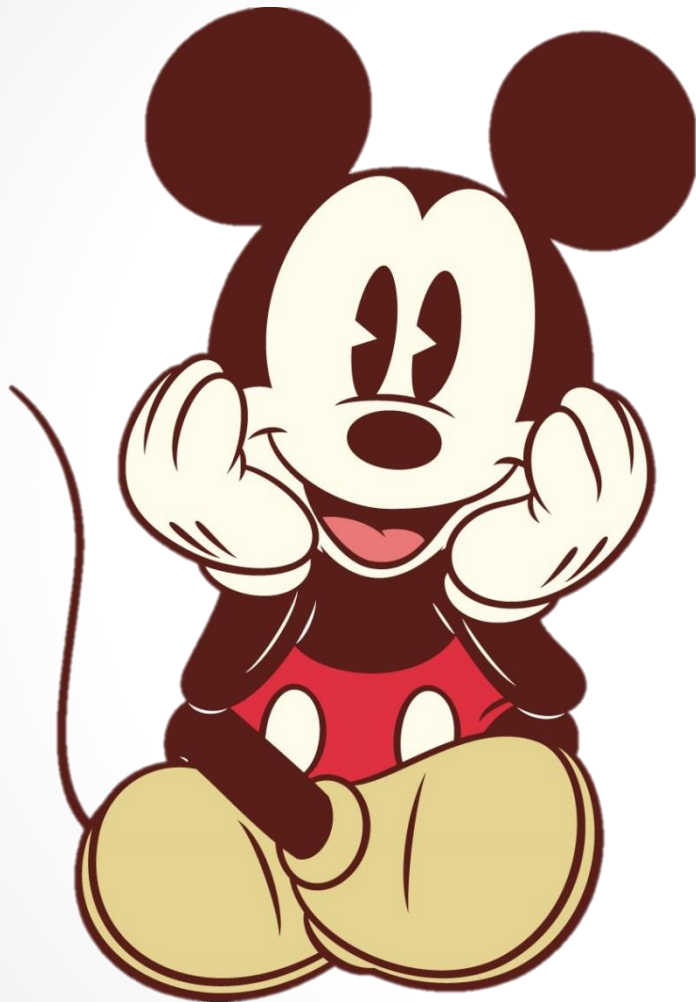


網管基本實務與能力

mickey@CNA



Mickey

米奇

米奇

Outline

- 宿網設備
 - switch & router
 - switch & router上的安全機制
- Switch & Router操作
 - 指令集
- case處理
 - 故障排除

宿網設備

Cisco

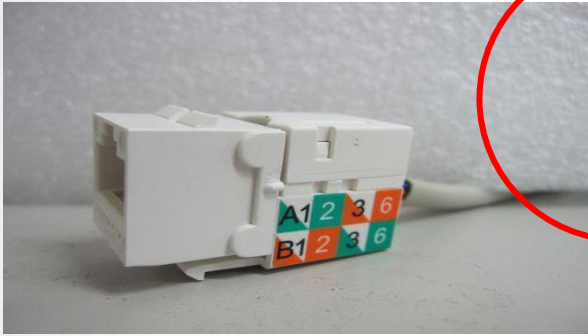
- 生產、研發網路設備的廠商
- 網路技術先進
- 全球主要骨幹網路、企業公司均採用

宿網架構

超市機房	•Cisco 6807
Router(各棟機房)	•Cisco 3750
Switch(各棟機房)	•Cisco 2960
Patch Panel	•機房集線板
Keystone	•寢室網路孔

網管負責範圍

Keystone & Patch panel



Switch

- Cisco Catalyst 2960 – L2 交換器



Fast Ethernet port

Gigabit Ethernet port
連接 switch or router

Router

- Cisco Catalyst 3750 – L3 交換器
 - 負責封包路由
 - 可鎖上ARP(IP-MAC)

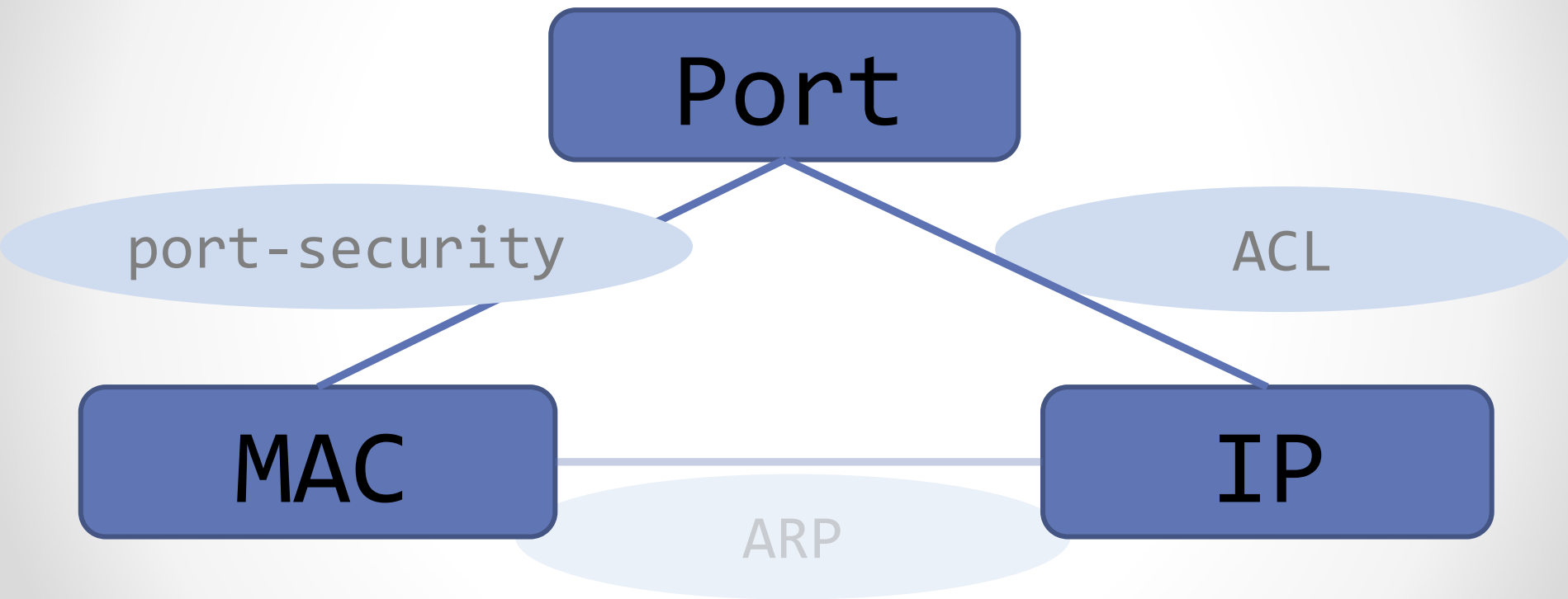


連接switch



連接光纖

宿網黃金三角



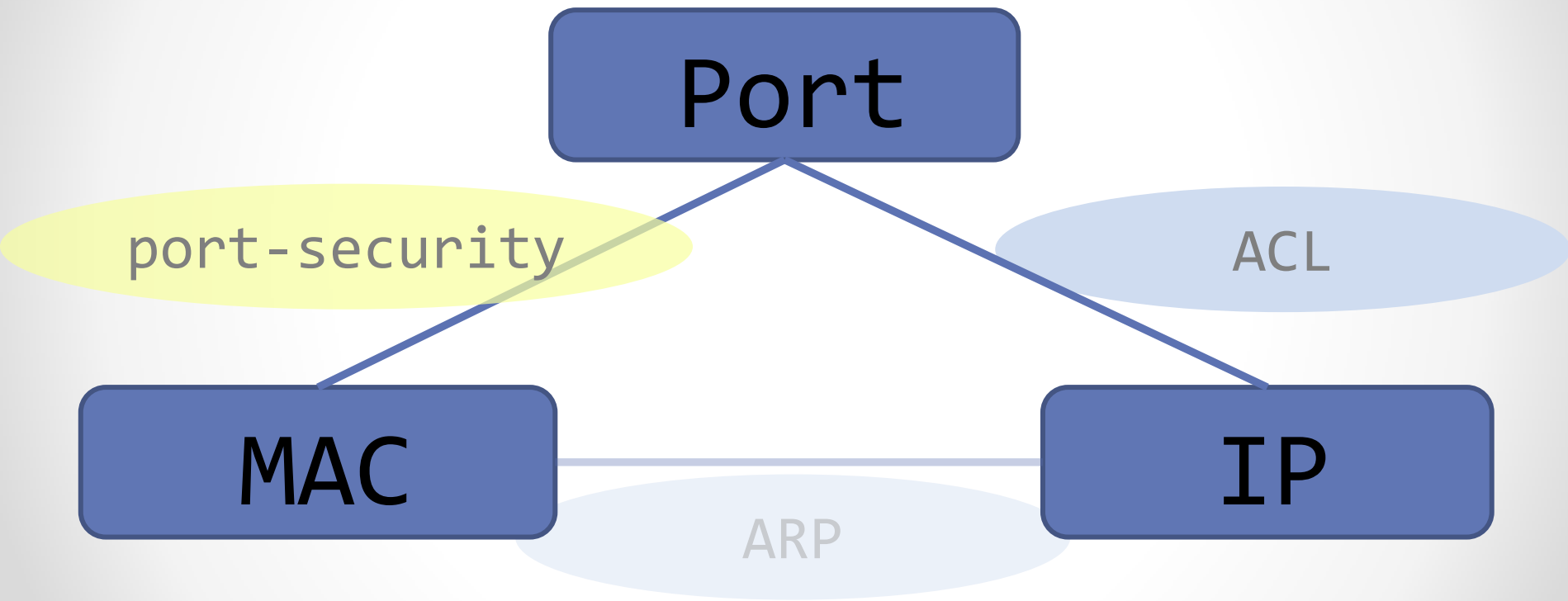
Switch安全機制

- Port-security -> 防止網路孔(port)被盜用
- ACL -> 限制通過的封包
- Dynamic ARP Inspection(DAI) -> 避免惡意攻擊
- DHCP snooping(嗅探) -> 紀錄ip資訊
- IP source guard -> 限制只能使用分配的ip
-

