Optically Transparent Antenna Array for Smart City Networks

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Smart cities seek to alleviate challenges of resource and infrastructure management within a community through the adoption of wireless networks and the internet of things. To accomplish this, more devices within the city will need wireless network access. As the rollout of smart city technology begins, several challenges still need to be addressed. One of these challenges is the increased network access that these many wirelessly enabled devices will. The frequency band proposed (millimeter wave) that provide sufficient network channel access would also result in shorter broadcast distances and network dead zones. Optically transparent network access points embedded into existing urban structures (building windows, automobile windshields, etc.) would unobtrusively mitigate these dead zones without being obtrusive to individual users or property owners. One such method to provide optically transparent network access is through the use of transparent conductive oxides (TCOs) in communication components. This approach has a major challenge: low gain. The thin films that allow TCOs to be transparent, also introduce parasitic resistance into radiating elements. Therefore, transparent devices are more inefficient than their traditionally opaque counterparts. The lower gain can be countered by means of using periodic structures, such as arrays, to counter lower gains.

In this study, several coplanar antenna elements operating at a carrier frequency of 5.8 GHz were simulated and manufactured using Gallium-doped Zinc Oxide. This study compares the return loss between the simulated and manufactured antenna elements. This study also presents the simulated gain and measured link-budget of the individual elements and a 4×1 antenna array for various beam angles. This study shows the use, application, and broader of optically transparent communication systems in smart cities.