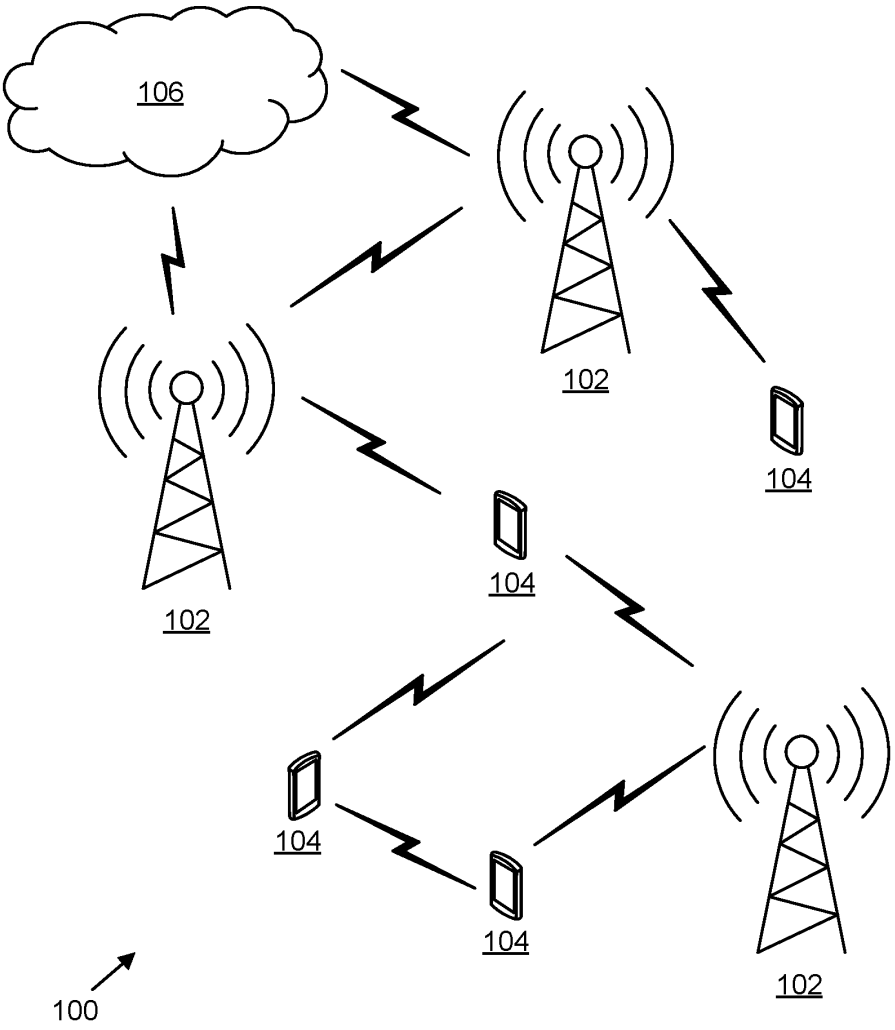


FIG. 1

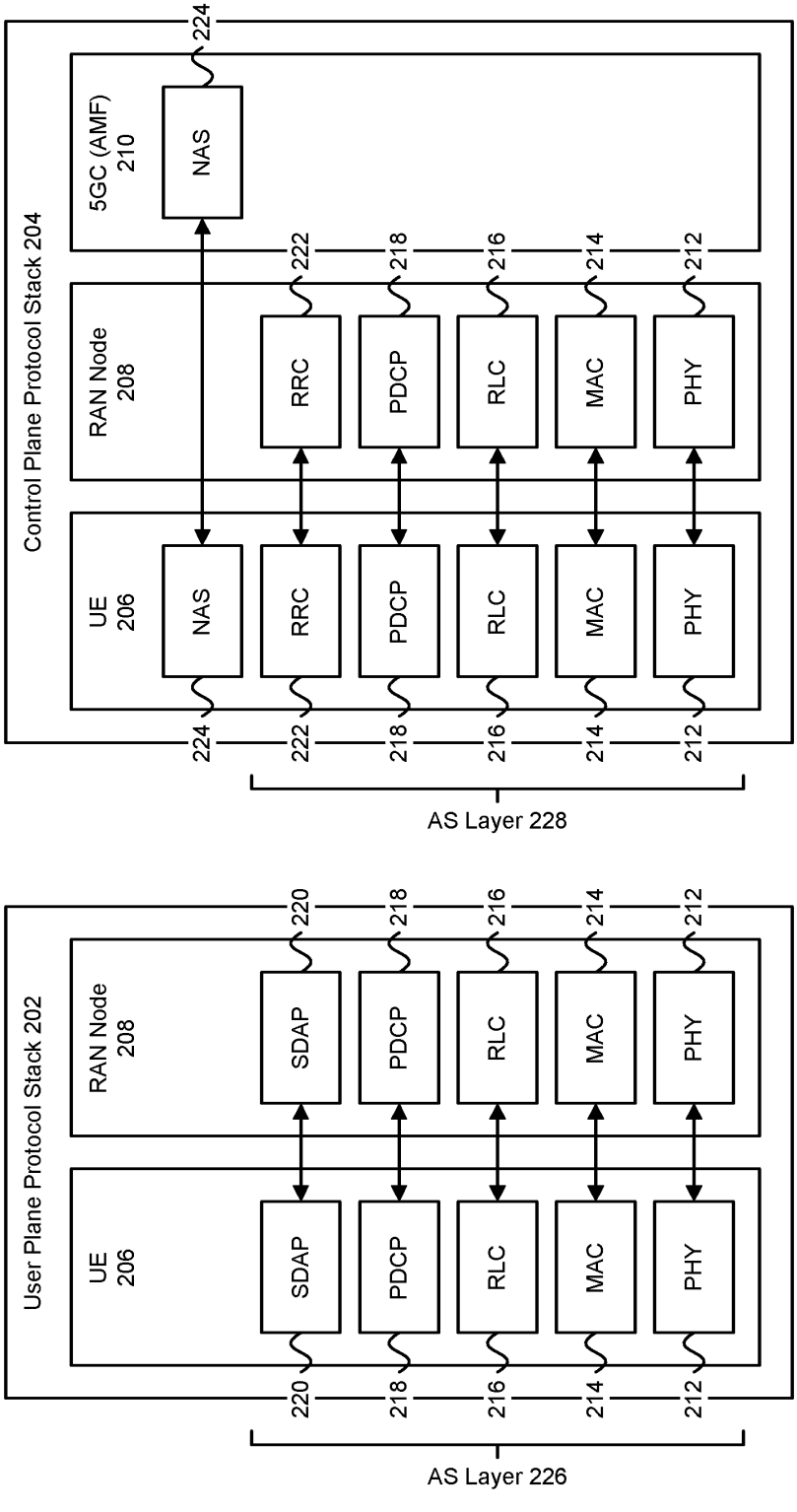

Control Plane Protocol Stack 204
5GC (AMF) 210
NAS
224
RAN Node 208
RRC
PDCP
RLC
MAC
PHY
222
218
216
214
212
UE 206
NAS
RRC
PDCP
RLC
MAC
PHY
AS Layer 228
User Plane Protocol Stack 202
RAN Node 208
SDAP
PDCP
RLC
MAC
PHY
220
218
216
214
212
UE 206
SDAP
PDCP
RLC
MAC
PHY
AS Layer 226
200

FIG. 2

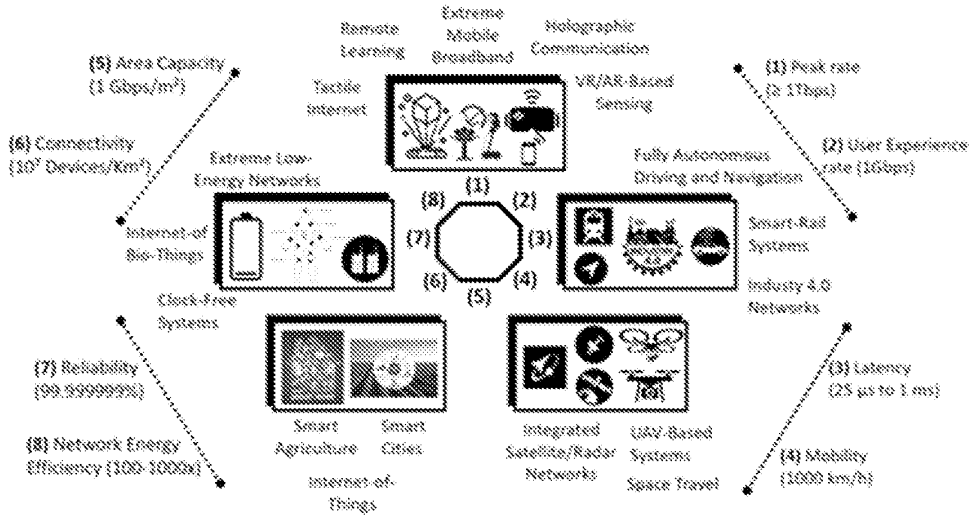

Remote Learning
Extreme Mobile Broadband
Holographic Communication
Tactile Internet
VR/AR-Based Sensing
(5) Area Capacity (1 Gbps/m²)
(1) Peak rate (≥ 1Tbps)
(6) Connectivity (10⁷ Devices/Km²)
(2) User Experience rate (1Gbps)
Extreme Low-Energy Networks
Fully Autonomous Driving and Navigation
(8)
(1)
(2)
(7)
(3)
(6)
(4)
(5)
Internet-of-Bio-Things
Smart-Rail Systems
Clock-Free Systems
Industry 4.0 Networks
(7) Reliability (99.999999%)
(3) Latency (25 µs to 1 ms)
(8) Network Energy Efficiency (100-1000x)
(4) Mobility (1000 km/h)
Smart Agriculture
Smart Cities
Integrated Satellite/Radar Networks
UAV-Based Systems
Space Travel
Internet-of-Things

