GUIDELINES FOR THE REGULATORY FRAMEWORKS OF INTELLIGENT TRANSPORT SYSTEMS IN ASIA AND THE PACIFIC
2.1 Stages of ITS development in Asia and the Pacific

The Asia-Pacific region consists of a wide range of countries that have different government systems, economic growth levels, population volumes and geopolitical locations. In terms of ITS development, the region ranges from countries with advanced levels of ITS development to countries with few basic traffic operation systems. To review ITS development in Asia and the Pacific, an approach has been taken to define each phase of ITS development at the macroscopic level and evaluate the selected countries’ progress in ITS development.
FIGURE 2.1
ITS development milestones

Stage 1: Initiation Stage
ITS-related activities are initiated by perceiving ITS technologies.

Stage 2: Take-off Stage
ITS plans or ITS development strategies are set up under the lead of the academic and/or public sectors.

Stage 3: Acceleration Stage
ITS-related pilot projects are carried out in earnest in collaboration with public and private sectors, and the feasibility of technologies implemented is evaluated.

Stage 4: Maturation Stage
Regulations, legislation or Acts related to ITS are introduced, covering the extensive integration of ITS technologies, maintenance and operation.

With reference to the ITS technology lifecycle process ("research", "development" and "adoption"), this report proposes four development milestones for ITS for the development of country-level ITS (figure 2.1).

Based on the four critical milestones shown in figure 2.1, the development status of ITS is classified in this report by each milestone in selected countries of the Asia-Pacific region (figure 2.2).


The timeline of ITS development in selected countries shows two different patterns: (a) countries that have experienced in sequence, from stage 1 to stage 4, and (b) countries that have pursued ITS development out of the stepwise process.

Two findings can be directly observed from the ITS development timeline:

- Regardless of the alignment of the sequential process, the countries that have established regulations, legislation or Acts related to ITS are regarded as being at the maturation stage. In other words, having regulations, legislation or Acts relating to ITS is the way to achieving mature ITS services in their countries; and
- Countries following the stepwise process, from stage 1 to stage 4, are generally considered to be ITS developed countries in the region. This means that the four critical milestones might be the way that they have intentionally or unintentionally followed in achieving ITS development.
In addition to the above two direct findings, three secondary observations have been indirectly found:

- Different patterns have been observed among the countries that have reached stage 3 or 4. For example, the Republic of Korea implemented stage 3 before stages 2 and 4, while Turkey completed stage 3 before stage 2. As these two countries already had good ITS facilities, there could have been a sound reason behind this rationale—i.e., they might have decided to test the feasibility of ITS applications with pilot projects, after which they established national plans or strategies to support continued ITS development and operation;

- It should be noted that countries that introduced ITS relatively recently did not follow the above sequence. Some countries skipped stage 1 to start at stage 2 or stage 3 as they might already understand the benefits of ITS from other countries and might have been testing pilot projects or trying to establish national plans and strategies;

- Assuming that those countries which have already reached stage 4 have perceived the importance of regulations, legislation or Acts for ITS, it might be true that the lessons learned have not been fully shared with latecomers in the region. As shown in figure 2.2, countries which have started ITS development in recent years have yet to establish their ITS regulatory frameworks. If the latecomers are aware of the reason why other countries have attempted to introduce regulations, legislation or Acts related to ITS, it is to be expected that the establishment of ITS regulatory frameworks would be noticed by other countries.

As shown in figure 2.2 of this chapter, a few countries in the region might have introduced some types of regulations for ITS on the country scale; these will be specifically examined in section 2.3 of this chapter. However, it is more difficult to identify comprehensive activities on regulations related to ITS at the regional level, which are instrumental in the integration of ITS services and maximizing ITS benefits for sustainable transport development. So far, only intermittent regional-level actions have been observed, including establishing technical standards based on those of the International Organization for Standardization (ISO), participation of a working party under the United Nations Economic Commission for Europe (UNECE) and subregional-level discussions.

ISO, as a representative example of the development of global technical standards, has several member countries from the Asia-Pacific region. ISO carries out technical standard development activities with experts nominated by national bodies. Among the various ISO Technical Committees (TC), ISO/TC 204 is responsible for the overall system and infrastructure aspects of ITS, including standardization of information, communications and control systems in the field of urban and rural surface transport—specifically, traveller information, traffic management, public transport, commercial transport, emergency and commercial services in the field of ITS. As of January 2019, 255 technical standards had been published and 86 technical standards are under development by the direct responsibility of ISO/TC 204. As of January 2019, among a total

2.2 Regional cooperation on ITS-related regulations

Before considering country-specific cases in the Asia-Pacific region, it is useful to explore regional cooperation related to ITS from the regulatory perspective.

19 Haruo Ozaki, Technical Standardization of ITS and Asian Initiatives for Intelligent Mobility, IATSS Research 42 (2018), pp. 72-76.
21 Ibid.
of 29 participating members (P-members) and 29 observing members (O-members), eight countries in the region were registered as P-members and eight others (excluding Hong Kong, China) countries are registered as O-members.

Apart from activities involving technical standards, some regulations concerning ITS have been discussed at the international level, with mainly European countries by UNECE. For example, the World Forum of Harmonization of Vehicle Regulations (WP 29) incorporates into its regulatory framework the technological innovations of vehicles. In particular, within WP 29, a Working Party on Automated/Autonomous and Connected Vehicles was established in 2018, which is a dedicated subsidiary working group directly related to ITS technologies. Even though WP 29 is under UNECE, some countries from this region participate; specifically, in 2018, 10 countries of this region attended the 176th session of WP 29, while six countries of this region attended the first session of the Working Party on Automated/Autonomous and Connected Vehicles.

