

Smart and integrated ticketing options

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TfSE Ticketing Options Study



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EXECUTIVE SUMMARY

Consult Hyperion has been engaged by Transport for the South East (TfSE) to contribute to its developing strategy for the region, in the field of Integrated and Smart Ticketing (IST). We have drawn on previous work which characterises travel patterns; existing TfSE knowledge and internet research to describe existing IST implementations and initiatives in the region; and on our own background in advising authorities throughout the world on IST.

The background research indicates that the South East region is unique in the UK. The factors that contribute to its uniqueness are: the gravitational pull of London, as one of the world's leading commercial and cultural centres; the existence of multiple multi-centre conurbations that are economic centres in their own right (e.g. Thames Valley, Solent region, Brighton and Hove, the Medway towns and the area around Gatwick) plus rural areas; that the South East is the gateway to London and the rest of the UK, with some of the world's busiest airports and ferry ports within the region or on its boundary. Therefore, it should not be supposed that a solution developed for any other UK region is likely to be a good fit for the South East.

One of our key learnings from our global projects is that new initiatives in IST are much easier where there is a single authority responsible for fare collection and transport operations. Clearly, this is not, and will not, be the case for TfSE. We were therefore heartened that TfSE required us to engage fully with stakeholders throughout the region, and national bodies, to develop the recommendations presented in this report. It is only with the buy-in of the stakeholders—operators in particular—that regional strategies are implementable.

We engaged stakeholders (largely transport operators and local authorities) via one-to-one interviews and a workshop. Several common themes emerged from the interviews. Great store was set by using improvements in fare collection to help meet societal gains: especially reduction in road congestion and improvements in urban air quality. A number of problems to be overcome were stressed, for example, the complication of bordering London, the complexity of existing technical standards and the intricate nature of existing fare policies and products. There was broad support for Pay-as-you-go (PAYG), which enables passengers to travel without first purchasing a ticket. It was generally agreed that the opportunity existed to define a strategy that would lead to PAYG and Account Based Ticketing (ABT); to rationalise fares (and increase passenger trust), for example by introducing fare capping (which puts a ceiling on aggregated PAYG fares, as in London); and to forge ahead into the new world of app-based travel and Mobility-as-a-Service (MaaS).

The factors mentioned above were confirmed at the workshop, where the participants pondered the role that TfSE should play in tackling the challenges and seizing the opportunities. It was felt that, due to the inherent complexities of the region, and the existing investments that have been made by operators in smart ticketing, it would not be desirable (or at the least, very high risk) for TfSE to deploy successfully a monolithic “one-size-fits-all” IST system, as is being attempted in other regions. Specifically, any initiative that could be represented as “just another card” was rejected. Instead, TfSE should play the role of facilitator, encouraging innovation, aligning policies (such as concessions and definition of peak/off-peak) and “stitching together” neighbouring or overlapping schemes where there is passenger benefit.

In order to facilitate a simple passenger experience (which incentivises public transport use) between schemes, there will be a need for fares collected by one operator to be apportioned

fairly to all the operators facilitating a journey, or collection of journeys. We recommend that TfSE build such a 'broker' system, able to take journey information from operators and calculate balancing payments to be made between operators. This could be a small-scale system at first, but able to grow with increasing integration.

The long-term, global trend is to merge fare collection into journey planning, booking and real-time travel information services, to create "Mobility as a Service" (MaaS). It is not yet clear who the dominant MaaS providers will be, but it would be wise not to rule out Google and Apple, who dominate the smart phone industry (Android and iOS), consumer-oriented geographical information systems (Google Maps and Apple Maps), and mobile wallets (Google Pay and Apple Pay); and have global reach and massive financial resources. Whoever may come to dominate, TfSE can facilitate early adoption in the South East by laying down standards for open data provision that can be acquired by MaaS providers to provide seamless services in the region.

The presence of London cannot be ignored. We recommend that Transport for London be encouraged to extend the reach of their PAYG systems (Oyster and Contactless Payment Cards) incrementally beyond the M25. We recognise that it would not be appropriate to cover the entire South East region, because there is little demand for travel to London from the more remote areas; because London's zonal charging model would break down over a vast region where there are many relatively short journeys taken on the periphery; and because capping breaks down where long, expensive journeys are undertaken.

There is demand for PAYG systems for conurbations and their hinterlands in the South East. This should be based on the payment card industry's EMV standard, because it is globally ubiquitous, proven to work in a transport setting and interoperable with London. Where cards must be issued especially for travel (for example, to the young and old), these should also be to the EMV standard, for simplicity of readers and back-office systems. Particular attention should be paid to the needs of rural areas, which are often served by a mix of smaller operators. Due to their scale, these operators may find it hard to invest and participate in technological innovation.

In summary, IST can play a vital role in helping to meet societal goals relating to road congestion and the environment, by simplifying door-to-door travel for the traveller, making public transport fully competitive with private car use. Excellent progress in smart ticketing has already been made by regional operators, and is continuing. However, perforce, these initiatives have been largely piecemeal and isolated. TfSE's ongoing role should be to encourage and facilitate standardisation and integration. This will be partly through promulgating policy and guidelines, but ought also to include an, initially small, operational role in determining apportionment of fares where integration has been brought about. New technology should be actively encouraged, for example EMV and app-based ticketing, leading to MaaS.

REVISION HISTORY

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1 INTRODUCTION

Transport for the South East (TfSE) is one of seven extant and emerging Sub-National Transport Bodies (STB) setup across the country. The establishment of STBs is provided for in the Cities and Local Government Devolution Act 2016, which is aimed at regions outside of Greater London. TfSE brings together 16 Local Transport Authorities (LTAs) and five Local Enterprise Partnerships (LEPs) under one unified body.

One of the core functions of an STB is advising the Secretary of State on the prioritisation of investment across the transport sector through the delivery of a Transport Strategy¹. The Transport Strategy also provides a blueprint for the implementation of TfSE's vision for transport.

The Economic Connectivity Review (ECR), developed by TfSE as the first stage of the Transport Strategy in 2018, examined the current and future economic landscape of the region, as well as its relationship with other regions. The ECR put the current contribution of the South-East region to the UK economy at £200 billion annually, with a forecasted growth to £330 billion over the next 30 years². One of the key outcomes of the ECR is the evidence for the economic potential of the South East. This further provides a case for the development of a Transport Strategy that sets a roadmap for the TfSE area to reach its full economic potential.

TfSE has been awarded funding by the DfT to develop a Transport Strategy, to support economic growth and development in the region.

This report presents the results of a study to consider the case for the development of further smart and integrated ticketing arrangements in the TfSE area. It also explores the potential role TfSE could play in the strategy implementation. This report is the result of the following activities carried out over the course of the project:

- Background research to understand the current Integrated and Smart Ticketing (IST) landscape in the South-East
- Interviews with TfSE's stakeholders to understand the challenges and opportunities with regards to IST.
- A stakeholder workshop to present preliminary potential options for TfSE's role in regard to IST, and to solicit their feedback.

The following stakeholder organisations were interviewed as part of this project:

1. Brighton & Hove City Council: Ben Thomas and Laura Wells,
2. First Group: Matthew Callow
3. Go South Coast: Paul Walker, Andrew Wickham
4. Govia Thameslink: Liam Ludlow
5. Hampshire City Council: Andrew Wilson and Sarah Cook

¹ Transport investment strategy –

Sets out the DfT's priorities and approach for future transport investment decisions (2017).

² The TfSE Economic Connectivity Review (2018)

6. Network Rail: James Waight
7. Rail Delivery Group: Duncan Henry
8. South Eastern: Sean McLaughlin
9. Stagecoach SE: Edward Hodgson
10. Transport Focus: Mike Hewitson
11. Transport for London: Matthew Hudson
12. Transport for the North: Alison Pilling

The output of this study on IST is one of the work streams that will feed into the development of the overall strategy.

1.1 Scope of TfSE

The map below shows the geographical scope of the TfSE area. Significant features of this region are:

- Conurbations including:
 - Solent (including Portsmouth and Southampton)
 - Medway
 - Brighton & Hove
 - Reading
 - The 'Gatwick diamond' (including Crawley and Redhill)
- Airports
 - Gatwick – major London hub
 - Southampton – regional airport
 - Heathrow - expansion is likely to affect areas to the west of London
- Seaports
 - Dover – rail tunnel and ferry crossings to continental Europe, freight, cruises
 - Portsmouth – ferry crossings to continental Europe, freight
 - Newhaven – ferry crossings to northern France
 - Southampton – cruise liner terminal, ferries to the Isle of Wight, freight
 - Shoreham – freight
 - Folkestone – freight
 - Sheerness – freight
 - Chatham - freight

These features make the SE region unique in the UK. Europe's busiest passenger airports and seaports are here and the SE acts as a gateway to the whole of the UK for business and leisure.

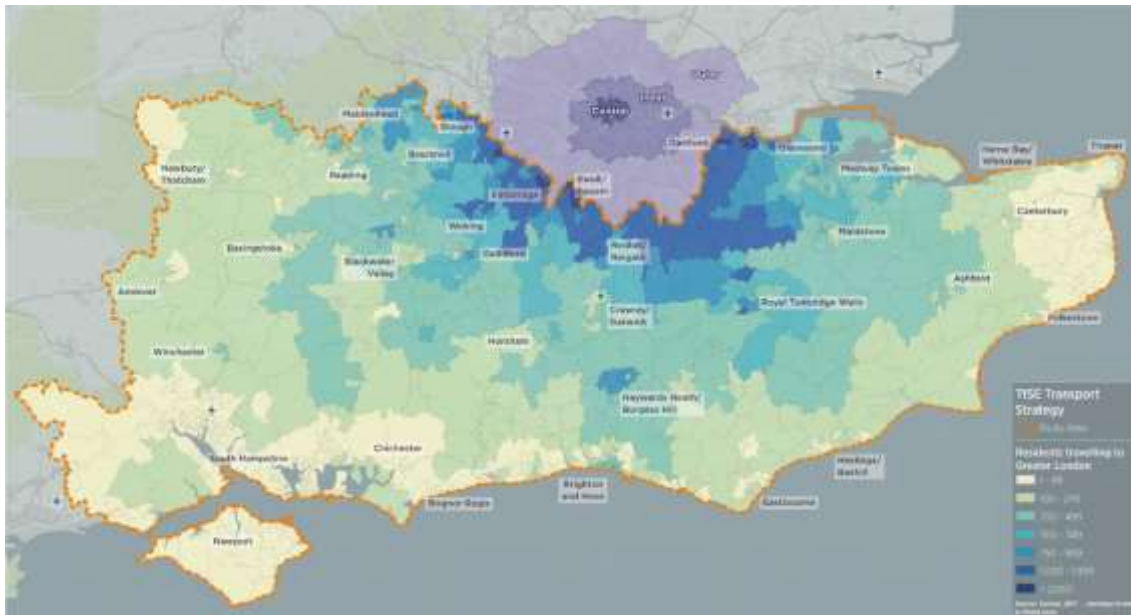


1.2 Current travel patterns in the South East

Travel pattern analysis shows that commuting to London from the SE is significant but, as one might expect, drops off as the distance from London increases. Most journeys are within the TfSE area (e.g. 84% of all commutes). Although London represents a focal point, there are multiple population centres and travel corridors within the region, each with their own characteristics. We aim to provide a comprehensive picture, highlighting regional travel patterns, while recognising the needs of the many passengers who regularly travel to London for work.

The growth of some travel corridors in the SE, such as the Thames Valley with its major population centres at Slough and Reading may be attributed in large part to their proximity to London. However, over time they have become substantial centres and destinations in their own right. In the south of the Region, there is a major coastal population strip which follows the path of the M27/A27 from Southampton to Eastbourne. The frequent congestion on the A27 demonstrates the difficulties of providing reliable transport links in an area which is bounded on one side by the sea and on the other by the South Downs National Park. The coastal cities of Southampton, Portsmouth and Brighton serve both as local hubs and as gateways to the motorway networks for travel within and beyond the region.

Further study will be required to investigate travel patterns across the region in greater detail.



prone to congestion. There are also a number of areas of heavy traffic across the region, many of them close to major cities and motorway junctions.



Figure 3 Annual highway demand, all journey purposes (Source – TfSE/Steer 2019)

The Gatwick Diamond³, an area around Gatwick Airport bounded by the Surrey Hills in the north and the South Downs in the south has a population of around 700,000 and has become a regional centre for development in addition to its strong transport links to London. Similarly, Dover is a key transit hub for both goods and passengers travelling either through the Tunnel or by ferry to continental Europe. The scale of this is evidenced by the severe impact of stacking⁴ lorries on the M20 when cross-channel services are subject to delays or cancellations.

In addition to the key communications hub at Dover, there are a number of other ports serving both freight and passenger vessels. As well as being a naval centre, Portsmouth⁵ has freight and ferry services to France, Spain, the Channel Islands and the Isle of Wight. Southampton⁶ is a major international cruise terminal, an industry which brings considerable economic benefit to the region. It is also a major container port.

Within the TfSE area there are mid-size conurbations which are more than simply London satellites and there are significant corridors of travel between some of these which TfSE will be analysing to better understand the travel patterns and consequent needs for IST. This analysis will require an assessment of not only the needs of people living and working in the region but also the large numbers of visitors who arrive in the UK by air, rail and sea through the excellent international communications links in the region.

