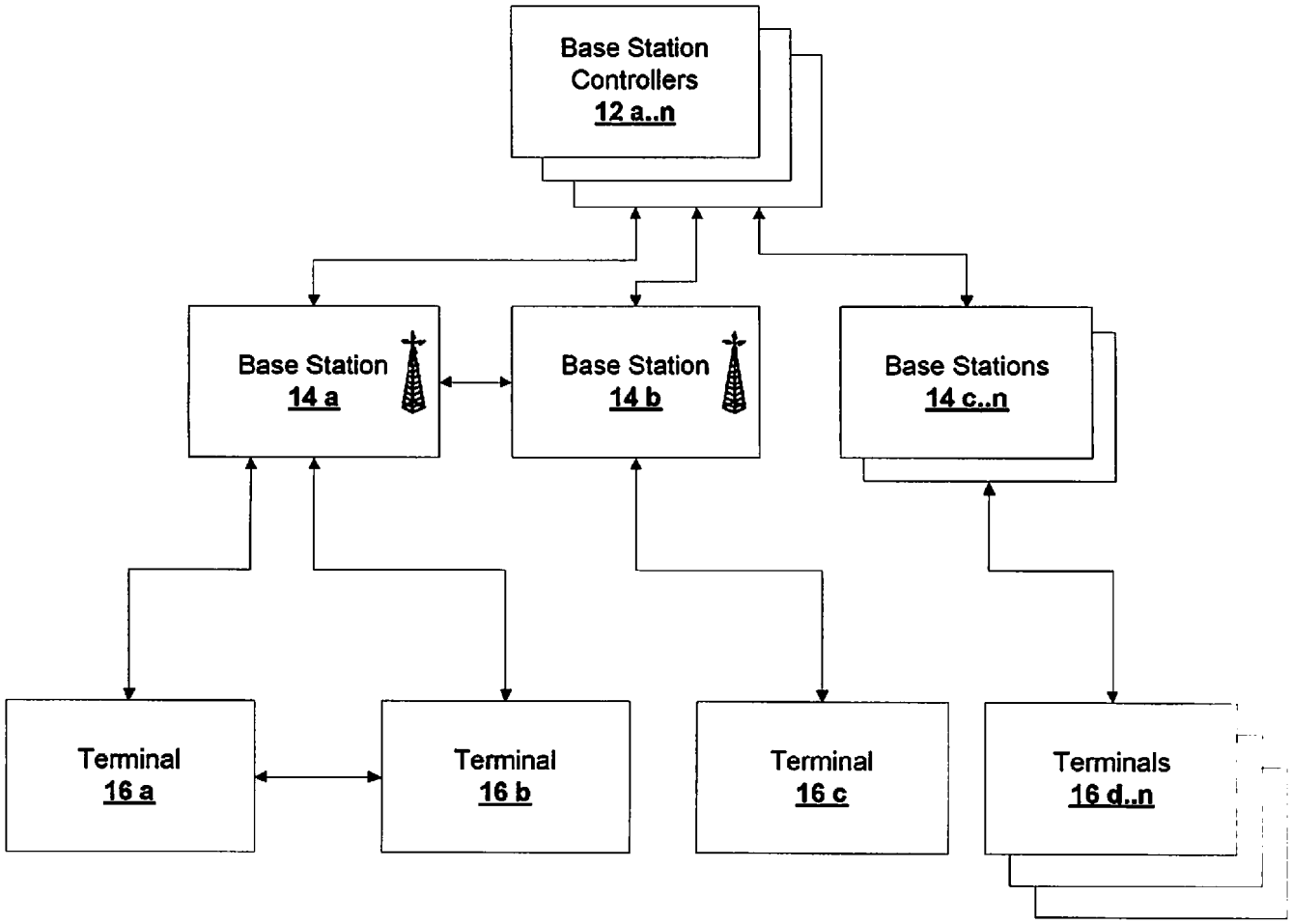

Base Station Controllers
12 a..n
Base Station
14 a
Base Station
14 b
Base Stations
14 c..n
Terminal
16 a
Terminal
16 b
Terminal
16 c
Terminals
16 d..n

FIG. 1

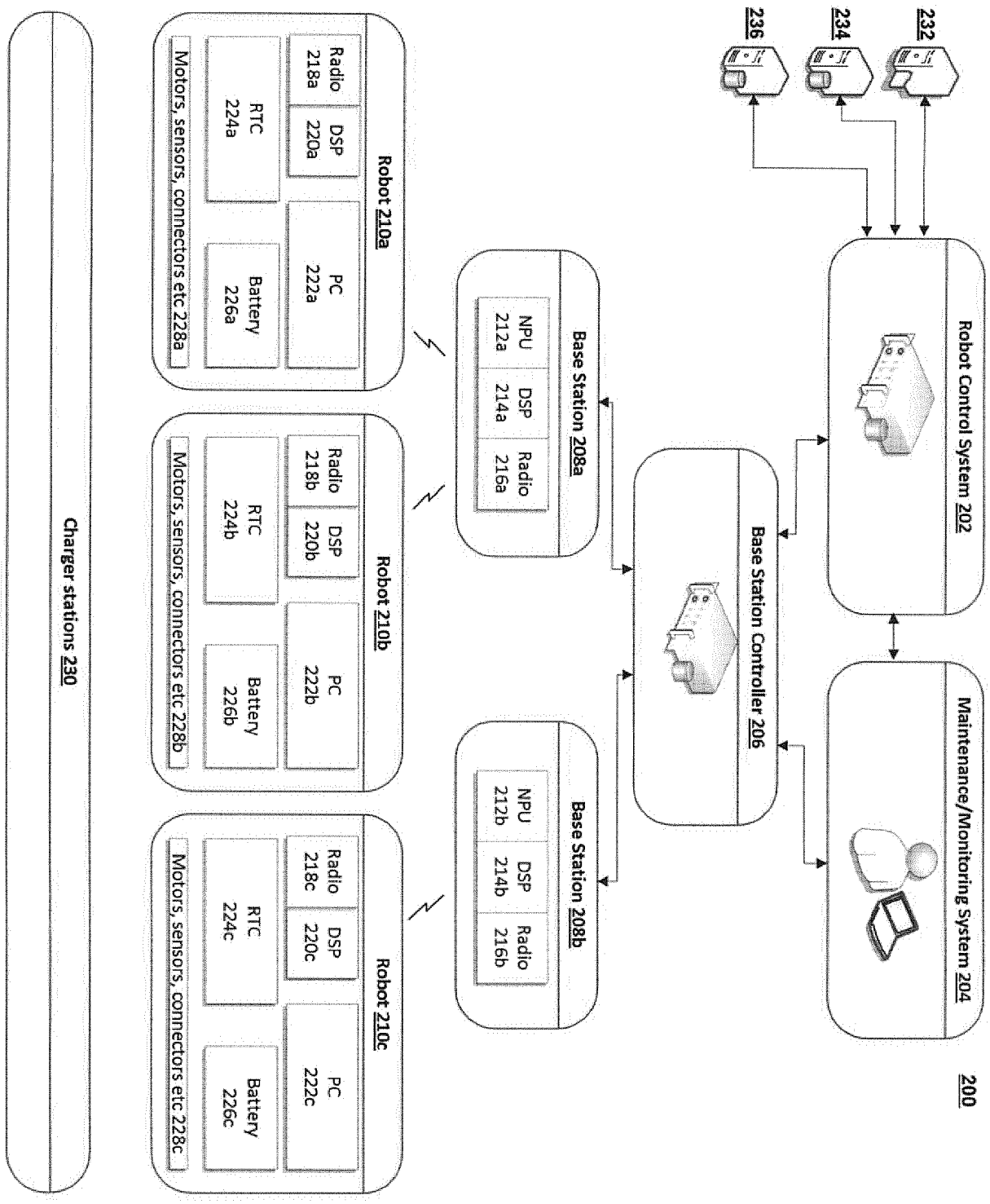

200
232
234
236
Robot Control System 202
Maintenance/Monitoring System 204
Base Station Controller 206
Base Station 208a
NPU 212a
DSP 214a
Radio 216a
Base Station 208b
NPU 212b
DSP 214b
Radio 216b
Robot 210a
Radio 218a
DSP 220a
PC 222a
RTC 224a
Battery 226a
Motors, sensors, connectors etc 228a
Robot 210b
Radio 218b
DSP 220b
PC 222b
RTC 224b
Battery 226b
Motors, sensors, connectors etc 228b
Robot 210c
Radio 218c
DSP 220c
PC 222c
RTC 224c
Battery 226c
Motors, sensors, connectors etc 228c
Charger stations 230

FIG. 2

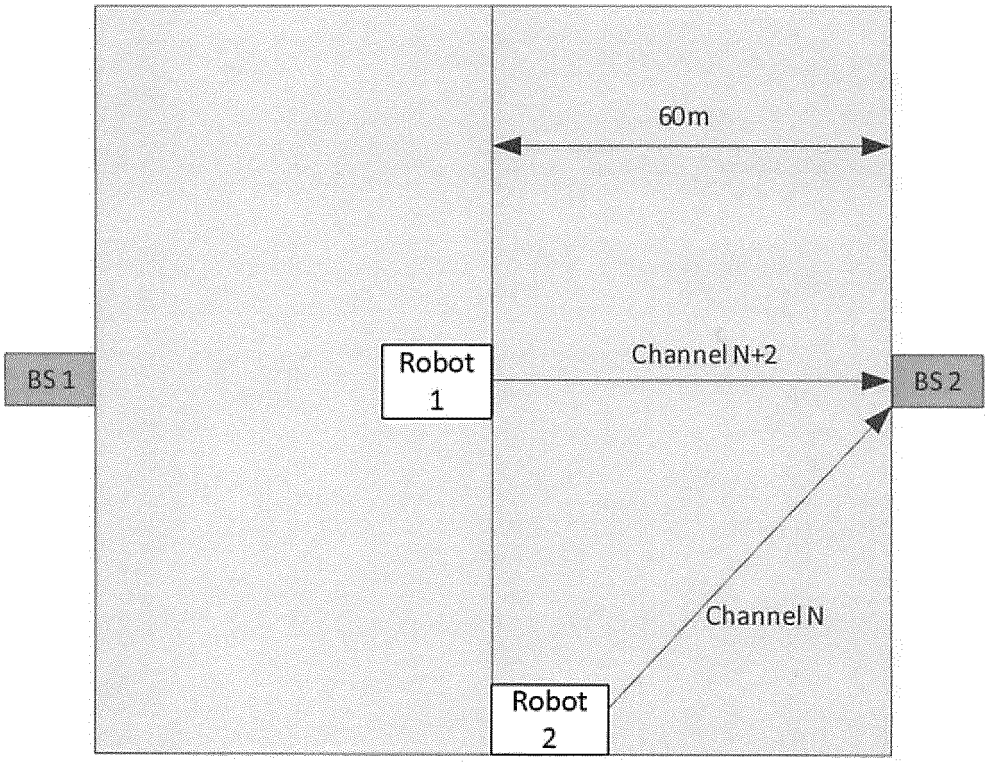


FIG. 3

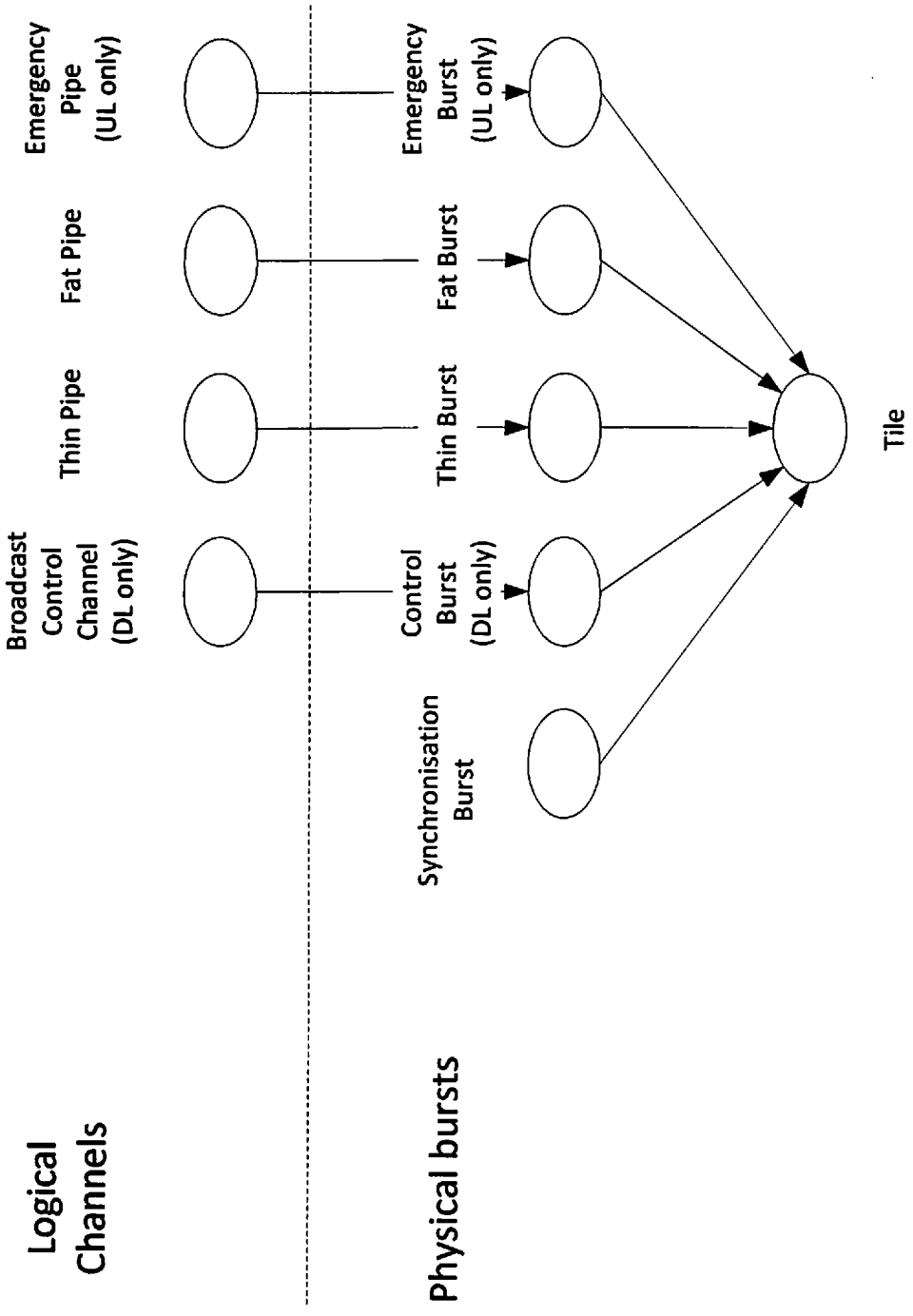

Logical Channels
Physical bursts
Broadcast Control Channel (DL only)
Thin Pipe
Fat Pipe
Emergency Pipe (UL only)
Control Burst (DL only)
Thin Burst
Fat Burst
Emergency Burst (UL only)
Synchronisation Burst
Tile

