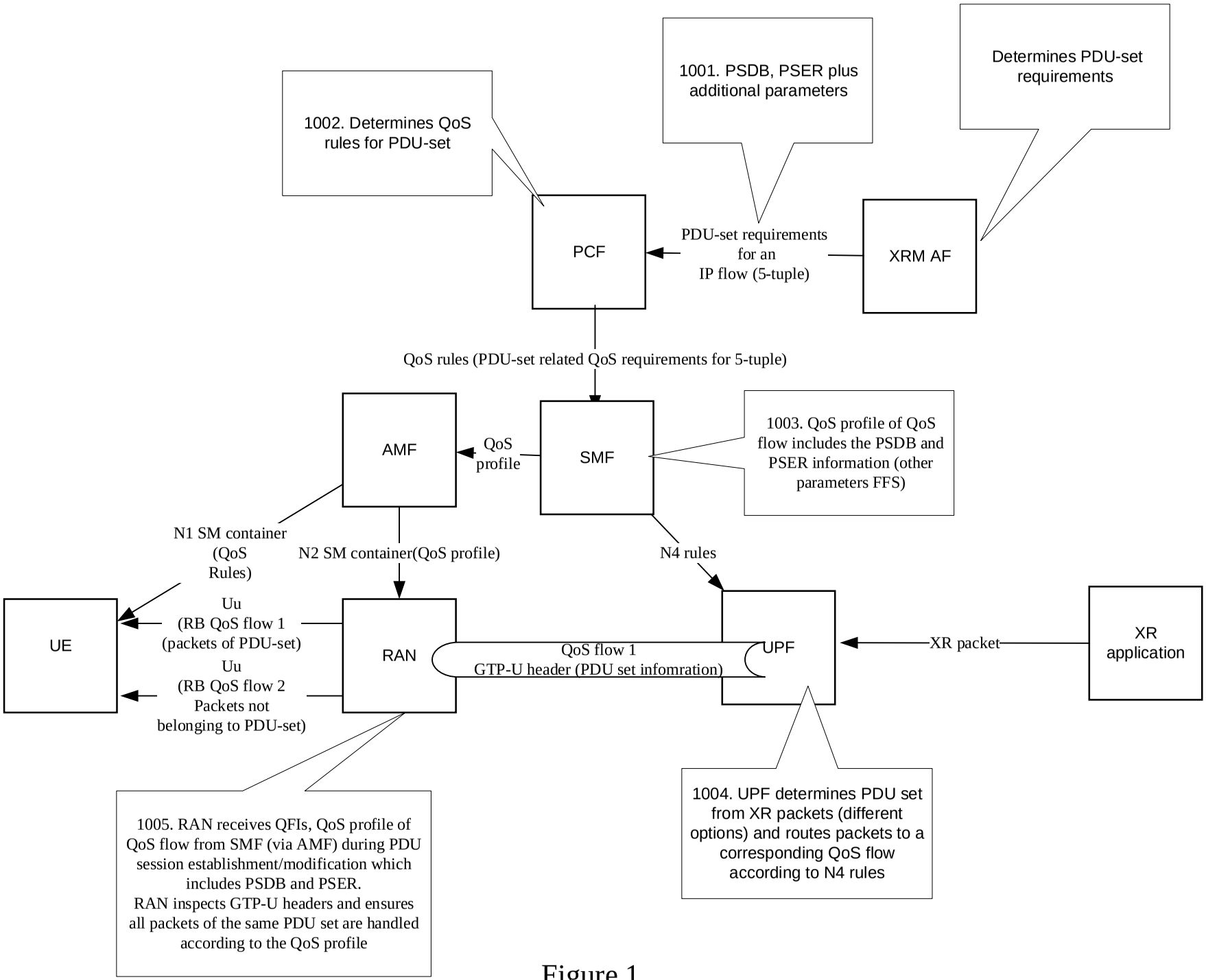

1002. Determines QoS rules for PDU-set
1001. PSDB, PSER plus additional parameters
Determines PDU-set requirements
PCF
PDU-set requirements for an IP flow (5-tuple)
XRM AF
QoS rules (PDU-set related QoS requirements for 5-tuple)
AMF
QoS profile
SMF
1003. QoS profile of QoS flow includes the PSDB and PSER information (other parameters FFS)
N1 SM container (QoS Rules)
N2 SM container(QoS profile)
N4 rules
UE
Uu (RB QoS flow 1 (packets of PDU-set)
Uu (RB QoS flow 2 Packets not belonging to PDU-set)
RAN
QoS flow 1 GTP-U header (PDU set infomration)
UPF
XR packet
XR application
1005. RAN receives QFIs, QoS profile of QoS flow from SMF (via AMF) during PDU session establishment/modification which includes PSDB and PSER.
RAN inspects GTP-U headers and ensures all packets of the same PDU set are handled according to the QoS profile
1004. UPF determines PDU set from XR packets (different options) and routes packets to a corresponding QoS flow according to N4 rules

