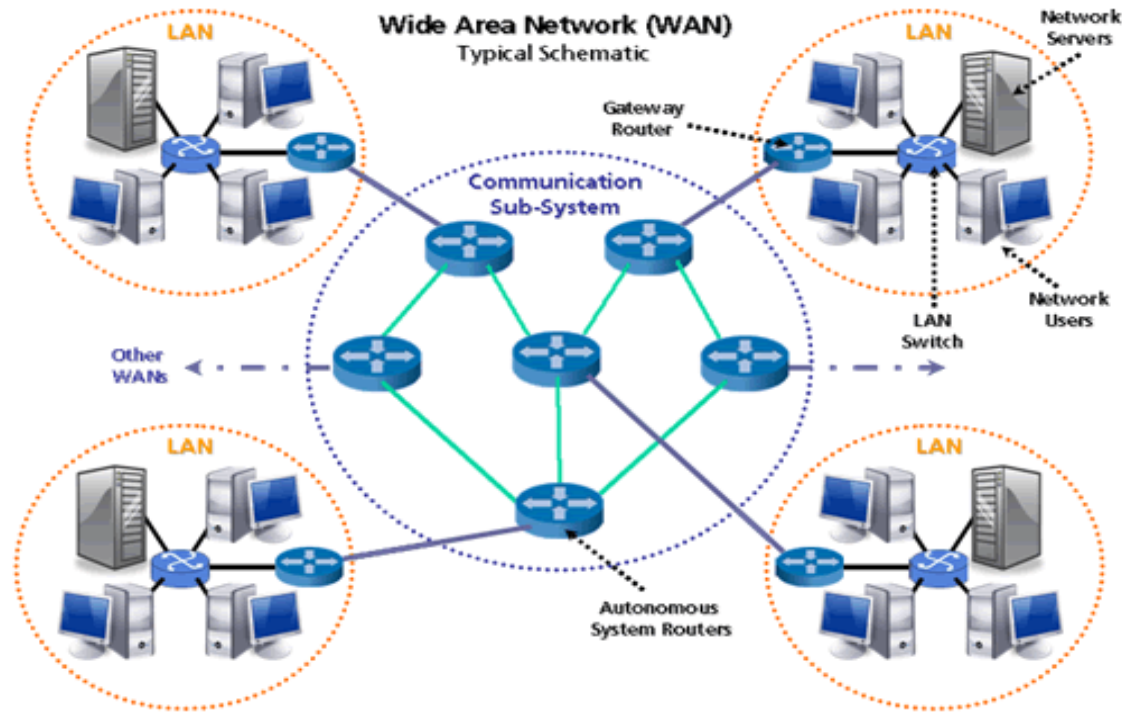# COSC 301
Network Management and Security

## Lecture 18: Interior Routing

Today's Focus

Interior Routing

-- Autonomous System

-- RIP

-- OSPF

Autonomous System

- The Internet does not consist of independent networks
  - Networks and routers are owned by organizations or individuals
  - Networks and routers owned by a given entity fall under a single administrative authority, which guarantees that internal routes remain consistent and viable.

- Autonomous System: a group of networks and routers controlled by a single administrative authority
  - Routers are free to choose their own mechanisms for discovering, validating, and checking consistency of routes
  - The Internet is divided into autonomous systems with each owned by a single administrative authority.
  - In the current Internet, each large ISP is an autonomous system.

