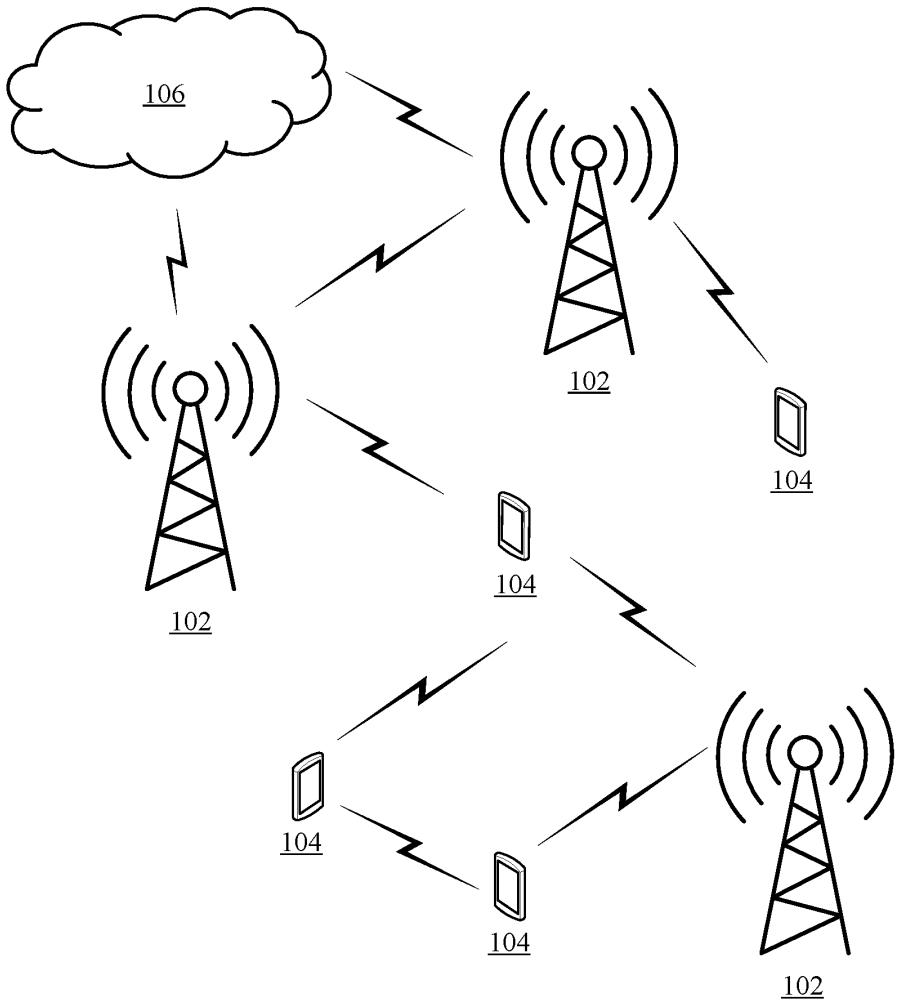

Figure 1

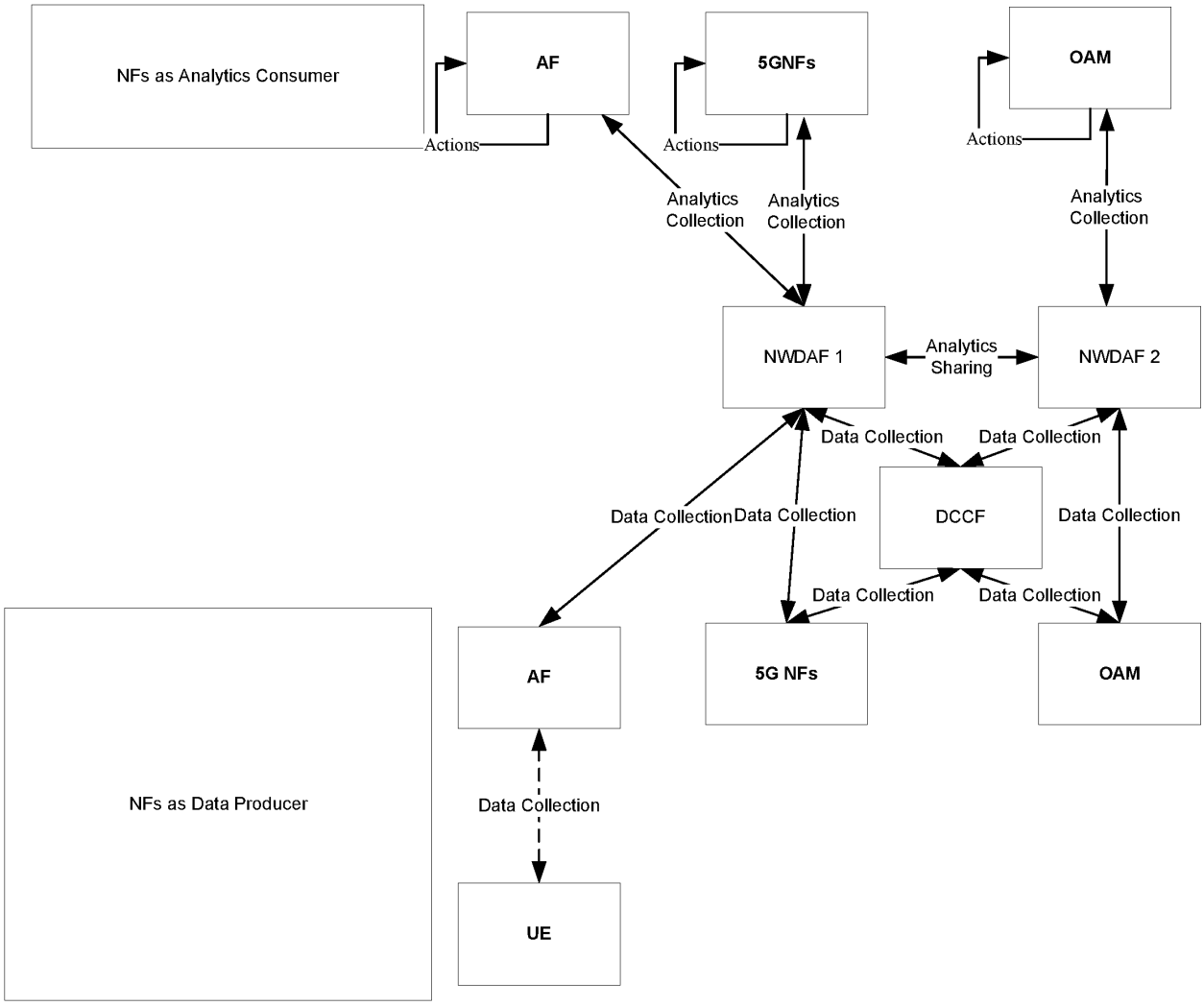
NFs as Analytics Consumer
AF
5GNFs
OAM
Actions
Actions
Actions
Analytics Collection
Analytics Collection
Analytics Collection
NWDAF 1
Analytics Sharing
NWDAF 2
Data Collection
Data Collection
Data Collection
Data Collection
DCCF
Data Collection
Data Collection
Data Collection
NFs as Data Producer
AF
5G NFs
OAM
Data Collection
UE

