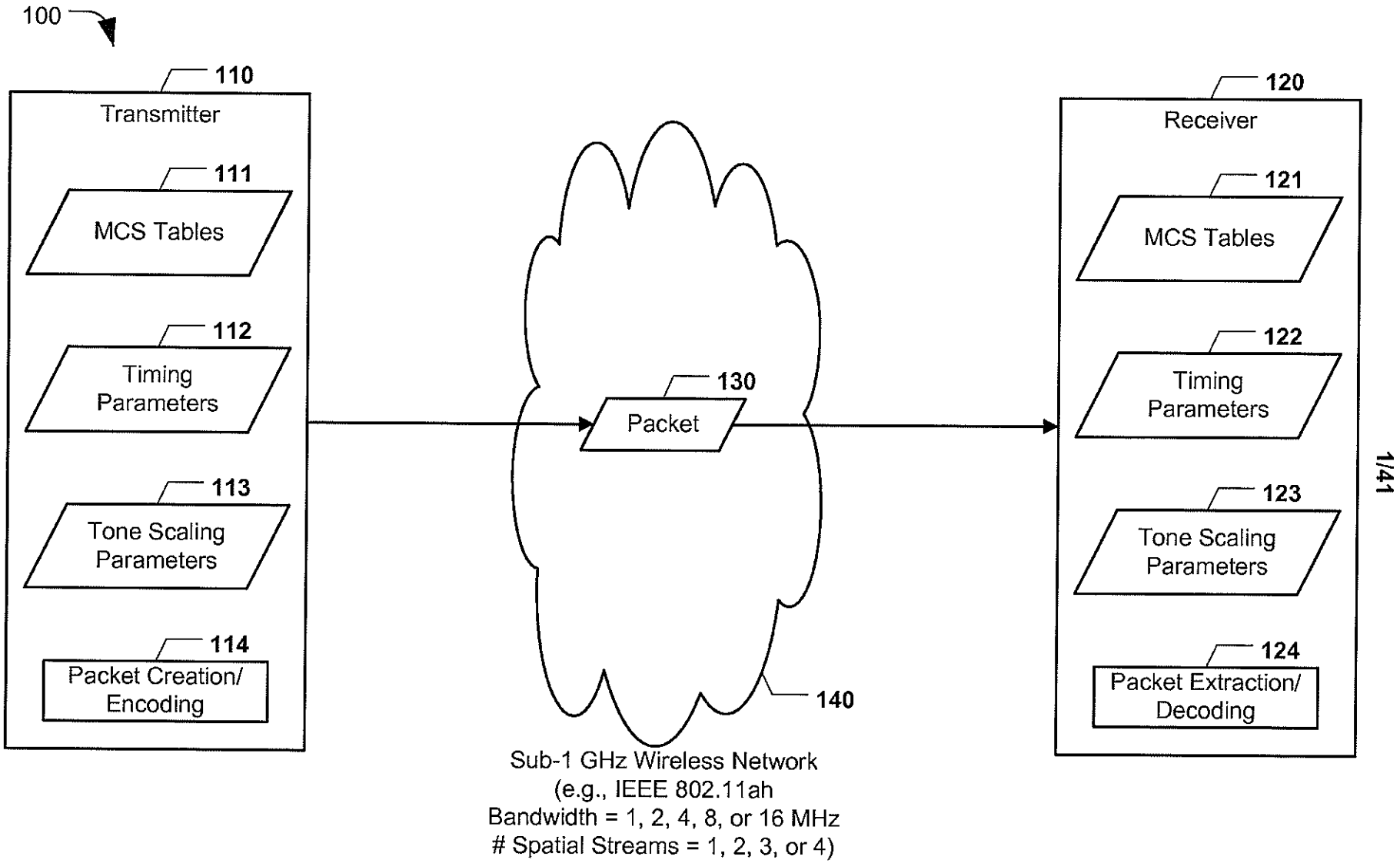

100
110
Transmitter
111
MCS Tables
112
Timing Parameters
113
Tone Scaling Parameters
114
Packet Creation/ Encoding
130
Packet
140
Sub-1 GHz Wireless Network
(e.g., IEEE 802.11ah
Bandwidth = 1, 2, 4, 8, or 16 MHz
# Spatial Streams = 1, 2, 3, or 4)
120
Receiver
121
MCS Tables
122
Timing Parameters
123
Tone Scaling Parameters
124
Packet Extraction/ Decoding

FIG. 1

1 MHz, 1 Spatial Stream - Option 1

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/4	1	24	2	24	6	1	150.0	166.7
1	BPSK	1/2	1	24	2	24	12	1	300.0	333.3
2	QPSK	1/2	2	24	2	48	24	1	600.0	666.7
3	QPSK	3/4	2	24	2	48	36	1	900.0	1000.0
4	16-QAM	1/2	4	24	2	96	48	1	1200.0	1333.3
5	16-QAM	3/4	4	24	2	96	72	1	1800.0	2000.0
6	64-QAM	2/3	6	24	2	144	96	1	2400.0	2666.7
7	64-QAM	3/4	6	24	2	144	108	1	2700.0	3000.0
8	64-QAM	5/6	6	24	2	144	120	1	3000.0	3333.3
9	256-QAM	3/4	8	24	2	192	144	1	3600.0	4000.0
10	256-QAM	5/6	8	24	2	192	160	1	4000.0	4444.4

MCS Idx = MCS Index
Mod = Modulation Scheme
R = Coding Rate
N_sd = # data symbols
N_sp = # pilot symbols
N_bpscs = # bits per subcarrier symbol
N_cbps = # coded bits per OFDM symbol
N_dbps = # data bits per OFDM symbol
N_es = # encoders used
GI = Guard Interval

FIG. 2A

1 MHz, 1 Spatial Stream - Option 2

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	24	2	24	12	1	300.0	333.3
1	QPSK	1/2	2	24	2	48	24	1	600.0	666.7
2	QPSK	3/4	2	24	2	48	36	1	900.0	1000.0
3	16-QAM	1/2	4	24	2	96	48	1	1200.0	1333.3
4	16-QAM	3/4	4	24	2	96	72	1	1800.0	2000.0
5	64-QAM	2/3	6	24	2	144	96	1	2400.0	2666.7
6	64-QAM	3/4	6	24	2	144	108	1	2700.0	3000.0
7	64-QAM	5/6	6	24	2	144	120	1	3000.0	3333.3
8	256-QAM	3/4	8	24	2	192	144	1	3600.0	4000.0
9	256-QAM	5/6	8	24	2	192	160	1	4000.0	4444.4
10	BPSK	1/4	1	24	2	24	6	1	150.0	166.7

FIG. 2B

1 MHz, 1 Spatial Stream - Option 3

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	24	2	24	12	1	300.0	333.3
1	QPSK	1/2	2	24	2	48	24	1	600.0	666.7
2	QPSK	3/4	2	24	2	48	36	1	900.0	1000.0
3	16-QAM	1/2	4	24	2	96	48	1	1200.0	1333.3
4	16-QAM	3/4	4	24	2	96	72	1	1800.0	2000.0
5	64-QAM	2/3	6	24	2	144	96	1	2400.0	2666.7
6	64-QAM	3/4	6	24	2	144	108	1	2700.0	3000.0
7	64-QAM	5/6	6	24	2	144	120	1	3000.0	3333.3
8	256-QAM	3/4	8	24	2	192	144	1	3600.0	4000.0
9	256-QAM	5/6	8	24	2	192	160	1	4000.0	4444.4
15	BPSK	1/4	1	24	2	24	6	1	150.0	166.7

