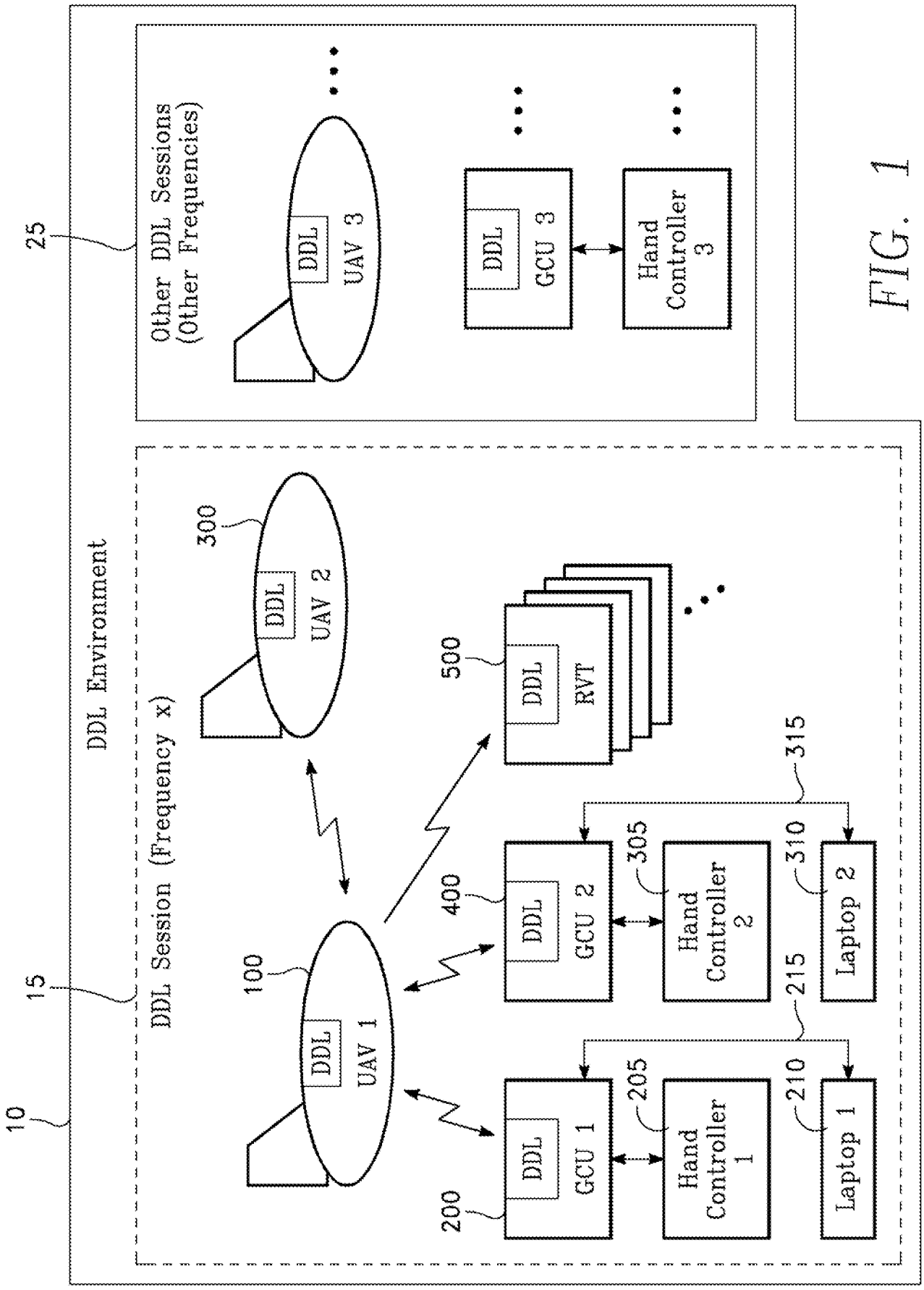

10
DDL Environment
15
DDL Session (Frequency x)
100
DDL
UAV 1
200
DDL
GCU 1
205
Hand Controller 1
210
Laptop 1
215
300
DDL
UAV 2
400
DDL
GCU 2
305
Hand Controller 2
310
Laptop 2
315
500
DDL
RVT
25
Other DDL Sessions (Other Frequencies)
DDL
UAV 3
DDL
GCU 3
Hand Controller 3

