FIG 1A

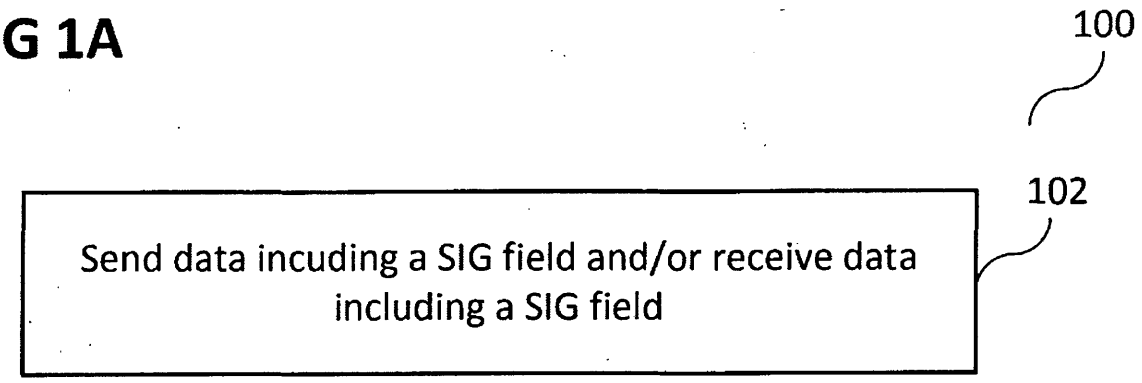


FIG 1B

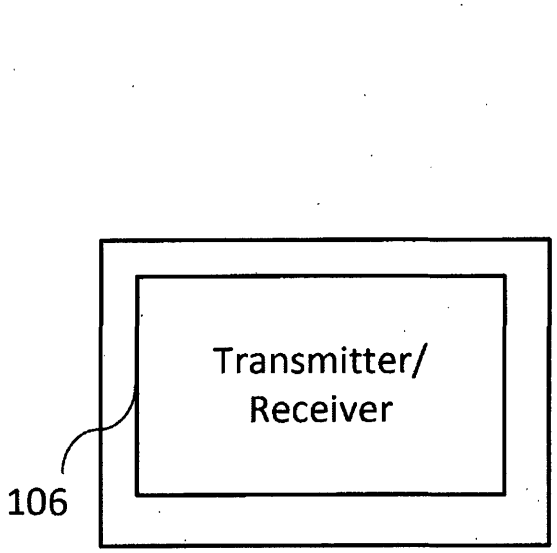


FIG 1C

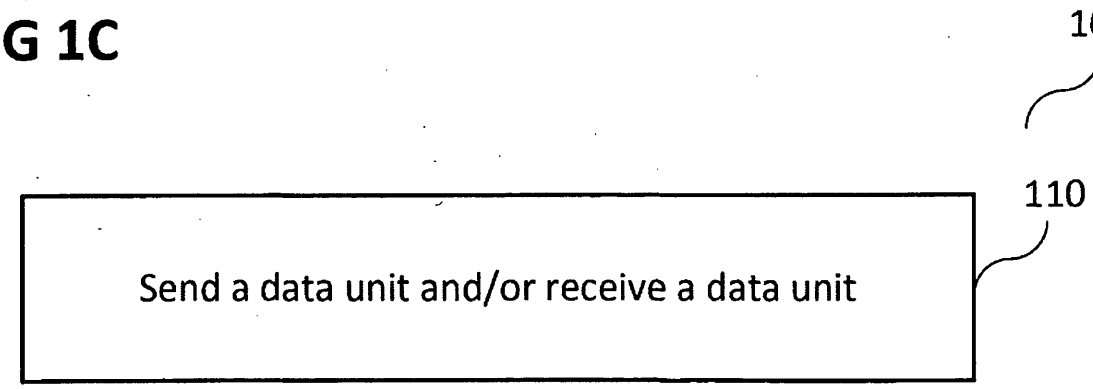


FIG 2

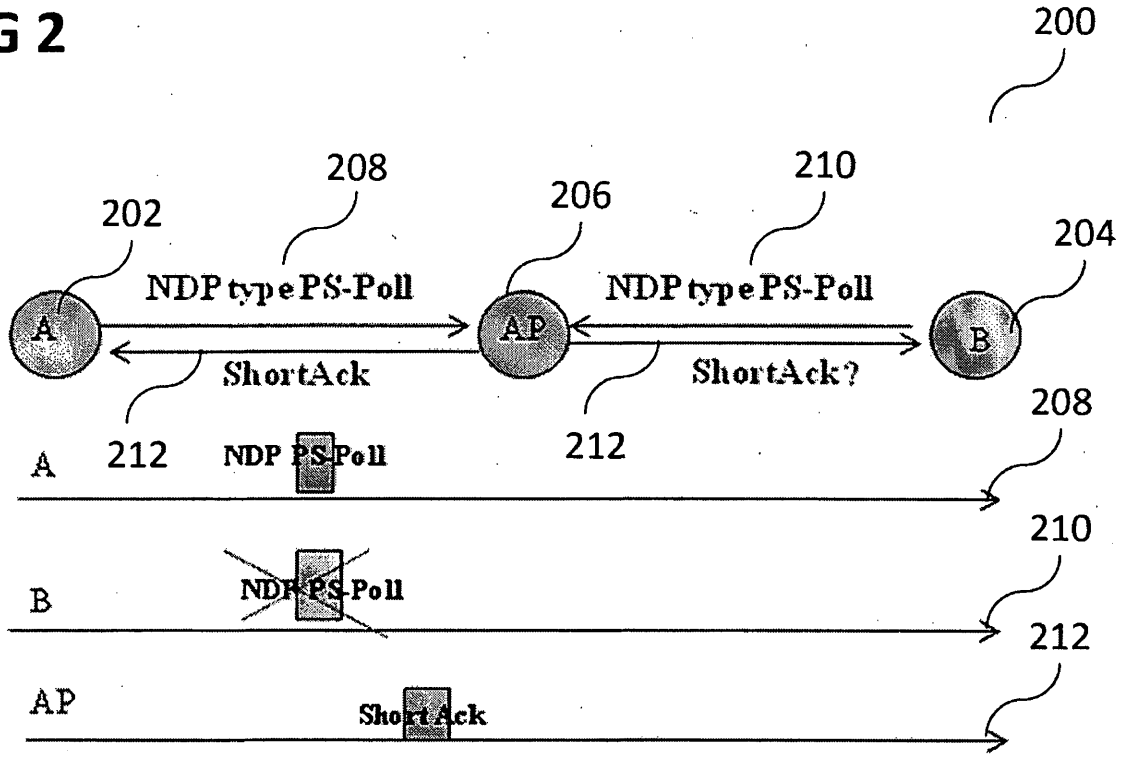

200
208
210
206
202
204
NDP type PS-Poll
NDP type PS-Poll
A
AP
B
ShortAck
ShortAck?
212
212
208
A
NDP PS-Poll
210
B
NDP PS-Poll
212
AP
ShortAck

FIG 3

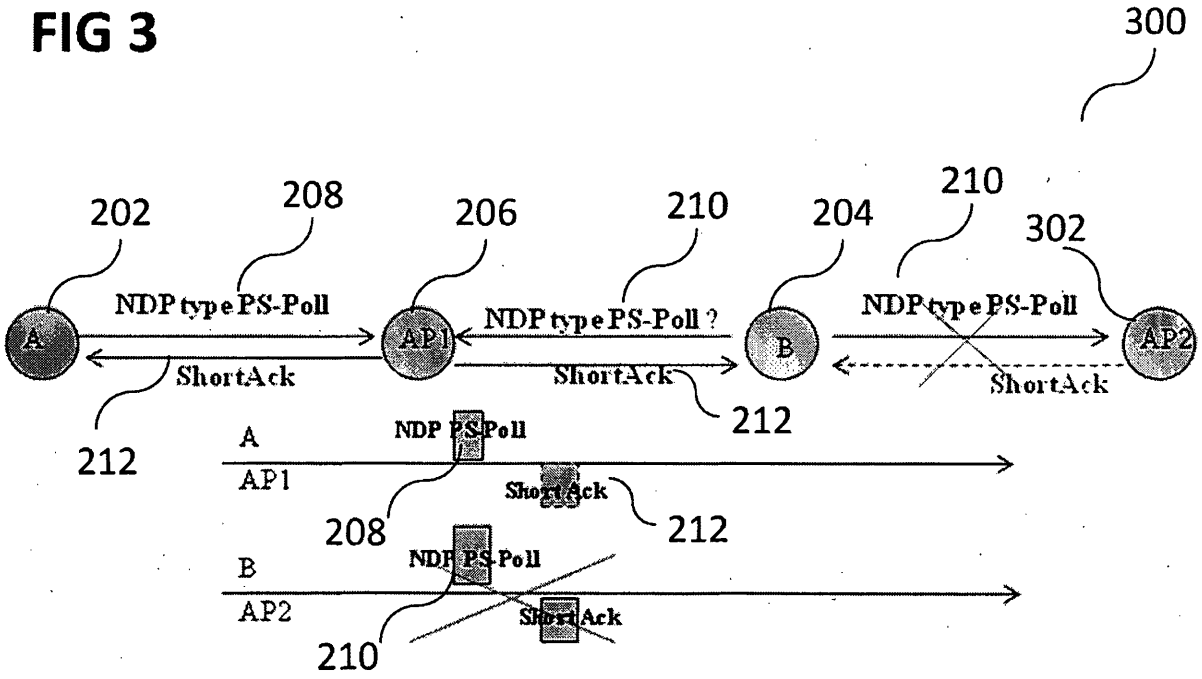

300
202
208
206
210
204
210
302
NDP type PS-Poll
NDP type PS-Poll ?
NDP type PS-Poll
A
AP1
B
AP2
ShortAck
ShortAck
ShortAck
212
212
A
NDP PS-Poll
AP1
ShortAck
208
212
B
NDP PS-Poll
AP2
ShortAck
210

