Scotland's Trunk Road and Motorway Network

Future Intelligent Transport Systems Strategy

2017

TRANSPORT
SCOTLAND
CÒMHDHAIL **ALBA**

CONTENTS

Ministerial Foreword

Scotland has been at the forefront of the use of Intelligent Transport Systems (ITS) and related services as they have developed over the last 30 years. Our Traffic Scotland service contributes positively to the safe and efficient movement of people, goods and services across the country and supports key industries such as tourism and the food and drink sector.

The Scottish Government has clear priorities for the sustainable growth of the country's economy. Transport, the environment and the digital sector feature highly in the strategies for meeting these goals. ITS cut across all three and I am pleased to see Transport Scotland setting out its thinking in this Future ITS Strategy.

The ITS Strategy is being developed to put the needs of our customers at the heart of what we do. This customer focus will be paramount in helping us to take strategic decisions on where to prioritise resources, what systems and services we need to provide, maintain and develop, what new technologies and innovations we need to invest in and develop, and tell us when it is right to move away from existing or obsolete ITS infrastructure and services

ITS is a rapidly evolving field, with developments taking place in a wide range of areas, not least in communication of information to travellers via mobile devices, both at trip planning stage and during the journey itself. In recognition of such rapid change, this Future ITS Strategy sets out our overall approach based on six strategic themes. It will assist in informing procurement, deployment, and maintenance of ITS equipment and services for the next ten years and beyond, building upon our successes and lessons learned to date, and guided by the views of the public as well as transportation professionals.

This Strategy sets out the broad principles of our intended approach and will be supported by the development of thematic Action Plans and costed delivery programmes. This affords the flexibility to align our specific initiatives as novel techniques and approaches and changing customer needs emerge.

Humza Yousaf MSP
Minister for Transport and the Islands

Executive Summary

Introduction

Transport Scotland is the national transport agency for Scotland. We deliver a safe, efficient, cost-effective transport system for the benefit of the people of and visitors to Scotland. Transport Scotland plays a key role in helping to achieve the Scottish Government's Purpose of creating a more successful country, with opportunities for all of Scotland to flourish, through increasing sustainable economic growth.

We operate Scotland's trunk road and motorway network on behalf of the Scottish Ministers. For many years we have invested in Intelligent Transport Systems (ITS) technology such as CCTV and Variable Message Signs on-road, and powerful traffic control and information systems and a state of the art control centre. This allows us to monitor traffic flows, inform travellers and react speedily to co-ordinate responses to incidents.

This Future ITS Strategy frames Transport Scotland's agenda for trunk roads and motorway ITS over the next ten years and beyond. It is aligned with Scotland's Strategic Priorities and the overall National Transport Strategy outcomes to deliver a safe and efficient network, inclusive, sustainable economic growth, embrace innovative solutions and to be customer focused.

The Core Aim and Structure of the strategy

The core aim of this Future ITS Strategy is to provide clarity on our priorities for the provision of ITS to contribute to the safe and efficient operation of Scotland's trunk roads and motorways and meet the needs of customers. It gives structure and direction for the development of action plans and funded delivery plans over successive five-year planning horizons.

The strategy is intended to be a living document which can adapt and evolve to react to the new technological innovations and societal changes which are likely to emerge in the future and to take advantage of opportunities to work with partners across the transport modes. This designed-in adaptability means plans can be regularly reviewed and updated to shape the requirements for successive five-year periods.

An ITS strategy with clear objectives meeting our customers' needs

We have created this objective led strategy to address three overarching needs—

- To ensure the Strategy has a distinctly Scottish context, aligned with the Scottish Government's Purpose, national strategic priorities and reflecting the diverse nature of the strategic road network and the geographic and socio-economic landscape of Scotland.

- To ensure the Strategy is customer focussed by putting the needs of our customers at the heart of what we do so that future decisions on ITS provision and investments contribute to a safe and efficient road network and are informed and driven by user needs.

- To ensure that decisions on investments in future ITS provision and operation align with Transport Scotland's established investment hierarchy and are objective-led by contributing to one or more of the specific Objectives we have set for the Strategy.

The four specific objectives leading the strategy are as follows—

- **Objective A – Innovation and Horizon Scanning**: On-going engagement with relevant governmental, national and international organisations to inform wider understanding of how innovative and beneficial ITS can be deployed in Scotland.

- **Objective B – Customer Focus:** Through various methods, regular engagement with users of both our network and data and information services Transport Scotland provides, inform prioritisation of resources, systems and services that will have most effective benefits to users.

- **Objective C – Planning and Adaptability:** Working collaboratively to set out how Transport Scotland and our partners will adapt to technological changes such as the growth in Intelligent Mobility, connected and autonomous vehicles, big data and the Internet of Things

- **Objective D – Asset Management and Delivery:** Present an informed context for annual reviews of our investment priorities that will deliver effective services aligned with our Investment Hierarchy and Transport Scotland's Road Asset Management Plan (RAMP).
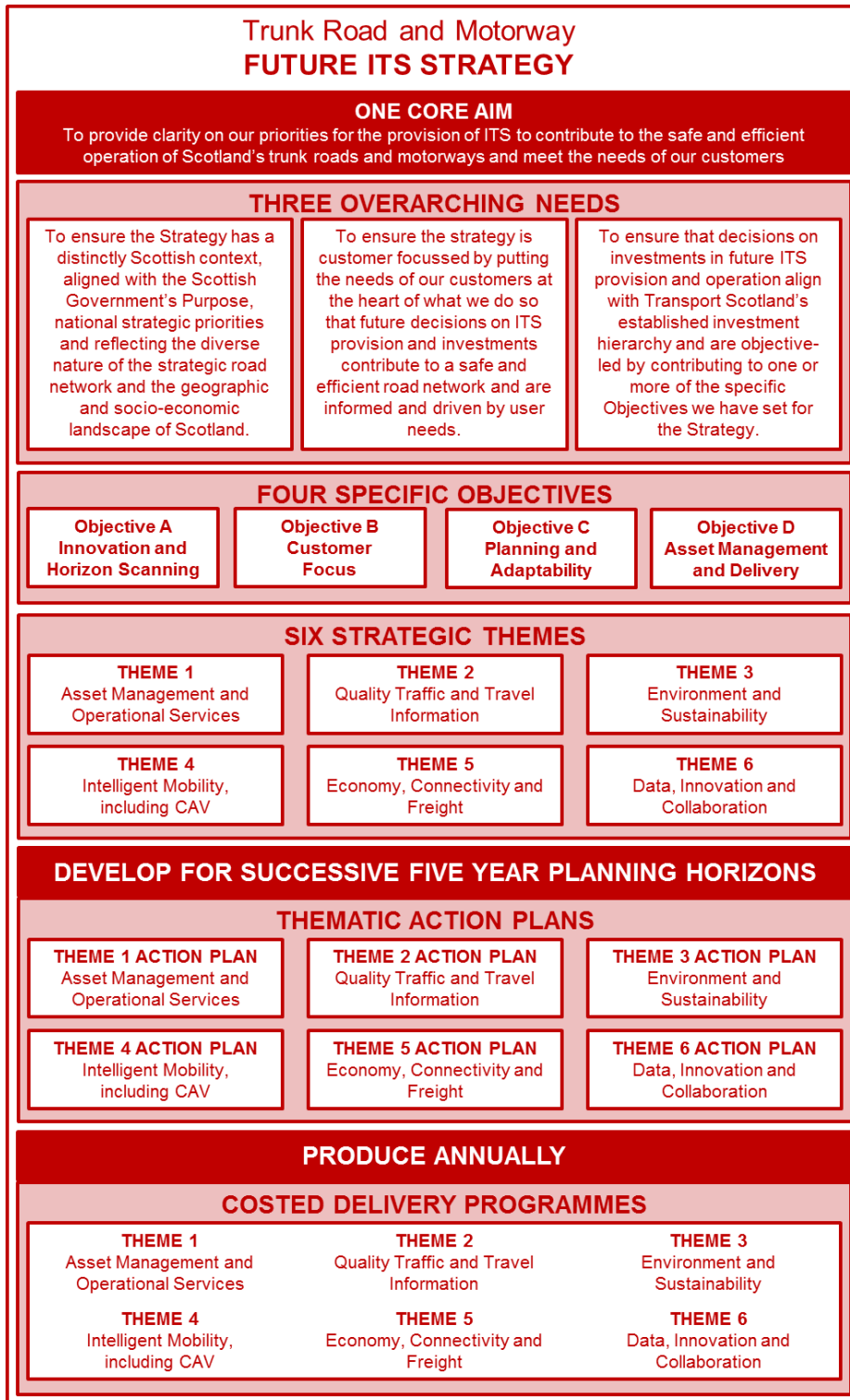
A structured, thematic strategy

The Strategy document consolidates Transport Scotland's knowledge and experience with informed views on developments and directions of innovation within the field. It provides a robust basis for future investment and collaboration.

To support the vision of a continually developing ITS Strategy, it will be supported by Action Plans which set out our priorities for interventions and investments needed to deliver the desired outcomes under each strategic theme over the five-year planning horizon of each Action Plan. The Action Plans will identify where additional resources might be required or where previous approaches can be modified to ensure our ITS provisions continue to be what we need.

In turn, the Action Plans will be supported by annual, costed delivery programmes prioritised to maximise benefits delivery in the most efficient ways and allow financial transparency and budgetary diligence.

In developing the strategy, we have identified six strategic themes each providing a starting point for the development of action plans and subsequent delivery programmes. The relationship between the Strategy, thematic Action Plans and annual Delivery Programmes is shown in the following diagram.

Trunk Road and Motorway
FUTURE ITS STRATEGY

ONE CORE AIM
To provide clarity on our priorities for the provision of ITS to contribute to the safe and efficient operation of Scotland's trunk roads and motorways and meet the needs of our customers

THREE OVERARCHING NEEDS

To ensure the Strategy has a distinctly Scottish context, aligned with the Scottish Government's Purpose, national strategic priorities and reflecting the diverse nature of the strategic road network and the geographic and socio-economic landscape of Scotland.	To ensure the strategy is customer focussed by putting the needs of our customers at the heart of what we do so that future decisions on ITS provision and investments contribute to a safe and efficient road network and are informed and driven by user needs.	To ensure that decisions on investments in future ITS provision and operation align with Transport Scotland's established investment hierarchy and are objective-led by contributing to one or more of the specific Objectives we have set for the Strategy.

FOUR SPECIFIC OBJECTIVES

Objective A Innovation and Horizon Scanning	Objective B Customer Focus	Objective C Planning and Adaptability	Objective D Asset Management and Delivery

SIX STRATEGIC THEMES

THEME 1 Asset Management and Operational Services	THEME 2 Quality Traffic and Travel Information	THEME 3 Environment and Sustainability
THEME 4 Intelligent Mobility, including CAV	THEME 5 Economy, Connectivity and Freight	THEME 6 Data, Innovation and Collaboration

DEVELOP FOR SUCCESSIVE FIVE YEAR PLANNING HORIZONS

THEMATIC ACTION PLANS

THEME 1 ACTION PLAN Asset Management and Operational Services	THEME 2 ACTION PLAN Quality Traffic and Travel Information	THEME 3 ACTION PLAN Environment and Sustainability
THEME 4 ACTION PLAN Intelligent Mobility, including CAV	THEME 5 ACTION PLAN Economy, Connectivity and Freight	THEME 6 ACTION PLAN Data, Innovation and Collaboration

PRODUCE ANNUALLY

COSTED DELIVERY PROGRAMMES

THEME 1 Asset Management and Operational Services	THEME 2 Quality Traffic and Travel Information	THEME 3 Environment and Sustainability
THEME 4 Intelligent Mobility, including CAV	THEME 5 Economy, Connectivity and Freight	THEME 6 Data, Innovation and Collaboration

Structure of the Strategy

The Six Strategic Themes

The six strategic themes represent our best thinking at the present time of the areas that will need to be facilitated, developed and delivered in our ITS provision in order to achieve the four principle objectives of the Strategy. The themes will be kept under review to ensure they continue to be relevant and appropriate. Where changes in policy or operations necessitate changes in one or more of the themes, the inherent adaptability of the Future ITS Strategy will facilitate such refreshes. The six strategic themes of the Strategy are summarised below.

Theme 1: Asset Management and Operational Services

- Developing the best use of existing roadside ITS assets and their control systems.

- Ensuring the inclusion of existing and future ITS assets in Transport Scotland's Road Asset Management Plan (RAMP).

- Considering the best way to exploit the capability of the Traffic Scotland National Control Centre, and how to plan for the future renewal and replacement of equipment, systems and contracts to maximise the efficiency of operations.

Theme 2: Quality traffic and travel information

- Providing the information travellers require to plan their journey, mode of travel and timing to maximise the efficiency of the road network.

- Taking account of the future requirements (preferred media, method of delivery) of all our customers, including the public, organisations and information providers.

Theme 3: Environment and Sustainability

- Using ITS to contribute to improved air quality, lower noise levels and reduce the adverse effects of heavy traffic.

- Determining how best to support a low carbon economy through the selection and use of ITS technology and greener travel choices, including low carbon vehicles.

Theme 4: Intelligent Mobility, including Connected and Autonomous Vehicles

- Determining and deploying new ITS technologies that will positively support users travelling across the road network.

- Including new technologies to support the move to more connected, cooperative and potentially more autonomous vehicles, and the concept of Mobility as a Service (MaaS).

Theme 5: Economy, Connectivity and Freight

- Examining how best to facilitate the movement of goods and services.

- Determining how best to support key industries and economic sectors such as health, tourism, the food industry, including the whisky trade, key agriculture and fishery routes to the continent.

- Working to improve connections in rural areas of Scotland and to the Islands.

Theme 6: Data, Innovation, and Collaboration

- Making sure ITS systems and services, where appropriate, safely capitalise on advances in digital technology, including improved connectivity, data analytics including the 'Internet of Things' (IoT) and Smart Cities.

- Reacting to the new technological innovations and societal changes which are likely to emerge in the future.

- Taking advantage of opportunities to work with partners across the transport modes.

Alignment of the Future ITS Strategy with the National Transport Strategy

The Future ITS Strategy is fully aligned with the 2016 refresh of the NTS.   The review of the NTS is expected to be completed during the first two to three years of the Future ITS Strategy and we will be fully engaged with the NTS review process during that time.

Where appropriate, developments in ITS supported by the ITS Strategy will be fed into the NTS review to ensure that the ITS Strategy continues to be fully aligned with the NTS now and in the future.

Alignment of the Future ITS Strategy and the Strategic Transport Projects Review

The Strategic Transport Projects Review (STPR) was published in 2008 and included specific recommendations for ITS (STPR Intervention 9), many of which have been delivered in the years since 2008. STPR is to be refreshed to support the outcomes of the NTS review and we will work with the review team to ensure appropriate alignments between the Future ITS Strategy and STPR2.

Glossary

The following is a list of definitions for terms appearing throughout the strategy.

Term	Definition
Autonomous Vehicles	'Autonomous vehicles' are those in which operation of the vehicle occurs without direct driver input to control the steering, acceleration, and braking and are designed so that the driver is not expected to monitor constantly the roadway while operating in self-driving mode.
Connected Vehicles	'Connected vehicles' are vehicles that use any of a number of different communication technologies to communicate with the driver, other vehicles on the road, roadside infrastructure, and to other systems and services via the Cloud.
Cooperative ITS (C-ITS)	A group of technologies and applications that allow effective data exchange through wireless technologies among elements and actors of the transport system. C-ITS are a broad concept which is not limited to V2V or to V2I communication but also includes C-ITS applied to vulnerable road users such as pedestrians, cyclists or motorcyclists.
DATEX II	A specification for the Information Model used for the exchange of road and travel information in Europe.
Day 1 and Day 1.5 Services	Terms promoted by industry and adopted by the European Commission that are used to refer to 'relatively mature' and 'soon to be mature' C-ITS services.
Disruptive Technology	A new / emerging technology that unexpectedly displaces an established one.
Intelligent Mobility	Encompassing everything from autonomous vehicles to seamless journey systems and multi-modal modelling software, Intelligent Mobility uses emerging technologies to enable the smarter, greener and more efficient movement of people and goods around the world.
Internet of Things (IoT)	The inter-networking of physical devices, vehicles, buildings and other items – embedded with electronics, software, sensors, actuators and network connectivity that enable these objects to collect and exchange data.
Mobility as a Service (MaaS)	Various forms of transport services, integrated into a single mobility services accessible by users on demand. MaaS has the potential to change the way people travel from A to B by

Term	Definition
	giving them personalised, informed whole route choice based on their preferences for a fare or subscription.
New ITS	Used in this document the term 'New ITS' refers to the specification and deployment of innovative technology such as C-ITS, Connected and Autonomous Vehicles, Electric Vehicles, MaaS and the enhancement of mobile and broadband communication coverage.
Smart Motorways (also known as Managed Motorways)	Smart motorways use innovative technology to actively control traffic flows by varying speed limits and using the hard shoulder as an extra lane. Their use has been shown to increase capacity, make journey times more reliable and relieve congestion while maintaining safety.
Traditional ITS	Used in this document the term 'Traditional ITS' refers to the deployment, operation, on-going maintenance and renewal of roadside infrastructure such as cable networks, CCTV and traffic detectors, gantry signals, VMS and information travellers via web services, smartphone apps, news feeds, social media and radio broadcasts.
V2I (Vehicle to Infrastructure)	The wireless exchange of data between vehicles and roadside infrastructure to intended to mitigate collisions and enable a wide range of other safety, mobility and provide other benefits.
V2V (Vehicle to Vehicle)	The wireless exchange of data between nearby vehicles that offers the opportunity for safety improvements and a wide range of other benefits.

Abbreviations

The following is a list of abbreviations and associated definitions for terms appearing throughout the strategy:

Abbreviation	Definition
ADAS	Advanced Driver Assistance Systems
aGVA	Approximate Gross Value Added
ARM	Availability, Reliability, Maintainability
AVT	Automated Vehicle Technologies
BCR	Benefit – Cost Ration
BIM	Building Information Modelling
CAV	Connected and Autonomous Vehicle
CAZ	Clean Air Zone
CCAV	Centre for Connected and Autonomous Vehicles (UK)
CCTV	Closed Circuit Television
C-ITS	Cooperative Intelligent Transport Systems
CO_2	Carbon Dioxide
DfT	Department of Transport (UK)
EIP	European ITS Platform
EU	European Union
FDP	Funded Delivery Plan
FRC	Forth Replacement Crossing
FTA	Freight Transport Association
GIS	Geographic Information System
HGV	Heavy Goods Vehicle
ICT	Information and Communication Technology
IDM	Investment Decision Making
IP	Internet Protocol
IRIS	Integrated Road Information System (used by Transport Scotland)
ITS	Intelligent Transport Systems
ITS (UK)	ITS United Kingdom
LED	Light Emitting Diode
LEZ	Low Emission Zone
MaaS	Mobility as a Service
MART	Multi-Agency Response Team
MSP	Member of the Scottish Parliament
NTDS	National Traffic Data System (used by Transport Scotland)

Abbreviation	Definition
NTS	National Transport Strategy (Scotland)
OBU	On-board unit (for C-ITS)
RHA	Road Haulage Association
RSU	Roadside unit (for C-ITS)
SES	Scotland's Economic Strategy
STPR	Strategic Transport Projects Review
TRBO	Trunk Road and Bus Operations (Transport Scotland)
TRISS	Trunk Road Incident Support Service
TRN	Trunk Road Network
TSNCC	Traffic Scotland National Control Centre
ULEZ	Ultra-Low Emission Zone
V2I	Vehicle to Infrastructure
V2V	Vehicle to Vehicle
VMS	Variable Message Sign
WRA	World Roads Association

1 Introduction

1.1 Background

Transport plays a critical role in helping to achieve the Scottish Government's Purpose of increasing sustainable economic growth with opportunities for all of Scotland to flourish. Scotland's transport infrastructure and service provision can help open up new markets, increase access to employment and help build a critical mass of business that can drive up competitiveness and deliver growth.

Transport Scotland is the national transport agency for Scotland. We seek to deliver a safe, efficient, cost-effective and sustainable transport system for the benefit of the people of Scotland, playing a key role in helping to achieve the Scottish Government's Purpose of increasing sustainable economic growth with opportunities for all of Scotland to flourish.