FIG. 2C

1 MHz, 2 Spatial Streams

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	24	2	48	24	1	600.0	666.7
1	QPSK	1/2	2	24	2	96	48	1	1200.0	1333.3
2	QPSK	3/4	2	24	2	96	72	1	1800.0	2000.0
3	16-QAM	1/2	4	24	2	192	96	1	2400.0	2666.7
4	16-QAM	3/4	4	24	2	192	144	1	3600.0	4000.0
5	64-QAM	2/3	6	24	2	288	192	1	4800.0	5333.3
6	64-QAM	3/4	6	24	2	288	216	1	5400.0	6000.0
7	64-QAM	5/6	6	24	2	288	240	1	6000.0	6666.7
8	256-QAM	3/4	8	24	2	384	288	1	7200.0	8000.0
9	256-QAM	5/6	8	24	2	384	320	1	8000.0	8888.9

FIG. 3A

1 MHz, 3 Spatial Streams

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	24	2	72	36	1	900.0	1000.0
1	QPSK	1/2	2	24	2	144	72	1	1800.0	2000.0
2	QPSK	3/4	2	24	2	144	108	1	2700.0	3000.0
3	16-QAM	1/2	4	24	2	288	144	1	3600.0	4000.0
4	16-QAM	3/4	4	24	2	288	216	1	5400.0	6000.0
5	64-QAM	2/3	6	24	2	432	288	1	7200.0	8000.0
6	64-QAM	3/4	6	24	2	432	324	1	8100.0	9000.0
7	64-QAM	5/6	6	24	2	432	360	1	9000.0	10000.0
8	256-QAM	3/4	8	24	2	576	432	1	10800.0	12000.0
9	256-QAM	5/6	8	24	2	576	480	1	12000.0	13333.3

FIG. 3B

1 MHz, 4 Spatial Streams

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	24	2	96	48	1	1200.0	1333.3
1	QPSK	1/2	2	24	2	192	96	1	2400.0	2666.7
2	QPSK	3/4	2	24	2	192	144	1	3600.0	4000.0
3	16-QAM	1/2	4	24	2	384	192	1	4800.0	5333.3
4	16-QAM	3/4	4	24	2	384	288	1	7200.0	8000.0
5	64-QAM	2/3	6	24	2	576	384	1	9600.0	10666.7
6	64-QAM	3/4	6	24	2	576	432	1	10800.0	12000.0
7	64-QAM	5/6	6	24	2	576	480	1	12000.0	13333.3
8	256-QAM	3/4	8	24	2	768	576	1	14400.0	16000.0
9	256-QAM	5/6	8	24	2	768	640	1	16000.0	17777.8

FIG. 3C

2 MHz, 1 Spatial Stream

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	52	4	52	26	1	650.0	722.2
1	QPSK	1/2	2	52	4	104	52	1	1300.0	1444.4
2	QPSK	3/4	2	52	4	104	78	1	1950.0	2166.7
3	16-QAM	1/2	4	52	4	208	104	1	2600.0	2888.9
4	16-QAM	3/4	4	52	4	208	156	1	3900.0	4333.3
5	64-QAM	2/3	6	52	4	312	208	1	5200.0	5777.8
6	64-QAM	3/4	6	52	4	312	234	1	5850.0	6500.0
7	64-QAM	5/6	6	52	4	312	260	1	6500.0	7222.2
8	256-QAM	3/4	8	52	4	416	312	1	7800.0	8666.7
9	256-QAM	5/6	8	52	4	416	346 2/3	1	8666.7	9629.6

FIG. 4A

2 MHz, 2 Spatial Streams

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	52	4	104	52	1	1300.0	1444.4
1	QPSK	1/2	2	52	4	208	104	1	2600.0	2888.9
2	QPSK	3/4	2	52	4	208	156	1	3900.0	4333.3
3	16-QAM	1/2	4	52	4	416	208	1	5200.0	5777.8
4	16-QAM	3/4	4	52	4	416	312	1	7800.0	8666.7
5	64-QAM	2/3	6	52	4	624	416	1	10400.0	11555.6
6	64-QAM	3/4	6	52	4	624	468	1	11700.0	13000.0
7	64-QAM	5/6	6	52	4	624	520	1	13000.0	14444.4
8	256-QAM	3/4	8	52	4	832	624	1	15600.0	17333.3
9	256-QAM	5/6	8	52	4	832	693 1/3	1	17333.3	19259.3

FIG. 4B

2 MHz, 3 Spatial Streams

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	52	4	156	78	1	1950.0	2166.7
1	QPSK	1/2	2	52	4	312	156	1	3900.0	4333.3
2	QPSK	3/4	2	52	4	312	234	1	5850.0	6500.0
3	16-QAM	1/2	4	52	4	624	312	1	7800.0	8666.7
4	16-QAM	3/4	4	52	4	624	468	1	11700.0	13000.0
5	64-QAM	2/3	6	52	4	936	624	1	15600.0	17333.3
6	64-QAM	3/4	6	52	4	936	702	1	17550.0	19500.0
7	64-QAM	5/6	6	52	4	936	780	1	19500.0	21666.7
8	256-QAM	3/4	8	52	4	1248	936	1	23400.0	26000.0
9	256-QAM	5/6	8	52	4	1248	1040	1	26000.0	28888.9

FIG. 4C

2 MHz, 4 Spatial Streams

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	52	4	208	104	1	2600.0	2888.9
1	QPSK	1/2	2	52	4	416	208	1	5200.0	5777.8
2	QPSK	3/4	2	52	4	416	312	1	7800.0	8666.7
3	16-QAM	1/2	4	52	4	832	416	1	10400.0	11555.6
4	16-QAM	3/4	4	52	4	832	624	1	15600.0	17333.3
5	64-QAM	2/3	6	52	4	1248	832	1	20800.0	23111.1
6	64-QAM	3/4	6	52	4	1248	936	1	23400.0	26000.0
7	64-QAM	5/6	6	52	4	1248	1040	1	26000.0	28888.9
8	256-QAM	3/4	8	52	4	1664	1248	1	31200.0	34666.7
9	256-QAM	5/6	8	52	4	1664	1386 2/3	1	34666.7	38518.5

FIG. 4D

4 MHz, 1 Spatial Stream

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	108	6	108	54	1	1350.0	1500.0
1	QPSK	1/2	2	108	6	216	108	1	2700.0	3000.0
2	QPSK	3/4	2	108	6	216	162	1	4050.0	4500.0
3	16-QAM	1/2	4	108	6	432	216	1	5400.0	6000.0
4	16-QAM	3/4	4	108	6	432	324	1	8100.0	9000.0
5	64-QAM	2/3	6	108	6	648	432	1	10800.0	12000.0
6	64-QAM	3/4	6	108	6	648	486	1	12150.0	13500.0
7	64-QAM	5/6	6	108	6	648	540	1	13500.0	15000.0
8	256-QAM	3/4	8	108	6	864	648	1	16200.0	18000.0
9	256-QAM	5/6	8	108	6	864	720	1	18000.0	20000.0

FIG. 5A

4 MHz, 2 Spatial Streams

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	108	6	216	108	1	2700.0	3000.0
1	QPSK	1/2	2	108	6	432	216	1	5400.0	6000.0
2	QPSK	3/4	2	108	6	432	324	1	8100.0	9000.0
3	16-QAM	1/2	4	108	6	864	432	1	10800.0	12000.0
4	16-QAM	3/4	4	108	6	864	648	1	16200.0	18000.0
5	64-QAM	2/3	6	108	6	1296	864	1	21600.0	24000.0
6	64-QAM	3/4	6	108	6	1296	972	1	24300.0	27000.0
7	64-QAM	5/6	6	108	6	1296	1080	1	27000.0	30000.0
8	256-QAM	3/4	8	108	6	1728	1296	1	32400.0	36000.0
9	256-QAM	5/6	8	108	6	1728	1440	1	36000.0	40000.0

