

RADIO LINK FAILURE PROCESSING METHOD AND DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to Chinese Patent Application No.
5 201911084294.X, filed in China on November 7, 2019, which is incorporated herein
by reference in its entirety.

TECHNICAL FIELD

[0002] Embodiments of the present invention relate to the field of
communications technologies, and specifically, to a method for handling radio link
10 failure (Radio Link Failure, RLF) and a device.

BACKGROUND

[0003] As shown in FIG. 1, integrated access and backhaul nodes (Integrated
Access and Backhaul node, IAB-node) are connected through wireless connection,
resulting in unstable links. When RLF occurs in a radio link between IAB-node 1
15 and IAB-node 2 and IAB-node 2 attempts to reconnect but fails, IAB-node 2 will
notify IAB-node 3 of occurrence of RLF in the radio link and trigger IAB-node 3 to
run a re-establishment procedure.

[0004] However, due to the occurrence of RLF in the radio link between
IAB-node 1 and IAB-node 2, IAB-node 3 cannot connect to an integrated access and
20 backhaul donor (IAB-donor) node through IAB-node 1. As a result, the IAB-donor
node cannot effectively schedule and configure network resources.

SUMMARY

[0005] An objective of embodiments of the present invention is to provide a method for handling radio link failure and a device, so as to resolve a problem that an IAB-donor node cannot effectively schedule and configure network resources
5 when RLF occurs in a radio link.

[0006] According to a first aspect of the embodiments of the present invention, a method for handling radio link failure is provided, applied to a first node in a relay network architecture in which data transmission is implemented through a relay node, where the first node has dual connectivity with a donor node through a first link and
10 a second link, including:

obtaining a first failure report, where the first failure report indicates that the first node has received a notification of backhaul recovery failure from a parent node of the first node, or the first failure report indicates that link failure has occurred in the first link, where the parent node of the first node is in the first link;
15 and

transmitting the first failure report to the donor node through the second link.

[0007] According to a second aspect of the embodiments of the present invention, a method for handling radio link failure is further provided, applied to a donor node
20 in a relay network architecture in which data transmission is implemented through a relay node, including:

obtaining, through a second link, a first failure report sent by a first node, where the first failure report indicates that the first node has received a notification of backhaul recovery failure from a parent node of the first node, or the first failure
25 report indicates that link failure has occurred in the first link, where the parent node of the first node is in the first link; where

the first node has dual connectivity with the donor node through the first link and the second link.

[0008] According to a third aspect of the embodiments of the present invention, a method for handling radio link failure is further provided, applied to a third node in a relay network architecture in which data transmission is implemented through a relay node, including:

5 in a case that RLF has occurred in a link between the third node and a parent node of the third node and a recovery attempt has failed, generating a second failure report; and

transmitting the second failure report to a child node of the third node, where the child node of the third node has dual connectivity with a donor node.

10 **[0009]** According to a fourth aspect of the embodiments of the present invention, a first node is further provided, where the first node is located in a relay network architecture in which data transmission is implemented through a relay node, and the first node has dual connectivity with a donor node through a first link and a second link, including:

15 a first obtaining module, configured to obtain a first failure report, where the first failure report indicates that the first node has received a notification of backhaul recovery failure from a parent node of the first node, or the first failure report indicates that backhaul recovery failure has occurred in the parent node of the first node, or the first failure report indicates that link failure has occurred in the first
20 link, where the parent node of the first node is in the first link; and

a first transmitting module, configured to transmit the first failure report to the donor node through the second link.

[0010] According to a fifth aspect of the embodiments of the present invention, a donor node is further provided, where the donor node is located in a relay network
25 architecture in which data transmission is implemented through a relay node, including:

a second transmitting module, configured to obtain, through a second link, a first failure report sent by a first node, where the first failure report indicates that the first node has received a notification of backhaul recovery failure from a parent
30 node of the first node, or the first failure report indicates that backhaul recovery

failure has occurred in the parent node of the first node, or the first failure report indicates that link failure has occurred in the first link, where the parent node of the first node is in the first link; where

the first node has dual connectivity with the donor node through the first
5 link and the second link.

[0011] According to a sixth aspect of the embodiments of the present invention, a third node is further provided, where the third node is located in a relay network architecture in which data transmission is implemented through a relay node, including:

10 a generation module, configured to, in a case that RLF has occurred in a link between the third node and a parent node of the third node and a recovery attempt has failed, generate a second failure report; and

a third transmitting module, configured to transmit the second failure report to a child node of the third node, where the child node of the third node has
15 dual connectivity with a donor node.

[0012] According to a seventh aspect of the embodiments of the present invention, a communications device is further provided, including a processor, a memory, and a program stored in the memory and capable of running on the processor, where when the program is executed by the processor, the steps of the
20 method for handling radio link failure according to the first aspect are implemented, or the steps of the method for handling radio link failure according to the second aspect are implemented, or the method for handling radio link failure according to the third aspect are implemented.

[0013] According to an eighth aspect of the embodiments of the present invention, a computer-readable storage medium is further provided, where the
25 computer-readable storage medium stores a computer program, and when the computer program is executed by a processor, the steps of the method for handling radio link failure according to the first aspect are implemented, or the steps of the method for handling radio link failure according to the second aspect are

implemented, or the method for handling radio link failure according to the third aspect are implemented.