Although they are only at the beginning stage of discussions, recent activities at the sub-regional level have taken place. For example, the Master Plan on ASEAN Connectivity 2025 by the Association of Southeast Asian Nations (ASEAN) secretariat includes strategies for achieving the vision of the ASEAN Connectivity 2025 that are related to ITS, such as sustainable infrastructure, digital innovation, seamless logistics, regulatory excellence and people mobility. Among these strategies, regulatory excellence is aimed at responding to the need for good regulatory practices in the preparation, adoption and implementation of rules, regulations and procedures in the ASEAN region, which are aimed at supporting the implementation of key policies for attaining the vision of ASEAN Connectivity 2025.

From the Asia-Pacific perspective, these actions by some countries have proven the necessity for an ITS regulatory framework. In addition, this will eventually contribute to drawing up overarching regulations related to ITS in a comprehensive way by appropriate intergovernmental leadership.

In this regard, regional cooperation and collaboration have already been emphasized. For example, in the ITS Guidelines for Sustainable Transport in the Asia-Pacific Region by ITS Asia-Pacific, the role of regulation for overall planning of ITS development at the Asia-Pacific level is reaffirmed by the statement that “to provide support for the interconnection, information sharing and application among intelligent transportation systems, ITS architecture needs to be constantly updated and maintained. Regulation on the management of ITS and the overall planning and coordination of key ITS projects should be improved.” In addition, to be prepared for future ITS technologies, a consistent approach to future regulation at the international level was also emphasized by the Minister for Infrastructure and Transport, Australia, in the High-Level Policy Roundtable during the twenty-third ITS World Congress in 2016. It is also inspiring that individual countries have recognized the regional

22 Australia, China, India, the Islamic Republic of Iran, Japan, the Republic of Korea, Malaysia and New Zealand.
23 Indonesia, Mongolia, Pakistan, the Philippines, Russian Federation, Singapore, Thailand and Turkey.
25 Australia, China, Georgia, India, Japan, Kazakhstan, Malaysia, Republic of Korea, Russian Federation and Uzbekistan.
28 ASEAN Secretariat, Master Plan on ASEAN Connectivity 2025 (Jakarta, 2016).
approach to developing regulations related to ITS. New Zealand, for example, considers a regional approach of regulations with other countries for the integration of ITS to be necessary in order to lead to reduced regulatory compliance costs for New Zealand transport operators and businesses working within the region.\(^{31}\)

### 2.3 Country-specific case studies

ITS applications prevalent in the Asia-Pacific region\(^{32,33}\) were analysed for eight countries, i.e., Azerbaijan, China, the Republic of Korea, the Russian Federation, Tajikistan, Thailand, Turkey and Viet Nam.\(^{34}\) ITS applications include the Advanced Traffic Management Systems (ATMS), Advanced Traveller Information Systems (ATIS) and Advanced Public Transport Systems (APTS), described below:\(^{35}\)

**(a) ATMS**

ATMS is aimed at improving traffic flows and safety by maximizing the efficiency of traffic management. ATMS uses a top-down approach through traffic management centres where real-time traffic data are integrated and processed, and the proper responses are determined. To achieve smooth traffic operations, cutting-edge traffic sensing technologies, information communications and data-processing techniques are incorporated for diagnosing traffic patterns and problems as well as for developing optimal traffic management strategies. Real-time operational solutions capable of mitigating traffic issues are provided by diverse information dissemination technologies, including Variable Message Signs (VMS), mobile devices and car navigation systems. A wide array of examples can be found in countries in the Asia-Pacific region, including electronic toll collection, advanced traffic signal control and automatic traffic enforcement systems.

**(b) ATIS**

ATIS keeps travellers updated with pre-trip and en-route traffic information in given areas. Traveller information ranges from incident details (crashes or road works) to real-time traffic conditions (the levels of road congestion). In operational terms, relevant data need to be collected and analysed in order to provide real-time information to the public. Various devices, such as surveillance cameras, fixed sensors (e.g., loop detectors and vehicle detection systems), probe cars and mobile phones collect necessary data. The Internet, radio, VMS, mobile/online services, and navigation devices are the major distributors of processed information to the public in the Asia-Pacific region.

**(c) APTS**

APTS employs diverse information technologies and traffic management strategies for public transport systems. The goal of APTS is to enhance the efficiency and reliability of public transport operations, as well as for users’ safety and convenience. The adoption of APTS is transforming the traditional services of public transport into more streamlined ones. From the perspective of travellers, APTS provides real-time information on public transport services through the Internet, mobile devices and information terminals; users can thus select the most feasible services. Examples of APTS applications in the Asia-Pacific region include urban public transport management, automatic fare collection, automated passenger information, automatic vehicle location and automatic passenger counter systems. Bus information systems offered in many major cities in this region are a primary example.

### 2.3.1 Azerbaijan

**(a) ITS services ATMS**

Although Azerbaijan only recently initiated ITS services, an ATMS has already been launched,
mainly in the capital city, Baku, with Closed-Circuit Television (CCTV) surveillance cameras, a traffic signal control system and an Illegal Parking Control System (IPCS):

- A total of 60 CCTV cameras have been installed by the Baku ITS (“NiiM”—Naqliyyati İnтеллектual İdarəetmə Merkezi) project, which can be controlled by the traffic management centre;

- A traffic signal control system, called the “Green Wave System”, is connected to the traffic management centre in Baku, with approximately 150 intersections that have traffic signals which are operated using loop detectors. The city has 300 intersections with traffic lights, of which 150 intersections are integrated into the ITS of NiiM and the remaining 150 intersections are operated manually by the traffic police. By a Presidential Decree of 2018, the remaining 150 intersections will also be transferred to NiiM. As of January 2019, work was underway on the integration;

- A total of 44 IPCS cameras were installed in 2010, particularly in the areas with traffic congestion due to frequent illegal parking. In 2018, all the cameras were upgraded, and the total number of cameras was increased to 100.

