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(54) **HYBRID AUTOMATIC REPEAT REQUEST DESIGN**

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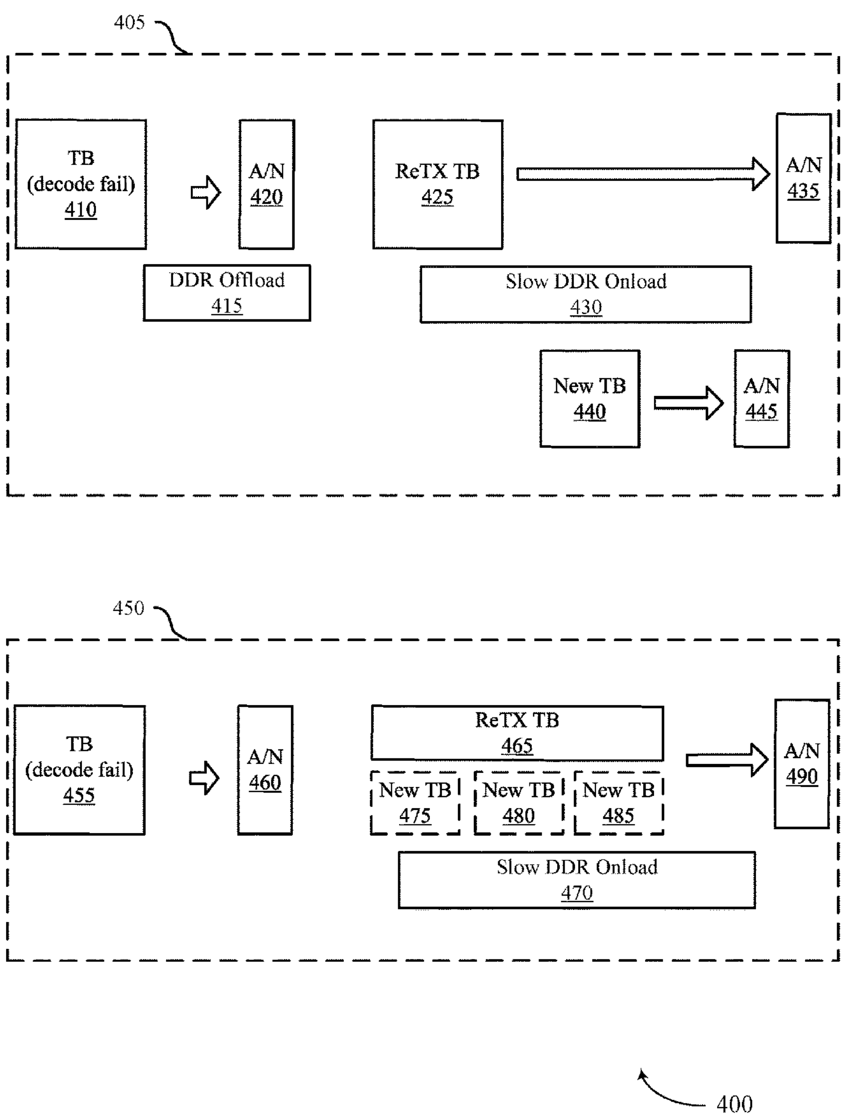
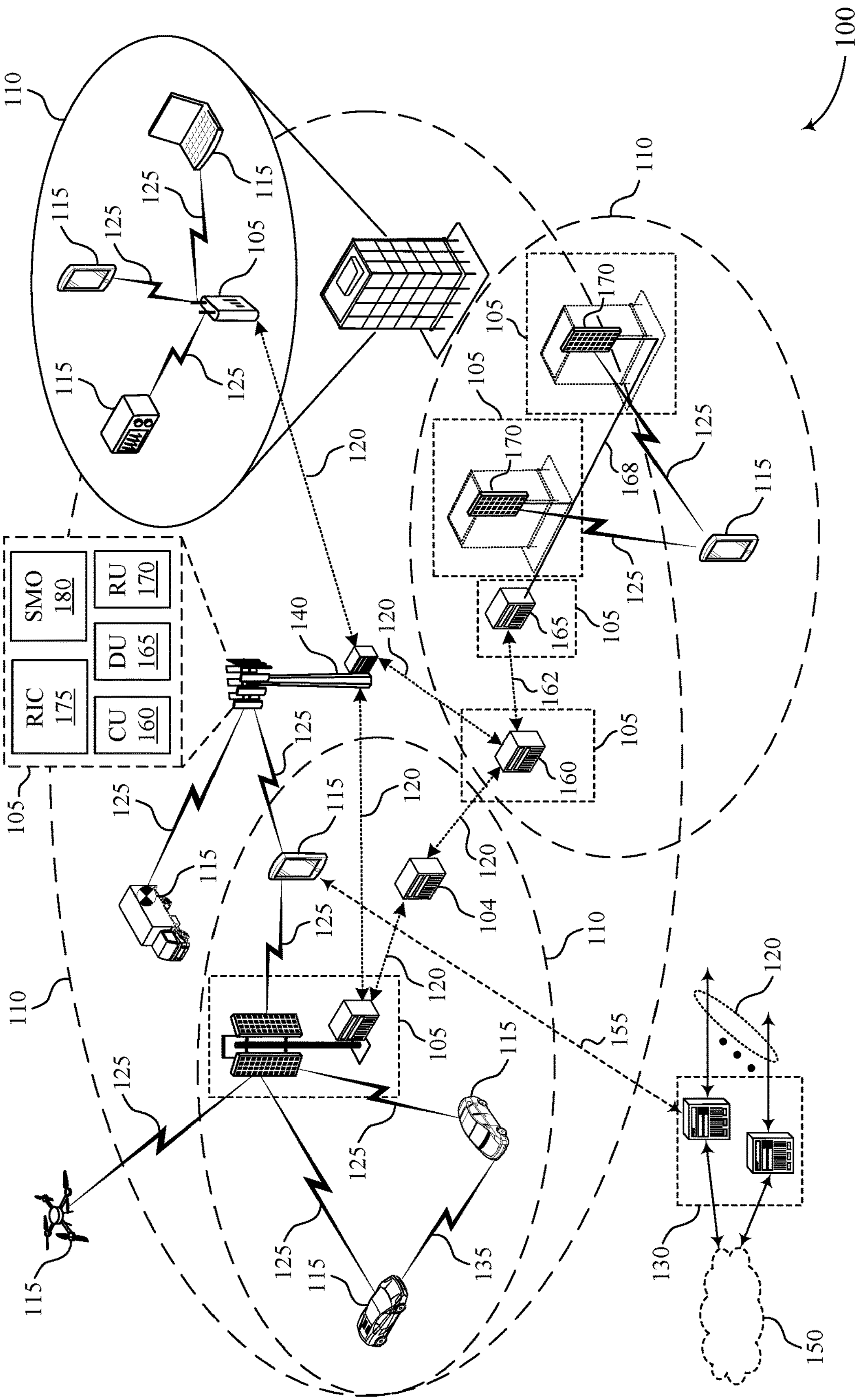
(57) **ABSTRACT**

Methods, systems, and devices for wireless communications are described. Techniques described herein provide HARQ design. In some examples, a user equipment (UE) may receive from a network entity, a transport block. The UE may transmit, to the network entity, one or more feedback messages that indicate that a reception of the transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the transport block. The UE may receive, from the network entity, the retransmission of the transport block. In some cases, the time delay may be a delayed timeline for a transmission of an acknowledgment feedback or a negative acknowledgment feedback associated with a reception of the retransmission of first transport block. In some examples, the time delay may be an extended transmission duration for the retransmission of the transport block.




RIC 175
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DU 165
RU 170
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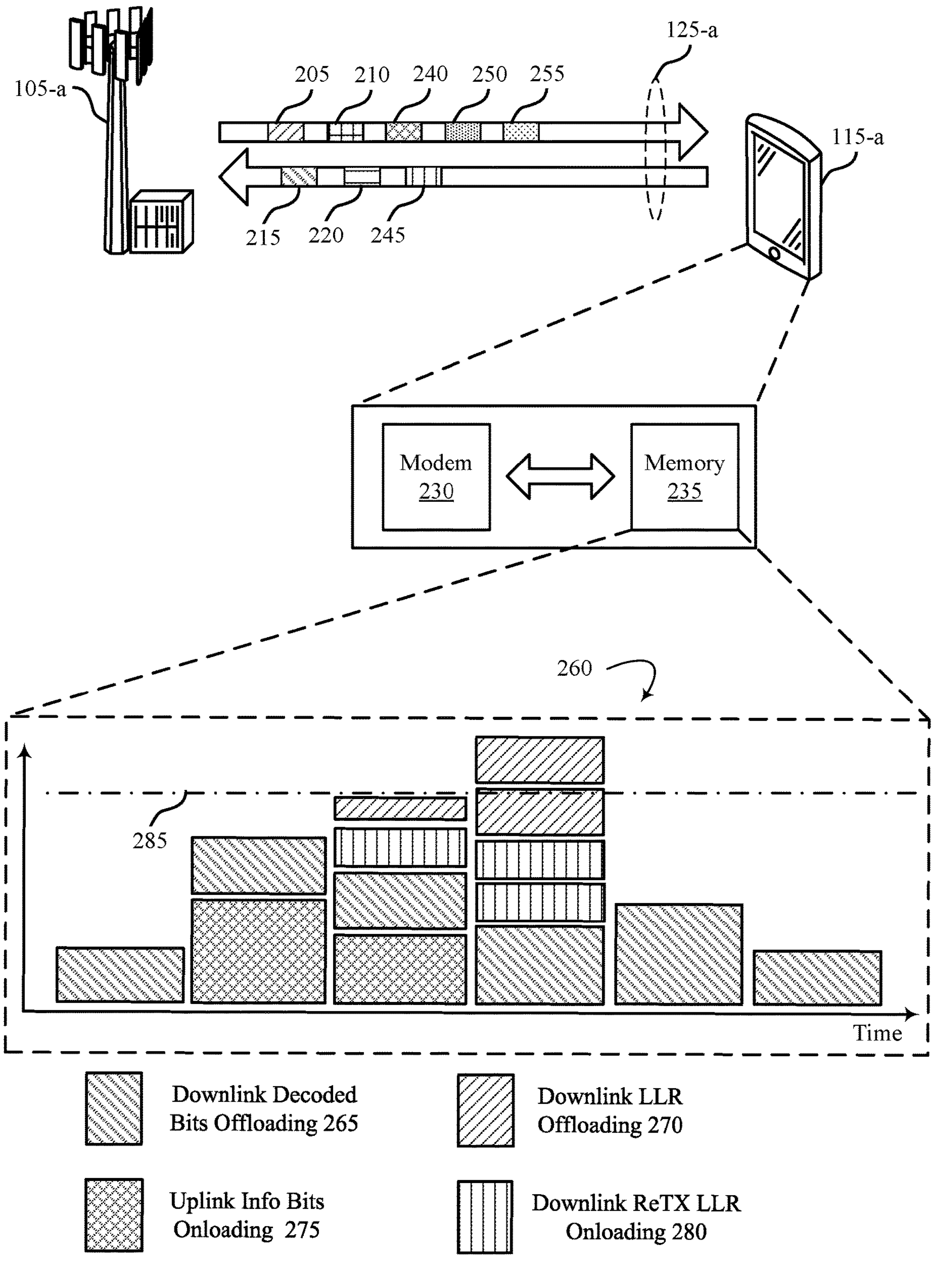
168
170
104

FIG. 1



125-a
205
210
240
250
255
105-a
115-a
215
220
245
Modem
230
Memory
235
260
285
Time
Downlink Decoded Bits Offloading 265
Downlink LLR Offloading 270
Uplink Info Bits Onloading 275
Downlink ReTX LLR Onloading 280
200

FIG. 2

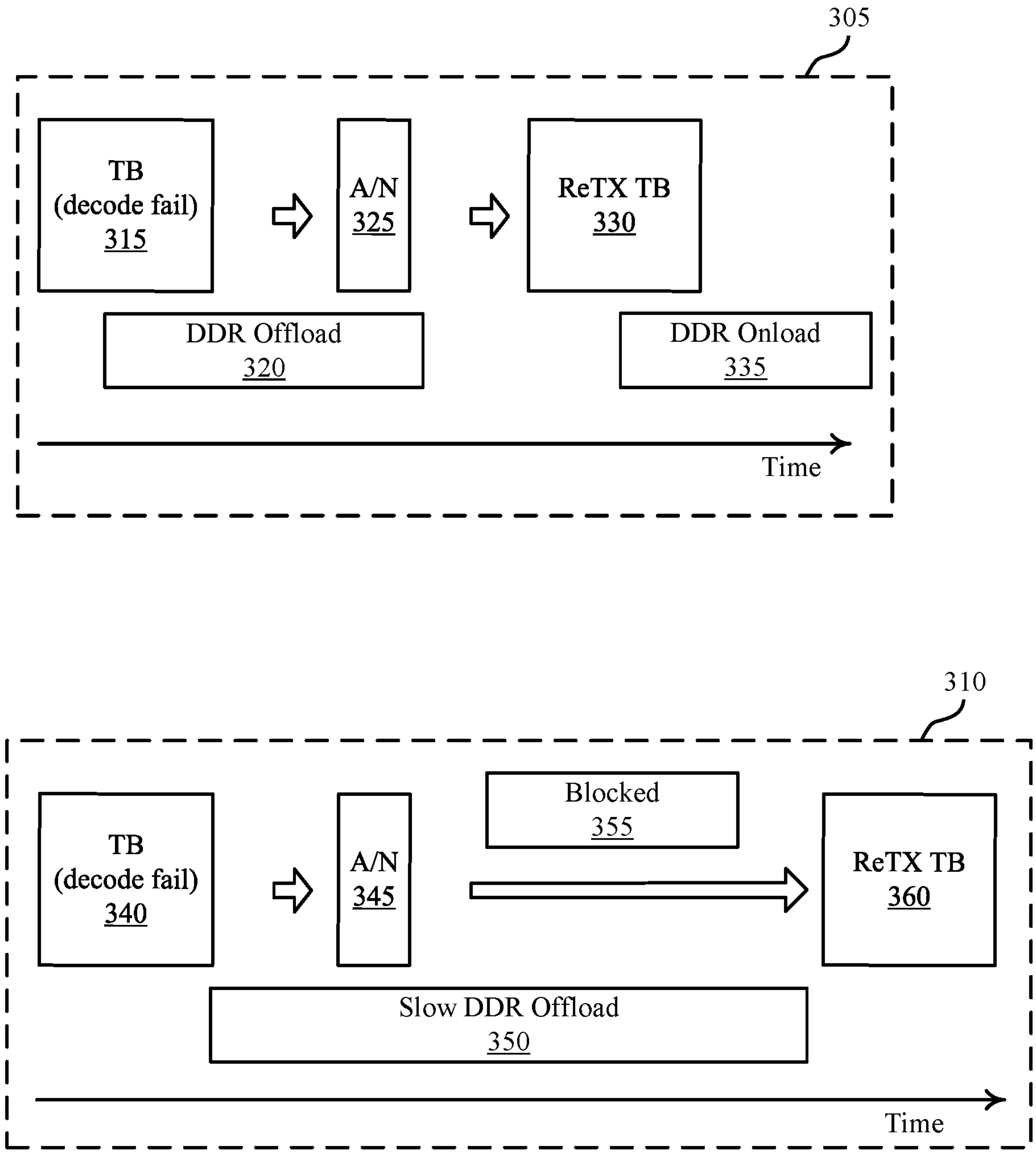

305
TB
(decode fail)
315
A/N
325
ReTX TB
330
DDR Offload
320
DDR Onload
335
Time
310
TB
(decode fail)
340
A/N
345
Blocked
355
ReTX TB
360
Slow DDR Offload
350
Time

FIG. 3

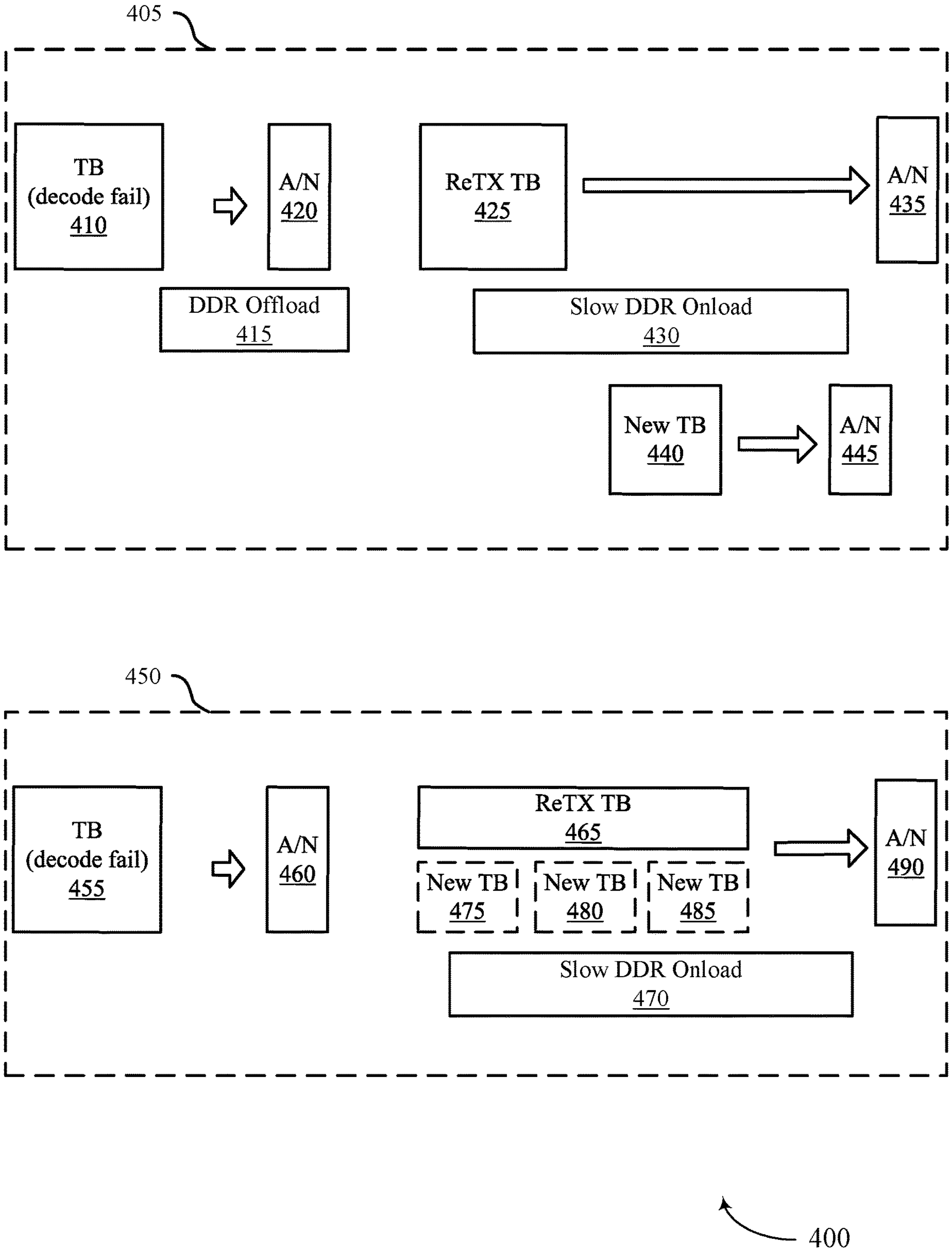

405
TB
(decode fail)
410
A/N
420
ReTX TB
425
A/N
435
DDR Offload
415
Slow DDR Onload
430
New TB
440
A/N
445
450
TB
(decode fail)
455
A/N
460
ReTX TB
465
New TB
475
New TB
480
New TB
485
A/N
490
Slow DDR Onload
470
400

FIG. 4

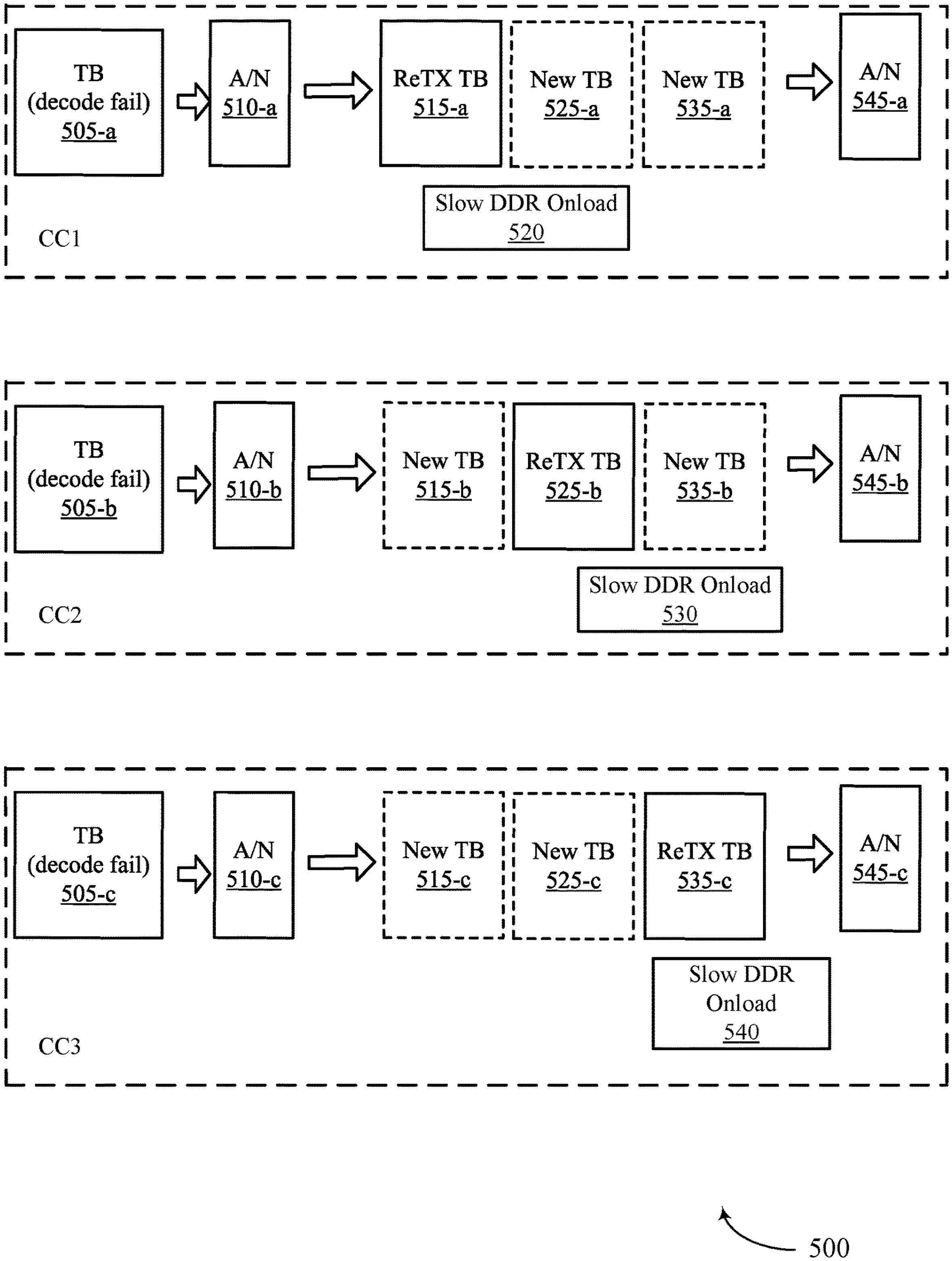

TB
(decode fail)
505-a
A/N
510-a
ReTX TB
515-a
New TB
525-a
New TB
535-a
A/N
545-a
Slow DDR Onload
520
CC1
TB
(decode fail)
505-b
A/N
510-b
New TB
515-b
ReTX TB
525-b
New TB
535-b
A/N
545-b
Slow DDR Onload
530
CC2
TB
(decode fail)
505-c
A/N
510-c
New TB
515-c
New TB
525-c
ReTX TB
535-c
A/N
545-c
Slow DDR
Onload
540
CC3
500

FIG. 5

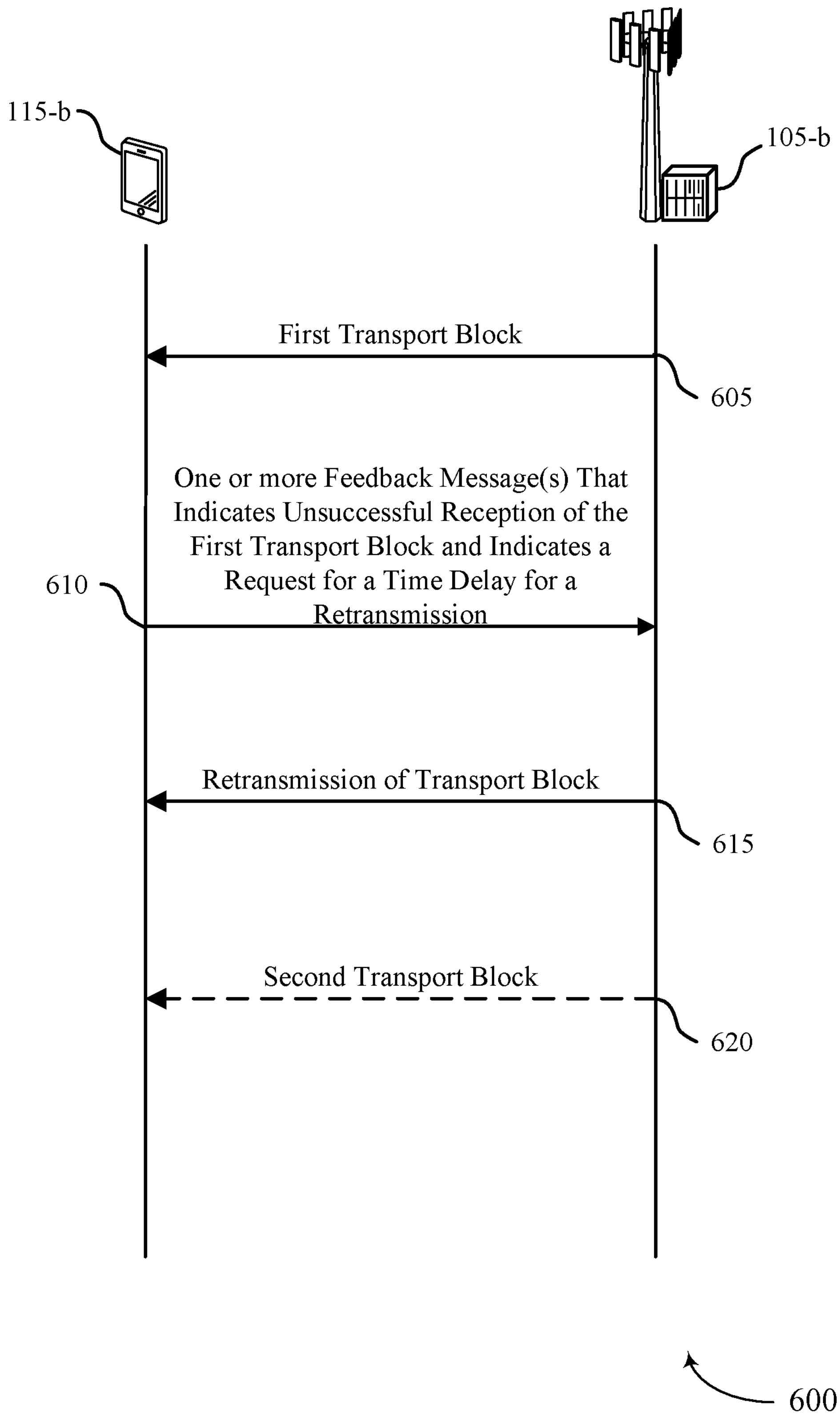

115-b
105-b
First Transport Block
605
One or more Feedback Message(s) That Indicates Unsuccessful Reception of the First Transport Block and Indicates a Request for a Time Delay for a Retransmission
610
Retransmission of Transport Block
615
Second Transport Block
620
600