[0014] In the embodiments of the present invention, when RLF occurs in a radio link, a failure report can be reported to a donor node through a node configured with dual connectivity, so that the donor node can schedule and configure network resources based on the failure report.

BRIEF DESCRIPTION OF DRAWINGS

[0015] Other advantages and benefits will become apparent to those of ordinary skill in the art by reading detailed description of the exemplary embodiments below.

10 The accompanying drawings are merely intended to illustrate the objectives of the preferred embodiments and are not intended to limit the present invention. Throughout the accompanying drawings, the same reference numerals represent the same components. In the accompanying drawings:

[0016] FIG. 1 is a schematic diagram of IAB in a non-DC scenario;

15 [0017] FIG. 2 is a schematic diagram of an IAB network architecture;

[0018] FIG. 3 is a schematic diagram of radio link monitoring;

[0019] FIG. 4 is a first flowchart of a method for handling radio link failure according to an embodiment of the present invention;

20 [0020] FIG. 5 is a second flowchart of a method for handling radio link failure according to an embodiment of the present invention;

[0021] FIG. 6 is a third flowchart of a method for handling radio link failure according to an embodiment of the present invention;

[0022] FIG. 7 is a schematic diagram of IAB in a DC scenario according to an embodiment of the present invention;

25 [0023] FIG. 8 is a schematic diagram of a first node according to an embodiment of the present invention;

[0024] FIG. 9 is a schematic diagram of a donor node according to an embodiment of the present invention;

[0025] FIG. 10 is a schematic diagram of a fourth node according to an embodiment of the present invention; and

[0026] FIG. 11 is a schematic diagram of a communications device according to an embodiment of the present invention.

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DESCRIPTION OF EMBODIMENTS

[0027] For better understanding of the embodiments of the present invention, the following technical points are first described:

[0028] 1. IAB dual connectivity (Dual Connectivity, DC) scenario:

[0029] An integrated access and backhaul (Integrated Access and Backhaul, IAB) node is introduced in new radio (New Radio, NR). An IAB-node can extend network coverage through radio concatenation. As shown in FIG. 2, an IAB-donor is connected to a core network (core network, CN) through a wired link (wired link, such as an optical fiber). Other IAB-nodes are connected to neighboring IAB-nodes or the IAB-donor through wireless backhaul (wireless backhaul). The IAB-donor includes a centralized unit (centralized unit, CU) and a distributed unit (distributed unit, DU), where the centralized unit is responsible for processing non-real-time protocols and services and the distributed unit is responsible for processing physical layer protocols and real-time services. The IAB-node includes a CU, and also includes a mobile termination (mobile termination, MT) as a device that connects the IAB-donor and the IAB-node. When an MT of an IAB-node (for example, node A) is connected to a DU of an upstream (upstream) node (for example, node B), node A is defined as a child node and node B is defined as a parent node. As shown in FIG. 2, an MT of IAB-node 2 is connected to a DU of IAB-node 1, and in this case, IAB-node 1 is a parent node and IAB-node 2 is a child node.

[0030] In addition, a DC-like scenario is introduced to IAB in NR. To be specific, when a child node is configured with DC, the IAB-node may be connected to two parent nodes simultaneously, as shown in a relationship between IAB-node 3 (child node) and IAB-node 4 (parent node)/IAB-node 2 (parent node) in FIG. 2.

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[0031] 2. Radio link monitoring (Radio Link Monitoring, RLM) in a primary cell (Primary Cell, PCell) and RLF:

[0032] As shown in FIG. 3, in an RLM function of a long term evolution (Long Term Evolution, LTE), a terminal (such as user equipment (User Equipment, UE))

5 monitors a radio link by measuring a signal to interference plus noise ratio (Signal to Interference plus Noise Ratio, SINR) of a cell reference signal (Cell Reference Signal, CRS) corresponding to a physical downlink control channel (Physical Downlink Control Channel, PDCCH) of a PCell. When a physical layer of the UE finds, through measurement, that the SINR of the vCRS corresponding to the
10 PDCCH of the PCell is lower than a specified threshold, it is determined that the radio link is out of synchronization (out-of-sync). The physical layer sends an out-of-sync indication to a higher layer (for example, a radio resource control (Radio Resource Control, RRC) layer). If the RRC layer consecutively receives N310 out-of-sync indications, the RRC layer of the UE starts a timer (Timer) T310.

15 **[0033]** If the measured CRS corresponding to the PDCCH of the PCell is higher than the specified threshold, it is determined that the radio link is in synchronization (in-sync). In this case, the physical layer sends an in-sync indication to the higher layer (for example, the RRC layer). If the RRC layer consecutively receives N311 in-sync indications, the UE stops the timer T310.

20 **[0034]** If the timer T310 expires, the UE determines that radio link failure occurs in the UE and starts a timer T311. During running of T311, the UE will attempt to find a suitable cell to perform RRC connection re-establishment. Before the re-establishment is successful, user-plane data reception and transmission between the UE and a network will be interrupted.

25 **[0035]** If the UE fails to re-establish a connection before T311 expires, the UE switches from an RRC connected (RRC_CONNECTED) state to an RRC idle (RRC_IDLE) state.

