Urban Foresight

Scoping MaaS in Strathclyde: technical report

PREPARED FOR:

Strathclyde Partnership for Transport and Glasgow City Council

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Mobility as a Service gives users a single point of access for planning, booking and accessing all types of transport. This has the potential to make active and sustainable transport more convenient for users, increasing the use of lower-carbon transport and reducing private car use. SPT and GCC's evidence suggests people in Strathclyde are looking for more integrated travel – which MaaS offers.

There are some technical barriers but on the whole, major operators are technologically equipped to enable MaaS. There are, however, significant regulatory and cultural barriers to MaaS. No operator is required to provide data to SPT or GCC, and bus operators lack trust in public authorities. This means that under current powers, a regional MaaS solution could have integrated journey-planning and some booking capabilities, but not for all transport options, not with access to a single price for multiple types of transport, and it would rest on voluntary participation by operators.

GCC and SPT should therefore begin a MaaS Readiness Programme which would build capabilities for a more sophisticated MaaS system over the next 1-5 years.

New powers under the Transport Act 2019 in smart ticketing and bus regulation could mandate operator participation in MaaS. These choices have significant financial and policy implications outwith the scope of this report, but for the purposes of MaaS alone, SPT and GCC should explore using these powers.

Executive Summary

What is this project?

This project scoped Mobility as a Service (MaaS) for the Strathclyde region. It defines the concept, explores potential opportunities and barriers to MaaS, and gives options for developing MaaS. It was commissioned by Strathclyde Partnership for Transport (SPT) and Glasgow City Council (GCC).

What is MaaS?

MaaS makes transport more accessible by enabling users to plan, book and access multiple forms of transport from a single system.

This is usually through a smartphone app: a MaaS system in Strathclyde would mean that a user could travel across the region with tickets, payment and journey-planning for the entire journey managed from their phone. Unlike the current situation, this would put booking and ticketing in one place, and unlike existing apps it would include both traditional public transport and newer types of transport like car-sharing and bike-sharing.

This can lead to modal shift and support carbon reduction goals by increasing the relative convenience of public and active travel.

It can also support public authorities by creating a rich source of data on how people are moving around.

How could it support policy objectives in Strathclyde?

SPT and GCC both have strategic goals of reducing carbon emissions and increasing use of public transport. National policy also prioritises reducing carbon, and supporting sustainable travel and integrated ticketing. Evidence from SPT and GCC on users' current experience of accessing transport suggests that making transport more seamless and integrated is important to citizens. The experience of places which have experimented with MaaS suggests it aligns well with this policy direction.

What needs to be in place for MaaS to work in Strathclyde?

MaaS works when a number of conditions are in place. These come under 5 main themes:

- **Transport provision**: MaaS needs a frequent, dense public transport network with a range of options for users. This creates underlying confidence in the availability of public transport, and creates demand for a tool to seamlessly navigate the system.

- **Operator data**: MaaS needs operators to share data to enable a central planning and booking system – such as timetable information, service availability, booking protocols, and payment systems. This in turn requires operational agreements over data, customer

service, risk and revenue. The technical and legal requirements can vary significantly but accessing operator data is fundamental to MaaS.

- **ICT infrastructure**: MaaS assumes that vehicles or stations can be accessed or unlocked via smartphone, and that operators are capable of mobile ticketing and booking. A standardised, interoperable smart-ticketing system is a useful foundation for MaaS – particularly systems which create individual user accounts - but is not necessary.

- **Policy and regulation**: MaaS requires a policy and regulatory environment that makes responsibilities clear, and sets out governance of data, operations, and relationships with national policymakers.

- **Citizen willingness**: MaaS assumes that a critical mass of citizens are willing to use public transport, and are willing and able to access public transport by smartphone.

What are the current barriers and opportunities for MaaS in Strathclyde?

The project assessed how ready Strathclyde is for MaaS in each of these headings.

Summary chart 1 below shows the most important conclusions by theme and relative importance. The longer the bar, the more important each factor is to the future of MaaS in Strathclyde.

Major opportunities identified in the research include:

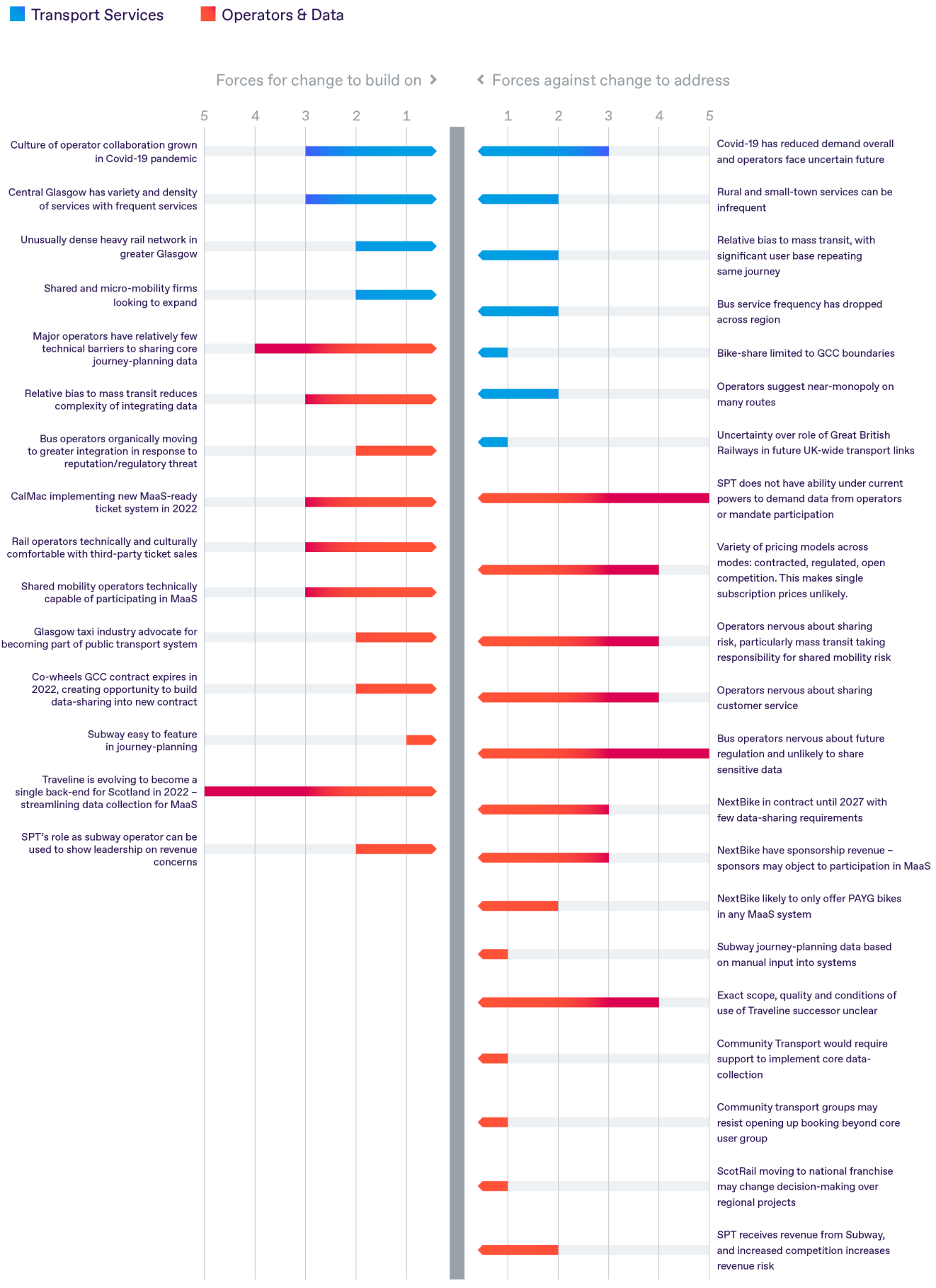
Major operators have relatively few technical barriers to sharing core data to enable MaaS. In particular, ScotRail already allows other organisations to book its tickets, and CalMac will have the ability to offer this from early 2022. Major bus companies are either ready, or could reasonably be expected to develop, the technological basis to share journey planning information, and make booking and ticketing available to third parties. Shared mobility providers are similarly equipped.

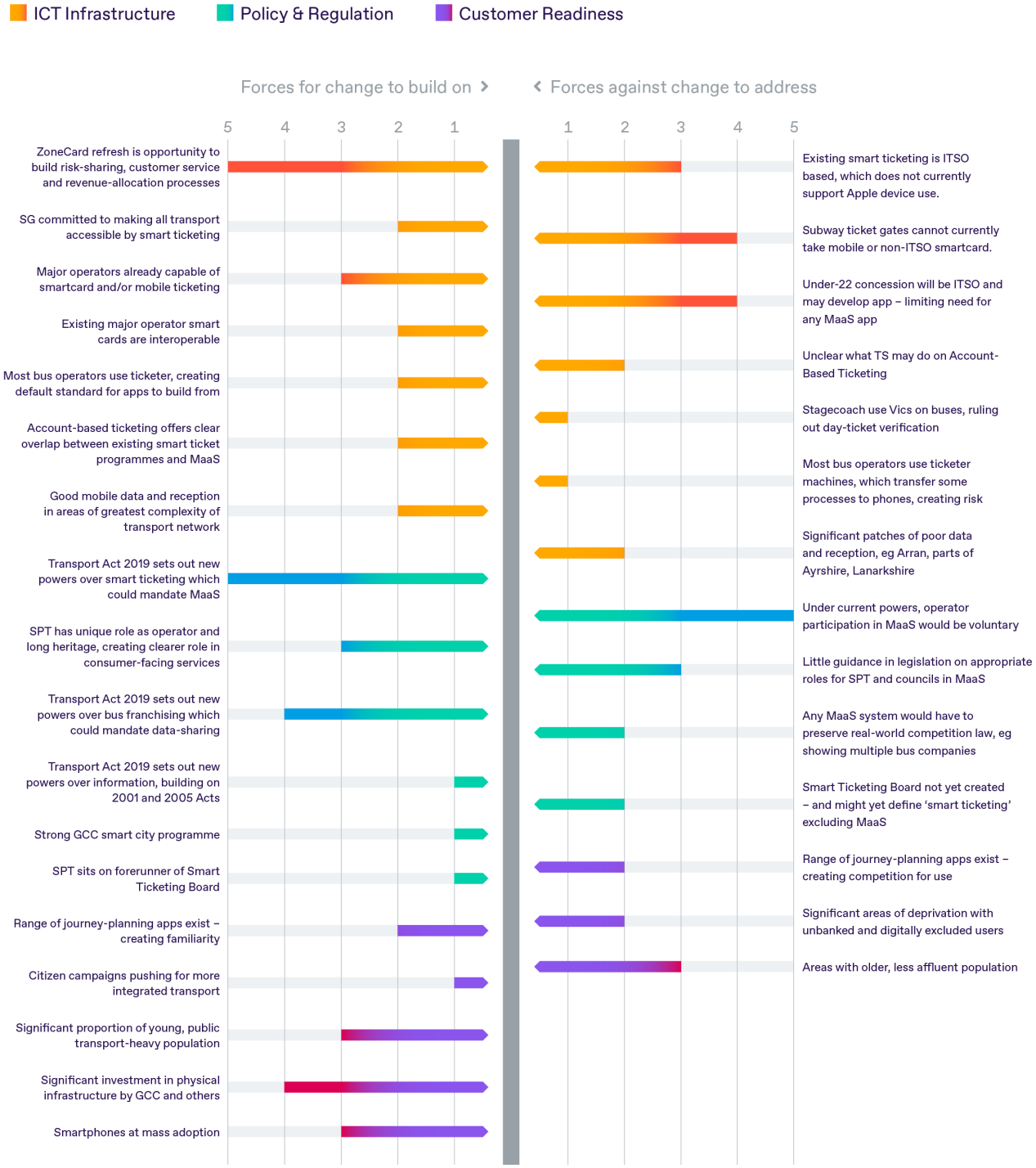
Traveline is evolving with Transport Scotland taking a more direct role and contracting with operators from next year. In effect this will be a single data system for all Scotland. For Strathclyde, this does create a significant dependency on the quality and structure of Traveline, but most likely this means capturing operator data on journey planning and service availability is significantly streamlined.

Co-Wheels' car-sharing contract with GCC is due to expire in 2022, creating a specific opportunity to request minimum data contributions when the contract is retendered.

The Covid-19 pandemic has placed operators on a publicly-supported, more coordinated footing. As operators look beyond the pandemic a greater culture of collaboration may be sustained.

Summary chart 1: barriers and opportunities for MaaS




ICT Infrastructure
Policy & Regulation
Customer Readiness
Forces for change to build on
Forces against change to address
5 4 3 2 1
1 2 3 4 5
ZoneCard refresh is opportunity to build risk-sharing, customer service and revenue-allocation processes
SG committed to making all transport accessible by smart ticketing
Major operators already capable of smartcard and/or mobile ticketing
Existing major operator smart cards are interoperable
Most bus operators use ticketer, creating default standard for apps to build from
Account-based ticketing offers clear overlap between existing smart ticket programmes and MaaS
Good mobile data and reception in areas of greatest complexity of transport network
Transport Act 2019 sets out new powers over smart ticketing which could mandate MaaS
SPT has unique role as operator and long heritage, creating clearer role in consumer-facing services
Transport Act 2019 sets out new powers over bus franchising which could mandate data-sharing
Transport Act 2019 sets out new powers over information, building on 2001 and 2005 Acts
Strong GCC smart city programme
SPT sits on forerunner of Smart Ticketing Board
Range of journey-planning apps exist – creating familiarity
Citizen campaigns pushing for more integrated transport
Significant proportion of young, public transport-heavy population
Significant investment in physical infrastructure by GCC and others
Smartphones at mass adoption
Existing smart ticketing is ITSO based, which does not currently support Apple device use.
Subway ticket gates cannot currently take mobile or non-ITSO smartcard.
Under-22 concession will be ITSO and may develop app – limiting need for any MaaS app
Unclear what TS may do on Account-Based Ticketing
Stagecoach use Vics on buses, ruling out day-ticket verification
Most bus operators use ticketer machines, which transfer some processes to phones, creating risk
Significant patches of poor data and reception, eg Arran, parts of Ayrshire, Lanarkshire
Under current powers, operator participation in MaaS would be voluntary
Little guidance in legislation on appropriate roles for SPT and councils in MaaS
Any MaaS system would have to preserve real-world competition law, eg showing multiple bus companies
Smart Ticketing Board not yet created – and might yet define 'smart ticketing' excluding MaaS
Range of journey-planning apps exist – creating competition for use
Significant areas of deprivation with unbanked and digitally excluded users
Areas with older, less affluent population

ZoneCard is being refreshed. ZoneCard is an existing multi-modal ticket with an established mechanism for revenue-sharing – albeit one resting on a legacy system without operators sharing detailed data on transport usage. This creates a foundation for more complex discussions about sharing revenue, risk and operations in MaaS.

However, the research identified critical limitations in Strathclyde:

Under current regulatory arrangements, SPT does not have the ability to demand data from operators or mandate participation in a MaaS system. Its ability to lead or commission a MaaS systems rests on relationships, voluntary agreements, and partnership working. In the short term, this places strict limits on what kind of MaaS solution is possible.

Bus operators are wary of potential plans for bus franchising, and relationships with public authorities are defined by mistrust. Bus operators are only likely to engage in a system if they can be confident it maintains or increases revenue, or preserves open competition, and does not expose information they consider commercially sensitive to either SPT or their competitors. In practice, that means they are likely to consider integrated journey planning and the ability to book services and show tickets – but not joint ticket prices, revenue-sharing, or information like how busy a bus is. It could also mean any MaaS solution simply links to operator's own app or sites when it offers booking, rather than being carried out in a single platform.

In the long-term, a voluntary arrangement creates significant dependency on other organisations. Any MaaS system risks operators seeing that they are exposed to new forms of competition and withdrawing. Unless a MaaS solution itself has a contract mandating participation on set terms – which is unlikely to be accepted by operators – it rests on operators believing it is in their interests to participate.

NextBike are not required to share data and will likely to be in contract until 2027. The NextBike contract with GCC is likely to run until its extension date of 2027 because it offers a yearly revenue stream to GCC. It does not require any data-sharing beyond minimum KPIs, or participation in integrated systems. NextBike would only gain revenue in any MaaS system by offering pay-as-you-go bikes, and NextBike also make significant advertising revenue from sponsorship, creating a wider risk that their sponsors object to diluting their brand through a common system.

Including subway is difficult. Existing smart ticketing is largely smartcard-based. For subway, this is on the ITSO format – which could be included in a mobile phone-based MaaS app, but not currently on Apple devices. Subway ticket gates would have to be upgraded to enable other mobile-phone based ticketing.

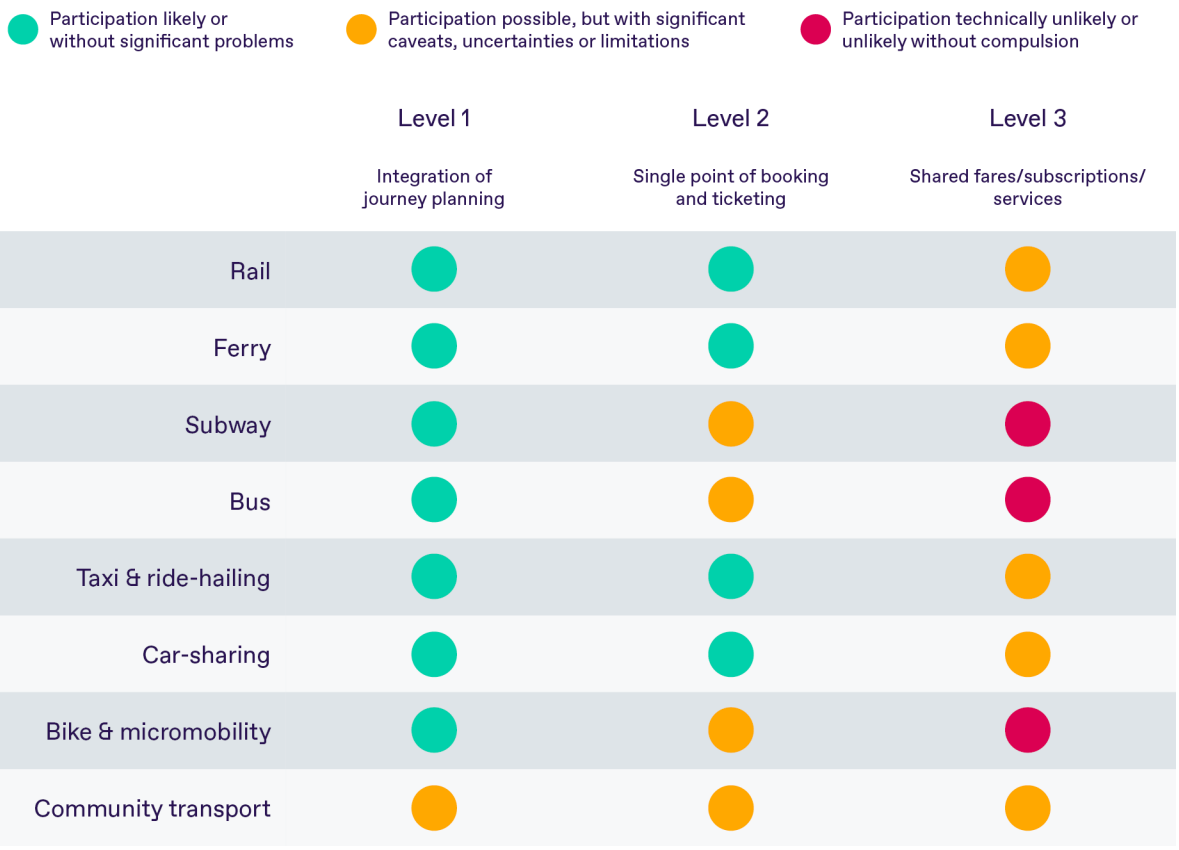
Incentives are not aligned to promote active travel. While SPT could potentially see increased revenue by making the subway part of a much more integrated network it would also have to accept there is some risk of losing subway revenue to walking, cycling and bus.

Strathclyde now has a range of consumer-facing mobility apps. Citymapper and Google Maps offer slick journey planning, most operators have their own apps, and a Traveline app with

integrated booking or a National Entitlement Card app may yet be developed by Transport Scotland. This means that the relative quality and functionality of any new MaaS app has to be relatively strong to gain a user-base.

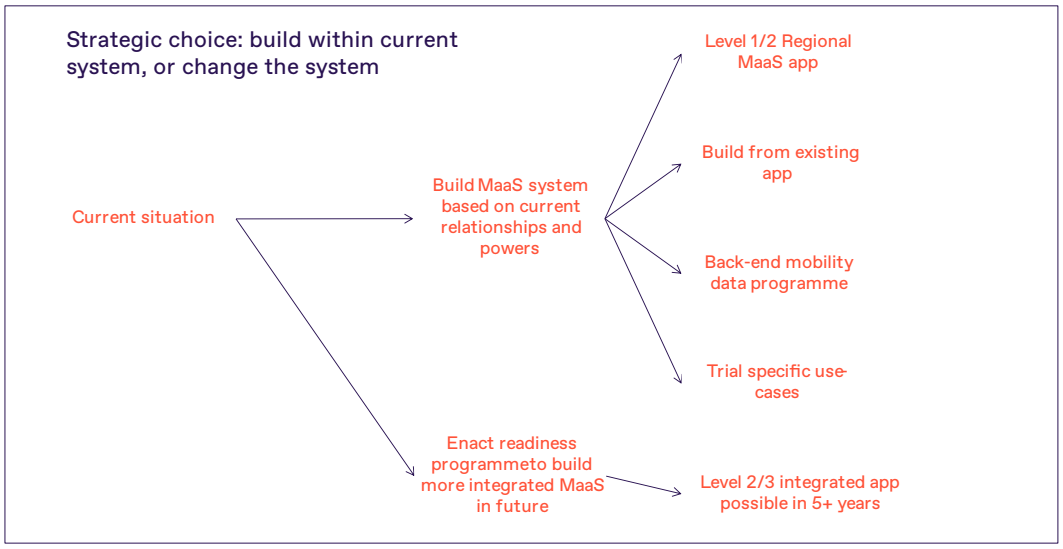
Summary table 1 shows the level of integrated MaaS service which is likely to be realistic, by mode, within the status quo of powers and relationships.

Summary table 1: level of integration likely, by mode, under current situation.



What models of MaaS could be implemented in the current situation?

This situation creates a strategic choice for Strathclyde: either to pursue a MaaS solution reflecting the current situation, or instead to focus on a MaaS readiness programme which builds capacity and aims to develop a more sophisticated system in future.



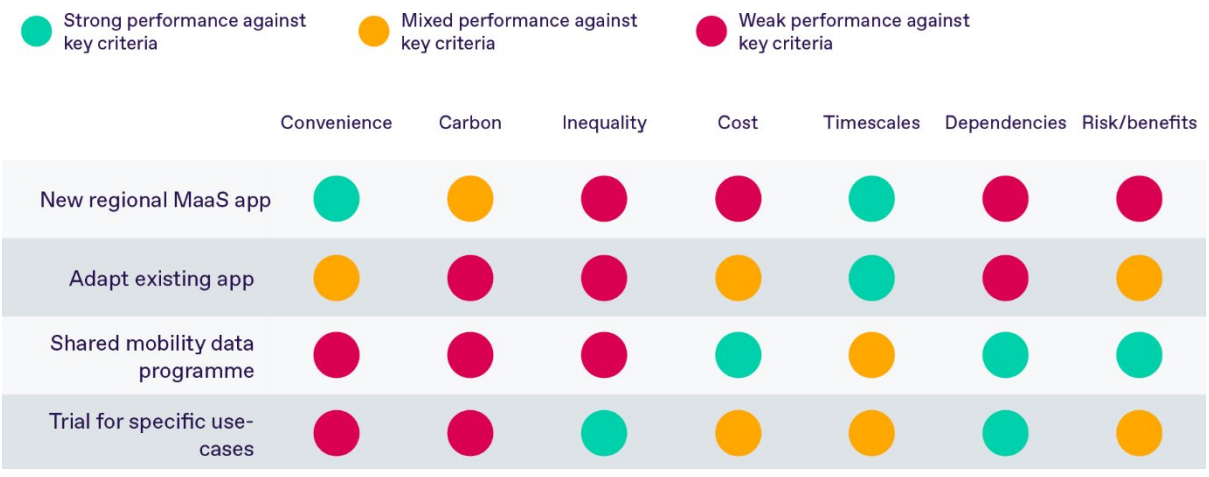
1. **A consumer-facing app** which rests on a voluntary arrangement with operators focussed on journey planning, access to booking and access to payment from a single platform, concentrated on existing mass transit modes. This would not be useable for all subway users without other investment and there is no guarantee over operator participation.
2. **Working with an existing app** to add MaaS-style features. This could be an operator app, a commercial journey-planner, or other public sector apps.
3. Creating a city-specific **open mobility data programme** to enable a range of front-end services. This would build on GCC's existing smart city portal.
4. **Trialling** a MaaS system looking at a particular use-case or target audience.

These options are appraised in the full report and are summarised in table 2.

Summary table 2: options for MaaS

Option	Governance	Spatial scale	Integration level	Transport included	Cost	Timescales
1: Build a new app focused on integrated booking and journey planning,	SPT/GCC commission app from software provider, manage contracts with operators for data sharing, voluntary participation from operators	Regional	Journey planning + some booking and payment	Rail, ferry, bus, car-sharing, bike-sharing. Subway only for journey-planning.	£200-500000 per annum Resource costs	6-12 months
2: Build out from an existing app/service focused on integrated booking and journey planning	SPT encourages/work with existing app providers to add multi-modal journeys & integrated ticketing	Regional	Journey planning + some booking and payment	Rail, ferry, bus, car-sharing, bike-sharing.	<£100,000	1-6 months
3: A shared mobility data programme as part of wider smart city initiatives:	GCC hosts a single hub offering wider data sets on mobility	Glasgow city	Enabling others to offer journey planning + booking and payment	Workstreams on every mode	<£50,000	Immediate start, 5-year horizon
4: Build a trial/pilot service around use-cases or audiences.	SPT scopes, plans and delivers trials	Region-wide, local/hyper-local trials	Integrated journey planning, booking and pricing for selected groups	Mass transit + modes for particular user groups	£100-400,000	1-2 years

Summary Table 3: scoring of options



What about future powers?

Relationships with operators could change under the terms of the 2019 Transport Act which creates new powers in bus franchising and smart ticketing. These wider policy choices have significant questions which are beyond the scope of this report. However, the Act creates the ability for SPT or GCC to mandate participation in smart ticketing schemes, which likely includes MaaS; and a different regulatory relationship with bus services could include data-sharing provisions. Using these powers is the clearest route to implementing an impactful MaaS system.

What could enable a more sophisticated MaaS system in future?

The second strategic option is not to target a solution immediately, but enact a **MaaS readiness programme**. This would start with an analysis of how to make the most of the opportunities and barriers outlined above. Potential responses could include:

Policy

This includes writing council and SPT policies which align with the requirements of MaaS, particularly in mandating data-sharing in mobility contracts.

It also includes understanding how national policymakers will pursue important themes such as smart ticketing and the NEC.

Relationship-building

This includes actions which focus on building trust: approaches which work within current powers to build operator comfort with integrated services through trials, cultural leadership and practical support.

Regulatory changes

This includes exploring potential changes to regulation under the terms of the 2019 Transport Act.

Operations changes

This includes looking at changes to finance, legal and risk management processes to enable MaaS.

Technology upgrades

This means software and hardware changes required to enable MaaS.

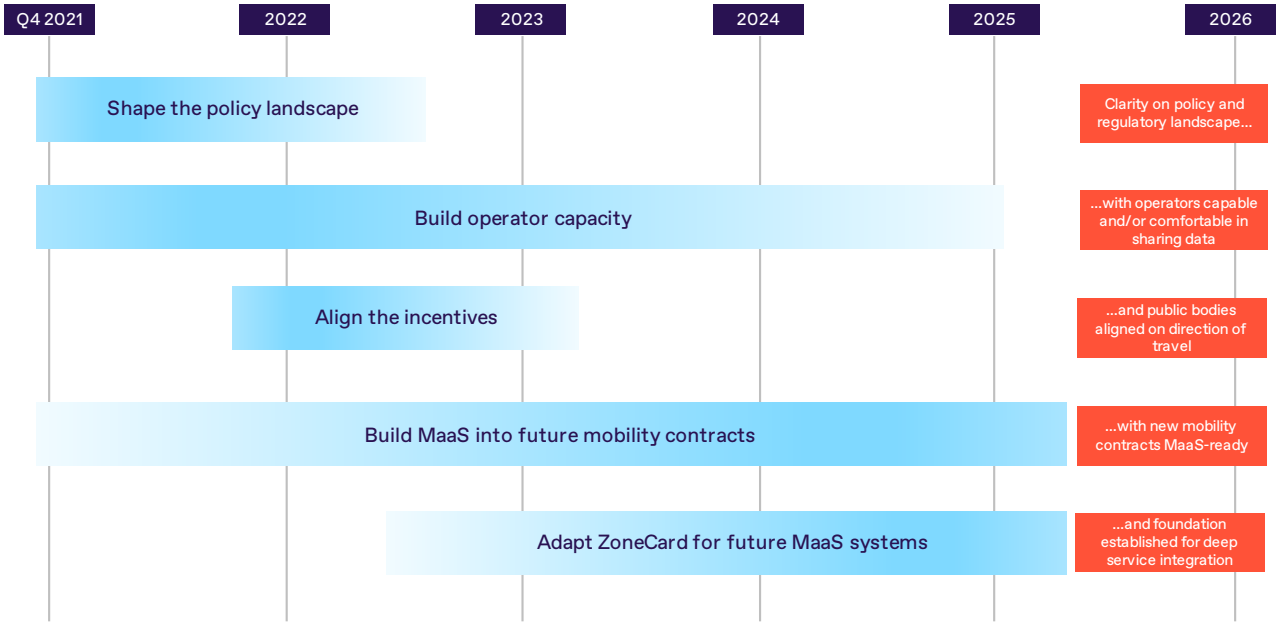
What would a MaaS readiness programme involve?

A MaaS readiness programme would identify actions in policy, relationships, regulation, operations and technology. Taken as a whole, they would build capacity for MaaS.

The objective is for SPT and GCC to be capable of commissioning a regional MaaS system which offers integrated journey-planning, booking, payment and ticketing verification – and some elements of integrated pricing - in 5 years' time.