FIG. 1

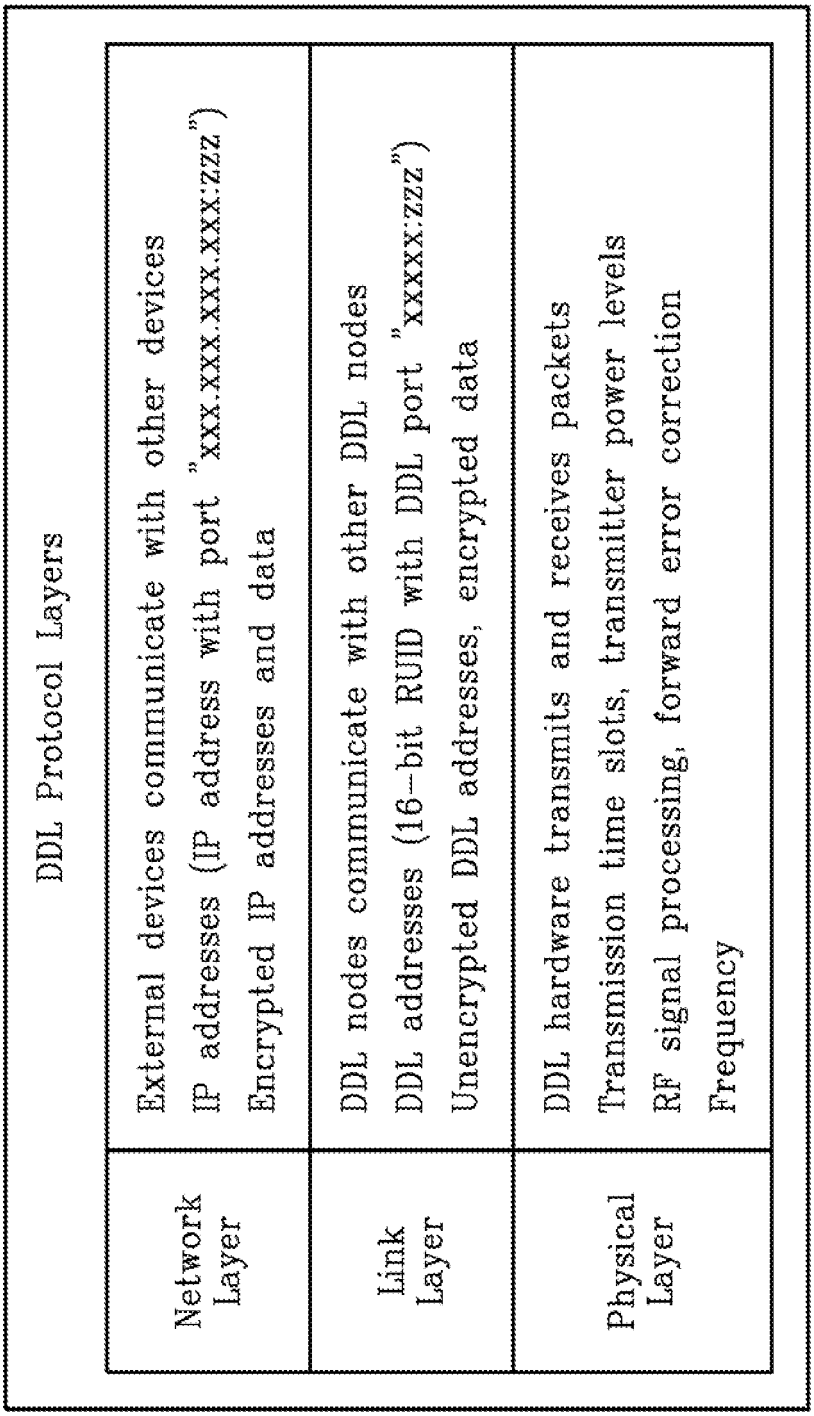

DDL Protocol Layers
Network Layer
External devices communicate with other devices
IP addresses (IP address with port "xxx.xxx.xxx.xxx:zzz")
Encrypted IP addresses and data
Link Layer
DDL nodes communicate with other DDL nodes
DDL addresses (16-bit RUID with DDL port "xxxxx:zzz")
Unencrypted DDL addresses, encrypted data
Physical Layer
DDL hardware transmits and receives packets
Transmission time slots, transmitter power levels
RF signal processing, forward error correction
Frequency