FIG 4

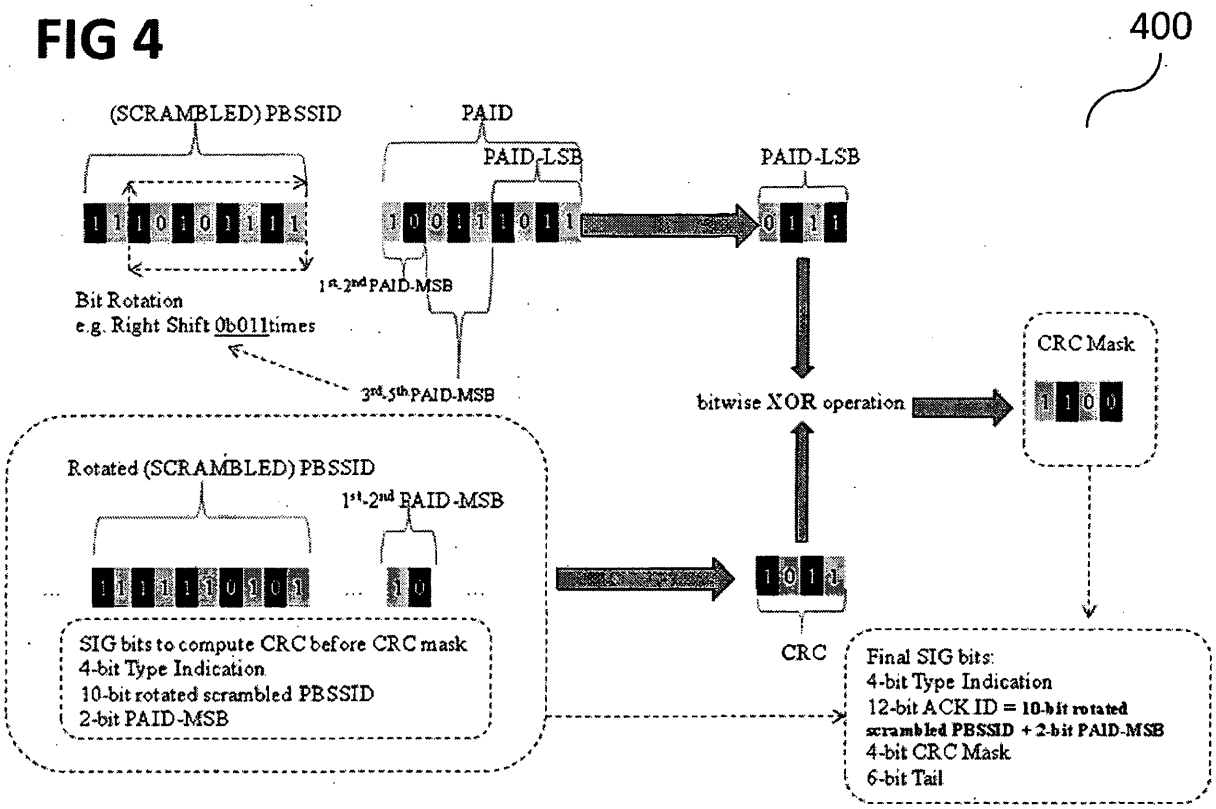

400
(SCRAMBLED) PBSSID
PAID
PAID-LSB
PAID-LSB
Bit Rotation
e.g. Right Shift 0b011times
1st-2nd PAID-MSB
3rd-5th PAID-MSB
CRC Mask
bitwise XOR operation
Rotated (SCRAMBLED) PBSSID
1st-2nd PAID-MSB
SIG bits to compute CRC before CRC mask
4-bit Type Indication
10-bit rotated scrambled PBSSID
2-bit PAID-MSB
CRC
Final SIG bits:
4-bit Type Indication
12-bit ACK ID = 10-bit rotated scrambled PBSSID + 2-bit PAID-MSB
4-bit CRC Mask
6-bit Tail

FIG 5

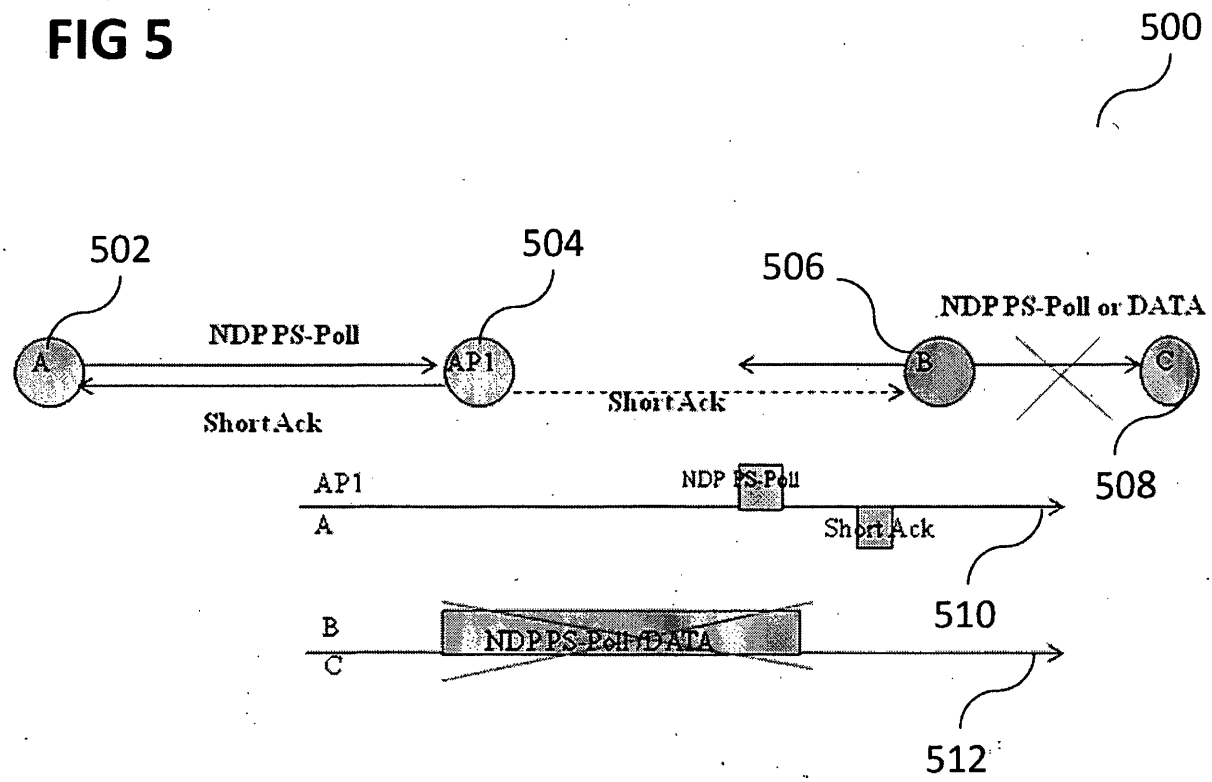

500
502
504
506
NDP PS-Poll or DATA
A
NDP PS-Poll
AP1
ShortAck
ShortAck
B
C
508
AP1
NDP PS-Poll
A
Short Ack
510
B
NDP PS-Poll/DATA
C
512

