Open Shortest Path First OSPF

Lab

Guide

Configuration Loading

To load a new configuration into startup-config

From the enable mode, perform these 3 steps:

1. **Write erase**

    Answer 'y' and wait a few seconds

2. **Copy   <file-name>   startup-config**

    Press 'enter' to the question and wait a few seconds

3. **Reload**

    Answer 'y' and wait for reboot

Labs Used

Lab	Name	Flash File
2-a	Global OSPF Configuration	OSPF-1
2-b	Interface Configuration	"
2-c	Area X Config - Inter/Intra	OSPF-2
2-d	Area X Config - Stub	OSPF-3
2-e	Area X Config - NSSA	"
2-f	Area X Config - TSA	"
2-g	DR / BDR Election	OSPF-4
2-h	Neighbor Config - NBMA	OSPF-5
2-i	Neighbor Config - Aggregation	"

Labs Used

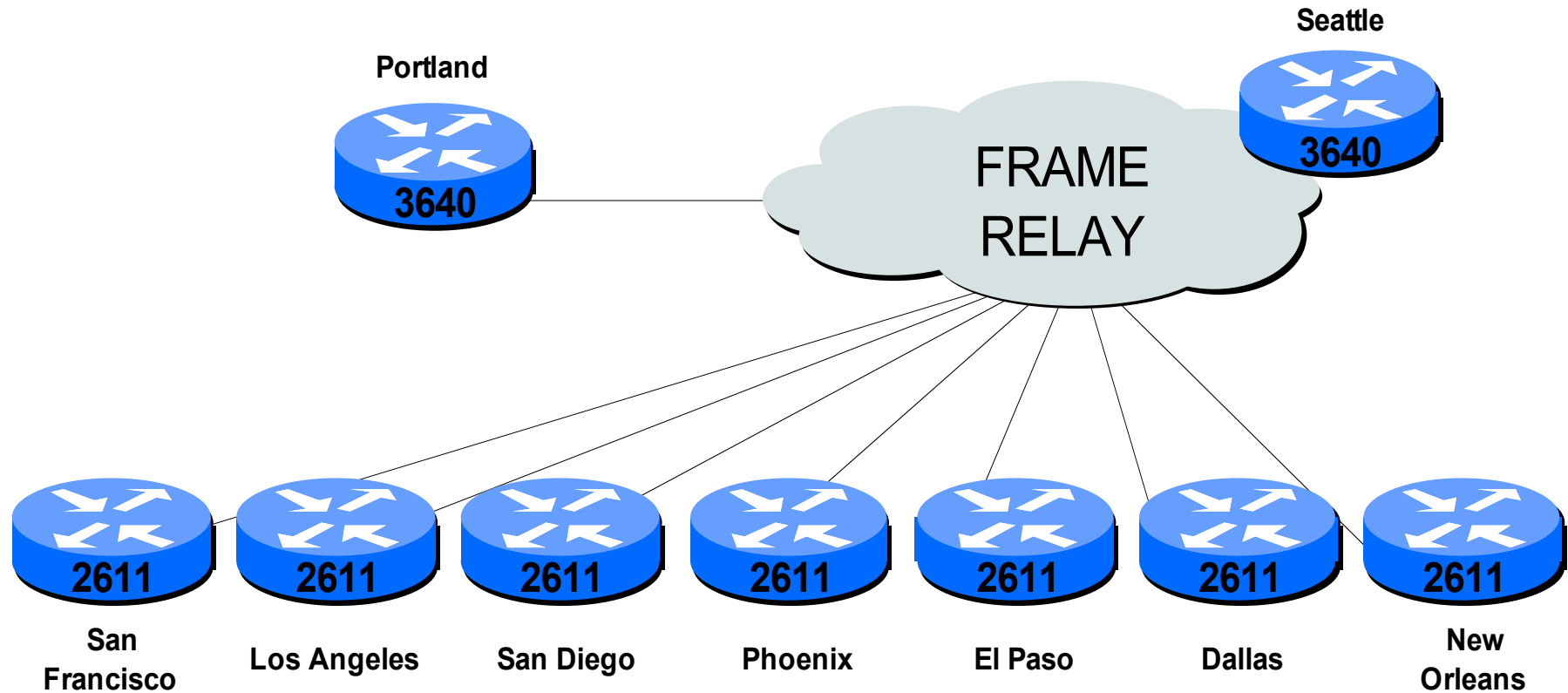| Lab	Name	Flash File
3-a	Troubleshooting	OSPF-6
4-a	Design - Area 0 and X	"
4-b	Design - Filtering	"
4-c	Design - Virtual Links	OSPF-7*
4-d	Design - Redistribution	OSPF-6
4-e	Design - ABR(s)	"

* Optional

LAB 1: Setup / Familiarization

- Purpose:
  - Review physical connectivity
- Tasks
  - Review equipment used
  - Review lab guide
- Commands used
  - Show ip route
  - Show version
  - Show running-config

Lab 1 - Physical Setup 1

Lab 1 - Physical Setup 2

LAB 2a:
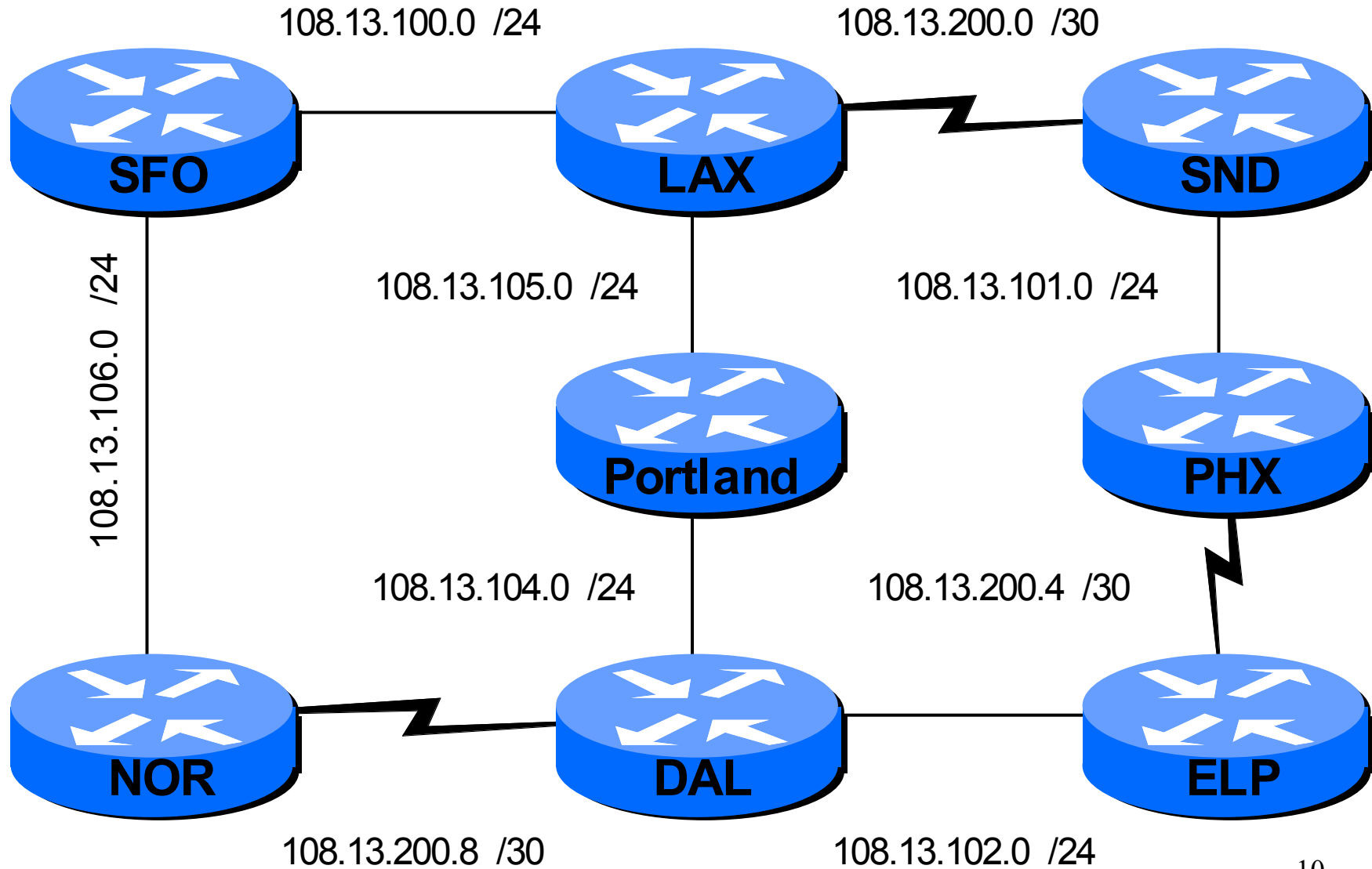
Global Configuration

Purpose:

