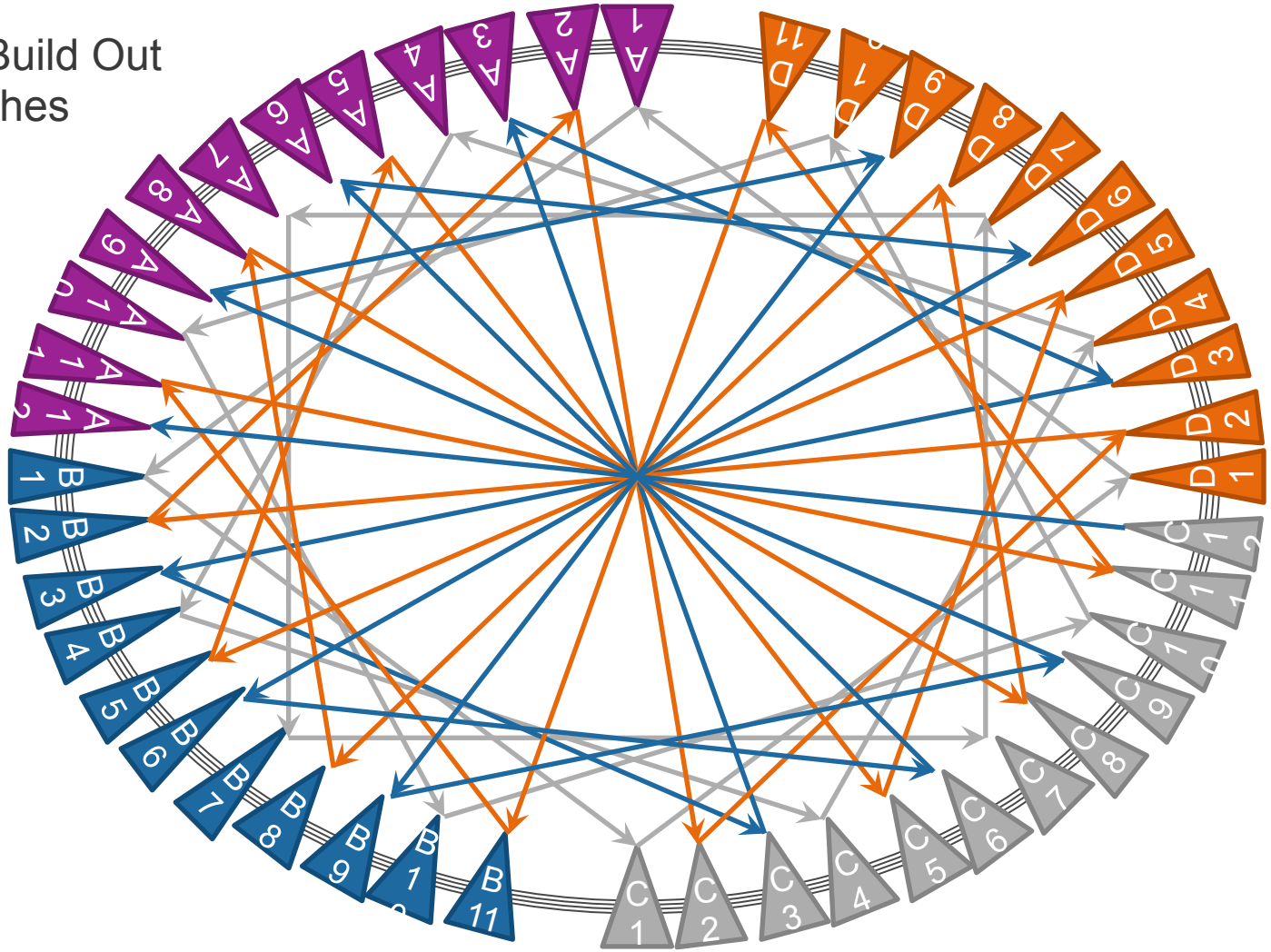
Incremental Build Out
44 Switches



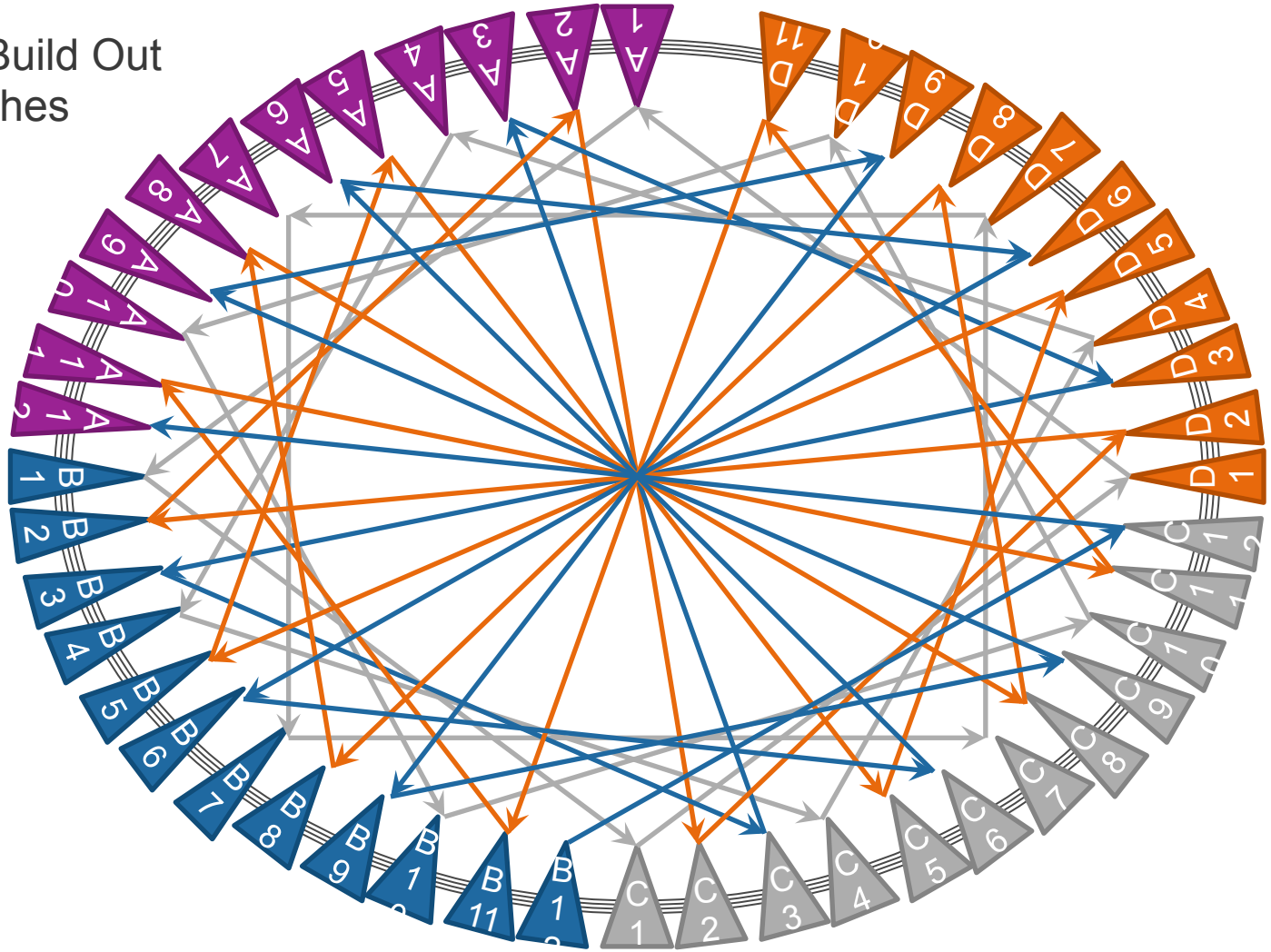
Incremental Build Out
45 Switches



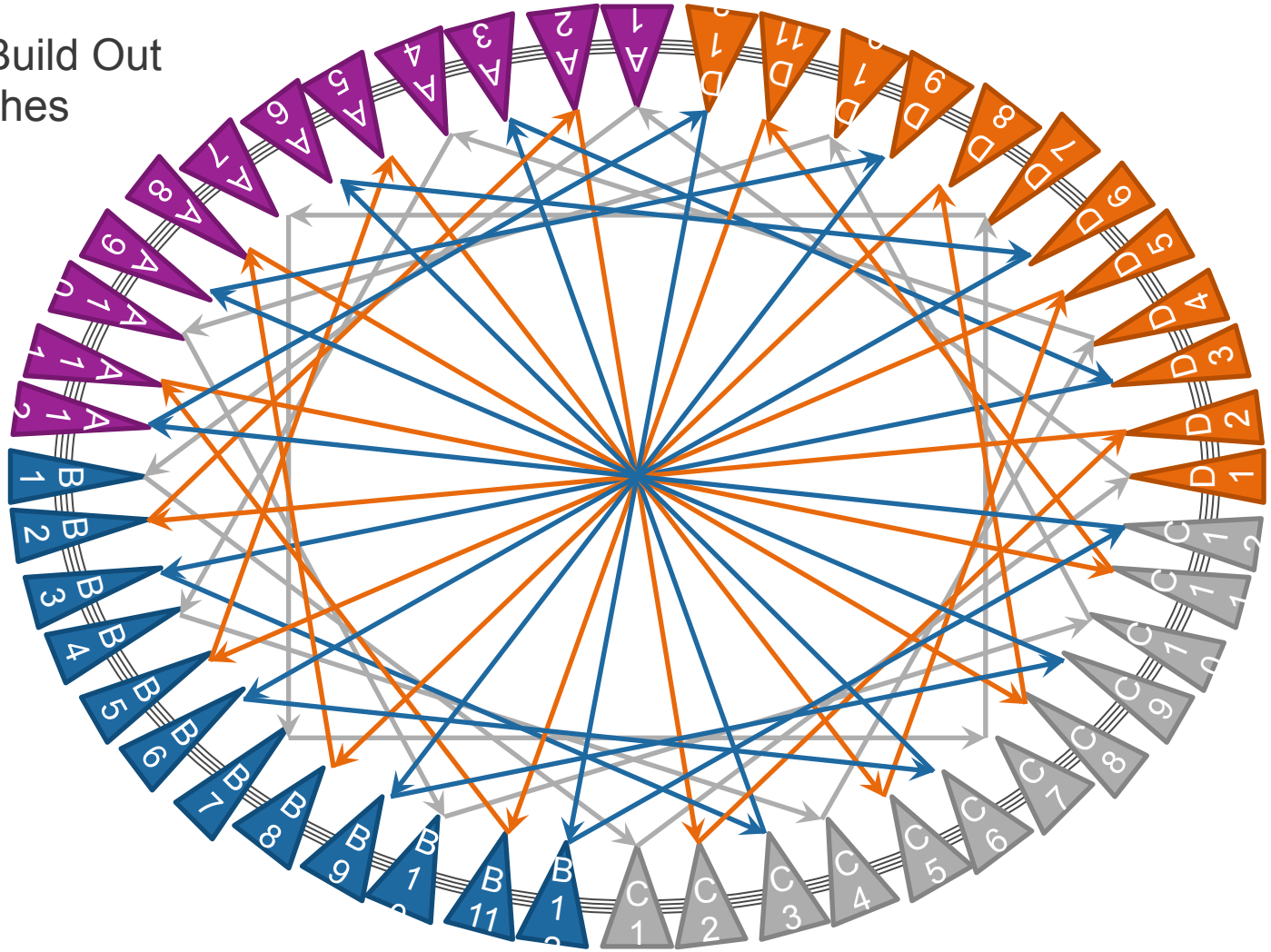
Incremental Build Out
46 Switches



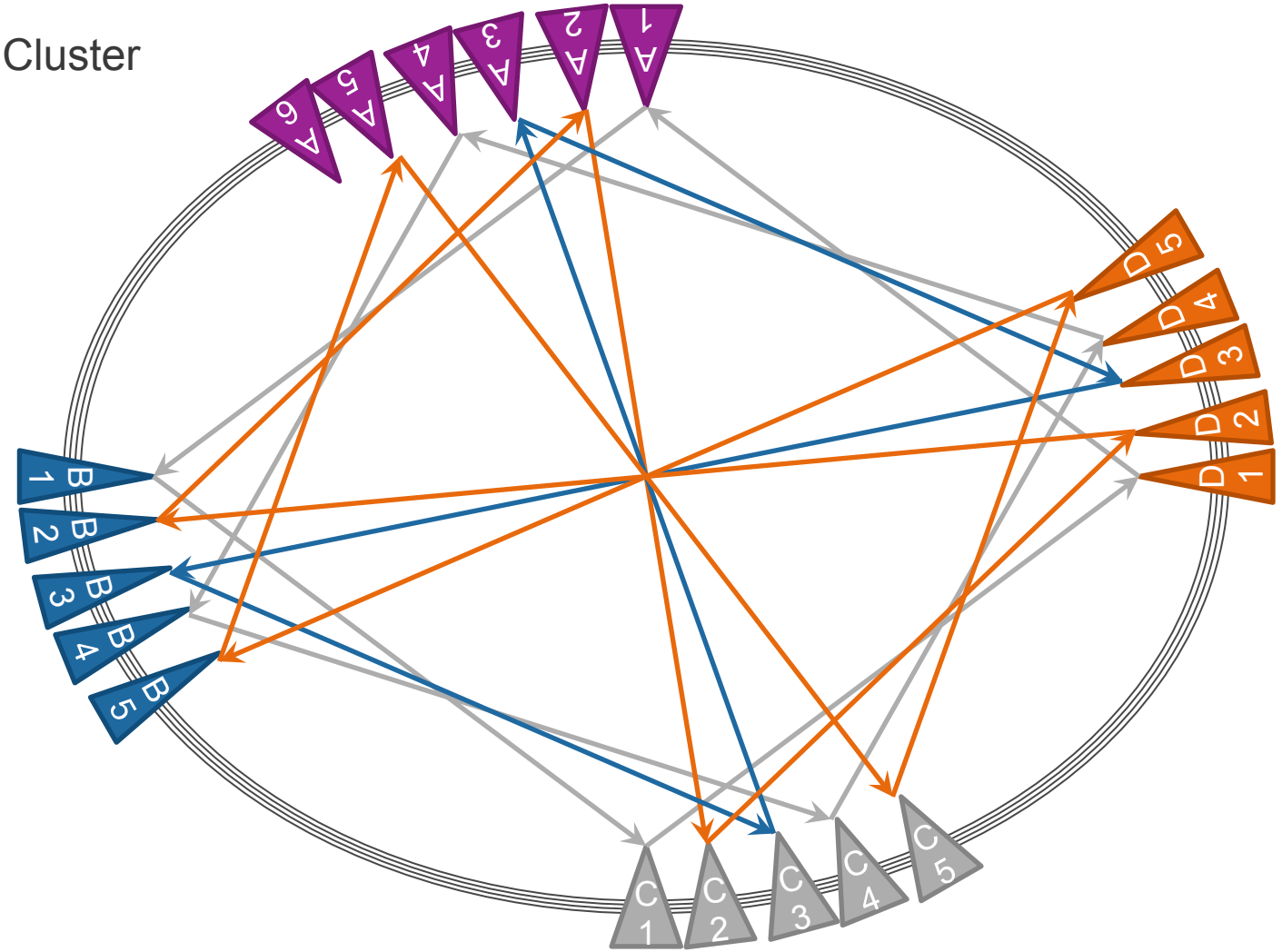
Incremental Build Out
47 Switches

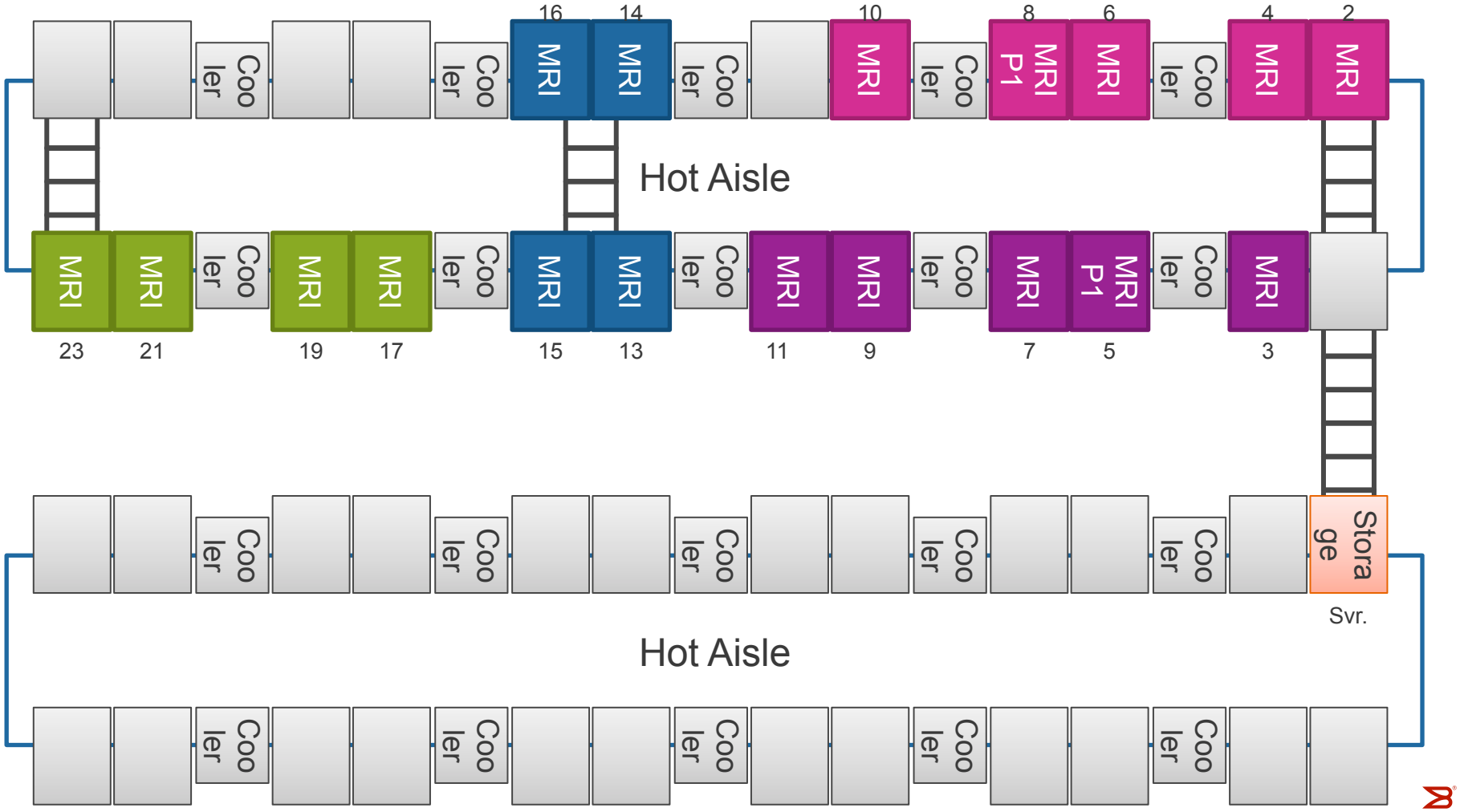


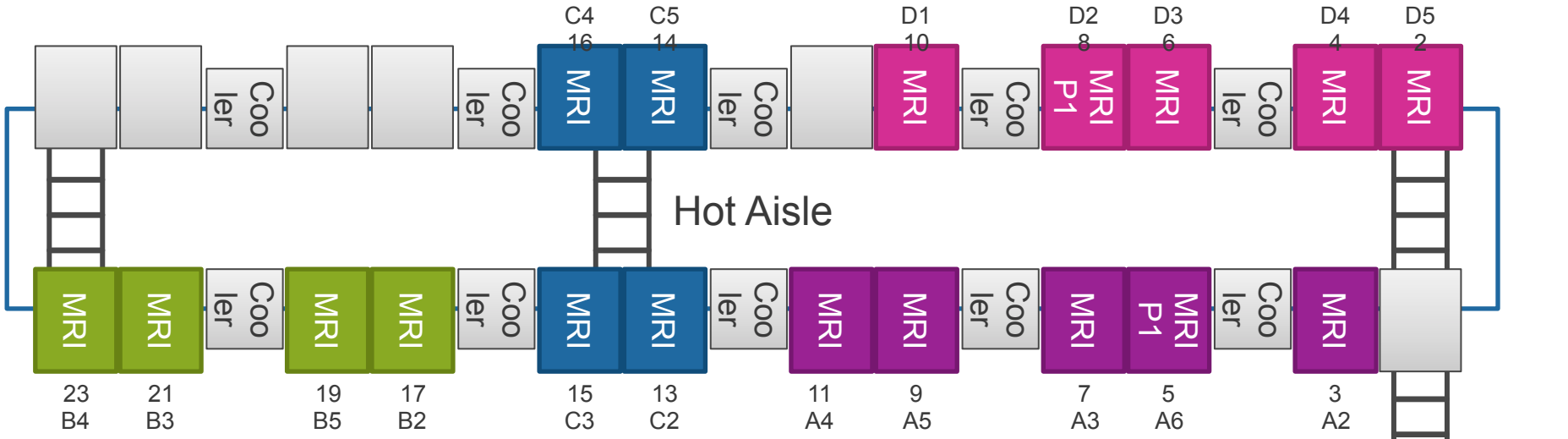
Incremental Build Out
48 Switches



21-Node Cluster




16
14
10
8
6
4
2
MRI
MRI P1
Cooler
Hot Aisle
23
21
19
17
15
13
11
9
7
5
3
Storage
Svr.
Hot Aisle



Mass. Open Cloud – Rack to Node Assignments

Svr. Bot — A1

Svr. Mid — B1

Svr. Top — C1

Both switches exist in the same rack.

BROCADE

Ethernet Name Services

Introduction to Ethernet Name Services

