Networks

IP Routing

A quick note regarding when the destination is not on the local network

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IP routing for the source host is quite simple: if the destination is on the local network, send the packet directly. This probably uses ARP (on the first packet) to get the hardware address of the destination

Networks

IP Routing

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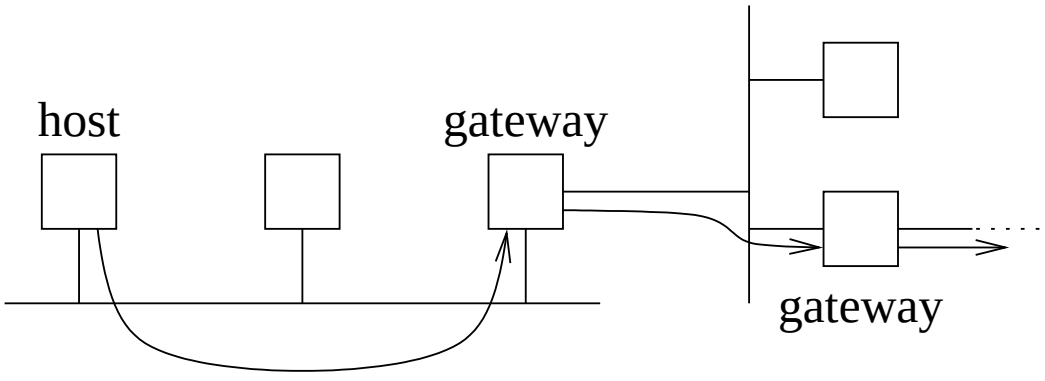

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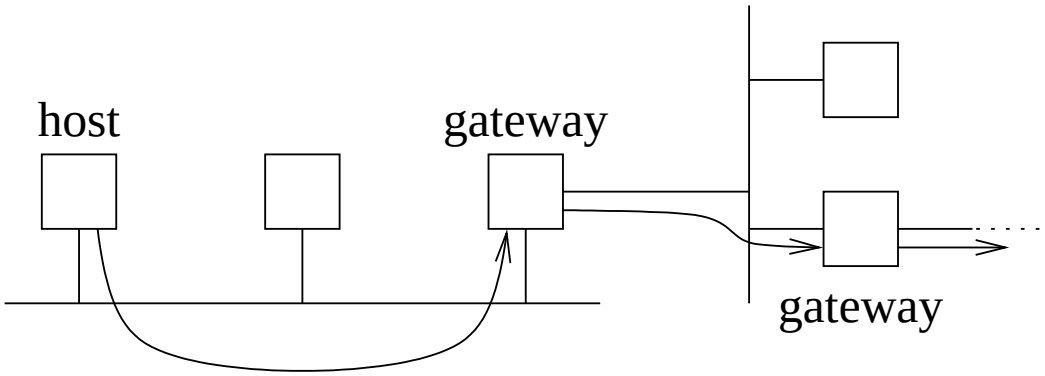

Gateway

This keeps the complexity of the software needed on the hosts down: only the gateway will need to have a bit of intelligence about routing

Networks

IP Routing

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We shall see later how it gets this information

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- is the destination on the local network?
- yes: send it directly, possibly with an ARP, if needed
- no: send it to the gateway, possibly with an ARP, if needed

Note in the latter case, the host might need to do an ARP for the *gateway*

Networks

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So, here, the physical and network addresses in the Ethernet frame are completely unrelated!

Networks

IP Routing

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The IP address is for the ultimate destination; the hardware address is for the next hop

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IP Routing

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Exercise Is ARP needed on a PPP connection?