FIG. 5B

4 MHz, 3 Spatial Streams

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	108	6	324	162	1	4050.0	4500.0
1	QPSK	1/2	2	108	6	648	324	1	8100.0	9000.0
2	QPSK	3/4	2	108	6	648	486	1	12150.0	13500.0
3	16-QAM	1/2	4	108	6	1296	648	1	16200.0	18000.0
4	16-QAM	3/4	4	108	6	1296	972	1	24300.0	27000.0
5	64-QAM	2/3	6	108	6	1944	1296	1	32400.0	36000.0
6	64-QAM	3/4	6	108	6	1944	1458	1	36450.0	40500.0
7	64-QAM	5/6	6	108	6	1944	1620	1	40500.0	45000.0
8	256-QAM	3/4	8	108	6	2592	1944	1	48600.0	54000.0
9	256-QAM	5/6	8	108	6	2592	2160	1	54000.0	60000.0

FIG. 5C

4 MHz, 4 Spatial Streams

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	108	6	432	216	1	5400.0	6000.0
1	QPSK	1/2	2	108	6	864	432	1	10800.0	12000.0
2	QPSK	3/4	2	108	6	864	648	1	16200.0	18000.0
3	16-QAM	1/2	4	108	6	1728	864	1	21600.0	24000.0
4	16-QAM	3/4	4	108	6	1728	1296	1	32400.0	36000.0
5	64-QAM	2/3	6	108	6	2592	1728	1	43200.0	48000.0
6	64-QAM	3/4	6	108	6	2592	1944	1	48600.0	54000.0
7	64-QAM	5/6	6	108	6	2592	2160	1	54000.0	60000.0
8	256-QAM	3/4	8	108	6	3456	2592	2	64800.0	72000.0
9	256-QAM	5/6	8	108	6	3456	2880	2	72000.0	80000.0

FIG. 5D

8 MHz, 1 Spatial Stream

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	234	8	234	117	1	2925.0	3250.0
1	QPSK	1/2	2	234	8	468	234	1	5850.0	6500.0
2	QPSK	3/4	2	234	8	468	351	1	8775.0	9750.0
3	16-QAM	1/2	4	234	8	936	468	1	11700.0	13000.0
4	16-QAM	3/4	4	234	8	936	702	1	17550.0	19500.0
5	64-QAM	2/3	6	234	8	1404	936	1	23400.0	26000.0
6	64-QAM	3/4	6	234	8	1404	1053	1	26325.0	29250.0
7	64-QAM	5/6	6	234	8	1404	1170	1	29250.0	32500.0
8	256-QAM	3/4	8	234	8	1872	1404	1	35100.0	39000.0
9	256-QAM	5/6	8	234	8	1872	1560	1	39000.0	43333.3

FIG. 6A

8 MHz, 2 Spatial Streams

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	234	8	468	234	1	5850.0	6500.0
1	QPSK	1/2	2	234	8	936	468	1	11700.0	13000.0
2	QPSK	3/4	2	234	8	936	702	1	17550.0	19500.0
3	16-QAM	1/2	4	234	8	1872	936	1	23400.0	26000.0
4	16-QAM	3/4	4	234	8	1872	1404	1	35100.0	39000.0
5	64-QAM	2/3	6	234	8	2808	1872	1	46800.0	52000.0
6	64-QAM	3/4	6	234	8	2808	2106	1	52650.0	58500.0
7	64-QAM	5/6	6	234	8	2808	2340	2	58500.0	65000.0
8	256-QAM	3/4	8	234	8	3744	2808	2	70200.0	78000.0
9	256-QAM	5/6	8	234	8	3744	3120	2	78000.0	86666.7

FIG. 6B

8 MHz, 3 Spatial Streams

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	234	8	702	351	1	8775.0	9750.0
1	QPSK	1/2	2	234	8	1404	702	1	17550.0	19500.0
2	QPSK	3/4	2	234	8	1404	1053	1	26325.0	29250.0
3	16-QAM	1/2	4	234	8	2808	1404	1	35100.0	39000.0
4	16-QAM	3/4	4	234	8	2808	2106	1	52650.0	58500.0
5	64-QAM	2/3	6	234	8	4212	2808	2	70200.0	78000.0
6	64-QAM	3/4	6	234	8	4212	3159	2	78975.0	87750.0
7	64-QAM	5/6	6	234	8	4212	3510	2	87750.0	97500.0
8	256-QAM	3/4	8	234	8	5616	4212	2	105300.0	117000.0
9	256-QAM	5/6	8	234	8	5616	4680	3	117000.0	130000.0

FIG. 6C

8 MHz, 4 Spatial Streams

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	234	8	936	468	1	11700.0	13000.0
1	QPSK	1/2	2	234	8	1872	936	1	23400.0	26000.0
2	QPSK	3/4	2	234	8	1872	1404	1	35100.0	39000.0
3	16-QAM	1/2	4	234	8	3744	1872	1	46800.0	52000.0
4	16-QAM	3/4	4	234	8	3744	2808	2	70200.0	78000.0
5	64-QAM	2/3	6	234	8	5616	3744	2	93600.0	104000.0
6	64-QAM	3/4	6	234	8	5616	4212	2	105300.0	117000.0
7	64-QAM	5/6	6	234	8	5616	4680	3	117000.0	130000.0
8	256-QAM	3/4	8	234	8	7488	5616	3	140400.0	156000.0
9	256-QAM	5/6	8	234	8	7488	6240	3	156000.0	173333.3

FIG. 6D

16 MHz, 1 Spatial Stream

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	468	16	468	234	1	5850.0	6500.0
1	QPSK	1/2	2	468	16	936	468	1	11700.0	13000.0
2	QPSK	3/4	2	468	16	936	702	1	17550.0	19500.0
3	16-QAM	1/2	4	468	16	1872	936	1	23400.0	26000.0
4	16-QAM	3/4	4	468	16	1872	1404	1	35100.0	39000.0
5	64-QAM	2/3	6	468	16	2808	1872	1	46800.0	52000.0
6	64-QAM	3/4	6	468	16	2808	2106	1	52650.0	58500.0
7	64-QAM	5/6	6	468	16	2808	2340	2	58500.0	65000.0
8	256-QAM	3/4	8	468	16	3744	2808	2	70200.0	78000.0
9	256-QAM	5/6	8	468	16	3744	3120	2	78000.0	86666.7

FIG. 7A

16 MHz, 2 Spatial Streams

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	468	16	936	468	1	11700.0	13000.0
1	QPSK	1/2	2	468	16	1872	936	1	23400.0	26000.0
2	QPSK	3/4	2	468	16	1872	1404	1	35100.0	39000.0
3	16-QAM	1/2	4	468	16	3744	1872	1	46800.0	52000.0
4	16-QAM	3/4	4	468	16	3744	2808	2	70200.0	78000.0
5	64-QAM	2/3	6	468	16	5616	3744	2	93600.0	104000.0
6	64-QAM	3/4	6	468	16	5616	4212	2	105300.0	117000.0
7	64-QAM	5/6	6	468	16	5616	4680	3	117000.0	130000.0
8	256-QAM	3/4	8	468	16	7488	5616	3	140400.0	156000.0
9	256-QAM	5/6	8	468	16	7488	6240	3	156000.0	173333.3

FIG. 7B

16 MHz, 3 Spatial Streams – Option 1

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	468	16	1404	702	1	17550.0	19500.0
1	QPSK	1/2	2	468	16	2808	1404	1	35100.0	39000.0
2	QPSK	3/4	2	468	16	2808	2106	1	52650.0	58500.0
3	16-QAM	1/2	4	468	16	5616	2808	2	70200.0	78000.0
4	16-QAM	3/4	4	468	16	5616	4212	2	105300.0	117000.0
5	64-QAM	2/3	6	468	16	8424	5616	3	140400.0	156000.0
6	64-QAM	3/4	6	468	16	8424	6318	3	157950.0	175500.0
7	64-QAM	5/6	6	468	16	8424	7020	4	175500.0	195000.0
8	256-QAM	3/4	8	468	16	11232	8424	4	210600.0	234000.0
9	256-QAM	5/6	8	468	16	11232	9360	5	234000.0	260000.0