This programme should include actions under 5 headings in broad order of priority. Actions are summarised in summary table 4.

1. **Shape the policy landscape.** SPT should push central policymakers to take decisions which support its ability to deliver a strong MaaS solution.
2. **Build operator capacity** for MaaS through tactical integrations between different operators, supporting hardware upgrades, and understanding operator projects.
3. **Align the incentives** for GCC and SPT to benefit from more integrated travel options in Glasgow City Centre.
4. **Build MaaS into new mobility contracts** with provisions for requiring data from operators.
5. **Develop ZoneCard** as a foundation for elements of a future MaaS system, such as using its revenue allocation method, risk-sharing and customer service tools.



Summary table 4: a MaaS readiness programme for Strathclyde

Responsibility	Type of intervention	Action	Timescale: action within...
Shape the policy landscape			
SPT	Policy	Engage with Smart Ticketing Board to define smart ticketing as including MaaS	12 months
SPT	Policy	Engage with Transport Scotland to advocate for interoperable booking through Traveline	6 months
SPT	Policy	Engage with Transport Scotland to understand future of account-based ticketing, the NEC and other services	6 months
SPT	Regulation	Take legal advice on use of Transport Act 2019 and explore other policy questions	6 months
GCC/councils	Policy	Pursue complementary policies in physical interchanges and core transport provision	Ongoing
Build operator capacity and willingness for MaaS			
SPT	Relationships	Build operator comfort by identifying value-added MaaS services – where there service is added to non-transport third parties	2 years
SPT	Relationships	Use CalMac's new capability to build operator comfort with MaaS: adding ferry to existing apps, eg bus operators' apps	12 months
GCC	Operations	Ask NextBike to speak to sponsors about MaaS and explore any potential conflicts	12 months
SPT	Technology upgrade	Identify and support community organisations looking to upgrade technology	2 years
SPT	Technology upgrade	Build mobile-first into future hardware upgrades including Subway accessible to mobile	5 years
SPT	Relationships	Understand direction of bus operator ticketing integration	Ongoing
Align the incentives across organisations to pursue MaaS			
GCC/SPT	Policy	Agree on subway/bike-sharing alignment of strategic goals and process for sharing revenue/risks	2 years

SPT	Policy	Coordinate new apps across region from public bodies	Ongoing
SPT	Relationships	Work with regional partners to upgrade digital connectivity	Ongoing
Build MaaS into future contracts			
GCC/councils	Policy	Require data-sharing to enable MaaS in future mobility contracts	Ongoing
GCC/councils	Policy	Require industry-standard data formats in mobility contracts	
GCC/councils	Policy	Require industry-standard vehicle unlocking in mobility contracts	
GCC/councils	Policy	Avoid vendor lock-in: contracts with providers who have exclusive agreements with other providers	
GCC/SPT	Policy	Limit exposure to contractors who will resist integration	
Adapt ZoneCard to build operational functions for future MaaS systems			
SPT	Policy	Secure option for SPT to access or own data from ZoneCard	12 months
SPT	Operations	Design-in expanding ZoneCard's revenue allocation process to include future modes/contracts	2 years
SPT	Technology upgrade	Explore potential for ZoneCard app with journey-planner	2 years
SPT	Operations	Add shared mobility provider(s) to ZoneCard consortium	2 years
SPT	Operations	Agree shared customer service protocols between partners	5 years
SPT	Operations	Develop risk-allocation processes between partners	5 years

1 Introduction

1.1 Project purpose

This project is a scoping study for Mobility as a Service (MaaS) in Strathclyde.

Its purpose is to define what MaaS could mean in Strathclyde, to identify its relationship with policy objectives, to understand potential demand, identify a set of options for progressing MaaS and make a recommendation on the way forward.

It was commissioned by Strathclyde Partnership for Transport (SPT) and Glasgow City Council (GCC) to Urban Foresight.

1.2 Terms of the project

The project covers:

- The entire Strathclyde region – recommendations and analysis can focus on a particular area, but the project is about working out what MaaS could mean for the wider region.
- Passenger transport.
- Actions in the next 1-10 years.

1.3 Methodology

The research for this project drew on:

- A literature review of emerging ideas and case-studies of MaaS
- Desk research, modelling and analysis.
- Interviews with stakeholders across operator, policy and wider stakeholder categories. These interviews allowed stakeholders to place information on or off the record. Organisations included:

Operators:	ScotRail
	CalMac
	McGill's
	FirstBus
	Stagecoach
	Community Transport Glasgow
	Rural Development Trust
	NextBike
	Co-wheels
	Enterprise Car Club
	Subway (SPT)

Policy and regulation:	SPT GCC Transport Scotland TacTrans
Data and other stakeholders:	Urban Big Data Centre, University of Glasgow AccessAble VisitScotland Traveline
International MaaS operators	Instant System and Citymapper were interviewed specifically for this project.

Some other operators, such as taxi industry representatives, were invited to participate but declined. Urban Foresight has had a range of wider conversations on MaaS with operators and MaaS platforms shortly before and during the course of this project, which have informed this report. This includes:

- MaaS services such as Trafi, Transdev, MaaS Global, Iomob, Google
- Operators such as FreeNow, Bolt, Lyft, Dott, Bleeper, Lime, Uber, LNER
- Policy organisations such as the ITF, EIT, UMoS, UITP, EMTA, Department for Transport, Technology Scotland, MaaS Alliance, and Transport Scotland's wider MaaS team.

1.4 Definitions

MaaS is defined in section 2.

This paper defines new powers in the 2019 Transport Act which have passed into law but have not yet been exercised by SPT, or are still being implemented by the Scottish Government, as **future regulation**. The existing set of regulatory relationships is referred to as **the existing system** or similar terminology.

Other terms used in this report include:

- Platform: a website, app or service which pools different services into a single place for others to use or access.
- Active and sustainable travel: a general term for any mode which is low-carbon, shared or public.
- API: application programming interface. A tool which allows an organisation to make its data or processes easily useable to other organisations, by connecting software systems.
- SDK: software development kit. A toolkit which allows an organisation to make data, processes and software design principles useable to other organisations.
- ABT: account-based ticketing. A ticketing process where tickets are 'on account', meaning

a user can tap-in to a service, and does not pay until they tap out and a fare is automatically calculated.

- NEC: National Entitlement Card. The smartcard providing free bus travel for over-65s, and now young people.
- LTAs: local transport authorities, the bodies in Scotland with statutory responsibility for certain transport tasks. These are typically local authorities but SPT is also an LTA.
- Mode: a type of transport, eg bus, car, train.
- Multi-modal: a journey using multiple modes.
- Point-to-point: a journey which is planned from an exact location to another exact location, as opposed to from stations or fixed public transport interchanges.
- Shared mobility: services where the vehicle is not owned by the users and is not mass transit, such as car-sharing or bike-sharing.
- Micromobility: shared mobility services with small vehicles. This usually refers to scooters and e-scooters, but is also sometimes used to refer to bike-sharing.

2 Defining Mobility as a Service

This section defines MaaS, sets out the most important concepts in its design, and the outcomes achieved in MaaS projects elsewhere.

2.1 What is Mobility as a Service?

MaaS redesigns transport around the user, so instead of planning, booking, paying or accessing transport by individual mode and from set stations or locations, users receive more bespoke options for their individual needs which cover point-to-point journeys and a range of modes, integrated into a single service.

In its original form, MaaS usually referred to a specific business model: an aggregator, which packaged up a range of transport options into a single annual or monthly subscription payment, which allowed booking and journey-planning from a single app.

Over time, the term has been diluted in general usage – to the extent that almost any transport operator with any kind of app might call themselves a 'MaaS operator' – but become more specific in academic and policy circles.

A good working definition is provided by the University of Sydney:

> "MaaS is a framework for delivering a portfolio of multi-modal mobility services that places the user at the centre of the offer. MaaS frameworks are ideally designed to achieve sustainable policy goals and objectives. MaaS is an integrated transport service brokered by an integrator through a digital platform. A digital platform provides information, booking, ticketing, payment (as PAYG and/or subscription plans), and feedback that improves the travel experience.
>
> The MaaS framework can operate at any spatial scale (i.e.urban or regional or global) and cover any combination of multi-modal and non-transport-related multi-service offerings, including the private car and parking, whether subsidised or not by the public sector.
>
> MaaS is not simply a digital version of a travel planner, nor a flexible transport service (such as Mobility on Demand), nor a single shared transport offering (such as car sharing). 'Emerging MaaS' best describes MaaS offered on a niche foundation. This relates to situations where MaaS is offered on a limited spatial scale, to a limited segment of society or focused on limited modes of transport. The MaaS framework becomes mainstream when the usage by travellers dominates a spatial scale and the framework encompasses a majority of the modes of transport."[1]

This leaves significant scope to define MaaS in a more specific way for individual places.

2.2 Concepts for creating MaaS systems: components, models, integration levels and data

This section sets out concepts which will be referred to later, to structure the analysis of how MaaS could work in Strathclyde.

2.2.1 The components of MaaS

A range of frameworks for breaking down MaaS into its component parts are available. UCL created a MaaS maturity index which aimed to understand the readiness of any given place for MaaS[2]. This includes the following elements:

- **Transport services and infrastructure**: how ready the current transport system is for MaaS. This includes the variety of modes available, the density of services, and the frequency of services.
- **Transport operator openness and data sharing**: the extent to which transport operators share data and make APIs available to third parties, and the commercial restrictions on sharing data.
- **Policy, regulation and legislation**: the extent to which key policies, regulations and laws which support MaaS are in place.
- **ICT infrastructure**: the penetration of MaaS enabling technologies. This includes internet access, smart ticketing infrastructure, and existing integrated products.
- **Citizen familiarity and willingness**: the extent to which citizens lifestyles and behaviour aligns with a MaaS model of transport provision.

In our previous MaaS projects Urban Foresight has found it useful to add a further distinction common in technology development between:

- **Back-end systems**: the data architecture, data integration, and the underpinning legal, operational, and commercial agreements to enable MaaS.
- **Front-end services** – the consumer-facing services such as journey planners, MaaS aggregators and apps which work from the back end. Terms like MaaS platform, MaaS service provider or MaaS provider mean front-end services.

For the rest of this report, an adaptation of UCL's framework will be used to structure insights on the current situation and considerations for a future MaaS system, but with an additional distinction throughout the report between front- and back-end activities.

2.2.2 What is required for MaaS to work?

Each of the categories above can be used to give an overall sense of what is necessary before MaaS can work:

- **Transport provision**: MaaS needs a frequent, dense public transport network with a range of options for users. This creates underlying confidence in the availability of public transport, and creates demand for a tool to seamlessly navigate the system.
- **Operator data**: MaaS needs operators to share data to enable a central planning and

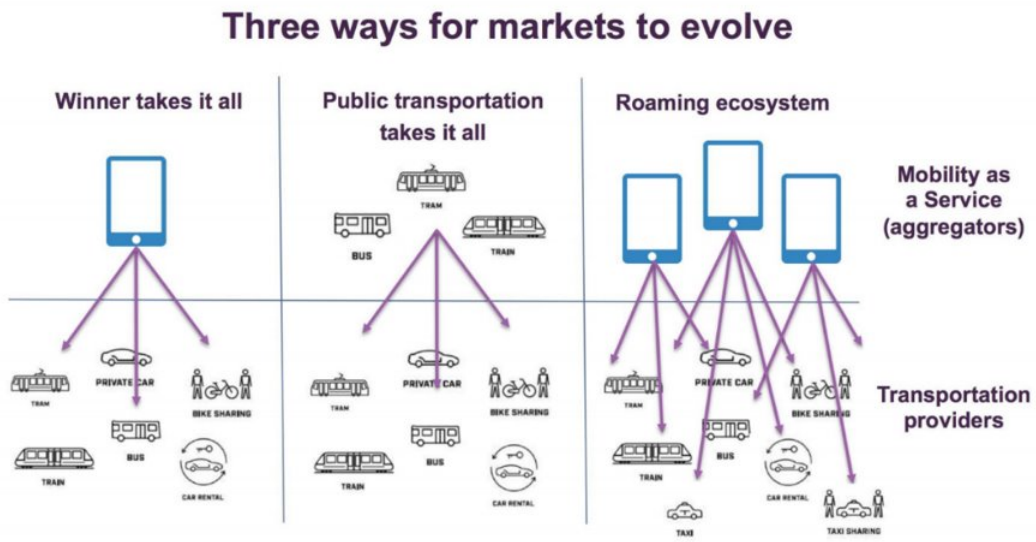
booking system – such as timetable information, service availability, booking protocols, and payment systems. This in turn requires operational agreements over data, customer service, risk and revenue. The technical and legal requirements can vary significantly but accessing operator data is fundamental to MaaS.

- **ICT infrastructure**: MaaS assumes that vehicles or stations can be accessed or unlocked via smartphone, and that operators are capable of mobile ticketing and booking. A standardised, interoperable smart-ticketing system is a useful foundation for MaaS – particularly systems which create individual user accounts - but is not necessary.
- **Policy and regulation**: MaaS requires a policy and regulatory environment that makes responsibilities clear, and sets out governance of data, operations, and relationships with national policymakers.
- **Citizen willingness**: MaaS assumes that a critical mass of transport users have smartphones, and are willing and able to access public transport by smartphone.

2.2.3 Broad models for MaaS systems

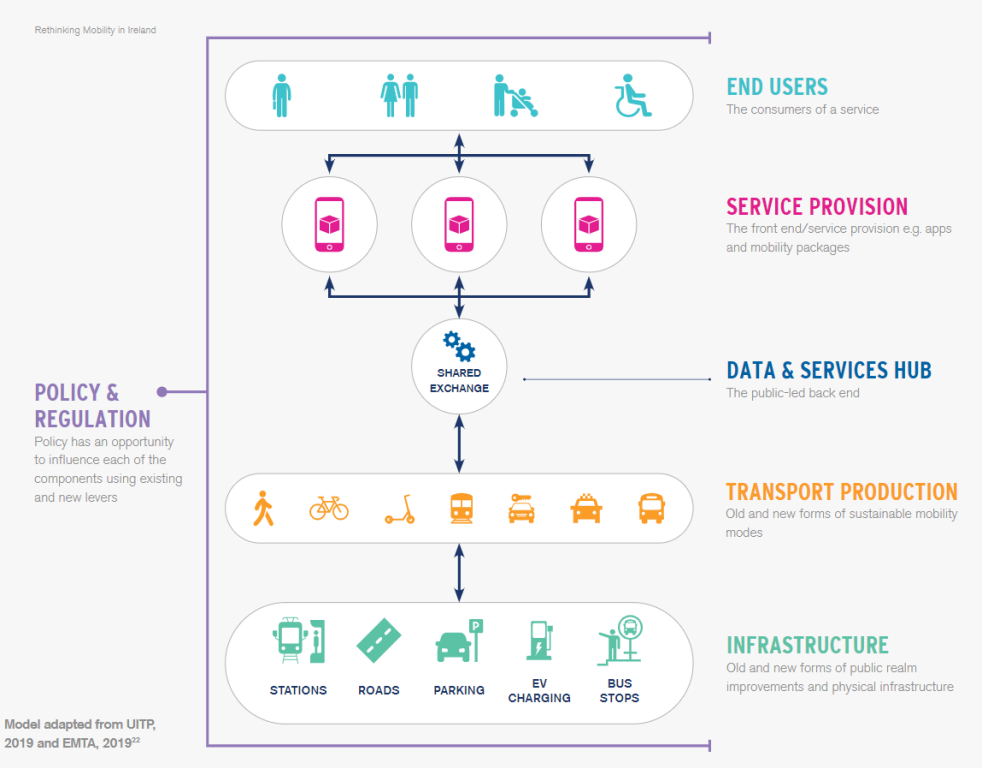
Most discussions of MaaS follow an early whitepaper[3] suggesting three broad models for how responsibilities are allocated: a private-led model where infrastructure, policy and transport services work on current mix of public and private, but with a private front- and back-end provider leading MaaS; a public-led system where a public organisation leads on front and back-end services; and a mixed ecosystem where public authorities create a back-end, with a range of private and public front-tend services.

Diagram 1: 3 main models of MaaS



Over time, the distinction between front-end and back services has crystallised. Urban Foresight's concept for a MaaS system for the Republic of Ireland shows how these responsibilities can be divided: that model proposes a single, publicly-owned back end, but with a range of private and public front-end services; with transport provided by public and private organisations; and infrastructure provided by public organisations.

Diagram 2: a MaaS concept for Ireland



2.2.4 Levels of integration in MaaS

Most discussions of MaaS distinguish between the varying level of integration any given system offers, usually derived from Sochor et al (2017)[4]:

- Level 0: No integration – single, separate services
- Level 1: integration of information – multimodal travel planners and price information across different modes.
- Level 2: integration of booking and payment – the ability to find, book and pay for a trip across multiple modes from a single platform.
- Level 3: integration of service – bundling of travel prices into point-to-point fares, monthly or annual subscriptions across multiple modes, and other consumer-facing services.
- Level 4: integration of societal goals.

This framework is common and is used throughout this paper because it creates an internationally-comparable reference point, and SPT may encounter references to levels of integration elsewhere. Some organisations suggest that level 2 is the minimum additional capability for a service to be considered a true MaaS system, adding new functionality to existing journey-planning services.

Three nuances should be noted:

- Since this framework was created, there is wider recognition that societal goals can be achieved at each level of integration – for example, creating a journey planner means

creating a routing algorithm, which has opportunities for policy influence (for example, prioritising active travel).

- The definition of 'booking and payment' has required expansion as some services, may be better not offering the ability to book, but the likelihood of service availability – such as micromobility, frequent bus services or the subway; an app could also be a central access point which then links to other organisation's websites, so is not necessarily offering direct booking itself.
- While level 2 integration is often considered the minimum additional capability to be considered MaaS, some services may not be appropriate for booking/payment in advance – such as an on-demand small ferry – and therefore lacking this kind of integration is not a significant disadvantage.

Where appropriate, this paper spells out where level 2 integration means a specific form of booking approach.

2.2.5 What data does MaaS require?

The term 'data' is often used liberally to describe many different sets of information. The most important data sets, processes, and underpinning legal agreements are covered below, mapped against the levels of integration.

Many of these datasets are both inputs for MaaS and are created or added to by MaaS: for example, MaaS requires information on locations of people and vehicles, but will itself create a significant dataset on where people are when they want to access vehicles.

These data categories set the foundation for discussing what kinds of MaaS solution are viable or desirable in Strathclyde. There are different options for structuring data, and the processes below present numerous choices over technical implementation. This should be treated as a broad overview.

Required at integration level...	Data category	Data item	Data type	Ownership/creation
1	Basic user information	ID and user account information	Static and dynamic	Mix of owned by operators and generated by MaaS platform
		User consent to location and information being used	Static	Generally held by MaaS platform
		User location	Dynamic	Generated by user, generally shared with MaaS platform
	Journey planning information	Timetables for fixed and mass transit	Static	Operators/existing open data programmes
		Walking distances and times	Static	MaaS platforms generally provide walking route-planning
		Historic data on journey times, traffic patterns, road use to design routes	Static	Operators, public authorities; MaaS platforms also generate this data
		Real-time journey planning information such as congestion	Dynamic	Public authorities, operators
		Information on accessibility, space for luggage, wi-fi availability	Static and dynamic	Operators
		Contextual data such as environmental impacts, data from connected devices on weather/air quality,	Dynamic	Wider smart-city initiatives and public authorities
		Location of vehicles	Dynamic	Operators
		Current speed of vehicles (to enable arrival time and journey time planning)	Dynamic	Operators
		Bike/scooter/car availability at docking stations	Dynamic	Operators
		Service updates	Dynamic	Operators
2	User information	Information to access certain services, such as driving licence, age	Static	Generally held by MaaS platform

		Payment information such as credit card details	Static	Operators or MaaS platform
	Service information	Prices – for each mode	Mix of static and dynamic	Operators
3	Service information	Prices – for complete journey	Mix of static and dynamic	Operators and/or MaaS platform

Required at integration level…	Process	Notes on ownership/management
1	Account and user verification	This is generally undertaken by MaaS systems but some operators want to retain ownership of customer – and therefore some systems are structured around the user still having an account with every operator, but those details are stored and saved on a MaaS platform so they do not need to sign-in separately.
	Gaining user consents	Generally undertaken by MaaS platforms or streamlined by MaaS platforms so users can give/refuse consent to multiple operators in one place.
	Anonymisation and security of personal data	Generally undertaken by MaaS platforms.
	Journey-planning data cleaning and collation	Most systems end up with joint working between MaaS platforms and operators to standardise data formats and resolve any data-cleaning issues.
	Route-planning	Most MaaS platforms have proprietary route-planning algorithms.
2	Booking processes	Generally undertaken by MaaS platforms – requiring operators to allow third-party booking.
	Availability management	The preference over showing real-time or predictive availability for bikes/scooters/cars varies by operator, and by MaaS platform – but this is usually a joint decision between operator and MaaS platform.
	Accessing vehicles	Access to services (whether by ticket, or code for bike/scooter/car sharing) is generally provided for users on MaaS platforms. This requires operators to allow a third party to offer access tokens/tickets/codes.
	Ticketing verification/activation	Depending on the transport type and existing hardware, tickets may have to be verified or activated. This is generally undertaken on MaaS platforms.
	Payment, security and anti-fraud	Mix of MaaS platforms running payment and fraud

	processes	processes, and operators retaining payment and fraud processes.
3	Pricing tools	Creating single point-to-point prices across multiple modes requires a process for agreeing revenues and costs, and presenting a price to the consumer. Where this exists it has been a MaaS platform or public authority leading this process.
	Analysis of usage	Rich analytical processes can help optimise MaaS. This is shared by MaaS platforms, operators and public authorities, depending on the governance of the system.

Integration level	Commercial/operational agreements required to share data
1	Agreements covering user data protection, use of input data, ownership and usage of data generated by MaaS platform Agreement on customer ownership.
2	Agreements required for level 1 plus: Commercial agreement on structure/management of booking, ticketing and payment processes. SLAs/contracts for tickets booked on same platform but otherwise legally/financially separate. Customer service protocols for booking/ticketing through shared system. Risk management processes for multi-modal journeys.
3	Agreements required for level 2 and 3 plus: Fuller insurance/risk-sharing processes. Revenue allocation processes. Joint customer service.

2.3 The experience of MaaS elsewhere

This project carried out a literature review to identify the latest thinking and practice in MaaS. The most important conclusions for the discussion that follows are:

2.3.1 MaaS has significant potential in modal shift

There is evidence from international MaaS trials and pilots that MaaS has an impact on public transport use increase, car use reduction, increase in shared services and micro-mobility modes. For example:

- In Helsinki, after one year of a full MaaS subscription app, 73% of trips were by public transport – compared to 48% of users outside the MaaS system. 12% of all bike trips are taken within 30 minutes before using mass transit – and 30% within 90 minutes after using public transport.[5]
- In Vienna, a trial of a MaaS app in 2014-16 found that 46% of participants changed their modal choice on leisure trips – and 21% of users reduced their car use. 69% of users in a MaaS pilot said information outlining reduced journey times was their main motivation for using the system.[6]
- In Gothenburg, 36% of non-car owner participants in a MaaS trial said they would delay purchasing a car thanks to the MaaS app.[7]
- In Sydney, in a trial of 100 users a subscription MaaS system, 17% of participants reported a change in their view to be less in favour of car ownership.[8]
- In Singapore, trial, 96% of users said they preferred using public transport after using the MaaS app.[9] The app in question closed in early 2021.

The exact mechanisms for modal shift are not always clear. Tools within MaaS systems which have some supporting evidence, or are at least considered by MaaS specialists to be the crucial new lever, are:

1. **Bundling**: There was evidence in transport planning, long before MaaS systems were considered, that smartcards and interoperable tickets can reduce car use: London saw car use drop 7% after introducing single passes for tube and bus, for example.[10] There is also evidence across numerous industries that consumers are receptive to new products, if they are bundled. MaaS takes forward this logic by exposing consumers to services they would not otherwise consider. There is strong academic evidence that are willing to try transport modes they did not use previously, if their MaaS subscription included them: Over 60% of users in London indicated they would be willing to try shared modes that they previously did not use, if their MaaS subscription plan included them.[11] This, in turn, can lead to an organic, consumer-led modal shift away from private cars.

2. **App design**: User-friendly and informative interfaces are key tools to change mobility behaviour. Behavioural change in app design is well-established and placing transport options in different locations or with different designs can nudge users towards those choices. For example, information on the mode with the lowest carbon emissions, or best route for air quality, can be added, filtered, and presented to the consumers to make

informed choices.

3. **Journey planning**: Journeys accessed through a common data system can give public authorities a clearer understanding of transport supply and demand. Routing algorithms also create specific opportunities to prioritise certain attributes, such as prioritising lower-carbon modes, or suggesting that users get from point to point in ways that logically use shared or public transport. Data on journeys created and held in a MaaS system allows mobility service providers give better information to users on how to get around – thus creating a virtuous circle of feedback and transport planning.

2.3.2 But there are few systems running at scale, with poor understanding of total usage

The reported real-world benefits are from pilots and trials, and not systems at scale so far. Around 40 European cities have been experimenting with MaaS, and most trials have had less than 500 users. In contrast, there are only few regular MaaS services up and running at scale offering level 2 or 3 integration. Only Helsinki has a mature, level 3 service, and this is currently loss-making to the MaaS service provider.[12]

MaaS providers are reticent to provide full user information in the public domain. There is also no industry standard for modelling demand for MaaS, as the concept rests on revealing latent demand. Traditional OD matrices have been used to model demand for MaaS in other cities, but this practice is not widespread. The Department for Transport funded a study in 2018-19 which created a new technique using mobile phone data to model demand for MaaS, which is promising but not yet commercially available.[13]

This means it is hard to provide accurate numbers on users of MaaS systems. Private conversations, some publicly-declared numbers, and Urban Foresight estimates suggest that MaaS systems are generally achieving less than 10% of their total populations. Helsinki is understood to be at around 2.5% of the total city population for regular users; Ile-de-France which has a level 2 system is at around 3%. It is also hard to quantify the relative success of these initiatives: in absolute terms, this means apps with tens of thousands of users, which most developers would be delighted to receive. It is not perhaps not the expectation of transformation some MaaS advocates suggest, however.

2.3.3 At an EU level, there is an emerging consensus away from public apps and towards back-end systems at an EU level

Cities and regions across Europe are increasingly focused on establishing the data rules of a MaaS system but permitting a range of consumer-facing apps – for a variety of reasons driven by the experience of MaaS trials and pilots. These reasons include:

- **Capacity**: maintaining and updating consumer-facing apps is costly and resource-

intensive for public authorities.

- **Consumer stickiness**: customers are loyal to apps and ruthless at rejecting poor user interfaces. They are used to juggling different apps. Public attempts to create new apps which have to attract consumers into a new single service fight against existing habits.
- **Desire for innovation**: Many places believe that by focusing on data, the market will trigger new combinations of services to emerge. For example, tourism business may add mobility to their traditional services, if there is publicly shaped data from which they can work. These are usually referred to as 'open mobility marketplaces' or similar.
- **Flexibility and futureproofing**: Places taking this approach may, in time, develop their own consumer-facing app; this approach reserves that option. Cities like Munich or Vienna which do have their own MaaS app have taken this approach – creating their own city platform but allowing private apps to work alongside them.
- **Control**: Public authorities understand that data has value and shaping the back-end platform can be as influential as front-end communications. The direction of travel, in other words, is for public authorities to act as honest brokers of data – and see data as the central tool for shaping future mobility systems, and leading modal shift.

2.3.4 MaaS could enable some tools to address inequality

There is limited practical evidence of MaaS achieving social objectives in reducing inequality. Beyond the general role of public transport in creating opportunities for lower-income groups, three cases are made on how MaaS could in theory do so:

- **Offering specific services for specific users.** MaaS is about user-centricity, and front-end services could improve the transport offer for people with specific disadvantages and needs. This could be a set of modes concentrated on low fares, or access requirements such as wheelchair access, learning difficulties, or language.
- **Improving access to shared services.** Services like car-sharing are often targeted at lower-income groups, because they may want to have access to a car, without the burdens of ownership.[14] MaaS improves access to these services and is therefore an appropriate tool for low-asset households.
- **Reducing poverty premiums**. Lower-income households often face higher up-front costs for services. In transport, this can include season tickets being cheaper – but requiring good credit or high up-front costs – leaving low-income users to buy daily tickets which are overall more expensive. It can also include higher costs for car insurance, which is usually priced by postcode and demographic data. MaaS could tackle these challenges by supporting lower-income users to take up subscriptions or integrated payments. This could either be through direct subsidy (for example, discounting a MaaS subscription for lower-income households), implicit subsidy (for example, risk premiums which are set city-wide, effectively cross-subsidising low-income users) or through 'mobility credits' – a token which can be used in any transport mode and are added to low-income users' accounts.

2.3.5 Selected ongoing projects in Scotland and UK

City	When?	Integration level?	How is the project structured?	Which transport modes are included?
Birmingham	Pilot from August 2017 to April 2019; now procuring MaaS solution.	3, in pilot stage	Partnership between PTO and MaaS Global. Tender is for a private whitelabel MaaS supplier.	PT (bus and tram), Private Car hire, taxis
London (Citymapper)	Founded in 2011	3	Completely privately owned by Citymapper. Used TfL's open data policy and buying TfL tickets at cost, then discounting for users.	PT(bus, rail, ferry, tram, metro), walking, cycling, taxi.
HiTrans	From 2019	2	App commissioned by HiTrans, to Mobileo, covering entire region	PT except ferry
TacTrans	From 2022	2	App commissioned by Tactrans to Fuse Mobility, at 3 pilot sties	Bus, rail, car-
Dundee/Fife	From 2021	1, 2 in future	App commissioned by Dundee City Council to Ember	Bus, rail, bike-share, car share

3 The potential of MaaS for Strathclyde

This section discusses how this international experience of MaaS could translate into the Strathclyde context, and the extent to which policy objectives and user needs could be met by MaaS.

3.1 The policy context for MaaS in Strathclyde

3.1.1 National policy

In December 2020 the Scottish Government issued an update to its 2018-32 Climate Change Plan.[15] This gives an overall goal of Scotland reducing emissions by 75% relative to 1990 levels by 2030, and achieving net zero by 2045. This is in line with the 2019 Climate Change Act. This overall goal is supported by specific objectives in transport including :

- Reducing car kilometres by 20% by 2030.
- Supporting modal shift from car to bus through over £500 millions of long-term bus priority infrastructure funding (the Bus Partnership Fund) to tackle the negative effects of congestion on bus services.
- Phasing out sales of new petrol and diesel cars by 2030.