FIG. 6

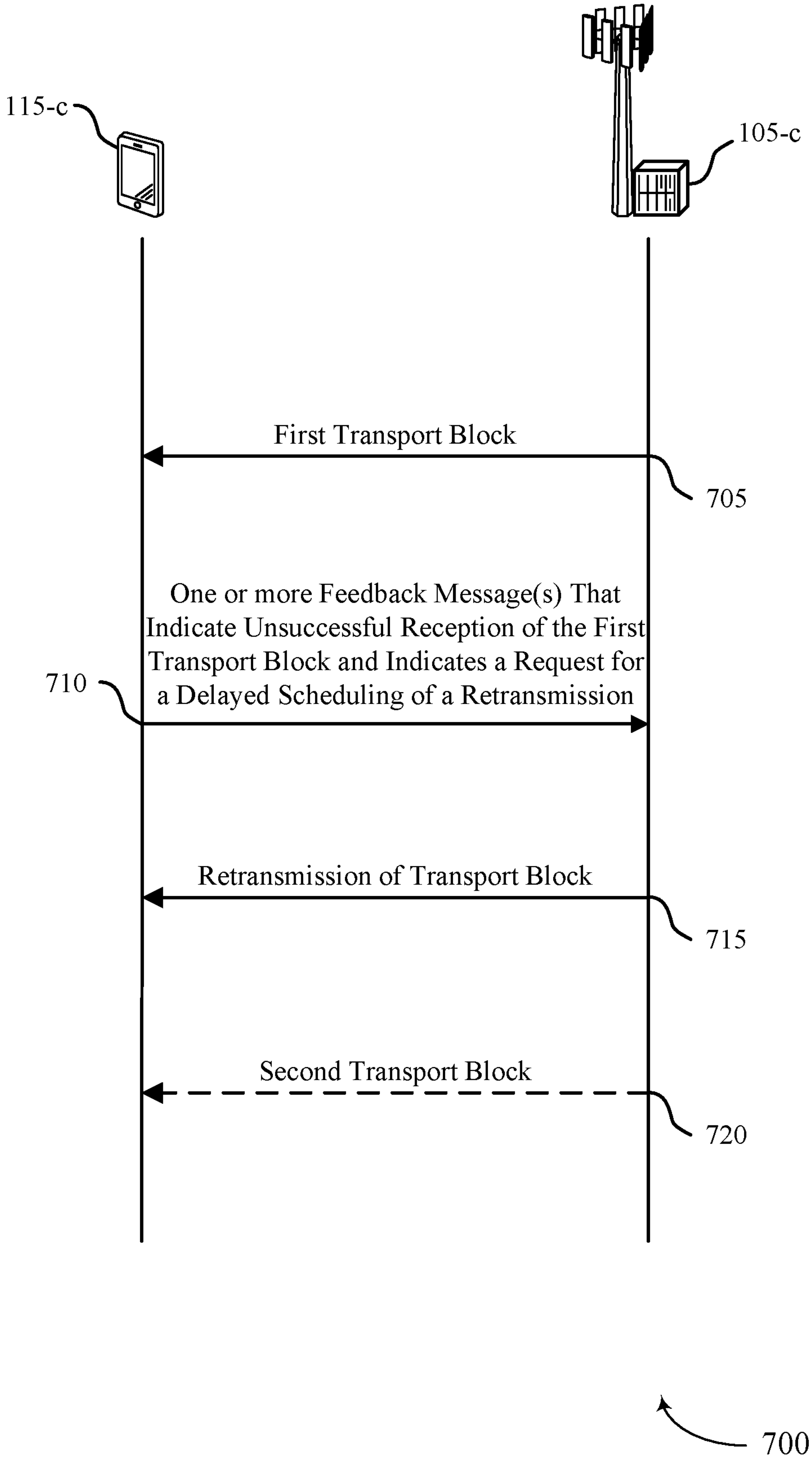

115-c
105-c
First Transport Block
705
One or more Feedback Message(s) That Indicate Unsuccessful Reception of the First Transport Block and Indicates a Request for a Delayed Scheduling of a Retransmission
710
Retransmission of Transport Block
715
Second Transport Block
720
700

FIG. 7

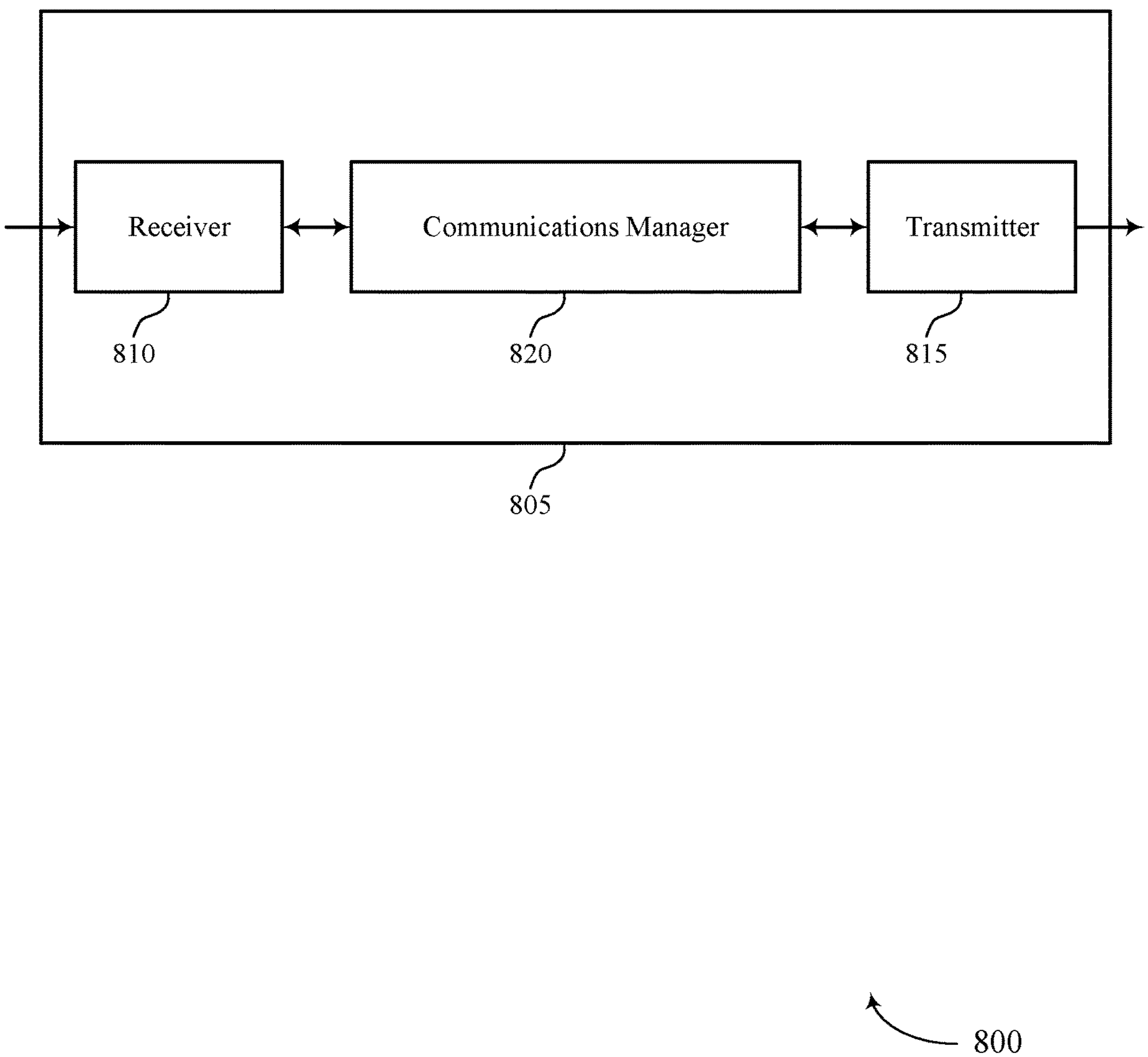

Receiver
Communications Manager
Transmitter
810
820
815
805
800

FIG. 8

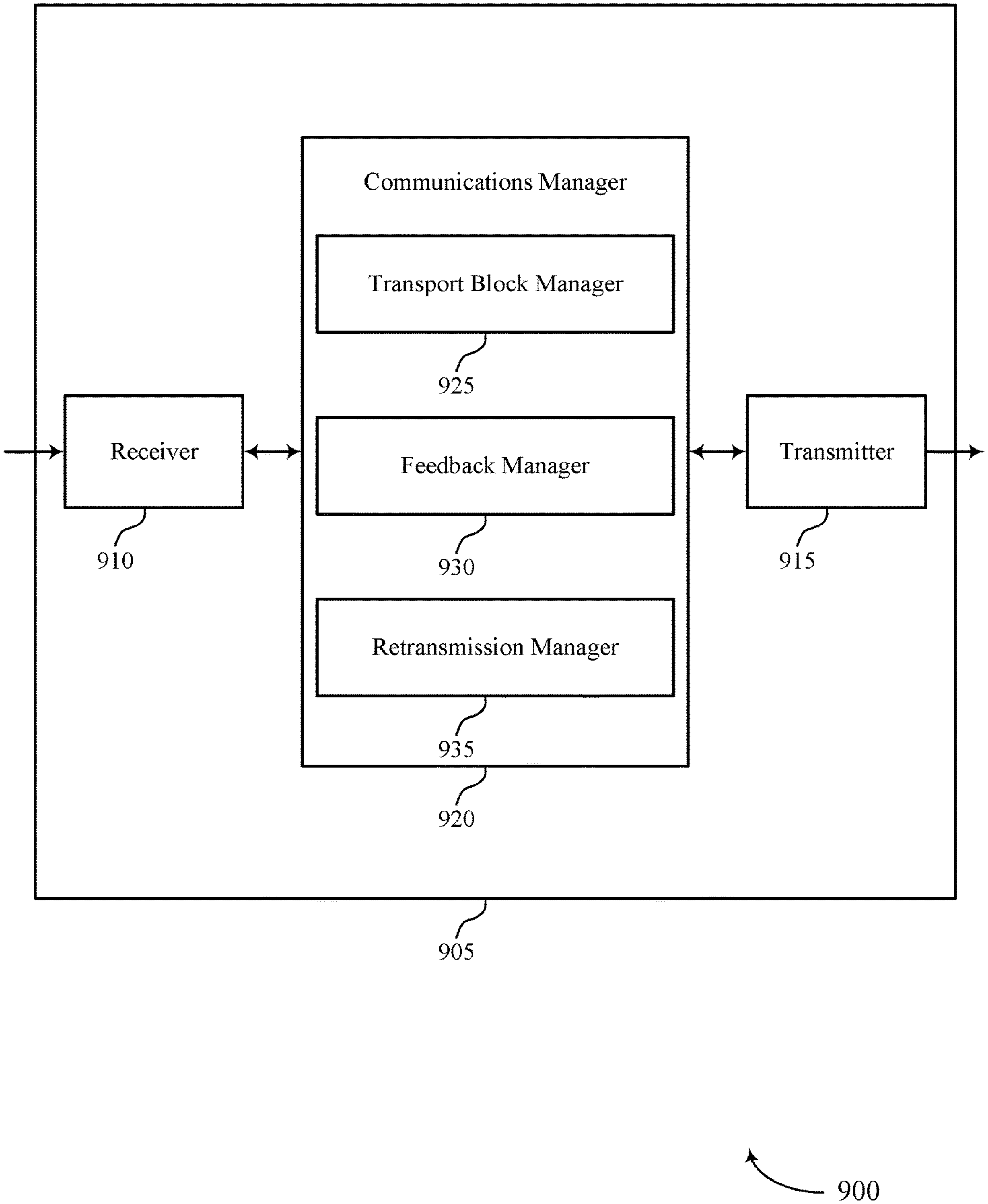

Communications Manager
Transport Block Manager
925
Receiver
Feedback Manager
Transmitter
910
930
915
Retransmission Manager
935
920
905
900

FIG. 9

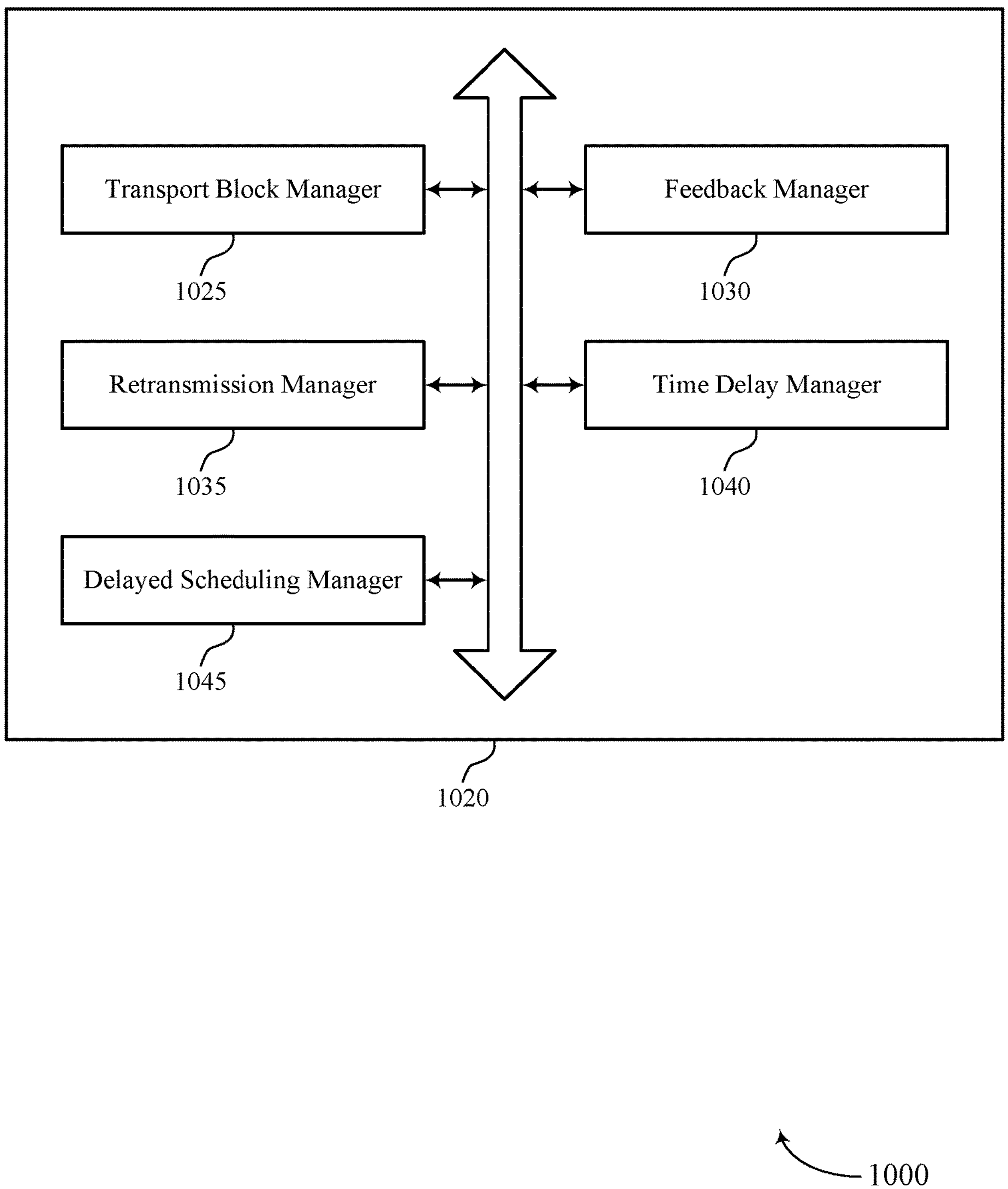

Transport Block Manager
1025
Feedback Manager
1030
Retransmission Manager
1035
Time Delay Manager
1040
Delayed Scheduling Manager
1045
1020
1000

FIG. 10

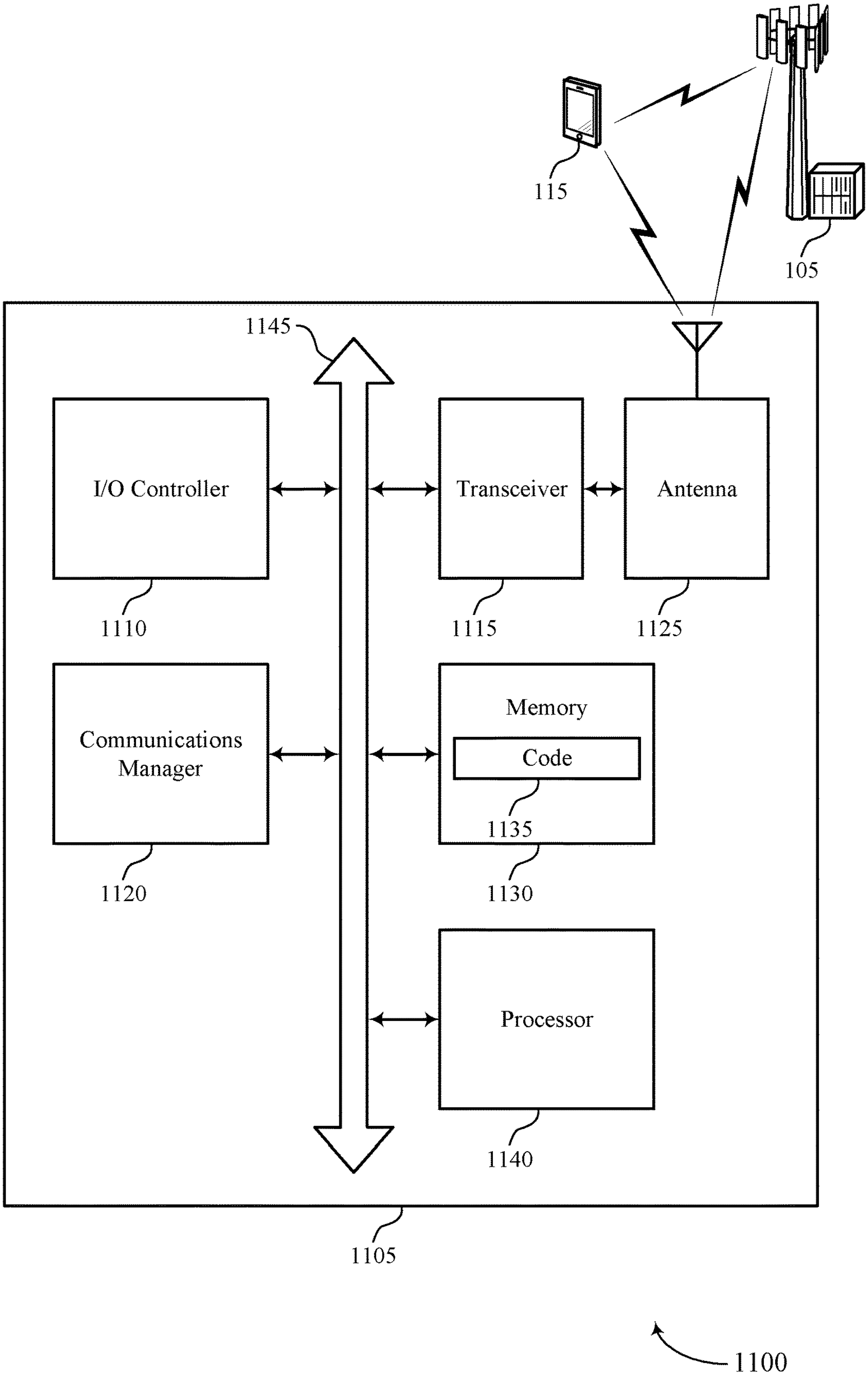

115
105
1145
I/O Controller
Transceiver
Antenna
1110
1115
1125
Communications Manager
Memory
Code
1135
1120
1130
Processor
1140
1105
1100

FIG. 11

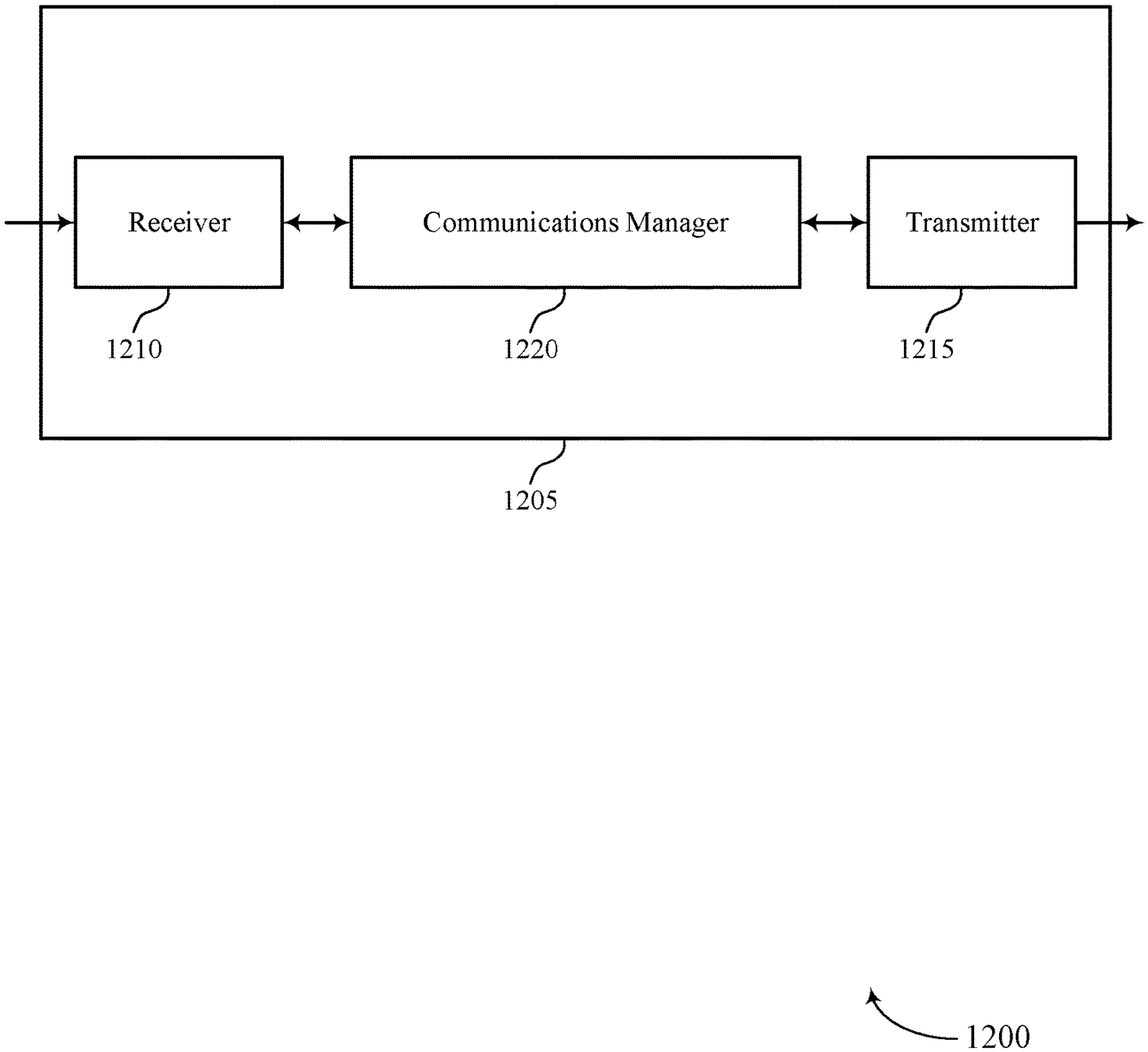

Receiver
Communications Manager
Transmitter
1210
1220
1215
1205
1200

FIG. 12

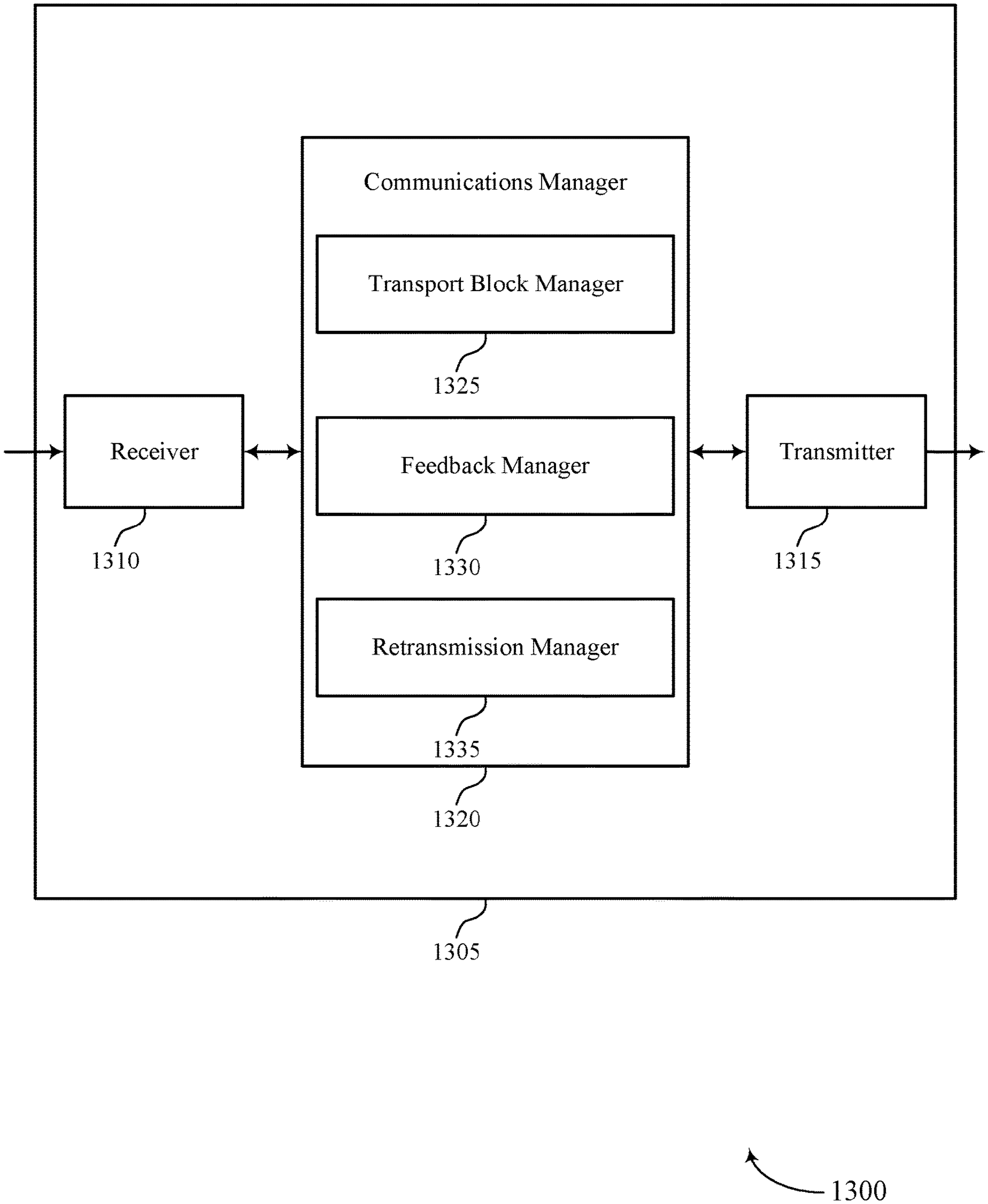

Communications Manager
Transport Block Manager
1325
Receiver
Feedback Manager
Transmitter
1310
1330
1315
Retransmission Manager
1335
1320
1305
1300

