

TCP/IP 通訊協定及應用

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<http://wmlab.csie.ncu.edu.tw/course/tcp>

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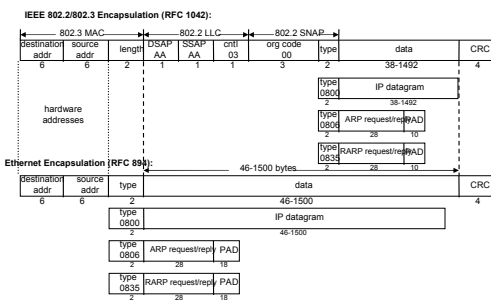
Link Layer

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Ethernet and IEEE 802 Encapsulation

- IEEE 802.2/802.3 encapsulation (RFC 1042) and Ethernet encapsulation (RFC 894)



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Ethernet and IEEE 802 Encapsulation

- RFC require that every Internet host:
 - 1. Must be able to send and receive packets using RFC 894 (Ethernet) encapsulation
 - 2. Should be able to receive RFC 1042 (IEEE 802) packets intermixed with RFC 894 packets
 - 3. May be able to send packets using RFC 1042 encapsulation. If the host can send both types of packets, default to send RFC 894
- Same type field
 - The IEEE 802 frame had same 2-byte type field with the Ethernet frame format
- Trailer Encapsulation
 - RFC 893 describes another form of encapsulation used on Ethernet called trailer encapsulation. It is deprecated nowadays

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SLIP: Serial Line IP

- What's SLIP?
 - It is a simple form of encapsulation for IP datagram on serial lines, and it specified in RFC 1055
 - SLIP has become popular through RS-232 serial port and high-speed modems
- The rules specify the framing used by SLIP:

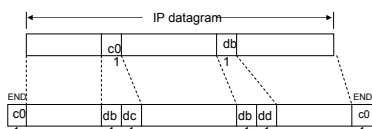


Figure 2.2 SLIP encapsulation

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SLIP: Serial Line IP

- Deficiencies of SLIP
 - Each end must know the other's IP address
 - There is no type field, it can't be used for some other protocol at same time
 - There is no checksum added by SLIP. This makes it essential that the upper layers provide some form of CRC
- Compressed SLIP
 - SLIP performance drawback
 - slow, to carry 1 byte of data requires 40 bytes header, an overhead of 40 bytes
 - CSLIP is specified in RFC 1144
 - CSLIP normally reduces the 40-byte header to 3 or 5 bytes
 - These smaller headers greatly improve the interactive response time

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PPP: Point-to-Point Protocol

- Three components of PPP
 - A way to encapsulate IP datagrams on a serial link. PPP supports either an asynchronous link with 8 bits of data and no parity or bit-oriented synchronous links
 - A link control protocol (LCP) to establish, configure, and test the data-link connection
 - A family of network control protocols (NCPs) specific to different network layer protocols

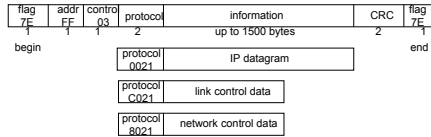


Figure 2.3 Format of PPP frames.

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PPP: Point-to-Point Protocol

- How to escape flag byte?
 - On a synchronous link
 - done by the hardware using a technique called bit stuffing
 - On asynchronous link
 - use 0x7d as an escape character, the next character of 0x7d had its sixth bit complemented as follows:
 - 0x7e is transmitted => 0x7d 0x5e
 - 0x7d is transmitted => 0x7d 0x5d
 - ASCII control character (less than 0x20) For example, the byte 0x01 is transmitted => 0x7d 0x21
- PPP using the link control protocol
 - omit the constant flag and address fields and to reduce the size of the protocol field from 2 bytes to 1 byte

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PPP: Point-to-Point Protocol

- advantages of PPP over SLIP
 - support for multiple protocols on a single serial line
 - a cyclic redundancy check on every frame
 - dynamic negotiation of IP address for each end
 - TCP and IP header compression similar to CSLIP
 - a link control protocol for negotiating many data-link options. The price we pay for all these features is 3 bytes of additional overhead
- What's Loopback Interface
 - A loopback interface allow a client and server on the same host to communicate with each other using TCP/IP
 - most system assign the IP address of 127.0.0.1, named localhost
 - in brief, it is just doing a test job

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Loopback Interface

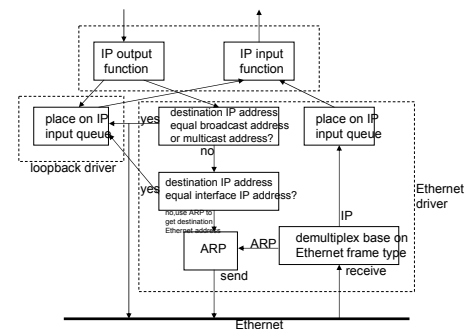


Figure 2.4 Processing of IP datagrams by loopback interface.

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MTU

- What's MTU (maximum transmission unit)
 - The limits the number of bytes of data is called the MTU
- If datagram is larger than the link layer's MTU
 - breaking the datagram up into smaller pieces (fragments), so that each fragment is smaller than the MTU

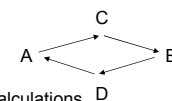
Network	MTU (bytes)
Hyperchannel	65535
16 Mbits/sec token ring (IBM)	17914
4Mbits/sec token ring (IEEE 802.5)	4464
FDDI	4352
Ethernet	1500
IEEE 802.3/802.2	1492
X.25	576
Point-to-point (low delay)	296

Figure 2.5 Typical maximum transmission units (MTUs).

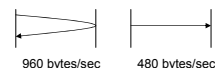
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Path MTU

- What's path MTU
 - Path MTU is the smallest MTU of any data link that packets traverse between the two hosts
- Why the path MTU between any two hosts need not be constant?
 - routing need not be symmetric, hence the path MTU need not be the same in the two directions



- Serial Line Throughput Calculations



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Summary



- Both SLIP and PPP are often used on slow links, both provide a way to compress the common fields that don't often change
- Loopback data has been completely processed by the transport layer and by IP when it loops around to go up the protocol stack