Figure 7.9   *ARP components*
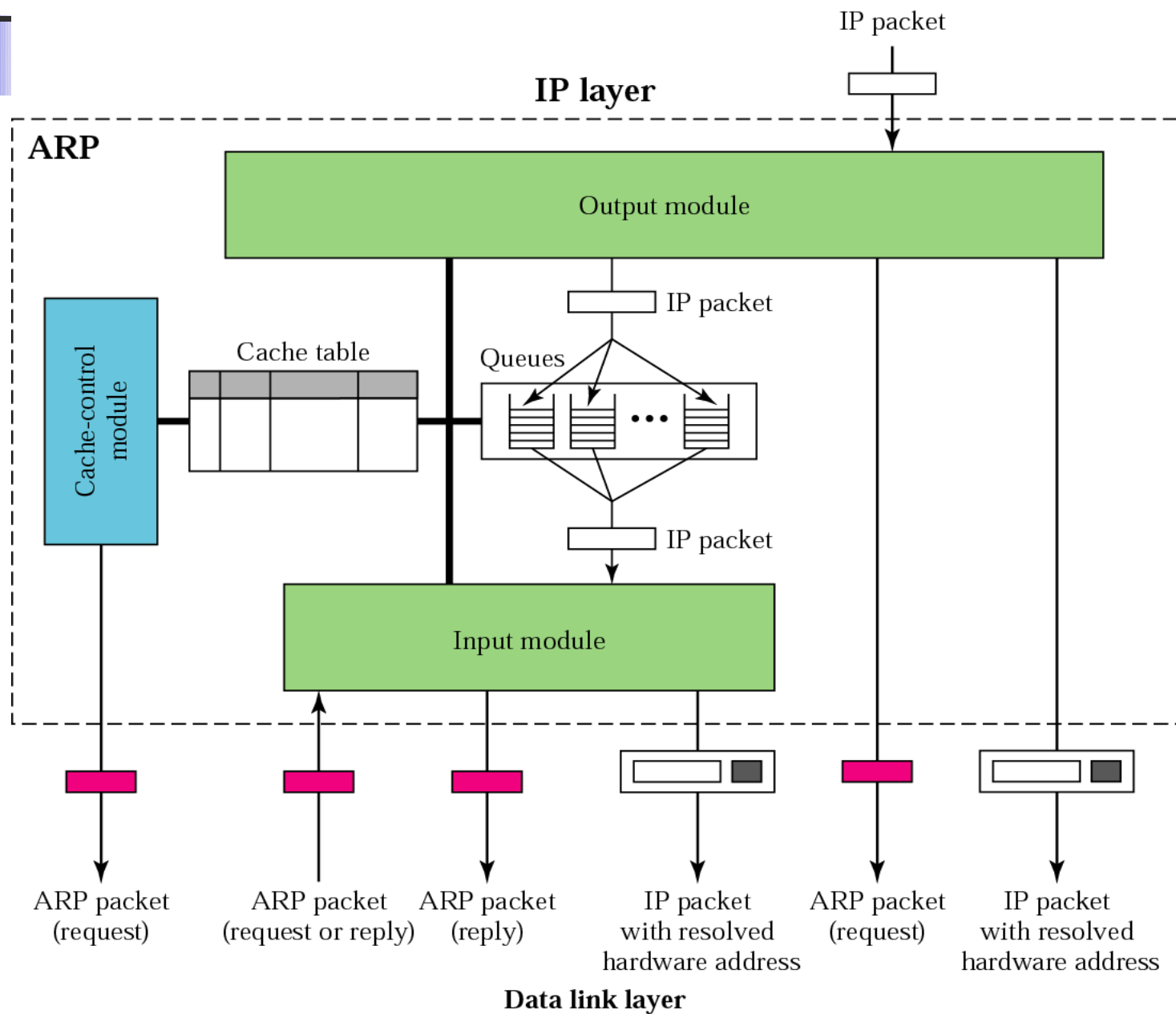
IP packet

IP layer

ARP

Output module

IP packet

Cache-control module

Cache table

Queues

IP packet

Input module

IP packet

ARP packet
(request)