³ <https://www.sussexchamberofcommerce.co.uk/events/member-events/the-gatwick-diamond-economic-summit>

⁴ <https://www.freightlink.co.uk/knowledge/articles/operation-stack-important-information-and-explanation>

⁵ <https://www.portsmouth-port.co.uk/freight/freight-destinations>

⁶ <http://www.southamptoncruisecentre.com/southampton-cruise-terminals.phtml>

1.3 Economic and transport policy trends

With an increasing focus on climate change and emissions⁷, pollution arising from transport is at the top of the political agenda. At time of writing, a statutory instrument to commit the UK to net-zero carbon emissions has been approved by the House of Commons and is expected to be approved by Parliament. Parliament has also approved plans to hold a Citizens' Assembly⁸ highlights the urgency of reducing emissions. In urban areas, quality of life can be severely impaired by breathing air filled with noxious substances. Although there have been issues around air quality for decades, it is now being prioritised as a serious threat to public health. This is reflected by the UK government making a legal commitment to net zero emissions⁹ by 2050.

In this context, it should be recognised that some forms of transit, such as road and rail, do provide safe havens for wildlife in the form of green corridors along railway tracks and roadside verges. Transport planning should include measures to take account of this kind of opportunity.

1.3.1 Urban trends

According to an article in the Economist¹⁰, approximately 50% of the world's population lives in cities, and this is expected to increase to 66% by 2050. In the UK, the current figure is nearer 60%. The average trip time has risen 16% from 1995 to 2013 due to congestion. Rapid urbanisation leads to 'congestion crunch' which in turn leads to increased pollution and reduced air quality.



The cost of peak time congestion in the UK in 2017 was over £37.7bn¹¹. According to the World Health Organisation¹² there are serious health implications to this pollution:

⁷ <https://www.bbc.co.uk/news/science-environment-46347453>

⁸ <https://uk.reuters.com/article/us-climate-change-britain-assembly/british-parliament-to-hold-citizens-assembly-on-climate-crisis-idUKKCN1TL1MA>

⁹ <https://www.gov.uk/government/news/pm-theresa-may-we-will-end-uk-contribution-to-climate-change-by-2050>

¹⁰ <https://www.economist.com/node/21707952>

¹¹ <http://www.parking-net.com/parking-news/inrix/traffic-congestion-uk-37-7-billion-in-2017>

¹² [https://www.who.int/en/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/en/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)

Ambient (outdoor) air pollution in both cities and rural areas was estimated to cause 4.2 million premature deaths worldwide per year in 2016; this mortality is due to exposure to small particulate matter ... which cause cardiovascular and respiratory disease, and cancers.

A recent report¹³ by Friends of the Earth, reported in the Guardian, shows that two of the ten most severely affected locations in the UK are located in the SE with pollution levels at almost double the objective target.

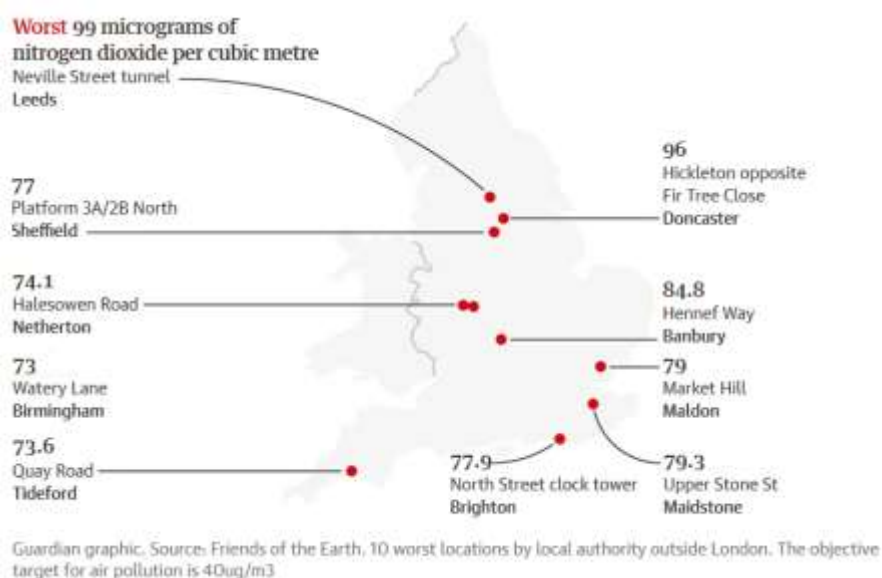


Figure 4: The 10 worst pollution locations in the UK by Local Authority (Source – The Guardian)

1.3.2 Trends in travel demand

The Commission on Travel Demand¹⁴ is an independent group, assembled as part of the Research Council UK funded DEMAND Centre. It was established to bring together the state-of-the-art in understanding how travel demand is changing and may change in the future, recognising controversies which exist over current forecasting practice.

The Commission highlights the societal changes brought about by widespread availability of broadband and mobile Internet access. Previously most workers would be expected to travel to work in the same location each day and would work a reasonably standard 5 day week between 9 am and 5pm. With improved communications has come greater flexibility. This has had a major effect on many different aspects of society.

The 24-hour society¹⁵ has become the norm, with people working flexible hours to suit both themselves and their employers. The success of London's night tube¹⁶ demonstrates this move towards constant availability. Greater connectivity across the country has also had a major effect on the housing¹⁷ market. Where previously people needed to live close to their place of

¹³ <https://www.theguardian.com/environment/2019/feb/27/pollution-map-reveals-unsafe-air-quality-at-almost-2000-uk-sites>

¹⁴ <http://www.demand.ac.uk/commission-on-travel-demand/>

¹⁵ <https://www.independent.co.uk/news/uk/home-news/britains-24-hour-culture-with-the-leisured-society-a-distant-dream-were-working-longer-and-less-10485410.html>

¹⁶ <https://www.london.gov.uk/press-releases/mayoral/night-tube-is-even-bigger-success-than-predicted>

¹⁷ <https://informpropertyanalysis.com/inform-property-market-updates/2018/8/28/remote-working-and-the-housing-market>

work, many can now work remotely either full time or on an occasional basis. This has resulted in a relative increase in house prices in remote areas where commuting might previously not have been viable. In an era where flexible working has become a statutory right for many, working from home on a Friday has become the norm. This is demonstrated by the almost empty¹⁸ car parks at many stations on a Friday.

There are noticeable differences in our travel patterns, depending on who we are – baby boomers over 60, Generation X-ers between 35 and 60, or millennials under 35. Even though the population is growing and employment rates are high, we drive less. We are travelling less by car and more by train and bike. Initiatives like ‘Safer Routes to School’¹⁹, which encourage students to walk or cycle on a specially designated safe route are supporting this trend. Fewer of us are getting driving licences, and we are getting them much later in our lives. Only the over-60 baby boomers – a key sector of the population and the first generation to fall in love with the car – are driving more than their predecessors.

It is against this backdrop that we have to plan public transport and for the growth of innovations such as Mobility as a Service, to include all forms of public transport, ride sharing, dockless bikes and autonomous vehicles. These developments could reinforce a shift away from the desire, and need, to own a car in many parts of the country. However, there are risks that ‘on-demand’ travel worsens our congestion and pollution challenges.

1.3.3 UK government policy

Major change is taking place in transit policy in the UK, based around the opportunities presented by technology and the need to provide convenient services for the travelling public, while limiting the impact on the environment. The Williams²⁰ Rail Review was launched by the Department for Transport in 2018, taking evidence through 2019, with a view to implementation starting in 2020. Its purpose is to put passengers at the heart of the railway of the future, while taking into account the needs of operators and the taxpayer.

The Rail Delivery Group²¹ has responded to the Williams²² review. They report that eight out of ten people feel the current system should be overhauled, while nine out of ten are in favour of smart or electronic ticketing. They also describe the need to include a range of flexible options to support passenger choice. IST offers a way of achieving these goals, incorporating flexibility to accommodate a variety of services in a format that is convenient for passengers.

The Rail Delivery Group itself has undertaken a consultation on simplification of fares, resulting in the publication of the ‘Easier Fares for All’ report²³. They received around 20,000 responses to the consultation, with very strong support for simplification of fare structures. At present, there is a huge variety of fare products available, which means that a passenger can never be sure of getting best value²⁴. The priorities highlighted by responses to the consultation were value for money, fair pricing, simplicity, flexibility and assurance. MaaS is specifically mentioned as a goal in the report, to be achieved by simplification of fare structures and implementation of

¹⁸ <https://www.theguardian.com/commentisfree/2018/jul/20/work-fridays-technology>

¹⁹ <https://www.sustrans.org.uk/scotland/schools/active-travel-funding-schools/safer-routes-school-fund>

²⁰ <https://www.gov.uk/government/news/keith-williams-a-railway-with-todays-and-tomorrows-passengers-at-its-heart-is-the-future>

²¹ <https://www.raildeliverygroup.com/media-centre/press-releases/2019/469762745-2019-02-18.html>

²² <https://www.transportfocus.org.uk/news-events-media/blog/put-passengers-heart-railway-welcome-signals-williams-rail-review/>

²³ https://www.raildeliverygroup.com/files/Publications/2019-02_easier_fares_for_all.pdf

²⁴ <https://www.yorkshirepost.co.uk/news/martin-lewis-expert-tips-on-how-to-find-the-cheapest-train-fares-1-8387017>

appropriate technologies. Account-based ticketing, to include capping and integration with other modes of transport such as buses and trams, was also considered desirable.

A Transport Catapult MaaS report²⁵ summarised the UK government policies relevant to improving mobility. These included:

- Department for Transport:
 - MaaS is considered to offer an opportunity to support the DfT's high-level policy commitments, namely: Boosting economic growth and opportunity, Building a One Nation Britain, Improving journeys, and Safe, Secure and Sustainable Transport. Specifically, MaaS would offer a greater level of integration between modes of transport and enable passengers to have confidence in choosing a variety of different options for their journey. This would encourage individuals to choose public transport more often, promoting social cohesion and sustainability.
 - The DfT's Single Departmental Plan (SDP) 2015-2020 outlines the progress made in supporting the Department's high-level policy commitments. The SDP's commitments cross a range of transport sector delivery areas and illustrate DfT's engagement in many initiatives that support the development of MaaS. These include capping of fares, introduction of more flexible part-time season tickets, focusing on accessibility to enable people with disabilities to have confidence in public transport provision.
- Department of Health:
 - To support active lifestyle objectives – through engaging the travel behaviour change capabilities of MaaS. This is typified by initiatives by TfL to encourage people to walk or cycle rather than taking the tube.
 - Improving patient and NHS transport – through engaging with MaaS Providers to provide mobility for NHS related transport demand. People with a disability may also have mobility issues and require access to local health services. At present transport provision can be patchy, whereas MaaS would allow for a more integrated service to more closely meet patients' needs.
 - Reducing respiratory and air quality related health issues – through engaging with MaaS Providers to manage travel patterns in areas with poor air quality. This could include managing the types and numbers of vehicles permitted in an area. This can be achieved in a number of ways, such as using bus lanes to promote public transport and giving low emissions vehicles exemptions to congestion charging.
- Department for Business, Innovation and Skills:
 - Supporting innovation and growth, particularly in the sharing economy. This could include car sharing, ride sharing and other innovative approaches to transport and ticketing.
 - Supporting new markets for Connected and Autonomous Vehicles (CAV). This might include provision of autonomous vehicles for use by visitors within a tourist area or more effective monitoring of the use of hire cars in and around airports.
- Local Authorities:
 - Development Planning - through the ability of MaaS to reduce the traffic impacts of new developments. Local authorities have previously been criticised for impractical approaches such as limiting parking²⁶ spaces on new developments. MaaS enables them to take a more constructive approach to traffic management.

²⁵ <https://ts.catapult.org.uk/intelligent-mobility/im-resources/maasreport/>

²⁶ <https://www.building.co.uk/buildings/parking-problems-on-housing-developments/5066454.article>

- Social cohesion - through MaaS facilitating the sharing economy, particularly through ridesharing and car-sharing.
- Partnership working - the ability of MaaS to create new ways for authorities to work with their transport supply-chain. Activities such as the Brighton²⁷ Smart Cities 5G demonstrator, supported by the Local Enterprise Partnership, have the potential to feed into future MaaS infrastructure.
- Traffic Management - the ability for MaaS to enable highway authorities to create a regulated market for allocating road space to the MaaS Providers who best meet highway authority requirements. This may be something as simple as having specific lanes for buses, cars with low emissions, or cars with more than one occupant. In cases of extreme pollution, as experienced in Paris²⁸ in 2016, authorities may mandate that cars with only odd or even numbered plates have access to an area on particular days. However, this may have the undesirable result that people buy two cars in order to have daily access.

At time of writing, the government has tabled secondary legislation, expected to pass very shortly, to mandate net-zero carbon emissions throughout the economy by 2050²⁹.

MaaS is expected to be a key enabler in reaching this goal³⁰ by offering a range of more convenient alternatives to individual passenger car journeys. These might include ride sharing, car sharing, or simply bus and train services that are better tailored to local needs. Paying for a recharge of electric vehicle at (say) a park and ride centre, potentially at a discount to that available commercially in city centre car parks might be considered.

The UK government has described its support for transformation in the area of mobility in its paper “Future of mobility: urban strategy³¹”. It promotes safe and secure mobility services designed around the needs of the individual, which prioritise active travel such as walking and cycling. It also highlights the key role of mass transit, with the aim of reducing congestion and emissions. Creative use of published data is seen as an important tool in managing an integrated mobility ecosystem.

