REPUBLIC OF TURKEY
MINISTRY OF TRANSPORT
AND INFRASTRUCTURE

ITS Intelligent Transportation Systems

National Intelligent Transportation Systems
Strategy Document and 2020-2023 Action Plan

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Roads, railways, ports, land, and marine transport vehicles, which are primarily essential in the development of the economy, are the material and political veins of national existence; and instruments for welfare and power.

Mustafa Kemal ATATÜRK

“The road is life; the road is civilization!”

The better we get to a point in transportation investments as a key element of development, the more we will clear the way for our country’s growth and strengthening. For this purpose, we are determined to continuously maintain our transportation and infrastructure investments.

Behind all achievements in the world are determination, courage and endeavour. Hopefully, in the coming period, we will carry forward Turkey to rank amongst the globally leading countries in information and communication technologies as well as in other fields. Together we will work harder for a Turkey designing, developing, producing, and selling its high-technology products to the entire world.

We are determined to carry The Republic of Turkey to 2023, the 100th anniversary of its establishment, in a way developed, confident and prosperous in all aspects.

Recep Tayyip ERDOĞAN
President

Roadmap of Intelligent Transportation

Investments for transportation and communication services, rapidly developing in parallel with globalization and technological advances, are the driving force of economic development as well as one of the most important indicators of social welfare. This situation dictates to acquire a dynamic infrastructure capable of being integrated with future developments and meeting today's demands. In this sense, we implement all our transportation and communication infrastructure works based on long-term planning and calculations.

One of the main agenda items of many countries around the world is the improvement of transportation modes and strengthening the position of the country in the international arena. Our country, under the leadership of our Honorable President Recep Tayyip Erdoğan, has adopted the principle of acting with inclusive and future-oriented moves in the transportation and communication field as in all other fields for the last 18 years.

With its almost completely reshaped infrastructure for the last 18 years, our country is ready to embrace technology to the full extent and is highly open and eligible for transformation. Now it is time to deliver a guideline on intelligent transportation systems to all relevant stakeholders, which will guide in all modes of transport to achieve our goals.

Our Ministry, as a legal authority of meeting the demands related to the legal and institutional regulations, establishing and encouraging the necessary infrastructure and systems of Intelligent Transportation Systems, has completed the preparation of the National ITS Strategy Document and Action Plan, with the valuable contributions of all public authorities and organizations, municipalities, universities, private sector representatives and non-governmental organizations that have a voice in this field.

This study aims to produce human and environment-oriented innovative projects based on advanced information technologies and to have a voice in the global dimension and region with fully integrated transportation systems maintaining the balance between transportation modes. This valuable roadmap is one of our most significant moves to shape the future of ITS, which cherish the past experiences, is inclusive, sustainable, open to developments. Together with my dear fellows, we will continue to raise our country to the level of contemporary civilization working with enthusiasm and devotion in serving our citizens with determination in transportation and communication-related fields. I would like to express my sincere thanks to all our stakeholders and industry representatives who will always walk with us towards transforming the unity in opinion into unity in action in ITS by embracing our roadmap in this process.

Adil KARAİSMAİLOĞLU
Minister of Transport and Infrastructure

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01 > EXECUTIVE SUMMARY

Intelligent Transportation Systems (ITS) are the systems incorporating multi-directional data exchange between user-vehicle-infrastructure-center as well as monitoring, measuring, analysis and control mechanisms, intended to reduce travel time, enhance traffic safety, ensure efficient and effective use of the existing road capacities, increase mobility and thus contribute to the country's economy and mitigate the environmental damage.

Information technologies-based ITS continuously develops and changes to meet public transportation demands in a safer, more efficient, and effective manner. Besides, technological advances in various fields can still find a field of application within the transportation sector. Development of communication technologies in particular, have been critical in expanding the use of autonomous and connected vehicles.

Of all the stages in a classic ITS application, field equipment is the part that is reflected on society. To expand and diversify the services, the field equipment on the roads have been intelligentized and expanded. Especially, measurement, information, control, and guidance systems have become extensively available to be used in transportation infrastructure. These systems have become manageable by connecting to control centers with the aid of developing communication technologies. However, connected and autonomous vehicles, which will be used on the roads soon, will be capable of accessing any kind of data without any need for such field equipment. The economic and social transformations that will be led by autonomous and connected vehicles, will affect the future plans of countries with the ever-growing transportation economy. Therefore, the relevant systems that have been so far strived to be expanded in the field, will eventually lose their importance and functionality.

In this context, Ministry of Transport and Infrastructure, keeping up with the global developments, prepared the National Intelligent Transportation Systems Strategy Document (2014-2023) and the Supplementary Action Plan (2014-2016) with broad participation by stakeholders and, put forth a strategy and vision in ITS field with the aim of delivering a roadmap for the future works in our country. This strategy document is the first document addressing the ITS components as a whole. However, the need to keep up with the technological advances in all sectors and meet the resulting social demands have made it necessary to update this document. Since the implementation period of the action plan expired in 2016, a need for preparing a new document for the new period has emerged.

In this regard, preparatory studies began to create the National Intelligent Transportation Systems Strategy Document and 2020-2023 Action Plan. Within scope of these studies, on-site visits have been performed to 69 institutions and organizations. Opinions were exchanged with these institutions regarding the current situation and the future of the intelligent transportation systems. The Municipalities Workshop, Strategic View Workshop, Strategy Document and Action Plan Workshop have been held with the participation of all stakeholders. Also, the strategies, goals, and action plans of the leading countries in the ITS field such as the USA, Germany, and Japan have been examined. In addition to these studies, a survey to identify the ITS inventory of our country has been performed and the responses provided have been analyzed.

As a result of all these efforts, our country's intelligent transportation systems vision has been determined as "a human and environment oriented transportation system in Turkey built with advanced information technologies" and our mission to achieve this vision has been determined as "to create a sustainable, productive, safe, efficient, innovative, dynamic, environment-friendly intelligent transport network which creates added value and integrated with all transport modes using latest technology while making use of national resources". Within the framework of this vision and mission, five main strategic goals have been identified as follows;

- Developing the ITS Infrastructure
- Providing a Sustainable Smart Mobility
- Ensuring Road and Driving Safety
- Creating a Livable Environment and Conscious Society
- Ensuring Data Sharing and Security

Implementable, monitorable and measurable actions have been determined in line with these goals. A responsible institution has been assigned for each action, and action implementation steps have been itemized with the institutions to cooperate.

It is aimed to use SEPSIS (Strategy and Action Plan Monitoring and Evaluation System) application, where data can be collected strategically, and monitoring activities can be performed effectively for action monitoring and performance evaluation.

Vision

A human and environment oriented transportation system in Turkey built with advanced information technologies.

Mission

To create a sustainable, productive, safe, efficient, innovative, dynamic, environment-friendly intelligent transport network which creates added value and integrated with all transport modes using latest technology while making use of national resources.

02 > ABBREVIATIONS

3G	3rd Generation
4G	4th Generation
5G	5th Generation
ACC	Adaptive Cruise Control
ACTIF	Architecture Cadre des Transports Intelligents en France (France Intelligent Transport Systems Framework Architecture)
AES	Advanced Encryption Standard
AFAD	Disaster and Emergency Management Presidency
AFC	Automatic Fare Collection
AI	Artificial Intelligence
AIS	Automatic Identification System
ARC-IT	Architecture Reference for Cooperative and Intelligent Transportation
ARI	Autofahrer-Rundfunk-Information Systems (Driver Radio Broadcasting Information Systems)
AU	Australia
BRT	Bus Rapid Transit
CACC	Cooperative Adaptive Cruise Control
CACS	Comprehensive Automobile Traffic Control Systems
CEN	European Committee for Standardization
CEN TC 278	CEN Intelligent Transportation Systems Technical Committee
C-ITS	Cooperative Intelligent Transportation Systems
CoHE	Council of Higher Education
CVRIA	Connected Vehicle Reference Implementation Architecture
DAB	Digital Audio Broadcasting
DGComms	Ministry of Transport and Infrastructure, Directorate General of Communications
DGH	Directorate General of Highways

DHMI	General Directorate of State Airports Authority
DSRC	Dedicated Short Range Communications
EES	Electronic Enforcement System
EMRA	Energy Market Regulatory Authority
ERGS	Electronic Route Guidance System
ERTICO	European Road Transport Telematics Implementation Coordination Organization
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
ETCS	Electronic Toll Collection System
ETSI	European Telecommunications Standards Institute
EU	European Union
GCC	Gendarmerie General Command
GDM	General Directorate of Meteorology
GDS	General Directorate of Security
GIS	Geographic Information Systems
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSM	Global System for Mobile Communications
HARTS	Harmonized Architecture Reference for Technical Standards
HGS	High-Speed Toll Collection System
ICTA	Information and Communication Technologies Authority
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IoT	Internet of Things
ISO	International Organization for Standardization
ISO TC 204	ISO Intelligent Transportation Systems Technical Committee
ITS	Intelligent Transportation Systems
IMM	Istanbul Metropolitan Municipality
KAREN	Keystone Architecture Required for European Networks
KOSGEB	Small and Medium Enterprises Development Organization of Turkey
LCS	Lane Control System
LoRa	Long Range
LoRaWAN	Long Range Wide Area Network
LPWAN	Low Power Wide Area Network
LTE	Long Term Evolution
M2M	Machine to Machine
MaaS	Mobility as a Service
MoIT	Ministry of Industry and Technology
MoNE	Ministry of National Education
MoTI	Ministry of Transport and Infrastructure
NB-IoT	NarrowBand- Internet of Things
NFC	Near Field Communication
NGO	Non-Governmental Organization
OBU	OnBoard Unit
OGS	Automatic Toll Collection System
PDPA	Personal Data Protection Authority
PTT	General Directorate of Post and Telegraph Organization
RA	Revenue Administration
RAD-IT	Regional Architecture Development for Intelligent Transportation

RDS	Radio Data System
RFID	Radio Frequency Identification
RTÜK	Radio and Television Supreme Council
SCATS	Sydney Coordinated Adaptive Traffic System
SEPSİS	Strategy and Action Plan Monitoring and Evaluation System
SET-IT	Systems Engineering Tool for Intelligent Transportation
TDZ	Technology Development Zones
TEYDEB	Technology and Innovation Funding Programs Directorate
TRT	Turkish Radio and Television Corporation
TSI	Turkish Standards Institution
TSR	Turkish State Railways
TÜBİTAK	Scientific and Technological Research Council of Turkey
TÜİK	Turkish Statistical Institute
UMT	Union of Municipalities of Turkey
USA	United States of America
U.S. DOT	United States Department of Transportation
V2I	Vehicle-to-Infrastructure
V2X	Vehicle-to-Everything
V2V	Vehicle-to-Vehicle
VICS	Vehicle Information and Communication Systems
VMS	Variable Message Signs
VTMS	Vessel Traffic Management System
VTOL	Vertical Take Off and Landing
VTSS	Vessel Traffic Service System

03 > INTRODUCTION

The rapid developments in information and communication technologies lead to newly-emerging trends and expectations in the social transportation concept and style. Intelligent transportation systems play a vital role in meeting these newly-emerging trends and expectations.

ITS utilizes information and communication technologies for transportation monitoring, analysis and management. Therefore, technological developments directly affect ITS and lead to the emergence of new ITS applications.

In addition to the technological developments, rapid urbanization, the increase in the number of vehicles and increasing population, and resulting increase in need for public transport along with similar developments, have necessitated the update of the 2014 ITS strategy document as well as redetermination of the actions.

In line with this, negotiations were held with the public authorities, municipalities, private sector institutions, universities and NGOs within the ITS ecosystem to determine the situation of intelligent transportation systems in our country. These negotiations provided information about the institutions' activities, capabilities and strategies, challenges faced, and needs within context of ITS.

The ITS-related strategy documents and action plans of the countries that serve as a model have been reviewed, and the global trends have been identified. The ITS ecosystem has been socially, economically, and technologically assessed in light of the information obtained as a result of the examination of the relevant policy documents, other high-level documents and model countries. It was also aimed to identify the effects of newly-emerging technologies and products on ITS by conducting a literature review.

"The Municipalities and ITS Ecosystem Stakeholder Analysis Workshop" has been held to identify the problems and solution methods, expectations, needs, and national strategies of the stakeholders in the ecosystem. "The ITS Ecosystem Strategic View Workshop" has been held to benefit from the views and opinions of the stakeholders on our country's national ITS strategy, vision, and mission. Finally, in "The ITS Strategy Document Update and Action Plan Workshop", the opinions of the institutions, who are responsible and concerned about the strategy document and

action plan, have been obtained.

A survey was conducted to collect information about the stakeholders' capabilities, their currently implemented projects and corporate capacities.

Considering the internal and external factors affecting the ITS ecosystem, a SWOT analysis has been performed to benefit from the ecosystem's existing strengths and opportunities at the maximum level as well as to minimize the threats and weaknesses.

As a result of all these efforts, our country's new national ITS vision and mission have been delivered. Five strategic goals have been identified within the context of this vision and mission. In line with these strategic goals, the aim is to achieve these thirty-one actions between the years 2020 and 2023.

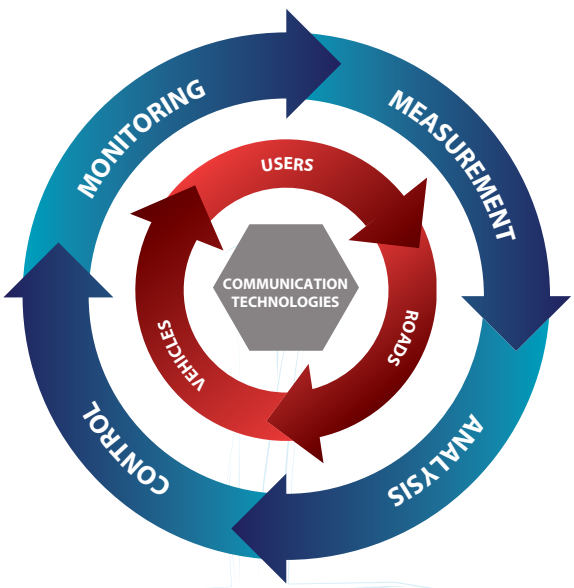
Firstly, in the intelligent transportation systems overview section of the strategy document, the description, historical development, needs and benefits of ITS, the technologies used in the applications, application samples, and the effect of the disruptive technologies on the applications are discussed. Then, in the ITS architectures and approaches section, brief information about the architecture is given. In the following two sections, the status of ITS around the world and in our country is addressed. In the next section, Turkey's ITS strategy, vision, mission, strategic goals and actions are presented. Finally, a method for monitoring and evaluation of actions is described. The last three annexes include the action plan table, worldwide ITS architecture examples, and worldwide ITS policies.

04 > OVERVIEW OF INTELLIGENT TRANSPORTATION SYSTEMS

4.1 Definition of Intelligent Transportation Systems

Intelligent Transportation Systems (ITS) are the information and communication-based systems incorporating multi-directional data exchange between user-vehicle-infrastructure-center as well as monitoring, measuring, analysis and control mechanisms developed with the intent to reduce travel time, enhance traffic safety, ensure efficient use of the existing road capacities, increase mobility, efficient use of energy and mitigate the environmental damage (Figure 1). Many applications have been developed using these systems. The common application areas and applications of Intelligent Transportation Systems are given in Table 1.

Figure 1: Definition of Intelligent Transportation Systems



Tablo 1: ITS Applications

SMART VEHICLES	SMART ROADS
▸ Smart Navigation, 360 Degrees Perimeter View ▸ Driver Assistance Systems ▸ Automated Parking ▸ Autonomous Vehicles	▸ Smart Intersections ▸ Passenger Information Systems ▸ EES, VMS,HGS, OGS, LCS, ACC ▸ Green Wave, Cameras ▸ Sensors
SMART CITIES	**ECONOMICS AND ENVIRONMENT**
▸ Smart City Management Centers ▸ Accident and Emergency Management ▸ Public Transport and Fleet Management ▸ Smart Parking ▸ Safe Transport Practices	▸ Smart Energy Systems ▸ Electric Vehicles ▸ Environment Friendly Transportation Infrastructure
INTEGRATION SYSTEMS	**INFORMATION AND SECURITY**
▸ Integration of All Modes of Transport ▸ Transportation Control Center ▸ Cooperative ITS ▸ Single Payment for All Modes of Transport	▸ All Transport Data, Big Data ▸ Data Security and Sharing ▸ Cyber Security ▸ Communication Systems

4.2 Historical Development

The first ITS studies began in the late 1960s and early 1970s in Japan with CACS (Comprehensive Automobile Traffic Control Systems), and in the USA and Germany with ERGS (Electronic Route Guidance System). The developments achieved in communication technologies since the mid-1980s accelerated the ITS applications. Large-scale projects were initiated with the partnership of the government and the industry, and ITS, which expanded with applications such as electronic toll collection systems, smart junction control systems, passenger and driver Information systems and traffic control centers in the 90s with these projects, began to be recognized as a separate discipline.

On the international scale, the first ITS congress was held in Paris in 1994 and has continued to be held every year in a different country since this date. In line with these events, as well as the technologies and needs that arose as a result of the knowledge obtained through academic researches, the countries established their own ITS organization. Besides the organizations established at the national scale, local structures such as ERTICO, ITS America, ITS Asia Pacific also exist.

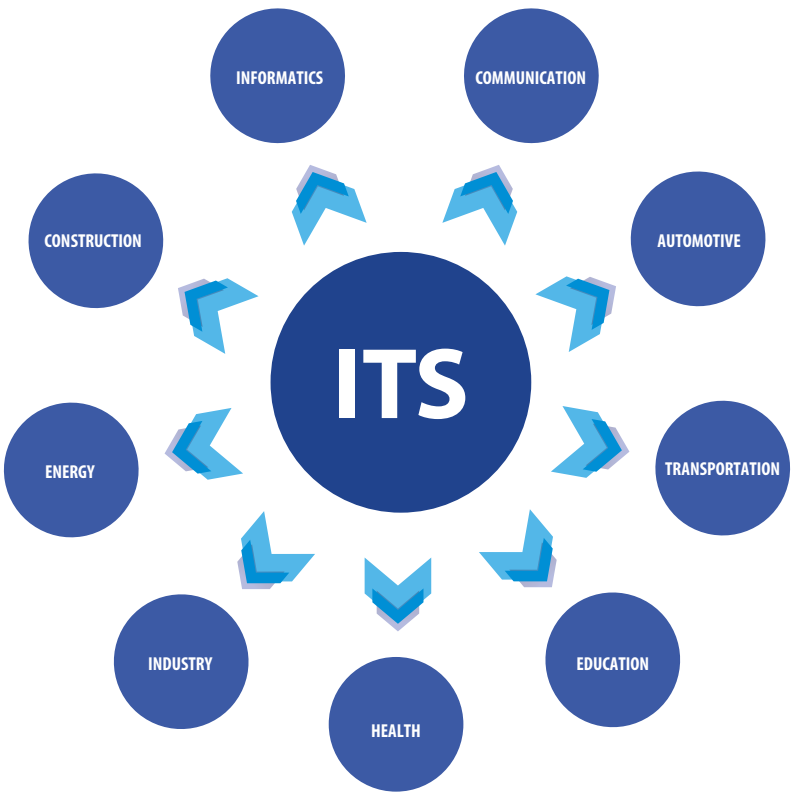
The historical development of ITS beginning from the 1960s to date is summarized in Figure 2.

Figure 2: Historical Development of Intelligent Transportation Systems

Especially after 2015, a serious competition started among the developed countries to grab share in the global ITS market. The diversification of the project studies within scope of ITS, increase in infrastructure and technology investments, enhancement of incentive mechanisms, and the direct reflection of ITS to country strategies were the most important indicators of this competition.

ITS technologies and applications have been diversifying and expanding in parallel with the rapid change observed in the information and communication technologies. ITS comes as an interdisciplinary concept, concerning and contributing to several sectors ranging from transportation to automotive, from health to the environment, and from communication to information technologies. Some sectors affected by ITS applications are given in Figure 3.

Figure 3: Sectors affected by the ITS Applications



Besides the fields given in Figure 3, ITS applications are in interaction with many other fields such as public, law, psychology, finance, etc.

4.3 The Need for ITS and Benefits of ITS

Considering the global population distribution, it is seen that urbanization also increased in developing countries as well as in developed countries between 2012 and 2019. Due to urban growth and population increase, certain changes affecting daily life occur in environmental, economic, social, and transportation areas.

The fact that employment opportunities in cities are higher than in rural areas is among the root causes of population increase. This situation also leads to traffic issues. Long distances between homes and work places in cities and use of private vehicles in addition to increased demand for public transport, leads to traffic jam rise. Vehicle and pedestrian traffic intensifies with urbanization.

The increase in traffic density leading to the increase in fuel consumption and carbon dioxide emission, necessitate the use of information and communication technologies in the transportation area. This whole situation brings to mind the ITS, which is one of the best methods to use.

Intelligent transportation systems enable us to minimize the human-driven errors. It can also eliminate many traffic-related adverse impacts such as loss of time, accidents involving death or personal injury, loss of property, air pollution, etc.

All these reasons mentioned above have once again demonstrated the importance of intelligent transportation systems. Solutions can be found to such requirements by the widespread use of ITS. These solutions will also bring

the following benefits:

- Increased mobility,
- Reduced traffic jam and contributions to public transport,
- Reduced traffic accidents and relevant deaths, injuries and property losses,
- Fuel saving by reducing the time spent in transportation,
- Reduced carbon emission and environmental pollution,
- Saving in maintenance costs of the vehicles due to reduced wear and tear times,
- Increased efficiency and effectiveness of emergency management systems,
- Reduced travel time and transportation convenience with vehicle-to-vehicle, vehicle-to-infrastructure, vehicle-to-center communication systems,
- Developing web-mobile applications that contributes to traffic safety and public transport,
- Convenient transportation through analysis of big data collected from vehicles, environment, and infrastructure through cameras, sensors and similar applications,
- Saving energy by adopting intelligent energy systems with increasing electric vehicles and hybrid vehicles,
- Better public security through the data obtained from cameras and similar applications,
- Optimization of passenger and freight mobility by accurate and instant information obtained through real-time data based mobile applications and services.

ITS, with its above-listed effects, has become one of the main focus areas in the world as well as in our country.

4.4 Technologies used in ITS Applications

Telecommunication, electronic and computer technologies are integrated with the transportation sector using intelligent transportation systems. Integrated operation of systems such as positioning, communication, and mapping provides the necessary technological infrastructure for the applications used in intelligent transportation systems. Some of the core technologies used in intelligent transportation systems are listed below.

4.4.1 Communication Technologies

4.4.1.1 Global Navigation Satellite System (GNSS)

GNSS (Global Navigation Satellite System) is used in accessing location information, route guidance applications, vehicle tracking systems and similar applications for travel planning in the ITS area.

4.4.1.2 Radio Frequency Identification (RFID)

RFID systems are especially used in toll collection systems. These structures, which have their own unique standards, offer the possibility of using both active and passive systems in the ITS field. The HGS tags used for toll collection in our country are one of the best examples for the RFID technology.

4.4.1.3 Dedicated Short Range Communications (DSRC)

DSRC (Dedicated Short-Range Communications) is a wireless communication technology using 5.9 GHz frequency band, which is specially designed for the vehicle-to-everything (V2X) communication. This technology is used in toll collection applications in the ITS field as in RFID systems. OGS, in use since 1999 in our country, is one of the best examples for toll collection, along with DSRC. It will play a significant role in vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications in forward-looking ITS studies.

Figure 4: Dedicated Short-Range Communications (DSRC)

4.4.1.4 Near Field Communication (NFC)

NFC (Near Field Communication) technology is a new generation near field wireless communication technology, which was approved as a standard by ISO/IEC on December 8, 2003. The application areas of the NFC technology in ITS include information sharing, data exchange, public transport, payment transactions, etc. Contactless payments and validating an entitlement to board public transport services via mobile phone and smart watch, which have been in use since recently, are one of the best use cases for the NFC technology.

4.4.1.5 Cellular Communication Networks

3G, 4G, 4.5G mobile communication technologies as well as 5G, which will soon come into play, can be used in many ITS applications such as security, navigation, in-vehicle information systems, and entertainment services, etc. Our country benefits from mobile communication technology advantages, especially from the progress made in mobile applications.

4.4.1.6 Radio Data System (RDS) and Digital Audio Broadcasting (DAB)

Radio Data System (RDS) and Digital Audio Broadcasting (DAB) are used for traffic, travel, and emergency announcements to wide areas. Today, information about the current song on the radio such as the song name, the singer, and the duration of the song, can be displayed on the radio screen via RDS. Also, information on incidents that occurs on the road can be communicated to drivers through RDS.

4.4.1.7 Low Power Wide Area Network (LPWAN) Technologies

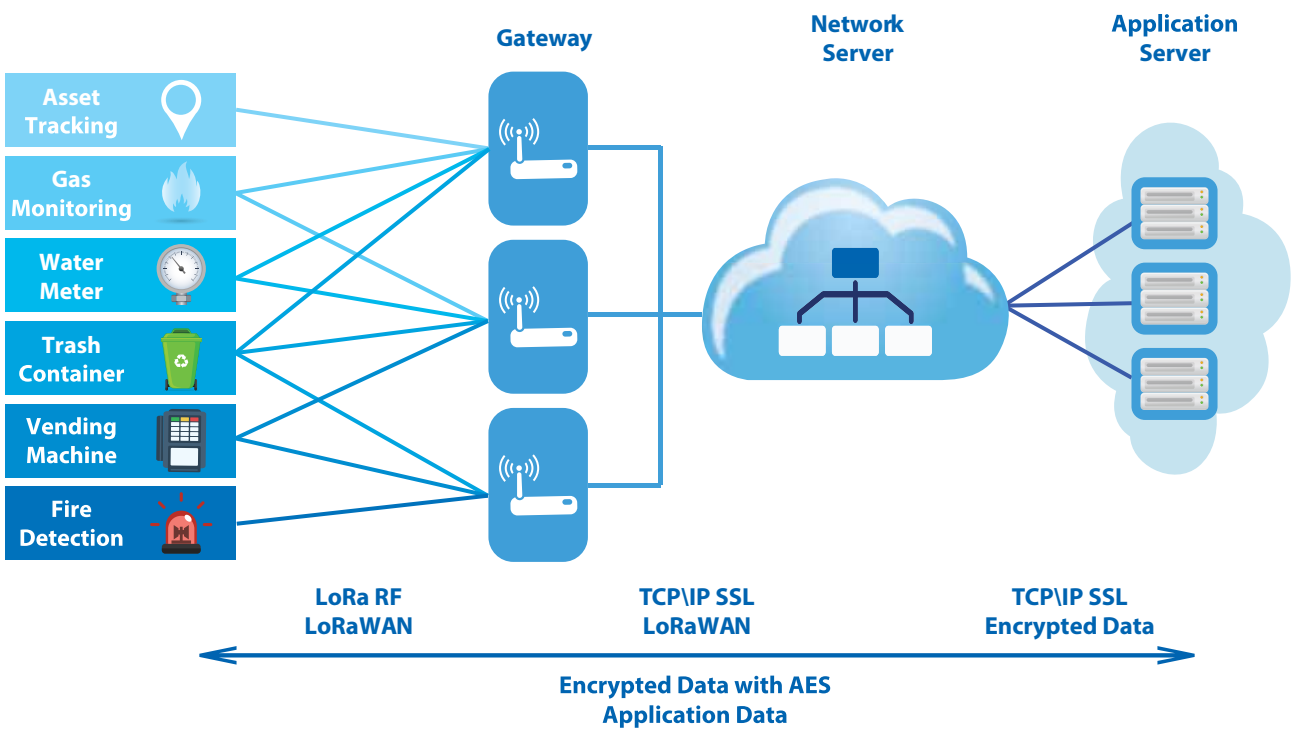
LPWAN enables wireless communication for the low power M2M and IoT devices deployed in very wide areas. NarrowBand-IoT, LoRa and Sigfox are some of LPWAN technologies.

- NarrowBand-IoT Technologies: It runs at NB-IoT licensed frequencies and uses the existing LTE network, namely the GSM network. In this technology, all end devices such as sensors and cameras can collect the data at a central

point via various communication Technologies (Internet, DSL, M2M, data line, etc.). With this technology, ITS-related data obtained from cameras and sensors can be transmitted to traffic control centers in areas where cabling is not possible. This technology is used in smart parking, toll collection systems, in-vehicle information systems and similar ITS applications.