- FSPF tells us where the RBridges are... but how do I know where my end-stations connect?
- How many places can a “MAC address live?

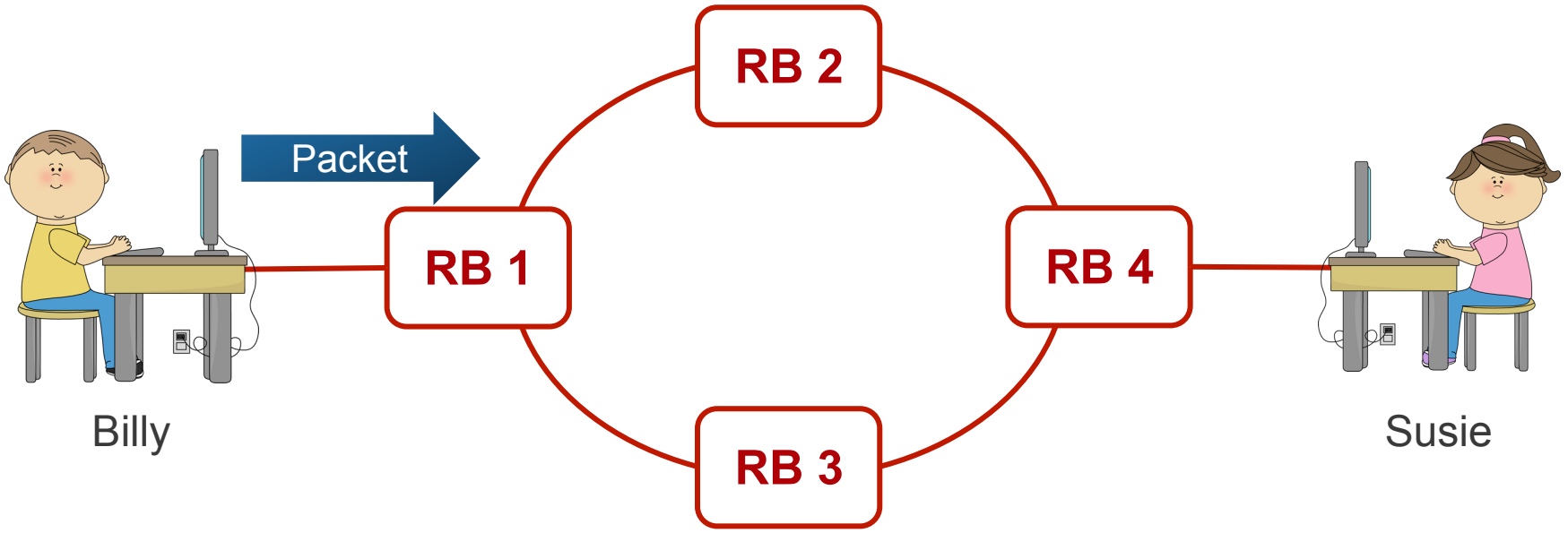
```
RBridge-5# show mac-address-table
VlanId   Mac-address        Type     State         Ports
100      02e0.522f.8801     System   Remote        XX VR1/X/X
100      50eb.1aa4.19db     System   Remote        XX 101/X/X
100      50eb.1ade.b077     System   Remote        XX 103/X/X
101      50eb.1aa4.19db     System   Remote        XX 101/X/X
125      02e0.52f0.2f01     System   Remote        XX VR1/X/X
125      50eb.1aa4.19db     System   Remote        XX 101/X/X
125      50eb.1ade.b077     System   Remote        XX 103/X/X
250      02e0.52cc.cd01     System   Remote        XX VR1/X/X