1.4 Integrated and Smart Ticketing trends

This section provides an overview of the technology trends in automatic fare collection that are pertinent to this report. There are a number of different approaches to smart ticketing currently present in the market, each with different features. Here we have endeavoured to provide an outline of the main types of systems and their relative strengths and weaknesses.

1.4.1 Closed-loop systems

At the front end of a smart ticketing system, the passenger needs a way of allowing the system to determine whether to let them travel or not. Conventionally, this has been a ticket in the passenger’s hand, allowing a reader to check the passenger’s right to travel. When smart ticketing systems emerged in the ‘offline’ world of the 1990s, storing the ‘travel right’ on the smart card was seen as the only way to design the architecture. Such systems are ‘card-centric’ or ‘card-based’. In most cases, to date, these are implemented with Contactless Transit Cards

²⁷ https://futurecities.catapult.org.uk/wp-content/uploads/2018/03/Hyperconnected_smart-city-demonstrators_v3.pdf

²⁸ <https://www.independent.co.uk/news/world/europe/paris-banned-cars-even-number-plates-pollution-latest-public-transport-air-smog-bans-a7462621.html>

²⁹ <https://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-8590>

³⁰ <https://www.gov.uk/government/publications/future-of-mobility-mobility-as-a-service>

³¹ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/786654/future-of-mobility-strategy.pdf

(CTCs) i.e. cards specific to 'transit' (with, perhaps, a few permitted ancillary uses). Because the CTCs operate in a closed environment (i.e. it is not 'general' payment instrument), these systems are termed 'closed-loop'.

Even where system components (e.g. station gates) were online, they were unable to perform online travel authorisations fast enough to meet the entry/exit speed requirements of the Transit industry. This reinforced the need for the data (travel rights and value) to be stored on the smart cards, for access at the point of presentation. This architecture became a massively distributed data management problem. Furthermore, a lost card could mean a lost PAYG balance, or a lost travel right. Examples of closed loop systems in the UK include the London Oyster Card System and ITSO (Integrated Transport Smartcard Organisation) implementations around the country.

Closed-loop systems can work well in an environment where there is a single operator in place, who controls the entire travel context. In this respect, Oyster has historically worked well for TfL. It enables the operator to implement a bespoke system, which takes account of local needs and can cater for the variety of passengers resident in a local area, thus promoting inclusion.

Closed-loop systems can become more problematic when they are implemented across multiple areas with multiple operators. For instance, a diversity of ITSO implementations have grown up across the UK. Although built to the same specification, they are not necessarily fully interoperable. Despite efforts by the Rail Delivery Group to provide a single Central Back Office for ITSO on rail³², this remains a challenging environment. This complexity³³ is magnified when taking buses, trams and other transport modes into account. Another obvious disadvantage of closed-loop systems is that the passenger must obtain the smart card in the first instance. This may be inconvenient for visitors from other countries or other parts of the UK.

1.4.2 Open-Loop systems

'Open-loop' is the term used for transit payment instruments which can also be used for generic payments outside of the transit system. By contrast, traditional transit payment smart cards (such as Oyster in London) have required customers to convert their money to transit-only funds stored in a transit account and used to pay for travel. Customers have been prepared to do this because of the benefits of speed of access to the transit system without having to stop to purchase tickets. However, the down-side is that they have to periodically load funds to their CTCs, such funds then being unavailable for other purposes unless a refund from the CTC is sought.

There are many payment instruments emerging, but the one which is currently most ubiquitously accepted by merchants is EMV, the smart debit and credit standard used by the large payment networks including Mastercard, Visa and American Express whose members are the banks. This approach has the obvious benefits that (i) fewer CTCs need to be issued by the transport operator, and (ii) customers can arrive in a city from anywhere in the world and travel using the bank cards in their pockets.

The leading example of open-loop payments in transit is London where all TfL readers have accepted both Oyster and contactless EMV (cEMV) payment cards from across the globe since 2014. Other cities around the world are committed to or have launched cEMV based schemes

³² https://www.raildeliverygroup.com/files/Publications/services/rsp/RSPS3002-02-01_ITSO_in_National_Rail_specification.pdf

³³ <https://cbwsmagazine.com/merseytravel-walrus-smartcard-reaches-million-ticket-sales/>

including New York, Boston and Milan. All the major bus companies in the UK also accept EMV on buses.

cEMV is convenient in many respects: it does not require the passenger to plan their travel. They can simply tap their payment card on the reader and travel at will. It also allows people arriving in a location to travel right away, without having to purchase a smart card for travel.

There are also some challenges associated with adoption of cEMV: it must be managed according to specifications³⁴ provided by the major card schemes, which has the potential to limit flexibility. At its most basic level, it also requires the passenger to hold some kind of EMV card. In some areas this may present issues with inclusion. Although the majority of the UK population holds at least one payment card, there are still significant unbanked or underbanked³⁵ populations. These might include people with minimal documentation who have recently arrived in the country, people with no permanent address and people under the age of 18. Although there are ways of ensuring that each of these populations have access to the transit system, it has the potential to add complexity.

1.4.3 Account-based ticketing

In an increasingly on-line world, we are seeing a shift toward account-based systems where customer accounts are held in a back office and a token to securely identify the relevant account where their travel right is held is stored 'in the cloud'. The result is an architecture that is much easier to manage, maintain and extend. It becomes easier to know your customer and make new offers such as loyalty. This approach will also accommodate potential future developments in technologies used to identify customers/accounts such as biometrics and beacons (which are Bluetooth Low Energy (BLE) devices broadcasting their presence). It is therefore more future-proofed than a card-based approach. However, it can have more issues with responsiveness at the point of use, compared to card-based architectures.

This is a fundamentally more sophisticated approach than the existing card-based closed-loop and open-loop solutions. It benefits from the many advantages of mobile technology and has the potential to support a diversity of services. In exceptionally busy environments, transaction response times and passenger throughput may not be sufficient. The context of any implementation should therefore be evaluated, to ensure that this will not present practical problems.

1.4.4 BIBO and TITO

A Be-In Be-Out scheme (BIBO) enables implementation of a logically closed fare scheme in a non-gated environment. The presence of the passenger on the network is detected as they travel, with no specific action required by the passenger. Convenient presence detection technology such as Bluetooth Low Energy (BLE) or Global Positioning System (GPS) will provide "touches" to a central system. There are few examples of BIBO systems in operation today due to the difficulties of accurately detecting when someone is making a journey. This is an active area of research.

In principle, this is the simplest form of transit payment, as the system observes the travel undertaken by the individual and charges for any journeys made. In practice, the passive nature of the passenger experience puts considerable onus on both the connectivity and system logic

³⁴ https://visaready.visa.com/Transit_Program.html

³⁵ <http://www.financialinclusioncommission.org.uk/facts>

to deal with complex real-world environments. Any observed activity must also be interpreted as the passenger does not specifically signal their intent in the form of a card tap. This may also have fraud and revenue collection implications. The high degree of observation and interpretation required for this system to work is likely to require the collection of large amounts of data, with potential privacy implications.

An alternative is to use an intentional user action such as Touch-In to mark the beginning of a journey. The same BIBO technology that works without any user-required actions could be used in Touch-In Touch-Out (TITO) or in Touch-In Be-Out schemes as well. Brighton and Hove Bus and Coach Company, part of the Go-Ahead group, are about to launch the first TITO open-loop payments system in the UK.

All modern smart phones support BLE, whereas not all support Near Field Communications (NFC). Therefore, systems allowing passengers to 'bring-your-own-device' (BYOD) using BLE technology have the potential to access a larger passenger base. BLE devices broadcasting their presence are known as beacons. A smartphone can not only act as a beacon but also as a detector of beacons. A BIBO approach could serve both gated and non-gated public transport environments with a single front-end technology. BIBO technology could also be used in other proximity environments like parking to facilitate a seamless journey experience.

The user experience in a parking context might be similar to existing car parks which support prepayment based on automatic number plate recognition (ANPR). This allows a driver to both enter and leave a car park without any delay. It would, however, be necessary to have some kind of funding account set up and there are associated privacy implications.

1.4.5 Mobile ticketing

There is a trend towards customers using their smart mobile devices for everything:

- Planning journeys;
- Buying tickets;
- Proof of travel right at readers and inspection points (using barcode or Near Field Communications (NFC) and potentially host-based card emulation (HCE) technologies). Barcode, also referred to as QR code, is a machine-readable visual representation of the ticketing data. NFC is a communications protocol which enables the phone to communicate with devices in its immediate environment. Host-based card emulation (HCE) enables the phone to directly emulate the functionality of a physical smart card.
- Customer care will mostly be handled through mobile apps.
- Mobile also enables provision and dissemination of rich user-focused information.

This shift towards mobile for everything is one of the key enablers for Mobility as a Service (MaaS) which is discussed in the next section. It provides convenience and flexibility in implementing a wide variety of services.

1.4.6 Mobility as a Service (MaaS)

MaaS is a relatively new concept that integrates different modes of transport into a single offering, typically on a single platform. From the passenger's perspective, MaaS seeks to make travel easier by providing a single digital platform to access mobility services, and a unified way of making payments. The journey to MaaS has been fuelled by the advent of new offerings such as e-hailing and car sharing services, seeking to cover the so called 'first and last mile' of customers' journeys, thereby providing the 'door to door' experience of the private car often not

covered by public transport. MaaS has the potential to reduce congestion by improving journey planning habits, while providing cheaper and more flexible travel for passengers.

There are two payment models associated with MaaS: Subscription Model and pay as you go (PAYG) model. The subscription model provides packaged services over a period of time. For example, unlimited rail travel plus 20 kilometres of ridesharing. The MaaS operator will typically make money by buying the transport services in bulk and selling them on to passengers.

The PAYG model is suited for environments with high volumes of point-to-point travel, where passenger journeys are aggregated, and charged accordingly. In the UK, there are a number of MaaS projects such as Whim (see below) in the West Midlands and CityMappers offering in London, with numerous others in different stages of development. In Denver, Colorado, Uber has recently partnered with Masabi to launch an offering which allows trips to be planned and paid for through their app that combines public transport mode with their usual ride hailing³⁶.



Figure 5: Uber app being used for public transport route planning in Denver.

³⁶ <https://www.intelligenttransport.com/transport-news/79164/uber-transit-ticketing-denver/>

Case study: Whim

MaaS Global has arrived in the UK from Finland and have launched in the West Midlands region. They are a start-up MaaS Provider that has been operating since 2016 in Helsinki. They have a mobile app called Whim, which:

- Plans to offer public transport modes, taxi, car hire and cycle hire when the agreements are in place in your region.
- Contains a journey planner, allowing customers to enter their start and end points and choose a single mode of transport which can be paid for through the app.
- Allows the customer to either subscribe to packages of mobility on a monthly payment basis or to pay for each journey at the point of booking or, if the cost is not known, at the point of completion of the journey (e.g. taxi).
- Has a single card-on-file payment mechanism using credit or debit bank cards.
- Purchased tickets that are stored in the app as 2-D bar codes and may be shown for inspection purposes.

MaaS Global is not a Transport Operator in its own right and so does not have automatic access to transport operators within the region. Negotiation of a deal with each new operator is necessary for them to achieve the levels of integrations needed for true MaaS. Therefore, it makes sense for them to target transport authorities such as Midlands Connect that can potentially bring more than one mode of public transport to the table. But the problem of integration persists if the transport operator does not choose to accept visual inspection or 2-D bar codes as tickets, for example in London on TfL modes.

The challenge will be for the small MaaS Provider, such as MaaS Global, to find a way to convince the Transport Operators to work with them. Like Netflix and Spotify, they will need a critical mass before they will start to make money. It seems likely that much larger organisations, such as Google, will step in and take the MaaS Provider role and provide it uniformly across the globe. They already have other parts of the solution in place such as Data Provision and, more recently, tickets sales as demonstrated by their work with ITSO on Mobile in the UK.

2 CURRENT TRANSPORT LANDSCAPE IN THE SOUTH EAST

Public transport modes in the South East include bus, train, ferry and hovercraft networks, which are delivered through various legal and contractual arrangements. Some services are funded by the local authorities, while others operate in a fully commercial setting. Typically, both the private sector and the public sector end up having different visions and strategies with regards to IST. This has resulted in a degree of fragmentation in the services provided, how ticketing systems are built and managed, as well as the range of ticketing products available to customers. This section provides some context on the current state of affairs in the South East region.

2.1 Commercial landscape

2.1.1 Rail

There are currently 18 franchised TOCs in Great Britain, five of which operate in the TfSE area:

- Cross Country
- Govia Thameslink Railway trading as:
 - Southern and
 - Thameslink (including Gatwick Express)
- South Western Railway
- Southeastern
- Great Western Railway

One of the challenges with rail franchises has been that their renewal dates are not aligned. As each one is renewed, the contract wording is revisited to include the latest direction from government relating to IST and mobility in general. In the early days of IST, the franchise wording was not tight enough and some franchises managed to avoid actually rolling out smart cards.

Rail lines in the SE are the busiest in the country with about 5,000 passenger trains running on 2,000 miles of track daily. According to the Office for Rail and Road (ORR), journeys in the South East dropped by 1.4% in the past year. Despite a significant number of journeys starting or ending in London, there's still a significant number of journeys made locally i.e. within the region.