FIG 6

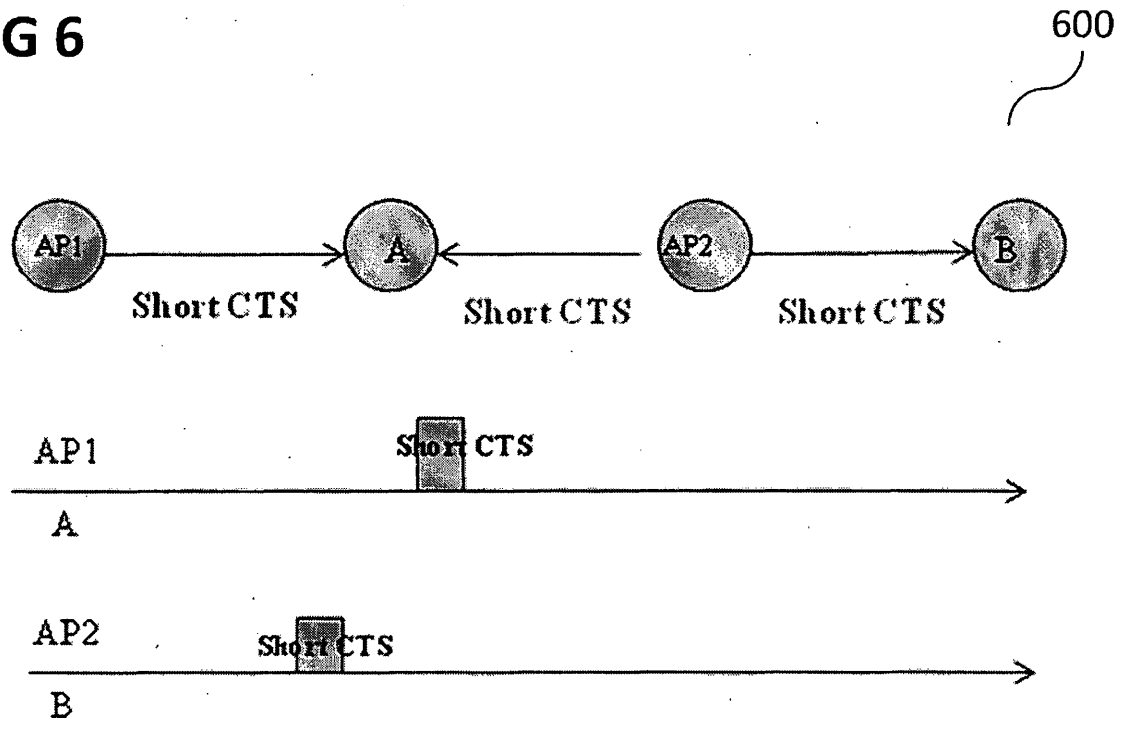

600
AP1
A
AP2
B
Short CTS
Short CTS
Short CTS
AP1
Short CTS
A
AP2
Short CTS
B

FIG 7

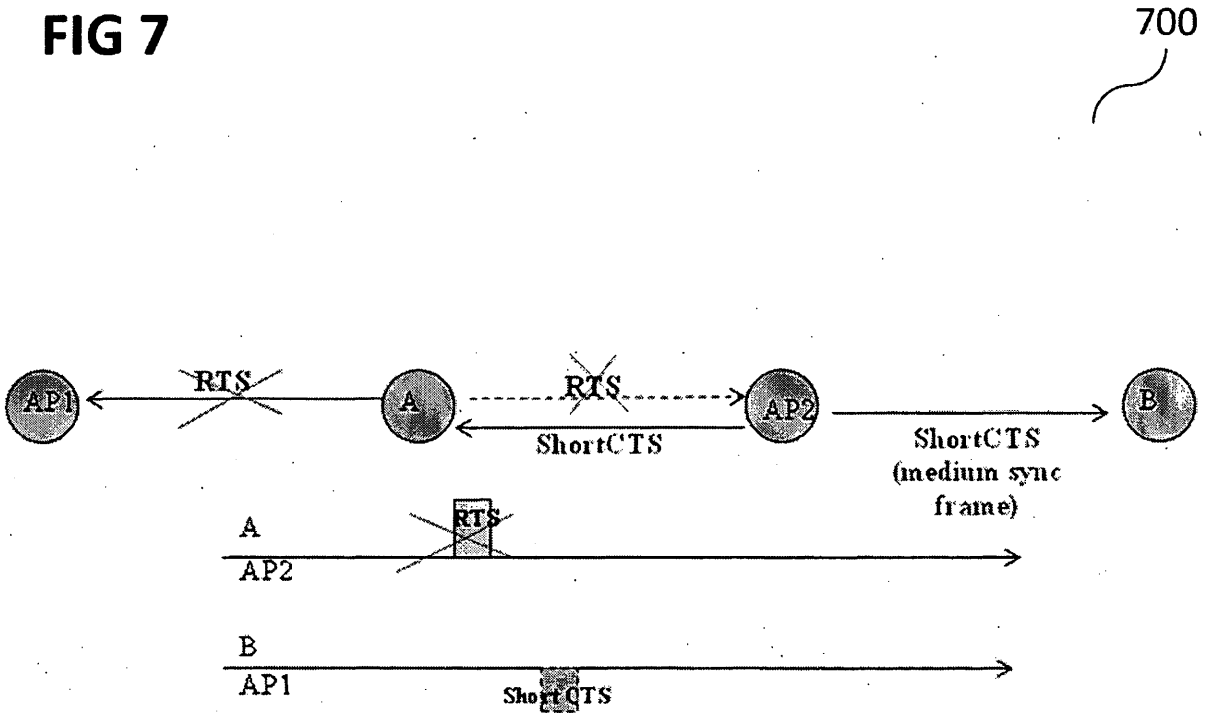

700
AP1
RTS
A
RTS
AP2
ShortCTS
B
ShortCTS
(medium sync
frame)
A
RTS
AP2
B
AP1
Short CTS

FIG 8

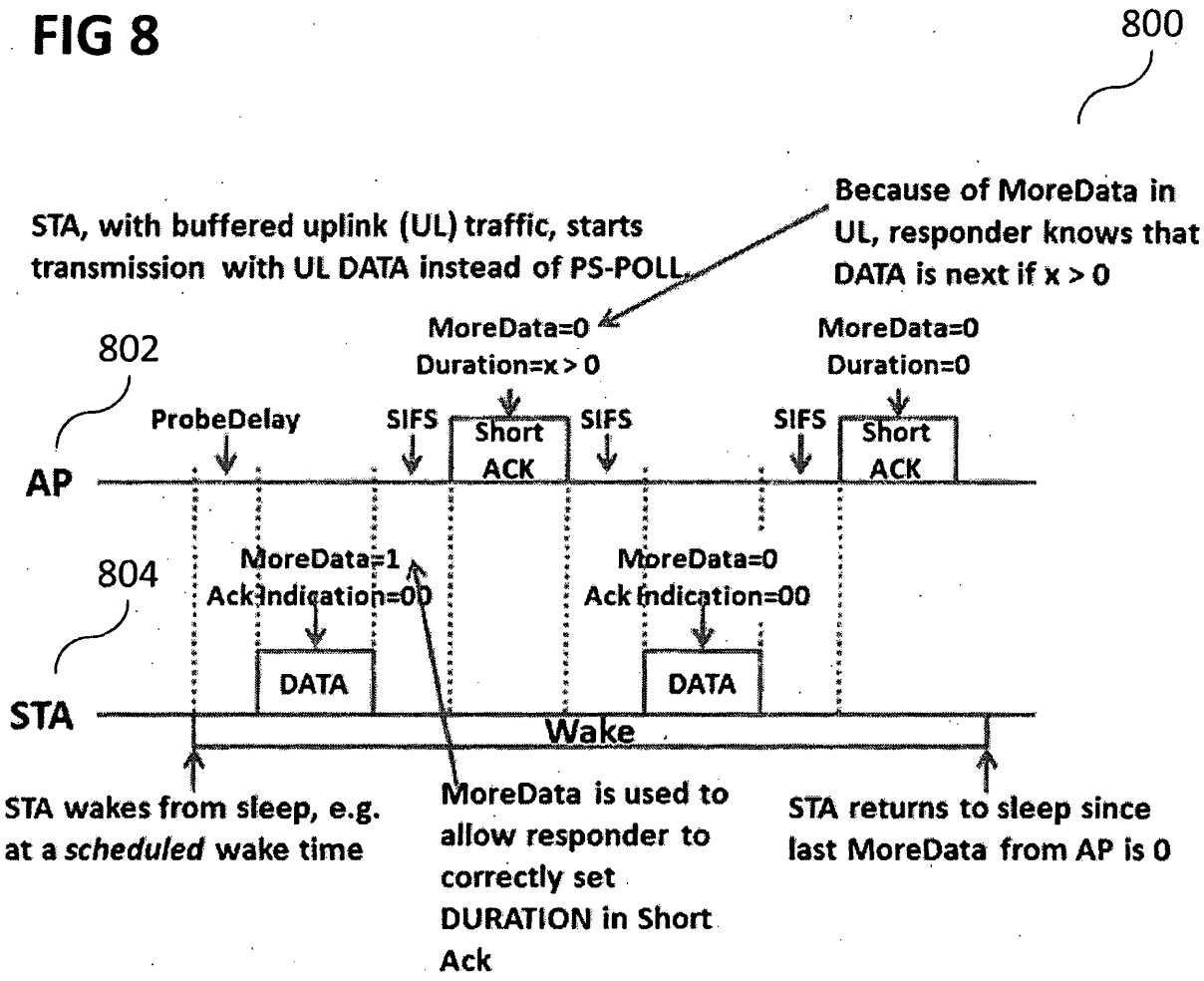


FIG 9

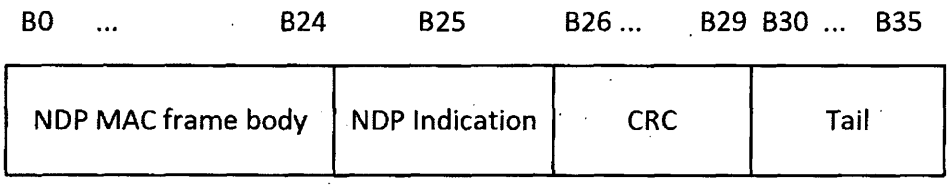


FIG 10

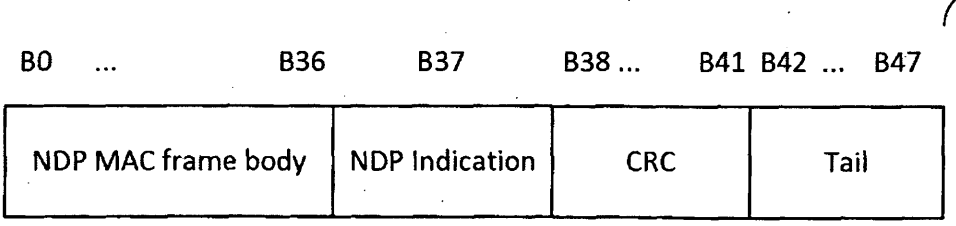


FIG 11

1100

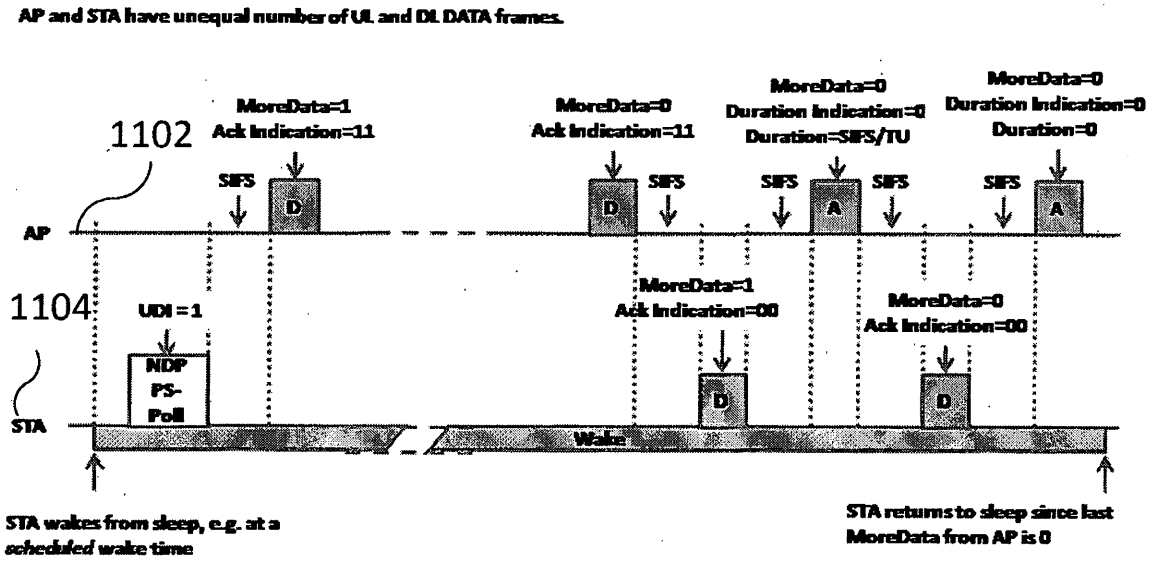


FIG 12

1200

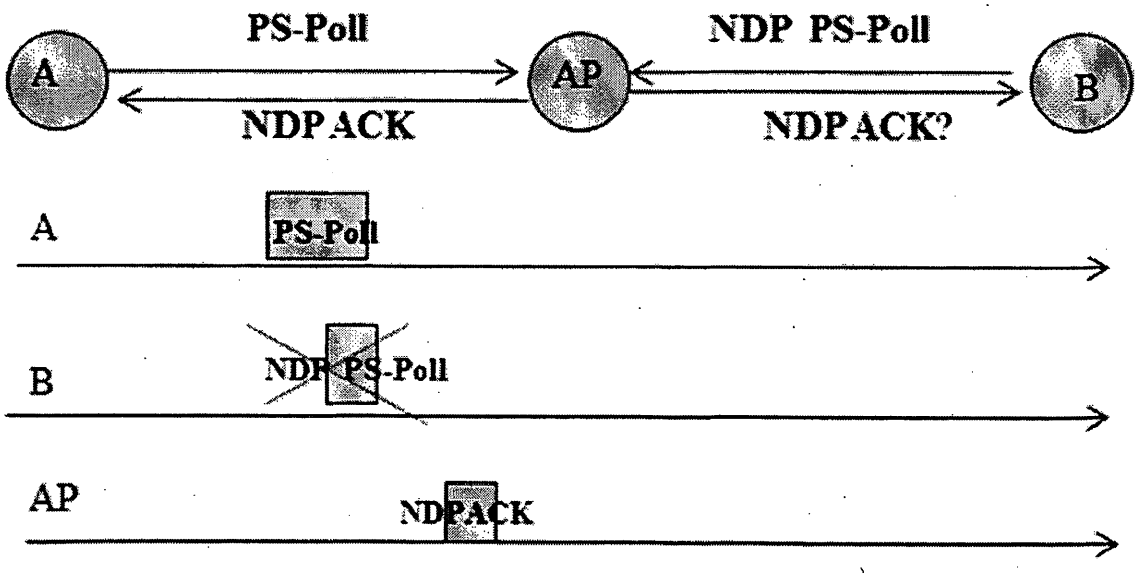


FIG 13

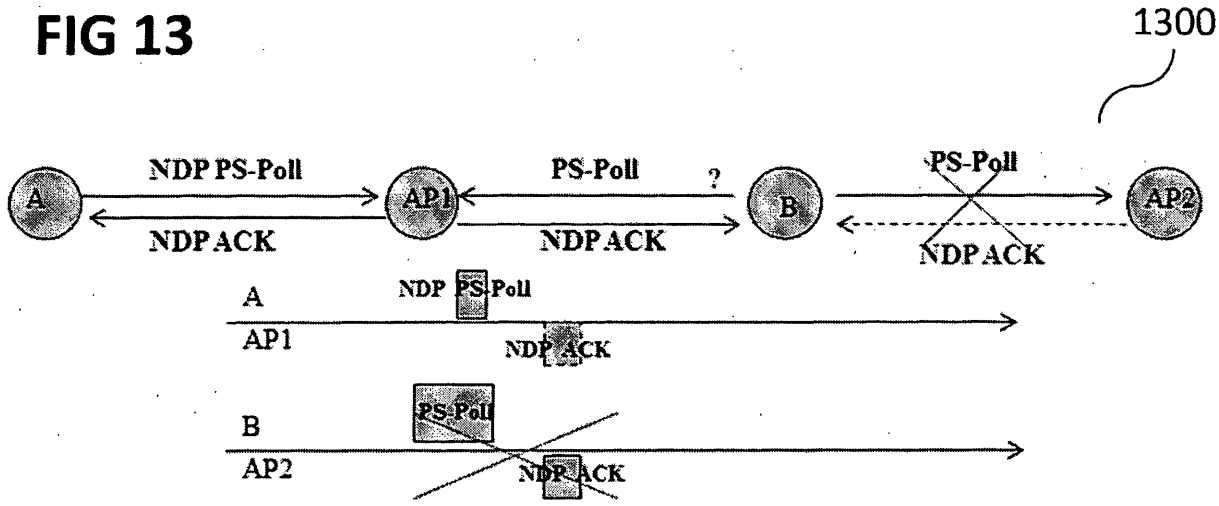

1300
A
NDP PS-Poll
AP1
PS-Poll
?
B
PS-Poll
AP2
NDP ACK
NDP ACK
NDP ACK
A
NDP PS-Poll
AP1
NDP ACK
B
PS-Poll
AP2
NDP ACK

FIG 14

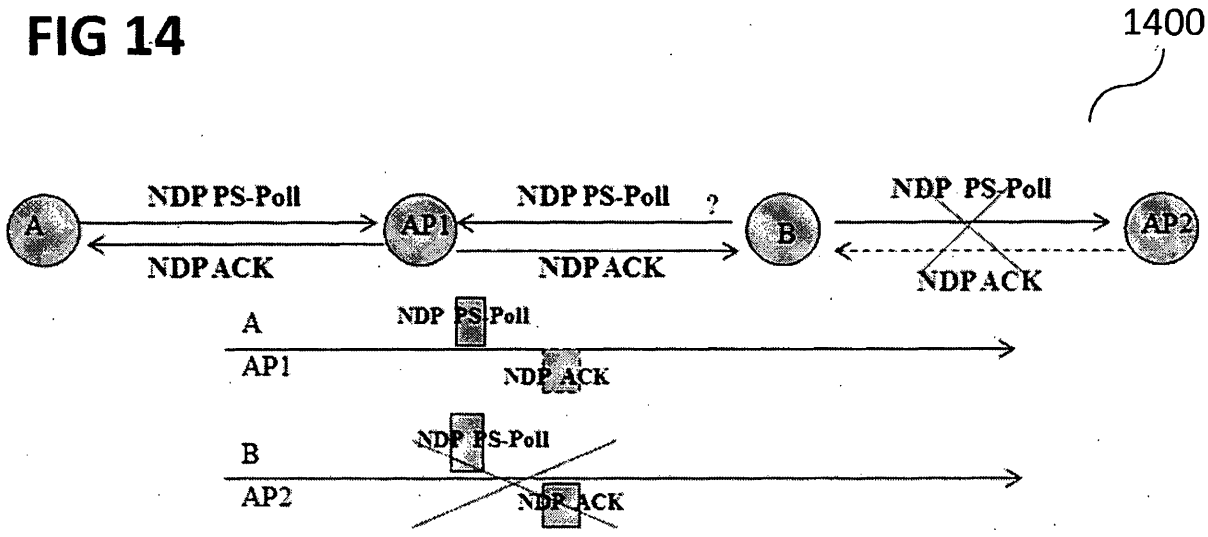

1400
A
NDP PS-Poll
AP1
NDP PS-Poll
?
B
NDP PS-Poll
AP2
NDP ACK
NDP ACK
NDP ACK
A
NDP PS-Poll
AP1
NDP ACK
B
NDP PS-Poll
AP2
NDP ACK

FIG 15

