NARLabs 國家實驗研究院

國家高速網路與計算中心

網路管理方法及原理介紹

網路與資安組副工程師
梁明章

承諾·熱情·創新

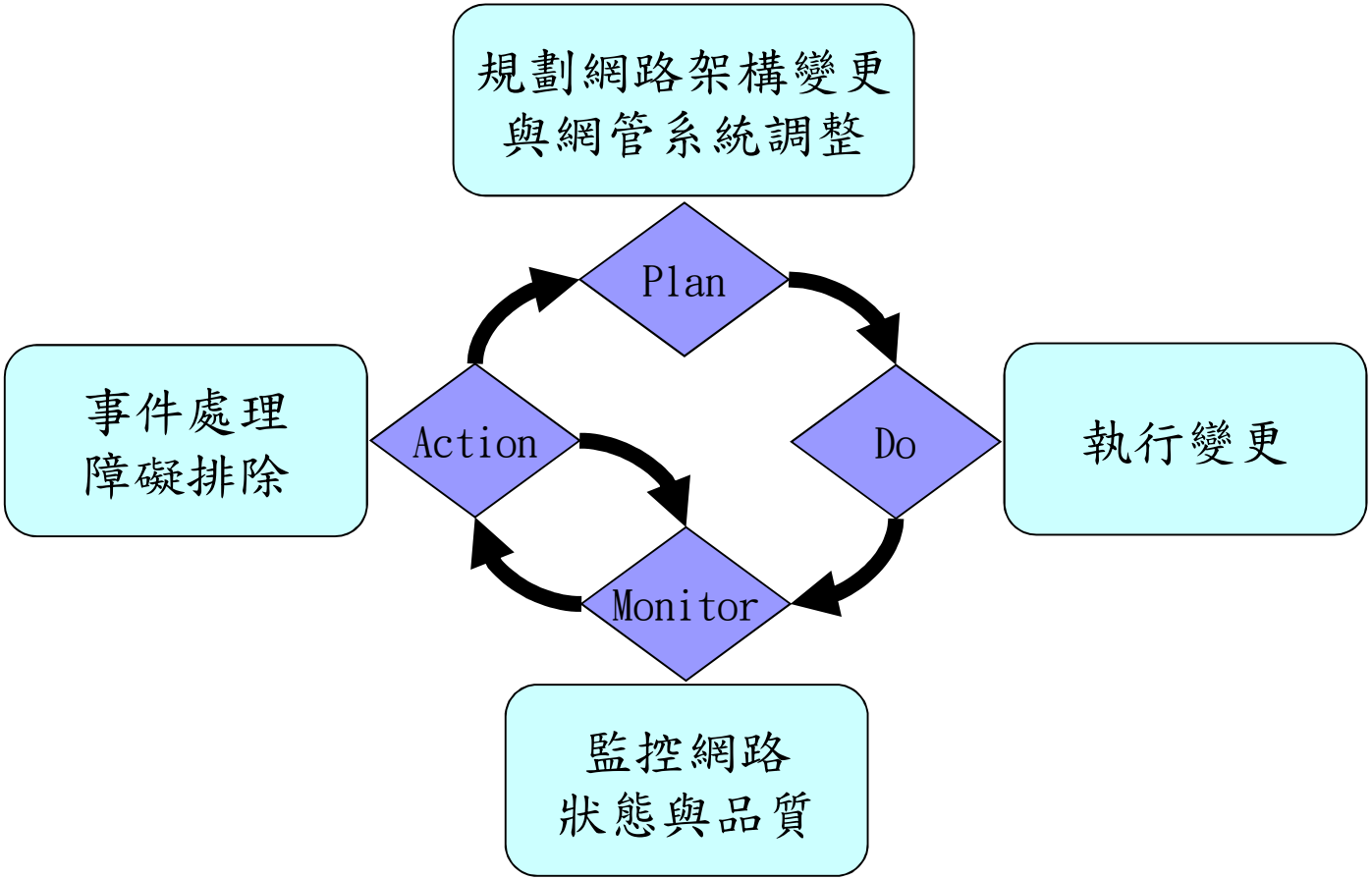
www.narlabs.org.tw

大綱

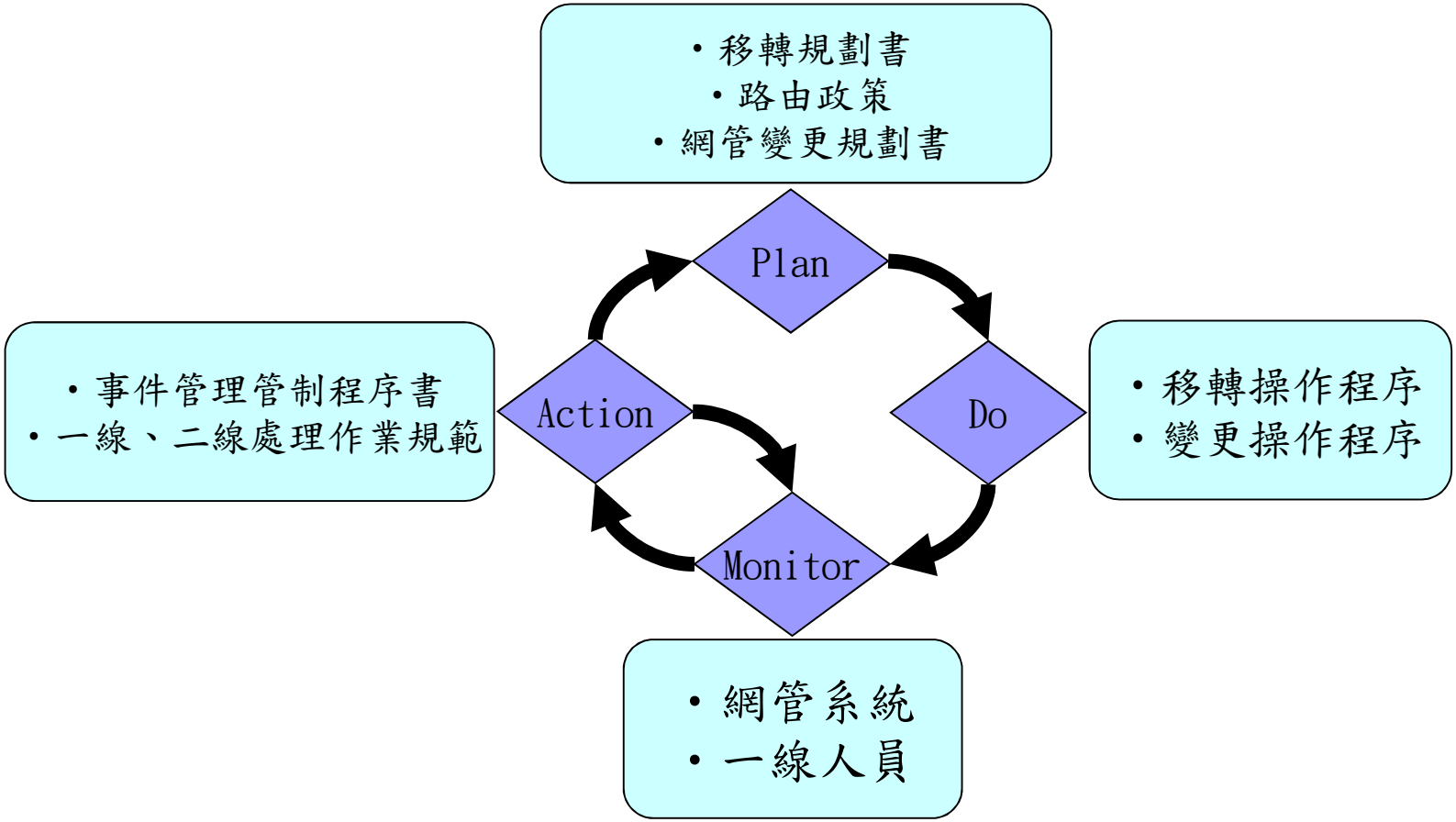
- 網管概說
- 資訊收集方法
- 了解需求與設備所能提供的資訊
- 進階網管的思考