FIG. 13

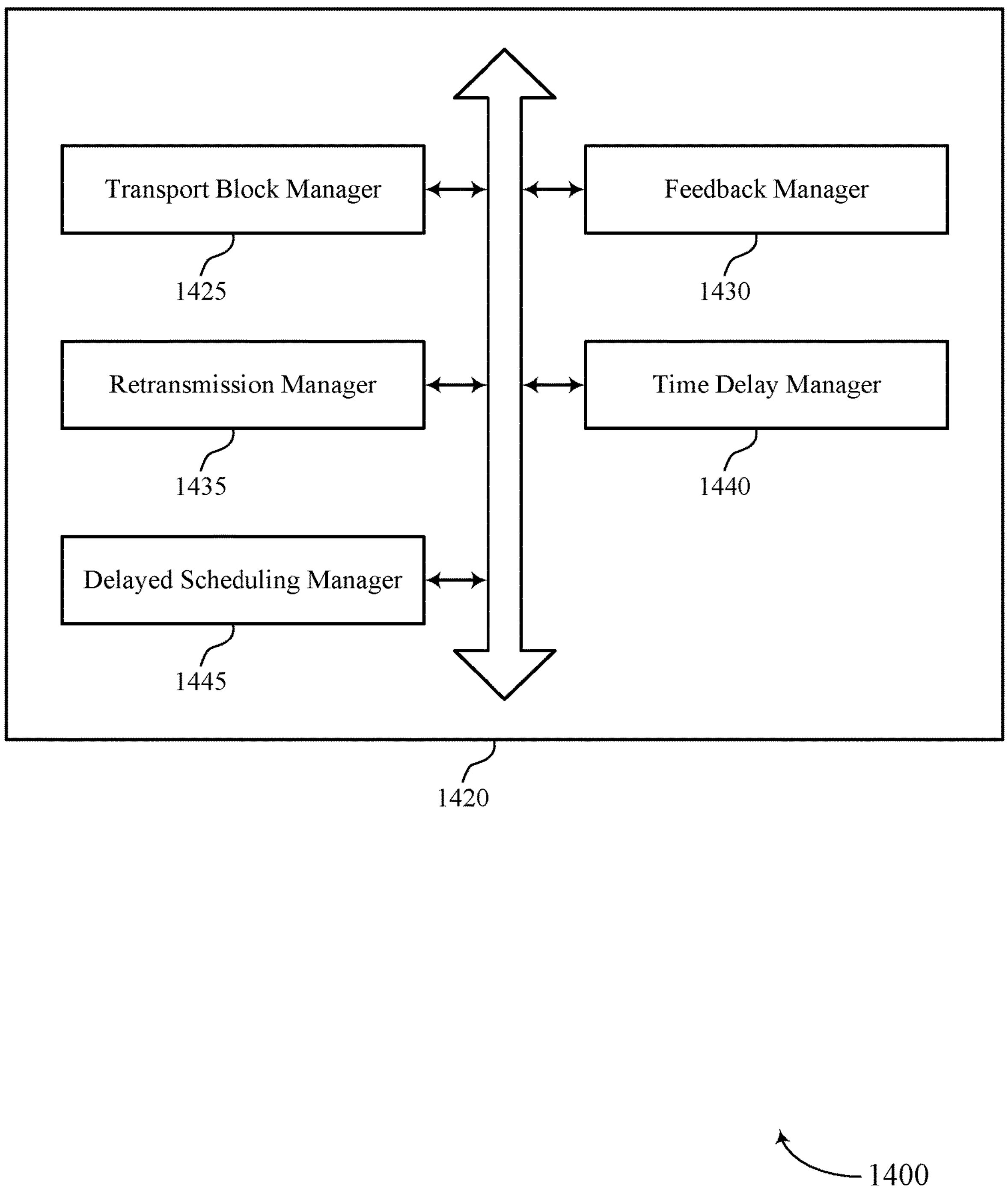

Transport Block Manager
1425
Feedback Manager
1430
Retransmission Manager
1435
Time Delay Manager
1440
Delayed Scheduling Manager
1445
1420
1400

FIG. 14

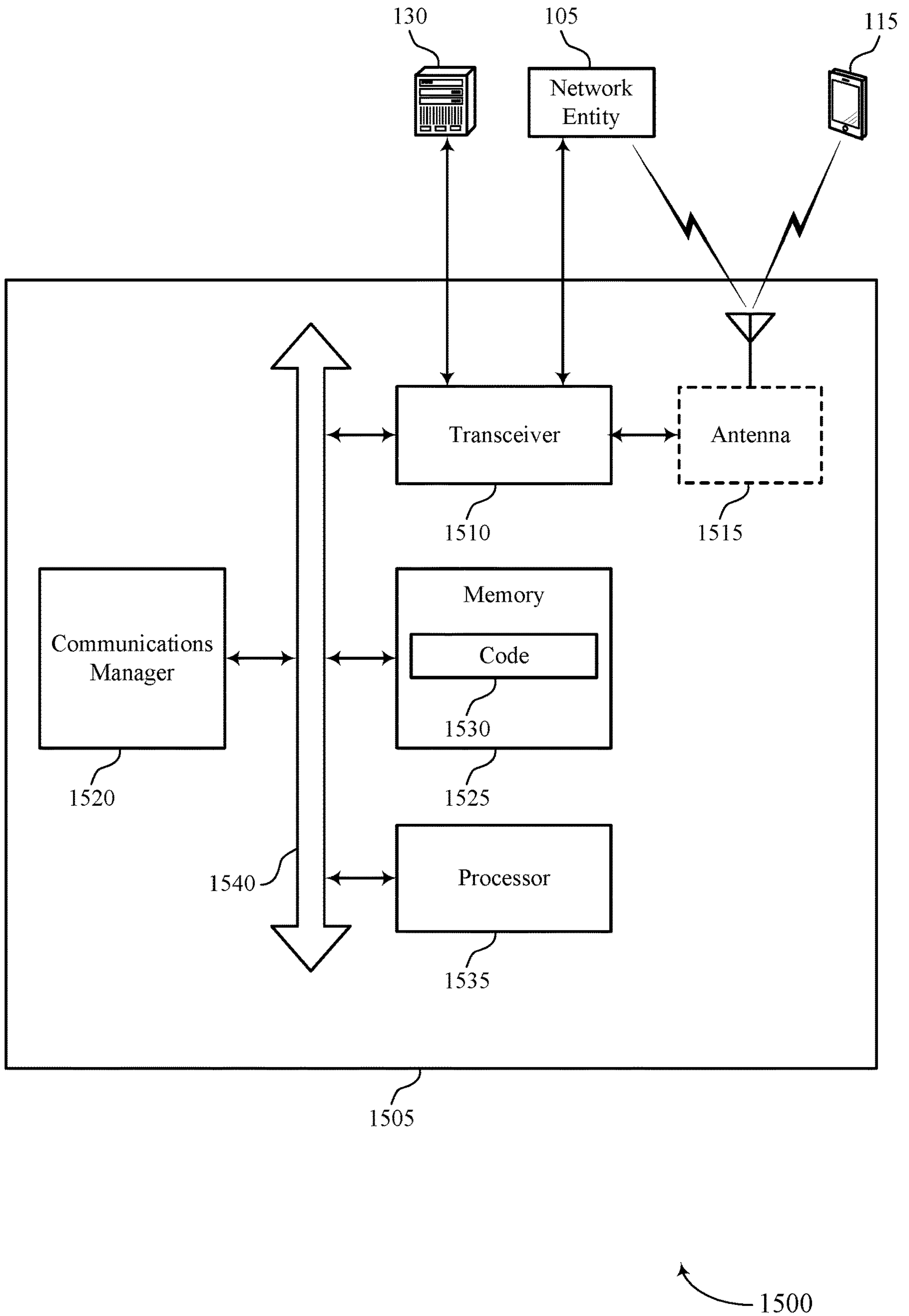

130
105
Network Entity
115
Transceiver
Antenna
1510
1515
Communications Manager
Memory
Code
1530
1520
1525
1540
Processor
1535
1505
1500

FIG. 15

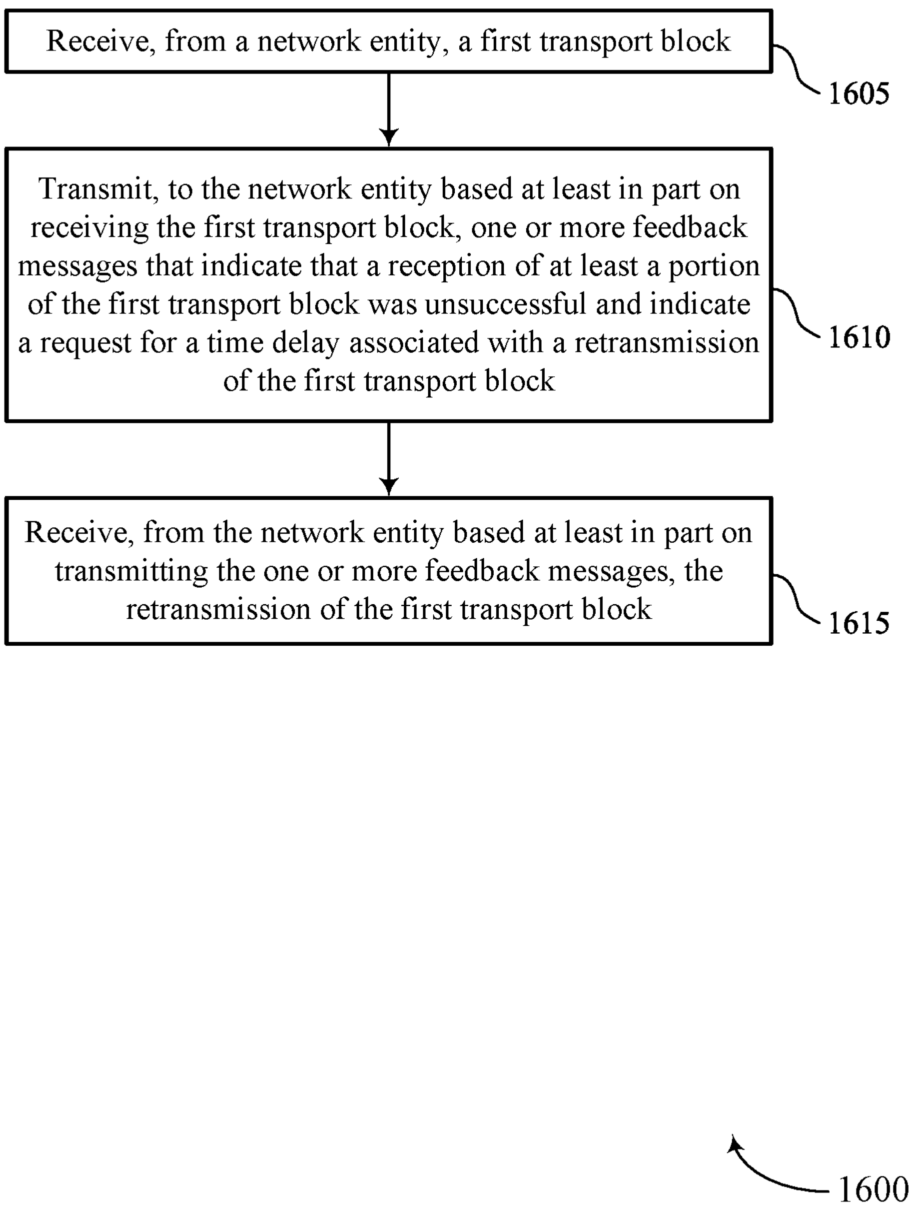

Receive, from a network entity, a first transport block
1605
Transmit, to the network entity based at least in part on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block
1610
Receive, from the network entity based at least in part on transmitting the one or more feedback messages, the retransmission of the first transport block
1615
1600

FIG. 16

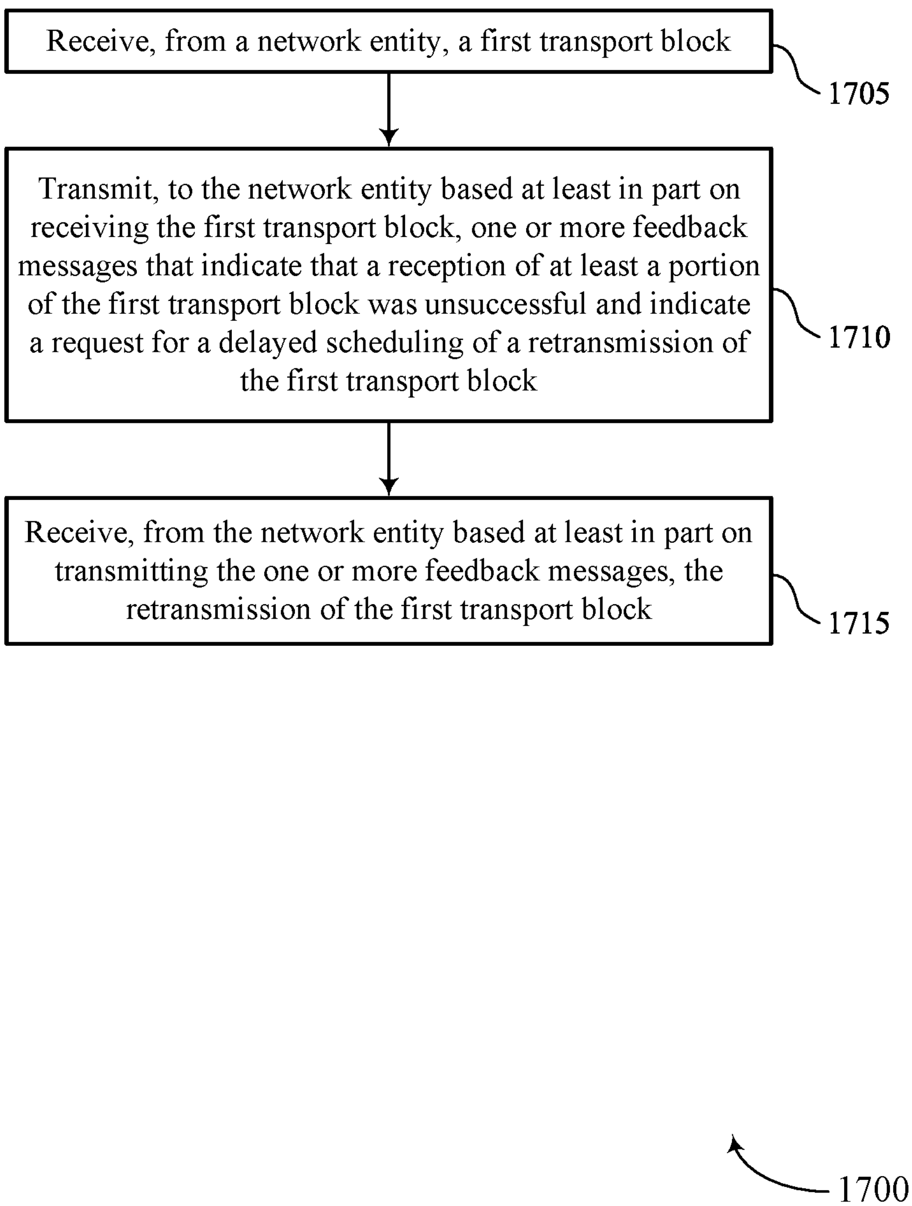

Receive, from a network entity, a first transport block
1705
Transmit, to the network entity based at least in part on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block
1710
Receive, from the network entity based at least in part on transmitting the one or more feedback messages, the retransmission of the first transport block
1715
1700

FIG. 17

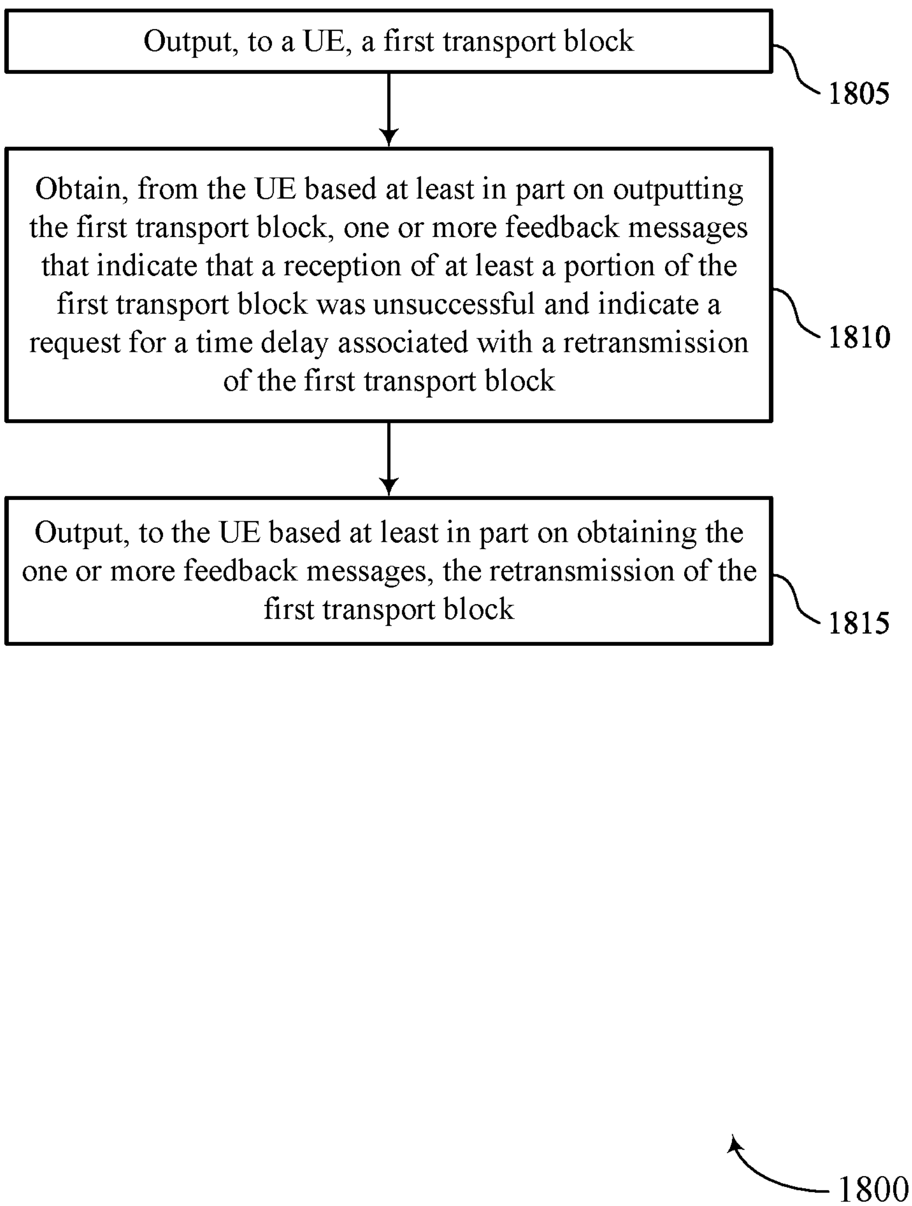

Output, to a UE, a first transport block
1805
Obtain, from the UE based at least in part on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block
1810
Output, to the UE based at least in part on obtaining the one or more feedback messages, the retransmission of the first transport block
1815
1800

FIG. 18

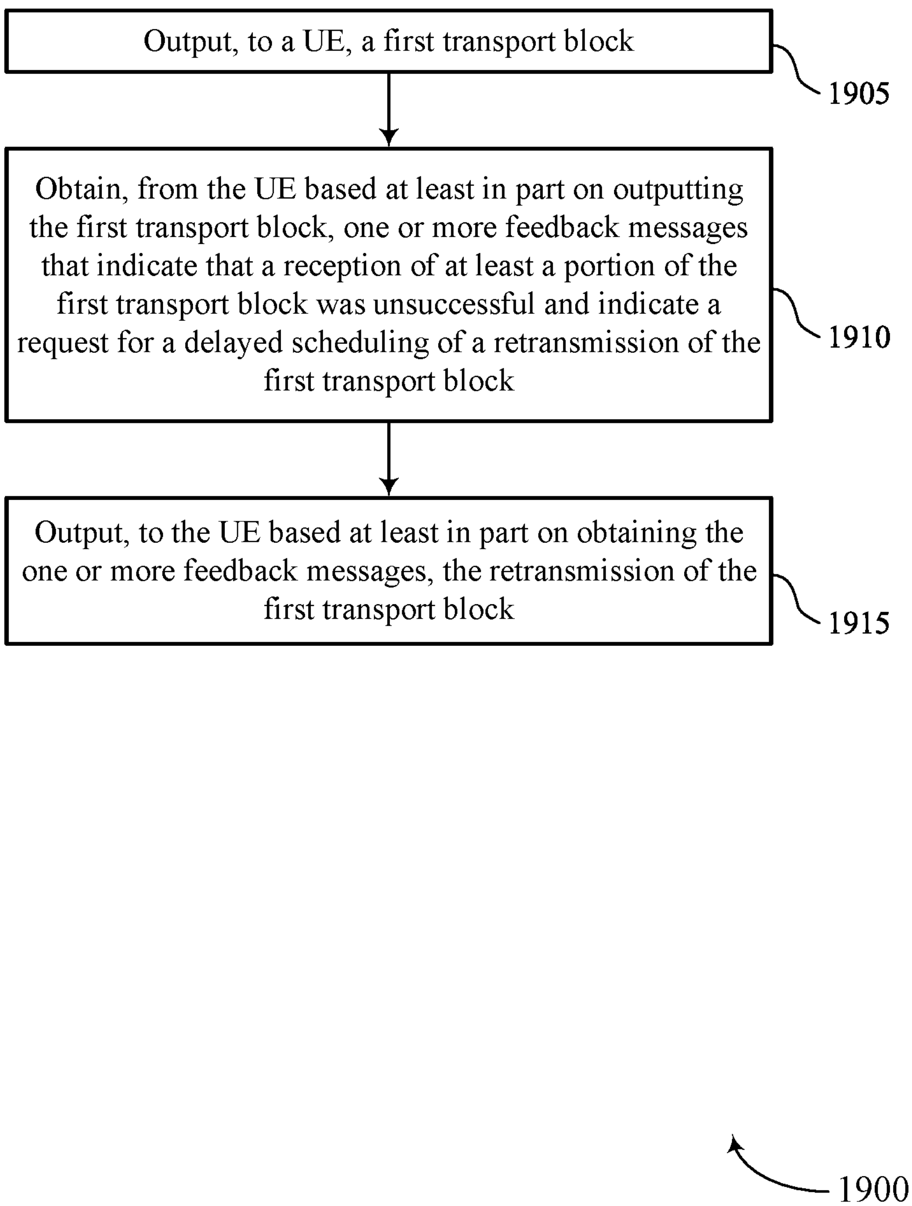

Output, to a UE, a first transport block
1905
Obtain, from the UE based at least in part on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block
1910
Output, to the UE based at least in part on obtaining the one or more feedback messages, the retransmission of the first transport block
1915
1900

FIG. 19

HYBRID AUTOMATIC REPEAT REQUEST DESIGN

FIELD OF TECHNOLOGY

[0001] The following relates to wireless communications, including hybrid automatic repeat request design.

BACKGROUND

[0002] Wireless communications systems are widely deployed to provide various types of communication content such as voice, video, packet data, messaging, broadcast, and so on. These systems may be capable of supporting communication with multiple users by sharing the available system resources (e.g., time, frequency, and power). Examples of such multiple-access systems include fourth generation (4G) systems such as Long Term Evolution (LTE) systems, LTE-Advanced (LTE-A) systems, or LTE-A Pro systems, and fifth generation (5G) systems which may be referred to as New Radio (NR) systems. These systems may employ technologies such as code division multiple access (CDMA), time division multiple access (TDMA), frequency division multiple access (FDMA), orthogonal FDMA (OFDMA), or discrete Fourier transform spread orthogonal frequency division multiplexing (DFT-S-OFDM). A wireless multiple-access communications system may include one or more base stations, each supporting wireless communication for communication devices, which may be known as user equipment (UE).

SUMMARY

[0003] The described techniques relate to improved methods, systems, devices, and apparatuses that support hybrid automatic repeat request (HARQ) design. For example, the described techniques provide for a HARQ procedure retransmission tapering. In some examples, a user equipment (UE) may receive, from a network entity, a transport block. The UE may transmit, to the network entity, one or more feedback messages that indicate that a reception of the transport block was unsuccessful and that indicate a request for a time delay associated with a retransmission of the transport block. In some examples, the time delay may be a delayed timeline for a transmission of an acknowledgment (ACK) feedback or a negative acknowledgment (NACK) feedback associated with a reception of the retransmission. In some cases, the time delay may be an extended transmission duration for the retransmission of the transport block.