Switch port-security

- 偵測MAC位址是否符合port上設定的
- 防止網路孔遭到盜用
- MAC不符 -> 產生violation
 - 申請時填錯 or 差錯孔
- violation 處理方式
 - shutdown -> 直接把port關閉(預設)
 - **restrict** -> 丟棄封包，紀錄在log
 - protect -> 丟棄封包，不紀錄在log

宿網黃金三角



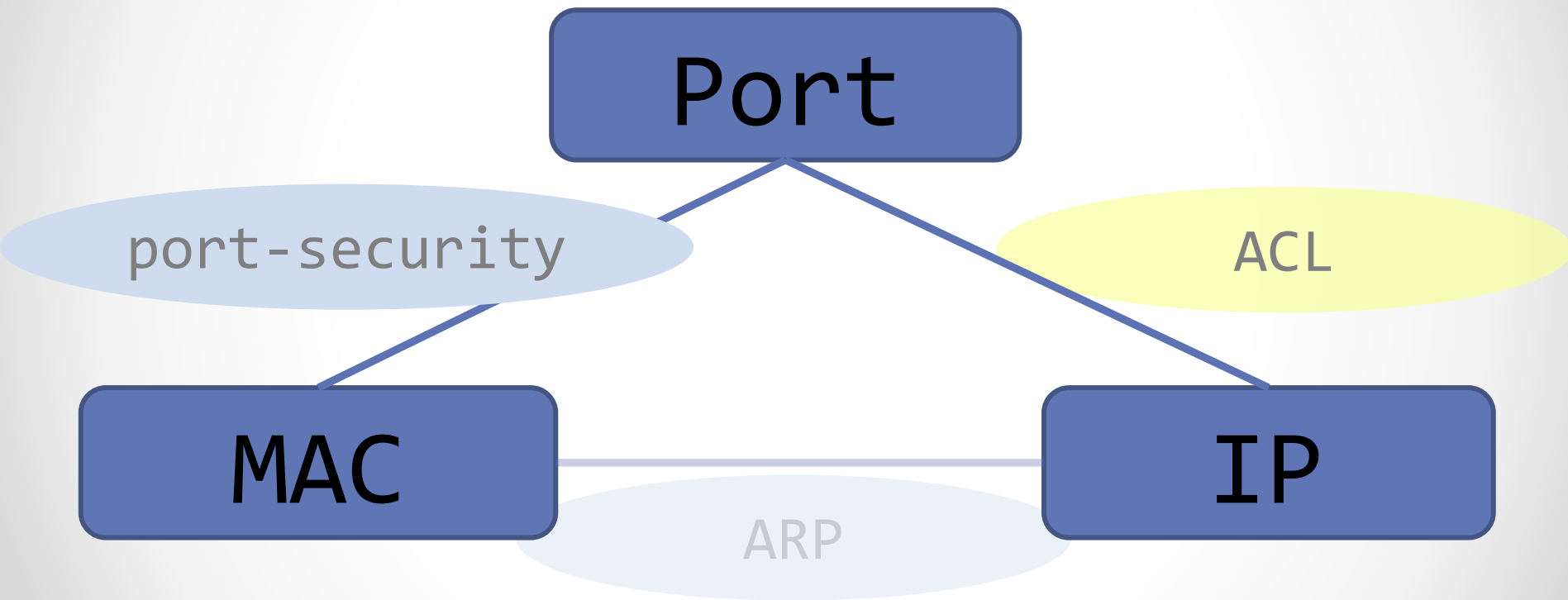
Switch err-disabled

- port-security(psecure-violation)
 - 卡號錯誤造成violation值不斷上升，達到上限
- link-flap
 - 網路不穩定，造成上下線頻繁(10秒內5次以上)
 - e.g. 爛線、keystone損毀
- bpduguard(偵測到bpdu封包)
 - 使用分享器、橋接器

Switch ACL

- Access Control List: 連線存取控制列表
- 限制port可通過的封包
 - permit(允許通過) or deny(不允許)
- 由上而下檢查，若符合就停止，若檢查到最後一項都不相符，則不允許通過
 - e.g. `permit ip host 140.123.1.2 any`
`permit ip host 140.123.1.3 any`

宿網黃金三角



Switch IP source guard

- 限制 IP 只能是宿網 DHCP server 發的
 - 防止盜用別人的 IP(手動設定IP)
 - 防止超流、中毒斷線仍能使用宿網
- 如果手動設定與DHCP server發的同一個IP？
- 檢查port上來的 IP 與 IP source binding table

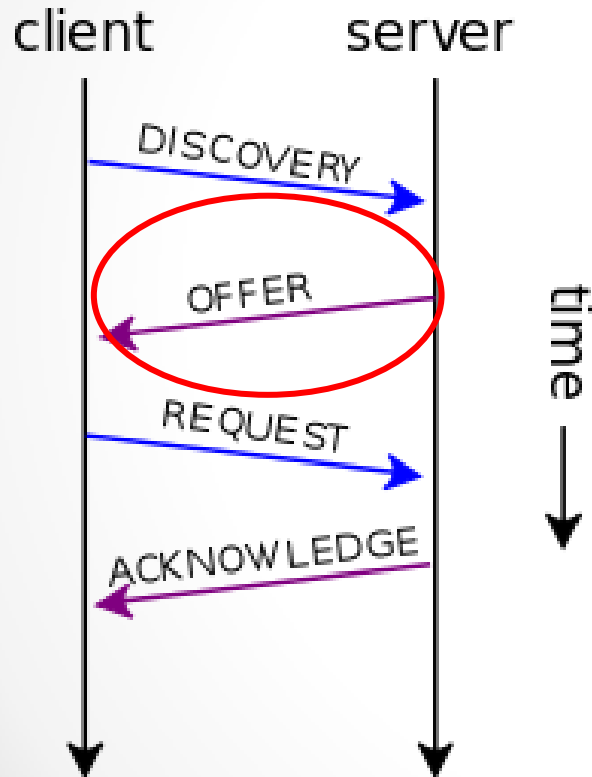
MAC	IP	port
aaaa.bbbb.cccc	140.123.10.3	5

IP source binding table
來自DHCP snooping binding table

Switch DHCP snooping

- 紀錄 DHCP server 分配 IP 紀錄 : MAC-IP-port
- 存在DHCP snooping binding table裡
- 提供資訊給IP source guard、DAI