FIG. 4

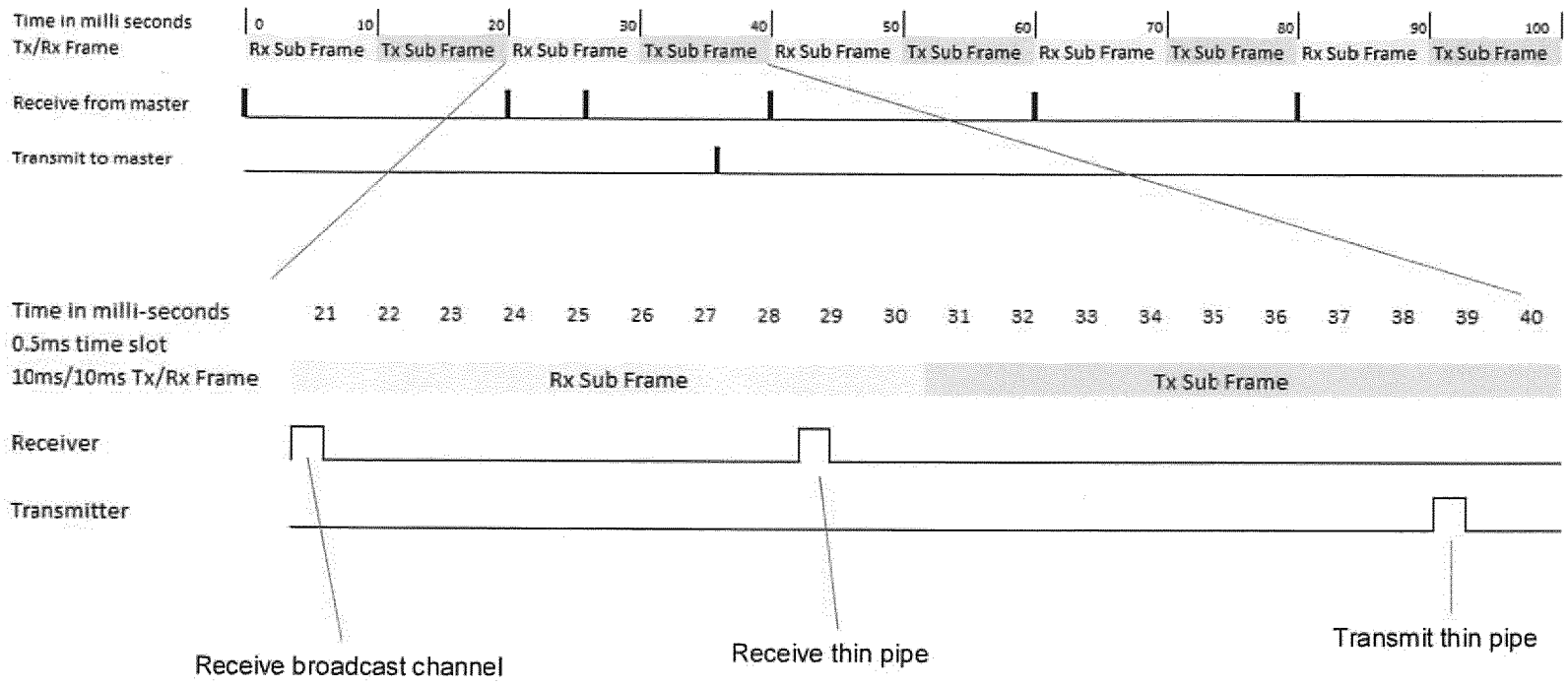

Time in milli seconds
0
10
20
30
40
50
60
70
80
90
100
Tx/Rx Frame
Rx Sub Frame
Tx Sub Frame
Rx Sub Frame
Tx Sub Frame
Rx Sub Frame
Tx Sub Frame
Rx Sub Frame
Tx Sub Frame
Rx Sub Frame
Tx Sub Frame
Receive from master
Transmit to master
Time in milli-seconds
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
0.5ms time slot
10ms/10ms Tx/Rx Frame
Rx Sub Frame
Tx Sub Frame
Receiver
Transmitter
Receive broadcast channel
Receive thin pipe
Transmit thin pipe

FIG. 5a

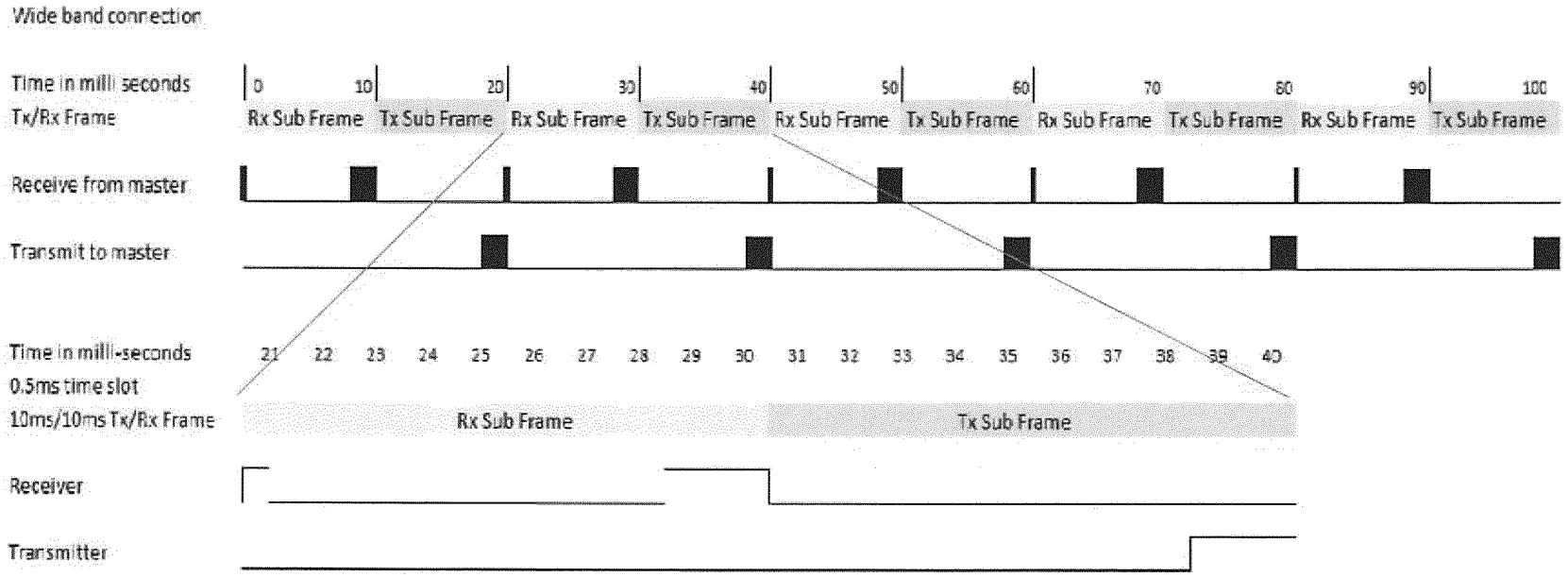

Wide band connection
Time in milli seconds
0
10
20
30
40
50
60
70
80
90
100
Tx/Rx Frame
Rx Sub Frame
Tx Sub Frame
Rx Sub Frame
Tx Sub Frame
Rx Sub Frame
Tx Sub Frame
Rx Sub Frame
Tx Sub Frame
Rx Sub Frame
Tx Sub Frame
Receive from master
Transmit to master
Time in milli-seconds
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
0.5ms time slot
10ms/10ms Tx/Rx Frame
Rx Sub Frame
Tx Sub Frame
Receiver
Transmitter

FIG. 5b

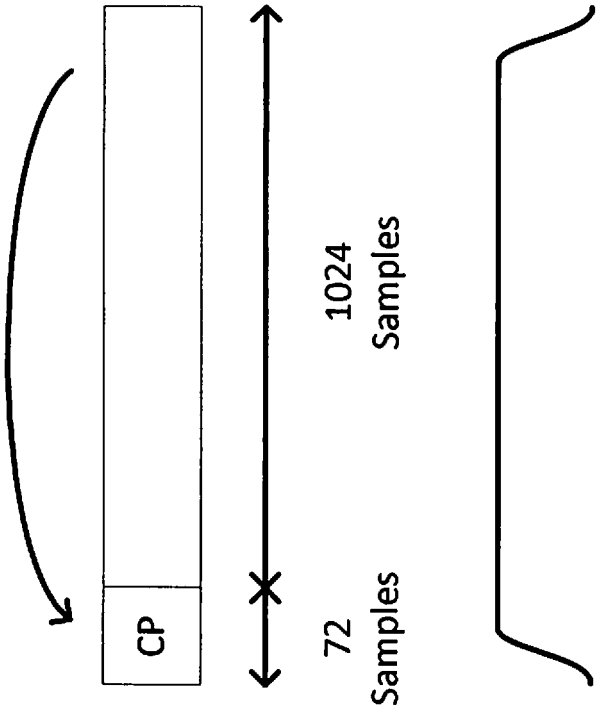


FIG. 6

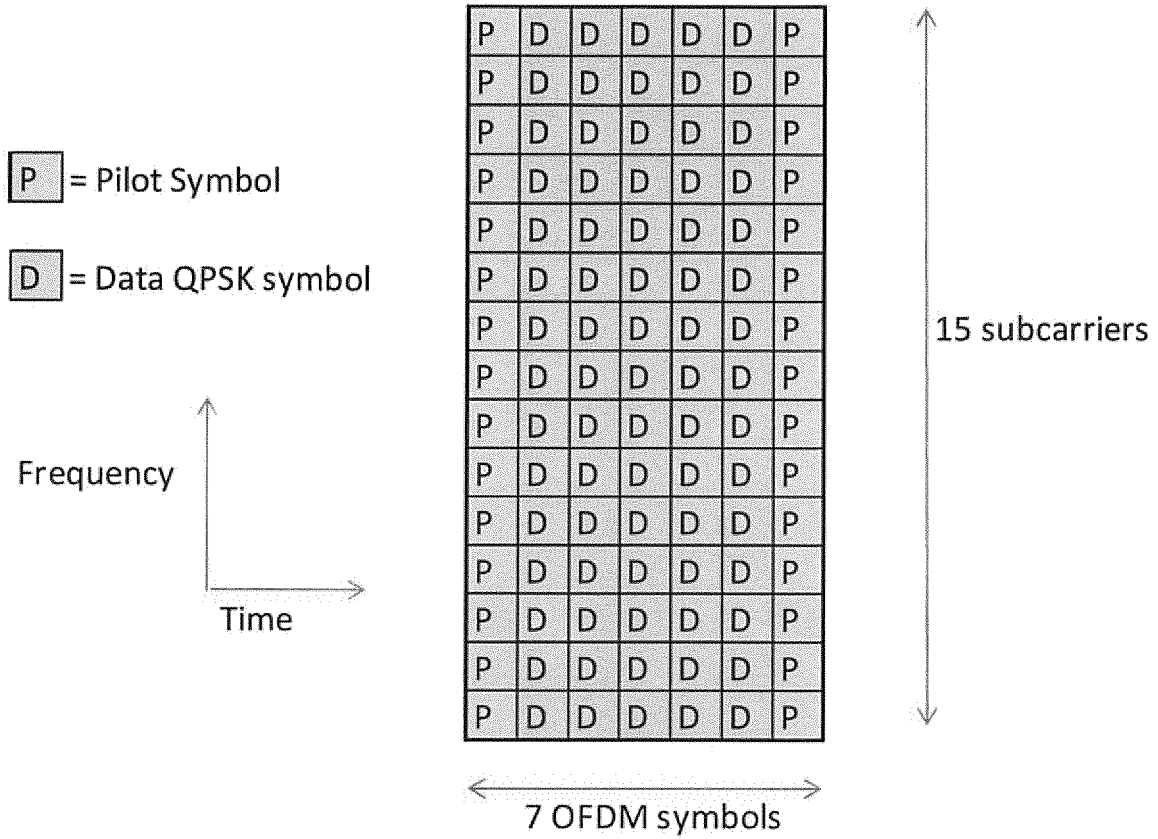

P = Pilot Symbol
D = Data QPSK symbol
Frequency
Time
P D D D D D P
15 subcarriers
7 OFDM symbols

