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Smart community infrastructures — Guidance on smart transportation by autonomous shuttle

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 268, Sustainable cities and communities, Subcommittee SC 1, Smart community infrastructures.

In the development of this document, ISO Guide 82 has been taken into account in addressing sustainability issues.

Introduction

Public transport using Connected and Autonomous electric Vehicles (eCAVs) will be a solution to a range of problems, including passenger need for flexible, demand responsive transport options and a shortage of drivers in ageing societies.

5G celluar and WLAN technologies provide the necessary vehicle-to-network (V2N), vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications that assist the navigation of autonomous shuttles.

However, eCAV shuttles that are wirelessly connected and driverless also address key environmental and road safety considerations in busy and polluted urban areas and therefore are likely to have a significant role in a future transport system. In particular, they can:

— provide comfortable and convenient transport for the young, elderly and disabled;

— reduce congestion and time lost to slow moving traffic, increasing efficiency;

— manage travel demand, relieve parking and optimise the use of road space;

— reduce carbon emissions, pollution and noise, promoting health and wellbeing;

— make cities more attractive and productive places, able to grow sustainably.

Technology that supports small autonomous vehicles for intra-city passenger transport also lends itself to local delivery services. Autonomous delivery pods are designed to carry parcels, groceries and food, making local distribution faster and more cost-efficient.

Key obstacles to the introduction of eCAV bus and delivery services include the ability to introduce autonomous vehicles among regular bus services and manually driven vehicles. Therefore, many autonomous experiments have been increasingly sophisticated shuttle services on a fixed, short routes around safe, off- and on-road spaces.

While trials and pilot schemes exist, they have not been at a scale that really demonstrate the extent to which eCAVs could form the basis of a genuine public transport service.

Nevertheless, a strategic city focus plus open innovation should form the basis of intelligent demand-responsive mobility that offers seamless journeys across multi-modal travel options that include autonomous shuttles. Key advantages of such transport systems, include:

— adaptability – eCAVs fit the environment and travel needs of passengers;

— flexible routing and demand responsive journeys;

— real time information across transport infrastructures;

— city-scale functionality and integration;

— safer and more accessible public transportation.

Rapidly developing pilot projects on eCAV shuttles can serve the development of smart transportation that help reach these goals.

Smart community infrastructures — Guidance on smart transportation by autonomous shuttle

1 Scope

This document aims to help industry, government and society to share useful guidance in the staged implementation of eCAV shuttle and delivery services, with a special focus on demand responsive passenger services. This document will help accelerate innovation and deliver smart transportation in cities.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

— lectropedia: available at http://www.electropedia.org/

3.1
autonomous vehicle

shuttle that is the term used to describe public transport services provided by electric Connected and Autonomous Vehicles (eCAVs)

Note to entry: While such vehicles are 'driverless' they are sometimes required by law to have a designated person who can take control of the vehicle or enact an emergency stop.

4 Common considerations about smart transportation by autonomous shuttle

4.1 Goals of smart transportation

Automobile transportation is on the cusp of the biggest revolution on public roads since the advent of the internal combustion engine. CAVs will spearhead the development of radically new mobility services. Vehicle-to-Everything connectivity improves road safely, enables collaboration between CAVs and allows authorities to orchestrate traffic flows in real time via wireless connectivity with strict security and privacy assurances.

This vision of ubiquitous autonomous public transport services requires fully fledged autonomous driving technologies and legal frameworks that are still years away.

However, in the meantime, there is a demand for a set of guidelines and standard approaches:

— to enable both the commercial development and public deployment of eCAVs;

— to provide a policy framework for the provision of tailored and responsive transportation services using eCAVs;

— to establish broad use cases for eCAVs;

— low speed urban transit;

— intercity transfer;

— tailored transport solutions to suit the needs for the young, elderly and people with disabilities and special needs.