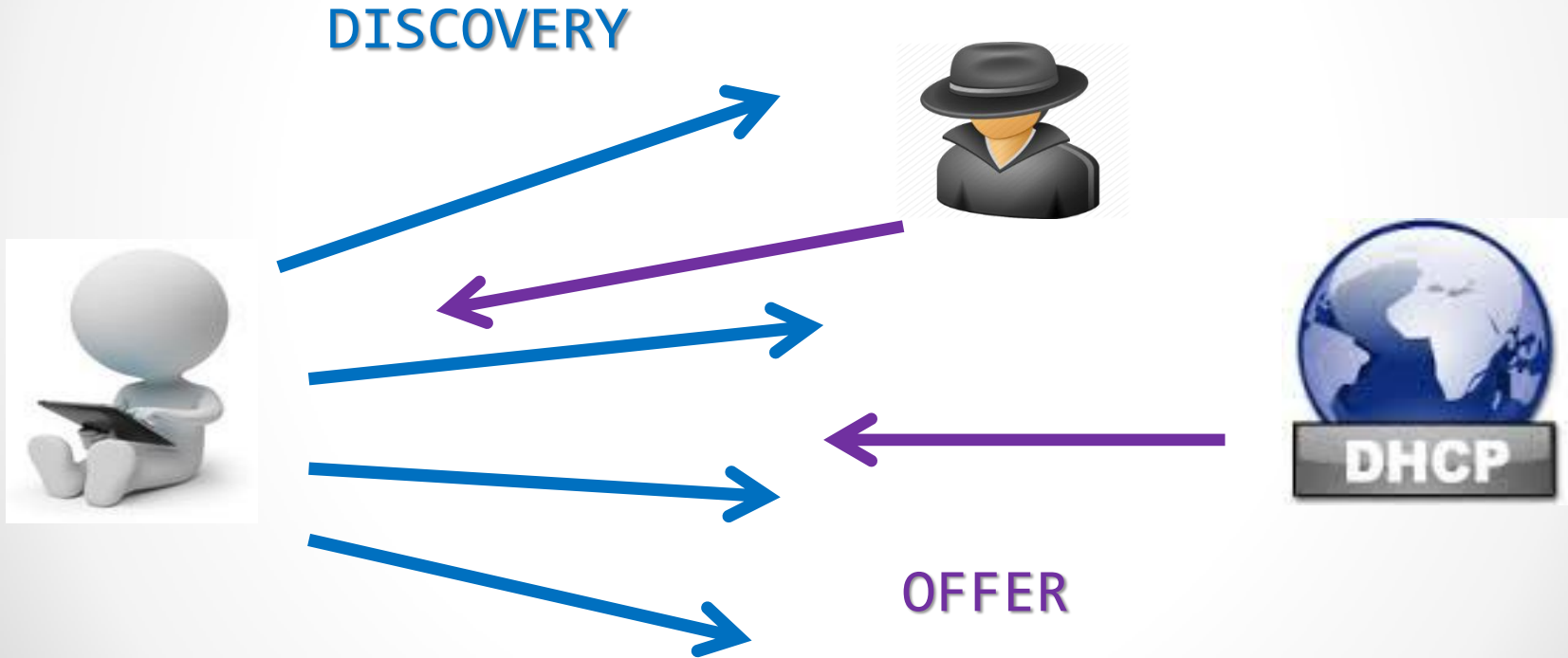
DHCP review



廣播 : DISCOVERY 、 REQUEST

單播 : OFFER 、 ACKNOWLEDGE

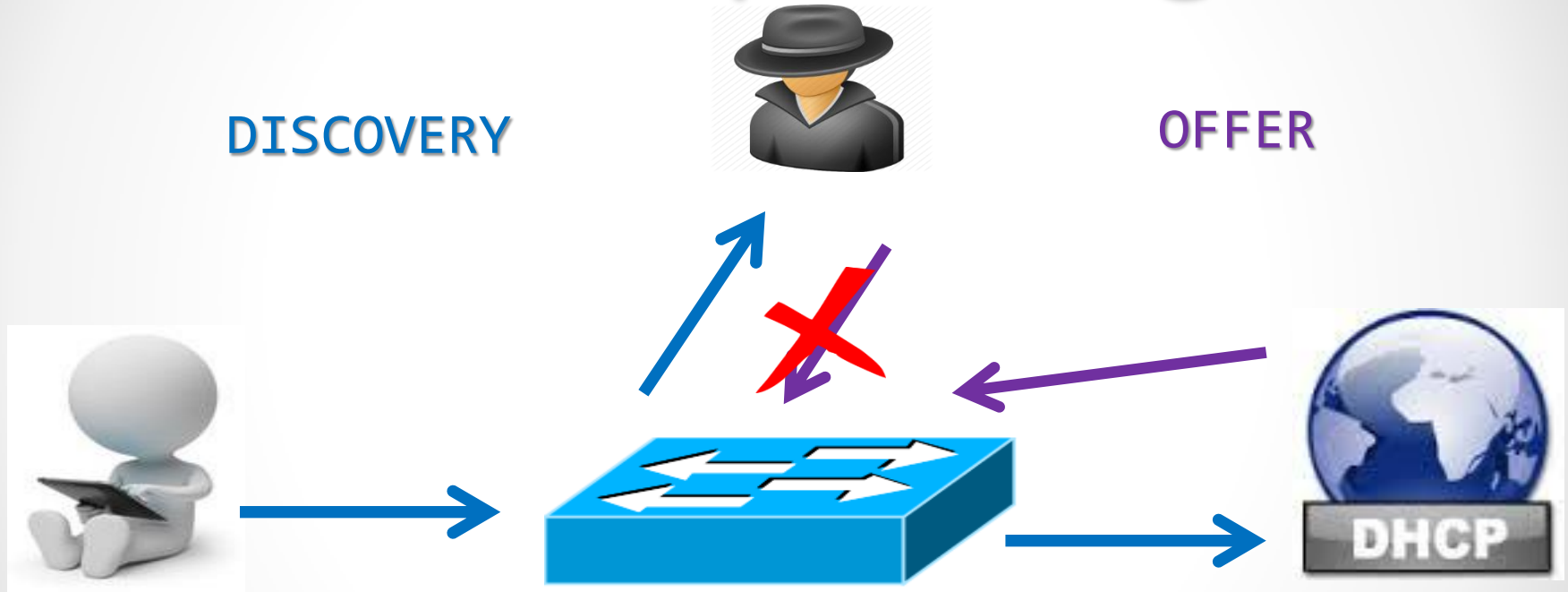
DHCP spoofing



DHCP spoofing

- 拿到假的DHCP server發出無效的IP，導致無法上網
- 防護機制：DHCP snooping
 - Switch uplink 介面設定成 trust
 - 其他設定成 untrust