ARP packet
(request or reply)

ARP packet
(reply)

IP packet
with resolved
hardware address

ARP packet
(request)

IP packet
with resolved
hardware address

Data link layer

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Table 7.1 Original cache table used for examples

State	Queue	Attempt	Time-Out	Protocol Addr.	Hardware Addr.
R	5		900	180.3.6.1	ACAE32457342
P	2	2		129.34.4.8	
P	14	5		201.11.56.7	
R	8		450	114.5.7.89	457342ACAE32
P	12	1		220.55.5.7	
F					
R	9		60	19.1.7.82	4573E3242ACA
P	18	3		188.11.8.71	

Example 2

The ARP output module receives an IP datagram (from the IP layer) with the destination address 114.5.7.89. It checks the cache table and finds that an entry exists for this destination with the RESOLVED state (R in the table). It extracts the hardware address, which is 457342ACAE32, and sends the packet and the address to the data link layer for transmission. The cache table remains the same.

Example 3

20 seconds later the ARP output module receives an IP datagram (from the IP layer) with the destination address 116.1.7.22. It checks the cache table and does not find this destination in the table. The module adds an entry to the table with the state PENDING and the Attempt value 1. It creates a new queue for this destination and enqueues the packet. It then sends an ARP request to the data link layer for this destination. The new cache table is shown in Table 7.2.

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Table 7.2 Updated cache table for Example 3

State	Queue	Attempt	Time-Out	Protocol Addr.	Hardware Addr.
R	5		900	180.3.6.1	ACAE32457342
P	2	2		129.34.4.8	
P	14	5		201.11.56.7	
R	8		450	114.5.7.89	457342ACAE32
P	12	1		220.55.5.7	
P	23	1		116.1.7.22	
R	9		60	19.1.7.82	4573E3242ACA
P	18	3		188.11.8.71	

Example 4

15 seconds later the ARP input module receives an ARP packet with target protocol (IP) address 188.11.8.71. The module checks the table and finds this address. It changes the state of the entry to RESOLVED and sets the time-out value to 900. The module then adds the target hardware address (E34573242ACA) to the entry. Now it accesses queue 18 and sends all the packets in this queue, one by one, to the data link layer. The new cache table is shown in Table 7.3.

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Table 7.3 *Updated cache table for Example 4*

State	Queue	Attempt	Time-Out	Protocol Addr.	Hardware Addr.
R	5		900	180.3.6.1	ACAE32457342
P	2	2		129.34.4.8	
P	14	5		201.11.56.7	
R	8		450	114.5.7.89	457342ACAE32
P	12	1		220.55.5.7	
P	23	1		116.1.7.22	
R	9		60	19.1.7.82	4573E3242ACA
R	18		900	188.11.8.71	E34573242ACA

Example 5

25 seconds later the cache-control module updates every entry. The time-out values for the first three resolved entries are decremented by 60. The time-out value for the last resolved entry is decremented by 25. The state of the next-to-last entry is changed to FREE because the time-out is zero. For each of the four pending entries the value of the Attempts is increased by 1. The value of the Attempts for the pending entry with the IP address 201.11.56.7 exceeded the maximum. The corresponding state is changed to FREE, the queue is deleted, and an ICMP message is sent to the original destination. See table 7.4.

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Table 7.4 *Updated cache table for Example 5*

State	Queue	Attempt	Time-Out	Protocol Addr.	Hardware Addr.
R	5		840	180.3.6.1	ACAE32457342
P	2	3		129.34.4.8	
F					
R	8		390	114.5.7.89	457342ACAE32
P	12	2		220.55.5.7	
P	23	2		116.1.7.22	
F					
R	18		875	188.11.8.71	E34573242ACA

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