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The target host recognises the request for its IP address

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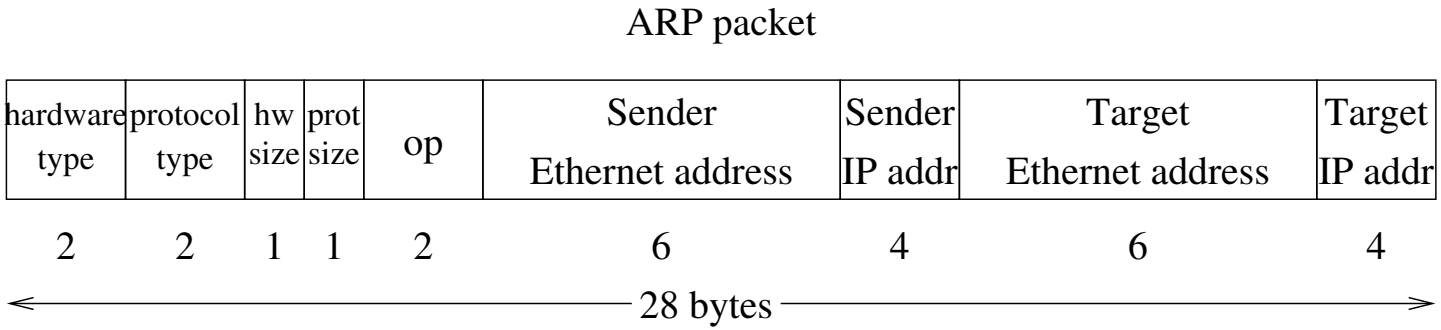
The source gets the reply and reads out the target's Ethernet address. It can now use that Ethernet address to send IP packets