DHCP spoofing

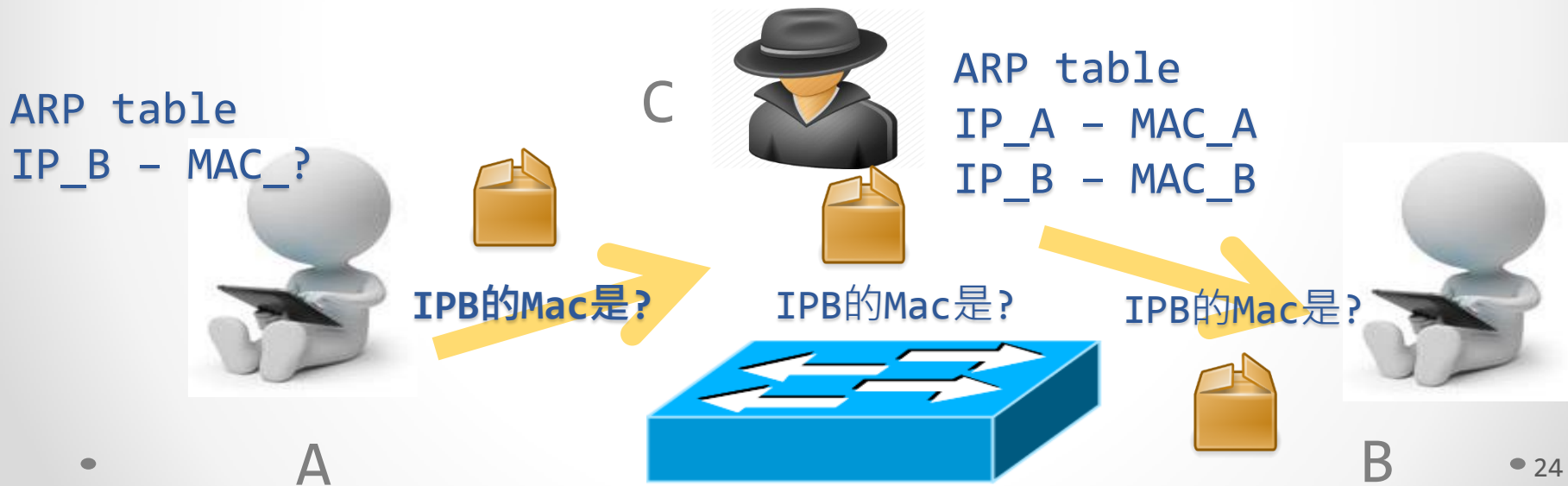


Switch DHCP snooping

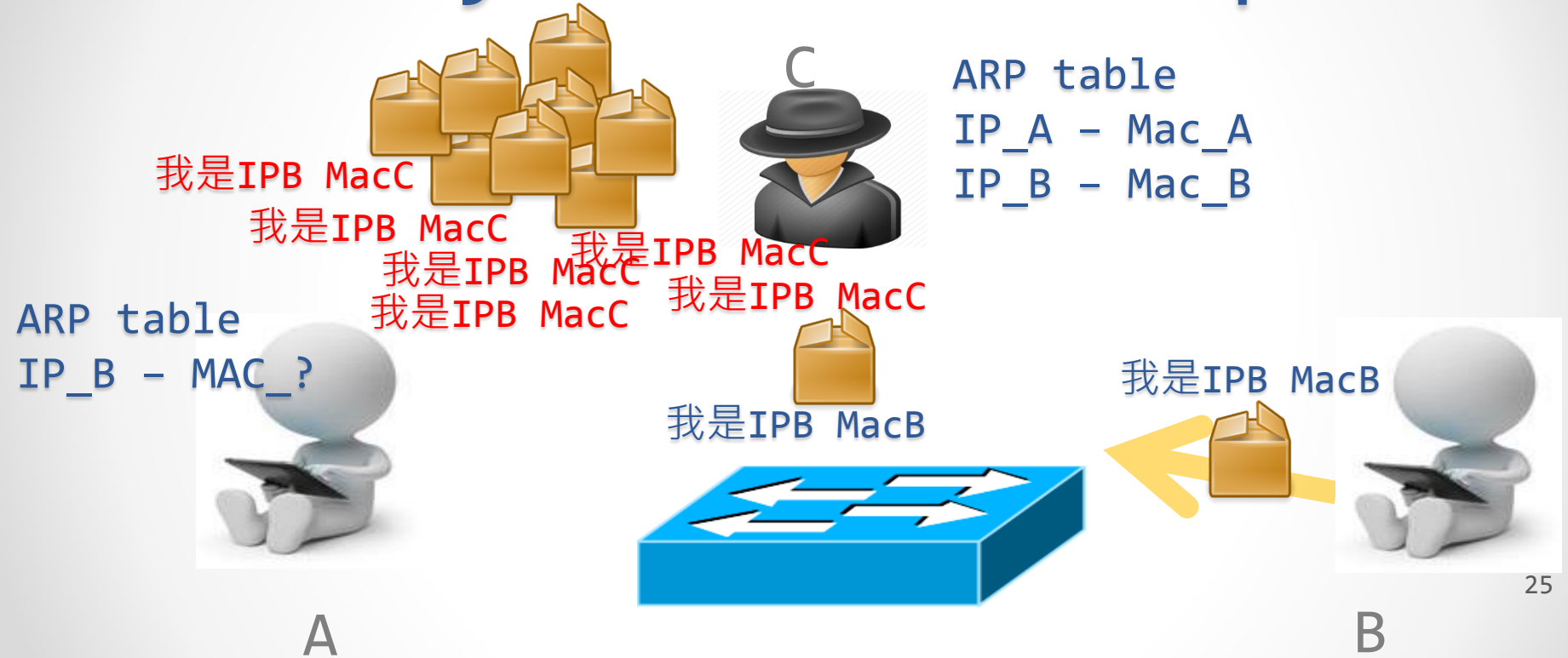
- 紀錄 DHCP server 分配 IP 紀錄 : MAC-IP-port
- 存在DHCP snooping binding table裡
- 提供資訊給IP source guard、DAI

Switch Dynamic ARP inspection

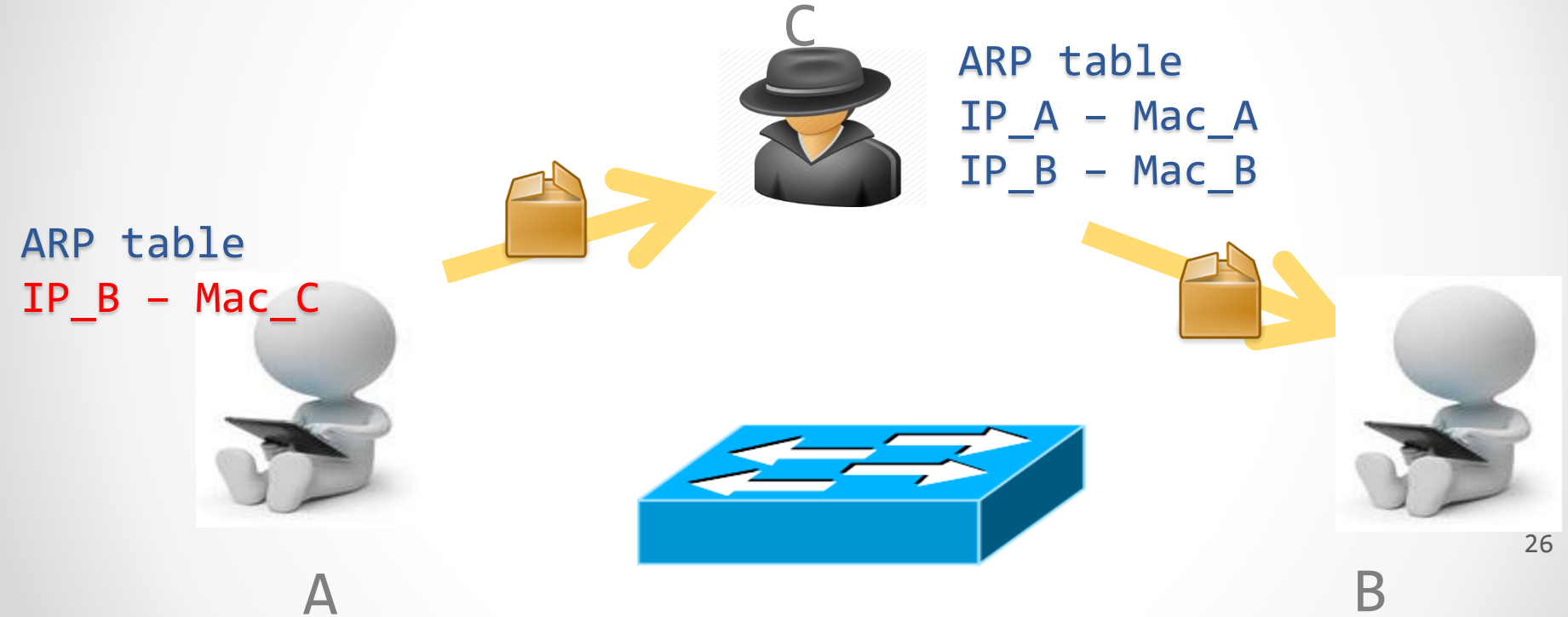
- 簡稱DAI
- 防止ARP spoofing(Man In The Middle)
 - 避免封包被撈走，資料外洩或遭修改



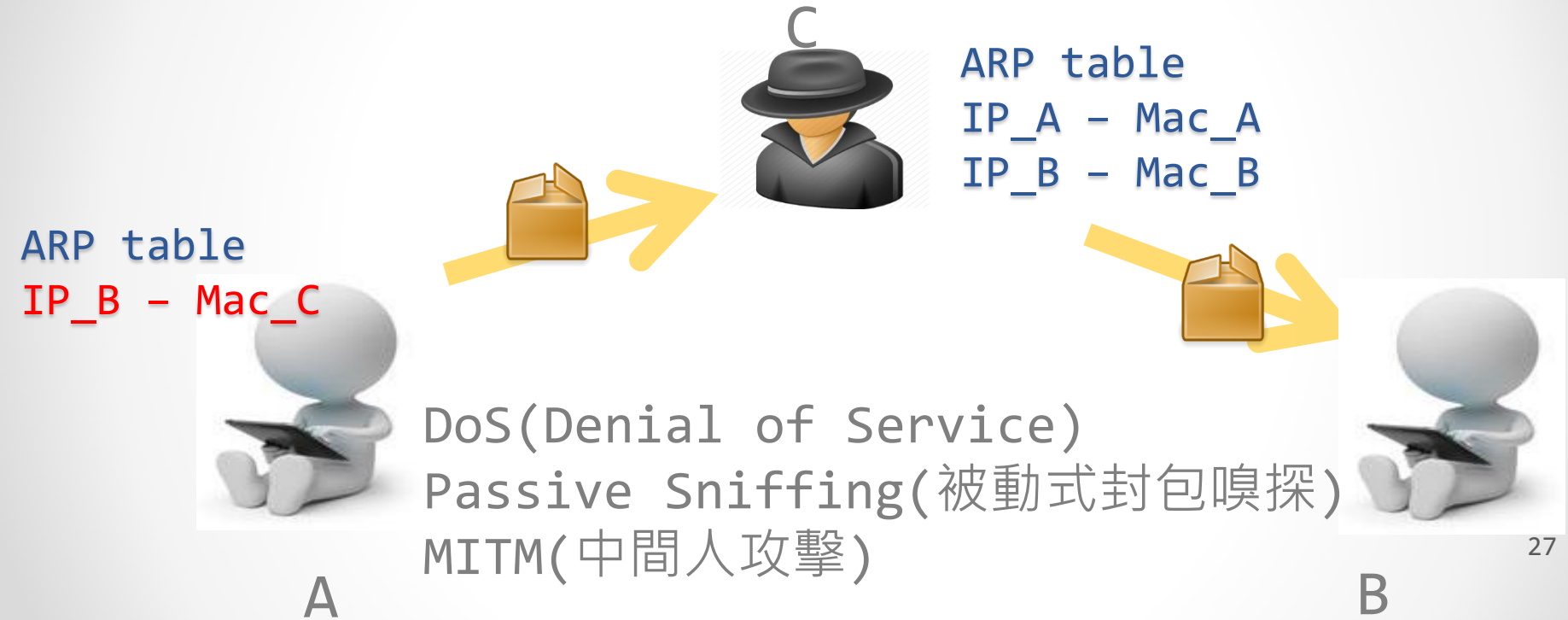
Switch Dynamic ARP inspection



Switch Dynamic ARP inspection



Switch Dynamic ARP inspection

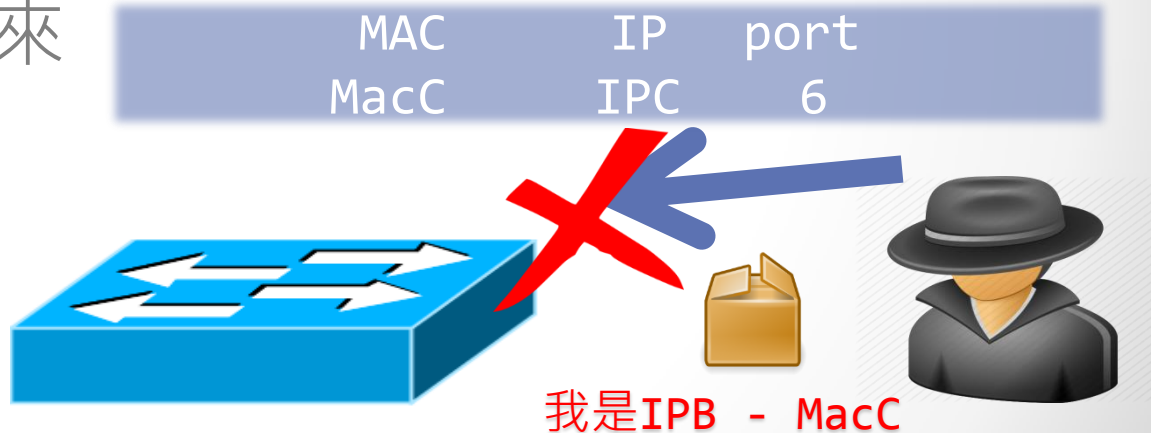


Switch Dynamic ARP inspection

- 保護機制：當switch收到ARP封包時，會先去找DHCP snooping binding table裡有沒有符合的，符合才會進行轉送和更新ARP table，若不符合，則被擋下來