Internet Routing
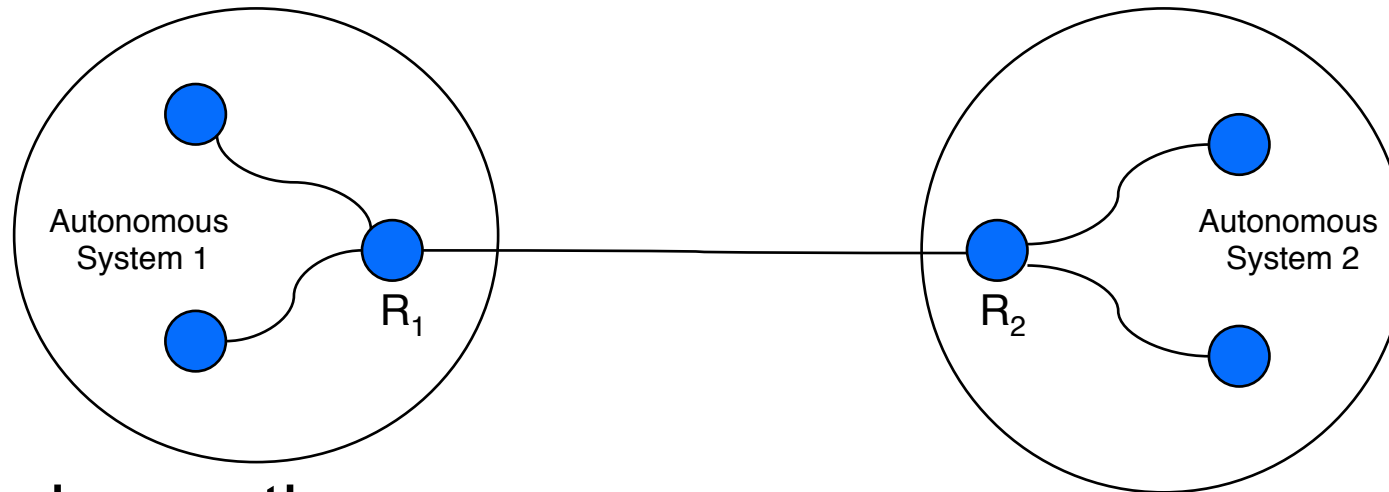
- Interior routing
  - Used within an autonomous system
  - Used within an area of administrative control
  - RIP, OSPF
- Exterior routing
  - Used between autonomous systems
  - Used to peer with networks without administrative control
  - BGP

Static vs. Dynamic

- ## Static routing

  - Advantage: simplicity, less software that might fail

  - Disadvantage: Limits on scalability, less resilience and load-balancing, slow response to handle problems

- ## Dynamic routing

  - Advantage: Scalable, optimal routes, automatic fail-over and fail-back, load balancing

  - Disadvantage: route update consumes bandwidth, additional load on router CPU

Routing Information Protocol (RIP)

- ## Early, easy, and common
  - Still used today in SOHO network
  - Set and forget; few knobs

- ## Straightforward implementation of Distance Vector algorithm
  - Routing by rumour/gossip
  - Alternative routes are not kept
  - Metric is hop-count, and metric of 16 indicates unreachability
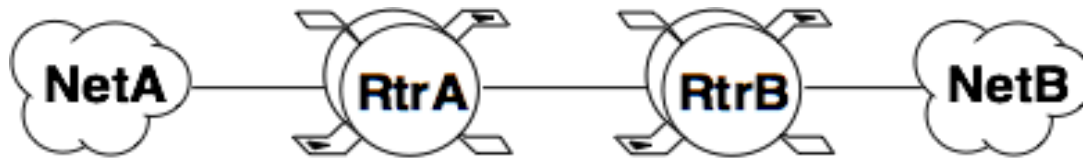
RIP Metric

Network with Fast Ethernet links between
A-B and B-C, and a 802.11g backup link A-C

What is RIP's next hop for A to C?

802.11g (<54Mbps)

FE (100Mbps)

FE (100Mbps)

