Research on Application of Relay technology in electric power

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Abstract: Because of the difference of the standard and the band, a new generation of wireless networks compared with the previous network presents "high bandwidth, small coverage characteristics, the single station coverage ability is relatively weak, in the actual network construction in accordance with the previous site planning and construction, covered outdoor coverage blind spots, weak areas will be a major challenge to the new a new generation of network deployment face. In order to better meet the needs of wireless electric network construction, the system introduces Relay technology to enhance the coverage, improve the cell edge throughput. In this paper, through theoretical research, system simulation, actual comparison and so on, we compare the performance of various Relay technologies, to provide data basis for the production practice day after.

1. Introduction

Because of the difference of the standard and the band, a new generation of wireless networks compared with the previous network presents "high bandwidth, small coverage characteristics, the single station coverage ability is relatively weak, in the actual network construction in accordance with the previous site planning and construction, covered outdoor coverage blind spots, weak areas will be a major challenge to the new a new generation of network deployment face. If the traditional macro station covering these areas, there will be room, location and transport are difficult to obtain, cost problem, the core of the city is about 20% of the existing site coordination problem of property. At the same time, a new generation of wireless electric network high bandwidth requirements for the transmission resource of single site requirements than before has increased by more than 5 times more than 120Mbps, the transfer of resources to limit network increases the difficulty of construction. In order to better meet the needs of wireless electric network construction, the system introduces Relay technology to enhance the coverage, improve the cell edge throughput. In this paper, through theoretical research, system simulation, actual comparison and so on, we compare the performance of various Relay technologies, to provide data basis for the production practice day after.

2. Theoretical analysis

Relay includes Type I Relay and Type II Relay, the former is used as a small base station in order to extend the cell coverage, it has a separate physical cell ID, can send an independent synchronization channel and the reference symbol[1]; the latter is used to upgrade the upper eNB Of the system capacity, there is no independent cell ID. In the LTE-Advanced R10 version, only Type I Relay is supported, including Outband Relay and Inband Relay. Outband Relay uses the frequency used on the link between Relay and DeNB and the frequency used on the link between Relay and UE to realize the simultaneous transmission of Un Port and Uu Port, but need more bandwidth resources. Inband Relay is in Un Port and Uu Port need to reuse the same carrier frequency resources, which need to ensure that the Un Port and Uu Port time division multiplexing work. The transmission from DeNB to Relay is done in the downlink subframe of DeNB and Relay, and the transmission of Relay to DeNB is completed in the uplink subframe of DeNB and Relay [2]. Wireless relay test equipment to be developed in-band or out-of-band equipment in one of the two forms.

Table 1: Major differences between Type I Relay and Type II Relay

Type	Type I Relay	Type II Relay
Cell ID	yes	no
Transparent	no	yes
layer	L3	L2/L1
frequency band	In-band、out-band	In-band
Duplex mode	FDD or TDD	TDD
terminal	Terminal can distinguish whether access to the Relay	Terminal can not distinguish whether access to the Relay
handover	Relay and eNodeB are inter-cell handovers	No perceptual handover
Control channel	There are independent control channels	There is no independent control channel
Backward compatibility	Support	Support
Forward compatibility	Support	Wait for determination
Synergy	It Supports eNodeB and Relay between ICIC and CoMP	It supports the cooperation between eNodeB, Relay and Relay
Application scenario	used to expand the coverage and increase the capacity of the scene	Used only to increase the capacity of the scene
Cooperation mode	Inter - cell collaboration	Collaboration within the cell
cost	Moderate	Does not produce the control channel, relatively Type I Relay cost is lower
Refer to the proposal	3GPP R1-091098	3GPP R1-091632、3GPP R1-092264

3. Access process

3.1 Process analysis

The signaling between RUE and DeNB mainly includes RRC signaling;
The signaling between RUE and RUE-EPC mainly includes NAS signaling;
RUE and DeNB communication to support the standard LTE Uu port signaling process;