- LoRa (Long Range): It is a commercialized, patented digital wireless data communication technology. LoRa enables cost-efficient, long-distance connection for the IoT devices deployed in wide areas. This technology is usually used in mining, natural resource management, renewable energy, logistics and supply chain management fields.
- Sigfox: This technology enables data transmission at a maximum of 100 bps and up to 10 km in urban areas and up to 50 km in rural areas. This technology is applied in smart parking, road maintenance notifications and bike-sharing applications in the ITS field.

Figure 5: LoRaWAN Technology



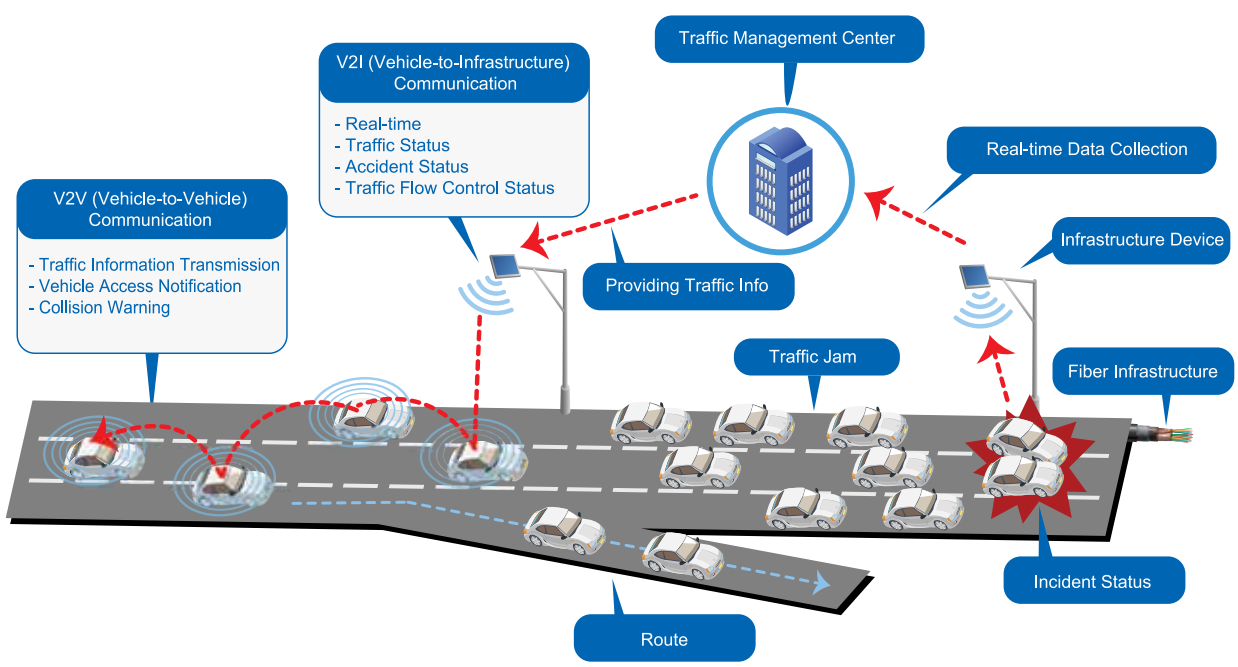
4.4.2 Sensing Technologies

Sensing technologies enable measuring the road, environment, weather and vehicle information required by ITS. Sensing technologies are sensor-based systems. They are used to obtain data about the vehicle quantity, traffic density, road, weather and emission status in the ITS field. Travel planning applications in particular, by processing and using the data obtained from the mobile devices and from the sensors deployed roadside, can offer drivers alternative routes while on their current route. These are inductive, ultrasonic, lidar, video camera, radar and similar sensor technologies.

4.4.3 Cooperative Intelligent Transportation Systems (C-ITS)

C-ITS is one of the innovative technologies that aims to increase the efficiency, safety and environmental performance of road transport and enables vehicles to interact with each other and with surrounding road infrastructure. C-ITS involves vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I) and/or infrastructure-to-infrastructure (I2I) communication and communication between vehicles and pedestrians or two-wheeled riders (vehicle-to-everything, V2X). C-ITS, using vehicle-to-vehicle and vehicle-to-infrastructure communications provided through in-vehicle and roadside communication devices, inform drivers about any incidents occurred on road and ensure a safe and comfortable journey. Furthermore, with the ever-developing communication technologies, drivers will be informed of priority vehicles with priority of way such as ambulances and police cars, which will ensure a faster response to road incidents. Test corridors deployments in European Union countries and the development of driverless/connected vehicles brought up C-ITS to Turkey's agenda and the test phase studies are being conducted.

Figure 6: Cooperative Intelligent Transportation Systems



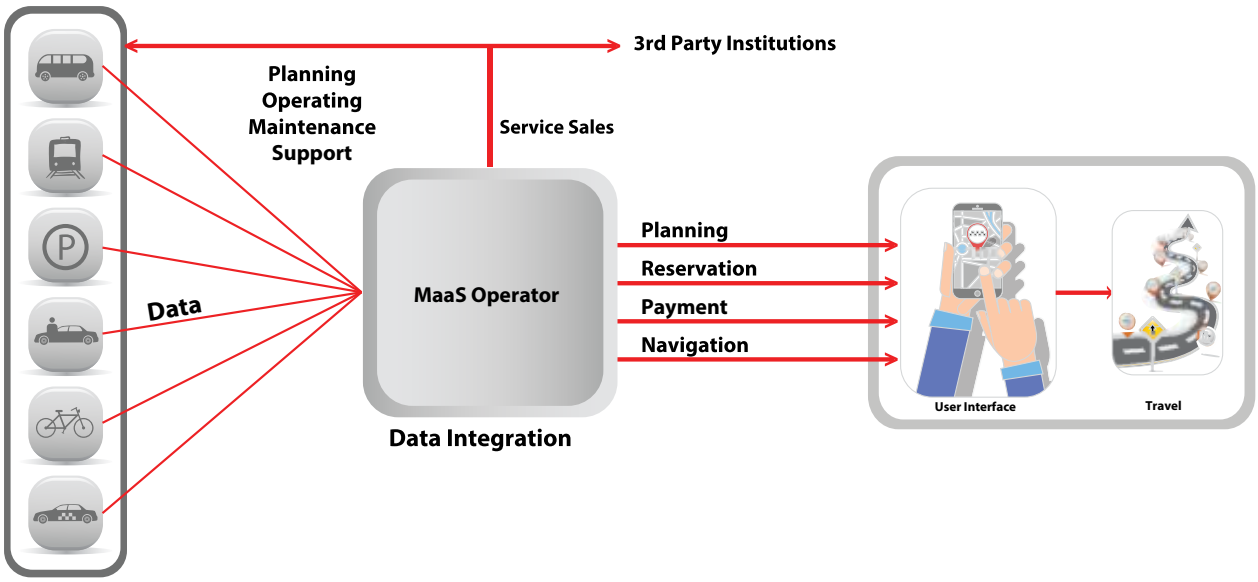
4.5 ITS Applications

Today, many ITS applications are available. This section briefly addresses the most outstanding applications that have the potential to become prevalent.

4.5.1 Mobility as a Service (MaaS)

MaaS (Mobility as a Service) means creating a single accessible mobility service through the integration of various types of transportation services on demand. MaaS was first implemented in Finland and played an important role in the national transport policy. MaaS operator offers public transport, vehicle, bike sharing, car rental, and similar transport options or a combination of them to fulfill the demand of a customer. MaaS enables users to access end-to-end travel experience using a single payment channel on an application instead of multiple toll and payment transactions. The main goal of MaaS is to offer users cheaper, sustainable, and efficient transport opportunities instead of using their private cars.

Figure 7: Mobility as a Service (MaaS)



4.5.2 Car Sharing

Car sharing refers to a car rental model where vehicles are rented for short periods (usually hourly) and used for short-distance trips in urban areas. Car sharing enables efficient use of roads and parking areas. The primary principle of car sharing is to provide benefits to users without the costs and liabilities incurred by vehicle ownership. Car sharing is considered as an alternative means of transportation in crowded cities since it is more flexible than public transport.

Figure 8: Car Sharing

4.5.3 Ride Sharing

Ride sharing is an instantaneous or planned mode of transport, which brings together the drivers of cars that have empty available seats and the passengers who will travel on the same route, thereby enabling them to save money from travel expenses. This method offers passengers personal comfort and benefit for the environment through sharing private cars, and thus contributes to reducing traffic jam.

4.5.4 Car Pooling

Car Pooling is sharing one or multiple private cars with other users in an organized manner. It refers to sharing a person's private car with someone else (e.g. his/her colleagues) for a fee continuously and regularly.

4.5.5 Park and Ride

It is a mode of transportation that uses the information system to encourage passengers to park their private cars in a parking lot near the public transport system and continue their trips by public transport.

4.5.6 Kiss and Ride

In this mode of transport, a private car passenger continues some part of his/her trip by public transport. For example, a person comes to a public transport stop by a friend's car and continues his/her trip by public transport.

4.5.7 Area Traffic Control

It refers to the implementation of coordinated traffic measures such as signal control and alternative route suggestion at the intersections and connections on a road network to enhance the performance of the entire road network. It provides benefits in reducing travel times, accidents, fuel consumption and traffic jam. However, area traffic control systems are quite complex and expensive. These systems are utilized in some regions in Hong Kong, Finland, and the United Kingdom.

4.5.8 Congestion Charging

It refers to the fee charged on vehicles being driven on roads within a defined zone. Today, there are examples of this application in cities like London and Amsterdam.

4.5.9 Advanced Taxi Applications

With the widespread use of smart phones, several mobile applications have been developed to meet the people's transportation needs. These applications provide users services of positioning, finding, calling, toll and route determination of the transportation vehicle. Also, some new applications allow taxi-sharing for passengers who will travel on the same route. Likewise, there are many domestic and foreign sourced applications which offers increased service quality, saving time, money and energy.

4.6 Impact of Disruptive and Innovative Technologies on ITS Applications

Disruptive and innovative technologies is a general concept where the technologies directly affect the industry, displace the conventional technologies and creates completely new sectors and services. In the future, the transportation industry and peoples' understandings and styles of transportation are expected to undergo a radical transformation due to the impact of disruptive and innovative technologies. With the impact of artificial intelligence, machine learning, and autonomous vehicles, it seems inevitable that all the components of transportation will become completely user-independent. It is believed that the big data, cloud computing, and MaaS services and the modes of transport will integrate more rapidly, which will allow integrated systems to offer services more efficiently, rapidly, and easily. With the widespread use of the V2X, 5G communication systems, and the Internet of Things technologies, the need for the traffic signal controllers, variable message signs, and similar systems in the existing infrastructure will be eliminated. It is foreseen that the services provided by these infrastructures will be directly transmitted to driver and autonomous vehicles via onboard information systems and immersive interfaces. The possible impacts of such technologies on the

transportation sector and intelligent transportation systems are given below.

4.6.1 Autonomous Vehicle Technologies

Autonomous vehicles can sense the surrounding objects utilizing radar, lidar, GPS odometry, artificial intelligence, sensors, cameras and similar technologies. Thus, they can move using real-time data without needing a driver.

4.6.2 Immersive Interfaces

Immersive Interfaces are technologies used to interact with virtual reality environments. With these technologies, new in-vehicle interfaces can be created which enables data sending without distracting the driver. Furthermore, they can lead to the emergence of new generation virtual reality simulations to model driver behaviors.

4.6.3 Internet of Things

It is a system of devices that communicate with each other through various communication protocols and form an intelligent network by connecting and sharing information. In other words, objects can be tracked, coordinated, or controlled through data networks or the Internet by embedding sensors and data transmission technologies into roads, infrastructures, mobile devices, and similar physical objects. Through IoT (Internet of Things), traffic management systems can provide real-time traffic status data by measuring the traffic flow speed and volume on city roads. Furthermore, IoT-based technologies will be able to provide a significant amount of transportation data for use in mobile internet-based traveling applications or autonomous vehicles.

4.6.4 5th Generation (5G) Mobile Networks

5th Generation (5G) mobile networks will constitute the future's mobile communication infrastructure. They will have much higher capacity and less latency than existing 4.5G systems. The wireless broadband infrastructure that will be provided by these networks will enable connectivity for both intelligent transportation services and several IoT applications.

4.6.5 Cloud Computing

It is the general name of the internet-based computing services for computers and other devices, providing computer resources that can be used when required and shared among users. Cloud computing is expected to reshape the automotive sector, modes, and services of transport. The developments in cloud computing and the internet of things technologies will help to solve transportation problems such as traffic jams and vehicle security. Recently, researchers have suggested cloud computing models such as ITS-Cloud, to enhance vehicle-vehicle communication and road safety for intelligent transportation systems.

4.6.6 Big Data

It refers to very big datasets that requires different collection and analysis methods using new technology and algorithms compared to conventional data. In other words, it refers to the collection, storage, cleansing, visualization, analysis, and interpretation of data incoming with a high volume, high variety, and high velocity from sensors and scientific tools. Today, this size ranges from tens of terabytes to petabytes. The big data platform has five components: variety, velocity, volume, verification and value. Big data consists of information with high volume, high data production velocity, and high data variety and enables data interpretation and process optimization.

In the context of intelligent transportation, processing and interpretation of the data obtained from sensors, cameras, software, traffic management centers, vehicles, and similar sources play a very important role in establishing decision-making mechanisms. With the realization of ITS, big volumes of traffic and transportation data is collected from infrastructures, vehicles and driver behaviors by means of information and communication technologies. Using big data, better simulation and modeling capabilities can be provided for ITS with rapid and dynamic modeling. Thus, it is foreseen that the management of traffic will be easier as well as it will be possible to predict and prevent traffic jams, traffic accidents and similar negative situations.

4.6.7 Open Data

It refers to the data usable and shareable free of charge and freely by everybody without being subjected to any

copyright, patent, or other control mechanisms.

"Open Data", which is one dimension of data access with many examples of use in the world, is created by the public private sector and citizens in the ecosystem. Within this ecosystem, different sectors can be provided service, the lives of legal and natural persons can be touched, and thanks to the ease of access created by Open Data, new opportunities arise within data axis. Among these opportunities, the most remarkable one with practical effect is the open data platforms where data collected by governments are presented, in accordance with open data standards, to citizens and entrepreneurs.

Open data has the potential to create major changes in the operation of a city and the lives of its residents. Open data has benefits for citizens, public sectors, and the private sector since it facilitates access to top quality data as it comes with a set of principles; which mainly are free of charge and continuous access, reusability, and innovation-orientedness.

Open data policies are also known to provide benefits in terms of increasing efficiency and transparency. The open data applications that will be implemented by all public authorities will contribute to the production of more transparent policies and allow citizens to provide feedback for the applications across the country.

Open data is a valuable resource to solve civil problems, increase transparency, and fill the gap between municipalities and citizens.

4.6.8 Blockchain Technologies

Blockchain is a scattered data recording system that enables encrypted process tracking. The reason why Blockchain is referred to as a data recording system instead of a database is that data, once recorded, cannot be changed or deleted. This feature is based on storing data by connecting the data accumulation blocks via encryption algorithms, just like a chain, and sharing this chain with many persons in a scattered manner. With this technology, each user can be connected to a network without an agent, send new operations, verify operations, and create new blocks. It enables user to perform operation without being connected to a center. So that, operations are performed securely.

Potential usage areas of Blockchain technology in the transportation sector include MaaS, data sharing, freight and logistics services. Blockchain technology will enable the establishment of MaaS platforms, facilitate data sharing in transportation, make the software that will run on connected vehicles and updates of such software safer, and thus will play a pivotal role in the future of autonomous and connected vehicles.

4.6.9 Artificial Intelligence, Machine Learning and Deep Learning

Developed countries have been conducting researches to utilize artificial intelligence for estimating transportation system's behavior, resolving transportation problems, transportation planning process, best decision-making and management applications to offer safer, efficient, and sustainable transportation services.

The transportation sector has transformed as a result of the studies conducted on autonomous vehicles, connected vehicles, and intelligent road systems. Driverless vehicle sector has been rapidly advancing due to applications such as traffic forecasts, smart decision making via machine learning, deep learning technologies, and big data. With all these technologies, it is foreseen that accidents can be prevented by early detection of potential accidents via pre-analysis of traffic scenarios.

Advanced information technologies infrastructure and solutions, artificial intelligence and big data and deep learning techniques are very critical for intelligent transportation solutions.

4.6.10 Drones

Drones, also known as unmanned aerial vehicles (UAVs), consist of a GPS module, cameras and similar components, and controlled remotely by software. Having been used for military purposes for years, drones have recently been used in areas such as traffic monitoring, weather monitoring, search and rescue, security, surveillance applications, precision agriculture, firefighting, product delivery and servicing duties.

05 > ITS ARCHITECTURES AND APPROACHES

ITS architecture is a conceptual design defining the structure and mode of operation of Intelligent Transportation Systems. This design should specify the structural specifications of ITS as well as define the main components in general, and all system components in detail. ITS architecture should be established based on countries, regions or cities and, be able toprovide information needed by investors in this field.

ITS architecture should be designed to involve following feautres for the stakeholders for ITS applications:

- Implementation Schedule: It should define the main phases for short, medium, and long-term implementation schedules, and point out the timings as to when to renew or improve existing components and when to prepare new components.
- Infrastructure Specifications: Infrastructure specifications should involve component standards and the standards on connection between components and external interfaces.
- Component Specifications: It should define the specifications of the system components in detail required for the ITS implementation.
- Cost-Benefit Analysis: It should enable conducting analyses in order to measure and define the costs and the benefits of improvements.
- Discover the Organizational Issues: It should define the factors and expectations such as data ownership, ensuring

data privacy, distribution of ITS revenues, relationships between stakeholders, which may be influential when organizing the ITS implementation.

- Performance of Risk Analysis: It should enable to analyze possible problems such as reliability of selected technologies, uncertainty of the income sources and the amount thereof and, disputes between stakeholders.

In order to develop an ITS architecture that meets above basic features, the solution that will be implemented should put forth a comprehensive, multi-layered structure that is accepted in the literature, applied in today's developed countries and applied to create the architectural design of similar large systems. Each layer should be designed based on users' needs and support the integration of selected ITS applications and services. In addition to these, an ITS architecture should:

- meet technical requirements and comply with the legislation
- support ITS systems at various scales (regional or local) based on the need
- serve as a guide by users and system designers
- specify the design and application requirements
- involve technologically-neutral components and defined processes
- and define the minimum criteria for the components, processes, and sub-systems constituting the system, and ensure interoperability and applicability.

Lastly, ITS architecture should have a systematic structure capable of meeting the requirements of all users (public authorities, transportation sector companies, ITS service providers, end-users, etc.). To achieve this, a multi-layered structure should be established covering all details that meet requirements at each layer. The frameworks that can be established based on this multi-layered structure are defined below.

- General or Conceptual Framework: Contains the top-level diagrams and definitions that illustrates the entire system and its operating principle.
- Functional or Logical Framework: Contains the processes, function definitions, and diagrams required to meet user requirements.
- Physical Framework: Contains the definitions of system's physical components and diagrams. It could also specify how to position them for a specific application.
- Communications Framework: Contains the communication requirements and definitions of the connections between the components defined and positioned within the physical framework.
- Organizational Framework: Defines the commercial and business relationships between the institutions.
- Information Framework: Defines the basic data types, where to store them, and how to process them.
- Operational Framework: Defines how to operate and administrate the system.

ITS architecture studies conducted by certain countries in the world are given in Annex 2.

06 > INTELLIGENT TRANSPORTATION SYSTEMS IN THE WORLD

More efficient, safer, and more environment friendly transportation can only be achieved by shifting to ITS applications and continuously developing them based on newly-emerging technologies. The main goal is to develop and expand the ITS technologies which are integrated with information and communication technologies, in order to efficiently manage today's critical issues such as reducing traffic death rates, reducing emissions and increasing traffic mobility.

National road network, urban traffic management and control, travel information, ticketing, integrated modes of transportation, logistics and fleet management, C-ITS, connected and autonomous vehicles, data management, road safety, reduced emissions, electric vehicles, communication technologies, mobility and accessibility, smart city and similar ITS components are brought into play in line with achieving this goal.

Developed countries in particular, due to increasing city populations, are looking to intelligent transportation systems to reach their main objectives such as managing the increased traffic, more efficient passenger and freight transport, saving on fuel consumption, reduced carbon emissions and protecting the environment. In addition to efficiently leveraging ITS, next efforts also focus on further developing these systems.

Information and communication technologies are utilized to provide the expected benefits from intelligent transportation systems. Cellular communication has an important place among these technologies. Once 5G technology is fully rolled out, latencies will fall below 10 milliseconds which will enable real time data transmission and consequently expand autonomous vehicles across the world. The potential advances in artificial intelligence and deep learning will also contribute to this process. At the same time, it is aimed to prevent accidents and safe travel for passengers through the development of advanced driver assistance systems. In addition, it is aimed to increase comfort, safety and efficiency in transportation through vehicle-to-vehicle, vehicle-to-infrastructure and vehicle-to-center communication.

Furthermore, many developed countries have decided to gradually increase the number of electric vehicles, for their contribution to the habitable environment and sustainability goals of ITS, and discontinue the production of fossil-fuel-consuming vehicles by 2030-2035s to reduce fuel consumption and emissions.

The detailed information on the studies of some countries in the ITS field is given in Annex 3.

07 > INTELLIGENT TRANSPORTATION SYSTEMS IN OUR COUNTRY

Population growth, rapid urbanization and increases in private vehicle ownerships, lead to traffic issues. As seen in many examples in the world, traffic management and control become easier and more efficient with the adoption of intelligent transportation systems. Besides, many developed countries pursue policies to encourage public transport as the primary approach. Furthermore, the ITS applications provide comfortable, efficient, and safe travel for drivers.

According to the 2010-2018 data of TÜİK (Turkish Statistical Institute), the population growth rate in the cities is 35% while the rate of increase in private vehicles is 64.33%. Urbanization, automobile ownership and increases in the number of drivers create demand for road transports and traffic density. This situation suggests that ITS applications in Turkey need to be expanded.

To that end, many institutions and organizations in Turkey have conducted various studies on ITS. To ensure coordination in these studies, Ministry of Transport and Infrastructure (MoTI) monitors the ITS-related policies, strategies, goals and rules of procedures and implementation. MoTI has also been conducting studies to ensure that identified standards are used across the country, and that communication infrastructures of these systems are expanded and necessary international relations are conducted.

Within this framework, the first strategy document and action plan for intelligent transportation systems prepared by Ministry of Transport and Infrastructure entered into force after published in the Official Gazette No.29156 dated October 25, 2014. The action plan, which is the annex of the strategy document covering the 2014-2016 period, consists of five strategic goals, 21 objectives and 38 actions. Nine of these actions in the action plan for the 2014-2016 period were defined as continuous actions and the remaining 29 were planned to be completed within that period.

Recently, huge and extensive changes and transformations have occurred across the world in industrial and digital fields as a result of the advances in information and communication technologies. The transportation industry is one of the primary sectors affected by this situation. This situation has deeply affected all modes of transportation. The emergence of disruptive technologies brought about many concepts including Cooperative ITS, connected vehicles, autonomous vehicles, driverless vehicles etc. With social needs changing and technologies undergoing radical transformations, an update for the 2014 strategy document has become necessary.

The studies that have been conducted by the institutions and organizations in our country and their capabilities are given below sorted by their organization types.

7.1 Studies Conducted by The Institutions, Agencies and Organizations within the scope of ITS

7.1.1 Public Authorities

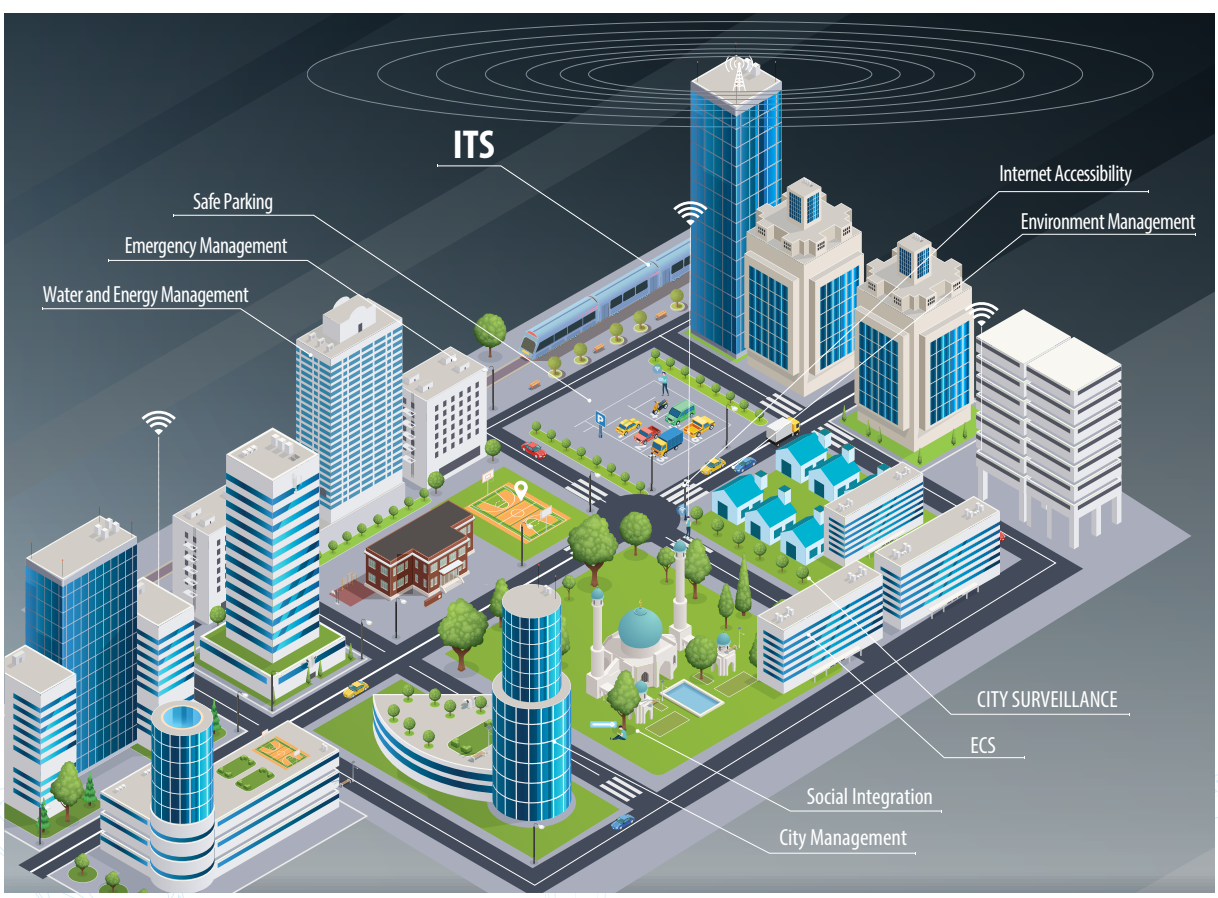
In our country, traffic control and signaling systems, passenger information systems, electronic toll collection systems and similar ITS applications have been extensively used in all modes of transportation. Many public authorities and organizations in the ITS ecosystem have been conducting their activities efficiently.

Ministry of Industry and Technology: Ministry of Industry and Technology (MoIT) has prepared the Strategy Document and Action Plan (2016-2019) for Turkey's Automotive Industry with a view to ensure the automotive industry production operations are implemented according to the international standards. The MoIT has been conducting the necessary harmonization studies to ensure the development of driver assistance systems, emergency brake system, active cruise control system, lane-keeping system, e-Call and similar ITS applications on transport vehicles.

Furthermore, several supports and incentives are provided to entrepreneurs, academic staff and private sector companies at the national and international levels within the framework of ITS in our country. Amongst these, are the incentives provided by TÜBİTAK TEYDEB, KOSGEB, San-Tez and the Development Agencies are examples.

Ministry of Environment and Urbanization: Ministry of Environment and Urbanization has been given the responsibility to prepare the smart city strategy and smart city program within scopes of the national strategy and action plans such as 10th Development Plan (2014-2018), National E-Government Strategy and Action Plan (2016-2019), Information Society Strategy and Action Plan (2015-2018) and National Broadband Strategy and Action Plan (2017-2020). In line with this, the 2020-2023 National Smart Cities Strategy and Action Plan Circular entered into force after published in the Official Gazette No.30988 dated December 24, 2019.

