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(54) Title: CONTENTION-BASED FEEDBACK FOR MULTICAST AND BROADCAST SERVICES

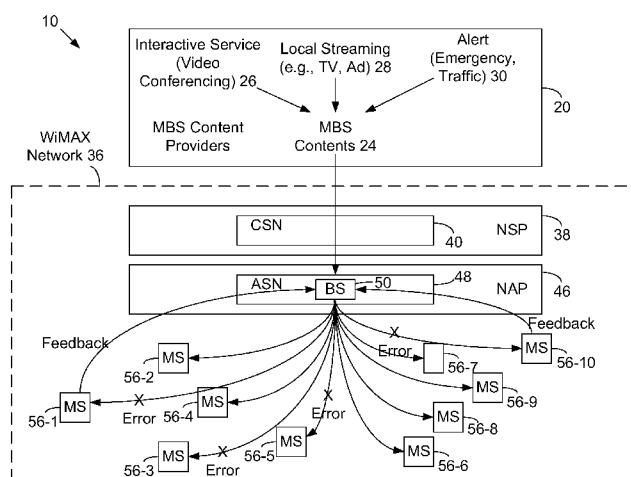


FIG. 1

(57) Abstract: In some embodiments, a mobile device includes interface to receive multicast and broadcast service (MBS) signals and to transmit uplink signals, The mobile device also includes logic to detect errors in the transmission of the received MBS signals and provide negative acknowledge (NACK) signals indicating at least some of the errors in a contention-based MBS feedback channel in at least some of the uplink signals. Other embodiments are described.



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CONTENTION-BASED FEEDBACK FOR MULTICAST AND BROADCAST SERVICES

BACKGROUND

5

RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional application 61/094,357, filed September 4, 2008.

10 TECHNICAL FIELD

Embodiments of the invention relate generally to providing feedback for multicast and broadcast services.

BACKGROUND ART

15 In wireless communication systems, multicast and broadcast service (MBS) refers to a multicast and broadcast service that delivers services to subscriber stations (SS) and/or mobile stations (MS). A benefit of MBS is that a fixed amount of resources can be used to support a very large number of users, as does the TV broadcast system. In single-base station (BS) access, the access to a MBS service is provided by a BS, and in Multi-
20 BS access, the access is provided by multiple BSs which belong to a MBS Zone. BSs within the MBS Zone may transmit synchronized signals to improve the reliability of reception. The synchronized transmission may require a MBS controller that coordinates multiple BSs.

There is currently not an acknowledge (ACK)/ negative-acknowledge (NACK) or
25 channel quality indicator (CQI) feedback mechanism in place for MBS since feedback overhead may increase linearly with an increasing number of users. This is a common problem with broadcast systems. MBS is mainly a downlink (DL) service without any uplink (UL) allocation or with a relatively small amount of UL used for such things as ranging, registration, and handover. Current MBS systems do not take advantage of link
30 adaptation and hybrid automatic repeat request (HARQ) gains. Rather, in a robust MBS system, packets are transmitted blindly, and individual packet reception is not monitored by the MBS system. A study suggests an 8-15% throughput gain when link adaptation is

used. A 3GPP long-term evolution (LTE) standard included a description of using multimedia broadcast/multicast service (MBMS) feedback for single-BS access, but to the inventors' knowledge did not give details on how this was to be accomplished.

The following are ways in which feedback can be sent in a broadband wireless network.

1. Contention-free dedicated feedback: HARQ feedback or CQI feedback for unicast can be sent contention-free over a dedicated channel. However, this does not provide a scalable solution for MBS.

2. Contention-free shared feedback (Power-based): Users send feedback over the shared channel by sending the same code or bit sequence, thus it is contention-free.

Combined received power is measured to tell if there was any feedback. This has been proposed for MBS, but the contention-free shared feedback approach is not appropriate for MBS feedback which is expected to have a large number of feedbacks. In the proposal, both ACKs and NACKs are sent in feedbacks. Energy detection is then used to determine an ACK to NACK ratio to decide whether re-transmission or power/data-rate adjustment is to be done.

3. Contention-based shared channel: Users send feedback contending over the shared channel. Time-domain, frequency-domain, or spreading-code contention can be used. The design and operation of contention-based channels such as code division multiplex access (CDMA) type channels are well known.

a. "Long-spreading" (sometimes called long coding) contention channel: many users share all frequencies. A pseudorandom code of a large length uses entire channel allocated. As an example, long code-words may have 144 frequencies. WiMax and LTE standards include long spreading.

b. "Short-spreading" (sometimes called short coding) slotted contention channel: A contention channel is divided into multiple small slots with short codes within each slot. Upon contention, each contender chooses a slot and a code within the slot. For example, if a long codeword use 144 frequencies (sometimes called tones), corresponding short pseudo noise code-words approach may use 9 slots of 16 frequencies (sometime called tones). Using short pseudo noise code-words results in a higher percentage of MSs being detected as compared with using long code-words by reducing interference among codewords. For example, if X MSs use long codes using 144 tones, a certain percentage are likely to be accurately detected by a base station. By contrast, if a

first group of $X/9$ MSs use a first slot of 16 tones, and a second group of $X/9$ MSs use a second slot of 16 tones, etc., the total percentage of accurately detected MSs will be higher than in the long-spreading situation.

As used herein, the term MBS is intended to be interpreted broadly to include
5 various multiple broadcast services including MBMS (multimedia broadcast/multicast service), which is a term sometime used in connection with LTE.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be understood more fully from the detailed description given
10 below and from the accompanying drawings of embodiments of the invention which, however, should not be taken to limit the invention to the specific embodiments described, but are for explanation and understanding only.

FIG. 1 is a block diagram representation of an MBS system including a WiMax network including a BS and several MSs according to some embodiments of the invention.

15 FIG. 2 is a block diagram representation of a BS of FIG. 1, according to some embodiments of the invention.

FIG. 3 is a block diagram representation of an MS of FIG. 1, according to some embodiments of the invention.

FIG. 4 is a graphical representation of a long spreading approach using an M tone
20 code on frequency and time domains in connection with some embodiments of the invention.

FIG. 5 is a graphical representation of a short spreading approach using an M/N tone code on frequency and time domains in connection with some embodiments of the invention.