The other hosts on the network need do nothing

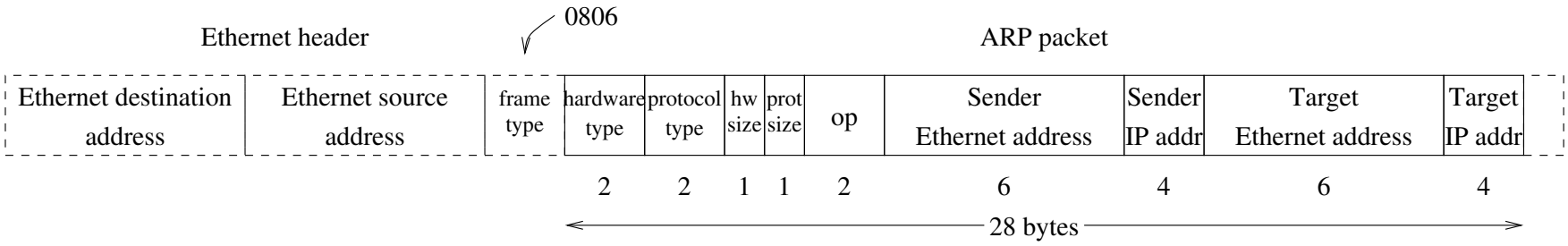
ARP



ARP packet

The Ethernet frame type for ARP is 0806

ARP



ARP packet within Ethernet frame

Contained within an Ethernet frame

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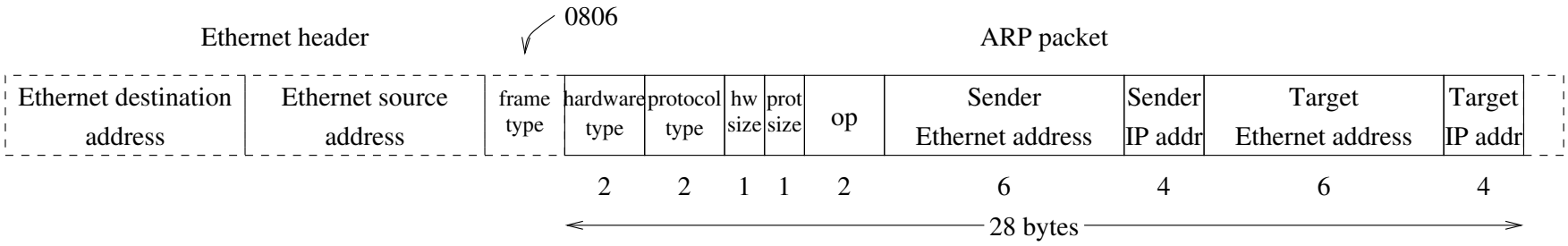
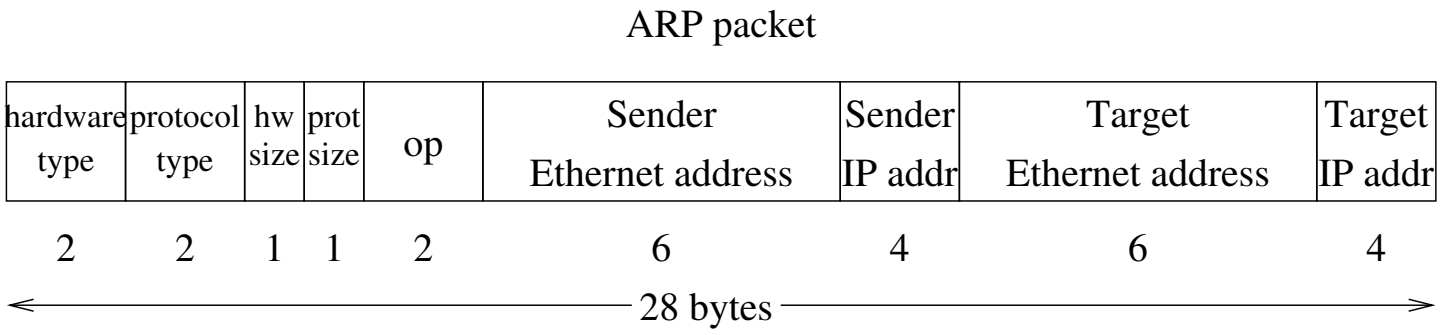


ARP packet within Ethernet frame

Contained within an Ethernet frame

The Ethernet type field allows the software that reads the packet from the Ethernet card to pass the contents of the packet to the software that implements ARP

ARP



ARP fields

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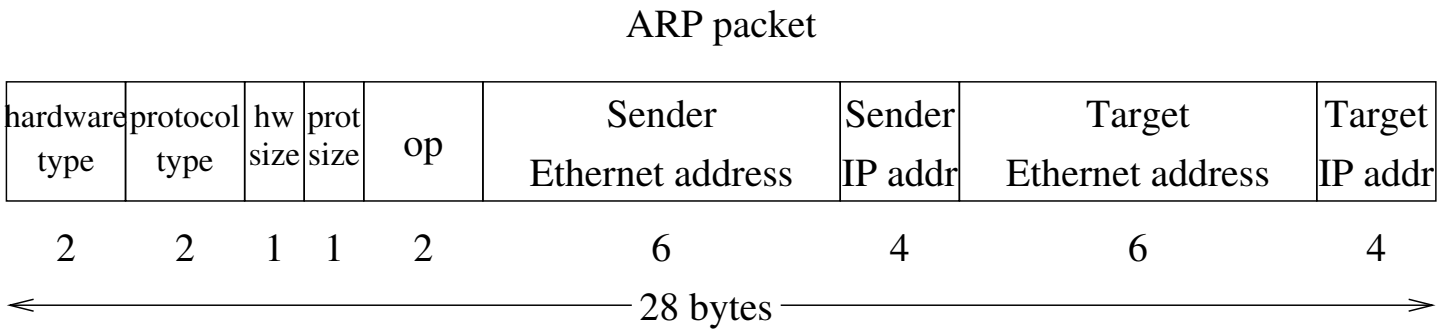

