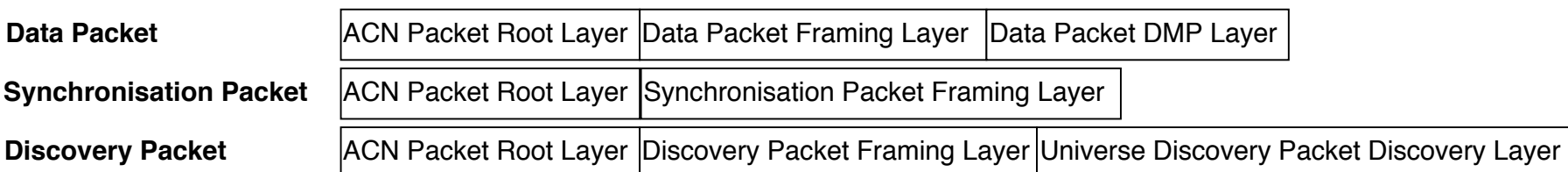# ANSI E1.31-2018 sACN Packet Structure

Key

← Grey boxes and arrows are added explanation

Bold numbers show the next octet index (start at 0)
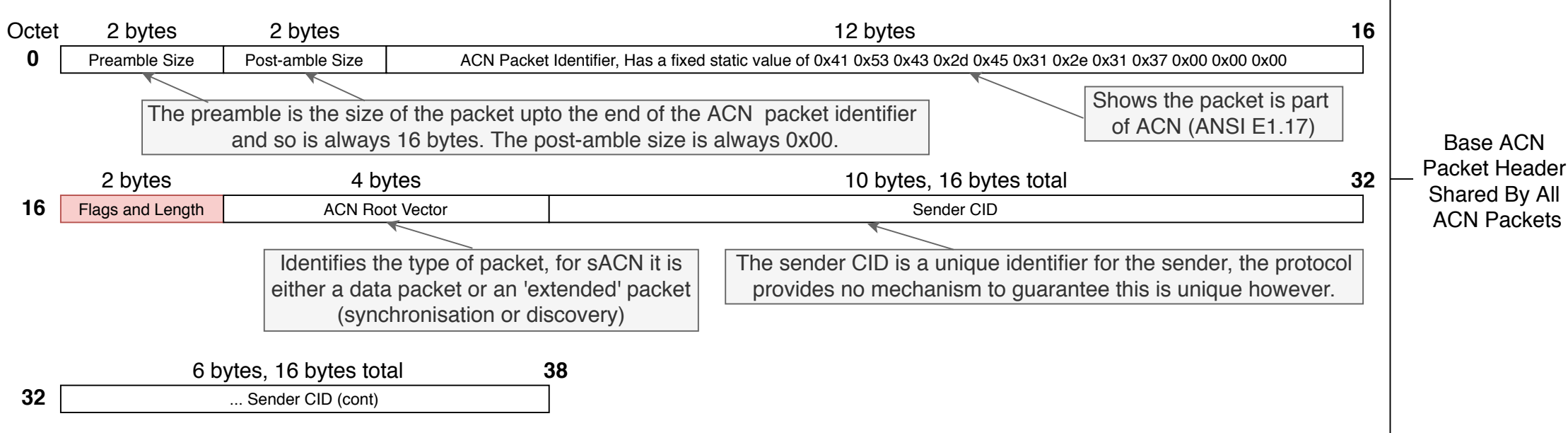Colours within the diagram refer to specific explanation in the same colour.