Former British Airways chief executive Keith Williams is currently leading a major review of the rail industry, supported by an expert challenge panel. This review is looking at the structure of the whole rail industry, including increasing integration between track and train, regional partnerships and improving value for money for passengers and taxpayers. It is expected that the resulting plans for reform will be implemented from 2020.

2.1.2 Buses

Outside of London, UK bus operators are not franchised, though the transit landscape is changing. Powers have been granted to new city mayors to allow them to franchise buses should they see fit and STBs such as TfSE can also apply for these powers. The commercial

landscape of the bus sector in the South-East involves a combination of both subsidised and commercial bus routes. However, the vast majority of bus services are provided on a commercial basis and not subsidised. With increasing pressure on local authority budgets, it is likely that there will be less funding available for subsidised services. Figures from the DfT show a total of 144.3 million ³⁷ bus miles in the region, 14% of which was subsidised in 2016-17. While bus miles have decreased in some regions, the South East has seen an increase of 5.8% over the last decade. Particularly, commercially run bus miles have increased by about 7% in the past four years, despite other regions seeing a decrease³⁸.

2.2 Concessionary landscape

The English National Concessionary Travel Scheme (ENCTS) mandates free off-peak travel for eligible disabled and senior citizens (those who have reached the pension age for women which is increasing from 60 to 66) anywhere within England³⁹. Concessionary travel is provided by Travel Concession Authorities (TCA). The role of TCAs could be assumed by County Councils, Passenger Transport Executives, Unitary Authorities and London Boroughs. The table below shows the number of bus passes currently in circulation within the South East region:

Local Area	Number of Concessionary Cards in Circulation
Medway	36,287
Kent	294,998
East Sussex	164,593
West Sussex	179,212
Brighton & Hove	41,821
Surrey	190,629
Berkshire	23,878
Isle of Wight	39,006
Hampshire	241,722
Portsmouth	31,659
Southampton	30,056

Table 1: Concessionary Landscape in the South East

There are other concessionary schemes and products on offer within the South East region including the Kent Young Persons scheme and the Sussex student card.

³⁷ The measure for the size of a bus network is the number miles travelled by all buses in service per year.

³⁸ All statistics are published by the DfT in their annual 'Bus Statistics' series.

³⁹ Enshrined in Primary Legislation through the Greater London Authority Act 1999 and the Transport Act 2000 (as modified by the Concessionary Bus Travel Act 2007).

There is also a move towards discretionary, concessionary travel in some parts of the region. For example, Hampshire County Council allows all disabled card holders to travel at any time of the day. Portsmouth has also been trialling a similar arrangement.

There are eight Railcards types that you can use, if qualified, to obtain discount on train ticket prices:

- Network Railcard
- 16-17 Railcard (available from September 2019)
- 16-25 Railcard
- 26-30 Railcard
- Disabled Person's Railcard
- Senior Railcard
- Two Together Railcard
- Family & Friends Railcard

These railcards are not smart cards but need to be shown to inspectors when travelling on a discounted ticket.

In addition, the Easit card is widely used in the region, providing passengers with a 15% discount on travel through their employers' membership of the scheme.

2.3 Integrated and Smart Ticketing landscape in the South-East.

2.3.1 Rail

This section provides an overview of the current state of affairs relating to rail in the South East. There are a number of smart ticketing schemes in the area, mostly led by transport operators. The predominant ticketing scheme is ITSO, with all operators offering season tickets on smart cards. A number of operators have PAYG offerings such as The KeyGo. There's minimal multi-modal integration, for example, customers are able to buy a train ticket that includes bus travel through PlusBus.

Integration between the South East and London is provided by all operators mostly through barcode tickets and smart season tickets, but there is still room for improvement in relation to local integration. For example, TfL does not accept barcodes and does not intend to in the future due to speed of throughput at gates that they need. The table below shows a cross section of the operators and their offerings.

TfSE still faces the challenging task of unifying operators and bringing their respective IST schemes together under acceptable technical and commercial arrangements. Nevertheless, the current state of IST may be a good starting point for the journey towards an integrated South East. The table below shows a cross section of the operators and their offerings.

The UK government has committed to phasing out the magnetic stripe paper tickets⁴⁰ and has mandated that all rail tickets must have an alternative to paper tickets. As part of this, the rail

⁴⁰ Also known as Credit Card Sized Tickets (CCST)

franchises have been introducing QR-code tickets (considerably cheaper than smart ticketing) and the government has been funding the Smart Tickets on National Rail (STNR) which has chosen to back ITSO technology. The government will have met its aim to have an alternative to paper tickets if either smart cards or QR-codes are on offer for any given rail ticket.

TOC	Smart offering	Integration	Product types
Crosscountry (Arriva)	Crosscountry	PlusBus; integrated bus and rail offering	Weekly Seasons
GWR	touch smart card	PlusBus	Season Tickets
South Western	Touch smart card	London integration, PlusBus	Season Tickets, carnet.
Thameslink	The Key	London Integration, multimodal (CitySaver), PlusBus	Season tickets, singles, returns, PAYG (KeyGo)
South Eastern (Govia)	The Key	London integration, PlusBus	Season tickets, singles and returns, PAYG (KeyGo)
Southern (Govia)	The Key	London integration, PlusBus	Season tickets, singles and returns, PAYG (KeyGo)

Table 2: IST Landscape in the South East – Rail

In addition to the above table, TfL Rail/Crossrail will start operating into Paddington from December 2019.

2.3.2 Bus

Until recently, ITSO has been the predominant ticketing technology for buses in the South-East. For example, Solent Go is an ITSO-based offering for buses and ferries, which is driven by Hampshire County Council in conjunction with Southampton, Portsmouth and Isle of Wight City Councils. It was the first multi-operator smart card in the UK outside of London. There is the possibility of including rail franchises in the Solent Go scheme, but progress has been slow with this.

Solent Go provides travel for a set consecutive number of days (1 day to 13 week passes), on majority of services in the South Hampshire area. It also allows customers to purchase and load tickets onto their cards using their Android devices.

The Isle of Wight Ferries pulled out of the scheme due to low ticket sales. Despite demand for a multi-operator ticket, Solent Go was used for less than one per cent of bus journeys in the wider Solent area in 2017/18. There are a number of reasons for the lack of uptake, including the pricing model (it does not compare favourably with what individual operators currently offer), a limited choice of modes, and a lack of retail outlets.



Figure 6: Solent Go operating area

The Portsmouth Park and Ride (P&R) smartcard was launched from the opening of the P&R in 2014, making it one of the first smartcards in the region. It now has over 30% of journeys being undertaken by smartcard users after the expansion of smartcard products to meet customer needs, including three carnet products and the simplification of the pricing model. The scheme has two smartcard ticketing vending machines at the P&R terminal and has recently introduced the Portsmouth P&R app (the same Android only app as Solent Go but branded as Portsmouth P&R), for the instant collection of top-ups. Success of the smartcards is based on high discounts on the PAYG price. Smartcard tickets provide higher discounts the larger the value of the product, easy access to smartcard purchase and a high proportion of regular users.

The Brighton & Hove Key Card is also a multi-operator ITSO-based offering allowing travel on several bus companies' vehicles: Metrobus, Big Lemon and Compass Travel's services, as well as Brighton & Hove Buses' own vehicles. There are two fare zones (City and Network). Ticket types available are 1-day to 1-year passes and multi-trip (carnet). There is no PAYG. There is also an app offering which uses QR-codes as tickets, rather than ITSO.

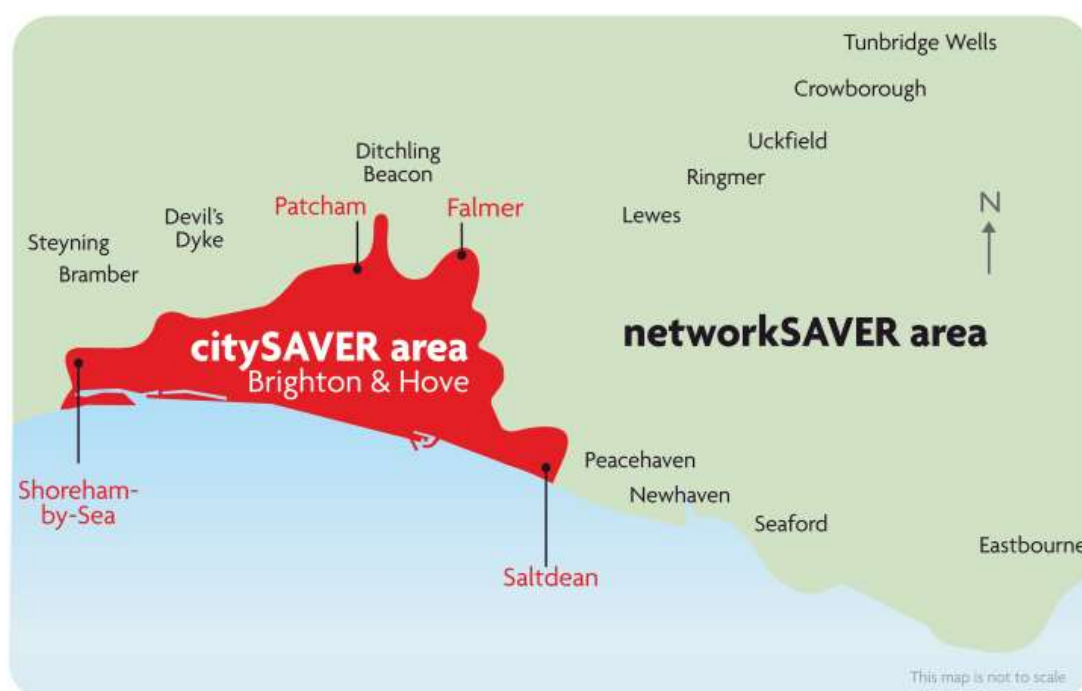


Figure 7: Brighton & Hove Key Card operating area

There are a number of operator-led integrated ticketing initiatives in the region, providing a degree of interoperability within a specified area. For example, the CitySaver; which allows for unlimited travel within the CitySaver zone and is serviced by Southern & Thameslink. In addition, the Discovery ticket is a product led by the South Downs National Park Authority in partnership with local transport authorities for travel in and around the National Park.

Commercial Bus Products in the TfSE area include:

- MegaRider (Stagecoach);
- mTickets (First, Arriva, Stagecoach, B&H Buses, Metrobus (Go Ahead), Portsmouth P&R (Portsmouth City Council));
- Connect (Arriva);
- Solent Go (Bluestar, First, Stagecoach, Unilink, Wheelers, Xelabus);
- Touch (First).

It is also worth noting that the 'Big 5' national bus operators have all recently introduced open-loop (bank card) payments on their buses. They are national operators and are seeking national solutions, while aiming to not be constrained locally, where possible.

The PlusBus⁴¹ initiative enables passengers to purchase a discounted bus pass in conjunction with their rail ticket. This is a nationwide scheme, with local restrictions in place to protect bus operators as necessary. Usage of this scheme will be explored in more detail in a future study.

⁴¹ https://www.nationalrail.co.uk/times/fares/ticket_types/plusbus.aspx

3 TFSE INTEGRATED SMART TICKETING OPTIONS APPRAISAL

This section describes workable models for Automatic Fare Collection (AFC) that could be applied to the South East region (or indeed any other region or city with multiple transport operators). To simplify the description, it is assumed that bank-issued Contactless Payment Cards (CPC) (debit or credit), or representations thereof in a mobile wallet such as Apple Pay or Google Pay, are used as tokens to gain access to the transport network and pay for travel. In principle, other tokens could be used for access and identification, and alternative means of payment, such as direct debit, could also be used. The architectures described could be adapted to offer all these possibilities, but CPCs give good consumer coverage (e.g. for international travellers) and CPC acceptance systems are being deployed by transport operators and authorities worldwide.

Options are presented for how Integrated Smart Ticketing might develop in the TfSE area. The options are then appraised in terms of suitability for the SE and TfSE.

We present the options for TfSE using two separate key measures and appraise them as we go:

- Degree of proactivity (i.e. how much direct involvement in system definition and procurement should TfSE have.)
- Scope, integration and business architecture (i.e. what is the scope of any systems, how integrated are they and how is this represented in the business architecture)

3.1 Degree of proactivity

Options P1-4 are ordered in decreasing levels of proactivity from TfSE and are summarised in Section 5.