In 2014, the State Agency of Azerbaijan Automobile Roads proposed the introduction of the first electronic toll collection system on motorway M3 (Alat-Astara). In the near future, turnstiles will be delivered to the country and from 2020, the M3 will become a toll highway.

**ATIS**

As a beginning stage of ITS development, VMS is providing traffic information to drivers in Azerbaijan (figure 2.3). A total of 48 VMS has been installed in Baku, showing traffic density by different colours (e.g., red indicates high congestion).

**APTS**

A Bus Management and Information System (BMIS) is the main ITS service of APTS in Azerbaijan. This system comprises two components, On-Board Equipment (OBE) and Bus Information Terminal (BIT):

- The OBEs have been installed on approximately 2,000 buses operating in downtown Baku. This equipment is built in with a wireless modem and Global Positioning System (GPS). However, as the OBEs have not been operating well technically, the service from BMIS has been discontinued.

- The BITs have been installed at bus stops (around 664 BITs in downtown Baku as of 2017) and are providing bus arrival information to the public (figure 2.4).
(b) ITS regulations
Only a few regulations related to ITS exist so far. For example, in December 2014, a regulation announcing temporary road closure was approved and issued via the Short Message Service (SMS). This regulation states that information about road reconstruction and repair, public events and crashes must be announced via SMS.

2.3.2 China

(a) ITS services

ATMS
China has been operating an extensive ATMS on highways. More than 25 provinces have provincial road network centres that cover a total of 130,000 km of expressways and 400,000 km of highways. Their main functions include traffic monitoring and control (traffic management), highway infrastructure management, toll collection management and settlement, and emergency management. Specifically, around 11,000 sets of traffic flow detection facilities, 39,000 monitoring cameras, 1,700 meteorological monitoring facilities, 200 bridge health monitoring facilities, and 170 cutting slope and road embankment settlement monitoring facilities are being operated. In addition, with strong support from the central Government, in the 1990s an Electronic Toll Collection System (ETCS) based on Dedicated Short-Range Communications (DSRC) was implemented. By 2017, the ETCS covered 130,000 km of expressways in 29 provinces with 70 million users. The ATMS in urban areas of China has a few unique functions:

- An integrated intelligent traffic management system has been adopted in urban areas in the form of an ATMS that has been developed for special occasions. This system was introduced during the Beijing Olympics in 2008, based on the Integrated Olympic Traffic Information Platform for approximately 20 different forms of traffic information, such as for buses, subways and highways. The real-time roadside information system covers 90 per cent of the regional road system inside the fifth ring road. In Shanghai, ITS was introduced in 2010 to prepare for the Shanghai World Expo. After implementing this system in Shanghai, the traffic flow speed increased by 3 per cent within the central inner city and the provided information showed 92 per cent accuracy. Since 2010, this system has been implemented in about 200 cities in China;

- Recent ITS projects have been incorporated into the framework of smart city plans. More than 300 cities in China have been developing smart city plans, while a total of 586 cities have built ITS centres and 325 cities have built intelligent dispatching platforms based on the Geographic Information System (GIS). In China, there are 95,000 nodes of video monitoring, of which 57,000 have high-definition video qualities. A multiplayer transport operation is possible through a coordination system among various ITS centres;

- In 2011, the Ministry of Transport announced a plan to build an integrated intelligent passenger transport hub, which includes Beijing, Shenzhen, Shanghai, Chongqing, Changsha and Chengdu.

Another ATMS application in China is the GPS network control system, which manages the logistics of critical commercial vehicles. This system monitors whether the tracked vehicles, particularly those transporting hazardous commodities, are on the pre-determined routes. A total of 3 million vehicles are monitored by this system.

ATIS
ATIS has been implemented jointly by the private and public sectors. While the provision of the Highway Information System through public websites has been developed by the central Government in about 30 provinces, various forms of traffic information are offered by private companies such as AutoNavi, Baidu
and Tencent. In addition, for the comprehensive management of logistics system, the public and private sectors are partnering to build a logistics information service platform with 100,000 enterprises and 200 million pieces of transaction data. This platform includes the Northeast Asia Logistics Information Service Network, through which container shipment information will be shared among China, Japan and the Republic of Korea.

**APTS**
The Intelligent Public Transport System, which is the representative form of APTS in China, was initiated by the Ministry of Transport in 2011 with the selection of a public transport metropolis. A total of 11 engineering standards were established that cover on-board intelligent service terminal, electronic bus stop board and data communication protocol including data collection. Nine cities (Beijing, Shenzhen, Zhengzhou, Shanghai, Jinan, Nanjing, Chengdu, Guangzhou and Xian) have piloted this system.

**b) ITS regulations**
Although China does not have dedicated regulations for ITS, existing national laws, rules and regulations have been amended to enable the implementation of ITS. Such amendments are fundamental principles that play a role in promoting ITS development. Examples are:

- Article 14 of the Road Traffic Safety Law requires passenger-carrying vehicles, heavy-duty trucks and semi-trailers using expressways to be equipped with driver record devices. The Article also states that the penalty for traffic law violations should be based on the ITS evidence;
- Article 10 of the Highway Law states that road management or transport operations should contribute to the promotion of ITS;
- Article 13 of the Administration of Toll Roads states that the number of stations on toll roads should be reduced and operated by computer networking management in order to increase the efficiency of traffic operations. This regulation promotes the implementation of ETCS on toll roads;
- Article 5 of the Urban Public Transport Ordinance promotes the change from public transport systems to intelligent public transport systems by using advanced management methods and new technologies.