25 FIG. 6 is a graphical representation of a downlink (DL) subframe and an uplink (UL) subframe that may be used in some embodiments of the invention.

FIG. 7 is a graphical representation of several base stations and mobile stations used in illustrating some aspects of some embodiments of the invention.

FIG. 8 is a graphical representation of mobile stations receiving signals of different
30 signal SINR/MCS levels from a base station used in illustrating some aspects of some embodiments of the invention.

FIG. 9 is block diagram representation of the mobile station of FIG. 3 according to

some embodiments of the invention.

DETAILED DESCRIPTION

The following disclosure describes scalable feedback mechanisms for MBS. In
5 some embodiments, these mechanisms are contention-based and may be used to advance
the state of the art in link adaptation and HARQ and significantly improve coverage and
spectral efficiency for MBS. In some embodiments, these mechanisms may be used in
supporting more cell edge users, supporting more video streams by using higher data rate
modulation and coding schemes (MCSs), and improving service quality by lowering
10 packet error rate (PER) through HARQ. By allowing the MBS link adaptation and HARQ
to work with NACK only feedback, the number of actually transmitted feedbacks may be
reduced.

The concept of contention-based feedback is not new in uni-cast, but it has not
been used for MBS feedback. Perhaps a reason why contention-based MBS feedback has
15 not been used is because there is a conceptual mismatch between MBS and contention-
based feedback. The conceptual mismatch is that MBS is directed to overall network
system performance in contrast to nominal contention-based feedback which distinguishes
feedbacks from each transmitting MS. Another possible reason for not providing MBS
feedback is that to the extent anyone thought about it, the potentially very large number of
20 ACKs from a large number of MSs (the ACK explosion problem) may have seemed
unworkable.

FIG. 1 illustrates an MBS system 10 in which contention-based feedback channels
are used to provide feedback for MBS signals from MSs 56 to a BS 50. System 10
includes MBS content providers 20 that provides MBS contents 24, which is provided to a
25 WiMax network 36. As an example, MBS contents 24 includes an interactive service 26
(such as video conferencing), local streaming 28 (such as television and associated
advertisements), and alert information 30 (such as emergency traffic information). Of
course, in other examples, not each of these is required and other content sources could be
included.

30 WiMax network 36 includes a network service provider (NSP) 38 having a
connectivity service network (CSN) 40, and network access provider (NAP) 46 having an
access service network (ASN) 48. ASN 50 includes at least one BS (typically many BSs)

of which BS 50 is an example. Network 36 may include additional NSPs, CSNs, NAPs, ASN, MSs, and BSs. These components of WiMax network 36 may be compliant with WiMax standards such as IEEE 802.16e, 802.16Rev2, and 802.16m and the WiMax Forum. Although the example of FIG. 1 is illustrated with a WiMax network, it may be used with other wireless systems using MBS signals. For example, it may be used with LTE based systems.

Various mobile stations (MSs), for example, MSs 56-1, 56-2, ... 56-10, are attempting to receive wireless MBS signals from BS 50. In practice, there may be many more MSs interfacing with BS 50. Over a particular range of time in the example, there is some error in the transmission to MSs 56-1, 56-3, 56-5, and 56-10, while there is not for the other MSs. As described in more detail below, MSs that meet the feedback condition provide a feedback signal to indicate an error to BS 50. In some embodiments, the feedback signals include NACK signals, but not ACK signals. BS 50 may then determine what, if any, changes should be made in response to the feedback signal. For example, BS 50 could make no change, retransmit signals, perform link adaptation, and/or do rate shaping.

The system of FIG. 1, may be implemented as frequency domain spreading, time domain spreading, or frequency-time domain spreading or CQI based channel as described herein.

FIG. 2 illustrates details on of BS 50 according to some embodiments, although various details of a BS are not illustrated in FIG. 2. In other embodiments, the details may be different. FIG. 2 includes modules that may represent executing software and/or firmware. BS 50 includes logic 62 that includes an MBS control module 64 and feedback detecting and interpreting module 66. MBS control 64 controls the providing of MBS signals to interface 68 and controls the transmission of signals by interface 68 through antenna(s) 70. As examples, MBS control module 64 may provide retransmission or link adaptation decisions. Feedback signals are received by antenna(s) 70 and are provided to feedback interpreting module 66. Various other signals are also received by antenna(s) 70 and provided to modules of BS 50 that are not specifically illustrated in or discussed in connection with FIG. 2. As will be explained in greater detail, feedback interpreting module 66 determines what, if any, changes should be made in response to the feedback signal. Modules 64 and 66 may include hardware such as one or more microprocessors,

digital signal processors (DSPs) that execute instructions from software and/or firmware stored in memory 74 or elsewhere. Modules 64 and 66 may share some or all hardware. Interface 68 may include hardware that executes instructions.

FIG. 3 illustrates details of MS 56-1 according to some embodiments, although
5 various details of an MS are not illustrated in FIG. 3. In other embodiments, the details may be different. FIG. 2 includes modules that may represent executing software and/or firmware. An interface 84 receives MBS signals from antenna(s) 78 and provides feedback signals and other signals to a base station such as BS 50 in FIGS. 1 and 2. In the example of FIG. 3, MS 56-1 includes logic 86 that includes an error detection module 88,
10 sample control module 90, and UL control module 94. Error detection 88 detects errors in the MBS signals. Merely as examples and not requirements, an error may be detected by, for example, a checksum being wrong, packets being out of order, or a delayed threshold being exceeded. Sample control module 90 determines whether MS 56-1 will provide a feedback signal to a remote BS indicating information about the error. For example,
15 sample control module 90 could generate a random number and if the random number is less than (or is less than or equals) a certain value, a feedback signal may be provided and otherwise it would not be provided – or vice versa (if the random number exceeds or equals to (or exceeds or equals) a certain value, a feedback signal may be provided and otherwise it would not be). The certain value can be pre-set or dynamically updated from,
20 for example, the base station. In some embodiments, module 90 controls a type of feedback.

Feedback control module 94 controls the contents of an uplink signal to be transmitted by interface 84 on antenna(s) 78. The UL signal may include one or more feedback signals. Modules 88, 90, and 94 may include hardware such as one or more
25 microprocessors or digital signal processors that execute instructions of software and/or firmware stored in memory 96 or elsewhere. Modules 88, 90, and 94 may share some or all hardware. Interface 84 may include hardware that executes instructions. Memory 74 and 96 may include Flash memory and/or other types of memory.