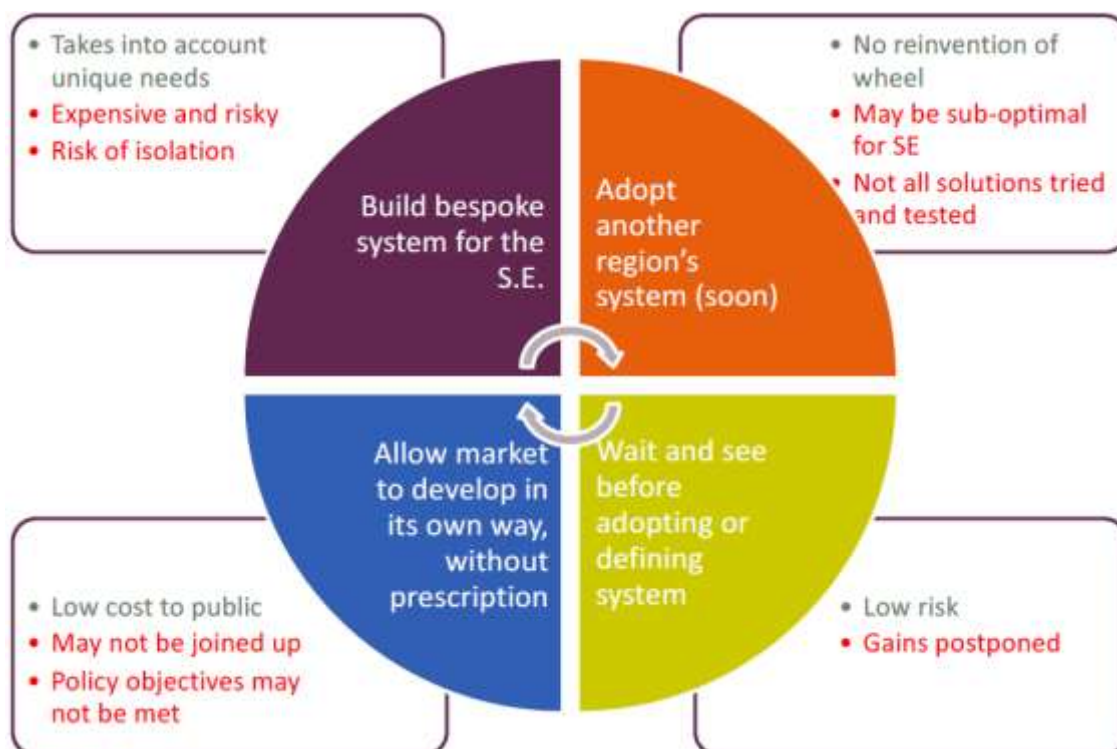


Figure 8: Options for degree of proactivity

3.1.1 Option P1: Build a bespoke system for the SE

This option is similar to doing what Transport for London (TfL) built for London in 2008-14 and what Transport for the North (TfN) is procuring now for the north of England. The attraction for the passenger would be that all modes and all operators could have a system that works with a small number of customer medium types. And any unique needs of the TfSE area could be taken into account.

But the down side is the very large cost of such a system and the time it would take to specify, procure and build can make for a high-risk project. It should be remembered that London is an anomaly compared to the rest of the UK; TfL had a clear business case to reduce the cost of Oyster card distribution and reduce queues to purchase cards and top-up card balances and it has proved a success. However, they have powers over all the operators within the TfL scheme which made their implementation relatively easy from a commercial point of view. By contrast, TfN has no powers over the operators in its scheme and is finding it difficult to keep the large national bus operators on board now that they have implemented open-loop transit payments on their fleets.

Finally, there is the risk of isolation, as we have seen with the card-based ITSO-based schemes that have been deployed to date that do not interoperate with each other. By the time they are deployed, alternative technologies have emerged, such as open-loop transit payments which can work wherever the passenger wants to travel with the bank card in his/her pocket.

The experience of TfN and the difficulty of building a business case for an expensive monolithic system for the SE and the difficulties in getting the large operators to agree to terms that support the business case would seem to suggest that this option is less than ideal.

Advantages	Disadvantage
Bespoke to the TfSE area, potentially meeting all requirements collected by TfSE. A single scheme for all modes and operators in the TfSE area would potentially offer the best customer experience.	High cost. Requires operators to buy into a new system and modify their equipment accordingly. Not attractive to national operators. Risk of isolation from having a bespoke regional solution.

3.1.2 Option P2: Adopt another region's system

This option ensures that there is no re-invention of the wheel, thereby potentially making savings in public money. However, the system adopted from another region may be sub-optimal for the needs of the TfSE area, which has unique features. If a regional system has not been procured with scaling to serve other regions as well as its own then it might not be possible. This is what happened with the TfL system which was never designed to be used elsewhere. Part of the system was developed by Cubic and part by TfL themselves. There were many discussions about other cities making use of TfL's open-loop back office, but none came to fruition. TfL is not a software house or systems integrator and is not well placed to offer such a service. Instead, a deal was struck with its supplier (Cubic) that they could use TfL's IPR in their implementations elsewhere around the globe.

In the UK, the next STBs expected to deploy IST ABT systems are TfN and Midlands Connect. These are not yet implemented and tested and so we cannot be sure what may become available to TfSE and by when (though we would expect it to be soon). For example, the TfN system might be live in 2020 or 2021, but there is still uncertainty around when their current back office procurement will complete and implementation begins.

In adopting another region's system, such as TfN's back office, the following would need to happen:

- TfSE would need to negotiate agreement to use other region's system and contractual terms.
- Local transport operators in the SE would need to agree to use the system and modify their field equipment (card readers and revenue inspection devices) accordingly.
- TfSE might need to agree to fund some of the field equipment needed, either to encourage operator buy in or to allow smaller operators to afford participation.

Advantages	Disadvantage
<p>A single scheme for all modes and operators in the TfSE area would potentially offer the best customer experience.</p> <p>Lower risk of isolation than P1.</p> <p>Potentially lower cost than P1.</p> <p>If national operators are already using the other region's system, they may be happier to accept this system re-use, rather than accommodating yet another system.</p>	<p>Requires local operators to buy into a new system and modify their existing field equipment or procure new field equipment accordingly.</p> <p>Since not bespoke to TfSE area, may not meet all requirements specified by TfSE.</p> <p>The other region would always put their needs before those of TfSE and the TfSE area customers and operators.</p>

3.1.3 Option P3: Wait and see before adopting or defining a system

This option is low risk, but any potential gains to the TfSE area from an ABT system would be postponed.

Advantages	Disadvantage
<p>Savings in taxpayers' money.</p> <p>Allows the market more time to innovate, e.g. MaaS providers are beginning to appear.</p>	<p>Delays in addressing the issues that customers in the TfSE area are facing with congestion and pollution.</p> <p>Does not define a role for TfSE beyond a watching brief.</p>

3.1.4 Option P4: Allow market to develop in its own way without prescription

This is the 'do minimum' option. It is low cost to the public purse in terms of immediate outlays but a cost-benefit comparison with a more proactive option might not be favourable. The resulting solution emerging from the market might not be joined up and might not allow for the long-term policy objectives of convenient alternatives to private car ownership, reduced carbon and other emissions and congestion.

Advantages	Disadvantage
<p>Lowest immediate cost to the public purse.</p> <p>Allows the market flexibility to innovate.</p> <p>Allows time for TfSE to plan to facilitate integration of existing solutions and steer the emerging market solutions.</p>	<p>Without any prescription, emerging solutions from the market will probably be fragmented.</p> <p>The market's goals, objectives and timescales may be different from those of TfSE. Their primary aim is likely to be to make money and not necessarily to provide the best IST or MaaS solution for the SE region.</p>

3.2 Scope, integration and business architecture

3.2.1 Option S1: Unified system for the South East

The unified system could be bespoke for the SE or an inherited or adapted version of TfL, TfN or Midland Connect. The defining characteristic is that, however it is specified and procured, it applies to all public transport in the region.

This is shown in Figure 9, in simplified form. In this model, there is a single body (neutral with regards to operators) that is responsible for collecting fares via the card payment network; which only requires an arrangement with a single acquiring bank. Operators themselves do not collect funds directly via an acquirer.

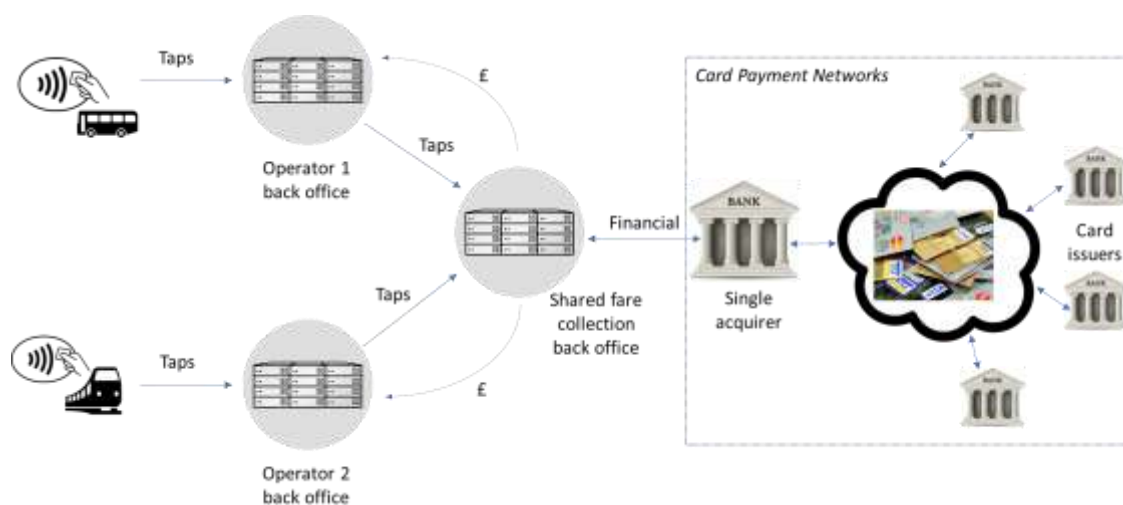


Figure 9: Unified architecture

Instead, all operators feed their tap data to the central body which performs functions such as:

- Determining when to seek authorisation against particular cards (this is a function of risk versus cost)
- Building journeys from taps
- Applying discounts (such as for off-peak or concessionary travel) and caps (daily, weekly, etc)
- Requesting funds via the acquirer
- Apportioning revenue between operators (according to agreed rules) and reimbursing accordingly (via the banking system, e.g. CHAPS or Faster Payments)

In principle, this is the most efficient system, in that some replication in every operator back office is avoided. It is most able to save the passenger time and money in accomplishing their journeys and to meet public policy objectives (such as reduced road congestion) if used to incentivise multi-operator travel.

On the negative side, this is the most disruptive option, while the ability to incentivise public transport usage through multi-operator journeys, though plausible, remains a conjecture. Operators may fear a loss of control, in terms of the technology they may deploy, suited to their

particular circumstances; and their ability to extract fares from their customers directly, in a timely fashion.

Ultimately, the cost/benefit advantage between the per-operator architecture and the unified architecture depends upon an estimate of the likely future level of multi-operator usage by individual passengers. This would need to be modelled convincingly before taking this option forward.

In this first approach, we are considering an architecture like that currently being procured by TfN. It is a single ABT back office to serve the whole of the region. Readers and revenue inspection devices from any transport operator can connect to the back office to exchange information to allow risk models to be implemented and journeys and fares calculated.

This is potentially the cleanest architecture and should result in a consistent user experience. It facilitates incentivising modal shift from car to public transport, for example by providing capping. It could also facilitate demand management and strategic planning since all the travel data would be available in the one back office. Demand management enables operators to target their resources most effectively. This may mean providing additional capacity at peak times or providing incentives to passengers to travel when the network is less busy.

On the down side, it is expensive to procure and relatively disruptive to operators who will have to make the existing readers and revenue inspection devices work with the new back office or install new ones.

Finally, this business architecture is potentially wasteful if multi-operator journeys are rare in practice and cheaper, existing single operator solutions could be used instead.

Advantages	Disadvantages
Consistent user experience. Can provide capping across modes, operators and the region to incentivise the use of public transport.	High cost. Potentially wasteful if, as the operators contest, multi-operator journeys are rarely needed by customers.
A single scheme for all modes and operators in the TfSE area would potentially offer the best customer experience. It is potentially the most efficient solution, not replicating functionality in multiple systems.	Most disruptive: Requires operators to buy into a new system and modify their equipment accordingly. Not attractive to national operators. Operators may fear a loss of control. Risk of isolation from having a bespoke regional solution.

Other options in this Scope, Integration and Business Architecture section are more fragmentary solutions.

3.2.2 Option S2: Sub-regional systems: conurbations, cross-country

The SE is typical of other regions in the UK where smart ticketing has been provided in the major cities or conurbations with more than one city or large town where there is obvious demand, e.g. Brighton and Hove, or the Solent (Portsmouth and Southampton). The gaps tend to be the 'bridges' between these 'islands' of conurbation. Consideration could be given to how

the bridges between the islands in the SE are provided for and whether smart ticketing is needed or can be cost effectively provided. Bridges between cities are commonly provided by national rail. TfSE should ensure that they do everything they can to support the relevant national rail work including:

- Smart Ticketing on National Rail
- The Williams Review
- The PAYG on Rail consultation.

If there are no modes of public transport operating on particular bridges, perhaps ride hailing is the answer and perhaps smart ticketing is not needed in this case if ride hailing can be included in future MaaS apps like Uber and others do already. Rather than focussing on the IST aspect, TfSE could try to ensure that ride hailing services are available where needed by encouraging MaaS provider solutions and ensuring that the open data needed for such solutions to thrive is available. Alternative modes might also be encouraged for the bridges where appropriate, for example, on-demand bus or mini-bus services.

The business architecture to support this approach is modelled on what Midlands Connect is proposing. The idea is that transport operators have their own ABT systems for their own journeys (such as the 'Big 5' national bus operators do) and that data would only be shared with a central broker system should it be necessary to calculate a multi-operator or multi-modal fare.

This approach is low risk for operators with their own ABT systems who can continue to operate as they are, with some lower level of integration to the Broker from their own back offices rather than having to modify their front-office field equipment, when compared to a single central back office architecture. This approach has the advantage that it allows for the organic growth of multi-operator journeys and could scale accordingly, rather than needing large capital investment up front.