Various guidance or implementation principles for ITS can be found in separate regulations. For example, a regulation promoting taxi reservations by mobile devices was established in 2016. This regulation can be considered as a leading regulation in encouraging mobile ITS services in reserving taxis.

### 2.3.3 Republic of Korea

(a) ITS services

**ATMS**
ATMS plays a fundamental role in ITS operation in the Republic of Korea and is mostly implemented through equipment or facilities for data collection on vehicles or at roadsides. Various traffic management services have been monitored through ATMS, i.e., traffic flow control, incident management, basic traffic information, care management, automatic traffic control and traffic administrative support. Among these services, care management is the proactive service that identifies and avoids threats that drivers may encounter. Traffic administrative support is used, from the managerial perspective, to help road infrastructure management, pollution control and travel demand management.

ETCS has been implemented since 2005, also known as “Hi-Pass”, which consists of an on-board unit, smart card, toll collection and office equipment. As of 2017, 332 toll booths on the entire national highway system had adopted ETCS.
Since the pilot project for traffic management on freeways (the Freeway Traffic Management Systems) was implemented between 1992 and 1994, ATIS was first fully implemented on the Seoul-Busan highway in 1999. Subsequently, it has been expanded to cover 3,860 km of expressways (100 per cent of all expressways in the country) and 2,554 km of national highways (approximately 20 per cent of all national highways in the country).

As of January 2019, several key services were being provided under ATIS in the Republic of Korea – basic traffic information service, tourist information, traffic information before departure, traffic information while driving, traveller’s guidance, parking information, pedestrian route guidance and bicycle route guidance.

APTS
A Bus Information System (BIS) and Bus Management System (BMS) are the major components of APTS in the Republic of Korea. Since the pilot study on BIS was conducted in Seoul in 2005, BIS is currently in operation in more than 40 provinces in the Republic of Korea. BIS mainly provides real-time arrival information to users through GPS devices installed in each bus. The BIS configuration scheme has eight elements – bus information centre, bus vehicle apparatus, bus-vehicle sensors, courier stations, bus company operating terminal, administrative agency operating terminal, other municipal bus connections information and vehicle location system.

BMS offers bus management services in connection with BIS. The comparison of components between BIS and BMS is shown in table 2.1.

### (b) ITS regulations
The Republic of Korea has established ITS-related legislation. More specifically, Chapter 4 of the National Transport System Efficiency Act defines the ITS plans and projects, in which Article 73 requires the Ministry of Land, Infrastructure and Transport (MOLIT)
to review and revise the ITS National Master Plan if necessary every 10 years. Further, if there are any key issues in terms of technical and political changes, MOLIT should review and revise the ITS National Master Plan every five years.

The core factors related to ITS that are defined in the “National Transport System Efficiency Act” include:

- Pre-delivery inspection;
- Legal standards for the definition of system standardization;
- Certification of standards and quality, and cancellation;
- Cancellation of the institutes designated for certifying standards and quality;
- Performance assessment criteria of ITS;
- Safety management criteria of ITS;
- Provision of traffic information using ITS;
- Commercialization in overseas and industrialization;
- Construction of integrated national ITS centre;
- Establishment of ITS association and definition on its business scope.

The major components of the ITS National Master Plan are:

- The objectives and goals of ITS development;
- The strategies and plans of ITS development and operation for each transport service;
- The strategies and plans of ITS development and operation for road, maritime and air transport;
- ITS research and development, industrialization and standardization;
- Finance for ITS development;
- Regulations related to ITS.

The National Transport System Efficiency Act covers other aspects of ITS development and operation, including:

- Under Article 73, the ITS plans for road, railway, maritime and air transport should be established based on the ITS National Master Plan;
- According to Article 76, the local Government must submit ITS implementation plans annually to the Minister of Land, Infrastructure and Transport;
- Under Article 77, the Minister of Land, Infrastructure and Transport will designate the responsible agency, if necessary, for effective implementation, design, evaluation and management of the ITS projects.

2.3.4 Russian Federation

(a) ITS services

**ATMS**

Moscow, the Russian Federation’s biggest ITS city, has various types of ATMS, including a traffic management control centre and a traffic incident detection and monitoring system. A total of 6,741 detectors and approximately 2,500 CCTVs have been installed to monitor traffic flow, and a total of 2,289 traffic signals are used to manage traffic control. In addition, 805 sets of cameras, 34 mobile cameras and 100,000 parking spaces are monitored to manage the traffic law violations.

ATMS has been introduced in Saint Petersburg. The ring road in Saint Petersburg is 142 km in length with 23 intersections, 146 bridges, overpasses and tunnels. The road is equipped with 112 traffic controllers, 550 variable message signs, 44 information boards, 32 roadside meteorological stations, 84 camorders and 514 traffic detectors for managing traffic flows. In addition to the above two cities, the Russian Federation is expanding ATMS to all domestic regions, which is within the framework of the road maintenance system called *Dortransnavigatsiya*. This system is designed for automated planning of the maintenance of roads and facilities by using navigation control and road machinery. All 34 state-owned institutions have implemented
this system and 9,000 vehicles with on-board navigation and communication equipment are in operation in this system.

As part of ATMS in the Russian Federation, tunnel traffic and bridge traffic management are other focus areas into which much effort has been put. In 2018, the bridge traffic management system was implemented on the Crimea bridge connecting the Crimea peninsula and the mainland of the Russian Federation.