Configure initial connectivity

LAB 2-a: Global Configuration

- **Purpose**
  - **Get OSPF up and running**

- **Tasks**
  - Configure OSPF process
  - Configure OSPF networks

- **Configuration Commands used**
  - Router OSPF <**process-id**>
  - Network A.B.C.D <**mask**> Area 0

- **Commands used**
  - Show ip route
  - Show ip protocol
  - Show ip ospf

Lab 2-a - Router and IP Setup

108.13.100.0 /24

108.13.200.0 /30

SFO

LAX

SND

108.13.106.0 /24

108.13.105.0 /24

108.13.101.0 /24

Portland

PHX

108.13.104.0 /24

108.13.200.4 /30

NOR

DAL

ELP

108.13.200.8 /30

108.13.102.0 /24

10

Lab 2-a - Worksheet 1

- Router _____
- OSPF Process ID _____
- Area: __**0**__
- Network ___.___.___.___ Mask ___.___.___.___
- Network ___.___.___.___ Mask ___.___.___.___
- Network ___.___.___.___ Mask ___.___.___.___
- Network ___.___.___.___ Mask ___.___.___.___

Lab 2-a - Worksheet 2

- **Commands used**:
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____

- **Output from**:
  - Show ip route: _____

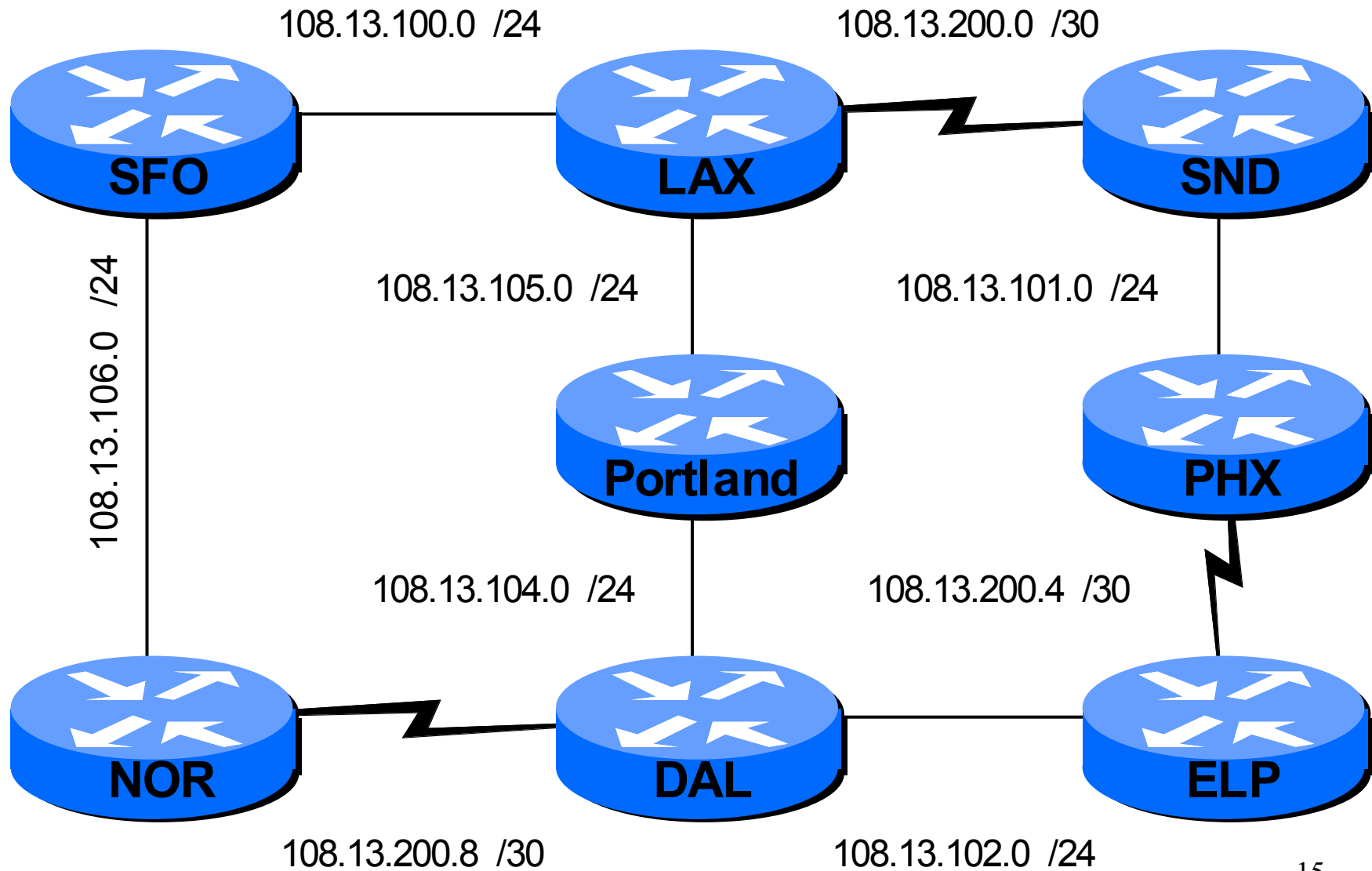# LAB 2b:
Interface Configuration

Purpose:

Observe the effect of
changing interface parameters

LAB 2-b: Interface Configuration

- **Purpose**
  - **Change interface parameters and view their effects.**
- **Tasks**
  - Change bandwidth
- **Configuration Commands used**
  - Bandwidth <**1-10000000**> Bandwidth in kilobits
  - ip ospf cost <**1-65535**> Cost
- **Commands used**
  - Show ip route
  - Show ip ospf interface

Lab 2-b - Router and IP Setup

108.13.100.0 /24

108.13.200.0 /30

SFO

LAX

SND

108.13.106.0 /24

108.13.105.0 /24

108.13.101.0 /24

Portland

PHX

108.13.104.0 /24

108.13.200.4 /30

NOR

DAL

ELP

108.13.200.8 /30

108.13.102.0 /24

15

Lab 2-b - Worksheet 1

- **Interface commands used: (Pick 1 intf *ONLY*)**
  - Interface _____
  - Bandwidth _____
  - ip ospf cost _____
- **Additional Commands used**:
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____
- **Output from**:
  - Show ip route: _____

LAB 2c:
Area X Configuration

Purpose:

Configure multiple [NORMAL] Areas

LAB 2-c: Area X Configuration

- **Purpose**
  - **See the route table differences with multiple areas**
- **Tasks**
  - Configure Area 0 and multiple Area X's
  - Inject routes into Area X
- **Configuration Commands used**
  - Network A.B.C.D <**mask**> Area 0
    - Serial to Seattle
  - Network A.B.C.D <**mask**> Area X
    - 3 loopback interfaces
- **Commands used**
  - Show ip route