Figure 1

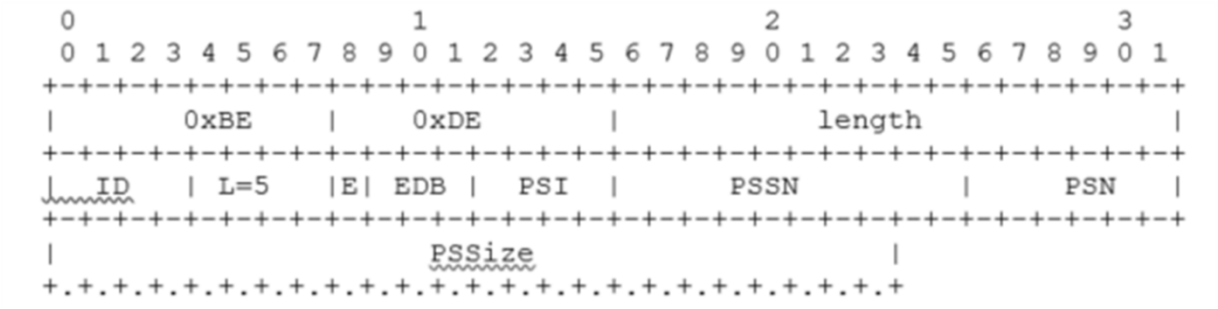


Figure 2

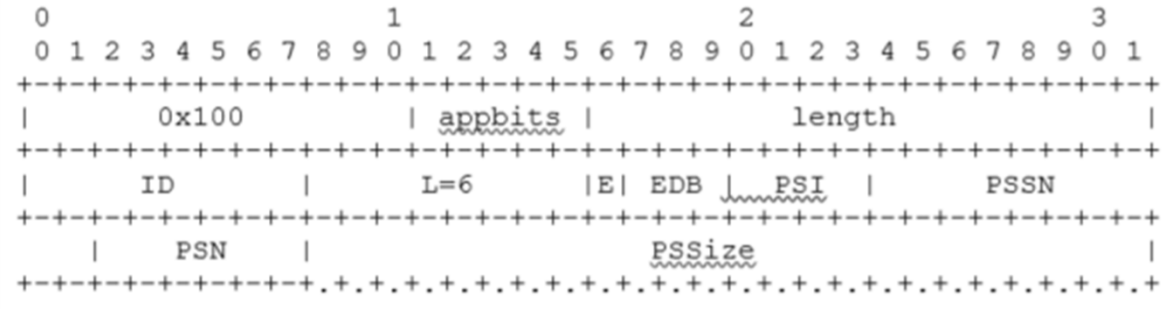


Figure 3

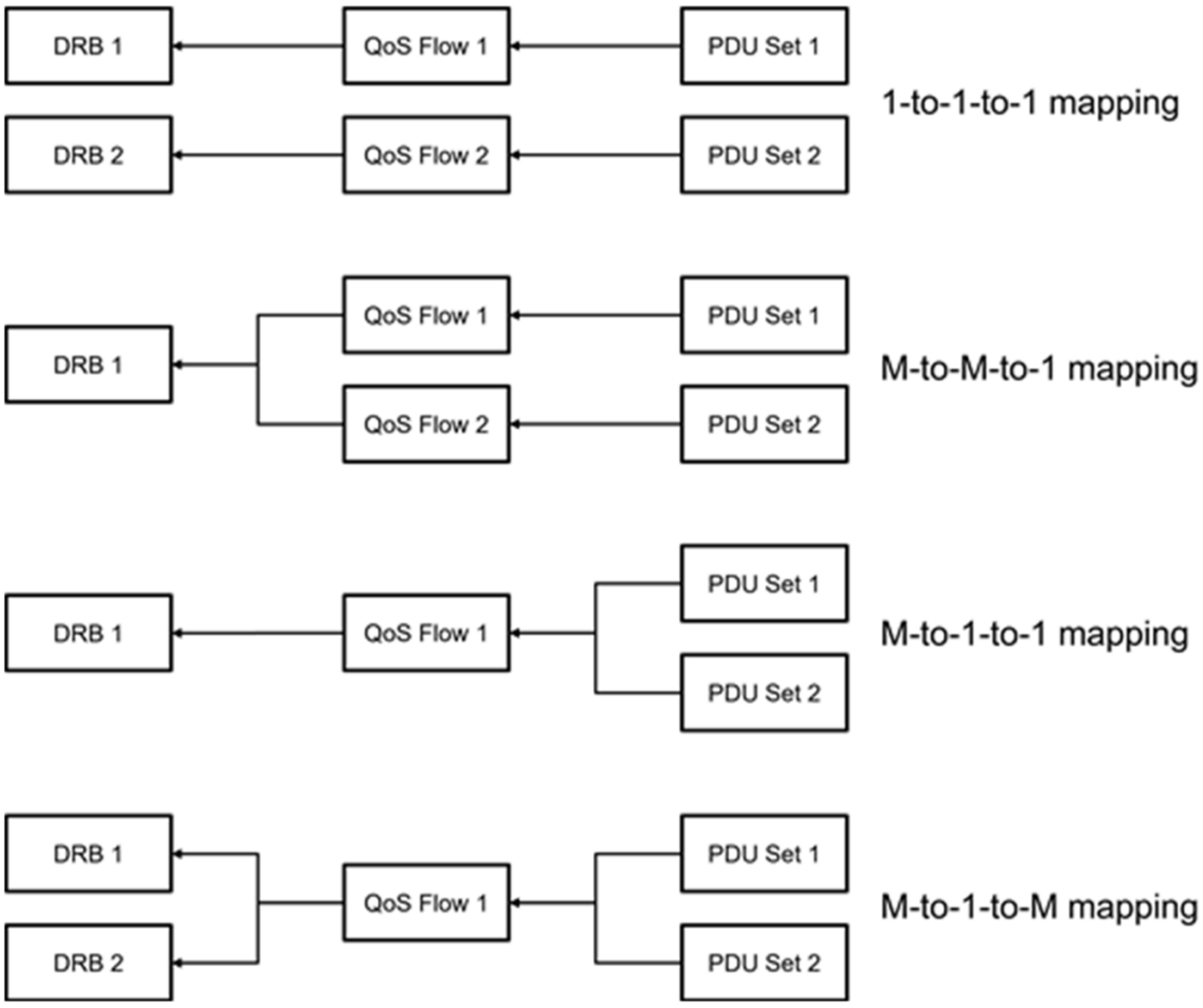

DRB 1
QoS Flow 1
PDU Set 1
DRB 2
QoS Flow 2
PDU Set 2
1-to-1-to-1 mapping
DRB 1
QoS Flow 1
QoS Flow 2
PDU Set 1
PDU Set 2
M-to-M-to-1 mapping
DRB 1
QoS Flow 1
PDU Set 1
PDU Set 2
M-to-1-to-1 mapping
DRB 1
DRB 2
QoS Flow 1
PDU Set 1
PDU Set 2
M-to-1-to-M mapping

Figure 4

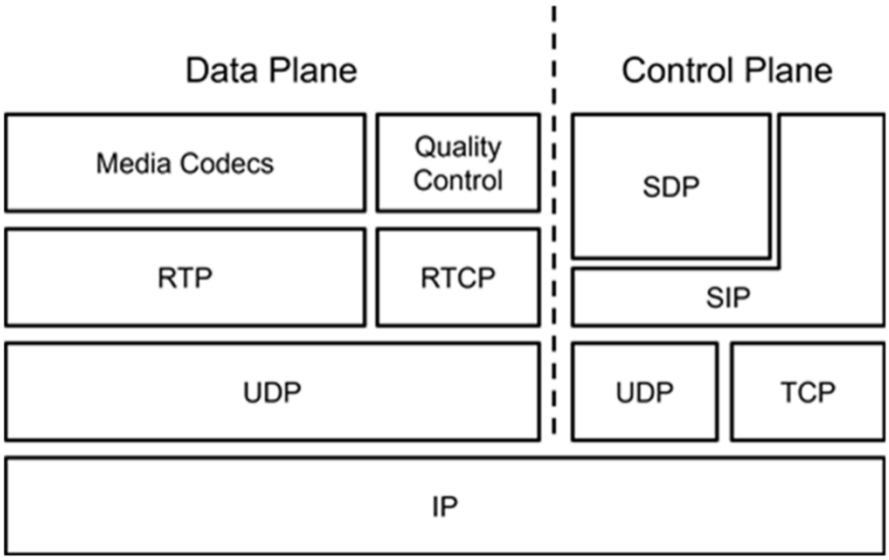

Data Plane
Control Plane
Media Codecs
Quality Control
SDP
RTP
RTCP
SIP
UDP
UDP
TCP
IP