網路管理工作流程

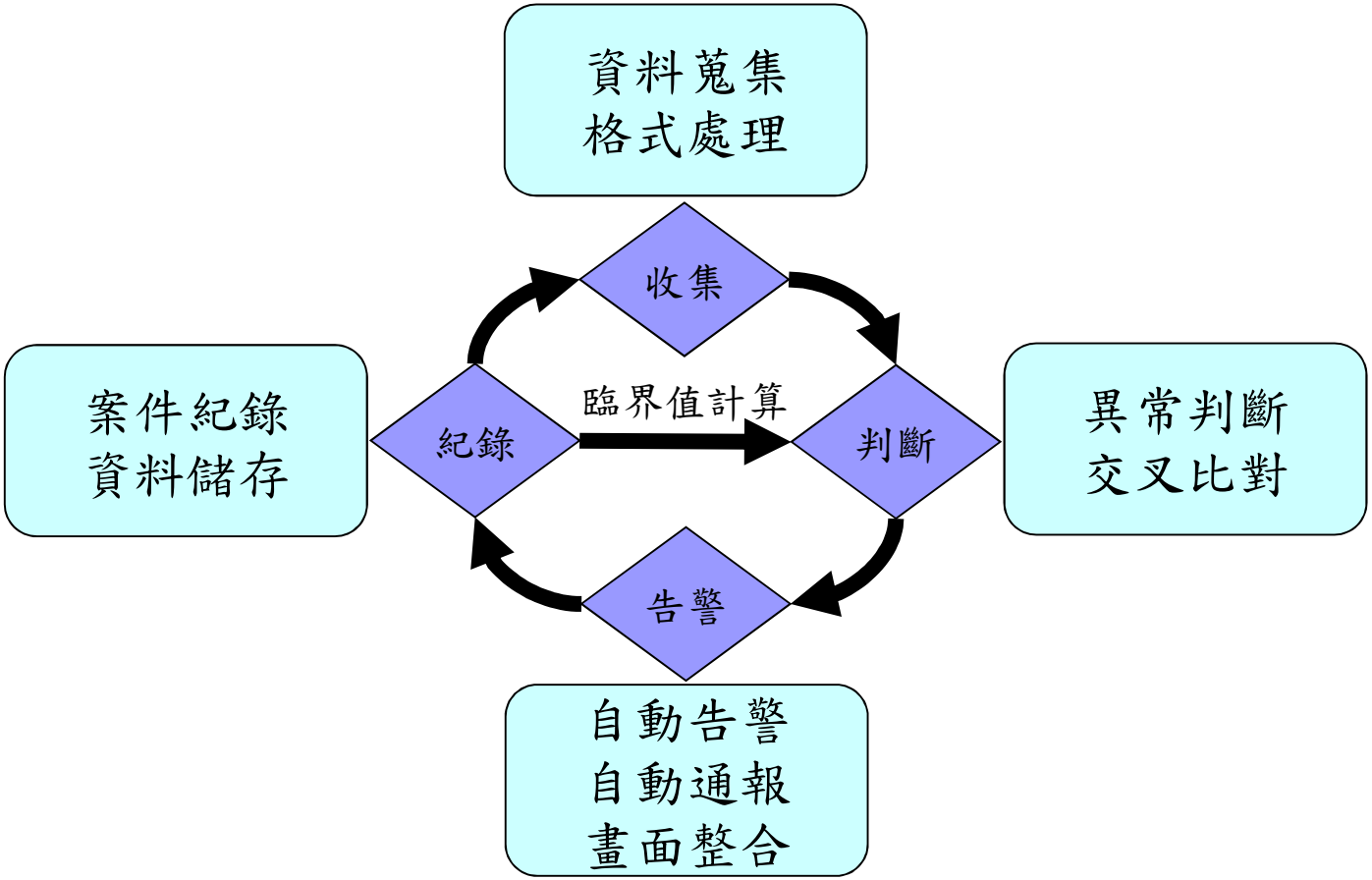
NARLabs



網路管理工作流程


・移轉規劃書
・路由政策
・網管變更規劃書
Plan
Do
Monitor
Action
・事件管理管制程序書
・一線、二線處理作業規範
・移轉操作程序
・變更操作程序
・網管系統
・一線人員

網路監控流程



監控項目舉例

- 設備故障發出的Trap
- 主動查詢的MIB
  - 機房環境
    - 環境溫度、設備電力
  - 互連網
    - Peering 狀態、使用狀態
  - 品質
    - End to End RTT、Packet Lost Rate
  - 流量異常
    - 骨幹、特定介面
  - Top N 排行榜
    - Bytes、Flows、Packets
  - 設備狀態
    - CPU、Memory 、風扇
  - 路由監控
    - 連線單位路由、互連網重點路由

網管資料收集來源

NARLabs

- Trap
- MIB (Management Information Base)
- System Log
- NetFlow
- Packet mirror/sniffer
- Simulate Telnet/SSH
- Internet Services Protocols
  - HTTP、XML、JSON