Lab 2-c - Router Setup

Lab 2-c - IP Setup

Lab 2-c - Worksheet 1

- Router _____ Lab # ___ Area # ___

- Serial 0/0 209.___.200.2 /30

- Loopback 1 ___.1.300.1 /24
- Loopback 2 ___.2.300.1 /25
- Loopback 3 ___.3.300.1 /26

Lab 2-c - Worksheet 2

- **Commands used**:
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____

- **Output from**:
  - Show ip route: _____
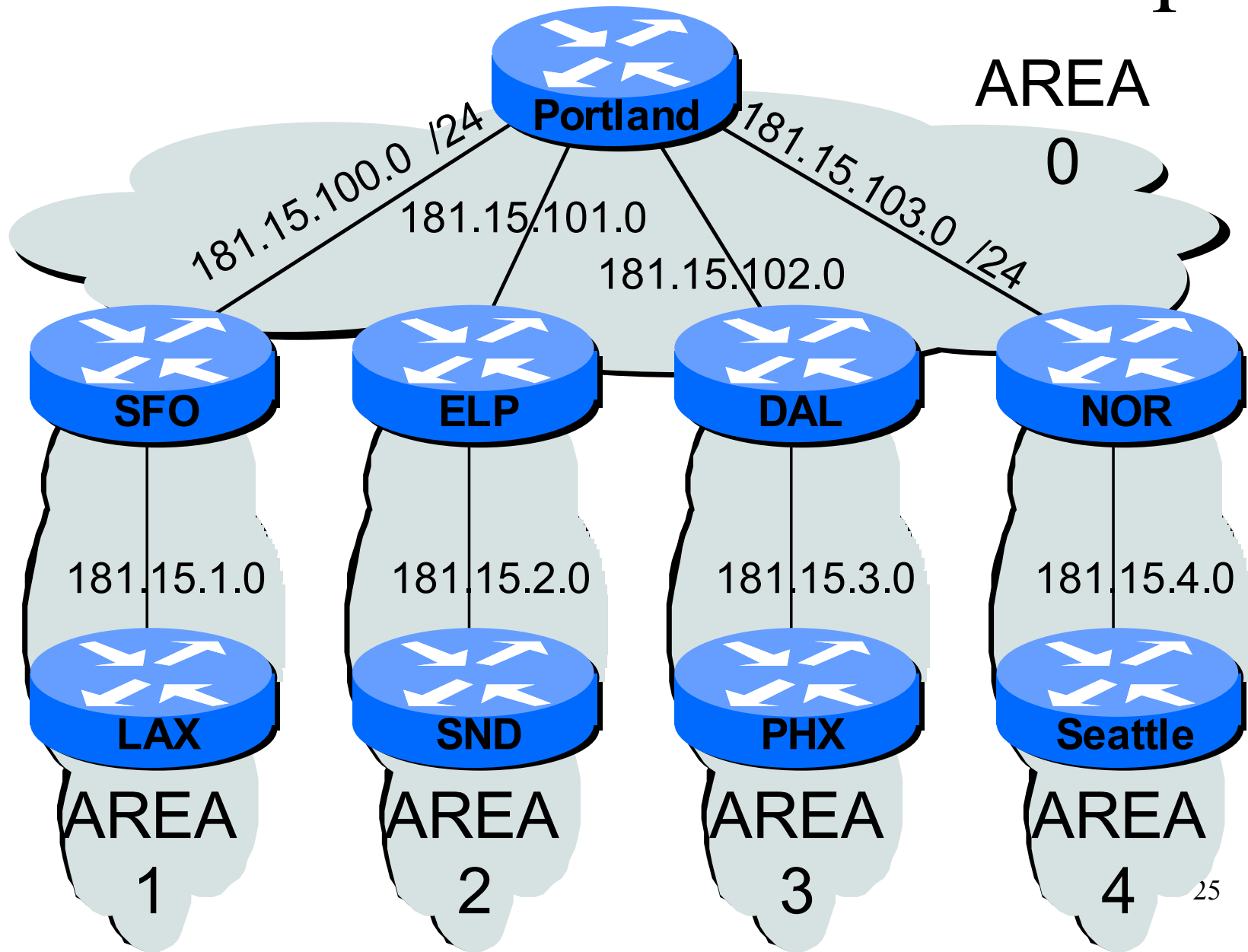
LAB 2d:
Area X Configuration

Purpose:

Configure multiple [STUB] Areas

LAB 2-d: STUB Area Config

- **Purpose**
  - **Configure STUB areas and inject routes**
- **Tasks**
  - Configure multiple STUB areas
- **Configuration Commands used**
  - Area X stub
- **Commands used**
  - Show ip route

Lab 2-d - Router and IP Setup

AREA 0

Portland

181.15.100.0 /24

181.15.101.0

181.15.102.0

181.15.103.0 /24

SFO   ELP   DAL   NOR

181.15.1.0   181.15.2.0   181.15.3.0   181.15.4.0

LAX   SND   PHX   Seattle

AREA 1   AREA 2   AREA 3   AREA 4

25

Lab 2-d - Worksheet 1

- Router _____ Lab # ___
- Area # ___ Area # ___

- E 0/0 181.15.___.0 Area# ___
- E 0/1 181.15.___.0 Area# ___
- Loopback 1 ___.1.300.1 /24 Area# ___
- Loopback 2 ___.2.300.1 /25 Area# ___
- Loopback 3 ___.3.300.1 /26 Area# ___