For many years, Transport Scotland has invested in the provision and management of Intelligent Transport Systems (ITS) for the benefit of trunk road users. This Future ITS Strategy presents our thinking on how best to serve the users of our road network by the use of ITS now and in the years to come and supports the four priorities of Scotland's Economic Strategy: Investment, Innovation, Inclusive Growth and Internationalisation.
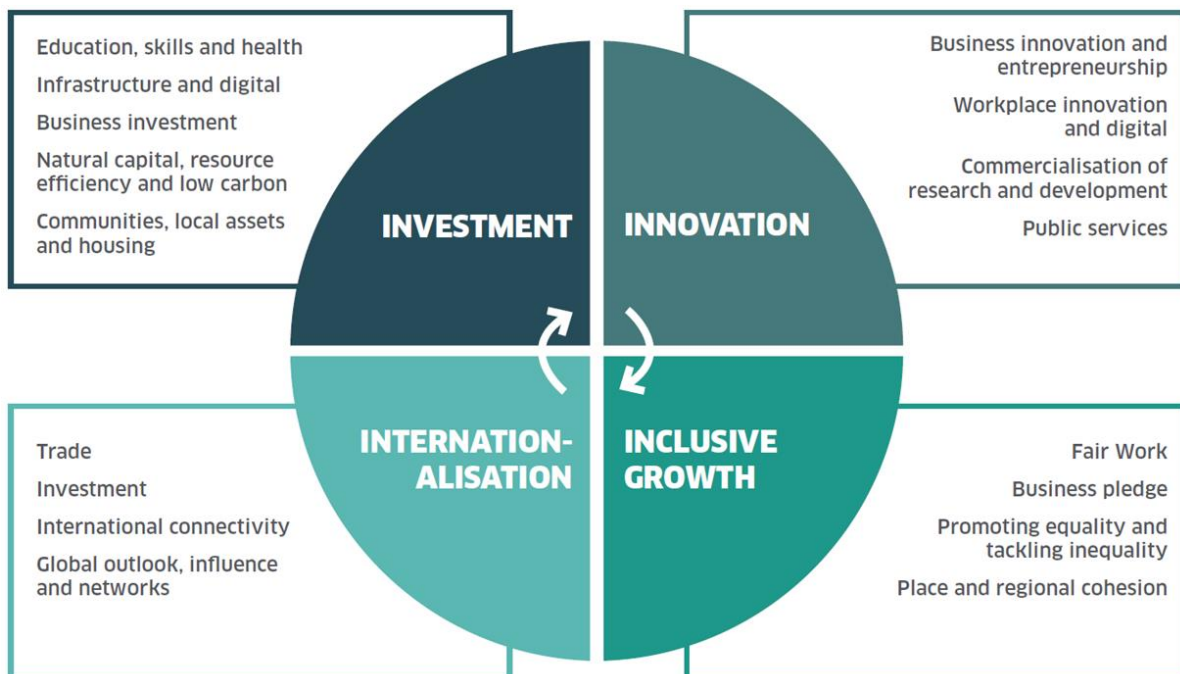
Figure 1.1: The Four Priorities of Scotland's Economic Strategy[1]

---

[1] http://www.gov.scot/Publications/2015/03/5984/0

Transport Scotland manages a comprehensive, multi-modal transport network that helps keep Scotland connected. This includes the safe and efficient operation of Scotland's network of trunk roads and motorways which are the main arteries of commerce, work, learning, leisure and tourism for the country, and are the focus of this strategy.
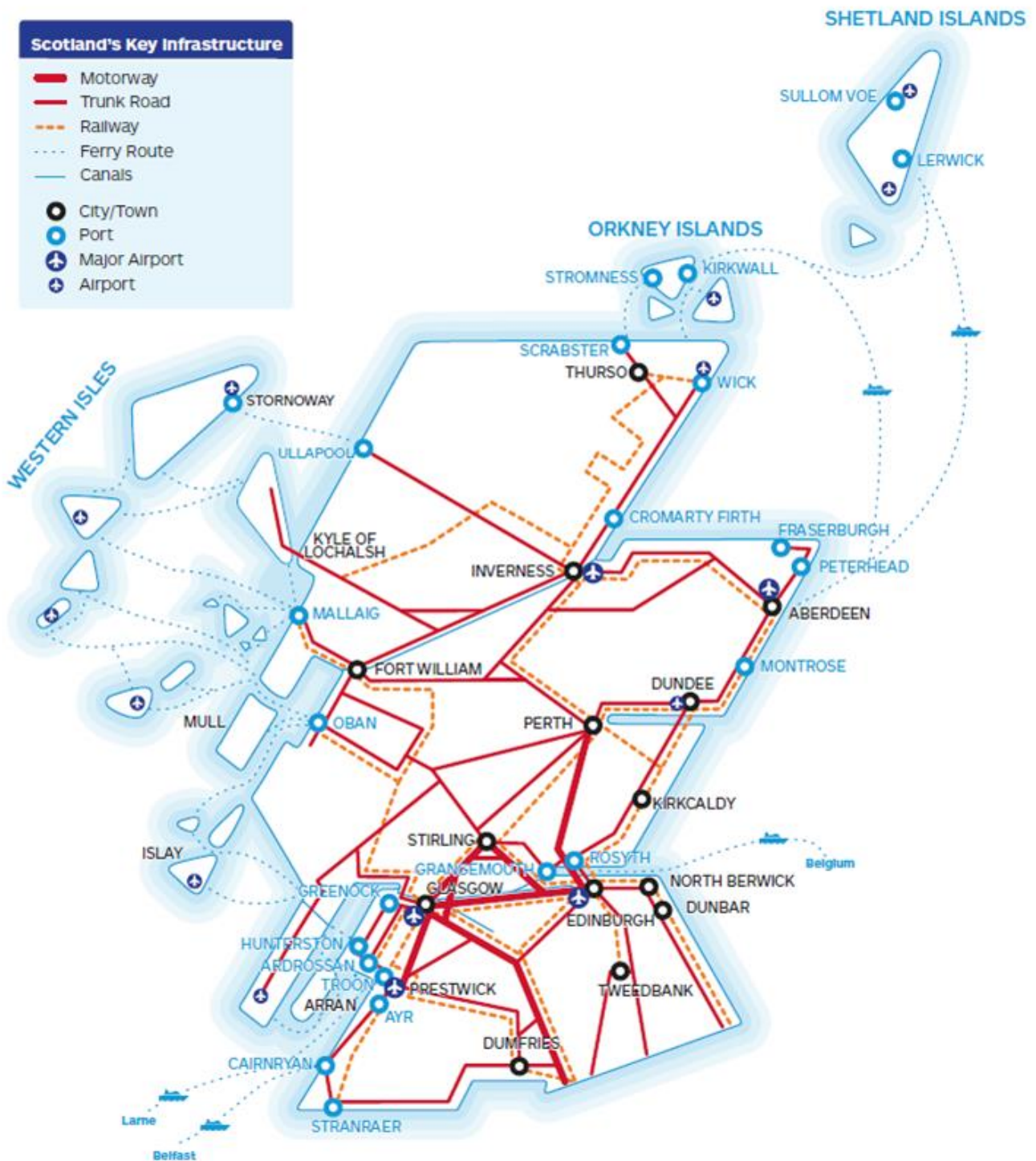

Figure 1.2: Scotland's Strategic Multi-Modal Transport Networks

<u>Trunk Road and Bus Operations Directorate</u>

Transport Scotland's Trunk Road and Bus Operations Directorate (TRBO) is responsible for the management and operation of Scotland's trunk road and motorway network.

The trunk road and motorway network connects Scotland's major cities, towns, airports and ports enabling the movement of people, goods and services. It is the Scottish Ministers' single biggest asset and is hugely diverse, ranging from the ten-lane M8 in the centre of Glasgow to single carriageway sections in the west Highlands.

The trunk road and motorway network is 3,507 km (2,179 miles) long, including slip roads and roundabouts. It has a gross asset value of over £20.8 billion and represents 6% of the total Scottish road network. It carries 35% of all traffic and 60% of heavy goods vehicles.

TRBO contributes to Transport Scotland's delivery priorities of:

- Improved connections across Scotland

- Better journey times, better reliability

- Greener transport alternatives, reduced emissions

- Enhanced safety, more innovation

1.2   Value of the Trunk Road Network

Transport Scotland commissioned research by the Transport Research Laboratory on 'The Value of the Trunk Road Network to Society and the Economy in Scotland'[2].

The research, published in March 2017, found that Scotland's trunk road network has significant economic and societal benefits, facilitating employment and access to a range of opportunities.

Increased connectivity delivered by the trunk road network also positively impacts on rural and remote communities and reduces regional inequalities in accessibility, benefiting regional cohesion.

The value of Scotland's trunk road network in quantitative and qualitative benefits are summarised in the following infographic.

---

[2] http://www.transport.gov.scot/report/value-trunk-road-network-society-and-economy-scotland-9878
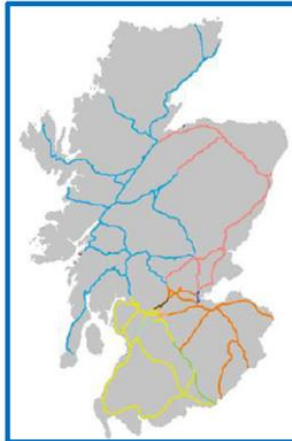
Figure 1.3: Value of the Trunk Road network

2   An objective led strategy to meet the needs of our customers

2.1   A distinctly Scottish context

Scotland's trunk road and motorway network mirrors the diversity of the country's geography and the distribution of its centres of population between urban and rural areas. Strategic roads range from the ten lane M8 motorway through Glasgow to relatively lightly trafficked single carriageway A roads in the more rural parts of Scotland; where the trunk road is the only road and therefore performs the function of both a local and a strategic route. This makes Scotland's trunk road network distinctly different from, for example, most of Highways England's strategic road network.

Delivery of the ITS Strategy will need to take account of these diversities and deliver ITS services in a distinctly Scottish context. It is unlikely that we will simply be able to follow the lead of others in the provision and implementation of ITS solutions. This underlines the continuing importance of Scotland being at the forefront of ITS developments, building on the rich history of innovation that has been part of Scotland's ITS focus since the early days of lane control and VMS around Glasgow in the 1970s. Transport Scotland will build on its founding principle as a Centre of Excellence to drive innovation in ITS, particularly in the area of rural connectivity.

2.2   What are Intelligent Transport Systems?

ITS is the term that describes technology and communications used to improve efficiency and safety for transport users. It includes monitoring equipment such as CCTV and traffic detection sensors, speed control and queue management via gantry signals; and informing travellers using Variable Message Signs (VMS), web services, smartphone apps, news feeds, social media and radio broadcasts. It also encompasses the growing field of connected and autonomous vehicles which are expected to have significant benefits for road safety and in transforming how real-time traffic monitoring and analysis can be carried out.

ITS contribute to enhanced transport resilience, smoother journeys, quicker reaction to incidents, environmental improvements, the economy and the overall safety of travel.

2.3   Why have we produced this Future ITS Strategy?

We are setting out how we will continue to consolidate our current position and react positively to the innovations in ITS and other related sectors. This strategy will help us to plan to use the capabilities of technology and the sheer volume of data that will be available to result in cleaner, safer and more efficient use of the trunk road network. It also allows us to communicate our priorities to our customers and partners.

Looking forward, advances in mobile and broadband telecommunications will mean more equipment could be connected and more locations covered. There will be more low carbon vehicles and choices of how to make an end-to-end journey. In-vehicle systems are expected to become commonplace; predictions are that by 2026[3] all new vehicles will have 'connected' technology on board. This could mean messages will be announced and displayed in-car as well as (or possibly in some cases rather than) roadside signs, and include details which are more personalised and relevant to the journey.

Vehicles will also have the potential to safely follow each other, to warn each other that they are braking, approaching road works or of bad weather ahead and automatically reduce their speed.

Through this Future ITS Strategy, Transport Scotland wishes to encourage a consensus for investment in ITS and seeks to establish a framework for collaboration to develop action plans for funded delivery. This will greatly assist us in assigning budgets, resources and having better understanding of on-going service delivery requirements and obligations.

Transport Scotland has a role to play in the standardisation and licensing for use of ITS technology and ensuring systems are interoperable across geographic boundaries. We also have to continue to manage traffic safely and efficiently for the benefit of all of our customers. We recognise the bigger picture: that the information the transport user wants is not just about the trunk road network. They want to know about local roads; if their connections to ferries, trains, buses and planes are on time and if routes are subject to delay or diversion because of the weather or incidents.

Best Practice from other ITS Strategies

We carried out a review of other ITS Strategies throughout the world to seek out best practice, and used the experience as co-hosts of the 11th ITS European Congress, held in Glasgow in June 2016, to see and hear about the latest developments first-hand.

As a result, we learned the following:

- having a good, formal strategy encourages collaborative working that leads to more effective outcomes from investment of money and resources

- canvassing user and stakeholder needs and involving them brings clarity of purpose

- a well-established governance process to manage project selection and investment, incorporating the views of both the public and private sector provides focus and direction.

---

[3] http://www.consultancy.uk/news/1763/kpmg-connected-cars-to-deliver-huge-uk-jobs-boost

2.4   Transport Scotland's Investment Hierarchy

Transport Scotland has an established Investment Hierarchy to target funding to interventions that enhance the trunk road and motorway network in the most efficient ways that deliver greatest economic and societal benefits.

The Investment Hierarchy is described as:

- investment aimed at maintaining and safely operating existing assets

- investment promoting a range of measures, including innovative solutions, to make better use of existing capacity, ensuring existing transport networks are fully optimised

- investment involving targeted infrastructure improvements.

The Investment Hierarchy applies equally to all transport interventions and is particularly relevant in the context of ITS investment.

In planning for the future we have used the principle of the Investment Hierarchy to develop four overarching objectives for the ITS strategy. These objectives provide a framework that will allow us to make better operational use of our existing ITS assets, find ways of using technology in new and innovative ways to improve existing capacity, and target investment where it can best deliver customers' needs; all within the constraints of available funding, good governance and proper fiscal control.

Objective A: Innovation and Horizon Scanning

Keep abreast of developments in ITS and identify how we can be innovative in the in the ITS services we provide to support the Scottish economy and realise environmental and safety benefits.

How:	Through engagement with and membership of relevant international, governmental, industry and sector groups such as ERTICO ITS Europe, other Scottish Government Departments, DfT, Highways England, ITS (UK), Devolved Administrations, local authorities, WRA (World Roads Association), CIHT and others.
When:	On-going engagement and horizon scanning, prepare for inclusion in ITS Strategy for the start of each Planning Horizon period.
Impact on the ITS Strategy:	Informs the development and regular review of ITS Strategy
Review Frequency:	Five Yearly or when required

Objective B: Customer Focus

Be aware of what our customers want from ITS and Traffic Scotland services and identify how we can continuously review, improve and evolve the information and services we provide to meet customers' needs and expectations across a range of platforms.

How:	Through regular engagement with customers comprising the general public road and transport users, the freight industry, public transport operators, media and broadcasters and users of our data including subscribers to our DATEX II information feeds.
When:	On-going engagement with customers to inform the evolution of the ITS Strategy at the start of each Planning Horizon period.
Impact on the ITS Strategy:	Informs the development and regular review of ITS Strategy
Review Frequency:	As required

Objective C: Planning and Adaptability

Set out how Transport Scotland and its partners adapt to technological changes and advancements to support ITS advancements such as connected vehicles, Big Data analytics and the growth in personal mobility choices.

How:	Through working closely with governmental, industry and sector groups and continuing awareness of developments in ITS and associated technologies.
When:	On-going engagement and horizon scanning, prepare for development of Thematic Action Plans for the start of each Planning Horizon period.
Impact on the ITS Strategy:	Informs the development of the Thematic Action Plans.
Review Frequency:	Every two years

Objective D: Asset Management and Delivery

Provide an informed context to make informed and effective investment decisions, justify investment and show best use of resources in ITS development, asset maintenance, deployment and renewal.

How:	Through the adoption of best practice Asset Management regimes in alignment with Transport Scotland's Road Asset Management Plan (RAMP).
When:	On-going assessment and evidence gathering to inform the preparation of Thematic Action Plans.
Impact on the ITS Strategy:	Enables exploitation, and makes best and appropriate use of existing Transport Scotland ITS and services.
Review Frequency:	Annually

A customer focussed strategy

This ITS Strategy has been developed to put the needs of our customers at the heart of what we do. As the strategy is delivered over its rolling five and ten-year planning horizons, this customer focus will continue be paramount in helping us to make strategic decisions on:

- where to prioritise resources

- what systems and services we need to provide, maintain and develop

- what new technologies and innovations we need to invest in and develop, and

- when to move away from existing or obsolete ITS infrastructure and services

In the strategy development phase, identifying customer needs has been a principal focus of the work that has been undertaken to date. This has to be accomplished in a number of ways, as summarised below.

Understanding the Needs of Users

In developing this Future ITS Strategy, Transport Scotland commissioned a specialist market research company to develop and conduct a number of focus group sessions at locations around the country to gather their perceptions of current ITS provision and their future needs.

Three different geographical locations were chosen for these focus group sessions to capture responses from people in both urban and rural communities and in parts of Scotland with different levels of ITS provision. These focus groups yielded valuable information across a range of ITS areas, including how people feel about

the information made available through variable message signs (VMS), social media, satellite navigation systems, smartphone apps, websites, and radio broadcasts.

It has given interesting insights into how people journey plan and what preferences they have for consuming traffic and travel information. Some examples of the comments made at focus group sessions are:

"I have seen the northbound signs telling us that the ferries have been cancelled which I think is really useful"

"If you are travelling along and you get information transmitted directly to your car then it is great, as long as it is accurate. I think you really pay attention if it suddenly comes into your personal space"

Perhaps not surprisingly, the focus of peoples' concerns are around journey times and journey time reliability; the desire for a safe and efficient transport network available when they want to travel; and accurate, up-to-date and reliable sources of travel information available across a variety of media platforms.

There was also evidence of a lack of awareness of many of the travel information services Transport Scotland provides through our Traffic Scotland service.

Stakeholders and suppliers

We held meetings and workshops with some of our key stakeholders, contractors and existing technology providers. This confirmed that there is an appetite for innovation, but also reinforced that the safety of the traveling public is of paramount importance. There is a real understanding that now, perhaps more than ever before, change is coming due to in-vehicle systems and how data can be processed and information disseminated.

Understanding the needs of Data Customers

Transport Scotland collects and uses a huge range of data in the course of operating our ITS services. Much of this data is made freely available to people and organisations who have a use for it. The data is made available via our DATEX II feeds and through our National Traffic Data Service (NTDS).

In developing the ITS Strategy, we asked our market researchers to undertake telephone interviews with subscribers to our DATEX II feeds. This was to help us to understand how they consume our data, what datasets are of particular importance to them and to what extent (if at all) we are collecting and making available data that no one is using.

Full details of the focus groups, stakeholder consultations and, research conducted to inform the development of the ITS Strategy is available in the accompanying research and consultation document Future Intelligent Transport Systems Strategy 2017 to 2022 – Research and Consultation Summary Report.

3 The core aim and structure of the strategy

The core aim of this Future ITS Strategy is to provide clarity on our priorities for the provision of ITS to contribute to the safe and efficient operation of Scotland's trunk roads and motorways and meet the needs of customers. It gives structure and direction for the development of action plans and funded delivery plans over successive five-year planning horizons.

The strategy is intended to be a living document which can adapt and evolve to react to the new technological innovations and societal changes which are likely to emerge in the future and to take advantage of opportunities to work with partners across the transport modes. This designed-in adaptability means plans can be regularly reviewed and updated to shape the requirements for successive five-year periods.

3.1 An ITS strategy with clear objectives meeting our customers' needs

We have created this objective led strategy to address three overarching needs:

- To ensure the strategy has a distinctly Scottish context, aligned with and contributing to the Scottish Government's Purpose, national strategic priorities and reflecting the diverse nature of the Scotland's strategic road network and the wider geographic and socio-economic landscapes of Scotland.

- To ensure we put our customers at the heart of what we do so that our future decisions on ITS provision is driven by user needs and in the interests of a safe and efficient network.

- To ensure decisions on investment in future ITS provision and operation align with Transport Scotland's Investment Hierarchy [4]and one or more of the four specific objectives we have set out for the strategy.

3.2 A structured, thematic strategy

The Strategy document consolidates Transport Scotland's knowledge and experience with informed views on developments and directions of innovation within the field. It provides a robust basis for future investment and collaboration.

In developing the strategy, we have identified six strategic themes each providing a starting point for the development of action plans and subsequent delivery programmes. The relationship between the Strategy, thematic Action Plans and annual Delivery Programmes is shown in the Structure of the Strategy diagram below.

---

[4] https://www.transport.gov.scot/publication/strategic-transport-projects-review-final-report/

Trunk Road and Motorway
FUTURE ITS STRATEGY

ONE CORE AIM
To provide clarity on our priorities for the provision of ITS to contribute to the safe and efficient operation of Scotland's trunk roads and motorways and meet the needs of our customers

THREE OVERARCHING NEEDS

To ensure the Strategy has a distinctly Scottish context, aligned with the Scottish Government's Purpose, national strategic priorities and reflecting the diverse nature of the strategic road network and the geographic and socio-economic landscape of Scotland.	To ensure the strategy is customer focussed by putting the needs of our customers at the heart of what we do so that future decisions on ITS provision and investments contribute to a safe and efficient road network and are informed and driven by user needs.	To ensure that decisions on investments in future ITS provision and operation align with Transport Scotland's established investment hierarchy and are objective-led by contributing to one or more of the specific Objectives we have set for the Strategy.

FOUR SPECIFIC OBJECTIVES

Objective A Innovation and Horizon Scanning	Objective B Customer Focus	Objective C Planning and Adaptability	Objective D Asset Management and Delivery
Ongoing engagement with relevant governmental, national and international organisations to inform wider understanding of how innovative and beneficial ITS can be deployed in Scotland.	Through various methods, regular engagement with users of both our netwrok and data and information services Transport Scotland provides, inform prioritisation of resources, systems and services that will have most effective benefits to users.	Working collaboratively to set out how Transport Scotland and our partners will adapt to technological changes such as the growth in Intelligent Mobility, connected and autonomous vehicles, big data and the Internet of Things	Present an informed context for annual reviews of our investment priorities that will deliver effective services aligned with our Investment Hierarchy and Transport Scotland's Road Asset Management Plan (RAMP).