C

A   B
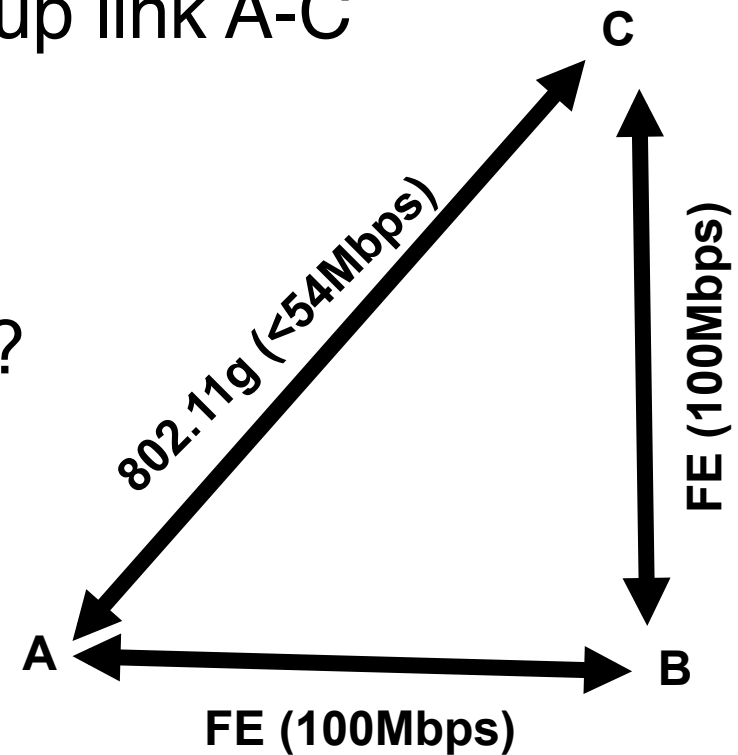
RIP Limitations (1)

- No Variable Length Subnet Masks support
  - e.g. /28, but is supported in RIPv2
- Slow convergence
  - Full advertisements broadcast every 30s
  - Count-to-Infinity

- **RtrA** loses connection to **NetA**

- Before **RtrA** sends update (of break), **RtrB** sends full update, advertising **NetA** at a cost of 1

- **RtrA** now thinks it can get to **NetA** via **RtrB** at a cost of 1+1=2 hops

- **RtrA** advertises this to **RtrB**, which sees an increased cost. **RtrB** advertises 2+1 = 3, continues to 16 (infinity/unreachability)

RIP Limitations (2)

- Limited diameter of network (15 hops)
- Only metric is hop-count
  - poor support for heterogeneous networks
- Advertisements not authenticated (v1)
  - attacking the network made very easy

RIP is okay when …

- Small network or minimal IT support
- Homogeneous network
  - With respect to link speed
- Convergence time is acceptable

RIP Optimizations

- ## Split Horizon
  - prevent a router from advertising a route back onto the interface from which it was learned.

- ## Hold Down Timer
  - upon failure, hold the route as down until the network has converged, to expire old information

- ## Poison Reverse
  - Route can be deleted due to split horizon or route timeout.
  - A router actively advertises routes as unreachable over the interface over which they were learned