250      50eb.1aa4.19db     System   Remote        XX 101/X/X
250      50eb.1ade.b077     System   Remote        XX 103/X/X
1027     02e0.52f1.cd01     System   Remote        XX VR1/X/X
1027     50eb.1aa4.19db     System   Remote        XX 101/X/X
1027     50eb.1ade.b077     System   Remote        XX 103/X/X
1044     02e0.5216.cd01     System   Remote        XX VR1/X/X
1044     50eb.1aa4.19db     System   Remote        XX 101/X/X
1044     50eb.1ade.b077     System   Remote        XX 103/X/X
Total MAC addresses    :  16
RBridge-5#
```

Frame Forwarding

A Basic Network

Step 1 – Billy sends a packet to Susie

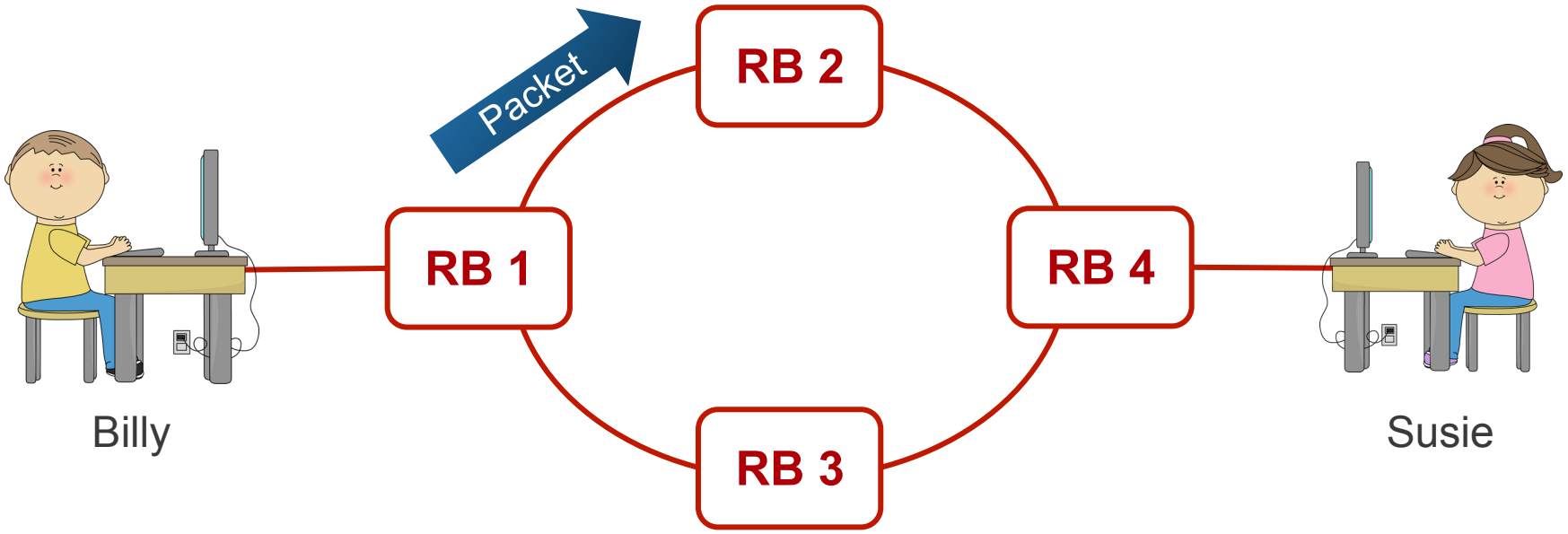
Does RB 1 know about Susie?
Who is the next hop? (RB 2)