SIX STRATEGIC THEMES

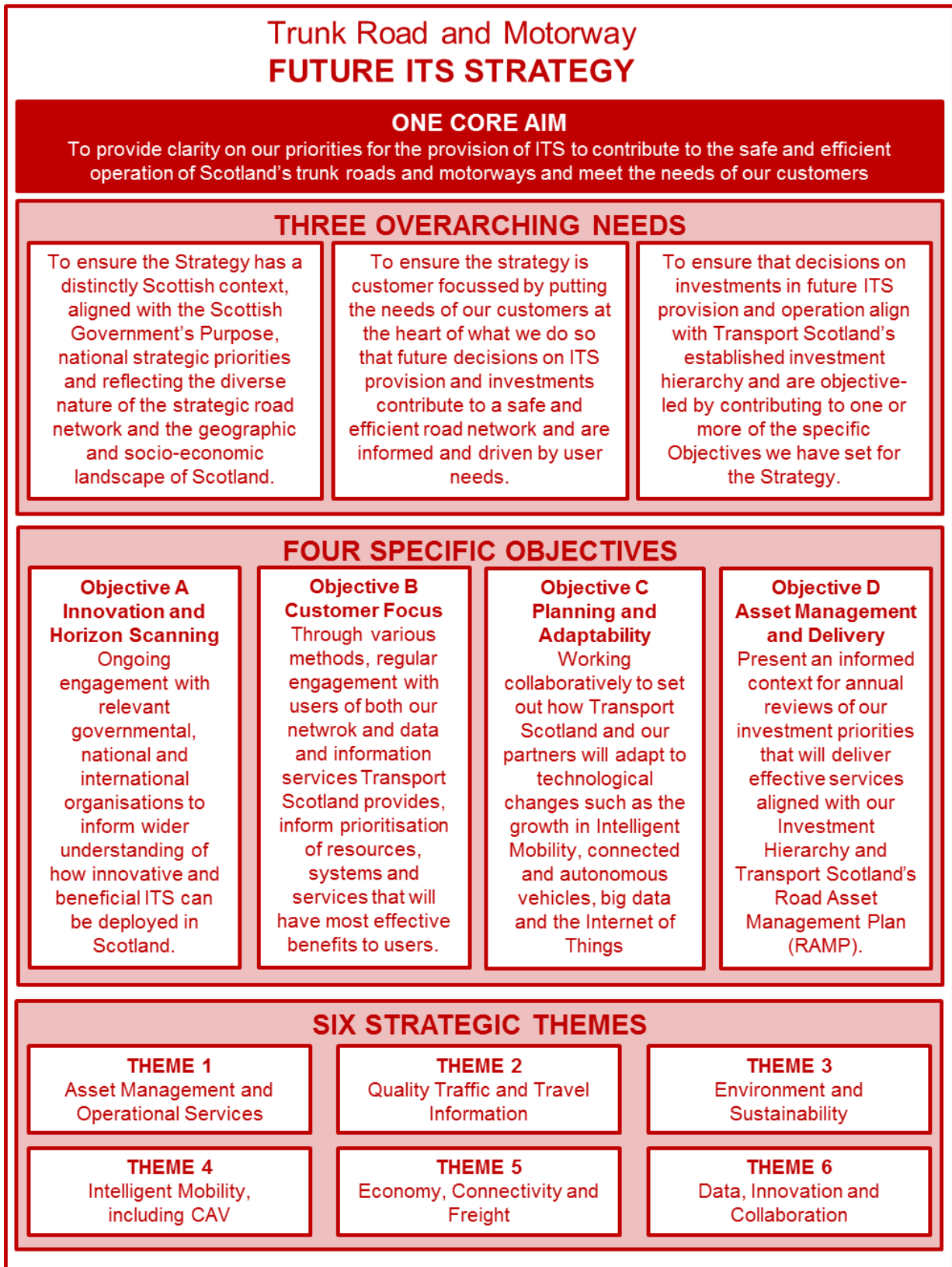| THEME 1 Asset Management and Operational Services	THEME 2 Quality Traffic and Travel Information	THEME 3 Environment and Sustainability
THEME 4 Intelligent Mobility, including CAV	**THEME 5** Economy, Connectivity and Freight	**THEME 6** Data, Innovation and Collaboration

Figure 3.1: Structure of the Strategy

3.3   The Six Strategic Themes

The six strategic themes represent our best thinking at the present time of the areas that will need to be facilitated, developed and delivered in our ITS provision in order to achieve the four principle objectives of the Strategy. The themes will be kept under review to ensure they continue to be relevant and appropriate. Where changes in policy or operations necessitate changes in one or more of the themes, the inherent adaptability of the Future ITS Strategy will facilitate such refreshes. The six strategic themes of the Strategy are summarised below.

Theme 1: Asset Management and Operational Services

- Developing the best use of existing roadside ITS assets and their control systems.

- Ensuring the inclusion of existing and future ITS assets in Transport Scotland's Road Asset Management Plan (RAMP).

- Considering the best way to maximise the capability of the Traffic Scotland National Control Centre, and how to plan for the future renewal and replacement of equipment, systems and contracts to maximise the efficiency of operations.

Theme 2: Quality traffic and travel information

- Providing the information travellers require to plan their journey, mode of travel and timing to maximise the safety and efficiency of the road network.

- Taking account of the future requirements (preferred media, method of delivery) of all our customers, including the public, organisations and information providers.

Theme 3: Environment and Sustainability

- Using ITS to contribute to improved air quality, lower noise levels and reduce the adverse effects of heavy traffic.

- Determining how best to support a low carbon economy through the selection and use of ITS technology and greener travel choices, including low carbon and electric vehicles and supporting Active Travel.

Theme 4: Intelligent Mobility, including Connected and Autonomous Vehicles

- Determining and deploying new ITS technologies that will positively support users travelling across the road network.

- Including new technologies to support the move to more connected, cooperative and potentially more autonomous vehicles, and the concept of Mobility as a Service (MaaS).

Theme 5: Economy, Connectivity and Freight

- Examining how best to facilitate the movement of goods and services.

- Determining how best to support key industries and economic sectors such as health; tourism; the food industry, including the whisky trade; key agriculture and; fishery routes to the continent.

- Working to improve connections in rural areas of Scotland and to the Islands.

Theme 6: Data, Innovation, and Collaboration

- Making sure ITS systems and services, where appropriate, safely exploit advances in digital technology, including improved connectivity, data analytics including the 'Internet of Things' (IoT) and Smart Cities.

- Reacting to the new technological innovations and societal changes which are likely to emerge in the future and to

- Taking advantage of opportunities to work with partners across the transport modes.

3.4   Action Plans and Delivery Programmes

To support the vision of a continually developing ITS Strategy, it will be supported by Action Plans which set out our priorities for interventions and investments needed to deliver the desired outcomes under each strategic theme over the five-year planning horizon of each Action Plan. The Action plans will identify where additional resources might be required or where previous approaches can be modified to ensure out ITS provisions continue to be what we need.

In turn, the Action Plans will be supported by annual, costed delivery programmes prioritised to maximise benefits delivery in the most efficient ways and allow complete transparency and budgetary diligence.

The following diagram shows the relationship between the Strategic Themes, Action Plans and Delivery Programmes.
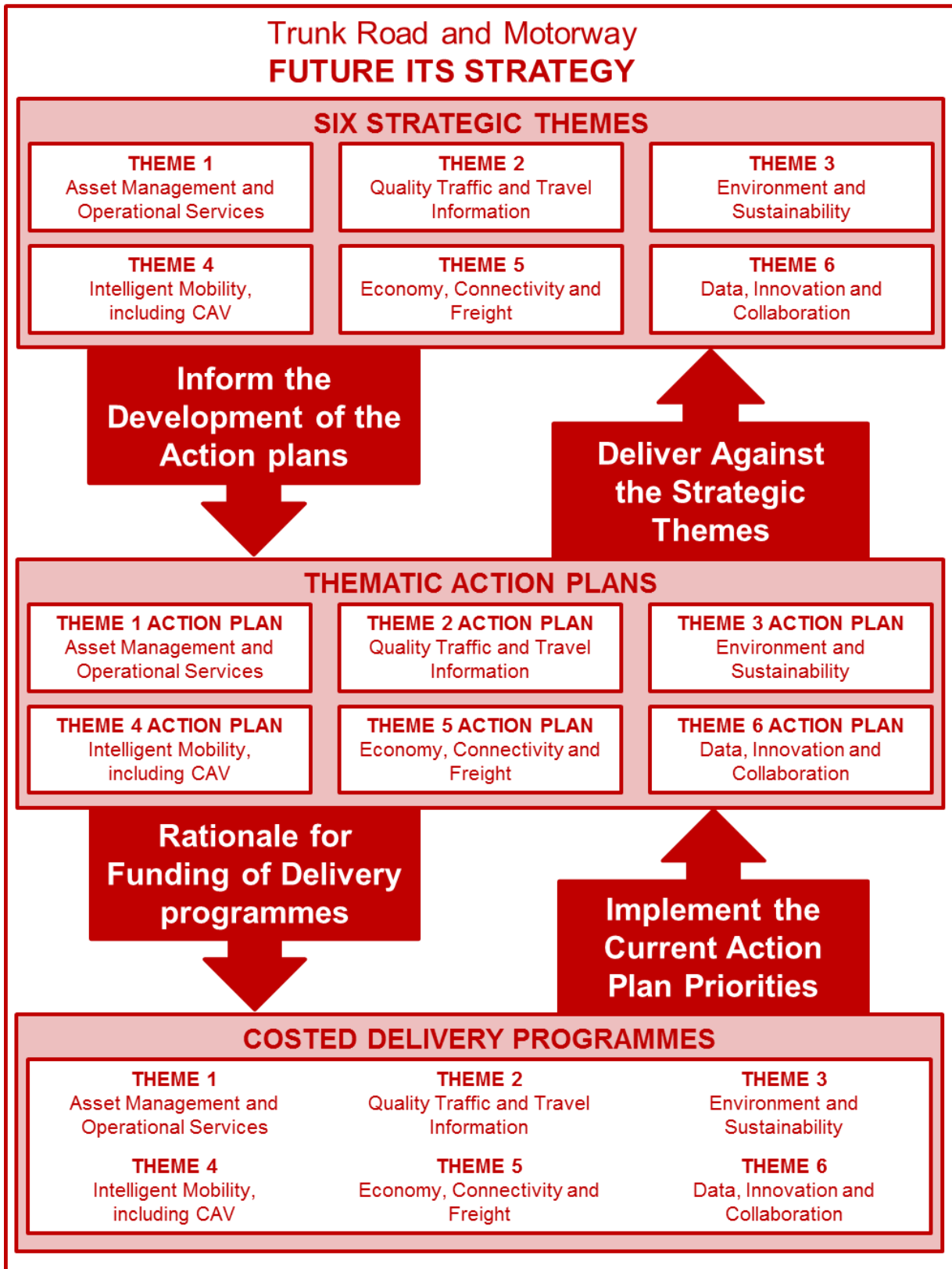
Trunk Road and Motorway
FUTURE ITS STRATEGY

SIX STRATEGIC THEMES

THEME 1
Asset Management and
Operational Services

THEME 2
Quality Traffic and Travel
Information

THEME 3
Environment and
Sustainability

THEME 4
Intelligent Mobility,
including CAV

THEME 5
Economy, Connectivity and
Freight

THEME 6
Data, Innovation and
Collaboration

Inform the Development of the Action plans

Deliver Against the Strategic Themes

THEMATIC ACTION PLANS

THEME 1 ACTION PLAN
Asset Management and
Operational Services

THEME 2 ACTION PLAN
Quality Traffic and Travel
Information

THEME 3 ACTION PLAN
Environment and
Sustainability

THEME 4 ACTION PLAN
Intelligent Mobility,
including CAV

THEME 5 ACTION PLAN
Economy, Connectivity and
Freight

THEME 6 ACTION PLAN
Data, Innovation and
Collaboration

Rationale for Funding of Delivery programmes

Implement the Current Action Plan Priorities

COSTED DELIVERY PROGRAMMES

THEME 1
Asset Management and
Operational Services

THEME 2
Quality Traffic and Travel
Information

THEME 3
Environment and
Sustainability

THEME 4
Intelligent Mobility,
including CAV

THEME 5
Economy, Connectivity and
Freight

THEME 6
Data, Innovation and
Collaboration

Figure 3.2: Relationships between the Strategic Themes, Action Plans and Delivery Programmes

3.5 Alignment of the Future ITS Strategy with the National Transport Strategy

The Future ITS Strategy is fully aligned with the 2016 refresh of the NTS. The review of the NTS is expected to be completed during the first two to three years of the Future ITS Strategy and we will be fully engaged with the NTS review process during that time. Where appropriate, developments in ITS supported by the ITS Strategy will be fed into the NTS review to ensure that the ITS Strategy continues to be fully aligned with the NTS now and in the future.

3.6 Alignment of the Future ITS Strategy and the Strategic Transport Projects Review

The first Strategic Transport Projects Review (STPR) was published in 2008 and included specific recommendations for ITS. i.e. STPR Intervention 9: "Using Intelligent Transport Systems (ITS) on parts of the road network to enhance road capacity and operations".

Many of the measures outlined in STPR Intervention 9 have been delivered in the years since 2008. STPR is to be refreshed to support the outcomes of the NTS review and we will work with the review team to ensure appropriate alignments between the Future ITS Strategy and STPR2.

3.7 Alignment of the Future ITS Strategy with the Strategic Road Safety Plan

Transport Scotland's ITS is a major contributor to keeping Scotland's trunk roads safe, for users and for the workers that carry out maintenance and installation works.

We will continue to put safety at the heart of our approach to using ITS through the use of proven technology and operational approaches. We will also look for opportunities to use innovative technology on a temporary basis to support safety objectives during scheme construction and maintenance operations.

The strategy will be aligned with The Safe System approach set out in Transport Scotland's Strategic Road Safety plan 2016.

4   The challenge ahead

The responsibility for successfully implementing this strategy lies with Transport Scotland. We seek a collaborative approach with other organisations for its delivery. Cooperation and mutual assistance between stakeholders, manufacturers and independent service providers will be essential if the benefits of ITS provision and operation are to be realised.

Our Future ITS Strategy will be live and evolving. It will be refreshed regularly in the light of progress: as new user needs are identified and; as technology develops and matures. Transport Scotland has the overarching requirement for governance and leadership. We will provide direction and reference points to those who want to be involved with ITS on the trunk road network.

We will be clear about our approach to striking the correct balance between renewing and refreshing 'Traditional ITS' such as smart motorways and directing investment towards the projected benefits of providing for innovative 'New ITS' such as connected vehicles.
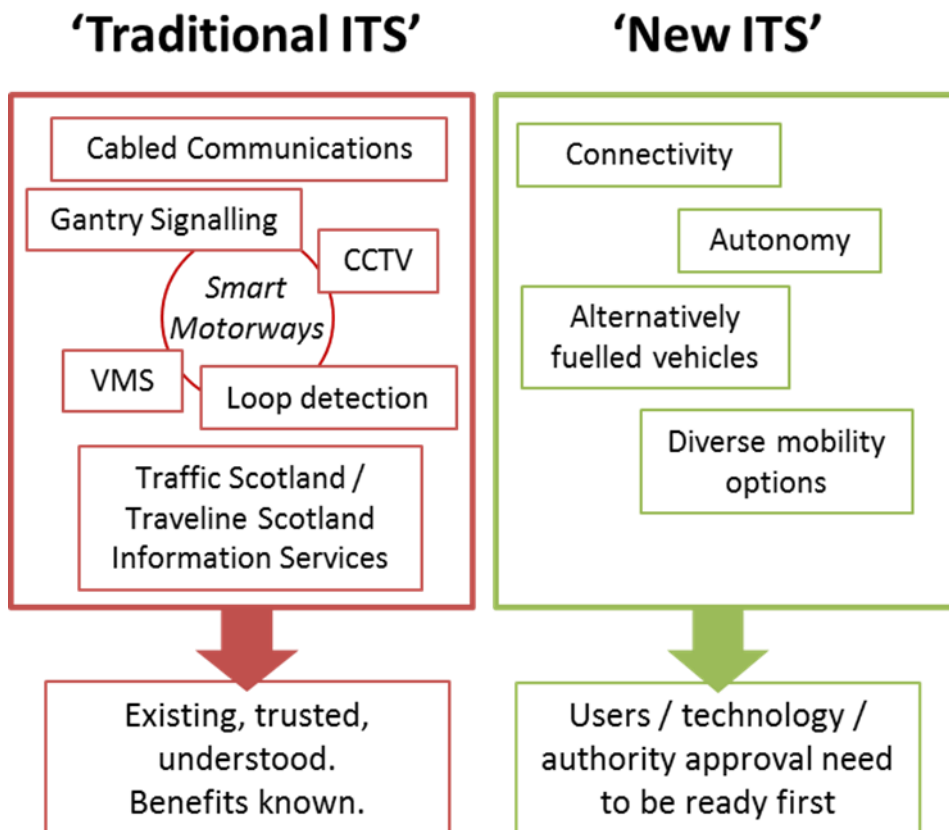
Figure 4.1: Traditional ITS and new ITS

4.1 Making sure the benefits of ITS are realised

To many people Intelligent Transport Systems are "just there". Little thought is given to how they work and why they work. Some may understand that somewhere people are in a computerised control centre pressing buttons to set signs and watching cameras, but they may not understand how many of the systems are automated and coordinated with each other and the skills and expertise required of the operators managing these systems cannot be understated.

ITS technology collects, analyses and presents information to the operators in a way which minimises the time taken to accurately detect, identify and respond to incidents across the whole of the motorway and trunk road network.

ITS can help to address congestion and air quality; improve access to Public Transport; provide infrastructure for electric vehicles; and better transport information provision. It helps to deliver significant improvements for a fraction of the cost of new infrastructure.

4.2 Embracing innovation and Technological Advances

Scotland is a country at the forefront of ITS adoption. Wherever feasible we want to be able to realise the benefits of technological advances as part of our desire to contribute to a prosperous economy.

Transport Scotland is in favour of innovation on the trunk road network. We are keen to encourage and support the development of new ITS technologies where there is a significant involvement from Scottish academia, companies and hi-tech start-ups. We will take a pro-active approach to any proposals and seek to identify suitable environments where trials can be carried out safely and with minimal impact on the travelling public.

We also want to take steps to create processes that are favourable to the early consideration of newer ITS solutions. We will consult with and take advice and assistance through active collaboration with organisations such as the Scottish Futures Trust, Scottish Enterprise, the Transport Systems Catapult, ITS (UK) and CCAV.

The most successful deployments of ITS are driven by the needs of our customers, effective operation and consistency of approach. To inform our position Transport Scotland regularly engages with key leaders and contemporaries in the field of ITS. This includes organisations such as ITS-UK, the Transport Systems Catapult, The European ITS Platform (EIP) and the Centre for Connected and Autonomous Vehicles (CCAV).

4.3   The Rise of Innovation and New Technology

The rise of the smartphone has ushered in new ways of interaction via the internet, including what information is available and how this is delivered and consumed. This is typified by the growth and uptake of social media, where users can access information via formal sources such as following @trafficscotland on Twitter or simply through crowd-sourced news or local interest pages.

The availability of comprehensive satellite image based mapping on a web page, mobile device or sat-nav console has created an environment where high quality navigation and information services can be created outside of Transport Scotland's domain.

The technology installed at the roadside and those systems that they are connected to has also changed. They have tended to become more cost-effective through the use of commercial off the shelf devices. There is a focus to increase the reliability of such equipment.

Technology that is proven

ITS has been proven to be cost effective and successful at improving traffic safety; managing disruption and congestion; and contributing to journey time reliability. The introduction of Managed Motorway type solutions on the M42 in England has had the following benefits:

- a 56% reduction in injury accidents

- journey times in congested conditions were reduced by 16% and journey time variability by 22% making journeys more predictable

- noise levels reduced by 2.1 dB(A)

- carbon monoxide and carbon dioxide emissions were both reduced by 4% as was fuel consumption

- subsidiary effects were a reduction in driver stress and an improvement in speed compliance

- there were also high levels of driver satisfaction with the scheme[5]

The full benefit of the introduction of the Managed Motorway on the Queensferry Crossing corridor will not be realised until the completion of the route. Since the opening of Phases 1 and 2 in 2013, following the completion of the Fife ITS and M9 Junction 1a construction contracts, accidents have reduced by around two thirds.

---

[5] http://www.its-uk.org.uk/filelibrary/file/ITS%20UK%20pitch%20for%20ITS%20longer.pdf

The world of ITS is constantly evolving. Developments in technology, often taking on board advances in IT and communications that have taken place outside the transport sector, can make equipment obsolete. End of life like-for-like replacement of assets is unusual. Innovation constantly brings the prospect of easier maintainability, higher performance and greater reliability, or even a completely new way of doing things.

The widespread deployment of ITS roadside infrastructure over the last 20 years is now an ageing asset. In the coming years some of this technology will become obsolete and will need to be replaced. This applies to both roadside equipment as well as in-station and control system infrastructure.

The challenge is how best to select the most appropriate investment against the backdrop of the disruptive technologies. As their use becomes established there will be a requirement to balance the continued use, replacement and deployment of traditional ITS technology. To inform our choices Transport Scotland will monitor the work undertaken by contemporaries in the field of ITS including the Government Office for Science's new Foresight project which will investigate how these issues will affect the transport of people and goods up to 2040[6].

Connected and Autonomous Vehicles

Some of the biggest developments being introduced have come in the automotive sector. The UK Government has enthusiastically allocated money for research and development in the area for Connected and Autonomous Vehicles (CAV). In 2015 the European Commission (EC) published a European strategy on Cooperative Intelligent Transport Systems[7] that manufacturers and EU member states are supporting.
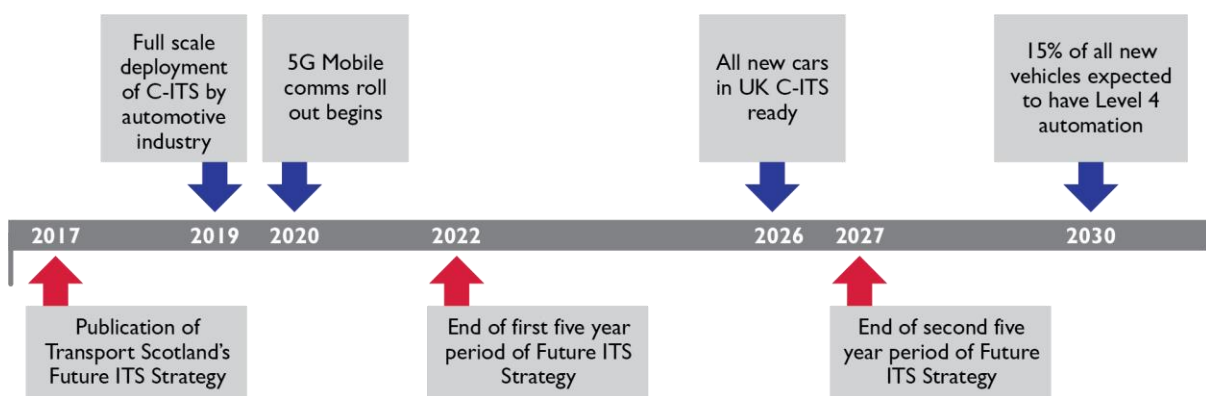
Figure 4.2: Expected timeline of developments affecting this strategy

---

[6] www.gov.uk/government/news/new-foresight-project-to-investigate-the-future-of-mobility
[7] ec.europa.eu/energy/sites/ener/files/documents/1_en_act_part1_v5.pdf

The completely autonomous, self-driving, A to B journey is likely to be many years down the line: issues of safety, security, and insurance liabilities are amongst the issues that need resolving. Connected and collaborative elements of a self-driving car are already available, for instance collision avoidance systems and automated parking capability are available on certain models of many new vehicle types. In a report by KPMG for the UK's SMMT (Society of Motor Manufacturers and Traders) it was projected that these will become more common-place by 2026[8].
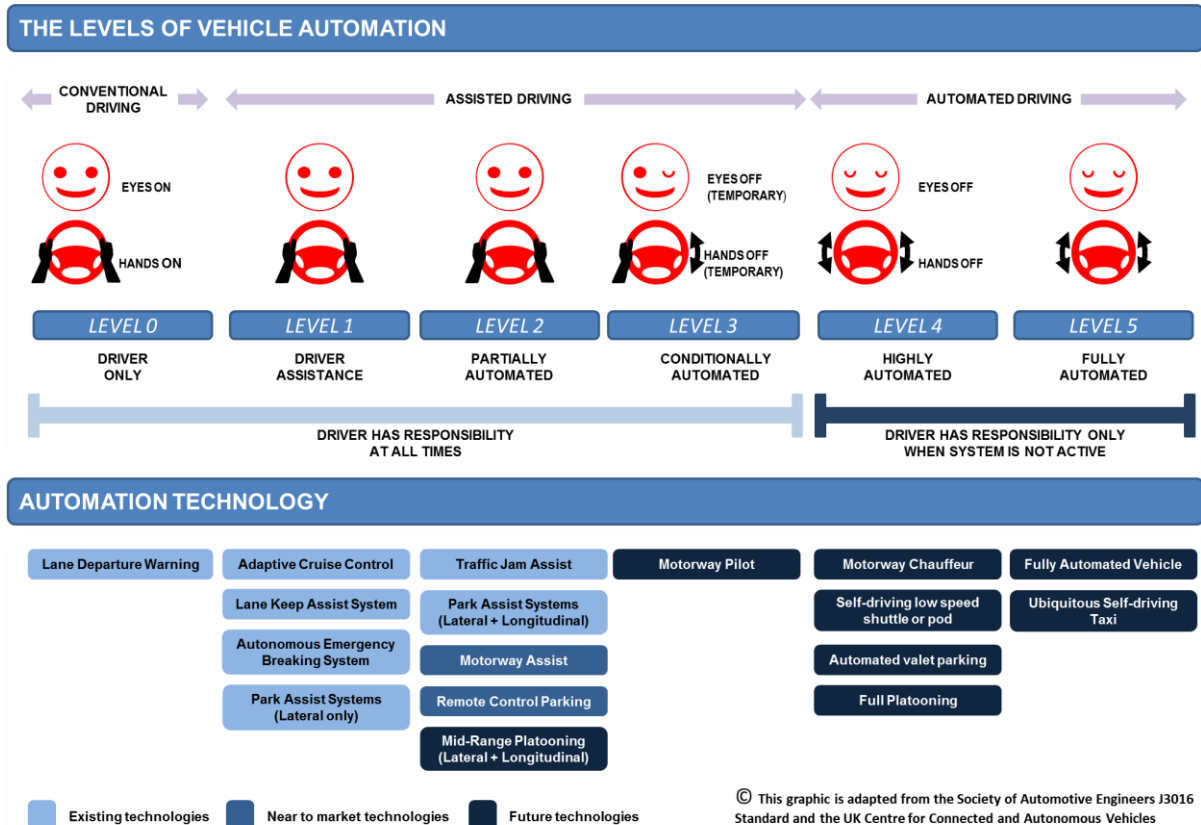
Figure 4.3: The six levels of autonomous driving

Connected vehicles can be expected to allow information to be passed to and collected from vehicles, for instance, meteorological conditions and surface traction information collected from vehicle sensors and then passed as warnings of ice to vehicles upstream. Connected vehicles will also allow information to be passed to in-stations and road operators.