SNMP

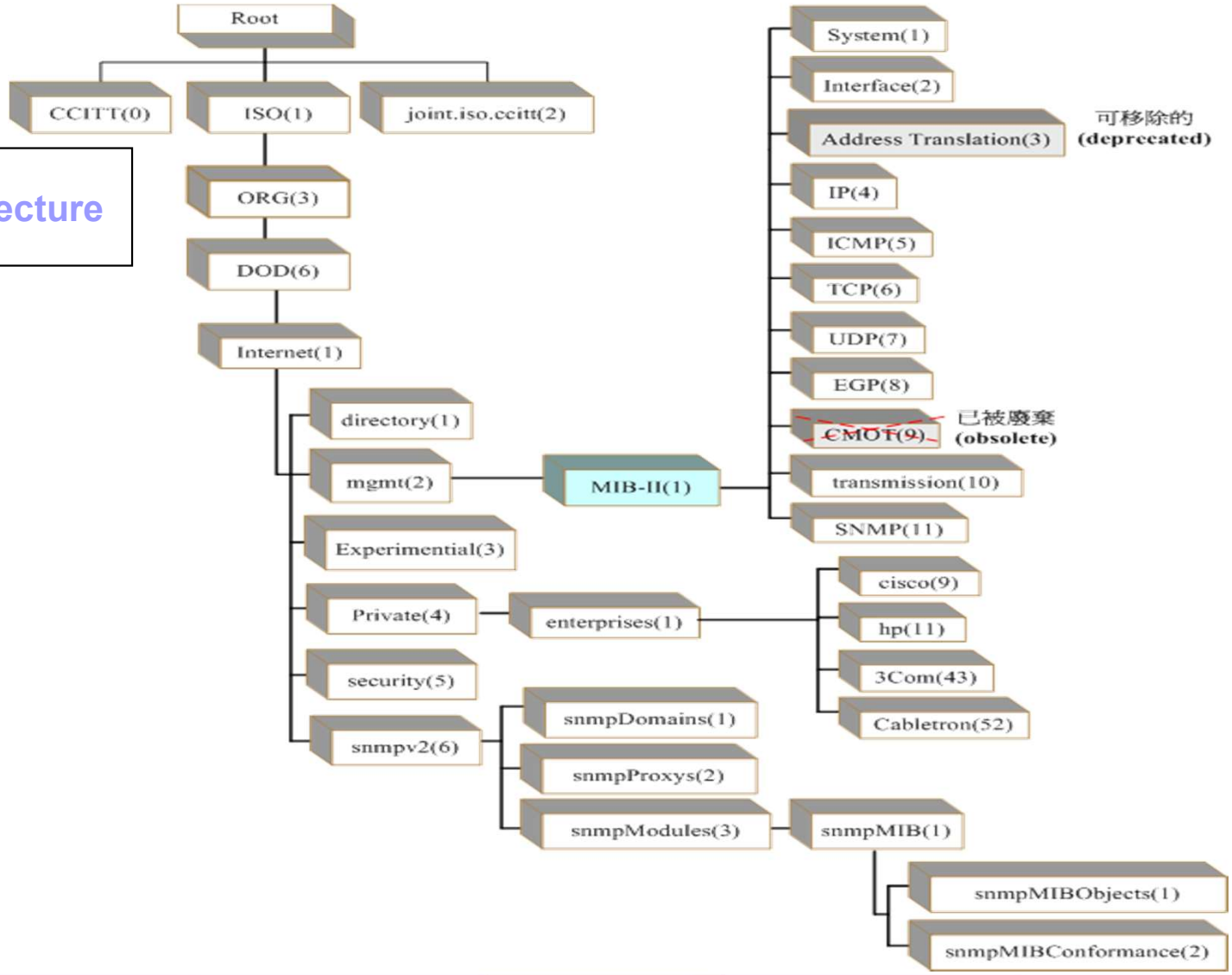
NARLabs

- **Simple Network Management Protocol**
- 主要運作方式
  - **Trap**：乃是SNMP Agent在指定狀況發生時主動發送給NMS的SNMP訊息封包，採用UDP封包單向傳輸。
  - MIB：乃是NMS主動向SNMP Agent發出SNMP查詢封包，代理人收到後，回送SNMP回應封包給NMS，是一來一回的UDP封包傳輸過程，若經驗資料充足，可能預見障礙之發生，進行預防。
- OID (Object Identifier)
  - Global identifier for a particular object type.
  - Trap & MIB 封包內都會包含OID以描述訊息意義。
- 參考網頁
  - http://tools.cisco.com/Support/SNMP/do/BrowseOID.do?local=en
  - http://netdisco.cvs.sourceforge.net/viewvc/netdisco/mibs/