Figure 5

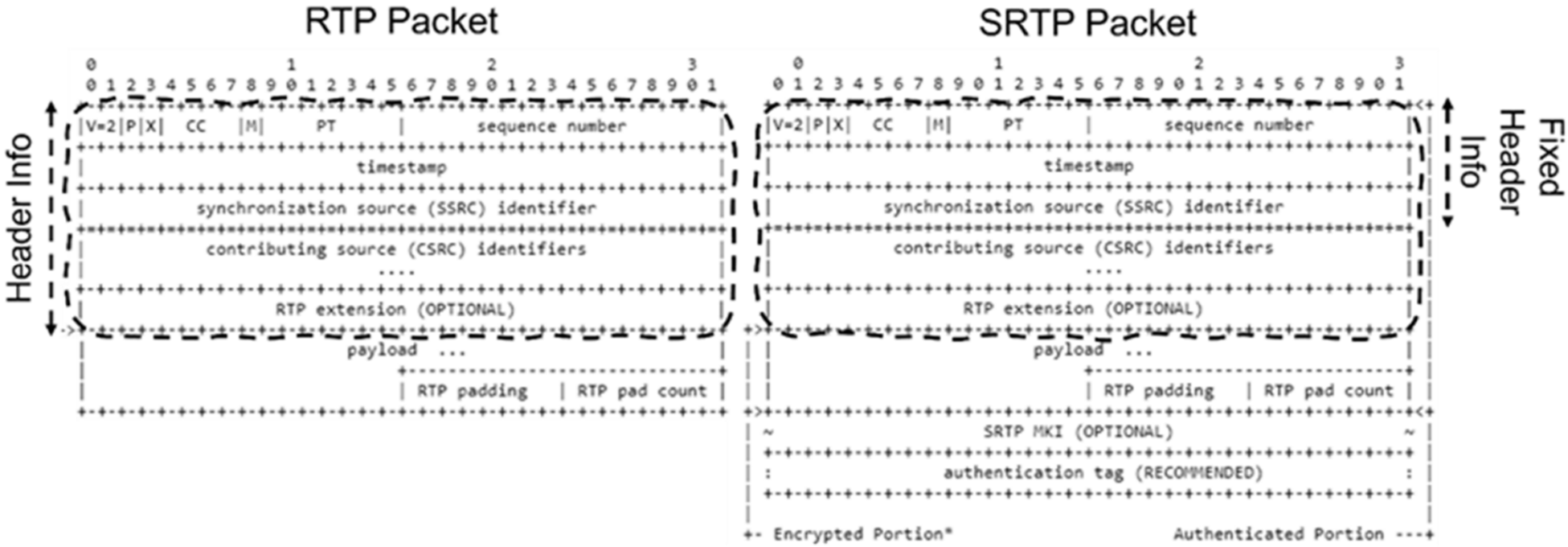

RTP Packet
SRTP Packet
Header Info
Fixed Header Info
0 1 2 3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
|V=2|P|X| CC |M| PT | sequence number |
| timestamp |
| synchronization source (SSRC) identifier |
| contributing source (CSRC) identifiers |
| .... |
| RTP extension (OPTIONAL) |
| payload ... |
| RTP padding | RTP pad count |
| ~ SRTP MKI (OPTIONAL) ~ |
| : authentication tag (RECOMMENDED) : |
+- Encrypted Portion*
Authenticated Portion ---+

