

# Novel System and Method for Determining Layout of Wireless Communication Network



Communications &amp; Information

Digital Broadcasting, Telecommunication and Optoelectronics

## Opportunity

5G networks use millimeter wave(mmWave) for high bandwidth transmission, yet the mmWave network suffers from severe outage impairment in highly obstructed urban scenarios. How to effectively suppress the outage at the stage of network planning and base station (BS) deployment is an important and urgent open problem. This invention presents two BS deployment techniques, the macro diversity-constrained (MDC) and the outage-constrained (OC) BS deployment techniques. These techniques share a common objective function while incorporating different constraints. The MDC minimizes the number of deployed BSs while it ensures each user position is covered by at least two BSs. The OC finds the minimum number of deployed BSs, subject to the link outage constraint at each user position. The OC BS deployment provides the outage guarantee that can be parameterized by threshold values. The invention will significantly improve the mmWave network efficiency.

## Technology

The invention describes two mmWave BS deployment approaches. The first approach minimizes the number of deployed BSs under the minimum macro diversity order  $d > 0$

Constraint such that each user position is covered by, at least,  $d$  BSs. This technique is referred to as the macro diversity-constrained (MDC) BS deployment technique. The OC minimizes the number of deployed BSs subject to the outage constraint so that the outage at each user position is less than a threshold. Both the macro diversity order  $d$  in the MDC and the outage threshold in the OC are tunable, and these enable us to explore different tradeoffs between the number of BSs (i.e., the cost) and the outage performance. The mmWave channel propagation is modeled by using the ray tracing in the presence of LoS and first order reflection paths. The MDC and OC BS deployment problems as combinatorial optimization problems were formulated.

## Advantages

The existing techniques could result in up to 50% user outage because they do not directly consider the outage probability due to obstacles. The invented techniques provide low user outage with large  $d$  in the MDC or low outage threshold in the OC, which can meet users' QoS requirement.

### IP Status

Patent granted

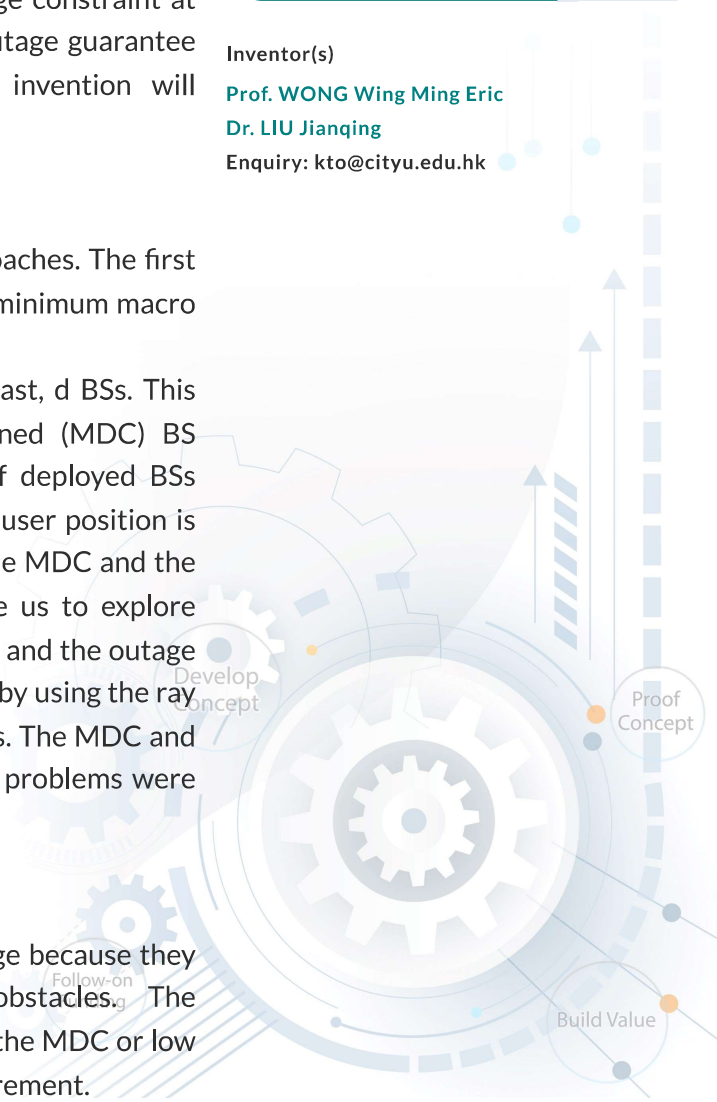
Technology Readiness  
Level (TRL) ?

3

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## Applications

The proposed two base station deployment techniques can be applied to building better mmWave networks, mmWave network planning, and increase user satisfactions.

