Lesson 5
TCP/IP suite, TCP and UDP Protocols

TCP/IP Suite: Application layer protocols

- TCP/IP Suite set of protocols with layers for the Internet
- TCP/IP communication 5 layers: L7, L4, L3, L2 and L1
- OSI L6 and L5 included in suite used layers L7 and L5
- Each Application layer L7 protocol assigned a Port and a number by IANA

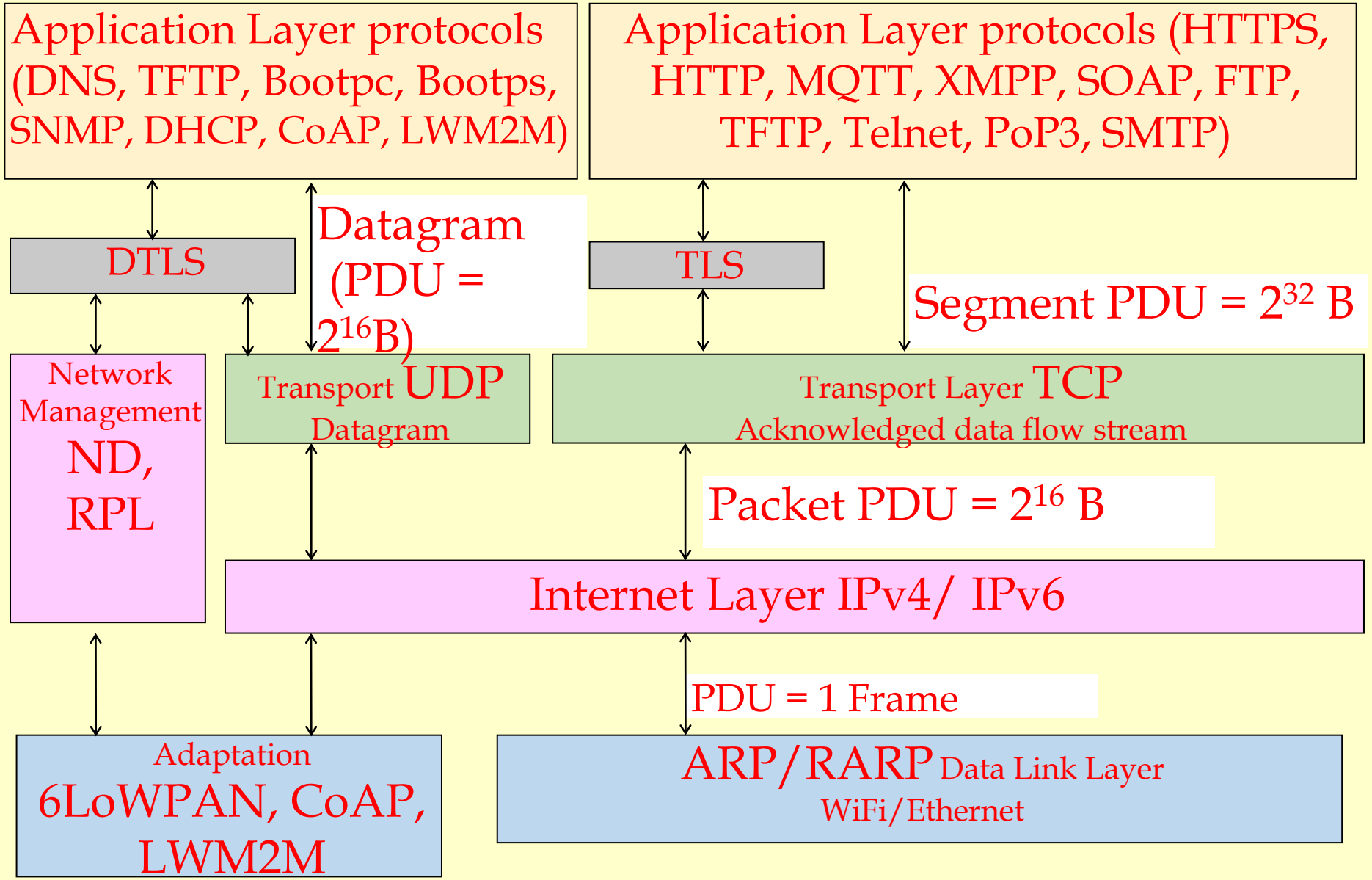

Fig. 4.6 IoT TCP/IP Suite of Protocols for Internet

TCP/IP Suite: Application layer protocols

- Examples for TCP stream communication:
- HTTPS, HTTP, MQTT, XMPP, SOAP, FTP, TFTP, Telnet, PoP3, SMTP, SSL/TLS and others