[0036] Duration of N310, N311, T310 and T311 is configured by the network.

[0037] Apart from determining based on the downlink signal, the UE will also
30 determine that radio link failure has occurred and trigger a re-establishment

procedure when a maximum number of RLC uplink transmissions of the UE is reached.

[0038] When a maximum number of random access channel (Random Access Channel, RACH) transmissions of the UE is reached, the UE will also determine that
5 radio link failure has occurred and trigger a re-establishment procedure.

[0039] The following clearly describes the technical solutions in the embodiments of the present invention with reference to the accompanying drawings in the embodiments of the present invention. Apparently, the described embodiments are some but not all of the embodiments of the present invention. All other
10 embodiments obtained by a person of ordinary skill in the art based on the embodiments of the present invention without creative efforts shall fall within the protection scope of the present invention.

[0040] In the specification and claims of this application, the term "include" and any other variants mean to cover a non-exclusive inclusion. For example, a process,
15 method, system, product, or device that includes a list of steps or units is not necessarily limited to those steps or units, but may include other steps or units not expressly listed or inherent to such a process, method, product, or device. In addition, in the specification and claims, the use of "and/or" represents presence of at least one of the connected objects, for example, "A and/or B" indicates that the following three
20 cases: only A, only B, or both A and B.

[0041] In the embodiments of the present invention, the word such as "an example" or "for example" is used to represent giving an example, an instance, or an illustration. Any embodiment or design solution described as "an example" or "for
example" in the embodiments of the present invention shall not be interpreted to be
25 more preferential or advantageous than other embodiments or design solutions. To be precise, the terms such as "an example" or "for example" are intended to present a related concept in a specific manner.

[0042] Technologies described in this specification are not limited to a long term evolution (Long Term Evolution, LTE) or LTE-Advanced (LTE-Advanced, LTE-A)
30 system, and may also be applied to various wireless communications systems, for

example, code division multiple access (Code Division Multiple Access, CDMA), time division multiple access (Time Division Multiple Access, TDMA), frequency division multiple access (Frequency Division Multiple Access, FDMA), orthogonal frequency division multiple access (Orthogonal Frequency Division Multiple Access, OFDMA), single-carrier frequency-division multiple access (Single-carrier Frequency-Division Multiple Access, SC-FDMA), and other systems.

[0043] The terms "system" and "network" are often used interchangeably. The CDMA system can implement radio technologies such as CDMA2000 and universal terrestrial radio access (Universal Terrestrial Radio Access, UTRA). The UTRA includes wideband CDMA (Wideband Code Division Multiple Access, WCDMA) and other CDMA variants. The TDMA system can implement radio technologies such as global system for mobile communications (Global System for Mobile Communication, GSM). The OFDMA system can implement radio technologies such as ultra mobile broadband (Ultra Mobile Broadband, UMB), evolved UTRA (Evolution-UTRA, E-UTRA), IEEE 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20, and Flash-OFDM. The UTRA and E-UTRA are part of the universal mobile telecommunications system (Universal Mobile Telecommunications System, UMTS). LTE and more advanced LTE (such as LTE-A) are new releases of UMTS that use E-UTRA. UTRA, E-UTRA, UMTS, LTE, LTE-A, and GSM are described in documents from an organization called 3rd generation partnership project (3rd Generation Partnership Project, 3GPP). CDMA2000 and UMB are described in documents from an organization named "3rd Generation Partnership Project 2" (3GPP2). The technologies described herein are applicable not only to the above-mentioned systems and radio technologies, but also to other systems and radio technologies.

[0044] An embodiment of the present invention provides a method for handling radio link failure, and the method is executed by a first node in a relay network architecture in which data transmission is implemented through a relay node, where the first node has dual connectivity with a donor node through a first link and a

second link, meaning that the first node is configured with DC and the first node may be referred to as a DC node.

[0045] As shown in FIG. 2, a link that sequentially connects IAB-node 3, IAB-node 2, IAB-node 1, and IAB-donor may be understood as the first link, and a link that sequentially connects IAB-node 3, IAB-node 4, IAB-node 5, and IAB-donor may be understood as the second link.

[0046] In some embodiments, the relay network architecture is an IAB network architecture or a vehicle to everything (Vehicle to everything, V2X) architecture. For example, when the relay network architecture is an IAB network architecture, the first node is an IAB-node configured with DC.

[0047] As shown in FIG. 4, the method specifically includes step 401 and step 402.

[0048] Step 401: Obtain a first failure report (failure report).

[0049] In the embodiments of the present invention, the first failure report may indicate any one of the following:

(1) the first node has received a notification of backhaul recovery failure from a parent node (BH RLF recovery failure from parents indication) of the first node, where the parent node of the first node is in the first link; and

(2) link failure has occurred in the first link.

[0050] In some embodiments, the first failure report may include one or more of the following:

(1) notification of backhaul recovery failure from the parent node of the first node;

(2) link quality information of the parent node of the first node;

(3) link quality information of the first node;

(4) a first measurement result, where the first measurement result includes a result obtained by the parent node of the first node measuring a second node; and

(5) a second measurement result, where the second measurement result includes a result obtained by the first node measuring the second node; where

the second node includes at least some of nodes through which the first failure report passes to be reported to the donor node.

[0051] Step 402: Transmit the first failure report to the donor node through the second link.