Figure 2

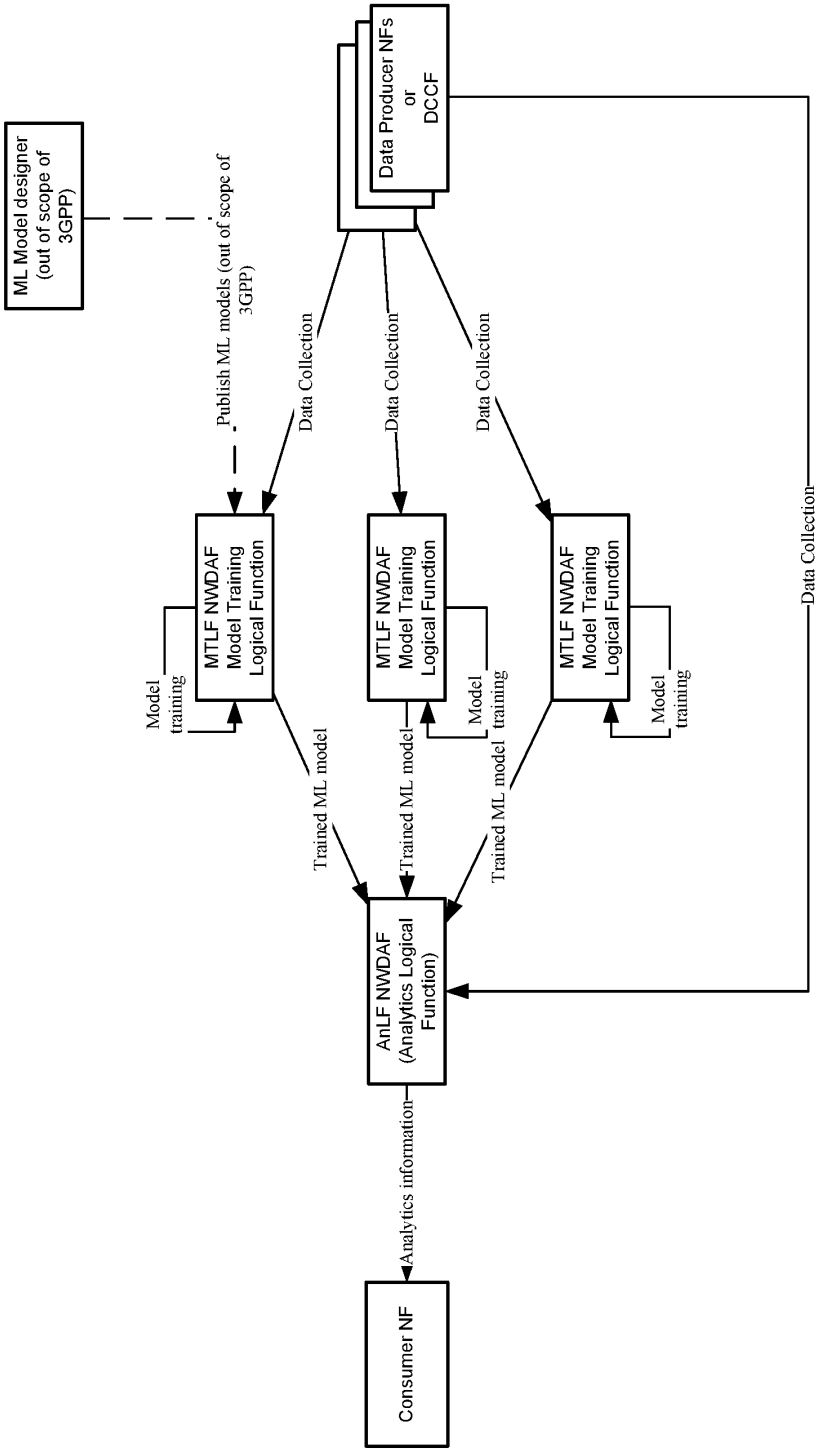
ML Model designer (out of scope of 3GPP)
Publish ML models (out of scope of 3GPP)
Data Producer NFs or DCCF
Data Collection
Data Collection
Data Collection
Data Collection
MTLF NWDAF Model Training Logical Function
MTLF NWDAF Model Training Logical Function
MTLF NWDAF Model Training Logical Function
Model training
Model training
Model training
Trained ML model
Trained ML model
Trained ML model
AnLF NWDAF (Analytics Logical Function)
Analytics information
Consumer NF

