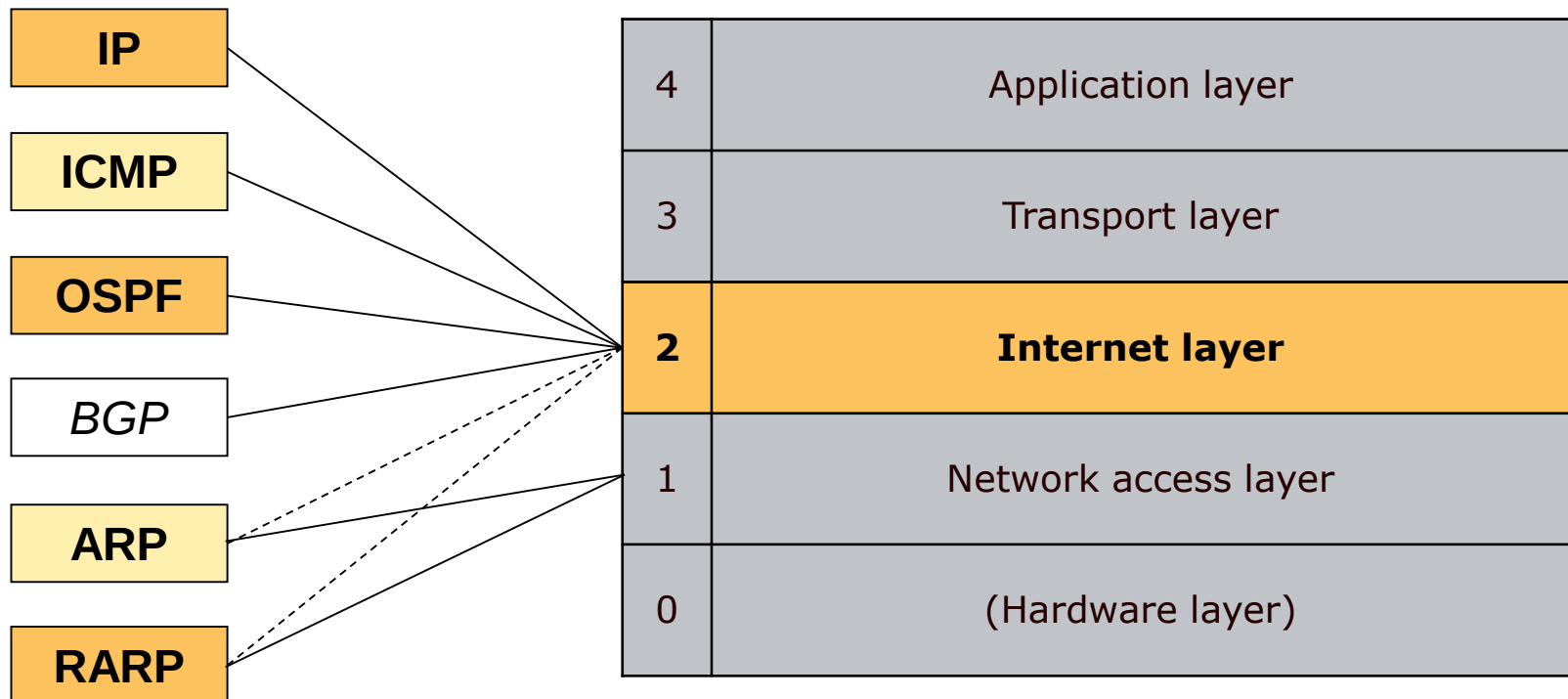


Other Protocols of the Internet Layer

1

TCP/IP Protocol Layers



ICMP (1/5)

2

ICMP - Internet Control Message Protocol (RFC 792 / 1256)

Functions:

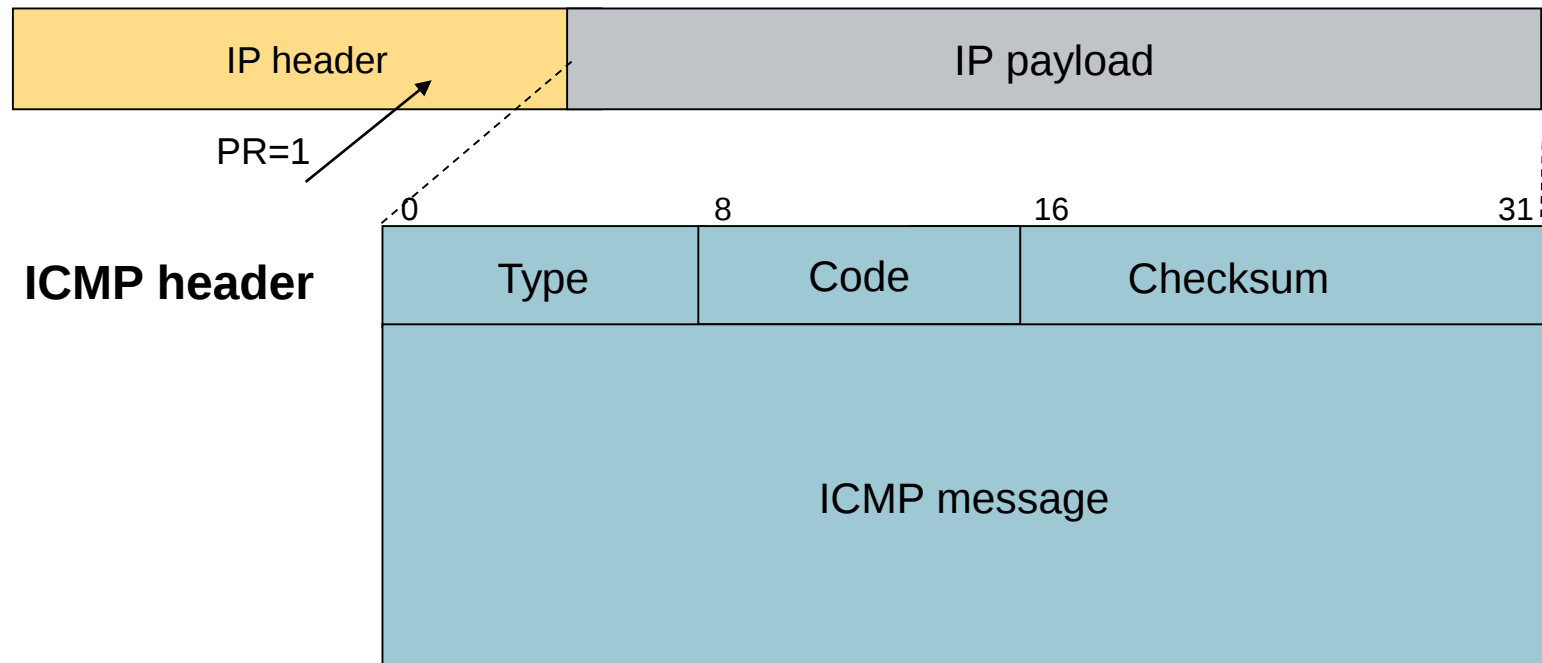
- Error diagnosis (e.g. accessibility via ping)
- Recording of timestamps
- Detection of expired timestamps
- Management of routing tables
- Flow control to avoid router overload
- Determination of permitted MTU (Maximum Transfer Unit)

Is encapsulated in IP datagram (protocol field in the IP header PR=1)

ICMP (2/5)

3

Data Format



ICMP (3/5)