Figure 9: Smart City Systems



Ministry of Transport and Infrastructure, Turkish State Railways: Signaling and driver assistance systems are utilized to increase driving safety and maintain railway safety. In addition, camera surveillance systems enable continuous monitoring of the railway network. Vehicles and stations are equipped with the necessary infrastructure in order for the citizens with limited mobility to benefit from the transportation services at the highest level. ITS applications are widely used in latest railway, metro and tramway vehicles, lines and stations.

Ministry of Transport and Infrastructure, General Directorate of Maritime Affairs: Automatic Identification System (AIS) is used to track the vessels over a certain tonnage. Vessel Traffic Services System (VTSS) and Vessel Traffic Management System (VTMS) ensure the coordination of vessel traffic and provide information to vessels. Regular Service Information System allows keeping information on regular public transport services (vessel route information, vessel capacities, etc.). Variable message signs inform passengers of the ferry pier timetable.

Ministry of Transport and Infrastructure, General Directorate of Highways: Within the context of ITS applications, the road transport network is equipped with signaling systems, road and weather control systems, toll collection systems, weight and size control systems, incident detection systems, tunnel control systems, radio broadcast systems, mobile applications and variable message signs. Additionally, traffic control and management centers, communication infrastructures and systems are being deployed and, transportation-planning activities are carried out.

Figure 10: Road Intelligent Transportation Systems on Highways

Ministry of Transport and Infrastructure, General Directorate of Transport Services Regulation: It acts as the national authority that coordinates the digital tachograph system and similar projects used for the inspections of freight and passenger transport vehicles.

Ministry of Transport and Infrastructure, General Directorate of Post and Telegraph Organization: It conducts the works to establish Türkiye Kart and Clearing Center within the framework of developing a nationwide e-payment system for every transport mode and establishing a clearing house (automatic toll collection system).

Figure 11: Türkiye Kart

Ministry of Interior, General Directorate of Provincial Administration: In our country, since there are separate service numbers in use for emergency calls (fire, health, public order, etc.), the task to integrate all emergency numbers under a single number (112) and establish 112-Call Centers, is carried out by the General Directorate of Provincial Administration. Other projects conducted within the scope of ITS are the Harmonized In-Vehicle Emergency Call Systems, 112 Emergency Call Center and Engelsiz (Abled) 112 Project.

Ministry of Interior, General Directorate of Security (GDS) and Gendarmerie General Command (GCC): The GDS and GCC ensures the deployments of electronic enforcement systems to enhance road security and safety, increase the efficiency of the transportation system and operating conditions. They contribute to ITS development and prevalence with road sensors, traffic density maps, traffic violation detection, license plate recognition, traffic training and similar applications.

The GDS and GCC continue their efforts to expand EES applications in intercity and urban roads in order to regulate and control the traffic. Average speed control system has been implemented on the selected pilot areas within DGH's road network. The GDS also works on the implementation of average speed control in the road network outside the highway. And the GCC makes efforts to expand the license plate recognition system application across the country for security purposes.

Figure 12: Electronic Enforcement System

7.1.2 Municipalities

There are applications currently in place within metropolitan municipalities, such as speed violation detection systems, red light violation detection, bus route control, traffic density tracking, automatic license plate recognition and scanning systems, passenger information systems, electronic payment systems, smart intersection, smart stop, smart parking and similar applications.

Metropolitan municipalities utilize ITS in electronic control systems, traffic measurement, and monitoring systems, variable message systems management, increasing traffic flow by shortening the waiting times in signalized intersection branches, automatic license plate recognition systems, smart parking information systems, tunnel and subway electromechanical systems management, internet and mobile-based transportation solutions. Municipalities also provide solutions for individuals with limited mobility such as specially designed pedestrian ways, crosswalks, pavements and ramps as well as specially designed public transport vehicles and smart stops.

In our country, many metropolitan municipalities have ITS applications in-service such as public transport card systems, passenger information systems, electronic toll collection systems, accident and emergency management systems, traffic incident management systems, freight and fleet management systems, etc.

In addition, traffic control centers for traffic management and operation have been established in many metropolitan municipalities particularly in Istanbul, along with many more widely-used intelligent transportation systems solutions.

The majority of the metropolitan municipalities have concentrated their ITS studies on mobile software. These include the EGO Cepte application of the Ankara Metropolitan Municipality, the IMM CepTrafik and MOBİETT applications of the Istanbul Metropolitan Municipality, Mobile Application of the Izmir Metropolitan Municipality, and BURULAŞ application of the Bursa Metropolitan Municipality.

The EGO Cepte application of Ankara Metropolitan Municipality allows inquires such as bus routes, addresses, stops, landmarks etc. Ankarakart balance inquiry and online top-up via credit card are possible on the application.

The MOBİETT application of the İstanbul Metropolitan Municipality provides access to real-time public transport information, bus current location, routes serving the stops, bus arrival times (in min) and travelling suggestions for point-to-point journeys. Feedback can be sent via the travel-rating feature on the application to enhance the service quality. The Ispark Parking Lots function in the application provides great convenience for finding parking lots for people traveling with their private cars.

The BURULAŞ mobile application of the Bursa Metropolitan Municipality provides information on which lines passing which bus stops, bus location, arrival times, travelling suggestions for end-to-end public transport journeys and smart stop information.

The İZUM mobile application of the Izmir Metropolitan Municipality provides information on traffic density, bus stop arrival times, available parking lots, nearest open pharmacy stores, road works, accidents and weather forecasts. Also, with this app people can monitor city surveillance cameras and plan their travels. It is also possible to monitor city traffic flows in real time.

7.1.3 Universities

Higher education institutions have been conducting many projects, articles, papers and thesis studies within the framework of ITS. The CoHE (The Council of Higher Education), in order for the quantitative and qualitative development of the competent human resource, grants doctoral scholarships. Automotive engineering departments are available in nearly 20 universities in our country, and many universities also have graduate programs in this field. Besides, it is seen that some universities have established application and research centers to conduct ITS studies. Our universities which conduct researches on ITS and their activities are as follows:

Middle East Technical University: The Computer Aided Design, Manufacturing and Robotics Research and Application Center (BİLTİR) has been conducting studies on infrastructure, smart vehicles, intelligent transportation infrastructure, intelligent traffic management, information systems for intelligent transportation, and communication systems for intelligent transportation, which are supported by the scientific research projects.

Boğaziçi University: Has been conducting studies on public transportation-oriented traffic planning, transport and freight accident disasters sensor researches, risk modeling transport and freight accident disasters, modelling of bus prioritized road strategies applied in Istanbul and, performance evaluation for intelligent transportation systems.

The researches in the Boğaziçi University Local Traffic Control Center and Intelligent Transportation Systems Laboratory (BOUN ITS LAB) enable to find solutions for transportation issues and develop projects. Laboratory researches and projects have been conducted on intelligent transportation systems, transportation integration, developing modes of urban road, marine and railway transports, etc. Additionally, Boğaziçi University conducts studies to provide proposals for airport access to boost efficiency.

Yıldız Technical University (YTU) : In the YTU Local Traffic Control Center and Intelligent Transportation Systems Laboratory, Istanbul's traffic can be monitored 24/7 in real-time with thousands of cameras, sensors, loop detectors and radars scattered across the city. Architecture components of Istanbul intelligent transportation system, allows data extraction. The devices of this laboratory and the data extracted from the architecture, support undergraduate studies and postgraduate and doctoral theses. Also, within this laboratory environment, scientific research projects and scientific publications at various levels are conducted and, regarding transport systems and traffic issues, solution offers are provided as demanded by public and private sector. Not only civil engineers but also electrical engineers, electronic engineers, control engineers, and topographical engineers can benefit from the laboratory.

The laboratory offers service opportunities in many areas related to transportation especially intelligent transportation systems at local, national, and international scales.

Okan University: Has been conducting researches to become a "Center of Excellence" in terms of intelligent, environment friendly transportation and autonomous vehicles. Additionally, traffic-engineering department under traffic management unit of this University examines traffic conditions and conduct studies on smart vehicles, roads and their operation.

Sabancı University: Within scope of sustainable (environmental) transportation planning, conducts studies on path selection for routes with low emission, fuel-consumption based road planning (environment friendly route planning by eliminating the environmentally hazardous factors), and use of electric vehicles in logistics.

Bandırma Onyedi Eylül University: Has been designated by CoHE as a specialized university to conduct ITS researches.

7.1.4 Private Sector

The private sector organizations operating as ITS stakeholders can be classified under the titles of mobile network operators, automotive manufacturers, service providers, suppliers, traffic and transportation industries. These organizations are conducting studies on geographic information systems, toll collection systems, traffic management systems (incident detection systems, weather/road status measurement, traffic data measurement, intersection joining control, passenger information/guidance), navigation and automation systems. They are also conducting studies for network devices, big data analysis and emergency call center solutions (112 Emergency System, E-Call, etc.).

7.1.5 Non-governmental Organizations

In Turkey, there are many NGOs conducting activities directly or indirectly related to ITS and its application areas. Some of them are given below:

Intelligent Transportation System Association of Turkey (ITS TURKEY): Conducts activities in ITS-related areas with the participation of all related stakeholders, and undertakes initiatives that contribute to ITS development at national and international levels.

Union of Municipalities of Turkey (UMT): It is the only local administration union where all municipalities are natural members, which was established to meet the needs of our municipalities such as training, consultancy, knowledge and experience sharing and technical support in order to facilitate a more modern municipal service delivery. UMT also represents municipalities through public administration institutions at national and international platforms and, protects their rights and interests. It supports e-municipality development by adopting and expanding the use of ITS-related information technologies and, provides necessary assistance to municipalities in line with all of its other duties.

Automotive Manufacturers Association (OSD): Contributes to the development of the Automotive Industry by bringing together the real and legal persons who are manufacturers of various motor vehicles such as trucks, pick-ups, trailers, tractors, buses, minibuses, minibuses and automobiles. The association where the manufacturers of new-generation vehicles such as electric, autonomous, driverless, connected, etc. are also members, continues to contribute to our country's ITS efforts.

7.2 ITS in Turkey's Policies and Strategy Documents

Technology continues to develop in every field in line with the needs around the world. The technologies in the ITS area have also improved due to such developments. The emergence and spread of applications that use these developing technologies calls for the need for policy, strategy and legislation.

Considering these needs, various institutions include intelligent transportation systems in their policy and strategy documents. Intelligent transportation systems were first addressed in ***The e-Turkey Initiative Action Plan (2002)*** as Intelligent Transportation Services. ***The National Climate Change Strategy Document (2010-2020)***, presents the development of intelligent transportation systems applications as a medium-term objective under the title of 'transportation'.

The Document of Turkey Transportation and Communication Strategy Goal 2023, prepared by Ministry of Transport and Infrastructure, addresses the intelligent transport systems subject in detail. In addition ***The National Intelligent Transportation Systems Strategy Document (2014-2023) and its annex Action Plan (2014-2016)***, prepared by Ministry of Transport and Infrastructure in 2014 based on the Medium-Term Program (2012-2014), is the first strategy document in the ITS field. The draft of ***The National Transport Master Plan covering the years 2016-2035,*** studied by Ministry of Transport and Infrastructure, addresses intelligent transport systems and related interoperability, passenger information systems, infrastructure development, and preparation for future technologies subjects. The Master Plan draft focuses on the development of ITS technologies and applications to increase efficiency in all sectors at the national level. The ***2017-2020 National Broadband Strategy and Action Plan*** published by Ministry of Transport and Infrastructure, included the "Development of Intelligent Transportation Systems" action under the strategic goal "Creating both Broadband Supply and Demand". ***The Regulation on the Procedures and Principles to Increase Energy Efficiency in Transportation,*** issued by Ministry of Transport and Infrastructure, aims to establish and spread an effective, high-speed, intelligent, safe and integrated ITS in transportation and communication in line with today's needs.

The 2018-2020 Medium Term Program states that "Transition to ICT-supported smart solutions (intelligent transport systems, smart buildings, smart grids, etc.) will be accelerated". "In order to use existing infrastructure more efficiently, to enhance traffic safety, to manage transport demand correctly and to make more effective planning, a national Intelligent Transport Systems (ITS) Strategy Document will be prepared, ITS architecture will be developed and ITS applications will be expanded" is the policy introduced in the ***Eleventh Development Plan (2019-2023).***

The 2020-2023 National Smart Cities Strategy and Action Plan, prepared by Ministry of Environment and Urbanization, addresses actions within the scope of intelligent transportation as an important component of smart cities.

Delivering the ITS goals, aims and actions specified within scope of above-mentioned top policy documents and other similar documents, will be facilitated with the realization of the below-given actions specified in ITS Strategy Document

and 2020-2023 Action Plan:

- setting the national ITS policies, strategies and goals,
- determining the national ITS architecture and standards,
- leveraging information and communication technologies at the highest level,
- increasing road, driving and traffic safety in all modes of transportation particularly in road networks,
- deploying traffic control centers,
- establishing new incentive mechanisms to develop domestic and national technologies with the traffic measurement and monitoring infrastructure,
- development of passenger information systems,
- reducing fuel consumption and emissions.

7.2.1 Studies conducted within the scope of the Strategy Document and 2020-2023 Action Plan

The intelligent transportation systems have been shaping into a new transportation solution in our country as so does in rest of the world. Intelligent Transport Systems is one of the latest investments in transportation and communication fields made by the Ministry of Transport and Infrastructure, which is regarded as the pioneer entity in development and progress initiatives.

The implementation period of the 2014-2016 Action Plan included in the annex of the 2014-2023 Strategy Document, has expired as of 2016. The rapid change in technology and in requirements and conditions, has made it necessary to update the Strategy Document.

In line with this necessity to update the Strategy document and develop the action plan for the new 2020-2023 period, a new vision and mission; and to achieve these, new strategic goals and actions, have been determined.

Within this scope;

- Face-to-face meetings have been held with the stakeholders to obtain the views and opinions of institutions/ organizations.
- A survey has been conducted to obtain accurate information on the current situation at the national level.
- The ITS strategy documents, ITS approaches, future plans, and goals of five countries - Japan, South Korea, USA, Germany, and the United Kingdom - have been examined.
- The ITS architectures of the USA, EU, Japan, and South Korea have been examined.
- The municipalities and ITS ecosystem stakeholder analysis workshop have been performed.
- The ITS ecosystem strategic view workshop has been held.
- A SWOT Analysis has been performed.
- The National ITS strategy document has been updated and the annex action plan workshop has been held.

Consequently, the resultant Draft National ITS Strategy Document and Action Plan have been presented for stakeholders' opinions and modified in line with their input. Thus, a holistic National Smart Transport Systems Strategy document and action plan 2020-2023 has been prepared that can meet the needs of all stakeholders related to the ITS, taking into account past experiences, current situation, international practices and good examples.

7.2.2 SWOT Analysis

Considering the internal and external factors affecting the ITS ecosystem, a SWOT analysis has been performed to benefit from the ecosystem's existing strengths and opportunities at the maximum level as well as to minimize the threats and weaknesses; this SWOT analysis is given in Table 2 and has been used to set the strategic goals.

Table 2: SWOT Analysis

STRENGTHS

1. Current communication infrastructure investments
2. An innovative and environment-friendly management mentality
3. Widespread R&D activities on information technologies
4. Society's interest towards ITS solutions
5. Various widely used mobile applications
6. Rapid adaptation to developing technologies
7. Public services delivered to society via information and communication technologies
8. Increase in the need for smart systems in the automotive sector
9. Participatory approach of stakeholders in the ITS ecosystem during the development of solutions

WEAKNESSES

1. National ITS architecture and ITS standards are not fully identified
2. Integration between transport modes is not fully achieved
3. Lack of coordination between stakeholders in gathering and sharing transportation data
4. Shortage of human resources specialized in the field of ITS

OPPORTUNITIES

1. Having reached a certain maturity level in the national R&D studies that also focus advanced technologies
2. Geographical proximity of Turkey to the markets where ITS applications are needed
3. Ease of access to information through technology
4. ITS needs supported by the improved road infrastructure
5. Social demand for safe and efficient transportation
6. Transformation in the way of society's mobility style with the use of new generation technologies
7. Requests and incentives to use domestic and national technologies
8. Emergence of new employment opportunities and reducing unemployment with the provision of new value added services

THREATS

1. High investment costs of the infrastructure required for ITS
2. The products used for ITS solutions having low national and domestical value-added rate
3. Globalization and increasing international competition

08 > ITS STRATEGY OF TURKEY

This chapter describes the vision, mission and strategic goals of the National ITS Strategy Document and Action Plan (2020-2023) then goes on to explain in detail the actions constituting the roadmap. In addition, the institutions/ organizations that will carry out the actions, the organizations to cooperate with, the implementation steps and the implementation methods of each corresponding action, are given in detail.

Transportation is the locomotive of a country's economic growth. Improvement and development of the transportation system ensures that people and freight reach the destination point as quickly and efficiently as possible and, contributes to the economic competitiveness of countries. Developed countries, having discovered the significant leverage effect of the ITS on economies, have launched investments in this field. The core benefits of intelligent transportation systems that led to a huge transformation in transportation include increased efficiency and growth in the economy and employment.

Thanks to ITS solutions, traffic jams are reduced and fuel-economy is achieved.

The projects that will be developed with domestic and national resources within the scope of ITS will provide a significant added value to our country. Therefore, the environment and domestic production are especially emphasized in the vision and mission sections of the strategy document. And, the environmental aspect of the issue, is addressed in the action plan as a separate strategic goal.

Since ITS is built based on data communication between the user, vehicle, infrastructure, and center, new infrastructure investments are inevitable. When the ITS architecture and standards are ready, integration and interoperability will be ensured, and the infrastructure will be utilized more efficiently and effectively.

8.1 Vision

Human and environment-oriented transportation system in Turkey built with advanced information technologies.

8.2 Mission

To create a sustainable, productive, safe, efficient, innovative, dynamic, environment-friendly intelligent transport network which creates added value and integrated with all transport modes using latest technology and also making use of national resources.

8.3 Strategic Goals

31 actions have been determined to achieve the following five strategic goals, which cover the near-term targets of our country in the ITS field.

- Strategic Goal-1: Development of the ITS Infrastructure
- Strategic Goal-2: Ensuring Sustainable Smart Mobility
- Strategic Goal-3: Ensuring Road and Driving Safety
- Strategic Goal-4: Creating a Livable Environment and Conscious Society
- Strategic Goal-5: Ensuring Data Sharing and Security

8.4 Long-Term Goals

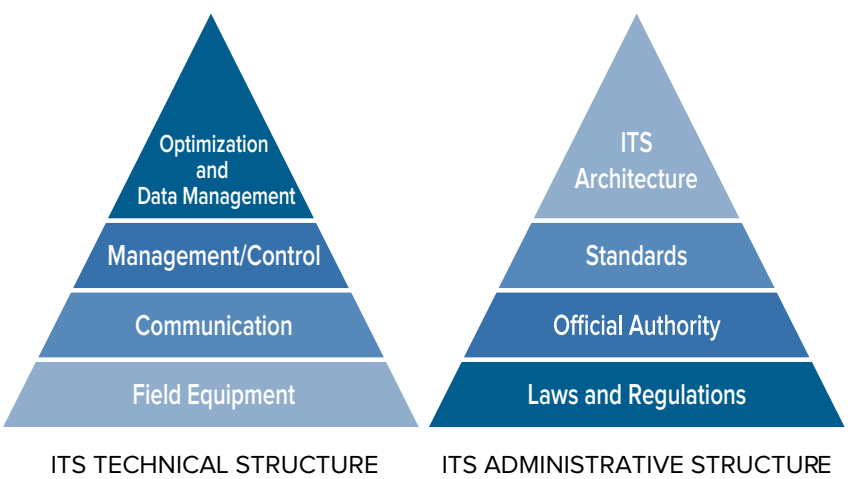
- Ensure the integration of all modes of transport based on developed ITS architecture and determined standards.
- Improve the existing ITS infrastructure and integrate it with the deployed C-ITS infrastructures, and to expand them across the country.
- Spread the use of in-vehicle information and communication systems and to perform studies on the domestic and national production of these systems.
- Conduct preparatory studies to make the existing infrastructure suitable for autonomous driving, and to develop fully autonomous vehicles and spread their use in all modes of transport.
- Perform the system and infrastructure works required to convert the motion energy of the rail systems into green energy.
- Perform legislation studies on vehicle and drive sharing, micro-mobility and similar alternative new transportation applications.
- Spread the use of Blockchain technologies in MaaS, data sharing, freight and logistics services and similar areas.
- Perform legislative arrangements for hover taxi (VTOL), drone and similar vehicles and spread its use within scope of ITS.
- Spread the use of smart materials, surface coating, nanotechnology and biotechnology products, recyclable and similar materials in the intelligent transportation field.
- Establish an IoT network incorporating ITS components to store the data collected from these components within big data environment and convert it into analyzable data and, optimize the transportation infrastructure using innovative technologies in artificial intelligence, deep learning, communication and similar fields.

- Anonymize the collected transportation data and use them for researches and development of innovative applications.
- Implement practices aimed at reducing traffic jams such as congestion charging, high-occupancy lane, low emission zone, flexible working hours, etc.
- Spread the use of smart energy solutions in the field of ITS.
- Expand accessibility applications in all modes of transportation.
- Facilitate transport operations by integrating the logistics centers with transport modes.
- Deploy and expand Autonomous Driving Test and Certification Centers where functional and operational tests of autonomous vehicles are performed and certification services are provided.
- Spread the sustainable urban mobility plans.

8.5 Actions

The actions that will be performed towards achieving the vision were planned by taking into account the basic functional structure of ITS. This structure is illustrated in Figure 13.

Figure 13: Technical and Administrative Structure of ITS



As seen in Figure 13, in order to achieve an implementable, efficient, effective and sustainable ITS, the technical and administrative structure has to be thoroughly defined. In our country, the ITS Technical Structure (except Optimization and Data Management) in some metropolitan cities and on important routes, is in operation. Strengthening the ITS Administrative Structure is important since it ensures ITS integration, efficiency and sustainability. Therefore, when determining the actions, the completion of the technical and administrative ITS structures has been addressed as a priority task.

Only one responsible institution has been assigned for each action in the action plan. However, regarding the actions defined for cities, municipalities were designated as the responsible institution in order for nationwide implementation.

To ensure coordination in the actions under the responsibility of the municipalities and metropolitan municipalities, before the implementation of the actions, a meeting will be held with the metropolitan municipalities' officials under the chairmanship of DGComms with the aim of establishing "Metropolitan Municipalities ITS Application Committee. This committee will ensure concerted implementation of the actions under the responsibility of the metropolitan cities.

STRATEGIC GOAL-1

DEVELOPMENT OF THE ITS INFRASTRUCTURE

Intelligent infrastructures that are capable of processing huge amounts of data collected in real-time and that can deliver better transportation services to businesses and citizens, are needed in our country as in the whole world.

11th Transportation, Maritime Affairs and Communications Forum aims to ensure technical and actual cooperation and coordination in transportation and to establish cities that “act together” at the national level. It will be easier to achieve this goal when the cities are equipped with intelligent transportation systems. Establishment of a technically and administratively strong ITS infrastructure is required for an applicable, efficient, effective, and sustainable transportation network. The strategic goal with the title “Development of the ITS Infrastructure”, has been determined to achieve this strong structure shown in Figure 13.

Action 1.1. Meeting the ITS Legislation Requirements

Legislation studies will be conducted for the subjects needed in the ITS field to enable our country to manage the ITS policies and projects effectively and efficiently.

This first action under the strategic goal “development of the ITS Infrastructure” will be implemented by DGComms. The action consisting of one implementation step will be implemented in cooperation with Ministry of Transport and Infrastructure’s Affiliated, Associated and Relevant Institutions, ICTA, Universities and PDPA.

75% part of an action will have been completed as the relevant legislation nears issuance phase, while the remaining 25% will be completed once the legislation is passed.

1.1. Meeting the ITS Legislation Requirements

Aim of Action	In order to ensure the establishment of a structure that will increase the efficiency and effectiveness of intelligent transportation systems in our country; setting policies, strategies and goals in this field and monitoring their implementation, making sure the identified standards are adopted nationwide to ensure the interoperability of the rapidly-spreading intelligent transportation systems and applications, preparing the legislation that will be needed in the ITS field within the scope of deployment of the communication infrastructures which constitutes the basis of these systems’ operability.
Implementation Step	**Conducting legislation studies**
Method	Legislation studies will be conducted on the applicability of the ITS architecture, nationwide adoption of identified ITS standards, in-vehicle communication systems, establishment of autonomous driving testing areas, expansion of the C-ITS, collection, sharing and security of the ITS data, compatibility, integration, interoperability in the ITS, etc.
Responsible Institution	DGComms
Institutions to Cooperate	Affiliated, Relevant and Associated Institutions of Ministry of Transport and Infrastructure, ICTA, PDPA, Universities
Action Completion Time	2023
Measurement Criteria	1- Completion of the legislative process before final approval 2- Promulgation of the legislation

Action 1.2. Development and Publishing of the ITS Architecture

The Intelligent Transportation System (ITS) architecture is a conceptual design that defines the structure of an integrated ITS and how it operates. The most important goal of the intelligent transportation systems architecture is to ensure the integration and interoperability in the ITS applications delivered at national or regional level, and to prevent the loss of cost and time by avoiding overlapping investments.

11th Transportation, Maritime Affairs and Communications Forum, remarking the new era of intelligent transportation in the citird, has set the objective: “Expanding the Intelligent Transportation Systems in the cities and providing integration with the National Intelligent Transportation System”. The development and publishing of the draft ITS architecture will ensure achieving this goal.

The national ITS architecture will put forward the relationship between the ITS standards, services, functions, technologies and data. The ITS architecture will also provide a roadmap for data sharing, management and planning.

This action under the strategic goal “development of the ITS Infrastructure” will be implemented by DGComms with the cooperation of Ministry of Industry and Technology, Ministry of Environment and Urbanization, DGH, GDS, GCC, ICTA, Universities, TÜBİTAK, PDPA, NGOs and Metropolitan Municipalities.

The action consists of two implementation steps. In the first implementation step, the national ITS architecture will be prepared. If the first implementation step is carried out by 2022, 50% of this action will have been completed successfully.

In the second implementation step, the national ITS architecture user manual will be prepared. If this manual is published by the end of 2023, the remaining 50% will have been completed successfully.

1.2. Development and Publishing of the ITS Architecture

Aim of Action	A national ITS architecture will provide a framework to plan, define, deploy and integrate the intelligent transportation systems. The architecture will allow simultaneously tracking the user services, the tasks and functions performed by the institutions as well as the information and data flows connecting the institutions. The architecture will show the user services provided over the ITS, the functions of the institutions and which information is transmitted between the components (flows).
Implementation Step-1	**1.2.1 Completion of the national ITS architecture**
Method	1. An intelligent transportation systems architecture development working group will be formed. 2. The architectures of the countries such as the USA, EU, South Korea, Japan, etc. will be reviewed. 3. Current situation analysis and inventory conduct will be performed to prepare a design meeting the needs of all the stakeholders. 4. Country reviews, current situation analysis and inventory conduct reports will be prepared. 5. After the determination of the reference architecture, it will be adopted according to the national requirements. In this context; - The ITS services will be defined accurately and completely. (user services; travel planning, traffic and emergency management, road pricing, etc.) - The transactions required for the user services will be defined as detailed activities and functions. - The physical units constituting the ITS will be defined on a sub-system basis. (roadside equipment, in-vehicle systems, control systems, etc.) - The interfaces required to enable data and information exchange between the physical components will be designed. - The stakeholders' roles and responsibilities will be determined. - The architecture enabling the connection between the ITS sub-systems and their boundaries will be physically created. 6. The relevant stakeholders will be provided with trainings on the established architecture. 7. A software tool to allow the stakeholders to use and update the architecture will be put into service.
Responsible Institution	DGComms
Institutions to Cooperate	Ministry of Industry and Technology, Ministry of Environment and Urbanization, Ministry of Interior, DGH, GDS, GCC, ICTA, PDPA, TÜBİTAK, Universities, Metropolitan Municipalities, NGOs, Relevant institutions and organizations
Action Completion Time	2022
Measurement Criteria	Preparing the ITS architecture
Implementation Step-2	**1.2.2 Preparation of the national ITS architecture user manual**
Method	The intelligent transportation systems architecture user manual will be prepared.
Responsible Institution	DGComms
Institutions to Cooperate	Ministry of Industry and Technology, Ministry of Environment and Urbanization, Ministry of Interior, DGH, GDS, GCC, ICTA, PDPA, TÜBİTAK, Universities, Metropolitan Municipalities, NGOs, Relevant institutions and organizations
Action Completion Time	2023
Measurement Criteria	Preparation of the manual

Action 1.3. Identification and Classification of the ITS Standards

The standards published directly and indirectly about ITS will be listed by the ITS Standard Working Group to be established. Then, these standards will be classified according to the subjects based on this list and will be made available to users. This action will be implemented by DGComms with the cooperation of ICTA, TSI, universities, private sector institutions, research institutions, NGOs and metropolitan municipalities in three implementation steps.