Figure 3

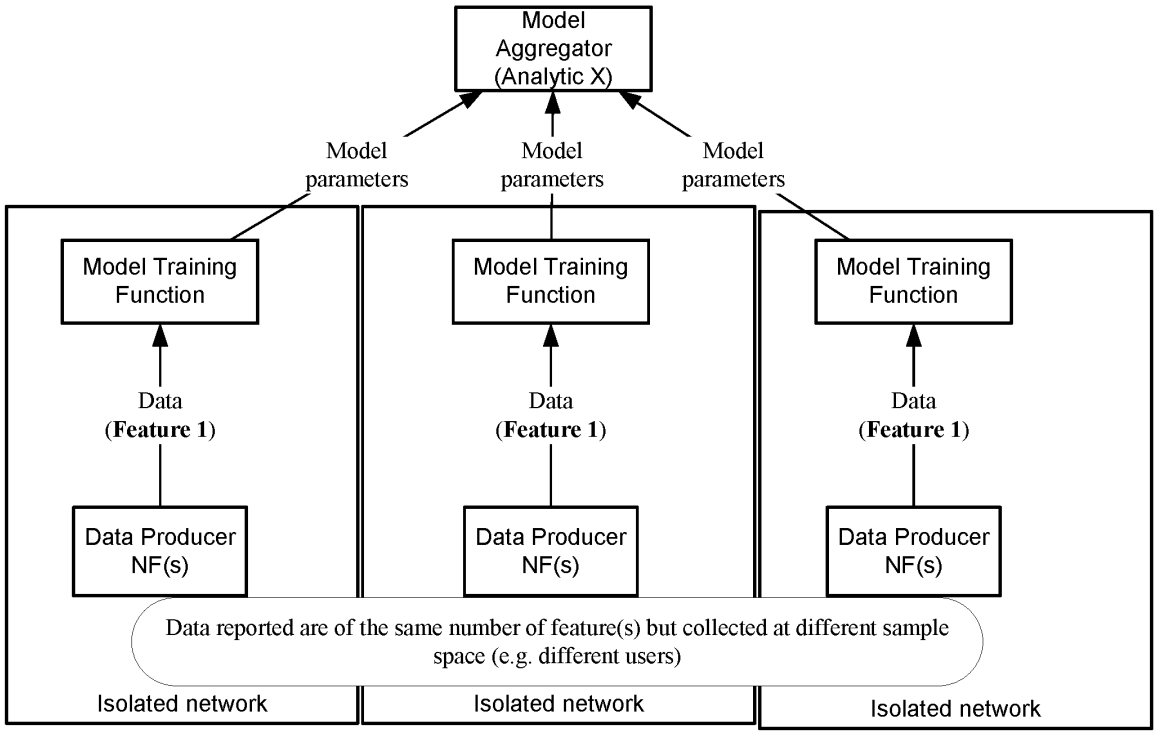

Figure 4A

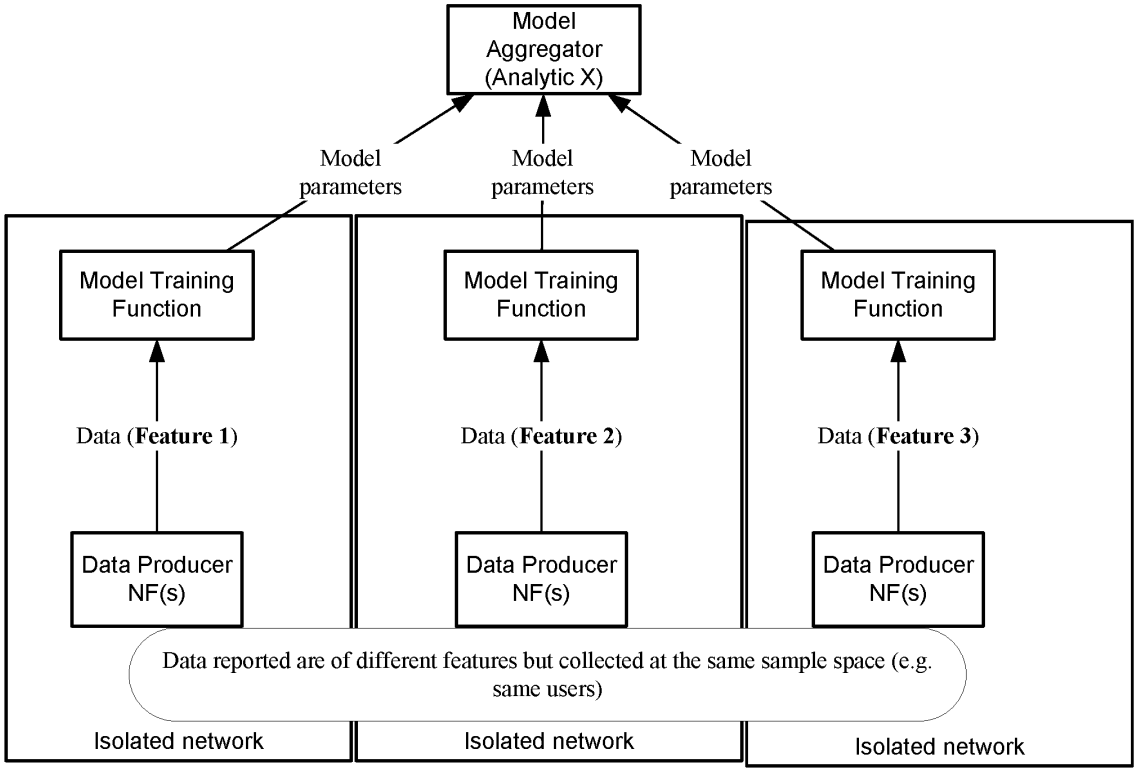

Figure 4B

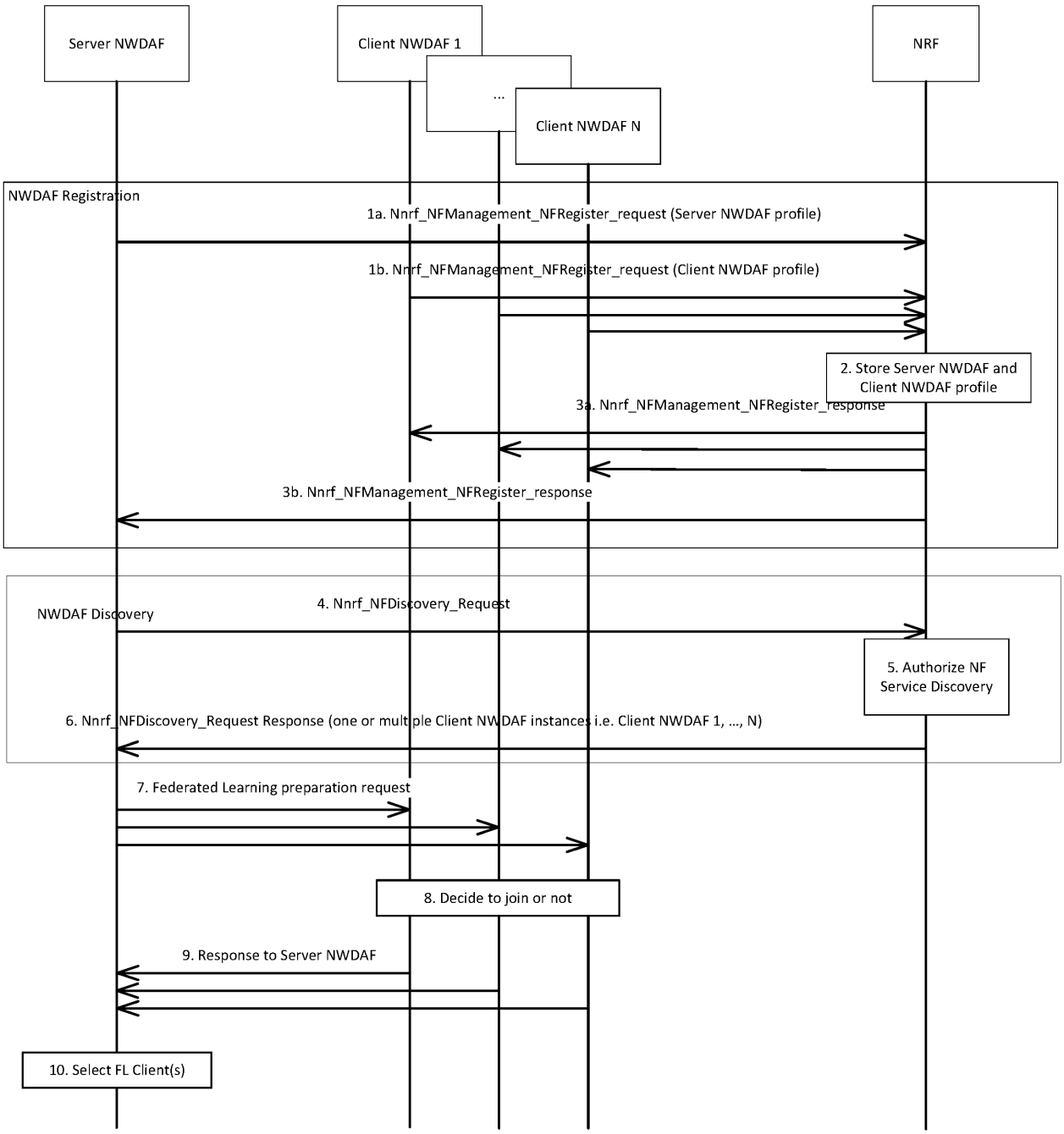
Server NWDAF
Client NWDAF 1
...
Client NWDAF N
NRF
NWDAF Registration
1a. Nnrf_NFManagement_NFRegister_request (Server NWDAF profile)
1b. Nnrf_NFManagement_NFRegister_request (Client NWDAF profile)
2. Store Server NWDAF and Client NWDAF profile
3a. Nnrf_NFManagement_NFRegister_response
3b. Nnrf_NFManagement_NFRegister_response
NWDAF Discovery
4. Nnrf_NFDiscovery_Request
5. Authorize NF Service Discovery
6. Nnrf_NFDiscovery_Request Response (one or multiple Client NWDAF instances i.e. Client NWDAF 1, ..., N)
7. Federated Learning preparation request
8. Decide to join or not
9. Response to Server NWDAF
10. Select FL Client(s)