FIG. 3

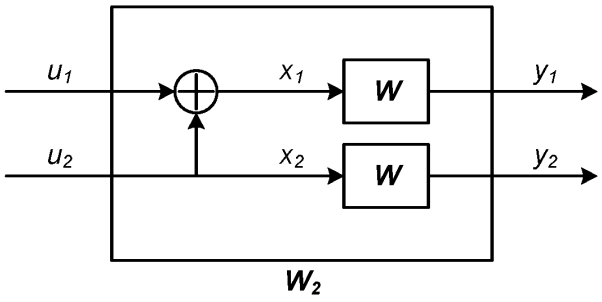

u_1
u_2
x_1
x_2
W
W
y_1
y_2
W_2

FIG. 4

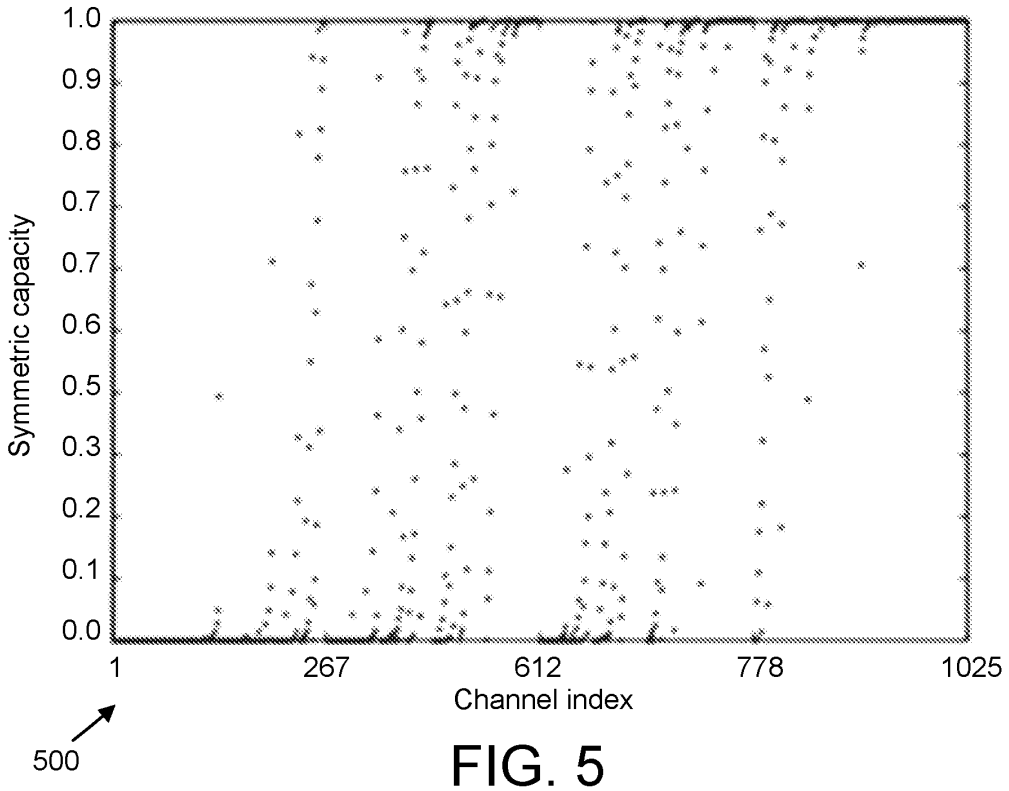


FIG. 5

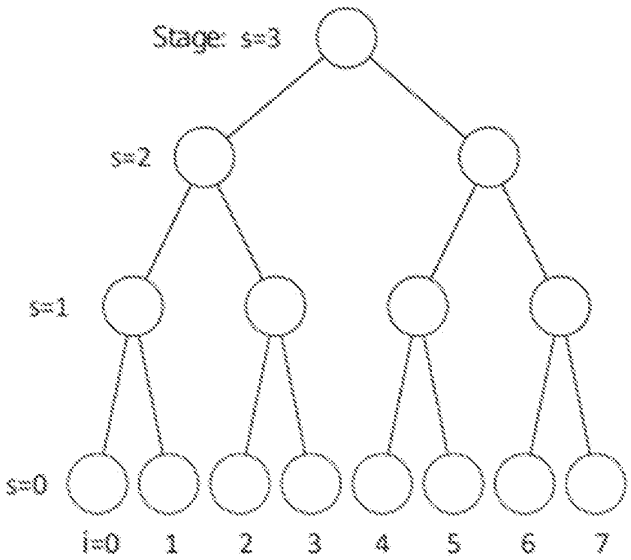


FIG. 6A

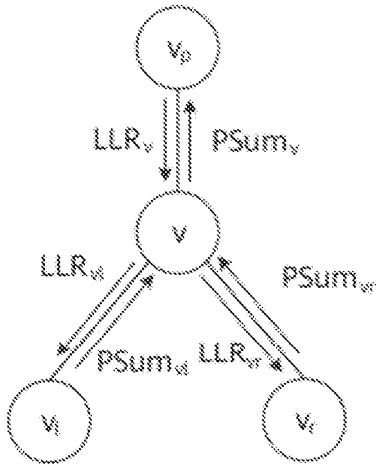
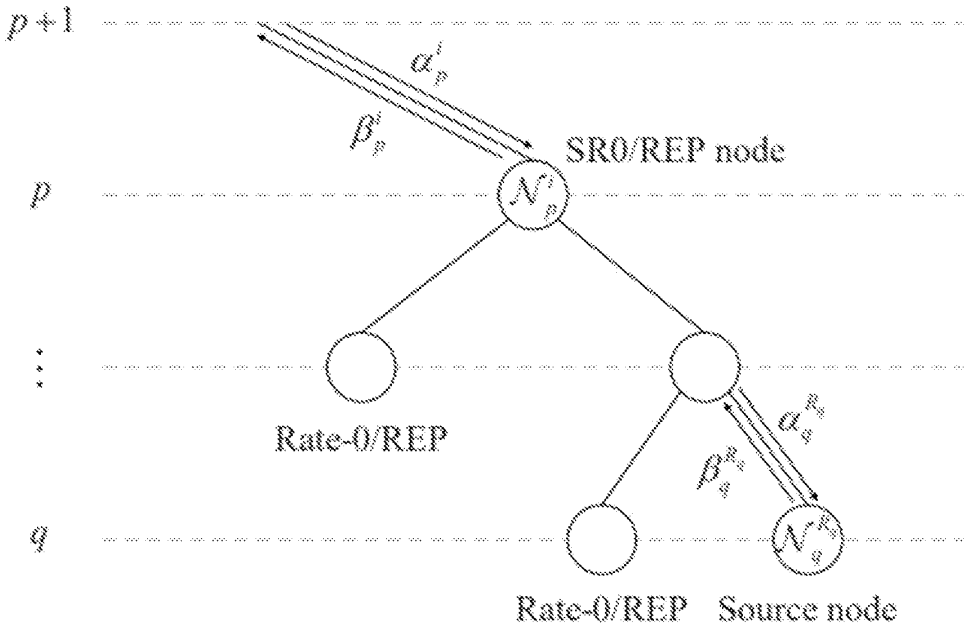
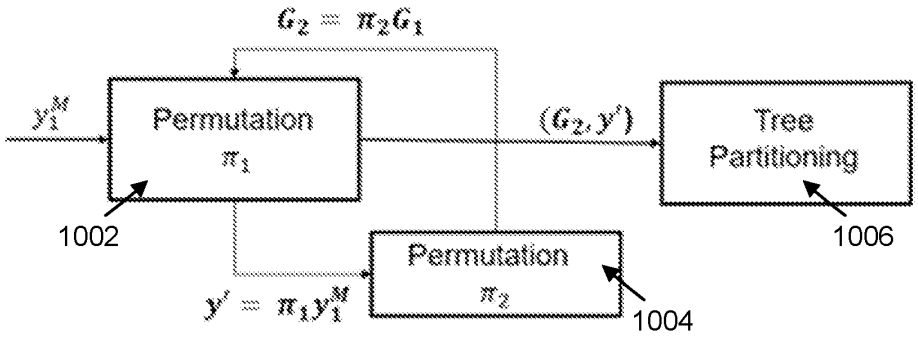