The plan also includes a specific commitment to exploring MaaS, framed as part of a wider shift to shared mobility :

> We will continue to develop and promote awareness of the role and benefits of shared transport such as car clubs and promote bike sharing, ride sharing and multi-modal journeys. This will be supported by Mobility as a Service (MaaS) and promotion of peer-to-peer car sharing. We are harnessing innovation within our transport system, investing up to £2 million over three years to develop MaaS in Scotland, and we are grant-funding CoMoUK, to increase awareness of the role and benefits of shared transport and look at the barriers to uptake of car clubs. We also have a new commitment to support the monitoring requirement for the National Transport Strategy set out in the Transport (Scotland) Act 2019, and to further our understanding of how and why people travel we will invest in data and develop a data strategy.

Transport Scotland's 2018 smart ticketing strategy includes MaaS in a wider discussion of smart ticketing.[16] It suggests that MaaS will be explored alongside other mobile-based payment and ticketing systems. Since then, Transport Scotland has overseen two rounds of funding under the MaaS Innovation Fund, with the latter round in 2021 awarding HiTrans funding to develop its consumer-facing MaaS app, and a consortium in Fife including the University of St Andrews and

Urban Foresight to trial multi-app mobility hubs.

The wider policy landscape for the Scottish Government prioritises inclusive growth, and ensuring that the transition to net zero is equitable, such as the Just Transition Commission recommendations of March 2021.[17]

From January 2022, all under-22s will be entitled to free bus travel in Scotland. This is delivered through the National Entitlement Card Programme Office, using the same technology as existing free bus travel for the over-60s.[18]

3.1.2 SPT's draft Regional Transport Strategy 2021-31

SPT is currently preparing a new RTS, in line with its statutory responsibilities to draft and consult upon a regional strategy.[19]

It establishes 5 key transport challenges for the region which the RTS will help tackle:

- Transport Emissions
- Access for All
- Regional Connectivity
- Active Living
- Public Transport Quality and Integration

Core objectives flow from these challenges. They are:

- To reduce transport emissions in the region
- To improve equality of access to the transport system and improve accessiblity to town centres, jobs, education facilities, hospitals and other opportunities.
- To improve connections between rgional centres of economic activity and development opportunites within the region, and to key domestic and international markets
- To enable walking, cycling and wheeling to be the most popular choices for short, everyday journeys.
- To make public transport a desireable travel choice for residents and visitors.

The draft RTS sets out a set of 118 options for activity. This list includes the specific option of Mobility as a Service (option 64), as well as integrated ticketing, multi-modal transport hubs, and improving the resilience and sustainability of rural transport services.

3.1.3 GCC strategies and plans

3.1.3.1 Glasgow's Climate Plan

In 2019, GCC declared a Climate Emergency. Its Climate Emergency Working Group produced a report with 61 recommendations, under an overall target of carbon neutrality for the city by 2030. This included the recommendation to carry out a feasibility study into integrated ticketing and 'more physically and digitally accessible travel'.[20]

In 2019 Glasgow's Climate Plan was published giving a timeline of actions for the Climate Emergency Working Group's report.[21] It confirmed the city-wide target of carbon neutrality by

2030. The plan noted that transport emissions are 'the biggest challenge for the city' and identified a 'well connected and thriving city' as one of its 5 main themes for action. Recommendations on transport will be taken forward across the Regional Transport Strategy, the Glasgow Transport Strategy, and policies such as Spaces for People.

3.1.3.2 Glasgow Transport Strategy

In September 2020 GCC published a draft Case for Change report alongside a public consultation on the future of transport in Glasgow. This was summarised into a Case for Change Report on Glasgow's Transport Strategy, 2021-31, published in June 2021. Citizen views on integrated transport in this process are covered below.

This identified four outcomes for transport policy in Glasgow:

- Transport contributes to a successful and just transition to a carbon neutral, clean and sustainable city.
- Transport has a positive role in tackling poverty, improving health and reducing inequalities.
- Transport contributes to continued and inclusive economic success and a dynamic, world class city.
- Places are created where we can all thrive, regardless of mobility or income, through liveable neighbourhoods and an inclusive City Centre.

It identified a further eight detailed transport planning objectives to guide decision-making in transport policy in Glasgow.

- To promote low carbon movement of people and goods in a resilient transport system that can adapt sustainably in the future.
- To achieve clean air through sustainable transport investment and decision-making.
- To encourage and enable physical activity and improved health & wellbeing through active travel.
- To promote an affordable, inclusive, equitable and sustainable travel system.
- To improve reliability, integration and convenience of sustainable travel modes for people and goods.
- To ensure the transport system is accessible by all.
- To improve the safety and personal security of all transport users and the public spaces that they use.
- To deliver spaces for people first and foremost, with high quality public spaces which respect and respond to the natural environment, with an effective sustainable travel hierarchy.

All of these objectives are relevant to discussions of MaaS, both in terms of desired outcomes such as reducing carbon, and informing detailed discussion of operational models. For example, safety is relevant to discussions of which mode to include in any MaaS system.

3.1.3.3 GCC Strategic Plan 2017-22

GCC's wider strategy emphasises inclusive growth:

> ‘Our vision is to have a world class city with a thriving, inclusive, economy where everyone can flourish and benefit from the city’s success.[22].

The strategy defines 7 cross-cutting themes which include ‘a sustainable and low-carbon city’. Specific GCC objectives which are relevant to MaaS include:

- 53: Review the options and feasibility for a new transport body for Glasgow, working in partnership across the Glasgow City Region, to provide a more connected service for all our citizens and visitors.
- Prioritise sustainable transport across the city.
- 56. Improve and refine the Statutory Quality Bus Partnership and explore, with transport providers, how to implement an integrated ticketing system.
- 57. Explore the feasibility of a local bus franchising framework to deliver a more connected service across the city.
- 58. Explore the feasibility of bringing the subway under the governance of the city and options for extending its coverage.
- 60: Become a carbon neutral city by 2037, reviewing our energy carbon masterplan in 2019, and investigating membership of international networks, the Carbon Neutral Alliance and C40.

3.1.3.4 Glasgow Economic Strategy 2016-2023

The Glasgow Economic Strategy 2016-2023[23] and associated action plan presents an economic vision for the region along with 11 objectives that support this aim. The vision is focussed on a ‘strong, competitive and outward-looking economy’ and one of the key strands is increasing digital, low carbon technology and infrastructure to facilitate sustainable development and business growth.

3.1.3.5 Digital Glasgow Strategy

This strategy sets out priorities and commitments to growing the digital economy in Glasgow, including an emphasis on mobility data.[24] It references MaaS as an option to increase efficiency and the passenger experience, and suggests it should be taken forward through the SPT RTS work.

3.1.4 Wider city-region approaches

In the past 5 years new regional economic approaches and governance have emerged. This includes:

3.1.4.1 City Region Deal

The Glasgow City Region City Deal[25] funds major infrastructure projects, in order to, among others, improve public transport and connectivity and drive business innovation and growth. It is a partnership between the UK and Scottish Governments, local authorities, skills institutions, and private businesses.

One of the key priorities of the City Deal is to focus on improved infrastructure with a £1.13 billion fund to support the delivery of improved transport and connectivity across Glasgow and the Clyde Valley and key development and regeneration sites.

3.1.4.2 Regional economic strategy

The city deal partners share an economic strategy and city-region cabinet. The portfolio lead for transport is North Lanarkshire council. The regional strategy[26] sets the overarching transport priority as: "work with our partners in Government, agencies and Strathclyde Passenger Transport to ensure strategic transport planning is embedded as a driver and enabler of economic growth as part of a more integrated approach to economic development and inclusive growth."

It also defines the role of SPT as 'To plan and deliver transport solutions for all modes of transport across the region'

3.1.5 Summary: wide support for MaaS, with significant room for interpretation

These policy strategies create a clear overall ambition: a carbon-neutral city in the next ten years with a lower-carbon transport system, with more active and sustainable travel, supporting an inclusive economy. The concept of MaaS has support in a broad push for more integrated transport, and the use of new technology. SPT and national strategies specifically note the role MaaS could play.

This support can, however, be characterised as broad but not deep: there are multiple touchpoints for MaaS and clear alignment of big-picture goals with the potential for MaaS. But there is not yet a single clear statement of the exact role MaaS could play at any level, or a definite policy vision at a national level for the progression of MaaS.

Overall, this means that an important part of scoping MaaS in Strathclyde is defining objectives that relate specifically to MaaS, working from this foundation of high-level policy alignment.

4 Understanding users in Strathclyde

This section discusses potential users of MaaS in Strathclyde, and the range of different user groups that should be targeted.

4.1 What kind of users do MaaS systems reach?

Some user types are more disposed to using MaaS in general. Important characteristics identified in research and projects include:

4.1.1 Age as a key factor of using MaaS

The willingness to change from private car ownership to MaaS is likely to be dependent on age[27]. Younger generations tend to favour access to services over ownership and often embrace the 'sharing economy'. On the other hand, older generations often favour ownership[28].

An academic survey in Australia showed that willingness to use MaaS is strongly correlated with age and lifecycle stage: young individuals who are employed full-time are most likely to use MaaS; older adults who have retired from the workforce and whose children have left home are least likely to use MaaS[29]. This suggests that on average, the younger the demographic of a place the more likely it is to embrace MaaS. At the same time, in cities with younger populations, driving license and car ownership are decreasing[30] – a trend which is also clearly beneficial for the potential implementation of MaaS.

Until 2016, SPT ran an app, iShoogle. Evidence on its users suggested that younger users were more likely to get information from the app than other age groups.[31]

An important complication in Scotland is the roll-out of free bus travel for under-22s, from early 2022. This is based on the NEC smartcard, and Transport Scotland have suggested in the past that an app may host the card. This would add a caveat to the willingness of younger people to engage in MaaS: they may already have a tool which is targeted at them, using smartphones.

4.1.2 Willingness to pay for services in advance

MaaS may require customers to pay in advance for a mobility package, so the willingness of people to pay for services in advance may be necessary for its success[32]. In particular, evidence shows that:

- 43% of users in Finland would be willing to pay for a mobility package, assuming it could cover all their mobility needs[33].
- There is a very close estimate of willingness to pay with the actual market price of a monthly, unlimited unimodal bus package in Manchester and several European cities[34].
- An online survey in Zurich showed that the willingness to pay was higher for bundles that

required in advance subscriptions than for standalone services[35].

Again, the presence of free and subsidised bus travel in Strathclyde complicates this picture. Under-22s and over-60s account for around two-fifths of the population. They will already receive free bus travel. This means that to attract use, a MaaS system will have to offer them benefits beyond reducing costs for bus.

4.1.3 Digital literacy and affluence

Given that technologies such as smartphones are required for the use of MaaS, it is important that citizens are willing and able to use them. Most discussion of MaaS note the potential for digital exclusion, but no consistent approaches to the challenge have yet emerged[36].

There are few specific assessments of the relationship between affluence and MaaS, but there is broad overlap between smartphone usage and income.[37]

There are niche operators who provide mobile-based payments, building on cultures of mobile banking in the developing world, which allow a user to use mobile phone top-up credit for mobility payments without a bank account. This could be added to a core MaaS service for users with bank accounts. Most mainstream MaaS provider require bank accounts.

4.1.4 Public transport usage

There is poor evidence on the extent to which extent to which MaaS users are already likely to take public transport: does MaaS add to the total number of people using active and sustainable travel, or target those who are already predisposed?

Several studies show that public transport is the most preferred option in MaaS systems, followed by car and bike sharing while taxi, car rentals are less preferred options[38]. A questionnaire survey in Greater Manchester showed that the most popular plans are the ones that include unlimited public transport and unlimited access to bus services[39].

Operators in shared and active mobility frequently report that they share a user base with competitors; they see the choice for consumers as between private car use, and the collective options of shared mobility.

On balance, this suggests that the most cautious approach is to assume MaaS is more likely to be taken up by those who already use public transport – but this is disputed, and not confirmed in the evidence.

4.2 Top user concerns in Strathclyde

4.2.1 Integration

Evidence from a range of sources identifies common themes in concerns over lack of integration, particularly in ticketing and multi-modal journeys.

SPT's RTS public survey received a significant number of comments suggesting that multi-operator ticketing and interchanges between different services were challenging. At least 30% of respondents identified that the lack of 'direct services for the journeys I want to make' was an issue, suggesting lack of point-to-point options are a barrier to taking public transport. SPT states that 'the need for better integrated ticketing for public transport was one of the most often mentioned problems by residents, partners and stakeholders.'[40]

GCC's Public Conversation also identified that fragmented travel is a significant concern. The problem statement which most respondents selected was that 'different ways to travel are not smart and integrated', with 74% of respondents agreeing. This was followed by high costs (70%) and safety concerns over cycling (67%).

An open form allowed respondents to GCC to suggest problems. Lack of protected cycle lanes was the most-mentioned theme (667 responses) with quality (such as inadequate service) and cost receiving similar returns (570 and 438 responses respectively). 281 people identified lack of public transport integration, 216 identified a fragmented public transport system, and 291 noted a lack of multi-modal smart/integrated ticketing as issues.

Community conversations identified an issue with 'Lack of integration in the public transport system and unequal access to public transport across the city. Different modes of transport not linked together physically, with timings, or with tickets.'

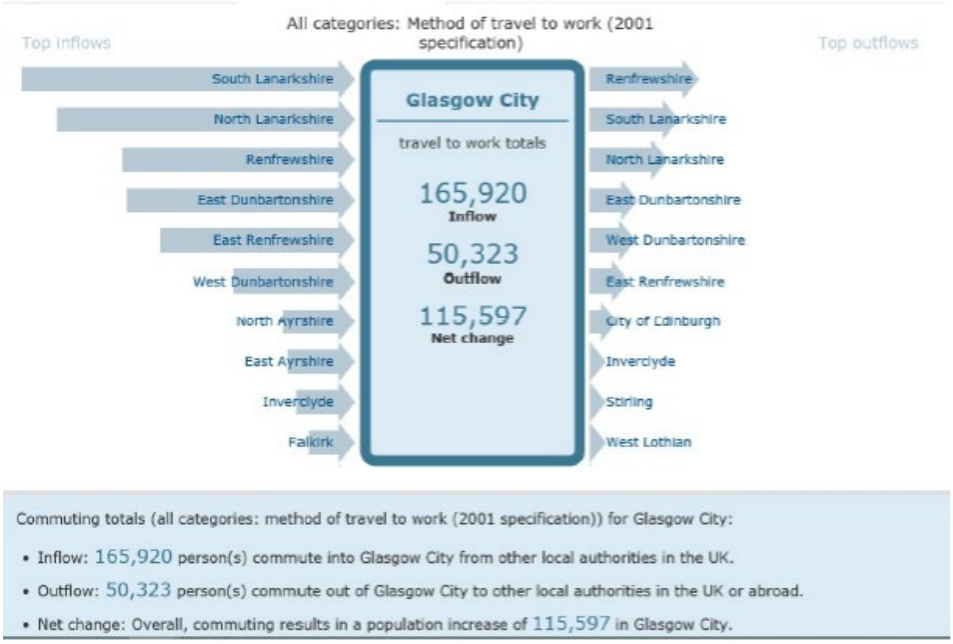
Respondents were then asked to support or disagree with policy focus statements. Support levels included:

- 89% support for 'We work towards a goal of a single, integrated, smart ticket for public transport in the city (with the potential to include other forms of mobility like cycle hire and car clubs).'
- 78% support for 'A smart, technologically savvy city where we use technology in transport for public benefit, we are open and transparent and encourage innovation through open data. We upskill Glasgow residents in carbon, energy and technological advances related to transport so that everyone benefits'

4.2.2 Reliability and information for commuters

Commuting is the biggest reason for travelling in Glasgow (25%). Compared to Edinburgh, Glasgow has a lower proportion of Glasgow residents working within Glasgow (60% vs. 72% for Edinburgh). At the same time, there are significant commuting flows in Glasgow from Dunbartonshire, Argyll and Bute, Renfrewshire, Inverclyde, and Lanarkshire[xxiv]. This shows the inter-connected nature of the travel to work area in the city-region. Table 1 below shows the scale

of commuting flows into and out of Glasgow City at the last census[41]:



From the overall SPT Regional Transport Public Survey population of GCC residents, 45% said they encountered issues on their journey to work. The main journey to work issues identified (identified by over 10% of each question sample), in order of priority, for each type of commuter are shown below.[42]

Table 1: journey to work issues by commuter mode, Source: SPT RTS Public Survey, 2019[43]

Motorcycle/car/van driver or passenger	Bus	Rail	Subway	Walk or cycle
Traffic congestion	Reliability of bus services	Reliability of rail services	Crowded services/ ability to get a seat	Availability of cycling facilities segregated from vehicular traffic
Conditions of road surfaces	Cost of bus fares	Cost of rail fares	Cost of subway fares	Condition of pavements/cycle lanes
Reliability of journey times by car	Frequency of bus services	Crowded services/ ability to get a seat	Frequency of subway services	Behaviour of other road users
	Reliability of journey times	Reliability of journey times		
		Frequency of rail services		

4.3 Demographic groups in Strathclyde

Census and survey data suggests that in broad terms, the Strathclyde region has:

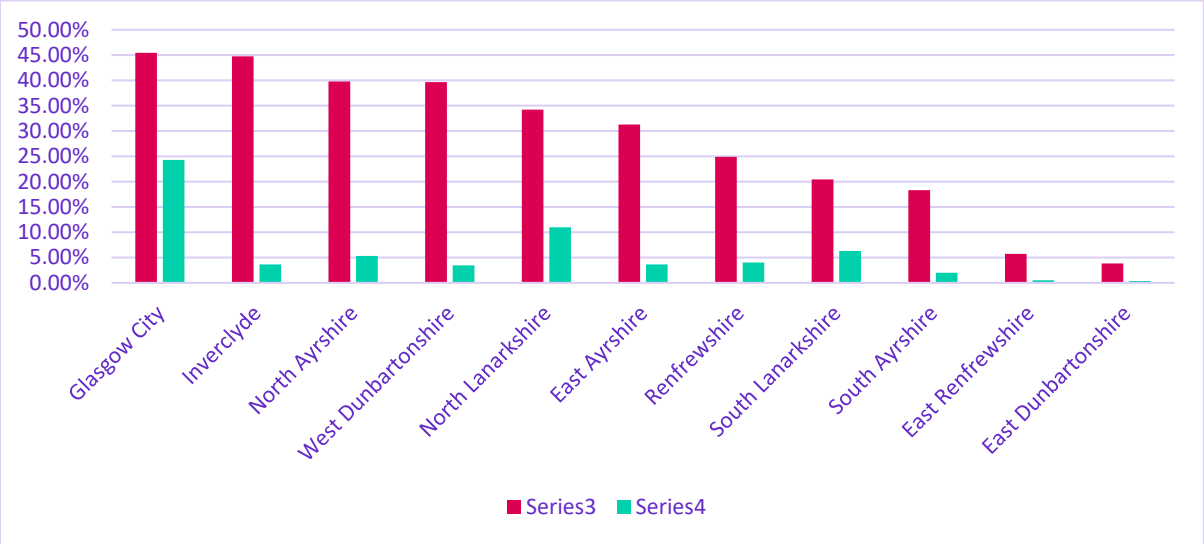
- Above-average levels of deprivation
- A sharp divide in age profiles between Glasgow city and other areas
- A divide in ethnic diversity between different council areas
- An increasing trend to urbanisation, albeit slowly.

The sections below discuss these trends, and how the evidence on MaaS in general in section 4.1 could apply to Strathclyde.

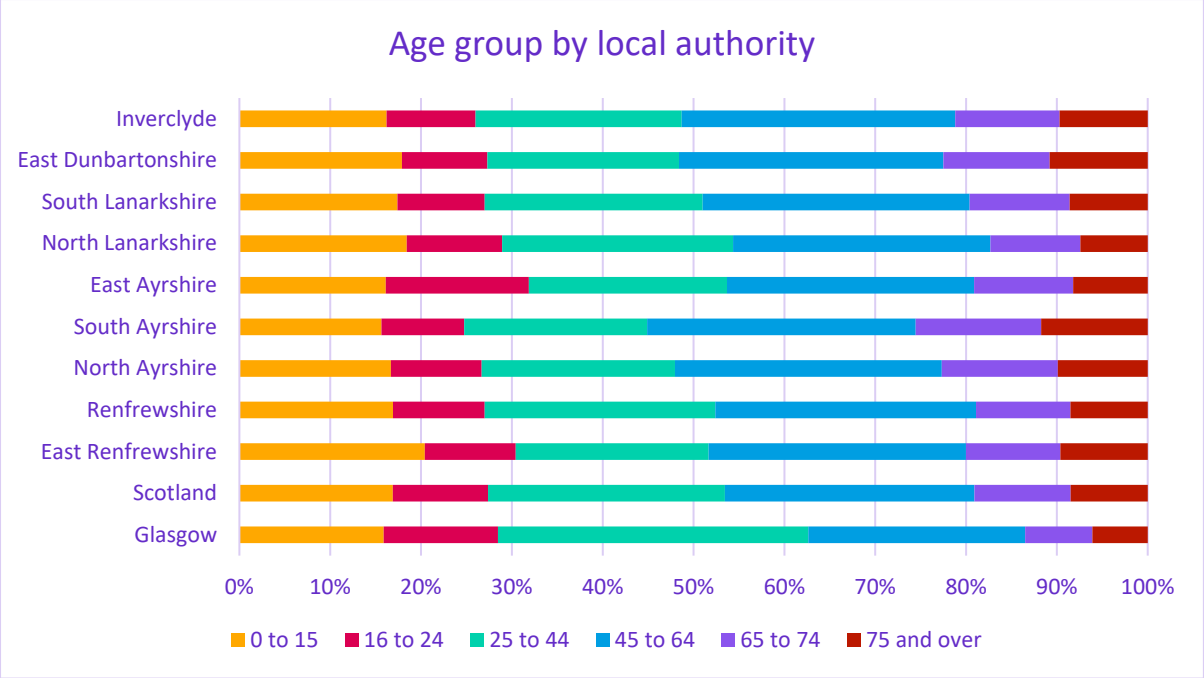
4.3.1 Deprivation, age and urban drift

A significant proportion of deprived areas are in the west of Scotland. In Glasgow City, for example, 45% of areas are in the most deprived category; 24% of the most deprived areas in Scotland are in Glasgow. Table 2 shows what proportion of a council is in the 20% most deprived, and what proportion of the Scotland-wide 20% is in that same council.

Table 2: proportion of 20% most deprived areas, local and national



Age profiles vary significantly by area. Glasgow city has the highest proportion of people under 44, with a particularly large relative share in the 25-44 age group. Relatively affluent councils like East Dunbartonshire and East Renfrewshire have profiles closely in line with the Scotland average, while councils out with the city-region core tend to have older populations, particularly Ayrshire.



National Records for Scotland population projections suggests that by 2028, more people will live in Glasgow city, and fewer in more rural and small-town local authorities.[44] This forecast was made before the Covid-19 pandemic.

This basic demographic picture creates a mixed foundation for MaaS. There is an urban core which is younger, a set of areas which are more affluent, and a potential trend to greater urbanization. This is a strong fit for the groups most likely to use MaaS. But this is concentrated on Glasgow city. The city itself also has pockets of deprivation, and the wider region has significantly older, less affluent areas.

4.3.2 Ethnic minorities

The proportion of people in Glasgow from a non-white ethnic background doubled between 2001 and 2011, reflecting the particular impact of asylum seeker settlement policy.[45] But while Glasgow has continued to become more ethnically diverse, this is not the picture across the wider region: the Ayrshire counties, inner suburbs and Lanarkshire remain predominantly mono-ethnic. At the last census, almost one in five people (17%) in Glasgow were an ethnic minority; of these, Pakistani and African were the largest identified ethnicity. This compares to 1.1% in North Ayrshire, or 1.1% in East Ayrshire.

A MaaS front-end service can in theory be in any language. In practice, this creates the requirement to update multiple versions of the app, and creates translation costs. Even with high ethnic diversity, 97.3% of people in Glasgow speak English. The working assumption of this paper is that any front-end service will be in English; alternatives in other languages, or adding an in-app explanation page, could be later additions.

4.3.3 Digital exclusion

In line with the broad picture that digital exclusion is correlated with affluence, Strathclyde has significant pockets of digital exclusion.

In 2015, around 1 in 10 adults in Glasgow did not have access to a bank account, or their partner's bank account.[46] This was the lowest of any Scottish city.

Citizens' Advice Scotland survey benefit claimants in 2015[47]. It identified that in Glasgow:

- 42% of respondents had never used the internet, and only just over a quarter used it often
- Almost half did not have a computer or an internet connection at home
- 35% of the clients surveyed were unable to use a computer at all
- Almost seven in 10 benefits clients surveyed would either be unable, or would need help, to claim benefits online

The Digital Glasgow Strategy notes best practice on addressing digital exclusion, and set out a range of pledges to upskill staff, grow basic digital skills, and focus on a digital participation programme.

4.3.4 Disability

Apps and front-end services can be designed to be accessible to people with learning difficulties and some kinds of disability. AccessAble work with GCC and are contracted to survey and map different venues and locations in terms of accessibility, such as airports, train stations and motorway stations. They then integrate the information into their app and website to provide accessibility information to people with disabilities.

However, data for disability-friendly services requires much more detail, particularly for physical disabilities: a city centre which has extensive pedestrian areas but also several steep hills and high rainfall means that including wheelchair access in a MaaS system requires extremely detailed data about levels, inclines, and street conditions. Users with visual impairment or learning disabilities have equally specific needs in the information on physical layout of stations, interchanges and availability of transport.

This data is both difficult to gather, and to keep updated. This kind of specific requirement is one of the reasons that, as described in Section 3, European cities are moving towards creating back-end systems which enable front-end services. This kind of data can be added to such back-end systems, with apps dedicated to particular users working from that system.

In terms of transport mode accessibility, buses are perceived as more accessible than trains. This is because trains have no level access and it is difficult to ask for assistance.

4.3.5 Tourists

In 2019, Glasgow welcomed 2.5 million domestic and international visitors, generating £774 million for the city's economy. This represents an 8% increase in trips and a 17% increase in spend year-on-year[48].

The train is the most common mode of transport for visitors coming into and departing from Glasgow, followed by plane, where Glasgow Airport is the main arrival point[49]. VisitScotland suggested that this is the location at which information and services are most confusing.

During their stay in Glasgow, tourists mostly rely on public transport, and many expressed complaints to VisitScotland regarding the complexity and fragmented service of the transport system. The stakeholder workshops in the context of the policy deliberation for Glasgow's Transport Strategy 2021-2031 in February 2020 suggested that there will be demand for tourist integrated ticketing.

Many visitors in Glasgow pass through in the space of half a day: the phrase that tourism organisations use is 'doing Scotland', with Edinburgh and Skye the crucial stops on itineraries that focus on whisky, history and scenery. For any MaaS solution, this creates a low tolerance for anything that requires significant time to access: installing a new app, for example, might feel pointless if a traveller is only passing through Glasgow and simply wants to get from Queen Street to Kelvingrove and back again.

Transport apps such as Citymapper, Moovit, Google Maps and others now operate around the world. VisitScotland suggested that the common transport app experience that most visitors in Glasgow have is Google Maps, and that either the ability to use an international app or a single Scotland-wide app would make most sense.

4.3.6 Leisure travellers

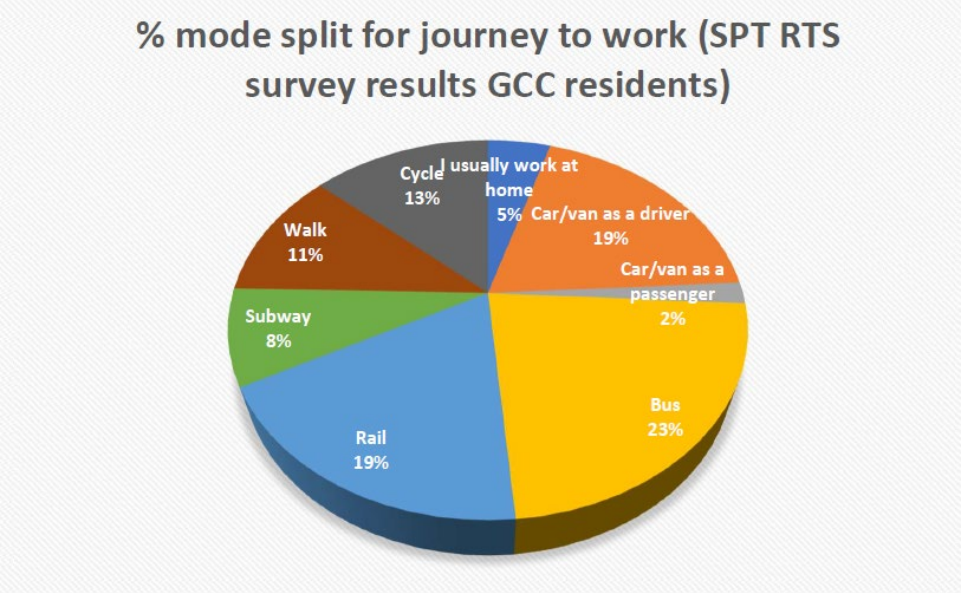
Strathclyde has several major destinations for leisure and recreation travel. This includes remote, rural and island areas such as the coast of the Clyde, Loch Lomond and the national park. It also includes Glasgow City as a destination for culture and shopping: around one-quarter of all journeys are for shopping.[50]

4.3.7 Commuters

In general, there is a higher reliance on cars for journeys to work in areas further from the city centre. In contrast to the Scottish average, most people in Glasgow city who travel for work (this excludes a sizeable proportion who are classed as working from home which can include some self-employed people) do not travel by car. Some 63% at a Scotland level drive to work by car or van compared to 45% in Glasgow. Only Edinburgh has a lower proportion of people driving to work than Glasgow, in Scotland.

Glasgow also sees the second highest rail-based commuting figures in Scotland (after West Dunbartonshire), and the second highest bus-based commuting in Scotland (after Edinburgh). Glasgow has a higher-than-average proportion of commuting trips made by bike (5% compared to the Scotland average of 2.8%, and 4% for large urban areas in Scotland). Glasgow has a lower proportion walking to work than comparable large urban areas in Scotland, at 13% compared to 15% for the latter.[51]

From the SPT Regional Transport Strategy Public Survey carried out in early 2019, the main ways of travelling to work by Glasgow residents are shown in the following figure.