---

[8] https://www.smmt.co.uk/wp-content/uploads/sites/2/CRT036586F-Connected-and-Autonomous-Vehicles-%E2%80%93-The-UK-Economic-Opportu...1.pdf

Changing the way we travel – travel choice and alternative fuels

In addition to the technological change, government policy is also changing. Air quality is a major issue and managing the adverse effects of traffic on the population is seen as a key area for attention. ITS can support and contribute to improvements in this area through the introduction of Low Emission Zones (LEZs).

There are also changes in the type of vehicles being used, with plug-in hybrid and fully electric vehicles expected to become much more commonplace. Scotland has a roadmap for the widespread adoption of plug-in vehicles with an ambitious vision of freeing towns, cities and communities from the damaging emissions of petrol and diesel fuelled vehicles by 2050. The infrastructure for this changeover presents a great opportunity for ITS services to utilise.

Tools and techniques are enabling completely new services to be created. One such concept is 'Mobility as a Service' or MaaS[9], where various forms of transport services are integrated into a single mobility service accessible by users on demand. The UK Transport Systems Catapult believes MaaS has great potential to change the way people travel from A to B by giving them a personalised, informed whole route choice based on their preferences for a fare or subscription. Proponents believe that the biggest effect MaaS is expected to have is that it reduces the need for personal car ownership with rental cars (delivered to the point of departure) or taxis.

Predicted changes in the make-up of the vehicle fleet in Scotland

The graphs overleaf interpret predictions made in 2015 by KPMG and for Switched on Scotland for the expected take up of CAVs and for alternative fuels. By their nature these predictions will have a margin of error. In 2016 McKinsey&Company[10] postulated that the take up of autonomous vehicle technology would be heavily dependent on progress of the technical, infrastructure and regulatory challenges. Their 'high disruption' scenario has a profile similar to KPMG's, with a 'low disruption' scenario (where the challenges take longer to resolve) shifting the timescale by up to five years (e.g. predictions for the end of the second five years of the ITS strategy in 2027 will not happen until 2032).

Similar issues may affect the alternative fuel scenario. Factors include emission regulations, including an increased focus on NO_x that may well result in a greater than expected reduction the number of diesel vehicles; increasingly viable electric and hydrogen units being manufactured; and the growth of the network of recharging / re-gassing stations. As an example the McKinsey report stated that "in 2030 the share of electrified vehicles could range from 10 to 50 percent of new vehicle sales"

---

[9] https://ts.catapult.org.uk/wp-content/uploads/2016/07/Mobility-as-a-Service_Exploring-the-Opportunity-for-MaaS-in-the-UK-Web.pdf
[10] https://www.mckinsey.de/files/automotive_revolution_perspective_towards_2030.pdf

with adoption rates likely to be highest in developed dense cities and slower in small towns and rural areas.

Such figures do not take into account the Scottish Government's pledge to phase out the sale of new cars and vans with petrol or diesel engines by 2032 as referenced in "A Nation With Ambition: The Government's Programme for Scotland 2017-18"[11].

Considerations

Maintaining an incremental approach to adopting new ITS technology may not always be in the best interests of Scotland. For a proportion of the new technology, Transport Scotland will not be in the role of specifier. For example automotive manufacturers are already installing cooperative ITS technology in new vehicles; there is continued growth in mobile communications: service operators can offer travel information services via apps, sensors can be located almost anywhere there is the requisite signal (and sufficient power) and there is significant growth in data visualisation and analytical capabilities.

With this background we will have to consider how to accelerate our investment decisions processes. We will need to make it clear how we will facilitate adoption of these new solutions and so bring cost savings, improved safety and greater efficiency to the economy as a whole.

The predicted changes in vehicle fleets in terms of connected vehicle and fuel type are illustrated in the following graphs.

---

[11] http://www.gov.scot/Resource/0050/00505210.pdf
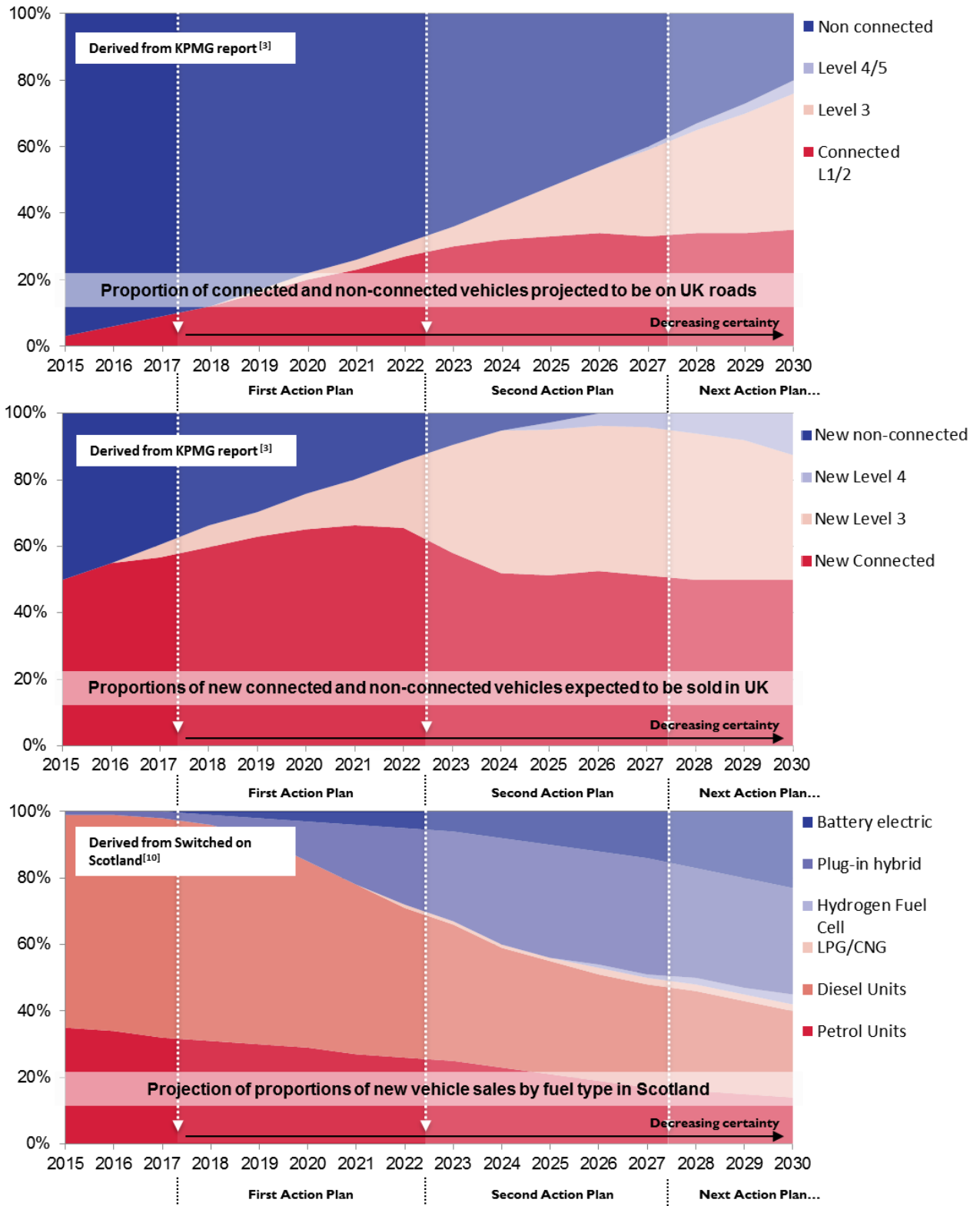
Figure 4.4: Predicted changes in vehicle fleets 2015-2030

5 Scotland's Strategic Priorities

5.1 Scottish Government's Purpose

The Scottish Government's purpose is to focus government and public services on creating a more successful country, with opportunities for all of Scotland to flourish, through increasing sustainable economic growth.

The approach to delivering this Purpose is set out in Scotland's Economic Strategy (SES), published in March 2015. The SES is built around two interdependent pillars: increasing competitiveness and tackling inequality.

The twin goals of tackling inequality and boosting competitiveness are underpinned by four priority areas for the Scottish Government:

- **Investing** in our people and infrastructure in a sustainable way

- Fostering a culture of **Innovation** and research and development

- Promoting **Inclusive growth** and creating opportunity through a fair and inclusive jobs market and regional cohesion; and

- Promoting Scotland on the **international** stage to boost our trade and investment, influence and networks.

To support this aim the Scottish Government has published a number of economic, transport, environmental and digital strategies. This section summarises those that are most relevant for this Future ITS Strategy.

5.2 Scotland's Economic Strategy (2015)[12]

This sets out an overarching framework for a more competitive and fairer Scotland. It describes the strategic direction for current and future Scottish Government policy. There are four broad priority areas where actions will be targeted to make a difference: investment, innovation, inclusive growth, and internationalisation.

A 'One Scotland' approach is promoted with all public sector agencies working together with the private sector, voluntary organisations, universities and colleges. A safe, efficient, effective and sustainable transport system, for both passengers and freight, remains one of the key enablers of sustainable economic growth.

---

[12] www.gov.scot/Resource/0047/00472389.pdf

5.3   Programme for Government (2017-2018)

The Programme for government sets out how the Scottish Government will build on work already underway, with a fresh set of priorities and reinforces the commitment to forward looking, caring and open government.

The Programme for Government sends a clear signal that Scotland is the place for innovation in digital and low carbon economy by making commitments to (among other things)–

- Promote the use of ultra-low emission vehicles (ULEVs), with a target to phase out the need for new petrol and diesel cars and vans by 2032
- Expand the electric vehicle charging network
- Accelerate the procurement of ULEVs in the public and private sectors, transforming public sector car and van fleets by the mid 2020s and commercial bus fleets by the early 2030s
- Introduce large scale pilots across the country to encourage private motorists to use ULEVs and remove barriers to their use
- Create Scotland's first 'electric highway' on the A9, including charging points along the route
- Create a Low Emissions Zone (LEZ) in one of Scotland's cities by the end of 2018, in Scotland's four biggest cities by 2020 and in all Air Quality management Areas by 2023
- Launch an app which provides in-car radio entertainment and tourist information for the A9 corridor

5.4   Alignment of the Future ITS Strategy with the Programme for Government

The Future ITS Strategy will support the measures and commitments set out in the Programme for Government.

The development of new ITS services and solutions will be able to make important contributions to the success of low carbon transport, LEZs and increased uptake in ULEVs as well as developments in Intelligent Mobility and connected and autonomous vehicles.

Improvements in digital connectivity across the country can help to bring ITS services to more people in all parts of Scotland and integrated in-car radio services providing tourist information can be supported by traffic and travel information services provided by Traffic Scotland Radio.

5.5   National Transport Strategy (2016)[13]

The National Transport Strategy (NTS) sets the long term vision for our transport policies. It was first published in 2006 after the Scottish Government consulted the public, interested individuals and a wide range of organisations on their views for the future of transport in Scotland. The NTS was refreshed in 2016.

Full Review of the National Transport Strategy

The 2016 refresh of the NTS recommended a fuller, collaborative review of the NTS in the next Scottish Parliamentary term. The Minister for Transport and the Islands, Humza Yousaf MSP, subsequently announced the inception of this full review of the NTS on Monday 22 August 2016.

The review of the NTS will set out an updated vision for what kind of transport we want for the whole of Scotland in 20 years' time and how we plan to get there. It will look at how we can successfully address the strategic challenges facing our transport network and how we can take advantage of the opportunities that present themselves. It will also inform the review of the Strategic Transport Project Review (STPR2) by providing a clearly defined set of strategic transport objectives.

Transport Scotland is committed to delivering a collaborative review of the NTS, by giving stakeholders and communities across Scotland a greater say in influencing the development of transport policy at a local, regional and national level.

5.6   Alignment of the Future ITS Strategy with the National Transport Strategy

The Future ITS Strategy is fully aligned with the 2016 refresh of the NTS.   The review of the NTS is expected to be completed during the first two to three years of the Future ITS Strategy and we will be fully engaged with the NTS review process during that time. Where appropriate, developments in ITS supported by the ITS Strategy will be fed into the NTS review to ensure that the ITS Strategy continues to be fully aligned with the NTS now and in the future.

---

[13] http://www.transport.gov.scot/system/files/documents/reports/Main%20doc%20-%20Transport%20Scotland%20-%20National%20Transport%20Strategy%20-%20January%202016%20-%20final%20online.pdf

5.7   Strategic Transport Projects Review (2009)[14]
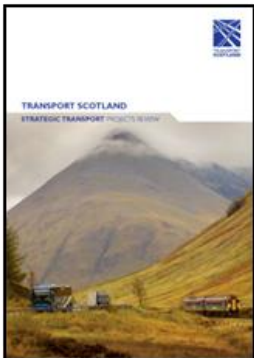
The Strategic Transport Projects Review (STPR) was published in December 2008. It contains 29 recommendations for delivering nationally important strategic interventions over the period 2012 - 2032.

Amongst the top four priorities identified by Ministers were: the Forth Replacement Crossing (FRC) which has seen the deployment of the first Managed Motorway on the Scottish Trunk Road Network and; the construction of the new Traffic Scotland National Control Centre (TSNCC) at Queensferry. There is also clear commitment within the Infrastructure Investment Plan 2011 to complete the A9 Dualling Perth to Inverness by 2025 and the A96 Dualling Inverness to Aberdeen by 2030.

STPR Intervention 9 is 'Using Intelligent Transport Systems (ITS) on Parts of the Road Network to Enhance Road Capacity and Operations'. This intervention supports the objectives of improving journey time reliability and journey times. It would involve the introduction of enhanced ITS, principally Managed and Controlled Motorway interventions, on the motorway and trunk road network in Central Scotland: M8; M90 and A90 approaching Edinburgh; A720 around Edinburgh and; M74, M77 and M80 approaching Glasgow.

Review of the Strategic Transport Projects Review (STPR II)

The review of STPR will offer an opportunity to review in detail Scotland's strategic transport priorities as part of any short or medium term needs within a long term delivery strategy. The review will bring together all existing and future commitments whilst also considering other strategic projects which have emerged over the period since the first review was published in 2008.

5.8   Alignment of the Future ITS Strategy and the Strategic Transport Projects Review

Many of the measures outlined in STPR Intervention 9 have been delivered in the years since 2008. STPR is to be refreshed to support the outcomes of the NTS review and we will work with the review team to ensure appropriate alignments between the Future ITS Strategy and STPR2.

---

[14] http://www.transport.gov.scot/strategic-transport-projects-review

5.9 The Climate Change (Scotland) Act 2009, Cleaner Air For Scotland (2015)
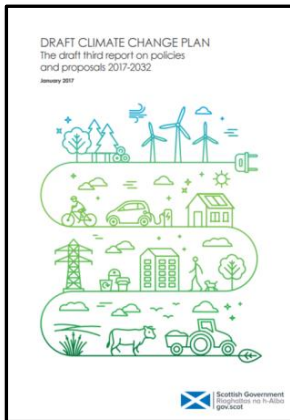
The Climate Change (Scotland) Act, 2009, sets out targets to reduce greenhouse gas emissions by at least 42% by 2020 and 80% by 2050, compared to a 1990-1995 baseline. To ensure the delivery of these targets, the Act also requires that the Ministers set annual targets for emissions from 2010 to 2050 and publish regular reports on proposals and policies.

'Draft Climate Change Plan – The draft third report on policies and proposals 2017-2032'[15] was published in January 2017. It sets out how the Scottish Government proposes to drive down emissions by 66% by 2032. The plan articulates real, on the ground changes that need to happen to achieve its ambitious targets. The Climate Change Plan, together with planned new Energy Strategy and Climate Change Bills will deliver an integrated approach to a low-carbon transition in Scotland.
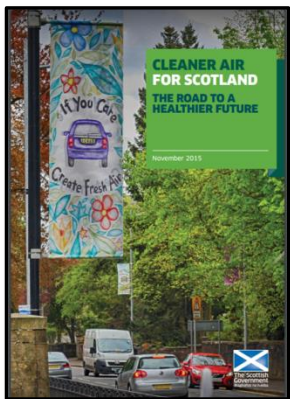
In November 2015 The Scottish Government published 'Cleaner Air for Scotland – The Road to a Healthier Future'[16] as a national strategy for all to work together towards the common aim of achieving the best possible air quality for Scotland. It promotes reducing transport emissions by supporting the uptake of low and zero emission fuels and technologies; promoting a modal shift away from the car through active travel (walking and cycling) and; reducing the need to travel.

5.10 Alignment of the Future ITS Strategy and the Climate Change and Air Quality

ITS tools can be used to improve air quality, lower noise levels and reduce the adverse effects of heavy traffic and traffic congestion. Under the framework of the Future ITS Strategy, we will look to align the deployment of ITS technology and services to reduce congestion, promote greener travel choices, and encourage increased use of electric, hybrid and fuel cell vehicles. We will look for ways to facilitate commercial freight movements in ways that have least impact on the environment, and ease the barriers to using public transport options.

---

[15] http://www.gov.scot/Publications/2017/01/2768/
[16] http://www.gov.scot/Resource/0048/00488493.pdf

5.11 Switched On Scotland – A roadmap to widespread adoption of plug-in vehicles (2013, followed by 2016 review and Phase 2 2017)

The Scottish Minister's vision (published 2013) is that by 2050, Scottish towns, cities and communities will be free from the damaging emissions of petrol and diesel fuelled vehicles. A key enabling action by Transport Scotland is the funding and development of the ChargePlace Scotland[17] network of publicly available electric vehicle charge points.

'Switched on Scotland Phase 2: An Action Plan for Growth'[18] was launched 13 June 2017. This refreshed document is an action plan to 2020 to continue to facilitate the growth in purchase and use of electric vehicles. We will continue to work with partners to take forward the actions in the Plan to decrease costs; enhance convenience; and change culture to where EVs are preferred to fossil fuelled vehicles.

5.12 Alignment of the Future ITS Strategy and the Adoption of Plug-In Vehicles

Through the Future ITS Strategy we will stay close to developments nationally and internationally on the development and use of plug-in vehicles. We will look for ways to support the uptake of electric and hybrid plug-in vehicles through ITS services and solutions.

---

[17] http://chargeplacescotland.org
[18] https://www.transport.gov.scot/media/39306/switched-on-scotland-phase-2.pdf

5.13 Realising Scotland's full potential in a digital world: a digital strategy for Scotland (2017)[19]

The Scottish Government published its first Digital Strategy in 2011. It looked at digital opportunities and challenges facing Scotland at that time and set out actions to improve our digital infrastructure, promote digital participation, develop a greater range of digital public services and stimulate the digital economy. Significant progress has been made in each of these areas, providing a platform upon which our updated strategy will build.

In 2017 the strategy was refreshed and published with an evidence discussion paper. It sets out a vision that the Scottish Government for Scotland to be recognised throughout the world as a vibrant, inclusive, open and outward-looking digital nation.
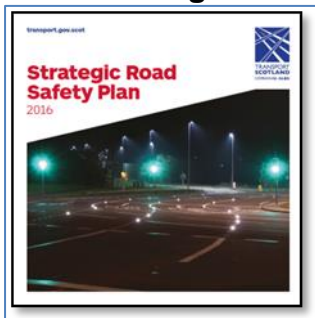
5.14 Alignment of the Future ITS Strategy and the Digital strategy

The Future ITS Strategy is closely aligned with Scotland's Digital Strategy in terms of the need for a vibrant digital economy. The predicted growth in connected and autonomous vehicles will only be realised if there are strong digital services available. Particularly in the more remote rural areas of Scotland it will be important to have fast and reliable digital platforms if connected and autonomous vehicles are to become commonplace.

Developments in this area will be closely monitored and opportunities for partnership working with Scottish Government Digital colleagues will be explored.