TCP/IP Suite: Application layers protocols

- Examples for the datagram communication using UDP:
- DNS, TFTP, Bootpc, Bootps, SNMP, DHCP, CoAP, LWM2M and others.
- Application layer security protocols: TLS and DTLS

TCP/IP Suite: Transport layer protocols

- Example 1
- TCP for the acknowledged data flow using connection oriented protocol
- Example 2: UDP for datagram for the unacknowledged data flow using connectionless protocol
- Other Examples: RSVP, DCCP and other protocols.

TCP/IP Suite: internet layer protocols

- Network layer called internet layer
- Example: IPv4
- IPv6
- RPL
- ICMP
- ICMPv6, IPSec and Others

TCP/IP Suite: Data Link layer protocols

- Examples
- PPP/ARP/RARP/NDP, MAC or other
- MAC protocol for Ethernet LAN or DSL or ISDN or other.

TCP at Transport Layer

- For acknowledged data flow when a segment transmits
- TCP protocol segment consists of the data which the transport layer receives on transfer from Application layer for transmission to the receiver end

TCP Connection oriented Feature

- Connection first establishes using a connection establishment procedure adopted when first time transmitting a TCP data stack
- Connection closes using a connection closing procedure adopted when last sequence completes transmission of TCP

TCP Protocol data unit

- PDU_{TCP} the maximum data unit = 2^{32}B which can transmit or receive at the layer when using TCP stream
- Protocol data unit, PDU_{TCP} = 1 Segment and 1 segment maximum value = 2^{32} B.
- .

TCP Data Stack Header

- *n* words
- N = 5 and extendable using option words and padding words
- Data stack to next layer or data packet to router has maximum V = (*n* + *len*) words where V <= (2^{14} – *n*).