FIG. 7C

16 MHz, 3 Spatial Streams – Option 2

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	468	16	1404	702	1	17550.0	19500.0
1	QPSK	1/2	2	468	16	2808	1404	1	35100.0	39000.0
2	QPSK	3/4	2	468	16	2808	2106	1	52650.0	58500.0
3	16-QAM	1/2	4	468	16	5616	2808	2	70200.0	78000.0
4	16-QAM	3/4	4	468	16	5616	4212	2	105300.0	117000.0
5	64-QAM	2/3	6	468	16	8424	5616	3	140400.0	156000.0
6	64-QAM	3/4	6	468	16	8424	6318	3	157950.0	175500.0
7	64-QAM	5/6	6	468	16	8424	7020	4	175500.0	195000.0
8	256-QAM	3/4	8	468	16	11232	8424	4	210600.0	234000.0
9	256-QAM	5/6	8	468	16	11232	9360	6	234000.0	260000.0

FIG. 7D

16 MHz, 4 Spatial Streams – Option 1

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	468	16	1872	936	1	23400.0	26000.0
1	QPSK	1/2	2	468	16	3744	1872	1	46800.0	52000.0
2	QPSK	3/4	2	468	16	3744	2808	2	70200.0	78000.0
3	16-QAM	1/2	4	468	16	7488	3744	2	93600.0	104000.0
4	16-QAM	3/4	4	468	16	7488	5616	3	140400.0	156000.0
5	64-QAM	2/3	6	468	16	11232	7488	4	187200.0	208000.0
6	64-QAM	3/4	6	468	16	11232	8424	4	210600.0	234000.0
7	64-QAM	5/6	6	468	16	11232	9360	5	234000.0	260000.0
8	256-QAM	3/4	8	468	16	14976	11232	6	280800.0	312000.0
9	256-QAM	5/6	8	468	16	14976	12480	6	312000.0	346666.7

FIG. 8A

16 MHz, 4 Spatial Streams – Option 2

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	468	16	1872	936	1	23400.0	26000.0
1	QPSK	1/2	2	468	16	3744	1872	1	46800.0	52000.0
2	QPSK	3/4	2	468	16	3744	2808	2	70200.0	78000.0
3	16-QAM	1/2	4	468	16	7488	3744	2	93600.0	104000.0
4	16-QAM	3/4	4	468	16	7488	5616	3	140400.0	156000.0
5	64-QAM	2/3	6	468	16	11232	7488	4	187200.0	208000.0
6	64-QAM	3/4	6	468	16	11232	8424	4	210600.0	234000.0
7	64-QAM	5/6	6	468	16	11232	9360	6	234000.0	260000.0
8	256-QAM	3/4	8	468	16	14976	11232	6	280800.0	312000.0
9	256-QAM	5/6	8	468	16	14976	12480	6	312000.0	346666.7

FIG. 8B

4 MHz, 4 Spatial Streams (Single Encoder)

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	108	6	432	216	1	5400.0	6000.0
1	QPSK	1/2	2	108	6	864	432	1	10800.0	12000.0
2	QPSK	3/4	2	108	6	864	648	1	16200.0	18000.0
3	16-QAM	1/2	4	108	6	1728	864	1	21600.0	24000.0
4	16-QAM	3/4	4	108	6	1728	1296	1	32400.0	36000.0
5	64-QAM	2/3	6	108	6	2592	1728	1	43200.0	48000.0
6	64-QAM	3/4	6	108	6	2592	1944	1	48600.0	54000.0
7	64-QAM	5/6	6	108	6	2592	2160	1	54000.0	60000.0
8	256-QAM	3/4	8	108	6	3456	2592	1	64800.0	72000.0
9	256-QAM	5/6	8	108	6	3456	2880	1	72000.0	80000.0

FIG. 9A

8 MHz, 2 Spatial Streams (Single Encoder)

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	234	8	468	234	1	5850.0	6500.0
1	QPSK	1/2	2	234	8	936	468	1	11700.0	13000.0
2	QPSK	3/4	2	234	8	936	702	1	17550.0	19500.0
3	16-QAM	1/2	4	234	8	1872	936	1	23400.0	26000.0
4	16-QAM	3/4	4	234	8	1872	1404	1	35100.0	39000.0
5	64-QAM	2/3	6	234	8	2808	1872	1	46800.0	52000.0
6	64-QAM	3/4	6	234	8	2808	2106	1	52650.0	58500.0
7	64-QAM	5/6	6	234	8	2808	2340	1	58500.0	65000.0
8	256-QAM	3/4	8	234	8	3744	2808	1	70200.0	78000.0
9	256-QAM	5/6	8	234	8	3744	3120	1	78000.0	86666.7

FIG. 9B

8 MHz, 3 Spatial Streams (Single Encoder)

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	234	8	702	351	1	8775.0	9750.0
1	QPSK	1/2	2	234	8	1404	702	1	17550.0	19500.0
2	QPSK	3/4	2	234	8	1404	1053	1	26325.0	29250.0
3	16-QAM	1/2	4	234	8	2808	1404	1	35100.0	39000.0
4	16-QAM	3/4	4	234	8	2808	2106	1	52650.0	58500.0
5	64-QAM	2/3	6	234	8	4212	2808	1	70200.0	78000.0
6	64-QAM	3/4	6	234	8	4212	3159	1	78975.0	87750.0
7	64-QAM	5/6	6	234	8	4212	3510	1	87750.0	97500.0
8	256-QAM	3/4	8	234	8	5616	4212	1	105300.0	117000.0
9	256-QAM	5/6	8	234	8	5616	4680	1	117000.0	130000.0

FIG. 9C

8 MHz, 4 Spatial Streams (Single Encoder)

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	234	8	936	468	1	11700.0	13000.0
1	QPSK	1/2	2	234	8	1872	936	1	23400.0	26000.0
2	QPSK	3/4	2	234	8	1872	1404	1	35100.0	39000.0
3	16-QAM	1/2	4	234	8	3744	1872	1	46800.0	52000.0
4	16-QAM	3/4	4	234	8	3744	2808	1	70200.0	78000.0
5	64-QAM	2/3	6	234	8	5616	3744	1	93600.0	104000.0
6	64-QAM	3/4	6	234	8	5616	4212	1	105300.0	117000.0
7	64-QAM	5/6	6	234	8	5616	4680	1	117000.0	130000.0
8	256-QAM	3/4	8	234	8	7488	5616	1	140400.0	156000.0
9	256-QAM	5/6	8	234	8	7488	6240	1	156000.0	173333.3

FIG. 9D

16 MHz, 1 Spatial Stream (Single Encoder)

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	468	16	468	234	1	5850.0	6500.0
1	QPSK	1/2	2	468	16	936	468	1	11700.0	13000.0
2	QPSK	3/4	2	468	16	936	702	1	17550.0	19500.0
3	16-QAM	1/2	4	468	16	1872	936	1	23400.0	26000.0
4	16-QAM	3/4	4	468	16	1872	1404	1	35100.0	39000.0
5	64-QAM	2/3	6	468	16	2808	1872	1	46800.0	52000.0
6	64-QAM	3/4	6	468	16	2808	2106	1	52650.0	58500.0
7	64-QAM	5/6	6	468	16	2808	2340	1	58500.0	65000.0
8	256-QAM	3/4	8	468	16	3744	2808	1	70200.0	78000.0
9	256-QAM	5/6	8	468	16	3744	3120	1	78000.0	86666.7