— to promote the optimal and efficient public transport and delivery services through the shared use of autonomous vehicles, that may act in either a conventional mode such as scheduled bus and freight services or a demand-responsive mode such as taxis and couriers;

— to understand the roles and responsibilities of transport authorities in the development of eCAVs;

— to focus on control systems necessary for eCAV services, including the exchange and interoperability of shared vehicle and passenger data;

— to accelerate the development and integration of supporting digital and physical infrastructures;

— to assure approaches to passenger and pedestrian safety and the security of personal data and build public trust;

— to offer an overview of recent developments;

— to shape and influence testing to ensure that trials also complement other key objectives of city transport strategies, such as active travel and greater reliance upon public and shared transport.

This document will help signpost the way towards these goals and offer some focus for the collaborative development of international standards for autonomous public transport services.

Smart transportation aims to satisfy United Nations Sustainable Development Goals (SDGs), especially goal 3 “Good Health and Wellbeing,” goal 7 “Affordable and Clean Energy,” goal 8 “Decent Work and Economic Growth,” goal 9 “Industry, Innovation and Infrastructure,” goal 11 “Sustainable Cities and Communities,” goal 12 “Responsible Consumption and Production,” goal 13 “Climate Change” and goal 15 “Life on Land.”

4.2 Basic characteristics of eCAVs

eCAV shuttle services will take many forms:

— large vehicles – conventionally sized buses;

— smaller vehicles for typically 6-14 passengers;

— urban pods for 2-6 passengers for intracity transit in compact cities and centres;

— autonomous saloon cars for intercity transit;

— eCAV freight has a particular application in compact urban centres;

— small delivery vehicles, designed for pavements and home delivery.

A critical aim of eCAV buses is the ability to offer a demand responsive passenger service in dense urban spaces, while larger intercity buses may continue providing a scheduled service. Autonomous public transport in urban spaces is in its very early stages of development. Therefore, to shape the implementation and the transformative impact upon urban life, deep engagement with all relevant transport stakeholders, citizens and passengers should be a priority.

Much collaborative discussion and public engagement will be required to understand the future of road design, traffic management and the adaptation of the rules of the road that would support the adoption

of autonomous shuttle services. This is important to take account of new autonomous technologies and develop user friendly interaction with the public, leading to trust and acceptance among passengers.

4.3 eCAV as integrated intelligent mobility

eCAV combine three key characteristics that are driverless, electric-powered and remotely connected.

These characteristics reflect critical changes ongoing in the automobile market. Cars are increasingly connected for purposes of geo-positioning, navigation and the monitoring of driving quality. Responding to public concern about air quality, particularly in urban environments, vehicles are increasingly electric powered. And while not yet a consumer trend, around the world much work and investment are supporting the development of autonomous and robotic technologies that drive vehicles autonomously.

Two such developments are the autonomous pods in Milton Keynes, UK, and driverless taxi service[6].

Self-driving pods have been undergoing trials on pavements in Milton Keynes. As part of the UK Autodrive project, Milton Keynes Council has been working to test out a new first/last mile transport solution for local people, shoppers and visitors to the city.

The pods can travel up to 24 km per hour and lasting up to 100 km off one charge – have been operating in the city centre from Central Railway Station. There are plans for the pods to continue to operate in the city, with a service being offered to residents.

What driverless taxi services have demonstrated is the potential for this technology to develop into a public transport service. This could enable first and last mile mobility options that can help people move around for their business in an efficient and safe way with improved travel options for those who cannot drive or might find it difficult to either use buses or cycle and walk.

These trials bring together the electric, connected and driverless characteristics, but they also have to take into account the context in which they must operate. That framework consists of four features: human behaviours, vehicle requirements, digital infrastructures, and the design and state of roads.

The interventions needed to make these contextual features fit for eCAV services are indicated in Figure A.1 in Annex A, and cover:

— data management and exchange – which are central to the connected characteristic, and relevant to human behaviours and digital infrastructures;

— establishing the mobile connectivity and a suitable operating environment – which are relevant to the road and digital infrastructures;

— the safe operation and insurance of vehicles bring together aspects of human behaviours and technical vehicle safety of eCAVs.