OID Tree

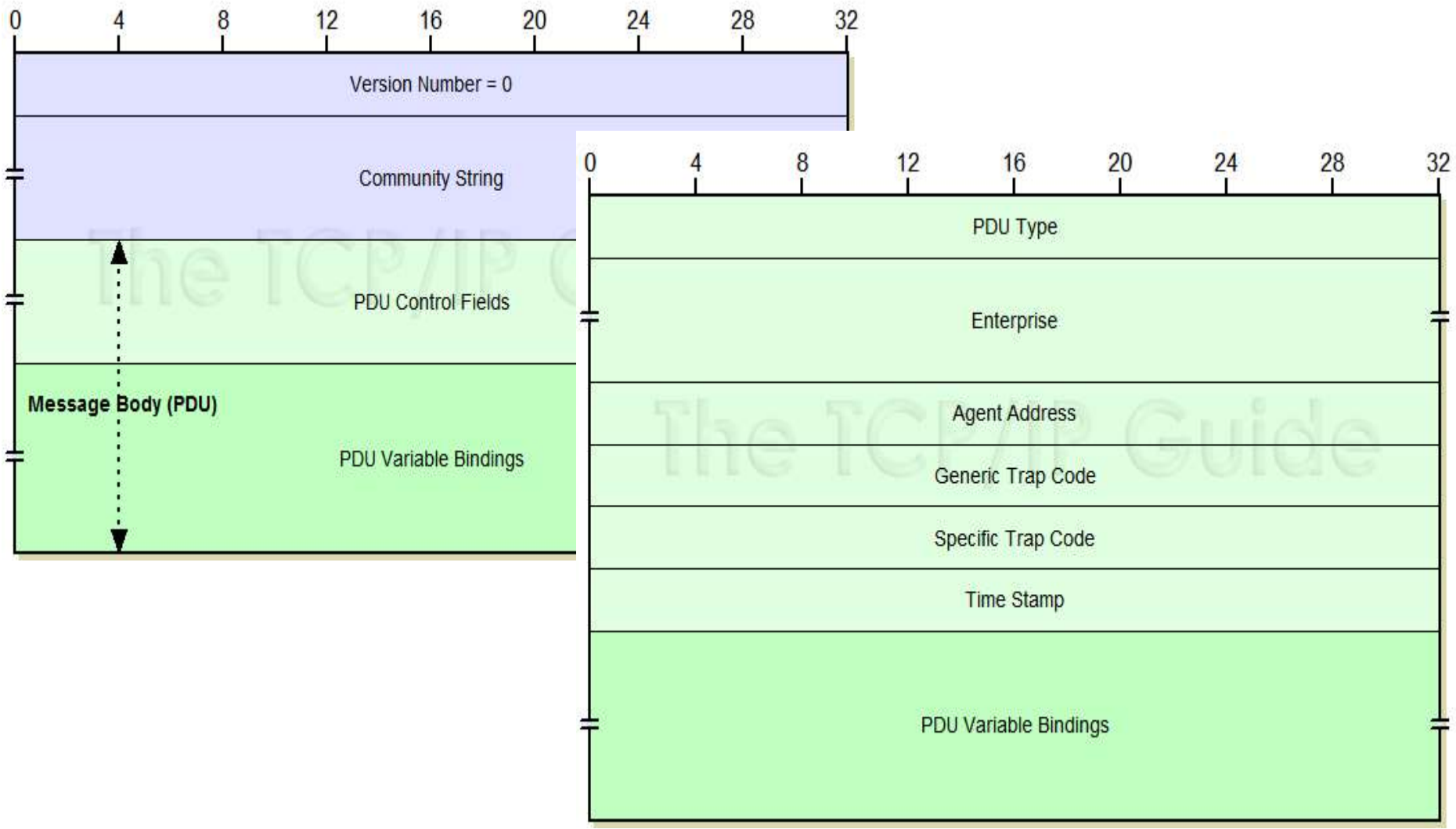
NARLabs

MIB-II Tree Architecture



NARLabs

SNMP Version 1 (SNMPv1) Trap Message Format



Trap

NARLabs

- 參考網頁
  - http://www.mibdepot.com/engine/cisco_TRAP.html
- 舉例

Object	linkDown
OID	1.3.6.1.6.3.1.1.5.3
Status	current
MIB	IF-MIB ; - View Supporting Images
Trap Components	ifIndex ifAdminStatus ifOperStatus
Description	"A linkDown trap signifies that the SNMP entity, acting in an agent role, has detected that the ifOperStatus object for one of its communication links is about to enter the down state from some other state (but not from the notPresent state). This other state is indicated by the included value of ifOperStatus."

MIB

Object	ifIndex
OID	1.3.6.1.2.1.2.2.1.1
Type	InterfaceIndex
Permission	read-only
Status	current
MIB	IF-MIB ; - View Supporting Images
Description	"A unique value, greater than zero, for each interface. It is recommended that values are assigned contiguously starting from 1. The value for each interface sub-layer must remain constant at least from one re-initialization of the entity's network management system to the next re-initialization."

MIB

Object	ifOperStatus
OID	1.3.6.1.2.1.2.2.1.8
Type	INTEGER
Permission	read-only
Status	current
Values	1 : up 2 : down 3 : testing 4 : unknown 5 : dormant 6 : notPresent 7 : lowerLayerDown
MIB	IF-MIB ; - View Supporting Images
Description	"The current operational state of the interface. The testing(3) state indicates that no operational packets can be passed. If ifAdminStatus is down(2) then ifOperStatus should be down(2). If ifAdminStatus is changed to up(1) then ifOperStatus should change to up(1) if the interface is ready to transmit and receive network traffic; it should change to dormant(5) if the interface is waiting for external actions (such as a serial line waiting for an incoming connection); it should remain in the down(2) state if and only if there is a fault that prevents it from going to the up(1) state; it should remain in the notPresent(6) state if the interface has missing (typically, hardware) components."

SNMP MIB Example

NARLabs

- snmpwalk -v2c -c ‘public' 192.168.3.12 .1.3.6.1.2.1.1.5
  - SNMPv2-MIB::sysName.0 = STRING: TN-7609P.twaren.net
- snmpwalk -v2c -c ‘public' 192.168.3.12 .1.3.6.1.2.1.31.1.1.1.1
  - IF-MIB::ifName.1 = STRING: Gi1/1
  - IF-MIB::ifName.2 = STRING: Gi1/2
- snmpwalk -v2c -c ‘public' 192.168.3.12 .1.3.6.1.2.1.2.2.1.7
  - IF-MIB::ifAdminStatus.1 = INTEGER: down(2)
  - IF-MIB::ifAdminStatus.2 = INTEGER: down(2)
- snmpwalk -v2c -c ‘public' 192.168.3.12 .1.3.6.1.2.1.2.2.1.8
  - IF-MIB::ifOperStatus.1 = INTEGER: down(2)
  - IF-MIB::ifOperStatus.2 = INTEGER: down(2)
- snmpwalk -v2c -c ‘public' 192.168.3.12 .1.3.6.1.2.1.31.1.1.1.18
  - IF-MIB::ifAlias.25 = STRING: 7609 <--> TN-12416P 10GbE 3/1
  - IF-MIB::ifAlias.28 = STRING: "to-TN-7609C-Ten2/2-Trunk"

System Log

NARLabs

- 由系統在指定狀況發生時主動發送給內部 Log Daemon 或外部的 Log Collector 機器以資記錄。
- 外部傳送大部分採用UDP傳輸，採用TCP傳輸的Daemon甚少。
- 資安設備、伺服器、網路設備都能提供這些資訊。
- **Unix**
  - **Jun 22 23:00:01 noc cron[16182]: (root) CMD (test -x /usr/sbin/run-crons && /usr/sbin/run-crons)**
  - **Jun 22 23:02:36 noc sshd[16966]: refused connect from 59-127-207-117.HINET-IP.hinet.net (::ffff:59.127.207.117)**
  - **Jun 22 23:02:49 noc sshd[17045]: Invalid user lmj from 140.110.96.20**
  - **Jun 22 23:02:55 noc sshd(pam_unix)[17048]: check pass; user unknown**
  - **Jun 22 23:02:55 noc sshd(pam_unix)[17048]: authentication failure; logname= uid=0 euid=0 tty=ssh ruser= rhost=140.110.96.20**
  - **Jun 22 23:02:56 noc sshd[17045]: error: PAM: Authentication failure for illegal user lmj from 140.110.96.20**

