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Deployment considerations for autonomous and integrated mobility services of the future

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Urban mobility has reached a critical saturation point in terms of infrastructure use as many metropolitan areas around the world are experiencing high levels of congestion on a daily basis. Private cars have been the preferred mode for passenger mobility for many years and this is despite numerous initiatives to promote active and public modes of transport. In the UK, approximately 70% of trips to work were made by cars in 2019, compared to 18% made by public transport. Mobility-as-a-Service (MaaS) is an emerging paradigm that provides an integrated mobility solution to travellers. It involves the synergetic operation of complementing, but also competing services, such as public transport, car sharing, ride hailing, micro-electromobility and others, offered through a single subscription package by a single entity, the MaaS operator. It is believed that wide adoption of MaaS can create a culture where car usership substitutes car ownership, thus reducing overreliance to private cars and effecting a shift to more sustainable modes of transport [1].

However, several barriers need to be overcome for MaaS and other integrated mobility services to become the preferred mobility option of the future. On user level, uncertainties exist regarding what exactly such mobility concepts entail [2] and this coupled with the technological savviness required [3] can limit the demographic groups interested in adopting the service [4]. In terms of business models, the interests of mobility providers participating in such schemes need to be codified and analysed, leading to the clear definition of the role and duties of the principal operator [5]. Furthermore, novelties such as smart contracts and blockchain technology can provide the required dynamicity and transparency required in such multi-stakeholder collaborations.

Information technology is expected to play an important role in the feasibility of integrated mobility services in the future. Provision of collaborative transport services must be supported by models and platforms that will allow the seamless integration of heterogenous data. Governance and fair use of such data will necessitate the creation and maintenance of digital marketplaces, and efforts towards this direction are already underway [6]. Applications for electronic ticketing [7], multi-modal and -service journey planning [8] and integrated multimodal information platforms must facilitate functionality that can address a diverse set of requirements as in a MaaS different modes and mobility services can be used for realising a trip. Some of them may be fixed in terms of paths and points of access, while others may be dynamic and in the near future automated [9, 10].

Automated and connected mobility is expected to revolutionise future transportation, but at the same time trigger substantial transformations on well-established practices. Two of them being traffic management and development and application of simulation models. The former is concerned with the efficient operation of transport networks, while the latter constitutes an important tool for the designing and planning of transportation services. Despite the uncertainty about when Connected Autonomous Vehicles (CAVs) will be extensively deployed on transport networks, the consensus is that this transition will take several years, during which hybrid traffic conditions will be present. As result, updating of traffic management systems and the evolution of simulation models will be needed and research on how this can be achieved is well under way. This transition may eventually render existing systems obsolete and the requirement of their progressive phasing out will create dilemmas regarding future investments for short-lived technological infrastructures.

In traffic management, studies are evaluating the impact that the presence of CAVs will have in traffic flow streams and while interacting with human-driven vehicles [11-14]. In these studies, the 'sensing' and connectivity capabilities of CAVs are evaluated and their effectiveness in variable traffic phenomena (vehicle platooning, traffic shockwaves, intersection crossing etc.) is measured. Results are promising in terms of the potential that CAV's have in enhancing human-dominated traffic flows, suppressing traffic flow disturbances, and increasing flow rates at signalised intersections.

Despite the challenges that the introduction of CAVs will bring, opportunities and benefits will also surface. The connectivity of vehicles will enhance awareness about their surroundings and allow proactive actions thus disrupting the progression of dangerous conditions. This will be ever so important due to the expected rise of micro-mobility and increase of vulnerable road users on transport networks. Removing the human element from the decision-making process concerning the operation of vehicles and the routes to be followed, has the potential to enhance safety and advance the optimisation of transport systems. Advanced control algorithms, operating in centralised or decentralised manners, can orchestrate the movement of vehicles in an optimal way, improving travel times and minimising congestion.

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