FIG. 6B



700

FIG. 7



1000

FIG. 10

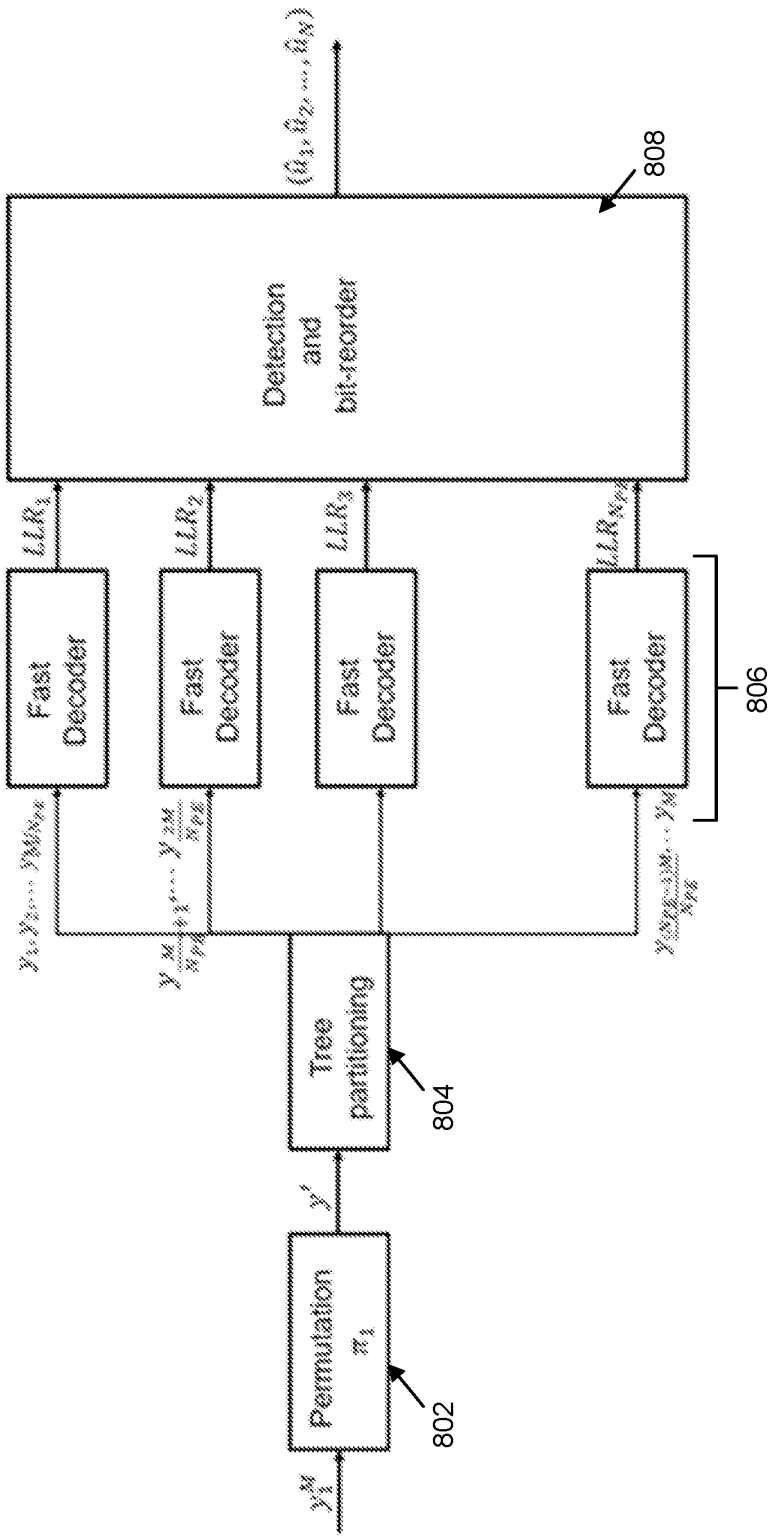

800
808
Detection and bit-reorder
Fast Decoder
Fast Decoder
Fast Decoder
Fast Decoder
806
Tree partitioning
804
Permutation π_1
802