Therefore, relevant interventions might include rules on personal data protection and privacy; security standards on the exchange of data; ensuring sufficient fibre backhaul network to support the edge computing and IoT roadside infrastructures; safety standards for autonomous shuttles and the insurance and liability rules underpinning their services.

In putting in place the right interventions that address the context in which eCAV services operate should support the public and commercial development of autonomous shuttles and public acceptance of this paradigm shift in urban mobility.

4.4 Key considerations

4.4.1 General

For the development and trials of eCAV transportation services in an actual city, key considerations include the role of transport authorities, legal and regulatory frameworks and service typologies.

4.4.2 Role of transport authorities

City governments are often the provider of 'infrastructure' and facilitator of trials, particularly when it comes to granting permissions and licenses for eCAV activities and installations.

The development and operation of vehicles is driven largely by industry and technology, often in collaboration with centres of research and expertise, such as universities with specialisms in robotics and artificial intelligence.

Universities also provide objective impact assessments and technical and non-technical advice based upon a pool of expertise and experience, for example, simulating eCAV impacts on existing transport networks.

The collaborative research and development between industry and universities will also support the development of business cases and implementation plans.

There will be a critical role for transport authorities to guide and lead the development of autonomous public transport:

— to be up to date and engaged in all trial activities;

— to provide assurance with regards to safety and testing;

— to shape development of CAVs to complement other urban transport policy objectives.

4.4.3 Legal and regulatory framework

Essential elements of the legal regulatory requirements are insurance and liability issues, especially who is liable for an accident involving an autonomous vehicle and what are the 'meet and greet' rules of the road.

Common and consistent rules of the road will be necessary to enable the widespread commercial development and adoption of services:

— the legal framework for autonomous public transport should consistent everywhere albeit devolved to take account of different terrains and environments and applied technologies in different places;

— regulators and testing organisations need to ensure vehicles are road legal and insured;

— a suitably licenced and trained test driver or test operator should supervise the vehicle at all times and be able to over-ride automated operation if necessary.

4.4.4 Service typology

Services will morph and grow over time as a result of innovation and passenger preferences, however, in the short-term services that are likely to development include:

— testing facilities;

— safe spaces in which to develop and test vehicles.

— autonomous shuttle passenger services;

— fixed short routes, e.g. last mile journeys into and out of urban centres that may be scheduled or demand responsive.

— autonomous, shared, demand responsive passenger services;

— hop on and hop off at designated points and times based upon algorithmic routes that respond to passenger requirements.

— intercity autonomous journeys;

— faster scheduled vehicles between city pick up and drop off points, which connect with local autonomous services.

— autonomous pods;

— ubscription based services for small vehicles to pick up and drop off passengers at various locations.

— autonomous taxi services.

— on-demand transport services based on a large algolism where road data are collected and fed.

NOTE A project trials an autonomous fleet of taxis in Phoenix, Aizona, US. Its aim is to make its vehicles the world's 'Most Experienced Driver.'

4.4.5 Public engagement and the dissemination of findings

Dissemination of findings from the early adoption of eCAV services, along with public engagement, is another key role that should be led by authorities related to or in charge of transportation, public roads and city governments. They should work closely with private and public stakeholders in wider communications to inform people about the introduction of such innovation.

4.5 Applicable city issues and expected advantages

To promote the holistic planning and uptake of eCAV bus services, it is important to have a comprehensive understanding of their long-term benefits and impacts. The benefits and impacts of eCAV shuttle bus and delivery services are economic, environmental and social.

a) Economic impacts centre around convenient and available services that improve connectivity and mobility in and between neighbourhoods. Such impacts include:

— encouraging visitors and inward investment;

— increasing transport efficiency;

— integrating traffic management;

— lowering transport costs;

— promoting tourism;

— resolving labour shortages;

— stimulating enterprise, innovation and new services.

b) Environmental impacts of eCAV services promote a cleaner less polluted local environment. Such impacts include:

— improving air quality;

— promoting green growth;

— reducing congestion;