Lab 2-d - Worksheet 2

- **Commands used**:
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____

- **Output from**:
  - Show ip route: _____

LAB 2e:
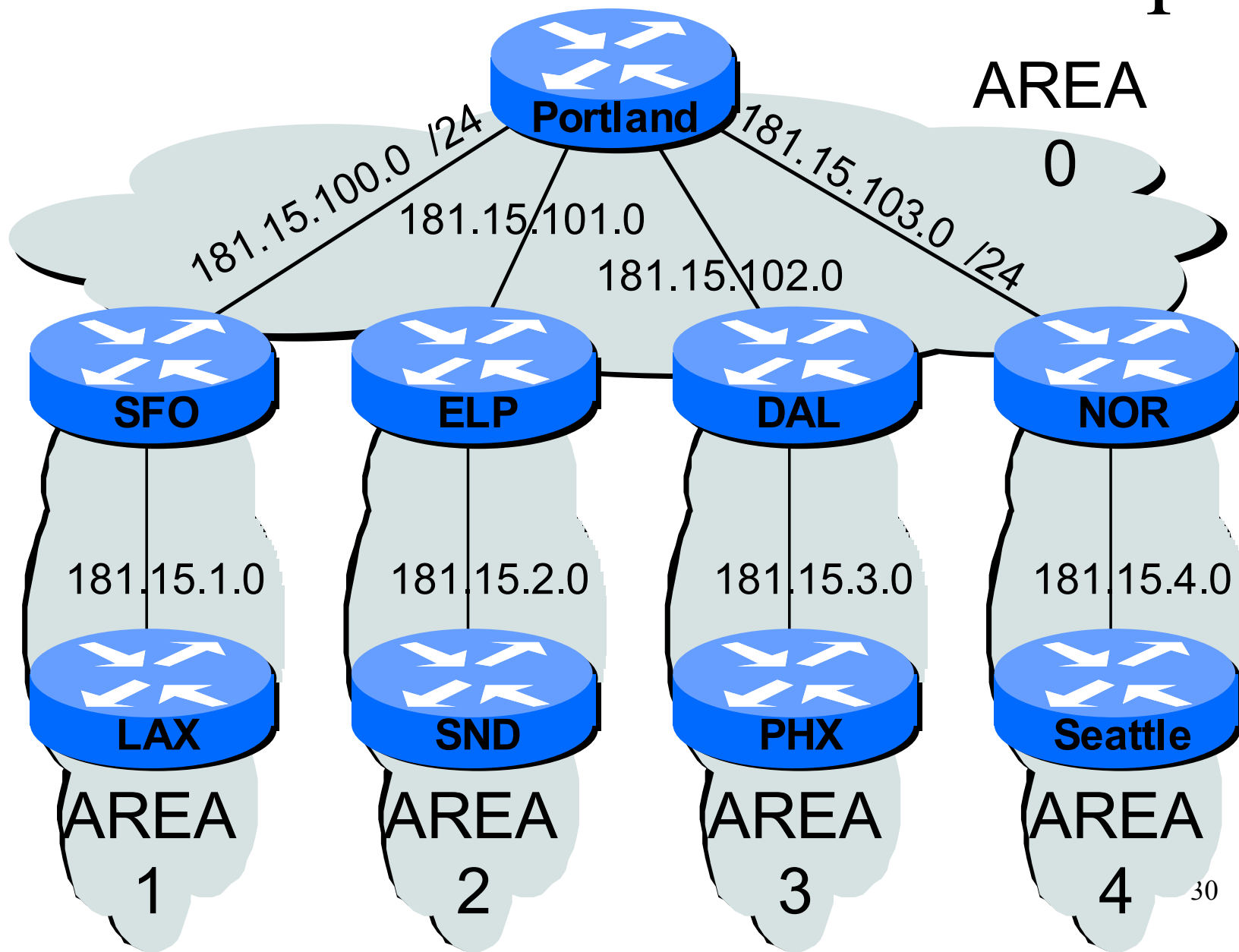## Area X Configuration

Purpose:

Configure multiple [NSSA] Areas

LAB 2-3e: NSSA Area Config

- **Purpose**
  - **Configure NSSA areas and inject routes**
- **Tasks**
  - Configure multiple NSSA areas
- **Configuration Commands used**
  - Area X nssa
- **Commands used**
  - Show ip route

Lab 2-e - Router and IP Setup

AREA 0

Portland

181.15.100.0 /24

181.15.101.0

181.15.102.0

181.15.103.0 /24

SFO

ELP

DAL

NOR

181.15.1.0

181.15.2.0

181.15.3.0

181.15.4.0

LAX

SND

PHX

Seattle

AREA 1

AREA 2

AREA 3

AREA 4

Lab 2-e - Worksheet 1

- **Commands used**:
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____

- **Output from**:
  - Show ip route: _____

LAB 2f:
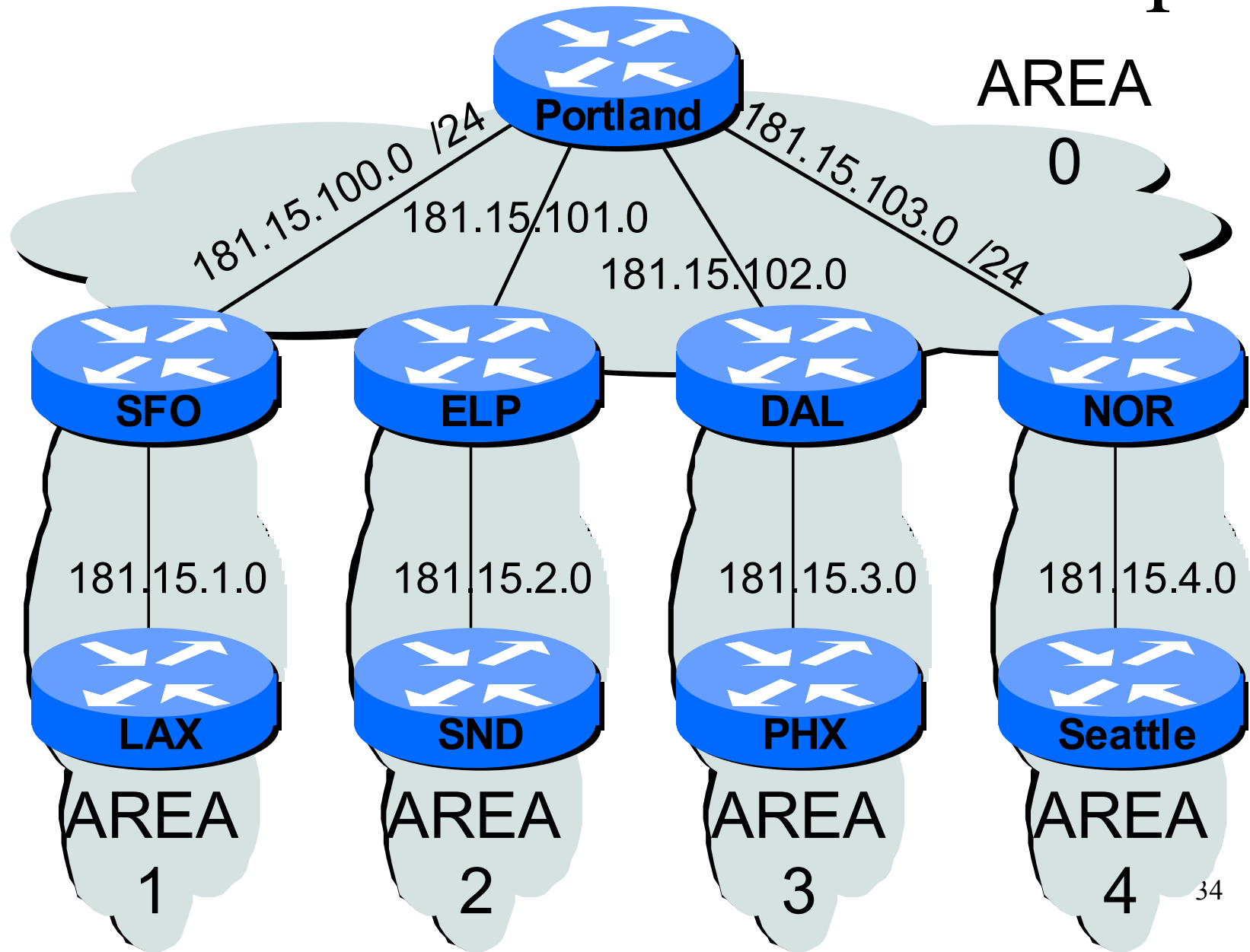## Area X Configuration

Purpose:

   Configure multiple [TSA] Areas

LAB 2-f: TSA Area Config

- **Purpose**
  - **Configure STUB areas and inject routes**
- **Tasks**
  - Configure multiple STUB areas
- **Configuration Commands used**
  - Area X stub no-summary
- **Commands used**
  - Show ip route

