

## SHORT TERM SCIENTIFIC MISSION (STSM) SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

**Action number: CA15127**

**STSM title: Joint provisioning of connectivity and computing services in a disaster scenario**

**STSM start and end date: Sept 15<sup>th</sup> to Sept 20<sup>th</sup> 2019**

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### PURPOSE OF THE STSM:

Among the most recent approaches to emergency network implementation, of particular interest are those which exploit on-site vehicles such as drones or cars, and which aim at the delivery of cellular communications in contexts of disaster by means of vehicle-mounted small cell base stations. Such an approach has been proposed first in order to flexibly densify the network in urban settings, in a cost-efficient way, by exploiting the correlation between spatio-temporal patterns of user mobility and the patterns of vehicular mobility. However, several important research challenges stand in the way of a practical implementation of such a paradigm, calling for innovative approaches. The proposed STSM is expected to foster the collaboration on this topic between HES SO and the group at Paderborn University led by prof. Falko Dressler. The proposed STSM falls within the scope of the WG1 (large scale natural disasters), though interactions with other working groups (WG2 in particular) are possible. Among the likely outcomes of the STSM is the preparation of a joint research proposal on the topic of the STSM.

### DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

The initial part of the work has consisted in the review of the state of the art on the use of small cell mounted on vehicles. A first question which has arisen, is whether the moving bs paradigm is of any benefit at all, in terms of CAPEX and OPEX. Indeed, many of the existing works give for granted that some benefit in terms of CAPEX, given that the correlation between patterns of user demand and of vehicular mobility has been investigated and characterized, and found to be high enough to make such a paradigm of some interest, at least in the most crowded parts of a city. From our review of the existing works, no conclusive answer to this issue has been found. This issue is crucial, as without an economic driver to the deployment of moving cells in normal condition, it would not be possible to exploit their availability on the onset of disaster. Indeed, once a disaster strikes, the process of bringing additional communication resources (such as

base stations) is hampered by the consequences of the disaster itself on vehicular and pedestrian mobility. Hence, unless vehicles with small cells on them are already present on the disaster location at the onset of the disaster, such a paradigm loses much of its interest, and it is hardly as interesting as current approaches based on bringing truck-mounted base stations on the disaster area.

In order to progress in such an investigation, it has appeared evident that an effort must be done in characterizing the distribution of distances of BS from users in such scenarios. The review of the state of the art has shown that such a characterization, which is key to optimally design such systems and correctly evaluate their impact on user perceived performance and on the economic viability of the moving base station paradigm, is still missing.

Finally, given the pivotal role played in such a network paradigm by the wireless backhaul technologies, we have started looking into the issue of designing mechanisms for proactively adapting the configuration of the wireless backhaul network to changes in its configuration and in link quality due to mobility, interference, obstacles (such as in mmwave), including changes due to the sudden unavailability of some nodes, possibly correlated to the consequences of a disaster.

#### **DESCRIPTION OF THE MAIN RESULTS OBTAINED**

The main outcome of the STSM is the elaboration of a set of research questions, and the individuation, for each of them, of an approach that we intend to follow in order to address them, together with a set of reserachers which could collaborate in the project. We have identified a simulation framework, a set of databases of vehicle mobility traces and of BS spatial distribution over which we will operate in our initial investigations.

#### **FUTURE COLLABORATIONS (if applicable)**

The research work performed in the STSM contributes to strengthening of the collaboration between Paderborn University and HES SO Valais, and it establishes the basis for future joint work on the topics of the STSM.