

Introduction to Network Engineering

Phate

Concept from

- alex/what-happens-when
- vasanthk/how-web-works

Network Engineering

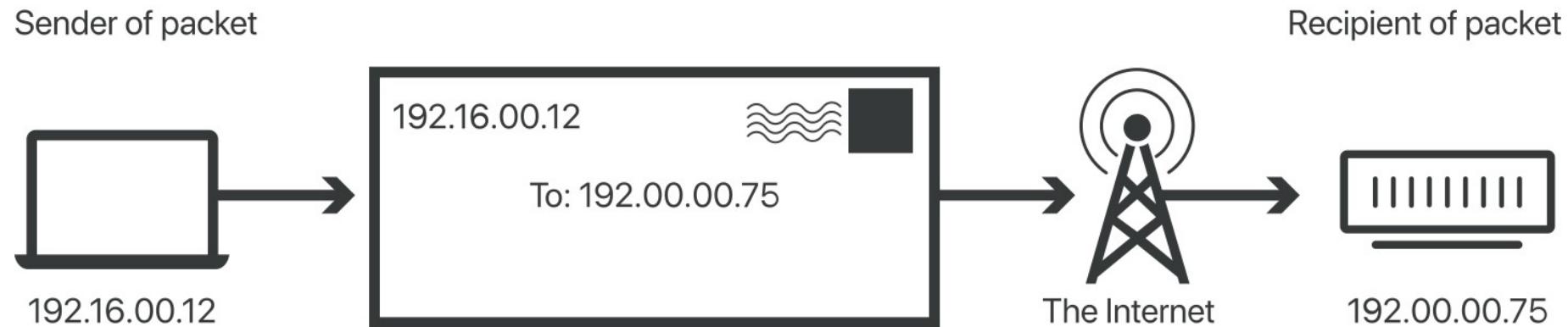


No internet
connection



Slow
internet
connection

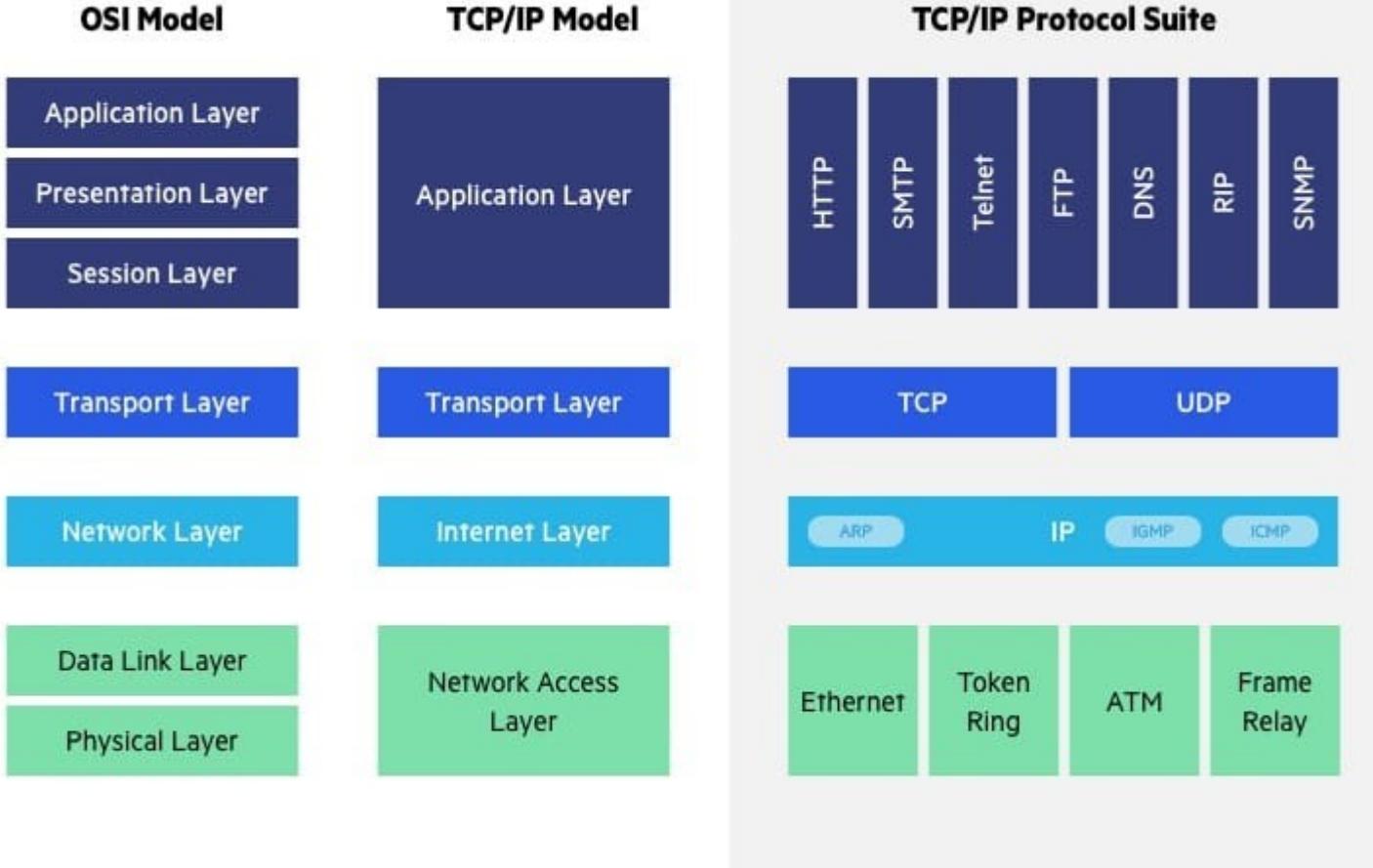
What is Network Engineering?



