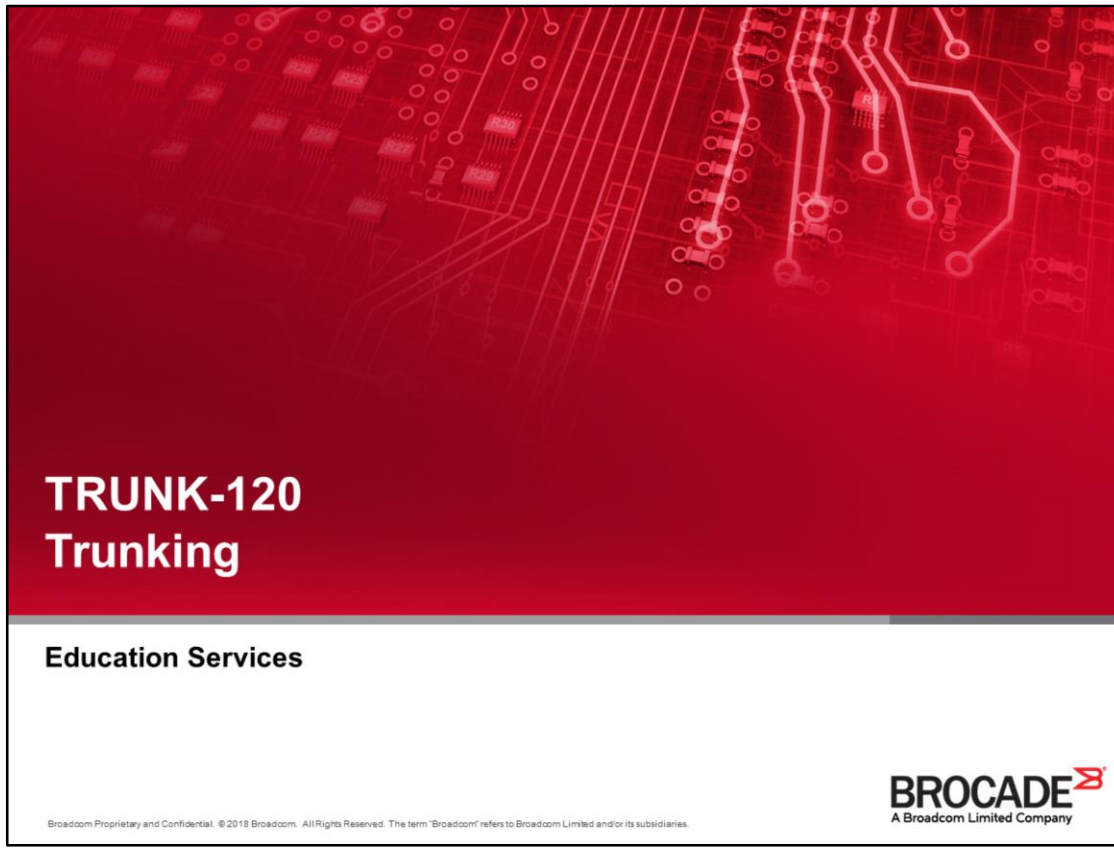


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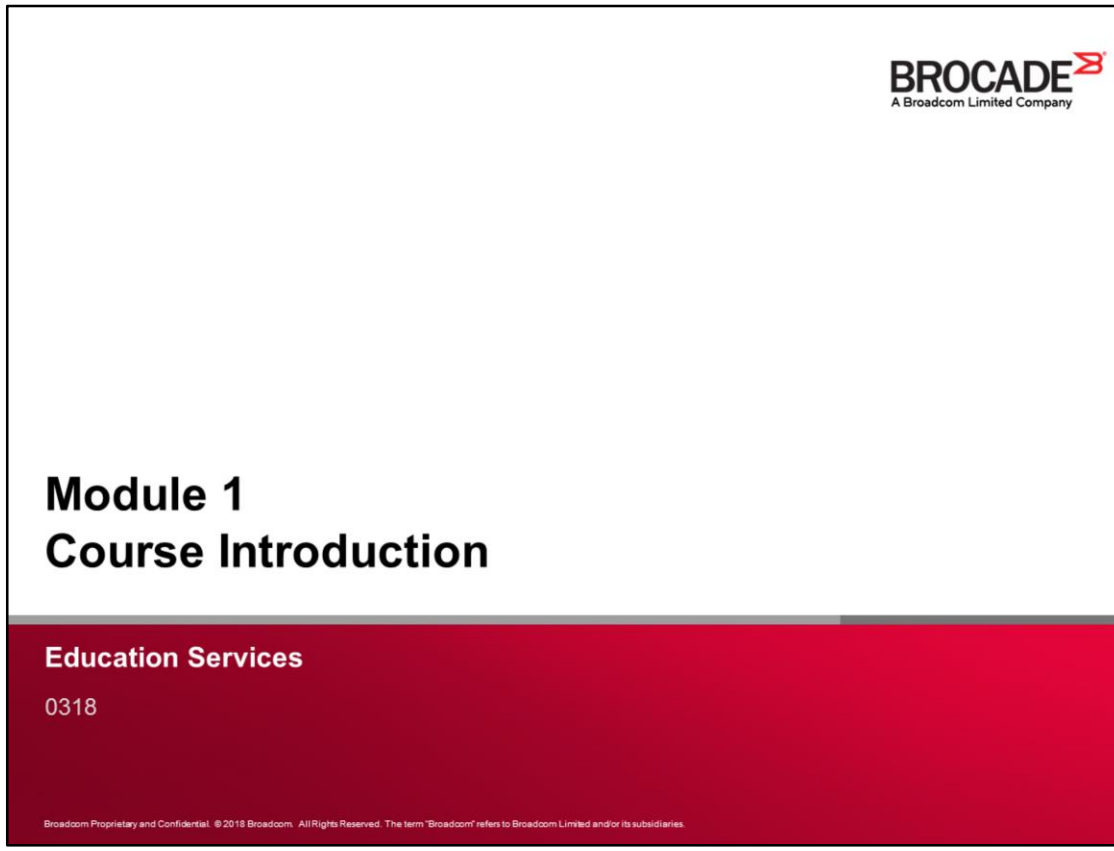
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Module 1
Course Introduction
Education Services
0318
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# Course Overview

- The purpose of this course is to explain trunking concepts in a Brocade Fibre Channel SAN


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# Course Objectives

- After completing this course, students should be able to explain how trunking works in a Fibre Channel SAN


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# Course Prerequisites

- Although not required, having a basic knowledge of Fibre Channel and Fibre Channel SANs is useful
  - Suggest taking the following courses before taking this one
    - Fibre Channel Theory (FC-120)
    - Zoning concepts (Zone-120)
    - Fabric Shortest Path First (FSPF-120)


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# Course Agenda

- Module 1: Course Introduction
- Module 2: Trunking
- Knowledge assessment quiz
- Optional material:
  - Demonstration