The first implementation step aims to establish a national ITS standard working group. If the implementation step is actualized in 2021, 30% of this action will have been completed successfully.

In the second step, 50% of the action will have been completed successfully if the ITS standards are classified until the end of 2023. In the third step, the determined standards will be included in the ITS architecture.

If this action step is completed until the end of 2023, the remaining 20% of the action will have been actualized successfully.

1.3. Identification and Classification of the ITS Standards

Aim of Action	Identify and classify directly or indirectly approved national and international standards in order to ensure efficiency and integration of ITS applications and projects.
Implementation Step-1	**1.3.1 Establishment of the ITS Standards Working Group**
Method	The institutions/organizations to be included in The ITS Standards Working Group and the working method will be determined.
Responsible Institution	DGComms
Institutions to Cooperate	ICTA, TSI, Universities, Private Sector Institutions, Research Institutions, Metropolitan Municipalities, NGOs, Relevant institutions and organizations
Action Completion Time	2021
Measurement Criteria	Establishment of the working group and holding its first meeting
Implementation Step-2	**1.3.2 Classification of the existing standards within the context of ITS**
Method	1. The ITS Standards Working Group will review, identify and determine the existing standards. 2. The ITS Standards Working Group will prepare a list of standards fitting compatible with the determined ITS architecture.
Responsible Institution	DGComms
Institutions to Cooperate	ICTA, TSI, Universities, Private Sector Institutions, Research Institutions, Metropolitan Municipalities, NGOs, Relevant institutions and organizations
Action Completion Time	2023
Measurement Criteria	Determination of the ITS standards compatible with the national ITS Architecture
Implementation Step-3	**1.3.3 Inclusion of the determined standards in the ITS architecture**
Method	1. The determined and classified standards will be correlated with the relevant sections of the ITS architecture. 2. These standards will be included in the ITS architecture.
Responsible Institution	DGComms
Institutions to Cooperate	Ministry of Industry and Technology, Ministry of Environment and Urbanization, Ministry of Interior, DGH, GDS, GCC, ICTA, PDPA, TÜBİTAK, Universities, Metropolitan Municipalities, NGOs, Relevant institutions and organizations
Action Completion Time	2023
Measurement Criteria	Inclusion of the determined standards within the ITS architecture

Action 1.4. Deployment of Provincial Traffic Control Centers

Measurement and data collection are important issues to solve the traffic problems of the metropolitan cities. The control centers will manage the city traffic efficiently through the evaluation of the data collected from the camera systems, critical intersections and passage points, vehicles' navigation and GPS devices and other similar systems.

Traffic control centers will be deployed in the metropolitan municipalities. These centers will enable instant monitoring of the traffic flow, density and incident data. Traffic measurement and observation infrastructure will be created using sensors to obtain instant traffic flow data and to be able to make future planning and event forecasts.

In addition, the existing traffic control centers will be adapted to the latest ITS architecture. These Provincial Traffic Control Centers, when deployed, will ensure data exchange with the relevant centers of other institutions and organizations in line with the ITS architecture.

This action will be implemented by Metropolitan Municipalities with the cooperation of Ministry of Transport and Infrastructure-General Directorate General of Communications, Ministry of Environment and Urbanization, DGH, GDS, GCC, AFAD, PDPA, General Directorate of Provincial Administration, Universities, and NGOs. Ensuring the integration of Provincial Traffic control centers with centers such as 112 emergency call centers or Security and Emergency Coordination Centers will be evaluated.

When traffic control centers and sensor infrastructures are deployed in the designated metropolitan municipality by the end of 2023, this action will have been completed.

1.4. Deployment of Provincial Traffic Control Centers

Aim of Action	Deploy provincial traffic control centers where the traffic is monitored, controlled and the collected data is used for information and planning to ensure fast, safe and comfortable transport for people living in the cities.
Implementation Step-1	**1.4.1 Deploying provincial traffic control centers**
Method	1. The Metropolitan Municipalities ITS Application Committee will determine and document the minimum requirements of the provincial traffic control centers. 2. The designated metropolitan municipalities, taking into account this document, will complete the deployment of the provincial traffic control center. 3. The committee will share the progress and status information for the implementation of the action every 6 months with the institutions to cooperate with.
Responsible Institution	Metropolitan Municipalities
Institutions to Cooperate	DGComms, Ministry of Environment and Urbanization, DGH, GDS, GCC, AFAD, PDPA, General Directorate of Provincial Administration, Universities, and NGOs
Action Completion Time	2023
Measurement Criteria	Deployment of provincial traffic control centers in specified provinces
Implementation Step-2	**1.4.2 Deployment of sensor infrastructure to collect traffic flow data in arterial roads (the busiest highways)**
Method	1. The Metropolitan Municipalities ITS Application Committee will determine and document the common technical criteria. 2. The designated metropolitan municipalities, in light of the Committee's document, will prepare a project document specifying the sensor requirements, deployment locations, and all other technical, administrative and feasibility requirements. 3. The sensor data will be monitored at the provincial traffic control center within the framework of the project document. 4. The committee will share the progress and status of the action every 6 months with the cooperating institutions.
Responsible Institution	Metropolitan Municipalities
Institutions to Cooperate	DGComms, Ministry of Environment and Urbanization, DGH, GDS, GCC, AFAD, PDPA, General Directorate of Provincial Administration, Universities, and NGOs
Action Completion Time	2023
Measurement Criteria	Deployment of sensor infrastructures in the arterial roads of designated municipalities

Action 1.5. Deployment of Road Traffic Control Centers

Road Traffic Control Centers will be deployed in the Regional Directorates of the Directorate General of Highways. These centers will enable to monitor traffic flow, density, and incident data in real-time. Additionally, Traffic measurement and observation infrastructure will be created using sensors to obtain real-time traffic flow data and make future planning and event forecasting. The existing traffic control centers will be adapted to the latest ITS architecture. The traffic control centers that will be deployed, will operate in integration with all the existing control centers (tunnel, bridge, etc.) of the relevant province.

This action will be completed by DGH with the cooperation of Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, DGComms, GDS, GCC, AFAD, PDPA, General Directorate of Provincial Administration, Universities, and NGOs.

The action will be completed when Road Traffic Control Centers are deployed in at least 2 Highway Regional Operating Centers by the end of 2023 and sensor infrastructure necessary for traffic flow data are deployed on roads in the entire region where the Traffic Control Center is deployed.

1.5. Deployment of Road Traffic Control Centers

Aim of Action	Deploy Road Traffic Control Centers where the traffic is monitored, controlled and the collected data is processed for information and planning to ensure fast, safe and comfortable transport for people living in the cities.
Implementation Step-1	**1.5.1 Deployment of road traffic control centers**
Method	1. The criteria of an integrated, interoperable Road Traffic Control Center conforming to the standards will be specified. 2. The systems that will be equipped in the Road Traffic Control Centers will be designed. 3. The criteria for the data exchange between the institutions and organizations to cooperate in line with the ITS architecture will be determined. 4. The Road Traffic Control Centers will be deployed.
Responsible Institution	DGH
Institutions to Cooperate	Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, DGComms, GDS, GCC, AFAD, PDPA, General Directorate of Provincial Administration, Universities, and NGOs
Action Completion Time	2023
Measurement Criteria	Deployment of Road Traffic Control Centers in at least 2 Regional Directorate of Highways
Implementation Step-2	**1.5.2 Deployment of traffic flow sensor infrastructure in state roads and highways**
Method	1. The technical, administrative, and feasibility documentation specifying the quantity, type, and deployment locations of the sensors, will be prepared as a project, then necessary arrangements will be made on the project in line with the opinions of the institutions to cooperate with. 2. The sensors will be deployed and monitored over the Road Traffic Control Center. 3. The progress and status of the action will be shared every 6 months with the cooperating institutions.
Responsible Institution	DGH
Institutions to Cooperate	Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, DGComms, GDS, GCC, AFAD, PDPA, General Directorate of Provincial Administration, Universities, and NGOs
Action Completion Time	2023
Measurement Criteria	Deployment of sensor infrastructure required for traffic flow data collection in all roads in the region where the traffic control centers are established

Action 1.6. Expanding the ITS Communication Infrastructure

Fiber communication infrastructure will be deployed on the divided roads and highways falling under DGH's area of responsibility, in order to meet the communication needs of the planned ITS systems for traffic monitoring, measurement and management,.

This action will be completed by the DGH with the cooperation of DGComms and ICTA. The action will have been actualized when fiber and broadband infrastructure is deployed on at least 5% of all divided roads and highways by the end of 2023.

1.6. Expanding the ITS Communication Infrastructure

Aim of Action	Make the communication infrastructure ready by using latest technologies to deliver fast and efficient ITS applications and services across the country.
Implementation Step	**Completion of the incomplete fiber and broadband infrastructures in all state roads and highways**
Method	1. The roads with planned maintenances, repairs and improvements, the roads under construction and the roads planned to be constructed will be listed in a report within scope of fiber and broadbant infrastructure deployments. 2. In accordance with this report, the roads will be determined on which the communication infrastructure will be deployed. 3. The necessary infrastructure deployments will be realized.
Responsible Institution	DGH
Institutions to Cooperate	DGComms, ICTA
Action Completion Time	2023
Measurement Criteria	Deployment of fiber and broadband infrastructure on at least 5% of all divided roads and highways

Action 1.7. Smart Parking Application and Deployment of Electric Vehicle Charging Station

Parking lot issue is amongst the main causes of congestions in urban traffic. Regarding these issues, an exemplary application will be realized for developing intelligent parking projects to resolve the parking lot problems and save time and fuel in metropolitan cities. Within the scope of the study, an infrastructure will be deployed which enables online monitoring of empty-occupied parking areas in the parking lots.

This action will be completed by the metropolitan municipalities with the cooperation of Ministry of Environment and Urbanization. 75% of the action will have been completed successfully if a smart parking application is actualized in at least one metropolitan municipality by the end of 2022.

The remaining 25% of the action will have been completed when at least one electric vehicle charging station is established in the smart parking area established in the second implementation step.

1.7. Smart Parking Application and Deployment of Electric Vehicle Charging Stations

Aim of Action	Deployment of an infrastructure that allows online monitoring of empty-occupied parking space amounts in the parking lots.
Implementation Step-1	**1.7.1 Development of a smart parking application**
Method	An exemplary project will be developed specifying all hardware, software and similar requirements for smart parking. The minimum project requirements; - Communication of the centrally-managed parking area sensors and the parking meters with the intelligent mobile devices will be ensured. - The parking areas will be managed according to the identification, guiding, warning and charging information automatically provided by the system. - It will operate integrated with the mobile phone applications in real-time. - Drivers will be provided information and suggestions about free parking spaces, fees, timing and alternative location information, warnings.
Responsible Institution	Metropolitan Municipalities
Institutions to Cooperate	Ministry of Environment and Urbanization
Action Completion Time	2022
Measurement Criteria	Deployment of a smart parking in at least one of the metropolitan municipalities
Implementation Step-2	**1.7.2 Deployment of Electric Vehicle Charging Station**
Method	1.7.1 Charging station will be deployed for electric vehicles at a suitable location within the parking lot deployed as per Implementation Step 1.
Responsible Institution	Metropolitan Municipalities
Institutions to Cooperate	Ministry of Environment and Urbanization
Action Completion Time	2022
Measurement Criteria	Deployment of at least one electric vehicle charging station in the smart parking

Action 1.8. Establishment of the Test and Application Corridor for C-ITS

It is aimed to deploy a C-ITS test and application corridor that will contribute to transforming the solutions developed in line with the requirements of ITS technologies into final products.

Applications will be developed based on communication technologies that involve concepts such as vehicle-to-infrastructure (V2I), vehicle-to-vehicle (V2V), infrastructure-to-vehicle (I2V), infrastructure-to-infrastructure (I2I) and generally referred to as vehicle-to-everything (V2X). It is aimed to reduce the accidents and traffic jams, ensure traffic safety, and reduce fuel consumption and negative environmental impacts with the corridor to be deployed. For this purpose, a transportation corridor will be deployed to provide basic services such as stationary car notification, emergency vehicle right of way, road construction, weather forecast, road status and traffic information. Cellular communication, new generation cellular communication, ITS-G5, RDS and similar communication technologies will be used through the corridor.

Various cooperative ITS applications will be tested under real-life traffic conditions to increase the traffic safety and efficiency. The services that will be offered within the C-ITS applications will help drivers drive safely and comfortably in the traffic. The stationary vehicle warning service will notify of the vehicles that have suddenly stalled or slowed down on the route. The weather forecast and road status information service will provide drivers with weather and road status information. The road works warning service will notify drivers of the zones where stationary and mobile road works being performed. The traffic status information service will provide information about the locations where the traffic is dense. Furthermore, the emergency vehicle right of way service will prioritize the vehicles with right of way in emergencies such as ambulance, fire truck and similar vehicles.

This action will be implemented in two implementation steps by the DGH with the cooperation of DGComms , Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, Ministry of Industry and Technology, TÜBİTAK, Universities, Municipalities and NGOs.

In the first implementation step, the C-ITS test and application corridor will be planned. 50% of the action will have been completed when the C-ITS test and application corridor is designated, its technical and administrative documentation is prepared and the project is planned by the end of 2021.

In the second implementation step, the remaining 50% of the action will have been completed when the deployment of the C-ITS test and application corridor is completed by the end of 2023.

1.8. Deployment of the Test and Application Corridor for C-ITS

Aim of Action	Deploy a C-ITS test and application corridor that will contribute to transforming the developed ITS solutions into final products.
Implementation Step-1	**1.8.1 Planning of the test and application corridor for C-ITS**
Method	1. The technical, administrative and feasibility documentation of the C-ITS test and application corridor will be prepared. 2. A project including the technical, administrative and feasibility documentation will be prepared.
Responsible Institution	DGH
Institutions to Cooperate	DGComms, Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, Ministry of Industry and Technology, TÜBİTAK, Universities, Municipalities and NGOs
Action Completion Time	2021
Measurement Criteria	Completion of preparation of the C-ITS test and application corridor project
Implementation Step-2	**1.8.2 Deployment of the test and application corridor for C-ITS**
Method	1. According to the project prepared in the implementation step 1.8.1, necessary installations will be performed for the C-ITS test and application corridor. In this implementation step, the following basic basic notification services (including but not limited to); - slow or stationary vehicle(s), - emergency brake light, - emergency vehicle approaching, - road works warning, - weather condition notification, - road and traffic status warnings, will be applied and tested. 2. ITS G5, RDS and cellular communication (3G, 4.5G, 5G) tests will be performed.
Responsible Institution	DGH
Institutions to Cooperate	DGComms, Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, Ministry of Industry and Technology, TÜBİTAK, Universities, Municipalities and NGOs
Action Completion Time	2023
Measurement Criteria	Deployment of the test and application corridor for C-ITS

Action 1.9. Establishment of New Incentive Mechanisms to Develop Domestic and National Technologies

This action aims to establish new incentive mechanisms to develop domestic and national ITS technologies. Especially the studies on autonomous systems, robotics, big data, artificial intelligence and new generation communication technologies will be included in the funding programs within the scope of ITS.

In the first implementation program of the action, Ministry of Transport and Infrastructure-UDHAM(Transport, Maritime and Communication Research Center) will include the ITS projects in Ministry of Transport and Infrastructure funding programs with the cooperation of DGComms, Ministry of Environment and Urbanization, Ministry of Industry and Technology, Ministry of Interior, ICTA, TÜBİTAK, KOSGEB, Provincial Bank, and UMT. 35% of this action will have been completed if at least one project, for each annual period, is covered by the program by the end of 2023.

In the second implementation step, Ministry of Industry and Technology, to include the ITS-related projects in the annual funding programs, will cooperate with DGComms, Ministry of Interior, Ministry of Environment and Urbanization, ICTA, TÜBİTAK, KOSGEB, Provincial Bank and UMT. 35% of this action will have been completed if at least one project, for each annual period, is covered by the end of 2023.

In the third implementation step, ITS ecosystem will be informed by TÜBİTAK, regarding the international funding programs with the cooperation of DGComms, Ministry of Foreign Affairs Directorate of European Union and TDZ. 30% of this action will have been completed if a meeting is held with stakeholders every six months by the end of 2023 within scope of this final implementation step.

1.9. Establishment of New Incentive Mechanisms to Develop Domestic and National Technologies

Aim of Action	Build incentive mechanisms that will first meet the national ITS requirements and then develop unique, domestic and national technologies capable of competing at global scale, and establish an integrated ecosystem incorporating all supporting mechanisms including manufacturers.
Implementation Step-1	**1.9.1 Inclusion of the ITS projects in Ministry of Transport and Infrastructure funding programs**
Method	1. ITS related priority topics to be included in the funding programs will be selected. 2. The subjects selected for each funding period will be included in the funding programs.
Responsible Institution	Ministry of Transport and Infrastructure-UDHAM
Institutions to Cooperate	DGComms, Ministry of Interior, Ministry of Environment and Urbanization, Ministry of Industry and Technology, ICTA, TÜBİTAK, KOSGEB, Provincial Bank, UMT
Action Completion Time	2023
Measurement Criteria	Inclusion of at least one ITS related project topic for each annual period.
Implementation Step-2	**1.9.2 Inclusion of ITS-related topics in the annual funding programs**
Method	1. The prioritized ITS related issues that will be included in the funding programs will be specified. 2. The topics determined for each funding period will be included in the funding programs.
Responsible Institution	Ministry of Industry and Technology
Institutions to Cooperate	DGComms, Ministry of Interior, Ministry of Environment and Urbanization, ICTA, TÜBİTAK, KOSGEB, Provincial Bank, UMT
Action Completion Time	2023
Measurement Criteria	Inclusion of at least one project topic within the context of ITS each year
Implementation Step-3	**1.9.3 Informing the ITS ecosystem on the international funding programs**
Method	1. A semi-annual information meeting will be planned. 2. Meetings will be held to address the latest topics and conditions of the international incentive mechanisms to inform the ITS ecosystem.
Responsible Institution	TÜBİTAK
Institutions to Cooperate	DGComms, Ministry of Foreign Affairs-Directorate of European Union, TDZ
Action Completion Time	2023
Measurement Criteria	Holding semi-annual meetings with the stakeholders

Action 1.10. Exploring the Disruptive and Innovative Technologies and Their Impacts on the ITS Field

This action will explore the developments in the artificial intelligence, deep learning, big data, mobile technologies, robotics, IoT, industry 4.0 and similar technologies, and publish a report on their effects on the ITS industry.

The action will be completed by DGComms with the cooperation of Ministry of Industry and Technology, ICTA, TÜBİTAK, Universities and NGOs.

The action will have been actualized provided that the document is ready by the end of 2021.

1.10. Exploring the Disruptive and Innovative Technologies and Their Impacts on the ITS Field

Aim of Action	Explore the impacts of disruptive and innovative technologies on our country's ITS systems and transportation industry, and develop a roadmap for the projects.
Implementation Step	**Preparation of a research report within the context of disruptive and innovative technologies**
Method	A report will be prepared on the impacts of artificial intelligence, Internet of Things (IoT), industry 4.0, virtual and augmented reality, cloud computing and big data on our country's ITS policies and applications.
Responsible Institution	DGComms
Institutions to Cooperate	Ministry of Industry and Technology, ICTA, TÜBİTAK, Universities, NGOs
Action Completion Time	2021
Measurement Criteria	Preparation of the relevant report

STRATEGIC GOAL-2

ENSURING SUSTAINABLE SMART MOBILITY

Smart mobility is defined as the optimization of passenger and freight mobility through accurate and instantaneous information on options in different transport modes to be provided using applications and services based on real-time data.

Smart mobility uses different modes of transportation in passenger and freight mobility, and thus provides comfortable, safe and flexible solutions. Therefore, by collecting and analyzing data from different modes of transportation, the entire transportation system is coordinated and sustainability is ensured. In the 11th Transportation, Maritime Affairs and Communications Forum, “To utilize the information and communication technologies extensively and effectively in order to complete the transformation of our country into an information society, and to increase the added value in the production of these technologies” was set as an information and communication goal. Creating and updating the “national mobility database”, and ensuring non-disabled transportation to the areas where citizens are served with all kinds of transportation means such as airports, railroad terminals, station, ports in all sectors are also among the goals of the forum. “To increase domestic added value in production” and “to ensure non-disabled transportation” were accepted as primary goals, and “Ensuring Sustainable Smart Mobility” was set as the strategic goal in the forum.

Action 2.1. ITS for Disabled Individuals and Individuals with Limited Mobility

Ministry of Family, Labor and Social Services will determine the requirements to increase the mobility and comfort of the individuals with limited mobility, and designate the institutions that will meet these requirements. This action will be actualized with the cooperation of Ministry of Transport and Infrastructure, Ministry of Interior, Ministry of Health, PDPA, NGOs, UMT and Municipalities.

In the first implementation step, a document on the ITS-related needs and solution recommendations will be prepared for those with limited mobility. 50% of this action will have been completed if a document including the studies performed is published until the end of 2021.

In the second implementation step, ITS projects and documentation for the responsible institutions for those with limited mobility, will be prepared and shared with the relevant institutions. The remaining 50% of this action will have been completed if a document including the studies performed is published by the end of 2021.

2.1. ITS for Disabled Individuals and Individuals with Limited Mobility

Aim of Action	Identify the ITS-related needs and solutions to facilitate the lives of individuals with limited mobility, and determine the institutions to provide these solutions.
Implementation Step-1	**2.1.1 Identify the ITS-related needs and discover solutions to facilitate the lives of individuals with limited mobility**
Method	A document including the problems faced during transportation, needs and recommended solutions for disabled individuals and individuals with limited mobility will be prepared and shared with the relevant institutions.
Responsible Institution	Ministry of Family, Labor and Social Services
Institutions to Cooperate	Ministry of Transport and Infrastructure, Ministry of Interior, Ministry of Health, PDPA, NGOs, UMT, Municipalities
Action Completion Time	2021
Measurement Criteria	Preparing and sharing with relevant institutions a document including the needs and recommended solutions
Implementation Step-2	**2.1.2 Identifying what ITS projects are needed by disabled individuals and individuals with limited mobility, and responsible institutions**
Method	According to the document prepared in the implementation Step 2.1.1, a report including the projects needed and the institutions responsible for these projects will be prepared and shared with the relevant institutions/organizations.
Responsible Institution	Ministry of Family, Labor and Social Services
Institutions to Cooperate	Ministry of Transport and Infrastructure, Ministry of Interior, Ministry of Health, PDPA, NGOs, UMT, Municipalities
Action Completion Time	2021
Measurement Criteria	Preparation of the document on the projects and responsible institutions and sharing it with the relevant institutions

Action 2.2. Passenger Information System

Passenger information systems will be deployed to deliver the public transport services information directly and instantly to passengers. These systems, when deployed, will also meet the needs of individuals with limited mobility. Additionally, as with public transport services diversifying and expanding, data sharing method for academic research and analyses will be established.

The action will be realized by Metropolitan Municipalities with the cooperation of Ministry of Family, Labor and Social Services, Ministry of Environment and Urbanization, ICTA, PDPA and UMT.

In the first implementation step, passenger information displays integrated with public transport vehicles, taking into account individuals with limited mobility, will be deployed at public transport stops and inside vehicles. 50% of the action will have been completed when this system is deployed in at least 20% of the terminals and in all of the existing vehicles of the designated municipalities by the end of 2022.

In the second implementation step, the basic data collected from all public transport vehicles will be shared anonymously. This will help develop and expand passenger information systems. The remaining 50% of the action will have been completed if the approach and method to be followed for automatic access to these basic data are determined and announced on the web sites of the designated municipalities by the end of 2022.

2.2. Passenger Information System

Aim of Action	Make transportation more efficient and comfortable through sharing real-time information about public transport, traffic status, weather forecast and social incidents with passengers waiting at the stop or traveling on the bus.
Implementation Step-1	**2.2.1 Installation of passenger information displays integrated with public transport vehicles at public transport stops and inside vehicles, with taking into account individuals with limited mobility.**
Method	1. The Metropolitan Municipalities ITS Applying Committee will determine the common technical criteria within the scope of the action. 2. The committee will prepare a report including the studies and this report will be taken as reference documentation by the responsible institutions. 3. Each metropolitan municipality, within framework of the reference document, will determine at which stops to deploy the passenger systems depending on the passenger density in line with the needs of their province. 4. The systems will be deployed at the specified stops and on all buses.
Responsible Institution	Metropolitan Municipalities
Institutions to Cooperate	Ministry of Family, Labor and Social Services, Ministry of Environment and Urbanization, ICTA, PDPA and UMT
Action Completion Time	2022
Measurement Criteria	Deployment of the system in at least 20% of the terminals as well as inside all the existing vehicles of the designated municipalities
Implementation Step-2	**2.2.2 Opening the raw data collected from all public transport vehicles for the mobile passenger information system to share anonymously**
Method	1. The Metropolitan Municipalities ITS Applying Committee will determine the common technical criteria within the scope of the action. 2. The committee will prepare a report including the studies and this report will be taken as a reference documentation by the responsible institutions. 3. Each metropolitan municipality will anonymize the data required for the applications that will be developed by the public and private sector to increase the efficiency and facilities offered to passengers in public transport services in their provinces within the framework of the reference documentation. 4. Each provincial municipality will publish data-sharing procedures, principles, and methods on its own web page.
Responsible Institution	Metropolitan Municipalities
Institutions to Cooperate	Ministry of Family, Labor and Social Services, Ministry of Environment and Urbanization, ICTA, PDPA and UMT
Action Completion Time	2022
Measurement Criteria	Announcement of the automatic data accessing approach and methods on the web pages of the designated municipalities

Action 2.3. Single Card Payment System

Actualization of this action will develop a common payment system across the country and deliver a card that allows traveling on all public transport vehicles. The action will be actualized by the PTT with the cooperation of DGComms, Ministry of Environment and Urbanization, TSR, TCDD Transport JSC., RA, UMT, and Metropolitan Municipalities.

In the first implementation step, the existing public transport electronic toll collection systems will be examined, a review report will be prepared by the end of 2021 and this report will be shared with the relevant institutions, and thus 10% of the action will have been completed.

In the second implementation step, the design of the common electronic toll collection system will be completed. Another 20% of the action will have been completed when the design document is shared with the relevant institutions by the end of 2021.

In the third implementation step, test, certification, card and clearinghouse centers will be established. Another 20% of the action will have been completed when the center is established by the end of 2021.

In the fourth implementation step, the common electronic toll collection system will be developed and applied in the pilot provinces. Another 20% of the action will have been completed when the pilot scheme is realized in at least two provinces by the end of 2022.

In the fifth implementation step, the common electronic toll collection system will be expanded. The remaining 30% of the action will have been completed when the system is implemented in at least 10 other metropolitan municipalities in addition to the pilot provinces by the end of 2023.

2.3. Single Card Payment System

Aim of Action	Ensure the integration of all public transportation toll collection systems at the national level through the establishment of a centralized system to enable passengers to benefit from all of these services with a single card.
Implementation Step-1	**2.3.1 Examination of the existing public transport electronic toll collection systems**
Method	1. A report will be prepared about the public transport charging systems currently used in our country and the world. 2. To establish the system within the framework of this report, the technical and administrative requirements of Turkey will be identified, a project feasibility study will be conducted, and a review report will be prepared.
Responsible Institution	PTT
Institutions to Cooperate	DGComms, Ministry of Environment and Urbanization, TSR, TCDD Transport JSC., RA, UMT, Municipalities
Action Completion Time	2021
Measurement Criteria	Preparation of the review report
Implementation Step-2	**2.3.2 Designing a common electronic toll collection system**
Method	A project document including the technical and administrative requirements as well as the feasibility study of the common electronic toll collection system will be prepared.
Responsible Institution	PTT
Institutions to Cooperate	DGComms, Ministry of Environment and Urbanization, TSR, TCDD Transport JSC., RA, UMT, Municipalities
Action Completion Time	2021
Measurement Criteria	Preparation of the design document
Implementation Step-3	**2.3.3 Establishment of the test, certification, card and clearing house**
Method	According to the document prepared in the implementation step 2.3.2, test, certification, card and clearing house will be established.
Responsible Institution	PTT
Institutions to Cooperate	DGComms, Ministry of Environment and Urbanization, TSR, TCDD Transport JSC.Transport JSC., RA, UMT, Municipalities
Action Completion Time	2021
Measurement Criteria	Establishment of the house
Implementation Step-4	**2.3.4 Realization of the common electronic toll collection system and implementation in the pilot provinces**
Method	According to the document prepared in the implementation step 2.3.2, a pilot project will be implemented.
Responsible Institution	PTT
Institutions to Cooperate	DGComms, Ministry of Environment and Urbanization, TSR, TCDD Transport JSC., RA, UMT, Municipalities
Action Completion Time	2022
Measurement Criteria	Actualization of pilot schemes in at least two provinces
Implementation Step-5	**2.3.5 Expanding the common electronic toll collection system**
Method	The system whose pilots completed as per implementation step 2.3.4, will be implemented in metropolitan municipalities.
Responsible Institution	PTT
Institutions to Cooperate	DGComms, Ministry of Environment and Urbanization, TSR, TCDD Transport JSC., RA, UMT, Municipalities
Action Completion Time	2023
Measurement Criteria	Realizing the deployments in at least 10 metropolitan municipalities other than the pilot scheme provinces

Action 2.4. Expanding the use of Drones for Logistics Purposes

This action will be implemented in the selected provinces to expand the use of drones for logistics purposes by the PTT with the cooperation of DGComms, and the Directorate General of Civil Aviation.

