THE IMPORTANCE OF IP HEADER AND UDP CHECKSUM

030

TECHNICAL NOTE

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For many years now, telecommunication service providers have been testing the Ethernet portion of their networks. Until recently, this practice has been enough to ensure that service-level agreements (SLAs) were met. However, with the strong demand for VoIP and IPTV, service providers now have to analyze higher-layer protocols to ensure proper data integrity at the crucial IP and UDP layers. This type of analysis can be achieved through the validation of checksums.

What is a checksum?

A checksum is an error-detection method in which each transmitted message results in a numerical value based on the value of the bytes in a message. The transmitter places the calculated value in the message and then sends the value with the message. The receiver applies the same formula to each received message and checks to make sure the accompanying numerical value is the same. If not, the receiver can assume that the message has been corrupted in transmission.

Why is a checksum important?

Most people are under the assumption that a cyclic redundancy check (CRC) or a frame check sequence (FCS) in Ethernet is good enough to detect errors. While this is true at the link layer (Layer 2 of the OSI stack), these checks do not work for the other layers. Even if every link implemented strong error detection in the form of frame CRCs, it is still essential that end-to-end checksums at and above the IP level be used at the receiving end host.

How are checksums calculated?

While it is not necessary to understand how the checksum is computed when analyzing IP and UDP traces, it is useful to know how and why it is done.

The IP header checksum is calculated as defined in RFC791:

The checksum field is the 16-bit one's complement of the one's complement sum of all 16-bit words in the header. For purposes of computing the checksum, the value of the checksum field is zero.

The UDP checksum error is calculated as defined in RFC768[30]:

The UDP checksum is calculated using the UDP header, UDP data (padded out by a zerofilled byte if needed to make the data end on a 16-bit boundary) and certain IP header fields. This IP-specific information used in calculating the checksum is called the UDP pseudo-header and for the purpose of calculating the checksum is laid out as shown in the figure below. The PROTOCOL field indicates the protocol being transported—in this case 17 for UDP. SOURCE IP ADDRESS and DESTINATION IP ADDRESS are self explanatory and the length of the UDP datagram (not including the pseudo-header) is placed in the UDP LENGTH field.

0	7	15 31
Source IP address		
Destination IP address		
0	Protocol	UDP length

Figure 1: *UDP pseudo-header*

Once the checksum is completed and placed in the user datagram, the datagram is passed to the IP layer for transport to the destination host. The pseudo- header and padding byte are not sent. Upon arrival, the datagram is identified as a UDP user datagram by the IP header's *PROTOCOL* field containing the value 17 and the IP datagram's data segment is passed to UDP.

Upon receipt of the user datagram, the UDP layer will recalculate the checksum to ensure that the user datagram has not been corrupted during transit. All information to build a pseudo-header is pulled from the IP header that the UDP user datagram was encapsulated in.

The reason for this rather convoluted procedure is in essence simple: UDP only provides a means of indicating the source and destination port numbers; it is left up to IP to ensure that the user datagram arrives at the right host. By including the destination IP address, when the UDP layer receives the newly arrived user datagram, it constructs its own pseudo-header using information gained from the IP header. The checksum is calculated and, if it matches the UDP checksum, then the user datagram is accepted for this host. This method allows UDP to ensure that IP has correctly performed its job and routed the datagram to the right destination.

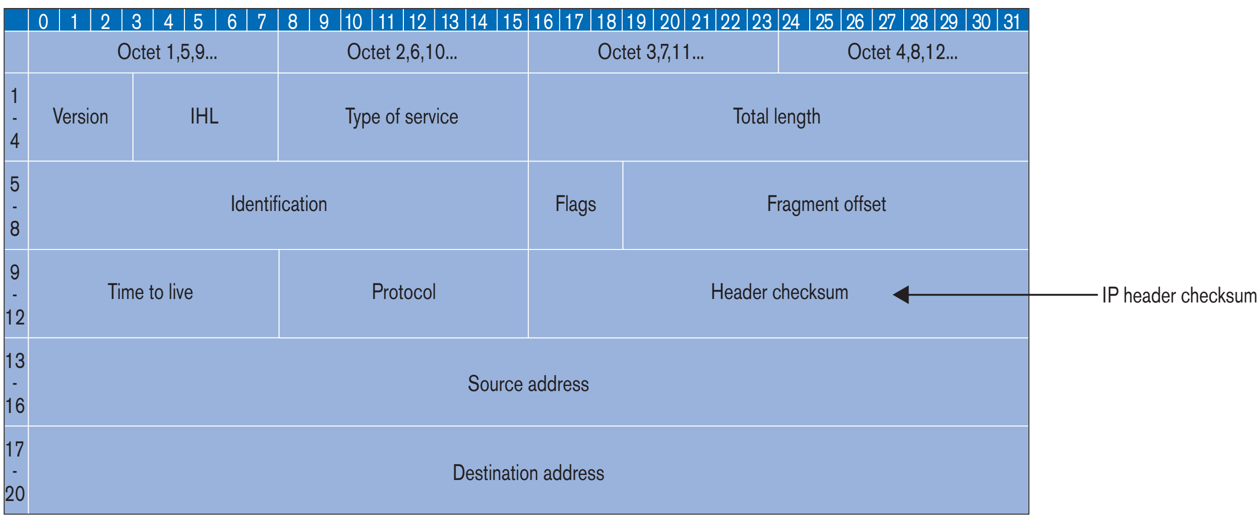

Figure 2: *Example of IP header checksum*

	0 – 7	8 – 15	16 – 23	24 – 31
	Octet 1,5	Octet 2,6	Octet 3,7	Octet 4,8
1 - 4	Source port		Destination port	
5 - 8	Length		Checksum ← UDP checksum	

Figure 3: Example of UDP checksum

Additional capability with the Packet Blazer:

The Packet Blazer can expertly monitor all Layer 2 traffic. This is validated by checking the FCS of all Ethernet frames. It can now also monitor the higher layers such as IP and UDP. Without this new visibility at higher layers, corrupt information may not be detected and the end result would be treated as a correct FCS at the Ethernet layer. With the latest Packet Blazer load, higher-layer protocols are no longer hidden and can now be fully monitored.

The FTB-8510 offers the capability to monitor the IP header checksum as well as the UDP checksum for errors. These parameters are analyzed and tracked as part of the Frame Analyzer and RFC 2544 tests.

Corresponding results such as the count and duration of such events are also included within the test results and displayed on the unit. With these latest enhancements, the FTB-8510 offers a higher level of testing.

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