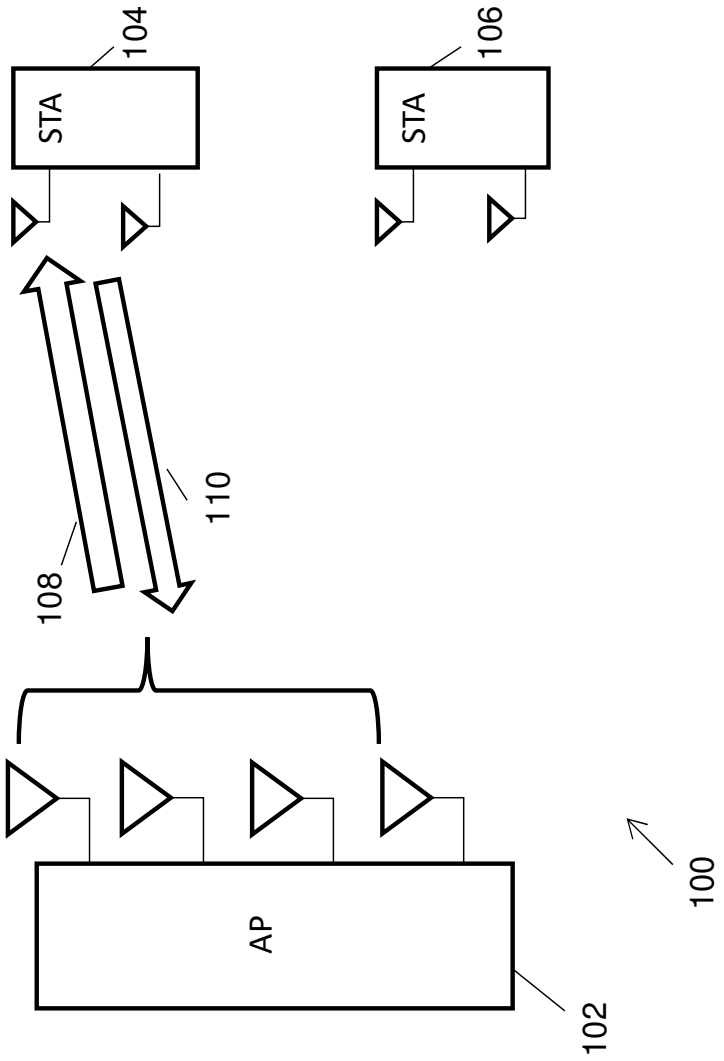


Figure 1

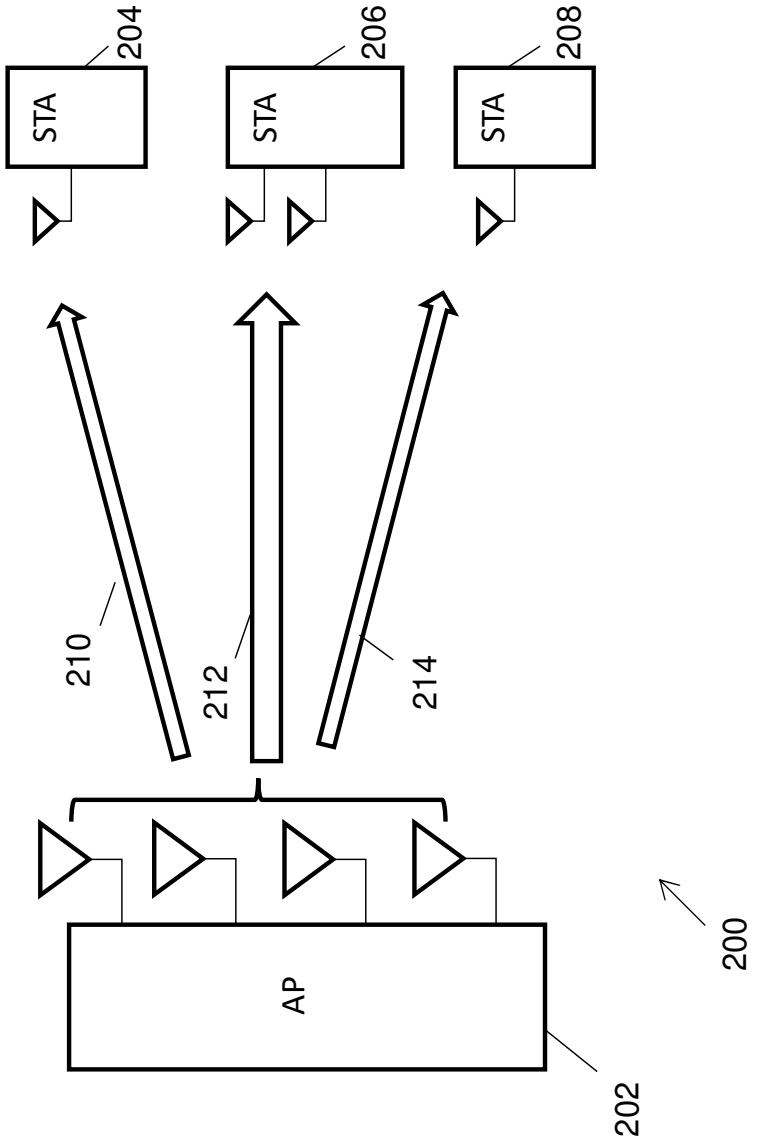


Figure 2

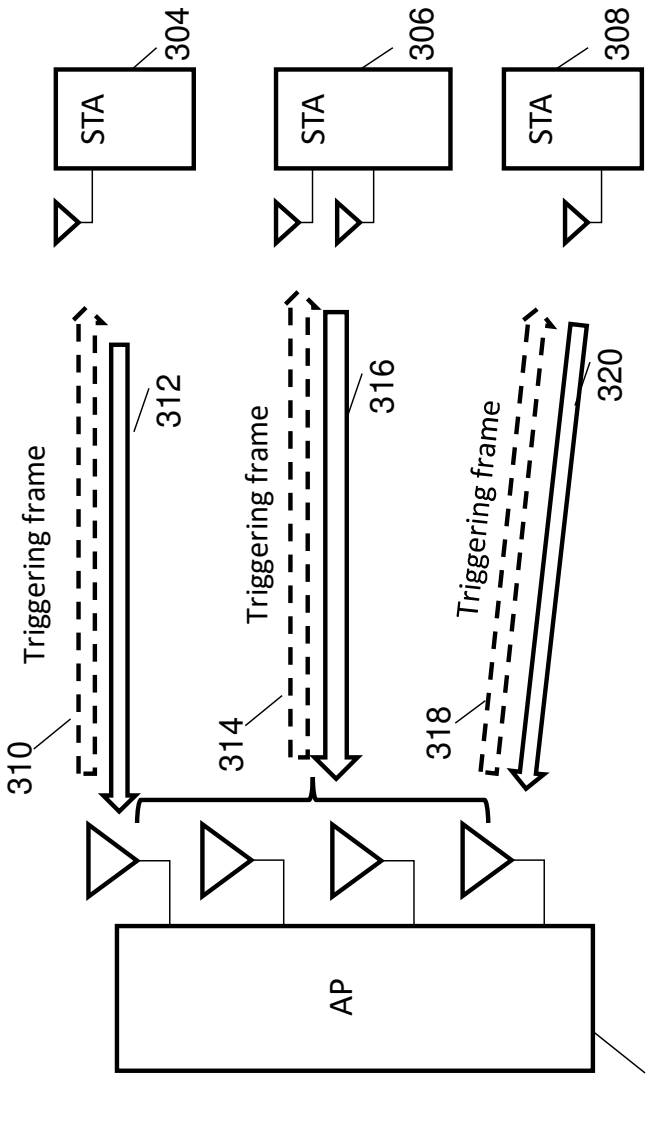

STA
304
STA
306
STA
308
Triggering frame
310
312
Triggering frame
314
316
Triggering frame
318
320
AP
302
300

Figure 3

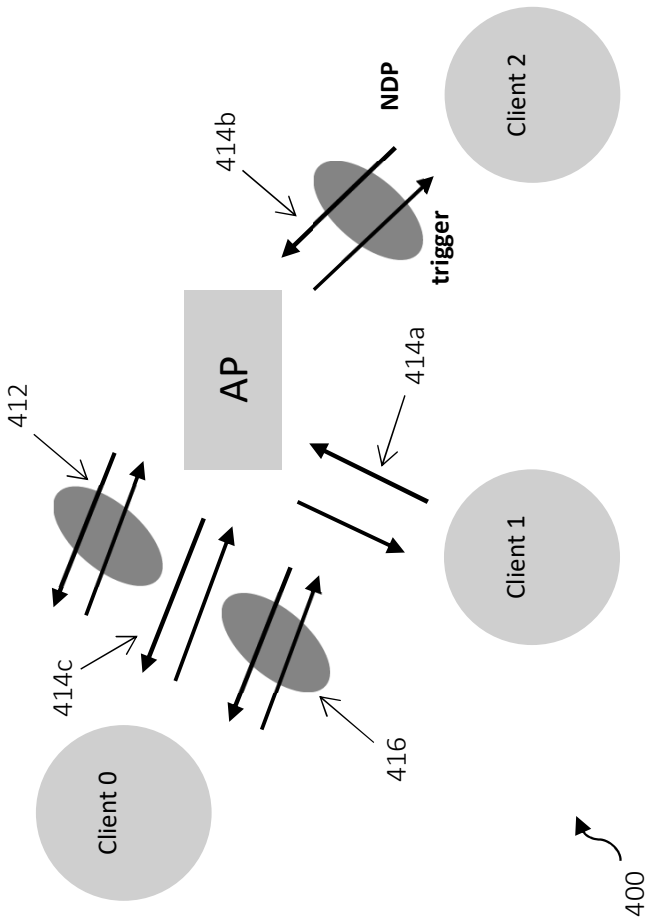

Client 2
NDP
414b
trigger
AP
414a
412
Client 1
414c
416
Client 0
400

Figure 4

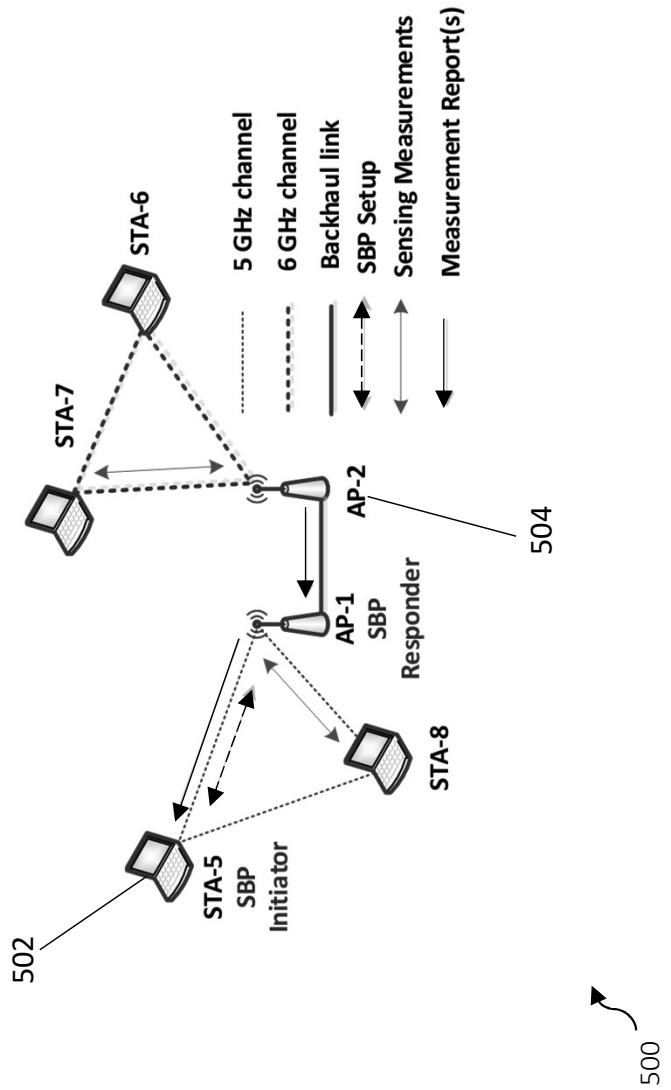

STA-6
STA-7
AP-2
AP-1
SBP
Responder
STA-8
STA-5
SBP
Initiator
502
504
500
5 GHz channel
6 GHz channel
Backhaul link
SBP Setup
Sensing Measurements
Measurement Report(s)

Figure 5

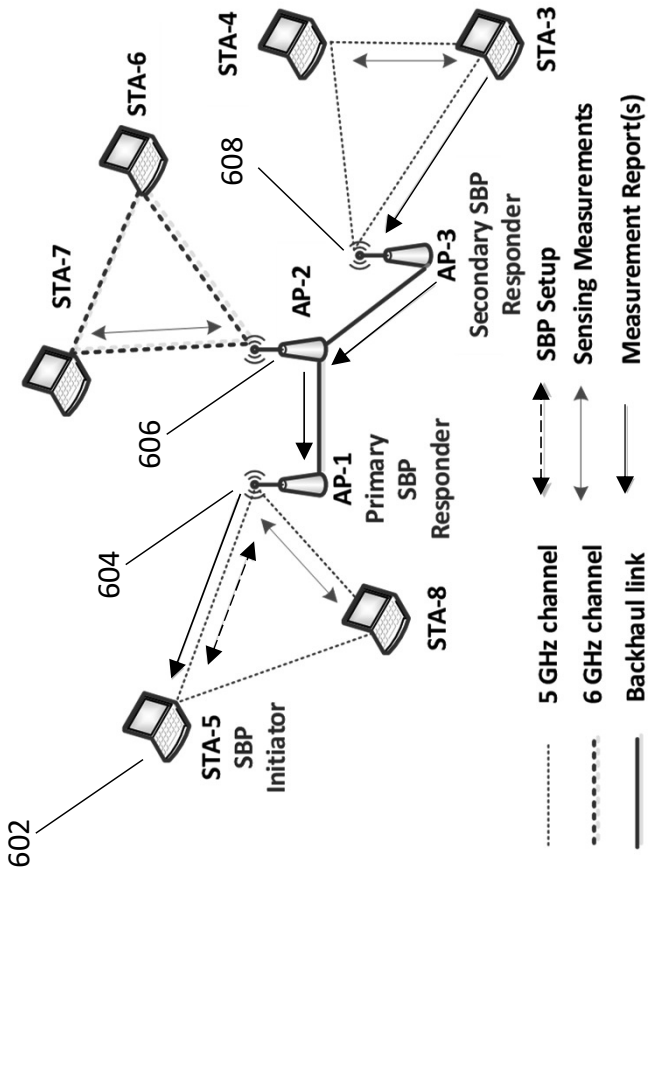

600
602
604
606
608
STA-5
SBP
Initiator
STA-8
AP-1
Primary
SBP
Responder
AP-2
AP-3
Secondary SBP
Responder
STA-7
STA-6
STA-4
STA-3
5 GHz channel
SBP Setup
6 GHz channel
Sensing Measurements
Backhaul link
Measurement Report(s)