1500

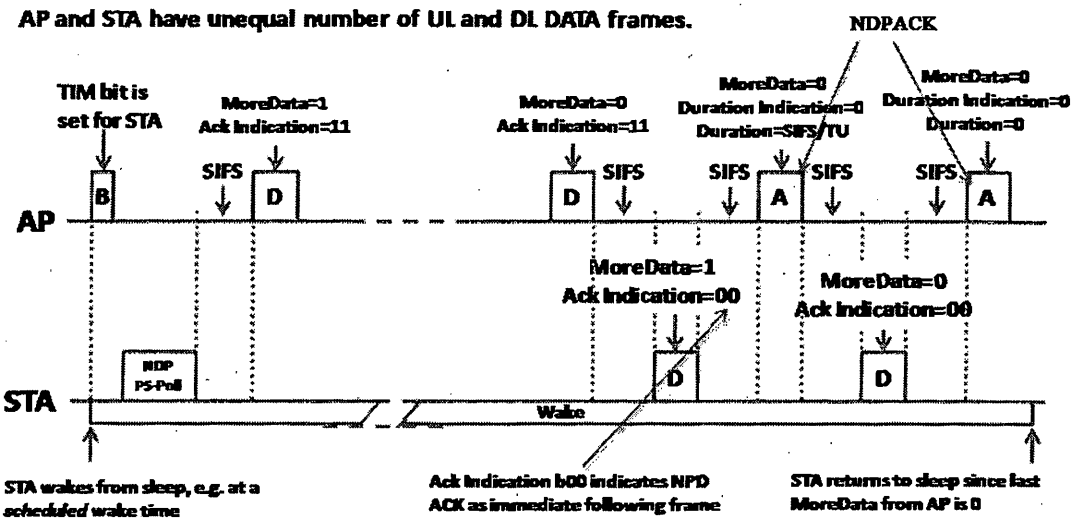


FIG 16

1600

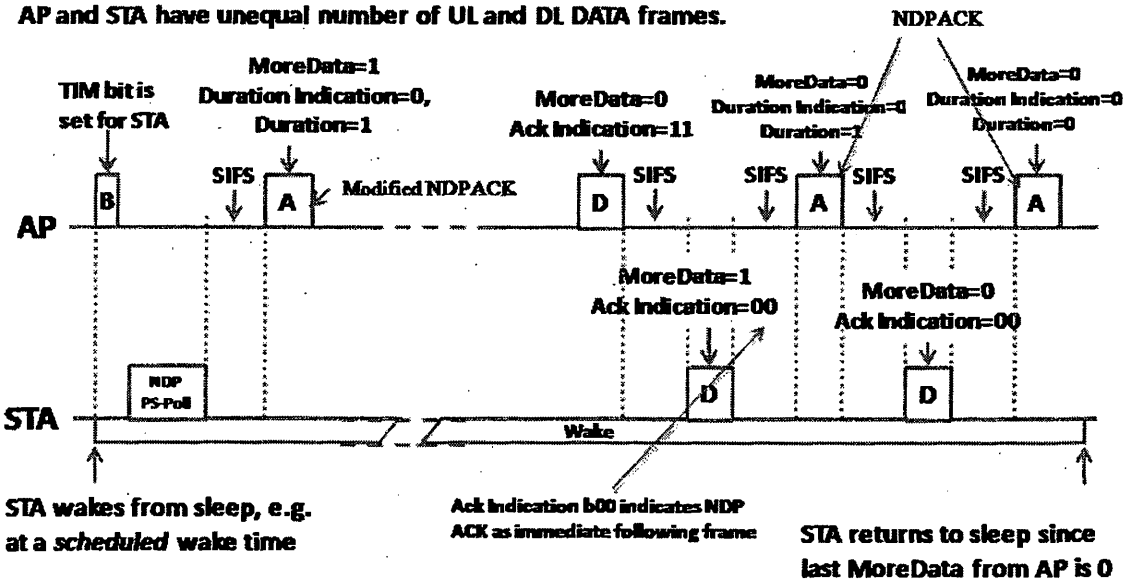


FIG 17

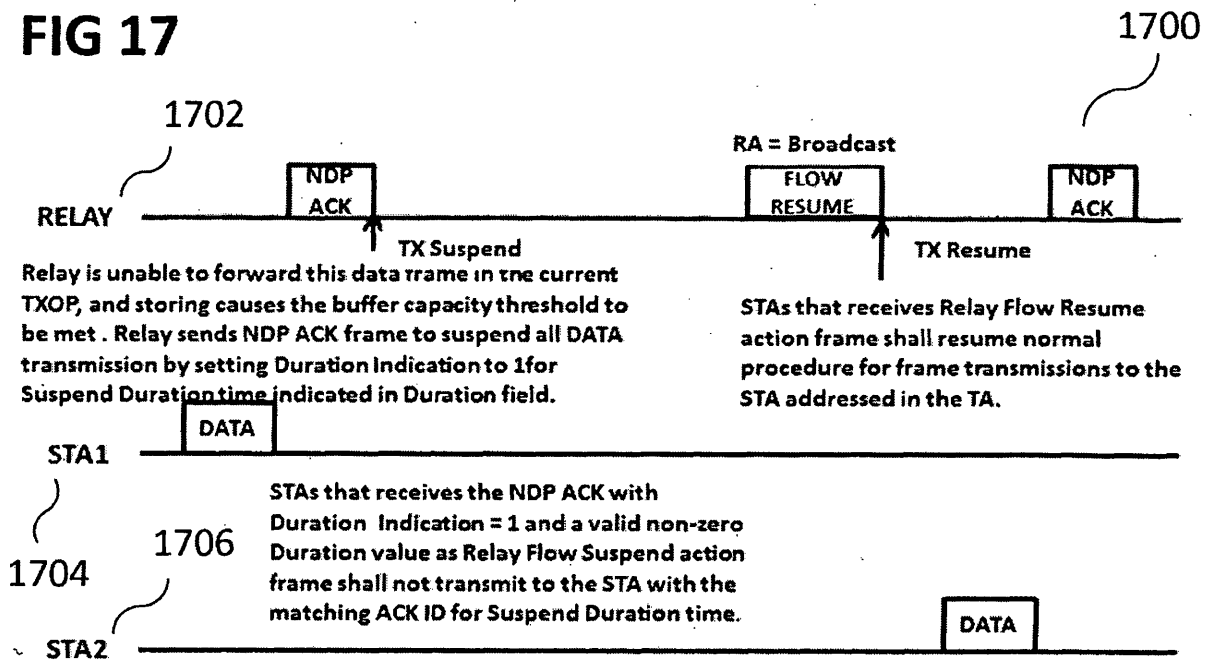

1700
1702
RELAY
NDP ACK
TX Suspend
RA = Broadcast
FLOW RESUME
NDP ACK
TX Resume
Relay is unable to forward this data frame in the current TXOP, and storing causes the buffer capacity threshold to be met . Relay sends NDP ACK frame to suspend all DATA transmission by setting Duration Indication to 1for Suspend Duration time indicated in Duration field.
STAs that receives Relay Flow Resume action frame shall resume normal procedure for frame transmissions to the STA addressed in the TA.
DATA
STA1
1704
1706
STAs that receives the NDP ACK with Duration Indication = 1 and a valid non-zero Duration value as Relay Flow Suspend action frame shall not transmit to the STA with the matching ACK ID for Suspend Duration time.
STA2
DATA