Source: SPT Regional Transport Public Survey, 2019[52]

4.4 Summary: pen portraits for MaaS users in Strathclyde

The project identified 8 broad categories of user for a future MaaS system, based on the broad demographic categories discussed above. The purpose is to shape thinking and understand how different options could serve user groups – not as a definitive statement of users.

Category	Who am I?	Where am I?	What are my mobility needs?	What do I want MaaS to do?
'Finnieston Man'	25-35 year old Digitally savvy Tertiary education Employed Some disposable income	Glasgow city inner suburbs, west end, southside	Less likely to own car but might buy in next 5 years Use mass transit, shared mobility, active travel Get across town for events, parties, work	Make my commute more seamless Give me options
'Bearsden Mum'	30-45 years old Parent and has elderly parents Affluent but not rich	East Ren, East Dunbartonshire, South Lanarkshire	Mobility needs set by family Need time and headspace to care for children and own parents	Create time. Create point-to-point journeys
Students	16-22 years old Digital native Little disposable income	Glasgow city, towns with FE colleges	Travel to uni/college Communal and active travel Cheap travel	Provide affordable travel on familiar routes Let me use my free bus pass
Mature and independent	35-64 years old Single or divorced Employed and career-focussed	Glasgow City, East Ren, West Dunbarton, Argyll	Travel to work Fast journey times	Give options for fastest journey Save time booking different options
Disabled	Physical or mental disability	Across region	Accessible transport Information on unique needs eg noise, signage Individual and bespoke needs	Create bespoke options for accessing transport Give confidence I can access places
'New Scots'	Ethnic minority/EFL Recently settled, possibly with family links	Lower-income BAME concentrated in Glasgow City, Renfrewshire, N Lanarkshire	Potential need for non-English services	Support wider opportunities and equalities

Low-income, PT-dependent	Low income, low assets Deprived area Unemployed or employed in care, retail, services	Glasgow City, Inverclyde, North Ayrshire, new towns across region	Not likely to own car, might have access to one Low cost	Expand range of accessible job opportunities Provide alternative to car ownership
‘Granda in Troon’	60+ years old Limited income, time rich Paper/offline preference	Outer suburbs, smaller towns and rural areas across region	Accessing family, healthcare and essential services (or having them access me)	Avoid confusing options for travel Let me use my free bus pass Reliable access

5 Objectives for MaaS in Strathclyde

The research for the project identified three core objectives for MaaS in Strathclyde. This is based on a logic model developed for the project and discussion with the project team at SPT and GCC. These objectives are, in order of importance:

1. **Improving the convenience of active and sustainable travel in Strathclyde**. The common theme of the evidence on MaaS and the needs of users in the evidence is convenience. Tools which can lead to modal shift, such as journey planning, nudges and bundling are all underpinned by an overall service which is easy for people to use and reduces the time, energy and thought it takes to plan travel by active and sustainable modes. Transport users in Strathclyde have a range of needs which are best distilled as wanting more convenient travel: better access to transport, with more integrated services between operators and more seamless connections, all rest on more convenient travel.

2. **Reducing carbon emissions.** Although the relationship between MaaS and reducing carbon is indirect, the overall importance of sustainability and low-carbon transport to both SPT and GCC warranted its inclusion as an overall objective.

3. **Tackling inequality**. The practical evidence-base for the ability of MaaS to tackle inequality is relatively weak. Theoretical approaches are outlined in section 2.3.4. However, social equity is a priority for GCC, and inequality is a theme in multiple policies. This objective was therefore included to ensure a clear relationships between MaaS and the overarching vision for the region as a fair, prosperous place.

The purpose of these objectives is first, to establish conceptual clarity on what is being attempted. Many MaaS projects try to achieve multiple objectives: it is common to see lists of up to 10 objectives, including outcomes which may be held in tension, such as increasing revenue for all operators and increasing choice for consumers. Many projects also require MaaS to achieve objectives which are best achieved by other, complementary policies – such as detailed targets for a given mode (for example an increase in cycling), or accelerating the shift to EVs. The objectives above represent a more focussed assessment of what MaaS is capable of doing, and how it fits into policy objectives for the Strathclyde region.

Second, these objectives shape the design of options for Strathclyde. MaaS is a flexible concept and prioritising convenience, reducing emissions and tackling inequality can be reflected in option design.

Finally, these objectives represent the first criteria which options will be scored against. They are the critical concepts against which the value of any given option should be assessed.

6 MaaS in practice: transport services and infrastructure

6.1 A framework for understanding barriers and opportunities for MaaS in Strathclyde

The sections that follow set out how MaaS could work in Strathclyde, based on detailed analysis of the current situation, willingness to participate in a future MaaS system, and technical and policy support for MaaS.

The sections that follow adapt UCL's MaaS readiness framework and cover 4 themes:

- Transport services and infrastructure
- Transport operator openness and data sharing
- Governance, policy, regulation and legislation
- ICT infrastructure

UCL's fifth theme, citizen familiarity and willingness, is covered above under section 4.

Each section sets out:

- How existing MaaS projects have approached this question
- Considerations for designing MaaS approaches in Strathclyde
- Barriers and risks in the local context to adopting a MaaS solution
- Opportunities in the local context for developing a MaaS solution

6.2 Basic provision information

Services available in Strathclyde with the regulatory regime are described in table 4.

Table 4: summary of services in Strathclyde

Mode	Spatial scale, number of operators	Regulation
Rail	ScotRail, national	Current nationwide franchise ending 2022
Ferry	CalMac, national Western Ferries	Nationwide publicly-owned and operated, with smaller operators
Subway	Glasgow, SPT	SPT owned and operated
Bus	Range of local, regional and national operators, with 4 major firms	Open competition with exception of publicly-tendered routes
Taxi and ride-hailing	Range of local, regional and national firms. Uber and Gett in Glasgow.	Open competition with regulated fares and licencing by local authorities for taxis.
Car-sharing	Mostly national firms	Open competition; councils award exclusive contracts to on-street car-sharing
Shared and micromobility	Local; NextBike and Co-Wheels Car Club in Glasgow	Exclusive contract with GCC
Community transport and DRT	Local; varies; MyBus	Range of groups, some with contracts with SPT or SPT-run services

6.3 Variety and density: a concentration on mass transit

The core of the region's network is provided by bus and rail services, with ferries playing an important role on major island routes. There is only one active travel operator running at scale, NextBike. Car-sharing is more advanced, as car rental firms increasingly offer car club-style services, and councils offer exclusive contracts to on-street car-sharing. Across the region, 13 organisations have dedicated lift-sharing clubs organized through Liftshare, while around 6000 people are registered for a regional lift-sharing club managed and promoted by SPT.[53]

Relative to places which have experimented with MaaS, particularly European capitals, this is a relative bias towards mass transit, and a relatively small presence for micro- and shared- mobility.

Bus operators also suggest that they are often a near-monopoly provider on parts of their network: describing routes where 90% of travellers will use their service which are effectively ceded to them by competitors, who in turn dominate other routes. ScotRail made a similar claim for routes like connections from central Glasgow to commuter towns like Bearsden, connections to outlying towns like Ayr or Helensburgh, where they asserted they are the dominant provider.

In the absence of strong data, the clear view from operators is of relatively limited options for many users in most parts of Strathclyde.

There are exception to this picture:

- In particular, central Glasgow. A user has the option of different bus companies, subway, taxi, car, bike or train for many routes – or combinations of those options.
- The southern inner suburbs, from around Giffnock north, have a greater density of rail and bus stations. For many residents, this will mean that even if they are repeating journeys, the exact conditions of each day in traffic, service updates or preference might mean they have a range of options.
- Towns in greater Glasgow which are well-connected to the city sometimes offer effective choice between rail and bus services for inwards journeys. Examples would include Paisley, where multiple bus operators run services to Glasgow centre as well as Scotrail, or places like Hamilton, Uddingston or Dumbarton.

This context has a number of implications for future MaaS systems. It means that the problem which MaaS is trying to solve – navigating transport systems – is generally less acute.

The places which turned to MaaS earliest did so in part because of the complexity of their transport system, and the immediate benefit that MaaS could bring. Paris, for example, was the scene of a fiercely competitive micromobility market (before licensing was introduced), making a digital tool to navigate complexity a compelling offer. Strathclyde is, in this specific sense, a simpler system.

Paradoxically, it can even be harder for MaaS systems to offer a useful service without diversity of supply, because it reduces the tolerance for inaccuracy in data, particularly on service availability. Crudely, the fewer options available, the more important it is that every aspect of using those options is seamless for users. When there are specific questions around showing availability of bikes (discussed below), the current provision could make for a less resilient system. Greater diversity of supply, particularly of shared and micromobility, hedges against errors by creating multiple options between any two points which on aggregate will give good options.

On the other hand, many places have struggled to launch new mobility services because it is extremely difficult to forecast demand for new services. Some companies and places have started and then withdrawn bike-sharing schemes – including Abellio, which withdrew its Bike and Go scheme, albeit due to Covid-19 and without heavy marketing of the scheme. Implementing a MaaS solution could provide a strong evidence base for planning and launching these services, if it creates a data resource on point-to-point journeys which can illustrate latent demand.

6.4 Multi-modal journeys in Strathclyde

This context could also mean that identifying particular locations in the network which present opportunities for modal shift is easier.

Strathclyde-specific data on multi-modal journeys is limited. However, across Scotland, Transport Scotland statistics suggests that most multi-modal journeys are concentrated on rail, air and ferry use.[54] With this in mind, Strathclyde has a number of features which create opportunities with multi-modal journeys:

- The extent of the heavy rail network in Strathclyde is unusual – no UK city, with the exception of London, has such a range and complexity of rail services. For the ScotRail franchise (and its successor), the Edinburgh-Glasgow intercity link and Strathclyde suburban routes are the core of the network in terms of volume, revenue and political visibility.
- There are specific transport hubs, such as Ardrossan, Glasgow Airport, and around George Square, which are multi-modal hubs. Links to Arran present a particularly clear case of a self-contained transport network on the island, accessed by a single mode, which is itself possible to access by public transport. This has historically been recognized through tickets aiming to give families access to holidays by rail, ferry and bus – and MaaS could have a similar user group in mind.

Detailed information on who is taking multi-modal journeys is also limited. However, most operators agreed with a broad categorisation of multi-modal journeys into three broad categories:

- Journeys which are taken by regular users, such as commuters or students, which use multiple modes – but the same combination, each day. For example, a commuter who takes the train into Queen Street, and then hops on the subway a few stops away.
- Journeys which are not regular, in the city centre. The impression across the interviews is that Glasgow city centre is just big enough and complex enough, with a wide enough spread of different kinds of destination from offices to food and drink and transport hubs, that even residents could vary how they get around from day to day. For example, a commuter who works in Merchant City but will have meetings in the West End, but then head to Ashton Lane after work, has multiple options for making those journeys. Depending on their preferences, traffic conditions or the weather, they could conceivably make those journeys with different combinations.
- Journeys by incoming visitors or tourists. As discussed above, they usually need to make connections between transport hubs, particularly Glasgow Airport to Queen Street. These connections often involve combinations of bus, rail, subway and walking.

The implication for MaaS in Strathclyde is again, that the underlying use-case is geographically mixed: there are some areas where the immediate use of a multi-modal tool might be limited, but there are clear areas where the network creates opportunities for a multi-modal tool – and there are users who want to connect journeys by different operators, even if there is not significant choice of operator for any given leg.

6.5 Existing integrated transport products

Multi-modal tickets and passes currently available (their publicity is discussed below) include:

- The plusbus ticket, which on purchase of a rail ticket also gives unlimited access to selected bus operators within a set geographical area.
- The Daytripper ticket, which covers subway, rail, most bus and most ferry services, and is aimed primarily at days out in the wider region for families. It is being withdrawn at the end of 2021.
- The Roundabout Ticket, which covers subway and ScotRail services for one day in Greater Glasgow. It costs £7.40 per adult. It costs £23.20 for a family of 6.

There is also ZoneCard. This covers rail, subway, some ferry and most bus services and is available in blocks of 1, 4, 10 or 52 weeks. The region is split up into zones, and tickets are priced by the number of zones accessed. A year-long ticket covering all available zones – the price of unlimited travel in Strathclyde – is £2929. ZoneCards cannot be refunded or replaced if lost or stolen.[55] Exact comparisons are difficult, but an annual season ticket in Greater Manchester covering bus, tram and train costs £1264, and a season ticket in Tyne and Wear covering buses, metro, some rail and ferry costs £1150.[56]

ZoneCard sales in 2018/19 were roughly half the number sold in 2006/07. On average the number of weeks sold per ticket increased, suggesting the broad pattern is a declining number of more committed, long-term users. [57]

ZoneCard is being upgraded, with a live tender for a new technology provider to upgrade the ticket to ITSO format. This will also include a refresh of the card's governance, such as considering terms of carriage and risk management.

Multi-operator bus tickets are also available: Glasgow Tripper is a coalition of First, McGills, Stagecoach, Whitelaws and Glasgow Citybus. This allows daily and weekly tickets across Greater Glasgow. There are some limitations, including no access to certain buses like airport services or football specials, and day tickets cannot be bought on Stagecoach buses.

Most stakeholder conversations suggested the same picture: the feeling that these existing options were not being heavily marketed, and that across operators publicity efforts were minimal. This means that the tickets themselves are useful for dedicated users who know how to navigate the system and were aware of their options, but were under-used or increasingly anachronistic. Most are a combination of being difficult to access (such as ZoneCard being only paper-based), reliant on detailed knowledge of any given part of the network (such as the Tripper card), or were targeting a particular demographic and use-case (such as daytripper which was seen as offering lower-income families better access to attractions and day visits).

Some places in Strathclyde are part of multi-modal tickets in other regions. For example, Airdrie is part of SESTrans' multi-modal OneTicket.

6.6 Frequency

Frequency is built into the MaaS readiness framework for two reasons: if services are infrequent then the general use of public transport is likely to suffer, but also the relative value of a tool to navigate live departures on the go is reduced. If a bus only comes once an hour to a small town, in practice many users in that town will already know that from timetables and do not need a data system to help them. As likely, if they do not want to wait for an hour, they will drive.

The picture for frequency in Strathclyde broadly maps onto variety and density: Glasgow city centre and inner suburbs has frequent services, with Subway trains arriving every 4 minutes, some bus routes served by different companies arriving every 2-10 minutes, and trains on major inner routes running every 15-30 minutes. Ferry services are relatively frequent, with the Arran ferry departing roughly every hour in summer.

Bus service frequency has overall declined across Strathclyde. In 2011, 35% of bus stops were served by at least 7 buses per hour on weekdays. This decreased to 23% by 2019.[58]

Smaller places, rural areas and island communities have sparser services. In particular, bus services to smaller towns in South Lanarkshire, and North, East and South Ayrshire, are often infrequent with services 3-5 times a day to nearby towns.

6.7 Covid-19

Covid-19 affects the picture for MaaS in two ways:

6.7.1 Demand changes

One study on changes to travel patterns included a survey of users in Glasgow and Ayrshire. It found a significant increase in walking and cycling, with 20% more people walking three times a week; fewer cars purchased; and an overall drop in trips of 14% if people work from home 2 days a week in future.[59]

Operators generally reported usage in the pandemic falling to less than 20% of usual demand in the 2020 lockdowns, with usage at the time of writing around 60-80% of 2019 levels. There was no clear sense of what kind of demand would come after the pandemic, but the general expectation was a reduction in public transport of 5-20% on pre-pandemic levels for at least a year – reflecting commuters working from home up to 2 days a week, and a new association between car travel and public health security. ScotRail was consulting on a new timetable at the time of writing, which would see around 20% fewer services across the network.[60]

Citymapper reported use across its app in the UK of around 70% of pre-pandemic levels in June 2021. At that point, both England and Scotland had retained some Covid-19 restrictions.

6.7.2 Cultural changes

Bus operators reported a significant change in the culture between operators. Before the pandemic, operators were unlikely to work together – the relationship was competitive, and regulation against anti-competitive behaviour meant that operators were nervous about being seen to co-operate. Pandemic support meant that operators were more dependent on public funds to survive, and that coordination (for example, agreeing which routes to run, to avoid public

funds being misspent) was appropriate – though with no requirements to share data or other technology processes. Operators agreed that this had shaped a new culture, where working together was more common.

7 MaaS in practice: operators and data

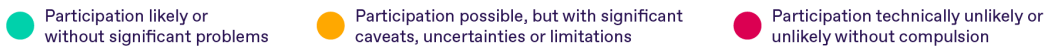
This section discusses the crux of a MaaS system for Strathclyde: operator data and willingness to participate in MaaS by sharing that data. It starts with an overview of the situation in Strathclyde. The technical ability to provide data and the commercial willingness to participate in MaaS go hand in hand: these are discussed together, for each mode in turn. Finally, some wider operational considerations for integrating data, such as risk, pricing and customer service, are considered thematically.

7.1 Overall operator capacity and willingness to share data

Table 7 summarises the discussion below on the combination of technical capacity to engage and commercial viability of doing so, structured by mode and by MaaS integration level.

Table 8 shows capacity and willingness to participate in data-sharing to underpin a MaaS system by major operators and mode. This was based on conversations with operators and each organisation was given an opportunity to fact-check this content. Community Transport, Taxi and car-sharing and bike sharing columns are generalised assessments of each mode, based on conversations and our wider experience of working with providers in these modes.

Table 7: overall operator ability to share data



	Level 1 Integration of journey planning	Level 2 Single point of booking and ticketing	Level 3 Shared fares/subscriptions/ services
Rail	●	●	●
Ferry	●	●	●
Subway	●	●	●
Bus	●	●	●
Taxi & ride-hailing	●	●	●
Car-sharing	●	●	●
Bike & micromobility	●	●	●
Community transport	●	●	●

Table 8: major operator/mode ability and willingness to share data

Operator/question	ScotRail	CalMac	Subway	FirstBus	Stagecoach	McGills	Community transport	Taxi	Co-Wheels	Car Sharing	NextBike	Shared/Micromobility
Is the operator currently technically capable of providing core information to enable real-time journey planning, eg vehicle location, timetabling information, and service updates?	Yes	Yes	Yes, note currently manual with eg Traveline	Yes	Yes	Yes	Varies, generally no	Varies, larger firms yes	Yes	Yes	Yes	Yes
Does the operator currently offer these journey-planning datasets to third-party journey-planners and booking services?	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes
Does the operator have an existing API with these journey planning elements?	Yes	No but will from 2022	No	Yes	Yes	Yes	No	Varies	Yes	Yes	Yes	Yes
Does the operator currently offer the ability to book its services via smartphone app?	Yes	No but will from 2022	No	Yes	Yes	Yes	No	Varies, mostly yes	Yes	Yes	Yes	Yes
Does the operator currently offer the ability to pay for services through its own smartphone app?	Yes	No but will from 2022	No	Yes	Yes	Yes	No	Varies, some yes	Yes	Yes	Yes	Yes

Does the operator currently offer the ability to show ticket/gain access through its own smartphone app?	Yes	No but will from 2022	No	Yes	Yes	Yes	No	Varies, some yes	From 2022	Yes	Yes	Yes
Does the operator currently allow third party apps/platforms to book, pay and show tickets?	Yes	No but will from 2022	No	No	No	No	No	Yes	No	Yes	No	Yes
Does the operator have an API with booking, payment and ticketing elements available to third parties?	Yes	No but will from 2022	No	No	No	No	No	No	No	No	No	Yes
Is the operator a participant in existing multi-modal products in Strathclyde?	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No
When will operator licence or contract end?	Abellio - 2022	-	-	-	-	-	Varies	-	2022	-	2027	-
Is the operator required to provide certain types of data under current terms of licence, franchise or legislation?	Yes	No	-	No	No	No	No	No	No	Yes	Some	Yes

7.2 Creation of a new single back-end for Scotland

The research for the project identified that Traveline, the existing journey-planning tool, is changing in ways which have a significant influence on the future direction of MaaS in Strathclyde.

It is evolving with Transport Scotland taking more direct ownership from next year, contracting directly with operators to receive their data and building a single back-end for Scotland showing all transport timetables and travel options.

This will likely include the ability to book any operators' service in rail, bus and ferry services, and likely a consumer-facing app or website.

This is a significant opportunity, in that it streamlines data-collection and creates a single data resource to build from. In practice, this would significantly shortcut developing any MaaS solution for Strathclyde. Any MaaS system would take the relevant information from Traveline.

However, it also creates significant risks around the exact format and terms of the new system. This includes questions over:

- Coverage of operators - it is not clear it would cover bike- and car-sharing, for example. Most likely, it is focused on rail, ferry, and bus, but it is also not clear if it would include smaller bus services or community transport.
- The information requested from operators and the conditions placed on operators: similar systems worldwide have made interoperable booking a condition of participation (so any operator which is a participant in the data system has to have its services open to booking by accredited third parties) but it is not clear if TS will demand this. In practice, this means that Traveline could be similar to its existing functionality – a single source of timetabling information – or could be the basis for much more sophisticated MaaS solutions.
- The conditions of use - it is not clear whether it will be possible to use one element of its data, or can only be used in a bundle – for example, whether anyone using timetable information also has to use the journey planner too or can pick elements of Traveline's system in isolation (in technical terms, this is sometimes called 'decoupling the stack').
- Basic data quality and ease of use. There have occasionally been concerns about the responsiveness of Traveline to requests to use information, and particularly with smaller operators, concerns over the reliability of data. For bus services in particular, timetables are provided but not real-time information – which in some places, is less useful for users accessing information on the move.
- The terms of operators' participation in the system, such as costs and conditions on exclusivity or openness of the data, or if further reporting data will be requested by TS.

One likely consequence is that operators' willingness to engage with other organisations requesting or using their data is diluted: they will feel they already contract with Transport Scotland, and would need a strong commercial incentive to go further with other organisations.

Overall, this is likely to represent an opportunity specifically for data to enable journey-planning, but adds significant uncertainty on the wider approach for Strathclyde.

7.3 Bus

7.3.1 Level 1 integration: small and large operators have different capabilities

The major bus operators are technically capable of providing information like real-time vehicle location and already do so in their own apps, and to third parties like bustimes.org. Those who also operate in England are already compelled to participate in a data-sharing system south of the border, the Bus Open Data Service, which requires real-time locations, timetables, fare data and historic punctuality data.

Smaller providers have less capacity. Smaller bus firms may have licensed location-based services (either hardware, or using fare payment and booking apps on a smartphone in the driver cab), but often these tools are designed to let an operator knowing where its vehicles are, planning routes and charging fares – not sharing that data with any central data system.

Creating the ability to track real-time vehicle location is not expensive, and increasingly it is seen within the industry as a minimum condition of operation. This does create a barrier to entry for new firms and small organisations to start offering services, but capital costs are already relatively high for new bus operators. Transport Scotland also has a support scheme for smaller operators, helping them with front- and back-end development and technology advisory services.

The influence of regulation and power dynamics is discussed below but purely as a matter of hardware and cost, few regions or cities would therefore consider it unreasonable to require level 1 integration as a basic capability of operators.

7.3.2 Regulation and the debate over future bus services

Bus services are currently run through open competition, with the exception of some tendered routes and bus support during the pandemic.

This has a number of consequences:

- Bus operators are fiercely protective of information which is commercially sensitive – and have significant leeway to define what ‘commercially sensitive’ means. In practice, any information which can be used to triangulate the profitability of certain routes, infer business models or route-planning techniques, is seen as proprietary.
- Local transport authorities can require bus operators to make information on routes, timetables and fares available, but under current relationships have no specific power to require other forms of data to enable MaaS, such as booking processes.
- Existing bus operator apps are subject to competition law and either have to show only their own services, or all services.

There is an ongoing debate over the future of bus regulation across Strathclyde. Bus franchising, and the idea of a new form of regional transport body with more direct commissioning of services, have been proposed by a range of organisations and individuals.

This sets the immediate context for any discussions of MaaS which looks to integrating booking, information and payment. The frank conclusion is that those discussions take place in an environment of distrust and confusion: rightly or wrongly, bus operators believe that SPT wants to end open competition. This suspicion is extended to councils, but the overall impression from project research was that this is less acute than attention on SPT.

The bus operators are moving towards more integrated ticketing. In 2018 they launched the Tripper ticket, a smart ticketing covering major operators, and in early 2021 set up their own alliance, the Glas-Go Bus Operator Alliance. Urban Foresight's interpretation is that this is a pre-emptive response to the concept of bus franchising, but it is nonetheless a serious attempt to make services more seamless. All the bus operators suggested the same ultimate evolution of the bus alliance, which is to first focus on ticket integration, so one ticket is valid on multiple operators' services, and ultimately single season tickets across multiple operators possible, and then looking at the possibility of multi-modal offers.

The bus operators expressed their view that moves to integrating bus services would be quicker this way than through established SPT channels and forums. The Competition and Markets Authority has published an exemption from competition law for integrated ticketing, setting out conditions on any shared ticketing scheme between operators.[61] This would give bus operators a framework for integrating services within the existing regulatory system.

This creates perhaps the single most important feature of data collection in the current system, pending further information on how Traveline will work in future. It broadly creates three options for including bus data in a MaaS system.

7.3.3 Voluntary participation in MaaS by bus operators

The first is that a MaaS system is introduced which is voluntary for bus operators, and is therefore seen by them to be in their interests. In practice a MaaS solution is only likely to be accepted voluntarily if it is:

- Conceptually similar and aligned to existing integration moves by the industry
- Is likely to increase operator revenue and preserve their margins by participation
- Does not ask operators to expose information they consider to be commercially sensitive to their competitors
- Does not ask operators to expose information they consider to be commercially sensitive to SPT or GCC – unless relationships and trust are significantly rebuilt
- Does not ask operators to lose control of customer-facing relationships
- Does not ask operators to enter into multi-modal ticket prices or shared revenue allocation unless they are guaranteed to see increased revenue
- Preserves open competition between operators.

In practice, this means a particular form of level 2 integration where a single journey planner has

additional functions in booking bus tickets. This could be either the ability to buy a bus ticket directly, or have an onward link to bus operators' own apps or websites. It would be extremely unlikely, at least at first, to offer deeper integration either between bus operators, or with other modes.

7.3.4 The post-pandemic period and its influence on bus operators

The second option is to try and use the complex dynamics shaping the bus industry.

If commuter flows are permanently reduced after the pandemic – if bus users start working from home even one or two days a week – it is possible the bus industry will face a fierce battle for revenue. The consequences of this are hard to predict. It could mean that tentative moves to more joined-up thinking by operators fall away: a new-found culture of collaboration could come under much greater strain when margins start coming under pressure. This could change the willingness of some operators to experiment with new ways of finding revenue, such as MaaS.

In this context, larger firms are used to a range of operating models, and global firms accept that they have to follow the model of city and regional authorities. They may consider a franchise model more attractive if they are the likely beneficiaries. Crudely, they could bet that their relative capability in winning public tenders and running tight-margin franchise services could offer greater long-term security than a downward market with open competition.

Other firms – particular smaller or faster-growing operators – may be more open to MaaS if it could be part of an industry hedge against franchises.

At the same time, the legal process for creating a franchise requires local transport authorities to show that a franchise would be necessary to achieve their general policy ambitions. An independent panel has to agree before a franchise structure can progress. For bus operators, the best way to show that a franchise is unnecessary is to show that policy goals of integration and convenience for users are possible through the existing relationships.

The second broad option available to SPT and GCC is therefore to maneouvre the bus operators into participation: to use the new pressure on bus operators to divide the industry, pick off willing participants in a MaaS system, make clear the threat of future regulation without participation, and game the relationships over the next 12 months to drive participation in MaaS. In practice this would mean identifying the operators most likely to engage in a MaaS solution, agreeing their participation, and using this to lead others into joining on the same terms.

It is important to stress both that this approach is deeply uncertain, sustains a culture of mistrust, and still ultimately lacks any contractual or legal sanction over operators. It would require incredibly adept political management and sequencing of advocacy and persuasion.

7.3.5 The Transport Act 2019 and the future of bus services

The third option is that SPT and GCC use new powers to request data from bus operators.

The 2001 Transport (Scotland) Act sets out some basic abilities for local transport authorities the

to require information from bus operators. This can include fares, routes, timetables and information for specific users like disabled passengers.[62] The 2005 Transport Act conferred this ability on Regional Transport Partnerships.[63] The 2019 Transport Act is discussed in greater detail below, under policy and regulation. In summary, it creates powers that could require the relevant data to enable MaaS from bus operators.

7.4 Ferry

Ferries are simpler to include in MaaS in some ways. Larger vessels on longer routes sail less frequently, meaning that timetabling and real-time data for departures is often straightforward. They also dock at set locations where onward connections are timed to coincide, travellers can often see approaching ships, and the influence of weather on sailing is understood by most travelers. This makes broad expectations on ferry punctuality and data quality less demanding.

On the other hand, there are specific forms of information which no other service requires. This includes the full names and ages of all travellers, not just the identity of an account owner booking a ticket, to comply with maritime safety regulations. Ferries carrying vehicles also need to know the length of any vehicles travelling, and any pets have to be registered for free tickets.

Ferry services also have a far higher proportion of services booked in advance than other modes – making it more like air travel in operations.

The major operator in Strathclyde is CalMac. CalMac are about to implement a new booking system from March/April 2022 which is online, mobile-based, and is explicitly designed to offer MaaS-style integration with other services. CalMac have well-established processes for third party sales of their tickets (for example through travel agents) and the clear expectation was that the new system will enable MaaS: of any operator, CalMac was the most positive about MaaS and is clearly designing ticketing projects and processes to participate in future MaaS systems.

Western Ferries operate the Gourock-Dunoon service. They currently offer online booking. Western Ferries were not contacted in this project but as there is no direct competitor for this route, the incentives are generally aligned for participation in MaaS.

CalMac operate the Kilcreggan Ferry. At the time of writing this was operating on a turn-up-and-go model, but ferry times were also available on Google Maps and Traveline. It is assumed that timetable information could therefore be made available if timetables resume, or that given the short distance it would be included in any MaaS system with maximum wait and journey times included in journey planning data.

The Yoker-Renfrew ferry is operated by Clydelink, and is also an on-demand service which it is assumed could be represented in MaaS in the same way as the Kilcreggan Ferry.

7.5 Rail

Rail services in Strathclyde are operated by Abellio ScotRail, who run the major commuter and long-distance lines within Scotland, including the Edinburgh-Glasgow line, West Highland main

line and services to Ayrshire; Avanti West Coast, LNER and Cross Country, who run intercity services connecting to England; and the Caledonian Sleeper.

Under the terms of its franchise, Abellio is required to make certain data available such as real-time disruption and location information and fares[64]. This means that the core data required for level 1 integration is already available.