FIG. 8

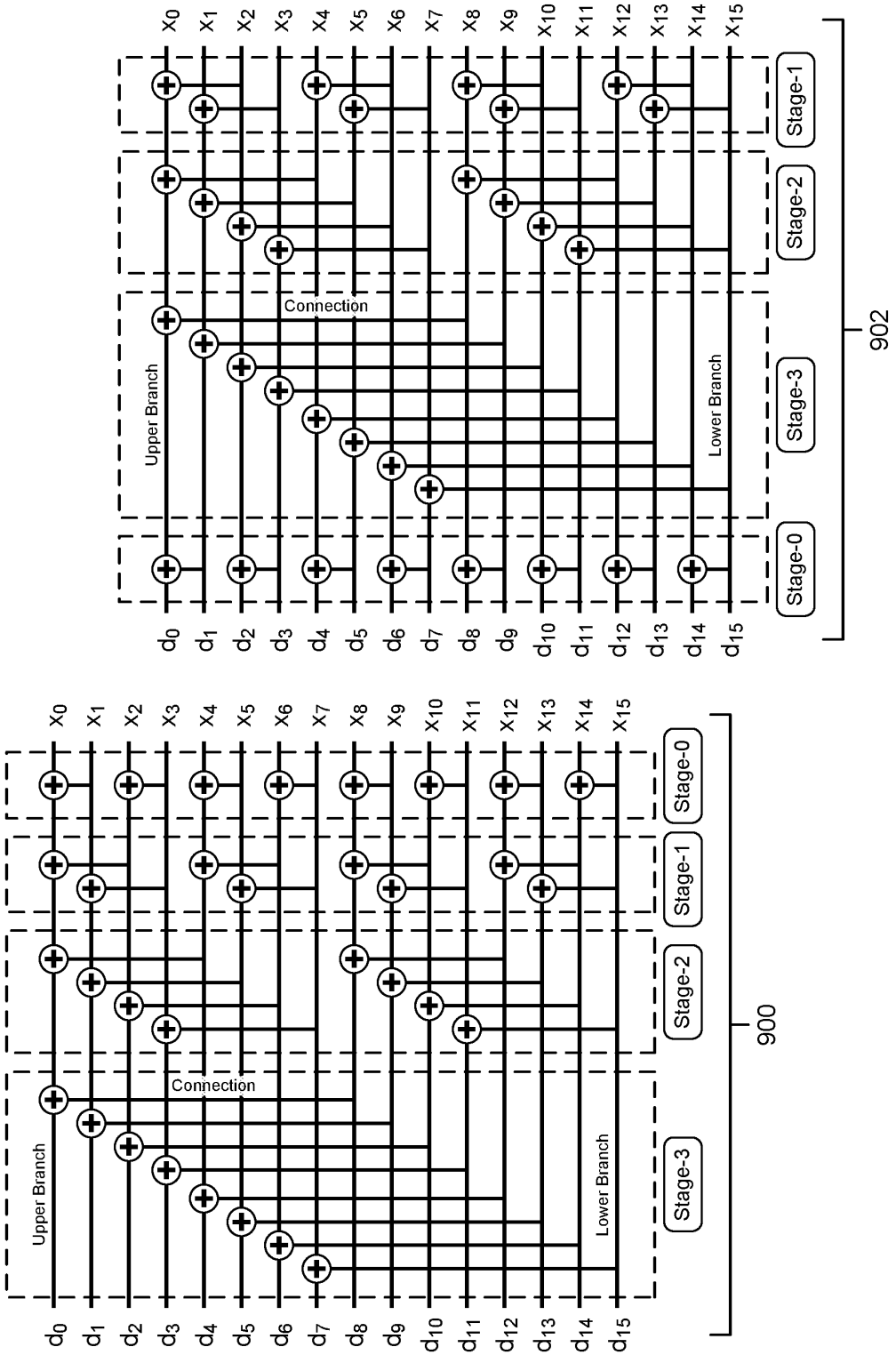

x0 x1 x2 x3 x4 x5 x6 x7 x8 x9 x10 x11 x12 x13 x14 x15
Upper Branch
Connection
Lower Branch
Stage-0
Stage-1
Stage-2
Stage-3
d0 d1 d2 d3 d4 d5 d6 d7 d8 d9 d10 d11 d12 d13 d14 d15
902
900