Figure 6

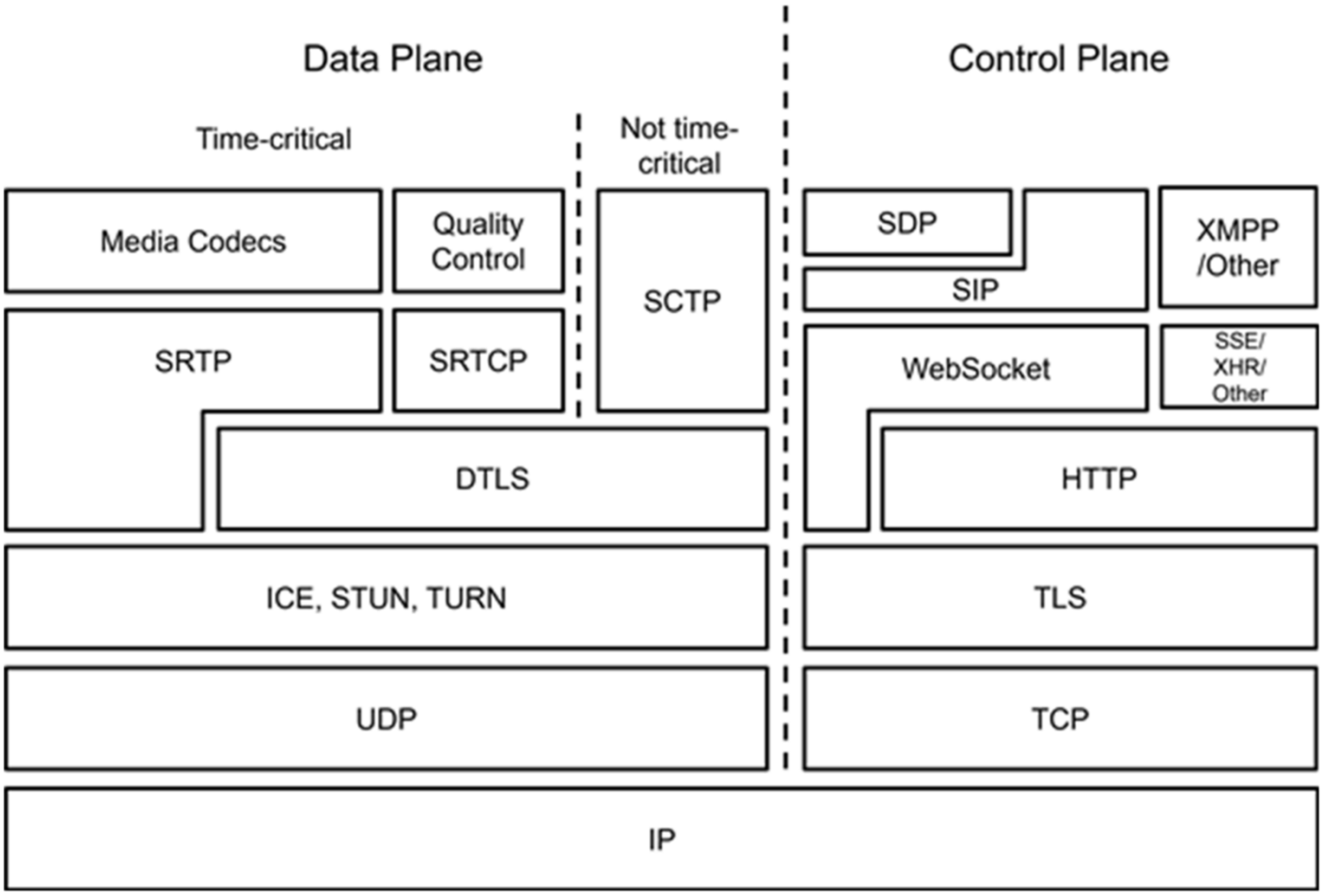


Figure 7



Figure 8

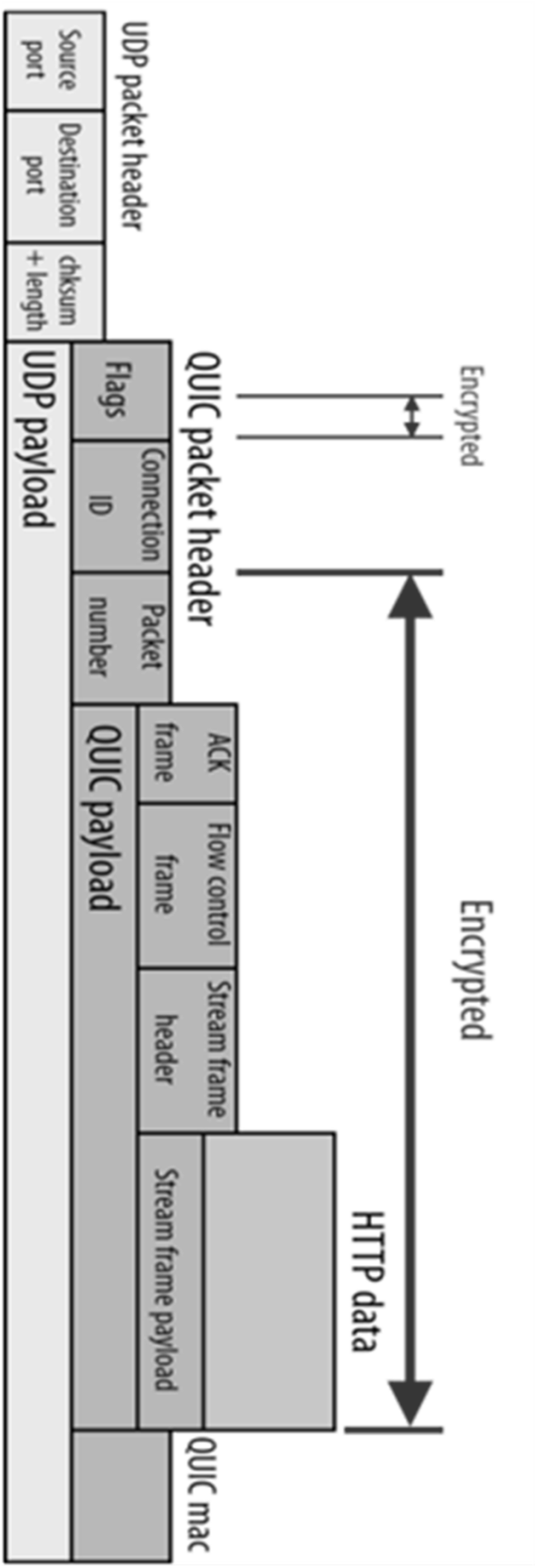

Encrypted
Encrypted
HTTP data
UDP packet header
Source port
Destination port
chksum + length
UDP payload
QUIC packet header
Flags
Connection ID
Packet number
QUIC payload
ACK frame
Flow control frame
Stream frame header
Stream frame payload
QUIC mac

Figure 9

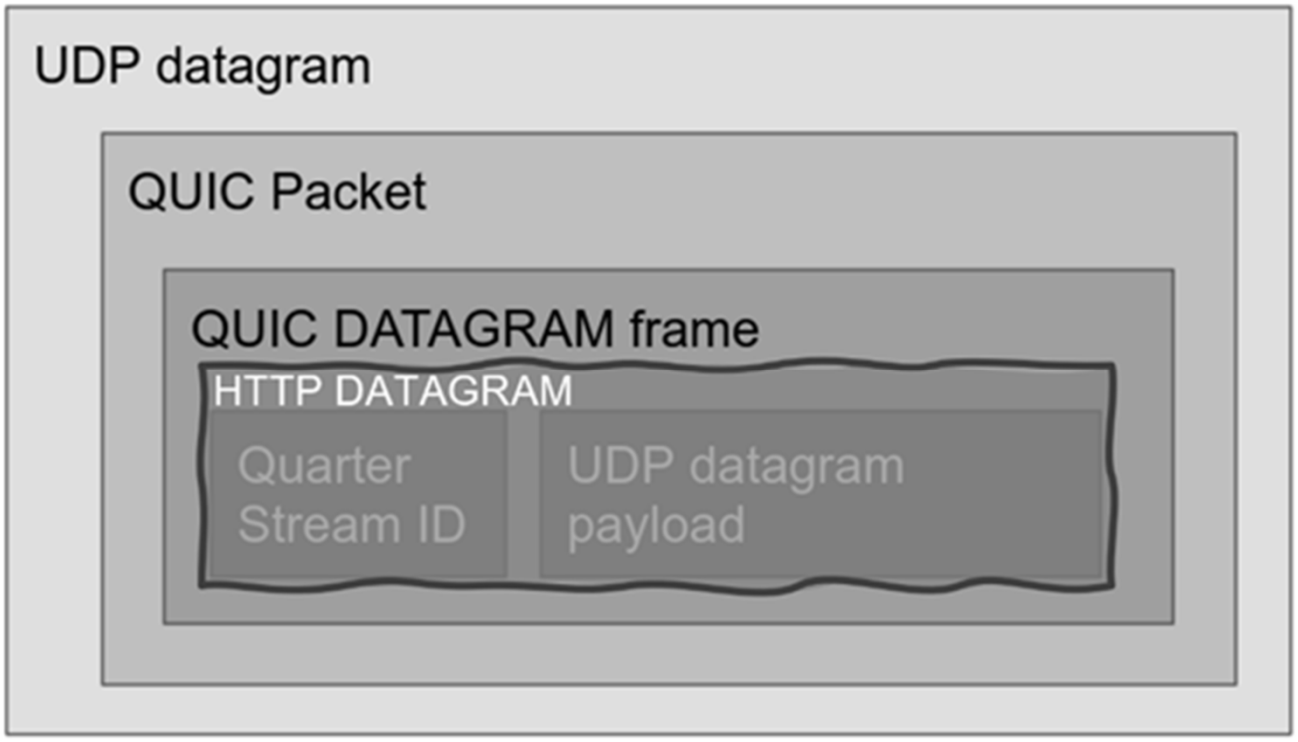

UDP datagram
QUIC Packet
QUIC DATAGRAM frame
HTTP DATAGRAM
Quarter Stream ID
UDP datagram payload