As an industry, rail is more advanced than other modes in offering open booking, as the rail industry has an established tradition of selling through third parties. As well as creating the technological basis for third-party ticketing, this also sets a benchmark for costs of participating in aggregation services: TrainLine is the dominant platform for booking train travel, charging rail operators a 5% commission for online sales and 2% for season tickets, as well as a fee to passengers.[65] TrainLine also offers its own Global API, allowing other organisations to add rail booking to their other services. National Rail Enquiries offers a similar service and most rail operators accept travel agent bookings.

ScotRail have their own app which allows users to plan, buy and verify tickets, and are participants in HiTrans' MaaS app, offering level 2 integration for rail. LNER have their own dedicated MaaS app, which allows their customers to book onward travel from stations, such as picking up a car-share car or book a taxi. ScotRail are also ZoneCard participants.

This situation suggests that practically and culturally, rail operators are likely participants in any MaaS solution, including level 2 integration of booking and payment. There is no obvious technical or operational barrier to doing so.

A number of caveats apply to this broad picture:

- The Abellio franchise ends in March 2022. This should not directly impinge on the technical ability of rail to participate in MaaS, or change the availability of certain data-sets. It may, however, change decision-making structures within ScotRail. ScotRail's participation in any MaaS system requires it not just to make data and processes open, but to make them available in a regional context where rail is competitive with bus. The importance of this consideration was downplayed by ScotRail in interview – it was seen as a minor concern – but as the franchise ends, decision-making processes might change and require sign-off at a national level, or greater due diligence or revenue modelling.

- Rail is split between devolved and UK-wide regulation and legislation. UK services are facing significant change, with the proposal for Great British Railways (GBR) including a new, taxpayer-owned booking and ticketing site and changes to season ticket structures and pricing. This also includes taking over Network Rail, which in Scotland is funded by the Scottish Government. It is unclear what balance of responsibilities will emerge, and the extent to which there will be knock-on consequences for integrated ticketing. Most likely, given the political cost of trying to create a single UK-wide organisation, rail services with a regional or sub-UK brand, such as London, Merseyside, Wales and Scotland will retain devolved control over fares, timetables and tickets; but cross-border and UK-wide services may face greater restrictions on access outwith GBR-owned

platforms.

- ScotRail have recently launched mobile ticketing, with tickets for purchase from their own app. In practice, many operators with recent investments in apps are keen to justify that spend and may be reluctant to act on MaaS – even if they are supportive in principle.

These caveats all rest on a measurement of political risk: of the likelihood of certain conditions emerging as a new settlement for rail emerges.

7.6 Subway

The subway is owned and operated by SPT. GCC's strategic plan suggests exploring the subway coming under the city council's governance, and both SPT's draft RTS and GCC's longlist of options for the GTS have a wider Glasgow Metro as an option for further development.

With the network's current route and scheduling, it is an unusual mode to include in timetabling: Traveline manually input subway travel times into its journey planning, working on the basis that a train arrives every 4 minutes at peak times and every 6 minutes at other times, within set operating hours, and that on average it is 2 minutes between each station, and that service updates are easy to include as there are effectively only two tracks to provide updates on. In effect, the subway is presented in existing journey planners as a maximum journey time, not a real-time service.

This is likely to be a practical approach in future, as long as the network remains relatively simple as it is today. At the margins, there may be users who prioritise journey times, for whom the difference between real-time and maximum – potentially the difference between a 1-minute and 6-minute wait - is significant. Using a maximum journey time may push them to other modes. It is hard to gauge how common this will be. Walking times to access trains are based on averages, too: so the total time from any given point to taking the subway is always going to be based on an indicative time.

For level 1 integration, therefore, any MaaS solution could take Traveline's data, and it will be an unusual but workable solution.

There are two main limitations on the subway's participation in more integrated MaaS system. The first, ticketing, is discussed below under ICT infrastructure.

The second consideration, under this chapter heading of data and commercial models, is that MaaS would expose subway to a form of competition from other modes. There is no strong evidence on the distances or routes over which subway is the standout option, or over which it is competitive with bus, rail, or active travel. This could be compiled by looking at GCC data on the busiest bike stations with SPT data on smartcard entries and exits, but even this would not provide a complete picture.

Most likely, a new MaaS solution which offered subway alongside other modes would be revenue neutral or positive – as a central contributor to an overall improvement in convenience. More

generally, SPT emphasised its purpose is to provide excellent public transport, and take a strategic view of integrated transport.

However, there is clearly some revenue risk, particularly over short-hop journeys. A one-off user presented with the choice of a £2 bus, £1.55 subway or £1.30 bike share may well prefer the bike.

It is hard to make accurate forecasts on this risk and it is important not to over-state the case. It is best seen as SPT facing the same dynamic as other operators: the potential to offer a better overall service and thereby increase demand, but in more focused competition on specific routes.

SPT's role as an operator could, on the other hand, have an important impact on relationships and the dynamics around implementing a MaaS system. In other MaaS projects, operators often feel strategic bodies are naïve: that they do not understand the pressures on operators, or the importance of preserving fair competition. SPT can legitimately claim that it is subject to those same pressures, and this could be used to demonstrate good faith.

In the shorter-term, the fact that GCC manages bike-sharing and SPT the subway means there is an opportunity to show leadership by reconciling potential conflicts of interest. This is reflected in the recommendations of this paper, which prioritise this point.

All of this is set in a bigger strategic context: the subway is vital to MaaS in Glasgow. It is one of the modes that creates density and variety of route-planning options, particularly for transport to important sites like Ibrox, Queen Street and the University. As important, it is instantly identifiable and part of Glasgow's identity. A MaaS system with no subway would be ineffective for users but as important, it would feel incomplete.

7.7 Shared and micromobility services

Shared mobility and micromobility covers car-sharing, bike-sharing, and newer forms of vehicles like e-scooters.

7.7.1 Understanding the shared mobility industry mindset

Shared mobility faces a number of technical challenges in creating data. They have more vehicles, which users need to individually identify and access on the go, with locations to the nearest metre.

Culturally, most shared mobility providers see themselves as disruptors, trying to take on traditional transport with services with newer, smaller, vehicles, or a better alternative to private car use. This means that in general, these technical challenges are faced down with new innovations and a relentless customer-focused mindset. Most providers in shared mobility therefore have little or no technical challenges with sharing location information and availability. They expect their users to be mobile-first, and have built new technology into their operations, and most are familiar with the concept of MaaS.

The industry is also organically moving towards standardization of core data-sets. A range of open source and industry-led standards are slowly being adopted, and increasingly micromobility providers will expect to be able to meet those technical standards.

However, this emphasis on technology means that providers can be exceptionally protective of proprietary technologies. In hardware, tools like geofencing to prevent e-scooters riders entering dangerous areas represent sophisticated intellectual property. In software, most aspects of a mobility providers' operations, from their app design, to data analytics on users, to accounts and identity, are sensitive. Newer firms in particular often see themselves as data-driven startups, and their valuations rest in the data-sets they create. This fosters a much sharper sense that data should actively be protected by operators, and is best kept away from public authorities.

This creates a general principle for thinking about shared mobility and MaaS: these operators are some of the most tech-savvy and best-equipped to shape the future of mobility. But for precisely that reason, they will draw acute distinctions between data they will, or will not, share to enable MaaS.

This is clearly shaped by regulation. Shared bike schemes and shared car schemes operate under road use regulation and are not specifically governed as services by transport legislation. E-bikes are treated like bikes in law, while e-scooters are currently illegal on the road but are being trialed elsewhere in the UK

In Strathclyde, the two contracted shared mobility operators are NextBike and Co-Wheels. They are discussed below.

7.7.2 NextBike/Ovo Bikes

NextBike has a contract with GCC which runs until 2025, with the option of a year's extension, and then a further year's extension. The contract was structured so that GCC provided capital investment up-front of around £800,000, with NextBike then required to pay GCC set sums after the first two years of the contract. This creates an incentive for GCC to extend the contract to its full term, until 2027. The bikes are sponsored by Ovo energy and are known to consumers as OvoBikes.

This contract requires NextBike to provide core data to GCC on users, and which stations are used, with various weekly and monthly reports. It requires no further data or processes from NextBike. This means that NextBike's participation in any MaaS system could only be on a voluntary basis.

NextBike operate across Europe and face few technical barriers to participating in MaaS systems. They do not have an API in line with some emerging standards such as TOMP-API, but have participated in other integration projects and their existing APIs and raw data is useable for MaaS. For example, they provide a bike-share scheme in Berlin, which is one of the more advanced MaaS systems offering level 2 integration.

This suggests that GCC have an incumbent who are broadly in line with their peer group in technical capacity for MaaS.

There are two significant caveats on the commercial basis for participation, and one wider concern about bike-sharing and MaaS.

First, NextBike stated that they would only offer pay-as-you-go bikes through any MaaS solution. Their subscription bikes have a flat monthly fee and are then free for the first 30 minutes. Pay-as-you-go bikes would generate revenue from pick-up, and NextBike's interests are therefore to prioritise pay-as-you-go bikes in any MaaS solution.

Second, GCC's view was that the business model was contingent on advertising: that the core revenue from the service was not sustainable and the promise of brand presence for a sponsor was necessary. This in turn could complicate MaaS, if it materially diluted the ability of NextBike to track users and prove value to sponsors.

NextBike qualified this: advertising is crucial to the business, but it was described as a fickle market, and they noted that there was no specific provision with their current sponsors on how they are represented in any aggregators or pooled booking systems. This was a moderation of GCC's understanding, and the overall impression from NextBike was of relative comfort in participating in MaaS. However, it was described as 'a conversation that would need to happen' with sponsors. There is a general risk that at the point of implementation, sponsors object to participation in a single system which dilutes their brand presence, and that if NextBike cannot be confident that revenue or usage increases overall – assuaging any such concerns from sponsors – then this existing commercial agreement would take precedence over participating in MaaS. If that happened, there is no sanction for GCC to mandate participation.

Finally, the contract with NextBike is specifically for GCC and does not extend beyond its boundaries. This reflects existing responsibilities for this type of transport, but has some quirks which would be carried through to any future regional MaaS system. Some specific sites are just outside GCC's boundaries but users may not be aware this is the case, such as Ikea at Braehead. Others are near bike-share hotspots but lie in other council areas – like the stretch of the south bank of the clyde just east of Glasgow Green. Others could conceivably form part of a bike-and-rail solution, such as East Renfrewshire or East Dunbartonshire. These patterns would be reflected in any MaaS system. Users would be able to take bikes to those locations (unless NextBike introduces some form of geofenced locking) and temporarily park them, but would not be able to dock them there. This creates a specific journey-planning question over how this kind of trade-off is shown: a user could be presented with no options for using the bikes outside GCC's boundaries; or they could be shown their options, and the cost of various lengths of stay there.

Glasgow city centre is the obvious location in the region for shared mobility services, given its population density. However, there is little evidence on the economies of scale necessary to make new forms of shared mobility viable – it could be that e-scooters and e-bikes work on a much smaller scale that bike sharing (where industry estimates vary, but suggest that 150,000-300,000 people is the smallest place to make a scheme work). If in future other councils in the inner suburbs look at these schemes, this could cause issues with interoperability with NextBike: the recommendations section discusses how to future-proof these kinds of contract, and suggests a role for SPT in shaping councils' execution of future micromobility contracts.

7.7.3 Co-wheels

Co-wheels car club have an exclusive contract with GCC for on-street car-sharing. This contract is due to expire in 2022. This creates an opportunity in the near future to ensure that a new mobility contract reflects the requirements of MaaS systems. The recommendations section discusses this in more detail.

Until then, Co-wheels are comfortable with MaaS on a commercial basis: they are broadly in line with the car-sharing industry view which is that they are a growth sector, and almost any exposure to shared information or booking would lead to uptake of their service. Both Co-wheels and Enterprise expressed the view that there is significant untapped demand for car-sharing in Glasgow, particularly in the city centre and west end. Co-wheels offer a franchised or branded service, and other car rental firms are keen to explore 'corporate MaaS' and B2B services.

Co-wheels offer real-time location for vehicles, but do not track journeys as they are happening. This offers a level of comfort to customers, at the price of less information for them (and for any MaaS system) on how people are using shared mobility. Their cars are currently accessed via a smartcard, which is provided by a specialist car-sharing hardware provider. This enables club members to access cars without a key. However, they will move this to an app from next year.

Co-wheels have a proprietary booking system, built by an in-house team, with booking already available via an app. The interview suggested no particular hesitancy for car-sharing to be available on other apps or platforms, despite this investment. They are a participant in Dundee City Council's level 1 integration app.

7.8 Taxi and ride-hailing

7.8.1 Taxi and private car hire

Taxi services vary significantly across the region, from large companies with new fleets through to small individual operators. Technical abilities vary in turn: some have real-time location on vehicles with booking through apps; many have mobile phones in cars which provide routes and can take contactless payment from users; while some are cash-only and can only be booked by phone.

Providing apps and mobile payment to taxi firms is itself a thriving industry, and firms like GlasGo, Glasgow Taxis or Southside Cars all have apps with real-time location, booking and payment.

Technical discussions on participation in a MaaS system is therefore as likely to pass through taxi firms' app suppliers and hardware providers than the firms themselves: most taxi firms will defer to their suppliers on what kind of integration is possible with other services. As a rough rule of thumb, most of these suppliers will not have the ability to integrate automatically through an API,

but will have a data feed or source of code which can be cleaned and made accessible for a central MaaS system.

Most taxi firms retain traditional phone booking, and other MaaS apps in Scotland which have not been able to integrate location and booking have simply included taxi phone numbers as an option in journey planning. Google Maps currently offers a link to download a taxi app for users in Glasgow.

In principle, taxi firms have much to gain from MaaS systems and many see MaaS as an opportunity to add a new revenue stream. Glasgow Taxis submitted a detailed response to GCC's Public Conversation consultation, urging better recognition of public hire taxis as part of an integrated public transport system.[66] This is held in tension with a fierce commitment to competition and protecting the taxi industry from threats such as ride-hailing: any system which is seen as undermining fair competition could be met with resistance.

The role of policy choices in relation to taxis and modal shift is discussed below, under policy and regulation.

7.8.2 Ride hailing

Ride-hailing in Glasgow apps include Gett and Uber. These companies were not contacted specifically for this project, but Urban Foresight has wider engagement with them. They are technically equipped for MaaS, and both have developer community sites. In Uber's case this offers an API that allows accredited third-party apps to add the core functionality of Uber's own app – requesting rides with pick-up and drop-off locations, fares and journey times. Gett has similar functions, but also specific libraries of code for businesses, couriers and a B2B employee offer.

In principle this means that the choice of including ride-hailing in any new system is open, subject to the terms and conditions these operators place on participation.

The question of supporting ride-hailing is a much bigger question – in particular whether they offer a useful service which makes it practical for urban residents to stop owning cars, or simply shift around car usage, is disputed. This should also be seen in context of relationships with the taxi industry, as taxi representative bodies would contest any ride-hailing presence on an SPT- or council-led system without taxi services given equal treatment.

7.9 Community Transport and DRT

SPT runs MyBus, which offers online and phone booking up to 2 hours before travelling. A range of charities and community organisations provide community transport across the region. They tend to use older vehicles, with booking by phone or email. Conversations with the Rural Development Trust and Community Transport Glasgow suggest huge interest in improving their mobile and online booking offer – but with the caveat they would need support to achieve those ambitions. Both organisations saw their service as a useful complement to mass transit, and were

keen to explore how MaaS could enable that role.

The technology to integrate with any MaaS solution is not necessarily complex: there are developers like Passenger which target small operators with cheap location and ticketing apps (their entry-level technology is £500 plus a 4% transaction fee). However, operators would need support to introduce the relevant systems.

Views of community transport organisations may significantly vary: elsewhere in Scotland our experience is that they see their focus as being on a small group of well-known individuals, for whom online or app booking is not appropriate. Some may even actively be hostile to participating in a new system which could swamp their existing routines and confuse existing customers.

Given this variability in both technical capacity and enthusiasm for MaaS, community transport providers need not be treated uniformly. Participation in any MaaS solution could be voluntary, or evolved over several years through grant-funding. Or, rural transport could be the focus of a trial service, to understand in detail the potential dynamics around expanding demand through better technology, and the costs of doing so on a wider scale.

7.10 Integrating data and services – operational considerations

This section considers broader themes in operational considerations which influence operators' willingness and ability to participate in MaaS data-sharing.

7.10.1 Pricing structures and pressures vary hugely, making fully integrated pricing difficult.

CalMac's fares are set by legislation and are structured as a road equivalent tariff; ScotRail fares are a mix of regulated and unregulated fares and the franchise makes specific conditions on processes for changing fares; bus operators set most prices freely; taxi fares are regulated but ride-hailing fares are not; shared mobility providers have a range of business models and prices for B2B or B2C offers. Concessions for the over-60s and under-22s on bus are funded to operators through a revenue agreement.

SPT and GCC directly control relatively few elements of ticket prices in the region, under current exercise of powers.

Creating a single price covering multiple modes requires a negotiation between operators over revenue sharing and the price presented to consumers. With the complexity of current fares, this is likely to be time-consuming and complex, even before the experience of other places on the difficulty of this process is considered.

Single subscriptions or multi-modal prices are therefore unlikely, unless they are set at a premium (so no operator feels disadvantaged), or use existing forms of multi-modal ticket in creative ways.

In this context, ZoneCard was represented by stakeholders as a curiosity – but the fact that a

multi-modal subscription already exists, even if on a slightly unorthodox footing, is a significant asset. This is discussed in greater detail in recommendations.

7.10.2 Operational requirements of sharing data are significant

The experience of existing MaaS systems is that sharing data and technological processes is often technically straightforward, but the more significant difficulties come in the legal, commercial and risk management processes that are required between different organisations. Conversations with operators suggested that the most important issues in Strathclyde are around liability, customer service, and booking and payment.

7.10.2.1 Liability, conditions of carriage and terms

Operators have hugely varied risk profiles and management processes. Mass transit systems have insurance and liability processes that reflect low-likelihood/high-impact macro-level risks – such as disruption to entire networks or vehicle faults – but the risk from an individual transport user are generally low. These risks are usually relatively low in financial consequence or can be mitigated with other public services' support – such as the risk of anti-social behaviour, or the risk of damage to windows, doors, or seats on vehicles. Operators which own physical premises also have risks around use of stairwells, lifts, walkways and platforms, particularly in wet and snowy weather – which are again low-likelihood, high-impact risks which revolve around corporate liability, negligence and mitigation.

This is not the case for modes which involve a significant level of individual influence.

Bike-sharing is subject to risks like fraud, theft, extended use beyond agreed hire times, and physical damage to bikes. User agreements usually specify that risk to the user and any potential harm to other pedestrians is taken by the user, and terms and conditions rule out any liability from use while inebriated or distracted while using a mobile phone. NextBike require a deposit of £5 to use the service, charge £10 for returning a bike outside a station, and £200 for a stolen bike (if they can recover the user details).

Any future micromobility schemes in Glasgow could face some very specific challenges: Urban Foresight's experience of e-scooter firms in Dublin and Newcastle is that proximity to nightlife and to water is a major issue, and companies have to account for a certain number of scooters thrown in rivers.

Car-sharing has a similar exposure to individual behaviour, but with significantly increased risk and costs from vehicle damage, theft or abuse. Strathclyde has some postcodes which attract a relatively high premium from insurers – and while this is part of car-sharing's appeal (it makes accessing a car relatively inexpensive), it is usually passed on to car-share operators too. Car-share is increasingly looking to technology which prevents a car being unlocked if an automatic breathalyser finds a maximum alcohol level, but this is some years away from mass adoption. Taxi and car-hire firms usually treat risk from users as a pricing matter – if you are sick in a cab, you pay a fixed cost on the spot – but also have insurance premiums that reflect this risk.

The broad picture is therefore that modes which individuals drive or steer have distinct risk profiles, and approaches to managing risk. A system which asked mass transit operators to share these risks is likely to be resisted by them. In practice, this means that providing integrated access to different modes has to come with a legal agreement on who takes what risk.

This is as much about the expectation or fear of shared liability as the reality. In theory it should be possible to logically assign risk by journey stage. For example, if a MaaS solution allows a user to plan and pay for an end-to-end journey using a bus, then the train, then a bike-share scheme, then it should be simple to allocate risks at each stage of the journey. However, in practice, operators are nervous that they could be *argued* to have shared liability by participating in shared journey-planning or payment. Imagine the user in question drinks on the subway: the bus and rail operator might believe that it could be liable for any damage to the bike. This might be wrong, or it may be purely hypothetical, but in a fundamentally voluntary context for participation in MaaS, the perception of risk and the tolerance of each operator to take on new risks is as important as the reality.

This fear is proportionate to the level of integration: full subscriptions with annual prices across all modes increase the nervousness; setting integration at around level 2, with integrated journey planning and booking but separate payment, is more likely to feel comfortable for operators – and their legal advisers.

7.10.2.2 Customer service

Just as different modes have different risk profiles, they also have different expectations of customer service, how responsive or reactive to customer requirements they can or should be, and the value they place on owning a customer relationship.

For modes like car-sharing or bike-sharing, customer expectations are often demanding: if on one occasion they find a car or bike cannot be accessed, they may stop using the service altogether. Expectations for bus, rail and ferry are different: a bus will usually eventually turn up, while there is a widespread acceptance in the UK that train times are more a matter of general guidance than strict timetabling. Ferries tend to be less frequent and there is a commonsense understanding that weather disrupts services.

At the same time, bus operators maintain that working in an open market places a premium on clear, consistent communication with customers – especially compared to long-distance monopoly providers like ScotRail or CalMac who could lose passengers to cars, but not to direct competitors in the same mode.

This may reflect bus operators' defence of the status quo. However, it is true to say that a customer might mean something different to different modes and business models. As noted above, many micromobility providers consider themselves tech companies, and this means that customer service through apps, live chats and individual rapid response is prioritised. This is not the case for rail, ferry or intercity bus which can generally rely on more traditional forms of customer service and engagement. This tends to involve call centres and online support, with longer-form mechanisms for formal complaints and feedback.

This may change: CalMac make significant revenue from purchases on ships, for example, so richer data on customers may become important. ScotRail's future arrangements could make certain requirements in customer-facing KPIs. Bus operators have yet to really explore rich analytics of customers or innovate with data – but they are starting, and this increases the commercial value of owning a customer relationship. Across all modes, the likely future direction of travel is towards greater sophistication with customers.

This means that just as operators are nervous about sharing liability, they are nervous about sharing customers – and in particular, bus operators will be reticent to engage in systems which dilute customer relationships.

Existing MaaS systems and tenders have a number of responses to these dynamics:

- Some create new customer service routes for customers who are using shared platforms with multiple modes. For example, a recent tender for a MaaS operator in Kent required the creation of a customer call and email response centre.
- Some require customers to pursue complaints or queries with the relevant operator for each stage of their journey. This has the cost of potentially confusing customers, and potentially creating work for operators in trying to pass customer service queries on to other operators, but does remove operators from complex need to share customer handling.

Again, there is a relationship between the real and perceived importance of these challenges, and the level of integration proposed. Crudely, the greater the emphasis on single pricing and services, the greater customer expectations of unified service, and the greater the complexity for operators.

7.10.2.3 Booking

In mass transit booking a service is conceptually simple: a customer buys a ticket and shows it or verifies it onboard. A bus, train or ferry either has space, or it does not.

Shared mobility is more complex and there is no consensus on the industry on how to show availability and offer booking and payment to customers. Some firms offer booking in advance, but the risk of this approach is that a user does not then turn up at a docking station, or other users arrive at a docking station first and are frustrated that bikes or scooters are booked up. Others show actual availability at a docking station, giving users real-time information, but only permit access once a user has arrived at a dock and paid on the spot. Some have developed a predictive information system, where users are shown the likely availability at any given docking station. None of these approaches are right or wrong, but reflect different ways of trying to balance different ways of helping users make choices.

In Strathclyde, NextBike currently offer the number of bikes available in real-time, and users can only rent bikes in person at the docking station. This places the onus on users to decide whether it is likely a bike will be available.

This is workable in the current system but in future could require an active decision on the best approach.

8 MaaS in practice: governance, policy, regulation and legislation

The broad alignment of policy and the goals of MaaS is discussed above in section 4. This section discusses the detail of specific policies, and how they interact with the operational considerations discussed above.

The experience of other places and the analysis above of transport provision and operators' data suggests there are 5 major policy choices:

- Defining a user group.
- Mode inclusion.
- Spatial scale.
- Governance: an overarching vision of which organisation does what, and in particular which organisation leads on developing a MaaS system.
- Business models.

8.1 Policy choices over users, spatial scale and mode

8.1.1 Main options for scale and scope

The choices over a target audience, the spatial scale and the modes included are interconnected – and leads logically to a choice on governance and funding. Most existing MaaS front-end services take one of three approaches:

- A niche offering, targeting a particular audience, and therefore limiting the geographic remit of the MaaS model and limiting the modes it includes. For example, high-end hotels providing a MaaS app might limit their options to taxis or car-sharing, reflecting their brand and positioning.
- A comprehensive offering which covers an entire jurisdiction, and aims to offer comprehensive access to transport within that area. For example, most city-regions creating MaaS apps cover their entire region – and include every main mode of public and shared transport, including intercity services.
- An initial set of services, confined to a particular geography or set of services, as a foundation for deeper integration. For example, HiTrans' app does not currently include ferries and Stagecoach tickets are manually processed, but the app is seen as a foundation for comprehensive services.

These options apply in Strathclyde and are reflected in the options appraisal covered in chapters 13 and 14. There are further detailed considerations over legal restrictions, and policy choices over the role of taxis, ride-hailing and cars in MaaS systems.

8.1.2 Legal restrictions on scale and scope

MaaS apps and platforms are not themselves specifically regulated, and legal guidelines on what services they can include is an untested, unclear area. However, a good working principle is that choices over what is included in the digital service should reflect the regulation of the physical service. For example, a MaaS app which includes bus services could not include just one bus operator under current regulation: this would be challenged as anti-competitive by other operators.

A further complexity would arise where participation in a MaaS system requires new investment in technology. Any MaaS system requires operators to have a minimum technical capability. The more advanced the MaaS system, the higher the floor. Operators could challenge this as an unfair barrier to competition.

8.1.3 Policy choices over private cars

Private car use is the antithesis of MaaS. However, there is no industry consensus over whether a MaaS system should exclude private car information entirely.

Including private car use makes a journey-planner more comprehensive, and when new services are competing with Google Maps – which shows private car journeys as the default – could be a mechanism to gain a user base. Uptake of cars with zero tailpipe emissions is increasing. This means that a MaaS system could include private cars and be compatible with reducing carbon, if it works in tandem with zero-emission or electrification policies. For rural areas in particular, including the private car may be the only way to genuinely offer a point-to-point service.

In Strathclyde, the combination of support for zero-emissions cars and the geography of the region aligns with this thinking.

However, for many journeys, private car use is the most time-efficient, and presenting equal choices for cars may reduce the modal shift to sustainable transport. Private car journey-planning is also more complex: route-finding is simple but live journey times, traffic conditions and route optimisation is much more complex, with Google and satnav firms like TomTom market leaders who have proprietary technology and deep datasets to draw on. Few MaaS technology providers will be able to compete with that sophistication.

For these reasons, most existing MaaS services do not include private car journey-planning.

One option is to launch a service with private car journey planning, and then phase out its use either in technology – discontinuing that functionality on an app – or using physical space regulation and tools like low-emissions zones to gradually disincentivise private car use.

Feedback from GCC suggested that given the overarching objectives of reducing private car use and encouraging modal shift, on balance private car use should not be included in any MaaS solution.

8.1.4 Policy choices over taxis and ride-hailing

The potential for MaaS to increase use of cars through taxis, ride-hailing and private hire at the expense of active and public transport is clear. One of the risks of a private-led MaaS provider without any oversight is that they are incentivised to steer people towards higher-margin services, like taxis. On the other hand, taxis, ride-hailing and private hire cars are convenient, and taxi providers claim that they are often the service which gives users confidence to stop using their car.

The evidence on how this plays out is extremely limited – both in general, and in MaaS systems. In general, evidence from the USA suggests that ride-hailing does lead to a reduction in private car registrations, but that this is more than compensated for with new ride-hailing registrations, with an overall increase of 0.7% registrations per capita.[67] As drivers spend time driving without passengers, overall emissions increase.[68] This is contested evidence and there is no consensus, with some studies suggesting that ride-hailing both competes with and complements mass transit in different places and at different times.[69]

In MaaS systems, this picture is equally confused. However, in Helsinki, the Whim app includes public hire taxis, and its annual subscriptions include unlimited public hire taxi use. It has not published detailed numbers on these subscriptions and some industry commentors suggest this is an implicit admission of increased taxi use.[70] In the face of pressure on its finances, the app's owner has suggested it may start pushing users towards taxis which give them a higher margin.[71]

Other policy objectives are relevant to taxis: in particular, GCC's Case for Change lists safe transport as an objective. There is no strong evidence on how MaaS improves safety, but micromobility providers concede that at night-time, and particularly in winter, taxis represent a safer option in the eyes of many users.[72] Taxis are regulated, with crucial levers like road space lying with councils. Interviews with senior SPT staff also suggested that private car hire is an important part of suburban and longer-distance modal shift – people who would currently drive into the centre using a shared vehicle – and these factors point to an open attitude to taxis and private hire vehicles.

Again, another option is that taxi services are phased in or out.

8.2 Policy choices over business models

The term 'MaaS provider' is used loosely to describe almost any organisation in the business of integrating transport through data. 5 major business models have been described or attempted in the MaaS industry:

- Publicly-funded whitelabel: a public authority pays a technology provider to create a MaaS system. This can be a back-end system (also referred to as 'middleware' in the MaaS market), or a front-end app. The company is contracted, usually on an annual basis, and usually without an up-front capital cost.
- Subscription models: a range of services are offered to users at packaged subscription prices. This business model creates revenue through volume discounts and strong data analytics – in the way that mobile phone companies sell airtime and data plans to

consumers, and do so at scale and understanding how they are used, to make a margin.
- Commission on transactions: every trip booked or accessed through a MaaS system has a commission charged by the platform.
- Commercial tie-ups: a MaaS platform charges operators to appear in its route-planning or service booking in particular ways, or with a certain discount.
- B2B MaaS, where a MaaS service is targeted at a discrete group of employees, through their employer. This model is gaining in momentum in France and Germany where many employers provide company cars.

These models are generally seen as the commercial model for private companies. In principle, there is nothing to stop any of these models being adopted by public authorities – if they can make the practicalities work.

