ชื่อ-สกุล [illegible] กระดาษแผ่นที่ 1 รหัสนักศึกษา [illegible]

for Staples

	Application
	Presentation
Data	Session
Segment	Transport
Packet	Network
Frame	Data link
Bits	Physical

Application	HTTP
Transport	TCP , UDP
Internet	IP
Network Access	ARP , PPP

for DCE | router(config)# clock rate 56000

user mode > enable

priviledge mode # configure terminal

global mode (config)#

erase startup-config // ลบ startup-config

reload // รีเทเทอร์

copy running-config startup config // save config

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router(config)# interface serial 0/0 เข้าไปเพื่อตั้งค่า interface

router (config-if)# ip address xxxx yyyy

ROM	POST	Perform POST
ROM	Boostrap	Load Boostrap
Flash TFTP server	Cisco IOS	Locate and Load IOS
NVRAM TFTP server console	Config	Locate and Load config file

Packet Forwarding Method

- Process switching
- Fast switching
- Cisco Express Forwarding

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Dynamic routing
- IGP
  - Distance: RIP, RIPv2, IGRP, EIGRP
  - linkstate: IS-IS, OSPF
- EGP + BGP

convergence ค่าจุดเข้าในการสร้าง table ทั้งหมดของ Network

Metric : values for determine which route are better than others {Hopcount, Bandwidth, Cost, Delay, Load, Reliability}

load balancing ; distributing packet at same cost

administrative Distance : ใช้ค่านี้เลือก routing protocols ถ้ามีมากกว่า 2 protocol

Distance vector know 2 thing
- Dis to final Dest
- Vector or direction

charactoristic
- Periodic update
- Neighbor
- Broadcast update
- Entire routing table is plus routing update

comparative
- Time to convergence
- scalability
- Resource usage
- Implementation & Maintenance

Network Discovery
cold start : start up
Exchange Info Int
Exchange

S	AD
Directed	0
static	1
EIGRP	5
IGRP	100
OSPF	110
RIP	120

RIP updated Timer (default 30)

Invalid Timer 180

Holddown timer 180

Flush timer 240

triggered update : less bandwidth

Bounded Update : EIGRP

Random Jitter

Routing loop Problem
- Count to Infinity
  - setting a maximum
- Prevent with holddown timer
- Split Horizon Rule
  ไม่ส่ง update ไปที่ที่ Interface ที่ส่ง update มา
- Route Poisoning
  ส่ง update บอกว่า route นี้ไปไม่ได้
- Split horizon + poison reverse
- IP & TTL

RIP v.1
- classful
- Metric ; hop count
- > 15 unreachable
- 30s update

Command 1 or 2	Version	Must be zero
Address family		Must be zero
IP address		
zer		
zer		
Metric		

RIP operation
- 2 type : request , respond

Trouble shooting cmd
show running config | show ip route
show ip protocols | debug ip rip

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passive interface cmd
(prevent router from sending update)
R(config-Router)# passive-interface type number

Difference between RIPv1 & RIPv2

RIPv1
- classful
- not support discontiguous subnet
- not support VLSM
- not send subnet mask
- Routing update are broadcast

RIPv2
- classless (CIDR - RFC 1517)
- next hop address is included
- Routing update are multicast
- authentication is optional
- Support VLSM
- Support Route Summarization (Prefix Aggregation)

RIPv1 limitation
- Loopback Interface : Virtual interface can ping and route
- Null interface : will serve as exit interface for static route
- Route redistribution : to disseminate a static route from one router to another
  R2(config-router)# redistribute static
- Verify and testing command
  - show ip interface brief , ping , traceroute
- to examine the content of routing update
  - debug ip rip

RIPv2

0 — 7, 8	— 15, 16	— 23, 24 — 31
Command = 1, 2	Version	Must be zero
Address family indentifier		Route tag
IP address		
Subnet mask		
Next Hop		
metric (Hops)		
Multiple Route Entry , up to 25		

Configuring RIPv2
R1(config)# router rip
R1(config-router)# version 2

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command to verify RIPv2 operation
- show ip interfaces brief
- show ip protocol
- debug ip rip
- show ip route

trouble shooting RIPv2
- check version
- Network statements
  - may be incorrectly typed
- Automatic summarization

OSPF link-state Routing protocol

- have complete map of network topology
- using identical map of network
- used link-state information to create topology
- apply dijkstra algorithm

link-state protocol work best in
- the network design is large hierarchical
- need fast convergence
- the admin have good knowledge