FIG. 10A

16 MHz, 2 Spatial Streams (Single Encoder)

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	468	16	936	468	1	11700.0	13000.0
1	QPSK	1/2	2	468	16	1872	936	1	23400.0	26000.0
2	QPSK	3/4	2	468	16	1872	1404	1	35100.0	39000.0
3	16-QAM	1/2	4	468	16	3744	1872	1	46800.0	52000.0
4	16-QAM	3/4	4	468	16	3744	2808	1	70200.0	78000.0
5	64-QAM	2/3	6	468	16	5616	3744	1	93600.0	104000.0
6	64-QAM	3/4	6	468	16	5616	4212	1	105300.0	117000.0
7	64-QAM	5/6	6	468	16	5616	4680	1	117000.0	130000.0
8	256-QAM	3/4	8	468	16	7488	5616	1	140400.0	156000.0
9	256-QAM	5/6	8	468	16	7488	6240	1	156000.0	173333.3

FIG. 10B

16 MHz, 3 Spatial Streams (Single Encoder)

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	468	16	1404	702	1	17550.0	19500.0
1	QPSK	1/2	2	468	16	2808	1404	1	35100.0	39000.0
2	QPSK	3/4	2	468	16	2808	2106	1	52650.0	58500.0
3	16-QAM	1/2	4	468	16	5616	2808	1	70200.0	78000.0
4	16-QAM	3/4	4	468	16	5616	4212	1	105300.0	117000.0
5	64-QAM	2/3	6	468	16	8424	5616	1	140400.0	156000.0
6	64-QAM	3/4	6	468	16	8424	6318	1	157950.0	175500.0
7	64-QAM	5/6	6	468	16	8424	7020	1	175500.0	195000.0
8	256-QAM	3/4	8	468	16	11232	8424	1	210600.0	234000.0
9	256-QAM	5/6	8	468	16	11232	9360	1	234000.0	260000.0

FIG. 10C

16 MHz, 4 Spatial Streams (Single Encoder)

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (Kbps)	
									8us GI	4us GI
0	BPSK	1/2	1	468	16	1872	936	1	23400.0	26000.0
1	QPSK	1/2	2	468	16	3744	1872	1	46800.0	52000.0
2	QPSK	3/4	2	468	16	3744	2808	1	70200.0	78000.0
3	16-QAM	1/2	4	468	16	7488	3744	1	93600.0	104000.0
4	16-QAM	3/4	4	468	16	7488	5616	1	140400.0	156000.0
5	64-QAM	2/3	6	468	16	11232	7488	1	187200.0	208000.0
6	64-QAM	3/4	6	468	16	11232	8424	1	210600.0	234000.0
7	64-QAM	5/6	6	468	16	11232	9360	1	234000.0	260000.0
8	256-QAM	3/4	8	468	16	14976	11232	1	280800.0	312000.0
9	256-QAM	5/6	8	468	16	14976	12480	1	312000.0	346666.7

FIG. 10D

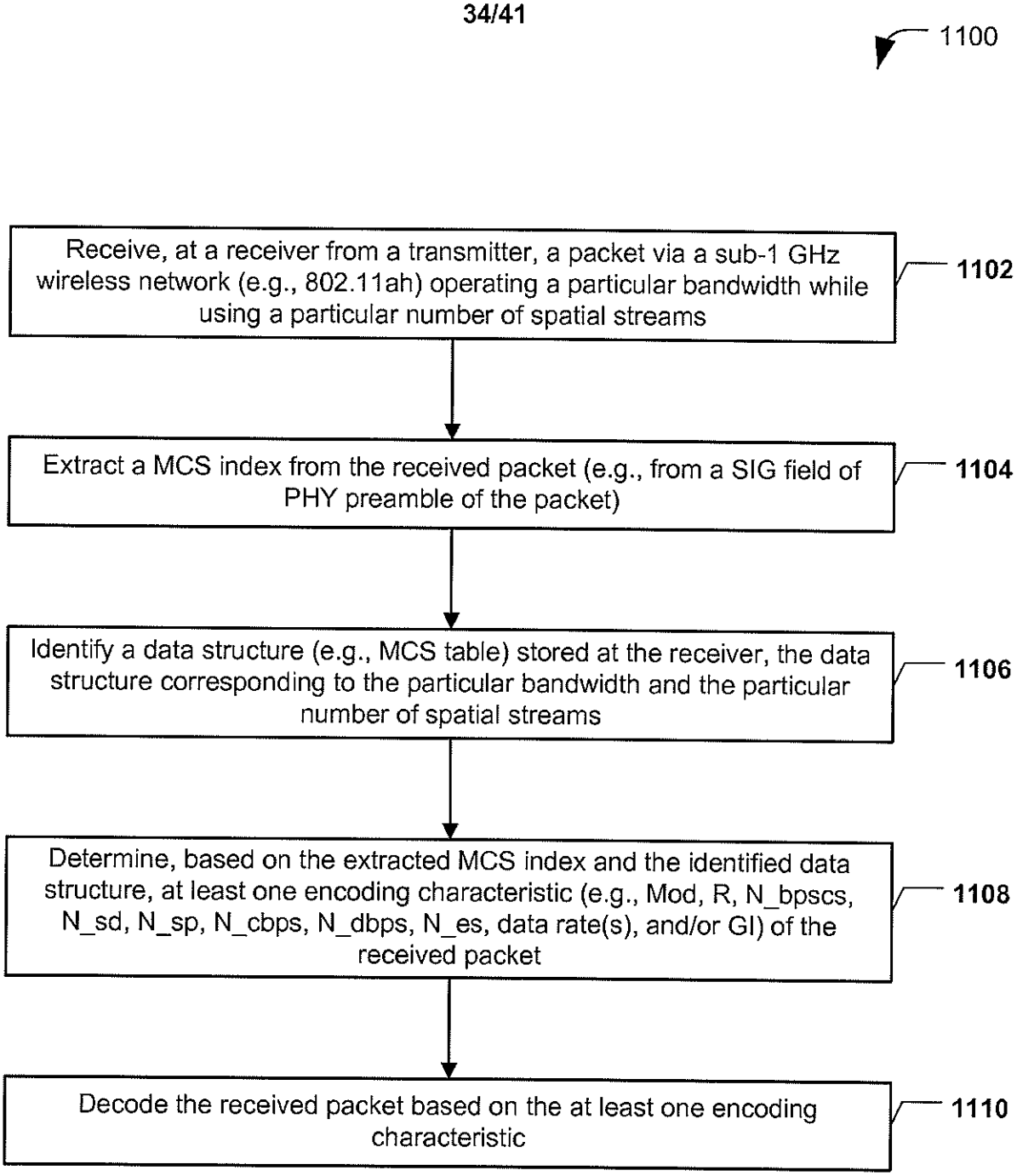

1100
Receive, at a receiver from a transmitter, a packet via a sub-1 GHz wireless network (e.g., 802.11ah) operating a particular bandwidth while using a particular number of spatial streams
1102
Extract a MCS index from the received packet (e.g., from a SIG field of PHY preamble of the packet)
1104
Identify a data structure (e.g., MCS table) stored at the receiver, the data structure corresponding to the particular bandwidth and the particular number of spatial streams
1106
Determine, based on the extracted MCS index and the identified data structure, at least one encoding characteristic (e.g., Mod, R, N_bpscs, N_sd, N_sp, N_cbps, N_dbps, N_es, data rate(s), and/or GI) of the received packet
1108
Decode the received packet based on the at least one encoding characteristic
1110

