

Computer Networks and Internets

《计算机网络与因特网》课件

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PART IV Internetworking

Chapter 23 (2)

An Error Reporting Mechanism(ICMP)

差错报告机制(ICMP)

23.2 Best-Effort Semantics and Error Detection

“尽力而为”语义和差错检测

- **IP Datagrams can be lost, duplicated, delayed, or delivered out of order.**
- **IP attempts to avoid errors and to report problems when they occur.**

23.3 Internet Control Message Protocol

互联网控制报文协议

- The TCP/IP suite includes a protocol that IP uses to send error messages when conditions such as the one described above arise.
- ICMP: Internet Control Message Protocol.
- The protocol is required for a standard implementation of IP.
- IP uses ICMP when it sends an error message, and ICMP uses IP to transport messages.

•ICMP 信息列表

Type	Name
0	Echo Reply
1	Unassigned
2	Unassigned
3	Destination Unreachable
4	Source Quench
5	Redirect
6	Alternate Host Address
7	Unassigned
8	Echo
9	Router Advertisement
10	Router Selection
11	Time Exceeded
12	Parameter Problem
13	Timestamp
14	Timestamp Reply
15	Information Request
16	Information Reply
17	Address Mask Request
18	Address Mask Reply
19	Reserved (for Security)
20-29	Reserved (for Robustness Experiment)
30	Traceroute
31	Datagram Conversion Error
32	Mobile Host Redirect
33	IPv6 Where-Are-You
34	IPv6 I-Am-Here
35	Mobile Registration Request
36	Mobile Registration Reply
37-255	Reserved

表 7-7 类型字段的值与 ICMP 报文的类型的关系

ICMP 报文种类	类型的值	ICMP 报文的类型
差错报告报文	3	目的站不可达
	4	源站抑制 (Source quench)
	11	时间超过
	12	参数问题
	5	改变路由 (Redirect, 或重定向)
询问报文	8 或 0	回送 (Echo) 请求或回答
	13 或 14	时间戳 (Timestamp) 请求或回答
	17 或 18	地址掩码 (Address mask) 请求或回答
	10 或 9	路由器询问 (Router solicitation) 或通告

Examples of ICMP error messages:

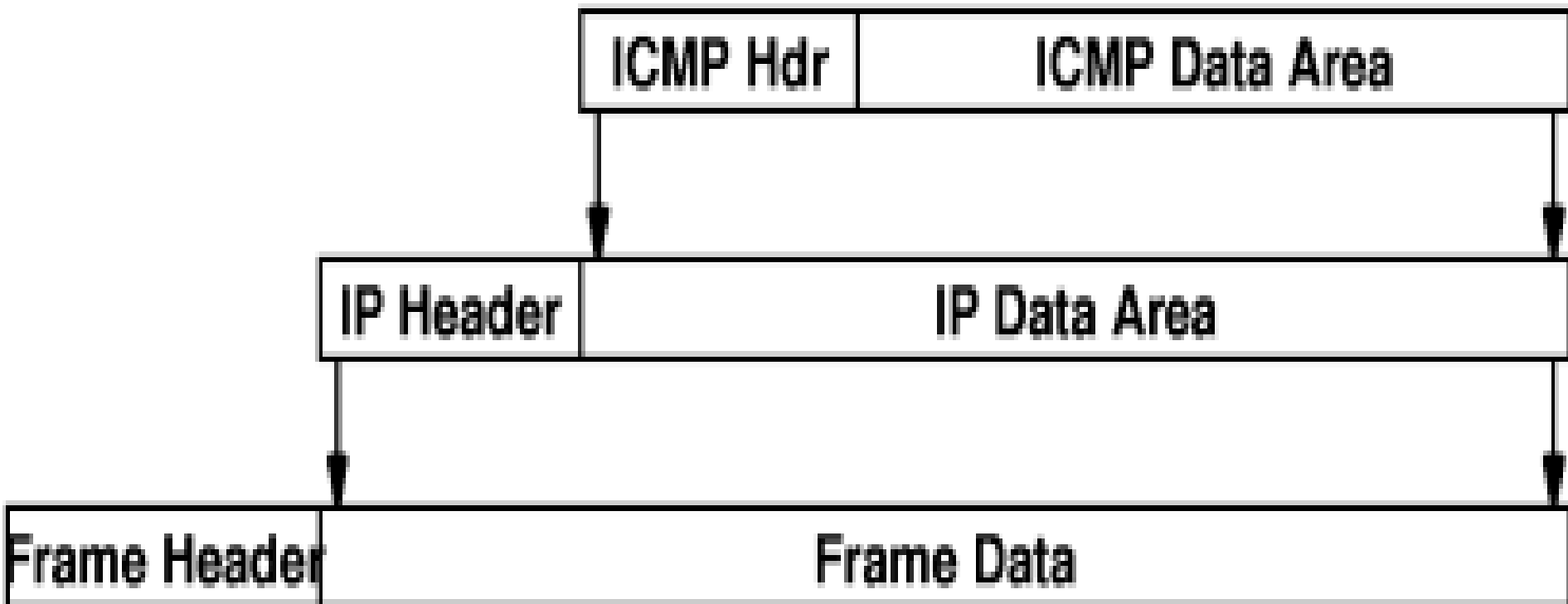
- **Source Quench(源抑制):**
- **Time Exceeded(超时).**
- **Destination Unreachable(目的不可达)**
- **Redirect(重定向).**
- **Parameter Problem(参数问题)**

Examples of ICMP informational messages:

- **Echo Request/Reply(回应请求/应答).**
- **Address Mask Request/Reply(地址屏蔽码请求/应答)**

23.4 ICMP Message Transport

- ICMP uses IP to transport each error message.
- The ICMP message is placed in the data area of the IP datagram.