The down sides of this approach are that the passengers will have potentially inconsistent experiences when taking multi-operator journeys compared to single operator. For example, who should they call if something goes wrong with a payment? Also, since the central Broker does not see all the journeys, there is no single system with access to the data needed for strategic planning.

The broker architecture, shown in Figure 10, is a hybrid of the per-operator and the unified architectures.

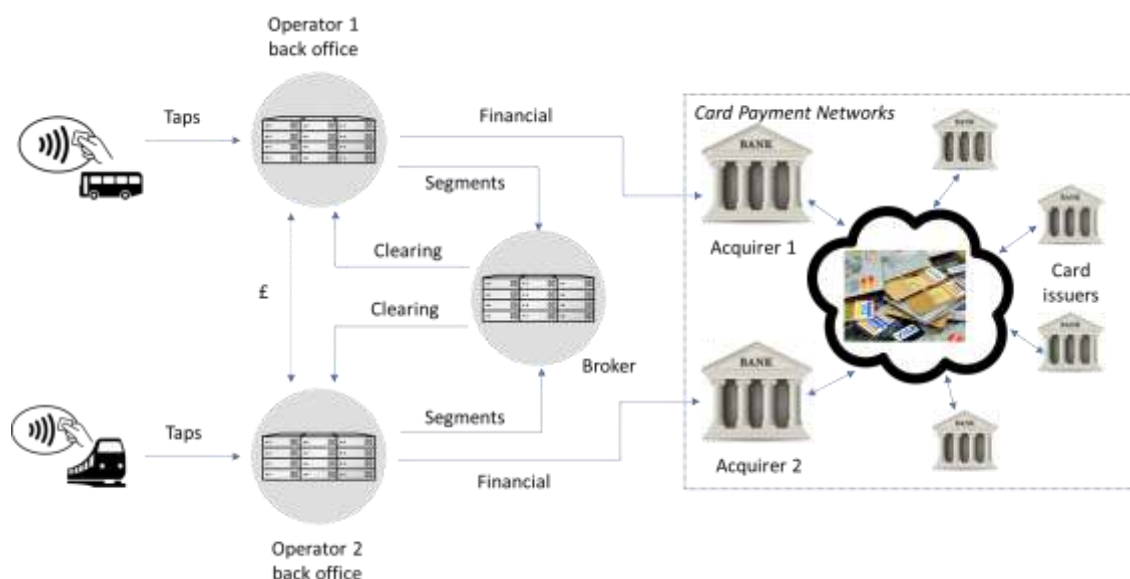


Figure 10: Broker architecture

Each operator retains its relationship with its acquiring bank, and seeks from that acquirer authorisations and financial settlement for the journeys that it sees, in the normal way. Sometimes, this may involve a pre-payment for a multi-operator journey. However, it also sends information on the travel segments that are undertaken by all passengers (as identified by their cards) to a central 'broker'. The broker will identify where journeys have been undertaken involving segments with more than one operator and apply any discount. 'Clearing' messages will be sent to the operators, indicating journeys for which:

- Some portion of a fare must be conveyed to (or received from) another operator
- A refund or credit is due to a passenger, because they have been charged full fares where a discount applies
- Net settlement instructions, based on aggregating the amounts specified in Clearing messages.

The main advantage of the broker architecture is that nothing is disrupted (neither in a business nor a technical sense) while multi-operator travel can be incentivised and handled cost-effectively as and when it occurs, at whatever scale it occurs.

The main disadvantage is that the traveller (in the multi-operator case) is somewhat exposed to the inherent complexity of the model. For example, for a single journey accomplished using three operators, he might see three separate debits and three credits (partial refunds) on his statement. A unified system would show just one debit (possibly at the level of a daily cap).

Advantages	Disadvantages
Low disruption for operators with their own ABT systems who can continue to operate as they are, with some lower level of integration to the Broker	Inconsistent customer experience for single operator and multi-operator journeys.
By making use of existing sub-regional systems, there are potential cost savings over building new systems.	The systems in each sub-region are different and do not interoperate, giving poor customer experience for those travelling across the SE.
	Multi app requirements, potential customer confusion, lower quality data from the system for demand management and strategic planning. Potentially higher chance of discounts not being applied and customers becoming disenfranchised.

3.2.3 Option S3: Mode-specific, Operator-specific

This is the baseline option in which each operator does what they think is best for themselves and their own passengers. Perhaps if they run a rail franchise and also bus services, there may be little or no integration between the two.

This is shown in Figure 11, in simplified form. In terms of organisation, it could be considered the default. Every operator makes its own arrangement with a card acquiring bank to validate CPCs, authorise transactions and claim funds. Each is free to field its own equipment at gates and on vehicles, subject to readers meeting payment scheme rules; and free to convey tap and other data between such equipment and its own back office in its own formats; again, constrained somewhat by payment scheme rules.

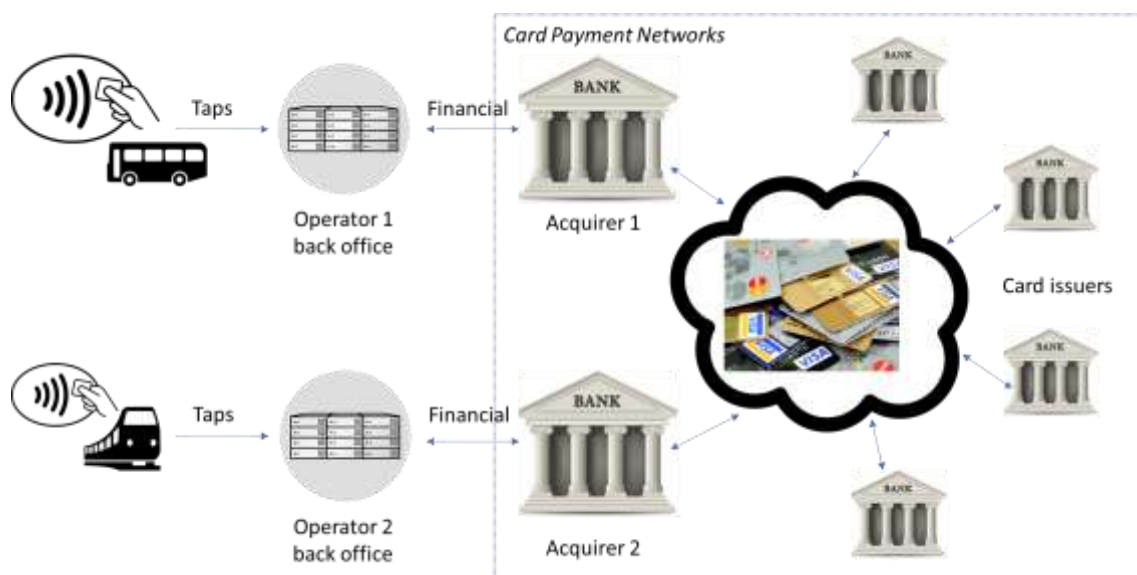


Figure 11: Per-operator architecture

There is no direct or indirect communication with other transport operators. Passengers cannot make savings (in money or time) if their door-to-door journey, or travel over a week or month, involves more than one operator. On the plus side, operators are not constrained by membership of an overarching AFC scheme in terms of innovation to meet the needs of travellers for the journey segments that each operator facilitates.

In this case, there is a potential role for TfSE to 'stitch together' where they can. Roles might include:

- Encouraging and lobbying operator behaviours to achieve public policy goals
- Funding of any changes to existing systems that might be needed (e.g. see Broker option above).
- Standardisation (e.g. peak/off-peak times)

Advantages	Disadvantage
Operators can innovate.	No communication between operators means that customer using more than one operator cannot benefit from potential capping of their overall fares.
	Operator's levels of innovation can vary significantly across the region. Requirement of multi-app.

N.B. Whichever model is selected, it is advisable to treat London commuting separately: IST for commuters into London is already provided along certain routes by TfL's Oyster/open-loop ABT scheme. There are already plans to extend the reach of TfL's scheme outside of London. This has the advantage that commuters can use one IST system for most of their travel needs when they travel to work.

Some of the train operators into London already provide smart season tickets using ITSO and the STNR programme could deliver more of this if needed. While ITSO cards can be read by TfL readers, they do not provide PAYG and so the commuters will need to switch to the TfL customer media in order to travel around London once they arrive.

TfSE should assess whether there are gaps in what the London commuters need in terms of IST.

4 FINDINGS FROM THE STAKEHOLDER WORKSHOP AND INTERVIEWS

A wide range of stakeholders with an interest in transit provision were consulted in preparation for this report. Interviews were undertaken with 12 experts and a stakeholder workshop was held in order to elicit a wide range of views. Further details of the workshop and interviews are included in the Appendices to this document.

4.1 Interview findings

This section summarises the findings from the interviews.

4.1.1 Recurring themes

4.1.1.1 Poor air quality and pollution remains a big challenge in the South East region.

There were unanimous concerns with regards to the air quality in the region. There was some diversity in the presumed causes of this. Some responses attributed this issue to congestion on the roads, and the inability to convince people to take public transport, instead of driving. In addition, there was some agreement on the historic failure of planning authorities to adequately consider how new developments will be serviced by public transport efficiently. The planning of new developments and transport planning must be approached holistically.

4.1.1.2 Low quality of transport service.

The reliability of transport services was called into question in a number of the responses. Bus journeys for example are impacted by congestion on the roads, making it difficult for people to plan their journeys. This lack of confidence in the service also encourages the use of personal vehicles, further congesting the roads. In addition, some responses indicated the need for bus and rail planning to be approached holistically. Punctuality of the buses and trains is important, but to a customer making a multimodal journey, the wait between getting off a train and boarding the next bus is equally important.

4.1.1.3 Complexity and cost of integrating with London.

Proximity to London and the nature of commuting between London and the South East presents a unique challenge; ticketing considerations in the area are influenced by what is happening in London. For example, the decision of which system to adopt (to copy London or do something tailored to an operating area) is complex and adds to the overall build cost of such systems. Questions remain on how best TfSE should deal with TfL to ensure more opportunities are created, while avoiding potential points of conflict.

4.1.1.4 Complex products and fares

Multiple products and complex fares structures confuse customers into buying more expensive alternatives or avoiding public transport altogether. According to one interviewee, the majority of their customers don't make journeys beyond their operating area, leading to low take-up of multi-operator products.

4.1.1.5 Complexity of ITSO

Some issues with ITSO were highlighted, interviewees lamented on the "slow and clunky" nature of the ticket purchase and provisioning. ITSO on Mobile (IoM) presents a potential solution, however it is limited to phones running on the Android platform. At least one of the interviewees reported some issues with IoM refusing to open gates in some cases. A number of

bus operators also highlighted their inability to find a low-cost, disposable and reliable ticketing medium that will work on rail.

Furthermore, the question of “who owns the customer?” in some instances remains unaddressed. For example, if a customer with a GTR card buys a ticket from Greater Anglia and then travels on South Western Railway, which of the operators is responsible for the customer end-to-end? Which of the operators get what data? However, the responses also acknowledge the level of ITSO coverage in terms of infrastructure, thus making a possible case for its further adoption going forward.

4.1.1.6 Lack of cooperation and conflicting ticketing strategies

The deregulated nature of the South East allows operators to be innovative to an extent; however, it leads to fragmentation in their respective visions for smart ticketing. It leads to operators ‘working in silos’ and focussing on their operating areas, making integration difficult.

4.1.2 Opportunities

A number of areas were identified that may present an opportunity to further improve the quality of transport services, as well as the overall customer satisfaction. These are explained in the following subsections.

4.1.2.1 A case for account-based ticketing.

There seems to be an appetite for an account-based ticketing system. This is both in terms of an EMV ABT, or something based on transport customer media. For example, a number of the interviewees alluded to the idea of an account-based ITSO offering; where the ITSO fare medium simply becomes an identifier to a customer account with prepaid funds or pre-purchased products. As the logic moves from the front office to the back-office, achieving integration amongst operators and modes will become easier. It also makes it possible to implement other services such as ‘capping’ and ‘fair price promise’ effectively.

4.1.2.2 Focus on improving local travel

There is a tendency to focus overly on integration with London, while neglecting local travel within the South East region. A number of the responses indicated the need for TfSE to focus on improving transport locally, as well as integrating with the rest of the country.

4.1.2.3 MaaS potential

The potential of MaaS to revolutionise the way people interact with public transport was common in many interview responses. A number of organisations are already running MaaS pilots around the country. This presents an opportunity to harmonise these efforts, to ensure interoperability is built in by design—if action is taken early enough. A well planned MaaS ecosystem will encourage more people to use public transport, thereby reducing congestion on the roads.

4.1.2.4 Mature IST landscape

The current IST landscape of the South-East is relatively mature taking into account the existence of ‘smart’ solutions in the area. For example, there’s been a significant investment by bus operators to accept EMV on buses. Similarly, a number of PAYG and ITSO-based solutions already exist in the region, including the physical infrastructure to support it. While these solutions are not integrated in many cases, the existence of some of the infrastructure may be a good starting point for the process of integration.

4.1.2.5 *Cooperation to achieve economies of scale (shared services shared data)*

With different local authorities doing different things, there is an opportunity to harmonise such efforts to achieve economies of scale. For example, the Rail Delivery Group (RDG), TfL, TfN, GTR, Scottish Rail, all have back-offices that work on a different basis and don't talk to each other. This redundancy could be avoided to save costs and harness large volumes of data generated daily, for the benefit of all stakeholders in the region.