FIG. 2

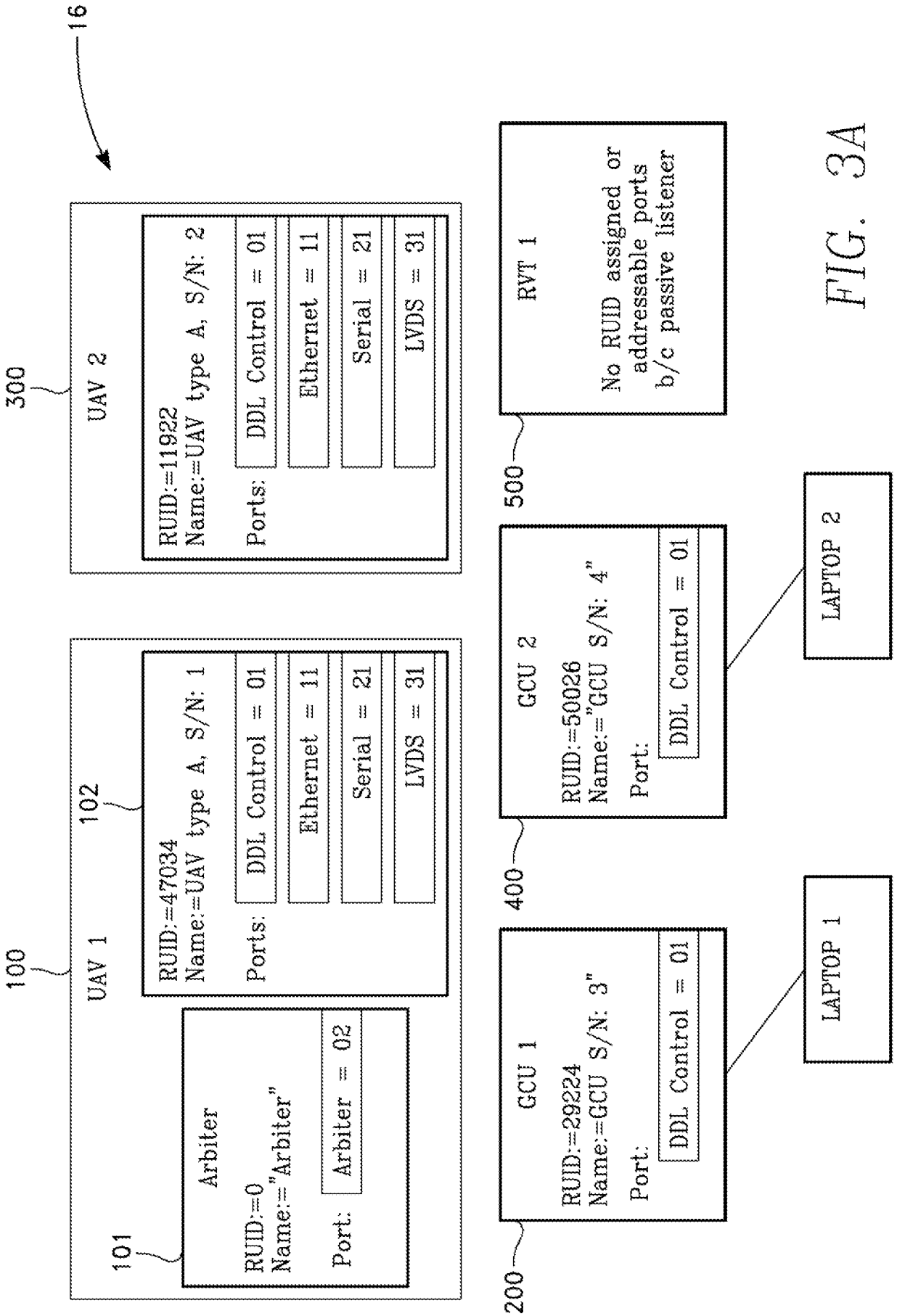

16
300
UAV 2
RUID:=11922
Name:=UAV type A, S/N: 2
Ports:
DDL Control = 01
Ethernet = 11
Serial = 21
LVDS = 31
100
UAV 1
102
RUID:=47034
Name:=UAV type A, S/N: 1
Ports:
DDL Control = 01
Ethernet = 11
Serial = 21
LVDS = 31
101
Arbiter
RUID:=0
Name:="Arbiter"
Port:
Arbiter = 02
500
RVT 1
No RUID assigned or addressable ports b/c passive listener
400
GCU 2
RUID:=50026
Name:="GCU S/N: 4"
Port:
DDL Control = 01
LAPTOP 2
200
GCU 1
RUID:=29224
Name:=GCU S/N: 3"
Port:
DDL Control = 01
LAPTOP 1