ARP fields

- Hardware type: 1 for an Ethernet address

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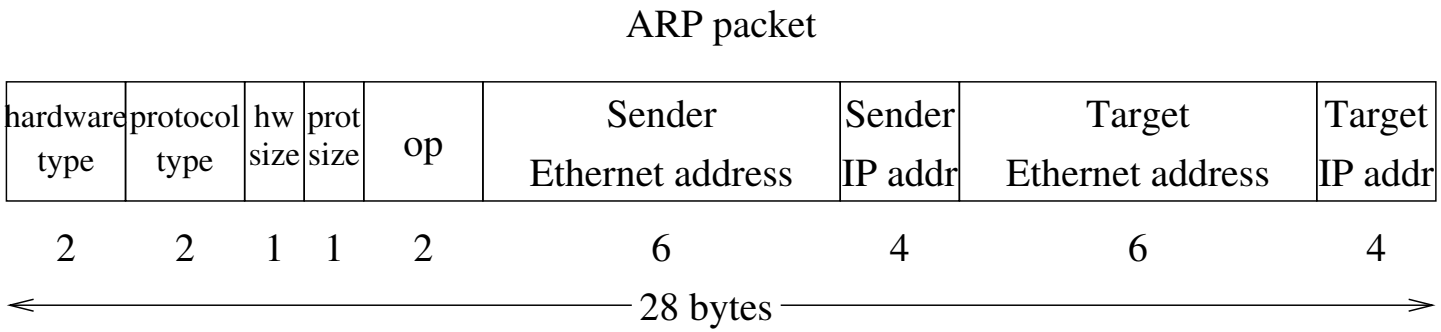

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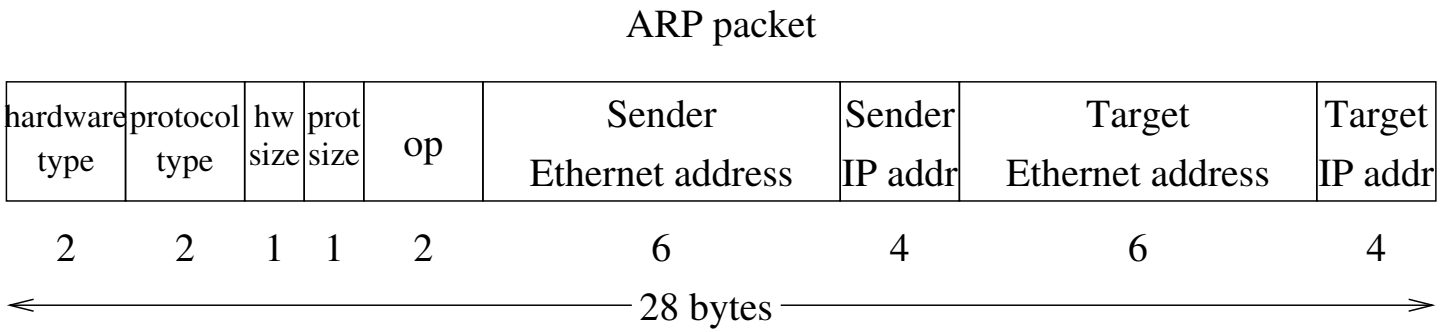

ARP fields

- Hardware type: 1 for an Ethernet address
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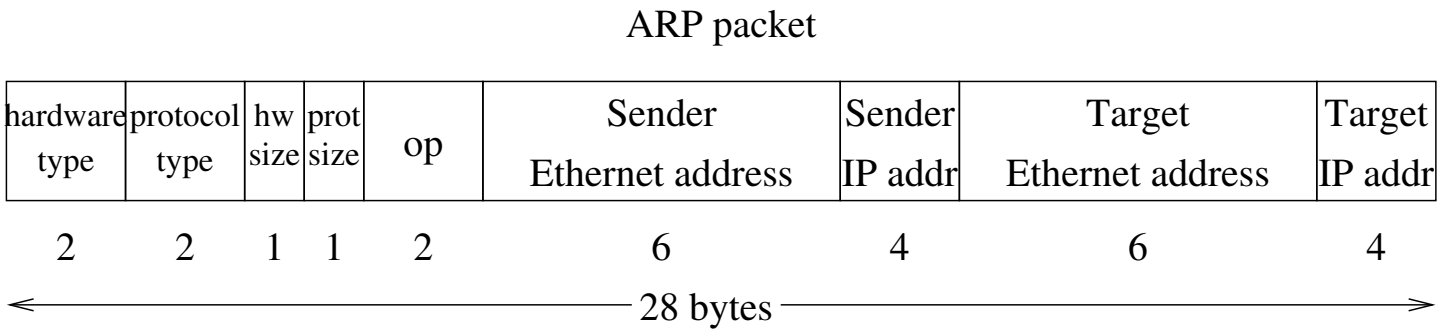
- Sizes: sizes in bytes of the address fields, 6 for Ethernet, 4 for IP

