CS2105 Lecture 6
Network Layer

17 February, 2014

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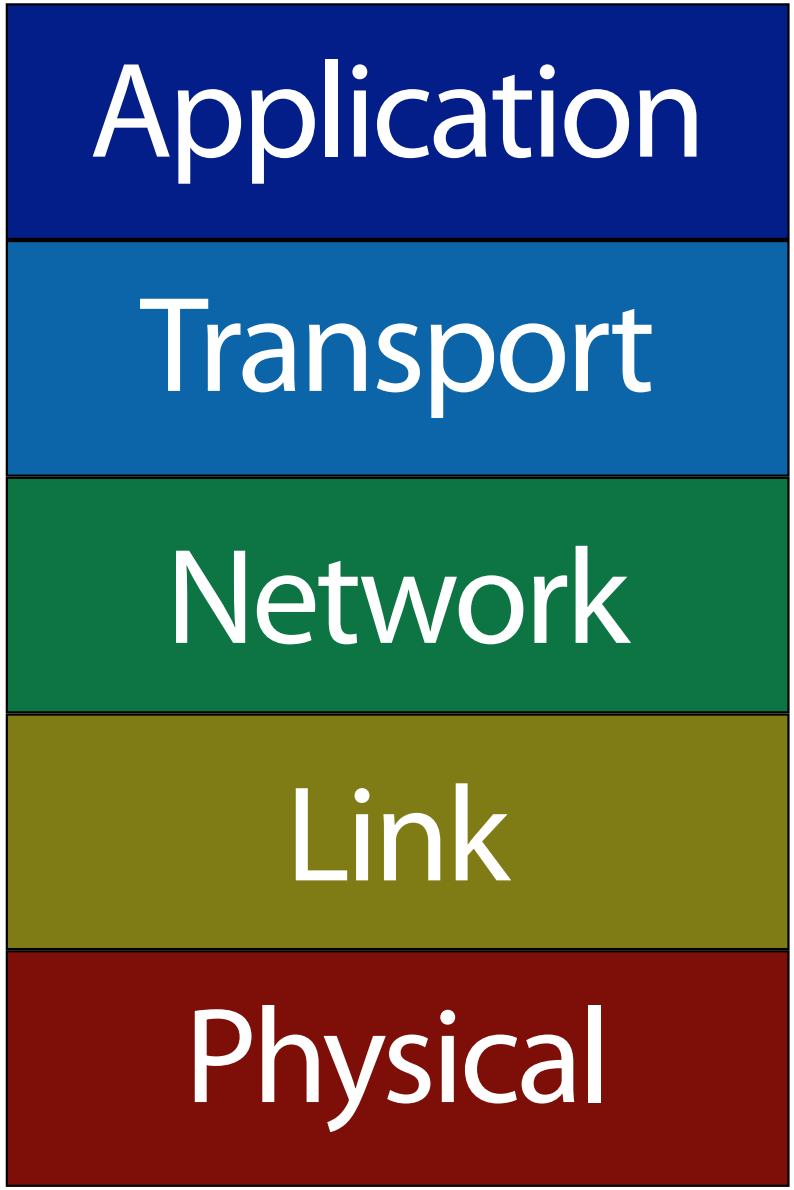