5 **[0052]** In the embodiments of the present invention, the first failure report is transmitted to the donor node through the second link in a manner of hop-by-hop transmission.

[0053] In the embodiments of the present invention, when RLF occurs in a radio link, a failure report can be reported to a donor node through a node configured with dual connectivity, so that the donor node can schedule and configure network
10 resources based on the failure report.

[0054] An embodiment of the present invention provides a method for handling radio link failure, and the method is executed by a donor node in a relay network architecture in which data transmission is implemented through a relay node. For
15 example, the donor node is a donor node in an IAB network architecture or a vehicle to everything architecture.

[0055] As shown in FIG. 5, the method specifically includes step 501.

[0056] Step 501: Obtain, through a second link, a first failure report sent by a first node.

20 **[0057]** In the embodiments of the present invention, the first failure report may indicate any one of the following:

(1) the first node has received a notification of backhaul recovery failure from a parent node (BH RLF recovery failure from parents indication) of the first node, where the parent node of the first node is in the first link; and

25 (2) link failure has occurred in the first link.

[0058] In an embodiment of the present invention, the method further includes: adjusting, based on the first failure report, a network parameter or a network topology. To be specific, the donor node may analyze the first failure report and reconfigure nodes in the network.

[0059] In some embodiments, the first failure report may include one or more of the following:

(1) notification of backhaul recovery failure from the parent node of the first node;

5 (2) link quality information of the parent node of the first node;

(3) link quality information of the first node;

(4) a first measurement result, where the first measurement result includes a result obtained by the parent node of the first node measuring a second node; and

10 (5) a second measurement result, where the second measurement result includes a result obtained by the first node measuring the second node; where

the second node includes at least some of nodes through which the first failure report passes to be reported to the donor node.

[0060] As shown in FIG. 2, IAB-node 3 is equivalent to the first node, IAB-node 2 is the third node, IAB-node 1 is the parent node of the third node, and IAB-node 4 and IAB-node 5 are equivalent to the second nodes.

[0061] In the embodiments of the present invention, a donor node can obtain a failure report reported by a first node configured with DC, so that the donor node can schedule and configure network resources based on the failure report.

20 **[0062]** An embodiment of the present invention provides a method for handling radio link failure, and the method is executed by a third node in a relay network architecture in which data transmission is implemented through a relay node. It can be understood the third node is a node that has encountered RLF.

[0063] In some embodiments, the relay network architecture is an IAB network architecture or a vehicle to everything architecture.

[0064] As shown in FIG. 6, the method specifically includes step 601 and step 602.

[0065] Step 601: In a case that RLF has occurred in a link between a third node and a parent node of the third node and a recovery attempt has failed, generate a
30 second failure report.

[0066] In the embodiments of the present invention, in a case that the third node satisfies a first condition, a second failure report is generated; where

the first condition includes one or more of the following:

(1) expiry of Timer 310 (T310) in a secondary cell group
5 (t310-expirySCG);

(2) failure of reconfiguration with sync in a secondary cell group
(syncReconfigFailure-SCG)

(3) reconfiguration failure in a secondary cell group
(scg-ReconfigFailure);

10 (4) failure of signaling radio bearer 3 integrity check
(srb3-IntegrityFailure);

(5) a maximum number of uplink transmissions being exceeded
(rlc-MaxNumRetx); and

(6) occurrence of a random access problem (randomAccessProblem).

15 **[0067]** In the embodiments of the present invention, the second failure report is equivalent to an initial failure report. For example, the second failure report includes link quality information of the third node, that is, link quality information of a node that has encountered RLF.

[0068] Step 602: Transmit the second failure report to a child node of the third
20 node.

[0069] In the embodiments of the present invention, the child node of the third node has dual connectivity with a donor node.

[0070] In the embodiments of the present invention, in a case that RLF has occurred in a link between a third node and a parent node of the third node and a
25 recovery attempt has failed, the third node generates a second failure report and transmits the second failure report to a child node of the third node. Because the child node of the third node has dual connectivity with a donor node, the donor node can obtain the second failure report from the child node of the third node, and then schedule and configure network resources based on the second failure report.

[0071] The following describes the methods provided in the embodiments of the present invention with reference to specific examples.

[0072] As shown in FIG. 7, a DC-like scenario is introduced to IAB in NR. To be specific, when a child node is configured with DC, the IAB-node may be
5 connected to two parent nodes simultaneously, as shown in a relationship between IAB-node 3 (child node) and IAB-node 4 (parent node)/IAB-node 2 (parent node) in FIG. 7.

[0073] For example, when radio link failure (radio link failure, RLF) occurs in a radio link between IAB-node 1 and IAB-node 2 and IAB-node 2 attempts to
10 reconnect but fails, link failure of IAB-node 2 will be reported to IAB-node 4.

[0074] The handling method is as follows:

[0075] When IAB-node 2 detects that radio link failure has occurred between IAB-node 1 and IAB-node 2 and attempts to reconnect but fails, IAB-node 2 generates a failure report (failure report) and transmits the failure report to IAB-node
15 3. After receiving the failure report, IAB-node 3 reports the failure report to another parent node. As shown in FIG. 7, IAB-node 3 reports the failure report to IAB-node 4.

