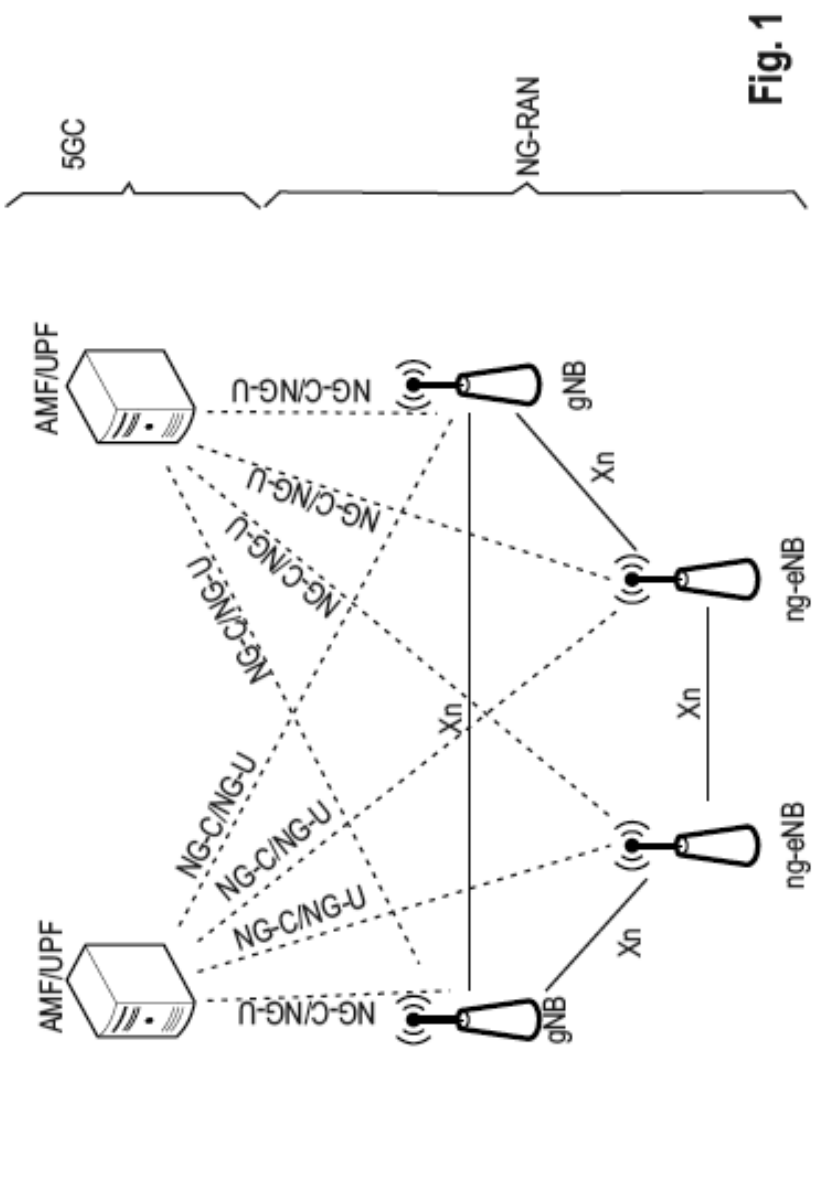

5GC
NG-RAN
AMF/UPF
AMF/UPF
NG-C/NG-U
NG-C/NG-U
NG-C/NG-U
NG-C/NG-U
NG-C/NG-U
NG-C/NG-U
NG-C/NG-U
NG-C/NG-U
gNB
gNB
ng-eNB
ng-eNB
Xn
Xn
Xn
Xn
100

Fig. 1

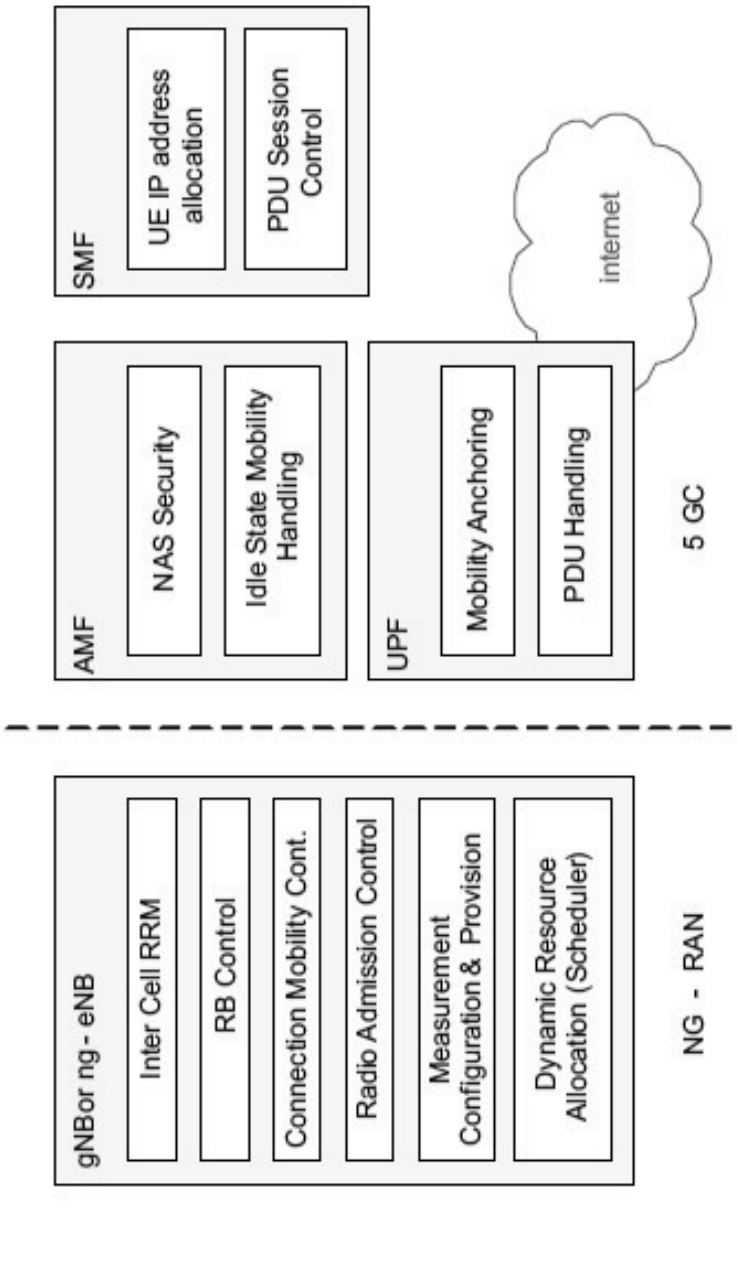

gNBor ng - eNB
Inter Cell RRM
RB Control
Connection Mobility Cont.
Radio Admission Control
Measurement Configuration & Provision
Dynamic Resource Allocation (Scheduler)
NG - RAN
AMF
NAS Security
Idle State Mobility Handling
UPF
Mobility Anchoring
PDU Handling
SMF
UE IP address allocation
PDU Session Control
internet
5 GC
200