Figure 10

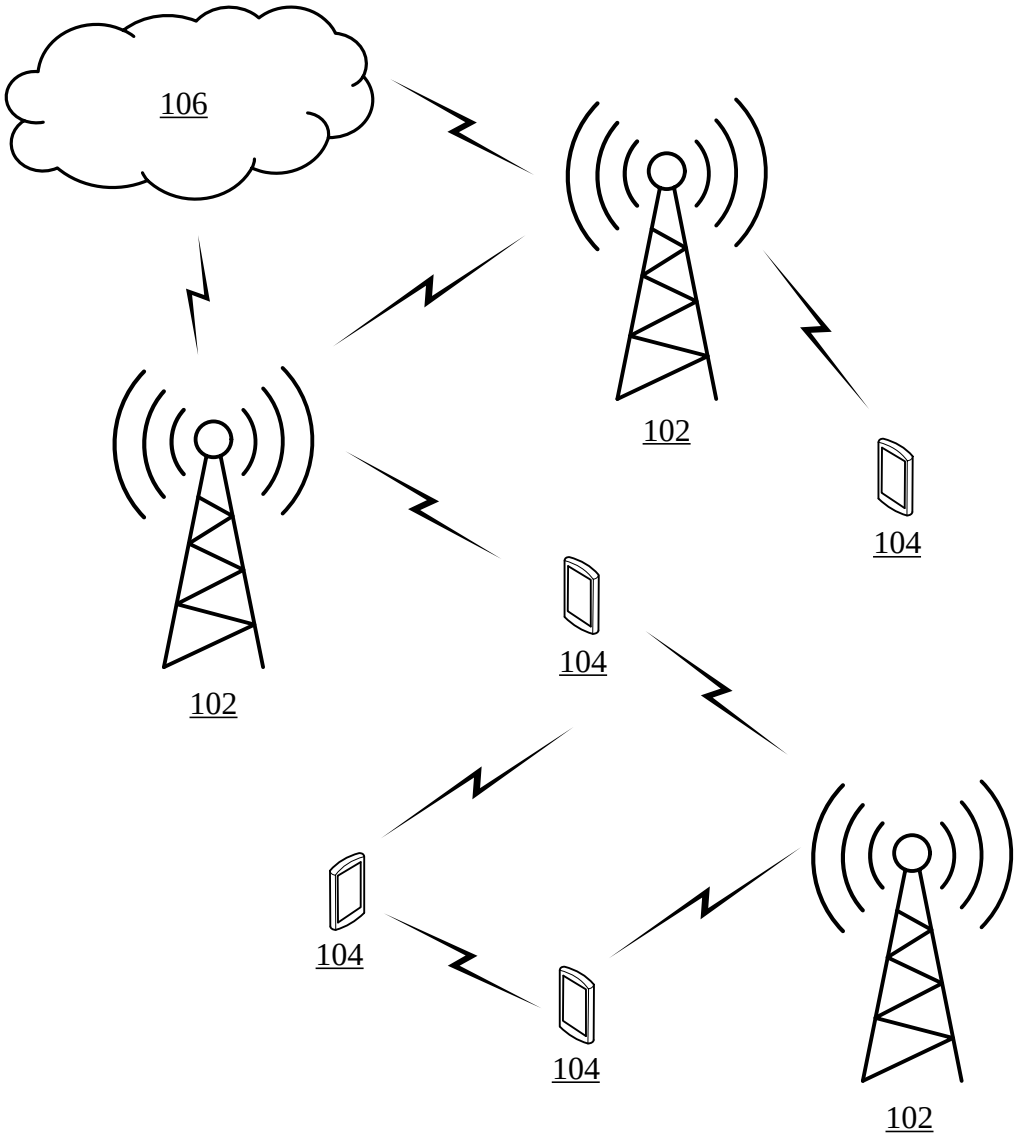


Figure 11

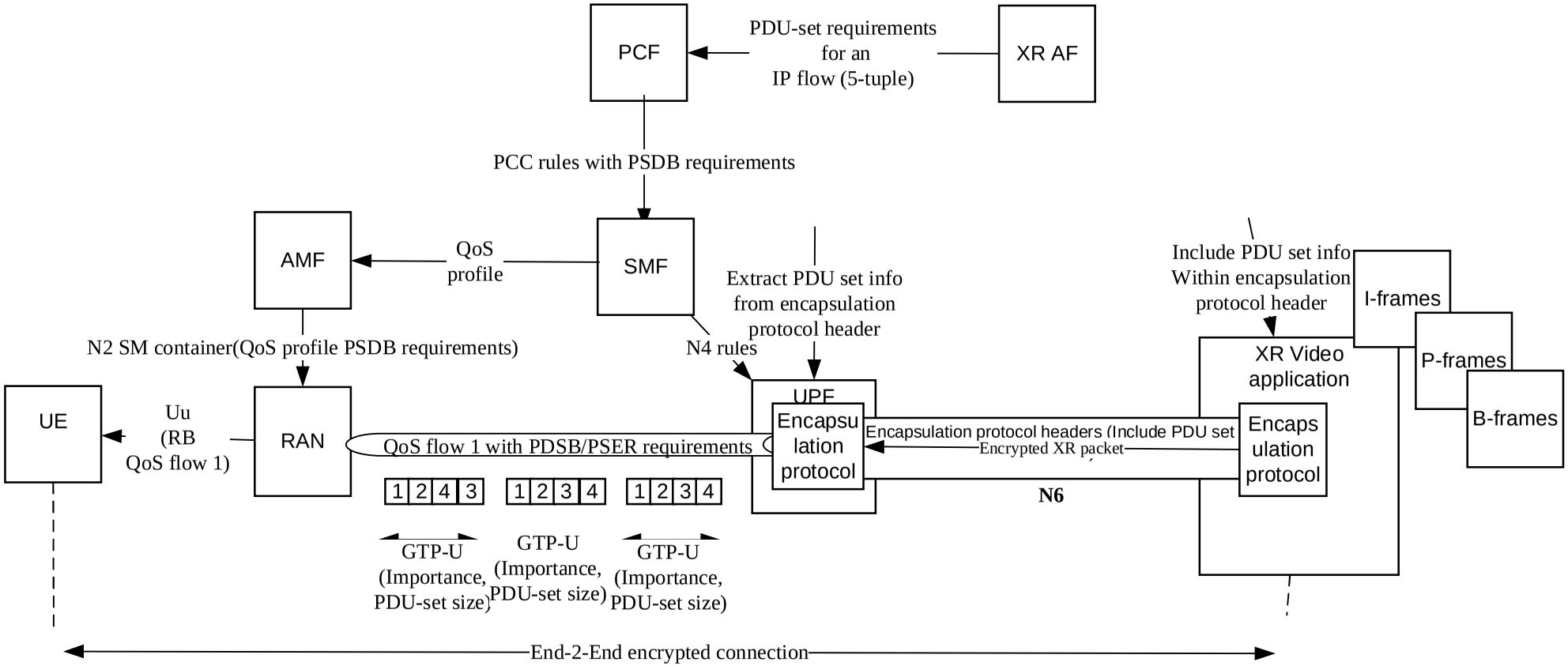

PCF
PDU-set requirements
for an
IP flow (5-tuple)
XR AF
PCC rules with PSDB requirements
AMF
QoS
profile
SMF
Extract PDU set info
from encapsulation
protocol header
Include PDU set info
Within encapsulation
protocol header
I-frames
P-frames
B-frames
XR Video
application
N2 SM container(QoS profile PSDB requirements)
N4 rules
UPF
UE
Uu
(RB
QoS flow 1)
RAN
QoS flow 1 with PDSB/PSER requirements
Encapsu
lation
protocol
Encapsulation protocol headers (Include PDU set
Encrypted XR packet
Encaps
ulation
protocol
1 2 4 3
1 2 3 4
1 2 3 4
N6
GTP-U
(Importance,
PDU-set size)
GTP-U
(Importance,
PDU-set size)
GTP-U
(Importance,
PDU-set size)
End-2-End encrypted connection