A

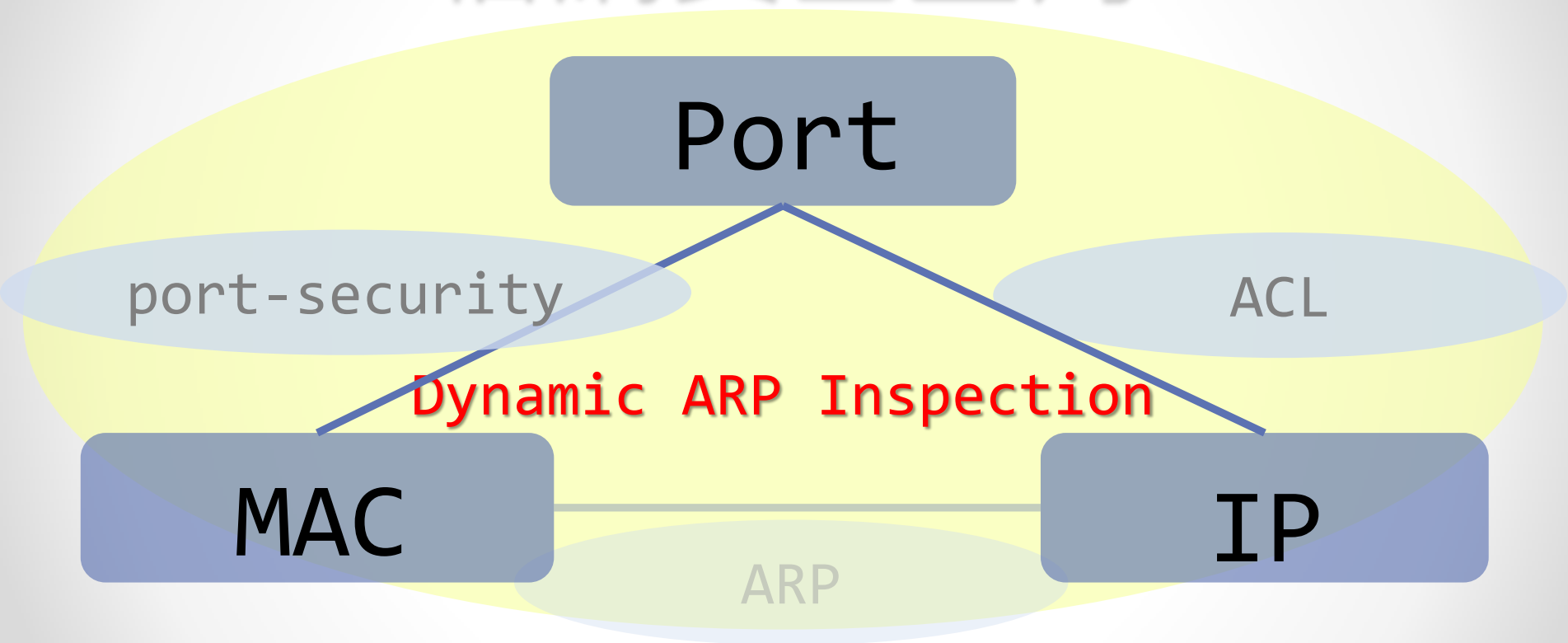


C

Switch安全機制(review)

- Port-security -> 防止網路孔(port)被盜用
- Err-disable -> 錯誤處理
- ACL -> 限制通過的封包
- DHCP snooping -> 紀錄ip資訊
- IP source guard -> 限制只能使用分配的ip
- Dynamic Arp Inspection(DAI) -> 避免惡意攻擊
-

宿網黃金三角



Router

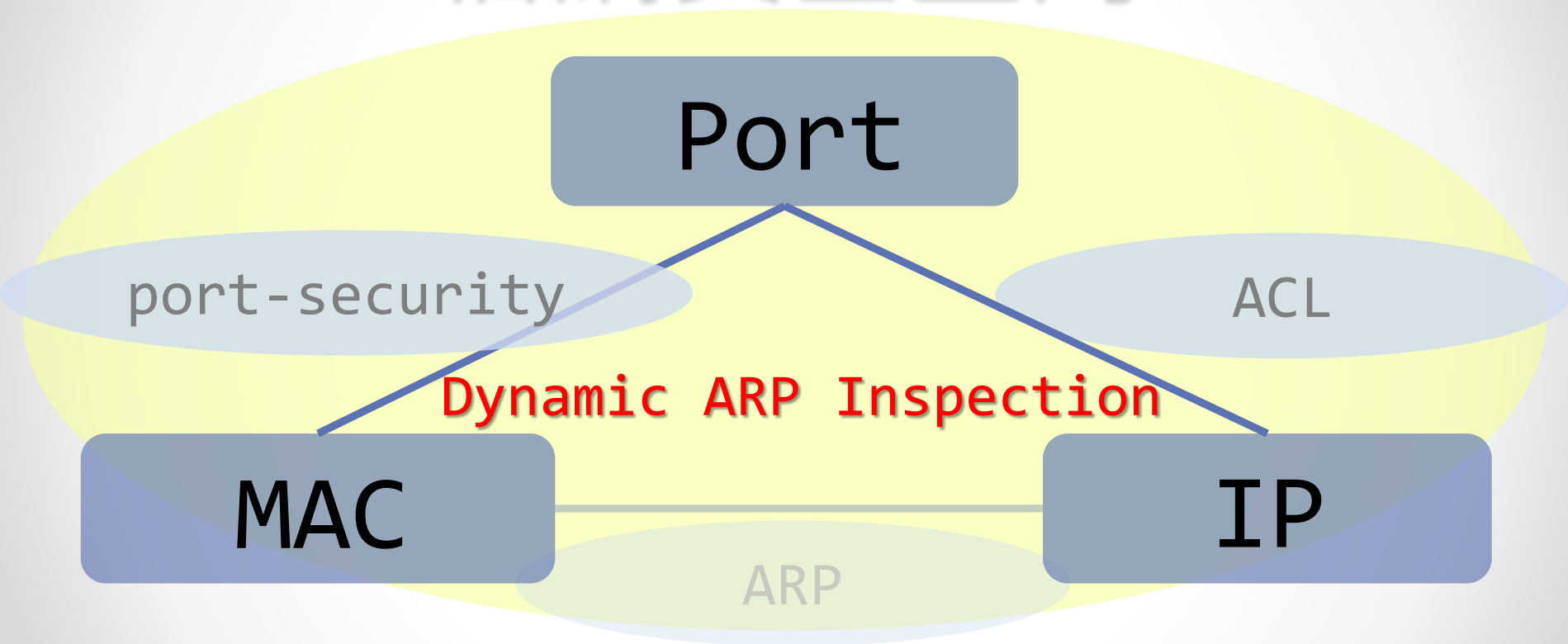
- Cisco Catalyst 3750 – L3 交換器
 - 負責封包路由
 - 可鎖上ARP(IP-MAC)



連接switch

連接光纖

宿網黃金三角



Switch操作

連上Switch

- 使用pietty連線
- Google “pietty”，第一個

pietty

{ piaip's PieTTY Project }

> Download 下載 | Donate! | Contact | PuTTY

RELATED SITES: Official PuTTY | My personal website

PieTTY/pputty/PuTTY 是什麼?