SPF = shortest path First

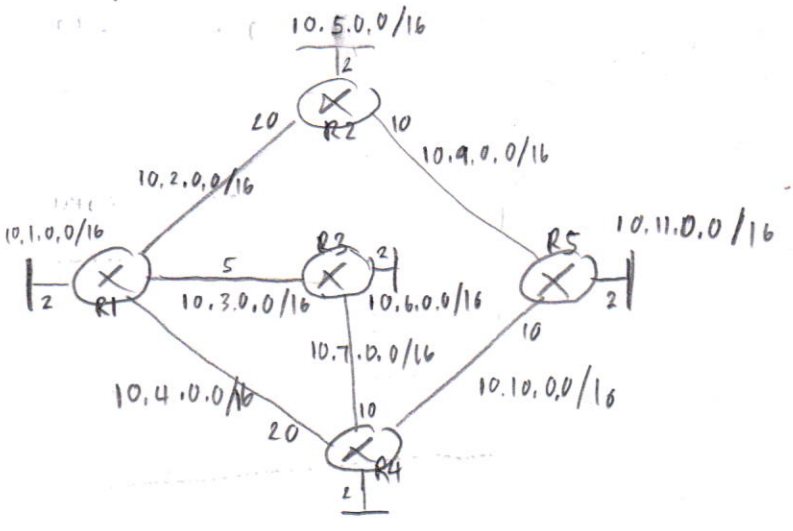
link-state Update
- Each router learn about of it's own directly connected networks.
- Each router is responsible for 'say hello' to it's neighbor
- each router build a link-state packet (LSP) containing the state of each directly connected link
- each router flood the LSP to all neighbor who then store all LSP's received in database
- each router use the database to construct a complete map of topology and compute the best path to each dest

OSPF data structure

Database	Table	Description
Adjacency Database	Neighbor Table	- list of all neighbor router - show ip ospf neighbor
link-state Database (LSDB)	Topology Table	- list info about other router in network - shows network topology - show ip ospf database
Forwarding Database	Routing Table	- list of route generated when algorithm is run - show ip route

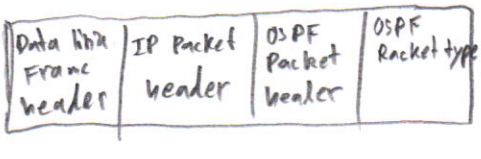
Link & Link-State
Say hello
Building the link-state Packet
Flooding LSP & Building database
Building the SPF tree and routing table

example



Destination	shortest path	Cost
10.5.0.0/16	R1 → R2	22
10.6.0.0/16	R1 → R3	7
10.7.0.0/16	R1 → R3	15
10.8.0.0/16	R1 → R3 → R4	17
10.9.0.0/16	R1 → R2	30
10.10.0.0/16	R1 → R3 → R4	25
10.11.0.0/16	R1 → R3 → R4 → R5	27

OSPF messages



OSPF Packet description

Type	Packet Name	Description
1	Hello	Discover neighbor and build adjacencie
2	Database description	check for database synchronization
3	link-state Request	Request specific link-state record
4	link-state Update	send specific requested link-state record
5	link-state Ack	Ack the other packet type

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ACL ops
- the last statement is alway implicit deny

standard vs extended

- check source add
- permit or deny entire protocol

- check source and dest add
- permit or deny specific protocol

Numbered ACL
you assign a number based on which protocol you want filtered
(1 to 99) and (1300 and 1999) : standard
(100 to 199) and (2000 to 2699) : extended

Named ACL
- Names can contain alphanumeric char
- suggested CAPITAL
- NO space or punctuation
- You can add or del entries within ACL

wildcard

128	64	32	16	8	4	2	1	
0	0	0	0	0	0	0	0	match all
0	0	1	1	1	1	1	1	Ignore last 6 Address Bits
1	1	1	1	1	1	0	0	Ignore first 6 Address Bits
1	1	1	1	1	1	1	1	Ignore all bit

the three Ps
- One ACL per protocol, direction, interface

Guideline
- Use ACL in firewall routers positioned between your internal network and external network such as internet
- Use ACL on a routers positioned between two part of your network to control traffic entering or exiting a specific part of network
- configure ACL on border routers, that is routers situated at the edge of your networks
- configure ACL for each network protocol configure on the border router interface

where to place ACL
Extended : close to source
standard : close to destination

standard ACL cmd

Router(config)# access-list access-list-number deny|permit|remark source [source-wildcard] [log]

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Apply ACL to interface
Router(config-if) ip access-group {access-list-number | access-list-name} {in | out}

