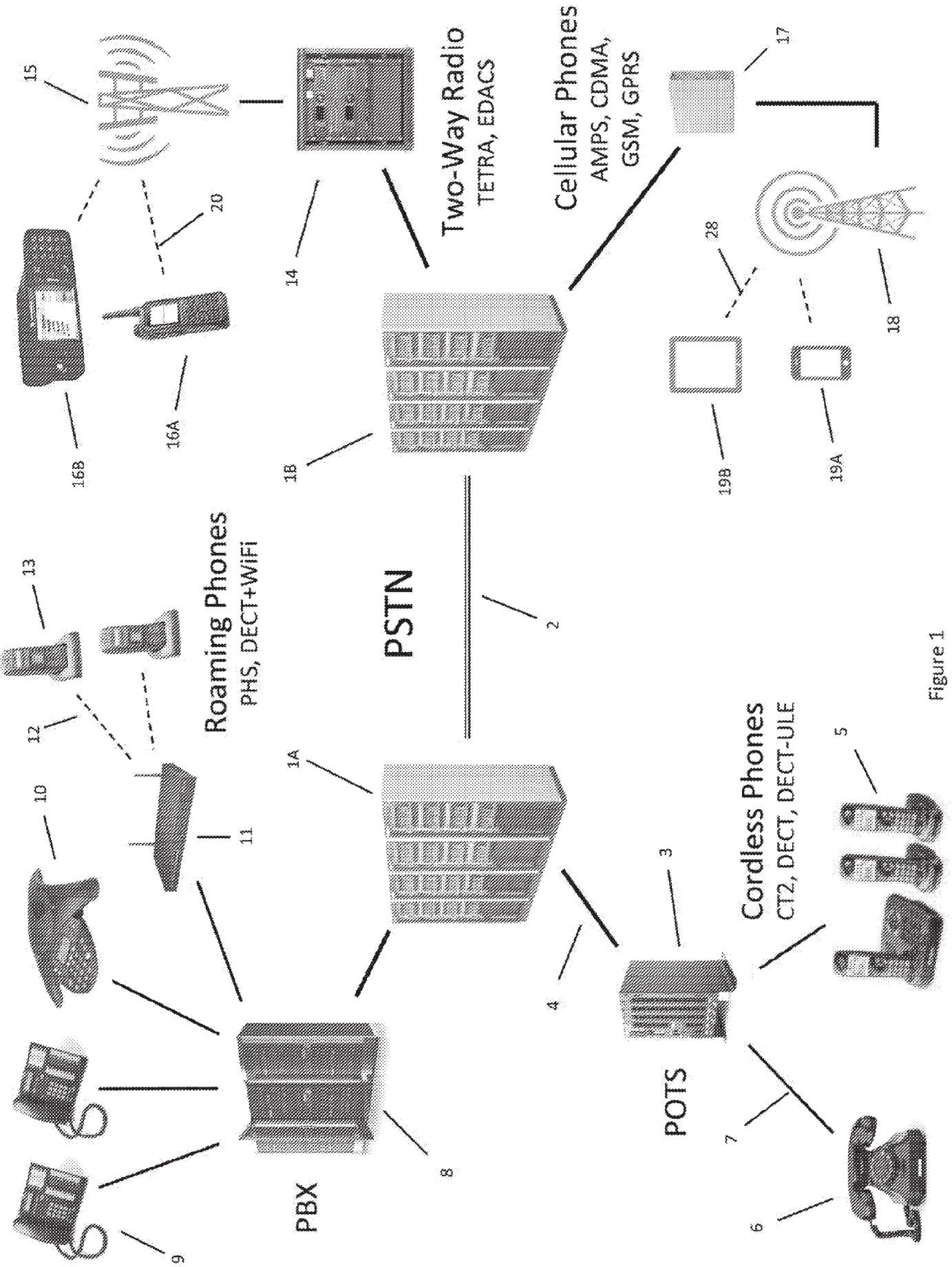

PSTN
2
1A
1B
PBX
8
9
10
11
12
13
Roaming Phones
PHS, DECT+WiFi
POTS
3
4
5
6
7
Cordless Phones
CT2, DECT, DECT-ULE
Two-Way Radio
TETRA, EDACS
14
15
16A
16B
20
Cellular Phones
AMPS, CDMA,
GSM, GPRS
17
18
19A
19B
28

Figure 1

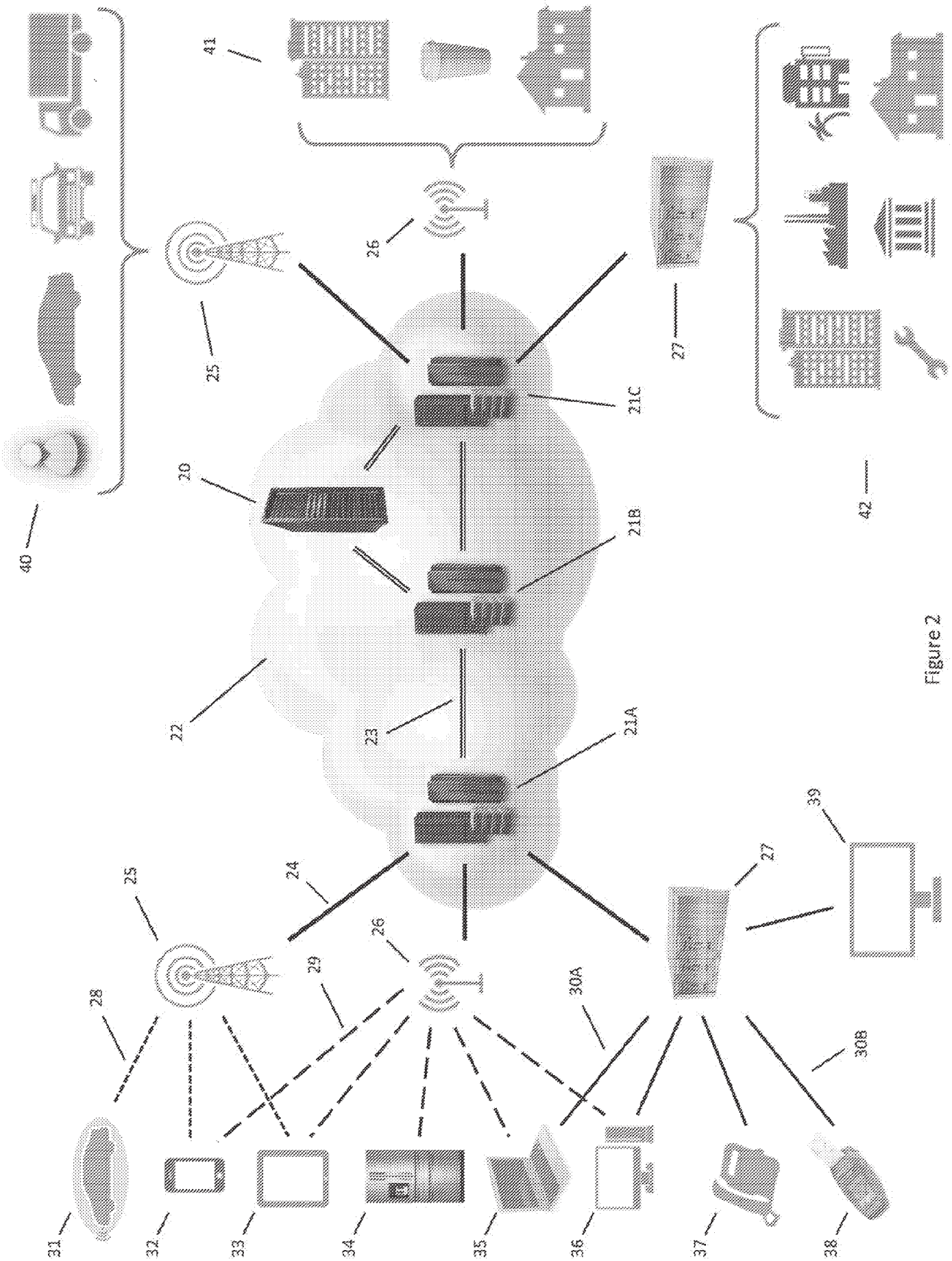

40
41
25
26
27
42
20
21C
21B
21A
22
23
24
25
26
27
39
28
29
30A
30B
31
32
33
34
35
36
37
38

Figure 2

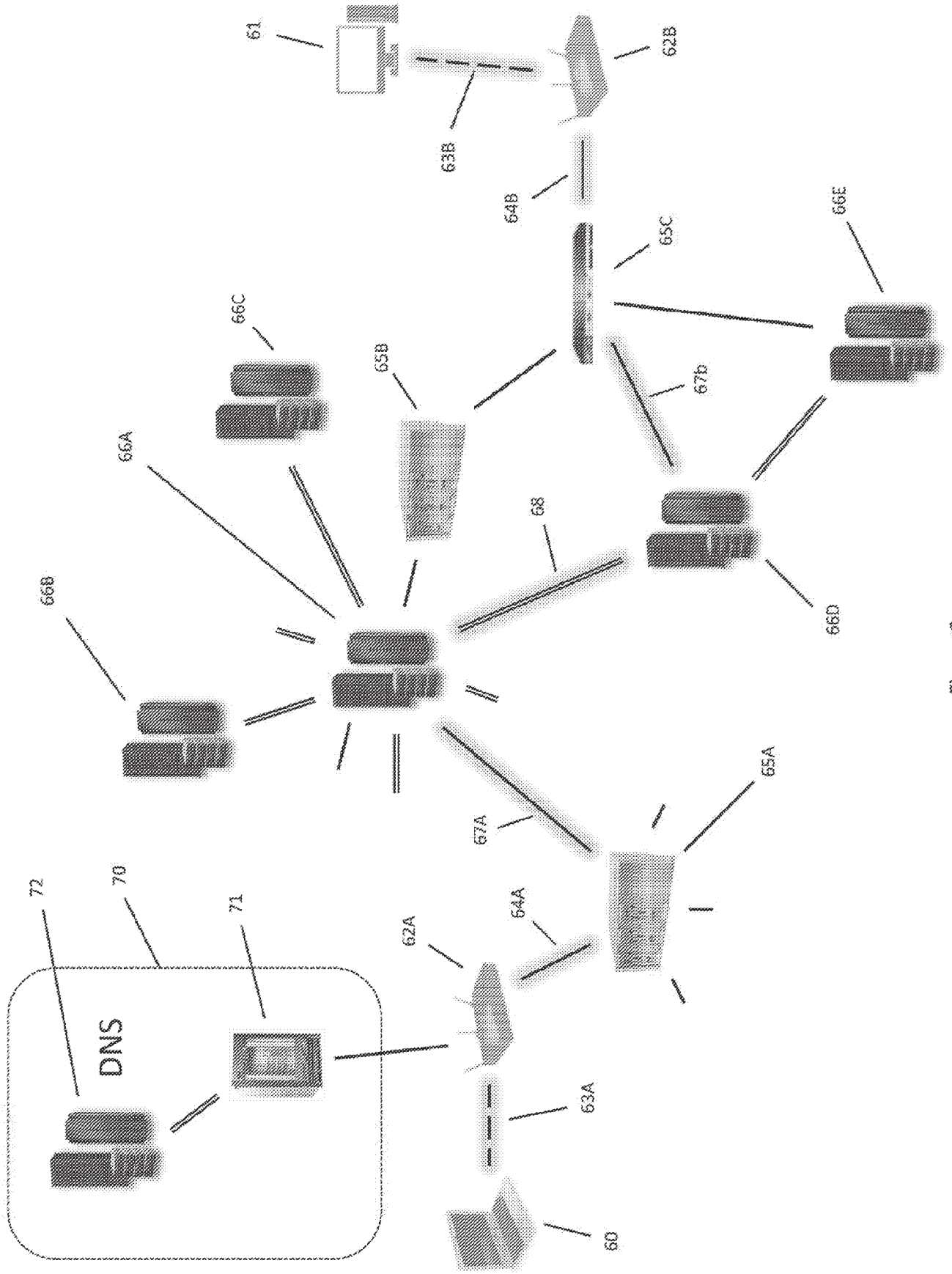
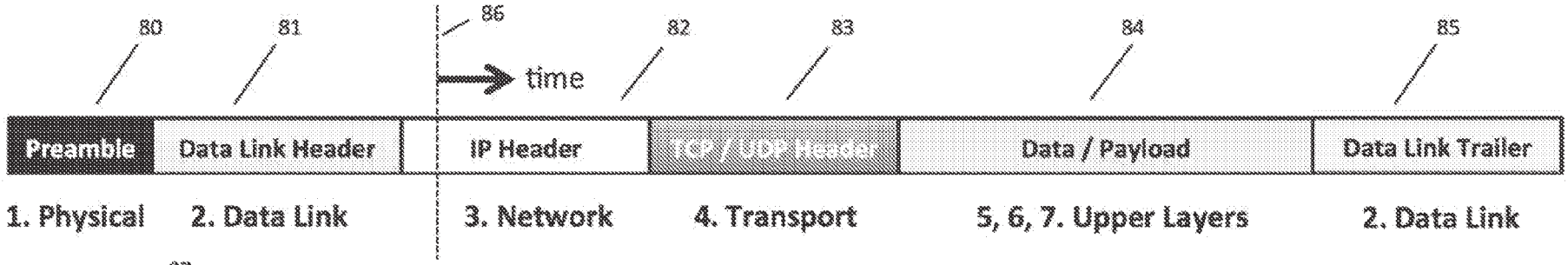

61
62B
63B
64B
65C
66E
66C
65B
67b
66A
68
66B
66D
65A
67A
72
70
71
62A
64A
DNS
63A
60

Figure 3



87

OSI Layer	Data Type	Current Examples
7. Application	Data (Upper Layers, App Layers, Payload)	Telnet, files (FTP, SFTP, FTAM, ZIP), email (SMTP, IMAP, POP3), web (DNS, HTTP, Safari, Firefox, Chrome, etc.), coms (SIP, IRC, NNTP, OTT), network mgmt (SNMP, DHCP, BGP, LDAP, CMIP), drivers (printer, scanner, camera), backup (NFS, online, custom)
6. Presentation		text (ASCII, EBCDIC, ZIP), graphics (PNG, JPG, GIF, BMP), sound & video (MP4, WMV, MOV, AVI, MIDI), documents (PDF, DOC, PPT, HTML, XML, MIME), streaming (RTP, RTSP, RTMP), encryption (TLS/SSL, SSH)
5. Session		SOCKS, RPC, authentication, full/half duplex, simplex
4. Transport	Segments, datagram	UDP, TCP, DCCP, VPN (GRE, PPTP, SSTM, SSH...), LCM
3. Network	Packet, datagram	IP, ICMP, IGMP
2. Data Link	Bit, frame, VLAN (802.1Q)	802.11, 802.3, ATM, PPP, HSUPA, LTE, DOCSIS, LLC
1. Physical (PHY)	Electrical, optical & RF signals (incl. bit streams)	WiFi, Ethernet, Serial, Parallel, Fiber, T1, 4G, Cable, Cu wire, RF Broadcast (FM, TV, DAB, DMB), Bluetooth, Bits

Figure 4

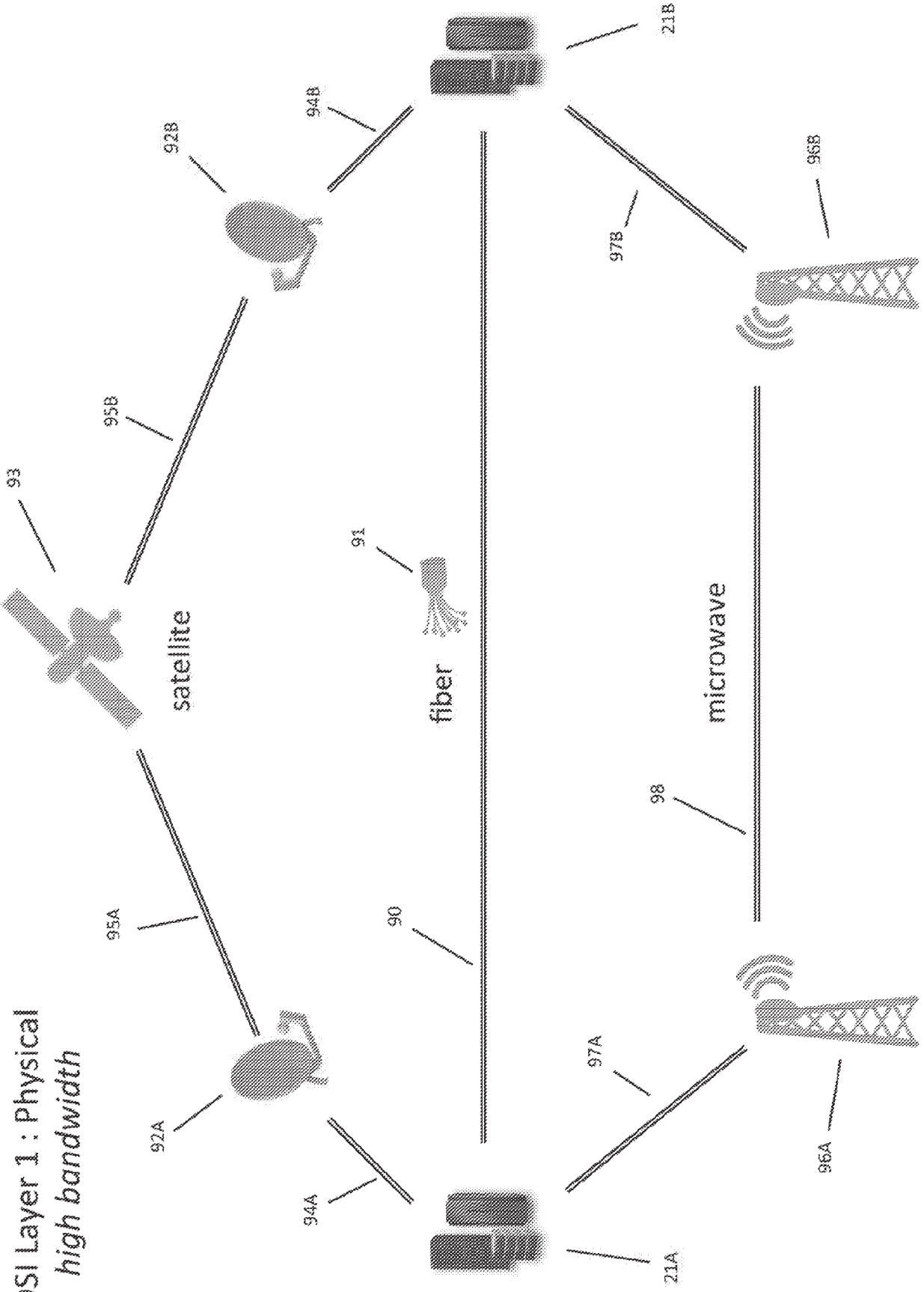
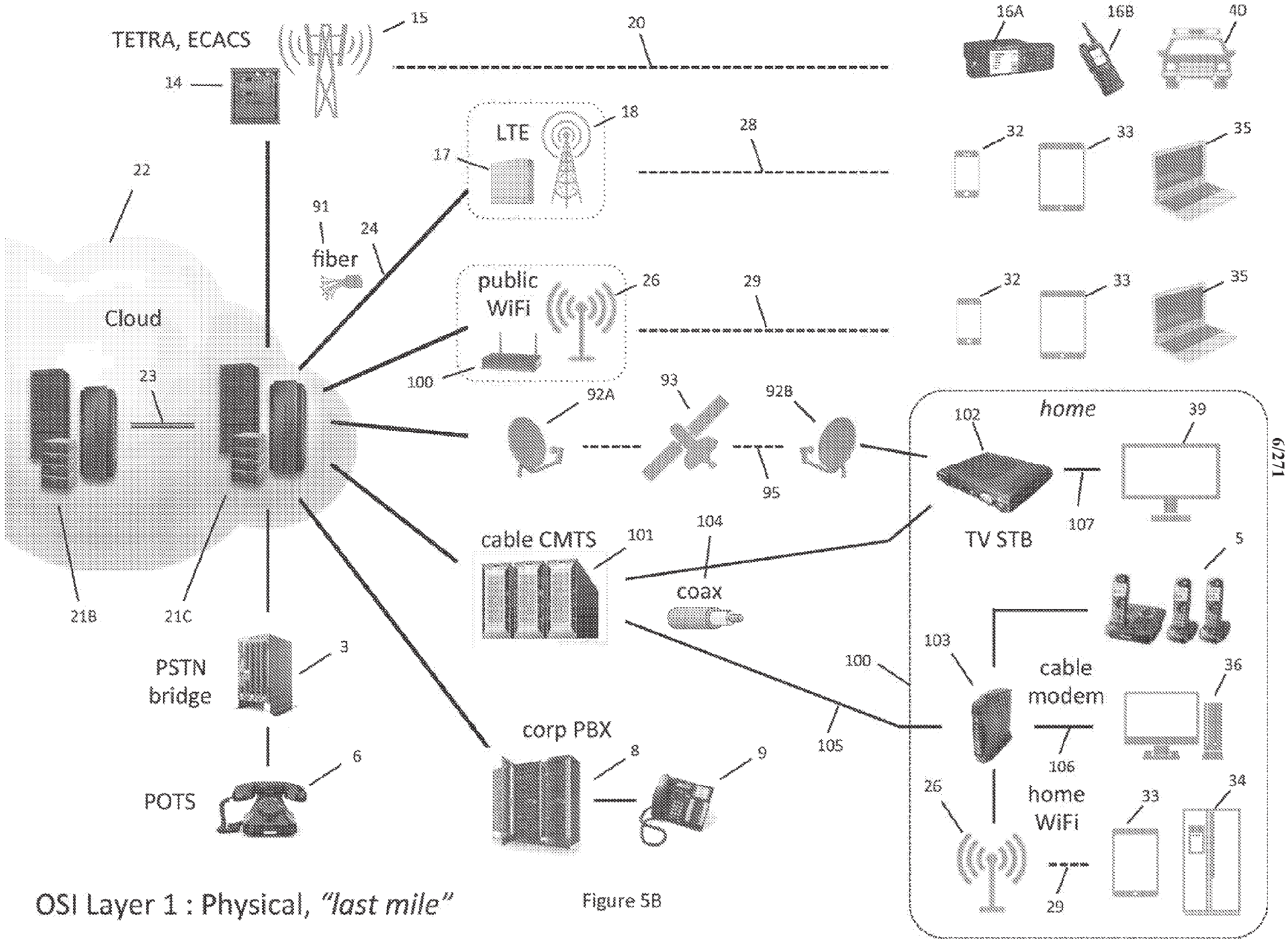

OSI Layer 1 : Physical
high bandwidth
satellite
fiber
microwave
93
91
98
90
95A
95B
92A
92B
94A
94B
97A
97B
96A
96B
21A
21B

Figure 5A



OSI Layer 1 : Physical, *"last mile"*

Figure 5B

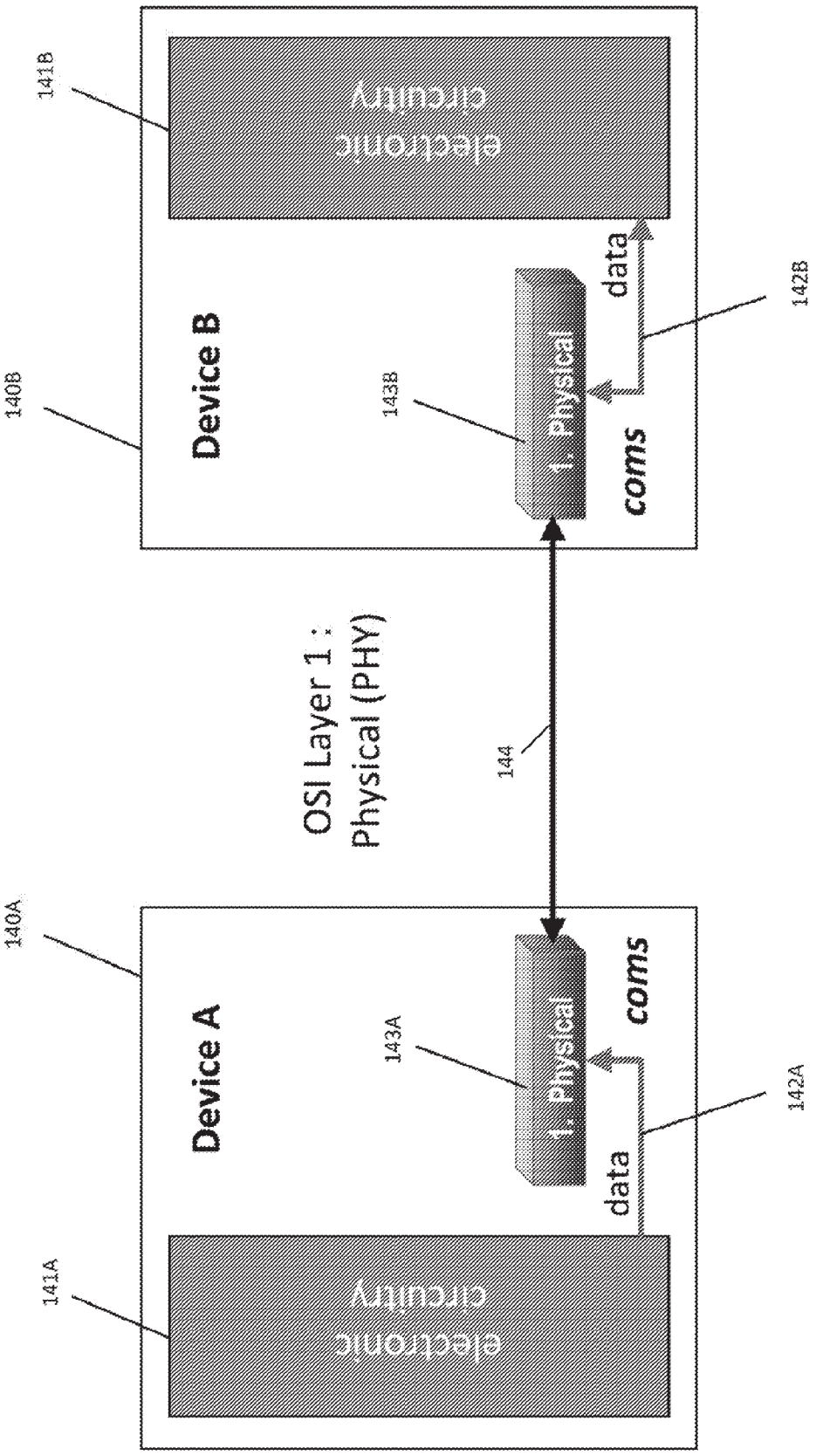

141B
electronic circuitry
Device B
140B
143B
1. Physical
coms
data
142B
OSI Layer 1 :
Physical (PHY)
144
140A
Device A
143A
1. Physical
coms
data
142A
141A
electronic circuitry

Figure 6A

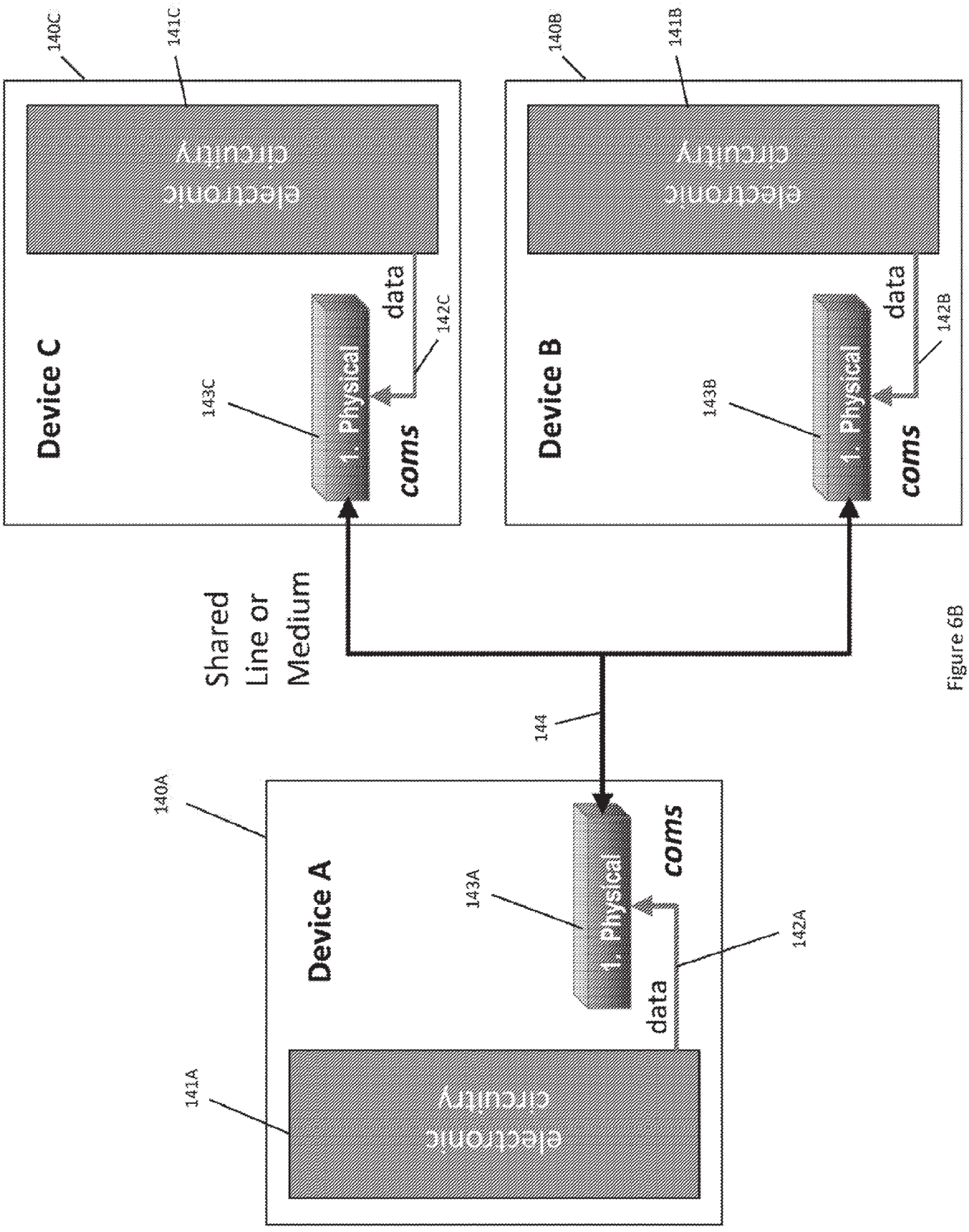

140C
141C
electronic circuitry
Device C
data
142C
143C
1. Physical
coms
140B
141B
electronic circuitry
Device B
data
142B
143B
1. Physical
coms
Shared Line or Medium
144
140A
Device A
143A
1. Physical
coms
142A
data
141A
electronic circuitry

Figure 6B

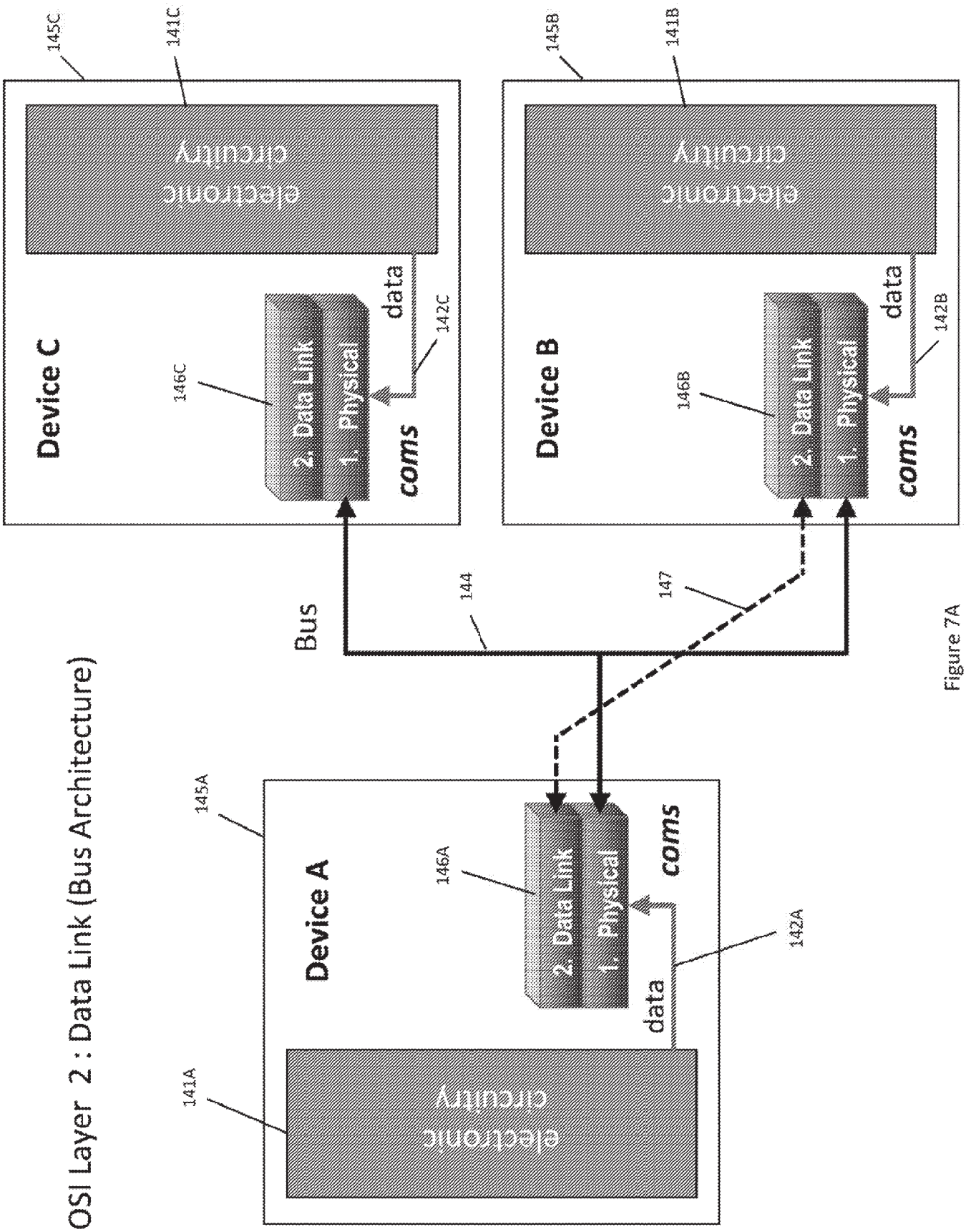

OSI Layer 2 : Data Link (Bus Architecture)
Device A
Device B
Device C
electronic circuitry
2. Data Link
1. Physical
coms
data
Bus
141A
141B
141C
142A
142B
142C
144
145A
145B
145C
146A
146B
146C
147

Figure 7A

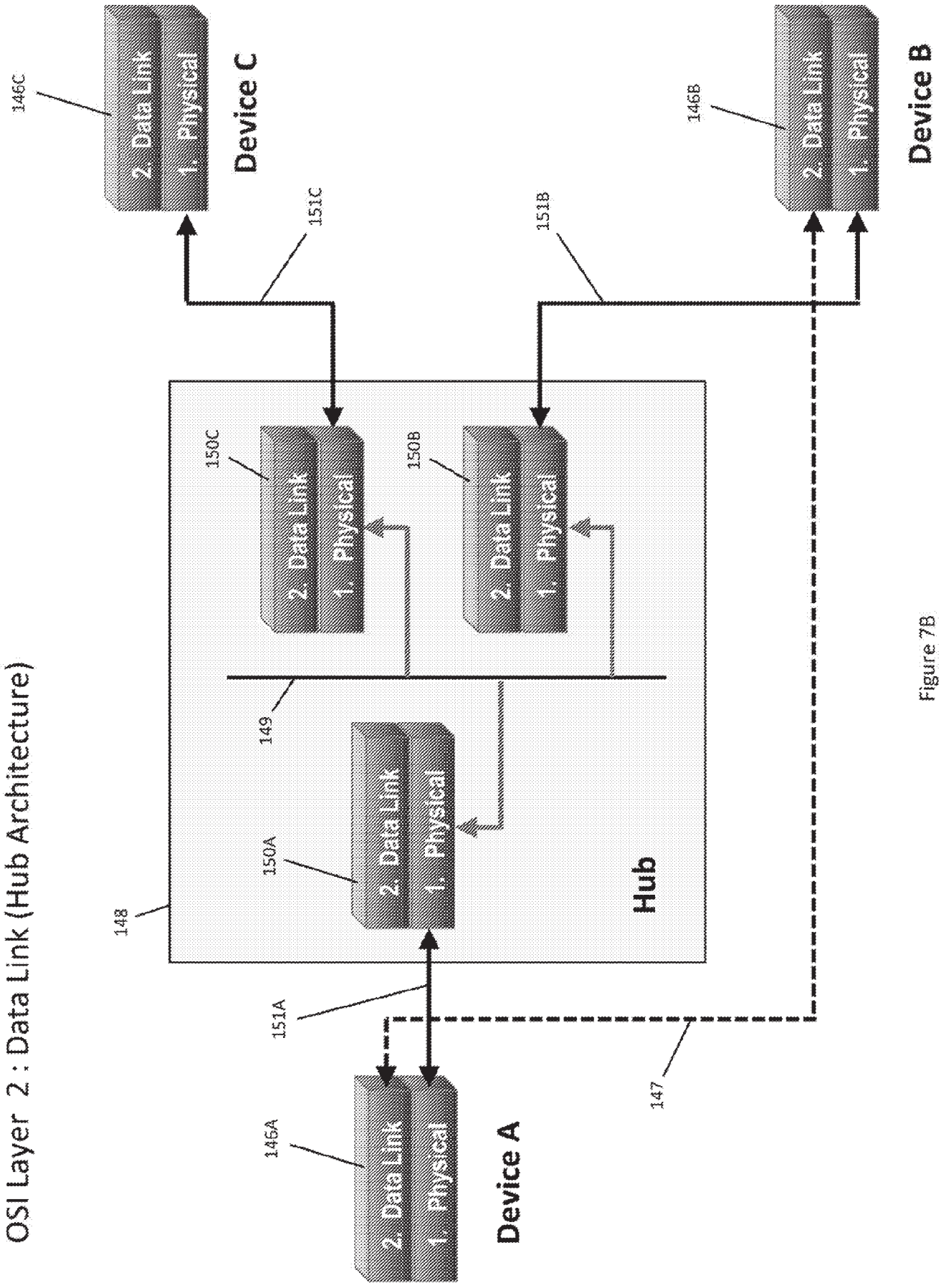

OSI Layer 2 : Data Link (Hub Architecture)
146C
2. Data Link
1. Physical
Device C
151C
146B
2. Data Link
1. Physical
Device B
151B
150C
2. Data Link
1. Physical
150B
2. Data Link
1. Physical
149
148
150A
2. Data Link
1. Physical
Hub
151A
147
146A
2. Data Link
1. Physical
Device A

Figure 7B

OSI Layer 2 : Data Link (Daisy Chain Architecture)

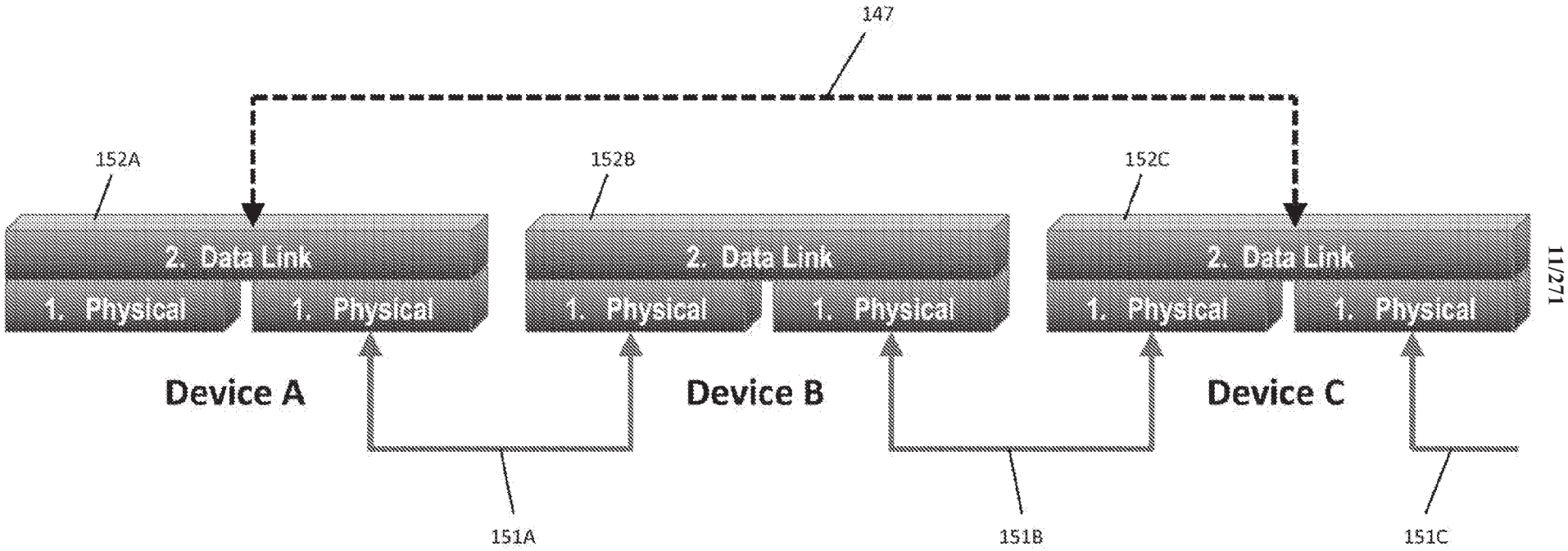


Figure 7C

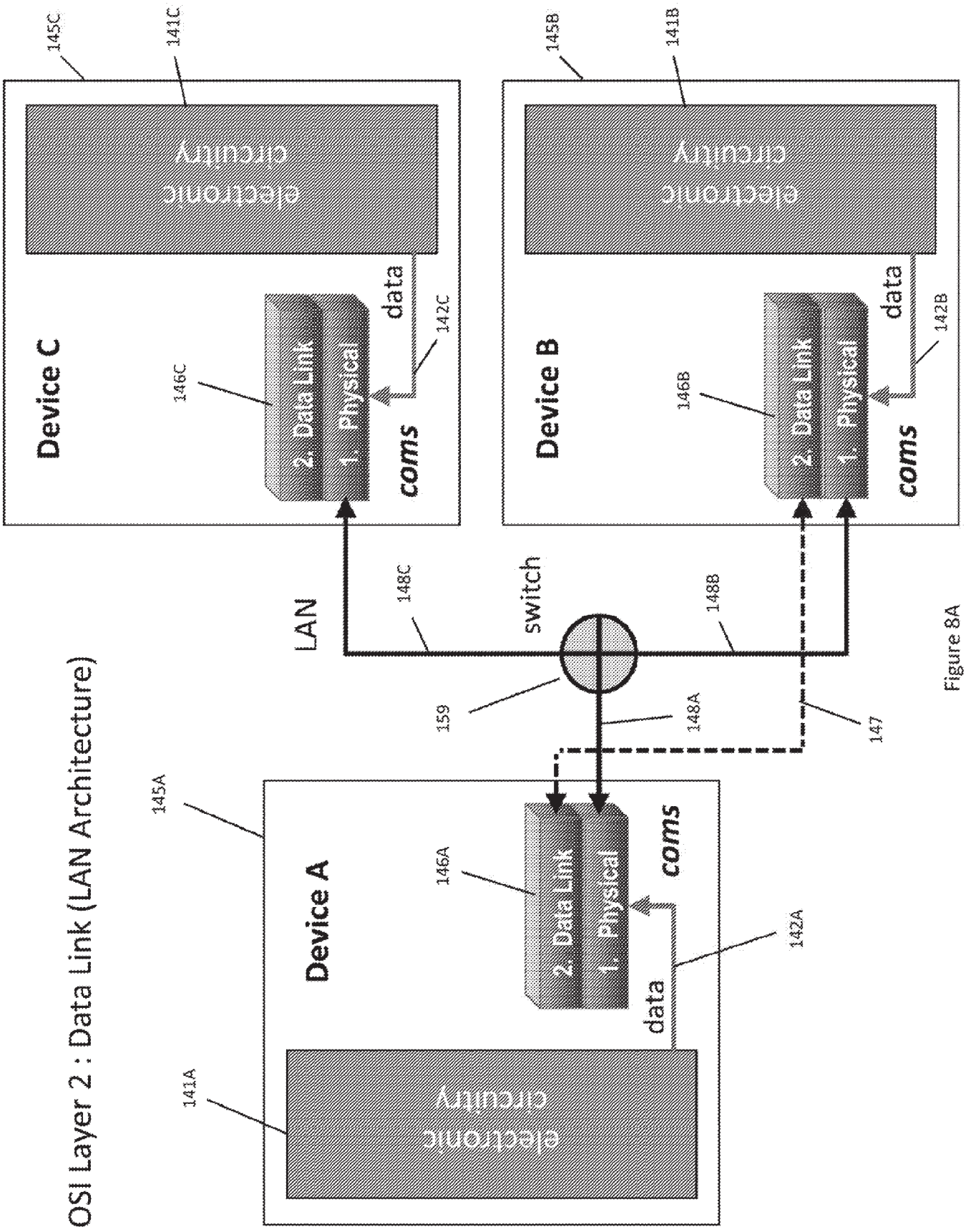

OSI Layer 2 : Data Link (LAN Architecture)
Device A
Device B
Device C
electronic circuitry
2. Data Link
1. Physical
coms
data
LAN
switch
145A
145B
145C
141A
141B
141C
142A
142B
142C
146A
146B
146C
147
148A
148B
148C
159

Figure 8A

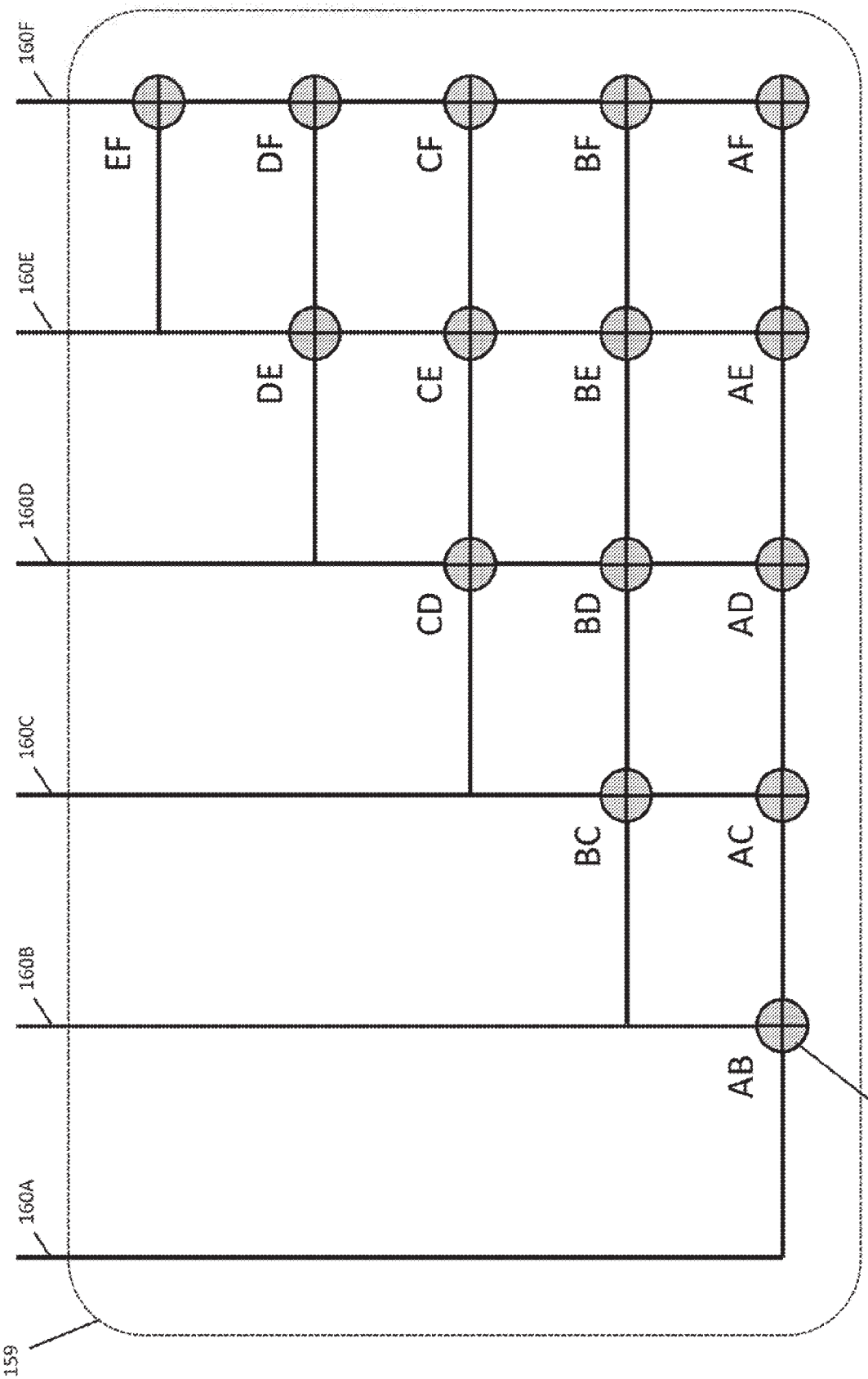

159
A
160A
B
160B
C
160C
D
160D
E
160E
F
160F
AB
AC
AD
AE
AF
BC
BD
BE
BF
CD
CE
CF
DE
DF
EF
161

Figure 8B

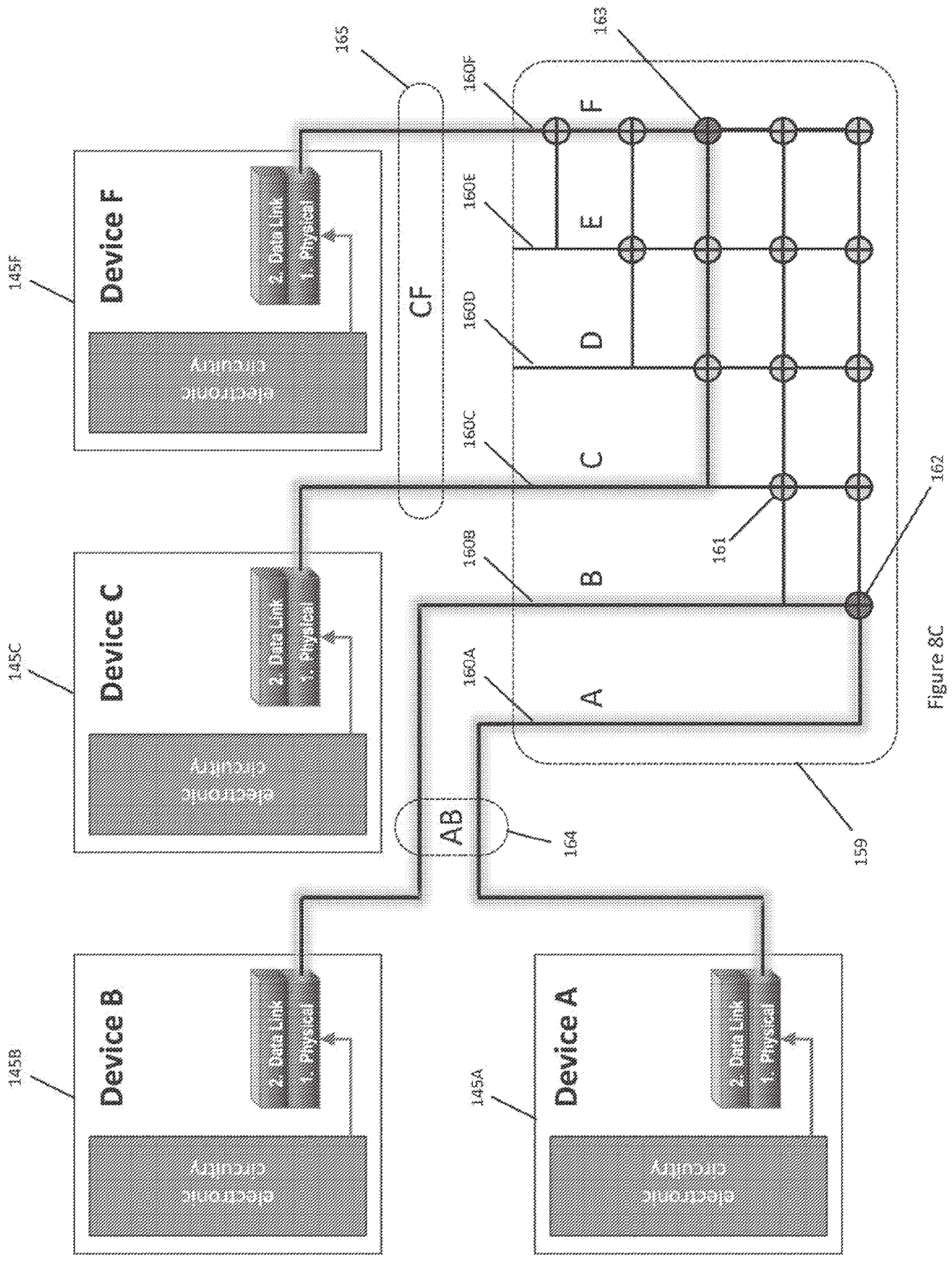
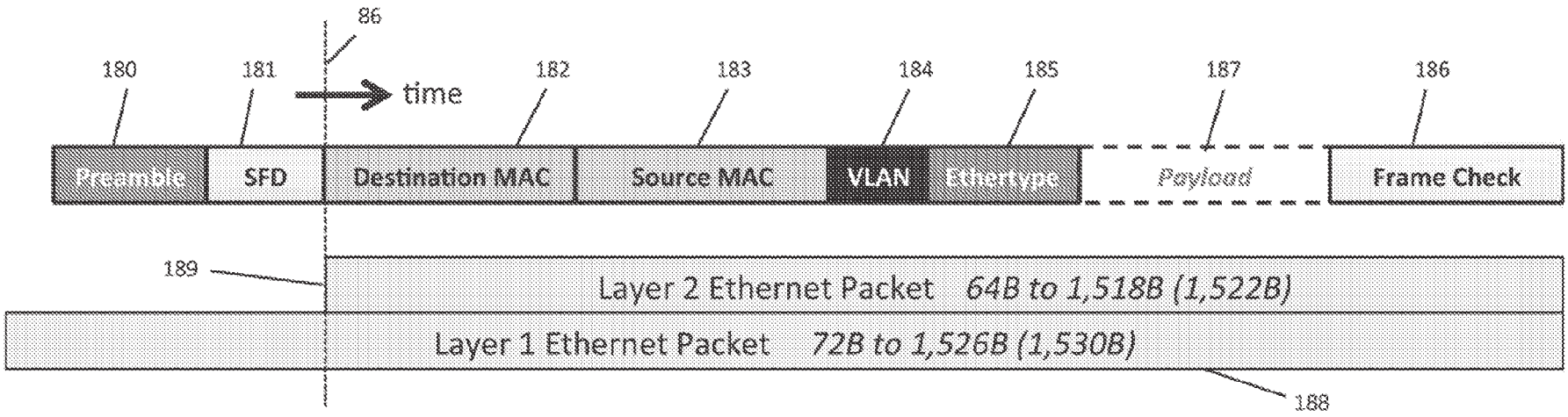

Device F
Device C
Device B
Device A
electronic circuitry
2. Data Link
1. Physical
145F
145C
145B
145A
CF
AB
165
164
159
160F
160E
160D
160C
160B
160A
161
162
163
F
E
D
C
B
A

Figure 8C



190

OSI Layers 1 & 2 : Data Link for Ethernet Packets (IEEE 802.3)

Layer	Packet Field	Size	Function
1	**Preamble**	7B	Data frame header
1	**SFD**	1B	Synchronize hardware devices (start frame delimiter)
2	**Destination MAC**	6B	Media Access Control (MAC) destination address on LAN
2	**Source MAC**	6B	Media Access Control (MAC) source address on LAN
2	**VLAN**	(4B)	802.1Q tag (optional)
2	**Ethertype**	2B	Type of data link (Ethernet II) or length (IEEE 802.3)
2–7	**Payload**	42B – 1500B	Content of packet (including network, IP, app info & data)
2	**Frame Check**	4B	Checksum of entire packet (32-bit CRC data link trailer)

Figure 9

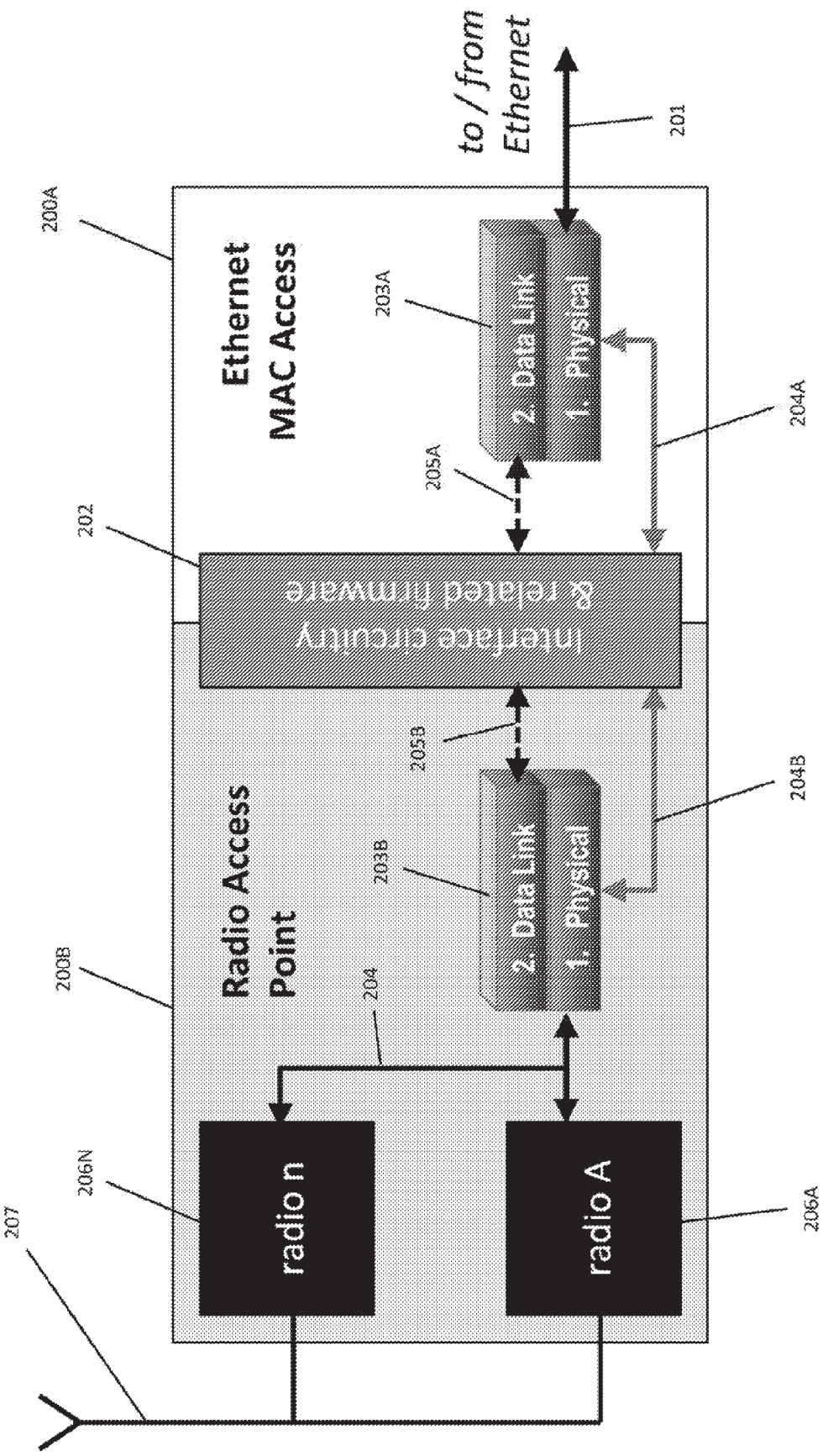
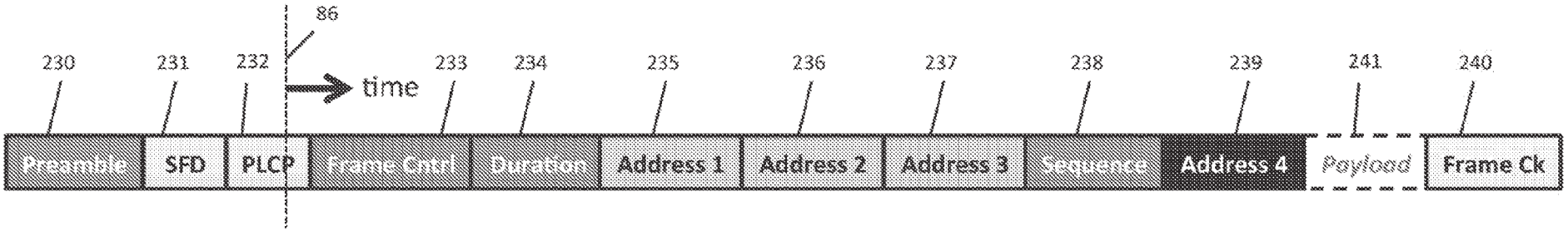

to / from Ethernet
201
200A
Ethernet MAC Access
203A
2. Data Link
1. Physical
204A
205A
202
interface circuitry & related firmware
205B
204B
203B
2. Data Link
1. Physical
Radio Access Point
200B
204
206N
radio n
radio A
206A
207

Figure 10



242

OSI Layers 1 & 2 : Data Link for WLAN Packets (WiFi, IEEE 802.11, etc.)

Layer	Packet Field	Size	Function
1	Preamble	10B	Data frame header
1	SFD	2B	Synchronize hardware devices (start frame delimiter)
1-2	PLCP	2B	Physical layer convergence procedure (length, rate, header error ck)
2	Frame Control	2B	Version Type (Management, Control, Data, Reserved)
2	Duration & ID	2B	NAV duration (except in power save mode, then Station ID)
2	Address 1	6B	BSS receiving station address (depends on To DS / From DS setting)
2	Address 2	6B	BSS transmitting station address (depends on To DS / From DS)
2	Address 3	6B	Conditional address (depends on To DS / From DS setting)
2	Sequence Cntrl	2B	Sequence & fragment number defining the packet frame
2	Address 4	6B	Source station address in WDS (wireless distribution system) mode
2–7	Payload	0 – 2312B	Content of packet (including network, IP, app info & data)
2	Frame Check	4B	Checksum of entire packet (32-bit CRC data link trailer)

Figure 11

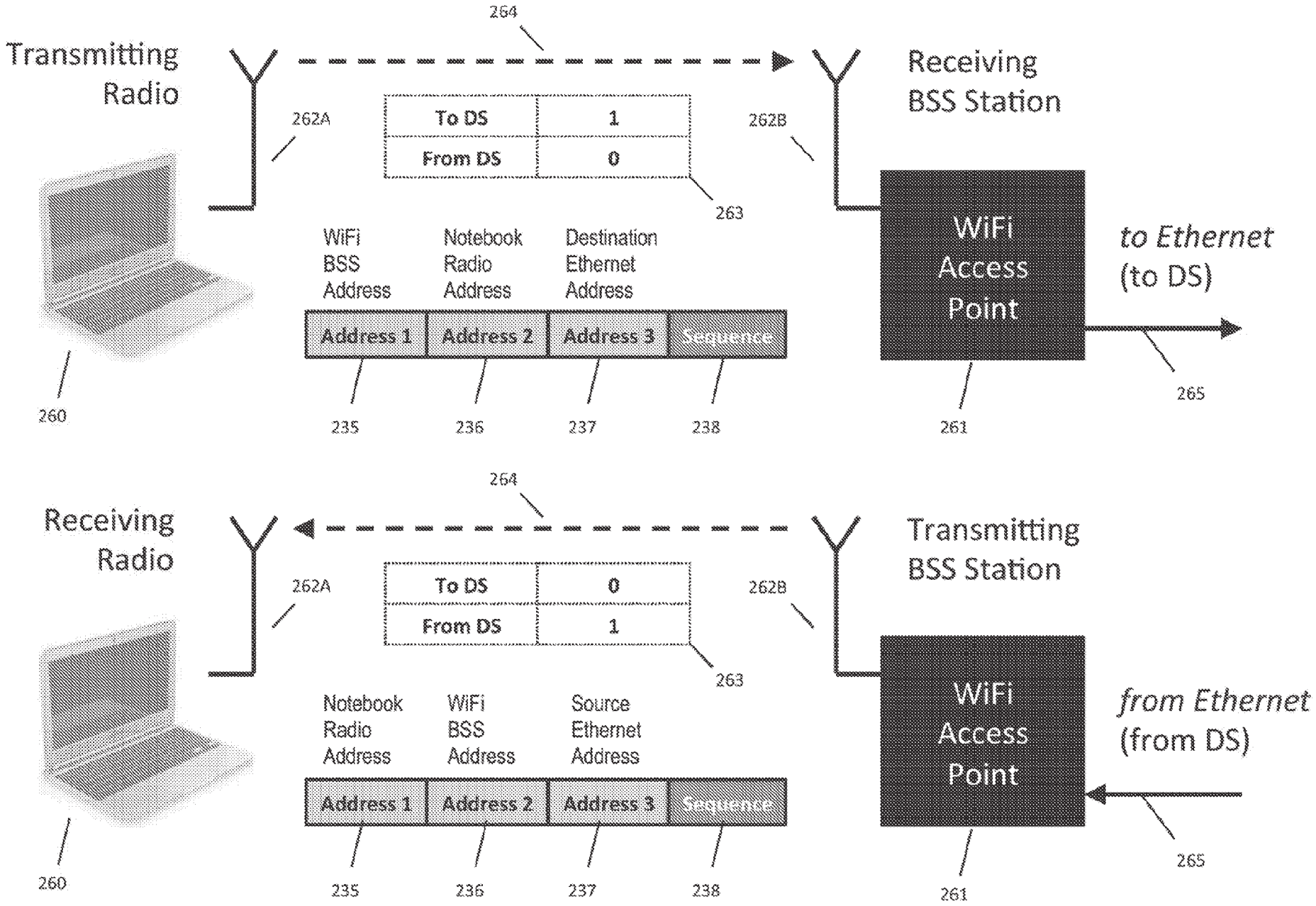

Transmitting Radio
264
262A
To DS 1
From DS 0
263
262B
Receiving BSS Station
WiFi Access Point
to Ethernet (to DS)
265
WiFi BSS Address
Notebook Radio Address
Destination Ethernet Address
Address 1
Address 2
Address 3
Sequence
260
235
236
237
238
261
Receiving Radio
264
262A
To DS 0
From DS 1
263
262B
Transmitting BSS Station
WiFi Access Point
from Ethernet (from DS)
265
Notebook Radio Address
WiFi BSS Address
Source Ethernet Address
Address 1
Address 2
Address 3
Sequence
260
235
236
237
238
261

Figure 12A

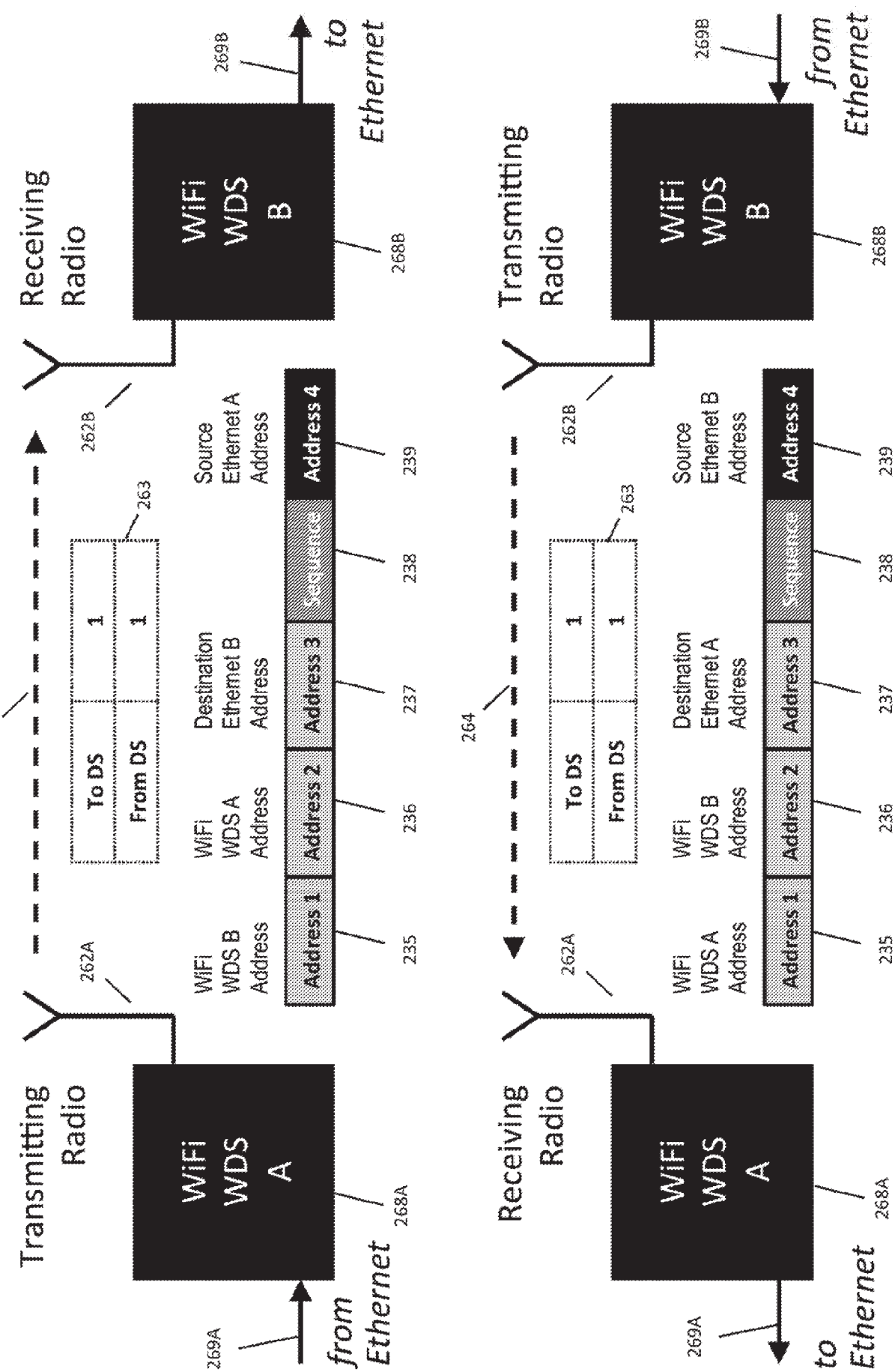

Transmitting Radio
WiFi WDS A
268A
from Ethernet
269A
262A
264
To DS
From DS
1
1
263
WiFi WDS B Address
WiFi WDS A Address
Destination Ethernet B Address
Source Ethernet A Address
Address 1
Address 2
Address 3
Sequence
Address 4
235
236
237
238
239
262B
Receiving Radio
WiFi WDS B
268B
to Ethernet
269B

Figure 12B

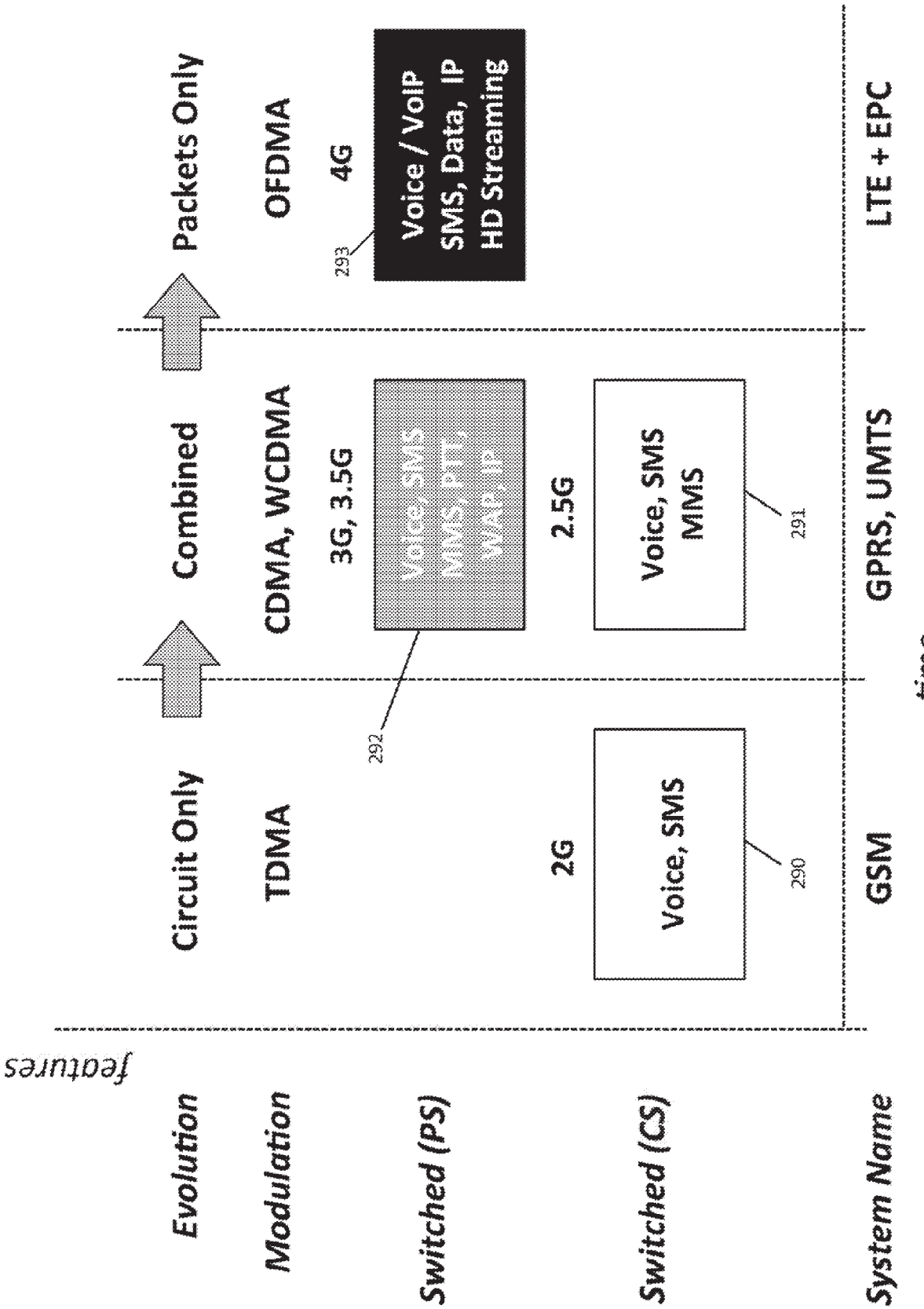

features
Evolution
Modulation
Packet Switched (PS)
Circuit Switched (CS)
System Name
Circuit Only
Combined
Packets Only
TDMA
CDMA, WCDMA
OFDMA
2G
3G, 3.5G
2.5G
4G
GSM
GPRS, UMTS
LTE + EPC
Voice, SMS
Voice, SMS MMS, PTT, WAP, IP
Voice, SMS MMS
Voice / VoIP SMS, Data, IP HD Streaming
290
291
292
293
time...

Figure 13

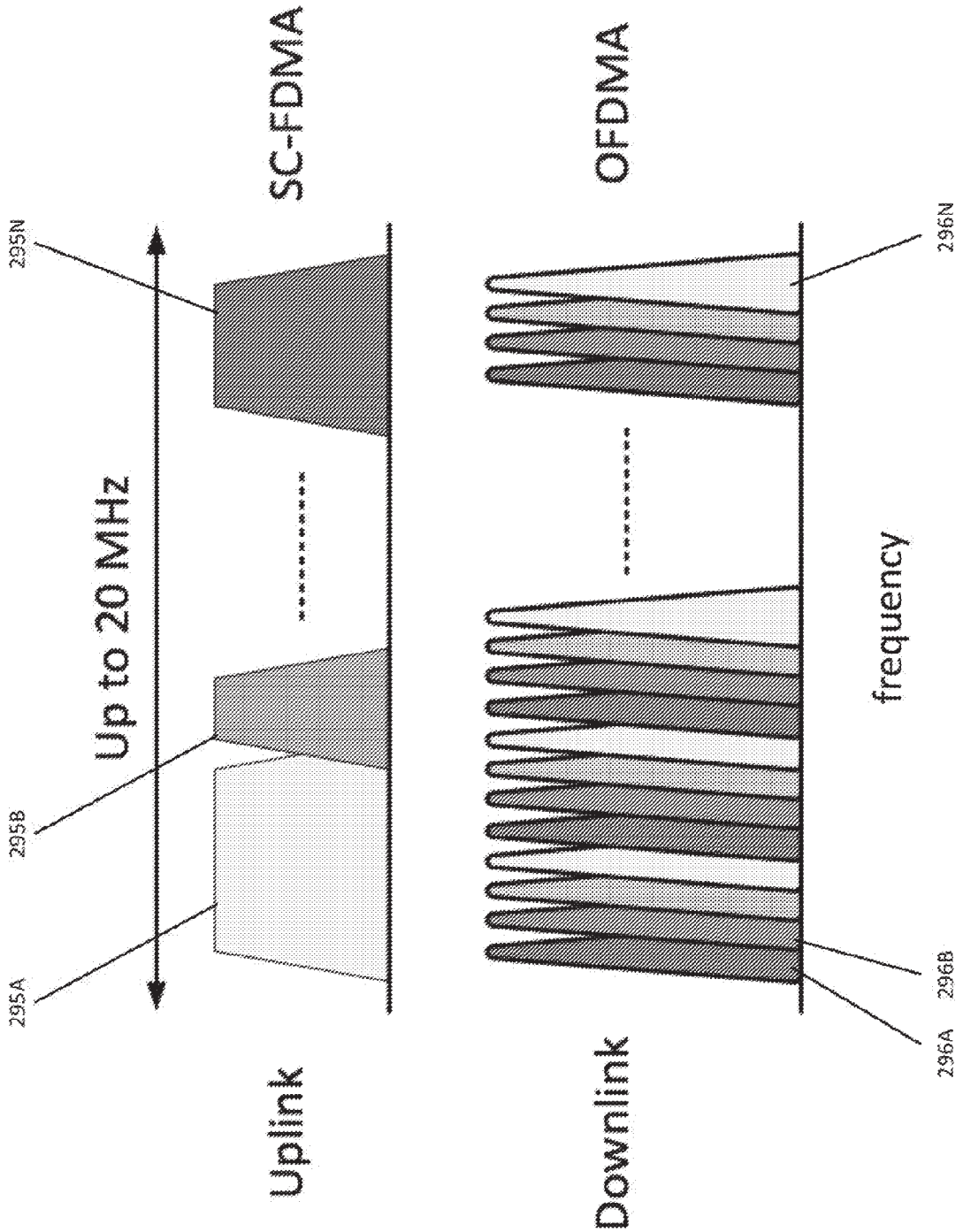

SC-FDMA
OFDMA
295N
Up to 20 MHz
295B
295A
Uplink
Downlink
frequency
296N
296B
296A

Figure 14A

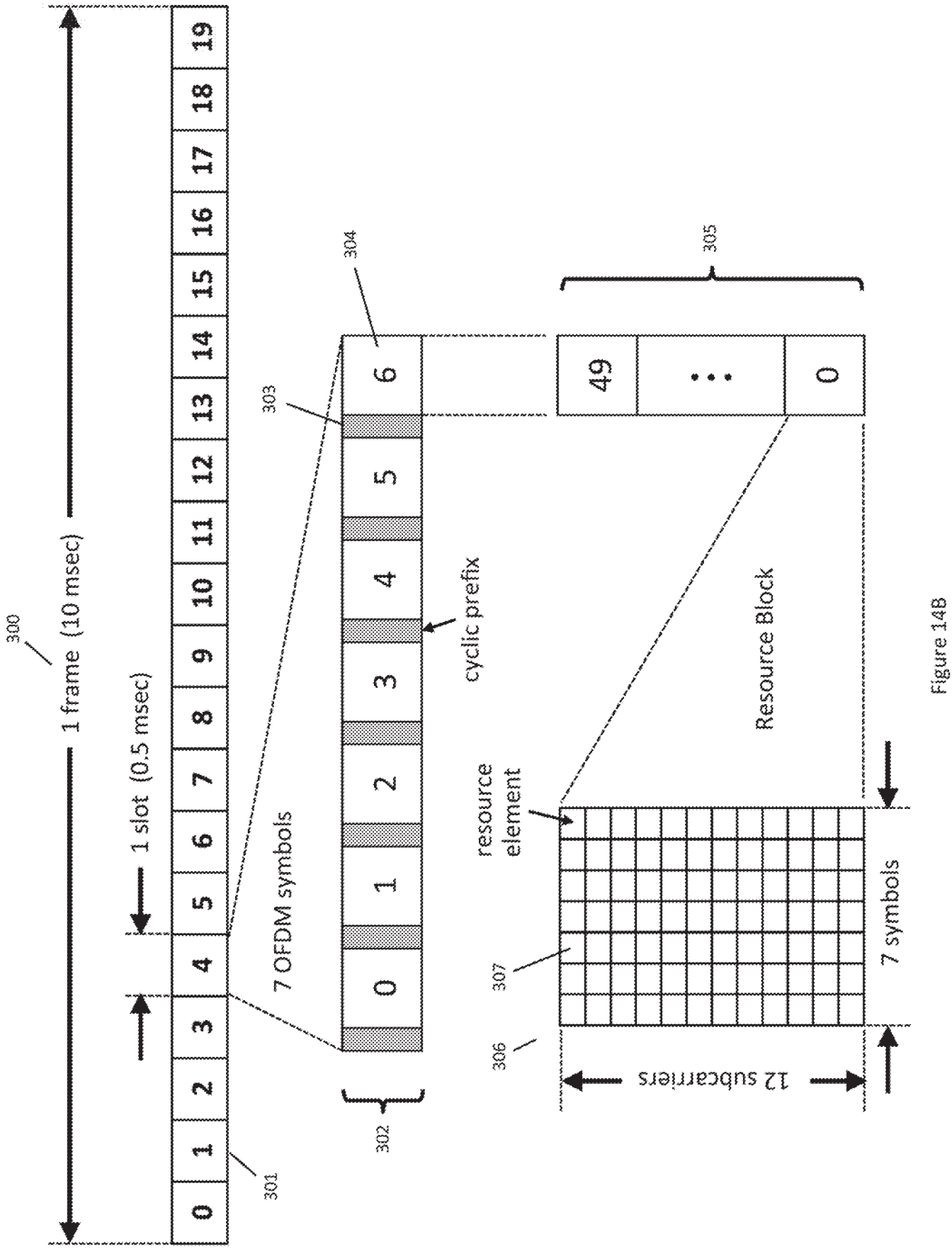

300
1 frame (10 msec)
1 slot (0.5 msec)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
301
303
304
7 OFDM symbols
cyclic prefix
0
1
2
3
4
5
6
302
305
49
0
resource element
Resource Block
307
306
12 subcarriers
7 symbols

Figure 14B

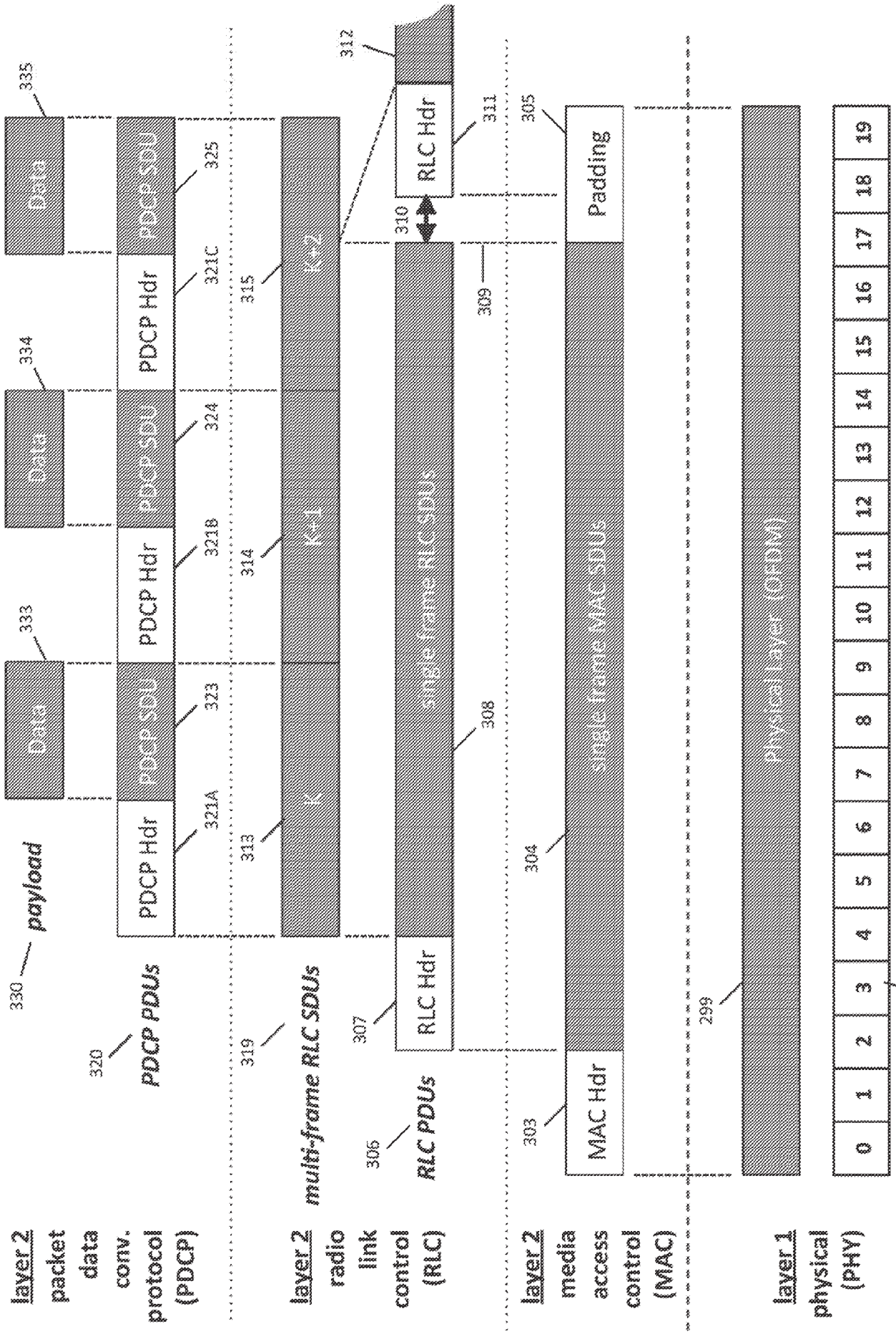

layer 2 packet data conv. protocol (PDCP)
layer 2 radio link control (RLC)
layer 2 media access control (MAC)
layer 1 physical (PHY)
payload
PDCP PDUs
multi-frame RLC SDUs
RLC PDUs
Data
PDCP Hdr
PDCP SDU
RLC Hdr
MAC Hdr
Padding
single frame RLC SDUs
single frame MAC SDUs
Physical Layer (OFDM)
330
320
319
307
306
303
304
299
301
300
308
309
310
311
312
313
314
315
321A
321B
321C
323
324
325
333
334
335
K
K+1
K+2
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19

Figure 15

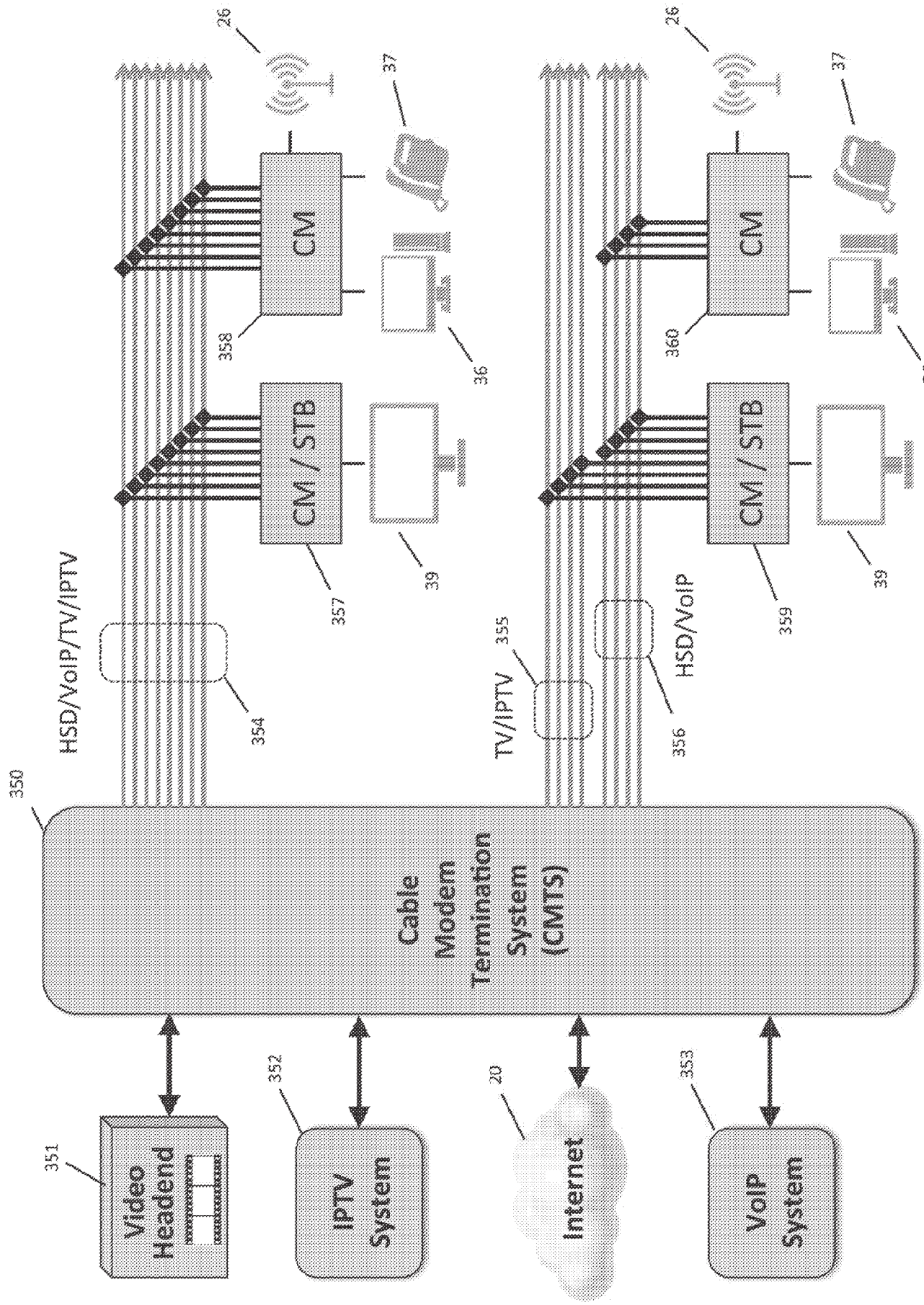

Video Headend
IPTV System
Internet
VoIP System
Cable Modem Termination System (CMTS)
HSD/VoIP/TV/IPTV
TV/IPTV
HSD/VoIP
CM
CM / STB
350
351
352
20
353
354
355
356
357
358
359
360
36
37
39
26

Figure 16

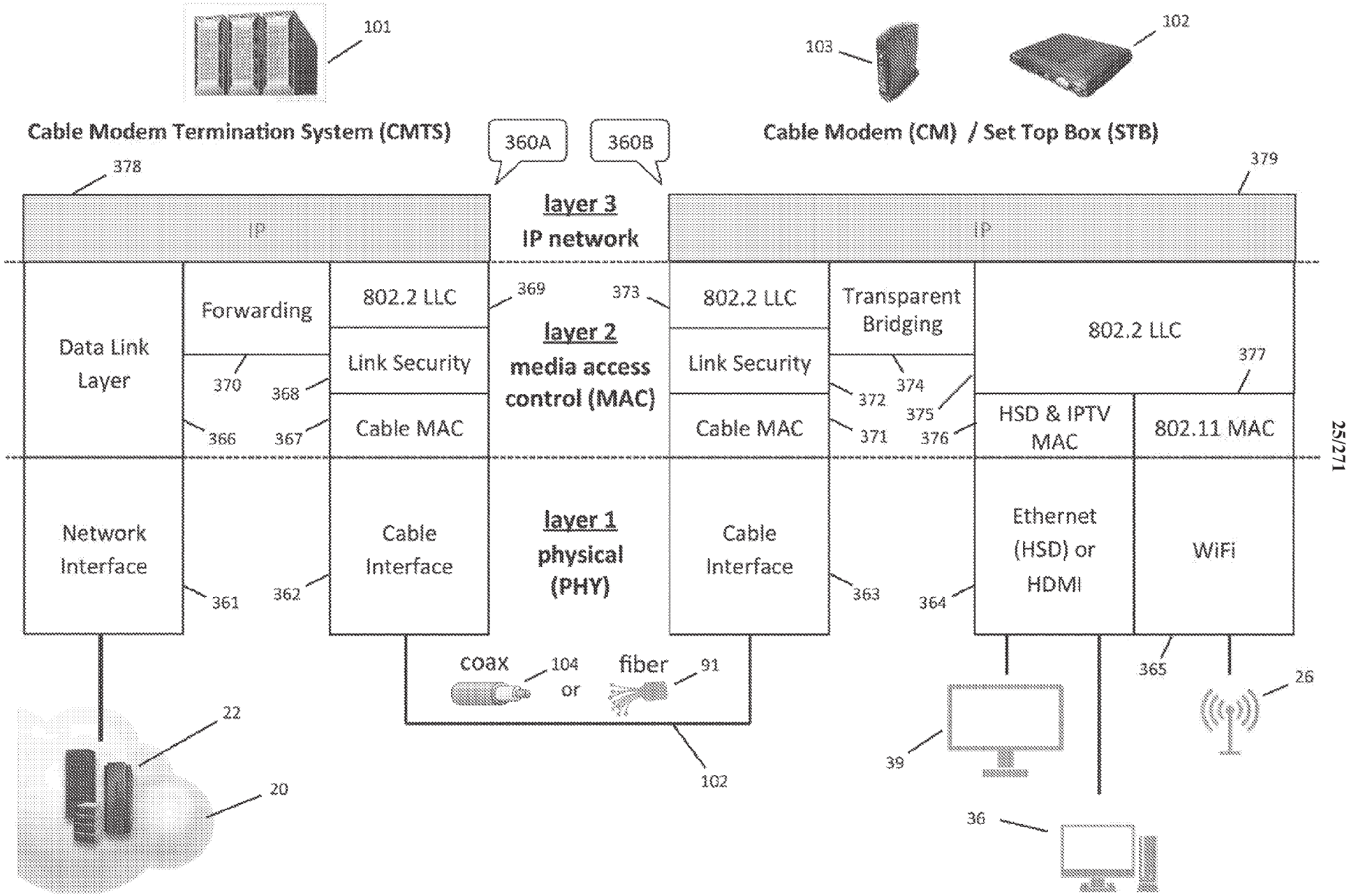

101
103
102
Cable Modem Termination System (CMTS)
360A
360B
Cable Modem (CM) / Set Top Box (STB)
378
379
IP
layer 3
IP network
IP
Data Link Layer
Forwarding
802.2 LLC
369
373
802.2 LLC
Transparent Bridging
802.2 LLC
377
Link Security
layer 2
media access control (MAC)
Link Security
374
372
375
HSD & IPTV MAC
802.11 MAC
370
368
366
367
Cable MAC
371
376
Cable MAC
Network Interface
Cable Interface
layer 1
physical (PHY)
Cable Interface
Ethernet (HSD) or HDMI
WiFi
361
362
363
364
365
coax
104
or
fiber
91
102
22
20
39
26
36

Figure 17

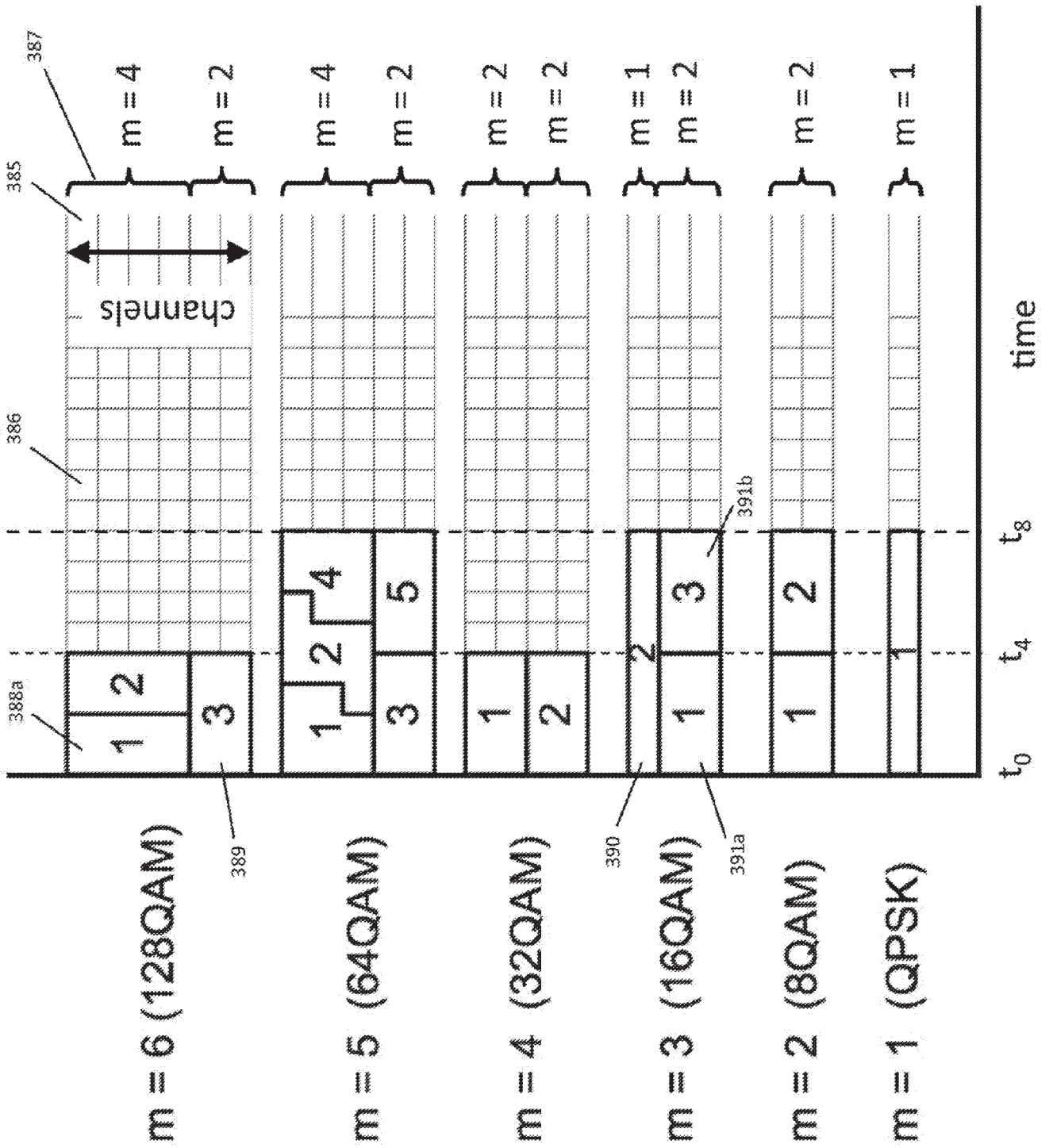

m = 6 (128QAM)
m = 5 (64QAM)
m = 4 (32QAM)
m = 3 (16QAM)
m = 2 (8QAM)
m = 1 (QPSK)
time
channels
m = 4
m = 2
m = 1
388a
389
390
391a
391b
385
386
387
t_0
t_4
t_8

Figure 18

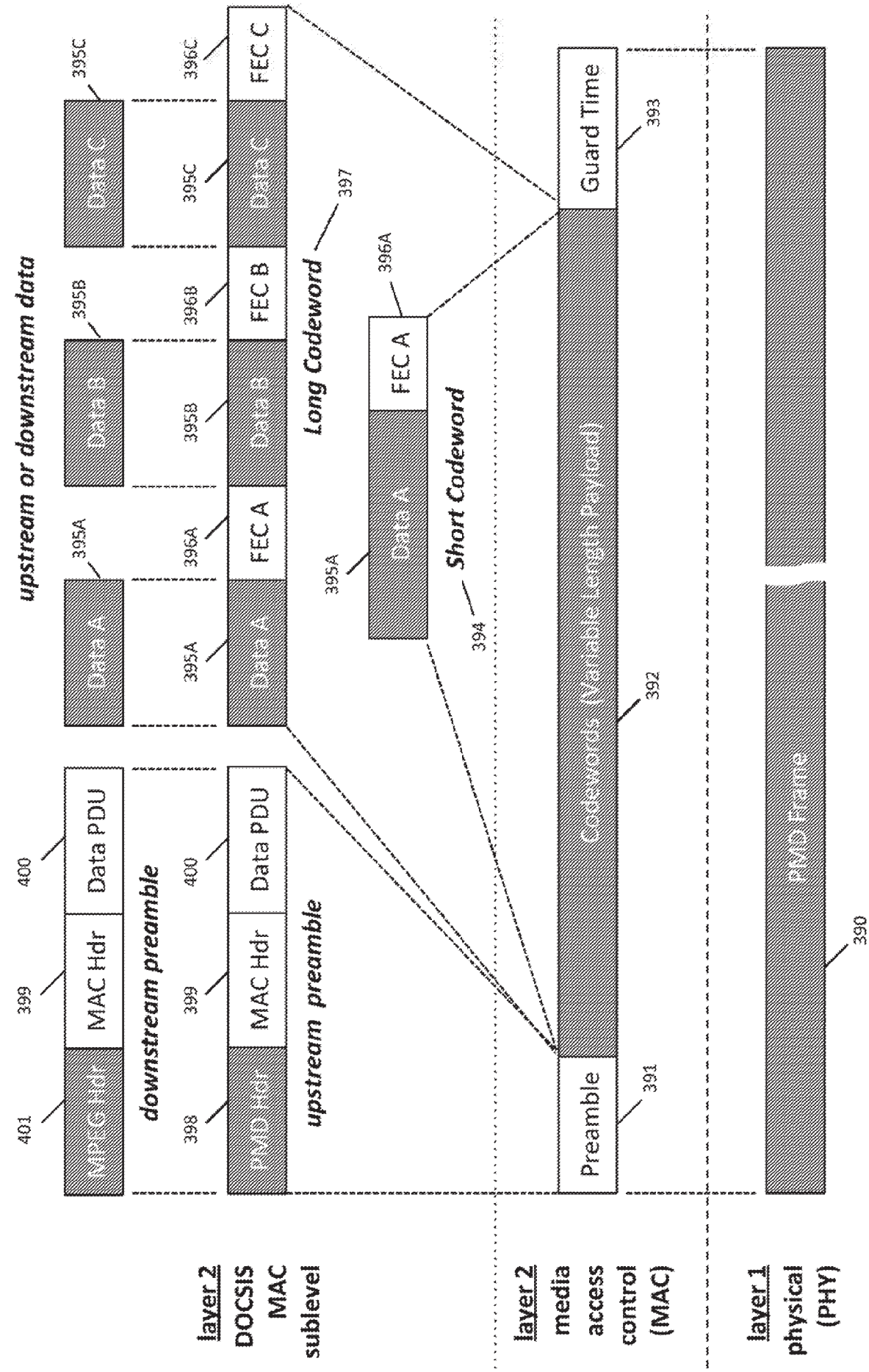

layer 2
DOCSIS
MAC
sublevel
layer 2
media
access
control
(MAC)
layer 1
physical
(PHY)
upstream or downstream data
downstream preamble
upstream preamble
Long Codeword
Short Codeword
MPEG Hdr
MAC Hdr
Data PDU
RMD Hdr
Data A
Data B
Data C
FEC A
FEC B
FEC C
Codewords (Variable Length Payload)
Preamble
Guard Time
RMD Frame
401
398
399
400
395A
395B
395C
396A
396B
396C
397
394
390
391
392
393

Figure 19

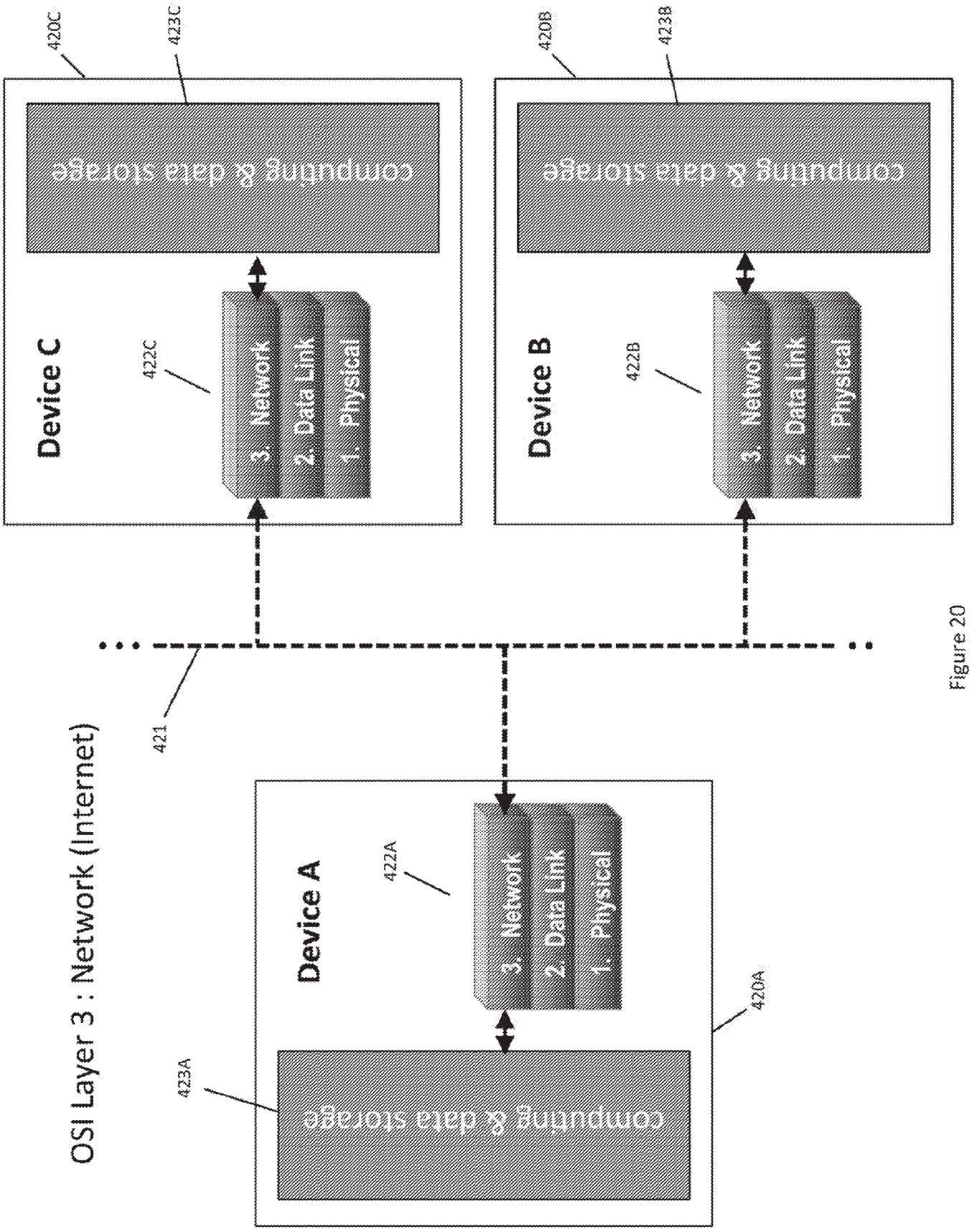

OSI Layer 3 : Network (Internet)
421
Device A
422A
3. Network
2. Data Link
1. Physical
423A
compute & data storage
420A
Device B
422B
3. Network
2. Data Link
1. Physical
423B
compute & data storage
420B
Device C
422C
3. Network
2. Data Link
1. Physical
423C
compute & data storage
420C

Figure 20

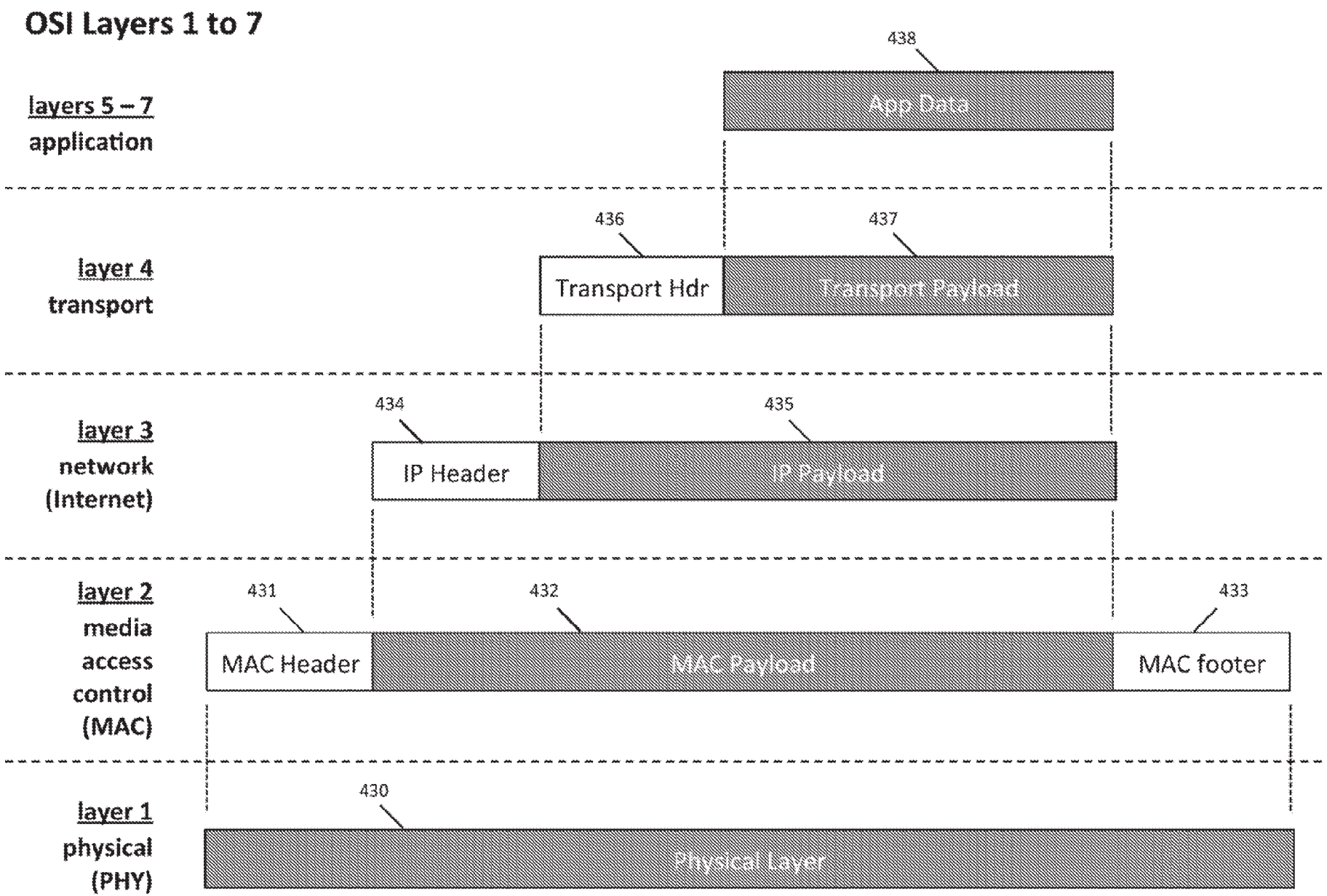

OSI Layers 1 to 7
layers 5 – 7
application
layer 4
transport
layer 3
network
(Internet)
layer 2
media
access
control
(MAC)
layer 1
physical
(PHY)
438
App Data
436
437
Transport Hdr
Transport Payload
434
435
IP Header
IP Payload
431
432
433
MAC Header
MAC Payload
MAC footer
430
Physical Layer

Figure 21

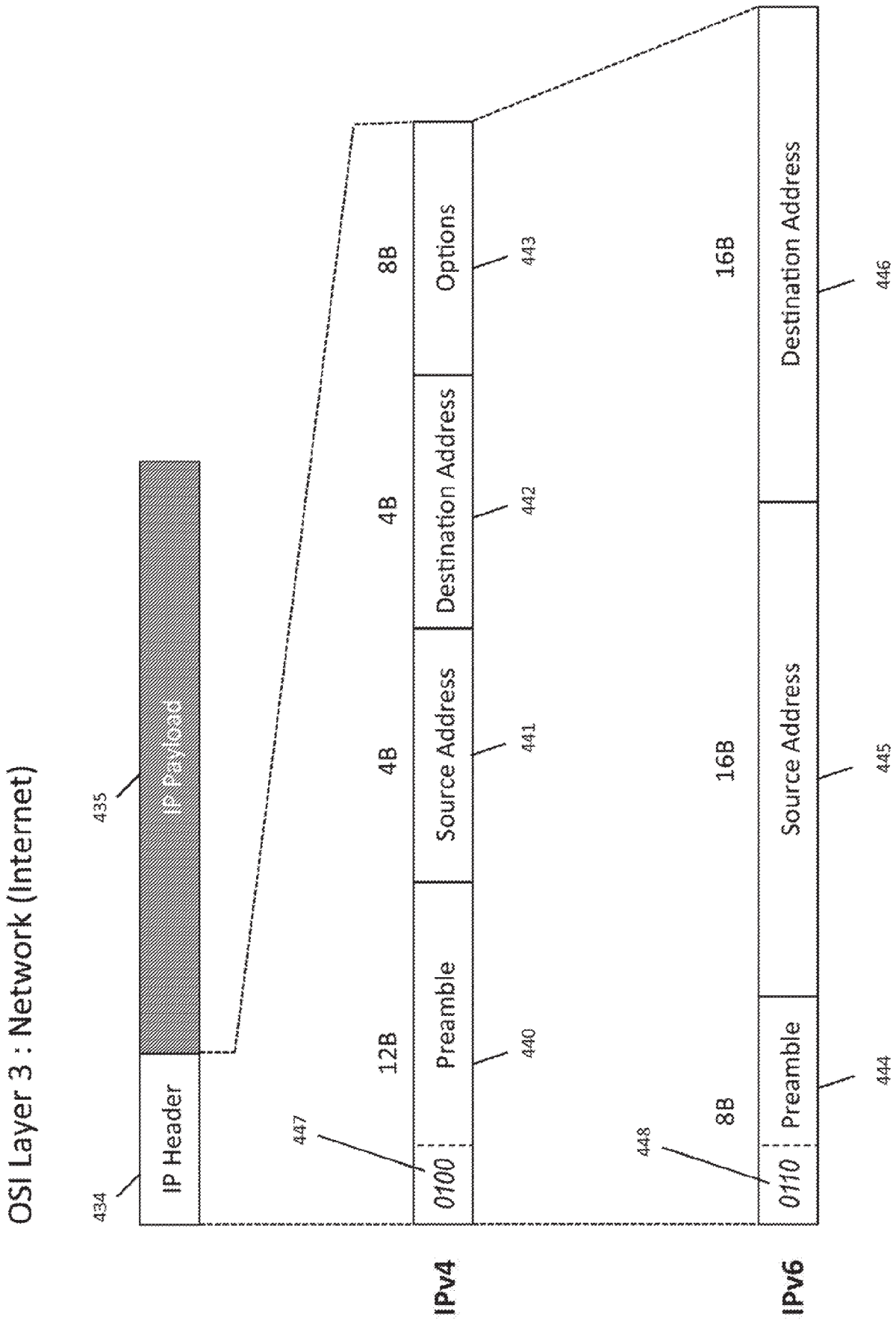
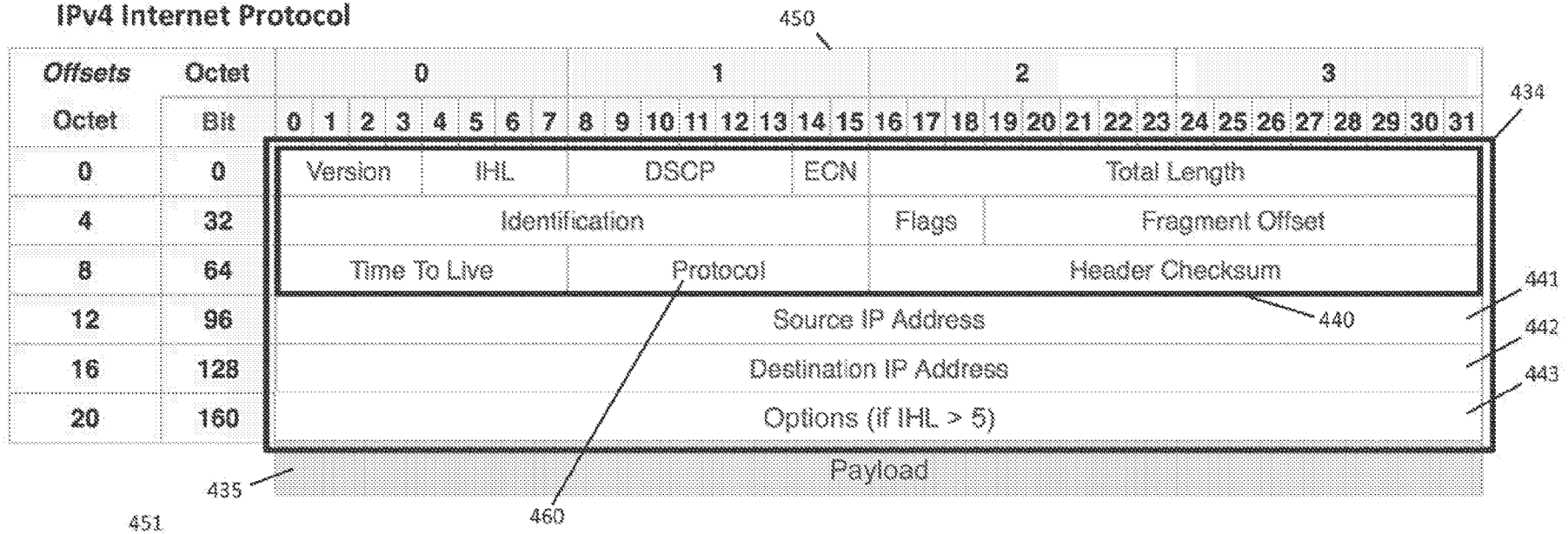

OSI Layer 3 : Network (Internet)
IP Header
IP Payload
434
435
IPv4
0100
Preamble
Source Address
Destination Address
Options
12B
4B
4B
8B
440
441
442
443
447
IPv6
0110
Preamble
Source Address
Destination Address
8B
16B
16B
444
445
446
448

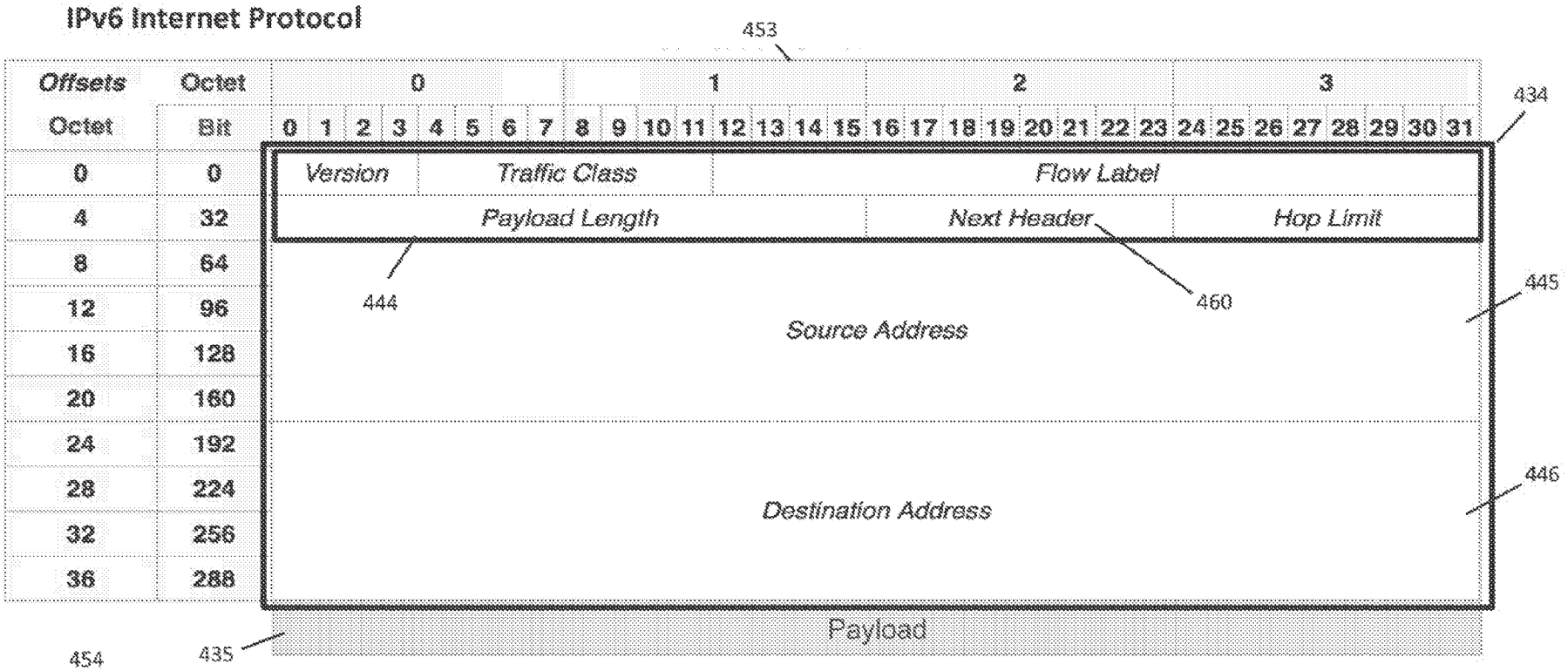
Figure 22



451

Layer	IPv4 Packet Field		Size		Function	
3	Version	IHL	4b	4b	Binary 0100 sets IP to version 4	# of 32b words in header 20 to 60B
3	DSCP	ECN	6b	2b	Differentiated services for QoS	Explicit network congestion notice
3	Total Length		2B		Length of IP packet incl. header and data, 20B to 65,535B	
3	Identification		2B		Uniquely identifies a group of fragments of a single IP datagram	
3	Flags	Frag Offset	3b	13b	Flags to manage fragmentation	Fragment offset from packet start
3	TTL	Protocol	1B	1B	Time-to-live to prevent immortals	Describes type of IP payload
3	Header Checksum		2B		16-bit checksum used for header error-checking, drops error packets	
3	Source Address		4B		IPv4 address of the sender of the packet, NAT may change IP address	
3	Destination Address		4B		IPv4 address of the receiver of the packet, NAT may change IP address	
3	Options (if IHL > 5)		4B		Infrequently used field, subject to security risks, active for IHL = 6 to 15	

Figure 23



454

Layer	IPv6 Packet Field		Size		Function	
3	Version	Traffic Class	4b	8b	Binary 0110 sets IP to version 6	6b differentiated services & 2b ECN
3	Flow Label		20b		Maintains path to avoid reordering in real-time applications	
3	Payload Length		2B		Payload size in octets, including any extension headers	
3	Next Header		1B		Specifies the type of next header, same as IPv4 protocol field	
3	Hop Limit		1B		Replaces IPv4 time to live field, decrements by 1 for each node passed	
3	Source Address		16B		The IPv6 address of the sending node	
3	Destination Address		16B		The IPv6 address of the destination node(s)	

Figure 24

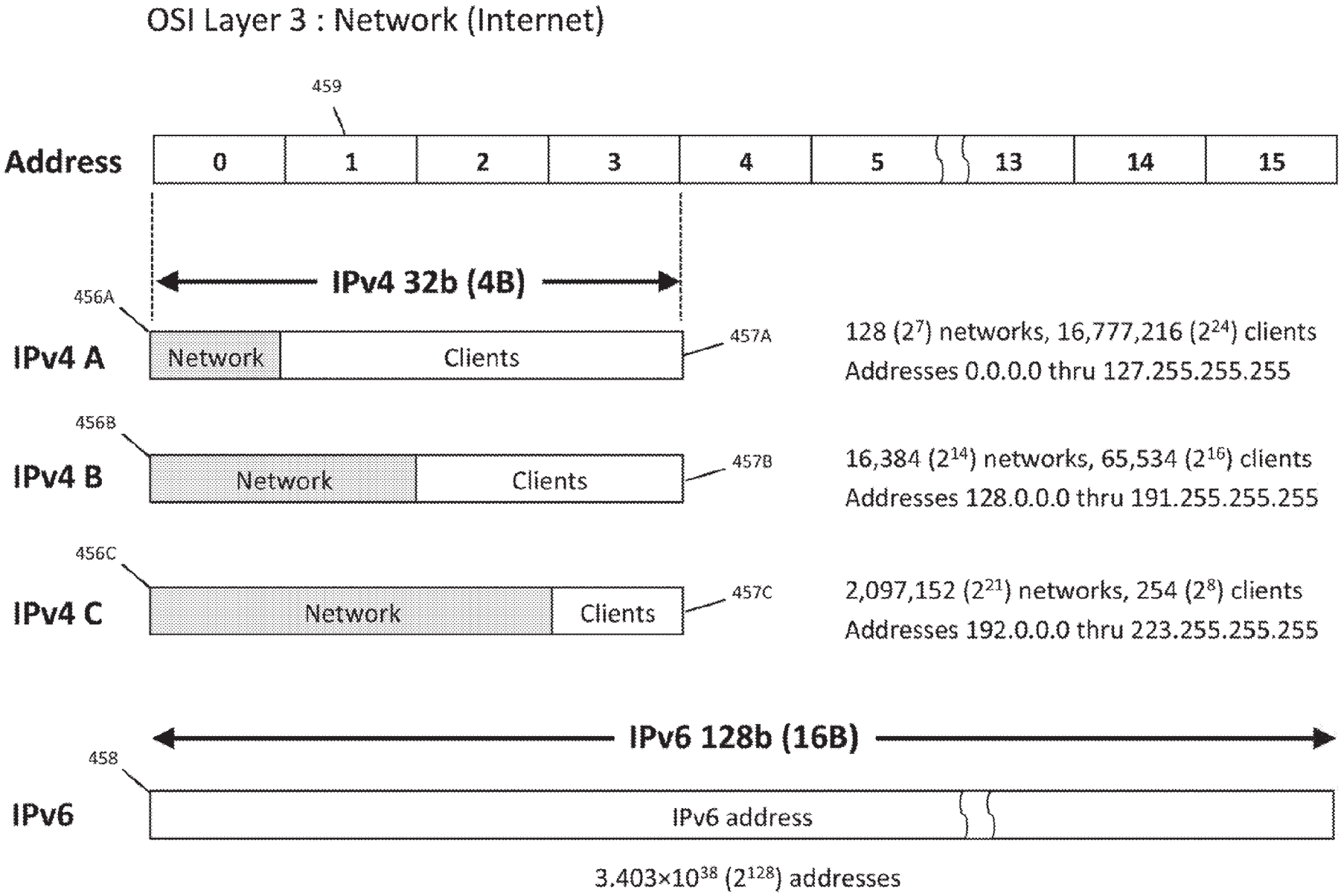

OSI Layer 3 : Network (Internet)
459
Address
0
1
2
3
4
5
13
14
15
IPv4 32b (4B)
456A
IPv4 A
Network
Clients
457A
128 (2^7) networks, 16,777,216 (2^24) clients
Addresses 0.0.0.0 thru 127.255.255.255
456B
IPv4 B
Network
Clients
457B
16,384 (2^14) networks, 65,534 (2^16) clients
Addresses 128.0.0.0 thru 191.255.255.255
456C
IPv4 C
Network
Clients
457C
2,097,152 (2^21) networks, 254 (2^8) clients
Addresses 192.0.0.0 thru 223.255.255.255
IPv6 128b (16B)
458
IPv6
IPv6 address
3.403×10^38 (2^128) addresses

Figure 25

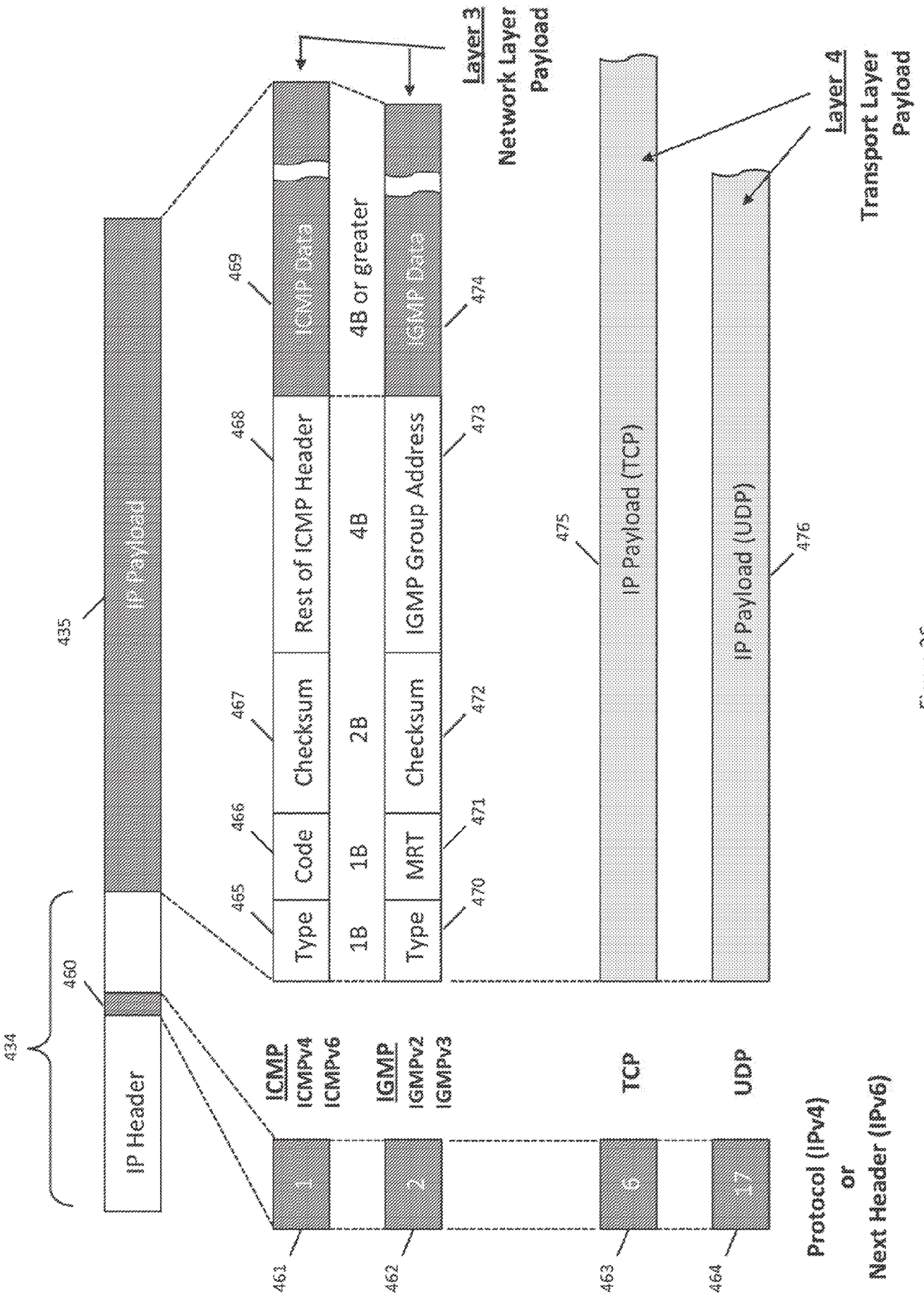

434
460
IP Header
435
IP Payload
ICMP
ICMPv4
ICMPv6
IGMP
IGMPv2
IGMPv3
TCP
UDP
1
2
6
17
461
462
463
464
Protocol (IPv4)
or
Next Header (IPv6)
Type
Code
Checksum
Rest of ICMP Header
1B
1B
2B
4B
4B or greater
465
466
467
468
469
ICMP Data
Type
MRT
Checksum
IGMP Group Address
1B
1B
2B
4B
470
471
472
473
474
IGMP Data
Layer 3
Network Layer
Payload
IP Payload (TCP)
IP Payload (UDP)
475
476
Layer 4
Transport Layer
Payload

Figure 26

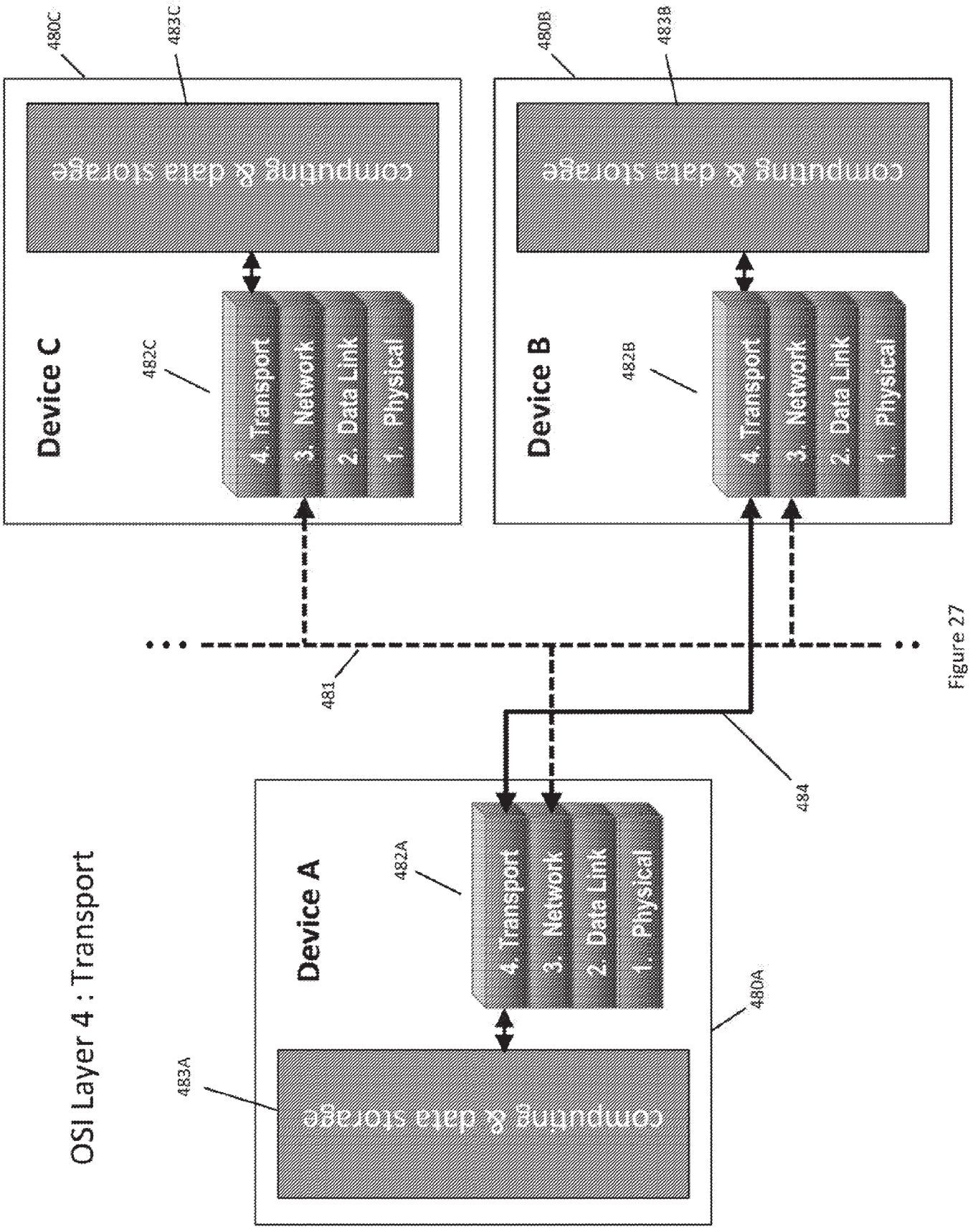

OSI Layer 4 : Transport
Device A
Device B
Device C
4. Transport
3. Network
2. Data Link
1. Physical
compute & data storage
480A
480B
480C
482A
482B
482C
483A
483B
483C
481
484