[0004] A method for wireless communication by a user equipment (UE) is described. The method may include receiving, from a network entity, a first transport block, transmitting, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block, and receiving, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0005] A user equipment (UE) for wireless communication is described. The user equipment (UE) may include one or more memories storing processor executable code, and one or more processors coupled with the one or more memories. The one or more processors may individually or collectively be operable to execute the code to cause the user equipment (UE) to receive, from a network entity, a first transport block, transmit, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block, and receive, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0006] Another user equipment (UE) for wireless communication is described. The user equipment (UE) may include means for receiving, from a network entity, a first transport block, means for transmitting, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block, and means for receiving, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0007] A non-transitory computer-readable medium storing code for wireless communication is described. The code may include instructions executable by one or more processors to receive, from a network entity, a first transport block, transmit, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block, and receive, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0008] In some examples of the method, user equipment (UEs), and non-transitory computer-readable medium described herein, the time delay includes a delayed timeline for a transmission of a first ACK feedback or a first NACK feedback associated with a reception of the retransmission of the first transport block.

[0009] Some examples of the method, user equipment (UEs), and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for receiving, from the network entity after transmitting the one or more feedback messages, a second transport block and transmitting, to the network entity based on receiving the second transport block, a second ACK feedback or a second NACK feedback associated with a reception of the second transport block, where the transmission of the second ACK feedback or the second NACK feedback occurs prior to the transmission of the first ACK feedback or the first NACK feedback.

[0010] In some examples of the method, user equipment (UEs), and non-transitory computer-readable medium described herein, the time delay includes an extended transmission duration for the retransmission of the first transport block.

[0011] Some examples of the method, user equipment (UEs), and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for receiving, from the network entity based on transmitting the one or more feedback messages, a second transport block, where the retransmission of the first transport block may be frequency-division multiplexed with the second transport block.

[0012] Some examples of the method, user equipment (UEs), and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for receiving, from the network entity, a second transport block on a second component carrier, where the first transport block may be received on a first component carrier.

[0013] In some examples of the method, user equipment (UEs), and non-transitory computer-readable medium described herein, transmitting the one or more feedback messages may include operations, features, means, or instructions for transmitting, to the network entity based on receiving the first transport block and the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block, where the one or more joint feedback messages indicate that the reception of at least the portion of the first transport block was unsuccessful and that a reception of at least the portion of the second transport block was unsuccessful and indicate the request for the time delay.

[0014] Some examples of the method, user equipment (UEs), and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for receiving, from the network entity based on a reception of at least a portion of the second transport block was unsuccessful, a retransmission of the second transport block, where the retransmission of the second transport block may be received after the retransmission of the first transport block.

[0015] In some examples of the method, user equipment (UEs), and non-transitory computer-readable medium described herein, transmitting the one or more feedback messages may include operations, features, means, or instructions for transmitting a NACK feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and transmitting a message that indicates the request for the time delay associated with the retransmission of the first transport block.

[0016] In some examples of the method, user equipment (UEs), and non-transitory computer-readable medium described herein, transmitting the one or more feedback messages may include operations, features, means, or instructions for transmitting a NACK feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the time delay associated with the retransmission of the first transport block.

[0017] A method for wireless communication by a user equipment (UE) is described. The method may include receiving, from a network entity, a first transport block, transmitting, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block, and receive, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0018] A user equipment (UE) for wireless communication is described. The user equipment (UE) may include one or more memories storing processor executable code, and one or more processors coupled with the one or more memories. The one or more processors may individually or collectively be operable to execute the code to cause the user equipment (UE) to receive, from a network entity, a first transport block, transmit, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block, and receive, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0019] Another user equipment (UE) for wireless communication is described. The user equipment (UE) may include means for receiving, from a network entity, a first transport block, means for transmitting, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block, and means for receive, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0020] A non-transitory computer-readable medium storing code for wireless communication is described. The code may include instructions executable by one or more processors to receive, from a network entity, a first transport block, transmit, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block, and receive, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0021] Some examples of the method, user equipment (UEs), and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for receiving, from the network entity, a second transport block on a second component carrier, where the first transport block may be received on a first component carrier.

[0022] In some examples of the method, user equipment (UEs), and non-transitory computer-readable medium described herein, transmitting the one or more feedback messages may include operations, features, means, or instructions for transmitting, to the network entity based on receiving the first transport block and receiving the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block, where the one or more joint feedback messages indicate that the reception of at least the portion of the first transport block and indicate that a reception of at least the portion of the second transport block was unsuccessful and indicate the request for the delayed scheduling.

[0023] In some examples of the method, user equipment (UEs), and non-transitory computer-readable medium described herein, transmitting the one or more feedback messages may include operations, features, means, or instructions for transmitting a NACK feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and transmitting a request message that indicates the request for the delayed scheduling.

[0024] In some examples of the method, user equipment (UEs), and non-transitory computer-readable medium described herein, transmitting the one or more feedback messages may include operations, features, means, or instructions for transmitting a NACK feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the delayed scheduling.

[0025] A method for wireless communication by a network entity is described. The method may include outputting, to a user equipment (UE), a first transport block, obtaining, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block, and outputting, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0026] A network entity for wireless communication is described. The network entity may include one or more memories storing processor executable code, and one or more processors coupled with the one or more memories. The one or more processors may individually or collectively be operable to execute the code to cause the network entity to output, to a UE, a first transport block, obtain, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block, and output, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0027] Another network entity for wireless communication is described. The network entity may include means for outputting, to a UE, a first transport block, means for obtaining, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block, and means for outputting, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0028] A non-transitory computer-readable medium storing code for wireless communication is described. The code may include instructions executable by one or more processors to output, to a UE, a first transport block, obtain, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block, and output, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0029] In some examples of the method, network entities, and non-transitory computer-readable medium described herein, the time delay includes a delayed timeline for obtaining a first ACK feedback or a first NACK feedback associated with the retransmission of the first transport block.

[0030] Some examples of the method, network entities, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for outputting, to the UE based on obtaining the one or more feedback messages, a second transport block and obtaining, from the UE based on outputting the second transport block, a second ACK feedback or a second NACK feedback associated with the second transport block, where the obtaining of the second ACK feedback or the second NACK feedback occurs prior to the obtaining of the first ACK feedback or the first NACK feedback.

[0031] In some examples of the method, network entities, and non-transitory computer-readable medium described herein, the time delay includes an extended transmission duration for the retransmission of the first transport block.

[0032] Some examples of the method, network entities, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for outputting, to the UE based on obtaining the one or more feedback messages, a second transport block and the retransmission of the first transport block, where the retransmission of the first transport block may be frequency-division multiplexed with the second transport block.

[0033] Some examples of the method, network entities, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for outputting, to the UE, a second transport block on a second component carrier, where the first transport block may be outputted on a first component carrier.

[0034] In some examples of the method, network entities, and non-transitory computer-readable medium described herein, obtaining the one or more feedback messages may include operations, features, means, or instructions for obtaining, from the UE based on outputting the first transport block and outputting the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block, where the one or more joint feedback messages indicate that the reception of at least the portion of the first transport block and a reception of at least the portion of the second transport block was unsuccessful and indicate the request for the time delay.

[0035] Some examples of the method, network entities, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for obtaining, from the UE based on outputting the first transport block and outputting the second transport block, one or more second feedback messages associated with the second transport block, where the one or more second feedback messages indicate that a reception of at least the portion of the second transport block was unsuccessful and outputting, to the UE based on the reception of the one or more second feedback messages, a retransmission of the second transport block, where the retransmission of the second transport block may be outputted after the retransmission of the first transport block.

[0036] In some examples of the method, network entities, and non-transitory computer-readable medium described herein, obtaining the one or more feedback messages may include operations, features, means, or instructions for obtaining a NACK feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and obtaining a request message that indicates the request for the time delay associated with the retransmission of the first transport block.

[0037] In some examples of the method, network entities, and non-transitory computer-readable medium described herein, obtaining the one or more feedback messages may include operations, features, means, or instructions for obtaining a NACK feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the time delay associated with the retransmission of the first transport block.

[0038] A method for wireless communication by a network entity is described. The method may include outputting, to a UE, a first transport block, obtaining, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block, and outputting, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0039] A network entity for wireless communication is described. The network entity may include one or more memories storing processor executable code, and one or more processors coupled with the one or more memories. The one or more processors may individually or collectively be operable to execute the code to cause the network entity to output, to a UE, a first transport block, obtain, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block, and output, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0040] Another network entity for wireless communication is described. The network entity may include means for outputting, to a UE, a first transport block, means for obtaining, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block, and means for outputting, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0041] A non-transitory computer-readable medium storing code for wireless communication is described. The code may include instructions executable by one or more processors to output, to a UE, a first transport block, obtain, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block, and output, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0042] Some examples of the method, network entities, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for outputting, to the UE, a second transport block on a second component carrier, where the first transport block may be outputted on a first component carrier.

[0043] In some examples of the method, network entities, and non-transitory computer-readable medium described herein, obtaining the one or more feedback messages may include operations, features, means, or instructions for obtaining, from the UE based on outputting the first transport block and outputting the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block, where the one or more joint feedback messages indicate that the reception of at least the portion of the first transport block and a reception of at least the portion of the second transport block was unsuccessful and indicate the request for the delayed scheduling.

[0044] In some examples of the method, network entities, and non-transitory computer-readable medium described herein, obtaining the one or more feedback messages may include operations, features, means, or instructions for obtaining a NACK feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and obtaining a request message that indicates the request for the delayed scheduling.

[0045] In some examples of the method, network entities, and non-transitory computer-readable medium described herein, obtaining the one or more feedback messages may include operations, features, means, or instructions for obtaining a NACK feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the delayed scheduling.

BRIEF DESCRIPTION OF THE DRAWINGS

[0046] FIG. **1** shows an example of a wireless communications system that supports hybrid automatic repeat request (HARQ) design in accordance with one or more aspects of the present disclosure.

[0047] FIG. **2** shows an example of a wireless communications system that supports HARQ design in accordance with one or more aspects of the present disclosure.

[0048] FIG. **3** shows an example of a timing diagram that supports HARQ design in accordance with one or more aspects of the present disclosure.

[0049] FIG. **4** shows an example of a timing diagram that supports HARQ design in accordance with one or more aspects of the present disclosure.

[0050] FIG. **5** shows an example of a timing diagram that supports HARQ design in accordance with one or more aspects of the present disclosure.

[0051] FIG. **6** shows an example of a process flow that supports HARQ design in accordance with one or more aspects of the present disclosure.

[0052] FIG. **7** shows an example of a process flow that supports HARQ design in accordance with one or more aspects of the present disclosure.

[0053] FIGS. **8** and **9** show block diagrams of devices that support HARQ design in accordance with one or more aspects of the present disclosure.

[0054] FIG. **10** shows a block diagram of a communications manager that supports HARQ design in accordance with one or more aspects of the present disclosure.

[0055] FIG. **11** shows a diagram of a system including a device that supports HARQ design in accordance with one or more aspects of the present disclosure.

[0056] FIGS. **12** and **13** show block diagrams of devices that support HARQ design in accordance with one or more aspects of the present disclosure.

[0057] FIG. **14** shows a block diagram of a communications manager that supports HARQ design in accordance with one or more aspects of the present disclosure.

[0058] FIG. **15** shows a diagram of a system including a device that supports HARQ design in accordance with one or more aspects of the present disclosure.

[0059] FIGS. **16** through **19** show flowcharts illustrating methods that support HARQ design in accordance with one or more aspects of the present disclosure.

DETAILED DESCRIPTION

[0060] In some wireless communications systems, a user equipment (UE) may communicate with a network entity. In some examples, signaling from the network entity may be encoded, and the UE may perform a decoding operation to process data transmitted by the network entity. In some examples, the UE may implement an incremental redundancy (IR) hybrid automatic repeat request (HARQ) procedure to mitigate decoding errors during the decoding operations. For example, the UE may write or offload log-likelihood ratios (LLRs) associated with the IR-HARQ process to a memory (e.g., a low-power double data rate (LPDDR) synchronous dynamic random-access memory (SRAM)) of the UE. As a part of the IR-HARQ procedure, the network entity may retransmit the encoded signaling if the UE fails to decode the initial encoded signaling, and the UE may read or onload the LLRs from the memory associated with the retransmitted encoded signaling. As a part of the decoding operation, the UE may write bits (e.g., offload) to the memory of the UE, the UE may read bits (e.g., onload) from the memory of the UE, or both onload and offload bits (e.g., information bits) to/from the memory of the UE. However, the bandwidth of the memory may limit an ability of the UE to write data to or read data from the memory.

[0061] Techniques for HARQ design may provide an efficient usage of the memory bandwidth. A UE may receive, from a network entity, a first transport block. The UE may transmit, to the network entity, one or more feedback messages that indicate that a reception of a portion of the first transport block was unsuccessful and that indicate a request for a time delay associated with a retransmission of the first transport block. In some examples, the time delay may be a delayed timeline for a transmission of a first acknowledgment (ACK) feedback or a first negative acknowledgment (NACK) feedback associated with a reception of the retransmission, among other examples. The delayed timeline for the ACK feedback or NACK feedback may support tapering of the LLR onload associated with the retransmission by spreading the LLR onload over a longer duration. In some cases, the time delay may be an extended transmission duration for the retransmission of the first transport block. The extended transmission duration may support tapering of the LLR onload associated with the retransmission by spreading the LLR onload over a longer duration. In some examples, the UE may receive, from the network entity, the retransmission of the first transport block and a second transport block. In some cases, the retransmission of the first transport block may be frequency-division multiplexed with the second transport block. In some cases, the UE may transmit, to the network entity based on receiving the second transport block, a second ACK feedback or a second NACK feedback (among other examples) associated with a reception of the second transport block, and a second ACK feedback or a second NACK feedback may be transmitted prior to the transmission of the first ACK feedback or a first NACK feedback associated with the retransmission of the first transport block.

[0062] In some examples, the UE may receive, from a network entity, a first transport block. The UE may transmit, to the network entity, one or more feedback messages that indicate that a reception of a portion of the first transport block was unsuccessful and that indicate a request for a delayed scheduling of a retransmission of the first transport block. In some examples, the delayed scheduling of the retransmission may support tapering of the LLR offload associated with the first transport block by spreading the LLR offload over a longer duration. In some examples, the UE may receive, from the network entity, the retransmission of the first transport block and a second transport block. In some cases, the UE may receive the retransmission of the first transport block on a first component carrier and the second transport block on a second component carrier. The UE may transmit, to the network entity, one or more joint feedback messages associated with the first transport block and the second transport block.

[0063] Aspects of the disclosure are initially described in the context of wireless communications systems. Aspects of the disclosure are also described in context of timing diagrams and process flows. Aspects of the disclosure are further illustrated by and described with reference to apparatus diagrams, system diagrams, and flowcharts that relate to HARQ design.

[0064] FIG. **1** shows an example of a wireless communications system **100** that supports HARQ design in accordance with one or more aspects of the present disclosure. The wireless communications system **100** may include one or more network entities **105**, one or more UEs **115**, and a core network **130**. In some examples, the wireless communications system **100** may be a Long Term Evolution (LTE) network, an LTE-Advanced (LTE-A) network, an LTE-A Pro network, a New Radio (NR) network, or a network operating in accordance with other systems and radio technologies, including future systems and radio technologies not explicitly mentioned herein.

[0065] The network entities **105** may be dispersed throughout a geographic area to form the wireless communications system **100** and may include devices in different forms or having different capabilities. In various examples, a network entity **105** may be referred to as a network element, a mobility element, a radio access network (RAN) node, or network equipment, among other nomenclature. In some examples, network entities **105** and UEs **115** may wirelessly communicate via one or more communication links **125** (e.g., a radio frequency (RF) access link). For example, a network entity **105** may support a coverage area **110** (e.g., a geographic coverage area) over which the UEs **115** and the network entity **105** may establish one or more communication links **125**. The coverage area **110** may be an example of a geographic area over which a network entity **105** and a UE **115** may support the communication of signals according to one or more radio access technologies (RATs).

[0066] The UEs **115** may be dispersed throughout a coverage area **110** of the wireless communications system **100**, and each UE **115** may be stationary, or mobile, or both at different times. The UEs **115** may be devices in different forms or having different capabilities. Some example UEs **115** are illustrated in FIG. **1**. The UEs **115** described herein may be capable of supporting communications with various types of devices, such as other UEs **115** or network entities **105**, as shown in FIG. **1**.

[0067] As described herein, a node of the wireless communications system **100**, which may be referred to as a network node, or a wireless node, may be a network entity **105** (e.g., any network entity described herein), a UE **115** (e.g., any UE described herein), a network controller, an apparatus, a device, a computing system, one or more components, or another suitable processing entity configured to perform any of the techniques described herein. For example, a node may be a UE **115**. As another example, a node may be a network entity **105**. As another example, a first node may be configured to communicate with a second node or a third node. In one aspect of this example, the first node may be a UE **115**, the second node may be a network entity **105**, and the third node may be a UE **115**. In another aspect of this example, the first node may be a UE **115**, the second node may be a network entity **105**, and the third node may be a network entity **105**. In yet other aspects of this example, the first, second, and third nodes may be different relative to these examples. Similarly, reference to a UE **115**, network entity **105**, apparatus, device, computing system, or the like may include disclosure of the UE **115**, network entity **105**, apparatus, device, computing system, or the like being a node. For example, disclosure that a UE **115** is configured to receive information from a network entity **105** also discloses that a first node is configured to receive information from a second node.

[0068] In some examples, network entities **105** may communicate with the core network **130**, or with one another, or both. For example, network entities **105** may communicate with the core network **130** via one or more backhaul communication links **120** (e.g., in accordance with an S1, N2, N3, or other interface protocol). In some examples, network entities **105** may communicate with one another via a backhaul communication link **120** (e.g., in accordance with an X2, Xn, or other interface protocol) either directly (e.g., directly between network entities **105**) or indirectly (e.g., via a core network **130**). In some examples, network entities **105** may communicate with one another via a midhaul communication link **162** (e.g., in accordance with a midhaul interface protocol) or a fronthaul communication link **168** (e.g., in accordance with a fronthaul interface protocol), or any combination thereof. The backhaul communication links **120**, midhaul communication links **162**, or fronthaul communication links **168** may be or include one or more wired links (e.g., an electrical link, an optical fiber link), one or more wireless links (e.g., a radio link, a wireless optical link), among other examples or various combinations thereof. A UE **115** may communicate with the core network **130** via a communication link **155**.

[0069] One or more of the network entities **105** described herein may include or may be referred to as a base station **140** (e.g., a base transceiver station, a radio base station, an NR base station, an access point, a radio transceiver, a NodeB, an eNodeB (eNB), a next-generation NodeB or a giga-NodeB (either of which may be referred to as a gNB), a 5G NB, a next-generation eNB (ng-eNB), a Home NodeB, a Home eNodeB, or other suitable terminology). In some examples, a network entity **105** (e.g., a base station **140**) may be implemented in an aggregated (e.g., monolithic, standalone) base station architecture, which may be configured to utilize a protocol stack that is physically or logically integrated within a single network entity **105** (e.g., a single RAN node, such as a base station **140**).

[0070] In some examples, a network entity **105** may be implemented in a disaggregated architecture (e.g., a disaggregated base station architecture, a disaggregated RAN architecture), which may be configured to utilize a protocol stack that is physically or logically distributed among two or more network entities **105**, such as an integrated access backhaul (IAB) network, an open RAN (O-RAN) (e.g., a network configuration sponsored by the O-RAN Alliance), or a virtualized RAN (vRAN) (e.g., a cloud RAN (C-RAN)). For example, a network entity **105** may include one or more of a central unit (CU) **160**, a distributed unit (DU) **165**, a radio unit (RU) **170**, a RAN Intelligent Controller (RIC) **175** (e.g., a Near-Real Time RIC (Near-RT RIC), a Non-Real Time RIC (Non-RT RIC)), a Service Management and Orchestration (SMO) **180** system, or any combination thereof. An RU **170** may also be referred to as a radio head, a smart radio head, a remote radio head (RRH), a remote radio unit (RRU), or a transmission reception point (TRP). One or more components of the network entities **105** in a disaggregated RAN architecture may be co-located, or one or more components of the network entities **105** may be located in distributed locations (e.g., separate physical locations). In some examples, one or more network entities **105** of a disaggregated RAN architecture may be implemented as virtual units (e.g., a virtual CU (VCU), a virtual DU (VDU), a virtual RU (VRU)).

[0071] The split of functionality between a CU **160**, a DU **165**, and an RU **170** is flexible and may support different functionalities depending on which functions (e.g., network layer functions, protocol layer functions, baseband functions, RF functions, and any combinations thereof) are performed at a CU **160**, a DU **165**, or an RU **170**. For example, a functional split of a protocol stack may be employed between a CU **160** and a DU **165** such that the CU **160** may support one or more layers of the protocol stack and the DU **165** may support one or more different layers of the protocol stack. In some examples, the CU **160** may host upper protocol layer (e.g., layer 3 (L3), layer 2 (L2)) functionality and signaling (e.g., Radio Resource Control (RRC), service data adaption protocol (SDAP), Packet Data Convergence Protocol (PDCP)). The CU **160** may be connected to one or more DUs **165** or RUs **170**, and the one or more DUs **165** or RUs **170** may host lower protocol layers, such as layer 1 (L1) (e.g., physical (PHY) layer) or L2 (e.g., radio link control (RLC) layer, medium access control (MAC) layer) functionality and signaling, and may each be at least partially controlled by the CU **160**. Additionally, or alternatively, a functional split of the protocol stack may be employed between a DU **165** and an RU **170** such that the DU **165** may support one or more layers of the protocol stack and the RU **170** may support one or more different layers of the protocol stack. The DU **165** may support one or multiple different cells (e.g., via one or more RUs **170**). In some cases, a functional split between a CU **160** and a DU **165**, or between a DU **165** and an RU **170** may be within a protocol layer (e.g., some functions for a protocol layer may be performed by one of a CU **160**, a DU **165**, or an RU **170**, while other functions of the protocol layer are performed by a different one of the CU **160**, the DU **165**, or the RU **170**). A CU **160** may be functionally split further into CU control plane (CU-CP) and CU user plane (CU-UP) functions. A CU **160** may be connected to one or more DUs **165** via a midhaul communication link **162** (e.g., F1, F1-c, F1-u), and a DU **165** may be connected to one or more RUs **170** via a fronthaul communication link **168** (e.g., open fronthaul (FH) interface). In some examples, a midhaul communication link **162** or a fronthaul communication link **168** may be implemented in accordance with an interface (e.g., a channel) between layers of a protocol stack supported by respective network entities **105** that are in communication via such communication links.

[0072] In wireless communications systems (e.g., wireless communications system **100**), infrastructure and spectral resources for radio access may support wireless backhaul link capabilities to supplement wired backhaul connections, providing an IAB network architecture (e.g., to a core network **130**). In some cases, in an IAB network, one or more network entities **105** (e.g., IAB nodes **104**) may be partially controlled by each other. One or more IAB nodes **104** may be referred to as a donor entity or an IAB donor. One or more DUs **165** or one or more RUs **170** may be partially controlled by one or more CUs **160** associated with a donor network entity **105** (e.g., a donor base station **140**). The one or more donor network entities **105** (e.g., IAB donors) may be in communication with one or more additional network entities **105** (e.g., IAB nodes **104**) via supported access and backhaul links (e.g., backhaul communication links **120**). IAB nodes **104** may include an IAB mobile termination (IAB-MT) controlled (e.g., scheduled) by DUs **165** of a coupled IAB donor. An IAB-MT may include an independent set of antennas for relay of communications with UEs **115**, or may share the same antennas (e.g., of an RU **170**) of an IAB node **104** used for access via the DU **165** of the IAB node **104** (e.g., referred to as virtual IAB-MT (vIAB-MT)). In some examples, the IAB nodes **104** may include DUs **165** that support communication links with additional entities (e.g., IAB nodes **104**, UEs **115**) within the relay chain or configuration of the access network (e.g., downstream). In such cases, one or more components of the disaggregated RAN architecture (e.g., one or more IAB nodes **104** or components of IAB nodes **104**) may be configured to operate according to the techniques described herein.

[0073] In the case of the techniques described herein applied in the context of a disaggregated RAN architecture, one or more components of the disaggregated RAN architecture may be configured to support HARQ design as described herein. For example, some operations described as being performed by a UE **115** or a network entity **105** (e.g., a base station **140**) may additionally, or alternatively, be performed by one or more components of the disaggregated RAN architecture (e.g., IAB nodes **104**, DUs **165**, CUs **160**, RUs **170**, RIC **175**, SMO **180**).

[0074] A UE **115** may include or may be referred to as a mobile device, a wireless device, a remote device, a handheld device, or a subscriber device, or some other suitable terminology, where the "device" may also be referred to as a unit, a station, a terminal, or a client, among other examples. A UE **115** may also include or may be referred to as a personal electronic device such as a cellular phone, a personal digital assistant (PDA), a tablet computer, a laptop computer, or a personal computer. In some examples, a UE **115** may include or be referred to as a wireless local loop (WLL) station, an Internet of Things (IoT) device, an Internet of Everything (IoE) device, or a machine type communications (MTC) device, among other examples, which may be implemented in various objects such as appliances, or vehicles, meters, among other examples.

[0075] The UEs **115** described herein may be able to communicate with various types of devices, such as other UEs **115** that may sometimes act as relays as well as the network entities **105** and the network equipment including macro eNBs or gNBs, small cell eNBs or gNBs, or relay base stations, among other examples, as shown in FIG. **1**.

[0076] The UEs **115** and the network entities **105** may wirelessly communicate with one another via one or more communication links **125** (e.g., an access link) using resources associated with one or more carriers. The term "carrier" may refer to a set of RF spectrum resources having a defined physical layer structure for supporting the communication links **125**. For example, a carrier used for a communication link **125** may include a portion of a RF spectrum band (e.g., a bandwidth part (BWP)) that is operated according to one or more physical layer channels for a given radio access technology (e.g., LTE, LTE-A, LTE-A Pro, NR). Each physical layer channel may carry acquisition signaling (e.g., synchronization signals, system information), control signaling that coordinates operation for the carrier, user data, or other signaling. The wireless communications system **100** may support communication with a UE **115** using carrier aggregation or multi-carrier operation. A UE **115** may be configured with multiple downlink component carriers and one or more uplink component carriers according to a carrier aggregation configuration. Carrier aggregation may be used with both frequency division duplexing (FDD) and time division duplexing (TDD) component carriers. Communication between a network entity **105** and other devices may refer to communication between the devices and any portion (e.g., entity, sub-entity) of a network entity **105**. For example, the terms "transmitting," "receiving," or "communicating," when referring to a network entity **105**, may refer to any portion of a network entity **105** (e.g., a base station **140**, a CU **160**, a DU **165**, a RU **170**) of a RAN communicating with another device (e.g., directly or via one or more other network entities **105**).