---

[19] https://beta.gov.scot/publications/realising-scotlands-full-potential-digital-world-digital-strategy-scotland/

5.15 Strategic Road Safety Plan 2016[20]

The Strategic Road Safety Plan sets out how Transport Scotland delivers road safety on the trunk road network. The first Strategic Road Safety Plan was published in 2007 and supported delivery of the Road Safety Framework to 2020.

The refreshed Plan reinforces our use of a Safe System approach within the road transport system. This approach is centred around the premise that deaths and injuries are unacceptable and they are avoidable. The updated Road Safety Plan refocuses our work on further reducing the numbers of accidents and casualties on the Trunk Road network.

The Plan highlights how technology, both on-road and in the control centre, is part of the Safe System approach. It also stresses the importance of tools to interrogate the Integrated Road Information System (IRIS) that contains details relating to all aspects of Scotland's trunk road network, from pavements and street furniture to road accident and casualty details.

Safety through transport resilience is also stressed. This includes the Scottish Multi-Agency Response Team (MART) which is physically based at the TSNCC. MART enables a strategic overview of event and incident handling on behalf of all the organisations involved.

5.16 Alignment of the Future ITS Strategy and the Strategic Road Safety Plan

Transport Scotland's ITS is a major contributor to keeping Scotland's trunk roads safe, for users and for the workers that carry out maintenance and installation works.

We will continue to put safety at the heart of our approach to using ITS through the use of proven technology and operational approaches. We will also look for opportunities to use innovative technology on a temporary basis to support safety objectives during scheme construction and maintenance operations.

---

[20] http://www.transport.gov.scot/report/strategic-road-safety-plan-2016-9049

5.17 Road Asset Management Plan for Scottish Trunk Roads (2016)[21]

The Road Asset Management Plan (RAMP) sets out how Scotland's trunk road network is maintained strategically and efficiently in order to protect our assets and provide the best possible service with the resources we have available.

The RAMP presents the type and number of trunk road assets that Transport Scotland is responsible for, including carriageways, footways, structure, lighting and drainage. For each asset type, the RAMP describes its current condition and the range of activities used to manage and maintain it throughout its life.

The RAMP is used by Transport Scotland and its service providers to provide full visibility of trunk road management and maintenance activities and to drive continual improvement. It may also be of interest to those who wish to know more about the service Transport Scotland proposes to deliver.

5.18 Alignment of the Future ITS Strategy and the Road Asset Management Plan

Transport Scotland has a large inventory of physical ITS equipment deployed across the network and a large number of complex systems that power our services. Some of these assets are approaching the end of their operational life and decisions will have to be taken on the most effective way to maintain or replace these assets.

It is reasonable to assume that in 20 to 25 years' time all of today's ITS assets will have been replaced, some like-for-like, some with upgrades and enhancements, others with something different such as roadside units to communicate directly with vehicles. Whilst making these changes we will look to adapt the existing supporting infrastructure wherever possible and not lose quality of service to road users.

The Future ITS Strategy will align with the RAMP in how we best manage, maintain and renew our infrastructure, systems and services.

---

[21] http://www.transport.gov.scot/report/strategic-road-safety-plan-2016-9049

6   Monitoring, controlling and informing Scotland's trunk roads

Transport Scotland uses ITS for the benefit of the use and operation of the trunk road network that we manage and maintain on behalf of the Scottish Ministers. Day to day monitoring, controlling and informing users is carried out by the Traffic Scotland Service. The National Traffic Data Service collates all the data and operational records we collect so that we can make informed planning decisions and review actions taken as part of our continual improvement processes.
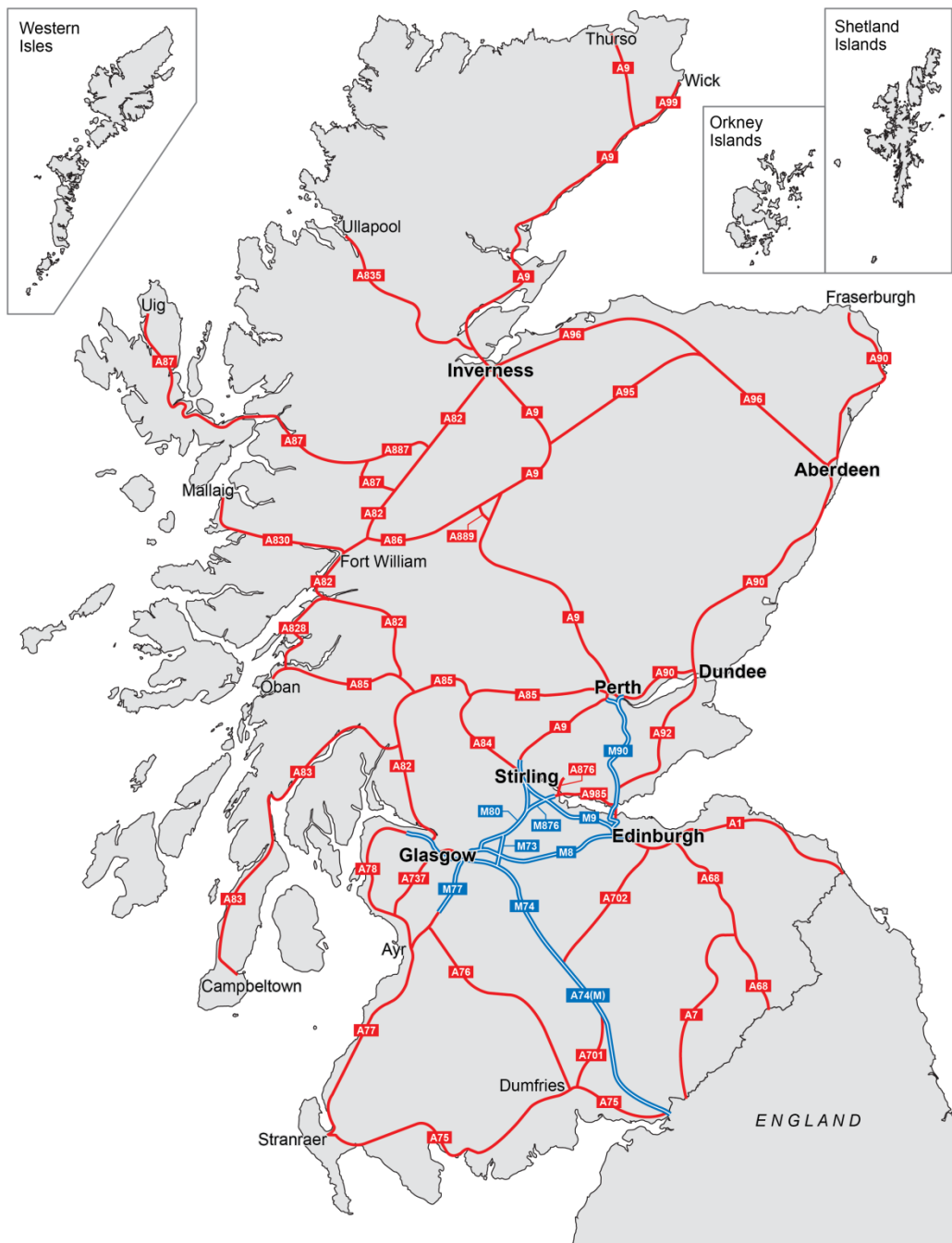
Figure 6.1: Scottish Trunk Road and Motorway Network

6.1 ITS currently provided and managed by Transport Scotland

The following Infographic illustrates the thousands of pieces of equipment ranging from small detector loops to large VMS Transport Scotland has installed on the trunk road network. This is all connected back to the Traffic Scotland National Control Centre (TSNCC) at South Queensferry.
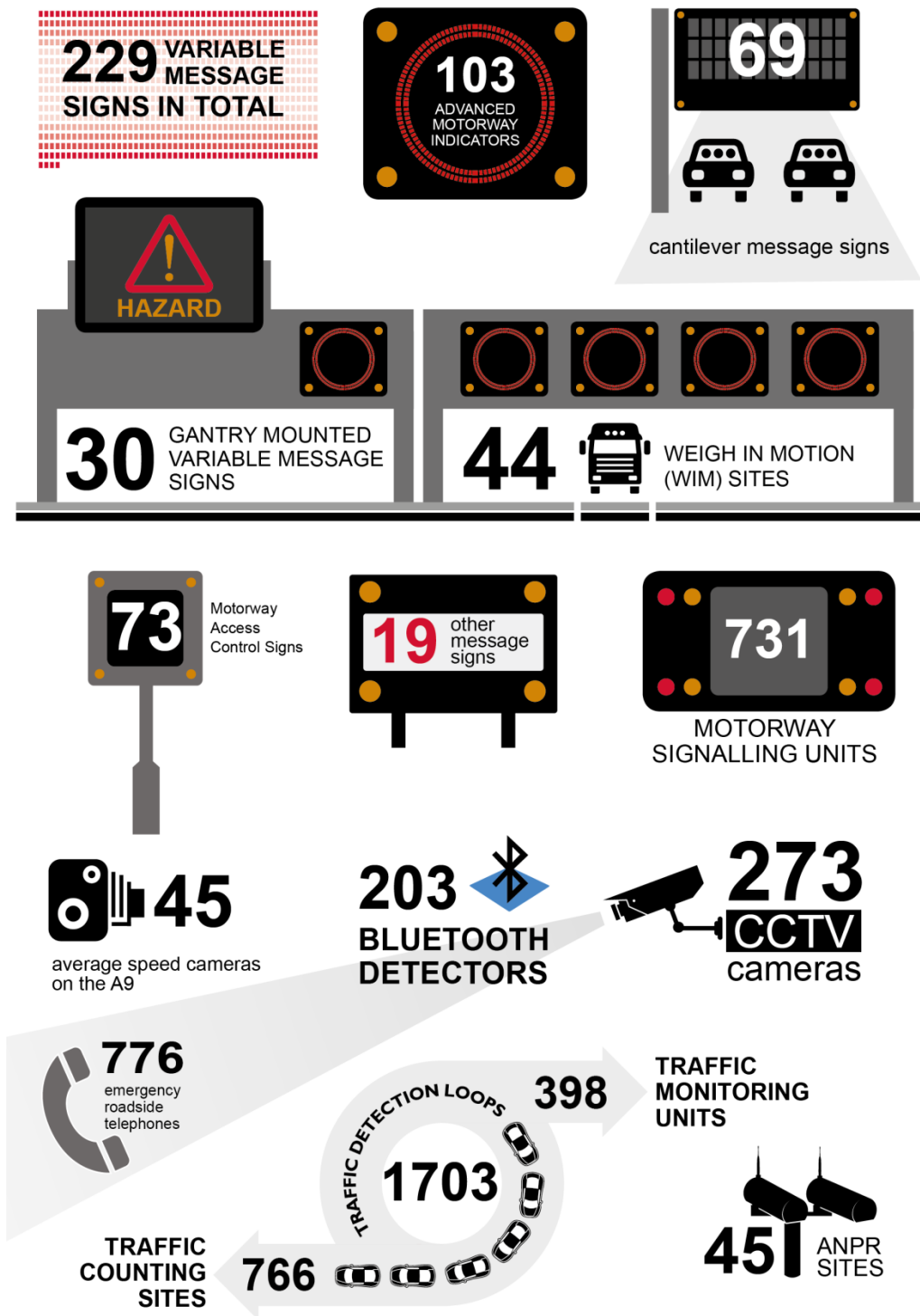

229 VARIABLE MESSAGE SIGNS IN TOTAL

103 ADVANCED MOTORWAY INDICATORS

69 cantilever message signs

HAZARD

30 GANTRY MOUNTED VARIABLE MESSAGE SIGNS

44 WEIGH IN MOTION (WIM) SITES

73 Motorway Access Control Signs

19 other message signs

731 MOTORWAY SIGNALLING UNITS

45 average speed cameras on the A9

203 BLUETOOTH DETECTORS

273 CCTV cameras

776 emergency roadside telephones

TRAFFIC DETECTION LOOPS **398** TRAFFIC MONITORING UNITS

1703

TRAFFIC COUNTING SITES **766**

45 ANPR SITES

Figure 6.2: Infographic of Transport Scotland ITS Assets (July 2017)

6.2   The Traffic Scotland National Control centre

The Traffic Scotland National Control Centre (TSNCC) provides a state-of-the-art facility for the co-ordination of a fully joined-up response during major travel incidents and severe weather as well as monitoring the daily operation of Scotland's trunk roads and motorways and co-ordinating the response to incidents as they occur. The TSNCC houses the Traffic Scotland Operator, the Traffic Scotland Systems Contractor, Police Scotland and the Met Office who work together in partnership to keep road users well informed and traffic moving.

Photo 6.3: The Traffic Scotland National Control Centre

Transport Scotland Resilience Room

The Transport Scotland Resilience Room (TSRR) is located within the TSNCC. During periods of significant disruption the TSRR is staffed by Transport Scotland personnel from across mode areas as appropriate, i.e. roads, bridges, rail, maritime, ferries, aviation. Its purpose is to provide up to date and accurate information and updates to Ministers, the SGoRD (Scottish Government Resilience Division) and other key stakeholders.

Trunk Road incident Support Service (TRISS)

The Trunk Road Incident Support Service (TRISS) supports the work of the Traffic Scotland Service. The service is highly visible to the travelling public and provides a valued contribution to the efficient operation of the trunk road network by making sure the network is cleared of incidents as quickly as possible whilst protecting customers.

6.3   The Traffic Scotland Service

24 hours a day, 365 days a year the award winning Traffic Scotland Service is the public face of Transport Scotland's ITS operations. It is a trusted and respected traveller information service and supports the safe and efficient operation of Scotland's motorway and trunk road network and is an essential part of our transport resilience responses.

The technology supporting the delivery of the Traffic Scotland Service comprises of a range of Intelligent Transport Systems (ITS) collecting information about the current state of the road network, processing that information and either directly managing the road network or providing information which allows road users to decide how best to use the road network.

The Traffic Scotland Service communicates with the public in a number of ways:

- By displaying messages on Variable Message Signs (VMS). These relay to drivers advance warning of issues affecting the road network including roadworks, accidents, events, bad weather and road closures

- On some sections of motorway, with overhead lane control signals, which also improve road safety and journey time reliability by informing drivers about lane closures and speed restrictions

- Using other technology platforms including the popular Traffic Scotland website, on mobile applications, social media and the internet based Traffic Scotland Radio station.

- The Traffic Scotland Operator is responsible for answering Emergency Roadside Telephones and assisting travellers who have broken down. They also work in partnership with our Operating Companies to ensure resources such as our Trunk Road Incident Support Service vehicles are deployed quickly to any identified problems

The Traffic Scotland service has an established responsibility to **monitor**, **control** and **inform** the network, and carry out planning for, and post review of, major incidents or events.

Traffic Scotland responsibilities

Monitor: The Traffic Scotland service monitors the network using CCTV, roadside hardware, communication with Police Scotland, Transport Scotland Operating Companies, the Trunk Road Incident Support Service (TRISS), weather forecasts and major event management services.

Control: All data collected is processed within the TSNCC. This operates 24 hours a day to ensure that traffic and travel information disseminated as part of the Traffic Scotland service is accurate.

Inform: Traffic and travel information processed by the TSNCC is disseminated via the Traffic Scotland service. This includes the Traffic Scotland website; associated web based travel information services (including mobile device apps, social media tools); Traffic Scotland Information Kiosks; the Traffic Scotland Customer Care Line; road side VMS, radio broadcasts and via multiple Traffic Scotland data services available to public, corporate and media users.

Plan: The Traffic Scotland service, along with Transport Scotland, and the MART plans for major disruptions and significant events on the network. Contingency plans, along with the dissemination of pre- and in-event information are a significant role of the service, encompassing all the Traffic Scotland systems.

Review: The Traffic Scotland service, along with Transport Scotland, reviews the impact of major disruptions and significant events on the network, in order to identify lessons learnt and areas of future system and operational development. The evidence provided by Traffic Scotland systems are a critical component of this review process.

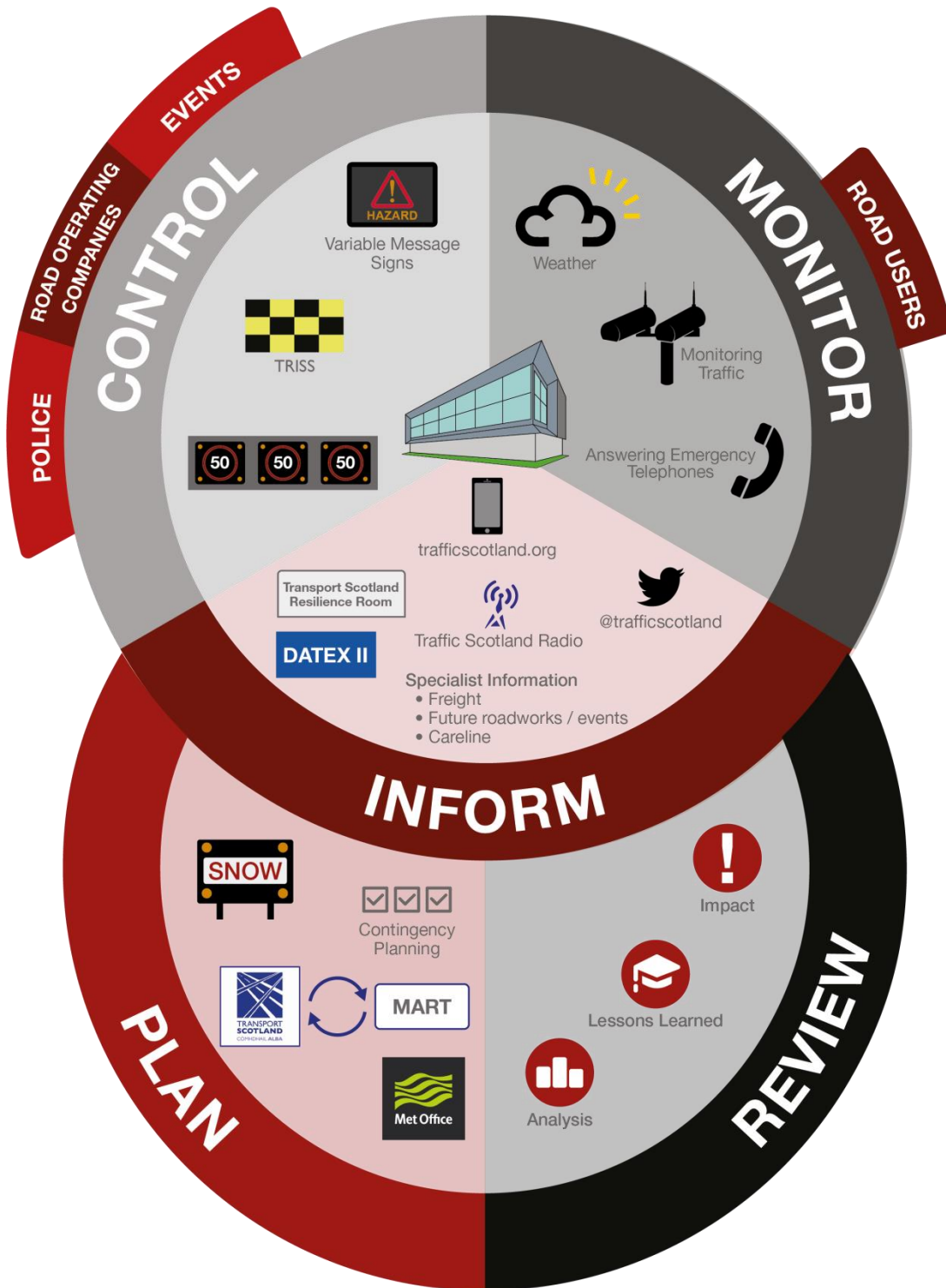**Photo 6.4: Traffic Scotland National Control Centre – Control Room**

Figure 6.5: Traffic Scotland Operations

6.4   The Multi Agency Response Team

The TSNCC also hosts the Multi Agency Response Team (MART) arrangements which enable a strategic overview of event and incident handling. This is a partnership between Transport Scotland, Police Scotland and the Met Office and can also include trunk road operating companies, Network Rail, ScotRail and others as required.

The MART can be called into operation whenever an event has the potential to cause severe network disruption. This allows us to:

- Ensure clear and efficient communication across various sectors including the Police, Trunk Road Operating Companies, ScotRail and Transport Scotland

- Reinstate the strategic transport Network to full capacity as quickly, and as safely, as possible

- Immediately share the latest traffic and travel information via the Traffic Scotland web site, web based data feeds, Traffic Scotland internet radio service and via radio travel bulletins. This is due to the tight operational liaison and the close proximity between the MART, the Traffic Scotland Operators, and the media team

6.5   National Traffic Data Service

The National Traffic Data System (NTDS) securely stores all of Transport Scotland's traffic count data and provides analytical tools for its users.

NTDS is Transport Scotland's single source for traffic count data collected across the Scottish Trunk Road Network. The system came into operation in 2013 and has been developed with both scalability and extendibility as its core. Designed predominantly to collect, process, store and report on traffic data the system is also expected to handle a variety of other data sources in the future from air quality data, traffic survey data and other related datasets.

NTDS is seen as a key system within Transport Scotland as the drive continues to integrate datasets across the organisation. This system provides clear benefits in terms of data analysis across datasets, cost savings in storage and processing and potential for further expansion.

7   Our six strategic themes

This Future ITS Strategy will be live and evolving. Its purpose is to signpost the way to the appropriate deployment of ITS that will benefit users who plan to use, travel on, and live near the trunk roads of Scotland; contribute to national economic wellbeing and; meet the relevant policy objectives set out by the Scottish Government. The development of action plans to do this should be the outcomes of the strategy.

Transport Scotland is the prime mover in the deployment of ITS. We have a duty to provide value for the public purse and make best use of the available funds and resources. We will aim to take advantage of new or improved technology.

The key objective for the publication of the strategy is so that we can progress with a common view across the wider ITS, Transport and Digital communities of what we are aiming to achieve.

Six Strategic Themes

Our strategy is aligned around the six themes as shown in the diagram on the following page. Within each of the themes there are specific challenges to address. On the following pages for each theme we have set goals to meet those challenges and listed the issues that should be considered when developing action plans to deliver the goals.

The themes are inter-related and aspects of each theme will not be realised without activity from another theme. For example management strategies to reduce emissions from freight vehicles could quite easily encompass all six themes. The intention of separating activities under theme headings is to concentrate expertise where it is most suited and appropriate.