The action will have been actualized if the studies are completed by the end of 2022.

2.4. Expanding the use of Drones for Logistics Purposes

Aim of Action	Expanding the use of drones for logistics purposes.
Implementation Step	**Use drones in cargo transportation**
Method	1. Technical and administrative regulations will be prepared for cargo transportation with drones. 2. Drone standards to be applied in cargo transportation will be determined taking into account the international standardization studies. 3. Licensing will be performed for companies that will operate in drone transportation. 4. Priority provinces or regions for drone transportation will be designated and pilot scheme will be conducted.
Responsible Institution	PTT
Institutions to Cooperate	DGComms, Directorate General of Civil Aviation
Action Completion Time	2022
Measurement Criteria	Commencing of implementation in at least one province

STRATEGIC GOAL-3

ENSURING ROAD AND DRIVING SAFETY

Improving traffic safety and travel comfort with widespread intelligent transportation systems applications and maintaining uninterrupted traffic flow conditions, were set as one of the 2023 goals for all sectors during the 11th Transport, Maritime Affairs and Communications Forum.

To that end, “Ensuring Road and Driving Safety” has been specified as a strategic goal.

Action 3.1. Completion of the Road Radio Deployments.

This action aims to deploy a radio to inform drivers about the road status for safe and comfortable travel. The action will be actualized in two implementation steps.

In the first implementation step, the DGH will deploy a road radio in the pilot region with the cooperation of the TRT, RTÜK, AFAD and GDS. 25% of the action will have been completed if radio broadcasting starts until the end of 2021.

In the second implementation step, when radio broadcasting is started in at least 4 geographical regions by DGH in cooperation with TRT by the end of 2023 with the aim of expanding road radio across the country, the remaining 75% of the action will have been actualized.

3.1. Completion of the Road Radio Deployment

Aim of Action	Deploy a radio that will inform drivers about the road, weather, and emergencies for a safe and comfortable drive.
Implementation Step-1	**3.1.1 Deploying road radio in the selected Pilot Region**
Method	1. Road radio deployment methods will be specified. 2. Using this method, the road radio will be deployed in the pilot region.
Responsible Institution	DGH
Institutions to Cooperate	TRT, RTÜK, DGS, AFAD
Action Completion Time	2021
Measurement Criteria	Starting the radio broadcasting in the pilot region
Implementation Step-2	**3.1.2 Expanding the road radio across the country**
Method	The road radio, after deployed in pilot regions, will be expanded across various geographic regions to serve drivers.
Responsible Institution	DGH
Institutions to Cooperate	TRT
Action Completion Time	2023
Measurement Criteria	Starting the radio broadcasting in at least 4 pilot regions

Action 3.2. Creating Traffic Accidents Database

“Traffic Electronic Control Systems will be expanded and integrated with Intelligent Transportation Systems in line with the objective of reducing traffic accident mortality rate by %50 included in the Road Traffic Safety Strategy and Action Plan”, as so stated in Article 841 of 10th Development Plan, also set herewith as a main target.

In addition, “Improving traffic safety and travel comfort by making intelligent transportation systems applications widespread and maintaining uninterrupted traffic flow conditions” goal is included in the 11th Transport, Maritime Affairs and Communications Forum.

This action aims to achieve these goals, reduce accidents and create a safe driving environment.

The action will be actualized by Ministry of Interior with the cooperation of Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, DGH, Ministry of Health, Ministry of Environment and Urbanization, DGS, GCC, AFAD, Municipalities, and the Insurance Information and Monitoring Center.

The first implementation step will determine which studies to conduct regarding the collection of the transportation accident data. 30% of the action will have been completed if the transportation accidents data set is identified, approved and the database is created by the end of 2021.

The second implementation step aims to analyze the collected data and take measures to reduce accidents. 30% of the action will have been completed if the death rates in traffic accidents occur across the country is reduced by 6%; and accident blackspots by 10% until the end of 2023.

Provided that the electronic systems to prevent accidents due to the black spots are established in the third implementation step until the end of 2023, 40% of the action will have been completed.

3.2. Creating Traffic Accidents Database

Aim of Action	Create traffic accidents dataset, analyze the collected data based on this dataset and identify measures, realize the applications to reduce the loss of life and property in the traffic accidents occurring on the highways of our country.
Implementation Step-1	**3.2.1 Identification of the transportation accidents dataset**
Method	1. "Accidents Dataset" document will be prepared within the context of the data to be collected from accidents. 2. According to this document, an information infrastructure system to allow collection and monitoring of the data will be established.
Responsible Institution	Ministry of Interior
Institutions to Cooperate	Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, Ministry of Health, Ministry of Environment and Urbanization, DGH, GDS, GCC, AFAD, TÜİK, PDPA, Municipalities, Insurance Information and Monitoring Center
Action Completion Time	2021
Measurement Criteria	Determination of the Transportation Accidents Database and creation of the database
Implementation Step-2	**3.2.2 Analysis of the collected data**
Method	1. The accident data collected will be analyzed, the causes of the accidents as well as the causes of the deaths and injuries will be identified and the measures to take will be determined. 2. Necessary actions will be taken to ensure that the determined measures are implemented.
Responsible Institution	Ministry of Interior
Institutions to Cooperate	Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, Ministry of Health, Ministry of Environment and Urbanization, DGH, GDS, GCC, AFAD, TÜİK, PDPA, Municipalities, Insurance Information and Monitoring Center
Action Completion Time	2023
Measurement Criteria	Reducing the annual death rate in traffic accidents across the country by at least 6%
Implementation Step-3	**3.2.3 Expanding the electronic systems to reduce accidents**
Method	Accident black spots will be identified, electronic systems will be deployed to prevent these blackspot accidents.
Responsible Institution	Ministry of Interior
Institutions to Cooperate	Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, Ministry of Health, Ministry of Environment and Urbanization, DGH, GDS, GCC, AFAD, TÜİK, PDPA, Municipalities, Insurance Information and Monitoring Center
Action Completion Time	2023
Measurement Criteria	Deploying electronic systems to prevent black spot accidents as well as reducing the accident black spots by 10%

Action 3.3. In-Vehicle Information and Communication System (IVICS)

Collecting vehicle and road status information, electronic toll collection, accident and emergency status information, driver information and similar services are critical to ensure road and driving safety. For this purpose, studies will be conducted to determine in-vehicle information and communication systems using cellular and wireless communication technologies as well as the requirements of the technical infrastructure for these systems to collect data.

The action will be implemented by DGComms with the cooperation of Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, Ministry of Industry and Technology, ICTA, DGH, GDS, AFAD, TSI, TÜBİTAK, PDPA and NGOs.

The action will have been completed if the preparation of the technical infrastructure document is completed by the end of 2022.

3.3. In-Vehicle Information and Communication System (IVICS)

Aim of Action	A study will be conducted to determine the in-vehicle information and communication systems using cellular and wireless communication technologies as well as the technical requirements for these systems to collect data.
Implementation Step	**Determination of the technical specifications of the in-vehicle information and communication system**
Method	A study will be conducted to determine the technical specifications of the in-vehicle information and communication systems and relevant technical infrastructure document will be prepared.
Responsible Institution	DGComms
Institutions to Cooperate	Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, Ministry of Industry and Technology, ICTA, DGH, PTT, DGS, AFAD, TSI, TÜBİTAK, PDPA, NGOs
Action Completion Time	2022
Measurement Criteria	Preparation of the IVICS technical infrastructure document

Action 3.4. Construction of Smart Parking Lots for Dangerous Goods and Freight Transport Vehicles

This action aims to construct smart parking areas supported by electronic systems for the freight transportation, which is one of the components of ITS. In these areas, services will be provided to meet the needs of safe parking, accommodation, refueling, etc.

In addition, the mobile application that will be developed will share the locations of parking lots, occupancy rates, and other services that can be provided in parking areas.

This action will be implemented by Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation with the cooperation of Ministry of Transport and Infrastructure-Directorate General of Communications, DGH, DGS, Municipalities and NGOs.

Firstly, 75% of the action will be completed by constructing a parking area with at least one pilot scheme until 2023. In the second implementation step, 25% of the action will have been completed if the mobile application is put into service.

3.4. Construction of Smart Parking Lots for Dangerous Goods and Freight Transport Vehicles

Aim of Action	Construct parking areas to meet the safe parking, accommodation, refueling and similar needs for dangerous goods and freight transport vehicles, develop a mobile application to share location, occupancy rate of these parking lots and similar data.
Implementation Step-1	**3.4.1 Construction of parking lots**
Method	1. A pilot region will be selected for the parking lot application. 2. An implementation project will be prepared after the determination of all facilities, equipment, physical infrastructure and similar needs within the pilot region. 3. Constructions will be performed within scope of the project.
Responsible Institution	Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation
Institutions to Cooperate	DGComms, DGH, DGS, Municipalities, NGOs
Action Completion Time	2023
Measurement Criteria	Realization of at least one parking lot implementation projects at a specified location
Implementation Step-2	**3.4.2 Development of mobile application**
Method	After the completion of parking lot construction, a mobile application software that shows the parking area facilities and characteristics will be developed.
Responsible Institution	Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation
Institutions to Cooperate	DGComms, DGH, DGS, Municipalities, NGOs
Action Completion Time	2023
Measurement Criteria	Putting the mobile application into service

Action 3.5. Smart Level Crossing Application

Smart traffic control systems will be established to reduce the loss of lives and properties at level crossings and to ensure safe driving and controlled passage.

This action will be actualized with the cooperation of Ministry of Transport and Infrastructure-TSR with the cooperation of TCDD Transport JSC., DGH, DGS, and Municipalities.

The smart level crossing application in the designated pilot region will be completed until 2023.

3.5. Smart Level Crossing Application

Aim of Action	Deploy smart traffic control systems at level crossings to reduce the loss of lives and properties and ensure safe driving and controlled passage.
Implementation Step	**Realizing the Smart level crossing application**
Method	1. Necessary electronic systems will be installed on the rails and level crossings in the selected region. 2. Traffic signaling and driver information systems will be installed.
Responsible Institution	Ministry of Transport and Infrastructure-TSR
Institutions to Cooperate	TCDD Transport JSC., DGH, DGS, Municipalities
Action Completion Time	2023
Measurement Criteria	Realization of a pilot scheme in the selected region

STRATEGIC GOAL-4

CREATING A LIVABLE ENVIRONMENT AND CONSCIOUS SOCIETY

“Creating a Livable Environment and Conscious Society” in line with the goal of expanding smart pedestrianized zones and bicycle transport, expanding clean-fuel and highly energy efficient vehicle technologies in urban transport, expanding environmentally more sensitive green communication applications in” transportation and communication sectors” was set as the strategic goal during the 11th Transport, Maritime Affairs and Communications Forum

Action 4.1. Creating ITS Awareness and Consciousness

This action aims to create public awareness of the innovations, benefits and opportunities provided by intelligent transportation systems and applications, and create demand.

DGComms will host national or international events aimed at ITS with the cooperation of ICTA, Universities and NGOs. This action will have been completed if at least one event is held every year between 2020 and 2023.

4.1. Creating ITS Awareness and Consciousness

Aim of Action	Create public awareness of the innovations, benefits and opportunities provided by intelligent transportation systems and applications, and create demand.
Implementation Step	**4.1.1 Organization of events within context of ITS**
Method	Necessary events will be organized (Hackathon, etc.)
Responsible Institution	DGComms
Institutions to Cooperate	ICTA, Universities, NGOs
Action Completion Time	2023
Measurement Criteria	Organizing at least one event a year

Action 4.2. Updating the School Curriculum to Accommodate Intelligent Transportation and Traffic Safety

Children and the young ones must become aware of intelligent transportation systems, which have evolved far beyond the conventional traffic approach as well as learn the rules and rights. In this context, it is aimed to update the traffic and traffic safety content of the courses taking into account ITS concepts starting from the pre-school education level. In addition, successful applications around the world will be included in the content. The traffic training parks of municipalities can be utilized for practical courses.

The action will be actualized by Ministry of National Education with the cooperation of Ministry of Family, Labor and Social Services, Ministry of Health, DGH, DGS, GCC, Universities, Municipalities and NGOs.

The action will have been completed successfully if the updated content is included in the 2021-2022 school curriculum.

4.2. Updating the School Curriculum to accommodate Intelligent Transportation and Traffic Safety

Aim of Action	Update the content of the courses provided on traffic and traffic safety, taking into account the ITS concepts from the pre-school education level.
Implementation Step	**Update the content of the courses provided on traffic and traffic safety starting from the pre-school education level**
Method	The current course content will be updated in the form of textbook in line with ITS subjects.
Responsible Institution	Turkey Ministry of National Education
Institutions to Cooperate	Ministry of Family, Labor and Social Services, Ministry of Health, DGH, DGS, GCC, Universities, Municipalities, NGOs
Action Completion Time	2021
Measurement Criteria	2021-2022 school year starting with the updated curriculum

Action 4.3. Establishment of ITS Departments within Municipalities

Interoperability and integration between the institutions and systems is essential for successful intelligent transportation systems. This action aims to establish an ITS department in municipalities to ensure interoperability and coordination between the institutions.

This action will be completed by Municipalities with the cooperation of Ministry of Environment and Urbanization, and UMT.

The action will have been actualized if at least 10 municipalities incorporate ITS departments within their organizational charts by the end of 2021.

4.3. Establishment of ITS Departments within Municipalities

Aim of Action	Establish authorized and responsible ITS departments in municipalities, which will also be responsible for the coordination with other ITS stakeholders.
Implementation Step	**Establishment of ITS departments**
Method	The duties and responsibilities will be identified regarding the ITS departments to be established or already existing.
Responsible Institution	Municipalities
Institutions to Cooperate	Ministry of Environment and Urbanization, UMT
Action Completion Time	2021
Measurement Criteria	ITS departments incorporated within the organizational charts of at least 10 municipalities

Action 4.4. Training Human Resources Qualified in the ITS Field

With the above action (establishment of ITS departments within municipalities) sets in motion, it will be an absolute necessity to provide training on ITS field for public personnel and especially the city officials.

This action, which aims to meet the training need, will be actualized by the Union of Municipalities of Turkey with the cooperation of DGComms, Ministry of Environment and Urbanization, MoNE, Universities, Municipalities, and NGOs. The action will have been actualized if the training schedule is prepared and periodic trainings starts by the end of 2021.

In addition, one other option to consider when carrying out these trainings is the distant training system, which is cost-effective and can reach larger masses.

4.4. Training Human Resources Qualified in the ITS Field

Aim of Action	Provide trainings on ITS for public personnel including municipal officials and create a human resource competent and experienced in the field of ITS.
Implementation Step	**To provide necessary ITS trainings for public personnel including municipal officials**
Method	1. A document will be prepared on the training schedule and its content. 2. Trainings will be conducted within the annual training schedule planned within scope of this document.
Responsible Institution	Union of Municipalities of Turkey
Institutions to Cooperate	DGComms, Turkey Ministry of National Education, Ministry of Environment and Urbanization, Universities, Municipalities, NGOs
Action Completion Time	2021
Measurement Criteria	Preparation of the annual training schedule and starting periodical trainings

Action 4.5. Using Electric Vehicles in Public Transport Fleets and Service Vehicles and Encouraging Public Transport Use

It is aimed to use electric vehicles in public transport and service vehicles to encourage the development of domestic and national technologies, to create a sustainable environment and switch to clean energy in the transportation field, and to create cities with a cleaner environment. In addition, society awareness towards public transport use will be raised.

This action will be actualized by Metropolitan municipalities with the cooperation of DGComms, Ministry of Industry and Technology, and Provincial Bank.

75% of the action will have been completed if selected metropolitan municipalities uptake electric vehicles within their public transport fleets.

10% of the action will have been completed if selected metropolitan municipalities uptake electric vehicles in their duty vehicle fleets.

As for the 3rd implementation step, the remaining 15% of the action will have been completed, if the metropolitan municipalities-which are designated with the purpose of encouraging public transport use-implement ITS application zones to reduce carbon emission ratio.

4.5. Using Electric Vehicles in Public Transport Fleet and Service Vehicles and Encouraging Public Transport Use

Aim of Action	Increase the use of electric vehicles in public transport and service vehicles to promote the development of competitive domestic and national technologies and, create cities with cleaner environment and raise public awareness towards public transport use.
Implementation Step-1	**4.5.1 electric vehicles uptake in public transport fleets**
Method	1. Vehicles will be purchased in accordance with the reference document that will be prepared by the Metropolitan Municipalities ITS Steering Committee within scope of determined ITS standards. 2. The data collected and experienced on the process will be reported.
Responsible Institution	Metropolitan Municipalities
Institutions to Cooperate	DGComms, Ministry of Industry and Technology, Provincial Bank
Action Completion Time	2021
Measurement Criteria	Electric vehicles uptake in public transport fleets of the designated metropolitan municipalities
Implementation Step-2	**4.5.2 electric vehicles uptake in service vehicles**
Method	1. Vehicle purchase processes will be conducted in accordance with the reference document that will be prepared by the Metropolitan Municipalities ITS Steering Committee within scope of determined ITS standards. 2. The data collected and experienced on the process will be reported.
Responsible Institution	Metropolitan Municipalities
Institutions to Cooperate	DGComms, Ministry of Industry and Technology, Provincial Bank
Action Completion Time	2021
Measurement Criteria	Uptake of at least one electric service vehicle in the designated metropolitan municipalities
Implementation Step-3	**4.5.3 Spreading the use of public transport vehicles**
Method	1. ITS application zones will be implemented to spread the Fostering public transport use vehicles by the designated metropolitan municipalities. 2. Related public awareness studies will be conducted.
Responsible Institution	Metropolitan Municipalities
Institutions to Cooperate	Ministry of Environment and Urbanization, UMT
Action Completion Time	2023
Measurement Criteria	Implementation of at least one ITS application zone by the designated metropolitan municipalities to reduce carbon emissions

Action 4.6. Reducing Fuel Consumption and Emissions

For the future of industry, it's of utmost importance to establish technical and administrative infrastructure required to spread electric vehicles across our country, which is on the rise worldwide. This action will be actualized by Ministry of Energy and Natural Resources with the cooperation of DGComms, Ministry of Industry and Technology, EMRA, TSI and NGOs.

In the first implementation step, legislation on electric vehicles and charging station infrastructure will be prepared. 50% of the action will have been completed if the relevant legislation is passed by the end of 2021.

In the second implementation step, the economic and technical analysis will be performed to create a roadmap for spreading the electric vehicles and charging station infrastructures. The remaining 50% of the action will have been completed if the study is completed by the end of 2022.

4.6. Reducing Fuel Consumption and Emissions

Aim of Action	Prepare legislation for the infrastructure required to spread electric vehicles across our country, which is rapidly growing worldwide.
Implementation Step-1	**4.6.1 Preparation of legislation on electric vehicles and charging station infrastructure**
Method	Preparing the legislation on the electric vehicles and charging station infrastructures.
Responsible Institution	Ministry of Energy and Natural Resources
Institutions to Cooperate	DGComms, Ministry of Industry and Technology, EMRA, TSI, NGOs
Action Completion Time	2021
Measurement Criteria	Enactment of the legislation
Implementation Step-2	**4.6.2 Making efforts to spread electric vehicles and charging station infrastructures**
Method	1. A report will be prepared to determine a roadmap for spreading electric vehicles and charging station infrastructure through economic, technical, administrative and feasibility studies. 2. Necessary measures and required actions will be taken in line with this report.
Responsible Institution	Ministry of Energy and Natural Resources
Institutions to Cooperate	DGComms, Ministry of Industry and Technology, EMRA, TSI, NGOs
Action Completion Time	2022
Measurement Criteria	Preparation of the roadmap report

Action 4.7. Encouraging Bicycle Use

Bicycles, aside from sports and recreational purposes, are used as an alternative mode of transportation in many countries around the world. The usage ratio has been increasing every day with the developed bicycle-sharing applications. This action aims to spread bicycle use in our country.

This action will be actualized by Metropolitan Municipalities with the cooperation of Ministry of Environment and Urbanization, Ministry of Health, and Ministry of Youth & Sports.

The action will have been completed when at least one pilot scheme is performed in the designated provinces.

4.7. Encouraging Bicycle Use

Aim of Action	Increase the use of bicycles as an alternative mode of transportation in addition to its recreational use as a sport.
Implementation Step	**Deploying the suitable infrastructure to spread bicycle use**
Method	1. Pilot routes that includes bicycle-parking points, bicycle renting systems and bicycle routes will be determined. 2. Necessary infrastructure on these routes will be deployed to ensure integration with public transport. 3. Metropolitan Municipalities ITS Steering Committee will prepare a report including the collected data and experiences.
Responsible Institution	Metropolitan Municipalities
Institutions to Cooperate	Ministry of Environment and Urbanization, Ministry of Health, Ministry of Youth & Sports
Action Completion Time	2021
Measurement Criteria	Realization of at least one pilot scheme in the designated provinces

Action 4.8. Evaluation of Users' ITS Service Experiences

Evaluation of the user feedbacks is important to improve the transportation services delivered by municipalities based on the needs.

This action aims to increase ITS service standards delivered by Municipalities taking into account user evaluations.

This action will be implemented by Metropolitan Municipalities with the cooperation of the relevant institutions and organizations.

This action will have been completed if at least one of the designated municipalities realizes this practice starting from 2020. The institutions and organizations offering the ITS services are also expected to perform these practices.

4.8. Evaluation of Users' ITS Service Experiences

Aim of Action	Increase ITS service standarts delivered by Municipalities based on user feedbacks.
Implementation Step	**ITS services to be made available for user feedback**
Method	1. ITS services will be made available for user feedback on mobile applications, web applications and available kiosks. 2. Obtained feedbacks will be analyzed and the applications will be improved accordingly.
Responsible Institution	Metropolitan Municipalities
Institutions to Cooperate	DGComms, UMT, Universities, NGOs
Action Completion Time	2023
Measurement Criteria	Implementation of this practice by at least one of the designated municipalities starting from 2020

Action 4.9. Disinfection and Social Distance Warning with Autonomous Robots

From time to time, pandemics occur across the world and especially affect most of the urban population. These areas, where passenger mobility is intense and disease easily transmitted, become risky environments.

This action aims to prevent the emergence/spread of pandemics in our country and combat effectively through a safe disinfection process in areas where mobility is intense.

This action will be implemented by DHMI with the cooperation of the Directorate General of Civil Aviation, TSR, and TCDD Transport JSC.

The action will have been completed when at least one pilot scheme is realized in the designated airport.

4.9. Disinfection and Social Distance Warning with Autonomous Robots

Aim of Action	It is aimed to disinfect the areas where human mobility is intense such as airports, train terminals, etc. with autonomous robots within the scope of combating pandemics.
Implementation Step	**Disinfection and social distance warning with autonomous robots**
Method	1. The project areas will be specified. 2. Disinfection and social distance warning will be performed with autonomous robots in the specified areas.
Responsible Institution	DHMI
Institutions to Cooperate	Directorate General of Civil Aviation, TSR, TCDD Transport JSC.
Action Completion Time	2021
Measurement Criteria	Performing one pilot experiment in one airport.

Action 4.10. Determination of the General Concept and Implementation Steps of the Pedestrianization Projects

Pedestrianization is a humanistic approach allowing people to walk around the city centers as pedestrians comfortably and safely, increasing the quality of life, fostering economic growth through an increase in human circulation on the streets, avenues, and squares where it is practiced. Pedestrianization projects are planned for this purpose, and its application is increasingly spreading within municipalities.

This action aims to determine strategy and concept in terms of physical arrangements, landscape arrangements, and technological applications to guide the pedestrianization projects that differ both in the planning and implementation phase in our country. This will pave the way for expanding the pedestrianization projects as well as allow pedestrians to walk around these areas safely and comfortably.

This action will be implemented by Ministry of Environment and Urbanization with the cooperation of Ministry of Environment and Urbanization, and the Union of Municipalities of Turkey.

This action will have been completed when the design guide specifying the general concept and implementation steps of pedestrianization projects is prepared.

4.10. Determination of the General Concept and Implementation Steps of the Pedestrianization Projects

Aim of Action	It is aimed to serve as a guide in pedestrianization projects that differ in design and implementation phases, to increase the number of pedestrianized roads and areas incorporating smart city solutions, to allow pedestrians to walk around the pedestrian ways and areas more safely and comfortably.
Implementation Step	**Determination of the general concept and implementation steps of the pedestrianization projects**
Method	1. The national and international literature will be scanned. 2. Questionnaires will be performed with both the pedestrians and craftsmen on a specified pedestrian way. 3. Land surveying will be conducted. 4. Land surveying results will be evaluated with the questionnaire results. 5. Sample pedestrian way and area designs will be prepared and a design guide will be prepared.
Responsible Institution	DGComms
Institutions to Cooperate	Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, Ministry of Environment and Urbanization, Union of Municipalities of Turkey
Action Completion Time	2022
Measurement Criteria	Preparation of the design guides specifying the general concept and implementation steps

STRATEGIC GOAL-5

ENSURING DATA SHARE AND SECURITY

“Expansion of Intelligent Transportation Systems in the cities and ensuring their integration with the National Intelligent Transportation Systems, creating and updating the national mobility database, ensuring technical and actual cooperation and coordination in transportation and to establish cities that ‘act together’ at the national level is the aim that was agreed upon during the 11th Transportation, Maritime Affairs and Communications Forum.

“Ensuring Road and Driving Safety” has been set as the strategic goal for reaching this aim.

Action 5.1. Establishment of the ITS Data Management Center (DMC)

The ITS Data Management Center (DMC), when established, will use the anonymized traffic flow data gathered from traffic measurement sensors, mobile applications data, road status and weather forecast information. This obtained data will be analyzed to produce real-time traffic density and flow data and will allow future incident forecasting.

The action will be implemented by DGComms with the cooperation of Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, ICTA, DGH, General Directorate of Provincial Administration, TÜİK, PDPA, GDS, GCC, GDM, AFAD, Municipalities and all other relevant public authorities.

In the first implementation step, necessary feasibility studies for the establishment of the ITS DMC will be performed, the technical and administrative documentation will be prepared by the end of 2021, and thus 25% of the action will have been actualized.

In the second implementation step, the ITS DMC will be established. The remaining 75% of the action will have been completed if the data sharing over the center begins by the end of 2023.

5.1. Establishment of the ITS Data Management Center (DMC)

Aim of Action	Perform a number of transportation analyzes and produce instant traffic density and flow data to provide incident forecasting through archiving and reusing the real-time data collected by the ITS.
Implementation Step-1	**5.1.1 Performing the necessary feasibility studies and preparing the technical and administrative documentations required to establish ITS DMC**
Method	1. Feasibility study will be performed. 2. Technical and administrative documentations will be prepared for the ITS DMC.
Responsible Institution	DGComms
Institutions to Cooperate	Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, ICTA, DGH, General Directorate of Provincial Administration, TÜİK, PDPA, GDS, GCC, GDM, AFAD, Municipalities, All Relevant Public Authorities
Action Completion Time	2021
Measurement Criteria	Preparation of the technical and administrative documentation
Implementation Step-2	**5.1.2 Establishment of the ITS DMC**
Method	Establishment process will be performed in accordance with the administrative and technical documentation prepared for the ITS DMC.
Responsible Institution	DGComms
Institutions to Cooperate	Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, ICTA, DGH, General Directorate of Provincial Administration, TÜİK, PDPA, GDS, GCC, GDM, AFAD, Municipalities, All Relevant Public Authorities
Action Completion Time	2023
Measurement Criteria	Establishment of the ITS DMC

Action 5.2. Integration of the ITS Data Management Center with DGH's Traffic Control Centers

Ensuring integration with the ITS DMC is essential to share the ITS data collected in the DGH's provincial traffic control centers, road traffic control centers and similar centers providing service within the scope of ITS. This integration will ensure interdisciplinary coordination and increase the efficiency of the investments and applications.