FIG. 7

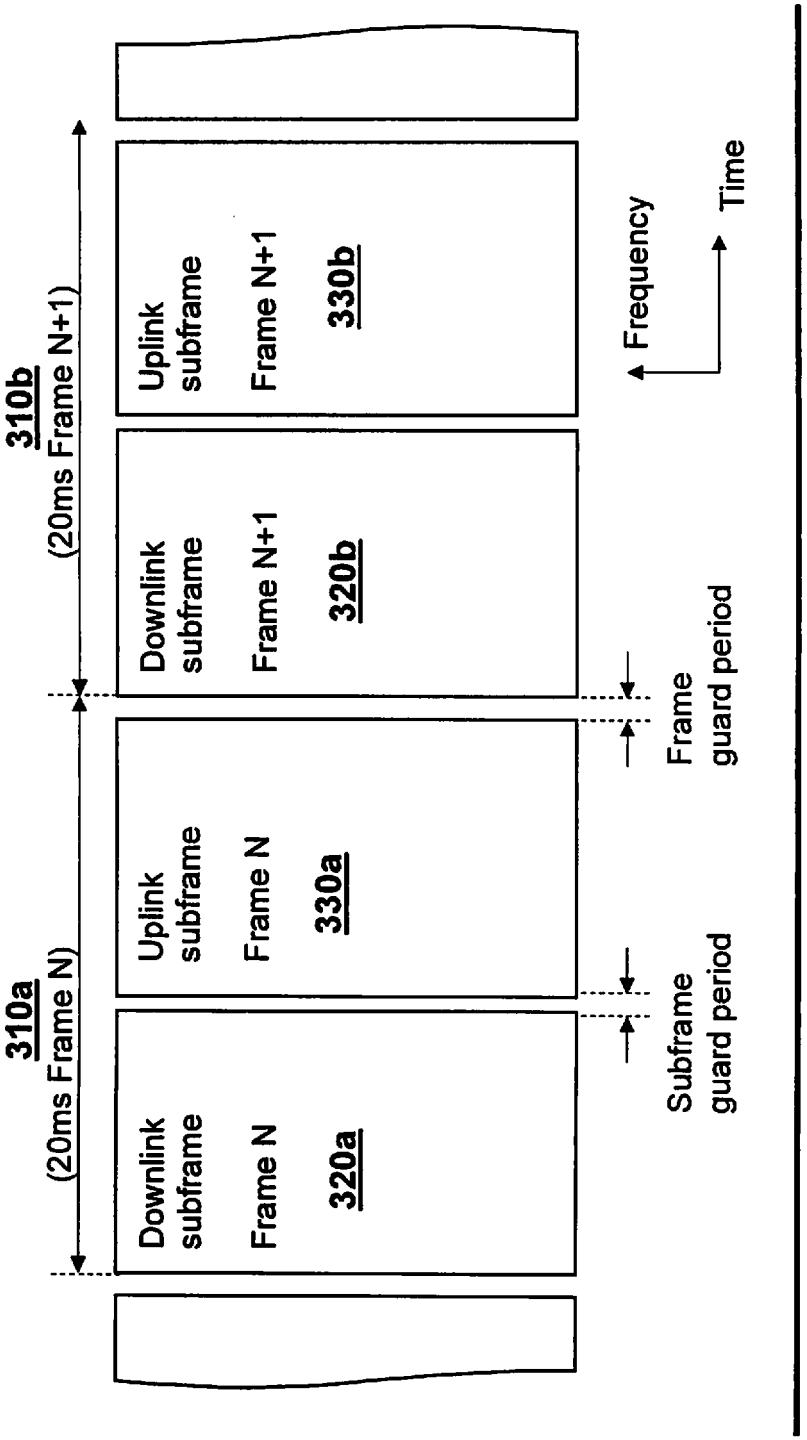

310a
(20ms Frame N)
310b
(20ms Frame N+1)
Downlink subframe
Frame N
320a
Uplink subframe
Frame N
330a
Downlink subframe
Frame N+1
320b
Uplink subframe
Frame N+1
330b
Subframe guard period
Frame guard period
Frequency
Time

FIG. 8

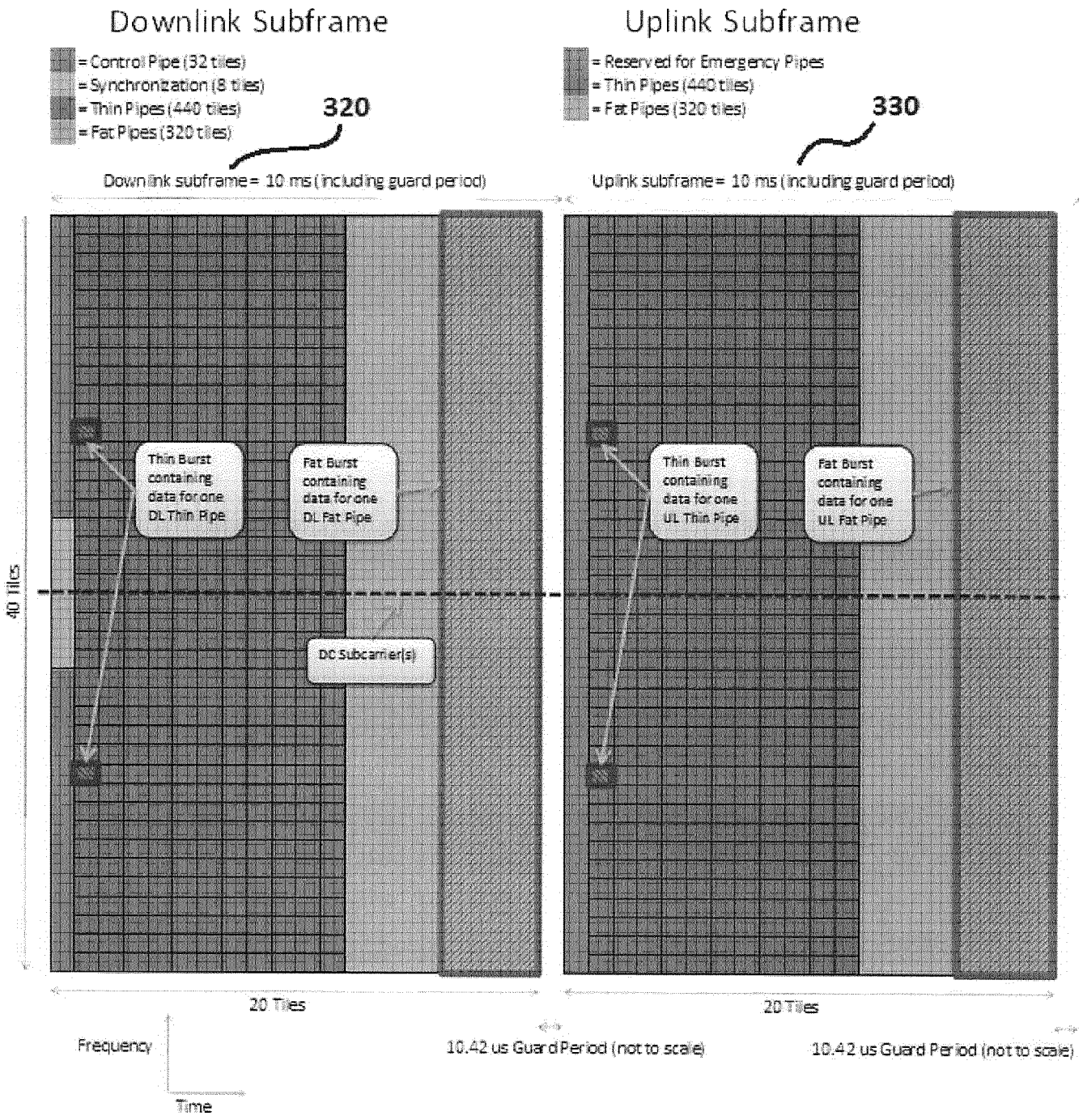

Downlink Subframe
= Control Pipe (32 tiles)
= Synchronization (8 tiles)
= Thin Pipes (440 tiles)
= Fat Pipes (320 tiles)
320
Downlink subframe = 10 ms (including guard period)
Uplink Subframe
= Reserved for Emergency Pipes
= Thin Pipes (440 tiles)
= Fat Pipes (320 tiles)
330
Uplink subframe = 10 ms (including guard period)
Thin Burst containing data for one DL Thin Pipe
Fat Burst containing data for one DL Fat Pipe
DC Subcarrier(s)
Thin Burst containing data for one UL Thin Pipe
Fat Burst containing data for one UL Fat Pipe
40 Tiles
20 Tiles
20 Tiles
Frequency
Time
10.42 us Guard Period (not to scale)
10.42 us Guard Period (not to scale)

FIG. 9a

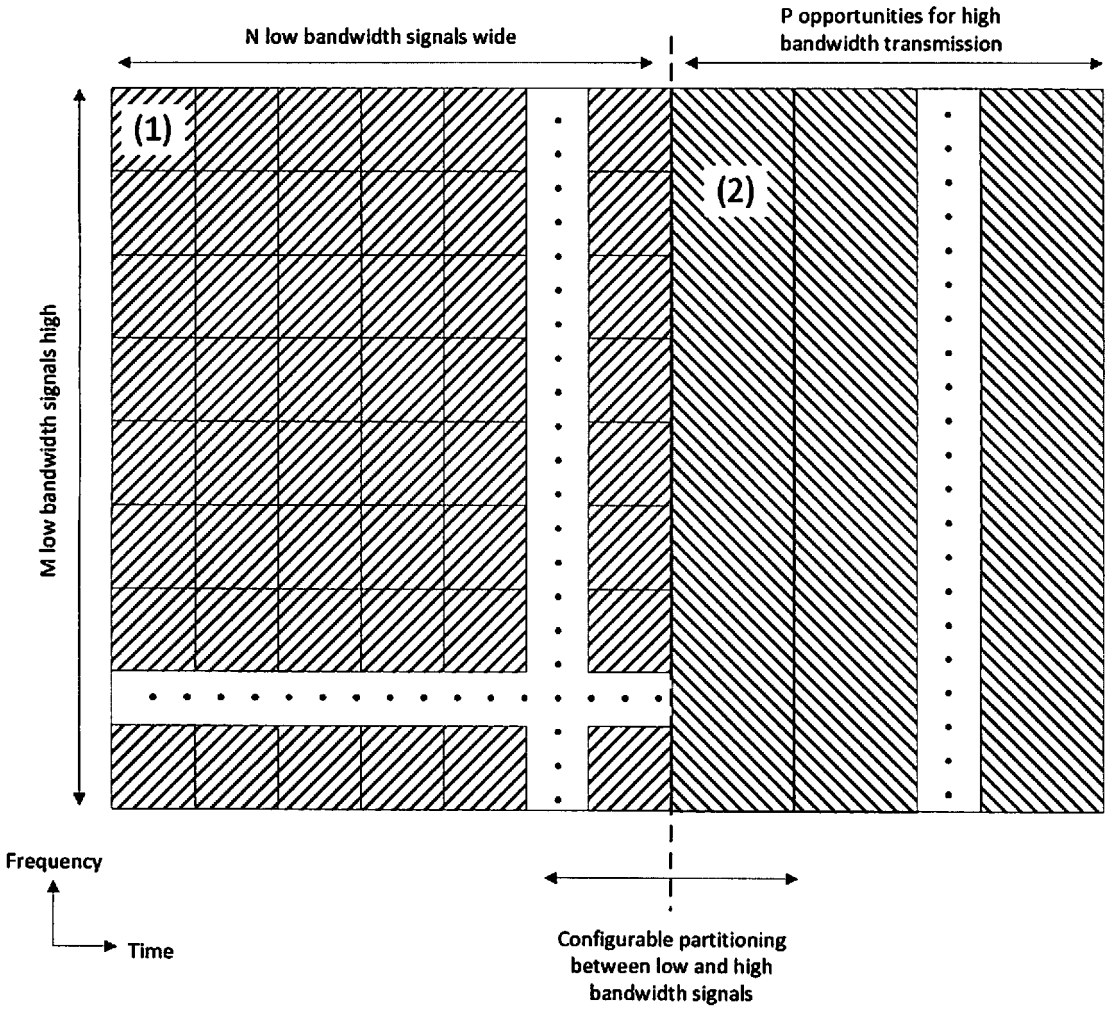

N low bandwidth signals wide
P opportunities for high bandwidth transmission
(1)
(2)
M low bandwidth signals high
Frequency
Time
Configurable partitioning between low and high bandwidth signals

FIG. 9b

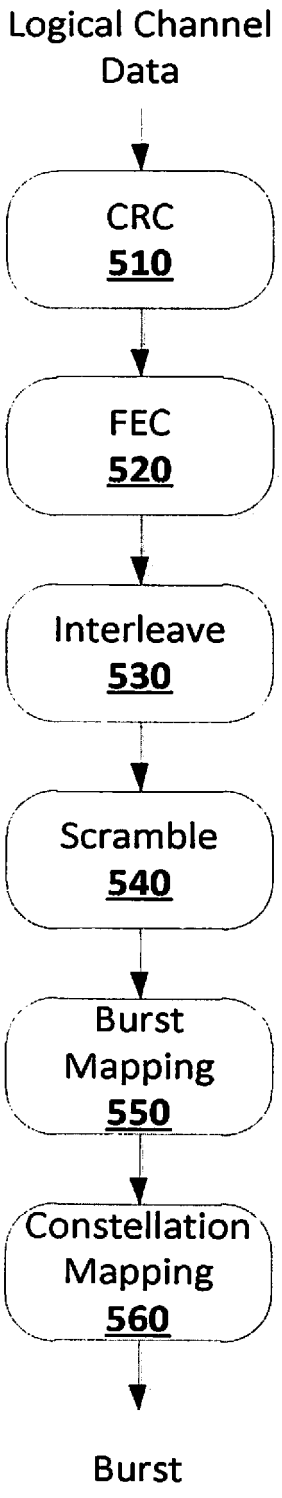

Logical Channel Data
CRC 510
FEC 520
Interleave 530
Scramble 540
Burst Mapping 550
Constellation Mapping 560
Burst