FIG. 4 illustrates a M tone code long spreading approach on frequency and time
30 domains. Slots may be formed of a particular number of frequencies $f_1, f_2 \dots f_M$ frequencies and time symbols. FIG. 5 illustrates a short spreading approach on frequency and time domain resources of N M/N tone codes each having M/N frequencies. Slots 1, 2,

... N correspond to different M/N tone codes.

In long spreading, users share the same channel. In short spreading, users may select a particular channel randomly or through another method. An advantage of a short spreading approach is that there is a higher probability of detection. Although the total number of MSs in the system may be the same with long spreading, there are fewer MSs contenting in the slot used and more MSs are detected than with long spreading, which may have a very low detection rate with a high number of contending MSs.

FIG. 6 illustrates a DL subframe 112 and an UL subframe 114, which are examples of WiMax frames. As an example, DL subframe 112 is used to transmit signals from a BS to an MS (such as BS 50 to MS 56-1). UL subframe 114 is used to transmit signals from an MS to a BS (such as MS 56-1 and BS 50). The embodiments of the invention are not restricted to the particular details of DL subframe 112 shown in FIG. 6. DL subframe 112 shows a preamble, UL map, DL map, FCH, and MBS OFDMA region as possibilities. UL subframe 114 may be used to carry various signals including fields MBS 1 ... MBS n-1, MBS n, which may represent different feedback channels. The different feedback channels may correspond to different MBS services. For example, one feedback channel may correspond to sending feedback to service 26 of FIG. 1 and another channel may correspond to sending feedback a particular one of local streaming 28. As shown in FIG. 6, MBS n further comprising slots 1, 2, ... N 116, which in some embodiments correspond to slots 1, 2, ... N of the short coding approach of FIG. 5. Thus, in the example of FIG. 6, short coding is used for the feedback channel MBS n. As discussed therein, other coding choice could be used. Other messages may be included in the DL and UL subframes.

In some embodiments, different feedback channels are used for providing feedback for different services. In other embodiments, feedback for different services can be provided over the same channel. In some embodiments, groups of base stations are in a zone of base stations, and different channels can be used for different zones. In some embodiments, some channels are used for different services and other channels are used for different zones.

A scalable and efficient feedback solution is desirable because of the large number of potential MSs in MBS systems. By using contention-based feedback for an MBS system, the number of feedbacks may be estimated by resolving contending code-words.

In order to further enhance the detection performance, false detection probability may be reduced because in some situations, what matters is ‘how many’, not ‘who sent what’. Further, allowing MBS link adaptation and HARQ to work with NACK only feedback reduces the number feedbacks compared with ACK. In some embodiments, the NACK
5 signals are provided by only a portion of the MSs because if there is too much contention, the probability of detection is reduced. Sampling may be used in which an MS sends NACK based on a network configured feedback transmission probability. For example, the receiver sends feedback only when its drawn random number is less than the feedback transmission probability.

10 In some embodiments, the contention-based MBS feedback works as follows. An MBS feedback contention channel may be allocated using either the “long-spreading” or the “short-spreading” approach. Still other coding approaches are discussed below. The invention is not restricted to allocating a different feedback channel for each MBS service or allocating a feedback channel for all services. In the case of Multi-BS access, feedback
15 channel allocation across BSs may be either identical or non-overlapping in terms of time-frequency allocation. Identical channel allocation could allow user’s movement between cells without signaling.

Upon detection of a packet reception failure (such as through error detection module 88 in FIG. 3), a receiver (such as MS 56-1) sends NACK-only feedback over the
20 contention channel (in long-spreading) or over a slot in the contention channel (in short-spreading). The receiver might choose to not send a NACK based on a NACK feedback reduction policy. The feedback reduction policy may be either pre-configured or dynamically configured, and transmitted either by unicast or multicast/broadcast. This policy may be set on a per BS basis or shared among multiple BSs. The invention is not
25 restricted to any particular way to select the slot for short-spreading. Some examples of slot selection include random selection and “sticky contention.”

The number of feedbacks may be estimated by resolving code-words received and a feedback reduction policy if any. The total number of the receivers may be known in other means such as a counting mechanism used in 3GPP (3rd Generation Partnership
30 Project). Feedbacks may be counted either at each BS or at the MBS controller that coordinates MBS functions across BSs by forwarding feedback responses from a BS in order to avoid double counting of the same responses.

HARQ retransmission and modulation and coding scheme (MCS) adaptation algorithms may be applied based on the feedback estimation. For example, the first frame may be sent with a particular MCS. Based on the percentage of the NACKs, the packet may be retransmitted and/or sent using higher or lower MCS in the next scheduled frame.

5 The retransmission delay, maximum retransmissions, the rate at which it adapts MCS level may vary.

Contention-based systems allow better estimation of the number of feedbacks than contention-free based approach by resolving contention between received codewords.

In some embodiments, the above-described MBS feedback design works for both

10 Single_BS access and Multi-BS access. In Single-BS access which is comprised of only one cell in FIG. 7, the access to a MBS service is provided by a single BS, and in Multi-BS access which is comprised of multiple cells in FIG 7, the access is provided by multiple BSs that transmit synchronized MBS signals to MSs resulting in improved reception reliability. In Multi-BS access, an MBS controller 130 coordinates the

15 synchronized transmission. Controller 130 may be in CSN 40, in ASN 48, or elsewhere.

For successful decoding of feedbacks, UL synchronization may be important. In general, UL synchronization may be achieved by Unicast initial ranging or periodic ranging. For unicast and MBS mixed scenario, MBS may benefit from the unicast ranging. On the other hand, for a dedicated MBS scenario, ranging operation might not be

20 available to benefit from. The following are some possible practices that may mitigate UL synchronization error. A longer cyclic prefix (CP) may ensure that the signals from distant BSs do not exceed CP period. MBS guard time with repetition coding may also help. In order to take into account the delays of signals from distant BSs, we may (1) insert empty guard time in the beginning and/or at the end of MBS feedback channel and

25 (2) use the repetition coding (e.g. 2, 4, or 6).

