Fen Line Users Association

King's Lynn | Watlington | Downham Market | Littleport | Ely | Waterbeach | Cambridge North

New technology for local transport

Introduction

Following a government announcement in 2025, systems using **driverless vehicles** (without even an on-board supervisor) can be piloted now, with the full regime being implemented in 2027.

This is an opportunity to provide transport services that would not be viable using buses with drivers.

One of FLUA's aims is "to seek the integration of other public transport services with Fen Line services". This paper sets out how autonomous vehicles could be used together with the railways to provide an integrated public transport service appropriate for East Anglia in the 21st century.

The opportunity

For public transport, the use of vehicles without drivers eliminates over 60% of the cost of operation and also simplifies the logistics of the system, which no longer has to be organised around drivers' shift patterns. Vehicles can be kept available, for instance in village centres and at rural railway stations, and can use the waiting time to charge their batteries. Coupled with automated route planning, this allows an efficient "turn up and go" service to be offered in areas that are comparatively sparsely populated and thus have low demand.

The system can be planned as a single network, rather than a patchwork of linear routes on which for many journeys passengers spend significant time waiting for a connecting service.

Running the vehicles on public roads allows the system to be rolled out more quickly than if dedicated tracks needed to be built. However, such tracks (possibly including tunnels under Cambridge city centre) should be used where needed to make journeys quicker and more reliable. These tracks can be narrower and lighter, and therefore cheaper to build, than a busway, as noted under "standards" below.

In order to run on roads, the vehicles need to use rubber tyres on flat tarmac or concrete; this provides them with more flexibility than would be viable with light rail or other physical guidance. For instance, stops can be off-line (similar to a bus lay-by) without needing expensive pointwork, and broken-down vehicles can be overtaken. It also allows gradients to be steeper than would be possible with steel wheels on rails; this reduces the land take for grade separated junctions and allows stops in tunnelled sections to be on the surface.

Cambridge travel-to-work area

In many towns and cities, employment is concentrated at the centre, along with retail and entertainment, surrounded by residential suburbs connected to the centre by radial bus or tram routes.

The Cambridge area is much more diverse, with significant employment on the edges of the City and in towns and villages beyond the green belt. Travel requirements are therefore also more diverse than in and around a typical urban area, and distances are greater. For many journeys, especially between locations that are outside the city,

there is not enough demand to sustain a regular bus service: either the buses will be nearly empty or the frequency will be too low, with most potential passengers finding there is not a bus at around the time they need to travel.

However, an automated system supporting vehicles that are smaller than buses (as well as larger vehicles where required) would be able to serve such journeys efficiently, and almost as conveniently as by car.

Rail is already providing an effective solution for local travel where demand is more concentrated, even for short journeys, as evidenced by the number of journeys between Cambridge and Cambridge North. This can be expected to increase now Cambridge South is open, and again when East West Rail is built. Other new services could be developed at a cost which can be expected to be less than building a separate mass transit system (metro, light rail, or bus rapid transit), for instance an all-stations shuttle between Ely and Whittlesford, eventually to be extended to Wisbech and Haverhill, could be provided; and new stations could be built, for instance on the line from Cambridge to Newmarket.

Most of the Fen Line stations are some distance from the centre of the communities they serve; this is even true of the new stations proposed to serve developments at Waterbeach, on Cambridge airfield, and at West Winch. Autonomous vehicles would be ideal for “last mile” travel to and from stations, reducing the need for car parks at stations.

Light rail and busways

Various proposals have been put forward for a tram or metro system for Cambridge, but they would still leave large areas of the city and surrounding villages much further than 400 metres from a tram stop. Thus there would still be a need for “last mile” transport, potentially including car and cycle parking at tram stops.

As stated above, much of the demand can be met by “heavy” rail; and an on-road automated transport system as described below could satisfy the rest. Speed and capacity on dedicated routes (including the busways currently being planned, which are to be built as flat tarmac) would be at least as high as with buses or light rail. Also, there would be less need for passengers to change between different systems, which adds to the journey time and makes it more difficult for them to get work done during the journey.

Proposed system

The “user experience”

Users of the system should be able to book journeys ahead or simply “turn up and go”, via an app or website or by presenting a credit card to a machine at a stop.

The experience of someone arriving at a stop not having pre-booked would be similar to someone arriving at the lifts in a tall building, i.e. they choose their destination on a touch screen (or through the app) and are told which vehicle to get into. Depending on how busy the system is, they might be sharing the vehicle with other passengers who will be picked up and dropped off on the way. There could be a premium-class service for people who do not want to share the vehicle.