Figure 6

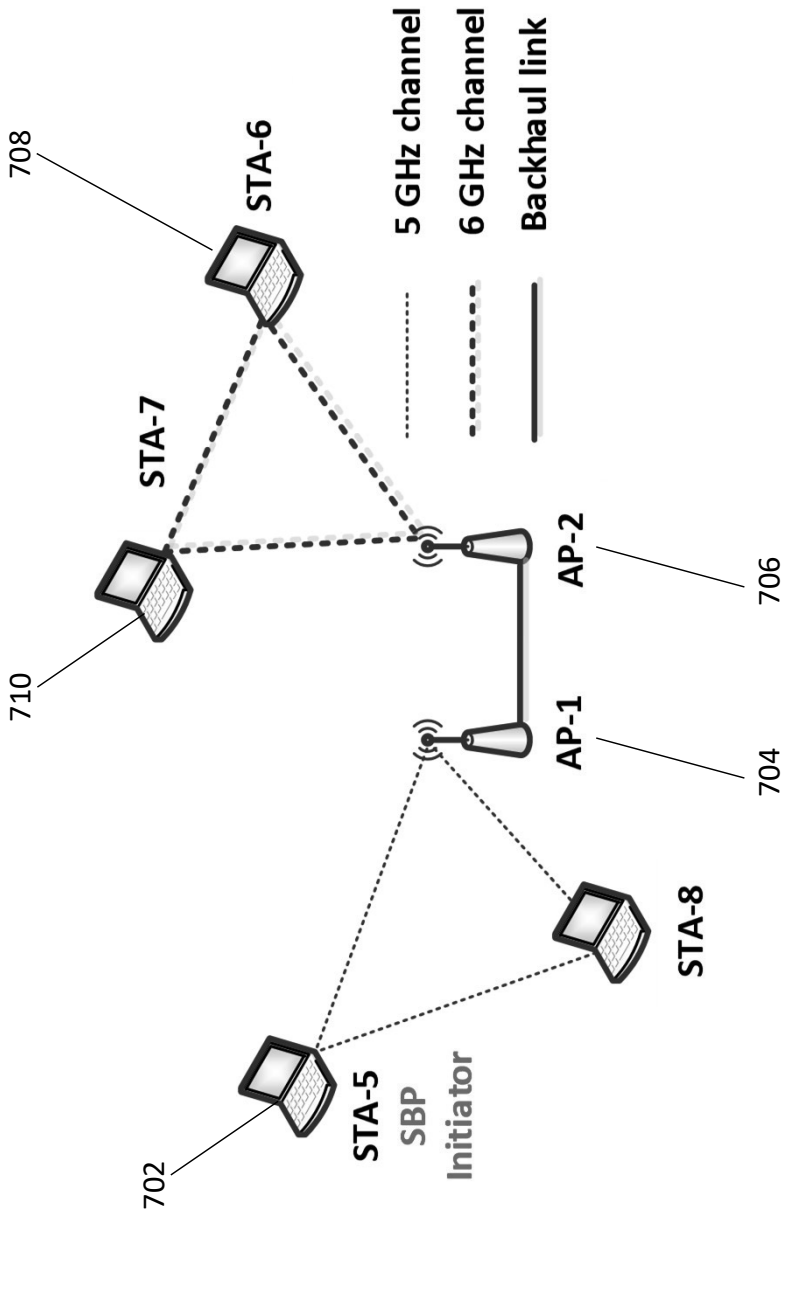

5 GHz channel
6 GHz channel
Backhaul link
STA-6
STA-7
AP-2
AP-1
STA-8
STA-5
SBP
Initiator
708
710
706
704
702
700

Figure 7

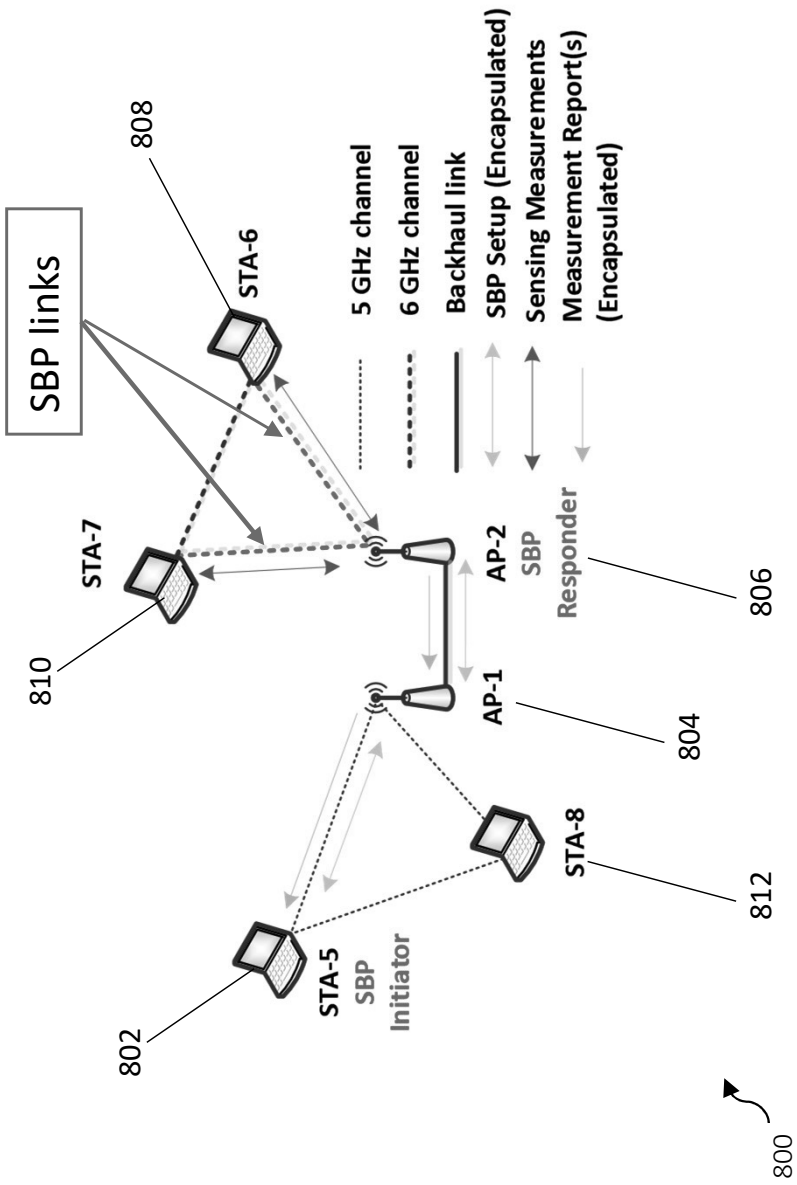
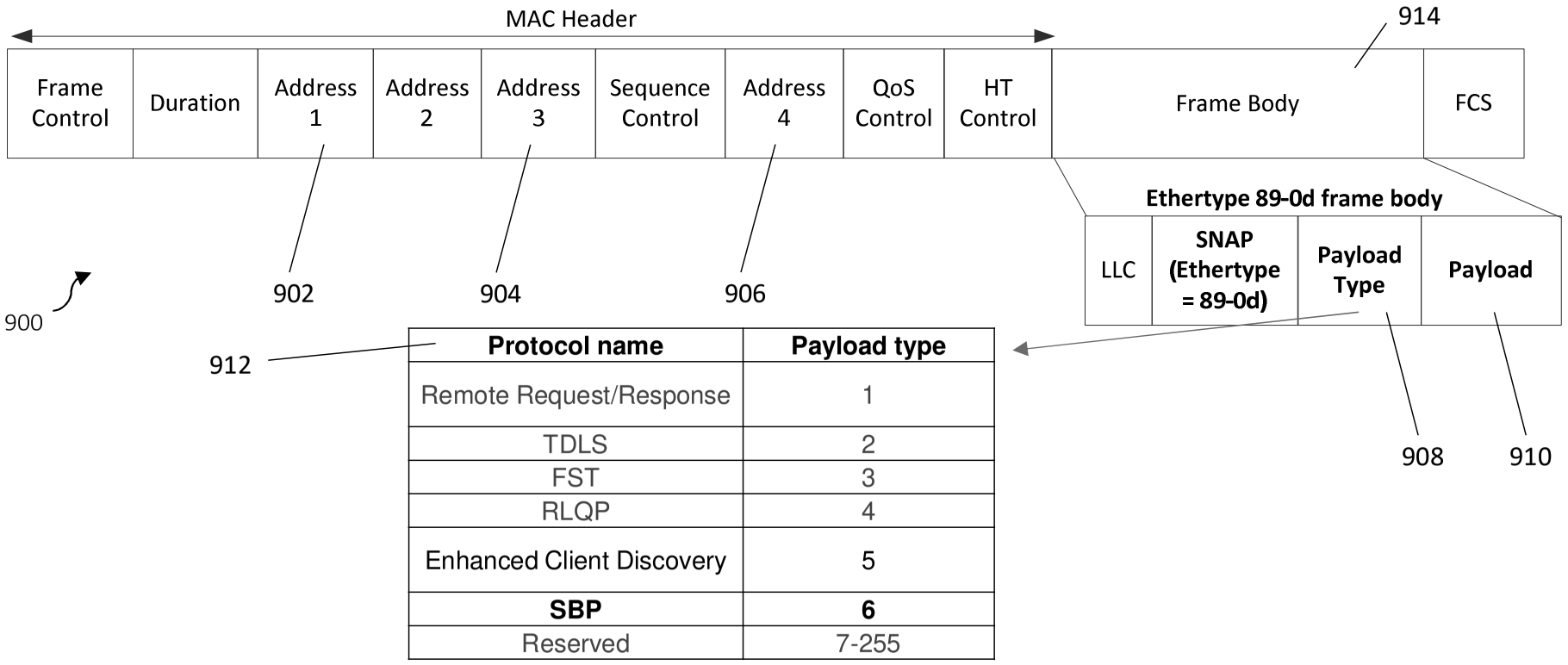

SBP links
808
STA-6
STA-7
810
AP-2
SBP
Responder
806
AP-1
804
STA-8
812
STA-5
SBP
Initiator
802
800
5 GHz channel
6 GHz channel
Backhaul link
SBP Setup (Encapsulated)
Sensing Measurements
Measurement Report(s)
(Encapsulated)

Figure 8



Protocol name	Payload type
Remote Request/Response	1
TDLS	2
FST	3
RLQP	4
Enhanced Client Discovery	5
SBP	**6**
Reserved	7-255

Figure 9A

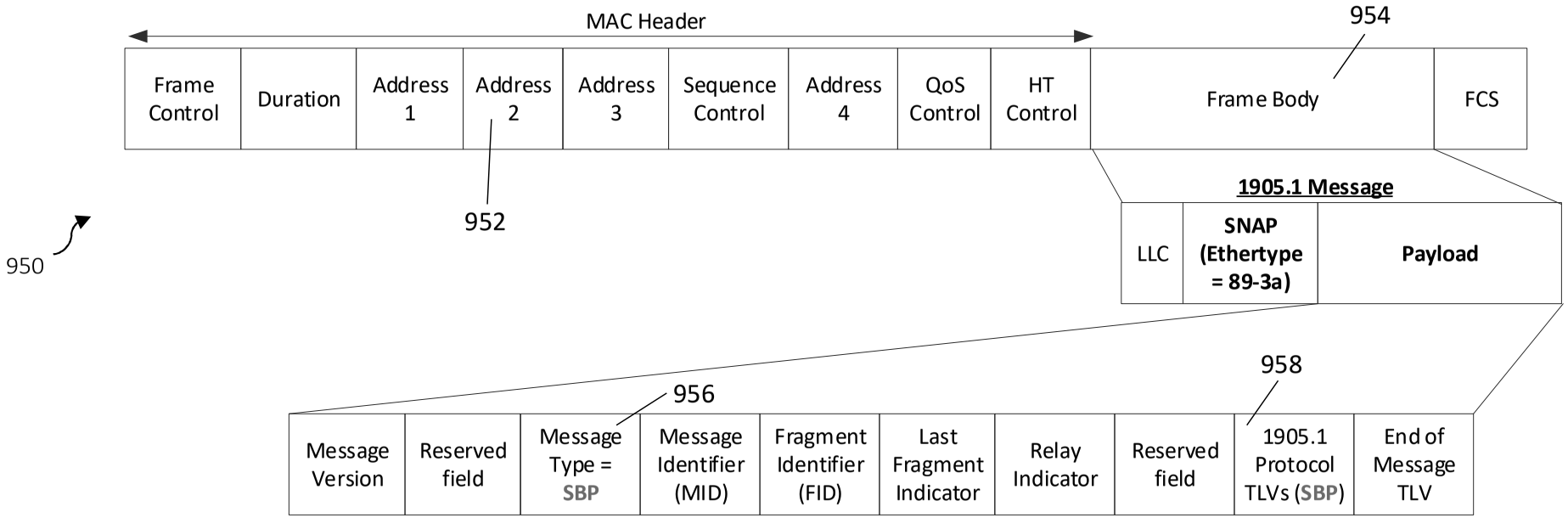


Figure 9B

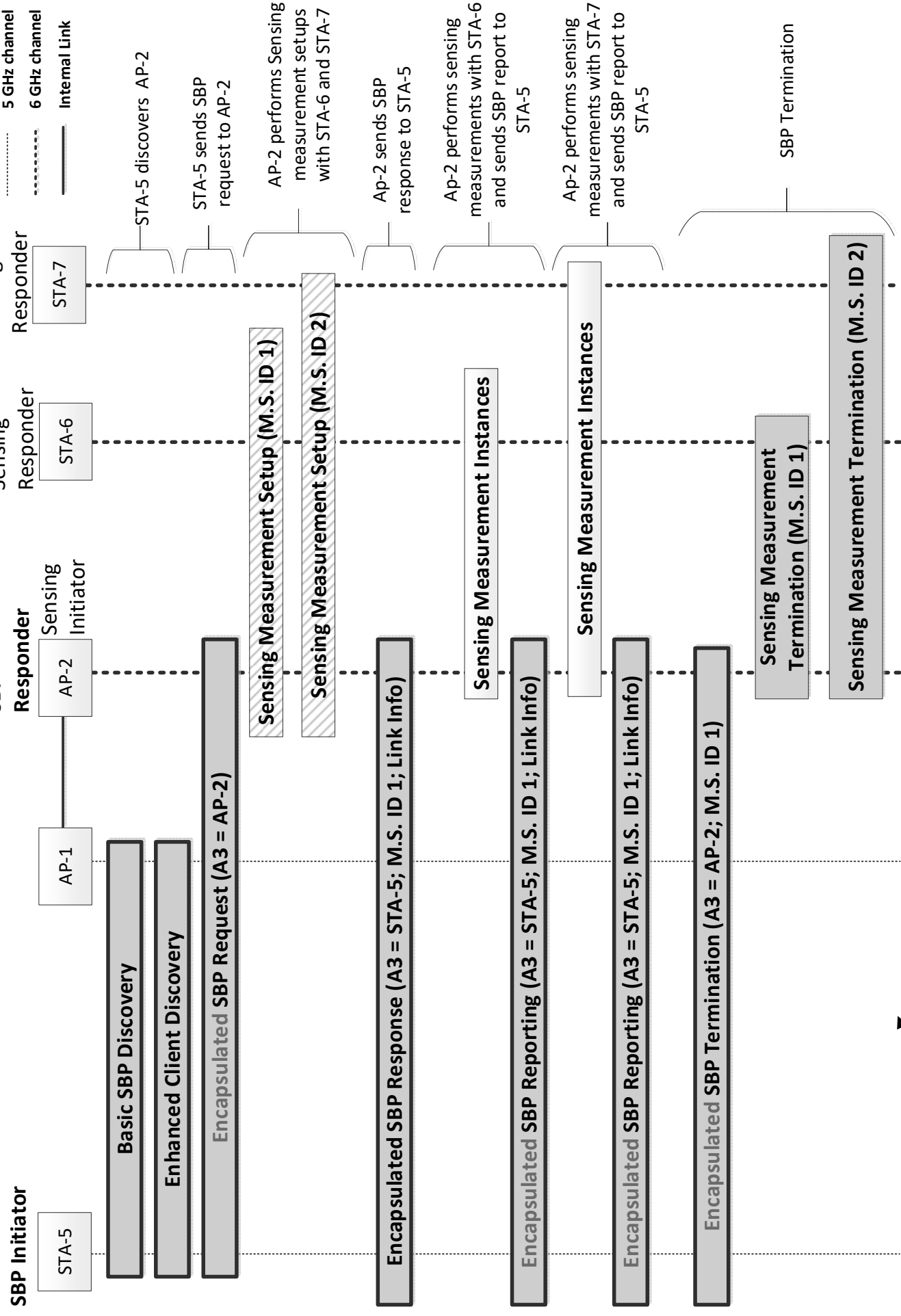

5 GHz channel
6 GHz channel
Internal Link
SBP Initiator
SBP Responder
Sensing Initiator
Sensing Responder
Sensing Responder
STA-5
AP-1
AP-2
STA-6
STA-7
Basic SBP Discovery
Enhanced Client Discovery
Encapsulated SBP Request (A3 = AP-2)
STA-5 discovers AP-2
STA-5 sends SBP request to AP-2
AP-2 performs Sensing measurement setups with STA-6 and STA-7
Sensing Measurement Setup (M.S. ID 1)
Sensing Measurement Setup (M.S. ID 2)
Ap-2 sends SBP response to STA-5
Encapsulated SBP Response (A3 = STA-5; M.S. ID 1; Link Info)
Ap-2 performs sensing measurements with STA-6 and sends SBP report to STA-5
Sensing Measurement Instances
Encapsulated SBP Reporting (A3 = STA-5; M.S. ID 1; Link Info)
Ap-2 performs sensing measurements with STA-7 and sends SBP report to STA-5
Sensing Measurement Instances
Encapsulated SBP Reporting (A3 = STA-5; M.S. ID 1; Link Info)
SBP Termination
Encapsulated SBP Termination (A3 = AP-2; M.S. ID 1)
Sensing Measurement Termination (M.S. ID 1)
Sensing Measurement Termination (M.S. ID 2)
1000

Figure 10

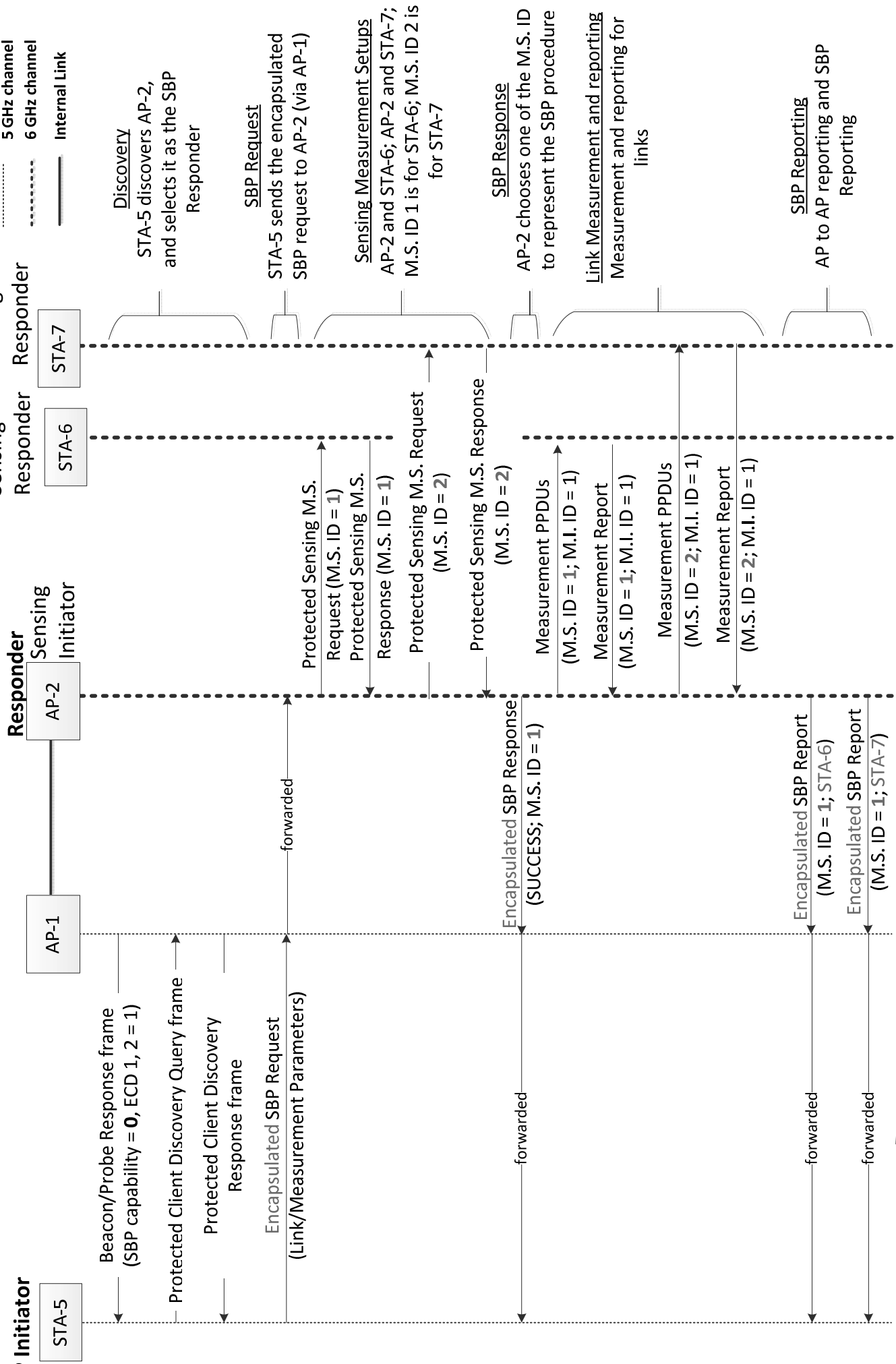

5 GHz channel
6 GHz channel
Internal Link
SBP Initiator
STA-5
AP-1
SBP Responder
AP-2
Sensing Initiator
Sensing Responder
STA-6
Sensing Responder
STA-7
Beacon/Probe Response frame (SBP capability = 0, ECD 1, 2 = 1)
Protected Client Discovery Query frame
Protected Client Discovery Response frame
Encapsulated SBP Request (Link/Measurement Parameters)
forwarded
Discovery
STA-5 discovers AP-2, and selects it as the SBP Responder
SBP Request
STA-5 sends the encapsulated SBP request to AP-2 (via AP-1)
Protected Sensing M.S. Request (M.S. ID = 1)
Protected Sensing M.S. Response (M.S. ID = 1)
Protected Sensing M.S. Request (M.S. ID = 2)
Protected Sensing M.S. Response (M.S. ID = 2)
Sensing Measurement Setups
AP-2 and STA-6; AP-2 and STA-7; M.S. ID 1 is for STA-6; M.S. ID 2 is for STA-7
SBP Response
AP-2 chooses one of the M.S. ID to represent the SBP procedure
Encapsulated SBP Response (SUCCESS; M.S. ID = 1)
forwarded
Measurement PPDUs (M.S. ID = 1; M.I. ID = 1)
Measurement Report (M.S. ID = 1; M.I. ID = 1)
Measurement PPDUs (M.S. ID = 2; M.I. ID = 1)
Measurement Report (M.S. ID = 2; M.I. ID = 1)
Link Measurement and reporting
Measurement and reporting for links
Encapsulated SBP Report (M.S. ID = 1; STA-6)
forwarded
Encapsulated SBP Report (M.S. ID = 1; STA-7)
forwarded
SBP Reporting
AP to AP reporting and SBP Reporting
1100