Figure 5A

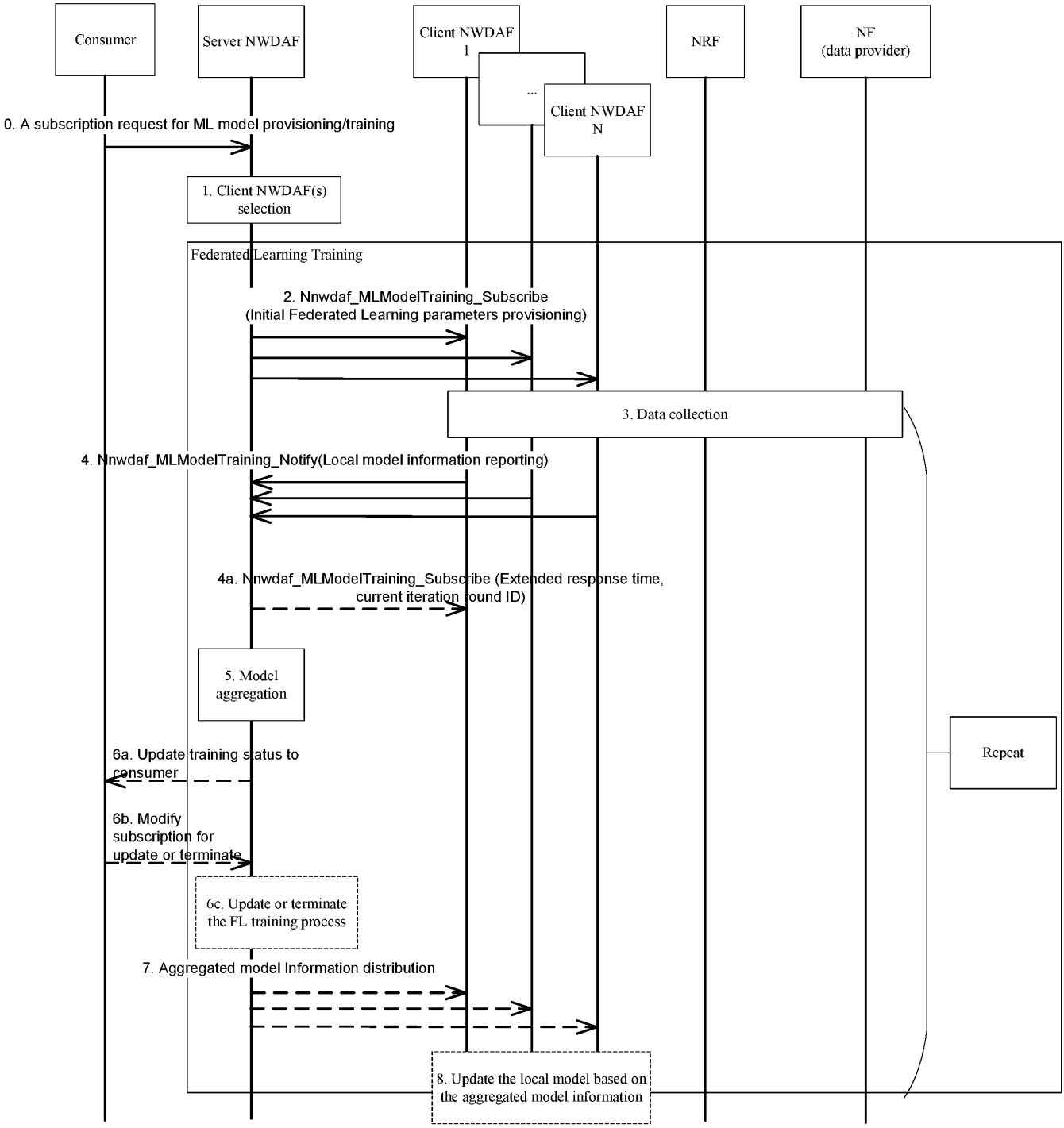
Consumer
Server NWDAF
Client NWDAF 1
...
Client NWDAF N
NRF
NF (data provider)
0. A subscription request for ML model provisioning/training
1. Client NWDAF(s) selection
Federated Learning Training
2. Nnwdaf_MLModelTraining_Subscribe (Initial Federated Learning parameters provisioning)
3. Data collection
4. Nnwdaf_MLModelTraining_Notify(Local model information reporting)
4a. Nnwdaf_MLModelTraining_Subscribe (Extended response time, current iteration round ID)
5. Model aggregation
Repeat
6a. Update training status to consumer
6b. Modify subscription for update or terminate
6c. Update or terminate the FL training process
7. Aggregated model Information distribution
8. Update the local model based on the aggregated model information

