

Study of Multi-hop Multi-path Relay

China Telecom



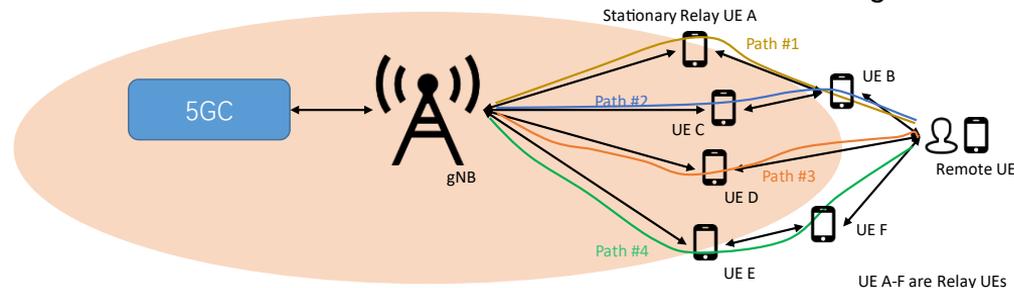
Relay is beneficial for extending communication range. It could be used for eMBB scenarios and vertical industry scenarios.

❑ Background

- Starting from Rel 12, 3GPP introduced the requirements to support of direct device connection and indirect device connection in TS 22.104, 22.185, 22.278, 22.261 and TS 22.115, etc.
- In Rel-12, the requirements are restricted to the use of public safety only for direct device connection. In Rel-15, requirements related to indirect network connection for wearable devices are introduced. Before Rel-17, the requirements of indirect network connection and direct device connection are restricted to one-hop only. In Rel-17, requirements of multi-hop indirect network connection are introduced for wearables, inHome, vertical and public safety scenarios.

❑ Enhanced indirect network connection for eMBB

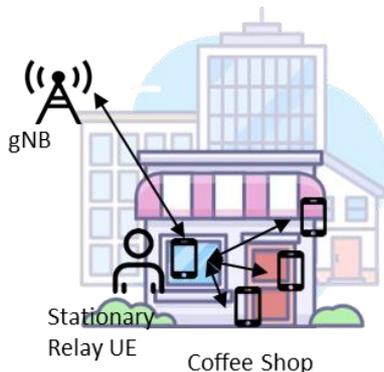
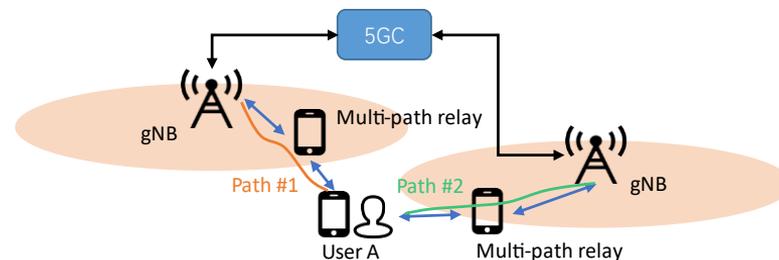
- Multi-hop Multi-path indirect network connection is not fully studied in the earlier releases.
- Relay UE for indirect network connection is cost-effective to extend cellular coverage without radio cell planning for eMBB scenarios.



Example Use Cases

□ Sending same data via different paths

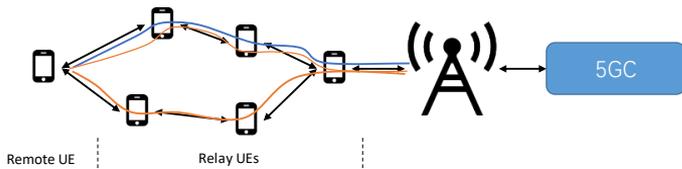
When the same traffic is transmitted over multiple hops via different paths, there are redundant paths available if the relay of one of the paths is down or out of coverage.



□ Network-assisted indirect network connection path management

Network assistance indirect network connection for communication performance optimization, especially when there are massive remote UEs behind the relay UE.

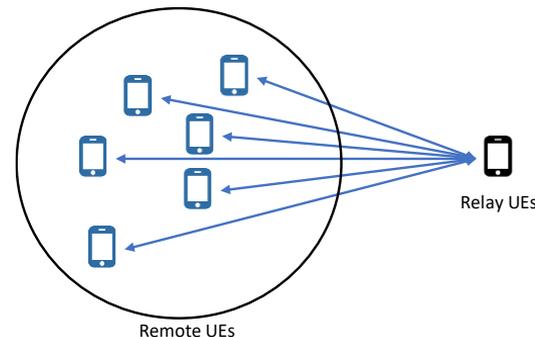
- 1) When the user is indoor or in the underground parking area, the cellular coverage is limited. When selecting the paths, based on the operator's policy, prioritization could be placed to the stationary relay UE, and different charging rate could be applied the stationary relay UE;
- 2) When the remote UEs are using media services via the relay UEs over multi-hop and multi-path, when the network indicates that there is congestion over one of the paths, it indicates the remote UE to switch to other paths or switch some packets to other paths.



□ Aggregated QoS for massive UEs behind relay

When there are massive remote UEs connecting through the relay UE to access the network, it is likely that some remote UEs would require high bandwidth services, e.g. media services. The remote UEs behind the relay could be seen as a group.

- 1) The aggregated QoS (e.g. bandwidth) of the remote UEs exceeds the capability of the relay UE, if the 5G system supports QoS sharing among the massive remote UEs according to the relay's capability, the capability of the relay UE could be shared;
- 2) The aggregated QoS (e.g. bandwidth) of the remote UEs is within the capability of the remote UE, but it's limited by the subscription of the relay UE. If the 5G system supports not limit the QoS by subscription but considers the capability of the relay UE, then its capability could be utilized wisely.



The objectives of this study are to study use cases and identify potential new requirements, including:

- Relay for indirect network connection:
 - Same traffic flows of a remote UE to be relayed via different indirect network connections paths;
 - Multi-hop multi-path relay connection, including network-assisted indirect network connection path management;
 - Mobility management enhancement for UE behind relay to avoid frequent relay discovery;
 - Aggregated QoS (e.g., bandwidth) management for massive devices using relay to access the network considering relay capability;
- Relay for direct device connection:
 - Multi-hop scenarios related with direct device connection to support extensive range communication;
 - Multi-path scenarios related with direct device connection to support high reliability;
 - Configuration and management of multi-hop and multi-path assisted direct device communication service;
 - 1) Management specific UE groups which are permitted to use the multi-hop and multi-path based communication service;
 - 2) Multi-hop and multi-path configuration for QoS assurance and service continuity;
- Other aspects, including charging and security;
- Gap analysis between the identified requirements and the existing requirements.

THANKS