System Log

NARLabs

- Cisco Router
  - Jun 15 18:42:02: %PFINIT-SP-5-CONFIG_SYNC: Sync'ing the startup configuration to the standby Router
  - Jun 15 18:42:02: %PFINIT-SP-1-CONFIG_SYNC_FAIL: Sync'ing the startup configuration to the standby Router FAILED, the file may be already locked by a command like: show config.
  - Jun 16 21:57:24: %OSPF-5-ADJCHG: Process 7539, Nbr 211.79.60.130 on Vlan20 from 2WAY to DOWN, Neighbor Down: Dead timer expired
  - Jun 16 21:57:24: %OSPFv3-5-ADJCHG: Process 7539, Nbr 211.79.60.130 on Vlan20 from 2WAY to DOWN, Neighbor Down: Dead timer expired
  - Jun 16 21:57:32: %PIM-5-NBRCHG: neighbor 211.79.60.116 DOWN on interface Vlan20 (vrf default) non DR
  - Jun 16 21:58:50: %PIM-5-NBRCHG: neighbor 211.79.60.116 UP on interface Vlan20 (vrf default)
  - Jun 22 15:23:02: %SYS-5-CONFIG_I: Configured from console by tjs onvty0 (192.168.3.98)
  - Jun 22 15:23:46: %SYS-5-CONFIG_I: Configured from console by tjs onvty0 (192.168.3.98)
  - Jun 22 15:23:59: %PFINIT-SP-5-CONFIG_SYNC: Sync'ing the startup configuration to the standby Router

Netflow

NARLabs

- 由設備主動發送符合指定條件的Flow Data給收集器，含有Layer3~4的資訊。
- **Version 5 packet header**

Bytes	Contents	Description
0-1	version	NetFlow export format version number (1,5,6,7,8,9)
2-3	count	Number of flows exported in this packet (1-30)
4-7	sys_uptime	Current time in milliseconds since the export device booted
8-11	unix_secs	Current count of seconds since 0000 UTC 1970
12-15	unix_nsecs	Residual nanoseconds since 0000 UTC 1970
16-19	flow_sequence	Sequence counter of total flows seen
20	engine_type	Type of flow-switching engine
21	engine_id	Slot number of the flow-switching engine
22-23	sampling_interval	First two bits hold the sampling mode; remaining 14 bits hold value of sampling interval

Netflow

NARLabs

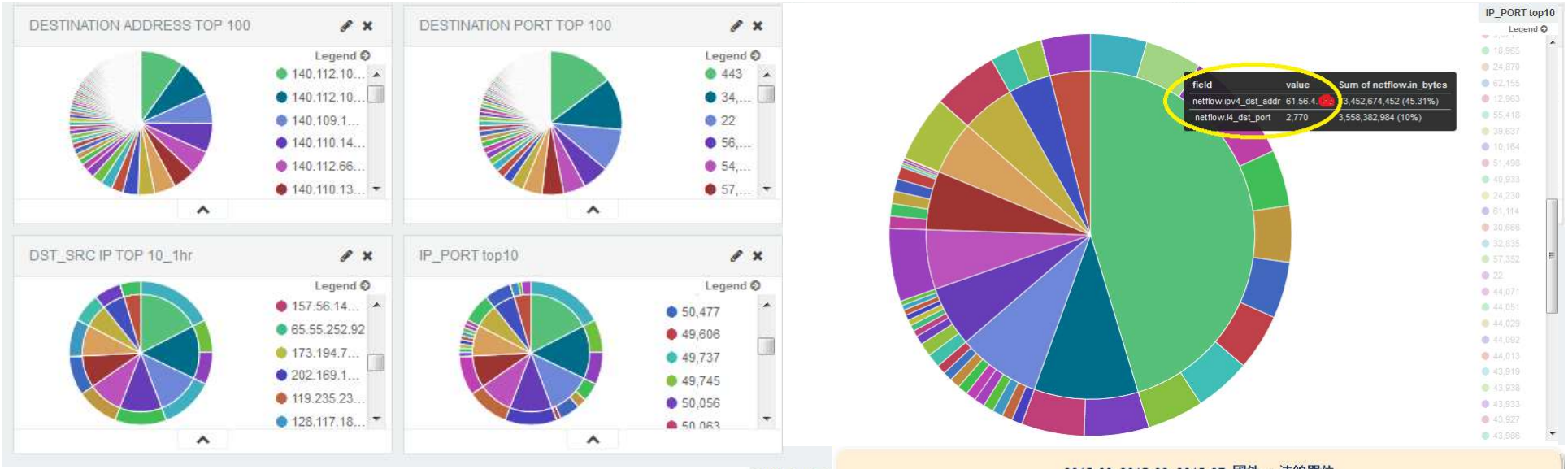
Version 5 packet record format

Bytes	Contents	Description
0-3	srcaddr	Source IP address
4-7	dstaddr	Destination IP address
8-11	nexthop	IP address of next hop router
12-13	input	SNMP index of input interface
14-15	output	SNMP index of output interface
16-19	dPkts	Packets in the flow
20-23	dOctets	Total number of Layer 3 bytes in the packets of the flow
24-27	first	SysUptime at start of flow
28-31	last	SysUptime at the time the last packet of the flow was received
32-33	srcport	TCP/UDP source port number or equivalent
34-35	dstport	TCP/UDP destination port number or equivalent
36	pad1	Unused (zero) bytes
37	tcp_flags	Cumulative OR of TCP flags
38	prot	IP protocol type (for example, TCP = 6; UDP = 17)
39	tos	IP type of service (ToS)
40-41	src_as	Autonomous system number of the source, either origin or peer
42-43	dst_as	Autonomous system number of the destination, either origin or peer
44	src_mask	Source address prefix mask bits
45	dst_mask	Destination address prefix mask bits
46-47	pad2	Unused (zero) bytes