FIG. 11

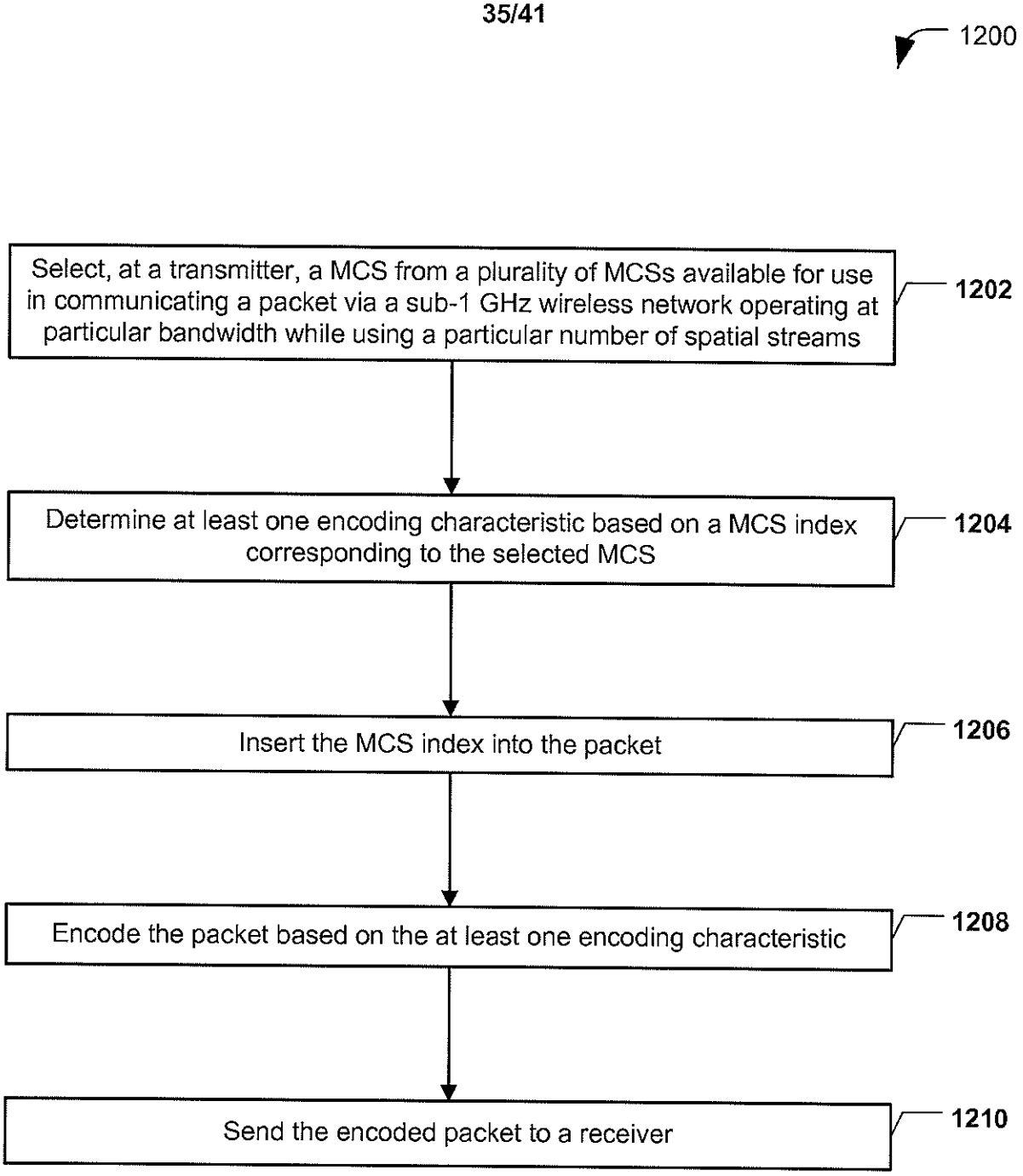

1200
Select, at a transmitter, a MCS from a plurality of MCSs available for use in communicating a packet via a sub-1 GHz wireless network operating at particular bandwidth while using a particular number of spatial streams
1202
Determine at least one encoding characteristic based on a MCS index corresponding to the selected MCS
1204
Insert the MCS index into the packet
1206
Encode the packet based on the at least one encoding characteristic
1208
Send the encoded packet to a receiver
1210

FIG. 12

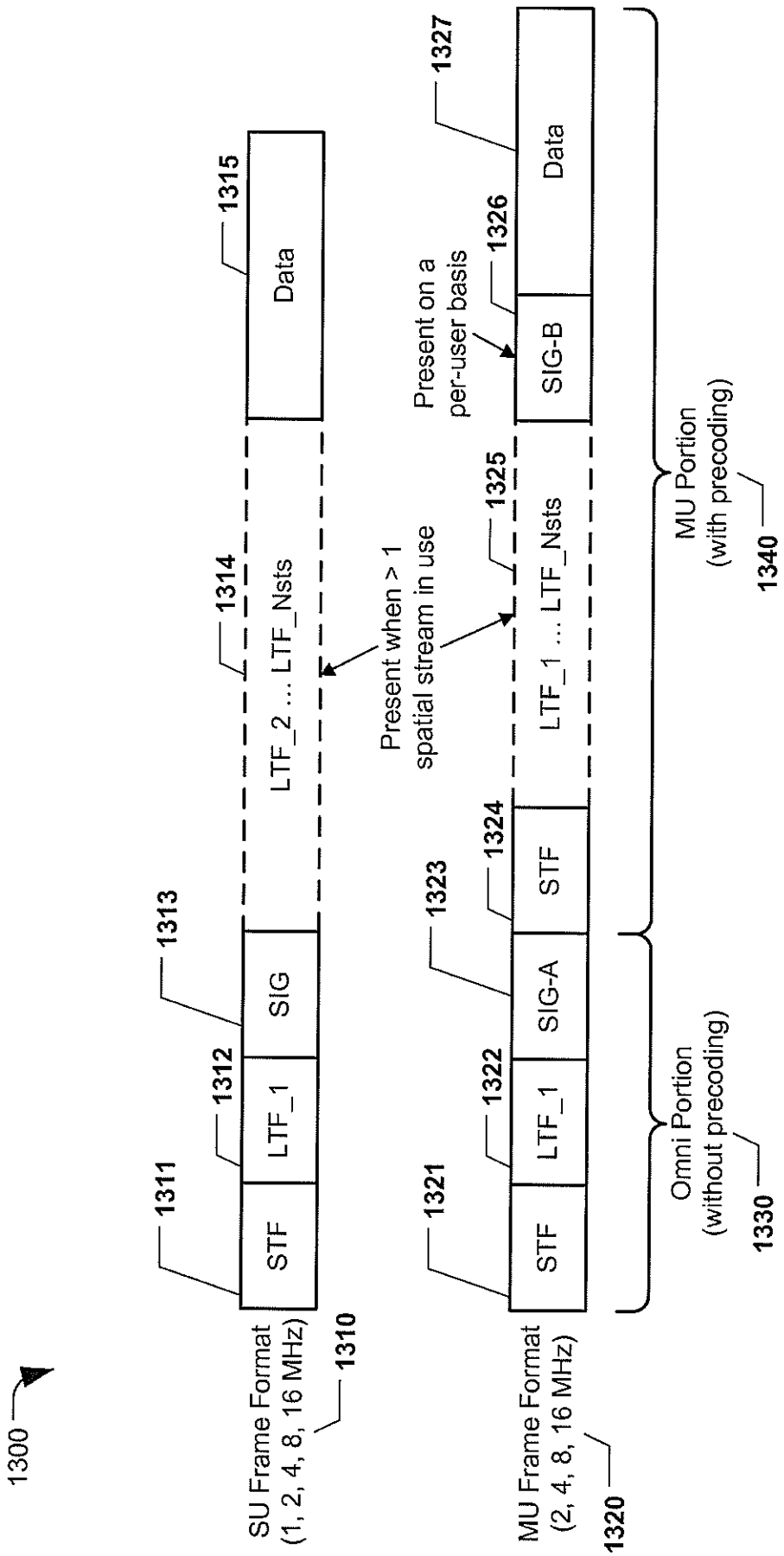

1300
SU Frame Format
(1, 2, 4, 8, 16 MHz)
1310
STF
1311
LTF_1
1312
SIG
1313
LTF_2 ... LTF_Nsts
1314
Data
1315
MU Frame Format
(2, 4, 8, 16 MHz)
1320
STF
1321
LTF_1
1322
SIG-A
1323
STF
1324
LTF_1 ... LTF_Nsts
1325
SIG-B
1326
Data
1327
Present when > 1
spatial stream in use
Present on a
per-user basis
Omni Portion
(without precoding)
1330
MU Portion
(with precoding)
1340