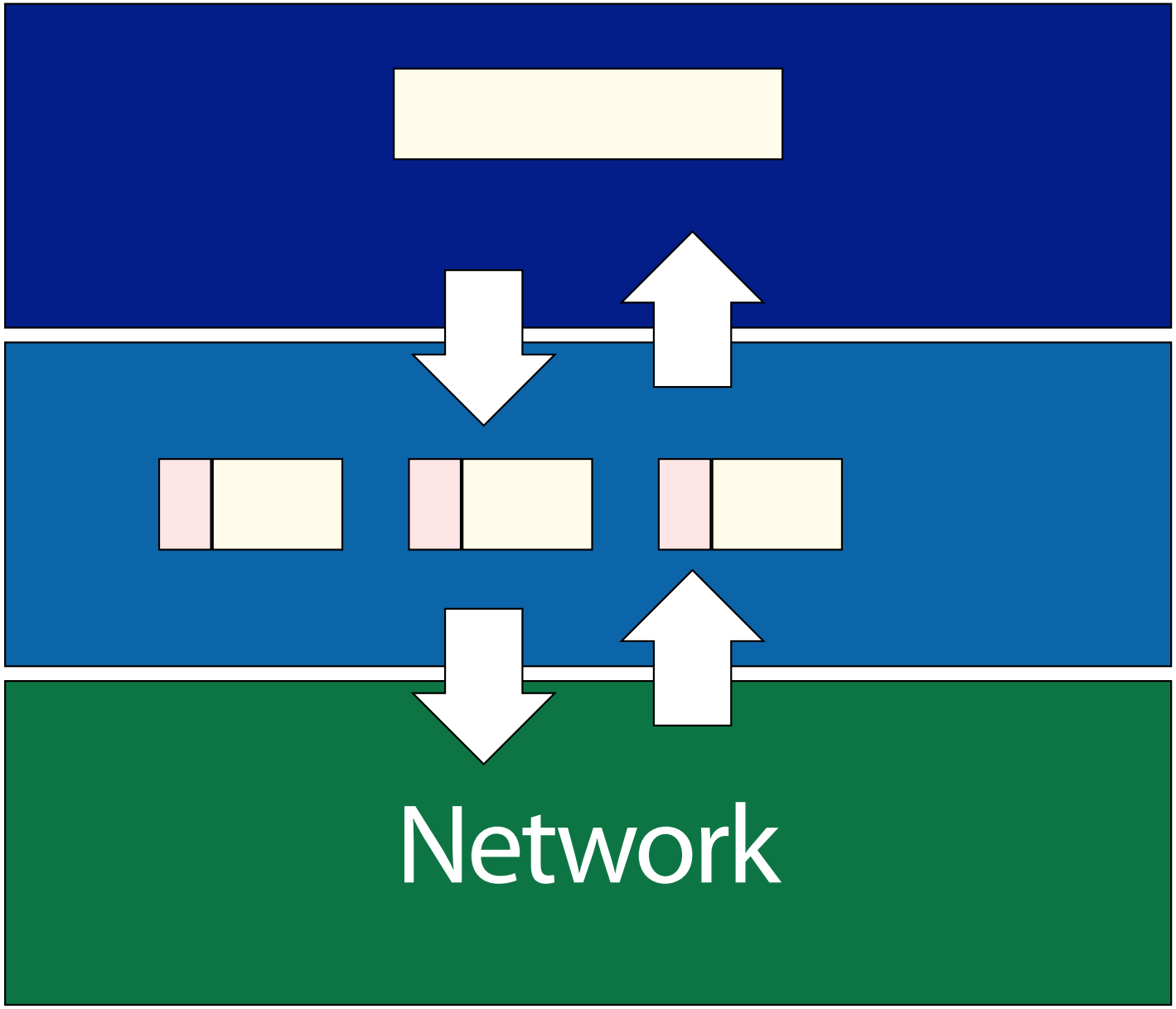
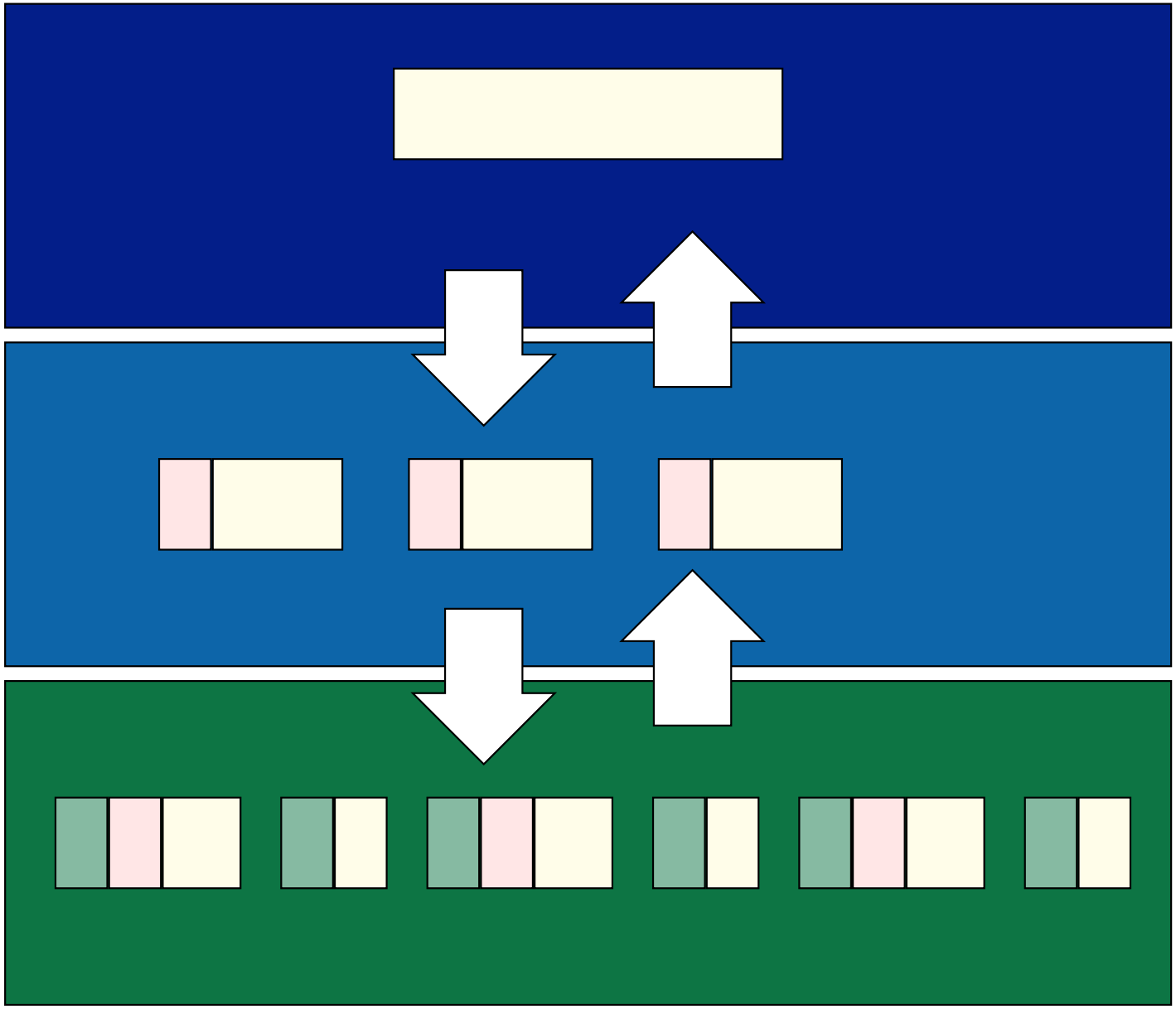
After this class, you are expected to be able to