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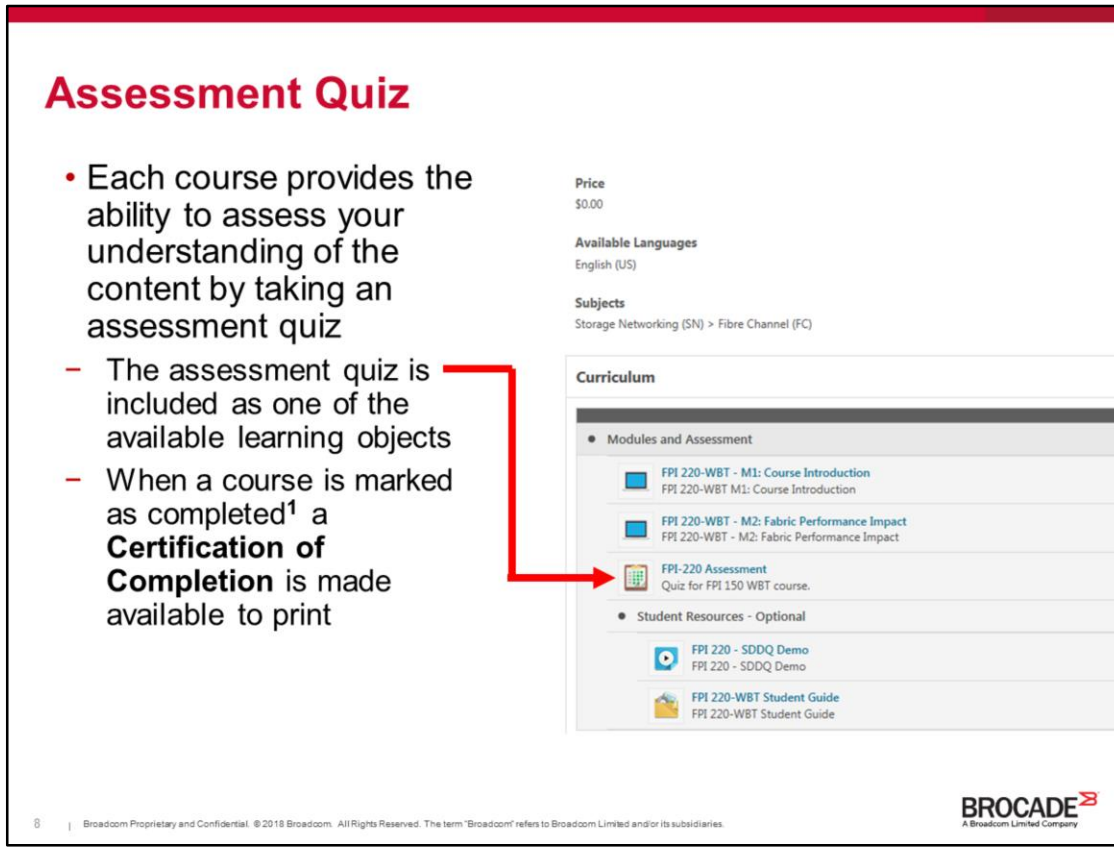


**Footnote 1: F**or a course to be marked as **completed** all non-optional course elements must be completed

# Course Certificate

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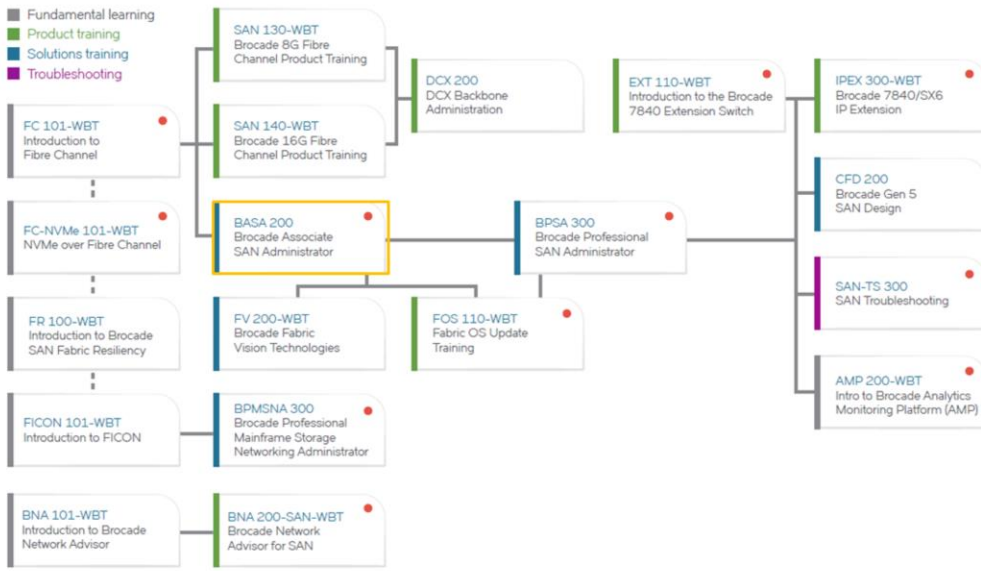
# Curriculum Paths




● Built-in assessments for these courses will be available by December 21st.
All other courses will have assessments added in Q1, 2018

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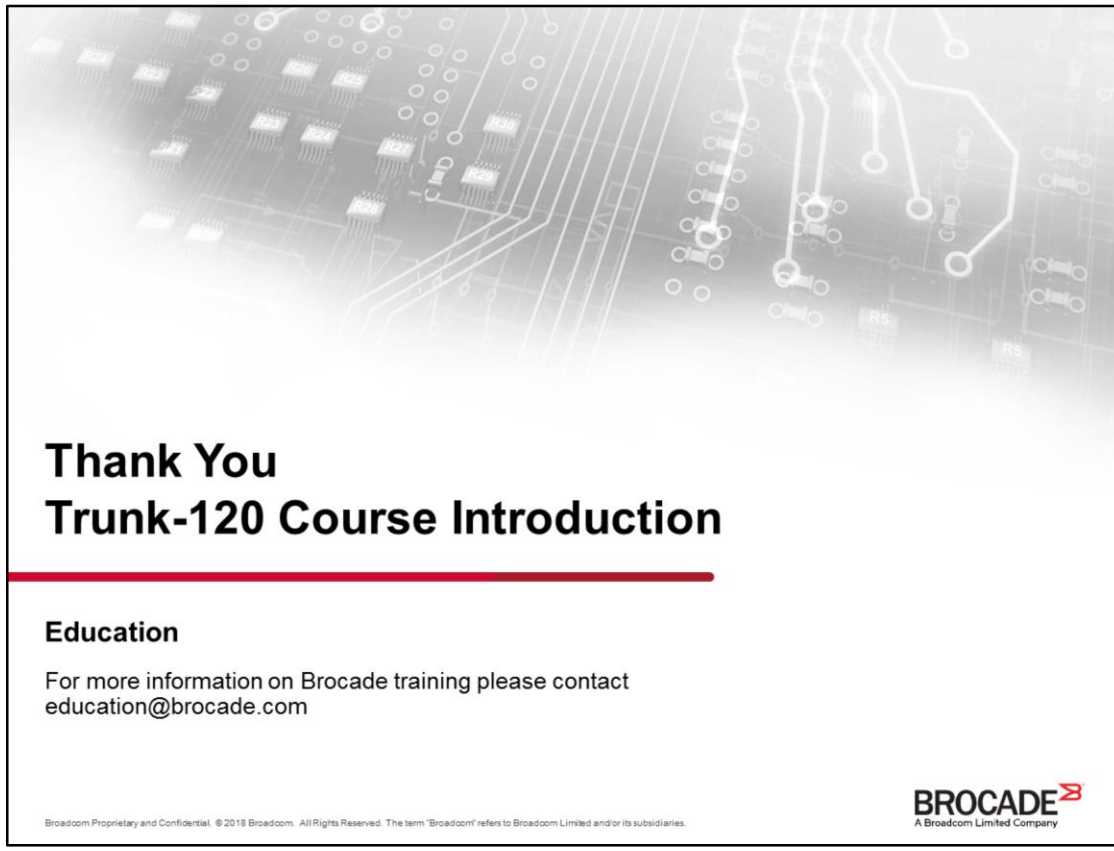

# Thank You
# Trunk-120 Course Introduction

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# Module 2
# ISL Trunking

**Education Services**

0218

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# Objectives

- After completing this module, attendees should be able to:
  - Manage Inter-Switch Link (ISL) functionally
  - Evaluate the trunking features of Brocade products