Figure 5B

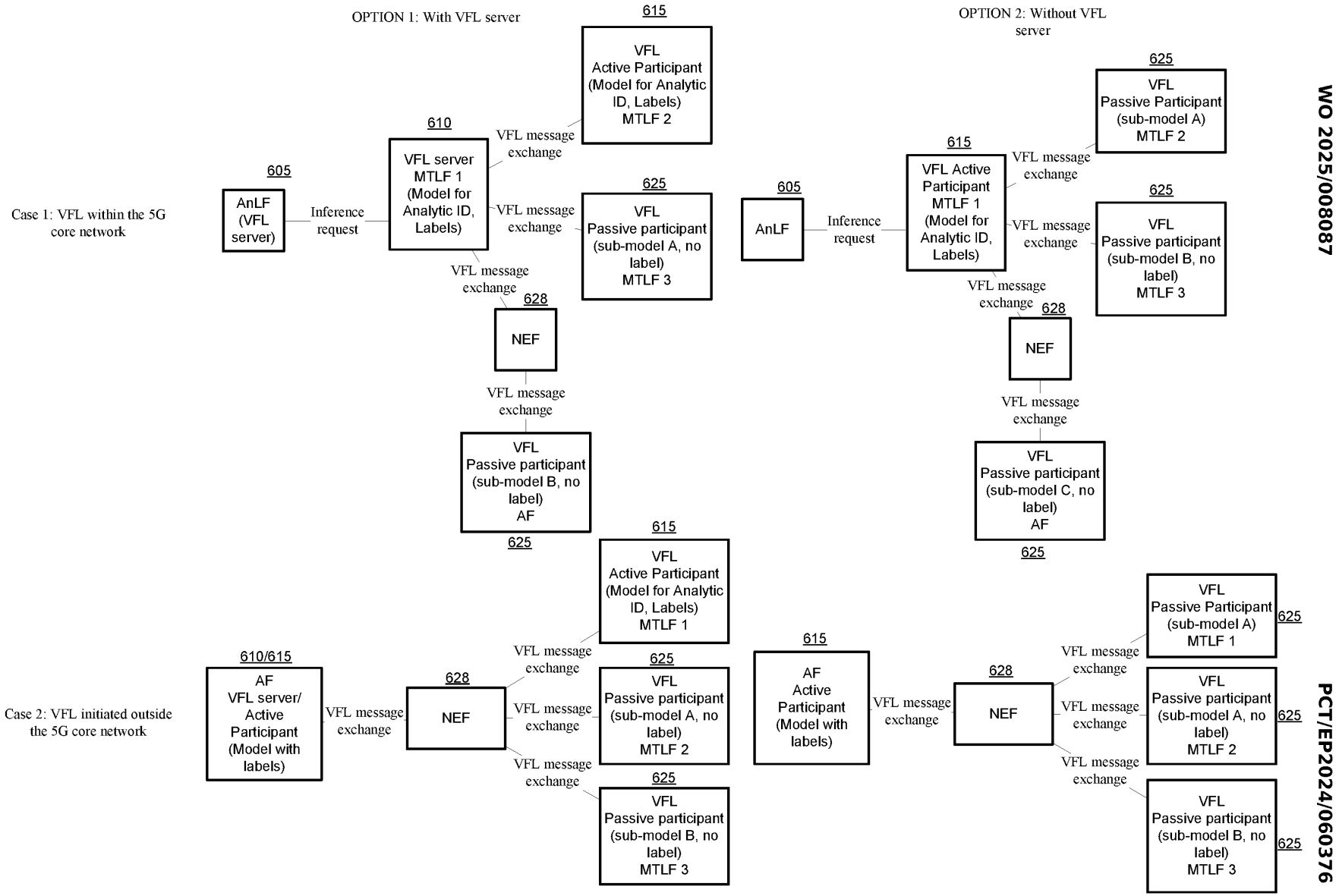

Figure 6

WO 2025/008087
PCT/EP2024/060376

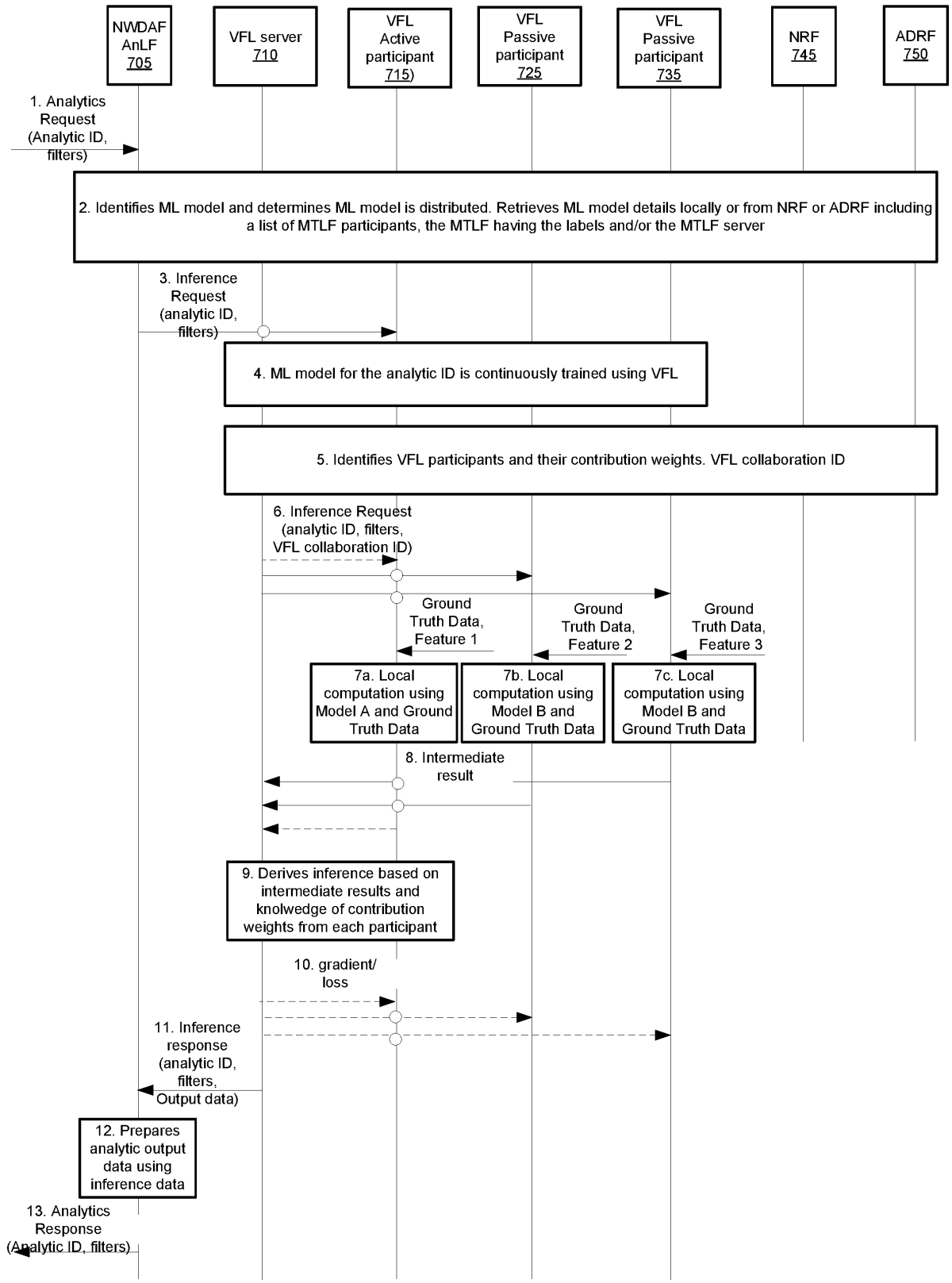
NWDAF AnLF 705
VFL server 710
VFL Active participant 715)
VFL Passive participant 725
VFL Passive participant 735
NRF 745
ADRF 750
1. Analytics Request (Analytic ID, filters)
2. Identifies ML model and determines ML model is distributed. Retrieves ML model details locally or from NRF or ADRF including a list of MTLF participants, the MTLF having the labels and/or the MTLF server
3. Inference Request (analytic ID, filters)
4. ML model for the analytic ID is continuously trained using VFL
5. Identifies VFL participants and their contribution weights. VFL collaboration ID
6. Inference Request (analytic ID, filters, VFL collaboration ID)
Ground Truth Data, Feature 1
Ground Truth Data, Feature 2
Ground Truth Data, Feature 3
7a. Local computation using Model A and Ground Truth Data
7b. Local computation using Model B and Ground Truth Data
7c. Local computation using Model B and Ground Truth Data
8. Intermediate result
9. Derives inference based on intermediate results and knolwedge of contribution weights from each participant
10. gradient/ loss
11. Inference response (analytic ID, filters, Output data)
12. Prepares analytic output data using inference data
13. Analytics Response (Analytic ID, filters)