Speaker notes

網路要處理的就是如何把封包轉交 **source to destination** 要知道資料送出後被目的端主機接收中間會發生甚麼事，對於應用開發雖然不需要知道每一層的細節，但是除錯時會有概念

OSI or TCP/IP Model



Speaker notes

ISO OSI 7 layers model 較早提出但過於太繁瑣，一般比較會用 TCP/IP model 定義來處理問題

HTTP/3 中 Google 提出的 QUIC 協定使用 UDP 取代 TCP 。

舉例使用手機在通訊軟體聊天室中輸入字串按下送出，使用 HTTPS 協定在 presentation layer 用公鑰加密，用 DNS 查詢 IP 後加入封包，最後用 Wifi 丟給 router 。 Router 判斷封包決定收下轉到內網或是丟給下一跳的 router ，到目的地主機假設使用有線網路，走 ethernet 收下封包，用私鑰解開，展示訊息在螢幕上。

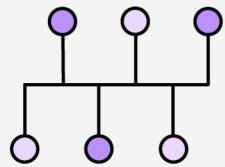
- Presentation or Session layer
 - SSL, TLS (HTTPS)
- Network layer
 - IP, ICMP
 - Router
- Data link layer
 - Ethernet, PPP
 - Switch(or network layer?)
- Physical layer
 - Cables, Hubs

Speaker notes

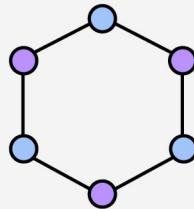
PTT 早期使用沒加密的 telnet，目前已經改用 Websocket 和 SSH <https://www.imperva.com/learn/application-security/osi-model/>