4.1.3 Potential roles for TfSE

There was consensus that it would be best if TfSE positioned itself as a strategic body, with active involvement in the IST landscape. Potential TfSE roles outlined in the responses include:

1. Create an alliance across the region to facilitate what the operators are doing.
2. Focus on promoting the region, making a case for investment in the South East.
3. Focus on planning issues, working with organisations such as Highways England and Network Rail.
4. Look to provide political oversight on transport related activities in the area.
5. Promote integration and cooperation among operators in the region to achieve collective benefits.
6. Be a single voice representing the region and ensure government funding is allocated to the South East.

4.1.4 Issues for TfSE to consider

4.1.4.1 *Don't add another layer of complexity.*

Interviewees felt very strongly about the idea of a new organisation joining the already overcrowded arena, and another sets of requirements to follow. Some interviewees felt there are already fragmentations in terms of ticketing, as well as in transport strategies, and felt TfSE mustn't add to this. The common phrase that kept coming up was don't re-invent the wheel!

4.1.4.2 *Don't come up with solutions specific to the South East.*

There's often the tendency to solve transport issues in isolation, the Oyster Card System is perhaps the prime example of this; it is great, but only if you're in London. The responses urged TfSE to create frameworks that align with the rest of the country, rather than creating standards that are specific to its region.

4.1.5 Highlights pertaining to the TfSE area

4.1.5.1 *Impact of Brexit on congestion around ports.*

The interview highlighted the potential increase in activity around some ports due to Brexit. For example, the Southampton port mostly serves markets outside the EU; it is anticipated that areas around the port will become busier. Therefore, planning must take this into account to avoid significant delays.

4.1.5.2 *Collaboration with other STBs to deliver ticketing solutions.*

With TfN's back-office in the pipeline, and the advances TfL has made over the years, there's some indication of the willingness of both bodies to accommodate TfSE and the region within their systems. Further discussions and investigations will be required to determine the viability of such approaches.

4.1.5.3 *Innovative approaches needed to improve the usage of public transport.*

One of the responses indicated the need for innovative thinking to encourage the use of public transport. For example, parking at stations should be seen more as a 'Park n Ride' rather than a city centre car park. The parking could be integrated into the ticketing and make the offering more cost effective. Transport bodies must factor in the cost and ease of parking, alongside the cost of travel and ensure the benefits are made clear to the customers.

4.2 Themes from the workshop

Not surprisingly, much of the consensus from the workshop aligned with the key findings above from the interviews. In this section, we highlight what the workshop and interview discussions focussed on the most.

4.2.1 Mobility as a Service (MaaS)

There seemed to be consensus in the room that the long-term vision of MaaS providing a much better passenger experience for planning, paying and travelling and is the preferred 'direction of travel'. However, it was agreed that mature MaaS offerings will take a considerable time to evolve.

It was agreed at the workshop that 'one size does not fit all' and that there is a clear role for TfSE to 'stitch together' various activities designed to improve IST across the region.

4.2.2 The personal car is the competition

Any future MaaS solution must be attractive enough to compete with the personal car. Ideally, it will be able to provide door-to-door journey solutions which are cost effective and can be used on demand.

4.2.3 ABT as a stepping stone to PAYG

The means of identifying the customer account at the point of travel needs to be common to wherever the passenger travels in the region if customer convenience is to be maximised and MaaS with PAYG is to take off. The current fragmentation of customer media types in use across the region presents a problem for the passenger and the MaaS provider:

- Oyster/open-loop (London only where barcode is not accepted)
- ITSO (regional schemes, some national rail and England-wide bus concessions)
- Barcode for national rail where open-loop is mostly not accepted.

CitiMapper recently launched a MaaS solution using a prepaid Mastercard as the customer medium. But this solution model only currently works in London where all of TfL's transport modes accept bank cards for payment.

It is not clear that there is a role for TfSE in addressing this issue beyond trying to ensure that there are solutions for those passengers not willing or able to use bank-issued cards as their customer medium.

4.2.4 Fares simplification as a stepping stone to PAYG

One of the barriers to PAYG is that the available fares are too many and complex. Perhaps TfSE can encourage fares simplification as a stepping stone to PAYG.

4.2.5 Pay As You Go and capping

There was agreement that passengers prefer PAYG offerings where possible, rather than having to understand the local tariffs and ticket types that give them a fair price for the journeys they make. There seemed to be agreement in the workshop that the ITSO schemes have failed to provide cost-effective PAYG and that now this is possible with open-loop bank cards, ITSO STR should not be used for PAYG, but rather use ABT solutions. Solutions will be needed for those both willing and able to use bank cards, and those in the population who do not have access to bank cards.

4.2.6 Data provision

In the medium to short term, perhaps the most useful work that TfSE can facilitate and encourage is in ensuring that the needed data is available to allow MaaS Providers to present their customers with journey planning, disruptions and fares information. Transport for the North IST Phase 2 is procuring systems for this purpose to serve the north of England.

As the data becomes available through open APIs, potential MaaS Providers will make use of it, as Google and Uber have shown in various parts of the world. TfSE could perhaps learn lessons from TfN and perhaps explore sharing their systems if they are scalable to serve other regions.

4.2.7 Smart phones

Smart phones seem key to the solution in as much as they can act as contactless customer media as well as being able to send queries and receive notifications. The comments from TfL in the workshop indicated that 15% of open-loop PAYG is using NFC phones. It was noted that once regular travellers are using their phones to pay, it is much simpler to send them timely, personalised notifications of any disruptions to their usual travel or even special offers. There is a shift in the way that IST systems are being rolled out. In NYC the open-loop transit payments roll out is starting with ApplePay and GooglePay rather than waiting for the US contactless bank card issuance to catch up.

5 RECOMMENDATIONS

This section presents the recommendations, derived from the research and consultations carried out during the study period. The findings from the interviews and workshop can be found in their relevant Appendices. This section distils the key findings into recommendations for TfSE in the light of:

- the landscape of IST and regulation in the UK
- interviews and the workshop conducted as part of this project and
- our experience on other relevant projects around the globe.

5.1 Confirm demand for multi-operator, multi-modal journeys

Facilitating door-to-door journeys without the need to use personal cars would meet social and environmental goals. However, the evidence from the interviews and the workshop is that, in practice, most public transport needs are currently met, it is generally supposed, by repetitive, single mode, single or return journeys (work, school/college, shopping, etc).

Recommendation: Further investigation is required to understand how much latent demand there is for multi-modal and multi-operator journeys in the TfSE area should there be more joined up IST. This should also include a better understanding of people's propensity to use these systems. Until there is evidence that this is needed, it will be hard to justify any region-wide IST implementations and to encourage transport operators to take part.

5.2 Encourage PAYG

There is evidence that passengers and operators prefer PAYG solutions which remove the need for tickets to be purchased in advance and for complex ticketing offers to be understood. Ideally, some kind of fair price promise will be implemented to encourage further modal shift away from personal cars.

Recommendation: TfSE should encourage the rollout of PAYG schemes, using modern, ubiquitous technology (see below). TfSE should also encourage fare simplification and fair-price promises within these schemes, so that trust in them among passengers is quickly established.

5.3 Re-use existing customer media or phones

The evidence is that account-based open-loop transit payments are the preferred PAYG solutions in recent times and that ITSO is withdrawing its card-based 'Stored Travel Rights'. There is also consensus amongst the stakeholders consulted that 'another plastic card' is not the right approach. TfL is still issuing 40,000 Oyster cards a day and many of these are only ever used once.

Recommendation: Rather than issuing new customer media, PAYG schemes in the South East should exploit something the passenger already has, be it a bank card, a smart identification card and, especially smart phones which can be used to provide a much richer customer experience. TfSE should try to ensure that there are also solutions available for passenger not willing or able to use bank-issued cards for travel; preferably using bank card (cEMV) technology, to simplify readers and back offices.

5.4 Facilitate MaaS

Mobility as a Service seems the inevitable 'direction of travel' and is commensurate with achieving policy goals. TfSE should further consider how to facilitate the integration of fare collection into MaaS value chain concepts (Customer—MaaS Provider—Data Provider—Transport Provider) and deprecate the old-fashioned notion of purchasing tickets where possible.

It is not yet clear who the MaaS providers will be and how many there will be for the passenger to choose from. Each will need to negotiate deals with the transport operators to sell their journeys. Of interest, TfL has refused to agree discounts to any MaaS Providers and so they will have to find other ways to make a profit. The personal car is the competition to the potential MaaS Providers. TfSE should consider what they can do to help MaaS Providers get established in the region.

In the medium to short term, perhaps the most useful work that TfSE can facilitate and encourage is in ensuring that the required data is available to allow MaaS Providers to present their customers with journey planning, disruptions and fares information. Transport for the North IST Phase 2 is procuring systems for this purpose to serve the north of England.

As the data becomes available through open APIs, potential MaaS Providers will make use of it, as Google and Uber have shown in various parts of the world. This is potentially very important since if such global providers get involved then visitors to the TfSE area will not need to obtain any local tool (e.g. cards, apps) at all. TfSE could perhaps learn lessons from TfN and perhaps explore sharing their systems if they are scalable to serve other regions.

Recommendation: TfSE should talk with TfN 'Phase 2' leaders to understand what lessons can be learned and what data hub systems might be shared in the future. TfSE should also consider forging links with other Data Providers in the MaaS value chain such as Traveline⁴².

5.5 Maintain dialogue with other STBs

It is not recommended that TfSE procures a monolithic ABT system for the TfSE area in the way that TfN and Midland Connects are working on for their regions. Central government is unlikely to have the appetite to continue to fund more of these expensive systems and there would seem to be the opportunity to learn lessons from the other STBs and make use of their systems if possible and appropriate.

Recommendation: TfSE should continue dialogue with TfN and Midland Connects about possible use of their ABT back office systems. This would potentially mean procuring 'front office' field device (readers and revenue inspection devices) for use in the TfSE area and routing message to and from a remote back office. At minimum, a dialogue will help TfSE avoid any mistakes made by the pioneering STBs.

5.6 Provide for London commuters separately

The presence of London cannot be ignored. We recognise that it would not be appropriate to cover the entire South East region, because there is little demand for travel to London from the more remote areas; because London's zonal charging model would break down over a vast

⁴² <https://www.traveline.info/about-traveline/>

region where there are many relatively short journeys taken on the periphery; and because capping breaks down where long, expensive journeys are undertaken.

Recommendation: We recommend that Transport for London be encouraged to extend the reach of their PAYG systems (Oyster and Contactless Payment Cards) incrementally beyond the M25. TfSE should work with TfL to agree what passenger types travelling between the TfSE region and London would benefit the most and thereby produce a prioritised list of routes to target for the extension. This should take into account the emerging results of the recent Rail PAYG consultation by DfT.

5.7 Join existing IST systems together

TfSE should define roles for itself in ‘stitching together the existing and emerging IST solutions in the SE and the national initiatives such as STNR on rail and ENCTS on buses. The consensus from the interviews and workshop is that TfSE should provide strategy, guidance and support to realise the Mobility as a Service vision. TfSE should play the role of facilitator, encouraging innovation, aligning policies (such as concessions and definition of peak/off-peak) and ‘stitching together’ neighbouring or overlapping schemes where there is passenger benefit.

In order to facilitate a simple passenger experience (which incentivises public transport use) between schemes, there will be a need for fares collected by one operator to be apportioned fairly to all the operators facilitating a journey, or collection of journeys.

Recommendation: In the event that there is a proven need for multi-operator journeys we recommend that TfSE constructs an outline business case for a ‘broker’ system, able to take journey information from operators and calculate balancing payments to be made between operators. This should be a small-scale system at first, but able to grow nimbly with increasing opportunity for creating integrated fare systems. A cost-benefit analysis would be needed to ensure that there is sufficient demand for multi-operator journeys to justify the initial investment.

The per-operator architecture (the default) does not facilitate meeting social goals such as reduced road congestion and improved air quality—so something must be done. While the unified architecture could do that to the maximum extent, it is a high-risk approach, disrupting existing systems and entailing high cost for a system that might not bring about a large number of multi-operator journeys in practice. The broker approach is a compromise solution, able to achieve most goals at modest risk. It could be rolled out by willing and proactive sub-regions and operators, on a small scale at first, with minimal disruption to existing systems.

5.8 Learn from recent MaaS research

The MaaS Alliance and UK Transport Systems Catapult commissioned a survey in spring 2017 to generate data on the critical regulatory enablers and barriers for the development and full deployment of MaaS. It is worth noting that policy targets on emissions are likely to have a positive effect on MaaS market developments.

A recent report⁴³ by the House of Commons Transport Committee concluded:

⁴³ <https://publications.parliament.uk/pa/cm201719/cmselect/cmtrans/590/590.pdf>

The key choices the Government can make are on its approach to the governance around MaaS in the areas of incentivising data sharing; introducing a regulatory framework such as a code of conduct and ensuring passenger rights are protected.

Recommendation: TfSE should consider the finding of the above reports and talking to the Transport Catapult and the House of Commons Transport Committee to ensure that its undertakings are consistent with national policy and to participate in any funded MaaS initiatives.

Finland was the first country to regulate to facilitate the pre-conditions necessary for MaaS. Their Act on Transport Services (also known as the Transport Code) was adopted in April 2017. All provisions in the Act entered into force by July 2018. It promotes customer-oriented, market-based transport services on a competitive basis. It aims to enable new technologies and digitalisation into the transport sector. It obliges transport operators to make essential data available and provides for the interoperability of ticketing and payment systems.

