

# ICMP: Internet Control Message Protocol

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# Outline

- **basic ideas**
- **ICMP header format**
- **message types**
- **ICMP related command (ping & traceroute)**

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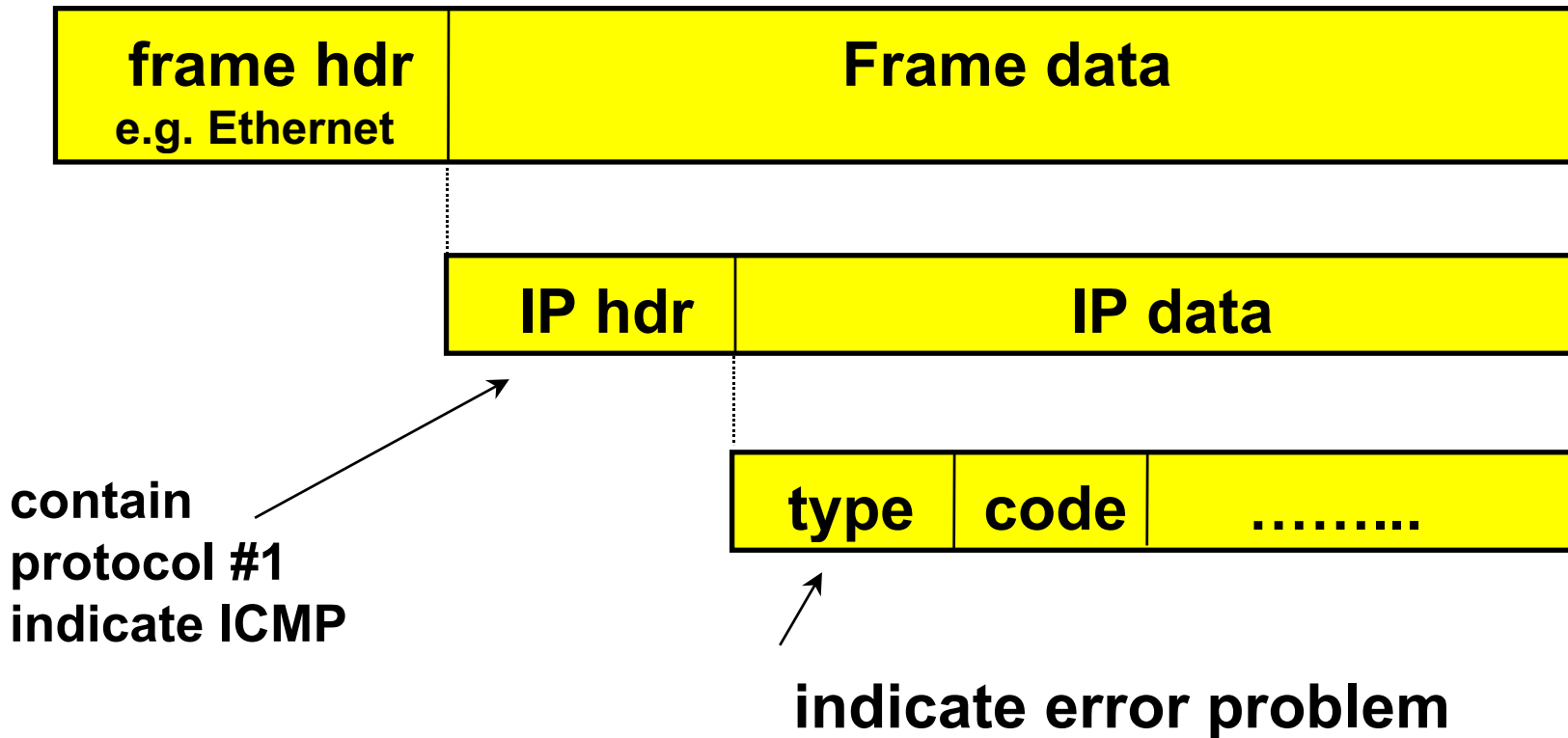
# ICMP

- **ICMP is provided within IP which generates error messages to help the IP layers (best effort delivery)**
- **Function of ICMP**
  - **a node recognizing a transmission problem.(ttl exceed, destination unreachable, etc.) generates ICMP messages**
  - **ICMP provides some useful diagnostics about network operation (ping, traceroute)**

