**3GPP TSG-SA WG1 Meeting #94-e S1-211248r4**

**Electronic Meeting, May 10-20, 2021**

Title: Proposal on consolidated requirements for FS\_VMR

Agenda Item: 7.14.1

Source: Qualcomm

Contact: Francesco Pica
 fpica <at> qti.qualcomm.com

# *Abstract: This document proposes and initial proposal on consolidated potential requirements for FS\_VMR, based on current TR 22.839 (v0.2.0).*

Note: rev4 changes are shown with revision marks, on top of rev3.

# Introduction

This document includes an initial proposal for consolidated requirements, based on use cases and potential requirements currently captured in TR 22.839 v0.2.0 (agreed in S1-93e, Feb. 2021)

Some TBDs are based on new inputs and potential agreements/outcomes from SA1#94-e.

# Proposal for Consolidation of potential requirements

The following table shows all current TR potential requirements, and considerations/proposals for consolidation.

|  |  |  |
| --- | --- | --- |
| **Current TR Requirement** | **Proposed Consolidated Requirement** | **Comments** |
| [PR 5.1-1] The 5G system shall support efficient operation of mobile base station relays, e.g. on board of mobile vehicles, connected wirelessly to the NG-RAN and serving nearby 5G NR UEs (inside and/or outside the vehicle). | Same as current, with minor rewording | Change “mobile vehicles” to “moving vehicles” |
| [PR 5.1-2] The 5G system shall support means, for a mobile network operator, to configure, provision and control the operation of a mobile base station relay, including * activation and/or deactivation of mobile relay operation;
* configuration of 5G spectrum (licensed or unlicensed) used by the mobile relay, over the radio links toward UE and RAN;
* configuration of relay operating conditions e.g. based on geographic areas or locations, specific time period(s), vehicle’s speed, itinerary, etc.

Note: besides the MNO, a 3rd party entity could also be enabled to provision and control some of the mobile base station relay operation, e.g. (de)activation, location restrictions, or other operating conditions. | **Modified as:**[PR 5.1-2] The 5G system shall support means, for a mobile network operator, to configure, provision and dynamically control the operation of a mobile base station relay, including * authorization, activation and/or deactivation of mobile relay operation;
* configuration of 5G spectrum (licensed or unlicensed) used by the mobile relay, over the radio links toward UE and RAN;
* configuration of relay operating conditions e.g. based on permitted geographic areas or locations, specific time period(s), vehicle’s speed, itinerary, etc.