Fig. 2

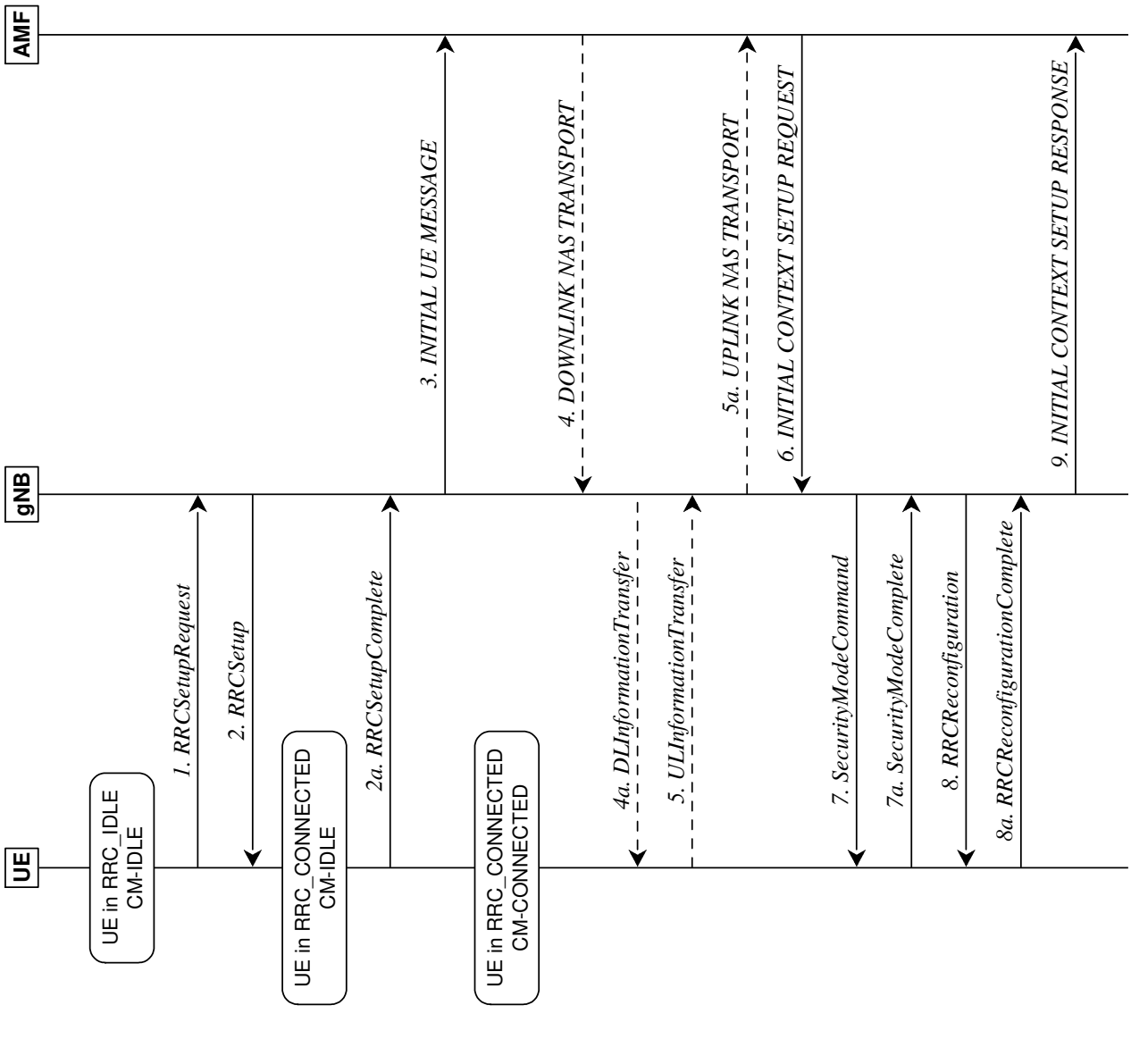

UE
gNB
AMF
UE in RRC_IDLE CM-IDLE
1. RRCSetupRequest
2. RRCSetup
UE in RRC_CONNECTED CM-IDLE
2a. RRCSetupComplete
UE in RRC_CONNECTED CM-CONNECTED
3. INITIAL UE MESSAGE
4. DOWNLINK NAS TRANSPORT
4a. DLInformationTransfer
5. ULInformationTransfer
5a. UPLINK NAS TRANSPORT
6. INITIAL CONTEXT SETUP REQUEST
7. SecurityModeCommand
7a. SecurityModeComplete
8. RRCReconfiguration
8a. RRCReconfigurationComplete
9. INITIAL CONTEXT SETUP RESPONSE
300

Fig. 3

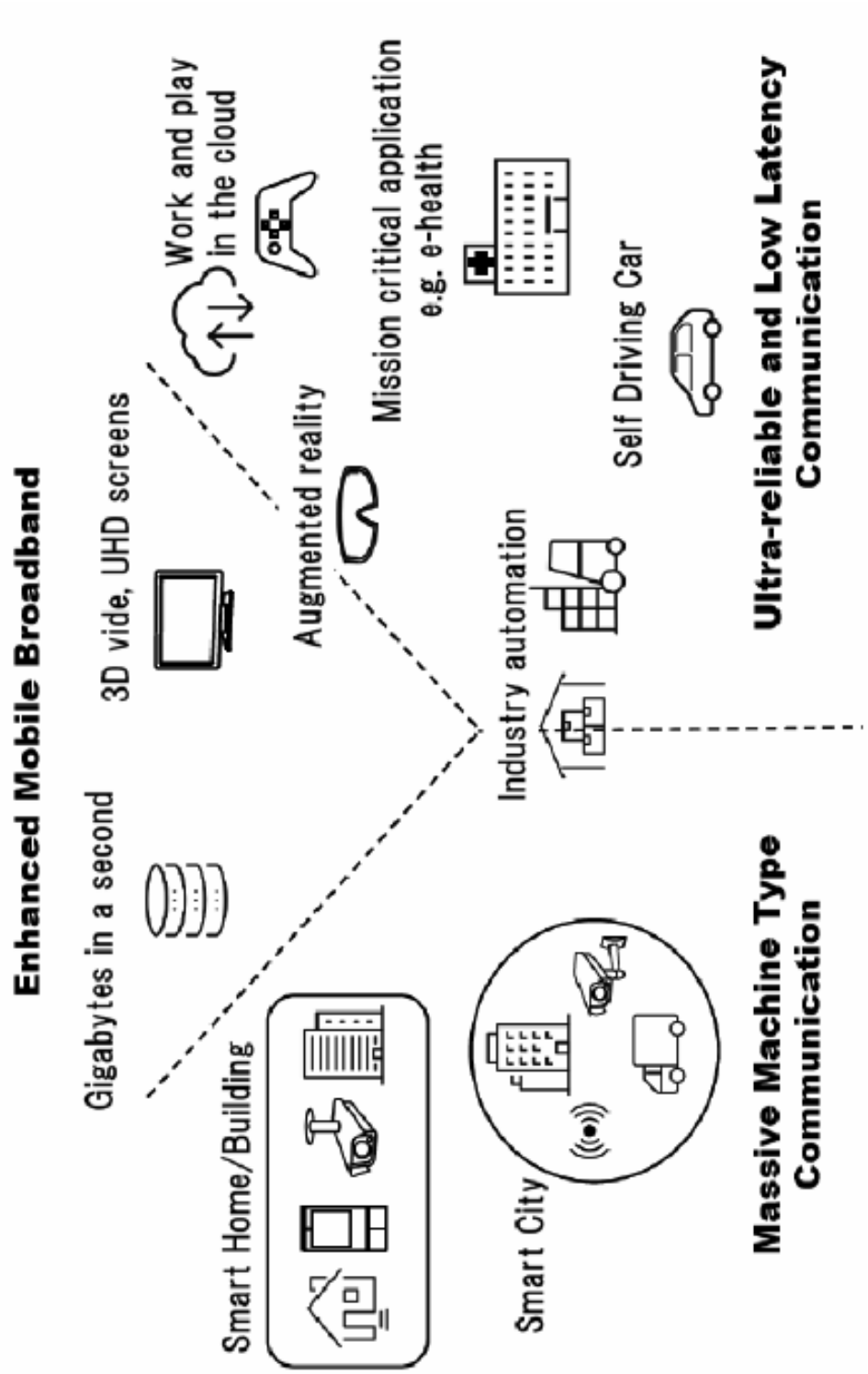

Enhanced Mobile Broadband
Gigabytes in a second
3D vide, UHD screens
Work and play in the cloud
Augmented reality
Mission critical application e.g. e-health
Smart Home/Building
Industry automation
Self Driving Car
Ultra-reliable and Low Latency Communication
Smart City
Massive Machine Type Communication
400