[0076] The failure report is triggered in any one of the following cases:

(1) expiry of T310 in a secondary cell group (t310-expirySCG): radio link
20 failure (radio link failure);

(2) failure of reconfiguration with sync in a secondary cell group (syncReconfigFailure-SCG): failure of SCG reconfiguration with sync (Failure of SCG reconfiguration with sync);

(3) reconfiguration failure in a secondary cell group (scg-ReconfigFailure): SCG configuration failure for RRC message on SRB3 (SCG configuration failure for RRC message on SRB3);
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(4) failure of signaling radio bearer 3 integrity check (srb3-IntegrityFailure): SCG integrity check failure (SCG integrity check failure);

(5) a maximum number of uplink transmissions being exceeded (rlc-MaxNumRetx): exceeding the maximum uplink transmission timing difference (Exceeding the maximum uplink transmission timing difference);

(6) occurrence of a random access problem (randomAccessProblem); and

5 (7) BH RLF recovery failure from parents indication (BH RLF recovery failure from parents indication).

[0077] The failure report is backhauled in link L in a manner of hop-by-hop transmission until it is transmitted to the IAB-donor.

[0078] Link L is defined as a link in which data is transmitted from a child node
10 of an IAB-node that has encountered RLF toward a DC-node, and finally to the IAB-donor. For example, a link that sequentially connects IAB-node 2, IAB-node 3, IAB-node 4, IAB-node 5, and IAB-donor may be understood as link L.

[0079] The initial failure report may include link quality information of a node that has encountered RLF.

15 **[0080]** Further, after receiving the failure report, IAB-node 3 transmits the failure report to IAB-node 4, then to IAB-node 5, and finally to IAB-donor.

[0081] Further, the failure report may also carry a measurement result obtained by IAB-node 3 measuring IAB-node 2, and measurement results of measuring other IAB-nodes, that is, measurement results of measuring, by a next child node of a
20 child node that has encountered RLF, all IAB-nodes through which the failure report passes to be reported to the IAB-donor, allowing the IAB-donor to reconfigure the IAB-nodes conveniently.

[0082] Further, when IAB-node 2 sends a BH RLF recovery failure notification to IAB-node 3, the notification may also carry a measurement result obtained by
25 IAB-node 2 measuring IAB-node 1, and measurement results of measuring other IAB-nodes, that is, measurement results of measuring, by a child node of the node that has encountered RLF, all IAB-nodes through which the notification passes to be reported to the IAB-donor, allowing the IAB-donor to reconfigure the IAB-nodes conveniently.

[0083] As shown in FIG. 8, an embodiment of the present invention provides a first node 800, where the first node 800 is located in a relay network architecture in which data transmission is implemented through a relay node, the first node 800 has dual connectivity with a donor node through a first link and a second link, and the
5 first node 800 includes:

a first obtaining module 801, configured to obtain a first failure report, where the first failure report indicates that the first node has received a notification of backhaul recovery failure from a parent node of the first node, or the first failure report indicates that link failure has occurred in the first link, where the parent node
10 of the first node is in the first link; and

a first transmitting module 802, configured to transmit the first failure report to the donor node through the second link.

[0084] Optionally, the first failure report includes one or more of the following:
the notification of backhaul recovery failure from the parent node of the
15 first node;

link quality information of the parent node of the first node;

link quality information of the first node;

a first measurement result, where the first measurement result includes a result obtained by the parent node of the first node measuring a second node; and

20 a second measurement result, where the second measurement result includes a result obtained by the first node measuring the second node; where

the second node includes at least some of nodes through which the first failure report passes to be reported to the donor node.

[0085] Optionally, the first transmitting module is configured to transmit the first
25 failure report to the donor node through the second link in a manner of hop-by-hop transmission.

[0086] Optionally, the relay network architecture is an IAB network architecture or a vehicle to everything architecture.

[0087] In the embodiments of the present invention, when RLF occurs in a radio
30 link, a failure report can be reported to a donor node through a node configured with

dual connectivity, so that the donor node can schedule and configure network resources based on the failure report.

[0088] As shown in FIG. 9, an embodiment of the present invention provides a donor node 900, where the donor node 900 is located in a relay network architecture in which data transmission is implemented through a relay node, and the donor node 900 includes:

a second transmitting module 901, configured to obtain, through a second link, a first failure report sent by a first node, where the first failure report indicates that the first node has received a notification of backhaul recovery failure from a parent node of the first node, or the first failure report indicates that link failure has occurred in a first link, where the parent node of the first node is in the first link; where

the first node has dual connectivity with the donor node through the first link and the second link.

[0089] Optionally, the first failure report includes one or more of the following:
the notification of backhaul recovery failure from the parent node of the first node;

link quality information of the parent node of the first node;

link quality information of the first node;

a first measurement result, where the first measurement result includes a result obtained by the parent node of the first node measuring a second node; and

a second measurement result, where the second measurement result includes a result obtained by the first node measuring the second node; where

the second node includes at least some of nodes through which the first failure report passes to be reported to the donor node.

[0090] In an embodiment of the present invention, the donor node 900 further includes:

an adjustment module, configured to adjust, based on the first failure report, a network parameter or a network topology.

[0091] Optionally, the relay network architecture is an IAB network architecture or a vehicle to everything architecture.