*[Note skipped…same as current]* | Added “dynamically”, from 5.2-3Added “authorization” and “permitted”, from 5.2-2 |
| [PR 5.2-1] The 5G system shall support the use of mobile base station relays (e.g. mounted on vehicles), which can provide 5G access to its authorized UEs in the vicinity. | See 5.1-1 and 5.4-1 | Merged into 5.1-1 and 5.4-1 |
| [PR 5.2-2] The 5G system shall enable the authorization of the mobile base station relays (e.g. mounted on vehicles) to work in a permitted area. When the mobile base station relay moves out of this area, it is not allowed to work as a base station. | See 5.1-2 | Merged into 5.1-2 |
| [PR 5.2-3] The 5G network can dynamically configure the operation parameters of a mobile base station relay, such as frequency band, permitted geographical area, etc. | See 5.1-2 | Merged with 5.1-2  |
| [PR 5.3-1] The 5G system shall support the use of vehicle mounted mobile base station relays, which provide 5G access to UEs in the vicinity | See 5.1-1 | Covered by 5.1-1  |
| [PR 5.3-2] Subject to operator policy, the 5G system shall support means to configure and enable a vehicle mounted mobile base station relays to allow access to all UEs, or to only allow access to certain authorized UEs e.g., vehicle owner’s family members, friends, etc | See 5.4-1 | Merged into by 5.4-1  |
| [PR 5.4-1] The 5G system shall support provisioning and configuration mechanisms to control UEs’ access to the 5G network via a mobile base station relay, based on * User/UE subscription and/or permission (can be specific to each preferred relay);
* User/UE or relay geographical location, time of the day, load, speed
 | **Modified as:**[PR 5.4-1] The 5G system shall support provisioning and configuration mechanisms to control UEs’ access to the 5G network via a mobile base station relay, based on * User/UE subscription and/or authorization (can be specific to each preferred relay, or a group of users, e.g., vehicle owner’s family members, friends, etc);
* User/UE or relay geographical location, time of the day, load, speed
 | Replaced “permission” with “authorization”, from 5.2-1Added “or a group of users, e.g., vehicle owner’s family members, friends, etc”, from 5.3-2 |
| [PR 5.5-1] The 5G system shall support mechanisms to control UEs selection of mobile base station relays and UEs access to the 5G network via a mobile base station relay, based on * user/UE subscription and/or permission (can be specific to each preferred relay);
* user preference, for manual selection of a specific relay.
 | **Modified as:**[PR 5.5-1] The 5G system shall support mechanisms to control UEs selection of mobile base station relays and UEs access to the 5G network via a mobile base station relay, based on user preference, e.g. for manual selection of a specific relay. | Removed first sub-bullet, covered by 5.4-1Added “e.g.” at the end |
| [PR 5.6-1] The 5G system shall support the use of mobile base station relay, which provides 5G access to UEs in the vehicle along the vehicle itinerary | See 5.1-1 | Covered by 5.1-1  |
| [PR 5.6-2] The 5G system shall provide means to ensure that UEs inside a vehicle, once provided with 5G access and connectivity via a mobile base station relay (e.g. mounted on the vehicle), remain connected via the mobile base station relay (e.g. mounted on the vehicle). | **Modified as:**[PR 5.6-2] The 5G system shall provide means to ensure that UEs (e.g. inside a vehicle), once provided with 5G access and connectivity via a mobile base station relay (e.g. mounted on the vehicle), remain connected via the relay. | Add “inside a vehicle” in (), as exampleReplace last part “mobile base station relay (e.g. mounted on the vehicle)” with “relay”, to simplify wording  |
| [PR 5.7-1] The 5G system shall be able to provide a means to optimize cell selection and minimize unnecessary cell reselection (between mobile base station relays or between mobile base station relays and fixed gNB,) in the presence of mobile base station relays. NOTE: This requirement is intended to provide the capability for the 5G system (UEs/ mobile base station relays) to be able to optimize selection of a mobile base station relay, e.g., in a vehicle where the UE is on board (or that moved together so far or that is expected to move together). | **Modified as:**[PR 5.7-1] The 5G system shall be able to provide a means to optimize cell selection and minimize unnecessary cell reselection (between mobile base station relays or between mobile base station relays and macro RAN) in the presence of mobile base station relays. *[Note skipped…same as current]* | Replaced *fixed* *gNB* with *macro RAN*  |