ARP



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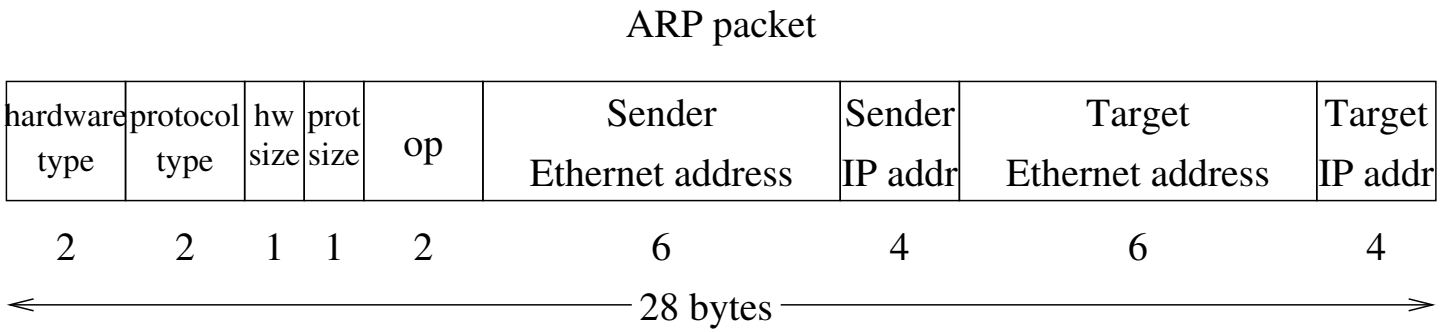

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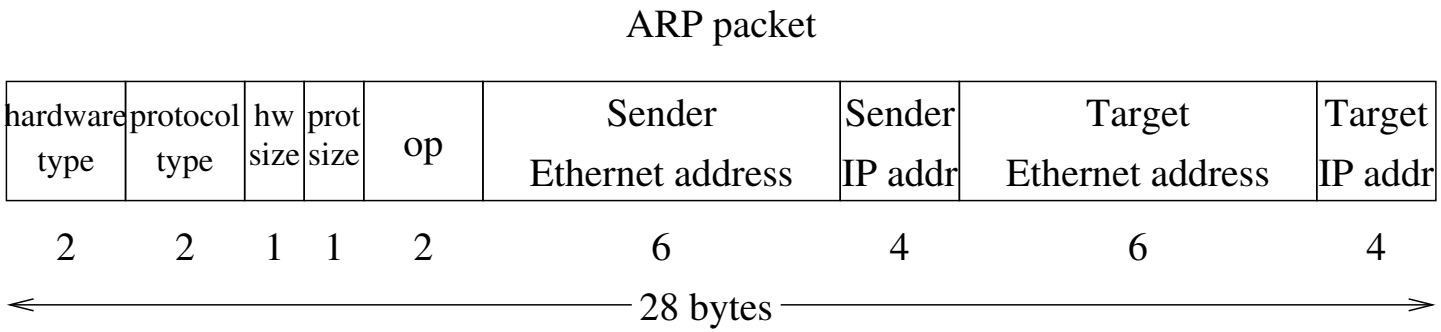