FIG 18

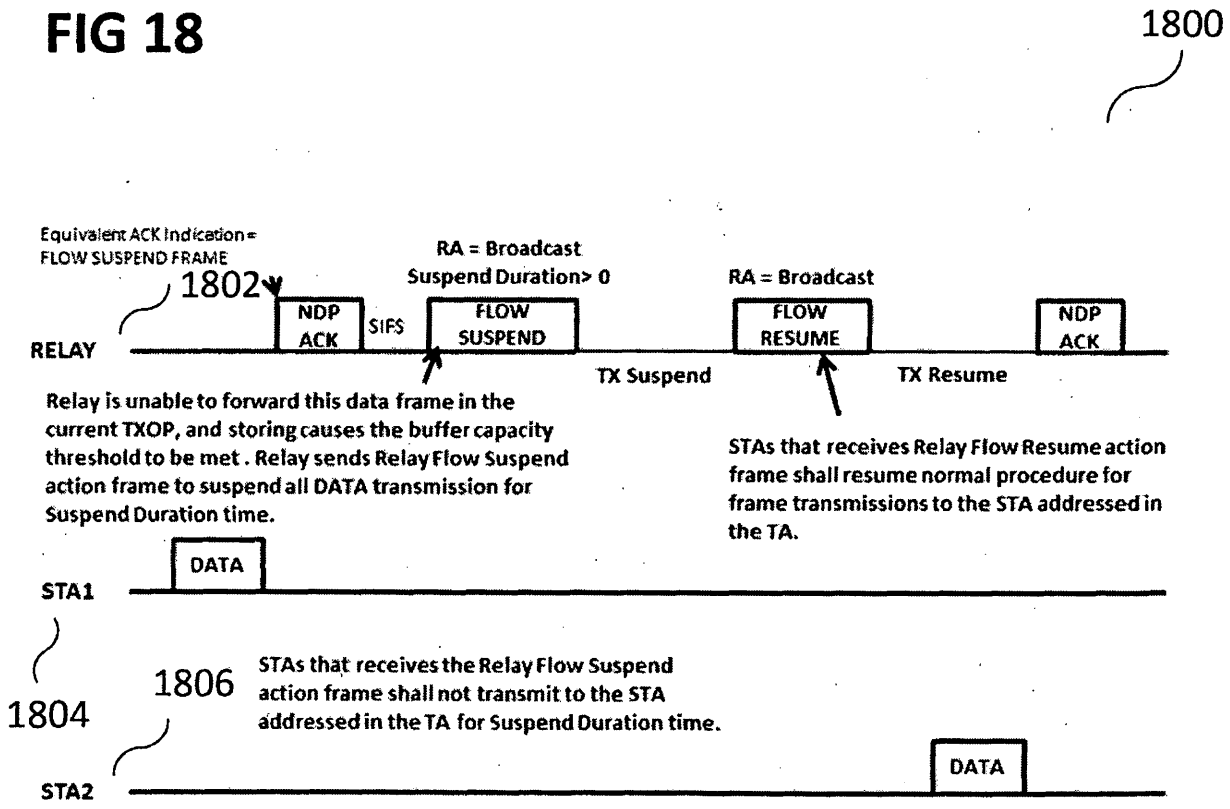

1800
Equivalent ACK Indication = FLOW SUSPEND FRAME
1802
RA = Broadcast
Suspend Duration> 0
RA = Broadcast
RELAY
NDP ACK
SIFS
FLOW SUSPEND
FLOW RESUME
NDP ACK
TX Suspend
TX Resume
Relay is unable to forward this data frame in the current TXOP, and storing causes the buffer capacity threshold to be met . Relay sends Relay Flow Suspend action frame to suspend all DATA transmission for Suspend Duration time.
STAs that receives Relay Flow Resume action frame shall resume normal procedure for frame transmissions to the STA addressed in the TA.
DATA
STA1
1804
1806
STAs that receives the Relay Flow Suspend action frame shall not transmit to the STA addressed in the TA for Suspend Duration time.
STA2
DATA

FIG 19

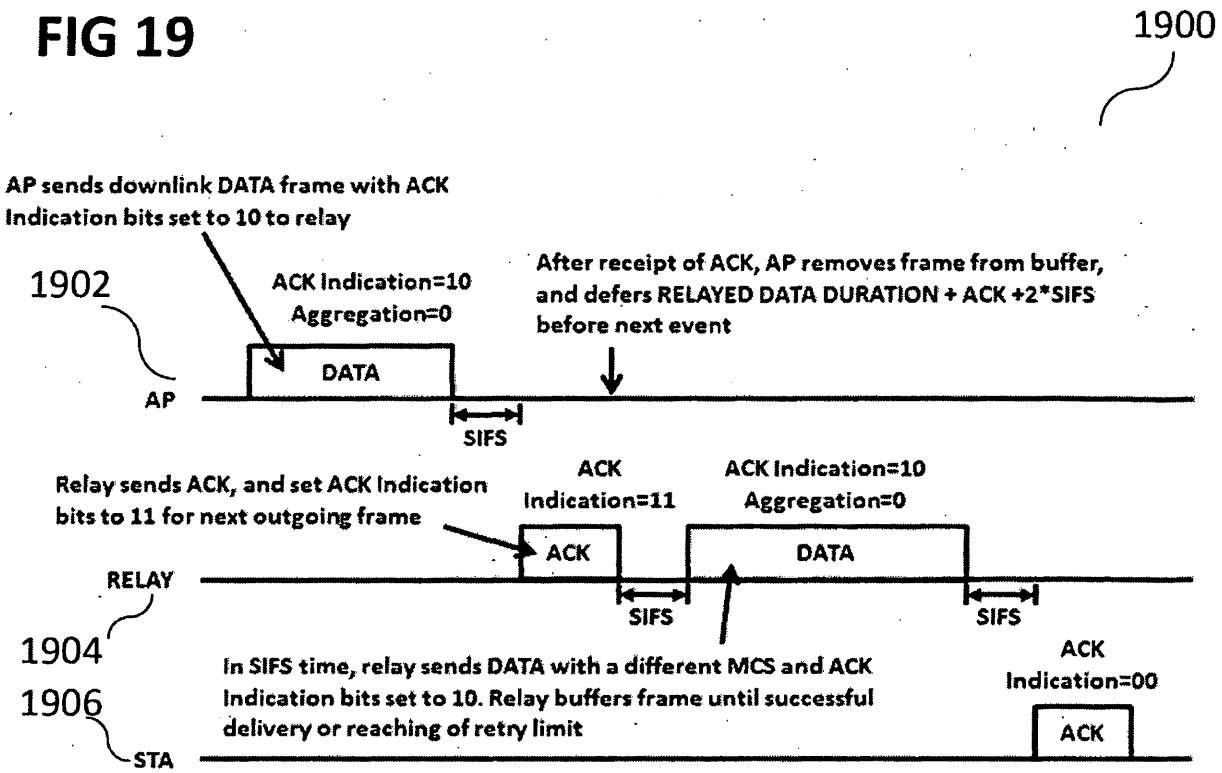

1900
AP sends downlink DATA frame with ACK Indication bits set to 10 to relay
1902
ACK Indication=10
Aggregation=0
After receipt of ACK, AP removes frame from buffer, and defers RELAYED DATA DURATION + ACK +2*SIFS before next event
AP
DATA
SIFS
Relay sends ACK, and set ACK Indication bits to 11 for next outgoing frame
ACK Indication=11
ACK Indication=10
Aggregation=0
ACK
DATA
RELAY
SIFS
SIFS
1904
In SIFS time, relay sends DATA with a different MCS and ACK Indication bits set to 10. Relay buffers frame until successful delivery or reaching of retry limit
ACK Indication=00
1906
ACK
STA