- ## Triggered Update
  - send updates as soon as something changes about a route's metric or state
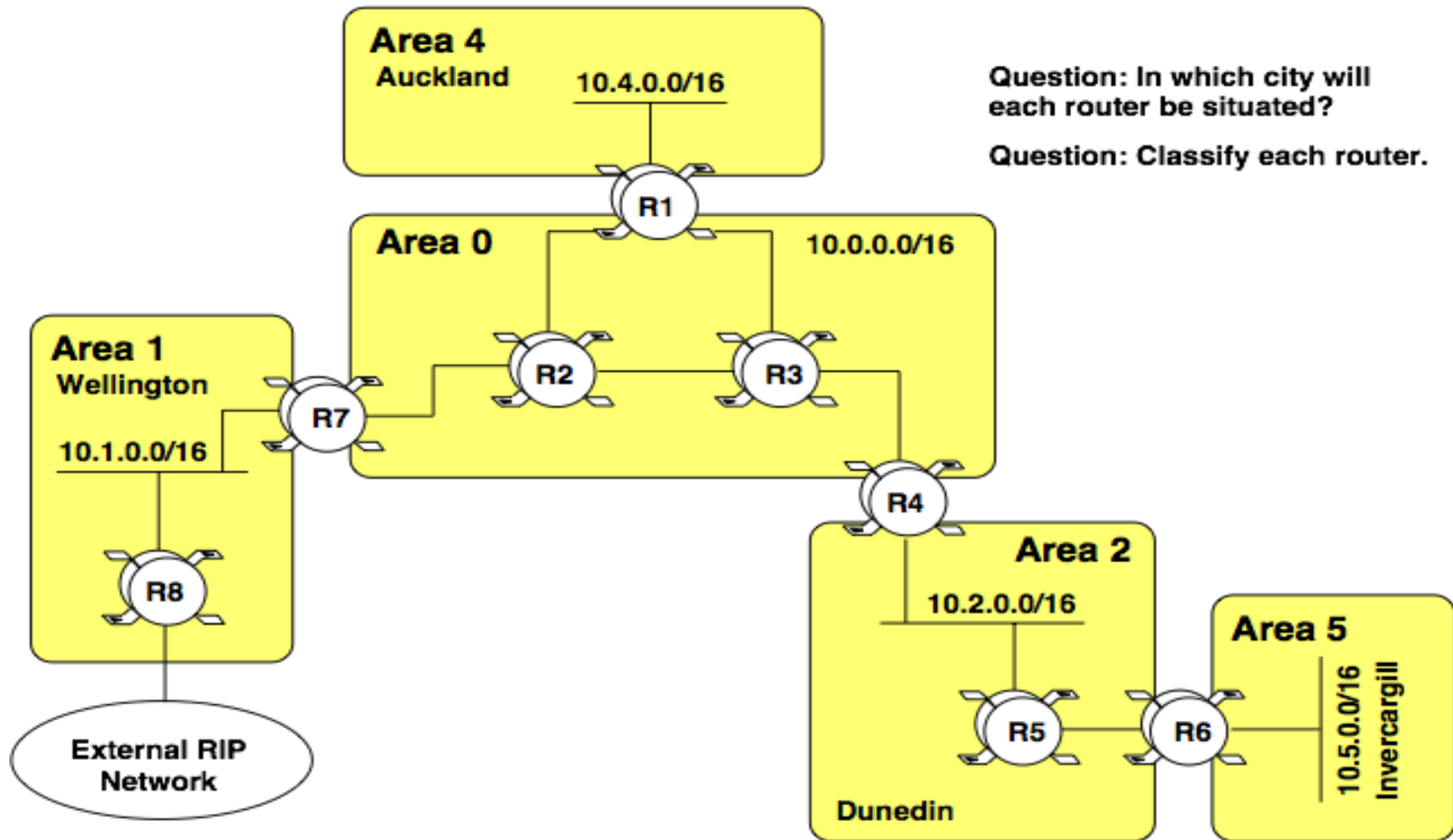
Link State vs. Distance Vector

- ## Distance Vector
  - routing by rumour
  - unaware of topology
  - distributed Bellman-Ford algorithm

- ## Link State
  - multicast local link states to all routers
  - each router then assembles topology
  - Dijkstra's algorithm
  - higher memory and processor requirements

OSPF

- Open Shortest Path First
  - Link State protocol

- Break AS into smaller areas
  - simplifying calculation requirements
  - routes summarised crossing areas

- Areas attached to backbone
  - area 0 is backbone area

OSPF

Area 4
Auckland   10.4.0.0/16

Question: In which city will each router be situated?

Question: Classify each router.