Figure 12

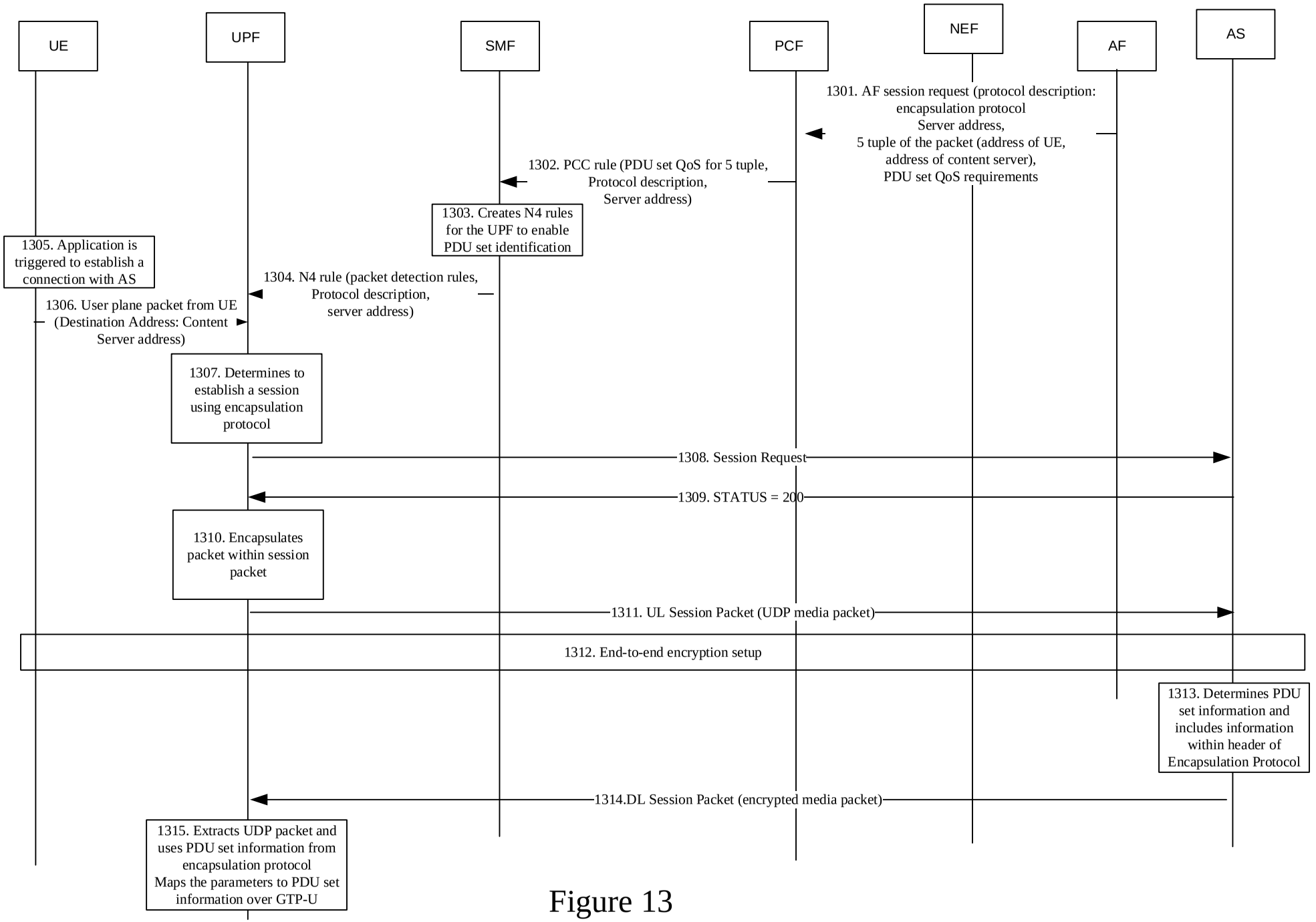

UE
UPF
SMF
PCF
NEF
AF
AS
1301. AF session request (protocol description: encapsulation protocol Server address, 5 tuple of the packet (address of UE, address of content server), PDU set QoS requirements
1302. PCC rule (PDU set QoS for 5 tuple, Protocol description, Server address)
1303. Creates N4 rules for the UPF to enable PDU set identification
1305. Application is triggered to establish a connection with AS
1304. N4 rule (packet detection rules, Protocol description, server address)
1306. User plane packet from UE (Destination Address: Content Server address)
1307. Determines to establish a session using encapsulation protocol
1308. Session Request
1309. STATUS = 200
1310. Encapsulates packet within session packet
1311. UL Session Packet (UDP media packet)
1312. End-to-end encryption setup
1313. Determines PDU set information and includes information within header of Encapsulation Protocol
1314.DL Session Packet (encrypted media packet)
1315. Extracts UDP packet and uses PDU set information from encapsulation protocol Maps the parameters to PDU set information over GTP-U

Figure 13

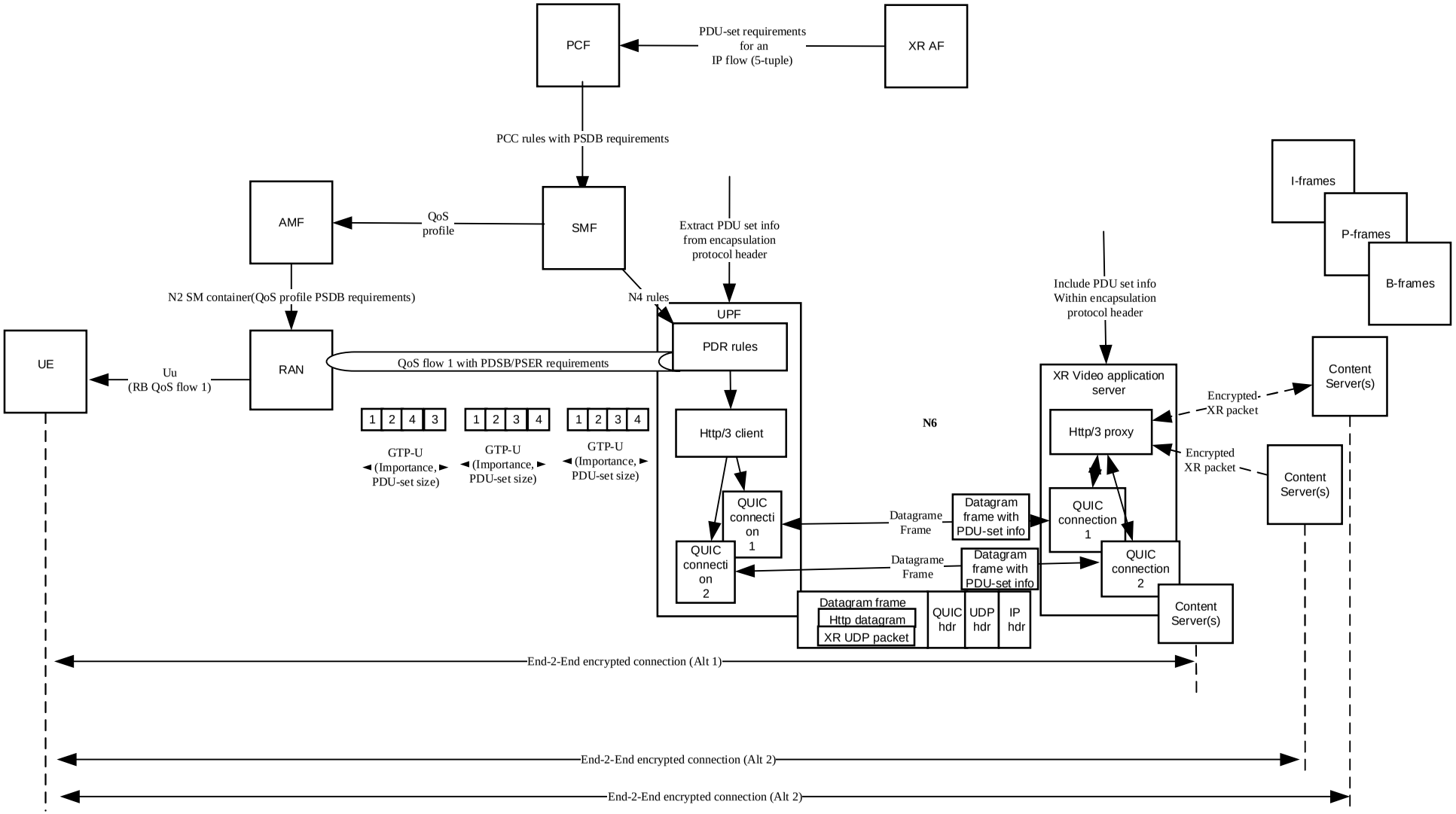

PCF
PDU-set requirements for an IP flow (5-tuple)
XR AF
PCC rules with PSDB requirements
AMF
QoS profile
SMF
Extract PDU set info from encapsulation protocol header
I-frames
P-frames
B-frames
N2 SM container(QoS profile PSDB requirements)
N4 rules
Include PDU set info Within encapsulation protocol header
UPF
UE
Uu (RB QoS flow 1)
RAN
QoS flow 1 with PDSB/PSER requirements
PDR rules
XR Video application server
Content Server(s)
Encrypted-XR packet
1 2 4 3
1 2 3 4
1 2 3 4
GTP-U (Importance, PDU-set size)
GTP-U (Importance, PDU-set size)
GTP-U (Importance, PDU-set size)
Http/3 client
N6
Http/3 proxy
Encrypted XR packet
Content Server(s)
QUIC connection 1
Datagrame Frame
Datagram frame with PDU-set info
QUIC connection 2
Datagram frame
Http datagram
XR UDP packet
QUIC hdr
UDP hdr
IP hdr
Content Server(s)
End-2-End encrypted connection (Alt 1)
End-2-End encrypted connection (Alt 2)
End-2-End encrypted connection (Alt 2)