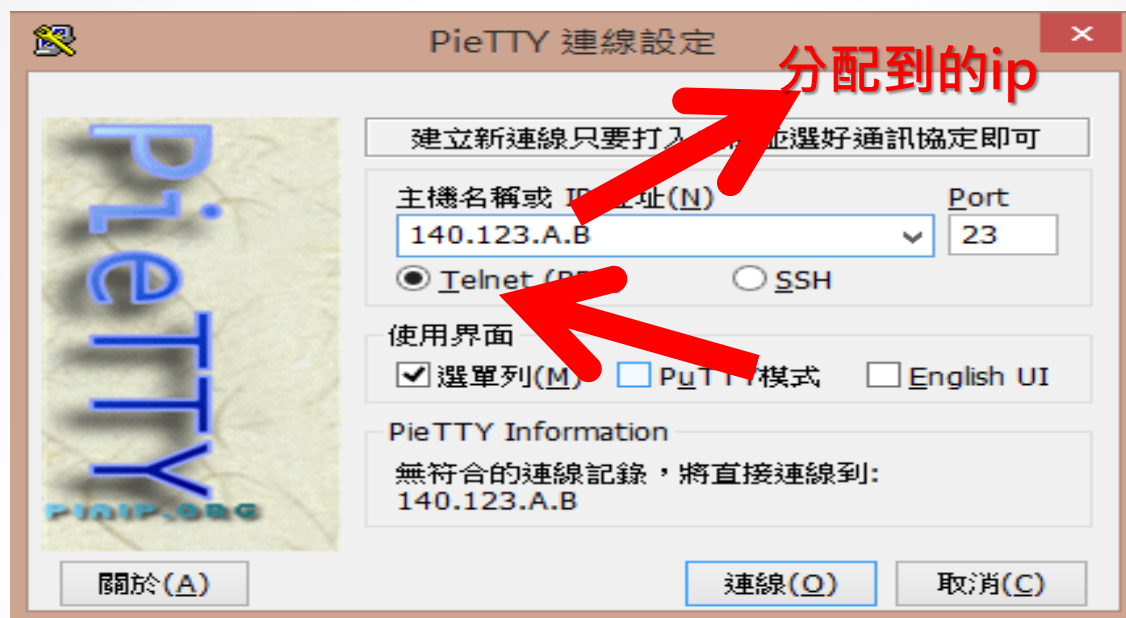
PuTTY 是個小巧方便的 Telnet/SSH 安全遠端連線程式，但用於非英語系文字時有非常多的問題，而且它對於初學者來說過於複雜的使用界面也為人詬病已久。PieTTY 則是源自於 PuTTY，修正與完整支援亞洲等多國語系



Downloads 下載

Recommended Release: 11/22/2010

[PieTTY 0.4.00b14 \(beta-14\)](#)



```
User Access Verification  
  
Username: [username]  
Password: [REDACTED]
```

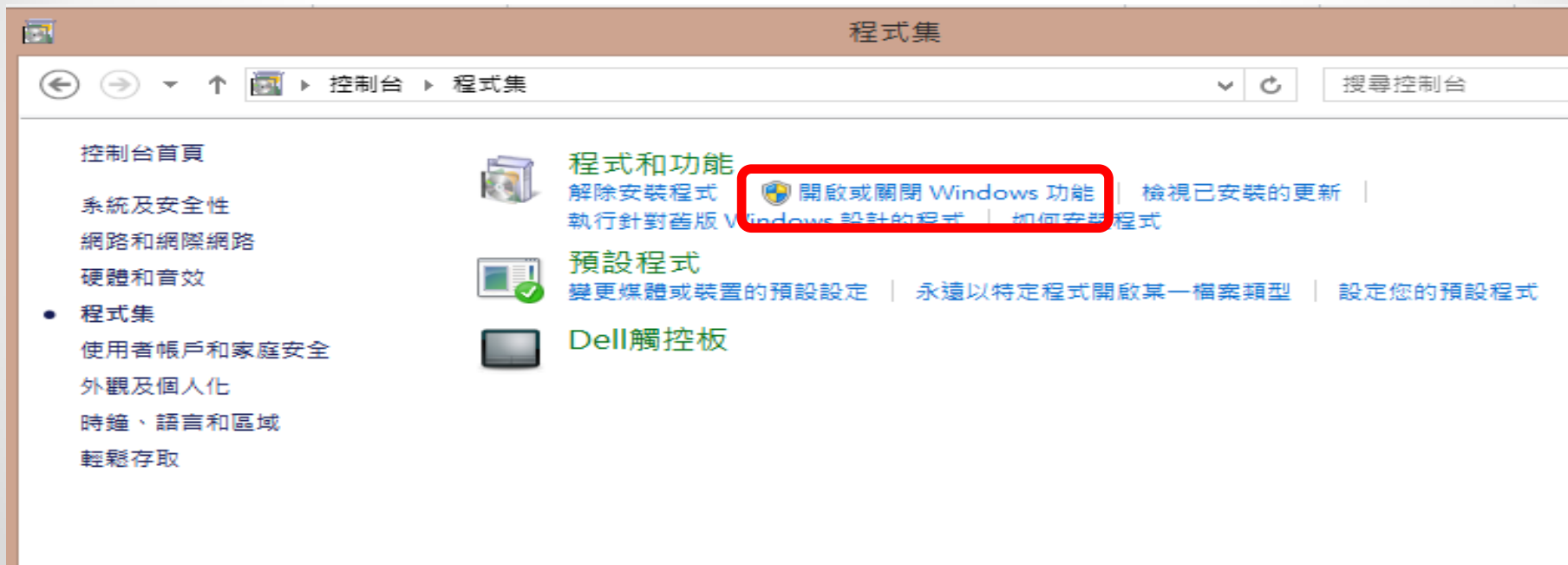
連上Switch

- 使用windows telnet 連線



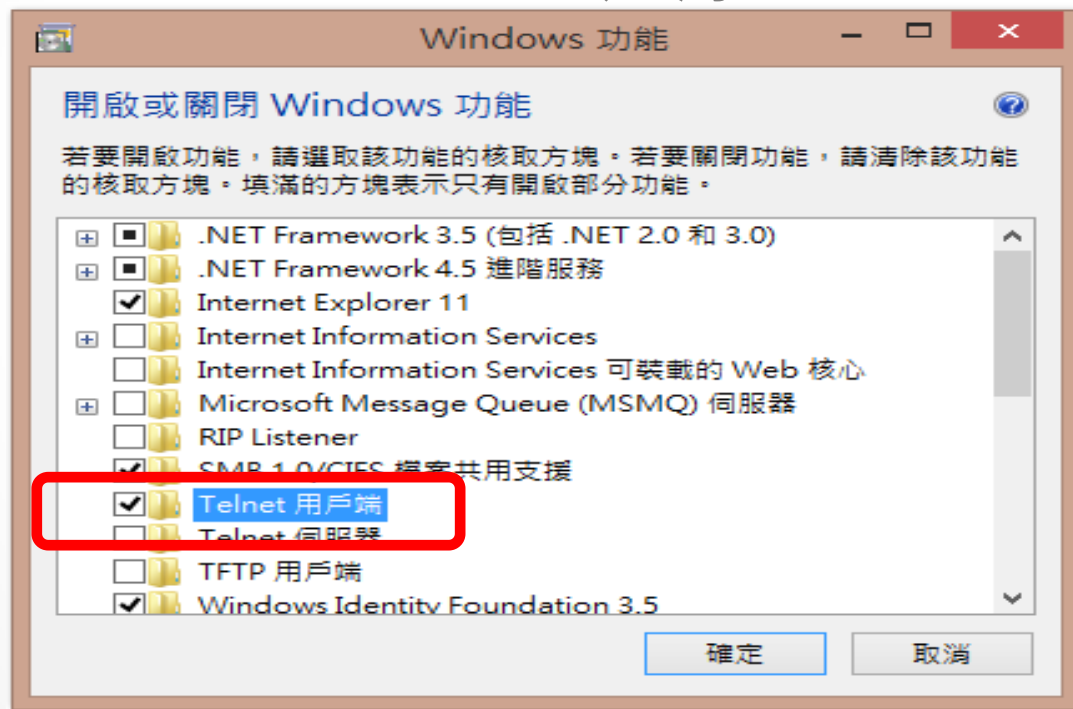
連上Switch

- 使用windows telnet 連線



連上Switch

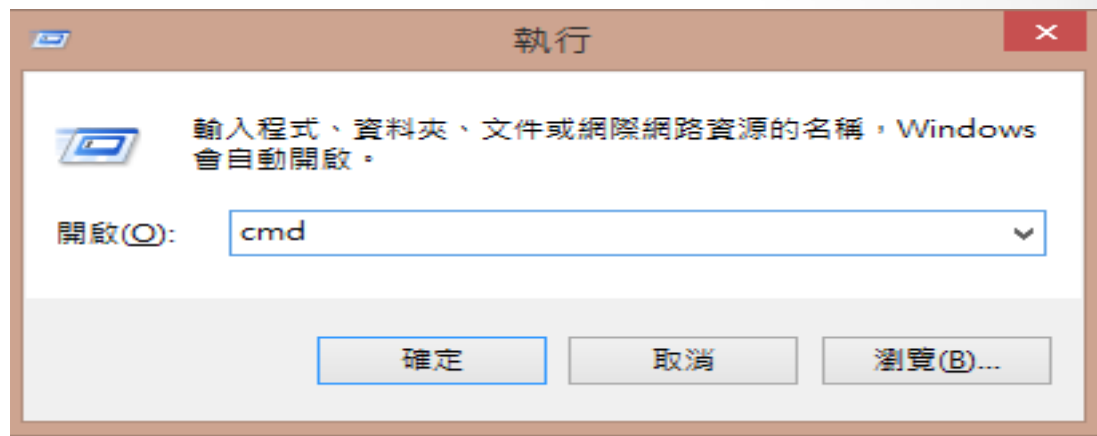
- 使用windows telnet 連線



連上Switch



+ R



連上Switch

```
C:\Windows\system32\cmd.exe
Microsoft Windows [版本 6.3.9600]
(c) 2013 Microsoft Corporation. 著作權所有，並保留一切權利。
C:\Users\mickey>telnet 140.123.A.B
```

```
C:\Users\mickey>telnet 140.123.A.B
User Access Verification
Username: [username]
Password: _
```