The action will be completed by DGComms with the cooperation of Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, Ministry of Health, ICTA, DGH, GDS, GCC, AFAD, PDPA and Municipalities.

This action will have been actualized if integration of the ITS Data Management Center (DMC) with the provincial traffic control centers, road traffic control centers and ITS-related similar centers is ensured by the end of 2023.

5.2. Integration of the ITS Data Management Center with DGH's Traffic Control Centers

Aim of Action	Ensuring integration with the ITS DMC to share the ITS data collected in the provincial traffic control centers, road traffic control centers and similar centers providing service within the scope of ITS.
Implementation Step	**Ensuring integration of ITS DMC with the DGH's provincial traffic control centers, road traffic control centers and similar centers**
Method	The data sharing standards will be identified and the integration process will be commenced.
Responsible Institution	DGComms
Institutions to Cooperate	Ministry of Transport and Infrastructure General Directorate of Transport Services Regulation, Ministry of Health, ICTA, DGH, DGS, GCC, AFAD, PDPA, Municipalities
Action Completion Time	2023
Measurement Criteria	Ensuring integration of ITS DMC with at least one of existing provincial traffic control centers, road traffic control centers or similar centers

09 > MONITORING AND EVALUATION METHOD

Efficient implementation, systematic monitoring and reporting are essential for strategy documents to succeed. Monitoring means periodically following up the developments regarding the achievement of the goals and objectives in the document based on the specified measurement criteria.

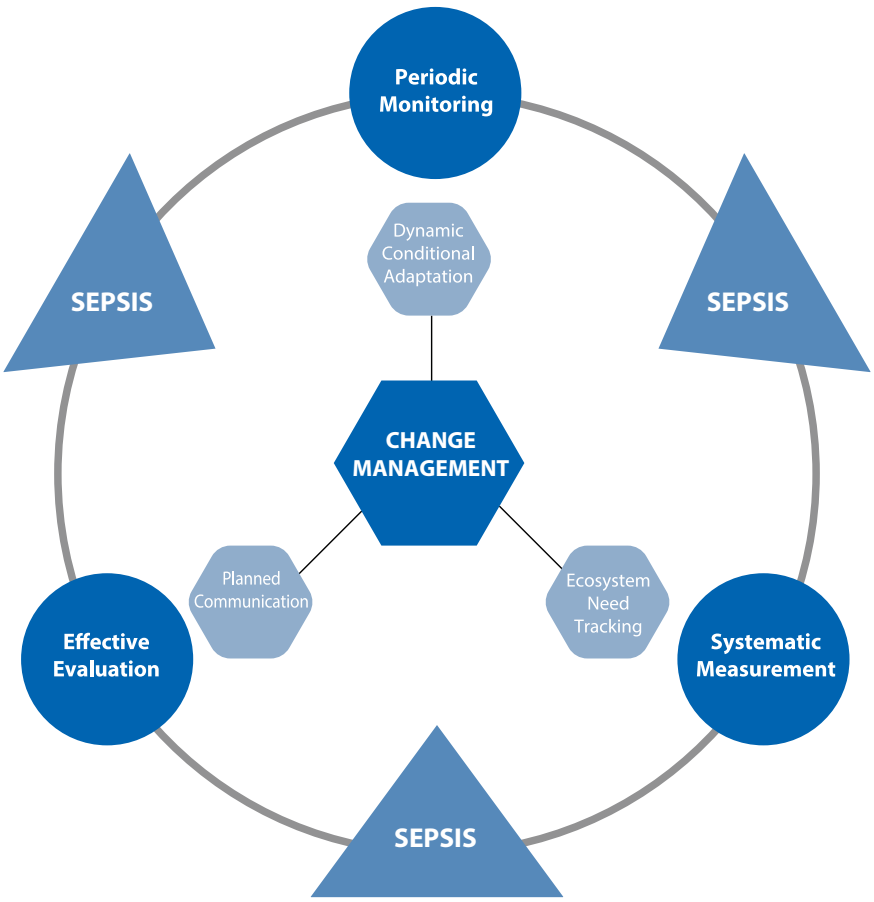
Monitoring operation will reveal the progress of achievement rates of the actions and enable to make evaluations accordingly. Evaluation is an indicator of how close we are to reach the set goals and objectives.

Accomplishing the ITS Strategy will depend on systematic monitoring of its implementation and efficiency. For this purpose, SEPSIS (Strategy and Action Plan Monitoring and Evaluation System) will be used as the monitoring and evaluation mechanism. SEPSIS has been previously developed for the purpose of monitoring and evaluation for the 2016-2019 National E-Government Strategy and Action Plan. SEPSIS is an application that all responsible and relevant institutions/organizations can access on the Internet for systematic data collection and effective implementation of monitoring operations. By using SEPSIS, institutions/organizations will periodically perform data entries they are expected to, which will show performance information and allow monitoring on the same system.

With SEPSIS, it is planned to;

- record all information about the actions including the list of the strategic goals, objectives and actions under the Action Plan,
- identify the performance indicators as well as the target values for the monitoring periods to the system,
- identify the weights to be used for measurement,
- periodically monitor and perform data entries regarding progress status of actions and realized values of performance indicators,
- identify the implementation steps, project/activities (action implementation steps) and corresponding weights,
- perform and report the calculations necessary for the performance measurements over the system

Figure 14: Strategy and Action Plan Monitoring and Evaluation System



ANNEX-1: ACTION PLAN TABLE

	STRATEGIC GOAL-1	DEVELOPMENT OF THE ITS INFRASTRUCTURE				
	Action Name	**Implementation Step**	**Responsible Institution**	**Institutions to Cooperate**	**Action Completion Time**	**Measurement Criteria**
ACTION 1.1	Meeting the ITS Legislation Requirements	Conducting legislation studies	DGComms	Ministry of Transport and Infrastructure's, Affiliated, Relevant and Associated Institutions, ICTA, PDPA, Universities	2023	1-Completion of the legislative process before final approval 2-Promulgation of the legislation
ACTION 1.2	Development and Publishing of the ITS Architecture	1. Completion of the national ITS architecture	DGComms	Ministry of Industry and Technology, Ministry of Environment and Urbanization, Ministry of Interior, DGH, GDS, GCC, ICTA, PDPA, TÜBİTAK, Universities, Metropolitan Municipalities, NGOs, Relevant institutions and organizations	2022	Preparing the ITS architecture
		2. Preparation of the national ITS architecture user manual			2023	Preparation of the manual
ACTION 1.3	Identification and Classification of the ITS Standards	1. Establishment of the ITS Standard Working Group	DGComms	ICTA, TSI, Universities, Private Sector Institutions, Research Institutions, Metropolitan Municipalities, NGOs, Relevant institutions and organizations	2021	Establishment of the working group and holding its first meeting
		2. Inclusion of the determined standards in ITS architecture			2023	Determination of the ITS standards compatible with the national ITS Architecture
		3. Inclusion of the determined standards in the ITS architecture		Ministry of Industry and Technology, Ministry of Environment and Urbanization, Ministry of Interior, DGH, GDS, GCC, ICTA, PDPA, TÜBİTAK, Universities, Metropolitan Municipalities, NGOs, Relevant institutions and organizations	2023	Inclusion of the determined standards in the ITS architecture
ACTION 1.4	Deployment of Provincial Traffic Control Centers	1. Deploying of provincial traffic control centers	Metropolitan Municipalities	DGComms, Ministry of Environment and Urbanization, DGH, GDS, GCC, AFAD, PDPA, General Directorate of Provincial Administration, Universities, NGOs	2023	Deployment of provincial traffic control centers in specified provinces
		2. Deploying of sensor infrastructure to collect traffic flow data in arterial roads (the busiest highways)			2023	Deployment of sensor infrastructures in the arterial roads of designated municipalities
ACTION 1.5	Deployment of Road Traffic Control Centers	1. Deployment of road traffic control centers	DGH	Ministry of Transport and Infrastructure-General Directorate of Transport Services Regulation, DGComms, GDS, GCC, AFAD, PDPA, General Directorate of Provincial Administration, Universities, NGOs	2023	Deployment of Road Traffic Control Centers in at least 2 Regional Directorate of Highways
		2. Deployment of traffic flow sensor infrastructure in state roads and highways			2023	Deployment of the sensor infrastructure required for traffic flow data collection in all roads in the region where the traffic control centers are established

	STRATEGIC GOAL-1	DEVELOPMENT OF THE ITS INFRASTRUCTURE				
	Action Name	**Implementation Step**	**Responsible Institution**	**Institutions to Cooperate**	**Action Completion Time**	**Measurement Criteria**
ACTION 1.6	Expanding the ITS Communication Infrastructure	Completion of the incomplete fiber and broadband infrastructures in all state roads and highways	DGH	DGComms, ICTA	2023	Deployment of fiber and broadband infrastructure in at least 5% of all divided roads and highways
ACTION 1.7	Smart Parking Application and Deployment of Electric Vehicle Charging Station	1.Development of a smart parking application	Metropolitan Municipalities	Ministry of Environment and Urbanization	2022	Deployment of a smart parking in at least one of the metropolitan municipalities
		2.Deployment of Electric Vehicle Charging Station			2022	Deployment of at least one electric vehicle charging station in the smart parking
ACTION 1.8	Deployment of the Test and Application Corridor for C-ITS	1. Planning the test and application corridor for C-ITS	DGH	DGComms, Ministry of Transport and Infrastructure- General Directorate of Transport Services Regulation, Ministry of Industry and Technology, TÜBİTAK, Universities, Municipalities, NGOs	2021	Completion of preparation of the C-ITS test and application corridor project
		2. Deploying of the test and application corridor for C-ITS			2023	Deployment of the test and application corridor for C-ITS
ACTION 1.9	Establishment of New Incentive Mechanisms to Develop Domestic and National Technologies	1. Inclusion of the ITS projects in Ministry of Transport and Infrastructure funding programs	Ministry of Transport and Infrastructure-UDHAM	DGComms, Ministry of Interior, Ministry of Environment and Urbanization, Ministry of Industry and Technology, ICTA, TÜBİTAK, KOSGEB, Provincial Bank, UMT	2023	Inclusion of at least one ITS-related project topic within the context of ITS each year
		2. Inclusion of ITS-related topics in the annual funding programs	Ministry of Industry and Technology	DGComms, Ministry of Interior, Ministry of Environment and Urbanization, ICTA, TÜBİTAK, KOSGEB, Provincial Bank, UMT	2023	Inclusion of at least one project topic for each annual year.
		3. Informing the ITS ecosystem on the international funding programs	TÜBİTAK	DGComms, Ministry of Foreign Affairs-Directorate of European Union, TDZ	2023	Holding semi-annual meetings with the stakeholders
ACTION 1.10	Exploring the Disruptive and Innovative Technologies and Their Impacts on the ITS Field	Preparation of a research report within the context of disruptive and innovative technologies	DGComms	Ministry of Industry and Technology, ICTA, TÜBİTAK, Universities, NGOs	2021	Preparation of the relevant report

	STRATEGIC GOAL-2	ENSURING SUSTAINABLE SMART MOBILITY				
	Action Name	**Implementation Step**	**Responsible Institution**	**Institutions to Cooperate**	**Action Completion Time**	**Measurement Criteria**
ACTION 2.1	ITS for Disabled Individuals and Individuals with Limited mobility	1. Identify the ITS-related needs and discover solutions to facilitate the lives of individuals with limited mobility.	Ministry of Family, Labor and Social Services	Ministry of Transport and Infrastructure, Ministry of Interior, Ministry of Health, PDPA, NGOs, UMT, Municipalities	2021	Preparation and sharing with relevant institutions a document including the needs and recommended solutions
		2. Identify what ITS projects are needed by disabled individuals and individuals with limited mobility, and the responsible institutions.			2021	Preparation of the document on the projects and responsible institutions and sharing it with the relevant institutions
ACTION 2.2	Passenger Information System	1. Installation of passenger information displays integrated with public transport vehicles at public transport stops and inside vehicles, with taking into account individuals with limited mobilitys	Metropolitan Municipalities	Ministry of Family, Labor and Social Services, Ministry of Environment and Urbanization, ICTA, PDPA, UMT	2022	Deployment of the system in at least 20% of the terminals as well as inside all the existing vehicles of the designated municipalities
		2. Opening the raw data collected from all public transport vehicles for the mobile passenger information system to share anonymously			2022	Announcement of the automatic data accessing approaches and methods on the web pages of the designated municipalities
ACTION 2.3	Single Card Payment System	1. Examination of the existing public transport electronic toll collection systems	PTT	DGComms, Ministry of Environment and Urbanization, TSR, TCDD Transport JSC., RA, UMT, Municipalities	2021	Preparation of the review report
		2. Designing a common electronic toll collection system			2021	Preparation of the design document
		3. Establishment of the test, certification, card and clearing house			2021	Establishment of the house
		4. Realization of the common electronic toll collection system and implementation in the pilot provinces			2022	Actualization of pilot schemes in at least two provinces
		5. Expanding the common electronic toll collection system			2023	Realizing the deployments in at least 10 metropolitan municipalities other than the pilot scheme provinces
ACTION 2.4	Expanding the use of Drones for Logistics Purpose	Use of drones in cargo transportation	PTT	DGComms, Directorate General of Civil Aviation	2022	Commencing of implementation in at least one province

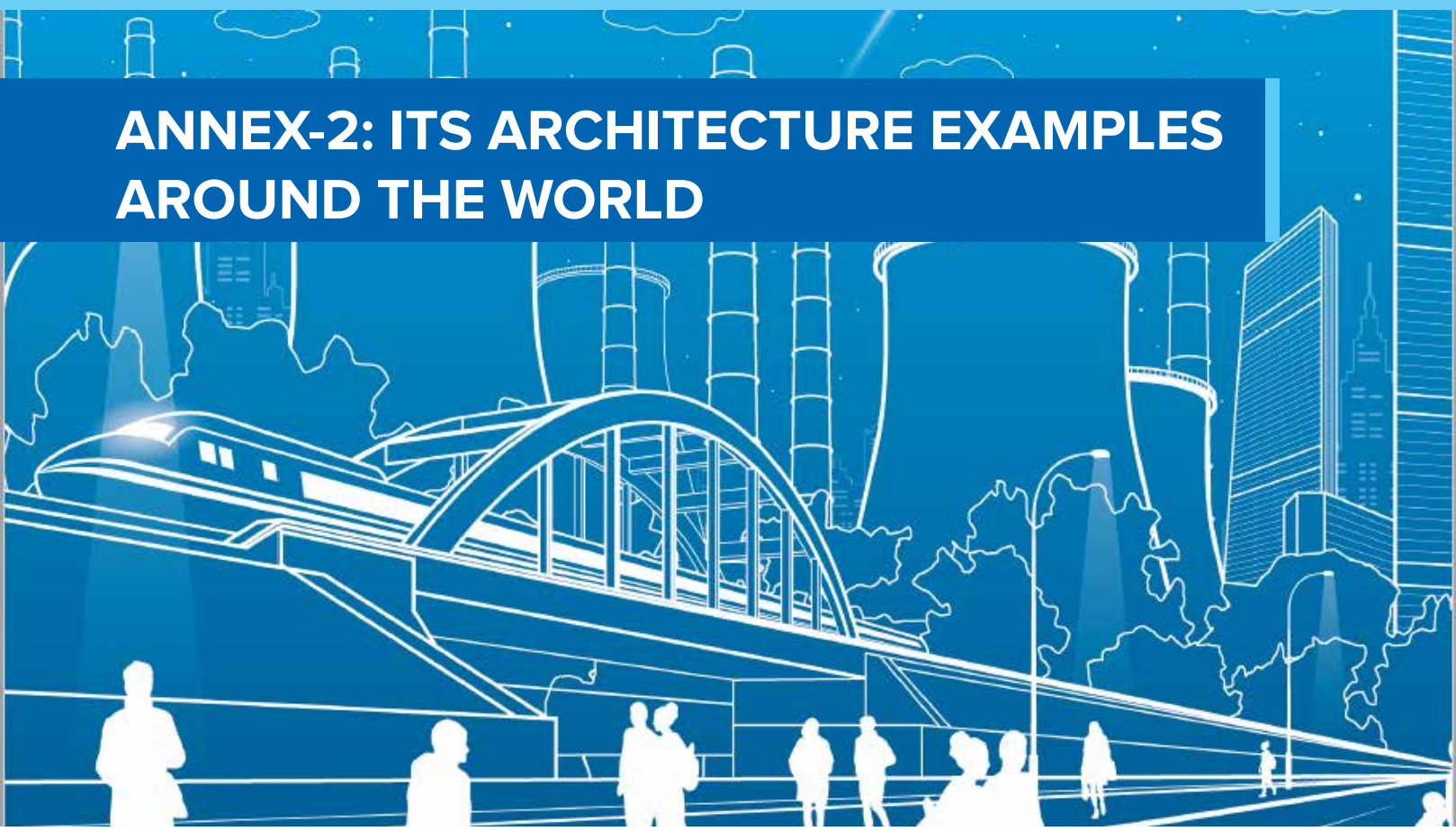
	STRATEGIC GOAL-3	ENSURING ROAD AND DRIVING SAFETY				
	Action Name	**Implementation Step**	**Responsible Institution**	**Institutions to Cooperate**	**Action Completion Time**	**Measurement Criteria**
ACTION 3.1	Completion of the Road Radio Establishment	1. Deploying of the road radio in the selected Pilot Region	DGH	TRT, RTÜK, DGS, AFAD	2021	Starting the radio broadcasting in the pilot region
		2. Expanding the oad radio across the country		TRT	2023	Starting the radio broadcasting in at least 4 pilot regions
ACTION 3.2	Creating Traffic Accidents Database	1. Identification of the transportation accidents dataset	Ministry of Interior	Ministry of Transport and Infrastructure-General Directorate of Transport Services Regulation, Ministry of Health, Ministry of Environment and Urbanization, DGH, GDS, GCC, AFAD, TÜİK, PDPA, Municipalities, Insurance Information and Monitoring Center	2021	Determination of the Transportation Accidents Database and creation of the database
		2. Analysis of the collected data			2023	Reducing the annual death rate in traffic accidents across the country by at least 6%
		3. Generalization of the electronic systems to reduce accidents			2023	Deploying electronic systems to prevent black spot accidents as well as reducing the accident black spots by 10%
ACTION 3.3	In-Vehicle Information and Communication System (IVICS)	Determination of the technical specifications of the in-vehicle information and communication system	DGComms	Ministry of Transport and Infrastructure-General Directorate of Transport Services Regulation, Ministry of Industry and Technology, ICTA, DGH, PTT, DGS, AFAD, TSI, TÜBİTAK, PDPA, NGOs	2022	Preparation of the IVICS technical infrastructure document
ACTION 3.4	Construction of Smart Parking Lots for Dangerous Goods and Freight Transport Vehicles	1. Construction of parking lots	Ministry of Transport and Infrastructure-General Directorate of Transport Services Regulation	DGComms, DGH, DGS, Municipalities, NGOs	2023	Realization of at least one parking lot implementation projects at a specified location
		2. Development of mobile application			2023	Putting the mobile service into service
ACTION 3.5	Smart Level Crossing Application	Smart level crossing application realization	Ministry of Transport and Infrastructure-TSR	TCDD Transport JSC., DGH, DGS, Municipalities	2023	Realization of a pilot scheme in the selected region

	STRATEGIC GOAL-4	CREATING A LIVABLE ENVIRONMENT AND CONSCIOUS SOCIETY				
	Action Name	**Implementation Step**	**Responsible Institution**	**Institutions to Cooperate**	**Action Completion Time**	**Measurement Criteria**
ACTION 4.1	Creating ITS Awareness and Consciousness	Organizing events within context of ITS	DGComms	ICTA, Universities, NGOs	2023	Organizing at least one event a year
ACTION 4.2	Updating the School Curriculum to Accommodate Intelligent Transportation and Traffic Safety	Update the content of the courses provided on traffic and traffic safety starting from the pre-school education level	Turkey Ministry of National Education	Ministry of Family, Labor and Social Services, Ministry of Health, DGH, DGS, GCC, Universities, Municipalities, NGOs	2021	2021-2022 school year starting the with the updated curriculum
ACTION 4.3	Establishment of an ITS Department with in Municipalities	Establishment of an ITS department	Municipalities	Ministry of Environment and Urbanization, UMT	2021	ITS Departments incorporated within at least 10 organizational charts of municipalities
ACTION 4.4	Training Human Resources Qualified in the ITS Field	Provide necessary ITS trainings to public personnel including municipal officials	Union of Municipalities of Turkey	DGComms, Turkey Ministry of National Education, Ministry of Environment and Urbanization, Universities, Municipalities, NGOs	2021	Preparation of the annual training schedule and starting periodical trainings
ACTION 4.5	Using Electric Vehicles in Public Transport Fleet and Service Vehicles, and Encouraging Using Public Transport	1. Uptake of electric vehicles in public transport fleets	Metropolitan Municipalities	DGComms, Ministry of Industry and Technology, Provincial Bank	2021	Including electric vehicles in public transport fleets of the designated metropolitan municipalities
		2. Uptake of electric vehicles within service vehicles			2021	Uptake of at least one electric vehicle in the designated metropolitan municipalities
		3. Spreading the use of public transport vehicles		Ministry of Environment and Urbanization, UMT	2023	Implementation of at least one ITS application zone by the designated metropolitan municipalities to reduce carbon emissions

	STRATEGIC GOAL-4	CREATING A LIVABLE ENVIRONMENT AND CONSCIOUS SOCIETY				
	Action Name	**Implementation Step**	**Responsible Institution**	**Institutions to Cooperate**	**Action Completion Time**	**Measurement Criteria**
ACTION 4.6	Reducing Fuel Consumption and Emissions	1. Preparation of legislation for electric vehicles and charging station infrastructure	Energy and Natural Resources Ministry	DGComms, Ministry of Industry and Technology, EMRA, TSI, NGOs	2021	Enactment of the legislation
		2. Making efforts to spread electric vehicles and charging station infrastructures			2022	Preparation of the roadmap report
ACTION 4.7	Encouraging Bicycle Use	Deploying the suitable infrastructure to spread bicycle use	Metropolitan Municipalities	Ministry of Environment and Urbanization, Ministry of Health, Ministry of Youth & Sports	2021	Realization of at least one pilot scheme in the designated provinces
ACTION 4.8	Evaluation of Users' ITS Service Experiences	ITS services to be made available for user feedback	Metropolitan Municipalities	DGComms, UMT, Universities, NGOs	2023	Implementation of this practice by at least one of the designated municipalities starting from 2020
ACTION 4.9	Disinfection and Social Distance Warning with Autonomous Robots	Disinfection and social distance warning with autonomous robots	DHMI	The Directorate General of Civil Aviation, TSR, TCDD Transport JSC.	2021	Performing one pilot operation in one airport.
ACTION 4.10	Determination of the General Concept and Implementation Steps of the pedestrianization projects	Determination of the general concept and implementation steps of the pedestrianization projects	DGComms	Ministry of Transport and Infrastructure-General Directorate of Transport Services Regulation, Ministry of Environment and Urbanization, Union of Municipalities of Turkey	2022	Preparation of the design guides specifying the general concept and implementation steps

	STRATEGIC GOAL-5	ENSURING DATA SHARE AND SECURITY				
	Action Name	**Implementation Step**	**Responsible Institution**	**Institutions to Cooperate**	**Action Completion Time**	**Measurement Criteria**
ACTION 5.1	Establishment of the ITS Data Management Center (DMC)	1. Performing the necessary feasibility studies and preparing the technical and administrative documentations quired to establish ITS DMC	DGComms	Ministry of Transport and Infrastructure-General Directorate of Transport Services Regulation, Ministry of Health, ICTA, DGH, DGS, GCC, AFAD, PDPA, Municipalities	2021	Preparation of the technical and administrative documentation
		2. Establishment of the ITS DMC			2023	Establishment of the ITS DMC
ACTION 5.2	Integration of the ITS Data Management Center with the Traffic Control Centers	Ensuring integration of the ITS DMC with the DGH's provincial traffic control centers, road traffic control centers and similar centers	DGComms	Ministry of Transport and Infrastructure-General Directorate of Transport Services Regulation, Ministry of Health, ICTA, DGH, DGS, GCC, AFAD, PDPA, Municipalities	2023	Ensuring integration of the ITS DMC with at least one of the established provincial traffic control centers, road traffic control centers and similar centers

ANNEX-2: ITS ARCHITECTURE EXAMPLES AROUND THE WORLD



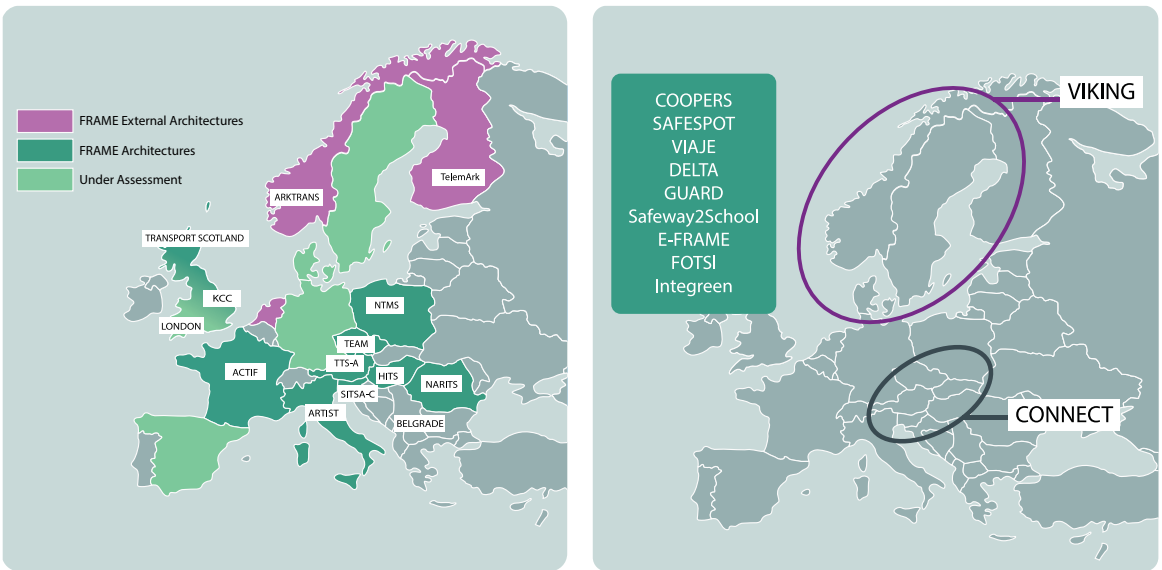
1. ITS Architecture in the European Union

In the European Union, the efforts to create an ITS architecture started with the KAREN project implemented between 1998-2000. This project aimed to establish the general structure of the ITS architecture, implement the ITS applications systematically in Europe, and ensure interoperability between the systems.

The FRAME architecture was developed at the end of the project. In the later years, the FRAME-NET, FRAME-S, E-FRAME projects were produced within the scope of the ITS architecture studies. Within the context of the project, at first, the Functional Architecture was established based on the user needs and stakeholder expectations. It was defined how to use the FRAME architecture for developing the national ITS architectures based on the EU ITS Directive (2010) and EU ITS Action Plan (2008). Many EU countries have used this architecture and developed their national ITS architectures and realized their ITS applications (Figure 15). The ITS Architecture of France - ACTIF, the ITS Architecture of Italy - ARTIST, the ITS Architecture of Austria - TTS-A, the ITS Architecture of Czechia - TEAM, the ITS Architecture of Hungary - HITS, and the ITS Architecture of Romania- NARITS have all been established based on the FRAME architecture. The FRAME architecture has been also used in EU's R&D projects such as VIKING and COOPERS.

On the other hand, the developments in the C-ITS field and the need for updating the ITS architecture required creating a sustainable ITS architecture. Therefore, software applications, where the entire ITS architecture can be easily seen and the system components and their relationship can be monitored for ITS planning, have been developed. The Browsing Tool and The Selection Tool applications are used in the FRAME architecture.