Netflow用途之一：統計分析

NARLabs

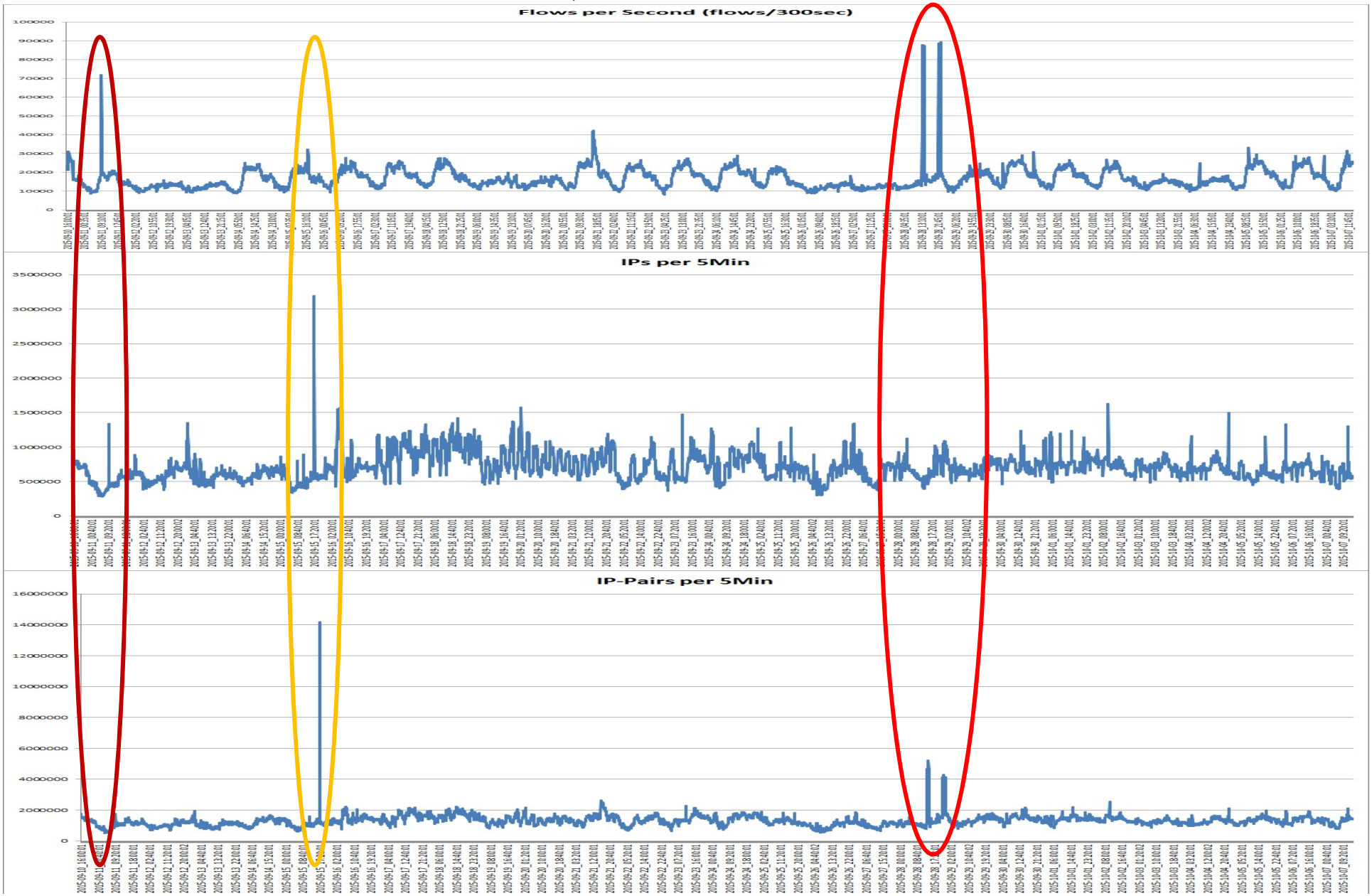
- 週期性的個人/組織/應用等之用量分析、排行圖表與特定查詢。



Flow / IP / IP-Pair 綜合比較：

不同的異常類型

NARLabs



Packet Mirror/Sniffer

NARLabs

- Mirror data 有觸犯隱私權的法律問題
- NetFlow主要提供L3~L4表頭資訊，但Packet mirror能提供L2~L7多方面資訊
- Mirror data 資訊處理所需之計算能力遠高於flow data，投注一般成本僅能針對特定對象範圍使用
- 資安偵測設備多是利用這方法

Simulate Telnet/SSH

NARLabs

- 網管程式以模擬 telnet 或 ssh client 的方式連上設備或主機，下達事先規劃的指令，並分析回應的內容，以獲取所需資訊。
- Perl/PHP/C/Java/C# 在網路上都有免費可用的 Telnet/SSH Lib 可以下載。
- Expect腳本執行程式可執行應答型的任務。

expect

NARLabs

```
#!/usr/bin/expect -f
set HOST [lindex $argv 0]
set USER [lindex $argv 1]
set PASS [lindex $argv 2]
set timeout -1
spawn -noecho ssh -o StrictHostKeyChecking=no $USER@$HOST
expect "*?assword:*"
send -- "$PASS\r"
send -- "\r"
expect "#"
send -- "terminal length 0\r"
send -- "show running-config\r"
send -- "show mpls ldp neighbor\r"
send -- "exit\r"
expect eof
```