FIG. 10

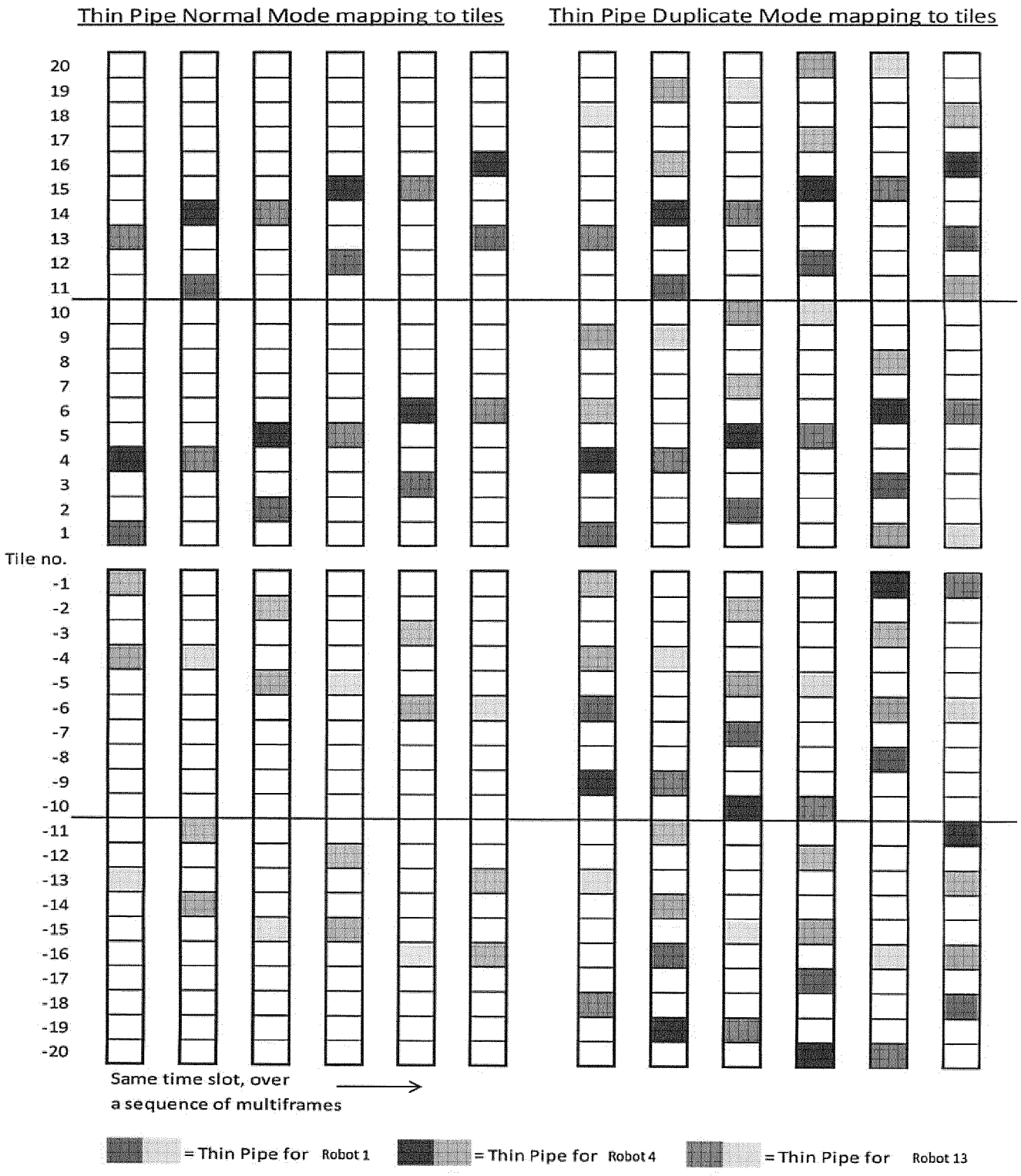

Thin Pipe Normal Mode mapping to tiles
Thin Pipe Duplicate Mode mapping to tiles
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
Tile no.
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
-16
-17
-18
-19
-20
Same time slot, over
a sequence of multiframes
= Thin Pipe for Robot 1
= Thin Pipe for Robot 4
= Thin Pipe for Robot 13

FIG. 11

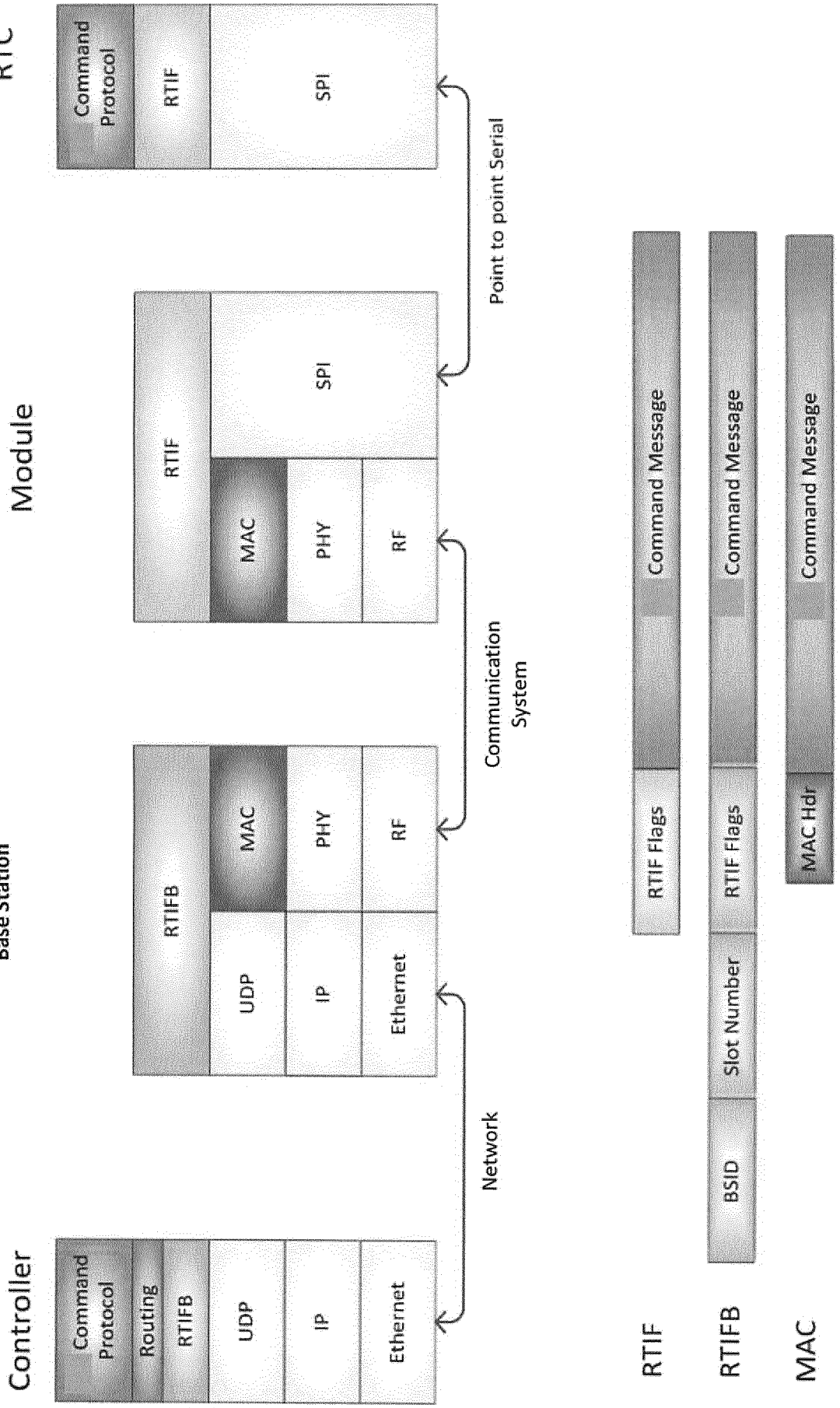

Controller
Command Protocol
Routing
RTIFB
UDP
IP
Ethernet
Network
Base Station
RTIFB
UDP
IP
Ethernet
MAC
PHY
RF
Communication System
Radio Module
RTIF
MAC
PHY
RF
SPI
Point to point Serial
RTC
Command Protocol
RTIF
SPI
RTIF
RTIF Flags
Command Message
RTIFB
BSID
Slot Number
RTIF Flags
Command Message
MAC
MAC Hdr
Command Message

FIG. 12

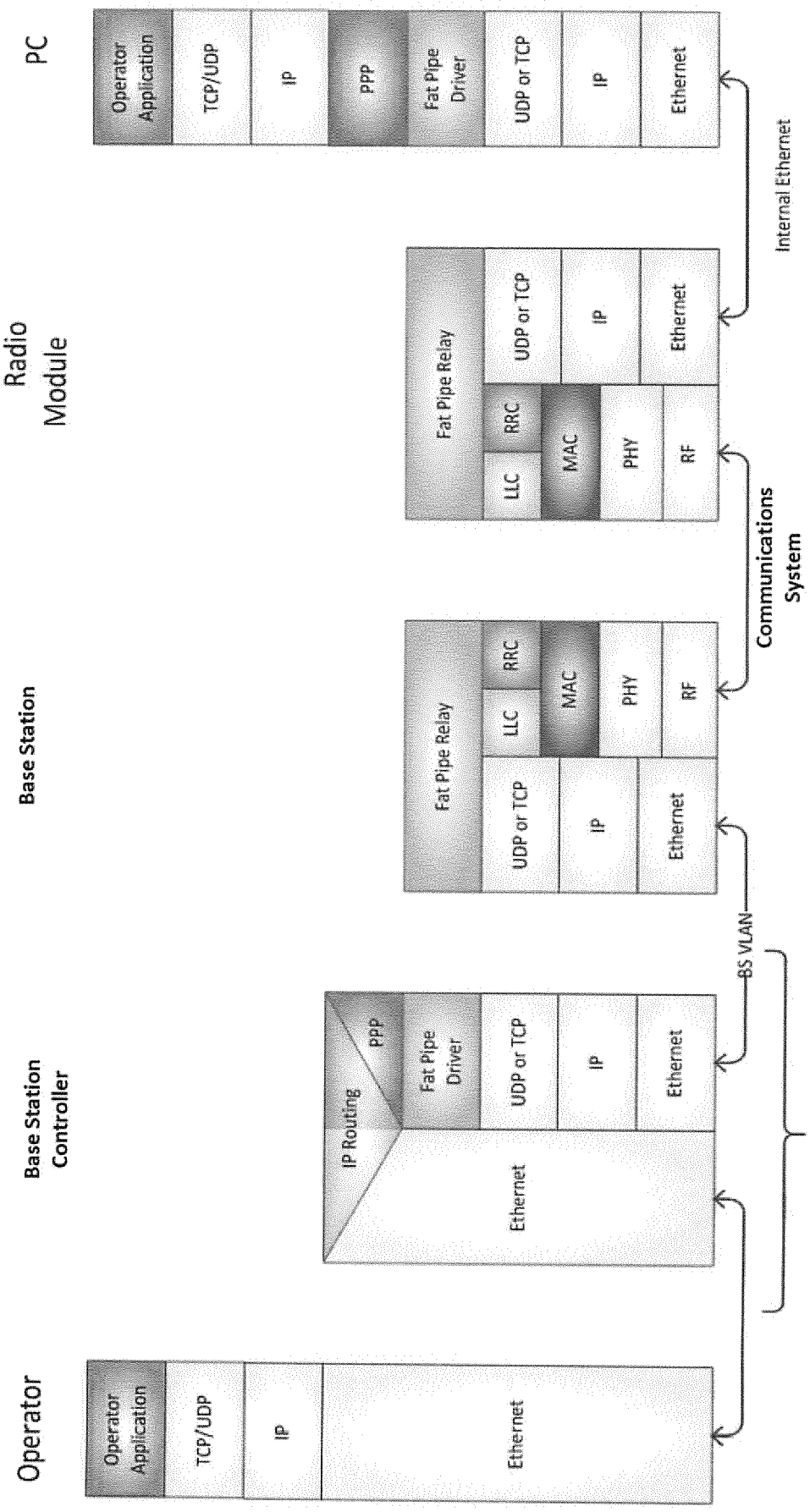

Operator
Operator Application
TCP/UDP
IP
Ethernet
Base Station Controller
IP Routing
PPP
Fat Pipe Driver
UDP or TCP
IP
Ethernet
Ethernet
BS VLAN
Network
Base Station
Fat Pipe Relay
UDP or TCP
IP
Ethernet
LLC
RRC
MAC
PHY
RF
Communications System
Radio Module
Fat Pipe Relay
UDP or TCP
IP
Ethernet
LLC
RRC
MAC
PHY
RF
Internal Ethernet
PC
Operator Application
TCP/UDP
IP
PPP
Fat Pipe Driver
UDP or TCP
IP
Ethernet