FCS **Payload** **IP** **VLAN** **Billy** **Susie**

A Basic Network

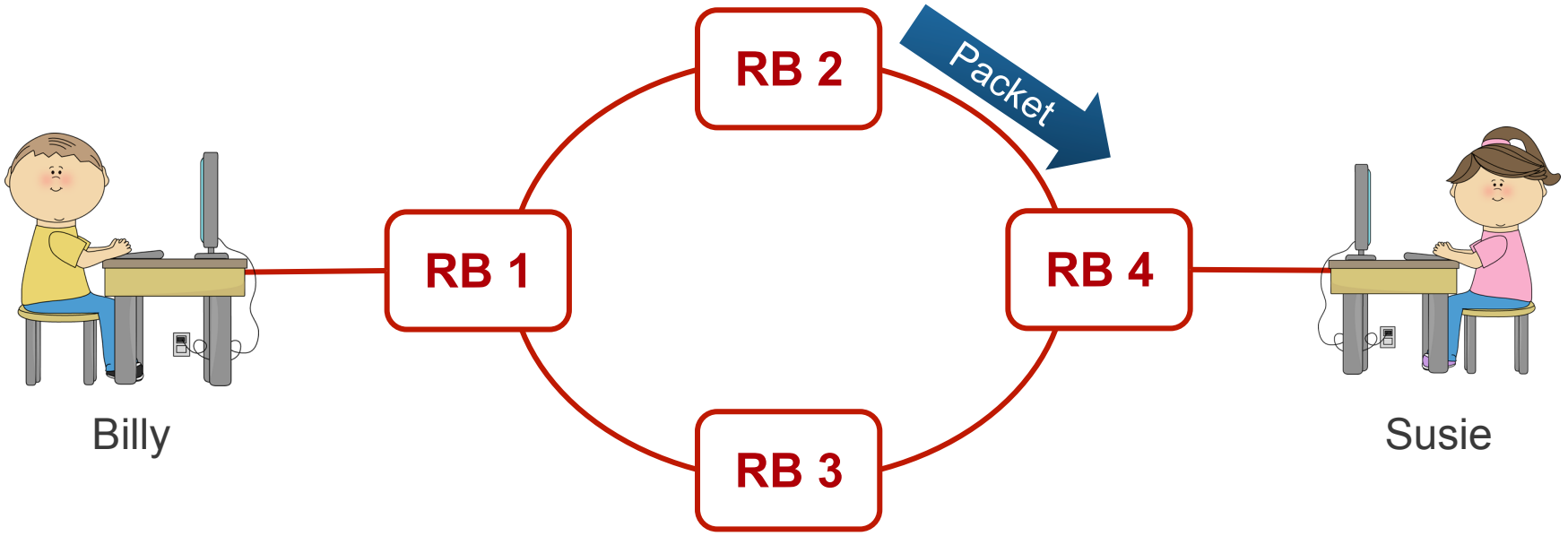
Step 2 – RB 1 puts a TRILL header on the packet, and forwards it to RB 2



FCS	Payload	IP	VLAN	Billy	Susie	RB 1	RB 4	Hop	RB 2	RB 4

A Basic Network

Step 3 – RB 2 changes the MAC addresses, and forwards it to RB 4

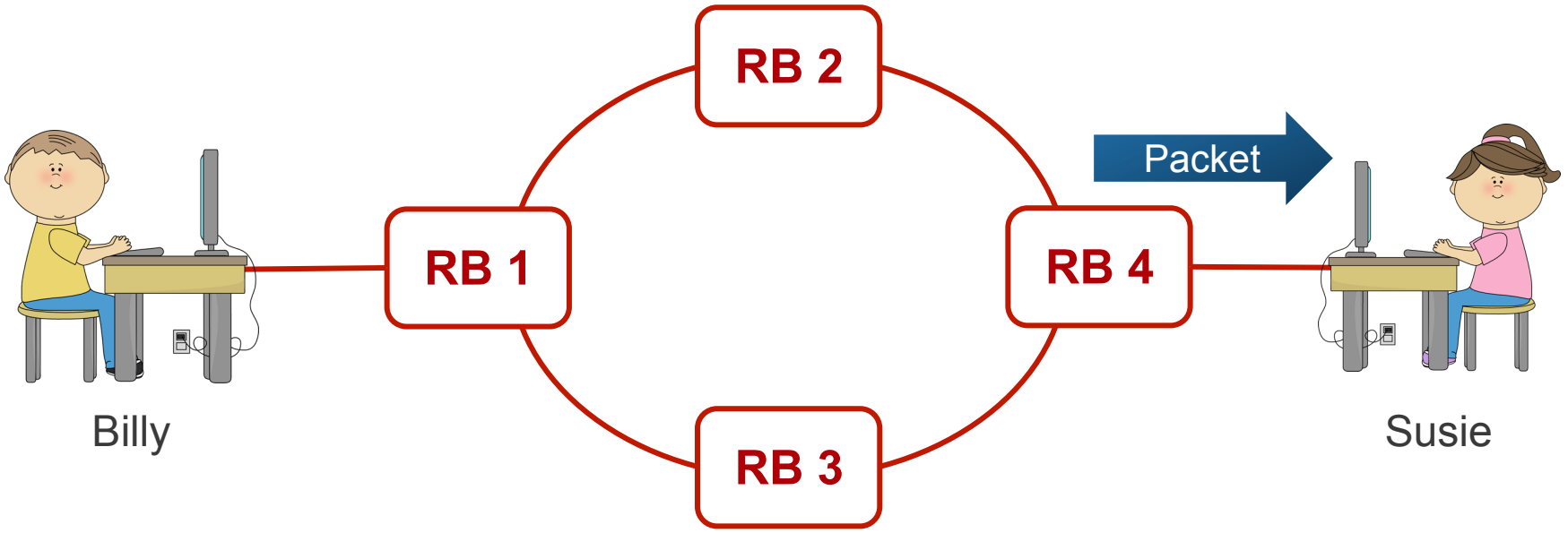


FCS	Payload	IP	VLAN	Billy	Susie	RB 1	RB 4	Hop	RB 2	RB 4

A Basic Network

Does RB 1 know about Susie?
Who is the next hop? (RB 2)

Step 4 – RB 4 pops the TRILL header, and forwards the packet to Susie.



FCS	Payload	IP	VLAN	Billy	Susie

The TRILL Header

RFC 6325

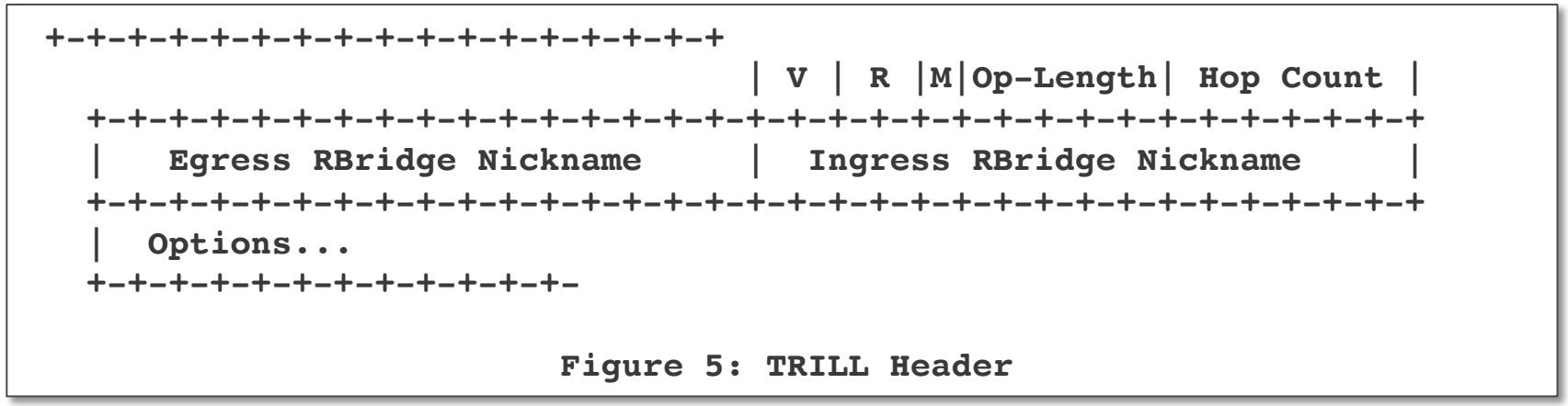


Figure 5: TRILL Header

V = Version – 2-bit – Currently “00”

R = Reserved – 2-bit – Currently “00”

M = Multi-Destination – 1-bit – 1=Multicast

Op-Length – 5-bit – How long is the options field?