FIG. 9

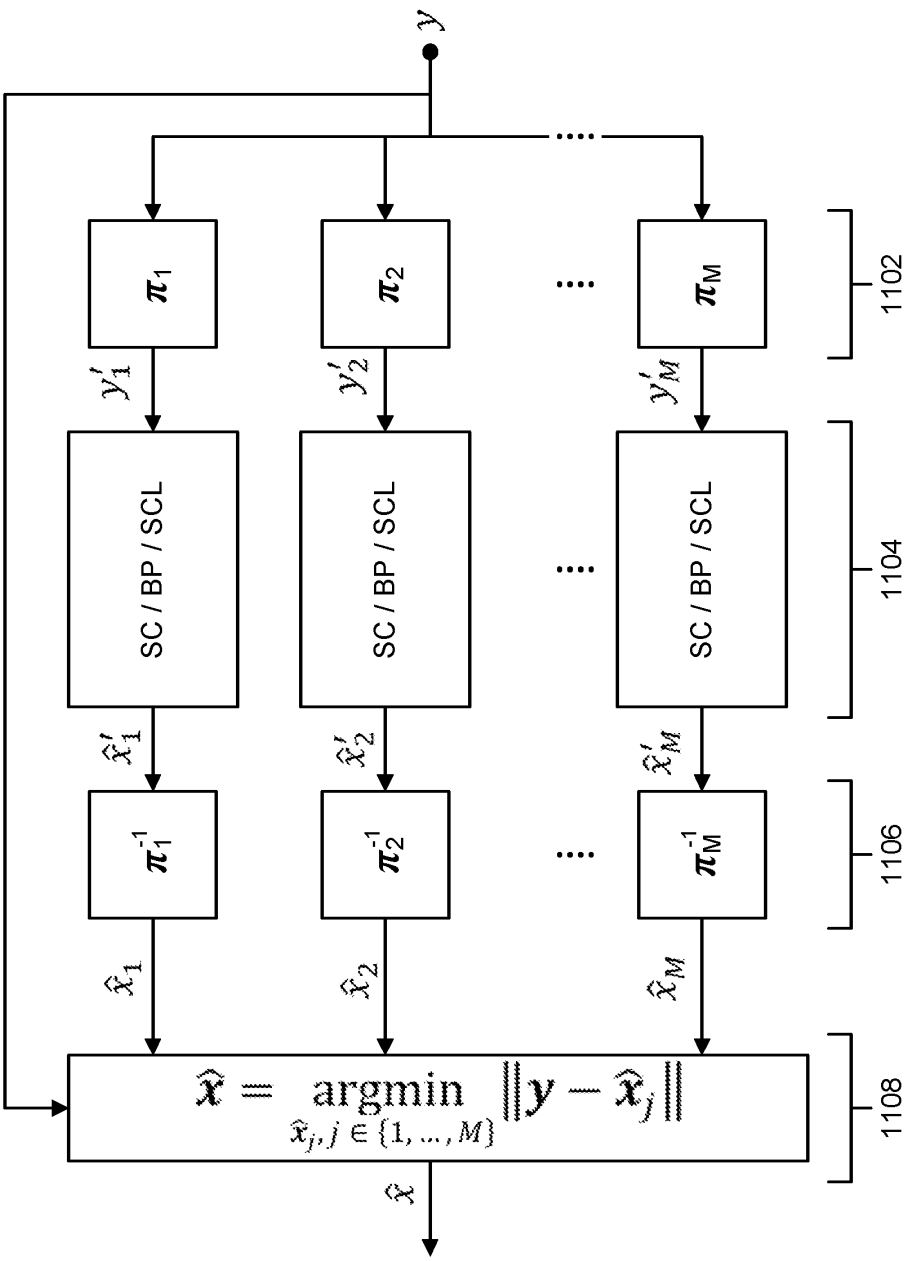

y
1100
π1
π2
πM
1102
y'1
y'2
y'M
SC / BP / SCL
SC / BP / SCL
SC / BP / SCL
1104
x̂'1
x̂'2
x̂'M
π1-1
π2-1
πM-1
1106
x̂1
x̂2
x̂M
x̂ = argmin ||y − x̂j||
x̂j, j ∈ {1, ..., M}
1108
x̂

FIG. 11

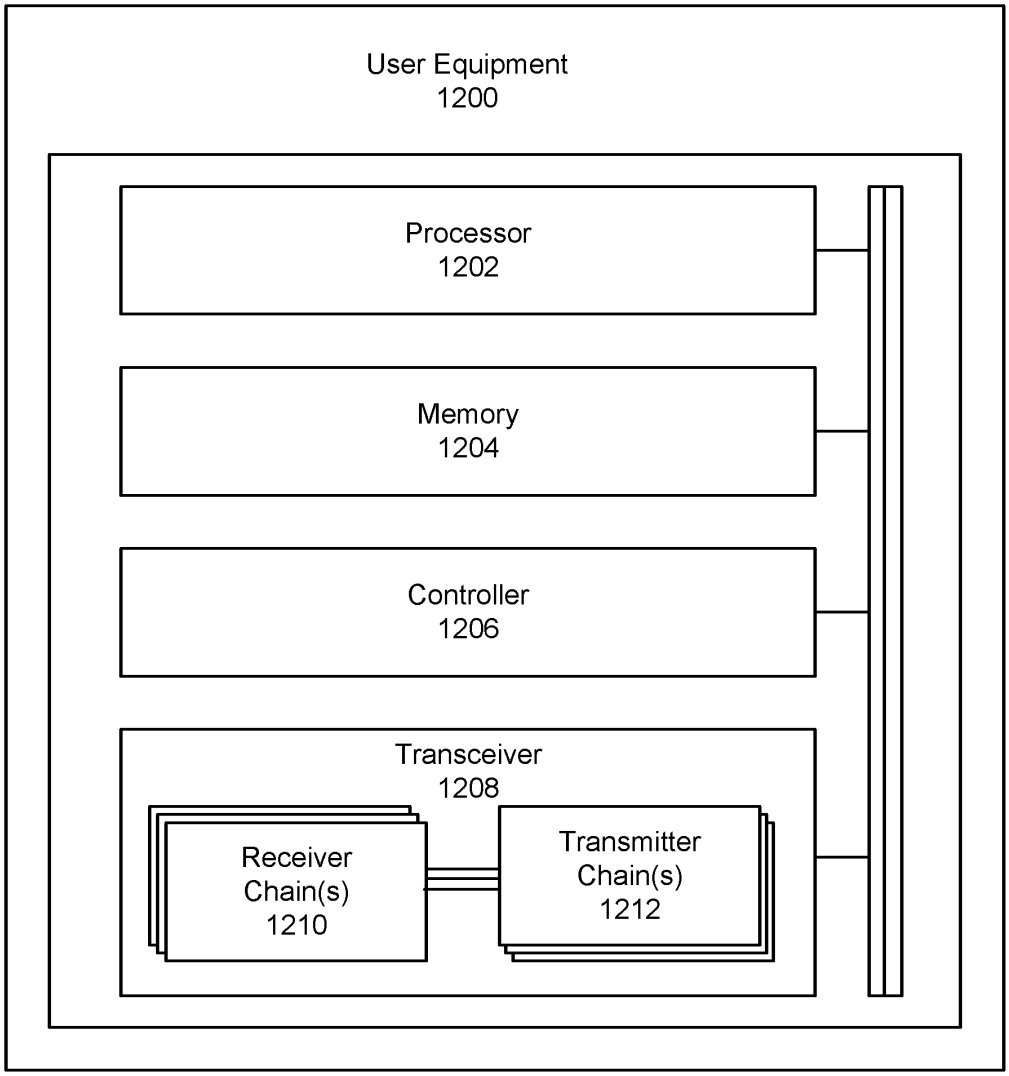

User Equipment
1200
Processor
1202
Memory
1204
Controller
1206
Transceiver
1208
Receiver
Chain(s)
1210
Transmitter
Chain(s)
1212