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Trunking
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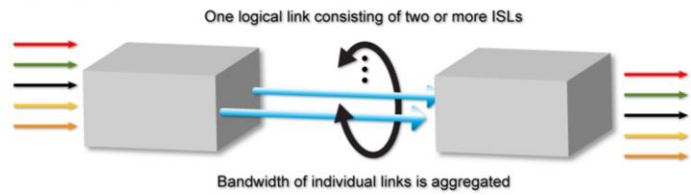
## Brocade ISL Trunking Overview

- The Trunking feature optimizes the use of bandwidth by allowing a group of ISLs to merge into a single logical link
- Trunking goals:
  - Reduce individual ISL congestion
  - Form a fault-tolerant, high bandwidth, logical ISL (called a *trunk* or *trunk group*) that withstands the failure of individual ISLs
- Trunk group characteristics:
  - Frames are multiplexed across all ISLs in the trunk group
  - One port in the trunk group (the trunk master) represents the entire trunk in the routing database
  - ASICs preserve in-order delivery

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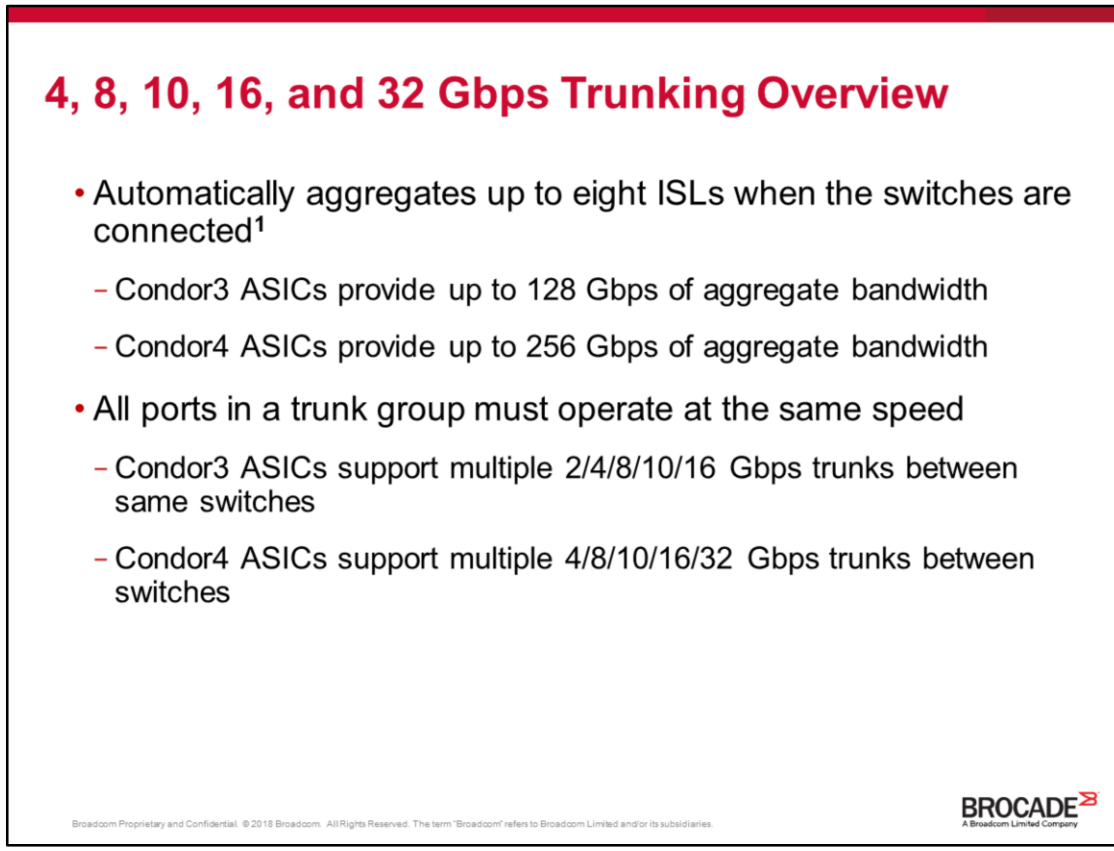
The routing database determines how frames are routed from input port to output port when going to the next destination. Fabric Shortest Path First (FSPF) puts available equal cost routes in the routing data base. One output port in the trunk group is put into the routing data base. When a communication between two end devices in a fabric is assigned a route through a trunk, the ASIC of the assigned trunk group port will be the same ASIC as all ports in the trunk group. This ASIC will multiplex frames across ISLs in the trunk group and maintain in-order delivery. The ASIC will send a frame down each link to determine the links latency. These individual link latency calculations will be used to maintain in-order delivery.

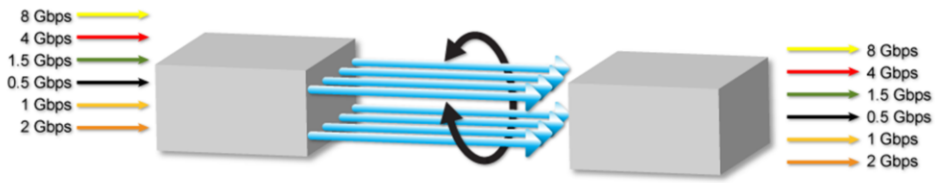
If some ports in a trunk group have QoS enabled and some ports have QoS disabled, the two different trunks are formed: one with QoS enabled and one with QoS disabled.




**Footnote 1**: Automatically creates ISL trunks using from 2 to 8 ISLs when the switches are connected and all trunking requirements are met.

## Trunking Requirements

- A Trunking license is required for all switches participating in Trunking
  - Trunking is available when the license is installed and the ports are reinitialized
- Trunking is enabled by default
  - If it has been disabled, it must be re-enabled on the trunk ports using the `portcfgtrunkport` CLI command
- Trunk ports must operate at a common speed and long distance setting
- Trunk ports must originate and end in a valid port group
  - Trunking port groups include: ports 0-7, 8-15, and so on
- When trunking criteria is met, the trunk forms automatically

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Switches are shipped with Trunking enabled on all ports. To use Trunking, you must first install the Brocade Trunking license. Trunking is enabled automatically when the Trunking license is activated and ports are reinitialized. Trunks are easily managed using either Fabric OS CLI commands or Web Tools.

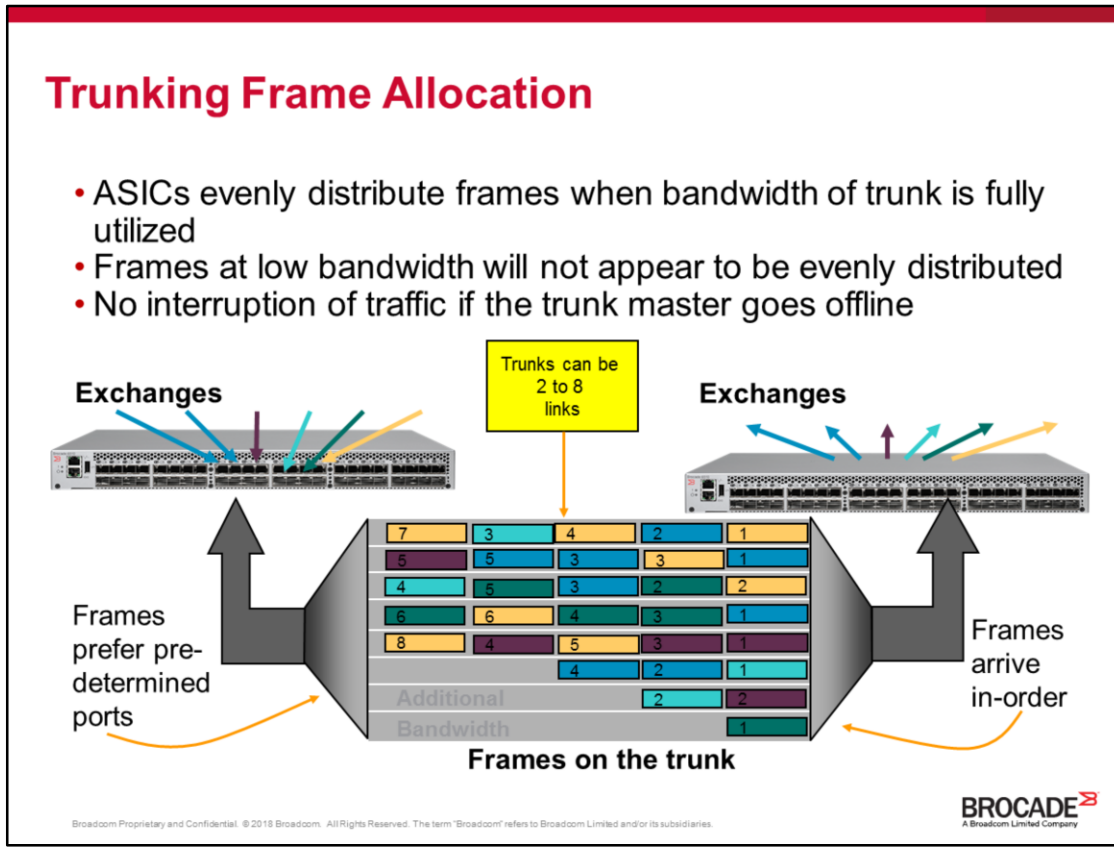
Trunk port-groups are ASIC specific and are discussed in more detail in subsequent slides.