FIG. 3A

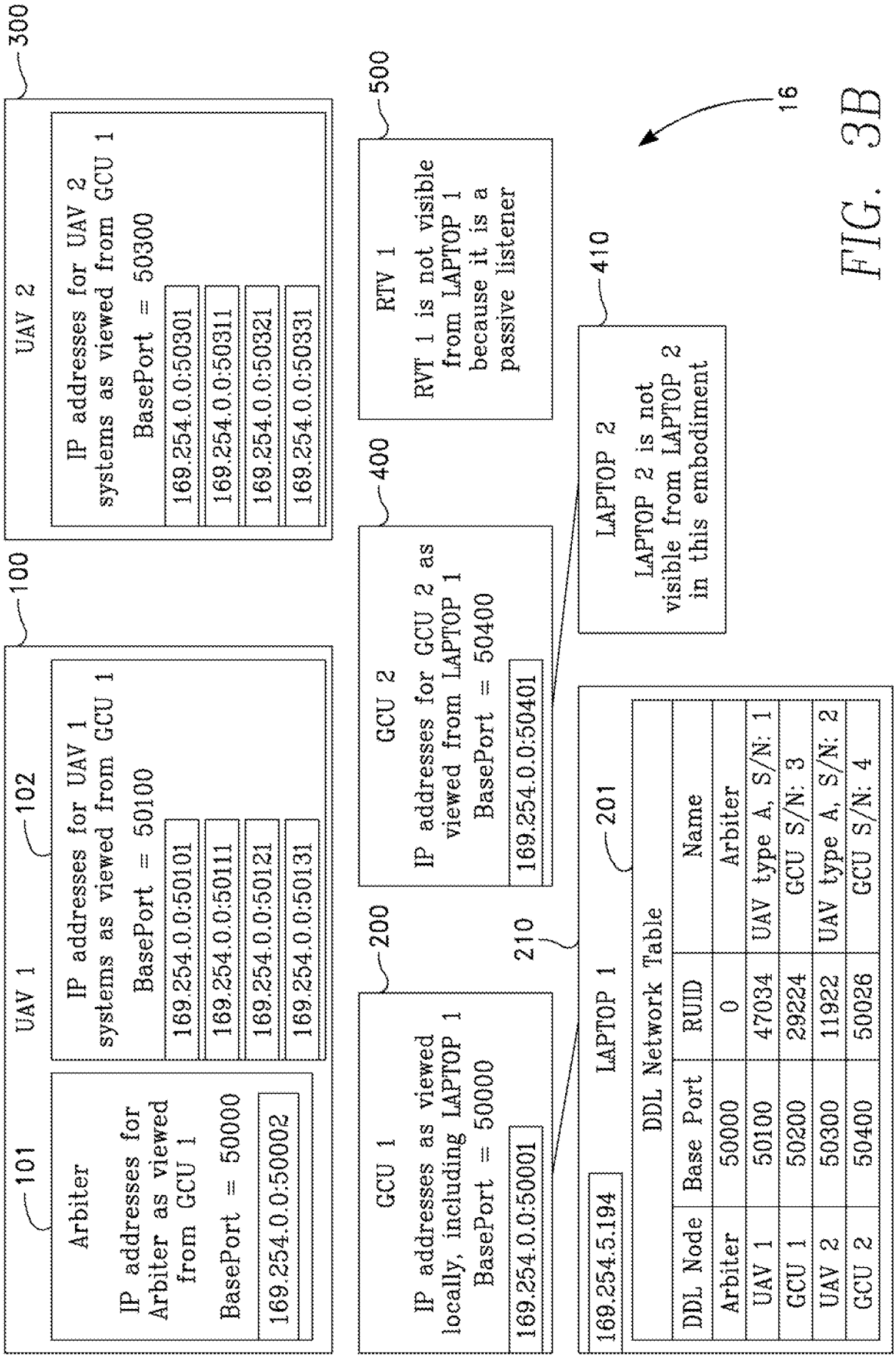

300
UAV 2
IP addresses for UAV 2 systems as viewed from GCU 1
BasePort = 50300
169.254.0.0:50301
169.254.0.0:50311
169.254.0.0:50321
169.254.0.0:50331
500
RTV 1
RVT 1 is not visible from LAPTOP 1 because it is a passive listener
16
100
UAV 1
102
IP addresses for UAV 1 systems as viewed from GCU 1
BasePort = 50100
169.254.0.0:50101
169.254.0.0:50111
169.254.0.0:50121
169.254.0.0:50131
101
Arbiter
IP addresses for Arbiter as viewed from GCU 1
BasePort = 50000
169.254.0.0:50002
400
GCU 2
IP addresses for GCU 2 as viewed from LAPTOP 1
BasePort = 50400
169.254.0.0:50401
410
LAPTOP 2
LAPTOP 2 is not visible from LAPTOP 2 in this embodiment
200
GCU 1
IP addresses as viewed locally, including LAPTOP 1
BasePort = 50000
169.254.0.0:50001
210
201
169.254.5.194
LAPTOP 1
DDL Network Table
DDL Node
Base Port
RUID
Name
Arbiter
50000
0
Arbiter
UAV 1
50100
47034
UAV type A, S/N: 1
GCU 1
50200
29224
GCU S/N: 3
UAV 2
50300
11922
UAV type A, S/N: 2
GCU 2
50400
50026
GCU S/N: 4

FIG. 3B

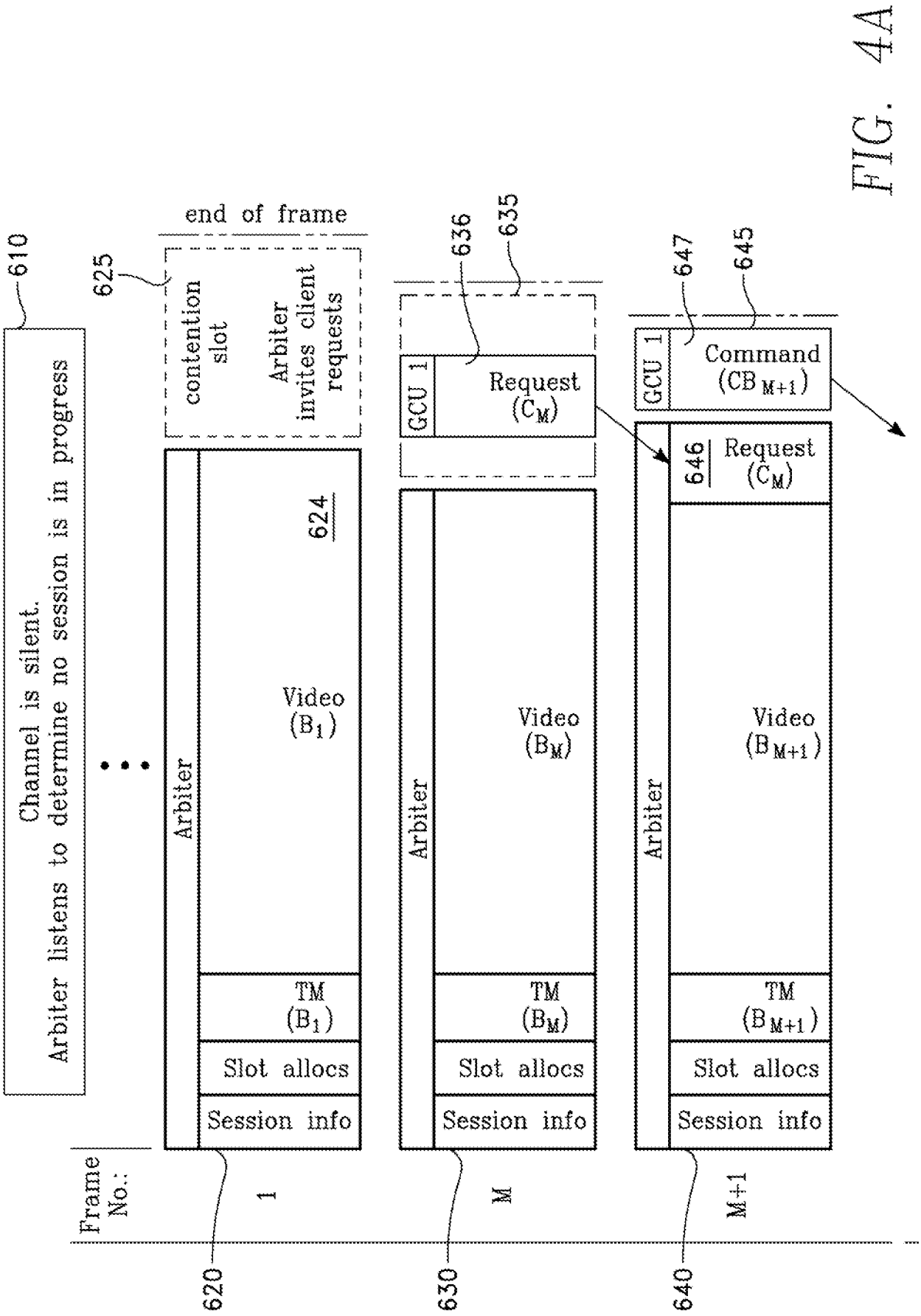

610
Channel is silent.
Arbiter listens to determine no session is in progress
625
contention slot
Arbiter invites client requests
end of frame
636
635
647
645
GCU 1
Request (C_M)
GCU 1
Command (CB_{M+1})
646
Request (C_M)
624
Video (B_1)
Video (B_M)
Video (B_{M+1})
Arbiter
TM (B_1)
TM (B_M)
TM (B_{M+1})
Slot allocs
Session info
Frame No.:
1
M
M+1
620
630
640