FIG. 12

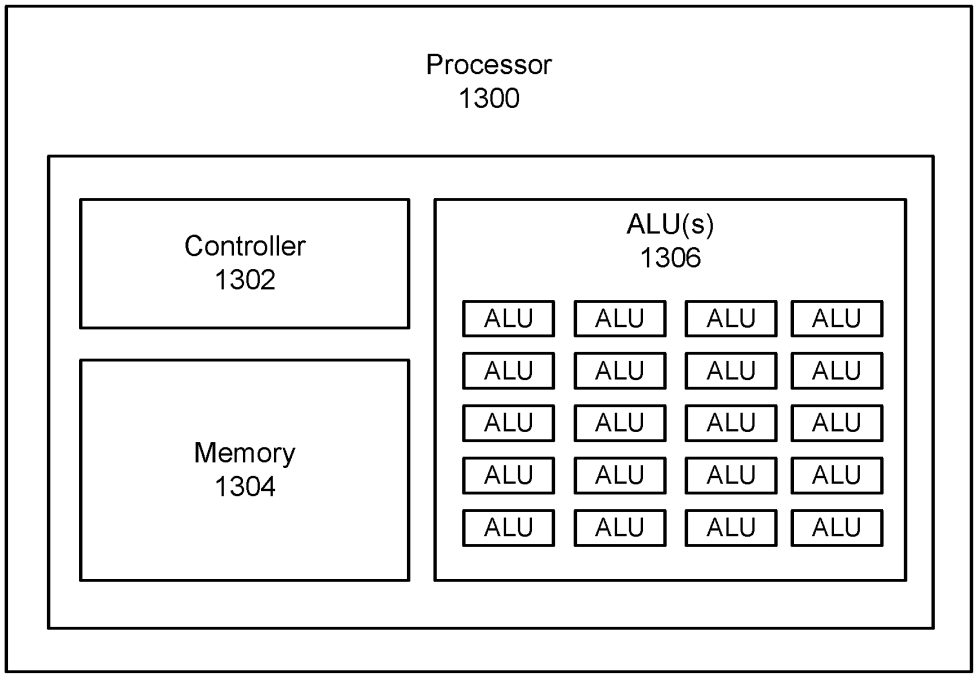

Processor
1300
Controller
1302
Memory
1304
ALU(s)
1306
ALU
ALU
ALU
ALU
ALU
ALU
ALU
ALU
ALU
ALU
ALU
ALU
ALU
ALU
ALU
ALU
ALU
ALU
ALU
ALU

FIG. 13

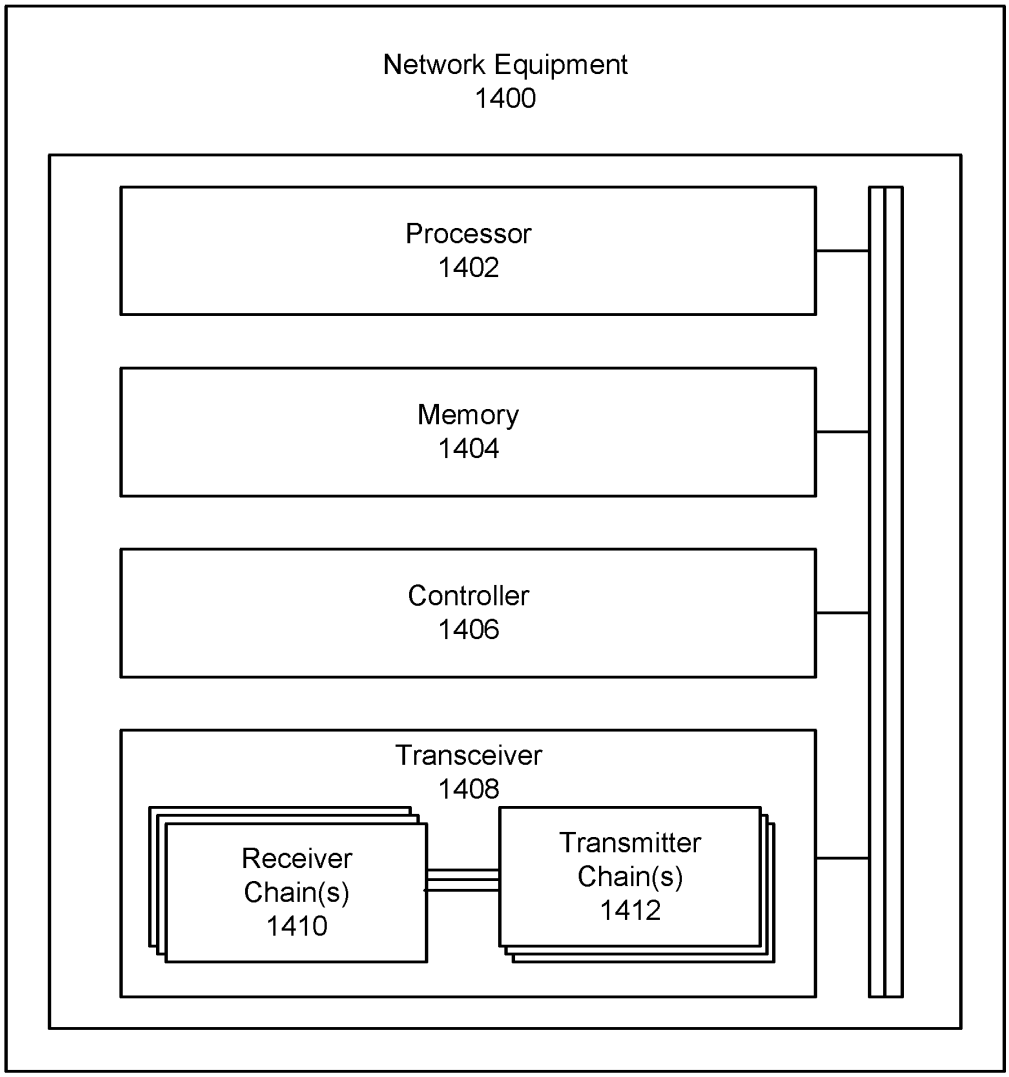

Network Equipment
1400
Processor
1402
Memory
1404
Controller
1406
Transceiver
1408
Receiver
Chain(s)
1410
Transmitter
Chain(s)
1412