Figure 7A

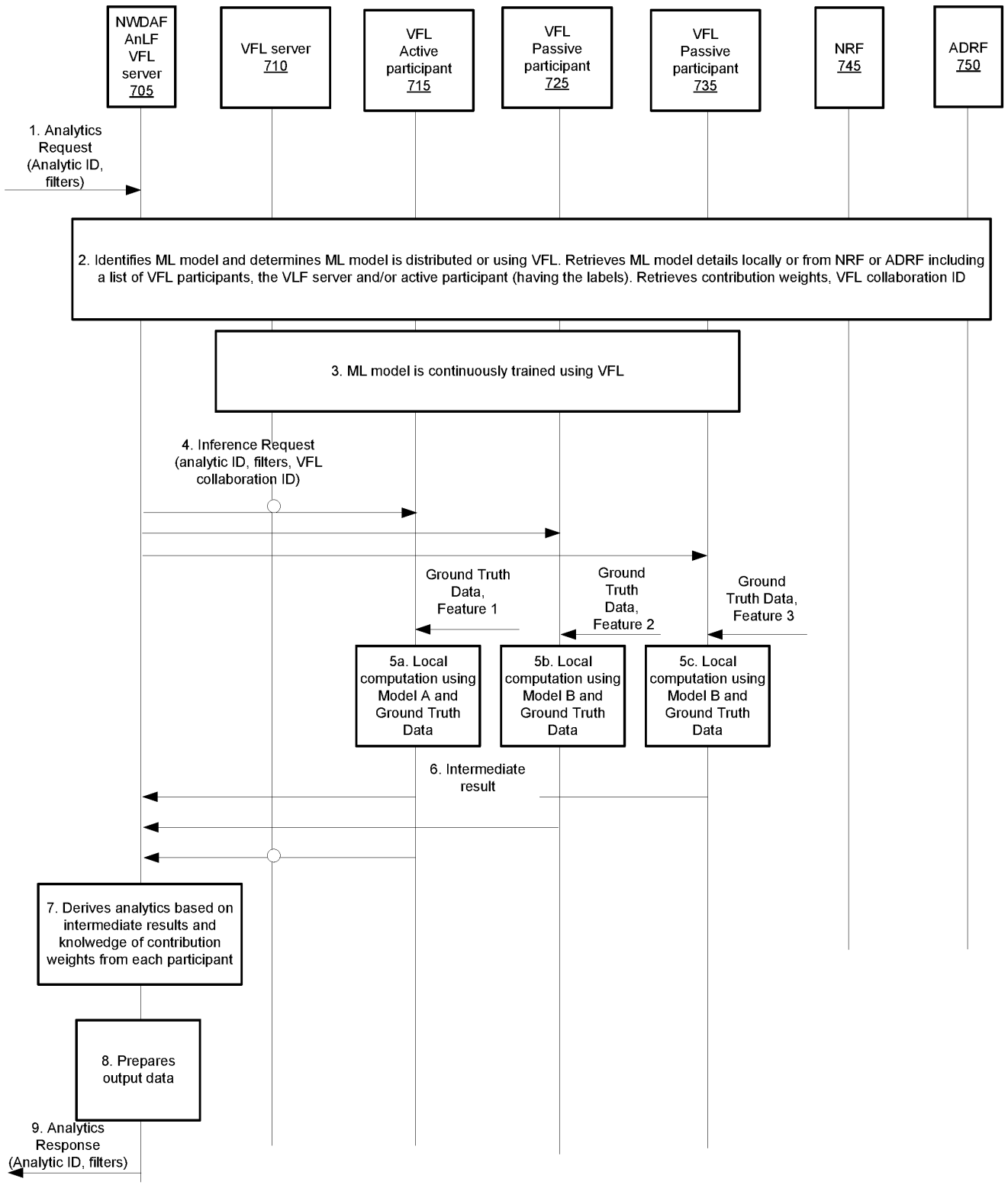
NWDAF AnLF VFL server 705
VFL server 710
VFL Active participant 715
VFL Passive participant 725
VFL Passive participant 735
NRF 745
ADRF 750
1. Analytics Request (Analytic ID, filters)
2. Identifies ML model and determines ML model is distributed or using VFL. Retrieves ML model details locally or from NRF or ADRF including a list of VFL participants, the VLF server and/or active participant (having the labels). Retrieves contribution weights, VFL collaboration ID
3. ML model is continuously trained using VFL
4. Inference Request (analytic ID, filters, VFL collaboration ID)
Ground Truth Data, Feature 1
Ground Truth Data, Feature 2
Ground Truth Data, Feature 3
5a. Local computation using Model A and Ground Truth Data
5b. Local computation using Model B and Ground Truth Data
5c. Local computation using Model B and Ground Truth Data
6. Intermediate result
7. Derives analytics based on intermediate results and knolwedge of contribution weights from each participant
8. Prepares output data
9. Analytics Response (Analytic ID, filters)

Figure 7B

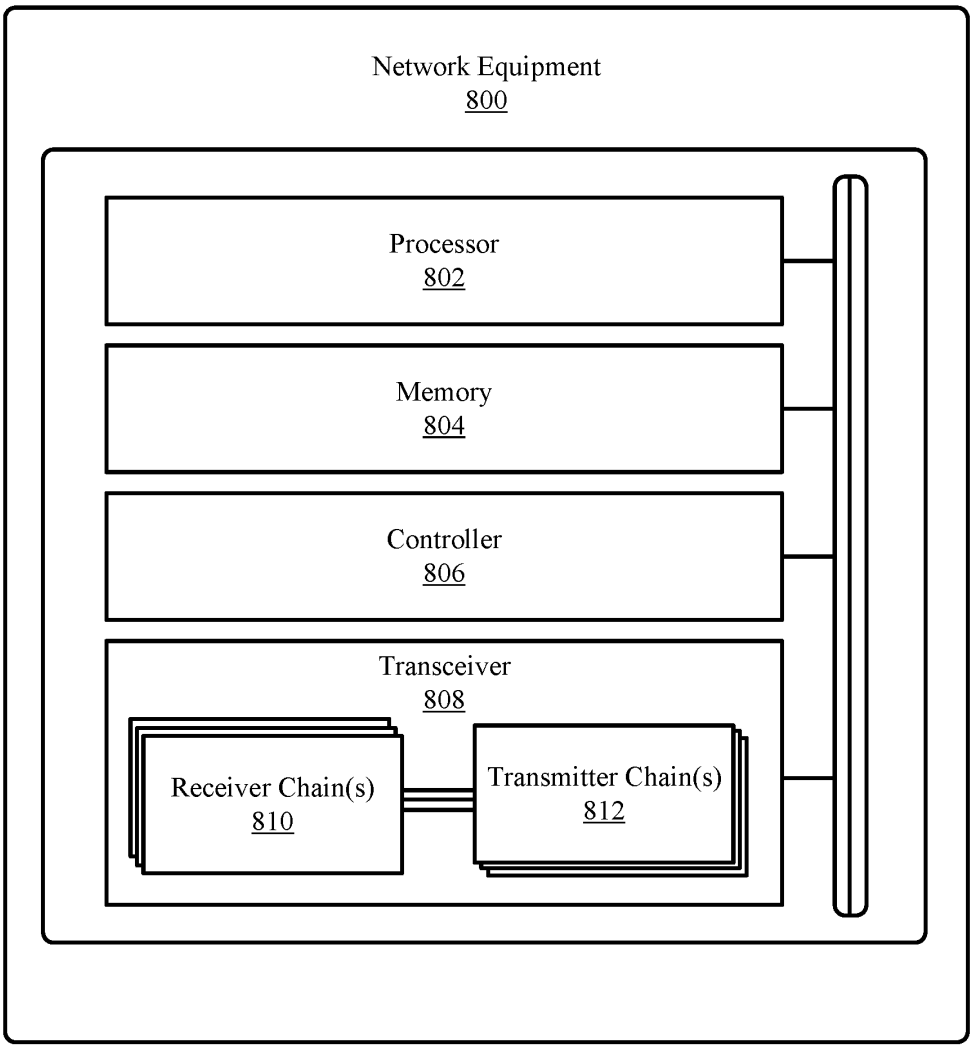
Network Equipment
800
Processor
802
Memory
804
Controller
806
Transceiver
808
Receiver Chain(s)
810
Transmitter Chain(s)
812