FIG. 4A

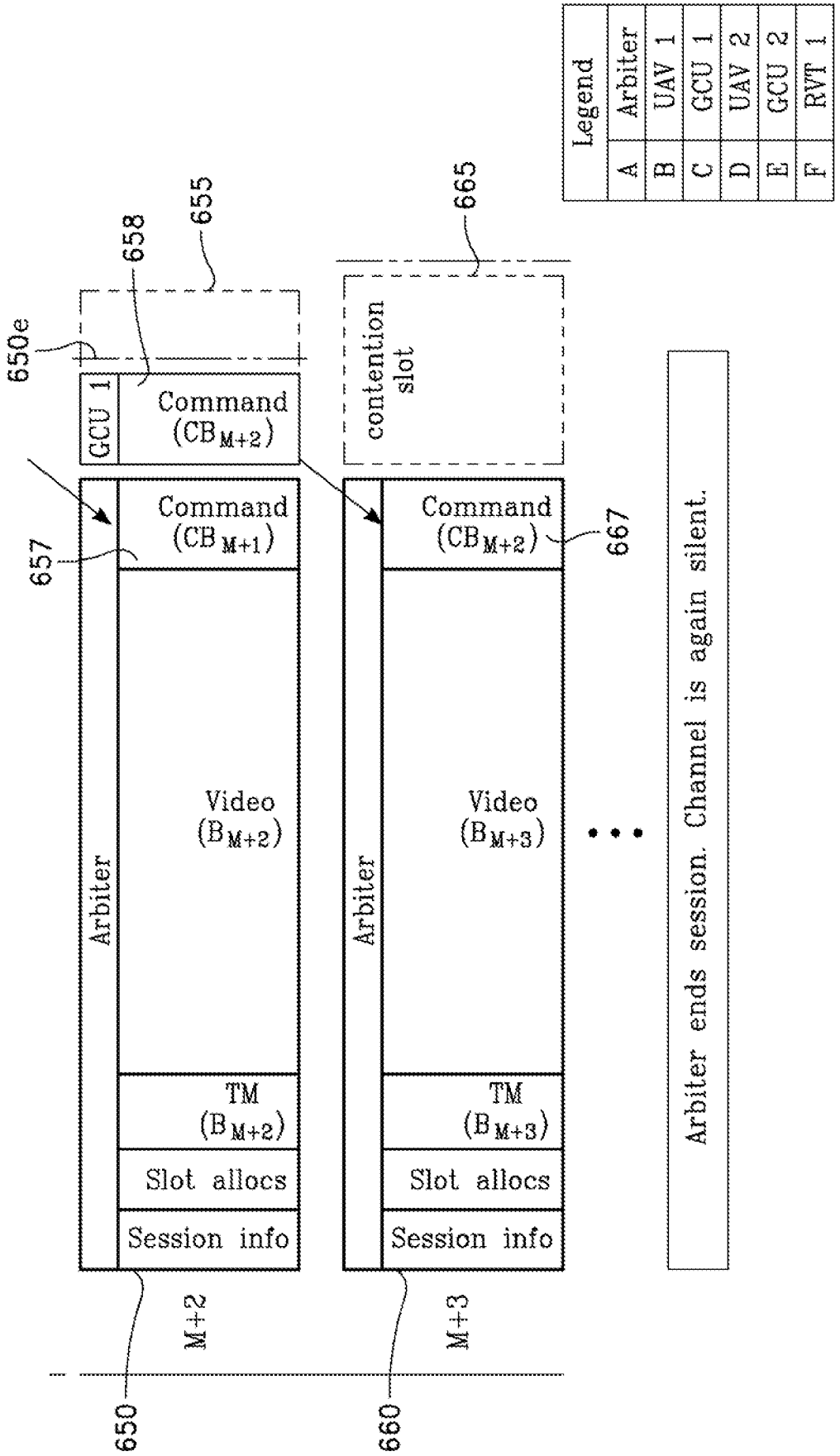

Legend
A Arbiter
B UAV 1
C GCU 1
D UAV 2
E GCU 2
F RVT 1
650e
655
658
665
GCU 1
Command (CB M+2)
contention slot
Command (CB M+1)
Command (CB M+2)
657
667
Arbiter
Video (B M+2)
Video (B M+3)
TM (B M+2)
TM (B M+3)
Slot allocs
Session info
Arbiter ends session. Channel is again silent.
M+2
M+3
650
660