FIG. 13

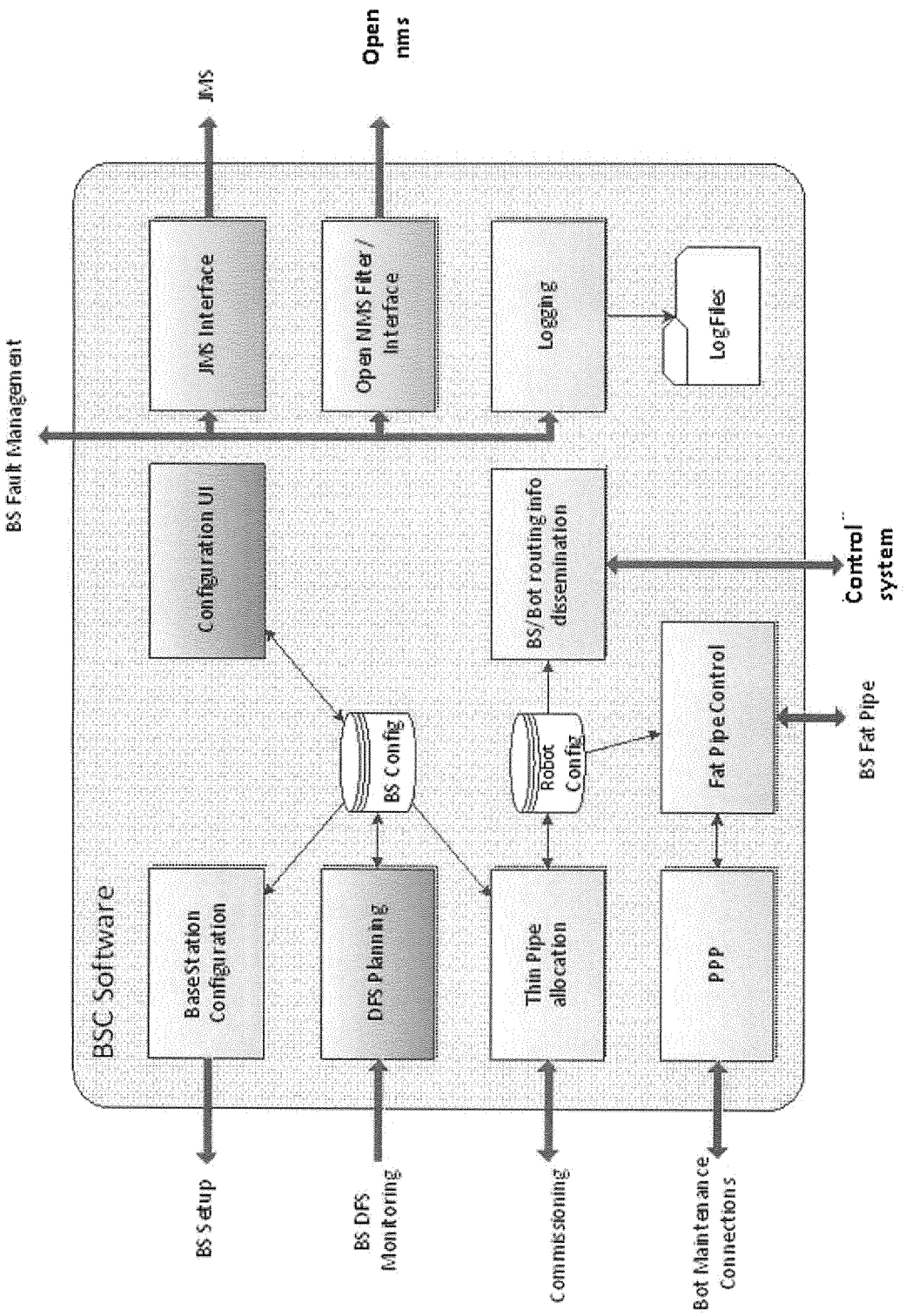

BS Fault Management
JMS
Open nms
BSC Software
JMS Interface
Open NMS Filter / Interface
Logging
Log Files
Configuration UI
BS/Bot routing info dissemination
Control system
BS Config
Robot Config
Fat Pipe Control
BS Fat Pipe
BaseStation Configuration
DFS Planning
Thin Pipe allocation
PPP
BS Setup
BS DFS Monitoring
Commissioning
Bot Maintenance Connections

FIG. 14

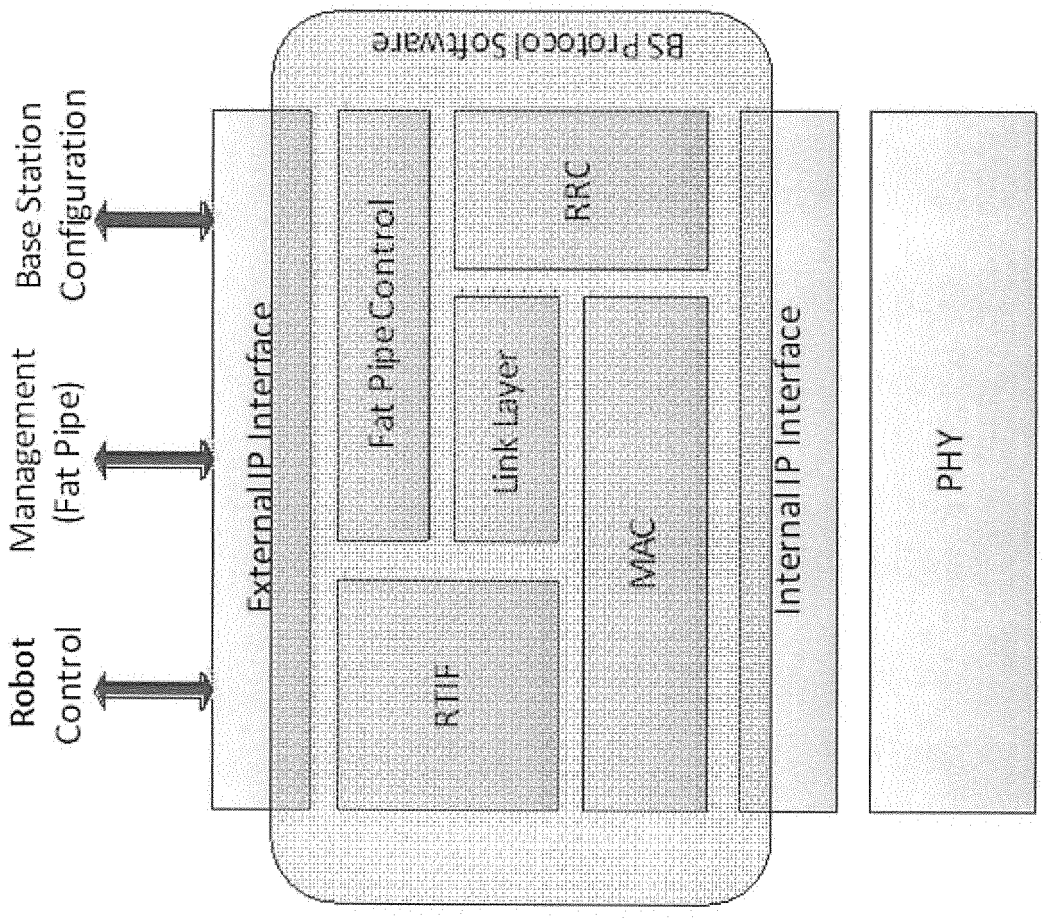

Robot Control
Robot Management (Fat Pipe)
Base Station Configuration
External IP Interface
BS Protocol Software
RTIF
Fat Pipe Control
Link Layer
MAC
RRC
Internal IP Interface
PHY

FIG. 15a

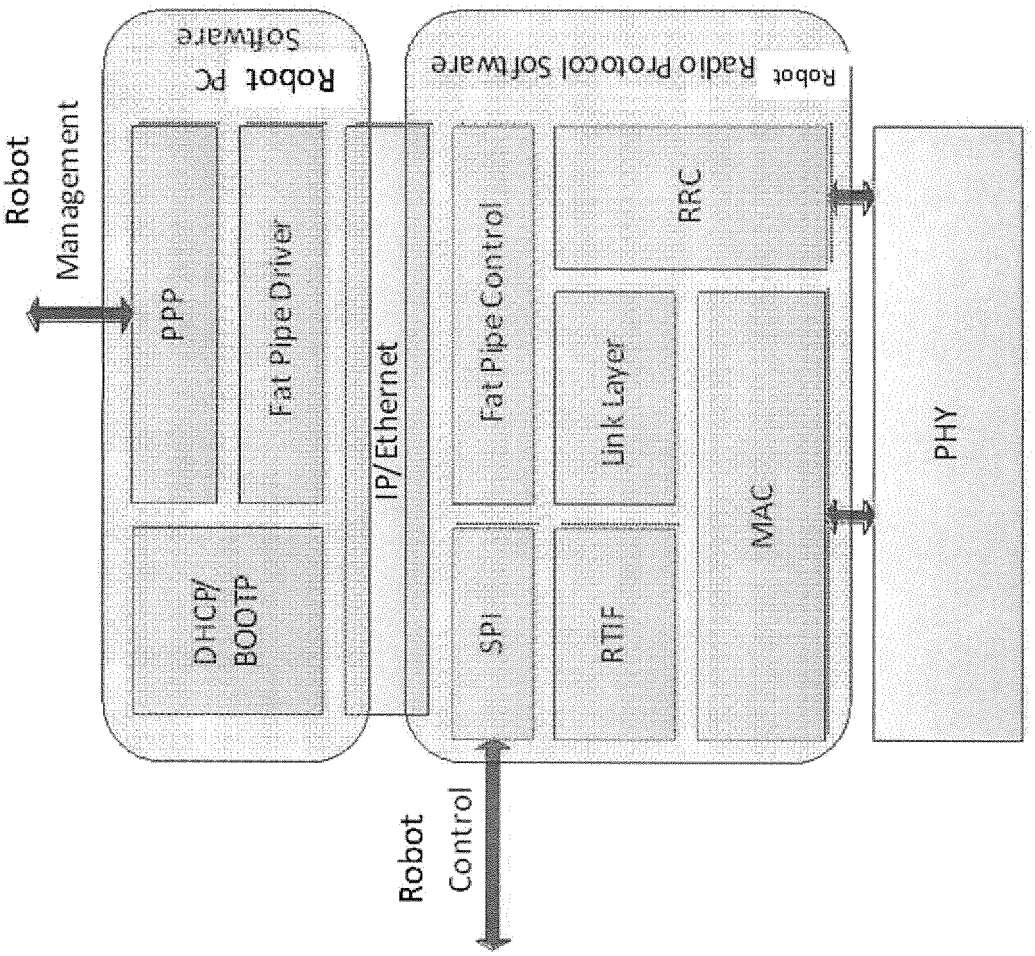

Robot
Management
Robot PC Software
PPP
Fat Pipe Driver
DHCP/
BOOTP
IP/Ethernet
Robot Radio Protocol Software
Fat Pipe Control
SPI
RTIF
Link Layer
MAC
RRC
PHY
Robot
Control

FIG. 15b

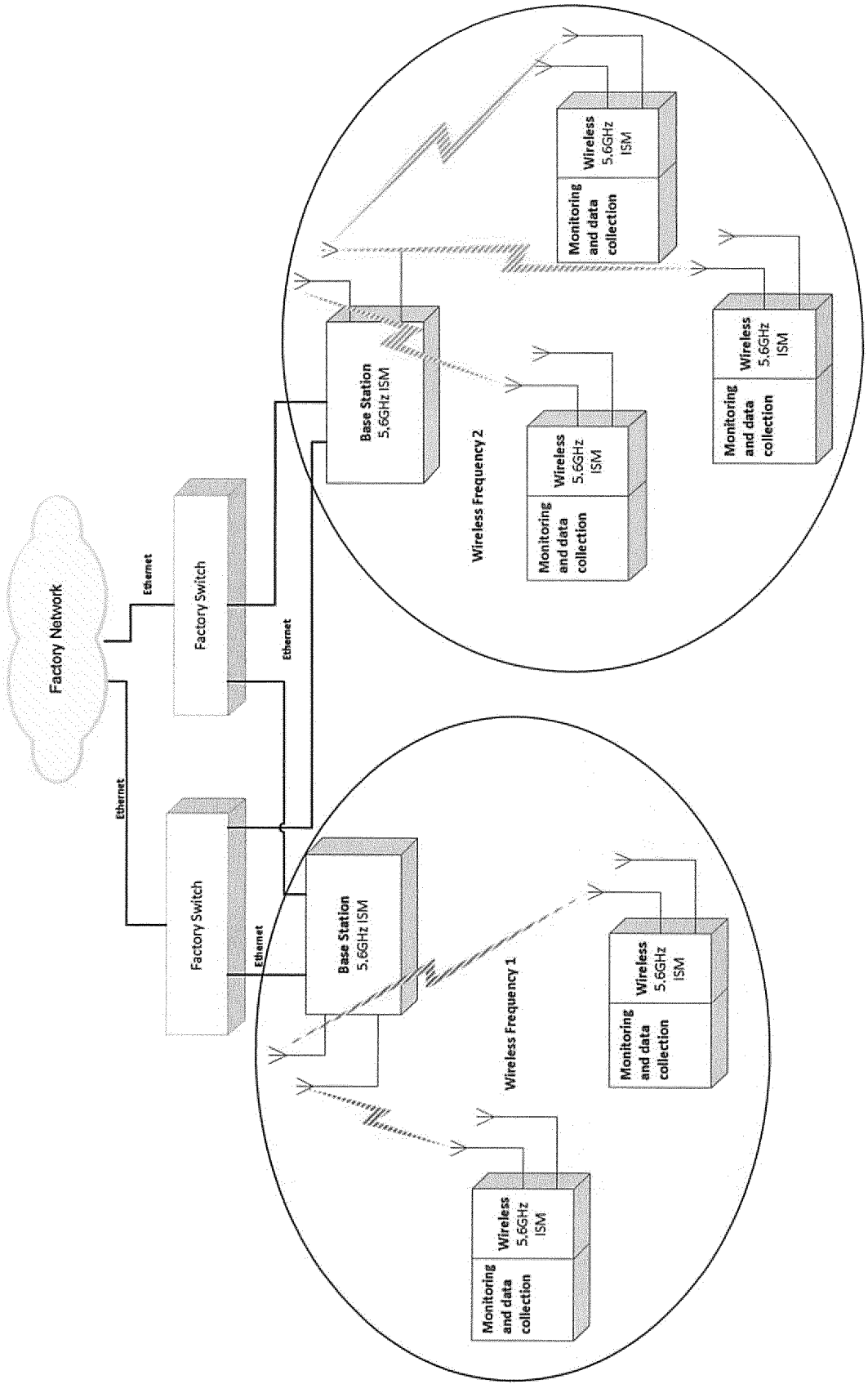

Factory Network
Ethernet
Factory Switch
Ethernet
Factory Switch
Ethernet
Ethernet
Base Station
5.6GHz ISM
Base Station
5.6GHz ISM
Wireless Frequency 1
Wireless Frequency 2
Wireless
5.6GHz
ISM
Monitoring
and data
collection
Wireless
5.6GHz
ISM
Monitoring
and data
collection
Wireless
5.6GHz
ISM
Monitoring
and data
collection
Wireless
5.6GHz
ISM
Monitoring
and data
collection