[0092] In the embodiments of the present invention, a donor node can obtain a failure report reported by a first node configured with DC, so that the donor node can
5 schedule and configure network resources based on the failure report.

[0093] As shown in FIG. 10, an embodiment of the present invention provides a third node 1000, where the third node 1000 is located in a relay network architecture in which data transmission is implemented through a relay node, and the third node 1000 includes:

10 a generation module 1001, configured to, in a case that RLF has occurred in a link between the third node and a parent node of the third node and a recovery attempt has failed, generate a second failure report; and

a third transmitting module 1002, configured to transmit the second failure report to a child node of the third node, where the child node of the third node
15 has dual connectivity with a donor node.

[0094] Optionally, the second failure report includes:

in a case that the third node satisfies a first condition, generating the second failure report; where

the first condition includes one or more of the following:

20 expiry of T310 in a secondary cell group;
failure of reconfiguration with sync in a secondary cell group;
reconfiguration failure in a secondary cell group;
failure of signaling radio bearer 3 integrity check;
a maximum number of uplink transmissions being exceeded; and
25 occurrence of a random access problem.

[0095] Optionally, the second failure report includes link quality information of the third node.

[0096] Optionally, the relay network architecture is an IAB network architecture or a vehicle to everything architecture.

[0097] In the embodiments of the present invention, in a case that RLF has occurred in a link between a third node and a parent node of the third node and a recovery attempt has failed, the third node generates a second failure report and transmits the second failure report to a child node of the third node. Because the child node of the third node has dual connectivity with a donor node, the donor node can obtain the failure report from the child node of the third node, and then schedule and configure network resources based on the failure report.

[0098] Referring to FIG. 11, FIG. 11 is a structural diagram of a communications device to which the embodiments of the present invention are applied. As shown in FIG. 11, the communications device 1100 includes a processor 1101, a transceiver 1102, a memory 1103, and a bus interface. The processor 1101 may be responsible for managing a bus architecture and general processing. The memory 1103 may store data that is used when the processor 1101 performs an operation.

[0099] In an embodiment of the present invention, the communications device 1100 further includes a program stored in the memory 1103 and capable of running on the processor 1101. When the program is executed by the processor 1101, steps of the foregoing method shown in FIG. 4, FIG. 5, or FIG. 6 are implemented.

[00100] In FIG. 11, a bus architecture may include any quantity of interconnected buses and bridges, specifically for interconnecting various circuits of one or more processors represented by the processor 1101 and a memory represented by the memory 1103. The bus architecture may further interconnect various other circuits such as a peripheral device, a voltage regulator, and a power management circuit. These are all common sense in the art, and therefore are not further described in this specification. The bus interface provides an interface. The transceiver 1102 may be a plurality of components, including a transmitter and a receiver, and provides units for communicating with a variety of other apparatuses on a transmission medium.

[00101] The communications device provided in this embodiment of the present invention can execute the foregoing method embodiment in FIG. 4, FIG. 5 or FIG. 6, with a similar implementation principle and similar technical effects. Details are not repeated herein in this embodiment.

[00102] Method or algorithm steps described with reference to the content disclosed in the present invention may be implemented by hardware, or may be implemented by a processor by executing a software instruction. The software instruction may include a corresponding software module. The software module may be stored in a random access memory (Random Access Memory, RAM), a flash memory, a read-only memory (Read-Only Memory, ROM), an erasable programmable read-only memory (Erasable PROM, EPROM), an electrically erasable programmable read-only memory (Electrically EPROM, EEPROM), a register, a hard disk, a removable hard disk, a compact disc read-only memory, or a storage medium in any other forms well-known in the art. For example, a storage medium is coupled to the processor, enabling the processor to read information from the storage medium or write information into the storage medium. Certainly, the storage medium may be a component of the processor. The processor and the storage medium may be located in an application-specific integrated circuit (Application Specific Integrated Circuit, ASIC). In addition, the ASIC may be located in a core-network interface device. Certainly, the processor and the storage medium may exist in the core-network interface device as discrete components.

[00103] A person skilled in the art should be aware that, in the foregoing one or more examples, functions described in the present invention may be implemented by hardware, software, firmware, or any combination thereof. In the case of implementation by software, the foregoing functions may be stored in a computer-readable medium or transmitted as one or more instructions or code in the computer-readable medium. The computer-readable medium includes a computer storage medium and a communication medium, where the communication medium includes any medium that enables a computer program to be transmitted from one place to another place. The storage medium may be any available medium accessible by a general-purpose or dedicated computer.

[00104] The objectives, technical solutions, and beneficial effects of the present invention are further described in detail in the foregoing specific embodiments. It should be understood that the foregoing descriptions are merely specific

embodiments of the present invention, but are not intended to limit the protection scope of the present invention. Any modification, equivalent replacement, or improvement made based on the technical solutions of the present invention shall fall within the protection scope of the present invention.

5 **[00105]** A person skilled in the art should understand that the embodiments of the present invention may be provided as a method, a system, or a computer program product. Therefore, the embodiments of the present invention may use a form of hardware only embodiments, software only embodiments, or embodiments with a combination of software and hardware. Moreover, the embodiments of the present
10 invention may use a form of a computer program product that is implemented on one or more computer-usable storage media (including but not limited to a disk memory, a CD-ROM, an optical memory, and the like) that include computer-usable program code.