Each theme description has four parts:

- A framing of the issues the theme looks to address

- An outlook for the theme

- Expected benefits for activities under the theme

- A table setting out the individual Challenges, their Goals and the Considerations required to realise the strategic aims.
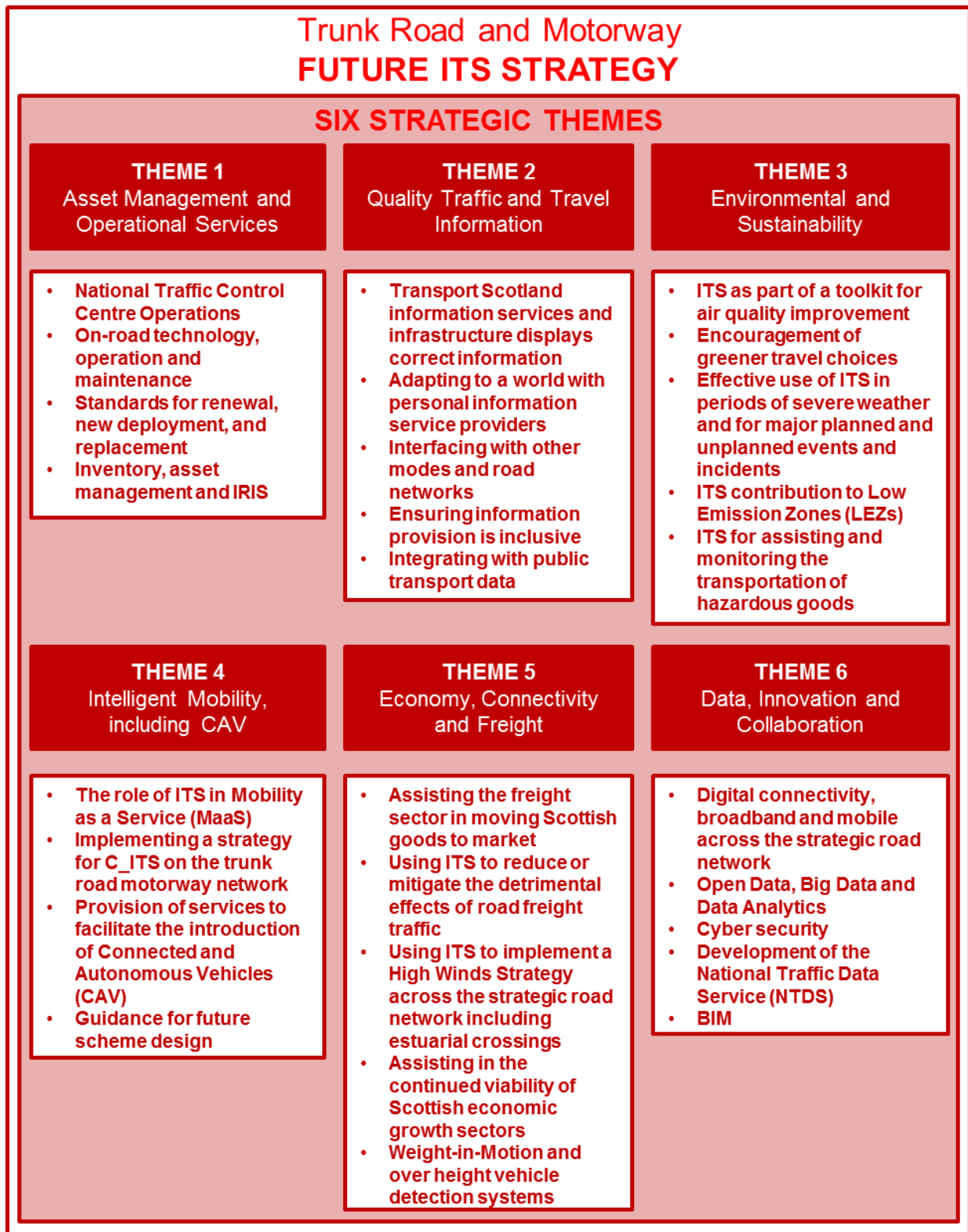
Trunk Road and Motorway
FUTURE ITS STRATEGY

SIX STRATEGIC THEMES

THEME 1 Asset Management and Operational Services	THEME 2 Quality Traffic and Travel Information	THEME 3 Environmental and Sustainability
• **National Traffic Control Centre Operations** • **On-road technology, operation and maintenance** • **Standards for renewal, new deployment, and replacement** • **Inventory, asset management and IRIS**	• **Transport Scotland information services and infrastructure displays correct information** • **Adapting to a world with personal information service providers** • **Interfacing with other modes and road networks** • **Ensuring information provision is inclusive** • **Integrating with public transport data**	• **ITS as part of a toolkit for air quality improvement** • **Encouragement of greener travel choices** • **Effective use of ITS in periods of severe weather and for major planned and unplanned events and incidents** • **ITS contribution to Low Emission Zones (LEZs)** • **ITS for assisting and monitoring the transportation of hazardous goods**
THEME 4 Intelligent Mobility, including CAV	THEME 5 Economy, Connectivity and Freight	THEME 6 Data, Innovation and Collaboration
• **The role of ITS in Mobility as a Service (MaaS)** • **Implementing a strategy for C_ITS on the trunk road motorway network** • **Provision of services to facilitate the introduction of Connected and Autonomous Vehicles (CAV)** • **Guidance for future scheme design**	• **Assisting the freight sector in moving Scottish goods to market** • **Using ITS to reduce or mitigate the detrimental effects of road freight traffic** • **Using ITS to implement a High Winds Strategy across the strategic road network including estuarial crossings** • **Assisting in the continued viability of Scottish economic growth sectors** • **Weight-in-Motion and over height vehicle detection systems**	• **Digital connectivity, broadband and mobile across the strategic road network** • **Open Data, Big Data and Data Analytics** • **Cyber security** • **Development of the National Traffic Data Service (NTDS)** • **BIM**

Figure 7.1: Strategic Themes and Specific Challenges

Horizon scanning

Within each of the themes we will keep and periodically update a technology prediction map for that theme. Each will be used to relate business objectives, with key decision points and development or activities that will enable something to be implemented. They will be used to give foresight of approaching maturity or adoption of technology, standards and directives. In this way we will keep abreast of wider innovation and implementation of technology in the ITS domain.

7.1   Theme 1 – Asset Management and Operational Services

Issues

How does Transport Scotland best exploit and manage its existing ITS assets, on-road and in the Traffic Scotland National Control Centre (TSNCC)? What is the best approach to take for planning the renewals, replacement, or possibly removal of ITS infrastructure on its network? What are the steps that could increase the levels of systems resilience and cyber security of the Traffic Scotland services and the potential integration of these services, information and data with the services of other users and stakeholders? How does Transport Scotland best measure the benefits realised from the above on the performance of the network?

Outlook

Many years of investment has seen Transport Scotland build up a considerable set of ITS tools and assets to help it monitor, control and inform traffic on the trunk road network. For instance we have a state of the art national control centre, and have installed new traffic detection systems, VMS and signals as part of the Queensferry Crossing scheme and on the M8 M73 M74 Improvements Project.

In the short to medium term our investment priority for new deployment is likely to focus on parts of the Glasgow motorway network where existing technology is approaching the end of its serviceable life. The A9 and A96 Dualling programmes, until 2030, present opportunities to install ITS infrastructure on important routes in more rural areas. With improvements in mobile and broadband communications and renewable power options in theory it will mean that almost anywhere on the trunk road network can be monitored. As connected vehicles become more common it will be possible to transmit advice directly to drivers as well as or instead of VMS. This 'anything anywhere' ability is likely to facilitate ITS for roadworks conditions and remote locations.

There is also the potential for traffic control to be used as part of emissions management initiatives. Increasingly organisations other than Transport Scotland will be collecting traffic flow data and through their own services communicating travel information and advice directly with drivers.

Infrastructure and Assets

Transport Scotland's existing portfolio of ITS is the result of many years of incremental deployment and enhancement. As technology performance, standards and specifications have improved so has the infrastructure. For example motorway signalling units are being superseded on Smart Motorway schemes with Advanced Motorway Indicators that can be enforced. MS4 VMS can now show a mix of symbols and text. CCTV and other detection systems have grown in number and complexity. A key part of our strategy is to continue to make the most out of this infrastructure.

It is reasonable to assume that in 20 to 25 years' time all of today's ITS assets will have been replaced, some like-for-like, some with upgrades and enhancements, others with something different such as roadside units to communicate directly with vehicles. Whilst making these changes we will look to adapt the existing supporting infrastructure wherever possible and not lose quality of service to road users.

<u>Road Safety</u>

Transport Scotland's ITS is a major contributor to keeping Scotland's trunk roads safe, for users and for the workers that carry out maintenance and installation works.

We will continue to put safety at the heart of our approach to using ITS through the use of proven technology and operational approaches. We will also look for opportunities to use innovative technology on a temporary basis to support safety objectives during scheme construction and maintenance operations.

<u>Delivering operational improvement</u>

The physical ITS assets we have at the roadside will be expected to have a working lifetime of 15 years on average. Control room core systems can be incrementally improved, but these also face re-investment due to more frequent obsolescence.

Therefore, in the coming years we will address issues of replacement and renewal of ITS assets in the following ways:

- We will produce guidance for when we are upgrading or renewing – answering questions such as are the standards used for existing infrastructure (e.g. gantry positions) suitable for today's solutions such as smart motorways?

- Whilst the benefits of innovation for smart motorways are tangible, we will also consider what provision (physically and operationally) we will make for the 'New ITS' of, for example, connected vehicles?

- Providing clarity on the standardisation of ITS we expect to be deployed

We will also review our Operational Services processes, procedures and functionality:

- Making sure that they are fit for purpose for today's road network and technology, and that we adapt them for new technology in the future such as cooperative ITS

- Looking to bring efficiencies to our operations e.g. speed of incident detection, control strategies for incidents and the subsequent recovery of the network

- Providing a common view of information that also supports other media channels

Expected impacts/benefits of Theme 1

- Supporting growth in Scotland's economy through improving the efficiency of trunk road network by managing congestion and incidents and so giving better journey time reliability

- Improved operational efficiencies through better resilience, additional functionality and operators having more information on which to base interventions

- Improved air quality by reducing emission concentration through informed actions to reduce congestion

- Effective deployment of ITS continuing to result in improvements in safety through and control and coordination with the emergency services.

- Supporting innovation in vehicle technology

Strategy Focus - Theme 1: Asset Management and Operational Services

Challenge	Goals	Considerations
National Traffic Control Centre Operations	Focussed on monitoring and controlling network in line with Scottish Government policy of integrated operation across all activities Providing prediction and analytical services To be a visible symbol of the active management and control of a national asset for the benefit of the economy of Scotland Accommodate the growth of data provided by connected and co-operative vehicle systems To have an action plan to deal with systems resilience, cyber security, obsolescence and the avoidance of legacy system issues Provide cross-system integrated reporting and analysis Establish how best to measure performance of network and systems	Continue core responsibility to use on-road infrastructure to deliver accurate and timely information and control How traffic control may be used to improve air quality Look at value in potential use of external media partner for support of websites, twitter, apps etc. Review to avoid any obsolescence within 'traditional ITS' assets Planning for deployment of Smart Motorway technologies across network (as appropriate) How to realise operational efficiencies How to increase the ability to deploy temporary ITS at roadworks Monitor development, implementation and operation of other control centre approaches, for instance CHARM in England and The Netherlands. Assess if this is a future approach for Scotland Avoiding limitations on future capability – for example what interface/consolidation might be needed with other stakeholders (e.g. Local Authorities, Police Scotland) How to ensure the desired level of operational resilience is maintained
On-road technology operation and maintenance	Fit for purpose with very high ARM (Availability, Reliability, Maintainability) characteristics	Programme required for the adoption of BIM (Building Information Management) for the technology asset estate (UK Government requirement)

Challenge	Goals	Considerations
	Creation of on-going asset life prediction on basis of maintenance cost, life expectance (technical, physical), obsolescence, compatibility Use of preventative maintenance strategies to lower whole life cost of assets	Scrutiny of proposals for replacement for life expired infrastructure (e.g. CCTV masts) by maintenance operating companies Implementation of remote monitoring and diagnostics via IP Move to lower power / greener options where possible Flexible, pragmatic and agile procurement How to ensure that existing systems and roadside equipment remain protected against cyber threats.
Standards for renewal, new deployment, and replacement	To provide guidance so that the right infrastructure is deployed on Transport Scotland's road network to cater for the expected growth in in-vehicle information To facilitate telecommunications and power provision for technology that will directly or indirectly aid network management responsibilities	There will be increasing number and eventual ubiquity of connected (V2I – Vehicle to Infrastructure) and co-operative (V2V – Vehicle to Vehicle) vehicles over the next 20 years New developments in detection, display and outstation technology are taking place all the time. New deployment needs to be sustainable and compatible with existing systems Business cases for infrastructure may be difficult to isolate within schemes or where critical mass of new technology is not yet available How to ensure that new and replacement roadside equipment and associated systems provide the desired level of resilience and cyber security.
Inventory and IRIS	Ensure all ITS infrastructure and equipment is recorded in an inventory and stored in IRIS	Liaison required between the Traffic Scotland Operator(s), transport Scotland and Operating Companies to ensure accurate recording and storing of inventory in IRIS.

7.2   Theme 2 – Quality traffic and travel information

Issues

Transport Scotland has a responsibility to provide accurate, relevant and timely trunk road information to its customers through its Traffic Scotland information services. Many may also receive this information through a third party; this is likely to increase as in-car systems become more common. What is Transport Scotland's future role and where should its investment priorities regarding information be focussed? How, where and what provision is needed including the use of historic information and prediction? How should this be managed to safeguard consistency and quality across information services?

Outlook

The growth of services from the likes of Google, Apple, TomTom, Here, Inrix, Waze and others illustrates the immense appetite for traffic and travel information. These service providers use highly accurate and regularly updated digital cartography coupled with information sourced from their user base and from publicly available data sets. This includes the DATEX II feed from Traffic Scotland.

The business case for these third party services is made because of the depth of coverage. These are not constrained to the motorway and trunk road network, but tend to consider all roads everywhere and other modes as a matter of course. This means they have (and will continue to develop) visualisation tools and targeting algorithms to analyse and personalise information in ways that have never existed before such as pushing data to users based on calendar events and regular journeys

As the ITS Information Usage graphic below illustrates there are many sources of data and multiple channels of dissemination. There is a core need to inform of current conditions, and an aspiration to provide short term prediction and long term modelling of traffic. The ability to control and manage this information for the trunk road network is a key responsibility of the Traffic Scotland service.

As Transport Scotland's role develops in the coming years and as the ITS Strategy rolls out, we will concentrate on improving and making the information we disseminate as current and correct as possible. Any future expansion of our role may also include an interest in non-trunk roads and areas including better real time and journey planning information for public transport users. Whilst understanding that there are a range of services currently provided by industry, our objective will be to work together with these services to complement and enhance Traffic Scotland's services.

Our goals of safety and efficiency are helped by road users planning ahead. We want accurate and timely traffic information on all platforms and so we share our data so that people can access journey planning information from whichever source they prefer.
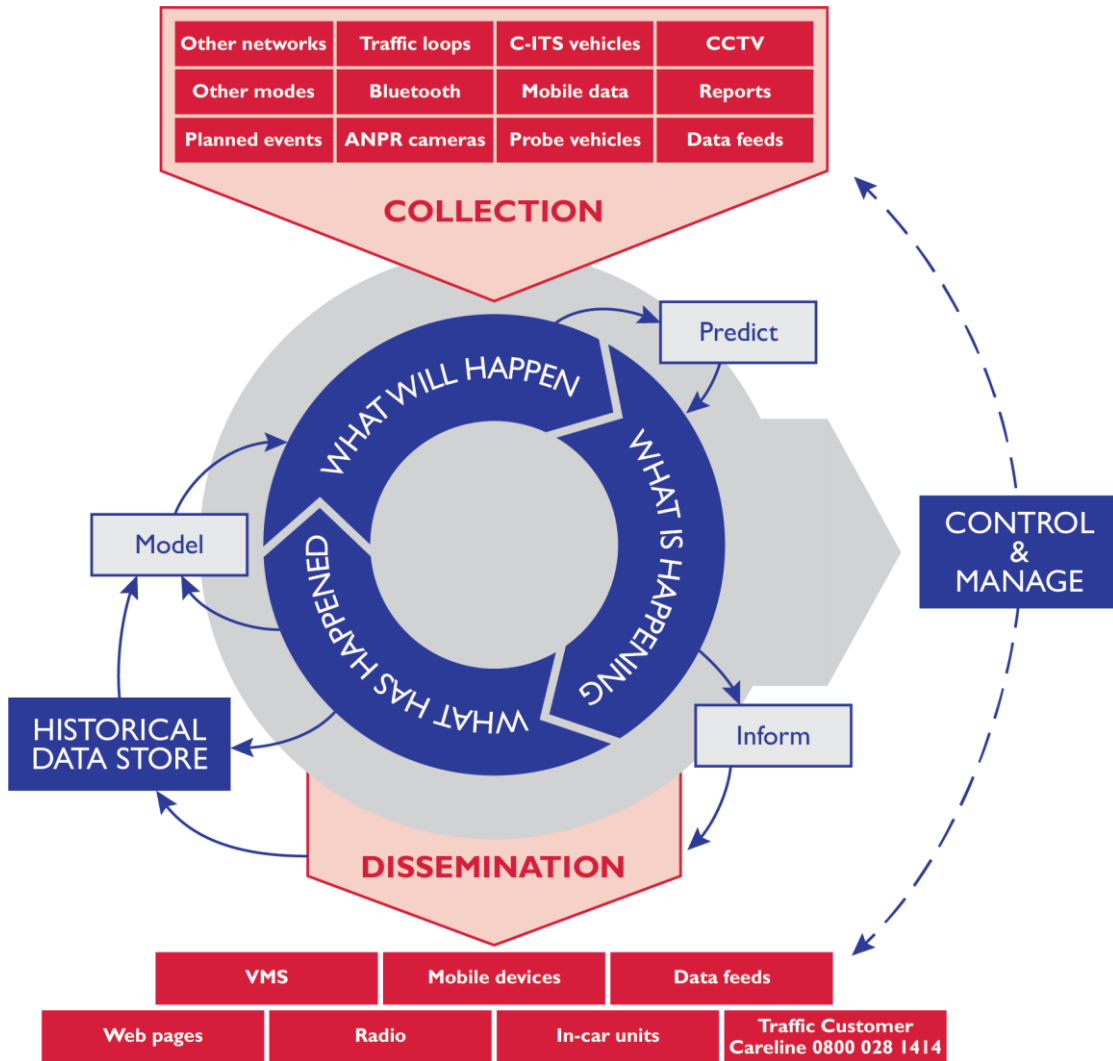
COLLECTION

Other networks	Traffic loops	C-ITS vehicles	CCTV
Other modes	Bluetooth	Mobile data	Reports
Planned events	ANPR cameras	Probe vehicles	Data feeds

WHAT WILL HAPPEN — WHAT IS HAPPENING — WHAT HAS HAPPENED

Predict

Model

Inform

CONTROL & MANAGE

HISTORICAL DATA STORE

DISSEMINATION

| VMS | Mobile devices | Data feeds |
| Web pages | Radio | In-car units | Traffic Customer Careline 0800 028 1414 |

Figure 7.2: ITS Information Usage

<u>Transport Scotland website, mobile web offering, social media, apps and Care Line</u>

We expect that many people will continue to choose to use Traffic Scotland for travel information services. We are committed to providing information through web and mobile platforms. We will continue to keep our information architecture under review and refresh our website and apps to keep up with best practice and conform to accessibility standards.

We also recognise that not all users have access to the latest technology and will maintain legacy web services where there is demand. We will also maintain the telephone based Traffic Scotland Customer Care Line.

Continual improvement and review

Transport Scotland will review its information architecture and if required modify it for current and future use. Early investment and programme planning will provide cost savings long term. Our website will be optimised for both desktop and mobile users making information easier to retrieve and understand and developed to comply with relevant web and accessibility standards.

For those who re-use our information (e.g. our DATEX II feeds and CCTV images) we will seek to make the interface as straightforward as possible whilst maintaining security. We will encourage those using our information within their own services to develop innovative solutions which are available across all platforms.

Expected impacts/benefits of Theme 2

- Bring in benefits of scale from association with third party information provider(s).

- Reduce spend on infrastructure and maintenance by avoiding duplication of detection technologies.

- Enabling better informed infrastructure, scenario and travel planning for Transport Scotland and its customers.

Strategy Focus - Theme 2: Quality traffic and travel information

Challenge	Goals	Considerations
Transport Scotland information services and infrastructure displays correct information	Reputation of VMS and indicator units (speed, lane etc.) kept high Transport Scotland being recognised as a source of truth If Transport Scotland deploys roadside C-ITS units to deliver information that is delivered locally and directly to vehicles, then that information is appropriate. Correct information is available and easy to find on Transport Scotland web and mobile services	Transport Scotland control and information systems needs to be fit for purpose, future capacity and capability requirement to be kept under review to ensure timely, planned refresh Type, size, design standards and guidance for location of VMS and C-ITS roadside units (RSUs) Usage guidance - what messages to display and when Timely planning to keep up with web technology
Adapting to a world with personal information service providers	Transport Scotland information and advice is trusted as part of the service providers information set Transport Scotland information is compliant to information and accessibility standards Transport Scotland is able to use information from service providers Transport Scotland information is credible for use by MaaS providers	Transport Scotland DATEX II feed needs to be comprehensive Delivery of best value, widest reach solution for off-road (e.g. web, twitter, radio) Transport Scotland information service - could this be done with branded services from one or more preferred service providers? Increased need for accurate advance information and for estimated time to clearance of disruptions Examination of potential models (and demand) for Transport Scotland to support interfacing with third party services for all Scottish traffic and travel information provided by public authorities and agencies.

Challenge	Goals	Considerations
Interfacing with other modes and road networks	Reduce consequences to business and the Scottish economy of delays, incidents, interruptions to ferry services by disseminating information that considers onward journey of traffic leaving the Transport Scotland trunk road network Pro-actively encourage seamless traffic and travel information experience for consumers from services for which Transport Scotland provides content	Information does not have borders, consideration needed on the level, reasoning, priority for non-trunk road information being disseminated by Transport Scotland directly Local authorities and ferry connections information needs to meet accuracy and timeliness standards
Integrating with Public Transport data	Travellers will have full awareness of alternatives to making all or some of their journey by public transport rather than their own vehicle.	Traveline Scotland to continue to be integral to the public facing travel information services provided by Transport Scotland If MaaS is to thrive in Scotland, dynamic, comprehensive and accurate information will need to be available.