8, 16 and 32 Gbps port groups include: ports 0-7; 8-15; and so on

- The Condor4 ASIC is the foundation for the Brocade Gen6 32 Gbps Fibre Channel products, such as the X6-4 and X6-8 directors as well as the G620 switch
- The Condor 3 ASIC is the foundation for the Brocade Gen5 16 Gbps products, such as the DCX 8510-4 and DCX 8510-8 directors as well as the 6520, 6510 and 6505 switches.

Long distance trunks must be set to the same distance.

See the *Brocade Fabric OS Administrators Guide* for additional information.



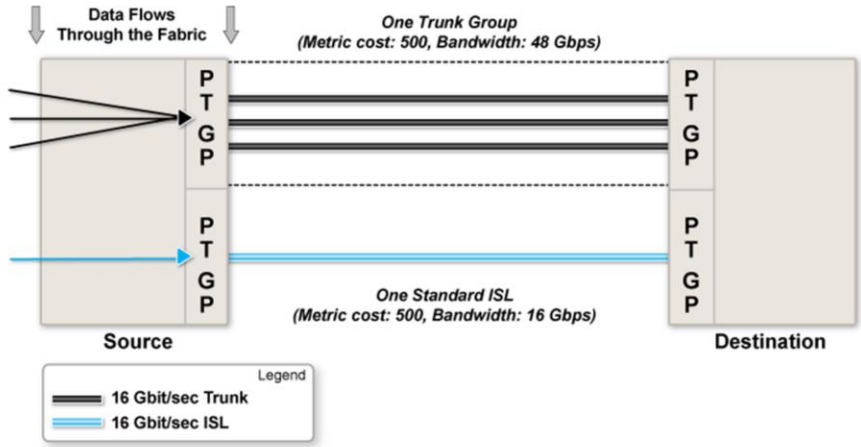

With ASIC trunking in effect, 8 ISLs are aggregated into a single logical ISL capable of up to 256 Gbps aggregate bandwidth. Frames entering the logical pipe are allocated to a predetermined port which happens to be the lowest back ASIC port in the port group. If that port is busy, they are allocated to another predetermined port. When the bandwidth of the pipe is fully utilized the frames are evenly distributed. When the aggregate bandwidth of the logical pipe is not fully utilized and the 1st predetermined port is free, the frames do not need to be evenly distributed. Calculated time differentials are needed to maintain in-order delivery of frames.

If traffic patterns involve large sequences of frames and high bandwidth utilization, then the frame allocation across the ISLs in the trunk begins to evenly distribute frames across the ISLs.

The predictable way frames are allocated to ASIC trunk groups enables non-disruptive loss of trunk master behavior which is also referred to as Pseudo-Master Trunking.

## Routing over Trunks

- A trunk group is considered one logical ISL, and is identified by the trunk master in the routing table
- The load assigned to a trunk group is based on the aggregate bandwidth of the trunk

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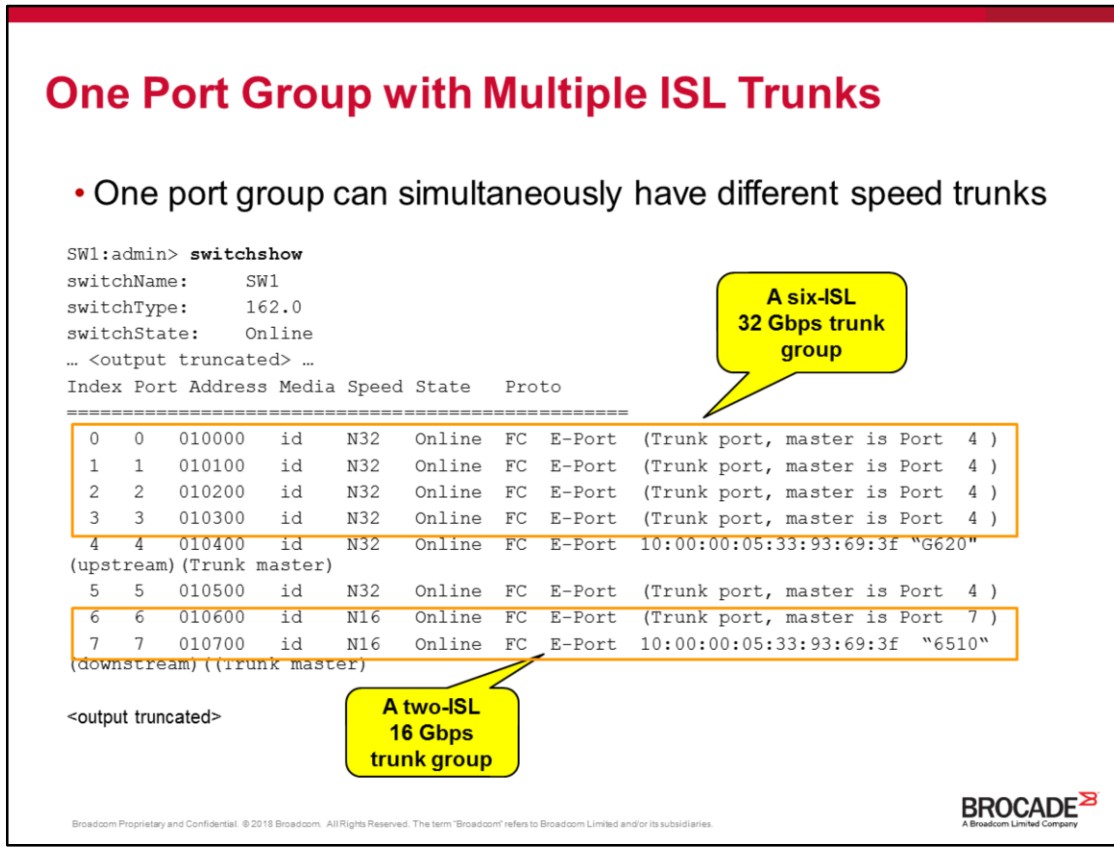
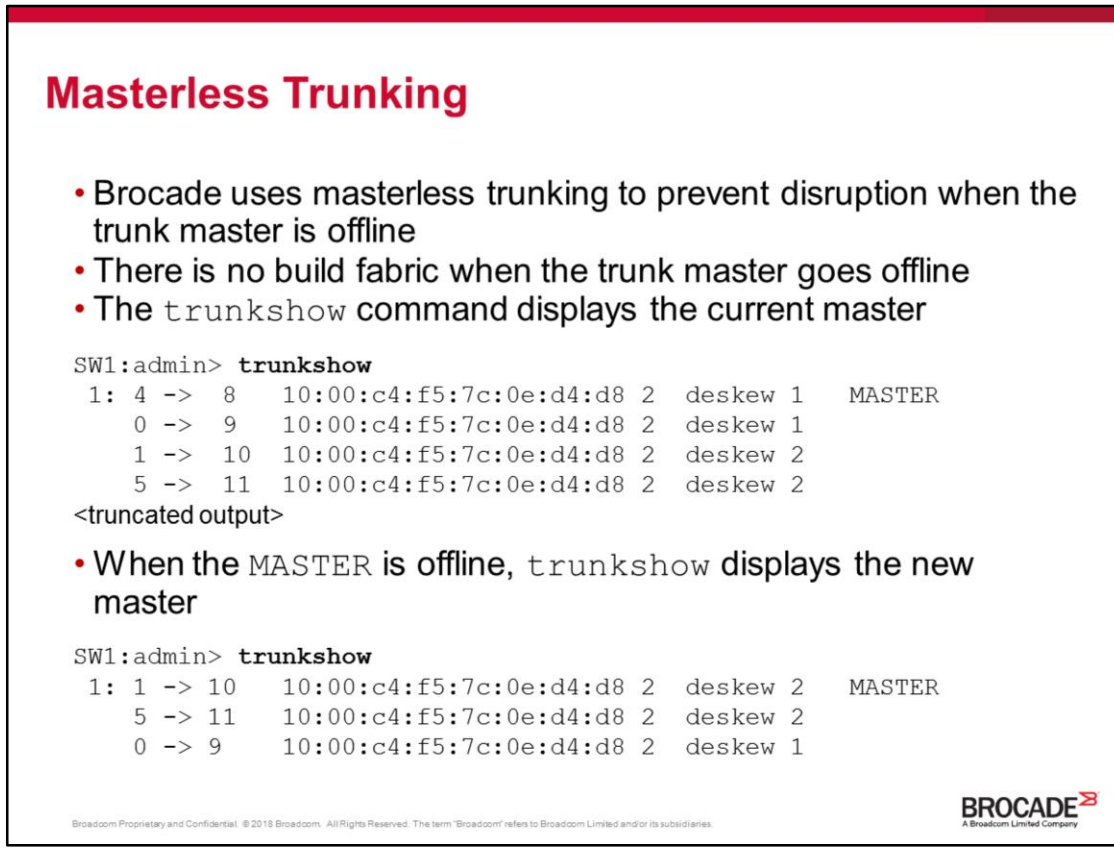
Dynamic Path Selection (DPS) is exchange-based routing where exchanges or communications between end devices in a fabric are assigned to egress ports in ratios proportional to the potential bandwidth of the ISL or trunk group.