Fig. 4

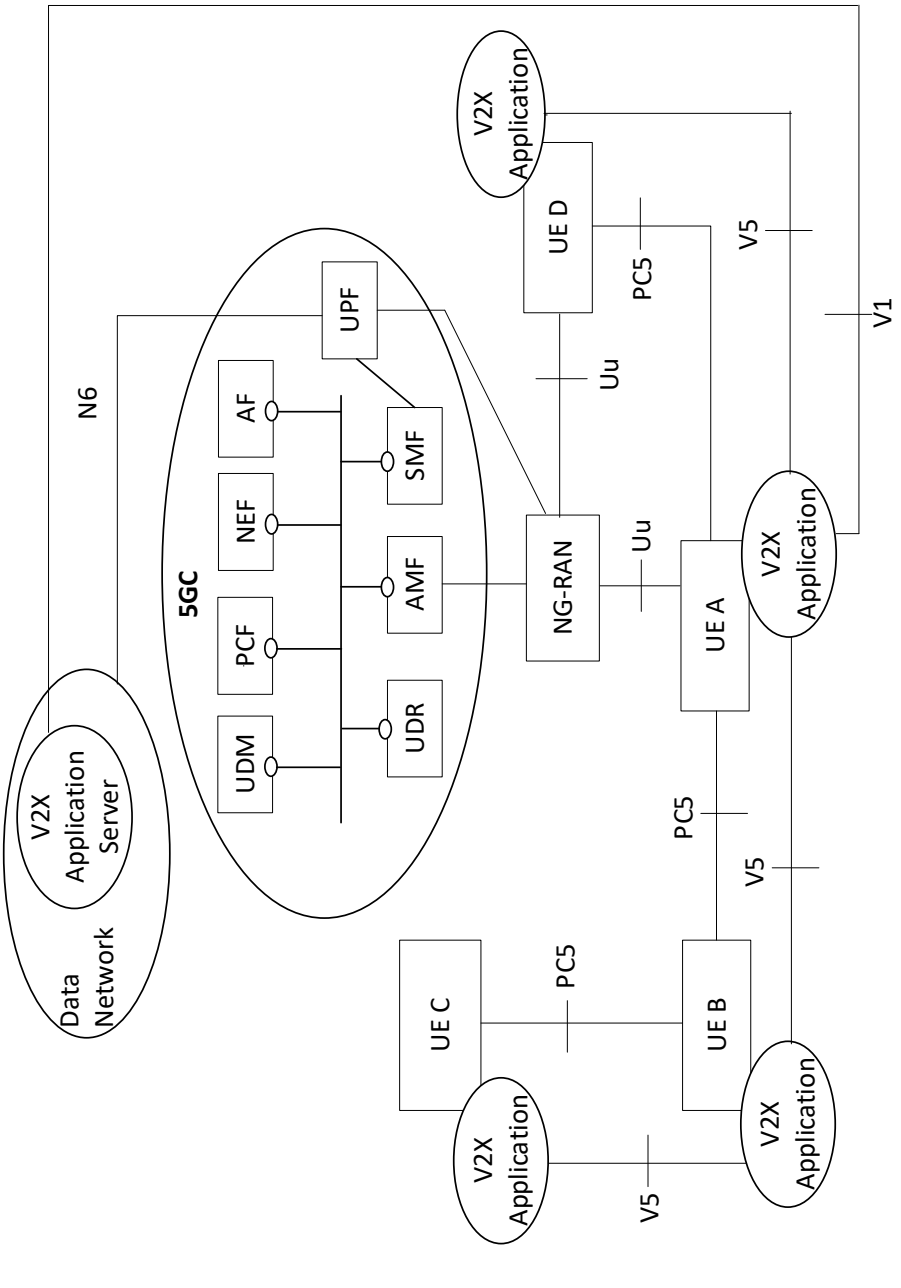

Data Network
V2X Application Server
N6
5GC
UPF
AF
NEF
PCF
UDM
SMF
AMF
UDR
NG-RAN
Uu
Uu
UE D
UE A
UE B
UE C
V2X Application
V2X Application
V2X Application
V2X Application
PC5
PC5
PC5
V5
V5
V5
V1
500

Fig. 5

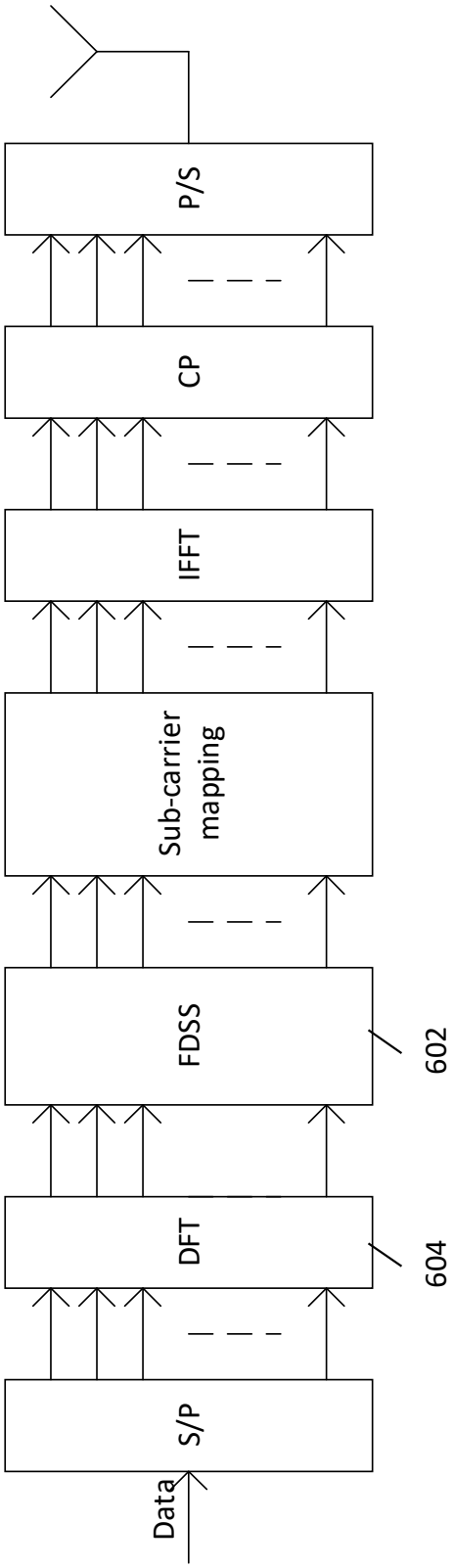


Fig. 6

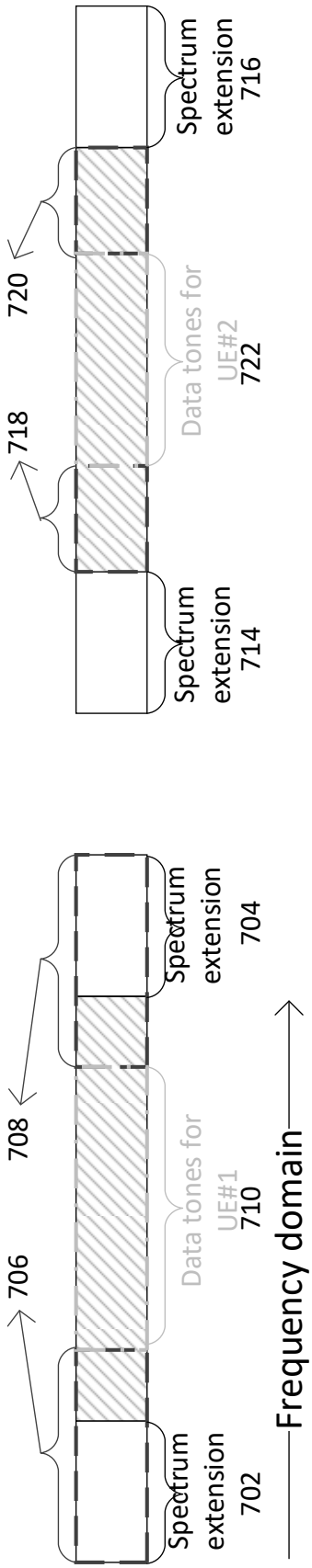

Spectrum extension 716
720
Data tones for UE#2 722
718
Spectrum extension 714
712
Spectrum extension 704
708
Data tones for UE#1 710
706
Spectrum extension 702
Frequency domain
700

Fig. 7

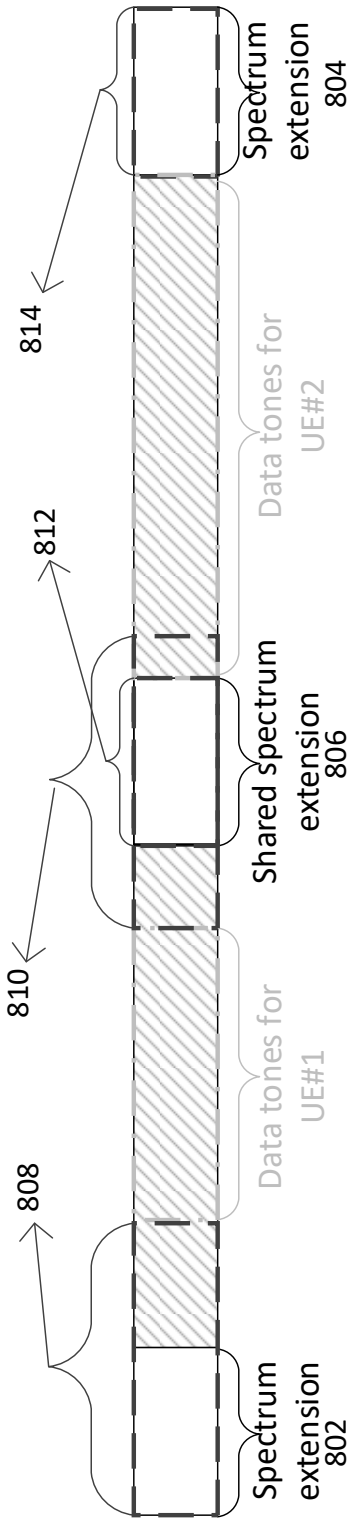

Spectrum extension 804
814
812
Data tones for UE#2
Shared spectrum extension 806
810
Data tones for UE#1
808
Spectrum extension 802
Frequency domain
800