- describe the basic services the network layer and IP provides
- understand how datagram fragmentation works
- understand IP address, subnet, subnet mask, and address allocation.
- understand the purposes of NAT and DHCP and how they works.
- understand how ping and traceroute are implemented with ICMP
- understand how forwarding is done in a router with longest prefix matching

``The Internet has Ran Out of IPv4 Addresses. These Hacks, Used to Keep the Internet Growing, Are Absolutely Brilliant."


Application
Transport
Network
Link
Physical


Network



The network layer resides on both end hosts and routers.

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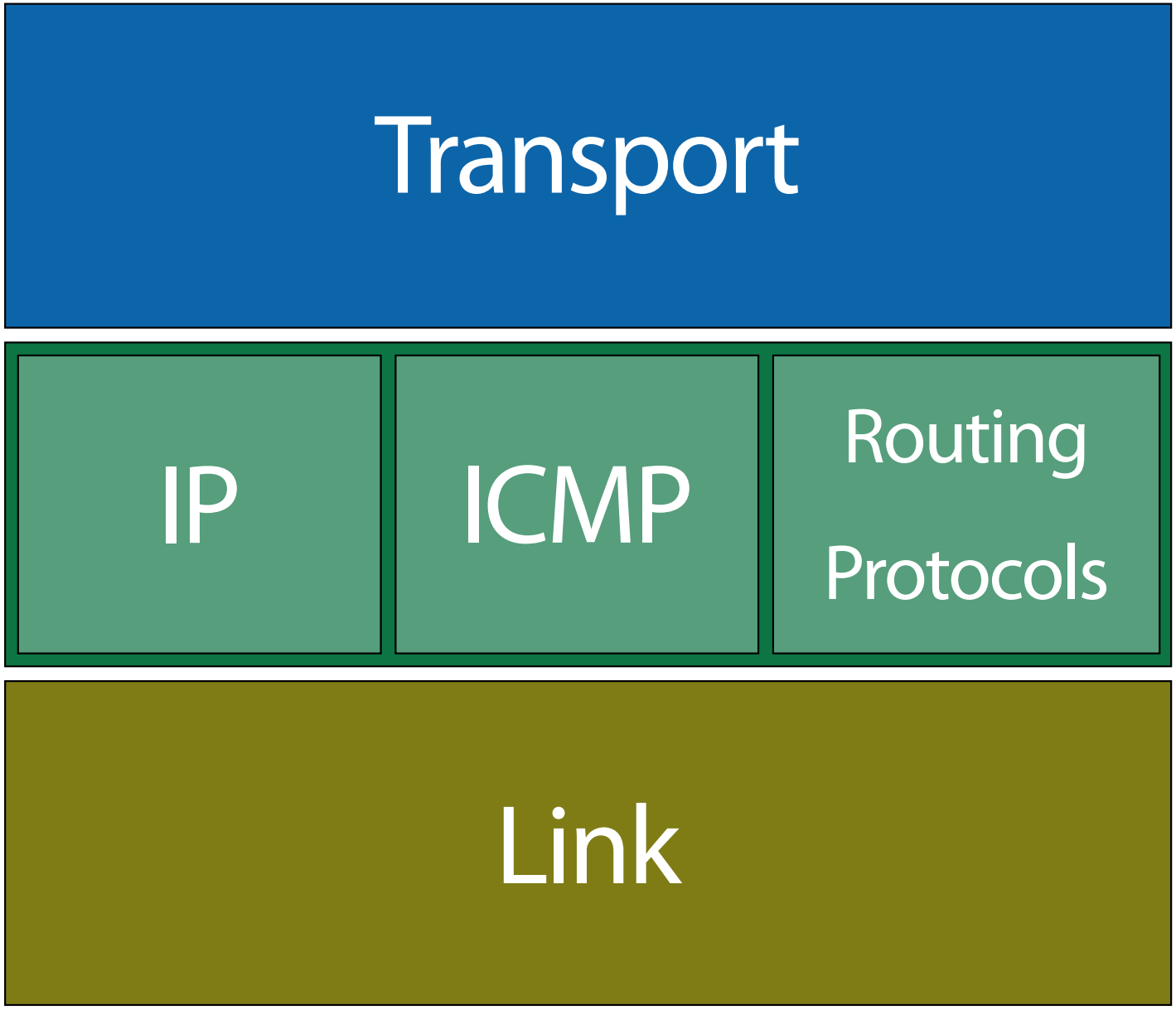
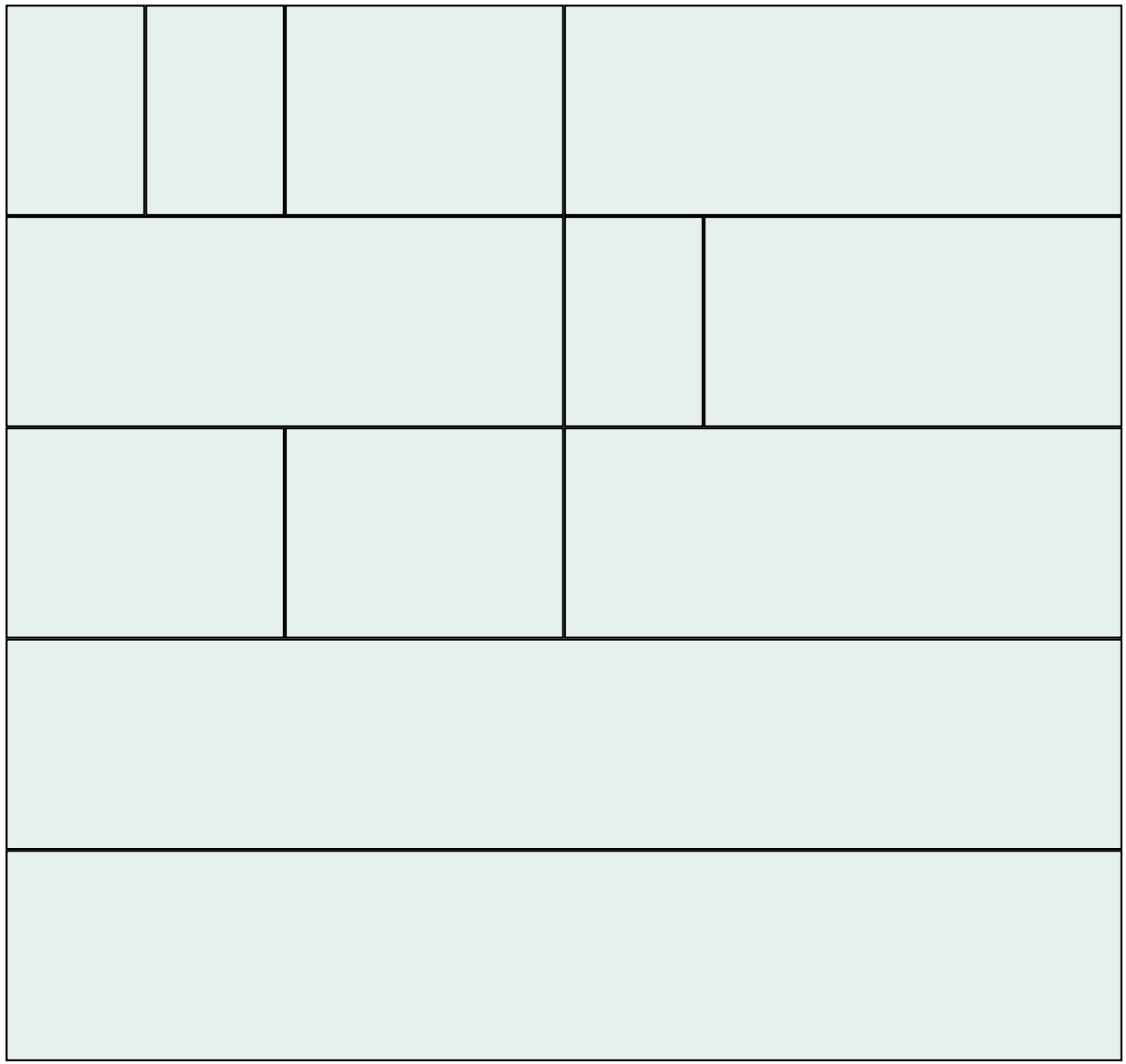
We focus on datagram networks in CS2105. You can read about the other alternative, virtual circuit, if you are interested, in Section 4.2.1.