When there are multiple routes to a destination, the input traffic will be distributed across the different routes in proportion to the bandwidth available on each of the routes. This improves utilization of the available routes, thus reducing possible congestion on the routes. Every time there is a change in the network (which changes the available routes), the input traffic can be redistributed across the available routes. This is a very easy and non-disruptive process when the Exchange-based Routing Policy is engaged.

Exchanges in the example depicted on this slide are allocated based on the primary criteria: link cost and secondary criteria: potential bandwidth. The potential bandwidth allocation depicted in this example yields flow allocations of 3:1.




The `switchshow` commands shows trunk groups associated with ports 0 – 5 and 6-7 with the master port of the individual trunk groups noted. The remaining ports in the trunk groups are the non-master ports. It should also be noted that only one trunk group represents the principal ISL path.

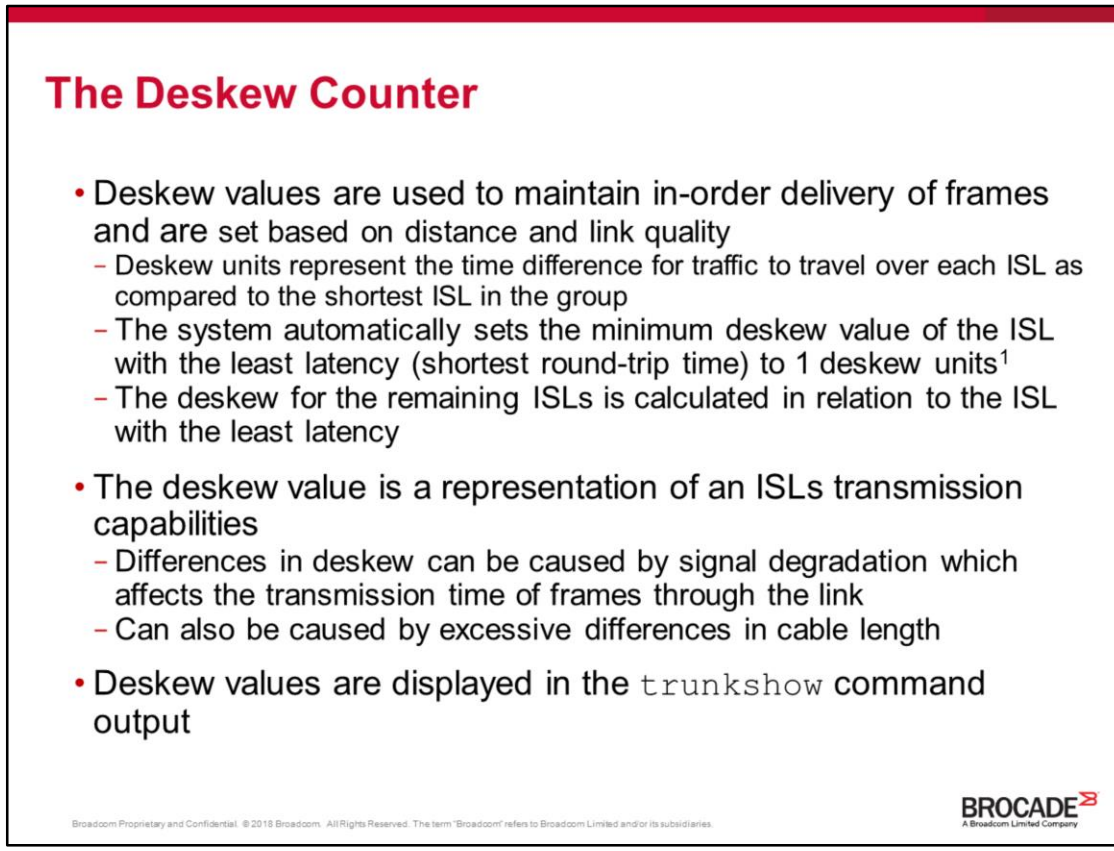



When the `Trunk Master` is disabled another pre-determined port takes over the role without fabric disruption.

**Note** – Gen6 products use a starting deskew value of 1, Gen5 and older products use a starting deskew value of 15. Deskew value is discussed on the next slide.

