



This is an electronic reprint of the original article. This reprint may differ from the original in pagination and typographic detail.

Saeed, Umar; Hämäläinen, Jyri; Mutafungwa, Edward; Wichman, Risto; Gonzalez, G. David; García-Lozano, Mario On the Use of Existing 4G Small Cell Deployments for 5G V2N Communication

Published: 01/01/2019

Document Version Publisher's PDF, also known as Version of record

Please cite the original version:

Saeed, U., Hämäläinen, J., Mutafungwa, E., Wichman, R., Gonzalez, G. D., & García-Lozano, M. (2019). On the Use of Existing 4G Small Cell Deployments for 5G V2N Communication. Poster session presented at European Conference on Networks and Communications, Valencia, Spain.

This material is protected by copyright and other intellectual property rights, and duplication or sale of all or part of any of the repository collections is not permitted, except that material may be duplicated by you for your research use or educational purposes in electronic or print form. You must obtain permission for any other use. Electronic or print copies may not be offered, whether for sale or otherwise to anyone who is not an authorised user.

On the Use of Existing 4G Small Cell Deployments for 5G V2N Communication

Umar Saeed¹, Jyri Hämäläinen¹, Edward Mutafungwa¹, Risto Wichman², David González G.³, Mario Garcia-Lozano⁴

¹Department of Communications and Networking, Aalto University, Finland ²Department of Signal Processing and Acoustics, Aalto University, Finland ³Wireless Signals Technologies Group, Corporate Systems and Technology, Continental AG, Germany ⁴Department of Signal Theory and Communications, Universitat Politécnica de Catalunya (UPC), Spain Corresponding author: umar.saeed@aalto.fi

I. INTRODUCTION

- Feasibility of V2N communication on existing cellular networks is investigated at sub-6 GHz as well as a millimeter wave frequency carrier
- V2N communication requires reliable coverage and a guaranteed QoS on the roads
- > Traditional coverage related studies focus on a network area in raster format
- Route-based evaluation allows to expand the vision with more complete picture of the expected QoS

IV. PERFORMANCE EVALUATION

A. Street coverage



Real world vehicular routes are formed using Google APIs and a realistic channel is simulated using a ray tracing software

II. NETWORK DEPLOYMENT AND BS PARAMETERS



TABLE I. Assumed BS capabilities

Parameter	Value			
	Macro BS		Small BS	
TX power Operation band Bandwidth Antenna gain Antenna height SINR threshold	46 dBm 2.6 GHz 20 MHz 18 dBi 30 m -7 dB	2.6 GHz 20 MHz	30 dBm 5 GHz 100 MHz 5 dBi 10 m -7 dB	28 GHz 500 MHz

- A realistic "half square cell plan" deployment in a 2.5 km by 2.5 km area in Vienna city is considered
- There are 17 macro base stations (BSs) with 221 small BSs placed strategically at their cell edges

III. METHODOLOGY

- Real world vehicular routes are generated by dropping random starting and ending points in the network area and then using Google Directions APIs for routes formation
- Signal-to-interference-plus-noise ratio (SINR) and the handover rate
- are used as the key performance measures from coverage perspective
 ➢ Street coverage is expressed in terms of SINR trace on a representative route as well as SINR CDFs at different carriers.
 ➢ The handover rate is expressed in terms of:
 - Street level crossing rate (SCLR) which is related to the classical LCR and is a measure of coverage fragmentation
 Street average fading duration (SFAD) which reflects the spatial duration of low SINR locations where connection might be lost

V. CONCLUSIONS AND FUTURE WORK

Good coverage at sub-6 GHz carrier with less than 2% outage
 Coverage at 28 GHz is fragmented with about 30% outage probability
 There is a need for further densification of small BSs especially close to the macro BSs sites

In future work, ultra-dense deployments with more performance evaluation measures will be analyzed



elec.aalto.fi/en