CQI-based MBS feedback may also be used. Besides the random selection of channel and code, NACK feedback may be sent based on the user's channel quality. Feedback channel may be divided into multiple slots according to SINR/MCS levels to be supported for MBS. For example, FIG. 8 illustrates 5 different signal-to-interference and

30 noise ratio (SINR)/modulation and coding scheme (MCS) (SINR/MCS) levels. The strongest is SINR/MCS level 1, which is closest to the BS and the weakest is SINR/MCS level 1 farthest from the BS. MS1 has SINR/MCS level 4, MS2 has SINR/MCS level 2,

and MS3 has SINR/MCS level 5. The channel may be either contention-free shared channel (power-based) or contention-based shared channel, meaning feedbacks may be counted either by power level or by resolving contending codes. Feedback may be sent over the slot that corresponds to the user's SINR/MCS level. In some embodiments, under this scheme, a total number of users in each level is tracked.

There are various ways to implement an MS. FIG. 9 illustrates some details of one such implementation of MS 56-1, although different details could be used. Referring to FIG. 9, an RF interface 146 is coupled to antenna 78. RF section (mixers) 148 are coupled between analog front end 152 and RF interface 146. Analog front end 152 is coupled to a baseband modem 154. Baseband modem 154 includes an interface 156 that interfaces between analog front end 152 and a hardware modem 160, DSP(s) 166, and ARM device(s) 168. RAM 172 and nonvolatile memory 176 (such as flash devices) provide memory and store instructions to be used by DSP(s) 166 and ARM device(s) 168. Addition hardware devices may be used. The hardware may work with or without executing instructions.

For instructive purposes, Table 1 shows examples of the number of feedbacks per video service under conditions of a total of 2,400 MSs per BS, 3,600 MSs per BS, and 12,000 MSs per BS for 12 video services, assuming that the users for each service is evenly distributed. Of course, that assumption is typically not true, but Table 1 is still instructive. Of course, the inventions are not limited to the details of Table 1.

12 Video Services	Per Service			
	Feedback allocation	# of MSs per BS	# Reception failures (20%)	# Feedbacks (25% sampling)
2,400	144 tones (9 slots * 16 tones in short-spreading)	200	40	10
3,600		300	60	15
12,000		1000	200	50

Table 1

Referring to Table 1, in the example of 200 MSs per BS per service, there is an error (failure) in transmission for 40 MSs (or a 20% failure rate) and a 25% sampling rate is

used, then feedback is provided by only 10 MSs. The BS knows that the 25% sampling rate is used, so the BS assumes that there are failures for 40 MSs and uses this assumption in determining what, if any, adjustments in MCS level or re-transmissions to make. In Table 1, 12,000 user support per BS with only 50 feedbacks per service is shown. Note
5 that more or less users may be supported by adjusting sampling rate and/or the amount of channel allocation.

The invention is not restricted to use with any particular wireless standard or protocol. Various wireless standards have been proposed including WiMAX, IEEE 802.16e, 802.16m, 802.16Rev12, 3GPP, 3GPP2, CMMB, MediaFLO, DVB-H, IEEE
10 802.16m, WiMax Forum, 3 GPP LTE.

In some embodiments, in addition to receiving NACK feedbacks from some or all MSs that detect errors, there may be some ACK feedbacks from some or all MSs that receive the MBS signals correctly. In other embodiments, there are only NACK feedbacks, not ACK feedbacks, to determine HARQ or link adaptation or other responses.
15

ADDITIONAL INFORMATION AND EMBODIMENTS

The “logic” referred to herein may be implemented in circuits, software, microcode, or a combination of them.

There are many details in which embodiments of the invention may be implemented. The following are some details that may be used in some embodiments (but
20 not necessarily all the same embodiment), but which are not required to be used in other embodiments:

- Full resource usage for MBS.
- 10 MHz bandwidth.
- 25 • A WiMax frame of 900 subcarriers, 48 symbols, and 5 ms frame.
- Feedback every 200 ms MBS transmission period.
- Frequency-domain spreading with 144 tones for long spreading, and 9 slots of 16 tones ($9 \times 16 = 144$ tones) for short-spreading.
- Feedback per MBS service and total of 12 IPTV services (for example, 384 kbps
30 video streams).
- QPSK 1/2
- Frequency-domain spreading with allocation of 144 tones for contention channel.

- 127 bit maximal PN codes for long-spreading.
 - 9 contention slots with 16 bit maximal PN codes for short-spreading.
 - Random slot and code selection in short spreading.
 - Fading Channel and adjacent tone permutation. No path loss and shadowing.
 - 5 • Simple correlation-based receiver for multi-user detection.
 - Eased false detection probability since MBS feedback does not require a strictly correct reception of codes.
 - Collisions and false detections are included as valid feedback detection count.
- Various other details may be used in other embodiments.

10 An embodiment is an implementation or example of the invention. Reference in the specification to “an embodiment,” “one embodiment,” “some embodiments,” or “other embodiments” means that a particular feature, structure, or characteristic described in connection with the embodiments is included in at least some embodiments, but not necessarily all embodiments. The various appearances of “an embodiment,” “one
15 embodiment,” or “some embodiments” are not necessarily all referring to the same embodiments.

When it is said the element “A” is coupled to element “B,” element A may be directly coupled to element B or be indirectly coupled through, for example, element C.

When the specification or claims state that a component, feature, structure,
20 process, or characteristic A “causes” a component, feature, structure, process, or characteristic B, it means that “A” is at least a partial cause of “B” but that there may also be at least one other component, feature, structure, process, or characteristic that assists in causing “B.” Likewise, that A is responsive to B, does not mean it is not also responsive to C.

25 If the specification states a component, feature, structure, process, or characteristic “may,” “might,” or “could” be included, that particular component, feature, structure, process, or characteristic is not required to be included. If the specification or claim refers to “a” or “an” element, that does not mean there is only one of the element.

The invention is not restricted to the particular details described herein. Indeed,
30 many other variations of the foregoing description and drawings may be made within the scope of the present invention. Accordingly, it is the following claims including any amendments thereto that define the scope of the invention.