FIG. 13

1400

Parameter	1 MHz	2 MHz	4 MHz	8 MHz	16 MHz	Description
N_sd	24	52	108	234	468	Number of complex data subcarriers
N_sp	2	4	6	8	16	Number of pilot subcarriers
N_st	26	56	114	242	484	Number of total subcarriers (excluding guards)
N_sr	13	28	58	122	250	Highest data subcarrier index
delta_f	31.25KHz					Subcarrier frequency spacing
T_dft	32us					IDFT/DFT period
T_gi	8us = T_dft/4					Guard interval duration
T_gi2	16us					Double guard interval duration
T_gis	4us = T_dft/8					Short guard interval duration
T_syml	40us = T_dft + T_gi = 1.25 x T_dft					OFDM symbol duration w/ Long GI
T_syms	36us = T_dft + T_gis = 1.125 x T_dft					OFDM symbol duration w/ Short GI
T_sym	T_syml or T_syms depending on the GI used					OFDM symbol duration
N_service	16					Number of bits in the SERVICE field
N_tail	6					Number of tails bits per BCC encoder
T_stf	160us = 20 x T_dft/4	80us = 10 x T_dft/4				Duration of STF field for SU and MU formats
T_ltf1	160us = T_gi2 + 2 x T_dft + T_gi + T_dft + T_gi + T_dft	80us = T_gi2 + 2 x T_dft				Duration of LTF1 field for SU and MU formats
T_sig	240us = 6 x T_syml **or** 200us = 5 x T_syml	80us = 2 x T_syml				Duration of SIG field for SU format, SIG-A for MU format
T_mimo_ltf	40us = T_syml					Duration of each LTF symbol after the SIG for SU format [whenever Nsts>1] and duration of each LTF after SIG-A in the MU format
T_mu_stf		40us = 5 x T_dft/4				Duration of MU STF field for MU format
T_sig_b		40us = T_syml				Duration of SIG-B field for MU format

FIG. 14

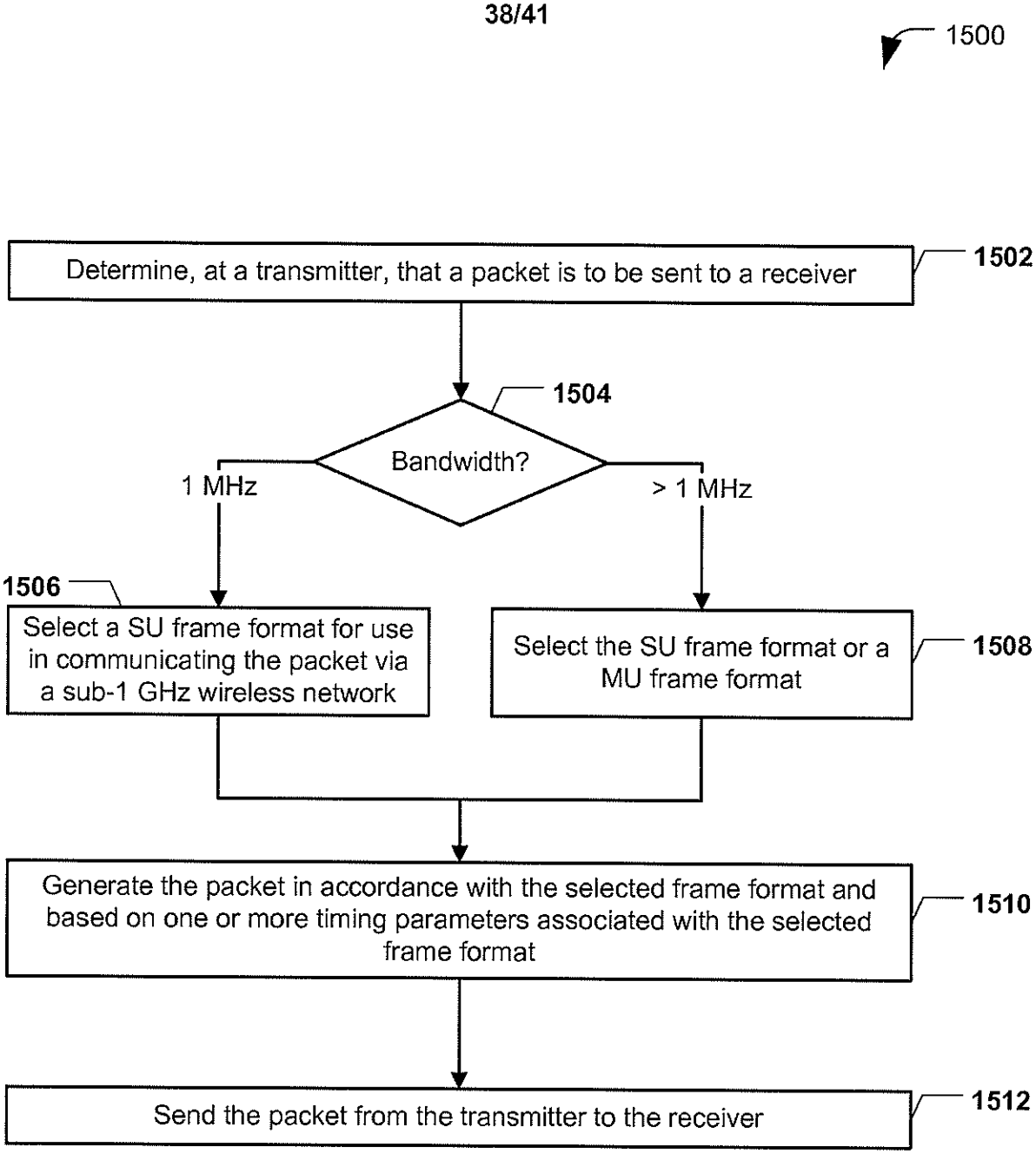

1500
Determine, at a transmitter, that a packet is to be sent to a receiver
1502
1504
Bandwidth?
1 MHz
> 1 MHz
1506
Select a SU frame format for use in communicating the packet via a sub-1 GHz wireless network
Select the SU frame format or a MU frame format
1508
Generate the packet in accordance with the selected frame format and based on one or more timing parameters associated with the selected frame format
1510
Send the packet from the transmitter to the receiver
1512

FIG. 15

1600

Field		Tone Scaling Parameter as a function of bandwidth					GI duration	
		1 MHz	2 MHz	4 MHz	8 MHz	16 MHz		
SU format	STF	6	12	24	48	96	-	
	LTF_1	26	56	114	242	484	1MHz: T_gi2 for first 2 OFDM symbols, T_gi1 for last 2 OFDM symbols >= 2MHz: T_gi2	
	SIG	26	52	104	208	416	T_gi1	
	MIMO-LTF	26	56	114	242	484	T_gi1	
	Data	26	56	114	242	484	T_gi or T_gis (depending on Short GI bit indication in SIG)	
MU format	STF		12	24	48	96	for >= 2MHz	-
	LTF_1		56	114	242	484		T_gi2
	SIG-A		52	104	208	416		T_gi1
	MU-STF		12	24	48	96		-
	MIMO-LTF		56	114	242	484		T_gi1
	SIG-B		56	114	242	484		T_gi1
	Data		56	114	242	484		T_gi or T_gis (depending on Short GI bit indication in SIG-A)