Figure 14

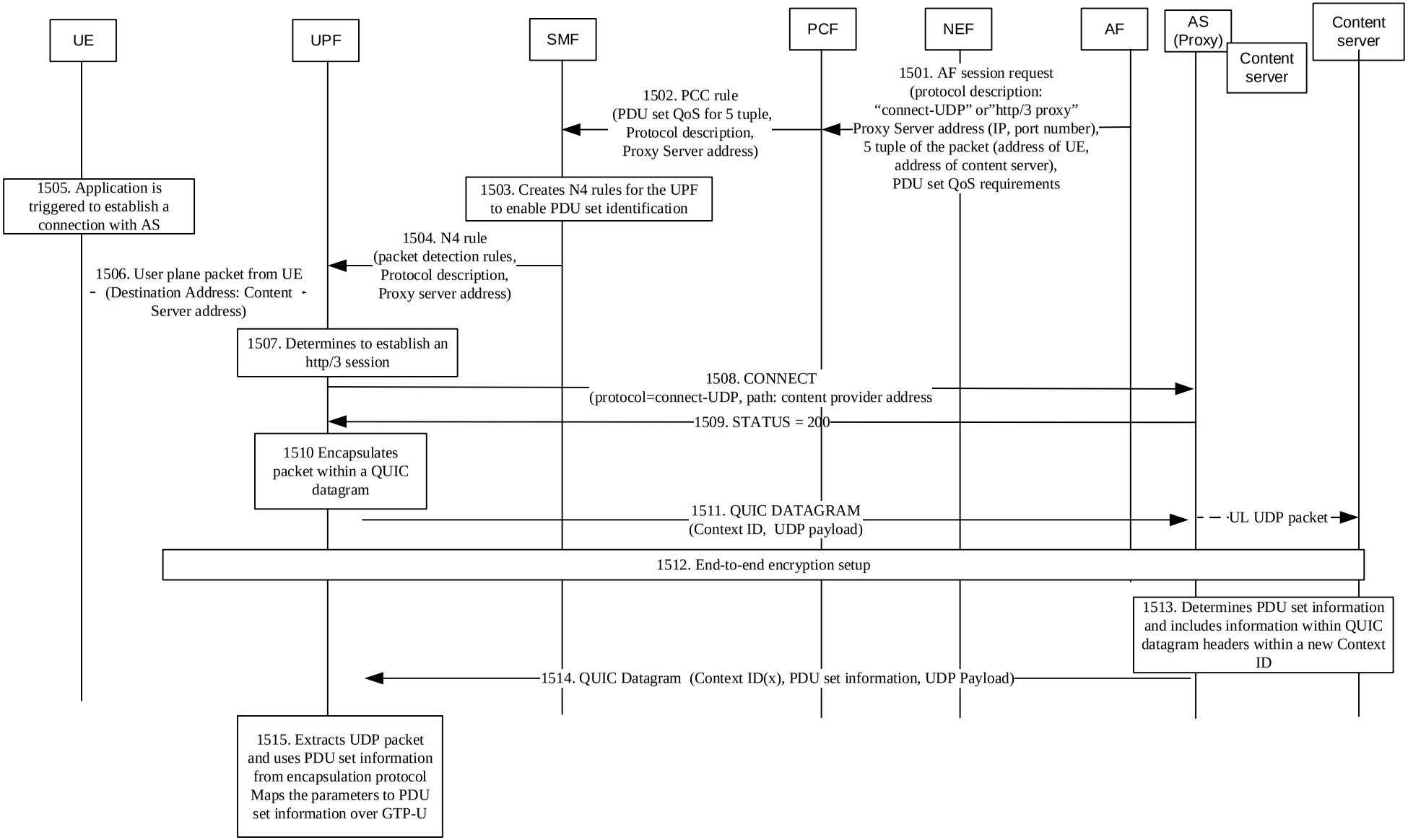

UE
UPF
SMF
PCF
NEF
AF
AS (Proxy)
Content server
Content server
1501. AF session request (protocol description: “connect-UDP” or”http/3 proxy” Proxy Server address (IP, port number), 5 tuple of the packet (address of UE, address of content server), PDU set QoS requirements
1502. PCC rule (PDU set QoS for 5 tuple, Protocol description, Proxy Server address)
1503. Creates N4 rules for the UPF to enable PDU set identification
1504. N4 rule (packet detection rules, Protocol description, Proxy server address)
1505. Application is triggered to establish a connection with AS
1506. User plane packet from UE (Destination Address: Content Server address)
1507. Determines to establish an http/3 session
1508. CONNECT (protocol=connect-UDP, path: content provider address
1509. STATUS = 200
1510 Encapsulates packet within a QUIC datagram
1511. QUIC DATAGRAM (Context ID, UDP payload)
UL UDP packet
1512. End-to-end encryption setup
1513. Determines PDU set information and includes information within QUIC datagram headers within a new Context ID
1514. QUIC Datagram (Context ID(x), PDU set information, UDP Payload)
1515. Extracts UDP packet and uses PDU set information from encapsulation protocol Maps the parameters to PDU set information over GTP-U