| [PR 5.7-2] The 5G system shall be able to provide a means to minimize unnecessary handover (between mobile base station relays, or between mobile base station relays and a fixed gNB and between) for a UE while served via an mobile base station relay, e.g., based on UE and relay relative mobility or speed. | **Modified as:**[PR 5.7-2] The 5G system shall be able to provide a means to minimize unnecessary handover (between mobile base station relays, or between mobile base station relays and macro RAN) for a UE while served via an mobile base station relay, e.g., based on UE and relay relative mobility or speed. | Replaced *fixed* *gNB* with *macro RAN* Fixed typo |
| [PR 5.8-1] The 5G system shall be able to provide a means to perform load balancing among mobile base station relays.NOTE: This requirement is intended to provide the capability for the 5G system (UEs/ mobile base station relays) to be able to optimize the load of network resources whenever possible | Same as current |  |
| [PR 5.9-1]: The 5G system shall support providing location service for the UEs accessing to the 5GS network via a mobile base station relay (e.g. mounted on a vehicle). | Same as current |  |
| [PR 5.9-2]: The 5G system shall support providing location information to a requesting UE or other location entity, for UEs accessing the 5GS network via a mobile base station relay (e.g. mounted on a vehicle), considering e.g. specific location granularity, and efficient UE power consumption. | Same as current |  |
| [PR 5.10-1] The 5G system shall be able to identify and differentiate the traffic relayed via a mobile base station relay, e.g. to apply specific charging policies. | Same as current |  |
| [PR 5.10-2] Online and offline charging shall be supported for UEs connected via a mobile base station relay | Same as current |  |
| [PR 5.10-3] The 5G system shall be able to provide and collect charging information for UEs using a mobile base station relay, including e.g.:- Identification of UEs/users involved;- Initiation/termination time of relay communication;- Duration and amount of data transmitted and received;- Type of service, QoS, other allocated resources (e.g. spectrum);- Geographic location(s) served by the relay- Other relay mobility information (e.g. itinerary, speed) | Same as current |  |
| [PR 5.11.1-1] The 5G system shall be able to support efficient handover when a UE active communication changes from the macro network to a mobile base station relay (e.g. mounted on a vehicle) and vice versa, ensuring end-to-end service continuity during mobility of the UE (e.g. entering or leaving the vehicle) and/or the relay | See next | Merge with #2 |
| [PR 5.11.1-2] The 5G system shall be able to support efficient handover when a UE active communication changes from the macro network to a mobile base station relay (e.g. mounted on a vehicle) and vice versa, ensuring end-to-end service continuity during mobility of the UE (e.g. moving outside the vehicle) and/or the relay. | **Modified as:**[PR 5.11.1-2] The 5G system shall be able to support efficient handover when a UE active communication changes from the macro network to a mobile base station relay (e.g. mounted on a vehicle) and vice versa, ensuring end-to-end service continuity during mobility of the relay and/or the UE (e.g. entering, leaving or moving outside the vehicle) ~~and/or the relay.~~ | To cover also #1 |
| [PR 5.11.2-1] The 5G system shall be able to support efficient handover of a UE active communication when a mobile base station relay (e.g. serving a UE inside a vehicle) changes between macro network nodes, ensuring end-to-end service continuity during mobility of the relay. | See next | Merge with #2 |
| [PR 5.11.2-2] The 5G system shall be able to support efficient handover of a UE active communication when a mobile base station relay (e.g. serving a UE outside a vehicle) changes between macro network nodes, ensuring end-to-end service continuity during mobility of the relay. | **Modified as:**[PR 5.11.2-2] The 5G system shall be able to support efficient handover of a UE active communication when a mobile base station relay (e.g. mounted on a vehicle, serving a UE inside or outside the vehicle) changes between macro network nodes, ensuring end-to-end service continuity during mobility of the relay. | To cover also #1 |
| [PR 5.11.3-1] The 5G system shall be able to support efficient handover when a UE active communication changes between mobile base stations relays (e.g. mounted on a vehicle), ensuring end-to-end service continuity during mobility of the UE (e.g. moving inside the vehicle). | See next | Merge with #2 |