Figure 11

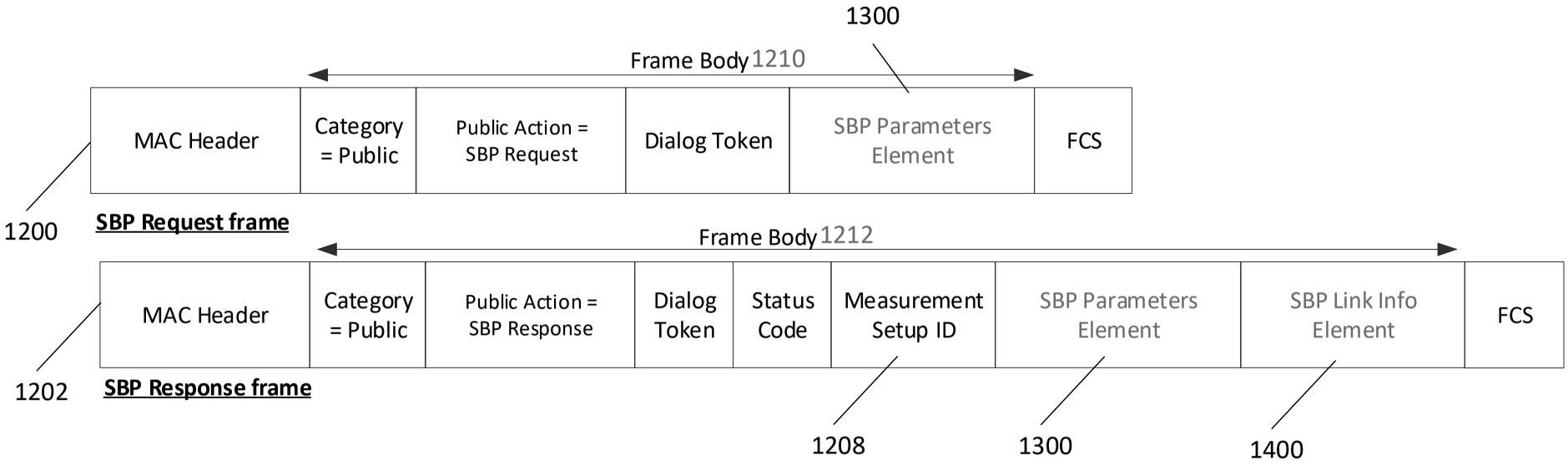


Figure 12A

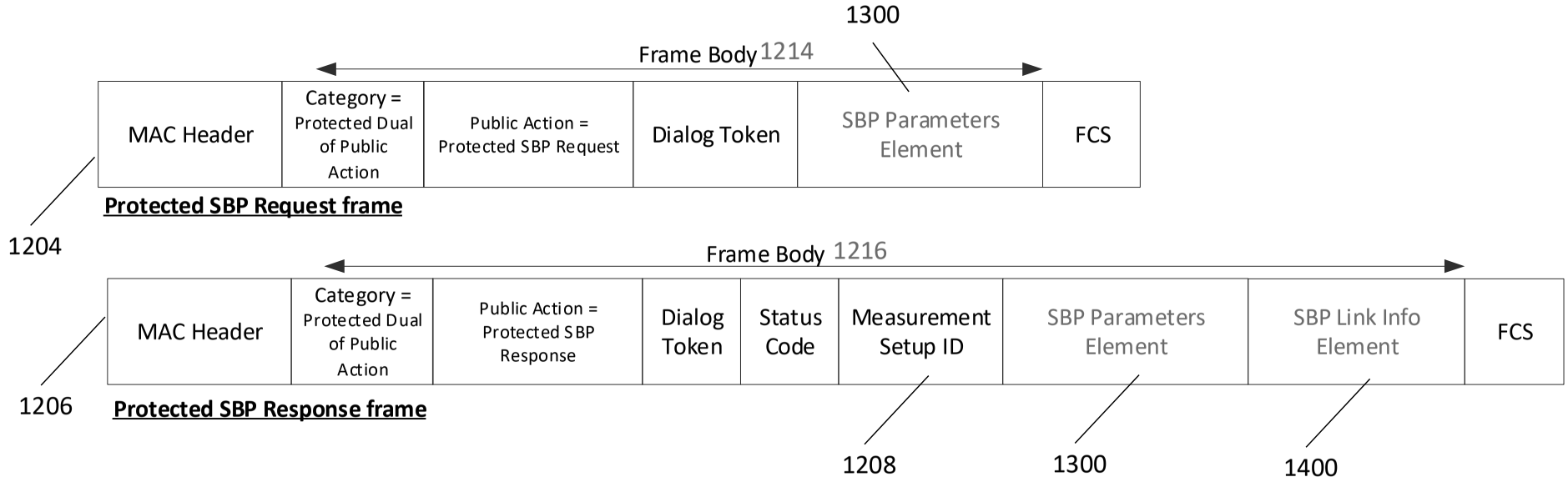


Figure 12B

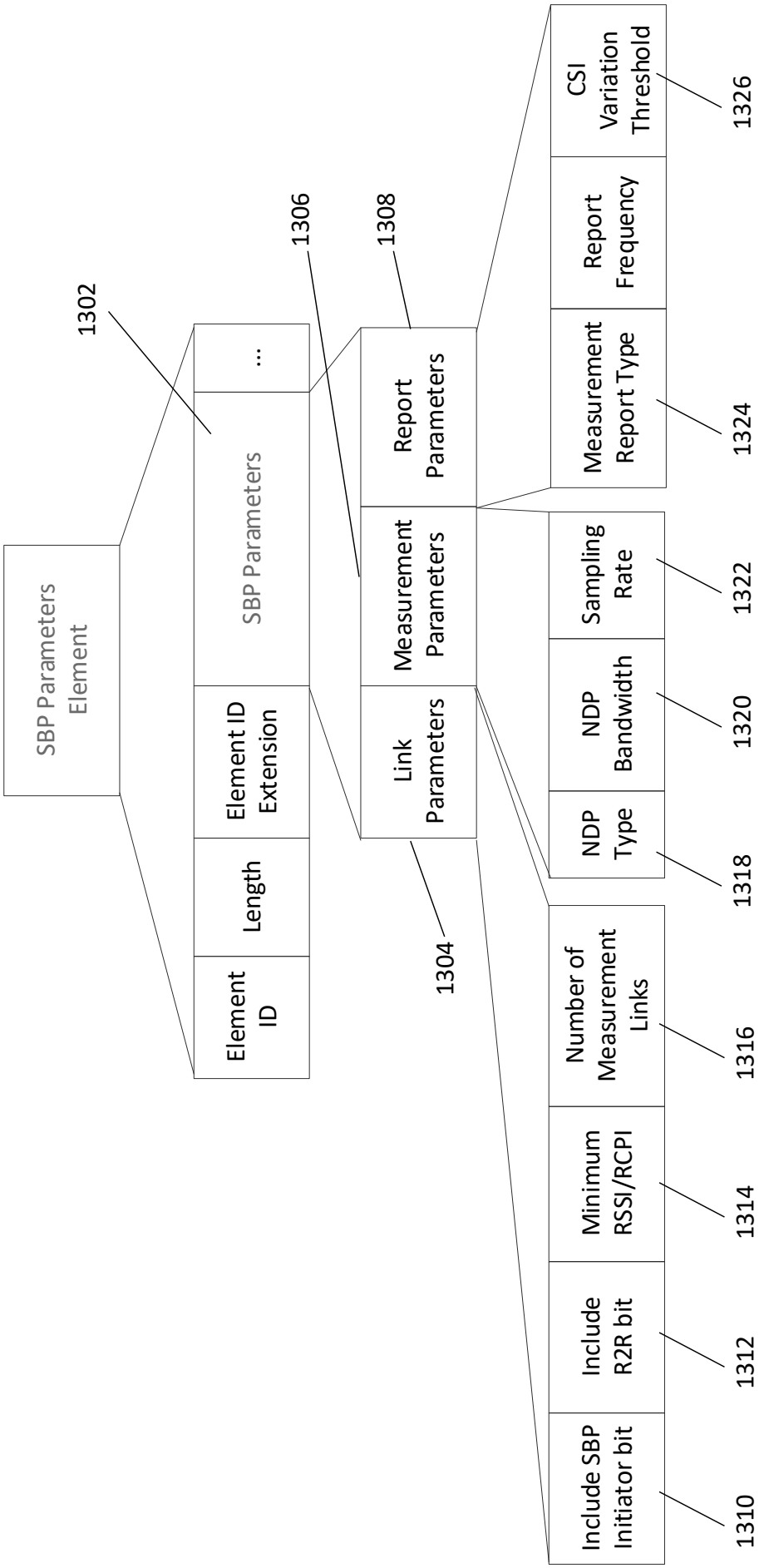

SBP Parameters Element
1302
Element ID
Length
Element ID Extension
SBP Parameters
...
1306
1304
Link Parameters
Measurement Parameters
Report Parameters
1308
Include SBP Initiator bit
1310
Include R2R bit
1312
Minimum RSSI/RCPI
1314
Number of Measurement Links
1316
NDP Type
1318
NDP Bandwidth
1320
Sampling Rate
1322
Measurement Report Type
1324
Report Frequency
CSI Variation Threshold
1326
1300

Figure 13

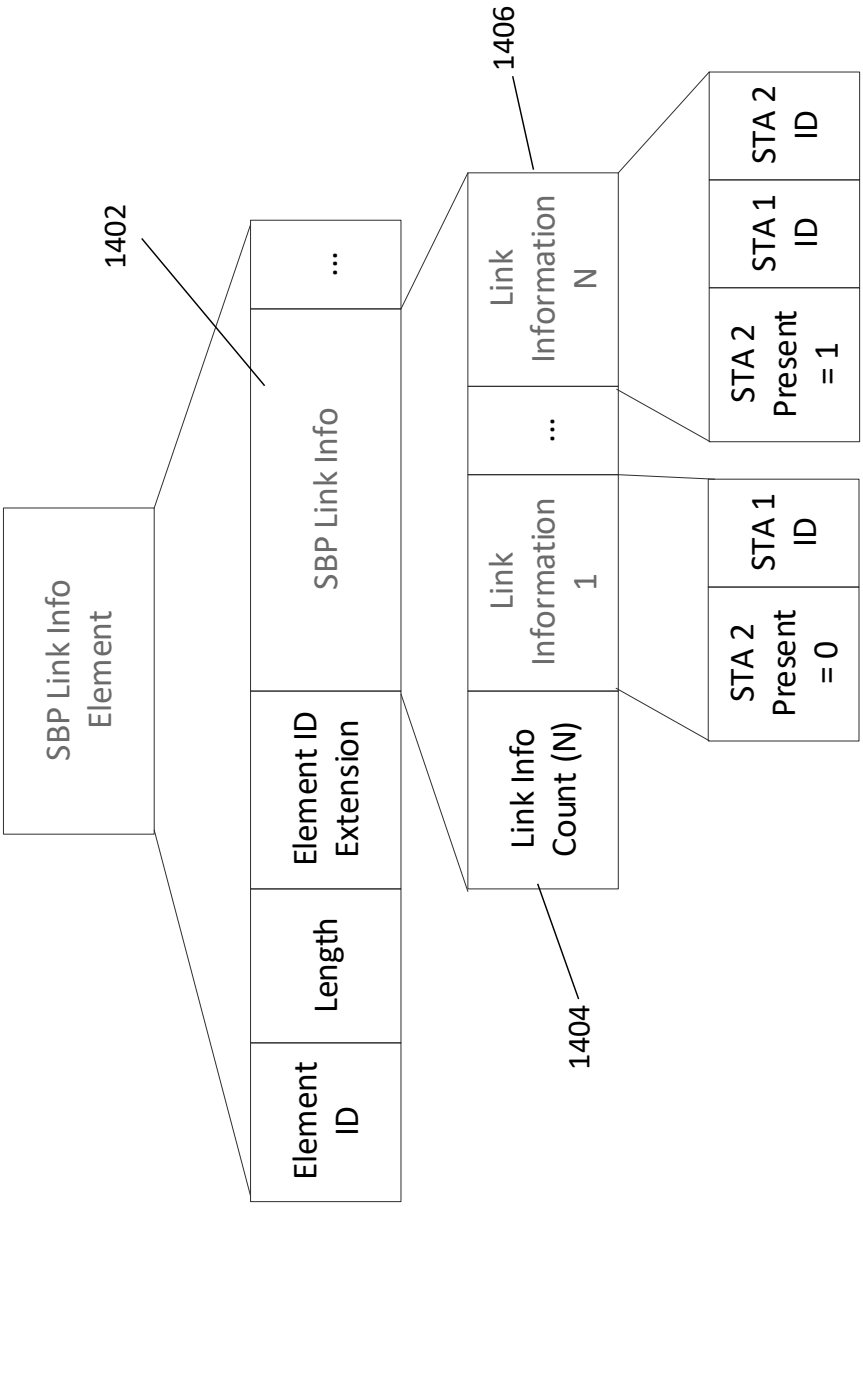

SBP Link Info Element
Element ID
Length
Element ID Extension
SBP Link Info
...
Link Info Count (N)
Link Information 1
...
Link Information N
STA 2 Present = 0
STA 1 ID
STA 2 Present = 1
STA 1 ID
STA 2 ID
1400
1402
1404
1406