Fig. 8

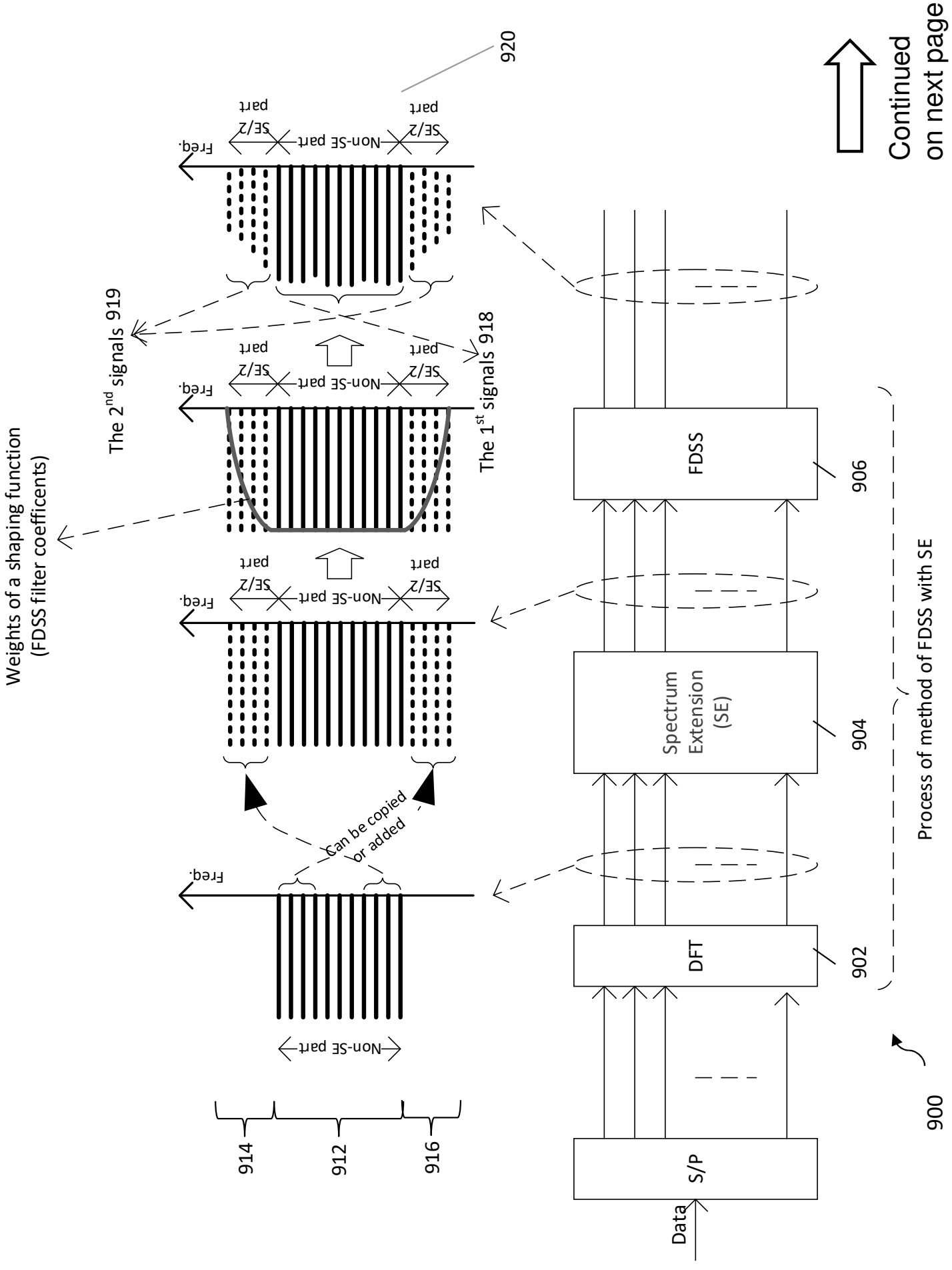

Data
S/P
DFT
902
Spectrum Extension (SE)
904
FDSS
906
900
Process of method of FDSS with SE
Continued on next page
920
Freq.
Non-SE part
SE/2 part
The 1st signals 918
The 2nd signals 919
Weights of a shaping function (FDSS filter coefficents)
Can be copied or added
914
912
916

Fig. 9

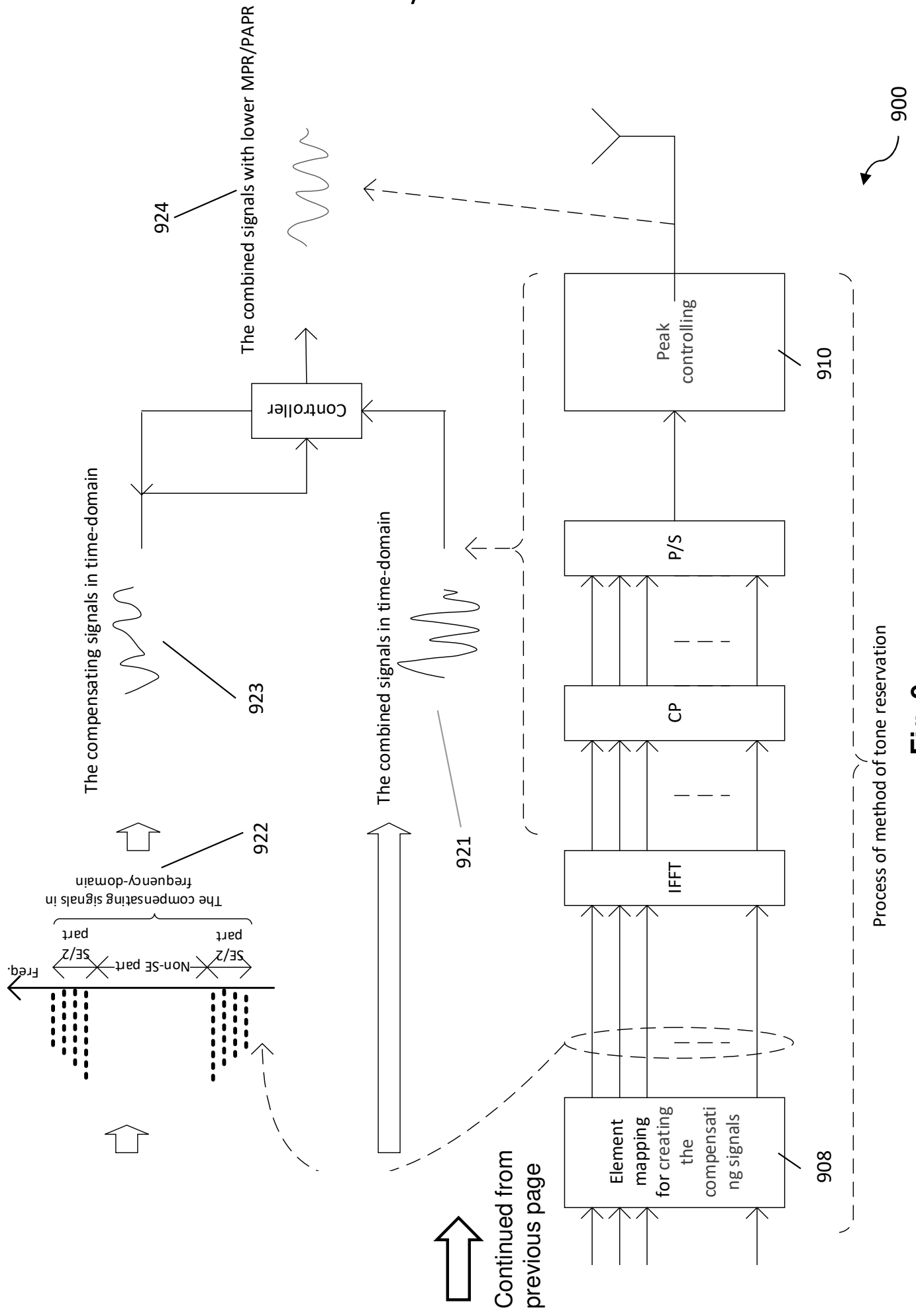

900
924
The combined signals with lower MPR/PAPR
Controller
910
Peak controlling
P/S
CP
IFFT
908
Element mapping for creating the compensating signals
Process of method of tone reservation
Continued from previous page
The compensating signals in time-domain
923
The combined signals in time-domain
921
922
The compensating signals in frequency-domain
SE/2 part
Non-SE part
SE/2 part
Freq.