Figure 27

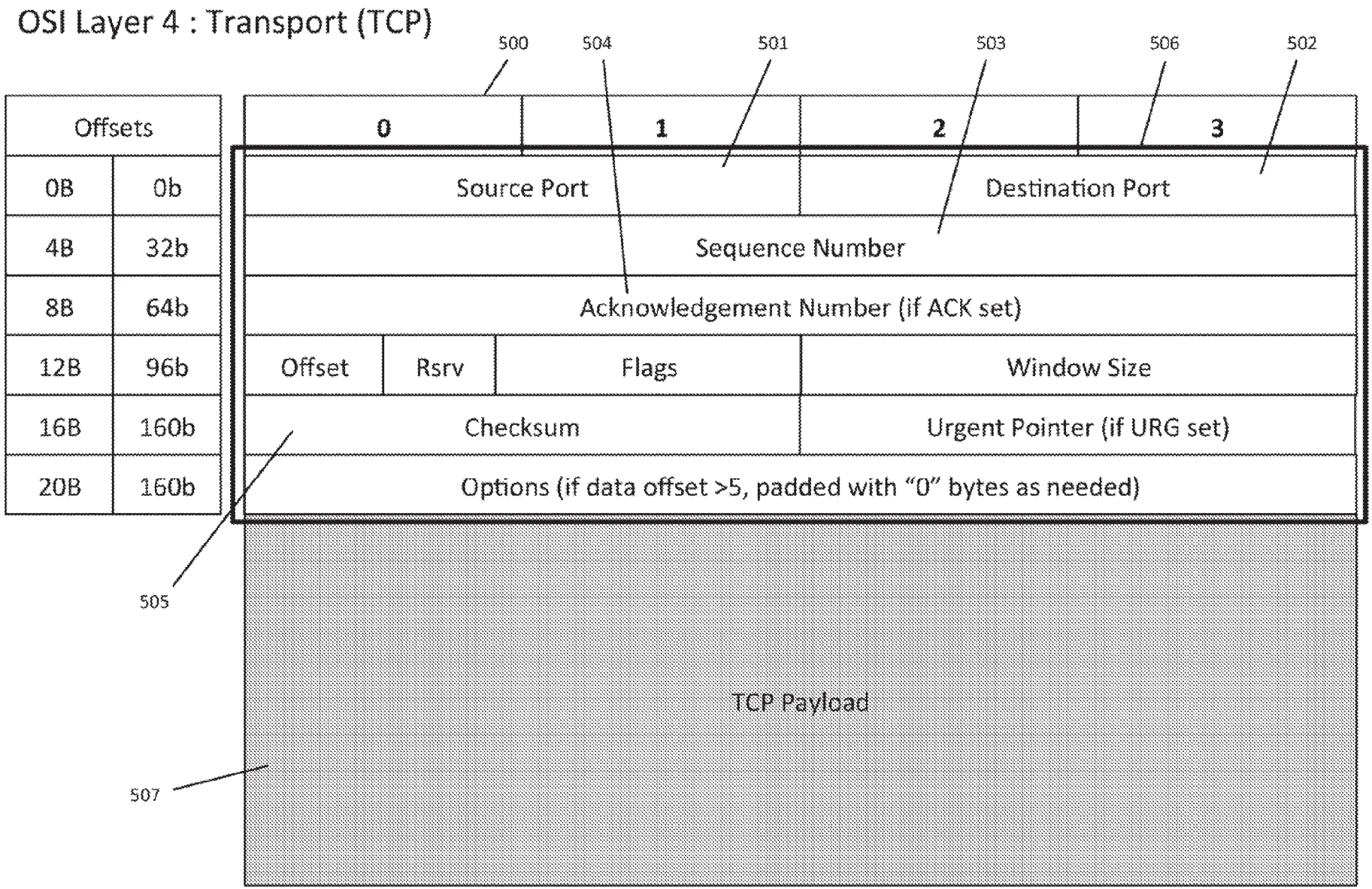

OSI Layer 4 : Transport (TCP)
500
504
501
503
506
502
Offsets
0
1
2
3
0B
0b
Source Port
Destination Port
4B
32b
Sequence Number
8B
64b
Acknowledgement Number (if ACK set)
12B
96b
Offset
Rsrv
Flags
Window Size
16B
160b
Checksum
Urgent Pointer (if URG set)
20B
160b
Options (if data offset >5, padded with "0" bytes as needed)
505
TCP Payload
507

Figure 28A

508

Layer	TCP Field	Size	TCP Function
4	**Source Port**	2B	Senders port, port for which reply should be sent
4	**Destination Port**	2B	Receiver's port (required), well known port # if server
4	**Sequence Number**	4B	Packet counter (SEQ #) incrementing each ACK reply by one
4	**Acknowledgement #**	4B	Acknowledges receipt of each packet in a sequence by sequence #
4	**Offset**	4b	Size of TCP header (offset from TCP header to data start), 20B to 60B
4	**Reserved**	3b	Reserved for future, default to 000 binary
4	**Flags**	9b	Control bits for congestion, urgency, acknowledgement, sync & reset
4	**Window Size**	2B	Size of the receive window
4	**Checksum**	2B	Error checking comprising 16b checksum of header and payload data
4	**Urgent Pointer**	2B	Offset from SEQ # indicating last urgent data byte (if URG is set to 1)
4	**Options**	1B to 40B	Option- Kind (1B required), Length (1B option), Data (var), as per Offset
4–7	**TCP Payload**	variable	TCP payload data

Figure 28B

OSI Layer 4 : Transport (TCP)

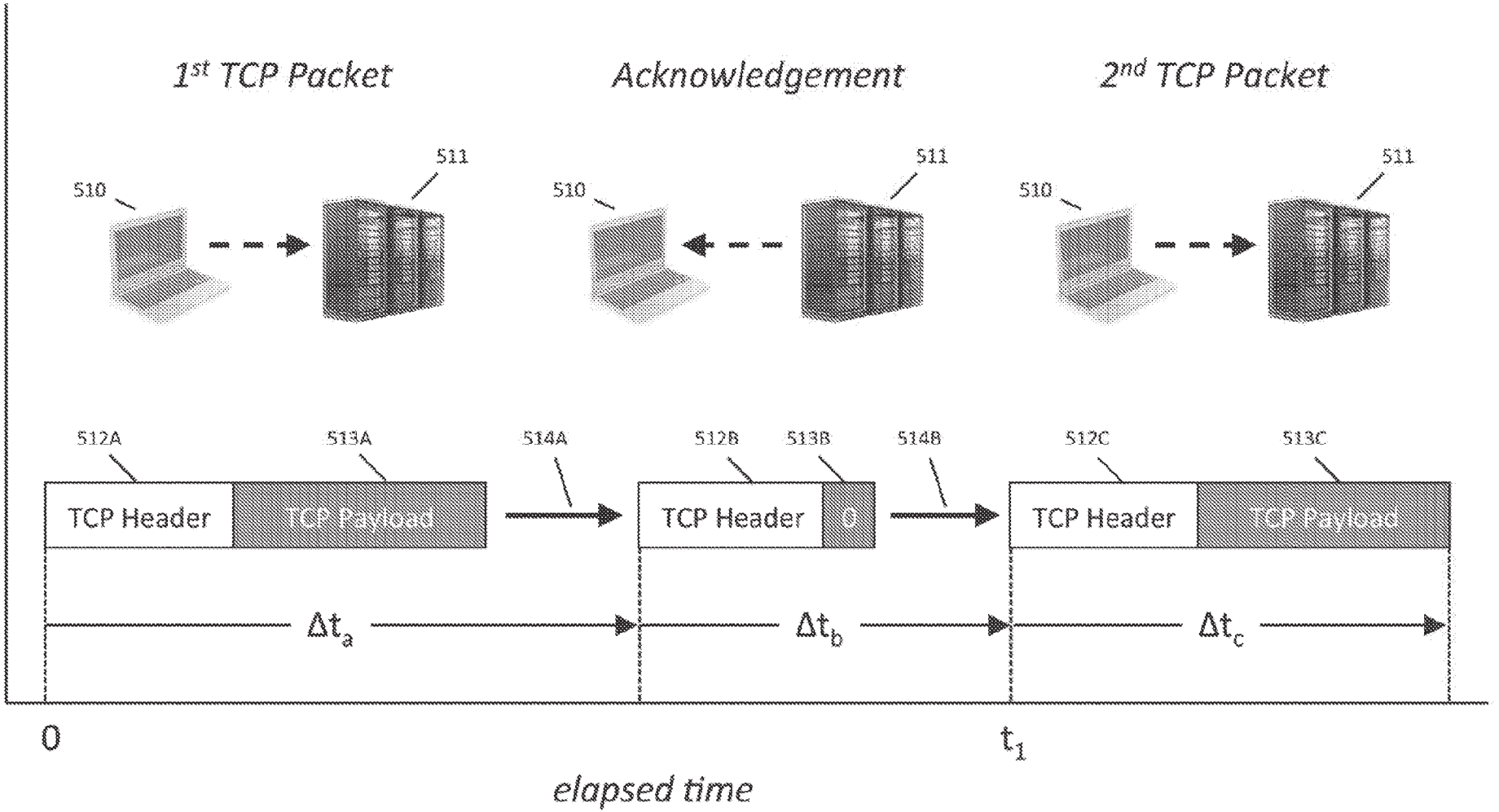
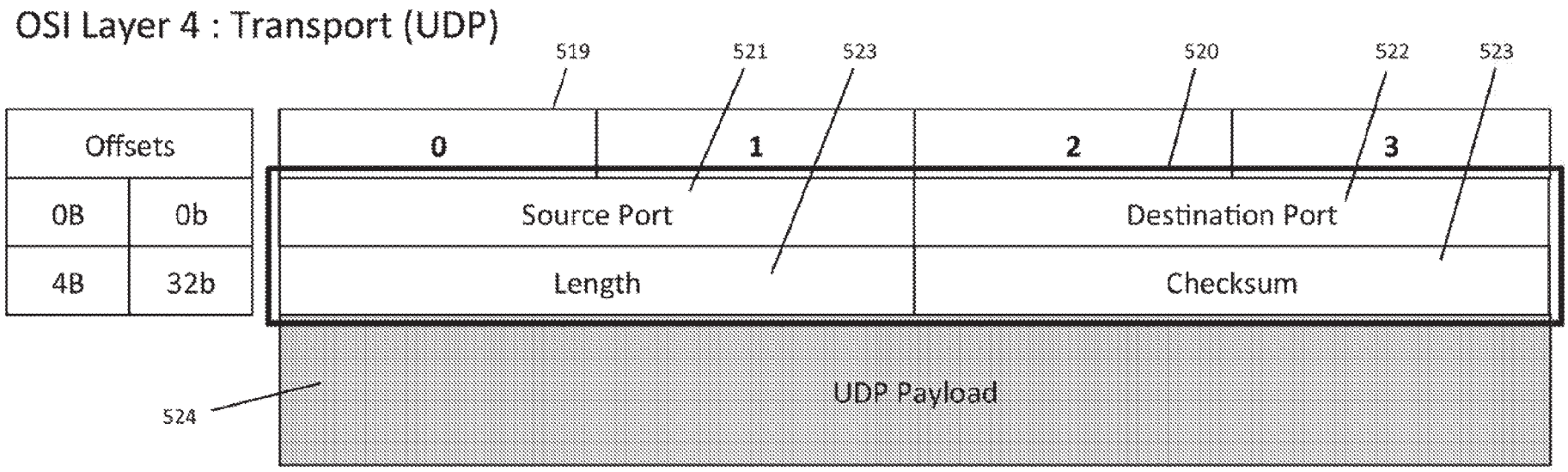


Figure 29



525

Layer	UDP Field	Size	Function
4	**Source Port**	2B	Senders port, port for which reply should be sent
4	**Destination Port**	2B	Receiver's port (required), well known port # if server
4	**Length**	2B	Total length of UDP header and payload, 8B to 65,535B
4	**Checksum**	2B	Error checking, required in IPv6, uses pseudo-header in IPv4 and IPv6
4–7	**UDP Payload**	variable	UDP payload data, 0B to 65,507B in IPv4

Figure 30

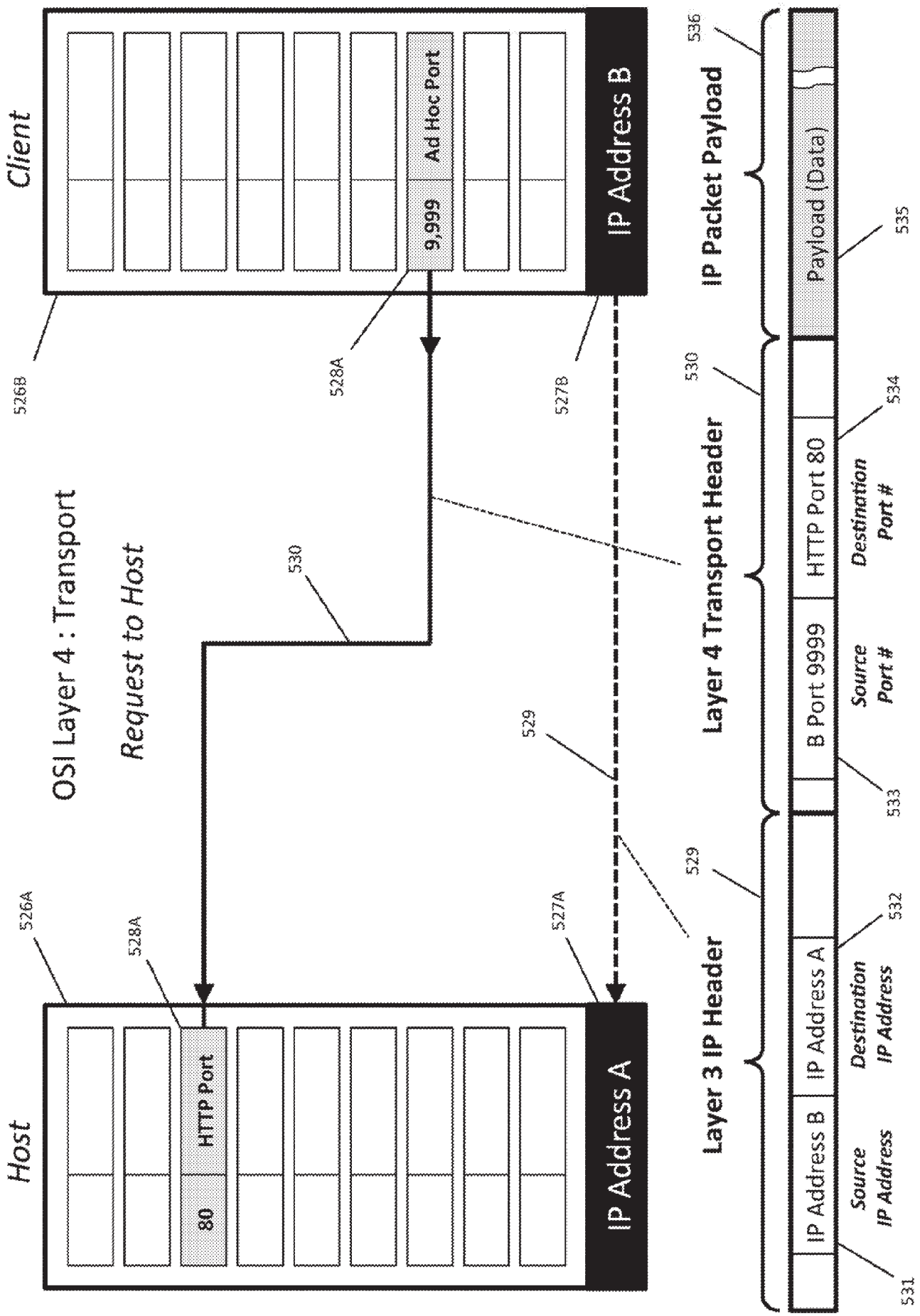

Client
Host
OSI Layer 4 : Transport
Request to Host
9,999
Ad Hoc Port
80
HTTP Port
IP Address B
IP Address A
526B
528A
527B
526A
528A
527A
530
529
Layer 3 IP Header
Layer 4 Transport Header
IP Packet Payload
536
530
529
534
533
532
531
535
IP Address B
IP Address A
B Port 9999
HTTP Port 80
Payload (Data)
Source IP Address
Destination IP Address
Source Port #
Destination Port #

Figure 31A

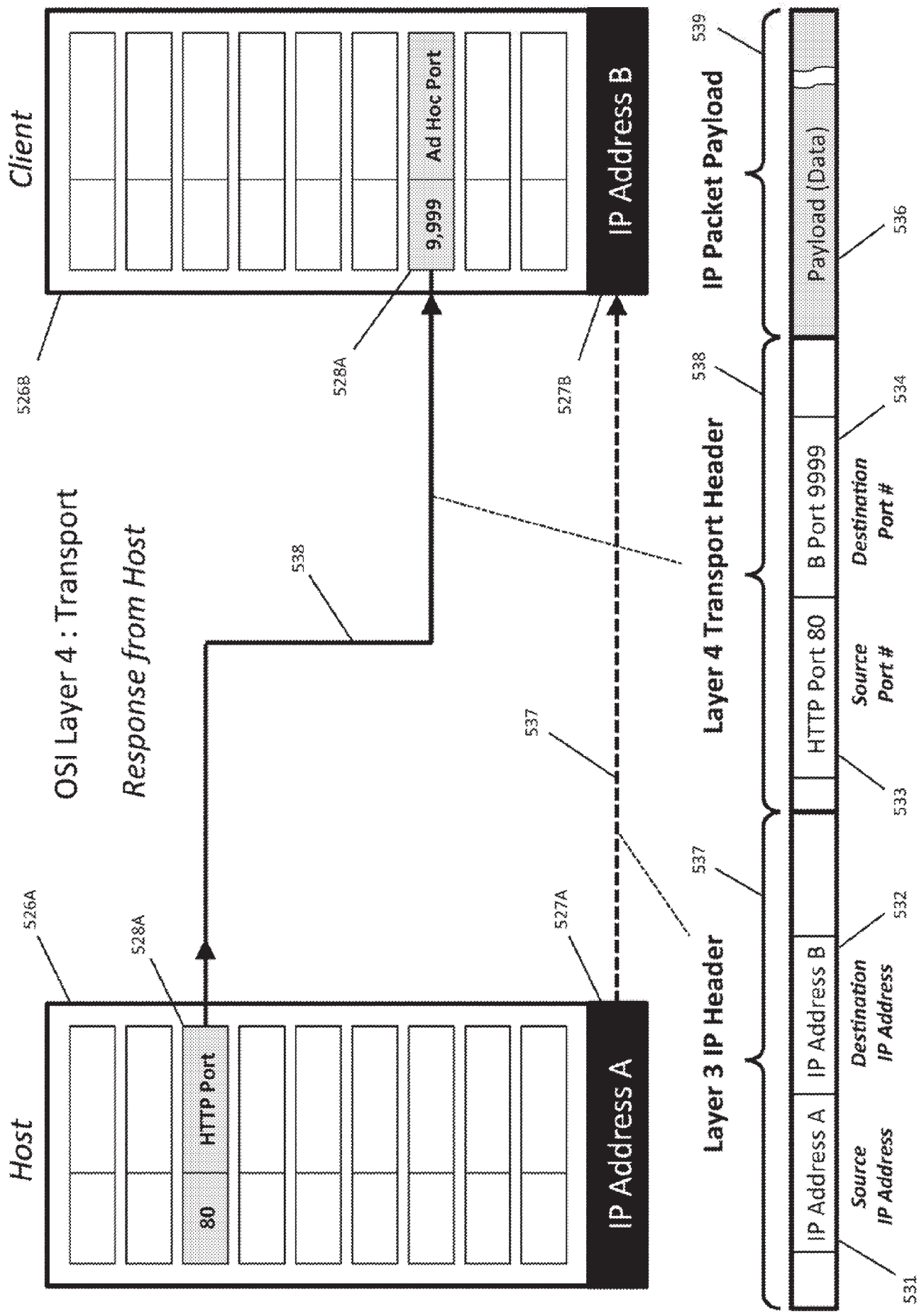

Host
Client
OSI Layer 4 : Transport
Response from Host
80
HTTP Port
9,999
Ad Hoc Port
IP Address A
IP Address B
526A
526B
528A
527A
527B
538
537
Layer 3 IP Header
Layer 4 Transport Header
IP Packet Payload
IP Address A
IP Address B
HTTP Port 80
B Port 9999
Payload (Data)
Source IP Address
Destination IP Address
Source Port #
Destination Port #
531
532
533
534
536
539

Figure 31B

540

Port #	UDP	TCP	Port Description	Registered
7	UDP	TCP	Echo/Ping (generally superseded by ICMP)	Official
20	UDP	TCP	FTP Data Transfer	Official
21	–	TCP	FTP Control (command)	Official
22	UDP	TCP	Secure shell (SSH) for secure login (SCP), SFTP, port forwarding	Official
23	UDP	TCP	Telnet	Official
25	–	TCP	Simple Mail Transfer (SMTP)	Official
26	UDP	TCP	Encrypted SMTP	Official
53	UDP	TCP	Domain Name Server (DNS)	Official
80	–	TCP	Hypertext Transfer Protocol (HTTP)	Official
110	–	TCP	Post Office Protocol (POP3)	Official
143	–	TCP	Internet Mail Access Protocol (IMAP)	Official
220	UDP	TCP	Internet Mail Access Protocol (IMAP v3)	Official
443	–	TCP	Hypertext Transfer Protocol over TLS/SSL (HTTPS)	Official
465	–	TCP	Simple Mail Transfer Protocol over TLS/SSL (SMTPS)	Official
989	UDP	TCP	FTPS Protocol (data): FTP over TLS/SSL	Official
990	UDP	TCP	FTPS Protocol (control): FTP over TLS/SSL	Official
992	UDP	TCP	TELNET protocol over TLS/SSL	Official
993	–	TCP	Internet Message Access Protocol over TLS/SSL (IMAPS)	Official
995	–	TCP	Post Office Protocol 3 over TLS/SSL (POP3S)	Official

Figure 31C

541

Port Number	UDP	TCP	Port Description	Registered
0 to 1,023	UDP	TCP	System Ports	Generally
1,024 to 49,151	UDP	TCP	Registered Ports, Open (Dynamic) Ports	Mixed
49,152 to 65,535	UDP	TCP	Open (Dynamic), Private and Ephemeral Ports	No

Figure 31D

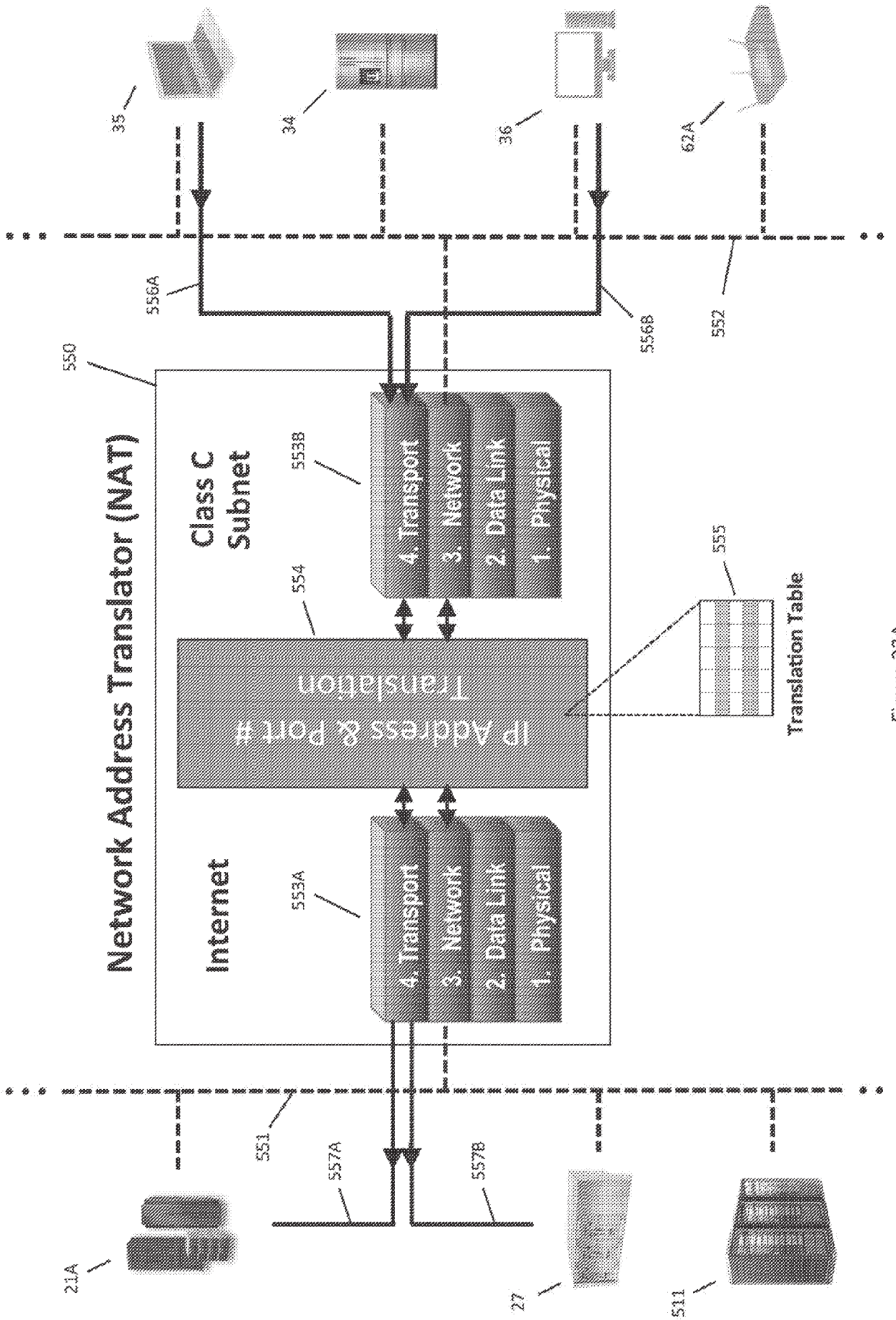

35
34
36
62A
556A
556B
552
550
Network Address Translator (NAT)
Class C Subnet
553B
4. Transport
3. Network
2. Data Link
1. Physical
554
IP Address & Port # Translation
555
Translation Table
Internet
553A
4. Transport
3. Network
2. Data Link
1. Physical
551
557A
557B
21A
27
511

Figure 32A

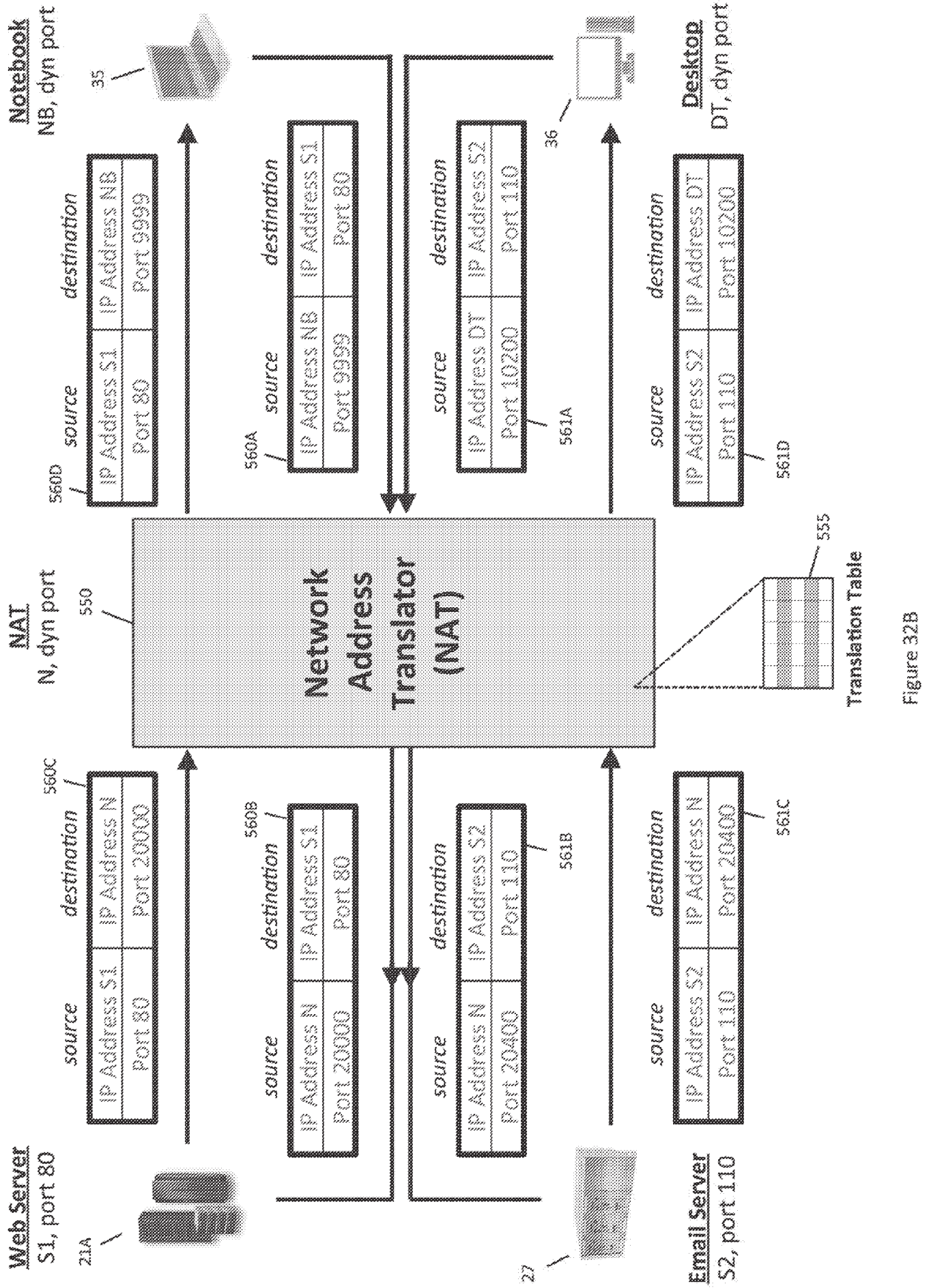

Notebook
NB, dyn port
35
Desktop
DT, dyn port
36
NAT
N, dyn port
550
Network Address Translator (NAT)
555
Translation Table
Web Server
S1, port 80
21A
Email Server
S2, port 110
27
560D
source
destination
IP Address S1
Port 80
IP Address NB
Port 9999
560A
IP Address NB
Port 9999
IP Address S1
Port 80
561A
IP Address DT
Port 10200
IP Address S2
Port 110
561D
IP Address S2
Port 110
IP Address DT
Port 10200
560C
IP Address S1
Port 80
IP Address N
Port 20000
560B
IP Address N
Port 20000
IP Address S1
Port 80
561B
IP Address N
Port 20400
IP Address S2
Port 110
561C
IP Address S2
Port 110
IP Address N
Port 20400

Figure 32B

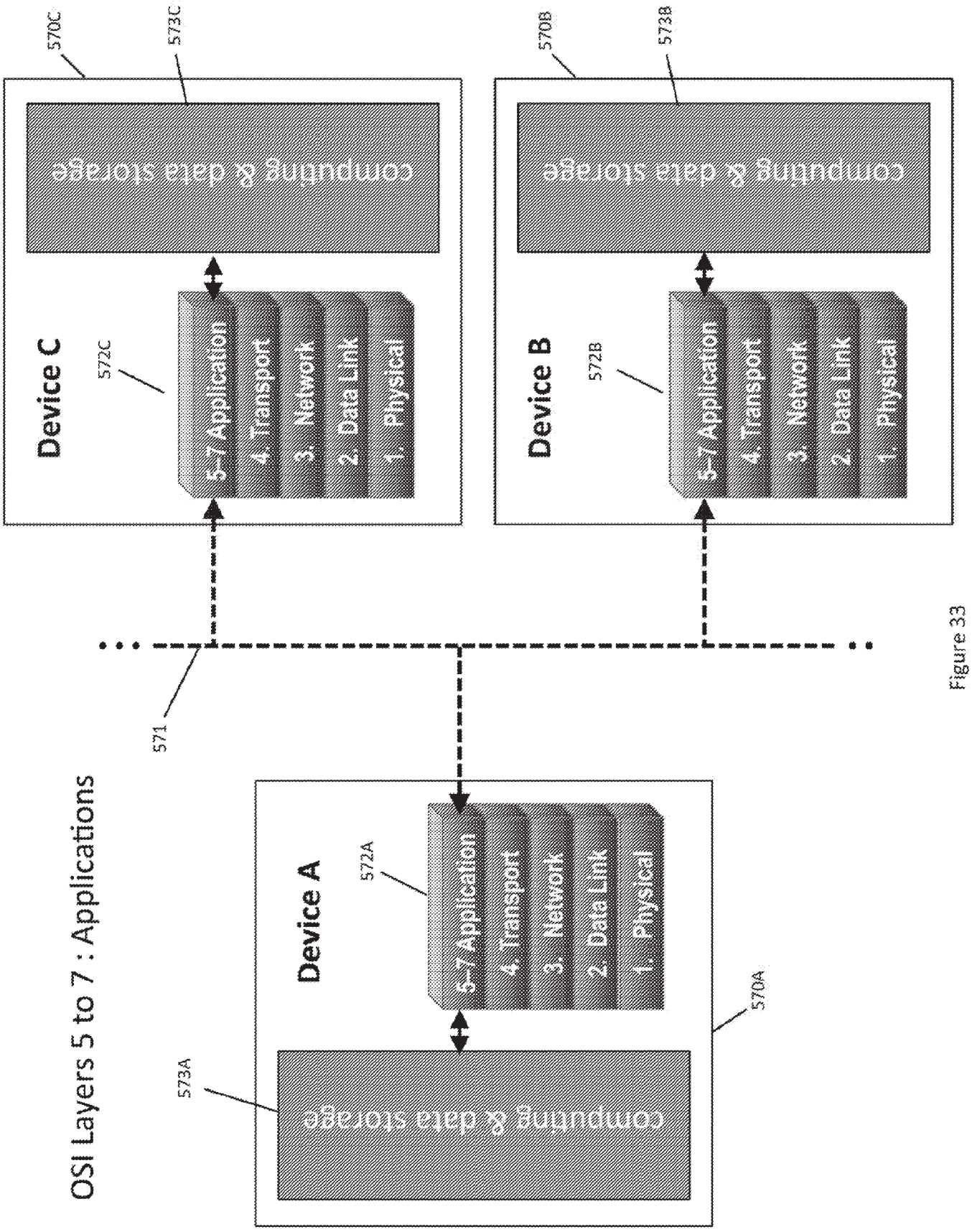

OSI Layers 5 to 7 : Applications
Device A
572A
5-7 Application
4. Transport
3. Network
2. Data Link
1. Physical
573A
compute & data storage
570A
571
Device C
572C
5-7 Application
4. Transport
3. Network
2. Data Link
1. Physical
573C
compute & data storage
570C
Device B
572B
5-7 Application
4. Transport
3. Network
2. Data Link
1. Physical
573B
compute & data storage
570B

Figure 33

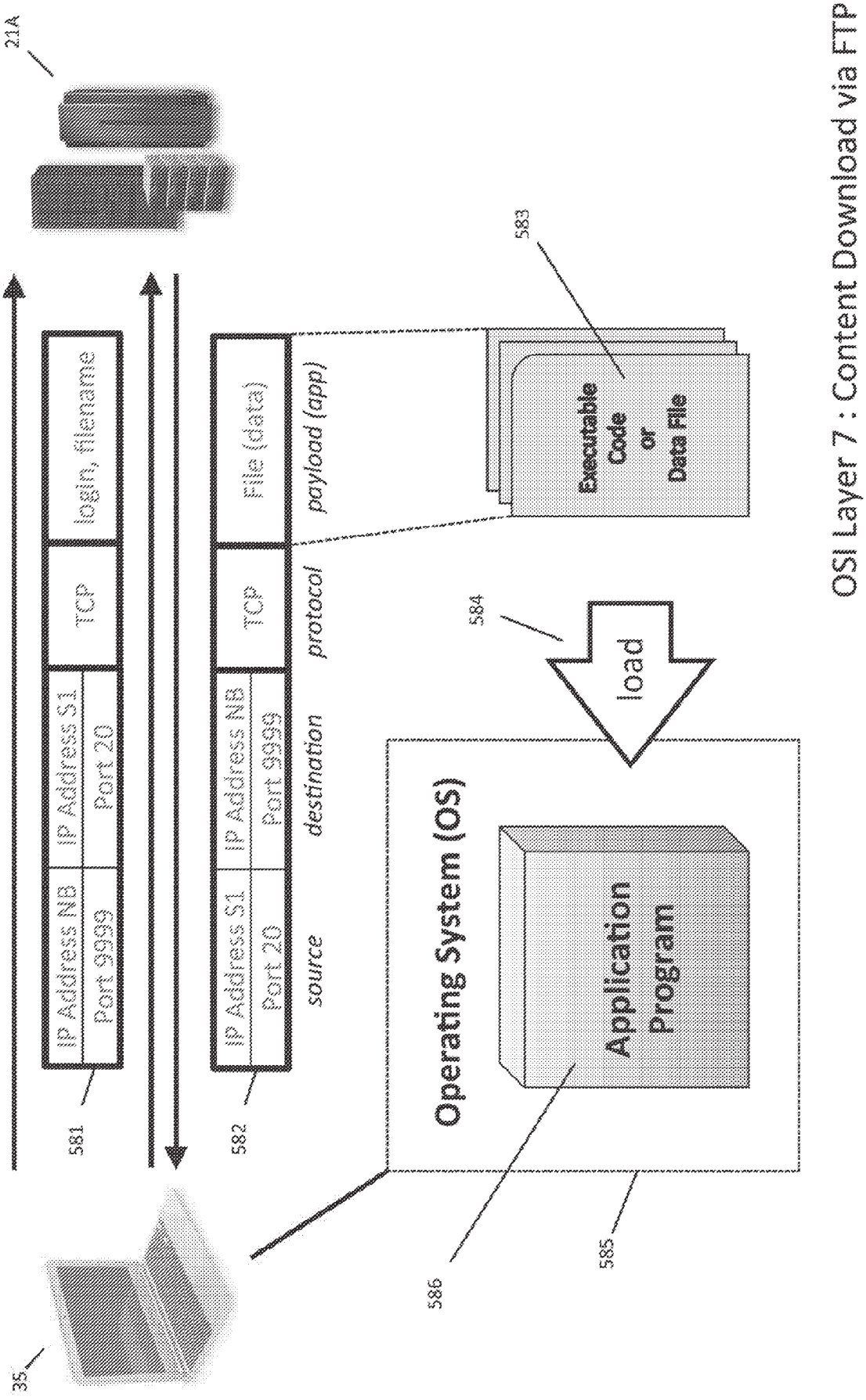

OSI Layer 7 : Content Download via FTP
Notebook
NB, dyn port
35
File Server
S1, port 20
21A
source
destination
protocol
payload (app)
IP Address NB
Port 9999
IP Address S1
Port 21
TCP
FTP command
580
IP Address NB
Port 9999
IP Address S1
Port 20
TCP
login, filename
581
IP Address S1
Port 20
IP Address NB
Port 9999
TCP
File (data)
582
583
Executable
Code
or
Data File
584
load
Operating System (OS)
Application
Program
585
586

Figure 34

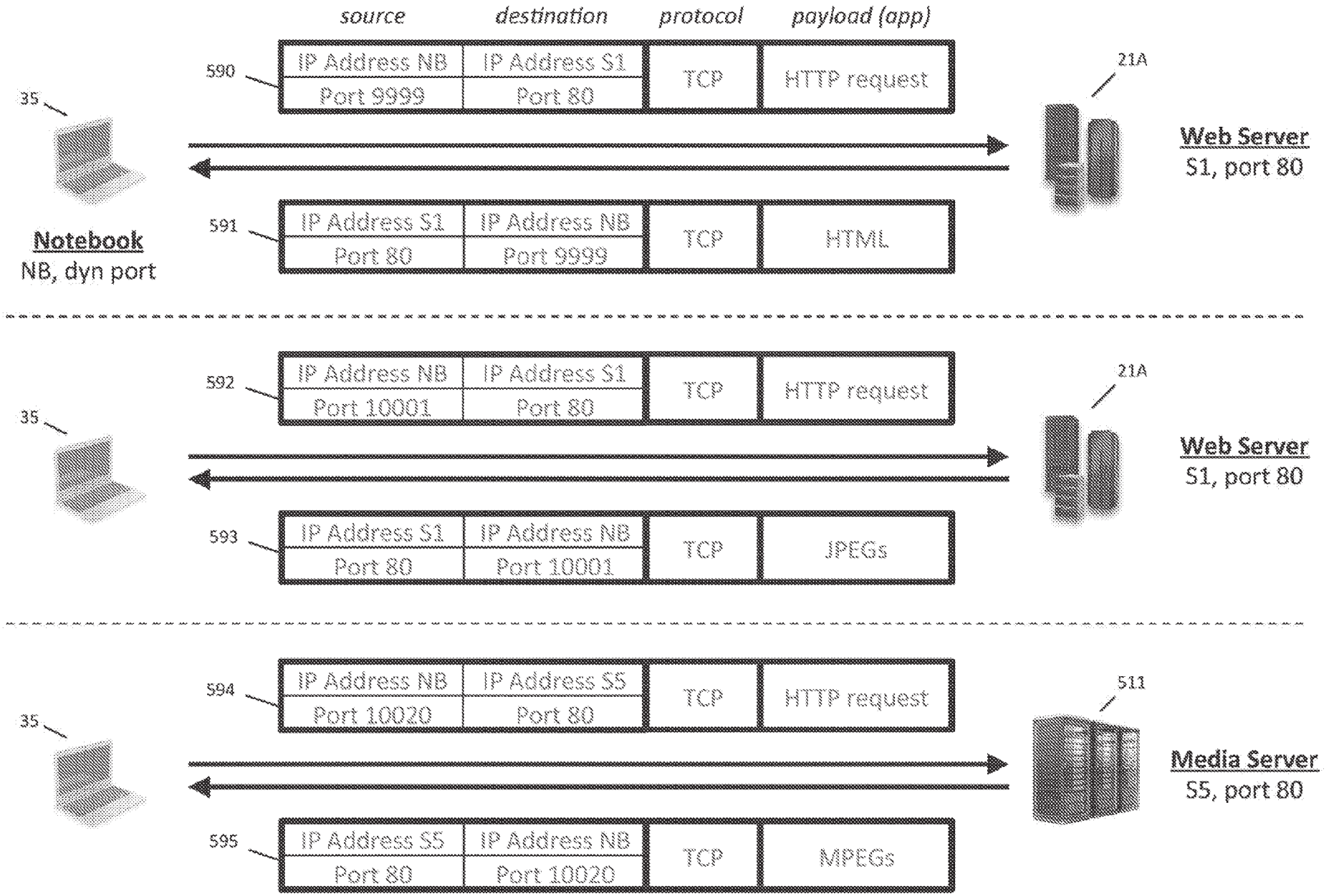


Figure 35A

OSI Layer 7 : web page download via HTTP

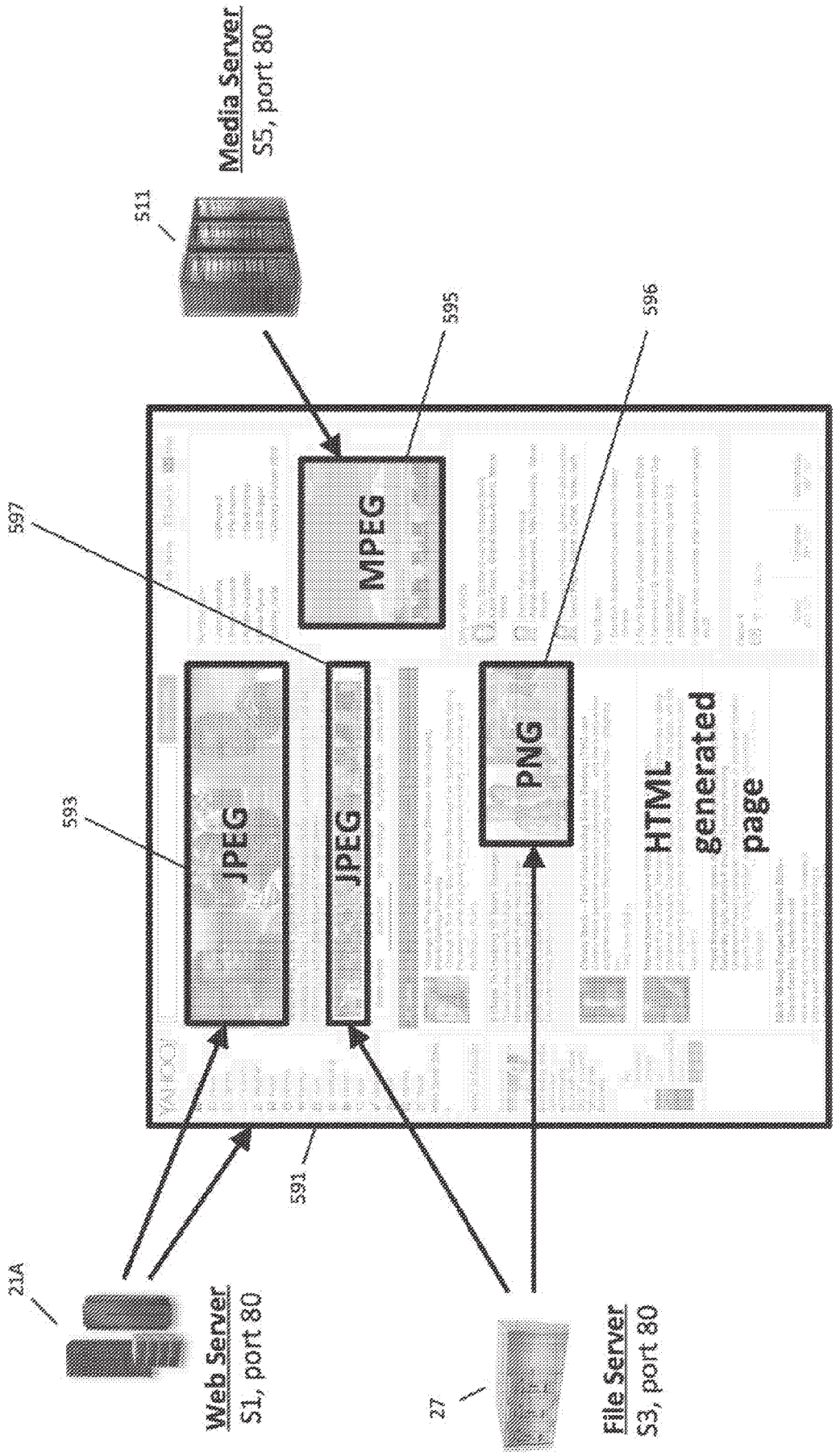

Media Server
S5, port 80
511
595
596
597
MPEG
JPEG
JPEG
PNG
HTML
generated
page
593
591
21A
Web Server
S1, port 80
27
File Server
S3, port 80

Figure 35B

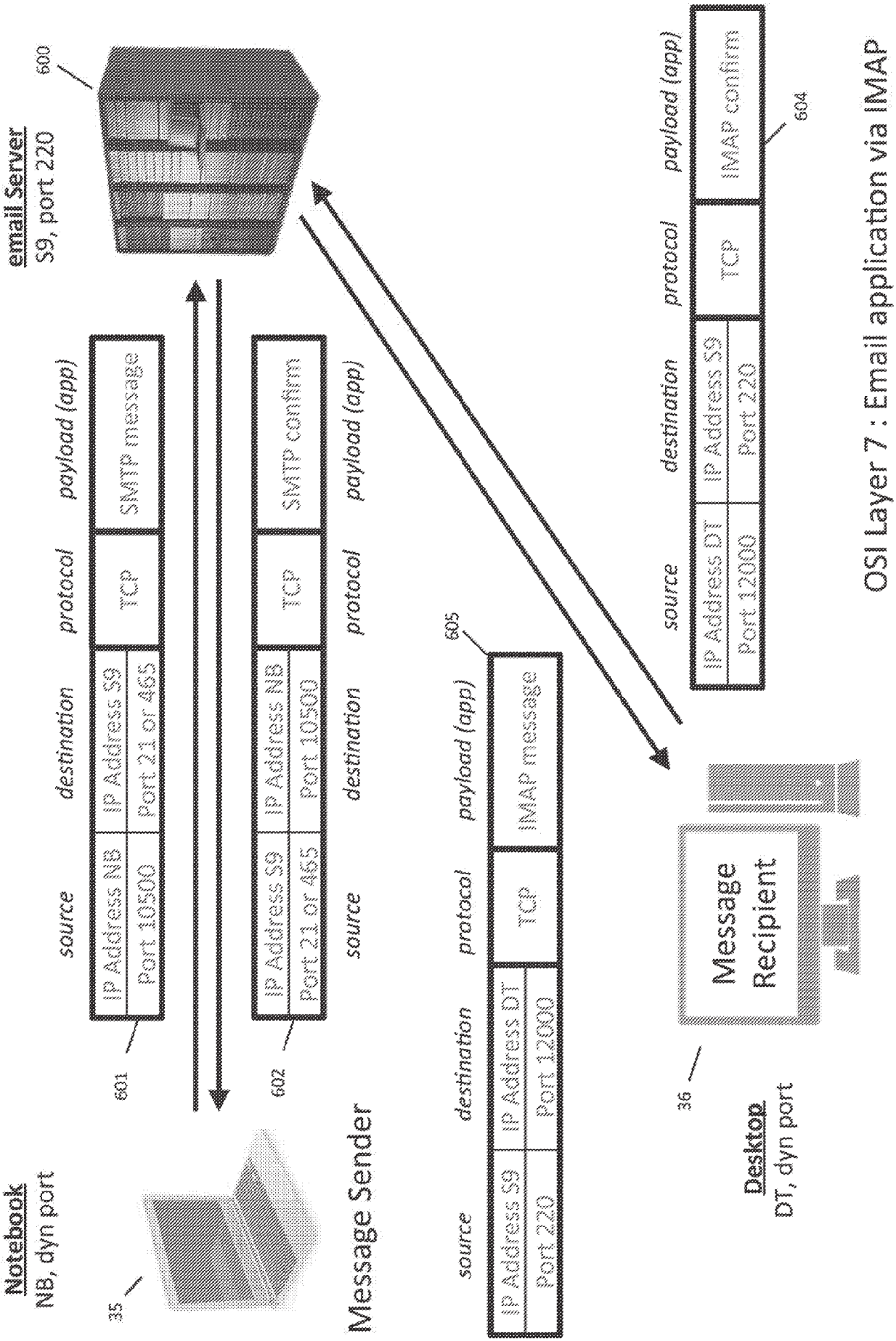

email Server
S9, port 220
600
Notebook
NB, dyn port
35
Message Sender
source
destination
protocol
payload (app)
IP Address NB
Port 10500
IP Address S9
Port 21 or 465
TCP
SMTP message
601
IP Address S9
Port 21 or 465
IP Address NB
Port 10500
TCP
SMTP confirm
602
IP Address S9
Port 220
IP Address DT
Port 12000
TCP
IMAP message
605
IP Address DT
Port 12000
IP Address S9
Port 220
TCP
IMAP confirm
604
Message Recipient
36
Desktop
DT, dyn port
OSI Layer 7 : Email application via IMAP

Figure 36

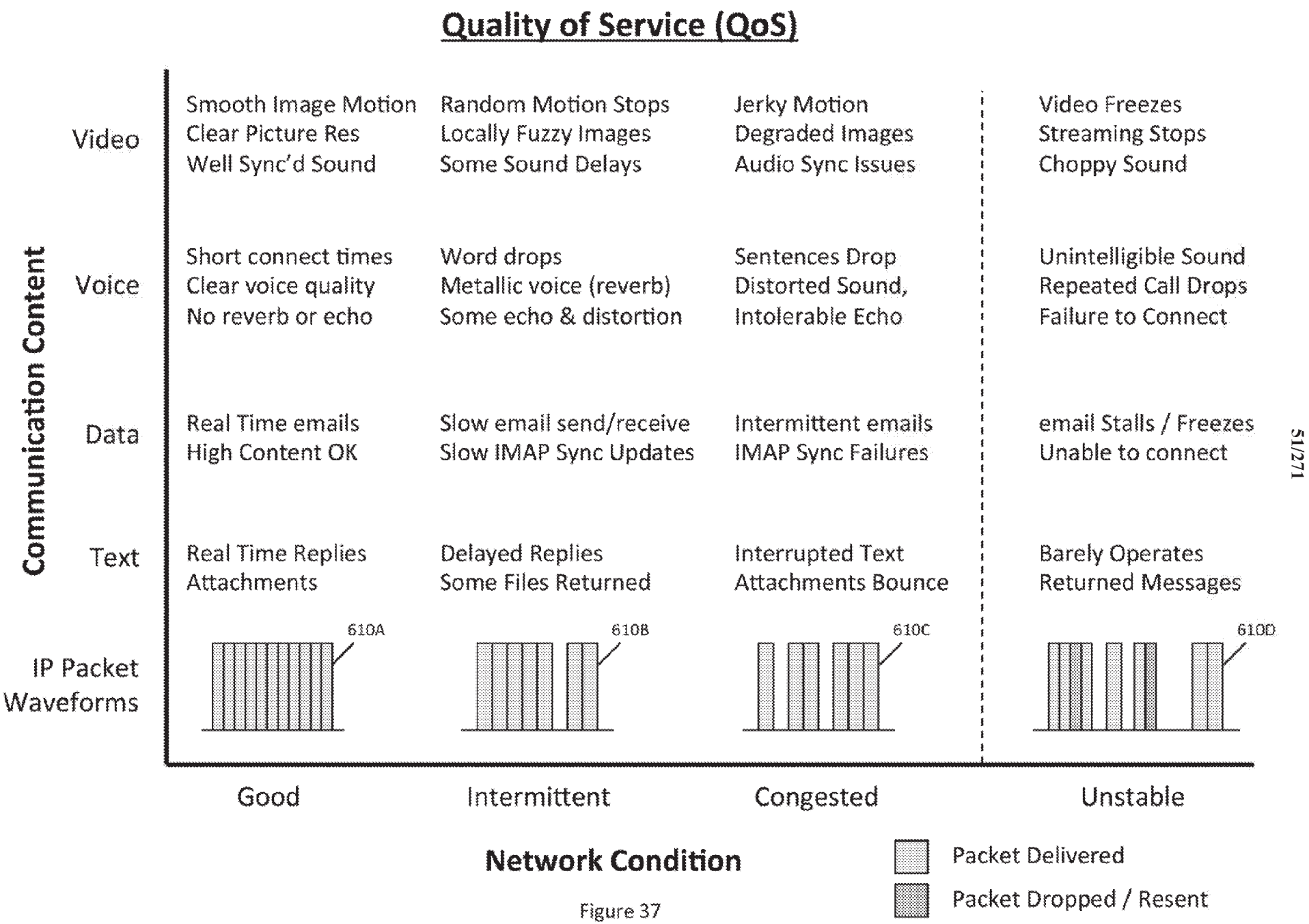

Quality of Service (QoS)
Communication Content
Video
Voice
Data
Text
IP Packet Waveforms
Smooth Image Motion
Clear Picture Res
Well Sync'd Sound
Random Motion Stops
Locally Fuzzy Images
Some Sound Delays
Jerky Motion
Degraded Images
Audio Sync Issues
Video Freezes
Streaming Stops
Choppy Sound
Short connect times
Clear voice quality
No reverb or echo
Word drops
Metallic voice (reverb)
Some echo & distortion
Sentences Drop
Distorted Sound,
Intolerable Echo
Unintelligible Sound
Repeated Call Drops
Failure to Connect
Real Time emails
High Content OK
Slow email send/receive
Slow IMAP Sync Updates
Intermittent emails
IMAP Sync Failures
email Stalls / Freezes
Unable to connect
Real Time Replies
Attachments
Delayed Replies
Some Files Returned
Interrupted Text
Attachments Bounce
Barely Operates
Returned Messages
610A
610B
610C
610D
Good
Intermittent
Congested
Unstable
Network Condition
Packet Delivered
Packet Dropped / Resent

Figure 37

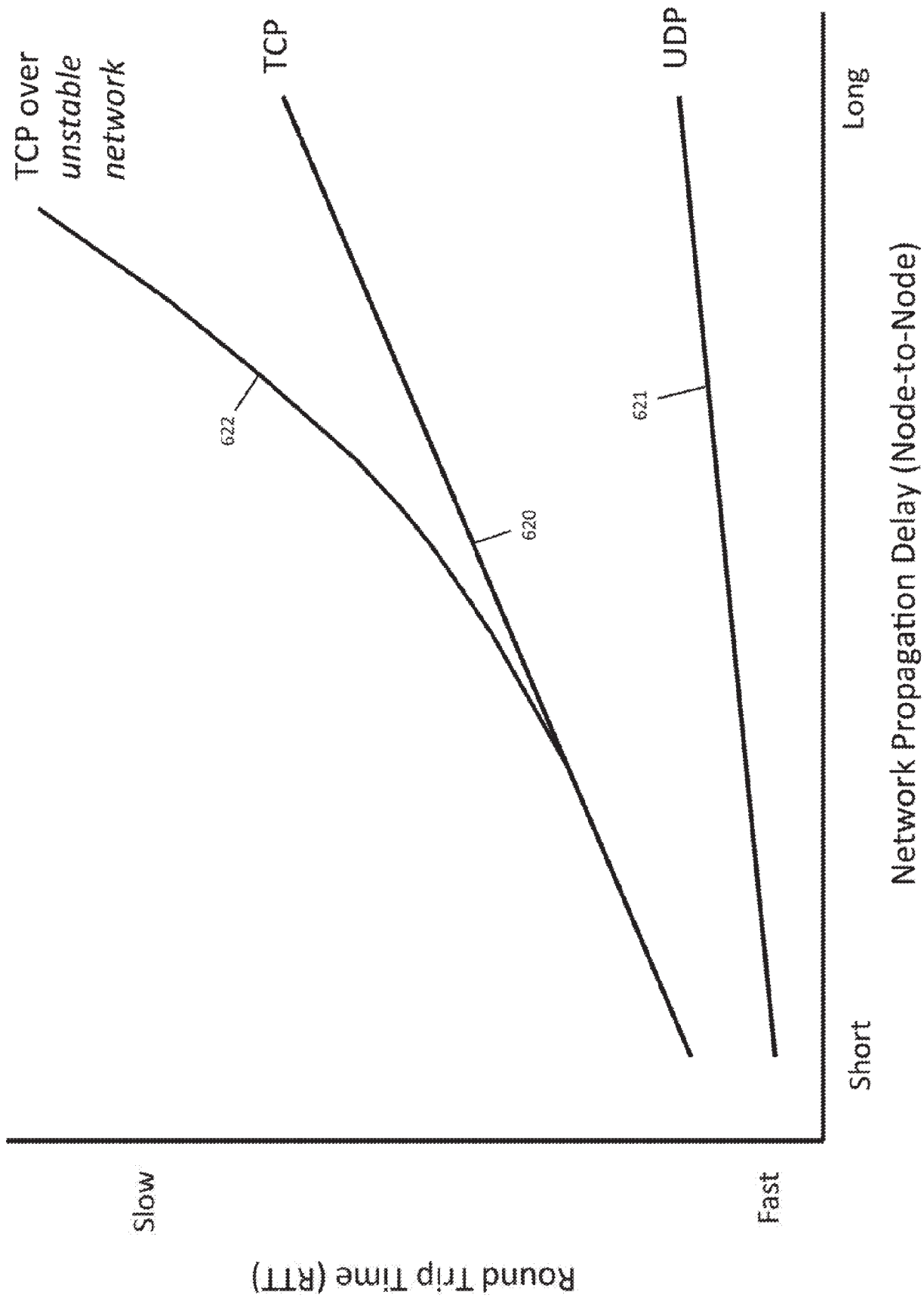

Round Trip Time (RTT)
Slow
Fast
Short
Long
Network Propagation Delay (Node-to-Node)
TCP over unstable network
TCP
UDP
622
620
621

Figure 38

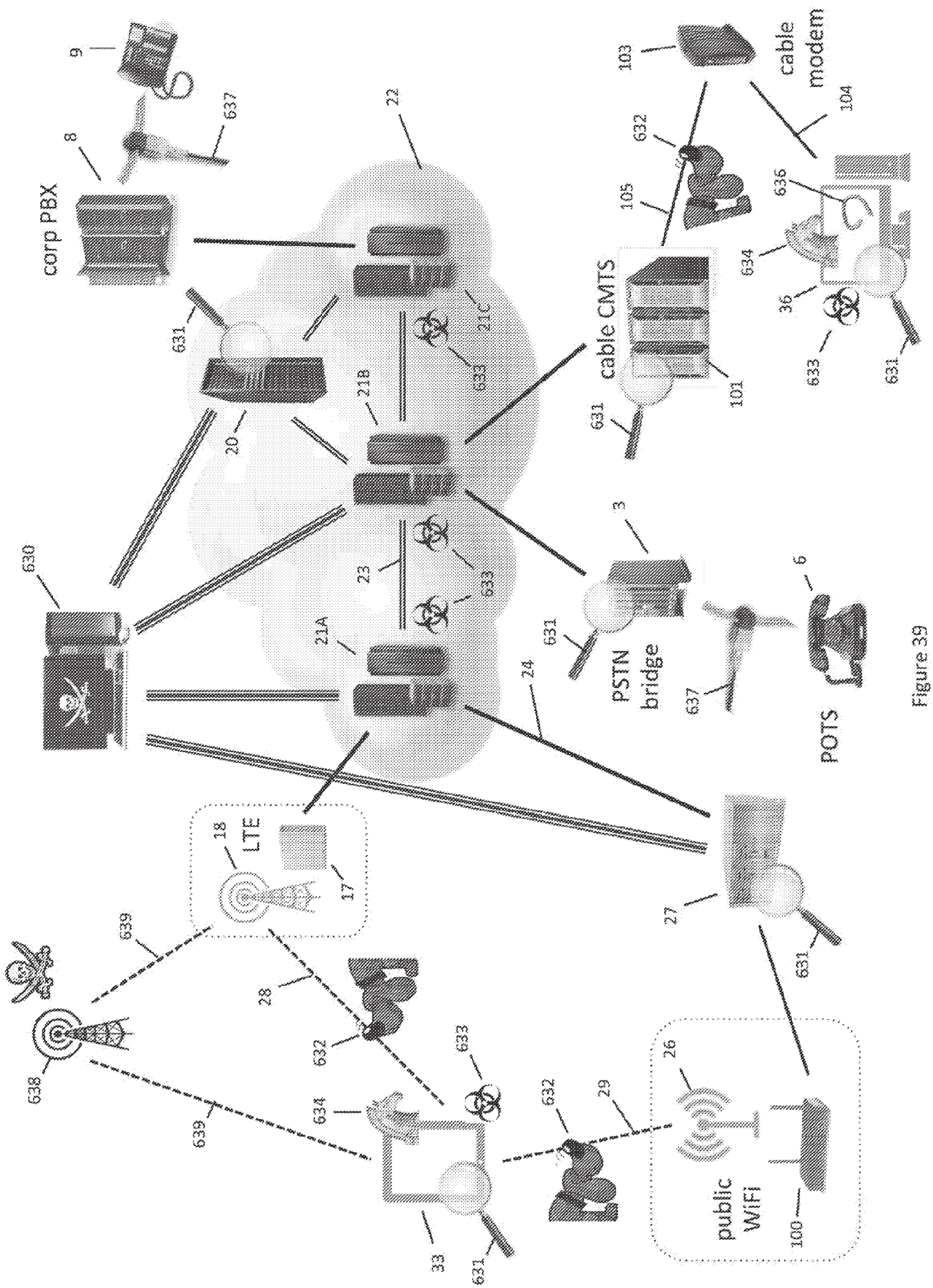

corp PBX
cable CMTS
cable modem
PSTN bridge
POTS
LTE
public WiFi
22
21A
21B
21C
23
24
20
27
28
29
26
33
630
631
632
633
634
636
637
638
639
100
101
103
104
105

Figure 39

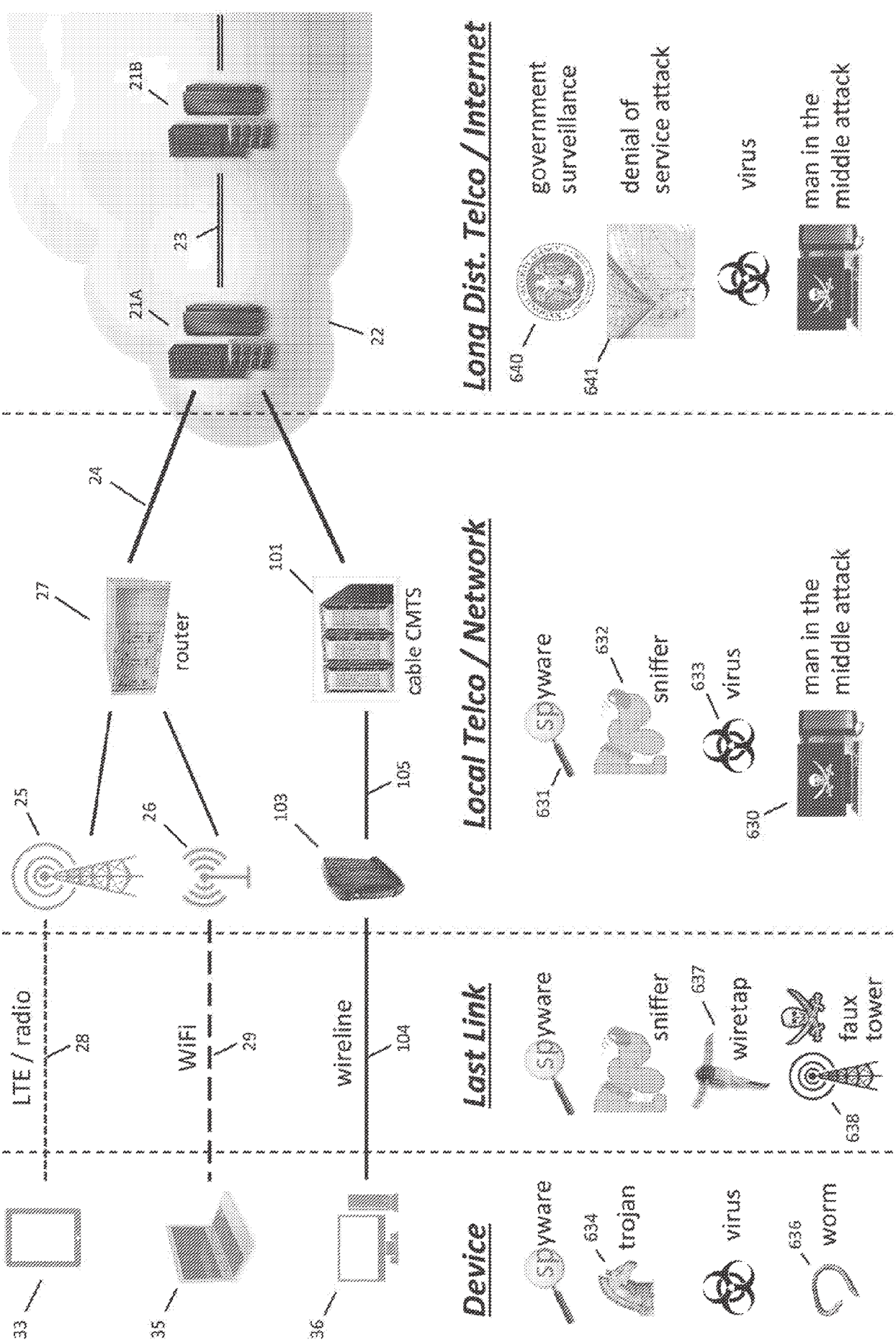

last mile
cloud
LTE / radio
28
WiFi
29
wireline
104
25
26
103
105
27
router
24
101
cable CMTS
21A
21B
23
22
Device
Last Link
Local Telco / Network
Long Dist. Telco / Internet
spyware
trojan
634
virus
worm
636
sniffer
wiretap
637
faux tower
638
spyware
631
sniffer
632
virus
633
man in the middle attack
630
government surveillance
640
denial of service attack
641
virus
man in the middle attack
33
35
36

Figure 40

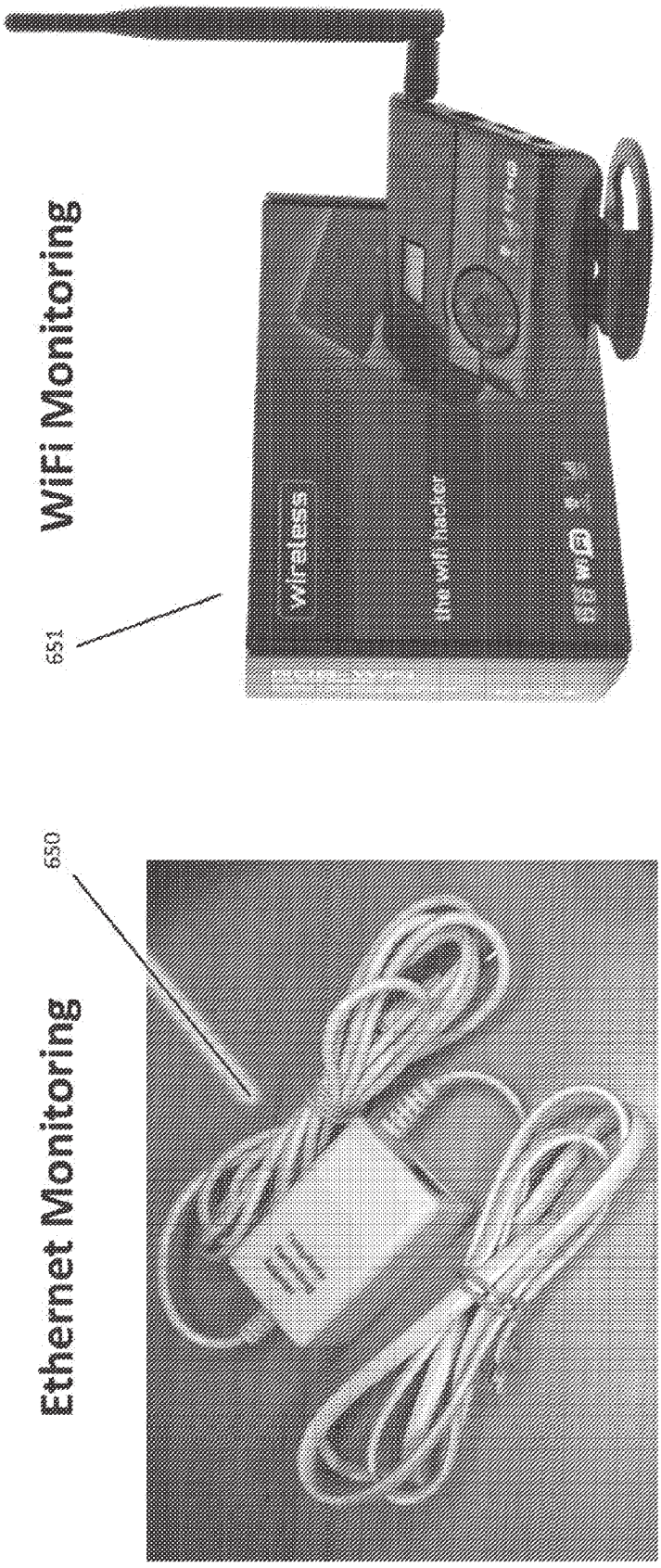
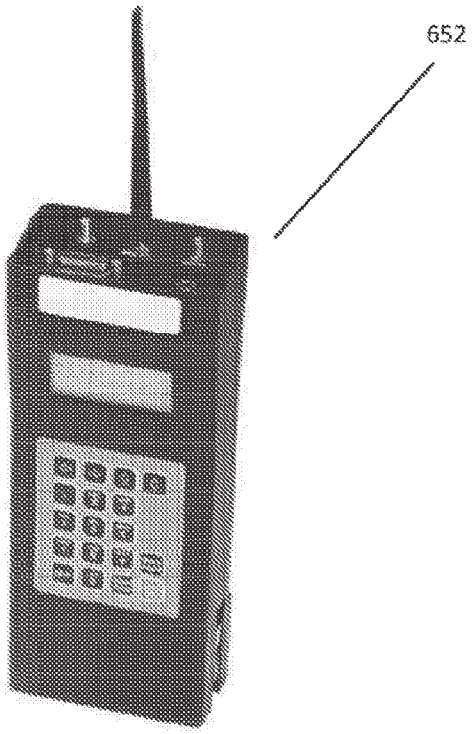

WiFi Monitoring
651
wireless
the wifi hacker
Ethernet Monitoring
650

Figure 41A

Cell Phone Monitoring



Cell Phone Monitoring

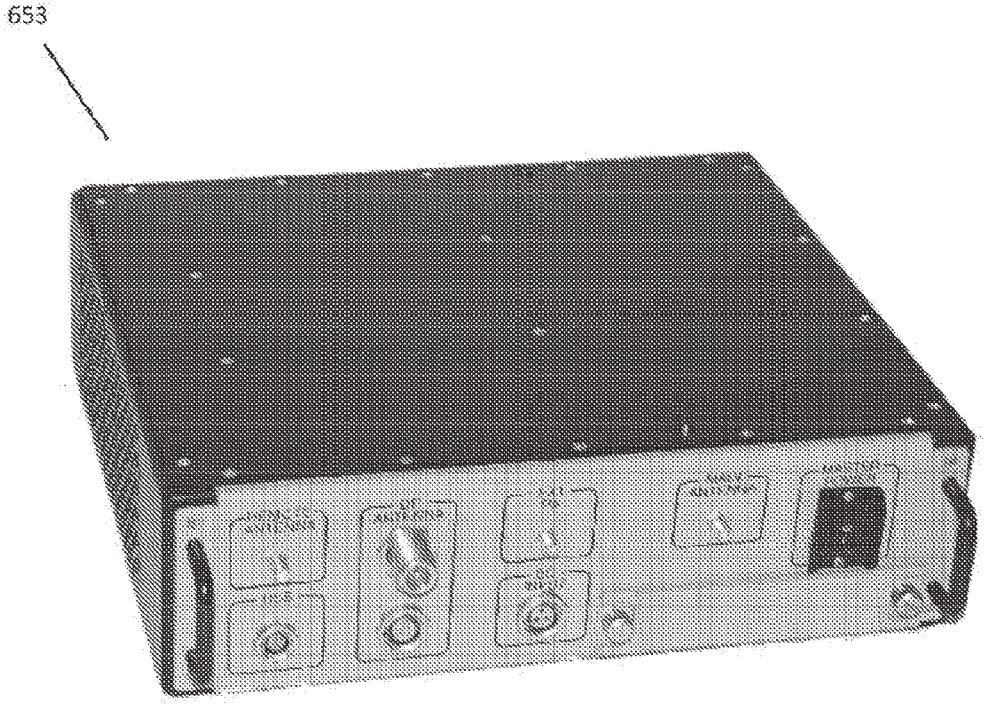


Figure 41B

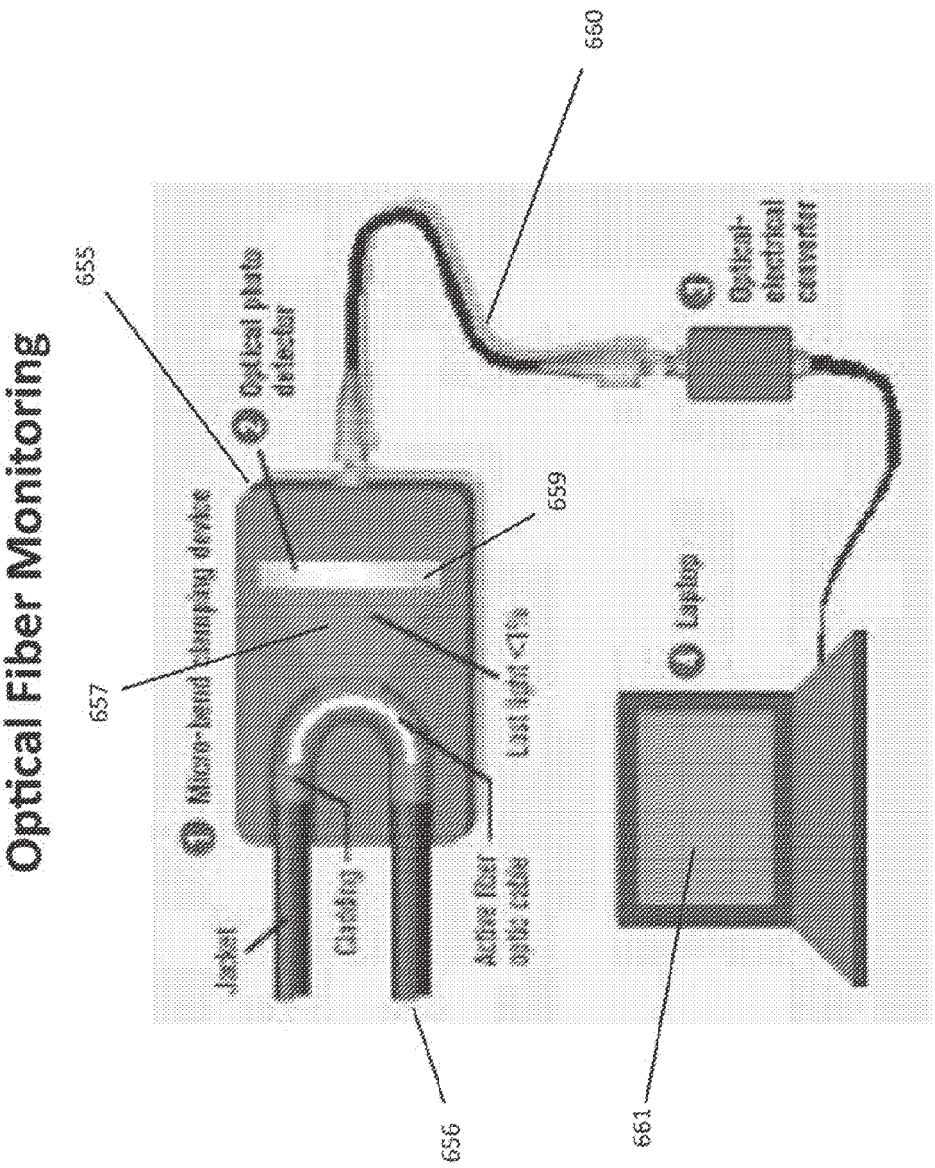

Optical Fiber Monitoring
655
660
657
659
656
661
Optical photo detector
Optical-electrical converter
Laptop
Jacket
Cladding
Active fiber optic cable

Figure 41C

Commercial Spyware Top 10 Comparison

FEATURES										
OS Support	Android, iPhone, iPad, BlackBerry, Symbian Nokia, Windows Mobile	Android, iPhone, BlackBerry, Symbian	iPhone, Android, BlackBerry, Windows Mobile, Symbian	Android, iPhone, BlackBerry	Android	Android, iPhone, BlackBerry, Symbian	iPhone, Android, BlackBerry, Windows Mobile, Symbian	iPhone, BlackBerry, Android, Symbian S60, Nokia, Windows Mobile	iPhone, iPad, BlackBerry, Android, Symbian, Windows Mobile	iPhone, Android, BlackBerry, Nokia phone, Windows Mobile
SPY on Calls	✓	✓	View Call History	✓	Voice Call Log	✓	✓	✓	✓	✓
SPY on SMS and MMS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SPY on Emails	✓	Email Logging	✓	✓	✓	✓	✓	✓	✓	✗
Track GPS Location	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Monitor Internet Use	Browsing History, Website Bookmarks, Blocking Websites	Browsing Website History	Log Tracking	View Visited Websites	View Visited Websites	View Visited Websites, Bookmarks	Browsing History	✗	✓	✗
Access Address Book	✓	✗	✓	✓	✗	✓	✓	✓	✓	✗
Access Calendar	✓	Monitor Appointments	✓	✓	✗	✓	✗	✗	✗	✗
Instant Messages	Skype, WhatsApp, iMessage	Skype, WhatsApp, BlackBerry Chat Logging	WhatsApp, iMessage,BlackBerry Message Chats	Skype, Gtalk, BBM, WhatsApp, iMessage, Facebook, Viber	✗	Skype, Gtalk, BBM, WhatsApp, iMessage, Facebook, Viber, WeChat, Yahoo	✓	✗	BBM, Facebook Chat	✗
Bugging	✓	✗	✗	✓	✗	✓	✗	✗	✗	✗
Control Apps	✓	✗	✓	✓	✗	✗	✓	✗	✗	✗
View Photos/Videos	✓	✓	✓	✓	✗	✗	✓	✓	✓	✗
Remote Control	✓	✗	✗	✓	Block Websites	✓	✓	✗	✓	✓

Figure 42

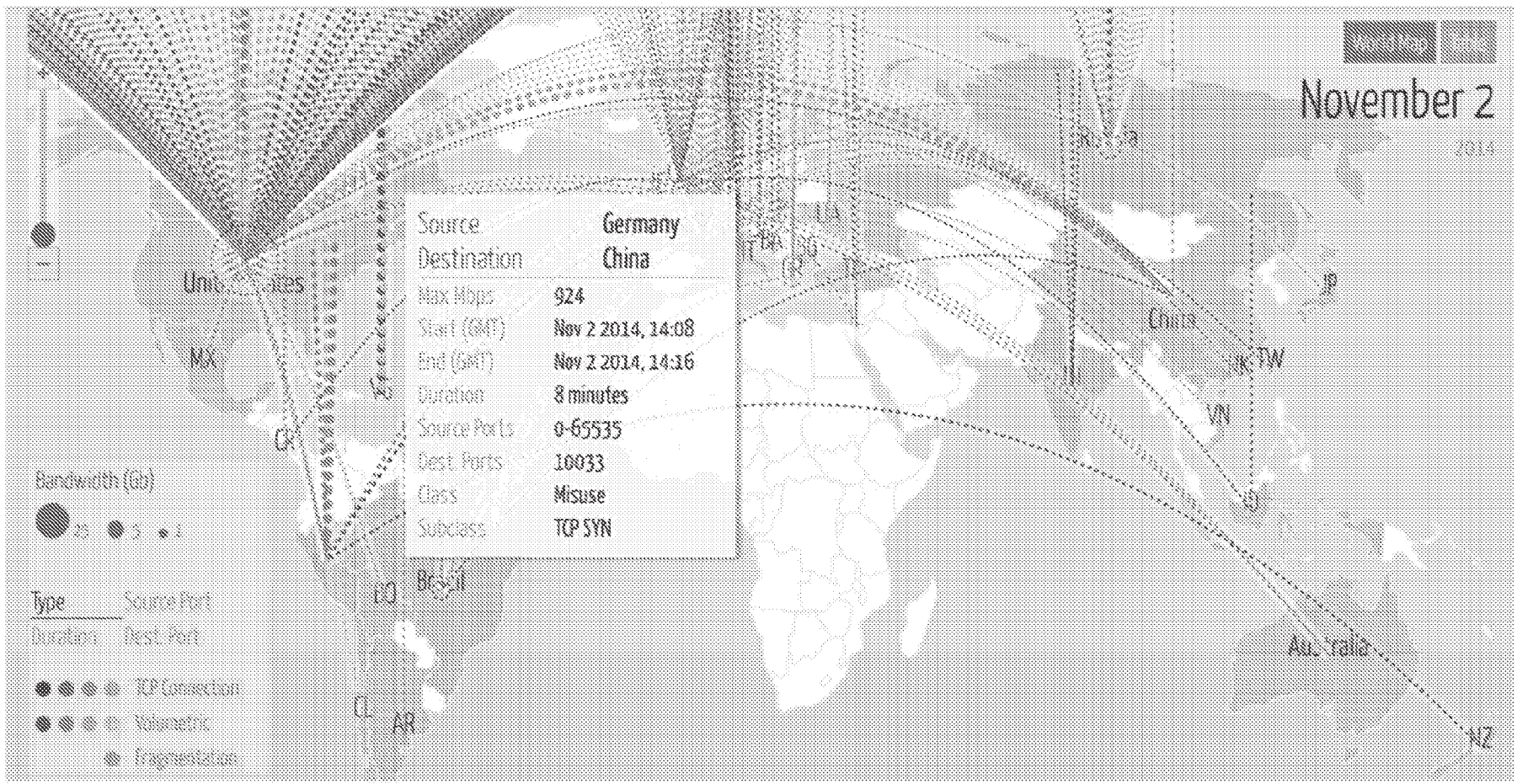

Digital Attack Map
Top daily DDoS attacks worldwide
Map
Gallery
Understanding DDoS
FAQ
About
November 2
2014
Source
Germany
Destination
China
Max Mbps
924
Start (GMT)
Nov 2 2014, 14:08
End (GMT)
Nov 2 2014, 14:16
Duration
8 minutes
Source Ports
0-65535
Dest. Ports
10033
Class
Misuse
Subclass
TCP SYN
Bandwidth (Gb)
Type
Source Port
Duration
Dest. Port
TCP Connection
Volumetric
Fragmentation
MX
CR
CO
CL
AR
JP
TW
VN
NZ

Figure 43

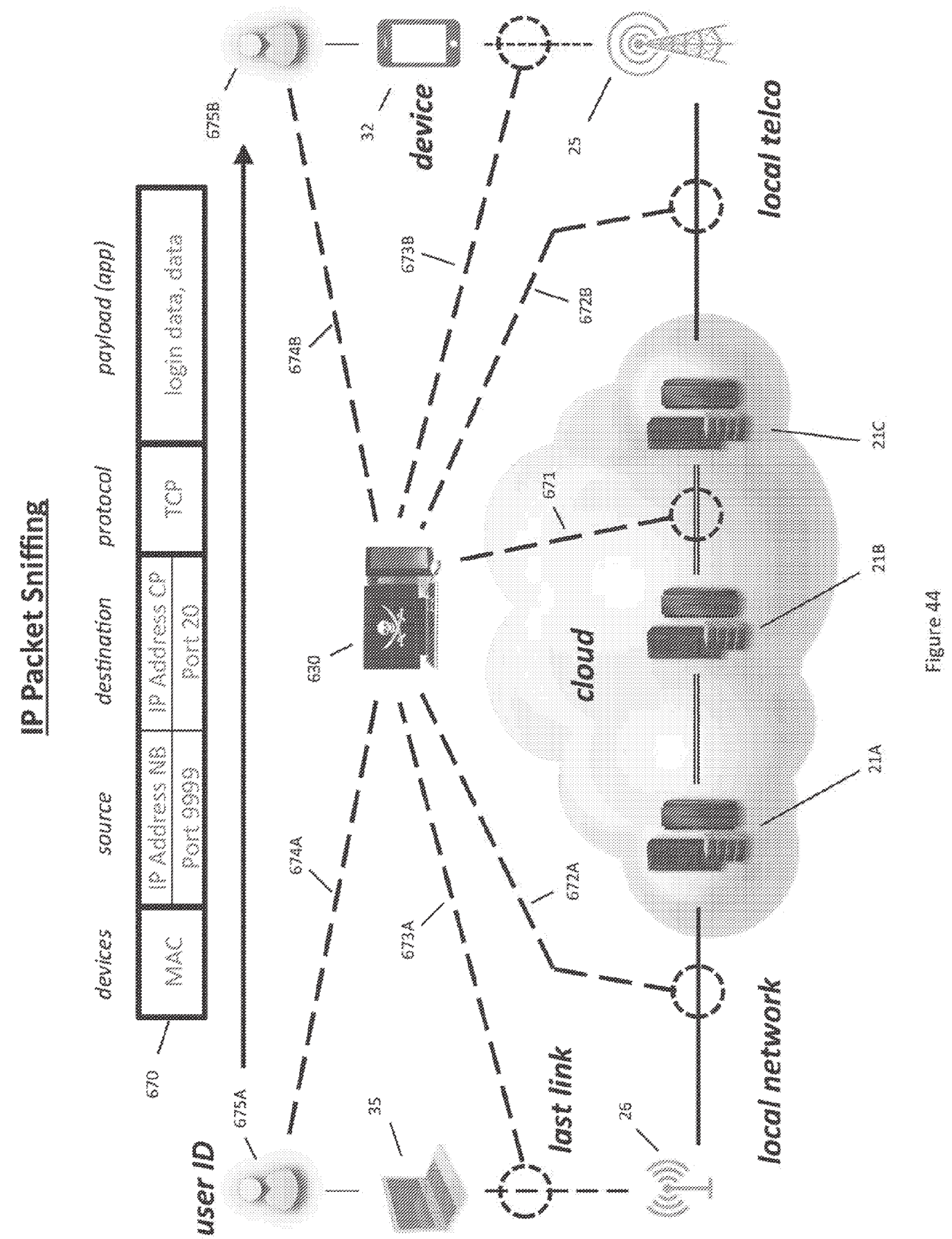
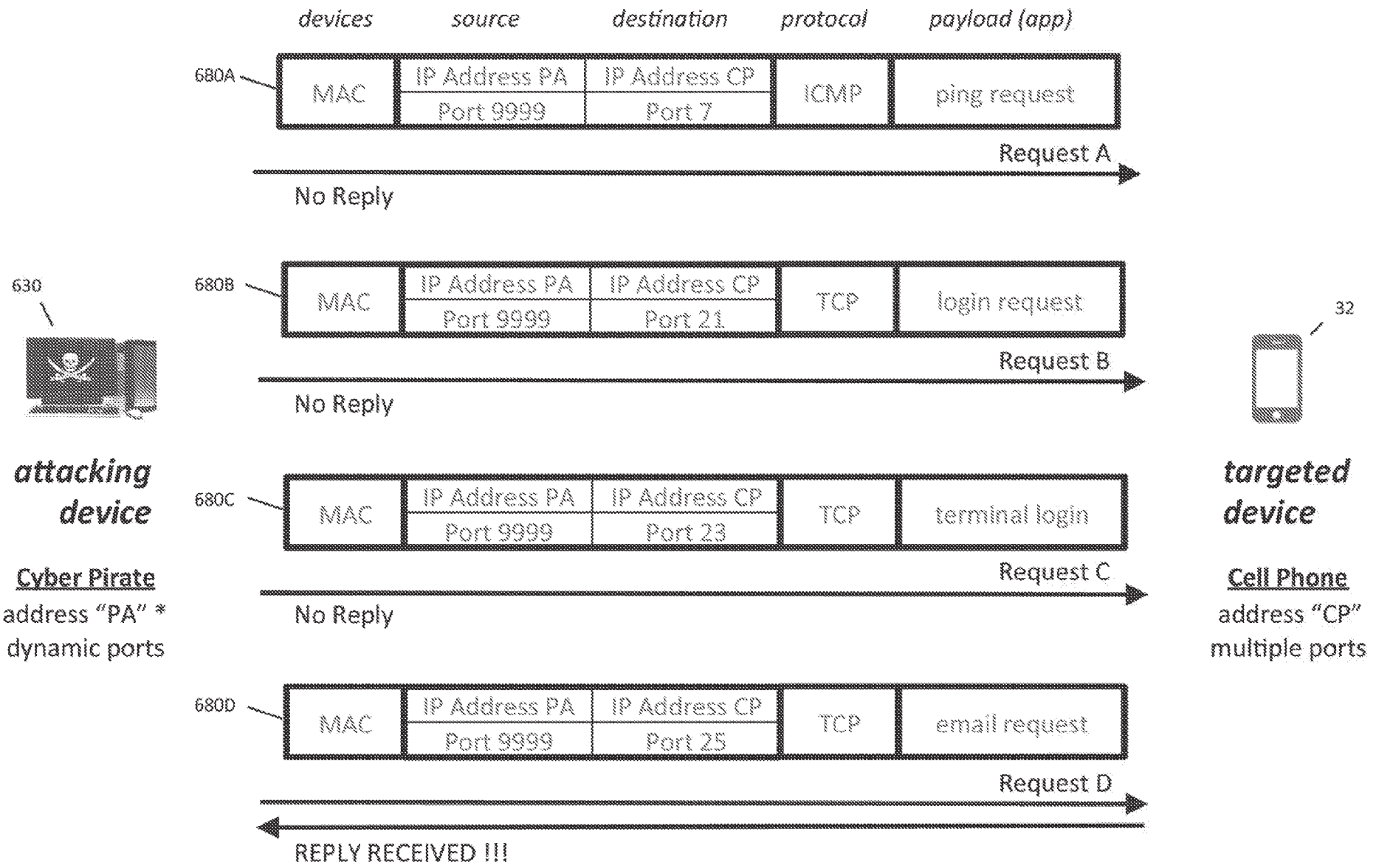

IP Packet Sniffing
devices
source
destination
protocol
payload (app)
MAC
IP Address NB
Port 9999
IP Address CP
Port 20
TCP
login data, data
670
675A
675B
674A
674B
673A
673B
672A
672B
671
630
35
26
32
25
21A
21B
21C
user ID
last link
local network
cloud
device
local telco

Figure 44

Port Interrogation Based Discovery



* pseudo-address PA disguises real device ID

Figure 45

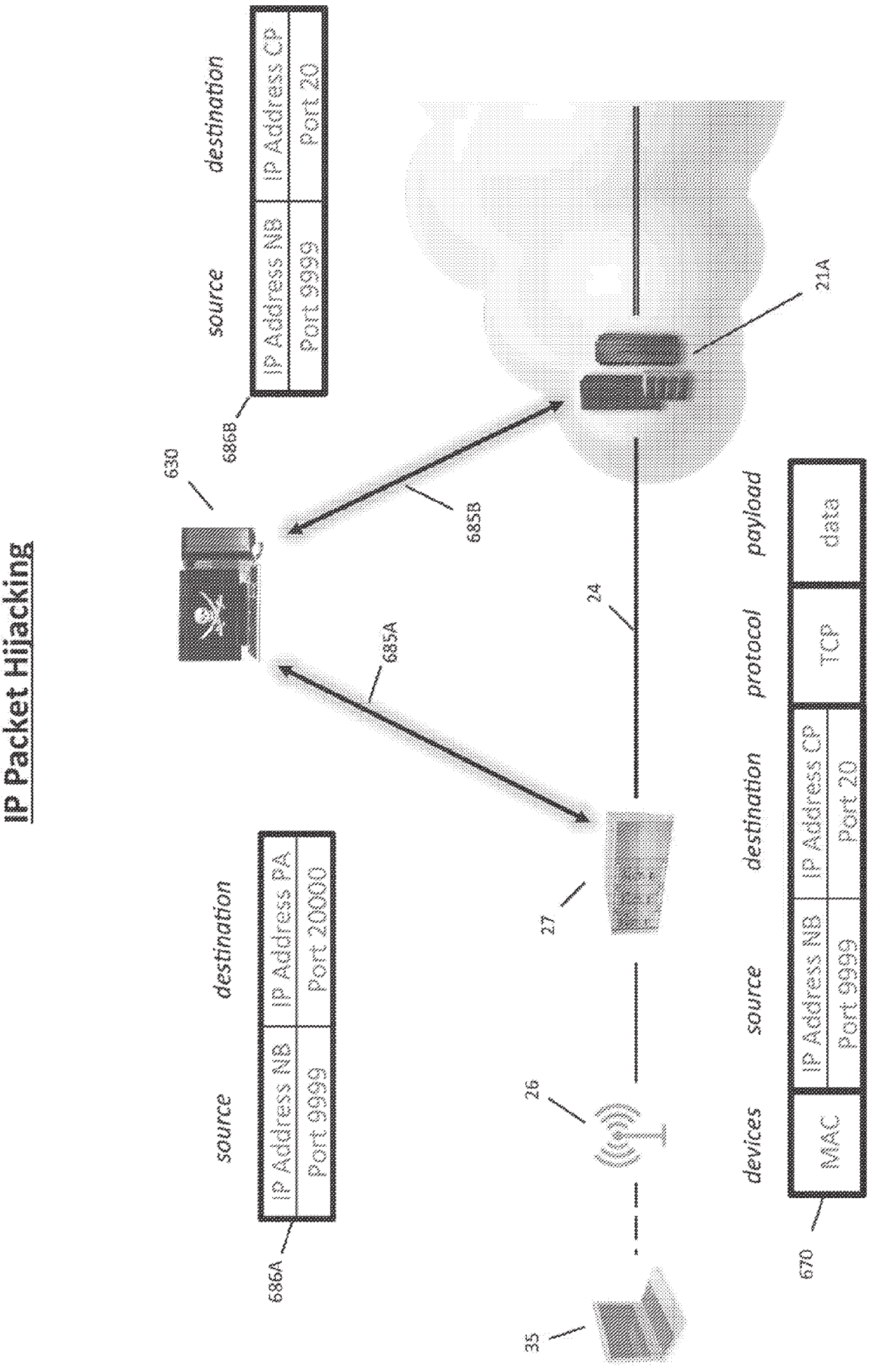

IP Packet Hijacking
source
destination
IP Address NB
IP Address PA
Port 9999
Port 20000
686A
source
destination
IP Address NB
IP Address CP
Port 9999
Port 20
686B
630
685A
685B
24
21A
27
26
35
devices
source
destination
protocol
payload
MAC
IP Address NB
IP Address CP
Port 9999
Port 20
TCP
data
670

Figure 46

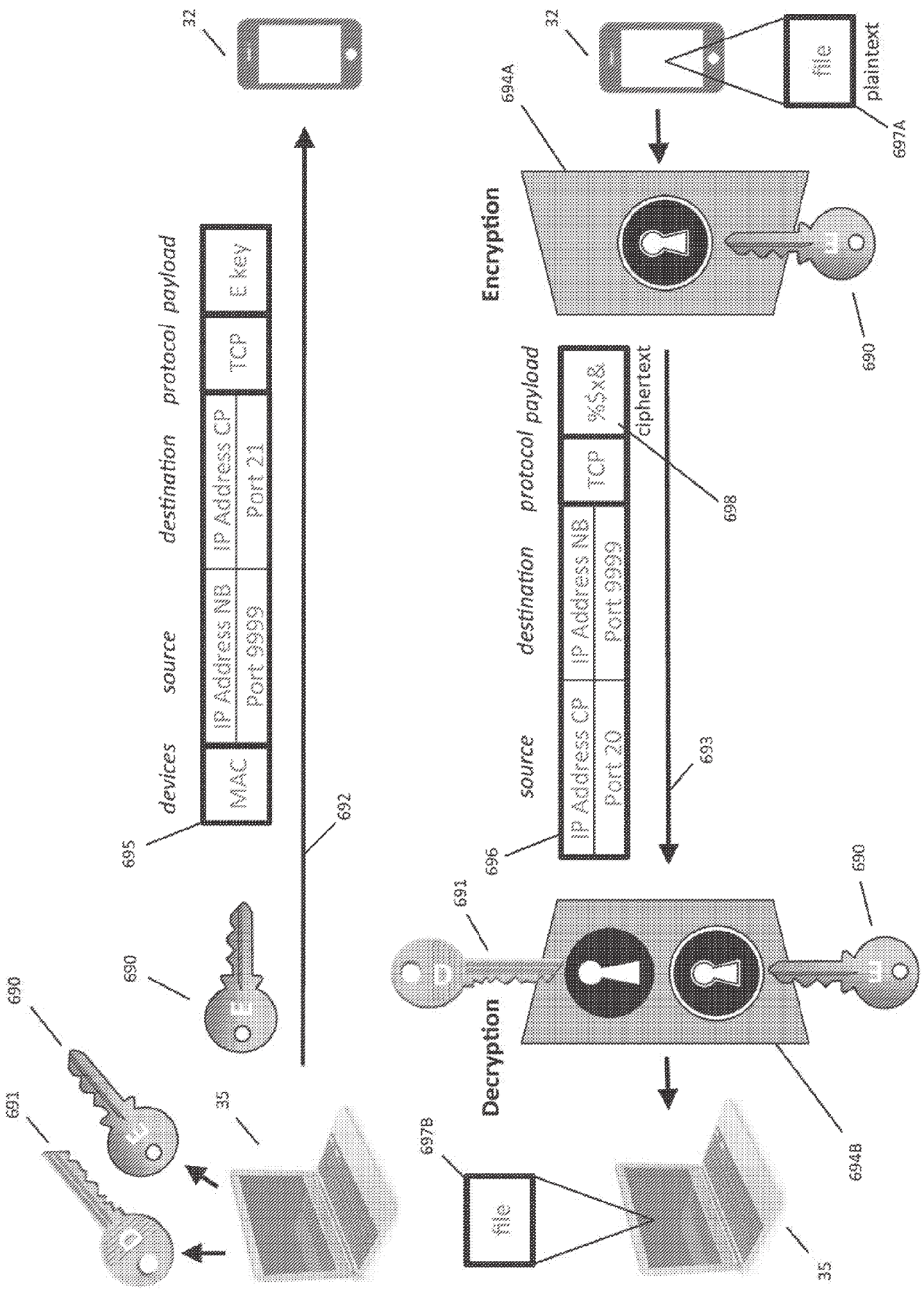

32
devices
source
destination
protocol
payload
MAC
IP Address NB
Port 9999
IP Address CP
Port 21
TCP
E key
695
692
690
691
35
Encryption
694A
file
plaintext
697A
690
ciphertext
698
693
696
IP Address CP
Port 20
IP Address NB
Port 9999
TCP
%$x&
Decryption
691
690
694B
697B
file
35

Figure 47

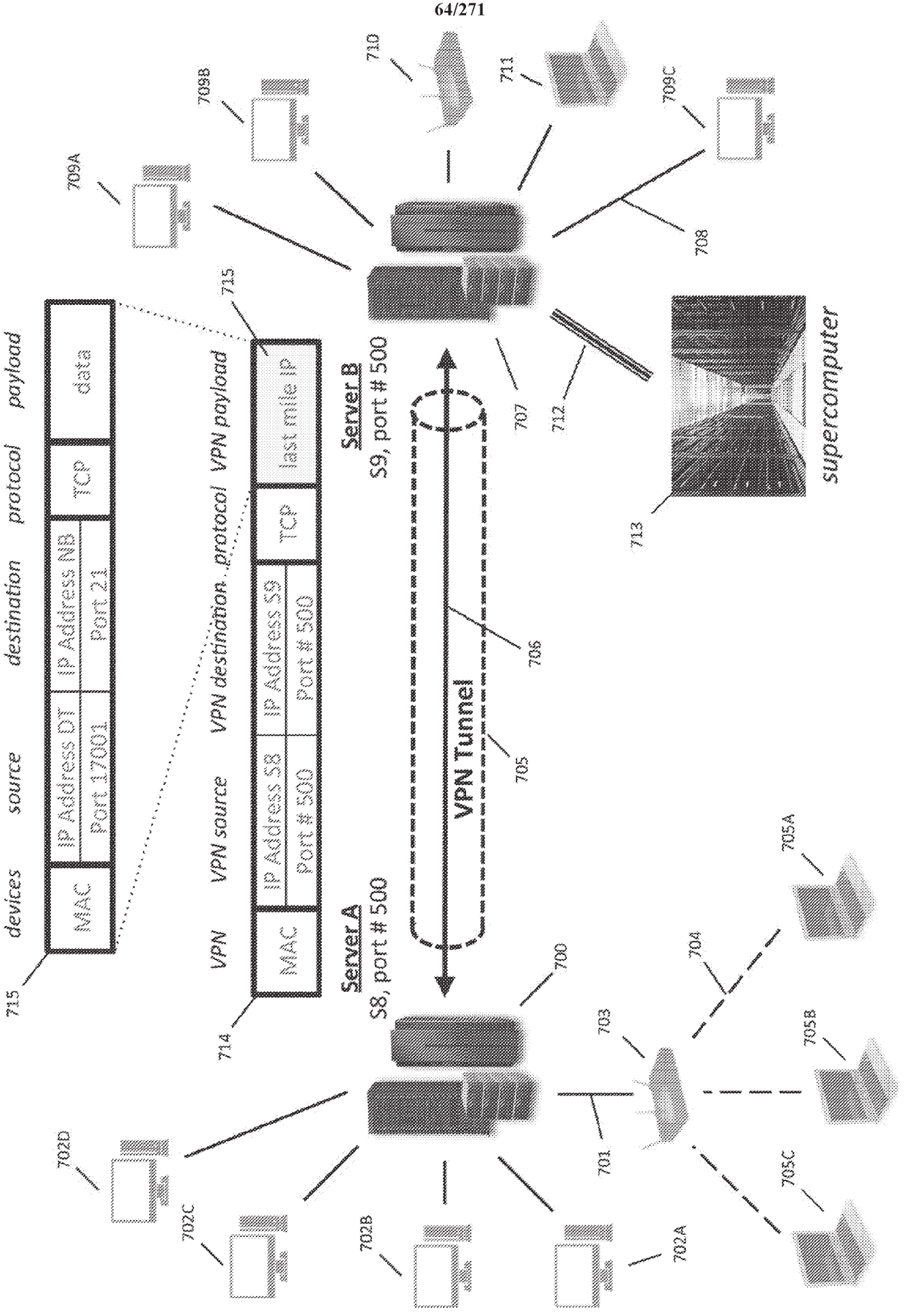

devices
source
destination
protocol
payload
MAC
IP Address DT
Port 17001
IP Address NB
Port 21
TCP
data
715
VPN
VPN source
VPN destination
protocol
VPN payload
MAC
IP Address S8
Port # 500
IP Address S9
Port # 500
TCP
last mile IP
714
715
Server A
S8, port # 500
Server B
S9, port # 500
VPN Tunnel
705
706
700
701
703
704
705A
705B
705C
707
708
709A
709B
709C
710
711
712
713
supercomputer
702A
702B
702C
702D

Figure 48A

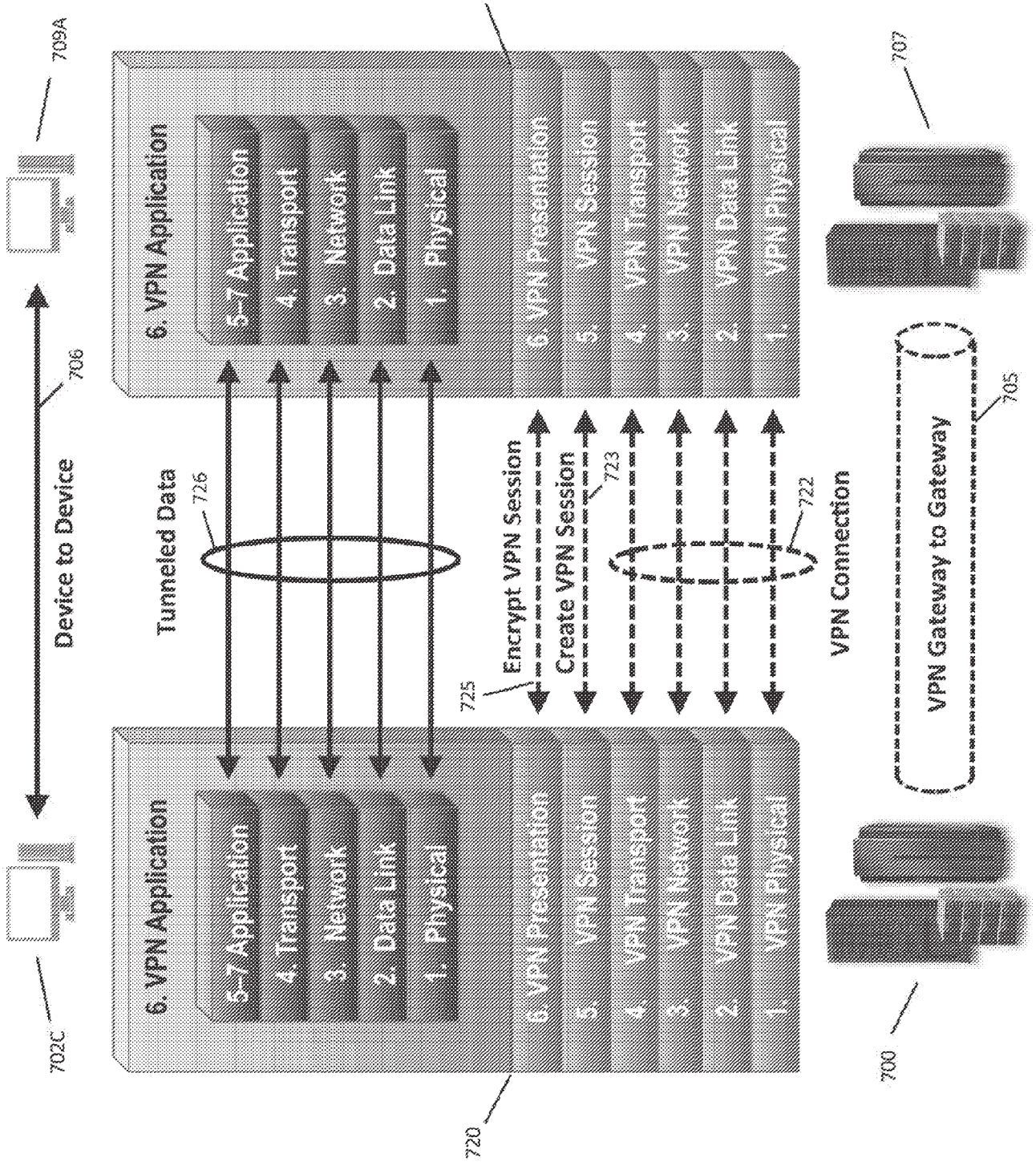

709A
721
707
6. VPN Application
5–7 Application
4. Transport
3. Network
2. Data Link
1. Physical
6 VPN Presentation
5. VPN Session
4. VPN Transport
3. VPN Network
2. VPN Data Link
1. VPN Physical
Device to Device
706
Tunneled Data
726
Encrypt VPN Session
Create VPN Session
723
725
722
VPN Connection
VPN Gateway to Gateway
705
702C
720
700

Figure 48B

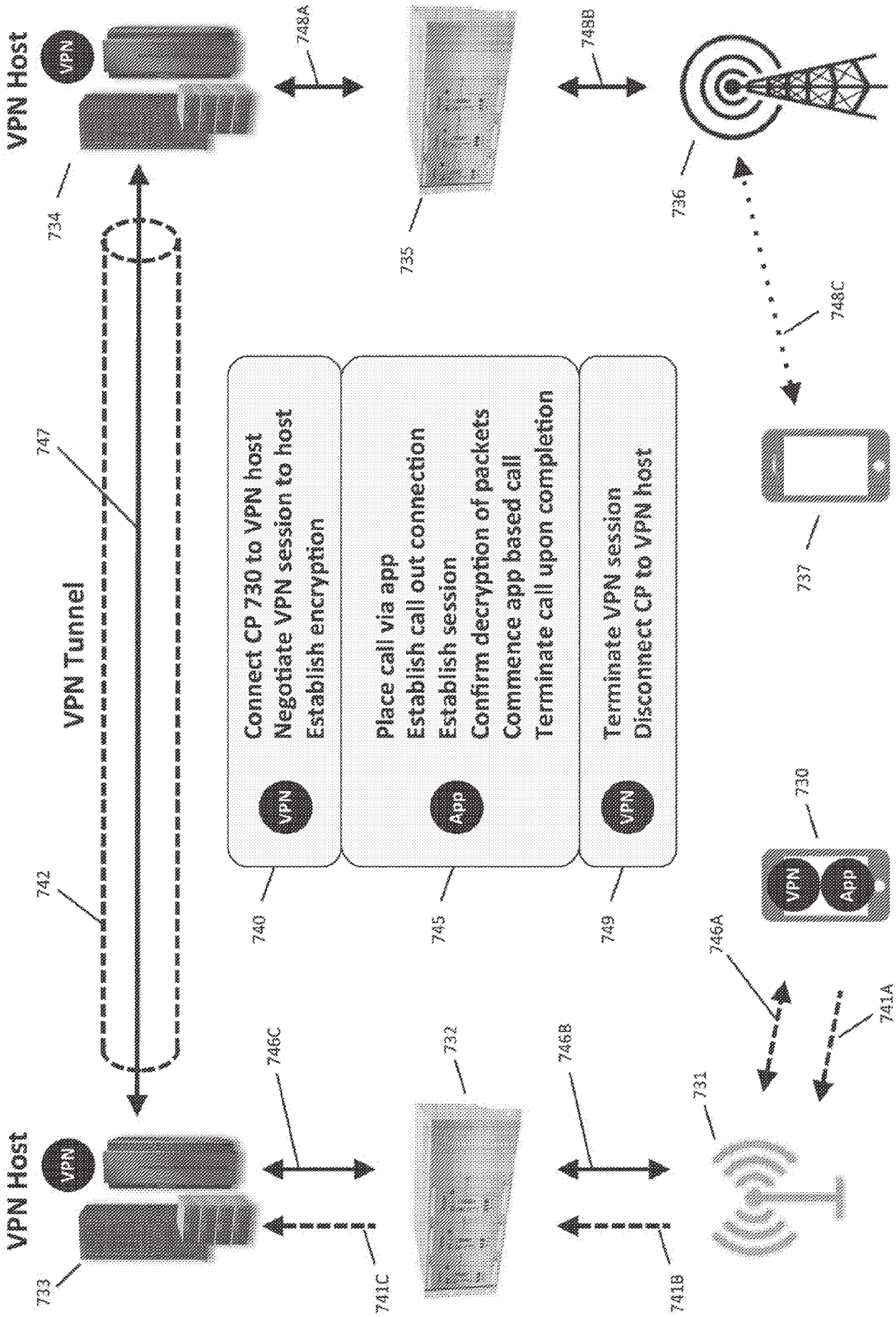

VPN Host
VPN
734
VPN Tunnel
747
742
733
741C
746C
732
746B
741B
731
746A
741A
730
VPN
App
737
748C
736
748B
735
748A
740
Connect CP 730 to VPN host
Negotiate VPN session to host
Establish encryption
VPN
745
Place call via app
Establish call out connection
Establish session
Confirm decryption of packets
Commence app based call
Terminate call upon completion
App
749
Terminate VPN session
Disconnect CP to VPN host
VPN

Figure 48C

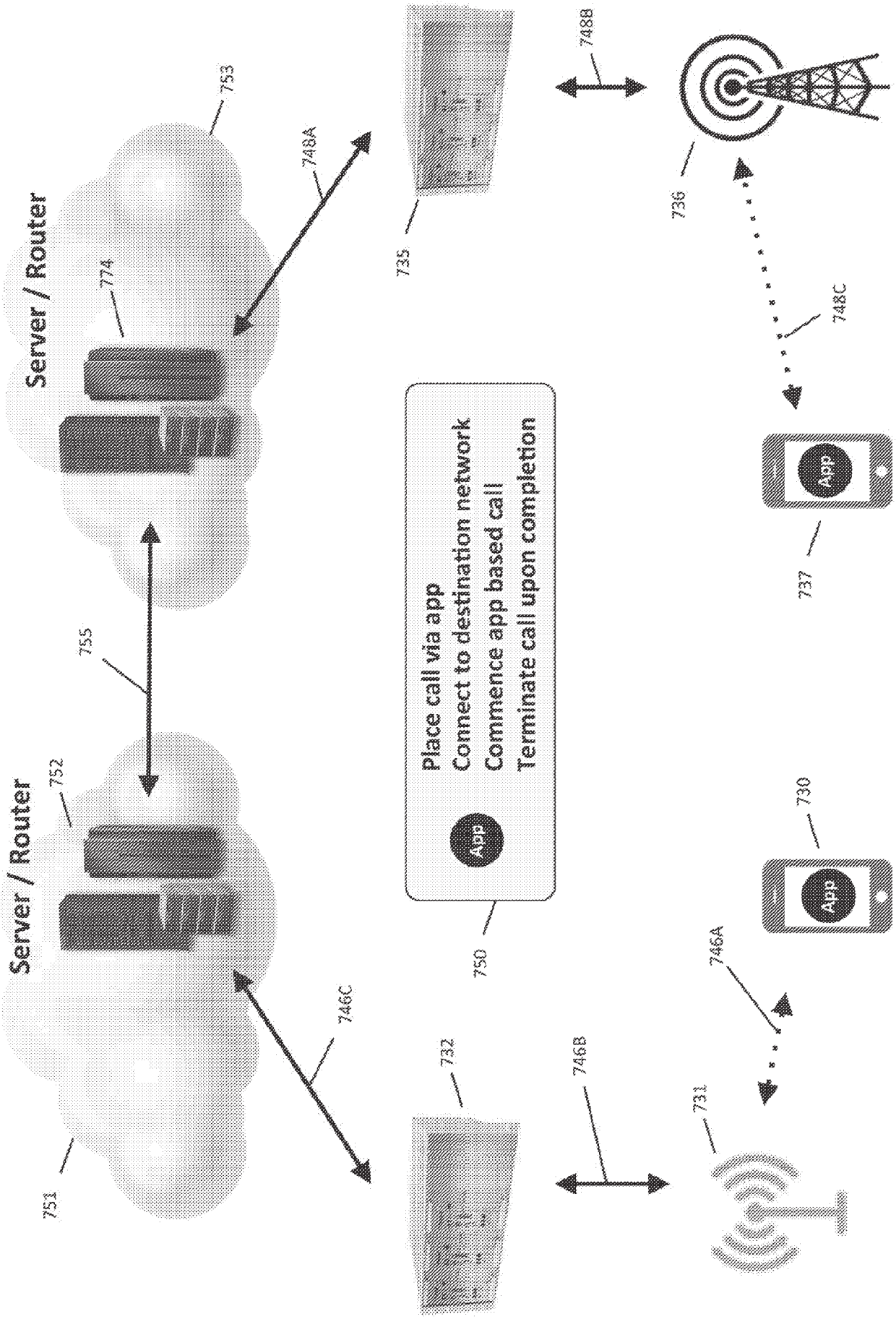

Server / Router
Server / Router
751
752
753
755
774
746C
748A
735
748B
736
748C
737
730
746A
746B
731
732
750
Place call via app
Connect to destination network
Commence app based call
Terminate call upon completion
App
App
App

Figure 49A

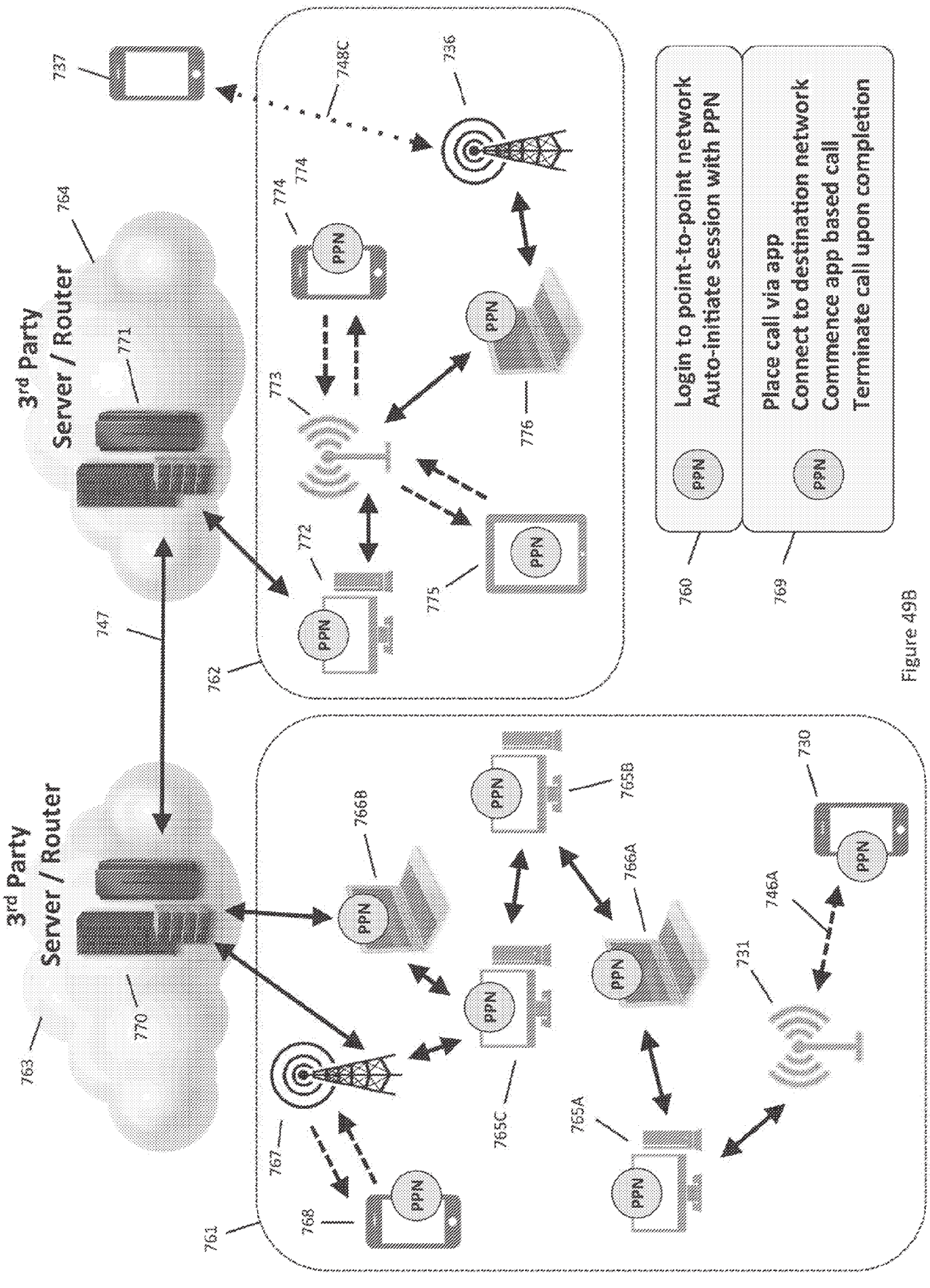

3rd Party Server / Router
763
770
764
771
747
737
748C
736
774
774
773
772
775
776
762
761
767
768
765C
765B
766B
766A
765A
730
731
746A
PPN
Login to point-to-point network
Auto-initiate session with PPN
760
Place call via app
Connect to destination network
Commence app based call
Terminate call upon completion
769

Figure 49B

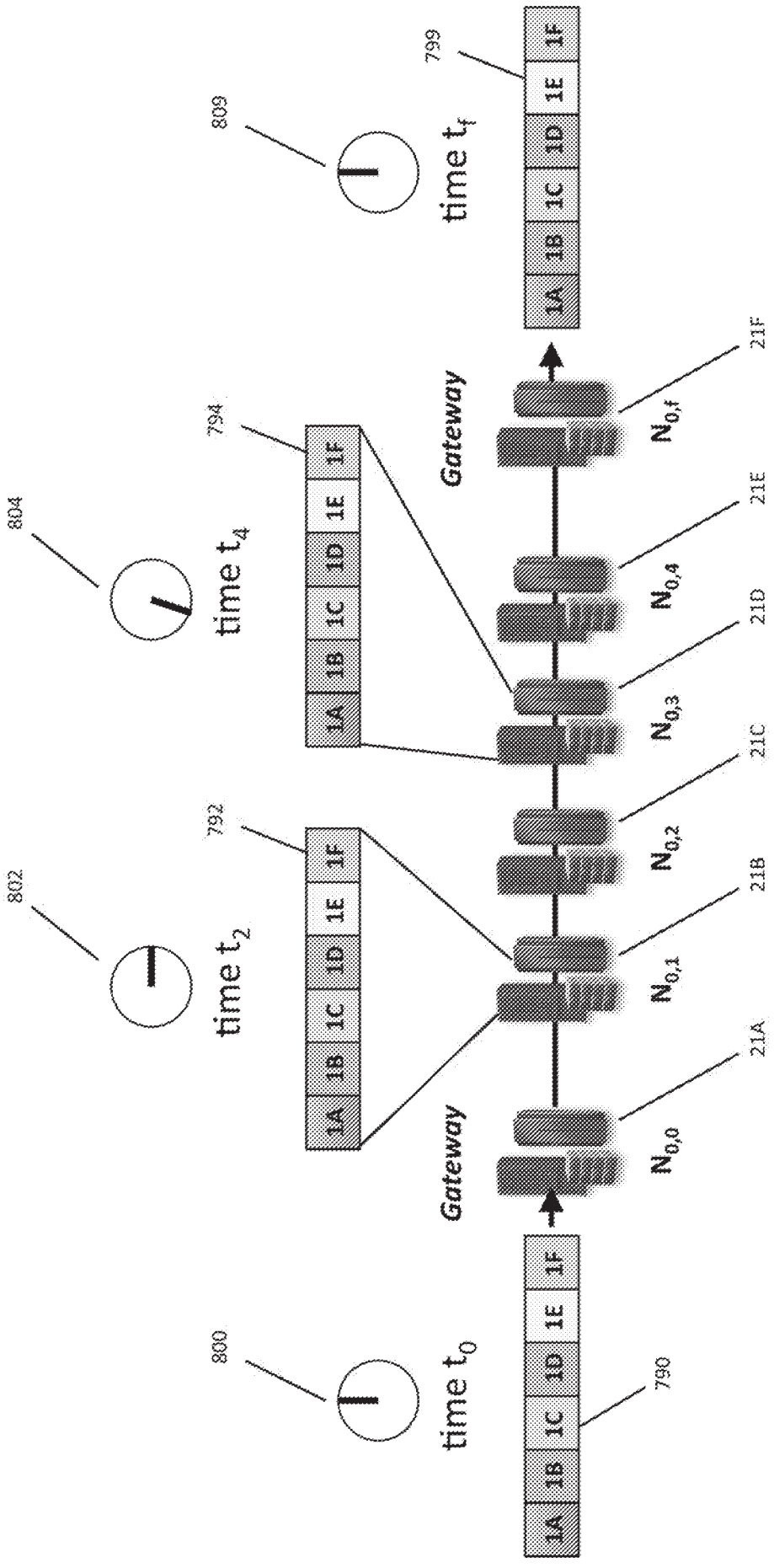

800
time t_0
790
1A 1B 1C 1D 1E 1F
Gateway
$N_{0,0}$
21A
802
time t_2
792
1A 1B 1C 1D 1E 1F
$N_{0,1}$
21B
804
time t_4
794
1A 1B 1C 1D 1E 1F
$N_{0,2}$
21C
809
time t_f
799
1A 1B 1C 1D 1E 1F
$N_{0,3}$
21D
$N_{0,4}$
21E
$N_{0,f}$
21F

Figure 50

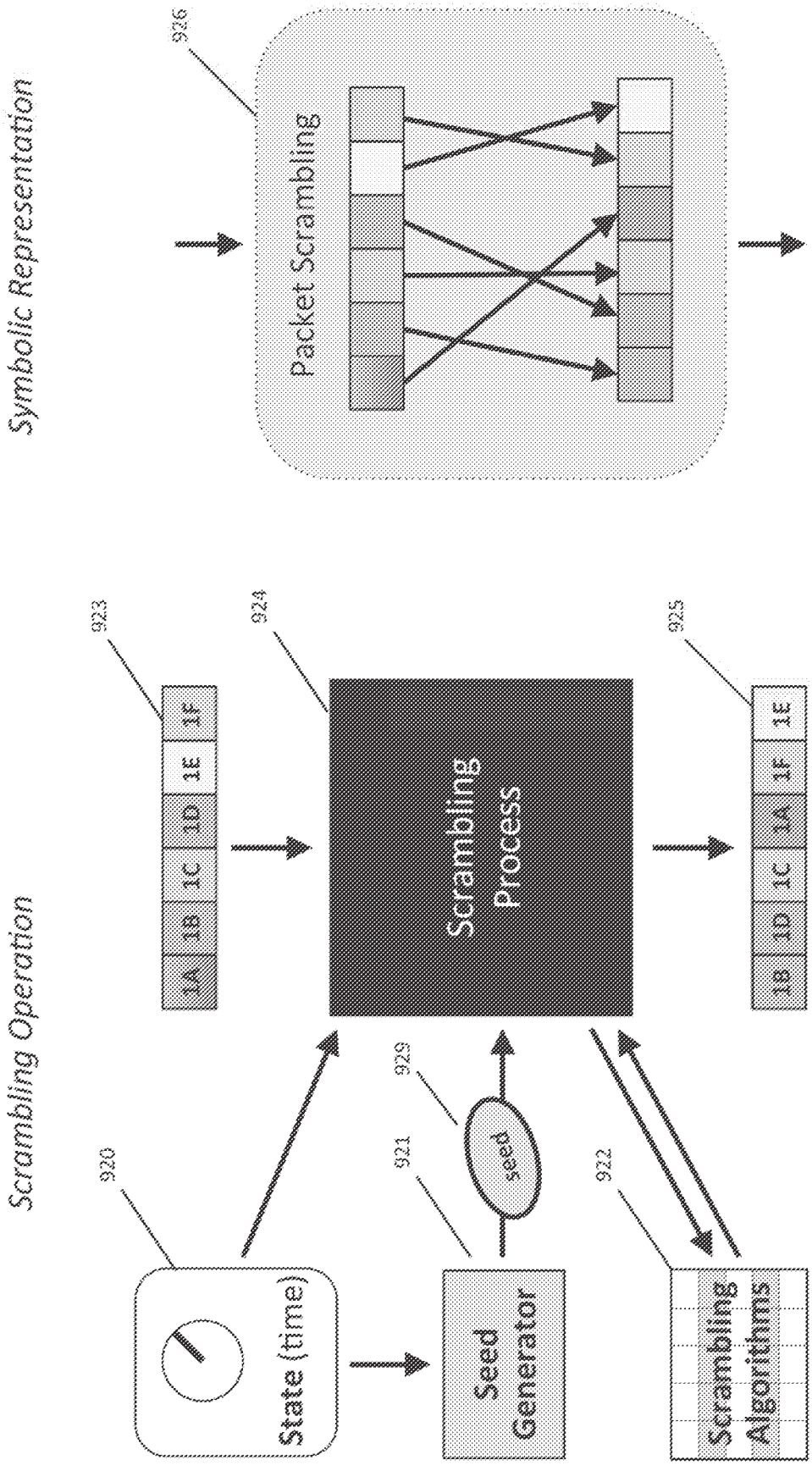

Symbolic Representation
926
Packet Scrambling
Scrambling Operation
923
924
925
1A 1B 1C 1D 1E 1F
Scrambling Process
1B 1D 1C 1A 1F 1E
920
921
929
922
State (time)
Seed Generator
seed
Scrambling Algorithms

Figure 51A

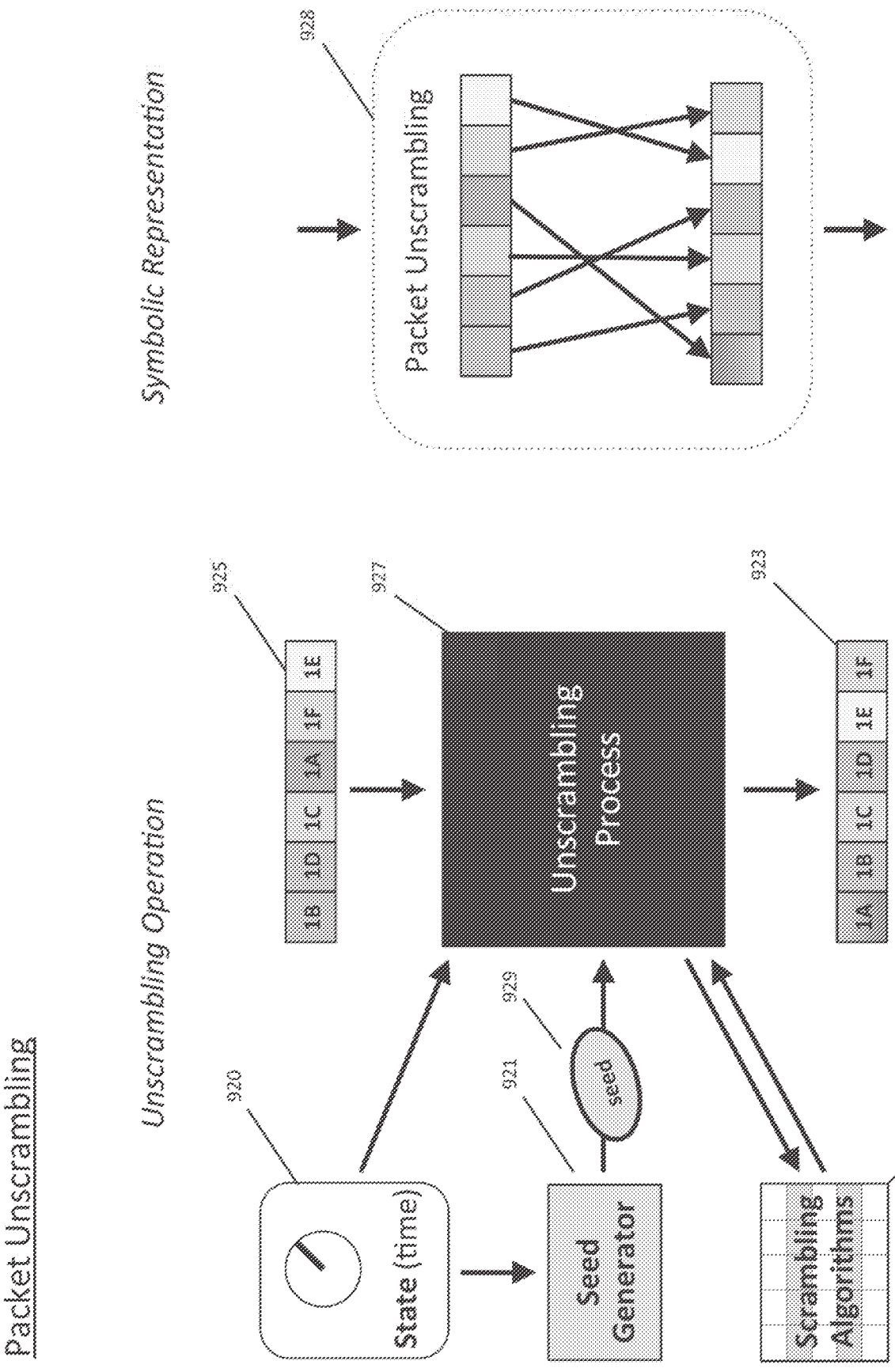

Packet Unscrambling
Unscrambling Operation
Symbolic Representation
928
Packet Unscrambling
925
1B
1D
1C
1A
1F
1E
927
Unscrambling Process
923
1A
1B
1C
1D
1E
1F
920
State (time)
921
Seed Generator
929
seed
922
Scrambling Algorithms