Figure 14

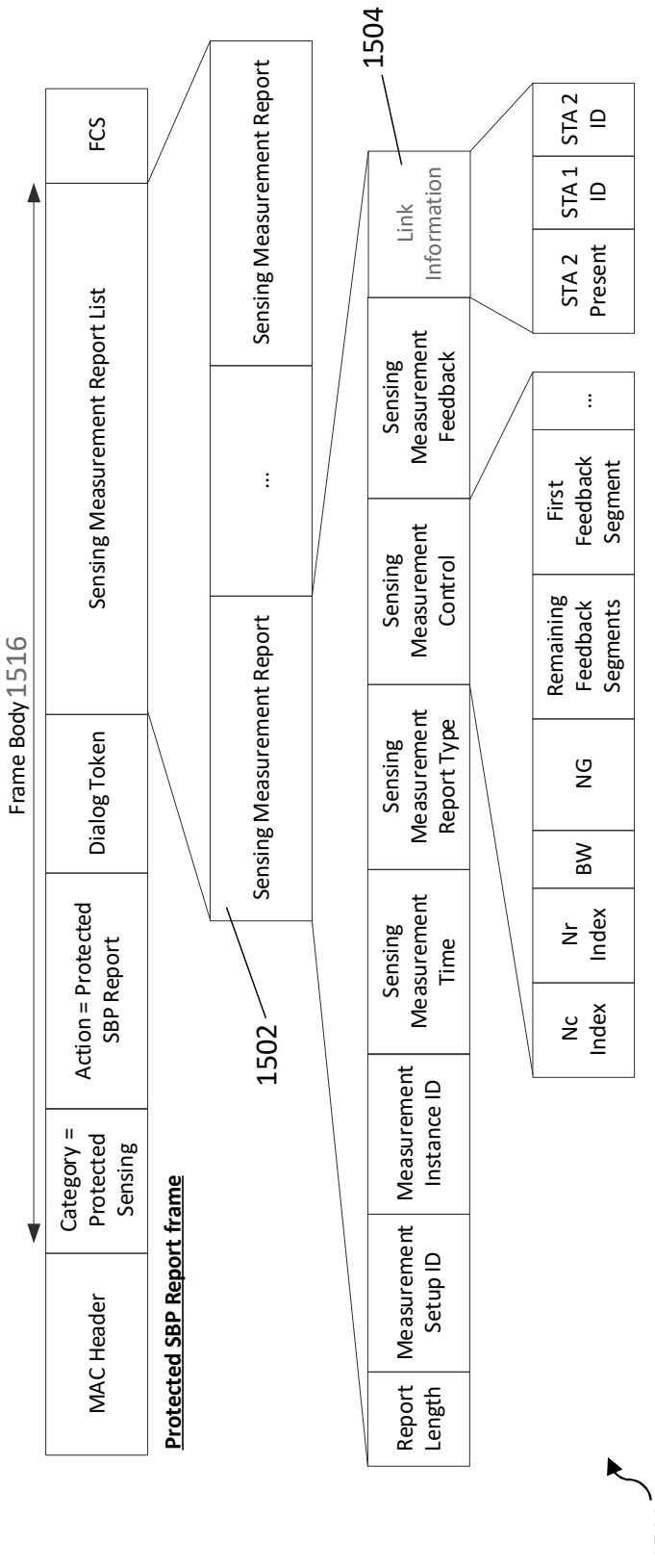


Figure 15A

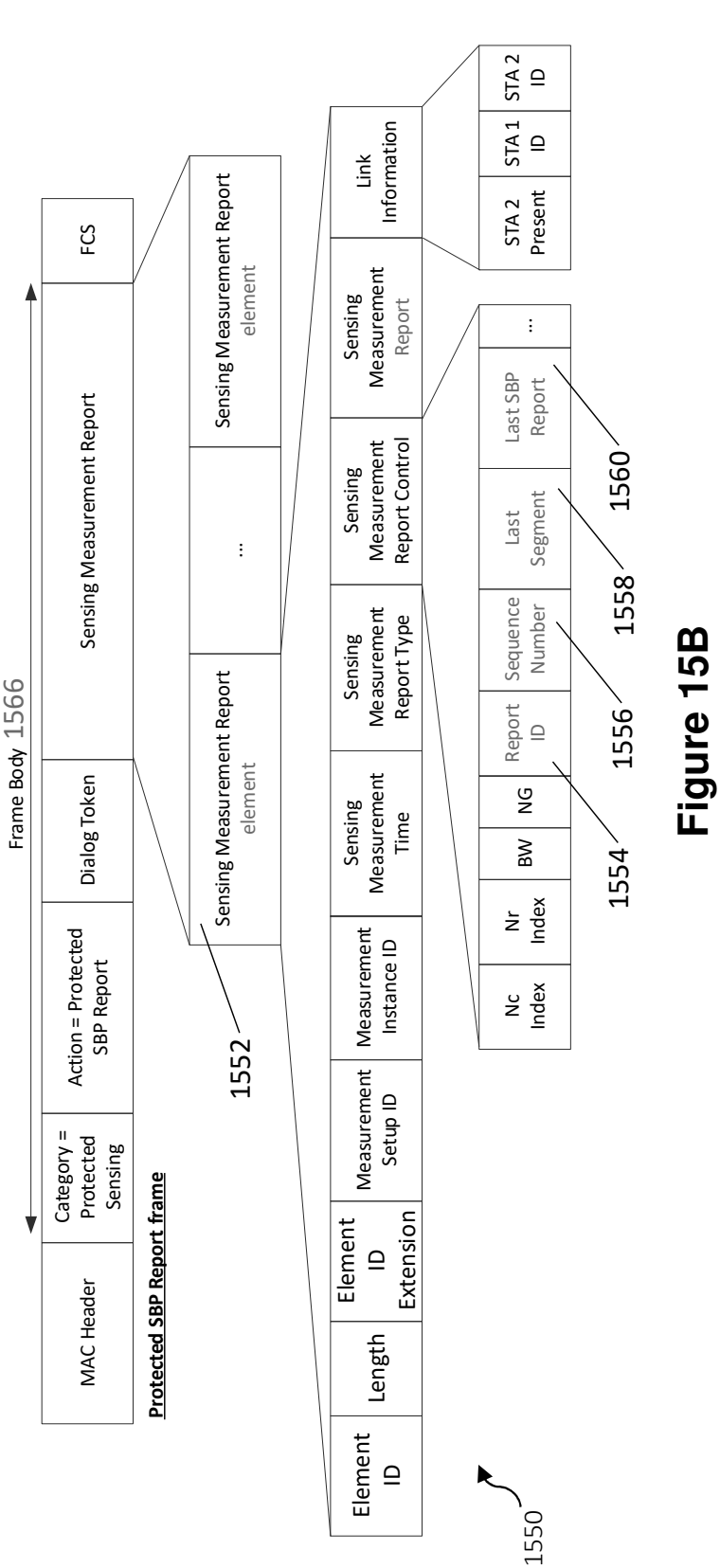
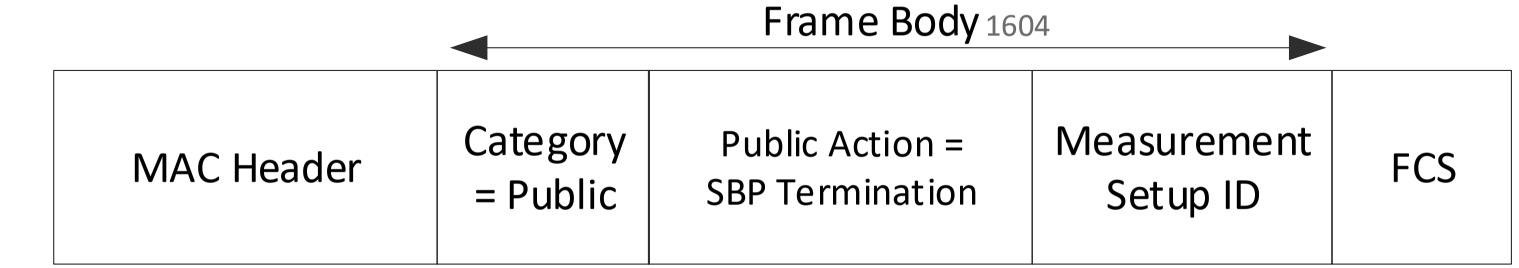
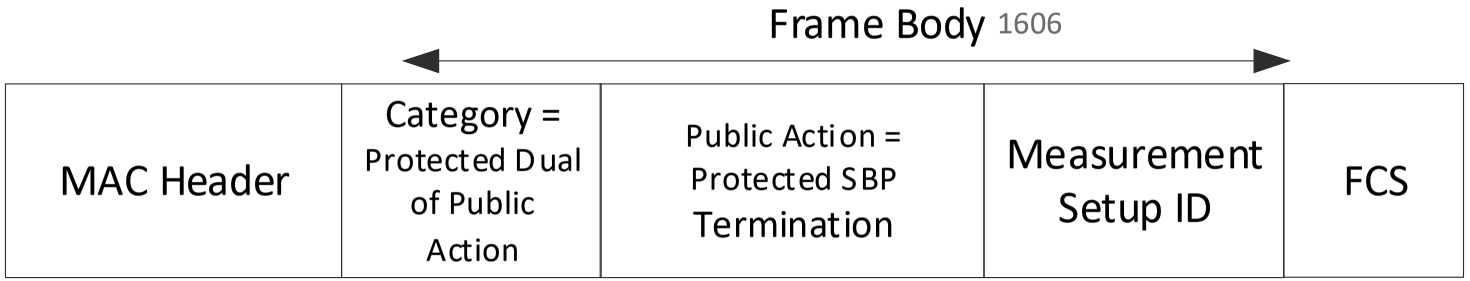


Figure 15B



SBP Termination frame

1600



Protected SBP Termination frame

1602

Figure 16

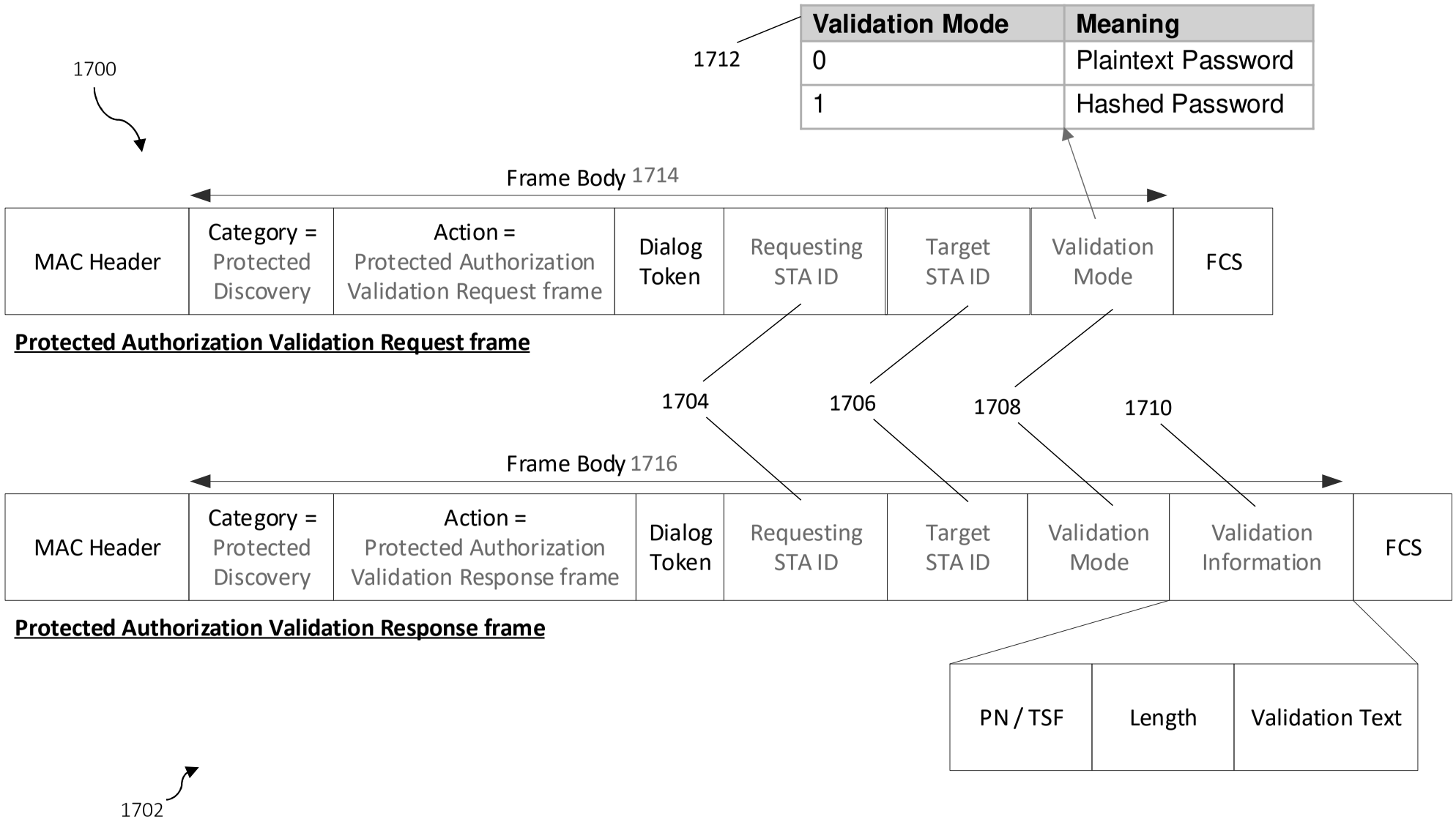

1700
1712
Validation Mode
Meaning
0
Plaintext Password
1
Hashed Password
Frame Body 1714
MAC Header
Category = Protected Discovery
Action = Protected Authorization Validation Request frame
Dialog Token
Requesting STA ID
Target STA ID
Validation Mode
FCS
Protected Authorization Validation Request frame
1704
1706
1708
1710
Frame Body 1716
MAC Header
Category = Protected Discovery
Action = Protected Authorization Validation Response frame
Dialog Token
Requesting STA ID
Target STA ID
Validation Mode
Validation Information
FCS
Protected Authorization Validation Response frame
PN / TSF
Length
Validation Text
1702

Figure 17

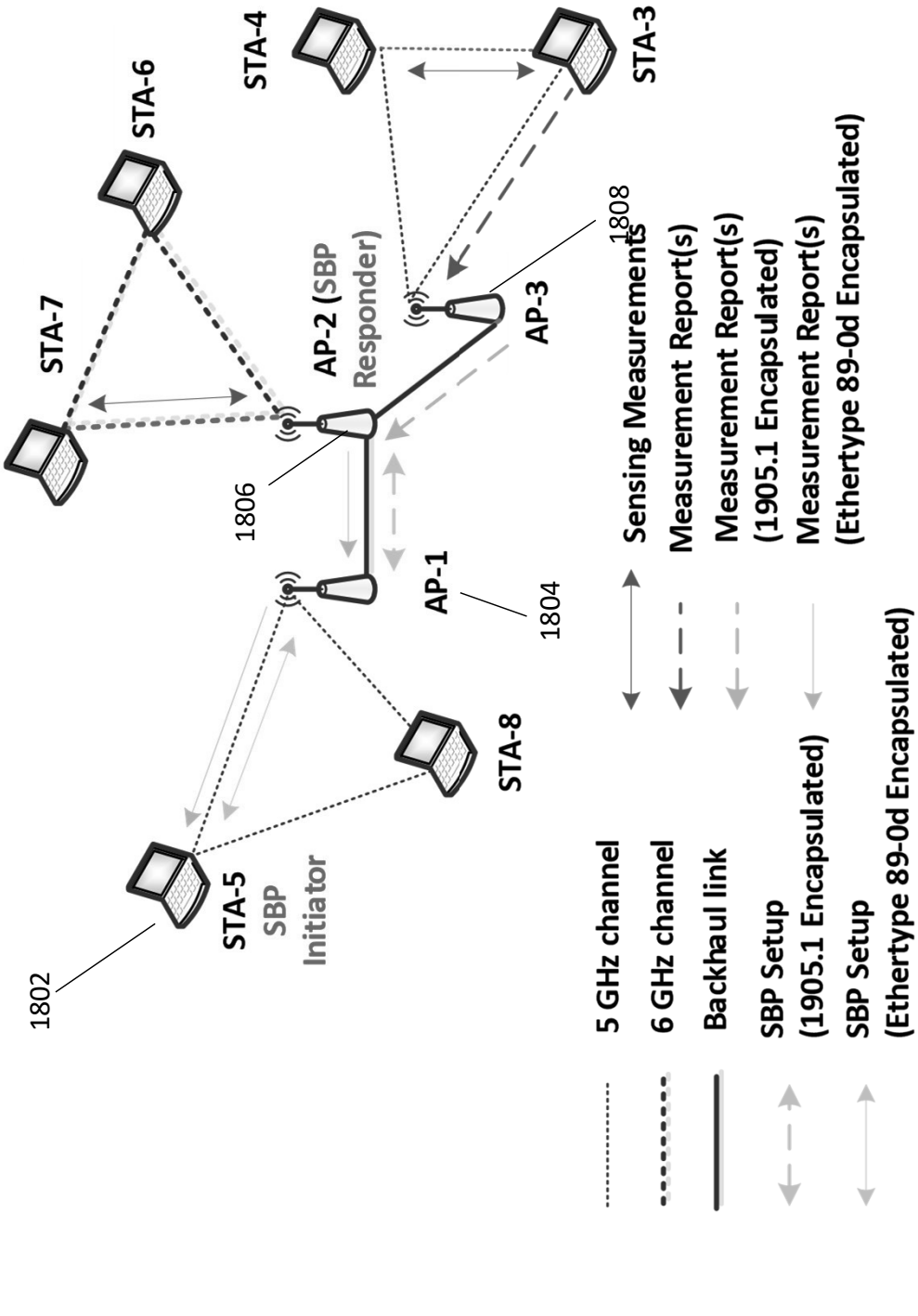

STA-7
STA-6
STA-4
STA-3
AP-2 (SBP Responder)
AP-3
AP-1
STA-8
STA-5
SBP Initiator
1802
1804
1806
1808
Sensing Measurements
Measurement Report(s)
Measurement Report(s) (1905.1 Encapsulated)
Measurement Report(s) (Ethertype 89-0d Encapsulated)
5 GHz channel
6 GHz channel
Backhaul link
SBP Setup (1905.1 Encapsulated)
SBP Setup (Ethertype 89-0d Encapsulated)
1800

Figure 18

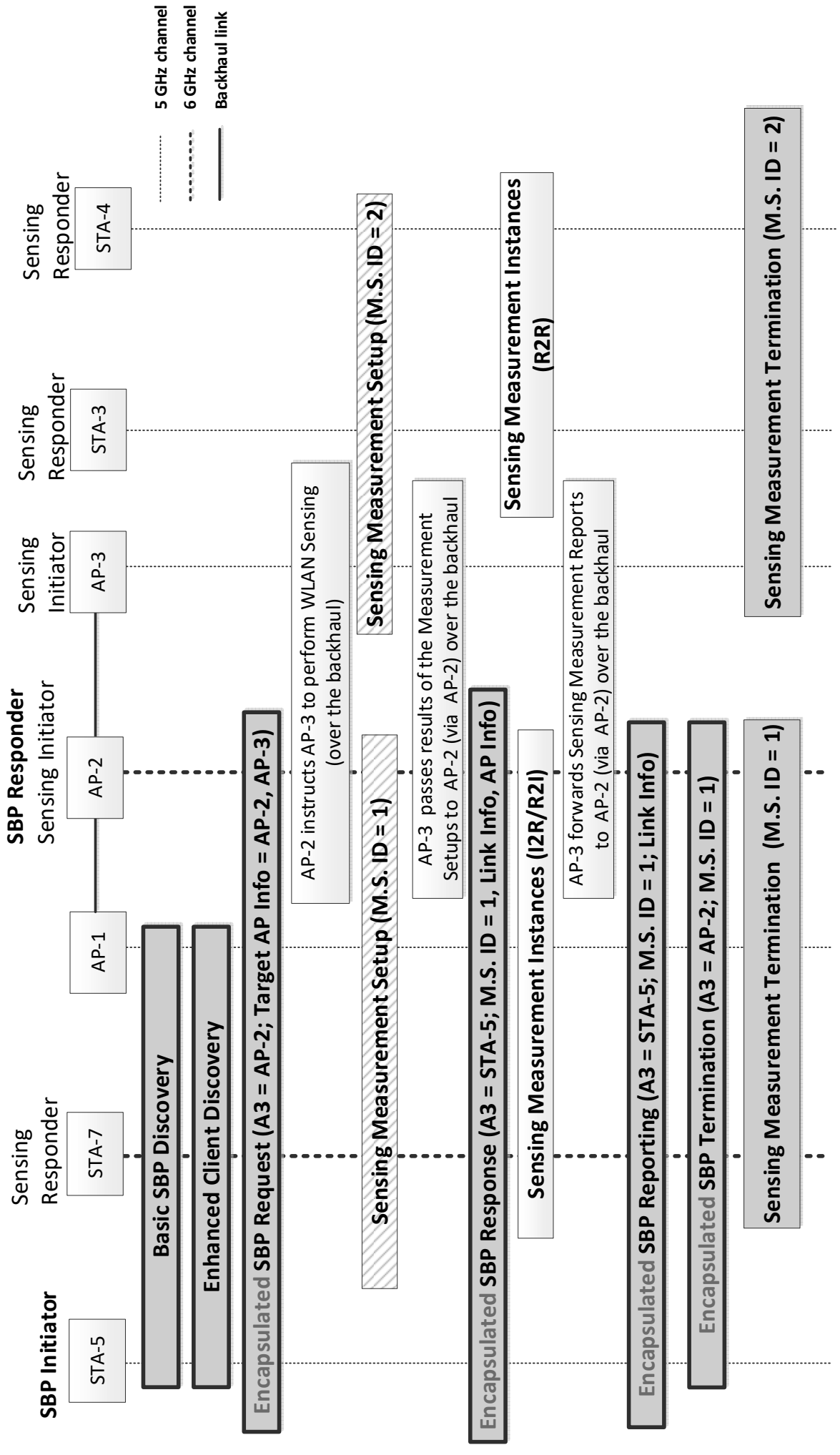

SBP Initiator
STA-5
Sensing Responder
STA-7
AP-1
SBP Responder
Sensing Initiator
AP-2
Sensing Initiator
AP-3
Sensing Responder
STA-3
Sensing Responder
STA-4
5 GHz channel
6 GHz channel
Backhaul link
Basic SBP Discovery
Enhanced Client Discovery
Encapsulated SBP Request (A3 = AP-2; Target AP Info = AP-2, AP-3)
AP-2 instructs AP-3 to perform WLAN Sensing (over the backhaul)
Sensing Measurement Setup (M.S. ID = 2)
Sensing Measurement Setup (M.S. ID = 1)
AP-3 passes results of the Measurement Setups to AP-2 (via AP-2) over the backhaul
Sensing Measurement Instances (R2R)
Encapsulated SBP Response (A3 = STA-5; M.S. ID = 1, Link Info, AP Info)
Sensing Measurement Instances (I2R/R2I)
AP-3 forwards Sensing Measurement Reports to AP-2 (via AP-2) over the backhaul
Encapsulated SBP Reporting (A3 = STA-5; M.S. ID = 1; Link Info)
Encapsulated SBP Termination (A3 = AP-2; M.S. ID = 1)
Sensing Measurement Termination (M.S. ID = 1)
Sensing Measurement Termination (M.S. ID = 2)
1900