| [PR 5.11.3-2] The 5G system shall be able to support efficient handover when a UE active communication changes between mobile base stations relays (e.g. mounted on a vehicle), ensuring end-to-end service continuity during mobility of the UE (e.g. moving outside the vehicle) and/or the relays | **Modified as:**[PR 5.11.3-2] The 5G system shall be able to support efficient handover when a UE active communication changes between mobile base stations relays (e.g. mounted on a vehicle), ensuring end-to-end service continuity during mobility of the relay and/or the UE (e.g. moving inside or outside the vehicle) ~~and/or the relays~~ | To cover also #1 |
| [PR 5.11.4-1] The 5G system shall be able to support efficient handover of a group of UEs’ active communications when a mobile base station relay serving a group of in vehicle UEs moves between donor gNBs, ensuring end-to-end service continuity during mobility of the relay | **Replaced by:**NOTE: the requirements on service continuity intend to apply to a mobile base station relay serving one or multiple active UEs | The “group of UEs” aspect would apply also to other service continuity use cases and requirements => General NOTE can be added for all. |
| [PR.5.12.6-001] The 5G system shall provide means for a UE to select a suitable mobile base station relay (e.g., a mobile base station relay that has a similar trajectory as the UE) | See 5.7-1 | Merged with 5.7-1 |
| [PR.5.13.6-001] The 5G system shall be able to minimize potential mobility ping-pongs when mobile base station relays are used. | See 5.7-1/2 | Covered by 5.7 |
| [PR.5.13.6-002] The 5G system shall be able to support simultaneous UE connectivity to RAN, using a direct UE access link to the macro RAN together with an access link via a mobile base station relay (e.g. mounted on a vehicle). | Same as current | Note: this was missed, by mistake, in r1 |
| [PR.5.14.6-001] The 5G system shall be able to support mechanisms to optimize mobility (e.g. re-selection, handover) and energy efficiency for a UE camped or connected via a vehicle mobile BS relay (e.g. for UEs located inside a vehicle, equipped with a BS relay) | Same as current, with minor rewording | Remove “vehicle” in front of mobile BS relay |
| [PR.5.15.6-001] The 5G System shall be able to support dynamic deployment and configuration of one or more mobile base station relays (e.g. mounted on vehicles) for providing ad-hoc indoor coverage extension in specific locations. | Same as current |  |
| [PR5.16.6-1] The 5G System shall be able to support mobile vehicle relays using NR satellite access to connect to a remote donor RAN node via a satellite link. | Same as current, with minor rewording | Align terminology: vehicle relay => BS relay (e.g. mounted on vehicles) |
| [PR5.16.6-2] The 5G System shall be able to support a mobile vehicle relay using NR satellite access with service continuity in the scenario where there is a transition from one serving satellite to another serving satellite | Same as current, with minor rewording | Align terminology: vehicle relay => BS relay (e.g. mounted on vehicles) |
| [PR-5.17-1] The 5G system shall be able to support RAN sharing between multiple PLMNs for UEs connected to 5G network via mobile base station relays (e.g. mounted on vehicles), where the donor RAN node is able to inter-connect to the multiple 5G core networks sharing the RAN.NOTE: the above requirement assumes that the mobile base station relays broadcast all PLMN-Ids of the sharing PLMN operators. | Same as current |  |
| [PR-5.17-2] The 3GPP System shall support end-to-end service continuity for a UE having active connection with a RAN via a mobile base station relay (e.g. mounted on a vehicle) when there is a change between a shared RAN (e.g. inside the vehicle) and a non-shared RAN (e.g. outside a vehicle), or when RAN sharing changes (for the same mobile relay) between different sharing PLMNs. | Same as current |  |
| [PR 6-1] The 5G system shall support mechanisms, for the HPLMN and/or VPLMN controlling a mobile base station relay, to enable/disable mobile relay operation if/when the relay (e.g. on a mobile vehicle) is roaming in a VPLMN. | Same as current |  |
| [PR 6-2] The 5G system shall be able to fulfil necessary regulatory requirements (e.g. for support of emergency services) when UEs access the 3GPP network via a mobile base station relay | Same as current |  |
| [PR 6-3] The 5G system shall be able to support priority services (e.g. MPS) when UEs access the 3GPP network via a mobile base station relay | Same as current |  |
| [PR 6-4] The 5G system shall ensure that end-to-end 5G security between the UE and 3GPP network is supported when the UE accesses the 3GPP network via a mobile base station relay | Same as current |  |
| [PR 6-5] The 5G system shall be able to minimize radio interference possibly caused by mobile base station relays (e.g. when mounted on moving vehicles) | Same as current |  |
|  |  |  |

