

IP层协议

IP层

ISP 网络服务提供商

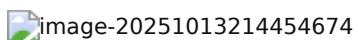
MAC 网卡物理地址

RTT 从源到目的的往返时间

MSS TCP窗口大小

TCP/IP 协议

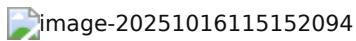
OSI TCP/IP



端口映射

- 例如 HTTPS □ FTP □ DHCP □ HTTP 端口映射
- TCP □ UDP 端口映射
- IP 端口映射

端口映射和**TCP/IP** 协议



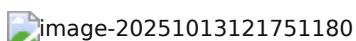
Socket

IP地址+端口

TCP

三次握手

TCP 协议 20世纪



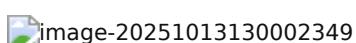
TCP 三报文SYN ACK FIN

- 1 SYN
- 0 ACK

四报文

ACK

- 1 SYN+ACK
- 1 SYN+ACK+ACK
- 1 ACK

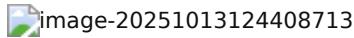


TCP

IP

- FIN+ACK
- ACK+**1**
- FIN+ACK
- FIN+ACK+ACK

+1



TCP/IP

IP

TCP

IP

IP

IP

IP

1. 送信

- FIN+ACK
- TCP Window rwnd 65535

2. 受信

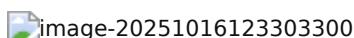
- ACK
- ACK+ACK
- ACK+rwnd

3. 確認

- ACK
- ACK+ACK

IP

- FIN+ACK
- FIN+ACK+ACK
 - FIN+ACK
 - ACK
- ACK+ACK



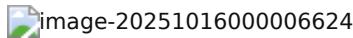
IP

IP

IP = $\min(\text{ACK}, \text{rwnd})$

□□

- សារពិនិត្យ ssthresh នៃការបញ្ចូលពាក្យសង្គម cwnd នឹង 1MSS នៃTCPដែលបានបញ្ចូល
- សារពិនិត្យ 1 នៃការបញ្ចូល
- និង ssthresh នៃការបញ្ចូល
- និងការបញ្ចូល
 - សារពិនិត្យការបញ្ចូល
 - $ssthresh = cwnd / 2$
 - cwnd នឹង 1MSS
- និង 3 នៃការបញ្ចូលACK
 - សារពិនិត្យការបញ្ចូលការបញ្ចូល
 - $ssthresh = cwnd / 2$
 - cwnd នឹង ssthresh + 3MSS
 - និងការបញ្ចូល



BBR

□Google និង TC នៃការបញ្ចូល

- និងការបញ្ចូល
- និងការបញ្ចូល BtlBw និង RTprop នៃការបញ្ចូល
- $\$ \approx BtlBw \times RTprop \$$

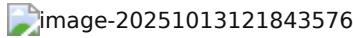
UDP

និងការបញ្ចូល និងការបញ្ចូល និងការបញ្ចូល

□□

- និងការបញ្ចូល
- និងការបញ្ចូល
- និងការបញ្ចូល UDP និងការបញ្ចូល
- និង

UDP និង 8 នៃការបញ្ចូល



IPV4 និង 8

IPV4

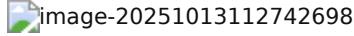
ipv4 និង 8 និង 8 និង 8 . និង

ip និង = និង + និង

- និងការបញ្ចូល
- និងការបញ្ចូល IP និងការបញ្ចូល
- និងការបញ្ចូល IP និងការបញ្ចូល
- និងការបញ្ចូល IP និងការបញ្ចូល

ip និង

- A
128
 - B
16384
 - C
2097152



2

- 0.0.0.0/0 ip範囲
 - 1.0.0.0/1 ip範囲
 - C 256-2=254 ip範囲

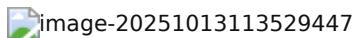
1

32

-  **1**
 -  **0** **1**

□□□□□□□□□□

- 1 IP
 - 0 IP



CIDR 100

□□□□□□□□□□ 1 □□IP□□□□ / 1□□□ □□

IPV6

ipv6 128 8 16 4

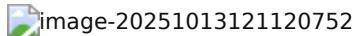
4

- $\overline{1010101010101010} \text{ :: } \overline{1010101010101010}$
 - $\overline{1010101010101010}0001\overline{10101010}$

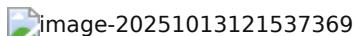
10 of 10

IPv4

64

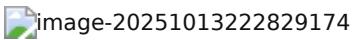


1



NAT

6



三

- **ipNAT**
 - **NAT**

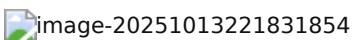
1

- NAT P2P
 - NAT

1

NAT

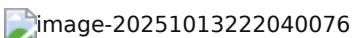
2



- 
 - 
 - 

NAT|||

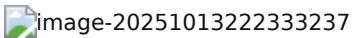
1



-        
 -         **DHCP** 

2

1



DHCP

A horizontal row of 15 empty square boxes, likely for grading student responses.