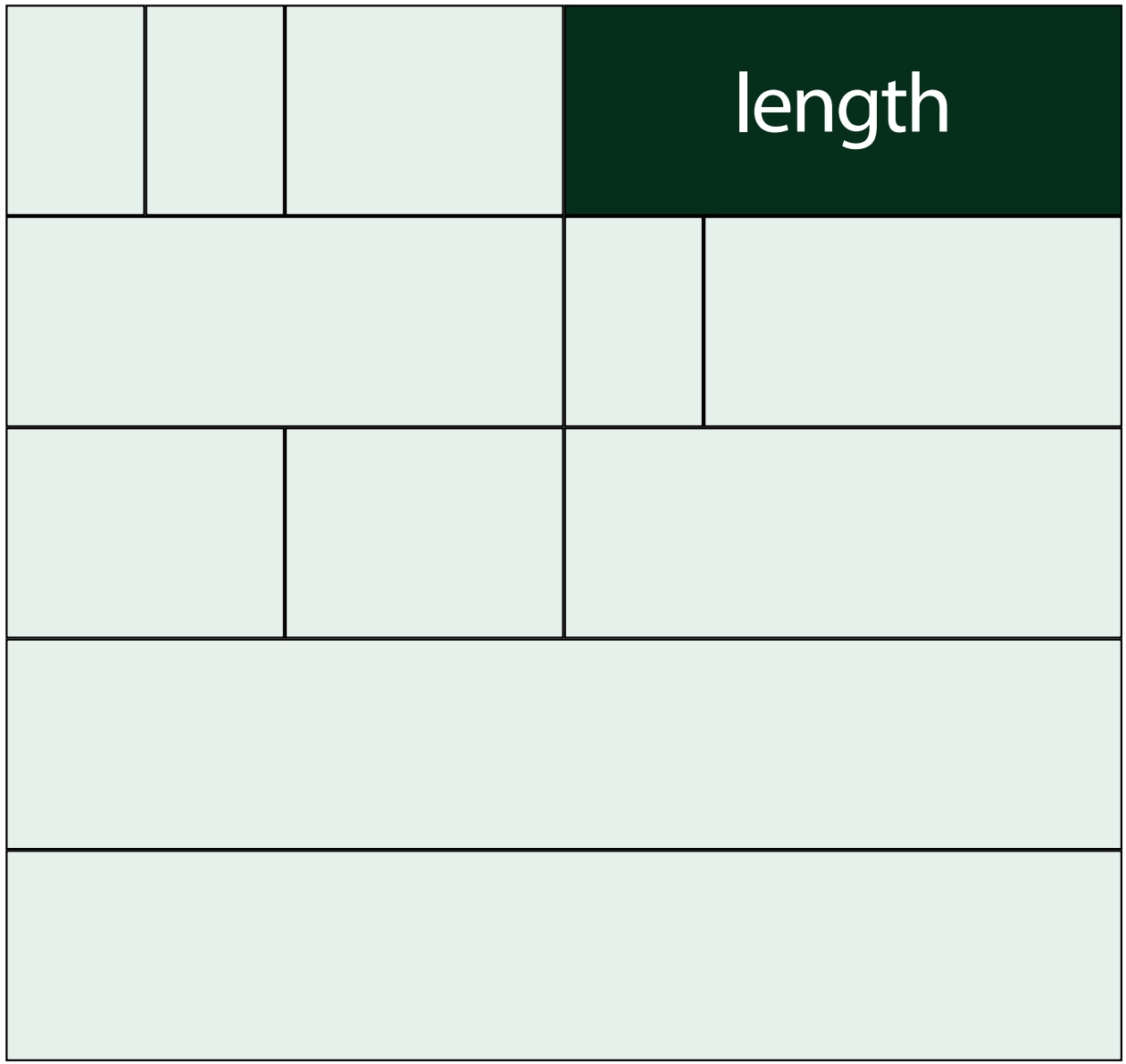

Transport
IP
ICMP
Routing
Protocols
Link

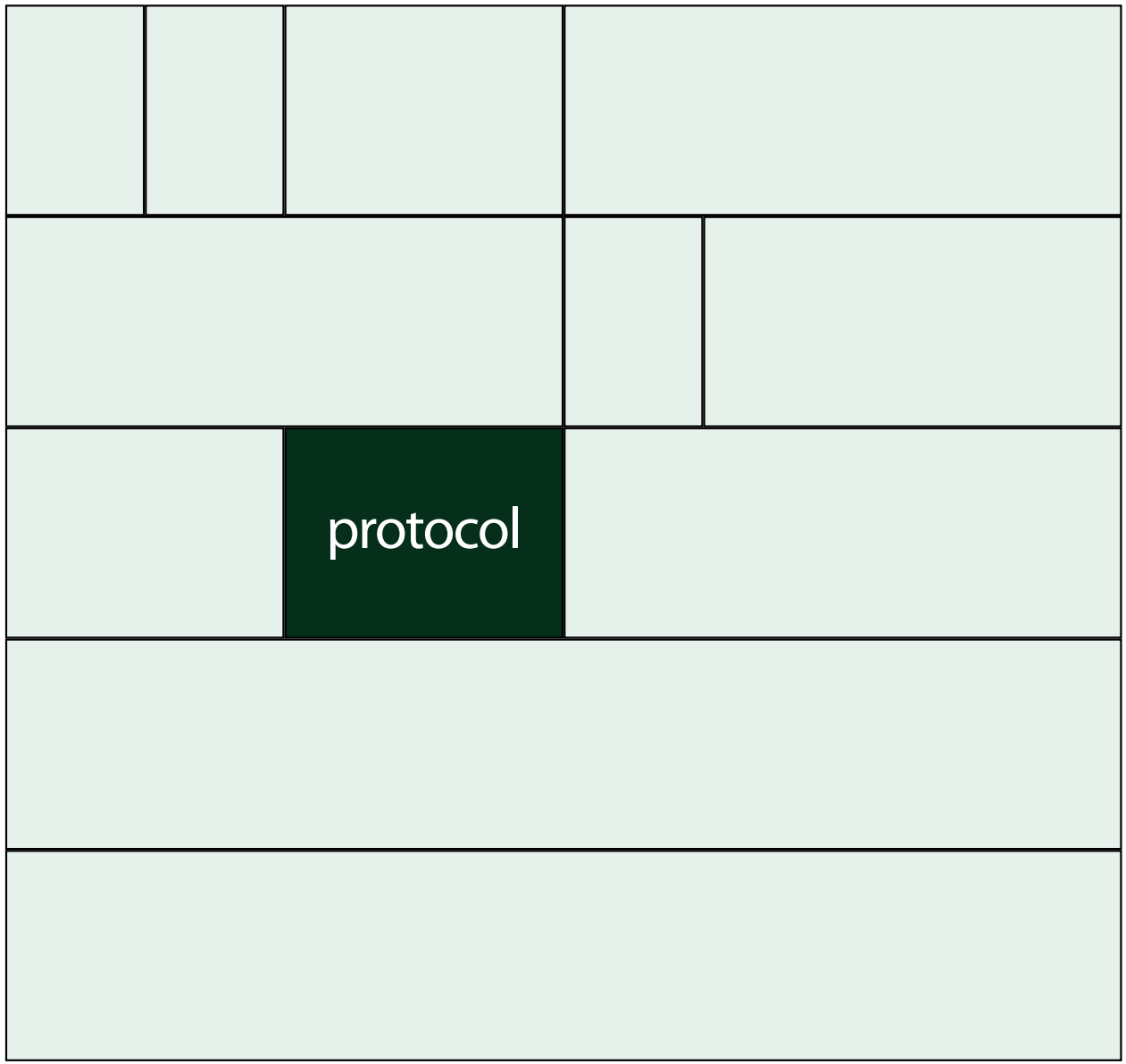
IP
The Internet Protocol
version 4

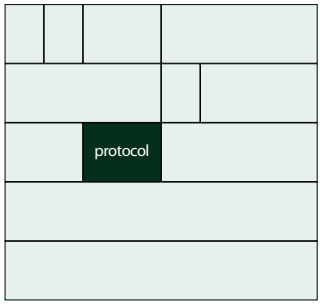
IP
The Internet Protocol
version 4

We focus on IPv4, which is still the dominant version of IP running today. IPv6, however, is increasingly being deployed and will replace IPv4 eventually. Interested students are encourage to read up Section 4.4.4 of the textbook to learn about IPv6.