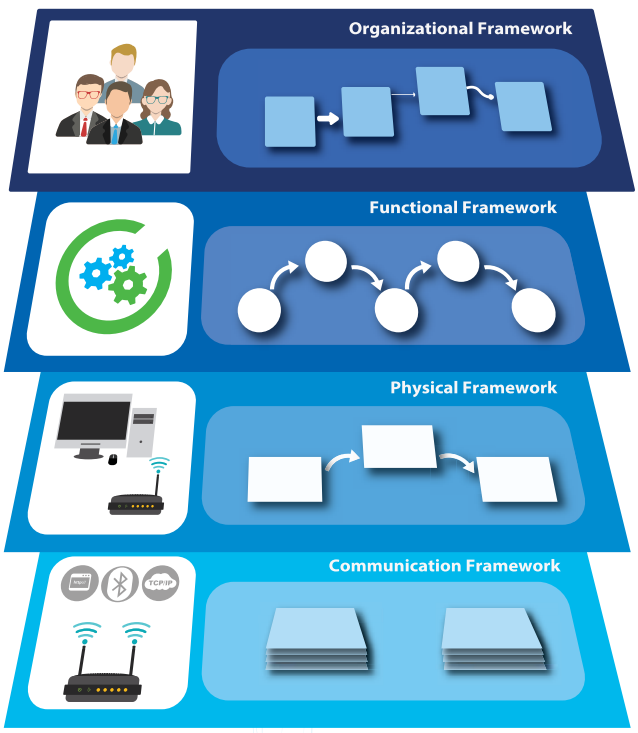
Figure 15: Countries with National ITS Architectures based on the FRAME Architecture and their Projects



2. ITS Architecture of the United States of America

The USA ITS Architecture has been developed according to ISO/IEC/IEEE 42010:2011 “Systems and Software Engineering-Architecture Description” standard. The rapid developments in ITS technologies necessitated the development of connected vehicles and applications as well as rearrangement of the existing architecture. Therefore, the ITS architecture has been reconfigured and an architecture development platform has been defined. This platform is named as “Connected Vehicle Reference Implementation Architecture (CVRIA)”. On this platform, a multi-layered architecture was created that is very similar to the one in the EU. The USA ITS architecture defines four frameworks. These frameworks have been defined in CVRIA platform, and thus the ITS architecture has been developed. The USA ITS Architecture structure is shown in Figure 16.

Figure 16: Multi-layered Framework Structure of the US National ITS Architecture



The services in the USA ITS architecture are grouped into 12 main categories. These are;

- Commercial Vehicle Operations
- Data Management
- Maintenance and Construction
- Parking Lot Management
- Public Safety
- Public Transport
- Support Services
- Sustainable Travel
- Traffic Management
- Passenger Information
- Vehicle Safety
- Weather Forecast

The USA ITS Architecture has been merged with the CVRIA platform and collectively named the "ARC-IT (Architecture Reference for Cooperative and Intelligent Transportation)". The USA ITS architecture has two tools, namely "RAD-IT (Regional Architecture Development Tool for Intelligent Transportation) and "SET-IT (Systems Engineering Software Tool for Intelligent Transportation)". RAD-IT allows ITS planning and high-level design. SET-IT allows making a more detailed design to implement the system with high-level design.

The CVRIA architecture also defines and classifies the stakeholders that will use the architecture. This allows defining the responsibilities and thus preventing organizational problems.

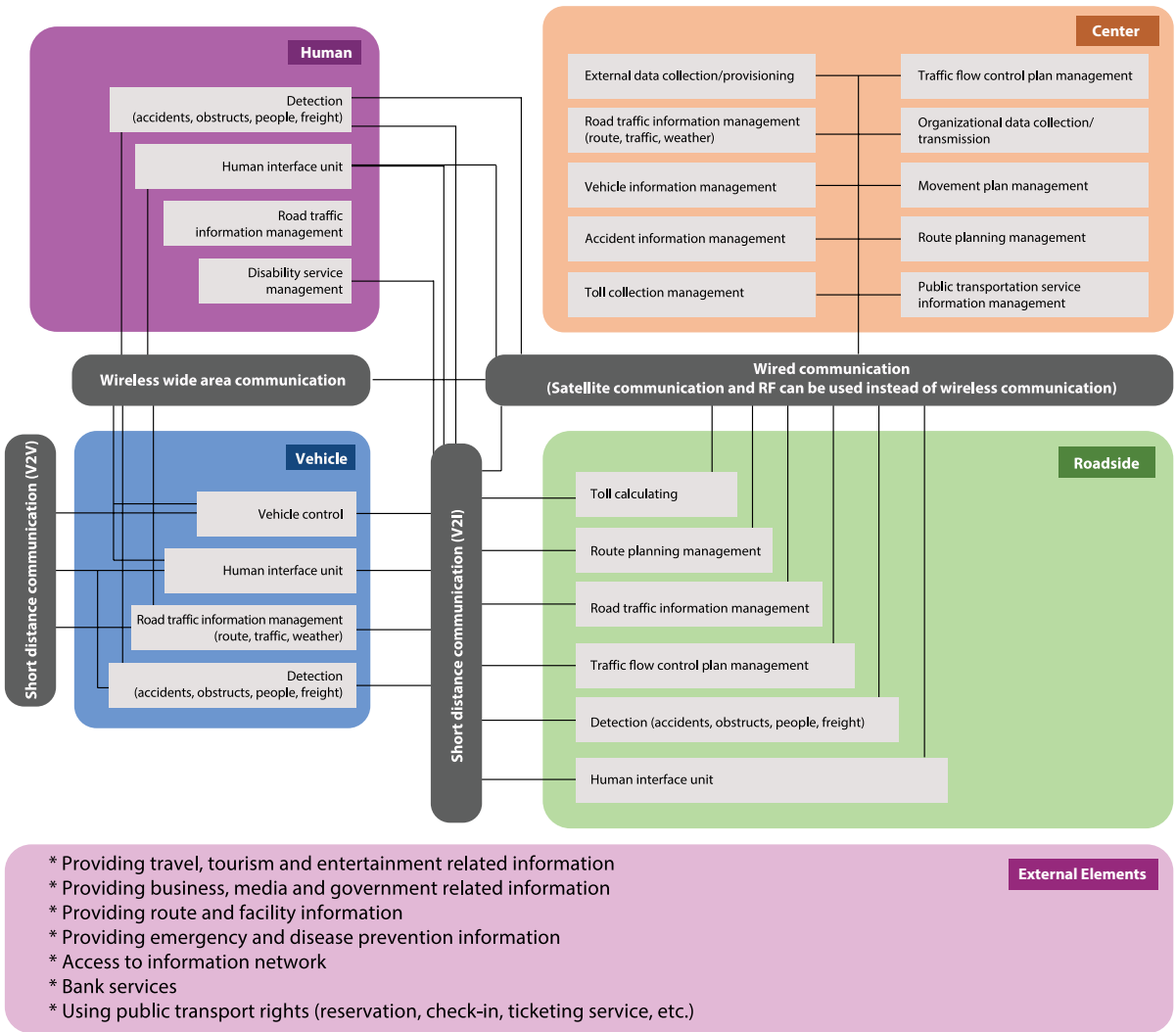
3. ITS Architecture of Japan

Japan is one of the leading countries in the ITS field and has been extensively using the ITS applications in all cities. In addition to the applications to prevent traffic jams and accidents, environmentally friendly systems and carbon emission-reducing applications have also been developed. Japan also stands out with its mobile phone/computer applications on transportation delivered for the users. The efforts to collect data and provide real-time data to its users started in the 90's, and better services have been continuously provided through various projects since 2000. Japan's architecture is shown in Figure 17.

One of the biggest factors making Japan a successful ITS practitioner is that it has countrywide standards for all ITS applications and equipment such as electronic toll collection. Japan ITS architecture consists of five main elements: human, center, vehicle, roadside and external. The communication infrastructures and standards between these parts have been defined.

The introduction of dedicated short-range communication (DSRC) technologies constituting the basis of V2X communication in Japan have increased the diversity and quality of real-time services. However, the very early adoption of this ever-developing technology around the world has also brought certain challenges. In the standardization process of DSRC technology, Japan has set its own standards that differ from the world. The fact that V2X communication will spread across the world soon and affect the existing ITS applications has led Japan to collaborate internationally. Especially, the standardization efforts for the new ITS applications, which the V2X communication will bring, aims compatibility with the world. V2X communication will positively affect the existing ITS services as well as lead to the development of new services. Japan, to ensure international compatibility and sustainability, has established collaborations with countries (USA and EU) for coordination and harmonization of ITS architecture.

Figure 17: ITS Architecture of Japan



4. ITS Architecture of South Korea

South Korea prepared the first version of the ITS architecture with the action plan published in 1999. Within scope of architecture, subsystems of the logical and physical frameworks were defined, as were in the US and EU architectures. However, problems were observed in the ITS applications due to the different interpretations of the architecture by the users. To eliminate these problems in the application, the second version of the ITS architecture was prepared in 2010. In this version, functional definitions were included in the logical framework. Also, the project framework layer was included to avoid inter-institutional disputes and potential legal problems.

Developed for a sustainable ITS, the architecture identified three fundamental principles:, *""to establish an infrastructure to ensure interoperability and conformity", "to assist in ITS planning and design operations"* and *"to avoid overlapping investments and identify all necessary services".*

South Korean ITS Architecture is similar to the multi-layered EU and USA architectures. The logical layer defines the functions necessary for the implementation of the identified services as well as the relationships between these functions. A flow diagram was prepared for each service. The physical framework defines the physical components, the relationships between these components, and how to deliver the functions in the logical framework. The physical framework consists of the architectural flow diagrams, characteristics of the physical components and characteristics

of data flow. The project framework includes definitions to allow implementing the services consisting of many components and services using the same components simultaneously. Definitions were made for the efficient use of the sources and services. In addition, the inter-institutional relationships were also defined.

The ITS services are grouped in seven categories in the South Korean ITS architecture. These are;

- Electronic Payment
  - Hi-Pass-Electronic Toll Collection System (ETCS)
  - Automatic Fare Collection (AFC) for Public Transport
- Traffic Management
  - Traffic Control and Traffic Status Information
  - Traffic Incident Management
  - Real-Time Adaptive Signal Control
  - Electronic Enforcement System
- Public Transport
  - Bus Operation Management
  - Bus Rapid Transit-BRT System
  - Bus Priority Roads
- Traffic Information System
  - Data Integration and Management
  - Real-Time Traffic Status Monitoring
  - Traffic Information
  - Transfer/Share Traffic Status Information to/with Relevant Centers
- Autonomous Vehicles and Smart Roads
  - C-ITS
  - Autonomous Driving
- Transport
  - Transport Vehicle Management
  - Management of Vehicles Carrying Dangerous Goods
- Passenger and Driver Information
  - Navigation
  - Passenger Information Systems

5. New Collaboration for a Global ITS Architecture

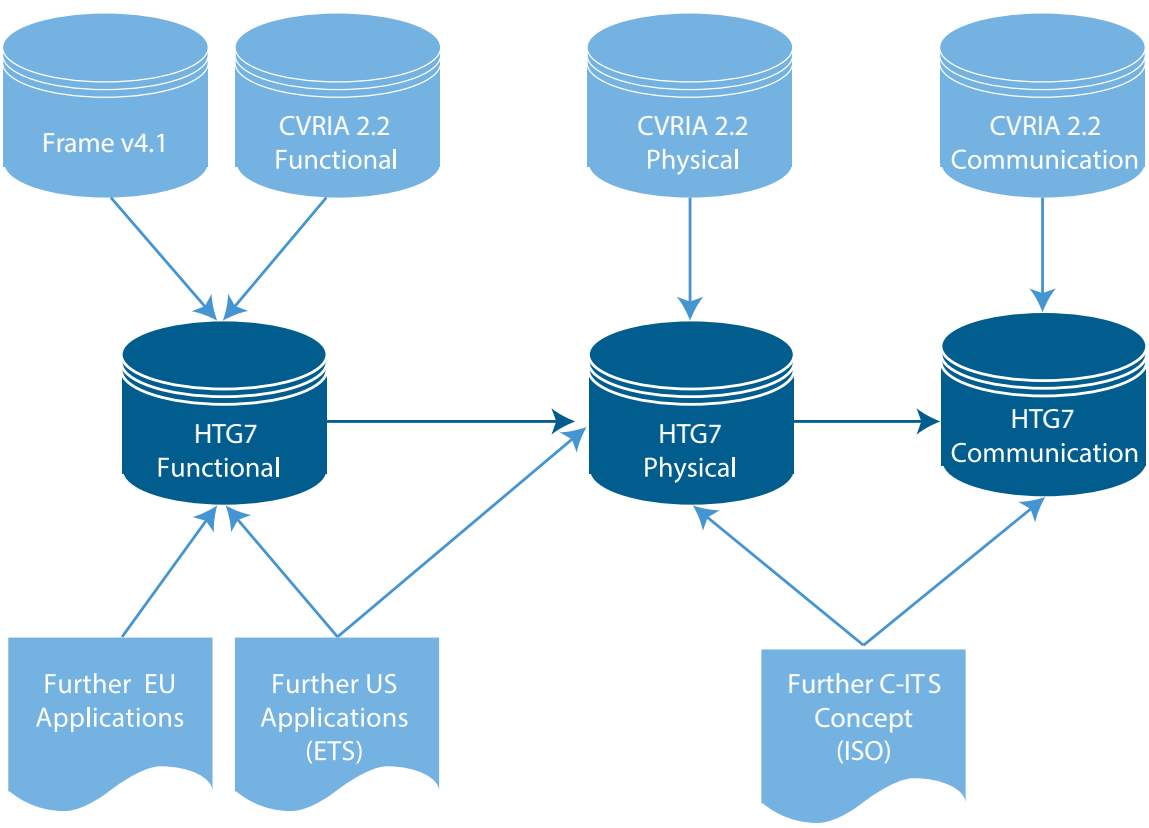
Japan and South Korea have been in the leading position in the field of ITS applications for many years. The ITS application demands by other countries have led these countries to work together for the harmonization of the standards. Another reason behind this joint work on standard harmonization is to expand C-ITS. EU, USA and Japan lead the studies conducted in the field of autonomous and connected vehicles, which is one of the most important components of C-ITS applications. However, the differences between the technologies and the standards used in these studies cause incompatibility during the implementation phase.

The USA and EU, seeing the differences between the standards, have addressed this need for harmonization and initiated an effort to develop a common architecture, and the Harmonization Working Group has been established with the participation of other countries. The aim of this study and the working group is to eliminate the differences and create a sustainable ITS architecture.

Similarly, other Asia-Pacific countries have also been conducting common ITS architecture studies. This study has been published by ESCAP (The United Nations Economic and Social Commission for Asia and the Pacific), of which Turkey is also a member. Like the Harmonization Working Group led by USA and EU, ESCAP countries as well recognized the necessity of creating a global ITS architecture and suggested to adapt this new architecture to a national ITS architecture.

The architecture, which was developed by the Harmonization Working Group using the ITS architecture development software tools developed by the USA and EU, was named "HARTS (Harmonized Architecture Reference for Technical Standards)". This architecture is created by integrating the EU's FRAME architecture with the USA's CVRIA architecture. The architecture development approach of this creation is shown in Figure 18. The establishment of the Functional Framework, Physical Framework, and Communication Framework has been prioritized. Data Flow Diagrams and definitions in each layer (framework) are very comprehensive. By clicking on each component defined on the diagrams, one can access the diagram and data of related component, and through an interactive interface the entire architectural data can be accessed.

Figure 18: Establishment of the HARTS Architecture



ANNEX-3: ITS POLICIES IN THE WORLD

1. ITS Policies of Japan

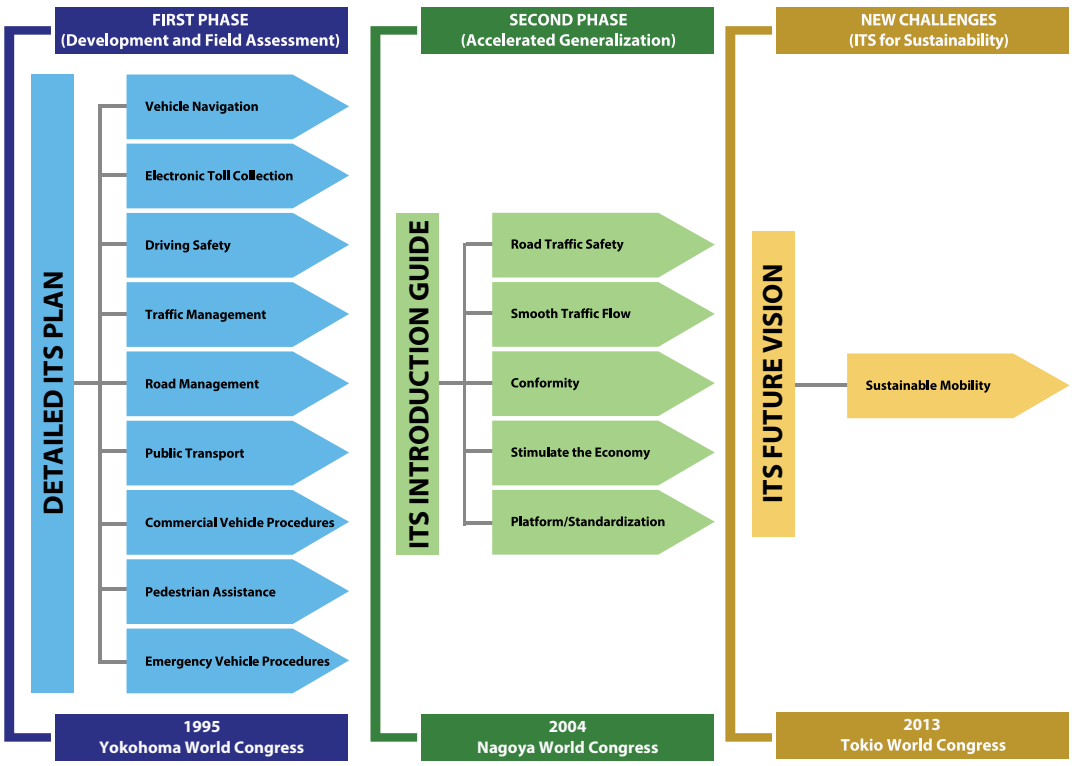
Japan, which is one of the biggest economies in the world today, has set strategic goals for ITS. A self-regulating organization, ITS Japan, organizes the ITS-related R&D studies and investments in Japan.

ITS Japan, at the governmental side, maintain efforts coordinating the council participated by Ministry of Interior and Communication, Ministry of Economy, Commerce and Industry, Ministry of Land, Infrastructure and Transportation, National Police Office universities, and sector representatives.

ITS Japan aims to have the safest roads and transportation in the world in line with the ITS strategies and action plans. To achieve this goal, ITS Japan has prioritized the prevention of accidents, elimination of damage caused by accidents, increasing transportation safety, protection of human life and implementation of the necessary political measures for sustainability.

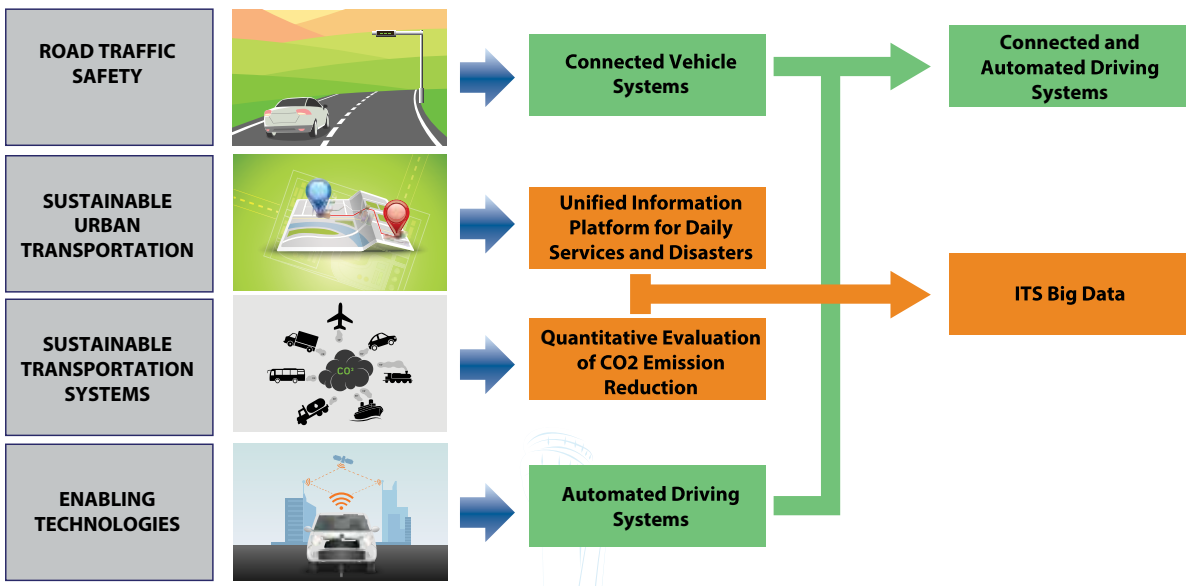
In 1995-2013, the ITS studies in Japan started with a three-stage plan, as seen in Figure 19.

Figure 19: Stages of Japan's ITS Studies



For 2013 and after, two main focus areas have been determined, as seen in Figure 20. The first one is ITS big data applications in transportation and the second one is connected and automated driving systems.

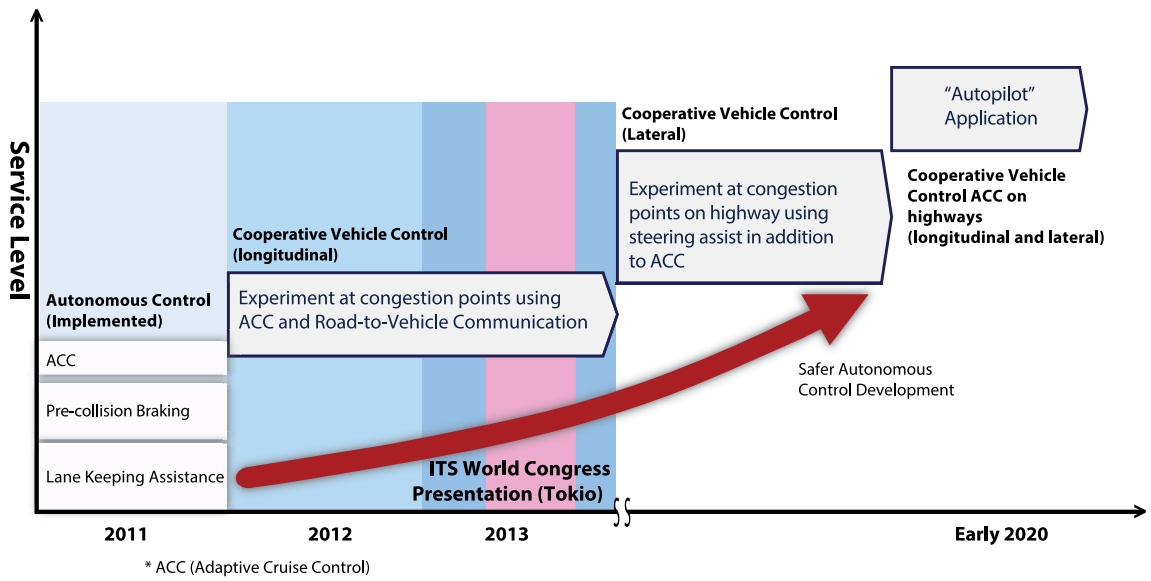
Figure 20: Japan's National ITS Project



In 2011, ITS Spot service was initiated nationwide and 1600 ITS Spot points were deployed on the highways. These ITS Spots communicate with vehicles via DSRC (Dedicated Short-Range Communication) based systems. The vehicles

equipped with ACC continue on their way by adapting their speeds according to the information from the ITS Spot points without causing any traffic jams. Thus, the drivers are provided with more specific traffic information to increase the quality of navigation systems and traffic safety in the city. ITS Japan foresees that besides the ITS Spots, automobiles equipped with the CACC (Cooperative Adaptive Cruise Control) technology will reduce the traffic jams on the roads. The plans that have been in implementation between 2011 and 2020 are shown in Figure 21.

Figure 21: Plans Implemented Between 2011 and 2020



VICS, one of the most extensive ITS applications in Japan, is a digital data communication system that provides necessary traffic information for drivers through in-vehicle navigation. VICS helps drivers in finding the most suitable route to reach their target destination and also helps reduce traffic jams. In Japan, VICS reduced carbon dioxide (CO2) emission by 2.4 million tonnes in 2009. In 2016, 35 millions of VICS were sold, which constitutes 78% of all automobiles in Japan.

In 2016, another successful application, second-generation electronic toll collection systems (ETC 2.0), were used in 39 millions of automobiles, which constitutes 87% of all automobiles. In the same year, owing to these systems, the traffic jams that occurred in the highway toll gates were reduced by 30%.

Japan's action and strategy plans are prepared considering the population, geographic status and natural disasters in the country. Accordingly, Japan aims to ensure transport convenience and availability for the aging population, construct earthquake-resistant infrastructures like roads, bridges, and tunnels, improve emergency management systems, and provide integration system with the multi-modal transportation. Accordingly, the summary of the strategic goals is given below;

- To actualize the plans to increase the transportation safety for all segments of the society, especially for elders and the disabled,
- To ensure increasing the mobility to achieve a sustainable environment, public health and energy efficiency goals,
- To prepare the infrastructure necessary to facilitate transition to autonomous driving in line with the main goal -the road and driving safety,
- To support sustainable R&D, innovation and scientific activities to gain competitiveness in the global ITS market,
- To conduct the necessary studies for the storage, protection, analysis and open access of all data collected from traffic,

- To contribute to increase the individual mobility, shorten the time spent in the traffic, and improve the ethical values of the society through ensuring integration between the modes of transport.

The short and long-term strategic goals of ITS Japan are summarized in Table 3.

Table 3: Summary Table of ITS Japan's Strategic Goals

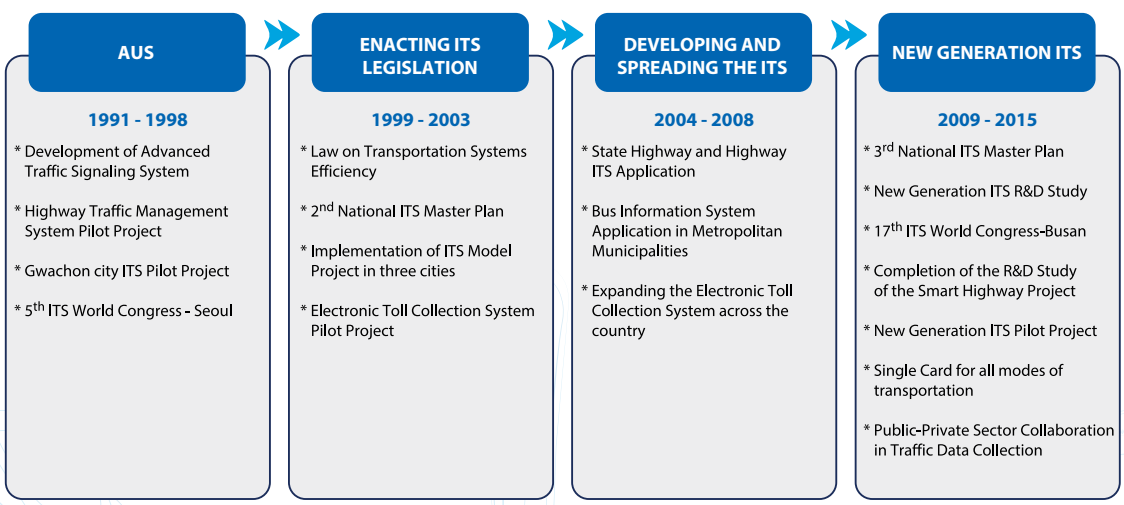
Short Term	Long Term
Ensuring road and driving safety	Semi-automated driving and market creation
Collecting data	Preparation of the existing infrastructure for automated driving
Transition to C-ITS	Data (Big Data) sharing and security
Sustainable mobility	V2X communication
Innovation activities	Accessible, comfortable and safe transport

2. ITS Policies of South Korea

The rapid industrialization process in the last thirty years has made South Korea one of the economic centers of Asia. South Korea, with its initiatives in information technologies and transportation sectors, gained competitiveness against the world giants in the field of ITS. South Korea is also one of the most important automotive manufacturers in the world.