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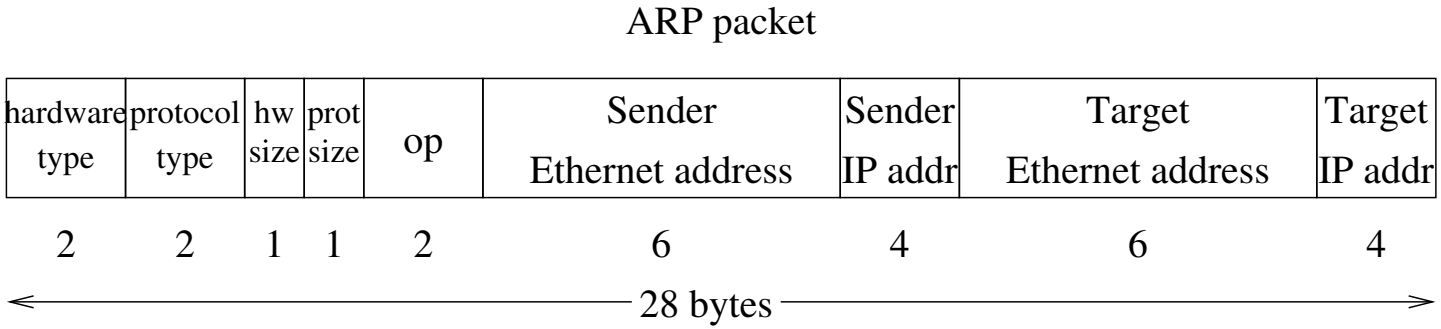

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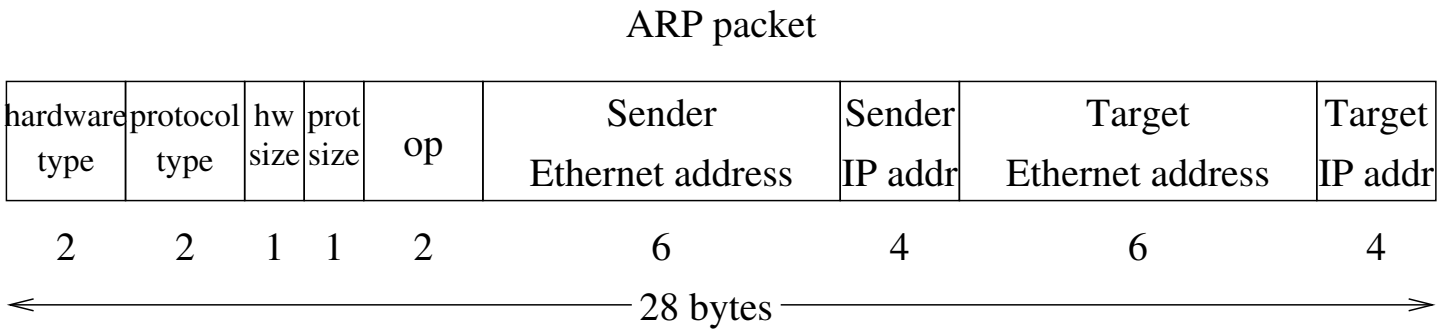

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This might be “no such host” or “host unreachable”

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All machines on the local network are free to read any ARP request or reply they see and modify their own ARP caches accordingly

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Without a gratuitous ARP a host might send an IP packet to the old cached, but now out-of-date hardware address

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And it makes no sense for gateway to forward an ARP to another network, which might not even be of the same physical type

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Used in the days before switches were common: this trick is unlikely to be used these days

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This trick allows us to extend an Ethernet (or other network) over a physically larger distance than its specifications allow, and to join a wireless network to a wired one so they appear to be a single network

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Note: this is different from a gateway we mentioned earlier, that connects two *different* networks