[0077] Signal waveforms transmitted via a carrier may be made up of multiple subcarriers (e.g., using multi-carrier modulation (MCM) techniques such as orthogonal frequency division multiplexing (OFDM) or discrete Fourier transform spread OFDM (DFT-S-OFDM)). In a system employing MCM techniques, a resource element may refer to resources of one symbol period (e.g., a duration of one modulation symbol) and one subcarrier, in which case the symbol period and subcarrier spacing may be inversely related. The quantity of bits carried by each resource element may depend on the modulation scheme (e.g., the order of the modulation scheme, the coding rate of the modulation scheme, or both), such that a relatively higher quantity of resource elements (e.g., in a transmission duration) and a relatively higher order of a modulation scheme may correspond to a relatively higher rate of communication. A wireless communications resource may refer to a combination of an RF spectrum resource, a time resource, and a spatial resource (e.g., a spatial layer, a beam), and the use of multiple spatial resources may increase the data rate or data integrity for communications with a UE **115**.

[0078] The time intervals for the network entities **105** or the UEs **115** may be expressed in multiples of a basic time unit which may, for example, refer to a sampling period of $T_s=1/(\Delta f_{max} \cdot N_f)$ seconds, for which Δf_{max} may represent a supported subcarrier spacing, and N_f may represent a supported discrete Fourier transform (DFT) size. Time intervals of a communications resource may be organized according to radio frames each having a specified duration (e.g., 10 milliseconds (ms)). Each radio frame may be identified by a system frame number (SFN) (e.g., ranging from 0 to 1023).

[0079] Each frame may include multiple consecutively-numbered subframes or slots, and each subframe or slot may have the same duration. In some examples, a frame may be divided (e.g., in the time domain) into subframes, and each subframe may be further divided into a quantity of slots. Alternatively, each frame may include a variable quantity of slots, and the quantity of slots may depend on subcarrier spacing. Each slot may include a quantity of symbol periods (e.g., depending on the length of the cyclic prefix prepended to each symbol period). In some wireless communications systems **100**, a slot may further be divided into multiple mini-slots associated with one or more symbols. Excluding the cyclic prefix, each symbol period may be associated with one or more (e.g., N_f) sampling periods. The duration of a symbol period may depend on the subcarrier spacing or frequency band of operation.

[0080] A subframe, a slot, a mini-slot, or a symbol may be the smallest scheduling unit (e.g., in the time domain) of the wireless communications system **100** and may be referred to as a transmission time interval (TTI). In some examples, the TTI duration (e.g., a quantity of symbol periods in a TTI) may be variable. Additionally, or alternatively, the smallest scheduling unit of the wireless communications system **100** may be dynamically selected (e.g., in bursts of shortened TTIs (STTIs)).

[0081] Physical channels may be multiplexed for communication using a carrier according to various techniques. A physical control channel and a physical data channel may be multiplexed for signaling via a downlink carrier, for example, using one or more of time division multiplexing (TDM) techniques, frequency division multiplexing (FDM) techniques, or hybrid TDM-FDM techniques. A control region (e.g., a control resource set (CORESET)) for a physical control channel may be defined by a set of symbol periods and may extend across the system bandwidth or a subset of the system bandwidth of the carrier. One or more control regions (e.g., CORESETs) may be configured for a set of the UEs **115**. For example, one or more of the UEs **115** may monitor or search control regions for control information according to one or more search space sets, and each search space set may include one or multiple control channel candidates in one or more aggregation levels arranged in a cascaded manner. An aggregation level for a control channel candidate may refer to an amount of control channel resources (e.g., control channel elements (CCEs)) associated with encoded information for a control information format having a given payload size. Search space sets may include common search space sets configured for sending control information to multiple UEs **115** and UE-specific search space sets for sending control information to a specific UE **115**.

[0082] In some examples, a network entity **105** (e.g., a base station **140**, an RU **170**) may be movable and therefore provide communication coverage for a moving coverage area **110**. In some examples, different coverage areas **110** associated with different technologies may overlap, but the different coverage areas **110** may be supported by the same network entity **105**. In some other examples, the overlapping coverage areas **110** associated with different technologies may be supported by different network entities **105**. The wireless communications system **100** may include, for example, a heterogeneous network in which different types of the network entities **105** provide coverage for various coverage areas **110** using the same or different radio access technologies.

[0083] The wireless communications system **100** may be configured to support ultra-reliable communications or low-latency communications, or various combinations thereof. For example, the wireless communications system **100** may be configured to support ultra-reliable low-latency communications (URLLC). The UEs **115** may be designed to support ultra-reliable, low-latency, or critical functions. Ultra-reliable communications may include private communication or group communication and may be supported by one or more services such as push-to-talk, video, or data. Support for ultra-reliable, low-latency functions may include prioritization of services, and such services may be used for public safety or general commercial applications. The terms ultra-reliable, low-latency, and ultra-reliable low-latency may be used interchangeably herein.

[0084] In some examples, a UE **115** may be configured to support communicating directly with other UEs **115** via a device-to-device (D2D) communication link **135** (e.g., in accordance with a peer-to-peer (P2P), D2D, or sidelink protocol). In some examples, one or more UEs **115** of a group that are performing D2D communications may be within the coverage area **110** of a network entity **105** (e.g., a base station **140**, an RU **170**), which may support aspects of such D2D communications being configured by (e.g., scheduled by) the network entity **105**. In some examples, one or more UEs **115** of such a group may be outside the coverage area **110** of a network entity **105** or may be otherwise unable to or not configured to receive transmissions from a network entity **105**. In some examples, groups of the UEs **115** communicating via D2D communications may support a one-to-many (1:M) system in which each UE **115** transmits to each of the other UEs **115** in the group. In some examples, a network entity **105** may facilitate the scheduling of resources for D2D communications. In some other examples, D2D communications may be carried out between the UEs **115** without an involvement of a network entity **105**.

[0085] The core network **130** may provide user authentication, access authorization, tracking, Internet Protocol (IP) connectivity, and other access, routing, or mobility functions. The core network **130** may be an evolved packet core (EPC) or 5G core (5GC), which may include at least one control plane entity that manages access and mobility (e.g., a mobility management entity (MME), an access and mobility management function (AMF)) and at least one user plane entity that routes packets or interconnects to external networks (e.g., a serving gateway (S-GW), a Packet Data Network (PDN) gateway (P-GW), or a user plane function (UPF)). The control plane entity may manage non-access stratum (NAS) functions such as mobility, authentication, and bearer management for the UEs **115** served by the network entities **105** (e.g., base stations **140**) associated with the core network **130**. User IP packets may be transferred through the user plane entity, which may provide IP address allocation as well as other functions. The user plane entity may be connected to IP services **150** for one or more network operators. The IP services **150** may include access to the Internet, Intranet(s), an IP Multimedia Subsystem (IMS), or a Packet-Switched Streaming Service.

[0086] The wireless communications system **100** may operate using one or more frequency bands, which may be in the range of 300 megahertz (MHz) to 300 gigahertz (GHz). Generally, the region from 300 MHz to 3 GHz is known as the ultra-high frequency (UHF) region or decimeter band because the wavelengths range from approximately one decimeter to one meter in length. UHF waves may be blocked or redirected by buildings and environmental features, which may be referred to as clusters, but the waves may penetrate structures sufficiently for a macro cell to provide service to the UEs **115** located indoors. Communications using UHF waves may be associated with smaller antennas and shorter ranges (e.g., less than 100 kilometers) compared to communications using the smaller frequencies and longer waves of the high frequency (HF) or very high frequency (VHF) portion of the spectrum below 300 MHZ.

[0087] The wireless communications system **100** may utilize both licensed and unlicensed RF spectrum bands. For example, the wireless communications system **100** may employ License Assisted Access (LAA), LTE-Unlicensed (LTE-U) radio access technology, or NR technology using an unlicensed band such as the 5 GHz industrial, scientific, and medical (ISM) band. While operating using unlicensed RF spectrum bands, devices such as the network entities **105** and the UEs **115** may employ carrier sensing for collision detection and avoidance. In some examples, operations using unlicensed bands may be based on a carrier aggregation configuration in conjunction with component carriers operating using a licensed band (e.g., LAA). Operations using unlicensed spectrum may include downlink transmissions, uplink transmissions, P2P transmissions, or D2D transmissions, among other examples.

[0088] A network entity **105** (e.g., a base station **140**, an RU **170**) or a UE **115** may be equipped with multiple antennas, which may be used to employ techniques such as transmit diversity, receive diversity, multiple-input multiple-output (MIMO) communications, or beamforming. The antennas of a network entity **105** or a UE **115** may be located within one or more antenna arrays or antenna panels, which may support MIMO operations or transmit or receive beamforming. For example, one or more base station antennas or antenna arrays may be co-located at an antenna assembly, such as an antenna tower. In some examples, antennas or antenna arrays associated with a network entity **105** may be located at diverse geographic locations. A network entity **105** may include an antenna array with a set of rows and columns of antenna ports that the network entity **105** may use to support beamforming of communications with a UE **115**. Likewise, a UE **115** may include one or more antenna arrays that may support various MIMO or beamforming operations. Additionally, or alternatively, an antenna panel may support RF beamforming for a signal transmitted via an antenna port.

[0089] Beamforming, which may also be referred to as spatial filtering, directional transmission, or directional reception, is a signal processing technique that may be used at a transmitting device or a receiving device (e.g., a network entity **105**, a UE **115**) to shape or steer an antenna beam (e.g., a transmit beam, a receive beam) along a spatial path between the transmitting device and the receiving device. Beamforming may be achieved by combining the signals communicated via antenna elements of an antenna array such that some signals propagating along particular orientations with respect to an antenna array experience constructive interference while others experience destructive interference. The adjustment of signals communicated via the antenna elements may include a transmitting device or a receiving device applying amplitude offsets, phase offsets, or both to signals carried via the antenna elements associated with the device. The adjustments associated with each of the antenna elements may be defined by a beamforming weight set associated with a particular orientation (e.g., with respect to the antenna array of the transmitting device or receiving device, or with respect to some other orientation).

[0090] The UEs **115** and the network entities **105** may support retransmissions of data to increase the likelihood that data is received successfully. HARQ feedback is one technique for increasing the likelihood that data is received correctly via a communication link (e.g., a communication link **125**, a D2D communication link **135**). HARQ may include a combination of error detection (e.g., using a cyclic redundancy check (CRC)), forward error correction (FEC), and retransmission (e.g., automatic repeat request (ARQ)). HARQ may improve throughput at the MAC layer in poor radio conditions (e.g., low signal-to-noise conditions). In some examples, a device may support same-slot HARQ feedback, in which case the device may provide HARQ feedback in a specific slot for data received via a previous symbol in the slot. In some other examples, the device may provide HARQ feedback in a subsequent slot, or according to some other time interval.

[0091] In some wireless communications systems, the UE **115** may communicate with the network entity **105**. In some examples, signaling from the network entity **105** may be encoded, and the UE **115** may perform a decoding operation to receive data transmitted by the network entity **105**. The UE **115** may implement an IR HARQ procedure to mitigate decoding errors during the decoding operations. For example, the UE **115** may write or offload LLRs associated with the IR-HARQ process to a memory (e.g., a LPDDR SRAM) of the UE **115**. Additionally, as a part of the IR-HARQ procedure, the network entity **105** may retransmit the encoded signaling if the UE **115** fails to decode the initial encoded signaling, and the UE **115** may read or onload the LLRs from the memory associated with a retransmission. Additionally, as a part of the decoding operation, the UE **115** may write bits (e.g., offload) to the memory of the UE **115**, the UE **115** may read bits (e.g., onload) from the memory of the UE **115** or both onload and offload bits (e.g., information bits) to the memory of the UE **115**. However, the bandwidth of the memory may limit an ability of the UE **115** to write data to or read data from the memory.

[0092] Techniques for HARQ design may provide an efficient usage of the memory bandwidth. The UE **115** may receive, from the network entity **105**, a first transport block. The UE **115** may transmit, to the network entity **105**, one or more feedback messages that indicate that a reception of a portion of the first transport block was unsuccessful and that indicate a request for a time delay associated with a retransmission of the first transport block. In some examples, the time delay may be a delayed timeline for a transmission of a first ACK feedback or a first NACK feedback associated with a reception of the retransmission. The delayed timeline for the ACK feedback or NACK feedback may support tapering of the LLR onload associated with the retransmission by spreading the LLR onload over a longer duration. In some cases, the time delay may be an extended transmission duration for the retransmission of the first transport block.

The extended transmission duration may support tapering of the LLR onload associated with the retransmission by spreading the LLR onload over a longer duration. In some examples, the UE **115** may receive, from the network entity **105**, the retransmission of the first transport block and a second transport block. In some cases, the retransmission of the first transport block may be frequency-division multiplexed with the second transport block. In some cases, the UE **115** may transmit, to the network entity **105** based on receiving the second transport block, a second ACK feedback or a second NACK feedback associated with a reception of the second transport block, and second ACK feedback or a second NACK feedback may be transmitted prior to the transmission of the first ACK feedback or a first NACK feedback associated with the retransmission of the first transport block.

[0093] In some examples, the UE **115** may receive, from a network entity **105**, a first transport block. The UE **115** may transmit, to the network entity **105**, one or more feedback messages that indicate that a reception of a portion of the first transport block was unsuccessful and that indicate a request for a delayed scheduling of a retransmission of the first transport block. In some examples, the delayed scheduling of the retransmission may support tapering of the LLR offload associated with the first transport block by spreading the LLR offload over a longer duration. In some examples, the UE **115** may receive, from the network entity **105**, the retransmission of the first transport block and a second transport block. In some cases, the UE **115** may receive the retransmission of the first transport block on a first component carrier and the second transport block on a second component carrier. The UE **115** may transmit, to the network entity **105**, one or more joint feedback messages associated with both the first transport block and the second transport block.

[0094] FIG. **2** shows an example of a wireless communications system **200** that supports HARQ design in accordance with one or more aspects of the present disclosure. The wireless communications system **200** may implement aspects of or may be implemented by aspects of the wireless communications system **100**. For example, the wireless communications system **200** includes a UE **115**-*a*, which may be an example of a UE **115** as described herein. The wireless communications system **200** may also include a network entity **105**-*a*, which may be an example of a network entity **105** as described herein.

[0095] The UE **115**-*a* may communicate with the network entity **105**-*a* using a communication link **125**-*a*. The communication link **125**-*a* may be an example of an NR or LTE link (among other examples) between the UE **115**-*a* and the network entity **105**-*a*. The communication link **125**-*a* may include bi-directional links that enable both uplink and downlink communications. For example, the network entity **105**-*a* may transmit downlink signals (e.g., downlink transmissions), such as downlink control signaling **205** and downlink data signals **210**, to the UE **115**-*a* using the communication link **125**-*a*, and the UE **115**-*a* may transmit uplink signals (e.g., uplink transmissions), such as uplink control signaling **215** and uplink data signals **220**, to the network entity **105**-*a* using the communication link **125**-*a*.

[0096] In some examples, the UE **115**-*a* may include a modem **230** and a memory **235**. The memory **235** may be a random-access memory (RAM), such as a LPDDR SRAM. In some examples, the network entity **105**-*a* may transmit, to the UE **115**-*a*, a transport block **240** including one or more bits carrying data (e.g., information bits). The transport block **240** may be encoded, and the UE **115**-*a* may decode the transport block **240** (e.g., encoded bits) to receive signaling from the network entity **105**-*a*. The UE **115**-*a* may perform a decoding operation to receive the data of the transport block **240** transmitted by the network entity **105**-*a*. In some cases, the UE **115**-*a* may transmit, to the network entity **105**-*a*, a feedback message **245** that indicates that a reception of a portion of the transport block **240** was unsuccessful. For example, the UE **115**-*a* may have failed to successfully decoded the transport block **240**. The network entity **105**-*a* may transmit, to the UE **115**-*a*, a retransmission **250** of the transport block.

[0097] In some examples, the UE **115**-*a*, the network entity **105**-*a*, or both may support IR-HARQ procedures. In some cases, IR-HARQ procedures may improve system robustness, coverage, and spectral efficiency. For example, the UE **115**-*a*, the network entity **105**-*a*, or both may implement IR-HARQ procedures to reduce decoding errors, a total quantity of retransmissions, or both during the decoding operations. As a part of an IR-HARQ procedure, the UE **115**-*a* may write or offload information to the memory **235**, and the information may be related to the transport block **240** that the UE **115**-*a* failed to successfully decode. The information may include one or more LLRs for the transport block **240** which the UE **115**-*a* may use in a soft combining procedure. As a part of the soft combining procedure, the UE **115**-*a* may offload LLRs for the transport block **240** that was unsuccessfully received.

[0098] During soft combining, to successfully decode the retransmission **250**, the UE **115**-*a* may read (e.g., onload) LLRs associated with previous instances of the transport block **240** from the memory **235**. The UE **115**-*a* may use the LLRs to detect errors in the retransmission **250** and successfully decode the retransmission **250**. Additionally, or alternatively, the UE **115**-*a* may perform other operations that may access the memory **235**, including reading or onloading information bits from the memory **235** or writing or offloading information bits to the memory **235**. The UE **115**-*a* may perform onloading and offloading of bits in accordance with a bandwidth of the memory **235**. The bandwidth of the memory **235** may limit the ability of the UE **115**-*a* to write data to or read data from the memory **235** and may become a bottleneck for the IR-HARQ process.

[0099] FIG. **2** shows an example of a memory usage diagram **260** for the memory **235**. In some examples, the horizontal axis of the memory usage diagram **260** may represent a time component of memory operations performed by the UE **115**-*a*, and the vertical axis of the memory usage diagram **260** may represent a DDR bandwidth access activity at the memory **235** of the UE **115**-*a*. For HARQ operation, the memory **235** may be accessed for different types (e.g., four types) of onloading and offloading operations: downlink decoded information bits offloading **265**, downlink LLR offloading **270**, uplink information bits onloading **275**, and downlink retransmission LLR onloading **280** (among other examples). The downlink decoded information bits offloading **265** and the uplink information bits onloading **275** may not be delayed otherwise the uplink or downlink data rate may not be sustained. The downlink LLR offloading **270** and downlink retransmission LLR onloading **280** may be tapered down to postpone or slow down the DDR access when reaching the DDR bandwidth limit at cost of extra delay. In some examples, the memory usage diagram **260** includes a DDR bandwidth limit **285**. For the example shown in FIG. **2**, the downlink retransmission LLR onloading **280** or the downlink LLR offloading **270** may be tapered to avoid exceeding the DDR bandwidth limit **285**. Techniques for HARQ design may provide an efficient usage of the memory bandwidth, among other advantages. Network entity and UE control signaling design as described herein may support dynamic or smart DDR bandwidth management and sustain throughput, among other advantages.

[0100] FIG. **3** shows an example of a timing diagram **300** that supports HARQ design in accordance with one or more aspects of the present disclosure. Aspects of the timing diagram **300** may implement, or be implemented by, aspects of wireless communications system **100** and the wireless communications system **200**, or any combination thereof.

[0101] In some examples, the HARQ design may be a delayed scheduling of a retransmission or a tapering of the retransmission to lower the activity density of the downlink decoded bits offloading to the memory **235**. In some cases, the UE **115**-*a* may transmit signaling to the network entity to support LLR offload tapering. For example, when a large transport block fails decoding, a large quantity of LLRs may be offloaded to the memory **235** by the UE **115**-*a*. The UE **115**-*a* may stretch the offloading of the LLRs over multiple slots or over a duration. When tapering of the offloading of the LLRs, the retransmission of the transport block that failed decoding may occur after the offloading of the LLRs to the memory **235** is completed.

[0102] In some examples, the UE **115**-*a* may indicate to the network entity **105**-*a* a request for a delayed scheduling of the retransmission **250** of the transport block that failed decoding. For example, UE **115**-*a* may transmit, to the network entity **105**-*a* based on receiving the transport block **240**, the feedback message **245** that indicates that a reception of at least a portion of the transport block **240** was unsuccessful and indicates a request for a delayed scheduling of a retransmission **250** of the transport block. In some cases, the request for the delayed scheduling may be together with the ACK or NACK feedback associated with the failed decoding of the transport block **240** or the request for the delayed scheduling may be in a separate feedback message. In some cases, the UE **115**-*a* may request that the retransmission **250** occur after a quantity of slots of the transmission of the feedback message **245**. The UE **115**-*a* or the network entity may determine the delay associated with the delayed scheduling of the retransmission using various techniques, such as by implementing artificial intelligence (AI) and/or machine learning (ML) techniques.

[0103] The timing diagram **300** shows a timing diagram **305** without tapering and a timing diagram with tapering of the retransmission **310**. For example, the timing diagram **305** without tapering shows the UE **115**-*a* receiving the transport block **315** that fails decoding, the downlink LLR offloading **320** to the memory **235**, and the UE **115**-*a* transmitting the feedback message **325** that indicates that a reception of at least a portion of the transport block was unsuccessful. After the downlink decoded bits offloading **320** is complete, the UE **115**-*a* may receive the retransmission **330** of the transport block and may perform the downlink retransmission LLRs onloading **335**.

[0104] For the timing diagram with tapering of the retransmission **310**, the UE **115**-*a* may receive the transport block **340** that fails decoding, and UE **115**-*a* may transmit the feedback message **345** that indicates that a reception of at least a portion of the transport block was unsuccessful and that indicates a request for a delayed scheduling of the retransmission of the transport block. In some cases, the indication of the request for the delayed scheduling of the retransmission of the transport block may be transmitted in a separate resource or separate feedback message from the ACK/NACK feedback. The downlink LLR offloading **350** to the memory **235** may be slowed or extended one or more additional slots, such as a set of slots, and the retransmission is blocked **355** for a duration during which the retransmission is not scheduled. After the blocked **355** duration or the delay, the UE **115**-*a* may receive the retransmission of the transport block **360**.

[0105] FIG. **4** shows an example of a timing diagram **400** that supports HARQ design in accordance with one or more aspects of the present disclosure. Aspects of the timing diagram **400** may implement, or be implemented by, aspects of wireless communications system **100** and the wireless communications system **200**, or any combination thereof.

[0106] In some examples, the HARQ design may be a delayed timeline for a transmission of an ACK or NACK associated with a reception of the retransmission of the transport block to lower the activity density of the downlink retransmission LLR onloading from the memory **235**. In some cases, the UE **115**-*a* may transmit signaling to the network entity to support LLR onload tapering. For example, when a large transport block is retransmitted, a large quantity of LLRs may be onloaded from the memory **235** to the modem **230** by the UE **115**-*a*. The UE **115**-*a* may stretch the onloading of the LLRs over multiple slots or over a duration. When tapering of the onloading of the LLRs, the decoding timeline for the physical downlink shared channel PDSCH may be delayed.

[0107] In some examples, the UE **115**-*a* may transmit, to the network entity **105**-*a*, a request for a slower ACK/NACK timeline (e.g., a larger N1 value) for the retransmission **250** of the transport block that failed decoding. For example, UE **115**-*a* may transmit, to the network entity **105**-*a* based on receiving the transport block **240**, the feedback message **245** that indicates that a reception of at least a portion of the transport block **240** was unsuccessful and indicates a request for a time delay associated with a retransmission **250** of the transport block **240**. In some examples, the time delay may be a delayed timeline for a transmission of the ACK/NACK associated with a reception of the retransmission **250** of the transport block **240**. In some cases, the request for the time delay may be together with the ACK or NACK feedback associated with the failed decoding of the transport block **240** or the request for the time delay in a separate feedback message. In some cases, the UE **115**-*a* may request that the delayed timeline for a transmission of the ACK/NACK occur after a quantity of slots of the transmission of the feedback message **245**. In some cases, the UE **115**-*a* may request that the delayed timeline for a transmission of the ACK/NACK occur after a quantity of slots of the reception of the retransmission **250** of the transport block. The UE **115**-*a* or the network entity **105**-*a* may determine the delay associated with the ACK/NACK using various techniques, such as by implementing artificial intelligence (AI) and/or machine learning (ML) techniques.

[0108] In some examples, in order to not slow down overall communication throughput, out of order processing between the retransmission **250** and a new transport block **255** that does not use onloading may be allowed. An in order HARQ-ACK report may mean that the HARQ-ACK of an early transmitted transport block may be sent no later than the HARQ-ACK associated with a later transport block. An out of order HARQ-ACK report may allow the HARQ-ACK of the early transmitted transport block to be sent later than the HARQ-ACK associated with a later transport block.

[0109] The timing diagram **400** shows a timing diagram **405** with a delayed ACK/NACK timeline associated with the retransmission of the transport block. The UE **115**-*a* may receive the transport block **410** that fails decoding, and UE **115**-*a* may transmit the feedback message **420** that indicates that a reception of at least a portion of the transport block was unsuccessful and that indicates a request for a time delay (e.g., delayed timeline for a transmission of the ACK/NACK associated with a reception of the retransmission). The UE **115**-*a* may perform downlink decoded bits offloading **415** to the memory **235**. The UE **115**-*a* may receive the retransmission **425** of the terminal block, and the downlink retransmission LLR onloading **430** from the memory **235** may be slowed or extended additional set of slots. After the delay, the UE **115**-*a* may transmit the ACK/NACK **435** associated with the reception of the retransmission. The timing diagram **405** also illustrates the out of order processing between the retransmission **250** and a new transport block **255** that does not use LLR onloading. The UE **115**-*a* may receive the new transport block **440** after the receiving the retransmission **425**, and the UE may transmit a HARQ-ACK **445** for the new transport block prior to transmitting the ACK/NACK **435** (e.g., HARQ ACK) of the retransmission.

[0110] In some examples, the HARQ design may be an extended transmission duration for the retransmission of the transport block to lower the activity density of the downlink retransmission LLR onloading from the memory **235**. The UE **115**-*a* may transmit to the network entity **105**-*a* a request for an extended transmission duration for the retransmission **250** of the transport block **240** that failed decoding. If a start and length indicator value (SLIV) (e.g., duration) for the retransmission is longer, the LLR onloading may be spread over a longer duration. For example, UE **115**-*a* may transmit, to the network entity **105**-*a* based on receiving the transport block **240**, the feedback message **245** that indicates that a reception of at least a portion of the transport block **240** was unsuccessful and indicates a request for a time delay associated with a retransmission **250** of the transport block **240**. In some examples, the time delay may be an extended transmission duration for the retransmission **250** of the transport block **240**. In some cases, the UE **115**-*a* may request the network entity **105**-*a* to schedule the retransmission of the transport block with a longer SLIV. The retransmission may be scheduled with either the same bandwidth but lower modulation and coding scheme (MCS) or same MCS but smaller bandwidth or with a repetition in case the longer SLIV is not supported. The UE **115**-*a* or the network entity **105**-*a* may determine the extended transmission duration for the retransmission using various techniques, such as by implementing artificial intelligence (AI) and/or machine learning (ML) techniques.

[0111] To further improve the UE (e.g., UE **115**-*a*) throughput, the network entity **105**-*a* may frequency-division multiplex (FDM) the retransmission **250** of the failed transport block with a new transmission of another transport block which does not use LLR onloading to decode. For example, the decoding and demodulation may run at full speed, and the LLR onloading for the failed transport block may be spread over a greater quantity of slots. The FDM of the retransmission and the new transmission may not use out of order scheduling. The multiplexing of the retransmission transport block and the new transport block may occur in either the frequency domain or in the spatial domain (e.g., two layers for the retransmission and two layers for the new transport block.