Figure 15

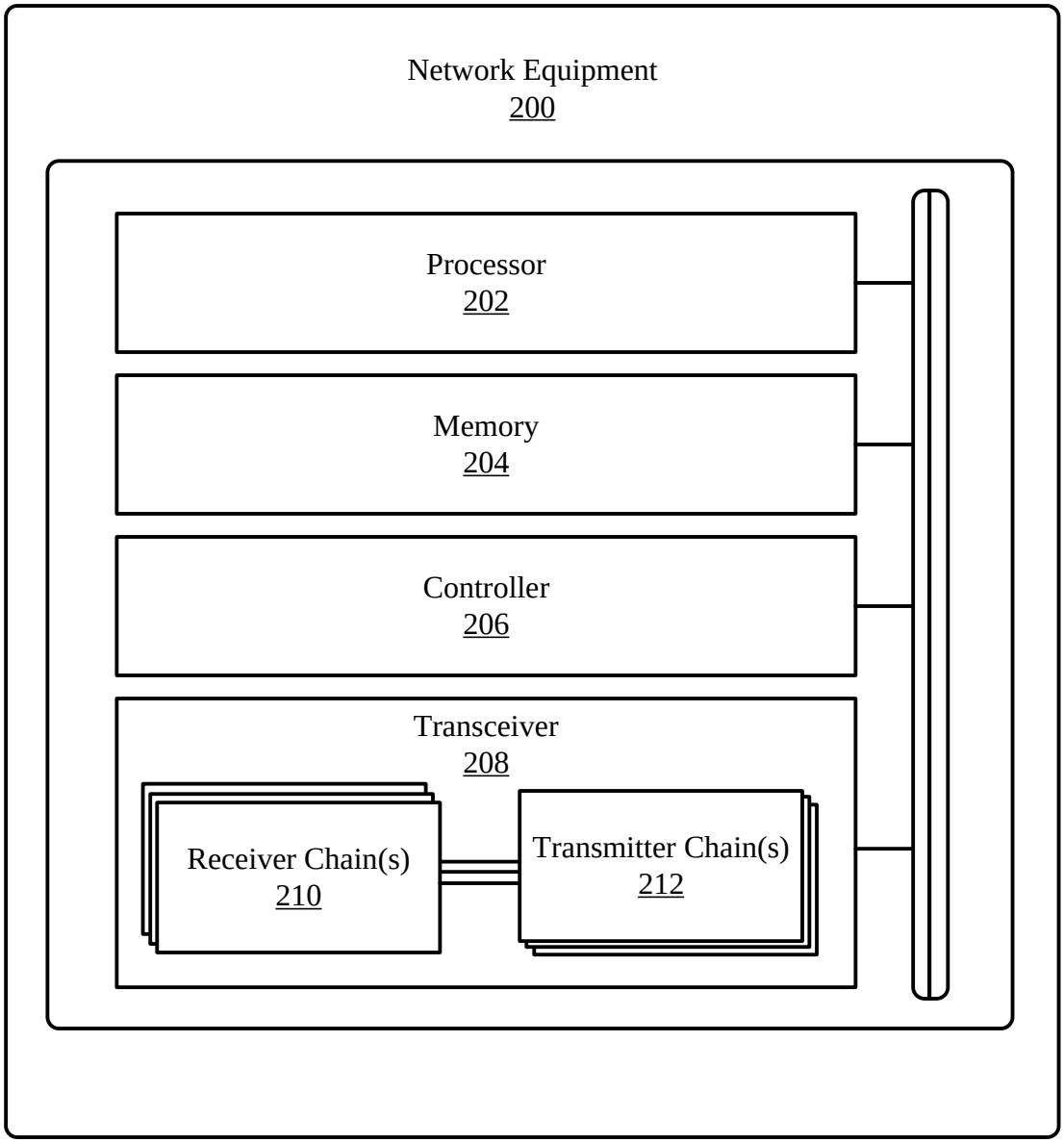

Network Equipment
200
Processor
202
Memory
204
Controller
206
Transceiver
208
Receiver Chain(s)
210
Transmitter Chain(s)
212

Figure 16

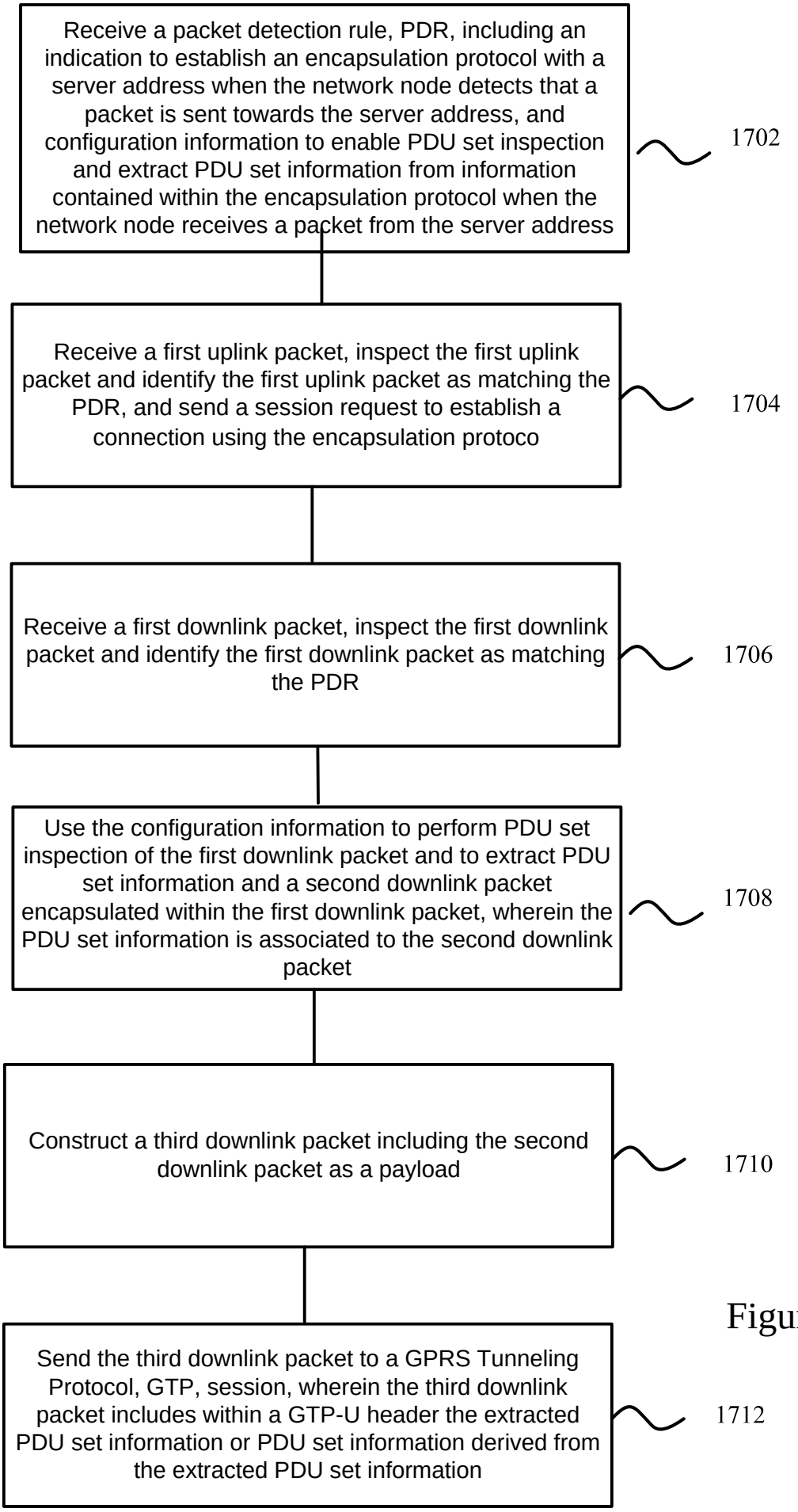

Receive a packet detection rule, PDR, including an indication to establish an encapsulation protocol with a server address when the network node detects that a packet is sent towards the server address, and configuration information to enable PDU set inspection and extract PDU set information from information contained within the encapsulation protocol when the network node receives a packet from the server address
1702
Receive a first uplink packet, inspect the first uplink packet and identify the first uplink packet as matching the PDR, and send a session request to establish a connection using the encapsulation protoco
1704
Receive a first downlink packet, inspect the first downlink packet and identify the first downlink packet as matching the PDR
1706
Use the configuration information to perform PDU set inspection of the first downlink packet and to extract PDU set information and a second downlink packet encapsulated within the first downlink packet, wherein the PDU set information is associated to the second downlink packet
1708
Construct a third downlink packet including the second downlink packet as a payload
1710
Send the third downlink packet to a GPRS Tunneling Protocol, GTP, session, wherein the third downlink packet includes within a GTP-U header the extracted PDU set information or PDU set information derived from the extracted PDU set information
1712

Figure 17

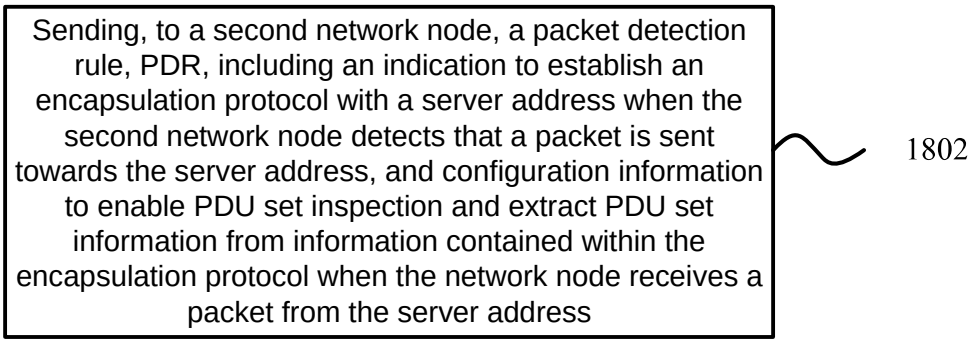

Sending, to a second network node, a packet detection rule, PDR, including an indication to establish an encapsulation protocol with a server address when the second network node detects that a packet is sent towards the server address, and configuration information to enable PDU set inspection and extract PDU set information from information contained within the encapsulation protocol when the network node receives a packet from the server address
1802

Figure 18