[00106] The embodiments of the present invention are described with reference to
15 the flowcharts and/or block diagrams of the method, the device (system), and the computer program product according to the embodiments of the present invention. It should be understood that computer program instructions may be used to implement each process and/or each block in the flowcharts and/or the block diagrams, or a combination of a process and/or a block in the flowcharts and/or the block diagrams.
20 These computer program instructions may be provided to a general-purpose computer, a special-purpose computer, an embedded processor, or a processor of any other programmable data processing device to generate a machine, so that the instructions executed by a computer or a processor of any other programmable data processing device generate an apparatus for implementing a specific function in one
25 or more processes in the flowcharts and/or in one or more blocks in the block diagrams.

[00107] These computer program instructions may be stored in a computer-readable memory that can instruct the computer or any other programmable data processing device to work in a specific manner, so that the
30 instructions stored in the computer-readable memory generate an artifact that

includes an instruction apparatus. The instruction apparatus implements a specific function in one or more processes in the flowcharts and/or in one or more blocks in the block diagrams.

[00108] These computer program instructions may be loaded onto a computer or another programmable data processing device, so that a series of operations and steps are performed on the computer or the another programmable device, thereby generating computer-implemented processing. Therefore, the instructions executed on the computer or the another programmable device provide steps for implementing a specific function in one or more processes in the flowcharts and/or in one or more blocks in the block diagrams.

[00109] It can be understood that the embodiments described in some embodiments of the present disclosure may be implemented by hardware, software, firmware, middleware, microcode, or a combination thereof. For hardware implementation, a module, a unit, a sub-module, a sub-unit, or the like may be implemented in one or more application-specific integrated circuits (Application Specific Integrated Circuits, ASIC), digital signal processors (Digital Signal Processing, DSP), digital signal processing devices (DSP Device, DSPD), programmable logic devices (Programmable Logic Device, PLD), field-programmable gate arrays (Field-Programmable Gate Array, FPGA), general-purpose processors, controllers, microcontrollers, microprocessors, and other electronic units for performing the functions described in this application, or a combination thereof.

[00110] Obviously, a person skilled in the art can make various modifications and variations to the embodiments of the present invention without departing from the spirit and scope of the present invention. The present invention is intended to cover these modifications and variations provided that they fall within the scope of protection defined by the following claims and their equivalent technologies.

CLAIMS

What is claimed is:

1. A method for handling radio link failure, applied to a first node in a relay network architecture in which data transmission is implemented through a relay node,
5 wherein the first node has dual connectivity with a donor node through a first link and a second link, and the method comprises:

obtaining a first failure report, wherein the first failure report indicates that the first node has received a notification of backhaul recovery failure from a parent node of the first node, or the first failure report indicates that link failure has occurred in
10 the first link, wherein the parent node of the first node is in the first link; and

transmitting the first failure report to the donor node through the second link.

2. The method according to claim 1, wherein the first failure report comprises one or more of the following:

the notification of backhaul recovery failure from the parent node of the first
15 node;

link quality information of the parent node of the first node;

link quality information of the first node;

a first measurement result, wherein the first measurement result comprises a result obtained by the parent node of the first node measuring a second node; and

20 a second measurement result, wherein the second measurement result comprises a result obtained by the first node measuring the second node; wherein

the second node comprises at least some of nodes through which the first failure report passes to be reported to the donor node.

3. The method according to claim 1, wherein the transmitting the first failure
25 report to the donor node through the second link comprises:

transmitting the first failure report to the donor node through the second link in a manner of hop-by-hop transmission.

4. The method according to claim 1, wherein the relay network architecture is an integrated access and backhaul node IAB network architecture or a vehicle to everything architecture.

5. A method for handling radio link failure, applied to a donor node in a relay network architecture in which data transmission is implemented through a relay node, comprising:

obtaining, through a second link, a first failure report sent by a first node, wherein the first failure report indicates that the first node has received a notification of backhaul recovery failure from a parent node of the first node, or the first failure report indicates that backhaul recovery failure has occurred in the parent node of the first node, or the first failure report indicates that link failure has occurred in a first link, wherein the parent node of the first node is in the first link; wherein

the first node has dual connectivity with the donor node through the first link and the second link.

15 6. The method according to claim 5, further comprising:

adjusting, based on the first failure report, a network parameter or a network topology.

7. The method according to claim 5, wherein the first failure report comprises one or more of the following:

20 the notification of backhaul recovery failure from the parent node of the first node;

link quality information of the parent node of the first node;

link quality information of the first node;

25 a first measurement result, wherein the first measurement result comprises a result obtained by the parent node of the first node measuring a second node; and

a second measurement result, wherein the second measurement result comprises a result obtained by the first node measuring the second node; wherein

the second node comprises at least some of nodes through which the first failure report passes to be reported to the donor node.

8. The method according to claim 5, wherein the relay network architecture is an IAB network architecture or a vehicle to everything architecture.

9. A method for handling radio link failure, applied to a third node in a relay network architecture in which data transmission is implemented through a relay node,
5 comprising:

in a case that RLF has occurred in a link between the third node and a parent node of the third node and a recovery attempt has failed, generating a second failure report; and

transmitting the second failure report to a child node of the third node, wherein
10 the child node of the third node has dual connectivity with a donor node.