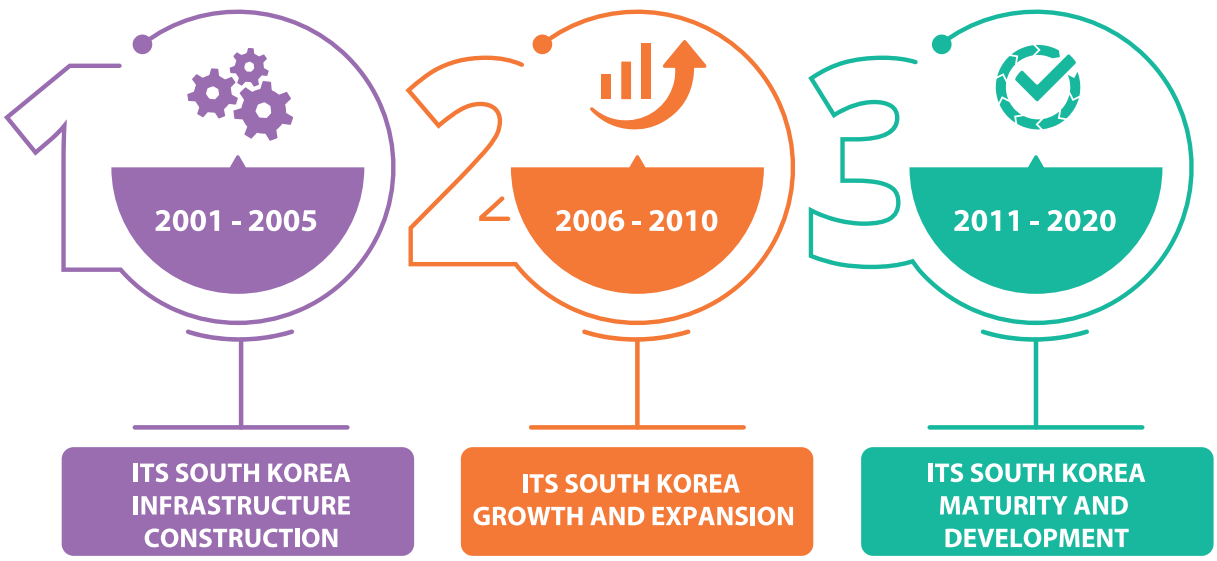
Due to the economic development and rapid population growth in South Korea, the number of vehicles has increased, which in turn traffic jam has become a serious concern. The first effort to solve this problem started in 1990. ITS South Korea, undertaken the duty of ensuring coordination between the private and public sector and universities, was established in 1999. South Korea is among the world leaders in the fields of ITS, real-time traffic status information, advanced public transportation information systems, and electronic toll collection. The development of ITS in South Korea took place in four steps, as shown in Figure 22.

Figure 22: Historical Development Process of South Korea's ITS



South Korea presented three national master plans related to ITS. The first one was published in 1997, the second one in 2000, and the third one in 2009 and revised in 2011. South Korea planned its 21st Century ITS goals in three steps for the period of 2001-2020, as seen in Figure 23. For the 2007-2020 period, 3.2 billion dollars of investment cost was estimated.

Figure 23: South Korea ITS Strategy Plan Periods



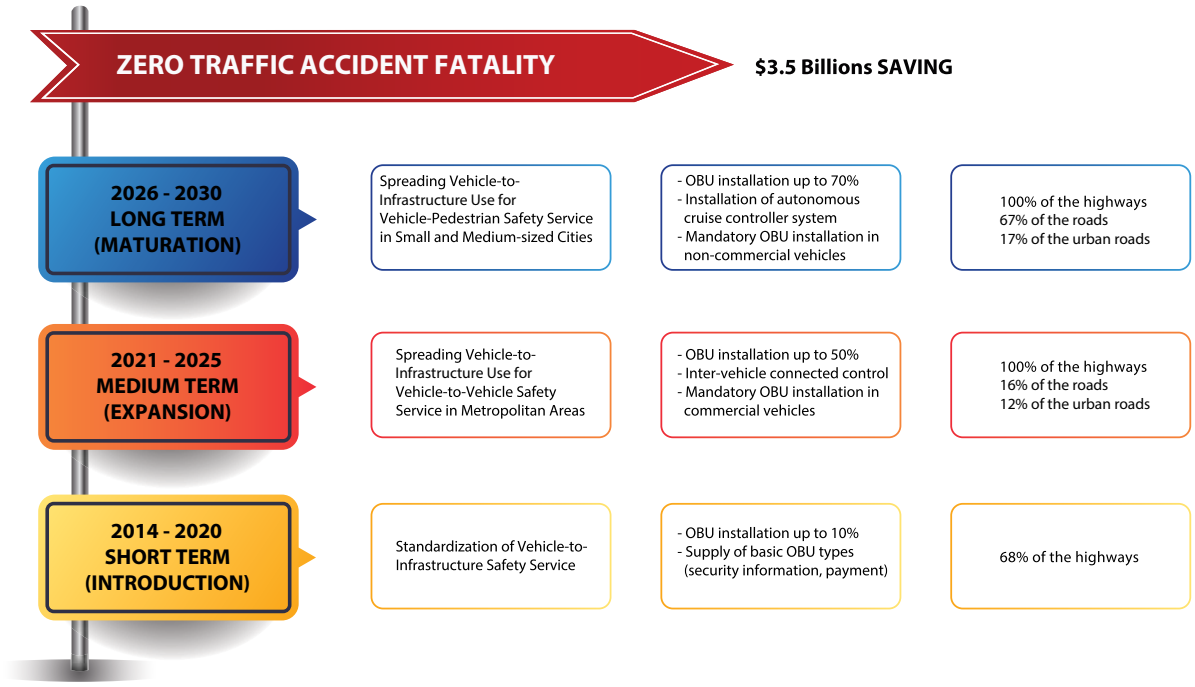
South Korea is among the world leaders in the following ITS application areas, which are;

- Providing real-time traffic status information,
- Advanced public transportation information systems,
- Highway electronic toll collection system (Hi-pass(ETCS),
- Smart card used in public transport - Single card (T-Money)

South Korea has saved 11 billion dollars and achieved a reduction of 0.81 million tonnes in greenhouse gas emissions by reducing traffic jams with the management of data collected by various real-time methods since 2009. South Korea also uses T-Money in public transport, with which 30 million contactless transactions are performed daily. The Hi-Pass system in the country covers 70% of the highways, and 31% of the vehicles use this system.

The South Korea government will gradually realize the electrification, automation, and mobility integration goals by 2030. The plan was made based on the periodic goals, namely short (2014-2020), medium (2021-2025) and long (2026-2030) term, which can be seen in Figure 24 titled: ”Zero Traffic Accident Fatality” and “Saving 3.5 billion dollars” set to be realized by 2030.

Figure 24: South Korea ITS Periods



South Korea ITS, with its globally competitive ITS ecosystem, aims to create comfortable, safe, environmentally friendly cities with sustainable mobility in human, environment, and infrastructure aspects and maximize the society's welfare. The long-term main goals have been set to realize these strategies.

These goals are summarized as follows;

- Standardization of the vehicle-to-infrastructure communication,
- Vehicle-to-infrastructure communication expansion to vehicle-to-vehicle in the metropolitan areas,
- Vehicle-to-vehicle communication expansion to vehicle-pedestrian in small and medium cities,
- Establishing "Zero-Carbon Cities and Regions" where the entire transportation runs on electric (Jeju Island example),
- Connecting all modes of transport (Integration Systems),
- Realization of a single type of payment for all modes of transport,
- Realization of automated driving systems and switching to fully automated driving,
- Switching to the C-ITS (Cooperative ITS),
- Updating and coordinating the existing ITS structure with the C-ITS,
- Gradual mandatory installation of OBUs in all vehicles,
- Completion of the projects targeting Level 3 and Level 4 automatic driving technologies, which started from 2015 to 2025, and switching to autonomous vehicles,
- Ensuring mobility integration using the information and communication technology,
- Enhancing the Public-Private-University collaboration,

The short and long-term strategic goals of ITS South Korea are summarized in Table 4.

Table 4: Summary Table of ITS South Korea's Strategic Goals

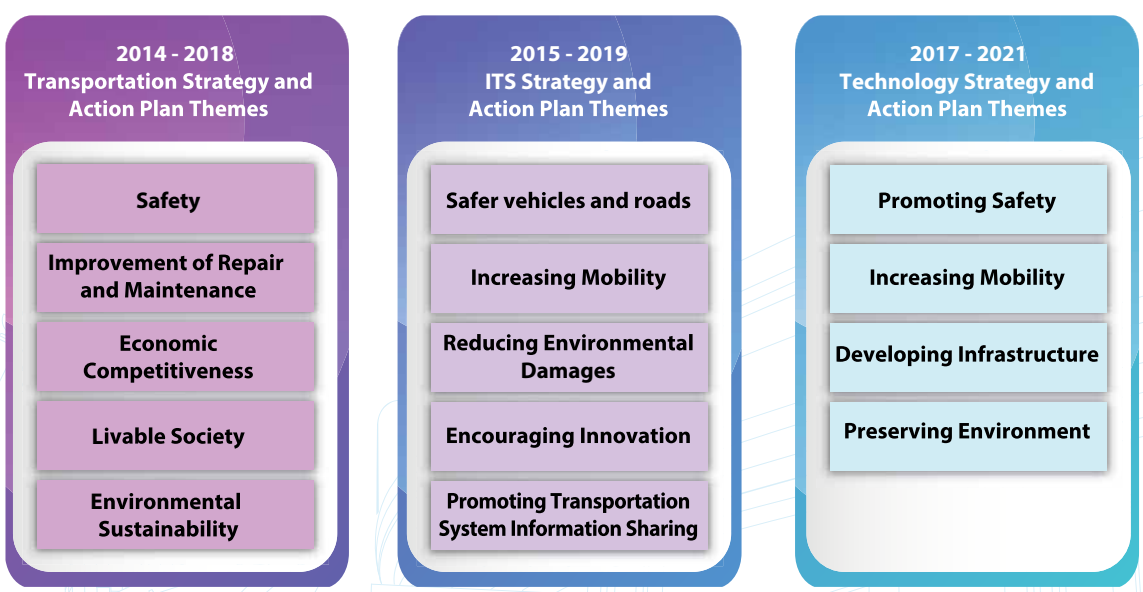
Short Term	Long Term
Setting data collection standards	Ensuring system security
Sustainable environment and livable society	Creating zero-carbon cities and regions
Comfortable and safe driving	Integration of the smart roads and all modes of transport
Automated driving systems and autonomous vehicles	Expanding the automated driving systems across the country
Sustainable mobility	Expanding C-ITS

3. ITS Policies of the USA

As one of the leading countries in the global ITS market, the USA makes significant investments and future plans in this field. The FAST (Fixing America's Surface Transportation) Law, which entered into force in December 2015, stipulates that the U.S.DOT Secretariat Office must coordinate the transport research planning and the scope to be multimodal. U.S. DOT summarizes the ITS vision as "Transform the Way Society Moves". And The ITS mission is summarized as "conduct research, development, and education activities to facilitate the adoption of information and communication technology to enable society to move more safely and efficiently. ".

U.S.DOT has set priorities, strategies, actions, and plans, including the research, development, and implementation activities for the years 2014-2018, 2015-2019, and 2017-2021 covering the whole transportation sector nationwide. The ITS-related strategy and action plans in the documentation prepared within this scope are summarized in Figure 25.

Figure 25: USA's ITS Strategy and Action Plans



The relationships between the USA ITS 2015-2019 strategic themes and the overall strategic goal areas specified by the U.S. DOT are given in Table 5.

Table 5: ITS Strategic Themes and Strategic Goal Areas

ITS Strategic Themes	U.S.DOT Strategic Goal Areas					
	Safety	Maintenance and Repair	Economic Competitiveness	Livable Communities	Safe, Cautious	Environmental Sustainability
Safer Vehicles and Roads	√	√	√	√	√	
Promoting Mobility	√	√	√	√	√	√
Reducing the Impacts of Environmental Damages			√	√		√
Promoting Innovation	√		√		√	√
Supporting the Transportation System Information Sharing	√	√	√	√	√	

U.S.DOT has identified four critical transportation topics that will be supported by the Research, Development and Technology Strategic Plan (2017-2021). These topics are:

Promoting Safety: It covers the safety issues affecting all modes and the development and deployment of countermeasures designed to address these issues. U.S.DOT's goal is to improve public health and safety by reducing transportation-related fatalities and injuries.

Improving Mobility: It refers to demographic, economic, geographic, cultural, and technological trends affecting travel demand, personal and commercial mobility across all transportation modes, and the effects of those trends on quality of life and access to economic and educational opportunities. U.S.DOT's goal is to improve the mobility of people and goods, reduce congestion, and increase access to opportunities for all.

Improving Infrastructure: It covers issues relating to the condition, costs, funding, and delivery of the transportation infrastructure, as well as the methods and technologies to increase its durability and resilience. U.S. DOT's goal is to improve the durability and extend the life of the transportation infrastructure, and ensure that critical transportation infrastructure is proactively preserved.

Preserving the Environment: It covers the effects of transportation activities on climate change and the environment and discusses approaches to avoid or mitigate those effects. U.S.DOT's goal is to advance environmentally sustainable policies and investments that reduce carbon and other harmful transportation-based emissions.

The USA's 2017-2021 Strategic Plan covers four main research topic areas. These are policy research, emerging technology, strengthening research coordination, and big data. The short and long-term strategic goals of the USA are summarized in Table 6.

USA, establishing its own ITS architecture, ensures that ITS is efficiently expanded across the country. At the same time, USA focuses on C-ITS efforts and updates its architecture accordingly. The USA keeps the leading position in the

production and use of electric vehicles. As for the Connected Vehicle Technology, USA achieves safer and time-saving driving, by developing DSRC (Dedicated Short-Range Communications) technology and ensuring communication between vehicles and with roadside infrastructure. USA reduces accidents driver injury and death rates by 57% using anti-collision technologies. The variable speed limit (VSL) systems, which have been in use for the last twenty years, have reduced the collision potential by 8-30%. DLMS (Dynamic Lane Merge Systems) improve highway performance and reduce aggressive driving maneuvers. The PIS (Truck Parking Information and Systems) used in the USA has a benefit/cost ratio between 4.2 and 7.

Table 6: USA's ITS Strategic Goals Summary Table

Short Term	Long Term
Ensuring road and driving safety	Preparation for switching to semi-automated driving
Economic competitiveness	Promoting ITS investments, development of market and improvement of R&D
Accessible transportation	Establishment of integration systems
Sustainable environment	Spreading electric vehicles
Sustainable mobility	Expanding the single type of payment C-ITS infrastructure in multimodal transportation

Moreover, the USA gives great importance to the development of autonomous vehicles and adapts its legal regulations accordingly. The reason is that USA foresees this can help save more than 1000 lives a year, and that fuel consumption and emissions will decrease by 50% if autonomous vehicles become prevalent.

4. ITS Policies of Germany

Intelligent transportation systems are an integral part of Germany's transportation strategies. "Intelligent Transport Systems in Germany" titled action plan was prepared by the ITS Advisory Council under the leadership of Ministry of Transport, Building and Urban Affairs of Germany. "Status and Framework for Intelligent Transport Systems in Germany" titled report presented as per Clause 17(1) of 2010/40/EU Directive, published in August 2011, determined the framework of the current ITS action plan. This action plan aims to increase road safety and efficiency, and reduce the negative environmental impacts of transportation. It is also aimed to develop the existing ITS infrastructure to constitute the basis of C-ITS, and spread the new ITS approaches rapidly.

In this ITS action plan prepared according to the EU ITS Directive;

- Optimum use of road, traffic and transportation information,
- Continuity of ITS services in traffic management and traffic information,
- ITS applications for transport efficiency, road security/safety and environmental sustainability have been specified as prioritized action plans.

"Optimum use of road, traffic and transportation information" action: Measures that increase the accessibility and quality of data produced by the public and private sectors related to road transport are addressed under this title. The sub-actions to achieve this goal have been determined as;

- To prepare a manual for collecting traffic incidents and data,
- To establish a quality management system for receiving and processing data for ITS services,

- To establish mobility data market,
- To optimize the accessibility of map-related road data for ITS,
- Transmission of safety-related traffic information to the user free of charge.

"Continuity of ITS services in traffic management and traffic information" action: The integration operations required for the interoperability of ITS services are addressed. Establishment of an ITS architecture that organizes various system approaches and recognized interfaces are aimed. The sub-actions to achieve this goal have been determined as;

- To develop a comprehensive intermodal ITS vision,
- To develop an ITS framework architecture for roads,
- To develop an ITS reference architecture that clarifies traffic management responsibilities,
- To develop an ITS reference architecture for transport,
- To define strategic transportation corridors,
- To develop field management for road construction works,
- To harmonize the adapted traffic control with the traffic information obtained,
- To take functional ITS provisions as a basis for the integration of innovative system elements in investment planning.

"ITS applications for transport efficiency, road security/safety and environmental sustainability have been specified as prioritized action plans" action: Measures required for realizing and expanding the ITS are defined. The sub-actions to achieve this goal have been determined as;

- Project planning for road transport telematics,
- Establishment and testing of cooperative systems,
- Introduction of eCall,
- Telematics-controlled HGV parking area as part of the information services for secure and safe parking areas for heavy goods vehicles(HGV) and other commercial vehicles.

Germany has developed further ITS-related action plans for the future. In this context;

- A database will be established where current technologies and their potential deployment areas within the ITS applications are determined. This database is important as it reveals which technologies can be used and what advantages and disadvantages they would bring.
- To use ITS services at optimum level, the FRAME architecture developed for highways and the architectures of other modes will be merged to form intermodal (intermodal transport) framework architecture.
- Following ITS reference architectures will be established in line with the reconfiguration of the existing ITS:
  - Adaptive traffic control systems outside the residential areas,
  - Adaptive traffic control systems inside the residential areas,
  - Traffic information,
  - Cooperative systems.
- To support the sustainable planning and use of ITS, a coordinated set of advanced training plans will be established for the implementation, use, and quality control of ITS practices and measures.
- Beyond the areas of above-mentioned actions, further optimization work will be carried out for all road transport telematics.
- New data acquisition, evaluation and connection possibilities in traffic control will uncover new uncharted parameters in addition to existing ones which will support effective traffic management.

- ITS approaches are needed for a comparative assessment and mobility of heavy loads across Europe. In this context, following issues will be focused:
  - Information portals about authorization-related provisions,
  - Electronic authorization procedures,
  - Route planning and route technical requirements including real-time network status data,
  - Freight tracking.

Table 7: Germany's ITS Strategic Goals Summary Table

Short Term	Long Term
Optimum use of road, traffic and travel information	Digital mobility
Advanced traffic management	Expanding C-ITS across the country
Efficient transport	Multimodal transportation optimization
Sustainable environment	Spreading electric vehicles
Safe driving	Autonomous driving systems

The short and long-term strategic goals of Germany are summarized in Table 7. Germany emphasizes digital mobility in ITS. Germany places importance on the further digitization of public transport in all its big metropolises, including Hamburg, Munich, Berlin, and Stuttgart, and supports this with mobile applications. It also really cares about the digitization of the infrastructures. Among the metropolises of Germany, Hamburg keeps the leading position in infrastructure digitization; Stuttgart in e-Mobility field; and Munich in sharing.

5. ITS Policies of the United Kingdom

The ITS United Kingdom Organization was established in 1992 to support the United Kingdom's road transportation informatics or telematics initiatives. ITS action plans focus on a certain area each year considering the ITS United Kingdom's basic development plans.

The United Kingdom's ITS mission is:

- Providing readily accessible opportunities for practitioners and stakeholders to meet on an equal footing to promote mutual understanding and to increase knowledge and awareness of ITS best practice,
- Leading informed and balanced debate on ITS and influencing relevant policies by acting as the recognized reference point for information on ITS,
- Engaging with, supporting and influencing policies and strategies and at national, European and international levels,
- Promoting the international excellence of UK technology, expertise and solutions.

The integration of the transportation systems with mobile communication and advanced mapping technology in the United Kingdom provides a fuel saving of 14% or 2.9 million barrels a year. Smart highways have increased the traffic safety and capacity and decreased the accidents involving personal injury by 56%, travel times in case of traffic jams by 16%, and travel time variability by 22%, and thus made the travel times more foreseeable. Additionally, a reduction of 2.1 dB in noise levels and 4% in carbon dioxide emissions has been obtained.

ITS United Kingdom has specified the performance measures and goals for the road transport system by 2020 in six categories, namely society, economics, environment, technology, policy, and system. In this context, some goals and performance indicators for 2020 are summarized as follows:

- **Social Goals:** User satisfaction at the level of 85% will be obtained with all modes of transport. The noise due to road traffic and vehicles will be reduced.
- **Economic Goals:** The cost of developing new vehicles will be decreased by 50%.
- **Environmental Goals:** The particles in all kinds of fuels will be reduced by 20%. The carbon dioxide emission will be reduced to 90 g/km. Carbon monoxide, hydrocarbon, and nitrogen oxides in vehicles consuming fossil fuels will be reduced to 50% of the value specified by the EURO 4 standard.
- **Systematic Goals:** 25% improvement in the accessibility of transportation, zero increase in traffic jams, a 50% increase in transportation availability, and a 50% reduction in the deviation in the arrival time calculation will be achieved.
- **Technological Goals:**
  - Increasing the efficiency in diesel engine vehicles to 55% in line with the continuous improvements in engine and power transmission efficiency,
  - Making the hydrogen fuel cell technology and infrastructure substantially applicable within the scope of the development of hybrid, electric, and alternative-fueled vehicles,
  - Continuing to develop software, sensor, electronic, and telematics technologies that ensure advances vehicle performance, control, adaptability, intelligence, mobility, and safety,
  - Using state-of-the-art technology materials including smart materials, surface plating, nanotechnology and biotechnology products as well as recyclable materials.
- **Politic Goals:**
  - It is targeted that biofuels constitute minimum 5.75% of the fuel sold.

Every year, the United Kingdom updates the previous year's strategies and goals, develops the ITS plans and implements these plans by evaluating them in terms of human, vehicle and infrastructure factors based on the needs. For this reason, the UK's below strategies for 2020 and beyond, have been set taking into account 2012-2017 action plans:

- Providing driver assistance systems, preparing necessary infrastructure and expanding eco-driving for a safe, efficient, and clean transportation,
- Developing ITS structure within the scope of public-private and international collaboration,
- Increasing mobility through the development of electronic toll collection systems, public transport, fleet management, and multimodal transport systems,
- Establishment of new data systems for data collection, sharing, and security,
- Establishing ultra-low emission zones for a livable environment.

ANNEX-4: STATUS OF THE INSTITUTIONS / ORGANIZATIONS TO BE RESPONSIBLE OR RELEVANT FOR THE ACTIONS

No	Institution / Organization Information	Total Number of Responsible Implementation Steps	Strategic Goal 1																			Strategic Goal 2										Strategic Goal 3									Strategic Goal 4													S. Goal 5		
			E1.01	E1.02		E1.03			E1.04		E1.05		E1.06	E1.07		E1.08		E1.09			E1.10	E2.1		E2.2		E2.3					E2.4	E3.1		E3.2			E3.3	E3.4		E3.5	E4.1	E4.2	E4.3	E4.4	E4.5			E4.6		E4.7	E4.8	E4.9	E4.10	E5.01		E5.02
			UA1.01.1	UA1.02.1	UA1.02.2	UA1.03.1	UA1.03.2	UA1.03.3	UA1.04.1	UA1.04.2	UA1.05.1	UA1.05.2	UA1.06.1	UA1.07.1	UA1.07.2	UA1.08.1	UA1.08.2	UA1.09.1	UA1.09.2	UA1.09.3	UA1.10.1	UA2.01.1	UA2.01.2	UA2.02.1	UA2.02.2	UA2.03.1	UA2.03.2	UA2.03.3	UA2.03.4	UA2.03.5	UA2.04.1	UA3.01.1	UA3.01.2	UA3.02.1	UA3.02.2	UA3.02.3	UA3.03.1	UA3.04.1	UA3.04.2	UA3.05.1	UA4.01.1	UA4.02.1	UA4.03.1	UA4.04.1	UA4.05.1	UA4.05.2	UA4.05.3	UA4.06.1	UA4.06.2	UA4.07.1	UA4.08.1	UA4.09.1	UA4.10.1	UA5.01.1	UA5.01.2	UA5.02.1
1	Disaster and Emergency Management Presidency	0							C	C	C	C																				C		C	C	C	C																	C	C	C
2	Ministry of Family, Labour and Social Services	2																				R	R	C	C																	C														
3	Research Institutions	0				C	C																																																	
4	Municipalities	1									C	C				C	C					C	C			C	C	C	C	C				C	C	C		C	C	C		C	R	C										C	C	C
5	Information Technologies and Communication Authority	0	C	C	C	C	C	C					C					C	C		C			C	C												C				C													C	C	C
6	Metropolitan Municipalities	11		C	C	C	C	C	R	R				R	R									R	R																				R	R	R			R	R					
7	Ministry of Environment and Urbanisation	0		C	C			C	C	C				C	C			C	C					C	C	C	C	C	C	C				C	C	C							C	C			C			C			C			
8	General Directorate Of State Airports Authority	1																																																		R				
9	Ministry of Foreign Affairs – Directorate for EU Affairs	0																		C																																				
10	General Directorate of Security	0		C	C			C	C	C	C	C																				C		C	C	C	C	C	C	C		C												C	C	C
11	Energy Market Regulatory Authority	0																																														C	C							
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16	Relevant Institutions and Organizations	0		C	C	C	C	C																																																
17	Bank of Provinces	0																C	C																										C	C										
18	Provincial Administration General Directorate	0							C	C	C	C																																												
19	General Command of Gendarmerie	0		C	C			C	C	C	C	C																						C	C	C						C												C	C	C
20	General Directorate of Highways	7		C	C			C	C	C	R	R	R			R	R															R	R	C	C	C	C	C	C	C		C												C	C	C
21	Small and Medium Enterprises Development Organization	0																C	C																																					
22	Personal Data Protection Authority	0	C	C	C			C	C	C	C	C										C	C	C	C									C	C	C	C																	C	C	C
23	Ministry of National Education	1																																								R		C												
24	Private Sector Organizations	0				C	C																																																	
25	General Directorate of Post and Telegraph Organization	6																								R	R	R	R	R	R						C																			
26	Radio and Television Supreme Council	0																														C																								
27	Ministry of Health	0																				C	C											C	C	C						C								C				C	C	C
28	Ministry of Industry and Technology	1		C	C			C								C	C	C	R		C																C								C	C		C	C							
29	Insurance Information and Monitoring Center	0																																C	C	C																				
30	Directorate General of Civil Aviation	0																													C																					C				
31	Civil Society Organizations	0		C	C	C	C	C	C	C	C	C				C	C				C	C	C														C	C	C		C	C		C				C	C		C					
32	Union of Municipalities of Turkey	1																C	C			C	C	C	C	C	C	C	C	C													C	R			C				C		C			
33	Turkish National Railway System Transportation Inc.	0																								C	C	C	C	C										C												C				
34	Technology Development Zones	0																		C																																				
35	The Turkish Radio and Television Corporation	0																														C	C																							
36	Turkish Standards Institution	0				C	C																														C											C	C							
37	Scientific and Technological Research Council of Turkey	1		C	C			C								C	C	C	C	R	C																C																			
38	Turkish Statistical Institute	0																																C	C	C																				
39	Ministry of Transport and Infrastructure -Affiliated and Related Institutions	0	C																																																					
40	Ministry of Transport and Infrastructure - General Directorate of Communication	12	R	R	R	R	R	R	C	C	C	C	C			C	C	C	C	C	R					C	C	C	C	C	C						R	C	C		R			C	C	C		C	C		C		R	R	R	R
41	Ministry of Transport and Infrastructure -Turkish National Railway System	1																								C	C	C	C	C										R												C				
42	Ministry of Transport and Infrastructure - Transportation Maritime Communication Research Center Presidency	1																R																																						
43	Ministry of Transport and Infrastructure - Transport Services Regulation General Directorate	2									C	C				C	C																	C	C	C	C	R	R														C	C	C	C
44	Ministry of Transport and Infrastructure	0																				C	C																																	
45	Universities	0	C	C	C	C	C	C	C	C	C	C				C	C				C																				C	C		C							C					

R: Responsible **C:** Collaborated

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