FIG. 4B

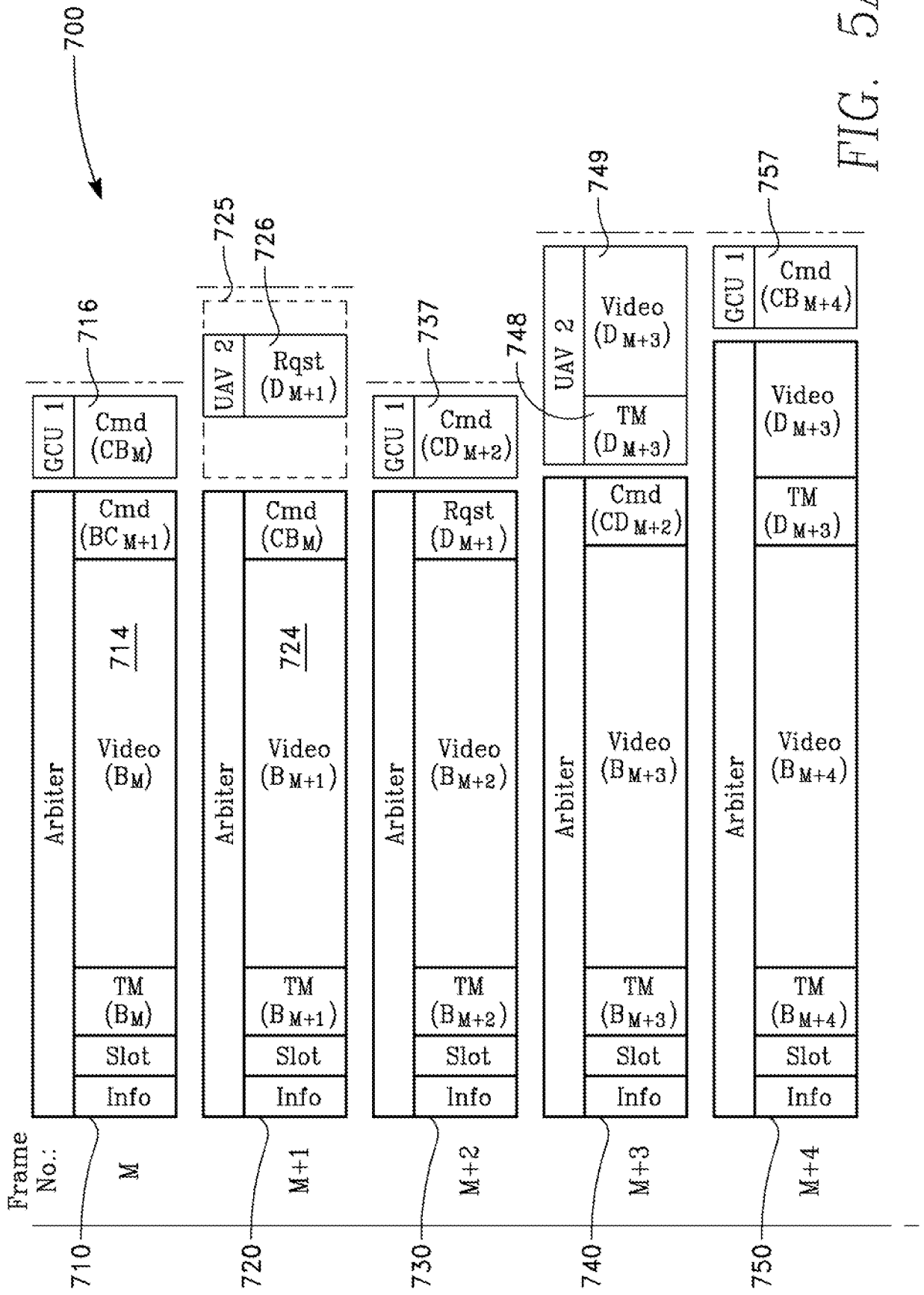

700
716
725
726
737
748
749
757
GCU 1
Cmd (CB M)
UAV 2
Rqst (D M+1)
GCU 1
Cmd (CD M+2)
UAV 2
Video (D M+3)
TM (D M+3)
GCU 1
Cmd (CB M+4)
Arbiter
Cmd (BC M+1)
714
Video (B M)
TM (B M)
Slot
Info
Arbiter
Cmd (CB M)
724
Video (B M+1)
TM (B M+1)
Slot
Info
Arbiter
Rqst (D M+1)
Video (B M+2)
TM (B M+2)
Slot
Info
Arbiter
Cmd (CD M+2)
Video (B M+3)
TM (B M+3)
Slot
Info
Arbiter
Video (D M+3)
TM (D M+3)
Video (B M+4)
TM (B M+4)
Slot
Info
Frame No.:
M
M+1
M+2
M+3
M+4
710
720
730
740
750

