was used in Section 3 to assess the effectiveness of multi-hop unicast communications in a vehicular scenario is used in these experiments. Therefore, an ideal wireless technology is assumed. In the next section we also perform an experimental evaluation based on a more complex model, and using the OMNeT++ simulator, that allows us to assess the correctness of the simplifications assumed in our mathematical model of the ETSI SLAAC configuration time, and also to derive some configuration guidelines.

The results obtained from our simulations (with a confidence interval of 95%) are shown in Figures 9–11, in which the values calculated from our analysis are also depicted. We make use of the same three scenarios that we used in Section 3: urban, city highway and motorway, and we also represent the results for different deployment scenarios (characterized by \( D_{RSU} \) and \( T_{RA} \)). Note that the range of the average time between Router Advertisements sent by the RSU (\( T_{RA} \)) depends on the traffic conditions scenario. This is so because the maximum value that could be configured in a real scenario should allow for vehicles to always have at least one configuration opportunity before changing area, and that means that \( T_{RA} \) has to be low enough to allow that a vehicle would be configured – in the worst possible case – when it is within one single hop of the RSU (i.e., the minimum time required by a vehicle to cross the whole coverage area of the RSU should not be higher than \( R_M \)). Note that in Figure 9 (urban scenario) we only show the case \( R = 150m \), as the results for \( R = 300m \) and \( R = 450m \) are almost exactly the same (the actual difference is negligible). Similarly, for the city highway and motorway scenarios (Figures 10 and 11) we also skip (due to space constraints) depicting the results for \( R = 450m \), as they are equivalent to those for \( R = 300m \). This is due to the fact that in the studied scenarios, the vehicular density proves to be enough to ensure multi-hop connectivity in most of the situations, and therefore \( \bar{T}_{conf} \approx \bar{T}_{RA}^{unsol} \). These are reasonable scenarios in terms of vehicular density, and they are actually the ones in which it makes sense to enable Internet multi-hop communications, as the probability of having multi-hop connectivity to the RSU is high enough, and the configuration time is short enough to support classical IP communications (e.g., infotainment, non-safety). We also analyze later in the paper sparser scenarios, in which the vehicular density is much lower.

From Figures 9–11 we can derive different conclusions. First of all, results show that our mathematical analysis perfectly matches our model of the ETSI SLAAC solution configuration time, assuming the simplifications that we have described in this section, namely: constant and homogeneous speed, perfect collision-free wireless medium, exponential inter-vehicle spacing. Another important conclusion is that in most of the scenarios, the IP address auto-configuration time can be kept very low by properly configuring the time interval between Router Advertisements, without using too