A further 2 models exist only in theory:

- Premium: this is a model based on the idea that point-to-point booking and payment is considered a premium service compared to existing services, and therefore a service with exclusive add-ons and services is a strong package for MaaS.
- MaaS 'super apps' – using the frequency of transport to use MaaS as the basis for a wider app business model, such as advertising revenue, another service such as shopping, or hospitality.

In Strathclyde, the voluntary nature of operator participation again shapes decisions: as noted above, bus operators in particular are mistrustful of SPT. A subscription, commission, tie-up or B2B model led by public authorities is extremely unlikely. It would be seen as creating a position of revenue generation, undercutting operator margins.

However, they are also nervous about a private MaaS operator gaining critical mass of a user, and then charging operators. In effect, a publicly-led app which is free for them to participate in may be the least-worst option.

8.3 Policy choices over behaviour change and nudges

Section 3.3 discusses some of the tools available in MaaS systems for influencing behaviour. The choices for any MaaS system in Strathclyde are extensive in terms of app design, nudges, changes to route planning algorithms and other tools.

However, the discussion above on operator willingness to share data suggests that aggressively seeking to nudge users towards a certain mode will upset the fragile balance of participation. MaaS is more likely to be accepted by operators (under the current regulatory regime) if it is seen as offering a neutral platform for free and fair competition – not as a tool to actively steer users towards one type of mode.

This suggests that at first, policy choices over nudging are light-touch, and framed as a collective encouragement to avoid private car use in favour of all public and active travel. Future policy options on behaviour change might be more extensive.

8.4 SPT's role in the ecosystem

The 2001 Transport Act defined local transport authorities as local authorities, but the-then Strathclyde Passenger Transport Authority was also named as a local transport authority.[73]

In 2005-6 Regional Transport Partnerships were created, and the current SPT structure was created. The overall purpose of RTPs is to coordinate regional transport at a strategic level. Transport Scotland's role is to lead on national policy and implementation and nationwide initiatives.

MaaS is a concept that has emerged since these responsibilities were set down in legislation. Formal responsibilities for different aspects of MaaS between national and regional bodies are therefore unclear. Implementing MaaS in Scotland has been structured by a combination of prior legislation, emerging practice, and informal relationships.

In other words, there is no central policy statement for Scotland which tells SPT what its role is.

8.4.1 SPT's role in back-end systems

Developments with Traveline, the MaaS Investment Fund and recent legislation broadly suggest that national bodies will lead on data standards, data control and data relationships with operators working across Scotland.

This logically points the role of RTPs towards coordination of any additional data at a regional or local level for services not included in nationwide systems, and brokering operational issues which are difficult and best understood in a regional context, such as risk, customer service or revenue allocation. Most RTPs, and certainly the MaaS teams at HiTrans and Tactrans, see their role as the coordinator or provider of back-end systems, working alongside institutions like Traveline.

8.4.2 SPT's role in front-end systems

The apportionment of consumer-facing services between RTPs and national bodies is less clear. Some transport brands are established at a national level – particularly ScotRail, and schemes like the NEC. RTPs are generally not consumer-facing brands, but with MaaS apps being developed on a regional scale, they are creating new sub-brands such as GoHi in the Highlands.

SPT's heritage, however, gives it a longer relationship with travellers: there is no firm evidence but it is probably the case that SPT has a bigger brand presence with consumers than other RTPs. Compared to some regions, Strathclyde also has a greater coherence and sense of identity. SPT is also an operator and the subway creates a highly visible home for SPT's brand.

These factors suggest that a consumer-facing role is appropriate. Any app which covers the region could branded by SPT, for example.

This does not necessarily mean that a MaaS system is contracted by SPT. In other sectors, like economic development, regional contracts are often branded by a regional body but formally procured and held by a local authority. This can be useful for aligning projects with capacity in

different organisations, or using different processes for procurement or accountability.

8.4.3 Operator views on SPT's role

Views from operators on the right role for SPT significantly varied.

Rail and ferry are used to dealing with RTPs across Scotland, and see SPT as a neutral, partnership organisation which is also the logical lead for MaaS. Both are participants in HiTrans' app and are comfortable with GoHi both leading on data integration and presenting consumer-facing services.

Bus operators do not see SPT as neutral. They suggested that control of any MaaS system would ideally not rest with SPT, though without clear suggestions on who else could steer MaaS. Moves to greater coordination by the industry were described as a pre-emptive response to greater control by SPT, and implicitly the suggestion is that the bus industry should be left to pursue more integrated services on its own. Interviews did, however, have a tacit recognition that SPT's leadership of front- and back-end systems was the most likely outcome. Seen in context of the discussion above about data, the overall picture is that bus operators will tolerate, not welcome, SPT leading MaaS, and only on conditions they believe acceptable under current regulation.

8.4.4 SPT's role

Overall, this means that the logical role for SPT (setting aside future powers) is:

- Coordinating MaaS, steering an overall programme which works with operator organisations and councils, and liaising with national authorities working on MaaS.
- Leading on the purchase or development of any data system (front or back end) which implements or support MaaS , and leading on any consumer-facing product which covers the whole region.
- Branding any regional consumer-facing products.

However, it is important to note that the policy context essentially leaves it to SPT to define its role in the MaaS ecosystem, reflecting the other pressures on it, and the wider relationships it has to maintain. This paper presents a view based on MaaS: other priorities will influence its role.

8.5 GCC and other councils' role in the ecosystem

8.5.1 Existing responsibilities

Councils are also Local Transport Authorities, and have responsibility for some underpinning infrastructure, road space allocation, regulation of taxis, and public realm improvements. Across Scotland they are also leading on mobility services, such as bike-share schemes. This gives them an influential role as a commissioner of services, with a direct contractual relationship with some operators. This paper assumes these roles do not change.

8.5.2 Potential new roles leading MaaS

Beyond existing roles, councils' functions are a matter of judgement.

In principle, there is no reason why a local authority cannot lead or procure its own MaaS solution. The broad principle for councils in Scotland is that they cannot assume an activity is lawful, but have to act in accordance with specific powers given to them by legislation[74]. The range of powers local authorities have over road space, transport, as well as a general powers to improve wellbeing in the 2003 Local Government Act, give ample scope to look to commission MaaS solutions under this remit. This is the basis on which other councils are working. Dundee City Council commissioned a MaaS app in 2019, and the City of Edinburgh Council announced plans in early 2021 for a MaaS solution.[75]

Councils are only responsible for physical transport systems within their boundaries, unless they explicitly agree to share services with others. The nature of MaaS, however, is that many of its data sources are on a wider spatial scale: for example a journey planner can use publicly-available data from Traveline, and there is nothing to stop any council pursuing data-sharing relationships with operators working outside its boundaries. Again, this is the experience of councils elsewhere. Dundee's app includes services in Fife and Angus, for example.

In theory, any council in Strathclyde could therefore commission its own MaaS solution for the whole region or for its area, either back-end or front-end.

The justification for doing so would be three-fold:

- That a council-level back-end system would allow for more detailed data sets and richer systems. For example, a back-end data system focussed on one council area could include information like local attractions, street conditions, or council-led roadworks.
- That a council has strong presence with consumers, and direct communications channels with councils; some councils like the idea of broader 'city apps' that provide wider services and information.
- Relationships with operators are less likely to be shaped by long histories and long memories: depending on the council, contacts with bus operators may be good and relationships trusting.

The limitation of a council-led approach are:

- If one council commissions a front-end service then others may too. This is likely to duplicate spending and resource.
- Few councils other than GCC have the critical mass of complexity and density of services to make MaaS viable.
- The wider role of RTPs in coordinating regional transport points to councils retaining responsibility for services strictly within their area, and leaving coordination and system-wide concepts like MaaS to a regional level.

8.5.3 Councils' role in wider smart city projects

Most smart city projects in Scotland are led by councils. GCC has an active programme, with some projects such as smart street lighting gaining a nationwide reputation. The University of Glasgow also has a dedicated urban data research centre.

This creates potential to build mobility into these wider efforts. This could either be through managing data-sets, building connected devices which have a dual mobility and city management function (for example, air quality sensors could feed into a MaaS system's routing algorithm), or trialling innovations on the cutting edge of mobility like geofencing micromobility.

This could either be a complement to regional efforts led by SPT – or be an alternative approach to MaaS altogether, focussed on a city-level rich back-end.

8.6 Operator roles in the ecosystem

Most MaaS systems assume the role of operators is to provide data to enable integrated systems, and to provide transport.

In Strathclyde, the existence of alliances of operators and the ZoneCard consortium creates a nuance: there is the potential for groups of operators to integrate their services over time, and organically evolve a MaaS offering. This would have the benefit to public organisations of saving time, resources and political capital creating a MaaS system. It comes at the significant cost of losing control of data flows, and losing oversight of the potential for better data to improve transport planning.

The role of RTPs as partnership organisations responsible for setting regional strategy suggests that operator-led and -owned MaaS systems should be resisted.

ZoneCard is an unusual arrangement and the picture from stakeholders suggests it rests on a fragile acceptance of its current mechanism. The recommendations in this report cover how its future governance could evolve to take account of MaaS.

8.7 Future regulation: the Transport Act 2019

The Transport Act 2019 sets out new powers in transport and ticketing for GCC and SPT (in its capacity as a Local Transport Authority). Data to enable MaaS is not specifically mentioned, but various provisions are relevant to MaaS.

8.7.1 Section 44 – ticketing schemes and smart ticketing

The 2001 Transport Act sets out the ability of Local Transport Authorities to create ticketing schemes. This is a power with a number of conditions on how it is exercised. First, Local Transport Authorities have to work with operators:

> "If an authority ascertain that the required ticketing arrangements are not being made available, that authority shall seek to make arrangements with the operator or operators of the local services concerned under which the operator or operators agree to make the

required ticketing arrangements available.[76]

If that fails they can require operators to adopt certain ticketing practices:

> If a local transport authority are unable to make satisfactory arrangements… they, or two or more such authorities acting jointly, may make a ticketing scheme covering the whole or any part of their area, or combined area, if they consider that the proposed scheme—
>
> (a)would be in the interests of the public; and
>
> (b)would to any extent implement their relevant general policies.

Section 44 of the 2019 Act sets out new powers for Local Transport Authorities to mandate forms of smart ticketing, amending the rights in the 2001 Act:

> A ticketing scheme must require the ticketing arrangements—
>
> (a)to be smart ticketing arrangements, and
>
> (b)to comply with the national technological standard for smart ticketing (to the extent it is relevant to the arrangements).
>
> (3B)A ticketing scheme may require the ticketing arrangements to include provision—
>
> (a)enabling payment in particular ways,
>
> (b)about the persons to whom payment may be made,
>
> (c)about enabling entitlement to travel to be evidenced in particular ways,
>
> (d)about providing information about the arrangements to the public,
>
> (e)about publicising local services, fares or ticketing arrangements provided or made available by any operator of a local service of a class specified in the scheme, and
>
> (f)as to the appearance of tickets.

Smart ticketing is itself defined as ticketing which 'include provision to the effect that evidence of a person's entitlement to travel may be held or produced by the person in electronic form (whether or not it may also be held or produced in another form).'

Any reasonable interpretation of this definition would include ticketing displayed or shown in a MaaS system or app. However, the Act also gives Ministers the right to define a smart ticketing standard, subject to advice from a new body, the National Smart Ticketing Advisory Board. This body has not yet been constituted, with Transport Scotland running a consultation until October 2021.[77] SPT sits on the predecessor version of this board, which represents an opportunity to shape its future.

This part of the Act therefore creates clear potential for MaaS: it creates a new power, directly applicable to SPT and GCC, over operators in smart ticketing, which is broadly defined in a way that logically includes MaaS. But it also creates a wider process which could create a different definition derived from practice, or advice to Ministers.

8.7.2 Section 38 – bus franchising

Section 38 of the Act sets out new powers to create bus franchises, where local transport authorities determine bus services. It sets conditions on their creation, with various consultations and steps that must be taken.

MaaS is not specifically mentioned, nor any of the specific data points which are required to enable MaaS. However, the amended 2001 Act section 13D 1.3 sets out that a franchise framework 'may provide for such other matters as the local transport authority think fit.'

This is open to interpretation and an overly generous interpretation could be challenged by any bus operator. However, at a minimum, it is fair to interpret this as meaning that a franchise could mandate the ability to book and show a ticket for a bus on third party apps or MaaS platforms. It would also make clear that setting minimum technical capabilities in order to provide a service would be appropriate.

As important, under a franchise the relationship between a public authorities and a bus operator would have changed to a direct contractor-buyer relationship with competition for the market, not competition within a market. This would fundamentally alter the dynamic between the commissioning public authority and bus operators. Most likely, concerns over competitors accessing sensitive information would recede, and data-sharing agreements would be placed on a contractual, formal basis, not partnership and relationships.

8.7.3 Section 35 – bus improvement partnerships

Section 35 of the Act amends the 2001 Act on Bus Improvement Partnerships. This gives local transport authorities the right to create partnerships, and mandate conditions on bus operators:

> An operational service standard may, in particular, impose requirements about—
>
> (a)the vehicles which are used to provide services,
>
> (b)the maximum fares that may be charged for particular journeys, or for journeys of particular descriptions on services to which the scheme applies,
>
> (c)ticketing and the manner in which entitlement to travel may be evidenced,
>
> (d)the pricing of multi-operator travel cards,
>
> (e)the provision of information to the public about local services,
>
> (f)the dates on which the timing of local services may be changed.

Again, these provisions do not specifically cover MaaS. However, they collectively cover many of the elements of MaaS. They could be argued to provide the basis for requiring open booking from bus operators as part of a partnership.

There are wider provisions which allow Ministers to make further changes. Bus improvement schemes can set out measures to be taken under the scheme, and Ministers are given the right (in section 38.3M.2) to issue further regulation which defines 'measures'. Participation in MaaS could be considered a measure, and this could create a legal avenue to mandating participation without franchising.

8.7.4 Section 39 – information on bus services

Section 39 of the Act sets out wider provisions on information-sharing when a local service is registered, cancelled or varied. A service has to be registered with information such as the planned route, stops, and layover locations.

The Act creates the ability to request this kind of information as well as passenger numbers and profits, and requiring this information to be provided in electronic form.

This is designed to improve competition, by enabling better information on how services work, and is not about creating a long-term legal basis for data-sharing.

However, it does create a legal mechanism which could be interpreted as requiring basic data-sharing when a service is varied. If open competition is preserved, subject to legal advice this may create an alternative route to request some types of information, in these specific circumstances.

8.7.5 Use of the act and full advice

The Act is relatively untested. Urban Foresight's interpretation is that smart ticketing and bus franchising provides a clear basis to put data-sharing on a mandated or contractual basis, while wider provisions are weaker and are less likely to offer a mechanism for obtaining operator data.

This does not constitute legal advice and recommendations in this report include seeking the advice of GCC and SPT legal teams over these provisions.

8.8 Future regulation: councils and contractual levers

Councils have significant scope to design contracts for services they run, such as exclusive bike-sharing scheme or car-sharing schemes. Cities with advanced MaaS systems have started building in data-sharing and interoperability as a condition of operation, and this option is available to councils in Strathclyde.

There are also wider principles of micromobility contracts which are not specifically about MaaS but support its implementation – for example, European cities are generally issuing licences to operate micromobility which last for 2-3 years. This is long enough to give certainty to companies and consumers over the availability of services, but short enough that rapid advances in technology can be accessed.

Contracts are clearly subject to other considerations, including the cost to suppliers to include data-sharing, which could be passed on to councils. However, strictly considering MaaS, council contracts over mobility services represent one of the clearest mechanisms for building capacity for MaaS as contracts expire and are retendered.

9 MaaS in practice: ICT infrastructure

9.1 Existing apps and platforms

Around 40 apps currently cover Strathclyde or parts of Strathclyde offering transport or journey-planning services. The major apps in transport include:

- Traveline, discussed above under operator data.
- Citymapper, an app available around the world which offers journey-planning information. In London, it offers a multi-modal pass. There is no suggestion that it is looking to expand this service to other cities.
- Google maps
- The major operators in rail and bus services all have apps, which include journey planners, timetables and the ability to buy and show tickets
- Many taxi firms have apps which allow users to request and pay for taxis, and Uber is available in Glasgow.

There are also other organisations outwith the transport sector who have apps, or are otherwise connected with multi-modal platforms:

- Loch Lomond National Park is a participant in a TacTrans MaaS app pilot.
- Hotel apps are standard. Most chain hotels have apps for their guests, and those with reward schemes or loyalty programmes sometimes have dedicated apps for those customers.
- VisitScotland reported a move away from apps from wider tourism businesses, driven by customer frustration at having to download and use multiple apps, and costs for businesses in maintaining apps. Glasgow Airport are the major app they reported having significant use and interest.
- A number of major events sites have apps, including Celtic, Rangers, and Partick Thistle, and the SEC.

From 2012 to 2015, SPT had an app, iShoogle. This allowed users to plan journeys and receive updates on services, as well as information on nearby amenities like shops or restaurants, and historic information on the subway. The app was withdrawn as user numbers were low and it was expensive to update, and user requests for features were not possible by updating the app.[78]

9.2 The relationship between smart ticketing and MaaS

In principle, MaaS relates to existing integrated and smart ticketing technologies in one of two ways:

- **A replacement for smart ticketing**. Some MaaS advocates fiercely define themselves in opposition to physical smartcard systems. They describe it as a 'leapfrog' technology,

where the ability to plan, book and verify journeys from a mobile phone makes all existing physical smartcard products redundant. For example, a MaaS app can show a bus ticket given to a driver, or a QR code to unlock a shared bike, or the ability to tap a mobile phone into ticket gates. This still rests on hardware abilities as buses, trains or ticket gates have to have equipment capable of scanning codes, or recognising mobile tickets, but makes smartcards unnecessary.

- **A complement to existing smart ticketing.** Others see MaaS as an evolution of smart ticketing. This can take a number of forms.

  Some smartcards can be uploaded onto a mobile phone, in the way that phones can also be used for contactless bank payments. A MaaS app on that phone can be linked up with that smartcard or bank card. This means that a user might have three separate products – a MaaS app, a bank card, and a season ticket on a smart card - but a user only has to use a phone to deploy all three and access transport.

  The concept of Account-Based Ticketing (ABT) is seen as a common resource for both smart ticketing and MaaS systems. The concept is that a user is linked to an account. That account is only charged after a journey is completed: a user taps in or out, and a fare is calculated, usually with the lowest possible fare automatically charged. This means users do not have to worry about fare structures or choosing the lowest cost option. ABT can in principle be linked to any device which is linked to an account and accepted by transport operators, which usually means a contactless card, a smartcard, or a mobile device. In this way, ABT is usually described as a good foundational technology which is appropriate for existing smartcard formats, but is a strong basis for future MaaS systems.

  Some ticketing providers are also positioning themselves as ‘fare payments as a service’: instead of public transit authorities commissioning their own bespoke ticketing systems, they create a single platform offering smart and mobile ticketing which multiple public transport authorities can use. This saves the authorities time and cost and streamlines updating the system. These platforms generally include the ability for other organisations to access ticketing processes, which enables MaaS apps. In effect these providers come from ‘traditional’ smart ticketing but have a product which create the basis for interoperable booking in MaaS.

This creates a strategic choice for MaaS systems on how to reflect, or build, on existing smart ticketing initiatives: either to work with the existing systems and build common capabilities, or look to their complete replacement. In Strathclyde, the crucial factors in shaping this decision are the national policy agenda, existing physical systems, and how these interacts with payments.

9.3 National smart ticketing approaches

9.3.1 Transport Scotland smart ticketing approach

The Scottish Government has committed to making all journeys on public transport accessible by 'some form of smart ticketing or payment.'

Since 2006, the ITSO standard has been the preferred format for smartcard travel in Scotland. Transport Scotland has worked with operators to introduce this standard. In its last smart ticketing strategy, Transport Scotland noted it would support operators to look at smart payment and mobile-based ticketing.

It also committed to a study to look at account-based ticketing (ABT) in Scotland. At the time of writing, it was unclear when this study will take place.

New powers in the Transport Act 2019 over smart ticketing are discussed above in section 9.7.

9.3.2 Free bus travel for under-22s and over-60s

The National Entitlement Card is on ITSO format, and free bus travel for the under-21s is using the same system.

This creates a specific limitation: as discussed above, young people are the prime audience for mobile-based systems, but in Scotland, a significant extension of bus travel rights will be in smartcard form.

Transport Scotland have pledged to explore offering the NEC card on a mobile device. This could mean either an upload function to a phone, or a new app with mobile ticketing.

9.3.3 SPT and GCC relationship with national smart ticketing

These initiatives create some uncertainty for SPT and GCC. There is clear policy support for smart ticketing. However, the extent to which new tools like ABT or an NEC app is prioritised is not clear.

9.4 Smart ticketing in Strathclyde

9.4.1 Ferry, bus, and rail

Operator smart ticketing in Strathclyde reflect the national picture: a range of initiatives which have collectively improved the availability of integrated ticketing over recent years, but with some significant variations in technology and approach.

Ferry and rail are currently relatively advanced. ScotRail accepts smart cards and mobile ticketing, has a mix of on-platform validation, ticket gates which are smart ticketing enabled, and some validation carried out on trains by staff with mobile devices. CalMac's new ticketing system is designed to be mobile-based, and integrate with MaaS apps, and though ferry terminals generally do not have ticket gates tickets will have to be validated before departure (most likely through

staff with a mobile device).

Bus operators present a more complex picture. Most major operators have apps which allow ticket purchase and verification. Most of these use QR codes which users have to scan as they board; some operators ask users to show their ticket to a bus driver; some like Stagecoach have QR codes but generally ask drivers to check tickets visually.

Bus smartcards are generally ITSO format, following national guidance. ITSO cards can be uploaded with multiple subscriptions, and at the moment this means that users in Strathclyde can add season tickets and pay-as-you-go tickets for subway, ScotRail, McGill's and Stagecoach onto the card. The cards are interoperable, so any individual operators' cards can be used to upload tickets for other services. The Tripper ticket, which covers FirstBus, McGill's, Stagecoach, Whitelaws and Citybus, is also ITSO format.

Most bus operators (and even community transport groups like Community Transport Glasgow) use the Ticketer machine. The dominance of the Ticketer machine makes integrated products across most bus operators easier, as any smart or mobile ticketing is working from consistent hardware on many buses. It also has a knock-on effect on software integration: a developer called Passenger is swiftly becoming the default app provider because of its focus on compatibility with Ticketer, and this means that operator apps are often using the same underlying code – making interoperable booking easier to implement.

It does, however, have some drawbacks. Ticketer is cloud-based and its machines have relatively little memory, and so certain functions are carried out from the phone rather than the machine – such as fraud verification for payments. This is less secure than machines carrying out these functions, and means that some mobile ticketing providers are reluctant to create ticketing systems reliant on Ticketer. Any MaaS supplier would have to be comfortable with Ticketer's capabilities.

Second, Stagecoach buses use a different hardware provider, Vix. This supplier does not offer back-office verification of Tripper tickets within 24 hours, meaning that users cannot buy daily tickets on Stagecoach and use them on other operators. This is a consequence of national buying by Stagecoach, as its west of Scotland unit cannot diverge from national technology relationships. Stagecoach's hardware is capable of contactless and mobile payment, which would be the basis of any MaaS system, but a complication would arise if a MaaS system was designed to maintain the existing Tripper ticket structure and price, or let users add their Tripper card to an app. Depending on the exact MaaS platform, it could mean that Stagecoach remains unable to offer day-tickets. Any MaaS platform would have to be compatible with Vix: it might seem reasonable to suggest Stagecoach move its technology in line with the market, but this could be considered discriminatory towards one operator.

Informally, most operators agreed that it will ultimately prove unsustainable for Stagecoach to remain an outlier. First and McGill's noted their openness, in principle, to standardizing all hardware and ensuring interoperability. More generally, the purpose of the bus alliance is to offer more integrated services, and interviews suggested that mobile-first integrated payments will be pursued over the next 12-36 months. If no MaaS solution is procured immediately, then a sensible

approach may therefore be to understand how these discussions evolve, push informally for more consistent hardware and ticketing approaches across bus operators – and build from a more integrated operator context in future.

9.4.2 Subway

The subway smartcards are also on ITSO format. Some suppliers have developed ITSO on mobile solutions, allowing an Android phone to emulate a plastic ITSO smartcard – in layman's terms, a phone becomes a smartcard.

However, this is currently only supported by Google Wallet. If MaaS is to integrate existing smartcards and offer emulation, this is a significant limitation given around half of all users are on Apple's iOS.[79] Apple does support apps which allow a user to buy a ticket on their phone, and load it to their smartcard – known as ITSO Part 11 Remote POST, or 'remote ticket download'.[80]

The alternative is to move beyond smartcards to mobile payments. However, while current subway ticket gates could be adapted to accept other ticketing and payment types, this would require significant upgrade works, including the readers on the gates as well as software and other hardware changes.

This means that a MaaS solution has a number of choices on how it includes subway:

- Provide subway journey-planning only, for all users.
- Provide subway journey-planning and a booking function where a user can load a subway ticket to a card from their phone.
- Allow users to upload their smartcard season ticket to phones, but with only a journey planning option on the app for Apple smartphone users
- Upgrade ticket gates to allow other forms of contactless payment, or mobile payments and ticketing.

9.4.3 Payment

At the moment, operators in Strathclyde all have their own payment systems, reflecting different corporate structures, technology systems, and business models. Payment systems is itself an entire market in transport services.

Payment systems crystallise many of the concerns discussed above about sharing risk under MaaS because companies are nervous about being exposed to the security, fraud and payment risks of others.

MaaS systems generally adopt one of three approaches to work around these concerns:

- Acting as a clearing house for payments as they happen, where providers trust the MaaS system to act as a broker between them and the payor.
- Creating a model with operators where revenues are collected by the MaaS platform and then distributed to operators in line with agreed contractual settlements – in other words, a revenue system between organisations, not a payment system for customers.

- Or creating a neutral platform where providers receive payment directly from customers, in line with their existing processes, fraud, customer verification and account processes, and the MaaS platform only acts as a portal to bring those payments into one place.

In the Strathclyde context, operator willingness is the main consideration and this points to the third option. Different MaaS platform providers have different approaches, and this would ultimately be clarified at point of procuring any MaaS solution – and there is also usually significant flexibility to adapt.

9.5 Smartphone and data reception in Strathclyde

Patterns of mobile data coverage closely map onto population centres. Most urban areas are well-covered by the main networks, but rural areas vary significantly.

There are particular blackspots: parts of Arran are frequently-visited but have poor data coverage; coverage of Lanarkshire by EE and Renfrewshire by Three is patchy.[81]

Operators have a wide range of wifi capabilities on vehicles. ScotRail offer wifi on some trains; Stagecoach discontinued wifi on some routes in the early stages of lockdown; McGill's offers wifi on its main routes; smaller operators generally do not offer wifi.

This broadly supports most of the analysis on transport provision and users: digital networks enable MaaS in more concentrated, urban areas, with important exclusions in rural and remote areas.

10 Understanding the way ahead for MaaS in Strathclyde

10.1 Assessing the barriers and opportunities to MaaS

The analysis above sets out a range of barriers to MaaS and opportunities which a MaaS system could build on. To give a sense of their relative importance, each factor was given a score from -5to 5, as a force working across the region against MaaS, or as a factor supporting its adoption.

Chart 1shows the relative importance of each barrier and opportunity.

10.2 The strategic choice: a less integrated solution now, or build integration gradually

This set of barriers and opportunity creates a significant strategic choice, even before any individual MaaS solution is considered.

With these conditions, there are limits on the type of MaaS solution which is currently available. In short, a MaaS system could only be with the voluntary participation of operators, and this would set strict limits on how integrated it could be. There are still options for focussing on the consumer-facing service, or to focus on the back-end and underpinning digital system – but fundamentally any solution or system built today would reflect the existing pattern of powers and relationships, and would be at level 2 integration at most.

The alternative is to avoid developing a new MaaS solution immediately, and instead prepare a programme which aims to address the barriers to MaaS – and build on the opportunities. This would collectively build capacity for MaaS, with the aim of enabling a much more sophisticated MaaS system in future. The sections that follow assess each of these two strategic choices in turn.