IP

1

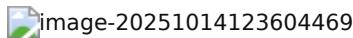
DHCP

2

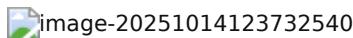
- ** DHCP Discover **
 - 68 → 67
 - IP 0.0.0.0 → 255.255.255.255
 - MAC



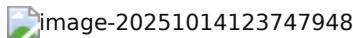
- DHCP ** DHCP Offer ** IP DNS
 - IP
 - MAC



- ** DHCP Request ** DHCP IP



- ** DHCP ACK ** IP



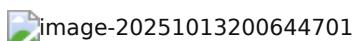
DNS

DNS UDP

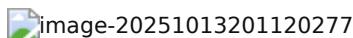
- UDP 512
- UDP 13

Hosts

- . 13

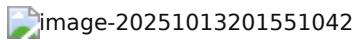


递归查询



DNS

1. IP
2. gethostbyname Hosts DNS
3. DNS DNS
4. DNS TLD .com .cn
5. TLD DNS TLD
6. DNS IP
7. DNS IP



DNS

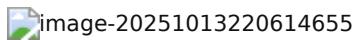
- A ୱୟାମିତିକୀୟିତା**IPv4**
- AAAA ୱୟାମିତିକୀୟିତା**IPv6**
- CNAME ନାମ ପରିବର୍ତ୍ତନ କରନ୍ତି
- MX ନାମ ପରିବର୍ତ୍ତନ କରନ୍ତି

SSH

କେବଳିକାରୀଙ୍କ ଯେଉଁଠାରେ କାମ କରିବାକୁ ପରିଚାରିତ କରିବାକୁ ପରିଚାରିତ କରିବାକୁ ପରିଚାରିତ କରିବାକୁ

କାମ

- କେବଳ TCP
- କେବଳ SSH
- କେବଳିକାରୀଙ୍କ **SSH**
- କେବଳିକାରୀଙ୍କ କାମ କରିବାକୁ
- କେବଳିକାରୀଙ୍କ କାମ କରିବାକୁ
- କେବଳିକାରୀଙ୍କ କାମ କରିବାକୁ
- କେବଳିକାରୀଙ୍କ କାମ କରିବାକୁ
- କେବଳିକାରୀଙ୍କ host କେବଳ host କାମ କରିବାକୁ host କାମ କରିବାକୁ host କାମ କରିବାକୁ
- କେବଳିକାରୀଙ୍କ host କେବଳ host କାମ କରିବାକୁ



କାମ

କାମ

- କେବଳିକାରୀଙ୍କ
- କେବଳିକାରୀଙ୍କ କାମ କରିବାକୁ
- କେବଳ host କାମ
- କେବଳିକାରୀଙ୍କ
- କେବଳିକାରୀଙ୍କ

SSH

କାମ ssh-keygen କାମ କରିବାକୁ **ssh-copy-id** କାମ କରିବାକୁ

HTTP

କାମ

- କେବଳ Stateless
- କେବଳ HTTP1.1
- କେବଳ Header
- କେବଳିକାରୀଙ୍କ
- କେବଳିକାରୀଙ୍କ

- 端口号**80**

协议

- **HTTP/1.1** 基于文本的请求响应协议
- **HTTP/2** 基于二进制的请求响应协议
- **HTTP/3** 基于 QUIC/UDP 的 TCP 替代协议，使用 TLS

HTTP/1.1

支持 **Keep-Alive** 协议

通过 **HTTP** 头部 `Connection: keep-alive` 来启用

- 通过 **Content-Length** 头部指定 Body 的长度
- 通过 **Content-Type** 头部指定 Body 的类型
 - 文本/二进制数据
 - 图像/音频等
- 使用 **TCP** 连接进行数据传输

HTTP2

协议

- 在 **TCP** 连接上实现，兼容 **HTTP/1.1**，但使用 **TCP** 连接

头部

- **Stream ID** 标识一个流

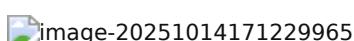
头部

- **Stream ID** 标识一个流
- **Stream_ID** 标识一个流

HTTP3

协议

- 基于 **TCP** 或 **QUIC** 或 **UDP** 的 **TCP** 替代协议
- 改进 **HTTP2** 协议
- 基于 **QUIC** 和 **TLS 1.3**



HTTPS

协议

端口号**443**

即 **Http** 协议加上 **S** 即 **SSL/TLS**

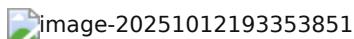
- **Https** = **Http** + **SSL/TLS**

1

-
 -

A decorative horizontal bar consisting of a series of small, evenly spaced rectangular blocks.

1



SSL

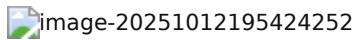
TLS1.2 ██████████ **TCP** █████

1. Client Hello TLS Version 1 Client Random
 - 1
 - 2
 2. Server Hello TLS Version 2 Server Random
 - 3
 - 4
 3. Certificate
 - 5
 4. Server Key Exchange
 - 6
 5. Server Hello Done
 - 7
 6. Certificate Verify
 - 8
 7. Encrypted Handshake Message
 - 9
 8. Encrypted Handshake Message
 - 10
 9. Client Finished
 - 11
 10. Client Finished
 11. Finished

TLS1.3 **2** **1**

1

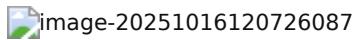
- 
 - 



QUIC

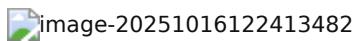
HTTP/2, HTTP/3, UDP, QPACK

- HTTP2 သူတဲ့ TLS သူတဲ့ TCP မှာ
- HTTP3
- UDP
- QPACK အတွက်



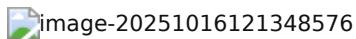
QUIC ပုံစံ

- QUIC ပုံစံ
- QUIC ပုံစံ
- QUIC ပုံစံ



လျော့လျော့

- လျော့လျော့ 1RTT လျော့လျော့လျော့လျော့လျော့လျော့
- လျော့လျော့ 0RTT



လျော့

- QUIC ပုံစံ ID လျော့လျော့လျော့
- ISP ပုံစံ ID လျော့လျော့