FIG. 16

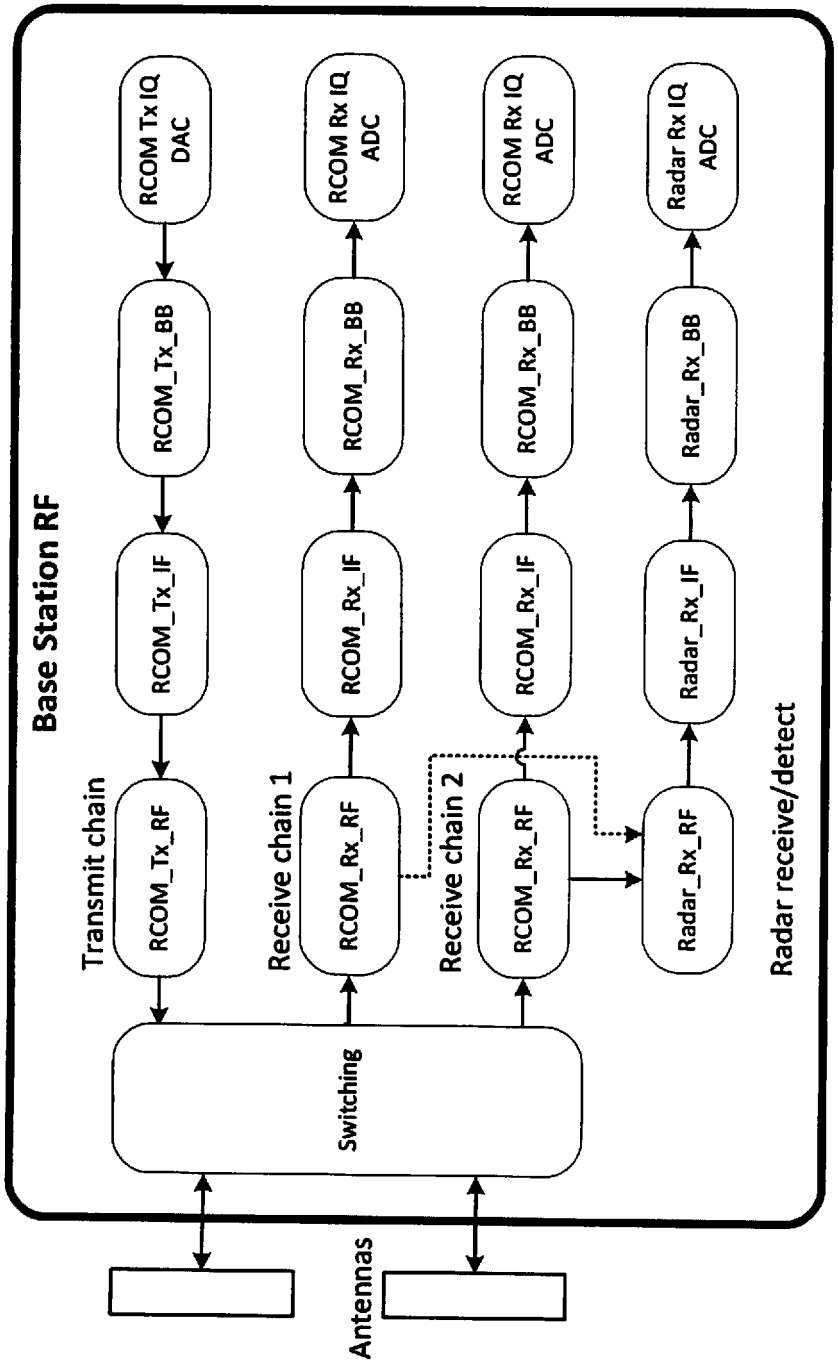

Base Station RF
Transmit chain
RCOM_Tx_RF
RCOM_Tx_IF
RCOM_Tx_BB
RCOM Tx IQ DAC
Receive chain 1
RCOM_Rx_RF
RCOM_Rx_IF
RCOM_Rx_BB
RCOM Rx IQ ADC
Receive chain 2
RCOM_Rx_RF
RCOM_Rx_IF
RCOM_Rx_BB
RCOM Rx IQ ADC
Radar_Rx_RF
Radar_Rx_IF
Radar_Rx_BB
Radar Rx IQ ADC
Radar receive/detect
Switching
Antennas

FIG. 17

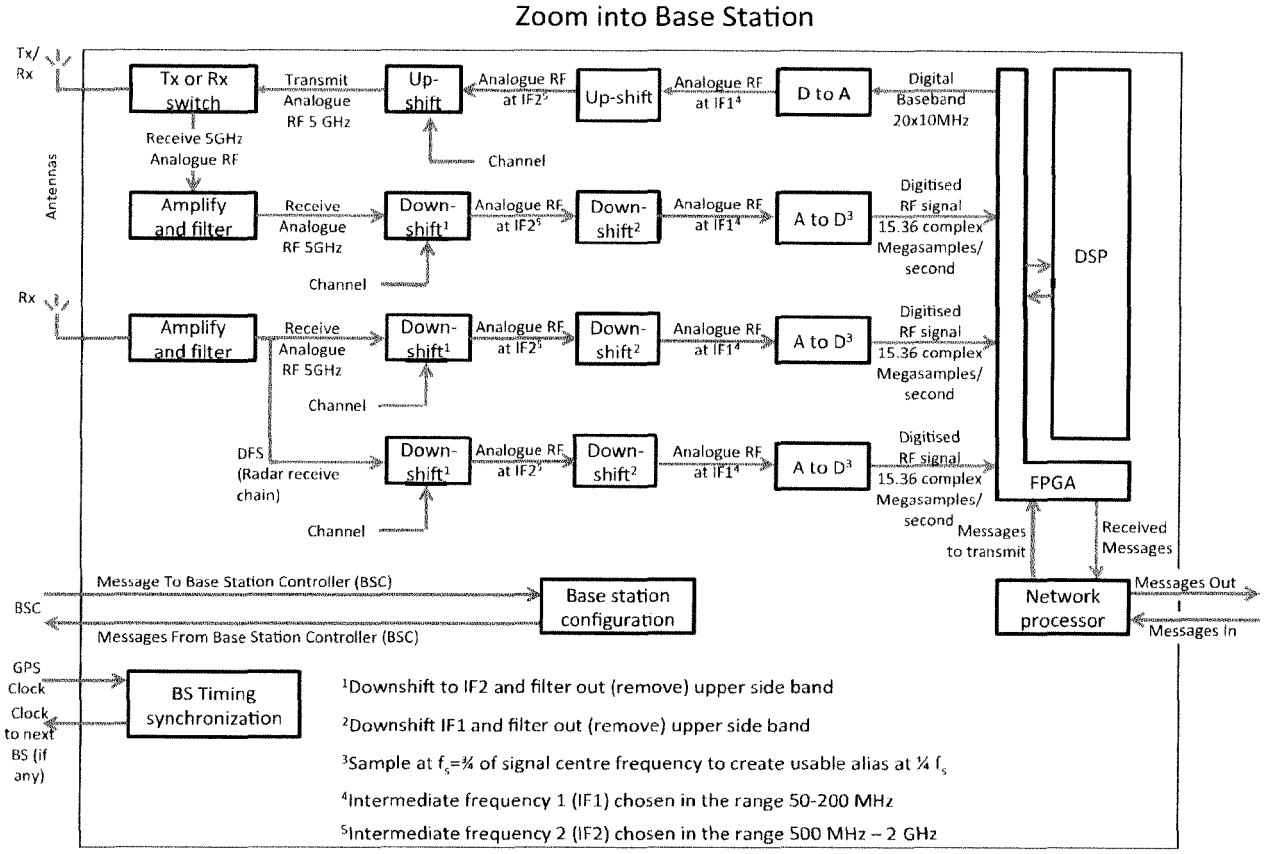

Zoom into Base Station
Tx/ Rx
Antennas
Rx
Tx or Rx switch
Transmit Analogue RF 5 GHz
Up-shift
Analogue RF at IF2[5]
Up-shift
Analogue RF at IF1[4]
D to A
Digital Baseband 20x10MHz
Receive 5GHz Analogue RF
Channel
Amplify and filter
Receive Analogue RF 5GHz
Down-shift[1]
Analogue RF at IF2[5]
Down-shift[2]
Analogue RF at IF1[4]
A to D[3]
Digitised RF signal 15.36 complex Megasamples/ second
DSP
Channel
Amplify and filter
Receive Analogue RF 5GHz
Down-shift[1]
Analogue RF at IF2[5]
Down-shift[2]
Analogue RF at IF1[4]
A to D[3]
Digitised RF signal 15.36 complex Megasamples/ second
Channel
DFS (Radar receive chain)
Down-shift[1]
Analogue RF at IF2[5]
Down-shift[2]
Analogue RF at IF1[4]
A to D[3]
Digitised RF signal 15.36 complex Megasamples/ second
FPGA
Channel
Messages to transmit
Received Messages
Message To Base Station Controller (BSC)
Base station configuration
BSC
Messages From Base Station Controller (BSC)
Network processor
Messages Out
Messages In
GPS Clock
Clock to next BS (if any)
BS Timing synchronization
[1]Downshift to IF2 and filter out (remove) upper side band
[2]Downshift IF1 and filter out (remove) upper side band
[3]Sample at f_s=¾ of signal centre frequency to create usable alias at ¼ f_s
[4]Intermediate frequency 1 (IF1) chosen in the range 50-200 MHz
[5]Intermediate frequency 2 (IF2) chosen in the range 500 MHz – 2 GHz

FIG. 17A

Estimated Uplink Max Signal Level

Frequency	5800.00 MHz	
Tx Power	6.50 dBm	The transmitter must produce at least this power
Testing tolerance	0.00 dB	Power setting tolerance
Tx Antenna Gain	0.00 dBi	Assuming 0dBi
		10dBm/MHz and we are -3.5dB down for 450kHz assuming we are using uplink power control.
EIRP	6.50 dBm	Transmiting at least this but no more than 6.5
Range	**1.00 m**	Assumed closest distance
Mean Path Loss	-47.71 dB	Assumed Line Of Site
Fading/Diversity Gain/Other Interference	0.00 dB	Assumes no fading
Receiver Antenna Gain	18.00 dBi	Assumes highest gain on boresight
Received Signal Level	-23.21 dBm	At antenna connector

FIG. 18

Estimated Uplink Minimum Signal Level

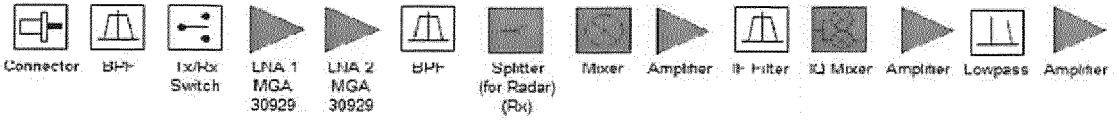
Frequency	5800.00 MHz	
Tx Power	6.50 dBm	The transmitter must produce at least this power
Testing tolerance	-1.50 dB	Power setting tolerance
Tx Antenna Gain	0.00 dBi	Assuming 0dBi
		10dBm/MHz and we are -3.5dB down for 450kHz assuming we are using uplink power control.
EIRP	5.00 dBm	Transmiting at least this but no more than 6.5
Range	**135.00 m**	Assumed at the corner of the grid
Mean Path Loss	-90.31 dB	Assumed Line Of Site
Fading/Diversity Gain/Other Interference	-10.00 dB	Assumes -10dB down after MRC
Receiver Antenna Gain	9.00 dBi	Assumes the minimum BS antenna gain
Received Signal Level	-86.31 dBm	
Thermal Noise	-174.00 dBm/Hz	
Bandwidth	56.53 dBHz	450kHz Bandwidth
Noise Figure	8.00 dB	Estimate
Noise power	-109.47 dBm/Hz	
Required CNR	8.50 dB	From Mathcad calculation
Receiver sensitivity	-100.97 dB	Approximately, receiver must receive this
Achieved CNR	23.16 dB	
Margin	14.66 dB	