Lab 2-f - Router and IP Setup

AREA 0

Portland

181.15.100.0 /24

181.15.101.0

181.15.102.0

181.15.103.0 /24

SFO

ELP

DAL

NOR

181.15.1.0

181.15.2.0

181.15.3.0

181.15.4.0

LAX

SND

PHX

Seattle

AREA 1

AREA 2

AREA 3

AREA 4

34

Lab 2-f - Worksheet 1

- **Commands used**:
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____

- **Output from**:
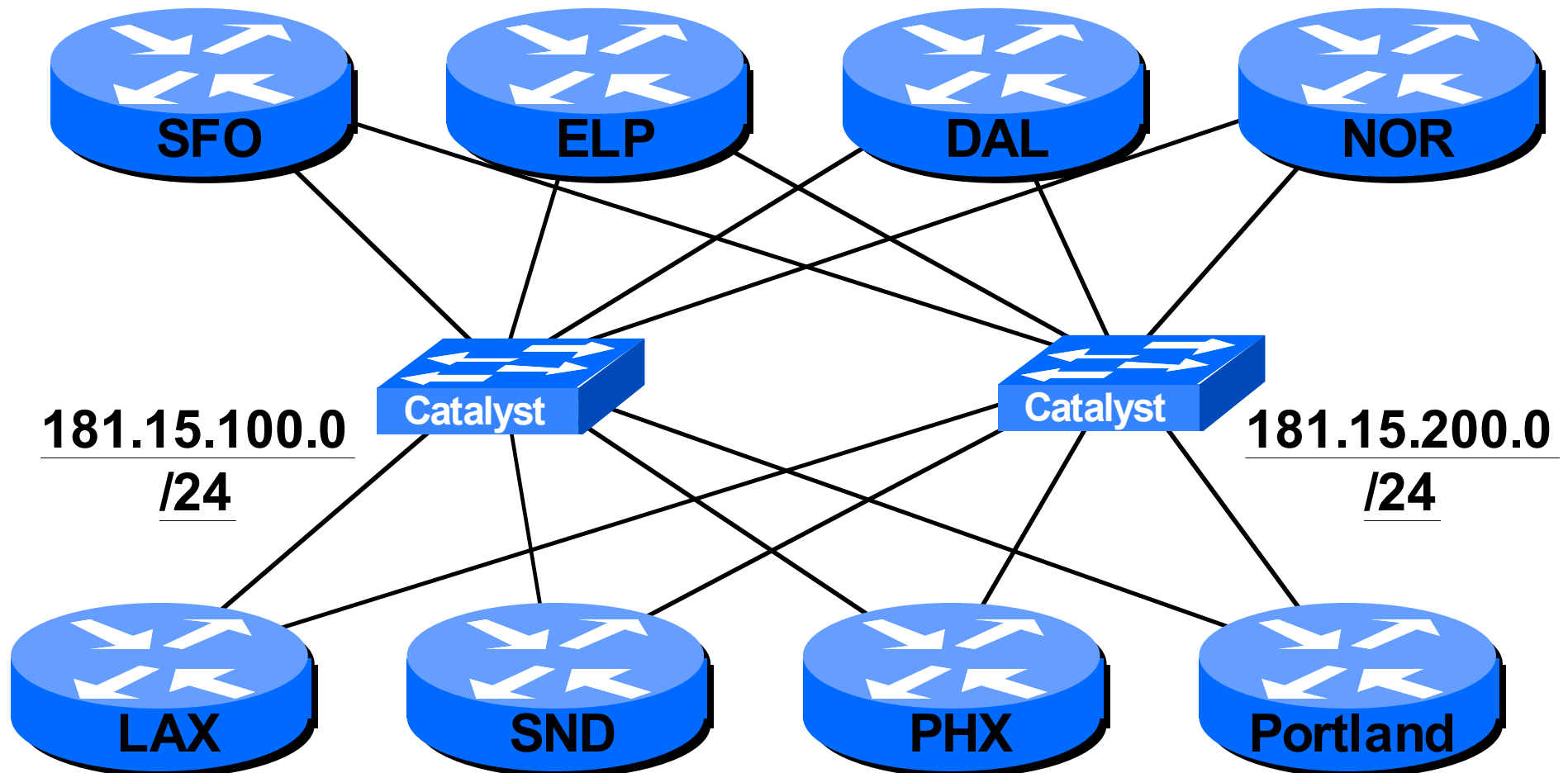 - Show ip route: _____

LAB 2g:
DR and BDR Configuration

Purpose:

Configure DR and BDR on Multi Access media

LAB 2-g: DR / BDR Election

- **Purpose**
  - **Understand the DR and BDR election process**

- **Tasks**
  - Configure routers onto two subnets

- **Configuration Commands used**
  - IP OSPF Priority

- **Commands used**
  - Show ip route

Lab 2-g - Router and IP Setup

SFO **ELP** **DAL** **NOR**

Catalyst **Catalyst**

181.15.100.0 /24 **181.15.200.0 /24**

LAX **SND** **PHX** **Portland**

Lab 2-g - Worksheet 1

- Router _____ Lab# ___

- E 0/0 181.15.100.___ /24
- E 0/1 181.16.200.___ /24

- OSPF Priority ____
- Hello timer ____
- Dead-interval timer ____

Lab 2-g - Worksheet 2

- **Commands used**:
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____

- **Output from**:
  - Show ip ospf neighbor:
  - DR _____ BDR _____

LAB 2h:
Neighbor Configuration

Purpose:

Configure neighbors on NBMA media

LAB 2-h: NBMA Configuration

- **Purpose**
  - **Configure OSPF over Frame-Relay**
- **Tasks**
  - Global OSPF configuration
  - Interface OSPF configuration
- **Configuration Commands used**
  - IP OSPF Network _____
- **Commands used**
  - Show ip route
  - Show ip ospf neighbor
  - Show ip ospf interface

Lab 2-h - Router and IP Setup

Lab 2-h - Worksheet 1

- Serial 0/0 209.___.200.0   /30
  - Command _____

- Serial 0/1 209.___.200.0   /30
  - Command _____

Lab 2-h - Worksheet 2

- **Commands used**:
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____

- **Output from**:
  - Show ip route: _____

LAB 2i:
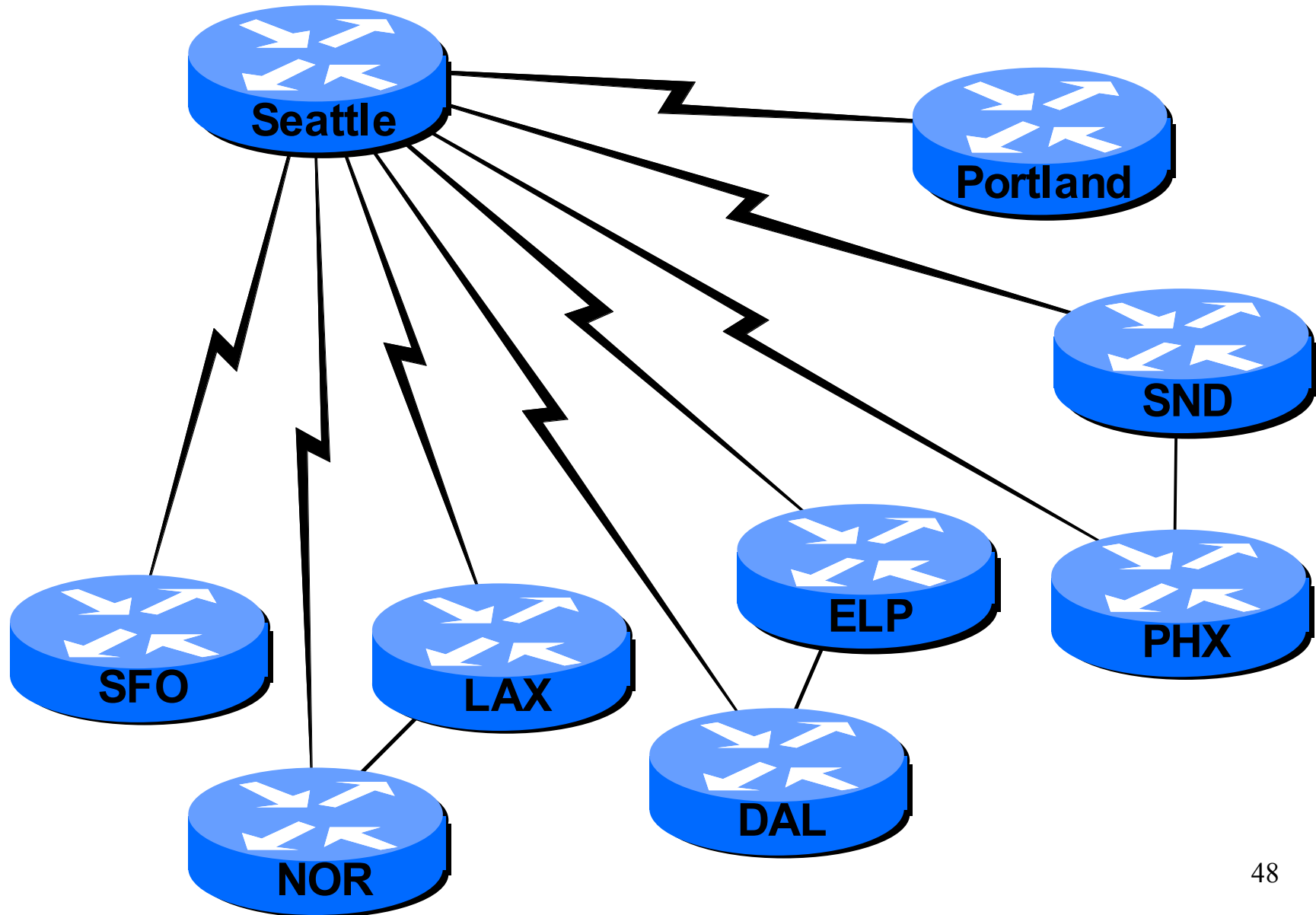## Neighbor Configuration

Purpose:

Configure aggregation for area announcement.

LAB 2-i: Network Aggregation

- **Purpose**
  - **Configure networks for aggregation at ABR**

- **Tasks**
  - Configure additional areas
  - Configure aggregation under global process

- **Configuration Commands used**
  - Summary-address **A.B.C.D \<mask\>**

- **Commands used**
  - Show ip route

Lab 2-i - Router Setup

Seattle

Portland

SND

SFO

LAX

ELP

PHX

DAL

NOR

Lab 2-i - IP Setup

Lab 2-i - Worksheet 1

- Serial 0/0 209.___.200.0 /30 Area# ____

- Serial 0/1 209.___.200.0 /30 Area# ____

- OSPF Process
  – Command _____

Lab 2-i - Worksheet 2

- **Commands used**:
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____

- **Output from**:
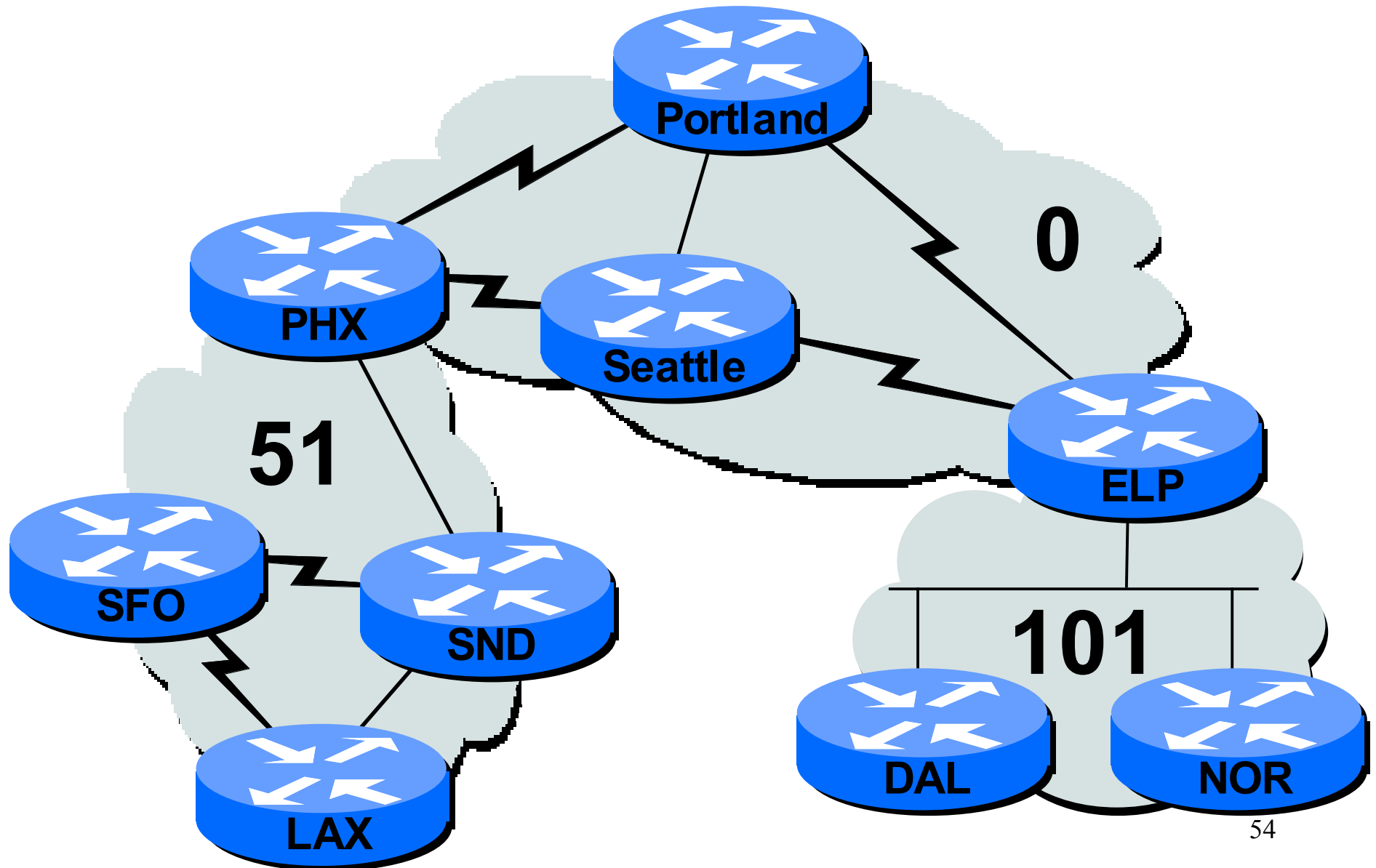 - Show ip route: _____

LAB 3a:
Troubleshooting

Purpose:

Run through normal operations and various break-and-fix scenarios

LAB 3-a: Troubleshooting

- **Purpose**
  - **Understand the Debug and Show output in certain break-and-fix scenarios.**
- **Tasks**
  - Troubleshoot break-and-fix scenarios
- **Configuration Commands used**
  - None
- **Commands used**
  - Show
  - Debug

Lab 3-a - Router Setup

Portland

PHX

Seattle

0

51

ELP

SFO

SND

101

LAX

DAL

NOR

54

Lab 3-a - Worksheet 1

- Router _____ Lab# ____
- E 0/0 ____.____.____.____ /___ Area ___
- E 0/1 ____.____.____.____ /___ Area ___
- S 0/0 ____.____.____.____ /___ Area ___
- S 0/1 ____.____.____.____ /___ Area ___

Lab 3-a - Worksheet 2

- **Commands used**:
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____

- **Output from**:
  - Show ip ospf: _____

  - Debug ip ospf: _____

LAB 4a:
Design

Purpose:

Initial Area 0 and Area X

LAB 4-a: Area 0 and X Setup

- **Purpose**
  - **Design and implement backbone and multiple areas.**
- **Tasks**
  - Configure cabling and IP subnet scheme
  - Enable IP subnets scheme and area design.
- **Configuration Commands used**

- **Commands used**
  - Show ip route
  - Show ip ospf neighbor
  - Show ip ospf interface

Lab 4-a - Router Setup

Lab 4-a - IP Setup

- Area 0 ____.____.____.____ /___
  - Serial links ____.____.____.____ /___
  - Ethernet links ____.____.____.____ /___
- Area 51 ____.____.____.____ /___
  - Serial links ____.____.____.____ /___
  - Ethernet links ____.____.____.____ /___
- Area 101 ____.____.____.____ /___
  - Serial links ____.____.____.____ /___
  - Ethernet links ____.____.____.____ /___