Network Topology

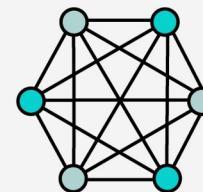
Bus



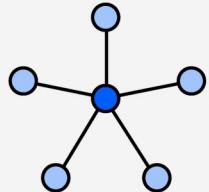
Ring



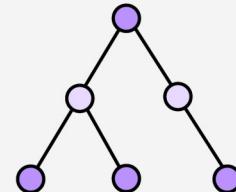
Mesh



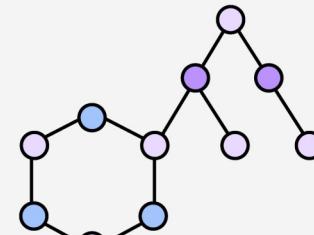
Star



Tree



Hybrid



Speaker notes

「拓樸」是指網路中各節點（設備）之間的連線方式，而不是特定的實體環境。Ring 環狀拓樸例如，EXO Labs 利用 thunderbolt 把 mac mini 串聯叢集，thunderbolt 是 Intel 開發的 P2P 連線標準，所以機器之間是透過多個埠串聯成一圈。Mesh 像如果大坪數房間，會使用多個 Wifi AP 來確保信號覆蓋提高可用性。Star 星狀拓樸較常見，舉例來說我們開發一個應用服務容器會接上 DB 容器存資料，同時也會另外接上 Redis 容器快取。當要設計一個系統時，了解資料會怎麼傳遞很重要。像環狀拓樸，只要單一段連線頻寬低效就會影響整體的效能。星狀拓樸可能遇到程式有 bug 單點故障整個服務就掛掉，那要如何設計備援機制可以橫向擴充

Debugging

Ping [Pong]

```
$ ping -c 4 google.com
PING google.com (142.250.66.78) 56(84) bytes of data.
64 bytes from hkg12s27-in-f14.1e100.net (142.250.66.78): icmp_seq=1 ttl=111 ti:
64 bytes from hkg12s27-in-f14.1e100.net (142.250.66.78): icmp_seq=2 ttl=111 ti:
64 bytes from hkg12s27-in-f14.1e100.net (142.250.66.78): icmp_seq=3 ttl=111 ti:
64 bytes from hkg12s27-in-f14.1e100.net (142.250.66.78): icmp_seq=4 ttl=111 ti:

--- google.com ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3005ms
rtt min/avg/max/mdev = 9.399/11.529/12.724/1.304 ms
```

Speaker notes

ICMP 主要用來做網管的協定，像是 ping 和 traceroute 都是使用 ICMP 協定來傳送封包。PING 的問題是能提供的資訊有
限制，而且有時候會被防火牆阻擋。

Traceroute

```
$ traceroute google.com
traceroute to google.com (142.250.66.78), 30 hops max, 60 byte packets
1 AllNewPCII.mshome.net (172.27.32.1) 0.188 ms 0.169 ms 0.156 ms
2 192.168.0.1 (192.168.0.1) 0.887 ms 0.538 ms 0.862 ms
3 ds1device.lan (192.168.1.254) 4.975 ms 5.864 ms 6.860 ms
4 * * *
5 192.168.41.245 (192.168.41.245) 10.844 ms 10.822 ms 10.812 ms
6 GANGDU-X68-2-PO2-VIP.IX.homeplus.net.tw (203.133.92.173) 24.941 ms 21.37
7 CL-BR93-2-PO13-GANGDU.IX.kbtelecom.net (203.187.23.241) 24.155 ms 18.970
8 TPNOC1-SC93-VL714-CLINGLIAN.IX.kbtelecom.net (203.187.6.45) 20.623 ms 12
9 TPNOC1-P93-2-ETH1-49-SC93.IX.kbtelecom.net (203.187.6.130) 41.719 ms TPNOC1-SC93-VL714-CLINGLIAN.IX.kbtelecom.net (203.187.6.45) 20.623 ms 12
10 * * CHIEF-P93-2-PO86-TPNOC1.IX.kbtelecom.net (203.187.9.66) 35.356 ms
11 72.14.213.145 (72.14.213.145) 39.320 ms 72.14.216.61 (72.14.216.61) 38.3
12 192.178.105.193 (192.178.105.193) 33.237 ms * *
13 142.251.226.168 (142.251.226.168) 21.072 ms 209.85.243.197 (209.85.243.197)
14 11 10 27 i 61 1 100 r 61 10 250 66 702 27 111 100 178 106 166 1100
```

IP Address

```
$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group defa
  link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
      valid_lft forever preferred_lft forever
    inet 10.255.255.254/32 brd 10.255.255.254 scope global lo
      valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
      valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP group de
  link/ether 00:15:5d:64:7a:c2 brd ff:ff:ff:ff:ff:ff
    inet 172.27.43.151/20 brd 172.27.47.255 scope global eth0
      valid_lft forever preferred_lft forever
    inet6 fe80::215:5dff:fe64:7ac2/64 scope link
      valid_lft forever preferred_lft forever
```

- Wireshark

server bind address

```
Usage: uvicorn [OPTIONS] APP
```

Options:

```
--host TEXT      Bind socket to this host. [default: 127.0.0.1]
```

Why is it always 0.0.0.0?