FIG. 19

Base Station Receive Chain

Version 0.0 / Fraser Edwards

DRAFT under Development



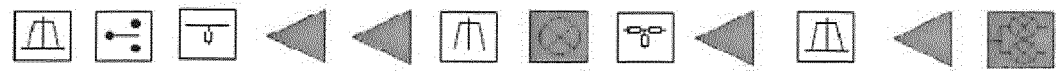
	Connector	BPF	Tx/Rx Switch	LNA 1 MGA 30929	LNA 2 MGA 30929	BPF	Splitter (for Radar) (Rx)	Mixer	Amplifier	IF Filter	IQ Mixer	Amplifier	Lowpass	Amplifier	
Individual Stage Values															
Stage gain min tolerance	-1.0	-1.5	-1.5	7.5	7.5	-1.5	-4.0	5.0	9.0	-4.0	4.0	7.0	-5.0	4.0	dD
Stage gain NOMINAL	-1.0	-1.0	-0.5	8.0	8.0	-1.0	-4.0	6.0	10.0	-6.0	5.0	8.0	-4.0	4.0	dB
Stage gain max tolerance	-1.0	-0.8	-0.4	8.5	8.5	-0.8	-4.0	7.0	11.0	-6.5	6.0	9.0	-3.0	4.0	dB
Stage NF min tolerance gain	1.0	1.5	1.5	2.5	2.5	1.5	4.0	11.7	6.0	4.0	11.0	6.0	5.0	6.0	dB
Stage noise figure NOMINAL	1.0	1.0	0.5	2.0	2.0	1.0	4.0	11.7	6.0	6.0	11.0	6.0	4.0	6.0	dB
Stage NF max tolerance gain	1.0	0.8	0.4	1.6	1.6	0.8	4.0	11.7	6.0	6.5	11.0	6.0	3.0	6.0	dB
Stage OIP3 min tolerance gain	100.0	100.0	39.0	35.0	35.0	100.0	100.0	24.0	25.0	100.0	14.0	24.0	100.0	20.0	dDm
Stage OIP3 NOMINAL	100.0	100.0	39.0	35.0	35.0	100.0	100.0	25.0	25.0	100.0	15.0	24.0	100.0	20.0	dBm
Stage OIP3 max tolerance gain	100.0	100.0	39.0	35.0	35.0	100.0	100.0	26.0	25.0	100.0	16.0	24.0	100.0	20.0	dBm
Approx. stage P1dB min tol gain	100.0	100.0	27.0	22.0	22.0	100.0	100.0	11.0	10.0	100.0	10.0	20.0	100.0	20.0	dBm
Approx. stage P1dB NOMINAL	100.0	100.0	27.0	22.0	22.0	100.0	100.0	11.0	10.0	100.0	10.0	20.0	100.0	20.0	dBm
Approx. stage P1dB max tol gain	100.0	100.0	27.0	22.0	22.0	100.0	100.0	11.0	10.0	100.0	10.0	20.0	100.0	20.0	dBm
Cumulative Stage Values															
Cum gain min tolerance	-1.0	-1.5	-3.0	4.5	12.0	10.5	20.5	15.5	24.5	16.5	20.5	27.5	22.5	26.5	dB
Cumulative gain NOMINAL	-1.0	-1.0	-1.5	6.6	11.6	13.5	25.5	19.5	29.5	19.6	24.5	32.6	28.6	32.6	dB
Cum gain max tolerance	1.0	0.8	1.2	7.3	15.8	16.0	29.0	22.0	33.0	22.5	28.5	37.5	34.5	38.6	dB
Cum NF min tolerance gain	1.0	2.5	3.7	5.9	6.2	6.2	7.4	7.4	7.4	7.4	7.6	7.7	7.7	7.7	dD
Cumulative NF NOMINAL	1.0	2.0	2.4	4.1	4.3	4.3	5.3	5.2	5.3	5.3	5.4	5.4	5.4	5.5	dB
Cum NF max tolerance gain	1.0	1.8	2.1	3.5	3.6	3.6	4.4	4.4	4.4	4.4	4.5	4.5	4.5	4.5	dB
Cum OIP3 min tolerance gain	100.0	96.2	39.0	34.7	34.2	32.7	20.3	23.8	24.3	16.3	13.1	18.6	13.6	15.6	dBm
Cumulative OIP3 NOMINAL	100.0	96.5	39.0	34.7	34.3	33.3	20.6	24.8	24.6	11.6	13.7	19.7	15.7	16.8	dBm
Cum OIP3 max tolerance gain	100.0	96.6	39.0	34.8	34.4	33.6	20.7	25.9	24.7	14.2	14.6	20.8	17.8	17.8	dBm
Cum IIP3 min tolerance gain	101.0	97.7	42.0	30.2	22.2	22.2	-0.2	8.0	-0.2	-0.2	-7.4	-8.9	-8.9	-10.9	dDm
Cumulative IIP3 NOMINAL	101.0	97.5	40.5	28.2	19.6	19.6	-4.9	5.3	-4.9	-4.9	-10.6	-12.6	-12.6	-15.7	dBm
Cum IIP3 max tolerance gain	101.0	97.4	40.2	27.5	18.6	18.6	-6.3	3.9	-6.3	-6.3	-13.9	-16.7	-16.7	-20.7	dBm

Signal Levels & Headroom	Antenna Connector Signal Level															Voltage on a 200 Ohm load	
Cumulative level min tolerance gain	-107.0	-108.0	-109.5	-111.0	-103.5	-96.0	-97.5	-87.5	-92.5	-83.5	-91.5	-87.5	-90.5	-85.5	-81.5	dBm	0.04 mVrms
Cumulative level NOMINAL	-107.0	-106.0	-109.0	-109.5	-101.5	-93.5	-94.5	-82.5	-88.5	-78.5	-88.5	-83.5	-75.5	-79.5	-75.5	dBm	0.06 mVrms
Cumulative level max tolerance gain	-107.0	-108.0	-108.8	-109.2	-100.7	-92.2	-93.0	-79.0	-86.0	-75.0	-85.5	-79.5	-70.5	-73.5	-69.5	dBm	0.15 mVrms
Cumulative level min tolerance gain	-23.0	-24.0	-25.5	-27.0	-19.5	-12.0	-13.5	-3.5	-8.5	0.5	-7.5	-3.5	3.5	-1.5	2.5	dBm	596.37 mVrms
Cumulative level NOMINAL	-23.0	-21.0	-25.0	-25.5	-17.5	-9.5	-10.5	1.5	-4.5	5.5	-4.5	0.5	8.5	4.5	8.5	dBm	1189.91 mVrms
Cumulative level max tolerance gain	23.0	24.0	24.8	25.2	16.7	8.2	9.0	5.0	2.0	9.0	1.5	4.5	13.5	10.5	14.5	dBm	2374.19 mVrms
Headroom min tolerance gain	-23.0	124.0	125.5	54.0	41.5	34.0	110.5	100.5	19.5	9.5	107.5	13.5	16.5	101.5	17.5	dD	
Headroom NOMINAL	-23.0	124.0	125.0	52.5	39.5	31.5	110.5	98.5	15.5	4.5	104.5	9.5	11.5	95.5	11.5	dB	
Headroom max tolerance gain	-23.0	124.0	124.8	52.2	38.7	30.2	109.0	95.0	13.0	1.0	101.5	5.5	6.5	89.5	5.5	dB	

FIG. 20

Version 0.0 / Fraser Edwards

DRAFT under Development



Individual Stage Values

		Level	BPF	Switch	Power Detect	PA	PA Driver	LO & Image Reject	Mixer	Temp Comp Attenuator	Amp	IF Filter	Amp	
Stage gain min tolerance	dB		-3.0	-1.5	-1.0	9.0	9.0	-3.0	0.0	-6.0	14.0	-6.0	9.0	
Stage gain NOMINAL	dB		-2.3	-1.0	-0.5	10.0	10.0	-2.3	0.0	-5.0	15.0	-5.0	10.0	
Stage gain max tolerance	dB		-2.0	-0.4	-0.4	10.5	10.5	-2.0	0.0	-5.0	16.0	-5.0	11.0	
Stage NF min tolerance gain	dB		3.0	1.5	1.0	7.0	3.5	3.0	12.0	6.0	10.0	10.0	8.0	
Stage noise figure NOMINAL	dB		2.3	1.0	0.5	7.0	3.5	2.3	12.0	6.0	10.0	10.0	8.0	
Stage NF max tolerance gain	dB		2.0	0.4	0.4	7.0	3.5	2.0	12.0	6.0	10.0	10.0		
Stage OIP3 min tolerance gain	dBm		100.0	37.0	100.0	35.0	25.0	100.0	20.0	100.0	25.0	100.0	20.0	
Stage OIP3 NOMINAL	dBm		100.0	37.0	100.0	35.0	25.0	100.0	20.0	100.0	25.0	100.0	20.0	
Stage OIP3 max tolerance gain	dBm		100.0	37.0	100.0	35.0	25.0	100.0	20.0	100.0	25.0	100.0	20.0	
Approx. stage P1dB min tol gain	dBm		100.0	27.0	100.0	18.0	15.0	100.0	10.0	100.0	15.0	100.0	10.0	
Approx. stage P1dB NOMINAL	dBm		100.0	27.0	100.0	18.0	15.0	100.0	10.0	100.0	15.0	100.0	10.0	
Approx. stage P1dB max tol gain	dBm		100.0	27.0	100.0	18.0	15.0	100.0	10.0	100.0	15.0	100.0	10.0	

Cumulative Stage Values

Cum gain min tolerance	dB		20.5	23.5	25.0	26.0	17.0	8.0	11.0	11.0	17.0	3.0	9.0	
Cumulative gain NOMINAL	dB		26.9	29.2	30.2	30.7	20.7	10.7	13.0	13.0	19.0	4.0	10.0	
Cum gain max tolerance	dB		31.2	33.2	33.6	34.0	23.5	13.0	15.0	15.0	21.0	5.0	11.0	
Cum NF min tolerance gain	dB		11.3	11.3	11.3	11.3	11.3	11.2	11.2	10.8	10.8	8.7	8.0	
Cumulative NF NOMINAL	dB		10.7	10.7	10.7	10.7	10.7	10.6	10.6	10.3	10.3	8.6	8.0	
Cum NF max tolerance gain	dB		7.1	7.1	7.1	7.1	7.1	7.1	7.0	6.6	6.6	2.3	0.0	
Cum OIP3 min tolerance gain	dBm		22.1	25.1	26.9	27.9	19.8	12.4	15.4	17.2	23.2	14.0	20.0	
Cumulative OIP3 NOMINAL	dBm		25.3	27.6	29.1	29.6	21.1	13.3	15.6	17.5	23.5	14.0	20.0	
Cum OIP3 max tolerance gain	dBm		26.8	28.8	29.9	30.3	21.6	13.8	15.8	17.8	23.8	14.0	20.0	
Cum IIP3 min tolerance gain	dBm		1.6	1.6	1.9	1.9	2.8	4.4	4.4	6.2	6.2	11.0	11.0	
Cumulative IIP3 NOMINAL	dBm		-1.6	-1.6	-1.1	-1.1	0.4	2.6	2.6	4.5	4.5	10.0	10.0	
Cum IIP3 max tolerance gain	dBm		-4.4	-4.4	-3.7	-3.7	-1.9	0.8	0.8	2.8	2.8	9.0	9.0	

Signal Levels & Headroom

		Antenna Connector Signal Level												
Cumulative level min tolerance ga	dBm	10.5	10.5	13.5	15.0	16.0	7.0	-2.0	1.0	1.0	7.0	-7.0	-1.0	-10.0
Cumulative level NOMINAL	dBm	16.9	16.9	19.2	20.2	20.7	10.7	0.7	3.0	3.0	9.0	6.0	0.0	10.0
Cumulative level max tolerance ga	dBm	21.2	21.2	23.2	23.6	24.0	13.5	3.0	5.0	5.0	11.0	-5.0	1.0	-10.0
Headroom min tolerance gain	dB		89.5	13.5	85.0	2.0	8.0	102.0	9.0	99.0	8.0	107.0	11.0	
Headroom NOMINAL	dB		83.1	7.8	79.8	-2.7	1.3	99.3	7.0	97.0	6.0	106.0	10.0	
Headroom max tolerance gain	dB		78.8	3.8	76.4	-6.0	1.5	97.0	5.0	95.0	4.0	105.0	9.0	

FIG. 21

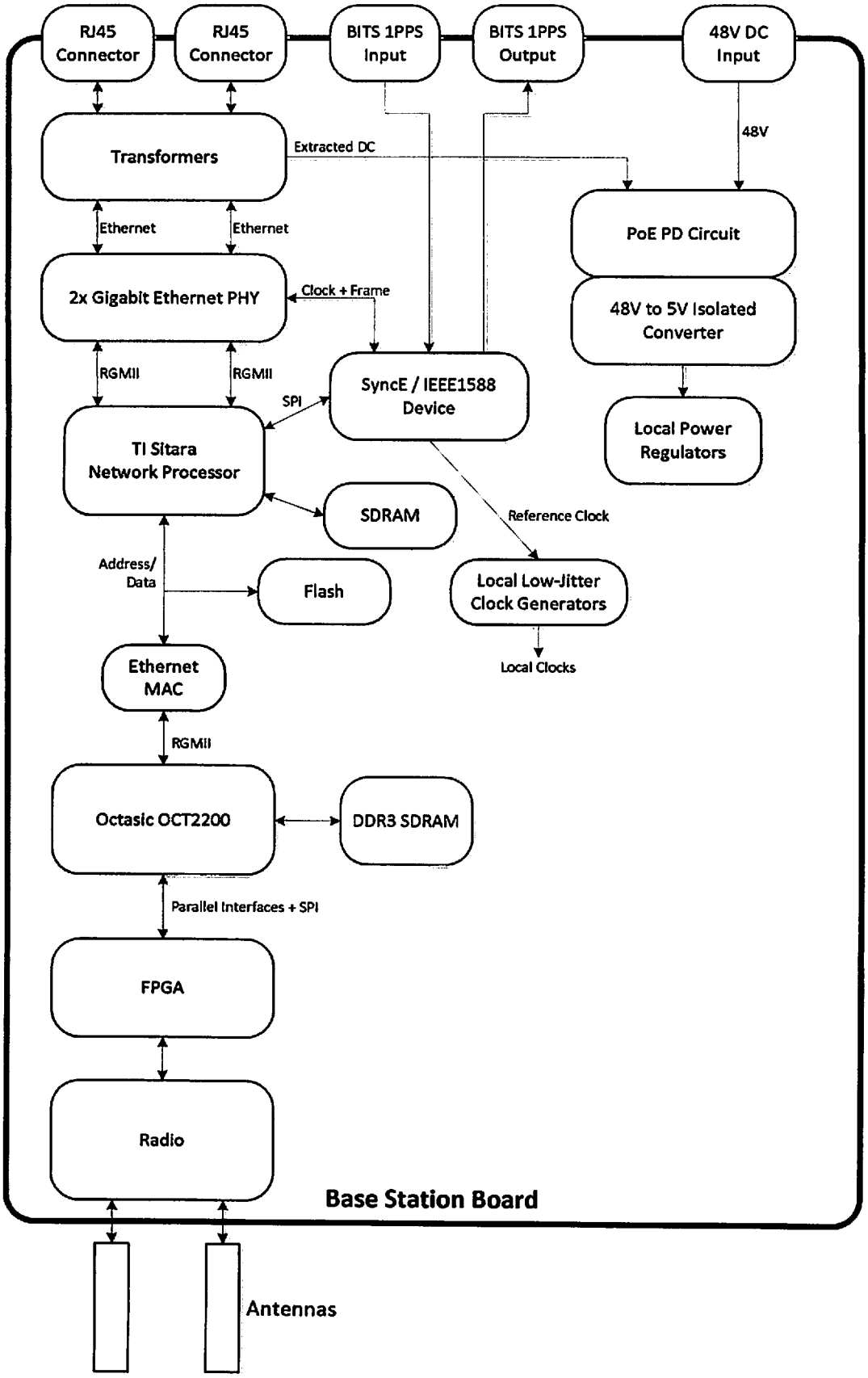

RJ45 Connector
RJ45 Connector
BITS 1PPS Input
BITS 1PPS Output
48V DC Input
Transformers
Extracted DC
48V
Ethernet
Ethernet
PoE PD Circuit
2x Gigabit Ethernet PHY
Clock + Frame
48V to 5V Isolated Converter
RGMII
RGMII
SyncE / IEEE1588 Device
SPI
Local Power Regulators
TI Sitara Network Processor
SDRAM
Reference Clock
Address/ Data
Flash
Local Low-Jitter Clock Generators
Local Clocks
Ethernet MAC
RGMII
Octasic OCT2200
DDR3 SDRAM
Parallel Interfaces + SPI
FPGA
Radio
Base Station Board
Antennas