Lab 4-a - Worksheet 1

- Router _____ Lab# ____
- E 0/0 ____.____.____.____ /___ Area ___
- E 0/1 ____.____.____.____ /___ Area ___
- S 0/0 ____.____.____.____ /___ Area ___
- S 0/1 ____.____.____.____ /___ Area ___

Lab 4-a - Worksheet 2

- **Commands used**:
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____

- **Output from**:
  - Show ip route: _____
  - Show ip ospf neighbor: _____
  - Show ip ospf interface: _____

LAB 4b:
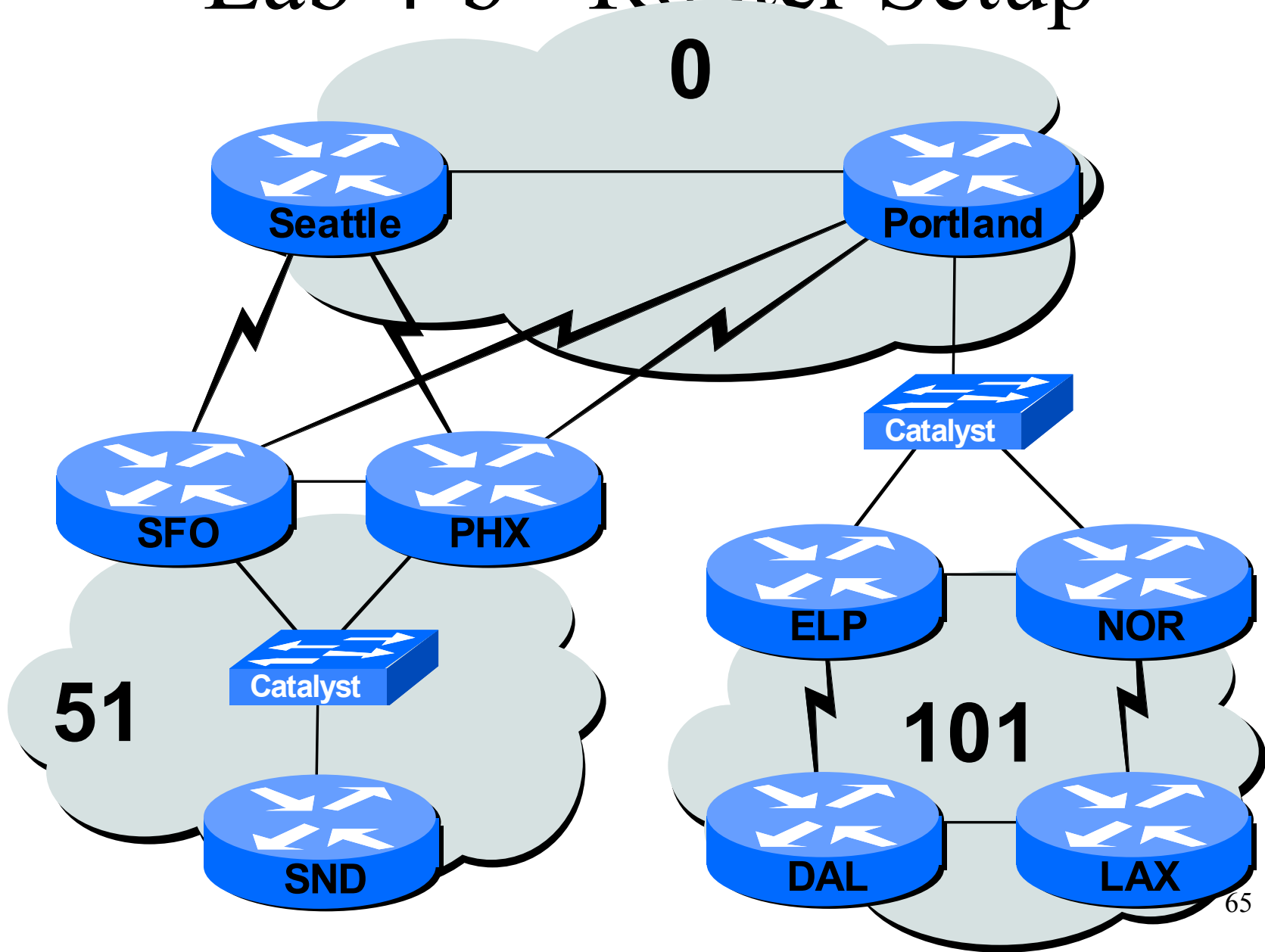
Design

Purpose:

   Understand filtering capabilities between areas.

LAB 4-b: Filtering

- **Purpose**
  - **Filter LSA and Routing Table entries**
- **Tasks**
  - Determine and implement filtering policy
- **Configuration Commands used**
  - Global
  - Interface
- **Commands used**
  - Show ip route
  - Debug ip route

Lab 4-b - Router Setup

0

Seattle

Portland

Catalyst

SFO

PHX

ELP

NOR

51

Catalyst

101

SND

DAL

LAX

65

Lab 4-b - Filtering Setup

- Seattle

- SFO

- LAX

- SND

- PHX

- Portland

- ELP

- DAL

- NOR

Lab 4-b - Worksheet 1

- E 0/0

- E 0/1

- S 0/0

- S 0/1

- Global

Lab 4-b - Worksheet 2

- **Commands used**:
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____

- **Output from**:
  - Show ip route: _____

LAB 4c:
Design

Purpose:

Use Virtual Links to "heal" areas.

LAB 4-c: Virtual Links

- **Purpose**
  - **Understand the use of Virtual Links**
- **Tasks**
  - Design and implement virtual links
- **Configuration Commands used**
  - Area **X** virtual-link **A.B.C.D**
- **Commands used**
  - Show ip route
  - Show ip ospf
  - Show ip ospf database

Lab 4-c - Router Setup

Lab 4-c - Virtual Link Setup

- Seattle ___.___.___.___

- SFO ___.___.___.___

- LAX ___.___.___.___

- SND ___.___.___.___

- PHX ___.___.___.___

- Portland ___.___.___.___

- ELP ___.___.___.___

- DAL ___.___.___.___

- NOR ___.___.___.___

Lab 4-c - Worksheet 1

- SFO - PHX

- ELP - NOR

- SND -

- LAX -

- DAL -

Lab 4-c - Worksheet 2

- **Commands used**:
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____

- **Output from**:
  - Show ip route: _____
  - Show ip ospf interface: _____
  - Show ip ospf database: _____