Figure 51B

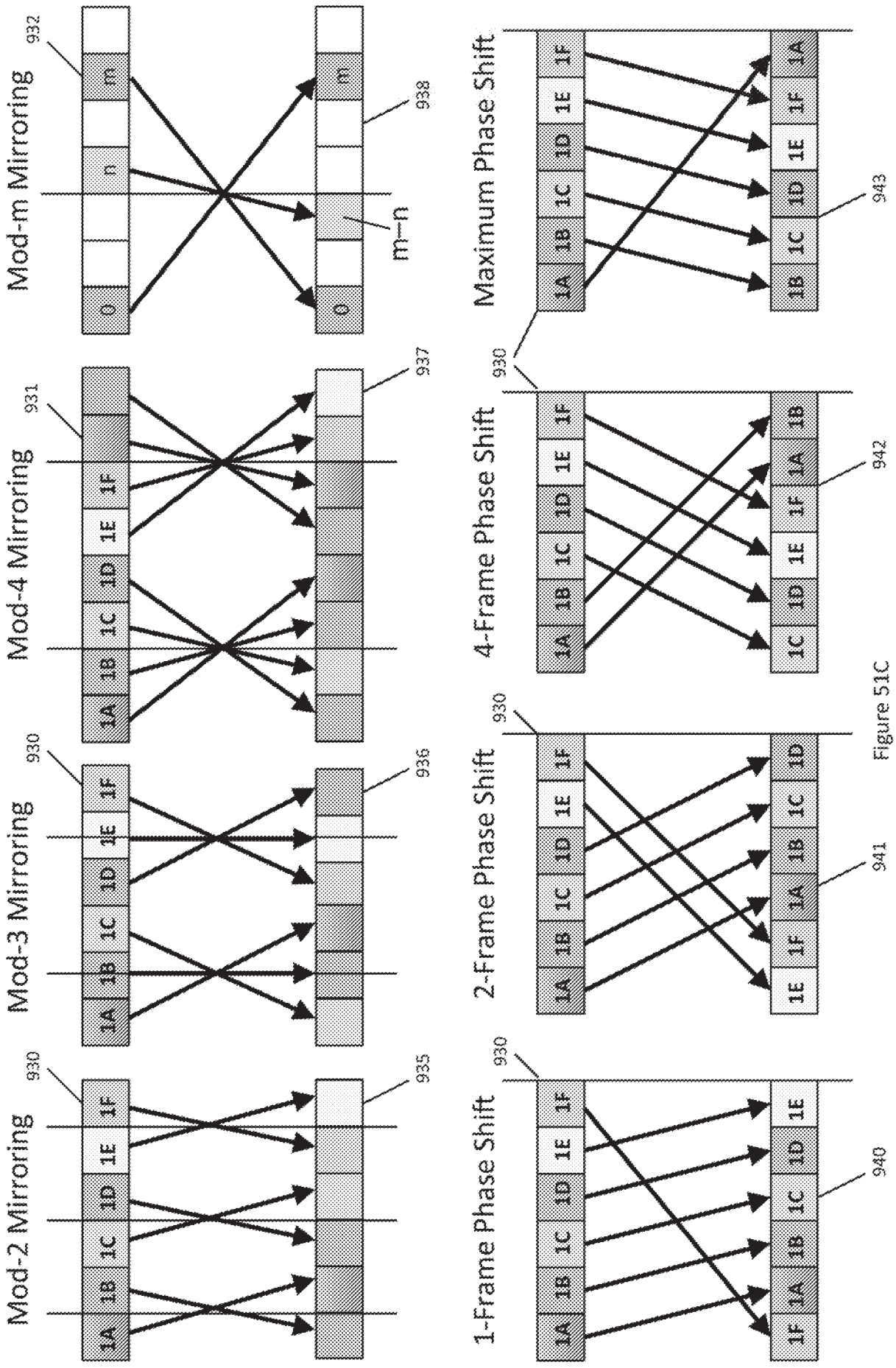

Mod-2 Mirroring
930
1A
1B
1C
1D
1E
1F
935
Mod-3 Mirroring
930
936
Mod-4 Mirroring
931
937
Mod-m Mirroring
932
0
n
m
m−n
938
1-Frame Phase Shift
940
2-Frame Phase Shift
941
4-Frame Phase Shift
942
Maximum Phase Shift
943

Figure 51C

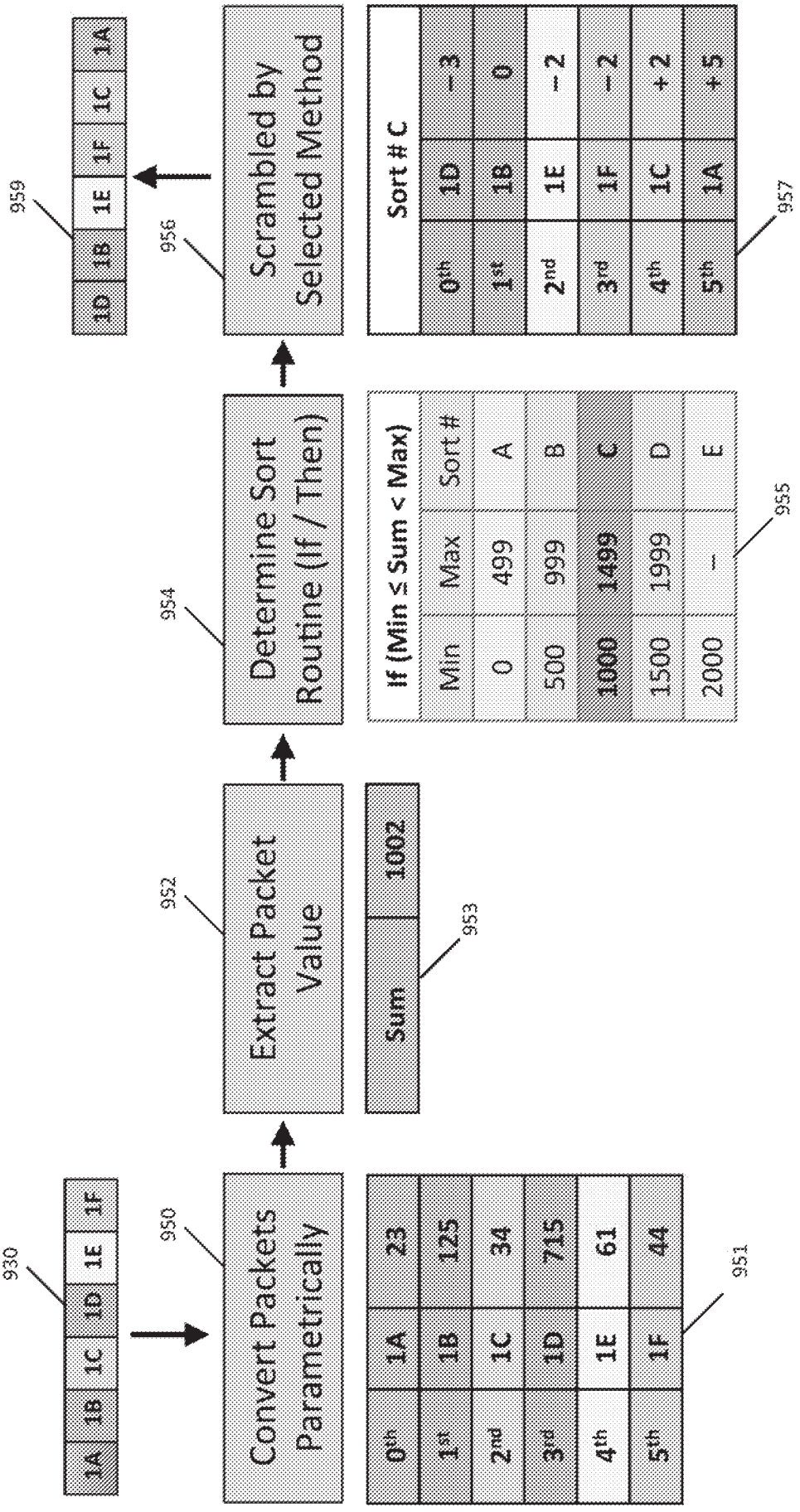

930
1A
1B
1C
1D
1E
1F
950
Convert Packets Parametrically
951
0th 1A 23
1st 1B 125
2nd 1C 34
3rd 1D 715
4th 1E 61
5th 1F 44
952
Extract Packet Value
953
Sum 1002
954
Determine Sort Routine (If / Then)
955
If (Min ≤ Sum < Max)
Min Max Sort #
0 499 A
500 999 B
1000 1499 C
1500 1999 D
2000 – E
956
Scrambled by Selected Method
957
Sort # C
0th 1D – 3
1st 1B 0
2nd 1E – 2
3rd 1F – 2
4th 1C + 2
5th 1A + 5
959
1D 1B 1E 1F 1C 1A

Figure 51D

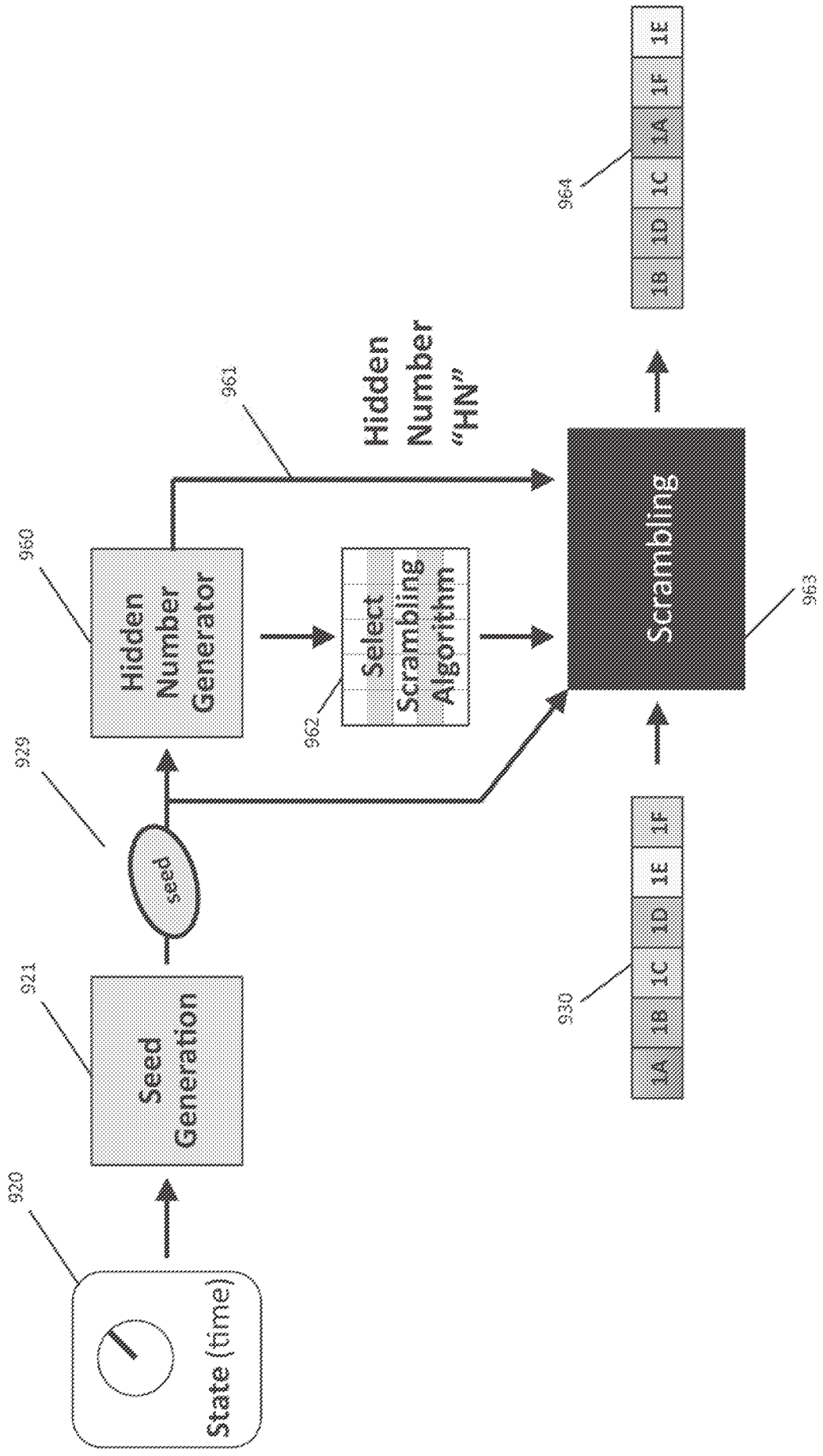

920
State (time)
921
Seed Generation
929
seed
930
1A 1B 1C 1D 1E 1F
960
Hidden Number Generator
961
Hidden Number "HN"
962
Select Scrambling Algorithm
963
Scrambling
964
1B 1D 1C 1A 1F 1E

Figure 51E

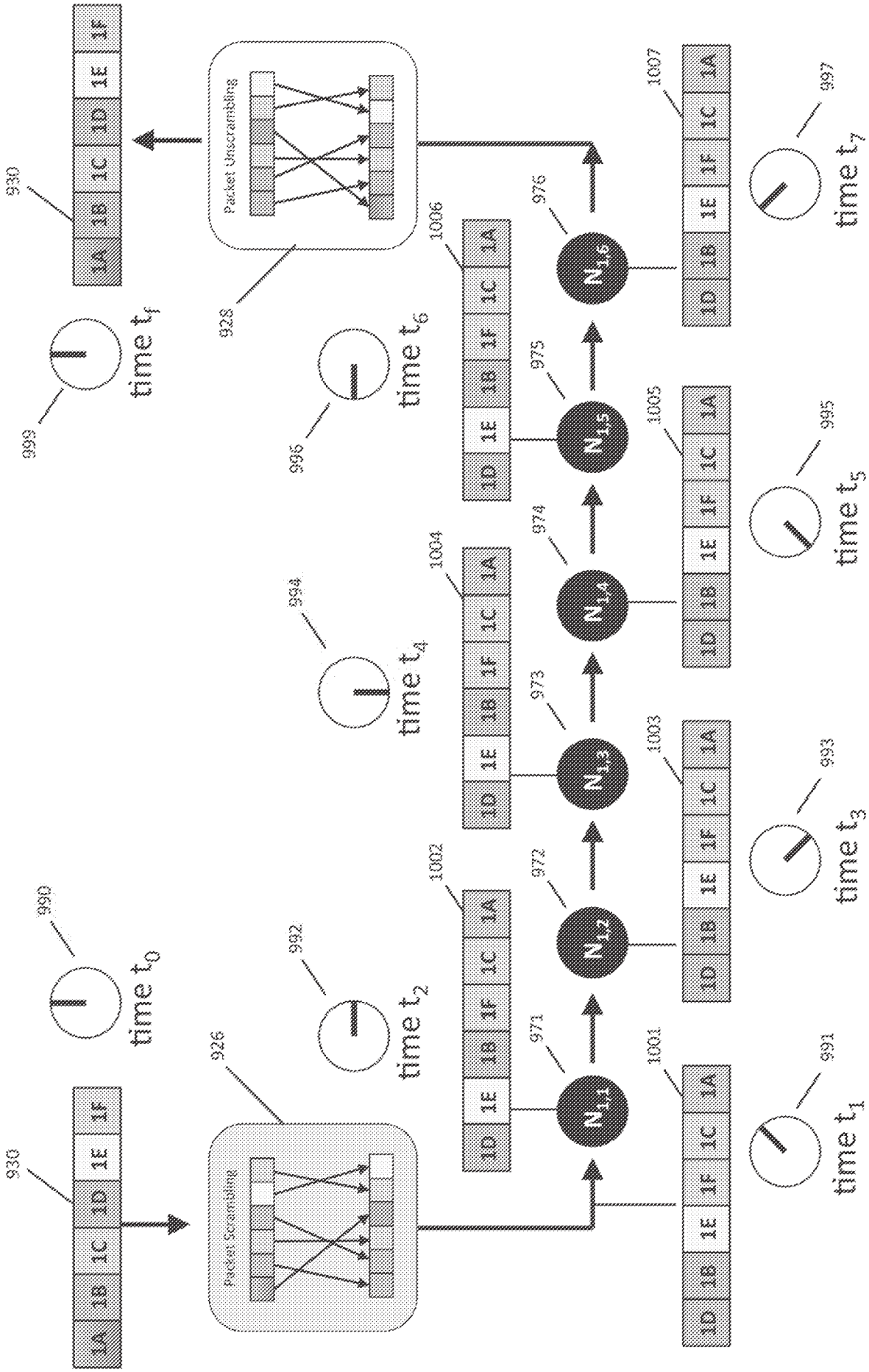

930
1A
1B
1C
1D
1E
1F
926
Packet Scrambling
928
Packet Unscrambling
990
time t_0
991
time t_1
992
time t_2
993
time t_3
994
time t_4
995
time t_5
996
time t_6
997
time t_7
971
972
973
974
975
976
$N_{1,1}$
$N_{1,2}$
$N_{1,3}$
$N_{1,4}$
$N_{1,5}$
$N_{1,6}$
1001
1002
1003
1004
1005
1006
1007

Figure 51F

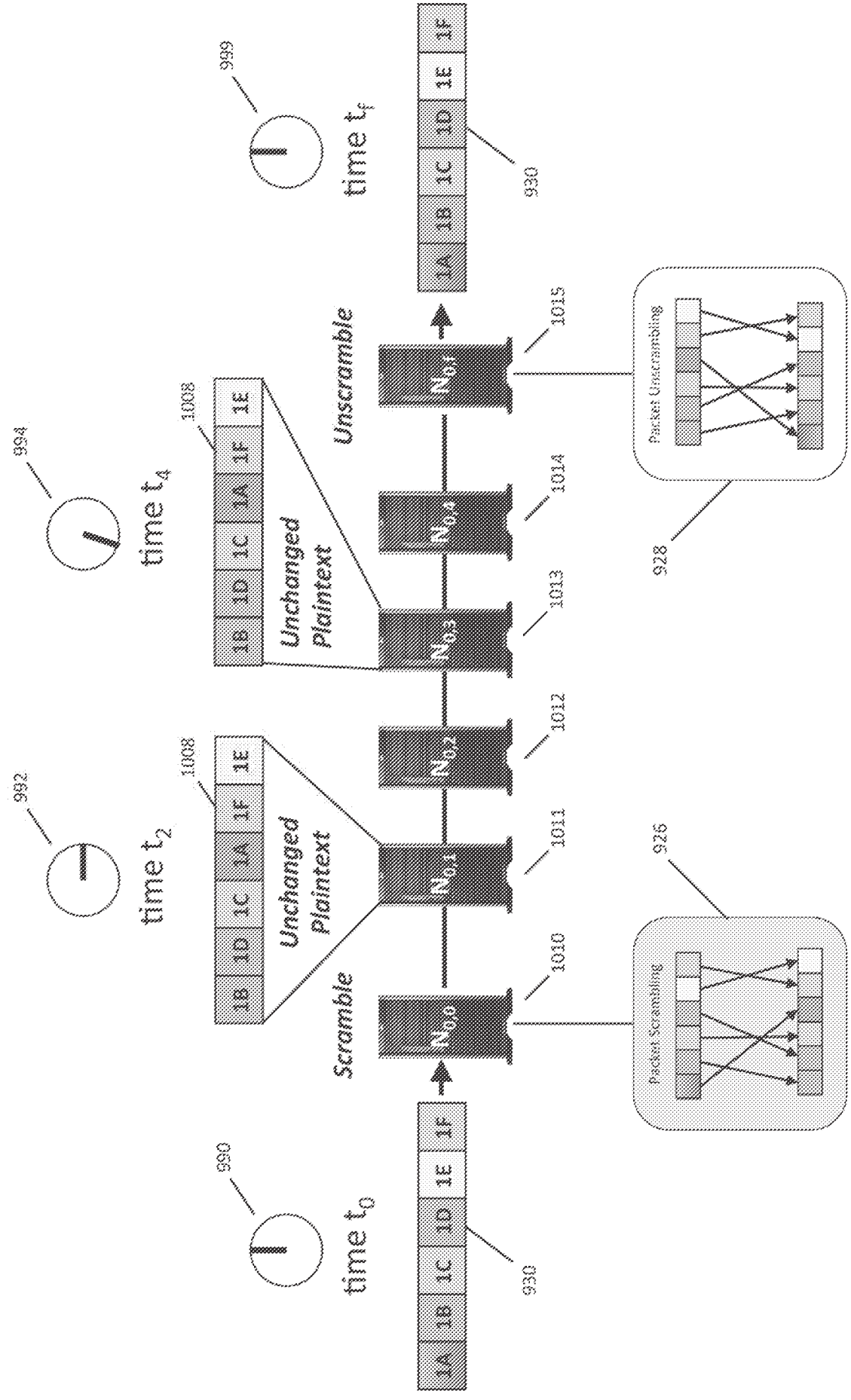

990
time t_0
930
1A 1B 1C 1D 1E 1F
Scramble
1008
1B 1D 1C 1A 1F 1E
Unchanged Plaintext
992
time t_2
994
time t_4
Unscramble
1008
1B 1D 1C 1A 1F 1E
Unchanged Plaintext
999
time t_f
930
1A 1B 1C 1D 1E 1F
1010
1011
1012
1013
1014
1015
926
Packet Scrambling
928
Packet Unscrambling

Figure 52

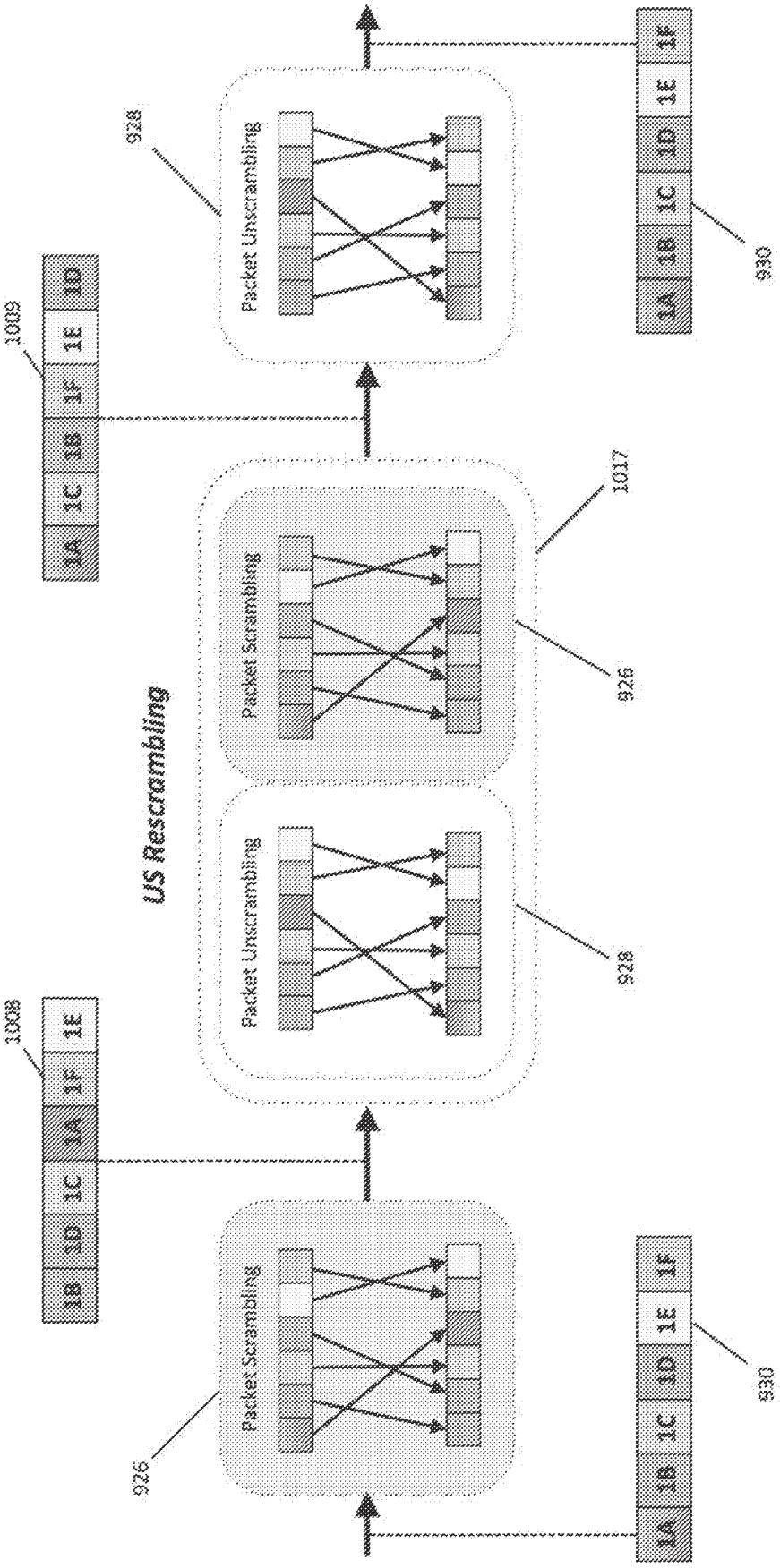

US Rescrambling
Packet Scrambling
Packet Unscrambling
926
928
930
1008
1009
1017
1A 1B 1C 1D 1E 1F

Figure 53

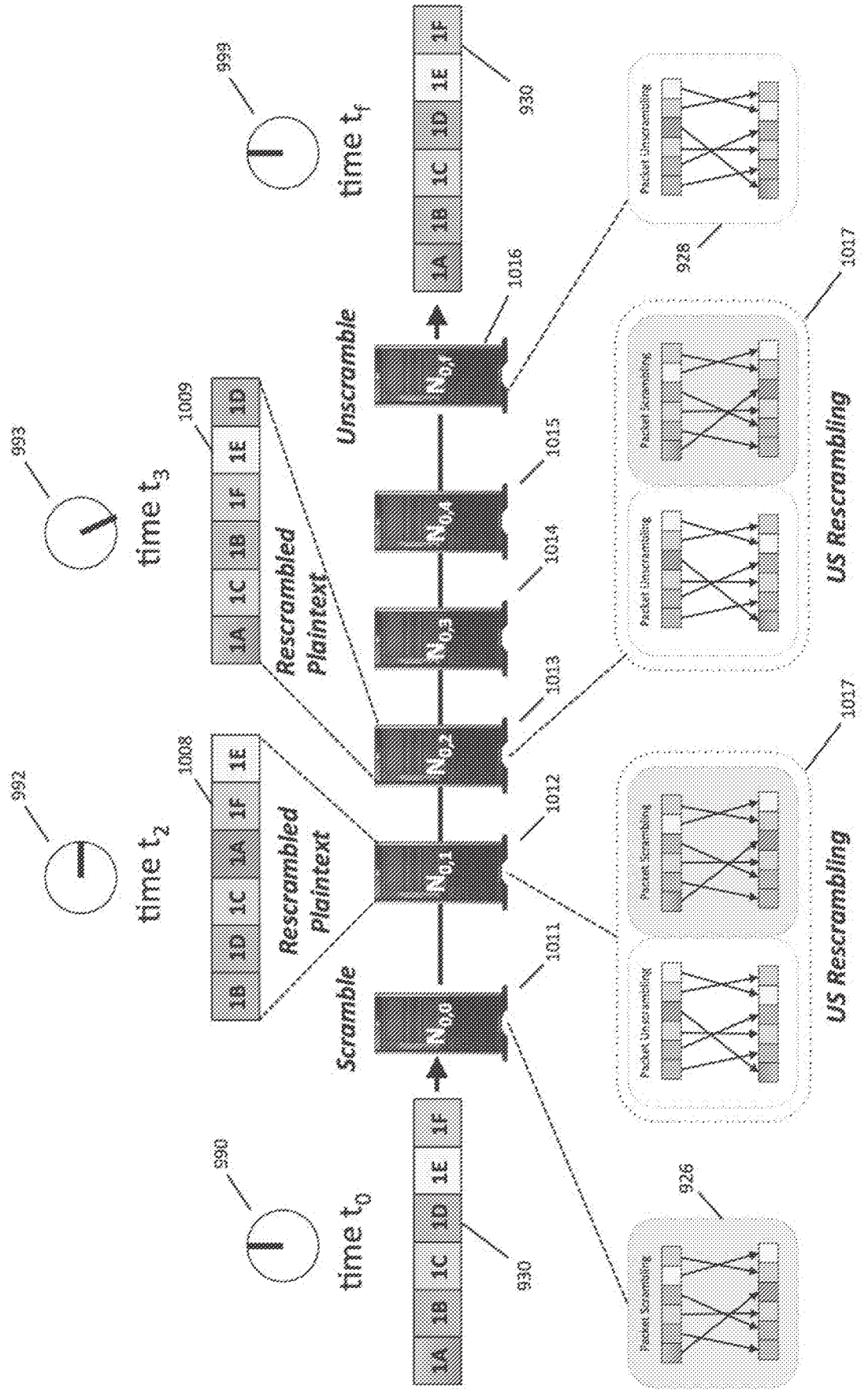

time t_0
time t_2
time t_3
time t_f
990
992
993
999
930
1008
1009
Rescrambled Plaintext
Scramble
Unscramble
1011
1012
1013
1014
1015
1016
1017
US Rescrambling
926
928
Packet Descrambling
Packet Unscrambling

Figure 54

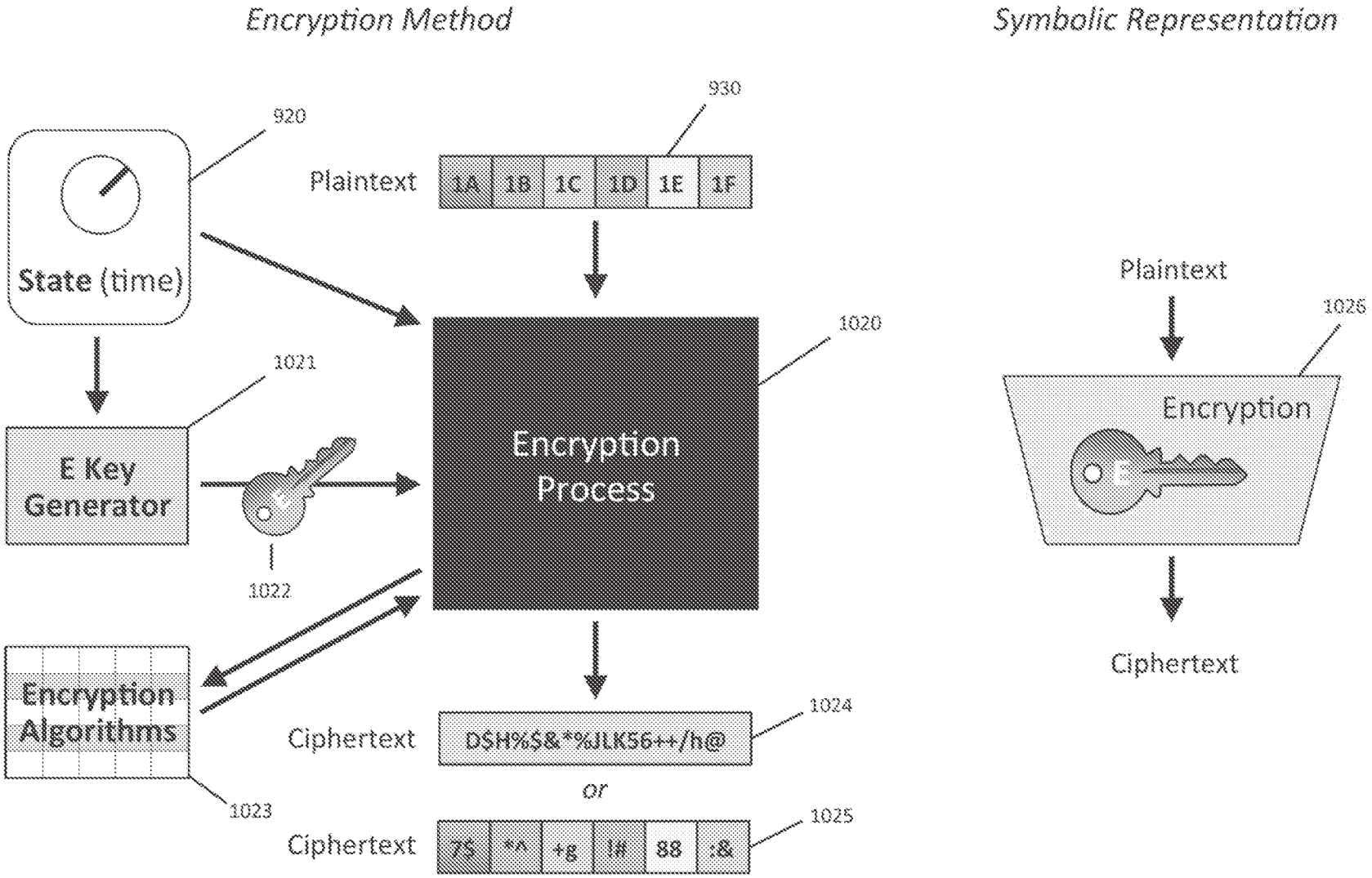

Encryption Method
Symbolic Representation
930
920
Plaintext
1A
1B
1C
1D
1E
1F
State (time)
1020
1021
E Key Generator
Encryption Process
1022
Encryption Algorithms
1023
Ciphertext
D$H%$&*%JLK56++/h@
1024
or
Ciphertext
7$
*^
+g
!#
88
:&
1025
Plaintext
1026
Encryption
Ciphertext

Figure 55A

Packet Decryption

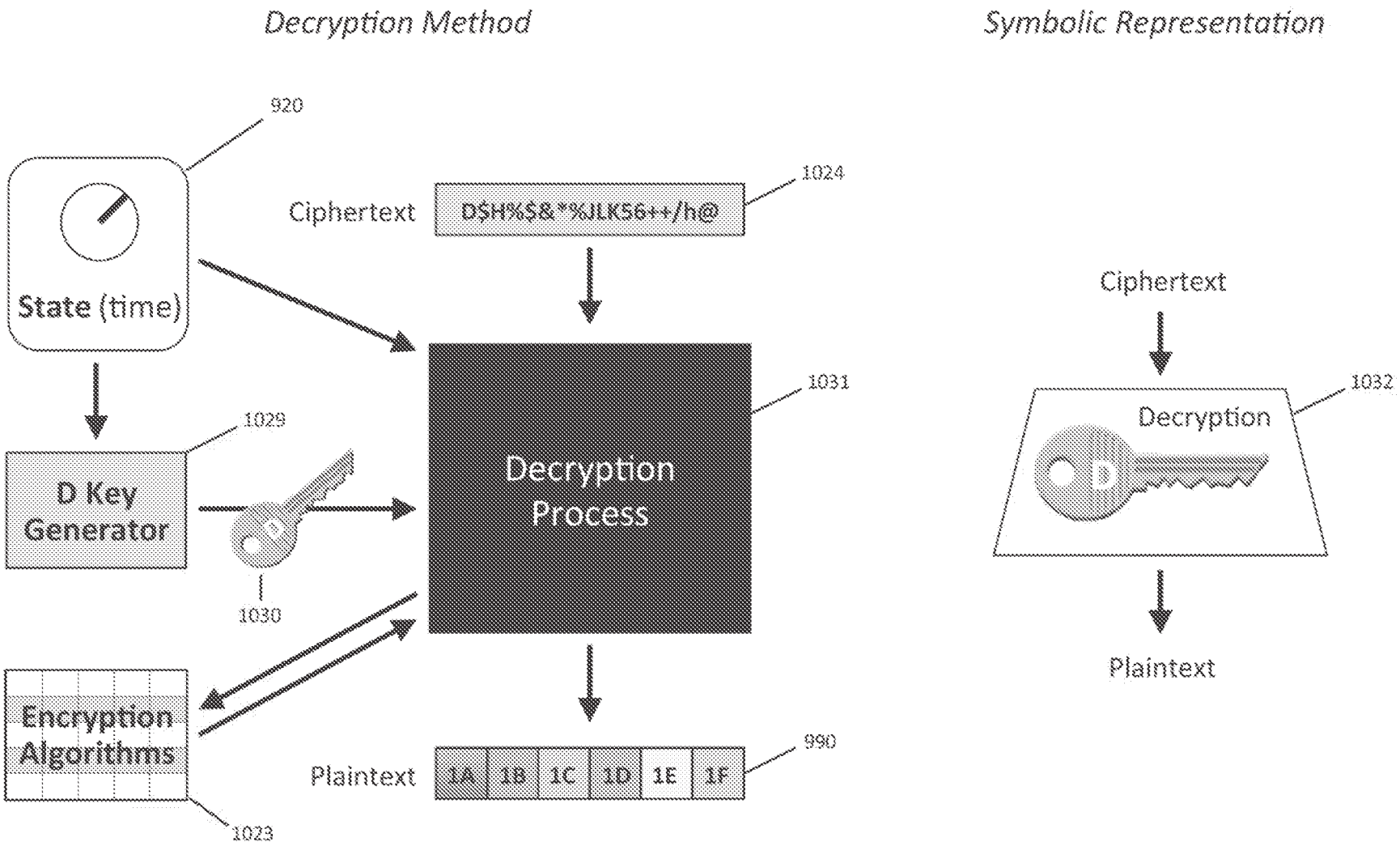


Figure 55B

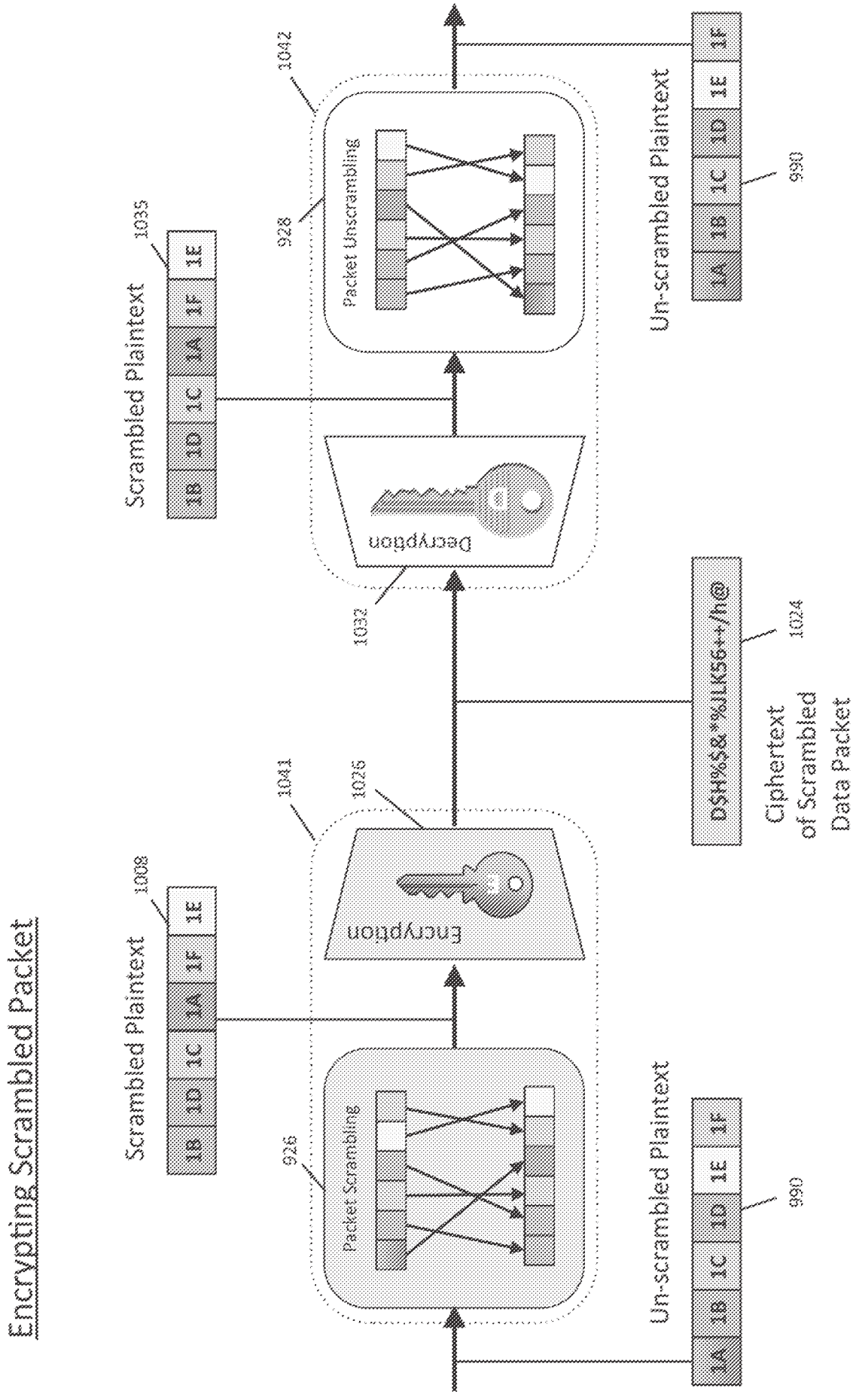

Encrypting Scrambled Packet
Scrambled Plaintext
1008
1B 1D 1C 1A 1F 1E
926
Packet Scrambling
1041
1026
Encryption
Un-scrambled Plaintext
1A 1B 1C 1D 1E 1F
990
DSH%$&*%JLK56++/h@
1024
Ciphertext of Scrambled Data Packet
1032
Decryption
928
Packet Unscrambling
1042
Scrambled Plaintext
1035
1B 1D 1C 1A 1F 1E
Un-scrambled Plaintext
1A 1B 1C 1D 1E 1F
990

Figure 56

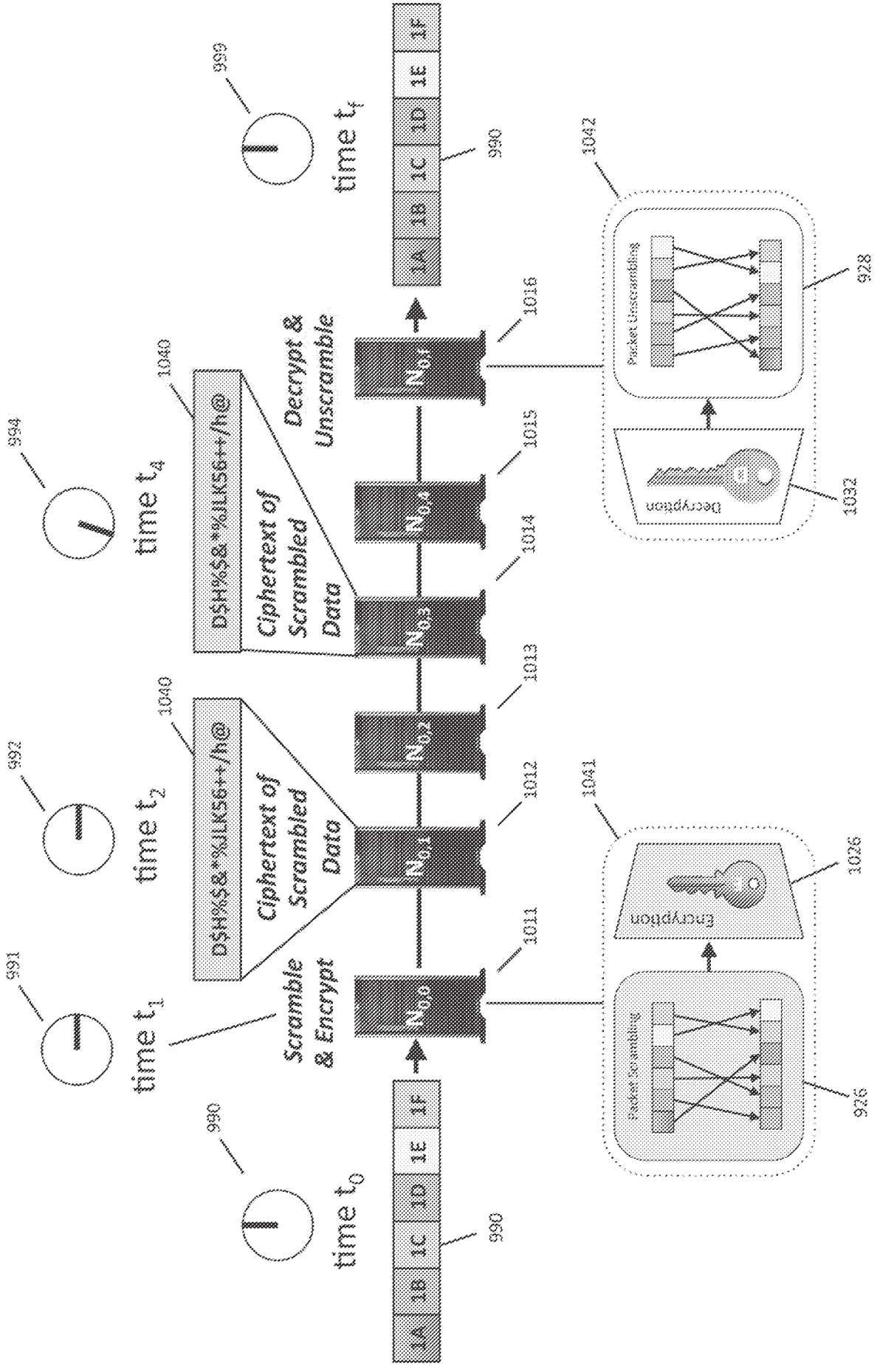

time t_0
time t_1
time t_2
time t_4
time t_f
990
991
992
994
999
1A 1B 1C 1D 1E 1F
Scramble & Encrypt
Decrypt & Unscramble
D$H%S& *%JLKS6++/h@
Ciphertext of Scrambled Data
1040
1011
1012
1013
1014
1015
1016
1041
1042
Packet Scrambling
Encryption
Packet Unscrambling
Decryption
926
928
1026
1032

Figure 57

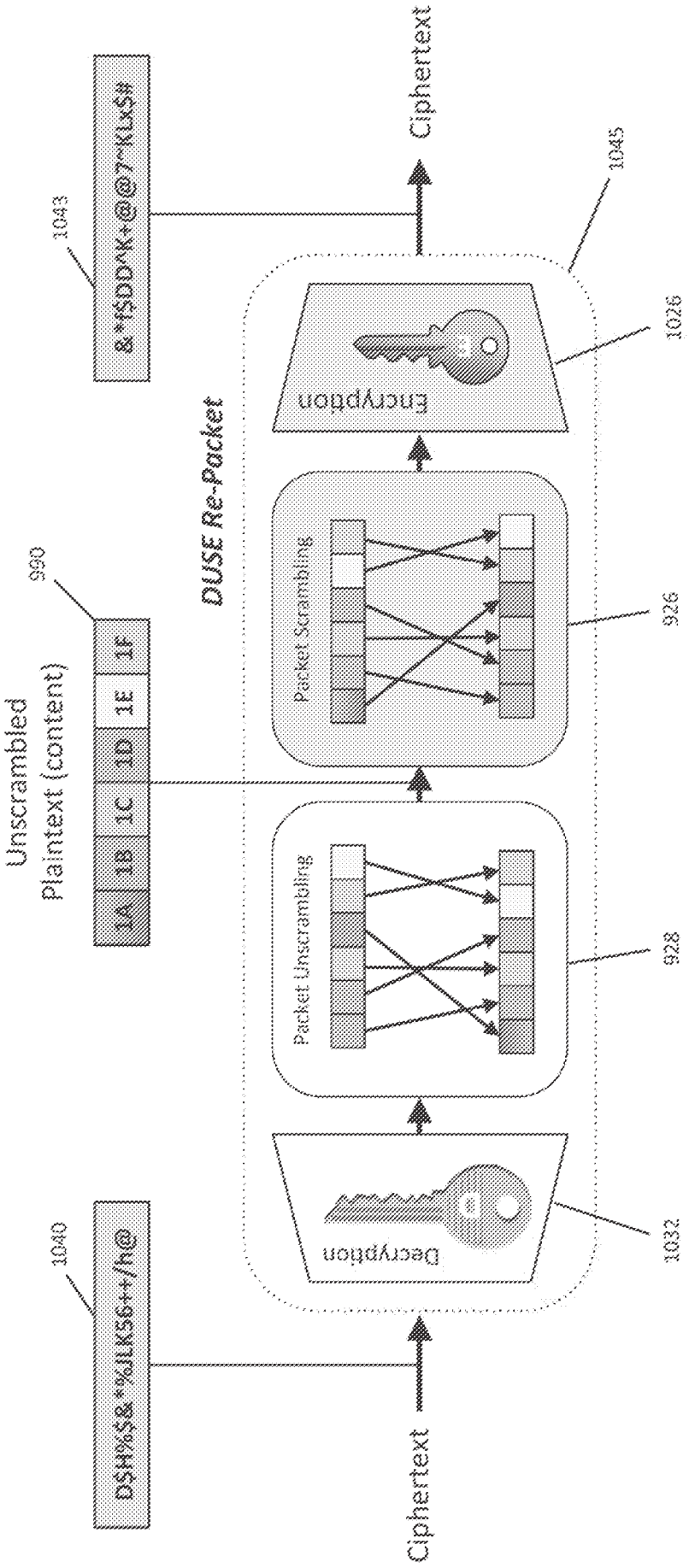

Ciphertext
1040
D$H%$&*%JLK56++/h@
Decryption
1032
928
Packet Unscrambling
926
Packet Scrambling
1026
Encryption
1045
DUSE Re-Packet
990
Unscrambled
Plaintext (content)
1A
1B
1C
1D
1E
1F
1043
&*fSDD^K+@@7~KL%S#
Ciphertext

Figure 58

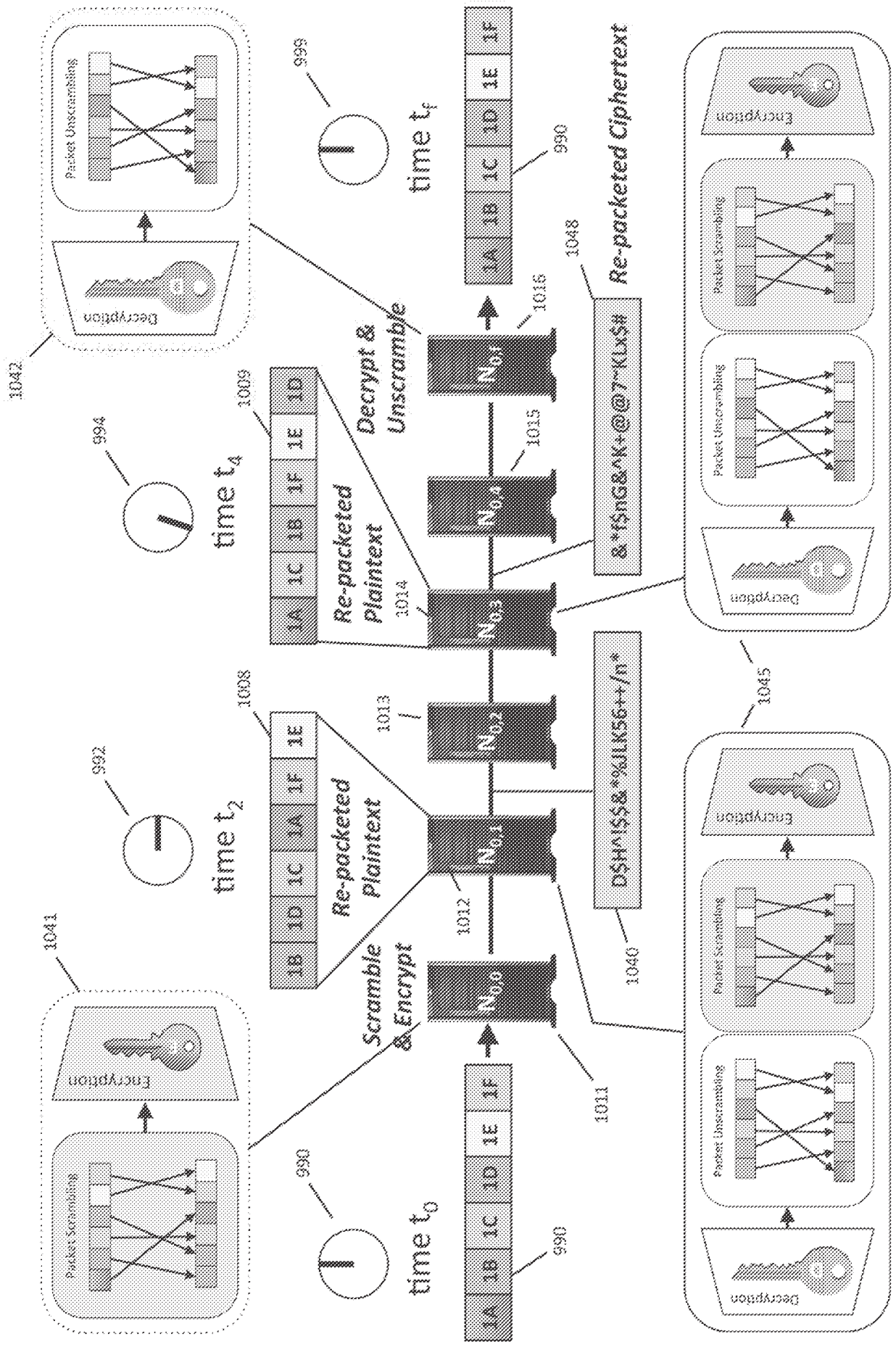

time t_0
time t_2
time t_4
time t_f
990
992
994
999
1A 1B 1C 1D 1E 1F
1B 1D 1C 1A 1F 1E
1A 1C 1B 1F 1E 1D
1A 1B 1C 1D 1E 1F
$N_{0,0}$
$N_{0,1}$
$N_{0,2}$
$N_{0,3}$
$N_{0,4}$
$N_{0,f}$
1011
1012
1013
1014
1015
1016
D$H^!S$&*%JLK56++/n*
1040
&*fSnG&^K+@@7~KLx$#
1048
Re-packeted Ciphertext
Scramble & Encrypt
Re-packeted Plaintext
Decrypt & Unscramble
Re-packeted Plaintext
1008
1009
1041
1042
1045
Encryption
Packet Scrambling
Packet Unscrambling
Decryption
DUSE Re-Packet
DUSE Re-Packet

Figure 59

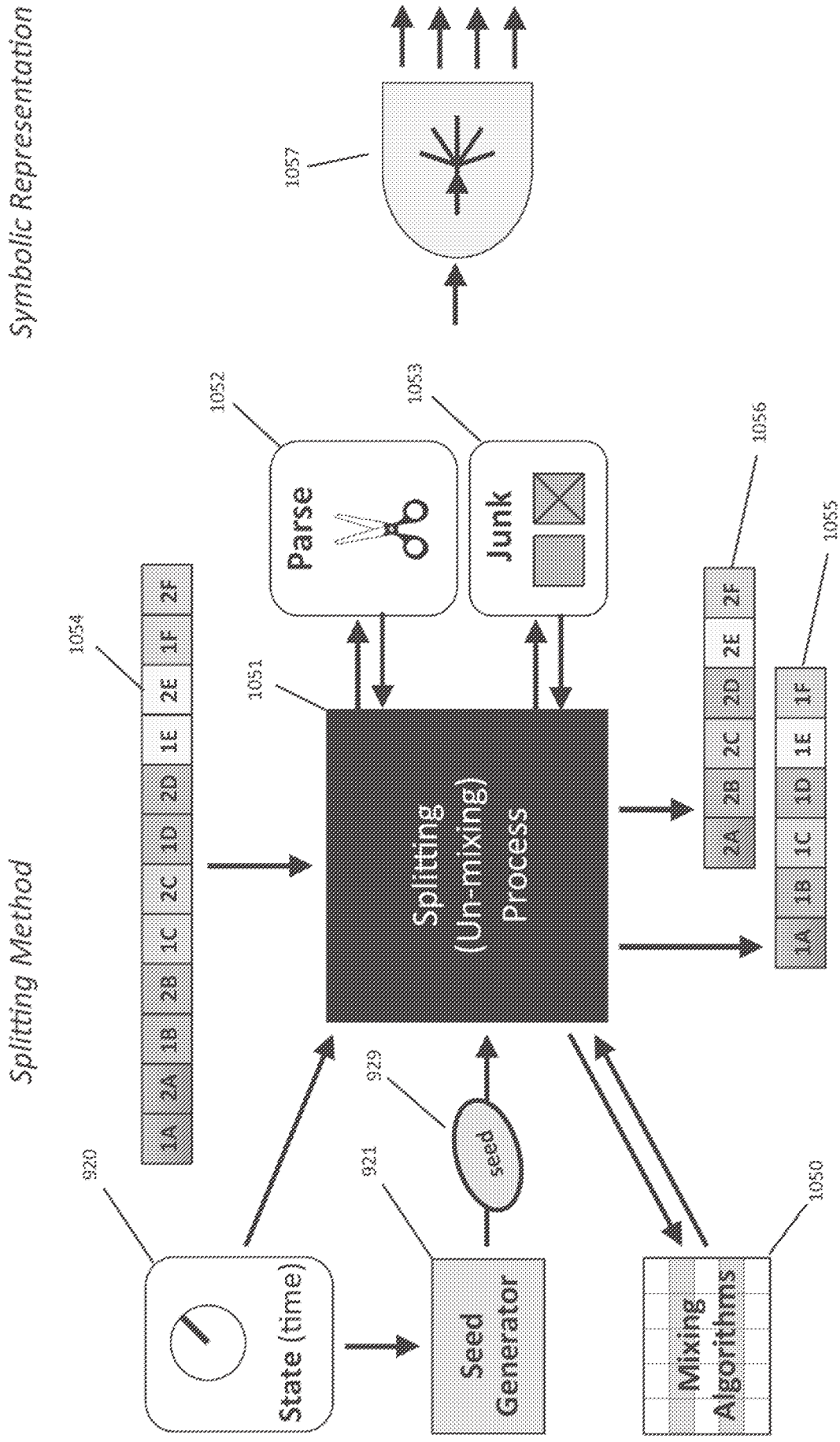

Symbolic Representation
Splitting Method
1057
1052
1053
Parse
Junk
1054
1A 2A 1B 2B 1C 2C 1D 2D 1E 2E 1F 2F
1051
Splitting (Un-mixing) Process
1056
2A 2B 2C 2D 2E 2F
1055
1A 1B 1C 1D 1E 1F
920
State (time)
921
Seed Generator
929
seed
1050
Mixing Algorithms

Figure 60A

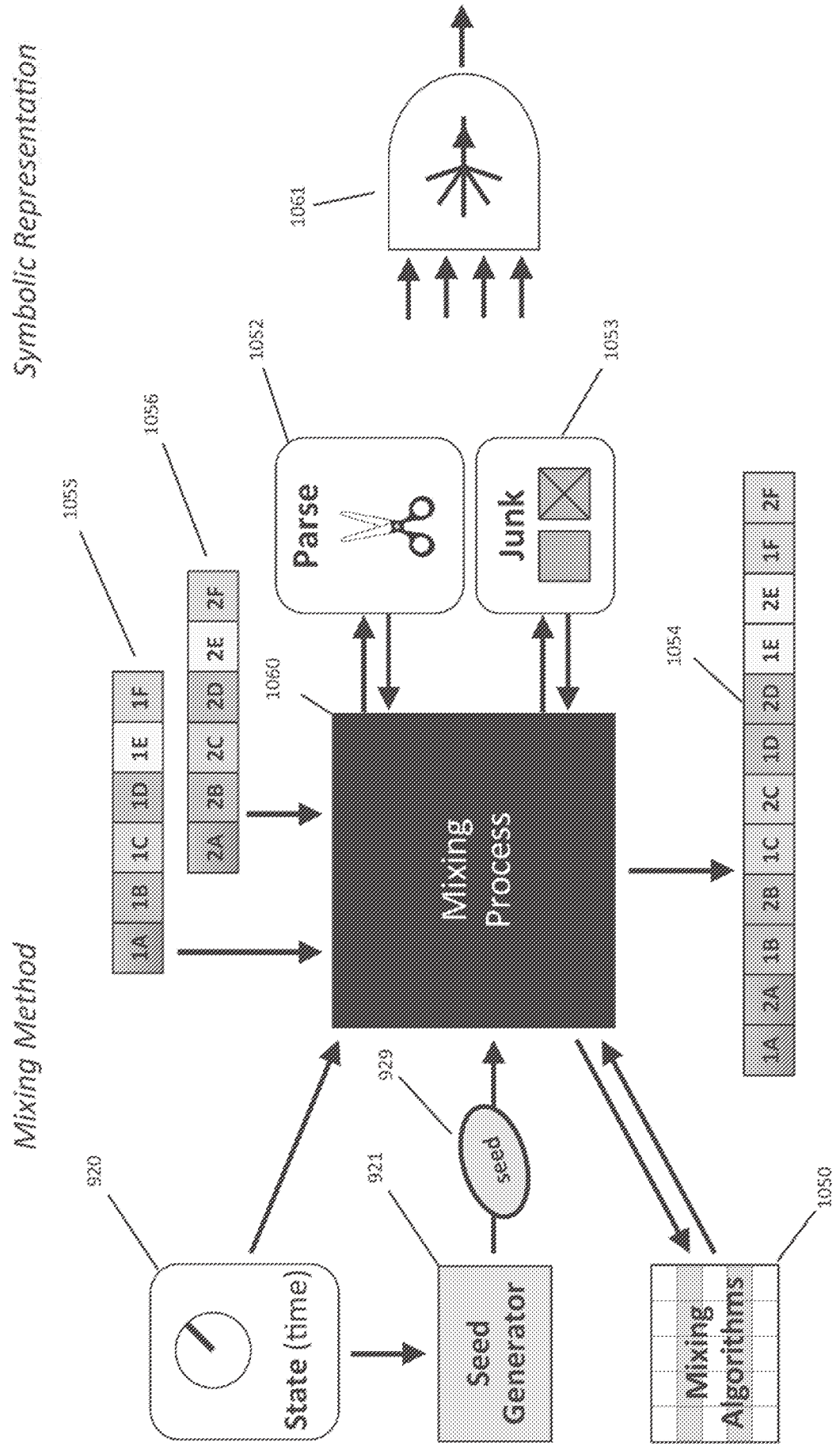

Symbolic Representation
Mixing Method
1061
1052
1053
1056
1055
1060
1054
Parse
Junk
Mixing Process
1A 1B 1C 1D 1E 1F
2A 2B 2C 2D 2E 2F
1A 2A 1B 2B 1C 2C 1D 2D 1E 2E 1F 2F
920
921
929
1050
State (time)
Seed Generator
seed
Mixing Algorithms

Figure 60B

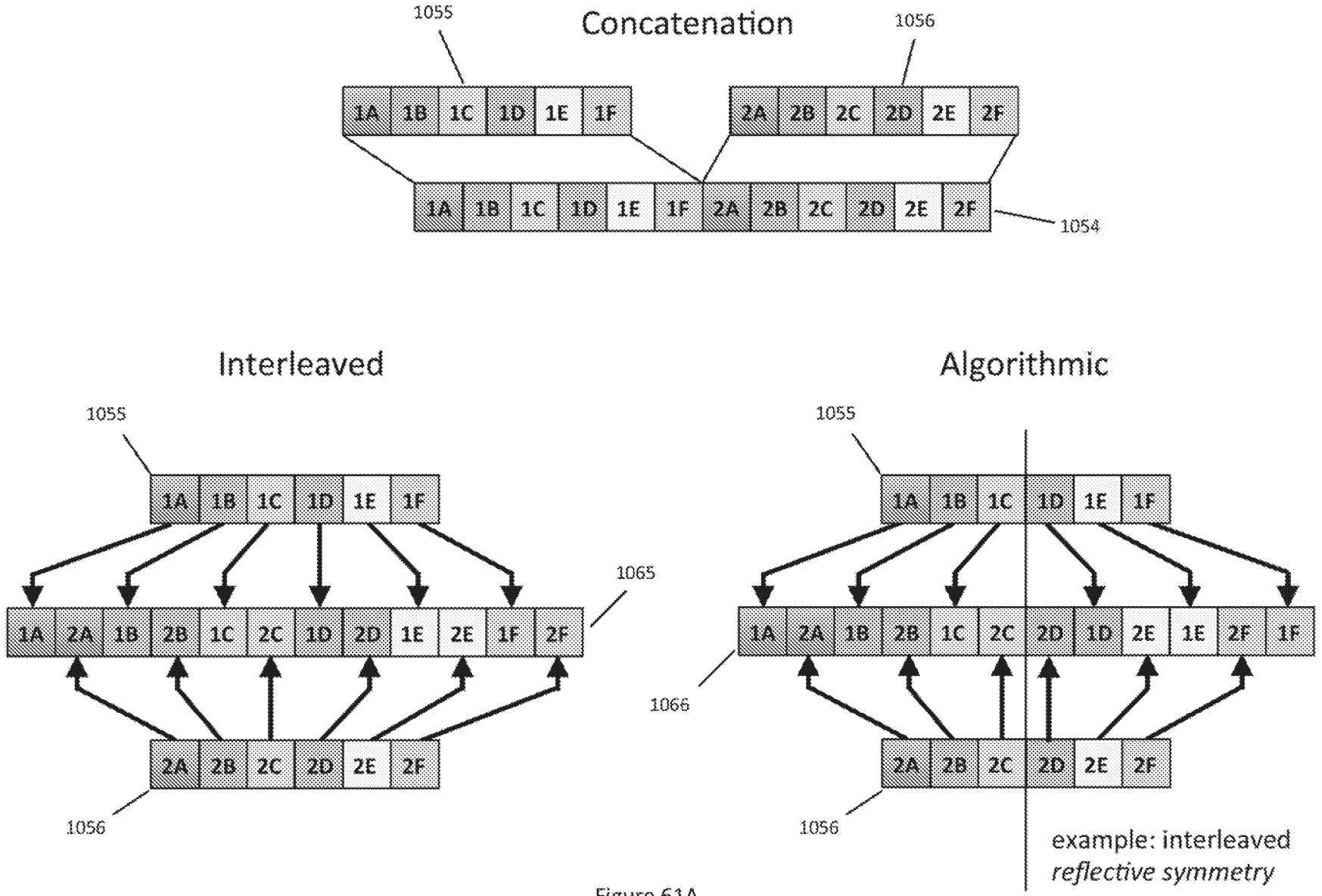

Concatenation
1055
1056
1A 1B 1C 1D 1E 1F
2A 2B 2C 2D 2E 2F
1A 1B 1C 1D 1E 1F 2A 2B 2C 2D 2E 2F
1054
Interleaved
1055
1A 1B 1C 1D 1E 1F
1065
1A 2A 1B 2B 1C 2C 1D 2D 1E 2E 1F 2F
2A 2B 2C 2D 2E 2F
1056
Algorithmic
1055
1A 1B 1C 1D 1E 1F
1066
1A 2A 1B 2B 1C 2C 2D 1D 2E 1E 2F 1F
2A 2B 2C 2D 2E 2F
1056
example: interleaved
reflective symmetry

Figure 61A

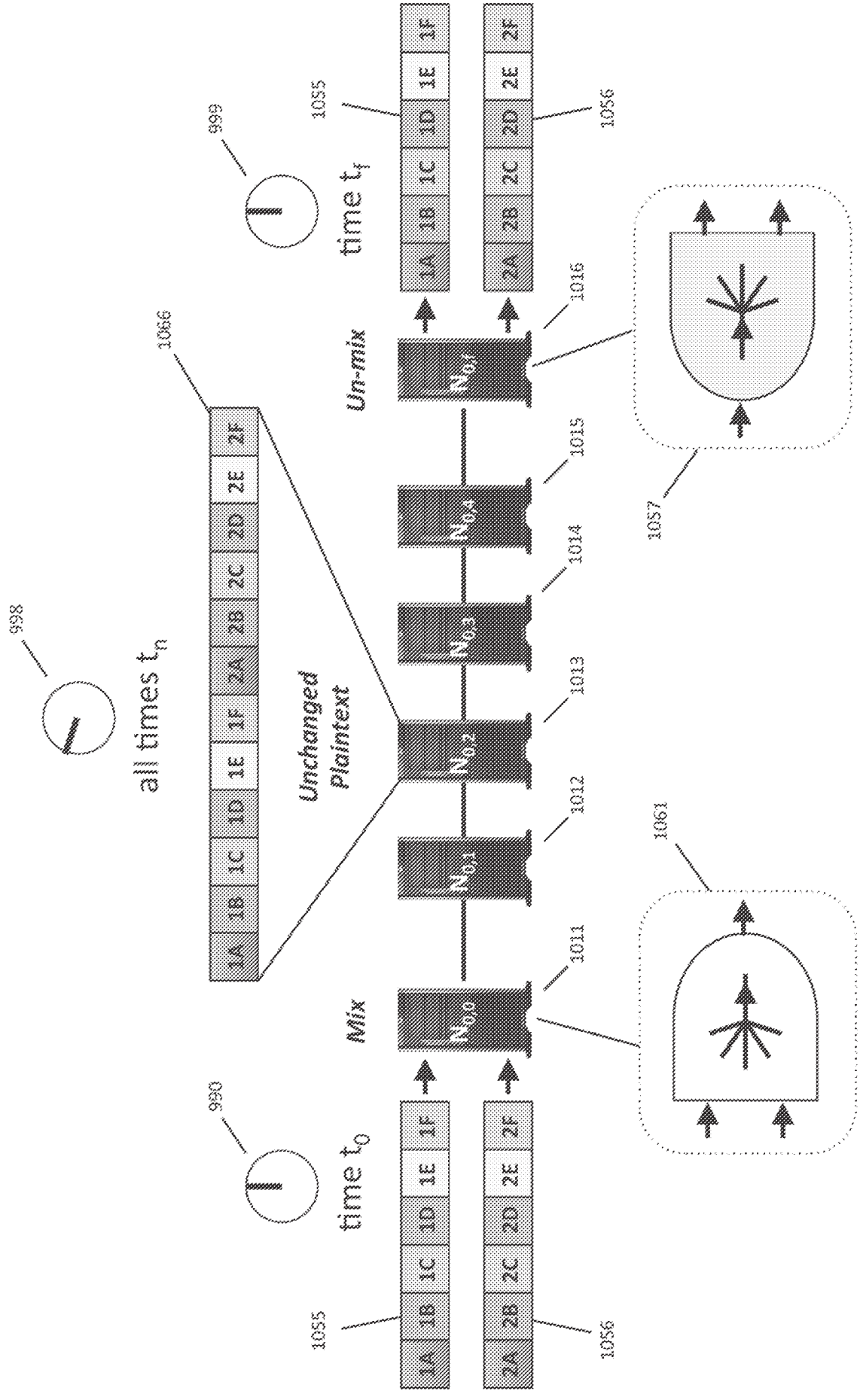

998
all times t_n
1066
1A 1B 1C 1D 1E 1F 2A 2B 2C 2D 2E 2F
Unchanged Plaintext
990
time t_0
1055
1A 1B 1C 1D 1E 1F
2A 2B 2C 2D 2E 2F
1056
Mix
$N_{0,0}$ 1011
$N_{0,1}$ 1012
$N_{0,2}$ 1013
$N_{0,3}$ 1014
$N_{0,4}$ 1015
$N_{0,f}$ 1016
Un-mix
999
time t_f
1055
1A 1B 1C 1D 1E 1F
2A 2B 2C 2D 2E 2F
1056
1061
1057

Figure 61B

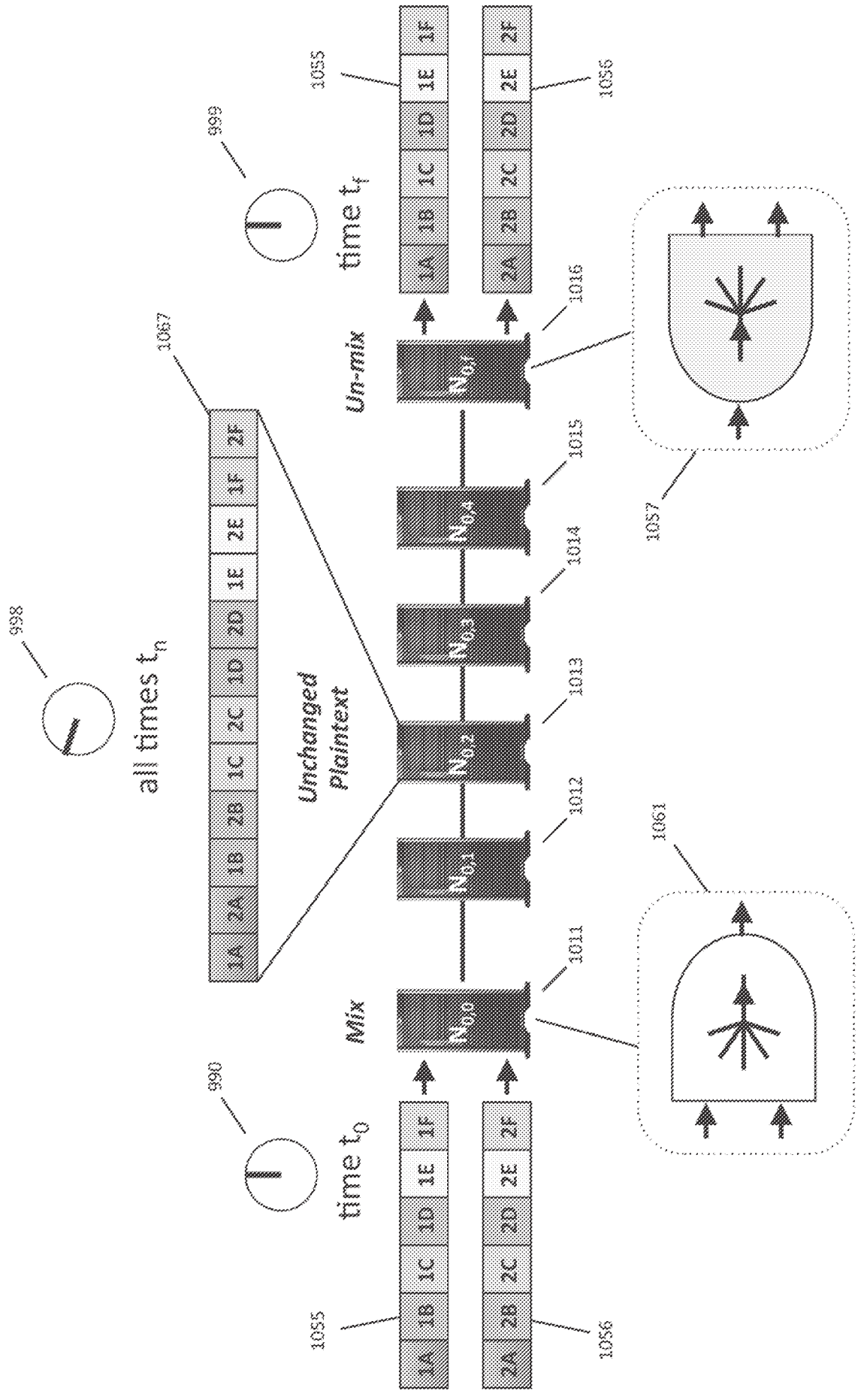

998
all times t_n
1067
1A 1B 2A 2B 1C 2C 1D 2D 1E 2E 1F 2F
Unchanged Plaintext
990
time t_0
Mix
1055
1A 1B 1C 1D 1E 1F
2A 2B 2C 2D 2E 2F
1056
1011
1012
1013
1014
1015
1016
1061
1057
999
time t_f
Un-mix

Figure 61C

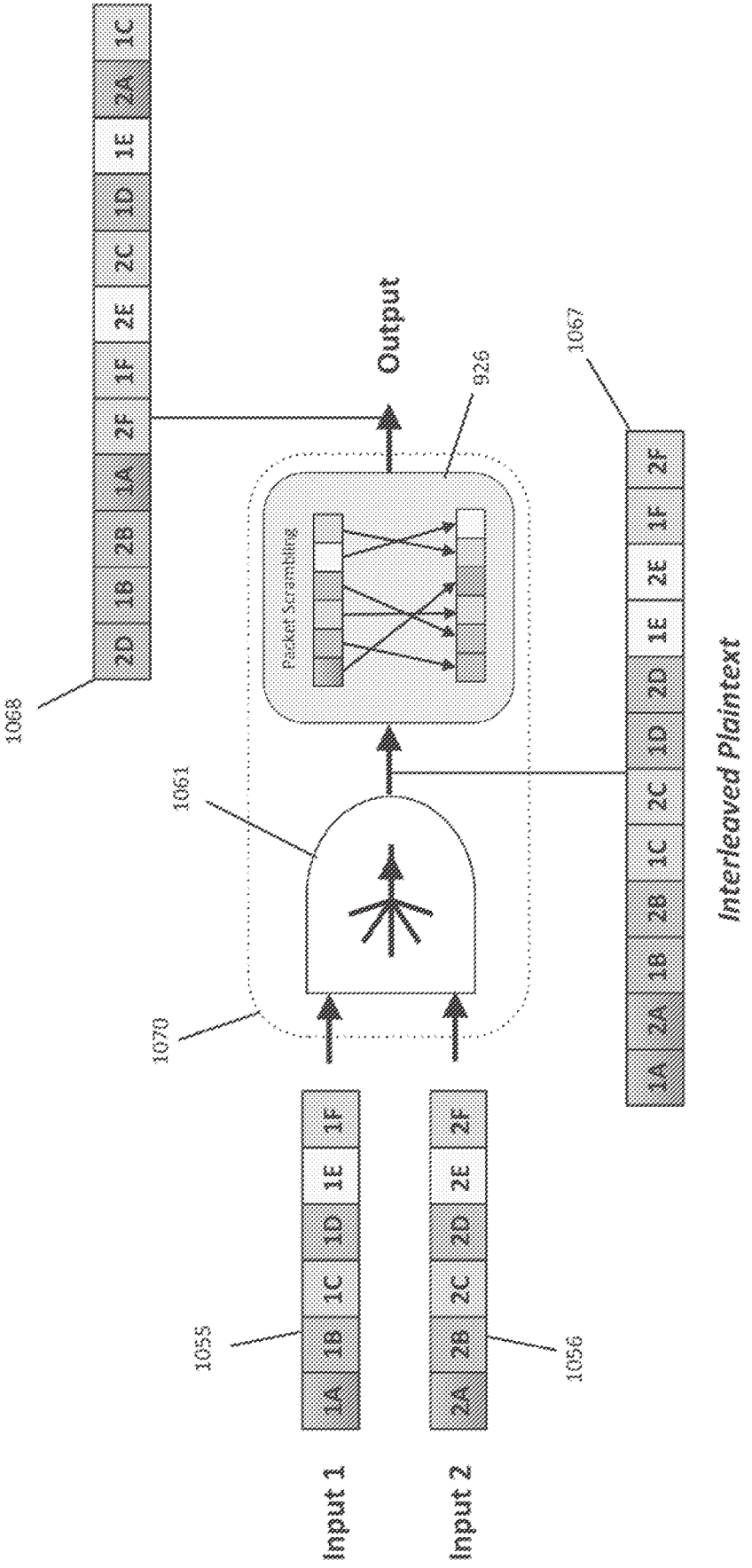

Input 1
1A 1B 1C 1D 1E 1F
1055
Input 2
2A 2B 2C 2D 2E 2F
1056
1061
1070
Packet Scrambling
926
Output
1067
1A 2A 1B 2B 1C 2C 1D 2D 1E 2E 1F 2F
Interleaved Plaintext
1068
2D 1B 2B 1A 2F 1F 2E 2C 1D 1E 2A 1C

Figure 62A

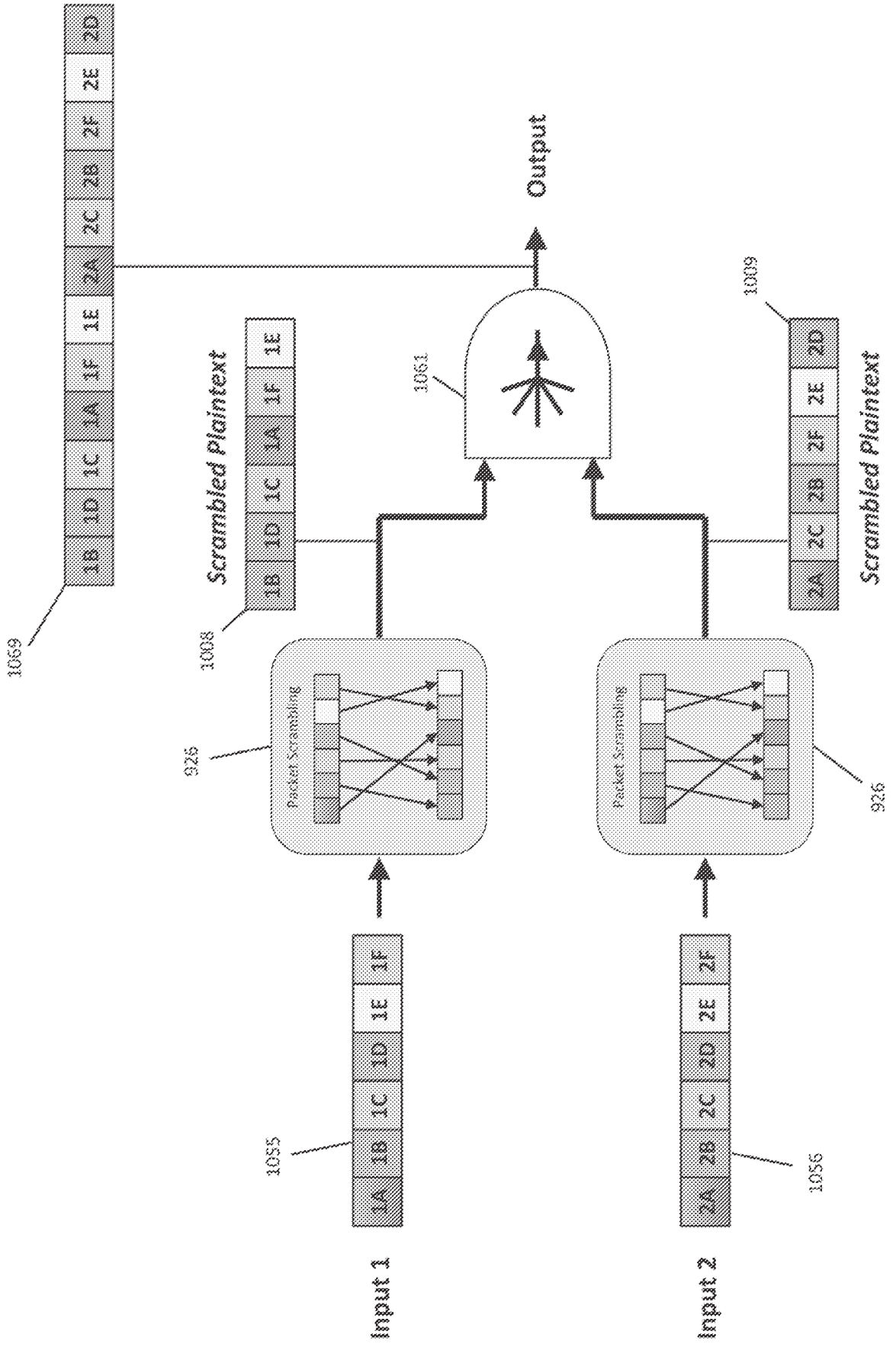

Input 1
Input 2
1A 1B 1C 1D 1E 1F
2A 2B 2C 2D 2E 2F
1055
1056
Packet Scrambling
925
926
Scrambled Plaintext
1008
1009
1061
Output
1059

Figure 62B

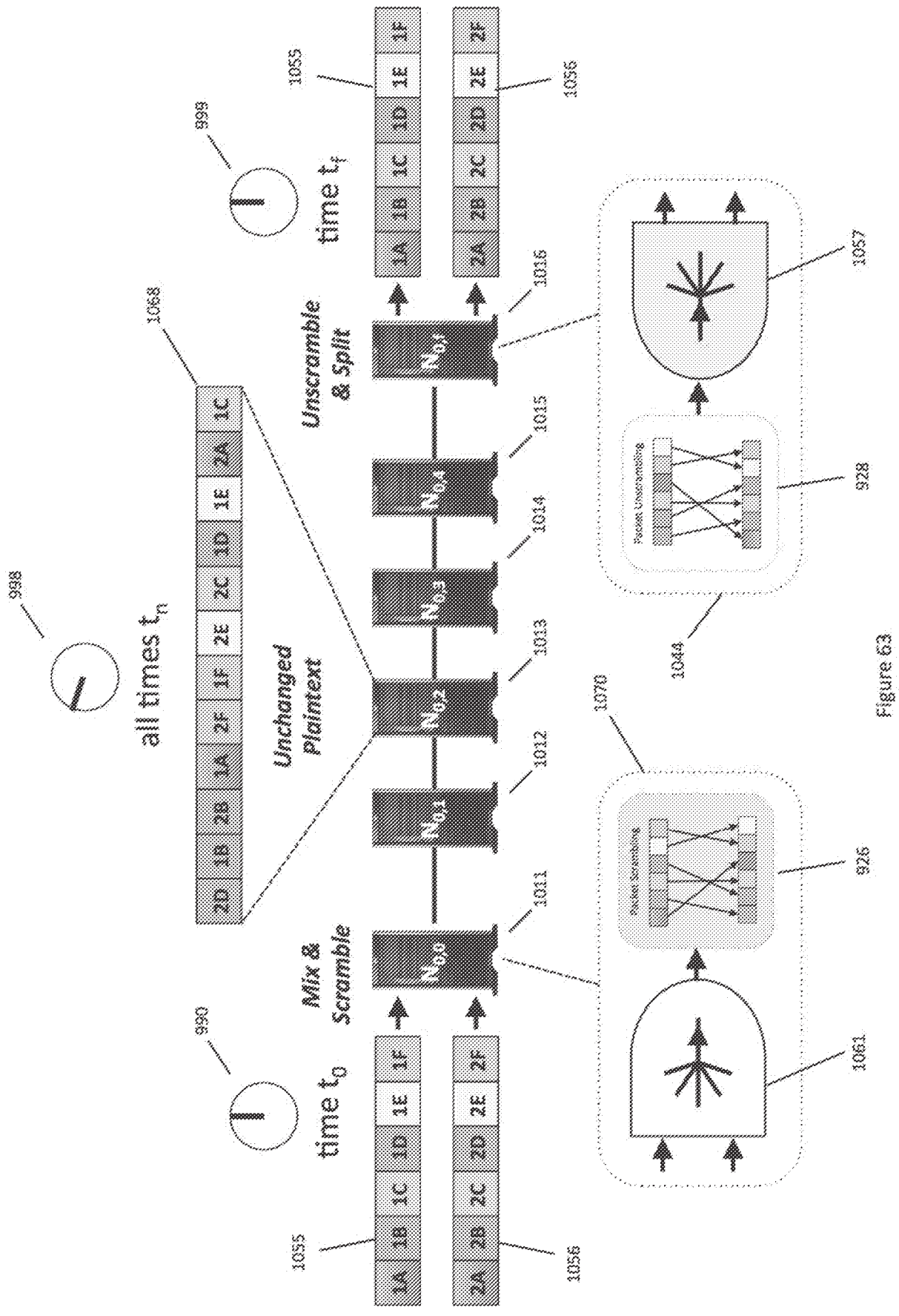

998
all times t_n
2D 1B 2B 1A 2F 1F 2E 2C 1D 1E 2A 1C
1068
Unchanged Plaintext
990
time t_0
Mix & Scramble
1A 1B 1C 1D 1E 1F
2A 2B 2C 2D 2E 2F
1055
1056
N_{01} N_{02} N_{03} N_{04} N_{0J}
1011 1012 1013 1014 1015 1016
Unscramble & Split
998
time t_f
1A 1B 1C 1D 1E 1F
2A 2B 2C 2D 2E 2F
1055
1056
1070
1044
Packet Unscrambling
928
1057
Packet Scrambling
926
1061

Figure 63

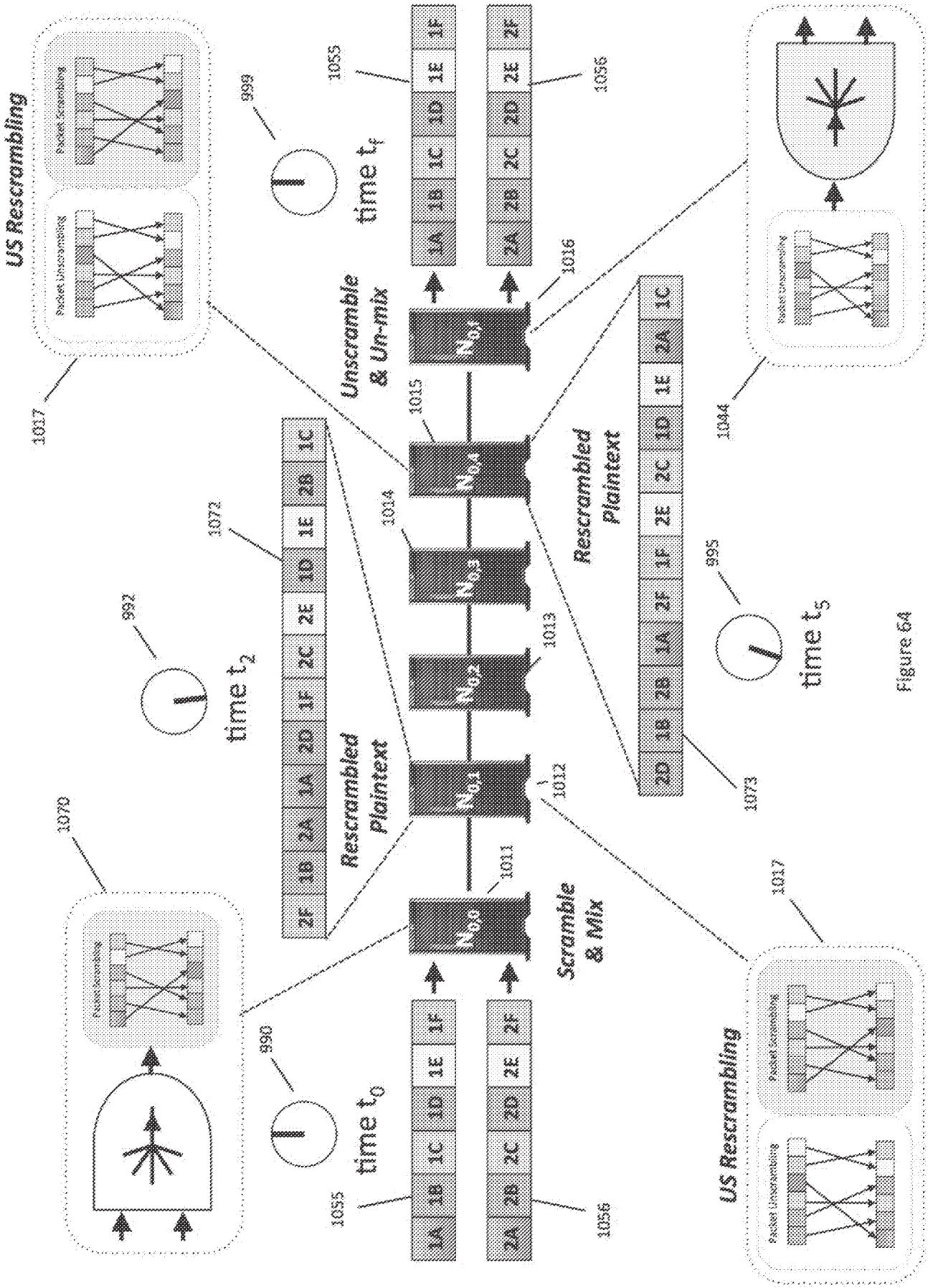

US Rescrambling
Packet Unscrambling
Packet Scrambling
1017
1070
990
time t_0
1055
1A 1B 1C 1D 1E 1F
2A 2B 2C 2D 2E 2F
1056
1011
N_{01}
N_{02}
N_{03}
N_{04}
N_{0J}
1012
1013
1014
1015
1016
Scramble & Mix
992
time t_2
1072
2F 1B 2A 1A 2D 1F 2C 2E 1D 1E 2B 1C
Rescrambled Plaintext
Unscramble & Un-mix
999
time t_f
1055
1056
Rescrambled Plaintext
2D 1B 2B 1A 2F 1F 2E 2C 1D 1E 2A 1C
1073
995
time t_5
1044
1017
US Rescrambling
Packet Unscrambling
Packet Scrambling

Figure 64

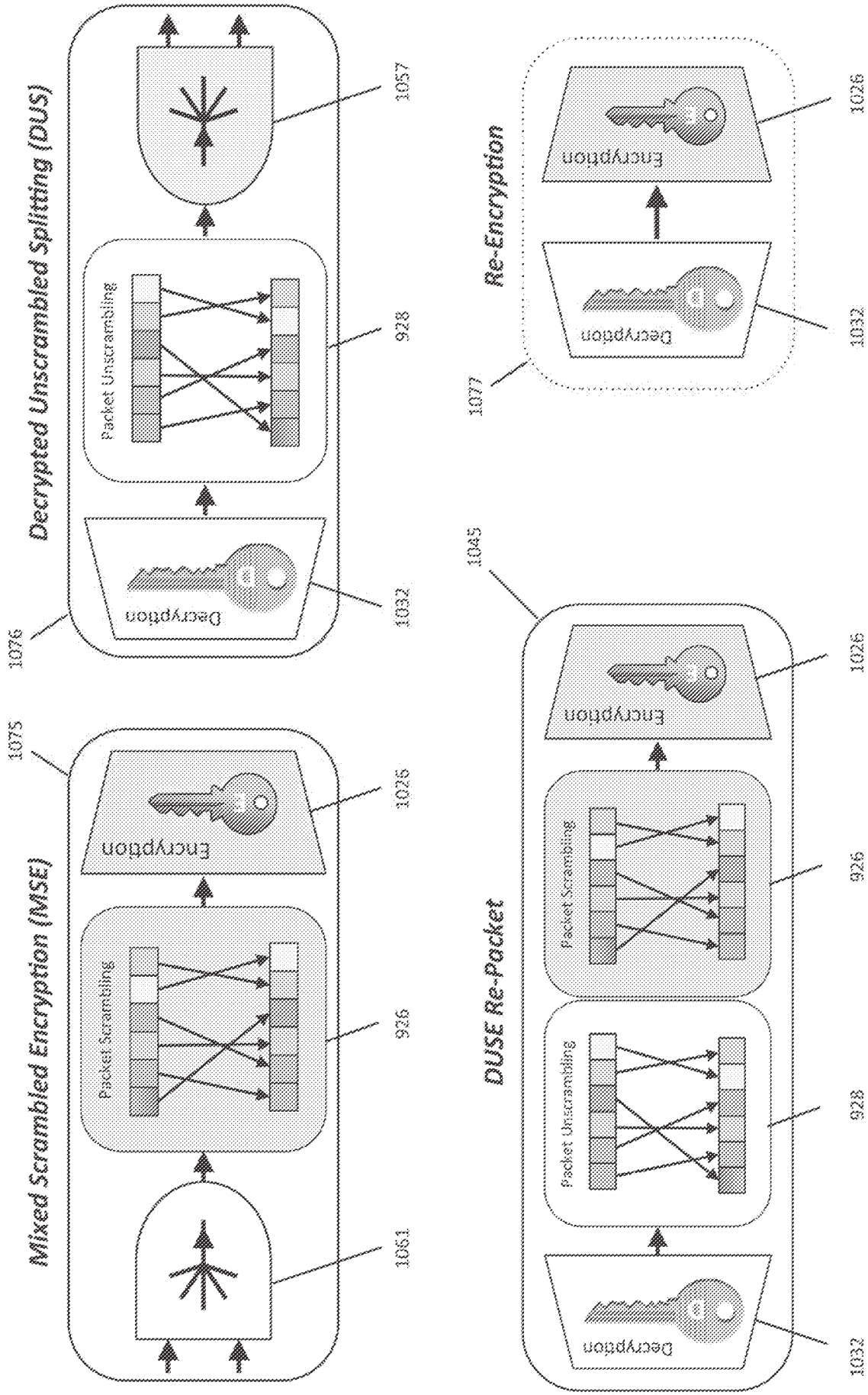

Mixed Scrambled Encryption (MSE)
Packet Scrambling
Encryption
1051
926
1026
1075
Decrypted Unscrambled Splitting (DUS)
Packet Unscrambling
Decryption
1057
928
1032
1076
DUSE Re-Packet
Packet Unscrambling
Packet Scrambling
Encryption
Decryption
1032
928
926
1026
1045
Re-Encryption
Decryption
Encryption
1077
1032
1026

Figure 65

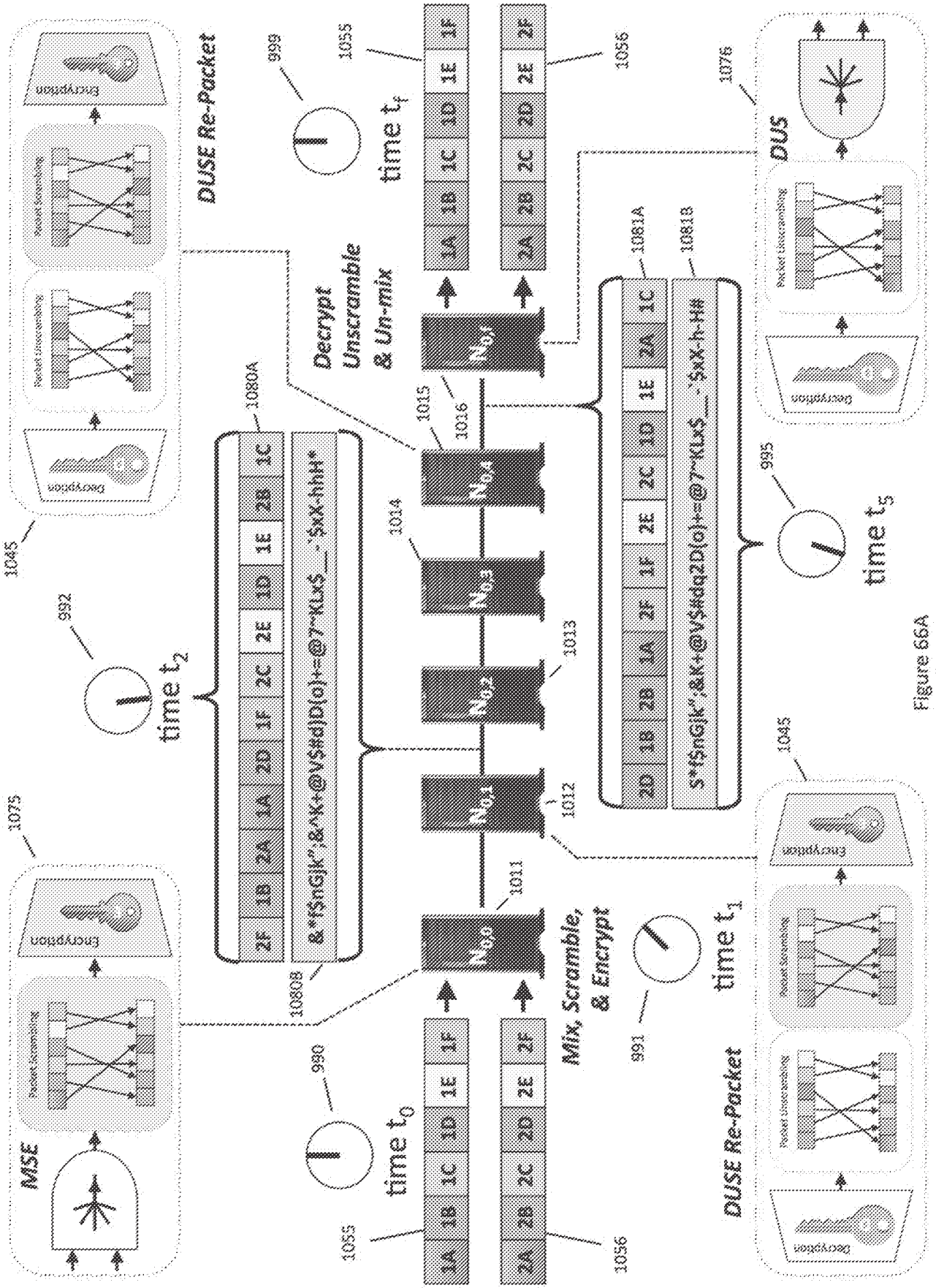

MSE
DUSE Re-Packet
DUSE Re-Packet
DUS
Encryption
Packet Scrambling
Packet Unscrambling
Decryption
Decrypt Unscramble & Un-mix
Mix, Scramble, & Encrypt
time t_0
time t_1
time t_2
time t_f
time t_5
1A 1B 1C 1D 1E 1F
2A 2B 2C 2D 2E 2F
&*f$nGjk",&^K+@V$#d]D[o]+=@7~KLx$__`$xX-hhH*
S*f$nGjk",&K+@V$Hdq2D[o]+=@7~KLx$__`$xX-h-H#
No.0
No.1
No.2
No.3
No.4
No.1
990
991
992
995
999
1011
1012
1013
1014
1015
1016
1036
1045
1055
1056
1075
1076
10808
1080A
1081A
1081B

Figure 66A

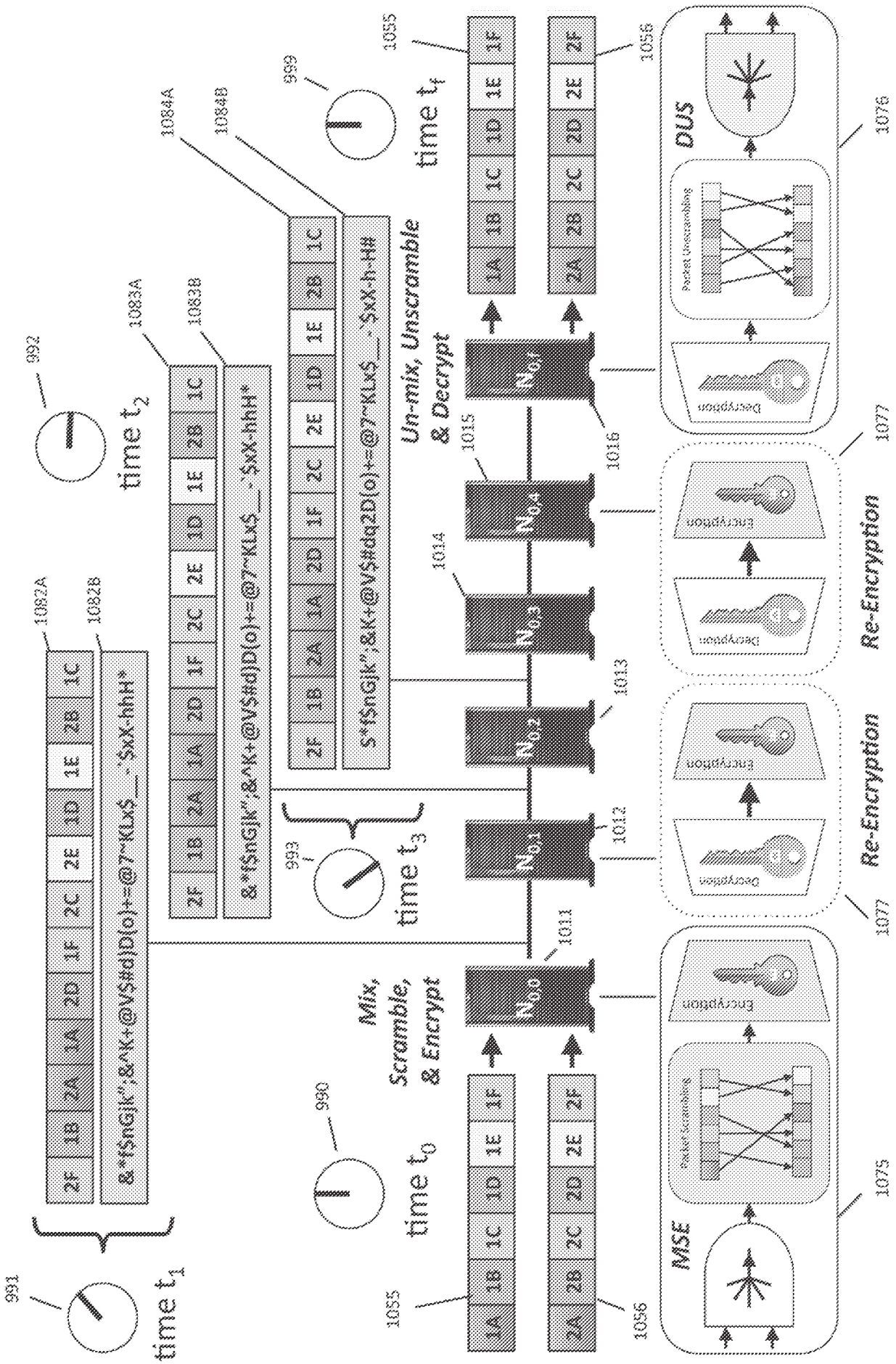

991
time t_1
2F 1B 2A 1A 2D 1F 2C 2E 1D 1E 2B 1C
&*f$nGjk";&^K+@V$#djD(o)+-=@7~KLx$__`$xX-hhH*
1082A
1082B
992
time t_2
1083A
1083B
1084A
1084B
999
time t_4
1055
990
time t_0
Mix, Scramble, & Encrypt
993
time t_3
Un-mix, Unscramble & Decrypt
1011
1012
1013
1014
1015
1016
1055
1056
MSE
Packet Scrambling
Encryption
Decryption
Re-Encryption
Re-Encryption
DUS
Packet Unscrambling
1075
1076
1077
1077

Figure 66B

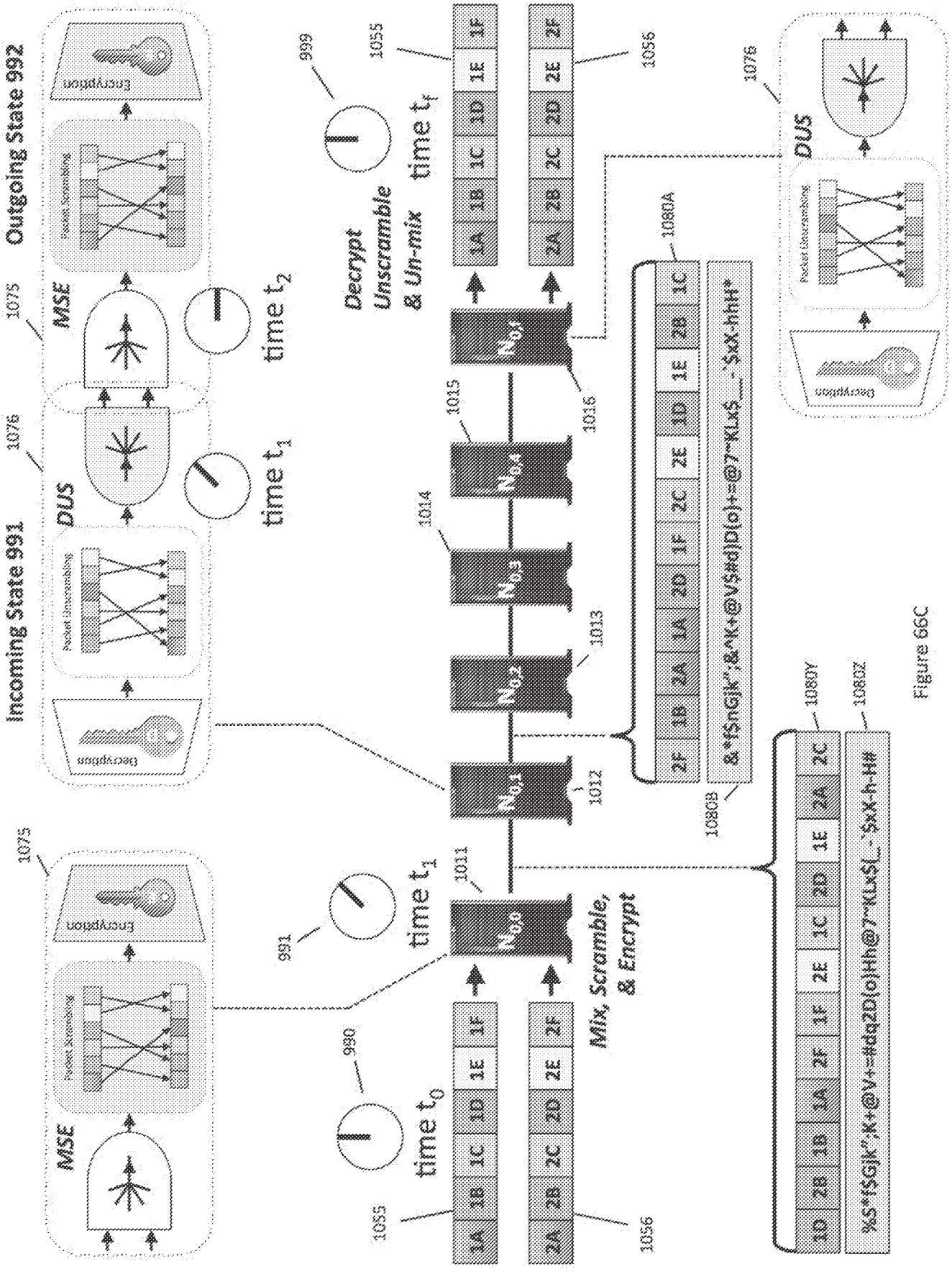

Incoming State 991
Outgoing State 992
MSE
DUS
Encryption
Decryption
Packet Scrambling
Packet Unscrambling
time t_0
time t_1
time t_2
time t_f
Mix, Scramble, & Encrypt
Decrypt Unscramble & Un-mix
991
999
1011
1012
1013
1014
1015
1016
1055
1056
1075
1076
1080A
1080B
1080Y
1080Z
1A 1B 1C 1D 1E 1F
2A 2B 2C 2D 2E 2F
&*fSnGjk";&^K+@V$#d)D(o)+=@7~KLx$__`$xX-hhH*
%S*fSGjk";K+@V+=#dq2D(o)Hh@7~KLxSL_`$xX-h-H#

Figure 66C

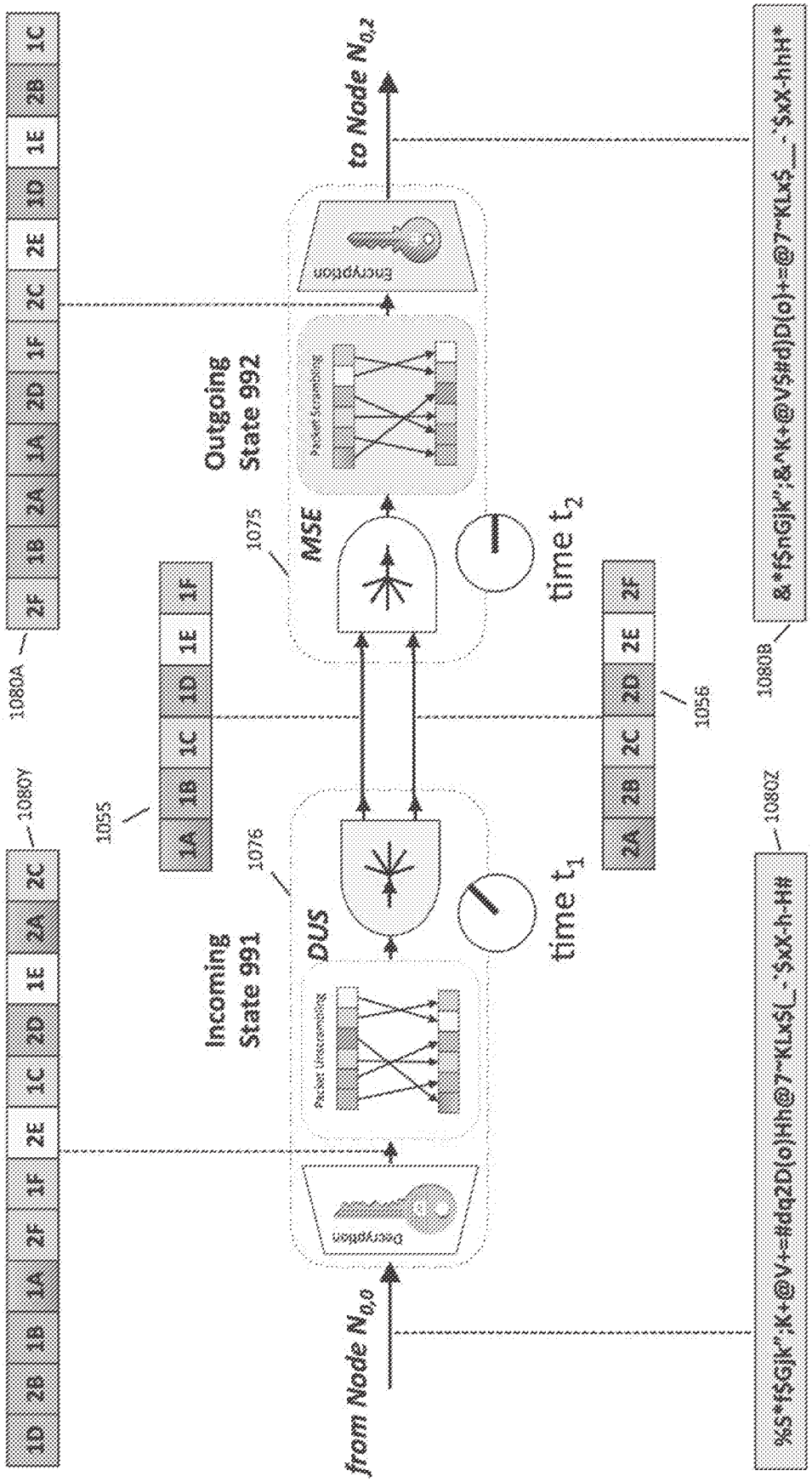

1D 2B 1B 1A 2F 1F 2E 1C 2D 1E 2A 2C
1080Y
1A 1B 1C 1D 1E 1F
1055
1076
Incoming State 991
DUS
Packet Uncompiling
Decryption
from Node $N_{0,0}$
time t_1
2F 1B 2A 1A 2D 1F 2C 2E 1D 1E 2B 1C
1080A
2A 2B 2C 2D 2E 2F
1056
1075
MSE
Outgoing State 992
Packet Compiling
Encryption
to Node $N_{0,2}$
time t_2
%S*fŞGjk";K+@V+=#dq2D(o)Hn@7~KLx$L_-`$xX-h-H#
1080Z
&*fŞnGjk";&^K+@VŞ#d)D(o)+=@7~KLx$__-`$xX-hHH*
1080B

Figure 66D

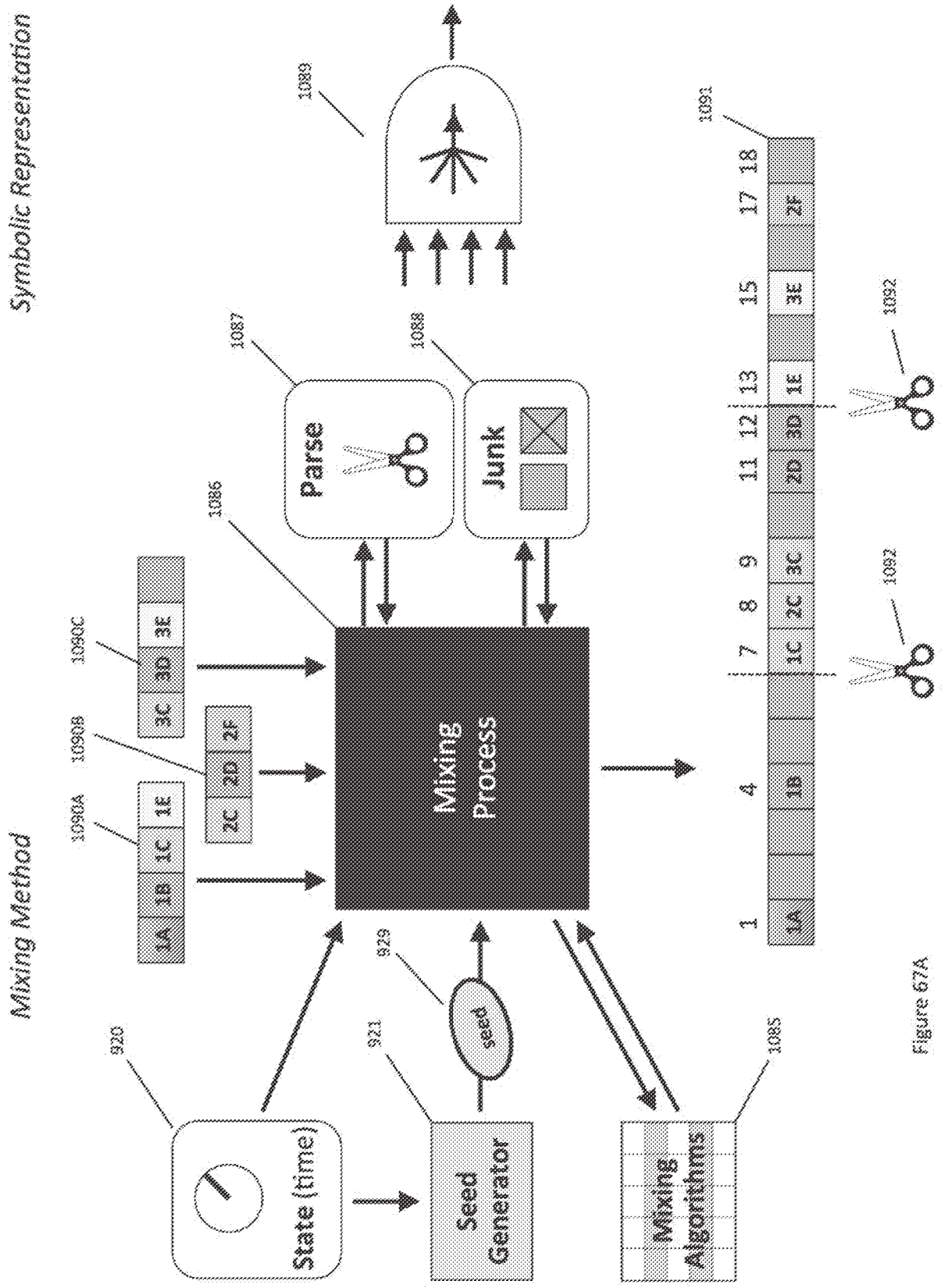

Symbolic Representation
Mixing Method
State (time)
Seed Generator
seed
Mixing Algorithms
Mixing Process
Parse
Junk
1A
1B
1C
1E
2C
2D
2F
3C
3D
3E
1 4 7 8 9 11 12 13 15 17 18
1085
1086
1087
1088
1089
1090A
1090B
1090C
1091
1092
1092
920
921
929

Figure 67A

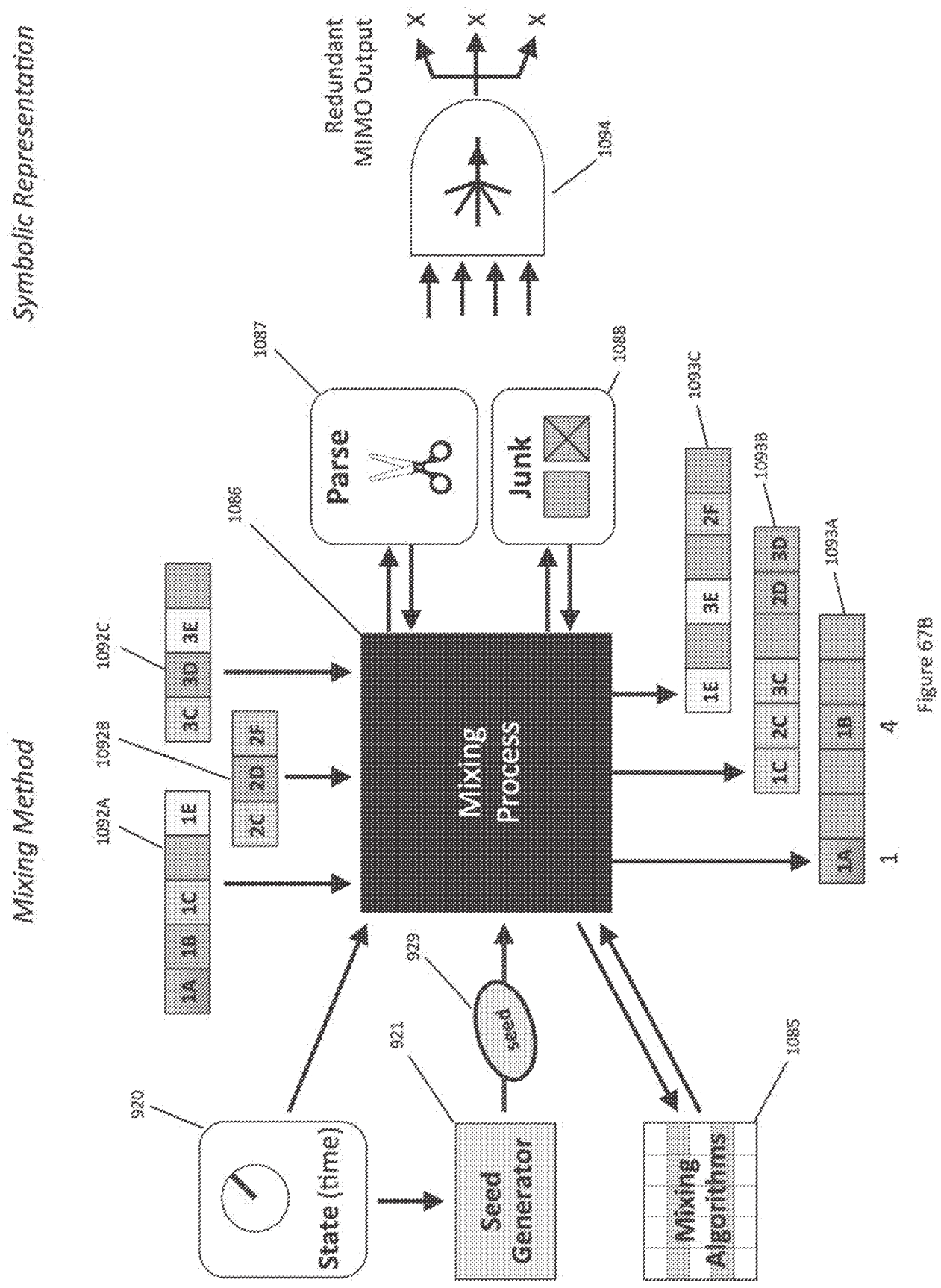

Mixing Method
Symbolic Representation
State (time)
920
Seed Generator
921
seed
929
Mixing Algorithms
1085
Mixing Process
1086
Parse
1087
Junk
1088
Redundant MIMO Output
1094
1092A
1092B
1092C
1093A
1093B
1093C
1A
1B
1C
1E
2C
2D
2F
3C
3D
3E
1
4

Figure 67B

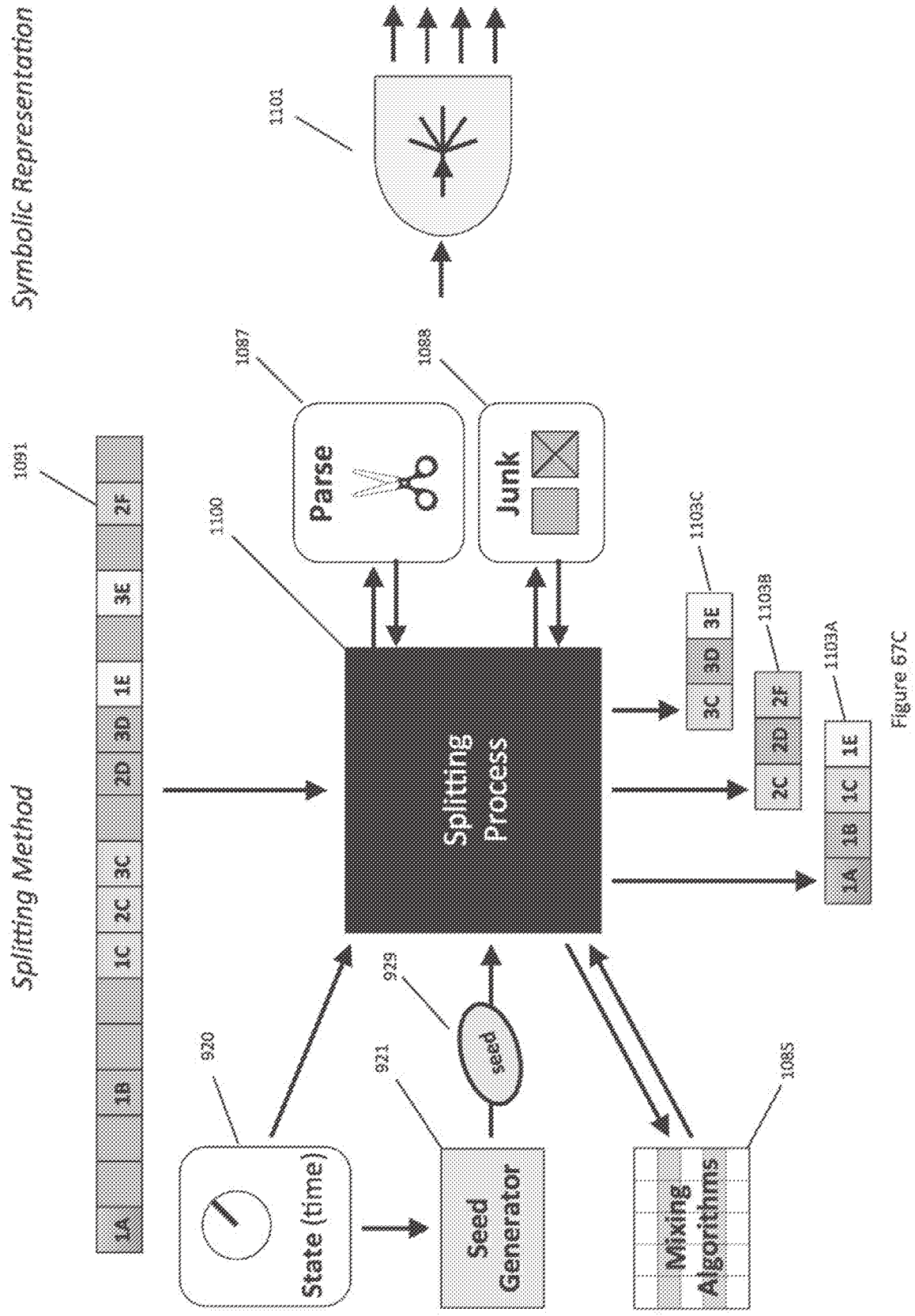

Symbolic Representation
Splitting Method
1091
1A
1B
1C
2C
3C
2D
3D
1E
3E
2F
1100
1097
Parse
1098
Junk
1101
Splitting Process
1103C
3C
3D
3E
1103B
2C
2D
2F
1103A
1A
1B
1C
1E
920
State (time)
921
Seed Generator
929
seed
1085
Mixing Algorithms

Figure 67C

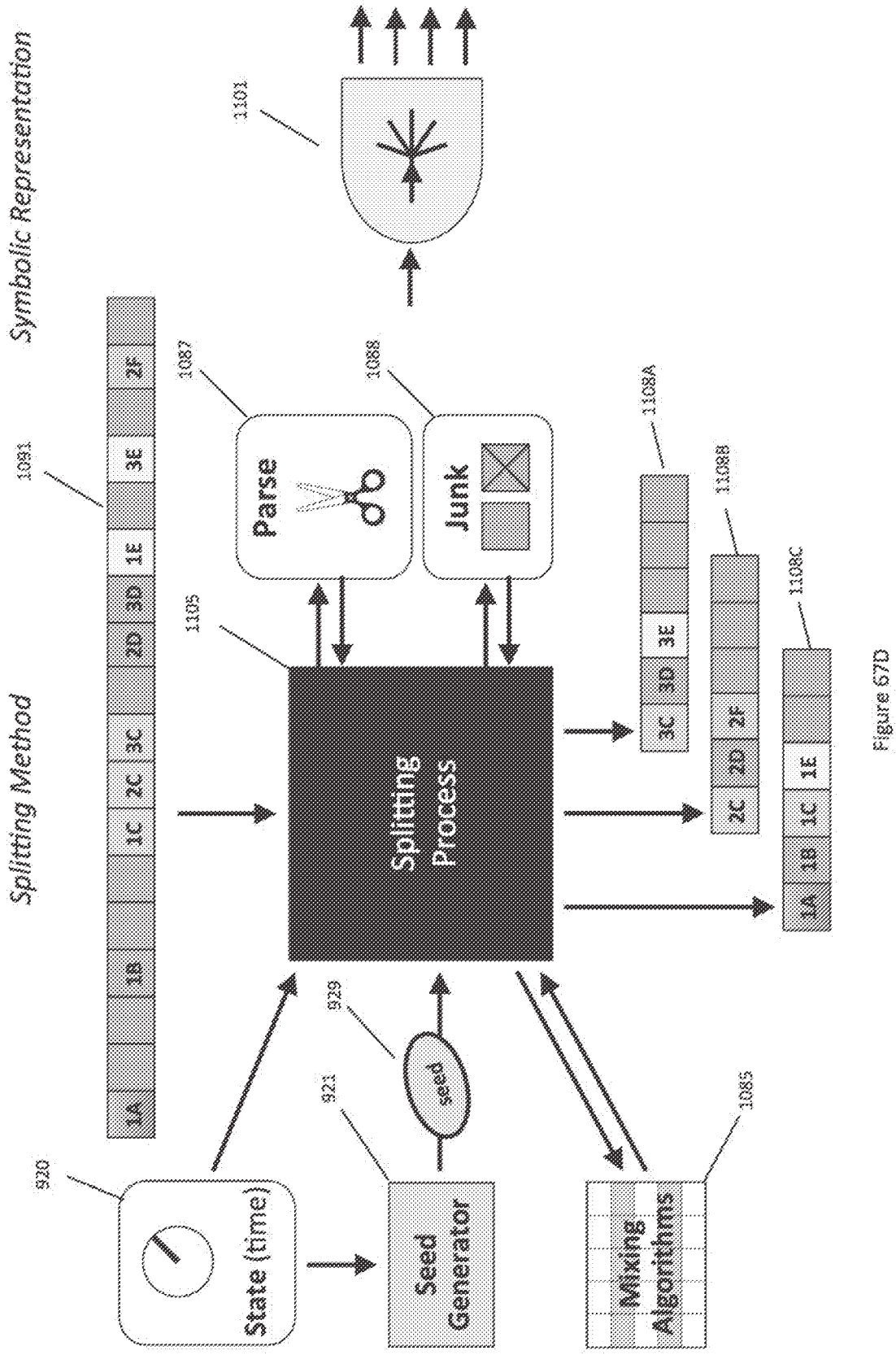

Symbolic Representation
Splitting Method
1101
1091
1087
1088
1105
1108A
1108B
1108C
1085
921
929
920
Parse
Junk
Splitting Process
State (time)
Seed Generator
seed
Mixing Algorithms
1A
1B
1C
2C
3C
2D
3D
1E
3E
2F

Figure 67D

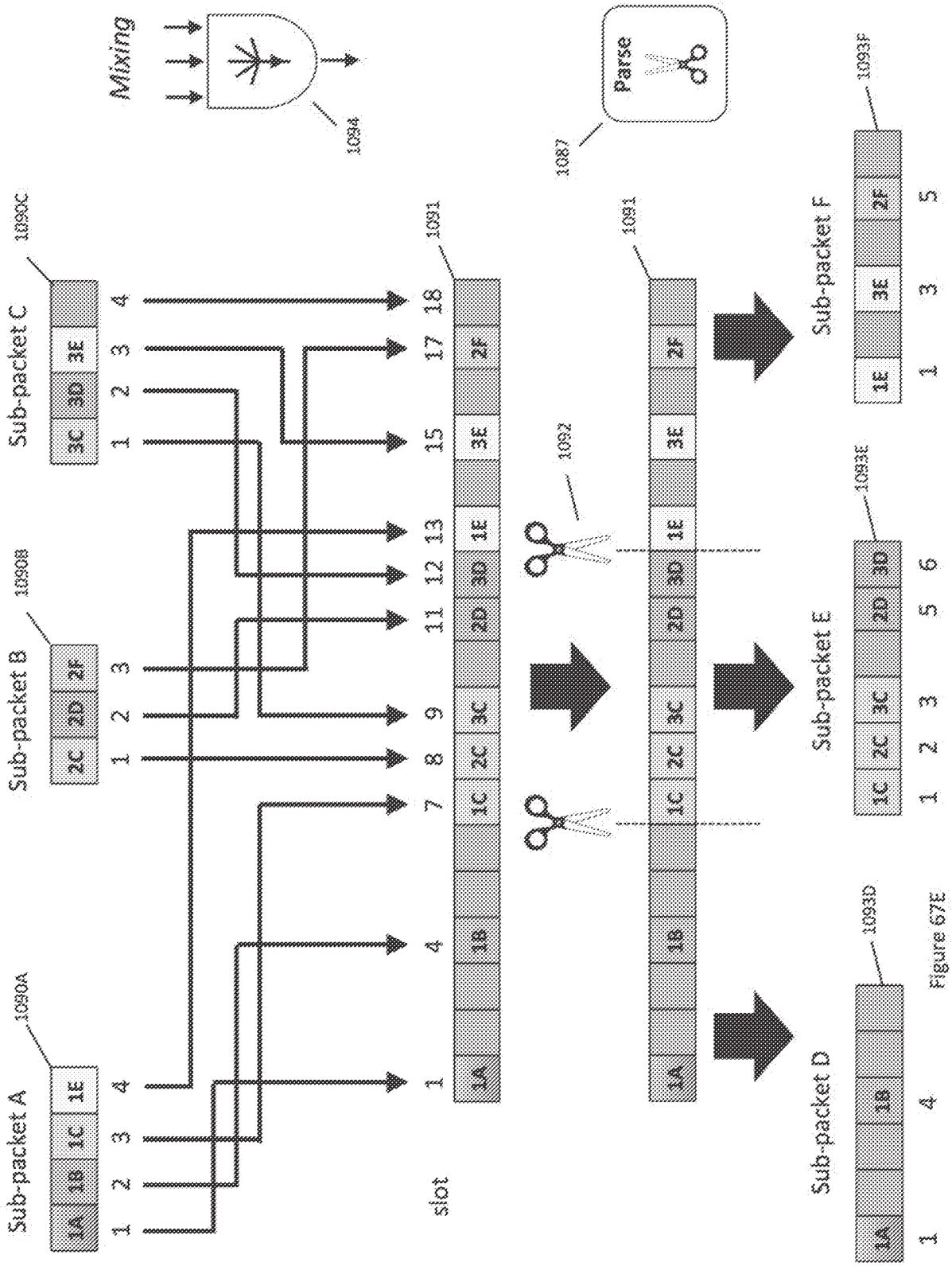

Sub-packet A
1090A
1A
1B
1C
1E
Sub-packet B
1090B
2C
2D
2F
Sub-packet C
1090C
3C
3D
3E
Mixing
1094
slot
1091
1087
Parse
1092
Sub-packet D
1093D
Sub-packet E
1093E
Sub-packet F
1093F