7.3   Theme 3 – Environment and Sustainability

Issues

ITS tools can be used to improve air quality, lower noise levels, and reduce the adverse effects of heavy traffic. How can we combine the deployment of this technology with the promotion of greener travel choices, take up of electric, hybrid and fuel cell vehicles, and easing of the barriers to using public transport options? How can we use ITS effectively as part of short term management strategies where the environment temporarily impacts or could impact the life of Scotland's people?

Outlook

The Scottish Government has worked to make Scotland a world leader on climate change and has a record of which it is proud. In 2017 it set a target of further reducing actual Scottish emissions by at least 66% by 2032. In the Cleaner Air for Scotland[22] strategy, published in November 2015, a range of transport interventions including the use of ITS have been proposed. Detection of air quality and its modelling are continually improving and the potential is there to make traffic management decisions on the basis of expected pollution levels. Research in a number of countries is being undertaken to examine the feasibility of extending smart motorway type control to reduce or relocate emissions.

Addressing the make-up of the vehicle fleet, Switched on Scotland[23] is a roadmap to the widespread adoption of plug-in vehicles in Scotland extending to 2050. It was published in 2013 with a review of progress published in November 2016[24]. The E-Cosse partnership is a public private partnership to advance electric vehicle adoption in Scotland.

Transport Scotland has implemented bus-lanes within Scotland's first smart motorway schemes on the M90 and M9 as part of the Queensferry Crossing project to promote and encourage the use of public transport.

The increasing implementation of Cooperative and Autonomous technologies will see potential for smoother, safer traffic flow with less speed fluctuation and lower fuel consumption.

The Multi Agency Response Team (MART)

Based at the TSNCC, MART enables a strategic overview of event and incident handling on behalf of all the organisations involved. It can be activated to deal with events where there is high risk of severe disruption to journeys with potential safety

---

[22] http://www.gov.scot/Resource/0048/00488493.pdf
[23] https://www.transport.gov.scot/media/30506/j272736.pdf
[24] https://www.transport.gov.scot/media/20291/j457836.pdf

risks for the travelling public or significant potential impact for large parts of the strategic transport network such as severe weather or the consequences.

We will continue to improve the prediction, information and monitoring technology available to MART.

Energy consumption reduction

Transport Scotland is working towards reducing lighting energy consumption by the introduction of LED lighting on trunk roads. Lighting accounts for around 86 percent of the energy consumption associated with roadside electrical apparatus. This equates to approximately 31GWh per annum.

We also continue to investigate the potential for intelligent lighting systems where street-lighting can be switched off during periods when low traffic flows are detected, e.g. the early hours of the morning.

Transport Scotland will continue to regularly review the range of options to manage the energy consumption from its roadside electrical assets - including lighting on trunk roads. Solar and wind powered options will be considered wherever possible.

Vehicle engine types

Across the UK changes to the traditional vehicle fleet have already commenced. There are increasing taxes for the more polluting vehicles and subsidies for hybrid and zero emission vehicles. It is expected that this will continue and there is potential for further moves towards changes in the consumption model for private vehicles, with increased use of car share clubs and other forms of shared use and ownership.

Transport Scotland will continue to monitor and encourage the move towards more sustainable transport.

Expected impacts/benefits of Theme 3

- Improved Air Quality.

- Improvements in decision making tools and visualisations to result in targeted long and short term interventions.

- Evidence based decision tools and applications that encourage the take up of more environmentally friendly travel options.

Strategy Focus - Theme 3: Environment and Sustainability

Challenge	Goals	Considerations
ITS as a part of a toolkit for air quality improvement	Use control and information signs and signals to smooth traffic and/or advertise alternative routes Use intelligent traffic system management to make the most efficient use of the existing transport assets Share communications and power infrastructure with Air Quality monitoring technology Support work associated with the viability of LEZs	Adaption of control systems to accommodate emission reduction strategies Target electric vehicles and re-charging points and C-ITS users for premium advice and data gathering Grow sensor network and modelling capabilities so that they become part of the traffic management and control decision process Use of ITS as part of LEZ and CAZ strategies.
Encouragement of greener travel choices	Assisting the Switched on Scotland initiative in the adoption of plug-in vehicles so that there is comprehensive information and advice provision that minimises range anxiety when travelling the trunk road network Adapt, where appropriate, to the changing requirements of the National Low Emission Framework	Electric and hybrid vehicles are more likely to be connected vehicles Look to prioritise creation V2I (vehicle to infrastructure) communications in the vicinity of charge points Consideration of Traffic Scotland's role in the provision of multi-modal travel information.

Challenge	Goals	Considerations
Effective use of ITS in periods of severe weather and for major planned and unplanned events and incidents	Provision of timely warnings and advice that result in potentially unsafe journeys being avoided Coordinated response with blue light services, Transport Scotland agents and local authorities to incidents Implement capability for dynamic road lighting	Build upon existing arrangements created around MART Cross refer with High Winds Management sub-theme in Theme 5 Freight.
ITS contribution to Low Emission Zones (LEZs)	Work collaboratively to provide ITS support to Low Emission Zones	Consider how best to use ITS infrastructure for messaging and monitoring compliance.
ITS for assisting and monitoring the transportation of hazardous goods	Coordinated response with blue light services, Transport Scotland agents and local authorities to incidents Meeting ISO 17687:2007 to support the application of automated identification, monitoring and exchange of emergency response information regarding dangerous goods carried on board road transport vehicles.	Build upon existing arrangements

7.4 Theme 4 – Intelligent Mobility, including Connected and Autonomous Vehicles

Issues

What facilitation is needed by Transport Scotland to encourage adoption and the growth of Intelligent Mobility services that will benefit businesses, residents and visitors to Scotland? What data will need to be collected, stored and transmitted, what role(s) should Transport Scotland undertake and where should risk lie (service providers, motor manufacturers, Transport Scotland)? The technology to support connected and autonomous vehicles will become common place in the next 20 years. How is this new technology going to be seen and used? What infrastructure and guidance should Transport Scotland provide, and what should we expect from vehicle manufacturers and equipment suppliers to provide what are known as "Day 1" C-ITS services?

Outlook

The Transport Systems Catapult defines Intelligent Mobility as "*Encompassing everything from autonomous vehicles to seamless journey systems and multi-modal modelling software, Intelligent Mobility uses emerging technologies to enable the smarter, greener and more efficient movement of people and goods around the world.*"[25]
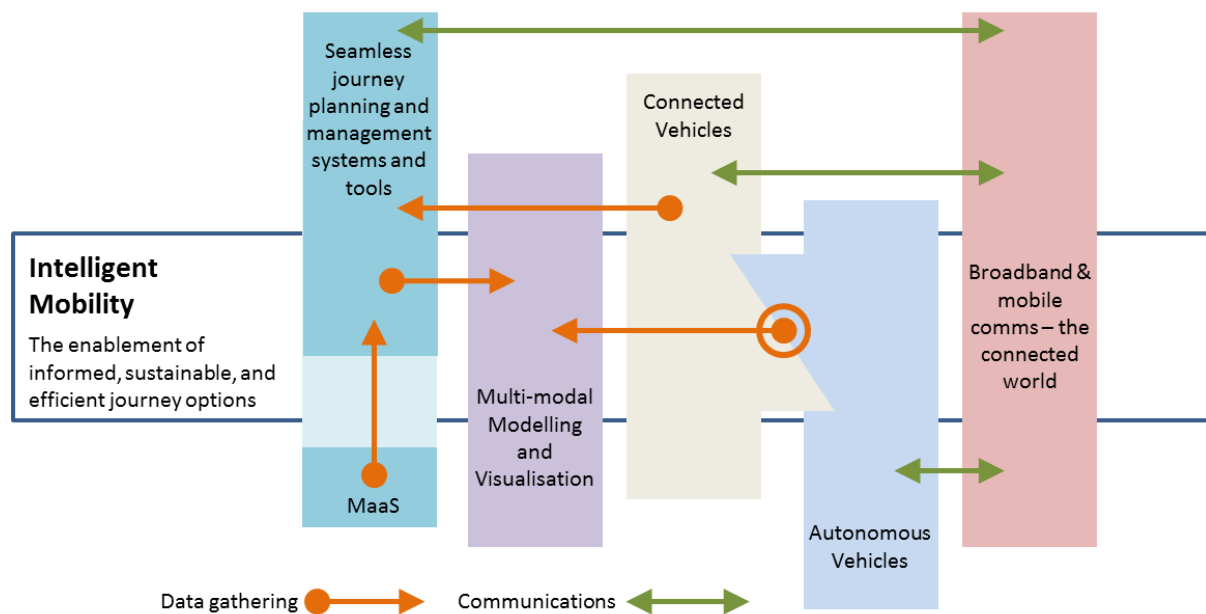
Figure 7.3: Intelligent Mobility

---

[25] https://ts.catapult.org.uk/intelligent-mobility/introduction/

Intelligent Mobility represents a goal of bringing together various building blocks of data records, information services and real-time or near real-time analysis. The desire is that customers of transport infrastructure, be it road, rail, water or airborne, can have secure access to accumulated knowledge and wisdom of the infrastructure owners and operators and receive advice to help them make informed and hopefully sustainable decisions before and during their journeys. This may be automated or via personal intervention or query, one solution will not meet all needs. The broad focus for Intelligent Mobility includes:

- Tackling the challenge of planning, creating and maintaining the currency of the interoperable information technology and asset management systems and solutions which will provide the core intelligence to underpin intelligent customer facing services
- Compatible and consistent approaches to supporting the use of infrastructure by connected and autonomous vehicles (CAVs)
- Enabling support for the realisation of innovative consumer facing concepts that can loosely be bracketed under the heading Mobility as a Service (MaaS)

Cooperative Intelligent Transport Systems (C-ITS) are a set of innovative technologies that may one day mean autonomous (self-driving) vehicles are possible on the road network. However, intelligent in-vehicle technology is already being introduced by manufacturers. This is going to lead to profound change for the transport sector, with road infrastructure operators having to adapt to new, 'disruptive' business models centred on vehicle and information services.

This move towards increased levels of automation in vehicles will be gradual, but highway authorities need to plan for the impacts on the network and to allocate the necessary funding. In the shorter term, Intelligent Mobility, particularly through aspects such as MaaS (Mobility as a Service) and car sharing is likely to have a far greater impact on the expectations and requirements of customers and therefore the delivery plans of highway authorities, including Transport Scotland.

Current Situation: Mobility as a Service (MaaS)

MaaS is an emerging concept that aims to enable a shift away from personally owned modes of transportation towards mobility solutions that individuals consume as a service. The concept is that users buy transportation and other related services from public and private providers through a gateway, possibly an app that creates and manages the different elements of their trip. MaaS is not limited to individual mobility but has the potential to be applied to movement of goods, particularly in urban areas. MaaS aims to take advantage of innovative new mobility services such as ride-sharing and e-hailing services, bike-sharing programs, and car-sharing services as well as on-demand "pop-up" transport services.

While it is likely that entrepreneurial private sector operators will eventually enter the MaaS arena and develop the concept and determine its eventual shape, it is unclear

at present to what extent Government can or should be leaders or early adopters of MaaS.

There are potentially regulatory implications that Government will need to understand, and these should become clear during the initial period of the ITS Strategy.

Transport Scotland's current smart ticketing strategy aligns with the intent of MaaS by moving towards account based ticketing and travel. However where MaaS endeavours to cater for the whole journey end to end, the challenge will be to address separate provider offerings into a single user account for that full end to end journey experience.

Scotland has expertise and experience in the key areas of energy, ICT and transport systems and has a number of large companies and SMEs. It has a supportive Government infrastructure and is the right size to offer companies the ability to trial MaaS products at a suitable scale before going global.

MaaS Scotland (previously the Scottish MaaS Alliance) is the champion for MaaS in Scotland.

Current situation: Connected and Autonomous Vehicles

An important milestone in attempting to address C-ITS issues occurred when the EC published a European strategy for C-ITS[26] in November 2016 (see graphic below). It reflects that, as a result of field operation trials the EC and the automotive sector expect that by 2019 technologies will be sufficiently mature to mean wide-scale, inter-operable commercial deployment of C-ITS across the continent can begin.

The consensus behind the EC strategy means it provides the framework for Scotland to plan on how to accommodate the requirements of industry and the end users of the new services. Supporting infrastructure such as roadside units, software and communications from Transport Scotland are likely to be required to realise some of the expected benefits to safety (e.g. collision avoidance), traffic efficiency (e.g. truck platooning), and driving comfort (e.g. speed adaption to smooth journeys and avoid stop-start congestion).

The EU C-ITS Platform Report (2016) proposes that bundles of C-ITS services are deployed in chronological order to realise benefits sooner due to quicker expected take up than if deployed individually. Much of our trunk road network corresponds to sections of identified Trans-European Network - Transport (TEN-T) corridors and core roads. Deployment Scenarios A and B represent a potential approach for Transport Scotland to consider.

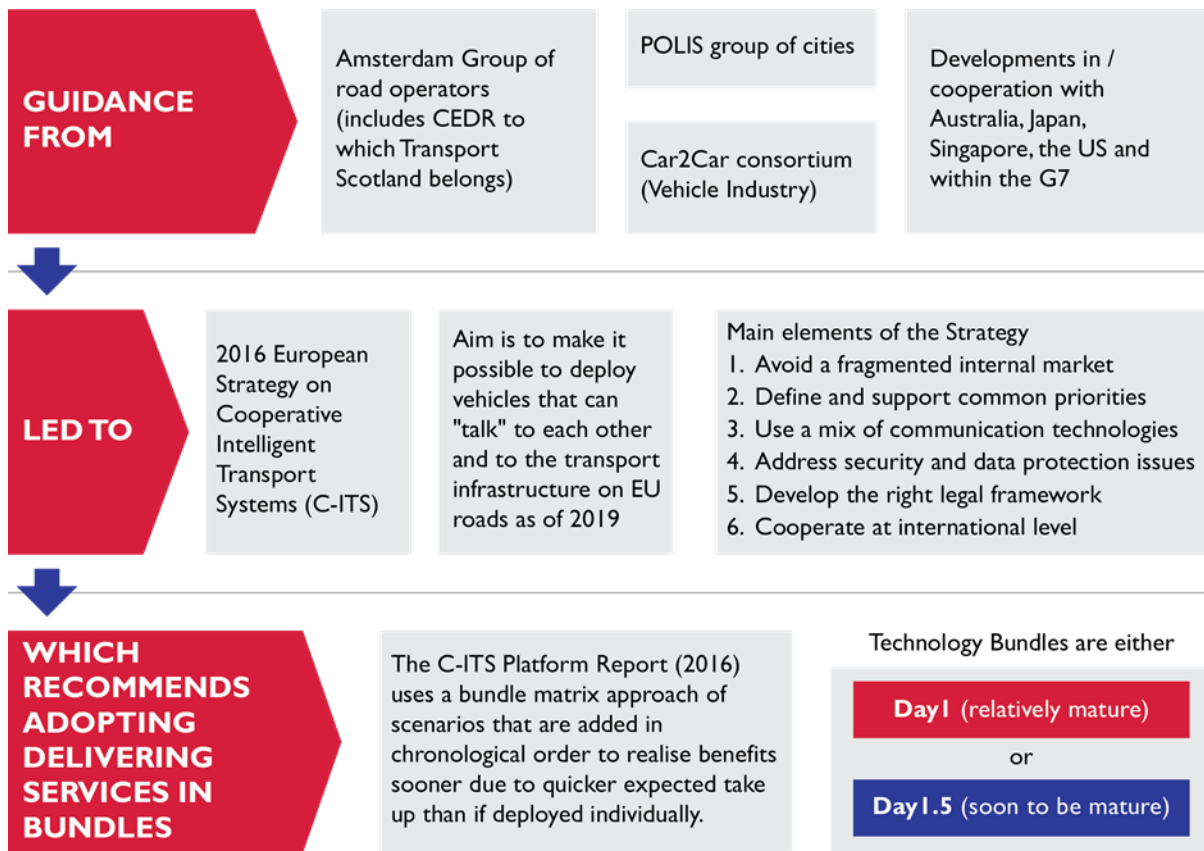[26] https://ec.europa.eu/transport/sites/transport/files/com20160766_en.pdf

GUIDANCE FROM

Amsterdam Group of road operators (includes CEDR to which Transport Scotland belongs)

POLIS group of cities

Car2Car consortium (Vehicle Industry)

Developments in / cooperation with Australia, Japan, Singapore, the US and within the G7

LED TO

2016 European Strategy on Cooperative Intelligent Transport Systems (C-ITS)

Aim is to make it possible to deploy vehicles that can "talk" to each other and to the transport infrastructure on EU roads as of 2019

Main elements of the Strategy
1. Avoid a fragmented internal market
2. Define and support common priorities
3. Use a mix of communication technologies
4. Address security and data protection issues
5. Develop the right legal framework
6. Cooperate at international level

WHICH RECOMMENDS ADOPTING DELIVERING SERVICES IN BUNDLES

The C-ITS Platform Report (2016) uses a bundle matrix approach of scenarios that are added in chronological order to realise benefits sooner due to quicker expected take up than if deployed individually.

Technology Bundles are either

Day1 (relatively mature)

or

Day1.5 (soon to be mature)

Figure 7.4: Factors and influences on the European C-ITS Strategy

UK Position

The UK, with a large automotive manufacturing and research base is fully behind the introduction of C-ITS, and it is a UK Government objective to be at the forefront of autonomous vehicle developments. Part of the remit of the Transport Systems Catapult is to be catalyst for research and development and the introduction of C-ITS in the UK.

In 2016, through CCAV, a £100m Intelligent Mobility Fund was set up to help secure the UK's position at the forefront of the development, construction, and use of advanced driver assistance systems (ADAS) and automated vehicle technologies (AVT).

Scottish position

Connected and autonomous vehicles are a reserved matter (i.e. under the UK Department for Transport (DfT) and not devolved). Therefore the Scottish Government will support the research, development, demonstration, and deployment of Connected and Autonomous Vehicles. In doing so, we will continue to engage with CCAV, Scottish Enterprise and the EIP (European ITS Platform) to keep abreast

of developments and commence planning for the impacts and benefits of these technologies to Scotland.

We will seek to hold a Connected and Autonomous Vehicle Demonstration Summit showcasing International developments and exploring with the transport industry how Scotland can best capitalise on the opportunities and benefits.

Transport Scotland will look to identify and support trials, such as, with the freight/logistics sector to provide a living test bed for the emerging technology that can increase productivity, improve road safety, reduce emissions, optimise road capacity and enable new mobility concepts. We will consult with and take advice and assistance through active collaboration with organisations such as the Scottish Futures Trust, Scottish Enterprise, the Transport Systems Catapult, ITS (UK) and the Centre for Connected and Autonomous Vehicles.

Expected impacts/benefits of Theme 4

- MaaS is expected to see a more multi-modal and less private car centred view of private travel for a proportion of travellers which may result in reductions in traffic levels through car sharing and greater use of public transport options

- Digital technologies help reduce human error, by far the greatest source of accidents in transport. The steady trend in improving road safety that the European Union (EU) has seen over the last decade has slowed down. C-ITS can help to revive a positive dynamic in the reduction of road fatalities, in order to reach the target of halving the overall number of road deaths in the EU between 2010 and 2020.

- Communication between vehicles, infrastructure and other road users is also crucial to increase the safety of future automated vehicles and their full integration in the overall transport system. In other words, connectivity and cooperation are prerequisites to safe automation.

- A Benefit Cost Ratio (BCR) of 3:1 for C-ITS has been predicted within the EC Strategy, but the significant benefits only likely to accrue between 5 and 10 years after initial investment and be societal not individual (e.g. safer travel in general).

- C-ITS will be part of a package of measures. New and improved roads will need to incorporate C-ITS within their designs.

Strategy Focus Theme 4: Intelligent Mobility, including Connected and Autonomous Vehicles

Challenge	Goals	Considerations
The role of ITS in Mobility as a Service (MaaS)	To provide an environment of support to the introduction of MaaS in Scotland. To ensure consideration of the potential of MaaS when considering future requirements Transport Scotland back office systems	MaaS is expected to be private sector led. Transport Scotland's role is likely to be as a supporting enabler for MaaS.
Implementing a strategy for C-ITS on the trunk road and motorway network	To promote the implementation of supporting technology for C-ITS where demonstrable benefits / business cases can be shown. Transport Scotland involvement in provision of enhanced information services to C-ITS vehicles in Scotland	Alignment with European Strategy Operational and maintenance impacts of deploying Road Side Units To encourage the take up of C-ITS by its contractors and the freight sector by the use of post manufacture on-board units (OBUs)
Provision of services to facilitate the introduction of Connected and Autonomous Vehicles (CAV)	Investigation of options for a CAV pilot or demonstrator in Scotland leading to greater understanding of challenges that the introduction of CAVs in Scotland are likely to face	The regulatory aspects of CAV are reserved to the UK Government Need to build and maintain relationships within DfT, EU institutions, vehicle manufacturers and service providers.
Guidance for future scheme design	Produce Scenario B guidance for accommodation in motorway ITS renewal projects Produce design guidance for A9 / A96 schemes that can be rolled out across the non-motorway network	Engagement of industry and other road operators is essential; this is a learning exercise for all Glasgow refurbishment and A9/A96 schemes will need guidance in near future

7.5   Theme 5 – Economy, Connectivity and Freight

Issues

Efficient, sustainable freight movements are essential to the economy of Scotland. For much of the country the potential for using rail is not available and road freight is the only option. The trunk road and motorway network represents 6% of the total Scottish road network yet carries 60% of heavy goods vehicle movements. Heavy vehicles cause more wear on road surfaces and their emissions and noise are higher than other vehicles on the network.

What evidence might be required to provide justification to hauliers for them to invest in dedicated C-ITS on-board units that aid their journeys and provide cost savings and help the environment? What tailoring of services is required by Transport Scotland and third parties for the freight sector and what assistance will the industry require from ITS?

Outlook

Freight traffic has a different set of operational conditions to general traffic for ITS to address. There are restrictions on routes, on the permissible hours drivers can be at the wheel, and the maximum speed at which lorries can travel is lower than that for general traffic. Braking distances are longer than for cars and; it takes longer to builds up speed from a standing start.

Heavy Goods Vehicles (HGVs) are contributors to poor air quality. Although legislation and technological developments mean engines will get considerably cleaner in next 5-10 years, NO_x emissions and particulates generated from tyre and brake pad wear will continue to prove a challenge. In the coming years consideration of introducing ULEZs (Ultra low emission zones) and CAZs (Clean air zones) restricting HGV access to the network or to certain times of the day are likely to be made.