Fig. 9

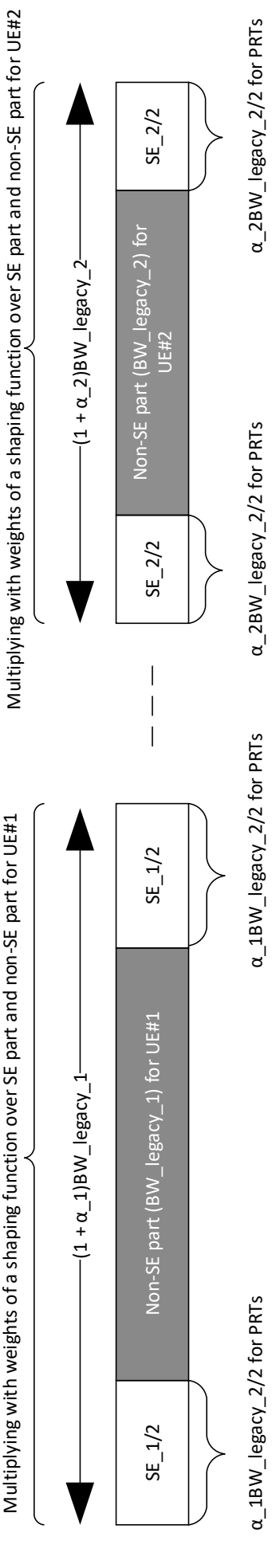

Multiplying with weights of a shaping function over SE part and non-SE part for UE#1
(1 + α_1)BW_legacy_1
SE_1/2
Non-SE part (BW_legacy_1) for UE#1
SE_1/2
α_1BW_legacy_2/2 for PRTs
α_1BW_legacy_2/2 for PRTs
Frequency domain
1000
Multiplying with weights of a shaping function over SE part and non-SE part for UE#2
(1 + α_2)BW_legacy_2
SE_2/2
Non-SE part (BW_legacy_2) for UE#2
SE_2/2
α_2BW_legacy_2/2 for PRTs
α_2BW_legacy_2/2 for PRTs
1002

Fig. 10

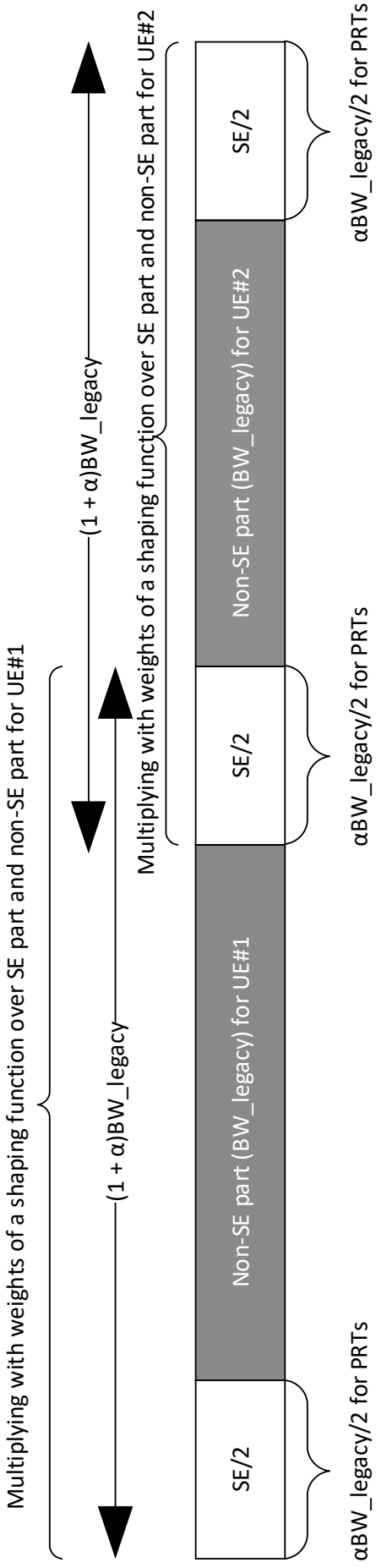

Multiplying with weights of a shaping function over SE part and non-SE part for UE#1
(1 + α)BW_legacy
Multiplying with weights of a shaping function over SE part and non-SE part for UE#2
(1 + α)BW_legacy
SE/2
Non-SE part (BW_legacy) for UE#1
SE/2
Non-SE part (BW_legacy) for UE#2
SE/2
αBW_legacy/2 for PRTs
αBW_legacy/2 for PRTs
αBW_legacy/2 for PRTs
1102
Frequency domain
1100

Fig. 11

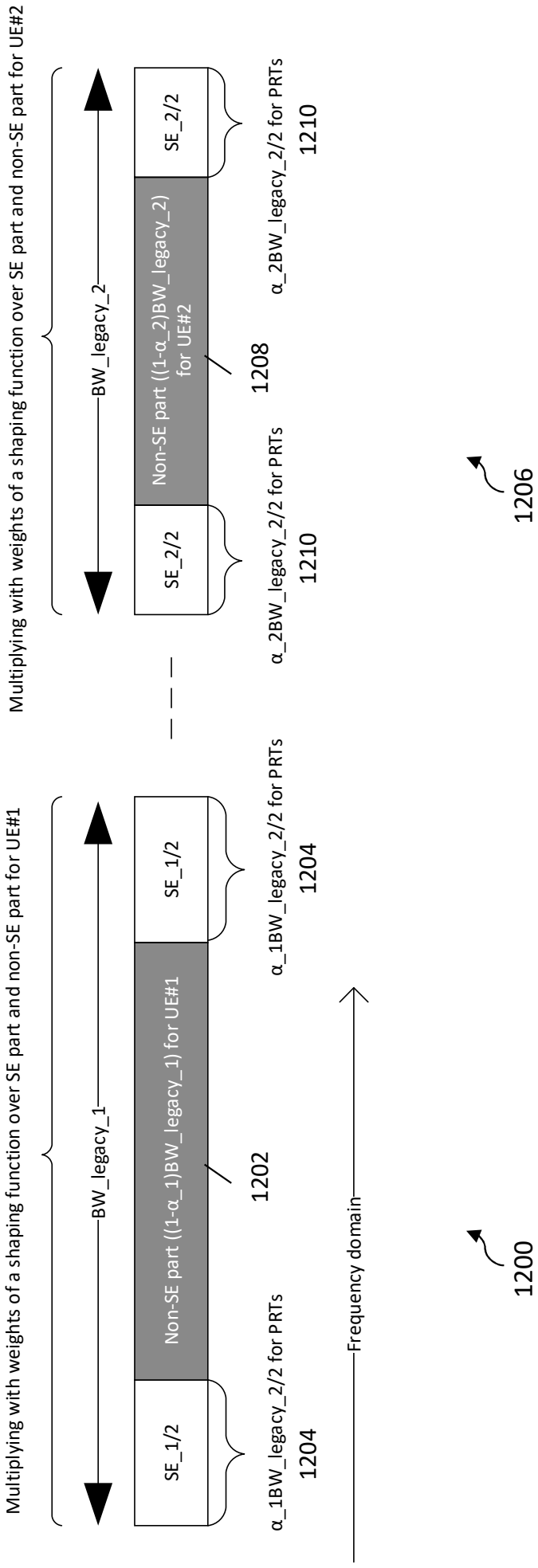

Multiplying with weights of a shaping function over SE part and non-SE part for UE#1
BW_legacy_1
SE_1/2
Non-SE part ((1-α_1)BW_legacy_1) for UE#1
SE_1/2
α_1BW_legacy_2/2 for PRTs
1204
1202
α_1BW_legacy_2/2 for PRTs
1204
Frequency domain
1200
Multiplying with weights of a shaping function over SE part and non-SE part for UE#2
BW_legacy_2
SE_2/2
Non-SE part ((1-α_2)BW_legacy_2) for UE#2
SE_2/2
α_2BW_legacy_2/2 for PRTs
1210
1208
α_2BW_legacy_2/2 for PRTs
1210
1206