Figure 67E

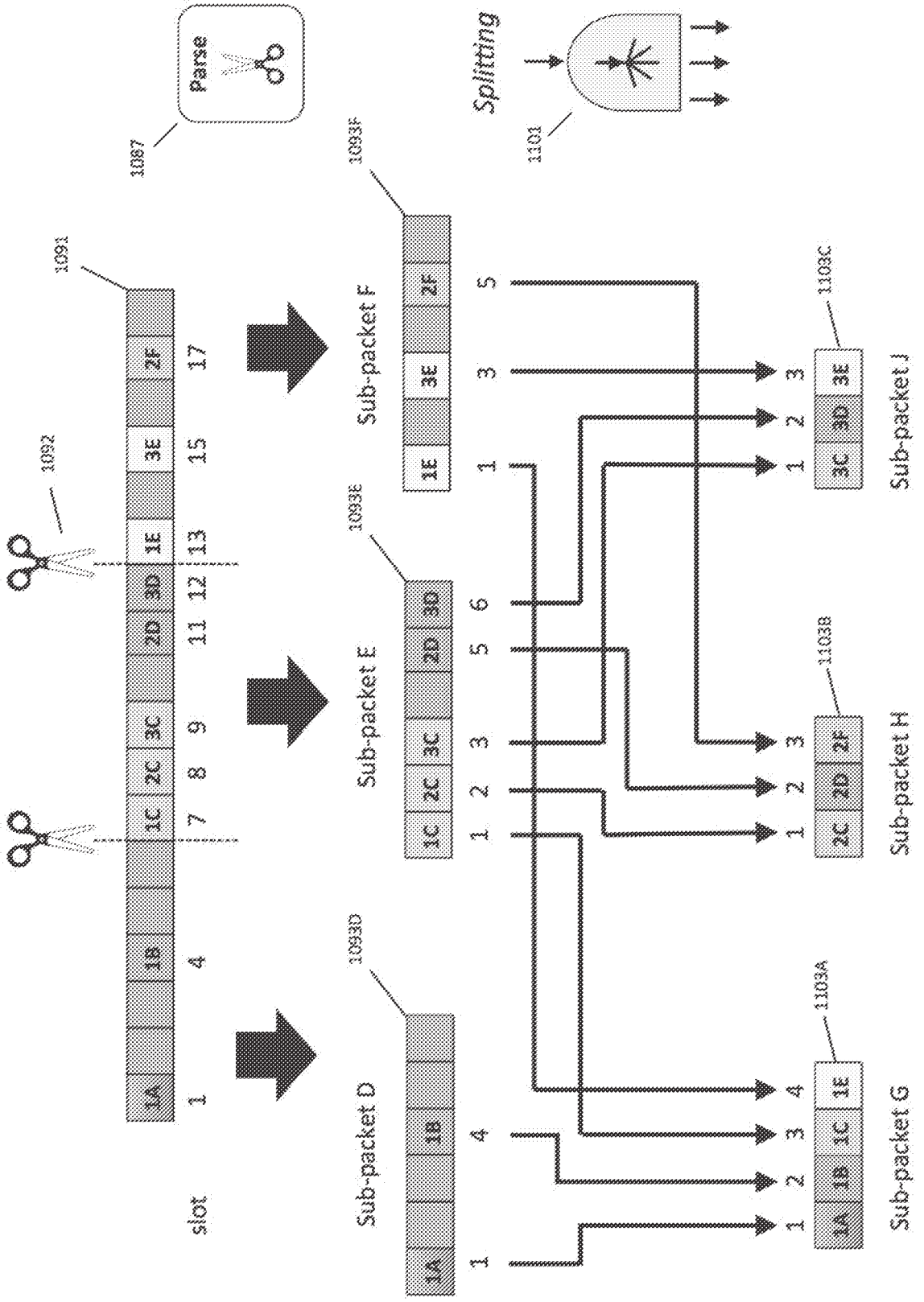

Parse
1087
1091
1092
1A
1B
1C
2C
3C
2D
3D
1E
3E
2F
slot
Splitting
1103
Sub-packet D
Sub-packet E
Sub-packet F
Sub-packet G
Sub-packet H
Sub-packet J
1093D
1093E
1093F
1103A
1103B
1103C

Figure 67F

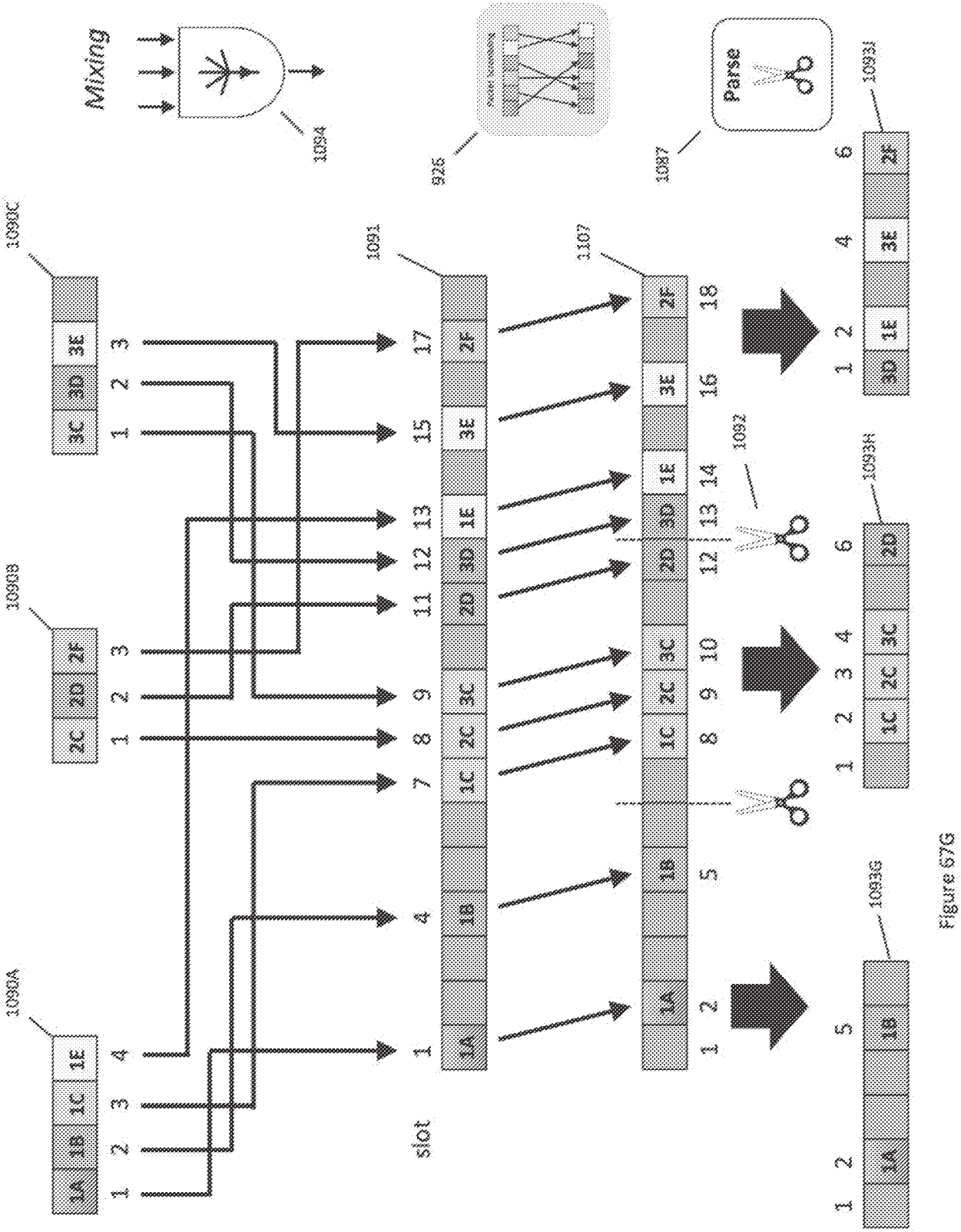

Mixing
1094
926
Parse
1087
1090A
1090B
1090C
1091
1107
1092
1093G
1093H
1093I
slot
1A
1B
1C
1E
2C
2D
2F
3C
3D
3E
1A
1B
1C
2C
3C
2D
3D
1E
3E
2F
1A
1B
1C
2C
3C
2D
3D
1E
3E
2F
1A
1B
1C
2C
3C
2D
3D
1E
3E
2F
1A
1B
1C
2C
3C
2D
3D
1E
3E
2F

Figure 67G

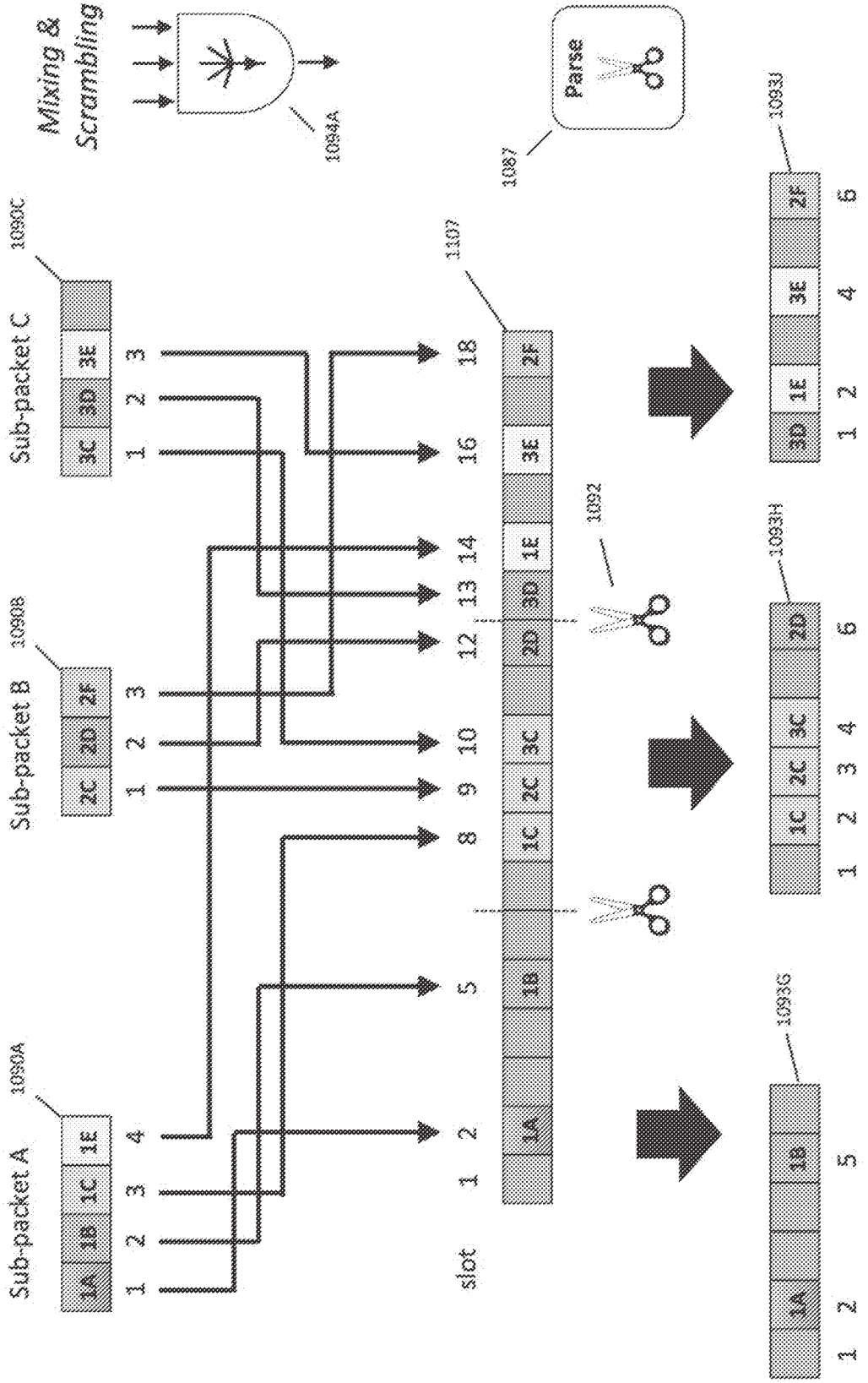

Sub-packet A
1090A
1A
1B
1C
1E
Sub-packet B
1090B
2C
2D
2F
Sub-packet C
1090C
3C
3D
3E
Mixing & Scrambling
1094A
1087
Parse
1092
1097
slot
1093G
1093H
1093J

Figure 67H

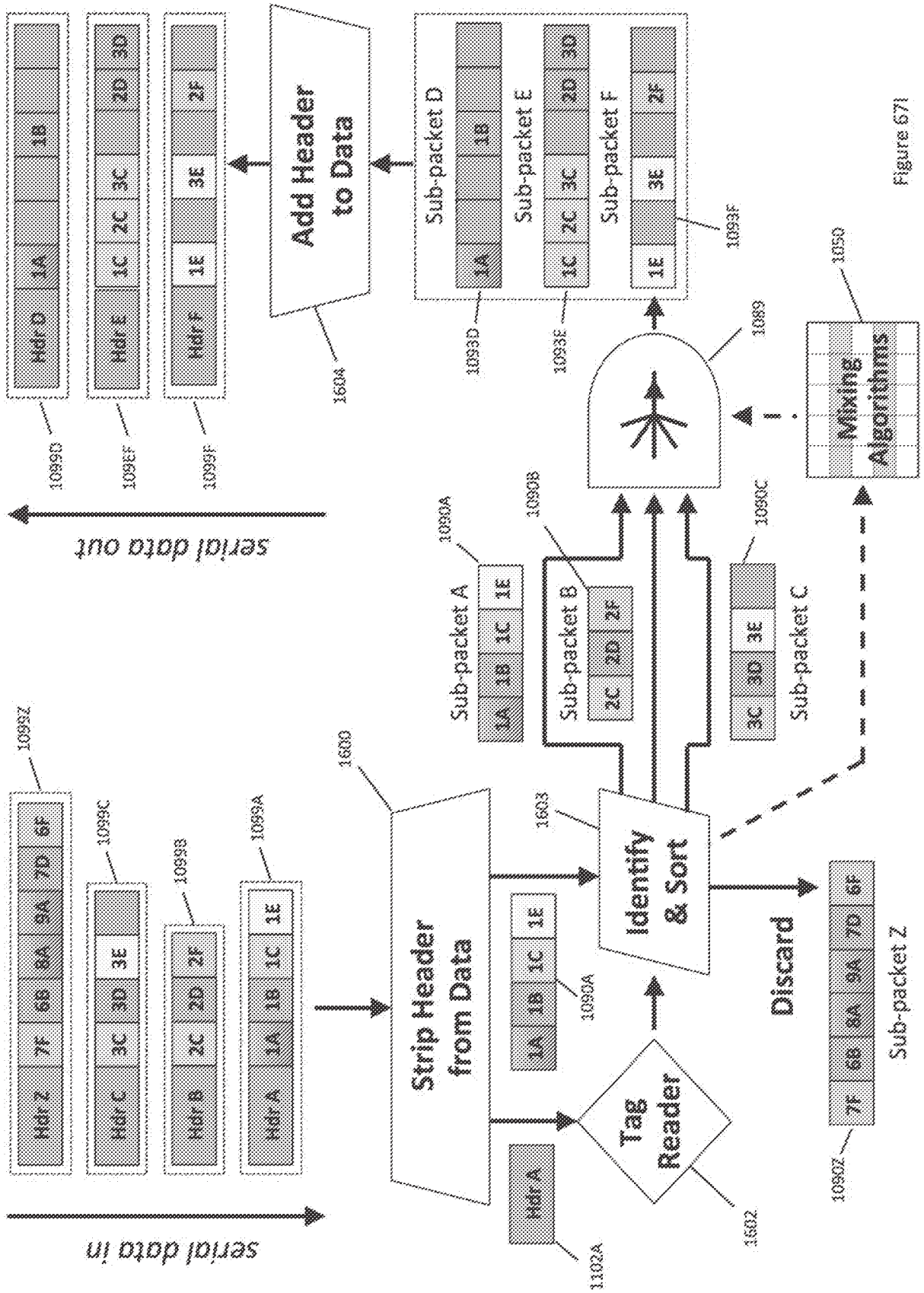

serial data in
Hdr Z
7F
6B
8A
9A
7D
6F
Hdr C
3C
3D
3E
Hdr B
2C
2D
2F
Hdr A
1A
1B
1C
1E
1099Z
1099C
1099B
1099A
1600
Strip Header from Data
1603
Identify & Sort
Discard
Tag Reader
1602
1102A
Hdr A
1A
1B
1C
1E
1090A
Sub-packet A
1A
1B
1C
1E
1090A
Sub-packet B
2C
2D
2F
1090B
Sub-packet C
3C
3D
3E
1090C
1089
1050
Mixing Algorithms
1093D
Sub-packet D
1A
1B
1093E
Sub-packet E
1C
2C
3C
2D
3D
1093F
Sub-packet F
1E
3E
2F
1604
Add Header to Data
Hdr D
1A
1B
1099D
Hdr E
1C
2C
3C
2D
3D
1099E
Hdr F
1E
3E
2F
1099F
serial data out
1090Z
7F
6B
8A
9A
7D
6F
Sub-packet Z

Figure 671

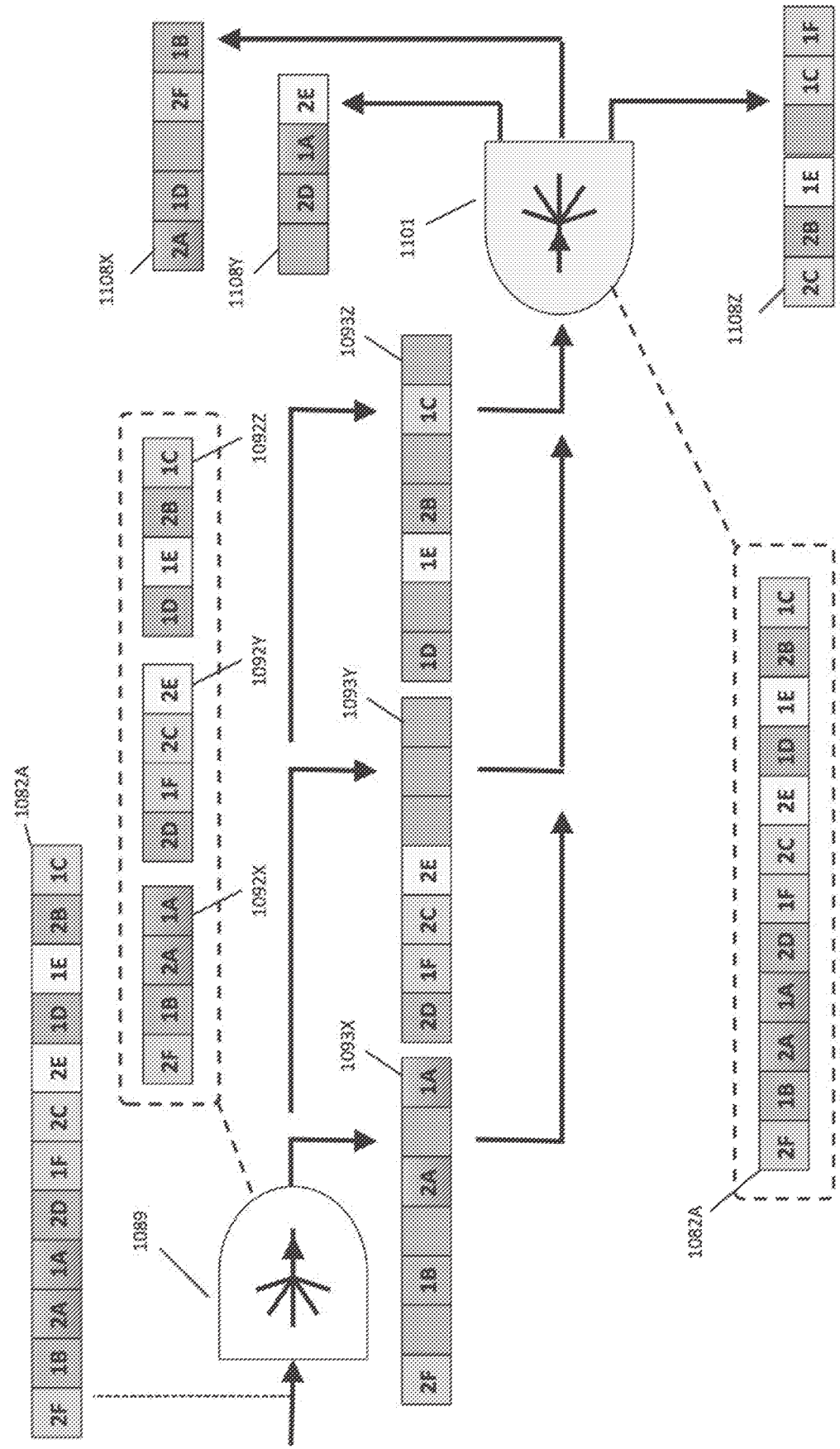

1092A
2F 1B 2A 1A 2D 1F 2C 2E 1D 1E 2B 1C
1089
1092X
2F 1B 2A 1A 2D 1F 2C 2E 1D 1E 2B 1C
1092Y
2F 1B 2A 1A 2D 1F 2C 2E 1D 1E 2B 1C
1092Z
2F 1B 2A 1A 2D 1F 2C 2E 1D 1E 2B 1C
1093X
2F 1B 2A 1A 2D 1F 2C 2E 1D 1E 2B 1C
1093Y
1093Z
1101
1108X
2A 1D 2F 1B
1108Y
2D 1A 2E
1108Z
2C 2B 1E 1C 1F

Figure 67J

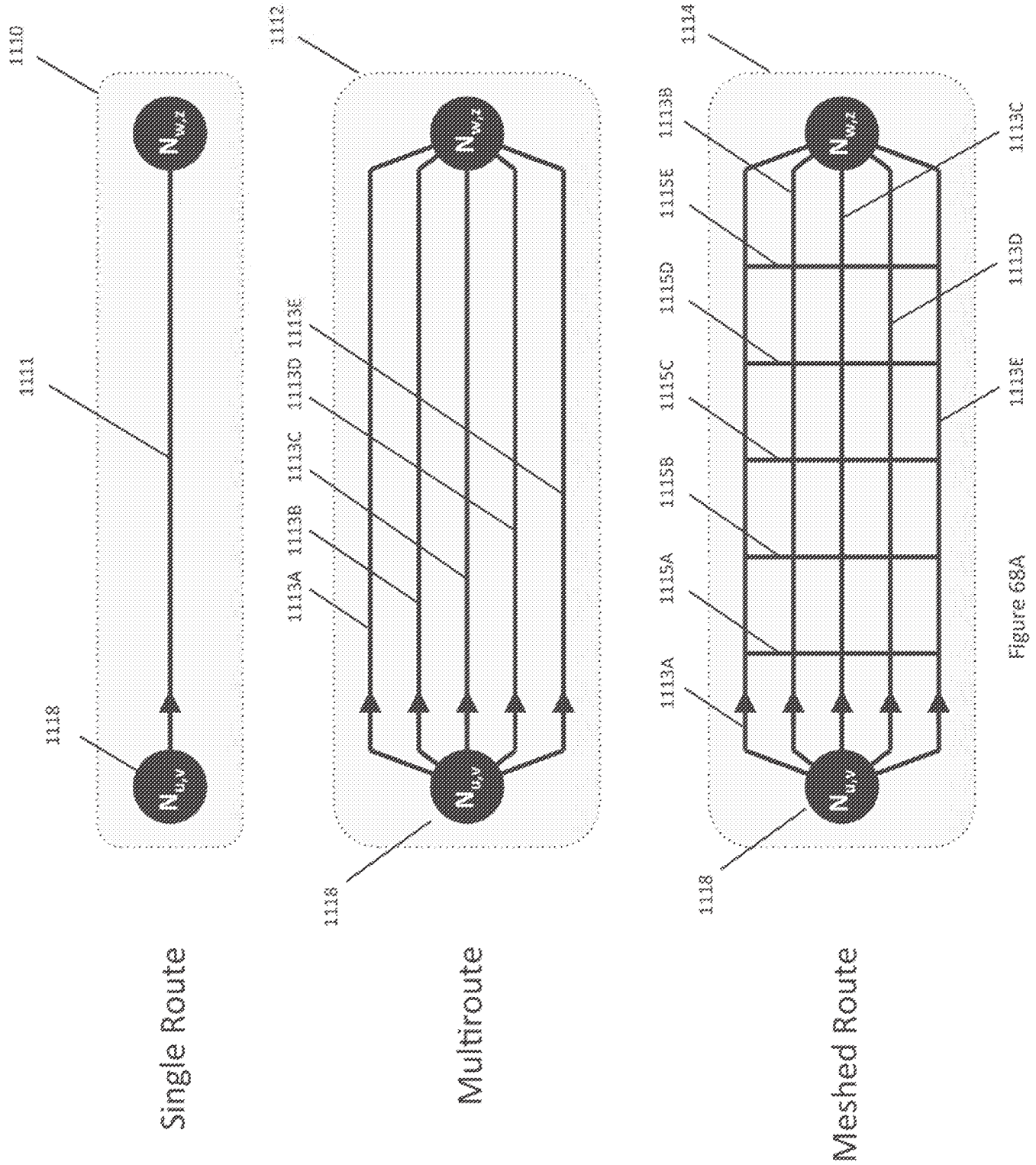

1110
1111
1118
Single Route
1112
1113A
1113B
1113C
1113D
1113E
1118
Multiroute
1114
1113A
1115A
1115B
1115C
1115D
1115E
1113B
1113C
1113D
1113E
1118
Meshed Route

Figure 68A

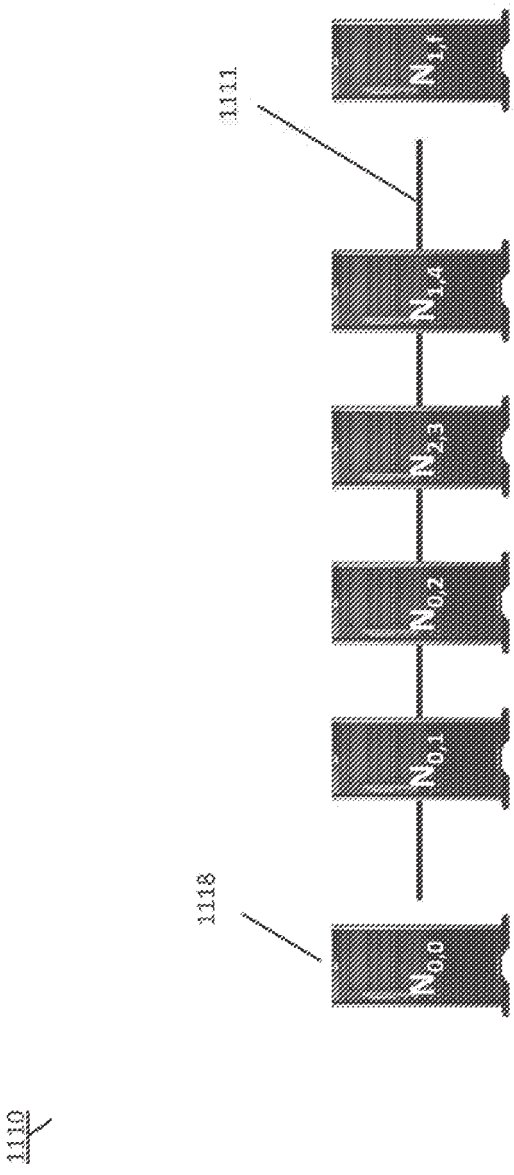


Figure 68B

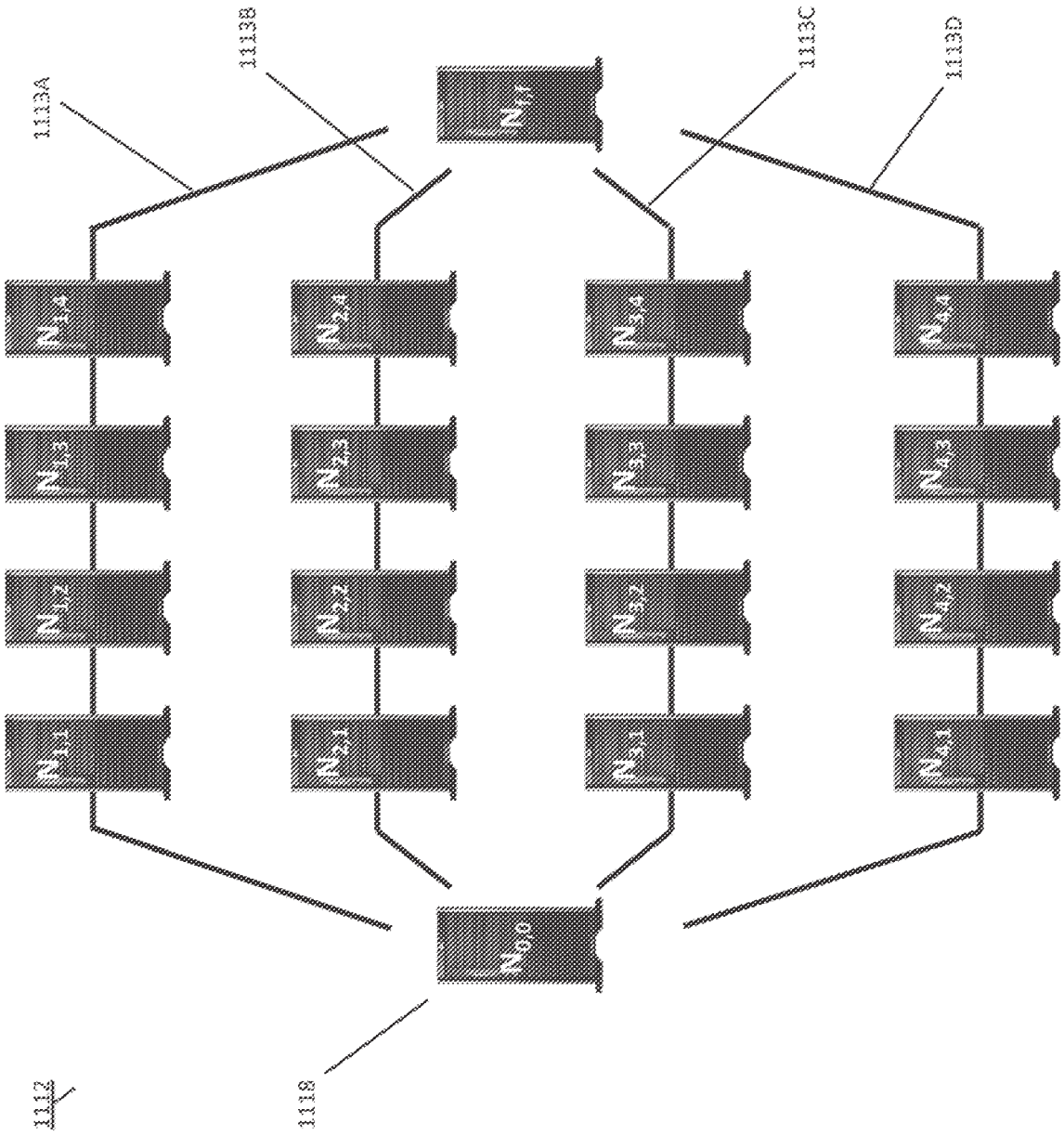

1112
1118
1113A
1113B
1113C
1113D
$N_{0,0}$
$N_{1,1}$
$N_{1,2}$
$N_{1,3}$
$N_{1,4}$
$N_{2,1}$
$N_{2,2}$
$N_{2,3}$
$N_{2,4}$
$N_{3,1}$
$N_{3,2}$
$N_{3,3}$
$N_{3,4}$
$N_{4,1}$
$N_{4,2}$
$N_{4,3}$
$N_{4,4}$
$N_{5,1}$

Figure 68C

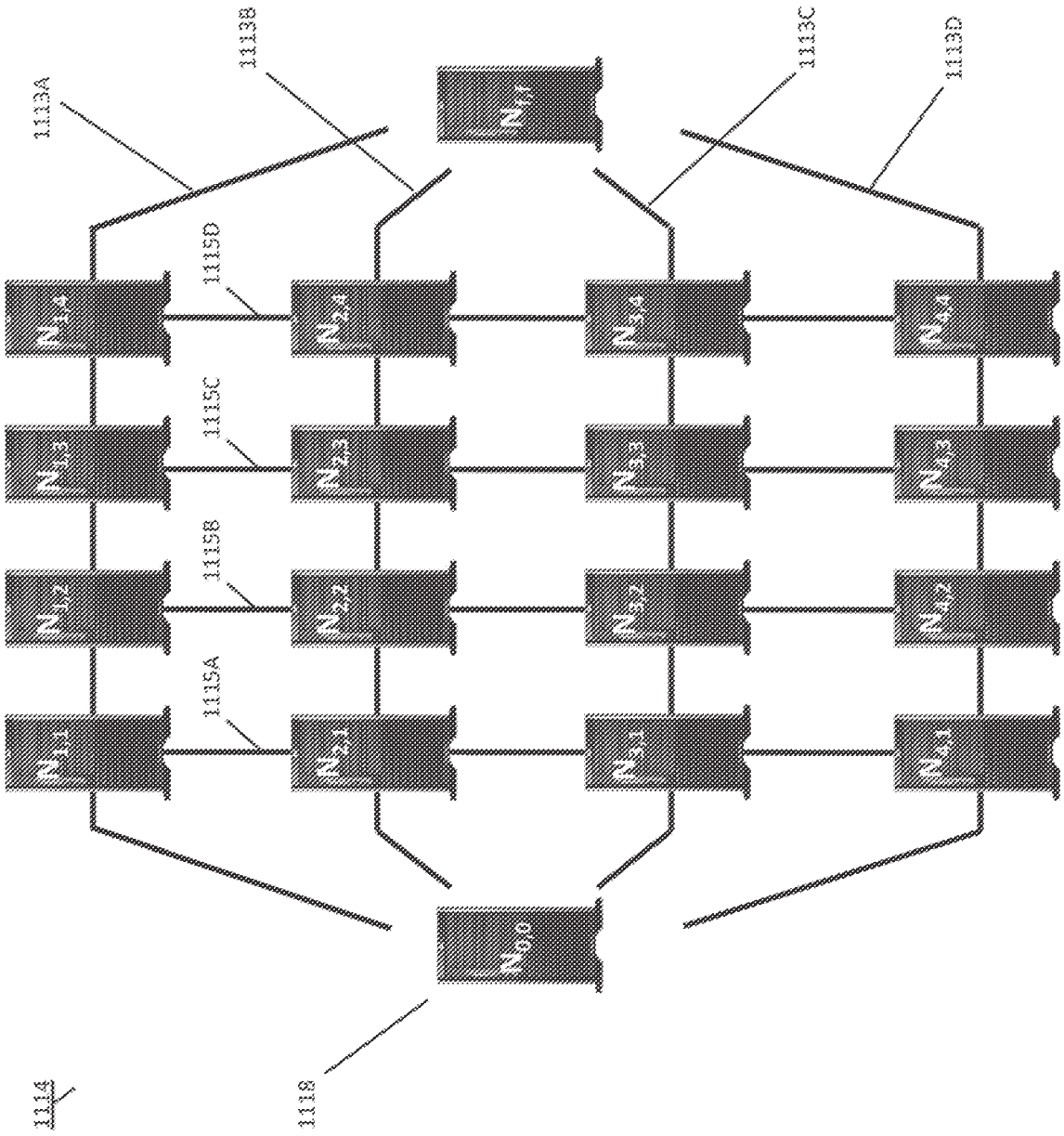

1114
1118
1113A
1113B
1113C
1113D
1115A
1115B
1115C
1115D
$N_{0,0}$
$N_{1,1}$
$N_{1,2}$
$N_{1,3}$
$N_{1,4}$
$N_{2,1}$
$N_{2,2}$
$N_{2,3}$
$N_{2,4}$
$N_{3,1}$
$N_{3,2}$
$N_{3,3}$
$N_{3,4}$
$N_{4,1}$
$N_{4,2}$
$N_{4,3}$
$N_{4,4}$
$N_{5,1}$
$N_{5,2}$
$N_{5,3}$
$N_{5,4}$
$N_{6,1}$

Figure 68D

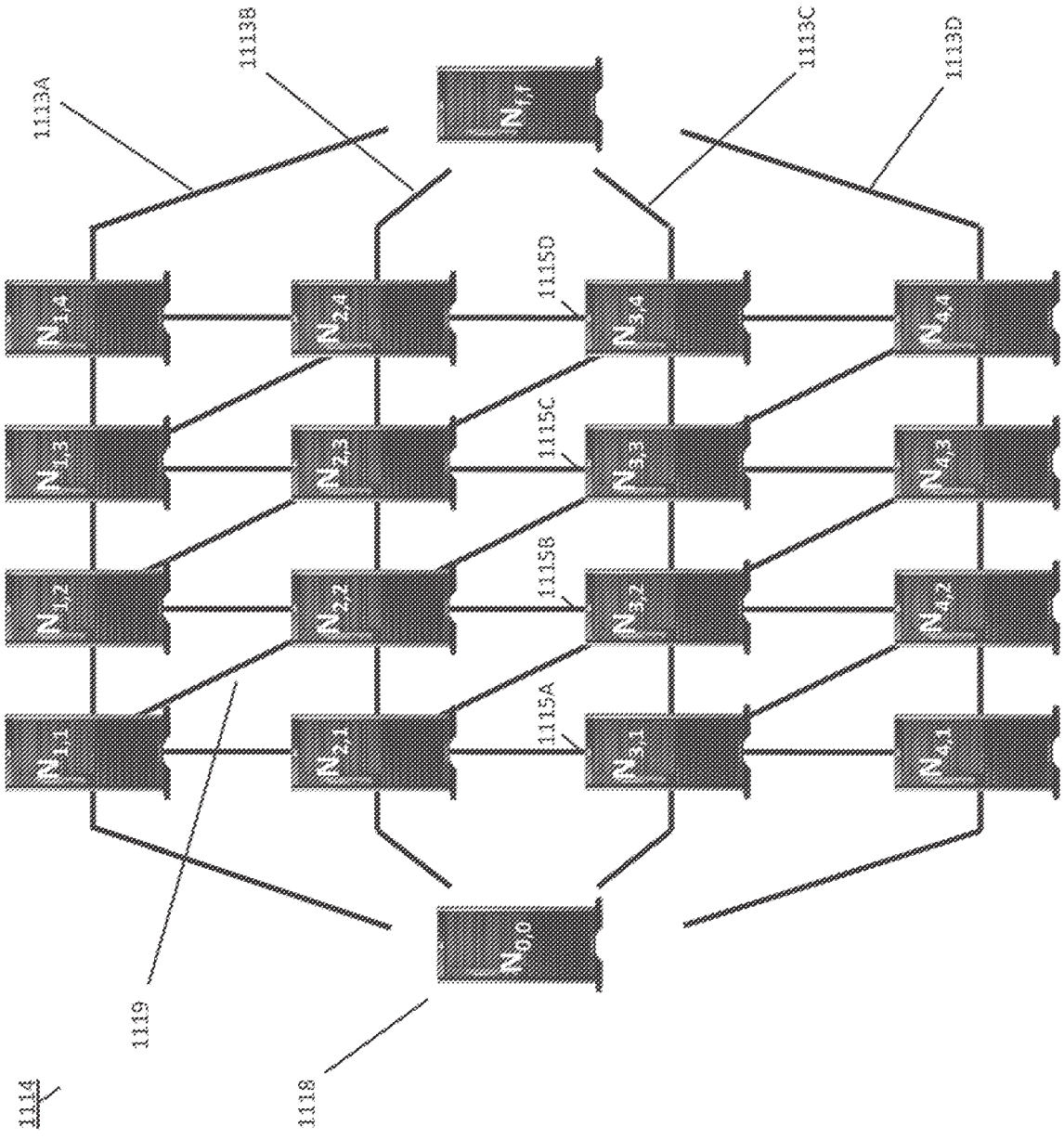

1114
1119
1118
1113A
1113B
1113C
1113D
1115A
1115B
1115C
1115D
$N_{0,0}$
$N_{1,1}$
$N_{1,2}$
$N_{1,3}$
$N_{1,4}$
$N_{2,1}$
$N_{2,2}$
$N_{2,3}$
$N_{2,4}$
$N_{3,1}$
$N_{3,2}$
$N_{3,3}$
$N_{3,4}$
$N_{4,1}$
$N_{4,2}$
$N_{4,3}$
$N_{4,4}$
$N_{5,1}$
$N_{5,2}$
$N_{5,3}$
$N_{5,4}$
$N_{6,1}$

Figure 68E

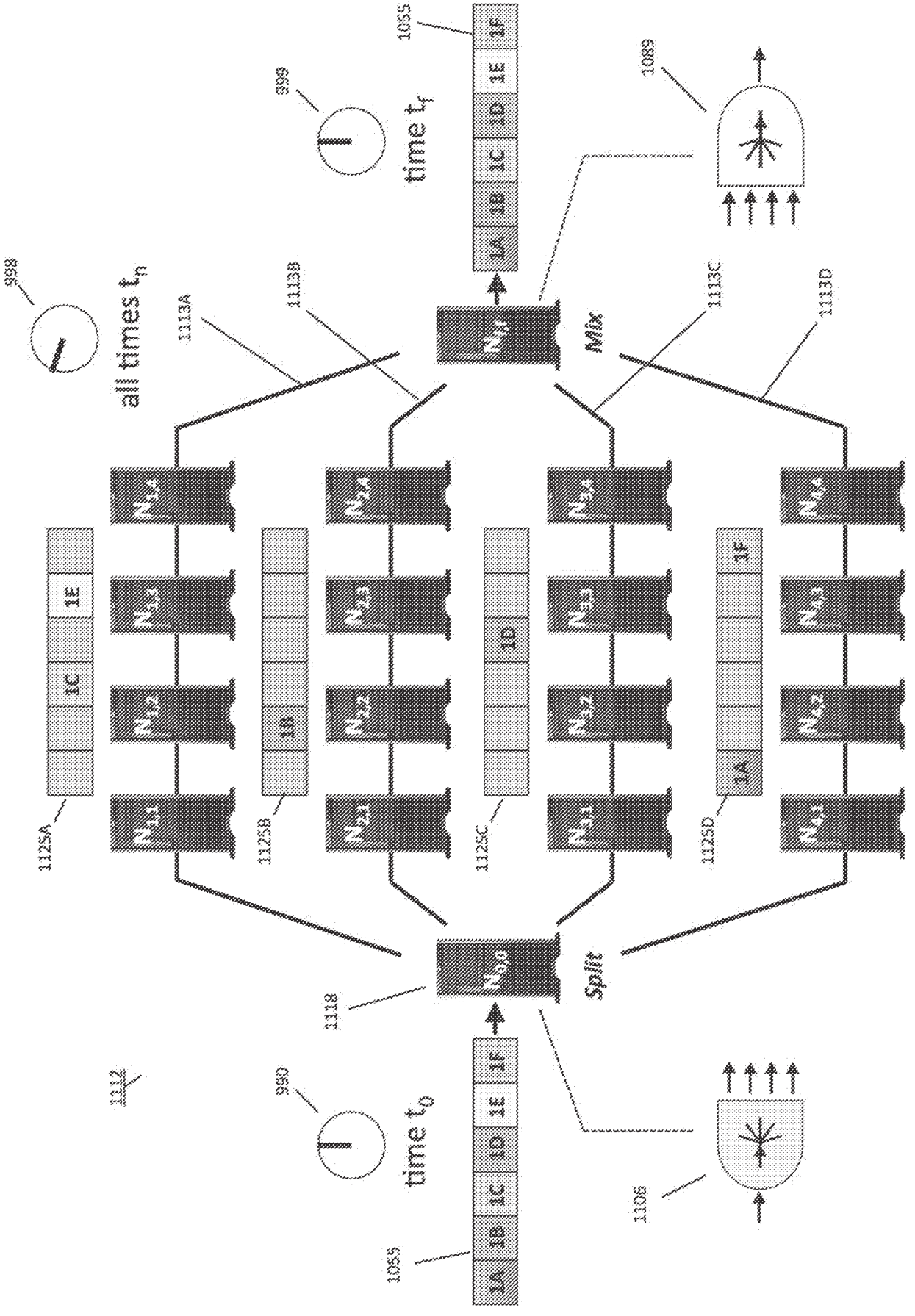

1112
998
all times t_n
999
time t_f
990
time t_0
1055
1A
1B
1C
1D
1E
1F
1089
1106
1118
Split
Mix
1113A
1113B
1113C
1113D
1125A
1125B
1125C
1125D

Figure 69

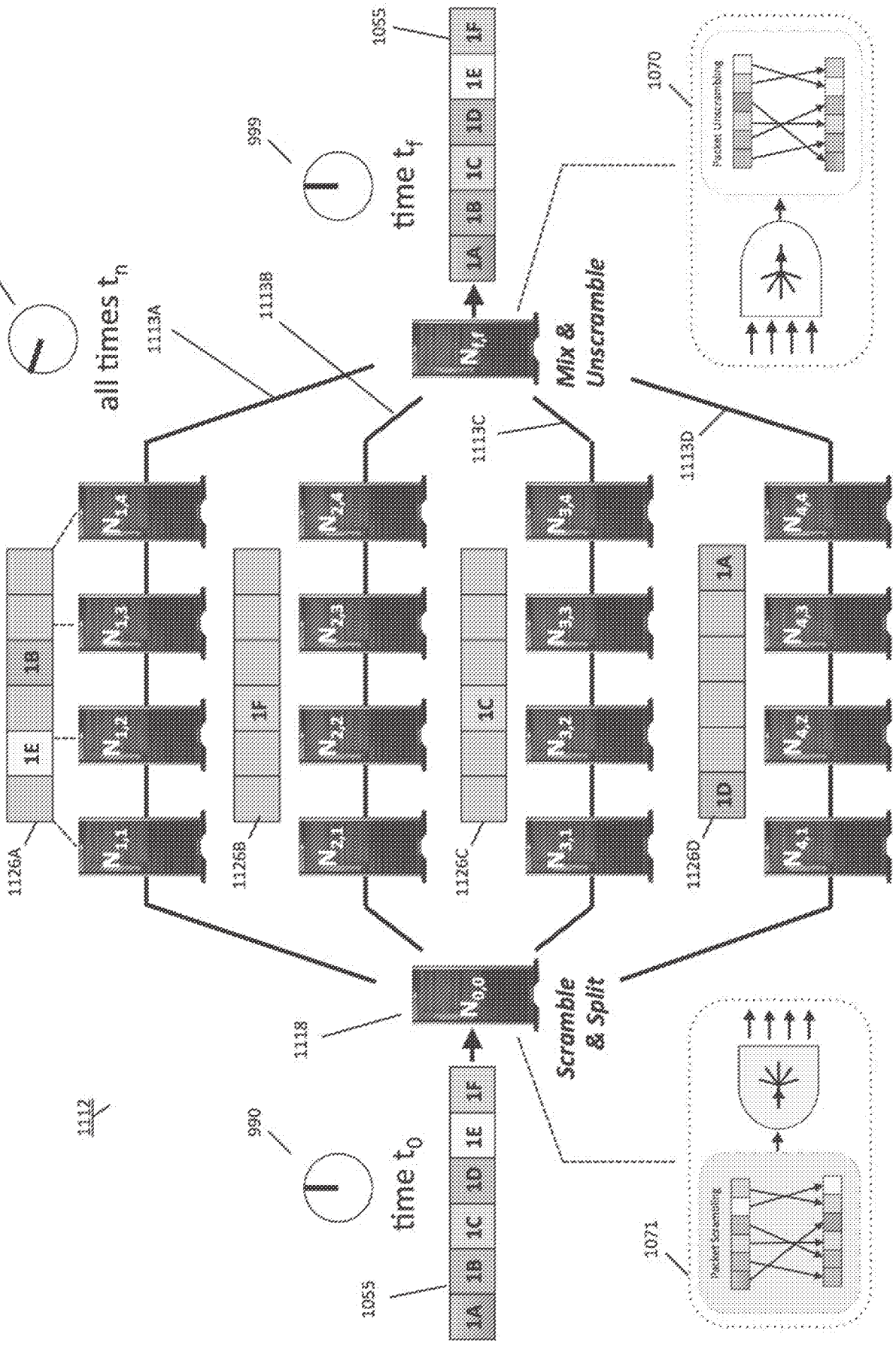

1112
998
all times t_n
999
time t_f
990
time t_0
1055
1A
1B
1C
1D
1E
1F
1118
1113A
1113B
1113C
1113D
Scramble & Split
Mix & Unscramble
1126A
1126B
1126C
1126D
1070
1071
Packet Unscrambling
Packet Scrambling

Figure 70

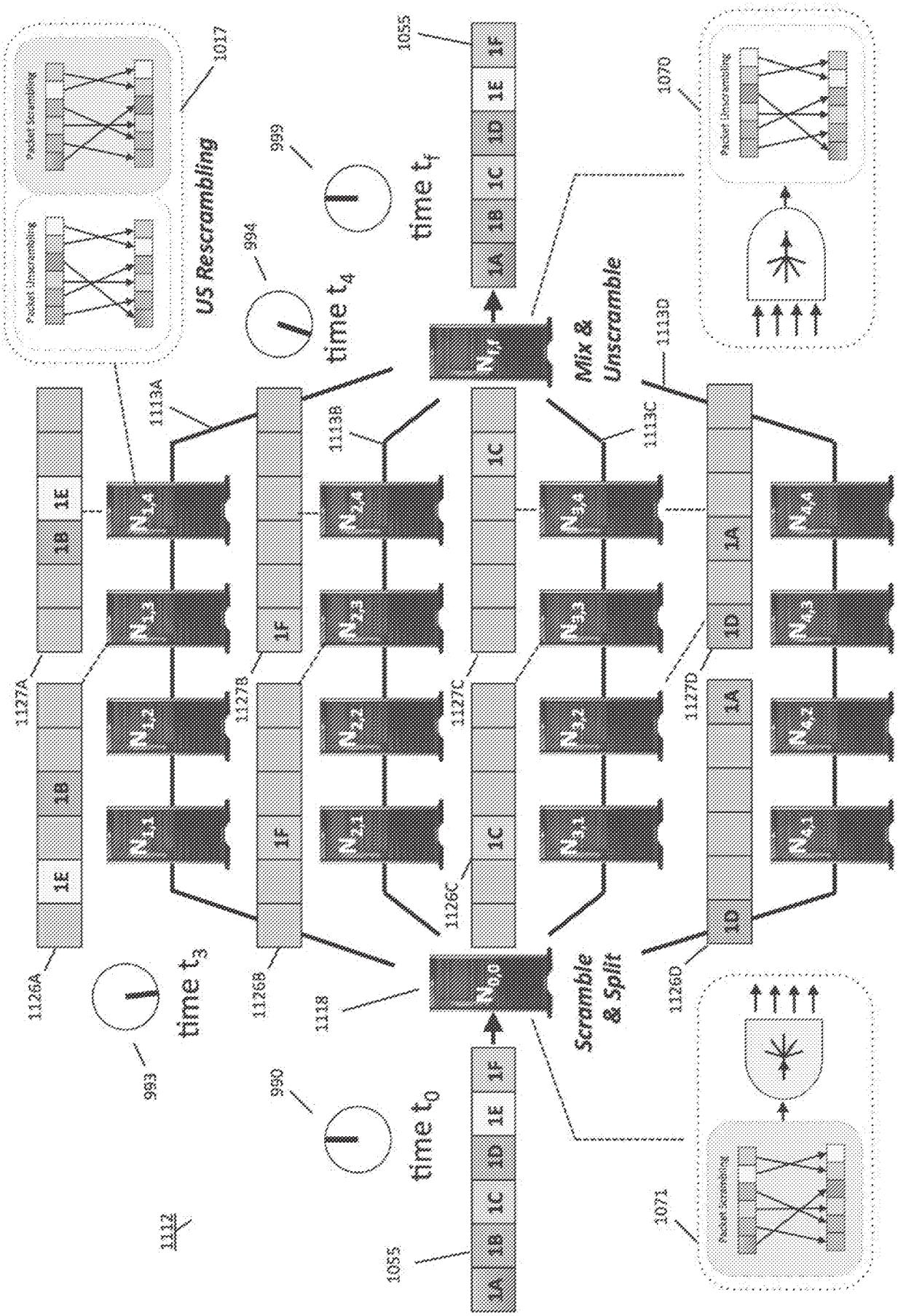

1112
1126A
1127A
1113A
1126B
1127B
1113B
1126C
1127C
1113C
1126D
1127D
1113D
1118
1017
1055
1070
1071
983
990
994
999
time t_0
time t_3
time t_4
time t_f
Scramble & Split
Mix & Unscramble
US Rescrambling
Packet Scrambling
Packet Unscrambling

Figure 71A

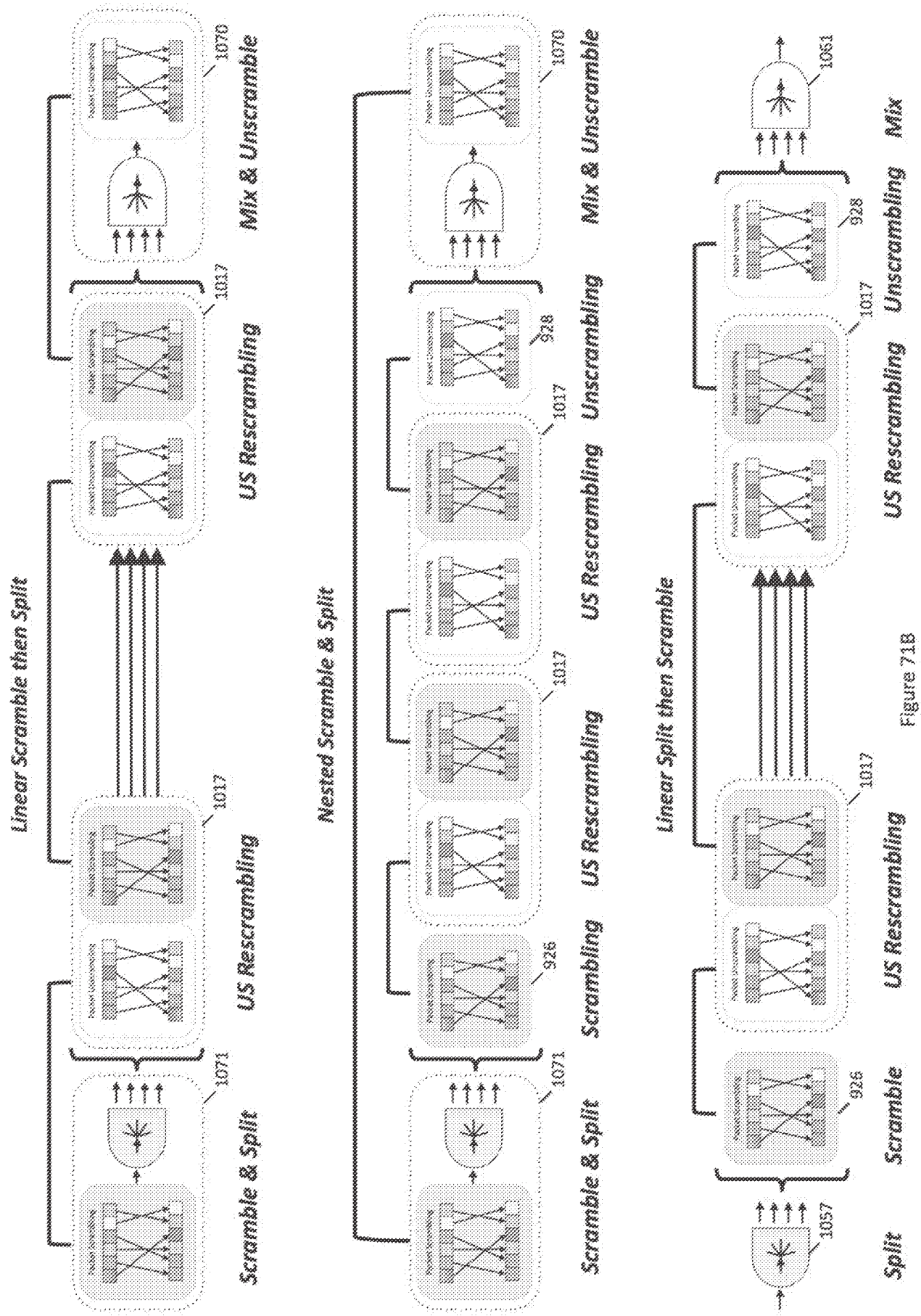

Linear Scramble then Split
Scramble & Split
US Rescrambling
Mix & Unscramble
1071
1017
1070
Nested Scramble & Split
Scramble & Split
Scrambling
US Rescrambling
Unscrambling
Mix & Unscramble
926
928
Linear Split then Scramble
Split
Scramble
US Rescrambling
Unscrambling
Mix
1057
1061

Figure 71B

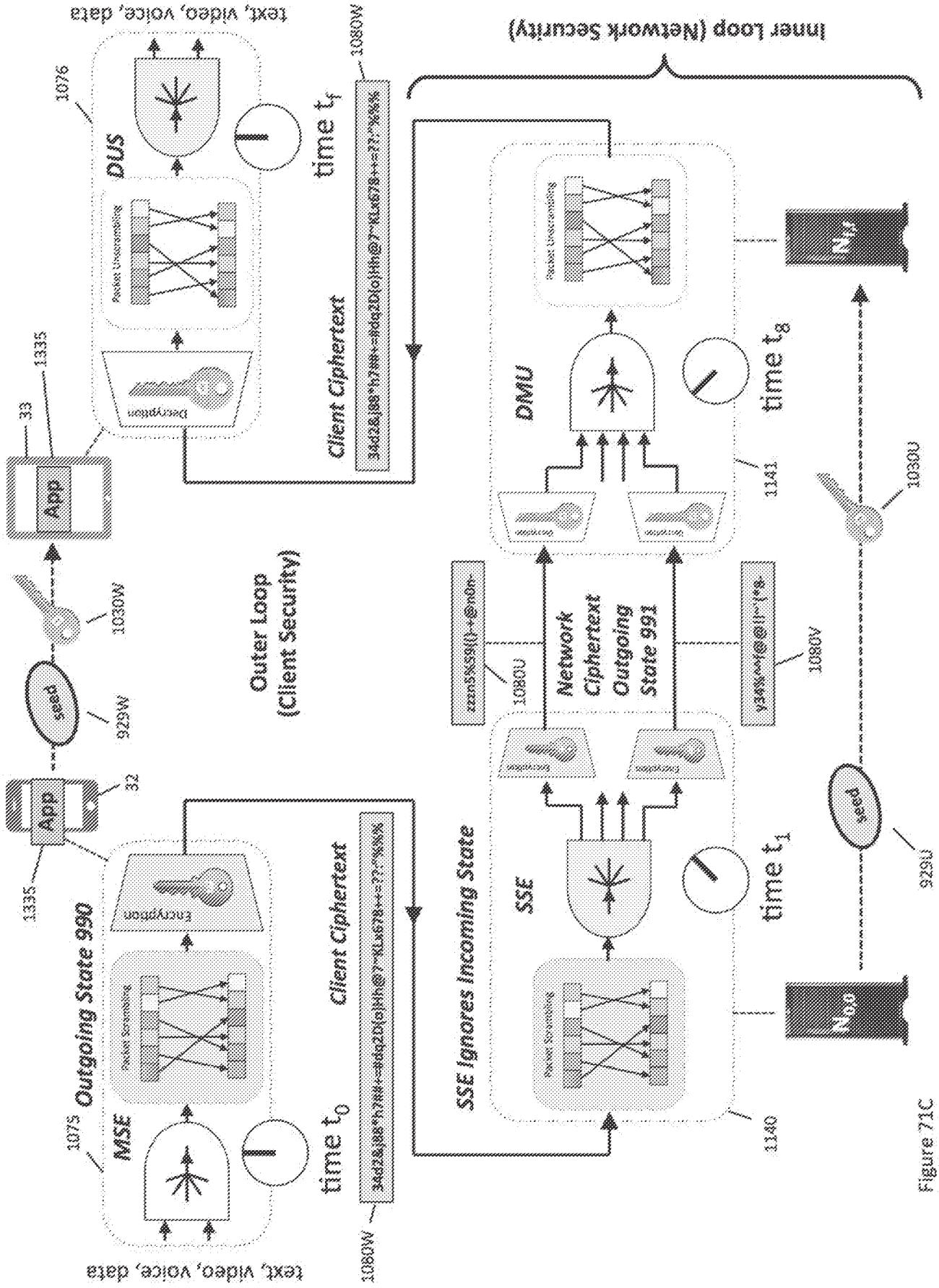

text, video, voice, data
1076
DUS
Packet Unscrambling
Decryption
time t_f
1080W
Client Ciphertext
3d428j88*h7##+=#dq2DjoJHh@7~KLs678++=??:*%%%
Inner Loop (Network Security)
33
1335
App
1030W
seed
929W
Outer Loop
(Client Security)
32
1335
App
Encryption
Packet Scrambling
1075
MSE
Outgoing State 990
text, video, voice, data
1080W
Client Ciphertext
3d428j88*h7##+=#dq2DjoJHh@7~KLs678++=??:*%%%
time t_0
SSE Ignores Incoming State
SSE
Encryption
Packet Scrambling
1140
time t_1
N_{00}
929U
seed
1030U
1141
DMU
Decryption
Packet Unscrambling
time t_8
N_{77}
1080U
zzn9$$$8(}~+@n0n-
Network Ciphertext Outgoing State 991
1080V
y2a$A^^e@!!*(*$-

Figure 71C

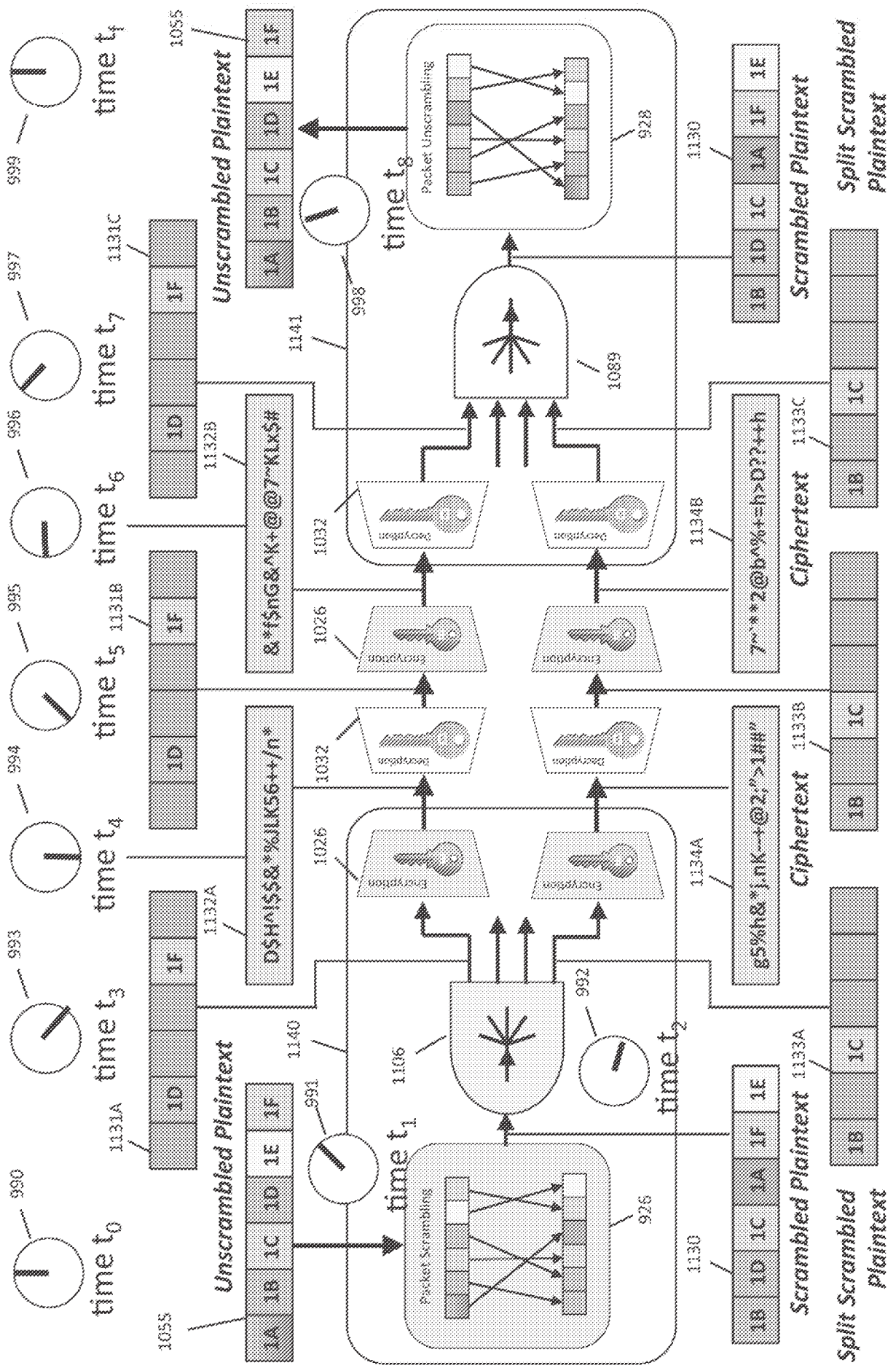

time t_0
time t_1
time t_2
time t_3
time t_4
time t_5
time t_6
time t_7
time t_8
Unscrambled Plaintext
Scrambled Plaintext
Split Scrambled Plaintext
Ciphertext
Packet Scrambling
Packet Unscrambling
Encryption
Decryption
1055
1130
1131A
1131B
1131C
1132A
1132B
1133A
1133B
1133C
1134A
1134B
1140
1141
1106
1026
1032
1089
926
928
990
991
992
993
994
995
996
997
998
999

Figure 72

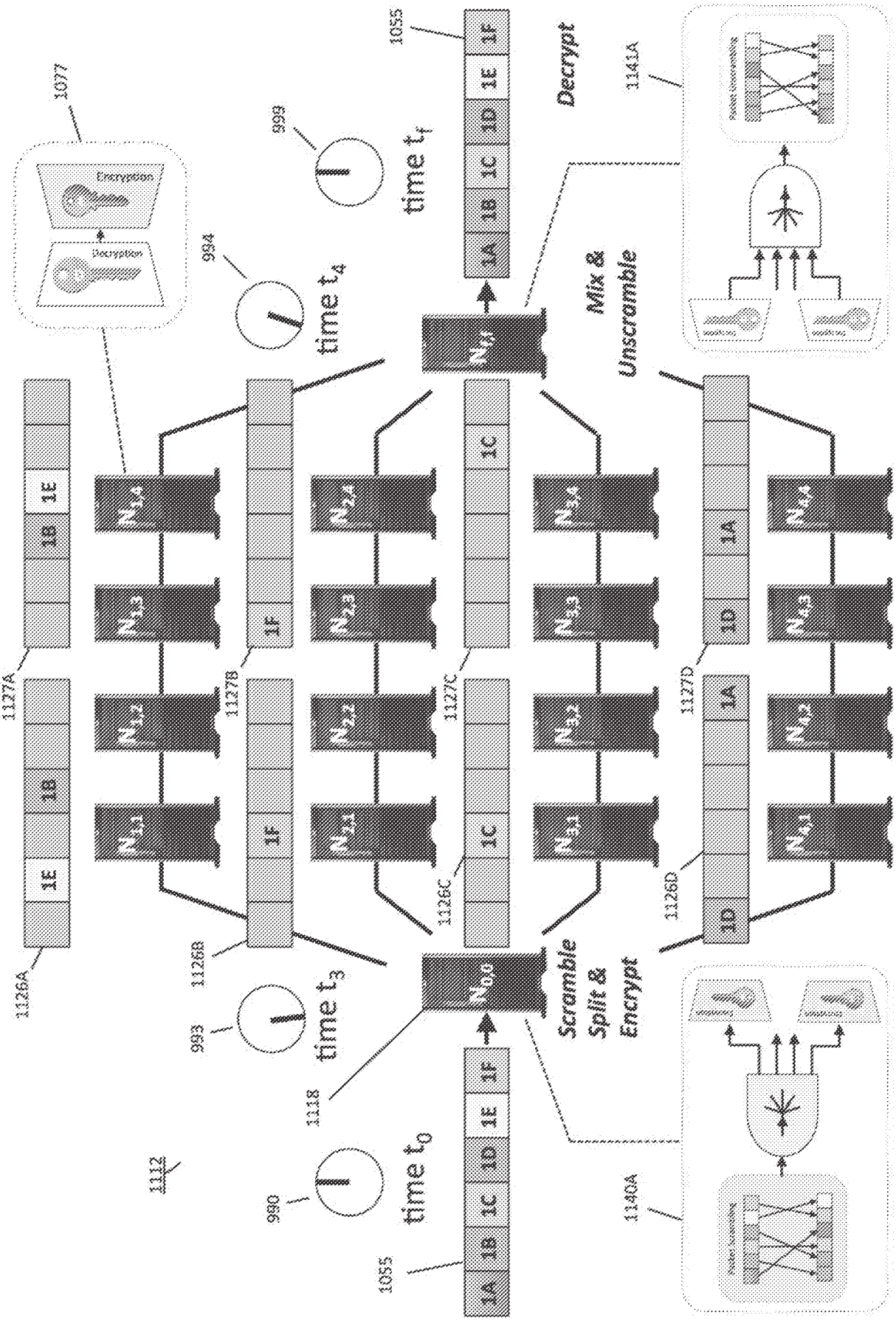

1112
1118
1126A
1126B
1126C
1126D
1127A
1127B
1127C
1127D
1140A
1141A
1055
1077
990
993
994
999
time t_0
time t_3
time t_4
time t_f
Scramble Split & Encrypt
Mix & Unscramble
Decrypt
Encryption
Decryption
1A
1B
1C
1D
1E
1F

Figure 73

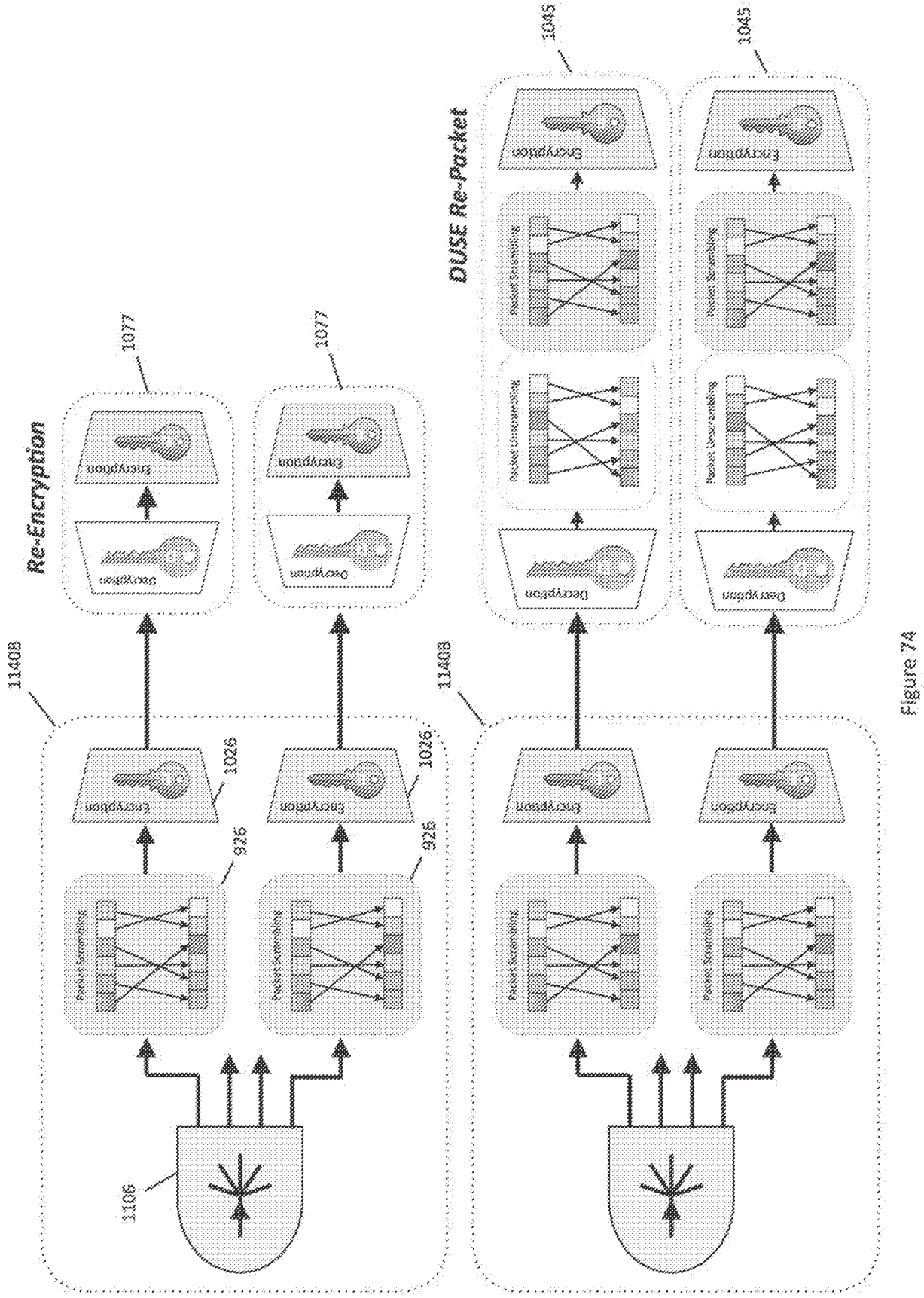

Re-Encryption
DUSE Re-Packet
1077
1045
1026
926
1140B
1106
Encryption
Decryption
Packet Scrambling
Packet Unscrambling

Figure 74

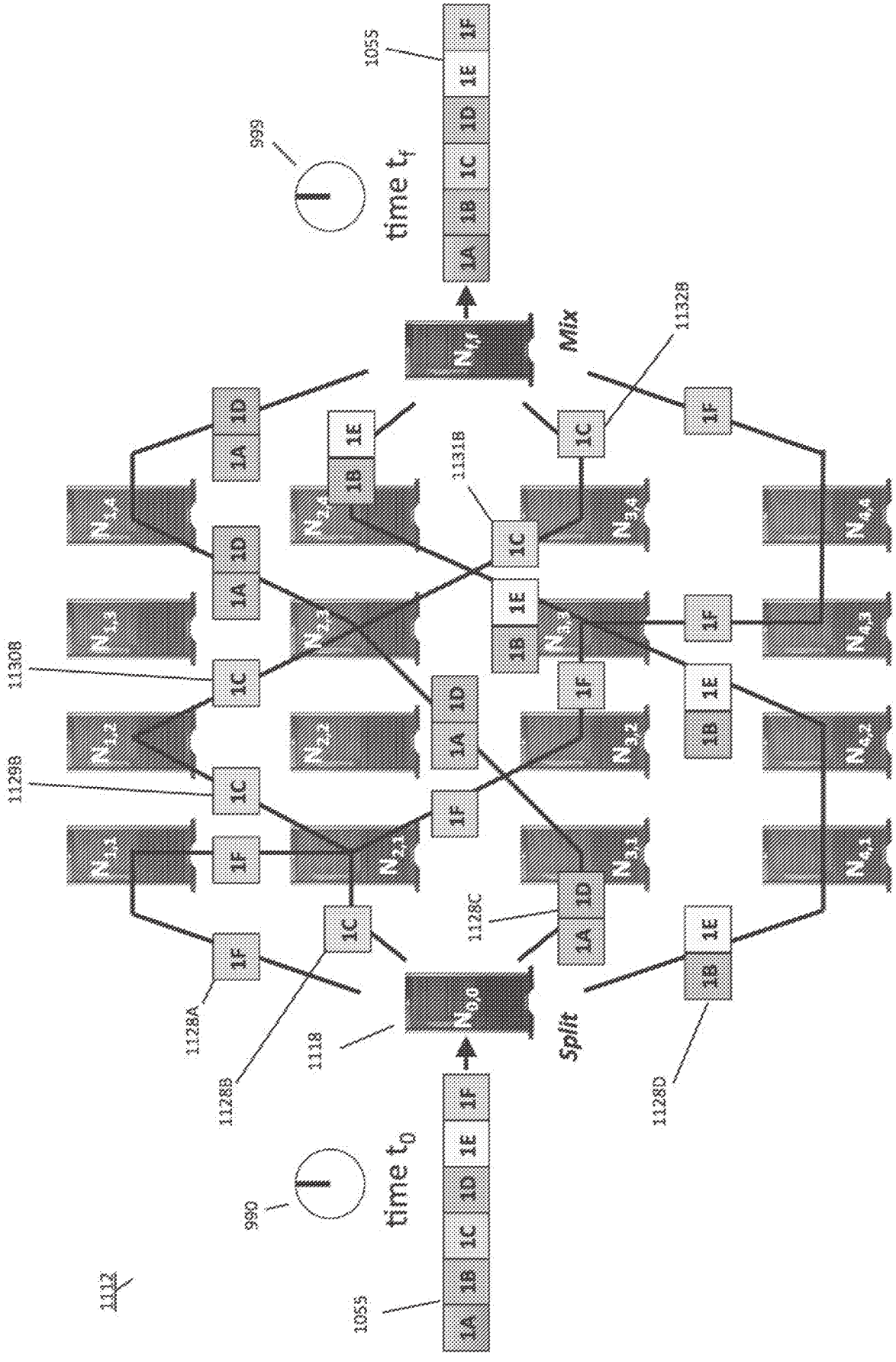

1112
990
time t_0
1055
1A
1B
1C
1D
1E
1F
1118
1128A
1128B
1128C
1128D
Split
999
time t_f
1055
Mix
11308
11288
11318
11328

Figure 75

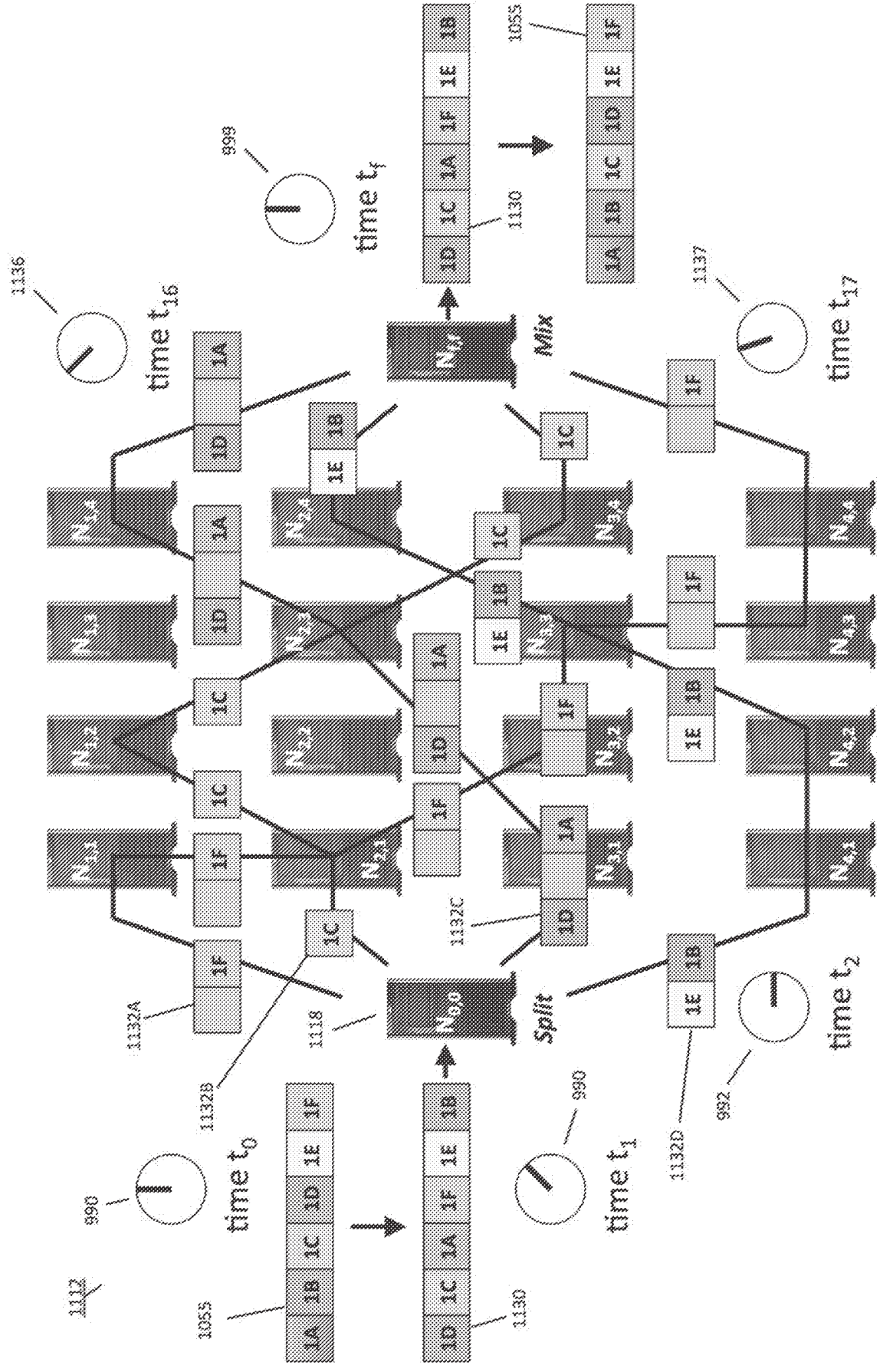

1112
990
time t_0
1055
1130
1132A
1132B
1118
1132C
Split
990
time t_1
1132D
992
time t_2
Mix
999
time t_f
1055
1130
1136
time t_{16}
1137
time t_{17}

Figure 76

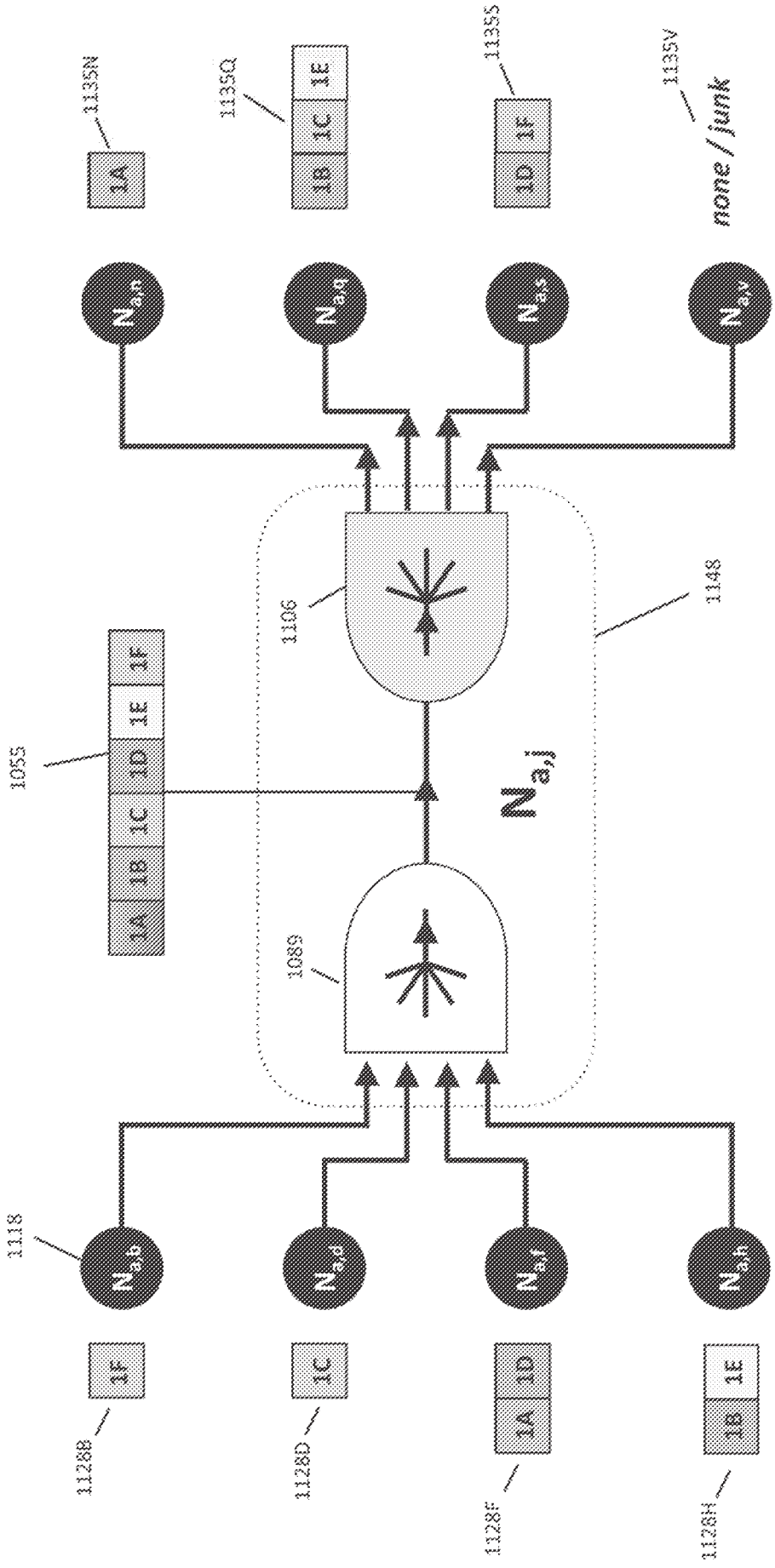

1135N
1A
1135Q
1B
1C
1E
11355
1D
1F
1135V
none / junk
$N_{a,n}$
$N_{a,o}$
$N_{a,s}$
$N_{a,v}$
1106
1148
1055
1A
1B
1C
1D
1E
1F
$N_{a,j}$
1089
1118
$N_{a,b}$
$N_{a,d}$
$N_{a,f}$
$N_{a,h}$
1128B
1128D
1128F
1128H

Figure 77A

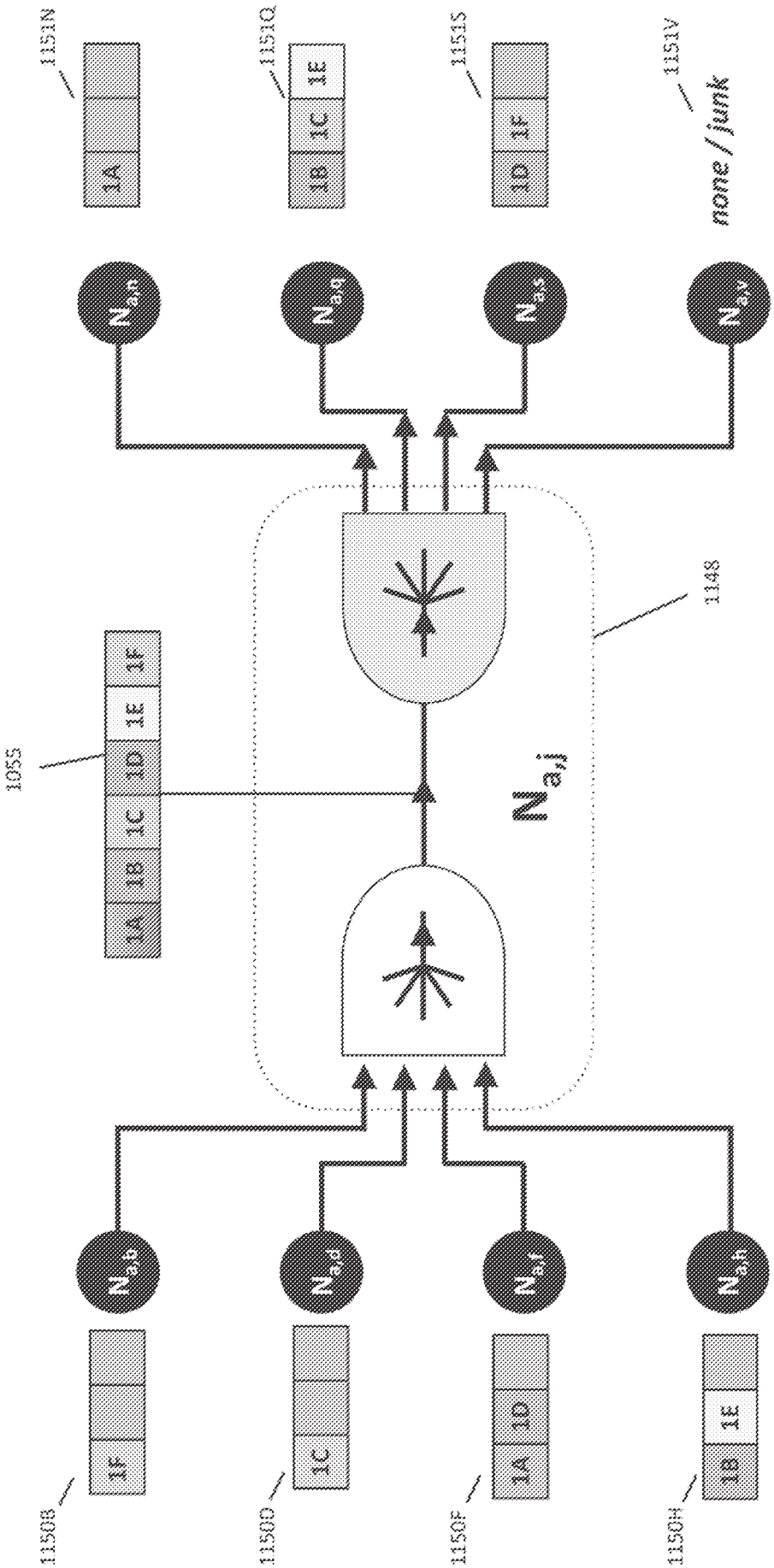

1151N
1151Q
1151S
1151V
none / junk
1A
1B
1C
1D
1E
1F
1055
1148
$N_{a,i}$
1150B
1150D
1150F
1150H

Figure 77B

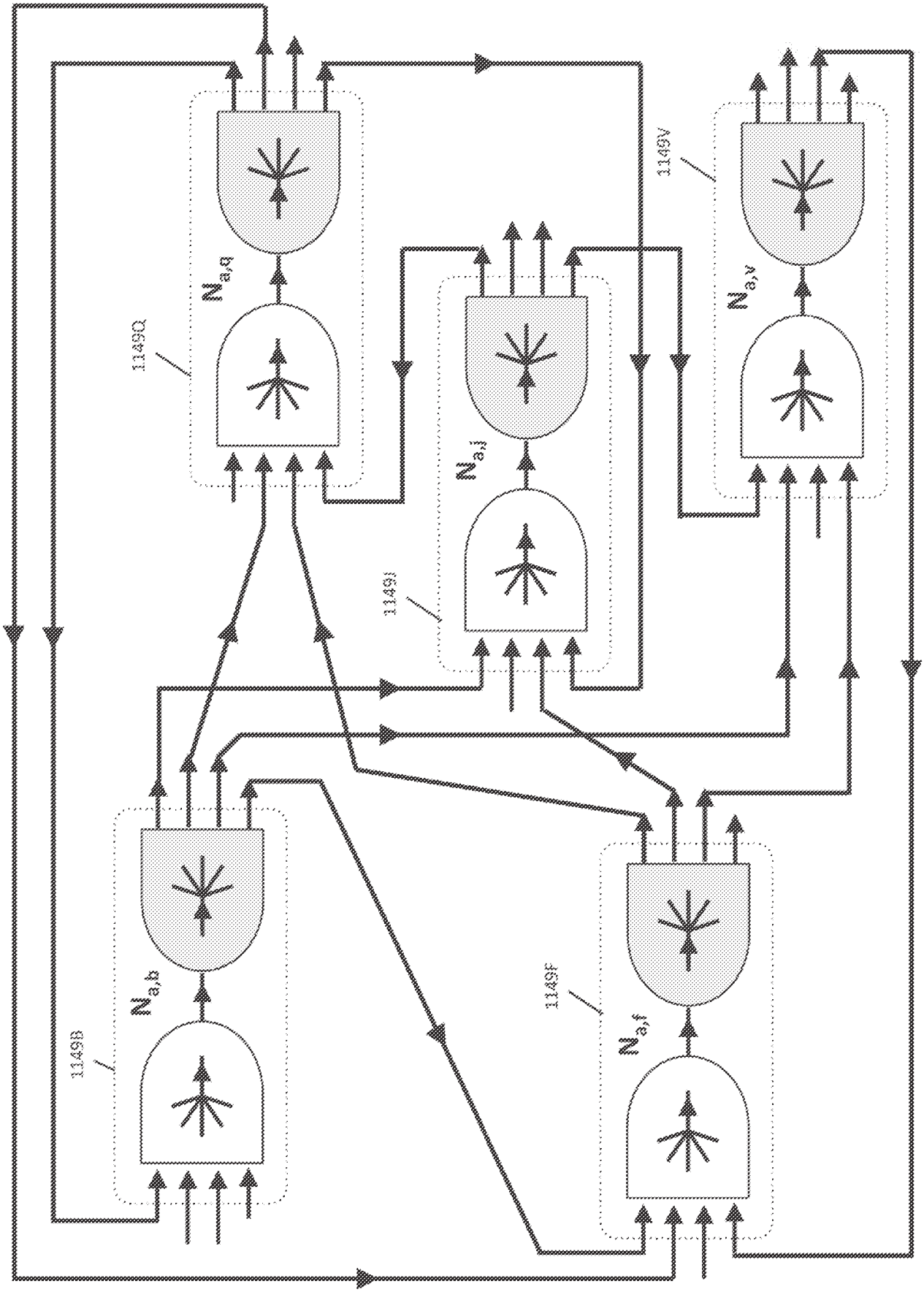


Figure 77C

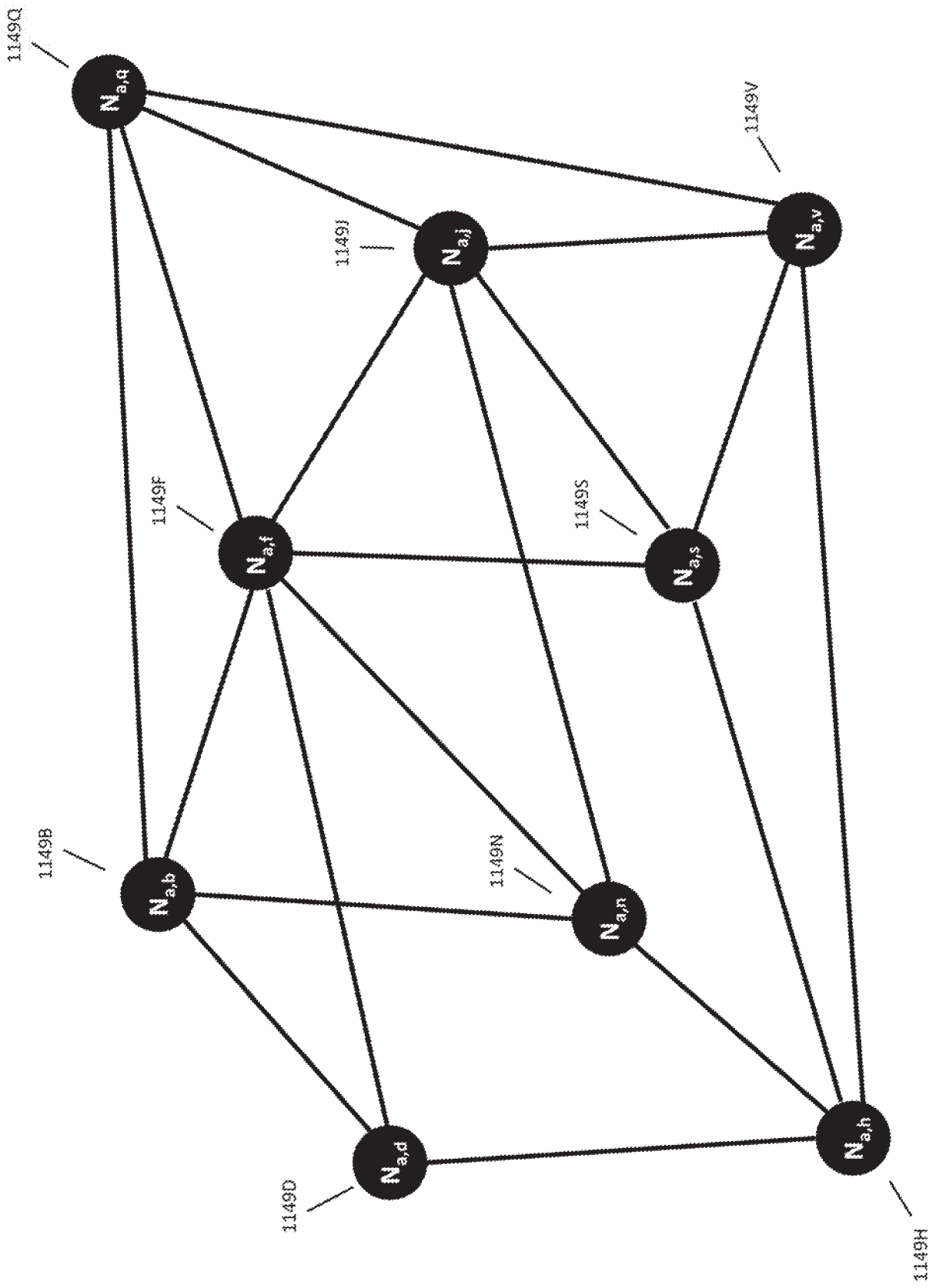

1149Q
$N_{a,q}$
1149V
$N_{a,v}$
1149J
$N_{a,j}$
1149F
$N_{a,f}$
1149S
$N_{a,s}$
1149B
$N_{a,b}$
1149N
$N_{a,n}$
1149D
$N_{a,d}$
$N_{a,h}$
1149H

Figure 77D

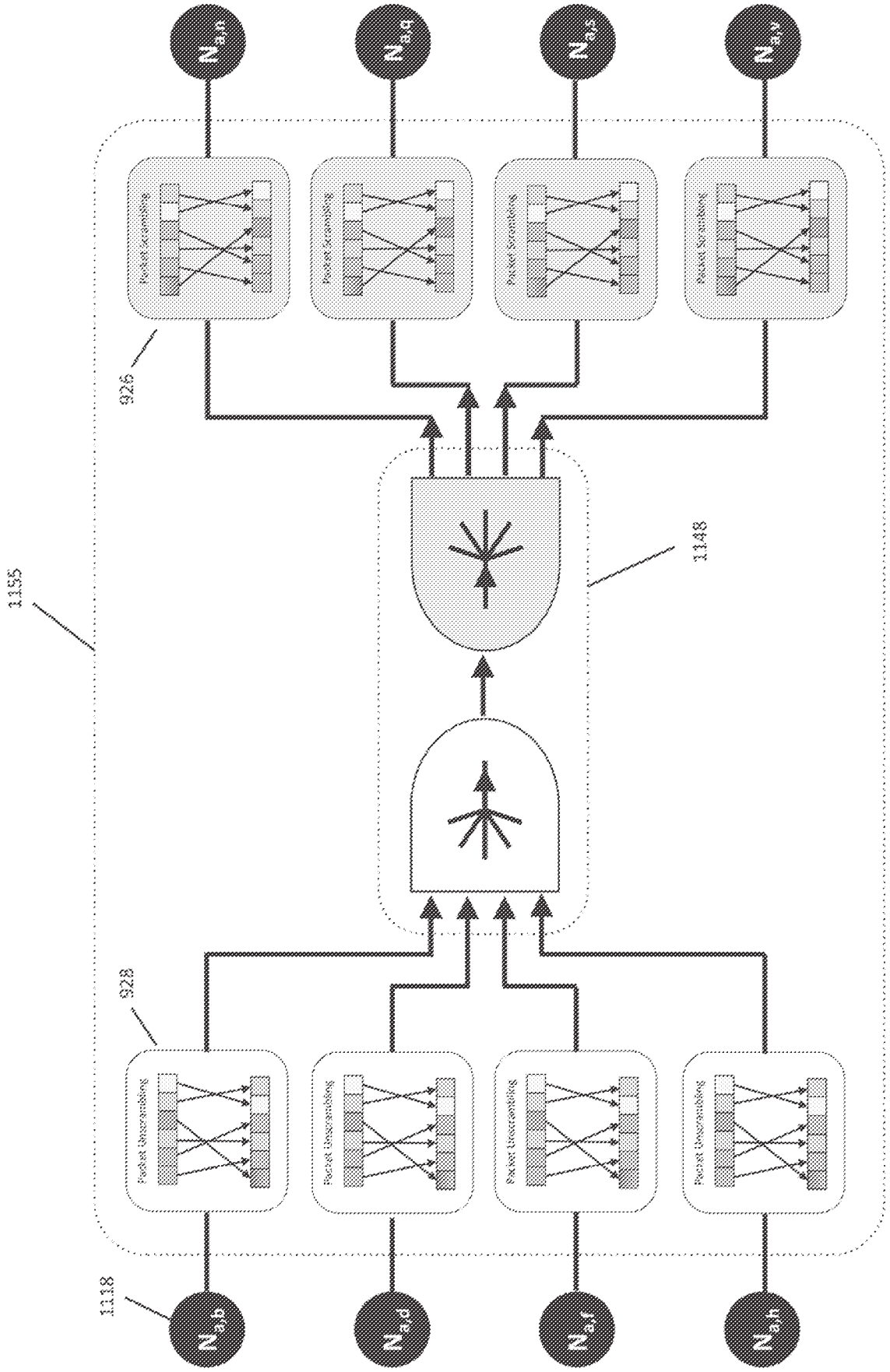

1155
926
928
1148
1118
Packet Scrambling
Packet Unscrambling

Figure 78A

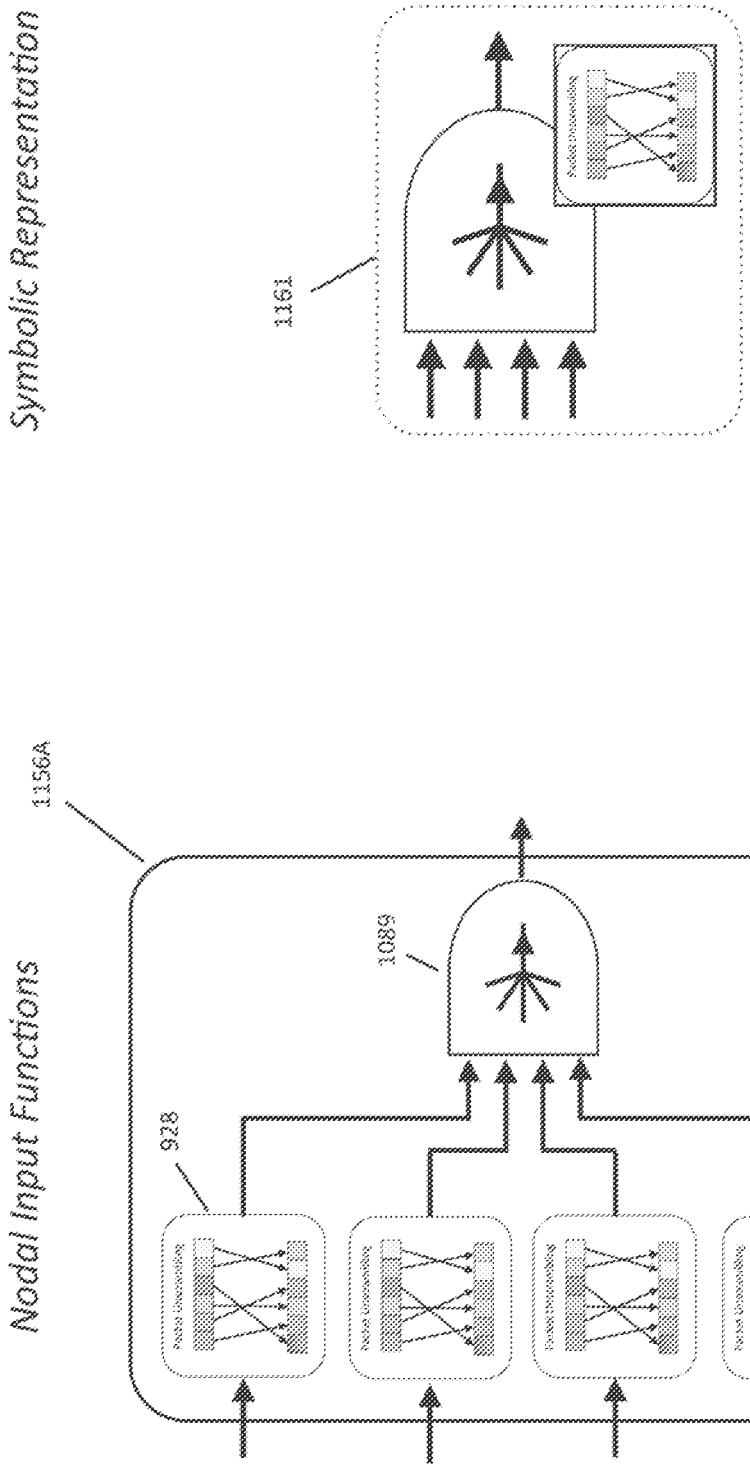

Symbolic Representation
1161
Nodal Input Functions
1156A
1089
928

Figure 78B

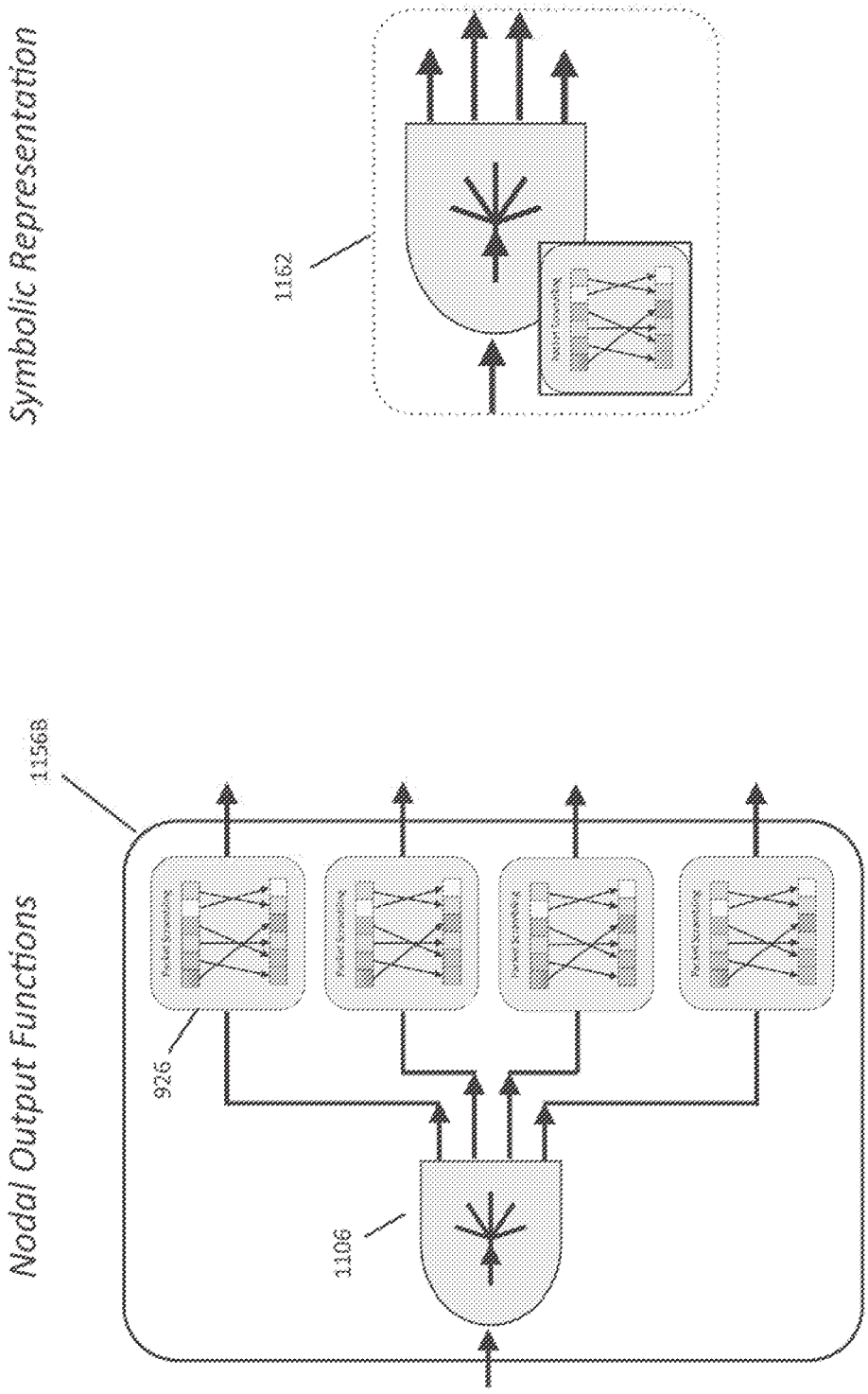

Symbolic Representation
1162
Nodal Output Functions
1156B
926
1106

Figure 78C

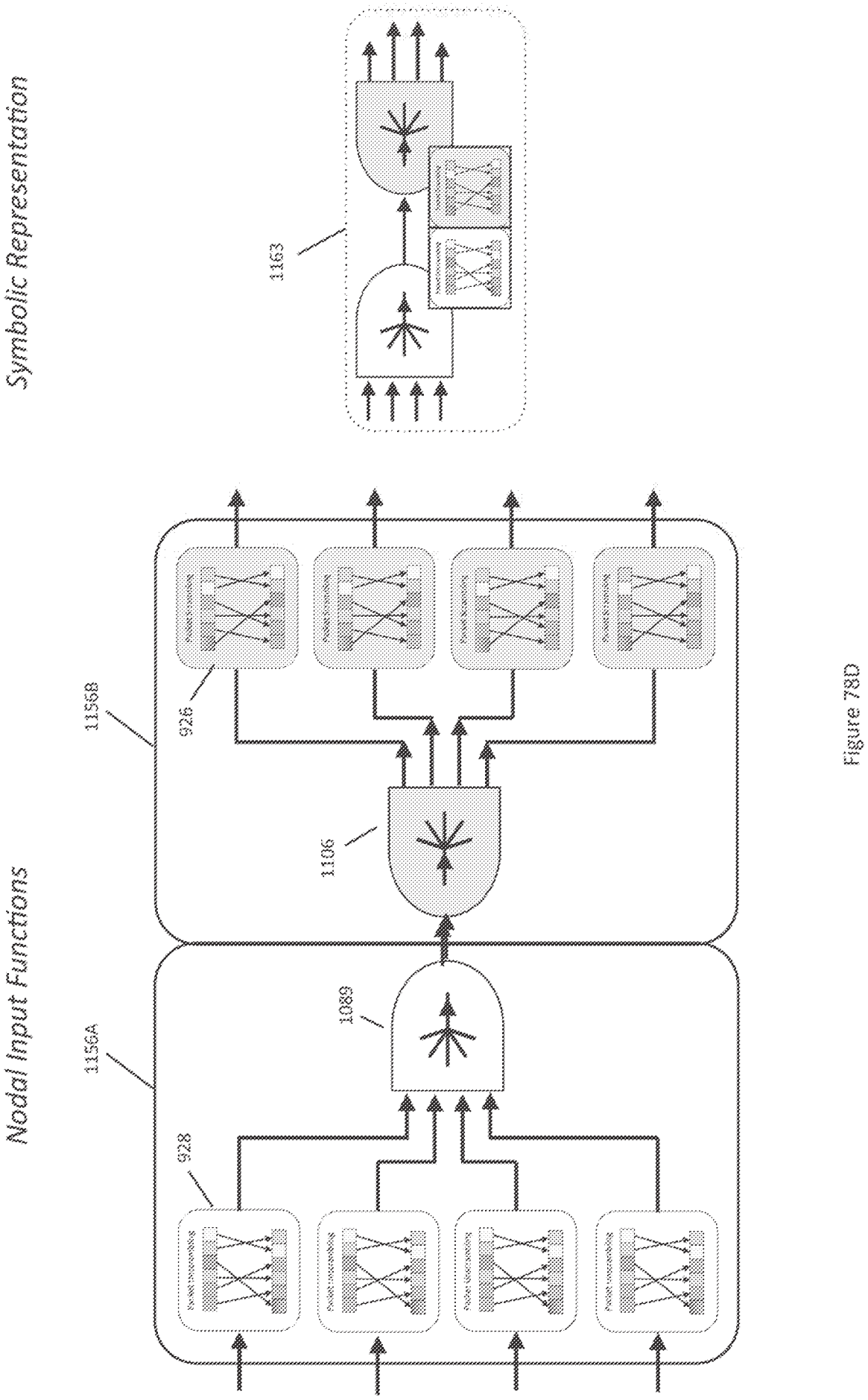

Symbolic Representation
1163
Nodal Input Functions
1156B
926
1106
1089
1156A
928

Figure 78D

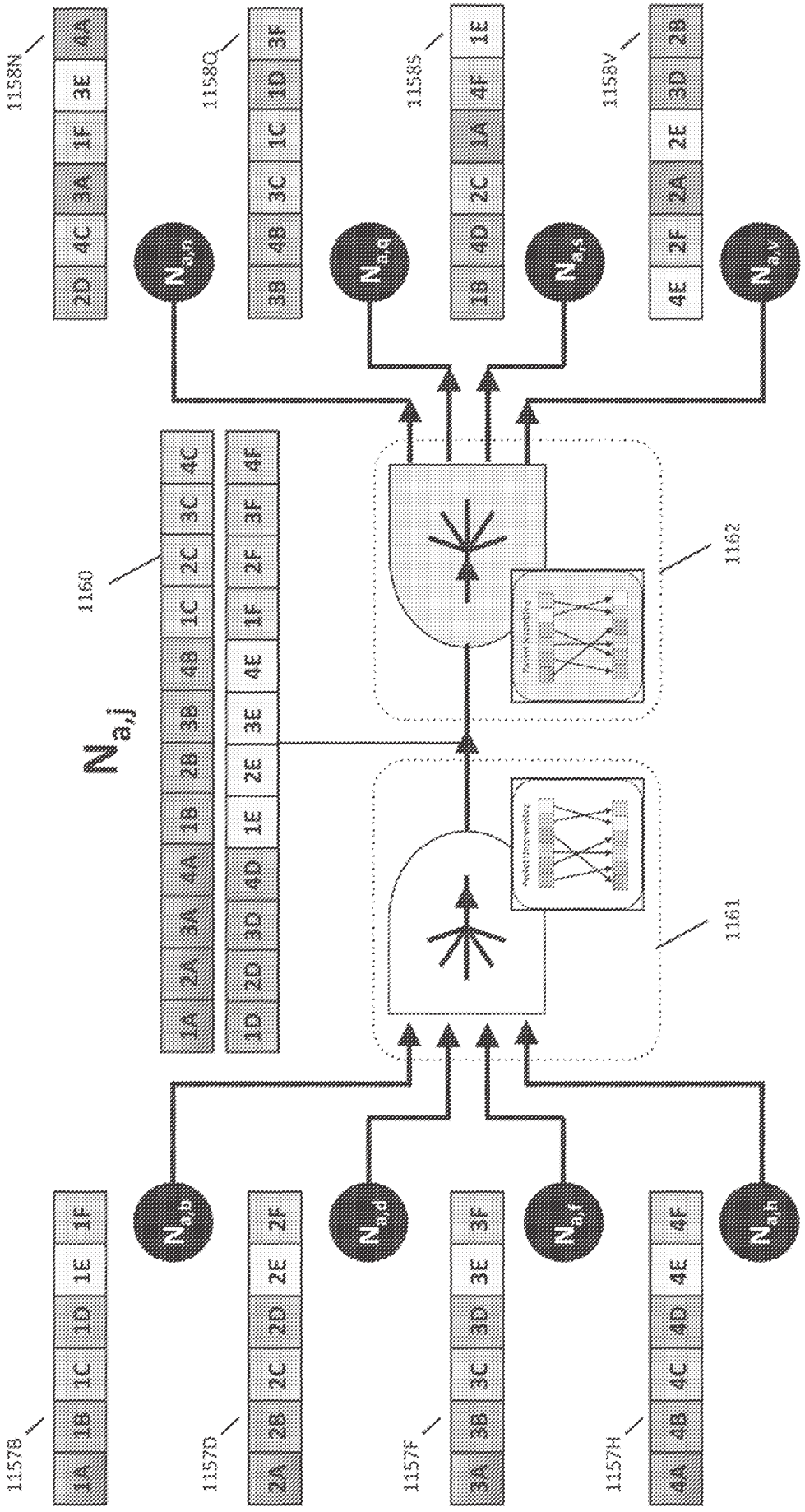

1158N
1158Q
1158S
1158V
1160
$N_{a,j}$
1162
1161
1157B
1157D
1157F
1157H

Figure 79A

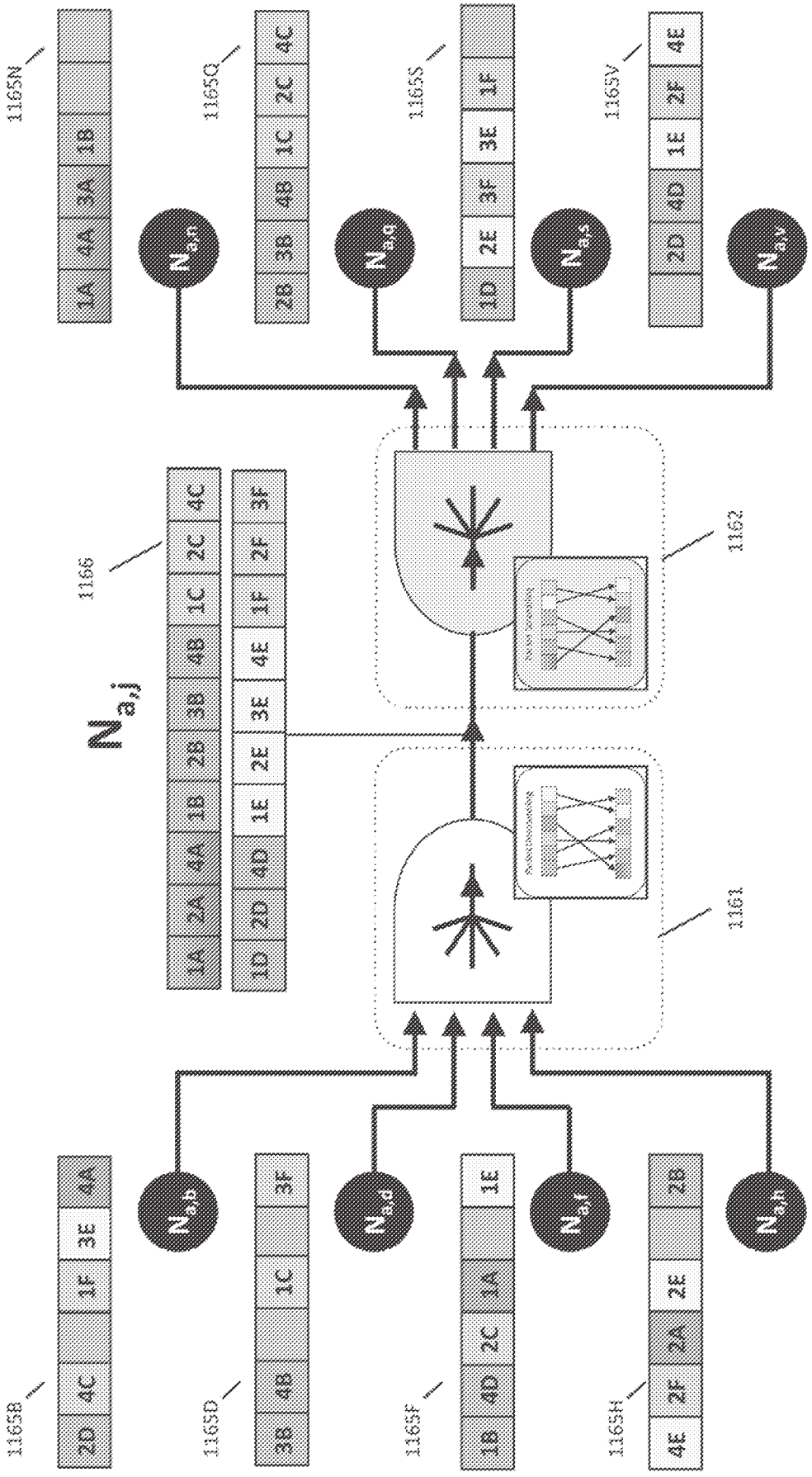

1165N
1A 4A 3A 1B
1165Q
2B 3B 4B 1C 2C 4C
1165S
1D 2E 3F 3E 1F
1165V
2D 4D 1E 2F 4E
1166
$N_{a,j}$
1A 2A 4A 1B 2B 3B 4B 1C 2C 4C
1D 2D 4D 1E 2E 3E 4E 1F 2F 3F
1162
1161
1165B
2D 4C 1F 3E 4A
1165D
3B 4B 1C 3F
1165F
1B 4D 2C 1A 1E
1165H
4E 2F 2A 2E 2B

Figure 79B

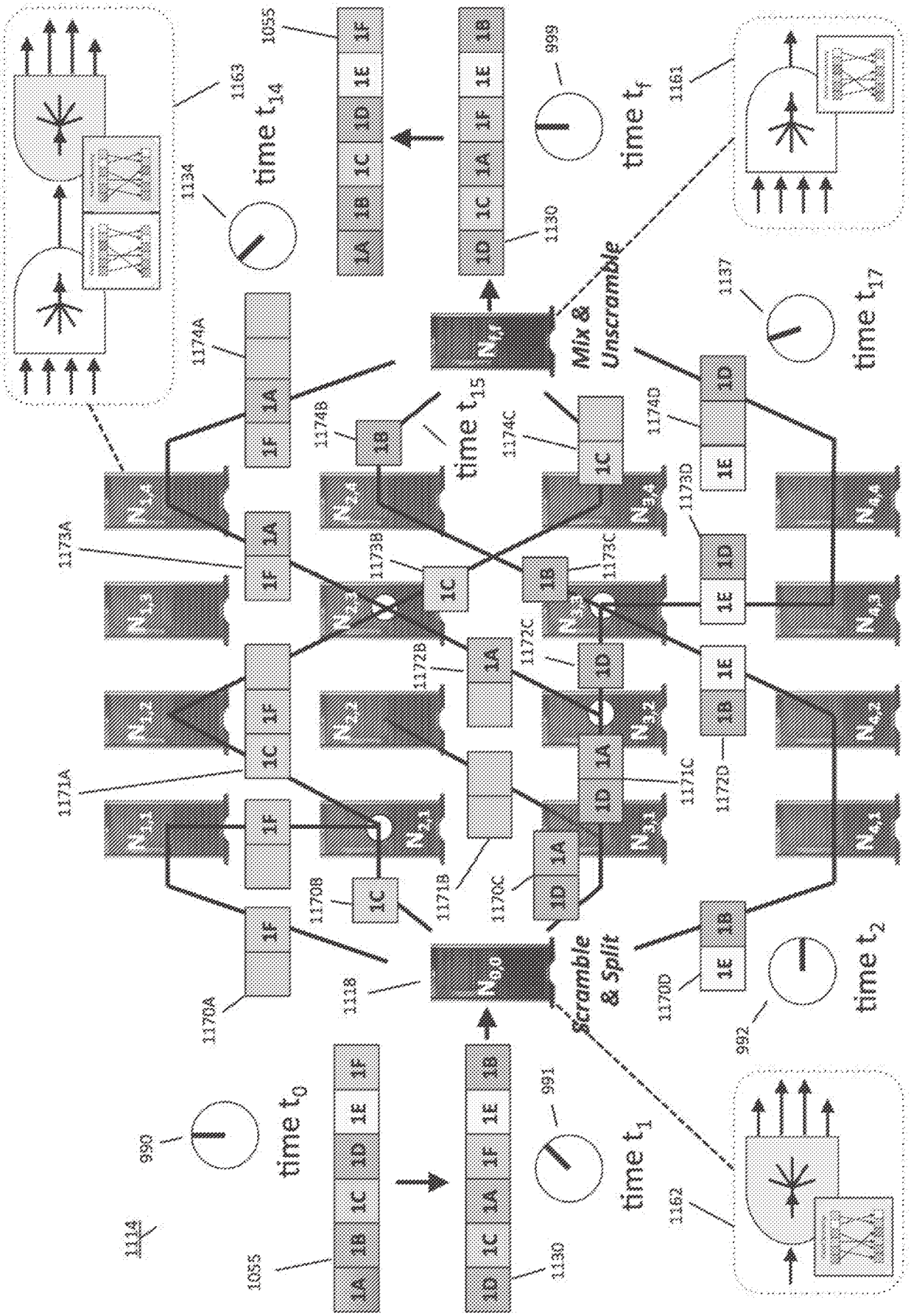

1114
990
time t_0
1055
1130
991
time t_1
992
time t_2
1162
1163
1134
time t_{14}
1055
1130
993
time t_f
1161
1137
time t_{17}
1118
1170A
1171A
1172A
1173A
1174A
1170B
1171B
1172B
1173B
1174B
1170C
1171C
1172C
1173C
1174C
1170D
1171D
1172D
1173D
1174D
Scramble & Split
Mix & Unscramble
time t_{15}

Figure 8D

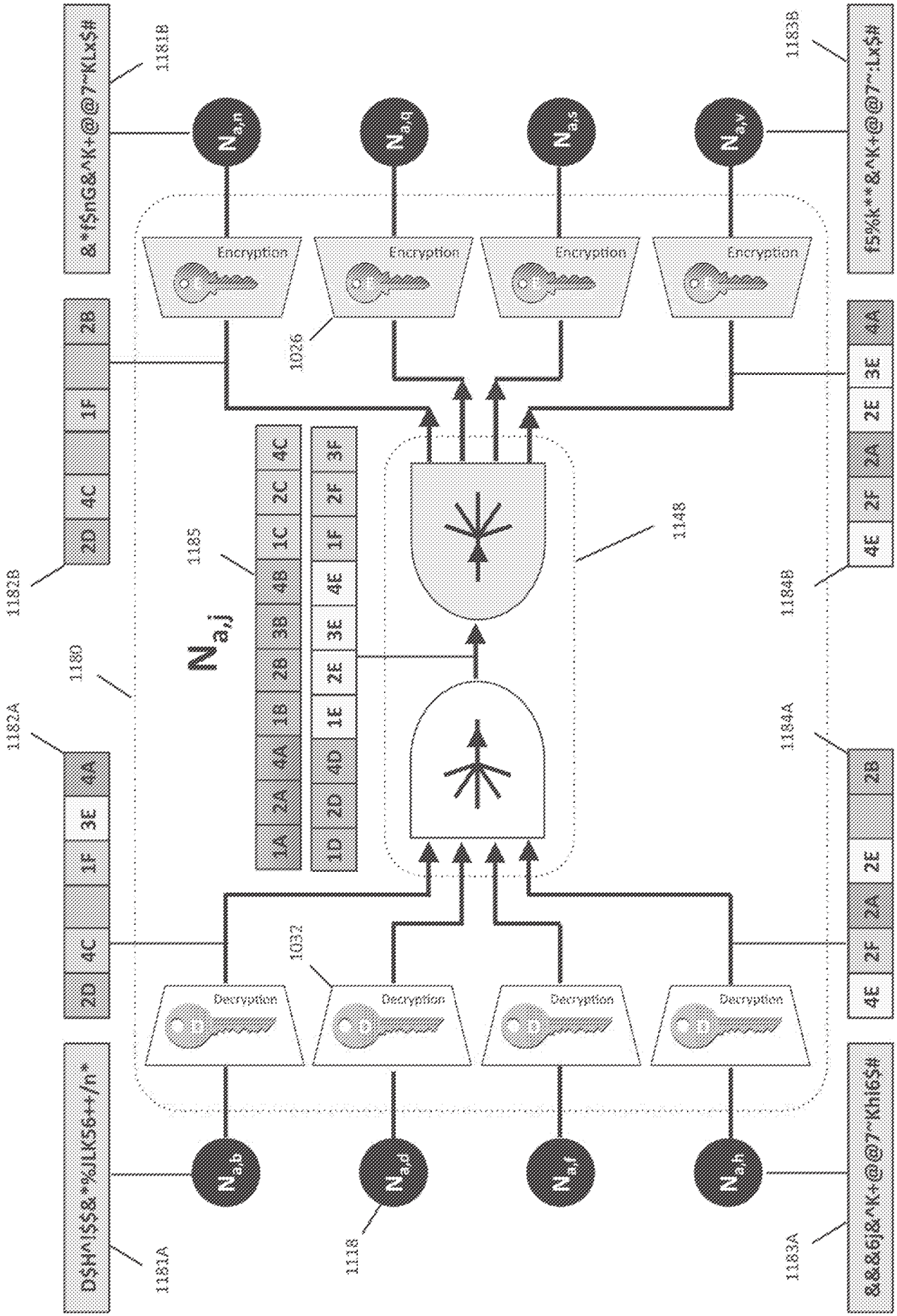

DH^IS&*%JLKS6++/n*
1181A
&*f$nG&^K+@@7~KLx$#
1181B
8&&6j&^K+@@7~Khl6S#
1183A
f5%k**&^K+@@7~Lx$#
1183B
1182A
1182B
1184A
1184B
1185
1148
1118
1026
1032
Encryption
Decryption

Figure 81A

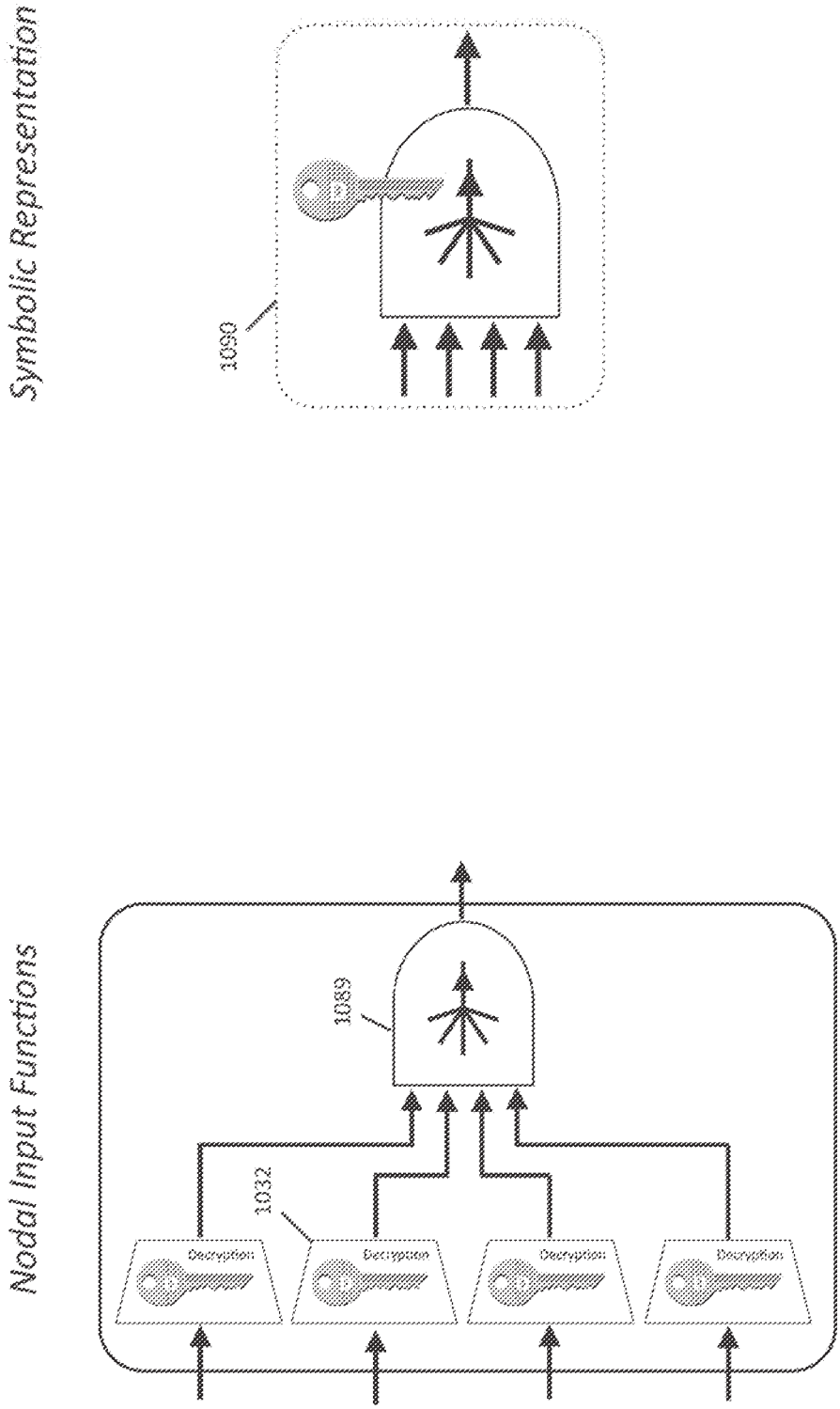

Symbolic Representation
1090
Nodal Input Functions
1089
1032
Decryption
Decryption
Decryption
Decryption

Figure 81B

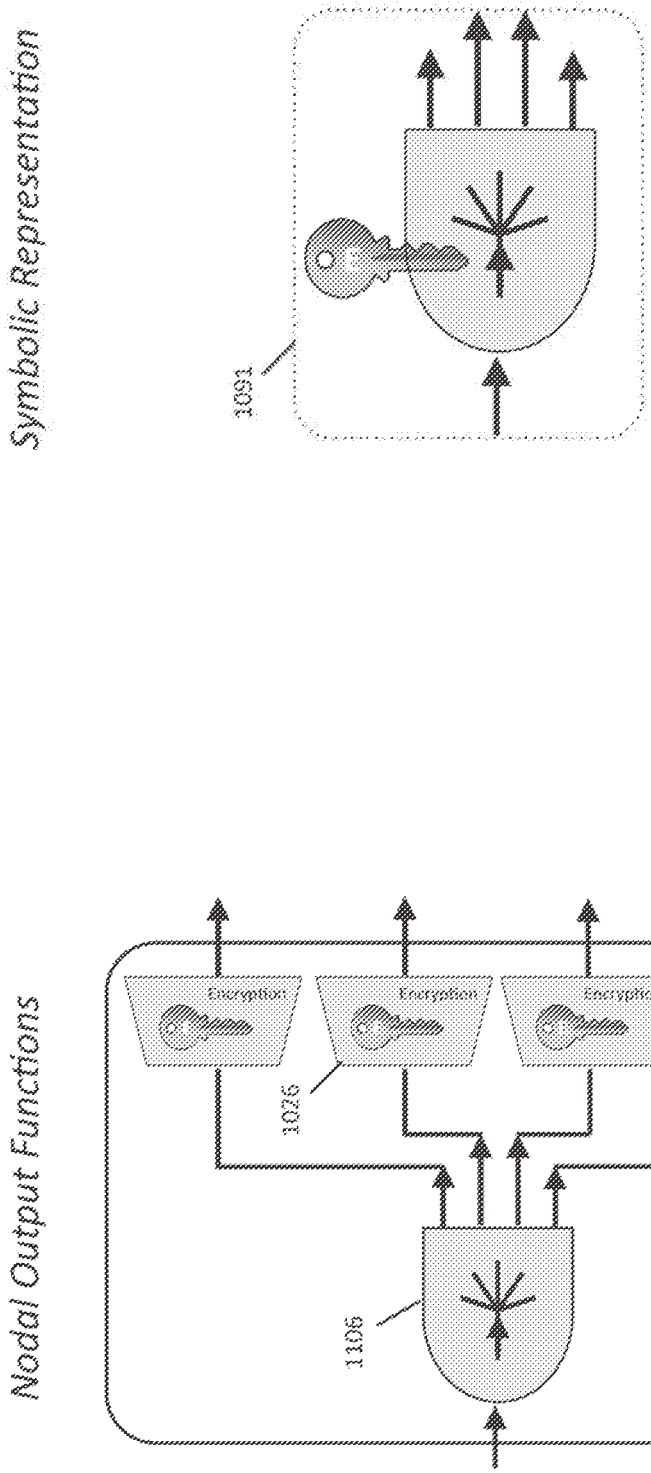

Symbolic Representation
1091
Nodal Output Functions
Encryption
Encryption
Encryption
Encryption
1026
1106