4

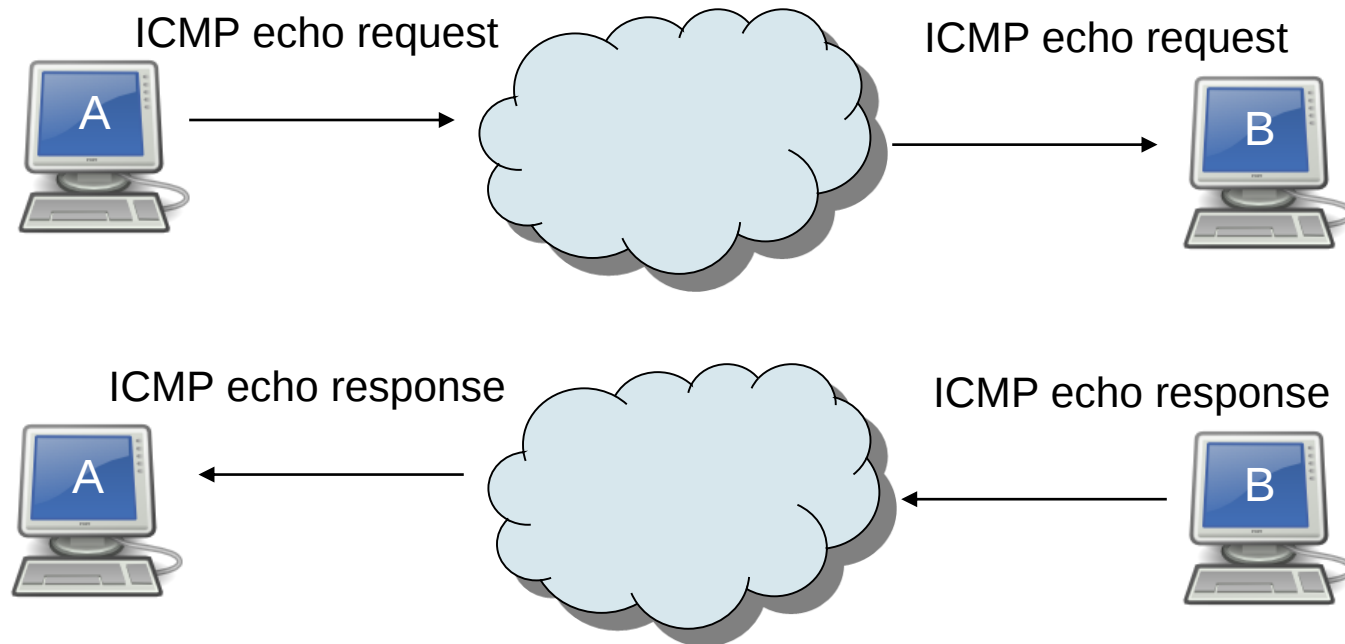
Message Types

0	Echo answer
3	Target not reached
4	Throttle sending rate
5	Change route
8	Echo request
9	Router advertisement
10	Search for a router
11	Lifetime of an IP datagram exceeded
13	Timestamp request
14	Timestamp answer
17	Query subnet mask

ICMP (4/5)

5

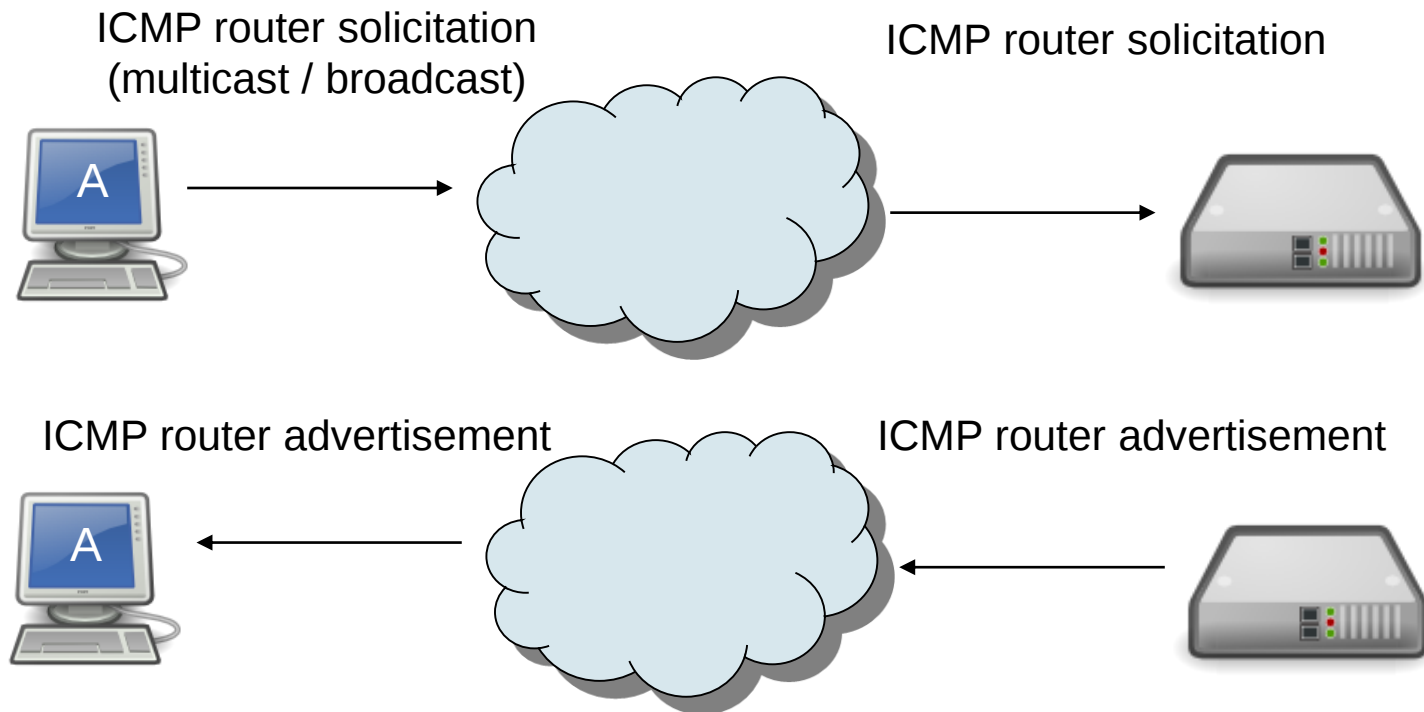
Testing Reachability



ICMP (4/5)