LAB 4d:
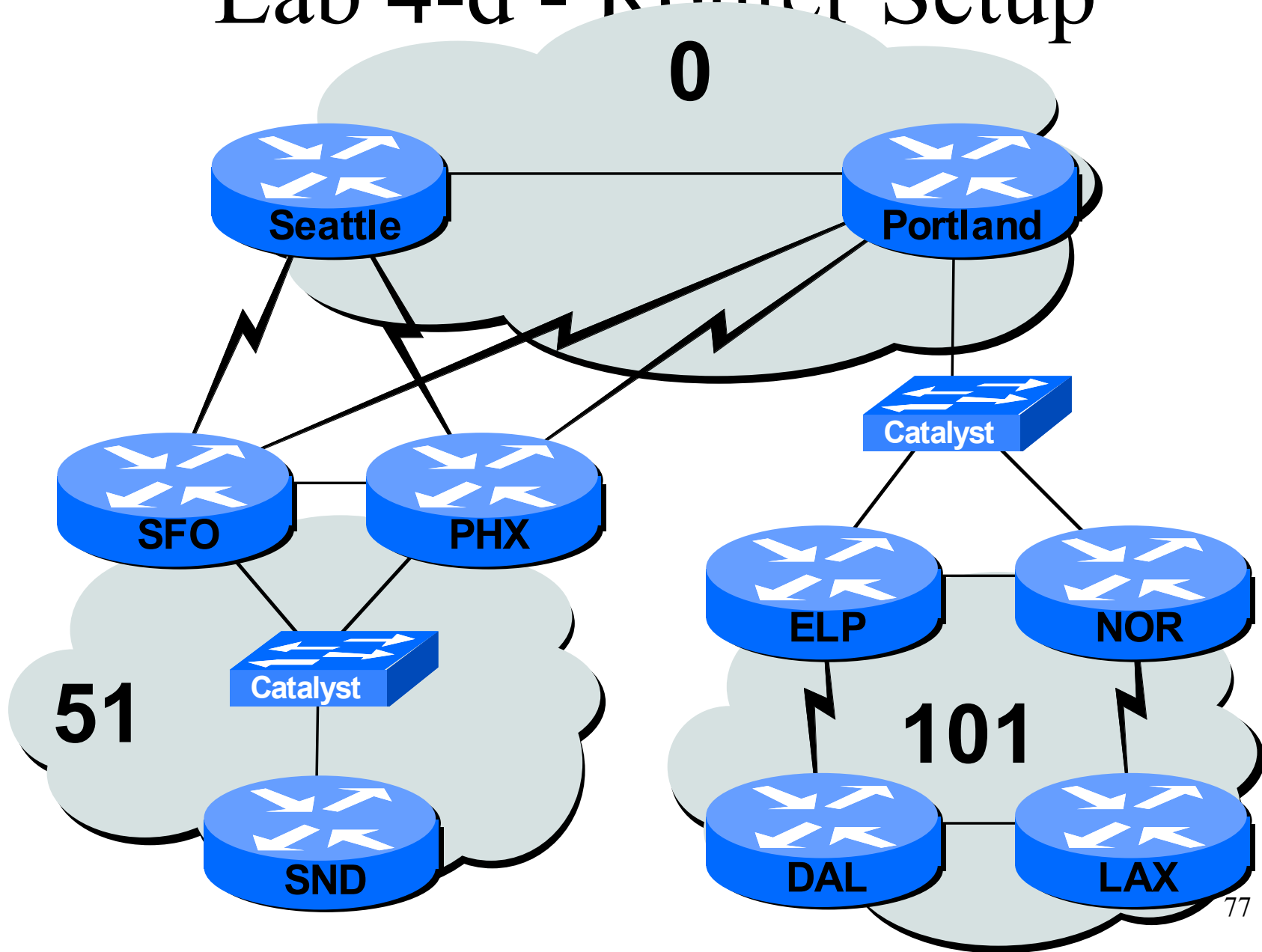## Design

Purpose:

  Understand the effects of Redistribution and ASBR's.

LAB 4-d: Redistribution

- **Purpose**
  - **Setup redistribution**
- **Tasks**
  - Configure additional IGP
  - Redistribute IGP into OSPF
- **Configuration Commands used**
  - Redistribute <protocol> [subnets]
- **Commands used**
  - Show ip route
  - Show ip ospf database

Lab 4-d - Router Setup

77

Lab 4-d - Worksheet 1

- IGP _____

Network (loopback 10)____.____.____.____ /___

- Redistribute into OSPF Process _____

Command _____

Lab 4-d - Worksheet 2

- **Commands used**:
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____

- **Output from**:
  - Show ip route: _____
  - Show ip protocol: _____
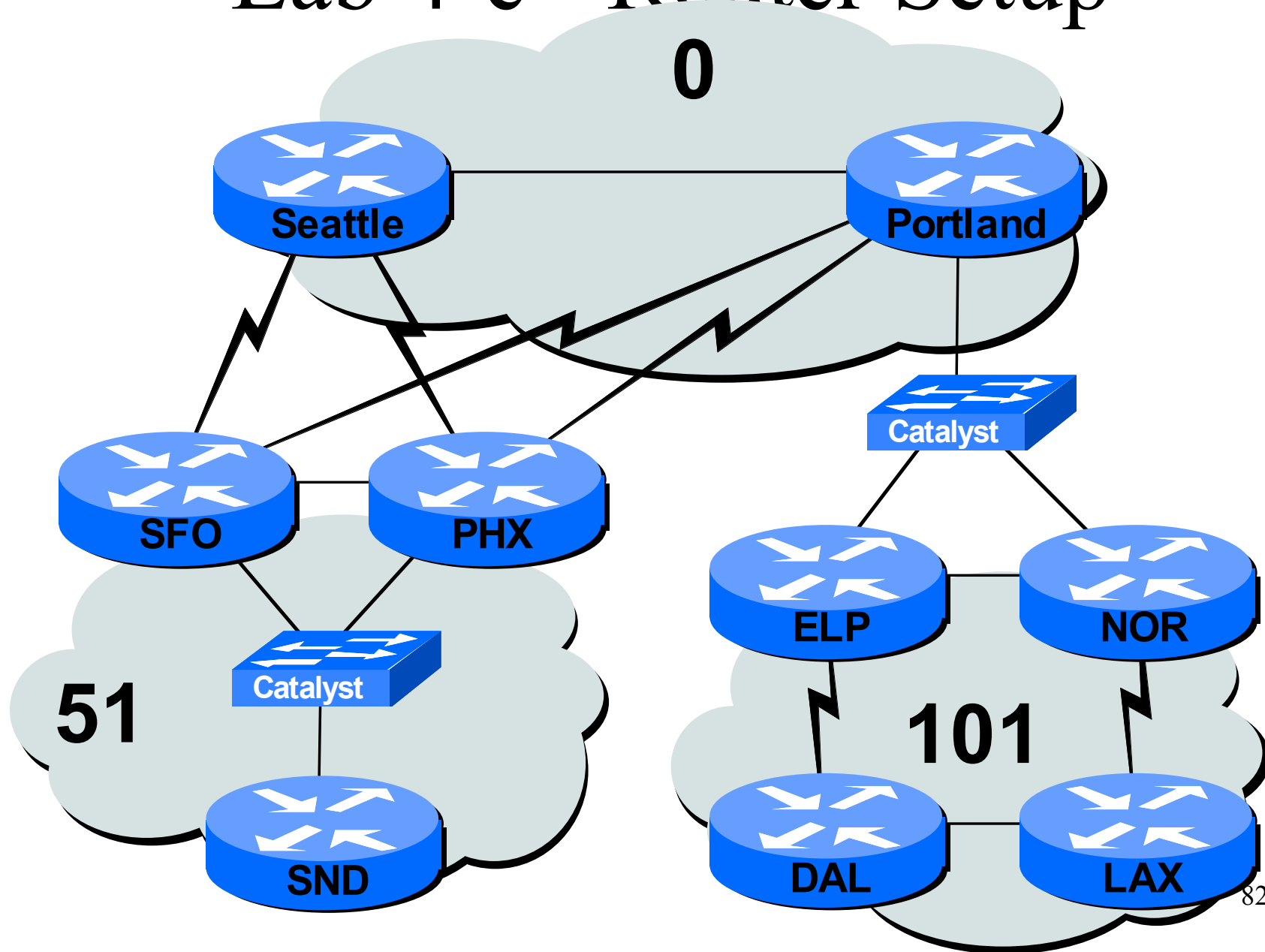
LAB 4e:
Design

Purpose:

  Understand the effects of multiple ABR's connecting Area 0 to Area X.

LAB 4-e: ABR Configuration

- **Purpose**
  - **Understand purpose of multiple ABR's**
- **Tasks**
  - Knock out redundant ABR
- **Configuration Commands used**

- **Commands used**
  - Show ip route

Lab 4-e - Router Setup

0

Seattle — Portland

51

SFO PHX
Catalyst
SND

101

Catalyst
ELP NOR
DAL LAX

82

Lab 4-e - Worksheet 1

- **Commands used**:
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____
  - _____ purpose _____

- **Output from**:
  - Show ip route: _____
  - Debug ip ospf: _____