Figure 81C

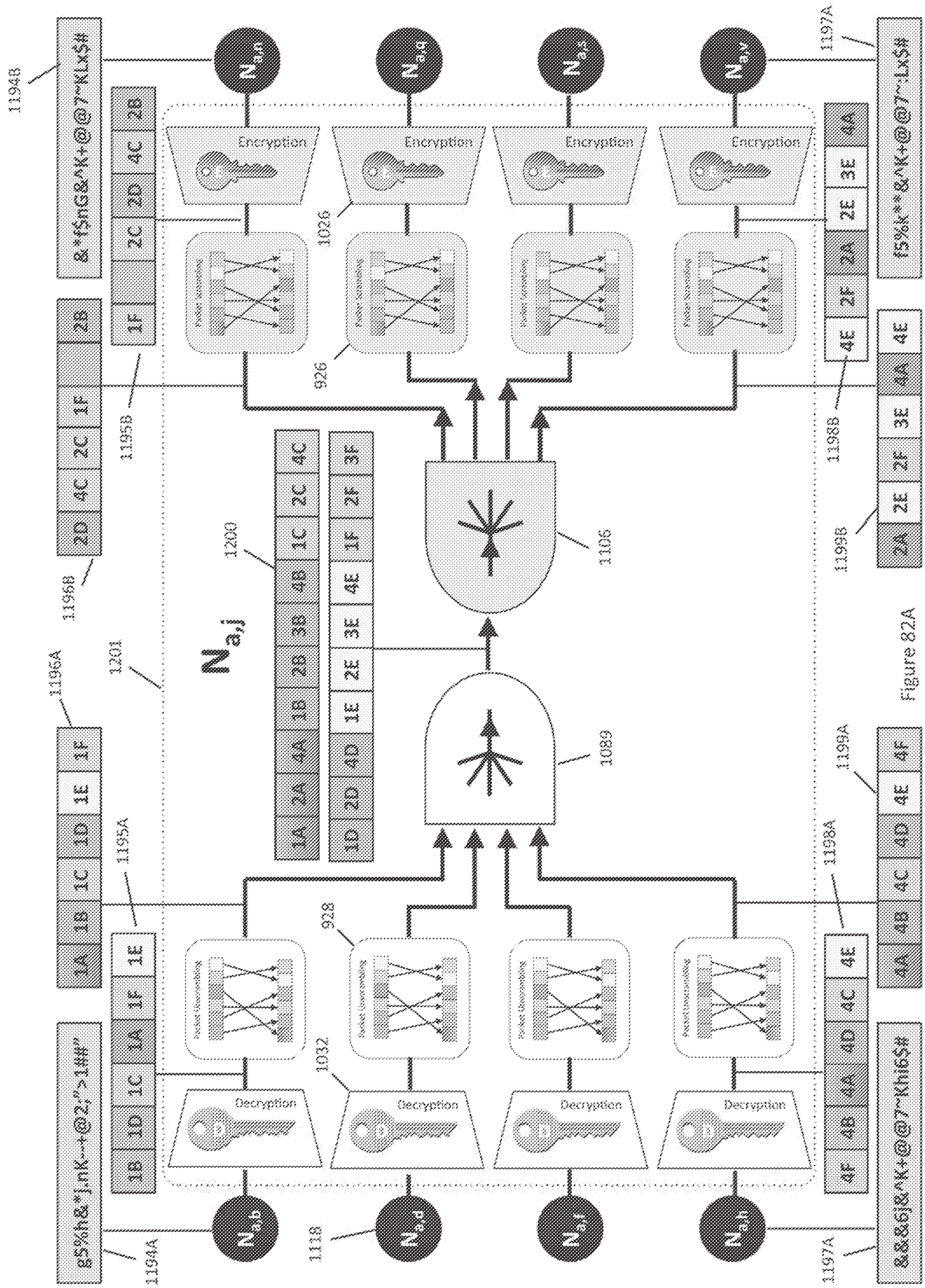

Encryption
Decryption
Packet Segmentation
Packet Reassembly
1948
1196B
1195B
1926
1026
1197A
1198B
1199B
1106
1200
1201
1196A
1195A
1089
1198A
1199A
1928
1032
1118
1194A
1197A
g5%h&*j,mK--+@2;">1##"
&*f5nG&^K+@@7~KLx$#
f5%k**&^K+@@7~Lx$#
&&&6j&^K+@@7~Khi6S#

Figure 82A

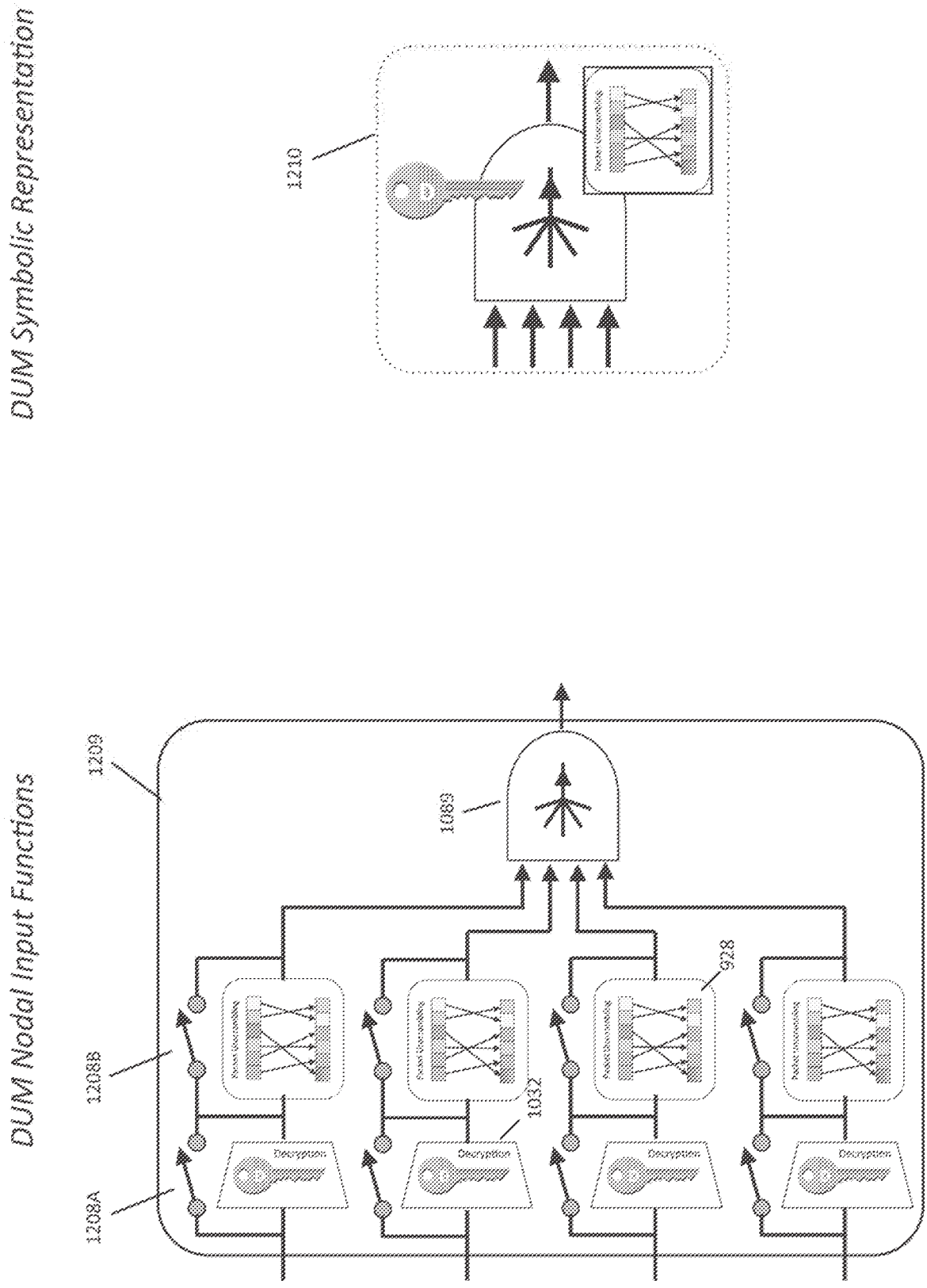
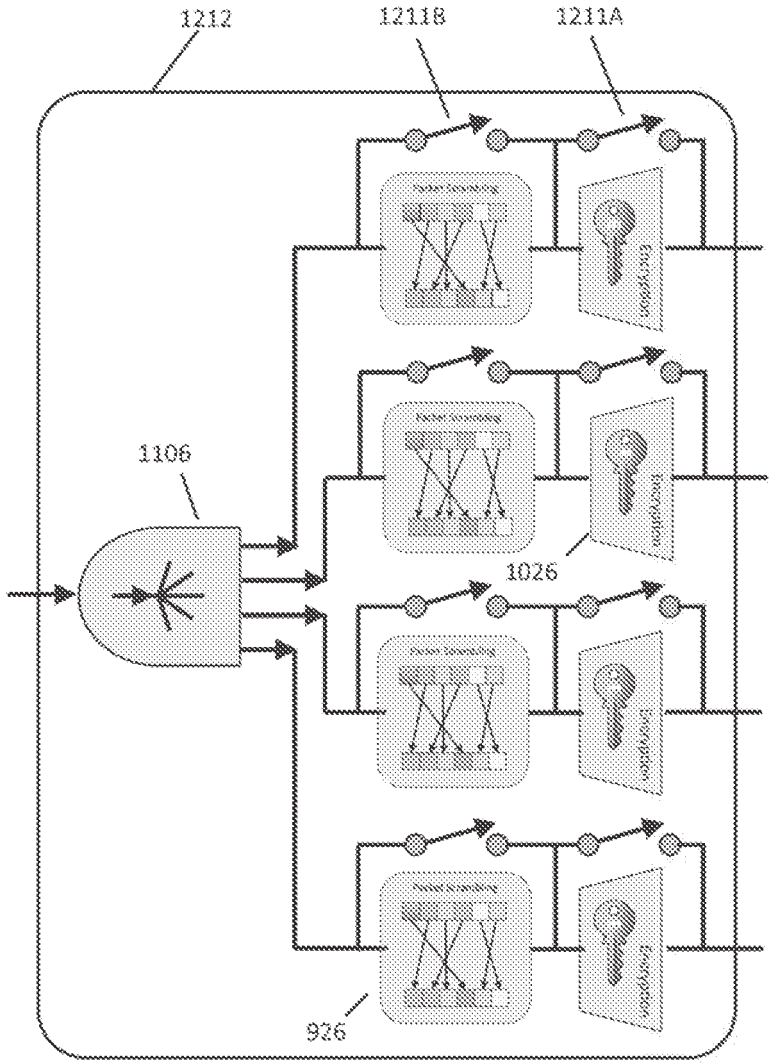

DUM Symbolic Representation
1210
DUM Nodal Input Functions
1209
1208B
1208A
1083
1032
928
Decryption
Decryption
Decryption
Decryption

Figure 82B

SSE Nodal Output Functions



Symbolic Representation

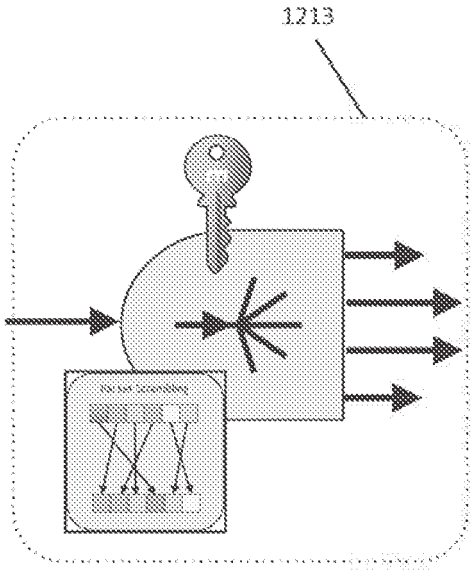


Figure 82C

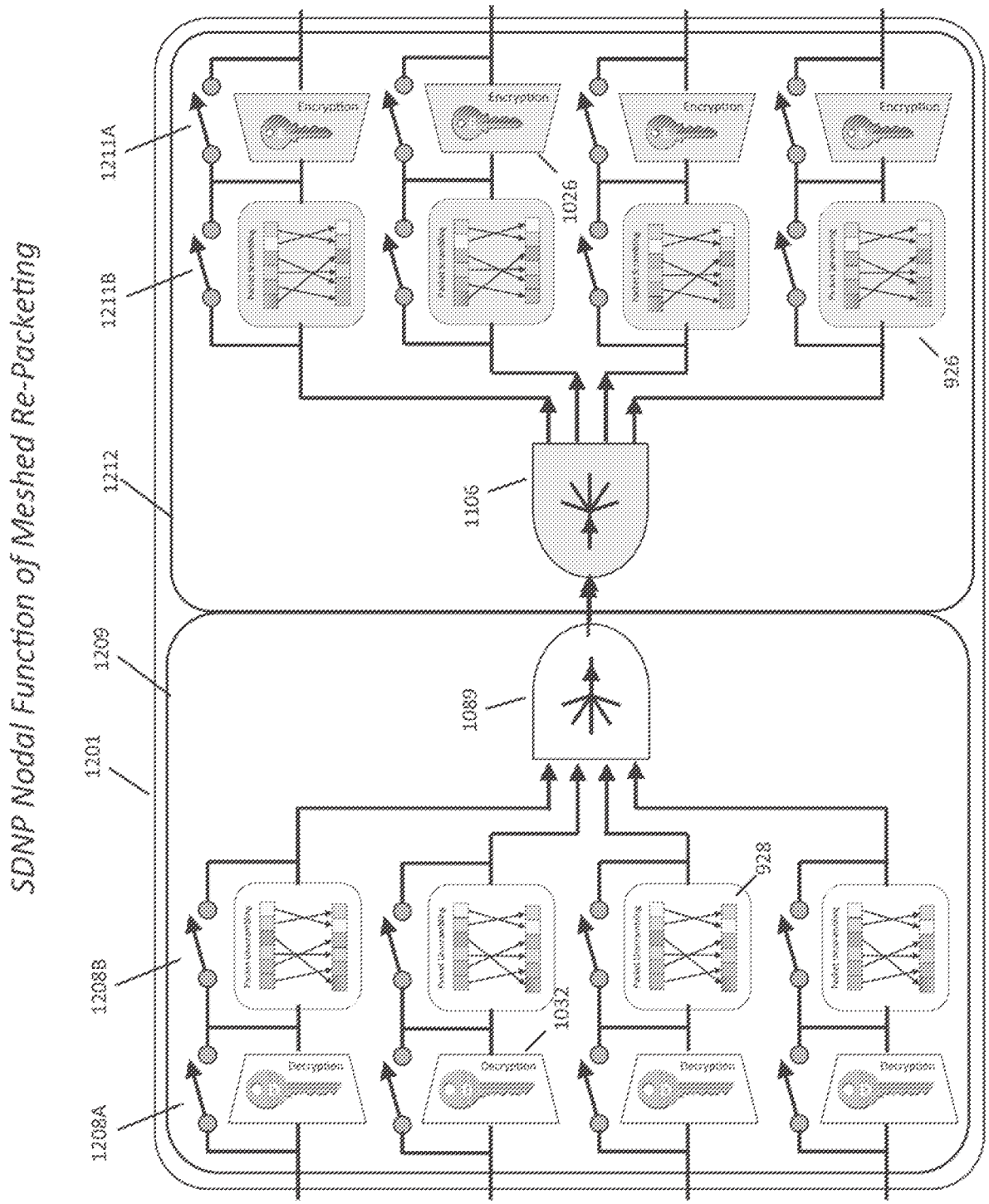

SDNP Nodal Function of Meshed Re-Packeting
1201
1209
1212
1211A
1211B
1208A
1208B
1089
1105
1026
1032
926
928
Encryption
Decryption

Figure 83A

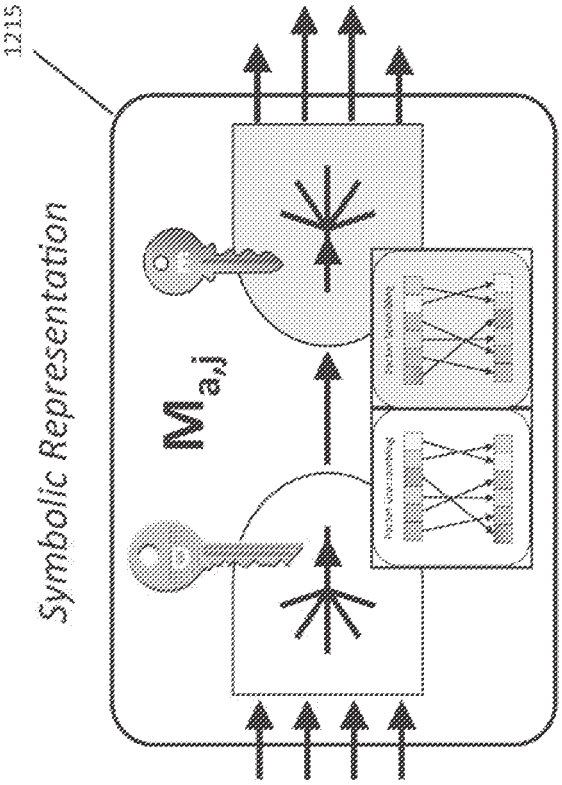


Figure 83B

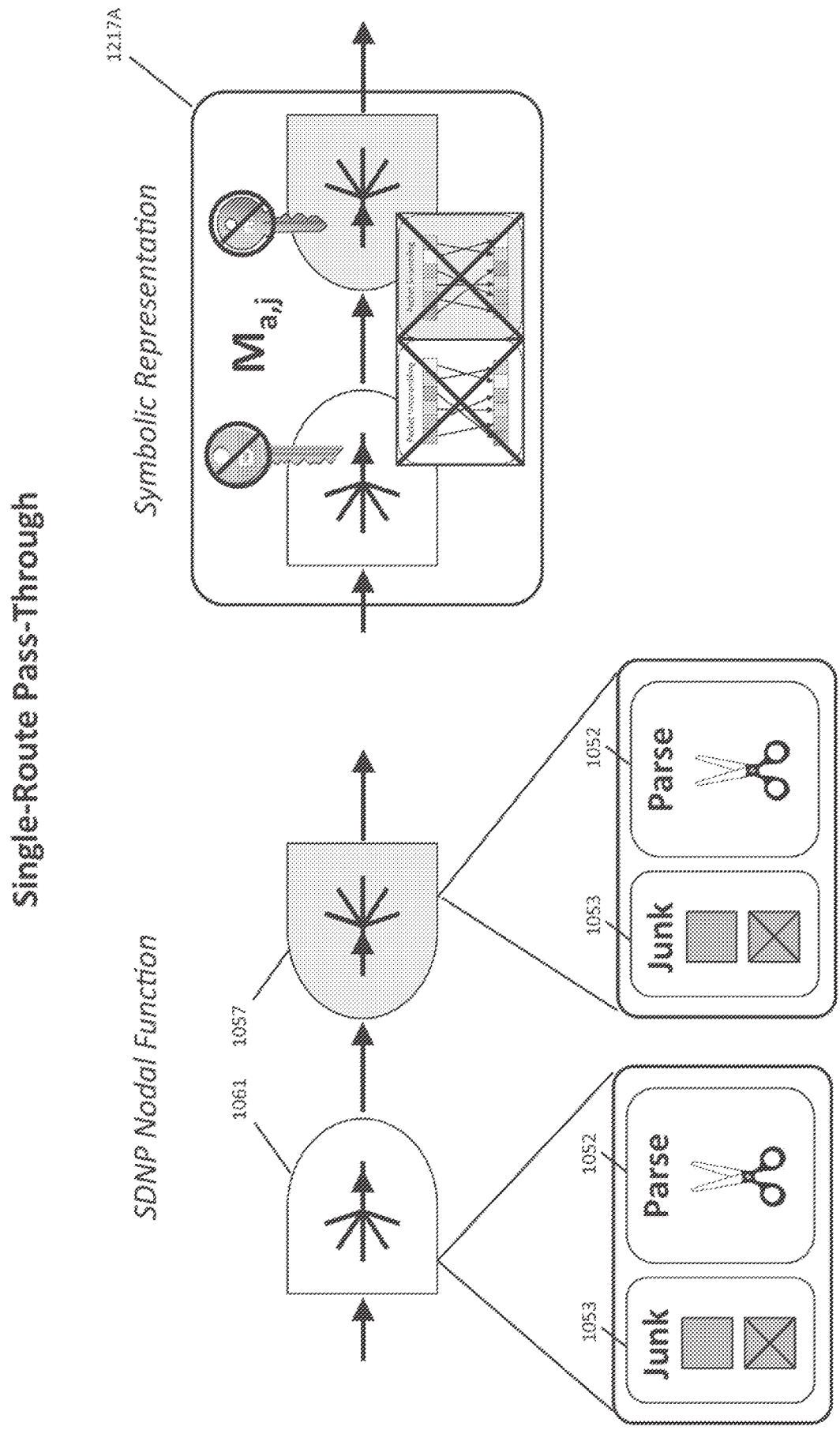

Single-Route Pass-Through
SDNP Nodal Function
Symbolic Representation
1217A
$M_{a,j}$
1061
1057
1052
1053
Parse
Junk
1052
1053
Parse
Junk

Figure 83C

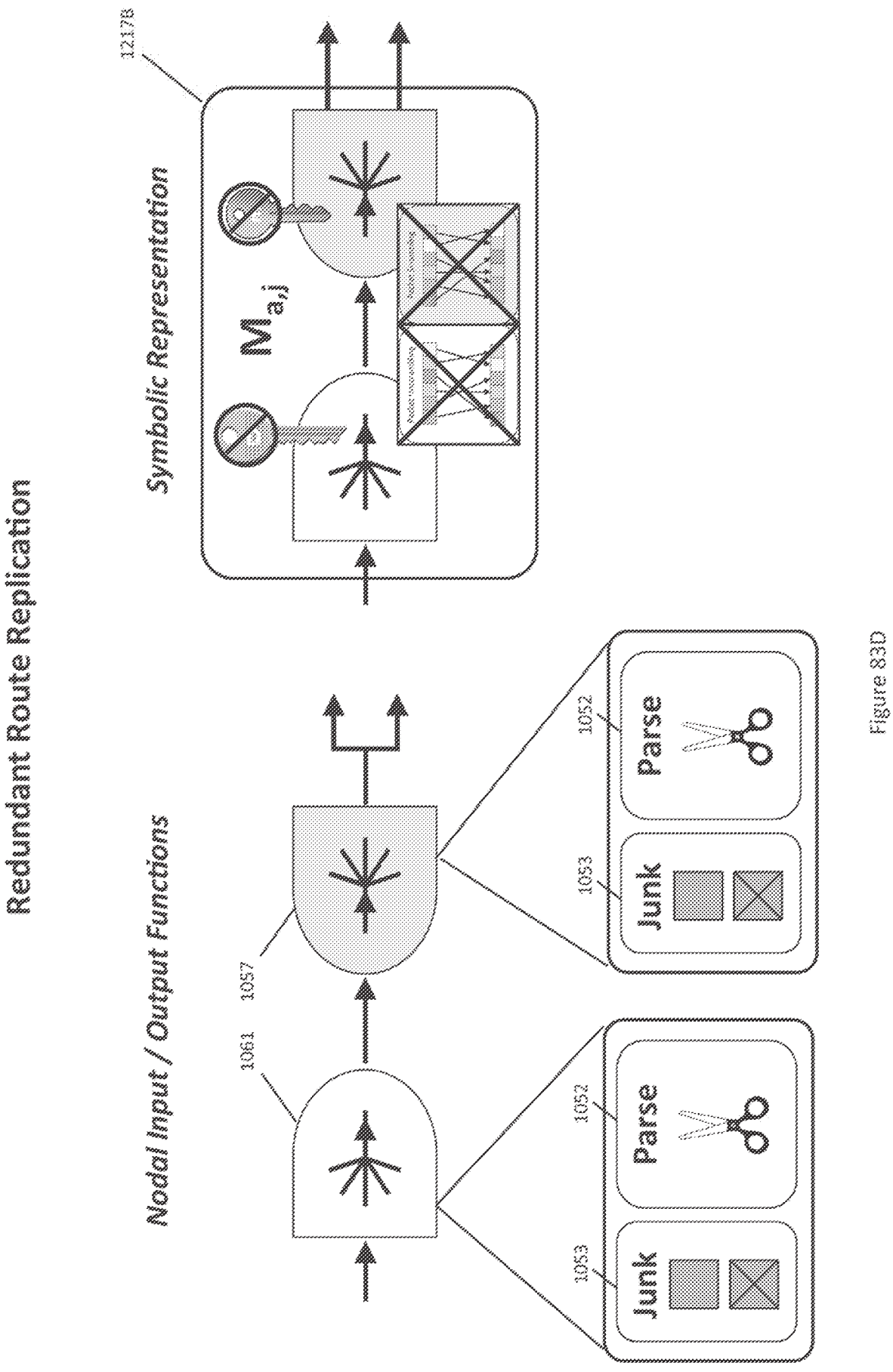

Redundant Route Replication
Nodal Input / Output Functions
Symbolic Representation
12178
$M_{a,j}$
1061
1057
1052
1053
Parse
Junk
Parse
Junk

Figure 83D

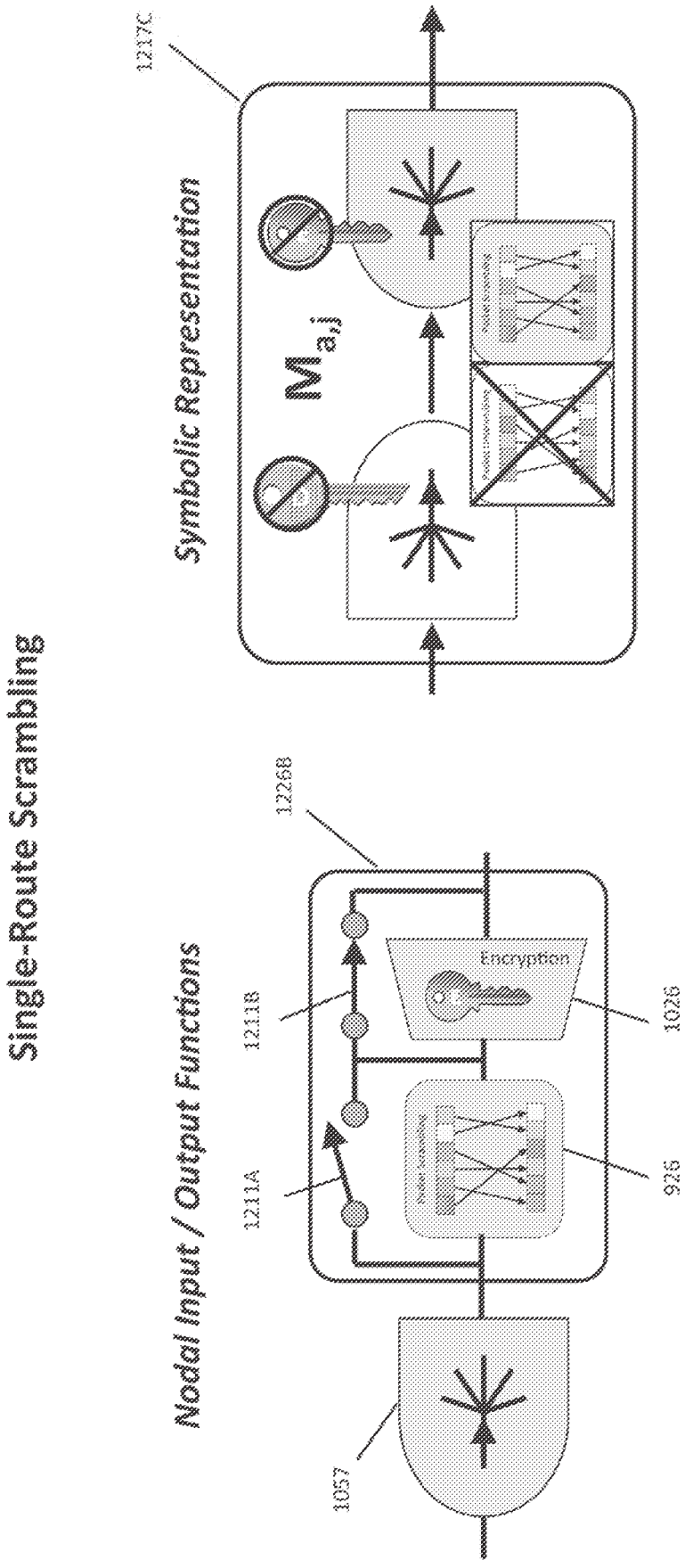

Single-Route Scrambling
Nodal Input / Output Functions
Symbolic Representation
1217C
12268
1211B
1211A
1026
925
1057
Encryption
$M_{a,j}$

Figure 83E

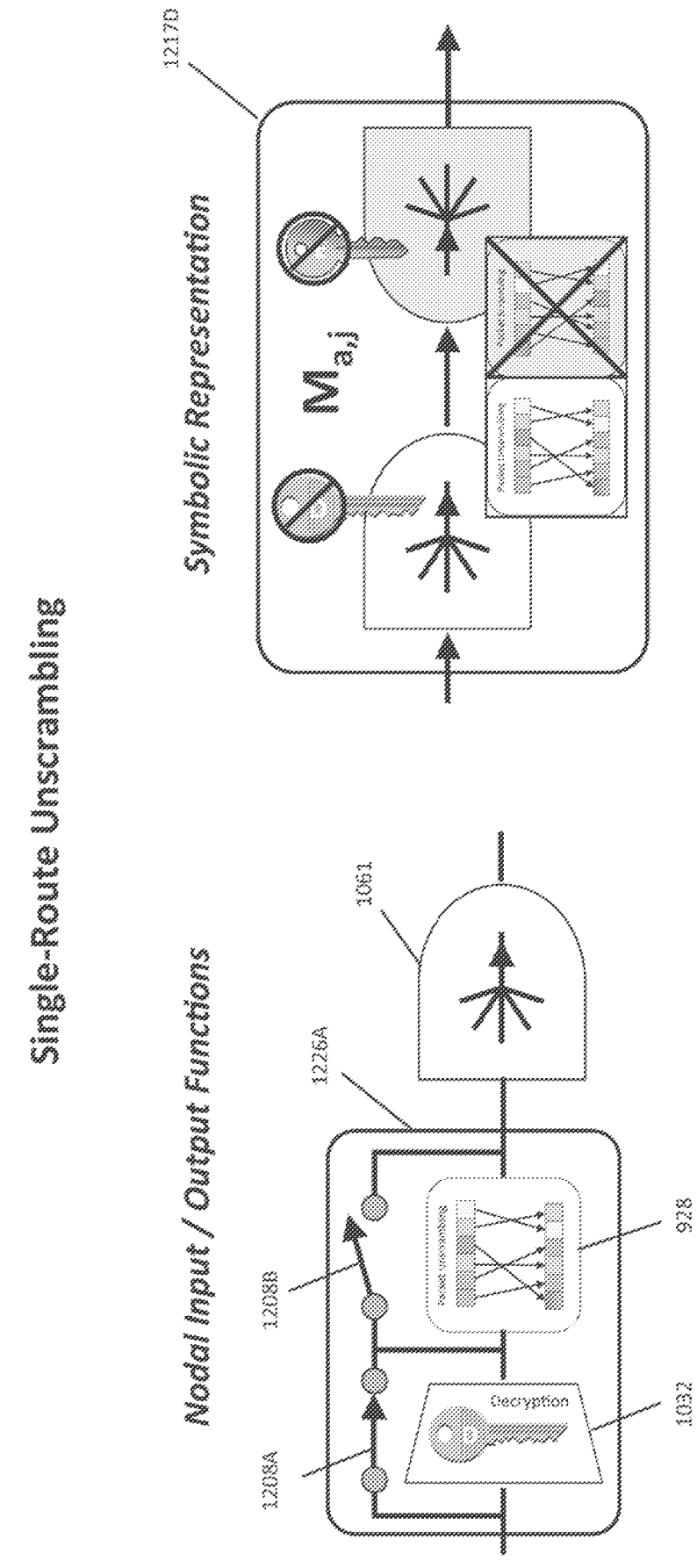
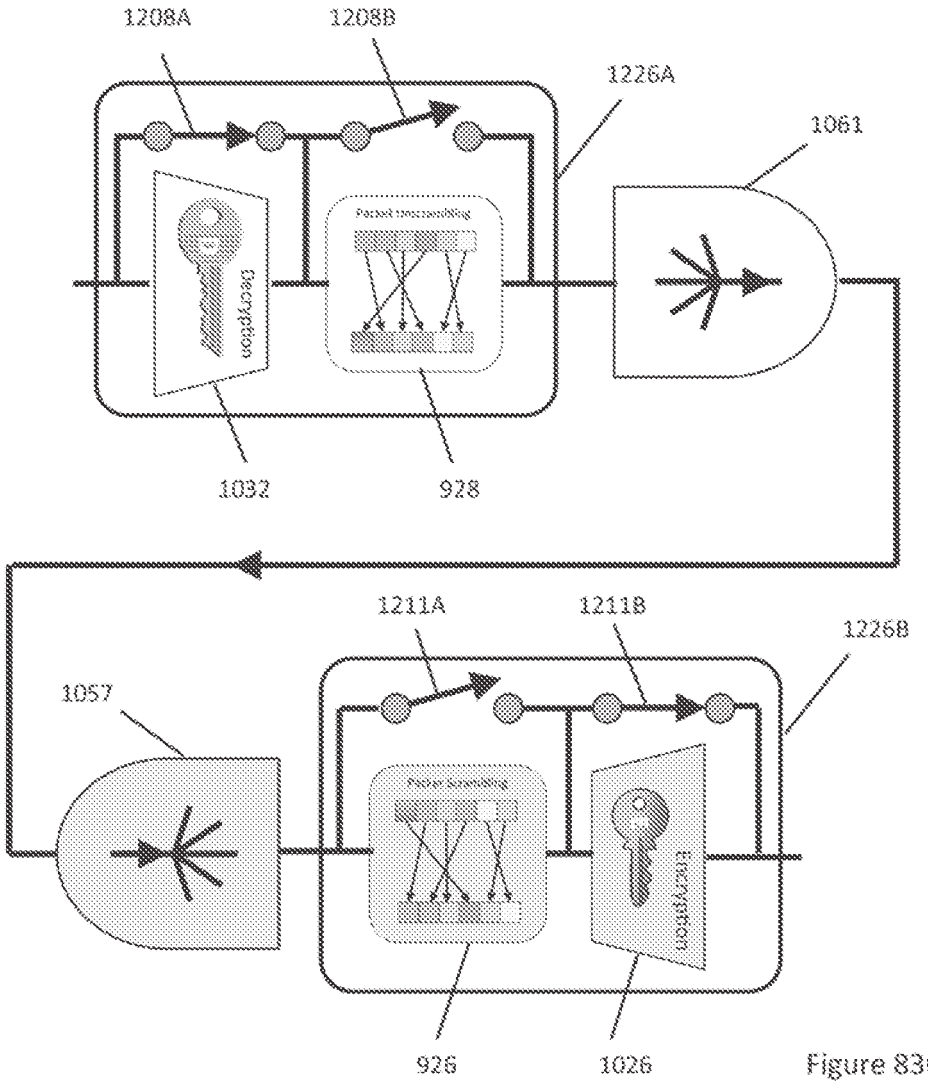

Single-Route Unscrambling
Nodal Input / Output Functions
Symbolic Representation
1208A
1208B
1226A
1061
928
1032
1217B
Decryption
$M_{a,j}$

Figure 83F

Single-Route Re-scrambling

Nodal Input / Output Functions



Symbolic Representation

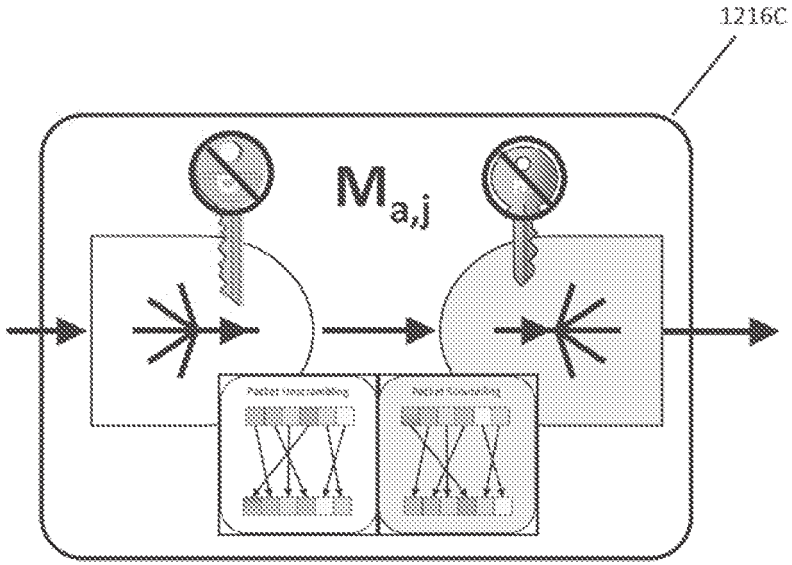


Figure 83G

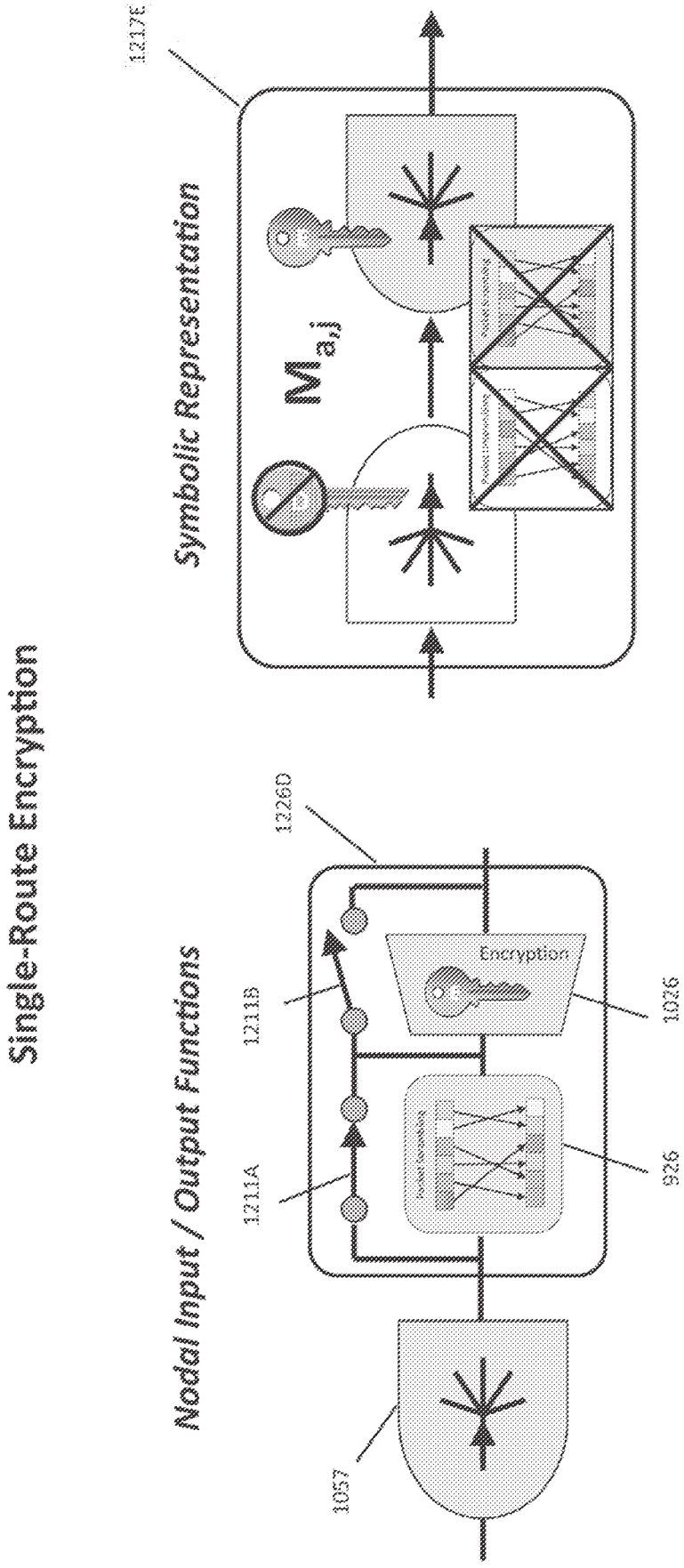

Single-Route Encryption
Nodal Input / Output Functions
Symbolic Representation
1057
1211A
1211B
1226D
926
1026
Encryption
$M_{a,j}$

Figure 83H

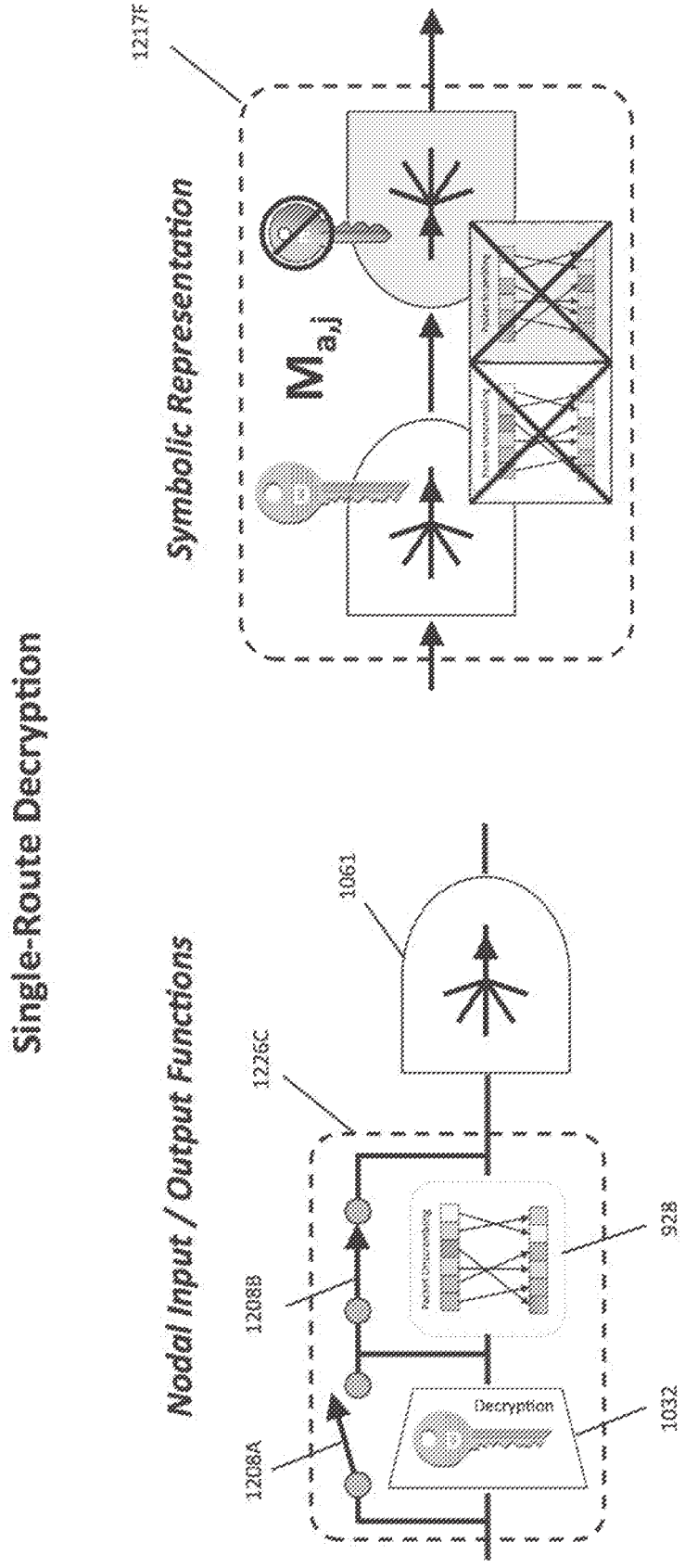

Single-Route Decryption
Nodal Input / Output Functions
Symbolic Representation
1217F
1226C
1061
1206B
928
1206A
1032
Decryption
$M_{a,j}$

Figure 83I

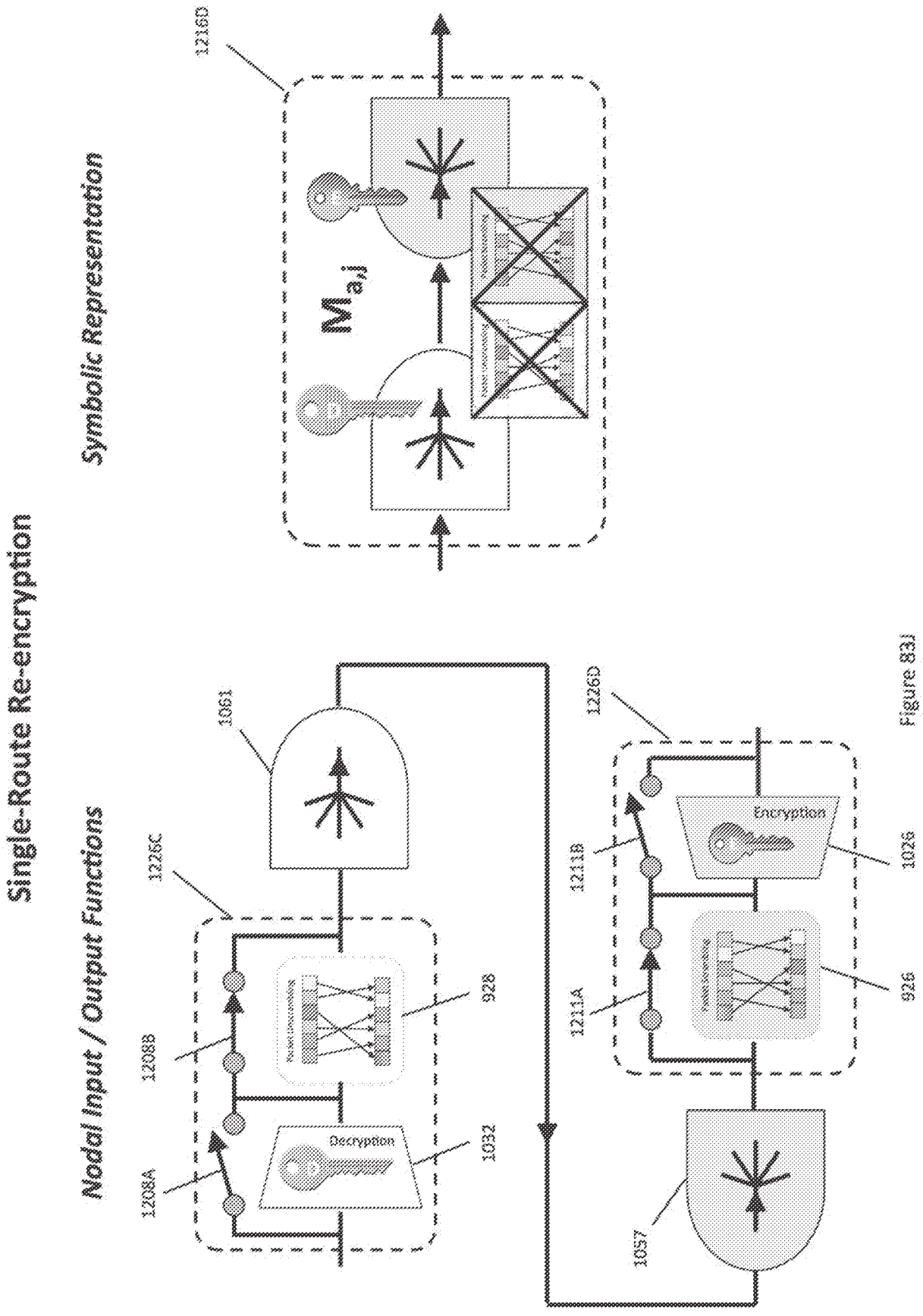

Single-Route Re-encryption
Nodal Input / Output Functions
Symbolic Representation
1216D
$M_{a,j}$
1061
1226C
1208A
1208B
928
1032
Decryption
1226D
1211A
1211B
926
1026
Encryption
1057

Figure 83J

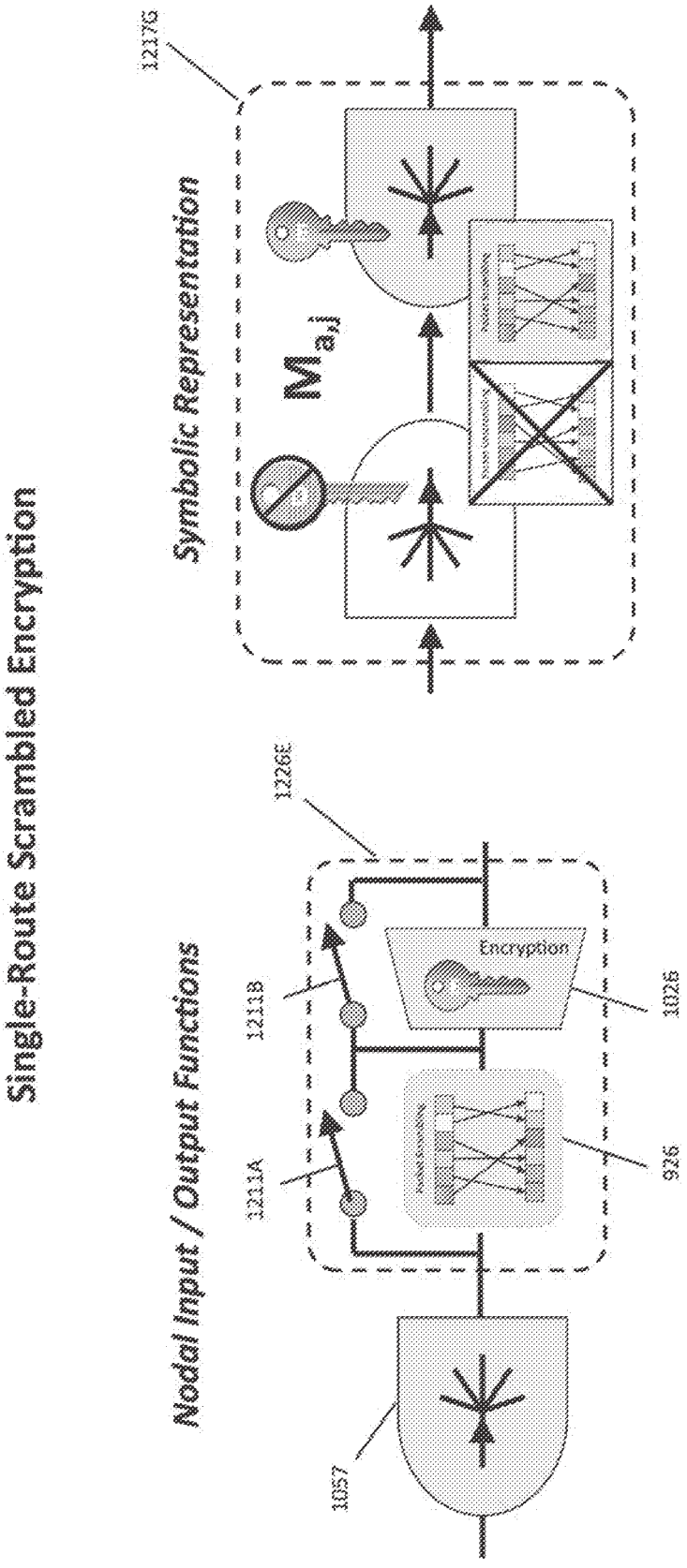

Single-Route Scrambled Encryption
Nodal Input / Output Functions
Symbolic Representation
Encryption
$M_{a,j}$
1057
1211A
1211B
1226E
926
1026
1227G

Figure 83K

Single-Route Unscrambled Decryption

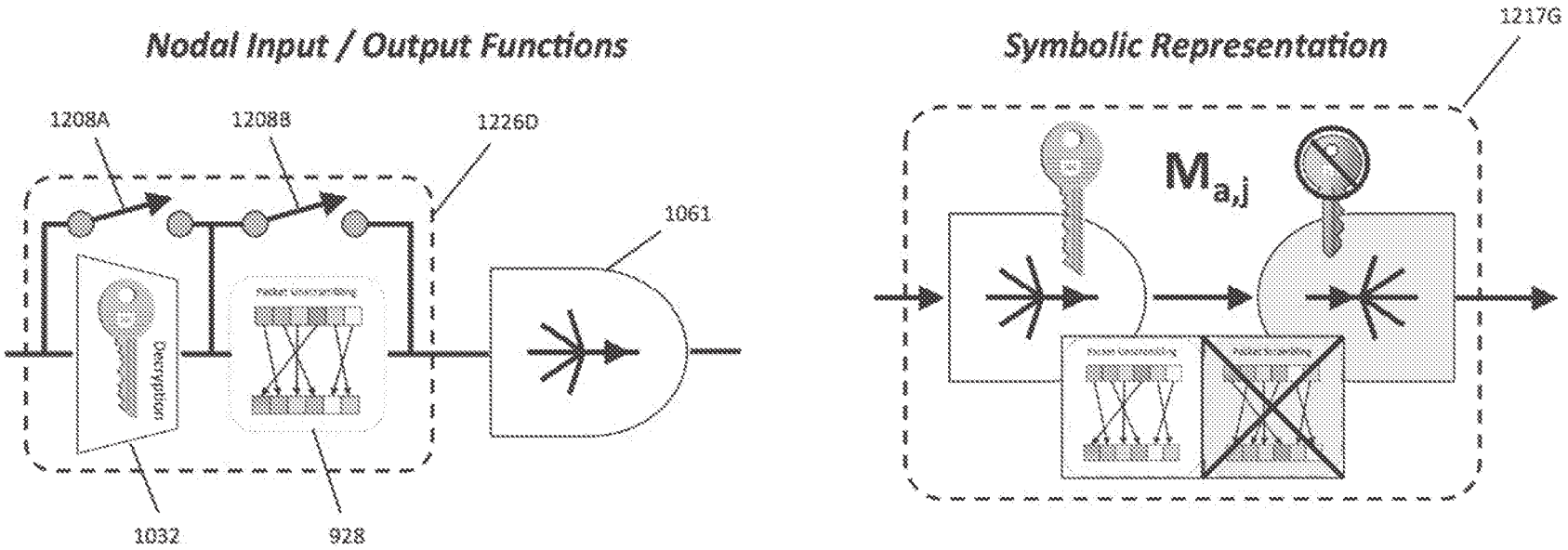


Figure 83L

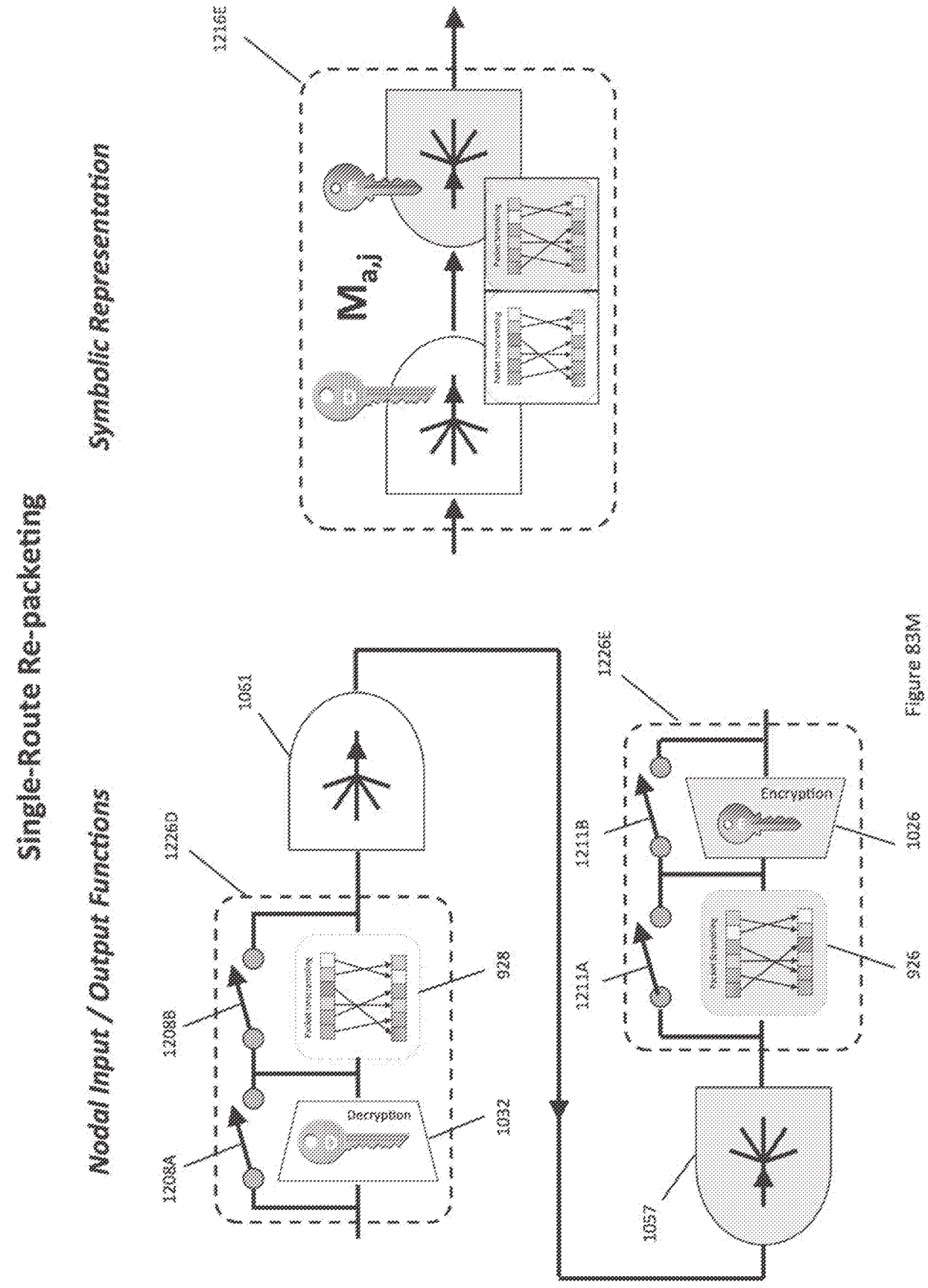

Single-Route Re-packeting
Nodal Input / Output Functions
Symbolic Representation
1216E
$M_{a,j}$
1051
1226D
1208B
1208A
928
1032
Decryption
1226E
1211B
1211A
1026
926
Encryption
1057

Figure 83M

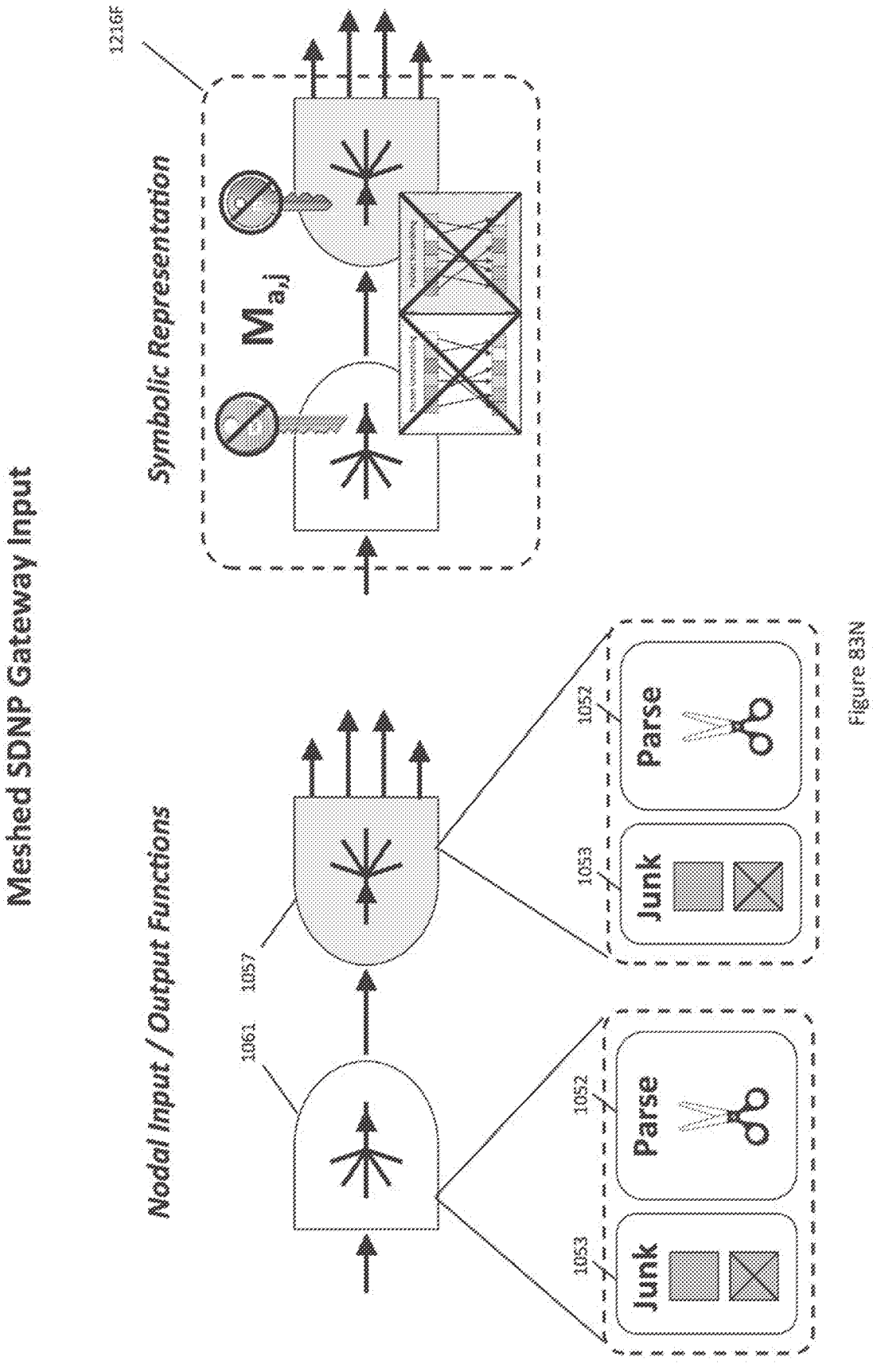

Meshed SDNP Gateway Input
Nodal Input / Output Functions
1061
1057
1053
Junk
1052
Parse
1053
Junk
1052
Parse
Symbolic Representation
1216F
$M_{a,j}$

Figure 83N

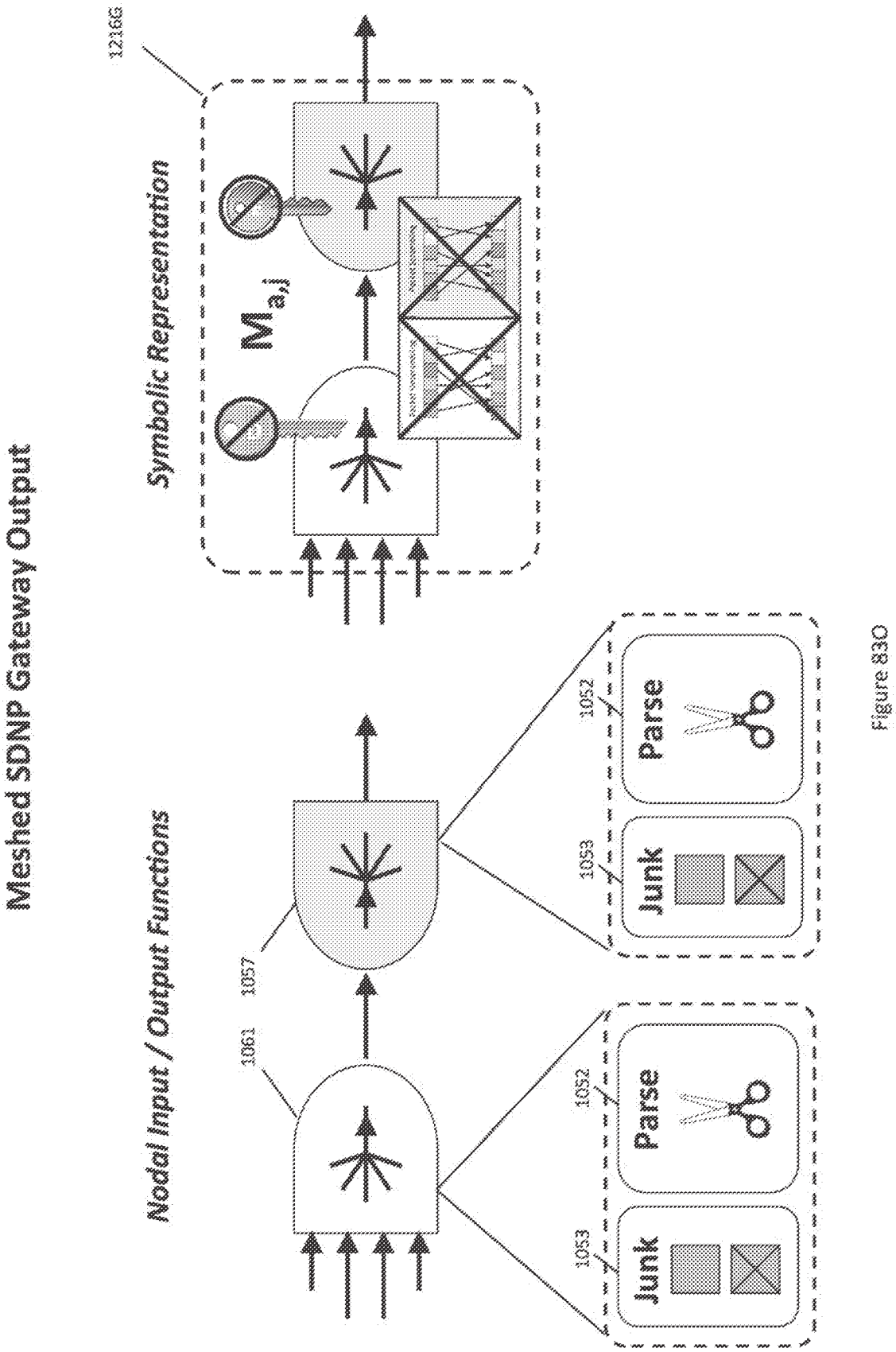
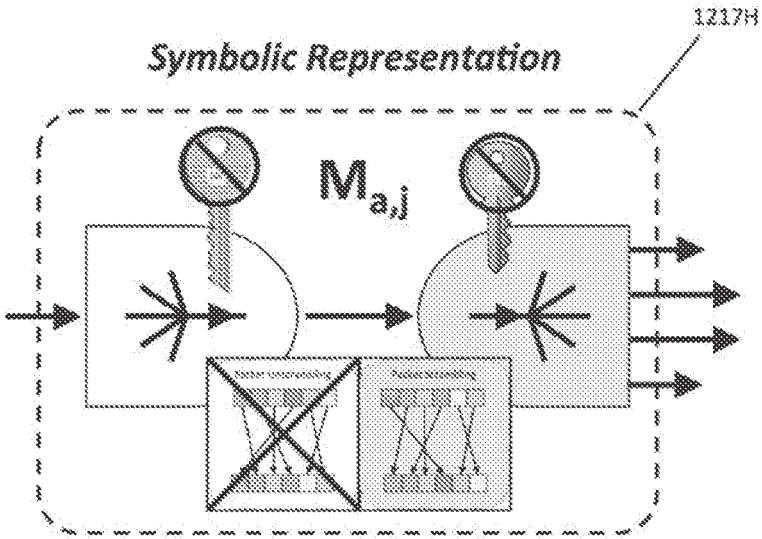

Meshed SDNP Gateway Output
Nodal Input / Output Functions
1061
1057
1052
1053
Parse
Junk
1052
1053
Parse
Junk
Symbolic Representation
12166
$M_{a,j}$

Figure 83O

Scrambled SDNP Gateway Input



Unscrambled SDNP Gateway Output

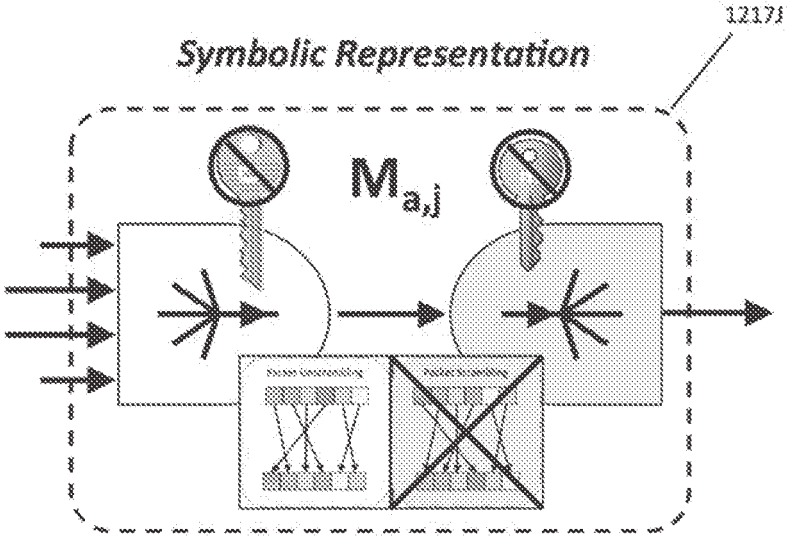


Figure 83P

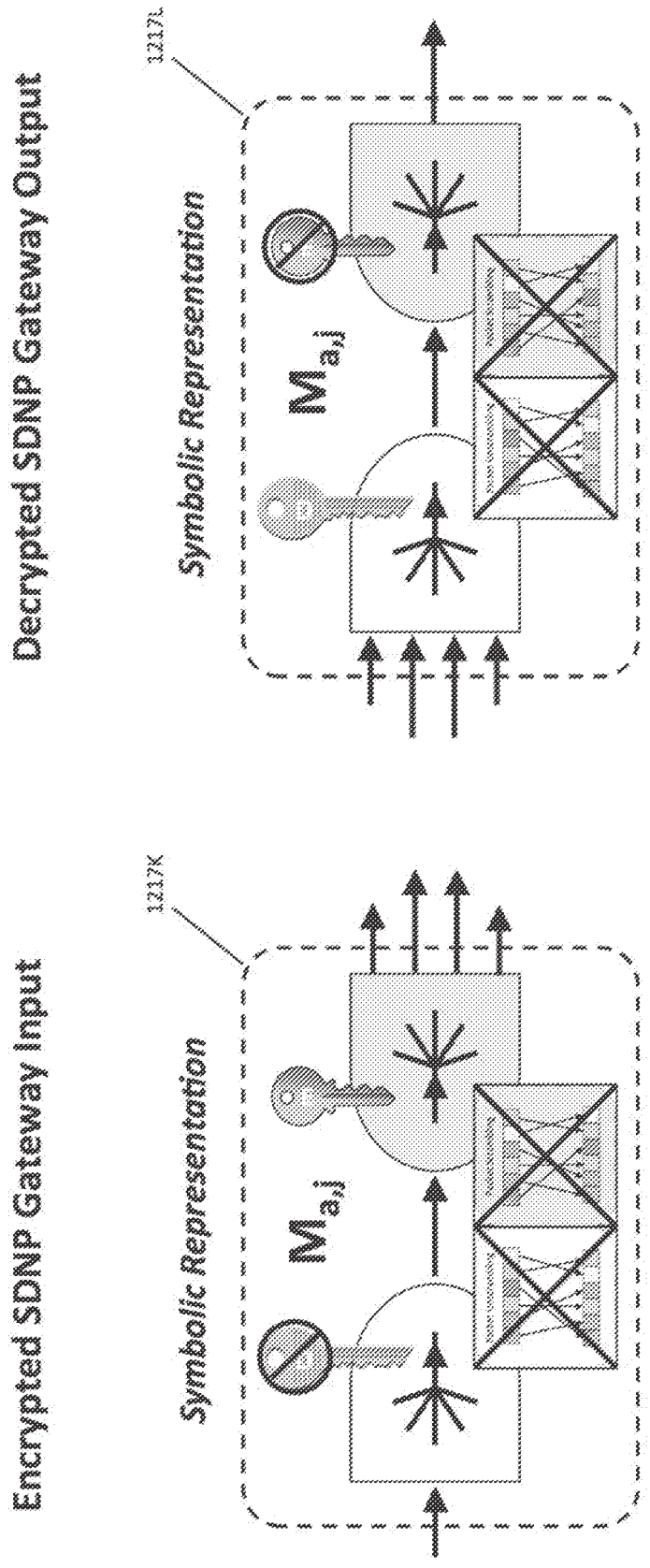

Encrypted SDNP Gateway Input
3217K
Symbolic Representation
$M_{a,j}$
Decrypted SDNP Gateway Output
3217L
Symbolic Representation
$M_{a,j}$

Figure 83Q

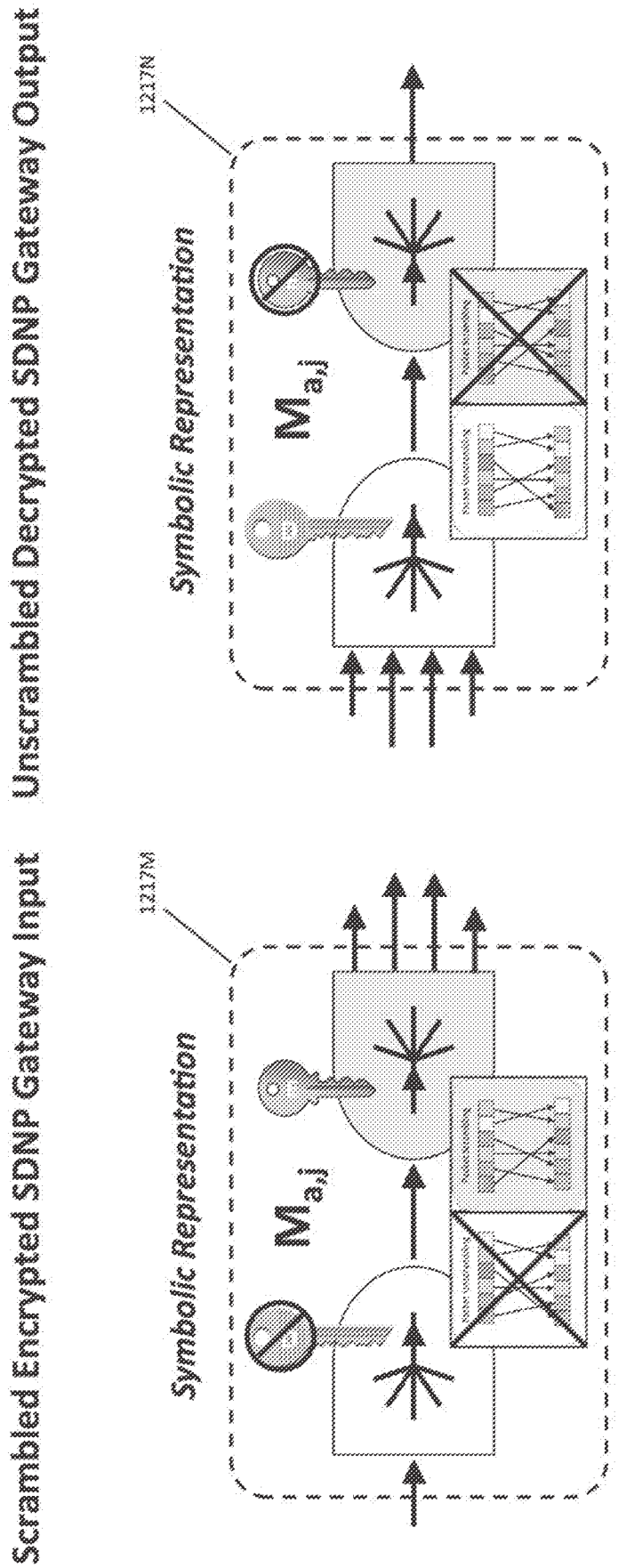

Scrambled Encrypted SDNP Gateway Input
Unscrambled Decrypted SDNP Gateway Output
Symbolic Representation
$M_{a,j}$
1221N
1221M

Figure 83R

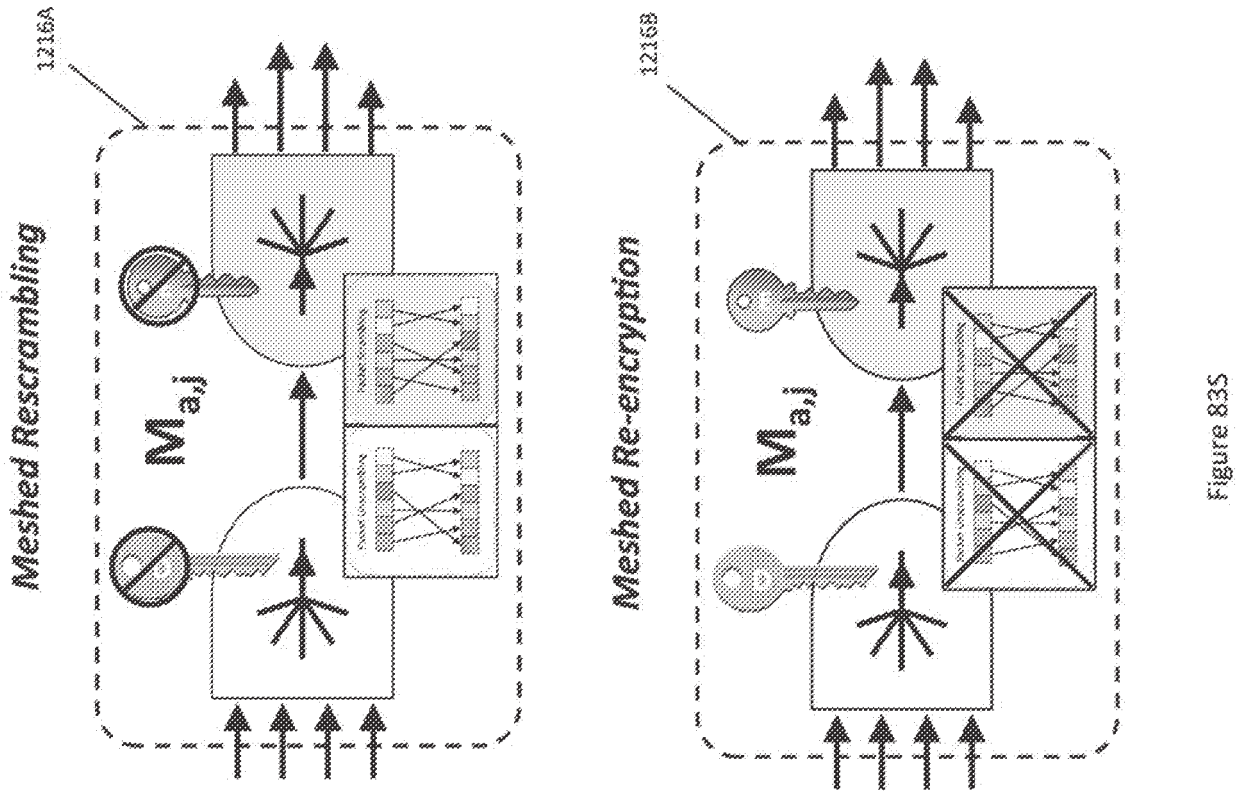

Meshed Rescrambling
1216A
$M_{a,j}$
Meshed Re-encryption
1216B
$M_{a,j}$

Figure 83S

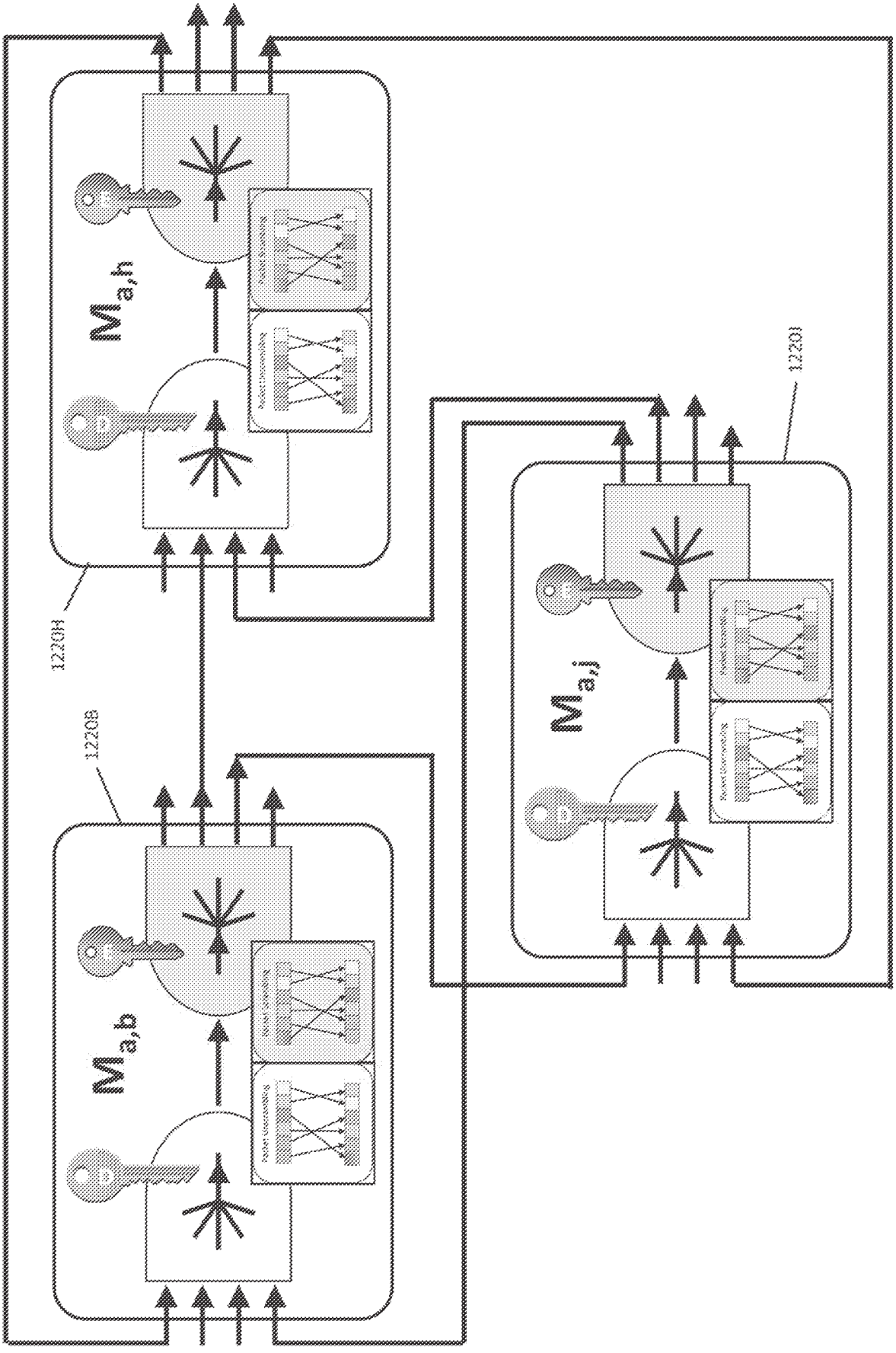


Figure 84A

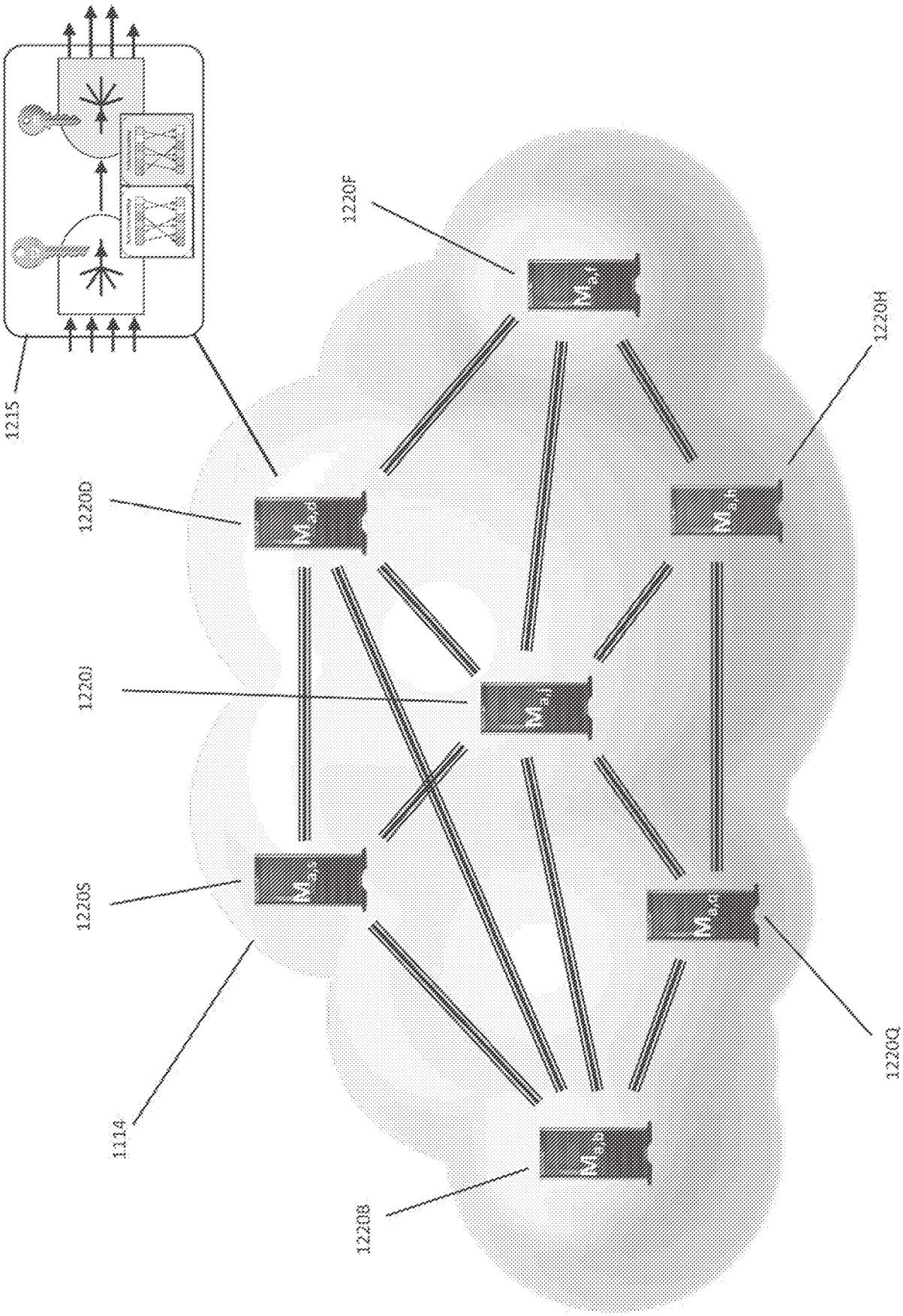


Figure 84B

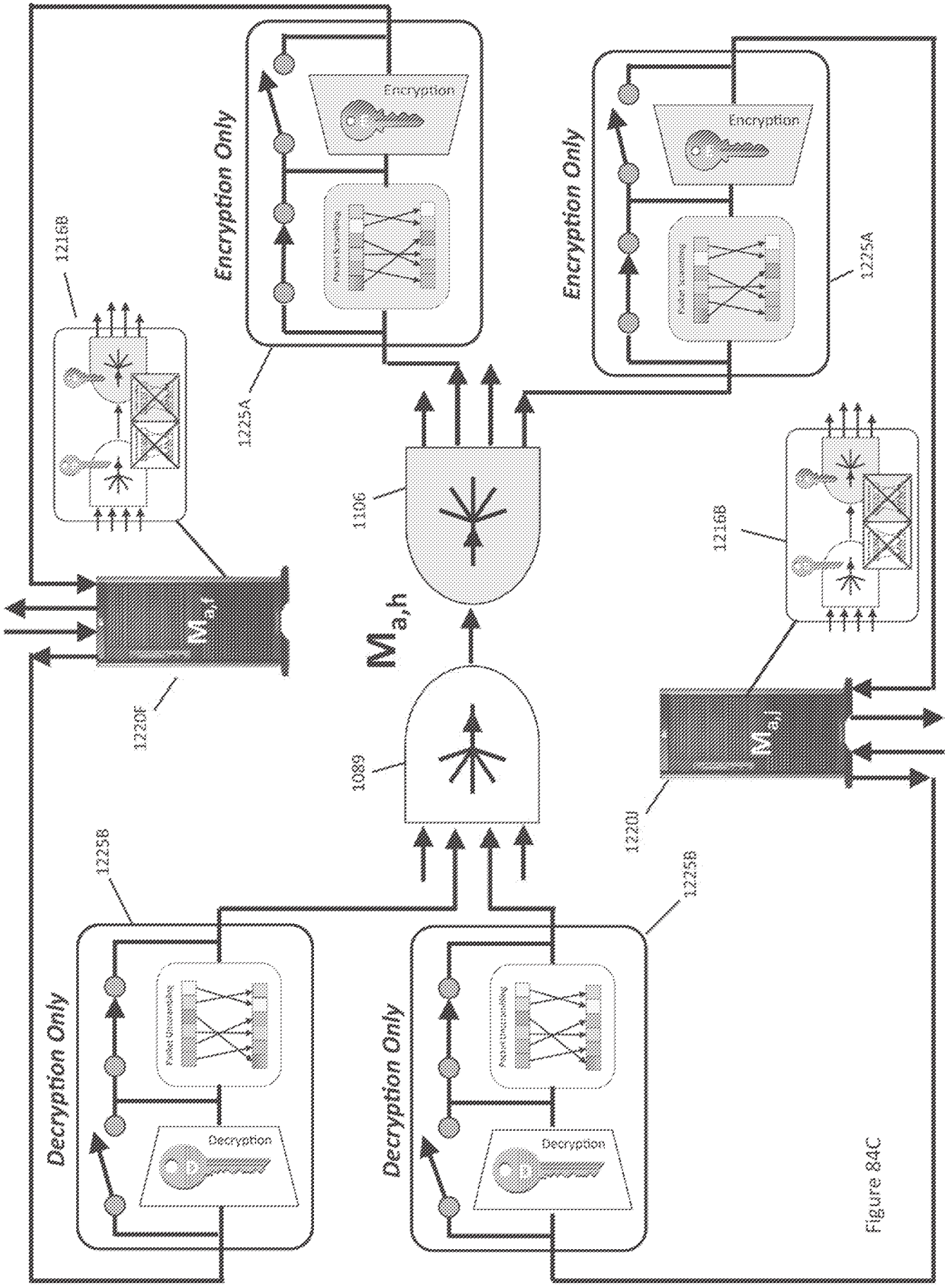

Encryption Only
Encryption
Encryption Only
Encryption
1216B
1225A
1225A
1106
1216B
$M_{a,h}$
$M_{a,M}$
$M_{a,l}$
1220F
1089
1220J
1225B
1225B
Decryption Only
Decryption
Decryption Only
Decryption

Figure 84C

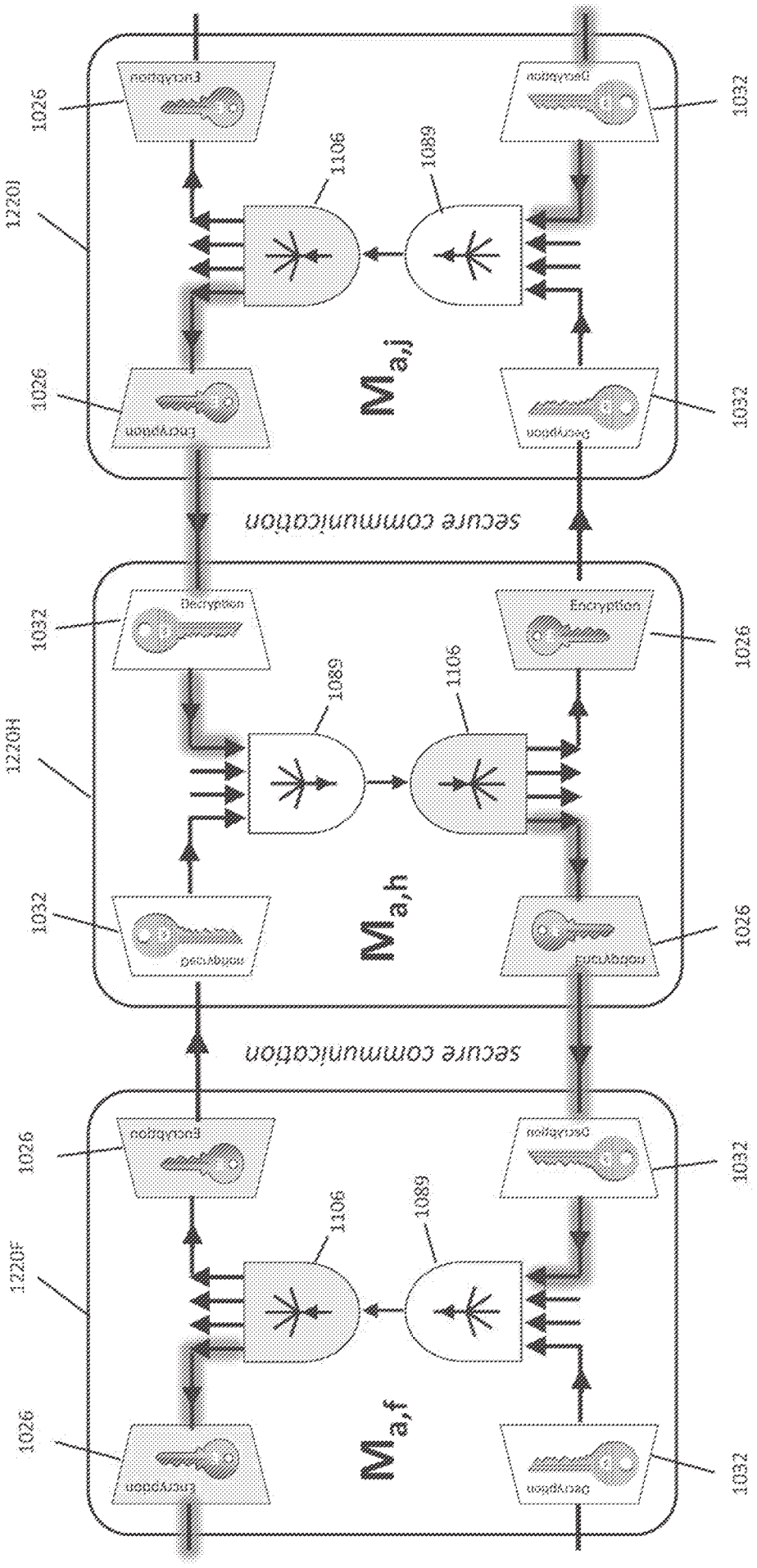

1220J
1220H
1220F
1026
1032
1106
1089
$M_{a,j}$
$M_{a,h}$
$M_{a,f}$
secure communication
secure communication
Encryption
Decryption

Figure 84D

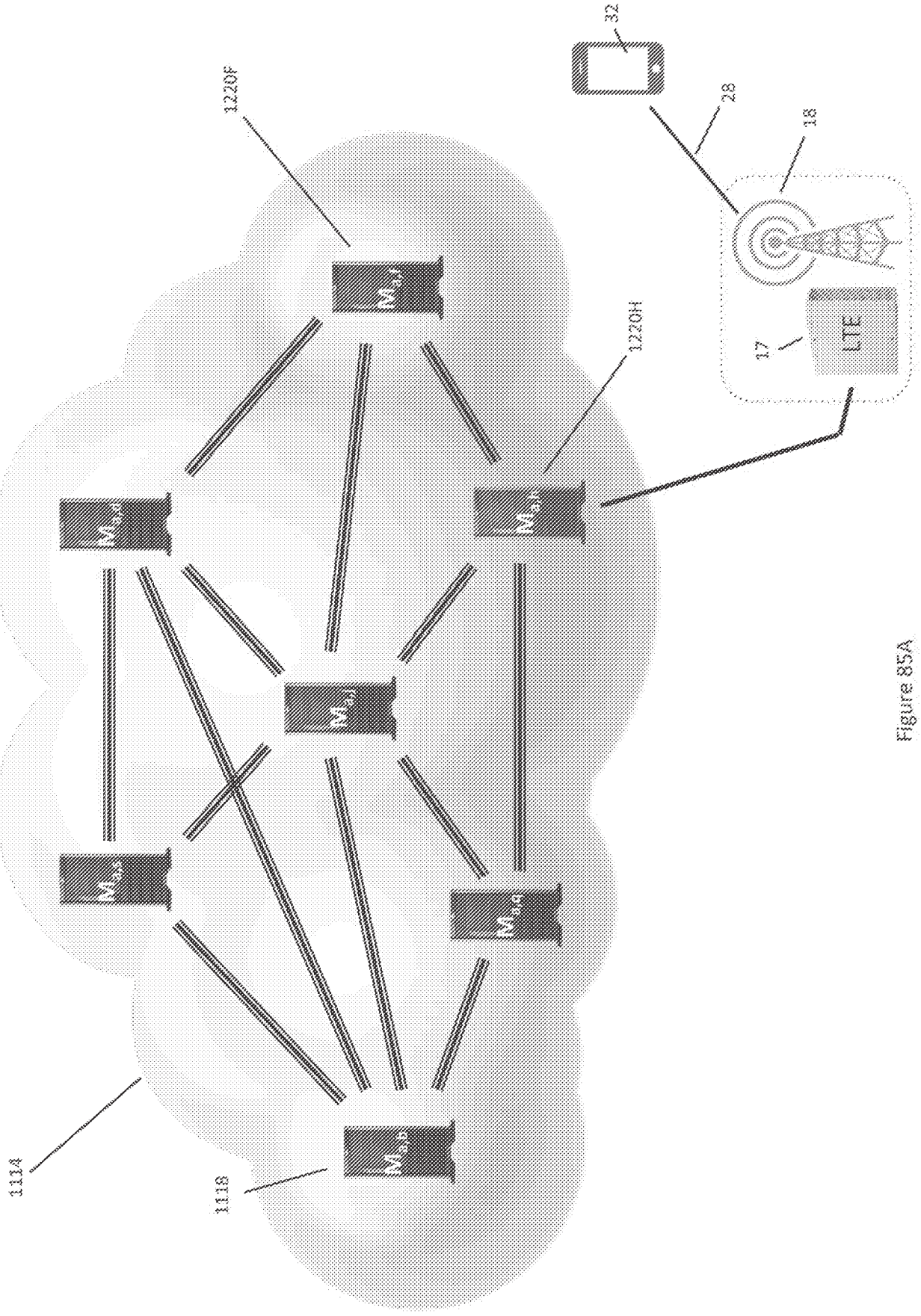


Figure 85A

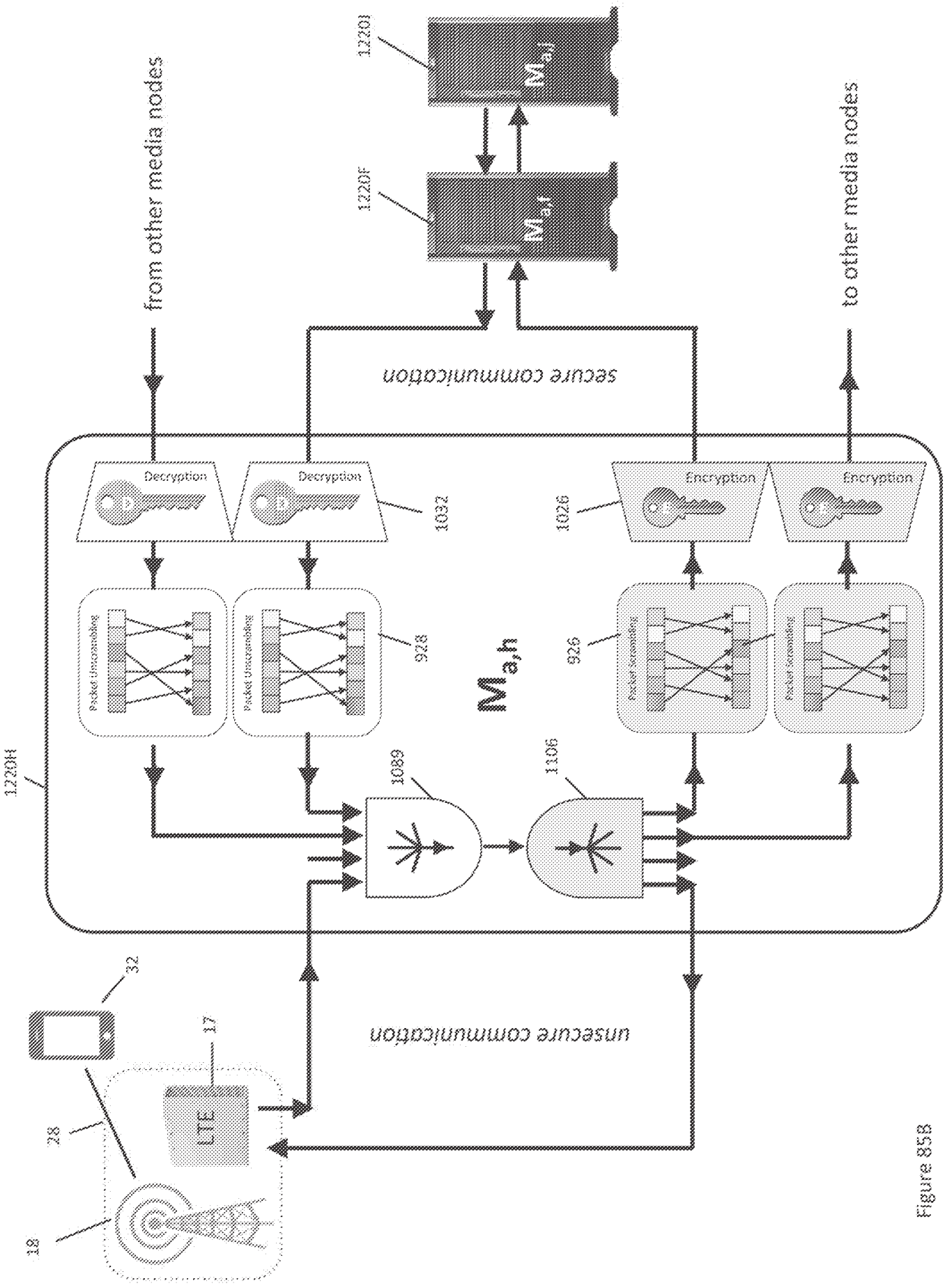

1220J
$M_{a,J}$
1220F
$M_{a,f}$
from other media nodes
to other media nodes
secure communication
Decryption
Decryption
1032
Encryption
Encryption
1026
Packet Unscrambling
Packet Unscrambling
928
$M_{a,h}$
926
Packet Scrambling
Packet Scrambling
1220H
1089
1106
32
17
LTE
28
18
unsecure communication

Figure 85B

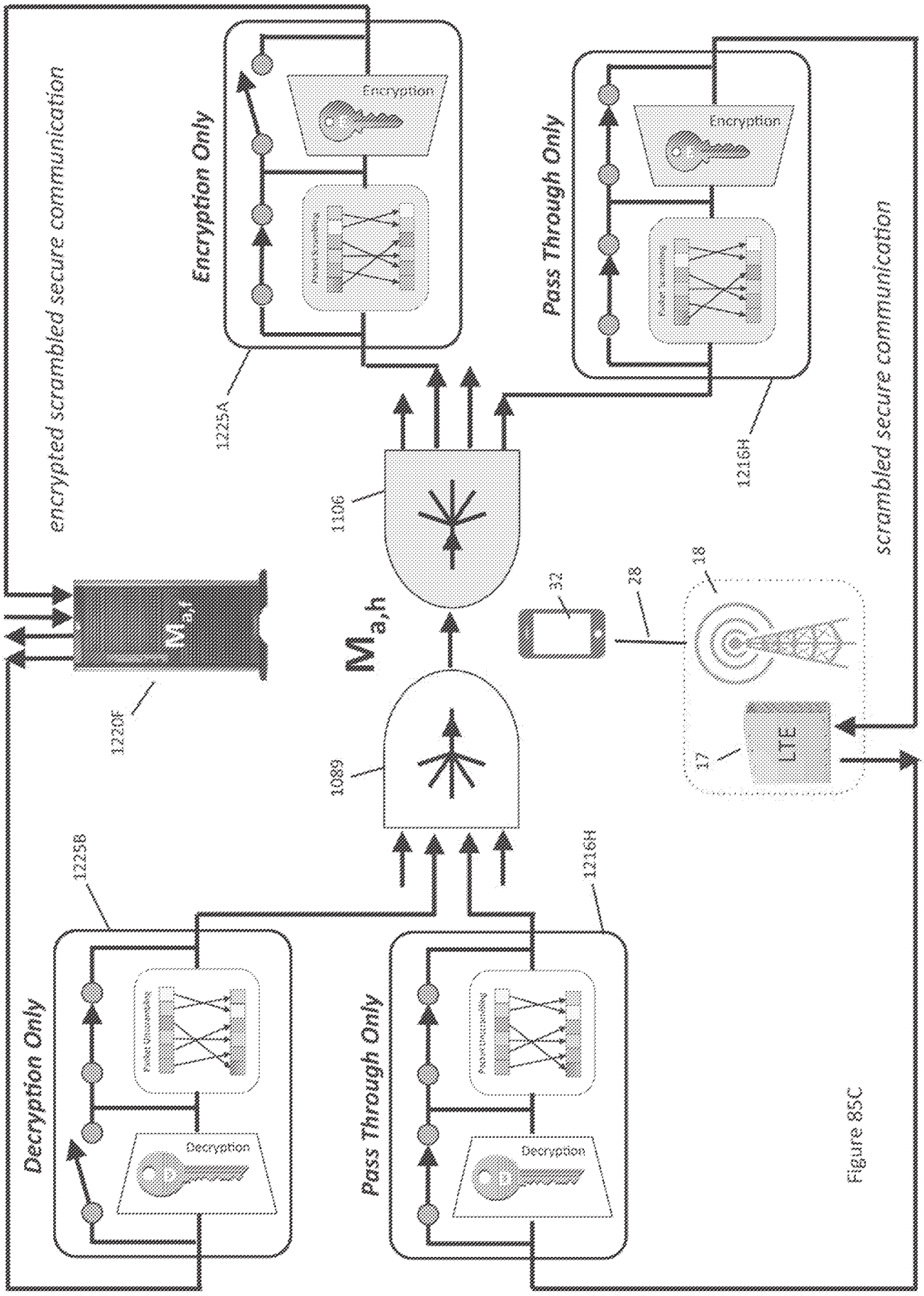

encrypted scrambled secure communication
Encryption Only
Encryption
1225A
Pass Through Only
Encryption
1216H
1106
32
28
18
17
LTE
scrambled secure communication
1220F
$M_{a,M}$
$M_{a,h}$
1089
Decryption Only
1225B
Decryption
Pass Through Only
1216H
Decryption

Figure 85C

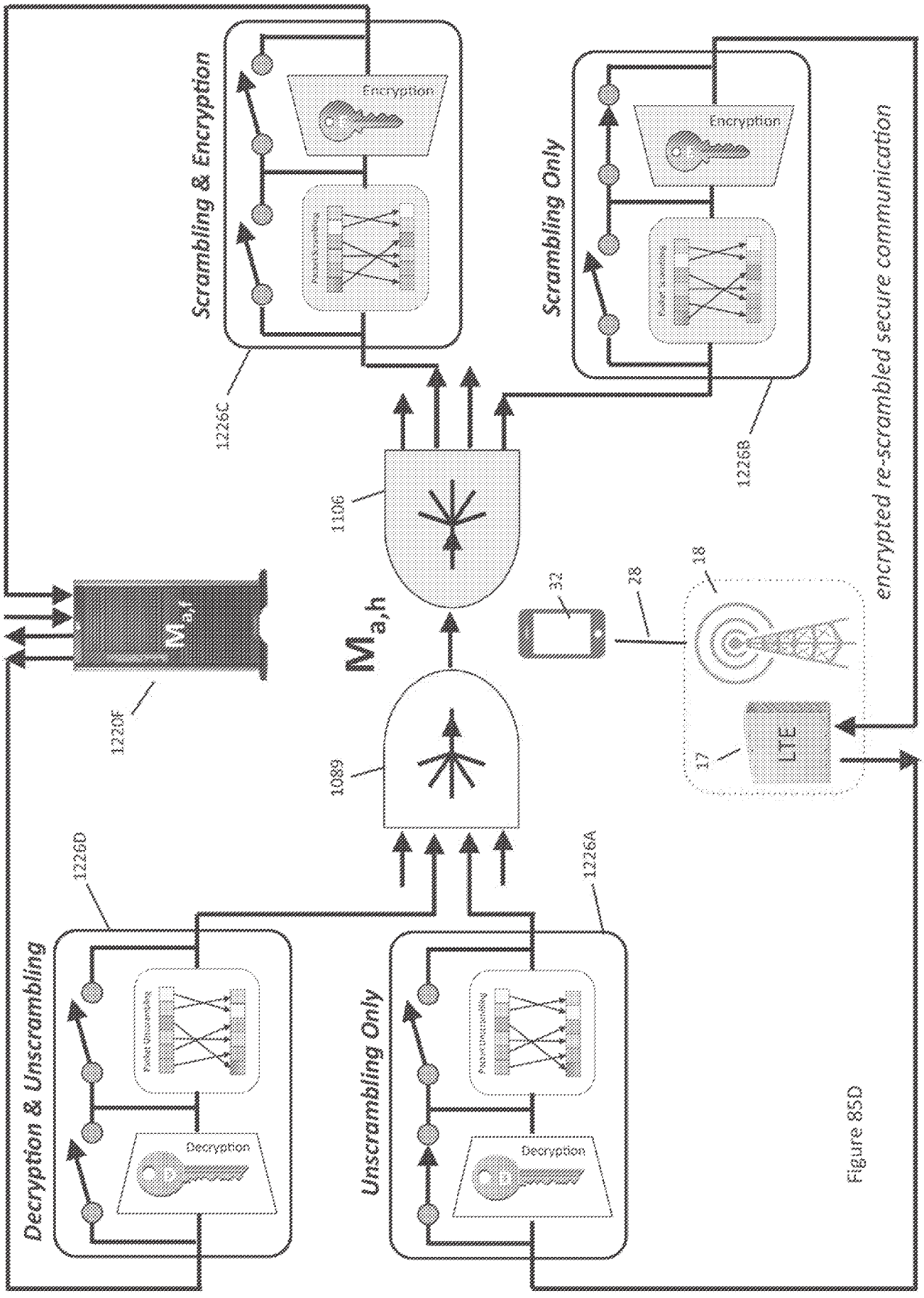

Scrambling & Encryption
Encryption
Packet Scrambling
1226C
Scrambling Only
Encryption
Packet Scrambling
1226B
1106
$M_{a,h}$
1089
$M_{a,M}$
1220F
32
28
18
17
LTE
encrypted re-scrambled secure communication
Decryption & Unscrambling
Packet Descrambling
Decryption
1226D
Unscrambling Only
Packet Descrambling
Decryption
1226A

Figure 85D

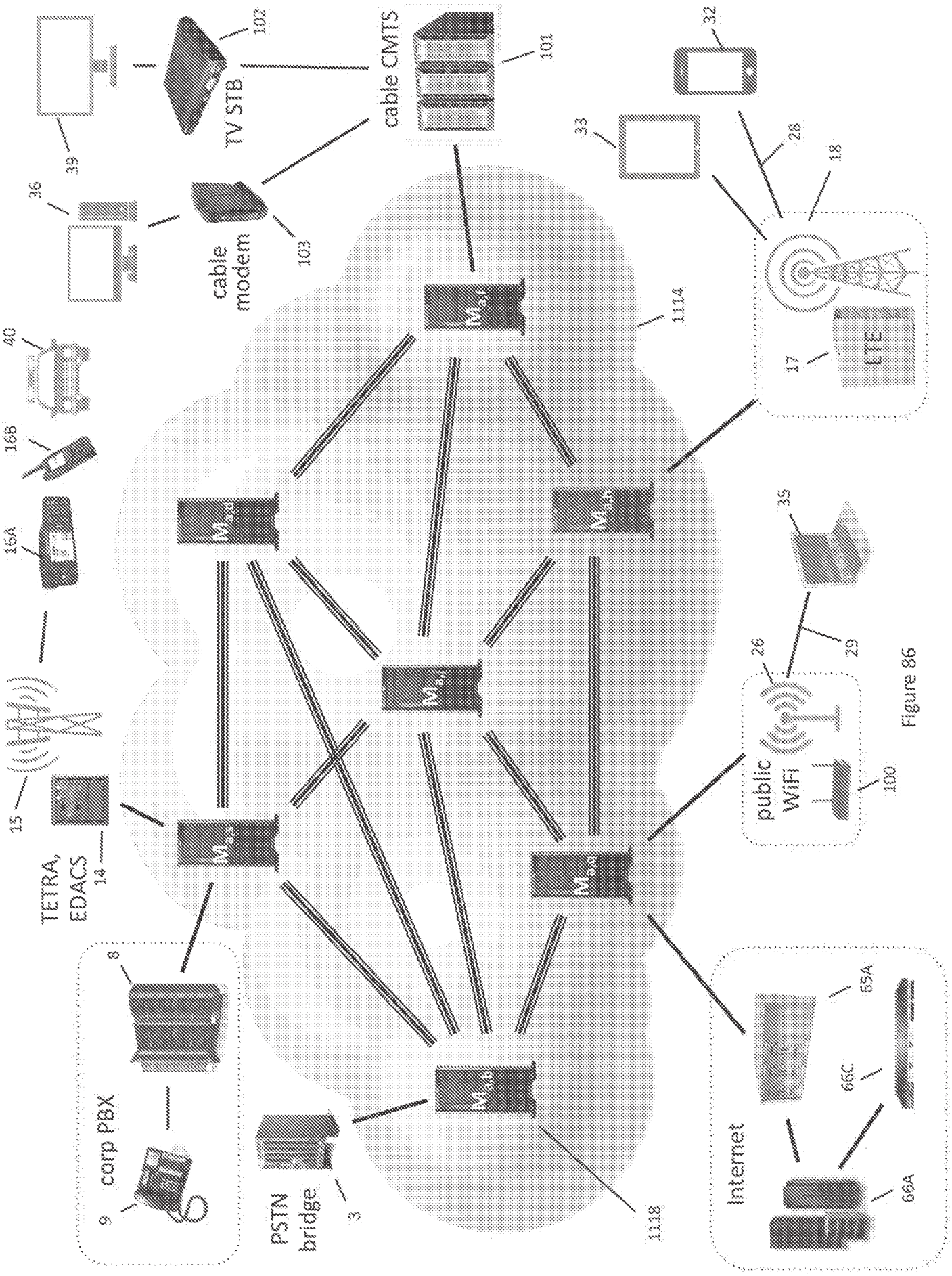

TV STB
cable CMTS
cable modem
LTE
TETRA, EDACS
corp PBX
PSTN bridge
Internet
public WiFi
1114
1118
39
102
101
103
36
32
33
28
18
17
40
16B
16A
15
14
8
9
3
35
29
26
100
65A
66C
66A

Figure 86

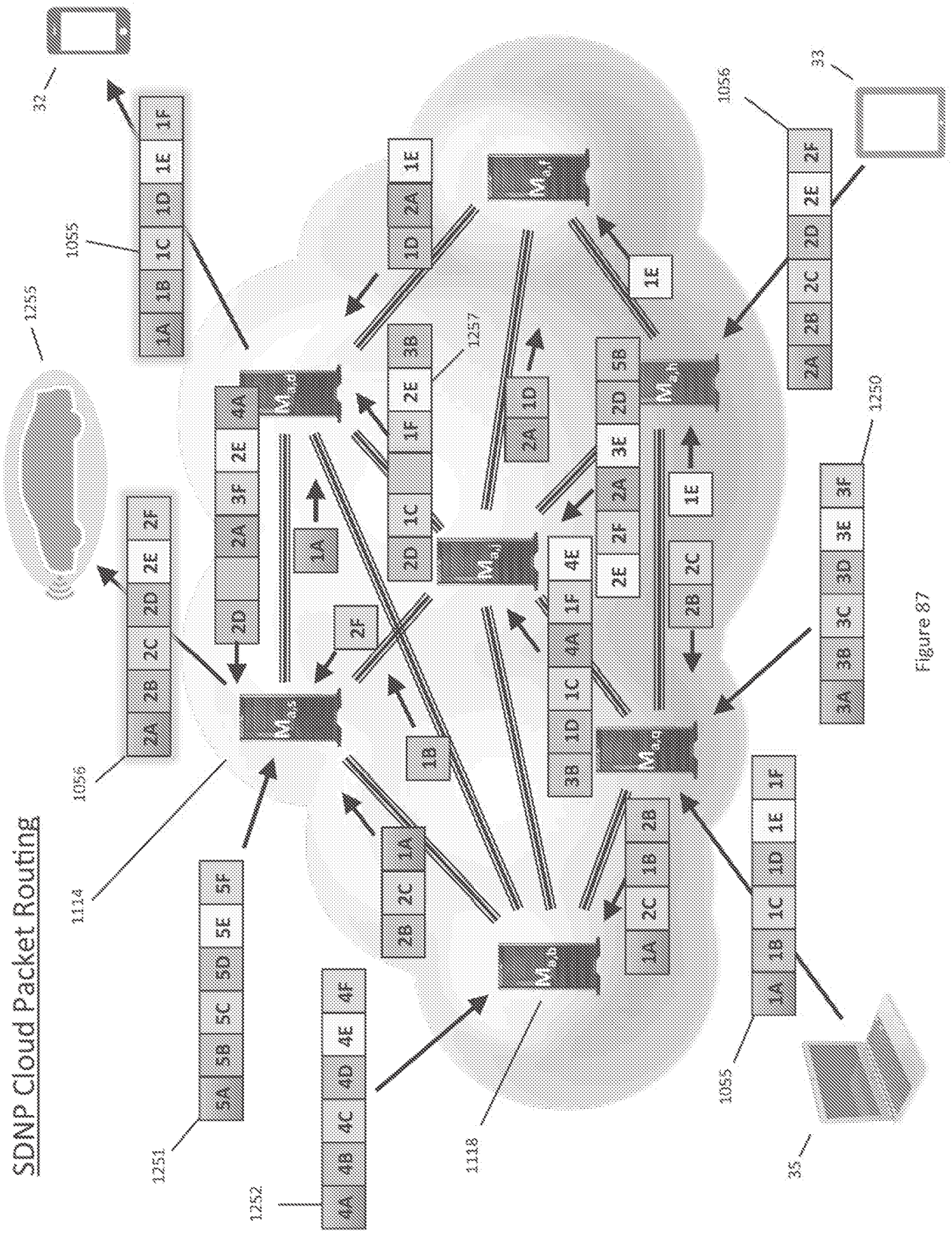

SDNP Cloud Packet Routing
32
33
35
1055
1056
1114
1118
1250
1251
1252
1255
1257
1A 1B 1C 1D 1E 1F
2A 2B 2C 2D 2E 2F
3A 3B 3C 3D 3E 3F
4A 4B 4C 4D 4E 4F
5A 5B 5C 5D 5E 5F

Figure 87

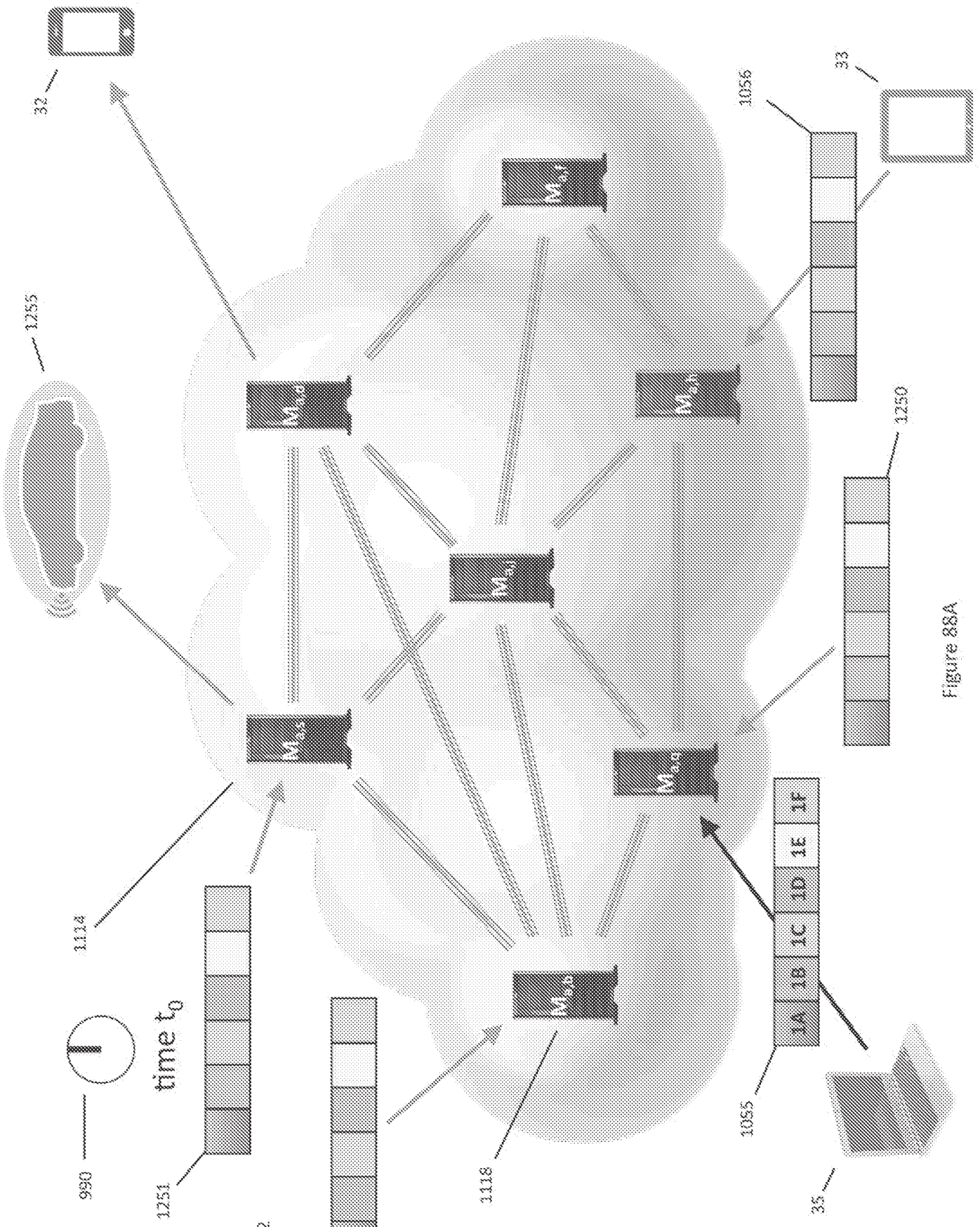

32
1255
1114
980
time t_0
1251
1252
1118
35
1055
1A
1B
1C
1D
1E
1F
1056
33
1250

Figure 88A

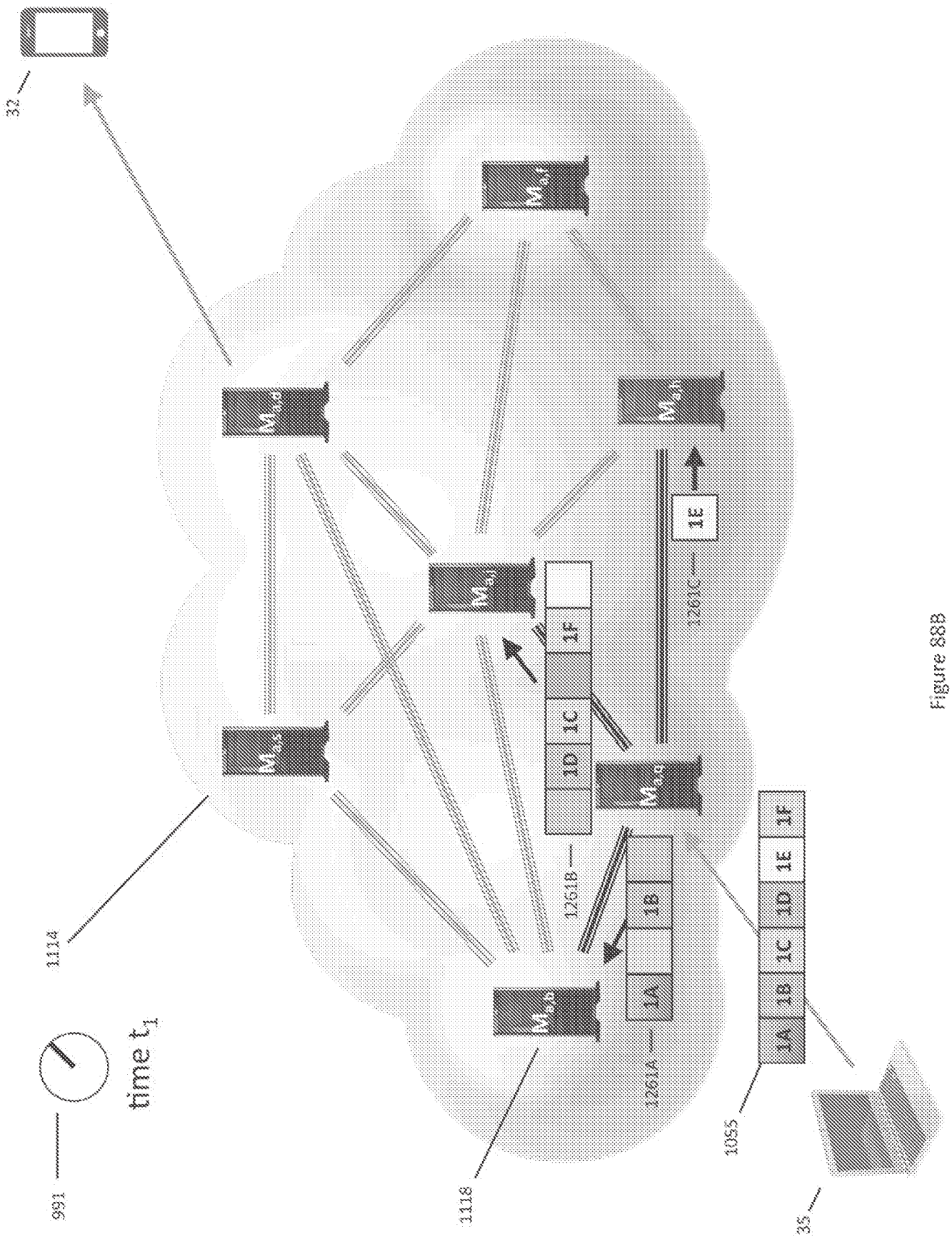

32
1114
991
time t_1
1118
1261A
1261B
1261C
1055
35
1A
1B
1C
1D
1E
1F

Figure 88B

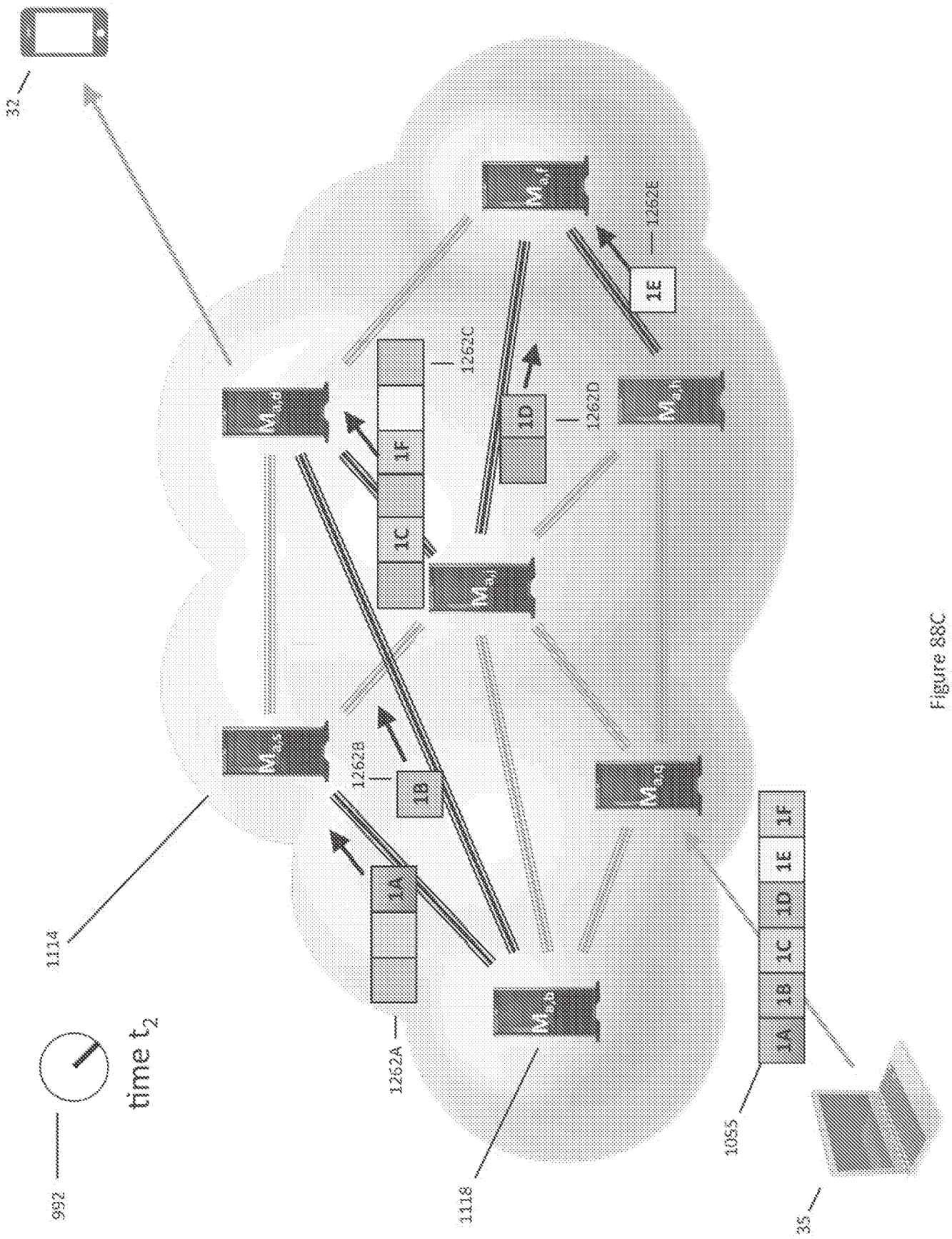

32
1114
992
time t_2
1252A
1262B
1262C
1262D
1262E
1A
1B
1C
1D
1E
1F
1118
1055
35