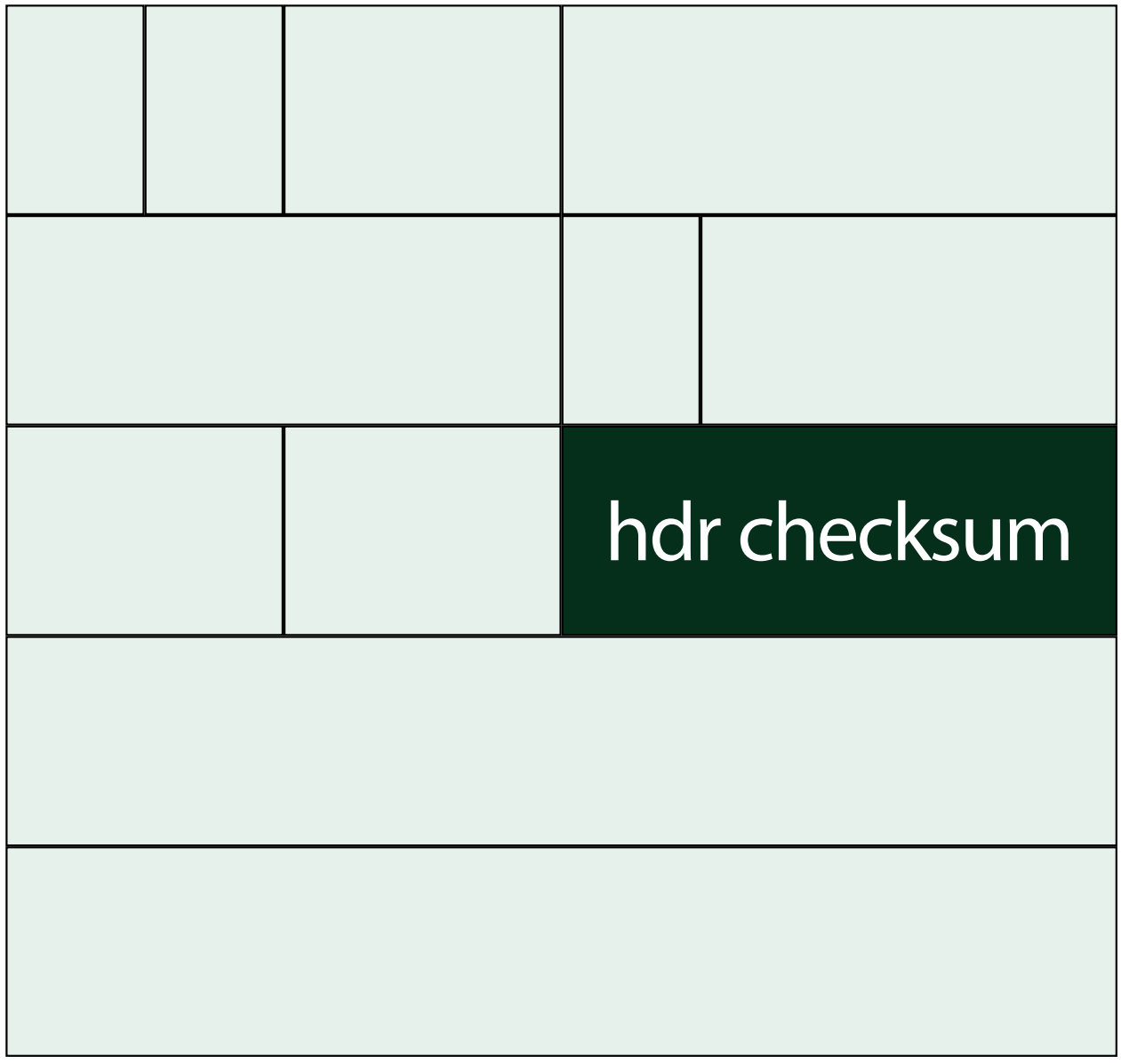


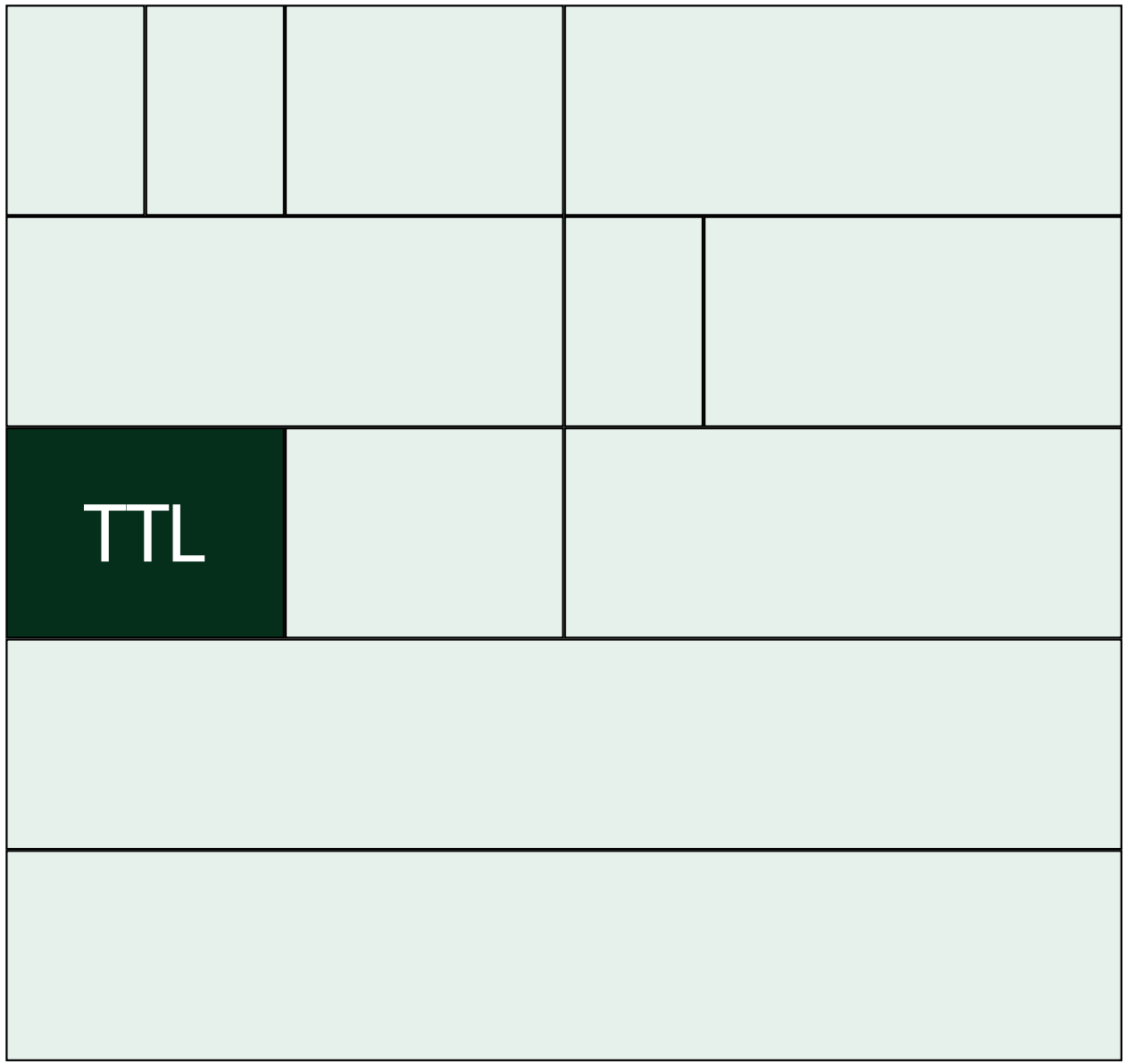

length

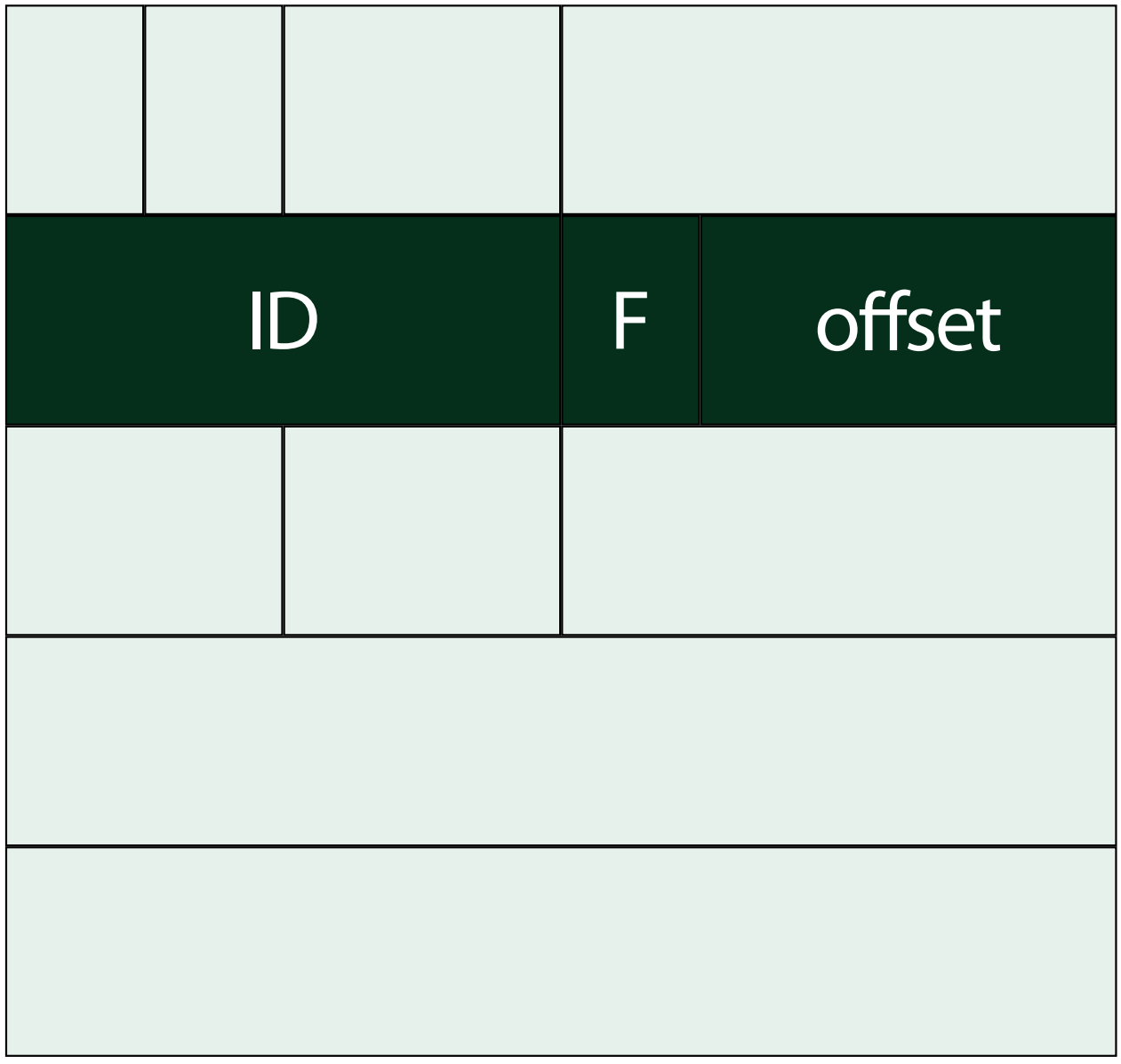

protocol

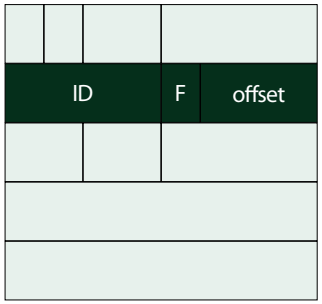


The list of protocol numbers are managed by IANA. See `http://www.iana.org/assignments/protocol-numbers/protocol-numbers.xml`