R1

Area 0   10.0.0.0/16

R2   R3

Area 1
Wellington

R7

10.1.0.0/16

R8

R4

Area 2

10.2.0.0/16

Area 5

External RIP
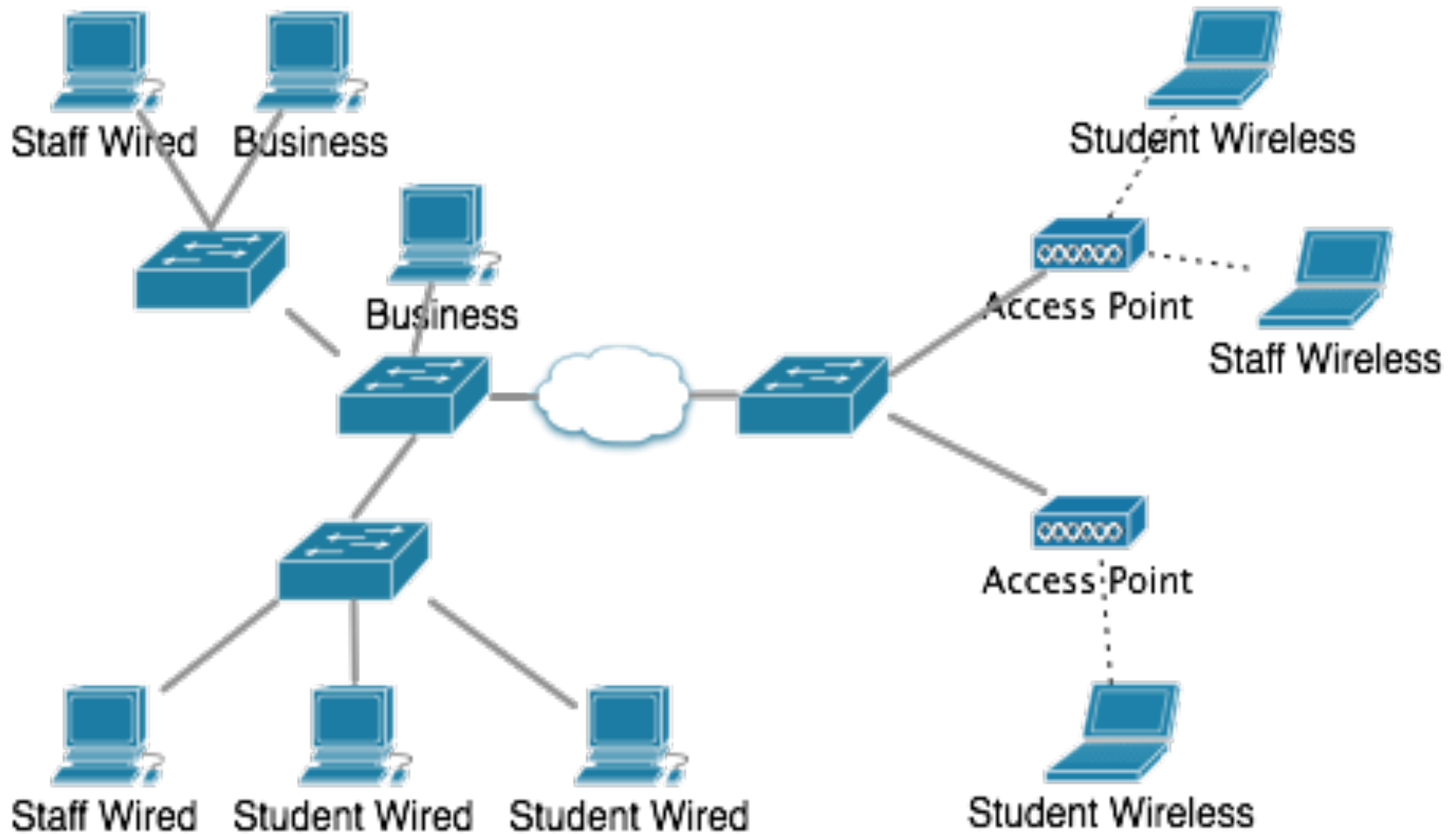Network

R5   R6

10.5.0.0/16 Invercargill

Dunedin

Virtual LANs

- A local area network configured by software, not by physical wiring
  - Virtually connecting devices in different physical LANs