Figure 19

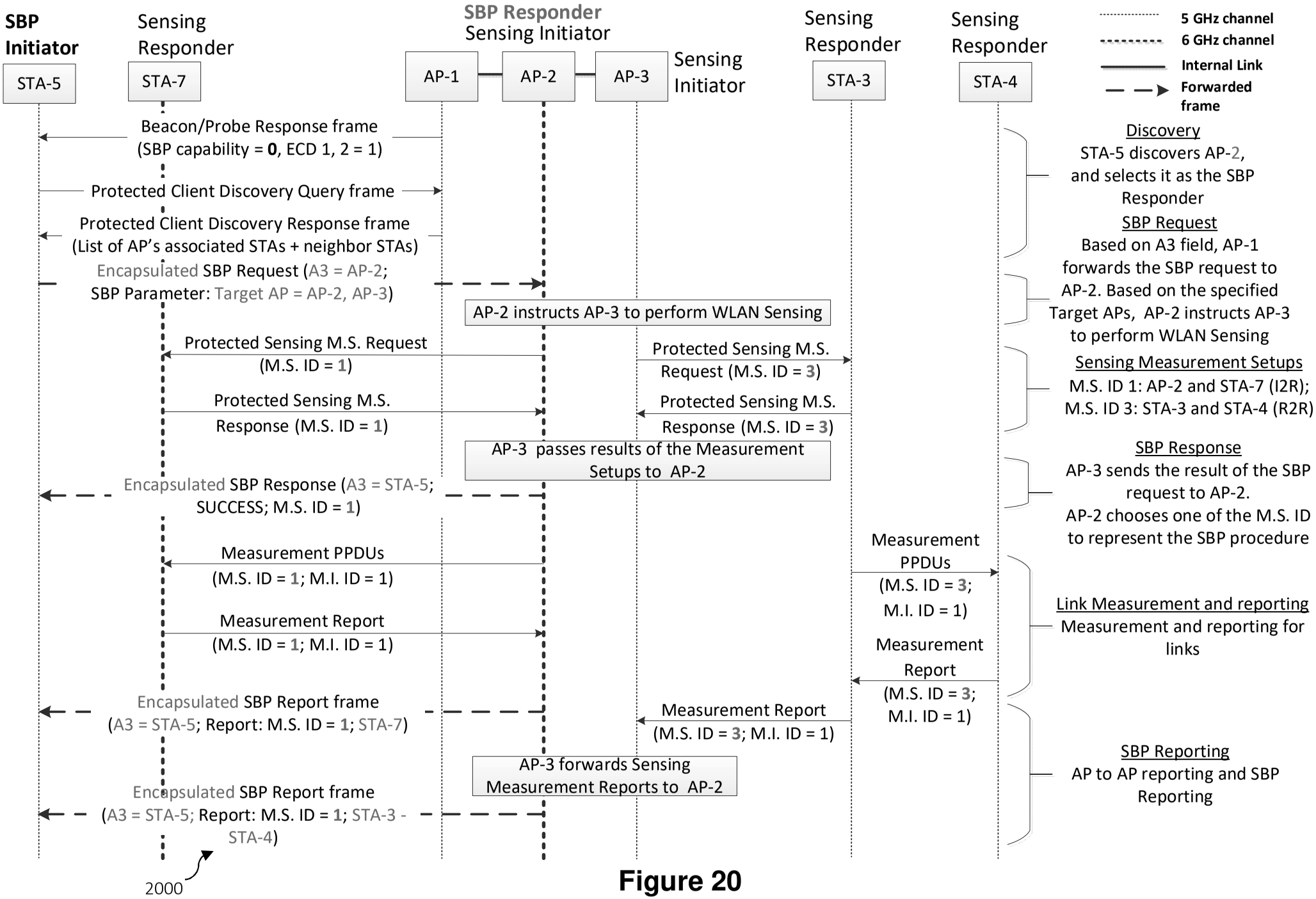
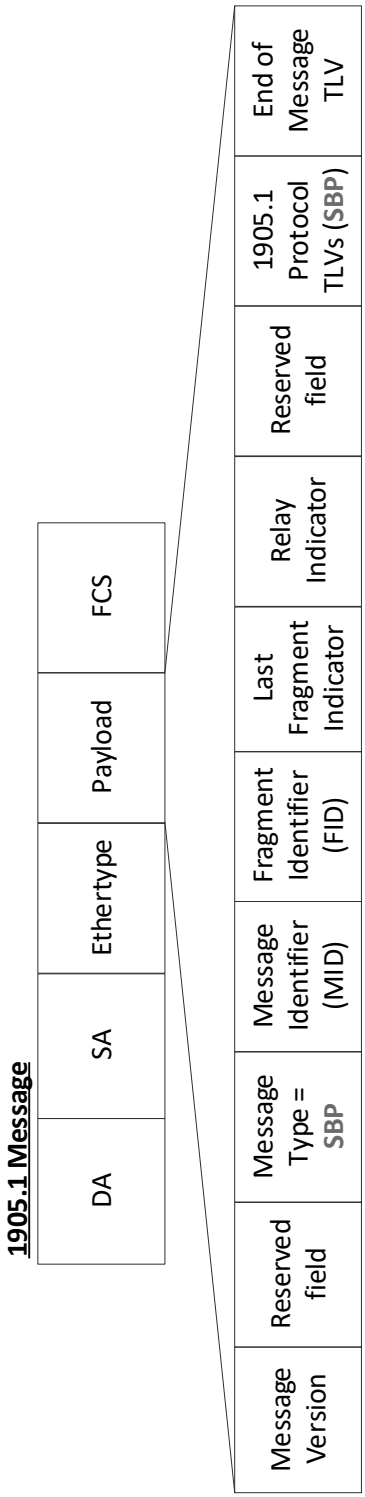

SBP Initiator
Sensing Responder
SBP Responder
Sensing Initiator
Sensing Responder
Sensing Responder
5 GHz channel
6 GHz channel
Internal Link
Forwarded frame
STA-5
STA-7
AP-1
AP-2
AP-3
Sensing Initiator
STA-3
STA-4
Beacon/Probe Response frame (SBP capability = 0, ECD 1, 2 = 1)
Protected Client Discovery Query frame
Protected Client Discovery Response frame (List of AP's associated STAs + neighbor STAs)
Encapsulated SBP Request (A3 = AP-2; SBP Parameter: Target AP = AP-2, AP-3)
AP-2 instructs AP-3 to perform WLAN Sensing
Protected Sensing M.S. Request (M.S. ID = 1)
Protected Sensing M.S. Request (M.S. ID = 3)
Protected Sensing M.S. Response (M.S. ID = 1)
Protected Sensing M.S. Response (M.S. ID = 3)
AP-3 passes results of the Measurement Setups to AP-2
Encapsulated SBP Response (A3 = STA-5; SUCCESS; M.S. ID = 1)
Measurement PPDUs (M.S. ID = 1; M.I. ID = 1)
Measurement PPDUs (M.S. ID = 3; M.I. ID = 1)
Measurement Report (M.S. ID = 1; M.I. ID = 1)
Measurement Report (M.S. ID = 3; M.I. ID = 1)
Encapsulated SBP Report frame (A3 = STA-5; Report: M.S. ID = 1; STA-7)
Measurement Report (M.S. ID = 3; M.I. ID = 1)
AP-3 forwards Sensing Measurement Reports to AP-2
Encapsulated SBP Report frame (A3 = STA-5; Report: M.S. ID = 1; STA-3 - STA-4)
2000
Discovery
STA-5 discovers AP-2, and selects it as the SBP Responder
SBP Request
Based on A3 field, AP-1 forwards the SBP request to AP-2. Based on the specified Target APs, AP-2 instructs AP-3 to perform WLAN Sensing
Sensing Measurement Setups
M.S. ID 1: AP-2 and STA-7 (I2R);
M.S. ID 3: STA-3 and STA-4 (R2R)
SBP Response
AP-3 sends the result of the SBP request to AP-2.
AP-2 chooses one of the M.S. ID to represent the SBP procedure
Link Measurement and reporting
Measurement and reporting for links
SBP Reporting
AP to AP reporting and SBP Reporting

Figure 20



2100

Figure 21

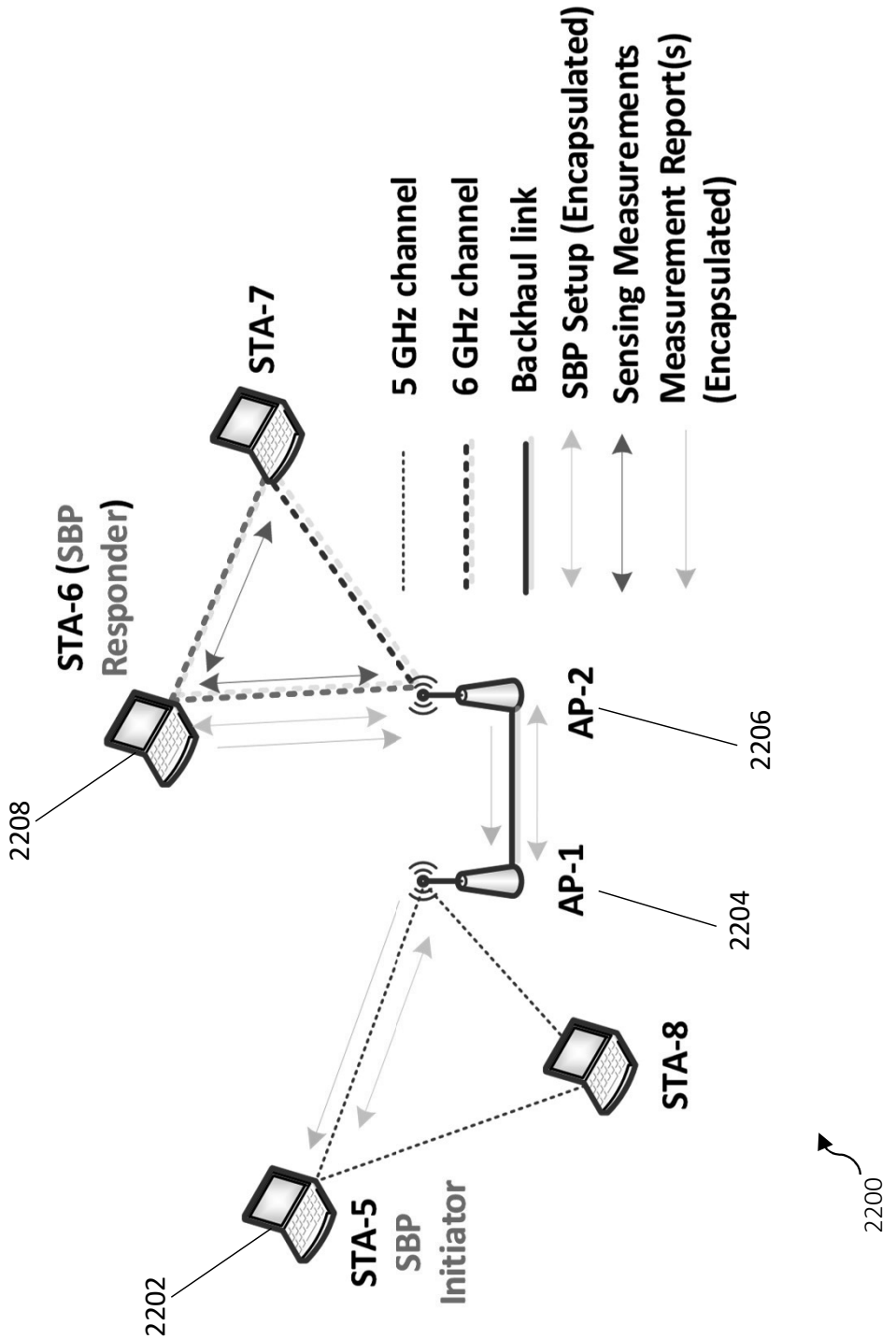

STA-6 (SBP Responder)
STA-7
5 GHz channel
6 GHz channel
Backhaul link
SBP Setup (Encapsulated)
Sensing Measurements
Measurement Report(s) (Encapsulated)
AP-2
AP-1
STA-8
STA-5 SBP Initiator
2208
2206
2204
2202
2200

Figure 22

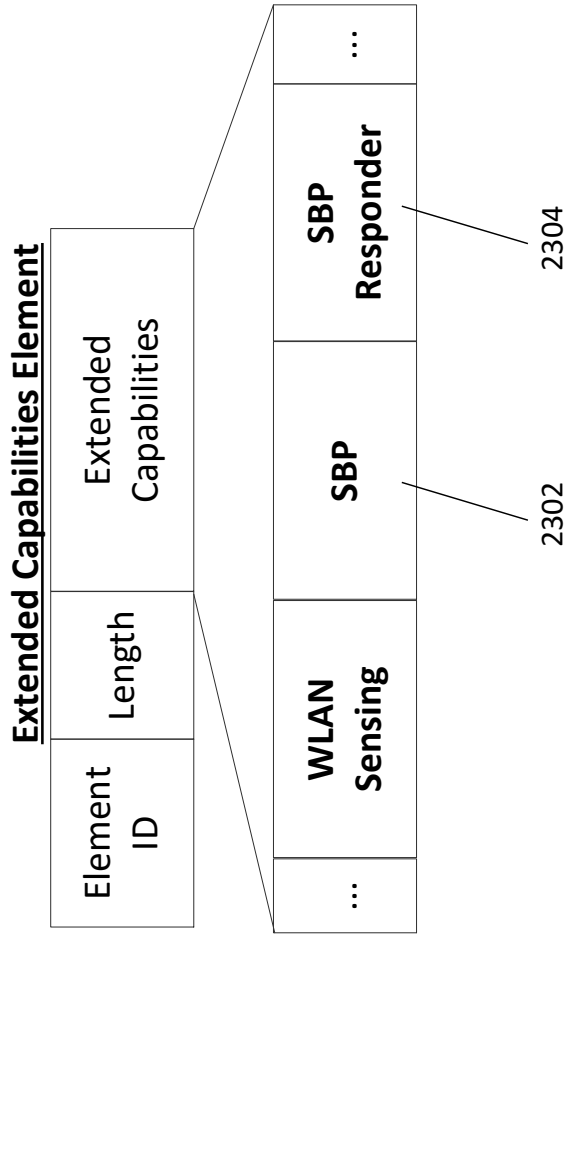

Extended Capabilities Element
Element ID
Length
Extended Capabilities
...
WLAN Sensing
SBP
SBP Responder
...
2302
2304
2300

Figure 23

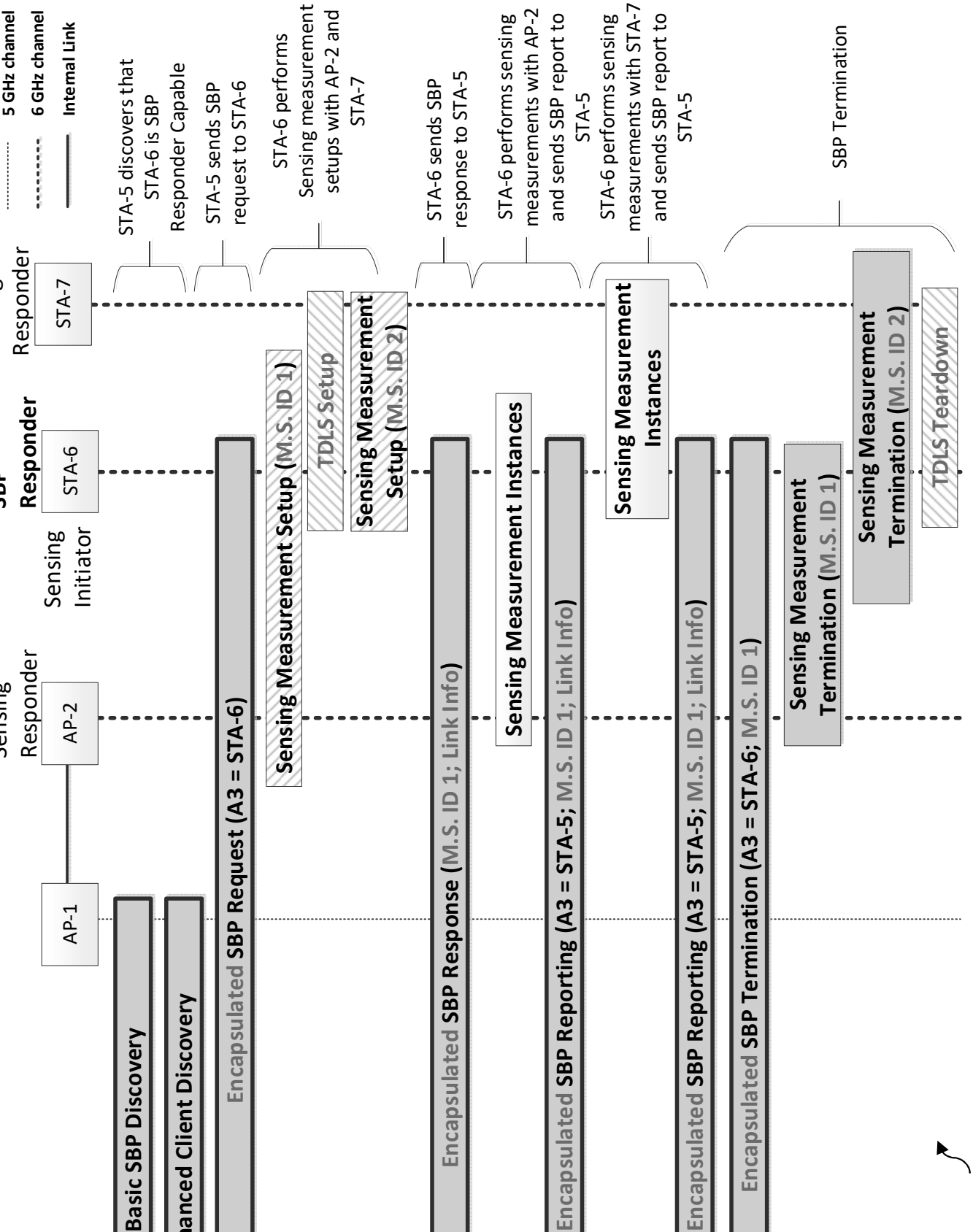

5 GHz channel
6 GHz channel
Internal Link
SBP Initiator
Sensing Responder
Sensing Initiator
SBP Responder
Sensing Responder
STA-5
AP-1
AP-2
STA-6
STA-7
Basic SBP Discovery
Enhanced Client Discovery
Encapsulated SBP Request (A3 = STA-6)
Sensing Measurement Setup (M.S. ID 1)
TDLS Setup
Sensing Measurement Setup (M.S. ID 2)
Encapsulated SBP Response (M.S. ID 1; Link Info)
Sensing Measurement Instances
Encapsulated SBP Reporting (A3 = STA-5; M.S. ID 1; Link Info)
Sensing Measurement Instances
Encapsulated SBP Reporting (A3 = STA-5; M.S. ID 1; Link Info)
Encapsulated SBP Termination (A3 = STA-6; M.S. ID 1)
Sensing Measurement Termination (M.S. ID 1)
Sensing Measurement Termination (M.S. ID 2)
TDLS Teardown
STA-5 discovers that STA-6 is SBP Responder Capable
STA-5 sends SBP request to STA-6
STA-6 performs Sensing measurement setups with AP-2 and STA-7
STA-6 sends SBP response to STA-5
STA-6 performs sensing measurements with AP-2 and sends SBP report to STA-5
STA-6 performs sensing measurements with STA-7 and sends SBP report to STA-5
SBP Termination
2400

