Further enhanced sidelink relay

RP-233524
Agenda item: 9.1.2.5
3GPP TSG-RAN#102
Edinburgh, Scotland, December 11-15, 2023
Source: Kyocera Corporation

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Background

- RAN#101 discussed the possibility of Further enhanced Sidelink Relay.
- The offline summary on RAN2 additional topics was provided with the conclusion below [RP-232627]

Summary/conclusions for SL relay:

⇨ There is support from companies for SL relay especially to cover the public safety applications
⇨ Acceptable objective if it is in Rel-19 package:
  - Support for multi-hop L2 relaying for U2N
  - For further discussion: multi-path enhancements multi indirect paths for a remote UE
    - Concerns from multiple companies on the time required for this additional scope

Observation

- Public Safety is the major use case of sidelink relay:
  - Considering the first responders are working in disaster sites, frequently without coverage, inside buildings, when NW is fallen victim, in a tunnel, on top of mountain, and so on, the availability of high-quality communication in out-of-coverage regions is essential.
- So, Rel-19 work should support advanced topologies, in order to provide powerful tools for users located in deep out-of-coverage regions.

Rel-19 Sidelink Relay should focus on advanced topologies for deep out-of-coverage users

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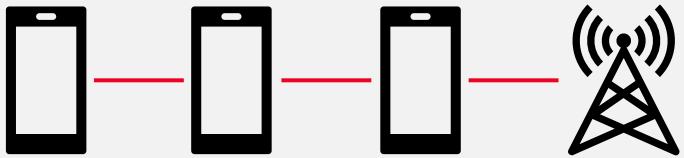
First priority – Multi-hop L2 relaying

- Multi-hop relaying provides the much-needed extension for out-of-coverage users.
  - Communication can be provided to a user who is unreachable by Rel-18 technology.

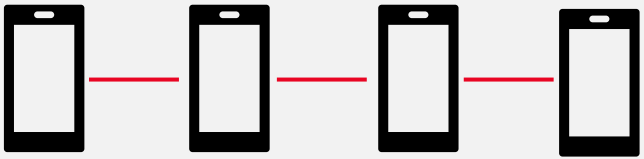
- Rel-17 U2N relay and Rel-18 U2U relay should be extended to multi-hop relaying, i.e.,
  - Multi-hop U2N relay (U2U2N relaying)
  - Multi-hop U2U relay (U2U2U relaying)

- These topologies are considered as combination of existing topologies, it's expected that the standardization efforts would be relatively limited, e.g., small enhancements within SRAP and PC5-RRC.

U2U2N relaying



U2U2U relaying



Multi-hop relaying should be supported for both L2 U2N and L2 U2U relaying

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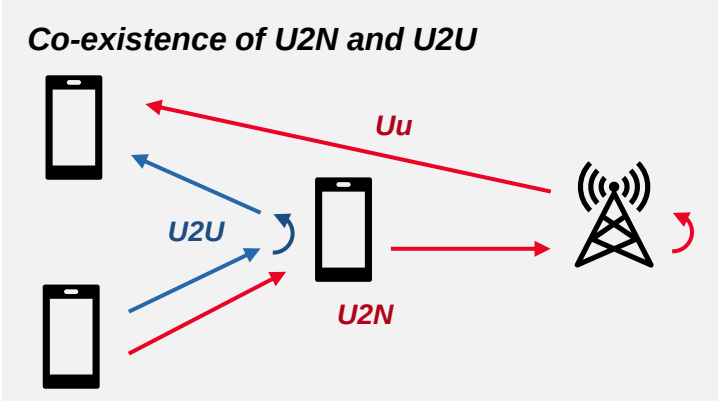
First priority – Co-existence of U2N and U2U relaying

- One physical relay UE can support both U2N and U2U services simultaneously [R2-2302445].
  - However, the co-existence of U2N and U2U relaying has not been discussed well.

- Depending on locations, communication between peer remote UEs can be provided by;
  - U2N relaying + Uu
  - U2U relaying
- So, service continuity between U2N and U2U relaying should be considered.