FIG. 5A

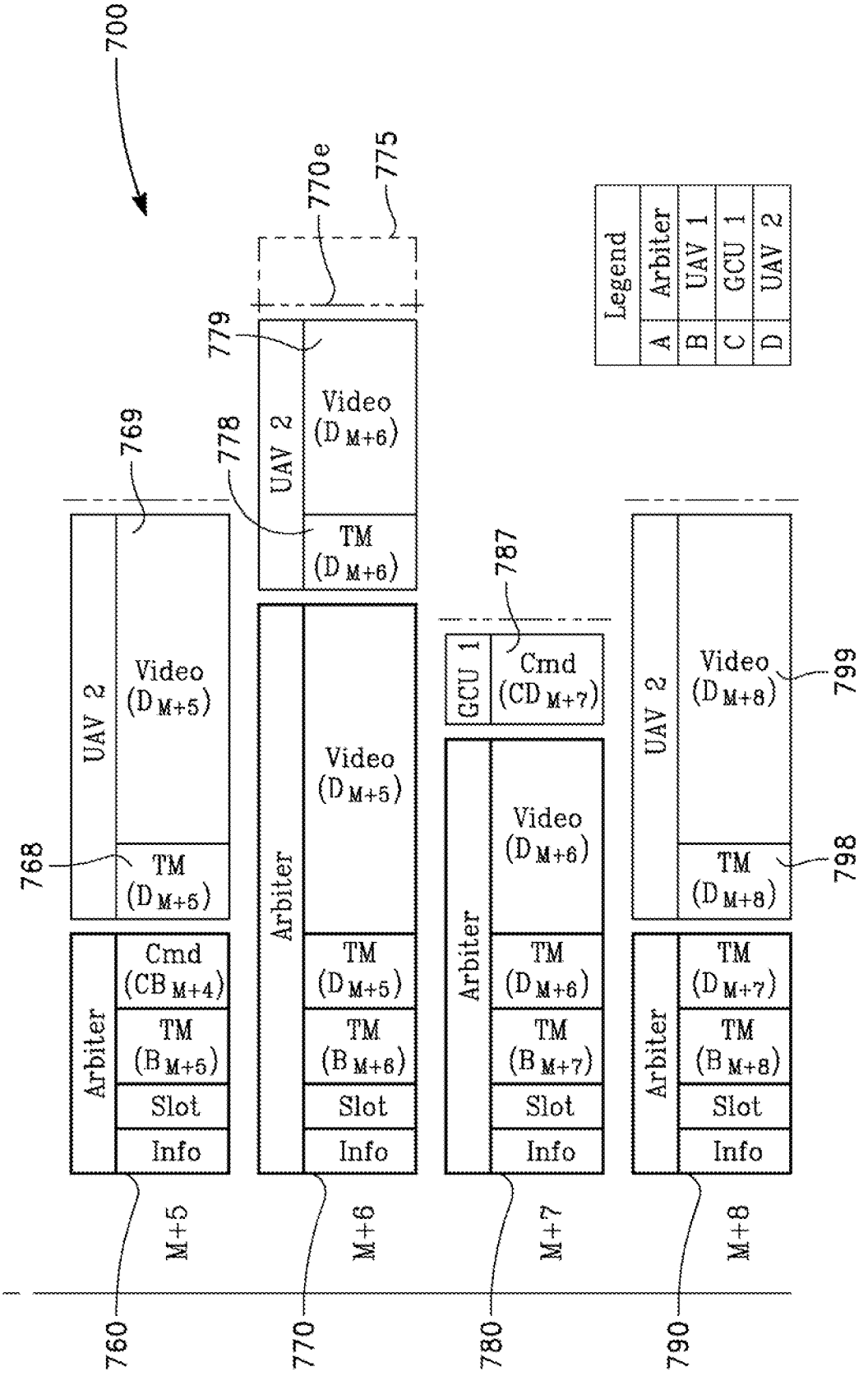

700
770e
775
779
778
769
768
798
799
787
Legend
A Arbiter
B UAV 1
C GCU 1
D UAV 2
UAV 2
Video (D M+6)
TM (D M+6)
Video (D M+5)
TM (D M+5)
GCU 1
Cmd (CD M+7)
Video (D M+8)
TM (D M+8)
Arbiter
Cmd (CB M+4)
TM (B M+5)
Slot
Info
TM (D M+5)
TM (B M+6)
TM (D M+6)
TM (B M+7)
TM (D M+7)
TM (B M+8)
M+5
M+6
M+7
M+8
760
770
780
790

