**3GPP TSG- SA1 Meeting # 105 S1-240245**

**Athens, Greece, 26 Feb - 1 March 2024** **(revision of S1-240074)**

**Source: CATT**

**Title:** **Study on** **Vehicle-Mounted Relays Phase3**

**Document for: Approval**

**Agenda Item: 7**

3GPP™ Work Item Description

Information on Work Items can be found at <http://www.3gpp.org/Work-Items>

See also the [3GPP Working Procedures](http://www.3gpp.org/specifications-groups/working-procedures), article 39 and the TSG Working Methods in [3GPP TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm)

Title: Study on Vehicle-Mounted Relays Phase3

Acronym: FS\_VMR\_ph3

Unique identifier:

Potential target Release: Rel-20

# 1 Impacts

{For Normative work, identify the anticipated impacts. For a Study, identify the scope of the study}

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Affects: | UICC apps | ME | AN | CN | Others (specify) |
| Yes |  |  | x | x |  |
| No | x |  |  |  |  |
| Don't know |  | x |  |  |  |

# 2 Classification of the Work Item and linked work items

## 2.1 Primary classification

### This work item is a …

|  |  |
| --- | --- |
| x | Study |
|  | Normative – Stage 1 |
|  | Normative – Stage 2 |
|  | Normative – Stage 3 |
|  | Normative – Other\* |

**\* Other = e.g. testing**

## 2.2 Parent Work Item

For a brand-new topic, use “N/A” in the table below. Otherwise indicate the parent Work Item.

|  |  |  |  |
| --- | --- | --- | --- |
| Parent Work / Study Items | | | |
| Acronym | Working Group | Unique ID | Title (as in 3GPP Work Plan) |
|  |  |  |  |

### 2.3 Other related Work Items and dependencies

|  |  |  |
| --- | --- | --- |
| Other related Work /Study Items (if any) | | |
| Unique ID | Title | Nature of relationship |
| 720005 | New Services and Markets Technology Enablers(SMARTER) | Overall normative work of 5G requirements applicable for 5G base station relay. |
| 840039 | Enhancement for UAVs (EAV) | Rel-17 normative work on UAV, covering the requirements for radio access node on-board UAV (UxNB) |
| 930021 | Stage1 of VMR | Rel-18 SA1 normative work on Mobile Base Station Relay, covering the requirements of the operation, service continuity, multi-link connectivity, etc. |
| 980018 | Architecture Enhancements for Vehicle-Mounted Relays | Rel-18 SA2 normative work for VMR, focusing on IAB (Integrated Access and Backhaul) architecture |
| 1020067 | Study on Vehicle Mounted Relays Phase 2 | Rel-19 SA2 study work on VMR, focusing on MWAB( mobile gNB with wireless access backhaul) architecture, where the relay node consisting of a UE co-located with a full gNB |

**Dependency on non-3GPP (draft) specification: No**

# 3 Justification

Wireless self-backhauling is an essential part of 5G network to address the considerable challenges in deployment and management caused by the usage of higher frequency bands (e.g. mmWave), increasingly high densification of access nodes, and diversified geographic area (e.g. sparsely populated areas, ocean), as a result enabling more options of network topology and deployment.

With the help of wireless backhaul, mobile base station relays become a promising solution to improve 5G cellular coverage and connectivity availability, especially for UEs located inside/near a moving vehicle such as a bus, train, UAV, eVTOL, and vessel. Besides, vehicle-mounted base stations or relays can adapt access capability (e.g RAT, frequency) between served UEs and serving RAN, e.g. enable UE without satellite access capability to get service via satellite. This is beneficial for UEs moving together with the vehicle to get continuously available service across the area with different access capability of access network.

From 3GPP SA1 perspective, the use case of onboard base stations in the vehicle was originally mentioned in SMARTER and captured in TS 22.261 for the support of wireless self-backhaul (sec 6.12), and performance KPI in-vehicle (sec 7.1). Then the use cases of the radio access node on-board UAV (UxNB) were identified in Rel-17 EAV, to serve as a resilient moving radio access node in the event of e.g. disaster monitoring, or emergency assistance. The requirements of control (e.g. start/stop) and operation (e.g. minimize power consumption, reduce interference) were defined in TS 22.125 (sec.6.4). However, further study was not carried out in the downgrade groups until Rel-18 VMR work item, a series of use cases focusing on ground vehicle-mounted relays were studied, and the requirements related to efficient operation, multi-link connectivity, mobility, charging were captured in TS 22.261 (sec 6.42). Accordingly, the functions based on two types of architecture (e.g. IAB, MWAB) have been studied and are under study in Rel-18 stage 2/3 and Rel-19 stage 2 individually.