Figure 8

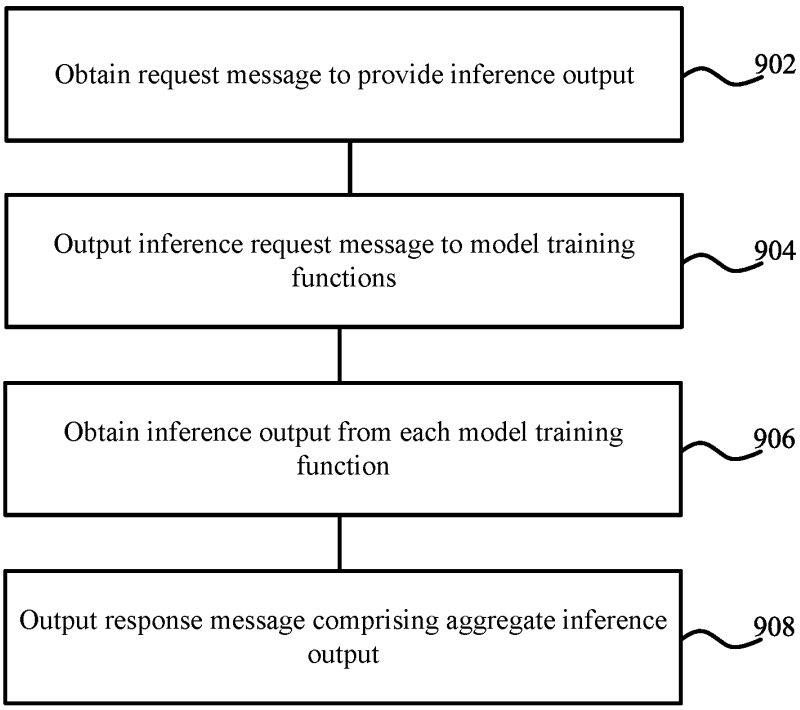
Obtain request message to provide inference output
902
Output inference request message to model training functions
904
Obtain inference output from each model training function
906
Output response message comprising aggregate inference output
908

Figure 9

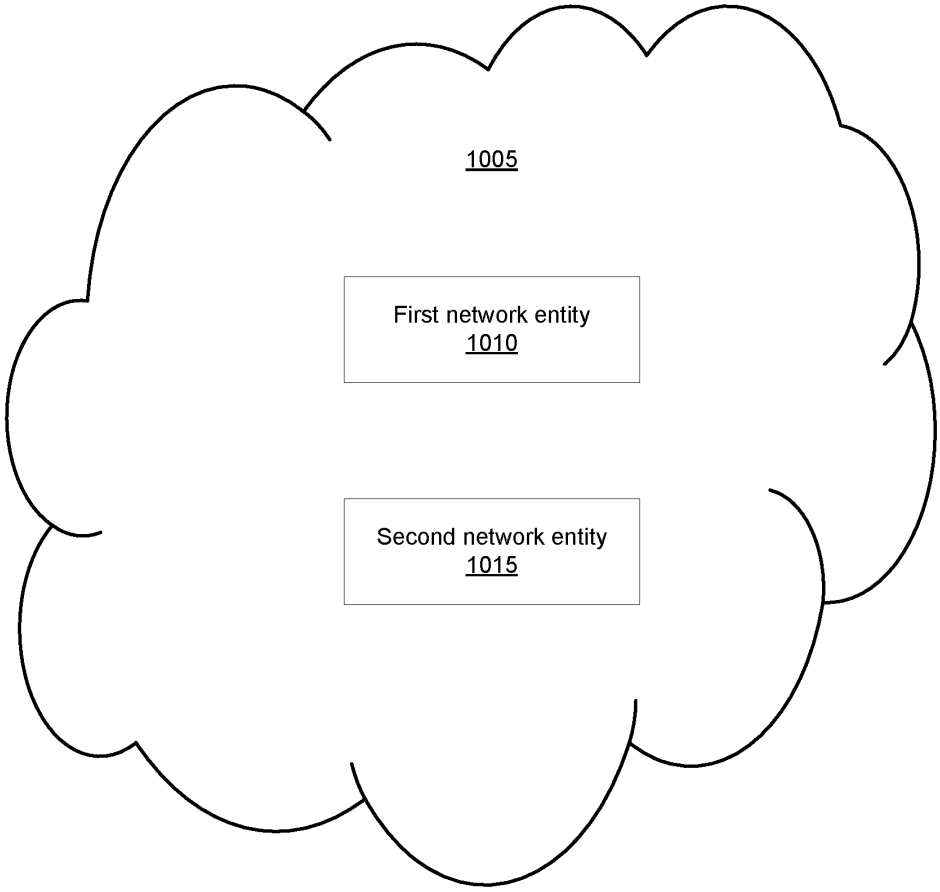

Figure 10