FIG 20

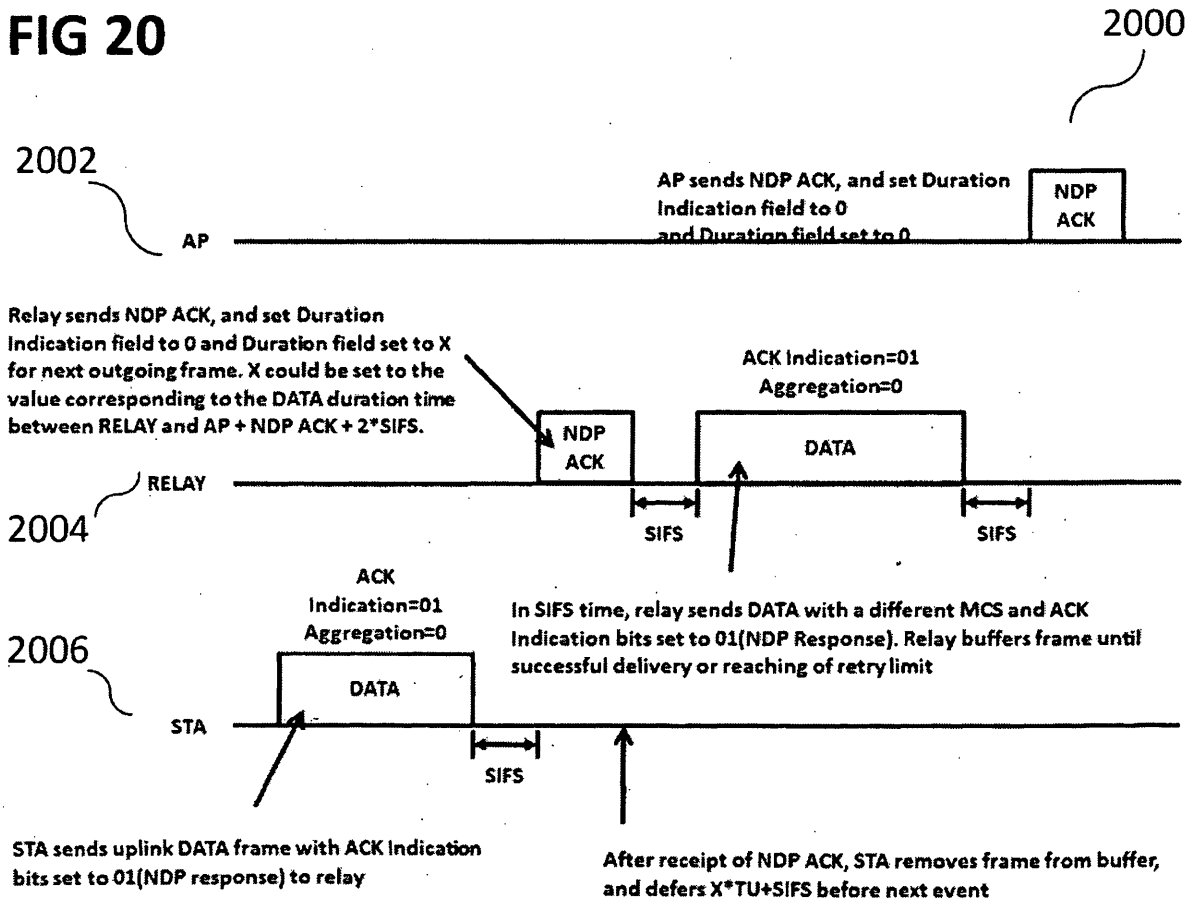

2000
2002
AP sends NDP ACK, and set Duration Indication field to 0 and Duration field set to 0
NDP ACK
AP
Relay sends NDP ACK, and set Duration Indication field to 0 and Duration field set to X for next outgoing frame. X could be set to the value corresponding to the DATA duration time between RELAY and AP + NDP ACK + 2*SIFS.
ACK Indication=01
Aggregation=0
NDP ACK
DATA
RELAY
2004
SIFS
SIFS
ACK Indication=01
Aggregation=0
In SIFS time, relay sends DATA with a different MCS and ACK Indication bits set to 01(NDP Response). Relay buffers frame until successful delivery or reaching of retry limit
2006
DATA
STA
SIFS
STA sends uplink DATA frame with ACK Indication bits set to 01(NDP response) to relay
After receipt of NDP ACK, STA removes frame from buffer, and defers X*TU+SIFS before next event

FIG 21

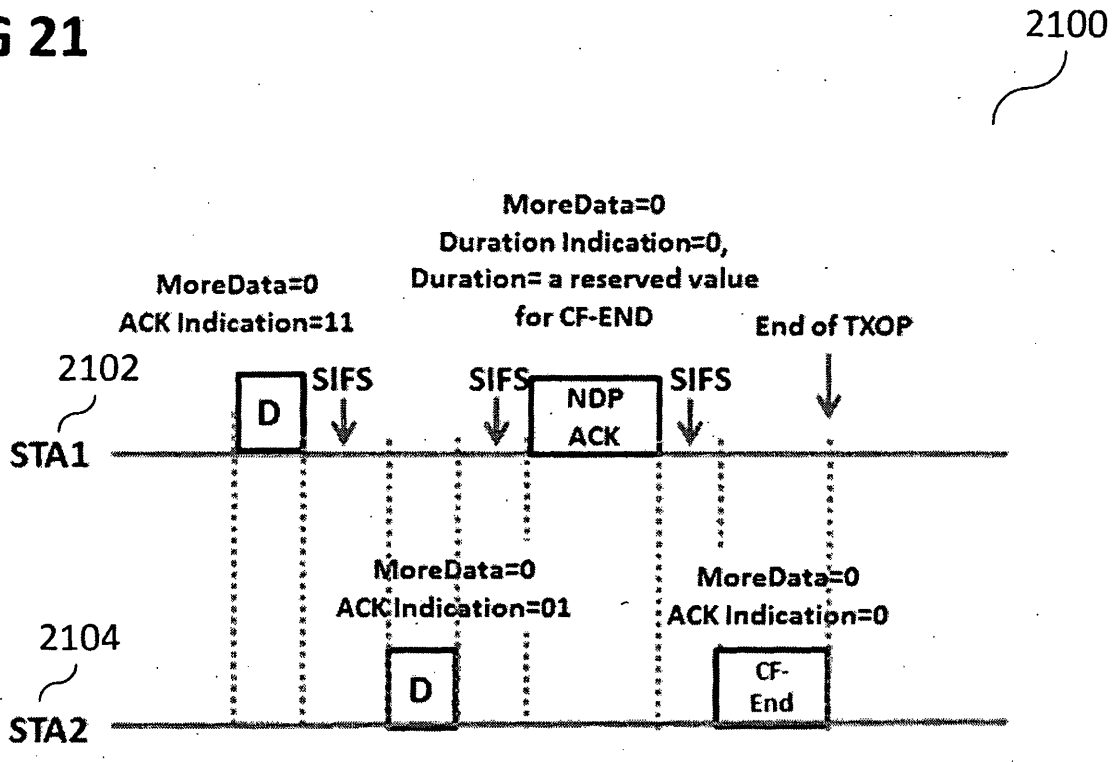

2100
MoreData=0
Duration Indication=0,
Duration= a reserved value
for CF-END
MoreData=0
ACK Indication=11
End of TXOP
2102
SIFS
SIFS
SIFS
D
NDP
ACK
STA1
MoreData=0
ACK Indication=01
MoreData=0
ACK Indication=0
2104
D
CF-
End
STA2

FIG 22

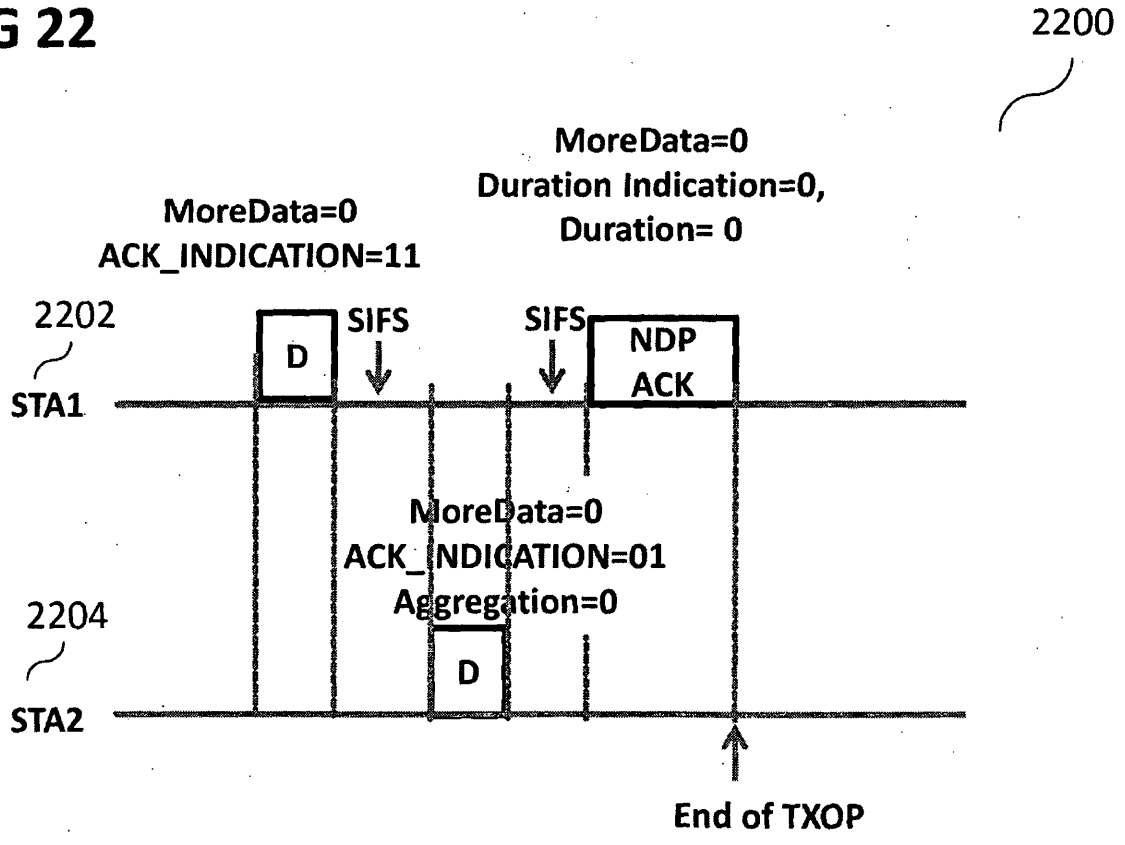

2200
MoreData=0
Duration Indication=0,
Duration= 0
MoreData=0
ACK_INDICATION=11
2202
SIFS
SIFS
D
NDP
ACK
STA1
MoreData=0
ACK_INDICATION=01
Aggregation=0
2204
D
STA2
End of TXOP

FIG 23

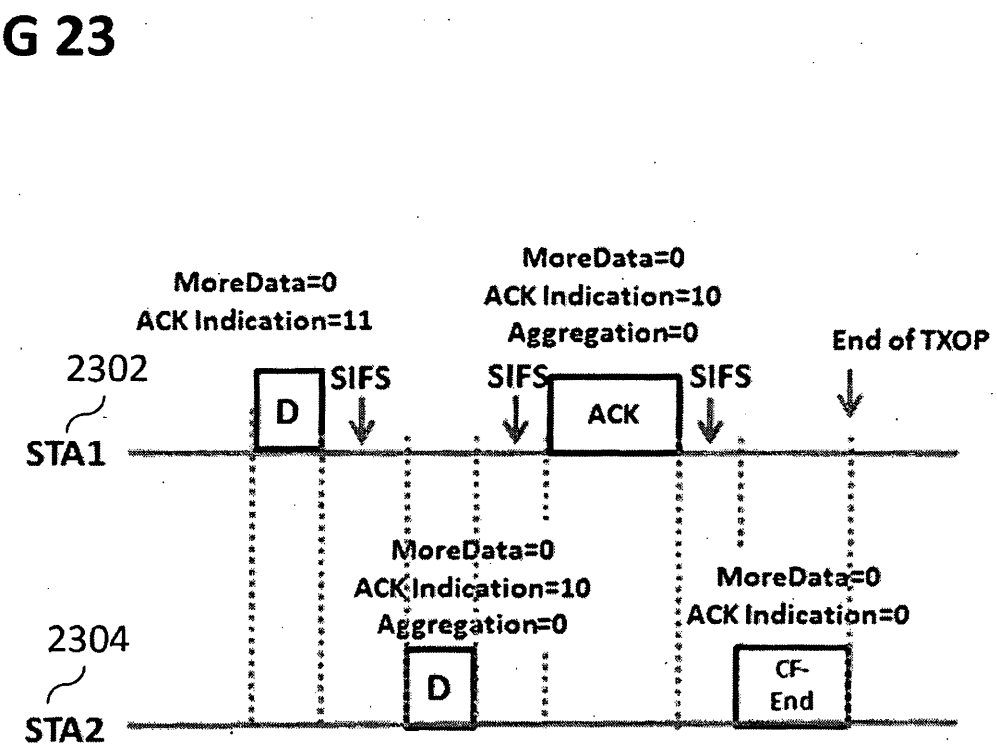

2300
MoreData=0
ACK Indication=11
MoreData=0
ACK Indication=10
Aggregation=0
End of TXOP
2302
SIFS
SIFS
SIFS
D
ACK
STA1
MoreData=0
ACK Indication=10
Aggregation=0
MoreData=0
ACK Indication=0
2304
D
CF-
End
STA2