Figure 88C

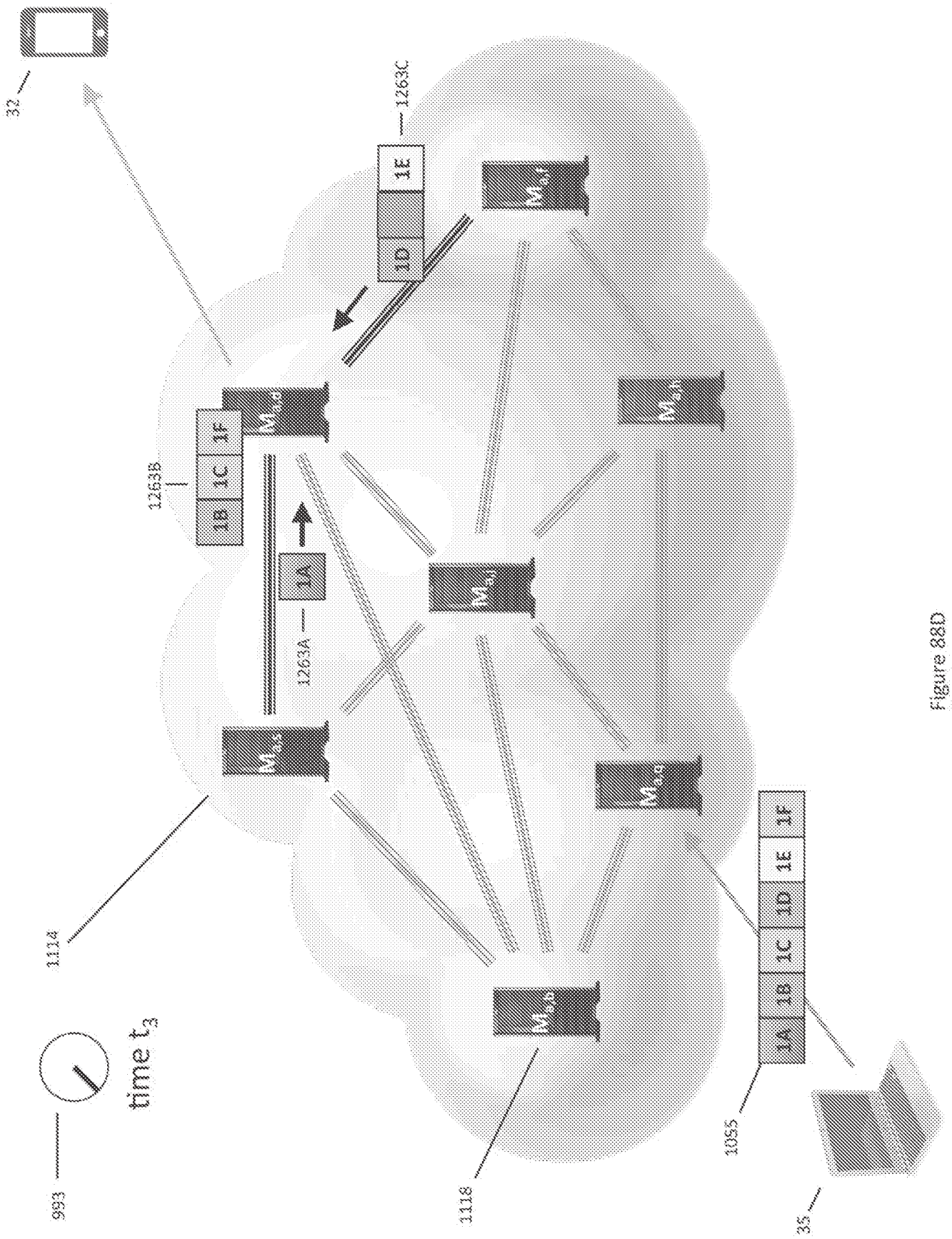

32
1263C
1E
1D
1F
1C
1B
1263B
1A
1263A
1114
time t_3
993
1118
1055
35

Figure 88D

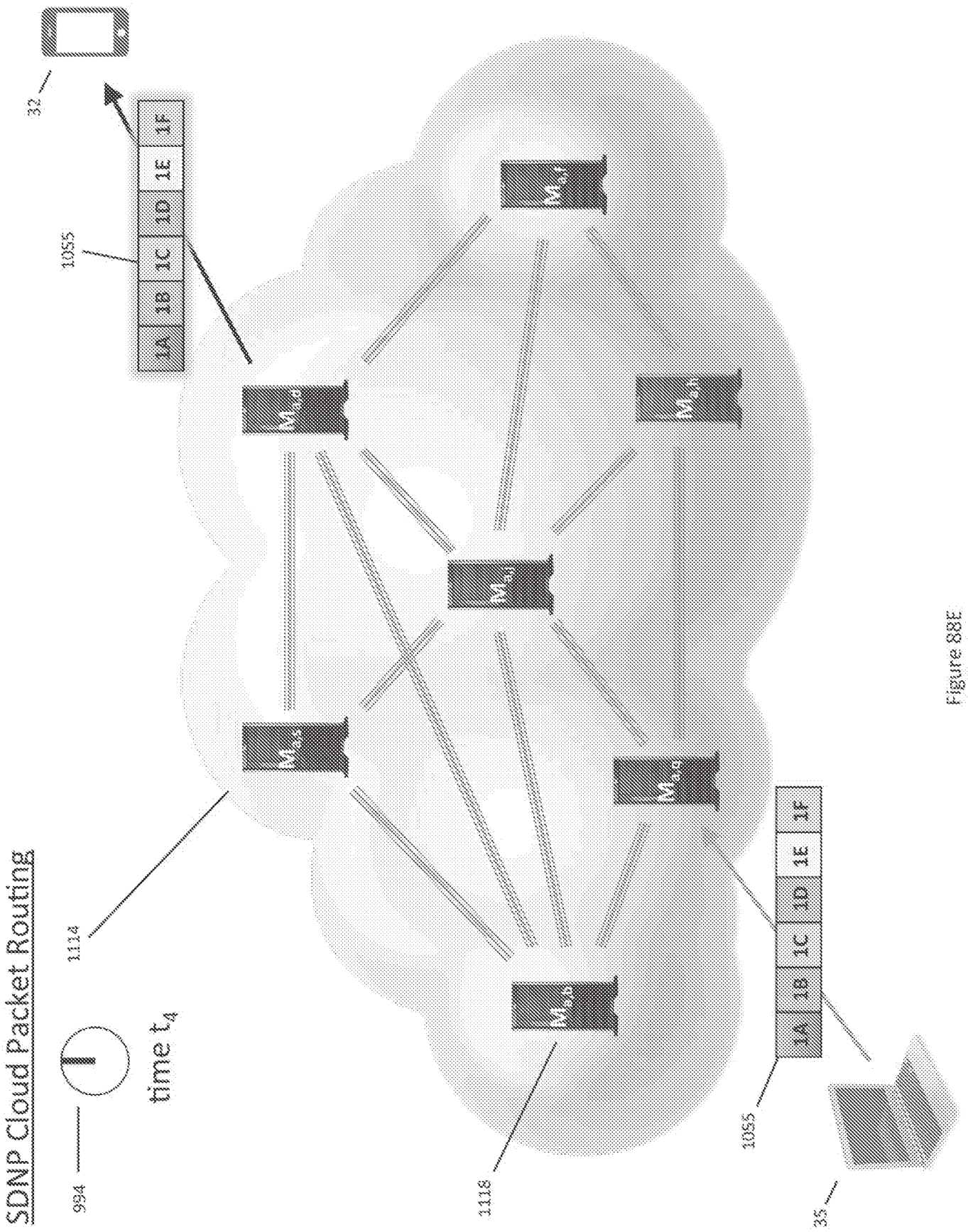

SDNP Cloud Packet Routing
994
time t_4
1114
1118
1055
1A
1B
1C
1D
1E
1F
32
35

Figure 88E

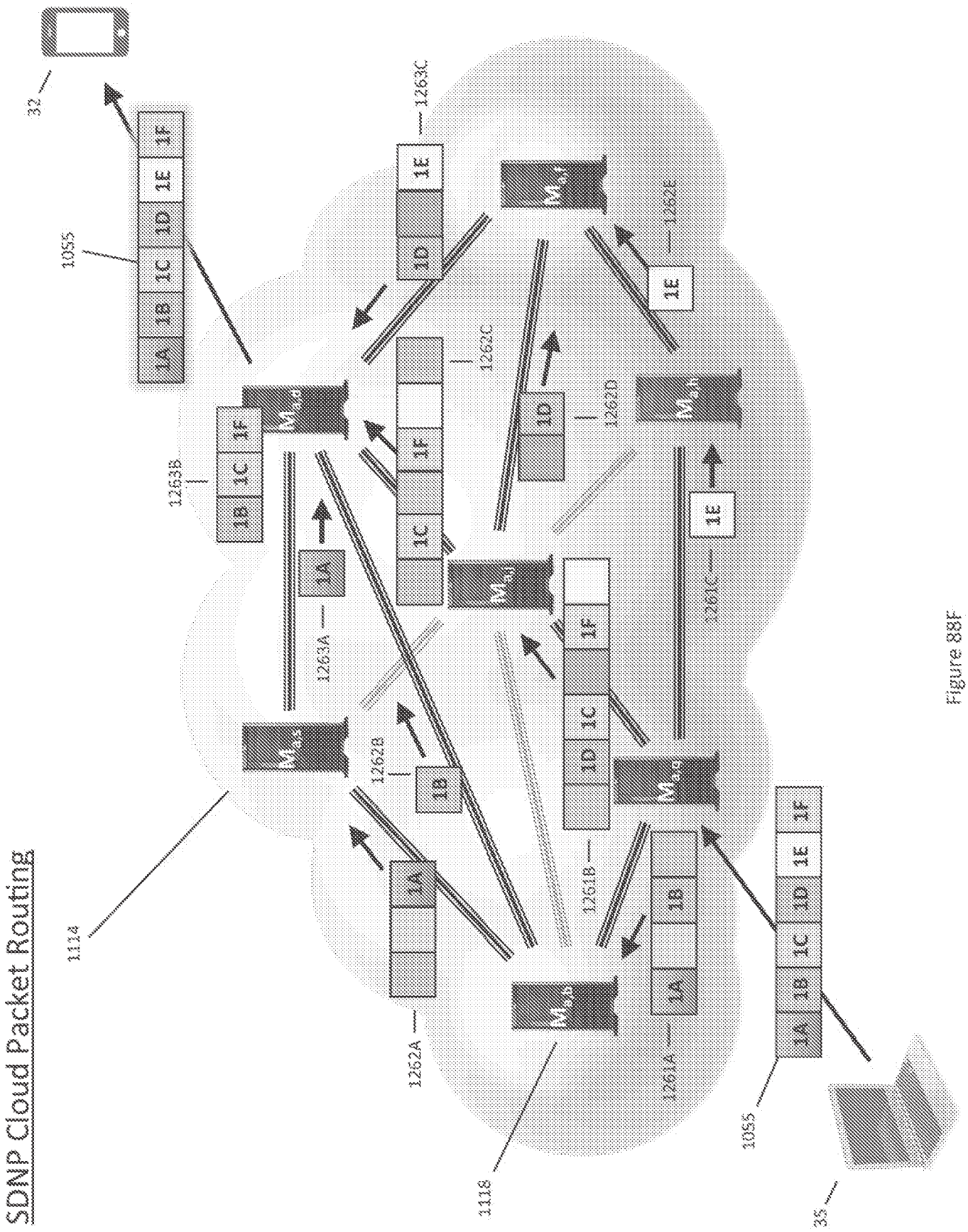

SDNP Cloud Packet Routing
32
1055
1A
1B
1C
1D
1E
1F
1114
1263B
1263A
1262B
1262A
1263C
1262C
1262D
1263E
1261C
1261B
1261A
1118
35

Figure 88F

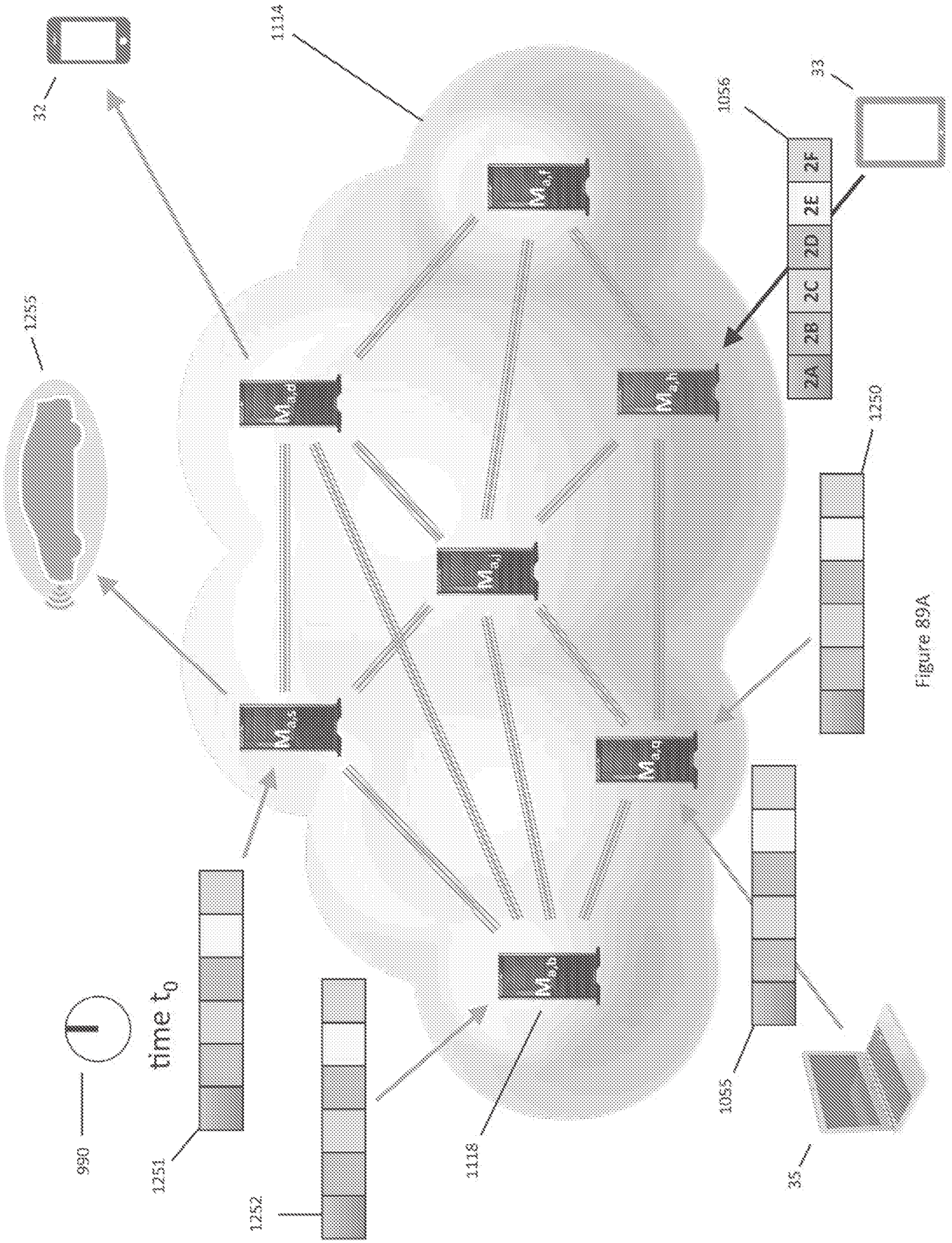

32
1114
33
1056
2A
2B
2C
2D
2E
2F
1255
1250
time t_0
980
1251
1252
1118
1055
35

Figure 89A

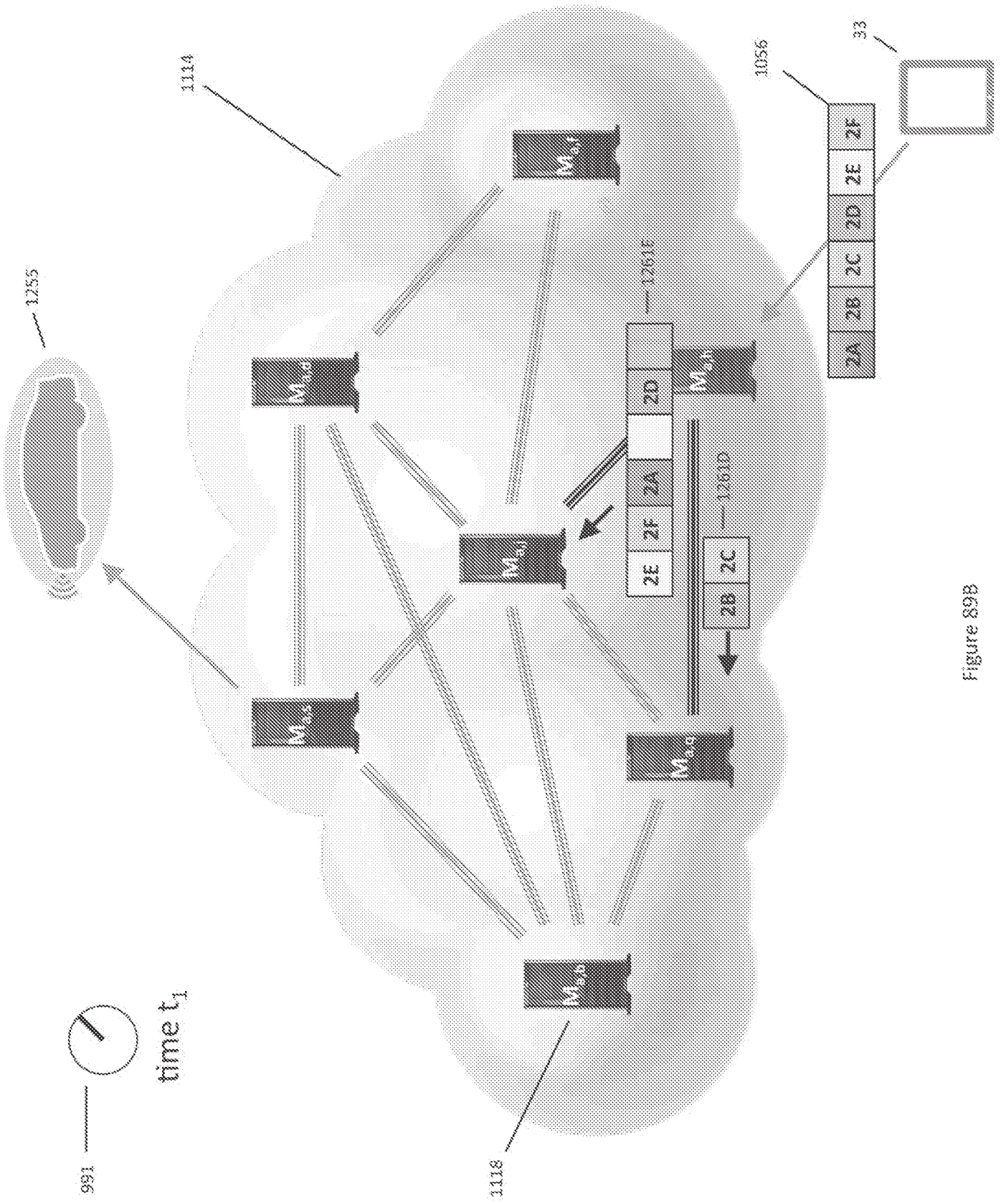


Figure 89B

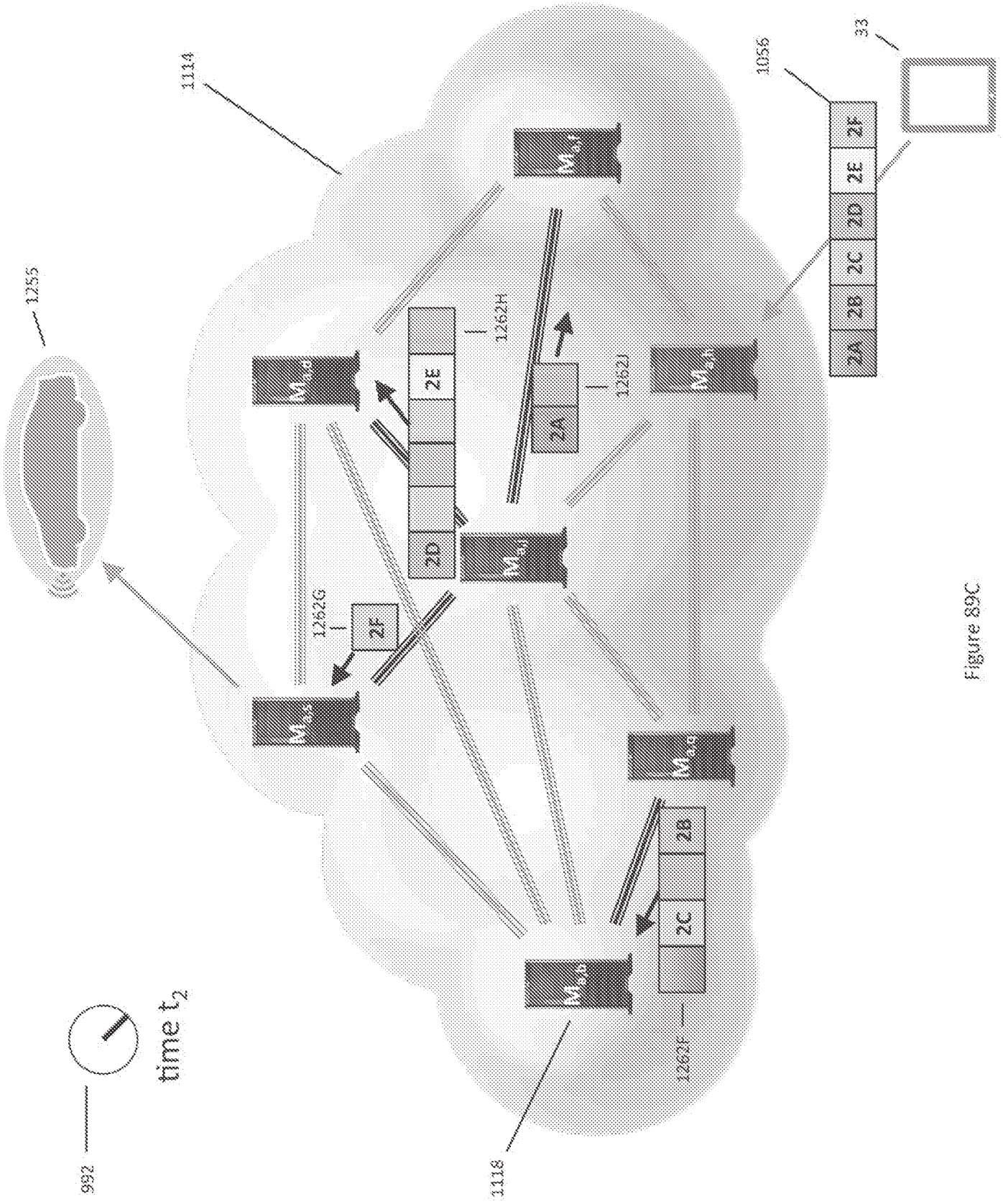

time t_2
986
1255
1114
1118
1056
33
1262G
1262H
1262J
1262F
2A
2B
2C
2D
2E
2F

Figure 89C

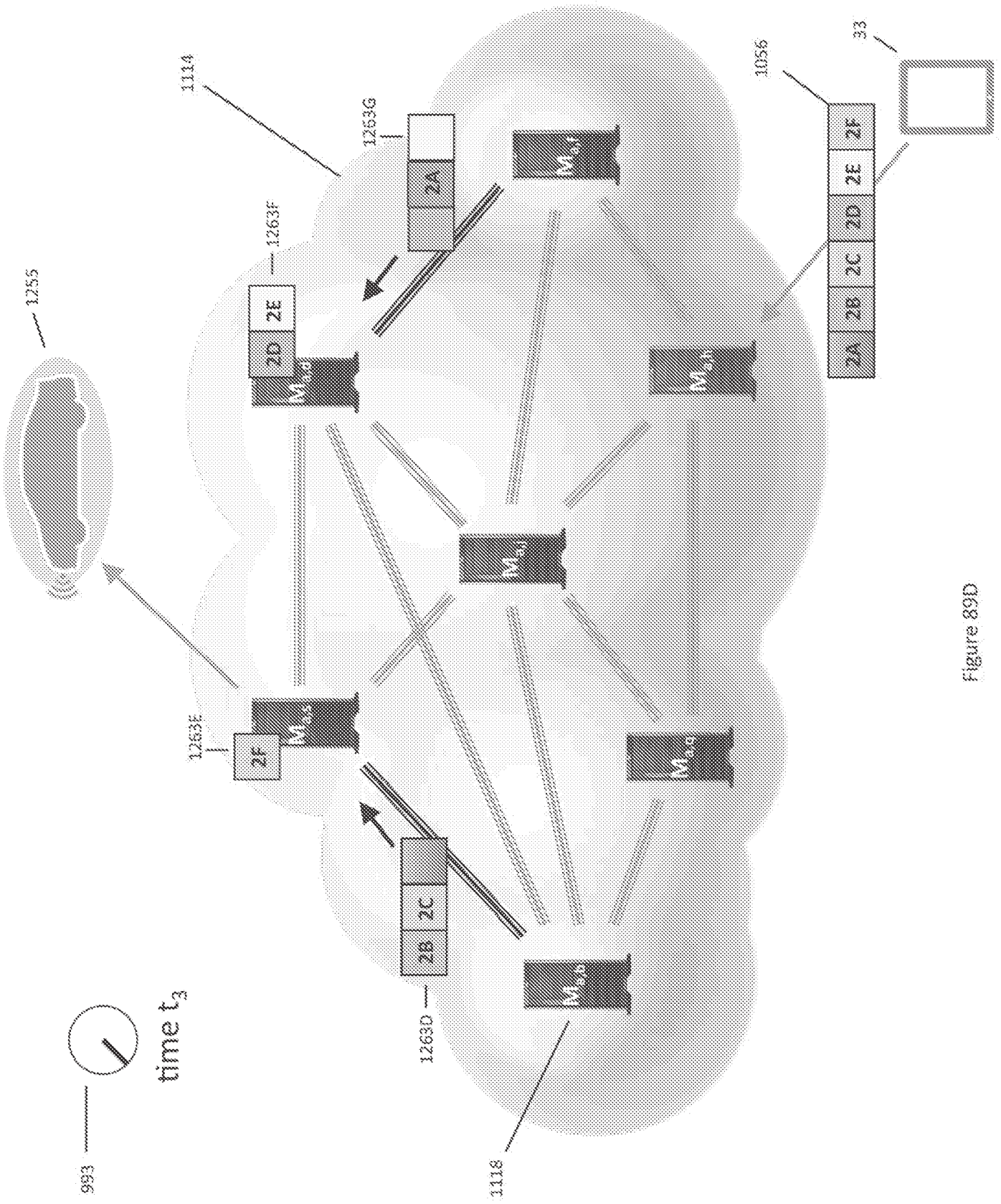

993
time t_3
1255
1114
1263G
1263F
1263E
1263D
1118
1056
33
2A
2B
2C
2D
2E
2F

Figure 89D

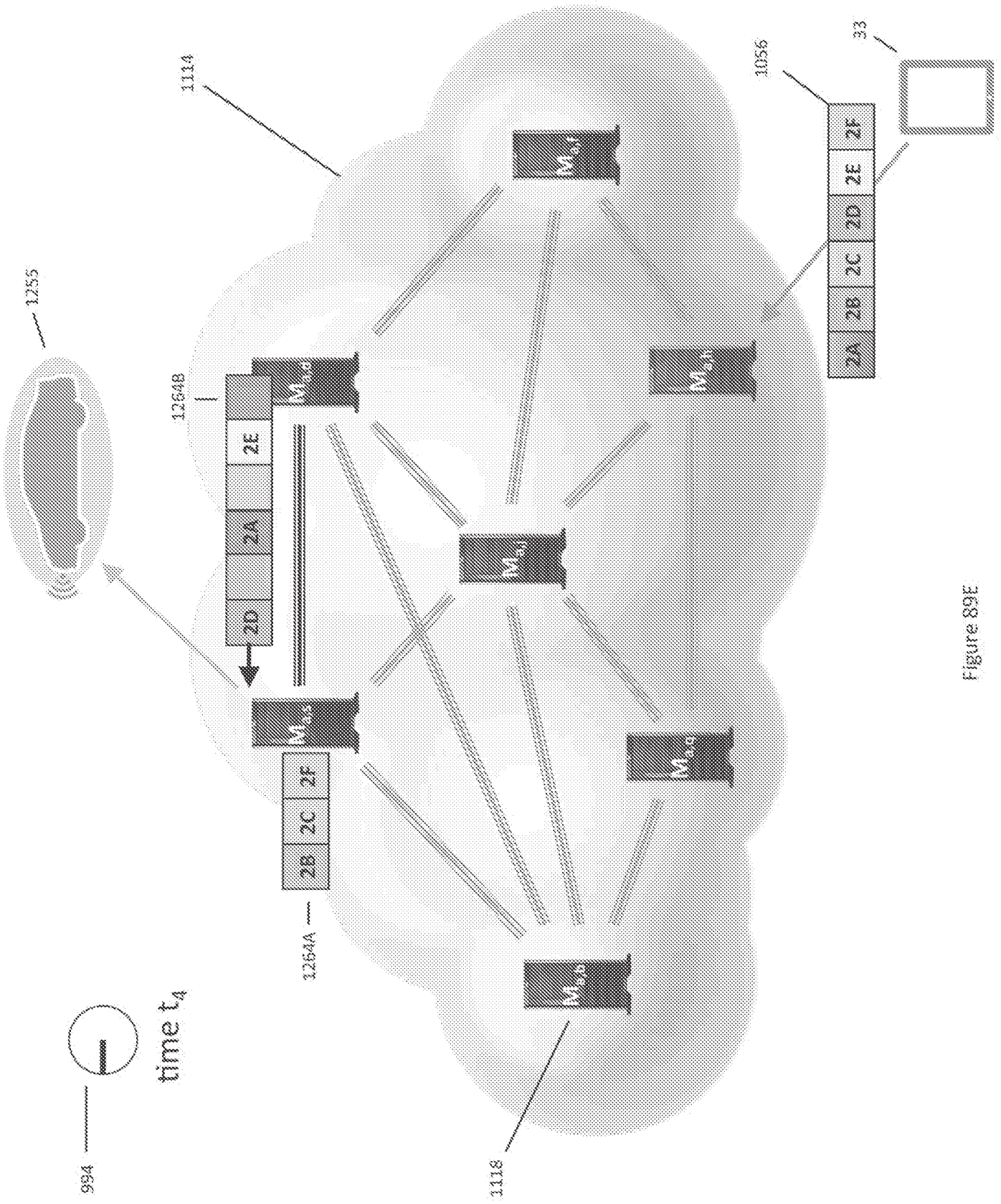

994
time t_4
1255
1114
12648
2D
2A
2E
1264A
2B
2C
2F
1118
1056
2A
2B
2C
2D
2E
2F
33

Figure 89E

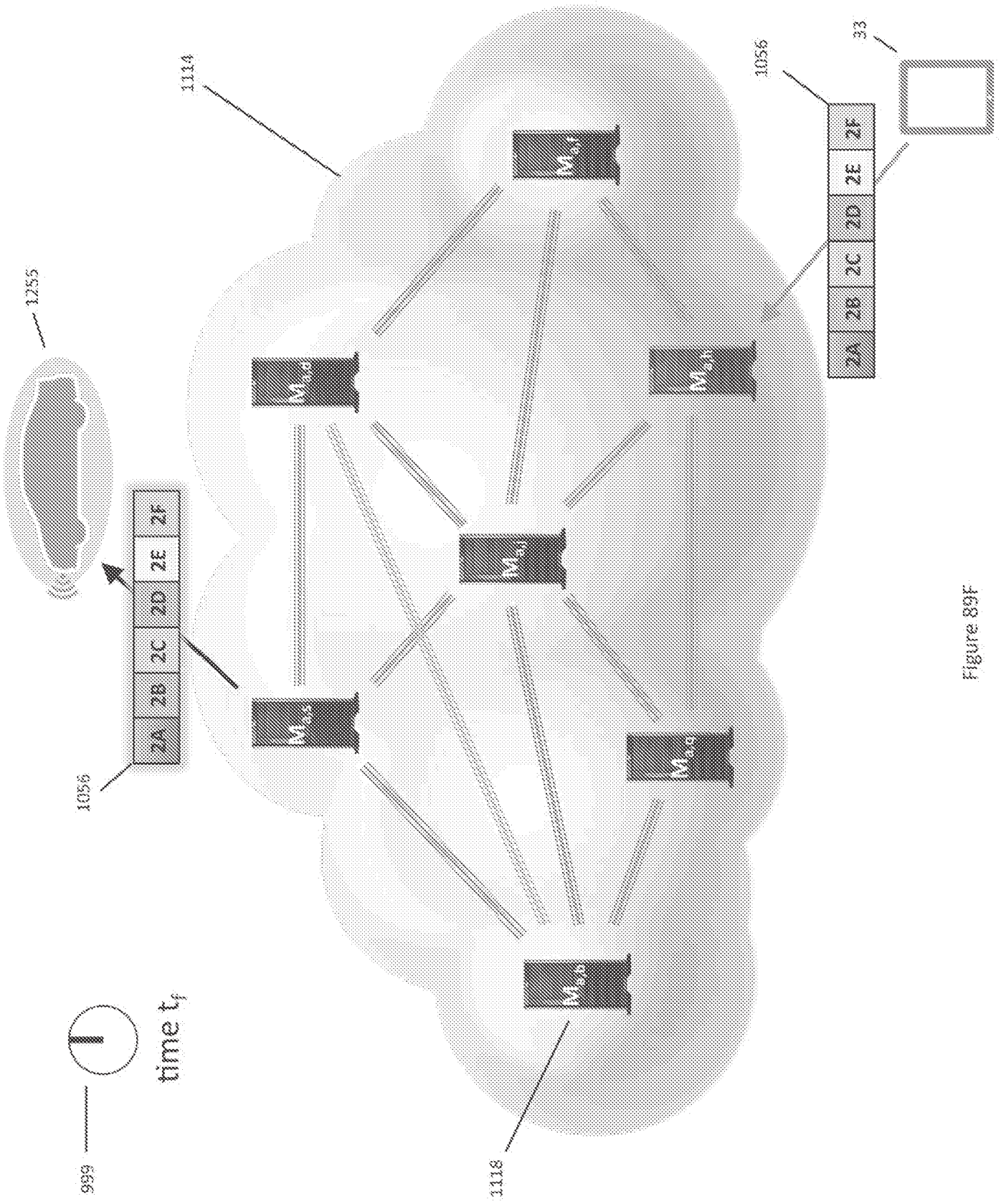


Figure 89F

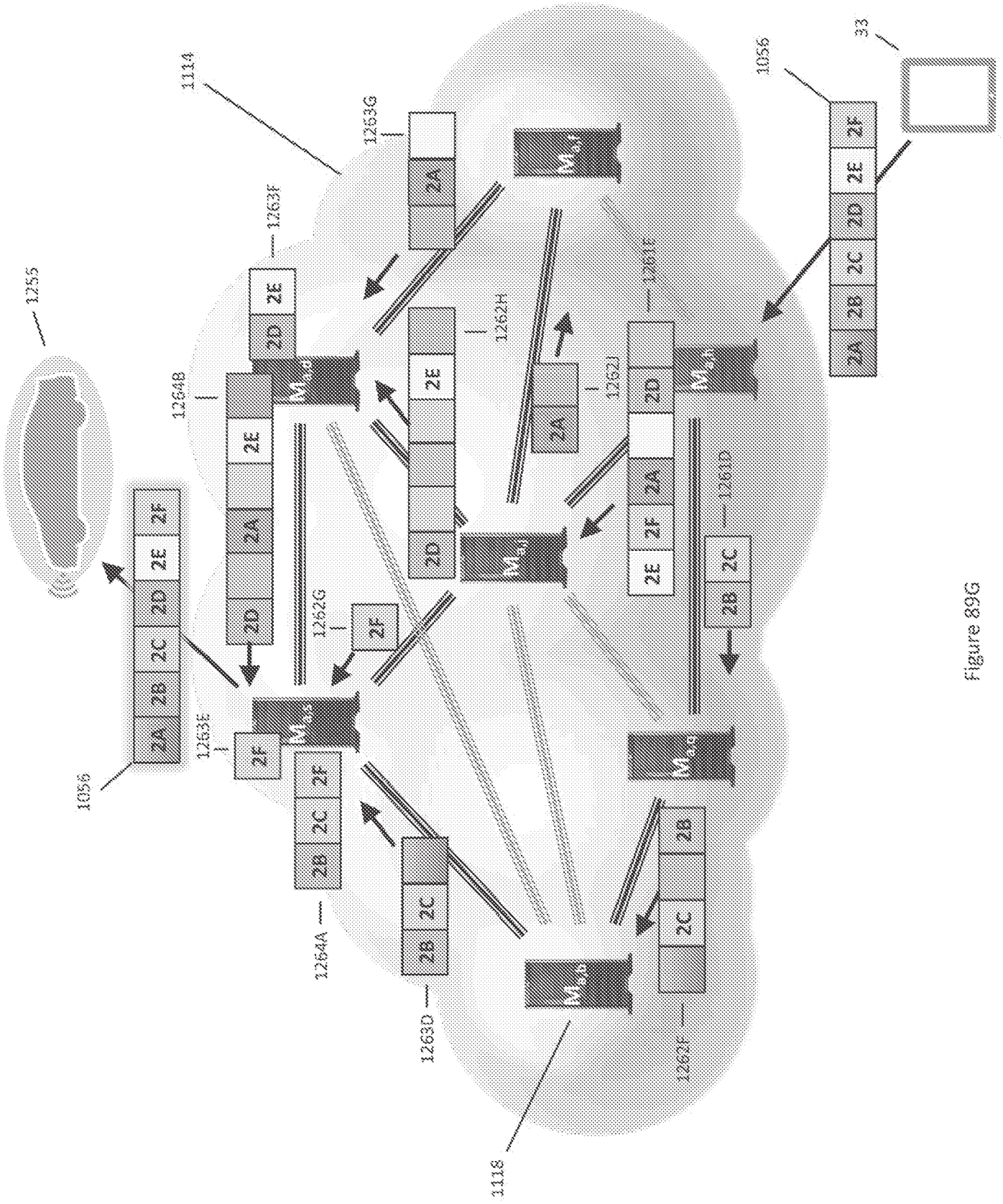

1255
1114
1056
1263G
1263F
1262H
1262J
1261F
1261D
1262G
1263E
1264A
1263D
1263F
1118
33
2A
2B
2C
2D
2E
2F

Figure 89G

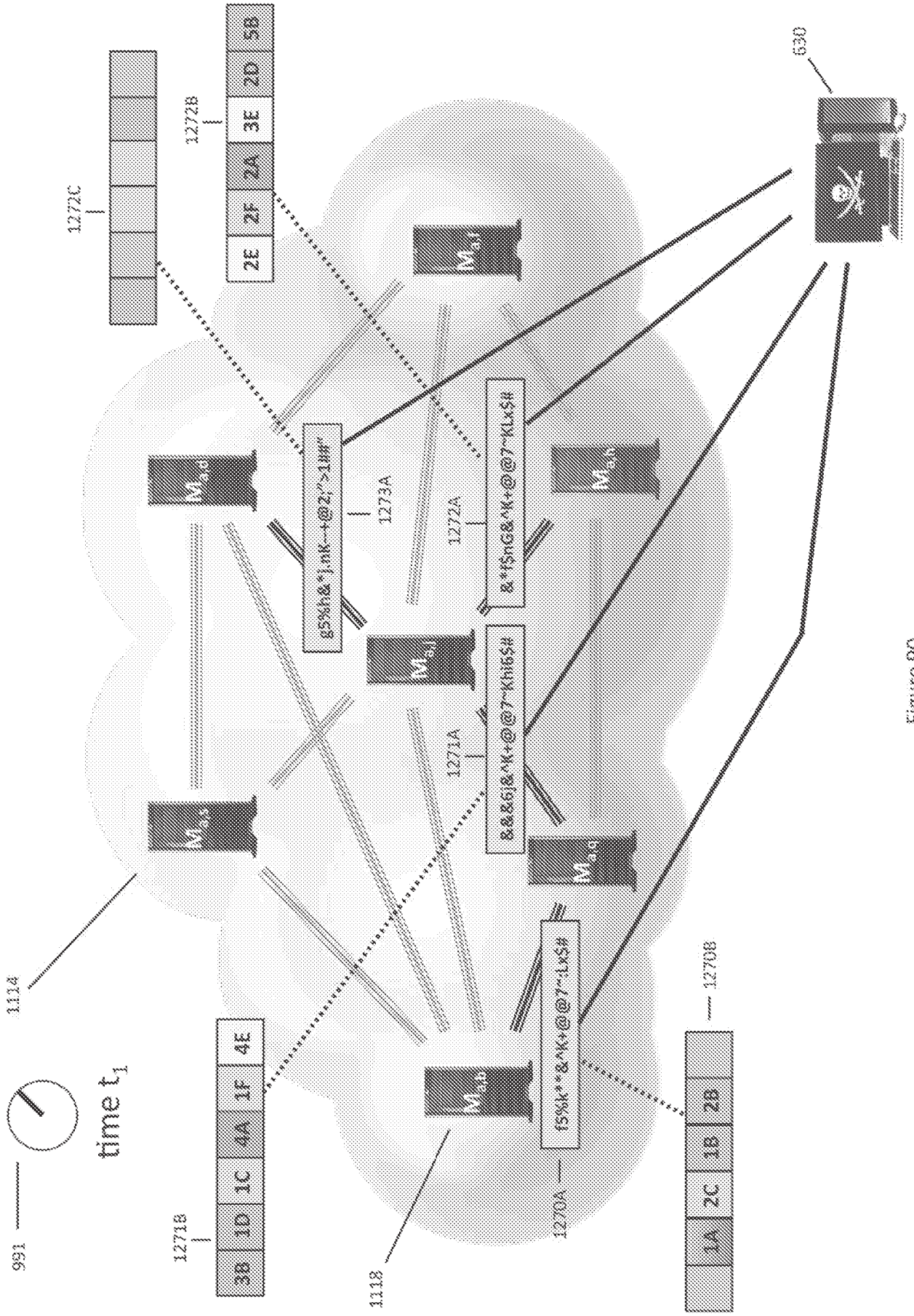

991
time t_1
1114
1118
1270A
1271A
1272A
1273A
1272C
1272B
1271B
1270B
1270C
630
3B 1D 1C 4A 1F 4E
2E 2F 2A 3E 2D 5B
1A 2C 1B 2B
&&&6j&^K+@@7~Khi6$#
&*!5nG&^K+@@7~KLx$#
f5%k**&^K+@@7~Lx$#
g5%h&*j;nK--+@2;'>1##'

Figure 90

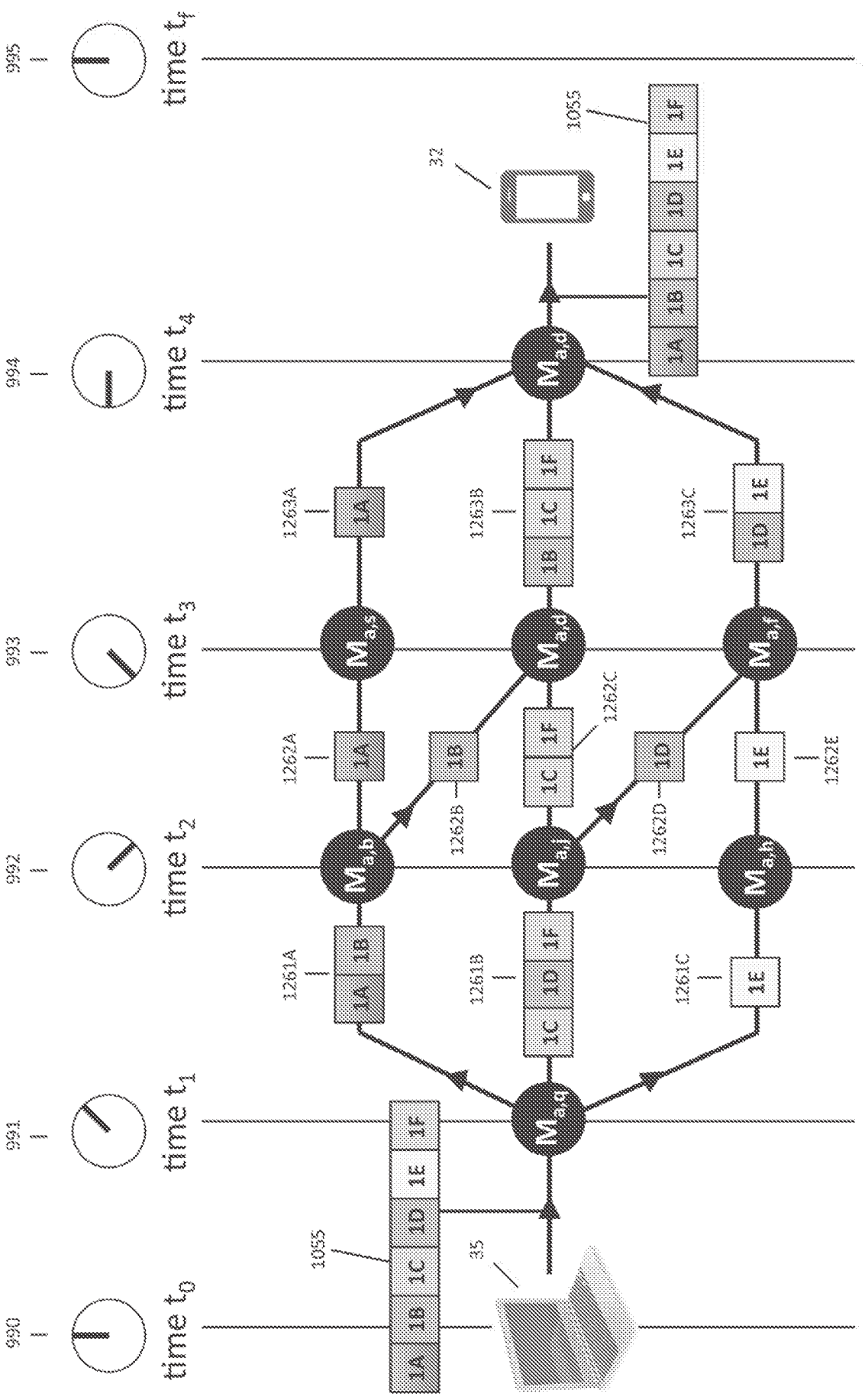

time t_0
time t_1
time t_2
time t_3
time t_4
time t_f
990
991
992
993
994
995
1055
35
32
1261A
1261B
1261C
1262A
1262B
1262C
1262D
1262E
1263A
1263B
1263C
1A
1B
1C
1D
1E
1F
$M_{a,0}$
$M_{a,1}$
$M_{a,2}$
$M_{a,3}$

Figure 91A

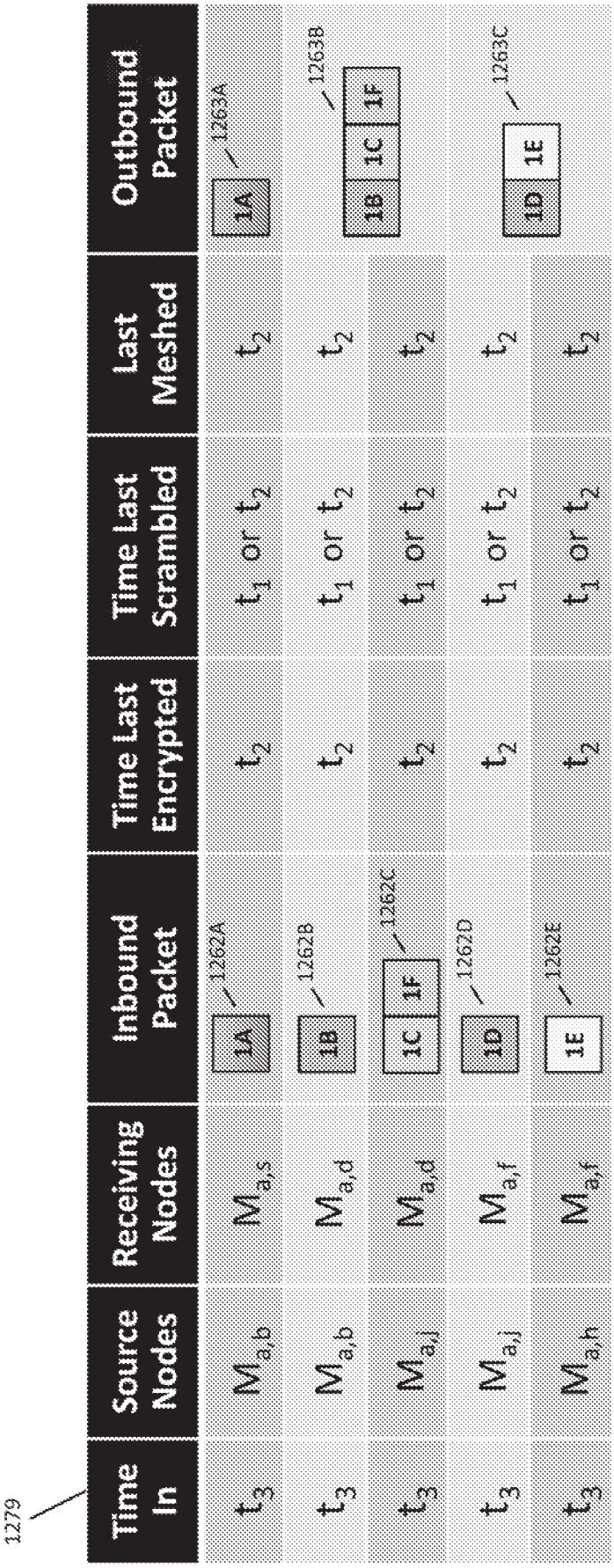

1279
Time In
Source Nodes
Receiving Nodes
Inbound Packet
Time Last Encrypted
Time Last Scrambled
Last Meshed
Outbound Packet
t_3
$M_{a,b}$
$M_{a,s}$
1A
1262A
t_2
t_1 or t_2
t_2
1A
1263A
t_3
$M_{a,b}$
$M_{a,d}$
1B
1262B
t_2
t_1 or t_2
t_2
1B 1C 1F
1263B
t_3
$M_{a,j}$
$M_{a,d}$
1C 1F
1262C
t_2
t_1 or t_2
t_2
t_3
$M_{a,j}$
$M_{a,f}$
1D
1262D
t_2
t_1 or t_2
t_2
1D 1E
1263C
t_3
$M_{a,h}$
$M_{a,f}$
1E
1262E
t_2
t_1 or t_2
t_2

Figure 91B

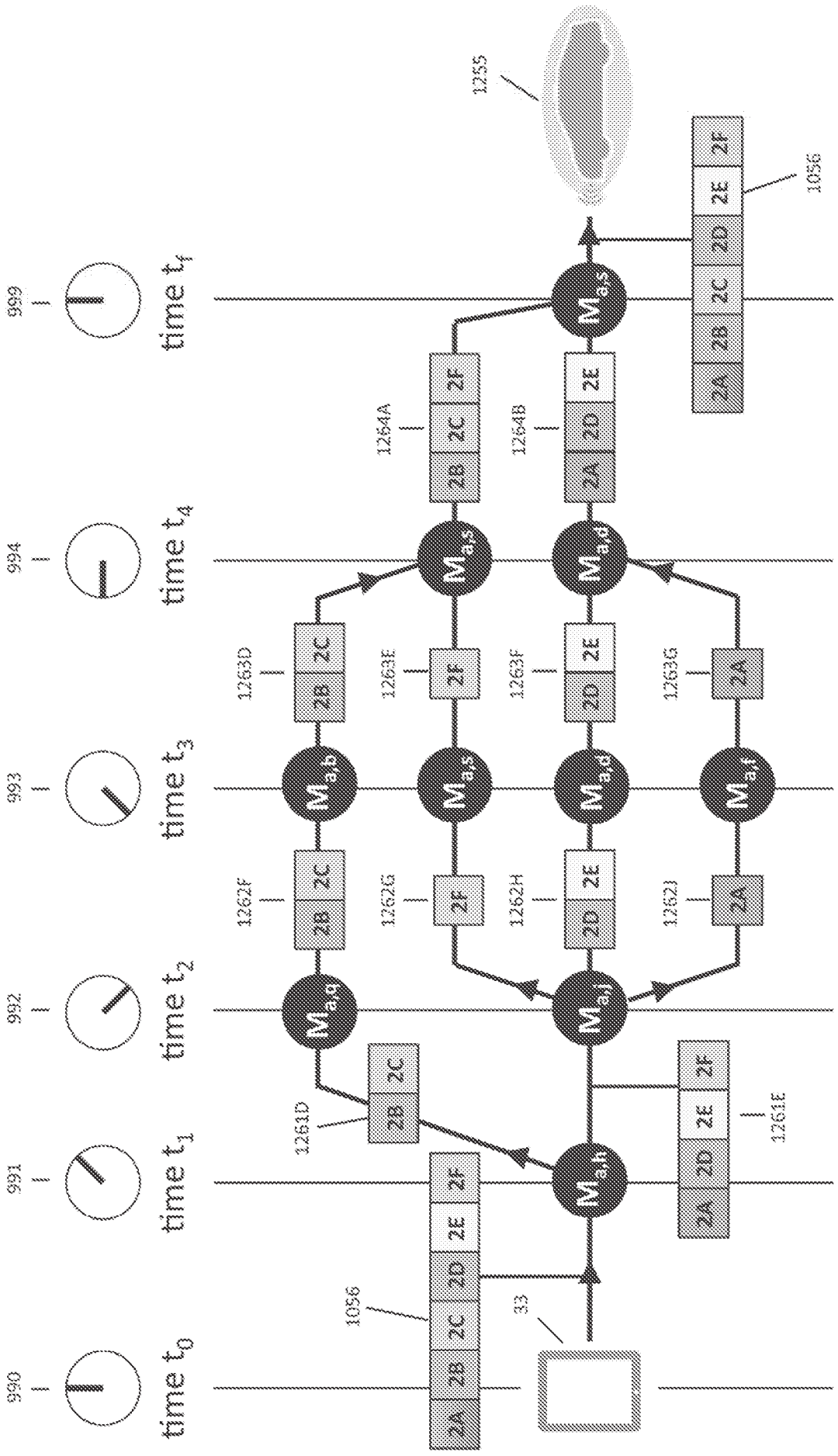

990
991
992
993
994
999
time t_0
time t_1
time t_2
time t_3
time t_4
time t_f
1255
1056
1264A
1264B
1263D
1263E
1263F
1263G
1262F
1262G
1262H
1262J
1261D
1261E
33
2A
2B
2C
2D
2E
2F
$M_{a,h}$
$M_{a,i}$
$M_{a,j}$
$M_{a,k}$
$M_{a,l}$
$M_{a,m}$
$M_{a,n}$
$M_{a,o}$
$M_{a,p}$
$M_{a,q}$
$M_{a,r}$
$M_{a,s}$

Figure 91C

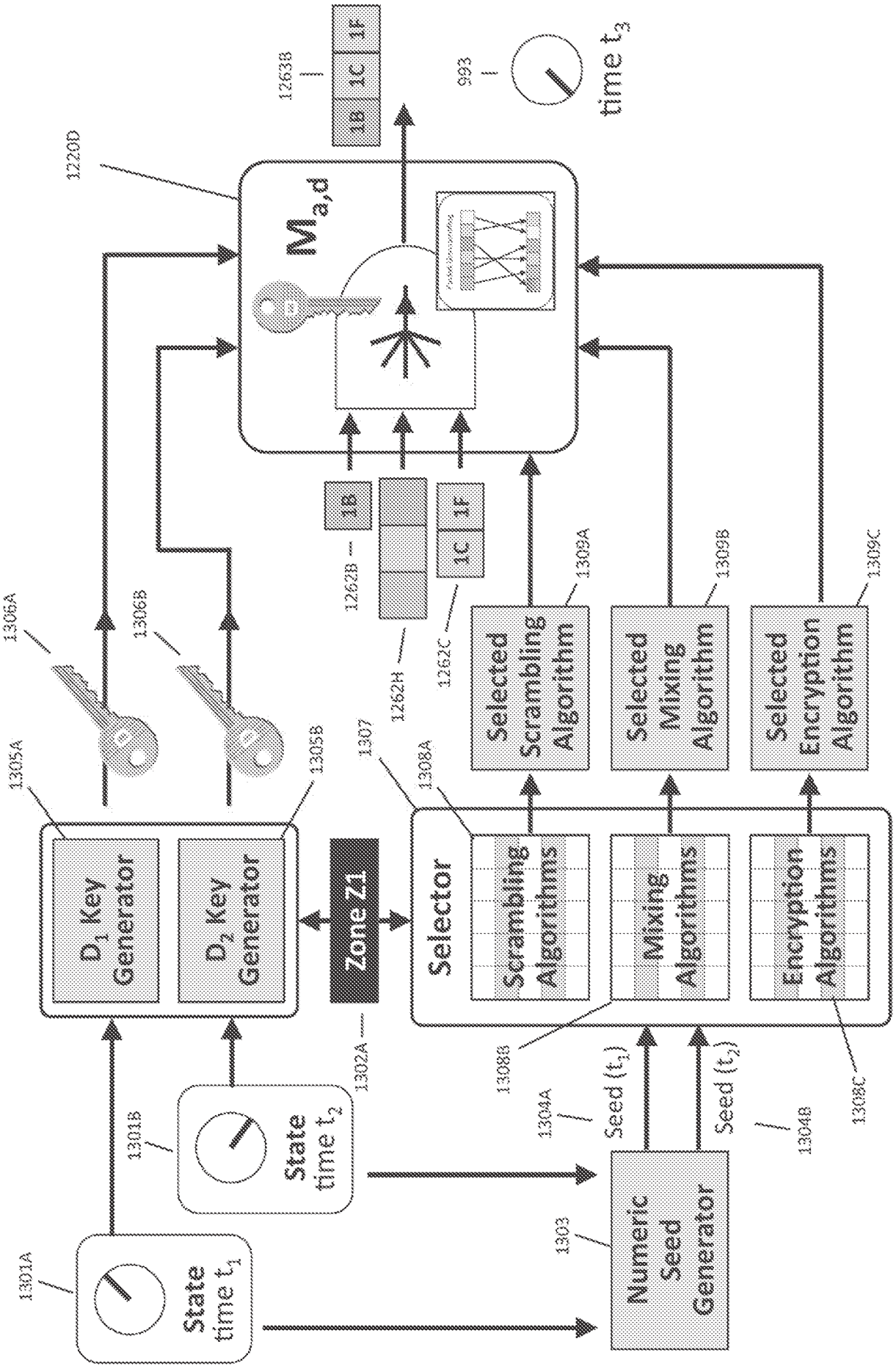

1220D
$M_{a,d}$
1263B
1B
1C
1F
993
time t_3
1306A
1306B
1305A
1305B
1307
1308A
1262B
1262H
1262C
1309A
1309B
1309C
Selected Scrambling Algorithm
Selected Mixing Algorithm
Selected Encryption Algorithm
D_1 Key Generator
D_2 Key Generator
Zone Z1
Selector
Scrambling Algorithms
Mixing Algorithms
Encryption Algorithms
1302A
1308B
1308C
1304A
1304B
Seed (t_1)
Seed (t_2)
1303
Numeric Seed Generator
1301A
State time t_1
1301B
State time t_2

Figure 92A

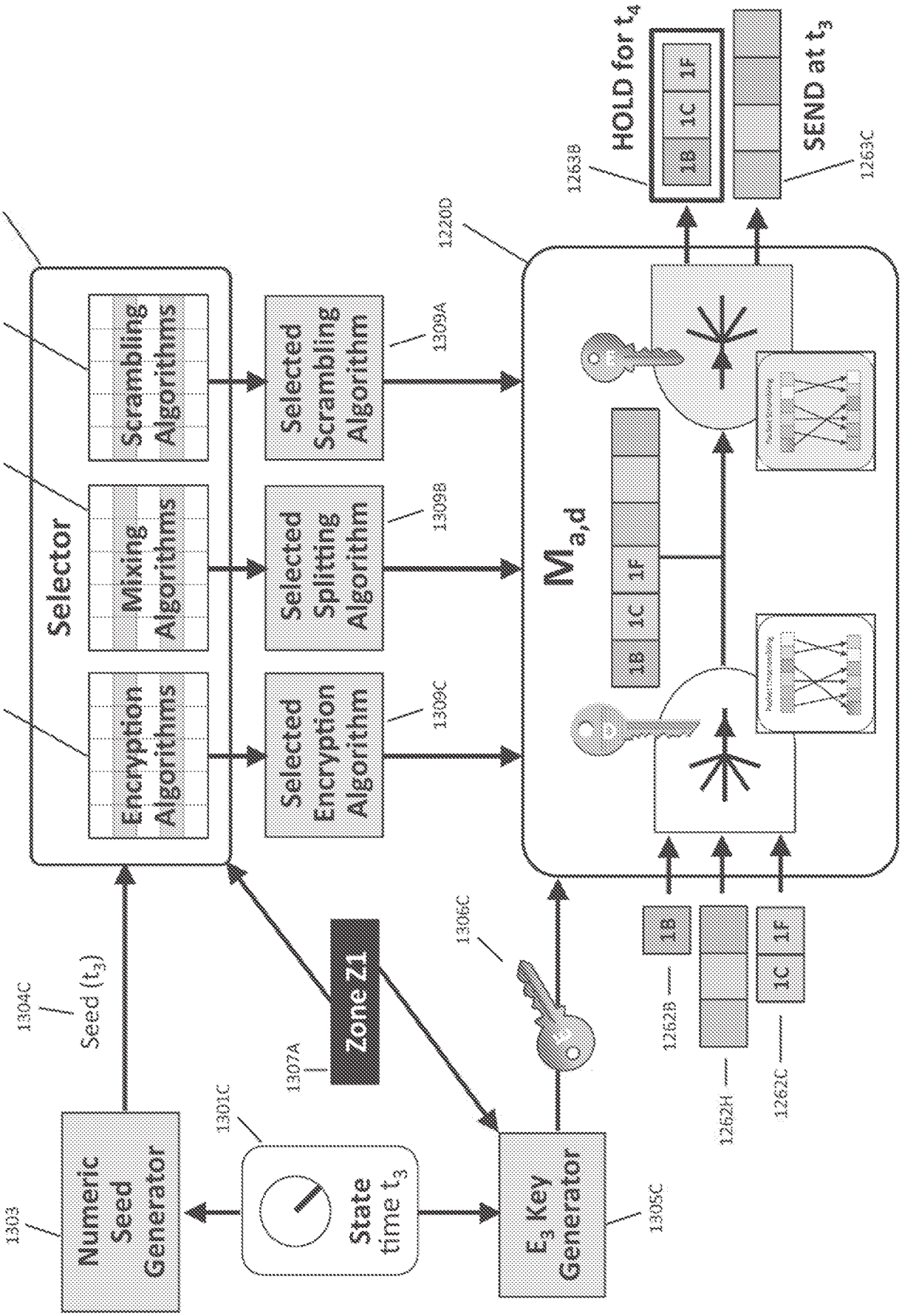

1303
Numeric Seed Generator
1304C
Seed (t_3)
1301C
State time t_3
1307A
Zone Z1
1305C
E_3 Key Generator
1306C
1307
Selector
1308A
Scrambling Algorithms
1308B
Mixing Algorithms
1308C
Encryption Algorithms
Selected Scrambling Algorithm
1309A
Selected Splitting Algorithm
1309B
Selected Encryption Algorithm
1309C
1220D
$M_{a,d}$
1B
1C
1F
1262B
1262H
1262C
1263B
HOLD for t_4
1263C
SEND at t_3

Figure 92B

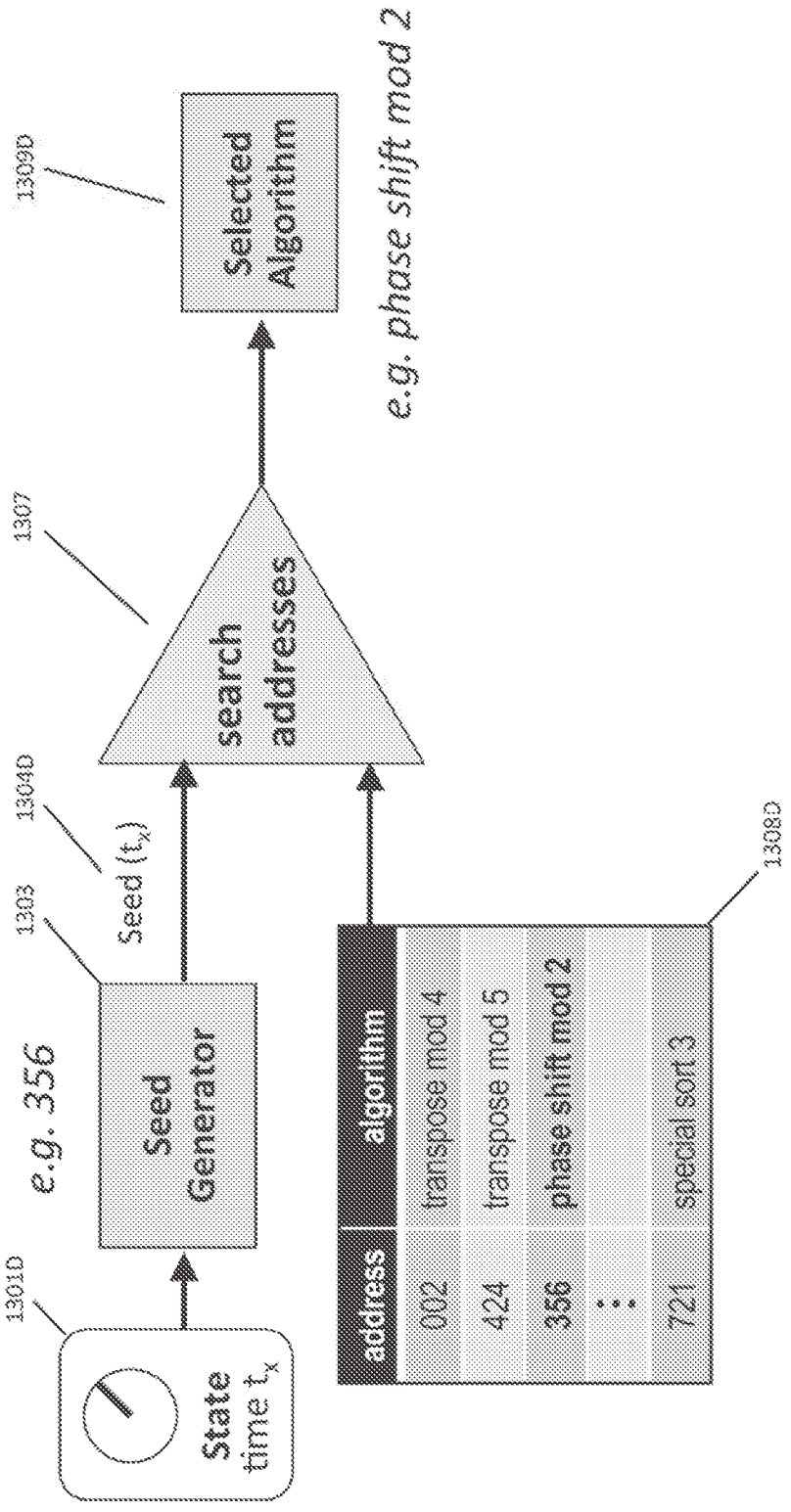

1309D
Selected Algorithm
e.g. phase shift mod 2
1307
search addresses
1304D
Seed (t_x)
1303
e.g. 356
Seed Generator
1301D
State time t_x
1308D
address
algorithm
002
transpose mod 4
424
transpose mod 5
356
phase shift mod 2
721
special sort 3

Figure 93

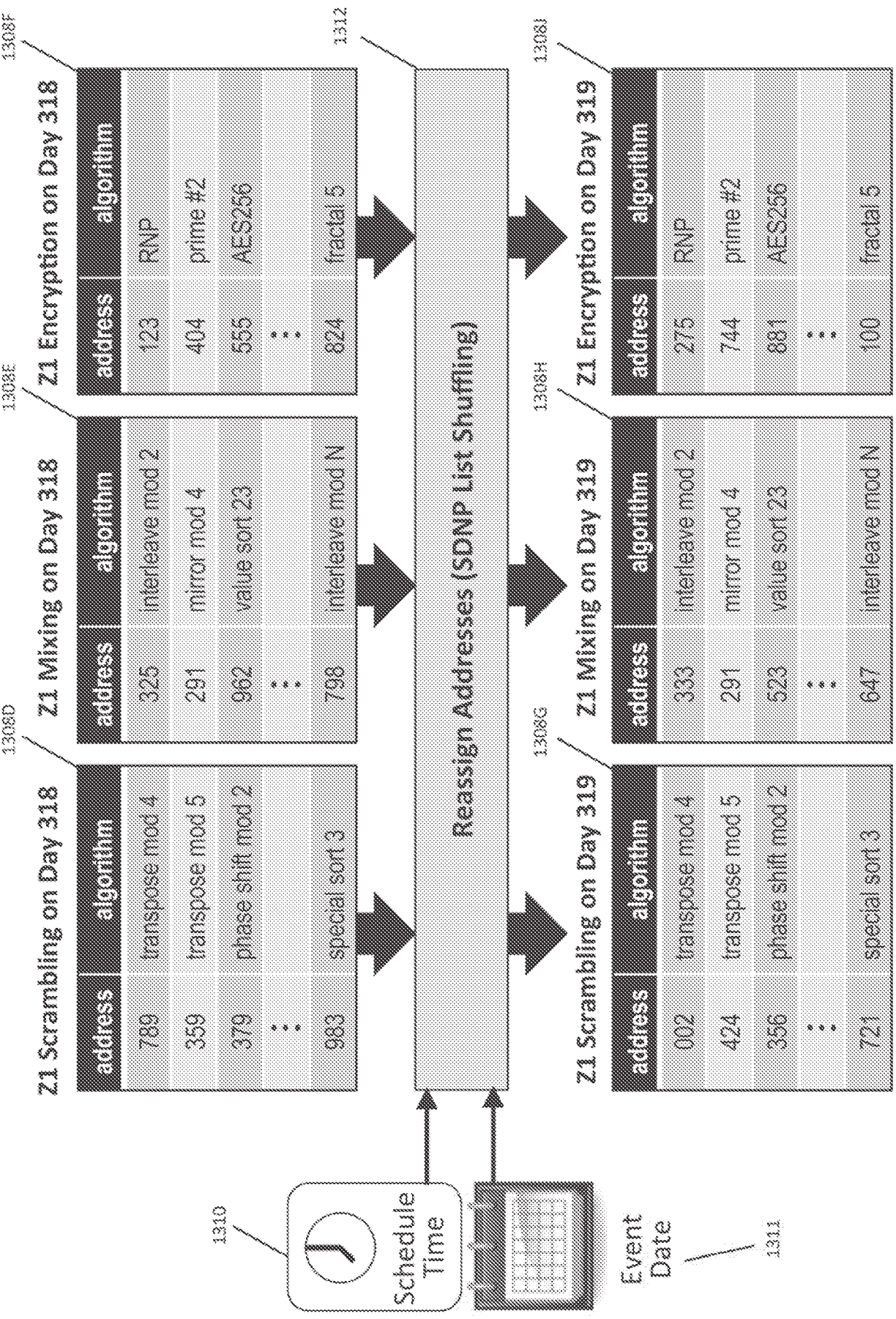

1308D
Z1 Scrambling on Day 318
address
algorithm
789
transpose mod 4
359
transpose mod 5
379
phase shift mod 2
983
special sort 3
1308E
Z1 Mixing on Day 318
address
algorithm
325
interleave mod 2
291
mirror mod 4
962
value sort 23
798
interleave mod N
1308F
Z1 Encryption on Day 318
address
algorithm
123
RNP
404
prime #2
555
AES256
824
fractal 5
1312
Reassign Addresses (SDNP List Shuffling)
1308G
Z1 Scrambling on Day 319
address
algorithm
002
transpose mod 4
424
transpose mod 5
356
phase shift mod 2
721
special sort 3
1308H
Z1 Mixing on Day 319
address
algorithm
333
interleave mod 2
291
mirror mod 4
523
value sort 23
647
interleave mod N
1308I
Z1 Encryption on Day 319
address
algorithm
275
RNP
744
prime #2
881
AES256
100
fractal 5
1310
Schedule Time
1311
Event Date

Figure 94

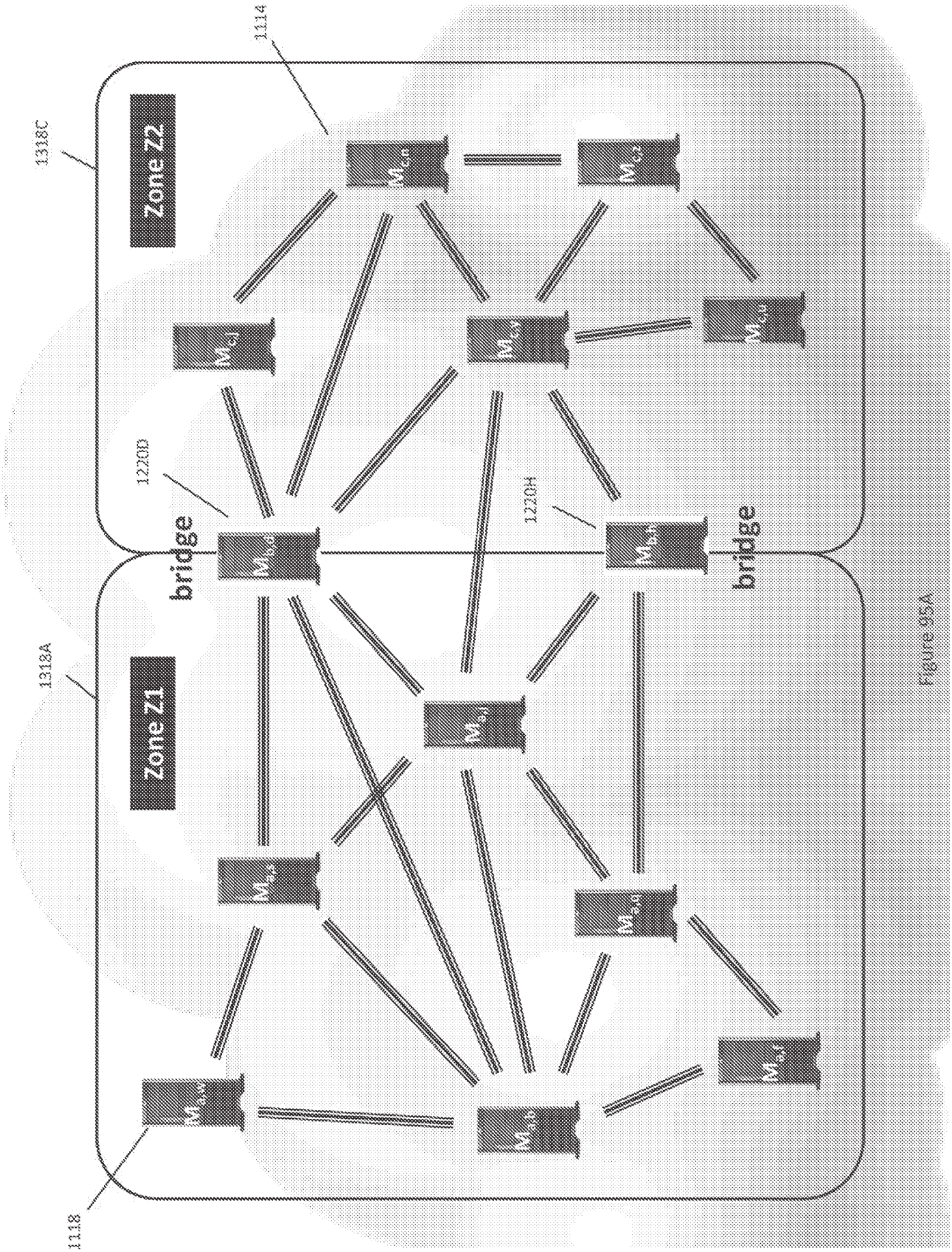

1318C
1114
Zone Z2
1220B
bridge
1220H
bridge
1318A
Zone Z1
1118

Figure 95A

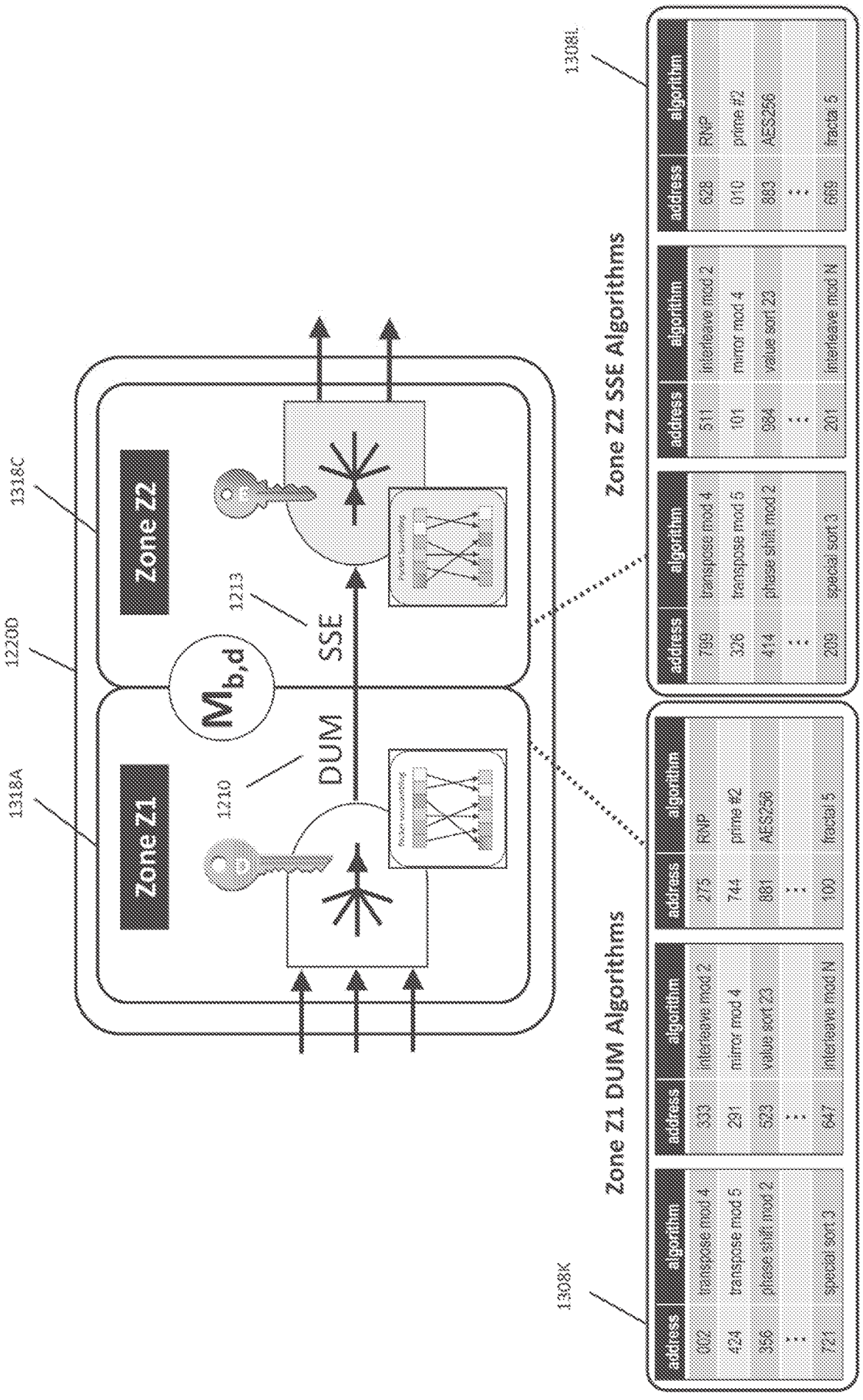

1318A
1220D
1318C
Zone Z1
Zone Z2
1210
DUM
$M_{b,d}$
1213
SSE
1308K
Zone Z1 DUM Algorithms
address
algorithm
002
transpose mod 4
434
transpose mod 5
356
phase shift mod 2
722
special sort 3
331
interleave mod 2
291
mirror mod 4
533
value sort 23
647
interleave mod N
275
RNP
744
prime #2
881
AES256
100
fractal 5
1308L
Zone Z2 SSE Algorithms
799
transpose mod 4
326
transpose mod 5
414
phase shift mod 2
239
special sort 3
511
interleave mod 2
101
mirror mod 4
984
value sort 23
201
interleave mod N
628
RNP
010
prime #2
883
AES256
669
fractal 5

Figure 95B

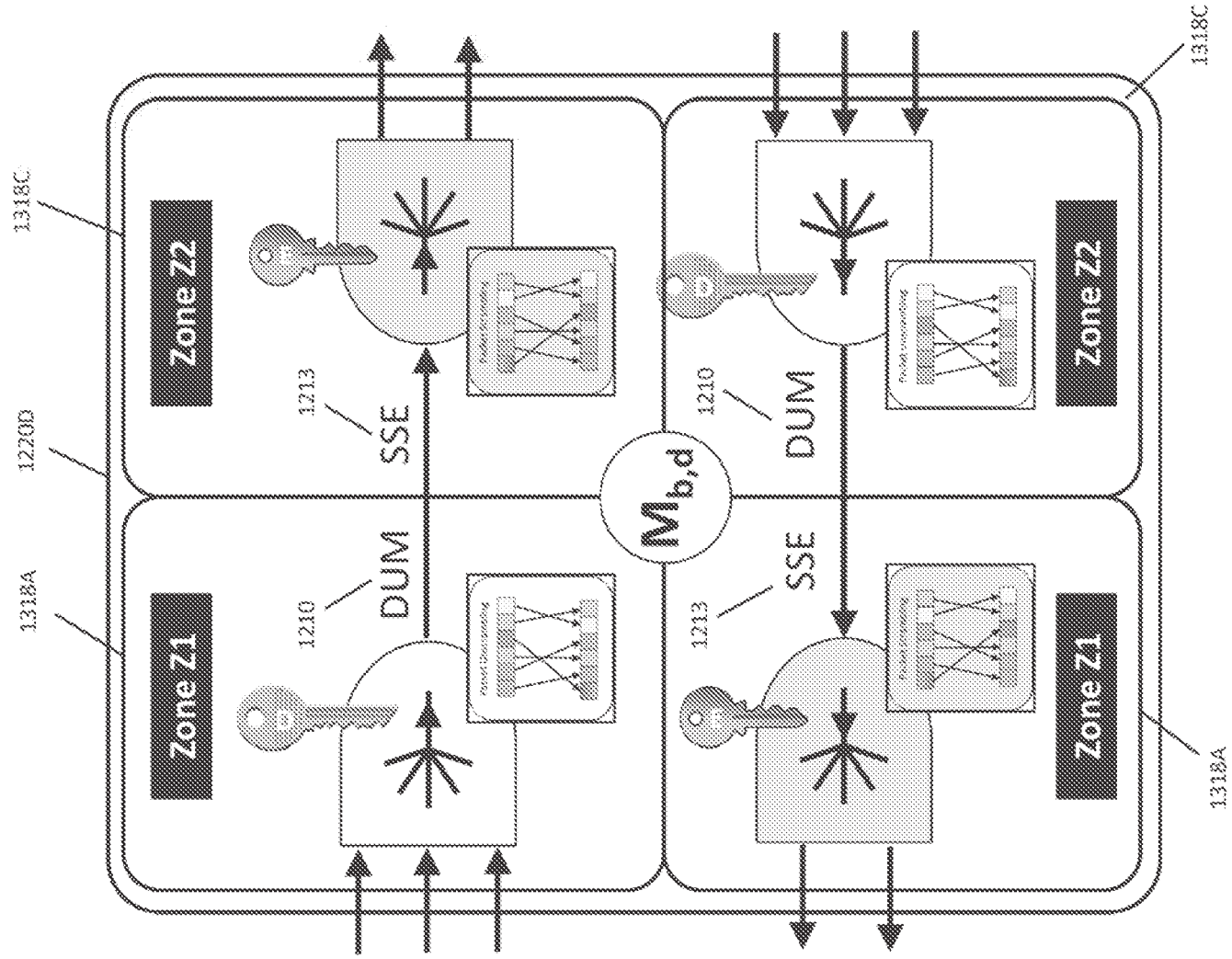

1318C
1220D
1318A
Zone Z2
Zone Z1
1213
SSE
1210
DUM
$M_{b,d}$
1210
DUM
1213
SSE
Zone Z2
Zone Z1
1318C
1318A

Figure 95C

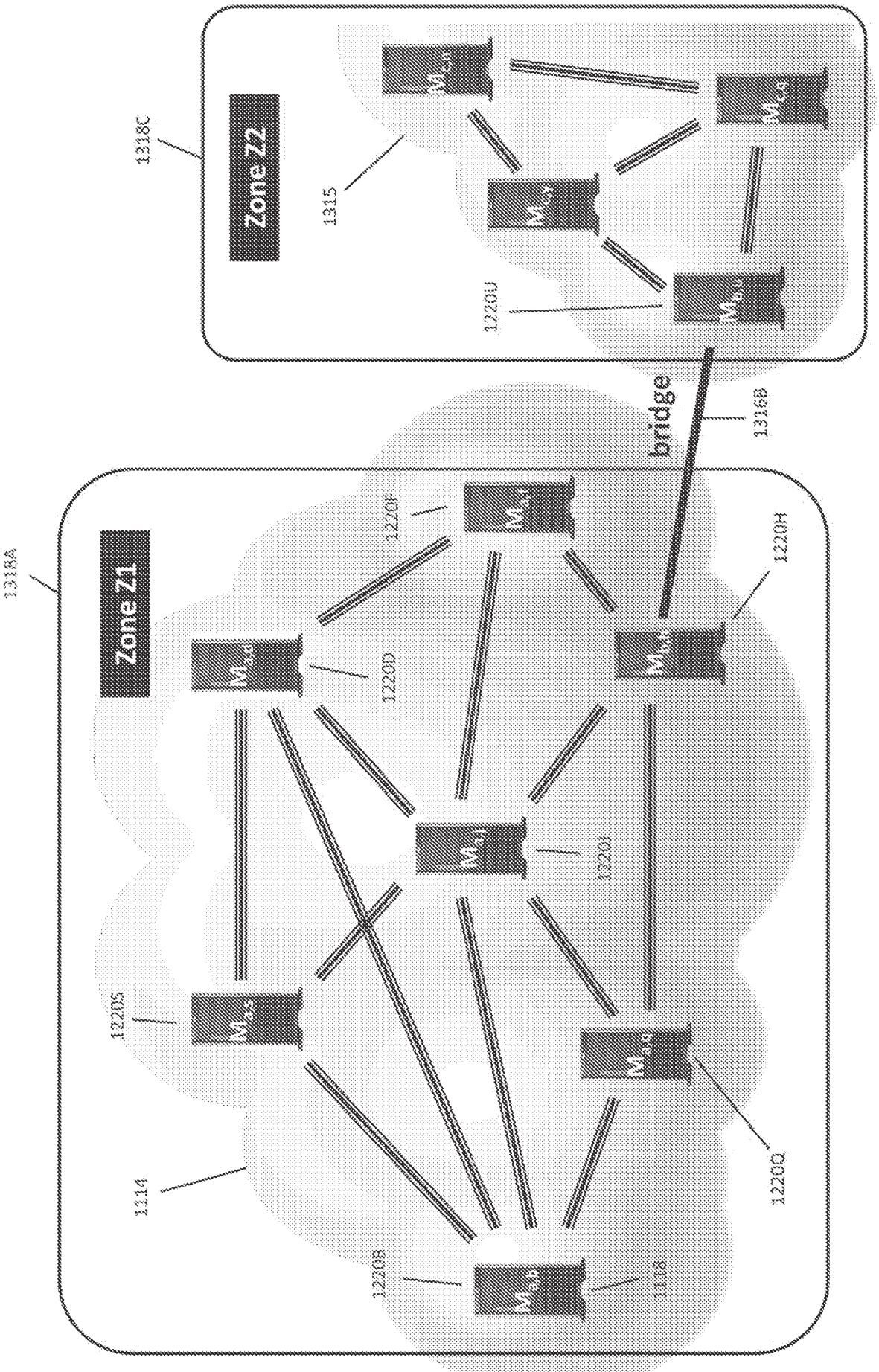

1318A
Zone Z1
1220S
1114
1220B
1118
1220Q
1220J
1220D
1220F
1220H
bridge
1316B
1318C
Zone Z2
1315
1220U

Figure 95D

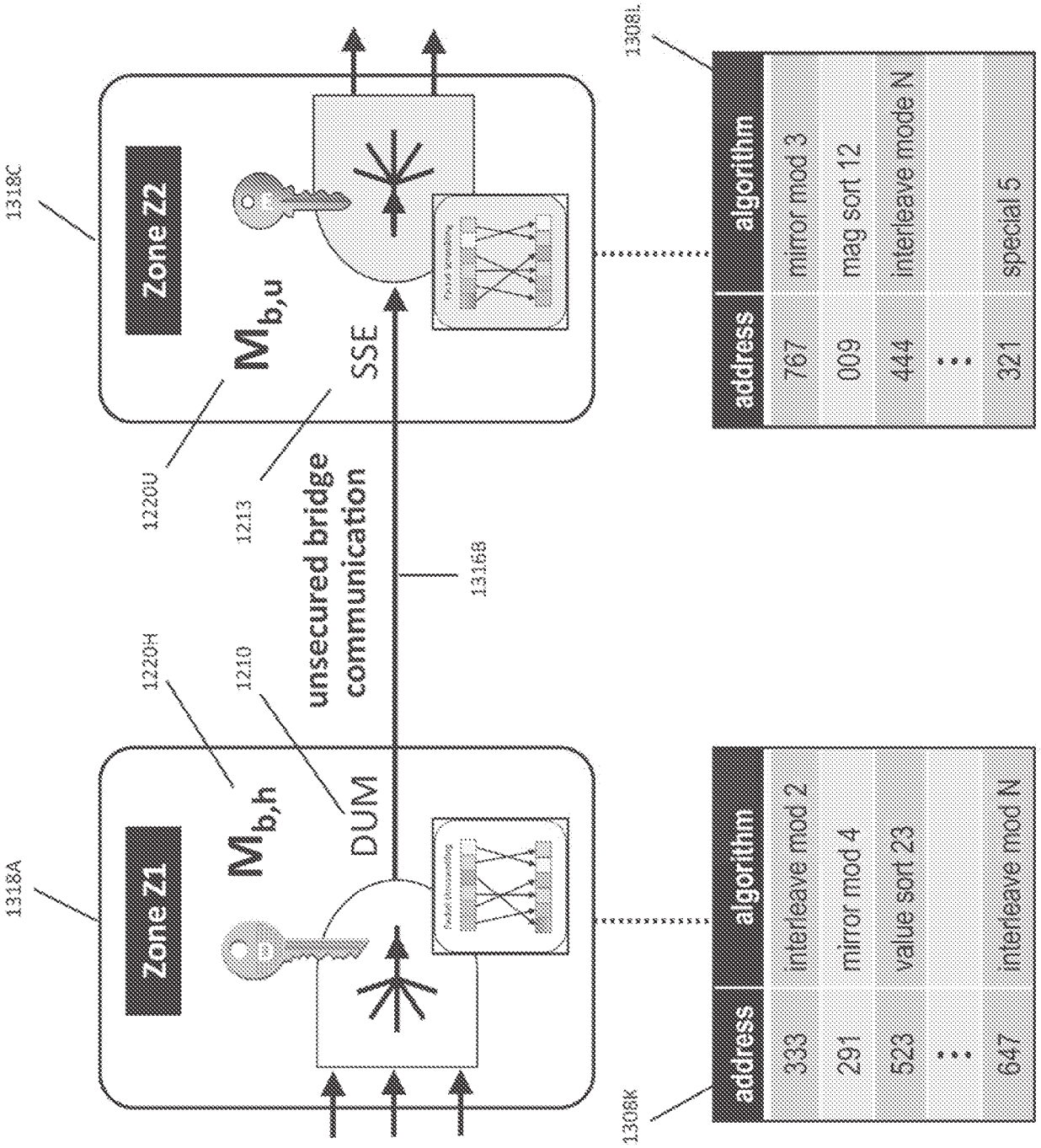

1318A
Zone Z1
$M_{b,h}$
1220H
1210
DUM
unsecured bridge communication
1316B
1213
SSE
1220U
$M_{b,u}$
Zone Z2
1318C
1308K
address
algorithm
333
interleave mod 2
291
mirror mod 4
523
value sort 23
647
interleave mod N
1308L
address
algorithm
767
mirror mod 3
009
mag sort 12
444
interleave mode N
321
special 5

Figure 95E

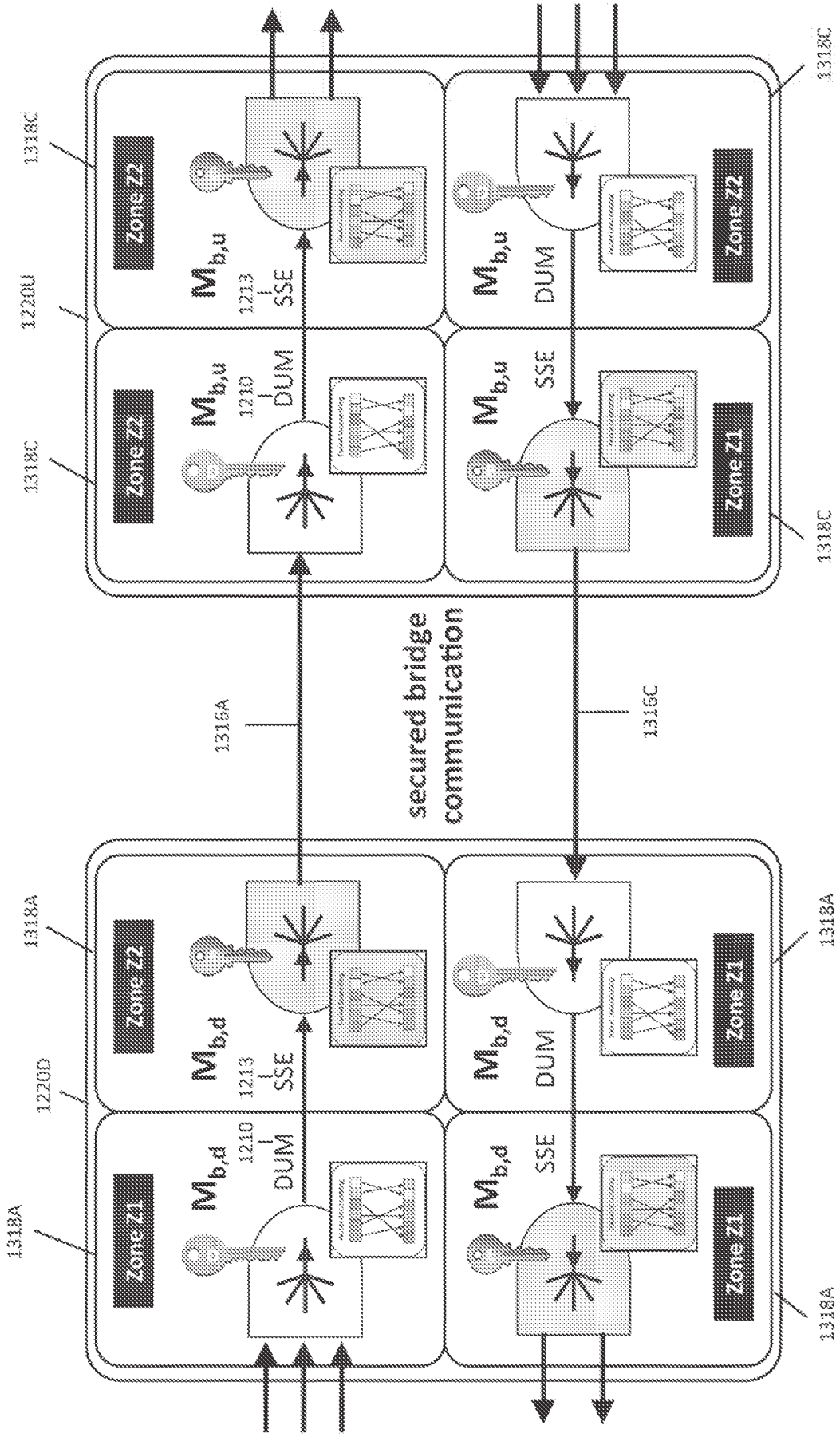

Zone Z1
Zone Z2
$M_{b,d}$
$M_{b,u}$
1210
DUM
1213
SSE
1220D
1220U
1318A
1318C
1316A
1316C
secured bridge communication

Figure 95F

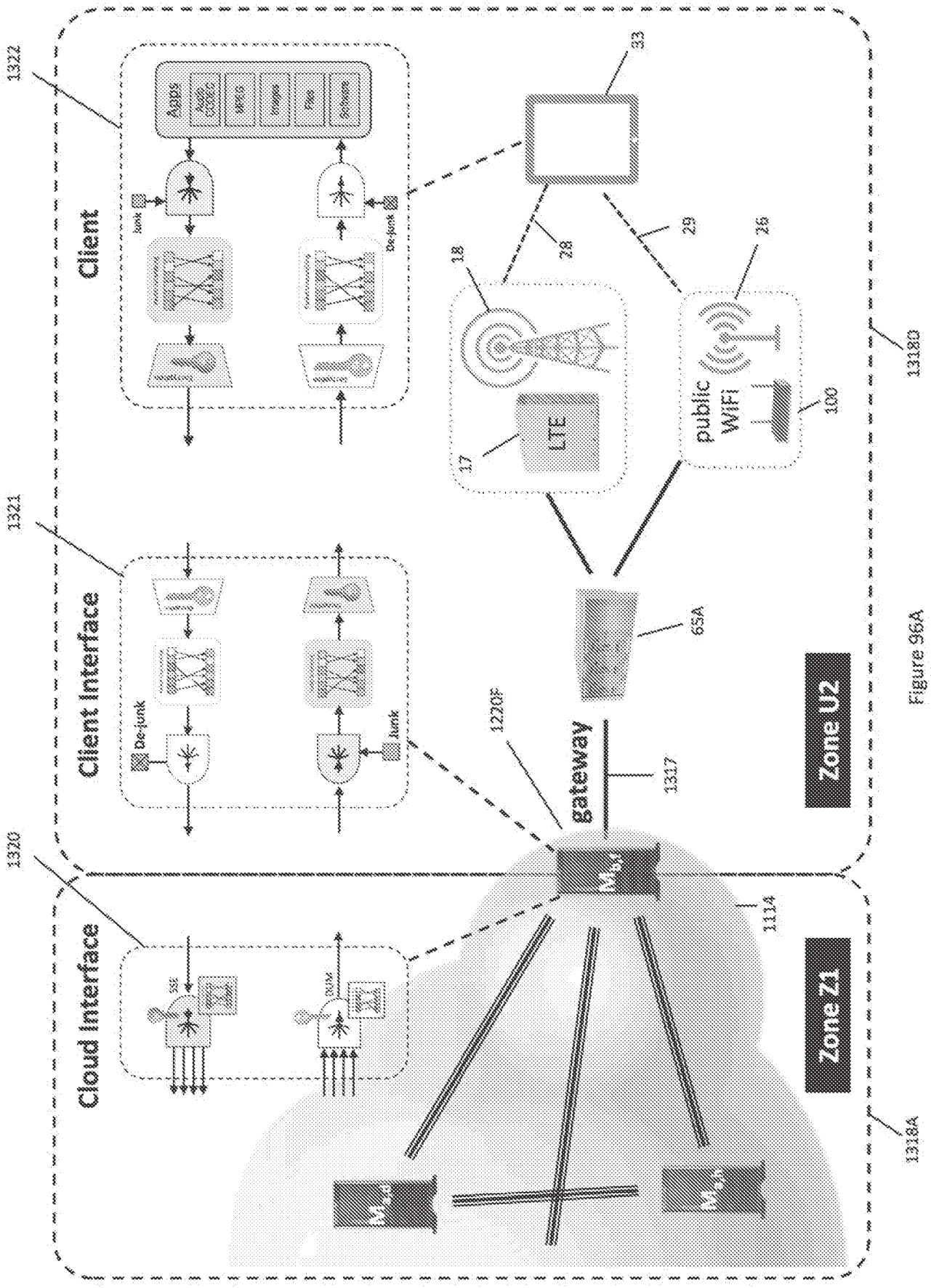

1322
Client
Apps
App Store
APIs
Images
Files
Services
Junk
De-junk
33
28
29
26
18
17
LTE
public WiFi
100
1318D
1321
Client Interface
De-junk
Junk
65A
1220F
gateway
1317
Zone U2
1320
Cloud Interface
SSE
DUM
1114
Zone Z1
1318A

Figure 96A

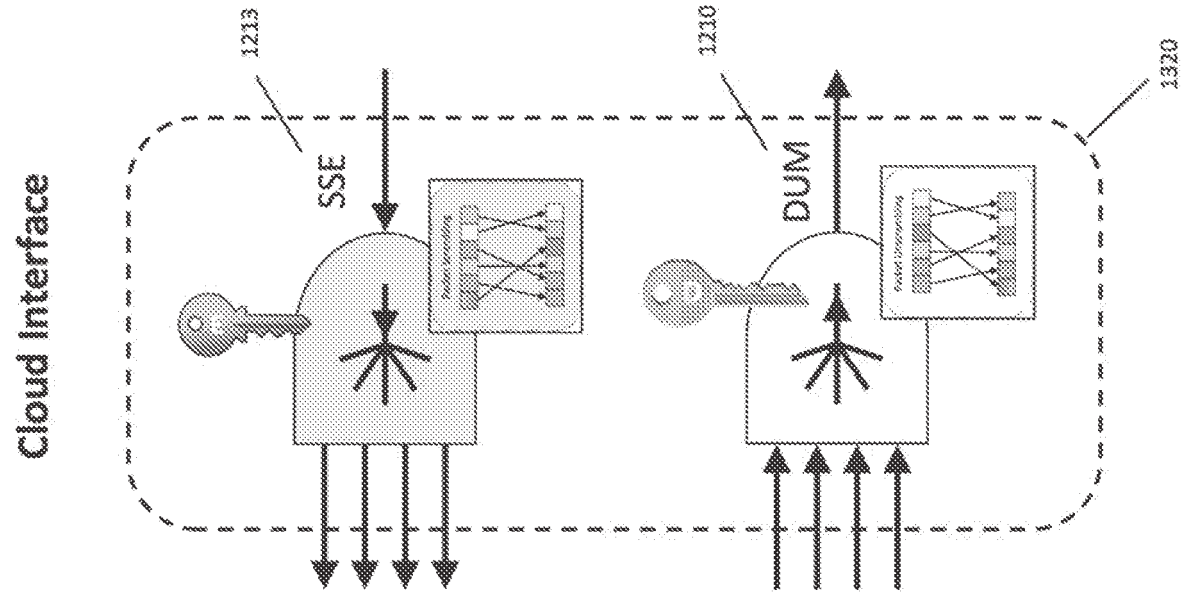


Figure 96B

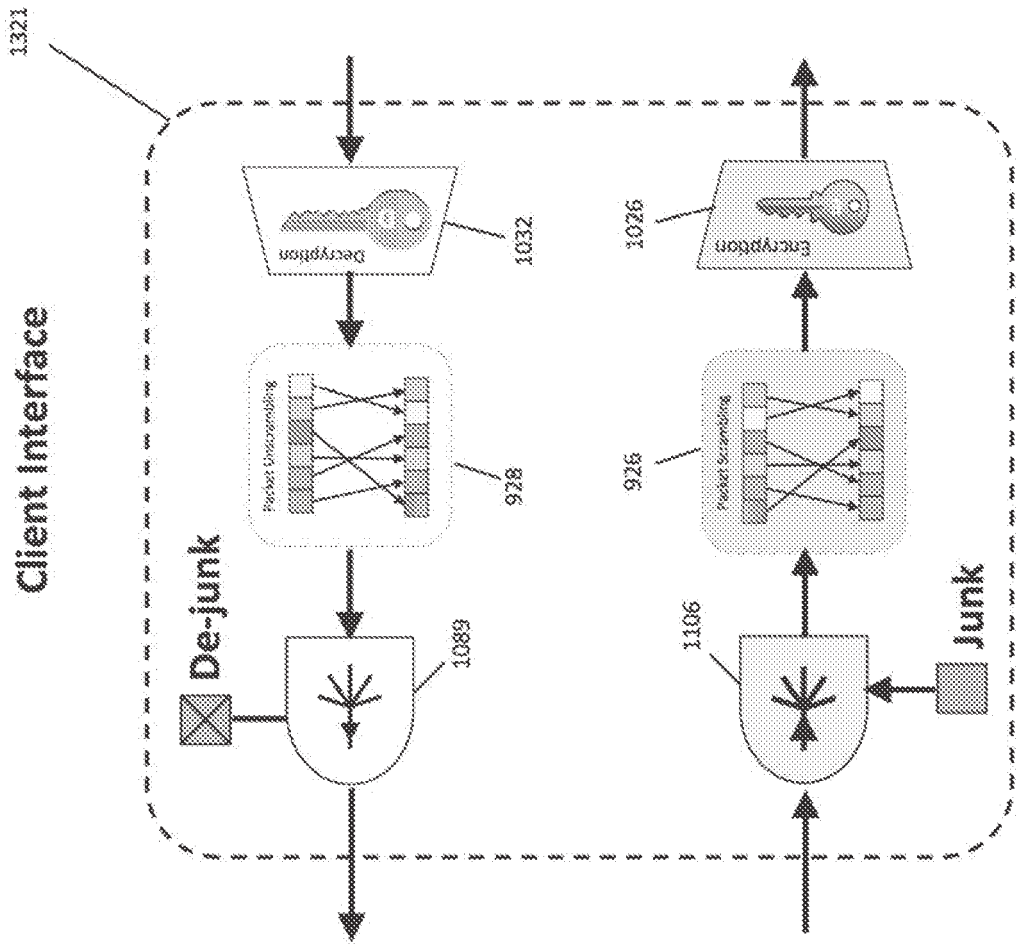

1321
Client Interface
De-junk
Decryption
1032
928
1089
Encryption
1026
926
1106
Junk

Figure 96C

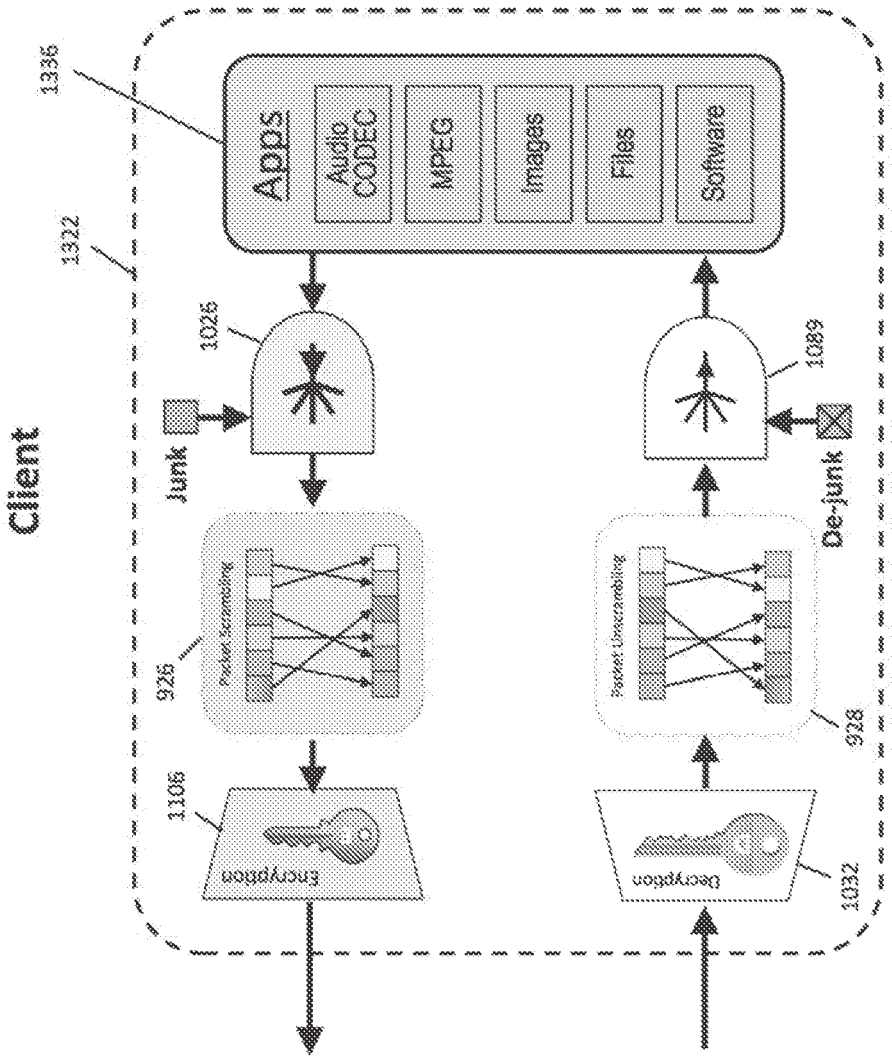

Client
1336
Apps
Audio CODEC
MPEG
Images
Files
Software
1322
1026
Junk
1089
De-junk
926
928
1106
1032
Encryption
Decryption

Figure 96D

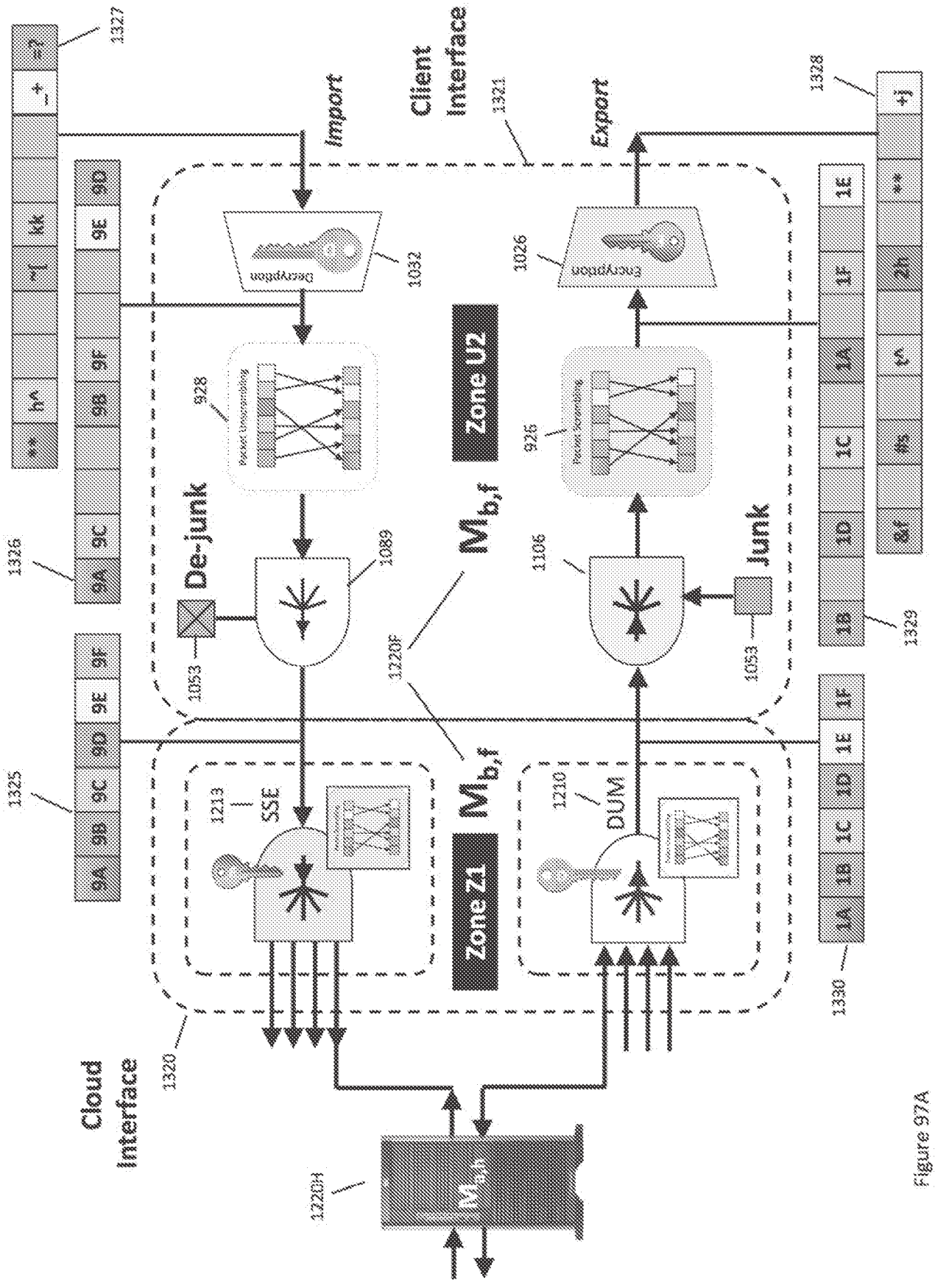

Cloud Interface
Client Interface
Import
Export
De-junk
Junk
SSE
DUM
Zone Z1
Zone U2
Encryption
Decryption
1320
1321
1325
1326
1327
1328
1329
1330
1053
1089
1106
1210
1213
1220F
1220H
1026
1032
926
928

Figure 97A

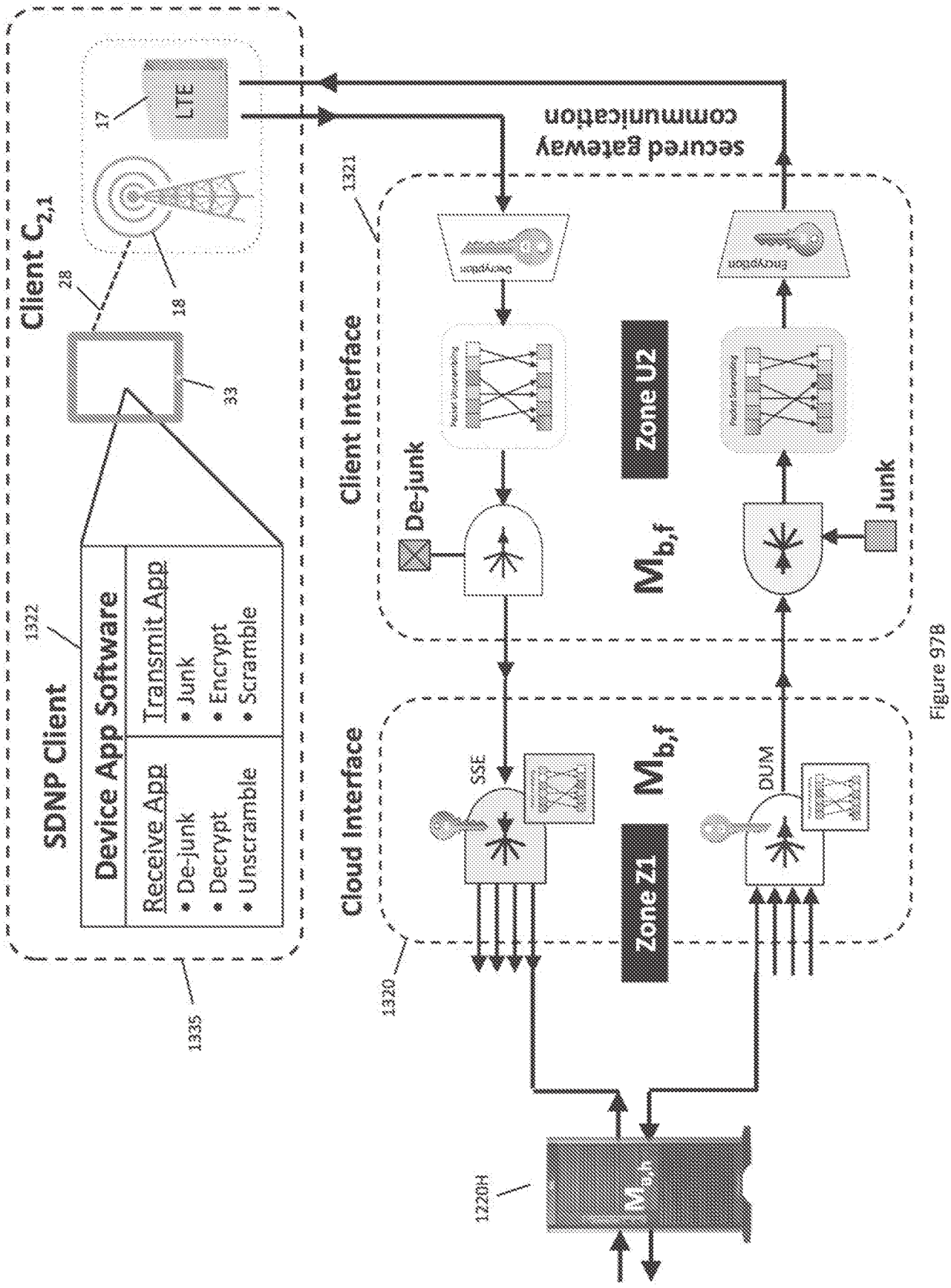

Client $C_{2,1}$
17
LTE
28
18
33
SDNP Client
1322
Device App Software
Receive App
• De-junk
• Decrypt
• Unscramble
Transmit App
• Junk
• Encrypt
• Scramble
1335
secured gateway communication
1321
Client Interface
De-junk
Junk
Zone U2
$M_{b,f}$
Cloud Interface
SSE
DUM
Zone Z1
$M_{b,f}$
1320
1220H
$M_{a,1}$

Figure 97B

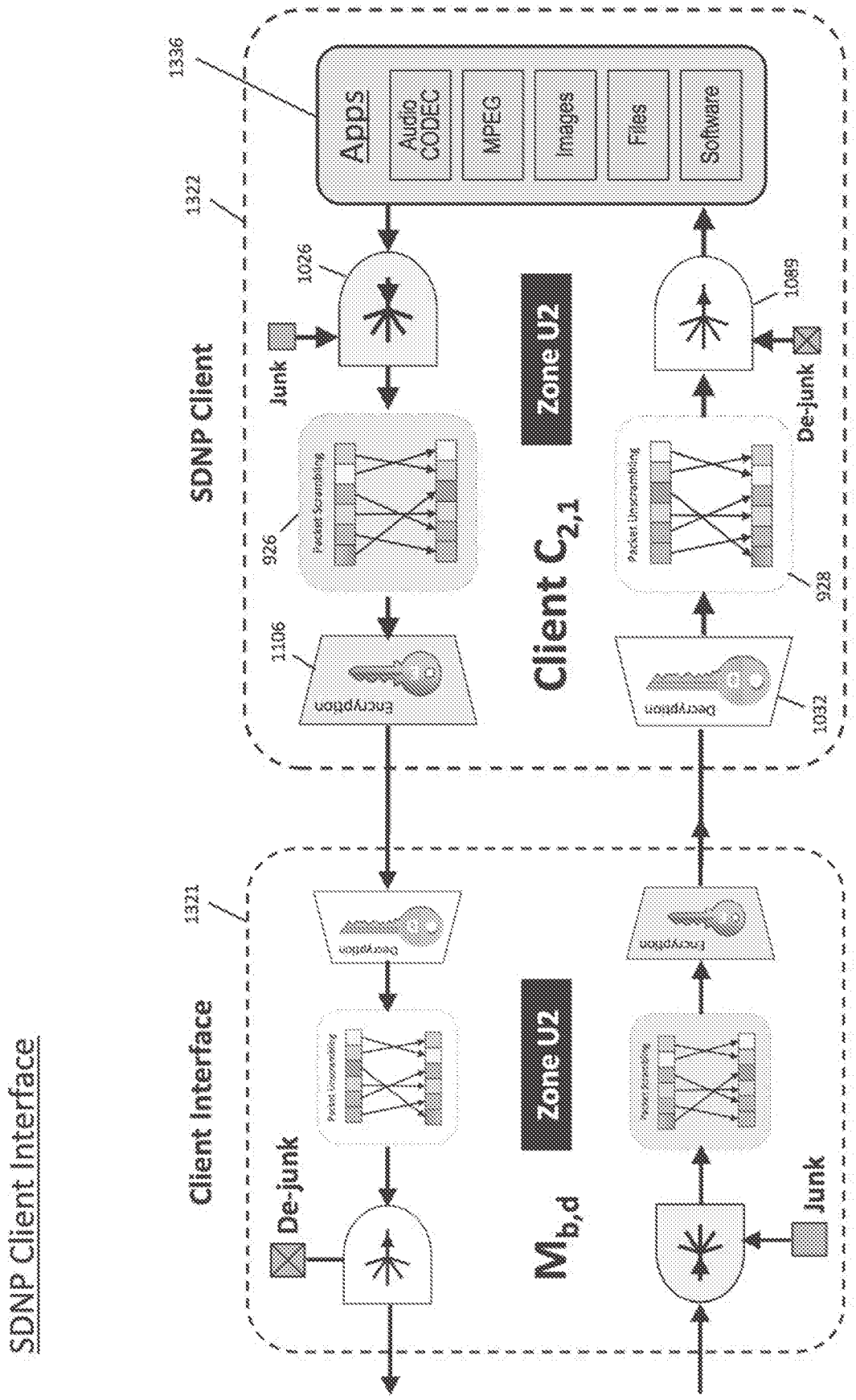

SDNP Client Interface
Client Interface
1321
De-junk
Junk
Zone U2
$M_{b,d}$
Client $C_{2,1}$
Zone U2
SDNP Client
1322
1336
Apps
Audio CODEC
MPEG
Images
Files
Software
1026
1089
Junk
De-junk
926
928
1106
1032
Encryption
Decryption
Packet Scrambling
Packet Unscrambling

Figure 98

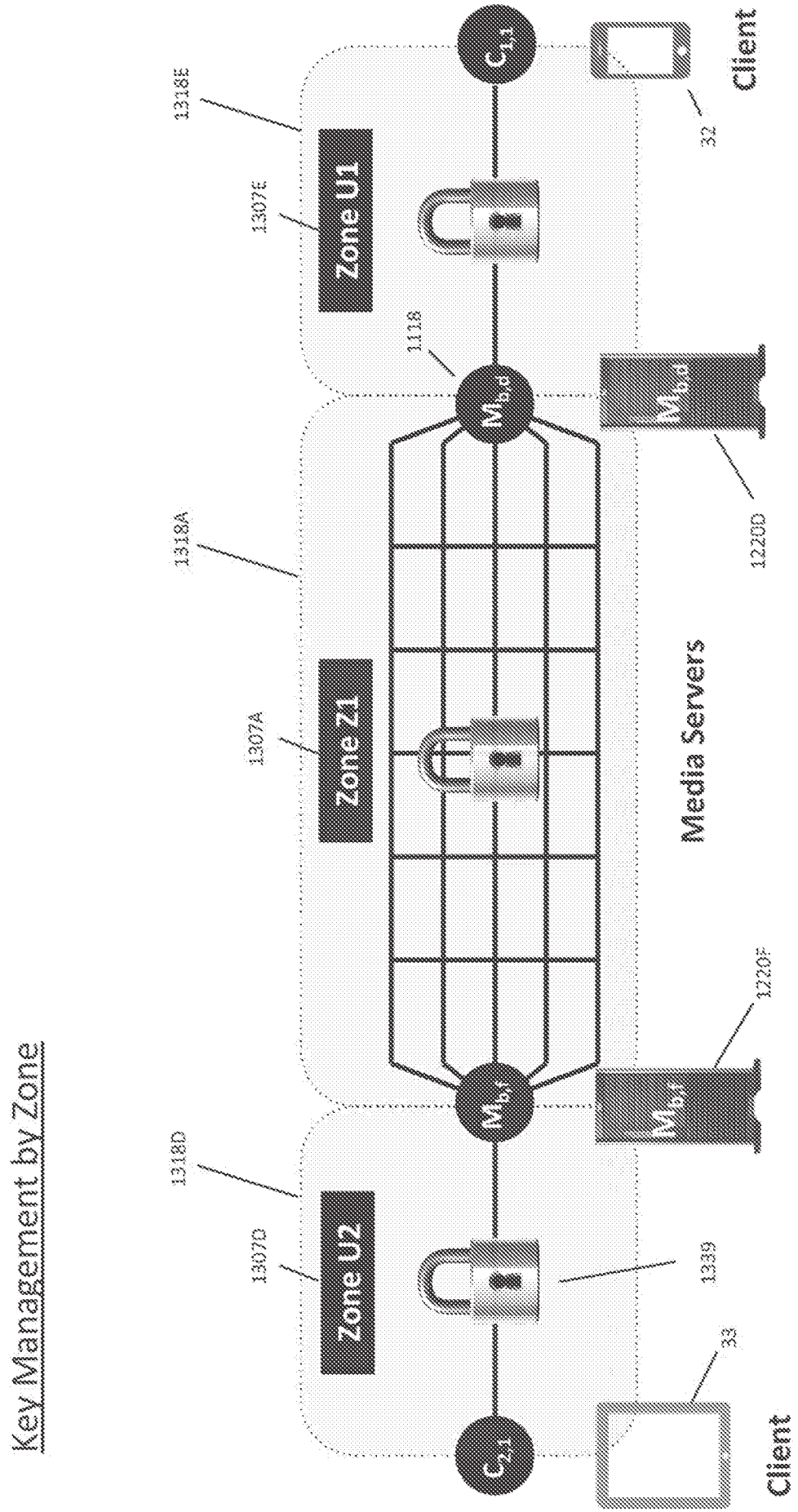

Key Management by Zone
1318E
1307E
Zone U1
1118
1318A
1307A
Zone Z1
1318D
1307D
Zone U2
1339
Media Servers
1220D
1220F
32
33
Client
Client

Figure 99A

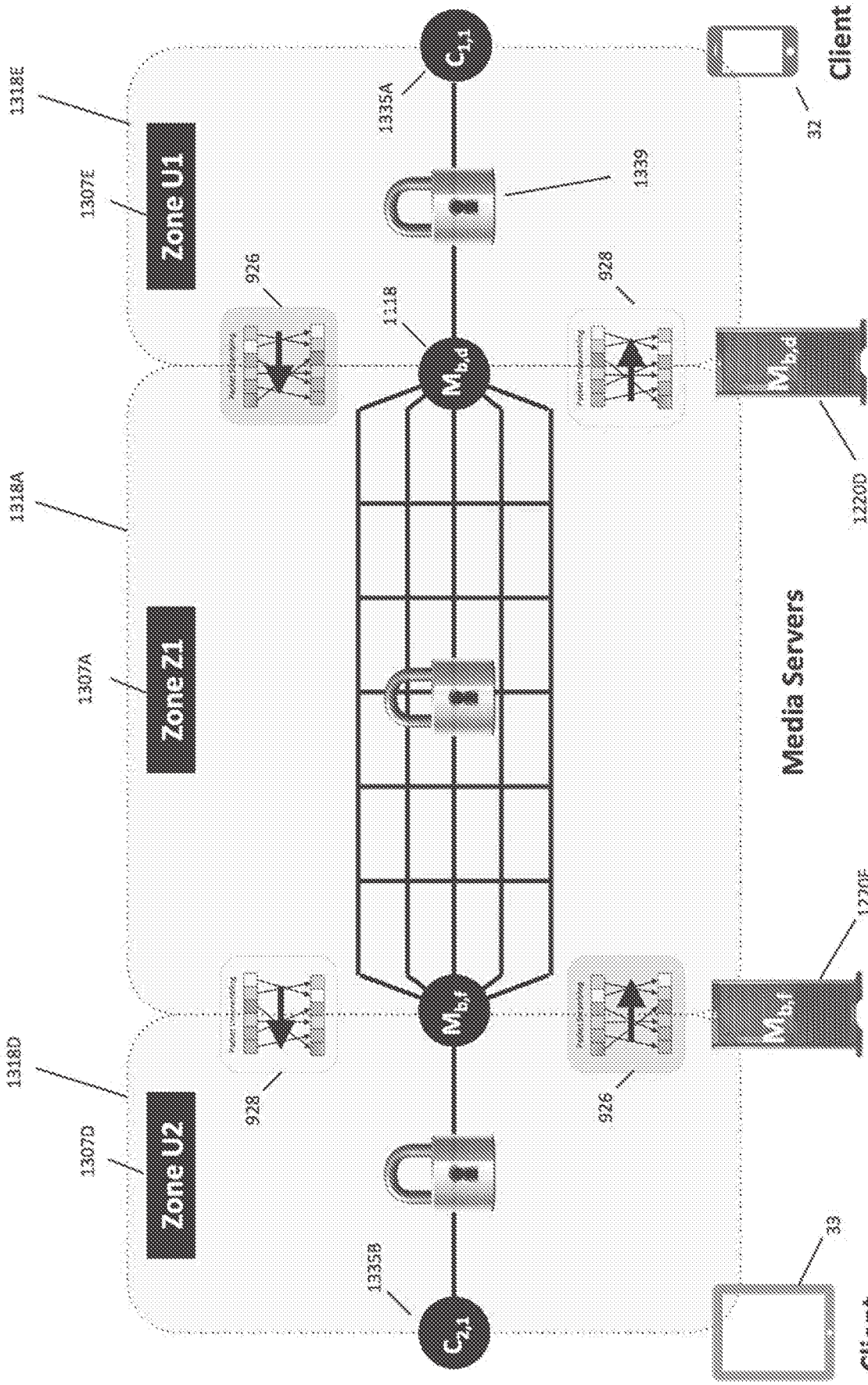

1318E
1307E
Zone U1
1318A
1307A
Zone Z1
1318D
1307D
Zone U2
926
928
928
926
1335A
1339
1118
1335B
$C_{1,1}$
$C_{2,1}$
$M_{b,d}$
$M_{b,f}$
$M_{a,d}$
$M_{a,f}$
1220D
1220F
Media Servers
32
33
Client
Client

Figure 99B

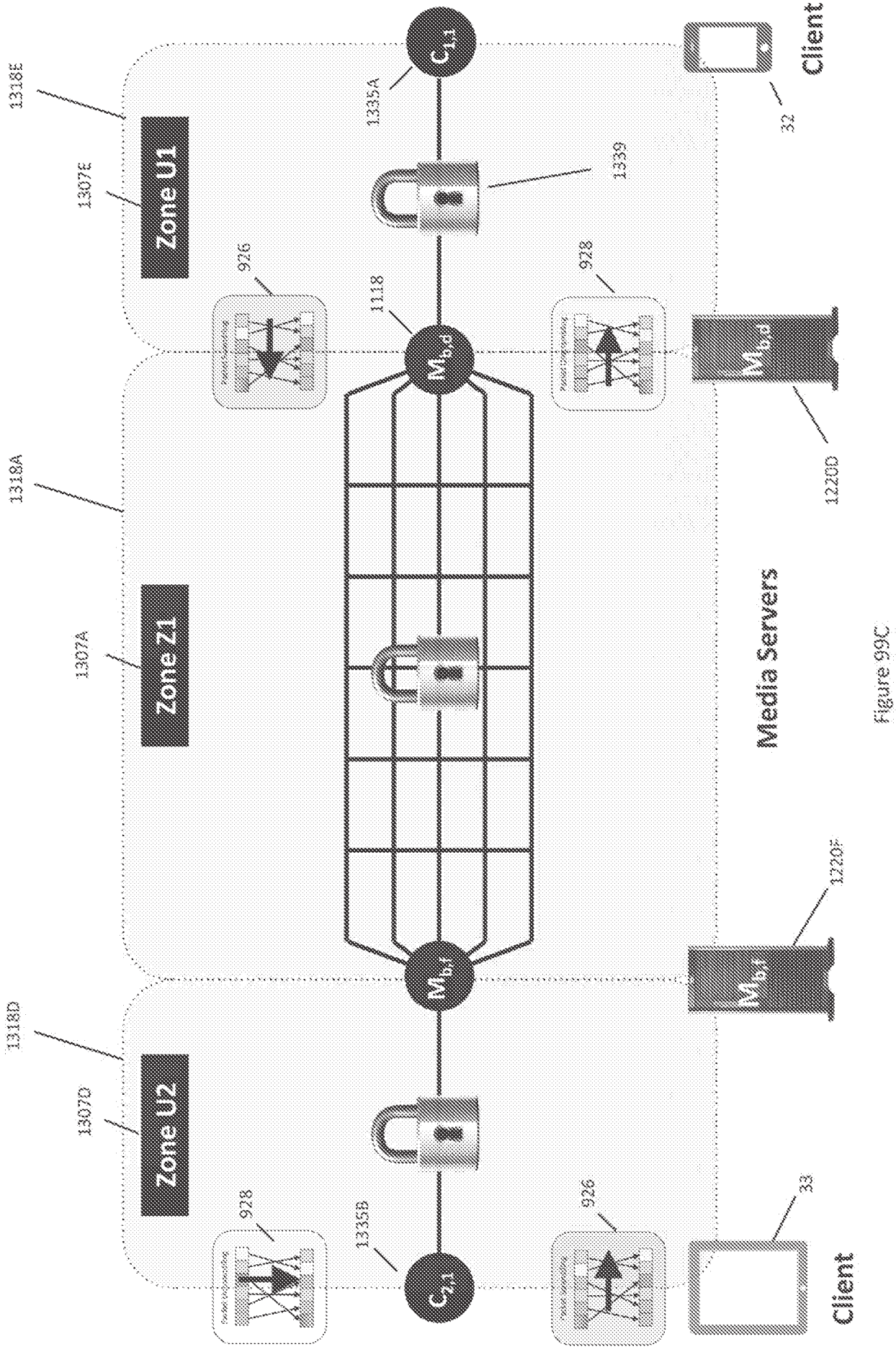

1318E
1307E
Zone U1
1335A
$C_{1,1}$
1339
926
928
1118
$M_{b,d}$
1220D
Client
32
1318A
1307A
Zone Z1
Media Servers
$M_{b,1}$
1220F
1318D
1307D
Zone U2
928
926
1335B
$C_{2,1}$
33
Client

Figure 99C

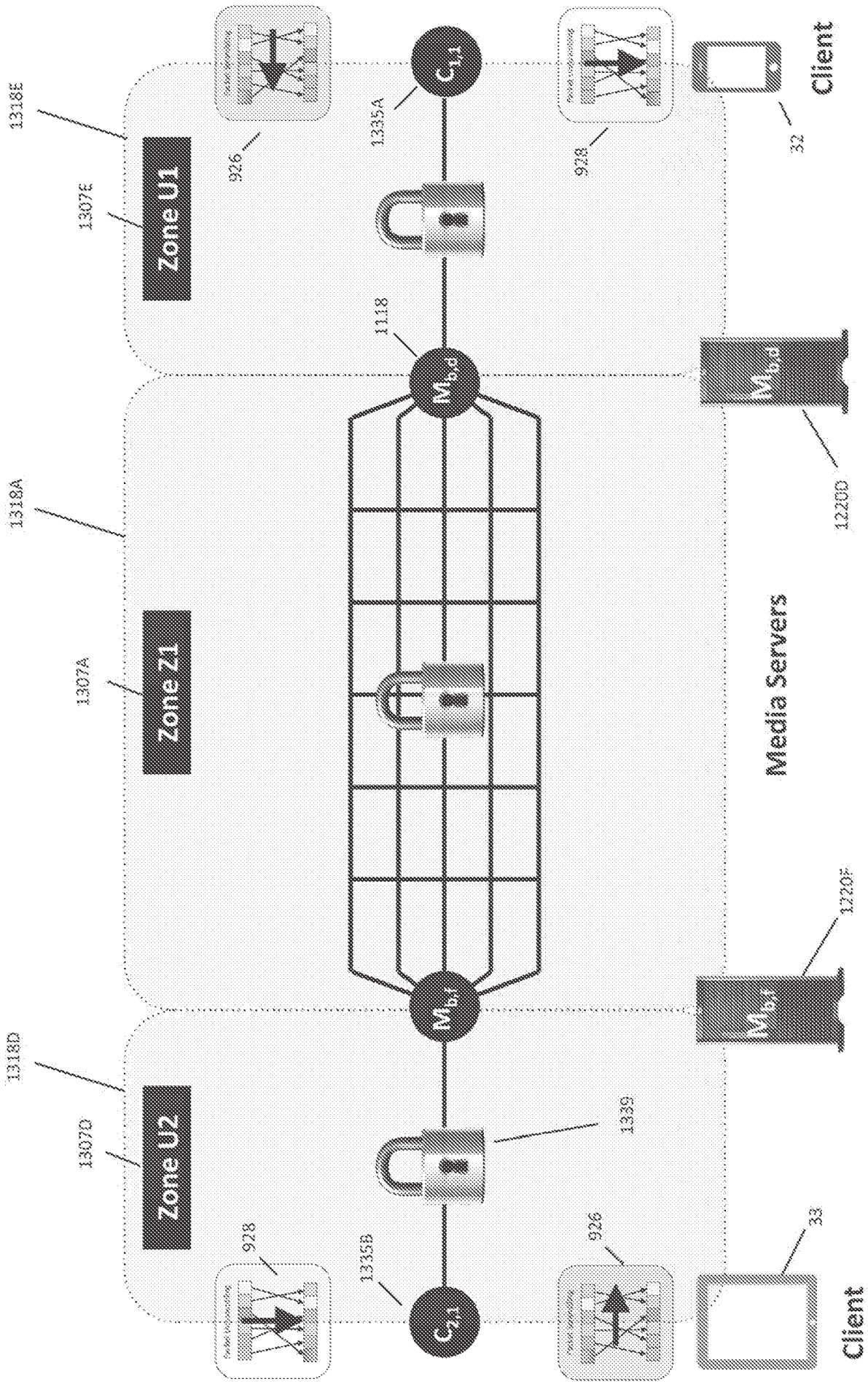

1318E
1307E
Zone U1
926
1335A
$C_{1,1}$
928
32
Client
1118
$M_{b,d}$
1318A
1307A
Zone Z1
$M_{b,d}$
1220D
Media Servers
$M_{b,1}$
1220F
1318D
1307D
Zone U2
1339
928
926
1335B
$C_{2,1}$
33
Client

Figure 99D

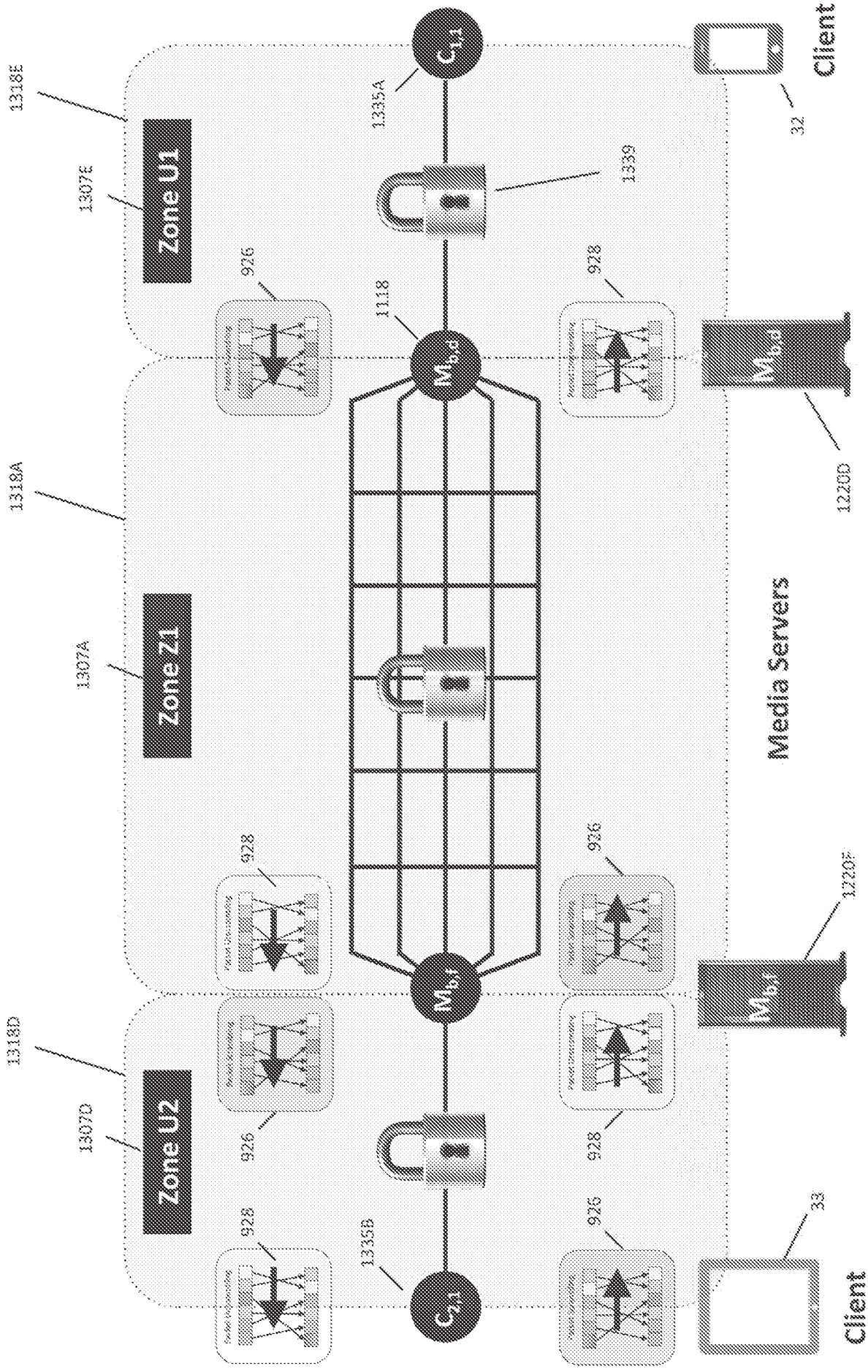

1318E
1307E
Zone U1
1318A
1307A
Zone Z1
1318D
1307D
Zone U2
1335A
1335B
1339
1118
926
928
1220D
1220F
Media Servers
Client
32
33