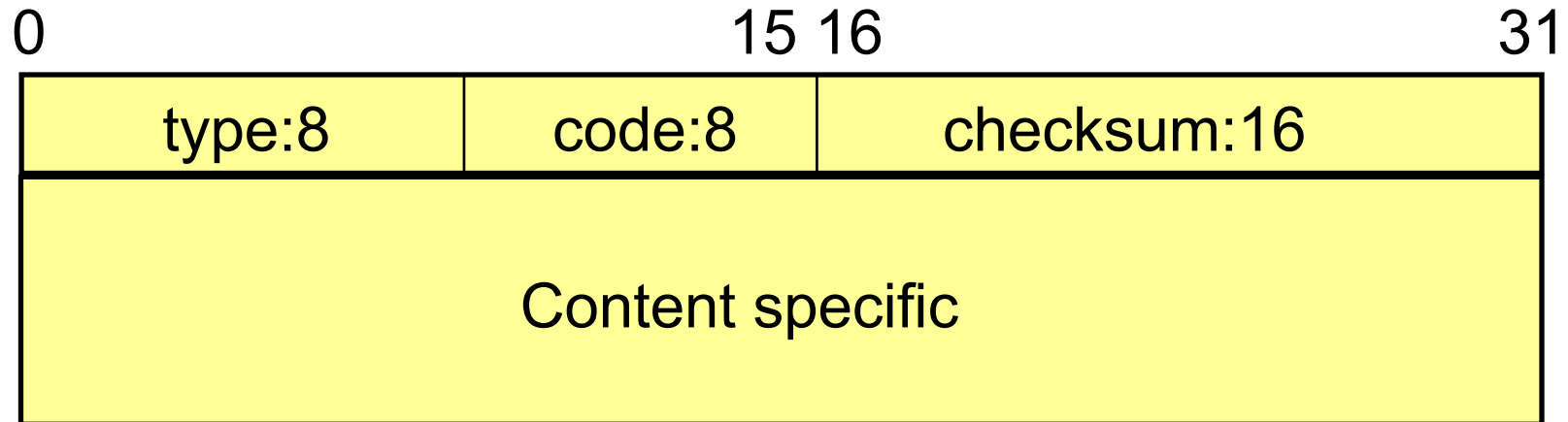
# ICMP

- **ICMP error messages never generates due to:**
  - ICMP error messages selves
  - Broadcast/Multicast
  - This to prevent broadcast Storms
- **What are Broadcast Storms**
  - a large number of broadcast datalink frames transmitted nearly simultaneous from several hosts
  - LAN may have been brought to a standstill

# ICMP encapsulation



# ICMP header



- **type** - relevant ICMP message
- **code** - more detail information
- **checksum** - covers ICMP header/data (not IP hdr)

# ICMP types

<b>type</b>	<b>code</b>	<b>meaning</b>
<b>0</b>	<b>0</b>	<b>echo reply</b>
<b>3</b>	<b>0</b>	<b>network is unreachable</b>
<b>3</b>	<b>1</b>	<b>host is unreachable</b>
<b>3</b>	<b>3</b>	<b>port is unreachable</b>
<b>4</b>	<b>0</b>	<b>source quench</b>
<b>5</b>	<b>0</b>	<b>redirect</b>
<b>8</b>	<b>0</b>	<b>echo request</b>

## ICMP types, cont.

<b>type</b>	<b>code</b>	<b>meaning</b>
<b>9/10</b>	<b>0</b>	<b>router discovery/advertisement</b>
<b>11</b>	<b>0</b>	<b>time exceed</b>
<b>12</b>	<b>0</b>	<b>parameter problem</b>
<b>13/14</b>	<b>0</b>	<b>time stamp request</b>
<b>17/18</b>	<b>0</b>	<b>network request/reply</b>

## ICMP type 0/8 echo request/reply

type=0 or 8	code	checksum
identifier		sequence number
optional data		

- ping sends icmp type 8 echo request to a node and expects an icmp type 0 echo reply
- identifier and sequence number are used to identify datagrams

## ICMP type 3 destination unreachable

type=3	code	checksum
unused (must be 0)		
Internet header + 64 bit of original data		

- **router is unable to deliver datagram, it can return the ICMP type 3 with failure code**
- **Internet header plus 64 bits of original datagram are used to identify the datagram caused the problem.**

## ICMP type 4 source quench

type=4	code	checksum
unused (must be 0)		
Internet header + 64 bit of original data		