Fig. 12

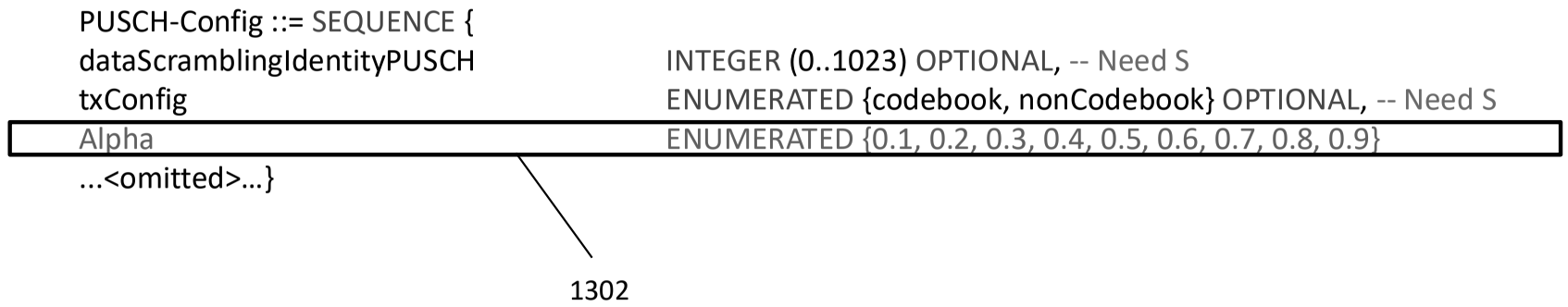

PUSCH-Config ::= SEQUENCE {
dataScramblingIdentityPUSCH INTEGER (0..1023) OPTIONAL, -- Need S
txConfig ENUMERATED {codebook, nonCodebook} OPTIONAL, -- Need S
Alpha ENUMERATED {0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9}
...<omitted>…}
1302
1300

Fig. 13

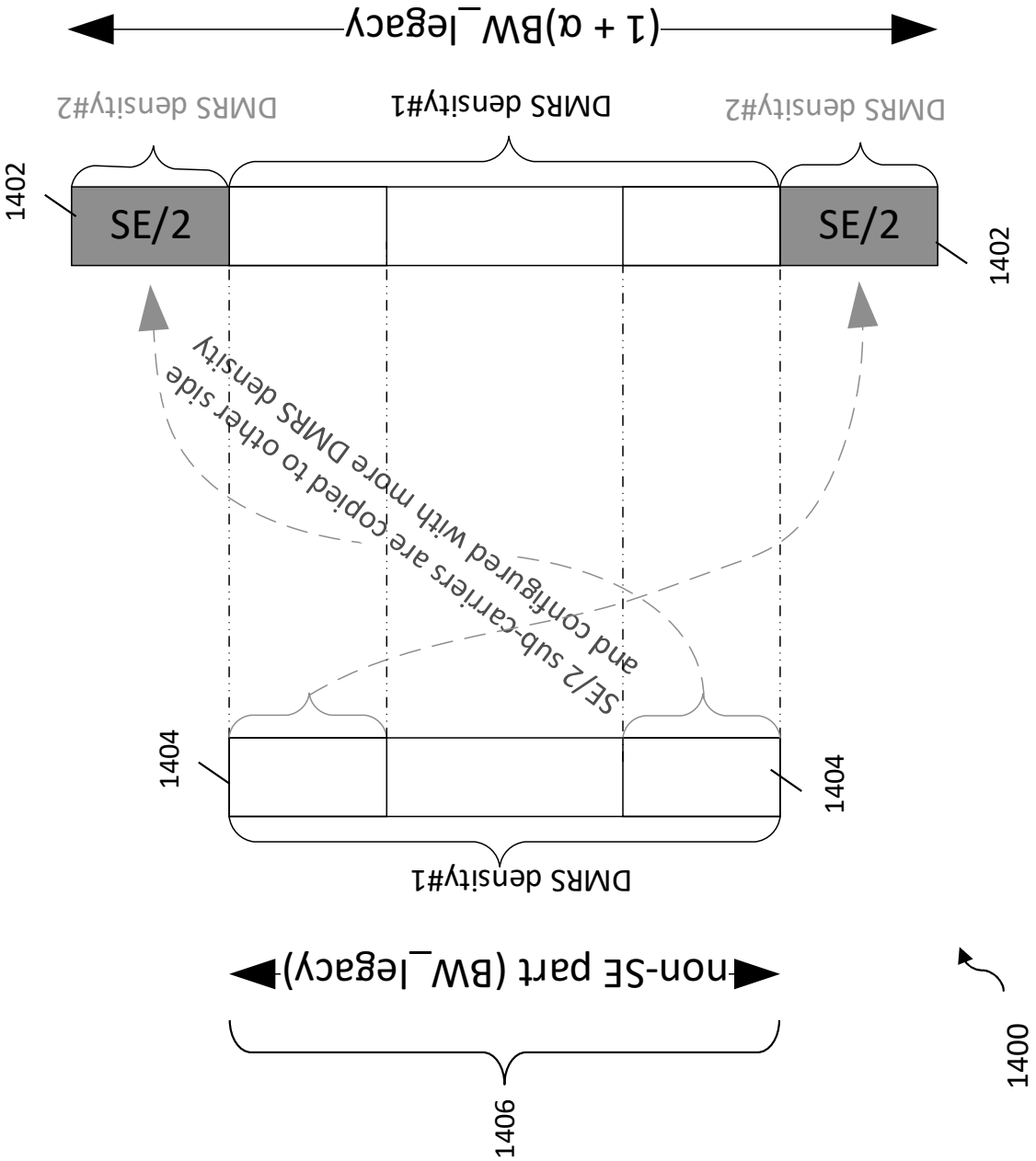

(1 + α)BW_legacy
DMRS density#2
DMRS density#1
DMRS density#2
1402
SE/2
SE/2
1402
SE/2 sub-carriers are copied to other side
and configured with more DMRS density
1404
1404
DMRS density#1
non-SE part (BW_legacy)
1406
1400