Extended ACL filter on :
- source
- destination
- Protocol
- Port

Configure extended IPv4 ACL cmd

access-list access-list-number {deny | permit | remark} protocol source [source-wildcard] [operator operand] [port port-number or name] destination [destination-wildcard] [operator operand] [port port-number or name] [established]

example

access-list 103 permit tcp 192.168.10.0 0.0.0.255 any eq 80
access-list 103 permit tcp 192.168.10.0 0.0.0.255 any eq 443

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OSPF operation

- Down state
- Init state
- two-way state

(establish Neighbor Adjacencie)

- exstart state
- Exchange state
- loading state

(Synchronize OSPF Database)

- Full state

OSPF cost

cost = reference bandwidth / interface bandwidth

example

Serial 1.544 Mbps	100,000,000 ÷ 1,544,000 = 64
Serial 128 Kbps	100,000,000 ÷ 128,000 = 781
Serial	100,000,000 ÷ 64,000 = 1562

Protocol		Port
FTP	TCP	20/21
SSH	TCP	22
Telnet	TCP	23
SMTP	TCP	25
DNS	UDP/TCP	53
DHCP	UDP	67/68
TFTP	UDP	69
HTTP	TCP	80
POP	TCP	110
HTTPS	TCP	443

DHCP: Dynamic Host configuration Protocol

use three different allocation method

- Manual admin assign a preallocated to IPV4 address
- Automatic
- Dynamic

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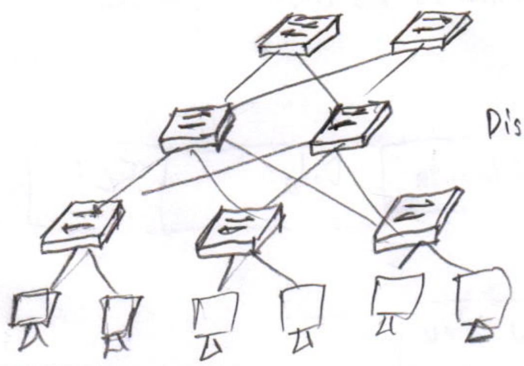
Access layer switch Feature



switch ทำงานบน layer 2
router ทำงานบน layer 3

ต้องเลือก switch อย่างไร
- cost ราคา
- port density จำนวน
- power ค่าไฟ ใช้เครื่องอื่นได้หรือไม่
- reliability ต้องเชื่อมต่อได้ตลอดเวลา
- port speed ความเร็วของ port gig หรือ Fast
- Frame buffer บัฟเฟอร์ ใช้ป้องกัน congestion
- scalability สามารถขยายต่อได้

MDF : Main Distribution Facility
IDF : Intermediate Distribution Facility
VCC : Vertical cross-connect
HCC : Horizontal cross-connect

ARP : Address Resolution Protocol
CIDR : classless Inter domain Routing

for Staples

segmentation : แบ่งย่อย collision domain
broadcast domain : set of device that receive a broadcast data frame

switch operation : Learning | Aging | Flooding | Forwarding | Filtering

Jeff Doyle
receive Frame
↓
learn address or refresh aging timer
↓
Is destination broadcast, multicast, unkown
no ↓ ↘ yes Flood packet
Are source and destination same interface
↓ ↘ yes Filte packet
Forward unicast to correct port

switch Forwarding method
1. Store and Forward switching - slower forwarding
รับเฟรมมาทั้งหมดก่อน แล้วค่อยส่งต่อ
2. cut Through switching - No FCS check
รับมาอย่างน้อย ip ของ destination แล้วส่งต่อเลย - No Automatic buffer

Switching domain
Collision domain ; segment where device must compete to communicate
Broadcast domain : extend of the network where a broadcast frame can be heard

switch Boot sequence
- POST
- run boot loader software
- Boot loader does low-level CPU init
- Boot loder init flash filesystem
- Boot loder locate and load def IOS

Switch port Security
Secure MAC Address
- static : manually config
- Dynamic : dynamic learn and store in the table
- sticky : both dynamic and static store in table