CLAIMS

What is claimed is:

1. A mobile device comprising:
an interface to receive multicast and broadcast service (MBS) signals and to
5 transmit uplink signals; and
logic to detect errors in the transmission of the received MBS signals and provide
negative acknowledge (NACK) signals indicating at least some of the errors in a
contention-based MBS feedback channel in at least some of the uplink signals.
2. The mobile device of claim 1, wherein the logic selectively provides the
10 NACK signals.
3. The mobile device of claim 2, wherein the logic selectively provides the
NACK signals by performing a probability function in response to the detected errors and
provides at least one of the NACK signals when the probability function yields one state
and to not provides the NACK signals when the probability function yields another state.
- 15 4. The mobile device of claim 1, wherein the interface does not also provide
ACK feedback in uplinks signals.
5. The mobile device of claim 1, wherein the feedback channel provides the
NACK signals in short codewords which are subsets of a larger number of bits.
6. The mobile device of claim 1, wherein the feedback channel
20 provides the NACK signals in long codewords.
7. The mobile device of claim 1, wherein the logic detects signal strength of
the MBS signals and chooses a particular feedback channel based on the detected signal
strength.
8. The mobile device of claim 1, wherein the MBS feedback channel is a first
25 MBS feedback channel, and wherein the logic provides additional NACK signals on
additional MBS feedback channels for different sources, wherein the sources are at least
one of MBS services and MBS base station zones.
9. The mobile device of claim 8, further comprising memory to hold
instructions and wherein the logic uses the instructions to detect the errors and selectively
30 provide the NACK.
10. The mobile device of claim 1, wherein the errors relate to quality of
service.

11. A base station comprising:

an interface to transmit multicast and broadcast service (MBS) signals and to receive uplink signals; and

logic to control transmission and some content of the MBS signals and to detect
5 negative acknowledge (NACK) signals in contention-based MBS feedback channels of the uplink signals and to react to at least some of the NACK signals.

12. The base station of claim 11, wherein the NACK signals have contents and depending on how many NACK signals are received in a particular time and on the contents of the NACK signals, the logic may respond by doing at least one of the
10 following (1) making no change in the MBS signals, (2) re-transmit some of the MBS signals, and (3) causing link adaptation.

13. The base station of claim 12, wherein the logic selectively responds either autonomously to the received NACK signals or by first communicating with an MBS controller.

14. The base station of claim 13, wherein when the logic communicates with an MBS controller, the BS forwards the collected feedback information from the uplink signals to the MBS controller and receives instructions from the MBS controller regarding how to respond.

15. The base station of claim 14, wherein the MBS controller is not included in
20 base station.

16. The base station of claim 11, wherein the logic provides signals to remote mobile stations and indicates to the remote mobile stations whether they are to provide MBS feedback signals in response to all detected errors or only in response to a portion of detected errors.

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17. A method comprising:

receiving multicast and broadcast service (MBS) signals; and

detecting errors in the transmission of the received MBS signals;

providing negative acknowledge (NACK) signals indicating at least some of the
30 errors in a contention-based MBS feedback channel in at least some of uplink signals; and transmitting the uplink signals.

18. The method of claim 17, wherein the logic selectively provides the NACK

signals by performing a probability function in response to the detected errors and provides at least one of the NACK signals when the probability function yields one state and to not provides the NACK signals when the probability function yields another state.

19. The method of claim 17, wherein the MBS feedback channel is a first MBS
5 feedback channel, and wherein additional NACK signals are provided on additional MBS feedback channels.