The Flags and Length field appears frequently throughout the packet structure, the field contains 2 parts. The flags which are the upper 4 bits and for sACN is always 0x7. The length is the bottom 12 bits and is the length of the rest of the packet in bytes including the flags and length field.
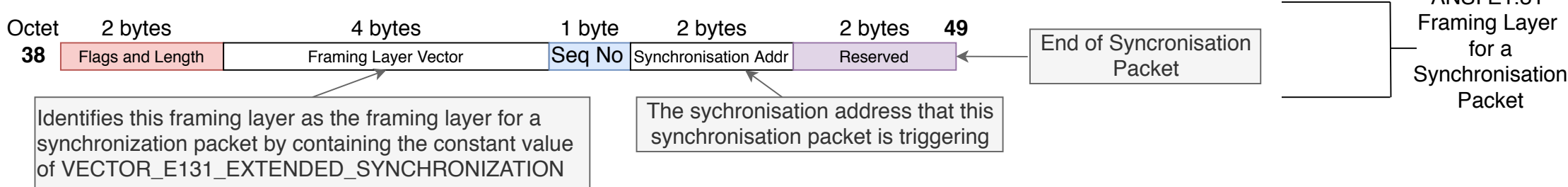
General Packet Structures (Not to Scale)

Data Packet	ACN Packet Root Layer	Data Packet Framing Layer	Data Packet DMP Layer
Synchronisation Packet	ACN Packet Root Layer	Synchronisation Packet Framing Layer	
Discovery Packet	ACN Packet Root Layer	Discovery Packet Framing Layer	Universe Discovery Packet Discovery Layer

ACN Packet Root Layer

16 bytes (all packets to scale unless otherwise noted)

Octet **0**
2 bytes	2 bytes	12 bytes	**16**
Preamble Size	Post-amble Size	ACN Packet Identifier, Has a fixed static value of 0x41 0x53 0x43 0x2d 0x45 0x31 0x2e 0x31 0x37 0x00 0x00 0x00	

The preamble is the size of the packet upto the end of the ACN packet identifier and so is always 16 bytes. The post-amble size is always 0x00.

Shows the packet is part of ACN (ANSI E1.17)

Octet **16**
2 bytes	4 bytes	10 bytes, 16 bytes total	**32**
Flags and Length	ACN Root Vector	Sender CID	

Identifies the type of packet, for sACN it is either a data packet or an 'extended' packet (synchronisation or discovery)

The sender CID is a unique identifier for the sender, the protocol provides no mechanism to guarantee this is unique however.

Octet **32**
6 bytes, 16 bytes total	**38**
... Sender CID (cont)	

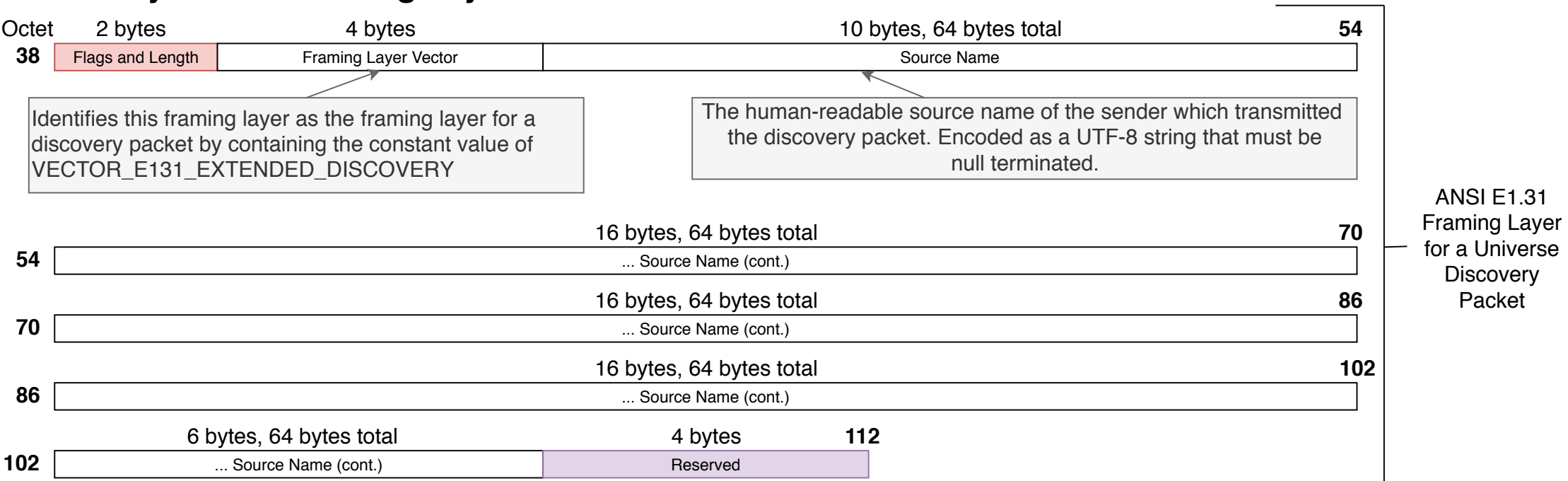Base ACN Packet Header Shared By All ACN Packets