FIG. 5B

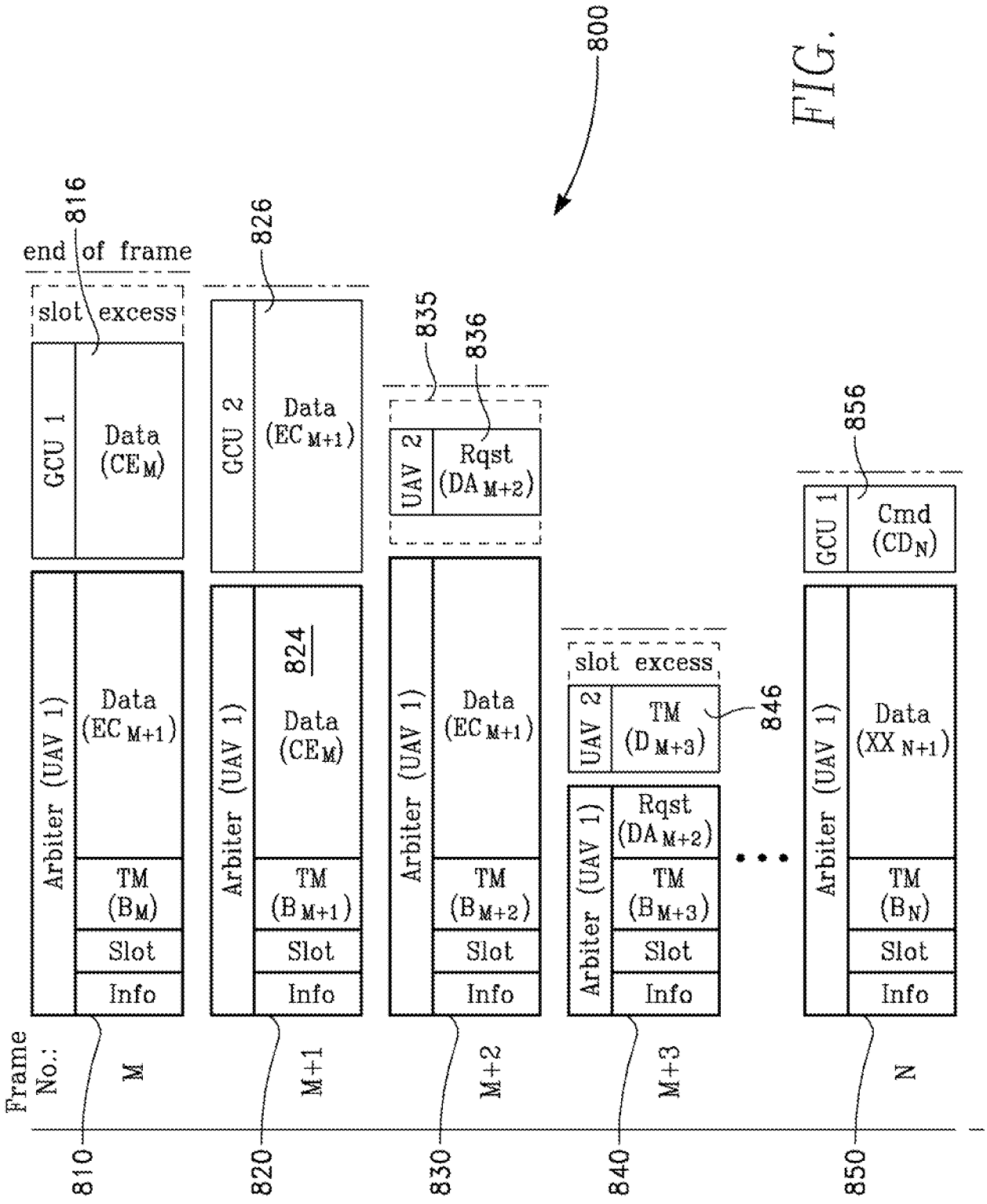

800
816
826
835
836
856
end of frame
slot excess
GCU 1
Data (CE M)
GCU 2
Data (EC M+1)
UAV 2
Rqst (DA M+2)
GCU 1
Cmd (CD N)
Arbiter (UAV 1)
Data (EC M+1)
824
Data (CE M)
Data (EC M+1)
slot excess
UAV 2
TM (D M+3)
846
Data (XX N+1)
TM (B M)
TM (B M+1)
TM (B M+2)
Rqst (DA M+2)
TM (B M+3)
TM (B N)
Slot
Info
Frame No.:
M
M+1
M+2
M+3
N
810
820
830
840
850

FIG. 6A

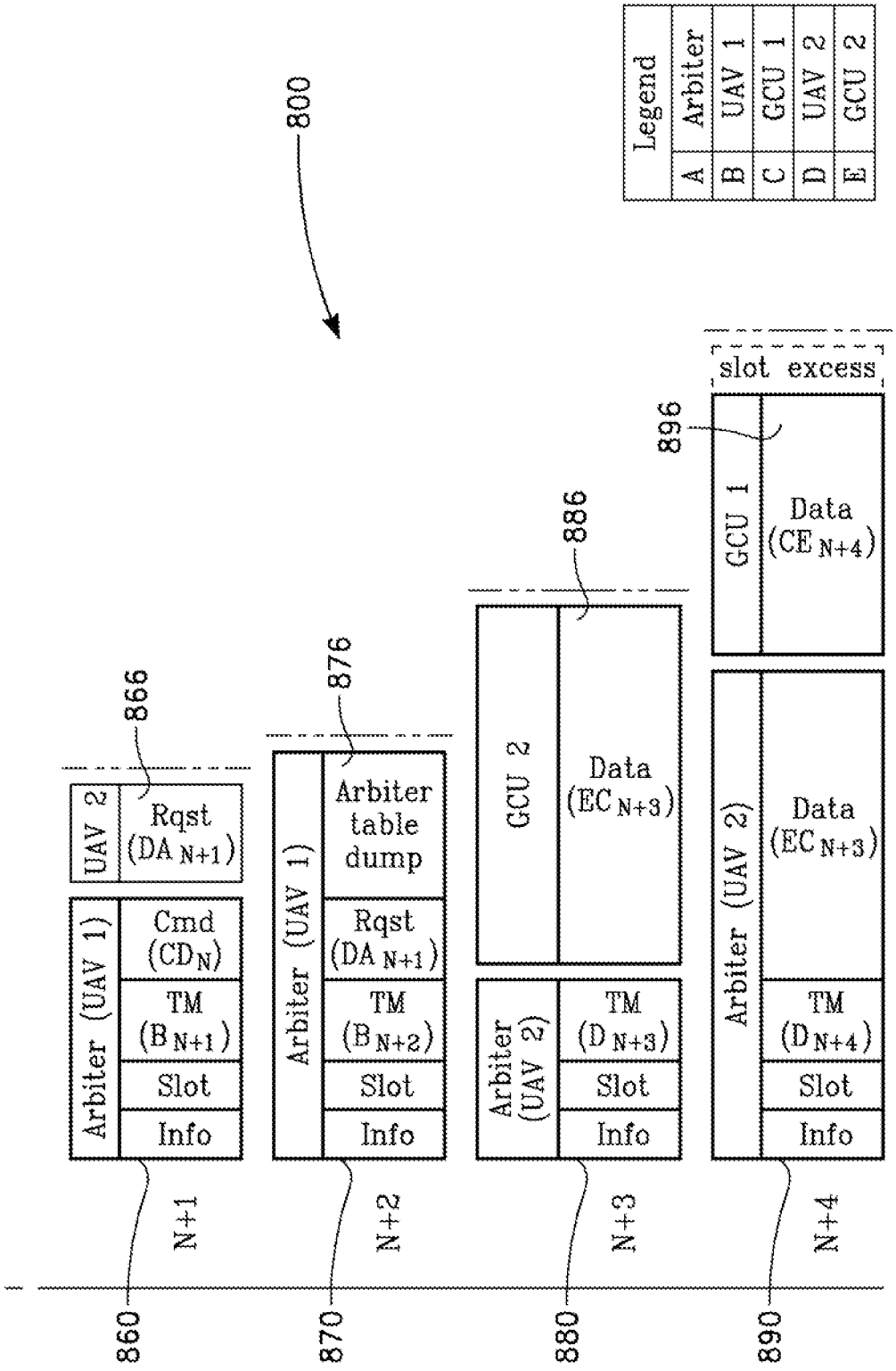

Legend
A Arbiter
B UAV 1
C GCU 1
D UAV 2
E GCU 2
800
slot excess
896
886
876
866
GCU 1
Data (CE N+4)
GCU 2
Data (EC N+3)
Arbiter table dump
Rqst (DA N+1)
UAV 2
Rqst (DA N+1)
Arbiter (UAV 1)
Cmd (CD N)
TM (B N+1)
TM (B N+2)
Arbiter (UAV 2)
TM (D N+3)
Arbiter (UAV 2)
Data (EC N+3)
TM (D N+4)
Slot
Info
N+1
N+2
N+3
N+4
860
870
880
890

FIG. 6B