

Outage-mitigation Base Station Deployment and User Association for Millimeter Wave Networks

 Communications & Information

Digital Broadcasting, Telecommunication and Optoelectronics

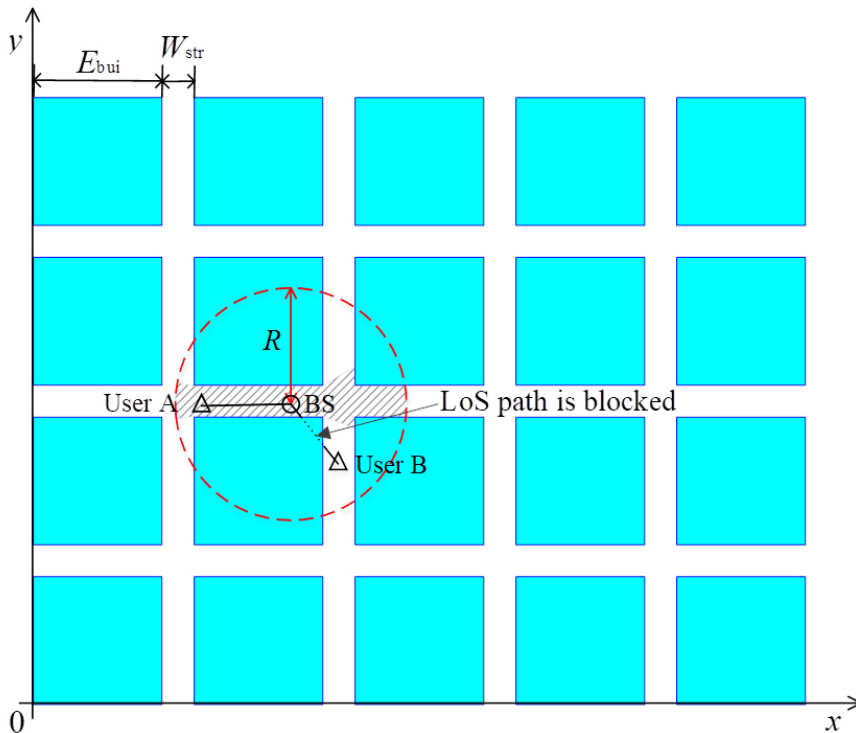


Fig. 1 2-dimensional Manhattan-type geometry.

Opportunity

The range of 5G connectivity is not great as the frequency waves are only able to travel a short distance. Added to this setback is the fact that 5G frequency is interrupted by physical obstructions such as trees, towers, walls and buildings. To counter this setback, more cell towers are needed to house more base stations (BS). To achieve the best performance of the network, outage probability needs to be minimized. This invention proposes a base station (BS) deployment scheme and a user association scheme to reduce the long-term outage probability of a millimeter wave (mmWave) communication network that 5G employs. It is accomplished by first taking the BS deployment problem as a stochastic optimization problem and solving it with a stochastic optimization algorithm, then a low-complexity user association algorithm is designed to maximize the number of users that can associate with BSs in a given time slot, when the positions of users are fixed.

IP Status

Patent granted



Technology Readiness Level (TRL) ?

4

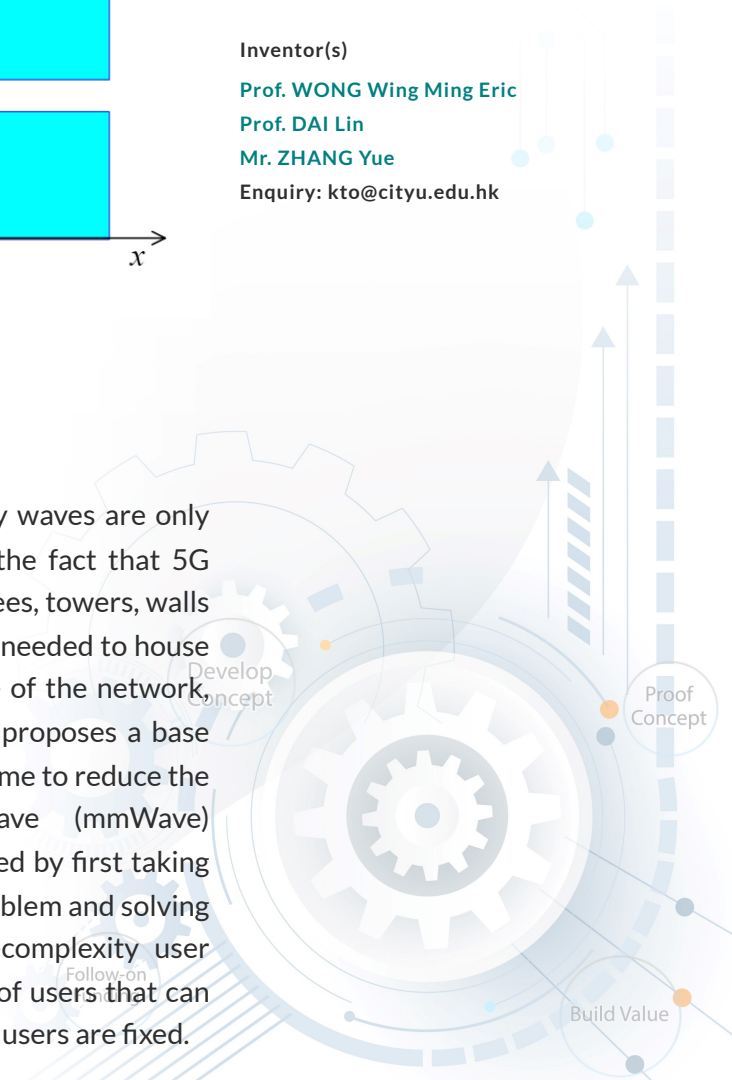
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Technology

The invention places two assumptions, (1) It is assumed that whether a user can physically access one BS is closely determined by their positions. Therefore, in order to avoid outage event, the positions of BSs should be carefully optimized. (2) It is also assumed that whether a user can be served by one BS also depends on the workload of the BS. To maximize the number of users that can be served by the BSs, the user association scheme should therefore also be optimized. With those assumptions, this invention uses a stochastic optimization framework for mmWave BS deployment. With the time-varying nature of users' positions taken into account, the proposed scheme can reduce the outage probability in the long term. A low-complexity user association scheme is also proposed, which can well balance the workloads among BSs and reduce the outage probability.

Advantages

- Compared with existing technologies, the proposed BS deployment scheme takes the spatial distribution of users into account.
- The proposed user association scheme has extremely low complexity.

Applications

- The invention can provide guidance on the dense mmWave small-cell network deployment and configuration.
- By properly deploying BSs and associating users with BSs, the minimum average outage probability can be achieved. This is of great interest for 5G network operator.