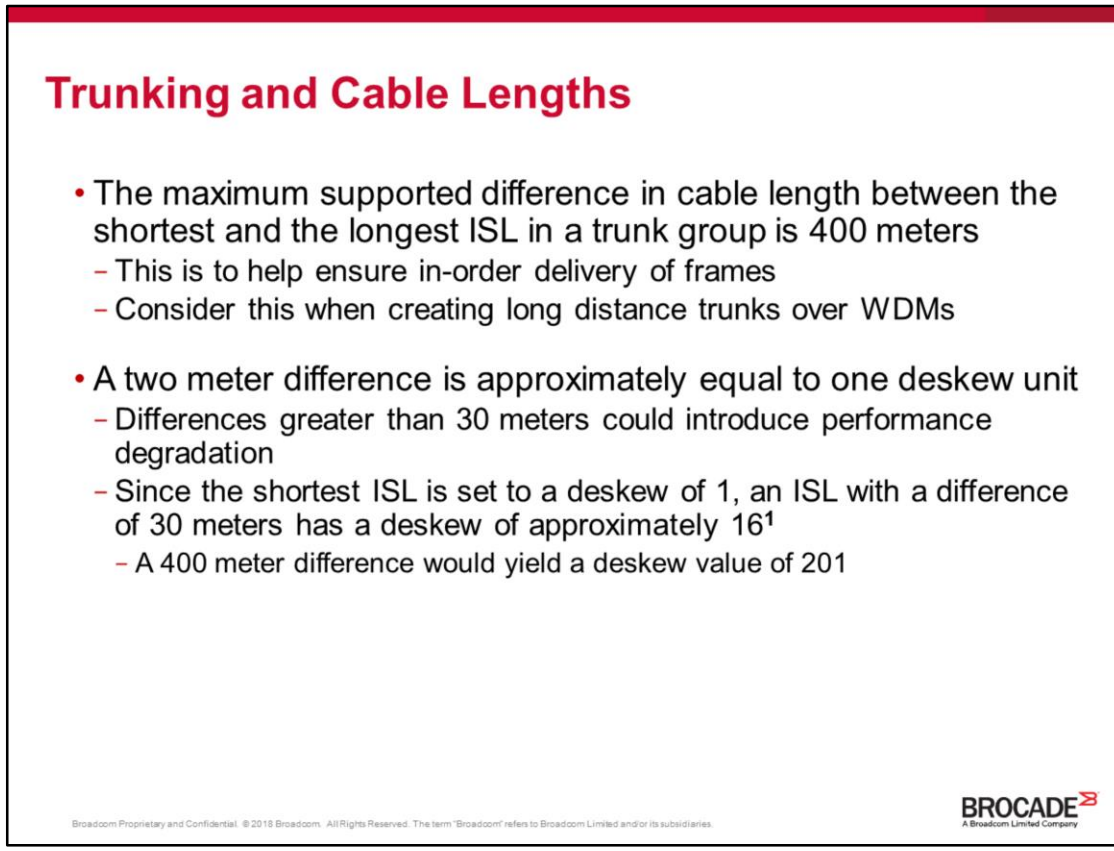
Example from 6510 Gen5 switch:

```
6510_Edge:FID128:admin> trunkshow
  1:   9->   9 10:00:c4:f5:7c:0e:c0:7c   2 deskew 15 MASTER
       8->   8 10:00:c4:f5:7c:0e:c0:7c   2 deskew 16
```




**Footnote** 1: Gen6 products use 1 as the minimum deskew value, Gen5 and older products use 15. The difference in latency (typically due to cable length) between the ISLs in a trunk determines the deskew value. This is needed for timing purposes so that delivery of frames across the trunk can be ensured. The shortest ISL is selected as the base and is assigned a deskew value of 10 nanoseconds (ns) for Gen6 products and 150ns for Gen5 and older products. The deskew values are expressed (shown in all command displays) by dividing the time value by 10. Example: A deskew value of 10ns is shows as 1 (10/10) and a deskew value of 150ns is shown as 15 (150/10).

The first ISL in the trunk to initialize is selected as the trunk master. The length of the cable is not a consideration when selecting the master. The deskew values for the other ISLs in the trunk will be calculated from the base ISL and may have a higher value. Each switch connected by the ISL will have a deskew value since each has a separate transmit line to the other. Due to the signal quality/optical media, cables that are identified as the same length may have a different deskew value. For example, one cable may have a deskew value of 1 and a cable of the same length may calculate to be 3. This is not a problem since deskew is a true measurement of its transmission capabilities.



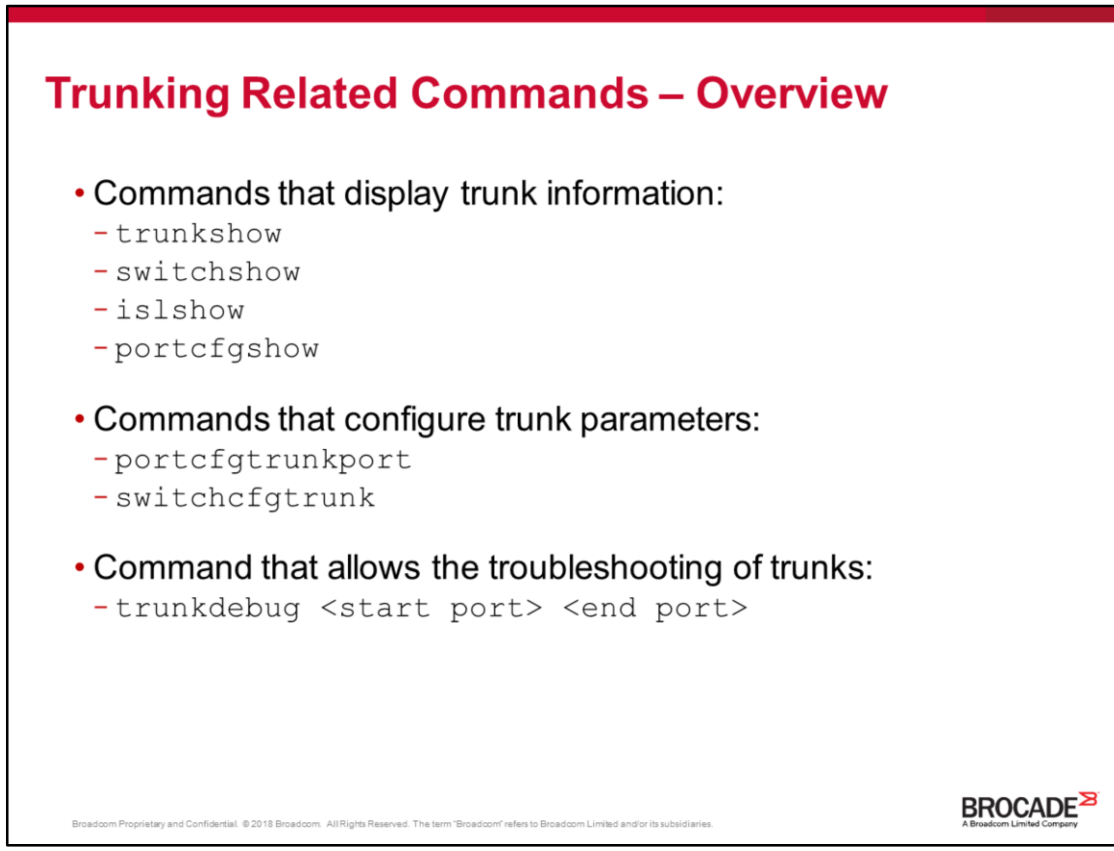

**Footnote** 1: Light in a vacuum travels much faster, but in optical cable the rate is about 5 ns/meter. 5ns/meter multiplied by 30 meters is 150 ns.

A two meter difference is approximately equal to one (10ns) deskew unit.

Differences greater than 30 meters could introduce performance degradation

For Gen5 and older products, since the shortest ISL is set to a deskew of 15 (150ns), an ISL with a difference of 30 meters has a deskew of approximately 30

A 400 meter difference would yield a deskew value of 215.




