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

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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
- 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	46 dBm	30 dBm		
Operation band	2.6 GHz	2.6 GHz	5 GHz	28 GHz
Bandwidth	20 MHz	20 MHz	100 MHz	500 MHz
Antenna gain	18 dBi	5 dBi		
Antenna height	30 m	10 m		
SINR threshold	-7 dB	-7 dB		

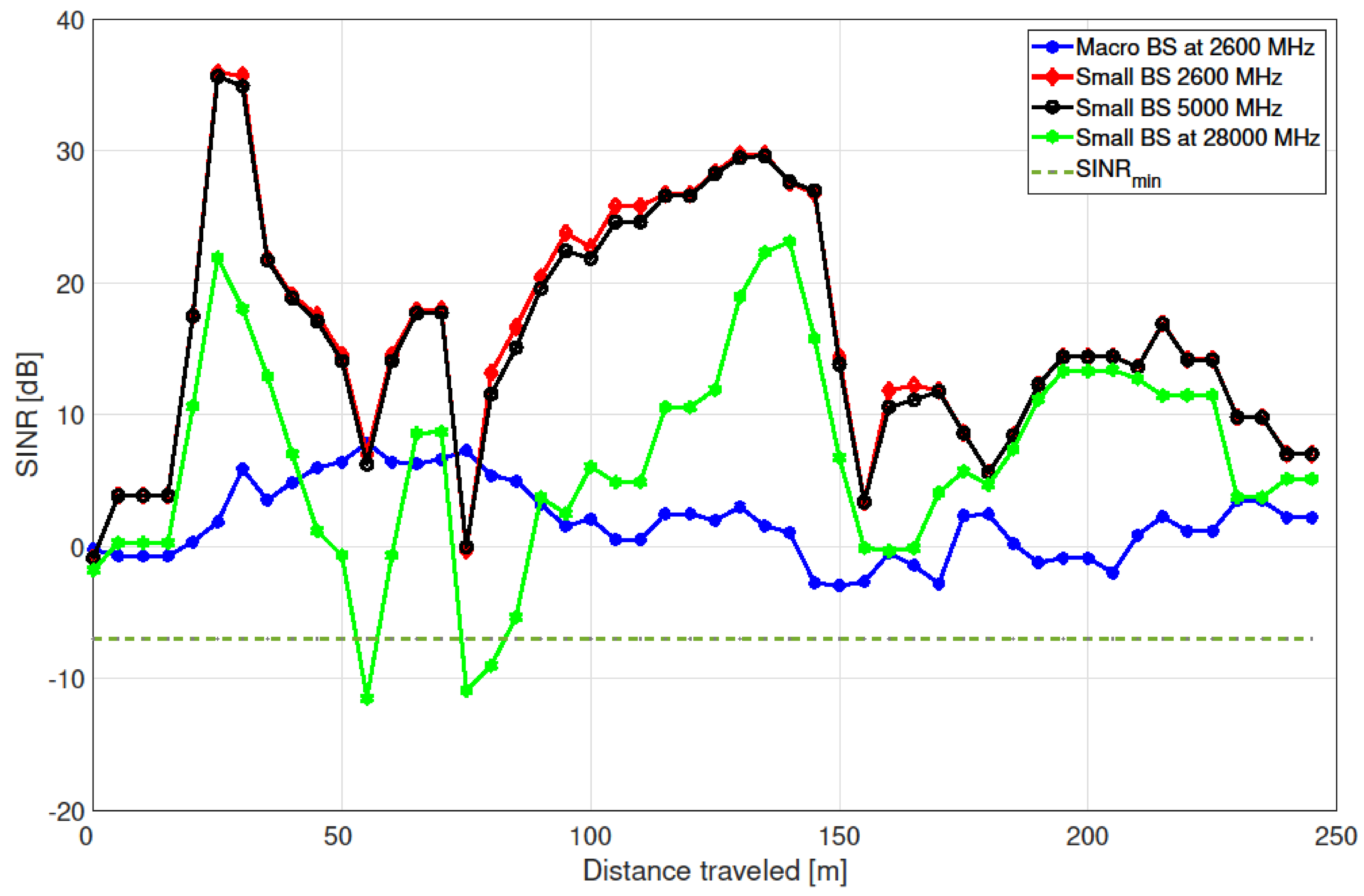
- A realistic "half square cell plan" deployment in a 2.5 km by 2.5 km area in Vienna city is considered
- There are 17 macro base stations (BSs) with 221 small BSs placed strategically at their cell edges