Internet Services Protocols

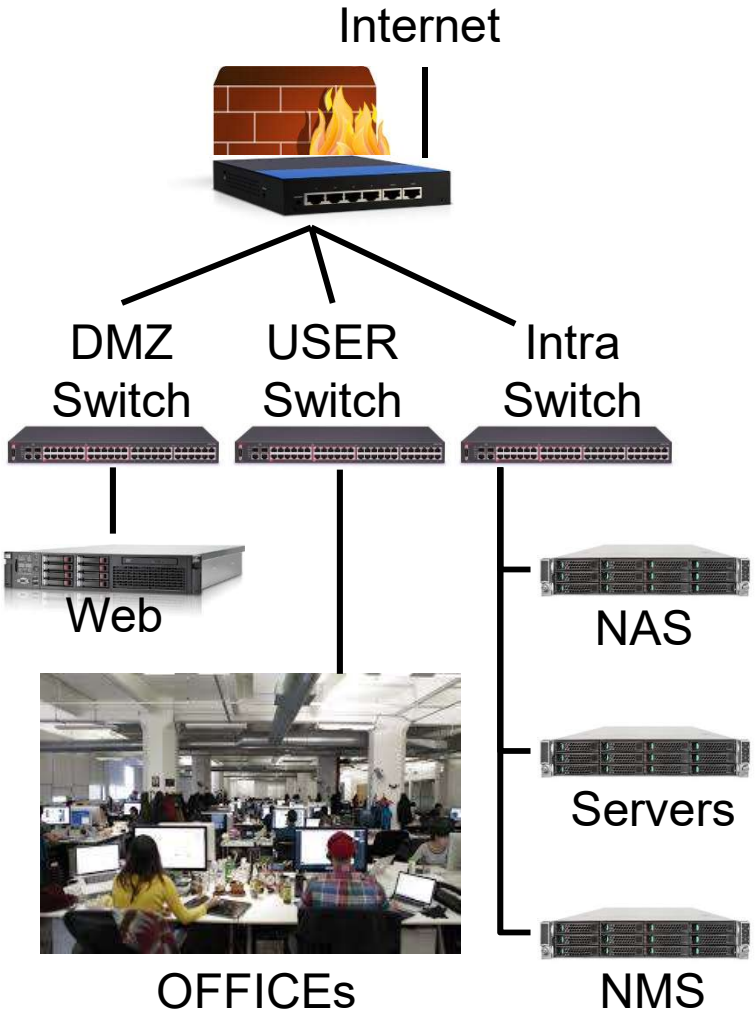
NARLabs

- 以程式模擬 client 連線，進行簡單對談，以確認服務正常或取得設備資訊。
  - HTTP、XML、JSON
- 了解**Internet Services Protocols**
  - **/etc/services (Unix)**
  - **C:\WINDOWS\system32\drivers\etc (MsWindows)**
  - Protocols 可參考RFC
  - 何謂RFC？
    - http://zh.wikipedia.org/w/index.php?title=RFC&variant=zh-hant
    - http://www.rfc-editor.org/
    - http://www.ietf.org/rfc.html

我們需要哪些網管功能?

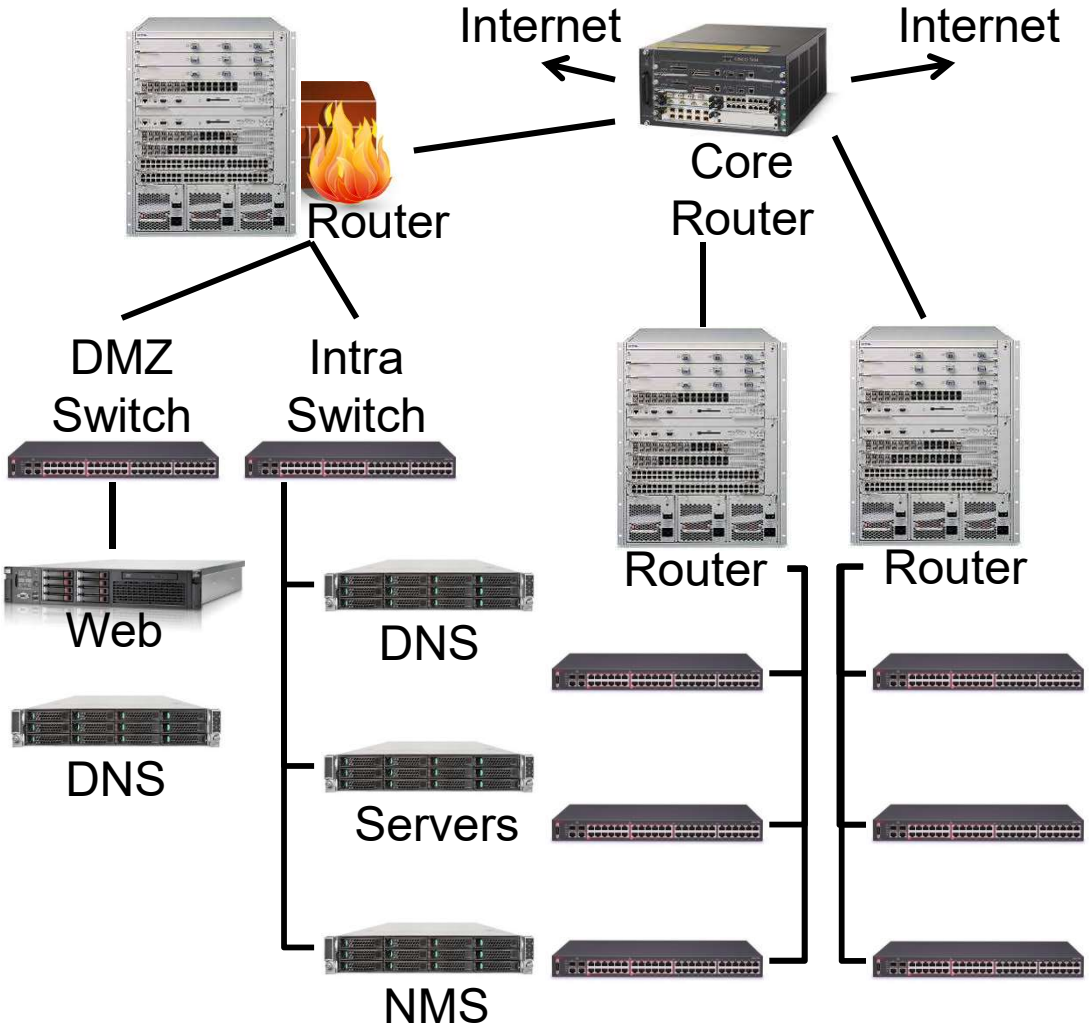
設備能給我們什麼資訊?

小型網路



- 狀態監控
  - Servers、Net-Dev、WAN
- 品質監控
  - Ping server/PC
  - MRTG/流量告警
  - 對外品質
- 分析
  - Mirror packets
  - Netflow
  - Syslog
  - Weblog
  - 資安