[0112] The timing diagram **400** shows a timing diagram **450** with extended transmission duration for the retransmission of the transport block. The UE **115**-*a* may receive the transport block **455** that fails decoding, and the UE **115**-*a* may transmit the feedback message **460** that indicates that a reception of at least a portion of the transport block was unsuccessful and indicates a request for a time delay (e.g., extended transmission duration for the retransmission). After the transmitting the feedback message, the UE **115**-*a* may receive the retransmission **465** of the transport block that has the extended transmission duration. The UE **115**-*a* may slow the downlink retransmission LLR onloading **470** due to the extended duration of the retransmission **465**. The UE **115**-*a* may transmit the ACK/NACK **490**. The timing diagram **450** also illustrates the FDM of the retransmission and transmission of new transport block **475**, new transport block **480**, and new transport block **485** with the UE **115**-*a* receiving the new transport block **475**, the new transport block **480**, and the new transport block **485**.

[0113] In some examples, the network entity **105**-*a* and the UE **115**-*a* may implement carrier aggregation, and the network entity **105**-*a* may transmit, to the UE **115**-*a*, one or more transport blocks across multiple component carriers. For example, the network entity **105**-*a* may transmit, to the UE **115**-*a*, a first transport block across a first component carrier, a second transport block across a second component carrier, and a third transport block across a third component carrier. In some cases, all three (in this example) of the transport blocks across the multiple component carriers may fail and the UE **115**-*a* may use LLR offloading and LLR onloading for the first transport block, the second transport block, and the third transport block. At peak envelop which may be the situation for DDR bandwidth to reach the limit, the UE **115**-*a* may support the multiple component carriers. The LLR onloading and LLR offloading of these multiple component carriers share the same DDR bandwidth, and the decoding status of different transport blocks may be different. In some examples, the UE **115**-*a* and network entity **105**-*a* may use the HARQ design with the tapering of the LLR onloading and LLR offloading for the multiple failed transport blocks.

[0114] In some examples, the indication of the LLR onloading or LLR offloading tapering request may be jointly signaled for the one or more transport blocks across multiple component carriers and/or slots. For example, when the UE **115**-*a* has more than one transport block on respective component carriers that fail, the LLR onloading or offloading for all of the transport blocks may be tapered down. The UE **115**-*a* may not send the tapering request to the network entity **105**-*a* multiple times; rather, the UE **115**-*a* may send one feedback message that indicates the retransmission of the multiple transport blocks be tapered down. For example, the UE **115**-*a* may transmit one joint indication for all failed transport blocks across multiple component carriers or slots whose HARQ-ACK are multiplexed on the same HARQ-ACK feedback codebook or transmission. In another example, the UE **115**-*a* may transmit one joint indication for all failed transport blocks that are scheduled in the same slot across different component carriers requesting a slower retransmission, so the indication may be per slot instead of per transport block. For example, the UE **115**-*a* may receive, from the network entity, a first transport block on a first component carrier and a second transport block on a second component carrier. The UE **115**-*a* may transmit, to the network entity **105**-*a* based on receiving the first transport block and the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block. The one or more joint feedback messages may indicate that the reception of first transport block was unsuccessful and that a reception of the second transport block was unsuccessful and may indicate the request for the time delay. In some cases, the one or more joint feedback messages may indicate the request for the slower ACK/NACK timeline for the retransmission of the transport block that failed decoding.

[0115] FIG. **5** shows an example of a timing diagram **500** that supports HARQ design in accordance with one or more aspects of the present disclosure. Aspects of the timing diagram **400** may implement, or be implemented by, aspects of wireless communications system **100** and the wireless communications system **200**, or any combination thereof.

[0116] In some examples, the HARQ design may be a retransmission tapering or time delay with staggered retransmission for carrier aggregation. For the carrier aggregation case, if multiple transport blocks fail across different component carriers at the same time, the retransmission taper may occur in the following manner: one or a subset of the failed transport blocks may be retransmitted in a given slot, and the retransmissions of the multiple failed transport blocks may be spread across multiple slots in a staggered manner to provide tapering of the LLR onloading. In order for the retransmission delay to provide tapering of the LLR onloading, the UE **115**-*a* may be provided the ordering of the staggered retransmissions of the transport blocks. In some examples, the network entity **105**-*a* and the UE **115**-*a* may agree that the retransmission of the failed transport blocks may follow a pre-defined order, such as based on a component carrier index. For example, the retransmission of the failed transport block associated with the first carrier component is transmitted first, the retransmission of the failed transport block associated with the second carrier component is transmitted second, and the retransmission of the failed transport block associated with the third carrier component is transmitted third.

[0117] The timing diagram **500** shows a staggered retransmission for carrier aggregation. The UE **115**-*a* may receive a first transport block **505**-*a* of a first component carrier that fails decoding, a second transport block **505**-*b* of a second component carrier that fails decoding, and a third transport block **505**-*c* of a third component carrier that fails decoding. The UE may transmit a feedback message **510**-*a*, a feedback message **510**-*b*, and a feedback message **510**-*c* that indicate that a reception of at least a portion of the transport block was unsuccessful and indicate a request for a time delay (e.g., time delay with staggered retransmission for carrier aggregation). In some cases, the feedback message **510**-*a*, the feedback message **510**-*b*, and the feedback message **510**-*c* may be jointly signaled in a single feedback message for the transport blocks across the multiple component carriers. After the transmitting the feedback message(s), the UE **115**-*a* may receive the retransmission **515**-*a* of the transport block of the first component carrier, a new transport block **515**-*b* of the second component carrier, and a new transport block **515**-*c* of the third component carrier. The UE **115**-*a* may slow downlink retransmission LLR onloading **520** associated with the retransmission of the transport block of the first component. The UE **115**-*a* may receive the retransmission **525**-*b* of the transport block of the second component carrier, a new transport block **525**-*a* of the first component carrier, and a new transport block **525**-*c* of the third component carrier. The UE **115**-*a* may slow downlink retransmission LLR onloading **530** associated with the retransmission of the transport block of the second component carrier. The UE **115** a may receive the retransmission **535**-*c* of the transport block of the third component carrier, a new transport block **535**-*a* of the first component carrier, and a new transport block **535**-*b* of the second component carrier. The UE **115**-*a* may slow downlink retransmission LLR onloading **540** associated with the retransmission of the transport block of the third component carrier. The UE may transmit an ACK/NACK **545**-*a*, an ACK/NACK **545**-*b* and an ACK/NACK **545**-*c*.

[0118] FIG. **6** shows an example of a process flow **600** that supports HARQ design in accordance with one or more aspects of the present disclosure. In some examples, the process flow **600** may implement or be implemented by aspects of the wireless communications systems **100** and **200** as described with reference to FIGS. **1** and **2**, respectively. For example, the process flow **600** may be implemented by a network entity **105**-*b*, which may be an example of the network entities **105** as described with reference to FIGS. **1** and **2**. The process flow **600** may be implemented by a UE **115**-*b*, which may be an example of the UEs as described with reference to FIGS. **1** and **2**.

[0119] In some examples, the operations illustrated in process flow **600** may be performed by hardware (e.g., including circuitry, processing blocks, logic components, and other components), code such as processor-executable code (e.g., software executed by a processor), or any combination thereof. Alternative examples of the following may be implemented, where some steps are performed in a different order than described or are not performed at all. In some cases, steps may include additional features not mentioned below, or further steps may be added.

[0120] At **605**, UE **115**-*b* may receive, from the network entity **105**-*b*, a first transport block.

[0121] At **610**, the UE **115**-*b* may transmit, to the network entity **105**-*b* based at least in part on receiving the first transport block, one or more feedback messages that indicate that a reception of a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block. In some examples, for transmitting the one or more feedback messages, the UE **115**-*b* may transmit a NACK feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful, and the UE **115**-*b* may transmit a message that indicates the request for the time delay associated with the retransmission of the first transport block. In some cases, for transmitting the one or more feedback messages, the UE **115**-*b* may transmit a NACK feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the time delay associated with the retransmission of the first transport block.

[0122] At **615**, the UE **115**-*b* may receive, from the network entity **105**-*b* based at least in part on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0123] In some examples, the time delay may be a delayed timeline for a transmission of a first ACK or a first NACK associated with a reception of the retransmission of the first transport block. The UE **115**-*b* may receive, from the network entity **105**-*b* after transmitting the one or more feedback messages, a second transport block. The UE **115**-*b* may transmit, to the network entity **105**-*b* based on receiving the second transport block, a second ACK or a second NACK associated with a reception of the second transport block. In some cases, the transmission of the second ACK or the second NACK may be prior to the transmission of the first ACK or first NACK.

[0124] In some examples, the time delay may be an extended transmission duration for the retransmission of the first transport block. In some examples, for receiving the retransmission of the first transport block, the UE may receive, from the network entity **105**-*b*, a second transport block, and the retransmission of the first transport block may be frequency-division multiplexed with the second transport block.

[0125] At **620**, the UE **115**-*b* may receive, from the network entity **105**-*b*, a second transport block on a second component carrier, and the first transport block may be received on a first component carrier. In some examples, for transmitting the one or more feedback messages, the UE **115**-*b* may transmit, to the network entity **105**-*b* based on receiving the first transport block and the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block. In some cases, the one or more joint feedback messages may indicate that the reception of the portion of the first transport block was unsuccessful and that a reception of a portion of the second transport block was unsuccessful and may indicate the request for the time delay. In some examples, the UE **115**-*b* may receive, from the network entity **105**-*b* based on the reception of a portion of the second transport block was unsuccessful, a retransmission of the second transport block. In some cases, the retransmission of the second transport block may be received after the retransmission of the first transport block.

[0126] FIG. **7** shows an example of a process flow **700** that supports HARQ design in accordance with one or more aspects of the present disclosure. In some examples, the process flow **700** may implement or be implemented by aspects of the wireless communications systems **100** and **200** as described with reference to FIGS. **1** and **2**, respectively. For example, the process flow **700** may be implemented by a network entity **105**-*c*, which may be an example of the network entities **105** as described with reference to FIGS. **1** and **2**. The process flow **700** may be implemented by a UE **115**-*c*, which may be an example of the UEs as described with reference to FIGS. **1** and **2**.

[0127] In some examples, the operations illustrated in process flow **700** may be performed by hardware (e.g., including circuitry, processing blocks, logic components, and other components), code such as processor-executable code (e.g., software executed by a processor), or any combination thereof. Alternative examples of the following may be implemented, where some steps are performed in a different order than described or are not performed at all. In some cases, steps may include additional features not mentioned below, or further steps may be added.

[0128] At **705**, UE **115**-*c* may receive, from the network entity **105**-*c*, a first transport block.

[0129] At **710**, the UE **115**-*c* may transmit, to the network entity **105**-*c* based at least in part on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block. In some examples, for transmitting the one or more feedback messages, the UE **115**-*c* may transmit a NACK feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful, and the UE **115**-*c* may transmit a request the request for the delayed scheduling. In some cases, for transmitting the one or more feedback messages, the UE **115**-*c* may transmit a NACK feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the delayed scheduling.

[0130] At **715**, the UE **115**-*c* may receive, from the network entity **105**-*c* based at least in part on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0131] At **720**, the UE **115**-*c* may receive, from the network entity **105**-*c*, a second transport block on a second component carrier, and the first transport block may be received on a first component carrier. In some examples, for transmitting the one or more feedback messages, the UE **115**-*c* may transmit, to the network entity **105**-*c* based on receiving the first transport block and the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block. In some cases, the one or more joint feedback messages may indicate that the reception of the portion of the first transport block was unsuccessful and that a reception of a portion of the second transport block was unsuccessful and may indicate the request for the delayed scheduling.

[0132] FIG. **8** shows a block diagram **800** of a device **805** that supports HARQ design in accordance with one or more aspects of the present disclosure. The device **805** may be an example of aspects of a UE **115** as described herein. The device **805** may include a receiver **810**, a transmitter **815**, and a communications manager **820**. The device **805**, or one or more components of the device **805** (e.g., the receiver **810**, the transmitter **815**, and the communications manager **820**), may include at least one processor, which may be coupled with at least one memory, to, individually or collectively, support or enable the described techniques. Each of these components may be in communication with one another (e.g., via one or more buses).

[0133] The receiver **810** may provide a means for receiving information such as packets, user data, control information, or any combination thereof associated with various information channels (e.g., control channels, data channels, information channels related to HARQ design). Information may be passed on to other components of the device **805**. The receiver **810** may utilize a single antenna or a set of multiple antennas.

[0134] The transmitter **815** may provide a means for transmitting signals generated by other components of the device **805**. For example, the transmitter **815** may transmit information such as packets, user data, control information, or any combination thereof associated with various information channels (e.g., control channels, data channels, information channels related to HARQ design). In some examples, the transmitter **815** may be co-located with a receiver **810** in a transceiver module. The transmitter **815** may utilize a single antenna or a set of multiple antennas.

[0135] The communications manager **820**, the receiver **810**, the transmitter **815**, or various combinations thereof or various components thereof may be examples of means for performing various aspects of HARQ design as described herein. For example, the communications manager **820**, the receiver **810**, the transmitter **815**, or various combinations or components thereof may be capable of performing one or more of the functions described herein.

[0136] In some examples, the communications manager **820**, the receiver **810**, the transmitter **815**, or various combinations or components thereof may be implemented in hardware (e.g., in communications management circuitry). The hardware may include at least one of a processor, a digital signal processor (DSP), a central processing unit (CPU), an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA) or other programmable logic device, a microcontroller, discrete gate or transistor logic, discrete hardware components, or any combination thereof configured as or otherwise supporting, individually or collectively, a means for performing the functions described in the present disclosure. In some examples, at least one processor and at least one memory coupled with the at least one processor may be configured to perform one or more of the functions described herein (e.g., by one or more processors, individually or collectively, executing instructions stored in the at least one memory).

[0137] Additionally, or alternatively, the communications manager **820**, the receiver **810**, the transmitter **815**, or various combinations or components thereof may be implemented in code such as processor-executable code (e.g., as communications management software or firmware) executed by at least one processor. If implemented in code executed by at least one processor, the functions of the communications manager **820**, the receiver **810**, the transmitter **815**, or various combinations or components thereof may be performed by a general-purpose processor, a DSP, a CPU, an ASIC, an FPGA, a microcontroller, or any combination of these or other programmable logic devices (e.g., configured as or otherwise supporting, individually or collectively, a means for performing the functions described in the present disclosure).

[0138] In some examples, the communications manager **820** may be configured to perform various operations (e.g., receiving, obtaining, monitoring, outputting, transmitting) using or otherwise in cooperation with the receiver **810**, the transmitter **815**, or both. For example, the communications manager **820** may receive information from the receiver **810**, send information to the transmitter **815**, or be integrated in combination with the receiver **810**, the transmitter **815**, or both to obtain information, output information, or perform various other operations as described herein.

[0139] The communications manager **820** may support wireless communication in accordance with examples as disclosed herein. For example, the communications manager **820** is capable of, configured to, or operable to support a means for receiving, from a network entity, a first transport block. The communications manager **820** is capable of, configured to, or operable to support a means for transmitting, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block. The communications manager **820** is capable of, configured to, or operable to support a means for receiving, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0140] Additionally, or alternatively, the communications manager **820** may support wireless communication in accordance with examples as disclosed herein. For example, the communications manager **820** is capable of, configured to, or operable to support a means for receiving, from a network entity, a first transport block. The communications manager **820** is capable of, configured to, or operable to support a means for transmitting, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block. The communications manager **820** is capable of, configured to, or operable to support a means for receiving, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0141] By including or configuring the communications manager **820** in accordance with examples as described herein, the device **805** (e.g., at least one processor controlling or otherwise coupled with the receiver **810**, the transmitter **815**, the communications manager **820**, or a combination thereof) may support techniques for more efficient utilization of communication resources.

[0142] FIG. **9** shows a block diagram **900** of a device **905** that supports HARQ design in accordance with one or more aspects of the present disclosure. The device **905** may be an example of aspects of a device **805** or a UE **115** as described herein. The device **905** may include a receiver **910**, a transmitter **915**, and a communications manager **920**. The device **905**, or one or more components of the device **905** (e.g., the receiver **910**, the transmitter **915**, and the communications manager **920**), may include at least one processor, which may be coupled with at least one memory, to support the described techniques. Each of these components may be in communication with one another (e.g., via one or more buses).

[0143] The receiver **910** may provide a means for receiving information such as packets, user data, control information, or any combination thereof associated with various information channels (e.g., control channels, data channels, information channels related to HARQ design). Information may be passed on to other components of the device **905**. The receiver **910** may utilize a single antenna or a set of multiple antennas.

[0144] The transmitter **915** may provide a means for transmitting signals generated by other components of the device **905**. For example, the transmitter **915** may transmit information such as packets, user data, control information, or any combination thereof associated with various information channels (e.g., control channels, data channels, information channels related to HARQ design). In some examples, the transmitter **915** may be co-located with a receiver **910** in a transceiver module. The transmitter **915** may utilize a single antenna or a set of multiple antennas.

[0145] The device **905**, or various components thereof, may be an example of means for performing various aspects of HARQ design as described herein. For example, the communications manager **920** may include a transport block manager **925**, a feedback manager **930**, a retransmission manager **935**, or any combination thereof. The communications manager **920** may be an example of aspects of a communications manager **820** as described herein. In some examples, the communications manager **920**, or various components thereof, may be configured to perform various operations (e.g., receiving, obtaining, monitoring, outputting, transmitting) using or otherwise in cooperation with the receiver **910**, the transmitter **915**, or both. For example, the communications manager **920** may receive information from the receiver **910**, send information to the transmitter **915**, or be integrated in combination with the receiver **910**, the transmitter **915**, or both to obtain information, output information, or perform various other operations as described herein.

[0146] The communications manager **920** may support wireless communication in accordance with examples as disclosed herein. The transport block manager **925** is capable of, configured to, or operable to support a means for receiving, from a network entity, a first transport block. The feedback manager **930** is capable of, configured to, or operable to support a means for transmitting, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block. The retransmission manager **935** is capable of, configured to, or operable to support a means for receiving, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0147] Additionally, or alternatively, the communications manager **920** may support wireless communication in accordance with examples as disclosed herein. The transport block manager **925** is capable of, configured to, or operable to support a means for receiving, from a network entity, a first transport block. The feedback manager **930** is capable of, configured to, or operable to support a means for transmitting, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block. The retransmission manager **935** is capable of, configured to, or operable to support a means for receive, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0148] FIG. **10** shows a block diagram **1000** of a communications manager **1020** that supports HARQ design in accordance with one or more aspects of the present disclosure. The communications manager **1020** may be an example of aspects of a communications manager **820**, a communications manager **920**, or both, as described herein. The communications manager **1020**, or various components thereof, may be an example of means for performing various aspects of HARQ design as described herein. For example, the communications manager **1020** may include a transport block manager **1025**, a feedback manager **1030**, a retransmission manager **1035**, a time delay manager **1040**, a delayed scheduling manager **1045**, or any combination thereof. Each of these components, or components or subcomponents thereof (e.g., one or more processors, one or more memories), may communicate, directly or indirectly, with one another (e.g., via one or more buses).

[0149] The communications manager **1020** may support wireless communication in accordance with examples as disclosed herein. The transport block manager **1025** is capable of, configured to, or operable to support a means for receiving, from a network entity, a first transport block. The feedback manager **1030** is capable of, configured to, or operable to support a means for transmitting, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block. The retransmission manager **1035** is capable of, configured to, or operable to support a means for receiving, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0150] In some examples, the time delay includes a delayed timeline for a transmission of a first acknowledgment feedback or a first negative acknowledgment feedback associated with a reception of the retransmission of the first transport block.

[0151] In some examples, the transport block manager **1025** is capable of, configured to, or operable to support a means for receiving, from the network entity after transmitting the one or more feedback messages, a second transport block. In some examples, the feedback manager **1030** is capable of, configured to, or operable to support a means for transmitting, to the network entity based on receiving the second transport block, a second acknowledgment feedback or a second negative acknowledgment feedback associated with a reception of the second transport block, where the transmission of the second acknowledgment feedback or the second negative acknowledgment feedback occurs prior to the transmission of the first acknowledgment feedback or the first negative acknowledgment feedback.

[0152] In some examples, the time delay includes an extended transmission duration for the retransmission of the first transport block.

[0153] In some examples, the transport block manager **1025** is capable of, configured to, or operable to support a means for receiving, from the network entity based on transmitting the one or more feedback messages, a second transport block, where the retransmission of the first transport block is frequency-division multiplexed with the second transport block.

[0154] In some examples, the transport block manager **1025** is capable of, configured to, or operable to support a means for receiving, from the network entity, a second transport block on a second component carrier, where the first transport block is received on a first component carrier.

[0155] In some examples, to support transmitting the one or more feedback messages, the feedback manager **1030** is capable of, configured to, or operable to support a means for transmitting, to the network entity based on receiving the first transport block and the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block, where the one or more joint feedback messages indicate that the reception of at least the portion of the first transport block was unsuccessful and that a reception of at least the portion of the second transport block was unsuccessful and indicate the request for the time delay.

[0156] In some examples, the retransmission manager **1035** is capable of, configured to, or operable to support a means for receiving, from the network entity based on a reception of at least a portion of the second transport block was unsuccessful, a retransmission of the second transport block, where the retransmission of the second transport block is received after the retransmission of the first transport block.

[0157] In some examples, to support transmitting the one or more feedback messages, the feedback manager **1030** is capable of, configured to, or operable to support a means for transmitting a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful. In some examples, to support transmitting the one or more feedback messages, the time delay manager **1040** is capable of, configured to, or operable to support a means for transmitting a message that indicates the request for the time delay associated with the retransmission of the first transport block.

[0158] In some examples, to support transmitting the one or more feedback messages, the feedback manager **1030** is capable of, configured to, or operable to support a means for transmitting a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the time delay associated with the retransmission of the first transport block.

[0159] Additionally, or alternatively, the communications manager **1020** may support wireless communication in accordance with examples as disclosed herein. In some examples, the transport block manager **1025** is capable of, configured to, or operable to support a means for receiving, from a network entity, a first transport block. In some examples, the feedback manager **1030** is capable of, configured to, or operable to support a means for transmitting, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block. In some examples, the retransmission manager **1035** is capable of, configured to, or operable to support a means for receive, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0160] In some examples, the transport block manager **1025** is capable of, configured to, or operable to support a means for receiving, from the network entity, a second transport block on a second component carrier, where the first transport block is received on a first component carrier.

[0161] In some examples, to support transmitting the one or more feedback messages, the feedback manager **1030** is capable of, configured to, or operable to support a means for transmitting, to the network entity based on receiving the first transport block and receiving the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block, where the one or more joint feedback messages indicate that the reception of at least the portion of the first transport block and indicate that a reception of at least the portion of the second transport block was unsuccessful and indicate the request for the delayed scheduling.

[0162] In some examples, to support transmitting the one or more feedback messages, the feedback manager **1030** is capable of, configured to, or operable to support a means for transmitting a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful. In some examples, to support transmitting the one or more feedback messages, the delayed scheduling manager **1045** is capable of, configured to, or operable to support a means for transmitting a request message that indicates the request for the delayed scheduling.

[0163] In some examples, to support transmitting the one or more feedback messages, the feedback manager **1030** is capable of, configured to, or operable to support a means for transmitting a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the delayed scheduling.

[0164] FIG. **11** shows a diagram of a system **1100** including a device **1105** that supports HARQ design in accordance with one or more aspects of the present disclosure. The device **1105** may be an example of or include the components of a device **805**, a device **905**, or a UE **115** as described herein. The device **1105** may communicate (e.g., wirelessly) with one or more network entities **105**, one or more UEs **115**, or any combination thereof. The device **1105** may include components for bi-directional voice and data communications including components for transmitting and receiving communications, such as a communications manager **1120**, an input/output (I/O) controller **1110**, a transceiver **1115**, an antenna **1125**, at least one memory **1130**, code **1135**, and at least one processor **1140**. These components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more buses (e.g., a bus **1145**).

[0165] The I/O controller **1110** may manage input and output signals for the device **1105**. The I/O controller **1110** may also manage peripherals not integrated into the device **1105**. In some cases, the I/O controller **1110** may represent a physical connection or port to an external peripheral. In some cases, the I/O controller **1110** may utilize an operating system such as iOS®, ANDROID®, MS-DOS®, MS-WINDOWS®, OS/2®, UNIX®, LINUX®, or another known operating system. Additionally, or alternatively, the I/O controller **1110** may represent or interact with a modem, a keyboard, a mouse, a touchscreen, or a similar device. In some cases, the I/O controller **1110** may be implemented as part of one or more processors, such as the at least one processor **1140**. In some cases, a user may interact with the device **1105** via the I/O controller **1110** or via hardware components controlled by the I/O controller **1110**.

[0166] In some cases, the device **1105** may include a single antenna **1125**. However, in some other cases, the device **1105** may have more than one antenna **1125**, which may be capable of concurrently transmitting or receiving multiple wireless transmissions. The transceiver **1115** may communicate bi-directionally, via the one or more antennas **1125**, wired, or wireless links as described herein. For example, the transceiver **1115** may represent a wireless transceiver and may communicate bi-directionally with another wireless transceiver. The transceiver **1115** may also include a modem to modulate the packets, to provide the modulated packets to one or more antennas **1125** for transmission, and to demodulate packets received from the one or more antennas **1125**. The transceiver **1115**, or the transceiver **1115** and one or more antennas **1125**, may be an example of a transmitter **815**, a transmitter **915**, a receiver **810**, a receiver **910**, or any combination thereof or component thereof, as described herein.

[0167] The at least one memory **1130** may include random access memory (RAM) and read-only memory (ROM). The at least one memory **1130** may store computer-readable, computer-executable code **1135** including instructions that, when executed by the at least one processor **1140**, cause the device **1105** to perform various functions described herein. The code **1135** may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. In some cases, the code **1135** may not be directly executable by the at least one processor **1140** but may cause a computer (e.g., when compiled and executed) to perform functions described herein. In some cases, the at least one memory **1130** may contain, among other things, a basic I/O system (BIOS) which may control basic hardware or software operation such as the interaction with peripheral components or devices.