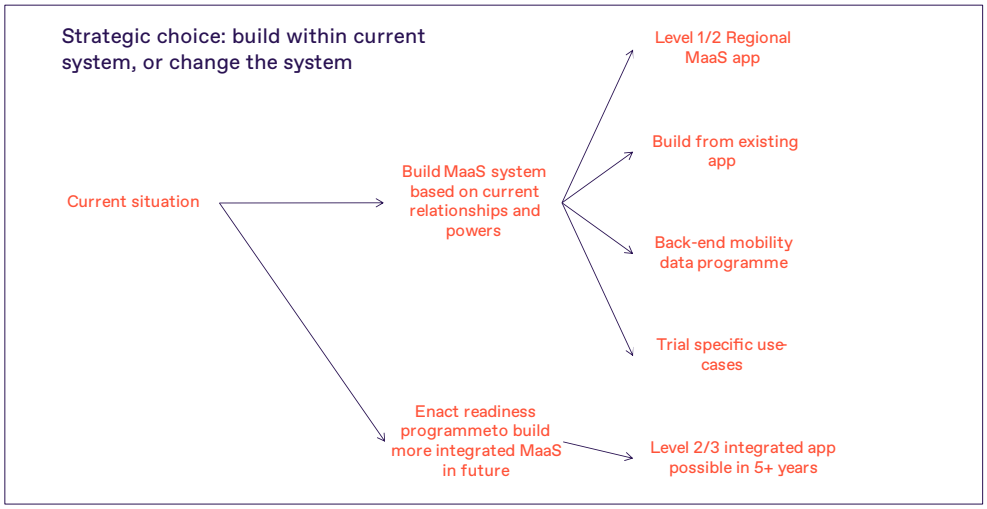
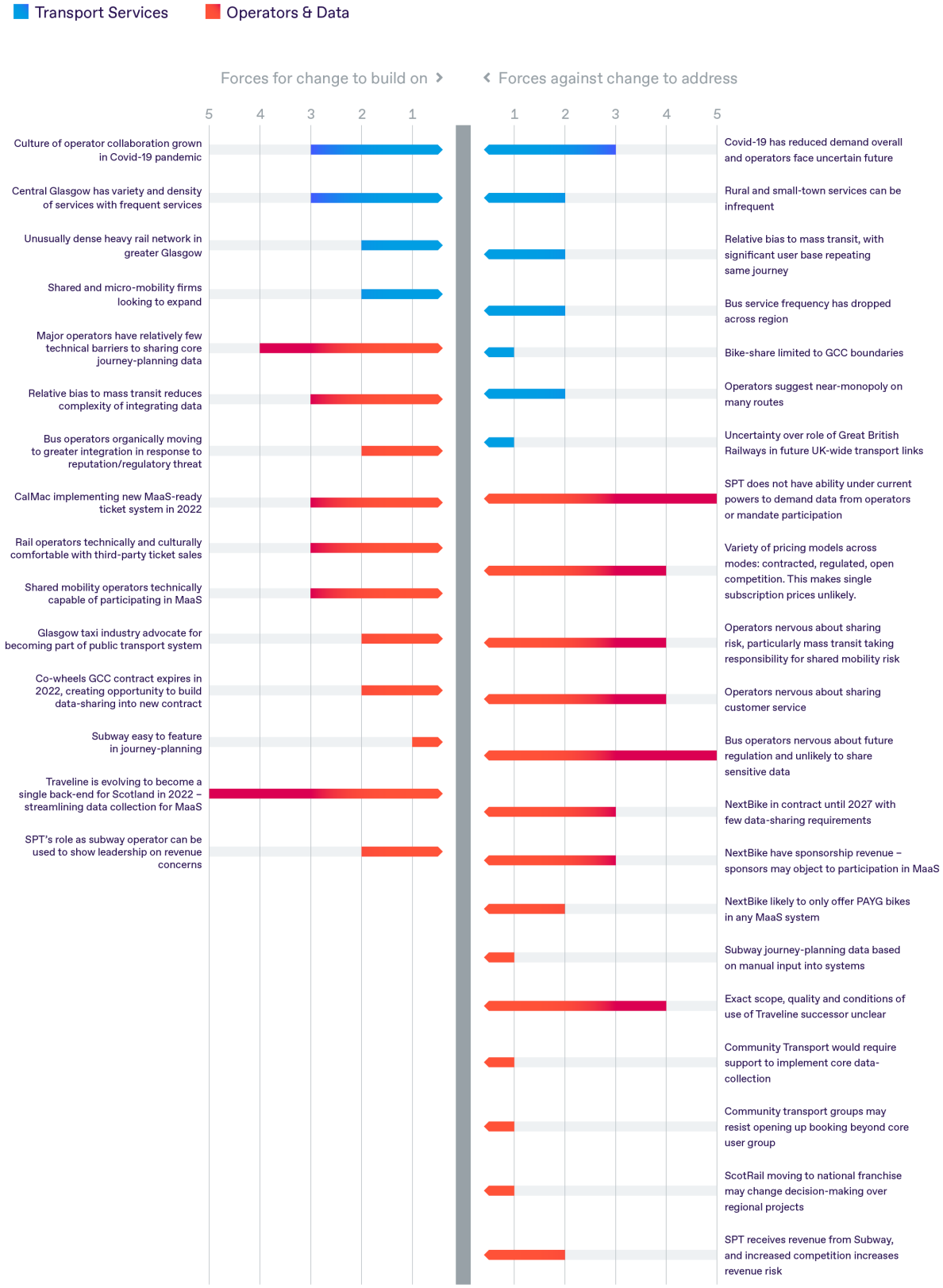
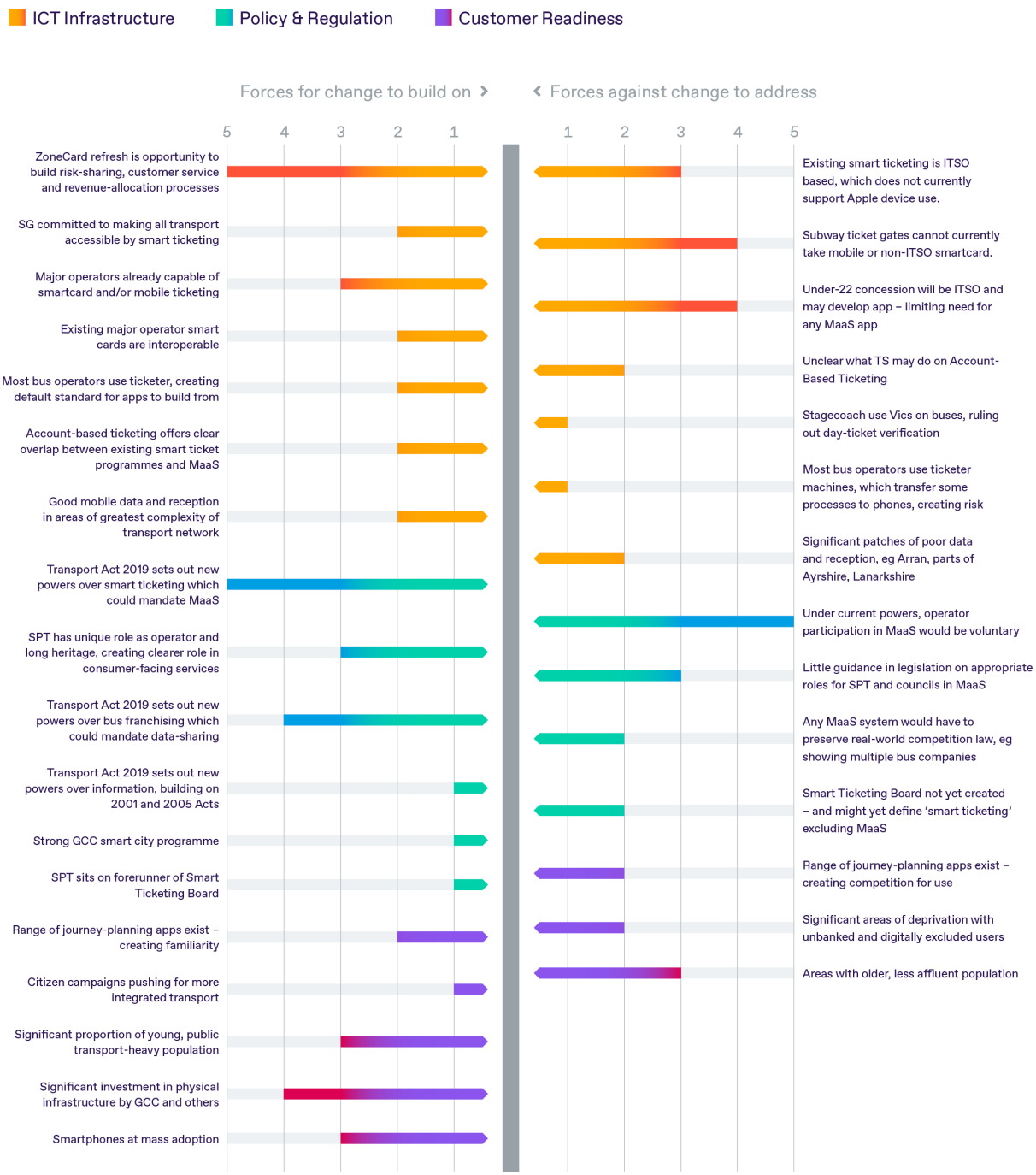


Chart 1: barriers and opportunities for MaaS




ICT Infrastructure
Policy & Regulation
Customer Readiness
Forces for change to build on
Forces against change to address
5 4 3 2 1
1 2 3 4 5
ZoneCard refresh is opportunity to build risk-sharing, customer service and revenue-allocation processes
SG committed to making all transport accessible by smart ticketing
Major operators already capable of smartcard and/or mobile ticketing
Existing major operator smart cards are interoperable
Most bus operators use ticketer, creating default standard for apps to build from
Account-based ticketing offers clear overlap between existing smart ticket programmes and MaaS
Good mobile data and reception in areas of greatest complexity of transport network
Transport Act 2019 sets out new powers over smart ticketing which could mandate MaaS
SPT has unique role as operator and long heritage, creating clearer role in consumer-facing services
Transport Act 2019 sets out new powers over bus franchising which could mandate data-sharing
Transport Act 2019 sets out new powers over information, building on 2001 and 2005 Acts
Strong GCC smart city programme
SPT sits on forerunner of Smart Ticketing Board
Range of journey-planning apps exist – creating familiarity
Citizen campaigns pushing for more integrated transport
Significant proportion of young, public transport-heavy population
Significant investment in physical infrastructure by GCC and others
Smartphones at mass adoption
Existing smart ticketing is ITSO based, which does not currently support Apple device use.
Subway ticket gates cannot currently take mobile or non-ITSO smartcard.
Under-22 concession will be ITSO and may develop app – limiting need for any MaaS app
Unclear what TS may do on Account-Based Ticketing
Stagecoach use Vics on buses, ruling out day-ticket verification
Most bus operators use ticketer machines, which transfer some processes to phones, creating risk
Significant patches of poor data and reception, eg Arran, parts of Ayrshire, Lanarkshire
Under current powers, operator participation in MaaS would be voluntary
Little guidance in legislation on appropriate roles for SPT and councils in MaaS
Any MaaS system would have to preserve real-world competition law, eg showing multiple bus companies
Smart Ticketing Board not yet created – and might yet define 'smart ticketing' excluding MaaS
Range of journey-planning apps exist – creating competition for use
Significant areas of deprivation with unbanked and digitally excluded users
Areas with older, less affluent population

11 Options for a MaaS solution under current conditions

Option	Governance	Spatial scale	Integration level	Modes included	Cost	Timescales
1: Build a new app focused on integrated booking and journey planning,	SPT or GCC commission app from software provider, manage contracts with operators for data sharing, voluntary participation from operators	Regional	1 or 2	Rail, ferry, bus, car-sharing, bike-sharing. Subway only for journey-planning.	£200-500000 per annum Resource costs	6-12 months
2: Build out from an existing app/service focused on integrated booking and journey planning	SPT encourages/work with existing app providers to add multi-modal journeys & integrated ticketing	Regional	1 or 2	Rail, ferry, bus, car-sharing, bike-sharing.	<£100,000	1-6 months
3: A shared mobility data programme as part of wider smart city initiatives:	GCC hosts a single hub offering wider data sets on mobility	Glasgow city	Aiming to enable level 2	Workstreams on every mode	<£50,000	Immediate start, 5-year horizon
4: Build a trial/pilot service around use-cases or audiences.	SPT or GCC scopes, plans and delivers trials	Region-wide, local/hyper-local trials	3	Mass transit + modes for particular user groups	£100-400,000	1-2 years

Option 1: build a new consumer-facing app

What does this solution involve?

This would be a new MaaS app offering up to level 2 integration.

Based on the analysis above the likely scope for this would be:

A system resting on voluntary participation from operators, focused on integrated booking but not pricing. SPT and GCC do not currently use the formal levers to mandate participation across all modes, particularly bus operators and NextBike. Under the current powers, this means the options are either to build an app which excludes bus and possibly bike-sharing, or create an app which is voluntary. An app without bus would, in our view, be pointless.

This therefore means a set of capabilities which operators can be confident either increases revenue, or preserves open competition. This means it would likely be focused on journey planning, booking and ticketing across all modes – but with ticket pricing, proprietary customer information, customer relationships and service modelling retained by each operator rather than held in common. It would not include existing subscription options or season tickets. It would also have to present choices reflecting existing competition rules: for example, a bus route that is currently competitive between two bus firms and rail would have to show options for all three.

It is important to stress that there is no guarantee over operator participation and no sanction for refusing to provide APIs. In implementing this option, SPT would sign new contracts with operators over what data they provide, and on what terms. It is possible that in this process, operators will not allow direct booking on a MaaS app and will instead only allow a single portal which then links to their own apps or websites.

Including subway for journey-planning only. As discussed above, at the moment subway gates cannot take contactless payment and only Android phones can emulate smartcards. This option would therefore include subway for journey-planning purposes only.

Including taxi but not ride-hailing services. This would work at the pace of taxi operators. This is an explicit policy choice that could be made either way within this option.

Including more capable community transport groups.

Building out from Transport Scotland's new data system. With Traveline moving to be a single data resource for Scotland, operators will already be contributing to a nationwide system. This therefore means that the most likely sources of data for a MaaS app in Strathclyde are taking Traveline's API, and adding any services which are missing (for example, car-sharing), and any contextual data which Traveline does not provide, such as weather or service updates. The benefit of this is that no new negotiation with operators would be necessary to receive the information they provide to Traveline.

This assumes that Traveline does not require organisations taking its timetable information to

use its route-planner.

Funded by SPT (or public bodies). Operators are nervous about any private organisation developing a MaaS platform which then charges them commission to appear on – which is an incentive to join a voluntary public-led app. However, they are unlikely to do so if that public platform is itself charging commission. They also currently pay to support Traveline, and could argue that providing data is also a cost to them. This therefore means that the most likely funding model is one which is free for operators to participate in, with the service funded by a public authority.

Using white-labelled technology. SPT/GCC have the option to design and build an app from scratch. This is a real option, if there is capacity and the desire to do so. However, given there is now a growing market in whitelabelled MaaS apps, and that apps have significant ongoing costs in updates, commissioning a software company is the route most places are taking.

Setting a requirement for vendor neutrality. Some MaaS apps are running tie-ups with mobility firms, especially ambitious start-ups trying to win significant market share who claim they can easily integrate the main global mobility providers. Given the relative immaturity of these newer forms of mobility in Strathclyde, this should be actively countered with a contractual provision that any app provider is neutral about choice of mobility providers. In our assessment this would not materially narrow the range of organisations competing to provide an app.

What is its governance?

Given the regional focus and discussion in section 8.4.4 on current roles, this would logically be commissioned and procured by SPT, or a council on SPT's behalf. A private MaaS provider would be contracted to provide the technology. Operators would provide data to Traveline, and SPT would use that data on Traveline's terms; any further data or processes not covered by traveline would be covered by a legal agreement between an operator and SPT.

What is its spatial scale?

Given the analysis above, a regional scale makes most sense for a consumer-facing app. Glasgow city has a great proportion of younger, more affluent and public-transport familiar users than the wider region. It would be the core of a regional app. However, regional is the spatial scale which captures important multi-modal hubs such as the airports and ferry terminals, and makes the governance of the app neater in aligning it with the regional transport strategy. In general, Strathclyde is a coherent geographical identity (with the possible exception of the more peripheral areas), and SPT has stronger brand awareness and sense of identity than some RTPs – which offers a stronger basis to develop a consumer-facing regional service. Given its overall role to coordinate transport planning, leading on a new consumer-facing strategic tool is appropriate, and in line with the roles other RTPs are taking.

What would it cost?

Direct costs include:

- A basic journey planner app is in the region of £30-50,000. This is usually an up-front

cost, with a smaller licencing or support cost on an annual basis.

- A whitelabel MaaS app with the specification above would be in the region of £150-500,000. This is usually an annual cost. Many providers are flexible, however, and would consider up-front capital spend or front-loading the contract, if that suits accounting processes at the commissioning organisation. For context, Berlin pays Trafi 350,000 Euros per year; HiTrans's project with Mobileo is a total of £500,000 over two years, which includes operational costs to the RTP.

Indirect costs include resource costs to manage legal and commercial agreements. It is vital not to see commissioning a whitelabel app as a turn-key solution for MaaS: firms which provide the software for a MaaS system can advise on the legal agreements, but the operational burden on drafting and executing them generally falls on whoever commissions the app.

Traveline's common data stack significantly shortcuts this process, as assuming it is based on open APIs, SPT/GCC would not need to contract directly with the main providers, but simply take the data from Traveline. Agreements would only be needed with Traveline, and any operators those not included in its system.

This could create resource requirements in legal/commercial teams, and possibly in data governance. If car-sharing is not included in Traveline's system and this is added for Strathclyde, for example, then this also creates a new requirement to hold common data on users, such as driver licence details. This would require a contract with car-sharing providers (or an addition to existing contracts) to govern the use and storage of that information.

These costs will vary significantly depending on the exact terms of Traveline's new model. Managing user verification or accounts, for example, is a significant task which would fall on SPT/GCC – or their commissioned app provider – if Traveline does not have this functionality.

Beyond this, setting the app at the level of integrating booking – but not with single prices and revenue allocation – should mean that time negotiating the extent of user information, rich analytics and proprietary information is not required, because there is no attempt to share this data.

If community transport is included then the likely cost of installing technology for each provider to contribute to an app is in the region of £1-10,000.

What are the timescales?

This option would be subject to public procurement. After procurement, a MaaS app would expect to be functional and launched to consumers with 6-12 months. Provider preferences on launching in beta with some modes, or waiting until all modes are available, vary.

Option 2: build out from an existing app

What does this solution involve?

This would be similar to option 2 in that it focuses actions on creating a new consumer-facing tool. However, it would seek to use existing apps as the foundation for doing so.

This could happen in a number of ways.

- **3A: tech provider**. Organisations like Google or Citymapper have slick, user-friendly apps. The bigger tech firms are global organisations, and so arrangements with places often proceed at the pace of global programmes: Google will sign up a range of places to a new service, and then launch in one go across the world. It can also mean lack of flexibility, and having set processes for sharing data, owning information and exploiting IP which are never altered. Strathclyde will be seen by them as small – they are interested in population centres of tens of millions – but a commercial agreement may be possible, on their terms. Younger firms like Citymapper or Moovit are more likely to be flexible, and a commercial agreement to add booking to its existing services in Strathclyde would likely be entertained.
- **3B: operator**. Most operators have apps. They could be encouraged or commissioned to add other modes. The challenge here is that existing apps are clearly branded and used for a specific purpose, and multi-modal journeys represent a different use case. In practice, bus operators would not tolerate any single bus operator becoming the basis for a MaaS system, so any programme to build from existing operator apps would have to work with all of them, at the same time. ScotRail and CalMac may be willing partners, but may only feel comfortable adding other modes on a national basis, which would add time and complexity.
- **3C: other public sector apps**. Existing public-sector apps could also be adapted. Other RTP apps are whitelabelled and locally-branded (for example HiTrans' app is called GoHi and commissioned to mobileo) and are therefore not suitable to adapt. Dundee City Council is developing an app which is open-source, which may create a route to adapt the basic code with Strathclyde branding and transport options, but it does not include the ability to book services. This is undergoing a Transport Scotland trial to test scalability in Fife. Traveline may make its front-end open source, or adaptable by RTPs.

What is its governance?

In each of these options, a public organisation (likely SPT, given it involves managing relationships across transport operators) would be responsible for expanding integration with other organisations.

Existing app owners would retain ownership. SPT's role would be informal, shaping other organisation's services – but likely without a formal role in their design.

3A would be a commercial agreement with a provider. This may be able to avoid procurement, given the specialist nature of the task.

3B would be a more relationship-led, influence-based model where partners are encouraged to add multi-modal booking. This could only be a voluntary programme for the major operators, based on encouraging them to add services which add value to their users. Those providers who are contracted with councils or SPT could be mandated to include other options in their consumer-facing services.

3C would require some developer resource to adapt these apps.

What is its spatial scale?

Regional, on the same basis as option 1.

What would it cost?

3A. This would be a bespoke price negotiated which is extremely difficult to predict but it is safe to assume it would be comparable to a whitelabel city app.

3B. Assuming that 5-10 providers are asked to add new functionality to their apps, and they have existing SaaS arrangements with their providers, this is likely £5-10,000 per provider. The caveat is that some may be tied in to longer-term app contracts and costs may be significantly higher. Most operators would ask for that cost to be funded.

3C. Using an open-source or open-access app would cost in the region of £10-40,000 to adapt for Strathclyde.

What are the timescales?

All of these options are likely to be quicker than building a new app, assuming partner organisations are willing to add further services to their existing modes. 6-12 months to complete a programme of adding further options to existing apps is realistic.

Option 3 – shared mobility data programme

What does this solution involve?

This option is the creation of a set of mobility datasets which a range of organisations can then use to build consumer-facing services.

That would mean some form of data hub, or central pool, which receives (or creates) data which is then accessible to accredited organisations. At its simplest this could be a website which then has downloadable data-set and tools to use the data; at a more complex level, it could be the purchase of new middleware software. GCC has an existing data portal and this provides a strong basis to work from.

In practice, this would cover the datasets which could be added to core information about mass transit available through Traveline to create much richer, more targeted services – other mobility providers, rich data on physical environment, local news, predictive analytics on major events or

weather, commercial tie-ups with local businesses, and interchanges with other smart city projects such as digital twinning.

The concept is that by creating a central set of data, new combinations of service and innovation can be developed. For example, other countries which have pursued this model expect that this is likely to evolve into a way of uniting logistics and passenger services, because if information on the location of a delivery car or van is ultimately added to a shared data system, then this could become available to passengers, too, allowing them to book the same vehicle. Others see this kind of common data resource as a precondition of autonomous vehicles having sufficient data inputs to be useful.

At the simpler level, it is more likely to enable a range of uses at around level 1 integration, but more complex data-sets could enable level 2 integration – on similar terms to the MaaS app solution outlined above, where bus operators would be unlikely to open full interoperable booking or data-sharing.

What is its governance?

A new data hub would have to be hosted and managed by a public sector organisation. This could be SPT or GCC, but universities and councils have fulfilled this role elsewhere. The University of Glasgow's Urban Big Data Centre has a similar facility, albeit it is selling data analytics, and the University of Strathclyde hosts a branch of the Future Cities Catapult, so one option could be to partner with a university.

What is its spatial scale?

This option would be reduced to a city-region level. This would have three benefits. First, there are a range of smart city projects taking place specifically in Glasgow which this could feed into. Second, a smaller focus would allow for the creation of a more comprehensive data-set – but keeping it at the level of the city-region (as opposed to GCC's boundaries) would include areas which are part of Glasgow's functional economic geography but not part of the city council. Finally, the city-region is the spatial scale for wider economic development through initiatives like the city deal, and this would align those efforts with mobility data.

What would it cost?

Costs for this option would vary significantly, but it would be an ongoing programme than an off-the-shelf purchase. A simple website with datasets is likely the cost of a programme officer in a smart city team plus basic hosting costs, in total less than £100,000 per year, and potentially far less.

Urban Foresight has a middleware solution designed for this kind of dataset collection. Parts of its code are open-source, meaning that a developer could use it as a basis for a tool in Glasgow. Costs for this would be low, under £20,000.

What are the timescales?

This option is not about creating a single front-end, but establishing a common data pool over

time. That could begin immediately but take place over months and years.

Option 4: pilot or trial more complex aspects of MaaS around priority use-cases

What does this solution involve?

This option would focus on the more complex aspects of MaaS, which could unlock behaviour change or identify future policy options – but need more evidence to proceed.

The options for this include:

- **5a. Rural on-demand transport.** Given the challenges of integrating community and on-demand services into any MaaS system, this would be a trial around small-town transport hubs with rural surrounding areas. Hypothetical examples could be Larkhall, Stewarton, or Brodick. The trial would build a MaaS solution around community transport which would enable users to book community transport at the same time as rail and/or bus travel.
- **5b. Inclusive MaaS: housing associations**. A number of housing associations in Strathclyde have tenant apps, which allow their users to pay rent, report repairs, and communicate with facilities managers. As housing association tenants are, on average, more likely to be lower-income and more likely to be disabled, a trial with a housing association could aim to explore the specific ways MaaS could be used to address inequality. For example, a given housing association could be given a mobile-based tool to access public transport and car-sharing (potentially using existing tools like ZoneCard). This could help identify the specific price-points at which they increase use of public transport, or gauge a sense of what proportion of users are put off by lack of credit, low income, digital exclusion or other accessibility concerns.
- **5c. Corporate MaaS: employers**. B2B MaaS services have emerged as viable business models in Europe, because employers have a clearly identifiable group of users, often own physical premises, and many have significant company car costs. SPT and Liftshare already have car clubs, and a trial with employers could experiment with creating a dedicated MaaS offer, exploring the price points and transport options necessary to drive modal shift for commuters.

What is its governance?

A trial could be designed, led and controlled by SPT or GCC, with significant scope to choose appropriate partners, decide on scope in terms of geography and mode inclusion, and adopt evaluation or lessons-learned protocols as desired.

What is its spatial scale?

Trials would focus on a smaller geographic location, most likely individual towns or discrete geographic areas below council level.

What would it cost?

Trials vary significantly but projects elsewhere in Scotland under the MaaS Investment fund are in the £100-400,000 range. Projects in Europe which have taken a similar approach are in the EUR250-1,000,000 range.

Funding may be available from the UK or Scottish Governments. There are no appropriate funding rounds currently live but this may change in 2022. A trial could ultimately be at no additional cost to SPT.

What are the timescales?

With funding, a trial usually takes 3-6 months' planning depending on scope. Trials usually last for a year to allow for seasonal effects or short-term factors to be isolated.

11.1 Assessing the options for a MaaS solution under current conditions

11.1.1 Criteria for appraisal

The project appraised the options against agreed criteria. These are:

Does it improve convenience?

This is an assessment of likelihood to improve the ease with which citizens can access, book and pay for public transport. This is closely linked to the level of integration offered by each solution, and the relative additional functionality compared to existing journey-planners.

This is defined as convenience for the pen portraits identified in Section 4. It would be measured in a full business case or project evaluation in line with existing questions and research on the user experience. Success would mean that future passenger surveys would report fewer concerns over integration and accessibility of ticketing.

Does it reduce carbon?

This is an assessment of likelihood to support the logic model outlined in Section 6 – and the level of confidence that this option will lead to the second-order effect of reducing carbon, or otherwise directly contribute to reduced carbon emissions.

Does it reduce inequality?

This is an assessment of how wider policy efforts to tackle inequality could be support or achieved by this option. This builds in the analysis in section 2, suggesting that tools to tackle inequality in MaaS rest on a more advanced, more integrated system.

Cost

Costs are scored relative to each other, not relative to other budget priorities or projects. This

includes an estimate of direct costs, and indirect resource and personnel costs.

Timescales

This includes an assessment of both when an option could begin, bearing in mind features like procurement timescales, and to implementation.

Dependencies on other organisations

This is an assessment of how dependent this solution would be on other organisations, outwith GCC and SPT. This is an operational input, but also includes long-term data ownership and control.

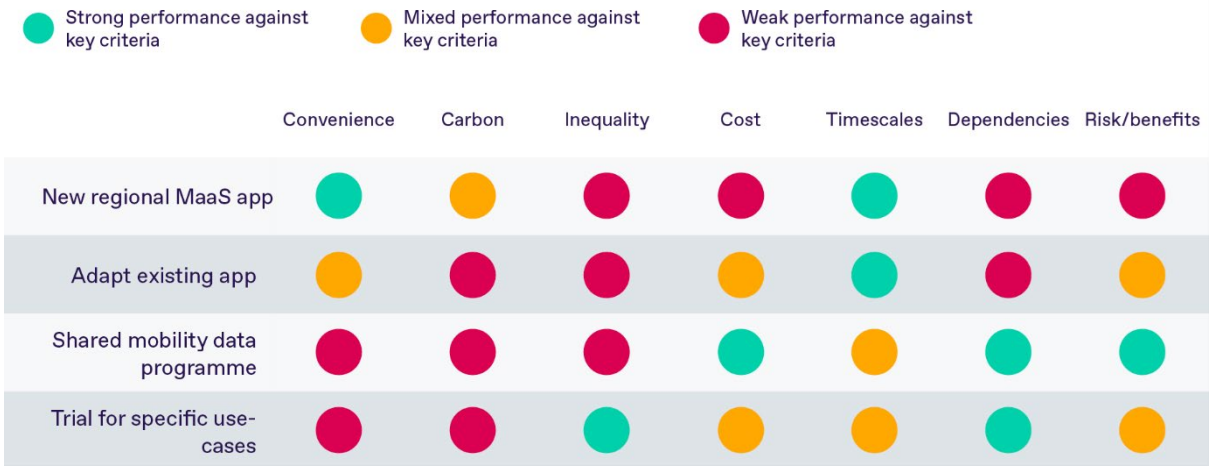
Operational benefits and risks

Operational risks are any dependences on technology, contracts, particular operators or risks arising from the nature of the solution, such as procurement or liability. Benefits are new opportunities for SPT and GCC arising from the solution beyond performance against the 3 core objectives.

Each criteria is given a red/amber/green rating, as a clear low/medium/high performance likelihood against each criteria.

11.1.2 Scoring

Overall scoring



Scoring by criteria

	Criteria: Convenience	Overall rating
New regional MaaS app	Level 2 integration would improve convenience for travellers by creating a new service with a single point of booking.	
Adapt existing app	Adding to an existing app would improve convenience, but only for the users of that app.	
Shared mobility data programme	This option would not directly improve convenience, and is back-end approach which enables front-end services which could in turn improve convenience.	
Trial Specific use-cases	This option would focus on improving convenience for the trial audience, but would not improve convenience at scale.	

	Criteria: Carbon	Overall rating
New regional MaaS app	Potential to create tool which supports modal shift and reduces carbon, with option to experiment with nudges, bundling and app design as behaviour change tools.	
Adapt existing app	Less ability to directly experiment with behaviour change tools.	
Shared mobility data programme	No direct impact on carbon reduction; could include carbon datasets which enables new innovation focused on carbon.	
Trial Specific use-cases	No systemic impact on carbon reduction, potential to provide results with longer-term impact.	

	Criteria: Inequality	Overall rating
New regional MaaS app	Level 2 integration would support more general access to public transport, but not offer direct tools to reduce inequality.	
Adapt existing app	Level 2 integration would support more general access to public transport, but not create direct tools to reduce inequality.	
Shared mobility data programme	Data on poverty and exclusion could be included in a data programme, but no direct impact on inequality.	
Trial Specific use-cases	A trial focusing on lower-income groups could have significant reputational potential and policy impact in understanding how MaaS can tackle inequality.	

	Criteria: Timescales	Overall rating
New regional MaaS app	6-12 months	
Adapt existing app	1-6 months	
Shared mobility data programme	Immediate start, 5-year horizon	
Trial Specific use-cases	1-2 years	

	Criteria: Cost	Overall rating
New regional MaaS app	£200-500,000 per annum Resource costs	
Adapt existing app	<£100,000	
Shared mobility data programme	<£50,000	
Trial Specific use-cases	£100-400,000	

	Criteria: Dependencies	Overall rating
New regional MaaS app	This would rest on voluntary participation by operators. This creates a significant dependence on their willing participation, and terms they would accept. It would also be dependent on a particular technology provider's platform.	
Adapt existing app	This would create a dependency on any partner app or provider.	
Shared mobility data programme	GCC would be able to shape and control this programme, setting terms of data and working organically over time to build trust in mobility data-sharing as part of wider smart city thinking.	
Trial Specific use-cases	This would have significant scope for SPT and GCC to control terms of participation.	