`trunkshow`

- Displays each trunk group
- Displays which local port is connected to which remote port
- Displays WWN of the other switch
- Displays deskew values and identifies the trunk master port

`switchshow`

- Displays the master port (trunk master) and each non-master port
- Displays the WWN of connected switch to trunked ports

`islshow`

- Displays bandwidth information associated with each trunk group

`switchcfgtrunk`

- Used to configure trunking to be ON or OFF on all ports on switch

`portcfgtrunkport`

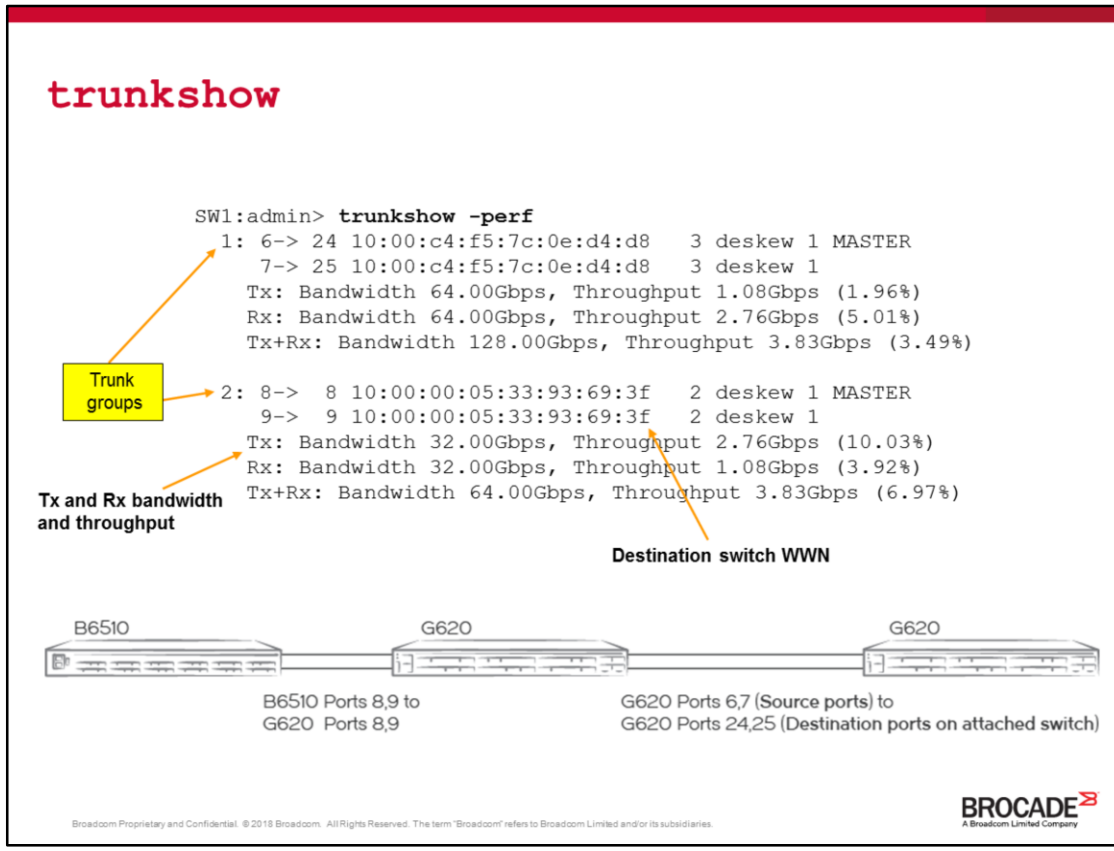
- Used to configure trunking per port as either ON or OFF, default is ON

`portcfgshow`

- Displays port configuration information including trunk ON/OFF status

`trunkdebug port1 port2`

- Tests specified ports in trunk group and reports trunking status. Possible trunkdebug outputs include:
  - Switch does not support trunking
  - Trunking license required
  - port port_id is not E_Port
  - port port_id trunking disabled
  - port port_id speed is not 2G, 4G, 8G, 10G, or 16G
  - port port_id and port port_id are not in same port group
  - port port_id and port port_id connect to different switches
  - port port_id and port port_id connect to the switch WWN
  - port port_id is not a trunking port due to: E_Port being disabled, or trunking might be disabled at remote port
  - port port_id and port port_id cannot trunk, please check link length to make sure difference is less than 400 m




Trunk master selection is not related to deskew.

Trunk master selection is based on the ASICs internal port values, it is predictable. It is dependent on distance and quality of the link and its associated connection points.

The switches in this example have multiple trunk groups between them. Notice that the trunk master is not always the lowest port number in the group nor is it related to the deskew value.

# islshow

- The `islshow` command displays
  - Speeds for each ISL in the trunk group
  - Aggregate bandwidth for the trunk group
  - WWN of the other switch
- In the example below note the following:
  - Each trunk group is represented by the trunk master of each trunk; port 8 of trunk group 1 points to port 9 of a trunk group on the attached switch
  - Port 15 is the trunk master of trunk group 2 on both of the switches

```
SW1:admin> islshow
  1:  8->  9 10:00:00:05:33:93:69:3f   3 6510_Edge  sp: 16.000G bw: 32.000G
TRUNK QOS CR_RECOV FEC
  2: 15-> 15 10:00:c4:f5:7c:0e:d4:d8   2 G620_Edge  sp: 32.000G bw: 64.000G
TRUNK QOS CR_RECOV FEC
```

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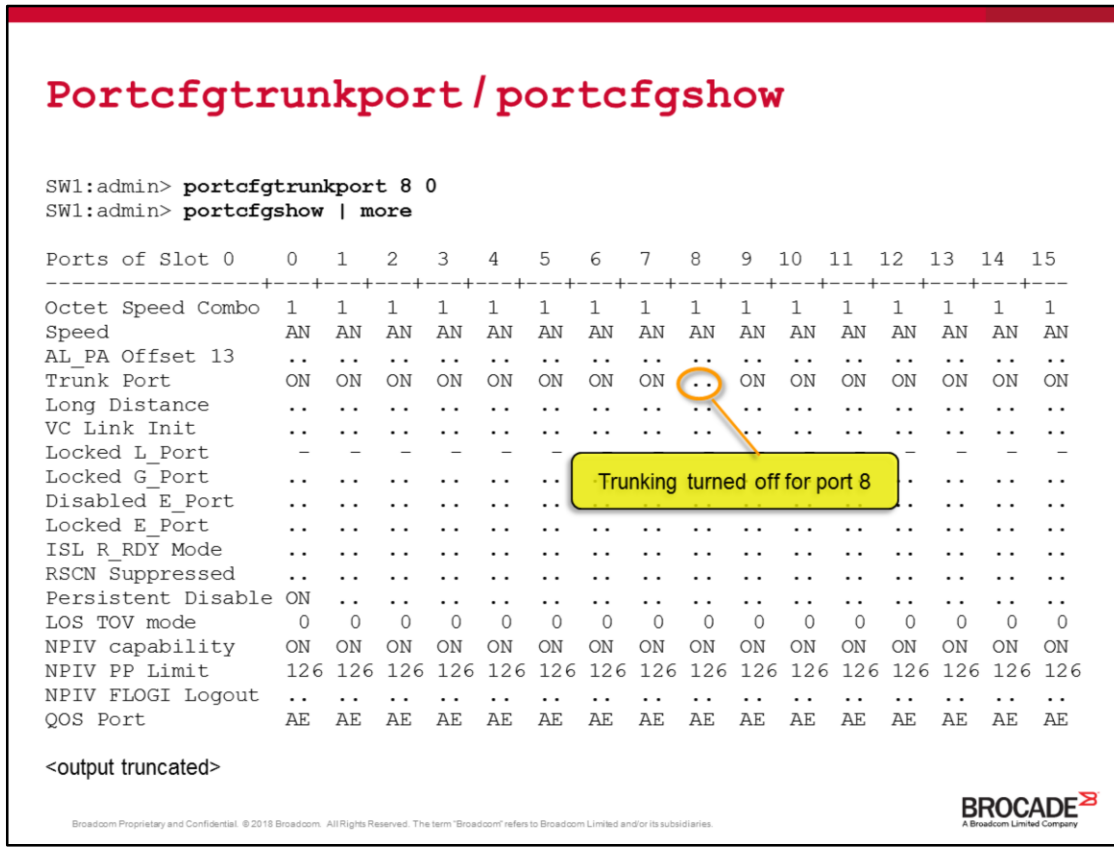



The `portcfgtrunkport` command is used to turn on or off trunking on one port, specified by port number. The last parameter indicates on or off (1 for on and 0 for off).