Fig. 14A

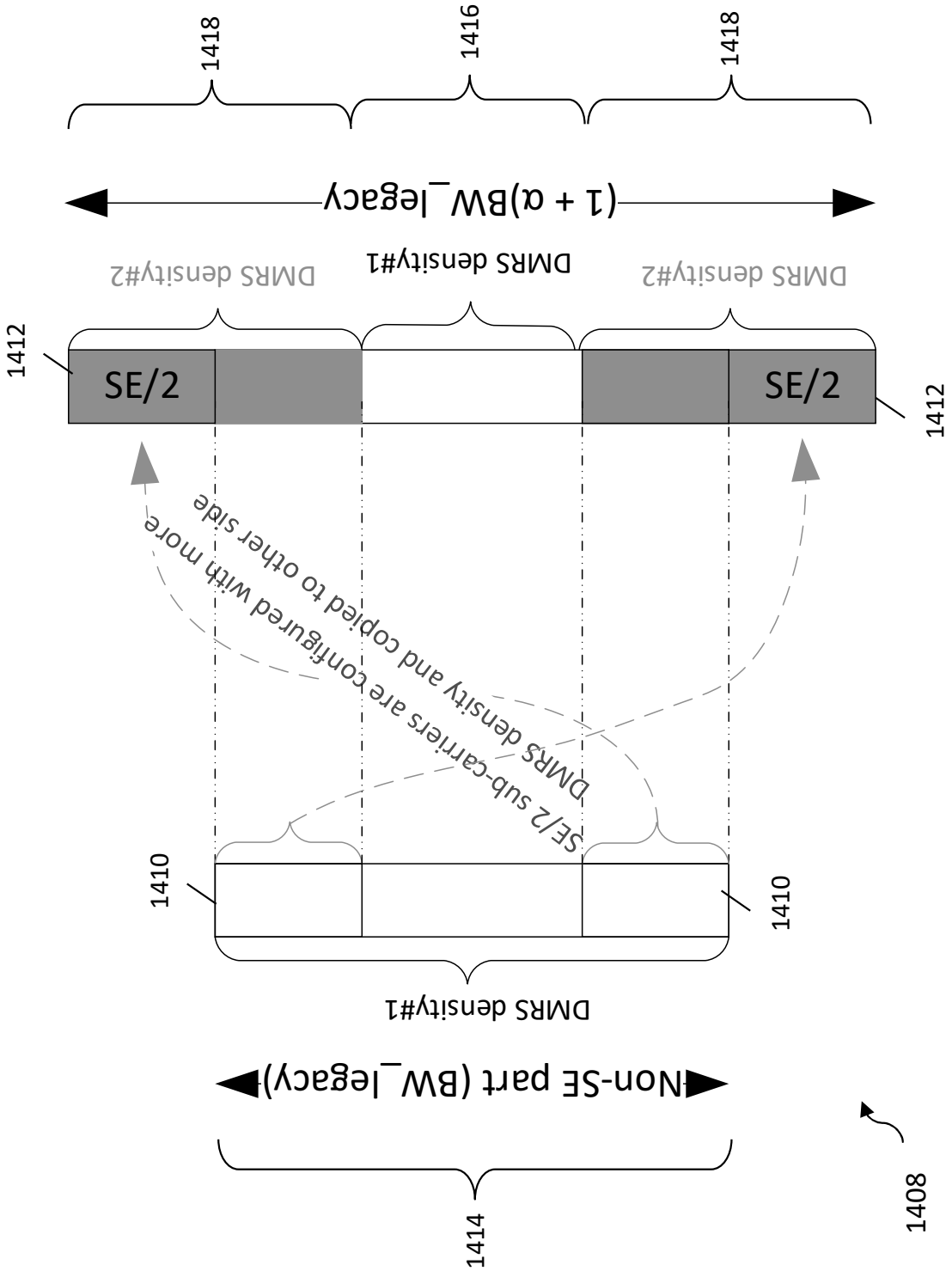

1418
1416
1418
(1 + α)BW_legacy
DMRS density#1
DMRS density#2
DMRS density#2
1412
SE/2
SE/2
1412
SE/2 sub-carriers are configured with more DMRS density and copied to other side
1410
1410
DMRS density#1
Non-SE part (BW_legacy)
1414
1408

Fig. 14B

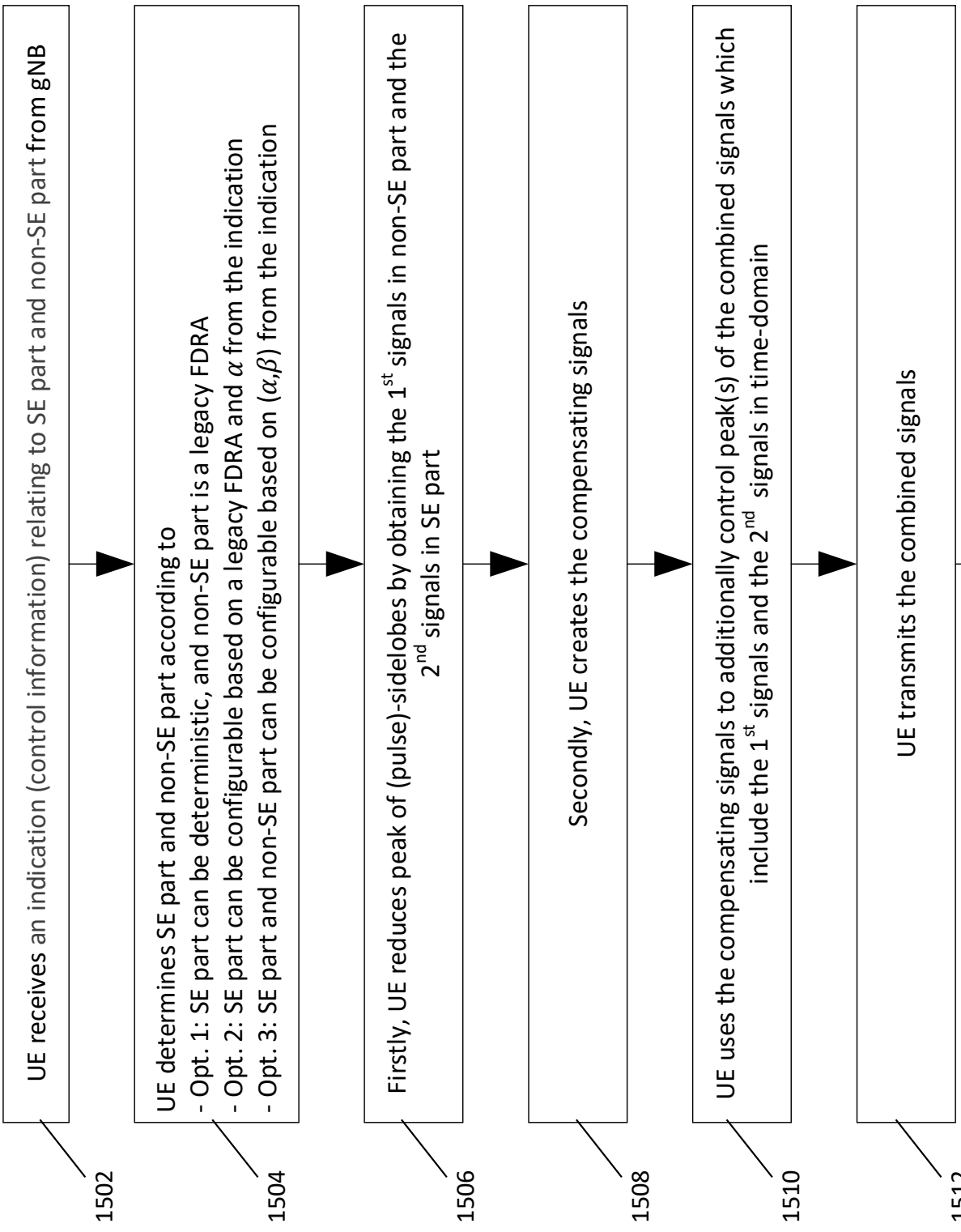

UE receives an indication (control information) relating to SE part and non-SE part from gNB
1502
UE determines SE part and non-SE part according to
- Opt. 1: SE part can be deterministic, and non-SE part is a legacy FDRA
- Opt. 2: SE part can be configurable based on a legacy FDRA and α from the indication
- Opt. 3: SE part and non-SE part can be configurable based on (α,β) from the indication
1504
Firstly, UE reduces peak of (pulse)-sidelobes by obtaining the 1st signals in non-SE part and the 2nd signals in SE part
1506
Secondly, UE creates the compensating signals
1508
UE uses the compensating signals to additionally control peak(s) of the combined signals which include the 1st signals and the 2nd signals in time-domain
1510
UE transmits the combined signals
1512
1500

Fig. 15

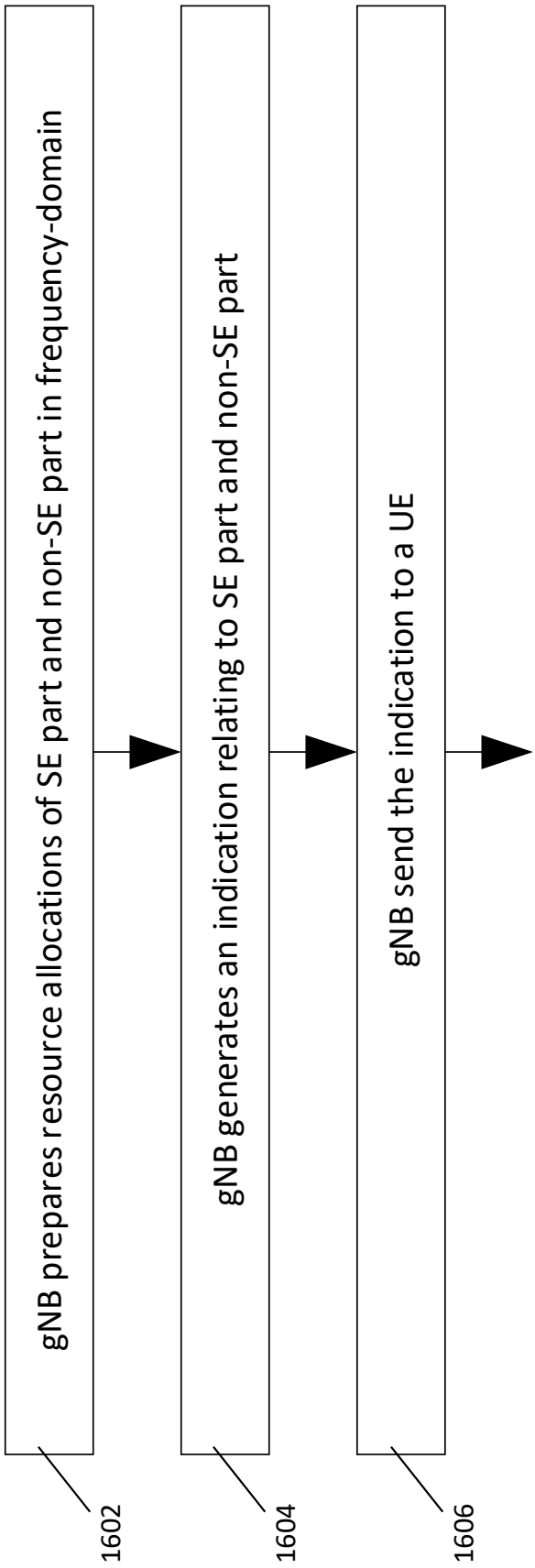

gNB prepares resource allocations of SE part and non-SE part in frequency-domain
gNB generates an indication relating to SE part and non-SE part
gNB send the indication to a UE
1602
1604
1606
1600