- IEEE802.1Q
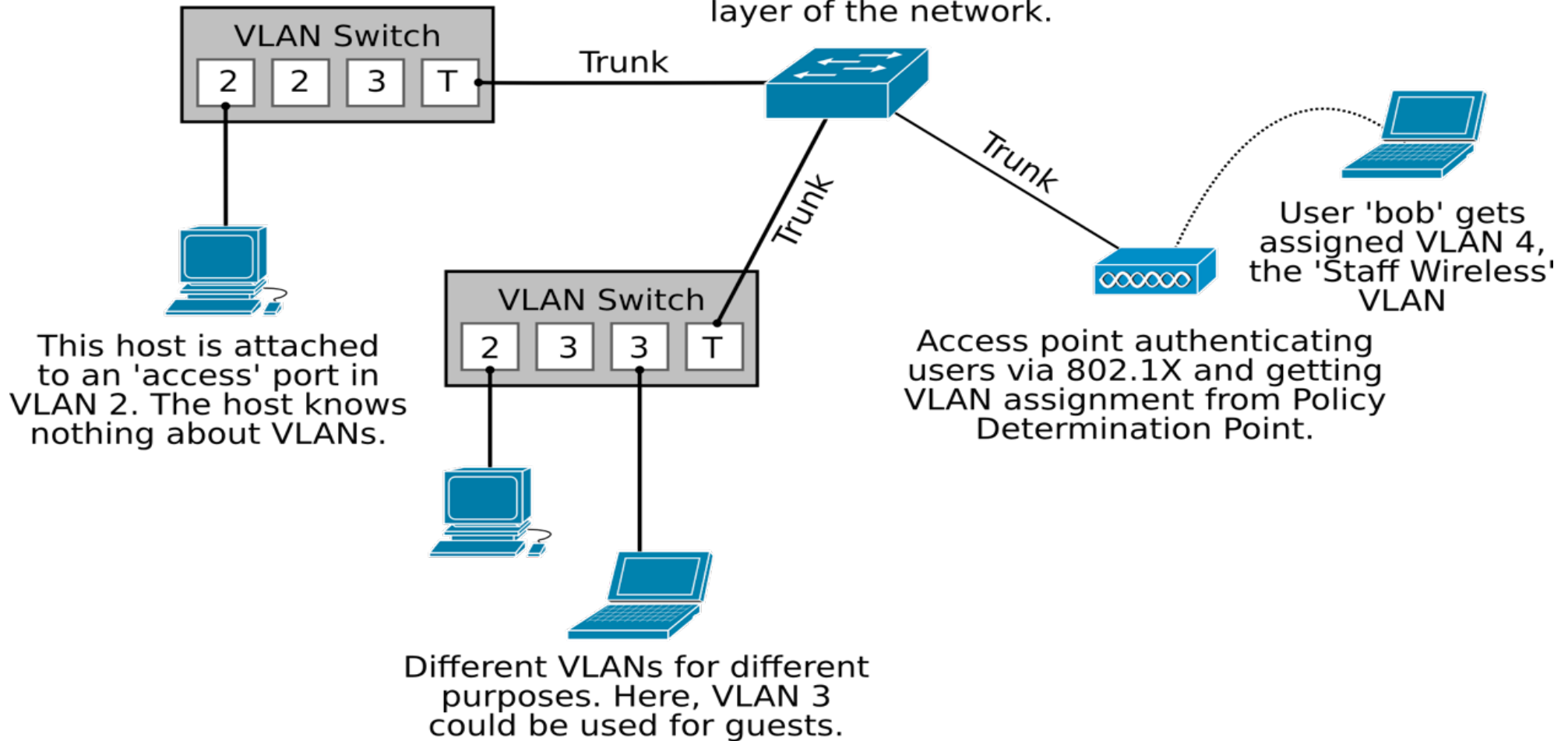 - The protocol most commonly used today to configure VLANs

VLAN Motivations

Port Assignments

Most switch ports will be assigned manually by the network admin.

Traffic on trunking links are tagged with the appropriate VLAN. The tags are not seen by the hosts in the access layer of the network.

VLAN Switch

| 2 | 2 | 3 | T |

Trunk

This host is attached to an 'access' port in VLAN 2. The host knows nothing about VLANs.

Trunk

Trunk

VLAN Switch

| 2 | 3 | 3 | T |

Different VLANs for different purposes. Here, VLAN 3 could be used for guests.

User 'bob' gets assigned VLAN 4, the 'Staff Wireless' VLAN

Access point authenticating users via 802.1X and getting VLAN assignment from Policy Determination Point.

Summary

- Autonomous system
- Internal routing protocols: RIP and OSPF
- VLAN