[0168] The at least one processor **1140** may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, a microcontroller, an ASIC, an FPGA, a programmable logic device, a discrete gate or transistor logic component, a discrete hardware component, or any combination thereof). In some cases, the at least one processor **1140** may be configured to operate a memory array using a memory controller. In some other cases, a memory controller may be integrated into the at least one processor **1140**. The at least one processor **1140** may be configured to execute computer-readable instructions stored in a memory (e.g., the at least one memory **1130**) to cause the device **1105** to perform various functions (e.g., functions or tasks supporting HARQ design). For example, the device **1105** or a component of the device **1105** may include at least one processor **1140** and at least one memory **1130** coupled with or to the at least one processor **1140**, the at least one processor **1140** and at least one memory **1130** configured to perform various functions described herein. In some examples, the at least one processor **1140** may include multiple processors and the at least one memory **1130** may include multiple memories. One or more of the multiple processors may be coupled with one or more of the multiple memories, which may, individually or collectively, be configured to perform various functions herein. In some examples, the at least one processor **1140** may be a component of a processing system, which may refer to a system (such as a series) of machines, circuitry (including, for example, one or both of processor circuitry (which may include the at least one processor **1140**) and memory circuitry (which may include the at least one memory **1130**)), or components, that receives or obtains inputs and processes the inputs to produce, generate, or obtain a set of outputs. The processing system may be configured to perform one or more of the functions described herein. For example, the at least one processor **1140** or a processing system including the at least one processor **1140** may be configured to, configurable to, or operable to cause the device **1105** to perform one or more of the functions described herein. Further, as described herein, being "configured to," being "configurable to," and being "operable to" may be used interchangeably and may be associated with a capability, when executing code stored in the at least one memory **1130** or otherwise, to perform one or more of the functions described herein.

[0169] The communications manager **1120** may support wireless communication in accordance with examples as disclosed herein. For example, the communications manager **1120** is capable of, configured to, or operable to support a means for receiving, from a network entity, a first transport block. The communications manager **1120** is capable of, configured to, or operable to support a means for transmitting, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block. The communications manager **1120** is capable of, configured to, or operable to support a means for receiving, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0170] Additionally, or alternatively, the communications manager **1120** may support wireless communication in accordance with examples as disclosed herein. For example, the communications manager **1120** is capable of, configured to, or operable to support a means for receiving, from a network entity, a first transport block. The communications manager **1120** is capable of, configured to, or operable to support a means for transmitting, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block. The communications manager **1120** is capable of, configured to, or operable to support a means for receiving, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0171] By including or configuring the communications manager **1120** in accordance with examples as described herein, the device **1105** may support techniques for improved communication reliability, reduced latency, more efficient utilization of communication resources, and improved coordination between devices.

[0172] In some examples, the communications manager **1120** may be configured to perform various operations (e.g., receiving, monitoring, transmitting) using or otherwise in cooperation with the transceiver **1115**, the one or more antennas **1125**, or any combination thereof. Although the communications manager **1120** is illustrated as a separate component, in some examples, one or more functions described with reference to the communications manager **1120** may be supported by or performed by the at least one processor **1140**, the at least one memory **1130**, the code **1135**, or any combination thereof. For example, the code **1135** may include instructions executable by the at least one processor **1140** to cause the device **1105** to perform various aspects of HARQ design as described herein, or the at least one processor **1140** and the at least one memory **1130** may be otherwise configured to, individually or collectively, perform or support such operations.

[0173] FIG. 12 shows a block diagram 1200 of a device 1205 that supports HARQ design in accordance with one or more aspects of the present disclosure. The device 1205 may be an example of aspects of a network entity 105 as described herein. The device 1205 may include a receiver 1210, a transmitter 1215, and a communications manager 1220. The device 1205, or one or more components of the device 1205 (e.g., the receiver 1210, the transmitter 1215, and the communications manager 1220), may include at least one processor, which may be coupled with at least one memory, to, individually or collectively, support or enable the described techniques. Each of these components may be in communication with one another (e.g., via one or more buses).

[0174] The receiver 1210 may provide a means for obtaining (e.g., receiving, determining, identifying) information such as user data, control information, or any combination thereof (e.g., I/Q samples, symbols, packets, protocol data units, service data units) associated with various channels (e.g., control channels, data channels, information channels, channels associated with a protocol stack). Information may be passed on to other components of the device 1205. In some examples, the receiver 1210 may support obtaining information by receiving signals via one or more antennas. Additionally, or alternatively, the receiver 1210 may support obtaining information by receiving signals via one or more wired (e.g., electrical, fiber optic) interfaces, wireless interfaces, or any combination thereof.

[0175] The transmitter 1215 may provide a means for outputting (e.g., transmitting, providing, conveying, sending) information generated by other components of the device 1205. For example, the transmitter 1215 may output information such as user data, control information, or any combination thereof (e.g., I/Q samples, symbols, packets, protocol data units, service data units) associated with various channels (e.g., control channels, data channels, information channels, channels associated with a protocol stack). In some examples, the transmitter 1215 may support outputting information by transmitting signals via one or more antennas. Additionally, or alternatively, the transmitter 1215 may support outputting information by transmitting signals via one or more wired (e.g., electrical, fiber optic) interfaces, wireless interfaces, or any combination thereof. In some examples, the transmitter 1215 and the receiver 1210 may be co-located in a transceiver, which may include or be coupled with a modem.

[0176] The communications manager 1220, the receiver 1210, the transmitter 1215, or various combinations thereof or various components thereof may be examples of means for performing various aspects of HARQ design as described herein. For example, the communications manager 1220, the receiver 1210, the transmitter 1215, or various combinations or components thereof may be capable of performing one or more of the functions described herein.

[0177] In some examples, the communications manager 1220, the receiver 1210, the transmitter 1215, or various combinations or components thereof may be implemented in hardware (e.g., in communications management circuitry). The hardware may include at least one of a processor, a DSP, a CPU, an ASIC, an FPGA or other programmable logic device, a microcontroller, discrete gate or transistor logic, discrete hardware components, or any combination thereof configured as or otherwise supporting, individually or collectively, a means for performing the functions described in the present disclosure. In some examples, at least one processor and at least one memory coupled with the at least one processor may be configured to perform one or more of the functions described herein (e.g., by one or more processors, individually or collectively, executing instructions stored in the at least one memory).

[0178] Additionally, or alternatively, the communications manager 1220, the receiver 1210, the transmitter 1215, or various combinations or components thereof may be implemented in code (e.g., as communications management software or firmware) executed by at least one processor. If implemented in code executed by at least one processor, the functions of the communications manager 1220, the receiver 1210, the transmitter 1215, or various combinations or components thereof may be performed by a general-purpose processor, a DSP, a CPU, an ASIC, an FPGA, a microcontroller, or any combination of these or other programmable logic devices (e.g., configured as or otherwise supporting, individually or collectively, a means for performing the functions described in the present disclosure).

[0179] In some examples, the communications manager 1220 may be configured to perform various operations (e.g., receiving, obtaining, monitoring, outputting, transmitting) using or otherwise in cooperation with the receiver 1210, the transmitter 1215, or both. For example, the communications manager 1220 may receive information from the receiver 1210, send information to the transmitter 1215, or be integrated in combination with the receiver 1210, the transmitter 1215, or both to obtain information, output information, or perform various other operations as described herein.

[0180] The communications manager 1220 may support wireless communication in accordance with examples as disclosed herein. For example, the communications manager 1220 is capable of, configured to, or operable to support a means for outputting, to a UE, a first transport block. The communications manager 1220 is capable of, configured to, or operable to support a means for obtaining, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block. The communications manager 1220 is capable of, configured to, or operable to support a means for outputting, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0181] Additionally, or alternatively, the communications manager 1220 may support wireless communication in accordance with examples as disclosed herein. For example, the communications manager 1220 is capable of, configured to, or operable to support a means for outputting, to a UE, a first transport block. The communications manager 1220 is capable of, configured to, or operable to support a means for obtaining, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block. The communications manager 1220 is capable of, configured to, or operable to support a means for outputting, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0182] By including or configuring the communications manager 1220 in accordance with examples as described herein, the device **1205** (e.g., at least one processor controlling or otherwise coupled with the receiver **1210**, the transmitter **1215**, the communications manager **1220**, or a combination thereof) may support techniques for more efficient utilization of communication resources.

[0183] FIG. **13** shows a block diagram **1300** of a device **1305** that supports HARQ design in accordance with one or more aspects of the present disclosure. The device **1305** may be an example of aspects of a device **1205** or a network entity **105** as described herein. The device **1305** may include a receiver **1310**, a transmitter **1315**, and a communications manager **1320**. The device **1305**, or one or more components of the device **1305** (e.g., the receiver **1310**, the transmitter **1315**, and the communications manager **1320**), may include at least one processor, which may be coupled with at least one memory, to support the described techniques. Each of these components may be in communication with one another (e.g., via one or more buses).

[0184] The receiver **1310** may provide a means for obtaining (e.g., receiving, determining, identifying) information such as user data, control information, or any combination thereof (e.g., I/Q samples, symbols, packets, protocol data units, service data units) associated with various channels (e.g., control channels, data channels, information channels, channels associated with a protocol stack). Information may be passed on to other components of the device **1305**. In some examples, the receiver **1310** may support obtaining information by receiving signals via one or more antennas. Additionally, or alternatively, the receiver **1310** may support obtaining information by receiving signals via one or more wired (e.g., electrical, fiber optic) interfaces, wireless interfaces, or any combination thereof.

[0185] The transmitter **1315** may provide a means for outputting (e.g., transmitting, providing, conveying, sending) information generated by other components of the device **1305**. For example, the transmitter **1315** may output information such as user data, control information, or any combination thereof (e.g., I/Q samples, symbols, packets, protocol data units, service data units) associated with various channels (e.g., control channels, data channels, information channels, channels associated with a protocol stack). In some examples, the transmitter **1315** may support outputting information by transmitting signals via one or more antennas. Additionally, or alternatively, the transmitter **1315** may support outputting information by transmitting signals via one or more wired (e.g., electrical, fiber optic) interfaces, wireless interfaces, or any combination thereof. In some examples, the transmitter **1315** and the receiver **1310** may be co-located in a transceiver, which may include or be coupled with a modem.

[0186] The device **1305**, or various components thereof, may be an example of means for performing various aspects of HARQ design as described herein. For example, the communications manager **1320** may include a transport block manager **1325**, a feedback manager **1330**, a retransmission manager **1335**, or any combination thereof. The communications manager **1320** may be an example of aspects of a communications manager **1220** as described herein. In some examples, the communications manager **1320**, or various components thereof, may be configured to perform various operations (e.g., receiving, obtaining, monitoring, outputting, transmitting) using or otherwise in cooperation with the receiver **1310**, the transmitter **1315**, or both. For example, the communications manager **1320** may receive information from the receiver **1310**, send information to the transmitter **1315**, or be integrated in combination with the receiver **1310**, the transmitter **1315**, or both to obtain information, output information, or perform various other operations as described herein.

[0187] The communications manager **1320** may support wireless communication in accordance with examples as disclosed herein. The transport block manager **1325** is capable of, configured to, or operable to support a means for outputting, to a UE, a first transport block. The feedback manager **1330** is capable of, configured to, or operable to support a means for obtaining, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block. The retransmission manager **1335** is capable of, configured to, or operable to support a means for outputting, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0188] Additionally, or alternatively, the communications manager **1320** may support wireless communication in accordance with examples as disclosed herein. The transport block manager **1325** is capable of, configured to, or operable to support a means for outputting, to a UE, a first transport block. The feedback manager **1330** is capable of, configured to, or operable to support a means for obtaining, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block. The retransmission manager **1335** is capable of, configured to, or operable to support a means for outputting, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0189] FIG. **14** shows a block diagram **1400** of a communications manager **1420** that supports HARQ design in accordance with one or more aspects of the present disclosure. The communications manager **1420** may be an example of aspects of a communications manager **1220**, a communications manager **1320**, or both, as described herein. The communications manager **1420**, or various components thereof, may be an example of means for performing various aspects of HARQ design as described herein. For example, the communications manager **1420** may include a transport block manager **1425**, a feedback manager **1430**, a retransmission manager **1435**, a time delay manager **1440**, a delayed scheduling manager **1445**, or any combination thereof. Each of these components, or components or subcomponents thereof (e.g., one or more processors, one or more memories), may communicate, directly or indirectly, with one another (e.g., via one or more buses) which may include communications within a protocol layer of a protocol stack, communications associated with a logical channel of a protocol stack (e.g., between protocol layers of a protocol stack, within a device, component, or virtualized component associated with a network entity **105**, between devices, components, or virtualized components associated with a network entity **105**), or any combination thereof.

[0190] The communications manager **1420** may support wireless communication in accordance with examples as disclosed herein. The transport block manager **1425** is capable of, configured to, or operable to support a means for outputting, to a UE, a first transport block. The feedback manager **1430** is capable of, configured to, or operable to support a means for obtaining, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block. The retransmission manager **1435** is capable of, configured to, or operable to support a means for outputting, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0191] In some examples, the time delay includes a delayed timeline for obtaining a first acknowledgment feedback or a first negative acknowledgment feedback associated with the retransmission of the first transport block.

[0192] In some examples, the transport block manager **1425** is capable of, configured to, or operable to support a means for outputting, to the UE based on obtaining the one or more feedback messages, a second transport block. In some examples, the feedback manager **1430** is capable of, configured to, or operable to support a means for obtaining, from the UE based on outputting the second transport block, a second acknowledgment feedback or a second negative acknowledgment feedback associated with the second transport block, where the obtaining of the second acknowledgment feedback or the second negative acknowledgment feedback occurs prior to the obtaining of the first acknowledgment feedback or the first negative acknowledgment feedback.

[0193] In some examples, the time delay includes an extended transmission duration for the retransmission of the first transport block.

[0194] In some examples, the transport block manager **1425** is capable of, configured to, or operable to support a means for outputting, to the UE based on obtaining the one or more feedback messages, a second transport block and the retransmission of the first transport block, where the retransmission of the first transport block is frequency-division multiplexed with the second transport block.

[0195] In some examples, the transport block manager **1425** is capable of, configured to, or operable to support a means for outputting, to the UE, a second transport block on a second component carrier, where the first transport block is outputted on a first component carrier.

[0196] In some examples, to support obtaining the one or more feedback messages, the feedback manager **1430** is capable of, configured to, or operable to support a means for obtaining, from the UE based on outputting the first transport block and outputting the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block, where the one or more joint feedback messages indicate that the reception of at least the portion of the first transport block and a reception of at least the portion of the second transport block was unsuccessful and indicate the request for the time delay.

[0197] In some examples, the feedback manager **1430** is capable of, configured to, or operable to support a means for obtaining, from the UE based on outputting the first transport block and outputting the second transport block, one or more second feedback messages associated with the second transport block, where the one or more second feedback messages indicate that a reception of at least the portion of the second transport block was unsuccessful. In some examples, the retransmission manager **1435** is capable of, configured to, or operable to support a means for outputting, to the UE based on the reception of the one or more second feedback messages, a retransmission of the second transport block, where the retransmission of the second transport block is outputted after the retransmission of the first transport block.

[0198] In some examples, to support obtaining the one or more feedback messages, the feedback manager **1430** is capable of, configured to, or operable to support a means for obtaining a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful. In some examples, to support obtaining the one or more feedback messages, the time delay manager **1440** is capable of, configured to, or operable to support a means for obtaining a request message that indicates the request for the time delay associated with the retransmission of the first transport block.

[0199] In some examples, to support obtaining the one or more feedback messages, the feedback manager **1430** is capable of, configured to, or operable to support a means for obtaining a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the time delay associated with the retransmission of the first transport block.

[0200] Additionally, or alternatively, the communications manager **1420** may support wireless communication in accordance with examples as disclosed herein. In some examples, the transport block manager **1425** is capable of, configured to, or operable to support a means for outputting, to a UE, a first transport block. In some examples, the feedback manager **1430** is capable of, configured to, or operable to support a means for obtaining, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block. In some examples, the retransmission manager **1435** is capable of, configured to, or operable to support a means for outputting, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0201] In some examples, the transport block manager **1425** is capable of, configured to, or operable to support a means for outputting, to the UE, a second transport block on a second component carrier, where the first transport block is outputted on a first component carrier.

[0202] In some examples, to support obtaining the one or more feedback messages, the feedback manager **1430** is capable of, configured to, or operable to support a means for obtaining, from the UE based on outputting the first transport block and outputting the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block, where the one or more joint feedback messages indicate that the reception of at least the portion of the first transport block and a reception of at least the portion of the second transport block was unsuccessful and indicate the request for the delayed scheduling.

[0203] In some examples, to support obtaining the one or more feedback messages, the feedback manager **1430** is capable of, configured to, or operable to support a means for obtaining a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful. In some examples, to support obtaining the one or more feedback messages, the delayed scheduling manager **1445** is capable of, configured to, or operable to support a means for obtaining a request message that indicates the request for the delayed scheduling.

[0204] In some examples, to support obtaining the one or more feedback messages, the feedback manager **1430** is capable of, configured to, or operable to support a means for obtaining a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the delayed scheduling.

[0205] FIG. **15** shows a diagram of a system **1500** including a device **1505** that supports HARQ design in accordance with one or more aspects of the present disclosure. The device **1505** may be an example of or include the components of a device **1205**, a device **1305**, or a network entity **105** as described herein. The device **1505** may communicate with one or more network entities **105**, one or more UEs **115**, or any combination thereof, which may include communications over one or more wired interfaces, over one or more wireless interfaces, or any combination thereof. The device **1505** may include components that support outputting and obtaining communications, such as a communications manager **1520**, a transceiver **1510**, an antenna **1515**, at least one memory **1525**, code **1530**, and at least one processor **1535**. These components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more buses (e.g., a bus **1540**).

[0206] The transceiver **1510** may support bi-directional communications via wired links, wireless links, or both as described herein. In some examples, the transceiver **1510** may include a wired transceiver and may communicate bi-directionally with another wired transceiver. Additionally, or alternatively, in some examples, the transceiver **1510** may include a wireless transceiver and may communicate bi-directionally with another wireless transceiver. In some examples, the device **1505** may include one or more antennas **1515**, which may be capable of transmitting or receiving wireless transmissions (e.g., concurrently). The transceiver **1510** may also include a modem to modulate signals, to provide the modulated signals for transmission (e.g., by one or more antennas **1515**, by a wired transmitter), to receive modulated signals (e.g., from one or more antennas **1515**, from a wired receiver), and to demodulate signals. In some implementations, the transceiver **1510** may include one or more interfaces, such as one or more interfaces coupled with the one or more antennas **1515** that are configured to support various receiving or obtaining operations, or one or more interfaces coupled with the one or more antennas **1515** that are configured to support various transmitting or outputting operations, or a combination thereof. In some implementations, the transceiver **1510** may include or be configured for coupling with one or more processors or one or more memory components that are operable to perform or support operations based on received or obtained information or signals, or to generate information or other signals for transmission or other outputting, or any combination thereof. In some implementations, the transceiver **1510**, or the transceiver **1510** and the one or more antennas **1515**, or the transceiver **1510** and the one or more antennas **1515** and one or more processors or one or more memory components (e.g., the at least one processor **1535**, the at least one memory **1525**, or both), may be included in a chip or chip assembly that is installed in the device **1505**. In some examples, the transceiver **1510** may be operable to support communications via one or more communications links (e.g., a communication link **125**, a backhaul communication link **120**, a midhaul communication link **162**, a fronthaul communication link **168**).

[0207] The at least one memory **1525** may include RAM, ROM, or any combination thereof. The at least one memory **1525** may store computer-readable, computer-executable code **1530** including instructions that, when executed by one or more of the at least one processor **1535**, cause the device **1505** to perform various functions described herein. The code **1530** may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. In some cases, the code **1530** may not be directly executable by a processor of the at least one processor **1535** but may cause a computer (e.g., when compiled and executed) to perform functions described herein. In some cases, the at least one memory **1525** may contain, among other things, a BIOS which may control basic hardware or software operation such as the interaction with peripheral components or devices. In some examples, the at least one processor **1535** may include multiple processors and the at least one memory **1525** may include multiple memories. One or more of the multiple processors may be coupled with one or more of the multiple memories which may, individually or collectively, be configured to perform various functions herein (for example, as part of a processing system).

[0208] The at least one processor **1535** may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, an ASIC, a CPU, an FPGA, a microcontroller, a programmable logic device, discrete gate or transistor logic, a discrete hardware component, or any combination thereof). In some cases, the at least one processor **1535** may be configured to operate a memory array using a memory controller. In some other cases, a memory controller may be integrated into one or more of the at least one processor **1535**. The at least one processor **1535** may be configured to execute computer-readable instructions stored in a memory (e.g., one or more of the at least one memory **1525**) to cause the device **1505** to perform various functions (e.g., functions or tasks supporting HARQ design). For example, the device **1505** or a component of the device **1505** may include at least one processor **1535** and at least one memory **1525** coupled with one or more of the at least one processor **1535**, the at least one processor **1535** and the at least one memory **1525** configured to perform various functions described herein. The at least one processor **1535** may be an example of a cloud-computing platform (e.g., one or more physical nodes and supporting software such as operating systems, virtual machines, or container instances) that may host the functions (e.g., by executing code **1530**) to perform the functions of the device **1505**. The at least one processor **1535** may be any one or more suitable processors capable of executing scripts or instructions of one or more software programs stored in the device **1505** (such as within one or more of the at least one memory **1525**). In some examples, the at least one processor **1535** may include multiple processors and the at least one memory **1525** may include multiple memories.

One or more of the multiple processors may be coupled with one or more of the multiple memories, which may, individually or collectively, be configured to perform various functions herein. In some examples, the at least one processor **1535** may be a component of a processing system, which may refer to a system (such as a series) of machines, circuitry (including, for example, one or both of processor circuitry (which may include the at least one processor **1535**) and memory circuitry (which may include the at least one memory **1525**)), or components, that receives or obtains inputs and processes the inputs to produce, generate, or obtain a set of outputs. The processing system may be configured to perform one or more of the functions described herein. For example, the at least one processor **1535** or a processing system including the at least one processor **1535** may be configured to, configurable to, or operable to cause the device **1505** to perform one or more of the functions described herein. Further, as described herein, being "configured to," being "configurable to," and being "operable to" may be used interchangeably and may be associated with a capability, when executing code stored in the at least one memory **1525** or otherwise, to perform one or more of the functions described herein.

[0209] In some examples, a bus **1540** may support communications of (e.g., within) a protocol layer of a protocol stack. In some examples, a bus **1540** may support communications associated with a logical channel of a protocol stack (e.g., between protocol layers of a protocol stack), which may include communications performed within a component of the device **1505**, or between different components of the device **1505** that may be co-located or located in different locations (e.g., where the device **1505** may refer to a system in which one or more of the communications manager **1520**, the transceiver **1510**, the at least one memory **1525**, the code **1530**, and the at least one processor **1535** may be located in one of the different components or divided between different components).

[0210] In some examples, the communications manager **1520** may manage aspects of communications with a core network **130** (e.g., via one or more wired or wireless backhaul links). For example, the communications manager **1520** may manage the transfer of data communications for client devices, such as one or more UEs **115**. In some examples, the communications manager **1520** may manage communications with other network entities **105**, and may include a controller or scheduler for controlling communications with UEs **115** in cooperation with other network entities **105**. In some examples, the communications manager **1520** may support an X2 interface within an LTE/LTE-A wireless communications network technology to provide communication between network entities **105**.

[0211] The communications manager **1520** may support wireless communication in accordance with examples as disclosed herein. For example, the communications manager **1520** is capable of, configured to, or operable to support a means for outputting, to a UE, a first transport block. The communications manager **1520** is capable of, configured to, or operable to support a means for obtaining, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block. The communications manager **1520** is capable of, configured to, or operable to support a means for outputting, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0212] Additionally, or alternatively, the communications manager **1520** may support wireless communication in accordance with examples as disclosed herein. For example, the communications manager **1520** is capable of, configured to, or operable to support a means for outputting, to a UE, a first transport block. The communications manager **1520** is capable of, configured to, or operable to support a means for obtaining, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block. The communications manager **1520** is capable of, configured to, or operable to support a means for outputting, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0213] By including or configuring the communications manager **1520** in accordance with examples as described herein, the device **1505** may support techniques for improved communication reliability, reduced latency, more efficient utilization of communication resources, and improved coordination between devices.

[0214] In some examples, the communications manager **1520** may be configured to perform various operations (e.g., receiving, obtaining, monitoring, outputting, transmitting) using or otherwise in cooperation with the transceiver **1510**, the one or more antennas **1515** (e.g., where applicable), or any combination thereof. Although the communications manager **1520** is illustrated as a separate component, in some examples, one or more functions described with reference to the communications manager **1520** may be supported by or performed by the transceiver **1510**, one or more of the at least one processor **1535**, one or more of the at least one memory **1525**, the code **1530**, or any combination thereof (for example, by a processing system including at least a portion of the at least one processor **1535**, the at least one memory **1525**, the code **1530**, or any combination thereof). For example, the code **1530** may include instructions executable by one or more of the at least one processor **1535** to cause the device **1505** to perform various aspects of HARQ design as described herein, or the at least one processor **1535** and the at least one memory **1525** may be otherwise configured to, individually or collectively, perform or support such operations.

[0215] FIG. **16** shows a flowchart illustrating a method **1600** that supports HARQ design in accordance with one or more aspects of the present disclosure. The operations of the method **1600** may be implemented by a UE or its components as described herein. For example, the operations of the method **1600** may be performed by a UE **115** as described with reference to FIGS. **1** through **11**. In some examples, a UE may execute a set of instructions to control the functional elements of the UE to perform the described functions. Additionally, or alternatively, the UE may perform aspects of the described functions using special-purpose hardware.

[0216] At **1605**, the method may include receiving, from a network entity, a first transport block. The operations of block **1605** may be performed in accordance with examples as disclosed herein. In some examples, aspects of the operations of **1605** may be performed by a transport block manager **1025** as described with reference to FIG. **10**.

[0217] At **1610**, the method may include transmitting, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block. The operations of block **1610** may be performed in accordance with examples as disclosed herein. In some examples, aspects of the operations of **1610** may be performed by a feedback manager **1030** as described with reference to FIG. **10**.

[0218] At **1615**, the method may include receiving, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block. The operations of block **1615** may be performed in accordance with examples as disclosed herein. In some examples, aspects of the operations of **1615** may be performed by a retransmission manager **1035** as described with reference to FIG. **10**.

[0219] FIG. **17** shows a flowchart illustrating a method **1700** that supports HARQ design in accordance with one or more aspects of the present disclosure. The operations of the method **1700** may be implemented by a UE or its components as described herein. For example, the operations of the method **1700** may be performed by a UE **115** as described with reference to FIGS. **1** through **11**. In some examples, a UE may execute a set of instructions to control the functional elements of the UE to perform the described functions. Additionally, or alternatively, the UE may perform aspects of the described functions using special-purpose hardware.

[0220] At **1705**, the method may include receiving, from a network entity, a first transport block. The operations of block **1705** may be performed in accordance with examples as disclosed herein. In some examples, aspects of the operations of **1705** may be performed by a transport block manager **1025** as described with reference to FIG. **10**.

[0221] At **1710**, the method may include transmitting, to the network entity based on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block. The operations of block **1710** may be performed in accordance with examples as disclosed herein. In some examples, aspects of the operations of **1710** may be performed by a feedback manager **1030** as described with reference to FIG. **10**.

[0222] At **1715**, the method may include receive, from the network entity based on transmitting the one or more feedback messages, the retransmission of the first transport block. The operations of block **1715** may be performed in accordance with examples as disclosed herein. In some examples, aspects of the operations of **1715** may be performed by a retransmission manager **1035** as described with reference to FIG. **10**.