Table2: Signaling between RUE and RUE-EPC

Process	Description	Requireme	Reason
GUTI reallocation procedure	The MME assigns a GUTI to the UE	no	The GUTI is assigned in the Attach process and does not need this process
Authentication procedure	Authentication process	yes	
Security mode control procedure	The control procedure of the context carrying the NAS signaling encryption	yes	
Identification procedure	The network requires the UE to provide a specific user identity, such as IMSI	no	There is no application scenario in Relay
EMM informationpr ocedure	Optional, the message can carry network name, time zone and other information	no	There is no application scenario in Relay
Attach procedurefor EPS service	Access to EPS adhesion process	yes	
Combined attach procedure	Access to EPS and non-EPS attachment process	no	There is no application scenario
UE initiated detach procedure		no	There is no application scenario
Network initiated detach procedure		yes	RUE configuration delete and exception flow triggers
Normal tracking area updating	The UE initiates the TAU after the position change	no	RUE There is no moving scene
Periodic trackingare a updating	Cyclic initiated TAU when the UE location has not changed	no	Relay does not have a periodic tracking area update scenario
Combined tracking area updating		no	There is no scenario for federated location updates
Service request procedure	Initiated by the UE for reconstructing the radio bearers and the S1 bearers	yes	An empty port failure scenario RUE initiates the process to resume bearer.

3.2 RUE in the scene and signaling process

RUE initial power up, or reset restart, or receive Detach signaling, initiated the Attach process [2,3].