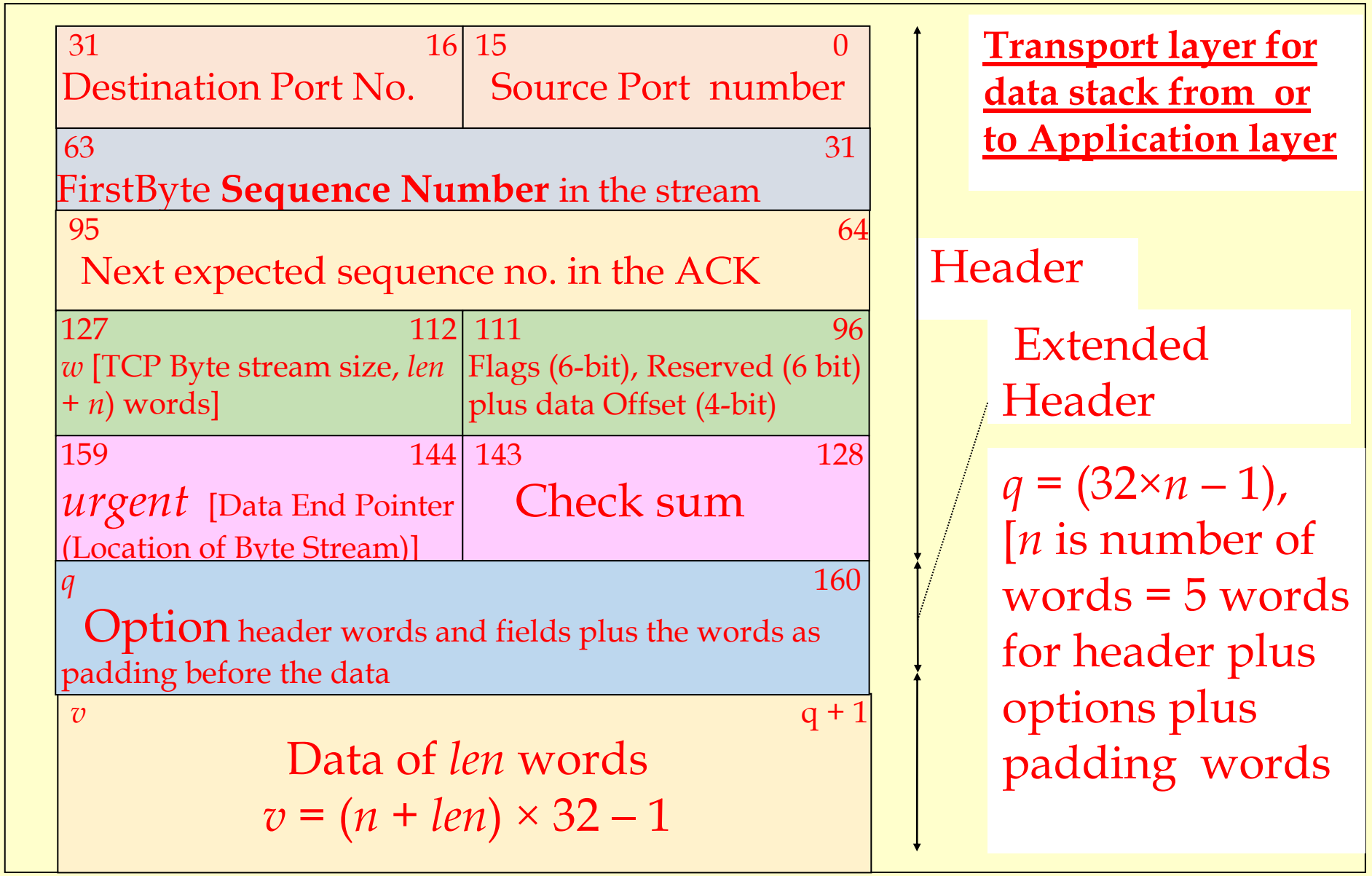

Fig. 4.7 Data stack received or transmitted at or to transport layer stream consisting of TCP header field 160 bits and extended header (n – 5) words when required plus data stack of *len* words from or for the Application layer

TCP Header Word Fields

- First: Upper 16 bits for the source port number and lower 16 bits are for destination port number
- Second: Stream First Byte Sequence Number

TCP Header Word Fields

- Third: Next expected sequence number sent bytes from the receiver in the Acknowledgement
- Fourth: 16-bit *w* [TCP Byte stream size, *len* + *n*) words] and Flags (6-bit), Reserved (6 bit) plus data Offset (4-bit)

TCP Header Word Fields

- Fifth: 16-bit *urgent* [Data End Pointer (Location of data stack last word)]
- 16-bit Check sum of the header n words to enable error detection at receiver in the header words
- Option header words and fields plus the words as padding before the data

TCP Features

- Full duplex acknowledged data flow from transport layer at one end (End 1) to transport layer of other end (End 2)
- Each TCP layer data stack reaches destination almost each time

TCP Features

- Retransmission from the next of last acknowledged sequence number to another sequence number
- One TCP connection communicates in one direction at an instance.
- segment stack

TCP Features

- Acknowledged flow means that the request as well as response messages communicate in unicast mode
- End 2 sends acknowledgement message and the header field of that conveys expected sequence number from transmitter by the receiver End 2.

UDP

- A half duplex unacknowledged data flow from transport layer at one end (End 1) to transport layer of other end (End 2)
- Datagram = Maximum 2^{16} B
- Each UDP layer data stack may or may not reach destination due unacknowledged flow

UDP Datagram

- One UDP datagram communicates in one direction at an instance between two ends
- PDU $_{UDP}$ the maximum data unit = 2^{16} B which can transmit or receive at the layer when using UDP datagram