10. The method according to claim 9, wherein the generating a second failure report comprises:

in a case that the third node satisfies a first condition, generating the second failure report; wherein

15 the first condition comprises one or more of the following:

expiry of T310 in a secondary cell group;

failure of reconfiguration with sync in a secondary cell group;

reconfiguration failure in a secondary cell group;

failure of signaling radio bearer 3 integrity check;

20 a maximum number of uplink transmissions being exceeded; and

occurrence of a random access problem.

11. The method according to claim 10, wherein the second failure report comprises link quality information of the third node.

12. The method according to claim 9, wherein the relay network architecture is
25 an IAB network architecture or a vehicle to everything architecture.

13. A first node, wherein the first node is located in a relay network architecture in which data transmission is implemented through a relay node, the first node has dual connectivity with a donor node through a first link and a second link, and the first node comprises:

a first obtaining module, configured to obtain a first failure report, where the first failure report indicates that the first node has received a notification of backhaul recovery failure from a parent node of the first node, or the first failure report indicates that backhaul recovery failure has occurred in the parent node of the first node, or the first failure report indicates that link failure has occurred in the first link, where the parent node of the first node is in the first link; and

a first transmitting module, configured to transmit the first failure report to the donor node through the second link.

14. The first node according to claim 13, wherein the first failure report comprises one or more of the following:

the notification of backhaul recovery failure from the parent node of the first node;

link quality information of the parent node of the first node;

link quality information of the first node;

a first measurement result, wherein the first measurement result comprises a result obtained by the parent node of the first node measuring a second node; and

a second measurement result, wherein the second measurement result comprises a result obtained by the first node measuring the second node; wherein

the second node comprises at least some of nodes through which the first failure report passes to be reported to the donor node.

15. The first node according to claim 13, wherein the first transmitting module is further configured to:

transmit the first failure report to the donor node through the second link in a manner of hop-by-hop transmission.

16. The first node according to claim 13, wherein the relay network architecture is an integrated access and backhaul node IAB network architecture or a vehicle to everything architecture.

17. A donor node, wherein the donor node is located in a relay network architecture in which data transmission is implemented through a relay node, and the donor node comprises:

a second transmitting module, configured to obtain, through a second link, a first failure report sent by a first node, wherein the first failure report indicates that the first node has received a notification of backhaul recovery failure from a parent node of the first node, or the first failure report indicates that backhaul recovery failure has occurred in the parent node of the first node, or the first failure report indicates that link failure has occurred in the first link, wherein the parent node of the first node is in the first link; wherein

the first node has dual connectivity with the donor node through the first link and the second link.

18. The donor node according to claim 17, wherein the donor node further comprises:

an adjustment module, configured to adjust, based on the first failure report, a network parameter or a network topology.

19. The donor node according to claim 17, wherein the first failure report comprises one or more of the following:

the notification of backhaul recovery failure from the parent node of the first node;

link quality information of the parent node of the first node;

link quality information of the first node;

a first measurement result, wherein the first measurement result comprises a result obtained by the parent node of the first node measuring a second node; and

a second measurement result, wherein the second measurement result comprises a result obtained by the first node measuring the second node; wherein

the second node comprises at least some of nodes through which the first failure report passes to be reported to the donor node.

20. The donor node according to claim 17, wherein the relay network architecture is an IAB network architecture or a vehicle to everything architecture.

21. A third node, wherein the third node is located in a relay network architecture in which data transmission is implemented through a relay node, wherein the third node comprises:

a generation module, configured to, in a case that RLF has occurred in a link between the third node and a parent node of the third node and a recovery attempt has failed, generate a second failure report; and

5 a third transmitting module, configured to transmit the second failure report to a child node of the third node, wherein the child node of the third node has dual connectivity with a donor node.

22. The third node according to claim 21, wherein the generating a second failure report comprises:

10 in a case that the third node satisfies a first condition, generating the second failure report; wherein

the first condition comprises one or more of the following:

expiry of T310 in a secondary cell group;

failure of reconfiguration with sync in a secondary cell group;

reconfiguration failure in a secondary cell group;

15 failure of signaling radio bearer 3 integrity check;

a maximum number of uplink transmissions being exceeded; and

occurrence of a random access problem.

23. The third node according to claim 22, wherein the second failure report comprises link quality information of the third node.

20 24. The third node according to claim 21, wherein the relay network architecture is an IAB network architecture or a vehicle to everything architecture.

25 25. A communications device, comprising a processor, a memory, and a program stored in the memory and capable of running on the processor, wherein when the program is executed by the processor, the steps of the method for handling radio link failure according to any one of claims 1 to 4 are implemented, or the steps of the method for handling radio link failure according to any one of claims 5 to 8 are implemented, or the method for handling radio link failure according to any one of claims 9 to 12 are implemented.

30 26. A computer-readable storage medium, wherein the computer-readable storage medium stores a computer program, and when the computer program is

executed by a processor, the steps of the method for handling radio link failure according to any one of claims 1 to 4 are implemented, or the steps of the method for handling radio link failure according to any one of claims 5 to 8 are implemented, or the method for handling radio link failure according to any one of claims 9 to 12 are implemented.