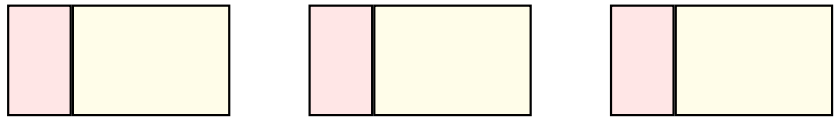

hdr checksum

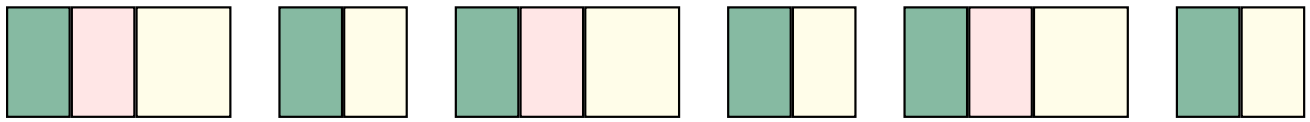

TTL

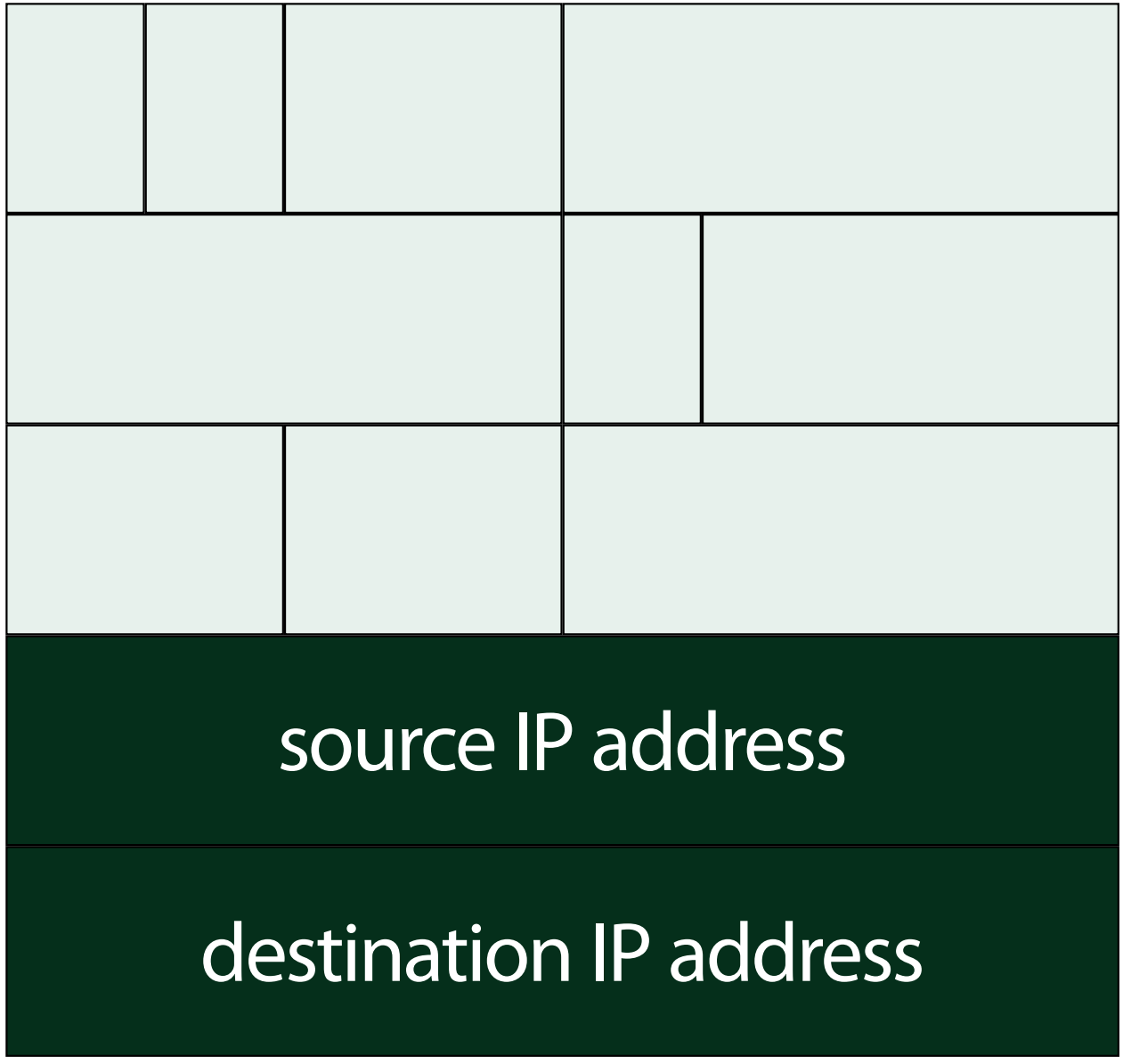

ID
F
offset



Flag is 1 if there is another fragment from the same segment. 0 if this is the last one. Offset is in multiple of 8-bytes.






source IP address
destination IP address

An IP address is
associated with **an interface**.

4,294,967,296

ran out in 2012
(but only 14% utilized)

network prefix + host identifier

Classless Inter-Domain Routing (CIDR) notation

The IPv4 address space registry can be found at: `http://www.iana.org/assignments/ipv4-address-space/`

You can query who owns a range of IP addresses using `whois`. For example: `whois -A 137.132.0.0/16`

``special" IP addresses

The list of special IP addresses can be found in RFC5735. `http://tools.ietf.org/rfc/rfc5735.txt`