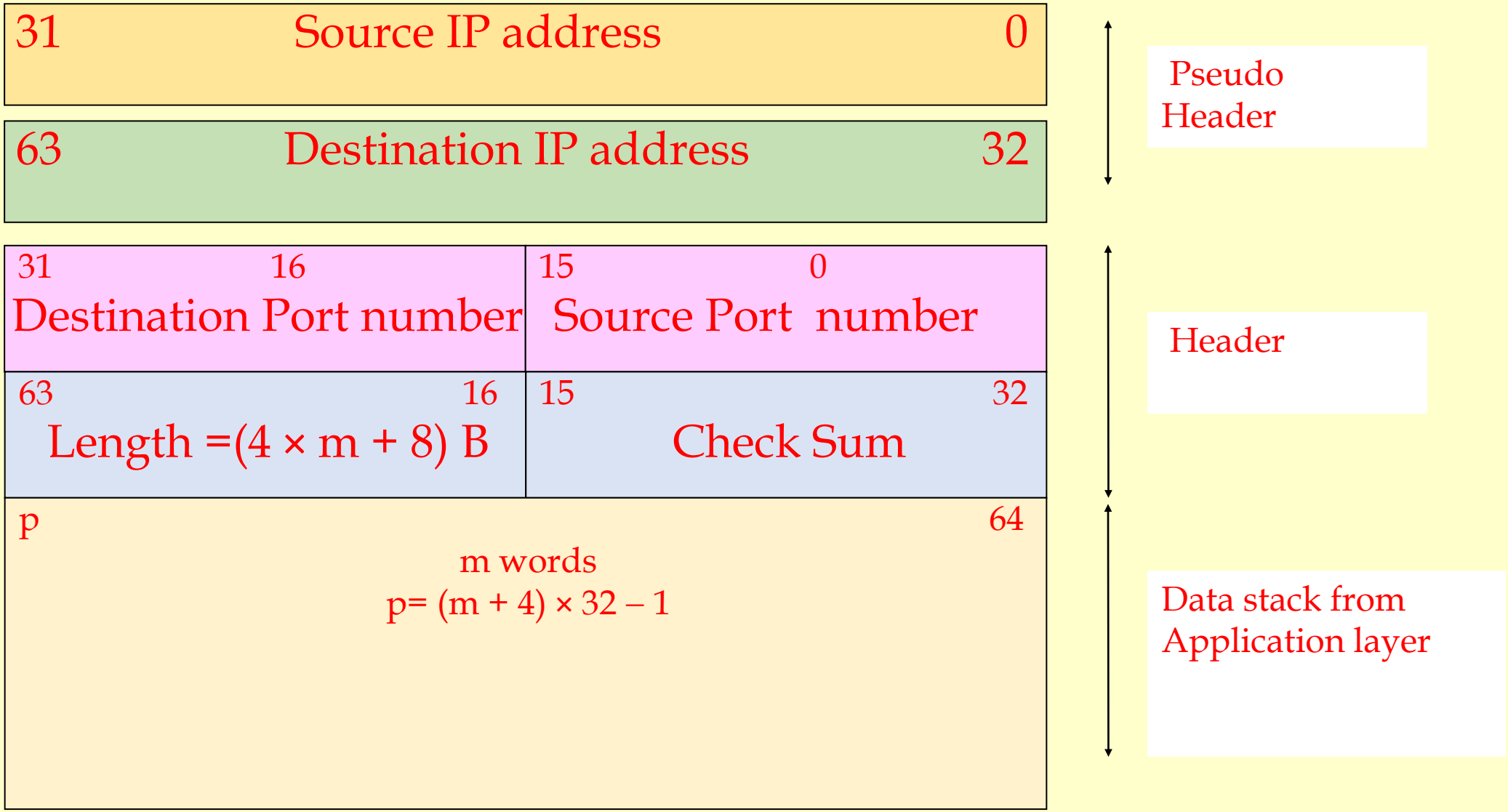

Fig. 4.8 Transport Layer UDP Header field with data stack from the Application layer and Pseudo header of 2 words (64 bits) for source and destination IP addresses

UDP Connectionless Unacknowledged Datagram Protocol

- Connectionless: No connection establishment procedure adopted when first time transmitting a UDP data stack
- No connection closure procedure adopted
- Permits multicasting, means to multiple destinations

UDP Protocol Data Unit

- Protocol data unit, PDU_{UDP} = 1 Datagram and 1 datagram maximum value = 2^{16} B.
- Data stack to network layer has maximum *m* words where m <= (2^{14} – 2)

UDP Header Two Words

- First word fields: upper 16 bits source port number and lower 16 bits destination port number
- Second word fields: upper 16 bits length, and lower 16 bits checksum.

UDP Header Second Word Fields

- Upper 16 bits for datagram length
- Lower 16 bits for UDP header’s checksum

Summary

We learnt

- TCP/IP suite of protocols for Internet
- TCP and UDP protocols
- Connection Oriented protocol
- Datagram
- Connectionless

End of Lesson 5 on
TCP/IP suite, TCP and UDP Protocols