The TRILL Header

RFC 6325

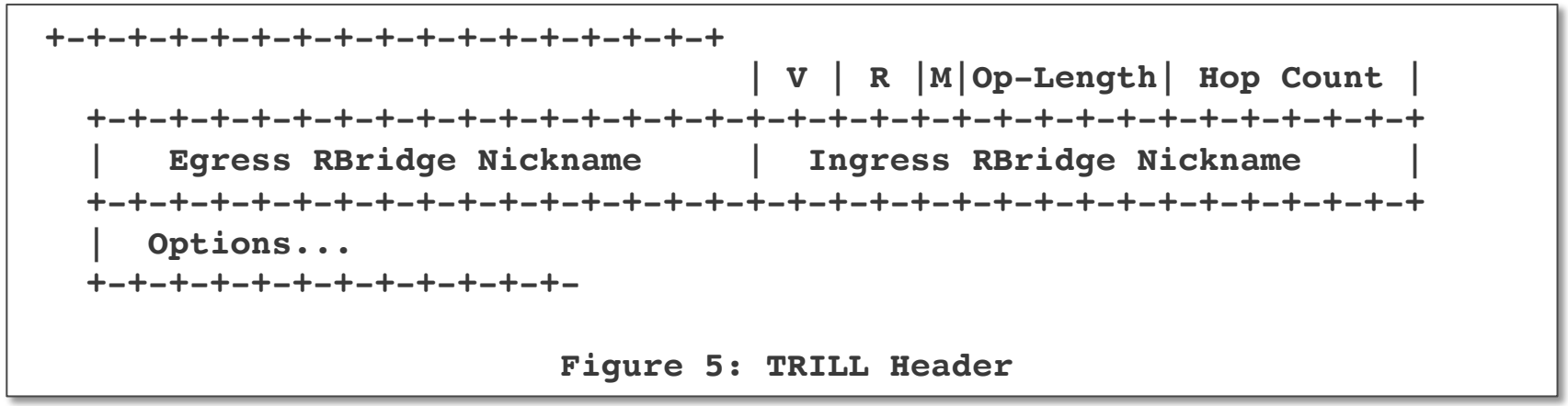


Figure 5: TRILL Header

Hop Count = Expected Distance

Egress RBridge Nickname

Ingress RBridge Nickname

Options

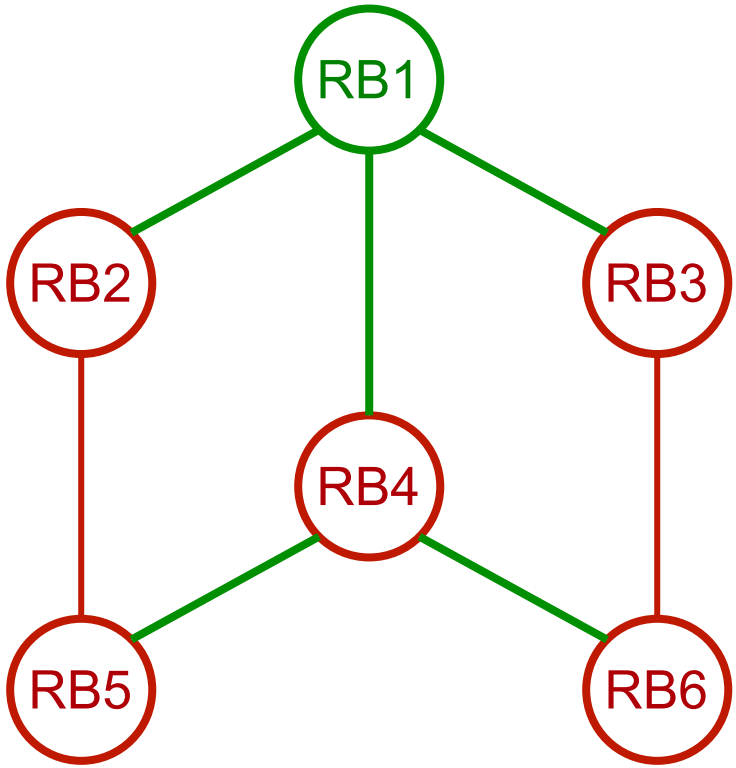
BROCADE

The BUM Tree

Broadcast / Unknown Unicast / Multicast

Building a Multicast Tree

- One RBridge is the root of the BUM tree.
- A loop-free, shortest path tree is formed to all RBridges.
- When a BUM frame is received, it is flooded out all other ISL ports on the tree.
- It's also flooded out of edge ports as appropriate.



```
RBridge-5# show fabric route multicast all

No. of nodes in cluster: 21

Root of the Multicast-Tree
==========================
 Rbridge-id: 2
 Mcast Priority: 1
 Enet IP Addr: 0.0.0.0
 WWN: 10:00:50:eb:1a:a4:29:ac
 Name: RBridge-2

Src-Index  Src-Port        Nbr-Index  Nbr-Port          BW    Trunk
-------------------------------------------------------------------
109        Te 101/0/46     105        Te 104/0/42       40G   Yes
115        Fo 101/0/52     114        Fo 103/0/51       40G   Yes
114        Fo 102/0/51     115        Fo 103/0/52       40G   Yes
108        Te 103/0/45     104        Te 19/0/41        40G   Yes
***SNIP***
```



```
RBridge-5# configure terminal
Entering configuration mode terminal
RBridge-5(config)# fabric route mcast rbridge-id 101 priority 10
RBridge-5(config-rbridge-id-101)# end
RBridge-5# show fabric route multicast all

No. of nodes in cluster: 21

Root of the Multicast-Tree
==========================
 Rbridge-id: 101
 Mcast Priority: 10
 Enet IP Addr: 0.0.0.0
 WWN: 10:00:50:eb:1a:a4:19:d8
 Name: RBridge-101

Src-Index  Src-Port        Nbr-Index  Nbr-Port          BW     Trunk
-------------------------------------------------------------------
***SNIP***
```

BROCADE

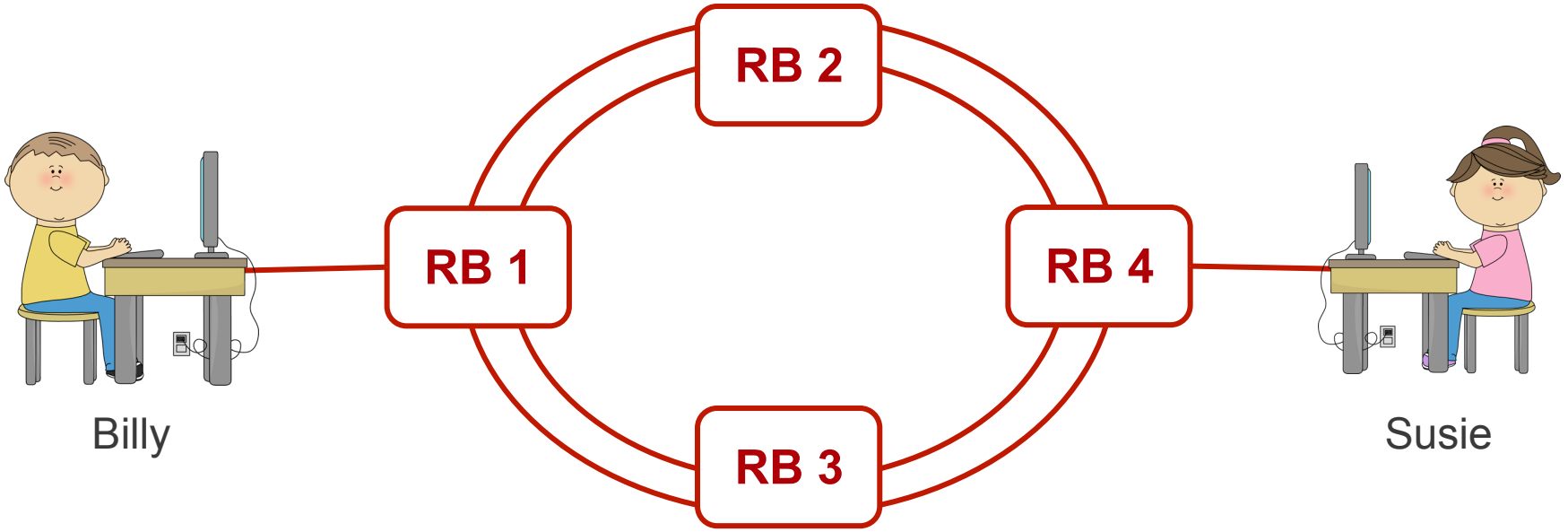
L1 & L2 ECMP

Equal Cost Multipath

The ECMP Challenge

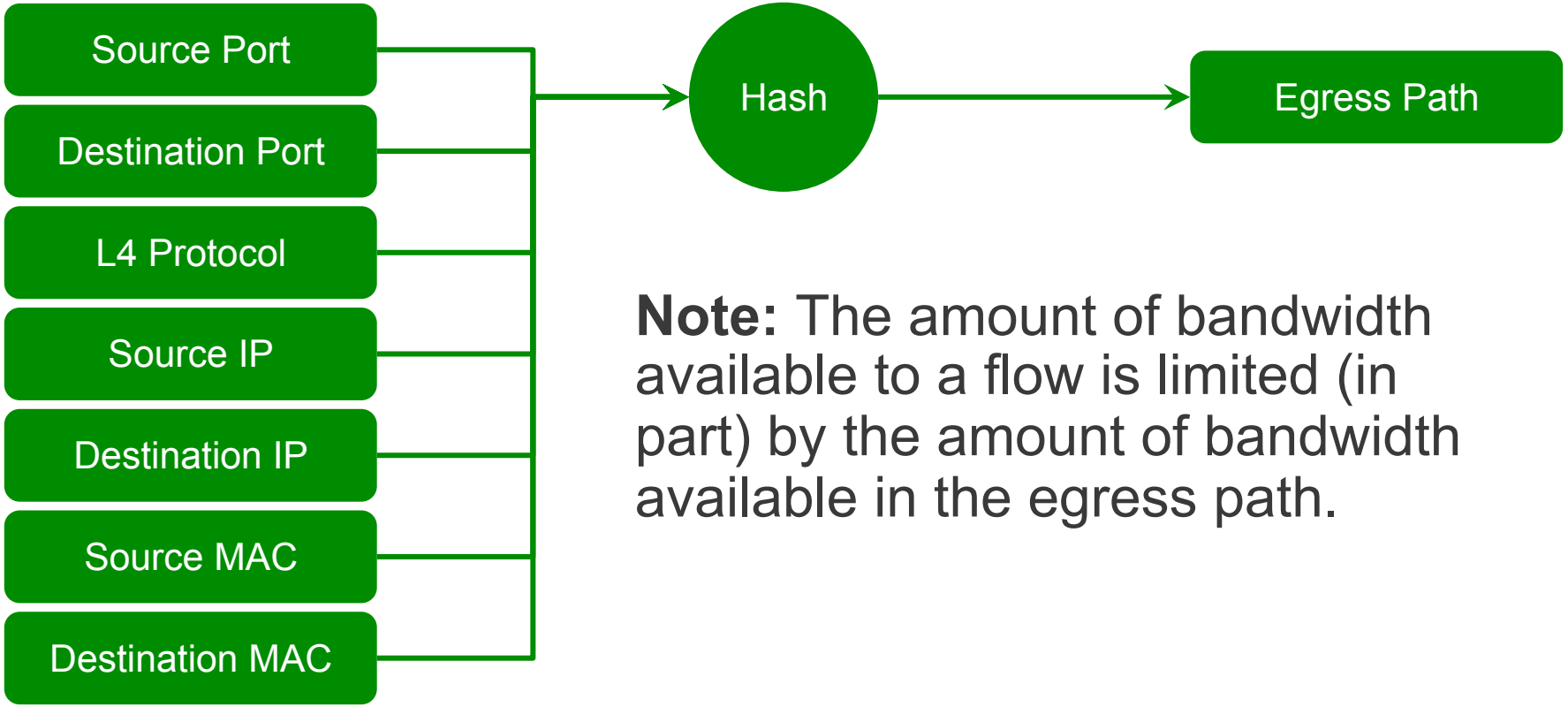
Packets can arrive in any order and TCP will re-sequence them.