20. The method of claim 17, wherein the feedback channel provides the NACK signals in short codewords.

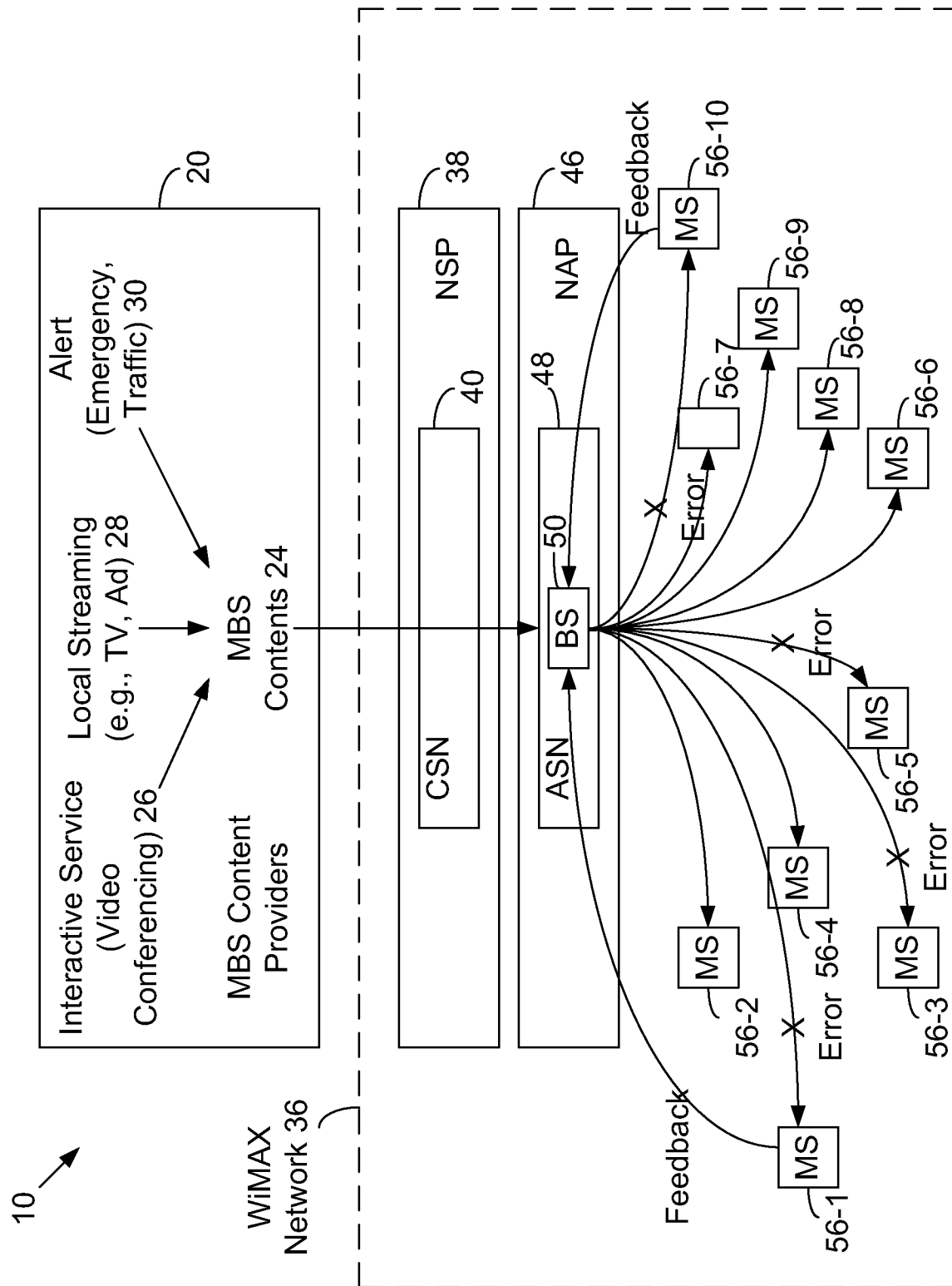


FIG. 1