Figure 24

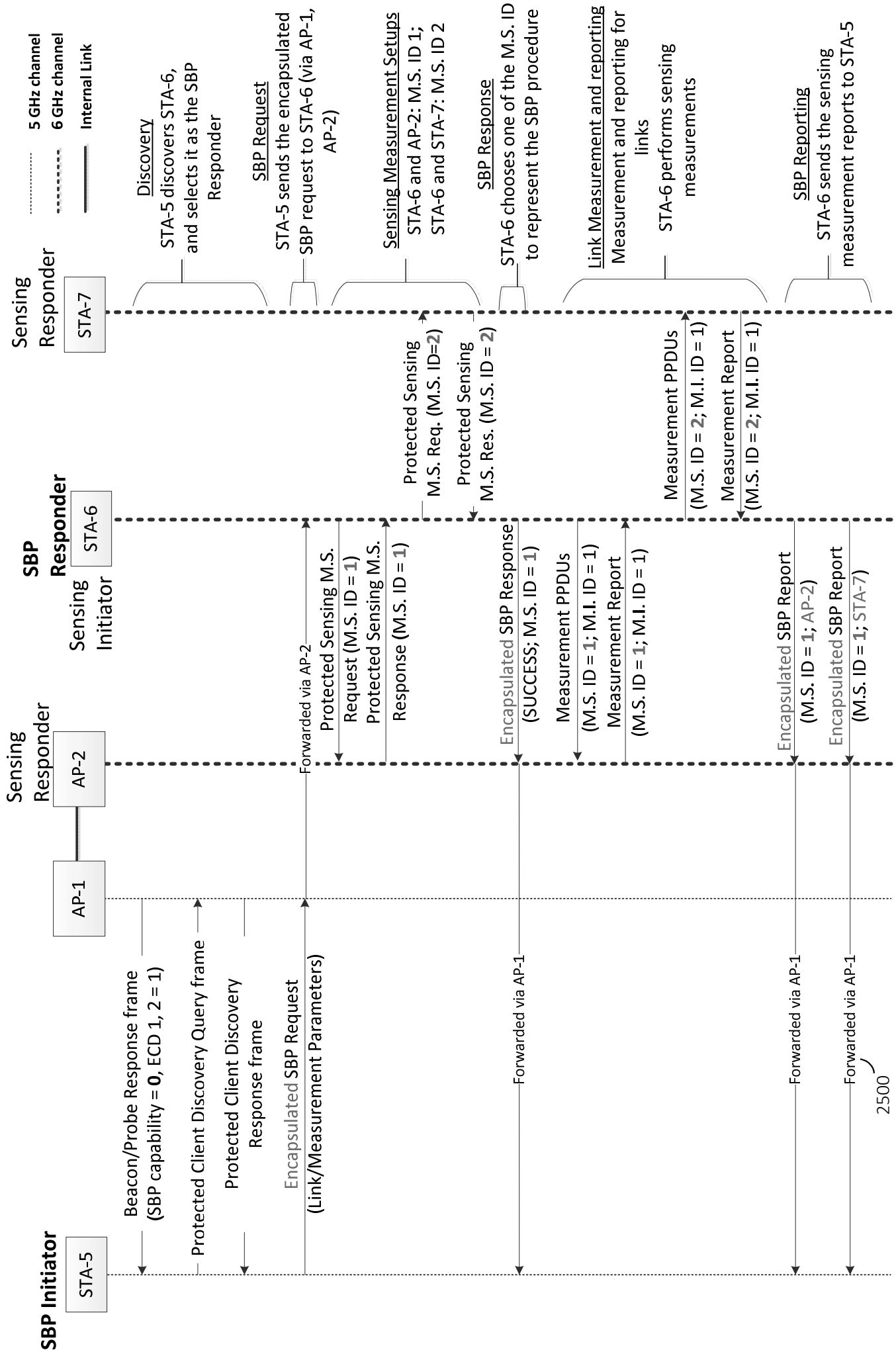

5 GHz channel
6 GHz channel
Internal Link
SBP Initiator
STA-5
Sensing Responder
AP-1
AP-2
SBP Responder
Sensing Initiator
STA-6
Sensing Responder
STA-7
Beacon/Probe Response frame (SBP capability = 0, ECD 1, 2 = 1)
Protected Client Discovery Query frame
Protected Client Discovery Response frame
Encapsulated SBP Request (Link/Measurement Parameters)
Forwarded via AP-2
Protected Sensing M.S. Request (M.S. ID = 1)
Protected Sensing M.S. Response (M.S. ID = 1)
Forwarded via AP-1
Encapsulated SBP Response (SUCCESS; M.S. ID = 1)
Measurement PPDUs (M.S. ID = 1; M.I. ID = 1)
Measurement Report (M.S. ID = 1; M.I. ID = 1)
Forwarded via AP-1
Encapsulated SBP Report (M.S. ID = 1; AP-2)
Encapsulated SBP Report (M.S. ID = 1; STA-7)
Forwarded via AP-1
2500
Discovery
STA-5 discovers STA-6, and selects it as the SBP Responder
SBP Request
STA-5 sends the encapsulated SBP request to STA-6 (via AP-1, AP-2)
Sensing Measurement Setups
STA-6 and AP-2: M.S. ID 1; STA-6 and STA-7: M.S. ID 2
Protected Sensing M.S. Req. (M.S. ID=2)
Protected Sensing M.S. Res. (M.S. ID = 2)
SBP Response
STA-6 chooses one of the M.S. ID to represent the SBP procedure
Link Measurement and reporting
Measurement and reporting for links
STA-6 performs sensing measurements
Measurement PPDUs (M.S. ID = 2; M.I. ID = 1)
Measurement Report (M.S. ID = 2; M.I. ID = 1)
SBP Reporting
STA-6 sends the sensing measurement reports to STA-5

Figure 25

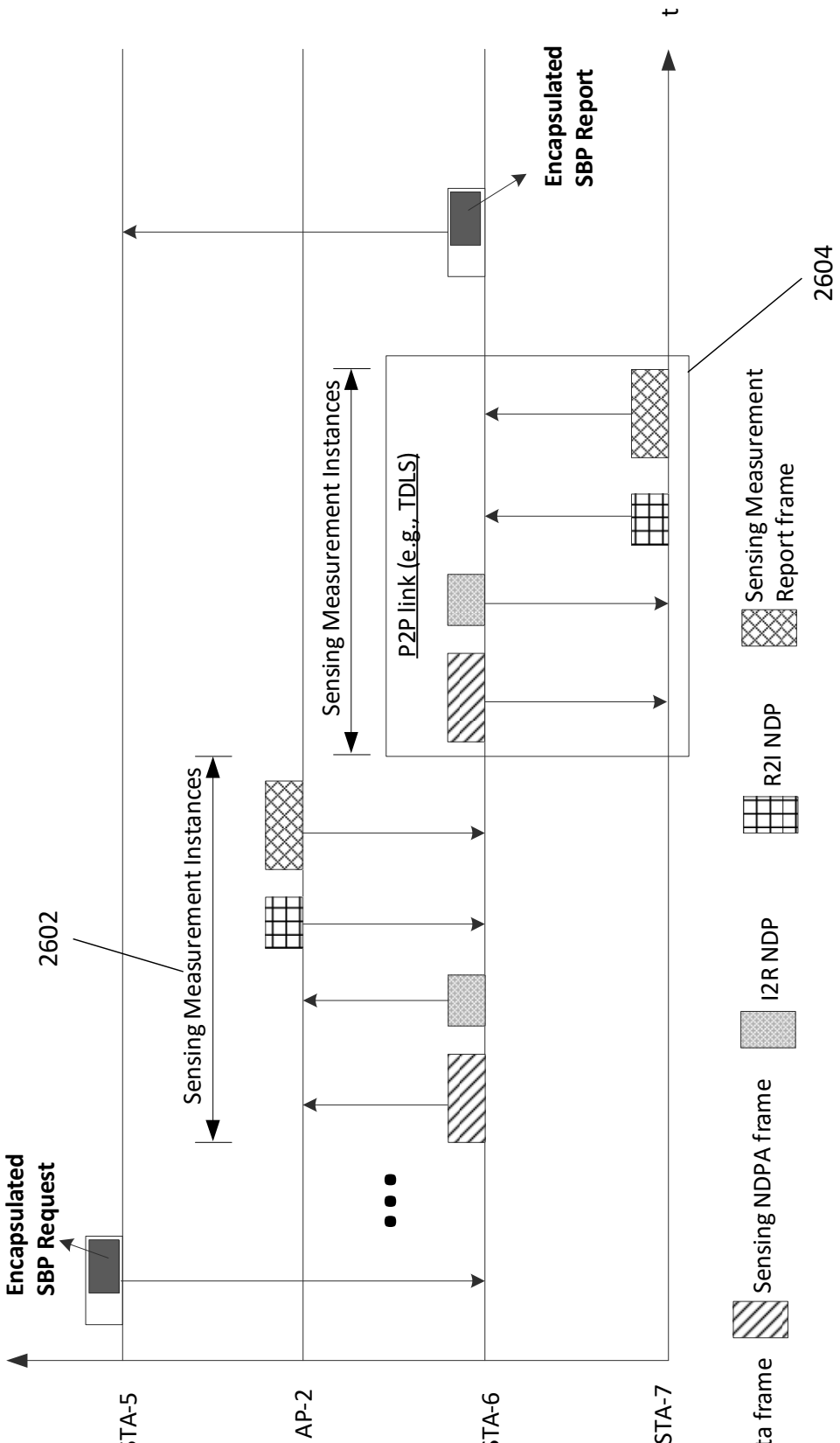

Encapsulated SBP Request
2602
Sensing Measurement Instances
Sensing Measurement Instances
P2P link (e.g., TDLS)
Encapsulated SBP Report
2604
t
SBP Initiator
STA-5
Sensing Responder
AP-2
SBP Responder (Sensing Initiator)
STA-6
Sensing Responder
STA-7
Legend:
Data frame
Sensing NDPA frame
I2R NDP
R2I NDP
Sensing Measurement Report frame
2600

Figure 26

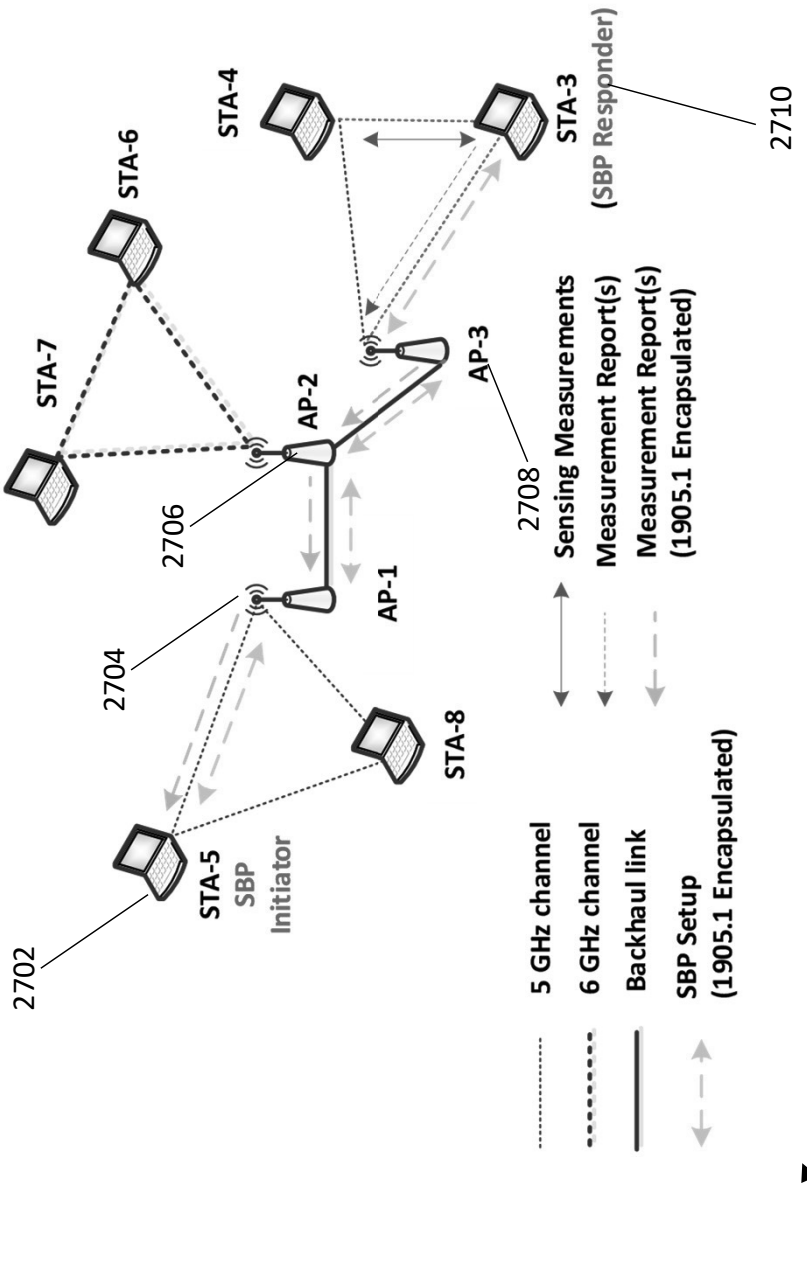

STA-4
STA-3
(SBP Responder)
2710
STA-6
STA-7
AP-2
AP-3
2706
2708
AP-1
2704
STA-8
STA-5
SBP
Initiator
2702
5 GHz channel
Sensing Measurements
6 GHz channel
Measurement Report(s)
Backhaul link
Measurement Report(s)
(1905.1 Encapsulated)
SBP Setup
(1905.1 Encapsulated)
2700