An ECMP Example



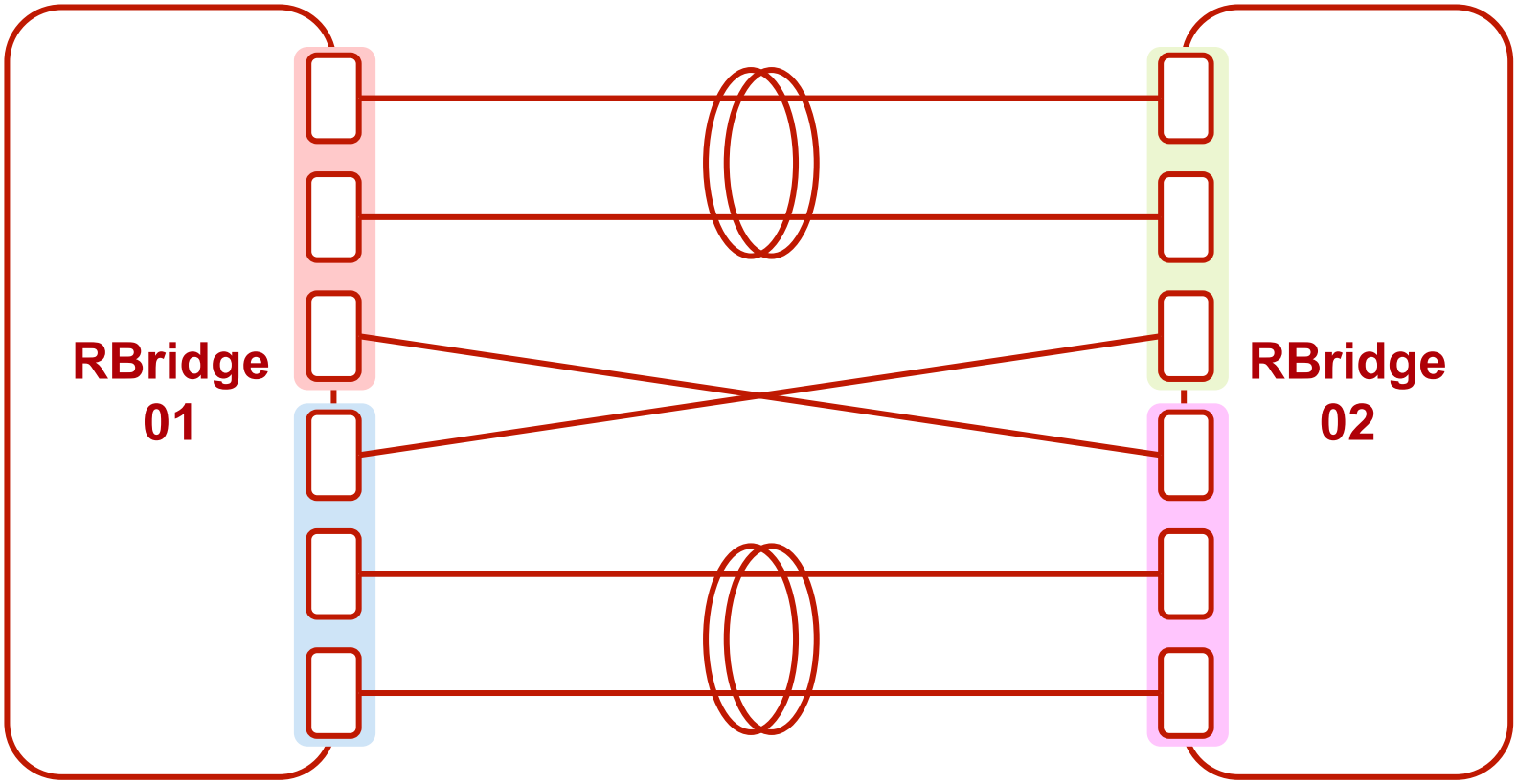
How [illegible] Bridge?

A Seven Tuple Hash



Note: The amount of bandwidth available to a flow is limited (in part) by the amount of bandwidth available in the egress path.

Brocade Trunks

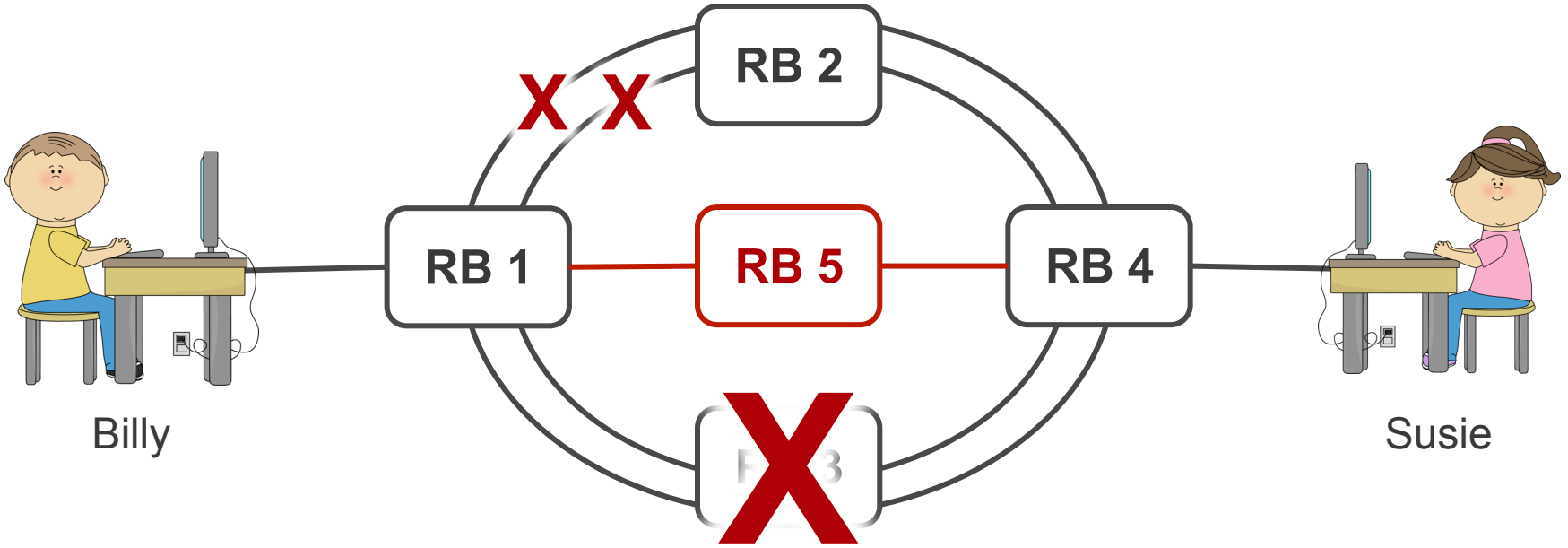


BROCADE

Physical Redundancy

A Quick Review

What Happens If...



BROCADE

Logical Chassis

Centralized vs. Distributed

Chassis vs. Fixed Form Factor

Why would I use one over the other?

- Chassis Attributes
  - Expensive
  - Central Physical Form Factor
  - Redundant Management
  - Single Control Plane
  - Single Configuration Point
  - Simple Hardware Replacement
- Fixed Form Factor Attributes
  - Less Expensive
  - Distributed Form Factor
  - Integrated Management
  - Multi-Control Plane
  - Multi-Configuration Point
  - Complex Hardware Replacement

Logical Chassis

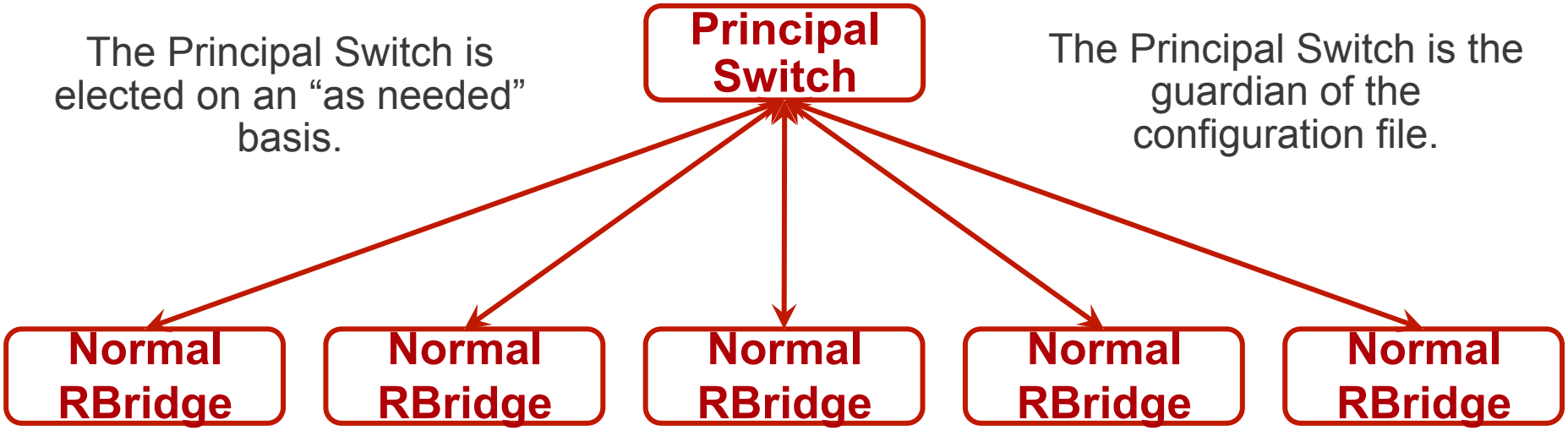
An effort to support the best of breed.

- Chassis Attributes
  - Expensive
  - Central Physical Form Factor
  - Redundant Management
  - Single Control Plane
  - Single Configuration Point
  - Simple Hardware Replacement
- Fixed Form Factor Attributes
  - Less Expensive
  - Distributed Form Factor
  - Integrated Management
  - Multi-Control Plane
  - Multi-Configuration Point
  - Complex Hardware Replacement

Handling a Common Configuration

Many configuration must be done on the Principal Switch!

The Principal Switch is elected on an “as needed” basis.



The Principal Switch is the guardian of the configuration file.