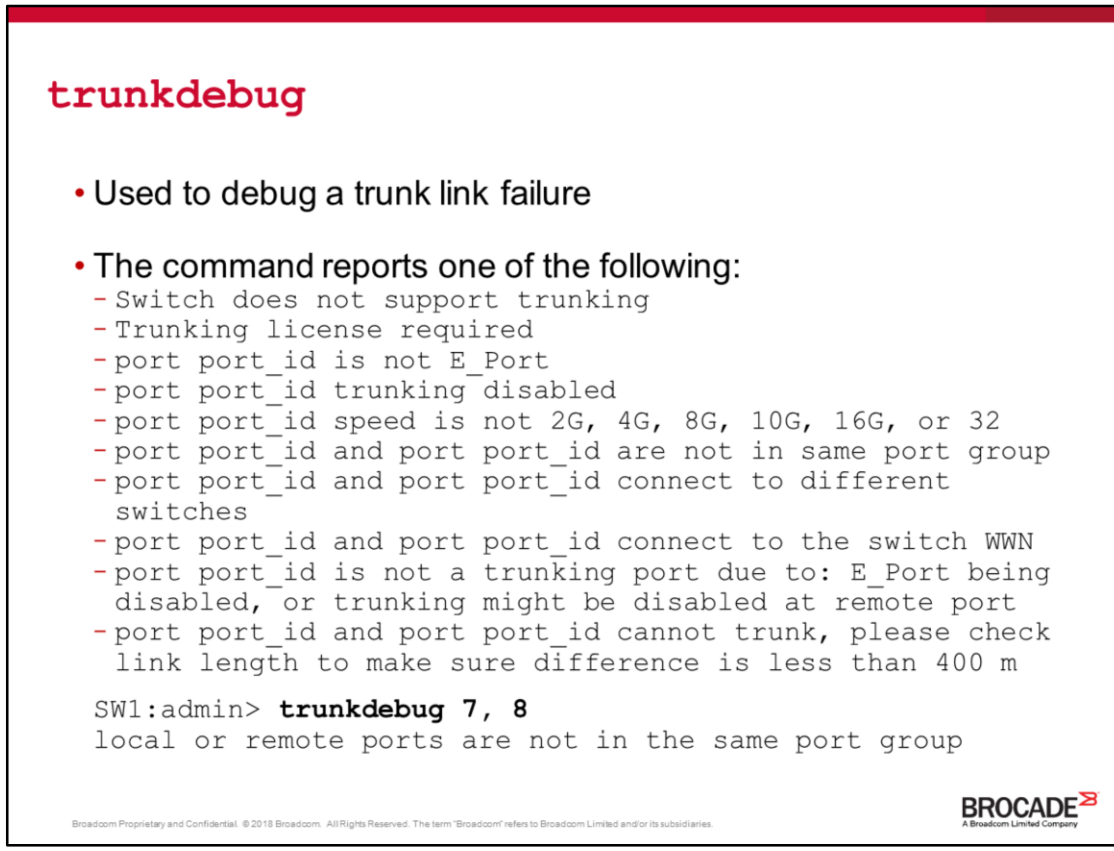
Usage: `portCfgTrunkPort [SlotNumber/]PortNumber Mode`

Mode: `1 - Configure port to be Trunking capable`
`0 - Configure port to be Trunking incapable`

The `switchcfgtrunk` command is used to turn on or off trunking capability for the whole switch:

Usage: `switchCfgTrunk Mode`

Mode: `0 - Configure ports to be Trunking incapable`
`1 - Configure ports to be Trunking capable`




This command has the following operands:

**port1** Specify the port index number of port 1. Use the `switchshow` command to view the index numbers for a port. This operand is required.

**port2** Specify the port index number of port 2. Use the `switchshow` command to view the index numbers for a port. This operand is required.

Example of debugging a trunk connection:

```
switch:admin> trunkdebug 43 44
Switch does not support trunking
switch:admin> trunkdebug 62 63
port 62 and 63 are trunked together
```

Director command syntax:

```
trunkdebug: area_number1 area_number2
```

# Summary

- ISLs are used to connect multiple switches together into a single fabric
- ISLs can be trunked together for increased bandwidth and high availability

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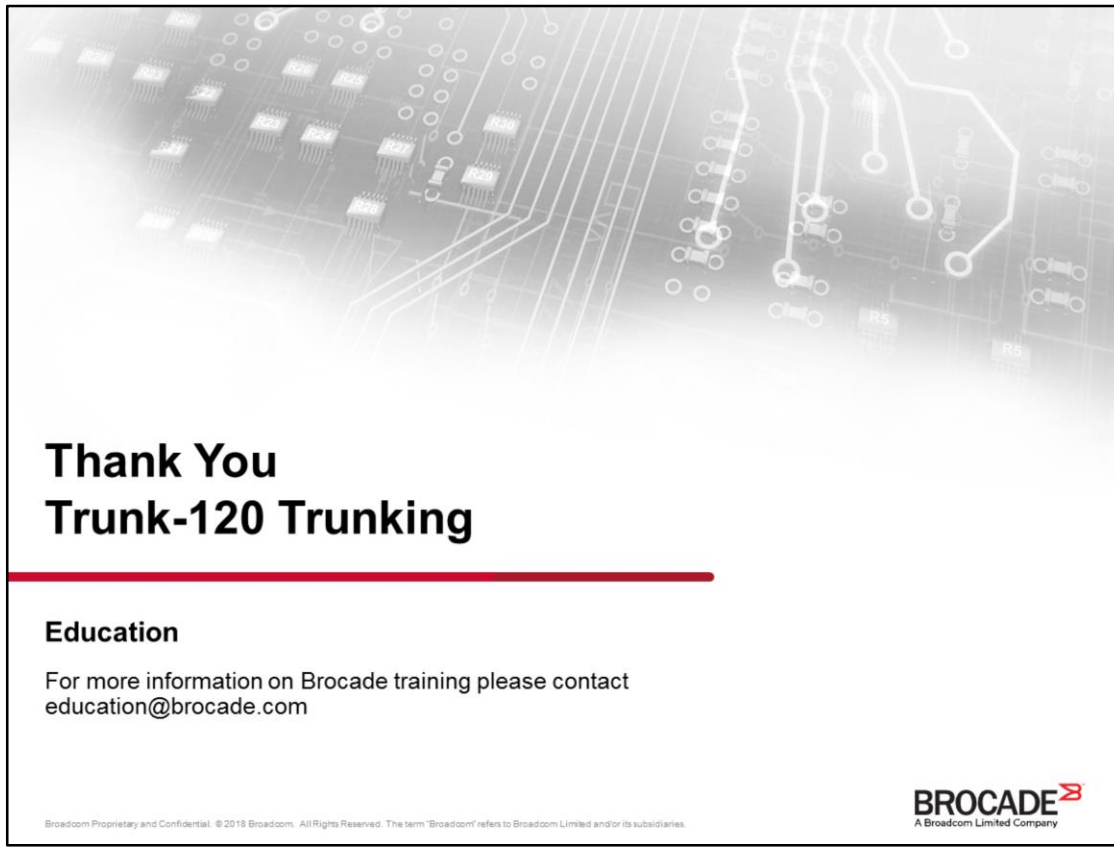

# Thank You
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