Figure 27

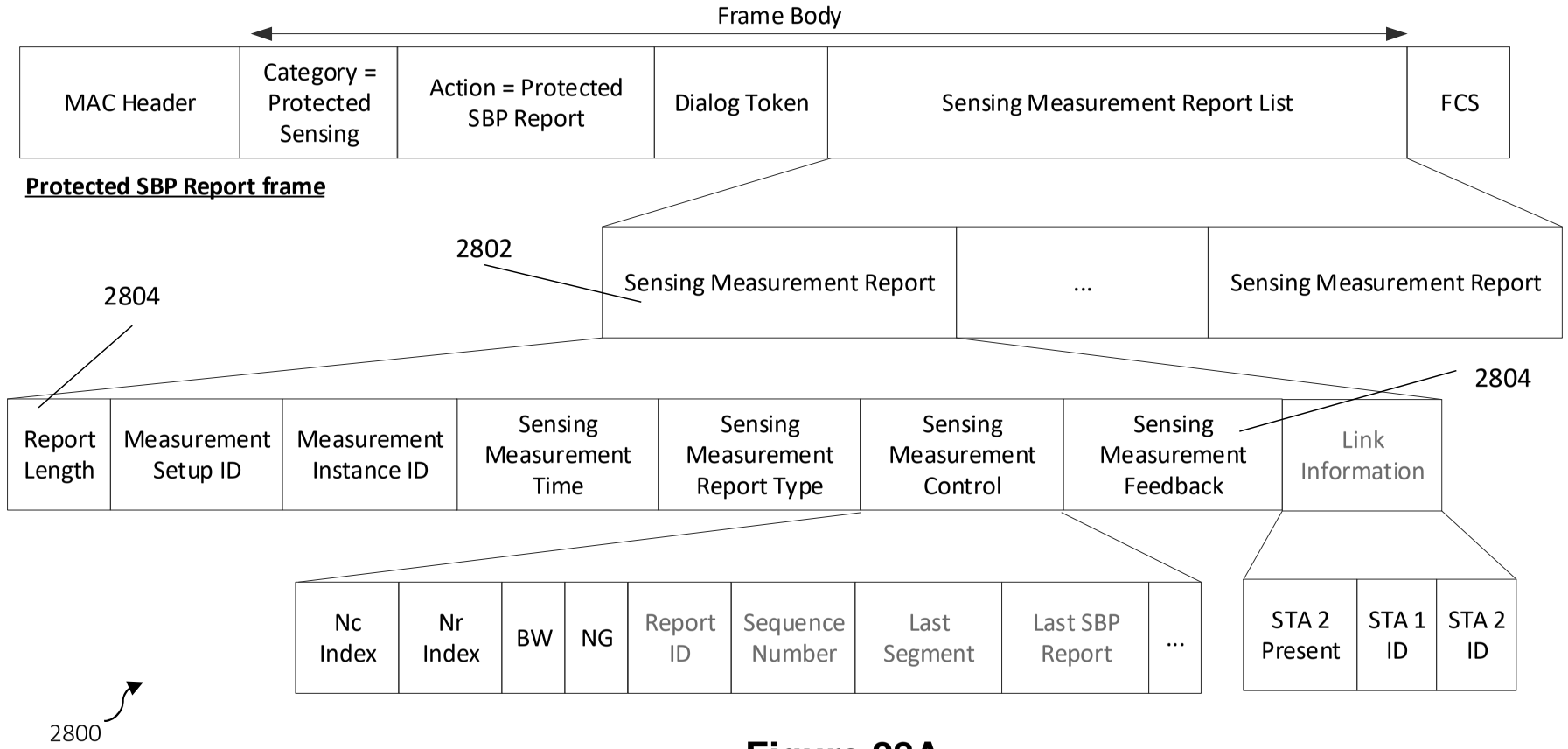


Figure 28A

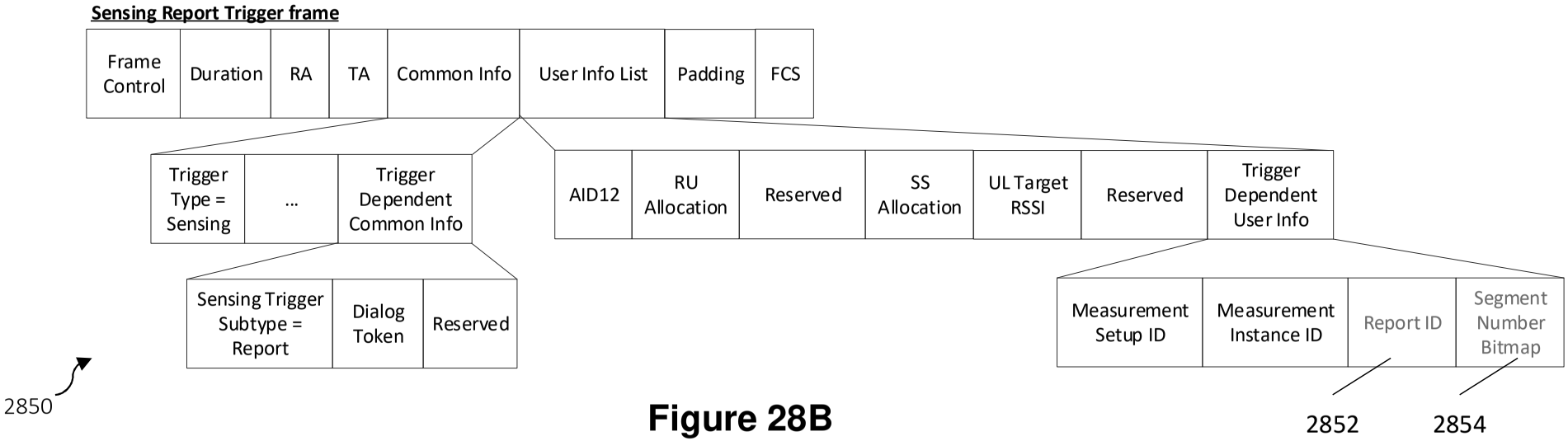


Figure 28B

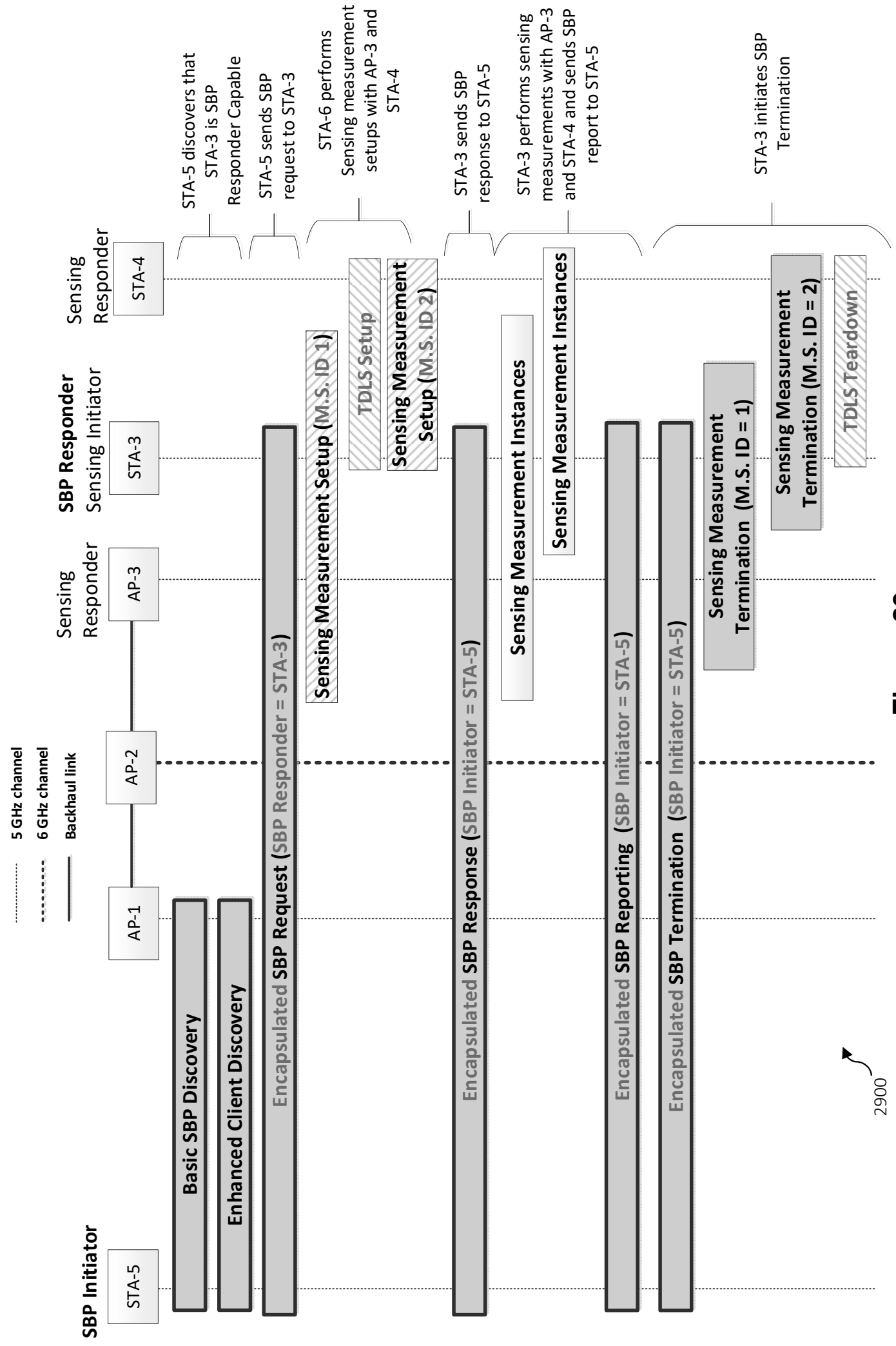
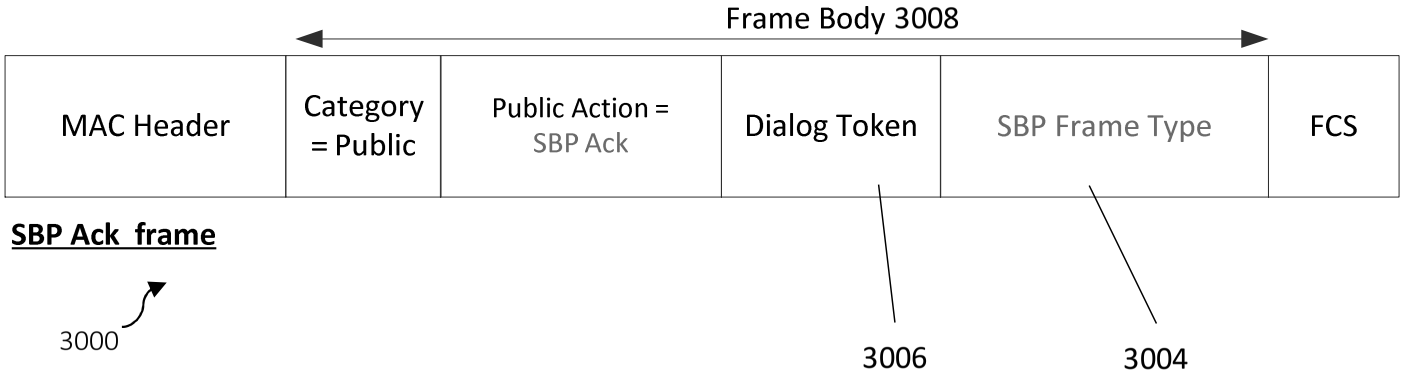

5 GHz channel
6 GHz channel
Backhaul link
SBP Initiator
STA-5
AP-1
AP-2
Sensing Responder
AP-3
SBP Responder
Sensing Initiator
STA-3
Sensing Responder
STA-4
Basic SBP Discovery
Enhanced Client Discovery
Encapsulated SBP Request (SBP Responder = STA-3)
Sensing Measurement Setup (M.S. ID 1)
TDLS Setup
Sensing Measurement Setup (M.S. ID 2)
Encapsulated SBP Response (SBP Initiator = STA-5)
Sensing Measurement Instances
Sensing Measurement Instances
Encapsulated SBP Reporting (SBP Initiator = STA-5)
Encapsulated SBP Termination (SBP Initiator = STA-5)
Sensing Measurement Termination (M.S. ID = 1)
Sensing Measurement Termination (M.S. ID = 2)
TDLS Teardown
STA-5 discovers that STA-3 is SBP Responder Capable
STA-5 sends SBP request to STA-3
STA-6 performs Sensing measurement setups with AP-3 and STA-4
STA-3 sends SBP response to STA-5
STA-3 performs sensing measurements with AP-3 and STA-4 and sends SBP report to STA-5
STA-3 initiates SBP Termination
2900

Figure 29



3002

Figure 30A

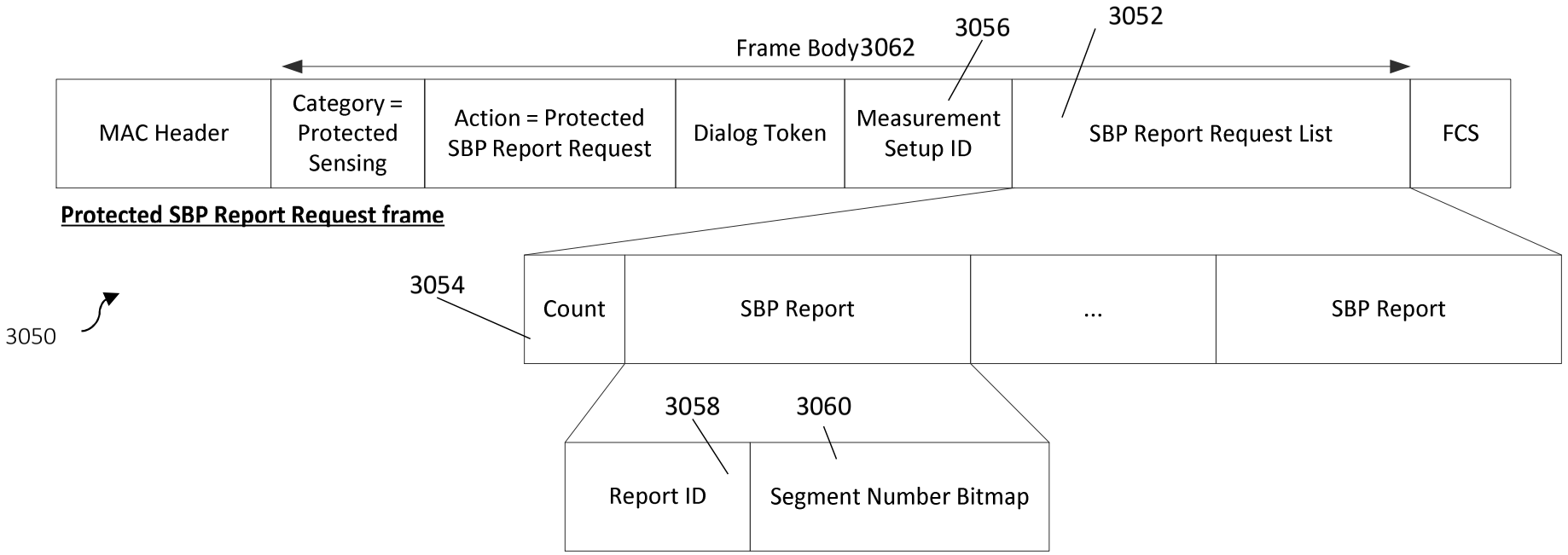


Figure 30B

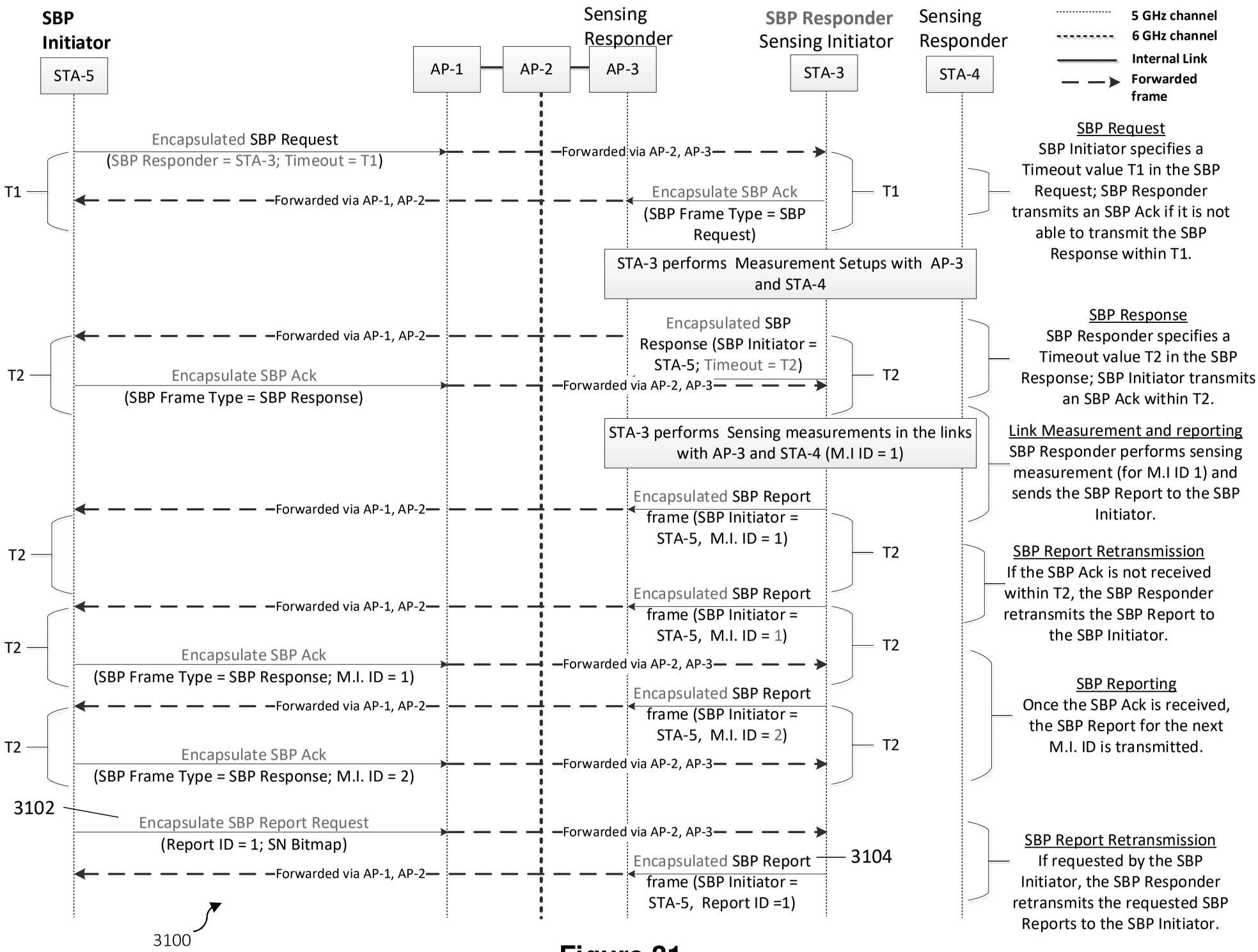

SBP Initiator
STA-5
AP-1
AP-2
Sensing Responder
AP-3
SBP Responder Sensing Initiator
STA-3
Sensing Responder
STA-4
5 GHz channel
6 GHz channel
Internal Link
Forwarded frame
Encapsulated SBP Request
(SBP Responder = STA-3; Timeout = T1)
Forwarded via AP-2, AP-3
T1
Forwarded via AP-1, AP-2
Encapsulate SBP Ack
(SBP Frame Type = SBP Request)
T1
SBP Request
SBP Initiator specifies a Timeout value T1 in the SBP Request; SBP Responder transmits an SBP Ack if it is not able to transmit the SBP Response within T1.
STA-3 performs Measurement Setups with AP-3 and STA-4
Forwarded via AP-1, AP-2
Encapsulated SBP Response (SBP Initiator = STA-5; Timeout = T2)
T2
Encapsulate SBP Ack
(SBP Frame Type = SBP Response)
Forwarded via AP-2, AP-3
T2
SBP Response
SBP Responder specifies a Timeout value T2 in the SBP Response; SBP Initiator transmits an SBP Ack within T2.
STA-3 performs Sensing measurements in the links with AP-3 and STA-4 (M.I ID = 1)
Link Measurement and reporting
SBP Responder performs sensing measurement (for M.I ID 1) and sends the SBP Report to the SBP Initiator.
Forwarded via AP-1, AP-2
Encapsulated SBP Report frame (SBP Initiator = STA-5, M.I. ID = 1)
T2
T2
SBP Report Retransmission
If the SBP Ack is not received within T2, the SBP Responder retransmits the SBP Report to the SBP Initiator.
Forwarded via AP-1, AP-2
Encapsulated SBP Report frame (SBP Initiator = STA-5, M.I. ID = 1)
T2
T2
Encapsulate SBP Ack
(SBP Frame Type = SBP Response; M.I. ID = 1)
Forwarded via AP-2, AP-3
SBP Reporting
Once the SBP Ack is received, the SBP Report for the next M.I. ID is transmitted.
Forwarded via AP-1, AP-2
Encapsulated SBP Report frame (SBP Initiator = STA-5, M.I. ID = 2)
T2
T2
Encapsulate SBP Ack
(SBP Frame Type = SBP Response; M.I. ID = 2)
Forwarded via AP-2, AP-3
3102
Encapsulate SBP Report Request
(Report ID = 1; SN Bitmap)
Forwarded via AP-2, AP-3
Forwarded via AP-1, AP-2
Encapsulated SBP Report frame (SBP Initiator = STA-5, Report ID =1)
3104
SBP Report Retransmission
If requested by the SBP Initiator, the SBP Responder retransmits the requested SBP Reports to the SBP Initiator.
3100