As further extension of 5G capability in access and backhaul connectivity, it’s possible for vehicular relays to drive more use cases or aspects not covered in the previous releases. For example,

* Manage user/service experience when UEs moves along with the vehicle across the areas covered by different access networks with heterogeneous access capability (e.g. frequency, RAT). The RAN on-board vehicle (e.g. UAV) can provide temporary 5G services to the users on a patrol ship. When UxNB moves across the areas with different network coverage, the backhaul RAN may change among gNB with different access capability (e.g. terrestrial gNB, gNB on board satellite (e.g. GEO). Although the change of backhaul link is transparent to served UEs, the impact on user/service experience caused by differentiated QoS of backhaul link shall be well managed regarding the policies, e.g minimize the impact via QoS harmonization, notify UEs of downgraded service without adjustment.
* Concurrent UE services via different backhaul links: vehicular relays can support more than one backhaul link and connect to different core network via those links. i.e. mobile base station relay is deployed on the ship to enable the onboard UEs access to remote land networks as usual, and the cruise host offers local multimedia content to the tourists via mobile base station relay as well. When UE intends to obtain various services simultaneously, the traffic of different services will be correctly routed via proper backhaul link to the remote network or local data network.

However, the impact of differentiated QoS and access capability of backhaul RAN, especially on service experience (e.g. QoS, QoE), and the impact of more than one backhaul links have not been studied yet and are well addressed in the current 3GPP specification.

Based on the above, it’s proposed to investigate additional use cases about managing user experience and concurrent services via different backhaul links, and identify the potential requirements.

# 4 Objective

The study item intends to investigate additional use cases and potential new service requirements for enhancing 5GS to support the following aspects of mobile base station relays mounted on vehicles (e.g. UAV, vessel):

* User/service experience management (e.g. based on different policy) when the vehicular relays changes the backhaul link with differentiated QoS and access capability
* Concurrent services via different backhaul links (e.g. efficient content delivery by local edge network)
* Other aspects related to charging, regulatory requirements(e.g. emergency services)

For the identified use cases, a gap analysis will be performed between potential new service requirements and existing 3GPP requirements and functionalities.

NOTE 1: Potential conflict with ongoing stage-2 work (FS\_VMR\_ph2) should be considered and avoided

NOTE 2: Single hop (NR-Uu) relay should be the main scenario.

# 5 Expected Output and Time Scale

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| New specifications {One line per specification. Create/delete lines as needed} | | | | | |
| Type | TS/TR number | Title | For info  at TSG# | For approval at TSG# | Rapporteur |
| “Internal TR” | 22. XXX | Study on Vehicle-Mounted Relays Phase 3 | TSG#106  (Dec.  2024) | TSG#107  (March 2025) | Qing Wan, CATT, wanqing1@cictmobile.com |
|  |  |  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Impacted existing TS/TR {One line per specification. Create/delete lines as needed} | | | |
| TS/TR No. | Description of change | Target completion plenary# | Remarks |
| {e.g. "22.281"} | {Possible values:  - either free text (e.g. “CS aspects to be removed")  - or "Specification to be withdrawn"} | {e.g. "TSG#89"} | {Free text, e.g. "This TS covers Stage 2" or "This TS covers Stage 3" or "This TS covers both stages 2 and 3"} |
|  |  |  |  |

# 6 Work item Rapporteur(s)

Qing Wan, CATT, wanqing1@cictmobile.com

# 7 Work item leadership

SA1

# 8 Aspects that involve other WGs

None identified yet at the current stage

# 9 Supporting Individual Members

{At least 4 supporting Individual Members are needed. There is an expectation that these companies will provide resources to progress the work. Note that having 4 supporting companies is a necessary but not sufficient condition: the usual TSG approval process by consensus is needed for the WID approval}

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| --- |
| Supporting IM name |
| CATT |
| China Unicom |
| TNO |
| Novamint |
| vivo |
| China Telecom |
|  |
|  |