FIG 24

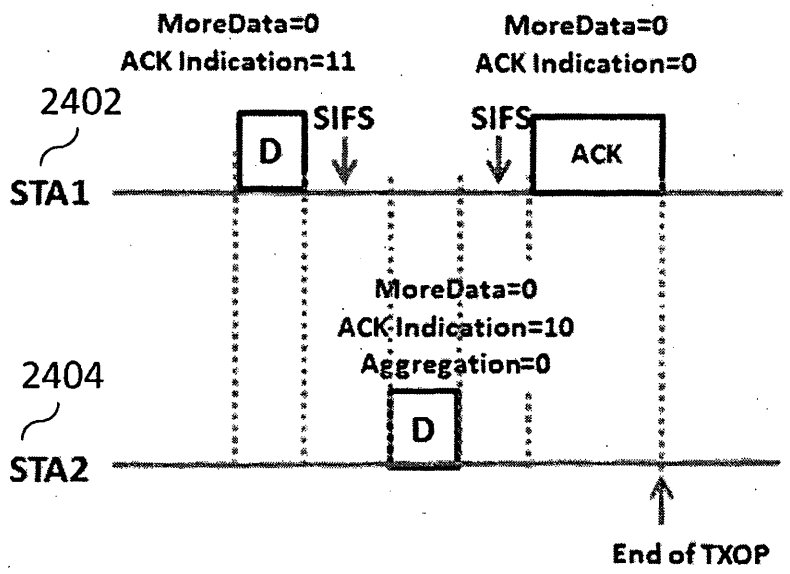

2400
MoreData=0
ACK Indication=11
MoreData=0
ACK Indication=0
2402
SIFS
SIFS
D
ACK
STA1
MoreData=0
ACK Indication=10
Aggregation=0
2404
D
STA2
End of TXOP

FIG 25

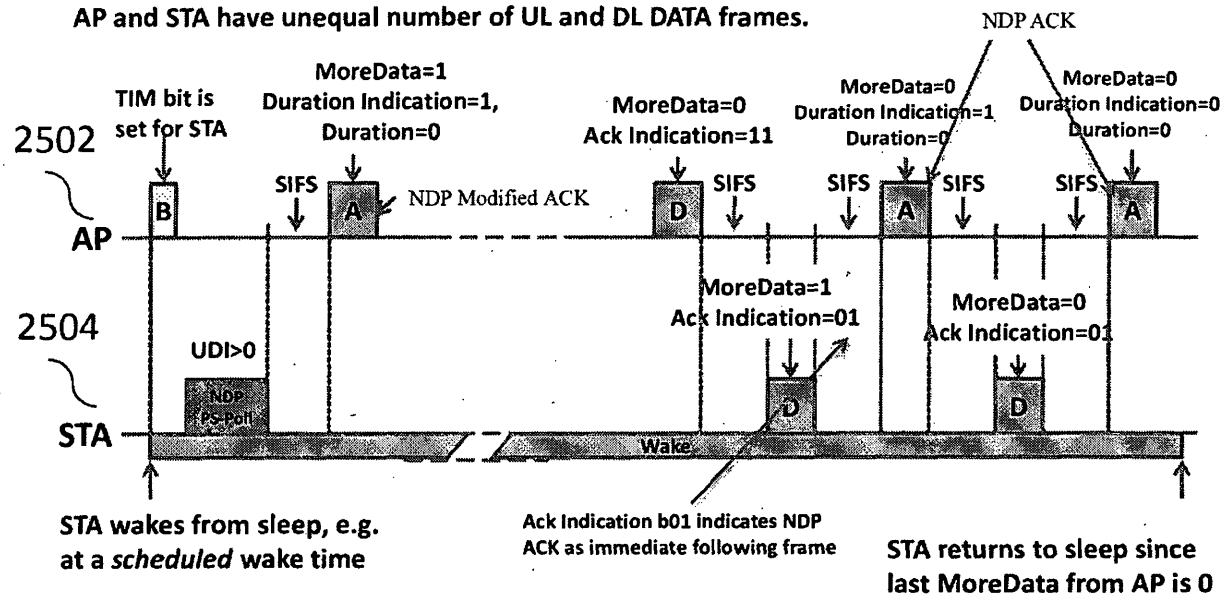

2500
AP and STA have unequal number of UL and DL DATA frames.
NDP ACK
TIM bit is set for STA
MoreData=1 Duration Indication=1, Duration=0
MoreData=0 Ack Indication=11
MoreData=0 Duration Indication=1 Duration=0
MoreData=0 Duration Indication=0 Duration=0
2502
AP
SIFS
B
A
NDP Modified ACK
D
SIFS
SIFS
A
SIFS
SIFS
A
2504
STA
UDI>0
NDP PS-Poll
MoreData=1 Ack Indication=01
MoreData=0 Ack Indication=01
D
D
Wake
STA wakes from sleep, e.g. at a scheduled wake time
Ack Indication b01 indicates NDP ACK as immediate following frame
STA returns to sleep since last MoreData from AP is 0

FIG 26

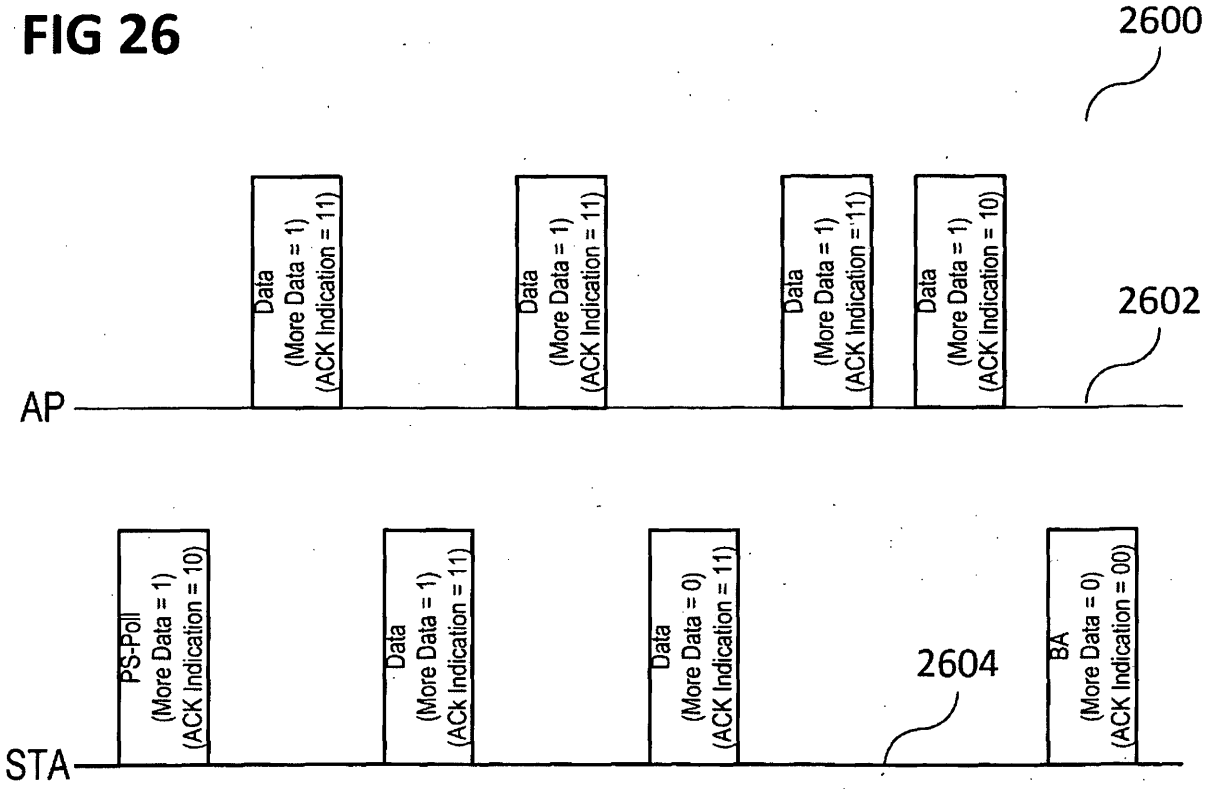

2600
2602
AP
Data (More Data = 1) (ACK Indication = 11)
Data (More Data = 1) (ACK Indication = 11)
Data (More Data = 1) (ACK Indication = 11)
Data (More Data = 1) (ACK Indication = 10)
2604
STA
PS-Poll (More Data = 1) (ACK Indication = 10)
Data (More Data = 1) (ACK Indication = 11)
Data (More Data = 0) (ACK Indication = 11)
BA (More Data = 0) (ACK Indication = 00)

FIG 27

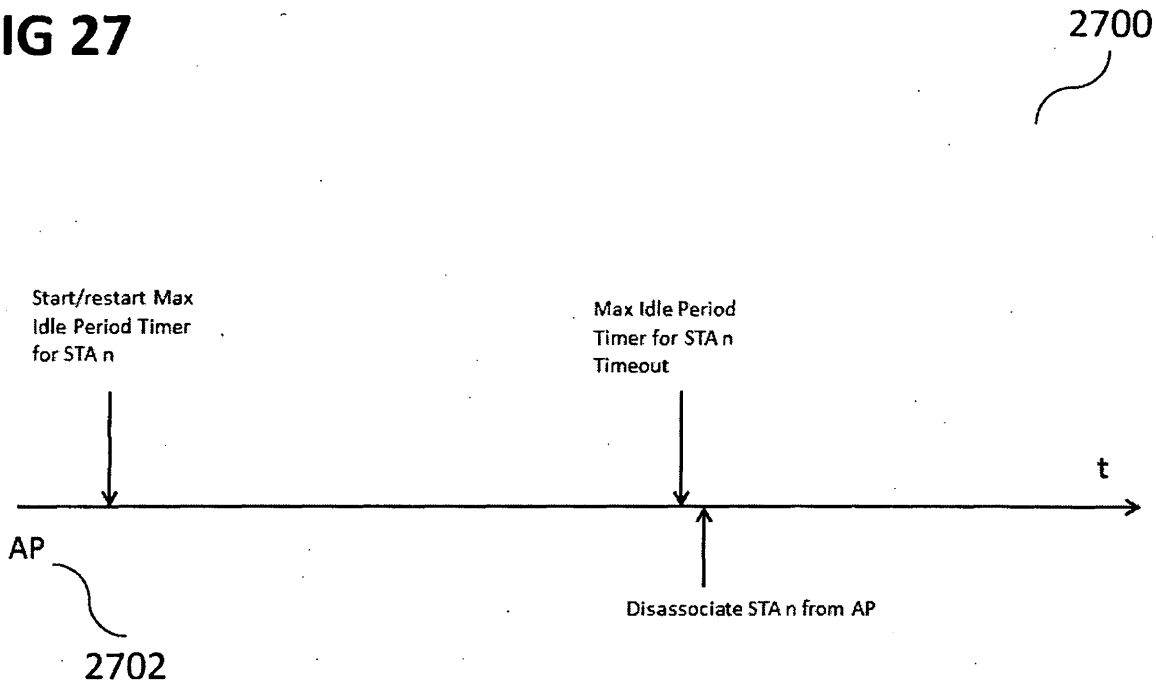

2700
Start/restart Max Idle Period Timer for STA n
Max Idle Period Timer for STA n Timeout
t
AP
2702
Disassociate STA n from AP