Figure 31

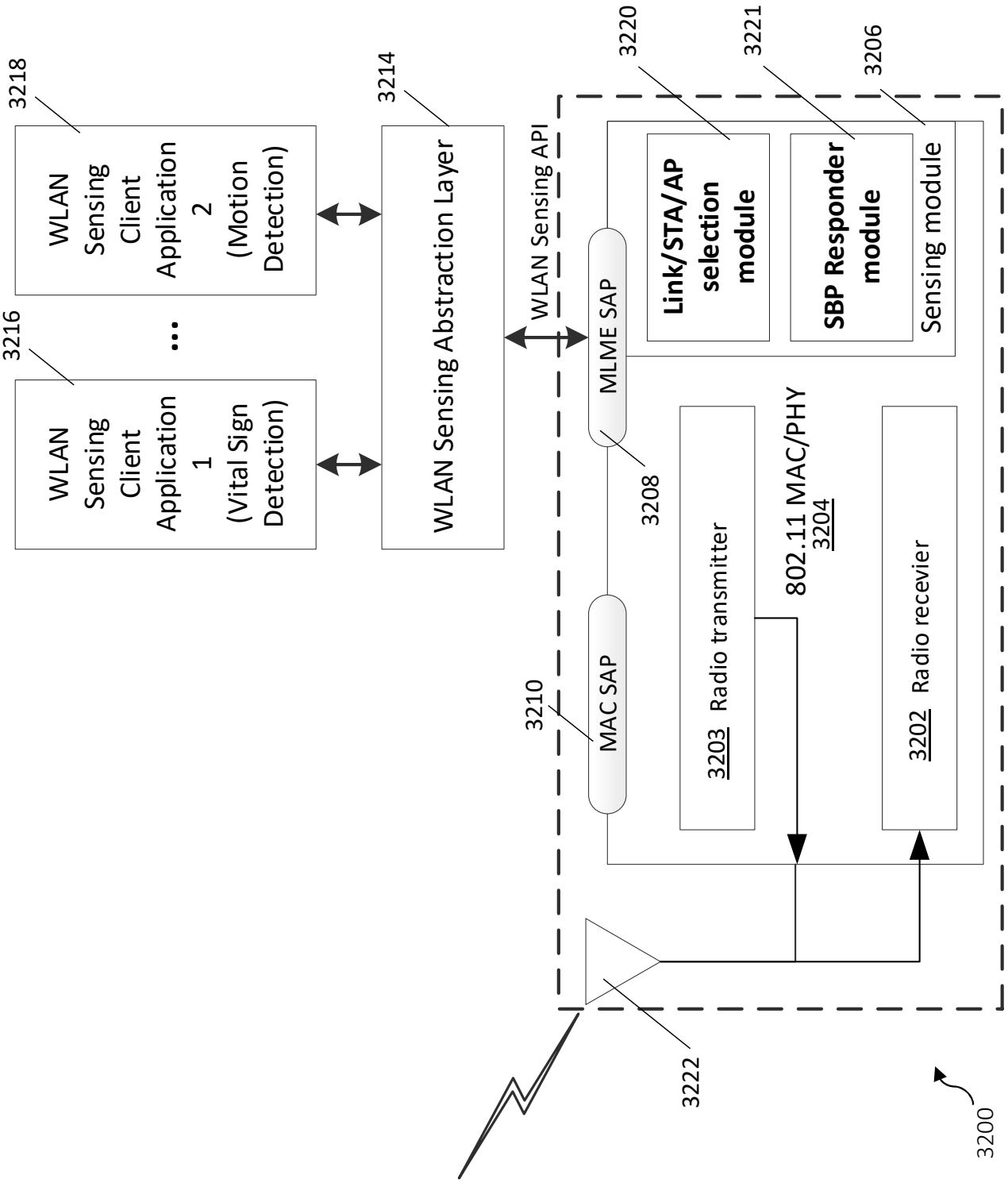

3218
WLAN Sensing Client Application 2 (Motion Detection)
3216
WLAN Sensing Client Application 1 (Vital Sign Detection)
...
3214
WLAN Sensing Abstraction Layer
WLAN Sensing API
3220
3221
3206
Link/STA/AP selection module
SBP Responder module
Sensing module
MLME SAP
3208
802.11 MAC/PHY
3204
3203 Radio transmitter
3202 Radio recevier
3210
MAC SAP
3222
3200

Figure 32

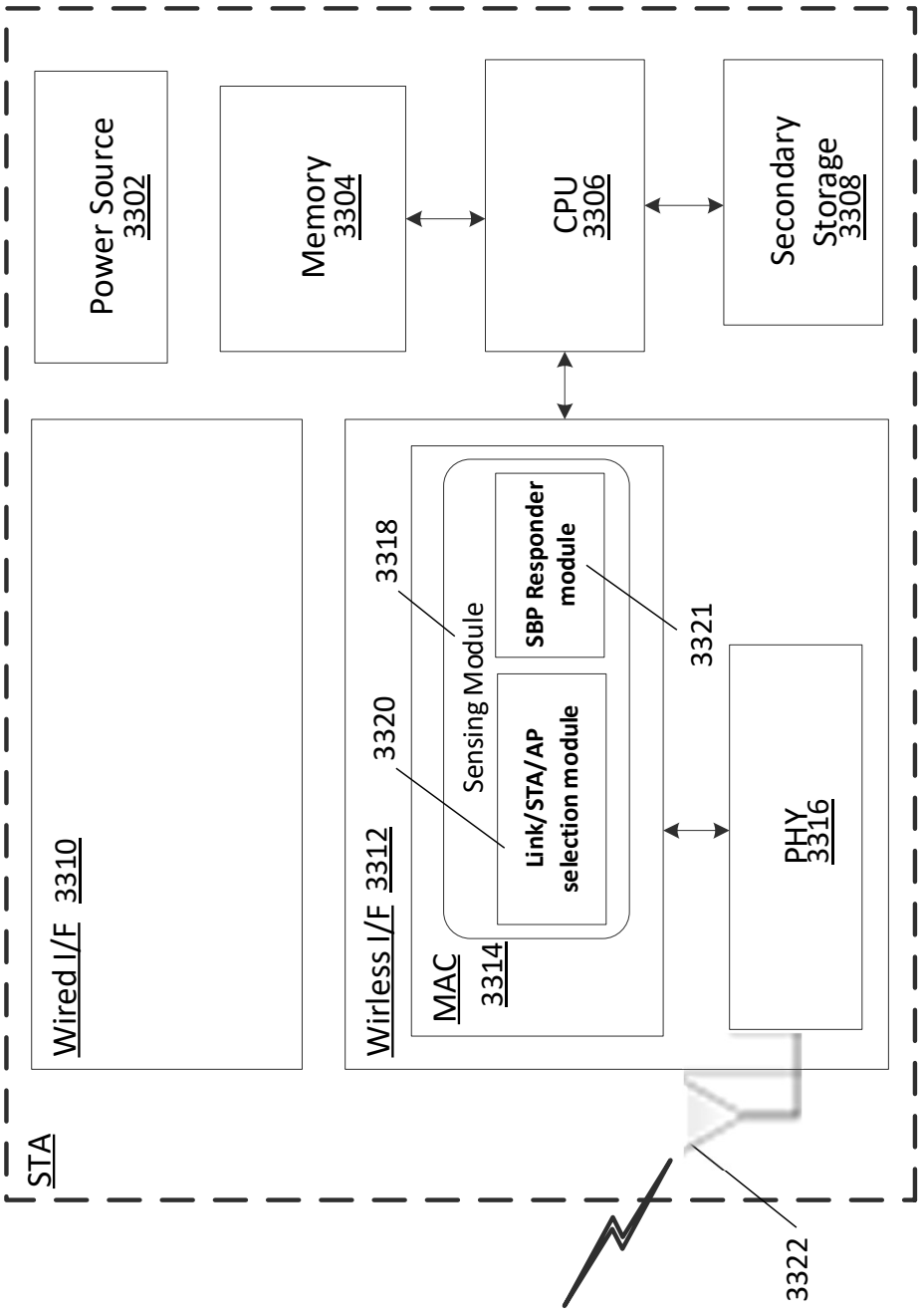

STA
Power Source 3302
Memory 3304
CPU 3306
Secondary Storage 3308
Wired I/F 3310
Wirless I/F 3312
MAC 3314
Sensing Module
3318
Link/STA/AP selection module
3320
SBP Responder module
3321
PHY 3316
3322
3300

Figure 33

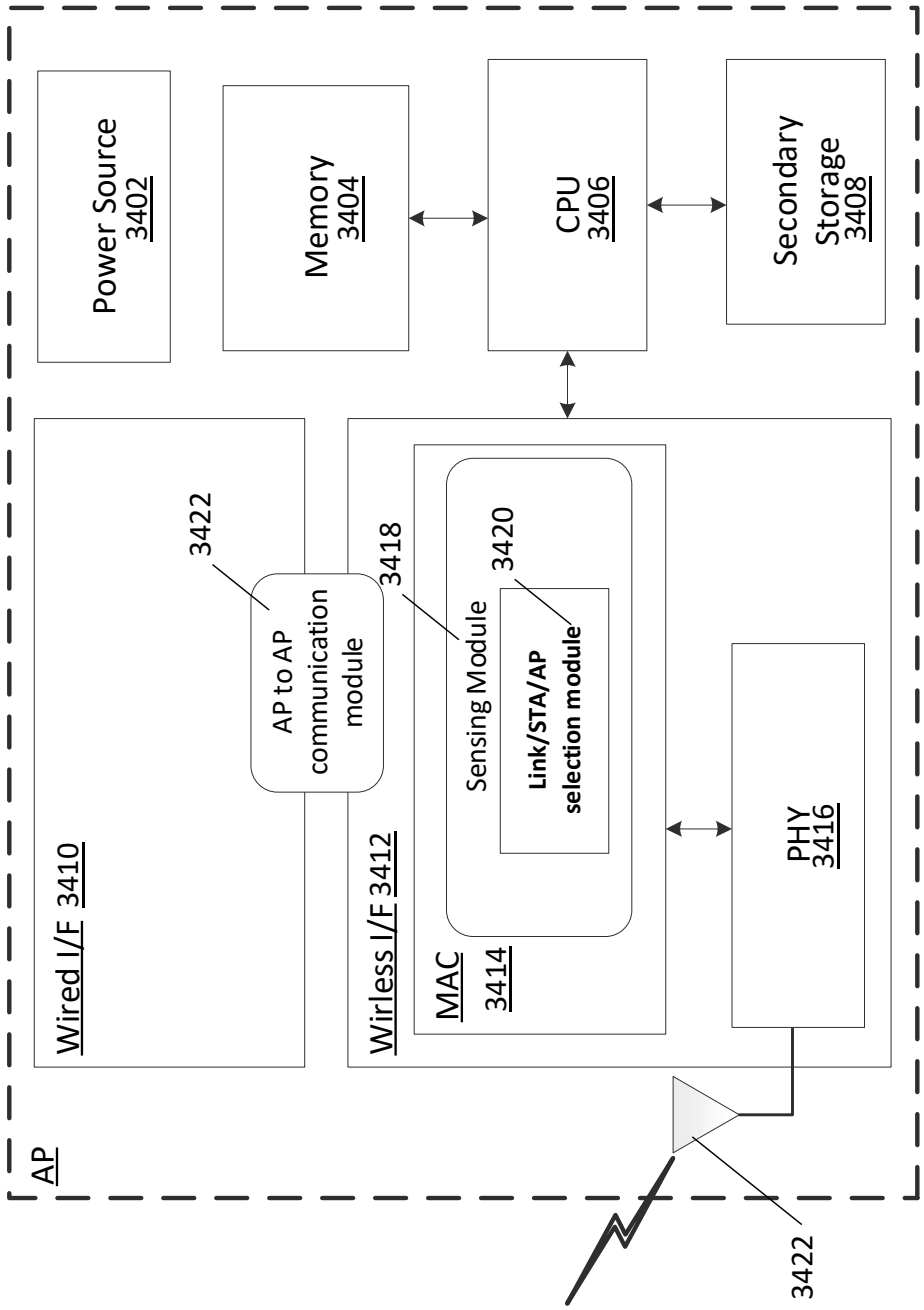

AP
Power Source 3402
Memory 3404
CPU 3406
Secondary Storage 3408
Wired I/F 3410
3422
AP to AP communication module
3418
Wirless I/F 3412
MAC 3414
Sensing Module
3420
Link/STA/AP selection module
PHY 3416
3422
3400

Figure 34

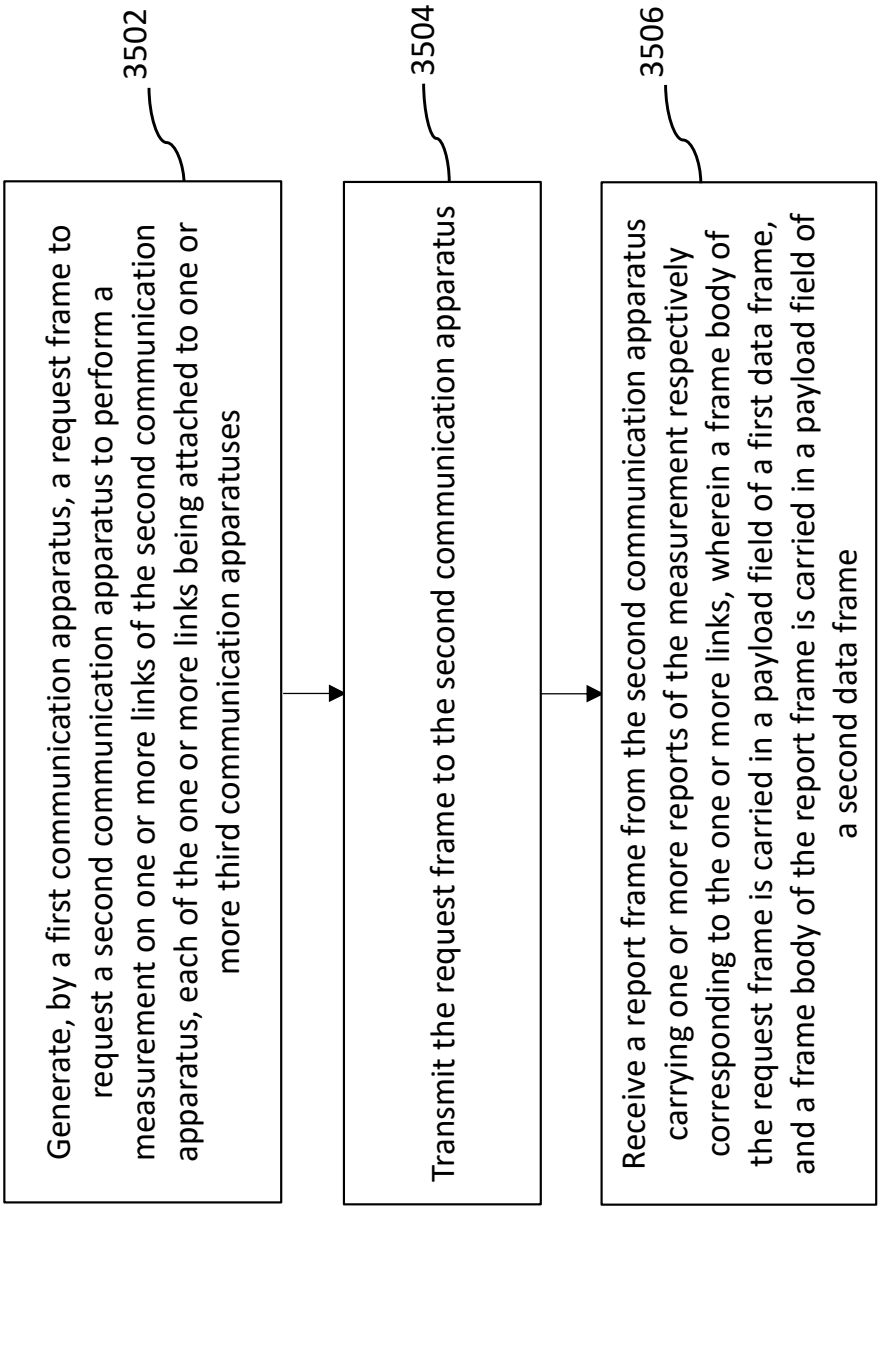

3502
Generate, by a first communication apparatus, a request frame to request a second communication apparatus to perform a measurement on one or more links of the second communication apparatus, each of the one or more links being attached to one or more third communication apparatuses
3504
Transmit the request frame to the second communication apparatus
3506
Receive a report frame from the second communication apparatus carrying one or more reports of the measurement respectively corresponding to the one or more links, wherein a frame body of the request frame is carried in a payload field of a first data frame, and a frame body of the report frame is carried in a payload field of a second data frame
3500

Figure 35

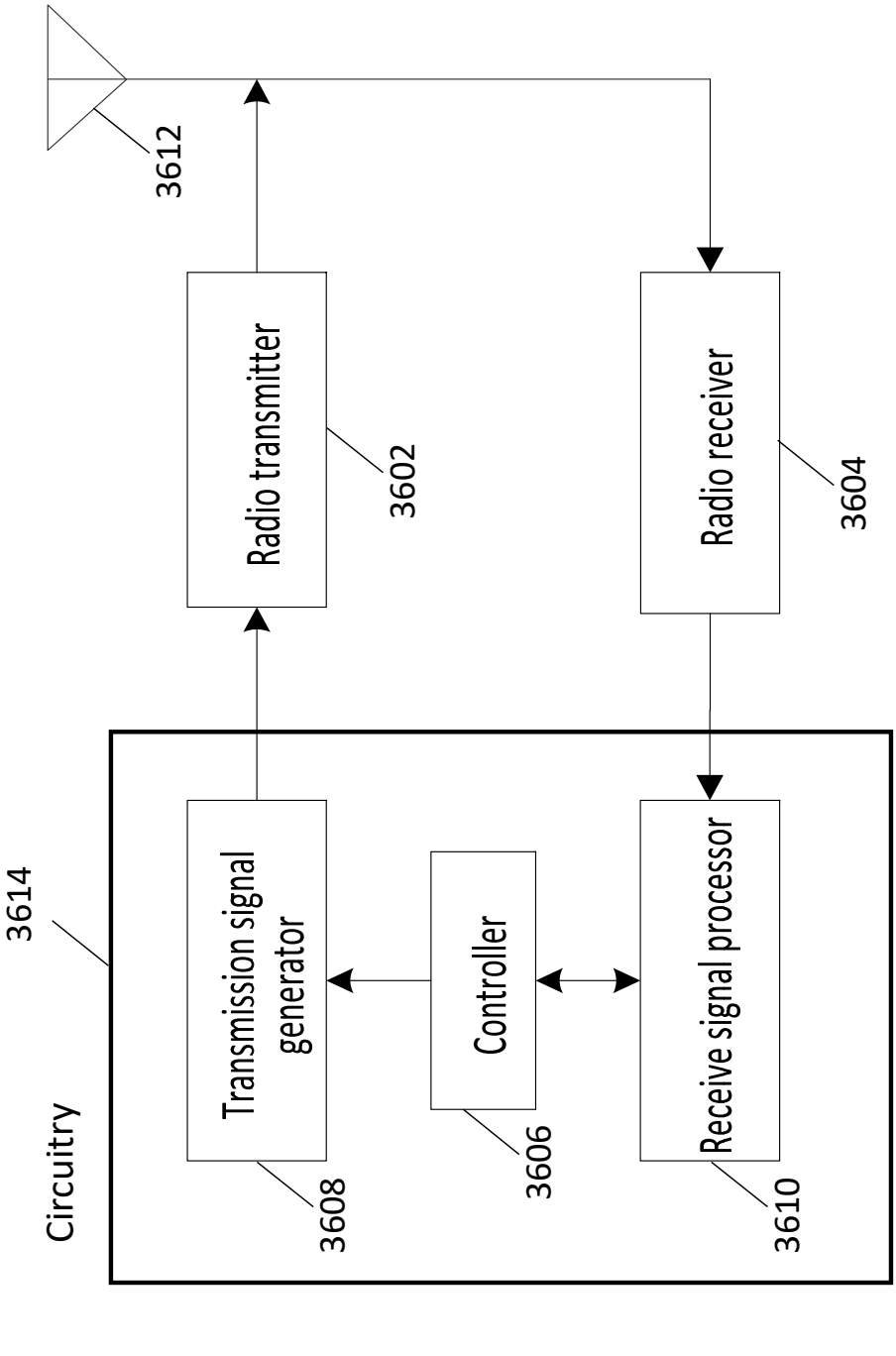

3612
Radio transmitter
3602
Radio receiver
3604
3614
Circuitry
Transmission signal generator
Controller
Receive signal processor
3608
3606
3610
3600

Figure 36