6

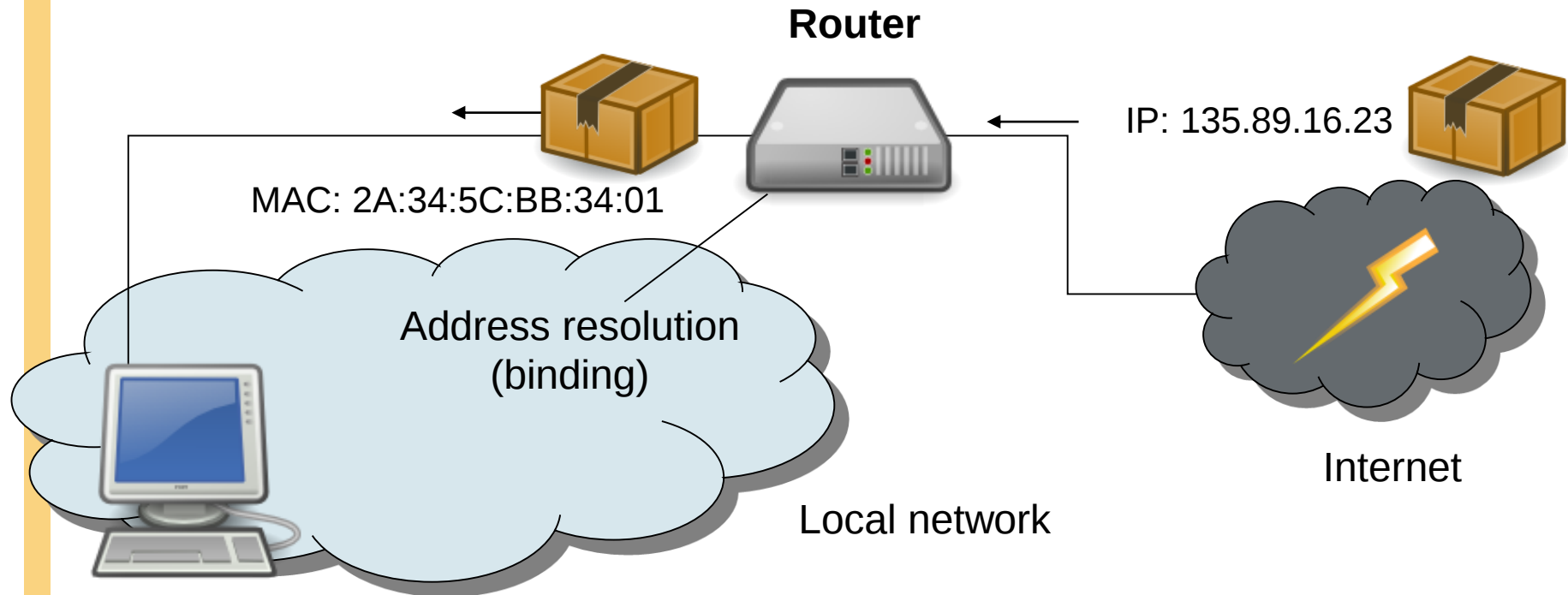
Determining Router (router solicitation)



ARP – Address Resolution Protocol (1/3)

7

Router must convert local network IP address into network address, e.g. Ethernet address



ARP – Address Resolution Protocol (2/3)

8

Possible methods:

1. Table search

- Router has internal address table for translation
- only feasible for small networks (throughput)

2. Direct calculation

- $f(\text{IP address}) = \text{HW address}$
- Prerequisite: HW address can be determined in such a way that calculation is possible

3. Message exchange

- Router sends request for address resolution of an IP address
- Centralized: ARP server responds with HW address
- Decentralized: Router broadcast → computer manages own IP address and answers when IP detected

ARP – Address Resolution Protocol (3/3)

9

ARP – Message format

- ARP request: IP address + translation request
- ARP answer: IP address + HW address

Problem:

- Inefficient, if before each data transfer ARP request must be initiated!

Solution:

- Using a cache for IP/HW addresses
(**ARP cache**)

IPv4 Problems

10

Current IP version (**IPv4**) is extremely successful

The reason being its well-thought-out IP-basic design:

- Use **was possible with new hardware technologies** – IPv4 was developed before the dissemination of LAN technology!
- Also functions in networks that are **orders of magnitude faster** than those for which it was originally designed
- Has coped with **enormous growth** in the global, heterogeneous Internet



BUT: larger growth than ever expected has brought IPv4 to the limits of its capabilities – the transition to its successor IPv6 is urgently needed