FIG 28

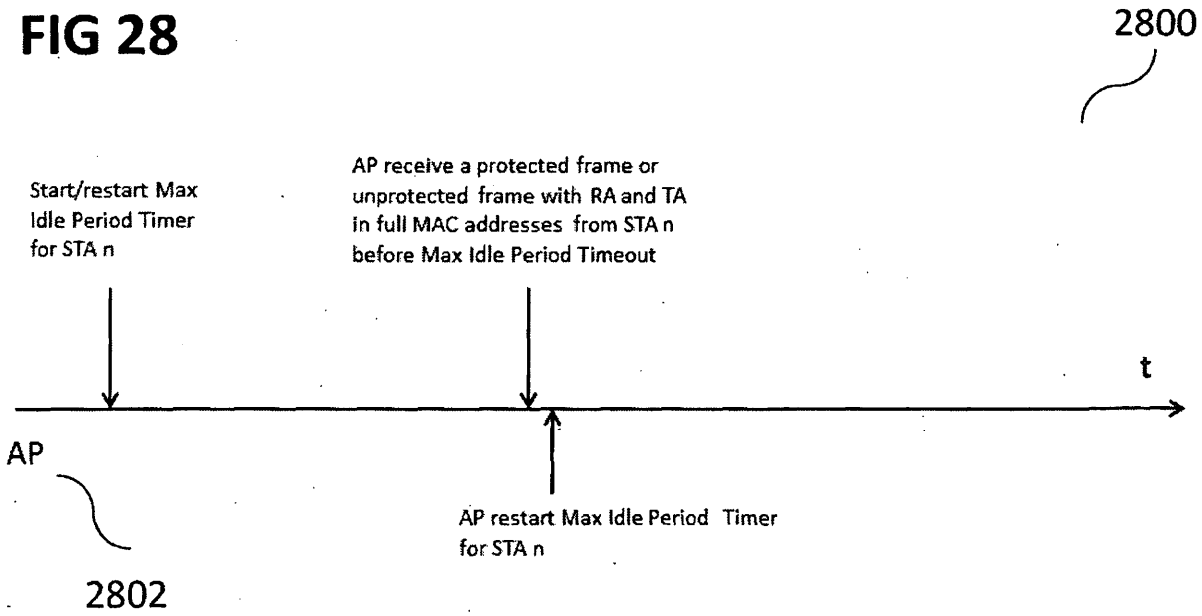

2800
Start/restart Max Idle Period Timer for STA n
AP receive a protected frame or unprotected frame with RA and TA in full MAC addresses from STA n before Max Idle Period Timeout
t
AP
2802
AP restart Max Idle Period Timer for STA n

FIG 29

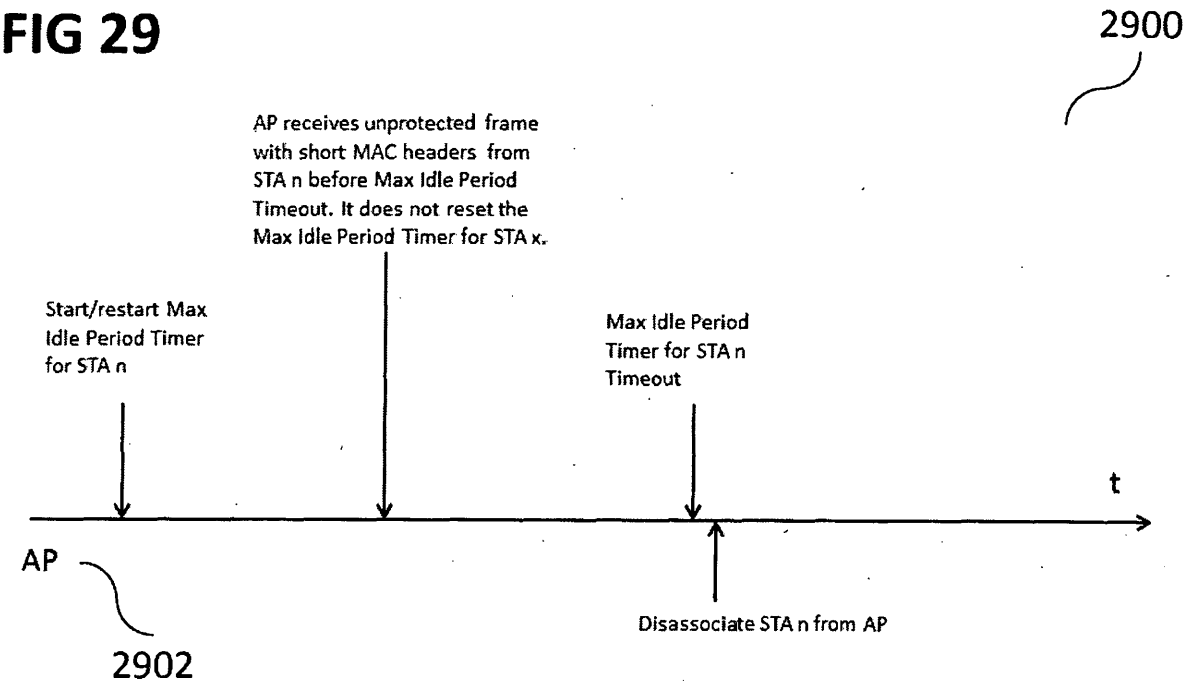
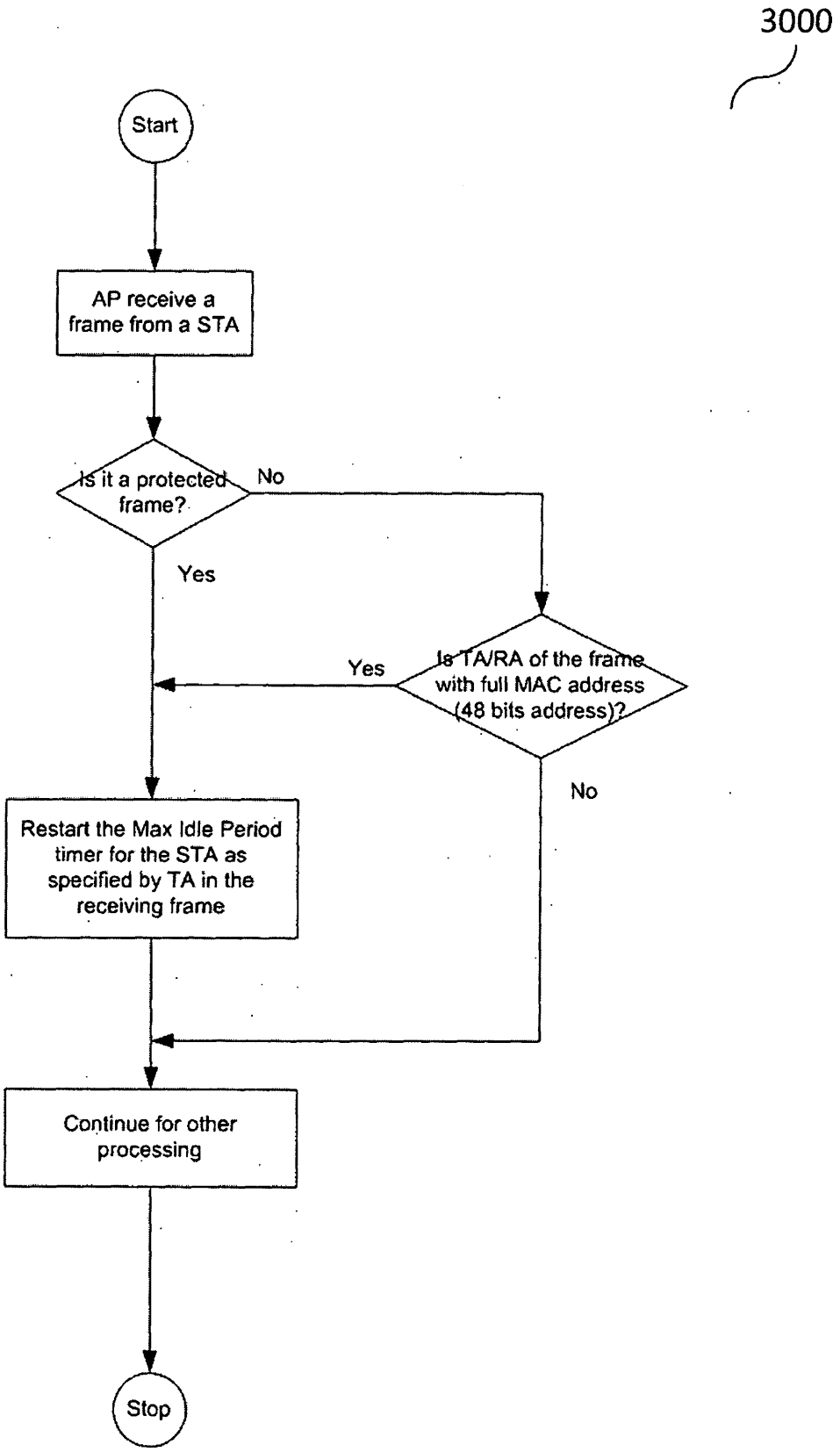

2900
AP receives unprotected frame with short MAC headers from STA n before Max Idle Period Timeout. It does not reset the Max Idle Period Timer for STA x.
Start/restart Max Idle Period Timer for STA n
Max Idle Period Timer for STA n Timeout
t
AP
2902
Disassociate STA n from AP

FIG 30


3000
Start
AP receive a frame from a STA
Is it a protected frame?
No
Yes
Is TA/RA of the frame with full MAC address (48 bits address)?
Yes
No
Restart the Max Idle Period timer for the STA as specified by TA in the receiving frame
Continue for other processing
Stop