Any RBridge may become the Principal switch.

```
RBridge-5# configure terminal
Entering configuration mode terminal
RBridge-5(config)# rbridge-id 5
RBridge-5(config-rbridge-id-5)# logical-chassis principal-priority 2
RBridge-5(config-rbridge-id-5)# end
RBridge-5# logical-chassis principal switchover
This operation will trigger logical-chassis principal switchover. Do you want
to continue? [y/n]:y
RBridge-5# show fabric all

VCS Id: 101
Config Mode: Distributed

Rbridge-id          WWN               IP Address         Name
-----------------------------------------------------------------------
*** SNIP ***
   5        10:00:50:EB:1A:A4:0B:C0   172.16.1.224      >"RBridge-5"*
*** SNIP ***
The Fabric has 21 Rbridge(s)

RBridge-5#
```

Lower is better

Indicates Principal Switch.

Redundant Management vs. Distributed Control Plane

- Each RBridge runs it's own control plane.
- Each RBridge has an internal hypervisor with redundant "management modules".
- By default, SW/0 is "Primary" and SW/1 is "Standby".
- In the event of a software crash, a failover will occur.

```
RBridge-5# show version

Network Operating System Software
Network Operating System Version: 5.0.1
Copyright (c) 1995-2014 Brocade Communications Systems, Inc.
Firmware name:      5.0.1d
Build Time:         17:53:30 Jun 12, 2015
Install Time:       16:49:09 Sep 29, 2015
Kernel:             2.6.34.6

BootProm:           1.0.1
Control Processor:  e500mc with 4096 MB of memory

Slot    Name    Primary/Secondary Versions                          Status
-------------------------------------------------------------------------
SW/0    NOS     5.0.1d                                              ACTIVE*
                5.0.1d
SW/1    NOS     5.0.1d                                              STANDBY
                5.0.1d

RBridge-5#
```


Replacing a failed RBridge

- Find the WWN of the new RBridge.
  - Either use the "show fabric all" command, or look at the plastic tag on the physical switch.
- Map the new WWN to the RBridge ID
  - From the Principal Switch, run the "vcs replace rbridge-id <rbridge-id>" command. You will be challenged for the WWN of the new switch.
- Connect the new RBridge to the ethernet fabric.
- Run the: "vcs vcsid <value> rbridge-id <value> logical-chassis enable" command on the new RBridge.

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Configuring VLANs

VLANs in VCS

- All VLANs are automatically distributed to all RBridges.
  - Inter-Switch Links are automatically configured as “VLAN Trunk” ports that carry all VLANs.
  - All VLANs share a common BUM tree.
- VLANs are globally configured.
- Interfaces must also be configured.
  - VLAN Trunk Ports
  - VLAN Access Ports

```
RBridge-5# configure terminal
Entering configuration mode terminal
RBridge-5(config)# interface vlan 2001
RBridge-5(config-Vlan-2001)# description VLAN_Desription
RBridge-5(config-Vlan-2001)# end
RBridge-5# show vlan 2001
VLAN      Name       State     Ports           Classification
(F)-FCoE             (u)-Untagged
(R)-RSPAN            (c)-Converged
(T)-TRANSPARENT      (t)-Tagged
========= ========== ========= =============== ================
2001      VLAN2001   INACTIVE  (no member port)

RBridge-5#
```

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Interface Configurations

Default Configuration

```
RBridge-5# show running-config interface ten 3/0/1
interface TenGigabitEthernet 3/0/1
 fabric isl enable   ← Can be an ISL
 fabric trunk enable   ← Can be part of a Brocade Trunk
 no shutdown
!
RBridge-5#
```

Access Port Configuration

```
RBridge-5# configure terminal
RBridge-5(config)# interface TenGigabitEthernet 3/0/1
RBridge-5(conf-if-te-3/0/1)# switchport
RBridge-5(conf-if-te-3/0/1)# switchport mode access
RBridge-5(conf-if-te-3/0/1)# switchport access vlan 2001
RBridge-5(conf-if-te-3/0/1)# do show run int ten 3/0/1
interface TenGigabitEthernet 3/0/1
 fabric isl enable
 fabric trunk enable
 switchport
 switchport mode access
 switchport access vlan 2001
 spanning-tree shutdown
 no shutdown
!
RBridge-5(conf-if-te-3/0/1)#
```

VLAN Trunk Port Configuration

```
RBridge-5# configure terminal
Entering configuration mode terminal
RBridge-5(config)# int ten 3/0/1
RBridge-5(conf-if-te-3/0/1)# switchport
RBridge-5(conf-if-te-3/0/1)# switchport mode trunk
RBridge-5(conf-if-te-3/0/1)# switchport trunk allowed vlan ?
Possible completions:
  add      Allow these VLANs to Xmit/Rx through the Layer2 interface
  all      Allow all Dot1Q VLANs to Xmit/Rx through the Layer2 interface
  except   Allow all VLANs except this vlan range to Xmit/Rx through the
Layer2 interface
  none     Allow no Dot1Q VLANs to Xmit/Rx through the Layer2 interface
  remove   Remove a VLAN range that Xmit/Rx through the Layer2 interface
RBridge-5(conf-if-te-3/0/1)# switchport trunk allowed vlan all
RBridge-5(conf-if-te-3/0/1)# end
RBridge-5#
```

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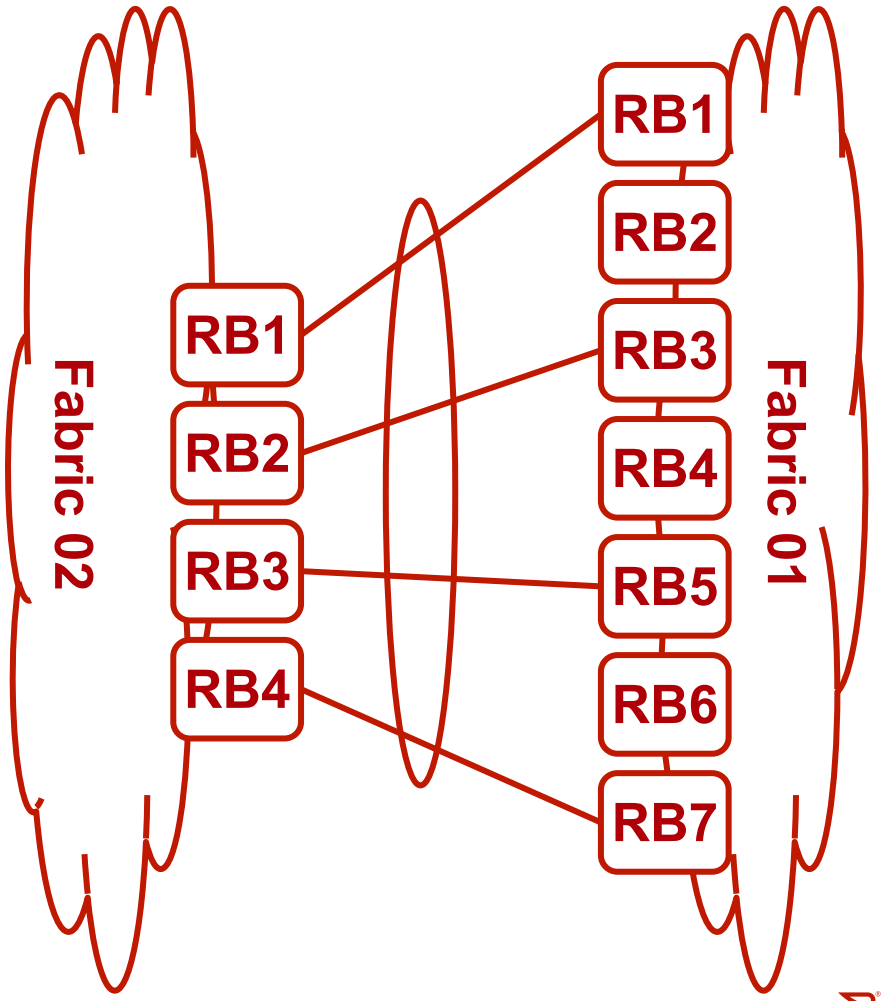
Virtual LAGs

Virtual LAGs

- Essentially a multi-port edge link.
- Link can be distributed across up to four RBridges.
- No topology restrictions.
- What happens if the switches lose contact with each other?



Configuring a VLAG

```
RBridge-5# show running-config interface Port-channel 1
interface Port-channel 1
 vlag ignore-split
 mtu 9216
 description Port_Channel_to_CSAIL_Switch
 switchport
 switchport mode access
 switchport access vlan 10
 spanning-tree shutdown
 speed 10000
 no shutdown
!
RBridge-5#
```

Adding an Interface to a VLAG

```
RBridge-5(config)# int ten 3/0/1
RBridge-5(conf-if-te-3/0/1)# no switchport
RBridge-5(conf-if-te-3/0/1)# channel-group 1 mode ?
Possible completions:
  active    Enable initiation of LACP negotiation on a port
  on        Enable static link aggregation on this port
  passive   Disable initiation of LACP negotiation on a port
RBridge-5(conf-if-te-3/0/1)# channel-group 1 mode active type ?
Possible completions:
  brocade    Brocade LAG
  standard   Standards based LAG
RBridge-5(conf-if-te-3/0/1)# channel-group 1 mode active type
standard
RBridge-5(conf-if-te-3/0/1)# no shutdown
```

Useful Troubleshooting Commands

- show port-channel <value>
- show port-channel detail
- show int port-channel <value>

NOTE: The most common reason why your port-channel won't come up is a speed mismatch between the port-channel and the physical interfaces.