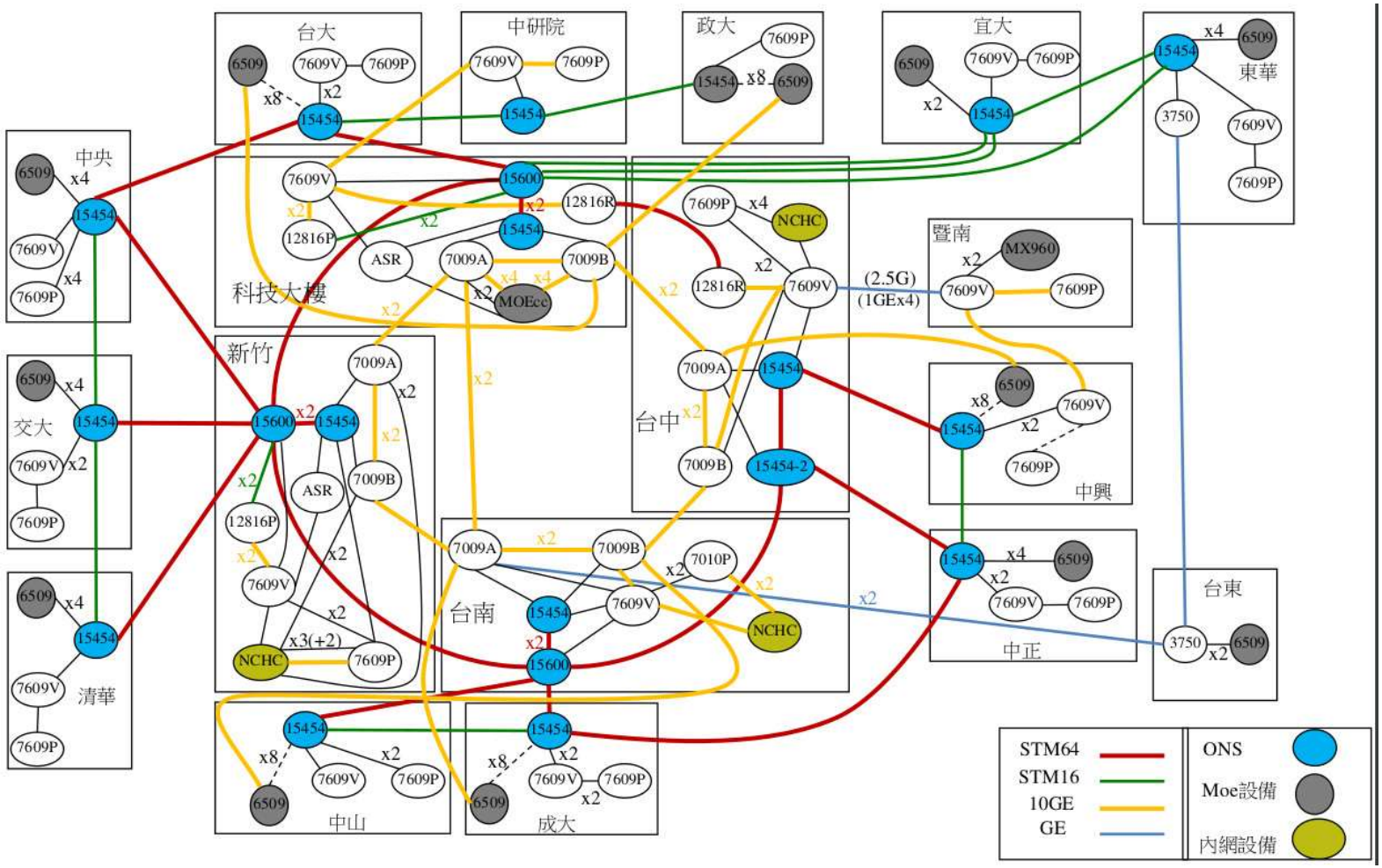
中型網路



- 狀態監控
  - Servers、Net-Dev、WAN、Intra-Routes
- 品質監控
  - Ping server/PC
  - MRTG/流量告警
  - 對內/外品質
- 分析
  - Netflow
  - Syslog
  - Weblog
  - 資安

骨幹網路

NARLabs



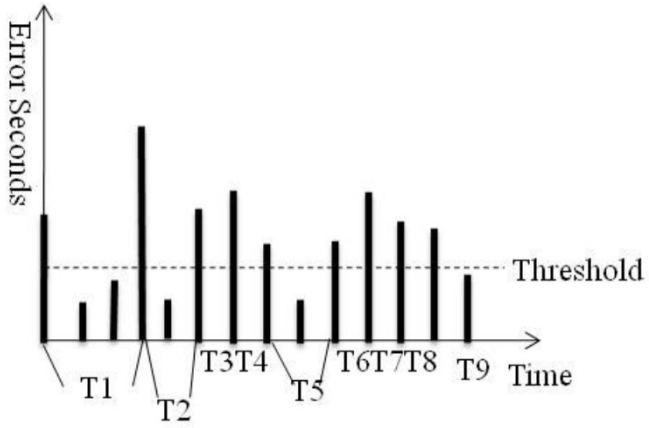
進階網管的思考

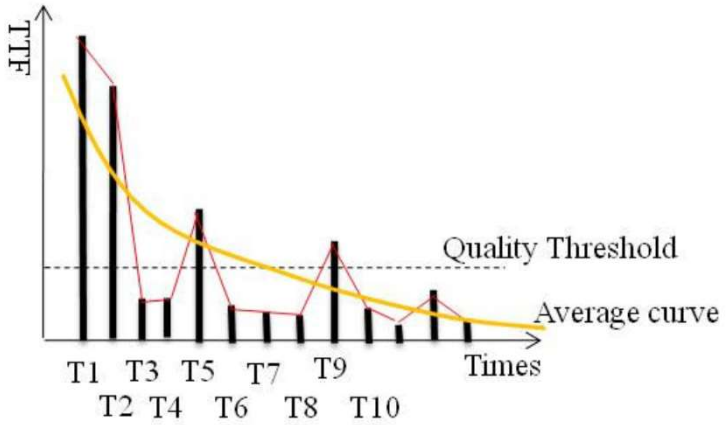
NARLabs

- 網路監控系統的存在意義
  - 協助工程師，縮短障礙時間，節省人力資源
- 基本要求
  - 自動運行
  - 快速察覺異常並通報
  - 良好的介面
- 進階要求
  - 智慧化的異常判斷
    - 何謂異常？如何才算異常？
    - 狀態值、量化值、臨界值
    - 誤告警率
    - 漏告警率
  - 智慧化的異常關鍵位置與原因之判斷
    - 多種類訊息自動彙整及綜合判斷能力，例如自動偵測惡意攻擊並查找來源與其他被攻擊者。
  - 智慧化的自動處置與控制
    - 根基於異常原因定位的準確率
  - 智慧化的回饋修正
- 大資料演算
  - 長時區間惡意行為偵測
  - 使用者行為分析，尋找價值。
  - 偵測異常的頻率與變化趨勢，提供預警。

趨勢偵測

Monitor Object	Threshold (Mbps)	Deviation (Mbps)	Time when over Threshold	Time when OK.	TTF
Throughput-A	80	-20	TA1	TB1	=TA2-TB1
Throughput-A	500	100	TA2	TB2	=TA3-TB2
Throughput-A	550	200	TA3	TB3	=TA4-TB3





敬請指教

Q&A