(1)Attach success

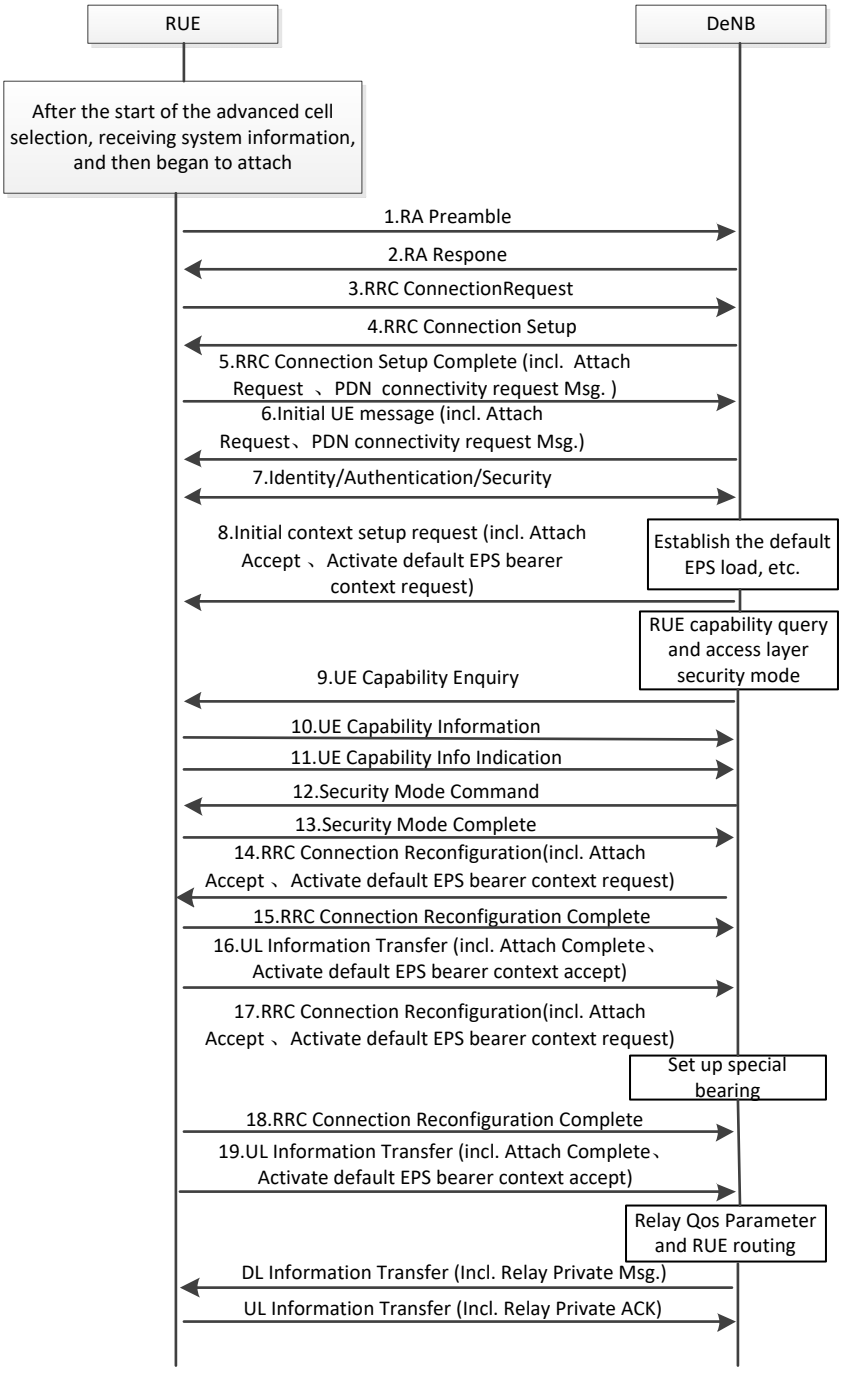

Fig.1RUE attach process

RUE network flow [4] (RRC layer signaling process unchanged, describes the NAS layer signaling process):

1. RUE completes the PLMN selection, selects the cell, the random access procedure, establishes the RRC connection between the RUE and the DeNB ;

2. RUE sends Attach Request and Pdn Connectivity Req NAS signaling to RUE-EPC (Attach Request contains information such as UE IMSI);

3. RUE-EPC according to IMSI and other information, according to 33.401 standard process, complete the AKA process RUE and NAS layer security model is established;

4. DeNB sends an RRC Connection Reconfiguration message to establish an empty bearer default bearer containing both the Attach Accept and Activate Default Bearer Context Reqs. Both NAS signaling is used for the default bearer establishment of the NAS layer;

5. After completing the default bearer establishment, RUE replies Attach Complete and Activate Default Bearer Context Accept to complete the entire attachment process;

6. The RUE-EPC then initiates the establishment of the dedicated bearer;

7. After the proprietary bearer is established, the RUE-EPC sends the Relay private NAS message to complete the QoS parameters and the RUE routing configuration.

(2)Attach fails and loops Attach

An error occurred in Attach process, RUE re-search and launch Attach:

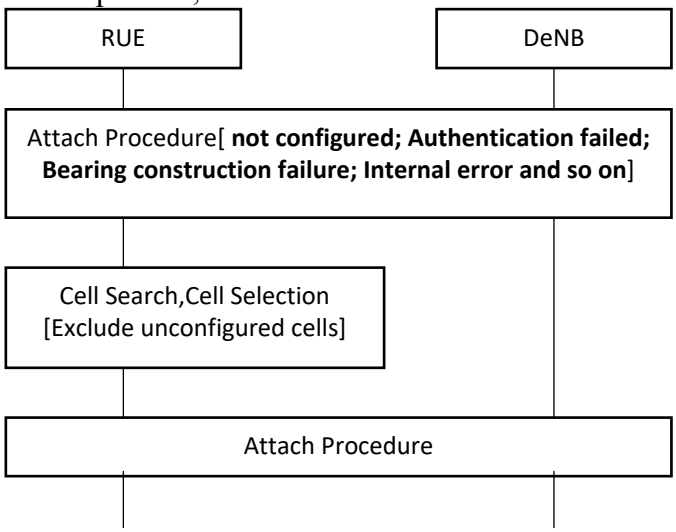

Fig.2. RUE attach cyclic process

1. RUE failed to attach, including: RUE is not configured in RUE-EPC, authentication fails, License or DeNB processing specifications are limited, bearer establishment fails, internal errors (such as memory allocation failure) and so on.

2. If the RUE is not configured in the RUE-EPC or RUE access is not a user specified cell configuration, the RUE could re-search area.

RUE-EPC in the Attach Reject message to carry the appropriate cause value, RUE cell search will exclude the configuration of the cell.

3. After RUE search to the area, the start of a new round of network process.

See 3GPP TS24.301 5.5.1.2.6 and 5.5.1.2.7 sections for other standard defined Attach exception scenarios and process flow.

3.3 RUE parameter update and signaling process

Applications: In the course of using Relay after the opening of characteristics in the process, some of the configuration parameters of the bearing may change, the QoS parameter is the most important RUE routing, carrying the user, if you modify the configuration, through the NAS signaling process to RUE, the RUE uses a new configuration for local processing[5,6].