In addition, the following inputs (updated / new requirements) have been submitted to S1-94e, pending final agreement.

Requirement updates:

S1-211240 Update to Other Aspects - sec.6

S1-211241 Update to sec 5.10 - Incentives and Charging

S1-211244 Update to use case on relay-macro connectivity

S1-211242 Update to use case on mobile relays sharing

New requirements:

S1-211020 New UC Monitoring of vehicle-mounted relays

S1-211115 Use case on VMR for improved connectivity and data transfer

S1-211185 New Use case: Mobility between Non-terrestrial coverage and terrestrial coverage for Mobile Vehicular

S1-211186 New Use case: Mobile Vehicular Relays using Non-terrestrial and terrestrial access simultaneously

S1-211245 New use case on multi-relay connectivity

S1-211247 New use case on relay traffic over a 5G transport NW

Based on the latest available revisions of the above docs, few updates/requirements, considered more stable than others, are also proposed to be captured in the initial consolidated list below.

Rest is captured as TBD, and listed at the very end (for reference), including both existing and new requirements not yet consolidated.

# Conclusions and Proposal

Based on the above, a text proposal is provided for Section 7 of TR 22.839, reflecting the suggested consolidated requirements.

Other changes or additions are:

- further terminology alignment: adding “(e.g. mounted on vehicle)” to some instances of BS relay, where missing (i.e. 5.1-2, 5.4-1, 5.5-1, 5.8-1, 6.12.6-1, 5.7-1/2, 5.10.1-3, 5.6.2-4);

- suggested some requirements’ sorting and grouping (into general, mobility & service continuity, charging, others);

- added one missing requirement from the TR (13.6-2), omitted by mistake;

- added introductory paragraph, to clarify terminology and main assumptions around a mobile BS relay;

- further updates, based on S1-94e email discussion and comments.

NOTE: further merging and/or grouping may be considered later.

# 7 Consolidated Potential Requirements

-------------------------- START of text proposal (new text) --------------------------

The requirements below refer to a “*mobile base station relay”*, which is a base station (BS) acting as a relay between a UE and the 5G network, i.e. providing a NR access link to UEs and connected wirelessly (using NR) through a donor NG-RAN to the 5G Core. Such BS relay is assumed to be mounted on a moving vehicle and serve UEs that can be located inside or outside the vehicle (or entering/leaving the vehicle).

 NOTE: the radio link used between a mobile BS relay and served UEs is assumed to be NR-Uu; in that regard, it should be clear that a BS relay is different than a UE relay (which uses instead a PC5-based link to provide indirect connection to remote UEs).

General requirements

[PR 5.1-1] The 5G system shall support efficient operation of mobile base station relays.

[PR 5.1-2] The 5G system shall support means, for a mobile network operator, to configure, provision and dynamically control the operation of a mobile base station relay (e.g. mounted on a vehicle), including

* authorization, activation and/or deactivation of mobile relay operation;
* configuration of frequency bands (maybe licensed or unlicensed) used by the mobile relay over the radio link toward UE and the backhaul link toward RAN, plus other radio parameters (e.g., duplex mode, transmit power etc.);
* configuration of relay operating conditions e.g. based on permitted geographic areas or locations, specific time period(s), vehicle’s speed, itinerary, etc.
* configuration of allowed VPLMN

[PR 5.4-1] The 5G system shall support provisioning and configuration mechanisms to control UEs’ access to the 5G network via a mobile base station relay (e.g. mounted on a vehicle), based on

* User/UE subscription and/or authorization (can be specific to each preferred relay, or a group of users, e.g., vehicle owner’s family members, friends, etc);
* User/UE or relay geographical location, time of the day, load, speed
* User preference

[PR-5.17-1] The 5G system shall be able to support RAN sharing via mobile base station relays (e.g. mounted on vehicles).

Multi-link connectivity

[PR.5.13.6-2] The 5G system shall be able to provide simultaneously fora UE with both link without a mobile base station and link via a mobile base station relay (e.g. mounted on a vehicle).

 [PR 5.x-001] The 5G system shall be able to provide simultaneously for a UE with multiple links via different mobile base station relays (e.g. mounted on different vehicles).

Mobility and Service Continuity

[PR 5.7-1] The 5G system shall be able to provide a means to optimize cell selection, minimize unnecessary cell reselection and optimize energy efficiency(between mobile base station relays or between mobile base station relays and macro RAN) in the presence of mobile base station relays (e.g. mounted on vehicles).

NOTE: This requirement is intended to provide the capability for the 5G system (UEs/ mobile base station relays) to be able to optimize UE (re)selection of a mobile base station relay, e.g., in a vehicle where the UE is on board (or that moved together so far or that is expected to move together).

[PR 5.7-2] The 5G system shall be able to provide a means to support efficient handover and minimize unnecessary handover for a UE in the presence of a mobile base station relay (e.g. mounted on a vehicle), ensuring end-to-end service continuity, e.g., based on UE and relay relative mobility or speed.

[PR5.16.6-2] The 5G System shall be able to support a mobile base station relays (e.g. mounted on vehicles) using NR satellite access with service continuity in the scenario where there is a transition from one serving satellite to another serving satellite

Charging

[PR 5.10-1] The 5G system shall be able to identify and differentiate the traffic relayed via a mobile base station relay (e.g. mounted on a vehicle), e.g. to apply specific charging policies.