FIG. 22

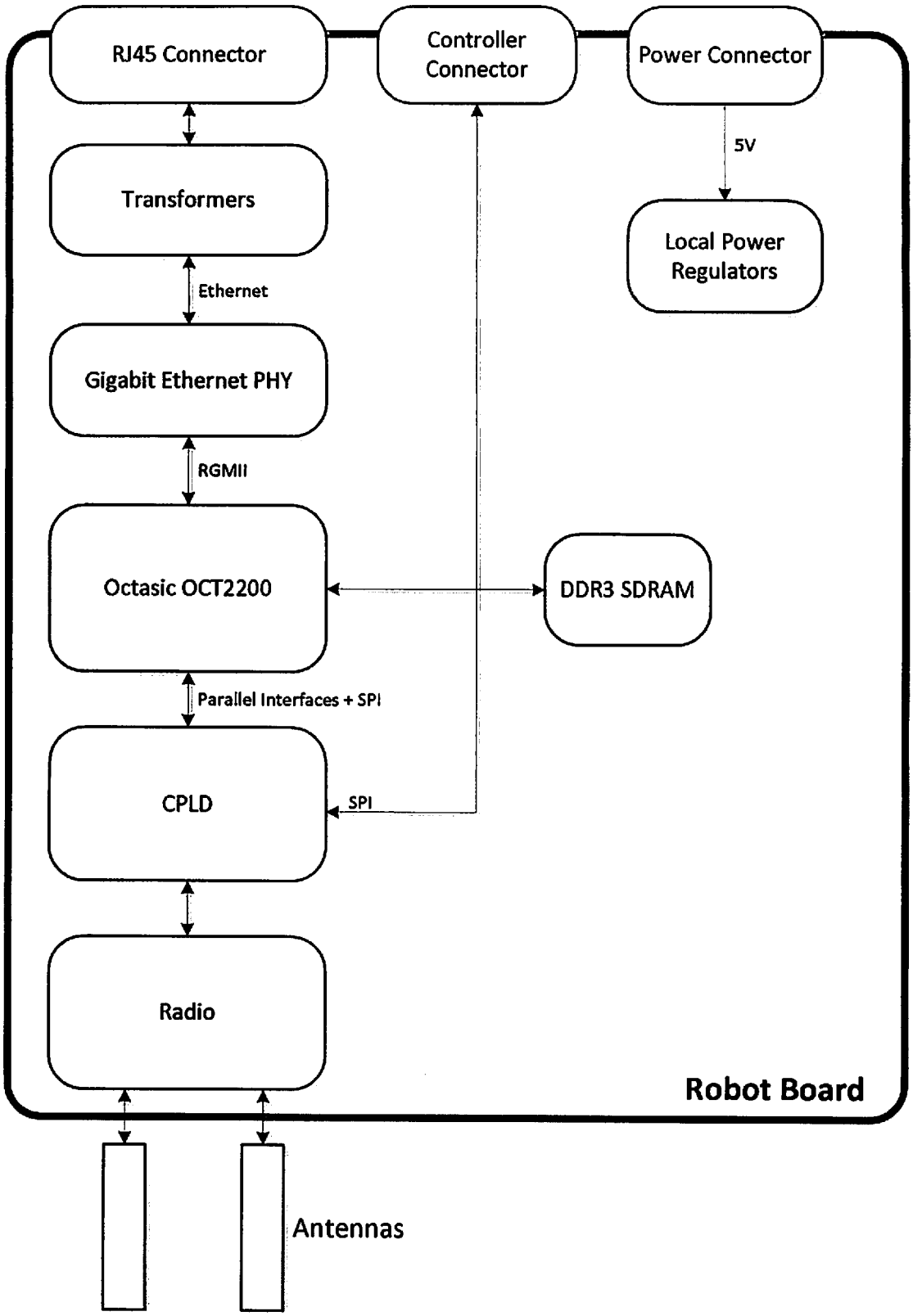

RJ45 Connector
Controller Connector
Power Connector
5V
Transformers
Local Power Regulators
Ethernet
Gigabit Ethernet PHY
RGMII
Octasic OCT2200
DDR3 SDRAM
Parallel Interfaces + SPI
CPLD
SPI
Radio
Robot Board
Antennas

FIG. 23

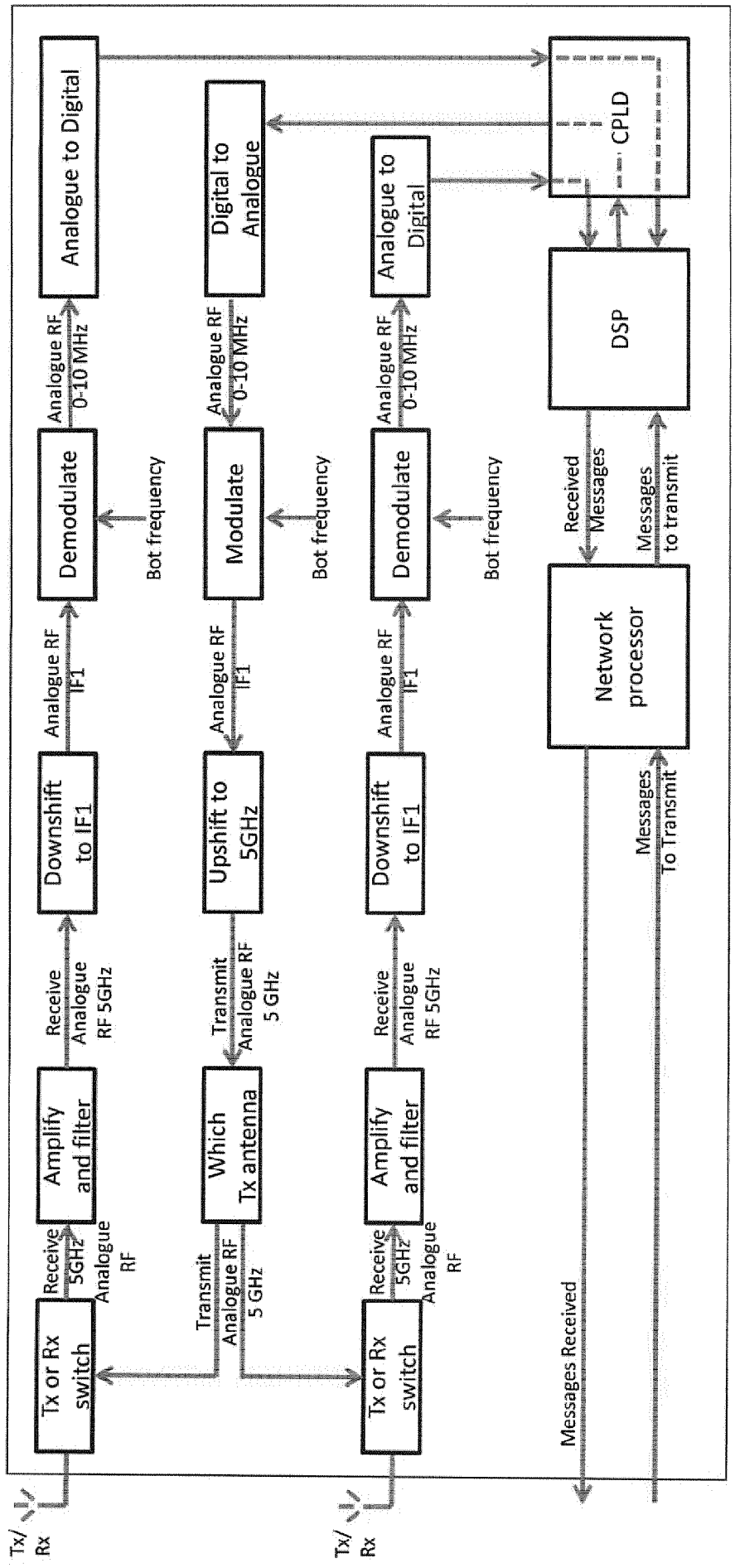

Tx/ Rx
Tx/ Rx
Tx or Rx switch
Receive 5GHz Analogue RF
Amplify and filter
Receive Analogue RF 5GHz
Downshift to IF1
Analogue RF IF1
Demodulate
Analogue RF 0-10 MHz
Analogue to Digital
Bot frequency
Transmit Analogue RF 5 GHz
Which Tx antenna
Transmit Analogue RF 5 GHz
Upshift to 5GHz
Analogue RF IF1
Modulate
Analogue RF 0-10 MHz
Digital to Analogue
Bot frequency
Tx or Rx switch
Receive 5GHz Analogue RF
Amplify and filter
Receive Analogue RF 5GHz
Downshift to IF1
Analogue RF IF1
Demodulate
Analogue RF 0-10 MHz
Analogue to Digital
Bot frequency
Messages Received
Network processor
Received Messages
Messages to transmit
Messages To Transmit
DSP
CPLD

FIGURE 23A

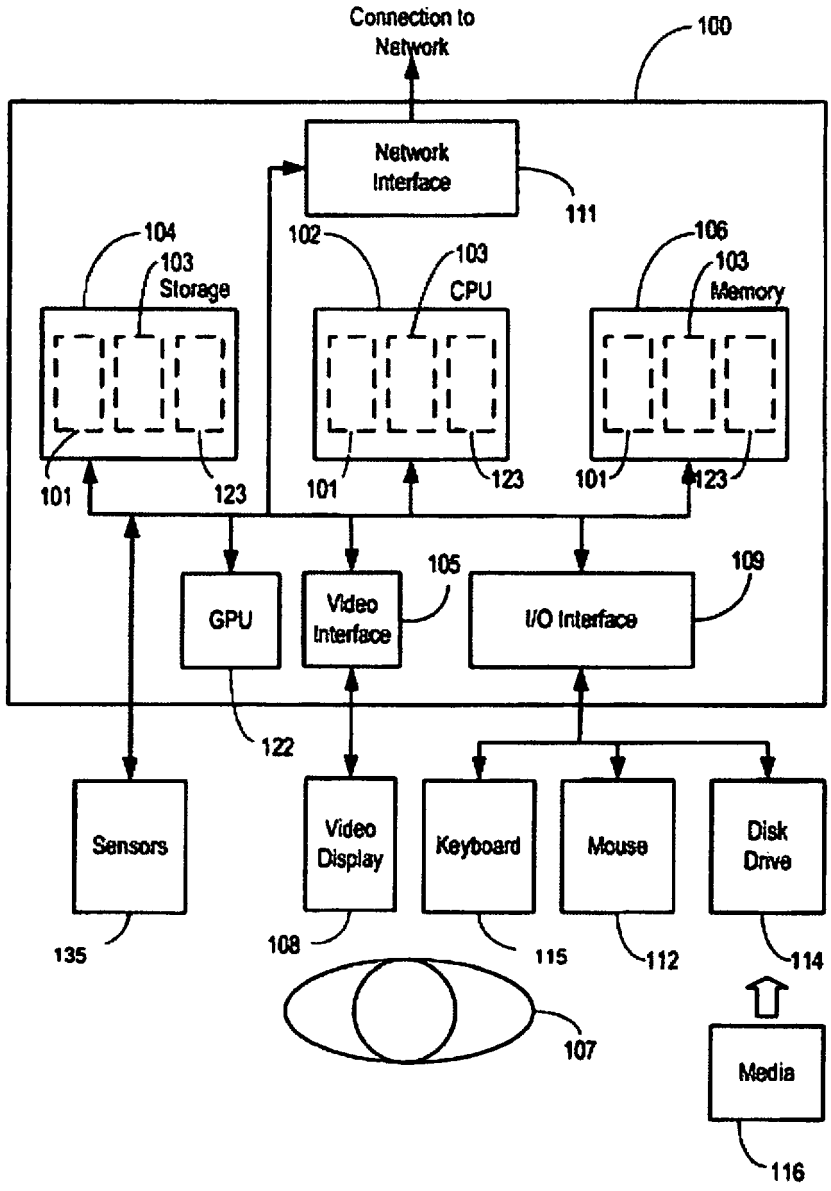

Connection to Network
100
Network Interface
111
102
104
103
Storage
103
CPU
106
103
Memory
101
123
101
123
101
123
GPU
105
Video Interface
109
I/O Interface
122
Sensors
Video Display
Keyboard
Mouse
Disk Drive
135
108
115
112
114
107
Media
116

FIG. 24