HTTP Debugging

- Status codes
 - 1xx: hold on
 - 2xx: here you go
 - 3xx: go away
 - 4xx: you fucked up
 - 5xx: I fucked up

- cURL

```
$ curl -I https://www.google.com
HTTP/2 200
```

- HTTP Cats, HTTP Status Dogs
- MDN Web Docs
- 人人都需要一個 HTTP proxy 來 debug,
mitmproxy

Question

Which parts of an HTTPS request are encrypted?

```
POST https://example.dev/api?parameter1=data HTTP/1.1
Content-Type: application/json
Authorization: Bearer SECRET_KEY

{
  "data": "secret content"
}
```

Answer

```
POST https://example.dev/api?parameter1=data HTTP/1.1
Content-Type: application/json
Authorization: Bearer SECRET_KEY

{
  "data": "secret content"
}
```

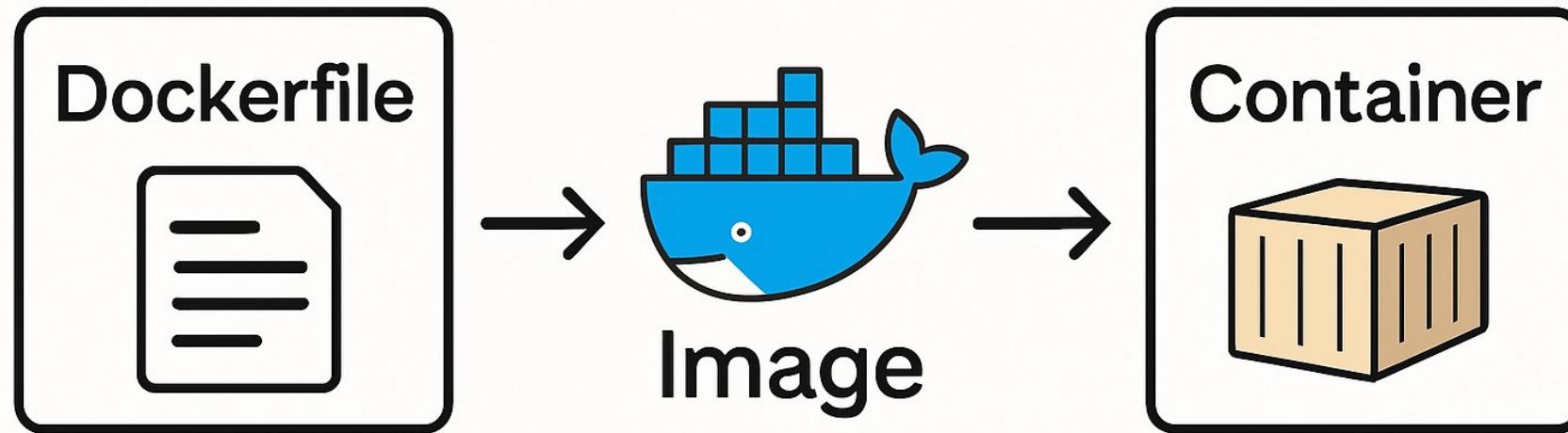
- request line (method, path, parameters)
- headers
- body
- DNS? DoH, DoT
- **HTTP Wiki**

Some References

- How to Become a Network Engineer in 2025!
- 什麼是 OSI 模型？
- OSI 七層架構和 TCP/IP 通訊協定的比較
- 什麼是網際網路通訊協定？
- 企業資料通訊Week4 (3) | HTTP message

Containerization

- OpenVZ 2005 --> Process Container 2006
- LXC 2008 --> Docker 2013 --> K8S 2014 --> OCI
2015