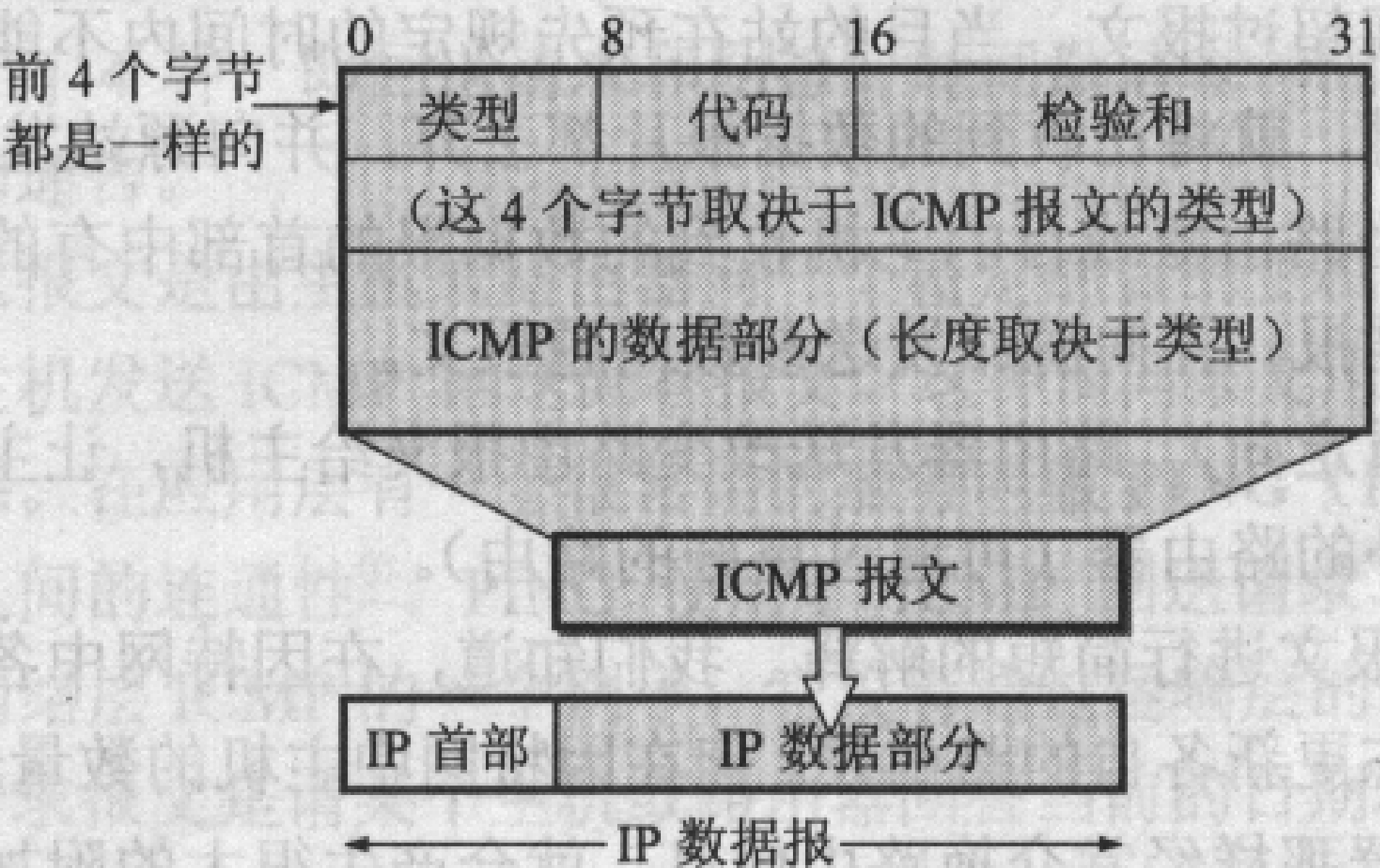


图 7-22 ICMP 报文的格式

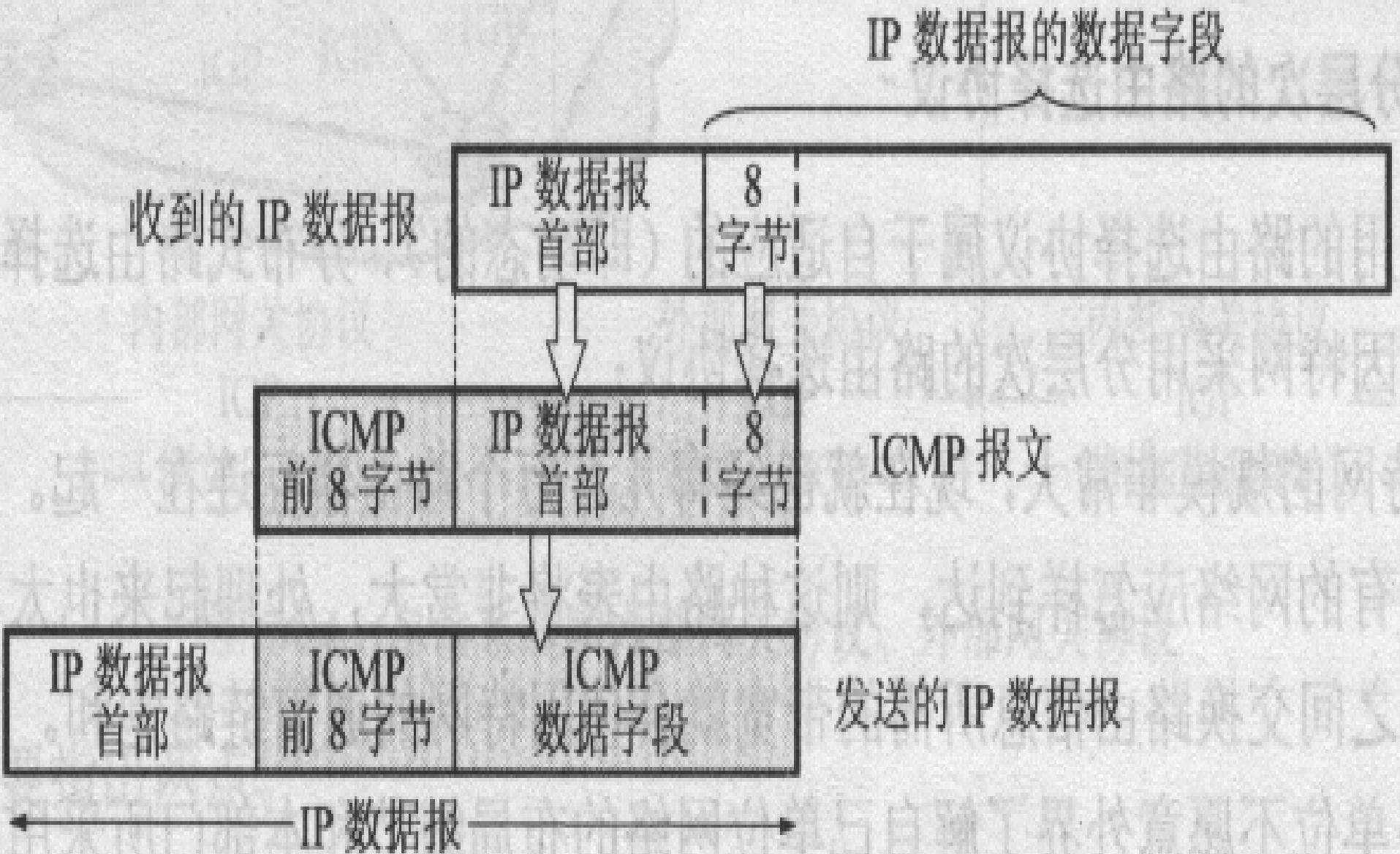


图 7-23 ICMP 差错报告报文的数据字段的内容

23.5 Using ICMP Message To test Reachability

用ICMP报文测试可达性

- Ping program uses the ICMP echo request and echo reply messages.
- Ping sends an IP datagram that contains an ICMP echo request message to the specified destination.
- Whenever an echo request arrives, the ICMP software must send an echo reply.

23.6 Using ICMP To Trace A Router用I C M P跟踪路由

- Each router that handles a datagram decrements the TIME TO LIVE counter in the header.
- If a counter reaches zero, the router discards the datagram and sends an ICMP time exceeded error back to the source.
- Traceroute program simply sends a series of datagram and waits for a response to each.

23.7 The last Address printed by Traceroute

- Traceroute continues to increment the TIME TO LIVE until the value is large enough for the datagram to reach its final destination.
- Send an ICMP echo request message; the destination host will generate an ICMP echo reply.
- Send a datagram to a nonexistent application; the destination host will generate an ICMP destination unreachable message.

23.8 Using ICMP For Path MTU Discovery

- In a router, IP software fragments any datagram that is larger than the MTU of the network over which the datagram is being transmitted.
- The smallest MTU along a path from a source to a destination is known as the path MTU.
- The error message consists of an ICMP message that reports fragmentation was required but not permitted.

作业

- ICMP对IP数据传输采取了哪些控制措施？
- 理解TraceRoute和PING的原理。
- 考虑如何利用ICMP协议对一个网络上的时延性能进行监控？