[PR 5.10-3] The 5G system shall be able to provide and collect charging information for UEs using a mobile base station relay (e.g. mounted on a vehicle), including specific relay information such as:

* Geographic location(s) served by the relay;
* Relay mobility information (e.g. itinerary, speed).

Other aspects

 [PR 6-2] The 5G system shall be able to fulfil necessary regulatory requirements (e.g. for support of emergency services) when UEs access the 3GPP network via a mobile base station relay (e.g. mounted on a vehicle).

[PR 6-3] The 5G system shall be able to support priority services (e.g. MPS) when UEs access the 3GPP network via a mobile base station relay (e.g. mounted on a vehicle).

[PR 6-4] The 5G system shall ensure that end-to-end 5G security between the UE and 3GPP network is supported when the UE accesses the 3GPP network via a mobile base station relay (e.g. mounted on a vehicle).

-------------------------------- END of text proposal ------------------------------------

**Annex**

*[Other pending requirements – To be yet consolidated]*

Satellite and Terrestrial relay links

[PR5.x.6-1] The 5G System shall be able to support mobile base station relays using NR satellite access and using NR terrestrial access to connect to 5GC.

[PR5.x.6-1] The 5G System shall be able to support mobile base station relays capable connecting via both NR satellite access and NR terrestrial access, to select one access as a relay link between the mobile base station relays and the 5GC.

[PR5.x.6-2] The 5G System shall be able to support a mobile base station relay capable of using both NR satellite access and NR terrestrial access with service continuity in the scenario when this mobile base station relay switches from using NR satellite access to using NR terrestrial access, and vice versa.

[PR5.x.6-2] The 5G System shall be able to support mobile base station relays capable of connecting in parallel via NR satellite access and NR terrestrial access as relay link to connect via both to 5GC at the same time.

[PR5.x.6-3] The 5G System shall be able to support mobile base station relays capable of connecting in parallel via NR satellite and NR terrestrial access to add a second relay link to allow more capacity (i.e. more UEs to access the network), via this mobile base station relay.

[PR5.x.6-4] The 5G System shall be able to support mobile base station relays connected via both NR satellite and NR terrestrial access to remove one of two relay links to adapt to decreased capacity demand for UEs accessing via this mobile base station relay.

[PR5.x.6-5] The 5G System shall be able to support traffic/load balancing between satellite and terrestrial access links used by a mobile base station relay, if capable of both NR satellite access and NR terrestrial access links at the same time.

Note 1: The simultaneous satellite and terrestrial links (from the relay) are assumed to carry traffic pertaining to different UEs.

Others

[PR.5.13.6-001] The 5G system shall be able to efficiently control UE idle mode mobility when mobile base station relays are used, e.g. to facilitate UEs connecting to the macro RAN (as opposed to a vehicle relay).

[PR y.x-1] The 5G system shall be able to provide a means to optimize network behaviour to efficiently deliver data based on the mobility information (e.g., itinerary), known or predicted, of the vehicle-mounted relays.

[PR 5.10-1] The 5G system shall be able to configure and provision specific required QoS for traffic relayed via a mobile base station relay, e.g. may be based on user’s subscription, geographical area, day/time of operation. relay type, itinerary/mobility, etc.

 NOTE: QoS is intended as end-to-end QoS, i.e. covering both UE access and relay backhaul QoS.

[PR 5.x-1] The 5G system shall support means to expose monitoring information of a mobile base station relay (e.g. number of UEs connected, QoS, geographical location, time of data monitoring/collection, etc.) to an authorized third-party based on monitoring parameters configured by the authorized third-party (e.g. data to monitor/collect, periodicity/schedule of monitoring, etc.).

[PR 5.x-001] The 5G system shall be able to support communication from/to users of one MNO (MNO-A) via mobile vehicle base station relays, where the relayed traffic is transported to/from the MNO-A network using 5G connectivity (RAN and 5GC) provided by a different MNO (MNO-B).

NOTE 1: the above requirement includes support of necessary policies and provisioning for end-to-end user’s QoS, e.g. based on MNO-A user/UE’s subscription.

NOTE 2: The 5G transport and connectivity provided by the different MNO (MNO-B) assumes a generic wireless BS backhaul, independent from the BS relay functionalities.