連上Switch

- Privileged EXEC mode(特權模式) :
可以做查詢、進入其他mode

```
CNAdemo#
```

Switch & Router 操作

Switch 查詢

- port 狀況 & 詳細資料
- err-disabled
- access-list 設定 (ACL)
- log 紀錄
- IP 狀況 (DHCP)

帳號：SAcourse

密碼：center21x

Switch 查詢 port 狀態

- # show interface status

```
CNAdemo#show interfaces status
```

Port	Name	Status	Vlan	Duplex	Speed	Type
Fa0/1		notconnect	1	auto	auto	10/100BaseTX
Fa0/2		notconnect	1	auto	auto	10/100BaseTX
Fa0/3		notconnect	1	auto	auto	10/100BaseTX
Fa0/4		notconnect	1	auto	auto	10/100BaseTX
Fa0/5		notconnect	1	auto	auto	10/100BaseTX
Fa0/6		notconnect	1	auto	auto	10/100BaseTX
Fa0/7		notconnect	1	auto	auto	10/100BaseTX
Fa0/8		notconnect	1	auto	auto	10/100BaseTX
Fa0/9		notconnect	1	auto	auto	10/100BaseTX
Fa0/10		notconnect	1	auto	auto	10/100BaseTX
Fa0/11		notconnect	1	auto	auto	10/100BaseTX
Fa0/12		notconnect	1	auto	auto	10/100BaseTX
Fa0/13		notconnect	1	auto	auto	10/100BaseTX
Fa0/14		notconnect	1	auto	auto	10/100BaseTX
Fa0/15		notconnect	1	auto	auto	10/100BaseTX
Fa0/16		notconnect	1	auto	auto	10/100BaseTX

Switch 查詢 port 狀態

- # show mac address-table

CNAdemo#show mac address-table				239	14cc.20fb.bfc3	DYNAMIC	Fa0/7
Mac Address Table				239	1803.73dc.6f2e	DYNAMIC	Fa0/24
-----				239	1c87.2ccb.0fc5	DYNAMIC	Gi0/1
				239	1c87.2ccb.1342	DYNAMIC	Gi0/1
Vlan	Mac Address	Type	Ports	239	1cb7.2c8e.e9d1	DYNAMIC	Gi0/1
----	-----	-----	----	239	206a.8a7f.b726	DYNAMIC	Gi0/1
All	0100.0ccc.cccc	STATIC	CPU	239	20cf.30c8.29c2	STATIC	Fa0/2
All	0100.0ccc.cccd	STATIC	CPU	239	2c60.0c91.e0d6	DYNAMIC	Gi0/1
All	0180.c200.0000	STATIC	CPU				

帳號：SAcourse

密碼：center21x

Switch 查詢 某一 port 狀態

- # show interface fa0/X status

```
Port      Name      Status      Vlan      Duplex  Speed  Type
Fa0/21    connected 239         a-full    a-100   10/100BaseTX
```

- # show mac address-table interface fa0/X
- # show mac address-table address [MAC]

```
CNAdemo#show mac address-table int fa0/21
```

Mac Address Table

Vlan	Mac Address	Type	Ports
239	6431.508b.bbdc	DYNAMIC	Fa0/21

Total Mac Addresses for this criterion: 1

```
CNAdemo#show mac address-table address 6431.508b.bbdc
```

Mac Address Table

Vlan	Mac Address	Type	Ports
239	6431.508b.bbdc	DYNAMIC	Fa0/21

Total Mac Addresses for this criterion: 1

Switch 查詢 某一port狀態

• # show interface fa0/X

○ input error :

- 封包傳送過小
- 爛線or網卡問題

○ CRC :

- 收到data所算出來了checksum與封包中紀錄的不符

```
CNAdemo#show int fa0/20
FastEthernet0/20 is down, line protocol is down (notconnect)
Hardware is Fast Ethernet, address is ec30.9134.8794 (bia ec30.9134.8794)
MTU 1500 bytes, BW 10000 Kbit/sec, DLY 1000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
Encapsulation ARPA, loopback not set
Keepalive set (10 sec)
Auto-duplex, Auto-speed, media type is 10/100BaseTX
input flow-control is off, output flow-control is unsupported
ARP type: ARPA, ARP Timeout 04:00:00
Last input never, output never, output hang never
Last clearing of "show interface" counters never
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/40 (size/max)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
    0 packets input, 0 bytes, 0 no buffer
    Received 0 broadcasts (0 multicasts)
    0 runs, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
    0 watchdog, 0 multicast, 0 pause input
    0 input packets with dribble condition detected
    0 packets output, 0 bytes, 0 underruns
    0 output errors, 0 collisions, 1 interface resets
--More--
```

Switch 查詢 err-disabled

- # show interface status err-disabled
 - psecure-violation 卡號跟機器紀錄的不同
 - link-flap 短時間內上上下下
 - bpduguard 分享 or 橋接器

```
CNAdemo#show interfaces status err-disabled
```

Port	Name	Status	Reason	Err-disabled Vlans
Fa0/22		err-disabled	psecure-violation	
Fa0/23		err-disabled	link-flap	
Fa0/24		err-disabled	bpduguard	

```
CNAdemo#
```


Switch 查詢 port-security

- # show port-security

```
CNAdemo#show port-security
Secure Port    MaxSecureAddr  CurrentAddr    SecurityViolation  Security Action
              (Count)        (Count)        (Count)
-----
      Fa0/2           1             1             0             Restrict
      Fa0/4           1             1             0             Restrict
      Fa0/5           1             1             0             Restrict
      Fa0/11          1             0            101            Restrict
      Fa0/21          1             1           5350            Restrict
-----
Total Addresses in System (excluding one mac per port)    : 0
Max Addresses limit in System (excluding one mac per port) : 8192
```

帳號 : SAcourse

密碼 : center21x

Switch 查詢 access-list

- # show access-list [ACL name]

```
CNAdemo#show access-list demoACL
Extended IP access list demoACL
 10 permit ip host 140.123. [redacted] any (17 matches)
 20 permit ip host 10.123 [redacted] any (10 matches)
 30 permit udp any any eq bootps (48 matches)
 40 permit udp any any eq bootpc
 50 deny ip any any (46 matches)
```

- 10 match：正常，表示有拿到正確IP。
- 20 match：未申請、超流斷線、中毒斷線=> 導到宿網首頁
- 30 match：做DHCP 相關請求 (ex: 電腦剛開機時)
- 40 match：不正常，作DHCP發送IP的動作
- 50 match：無法連線，可能手動設定錯IP

帳號：SAcourse

密碼：center21x

Switch 查詢 log紀錄

- # show log | include 0/X[,.]

```
Sep 15 17:11:22: %LINK-3-UPDOWN: Interface FastEthernet0/3, changed state to up
Sep 15 17:11:23: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up
Sep 15 17:11:24: %LINEPROTO-5-UPDOWN: Line protocol on interface FastEthernet0/3, changed state to down
Sep 15 17:11:26: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up
Sep 15 17:20:11: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to down
Sep 15 17:20:12: %LINK-3-UPDOWN: Interface FastEthernet0/3, changed state to down
Sep 15 17:20:25: %LINK-3-UPDOWN: Interface FastEthernet0/3, changed state to up
Sep 15 17:20:28: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up
Sep 15 17:21:03: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to down
```

```
Sep 28 11:47:35: %PORT_SECURITY-2-PSECURE_VIOLATION: Security violation occurred, caused by MAC address cccc.cccc.cccc on port FastEthernet0/21.
Sep 28 11:49:53: %PORT_SECURITY-2-PSECURE_VIOLATION: Security violation occurred, caused by MAC address cccc.cccc.cccc on port FastEthernet0/21.
Sep 28 11:50:02: %PORT_SECURITY-2-PSECURE_VIOLATION: Security violation occurred, caused by MAC address cccc.cccc.cccc on port FastEthernet0/21.
Sep 28 11:50:58: %PORT_SECURITY-2-PSECURE_VIOLATION: Security violation occurred, caused by MAC address cccc.cccc.cccc on port FastEthernet0/21.
Sep 28 11:51:03: %PORT_SECURITY-2-PSECURE_VIOLATION: Security violation occurred, caused by MAC address cccc.cccc.cccc on port FastEthernet0/21.
```

帳號 : SAcourse

密碼 : center21x

Switch 查詢 IP取得狀況

- # show ip dhcp snooping binding
 - Lease (sec): 剩下的租約時間，從3600開始倒數，到1800會重新申請租約，時間到就釋出IP

```
CNAdemo#show ip dhcp snooping binding
```