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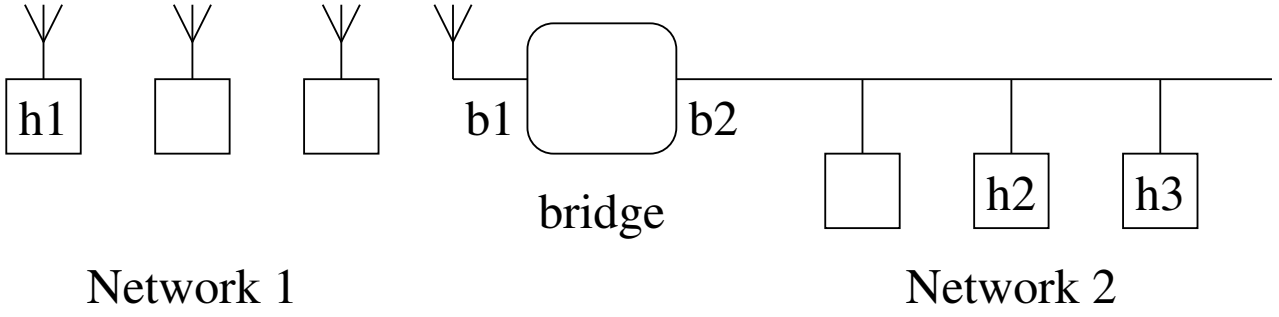
ARP Bridging



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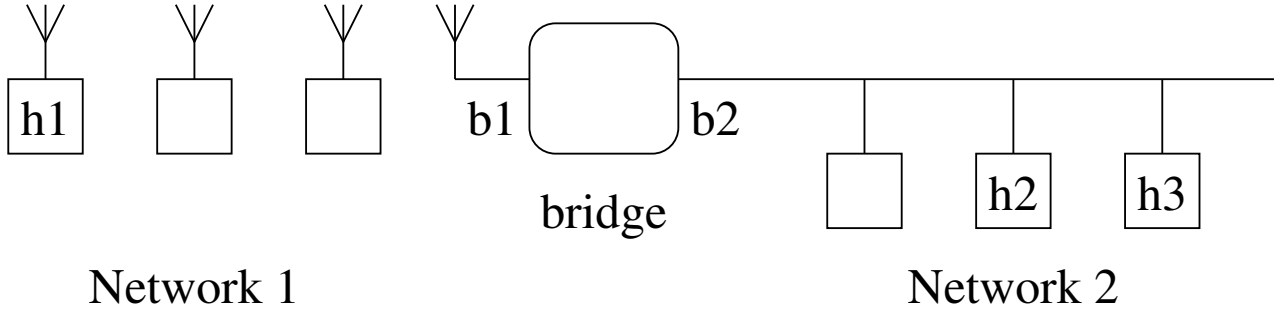

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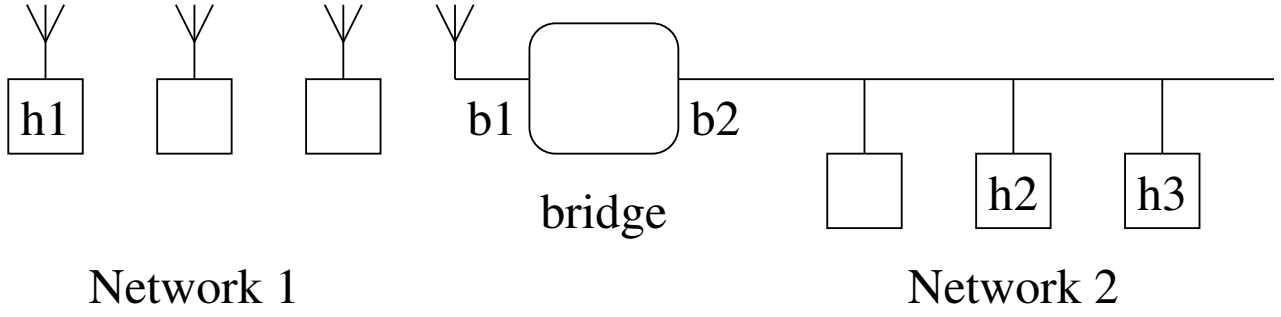