FIG. 14

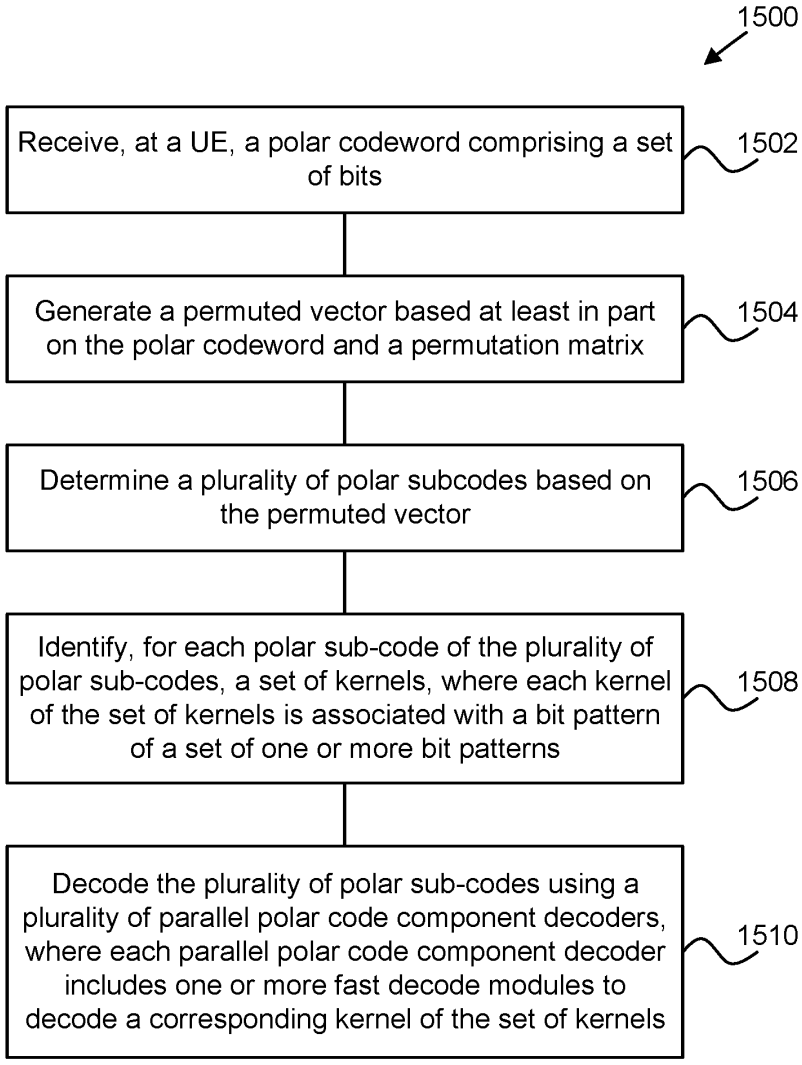

1500
Receive, at a UE, a polar codeword comprising a set of bits
1502
Generate a permuted vector based at least in part on the polar codeword and a permutation matrix
1504
Determine a plurality of polar subcodes based on the permuted vector
1506
Identify, for each polar sub-code of the plurality of polar sub-codes, a set of kernels, where each kernel of the set of kernels is associated with a bit pattern of a set of one or more bit patterns
1508
Decode the plurality of polar sub-codes using a plurality of parallel polar code component decoders, where each parallel polar code component decoder includes one or more fast decode modules to decode a corresponding kernel of the set of kernels
1510

FIG. 15

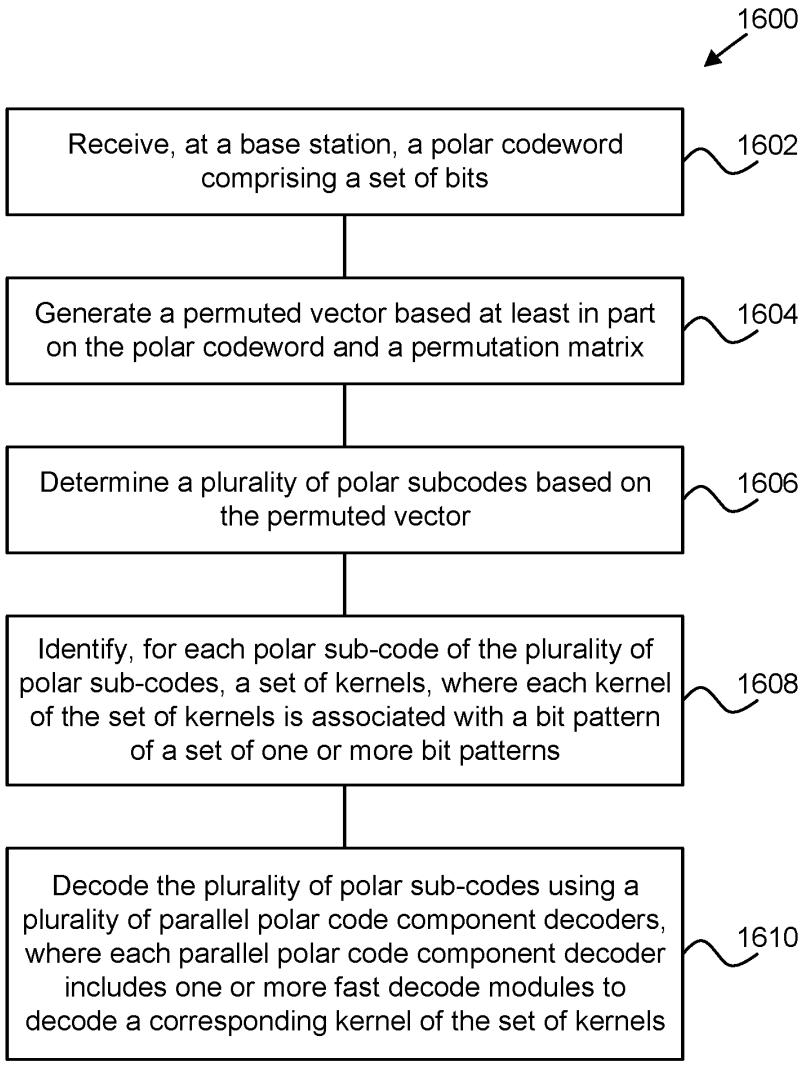

1600
Receive, at a base station, a polar codeword comprising a set of bits
1602
Generate a permuted vector based at least in part on the polar codeword and a permutation matrix
1604
Determine a plurality of polar subcodes based on the permuted vector
1606
Identify, for each polar sub-code of the plurality of polar sub-codes, a set of kernels, where each kernel of the set of kernels is associated with a bit pattern of a set of one or more bit patterns
1608
Decode the plurality of polar sub-codes using a plurality of parallel polar code component decoders, where each parallel polar code component decoder includes one or more fast decode modules to decode a corresponding kernel of the set of kernels
1610

FIG. 16