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AFSIW Technological Platform Opportunities for 5G and Beyond

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Presently, available radio-frequency technologies are non-planar metallic waveguides, low temperature co-fired ceramics (LTCC) and conventional planar printed circuit boards (PCB), including microstrips, coplanar waveguides and conventional substrate integrated waveguides (SIW).

On the one hand, the non-planar metallic waveguide technology is nowadays a must regarding insertion loss, power handling, and Q-factor performances, while being essentially shielded. However, this technology is high-cost, occupies a large volume, presents constraints for stacking configurations and is difficult to interconnect with active devices. Furthermore, its complex manufacturing leads to high costs and is not compatible with the large volumes expected for 5G and beyond applications.

On the other hand, the planar technologies, including conventional printed circuit boards and LTCC, provide high-integrability with active components and low weight. Furthermore, their manufacturing process allows low-cost and high-volume production. However, those technologies are relatively high-loss, not shielded (extra shield is required), low Q-factor, and handle low power.

To offer a technological alternative, a technology has been proposed in [1] to provide a high Q-factor substrate integrated waveguide. This technology is basically an air-filled (or hollowed) waveguide integrated in a multilayer printed circuit board. Since this technology has been developed with some key features including the thermal compensation [2] or configurability [3]. Furthermore, a lot of components have been reported in the literature from numerous groups, leading to the implementation of heterogeneous integrated systems.

The purpose of this paper is to provide an overview of the AFSIW technological platform and discuss on the advantages it could bring for 5G and Beyond applications. User terminals are quite certainly not of purpose due to the large size of the AFSIW transmission line topology compared to conventional PCB technologies. However, 5G, which is still under definition by the 3GPP, especially at millimeter wave frequencies, also concerns numerous aspects apart from the user terminal. In particular, the AFSIW technological platform may find applications for on the move terminals or backhauling. Furthermore, satellites are also another interesting application of this platform as they are expected to take a role in the 5G network with this inclusion of the satellite elements in the recent Release 17 of the 3GPP and the involvement of the satellite industry in this global initiative.

References

[1] F. Parment, A. Ghiotto, T.P. Vuong, J.M. Duchamp, and K. Wu, “Air-filled substrate integrated waveguide for low loss and high power handling millimeter-wave substrate integrated circuits,” IEEE Transactions on Microwave Theory and Techniques, vol. 63, no. 4, pp. 1228-1238, Apr. 2015, doi: 10.1109/TMTT.2015.2408593.
[2] T. Martin, A. Ghiotto, T.-P. Vuong, F. Lotz, “Configurable perforated air-filled substrate integrated waveguide (AFSIW) for generic high-performance systems on substrate,” IEEE Transactions on Microwave Theory and Techniques, vol. 67, no. 11, pp. 4308 - 4321, Sep. 2019, doi: 10.1109/TMTT.2019.2940193.
[3] T. Martin, A. Ghiotto, T.-P. Vuong, F. Lotz, “Self-temperature-compensated air-filled substrate integrated waveguide (AFSIW) cavities and filters,” *IEEE Transactions on Microwave Theory and Techniques*, vol. 66, no. 8, pp. 3611 - 3621, Aug. 2018, doi: 10.1109/TMTT.2018.2851243.