ETCS also has been implemented largely through the strategy of toll road development under the Transport System Modernization 2002-2010 Plan. Much effort has been put into establishing ETCS along the highways – particularly the Europe-West China Corridor and the Pan-European Corridor. There is continuous demand to construct more than 9,000 km of highways, to which the Russian Federation is responded to by constructing 3,000 km and 9,000 km of toll roads by 2020 and 2030, respectively. A representative example of ETCS is the M-4 “Don” highway, which is 1,517 km in length and has four types of toll payment methods (cash, credit card, contactless smart card “T-card” and transponder “T-pass”). Federal highway M-1 Belarus also has ETCS with three methods of toll payment (cash, bank card and transponder).

**ATIS**

ATIS has been implemented extensively in major cities, such as Kazan, Moscow, Saint Petersburg and Sochi. Moscow has 144 spots offering electronic displays with three-minute updated traffic information.

Considering the nature of the country, the weather information system plays an important role in ATIS. The Government launched an automated system for meteorological support in 2007 for the total network of Federal roads.

For example, in the north-western part of the Russian Federation, weather information is provided through 966 weather monitoring systems and 1,371 video surveillance units.

This system monitors the weather conditions on the roads, and provides drivers with traffic and weather information.

Further, the interval of providing weather information depends on the situation. For example, warnings on hazardous natural hydro-meteorological phenomena are announced without delay, while warnings on natural hazard and complex meteorological phenomena are distributed on a daily basis. Details of past and expected meteorological conditions for three-day periods are announced every day while details of the heaviest spring flooding are provided between 1 January and 15 March every year.

**APTS**

A Surface Public Transport Dispatching Control System, which is one of many applications under APTS, has more than 10,000 units equipped with the global satellite navigation system (GLONASS) in Moscow.

In addition, other services under APTS are currently operating in the Russian Federation, such as the Troika card for payments for all means of public transport in Moscow, car-sharing services, parking assistance services (Moscow Parking), real-time taxi reservation services (e.g., Yandex Taxi), real-time public transport information services (Mosgorpass), bike sharing services (Velobike) and public transport ticketing services.

**(b) ITS regulations**

In 2003, a few private companies established the “Non-commercial partnership ITS-Russia”, which became the platform for the dialogue between businesses, academia, Government and users of ITS services in the Russian Federation.

The first document that set the basis for ITS deployments in the Russian Federation was developed by the Ministry of Transport and approved by the Government of the Russian Federation through the Order No. 1734-R on 22 November 2008, “On the transport strategy
of the Russian Federation for the period up to 2030”. ITS was stated in the fifth section of this document: “The main directions of the state policy in the field of transport”, in item 6 – “Innovative development of transport system: Stimulation of development and introduction of ITS providing effective management of transport streams and vehicles, and the improvement of quality of transport services”. After this document was issued, amendments were made based on pre-existing relevant regulations to supplement ITS-related regulations.

For example, in 2009, the Federal Road Agency (Rosavtodor) developed a document about the development of ITS on federal road networks, which specifically stated that regulations related to ITS should be legislated with three layers of each stakeholder: (a) the authorities (ministries and departments); (b) scientific organizations (carrying out studies and evaluation of the effectiveness of projects during the life cycle); and (c) businesses (implementation of ITS). In 2011, the Government of Moscow issued Decree No. 1 on 1 November 2011, “About the creation of ITS of Moscow”. In 2013, Federal Law No. 395-FZ on the ERA-GLONASS State Automated System, which was approved on 28 December 2013 (and amended on 13 July 2015), established the mechanisms for the formation and usage of ERA-GLONASS system information resources, rights and responsibilities of government bodies and the requirements for interagency data transfer in the course of the system’s operation.

In 2017, the Government of Moscow cancelled Decree No. 1 of 1 November 2011 and issued a new regulation No. 597 on 30 July 2017, “About ITS of Moscow”. In addition, a new strategy, Digital Economy of the Russian Federation, was approved in 2017 in the Government of Russian Federation Decree No. 632 on 28 July 2017, which states that the standardization of transport information in 20 cities should be completed by 2020. Mobile payment systems and unified travel documents are part of the standardization required by this strategy.

### 2.3.5 Tajikistan

**a) ITS services ATMS**

Since 2013, Tajikistan has implemented its ATMS mainly in the capital, Dushanbe, with a “Safe City” project. Through this project, traffic signals at 70 major intersections, 15 urban checkpoints and 850 video surveillances cameras have been installed, and 100 police patrols have been equipped with GPS units. To enable traffic monitoring and control operations by CCTVs, a traffic control centre was constructed in Dushanbe (figure 2.5).

**FIGURE 2.5**

Traffic control centre in Dushanbe

Compared to urban areas, the application of ATMS is limited in other areas. However, plans have been established to expand ATMS as part of projects being implemented by multilateral development banks or official development assistance agencies, except for ETCS. They include:

- Traffic monitoring systems are to be established during the second phase of the Central Asia Road Link – Sughd Oblast (Cars-2), supported by the World Bank;

- A unified automated information system was established for risk management at 72 customs border posts in 2011 with assistance from the Asian Development Bank, which is in operation. This system contributes to the advancement of ITS technologies for cross-border services.
by electronic Transports Internationaux Routiers;

- A Weigh-In-Motion (WIM) system is being built for load inspections of freight vehicles from 2015 to 2020, supported by the World Bank. The second stage of the project, which is currently underway, will integrate High-Speed Weigh-In-Motion (HSWIM) technology on the route between Kuchkak and Niyozbek municipalities;

- The installation of an automated intelligent tunnel traffic control system is under discussion with the Japan International Cooperation Agency, which will be implemented in five major tunnels in Tajikistan. The system will integrate ITS technologies to monitor and manage tunnel traffic;

- The first toll road in Tajikistan, the Dushanbe-Chanak highway, was opened in 2010, for which ETCS was incorporated with Radio Frequency Identification (RFID) technology.