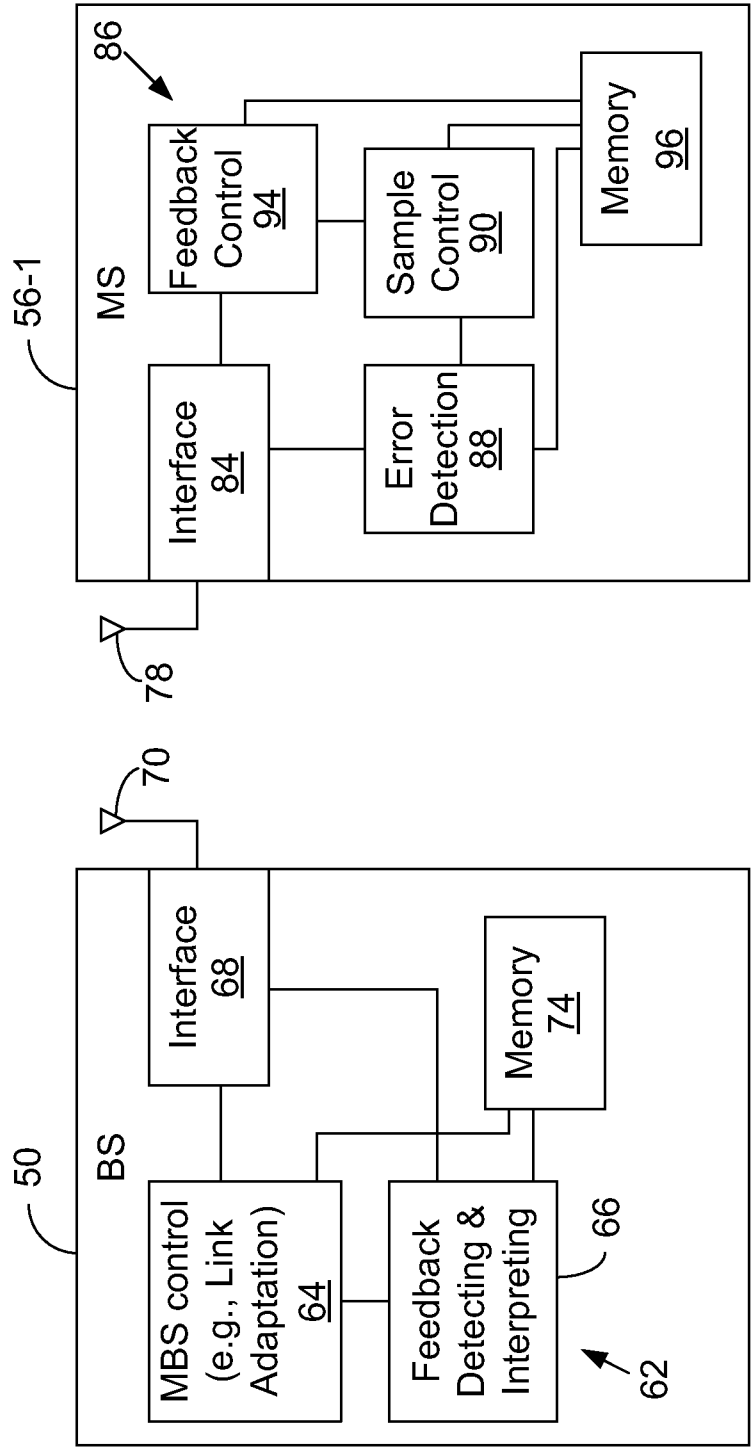


FIG. 2

FIG. 3

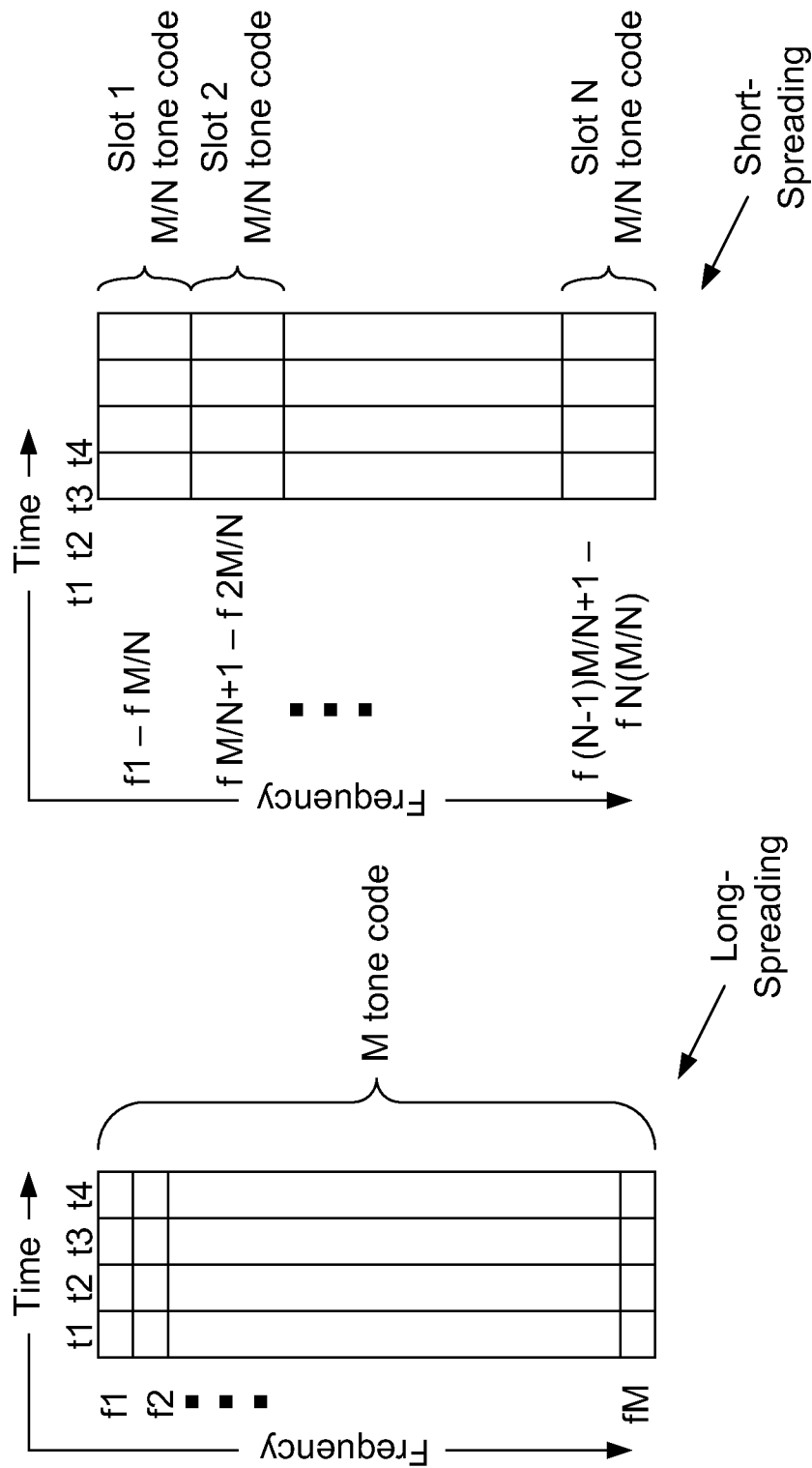


FIG. 4

FIG. 5

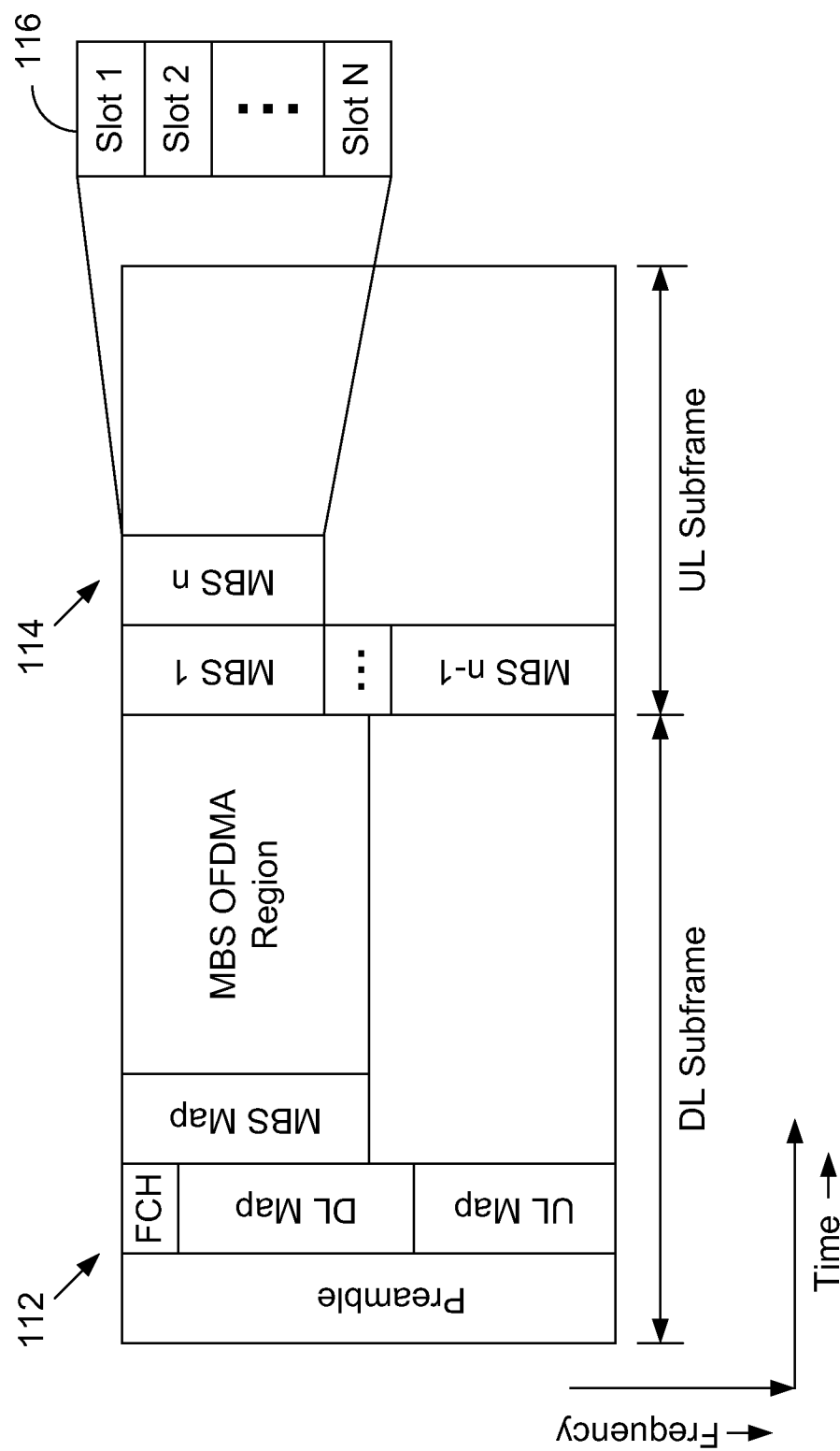