Service continuity for co-existence of U2N and U2U should be considered

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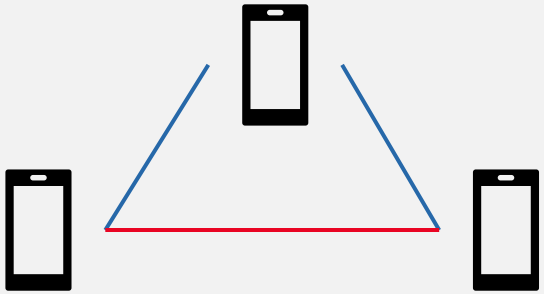
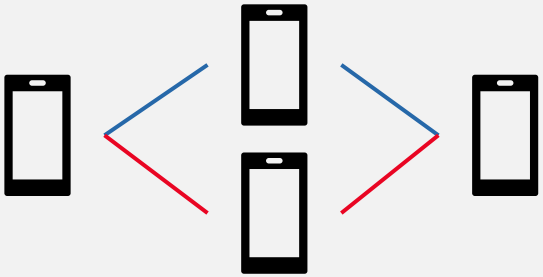
Second priority – U2U relaying enhancements

- The existing U2U relaying is enhanced to support service continuity (e.g., indirect-to-indirect path switch).
- U2U multi-path relaying provides better quality even for out-of-coverage users.
  - It would offer more robust and/or with higher data rate communication, than Rel-16 Sidelink and Rel-18 U2U relay.
- Two topologies could be considered, i.e.,
  - Direct path (i.e., Rel-16 Sidelink) + Indirect path (i.e., Rel-18 U2U relay).
  - Two indirect paths.

Direct path + Indirect path



Two indirect paths



U2U multi-path relaying provides more robust and higher data rate for OoC users

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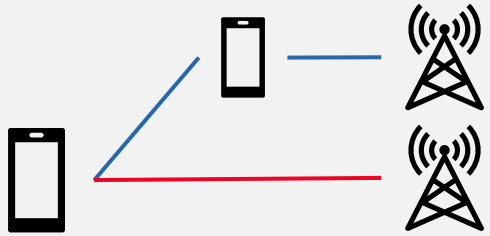
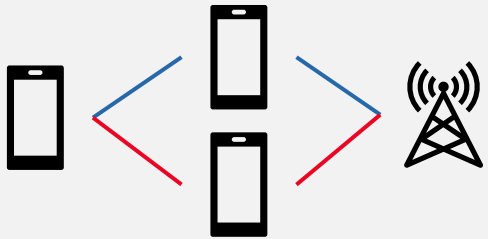
Second priority – Multi-path U2N relaying enhancements

- Currently, U2N multi-path supports the limited topology, i.e., intra-gNB and direct path + indirect path.
  - Advanced topologies would provide powerful connections for remote UEs.
- Enhanced topologies could be considered, i.e.,
  - Inter-gNB multi-path relaying, which provides more flexible and robust connection for e.g., cell-edge users.
  - Two indirect path relaying, which provides U2N multi-path connection for e.g., OoC users.
  - Direct path + Multi-hop indirect path.
- Service continuity for these topologies should also be supported to support seamless mobility (e.g., one of the existing paths can be path switched to a new direct/indirect path, instead of release + add)

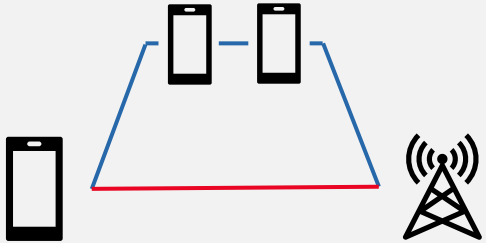
Inter-gNB multi-path relaying



Two indirect paths



Multi-hop indirect path



U2N multi-path relaying can be enhanced with various new topologies

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Potential objectives

First priority

- Support multi-hop relaying for L2 U2N and L2 U2U relays [RAN2]
  - Maximum number of hops is FFS.
- Support service continuity for co-existence of U2N and U2U relaying provided by one relay UE: [RAN2]
  - Path switch between U2N and U2U relaying

Second priority

- Support enhancements for U2U relay [RAN2]
  - Service continuity (direct-to-indirect path switch)
  - Direct path (Rel-16 Sidelink) + Indirect path (Rel-18 U2U relay)
  - Two indirect paths
- Support enhancements for U2N multi-path relaying, including: [RAN2, RAN3]
  - Inter-gNB multi-path relay
  - Intra-gNB, two indirect path
  - Intra-gNB, direct + multi-hop indirect path
  - Service continuity, while maintaining multipath, and/or Conditional path switch

Further enhanced sidelink relay for advanced topologies should be approved for Rel-19

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