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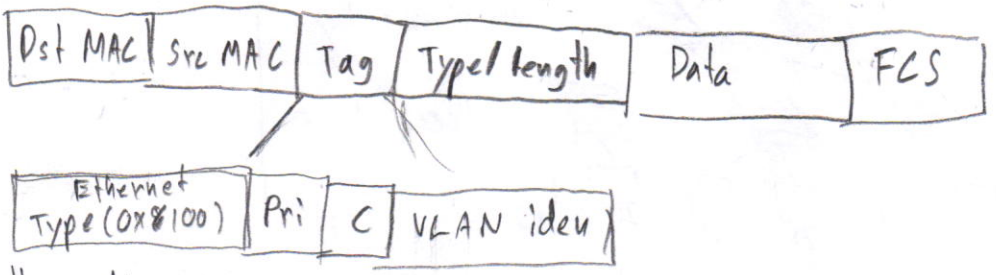
VLAN and Inter VLAN

ประโยชน์ของ VLAN
- Improved security
- Reduced cost
- Better Performance
- Smaller Broadcast Domain
- IT Efficiency
- Management Efficiency

VLAN Trunks : 802.1Q

VLAN is a broadcast domain of its own

802.1Q Frame

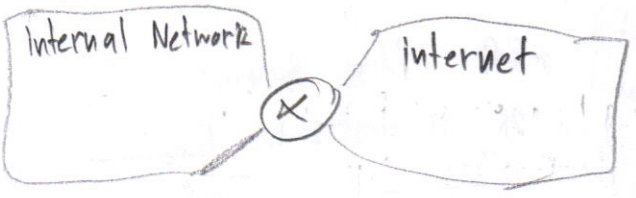


- A frame that belong to the native VLAN will not be tagged

VTP (VLAN Trunking Protocol)

VTP mode : Server, Client, Transparent

NAT operation



4 type
- Inside local
- Inside global
- Outside local
- Outsid global

Type of NAT (

- static : one-to-one mapping
  network admin can SSH to the server
- Dynamic : use pool of public add

- Port address Translation aka. NAT overload
  : using Port Number

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EIGRP : cisco-proprietary distance-vector routing protocol

Feature

Diffusing Update Algorithm (Dual) : used as its routing algorithm
: guarantee loop-free and back-up path

Establishing Neigbor Adjacencies : established relationship with directly connected
: adjacencies are used to track the status of these neighbors

Reliable Transport protocol : EIGRP provide delivery EIGRP packet to neighbor

Partial and Bounded update : sent partial triggered updated
: only those router that requir the information are updated

Equal and Unequal cost Load Balancing : support equal cost loud balancing an unequal
:

EIGRP use protocol-dependent module (PDM)

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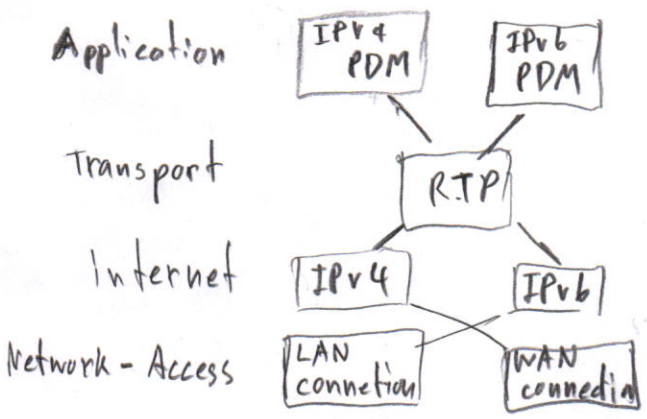

Packet Type

Hello	Discover other EIGRP router
Update	Convey routing infomation
Ack	Ack EIGRP packet
Query	request specific info
Reply	Respond to query

An Autonomous System (AS) is a collection of networks under the control of 1 Authority

EIGRP composit Metric = Bandwidth + Delay x 256

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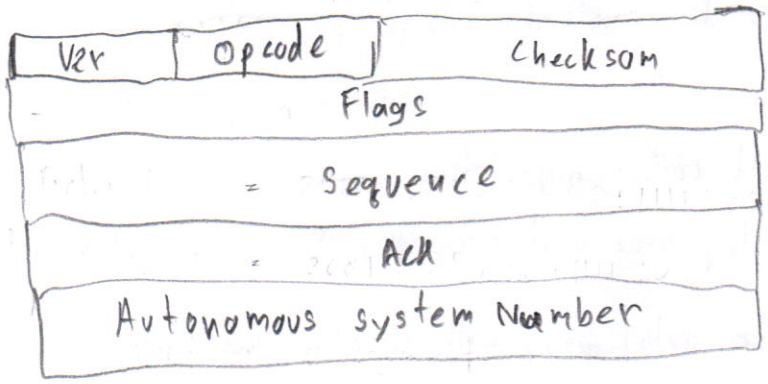
EIGRP Packet Header



TLV Types