FIG. 6

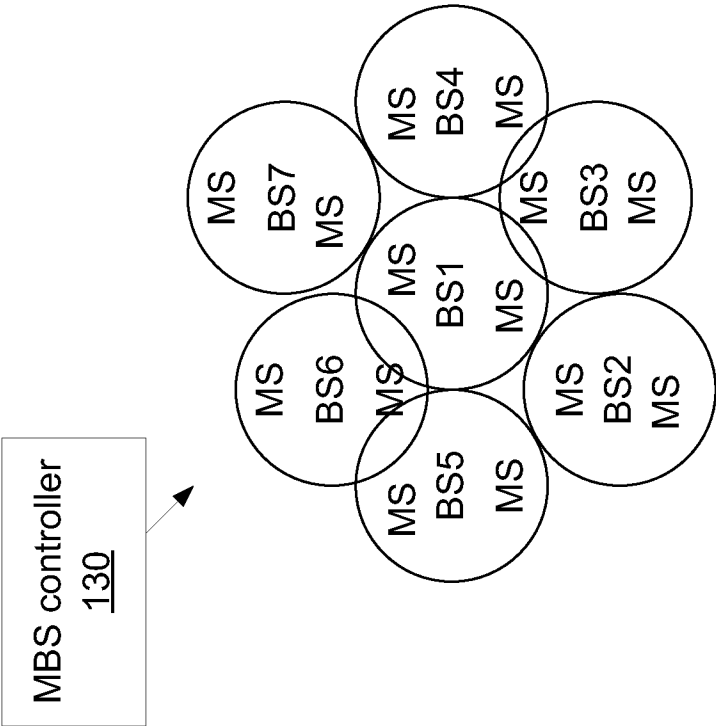


FIG. 7

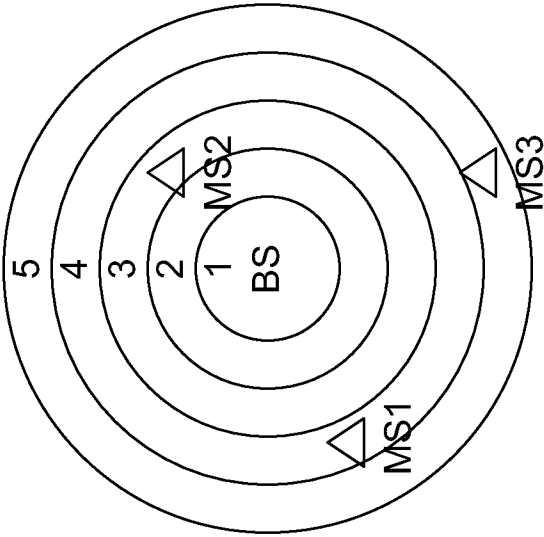


FIG. 8

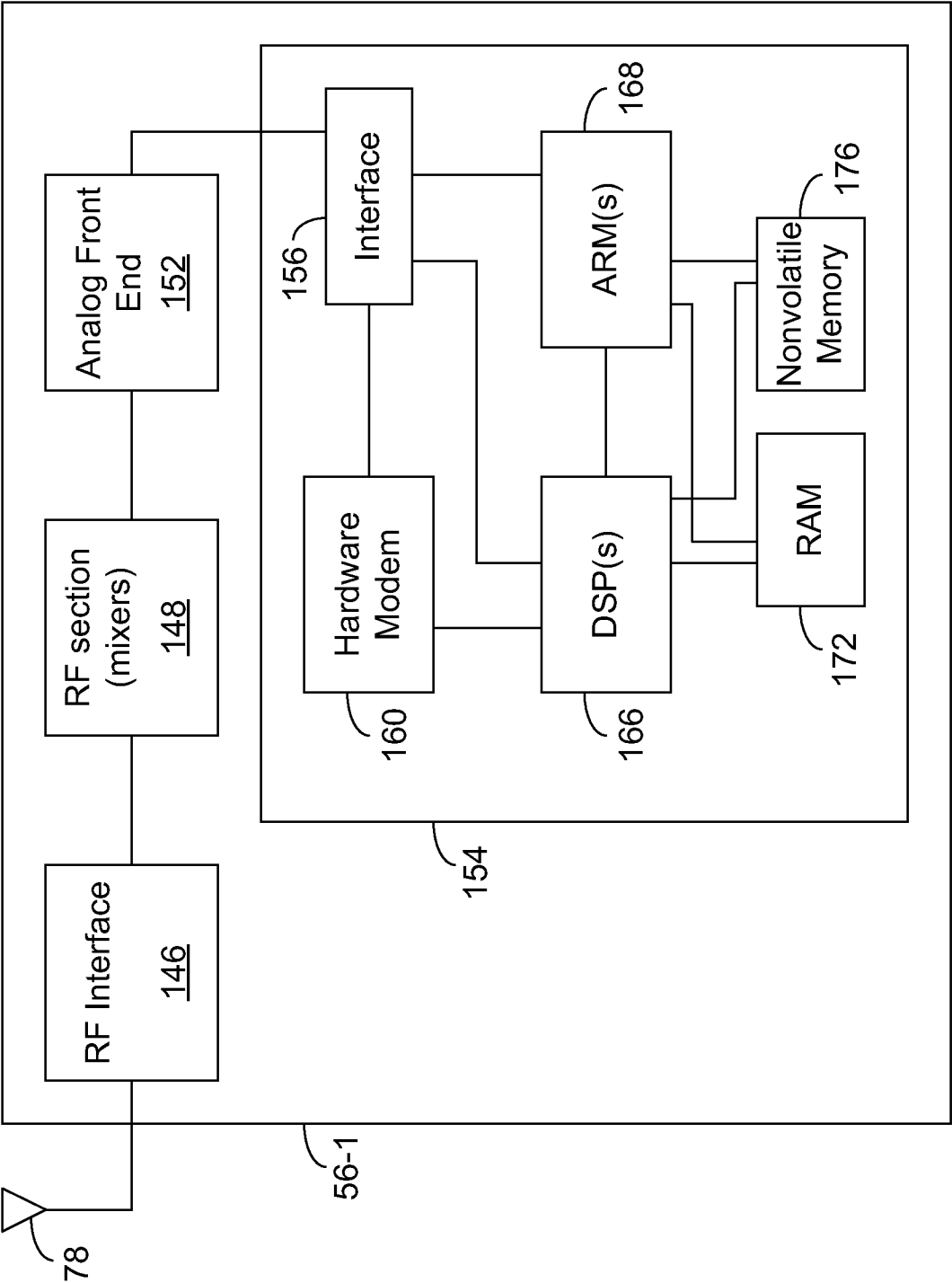


FIG. 9