**ATIS**
A passenger information system has been established in Dushanbe to provide bus information since January 2014, under a Memorandum of Understanding (MoU) between the United Nations Development Programme and the Dushanbe Mayor. Information boards have been installed at 25 bus stops, and 60 buses and trolleys have been equipped with GPS. A parking information system is also under consideration for this project.

**APTS**
In addition to the passenger information system, intelligent bus stops which were built in Dushanbe in February 2018 are a unique system of APTS in Tajikistan (Figure 2.6). A total of 36 bus stops have become intelligent bus stops with modern facilities, including CCTVs.

In July 2017, an Automatic Fare Collection (AFC) system was launched with a smart card, called “City Card”, for public transport payment and fare allocation. At the beginning of the project, 360 buses and trolleys were equipped with smart card readers and, as of April 2018, all buses can accept payment by using the smart card.

Since a taxi service can be part of a public transport system, a new service for taxi reservations through a mobile application was recently launched. This system enables a customer’s location to be acquired by GPS to reserve the taxi.

(b) ITS regulations
Currently, Tajikistan has no regulations related to ITS, either at the national or provincial level. However, the Ministry of Transport is reviewing ITS-related regulations of other countries in preparation for issuing regulations for ITS. This will be done by the amendment of existing regulations such as the Law of Tajikistan on...
Highways and Road Activities. In addition, information communications technology-related regulations mainly covering electrical communications and information security are also expected to be amended for ITS. Given that ITS is largely private sector-driven, the Law on Public-Private Partnerships, which was adopted in 2012, could be utilized to legislate the regulations for ITS in cooperation with the private sector.

2.3.6 Thailand

(a) ITS services

ATMS

In Thailand, Area Traffic Control (ATC) has been implemented in many urban areas (such as Bangkok, Chiang Mai, Phuket and Pattaya). ATC is the adaptive signal control, which employs real-time traffic data in adjusting timings of traffic signals in road networks, thereby ensuring overall improved efficiency of traffic control. Previously, Bangkok used the Split Cycle Offset Optimisation Technique system in the late 1990s at 61 intersections. The project was later terminated due to a contract dispute and ATC was extended to an additional 200 intersections in Bangkok. The system was also installed in Chiang Mai (40 intersections), Pattaya (23 intersections), Udon Thani, Hat Yai and Phuket (6 intersections) because of its efficiency in traffic control and management. However, most urban signalized intersections in Thailand still operate by either manual or fixed time control.

In the case of national and rural highways, many intersections are now operated by actuated traffic signal control, which is signal timing in response to current traffic flows. On the other hand, expressways and motorways in Thailand are efficiently operated by traffic management centres (figure 2.7). The centres are the heart of Thailand’s traffic data collection and analysis, enabling action to be taken in response to real-time traffic conditions and incidents. Each expressway/motorway section (between 30 km to 70 km) is operated by a sub-control centre. The roads are equipped with CCTVs, sensors and VMS. The centres also have mobile applications for disseminating motorists’ information. The traffic situation is monitored on a real-time basis, and action is taken as and when necessary to deal with emergencies and other situations requiring road management.

There are police traffic command and control centres in Bangkok and some other cities in Thailand that monitor traffic conditions through an extensive CCTV network and respond through police traffic control. The “Bor Kor 02” traffic command centre is the operational core in Bangkok (figure 2.8), which provides integrated command of traffic flow control carried out by local police in sub-districts. The centre provides traffic information via the 1197 traffic hotline. The hotline is also used for receiving real-time incident reports. There are several traffic radio channels in Thailand that are popular for their incident reports.

FIGURE 2.7
Motorway traffic management centre, Thailand

ATIS

Traffic information, such as that concerning traffic conditions (coloured congestion) and road incidents, is collected mainly by road authorities (e.g., from roadside sensors and detectors) and provided to travellers through various agencies in Thailand. Mobile applications and VMS managed by various agencies provide on-road traffic information and trip planning advice.
Although data on traffic and travel conditions are collected by several agencies, the Intelligent Traffic Information Center (iTIC) Foundation collects a broad range of data from the public and private sectors, and releases the information to the public and businesses. The data are received from many sources, such as CCTVs, taxis, and logistics and mobile probes. Real-time traffic conditions and incident situations are broadcast to car navigation and portable navigation devices (figure 2.9) using the Radio Data System-Traffic Message Channel (RDS-TMC) on FM radio frequency.

Mobile applications for traveller information exist in Thailand. For example, the Ministry of Transport has launched a few applications to provide information for travellers. Some applications are popular with the private sector (e.g., Google, HERE and T-Square Traffic) because they contain useful multi-modal information, are easy to access and use, and provide extensive in the areas covered.

More recently, Thailand has required buses, trucks and all public service vehicles to install Global Navigation Satellite System (GNSS) tracking devices that are linked to the Department of Land Transport in real-time. In 2018, around 300,000 vehicles were tracked and recorded. Currently, the data are used for surveillance and enforcement, but can be used to provide real-time traveller information.

