

4 TOWARDS A HYBRID ROAD INFRASTRUCTURE

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Being used on roads, self-driving vehicles will continue to physically interact with the infrastructure, whether it be urban or interurban roads. However, unlike conventional vehicles, they will almost exclusively rely on sensors to decipher the environment they operate in. The traditional road, which currently takes into account the driver's environmental perception capacities, should further evolve to adapt to this new type of transport. The whole challenge is to be able to assess the nature, scope and timeframe of such evolutions, so as to measure their social and economic acceptability. In this perspective, Ifsttar is developing an infrastructure liable to support autonomous vehicles. The latter is a component of R5G ©, the 5th Generation Road.

Constraints to anticipate

Roads are designed on the one hand to support the various rolling loads and on the other hand to enable drivers to adapt to traffic conditions. The self-driving car will have to be aware of all the characteristics of the infrastructure it is using in order to operate safely. But the vehicle may also affect the specificities of such infrastructure. For instance, by driving in numbers and always at the same place, a large number of heavy self-driving trucks could damage the roadway. Likewise, if they are too close to one another they are liable to impact the engineered structures they run across.

Road assets are also concerned. For instance, road markings, initially designed to be visible to the human eye, will also be used by self-driving vehicles so they may precisely locate themselves on their respective traffic lanes. This means that we also need to look into the potential link between the performance of onboard cameras and the visibility of said markings.

The role of digital technologies

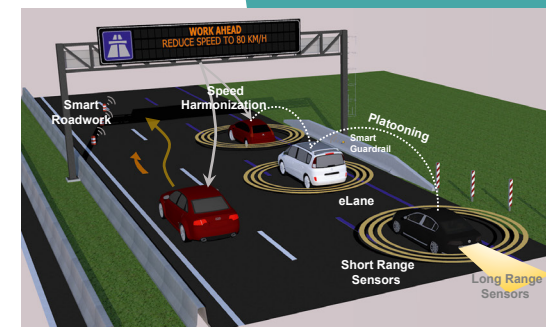
The sensors present onboard every autonomous vehicle are responsible for analysing the road. If they cannot read it, an onboard digital mapping system will take over to gather the missing information. The physical infrastructure will thus become increasingly digital. The challenge is then to conceive this digital infrastructure and to keep it up to date, which raises the issue of data exchange standards and formats. Not to mention scientific issues. For if the geometry of roads shows little change over time (except in roadworks areas), what about the skid resistance of road pavements or the visibility of markings which are highly sensitive to weather conditions?

To ensure the power-supply of this digital infrastructure and keep it up to date, it will have to be connected not only to vehicles but also the management centres in charge of maintenance, traffic and weather forecasts.

A necessarily hybrid infrastructure

The infrastructure supporting self-driving vehicles will thus be hybrid, i.e. both physical and digital. The roads connectivity will make it possible to constantly refresh the digital infrastructure thanks to the roadside units² (G5 technology) or via cellular networks (3G or 4G).

Besides, this infrastructure may support vehicles featuring different levels of automation (0 to 5) as well as vulnerable users. The interactions will have to unfold in full safety without compromising traffic flow.



▲ Hybrid motorway equipped with a dedicated lane for the traffic of autonomous vehicles

1. COSYS: Components and systems Department
2. The function of roadside unit is to coordinate all of the connected objects across the covered area, whether they are static or mobile. See paper on [connected and cooperative roads](#).



▲ Hybrid urban intersection adapted to the traffic of autonomous vehicles

Further readings

Hautière N., De-La-Roche C. et Op-De-Beek F. *Comment adapter les infrastructures routières aux enjeux de la mobilité de 2030*. In TEC: Transport Environnement Circulation, 217: 25-32, 2013.

Lepert P., Hautière N., 2010. *Projet DIVAS: Dialogue Infrastructure Véhicules pour Améliorer la Sécurité routière*. Hermès.

Hautière N., Tattegrain H., Guilbot M. *Véhicules connectés et autonomes: quels enjeux technologiques, juridiques et de sécurité routière?* Hygiène & Sécurité du Travail - N° 246, pages 100-103, mars 2017.

Hautière N., *L'infrastructure routière devra-t-elle être aussi intelligente que les véhicules?* TEC, N° 231, 2016.



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➤ 5th Generation Road, aka R5G ©, thematic paper

➤ SCOOP project on connected vehicles and roads