	Criteria: Operational risk	Overall rating
New regional MaaS app	The greatest operational risk is that operators resist participation, after a provider is identified, resulting in spend without the desired outcome. Procurement risks – budgets, timescales, willingness of market to reflect local context. Reputational risks over creating new service with poor usage. Technology risks – reliant on supplier, security, avoiding downtime, GDPR compliance, changes in EU law for EU suppliers.	
Adapt existing app	Few organisational risks but reliant on other organisations' risk management.	
Shared mobility data programme	Reputational risk of being seen to collect data on citizens.	
Trial Specific use-cases	Risks will vary significantly by trial approach.	

12 A roadmap for integrated MaaS

This section sets out the second strategic choice: deciding not to proceed with a MaaS solution now, but instead delivering a series of actions which build builds capacity for MaaS. This would address specific barriers, build on identified strengths, and aim over the course of 5 years to put Strathclyde in a position to develop a more sophisticated MaaS system at level 2 or 3 integration.

12.1 Overall requirements by theme

The headings above set out the themes of work which need to be undertaken to make the region ready for MaaS. The end state in each theme are set out in section 2.2.2 above and can be summarised as:

- **Transport provision**: MaaS needs a frequent, dense public transport network with a range of options for users.
- **Operator data**: MaaS needs operators to share data to enable a central planning and booking system – such as timetable information, service availability, booking protocols, and payment systems. This in turn requires operational agreements over data, customer service, risk and revenue.
- **ICT infrastructure:** MaaS assumes that vehicles or stations can be accessed or unlocked via smartphone, and that operators are capable of mobile ticketing and booking.
- **Policy and regulation**: MaaS requires a policy and regulatory environment that makes responsibilities clear, and sets out governance of data, operations, and relationships with national policymakers.
- **Citizen willingness**: MaaS assumes that a critical mass of transport users have smartphones, and are willing and able to access public transport by smartphone.

12.2 The range of actions to enable MaaS

Many of the policy levers to achieve these goals are about matters outwith the scope of this report – particularly transport provision, which is largely about core public transport services. Actions relating to MaaS focus on operators and data, ICT and policy. Potential actions can be further categorised into:

Policy

These are responses which are about setting policy and agreeing broad approaches and guidelines across organisations.

This includes writing council and SPT policies which align with the requirements of MaaS, particularly in mandating data-sharing in mobility contracts.

It also includes understanding how national policymakers will pursue important themes such as smart ticketing and the NEC.

Relationship-building

These are actions which focus on building trust: approaches which work within current powers to build operator comfort with integrated services through trials, cultural leadership and practical support.

Regulatory changes

These are actions which look at changing the regulatory landscape in which MaaS can be built, using powers in the 2019 Transport Act. These often involve significant questions which are beyond the scope of this report. However, using these powers is the clearest route to implementing a more integrated MaaS system. At a minimum, SPT and GCC could therefore more fully explore these powers and how considerations for MaaS interact with wider policy questions.

Operations changes

This includes looking at changes to finance, legal and risk management processes to enable MaaS.

Technology upgrades

This means software and hardware changes required to enable MaaS.

12.3 Structuring actions: responsibilities, funding and timescales

12.3.1 Governance

A MaaS readiness programme is flexible in governance: it could be structured as a shared programme team between SPT and GCC, or with an accountable lead individual appointed.

Most actions themselves have a logical organisation to lead, following existing responsibilities or a regional/council geographic focus.

12.3.2 Costs

For most actions, there are no new revenue or capital costs, and the main requirement is staff time. These actions broadly assume no new headcount or staffing, but where staff time is likely to be significant this is noted.

Some actions have new costs, largely capital costs. In most cases, it is obvious which organisation would fund those costs. Costs given are indicative.

13.3.3 Timescales and interdependency

Timescales are indicative. They are driven by a combination of external influence – for example, opportunities to make changes to contracts which have a specific retendering date – and of likely timescales for implementation given resource requirements or the nature of the task.

None of the actions are strictly interdependent: there are no actions which are an absolute prerequisite to taking other actions.

However, there is a broad order of priority which is as follows:

1. **Shape the policy landscape.** Many important questions rest on an understanding of the legal and policy framework, and national initiatives like smart ticketing, the NEC and the future of Traveline will have a critical bearing on the future of MaaS in Strathclyde. The first priority is therefore to understand and influence this policy landscape.

2. **Build operator capacity and willingness for MaaS**. Operator data is the core of MaaS and creates the largest range of significant barriers to MaaS. Pending further clarity on some of the regulatory aspects of operator data, building capacity for MaaS with operators should therefore be the second priority. This needs to be seen holistically with understanding the regulatory options - operators will be sensitive to any public messaging about regulation – but this second theme is suggested as a parallel workstream.

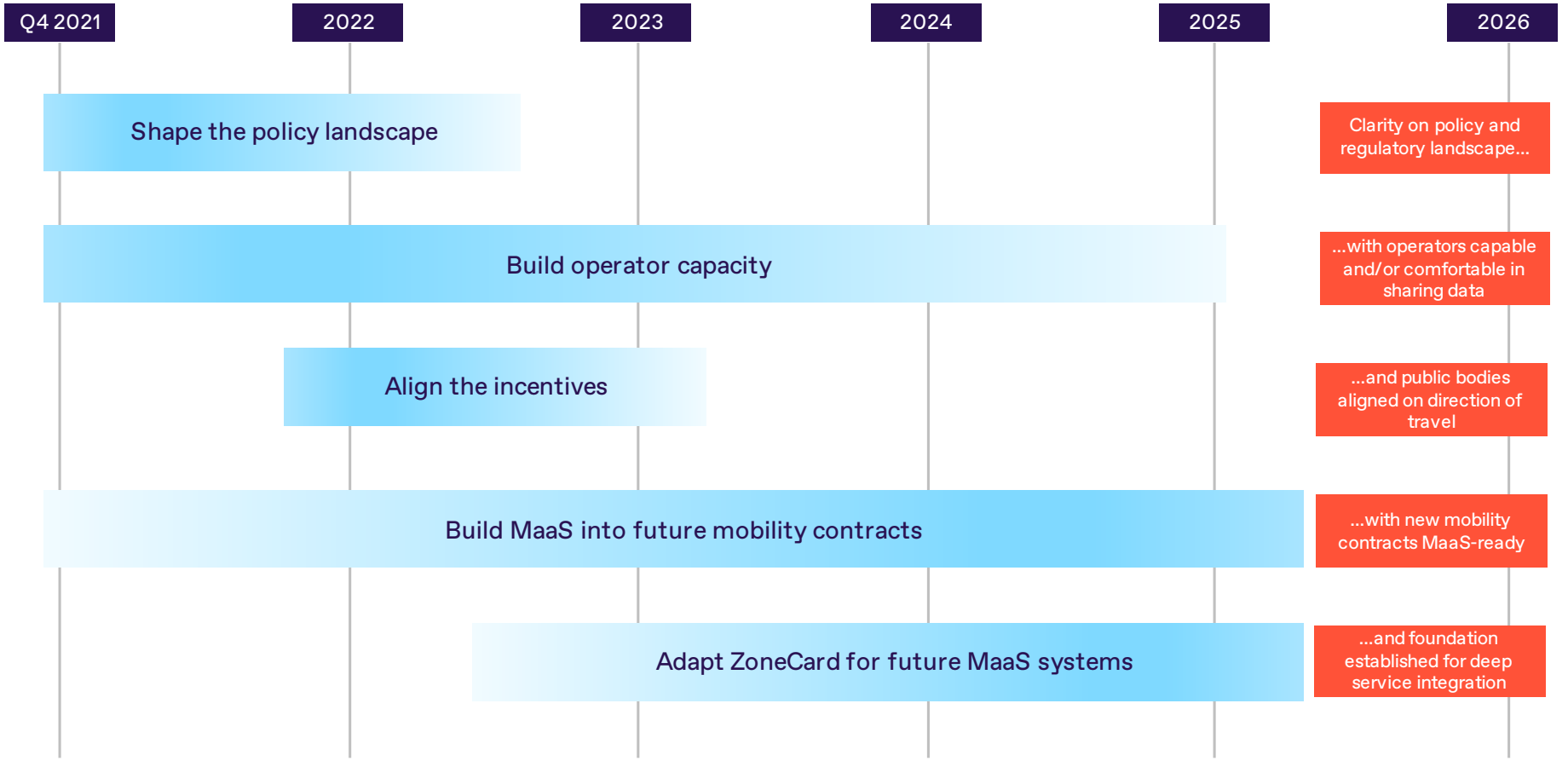
3. **Aligning the incentives**. SPT and GCC's role with subway and bike-sharing is an opportunity to show leadership, but this is less urgent than understanding the macro policy environment and working with operators on data. This should be a priority for mid/late 2022 and beyond.

4. **Build MaaS into future mobility contracts.** Some contracts, such as GCC car-sharing, have an immediate opportunity to reshape contracting to enable MaaS. Others may emerge over the years ahead. There are therefore some immediate actions in this heading, but it is otherwise a working principle for the future where the impact builds over time.

5. **Adapt ZoneCard for future MaaS systems.** ZoneCard has potential to be significant for the future of MaaS, but its governance is unique and movement on key operational issues has to be worked through the consortium. While actions under this heading are important, and some require immediate attention, an overall attempt to use ZoneCard for MaaS should be seen as a longer-term phase of work where the impact builds over time.

Taken as a whole, these actions should result in an end situation where:

- There is clarity over the policy framework, the role of national programmes, and the regulatory relationships with operators
- Operator capacity and willingness to share data is improved
- Different public organisations are working in the same direction
- New mobility contracts are ready for MaaS
- Significant operational potential for deep integration is created.


Q4 2021
2022
2023
2024
2025
2026
Shape the policy landscape
Build operator capacity
Align the incentives
Build MaaS into future mobility contracts
Adapt ZoneCard for future MaaS systems
Clarity on policy and regulatory landscape...
...with operators capable and/or comfortable in sharing data
...and public bodies aligned on direction of travel
...with new mobility contracts MaaS-ready
...and foundation established for deep service integration

1. Shape the policy landscape

SPT and GCC's ability to implement MaaS is shaped by national policymakers. Both organisations should engage with national-level government to develop policies and processes which support regional and city-level efforts.

1.1 Engage with the Smart Ticketing Board to define smart ticketing as including MaaS

Lead organisation	SPT
Type of intervention	Policy
Timescale	Within 12 months
Costs	Staff time
Description	As discussed in section 9.7 of this paper, the interpretation of Section 41 of the 2019 Transport Act could be crucial in shaping SPT's future powers, in that it could give SPT and GCC greater powers to request certain ticketing formats which enable MaaS. SPT should engage with the new Smart Ticketing Board, when established, to confirm that the definition of smart ticketing in the act includes MaaS.

1.2 Engage with Transport Scotland to advocate for interoperable booking through Traveline

Lead organisation	SPT
Type of intervention	Policy
Timescale	Immediate: Transport Scotland's timescales are not known but a tender may be issued within the next 3 months.
Costs	Staff time
Description	Traveline already short-cuts the collection of journey planning data. If it evolves into a single back-end for all of Scotland, with the ability to book mass transit services through a single platform, then SPT's role in the ecosystem becomes much clearer – as a regional coordinator of front-end services – and it would create the ability to build level 2 integration without any direct contracting or negotiation with major operators.

	This should therefore be advocated for by SPT. SPT should engage with Transport Scotland to understand the future of Traveline and push for a solution which requires operators to provide reciprocal booking, and has an API available to RTPs to use those elements in new front-end services, with the ability to add further regional or local services.

1.3 Engage with Transport Scotland to understand the future of ABT, NEC and front-end services

Lead organisation	SPT and GCC
Type of intervention	Policy
Timescale	Within 6 months
Costs	Staff time
Description	At the time of writing there is some uncertainty over nationwide technology developments which could shape MaaS in Strathclyde, including future account-based ticketing systems, whether the NEC and free bus services for under-22s will evolve into a full mobile ticketing app, or if any wider consumer-facing apps will be delivered. SPT and GCC should engage with Transport Scotland to understand its long-term agenda on these items.

1.4 Understand the new powers

Lead organisation	SPT and GCC
Type of intervention	Regulation
Timescale	Within 6 months
Costs	Staff time
Description	As discussed in section 9.7 of this paper, the interpretation of Sections 44 and 38 of the 2019 Transport Act could be crucial in shaping SPT and GCC's future powers. Powers over smart ticketing and bus franchising appear to offer a clear basis for mandating data for MaaS. These questions have multiple other policy considerations. SPT and GCC should, at a minimum, seek legal advice should on how these powers could be applied to MaaS.

1.5 Pursue complementary policies

Lead organisation	GCC and councils
Type of intervention	Policy
Timescale	Ongoing
Costs	No additional costs
Description	Policies in physical infrastructure, electrification and service provision are outwith the scope of this report. However, two policies are worth mentioning for the role they play in shaping operators' views of public authorities, and underpinning systems which MaaS relies upon: • Effective interchanges are particularly important for enabling multi-modal travel. Decision points when people depart a bus, train or subway and then find (or cannot find) an option to complete their journey are crucial. MaaS can create a digital guide to these decision points but close proximity of frequent, reliable services is a precondition of people using active or sustainable modes. • Bus priority. Bus operators argue that the crucial limitation on uptake is journey times, and that councils can enable them by creating more bus priority routes, lanes or zones. Urban Foresight's experience of operational MaaS projects suggests that reliability and frequency of bus services is a precondition of uptake through MaaS.

2. Build operator capacity and willingness for MaaS

Pending any wider change to regulation or the implementation of a MaaS solution in line with the other options above, SPT and GCC can take action to gradually build operator capacity for MaaS. Most of the actions with operators are suggested for SPT, in line with existing strategic structures – but similar actions could also be undertaken by GCC.

2.1 Build operator comfort with third-party booking by identifying value-added MaaS services

Lead organisation	SPT
Type of intervention	Relationship-building

Timescale	Over next 2 years
Costs	Staff time; bus operator development costs should be small
Description	Bus operators are the stand-out poor relationships, and are wary of third-party ticket sales and competition in journey-planning. Pending future powers, SPT should focus on building bus operator comfort with the idea of new patterns of data-enabled, integrated services, coordinated by public authorities. This should focus on identifying and implementing 3-5 value-added use-cases for MaaS, where bus operator data is shared (along with other modes such as car-sharing) with selected third parties who have their own apps, to explore potential for revenue uplift. This would be voluntary, but have the aim of showing bus operators that sharing data with third parties alongside other mobility services is feasible.

2.2 Use CalMac's new capabilities to build operator comfort with MaaS

Lead organisation	SPT
Type of intervention	Relationship-building
Timescale	Within next 12 months
Costs	Staff time; under £50,000
Description	CalMac's new system creates an opportunity to make tactical integrations, informally brokered by SPT. For example, once its system is operational, existing bus and rail apps could plug in CalMac's booking API. A user of those apps could now access another mode. SPT has no formal sanction for this approach, but ferry is a safe option for other modes to include because it does not compete with them. It is therefore a good tool to gradually build operator comfort with the idea that apps should include multiple modes. SPT could even fund any development work, which depending on the app in question is in the region of £10-50,000.

2.3 Request NextBike speak to sponsors about MaaS

Lead organisation	GCC
Type of intervention	Operations
Timescale	Within 12 months

Costs	None
Description	NextBike's relationship with their sponsors has a critical bearing on its participation in MaaS: NextBike are culturally and technically comfortable with MaaS but until a specific conversation takes place with Ovo, their participation in any MaaS system remains hypothetical. GCC should ask NextBike to have an exploratory conversation with Ovo, to gauge in more detail any concerns or legal issues with NextBike participating in any shared mobility system.

2.4 Support community transport organisations looking to upgrade technology

Lead organisation	SPT
Type of intervention	Technology upgrade
Timescale	Over next 2 years
Costs	Staff time; grants likely to be >£10,000
Description	Community transport organisations could be given grants to upgrade ticketing and mobile infrastructure to enable real-time journey planning (for those that want to do so). The bigger influence, however, is long-term certainty over funding. For the purposes of MaaS, moving to longer budgeting cycles with grants awarded on a 3-5 year basis would give greater confidence to community operators to invest in technology.

2.5 Build mobile-first ticketing into future hardware upgrades

Lead organisation	SPT
Type of intervention	Technology upgrade
Timescale	Over next 5 years
Costs	Staff time; upgrading subway ticket gates to accept EMV standard will be in region of £500,000-£1million.
Description	Decisions on upgrading hardware such as subway ticket gates are subject to numerous considerations. For the purposes of a MaaS, the ability to access the subway with a mobile phone – whether emulating a smartcard, taking payment from a stored bank card, or

	from an app – is essential to success. It should be considered a precondition of MaaS. This should be factored in to any long-term hardware programmes.

2.6 Understand the future direction of bus smart ticketing

Lead organisation	SPT
Type of intervention	Relationship-building
Timescale	Ongoing
Costs	Staff time
Description	The bus operator alliance has a clear intention to move towards integrated ticketing. SPT cannot directly shape this group, and standardising technology is easier said than done. SPT can at least seek to understand what kinds of technology bus operators will be pursuing in future, and how this is changing operator decisions – for example, if Stagecoach in the west of Scotland will be forced to diverge from its UK-wide technology provider, or whether all operators are organically moving to interoperable mobile-first tickets working from Ticketer machines. SPT should engage with the bus operator alliance to understand this kind of initiative.

3. Align the incentives across organisations to promote sustainable travel

3.1 SPT and GCC – subway/bike-sharing

Lead organisation	SPT and GCC
Type of intervention	Policy
Timescale	Within 2 years
Costs	Staff time
Description	SPT and GCC's strategic incentives are aligned: both want increased active and sustainable travel. Shorter-term financial incentives, however, are not aligned on how subway interacts with shared mobility in Glasgow city centre. All operators would face similar competition in a MaaS system, but because these two modes

	are more clearly under the control of public authorities, there is an opportunity to show leadership and align shorter- and long-term objectives. For example: • A broad MoU or agreement that notes the strategic principle of increasing active and sustainable travel, and agrees to work collectively to offer choice to customers, including through MaaS systems. • A fuller revenue-sharing agreement which creates a mechanism for either organisation to be compensated (or the opposite – to respect competition for revenue) if a future multi-modal offer has a directly attributable revenue decline in one mode, to the benefit of the other. This would have to be a bilateral arrangement between GCC and SPT, not an agreement with NextBike. Urban Foresight's understanding is that there is no specific bar to this in competition law, but this should be checked with in-house legal teams. • An analysis of subway tickets and tap-ins by station, cross-referenced with GCC's reporting from Nextbike on the busiest bike-docking stations. This would not provide a direct figure for comparable point-to-point journeys, but it would give some sense of the relative overlap in high-use locations and identify any specific areas of concern. • GCC's strategic plan suggests exploring bringing the subway under the city council's governance. Any such exploration should consider how active travel funding and subway revenue interact.

3.2 Coordinate new front-end services

Lead organisation	SPT
Type of intervention	Policy, relationship-building
Timescale	Ongoing
Costs	Staff time
Description	SPT cannot regulate front-end apps. It can, however, coordinate public-sector consumer-facing apps, working through its board members who are elected representatives, and relationships with councils, to understand if any councils plan to develop new consumer-facing services. SPT can then work with councils to

	ensure this is compatible with wider MaaS initiatives.

3.3 Work with regional partners on upgrades to digital connectivity and digital exclusion

Lead organisation	SPT and GCC
Type of intervention	Relationship-building
Timescale	Ongoing
Costs	Staff time
Description	GCC and SPT should ensure that regional partners and forums, such as the city region growth deal, should understand the role that improved digital connectivity plays in sustainable transport. In particular, a regional MaaS system would currently not include parts of Arran and Ayrshire which lack mobile data coverage. More uniform coverage and 4/5G coverage would support a more holistic MaaS solution.

4. Build MaaS into future mobility contracts

4.1 Require data sharing from mobility providers

Lead organisation	SPT, GCC and councils
Type of intervention	Policy
Timescale	Ongoing
Costs	Staff time
Description	Contracts are an effective mechanism to require operators to share information to enable MaaS. Councils in Strathclyde should therefore build MaaS participation clauses into future contracts, setting out the requirement to participate in any integrated journey-planning, booking and ticketing system. SPT should work with councils to enable this approach. This recommendation is potentially held in tension with other objectives: a contract has to be proportionate, represent good value to taxpayers, and focus on the core provision of a service. Making requirements on data can increase costs, and operators may be able

	to provide a good core service but not offer data integration. It is therefore difficult to say with absolute certainty how any given contract should require data, and how this should be balanced with other procurement outcomes. Two options are available: • Any given mobility contract could stipulate the exact datasets which the commissioning authority requires. The benefit is that this creates clear responsibilities and leaves less room for interpretation. The risk is that MaaS is a fast-moving area, and being this specific may exclude emerging datasets. • A broad provision which requires the contractor to participate in MaaS systems, and in particular to make available journey-planning information, the ability to book services on a third party MaaS services, and the ability to pay or access services from a third party MaaS service. Either approach may be appropriate depending on the nature of the contract and the wider commercial relationship with the contractor. Urban Foresight has an emerging preference for the latter approach in our operational MaaS projects, as it retains some flexibility while establishing the clear principle of participation. MaaS is not a term that has any legal standing and legal advice should be sought on the exact wording before any contracts include this kind of provision.

4.2 Require industry standard data formats

Lead organisation	SPT, GCC and councils
Type of intervention	Policy
Timescale	Ongoing
Costs	Staff time
Description	Different modes are organically evolving data standards which put information in standardised formats and code. Most are governed by non-profit organisations or informal industry coalitions, rather than having publicly-led or guaranteed statutory underpinnings. These make it easier for MaaS systems to integrate data. They are not necessary for integration, but they streamline data cleaning and manipulation. Not all providers will meet these standards, but may

	still be capable of integrating with MaaS systems. They should be viewed as best practice: data standards which are not currently necessary, but are rapidly becoming standard and are likely to become a minimum capability within the next 2-5 years. GCC, SPT and councils should therefore ask any contractor to confirm they will become capable of meeting relevant standards. This should be checked at the time of issuing a contract, particularly to ensure compatibility with any Scottish Government requirements, but at the time of writing, the relevant data standards would be: • Mass transit: bus operators should be capable of meeting the UK Government's Bus Open Data Standards which uses the TransXChange 2.4 PTI 1.1.a data profile for timetable data, the SIRI-VM data scheme for real-time vehicle location, and the NeTEX standard for fares and ticketing. • Mass transit operators should also be capable of publishing journey planning and real-time information in General Transit Feed Specification format. • Shared and micromobility providers should be capable of providing real-time data to the format of the General Bikeshare Feed Specification; they should also be compliant with the Mobility Data Specification (MDS), a set of standardised APIs. • At the time of writing the City Data Standard - Mobility (CDS-M) is in prototype and is designed to better reflect existing standards in the EU than MDS. The status of this standard should be reviewed at time of commissioning, and bidders asked to demonstrate ability in relation to CDS-M. • The Transport Operator MaaS Provider (TOMP) API is newer but is designed as an international standard for MaaS, with an emphasis on booking. Many mobility providers will not currently be compatible with this standard and it assumes a MaaS provider debits user accounts and then reconciles payment with operators – which is a significant choice on payment processes. However, this may change to become more flexible and may become more of an industry standard. Operators' ability to meet TOMP-API should therefore be assessed at commissioning. Wording should retain some flexibility – asking for capability to meet these standards or equivalents.

4.3 Require industry standard access

Lead organisation	GCC and councils
Type of intervention	Policy
Timescale	Ongoing
Costs	Staff time
Description	Most shared and micromobility providers will now provide access to vehicles by phone. This capability should be a requirement of contracts: providers who can currently only provide access to vehicles with smartcards or physical keyfobs should either be ruled out, or at least expected to develop mobile-first access during a contract.

4.4 Limit contracts to appropriate timescales

Lead organisation	GCC and councils
Type of intervention	Policy
Timescale	Ongoing
Costs	Staff time
Description	Contract length also has multiple trade-offs between price, risk-sharing, locking in a provider, and giving security to users. Many places with mature MaaS systems are now limiting mobility contracts to less than 5 years, with 2-3 years for services like micromobility. This is long enough to secure good value and give investors confidence, but short enough that fast-evolving data approaches can be regularly reviewed.

4.5 Avoid vendor lock-in

Lead organisation	GCC and councils
Type of intervention	Policy
Timescale	Ongoing
Costs	Staff time

Description	Private journey planners and MaaS apps are exploring tie-ups with mobility providers. Some degree of cooperation is inevitable: certain mobility providers are likely to become favourites with MaaS providers due to their data quality, culture or commercial terms, and vice versa. However, SPT and GCC should avoid committing to any contract which then creates a requirement to use a particular technology or partner. For example, no mobility operator should have an exclusive arrangement with a MaaS provider: they should participate in any data-sharing scheme required by the commissioner, with any MaaS provider. Future procurements could, within the limits of procurement law, ask bidders to declare any commercial relationships or conflicts of interest, which could be prejudicial to future MaaS systems.

4.6 Limit exposure in business models to avoiding integration

Lead organisation	GCC and councils
Type of intervention	Policy
Timescale	Ongoing
Costs	Staff time
Description	Mobility offers a range of funding models for contracts. Bike-sharing contracts, for example, are usually free for councils, or create revenue – whereas in Europe, they are generally subsidised services. These models have benefits and risks which go beyond MaaS. However, there is a general principle: encourage business models which allow data-sharing. This means avoiding: • Reliance on branding or advertising which could be diluted in MaaS. • Reliance on a particularly profitable route or set of users which MaaS could compromise – for example, a route which is known to be busy but has multiple mode options for travellers. • Business models where the operator monetises data, for example by selling on contextual data on users, and is therefore less likely to share data.

5. Adapt ZoneCard for future MaaS offerings

The ZoneCard consortium is established as a partnership, and is formally a separate entity which operators and SPT collectively control. This creates clear limitations on how far SPT can use it to create MaaS-style arrangements and conversations with SPT suggest it is an arrangement to be treated with the utmost care.

However, there are elements of ZoneCard which are a strong asset for future MaaS systems. This is less about ZoneCard itself, and more about the opportunity to build skills, processes and culture as ZoneCard enters a period of change – and which can be adapted for MaaS in future.

5.1 Secure the option for SPT to access or own data

Lead organisation	SPT
Type of intervention	Policy
Timescale	Within 12 months
Costs	Staff time
Description	An important principle is worth trying to build in: that regional public transport bodies are the appropriate home for data which helps plan regional transport strategies, and therefore have at the very least the right to see data on how people are currently accessing the product. In practice, this means that any data flows created by ZoneCard's new capabilities showing how people are travelling should be either shared by the whole consortium, or that SPT has the right to access the information. Ideally, this data would be owned by SPT, and SPT would find a mechanism in ZoneCard to position itself as a neutral, logical home for capturing and analysing that integration: but this is recognised as difficult within current constraints. At the very least, the concept of ZoneCard becoming an independent consortium of operators, with no involvement of SPT, should be treated with extreme caution. This could effectively cede any option to access or control core data on multi-modal journeys altogether, and rule out any attempts to create a regional MaaS system under SPT's sponsorship with any of the elements of ZoneCard.

5.2 Design in the potential expansion of ZoneCard in revenue allocation contracts

Lead organisation	SPT
Type of intervention	Policy
Timescale	Within 2 years
Costs	No additional costs
Description	ZoneCard's upgrade will include a mechanism for revenue allocation. An independent consultancy will be tasked with identifying how many journeys each operator provided. Total income from ZoneCard will be divided among operators accordingly. This creates an opportunity to build capability in revenue allocation for a future MaaS system – and as important, build a culture with operators that is comfortable with data-informed revenue allocation. When this consultancy is procured, bidders should be asked to explain their capabilities for adding more complex revenue questions, particularly questions over how shared and micromobility services can feature.

5.3 Explore the potential for a front-end service

Lead organisation	SPT
Type of intervention	Technology upgrade
Timescale	Over 5 years
Costs	Staff time; front-end app costs will vary significantly depending on scope.
Description	The ZoneCard upgrade project may develop an app. This is expected to be focussed on remote ticket download, with no wider functionality in the initial stages. After ZoneCard's upgrade, however, SPT and the consortium should consider that if ZoneCard added an app with functions including a journey planner and the ability to plan and book services, it has the core of a MaaS service with an existing user base and with the most difficult part of level 3 integration, revenue allocation, already developed. They should therefore consider developing a journey-planner app in future. Combined with registration of existing smartcards, this would at first have the same limitations of ITSO formats discussed

	above. The ambition should therefore be to explore, over a longer-term horizon, how ZoneCard could move to mobile ticketing altogether, combined with integrated journey-planning and booking on an app. This would in its own right be a significant technical project. A first step could therefore be to explore whether the basic top-up app for ZoneCard could add a simple journey planner. An alternative would be to have exploratory discussions with the consortium on creating a consumer-facing app, after the planned upgrade.

5.4 Add shared mobility as an add-on to the ZoneCard consortium

Lead organisation	SPT
Type of intervention	Policy
Timescale	Within 3 years
Costs	Staff time
Description	A crucial difference between ZoneCard and MaaS is that the existing product does not include shared and micromobility services. Changing the consortium to include these modes is complex, and subject to all the concerns about competition and customer ownership discussed above. An interim arrangement, to build operator comfort, is to add shared mobility as a top-up payment. This could either be that the same smartcard unlocks (for example) car-share vehicles – which would depend on interoperable cards, or that any ZoneCard app also includes shared and micromobility availability and booking.

5.5 Agree shared customer service protocols

Lead organisation	SPT
Type of intervention	Policy
Timescale	Within 5 years
Costs	Staff time
Description	ZoneCard has a central customer service team. However, ZoneCards cannot be refunded or replaced if lost or stolen, and operators and SPT suggested that operators provide the bulk of

	customer service queries, even for those relating to ZoneCard. Understanding the scope and limitations of shared customer service in ZoneCard would be a useful capability for a future MaaS system. SPT and the consortium should therefore either: • Develop the shared customer service team for all ZoneCard users. • Develop clear processes for allocating customer service complaints or feedback to individual operators, through a central communications channel, for any ZoneCard users. • Or, agree that customer service should be carried out by individual operators for anything relating to services, and SPT should handle customer service queries for anything relating to the multi-modal ticket itself. The purpose should be to agree clear principles which could be sustained into MaaS, and develop organisational knowledge on how customer service sharing works in practice.

5.6 Develop risk-allocation processes which are a basis for MaaS

Lead organisation	SPT
Type of intervention	Policy
Timescale	Within 5 years
Costs	Staff time
Description	SPT described ZoneCard's risk governance and conditions of carriage as due for a refresh. This is an opportunity to establish principles of multi-modal risk sharing, which could be taken on into a future MaaS system. A clear agreement should be brokered with the whole consortium agreeing how risks are allocated by each operator.

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