**FIGURE 2.8**

Police traffic command and control centre “Bor Kor 02” in Bangkok

**FIGURE 2.9**

Traffic information includes congestion levels, incidents and CCTV from iTIC

**APTS**

In Thailand, APTS mainly provides electronic payment and public transport information systems. The electronic payment system on public transport is applied in urban rail services in Bangkok. Various payment methods, such as common e-ticket (also known as a smart card), are used on all urban rail transport systems. A “Spider (Mangmoom) Card” (figure 2.10) is used for integrated payments on rail, bus and boat transport. However, currently only two rail lines share this common e-ticket. Other forms of payment have also been introduced for car and motorcycle taxis, such as a credit card and QR code. The Rabbit Card,
the common card for the Skytrain or Bangkok Mass Transit System, can also be used at many commercial stores.

Public transport information systems mainly include bus information through mobile applications. Some applications offered by the public bus authority and private sector give travellers real-time bus information, such as bus routes, travel times and connections.

In addition to Bangkok, many new bus lines have been introduced around Thailand. The new lines often provide travellers with bus information. For example, bus services in Chulalongkorn University (Bangkok) and Khon Kaen University (Khon Kaen) as well as in Phuket and Chiang Mai provide information to riders via mobile applications or smart bus information signs at bus stops.

(b) ITS regulations

Although Thailand has developed ITS master plans – the first ITS Master Plan by the Office of Transportation, and Traffic Policy and Planning (OTP) was for 2005-2014, the second OTP ITS Master Plan for 2012-2017, and the third OTP ITS Master Plan for 2018-2023 – action with regard to ITS regulations has not been comprehensive. In Thailand, it is a widespread practice to pursue matters with a development plan that serves as a guideline for planning, implementation and operation. Three current plans are related to ITS – the Transport Strategic Plan for 2017-2021, Digital Transport Plan 2021 and ITS Development Master Plan for the Bangkok Metropolitan Region, 2018.

The two first plans indicate the importance of concrete and comprehensive regulations for ITS. The first plan contains one strategy for the use of technologies to provide better transport administration and services, and includes ITS in this category. Another strategy in this plan is to revise or develop the regulation system for transport; however, ITS regulations are not considered in this strategy. The programmes to be carried out during 2017-2021 include improvement of service quality with trucks and buses, the regulation of rail and air transport, and an ITS plan for provincial cities.

The second plan, “Digital Transport Plan 2021”, covers the transformation of conventional transport activities and administration into “digital” services. Several directions are advised in this plan, including the advancement of ITS in Bangkok and its surrounding vicinities, and it encourages the construction of a digital transport ecosystem on the digital government platform. In this plan, future actions related to ITS are defined. For example, ITS data are geared towards open sharing through the National Multimodal Transport Information Center. Many agencies would exchange transport data based on this plan.

The third plan, ITS Development Master Plan for the Bangkok Metropolitan Region, 2018, defines many directions for developing ITS in the Bangkok metropolitan area. One activity is for more concrete ITS-related laws and regulations to be developed. Notable activities related to such laws and regulations include guidelines and regulations for open data, autonomous vehicles, Mobility-as-a-Service (MaaS), public sector restructuring and public-private collaboration in ITS projects. This plan
also reviews international ITS standards and outlines some standards for ITS in Thailand.

2.3.7 Turkey

(a) ITS services

ATMS

The most popular application of ATMS in Turkey is for traffic operation facilities such as traffic signals. A total of 2,726 signalization systems are in operation on highways, and 2,281 signalization systems are managed by the traffic management centre in Istanbul Metropolitan Municipality. Several types of traffic signals are currently operated, including fixed-time, semi-actuation, full actuation and green wave.

In response to the increasing interest in smart cities, the Istanbul Metropolitan Municipality considers ATMS to be a major component. A total of 539 monitoring stations for vehicle speeds and volumes have been installed on highways, and analysed information from the stations is provided on maps. In addition, 99 WIM stations are currently in operation for monitoring and controlling overloaded freight vehicles.

By the end of 2018, Turkey had 361 tunnels with a total length of 463 km. Tunnels longer than 500 m are equipped with various tunnel control systems.

To facilitate access to the emergency services, including the traffic emergency service, the Ministry of Internal Affairs is generalizing the emergency call system with the objective of offering a single contact number for all emergency services.

ETCS has been widely applied on all public motorways and is operating as “fully cashless” using Dedicated Short-Range Communication (DSRC) and Radio Frequency Identification (RFID) technologies. The number of users of DSRC and RFID-type systems are 1.95 million and 12 million, respectively. ETCS has been implemented at 99 toll plazas in the country, of which eight use multi-lane free-flow systems (figure 2.11). Since 2014, Turkey has been changing the classic toll gates over to multi-lane, free-flow systems.

ATIS

ATIS utilizes various types of media to provide traffic information in Turkey. The official website of the General Directorate of Highways provides information on road conditions, including road works, closed roads, optimal travel routes and tourism sites plus an online traffic map. VMS is used for disseminating meteorological and traffic information. Radio broadcasting on some road sections and in long tunnels is also used for providing information to road users with regard to traffic and tunnel conditions. Mobile applications, which have become widespread since 2012 with more than 3.5 million downloads, provides a traffic density map, travel times and route distance calculation.

In addition to information provided by the General Directorate of Highways, the Istanbul Metropolitan Municipality and Izmir Metropolitan Municipality provide information on traffic and road conditions. Istanbul Metropolitan Municipality also provides information generated by an intelligent parking system about vacant parking space by mobile application, VMS and a traffic density map. The Istanbul traffic

FIGURE 2.11
Multi-lane, free-flow toll gates in Istanbul

![Multi-lane, free-flow toll gates in Istanbul](image-url)
density map also provides information on travel planning, travel times, traffic signals, and locations of cameras and pharmacies. The Izmir Metropolitan Municipality delivers various types of information through mobile applications, such as travel planning, travel times, bus service lines, vacant parking spaces, the location of cameras and pharmacies, road works and crashes.