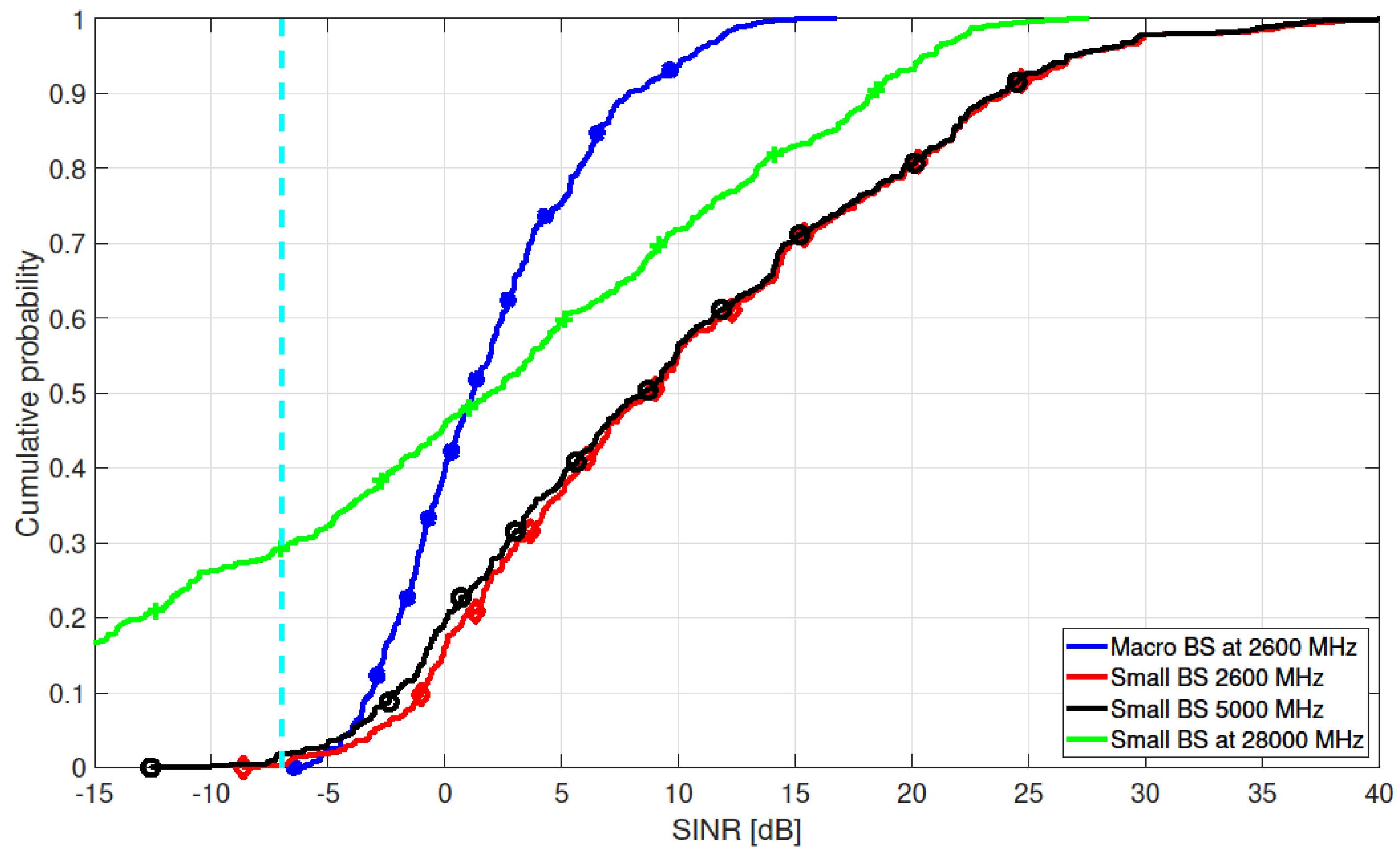
III. METHODOLOGY

- 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

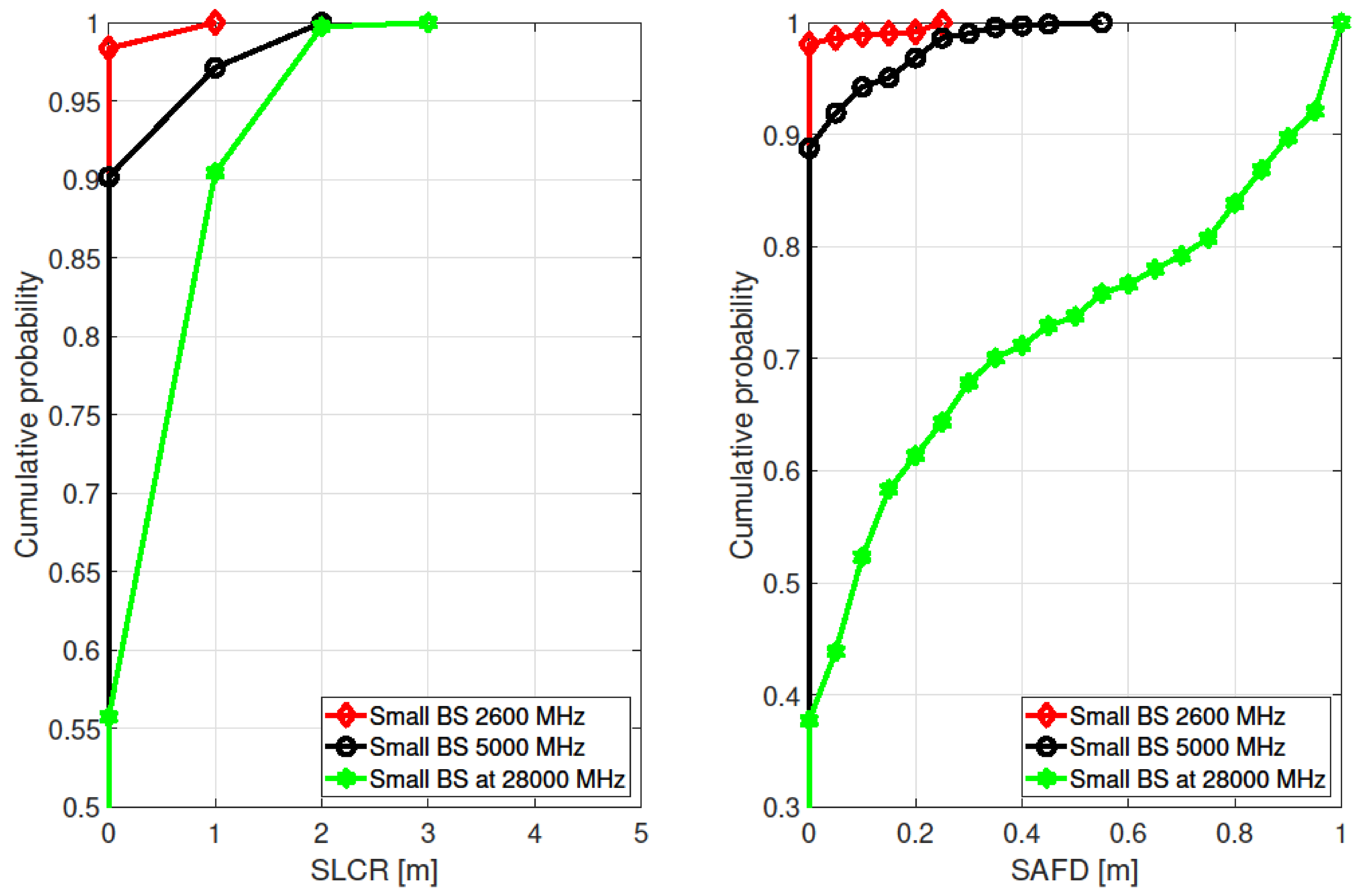
IV. PERFORMANCE EVALUATION

A. Street coverage





B. Handovers between carriers



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

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