[0223] FIG. **18** shows a flowchart illustrating a method **1800** that supports HARQ design in accordance with one or more aspects of the present disclosure. The operations of the method **1800** may be implemented by a network entity or its components as described herein. For example, the operations of the method **1800** may be performed by a network entity as described with reference to FIGS. **1** through **7** and **12** through **15**. In some examples, a network entity may execute a set of instructions to control the functional elements of the network entity to perform the described functions. Additionally, or alternatively, the network entity may perform aspects of the described functions using special-purpose hardware.

[0224] At **1805**, the method may include outputting, to a UE, a first transport block. The operations of block **1805** may be performed in accordance with examples as disclosed herein. In some examples, aspects of the operations of **1805** may be performed by a transport block manager **1425** as described with reference to FIG. **14**.

[0225] At **1810**, the method may include obtaining, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block. The operations of block **1810** may be performed in accordance with examples as disclosed herein. In some examples, aspects of the operations of **1810** may be performed by a feedback manager **1430** as described with reference to FIG. **14**.

[0226] At **1815**, the method may include outputting, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block. The operations of block **1815** may be performed in accordance with examples as disclosed herein. In some examples, aspects of the operations of **1815** may be performed by a retransmission manager **1435** as described with reference to FIG. **14**.

[0227] FIG. **19** shows a flowchart illustrating a method **1900** that supports HARQ design in accordance with one or more aspects of the present disclosure. The operations of the method **1900** may be implemented by a network entity or its components as described herein. For example, the operations of the method **1900** may be performed by a network entity as described with reference to FIGS. **1** through **7** and **12** through **15**. In some examples, a network entity may execute a set of instructions to control the functional elements of the network entity to perform the described functions. Additionally, or alternatively, the network entity may perform aspects of the described functions using special-purpose hardware.

[0228] At **1905**, the method may include outputting, to a UE, a first transport block. The operations of block **1905** may be performed in accordance with examples as disclosed herein. In some examples, aspects of the operations of **1905** may be performed by a transport block manager **1425** as described with reference to FIG. **14**.

[0229] At **1910**, the method may include obtaining, from the UE based on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block. The operations of block **1910** may be performed in accordance with examples as disclosed herein. In some examples, aspects of the operations of **1910** may be performed by a feedback manager **1430** as described with reference to FIG. **14**.

[0230] At **1915**, the method may include outputting, to the UE based on obtaining the one or more feedback messages, the retransmission of the first transport block. The operations of block **1915** may be performed in accordance with examples as disclosed herein. In some examples, aspects of the operations of **1915** may be performed by a retransmission manager **1435** as described with reference to FIG. **14**.

[0231] The following provides an overview of aspects of the present disclosure:

[0232] Aspect 1: A method for wireless communication by a UE, comprising: receiving, from a network entity, a first transport block; transmitting, to the network entity based at least in part on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block; and receiving, from the network entity based at least in part on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0233] Aspect 2: The method of aspect 1, wherein the time delay comprises a delayed timeline for a transmission of a first acknowledgment feedback or a first negative acknowledgment feedback associated with a reception of the retransmission of the first transport block.

[0234] Aspect 3: The method of aspect 2, further comprising: receiving, from the network entity after transmitting the one or more feedback messages, a second transport block; and transmitting, to the network entity based at least in part on receiving the second transport block, a second acknowledgment feedback or a second negative acknowledgment feedback associated with a reception of the second transport block, wherein the transmission of the second acknowledgment feedback or the second negative acknowledgment feedback occurs prior to the transmission of the first acknowledgment feedback or the first negative acknowledgment feedback.

[0235] Aspect 4: The method of any of aspect 1, wherein the time delay comprises an extended transmission duration for the retransmission of the first transport block.

[0236] Aspect 5: The method of aspect 4, wherein receiving the retransmission of the first transport block further comprising: receiving, from the network entity based at least in part on transmitting the one or more feedback messages, a second transport block, wherein the retransmission of the first transport block is frequency-division multiplexed with the second transport block.

[0237] Aspect 6: The method of any of aspects 1 through 5, further comprising: receiving, from the network entity, a second transport block on a second component carrier, wherein the first transport block is received on a first component carrier.

[0238] Aspect 7: The method of aspect 6, wherein transmitting the one or more feedback messages, further comprises: transmitting, to the network entity based at least in part on receiving the first transport block and the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block, wherein the one or more joint feedback messages indicate that the reception of at least the portion of the first transport block was unsuccessful and that a reception of at least the portion of the second transport block was unsuccessful and indicate the request for the time delay.

[0239] Aspect 8: The method of any of aspects 6 through 7, further comprising: receiving, from the network entity based at least in part on a reception of at least a portion of the second transport block was unsuccessful, a retransmission of the second transport block, wherein the retransmission of the second transport block is received after the retransmission of the first transport block.

[0240] Aspect 9: The method of any of aspects 1 through 8, wherein transmitting the one or more feedback messages further comprises: transmitting a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful; and transmitting a message that indicates the request for the time delay associated with the retransmission of the first transport block.

[0241] Aspect 10: The method of any of aspects 1 through 9, wherein transmitting the one or more feedback messages further comprises: transmitting a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the time delay associated with the retransmission of the first transport block.

[0242] Aspect 11: A method for wireless communication by a UE, comprising: receiving, from a network entity, a first transport block; transmitting, to the network entity based at least in part on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block; and receive, from the network entity based at least in part on transmitting the one or more feedback messages, the retransmission of the first transport block.

[0243] Aspect 12: The method of aspect 11, further comprising: receiving, from the network entity, a second transport block on a second component carrier, wherein the first transport block is received on a first component carrier.

[0244] Aspect 13: The method of aspect 12, wherein transmitting the one or more feedback messages, further comprises: transmitting, to the network entity based at least in part on receiving the first transport block and receiving the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block, wherein the one or more joint feedback messages indicate that the reception of at least the portion of the first transport block and indicate that a reception of at least the portion of the second transport block was unsuccessful and indicate the request for the delayed scheduling.

[0245] Aspect 14: The method of any of aspects 11 through 13, wherein transmitting the one or more feedback messages further comprises: transmitting a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful; and transmitting a request message that indicates the request for the delayed scheduling.

[0246] Aspect 15: The method of any of aspects 11 through 14, wherein transmitting the one or more feedback messages further comprises: transmitting a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the delayed scheduling.

[0247] Aspect 16: A method for wireless communication by a network entity, comprising: outputting, to a UE, a first transport block; obtaining, from the UE based at least in part on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block; and outputting, to the UE based at least in part on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0248] Aspect 17: The method of aspect 16, wherein the time delay comprises a delayed timeline for obtaining a first acknowledgment feedback or a first negative acknowledgment feedback associated with the retransmission of the first transport block.

[0249] Aspect 18: The method of aspect 17, further comprising: outputting, to the UE based at least in part on obtaining the one or more feedback messages, a second transport block; and obtaining, from the UE based at least in part on outputting the second transport block, a second acknowledgment feedback or a second negative acknowledgment feedback associated with the second transport block, wherein the obtaining of the second acknowledgment feedback or the second negative acknowledgment feedback occurs prior to the obtaining of the first acknowledgment feedback or the first negative acknowledgment feedback.

[0250] Aspect 19: The method of aspect 16, wherein the time delay comprises an extended transmission duration for the retransmission of the first transport block.

[0251] Aspect 20: The method of aspect 19, further comprising: outputting, to the UE based at least in part on obtaining the one or more feedback messages, a second transport block and the retransmission of the first transport block, wherein the retransmission of the first transport block is frequency-division multiplexed with the second transport block.

[0252] Aspect 21: The method of any of aspects 16 through 20, further comprising: outputting, to the UE, a second transport block on a second component carrier, wherein the first transport block is outputted on a first component carrier.

[0253] Aspect 22: The method of aspect 21, wherein obtaining the one or more feedback messages, further comprises: obtaining, from the UE based at least in part on outputting the first transport block and outputting the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block, wherein the one or more joint feedback messages indicate that the reception of at least the portion of the first transport block and a reception of at least the portion of the second transport block was unsuccessful and indicate the request for the time delay.

[0254] Aspect 23: The method of any of aspects 21 through 22, further comprising: obtaining, from the UE based at least in part on outputting the first transport block and outputting the second transport block, one or more second feedback messages associated with the second transport block, wherein the one or more second feedback messages indicate that a reception of at least the portion of the second transport block was unsuccessful; and outputting, to the UE based at least in part on the reception of the one or more second feedback messages, a retransmission of the second transport block, wherein the retransmission of the second transport block is outputted after the retransmission of the first transport block.

[0255] Aspect 24: The method of any of aspects 16 through 23, wherein obtaining the one or more feedback messages further comprises: obtaining a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful; and obtaining a request message that indicates the request for the time delay associated with the retransmission of the first transport block.

[0256] Aspect 25: The method of any of aspects 16 through 24, wherein obtaining the one or more feedback messages further comprises: obtaining a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the time delay associated with the retransmission of the first transport block.

[0257] Aspect 26: A method for wireless communication by a network entity, comprising: outputting, to a UE, a first transport block; obtaining, from the UE based at least in part on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block; and outputting, to the UE based at least in part on obtaining the one or more feedback messages, the retransmission of the first transport block.

[0258] Aspect 27: The method of aspect 26, further comprising: outputting, to the UE, a second transport block on a second component carrier, wherein the first transport block is outputted on a first component carrier.

[0259] Aspect 28: The method of aspect 27, wherein obtaining the one or more feedback messages, further comprises: obtaining, from the UE based at least in part on outputting the first transport block and outputting the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block, wherein the one or more joint feedback messages indicate that the reception of at least the portion of the first transport block and a reception of at least the portion of the second transport block was unsuccessful and indicate the request for the delayed scheduling.

[0260] Aspect 29: The method of any of aspects 26 through 28, wherein obtaining the one or more feedback messages further comprises: obtaining a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful; and obtaining a request message that indicates the request for the delayed scheduling.

[0261] Aspect 30: The method of any of aspects 26 through 29, wherein obtaining the one or more feedback messages further comprises: obtaining a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the delayed scheduling.

[0262] Aspect 31: A user equipment (UE) for wireless communication, comprising one or more memories storing processor-executable code, and one or more processors coupled with the one or more memories and individually or collectively operable to execute the code to cause the user equipment (UE) to perform a method of any of aspects 1 through 10.

[0263] Aspect 32: A user equipment (UE) for wireless communication, comprising at least one means for performing a method of any of aspects 1 through 10.

[0264] Aspect 33: A non-transitory computer-readable medium storing code for wireless communication, the code comprising instructions executable by one or more processors to perform a method of any of aspects 1 through 10.

[0265] Aspect 34: A user equipment (UE) for wireless communication, comprising one or more memories storing processor-executable code, and one or more processors coupled with the one or more memories and individually or collectively operable to execute the code to cause the user equipment (UE) to perform a method of any of aspects 11 through 15.

[0266] Aspect 35: A user equipment (UE) for wireless communication, comprising at least one means for performing a method of any of aspects 11 through 15.

[0267] Aspect 36: A non-transitory computer-readable medium storing code for wireless communication, the code comprising instructions executable by one or more processors to perform a method of any of aspects 11 through 15.

[0268] Aspect 37: A network entity for wireless communication, comprising one or more memories storing processor-executable code, and one or more processors coupled with the one or more memories and individually or collectively operable to execute the code to cause the network entity to perform a method of any of aspects 16 through 25.

[0269] Aspect 38: A network entity for wireless communication, comprising at least one means for performing a method of any of aspects 16 through 25.

[0270] Aspect 39: A non-transitory computer-readable medium storing code for wireless communication, the code comprising instructions executable by one or more processors to perform a method of any of aspects 16 through 25.

[0271] Aspect 40: A network entity for wireless communication, comprising one or more memories storing processor-executable code, and one or more processors coupled with the one or more memories and individually or collectively operable to execute the code to cause the network entity to perform a method of any of aspects 26 through 30.

[0272] Aspect 41: A network entity for wireless communication, comprising at least one means for performing a method of any of aspects 26 through 30.

[0273] Aspect 42: A non-transitory computer-readable medium storing code for wireless communication, the code comprising instructions executable by one or more processors to perform a method of any of aspects 26 through 30.

[0274] It should be noted that the methods described herein describe possible implementations, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible. Further, aspects from two or more of the methods may be combined.

[0275] Although aspects of an LTE, LTE-A, LTE-A Pro, or NR system may be described for purposes of example, and LTE, LTE-A, LTE-A Pro, or NR terminology may be used in much of the description, the techniques described herein are applicable beyond LTE, LTE-A, LTE-A Pro, or NR networks. For example, the described techniques may be applicable to various other wireless communications systems such as Ultra Mobile Broadband (UMB), Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20, Flash-OFDM, as well as other systems and radio technologies not explicitly mentioned herein.

[0276] Information and signals described herein may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[0277] The various illustrative blocks and components described in connection with the disclosure herein may be implemented or performed using a general-purpose processor, a DSP, an ASIC, a CPU, an FPGA or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor but, in the alternative, the processor may be any processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices (e.g., a combination of a DSP and a microprocessor, multiple microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration). Any functions or operations described herein as being capable of being performed by a processor may be performed by multiple processors that, individually or collectively, are capable of performing the described functions or operations.

[0278] The functions described herein may be implemented using hardware, software executed by a processor, firmware, or any combination thereof. If implemented using software executed by a processor, the functions may be stored as or transmitted using one or more instructions or code of a computer-readable medium. Other examples and implementations are within the scope of the disclosure and appended claims. For example, due to the nature of software, functions described herein may be implemented using software executed by a processor, hardware, firmware, hardwiring, or combinations of any of these. Features implementing functions may also be physically located at various positions, including being distributed such that portions of functions are implemented at different physical locations.

[0279] Computer-readable media includes both non-transitory computer storage media and communication media including any medium that facilitates transfer of a computer program from one location to another. A non-transitory storage medium may be any available medium that may be accessed by a general-purpose or special-purpose computer. By way of example, and not limitation, non-transitory computer-readable media may include RAM, ROM, electrically erasable programmable ROM (EEPROM), flash memory, compact disk (CD) ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other non-transitory medium that may be used to carry or store desired program code means in the form of instructions or data structures and that may be accessed by a general-purpose or special-purpose computer, or a general-purpose or special-purpose processor. Also, any connection is properly termed a computer-readable medium. For example, if the software is transmitted from a website, server, or other remote source using a coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave, then the coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of computer-readable medium. Disk and disc, as used herein, include CD, laser disc, optical disc, digital versatile disc (DVD), floppy disk and Blu-ray disc. Disks may reproduce data magnetically, and discs may reproduce data optically using lasers. Combinations of the above are also included within the scope of computer-readable media. Any functions or operations described herein as being capable of being performed by a memory may be performed by multiple memories that, individually or collectively, are capable of performing the described functions or operations.

[0280] As used herein, including in the claims, "or" as used in a list of items (e.g., a list of items prefaced by a phrase such as "at least one of" or "one or more of") indicates an inclusive list such that, for example, a list of at least one of A, B, or C means A or B or C or AB or AC or BC or ABC (i.e., A and B and C). Also, as used herein, the phrase "based on" shall not be construed as a reference to a closed set of conditions. For example, an example step that is described as "based on condition A" may be based on both a condition A and a condition B without departing from the scope of the present disclosure. In other words, as used herein, the phrase "based on" shall be construed in the same manner as the phrase "based at least in part on."

[0281] As used herein, including in the claims, the article "a" before a noun is open-ended and understood to refer to "at least one" of those nouns or "one or more" of those nouns. Thus, the terms "a," "at least one," "one or more," "at least one of one or more" may be interchangeable. For example, if a claim recites "a component" that performs one or more functions, each of the individual functions may be performed by a single component or by any combination of multiple components. Thus, the term "a component" having characteristics or performing functions may refer to "at least one of one or more components" having a particular characteristic or performing a particular function. Subsequent reference to a component introduced with the article "a" using the terms "the" or "said" may refer to any or all of the one or more components. For example, a component introduced with the article "a" may be understood to mean "one or more components," and referring to "the component" subsequently in the claims may be understood to be equivalent to referring to "at least one of the one or more components." Similarly, subsequent reference to a component introduced as "one or more components" using the terms "the" or "said" may refer to any or all of the one or more components. For example, referring to "the one or more components" subsequently in the claims may be understood to be equivalent to referring to "at least one of the one or more components."

[0282] The term "determine" or "determining" encompasses a variety of actions and, therefore, "determining" can include calculating, computing, processing, deriving, investigating, looking up (such as via looking up in a table, a database or another data structure), ascertaining and the like. Also, "determining" can include receiving (e.g., receiving information), accessing (e.g., accessing data stored in memory) and the like. Also, "determining" can include resolving, obtaining, selecting, choosing, establishing, and other such similar actions.

[0283] In the appended figures, similar components or features may have the same reference label. Further, various components of the same type may be distinguished by following the reference label by a dash and a second label that distinguishes among the similar components. If just the first reference label is used in the specification, the description is applicable to any one of the similar components having the same first reference label irrespective of the second reference label, or other subsequent reference label.

[0284] The description set forth herein, in connection with the appended drawings, describes example configurations and does not represent all the examples that may be implemented or that are within the scope of the claims. The term "example" used herein means "serving as an example, instance, or illustration," and not "preferred" or "advantageous over other examples." The detailed description includes specific details for the purpose of providing an understanding of the described techniques. These techniques, however, may be practiced without these specific details. In some instances, known structures and devices are shown in block diagram form in order to avoid obscuring the concepts of the described examples.

[0285] The description herein is provided to enable a person having ordinary skill in the art to make or use the disclosure. Various modifications to the disclosure will be apparent to a person having ordinary skill in the art, and the generic principles defined herein may be applied to other variations without departing from the scope of the disclosure. Thus, the disclosure is not limited to the examples and designs described herein but is to be accorded the broadest scope consistent with the principles and novel features disclosed herein.

What is claimed is:

1. A user equipment (UE), comprising:

one or more memories storing processor-executable code; and

one or more processors coupled with the one or more memories and individually or collectively operable to execute the code to cause the user equipment (UE) to:

receive, from a network entity, a first transport block;

transmit, to the network entity based at least in part on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block; and

receive, from the network entity based at least in part on transmitting the one or more feedback messages, the retransmission of the first transport block.

2. The UE of claim **1**, wherein the time delay comprises a delayed timeline for a transmission of a first acknowledgment feedback or a first negative acknowledgment feedback associated with a reception of the retransmission of the first transport block.

3. The UE of claim **2**, wherein the one or more processors are individually or collectively further operable to execute the code to cause the UE to:

receive, from the network entity after transmitting the one or more feedback messages, a second transport block; and

transmit, to the network entity based at least in part on receiving the second transport block, a second acknowledgment feedback or a second negative acknowledgment feedback associated with a reception of the second transport block, wherein the transmission of the second acknowledgment feedback or the second negative acknowledgment feedback occurs prior to the transmission of the first acknowledgment feedback or the first negative acknowledgment feedback.

4. The UE of claim **1**, wherein the time delay comprises an extended transmission duration for the retransmission of the first transport block.

5. The UE of claim **4**, wherein the one or more processors are individually or collectively further operable to execute the code to cause the UE to:

receive, from the network entity based at least in part on transmitting the one or more feedback messages, a second transport block, wherein the retransmission of the first transport block is frequency-division multiplexed with the second transport block.

6. The UE of claim **1**, wherein the one or more processors are individually or collectively further operable to execute the code to cause the UE to:

receive, from the network entity, a second transport block on a second component carrier, wherein the first transport block is received on a first component carrier.

7. The UE of claim **6**, wherein, to transmit the one or more feedback messages, the one or more processors are individually or collectively further operable to execute the code to cause the UE to:

transmit, to the network entity based at least in part on receiving the first transport block and the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block, wherein the one or more joint feedback messages indicate that the reception of at least the portion of the first transport block was unsuccessful and that a reception of at least the portion of the second transport block was unsuccessful and indicate the request for the time delay.

8. The UE of claim **6**, wherein the one or more processors are individually or collectively further operable to execute the code to cause the UE to:

receive, from the network entity based at least in part on a reception of at least a portion of the second transport block was unsuccessful, a retransmission of the second transport block, wherein the retransmission of the second transport block is received after the retransmission of the first transport block.

9. The UE of claim **1**, wherein, to transmit the one or more feedback messages, the one or more processors are individually or collectively further operable to execute the code to cause the UE to:

transmit a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful; and

transmit a message that indicates the request for the time delay associated with the retransmission of the first transport block.

10. The UE of claim **1**, wherein, to transmit the one or more feedback messages, the one or more processors are individually or collectively further operable to execute the code to cause the UE to:

transmit a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the time delay associated with the retransmission of the first transport block.

11. A user equipment (UE), comprising:

one or more memories storing processor-executable code; and

one or more processors coupled with the one or more memories and individually or collectively operable to execute the code to cause the UE to:

receive, from a network entity, a first transport block;

transmit, to the network entity based at least in part on receiving the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block; and

receive, from the network entity based at least in part on transmitting the one or more feedback messages, the retransmission of the first transport block.

12. The UE of claim **11**, wherein the one or more processors are individually or collectively further operable to execute the code to cause the UE to:

receive, from the network entity, a second transport block on a second component carrier, wherein the first transport block is received on a first component carrier.

13. The UE of claim **12**, wherein, to transmit the one or more feedback messages, the one or more processors are individually or collectively further operable to execute the code to cause the UE to:

transmit, to the network entity based at least in part on receiving the first transport block and receiving the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block, wherein the one or more joint feedback messages indicate that the reception of at least the portion of the first transport block and indicate that a reception of at least the portion of the second transport block was unsuccessful and indicate the request for the delayed scheduling.

14. The UE of claim **11**, wherein, to transmit the one or more feedback messages, the one or more processors are individually or collectively further operable to execute the code to cause the UE to:

transmit a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful; and

transmit a request message that indicates the request for the delayed scheduling.

15. The UE of claim **11**, wherein, to transmit the one or more feedback messages, the one or more processors are individually or collectively further operable to execute the code to cause the UE to:

transmit a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the delayed scheduling.

16. A network entity, comprising:

one or more memories storing processor-executable code; and

one or more processors coupled with the one or more memories and individually or collectively operable to execute the code to cause the network entity to:

output, to a user equipment (UE), a first transport block;

obtain, from the UE based at least in part on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a time delay associated with a retransmission of the first transport block; and

output, to the UE based at least in part on obtaining the one or more feedback messages, the retransmission of the first transport block.

17. The network entity of claim **16**, wherein the time delay comprises a delayed timeline for obtaining a first acknowledgment feedback or a first negative acknowledgment feedback associated with the retransmission of the first transport block.

18. The network entity of claim **17**, wherein the one or more processors are individually or collectively further operable to execute the code to cause the network entity to:

output, to the UE based at least in part on obtaining the one or more feedback messages, a second transport block; and

obtain, from the UE based at least in part on outputting the second transport block, a second acknowledgment feedback or a second negative acknowledgment feedback associated with the second transport block, wherein the obtaining of the second acknowledgment feedback or the second negative acknowledgment feedback occurs prior to the obtaining of the first acknowledgment feedback or the first negative acknowledgment feedback.

19. The network entity of claim **16**, wherein the time delay comprises an extended transmission duration for the retransmission of the first transport block.

20. The network entity of claim **19**, wherein the one or more processors are individually or collectively further operable to execute the code to cause the network entity to:

output, to the UE based at least in part on obtaining the one or more feedback messages, a second transport block and the retransmission of the first transport block, wherein the retransmission of the first transport block is frequency-division multiplexed with the second transport block.

21. The network entity of claim **16**, wherein the one or more processors are individually or collectively further operable to execute the code to cause the network entity to:

output, to the UE, a second transport block on a second component carrier, wherein the first transport block is outputted on a first component carrier.

22. The network entity of claim **21**, wherein, to obtain the one or more feedback messages, the one or more processors are individually or collectively further operable to execute the code to cause the network entity to:

obtain, from the UE based at least in part on outputting the first transport block and outputting the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block, wherein the one or more joint feedback messages indicate that the reception of at least the portion of the first transport block and a reception of at least the portion of the second transport block was unsuccessful and indicate the request for the time delay.

23. The network entity of claim **21**, wherein the one or more processors are individually or collectively further operable to execute the code to cause the network entity to:

obtain, from the UE based at least in part on outputting the first transport block and outputting the second transport block, one or more second feedback messages associated with the second transport block, wherein the one or more second feedback messages indicate that a reception of at least the portion of the second transport block was unsuccessful; and

output, to the UE based at least in part on the reception of the one or more second feedback messages, a retransmission of the second transport block, wherein the retransmission of the second transport block is outputted after the retransmission of the first transport block.

24. The network entity of claim **16**, wherein, to obtain the one or more feedback messages, the one or more processors are individually or collectively further operable to execute the code to cause the network entity to:

obtain a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful; and

obtain a request message that indicates the request for the time delay associated with the retransmission of the first transport block.

25. The network entity of claim **16**, wherein, to obtain the one or more feedback messages, the one or more processors are individually or collectively further operable to execute the code to cause the network entity to:

obtain a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the time delay associated with the retransmission of the first transport block.

26. A network entity, comprising:

one or more memories storing processor-executable code; and

one or more processors coupled with the one or more memories and individually or collectively operable to execute the code to cause the network entity to:

output, to a user equipment (UE), a first transport block;

obtain, from the UE based at least in part on outputting the first transport block, one or more feedback messages that indicate that a reception of at least a portion of the first transport block was unsuccessful and indicate a request for a delayed scheduling of a retransmission of the first transport block; and

output, to the UE based at least in part on obtaining the one or more feedback messages, the retransmission of the first transport block.

27. The network entity of claim **26**, wherein the one or more processors are individually or collectively further operable to execute the code to cause the network entity to:

output, to the UE, a second transport block on a second component carrier, wherein the first transport block is outputted on a first component carrier.

28. The network entity of claim **27**, wherein, to obtain the one or more feedback messages, the one or more processors are individually or collectively further operable to execute the code to cause the network entity to:

obtain, from the UE based at least in part on outputting the first transport block and outputting the second transport block, one or more joint feedback messages associated with both the first transport block and the second transport block, wherein the one or more joint feedback messages indicate that the reception of at least the portion of the first transport block and a reception of at least the portion of the second transport block was unsuccessful and indicate the request for the delayed scheduling.

29. The network entity of claim **26**, wherein, to obtain the one or more feedback messages, the one or more processors are individually or collectively further operable to execute the code to cause the network entity to:

obtain a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful; and

obtain a request message that indicates the request for the delayed scheduling.

30. The network entity of claim **26**, wherein, to obtain the one or more feedback messages, the one or more processors are individually or collectively further operable to execute the code to cause the network entity to:

obtain a negative acknowledgment feedback message that indicates that the reception of at least the portion of the first transport block was unsuccessful and that indicates the request for the delayed scheduling.

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