Transparent antenna applied for RF harvesting applications

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With the tremendous growth and relevance of Internet of Things (IoT) is last years it became a demand to identify, communicate and transfer energy to all objects. These technologies are often desired to be hidden (or transparent) to the human eyes, not only by its aesthetic reasons but also by its reusability of the space which is often crucial. This reasons led to a significant grow in research of transparent conductors and antennas.
Transparent antennas are characterized by a certain level of optical transparency and are potentially suitable for automotive industry mainly for vehicular communications; integration with solar panels of small satellites and lately for wireless power transmission.
Transparent antennas are based on the use of transparent conductive oxides (TCO) films that can be prepared from a variety of semiconducting oxides such as tin, zinc, indium, silver and gold. The main figure of merit of this conductors can be defined as the ratio of electrical conductivity to the optical absorption coefficient of the film. However, other figures of merit can be considered such as conductivity, thermal durability, etch-ability, deposition temperature, toxicity and cost.

As similarity with the well-known microstrip patch antennas, the transparent antennas can be designed with transparent conductive ground, however, they are much less aesthetically suitable for window glass applications. For this reason coplanar waveguide (CPW) designs proved to be more suitable for this type of antennas as the conductive side is only on one side of the substrate.
Coplanar antennas lead to a feeding challenge where a transition from a microstrip side (circuit) to the antenna side (CPW antenna) need to be performed. Two methods have been named, the electrical contact (e. g. connector, air Bridge, via hole) and the electromagnetic coupling. From the electromagnetic coupling several interesting designs can be applied namely, by the use of transition using radial stubs and folded baluns.

The main focus of this paper is to implement, study and compare two different feeds for transparent antennas: electrical contact by the use of quick end launchers (QEL) and electromagnetic coupling by one of the previous referred approaches. With these two different "plug and play" circuits to integrate antennas, one electrical, another electromagnetic coupled, comparison with the non-transparent version can be performed providing a valid information of the viability of transparent antennas for harvesting applications considering its inherent reduced efficiency.