RUE carries the update signaling process as the standard process, and the signaling flow of the RUE route update is private:

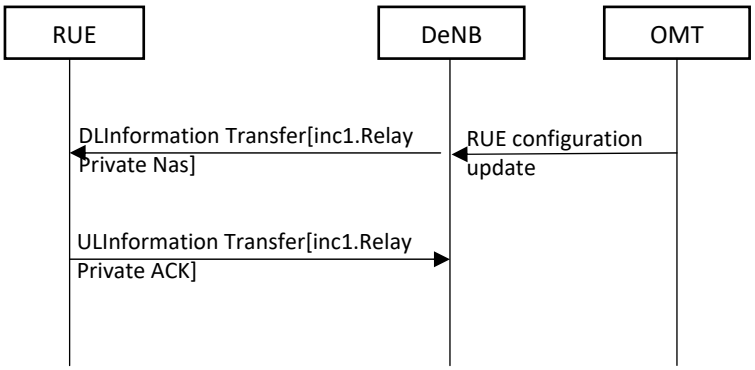

Fig.3 RUE bearing update signaling processes

3.4 Delete / modify signaling process

Application scenario: the user removes the RUE configuration from the RUE-EPC or the Relay on the DeNB features the switch from open to close, and requires Detach and RRC connection release processes to release the RUE.

1) If the RUE OM IP dynamic modification, directly using RUE network back or re-access procedures to ensure consistent RUE-EPC and RUE data;

2) If it is DHCP IP, LAN IP, RUE routing information, load scheduling information dynamic update, the completion of the RUE data redistribution through the private NAS process.

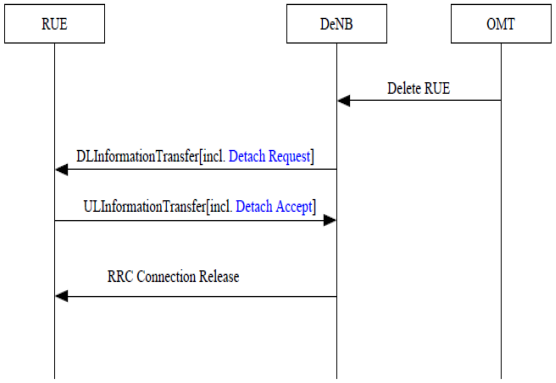

Fig.4 RUE reassignment process

1. The user from the OMT configuration, delete the RUE configuration from DeNB;
2. RUE-EPC send Dettach Request signaling to RUE;
3. RUE finished processing reply Dettach Accept;
4. DeNB RRC Connection Release connection release empty send.

In addition, in addition to the above signaling process, due to the Relay switch on the DeNB feature is not open, DeNB need to be directly connected to the RRC phase of the establishment of the release of RUE.

4. Conclusion

Relay technology as a coverage enhancing technology, according to actual load survey of the current LTE network found that, LTE network load is lighter, the spectrum resource utilization rate is not high, at the same time, the current LTE network priority low frequency networking, high frequency (2.6G) spectrum resources idle at the same time, the transmission mode returns have some disadvantages respectively:

- Optical & Cable : High cost, slow speed, difficult to deploy·
- Microwave : LOS, PtP, Complex network, high cost, rain and fog attenuation
- Non-License Spectrum of Wi-Fi is vulnerable to interference, QOS is uncontrollable.

Therefore, operators in the construction process, in some circumstances the traditional transmission line or difficult to obtain, or the cost is too high, and the new transmission construction period is longer, there affect the wireless network deployment / opening speed.

At this time, wit h low load by LTE network, out-band Relay ,and the use of spectrum resources idle LTE network, can provide a low cost last mile transmission to traditional transmission which is difficult to obtain or acquire the high cost of the site quickly.

5. Reference

[1] 3GPP R1-091098
[2]3GPP R1-091632
[3]3GPP R1-092264
[4]3GPP TS36.117 Evolved Universal Terrestrial Radio Access (E-UTRA);Relay conformance testing(Release 11)

[5]TS 36.116 Evolved Universal Terrestrial Radio Access (E-UTRA); Relay radio transmission and reception(Release 11)
[6]TR 36.806 Evolved Universal Terrestrial Radio Access (E-UTRA); Relay architectures for E-UTRA (LTE-Advanced) (Release 11)