MacAddress	IpAddress	Lease(sec)	Type	VLAN	Interface
20:CF:30:C8:29:C2	140.123.	3594	dhcp-snooping	239	FastEthernet0/2

Total number of bindings: 1

帳號：SAcourse

密碼：center21x

DEMO

- # show interface [fa0/X] status
- # show mac address-table
- # show mac address-table interface fa0/X
- # show mac address-table address [MAC]
- # show interface fa0/X
- # show interface status err-disabled
- # show port-security
- # show access-list [ACL name]

Switch 操作

- port-security
 - 鎖上 port-security
 - 解鎖 port-security
- ACL
 - 設定、套用 ACL
 - 取消 ACL 套用、刪除 ACL

Switch 操作

- 進入全域設定模式
 - # configure terminal

```
CNAdemo#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
CNAdemo(config)#
```

帳號：SAcourse

密碼：center21x

Switch 操作 port-security(鎖)

設定 port-security : (port 綁 MAC)

- # configure terminal 進入全域設定模式
- (config) # interface fa0/x 針對哪個port做設定
- (config-if) # switchport mode access
- (config-if) # switchport port-security violation restrict
- (config-if) # switchport port-security mac-address aaaa.aaaa.aaab
- (config-if) # switchport port-security
- (config-if) # end

Switch 操作 port-security (鎖)

- port-security 鎖上多組卡號 (port 綁 MAC)
 - 預設可以鎖上的卡號是1組
 - (config-if)# switchport port-security maximum [數量]
 - 若實際上鎖上去的卡號數量比設定可以鎖卡號的最大數量少，等於沒有鎖卡號，因為沒有鎖的空位，會讓連到該port的人變成dynamic mac

帳號：SAcourse

密碼：center21x

Switch 操作 port-security (鎖)

- 檢查port-security設定
 - # show running-config interface fa0/X

```
CNAdemo#show run int fa0/20
Building configuration...

Current configuration : 324 bytes
!
interface FastEthernet0/20
 switchport mode access
 switchport port-security maximum 3
 switchport port-security
 switchport port-security violation restrict
 switchport port-security mac-address aaaa.aaaa.aaab
 switchport port-security mac-address aaaa.aaaa.aaac
 switchport port-security mac-address aaaa.aaaa.aaad
end
```

帳號 : SAcourse

密碼 : center21x

Switch 操作 port-security (解)

- 解除 port-security(依鎖上的順序反著解回去)
 - # configure terminal
 - (config) # interface fa0/x
 - (config-if) # no switchport port-security
 - (config-if) # no switchport port-security mac-address
 - (config-if) # no switchport port-security violation
 - (config-if) # no switchport port-security maximum
 - (config-if) # end

Switch 操作 port-security (解)

- 檢查port-security設定
 - #show running-config interface fa0/X

```
CNAdemo#show run int fa0/20
Building configuration...

Current configuration : 324 bytes
!
interface FastEthernet0/20
 switchport mode access
end
```

Demo

鎖port-security

- # configure terminal 進入全域設定模式
- (config) # interface fa0/x 針對哪個port做設定
- (config-if) # switchport mode access
- (config-if) # switchport port-security violation restrict
- (config-if)# switchport port-security maximum [數量]
- (config-if) # switchport port-security mac-address aaaa.aaaa.aa[xx]
- (config-if) # switchport port-security mac-address aaaa.aaaa.aa[xx]
- (config-if) # switchport port-security
- (config-if) # end

解port-security

- # show running-config
- # configure terminal
- (config) # interface fa0/x
- (config-if) # no switchport port-security
- (config-if) # no switchport port-security mac-address
- (config-if) # no switchport port-security violation
- (config-if) # no switchport port-security maximum
- (config-if) # end

Switch 操作 ACL rule(鎖)

- 設定 ACL : (port 限制可通行的封包、IP)
 - # configure terminal
 - (config)# ip access-list extended [ACL name]
 - (config-ext-nacl) # 10 permit ip host 140.123.239.254 any
 - (config-ext-nacl) # 20 permit ip host 10.123.239.254 any
 - (config-ext-nacl) # 30 permit udp any any eq bootps
 - (config-ext-nacl) # 40 permit udp any any eq bootpc
 - (config-ext-nacl) # 50 deny ip any any
 - (config-ext-nacl) # end

Switch 操作 ACL rule (鎖)

- 檢查 ACL 設定

- # show access-list [ACL name]

```
CNAdemo#show access-list demoACL
Extended IP access list demoACL
 10 permit ip host 140.123. [REDACTED] any
 20 permit ip host 10.123. [REDACTED] any
 30 permit udp any any eq bootps
 40 permit udp any any eq bootpc
 50 deny ip any any
```

Switch 操作 ACL rule (鎖)

- 把ACL套用到port上
 - # configure terminal
 - (config) # interface fa0/x
 - (config-if) # ip access-group [ACL name] in
 - (config-if) # end
- in: inbond限制進來這個port

Switch 操作 ACL rule (鎖)

- 檢查 ACL 有沒有套用到port
 - # show running-config interface fa0/X

```
CNAdemo#show run int fa0/20
Building configuration...

Current configuration : 352 bytes
!
interface FastEthernet0/20
  switchport mode access
  switchport port-security maximum 3
  switchport port-security
  switchport port-security violation restrict
  switchport port-security mac-address aaaa.aaaa.aaab
  switchport port-security mac-address aaaa.aaaa.aaac
  switchport port-security mac-address aaaa.aaaa.aaad
  ip access-group demoACL in
end
```

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Switch 操作 ACL rule (解)

- 解除 ACL 套用
 - # configure terminal
 - (config) # interface fa0/x
 - (config-if) # no ip access-group in
 - (config-if) # end
- 刪除 ACL 設定
 - # configure terminal
 - (config) # no ip access-list extended [ACL name]
 - (config) # end

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密碼：center21x

Switch 操作 ACL rule (解)

- 檢查 ACL 解除套用
 - # show running-config interface fa0/x

```
CNAdemo#show run int fa0/20
Building configuration...

Current configuration : 58 bytes
!
interface FastEthernet0/20
  switchport mode access
end
```

Switch 操作 ACL rule (解)

- 檢查 ACL 設定已刪除
 - # show access-list [ACL name]

```
CNAdemo#show access-list demoACL  
  
CNAdemo#
```

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Switch 小技巧

- `tab`鍵：自動補齊(若有多種選項，則不變)
- `?`：可以查詢接下來可以接甚麼指令
 - `<cr>`：到此已是可執行的指令
- `(config) # do show interface status`
- `# write memory`
 - 改完設定，寫進memory

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Demo

鎖ACL

- # configure terminal
- (config)# ip access-list extended [ACL name]
- (config-ext-nacl) # 10 permit ip host 140.123. [REDACTED] any
- (config-ext-nacl) # 20 permit ip host 10.123. [REDACTED] any
- (config-ext-nacl) # 30 permit udp any any eq bootps
- (config-ext-nacl) # 40 permit udp any any eq bootpc
- (config-ext-nacl) # 50 deny ip any any
- (config-ext-nacl) # end

套用到port

- # configure terminal
- (config) # interface fa0/x
- (config-if) # ip access-group [ACL name] in
- (config-if) # end

Router 操作

Router ARP(鎖)

- # configure terminal
- (config) # arp [IP] [MAC] arpa
- (config) # end

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Router ARP(鎖)

- 查詢ARP
- # show ip arp [IP or MAC]

```
CNAdemo#show ip arp 1.1.1.1
```

Protocol	Address	Age (min)	Hardware Addr	Type	Interface
Internet	1.1.1.1	-	aaaa.aaaa.aaaa	ARPA	

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Router ARP(解)

- # configure terminal
- (config) # no arp [IP]
- (config) # end

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密碼：center21x

Case 處理

Case 處理 – 基本詢問

- 是否有申請網路(剛開學時)
- 有沒有繳費(過繳費斷線時間)
- 是否中毒 or 超流斷線
- 甚麼時候開始不能用
 - 帶回家再帶來、一直不能用
 - 手機 or 外接裝置插usb上去，會自動開啟共用
- 期間做過甚麼事(載甚麼軟體、動過甚麼設定)

Case 處理 – 小電腦圖示

- 紅色叉叉

- 網路線未連接
- 網路介面卡未啟用
- **err-disabled**
- 線路問題



- 黃色驚嘆號(無法辨識的網路)

- 申請錯床位
- 超流 or 中毒斷線
- 開啟共用、手動設定 IP



- ○ 卡號錯誤

Case 處理 – 小電腦圖示

- 正常(已連線)
 - DNS 設定錯誤
 - 須設定成自動取得
 - 防毒軟體(e.g. McAfeeX)



Case 處理 - 其他

- 可以幫忙下載、安裝 Office 嗎？
- 電腦中毒無法開機，可以幫我重灌嗎？

→ 非網管業務範圍

- 可以連到校內網站（ex：宿網首頁），但不能玩線上遊戲、FB

→ 連外問題，可注意相關公告

- 宿網首頁 (<https://www.dorm.ccu.edu.tw/>)
- 忘記宿網密碼 => 可到宿網申請系統使用「忘記密碼」功能

Q & A

Thank you for listening