127.0.0.0/8

10.0.0.0/8
172.16.0.0/12
192.168.0.0/16

169.254.0.0/16

0.0.0.0/32

255.255.255.255/32

DHCP
Dynamic Host Configuration Protocol

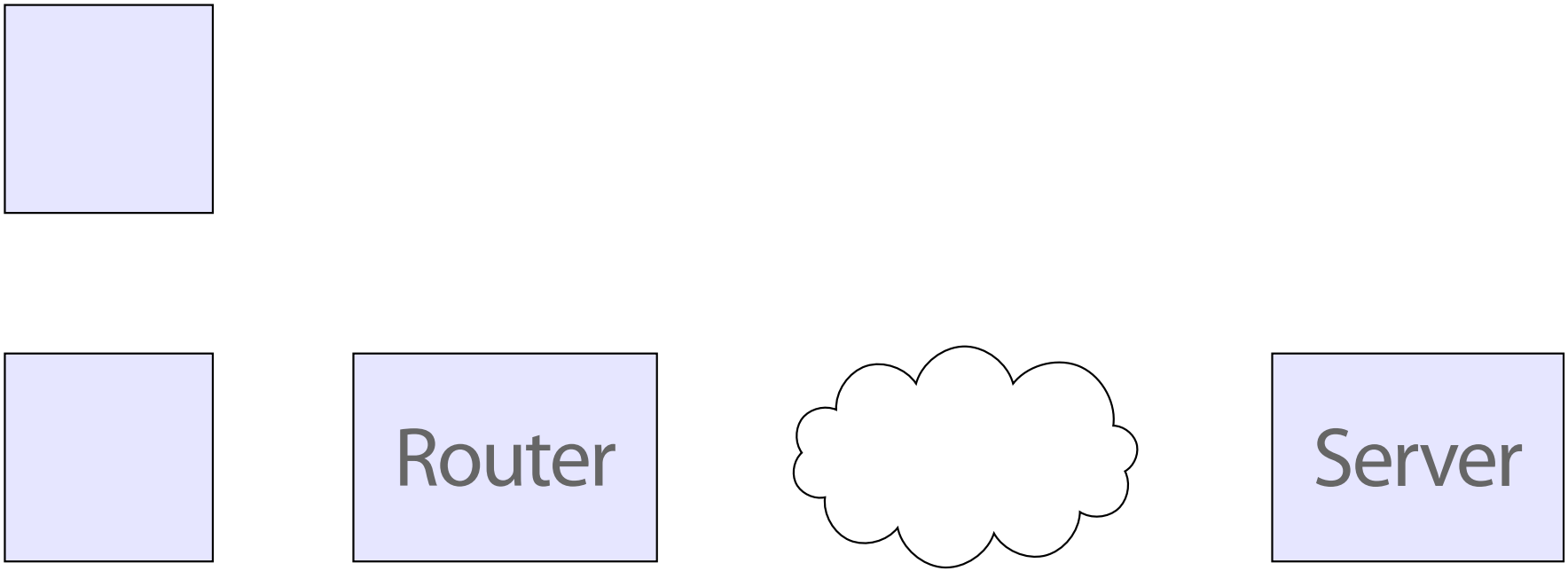
1. DHCP Discover

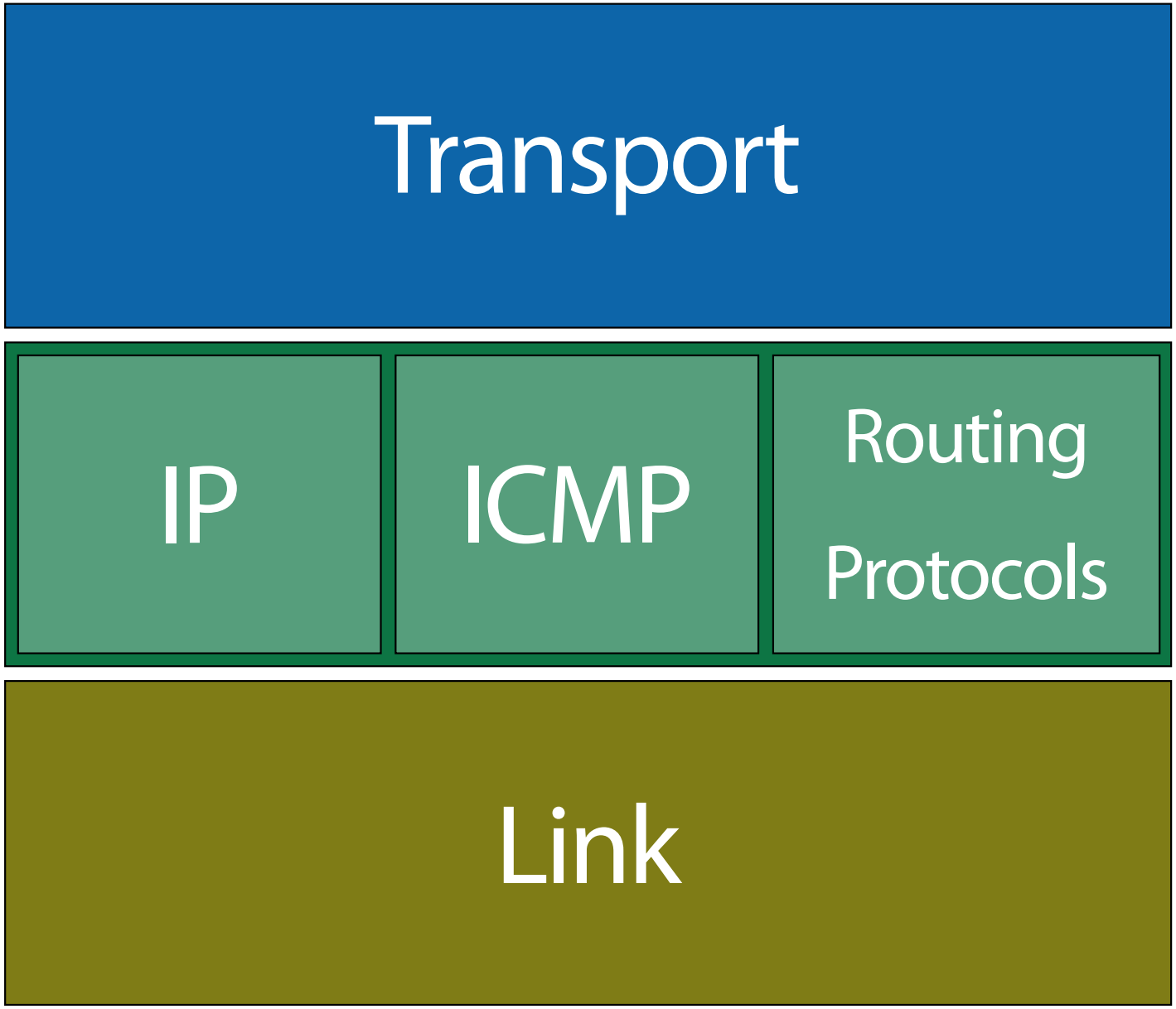
2. DHCP Offer

3. DHCP Request

4. DHCP ACK

NAT
Network Address Translation


Router
Server


Transport
IP
ICMP
Routing
Protocols
Link

ICMP
Internet Control Message Protocol

ping

traceroute