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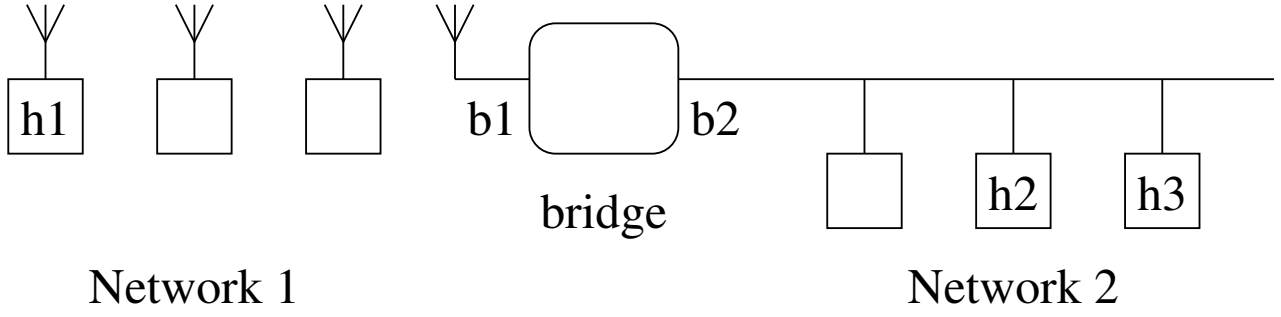

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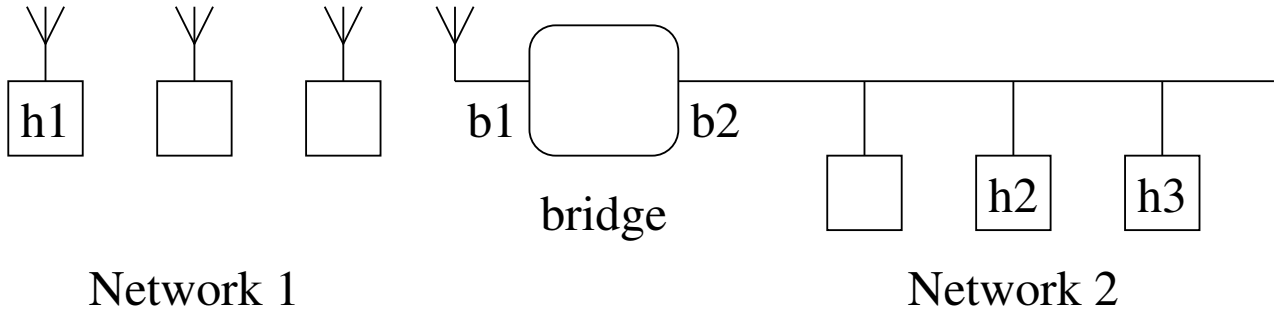

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The bridge sees this request and responds on behalf of h2 (a *proxy* ARP), but it supplies its *own* hardware address b1

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If h2 replies, it can either use b2 which it got from the original packet or do an ARP request, which the bridge proxies in a symmetrical way

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If h1 is communicating with both h2 and h3 its cache will show them to have the *same* hardware address b1: this is not a problem

ARP

ARP Bridging

Exercise Find out if your home network does ARP bridging, or if it simply acts like a switch on a single network

Exercise Make sure you understand the difference between what a gateway does, what a switch does and what a bridge does

Virtual Bridging

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It is often better to split a large network into several smaller ones: see subnetting, later

RARP

Exercise Read about *Reverse ARP* (RARP): given a hardware address find the IP address