Synchronisation Packet Framing Layer

Reserved space which is ignored by receivers and transmitted as 0's by senders.

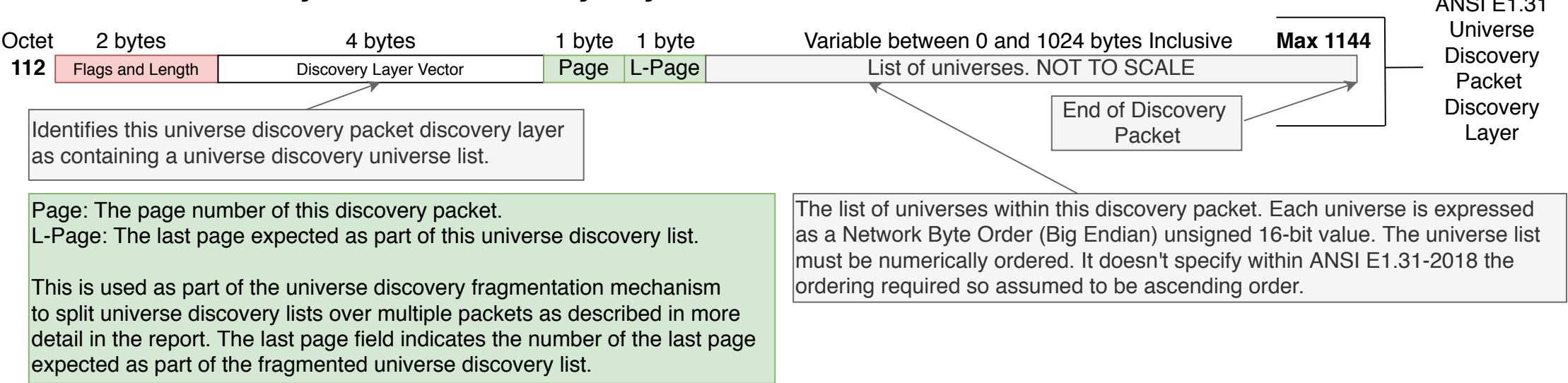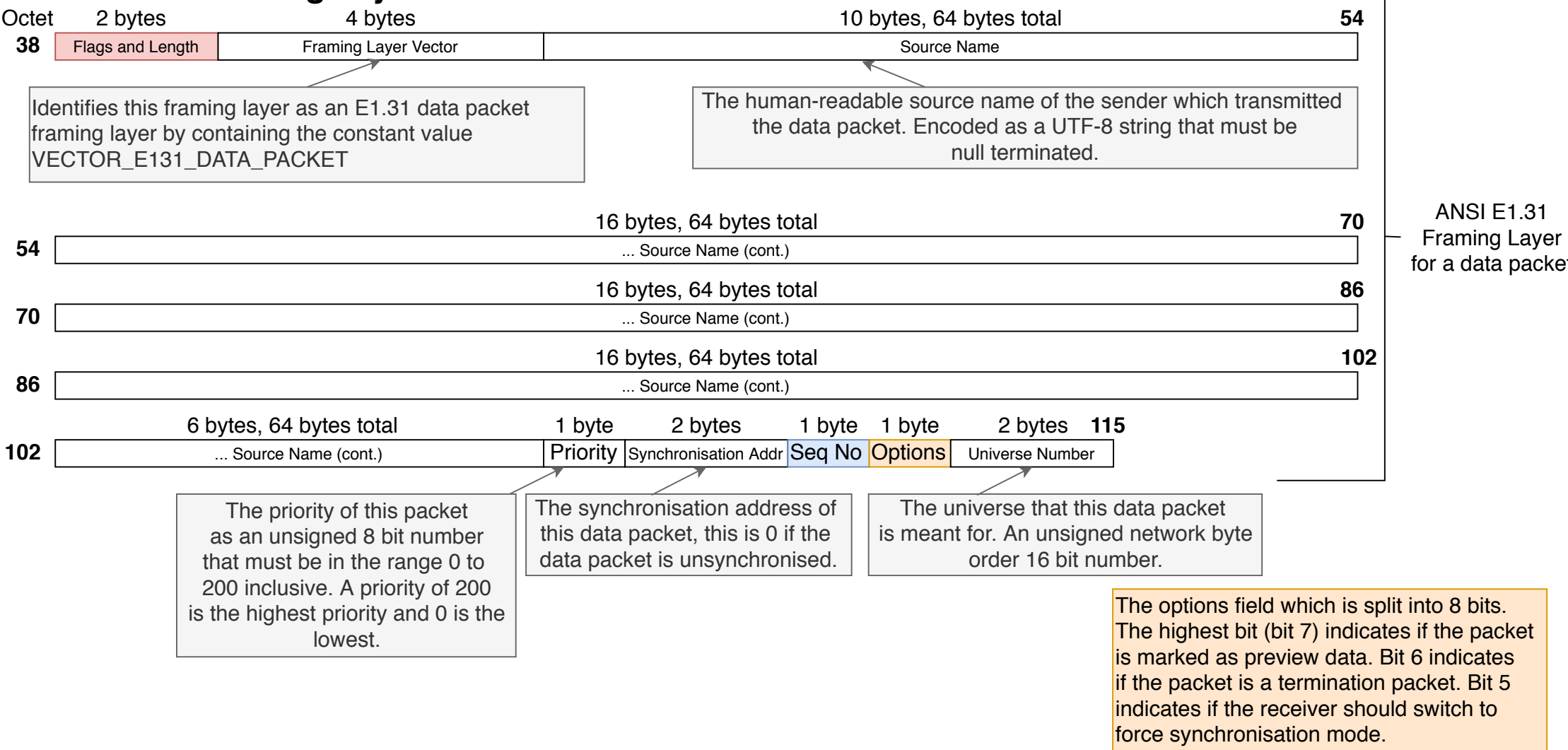The sequence number field (described in more detail in report body)