Figure 99E

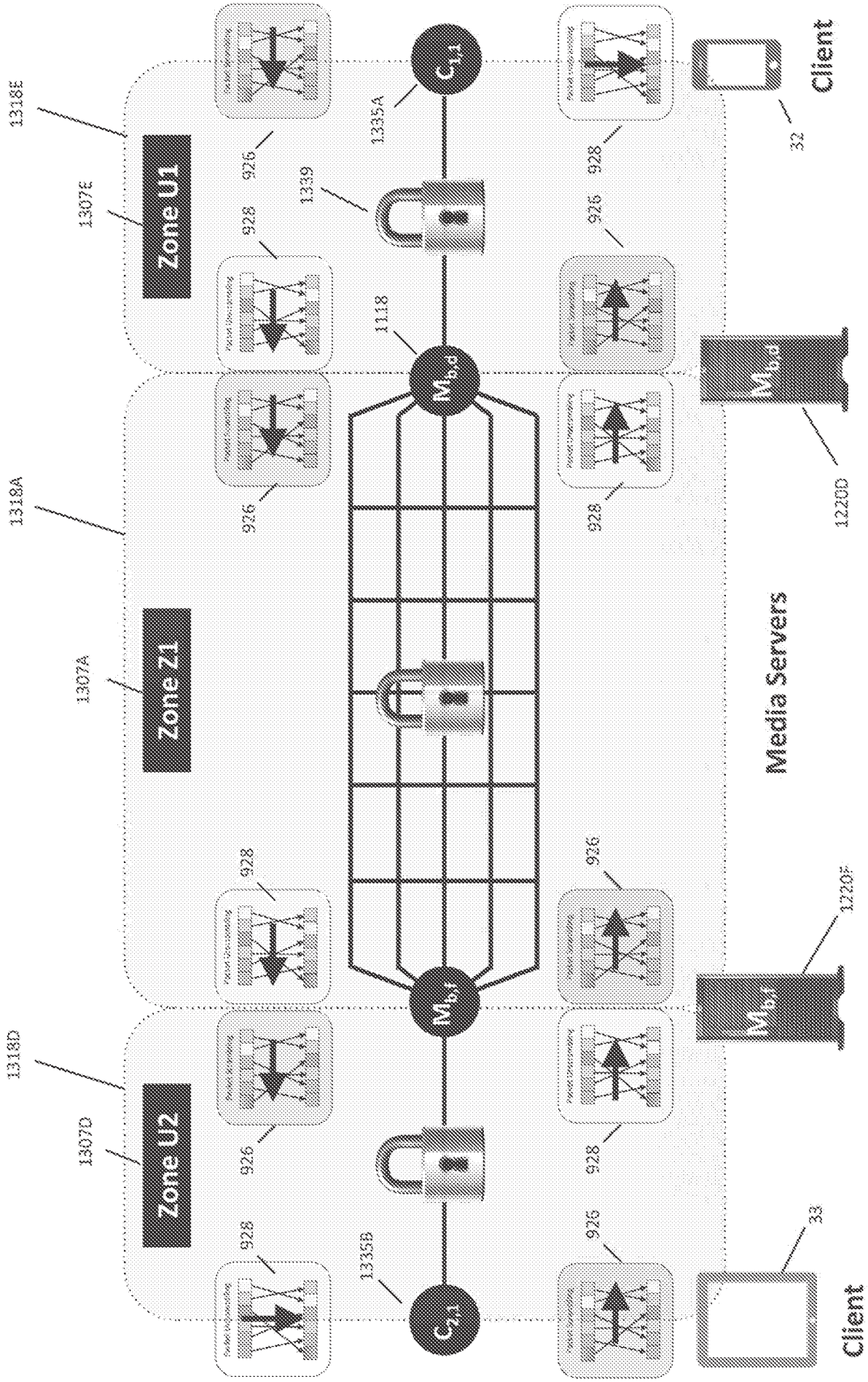

1318E
1307E
Zone U1
1318A
1307A
Zone Z1
1318D
1307D
Zone U2
926
928
1339
1335A
1335B
1118
$C_{1,1}$
$C_{2,1}$
$M_{b,d}$
$M_{b,f}$
$M_{b,d}$
$M_{b,f}$
1220D
1220F
Media Servers
Client
32
Client
33

Figure 99F

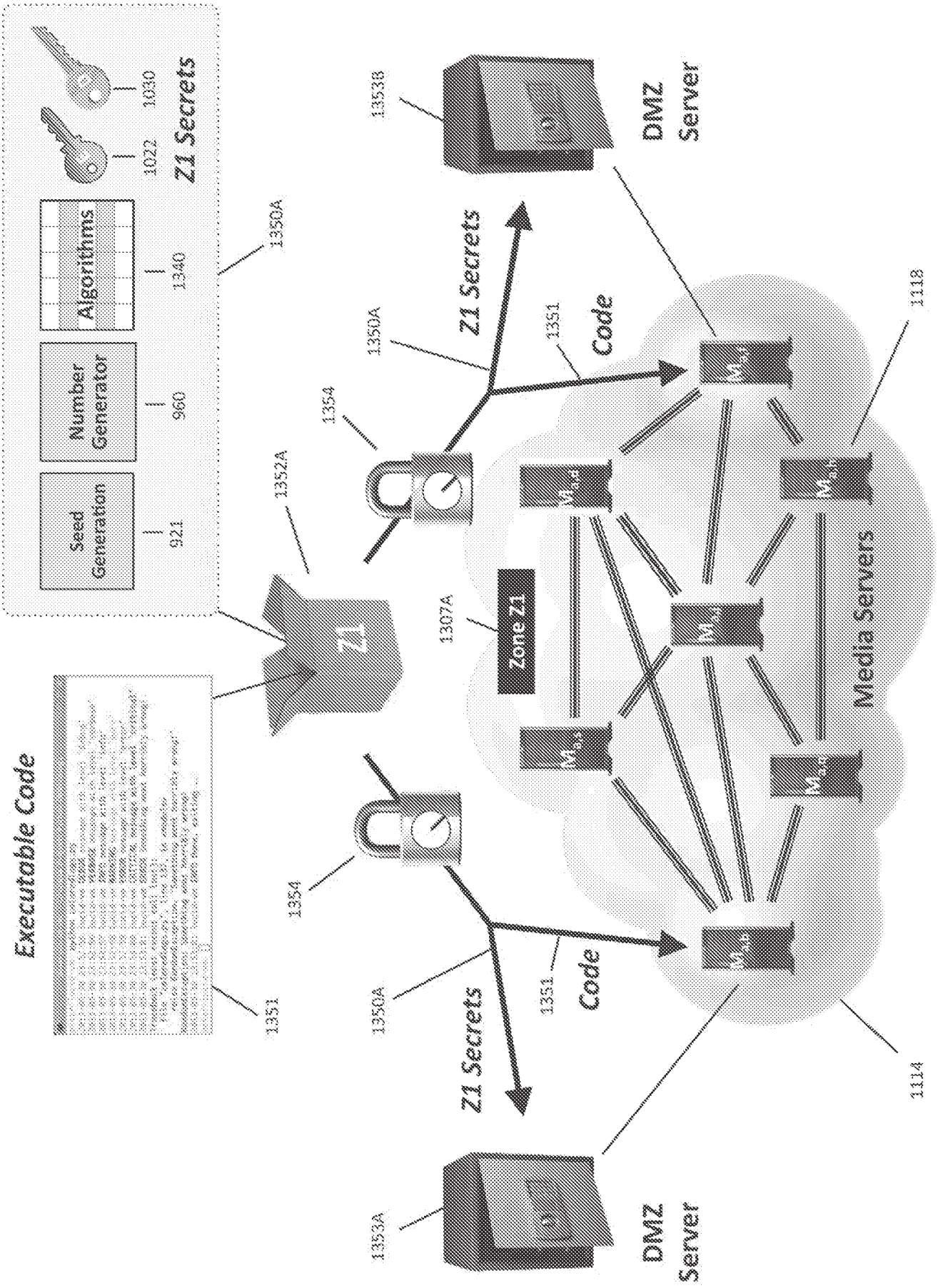

Executable Code
Seed Generation
Number Generator
Algorithms
921
960
1340
1022
1030
Z1 Secrets
1350A
1352A
Z1
1307A
Zone Z1
1354
1351
Code
1353A
1353B
DMZ Server
Media Servers
1114
1118

Figure 100A

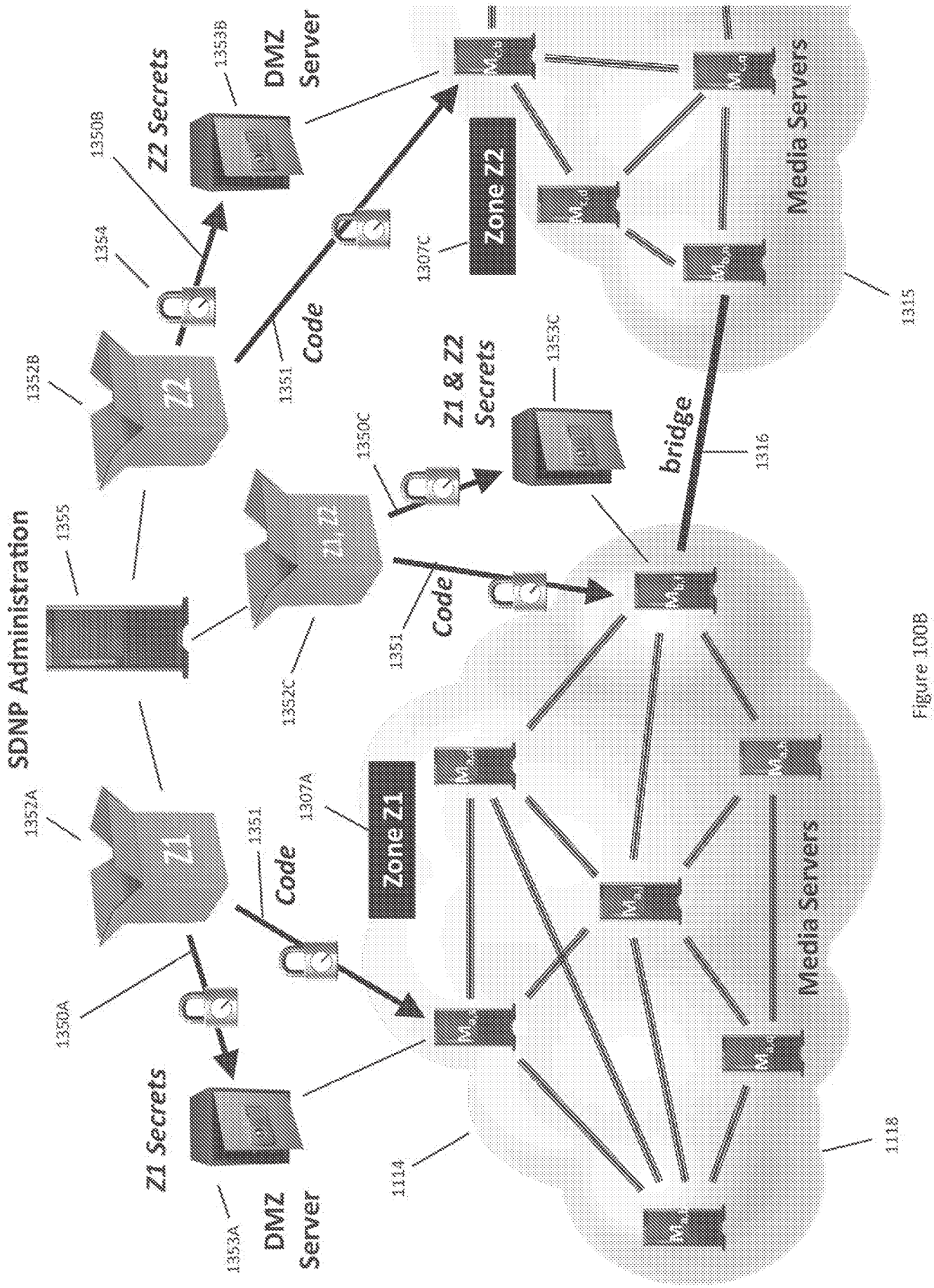

SDNP Administration
1355
1352A
Z1
1352B
Z1
1352C
Z1 Z2
1350A
1350B
1350C
1354
Z1 Secrets
Z2 Secrets
Z1 & Z2 Secrets
1353A
1353B
1353C
DMZ Server
DMZ Server
1351
Code
1351
Code
1351
Code
1307A
Zone Z1
1307C
Zone Z2
bridge
1316
1315
1114
1118
Media Servers
Media Servers

Figure 100B

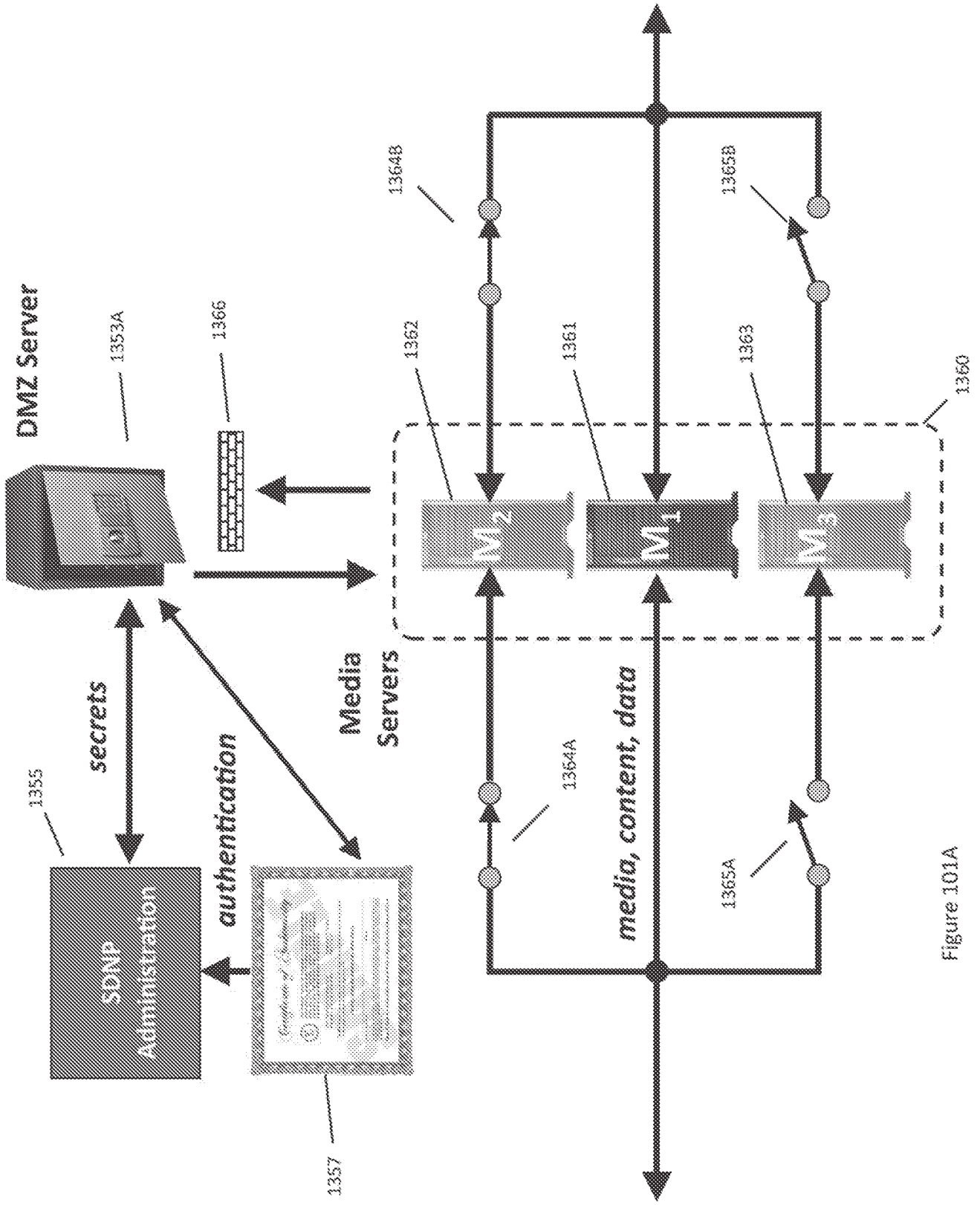

DMZ Server
1353A
1366
1362
1361
1363
1360
1364B
1365B
Media Servers
secrets
authentication
1355
SDNP Administration
1364A
media, content, data
1365A
1357

Figure 101A

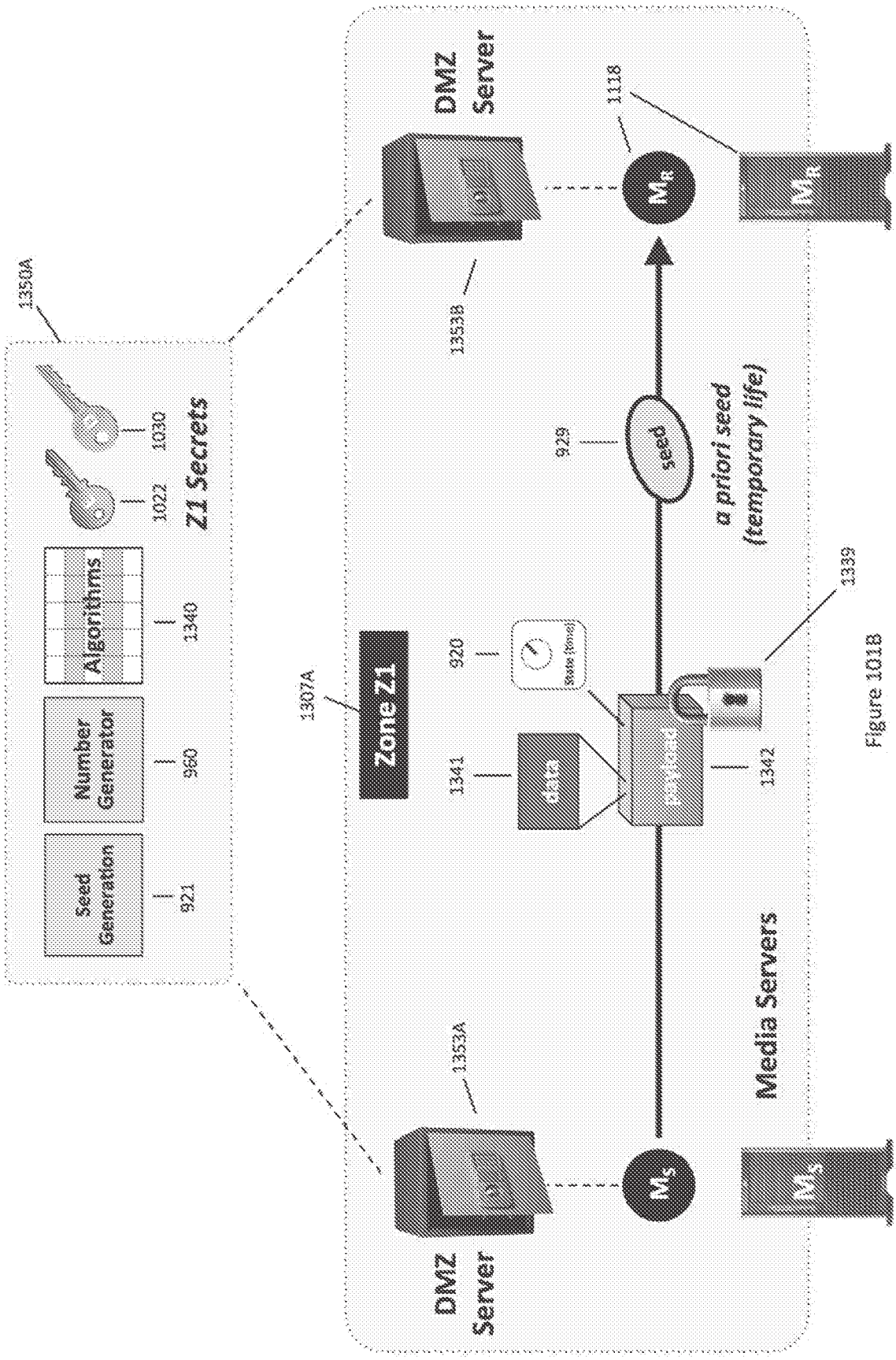

1350A
Seed Generation
Number Generator
Algorithms
921
960
1340
1022
1030
Z1 Secrets
1307A
Zone Z1
DMZ Server
1353A
1353B
1341
920
929
seed
a priori seed
(temporary life)
1339
1342
1118
Media Servers
M_S
M_R

Figure 1013

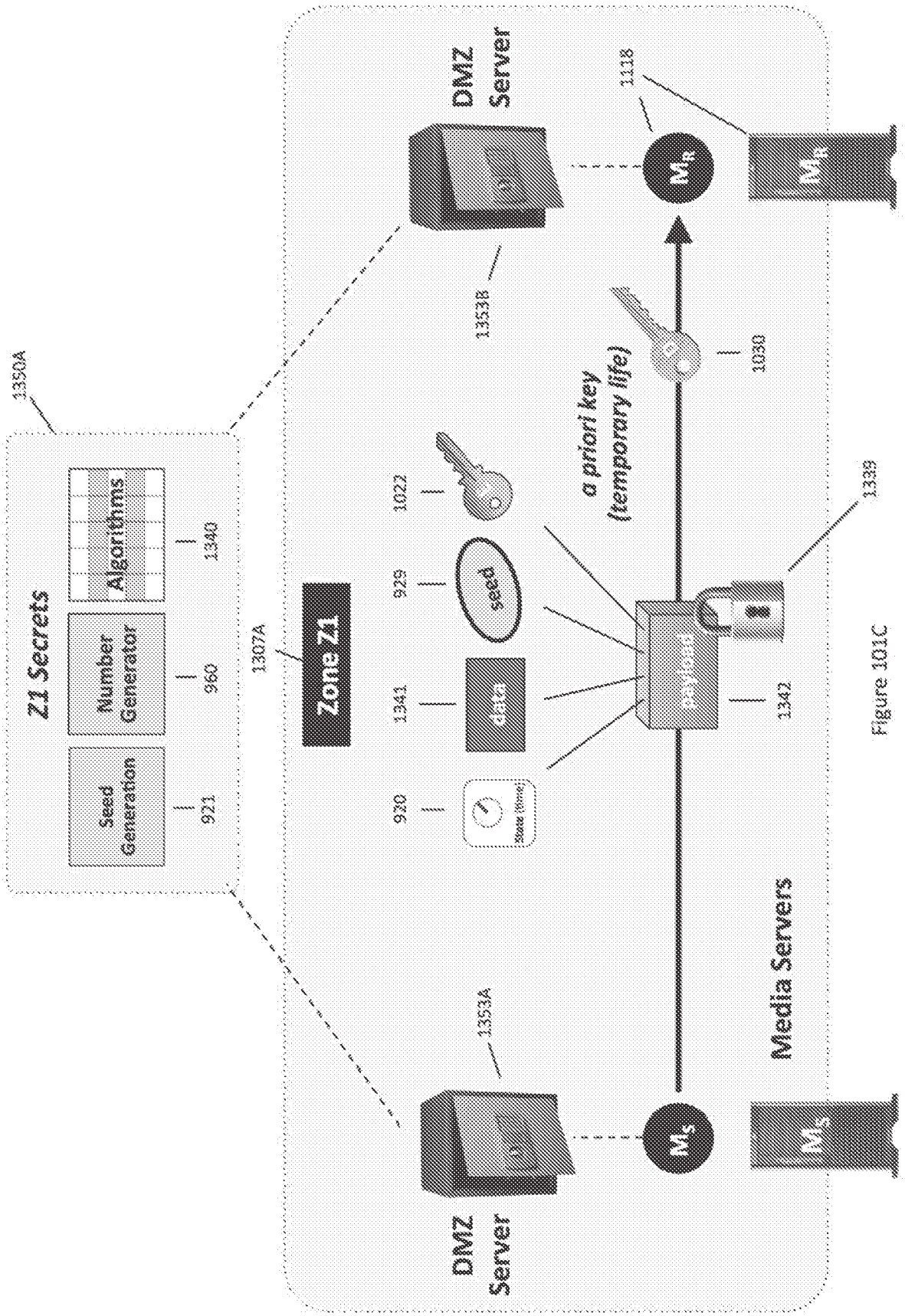

1350A
Z1 Secrets
Seed Generation
Number Generator
Algorithms
921
960
1340
1307A
Zone Z1
DMZ Server
1353B
1118
M_R
1022
929
seed
1341
data
930
State (time)
a priori key
(temporary life)
1030
1339
1342
Media Servers
1353A
DMZ Server
M_S
M_S

Figure 101C

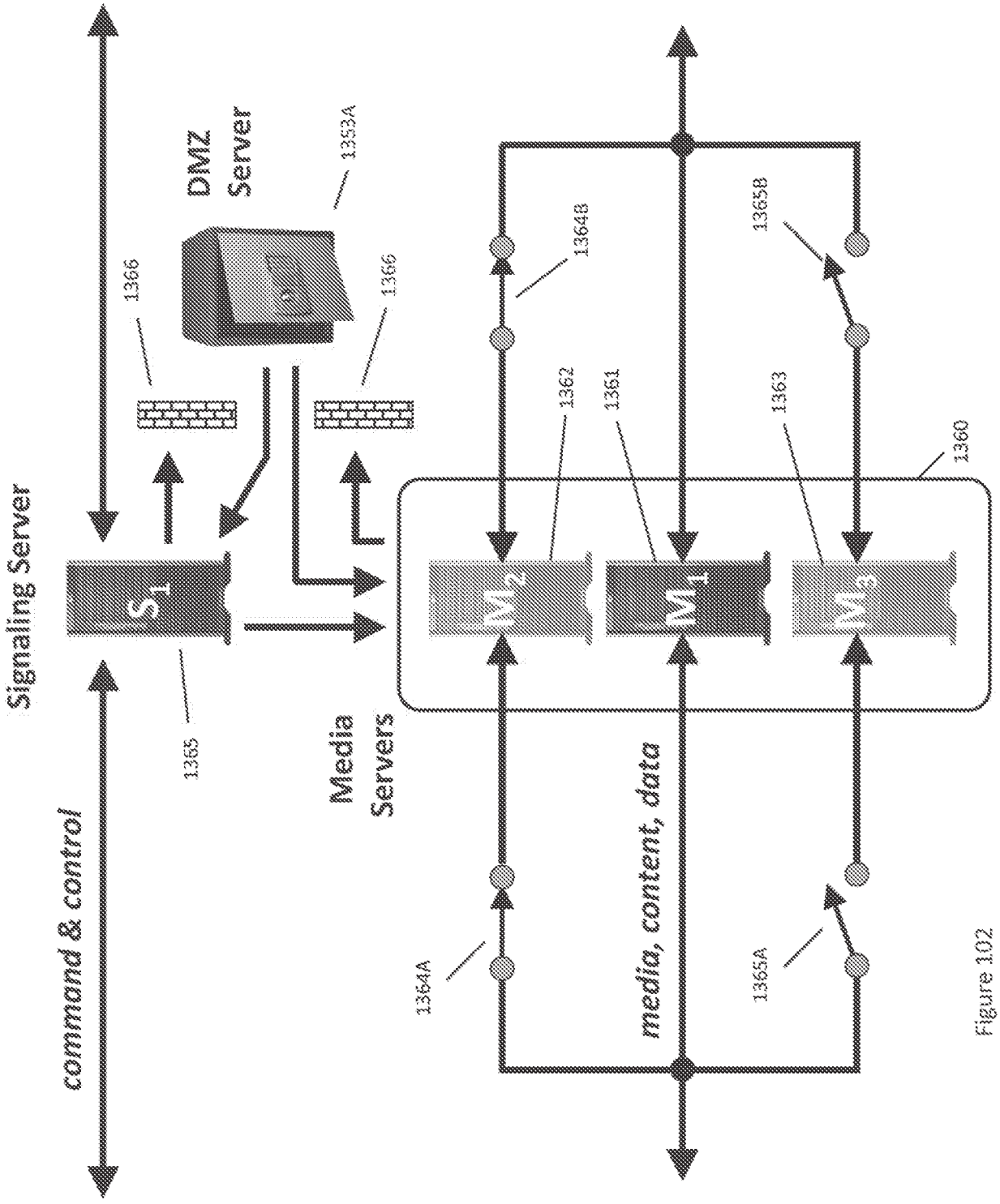

Signaling Server
command & control
1365
S_1
1366
DMZ Server
1353A
1366
Media Servers
1364A
1362
1361
1363
1360
M_2
M_1
M_3
13648
13658
media, content, data
1365A

Figure 102

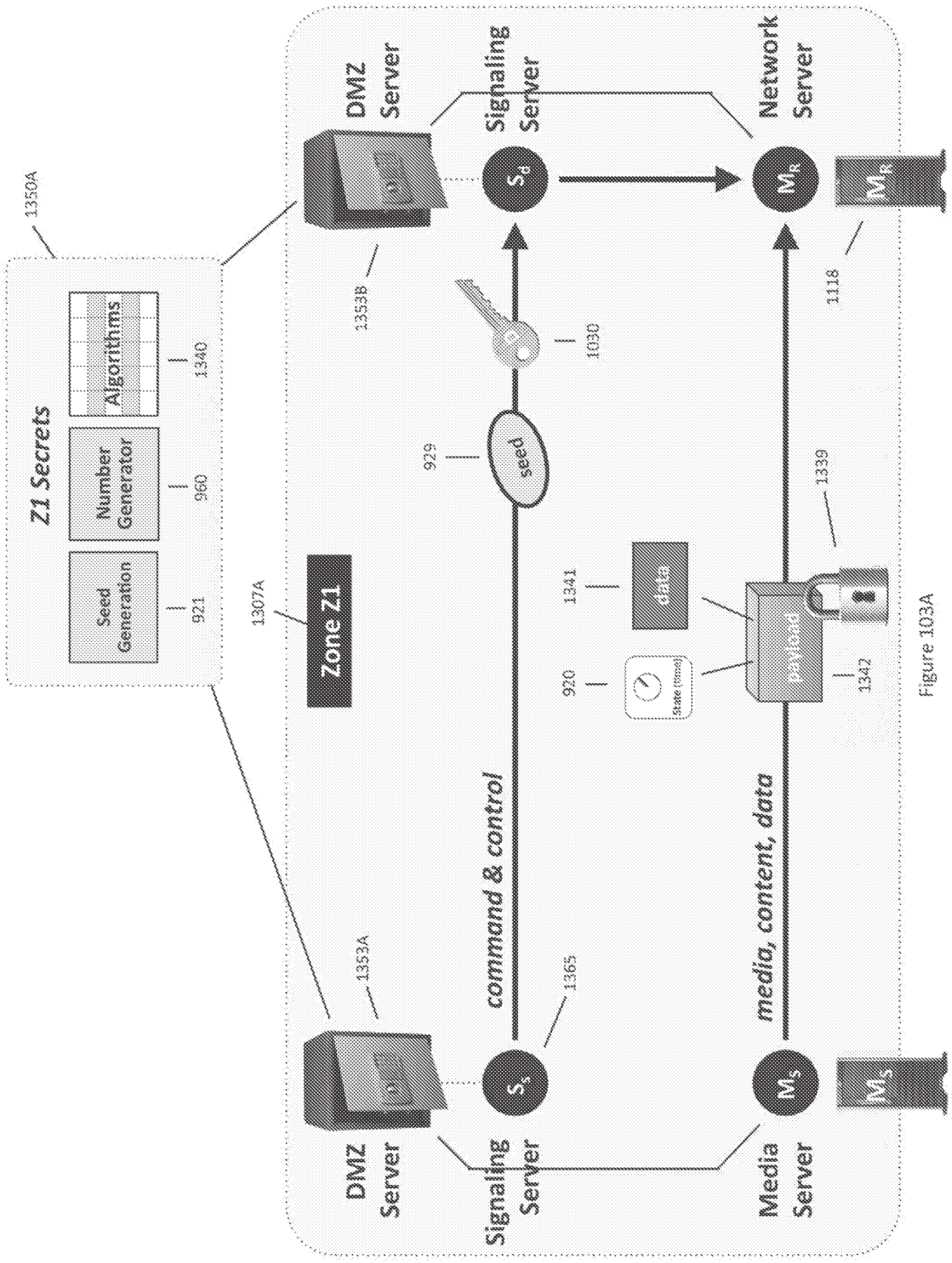

1350A
Z1 Secrets
Seed Generation
Number Generator
Algorithms
921
960
1340
1307A
Zone Z1
DMZ Server
Signaling Server
Network Server
Media Server
1353B
1353A
1365
1118
1339
1342
1341
1030
929
seed
920
data
State (time)
command & control
media, content, data
S_d
M_R
S_s
M_S

Figure 103A

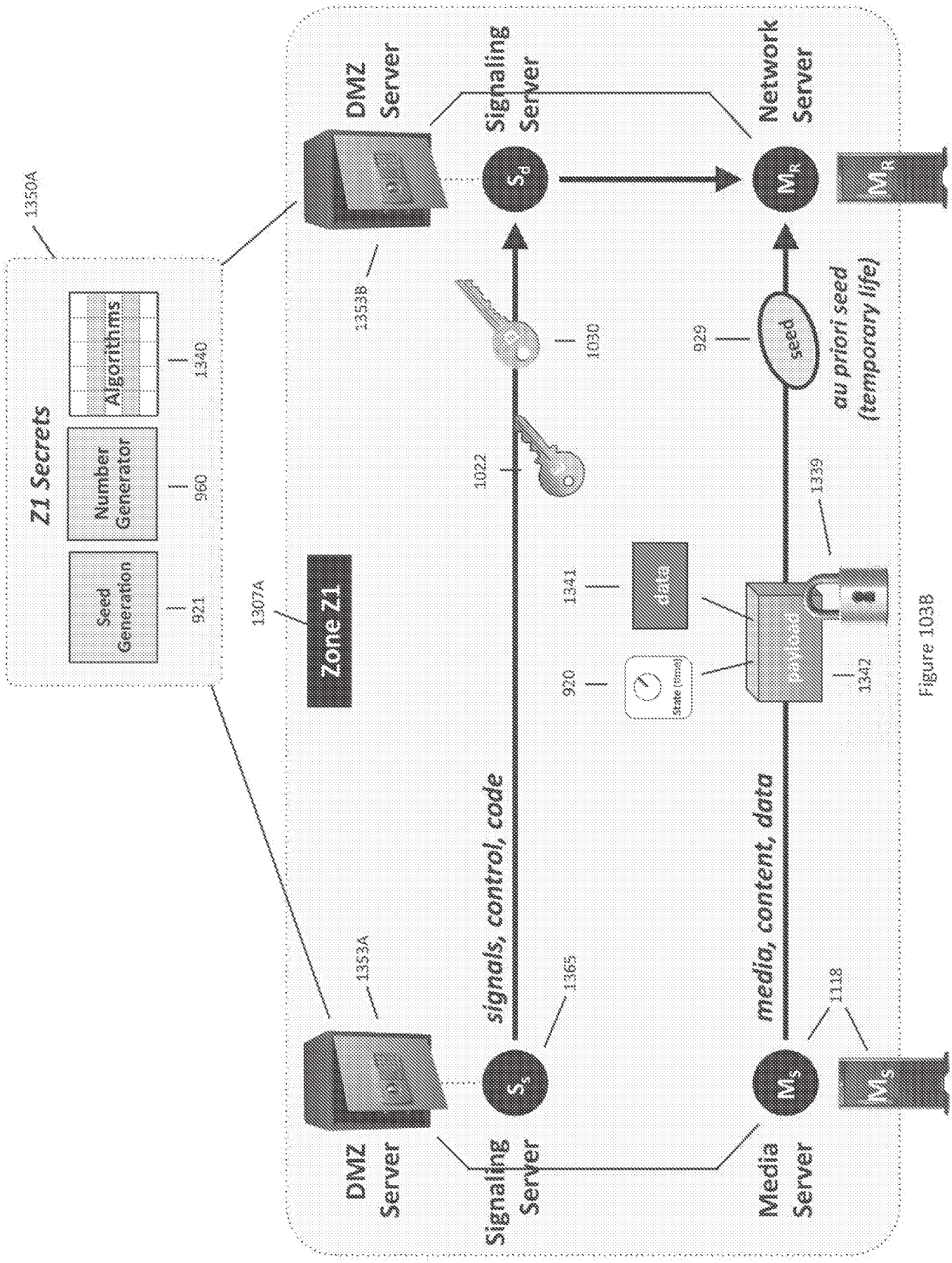

1350A
Z1 Secrets
Seed Generation
Number Generator
Algorithms
921
960
1340
1307A
Zone Z1
DMZ Server
Signaling Server
Network Server
Media Server
1353B
1353A
1030
1022
929
seed
au priori seed (temporary life)
1339
1341
data
920
State (time)
1342
1365
1118
signals, control, code
media, content, data

Figure 103B

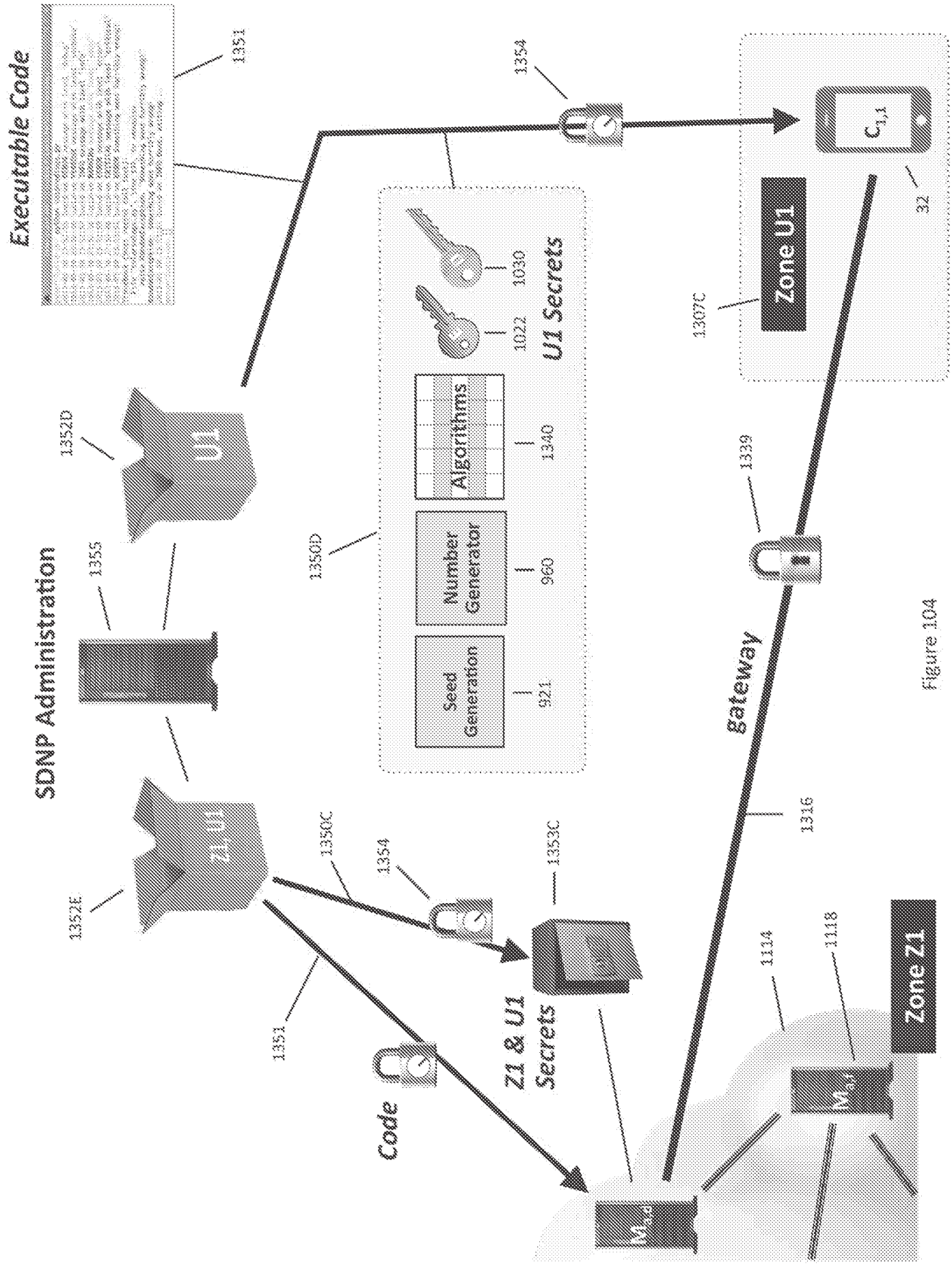

Executable Code
1351
1354
1352D
U1
1355
SDNP Administration
1352E
Z1 U1
1350C
1354
1353C
1351
Code
Z1 & U1 Secrets
1350D
Seed Generation
921
Number Generator
960
Algorithms
1340
1022
1030
U1 Secrets
1307C
Zone U1
$C_{1,1}$
32
1339
gateway
1316
1114
1118
$M_{1,1}$
Zone Z1
$M_{n,n}$

Figure 104

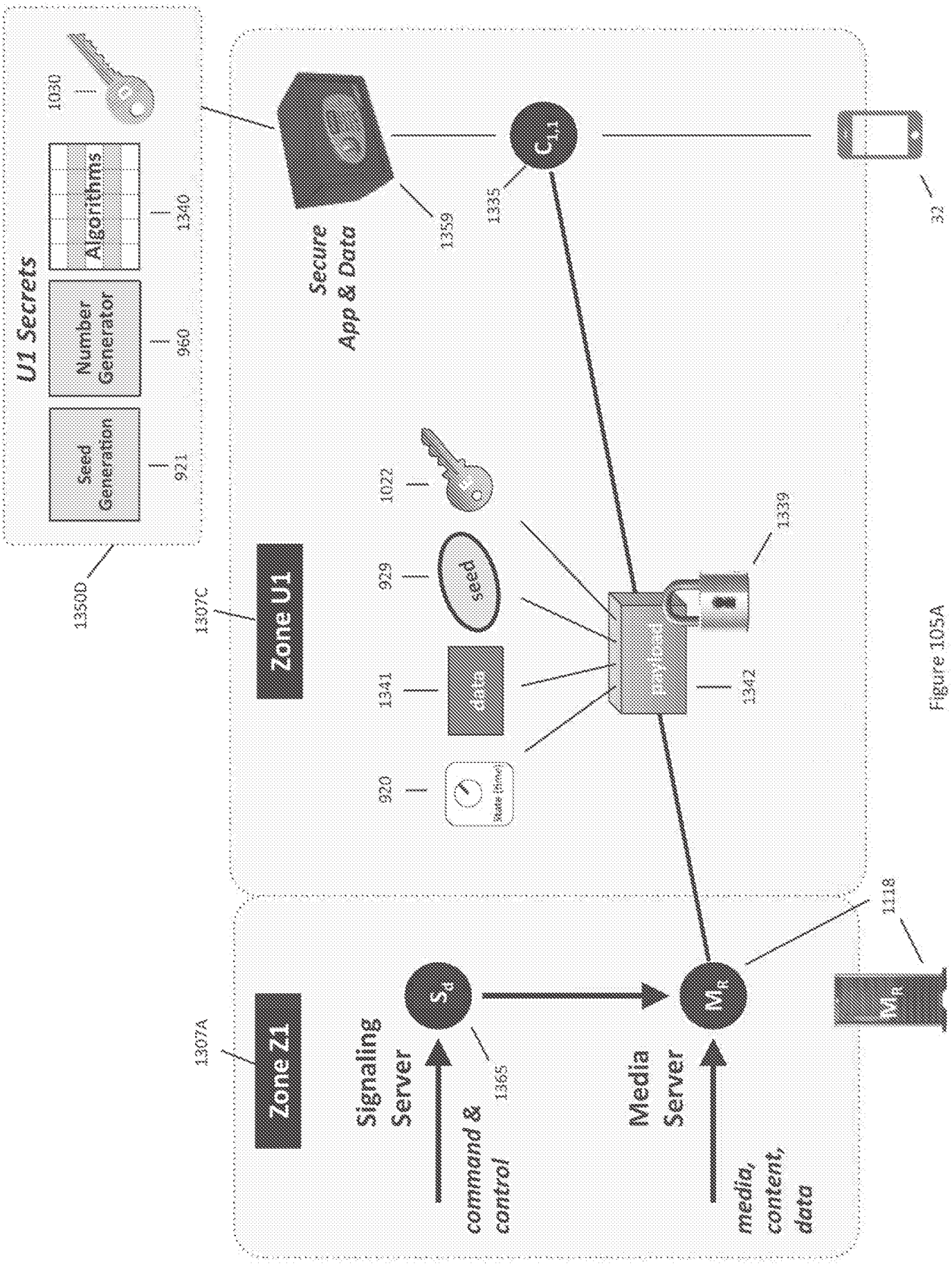

U1 Secrets
Seed Generation
Number Generator
Algorithms
921
960
1340
1030
1350D
1307C
Zone U1
Secure App & Data
1359
1335
32
920
1341
929
1022
Rate (time)
data
seed
1339
1342
1307A
Zone Z1
Signaling Server
command & control
1365
Media Server
media, content, data
1118

Figure 105A

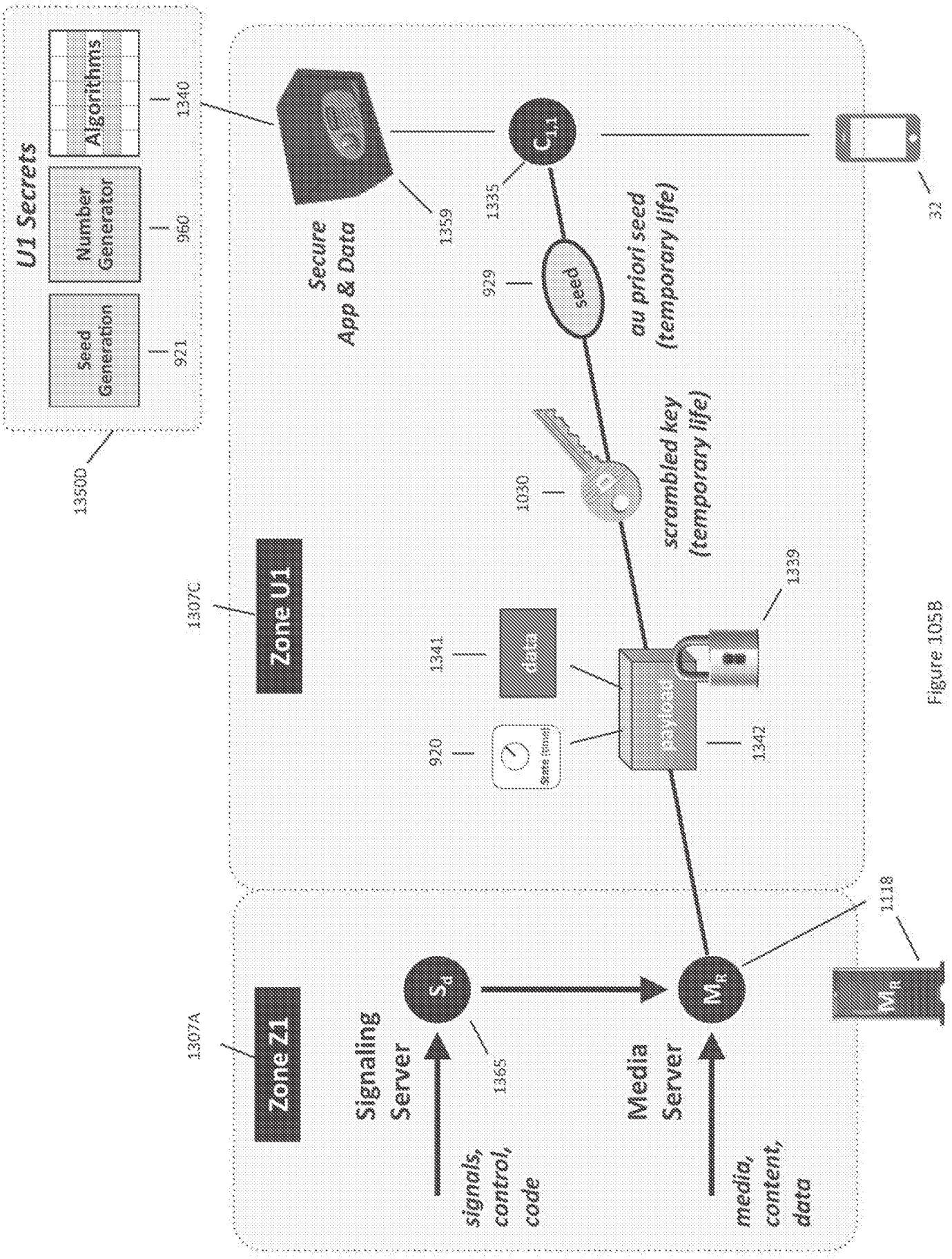

U1 Secrets
Seed Generation
Number Generator
Algorithms
921
960
1340
1350D
Zone Z1
1307A
Zone U1
1307C
Secure App & Data
1359
1335
929
seed
au priori seed (temporary life)
scrambled key (temporary life)
1030
1339
1341
920
1342
data
Signaling Server
Media Server
signals, control, code
media, content, data
1365
1118
32

Figure 105B

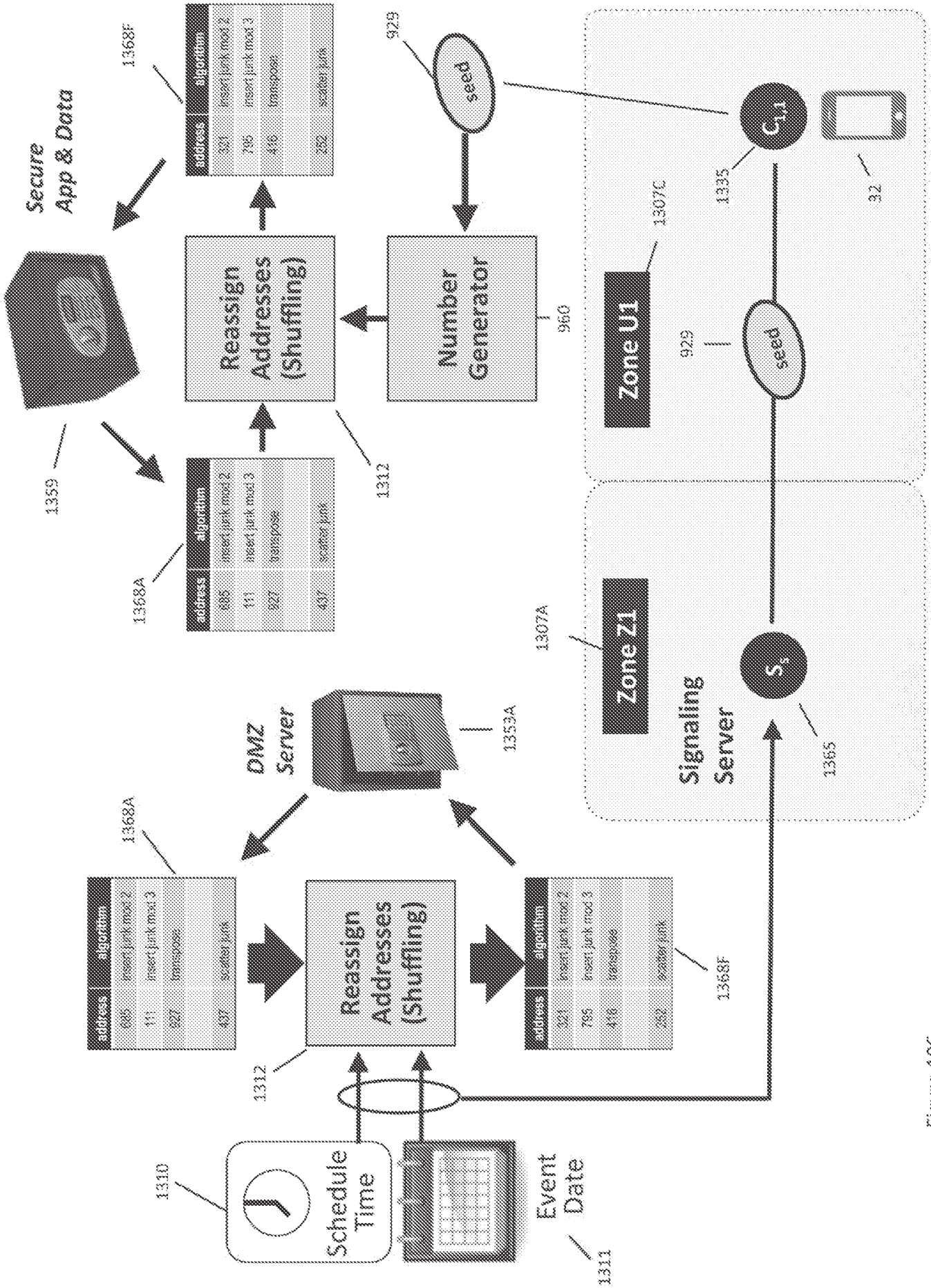

Secure App & Data
1368F
address
algorithm
321
insert junk mod 2
795
insert junk mod 3
416
transpose
252
scatter junk
929
seed
1359
Reassign Addresses (Shuffling)
Number Generator
960
1307C
Zone U1
1335
$C_{1,1}$
32
1368A
address
algorithm
886
insert junk mod 2
111
insert junk mod 3
527
transpose
437
scatter junk
1312
929
seed
DMZ Server
1353A
1307A
Zone Z1
Signaling Server
S_1
1365
1368A
address
algorithm
886
insert junk mod 2
111
insert junk mod 3
527
transpose
437
scatter junk
Reassign Addresses (Shuffling)
1312
address
algorithm
321
insert junk mod 2
795
insert junk mod 3
416
transpose
252
scatter junk
1368F
1310
Schedule Time
Event Date
1311

Figure 106

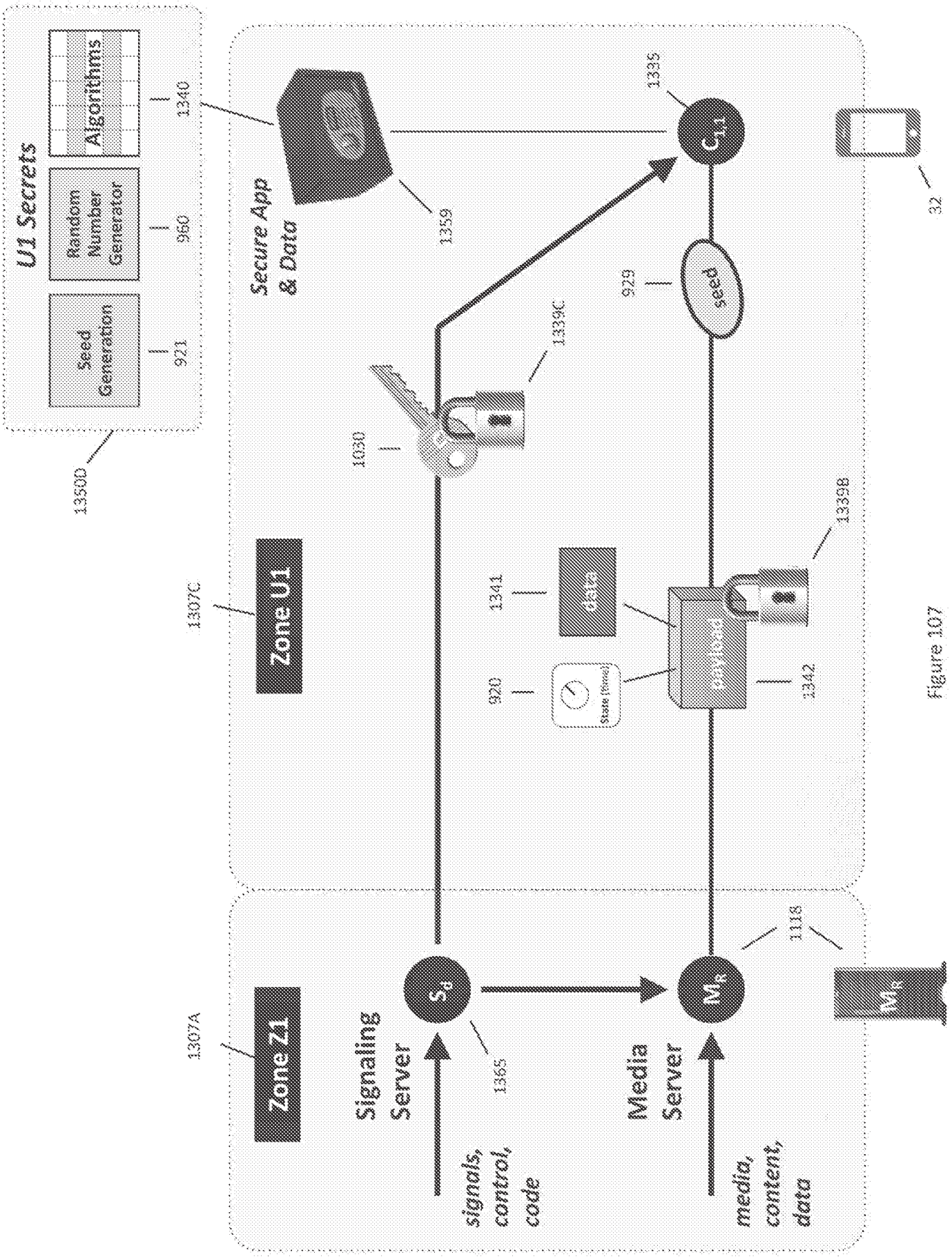

U1 Secrets
Seed Generation
Random Number Generator
Algorithms
921
960
1340
1350D
Secure App & Data
1359
1339
1339C
1030
929
seed
1307C
Zone U1
1341
data
920
State (time)
1339B
1342
32
1307A
Zone Z1
Signaling Server
1365
Media Server
1118
signals, control, code
media, content, data

Figure 107

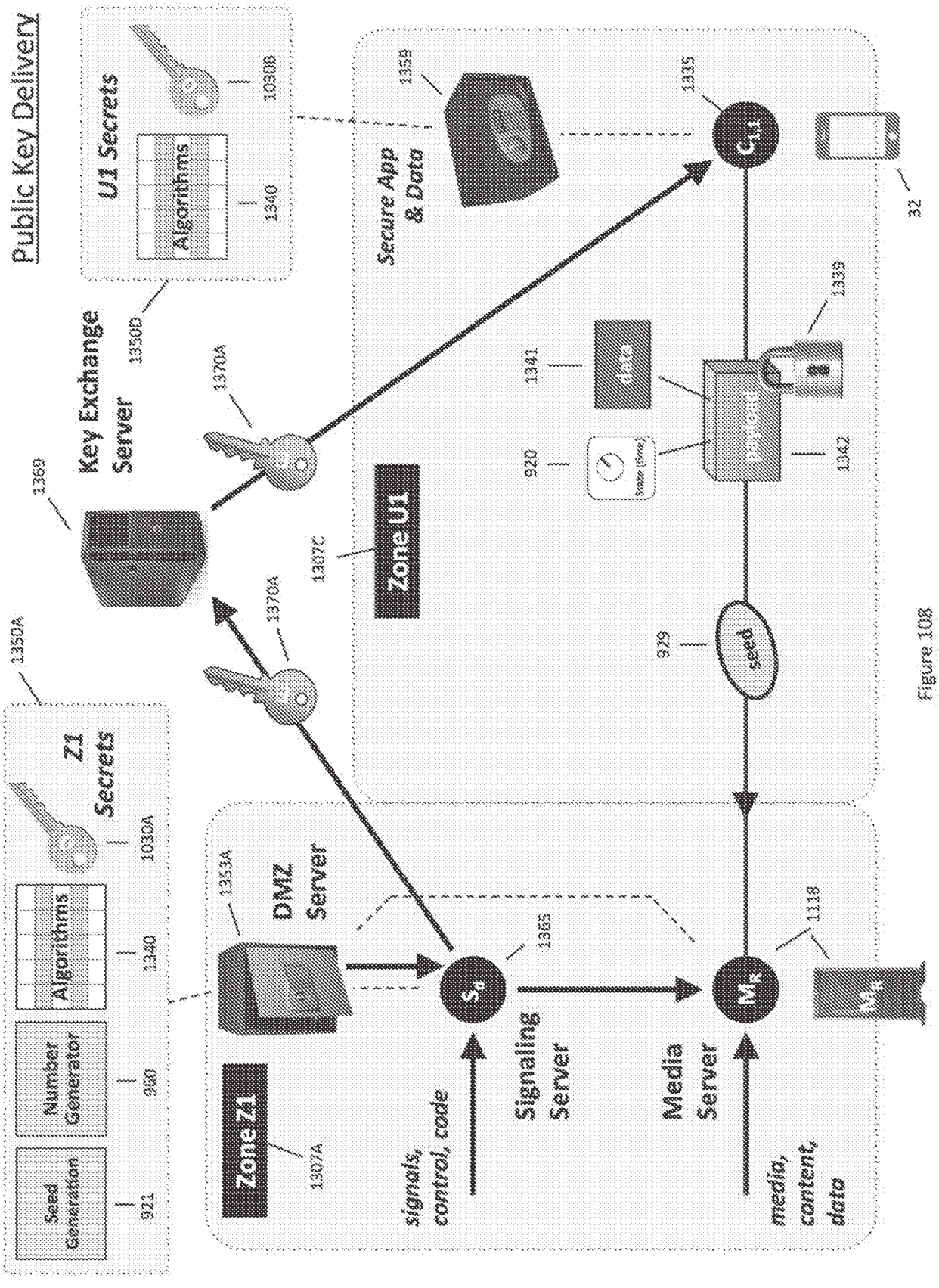

Public Key Delivery
U1 Secrets
Algorithms
1340
1030B
1350D
Key Exchange Server
1369
1370A
Secure App & Data
1339
1335
Zone U1
1307C
data
1341
920
1342
1339
32
seed
929
1350A
Z1 Secrets
Seed Generation
Number Generator
Algorithms
921
960
1340
1030A
1370A
DMZ Server
1353A
Zone Z1
1307A
signals, control, code
Signaling Server
1365
Media Server
1118
media, content, data

Figure 108

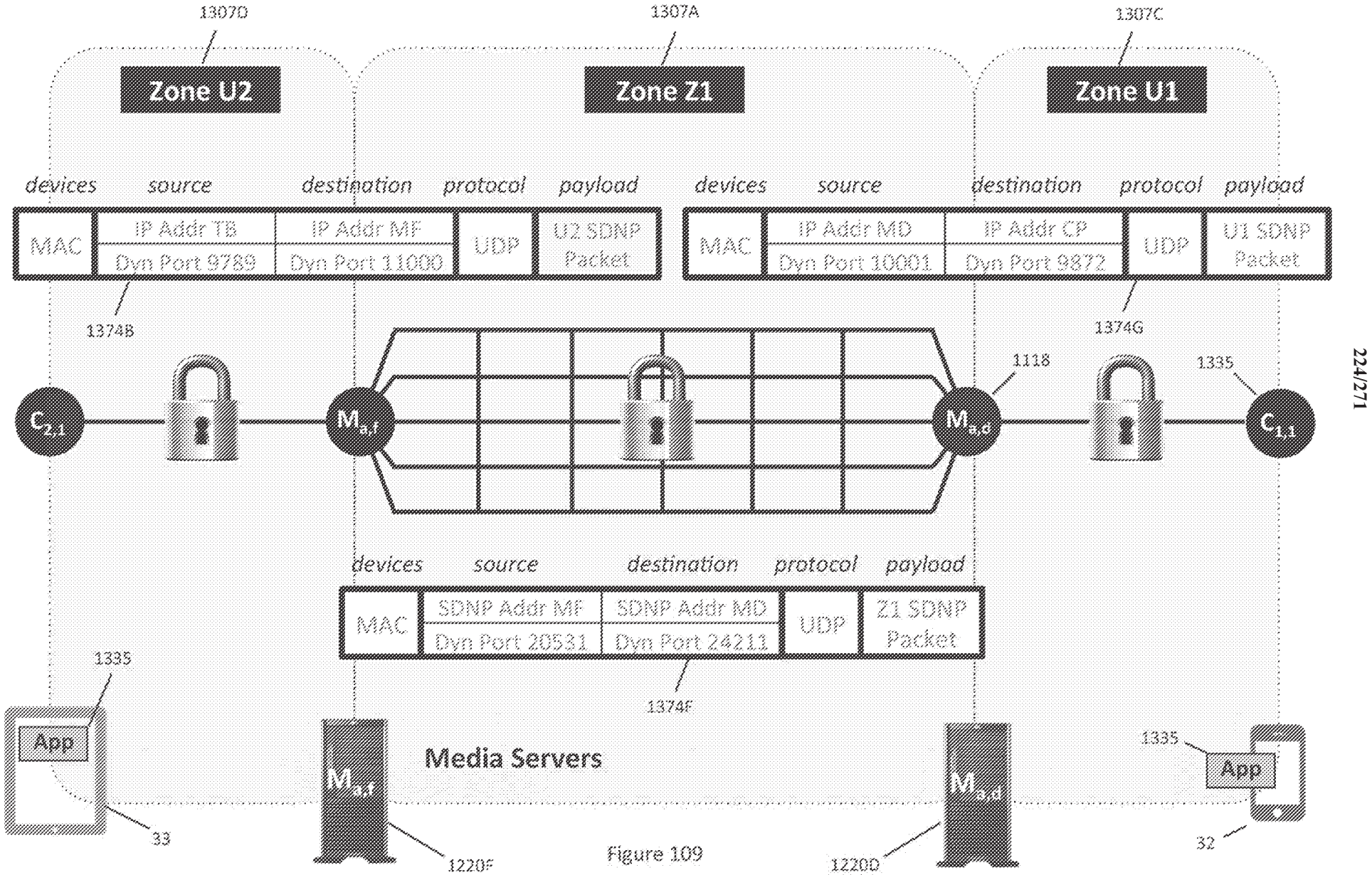

1307D
1307A
1307C
Zone U2
Zone Z1
Zone U1
devices
source
destination
protocol
payload
MAC
IP Addr TB
Dyn Port 9789
IP Addr MF
Dyn Port 11000
UDP
U2 SDNP Packet
1374B
devices
source
destination
protocol
payload
MAC
IP Addr MD
Dyn Port 10001
IP Addr CP
Dyn Port 9872
UDP
U1 SDNP Packet
1374G
1118
1335
C2,1
Ma,f
Ma,c
C1,1
devices
source
destination
protocol
payload
MAC
SDNP Addr MF
Dyn Port 20531
SDNP Addr MD
Dyn Port 24211
UDP
Z1 SDNP Packet
1374F
1335
App
33
Ma,f
Media Servers
Ma,d
1335
App
32
1220F
1220D

Figure 109

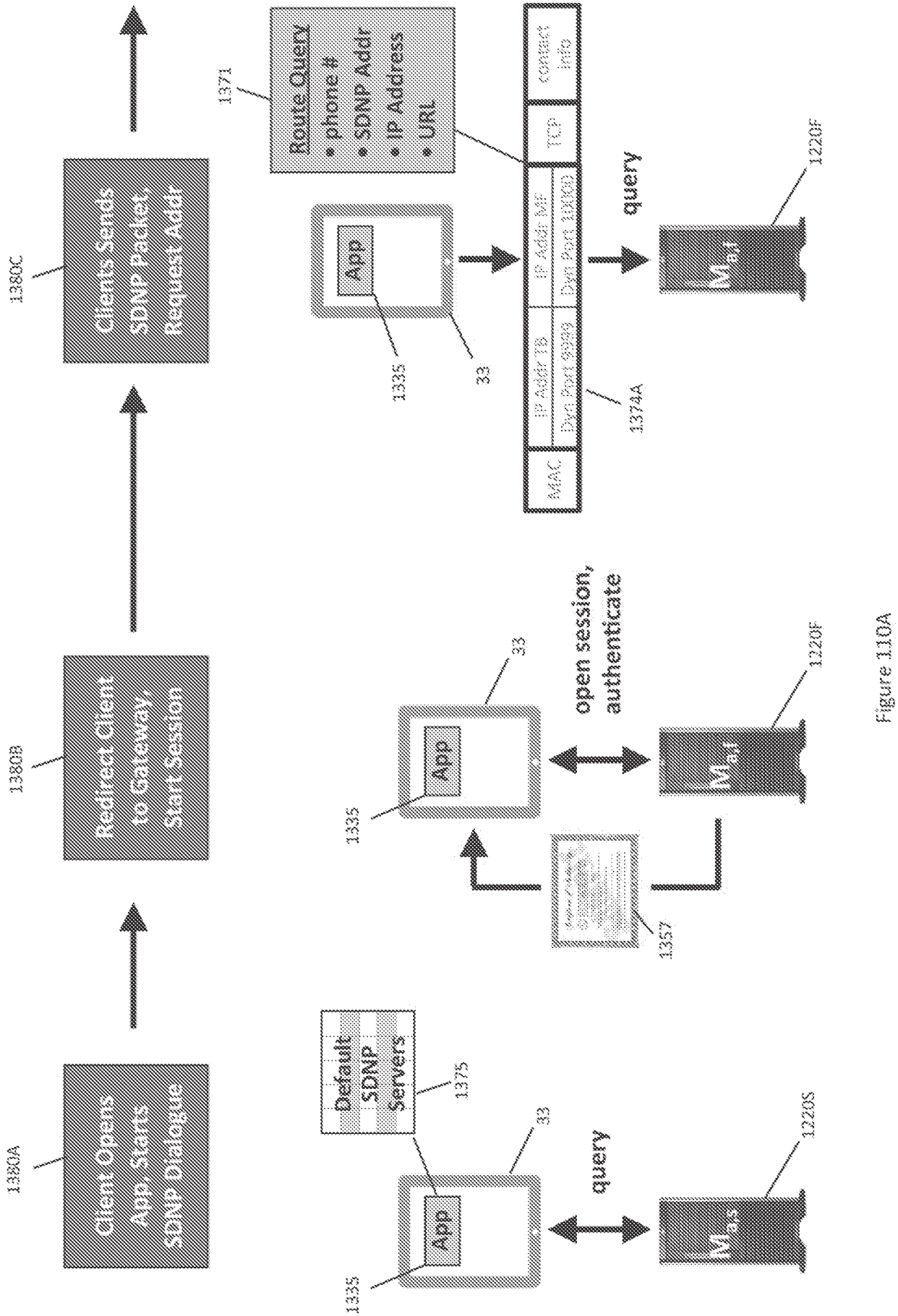

1380A
Client Opens App, Starts SDNP Dialogue
1380B
Redirect Client to Gateway, Start Session
1380C
Client Sends SDNP Packet, Request Addr
1371
Route Query
• phone #
• SDNP Addr
• IP Address
• URL
1335
App
33
1374A
MAC
IP Addr TB
Dyn Port 49949
IP Addr MF
Dyn Port 10000
TCP
contact info
query
1220F
open session, authenticate
1357
Default SDNP Servers
1375
query
1220S

Figure 110A

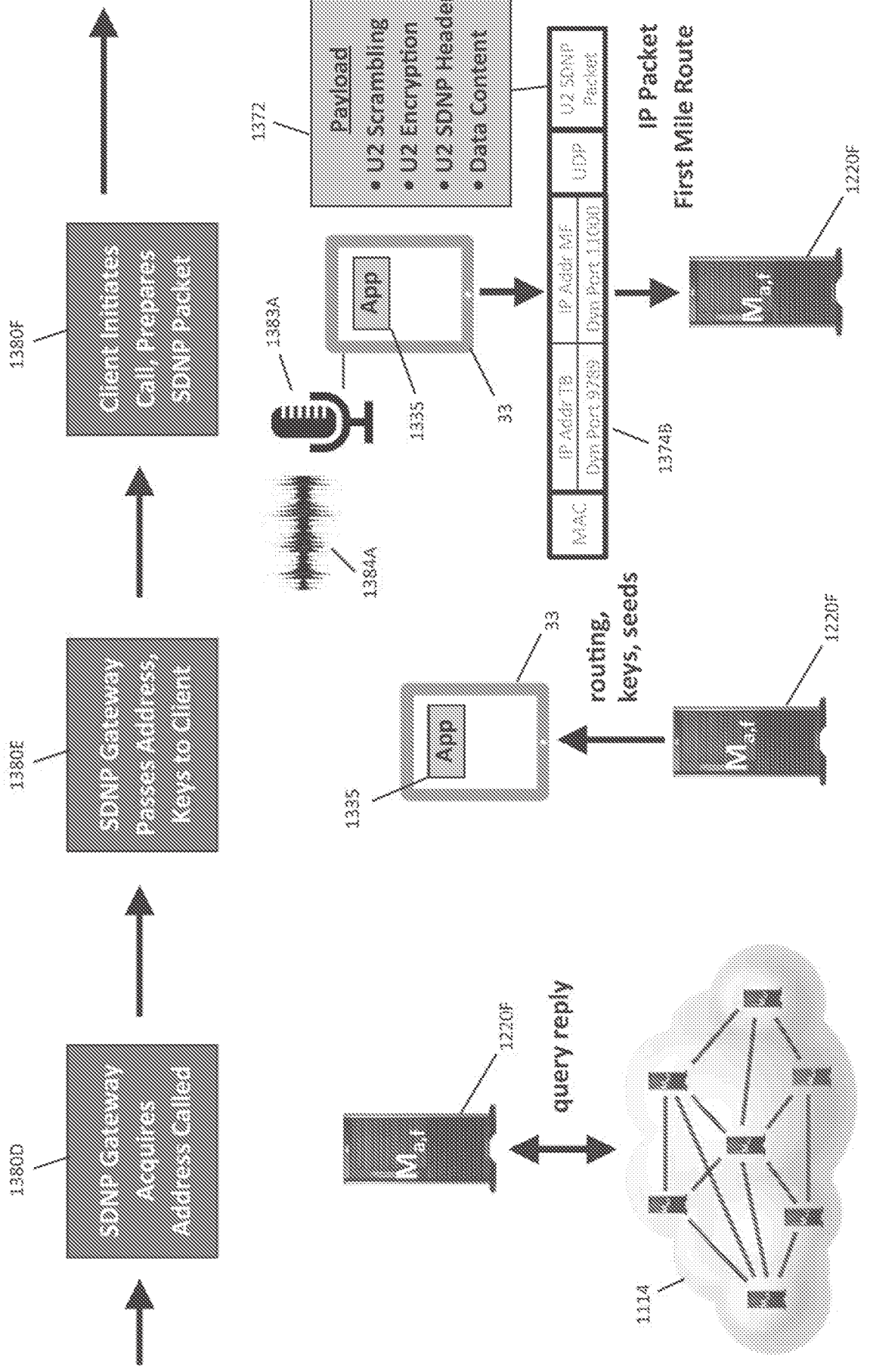

1380D
SDNP Gateway Acquires Address Called
1380E
SDNP Gateway Passes Address, Keys to Client
1380F
Client Initiates Call, Prepares SDNP Packet
1220F
Mail
query reply
routing, keys, seeds
33
1335
App
1383A
1384A
1372
Payload
• U2 Scrambling
• U2 Encryption
• U2 SDNP Header
• Data Content
MAC
IP Addr TB
Dyn Port 9789
IP Addr MF
Dyn Port 11600
UDP
U2 SDNP Packet
1374B
IP Packet
First Mile Route
1114

Figure 110B

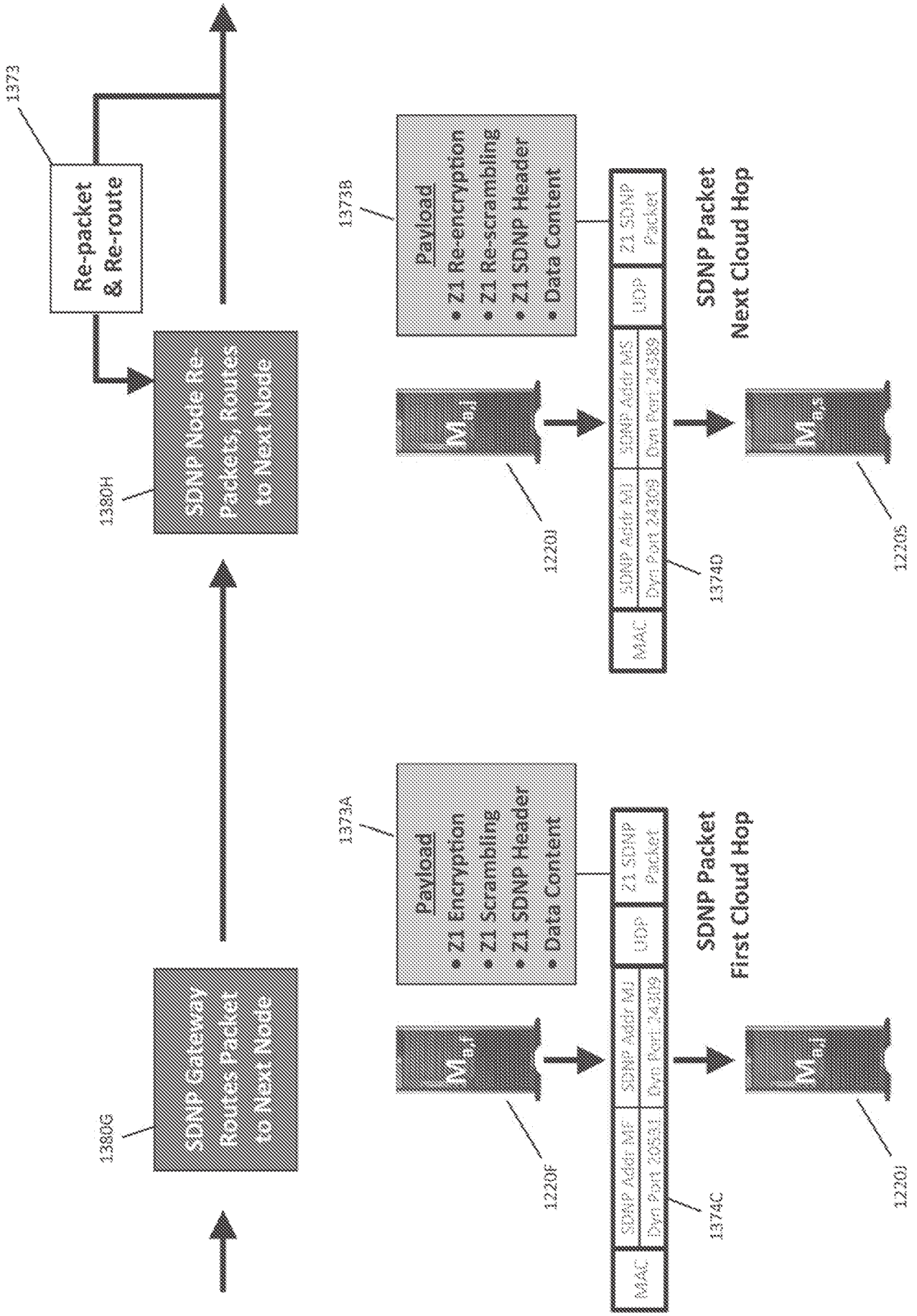

1380G
SDNP Gateway
Routes Packet
to Next Node
1380H
SDNP Node Re-
Packets, Routes
to Next Node
1373
Re-packet
& Re-route
1373A
Payload
• Z1 Encryption
• Z1 Scrambling
• Z1 SDNP Header
• Data Content
1373B
Payload
• Z1 Re-encryption
• Z1 Re-scrambling
• Z1 SDNP Header
• Data Content
MAC
SDNP Addr MS
Dyn Port 24309
SDNP Addr MF
Dyn Port 20533
UDP
Z1 SDNP
Packet
1374C
1374D
SDNP Packet
First Cloud Hop
SDNP Packet
Next Cloud Hop
1220F
1220G
1220I
1220J

Figure 110C

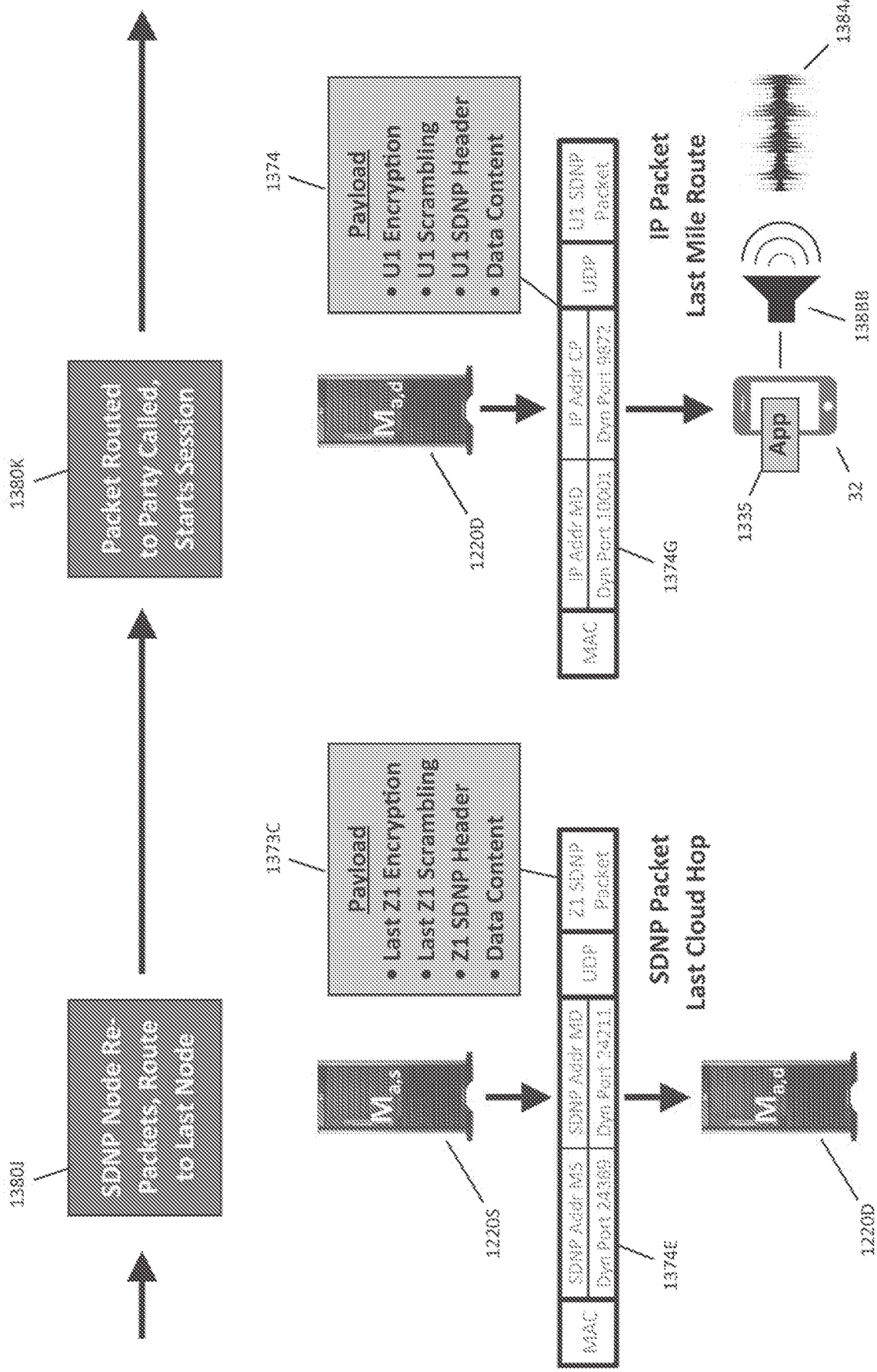

1380I
SDNP Node Re-Packets, Route to Last Node
1380K
Packet Routed to Party Called Starts Session
1373C
Payload
• Last Z1 Encryption
• Last Z1 Scrambling
• Z1 SDNP Header
• Data Content
1374
Payload
• U1 Encryption
• U1 Scrambling
• U1 SDNP Header
• Data Content
1220S
1220D
1220D
1374E
MAC
SDNP Addr M/S
Dyn Port 24389
SDNP Addr M/D
Dyn Port 24211
UDP
Z1 SDNP Packet
1374G
MAC
IP Addr M/D
Dyn Port 10001
IP Addr CP
Dyn Port 9872
UDP
U1 SDNP Packet
SDNP Packet
Last Cloud Hop
IP Packet
Last Mile Route
1384A
1388B
1335
App
32

Figure 110D

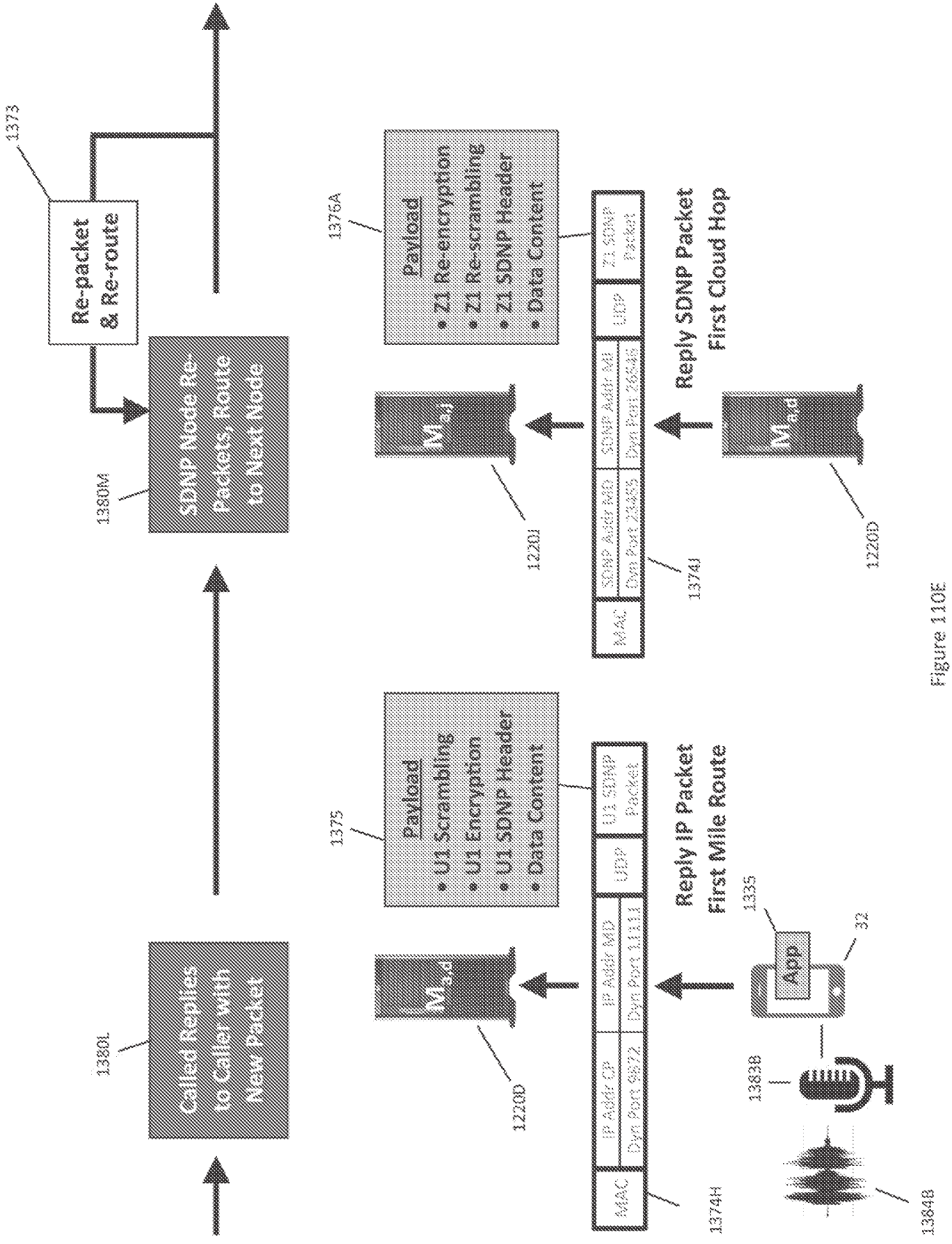

1373
Re-packet
& Re-route
1380M
SDNP Node Re-
Packets, Route
to Next Node
1380L
Called Replies
to Caller With
New Packet
1376A
Payload
• Z1 Re-encryption
• Z1 Re-scrambling
• Z1 SDNP Header
• Data Content
1375
Payload
• U1 Scrambling
• U1 Encryption
• U1 SDNP Header
• Data Content
1220J
1220D
1374J
1374H
MAC
SDNP Addr MD
Dyn Port 26545
UDP
Z1 SDNP
Packet
IP Addr CP
Dyn Port 9872
U1 SDNP
Packet
Reply SDNP Packet
First Cloud Hop
Reply IP Packet
First Mile Route
1335
App
32
13838
13848

Figure 110E

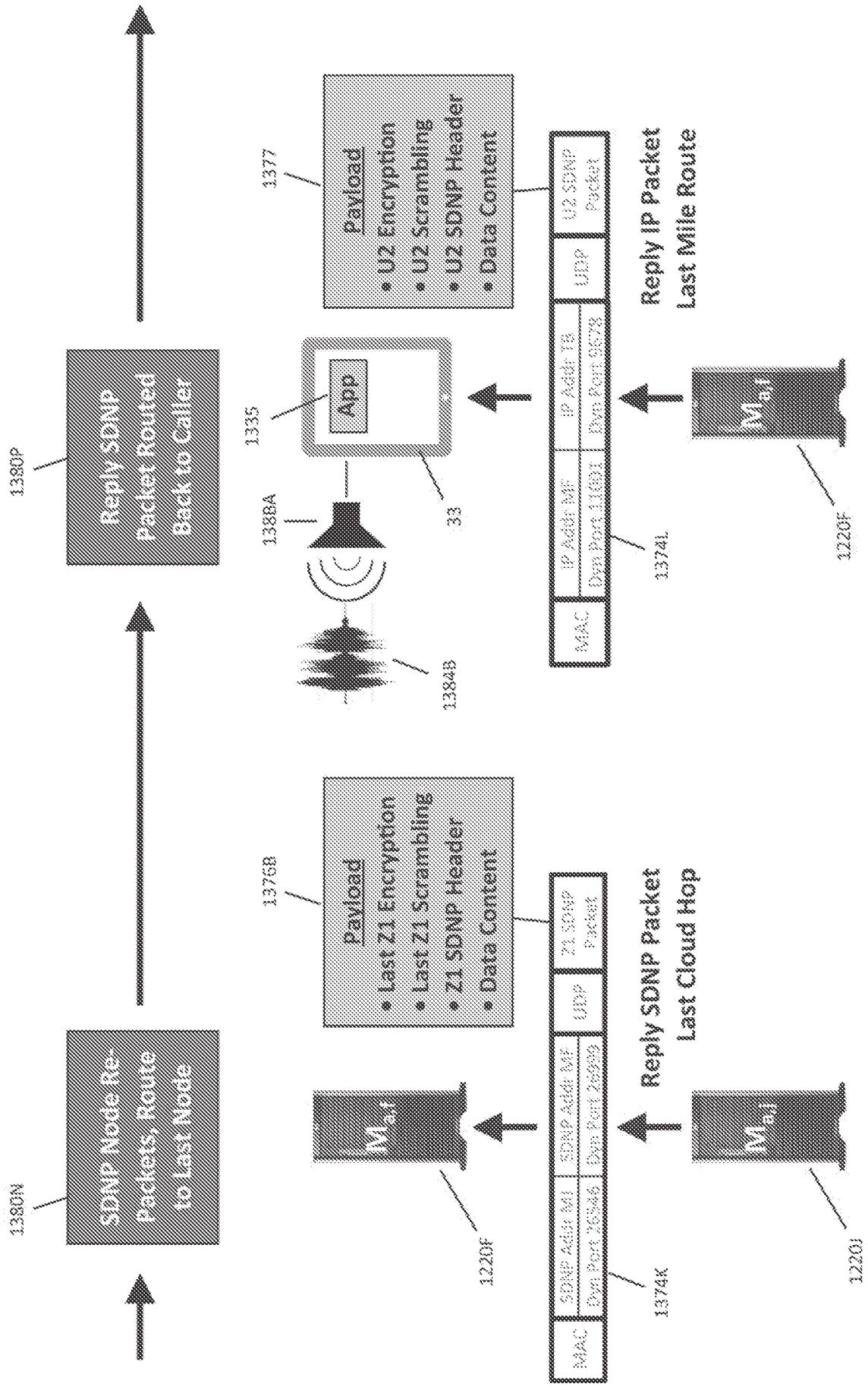

1380N
SDNP Node Re-Packets, Route to Last Node
1380P
Reply SDNP Packet Routed Back To Caller
1376B
Payload
• Last Z1 Encryption
• Last Z1 Scrambling
• Z1 SDNP Header
• Data Content
1377
Payload
• U2 Encryption
• U2 Scrambling
• U2 SDNP Header
• Data Content
1335
App
138BA
1384B
33
MAC
SDNP Addr MF
Dyn Port 26946
UDP
Z1 SDNP Packet
1374K
IP Addr MF
Dyn Port 11681
IP Addr TB
Dyn Port 9678
UDP
U2 SDNP Packet
1374L
Reply SDNP Packet Last Cloud Hop
Reply IP Packet Last Mile Route
1220F
1220J
1220F

Figure 110F

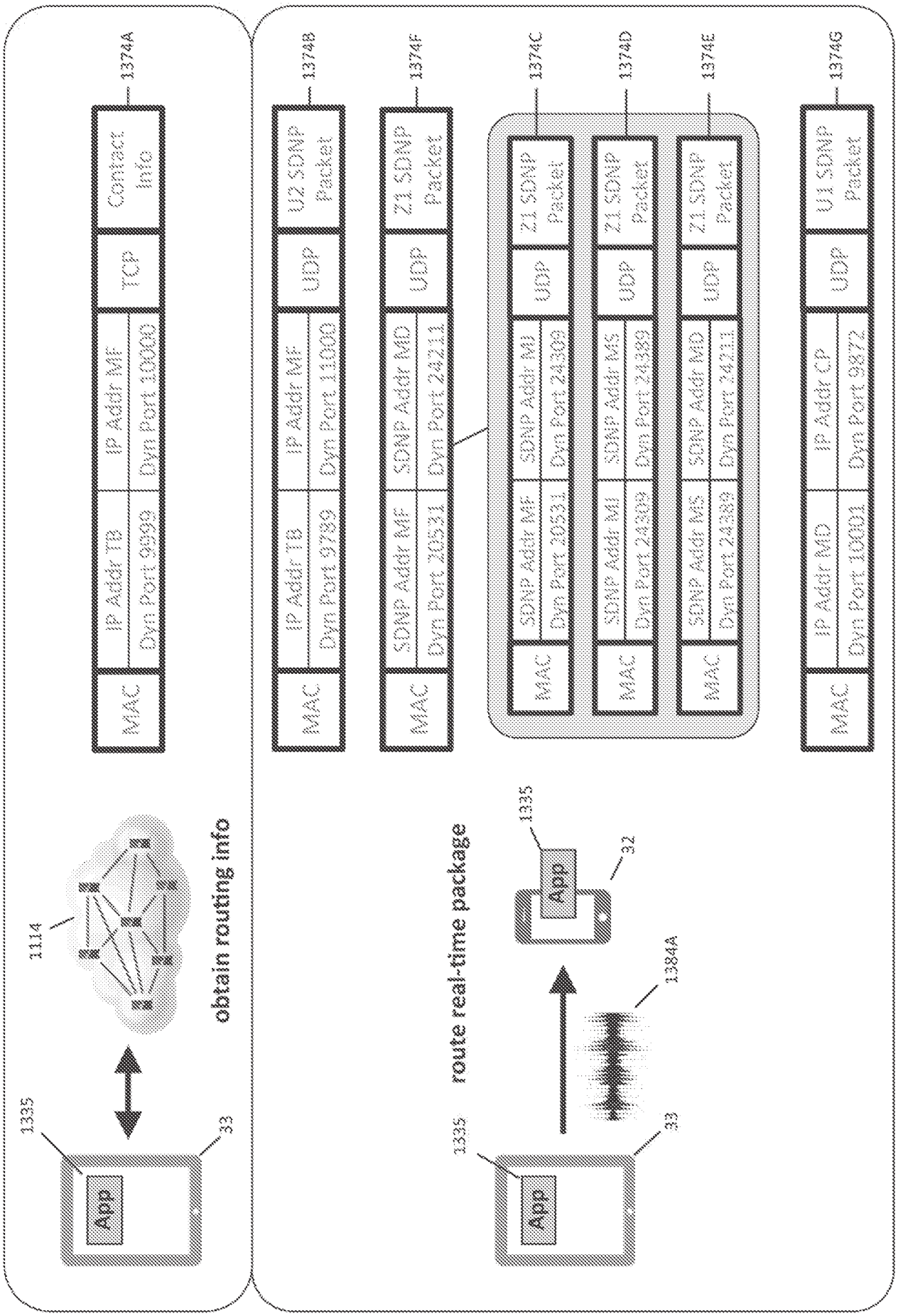
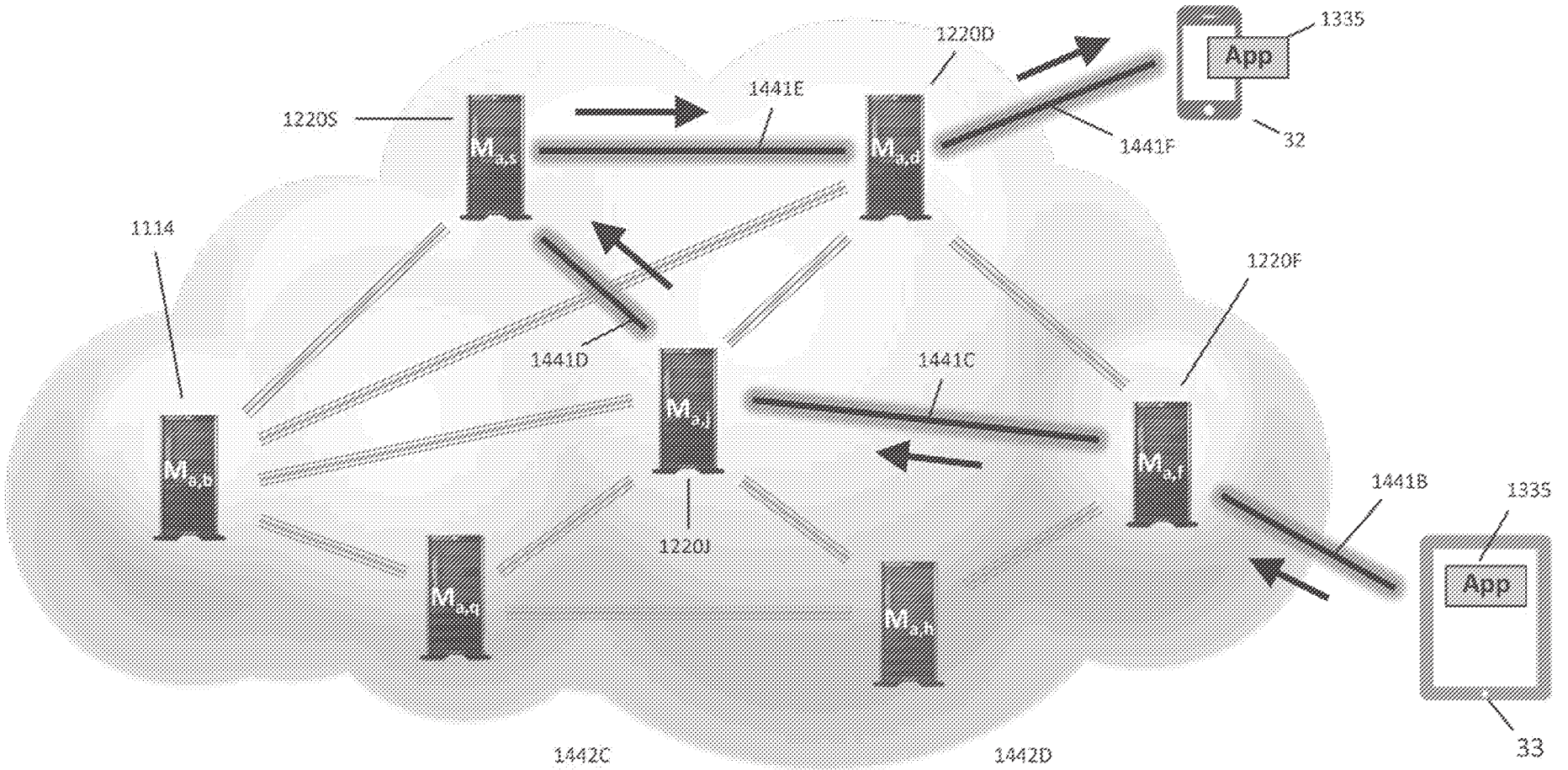

1374A
MAC
IP Addr TB
Dyn Port 9999
IP Addr MF
Dyn Port 10000
TCP
Contact Info
1374B
MAC
IP Addr TB
Dyn Port 9789
IP Addr MF
Dyn Port 11000
UDP
U2 SDNP Packet
1374F
MAC
SDNP Addr MF
Dyn Port 20531
SDNP Addr MD
Dyn Port 24211
UDP
Z1 SDNP Packet
1374C
MAC
SDNP Addr MF
Dyn Port 20531
SDNP Addr MI
Dyn Port 24309
UDP
Z1 SDNP Packet
1374D
MAC
SDNP Addr MI
Dyn Port 24309
SDNP Addr MS
Dyn Port 24389
UDP
Z1 SDNP Packet
1374E
MAC
SDNP Addr MS
Dyn Port 24389
SDNP Addr MD
Dyn Port 24211
UDP
Z1 SDNP Packet
1374G
MAC
IP Addr MD
Dyn Port 10001
IP Addr CP
Dyn Port 9872
UDP
U1 SDNP Packet
1114
obtain routing info
1335
App
33
route real-time package
1335
App
32
1384A
1335
App
33

Figure 111A


1335
App
1220D
1441E
1220S
1441F
32
1114
1220F
1441D
1441C
1441B
1335
App
1220J
33

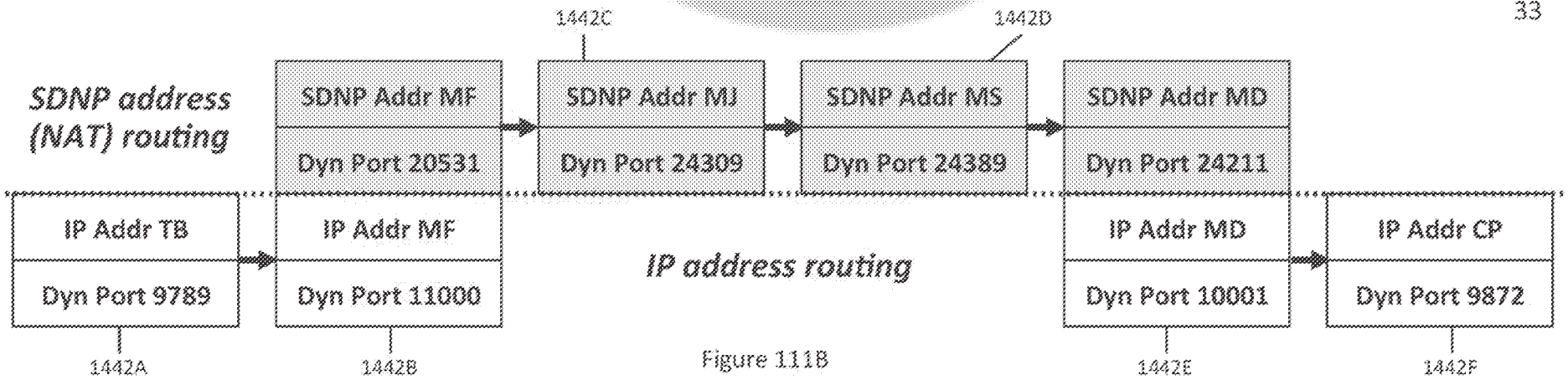

1442C
1442D
SDNP address (NAT) routing
SDNP Addr MF
SDNP Addr MJ
SDNP Addr MS
SDNP Addr MD
Dyn Port 20531
Dyn Port 24309
Dyn Port 24389
Dyn Port 24211
IP Addr TB
IP Addr MF
IP Addr MD
IP Addr CP
IP address routing
Dyn Port 9789
Dyn Port 11000
Dyn Port 10001
Dyn Port 9872
1442A
1442B
1442E
1442F

Figure 111B

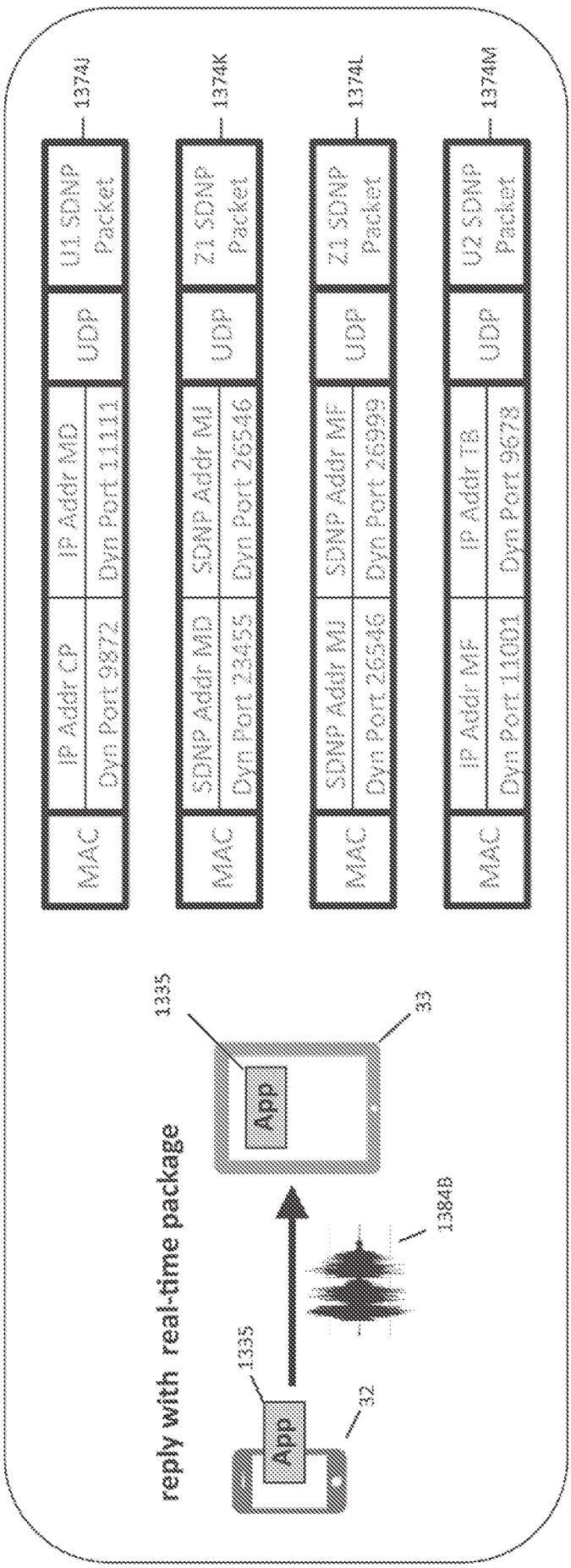

1374J
MAC
IP Addr CP
Dyn Port 9872
IP Addr MD
Dyn Port 11111
UDP
U1 SDNP Packet
1374K
MAC
SDNP Addr MD
Dyn Port 23455
SDNP Addr MJ
Dyn Port 26546
UDP
Z1 SDNP Packet
1374L
MAC
SDNP Addr MJ
Dyn Port 26546
SDNP Addr MF
Dyn Port 26999
UDP
Z1 SDNP Packet
1374M
MAC
IP Addr MF
Dyn Port 11001
IP Addr TB
Dyn Port 9678
UDP
U2 SDNP Packet
reply with real-time package
1335
App
32
1384B
1335
App
33

Figure 112A

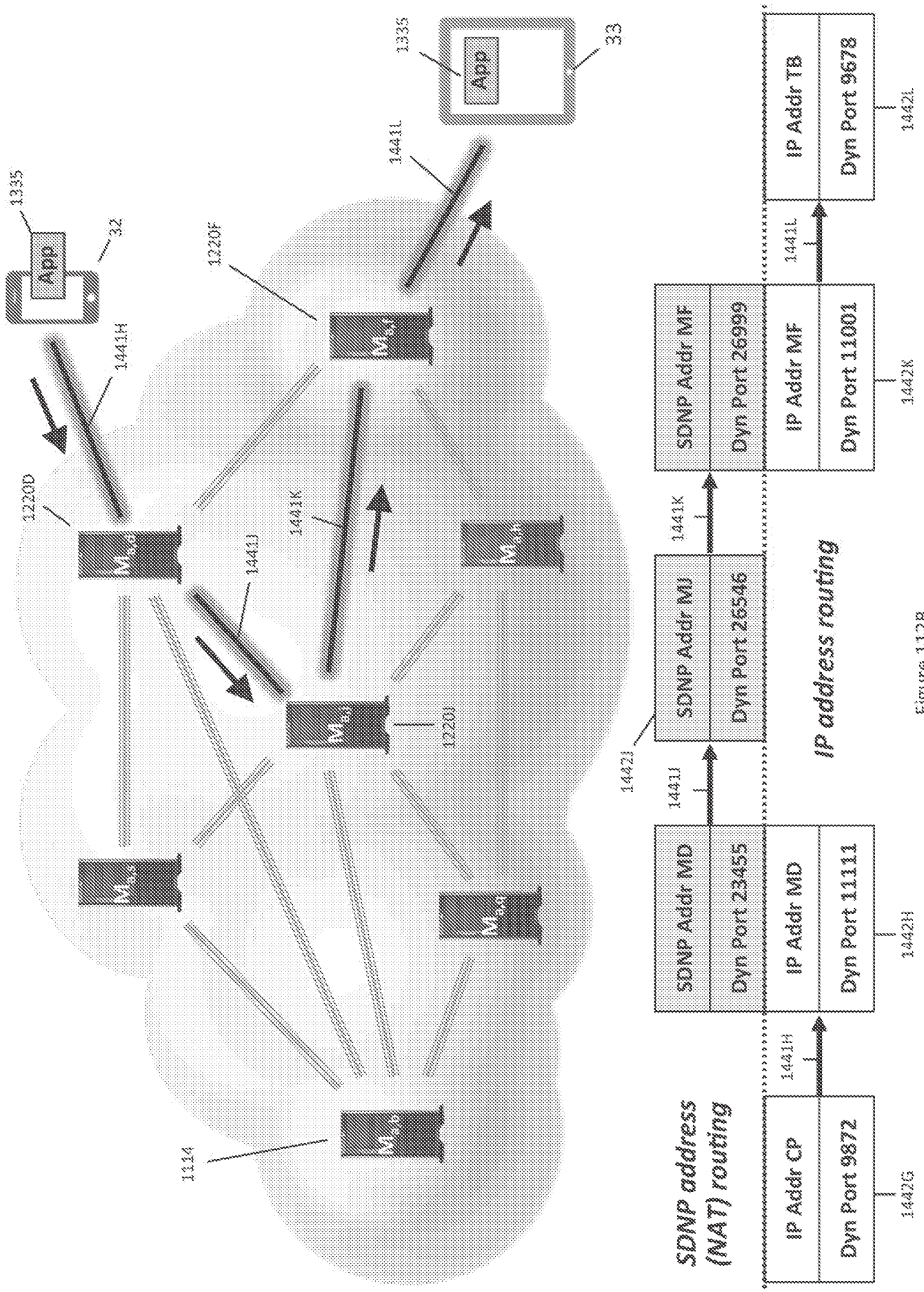

1335
App
32
1220D
1441H
1441J
1441K
1220F
1441L
1335
App
33
1220J
1114
SDNP address (NAT) routing
IP address routing
SDNP Addr MD
Dyn Port 23455
IP Addr MD
Dyn Port 11111
1442H
SDNP Addr MJ
Dyn Port 26546
1442J
SDNP Addr MF
Dyn Port 26999
IP Addr MF
Dyn Port 11001
1442K
IP Addr CP
Dyn Port 9872
1442G
IP Addr TB
Dyn Port 9678
1442L

Figure 112B

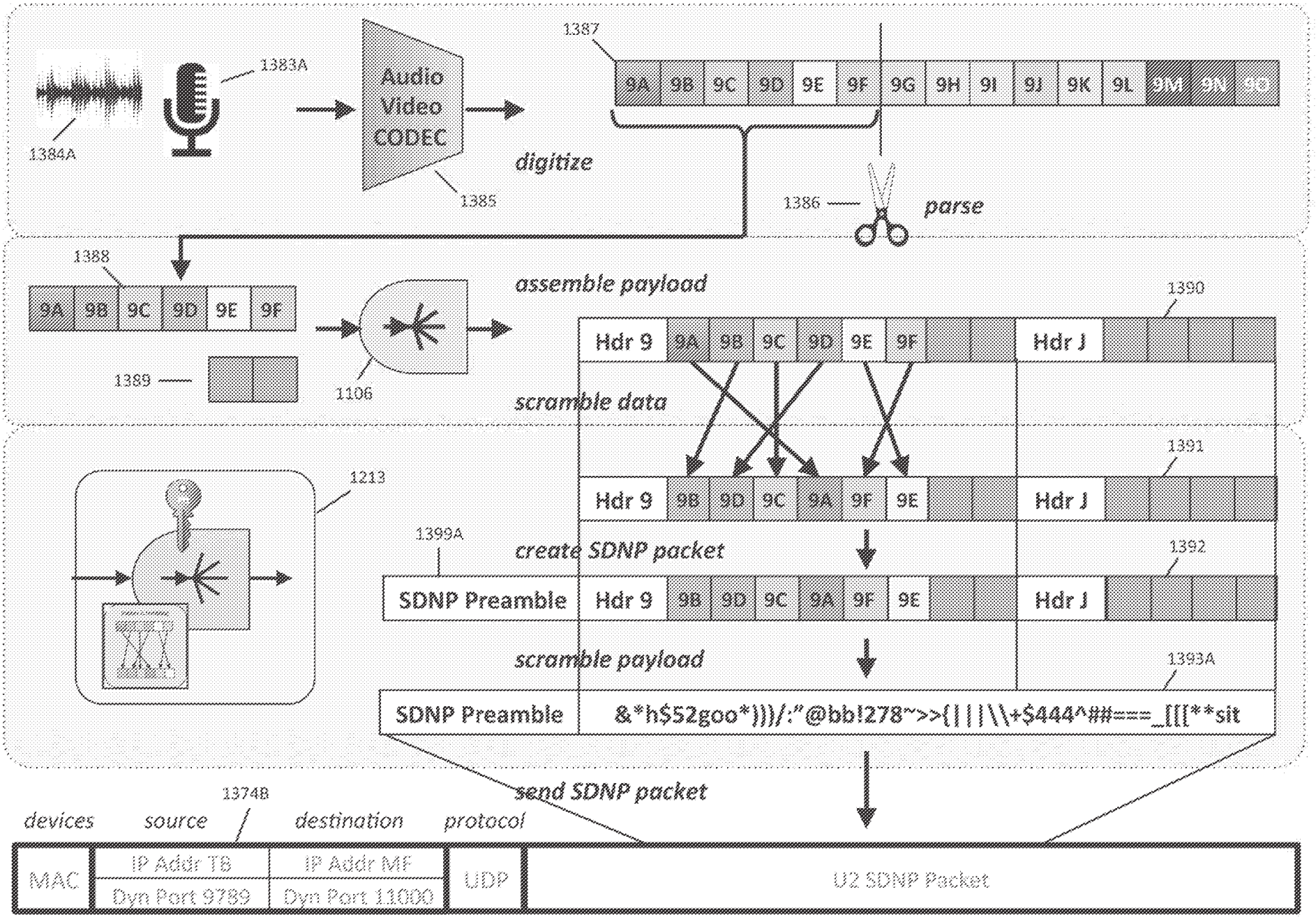

1384A
1383A
Audio Video CODEC
1385
digitize
1387
9A 9B 9C 9D 9E 9F 9G 9H 9I 9J 9K 9L 9M 9N 9O
1386
parse
1388
9A 9B 9C 9D 9E 9F
1389
1106
assemble payload
1390
Hdr 9 9A 9B 9C 9D 9E 9F Hdr J
scramble data
1391
Hdr 9 9B 9D 9C 9A 9F 9E Hdr J
1213
1399A
create SDNP packet
1392
SDNP Preamble Hdr 9 9B 9D 9C 9A 9F 9E Hdr J
scramble payload
1393A
SDNP Preamble &*h$52goo*)))/:"@bb!278~>>{|||\\+$444^##===_[[[**sit
send SDNP packet
1374B
devices
source
destination
protocol
MAC
IP Addr TB
Dyn Port 9789
IP Addr MF
Dyn Port 11000
UDP
U2 SDNP Packet

Figure 113A

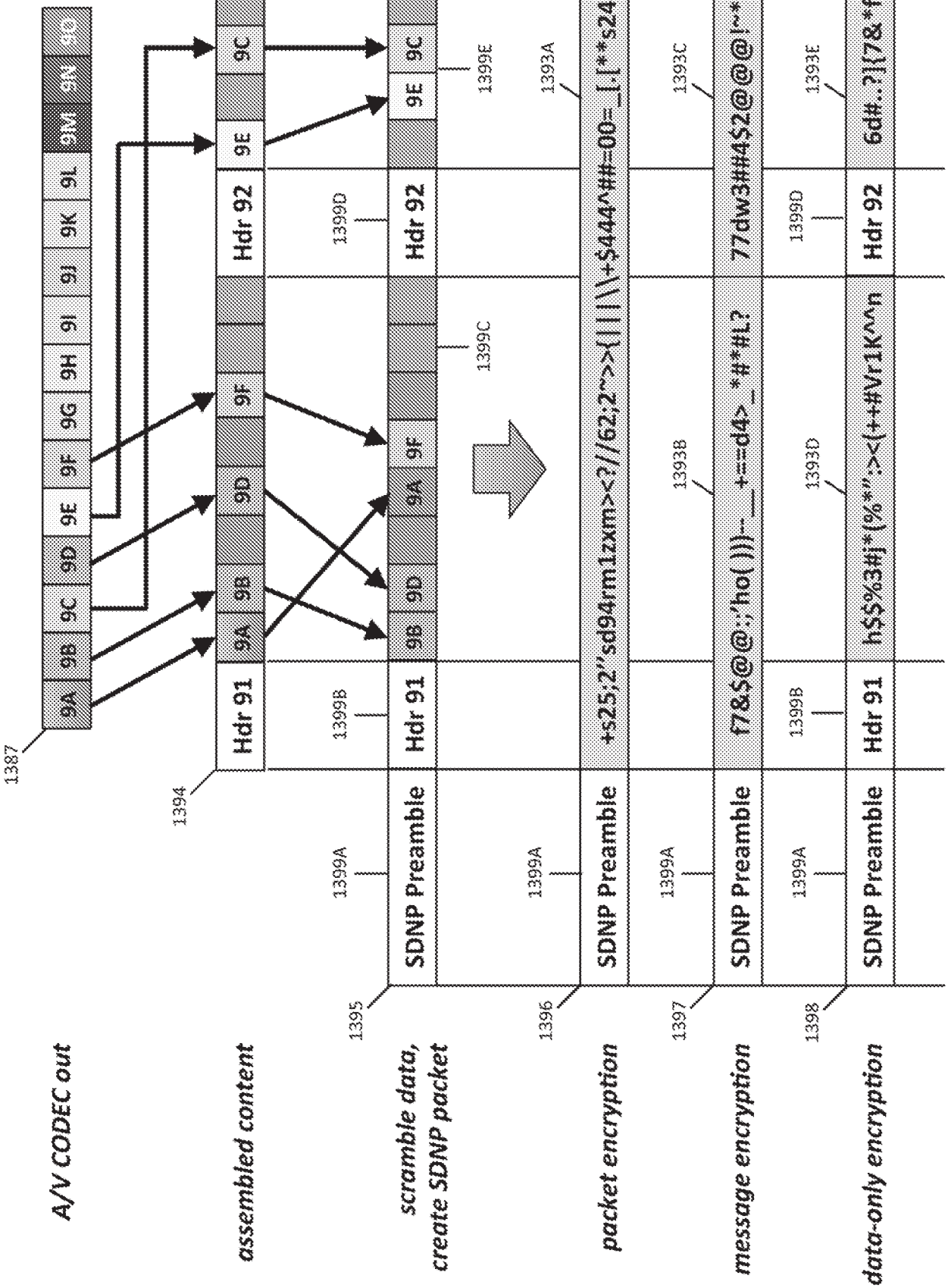
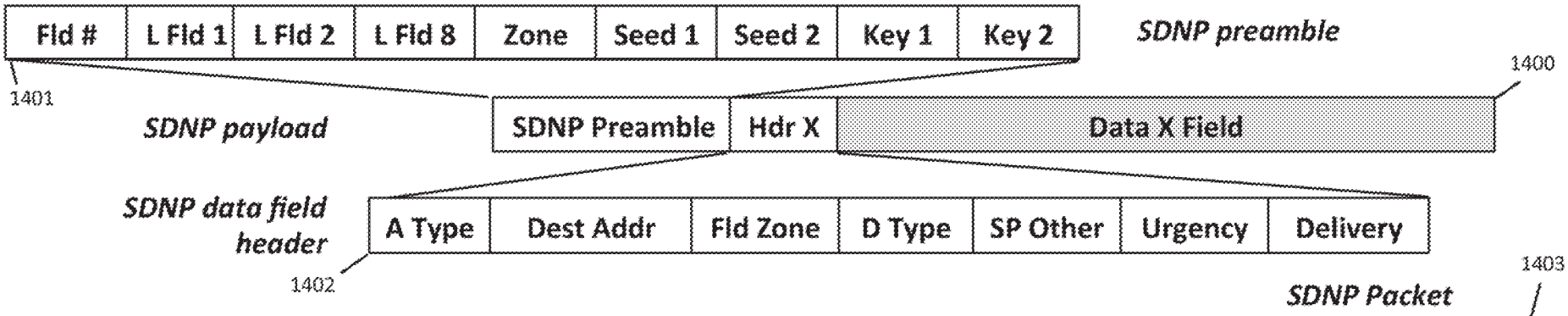

A/V CODEC out
1387
9A 9B 9C 9D 9E 9F 9G 9H 9I 9J 9K 9L 9M 9N 9O
assembled content
1394
Hdr 91 9A 9B 9D 9F Hdr 92 9E 9C
1399B
1399D
scramble data, create SDNP packet
1395
SDNP Preamble Hdr 91 9B 9D 9A 9F Hdr 92 9E 9C
1399A
1399C
1399E
1393A
packet encryption
1396
SDNP Preamble +s25;2"sd94rm1zxm><?//62;2~>>{|||\\+$444^##=00=_[.[**s24
1399A
1393B
1393C
message encryption
1397
SDNP Preamble f7&$@@:;'ho( ))-__+==d4>_*#*#L? 77dw3##4$2@@@!~*(
1399A
1399B
1393D
1399D
1393E
data-only encryption
1398
SDNP Preamble Hdr 91 h$$%3#j*(%*":><(+#Vr1K^^n Hdr 92 6d#..?](7&*f
1399A

Figure 113B



Layer	Packet Field	Size	Function
3	Field #	4b	Number of Fields
3	L Field 1, 2, X	8B	Length of Data Field1, 2, ..., 8
3	Zone	12b	Current SDNP zone (one of 4096 zones)
5	Seed 1, 2	8B, 8B	Two 32 bit seeds (for scrambling, mixing, etc.)
6	Key 1, 2	64B, 64B	Two 512 bit keys (for encryption)
3	A (Address) Type	2b	Type of Destination Address (SDNP Zip, IPv4, IPv6, NAT, POTS #)
3	Destination Addr	1B to 12B	IP Address, SDNP address, NAT address, SDNP ZIP, phone #
3	Field Zone	12b	SDNP zone carry-forward (one of 4096 zones)
4	D (Data) Type	2b	Type of Data (voice, text, video, data, software...)
6	Field Other	8B	Field expansion, Field unscrambling info, etc.
4	Urgency	2b	Urgency of sub-packet (snail, normal, priority, urgent)
4	Delivery	2b	QoS Marker (Normal, Redundant, Special, VIP...)
5 to 7	Data in Packet X	0 to 200B	Data up to 200B per sub-packet, 8 sub-packet max

Figure 114

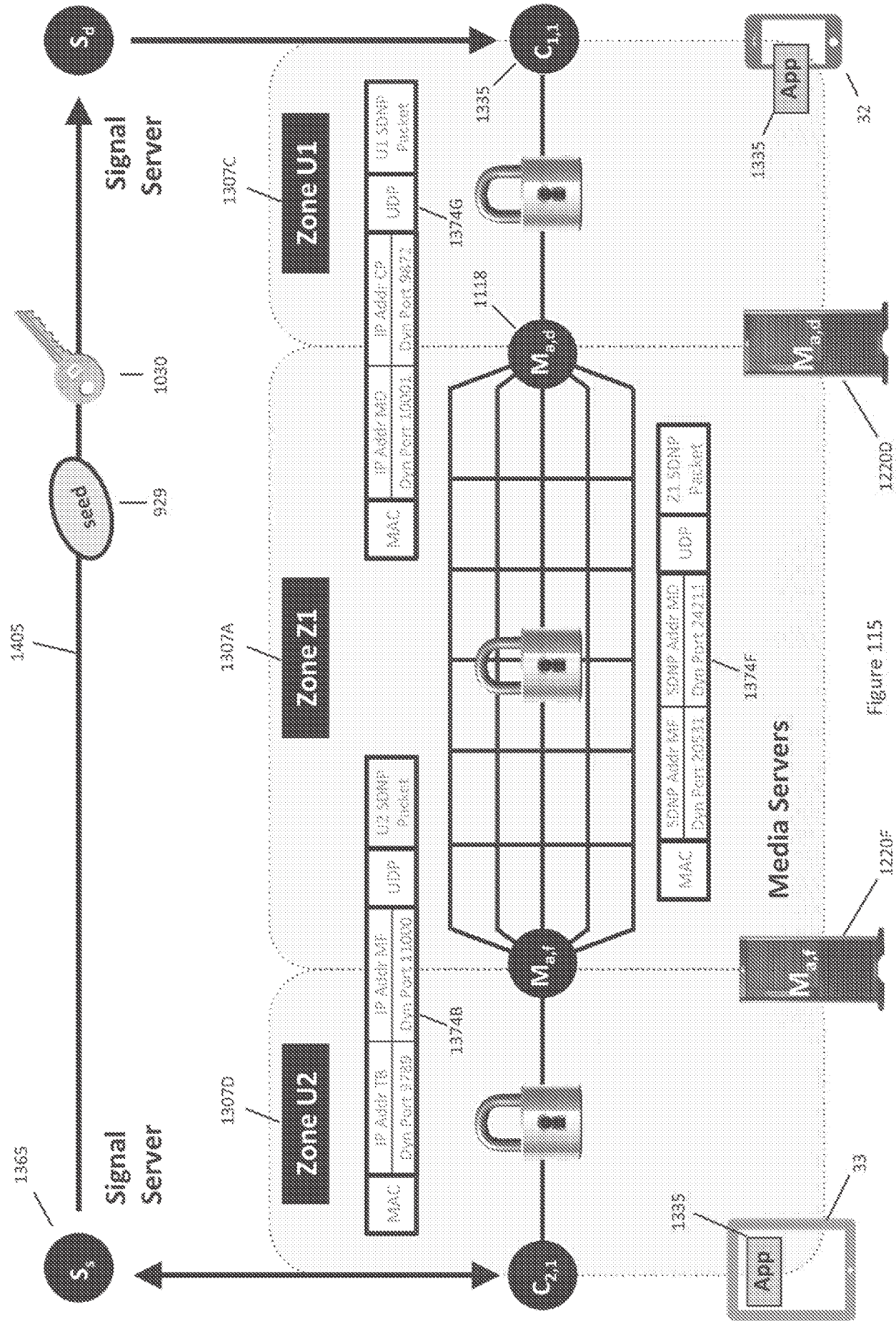

Signal Server
Signal Server
Signal Server
seed
929
1030
1405
1365
1335
1335
1335
33
32
1220F
12200
1374F
1374G
1374B
1307C
1307A
1307D
1118
Zone U1
Zone Z1
Zone U2
Media Servers
App
App
MAC
IP Addr TB
Dyn Port 9789
IP Addr MB
Dyn Port 11000
UDP
U2 SDNP Packet
MAC
IP Addr MB
Dyn Port 10001
IP Addr CP
Dyn Port 9871
UDP
U1 SDNP Packet
MAC
SDNP Addr MP
Dyn Port 20531
SDNP Addr MD
Dyn Port 24211
UDP
Z1 SDNP Packet

Figure 115

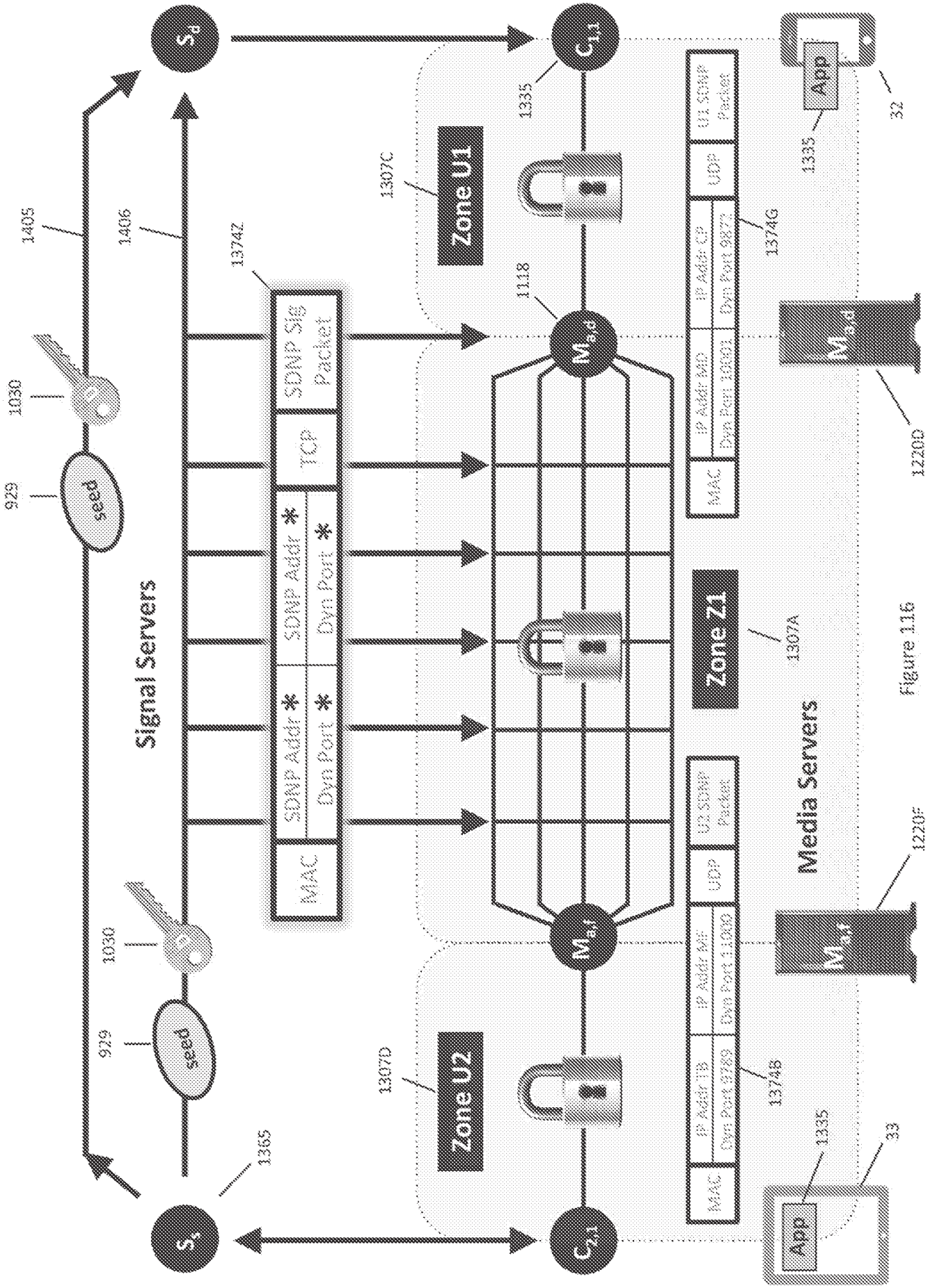

Signal Servers
Media Servers
Zone U1
Zone U2
Zone Z1
seed
seed
1405
1406
1030
1030
929
929
1365
1374Z
1307C
1307D
1307A
1118
1335
1335
1335
1374G
1374B
1220D
1220F
32
33
App
App
MAC
SDNP Addr *
Dyn Port *
SDNP Addr *
Dyn Port *
TCP
SDNP Sig Packet
IP Addr MD
Dyn Port 16001
IP Addr CP
Dyn Port 9877
UDP
U1 SDNP Packet
IP Addr MF
Dyn Port 11080
IP Addr TB
Dyn Port 8765
UDP
U1 SDNP Packet