Recommendation: Now that Finnish Transport Code has been in force for a year, the Finish authorities should be contacted to understand any lessons learnt.

APPENDIX A STAKEHOLDER INTERVIEWS

As part of the study presented in this report, a stakeholder engagement exercise was conducted to get their views on the topic. The interviews sought to identify:

- The local challenges related to IST specifically and transport in general.
- Local opportunities TfSE may harness to further IST in the region.
- The potential role TfSE could play in improving transport services in the region.

The interviews were conducted over the phone, lasting for 30 – 45 minutes. The interviews were semi-structured, with a predetermined list of questions as well as prompts, to help keep the responses within context. This allowed for the tuning of the interview to best suit the category of stakeholders interviewed.

The stakeholders interviewed fall into the following categories: Bus Operators, Train Operating Companies, other STBs, Transport Bodies and Local Authorities. The following stakeholder organisations were interviewed:

1. Brighton & Hove City Council: Ben Thomas and Laura Wells,
2. First Group: Matthew Callow
3. Go South Coast: Paul Walker, Andrew Wickham
4. Govia Thameslink: Liam Ludlow
5. Hampshire City Council: Andrew Wilson and Sarah Cook
6. Network Rail: James Waight
7. Rail Delivery Group: Duncan Henry
8. South Eastern: Sean McLaughlin
9. Stagecoach SE: Edward Hodgson
10. Transport Focus: Mike Hewitson
11. Transport for London: Matthew Hudson
12. Transport for the North: Alison Pilling

A.1 Interview analysis methodology

A thematic and deductive approach was adopted for the analysis of the interview responses. This approach focuses on systematically grouping the data collected to identify:

- Similarities and/or patterns in the responses (themes)
- Areas where the responses differ or present something unique (highlights).

The different steps involved in the analysis are described below:

1. **Data Preparation:** The notes taken during the interview are cleaned up to produce transcripts with standalone sentences. The original words of the interviewee are preserved as much as possible. This process also provides the first impressions of the responses.
2. **Data Coding:** The goal of this step is to provide a way of indexing the responses, to make them suitable for categorisation. The transcripts are analysed one by one to label relevant concepts. A concept is relevant if it is repeated, surprising, confirms or challenges a preconceived notion, or where the interviewee explicitly states its importance.
3. **Data Categorisation:** The codes identified for each transcript in the previous step are abstracted into predetermined categories. This categorisation allows for the responses to be examined side-by-side to identify themes and highlights. Themes shows the significance of the underlying points, having been repeated in different transcripts, while highlights capture the unique categories that do not fall into themes.

APPENDIX B INTERVIEW SCRIPT

1. What are the biggest transport challenges facing South east area?
 - a. *prompt: bus patronage down in UK, concessionary funding commitments for future, new apps and new mobility (specifics uber/taxi; MaaS)*
2. What are the specific challenges facing your operating area/sub-region/city?
 - a. *Prompt: who are the non-users you want to get to? What types of integrated journey do you want to fulfil?*
3. What is your vision for integrated ticketing? *[Note integrated ticketing definition: ease of using different modes and/or operators within one integrated ticket or payment tool (virtual or other)]*
 - a. *Check: end-to-end, check multi-modal – esp rail-bus*
 - b. What are the best examples of integrated ticketing in the region? (UK?) – Why have these worked?
 - c. How developed are your plans?
 - d. Impact/role of EMV [probe on Model 1 and Model 2]
 - e. Impact/role of ITSO
 - f. What are biggest drivers and what are biggest barriers?
4. What could be the potential role? Where would TfSE add value? (prompt on following (not mutually exclusive))
 - a. Technical/commercial [eg back office arrangements/settlement *[ask about TfN and Connect examples]*]
 - b. Organizational [partnerships to create change, a voice for transport in the area]
 - c. Standards [define and ensure local standards are agreed]
 - d. Innovation & Investment [support local demonstrations, focus on a target area or group (eg young people)]
5. Where get most bang for buck?
6. What shouldn't they do?
7. Ideal scenario in 5 10 20 years?

Bus operators

Large: their Group's views/initiatives? Views from other geographies that they cover.

Small: particular barriers for adoption of smart?

Train operators

View on national initiatives?

Transport Bodies

What are their initiatives? What role do they see for SNTB?

SNTB

Views on potential role of TfSE? Lessons learnt from their side?

London – Oyster / contactless developments and the SE

APPENDIX C STAKEHOLDER WORKSHOP

C.1 Purpose

Having evaluated the TfSE regional background and held telephone interviews with 12 stakeholders, a stakeholder workshop was held to share the findings to date and seek honest and creative comment from the stakeholders. The aim was to start building consensus on an appropriate strategy for IST in the TfSE area. It was explained to the attendees that the current work is one of several streams in the overall transport strategy for the region and the emerging IST strategy will be integrated with the other work streams.

C.2 Attendees

The workshop was held on Wed 5 June in the Hilton, Gatwick Airport, and the attendees were as follows:

Organisation	Delegate
Luke Taylor-Sales	Brighton and Hove Buses
Andrew Wilson	Hampshire County Council
Andrew Wickham	Blue Star Buses
Kevin Travers	Enterprise M3
Ben Thomas	Brighton and Hove City Council
Paul Holloway	Brighton and Hove City Council
Andy Shaw	Transport for London
Thomas Kounnas	Go Ahead Group
Richard Higgins	Gatwick Airport
Rob Vince	Stagecoach
Lisa Emmett	Go Ahead Group
Rob Dickin	Transport for the South East
Sarah Valentine	Transport for the South East
Benn White	Transport for the South East
Neil McEvoy	Consult Hyperion
John Elliott	Consult Hyperion

C.3 Overview of the day

The workshop began at 10am and was facilitated by Neil McEvoy. Neil introduced the workshop and invited Rob Dickin to give an overview of the TfSE programme of work of which this ITS work stream is part and place the current project in context. TfSE were keen to understand from participants where they can add value to IST in the region and how passenger experience can be improved based on best practice and lessons learned.

Neil went on to give an overview of the characteristics of the TfSE area and highlighted how it has some important differences from other parts of the UK including:

- Commuting to London, though the figures show that this does not dominate the travel patterns of the whole region.

- Corridors between key population areas
- Airports and seaports, which are high volume points of entry to the UK as a whole.

Participants were asked to contribute ideas from existing schemes and highlight what has been successful, might be reused and where there is already integration and interoperability. There was a lively discussion with many participants contributing enthusiastically.

Various existing and nascent smart ticketing schemes were discussed including:

- Two ITSO-based schemes (Solent Go for the Portsmouth/Southampton region and the Key for the Brighton and Hove region).
- TfL's Oyster and open-loop transit payments implementation which is spreading outside of London to important London commuting points such as Gatwick airport.
- Various other implementations of open-loop transit payments by private bus operators.
- Transport for the North and Transport for West Midlands planning, business case and procurement activities.

The interviews that had taken place during this project were then described and the challenges, opportunities and highlights that they have revealed.

There was then a brief break-out session for some 'blue sky thinking' about 'what might good look like?' for travellers in the SE. This was discussed in two groups, with feedback shared at the end.

The workshop concluded with a session on the options that the project has been considering so far and invited comments from the floor. Options included:

- Degree of proactivity of TfSE in IST
- Degree of integration of IST solutions within the SE.
- Business architecture
- Continued extension of TfL's Oyster/open-loop beyond London
- Mobility as a Service

In conclusion, outcomes were collected under the three headings of:

- What does the group agree on?
- What does the group disagree on?
- How might consensus be developed?

The workshop was then wrapped up by outlining the project next steps and thanking all participants for their contributions.

APPENDIX D GLOSSARY

Term	Meaning
5G	Advanced mobile networking technology
A27	Major road along the south coast, mostly in Sussex
ABT	Account-based ticketing – ticketless way of allowing people to travel, using a secure token linked to an account in the back office
ANPR	Automatic Number Plate Recognition – vehicle tracking technology
ApplePay	Mobile payment solution provided by Apple on their phones
AFC	Automatic Fare Collection
Autonomous Vehicles	Vehicles which can control themselves with little or no human intervention
Baby Boomers	People over 60, born in the post-war baby boom
barcode	Visual, machine-readable representation of data
Beacon	BLE device which broadcasts its presence
BIBO	Be-In Be-Out – transport charging scheme depending on sensing when a person joins and leaves the transport environment
Biometrics	Identity technology involving a person's physical characteristics
BLE	Bluetooth Low Energy – communications protocol used by mobile phones
Broker	Mechanism to allow back offices of different operators to interact, without affecting the front end experience
BYOD	Bring Your Own Device – scheme for users to use whichever device they already own
Capping	See Fare Capping.
Carnet	Tickets permitting multiple individual journeys e.g. a pack of 10 singles
Carpooling	Arrangement where people travel together on a car journey e.g. to work
Car sharing	Schemes such as car clubs for renting a car for a short period of time
CAV	Connected and Autonomous Vehicles – vehicles with a high level of connectivity which can control themselves with little or no human intervention
cEMV	Contactless EMV
Central Back Office	Single ITSO back office developed by RDG to integrate ITSO on rail offerings
Citizens' Assembly	Group selected to represent the population in discussing a specific topic
Cloud	Computing resources online in a non-specific area – information is said to be held 'in the cloud'
Closed-loop systems	Systems which are managed by a single organization in a closed environment

Term	Meaning
Commission on Travel Demand	Group researching current and future changes in travel demand
Contactless	Payment or transit protocol where a smart card is tapped on a reader
CPC	Contactless Payment Card
CTC	Contactless Transit Card
Cubic	Technology company which implemented the TfL Oyster system
Customer Media	ITSO term for the card or other device which a passenger carries in order to travel
DEMAND Centre	Centre funded by Research Councils, focusing on energy use and mobility
DfT	Department for Transport
Dockless bikes	Bikes which can be hired using an app and do not need a docking station
Easier Fares For All	Review conducted by RDG to simplify rail fares
ECR	Economic Connectivity Review
Elizabeth Line	Metro rail link across London, previously known as Crossrail
EMV	Europay, Mastercard, Visa – global standard for chip card transactions
ENCTS	English National Concessionary Travel Scheme – governs concessionary fares across the country
End-to-end travel	Travel from the very start to the very end of a journey e.g. walking to the bus stop, bus to the train station, train to another station, taxi to the destination
Extinction Rebellion	Climate Change Campaign
Fare Capping	Process that puts a period-based ceiling on the amount a passenger can be charged for travel e.g. daily, weekly or monthly. This gives the passenger confidence in using the service, knowing that there is a fixed upper limit on charges and that they will be charged a fair price without needing to understand the tariffs.
Gatwick Diamond	Business area around Gatwick Airport
Generation X-ers	People aged 35 – 60 years old
GooglePay	Mobile payment solution provided by Google for users of android phones
GPS	Global Positioning System – satellite navigation system
GTR	Govia Thameslink Railway
HCE	Host-based Card Emulation – emulates smartcard functionality on a phone
IST	Integrated and Smart Ticketing
ITSO	Integrated Transport Smartcard Organisation
IoM	ITSO on Mobile
KeyGo	ThamesLink Travel smartcard
LA	Local Authority

Term	Meaning
LEP	Local Enterprise Partnership
LTA	Local Transport Authority
M20	Motorway in Kent adjoining the Channel Tunnel
M25	London orbital motorway
M27	Motorway joining the M3 to Southampton
MaaS	Mobility as a Service
Medway	Built up area to the east of London, which follows the river Medway
Millennials	People under the age of 35, born around the millennium
Multimodal	Combining multiple forms of transport
NFC	Near Field Communications – mobile communications technology
NHS	National Health Service
Open loop systems	Payment instruments which can be used for generic payments as well as transit
ORR	Office for Rail and Roads
Oyster	London closed loop travel scheme run by TfL
P&R	Park and Ride – scheme to allow motorists to park in a designated area and complete their journey by bus.
PAYG	Pay As You Go enables passengers to travel without first purchasing a ticket.
PlusBus	Standard offering for bus travel in addition to rail travel across the UK network
QR code	Barcode in the form of a matrix, more advanced than basic barcodes
Rail Delivery Group	Organisation responsible for rail services in the UK
Ride Sharing	Arrangement where two or more people share a car journey – may be carpooling or passengers sharing a car for hire
SDP	DfT Single Departmental Plan
SE	South East (of England)
Smart Cities	Initiative to promote adoption of smart technologies in major cities
South Downs National Park	Protected area of countryside, mostly in Sussex
STB	Sub-national Transport Body
STNR	Smart Ticketing on National Rail – scheme run by RDG to bring together all ITSO rail offerings in the UK
Surrey Hills	Area of Outstanding Natural Beauty in Surrey
TCA	Travel Concession Authority – manages concessionary travel in their local area
TfL	Transport for London
TfN	Transport for the North
TfSE	Transport for the South East
TfWM	Transport for the West Midlands

Term	Meaning
Thames Valley	Built up corridor to the west of London, following the path of the Thames
TITO	Touch-In Touch-Out - transport charging scheme depending on the passenger to touch in when they join and touch out when they leave the transport environment
TOC	Train Operating Company
Transport Catapult	Government organization created to promote innovation in transport
Tunnel	Channel tunnel between the UK and France
Unbanked	Individuals who do not have any banking relationships
Underbanked	Individuals who do not have sufficient banking relationships
Williams Rail Review	Wide-ranging review of rail travel launched by DfT in 2018

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