Manufacturers are starting to build cooperative systems technology into new units. Across Europe there are examples of operators installing on-board units (OBUs) in their trucks to help in the implementation of 'last mile' distribution opportunities, provide local updates and facilitate signal priority for HGVs. This is the start of road freight benefiting from C-ITS with Vehicle to Vehicle (V2V) systems bringing the possibility of road train platoons and Vehicle to Infrastructure (V2I) systems encouraging more efficient driving that will give fuel, tyre and other component cost savings.

Freight movement by road is essential to Scotland's economy; even more so north of the central belt. The country's geography means that it has a limited number of exit/entry points. Where goods are headed for the European continent delays in England may affect delivery to/from Scotland. During 2015 the effect of Operation Stack, because of disruption on ferries across the English Channel, caused financial

hardships – in particular for Scottish fish exporters to continental Europe, whose products were unable to reach the restaurant tables in time.

This highlights the economic need for enhancing the information services for the freight sector (there is already an existing market) through improved data gathering and richer information provision will be driven by user need. The road, port and ferry operators will all need to be involved in providing ITS services that are freight specific (and freight sector specific e.g. Timber Transport Forum[27]). Initiatives will need to be coordinated to provide economy of scale, re-use of assets, GIS etc.)

Freight and Logistics

Transport Scotland works closely with the haulage industry through strong links developed and maintained with the Freight Transport Association (FTA), the Road Haulage Association (RHA) and the Office of the Transport Commissioner for Scotland.

Transport Scotland also participates in the Scottish Freight and Logistics Advisory Group (ScotFLAG). This was set up to increase sustainable economic growth in Scotland, recognising the importance of freight in the transport sector. Within its remit is prioritising and co-ordinating action taken by industry and other stakeholders in response to government policies with regard to freight.

ScotFLAG's operating principles encourage collective ownership and participation as well as an acceptance that the group is not a lobbying organisation. As an existing partnership developing efficiencies and supporting sustainable practices ScotFLAG is ideally placed for continuing engagement regarding the uptake of ITS under this theme.

Weigh-in-motion and over height detection

Transport Scotland will continue to invest in, operate and maintain technology that helps protect the structure of our road network. This includes weigh-in-motion detection sites jointly operated with the DfT and other agencies to detect and prosecute overweight lorries. We will also consider installing over height detection systems to protect low bridges and where high sided vehicles have been temporarily banned due to high winds.

High wind management

Parts of Transport Scotland's network are exposed and HGVs are particularly vulnerable to the effects of high winds. Loss of control and overturned vehicles can cause injuries and result in serious delays. We will continue to improve our preparedness for high winds and the timely dissemination of specific warnings to freight operators.

---

[27] http://timbertransportforum.org.uk/maps/agreed-routes

Expected impacts/benefits of Theme 5

- Cost savings and efficiencies through better certainty of network availability, conditions and inter-modal connections for hauliers and exporters.

- Reduced emissions and noise, better air quality

- Reduced road maintenance costs, particularly at junction approaches where signal priority and/or approach advice for HGVs can be given.

Strategy Focus – Theme 5: Economy, Connectivity and Freight

Challenge	Goals	Considerations
Weigh-in motion and over height detection	Avoid unnecessary damage to trunk road infrastructure	Liaison with enforcement agencies and other infrastructure owners Engage with the Traffic Commissioner for Scotland
Assisting the freight sector in moving Scottish goods to market	To provide targeted ITS information services that support the movement of Scottish produced goods effectively from point of production to point of sale or consumption	Specific freight routes need identification Interface with ferry services and with Highways England Involve Transport Scotland sponsored ScotFLAG group Engage with the FTA and RHA
Using ITS to reduce or mitigate the detrimental effect of road freight traffic	To use ITS targeted at HGVs that will result in fuel savings, reduced road surface wear, and improve air quality	Research if road-trains are possible on Scottish trunk roads, and if they are needed Identify specific traffic signal junctions (or groups of junctions) where priority for HGVs could be given so saving fuel, brake liners, rutting in road surface etc.
Using ITS to implement a High Wind Strategy across the Scottish strategic road network including estuarial crossings	Reducing the number of incidents involving high sided vehicles due to high winds	Timely and geographically appropriate information provision Understanding of industry requirements (e.g. extending to snow and ice warnings?)
Assisting in the continued viability of Scottish economic growth sectors	To support the use of electronic logistics services	Understanding industry requirements

7.6   Theme 6 – Data, Innovation and Collaboration

Issues

Considering the role Transport Scotland should take in embracing Big Data, Smart Cities, Smart Scotland, and the Internet of Things. Reliable and accurate transportation data is a coveted component for third party information providers. Where should we position ourselves, what engagement should we have with the market and what are the expectations?

Outlook

Across the digital spectrum there are huge opportunities to create new business and jobs in the provision of the infrastructure and the insight into and participation with the connected world. There is a national desire to position the UK as a global leader within these industries[28].

In March 2017 the Scottish Government refreshed its vision to be a vibrant, inclusive, open and outward-looking digital nation[29] by publishing 'Realising Scotland's full potential in a digital world: a digital strategy for Scotland'[30] and an accompanying evidence paper. The strategy will be implemented by improving and extending broadband and mobile networks; ensuring Scotland is a world leader in cyber resilience; positioning to support change and innovation through the effective use of data; increasing digital participation; delivering digital public services meeting the needs of users; improving the nation's digital skills and; offering digital support for businesses.

Using and exploiting the general investment in digital infrastructure, security and capability in Scotland will be essential to realise efficiency savings where ITS is involved.

There are major prospects for the 'Internet of Things' (IoT). This is the concept of networks of sensors that connect the physical world to the internet, and the large amount of data these devices generate. Being able to hook up disparate sources has the potential to create far richer pictures of what is happening, has occurred, and can be predicted.

The virtually unlimited data access leads to the opportunities afforded through 'Big Data' This is a term that the DfT considers "refers to both large volumes of data with high level of complexity and the analytical methods applied to them which require more advanced techniques and technologies in order to derive meaningful information and insights in real time".

---

[28] https://www.gov.uk/government/publications/uk-digital-strategy/ministerial-foreword
[29] https://beta.gov.scot/policies/digital/
[30] http://www.gov.scot/Publications/2017/03/7843

To make all of this work there has to be cross-sector collaboration and pragmatism mixed with clear definition of desired outcomes. For example Transport Scotland will need to decide what mix of telecommunications, systems resilience and cyber security we require to deliver our service. To what extent we install, operate, lease from others and if it would be beneficial to make available to others unused elements of our infrastructure (e.g. spare ducts, roadside land in rural areas) to enable their services.

It also requires a mix of 'blue chip' ICT (Information and Communication Technology) and the burgeoning innovation of small and medium sized enterprises (SMEs). Robust, reliable and secure ICT is fundamental to the central control and management systems connected to Transport Scotland's on-road equipment; as does the use of digitised records such as BIM (Building Information Management) when adopted for all Transport Scotland assets.

There will be a continuing responsibility to maintain reliable source data for major information services (web, in-car, mobile etc.), and at the same time stimulate the development of new MaaS ventures, and those creating small dedicated apps containing some limited but strongly targeted transport content. This could be through the creation of a similar model to that as established by TfL (Transport for London). Through its Open Data policy[31] TfL has enabled over 8,500 developers to exploit its data further and bring apps and services faster to market and in ways that TfL would not be able to and/or would never do. We will continue to engage with the EU ITS Platform and the DfT to support the development of a Single Point of Access portal for travel information. The Scottish Government has set out its ambition for making non-personal and non-commercially sensitive data open and available for others to use and reuse in its Open Data Strategy published in 2015[32]

Expected impacts/benefits of Theme 6

- Adopting BIM for ITS assets provides improved and more cost-effective asset management, planning and maintenance of ITS assets within the overall highway context.

- As an enabler for MaaS to become a reality through the availability of reliable data to developers.

- Savings and efficiencies through the use of national ICT contracts and digital infrastructure provision programmes.

- Growth in integrated, collaborative approaches through the de-mystification of ITS data, improving its availability, and encouraging the development of added-value use cases.

---

[31] https://tfl.gov.uk/info-for/open-data-users/
[32] https://beta.gov.scot/publications/open-data-strategy/

Strategy Focus - Theme 6: Data, innovation and collaboration

Challenge	Goals	Considerations
Digital connectivity, broadband and mobile, across the strategic road network	ITS technology can be located wherever on the network it is needed Continue to support digital corridors and the role out of national broadband through share ducting use and reciprocal agreements as required.	Investigate cost share cabling or duct capacity with rural broadband – tie in with Digital Scotland Superfast Broadband (DSSB)[33] and Community Broadband Scotland (CBS)[34] programmes Potential use of SWAN (Scottish Wide Area Network)[35] Tie in with Scottish Government Mobile Connectivity Action Plan[36]. Look to complement programme by, for example putting in mobile masts in rural areas, e.g. where charge points are planned
Open Data, Big Data and analytics	Meet Scottish Government Open Data Strategy guidance for traffic data To apply Big Data techniques and technology to enrich the knowledge of the operation of Scotland's transport networks To provide a platform to harness the knowledge and wisdom possible from analysing the data for planning, actions and retrospective analysis	Charter for making data available on the TfL model? Be multi-modal in outlook How to set up? Involve academia, key partners? Exploiting exiting groups and facilities e.g. CENSIS Universities group, University of Strathclyde etc. Enhancements to NTDS Opportunities for consolidation with other Transport Scotland data stores and systems.

---

[33] https://www.scotlandsuperfast.com/
[34] http://www.hie.co.uk/community-support/community-broadband-scotland/
[35] https://www.scottishwan.com/
[36] https://beta.gov.scot/publications/mobile-action-plan/

Challenge	Goals	Considerations
Cyber Security	All Traffic management and control systems should be secure	Need specialist advice and support to realise Identify compliance with ISO and UK Government Standards and any actions required for non-conformances
Development of the National Transport Data Service (NTDS)	To deliver and maintain a sector leading service for the provision of transport data across the strategic road network, accessible by practitioners and public.	Complexity and number of data sources. Reliability of traffic monitoring sites and maintenance of roadside and in-road equipment. Pace of development of NTDS systems.
BIM	To adopt Level 2 BIM for Transport Scotland ITS assets	BIM is recommended to be adopted on Public Sector projects where appropriate from April 2017. BIM guidance at Scottish Futures Trust[37]

---

[37] https://bimportal.scottishfuturestrust.org.uk/

8   Implementation and Delivery

8.1   Summary

This Future ITS Strategy frames Transport Scotland's agenda for trunk road ITS over the next 10 years and beyond. It is aligned with the overall National Transport Strategy outcomes to deliver a safe and efficient network, sustainable economic growth, embrace innovative solutions and to be customer focussed.

The strategy will not stand still, we want it to continue to be live and evolve as knowledge and understanding grows, and adapt with technology developments. We have set out the following four objectives to lead and keep fresh the direction of the implementation and delivery of the strategy.

Objective A – Innovation and Horizon Scanning: On-going engagement over the strategy period with relevant governmental, national and international organisations to inform wider understanding of how innovative and beneficial ITS can be deployed in Scotland.

Objective B – Customer Focus: Through various methods, regular engagement with the users of our network, and the data and information Transport Scotland provides, to inform prioritisation of resources, systems and services that will have the most effective benefits for those users.

Objective C – Planning and Adaptability: Working collaboratively to set out how Transport Scotland and its partners will adapt to technological changes such as connected vehicles, data analytics and the growing personal mobility choices.

Objective D – Asset Management and Delivery: To present an informed context for annual reviews of investment priorities that will align with Transport Scotland's Road Asset Management Plan (RAMP).

Our strategy is structured around *six non-exclusive Strategic Themes*:

Theme 1: Asset management and operational Services – making the most of the ITS we have already

Theme 2: Quality Traffic and Travel Information – for individuals and information service providers

Theme 3: Environment and Sustainability – using ITS to complement initiatives on air quality and alternative fuels

Theme 4: Intelligent Mobility, including Connected and Autonomous Vehicles – adapting to the expected increasing presence of CAVs on the network and the broad needs and potential effects that might result from Mobility as a Service

Theme 5: Economy, Connectivity and Freight – assisting the path of goods to market whilst reducing detrimental effects of road freight traffic with technology

Theme 6: Data, Innovation and Collaboration – communications, connectivity, analytics, security, and asset management information

We have set out a *four point governance model* that Transport Scotland will establish to advance the strategy. This is shown in the following diagram. It is founded upon four main activities arranged around six strategic themes, described in detail in Chapter 7. As part of the governance process Transport Scotland will report on progress periodically:

- **Elaborating** the strategy through engagement with industry, academia and other stakeholders

- Developing **Action Plans** associated with the six themes of the strategy

- Creating **Funded Delivery Plans** to implement Action Plans

- **Monitoring and Evaluating** to inform our **review and refreshing of the strategy**.

8.2   Implementation

We will now embark on setting up the leadership of the governance process so that it is clear to all who have an interest how they can engage with the strategy. We will consult further with other parts and agencies of the Scottish Government, our contractors and supply chains, interested organisations such as ITS UK, MaaS Scotland, CCAV and the Transport Systems Catapult on how best to accommodate new ITS technology within our operational domain.
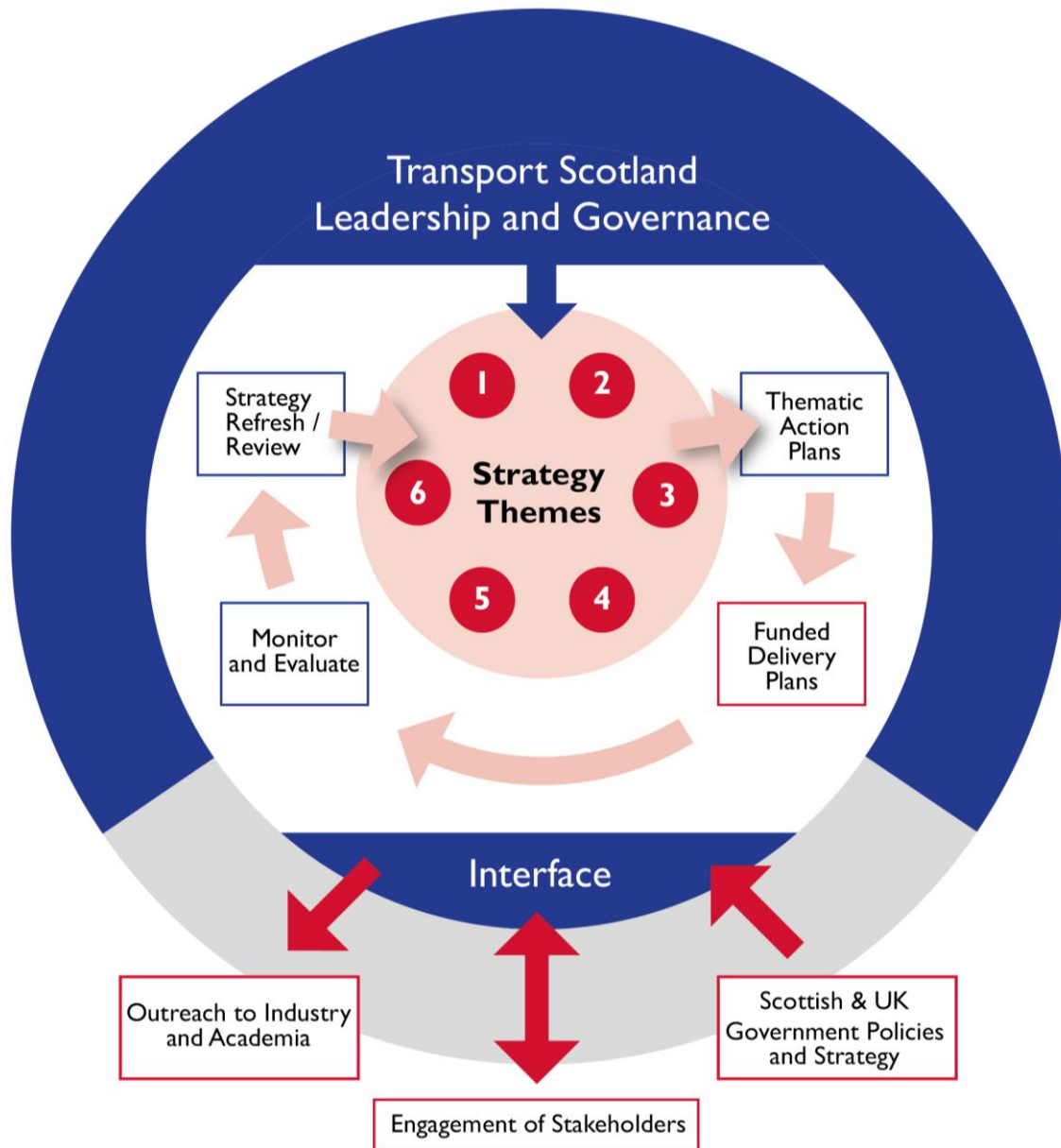
Figure 8.1: Transport Scotland ITS Strategy Operation

8.3 Leadership

With this Future ITS Strategy, Transport Scotland is demonstrating how it is being pro-active in adapting to the pace of technological change and how that might influence future investment decisions. We are providing the framework for the development of action plans and delivery programmes to ensure appropriate, value for money investment is made.

We will make our position clear so that scheme designers, maintenance contractors, and the wider industry understands how, where and when we expect ITS to be in place on the trunk road network.

We will continue to involve those organisations that interface with our network, be they local authorities, ferry connections, public transport operations or across the border to Highways England's network. We will maintain compatibility, interoperability, and the sharing and dissemination of information with them for the benefit of all our respective customers.

We shall assist other parts of government, industry and service providers in promoting and establishing 'New ITS' and other new technology. This includes connected and autonomous vehicles (i.e. Cooperative ITS or C-ITS), MaaS, the roll out of electric charge points, and the establishment of mobile and broadband communication coverage in less populated areas.

8.4   Monitoring and Evaluation

All investment will be subject to evaluation of the benefits gained by the implementation of the Action plans through the annual Delivery Programmes. This will inform future refreshes of the ITS Strategy.

8.5   Outreach and Dissemination

Transport Scotland will also oversee outreach and dissemination activities associated with the Future ITS Strategy. For example—

- Publication on Transport Scotland's website and creation of other media to publicise the strategy

- Organising technical seminars in Scotland to provide greater understanding of new and existing ITS technology

- Coordination and encouragement of publicity through papers, articles, and other media of the objectives, progress and success of the strategy

- Building links with academia and other research organisations

- Establishing, developing and maintaining relationships across the ITS sector, within Scotland, the rest of the UK and internationally

- Establish contacts and relationships with key player such as vehicle manufacturers and CAV service providers

Appendix   Sources of Further Information

ITS-UK

Transport Scotland is a Foundation Member of ITS United Kingdom, the UK association for the promotion of Intelligent Transport Systems. This is a not-for-profit public/private sector association financed by members' subscriptions

It works to bring the benefits that ITS can offer in terms of economic efficiency, transport safety, and environmental benefits to the United Kingdom - and at the same time expand the ITS market. Useful guides and briefing notes are available on its website[38].

The "EU ITS Platform" (EUEIP)[39]

EUEIP brings together the majority of the European key players, cooperating to establish an open "forum", aiming at providing valid contribution for the future strategy and policy recommendation for better development of ITS service along European road Corridors.

It is the follow up of projects already supported by the European Commission TEN-T programme including Streetwise and Easyway in which Transport Scotland has participated.

---

[38] http://www.its-uk.org.uk/publications
[39] https://eip.its-platform.eu

Scottish Futures Trust[40]

The Scottish Futures Trust (SFT) is an independent company, established by the Scottish Government with a responsibility for delivering value for money across public sector infrastructure investment. SFT operates at arm's length from the Government but works closely with the public sector to seek and deliver improved value for taxpayers.

It's estimated that SFT's work during 2015/16 delivered £146m of net benefits and savings to infrastructure investment in Scotland

ERTICO[41]

ERTICO - ITS Europe is a partnership of around 100 companies and institutions involved in the production of Intelligent Transport Systems (ITS). Together, ERTICO Partners conduct a range of activities to develop and deploy ITS to save lives, protect the environment and sustain mobility in the most cost-effective way

The Centre for Connected and Autonomous Vehicles (CCAV)[42]

The CCAV is a joint policy unit of the UK Department for Transport and the UK Department for Business, Energy and Industrial Strategy. It was set up to keep the UK at the forefront of the development of connected and autonomous vehicle technology.

---

[40] http://www.scottishfuturestrust.org.uk/
[41] http://ertico.com/
[42] https://www.gov.uk/government/collections/driverless-vehicles-connected-and-autonomous-technologies

The Transport Systems Catapult (TSC)[43]

The TSC is one of eleven elite technology and innovation centres established and overseen by the UK's innovation agency, Innovate UK. It was created to drive and promote Intelligent Mobility – using new and emerging technologies to transport people and goods more smartly and efficiently.

The Transport Systems Catapult is working in partnership with industry, government authorities and research bodies to champion innovation in transport. The main focus areas that we are currently working on include automated transport systems, modelling & visualisation, customer experience and information exploitation and smart infrastructure.

In 2016 it published its Technology Strategy for Intelligent Mobility to cover the period to 2030.

MaaS Scotland[44]

MaaS Scotland is a Technology Scotland Special Interest Group and a trade body.

Supported since 2013 by Scottish Enterprise initially under the banner of the Scottish MaaS Alliance it comprises 50 companies, from global players to small SMEs, operating along the MaaS value chain. It is hosted by Technology Scotland and partnered by Scotland IS. These two trade networks cover the hardware and software skills and products MaaS needs.

Its aim is to work with companies and organisations to create the future of mobility, that is, the integration of various forms of transport into one single mobility service. It wants now to bring forward a number of pilot projects that will prove the MaaS concept in a Scottish context such as in the ones in Stirling, in Perth and Kinross and in the Cairngorms National Park. Another potential pilot could be on the Ardrossan-Brodick ferry route in association with Stagecoach, Abellio and Calmac.

---

[43] http://ts.catapult.org.uk
[44] https://maas-scotland.com/

Transport Scotland
Trunk Road & Bus Operations directorate
Buchanan House, 58 Port Dundas Road,
Glasgow, G4 0HF
info@transport.gov.scot

Follow us:

 transcotland   @transcotland

transport.gov.scot

Scottish Government
Riaghaltas na h-Alba