Fig. 16

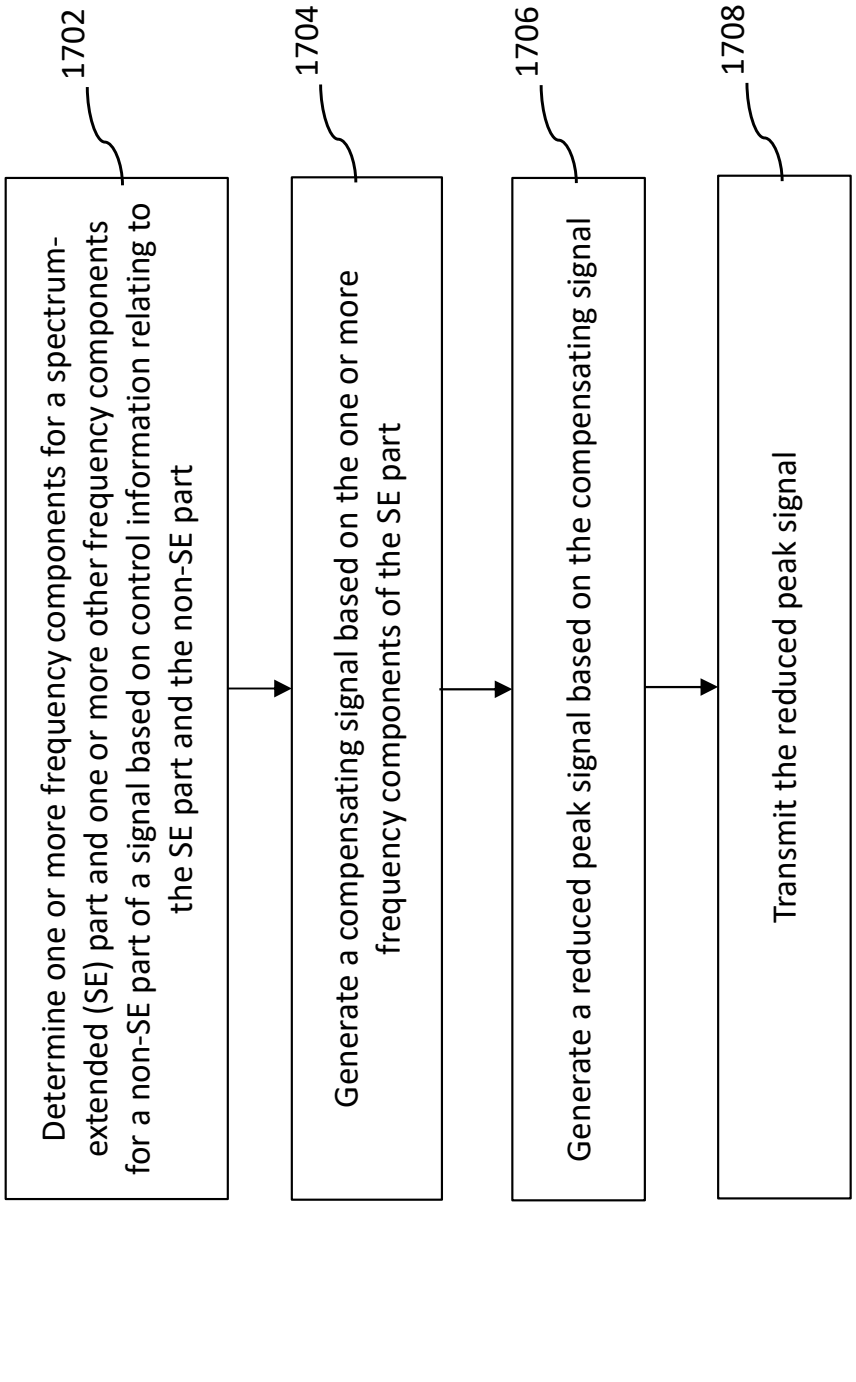

1702
Determine one or more frequency components for a spectrum-extended (SE) part and one or more other frequency components for a non-SE part of a signal based on control information relating to the SE part and the non-SE part
1704
Generate a compensating signal based on the one or more frequency components of the SE part
1706
Generate a reduced peak signal based on the compensating signal
1708
Transmit the reduced peak signal
1700

Fig. 17

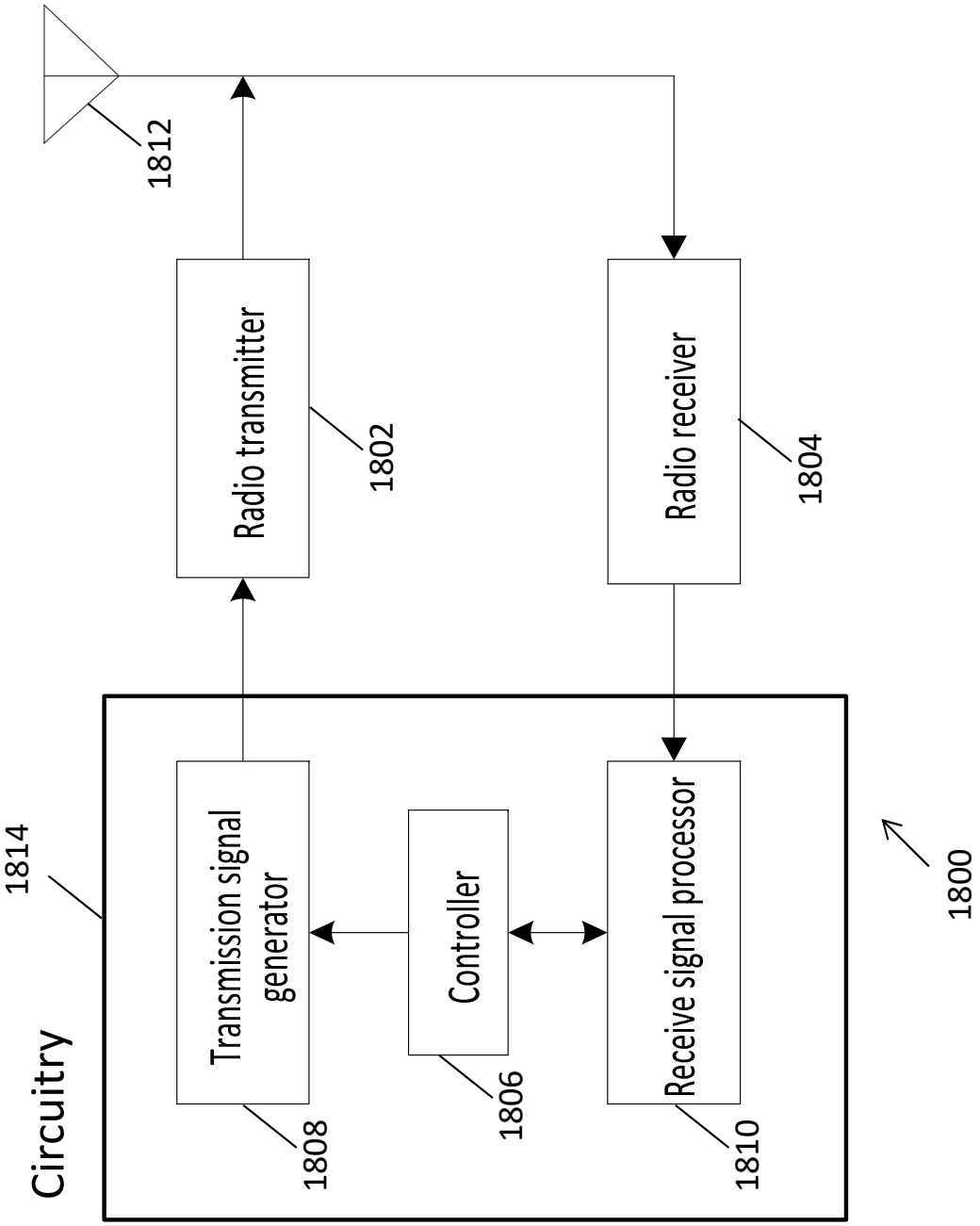

1812
Radio transmitter
1802
Radio receiver
1804
1814
Circuitry
Transmission signal generator
1808
Controller
1806
Receive signal processor
1810
1800

Fig. 18