- router detected hosts were overloaded would send this message to hosts that were the major cause.
- The hosts would then reduce the rate at which subsequent messages are sent
- RFC recommends that router must not generate source quench, host must still accept the message but need take no action

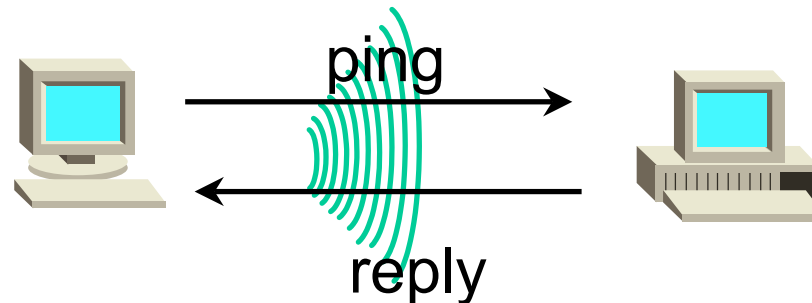
## ICMP type 5 route change request

type=5	code	checksum
IP address of a more suitable router		
Internet header + 64 bit of original datagram		

- **use only by router to suggest a more suitable route to the originator (also called ICMP redirect)**

## ping - ICMP echo request/reply

- ping sends an ICMP echo request to a remote host, which then return an ICMP echo reply to the sender
- All TCP/IP node is supposed to implement ICMP and respond to ICMP echo



# ping command

- variants #1
  - send a single echo request message and wait for a reply
  - another request is sent if the reply is not received within one seconds
  - continue until at least one reply is received or stop after time out

```
% ping nontri
```

```
nontri.ku.ac.th is alive
```

```
% ping aix1
```

```
no answer from aix1.cpe.ku.ac.th
```

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# ping command, cont.

- **variants #2**
  - **send an echo request message every seconds and records the time it takes for each reply**
  - **every echo request contains a unique sequence number to match replies and request**
  - **also record round-trip timing**
  - **also do packet lost statistics**
  - **see example next slide**

# ping example

```
% ping -s nontri.ku.ac.th
```

```
PING nontri.ku.ac.th: 56 data bytes
```

```
64 bytes from nontri.ku.ac.th (158.108.2.71): icmp_seq=0. time=3. ms
```

```
64 bytes from nontri.ku.ac.th (158.108.2.71): icmp_seq=1. time=2. ms
```

```
64 bytes from nontri.ku.ac.th (158.108.2.71): icmp_seq=2. time=3. ms
```

```
64 bytes from nontri.ku.ac.th (158.108.2.71): icmp_seq=3. time=2. ms
```

```
^C
```

```
----nontri.ku.ac.th PING Statistics----
```

```
4 packets transmitted, 4 packets received, 0% packet loss
```

```
round-trip (ms) min/avg/max = 2/2/3
```

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# ping as debugging tools

- **What we get from ping?**
  - **Timing information**
  - **Connection reliability**
  - **Destination is reachable (routable)**
  - **Layer is functional, but not guaranteed telnet!**

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# ping results

- **no response**
  - no end node, no connection
- **lost packet (significant when >2-3%)**
  - transmission error on WAN/LAN, overloading bridges/routers
- **time acknowledge vary**
  - host/network overloading, >100 ms make telnet less acceptable)
- **no lost and echo time is reasonably constant**
  - **Congratulation! That's all we want.**

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# traceroute

- **command to determine the active route to a destination address**
- **How to?**
  - **send a UDP messages to an unused port on the target host with ttl=1**
  - **router decrease ttl to 0, it has to return an ICMP time exceed message**
  - **traceroute sets ttl =2 and retransmits, this time go one more hop**
  - **ttl++ until UDP messages reach the destination.**
  - **the target returns an ICMP service unavailable because there is no UDP port service.**

## traceroute, example

```
% traceroute nwg.nectec.or.th
```

```
traceroute to nwg.nectec.or.th (192.150.251.31), 30 hops max, 40 byte packets
```

```
1  router.cpe.ku.ac.th (158.108.33.1) 4 ms 4 ms 3 ms
```

```
2  158.108.250.1 (158.108.250.1) 3 ms 4 ms 4 ms
```

```
3  192.150.250.101 (192.150.250.101) 8 ms * 13 ms
```

```
4  nwg.nectec.or.th (192.150.251.31) 12 ms 8 ms 8 ms
```

- usually probes each hop 3 times
- a lost message or a router that doesn't respond is denote with an "\*"