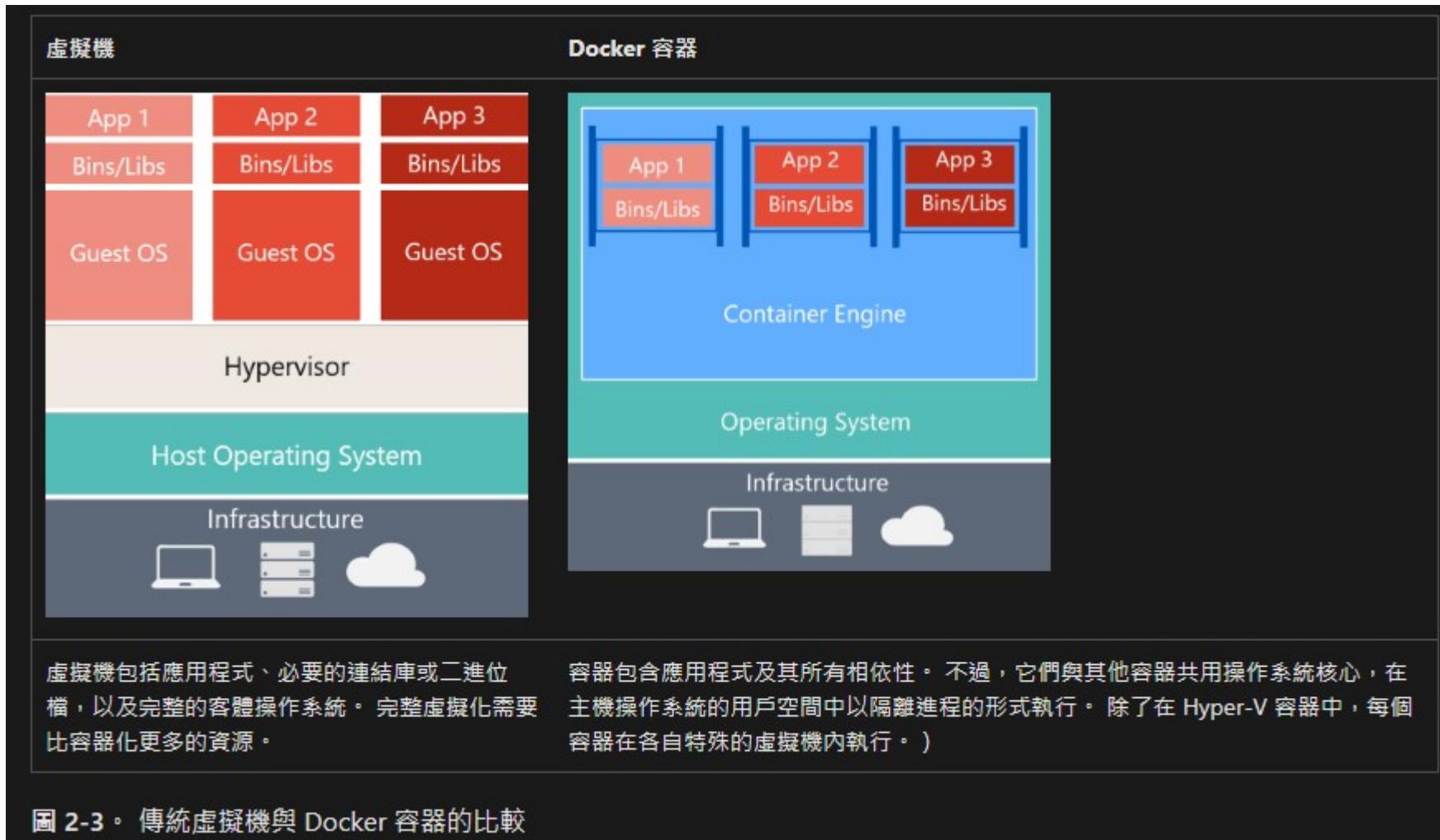


圖 2-3。傳統虛擬機與 Docker 容器的比較

- 为什么程序员都应该学用容器技术

覺得變麻煩的人，純粹只是以前跳過
很多應該做好的本職工作

Live Demo

Afterword

- reveal.js, GitHub repo
- Plugins, Tools and Hardware
- Reveal.js-plugins