FIG. 16

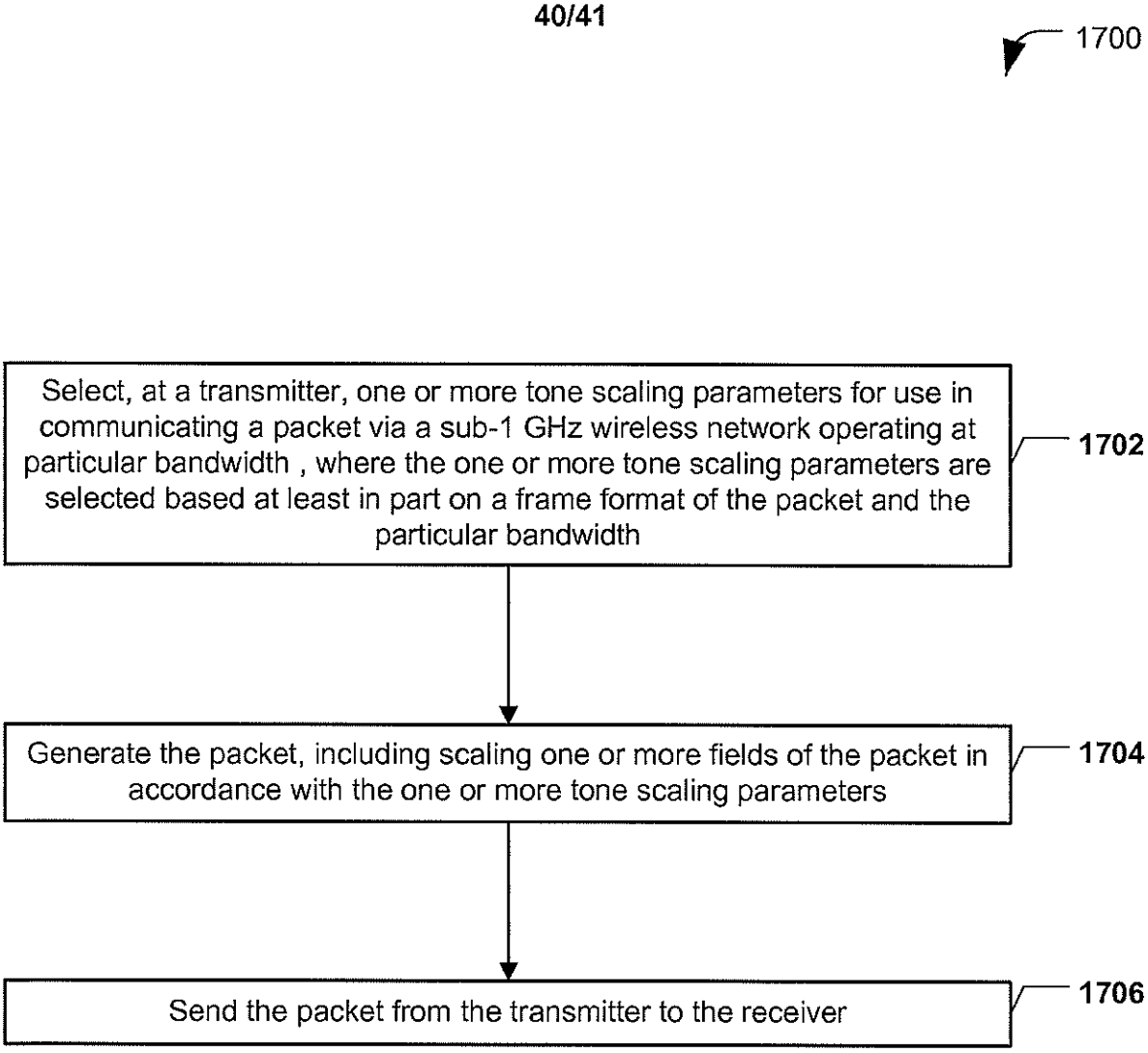

1700
Select, at a transmitter, one or more tone scaling parameters for use in communicating a packet via a sub-1 GHz wireless network operating at particular bandwidth , where the one or more tone scaling parameters are selected based at least in part on a frame format of the packet and the particular bandwidth
1702
Generate the packet, including scaling one or more fields of the packet in accordance with the one or more tone scaling parameters
1704
Send the packet from the transmitter to the receiver
1706

FIG. 17

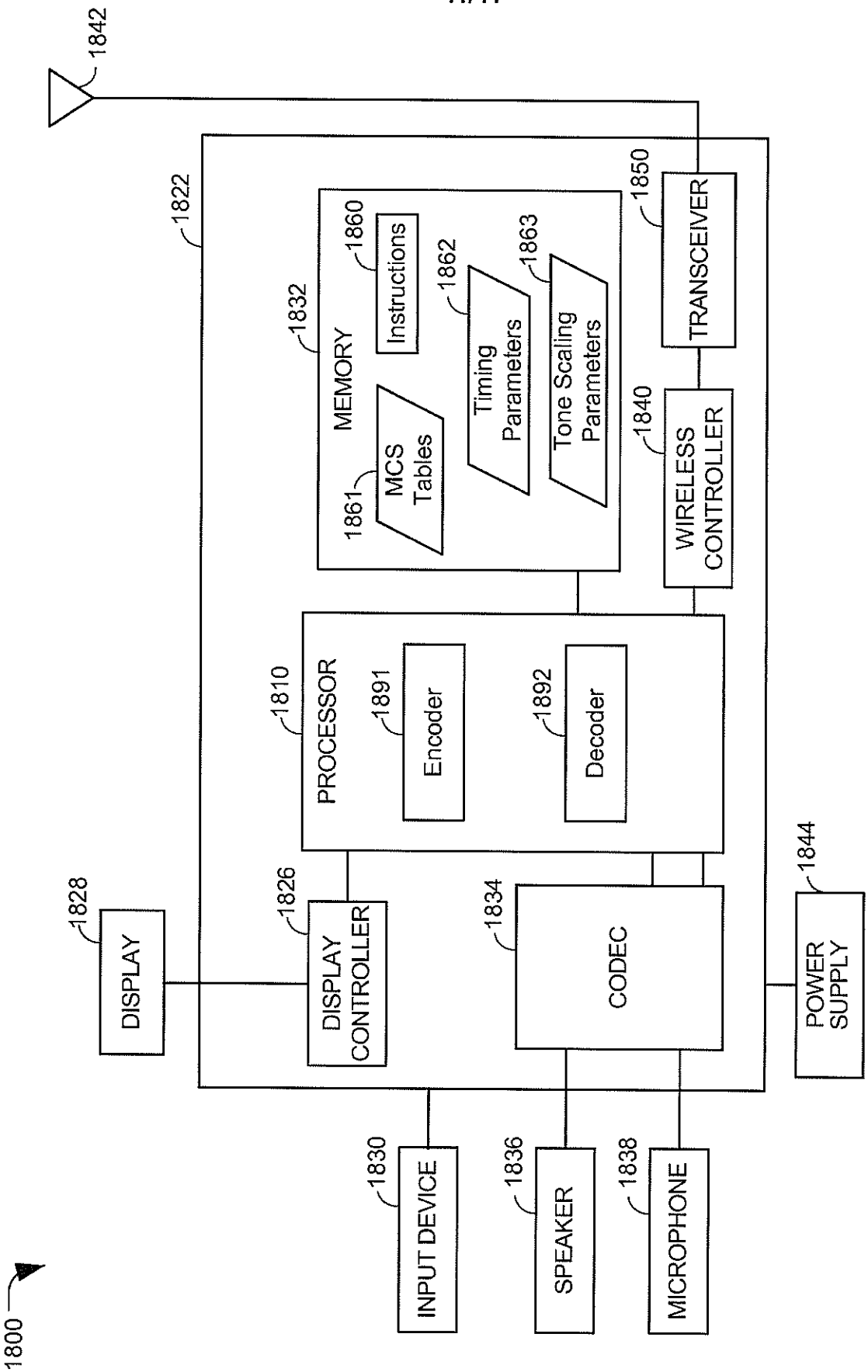

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FIG. 18