Figure 116

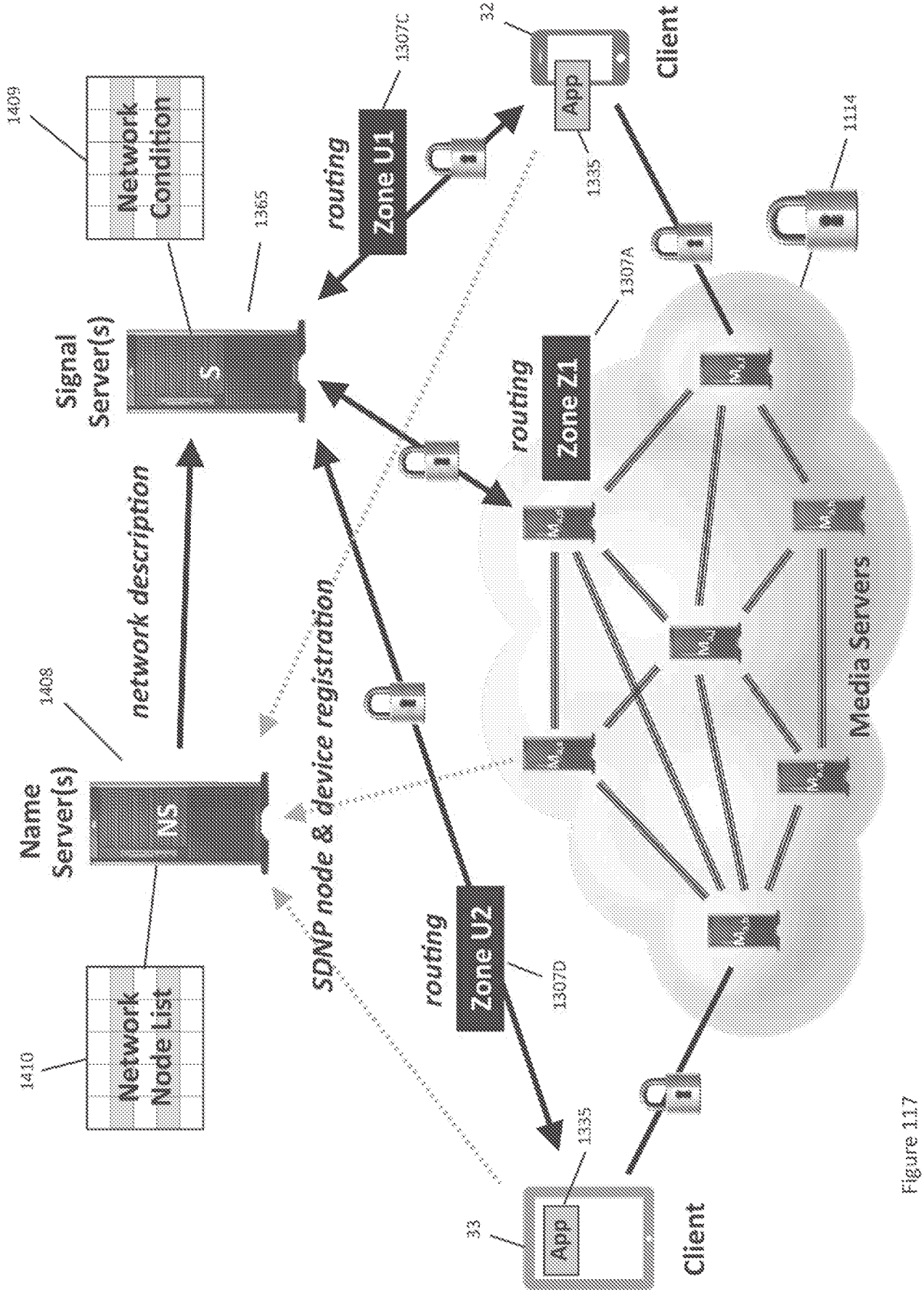

1409
Network Condition
1365
Signal Server(s)
S
network description
1408
Name Server(s)
NS
1410
Network Node List
SDNP node & device registration
routing
Zone U1
1307C
routing
Zone Z1
1307A
routing
Zone U2
1307D
32
App
1335
Client
1114
Media Servers
33
App
1335
Client

Figure 1.17

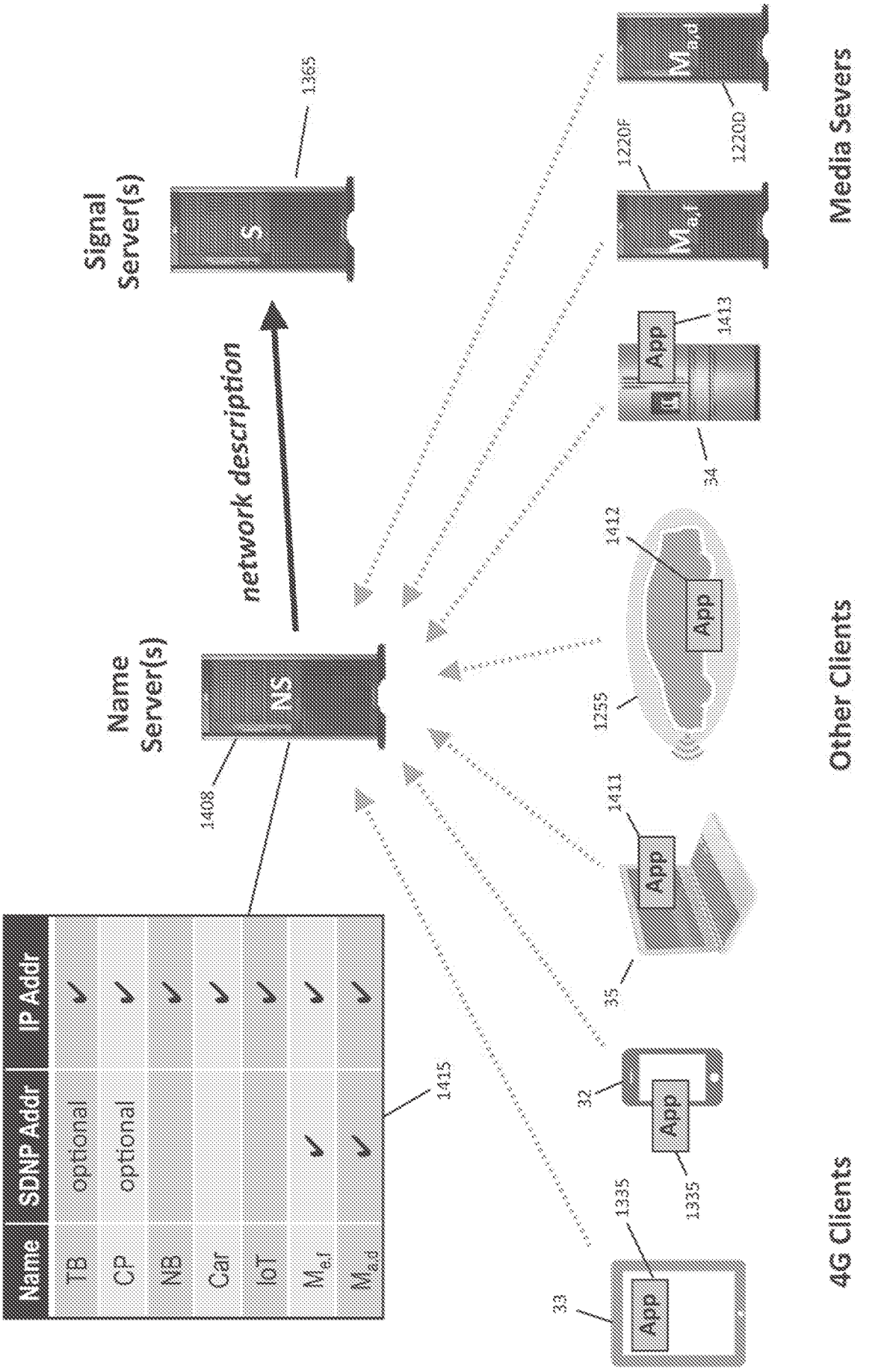

Name | SDNP Addr | IP Addr
TB | optional | ✓
CP | optional | ✓
NB | | ✓
Car | | ✓
IoT | | ✓
$M_{e.l}$ | ✓ | ✓
$M_{e.d}$ | ✓ | ✓
1415
Name Server(s)
NS
1408
network description
Signal Server(s)
S
1365
4G Clients
Other Clients
Media Severs
App
1335
1411
1412
1255
1413
1220F
1220D
32
33
34
35

Figure 118

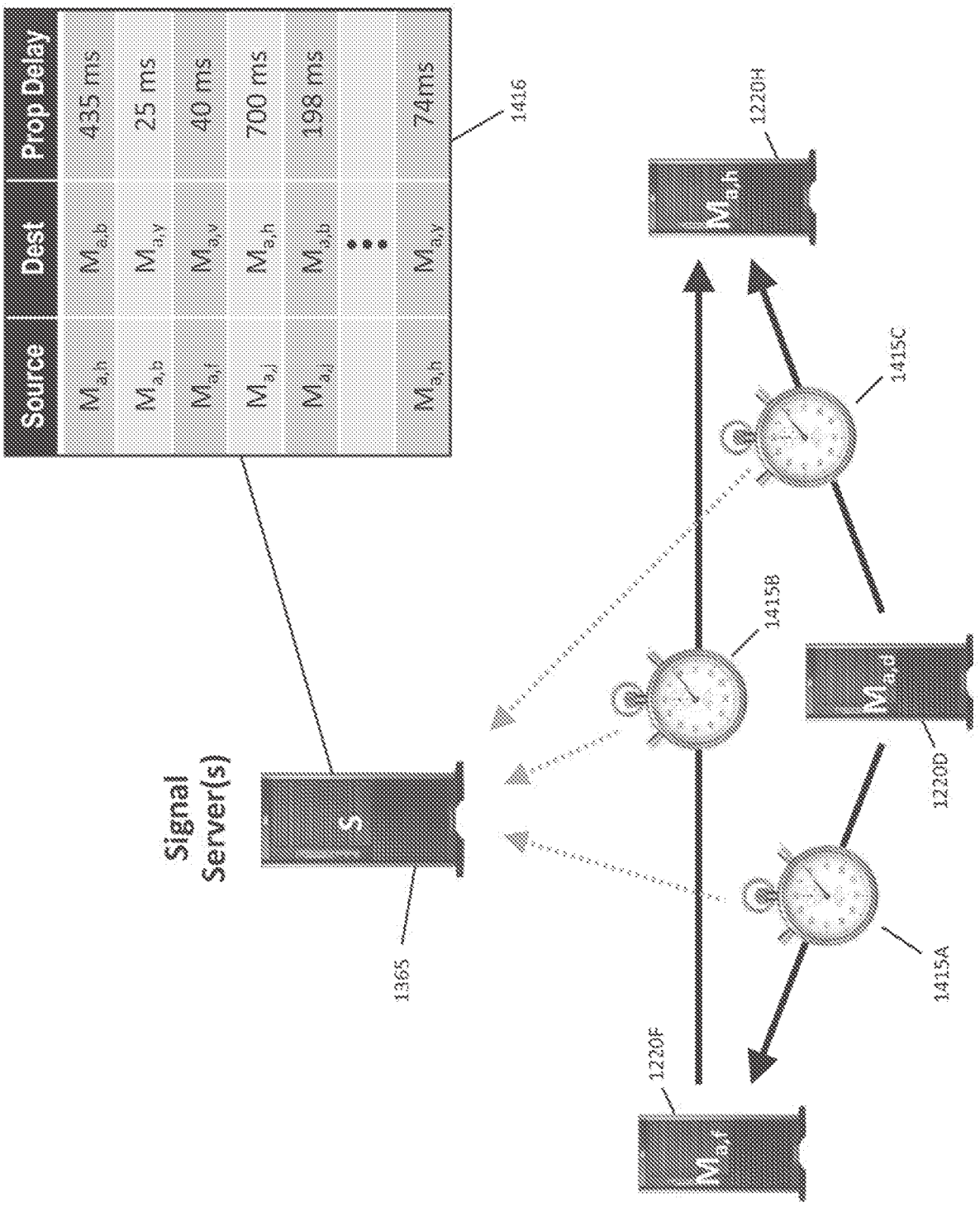

Source
Dest
Prop Delay
$M_{a,h}$ $M_{a,b}$ 435 ms
$M_{a,b}$ $M_{a,y}$ 25 ms
$M_{a,f}$ $M_{a,v}$ 40 ms
$M_{a,j}$ $M_{a,h}$ 700 ms
$M_{a,j}$ $M_{a,b}$ 198 ms
$M_{a,h}$ $M_{a,y}$ 74ms
1416
Signal Server(s)
S
1365
1415B
1415A
1415C
$M_{a,f}$
1220F
$M_{a,d}$
1220D
$M_{a,h}$
1220H

Figure 119

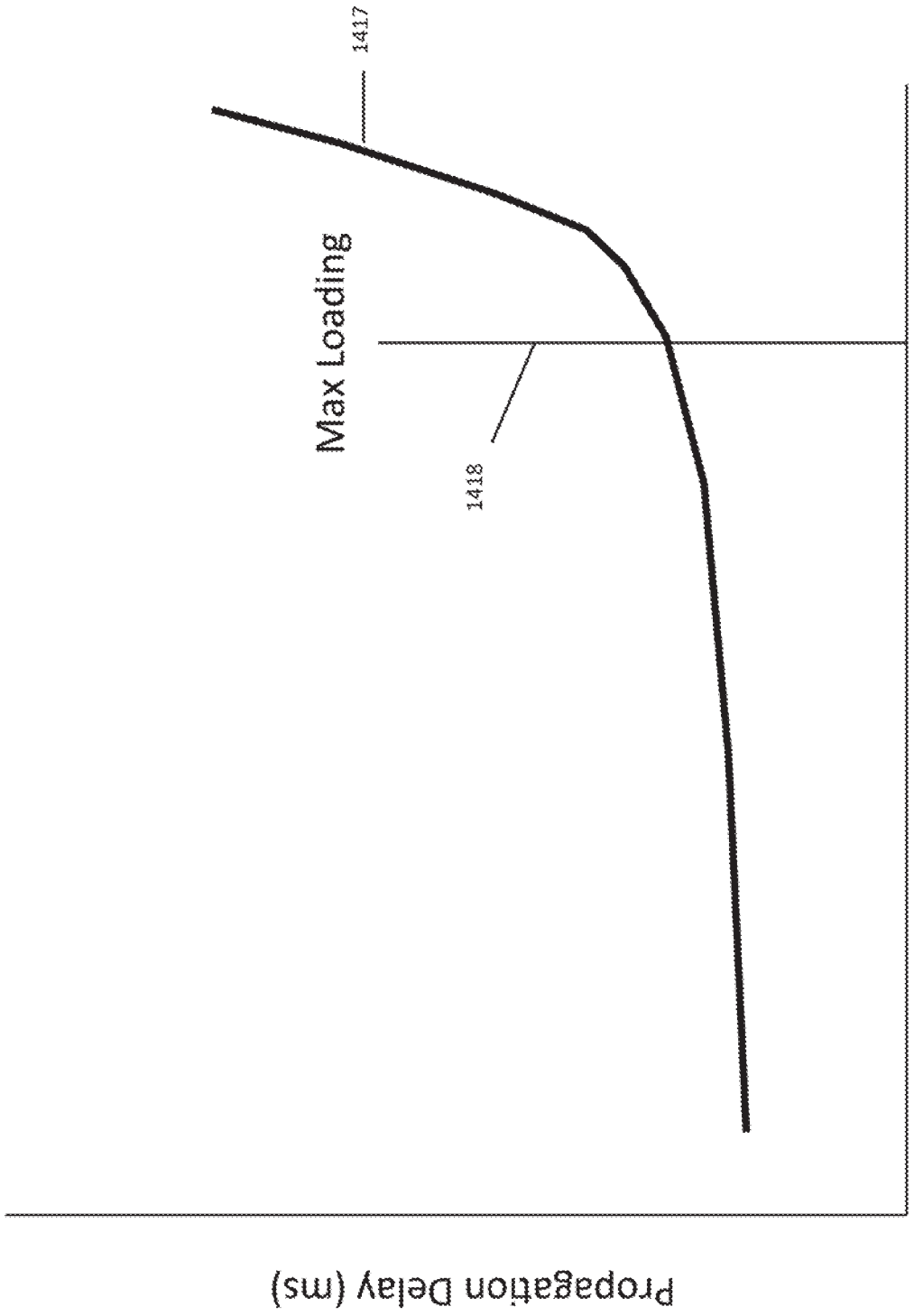
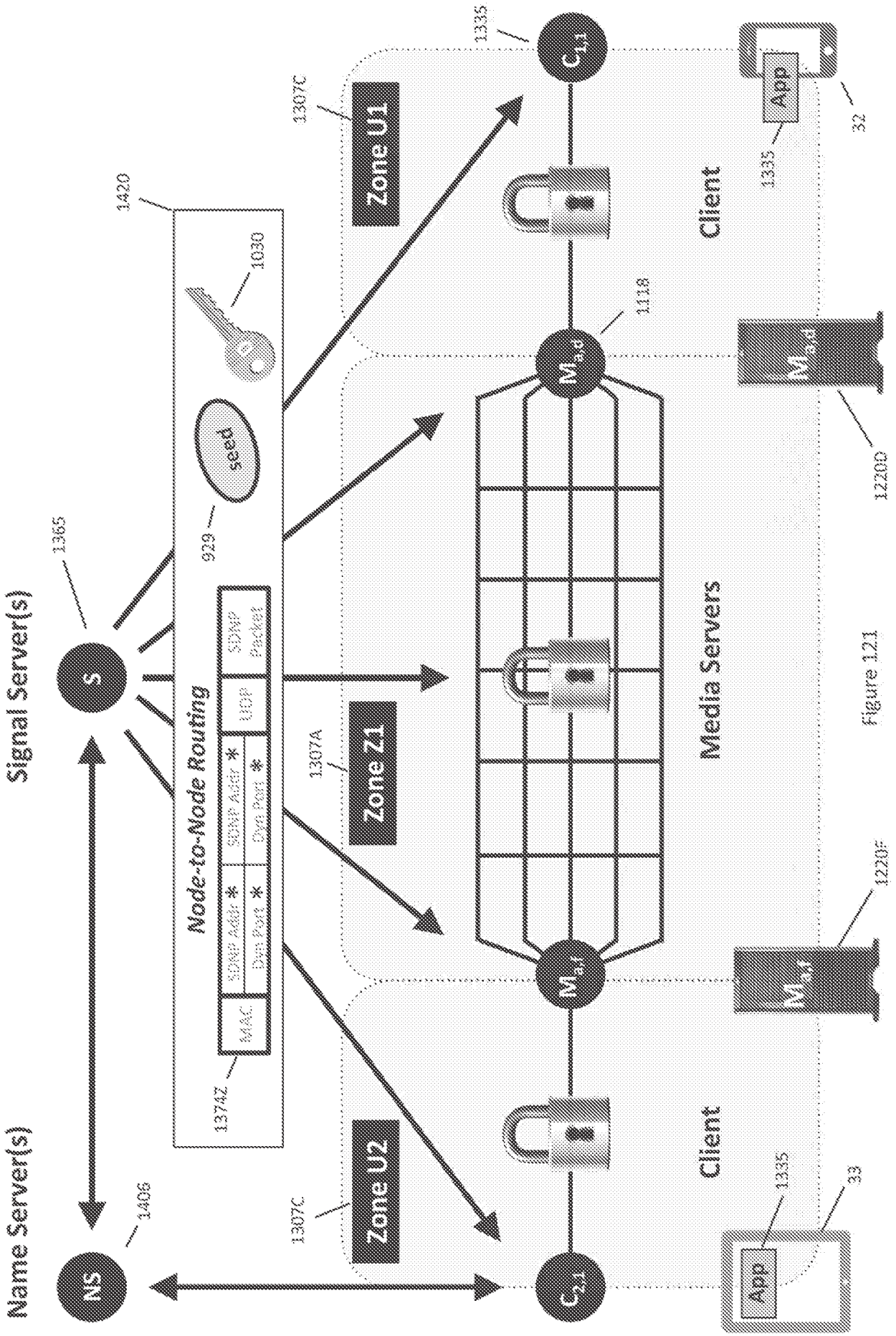

Propagation Delay (ms)
Number or Size of Test Packets Sent
Max Loading
1417
1418

Figure 120


Name Server(s)
NS
1406
Signal Server(s)
S
1365
Node-to-Node Routing
MAC
SDNP Addr *
Data Port *
SDNP Addr *
Data Port *
UDP
SDNP Packet
1374Z
1420
seed
929
1030
Zone U1
Zone Z1
Zone U2
1307C
1307A
1307C
Media Servers
Client
Client
1335
1335
1335
App
App
1118
1220D
1220F
32
33
Figure 121

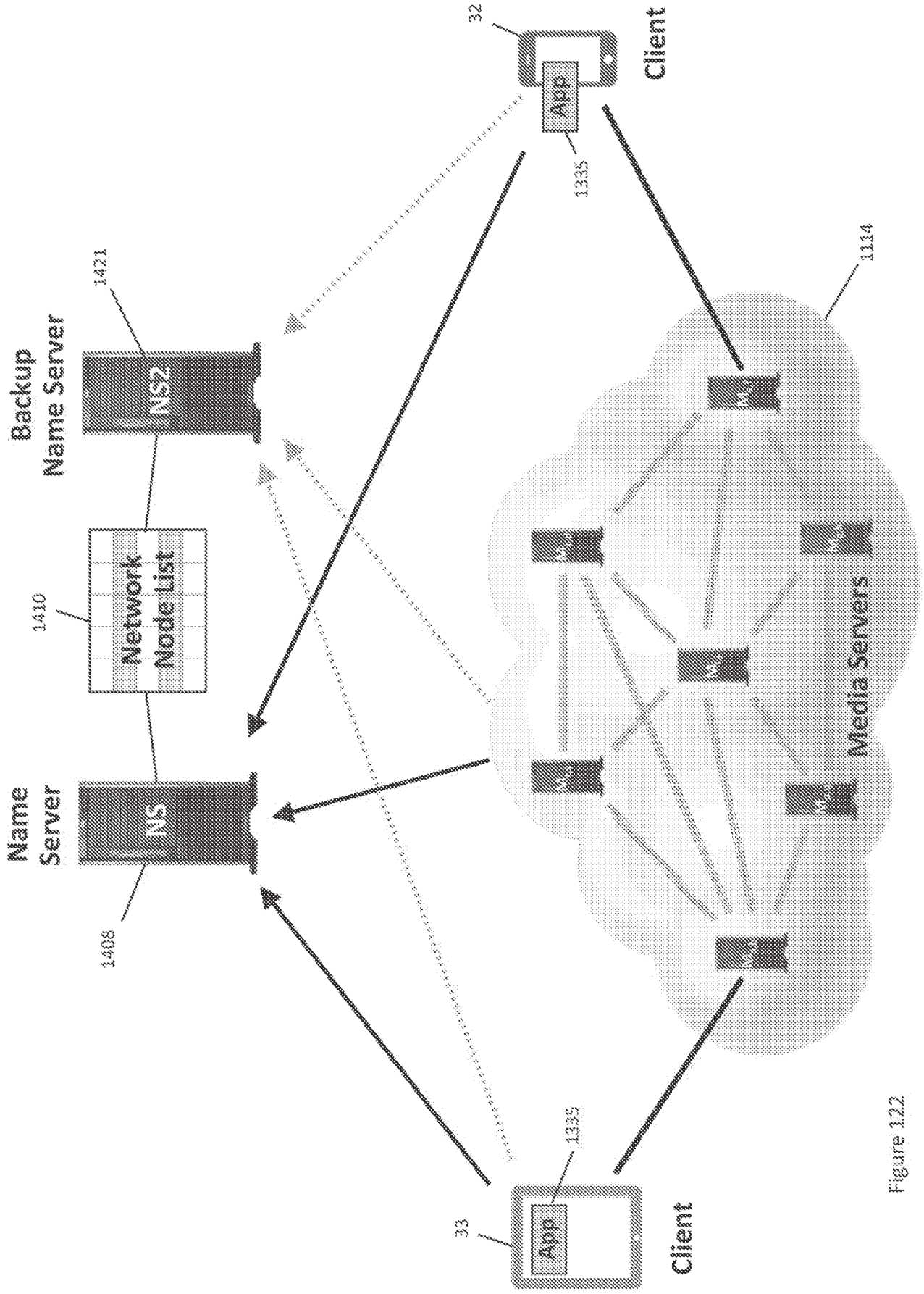

Backup
Name Server
1421
NS2
1410
Network
Node List
Name
Server
NS
1408
32
App
1335
Client
1114
Media Servers
33
App
1335
Client

Figure 122

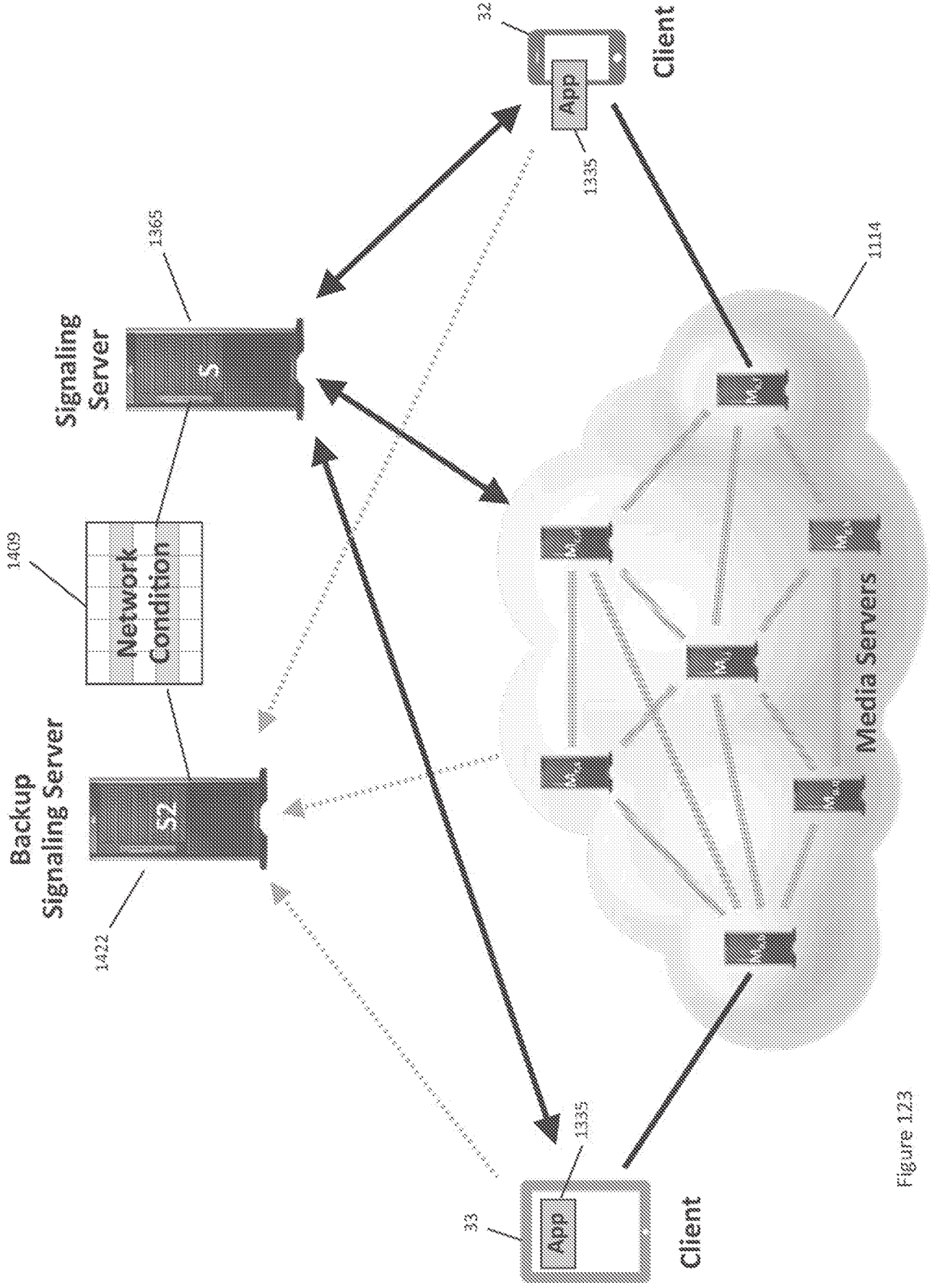

Backup
Signaling Server
S2
1422
1409
Network
Condition
Signaling
Server
S
1365
32
App
Client
1335
1114
Media Servers
33
App
Client
1335

Figure 123

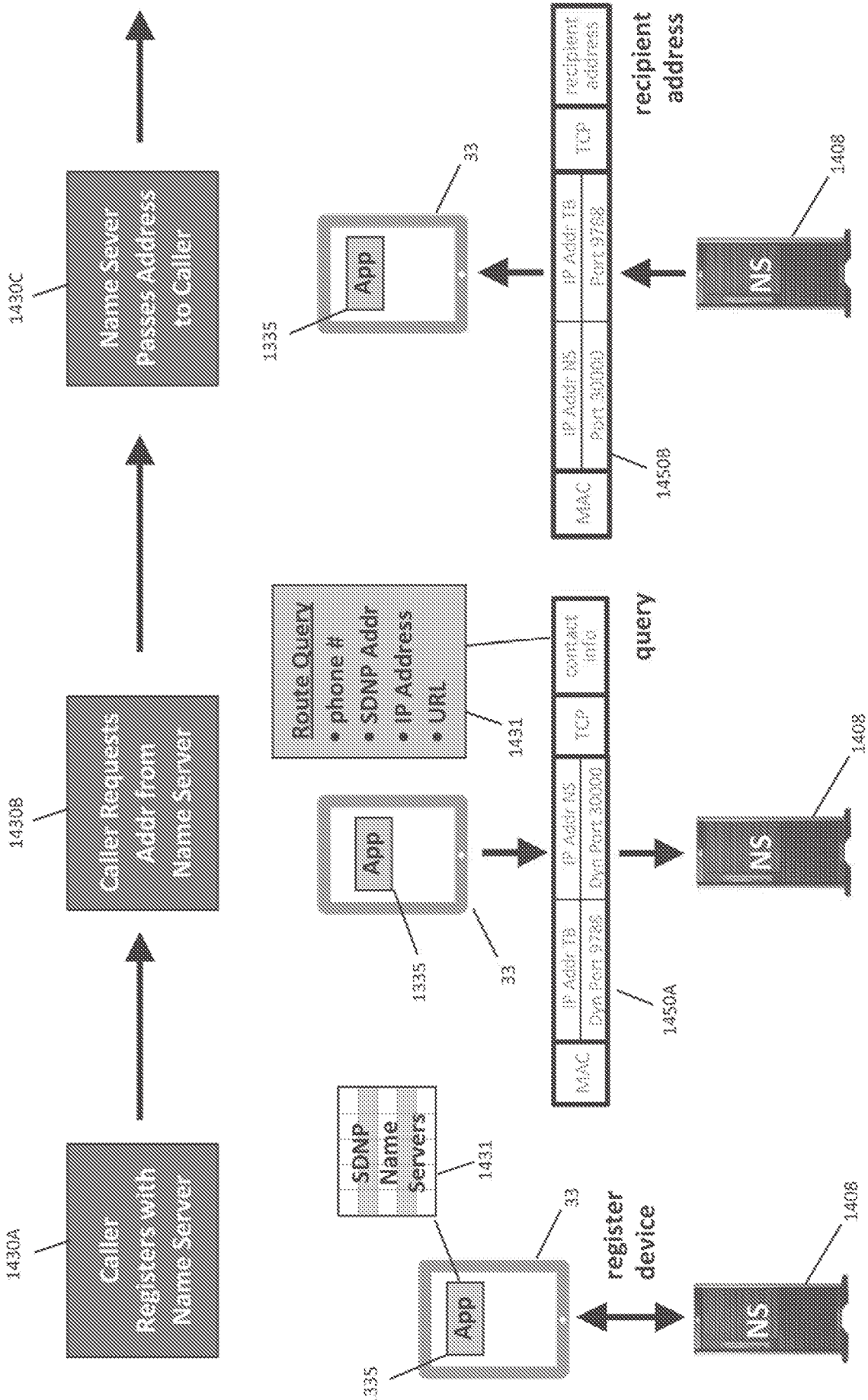

1430A
Caller Registers with Name Server
1430B
Caller Requests Addr from Name Server
1430C
Name Sever Passes Address to Caller
SDNP Name Servers
1431
Route Query
* phone #
* SDNP Addr
* IP Address
* URL
1431
App
1335
33
register device
query
recipient address
MAC
IP Addr TB
Dyn Port 3768
IP Addr NS
Dyn Port 3000
TCP
contact info
1450A
MAC
IP Addr TB
Port 3000
IP Addr TB
Port 3768
TCP
recipient address
1450B
NS
1408

Figure 124A

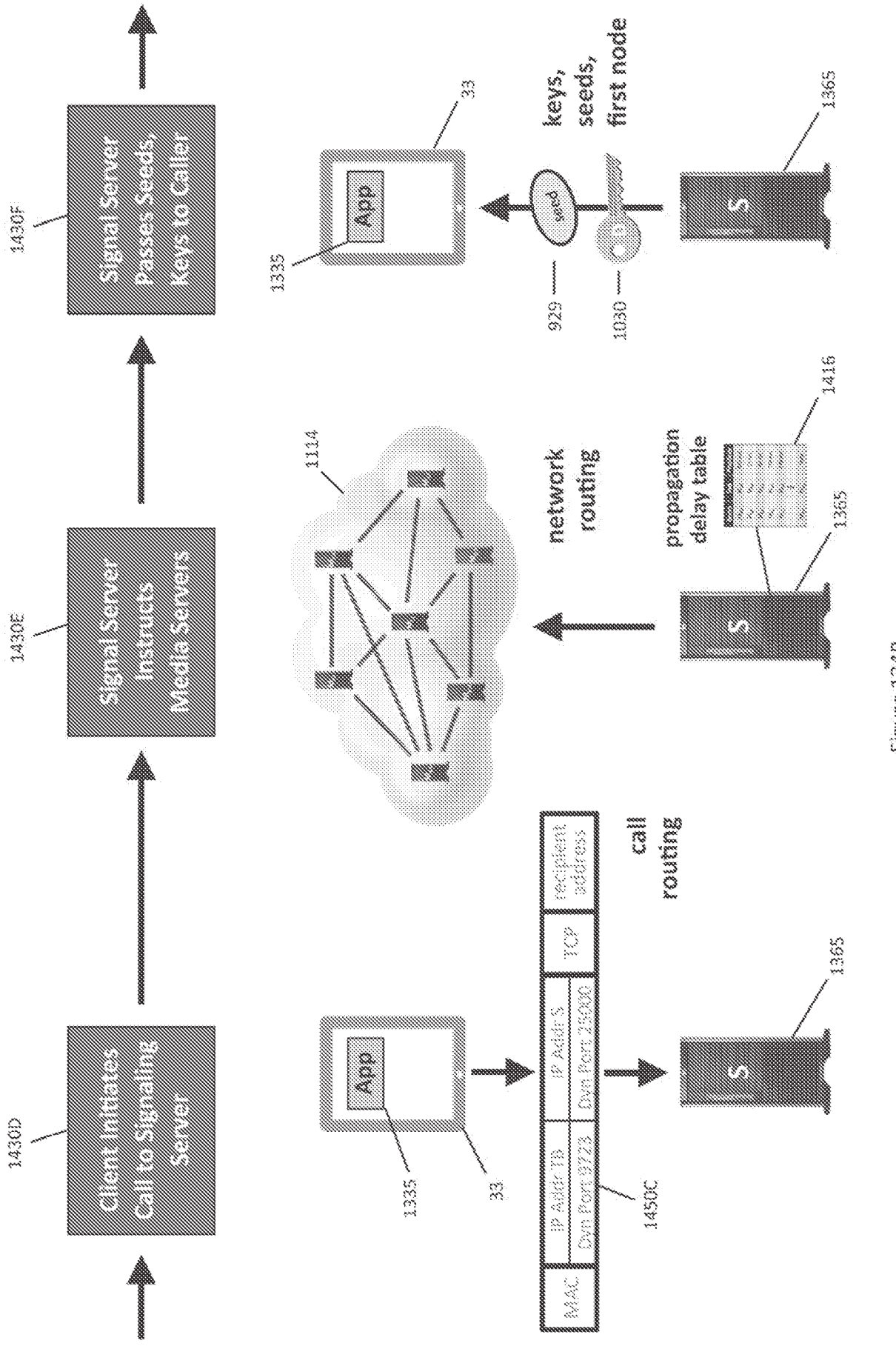

1430D
Client Initiates Call to Signaling Server
1430E
Signal Server Instructs Media Servers
1430F
Signal Server Passes Seeds, Keys to Caller
1335
App
33
MAC
IP Addr TB
Dyn Port 9723
IP Addr S
Dyn Port 25000
TCP
recipient address
1450C
call routing
1114
network routing
propagation delay table
1416
1365
S
keys, seeds, first node
929
seed
1030

Figure 124B

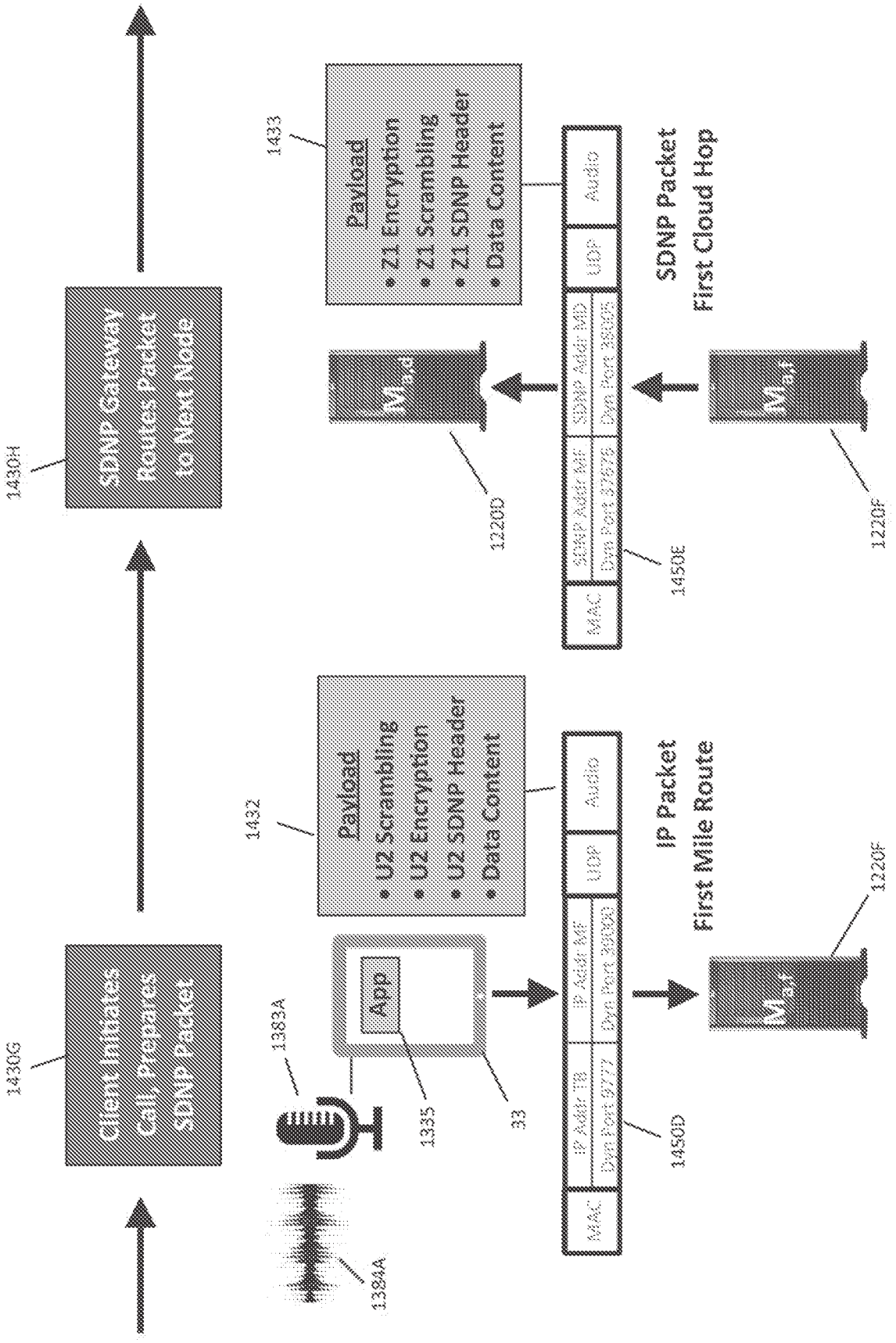

1430G
Client Initiates Call, Prepares SDNP Packet
1384A
1383A
App
1335
33
1432
Payload
• U2 Scrambling
• U2 Encryption
• U2 SDNP Header
• Data Content
MAC
IP Addr TB
Dyn Port 9777
IP Addr MF
Dyn Port 38000
UDP
Audio
1450D
IP Packet
First Mile Route
1220F
1430H
SDNP Gateway Routes Packet to Next Node
1433
Payload
• Z1 Encryption
• Z1 Scrambling
• Z1 SDNP Header
• Data Content
1220D
MAC
SDNP Addr MF
Dyn Port 37676
SDNP Addr MD
Dyn Port 38000
UDP
Audio
1450E
SDNP Packet
First Cloud Hop
1220F

Figure 124C

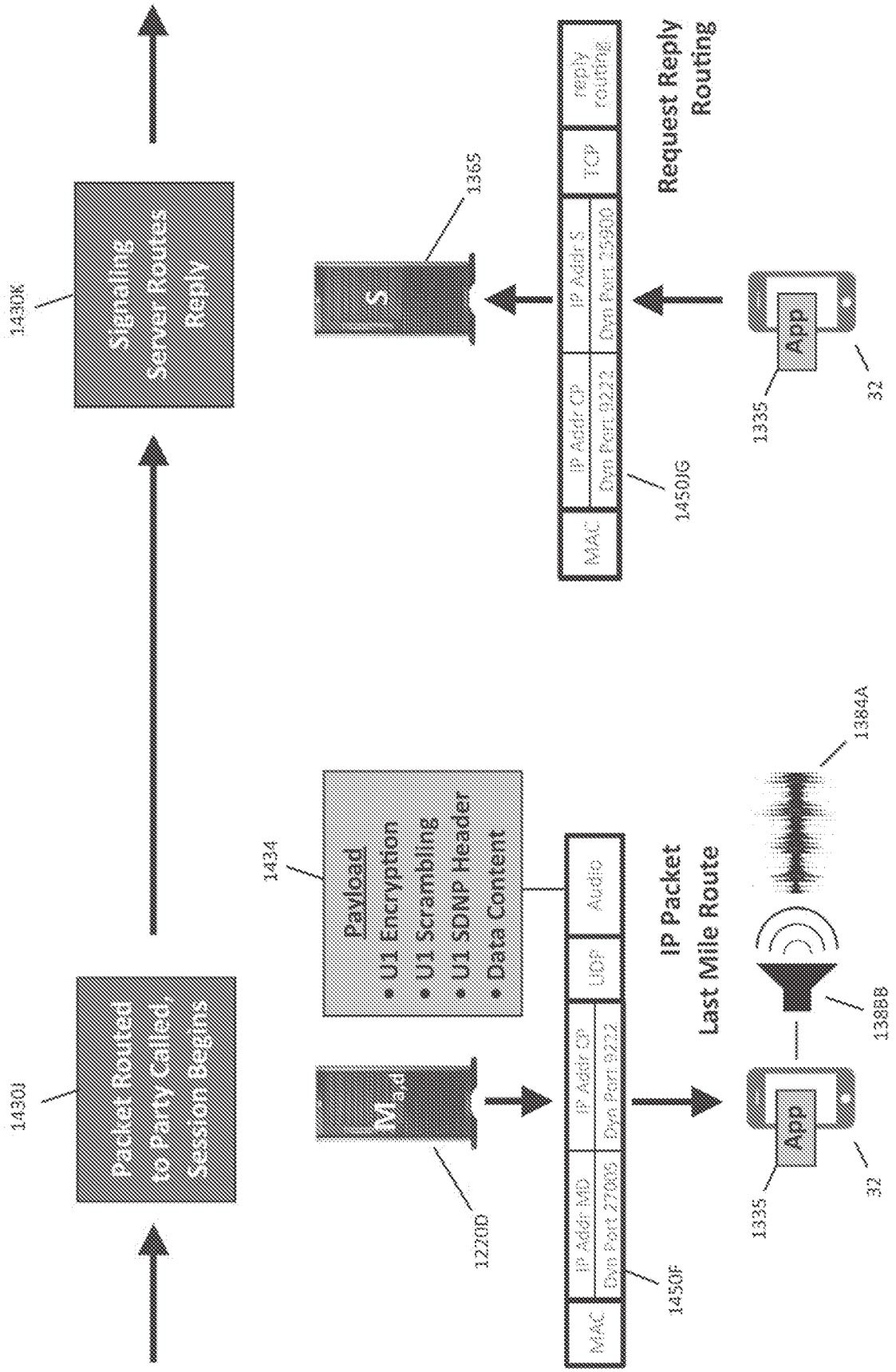

1430J
Packet Routed to Party Called, Session Begins
1430K
Signaling Server Routes Reply
1434
Payload
• U1 Encryption
• U1 Scrambling
• U1 SDMP Header
• Data Content
1220D
MAC
IP Addr MD
Dyn Port 27005
IP Addr CP
Dyn Port 9222
UDP
Audio
1450F
IP Packet
Last Mile Route
1335
App
32
1388B
1364A
1365
S
MAC
IP Addr CP
Dyn Port 9222
IP Addr S
Dyn Port 25980
TCP
reply routing
1450G
Request Reply Routing
1335
App
32

Figure 124D

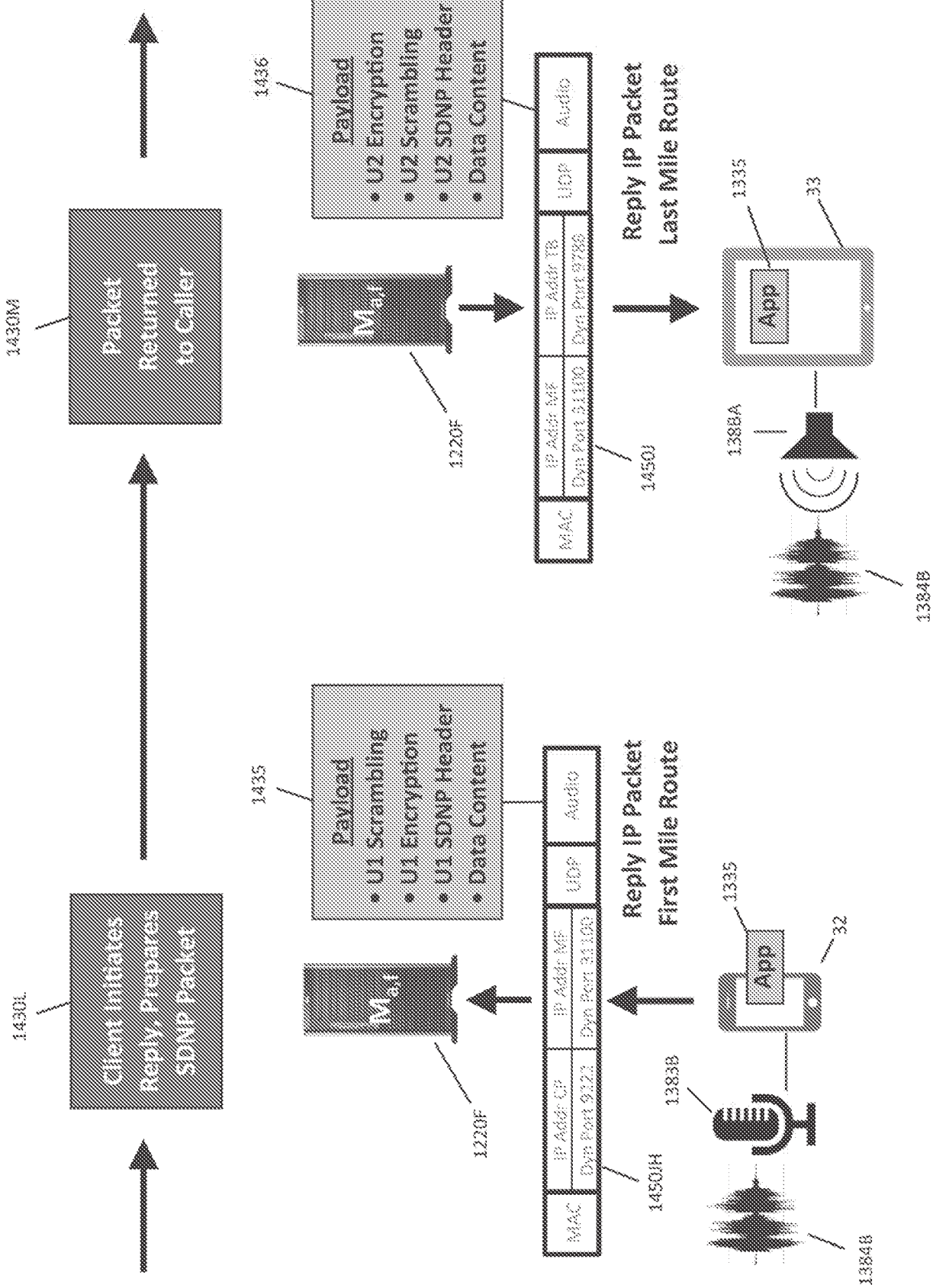

1430L
Client Initiates Reply, Prepares SDNP Packet
1430M
Packet Returned to Caller
1435
Payload
• U1 Scrambling
• U1 Encryption
• U1 SDNP Header
• Data Content
1436
Payload
• U2 Encryption
• U2 Scrambling
• U2 SDNP Header
• Data Content
1220F
1220F
MAC
IP Addr CP
Dyn Port 9123
IP Addr MF
Dyn Port 31100
UDP
Audio
MAC
IP Addr MF
Dyn Port 31100
IP Addr TB
Dyn Port 6786
UDP
Audio
1450H
1450I
Reply IP Packet First Mile Route
Reply IP Packet Last Mile Route
1335
App
32
1335
App
33
1383B
1384B
138BA
1384B

Figure 124E

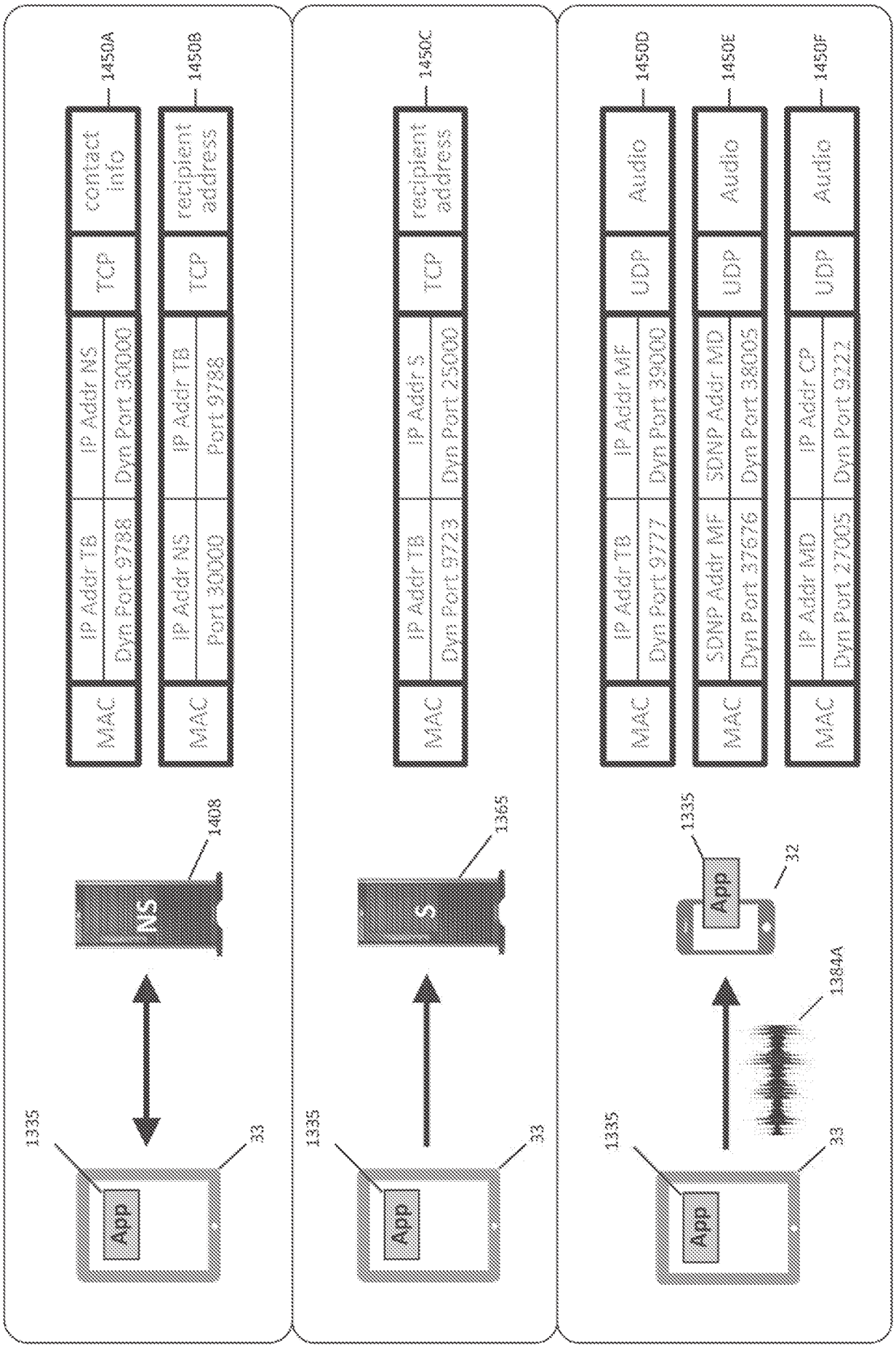
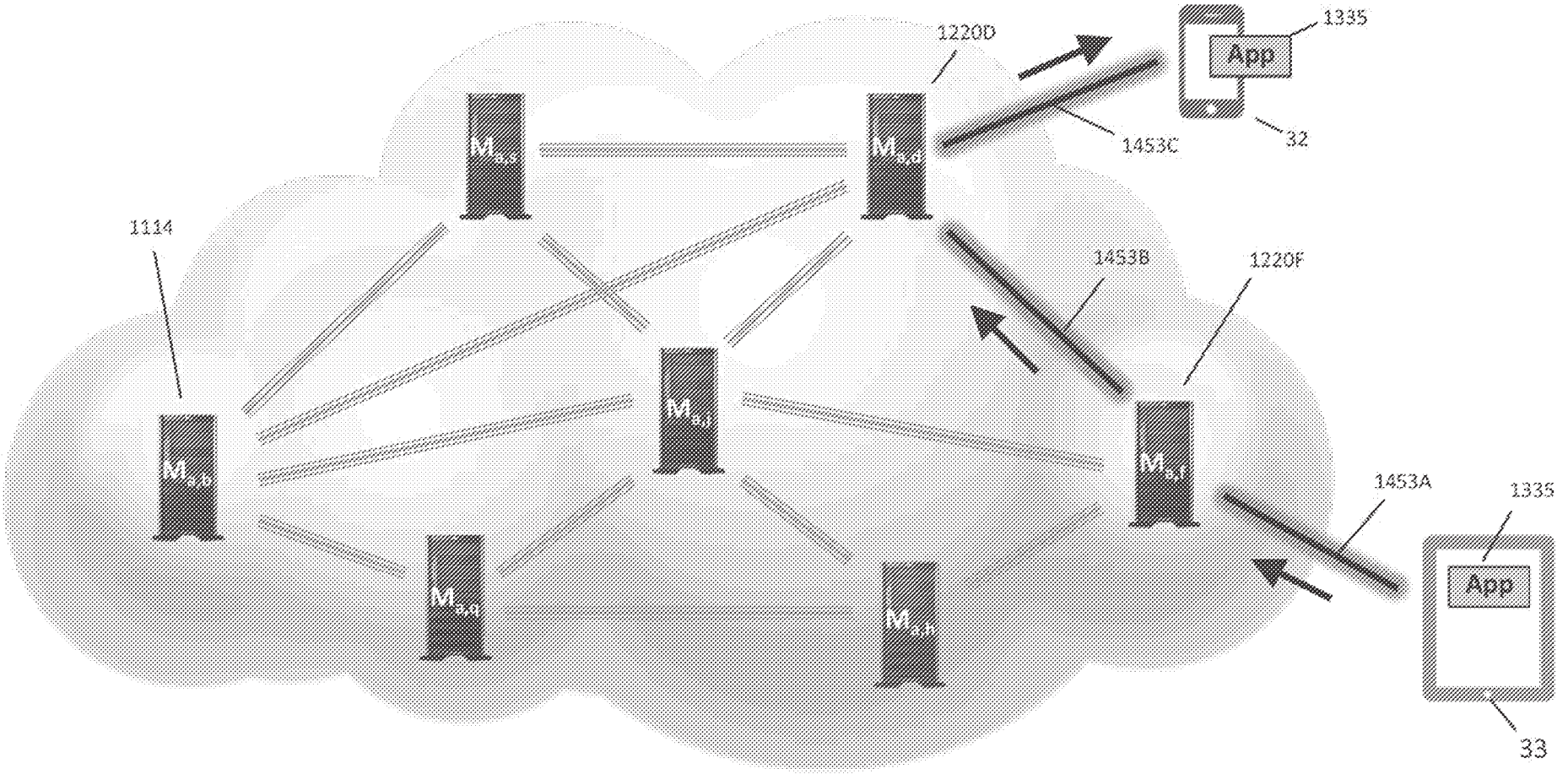

1335
App
33
NS
1408
MAC
IP Addr TB
Dyn Port 9788
IP Addr NS
Dyn Port 30000
TCP
contact info
1450A
MAC
IP Addr NS
Port 30000
IP Addr TB
Port 9788
TCP
recipient address
1450B
1335
App
33
S
1365
MAC
IP Addr TB
Dyn Port 9723
IP Addr S
Dyn Port 25000
TCP
recipient address
1450C
1335
App
33
1384A
1335
App
32
MAC
IP Addr TB
Dyn Port 9777
IP Addr MF
Dyn Port 39000
UDP
Audio
1450D
MAC
SDNP Addr MF
Dyn Port 37676
SDNP Addr MD
Dyn Port 38005
UDP
Audio
1450E
MAC
IP Addr MD
Dyn Port 27005
IP Addr CP
Dyn Port 9222
UDP
Audio
1450F

Figure 125A


1220D
1335
App
1453C
32
1114
1453B
1220F
1453A
1335
App
33

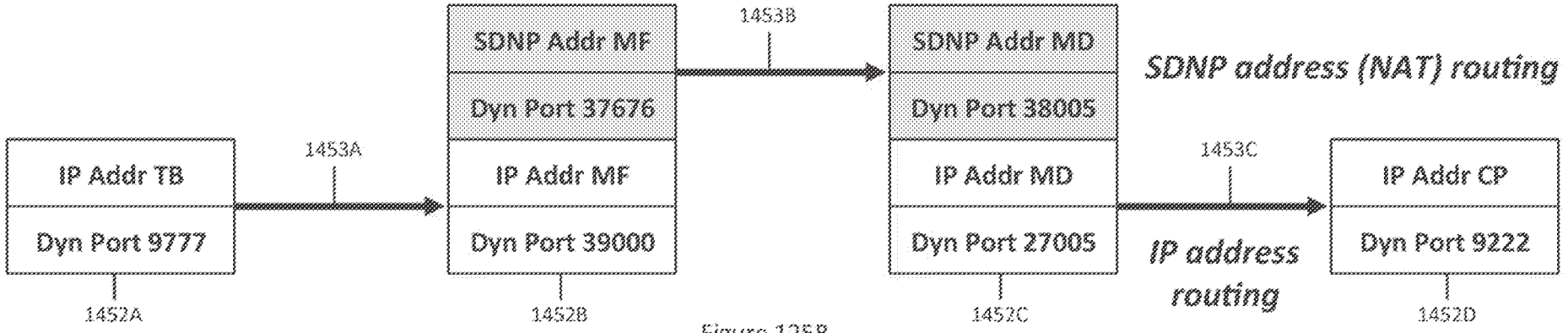

SDNP Addr MF
Dyn Port 37676
IP Addr MF
Dyn Port 39000
1452B
1453B
SDNP Addr MD
Dyn Port 38005
IP Addr MD
Dyn Port 27005
1452C
SDNP address (NAT) routing
IP Addr TB
Dyn Port 9777
1452A
1453A
1453C
IP Addr CP
Dyn Port 9222
1452D
IP address routing

Figure 125B

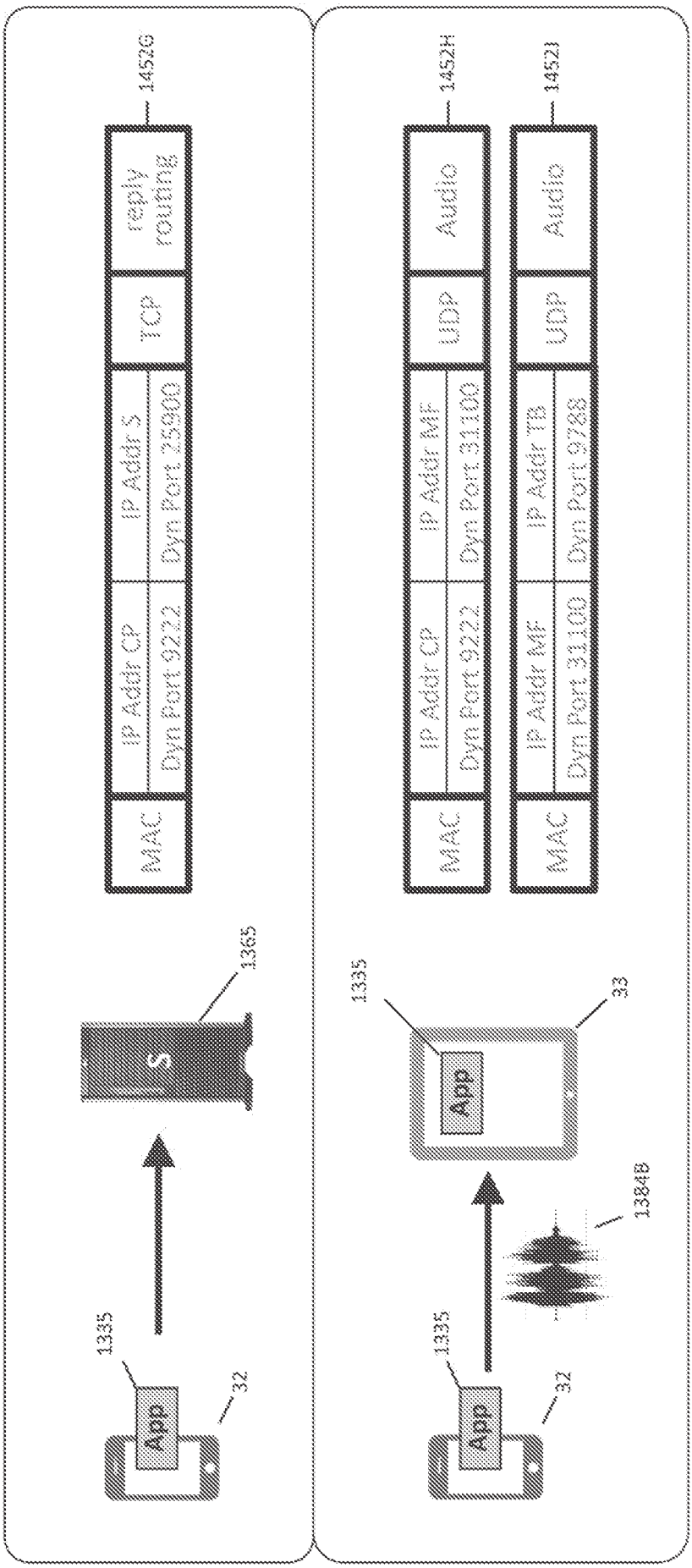
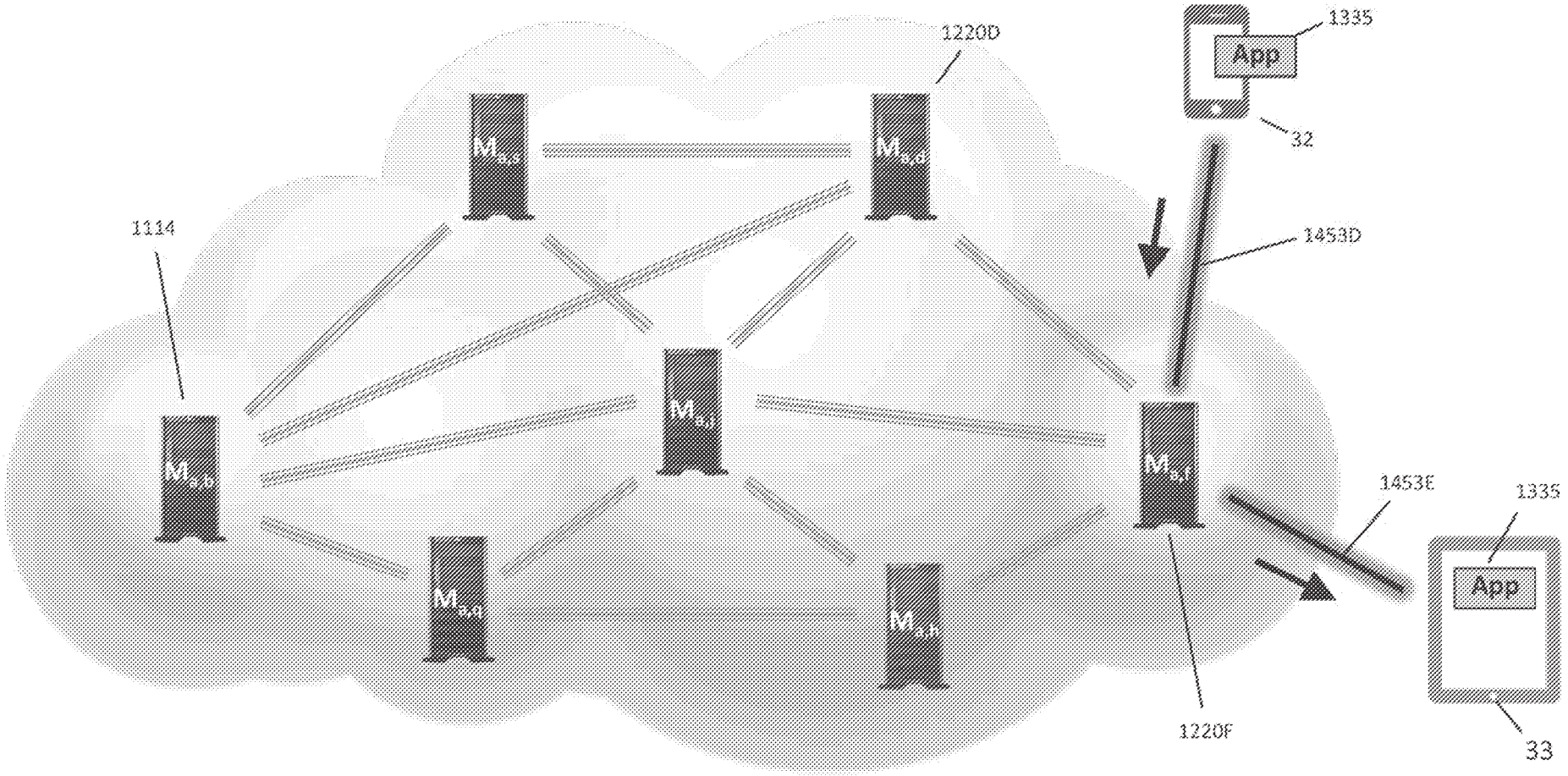

14526
MAC
IP Addr CP
Dyn Port 9222
IP Addr S
Dyn Port 25900
TCP
reply routing
1452H
MAC
IP Addr CP
Dyn Port 9222
IP Addr MF
Dyn Port 31100
UDP
Audio
1452I
MAC
IP Addr MF
Dyn Port 31100
IP Addr TB
Dyn Port 9788
UDP
Audio
1365
S
1335
App
32
1335
App
33
1384B
1335
App
32

Figure 126A


1220D
1335
App
32
1114
1453D
1453E
1335
App
33
1220F

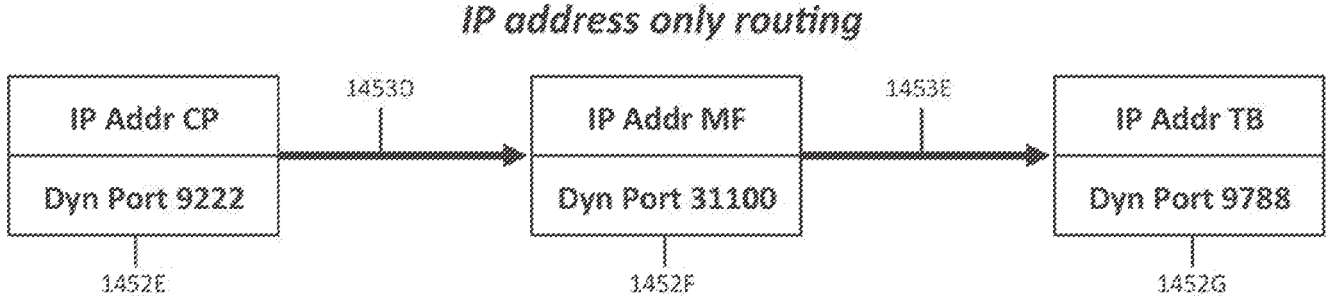
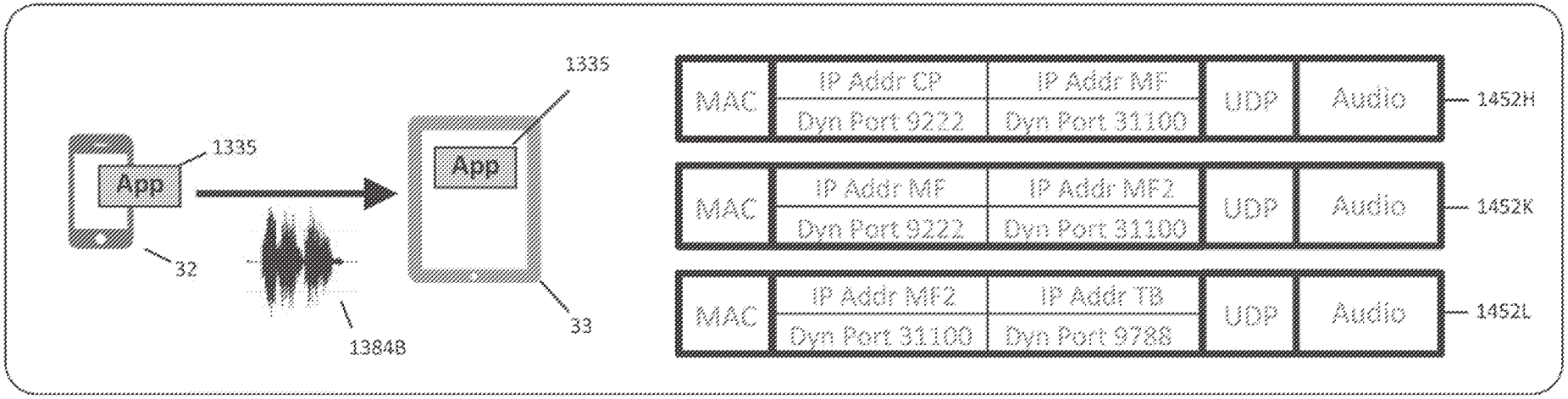

IP address only routing
IP Addr CP
Dyn Port 9222
1452E
1453D
IP Addr MF
Dyn Port 31100
1452F
1453E
IP Addr TB
Dyn Port 9788
1452G

Figure 126B



translated IP address routing (using backup server)

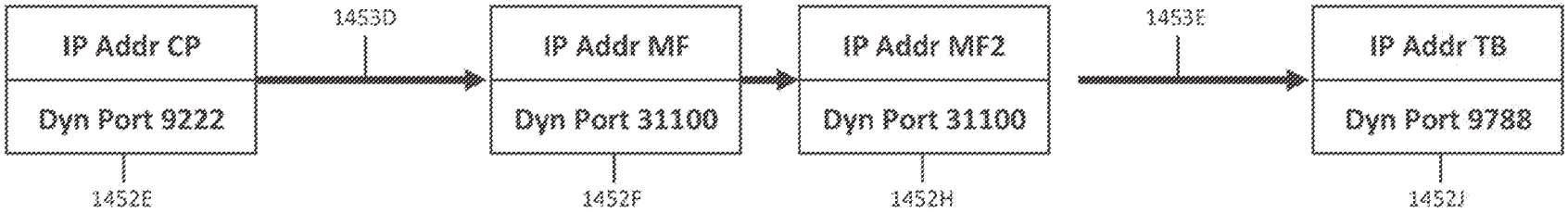


Figure 126C

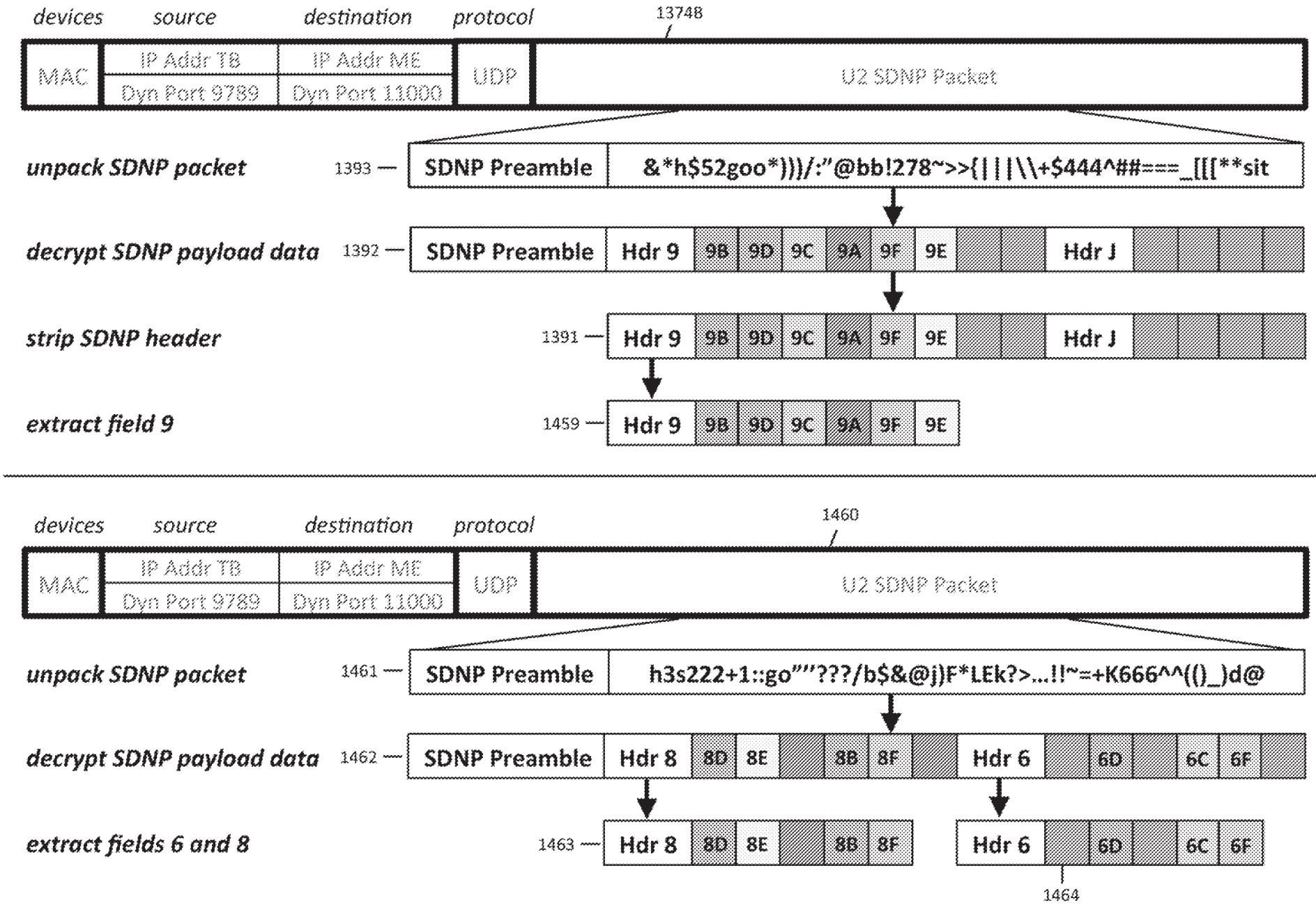

devices
source
destination
protocol
13748
MAC
IP Addr TB
Dyn Port 9789
IP Addr ME
Dyn Port 11000
UDP
U2 SDNP Packet
unpack SDNP packet
1393
SDNP Preamble
&*h$52goo*)))/:"@bb!278~>>{|||\\+$444^##===_[[[**sit
decrypt SDNP payload data
1392
SDNP Preamble
Hdr 9
9B
9D
9C
9A
9F
9E
Hdr J
strip SDNP header
1391
extract field 9
1459
devices
source
destination
protocol
1460
MAC
IP Addr TB
Dyn Port 9789
IP Addr ME
Dyn Port 11000
UDP
U2 SDNP Packet
unpack SDNP packet
1461
SDNP Preamble
h3s222+1::go"'"???/b$&@j)F*LEk?>...!!~=+K666^^(()_)d@
decrypt SDNP payload data
1462
SDNP Preamble
Hdr 8
8D
8E
8B
8F
Hdr 6
6D
6C
6F
extract fields 6 and 8
1463
Hdr 8
8D
8E
8B
8F
Hdr 6
6D
6C
6F
1464

Figure 127

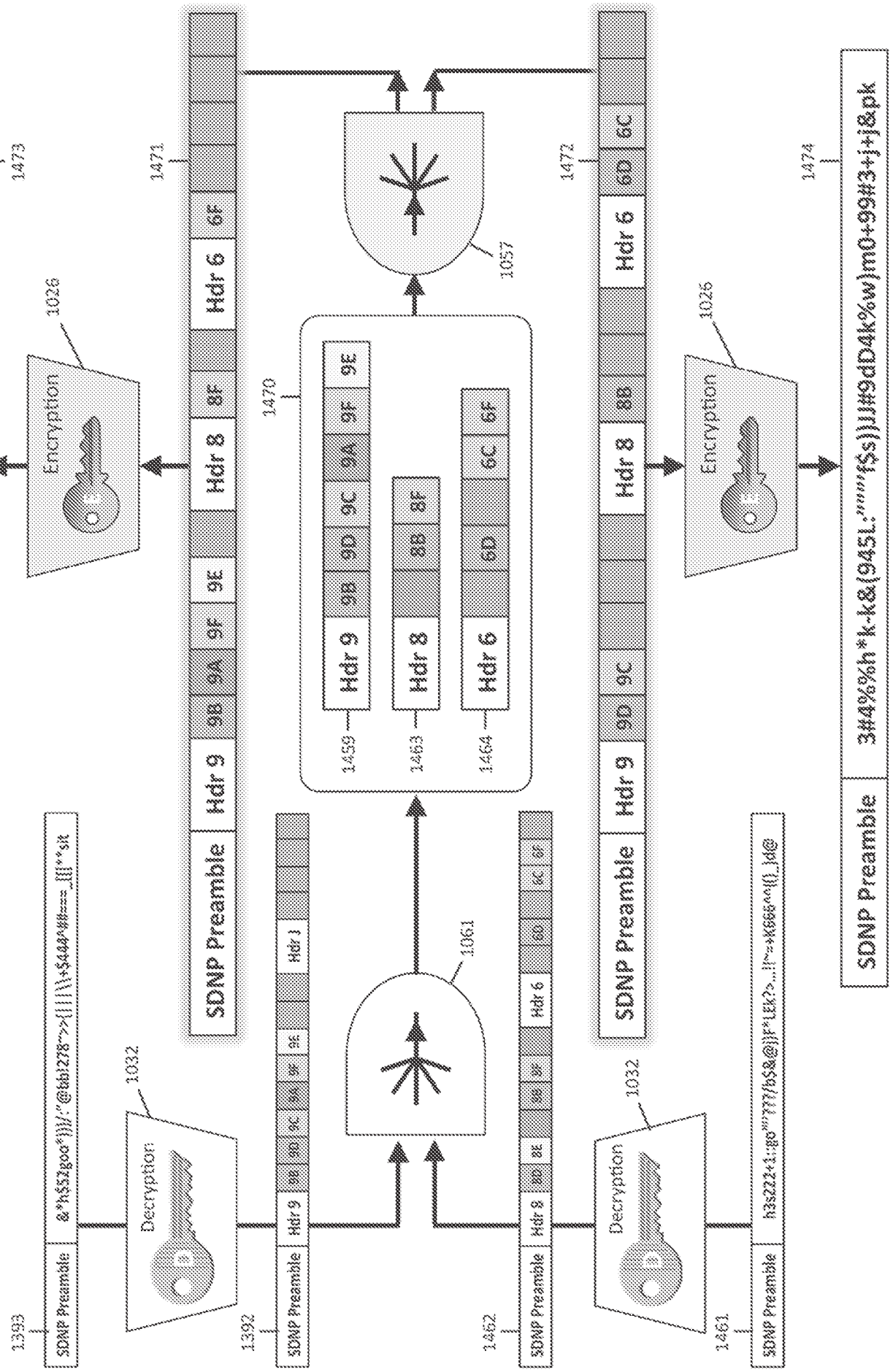

SDNP Preamble
993d3h%&l%^^k#>K(h)-+@kL0n++#~1h$b^n7^m)^+m*))?.>
1473
Encryption
1026
SDNP Preamble
Hdr 9
9B
9A
9F
9E
Hdr 8
8F
Hdr 6
6F
1471
1470
Hdr 9
9B
9D
9C
9A
9F
9E
1459
Hdr 8
8B
8F
1463
Hdr 6
6D
6C
6F
1464
1057
1061
1472
SDNP Preamble
Hdr 9
9D
9C
Hdr 8
8B
Hdr 6
6D
6C
1026
Encryption
1474
SDNP Preamble
3#4%%h*k-k&(9451:"""f$s)JJJ#9dD4k%w)m0+99#3+j+j&pk
1393
SDNP Preamble
1032
Decryption
1392
SDNP Preamble
Hdr 9
1462
SDNP Preamble
Hdr 8
1032
Decryption
1461
SDNP Preamble

Figure 128

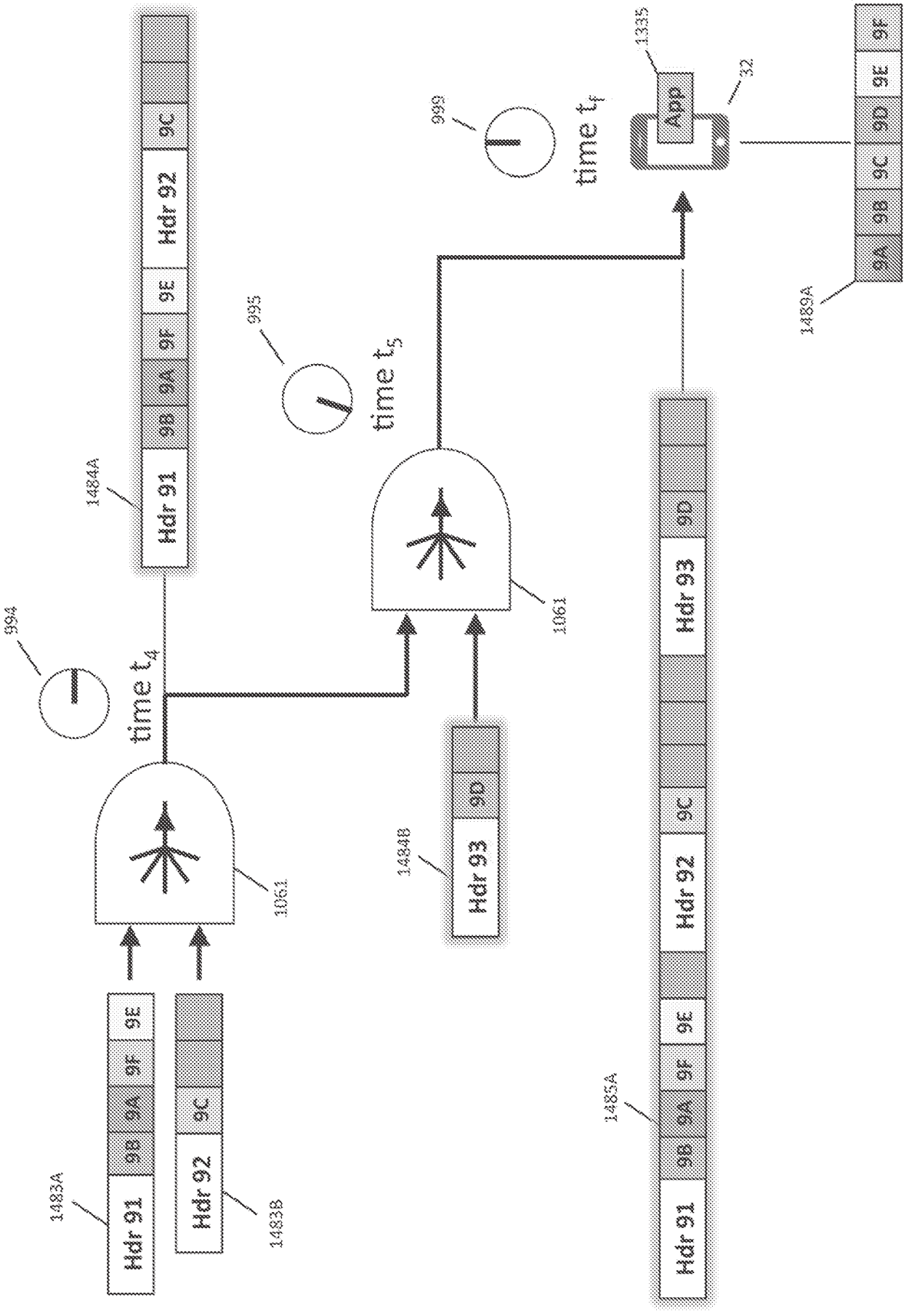

1483A
Hdr 91
98
9A
9F
9E
1483B
Hdr 92
9C
1061
994
time t_4
1484A
Hdr 91
98
9A
9F
9E
Hdr 92
9C
1484B
Hdr 93
9D
1061
995
time t_5
999
time t_f
1335
App
32
1485A
Hdr 91
98
9A
9F
9E
Hdr 92
9C
Hdr 93
9D
1489A
9A
98
9C
9D
9E
9F

Figure 129A

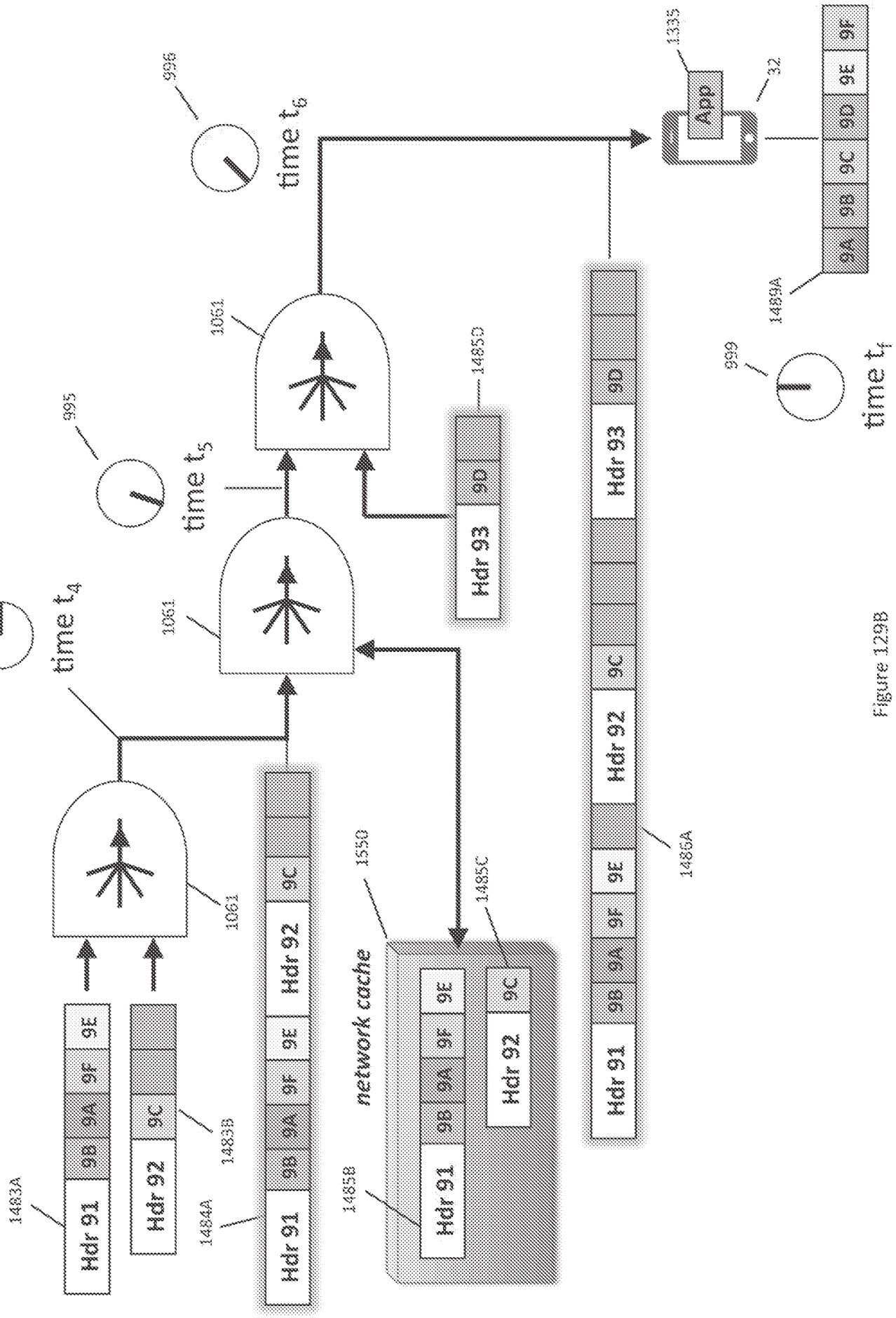

994
time t_4
995
time t_5
996
time t_6
999
time t_f
1061
1061
1061
1483A
Hdr 91
9B
9A
9F
9E
1483B
Hdr 92
9C
1484A
Hdr 91
9B
9A
9F
9E
Hdr 92
9C
1485B
Hdr 93
9D
1485C
Hdr 92
9C
1485B
Hdr 91
9B
9A
9F
9E
1485D
Hdr 93
9D
1485A
Hdr 91
9B
9A
9F
9E
Hdr 92
9C
Hdr 93
9D
1489A
9A
9B
9C
9D
9E
9F
1335
App
32
1550
network cache

Figure 129B

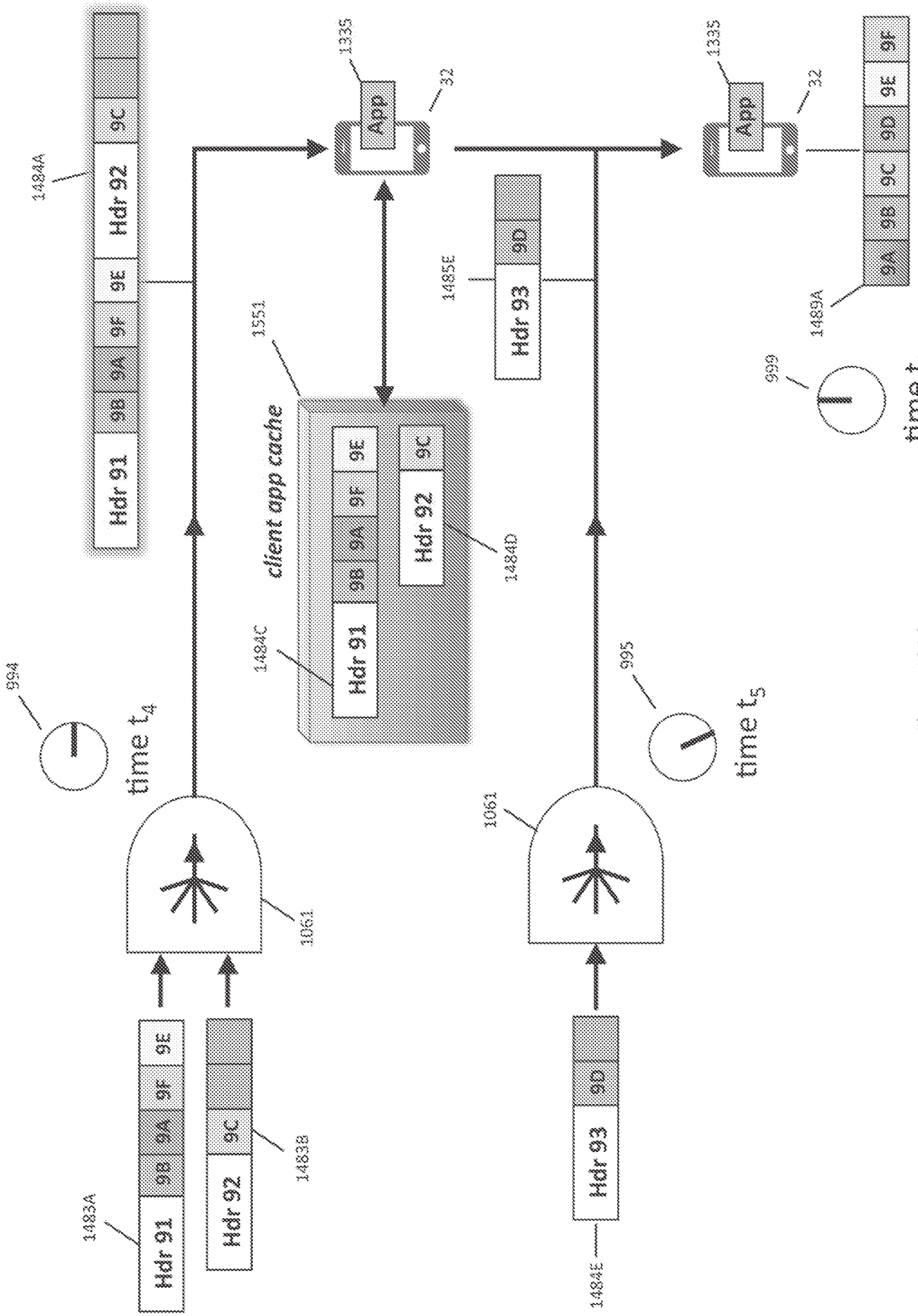

1484A
Hdr 91
9B
9A
9F
9E
Hdr 92
9C
1335
App
32
1551
client app cache
1484C
Hdr 91
9B
9A
9F
9E
Hdr 92
9C
1484D
1485E
Hdr 93
9D
994
time t_4
1061
1483A
Hdr 91
9B
9A
9F
9E
Hdr 92
9C
14838
1484E
Hdr 93
9D
995
time t_5
1061
1335
App
32
1489A
9A
9B
9C
9D
9E
9F
999
time t_f

Figure 129C

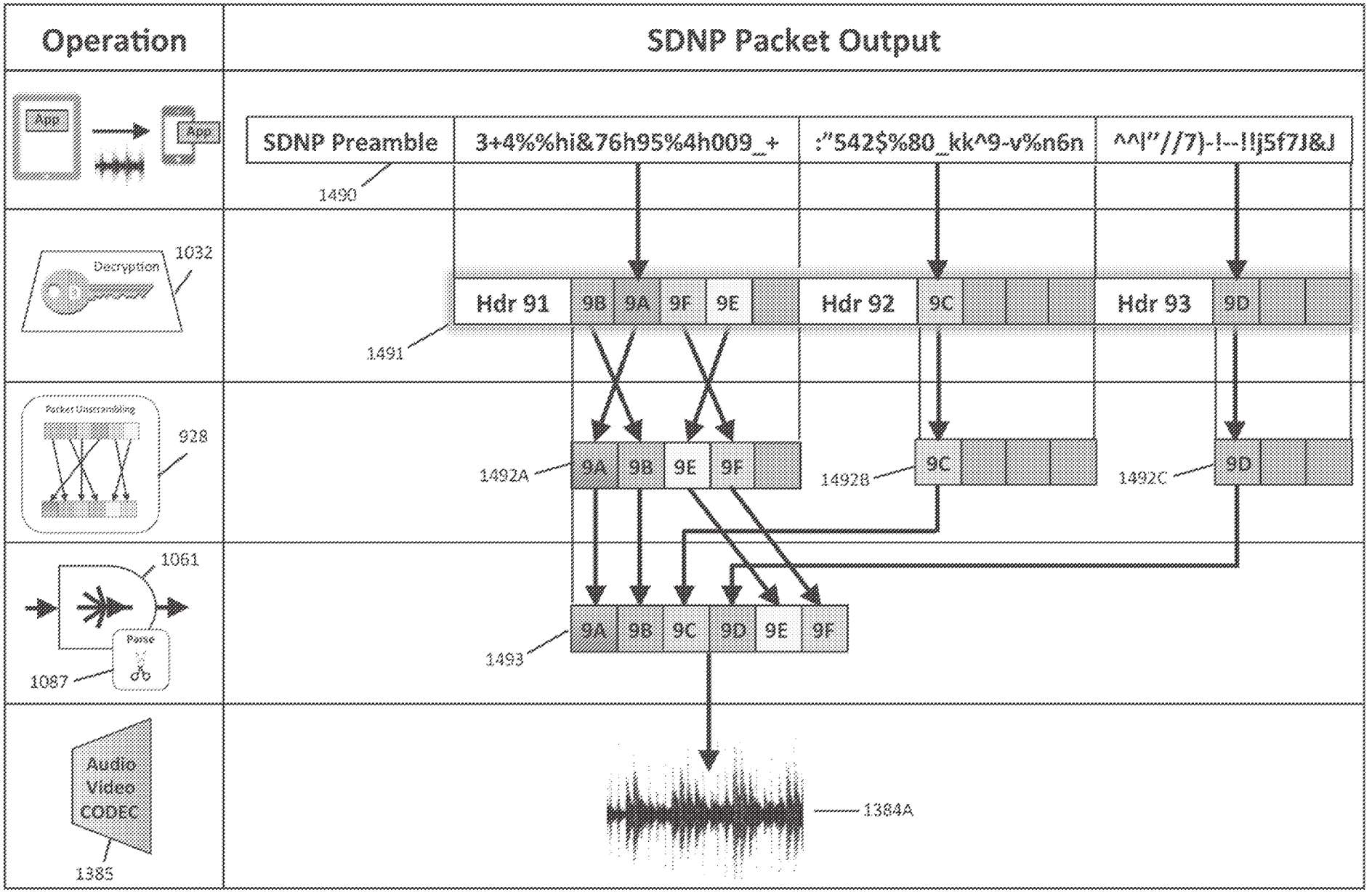

Operation
SDNP Packet Output
App
App
SDNP Preamble
3+4%%hi&76h95%4h009_+
:"542$%80_kk^9-v%n6n
^^|"//7)-!--!!j5f7J&J
1490
Decryption
1032
Hdr 91
9B
9A
9F
9E
Hdr 92
9C
Hdr 93
9D
1491
Packet Descrambling
928
1492A
9A
9B
9E
9F
1492B
9C
1492C
9D
1061
Parse
1087
1493
9A
9B
9C
9D
9E
9F
Audio
Video
CODEC
1385
1384A

Figure 129D

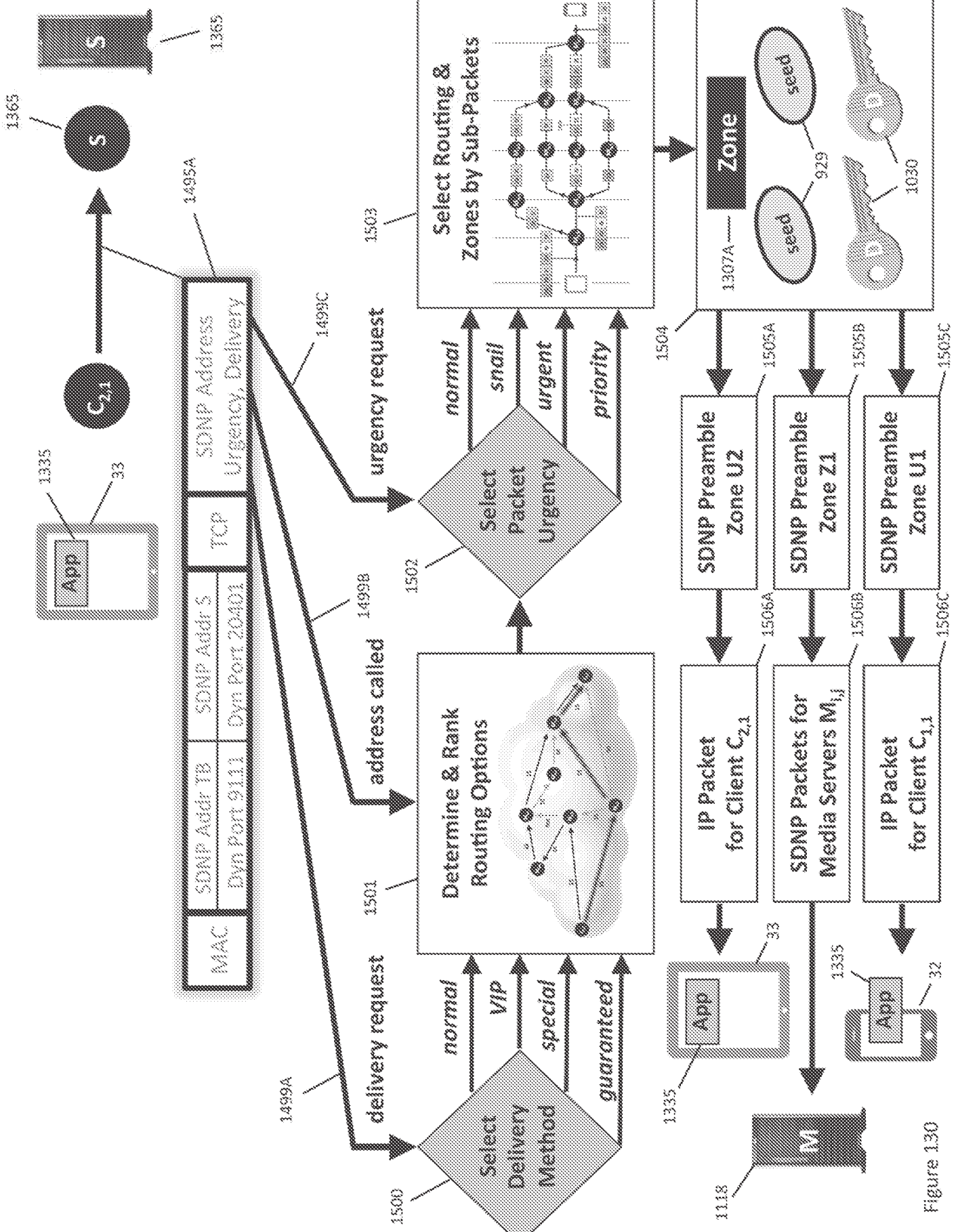
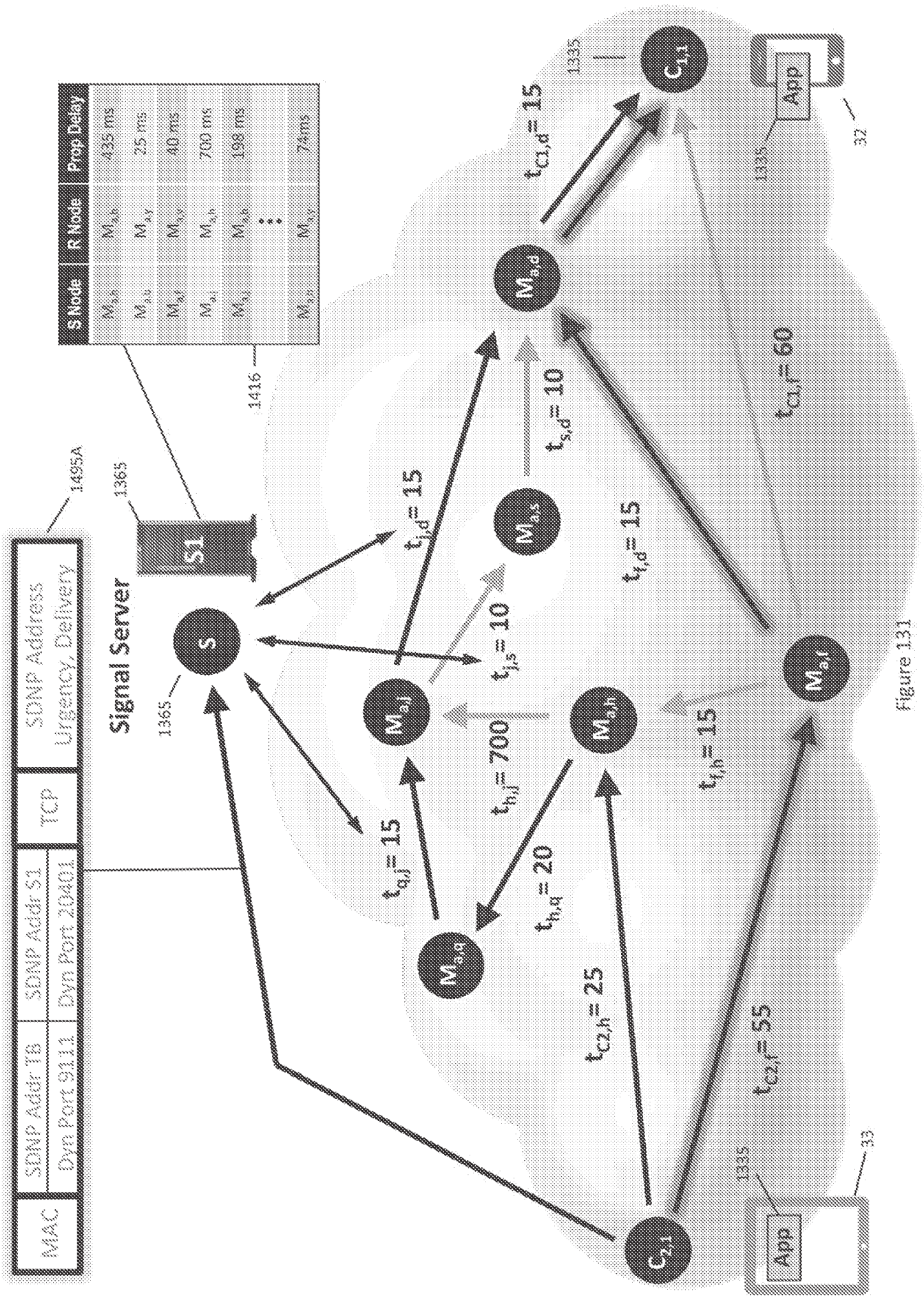

1365
S
1365
S
1335
33
App
$C_{2,1}$
1495A
MAC
SDNP Addr TB
Dyn Port 9111
SDNP Addr S
Dyn Port 20401
TCP
SDNP Address
Urgency, Delivery
1499C
urgency request
1503
Select Routing & Zones by Sub-Packets
normal
snail
urgent
priority
1502
Select Packet Urgency
1504
Zone
1307A
seed
929
seed
1030
1505A
1505B
1505C
SDNP Preamble Zone U2
SDNP Preamble Zone Z1
SDNP Preamble Zone U1
1506A
1506B
1506C
IP Packet for Client $C_{2,1}$
SDNP Packets for Media Servers $M_{i,j}$
IP Packet for Client $C_{1,1}$
1335
33
App
1335
32
App
1118
M
14998
address called
1501
Determine & Rank Routing Options
1499A
delivery request
normal
VIP
special
guaromteed
1500
Select Delivery Method

Figure 130


MAC
SDNP Addr TB
Dyn Port 9111
SDNP Addr S1
Dyn Port 20401
TCP
SDNP Address
Urgency Delivery
1495A
Signal Server
1365
S1
1365
S
1416
S Node
R Node
Prop Delay
$M_{a,a}$
$M_{a,h}$
435 ms
$M_{a,s}$
$M_{a,y}$
25 ms
$M_{a,f}$
$M_{a,y}$
40 ms
$M_{a,.}$
$M_{a,h}$
700 ms
$M_{a,.}$
$M_{a,b}$
198 ms
$M_{a,y}$
$M_{a,y}$
74ms
$t_{q,j}$= 15
$t_{h,j}$= 700
$t_{h,q}$= 20
$t_{C2,h}$= 25
$t_{C2,f}$= 55
$t_{f,h}$= 15
$t_{f,d}$= 15
$t_{C1,f}$= 60
$t_{s,d}$= 10
$t_{j,s}$= 10
$t_{j,d}$= 15
$t_{C1,d}$= 15
$M_{a,q}$
$M_{a,j}$
$M_{a,h}$
$M_{a,s}$
$M_{a,d}$
$M_{a,f}$
$C_{2,1}$
$C_{1,1}$
1335
App
33
32
Figure 131

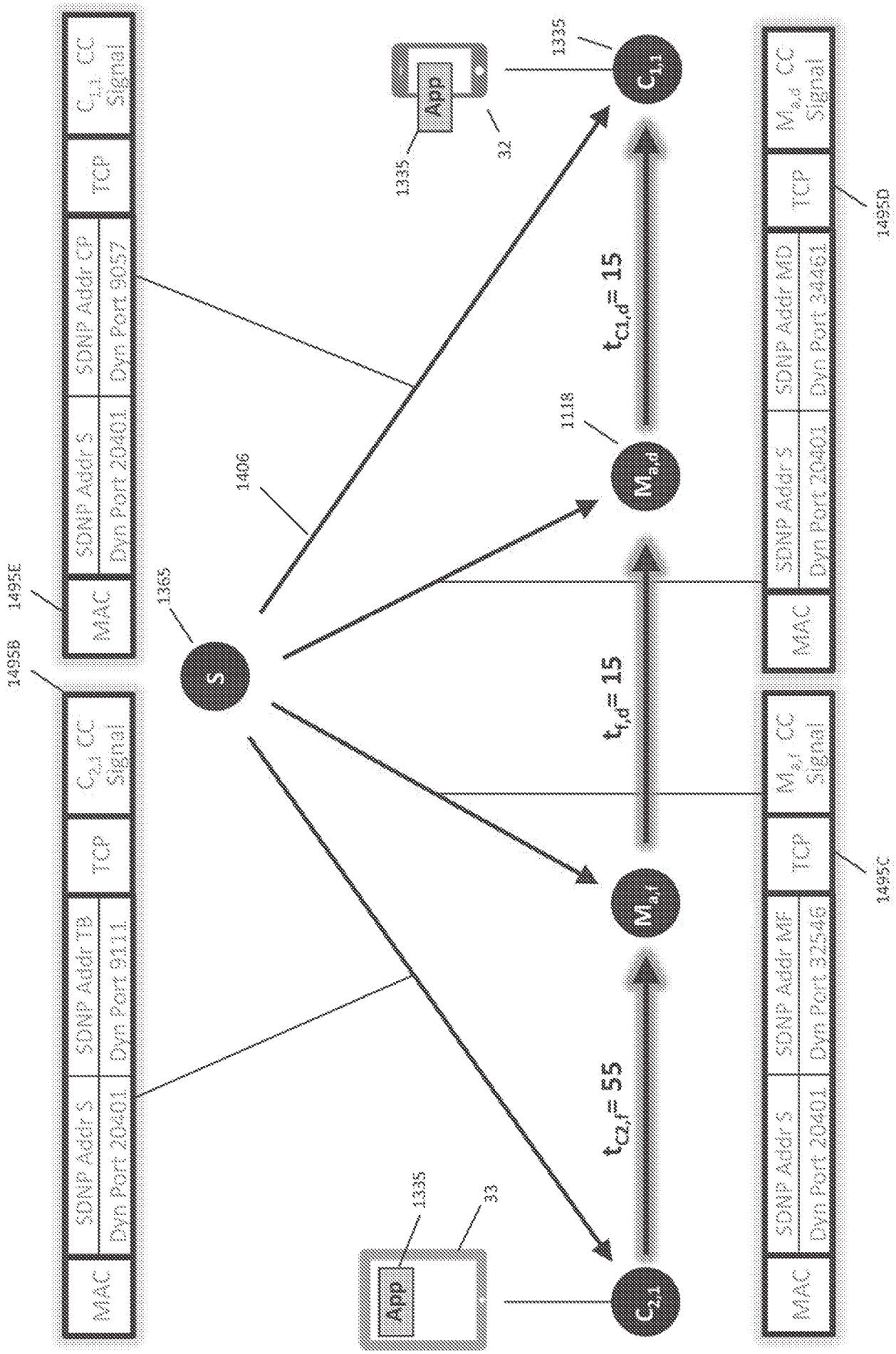

MAC
SDNP Addr S
Dyn Port 20401
SDNP Addr TB
Dyn Port 9111
TCP
$C_{2,1}$ CC Signal
1495B
MAC
SDNP Addr S
Dyn Port 20401
SDNP Addr CP
Dyn Port 9057
TCP
$C_{1,1}$ CC Signal
1495E
MAC
SDNP Addr S
Dyn Port 20401
SDNP Addr MF
Dyn Port 32546
TCP
$M_{a,1}$ CC Signal
1495C
MAC
SDNP Addr S
Dyn Port 20401
SDNP Addr MD
Dyn Port 34461
TCP
$M_{a,d}$ CC Signal
1495D
S
1365
1406
App
1335
33
App
1335
32
$C_{2,1}$
$C_{1,1}$
$M_{a,1}$
$M_{a,d}$
1118
$t_{C2,f}$ = 55
$t_{f,d}$ = 15
$t_{C1,d}$ = 15

Figure 132A

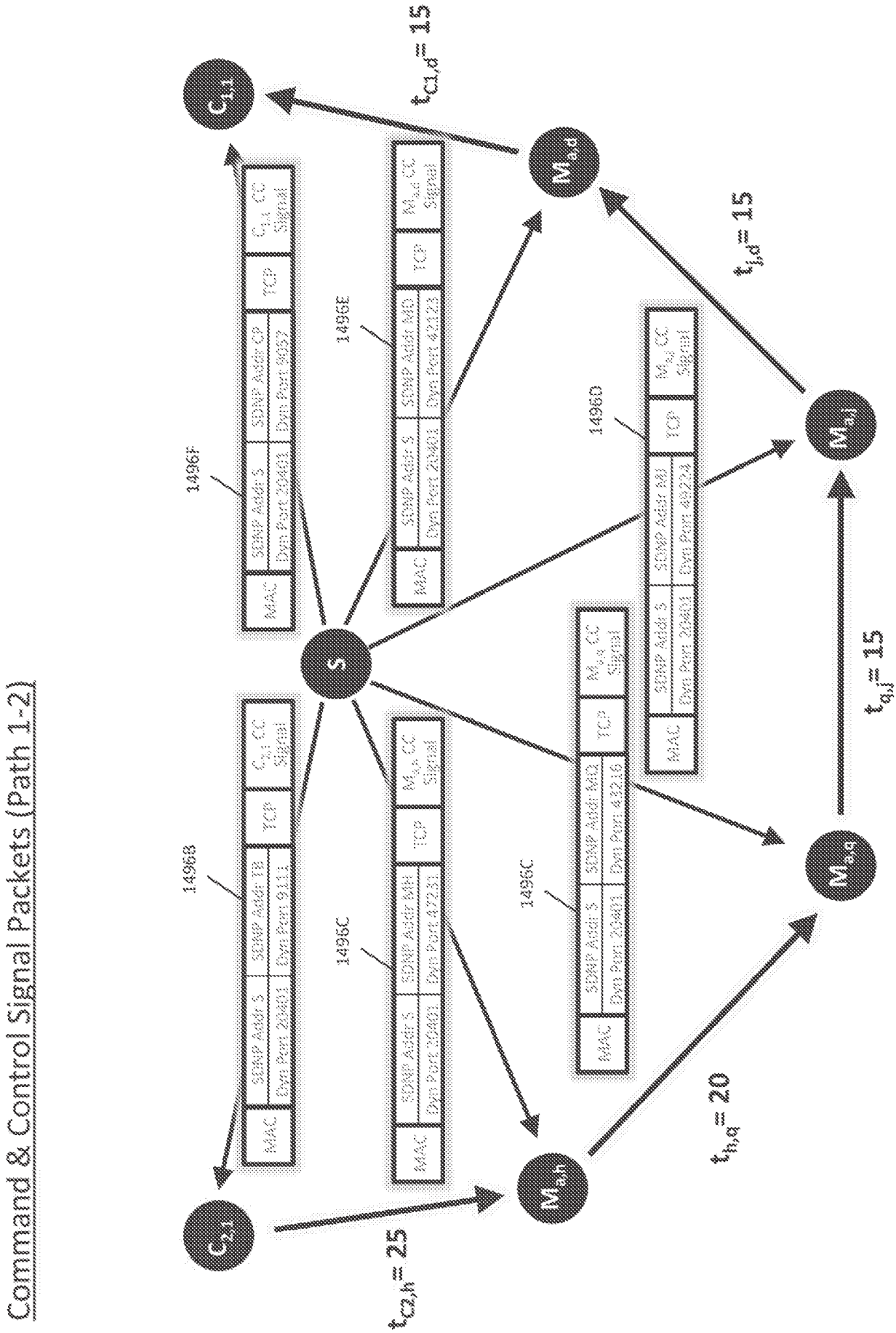

Command & Control Signal Packets (Path 1-2)
$C_{2,1}$
$C_{1,1}$
S
$M_{a,h}$
$M_{a,q}$
$M_{a,j}$
$M_{a,d}$
$t_{C2,h}$= 25
$t_{h,q}$= 20
$t_{q,j}$= 15
$t_{j,d}$= 15
$t_{C1,d}$= 15
1496B
1496C
1496C
1496D
1496E
1496F
MAC
SDNP Addr S
Dyn Port 20401
SDNP Addr TB
Dyn Port 9111
TCP
$C_{2,1}$ CC Signal
SDNP Addr MH
Dyn Port 47231
$M_{a,h}$ CC Signal
SDNP Addr MA
Dyn Port 49216
SDNP Addr MJ
Dyn Port 49224
$M_{a,j}$ CC Signal
SDNP Addr MD
Dyn Port 49223
$M_{a,d}$ CC Signal
SDNP Addr CP
Dyn Port 9087
$C_{1,1}$ CC Signal

Figure 132B

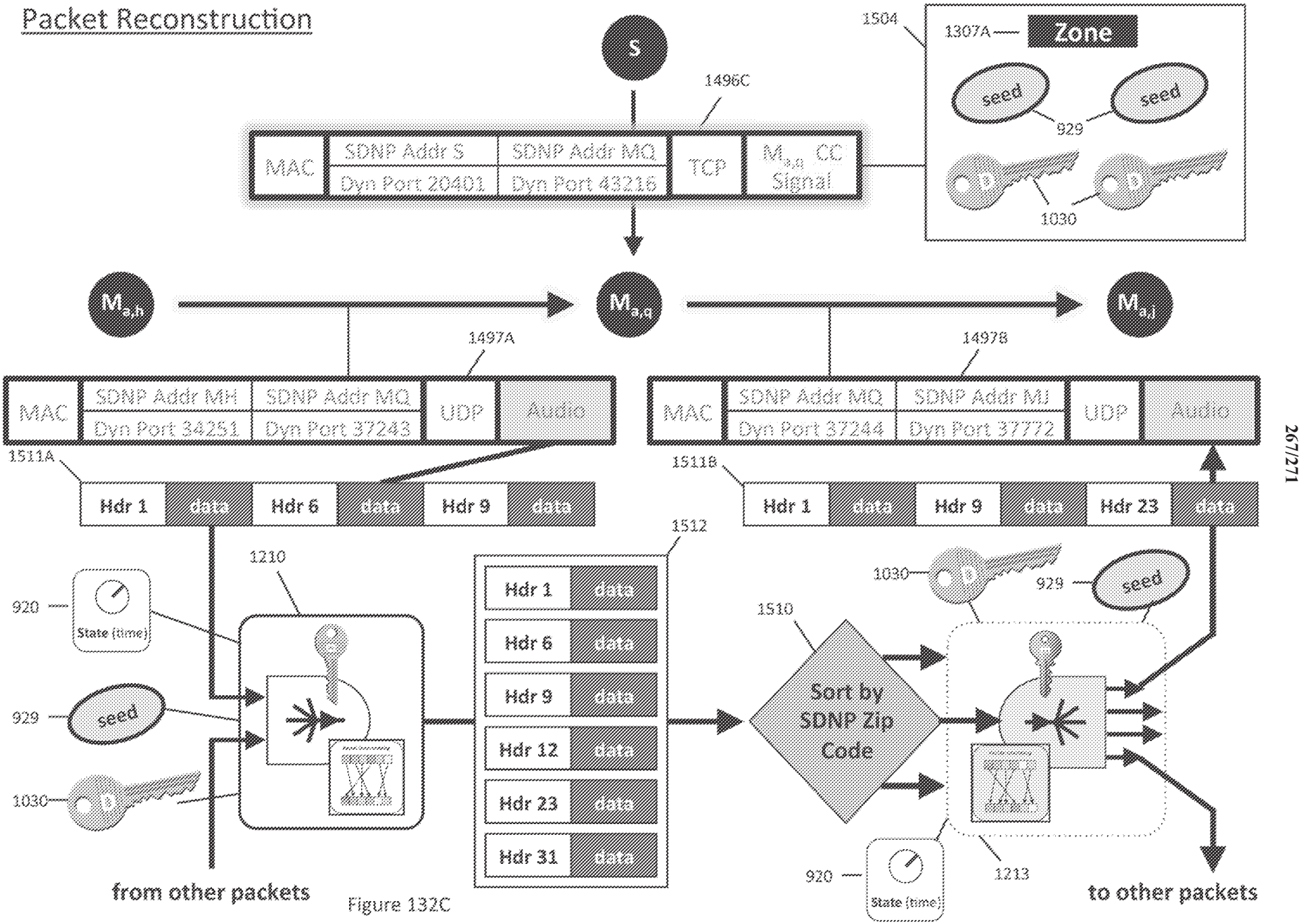

Packet Reconstruction
S
1496C
MAC
SDNP Addr S
Dyn Port 20401
SDNP Addr MQ
Dyn Port 43216
TCP
$M_{a,n}$ CC Signal
1504
1307A
Zone
seed
seed
929
1030
$M_{a,h}$
$M_{a,q}$
$M_{a,j}$
1497A
1497B
MAC
SDNP Addr MH
Dyn Port 34251
SDNP Addr MQ
Dyn Port 37243
UDP
Audio
MAC
SDNP Addr MQ
Dyn Port 37244
SDNP Addr MJ
Dyn Port 37772
UDP
Audio
1511A
1511B
Hdr 1
data
Hdr 6
data
Hdr 9
data
Hdr 1
data
Hdr 9
data
Hdr 23
data
1512
1210
920
State (time)
929
seed
1030
Hdr 1
data
Hdr 6
data
Hdr 9
data
Hdr 12
data
Hdr 23
data
Hdr 31
data
1510
Sort by SDNP Zip Code
1030
929
seed
920
State (time)
1213
from other packets
to other packets

Figure 132C

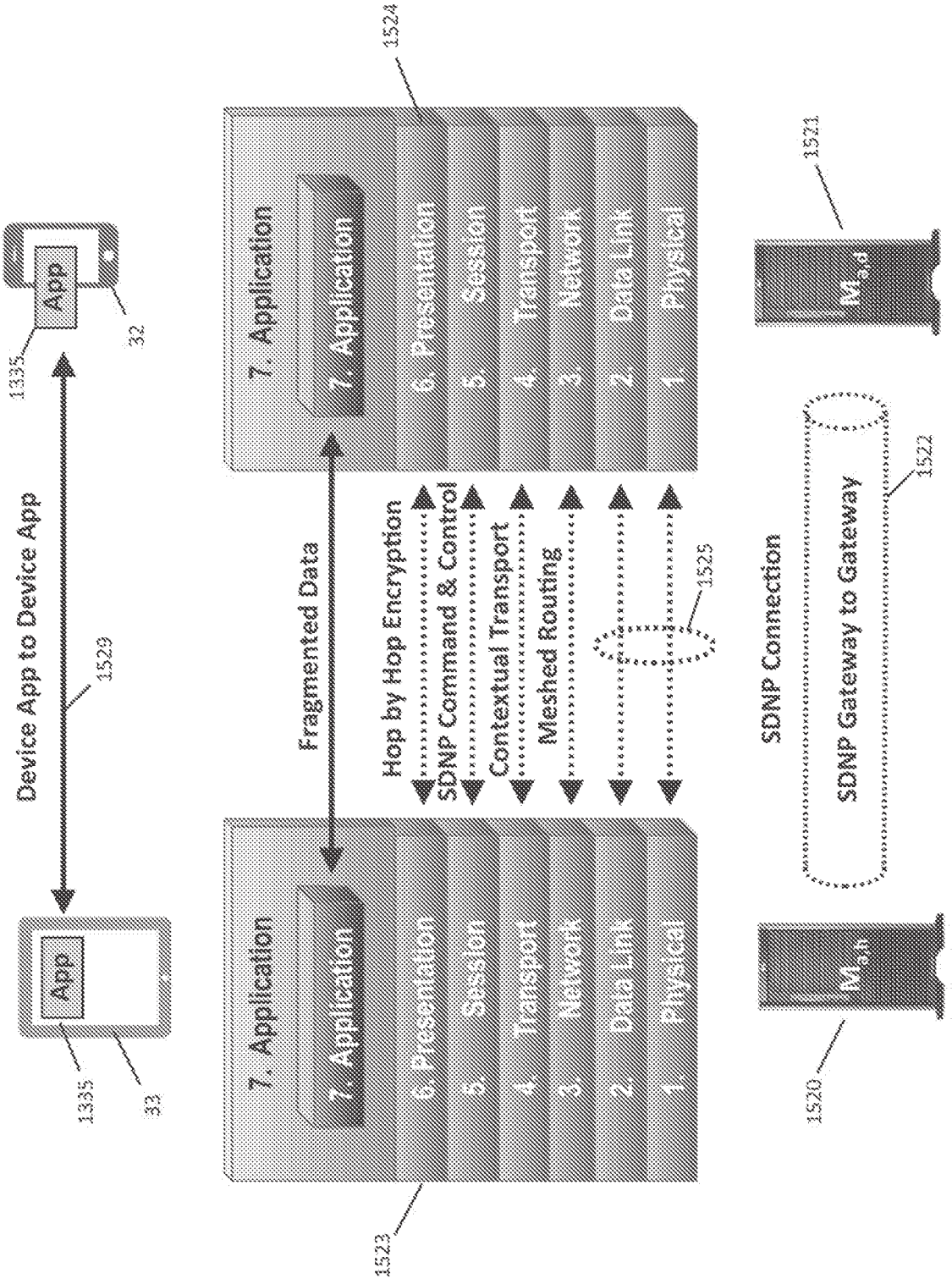

App
1335
33
Device App to Device App
1529
App
1335
32
7. Application
7. Application
6. Presentation
5. Session
4. Transport
3. Network
2. Data Link
1. Physical
1523
Fragmented Data
Hop by Hop Encryption
SDNP Command & Control
Contextual Transport
Meshed Routing
1525
1524
7. Application
7. Application
6. Presentation
5. Session
4. Transport
3. Network
2. Data Link
1. Physical
SDNP Connection
SDNP Gateway to Gateway
1522
1520
1521

Figure 133A

Encrypted SDNP Tunnel Session

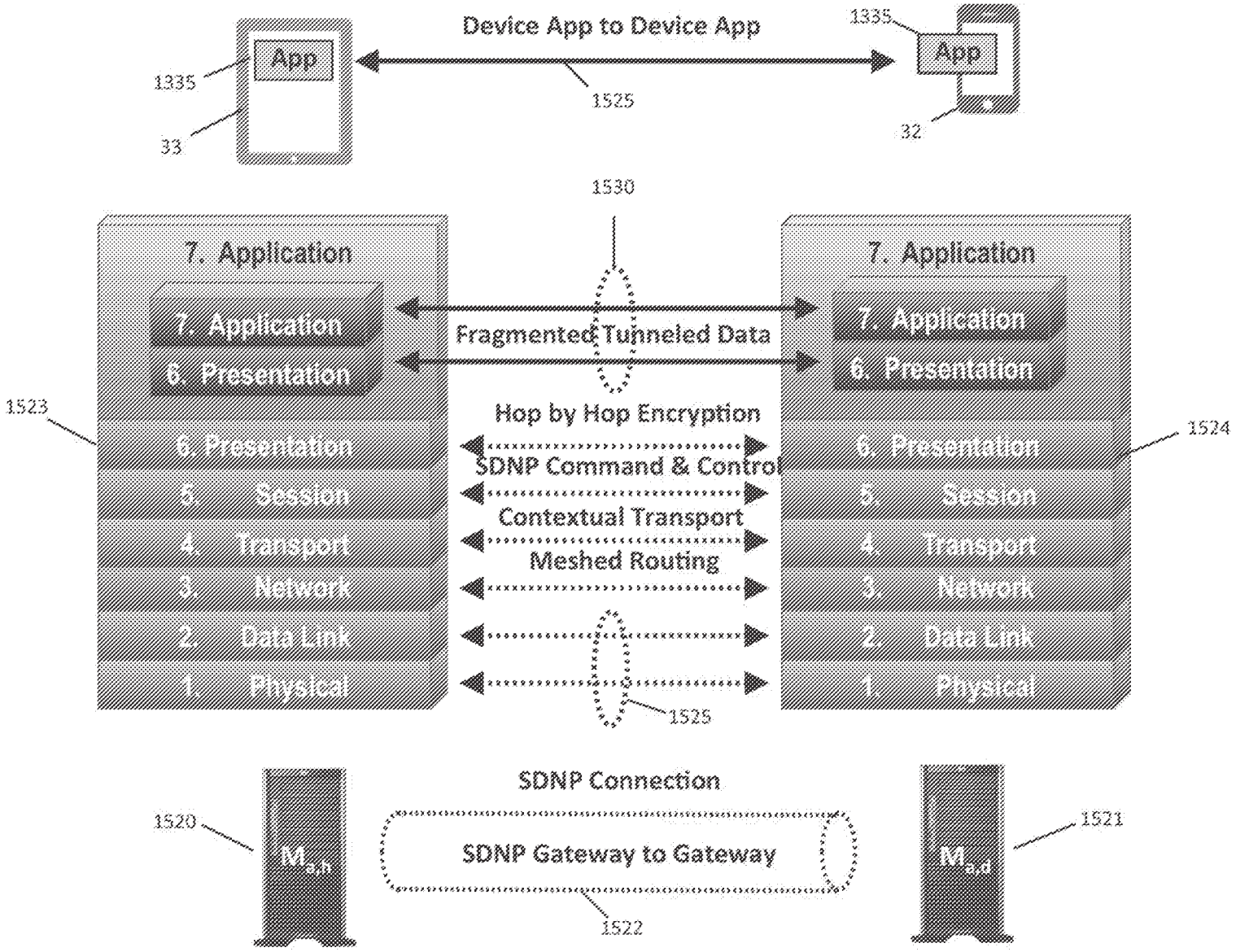


Figure 133B

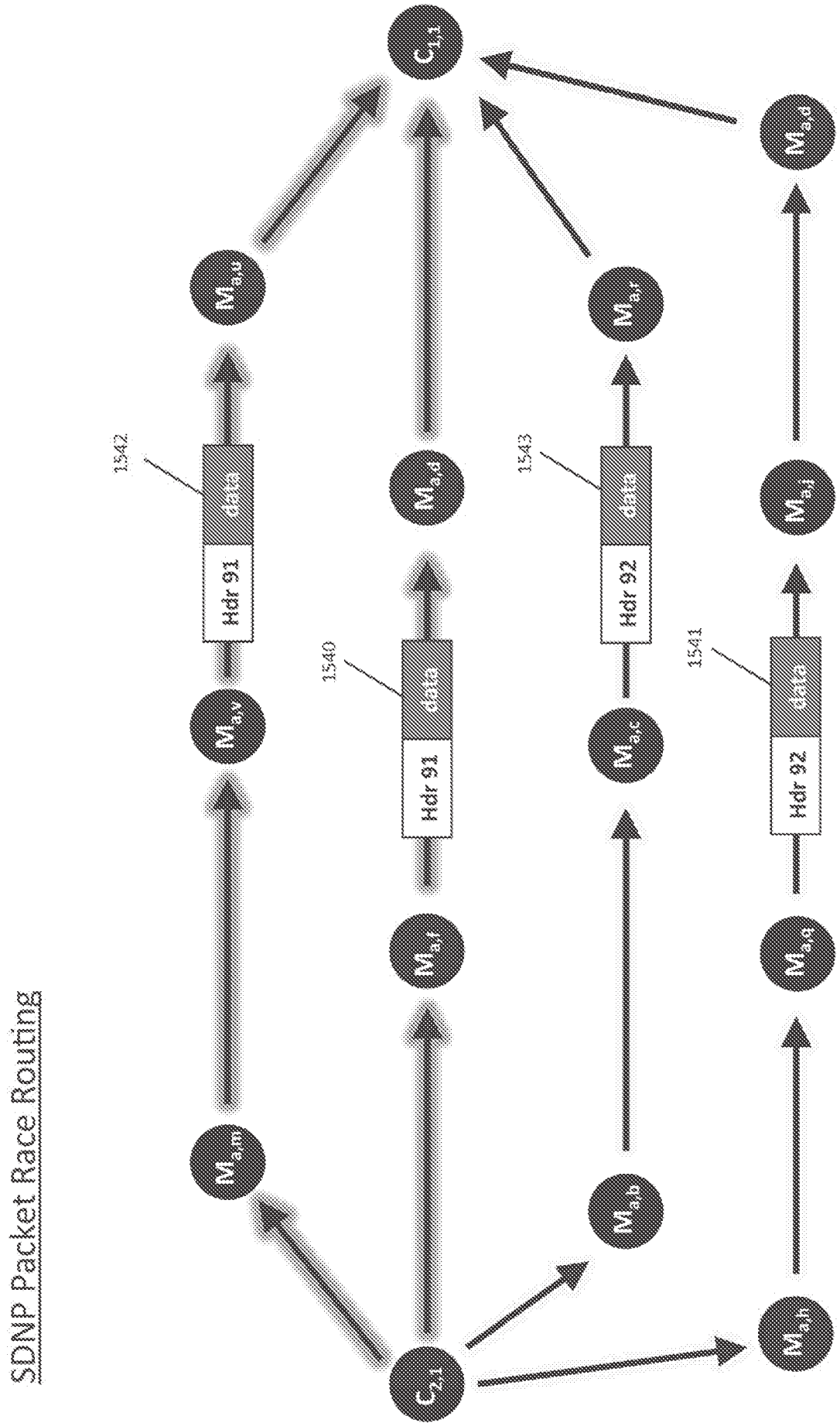

SDNP Packet Race Routing
$C_{2,1}$
$M_{a,m}$
$M_{a,v}$
$M_{a,u}$
$C_{1,1}$
$M_{a,t}$
$M_{a,d}$
$M_{a,J}$
$M_{a,b}$
$M_{a,c}$
$M_{a,r}$
$M_{a,q}$
$M_{a,J}$
$M_{a,n}$
1540
Hdr 91
data
1541
Hdr 92
data
1542
Hdr 91
data
1543
Hdr 92
data

Figure 134

Parameter	OTT	VPN	PTP	SDNP
Source Addr	Visible	Encrypted	Visible	None (NAT)
Destination Addr	Visible	Encrypted	Visible	None (NAT)
Encrypted Payload	Static (Optional)	Static (Optional)	Static (Optional)	Dynamic
Scrambled Payload	No	No	No	Dynamic
Meshed Routing	No	No	No	Dynamic
Routing Nodes	Internet Servers	Dedicated Servers	Users	Dedicated Servers
Delay	Uncontrolled	Single Route	Minimal Control	Dynamic Minimum

Figure 135