Octet **38**
2 bytes	4 bytes	1 byte	2 bytes	2 bytes	**49**
Flags and Length	Framing Layer Vector	Seq No	Synchronisation Addr	Reserved	

End of Syncronisation Packet

ANSI E1.31 Framing Layer for a Synchronisation Packet

Identifies this framing layer as the framing layer for a synchronization packet by containing the constant value of VECTOR_E131_EXTENDED_SYNCHRONIZATION

The sychronisation address that this synchronisation packet is triggering

Discovery Packet Framing Layer

Octet **38**
2 bytes	4 bytes	10 bytes, 64 bytes total	**54**
Flags and Length	Framing Layer Vector	Source Name	

Identifies this framing layer as the framing layer for a discovery packet by containing the constant value of VECTOR_E131_EXTENDED_DISCOVERY

The human-readable source name of the sender which transmitted the discovery packet. Encoded as a UTF-8 string that must be null terminated.

Octet **54**
16 bytes, 64 bytes total	**70**
... Source Name (cont.)	

Octet **70**
16 bytes, 64 bytes total	**86**
... Source Name (cont.)	

Octet **86**
16 bytes, 64 bytes total	**102**
... Source Name (cont.)	

Octet **102**
6 bytes, 64 bytes total	4 bytes	**112**
... Source Name (cont.)	Reserved	

ANSI E1.31 Framing Layer for a Universe Discovery Packet

Universe Discovery Packet Discovery Layer

Octet **112**
2 bytes	4 bytes	1 byte	1 byte	Variable between 0 and 1024 bytes Inclusive	**Max 1144**
Flags and Length	Discovery Layer Vector	Page	L-Page	List of universes. NOT TO SCALE	

ANSI E1.31 Universe Discovery Packet Discovery Layer

Identifies this universe discovery packet discovery layer as containing a universe discovery universe list.

End of Discovery Packet

Page: The page number of this discovery packet.
L-Page: The last page expected as part of this universe discovery list.

This is used as part of the universe discovery fragmentation mechanism to split universe discovery lists over multiple packets as described in more detail in the report. The last page field indicates the number of the last page expected as part of the fragmented universe discovery list.

The list of universes within this discovery packet. Each universe is expressed as a Network Byte Order (Big Endian) unsigned 16-bit value. The universe list must be numerically ordered. It doesn't specify within ANSI E1.31-2018 the ordering required so assumed to be ascending order.

Data Packet Framing Layer

Octet **38**
2 bytes	4 bytes	10 bytes, 64 bytes total	**54**
Flags and Length	Framing Layer Vector	Source Name	

Identifies this framing layer as an E1.31 data packet framing layer by containing the constant value VECTOR_E131_DATA_PACKET

The human-readable source name of the sender which transmitted the data packet. Encoded as a UTF-8 string that must be null terminated.

Octet **54**
16 bytes, 64 bytes total	**70**
... Source Name (cont.)	

Octet **70**
16 bytes, 64 bytes total	**86**
... Source Name (cont.)	

Octet **86**
16 bytes, 64 bytes total	**102**
... Source Name (cont.)	

Octet **102**
6 bytes, 64 bytes total	1 byte	2 bytes	1 byte	1 byte	2 bytes	**115**
... Source Name (cont.)	Priority	Synchronisation Addr	Seq No	Options	Universe Number	

ANSI E1.31 Framing Layer for a data packet

The priority of this packet as an unsigned 8 bit number that must be in the range 0 to 200 inclusive. A priority of 200 is the highest priority and 0 is the lowest.

The synchronisation address of this data packet, this is 0 if the data packet is unsynchronised.

The universe that this data packet is meant for. An unsigned network byte order 16 bit number.

The options field which is split into 8 bits. The highest bit (bit 7) indicates if the packet is marked as preview data. Bit 6 indicates if the packet is a termination packet. Bit 5 indicates if the receiver should switch to force synchronisation mode.

Data Packet DMP Layer

Variable between 1 and 513 bytes inclusive **MAX 638**

Octet **115**
2 bytes	1 byte	1 byte	2 bytes	2 bytes	2 bytes	Property Values, NOT TO SCALE
Flags and Length	Vector	Addr T	1st Property Addr	Addr Increment	Property Value Count	Property Values

End of Data Packet

ANSI E1.31 Framing Layer for a data packet

Identifies this data packet DMP layer as containing set property data. Uses constant VECTOR_DMP_SET_PROPERTY.

The address of the first property value in the property values data field. Always 0x0000 in E1.31-2018 data packets.

The size of each property value, always 0x0001 in E1.31-2018 data packets to indicate each property has a 1 byte length.

The number of properties within the property values field. Is always at least 0x0001 as all packets contain at least a start-code. Max value of 0x0201 as 513 maximum property values per data packet.

The actual data + start-code. Length up to 513 bytes.

The Address Type & Data Type Field. Indicates the format of the address and data. Always 0xa1 for ANSI E1.31-2018 data packets.

Diagram inspired by layout used in Fig. 5. ICMP packet structure from Determining proximal geolocation of IoT edge devices via covert channel - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/ICMP-packet-structure_fig5_316727741 [accessed 20 Apr, 2020]