For longer journeys the user would be taken to a rail station. If the station at which they leave the train is not close to their destination there would be a vehicle waiting for them there.

Thus, using the system would be nearly as fast and convenient as car travel, and without the problems of finding a parking space at the destination.

Users would be able to select options for the route planning, such as accessibility requirements, and have the system remember them. DfT has published research on accessibility issues arising from the lack of a driver, and how they can be mitigated.

When booking ahead, for instance to travel to a meeting, users could specify the arrival time and the system would then plan a route and say when to be at the location from which they would depart. It could also message them in the case of disruption, perhaps to say an earlier departure is needed.

The system could automatically provide rail replacement transport for disruption and scheduled possessions.

Infrastructure

The system can use the existing road network, greatly reducing the amount of infrastructure that needs to be built. As noted above, dedicated guideways can be added, for instance to bypass areas that are congested. Speeds on the guideways could be higher than on roads.

Although vehicles could pick up and set down anywhere for journeys booked on-line, there should also be stops, similar to (or, indeed, shared with) bus stops, with terminals similar to ticket machines.

Facilities for charging vehicle batteries should be distributed around the system, so that empty vehicles do not have to travel far to reach a charging point. It might also be necessary to provide some places for empty vehicles to wait off-street, for instance positioned ready for the morning (or evening) peak.

Maintenance facilities will of course be required, along with a control room which includes CCTV monitoring and responding to passenger requests for help. There also needs to be hosting for the software that allocates vehicles to journey requests and plans routes and timing. This software also needs an interface to rail journey planners and ticketing systems.

Vehicles

Currently, most road-going driverless vehicles are modified versions of vehicles that have a driver, either to accommodate a supervisor or to reduce the amount of design and development work needed. However, it is likely that they will quickly evolve into something more like current guided driverless vehicles such as shuttles between airport terminals.

Many journeys will be one person travelling on a route for which there is no other demand at that time, so there will need to be vehicles that can carry a single passenger economically. This does not preclude them having more seats – many car journeys are a single person in a vehicle with 5 or even 7 seats.

The system also needs to support vehicles able to carry a larger number of passengers, to serve peak time demand; they need to be no wider than the smaller vehicles, but can be longer and possibly articulated, like trams. There will also need to be vehicles able to accommodate wheelchairs etc, which passengers can request when booking a journey.

Standards

Several aspects of the system will need to be specified by standards that will need to be adopted nationally and then internationally in order to create an efficient market for the vehicles and other components of the system.

There will need to be communications standards for vehicle-to-vehicle and vehicle-to-infrastructure, the latter including: audio and video between the control-room and passengers; scheduling; telemetry; traffic monitoring; and, in exceptional conditions, remote control of the vehicle.

The control system will need an open interface to the journey planning and booking facility, for example to allow venues to integrate travel with their booking systems.

Where a journey is partly by rail it should be possible for the system to use the rail industry’s standard third party ticket sales interface for the part of the journey that is by rail.

There needs to be a standard specification for vehicles that can run on the guideways. Parameters to be specified would include: guidance system; width and height (within which vehicles must fit, including allowance for

vehicle suspension and accuracy of the guidance); axle weight; maximum gradient; and minimum radius of curves. To reduce the need for overtaking there should also be specifications for cruising speed, acceleration (from stops), and braking.

Guideway specifications should be such as to minimise the land take and construction cost, including for tunnels. This includes supporting steep gradients, including at grade separated junctions and at access points to tunnels. Vehicles that can use the guideway will need to be narrower and lighter than the buses that are used on most routes today.

Data collection

Accounting and other information about users would be similar to that held for contactless travel on other systems such as TfL's.

The system should also collect anonymised data which will allow it to learn about travel patterns and proactively position vehicles where they are likely to be needed. This includes using higher-capacity vehicles at times of high demand. It will also allow planners to identify where there is spare capacity and where extra capacity (such as a new guideway) is needed.

Implementation

The system can be rolled out in phases, starting with the area around a railway station such as Cambridge North.

Much of the software needs to be completed before operation begins. This includes: the app used to book journeys; software to run on the terminals at stops; and journey planning (including allocating vehicles, and routing). Some of this might be available off-the-shelf from the supplier of the vehicles.

The physical infrastructure required in areas where the system is available is minimal, being similar to bus stops.

Depending on the self-driving technology used, detailed mapping of the area might be necessary.

Maintenance facilities (including battery charging) and a control room will be needed, but it should be possible to use temporary facilities during the first phases.