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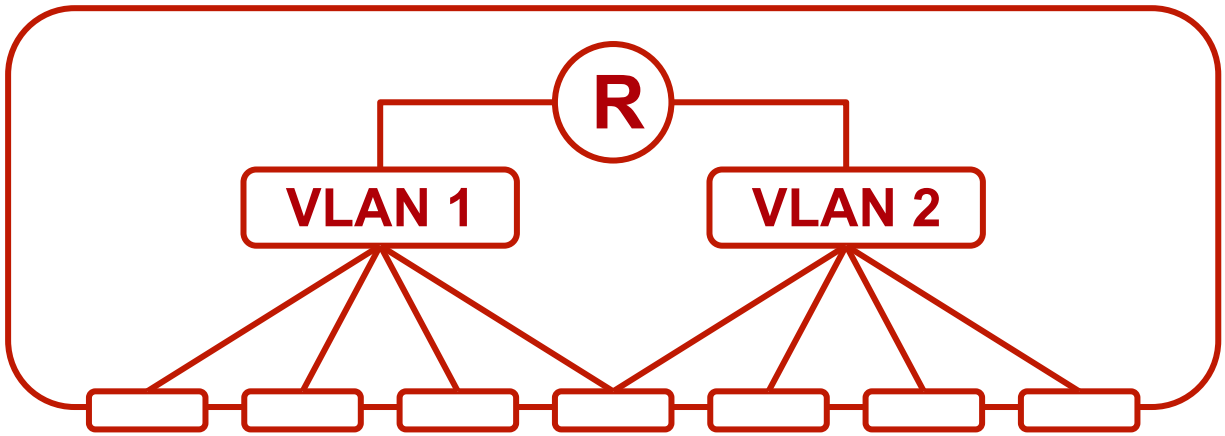
Routing 101

Routing on a Switching Platform



Routing is not distributed across the system, but is configured on each RBridge.

Configuring a Routed Interface

```
RBridge-5# configure terminal
Entering configuration mode terminal
RBridge-5(config)# interface vlan 2001
RBridge-5(config-Vlan-2001)# exit
RBridge-5(config)# rbridge-id 3
RBridge-5(config-rbridge-id-3)# interface ve 2001
RBridge-5(config-rbridge-Ve-2001)# ip addr 172.24.100.1/24
RBridge-5(config-rbridge-Ve-2001)# no shutdown
RBridge-5(config-rbridge-Ve-2001)# end
RBridge-5#
```

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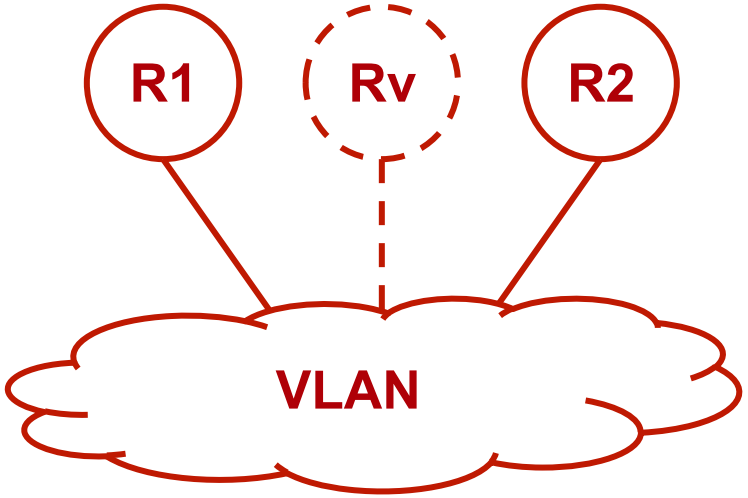
VRRPe

Virtual Router Redundancy Protocol Extended

What is VRRP-e

- A modification of the IETF “VRRP” standard.
- Two (or more) physical routers provide services for a virtual router.
- If one router fails, the other router takes over.
- High availability is achieved.



With “short-path-forwarding” enabled, even the backup routers can forward traffic.

Configuring VRRP-extended

```
RBridge-5# configure terminal
Entering configuration mode terminal
RBridge-5(config)# rbridge-id 3
RBridge-5(config-rbridge-id-3)# protocol vrrp-e
RBridge-5(config-rbridge-id-3)# interface ve 2001
RBridge-5(config-rbridge-Ve-2001)# vrrp-extended 1
RBridge-5(config-vrrp-extended-group-1)# advertise-backup
RBridge-5(config-vrrp-extended-group-1)# short-path-forwarding
RBridge-5(config-vrrp-extended-group-1)# virtual-ip 172.24.100.2
RBridge-5(config-vrrp-extended-group-1)# enable
RBridge-5(config-vrrp-extended-group-1)# end
RBridge-5#
```

Useful Troubleshooting Commands

- show vrrp rbridge-id <value>
- show vrrp summary rbridge-id <value>
- show vrrp detail rbridge-id <value>

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Virtual Fabrics

Types of Virtual Fabrics

- Transport Virtual Fabric
  - Allows multiple VLANs to be carried across a single Virtual Fabric.
  - Great for dragging a tenants VLANs across a network.
  - Eliminates the need to coordinate VLANs between tenants.
- Service Virtual Fabric
  - Allows a single VLAN to be carried without the need to de-conflict.
  - Allows VLAN numbers to be changed in flight.
  - Maps well to Virtual Fabric Extension

Both technologies leverage “Fine Grain Labeling”, in RFC 7172
FGL Leverages the Options field of the TRILL header to expand the VLAN ID Space

Configuring Service Fabrics

```
interface TenGigabitEthernet 3/0/1
  switchport
  switchport mode trunk
  switchport trunk allowed vlan add 2,3100
  switchport trunk allowed vlan add 7000 ctag 3500
  no shutdown
```

Configuring Transport Fabrics

```
interface Vlan 6050
  transport-service 2
  spanning-tree shutdown

interface TenGigabitEthernet 1/4/23
  switchport
  switchport mode trunk
  switchport trunk allowed vlan add 5050 ctag 50-59
```

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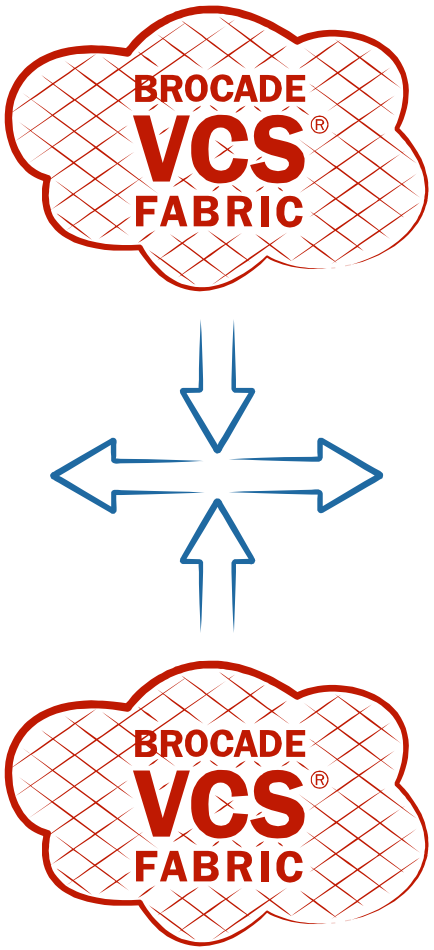
Virtual Fabric Extension

VF Extension Overview

- Used to extend a Broadcast Domain between locations.
- Uses a VXLAN tunnel:
  - Unencrypted
  - Unprotected
  - Line Rate
- Can be used across a routed infrastructure.



Configuring Virtual Fabrics

VRRPe Configuration

```
rbridge-id 1
  interface Ve 200
    ip mtu 9018
    ip proxy-arp
    ip address 20.20.20.1/24
    vrrp-extended-group 200
      virtual-mac 02e0.5200.00xx
      virtual-ip 20.20.20.3
      advertisement-interval 1
      enable
      no preempt-mode
      short-path-forwarding
    !
    no shutdown
```

```
rbridge-id 2
  interface Ve 200
    ip mtu 9018
    ip proxy-arp
    ip address 20.20.20.2/24
    vrrp-extended-group 200
      virtual-mac 02e0.5200.00xx
      virtual-ip 20.20.20.3
      advertisement-interval 1
      enable
      no preempt-mode
      short-path-forwarding
    !
    no shutdown
```

Configuring Virtual Fabrics

Overlay Gateway Configuration

```
overlay-gateway Extension1
  type layer2-extension
  ip interface Loopback 2
  attach rbridge-id add 1-2
  map vlan vni auto
  site  Datacenter2
    ip address 3.3.3.1
    extend vlan add 1-100
  activate
```

Useful Troubleshooting Commands

- `show vlan brief`
- `show tunnel`
- `show mac`

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AMPP

Automatic Migration of Port Profiles

Automatic Migration of Port Profiles

- Used to automatically configure a port based on who is connected.
  - VLAN
  - Security
  - Quality of Service
  - FCoE
- Connected device is identified by MAC address.
- Can be interfaces with vCenter for automatic configuration.
- Can also be integrated with OpenStack.

Creating a Profile

```
VDX# configure terminal
VDX(config)# port-profile <profile-name>
VDX(config…)# vlan-profile
VDX(config… …)# switchport
VDX(config… …)# THE REST OF THE SWITCHPORT COMMANDS
VDX(config… …)# no shut
VDX(config… …)# end
VDX#
```

Associate a MAC to a Profile

```
VDX# configure terminal
VDX(config)# port-profile <profile-name> static <mac>
VDX(config)# end
VDX#
```

Enable a Profile

```
VDX# configure terminal
VDX(config)# port-profile <profile-name> activate
VDX(config)# end
VDX#
```

Enable AMPP on an Interface

```
VDX# configure terminal
VDX(config)# interface <type> <interface>
VDX(config…)# port-profile-port
VDX(config…)# mtu 9216
VDX(config…)# end
VDX#
```

Automating AMPP with vCenter

```
VDX(config)# vcenter <name> url https://<address>
username <name> password <password>
VDX(config)# vcenter <name> activate
VDX(config)#
```

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NSX Integration

NSX Gateway Overview

- Limit of 8 RBridges in the fabric.
- Can be used to translate between VXLAN and VLAN.
- Can be receive coordinate automatically with the NSX Controller.

Pre-Work

- Create a client certificate and share with NSX
- Configure a VCS Virtual IP Address

Configuring NSX Gateway

```
overlay-gateway nsx_gateway
  attach rbridge-id 1,2
  type nsx
  ip interface ve 10 vrrp-extended-group 100
  attach vlan 5,14-17
  activate

nsx-controller profile 1
    ip address 10.1.2.3
    reconnect-interval 40
```


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Thank You