**APTS**

A public transport management service is the current representative application of APTS by the metropolitan municipalities. This service includes monitoring bus operations, providing information through mobile application, a website and information panels on bus stops as well as electronic payments.

**(b) ITS regulations**

In Turkey, there is no specific legislation dedicated to ITS. However, several regulations exist that enable the establishment of ITS. Also, Turkey is a candidate country for European Union membership, and thus is obligated to adopt the European Union legislation on ITS, including electronic toll collection and tunnel safety:


- Commission Decision of 6 October 2009 on the definition of the European Electronic Toll Service and its technical elements (2009/750/EC);


- Directive 2010/40/EU of the European Parliament and the Council of 7 July 2010 on the framework for the deployment of ITS in the field of road transport and for interfaces with other modes of transport.


Some regulations, such as the Metropolitan Municipality Law, the Law on Services of the General Directorate of Highways and the Highway Traffic Law, are not specifically related to ITS; however, they allow for the installation and operation of some components of ITS. The followings are cases for directly referring to or dealing with ITS:

1. **Law on Services of the General Directorate of Highways**

   - This law determines the organizational structure and duties of the General Directorate of Highways. Pursuant to this law, the General Directorate of Highways establishes ITS on the roads included in its road network.

2. **Regulation on Organization and Duties of the General Directorate of Highways**

   - In this context, the duties for “the establishment and control of Intelligent Transport Systems such as traffic management and driver information systems for the realization of safe, efficient and rapid traffic management”, “the establishment of management information system for tunnels and large structures”, and “realization or procurement of road pricing, toll collection and the related operations of the toll roads” are assigned to the related departments.

Although not related to legislation, there are also cases where technical documentation for ITS installation has to be prepared. Such documentation includes the technical specifications for ITS to be installed on the state road network of the General Directorate of Highways – for example, cameras, VMS, signalization, management centres, databases and meteorological stations.
The Tenth Development Plan 2014-2018 (Onun-cu Kalkınma Planı 2014-2018) proposed that ITS be deployed from 2014 to 2018. Major strategic areas are largely divided into (a) logistics transport, (b) information and communication technologies and (c) urban infrastructure.

For a plan that contains a specific action, the Integrated Urban Development Strategy and Action Plan 2010-2023 (KENTGES Bütünleşik Kentsel Gelişme Stratejisi ve Eylem Planı 2010-2023) was issued in the Official Journal (Resmi Gazete) on 4 November 2010. This action plan covers the following action on the use of information technologies in urban transport systems. Also, this action, which is under the responsibility of the municipality authorities, is intended on the action capacity development and institutional structuring, and valid for the period 2010-2023:

- Action: 5.5.4. – “The regulations shall be made for the efficient use of information technologies in urban transport”, “In the cities, it is required to establish transport control centres, to monitor real-time mobility by Global Positioning System receivers and to notify by communication technologies (Internet, GSM etc.)”.


- (a) Generalizing ITS on highway networks, the establishment of a traffic management centre in regional divisions of the General Directorate of Highways and a main traffic management centre in the headquarter of General Directorate of Highways;
- (b) Completing and optimizing fibre-optic and broadband networks along the highways to promote adequate ITS;
- (c) Assigning the specific frequency and leading vehicle manufacturers for integrating vehicle-to-vehicle and vehicle-to-infrastructure communication systems with vehicle electronic systems;
- (d) Designating nationwide ITS user services and their logical framework and physical units;
- (e) Developing local mobile traveller information systems;
- (f) Establishing traffic management centres in metropolitan municipalities within specified standards.

In addition, the 30 metropolitan municipalities in Turkey have each created a strategic plan for their activities during a specific period, but in general for five years. The strategic plan also covers transport-related issues. Municipalities prepare their strategic plans to meet their own needs. ITS-related actions generally focus on components of traffic management systems, particularly signalization systems. The Istanbul Metropolitan Municipality Strategic Plan 2015-2019 (İstanbul Büyükşehir Belediyesi Stratejik Plan 2015-2019) includes the objective of the “Generalization of Intelligent Transport Systems to Include all Public Transportation Vehicles” (Akıllı Ulaşım Sistemlerini Tüm Toplu Ulaşım Araçlarını Kapsayacak Şekilde Yaygınlaştırmak) under the strategic goal of “providing transport services that are accessible, sustainable, qualified, economical, fast, safe, comfortable and human-oriented” (İnsan Odaklı, Erişilebilir, Sürdürülebilir, Kaliteli, Ekonomik, Hızlı, Güvenli, Konforlu Ulaşım Hizmetini Sunmak).

Furthermore, the eleventh Transportation, Maritime Affairs and Communication Forum in 2013 proposed the establishment of intelligent highways on state highways and motorways until 2035 as that would allow vehicles to communicate with ITS and other vehicles until 2035.
2.3.8 Viet Nam

(a) ITS services

**ATMS**

ATMS has been launched in many major cities in Viet Nam, such as Da Nang, Hanoi and Ho Chi Minh, as part of ITS projects. In such cities, traffic monitoring and management systems are being developed with the focus on building a surveillance camera system, traffic management centre and radio system for collecting information and providing it to users.

For example, a pilot scheme to develop a traffic management model on Thang Long Boulevard in Hanoi is in progress. In addition, the traffic management centre in Hanoi handles traffic crashes, traffic information and facility maintenance via vehicle detectors, CCTVs and VMS. Da Nang is also working on a smarter traffic system program for the whole city.

Apart from ATMS in urban areas, the following applications have been implemented on highways in Viet Nam:

- The first freeway management system was introduced on the Cau Gie-Ninh Binh expressway that includes traffic monitoring and control systems for traffic crashes and congestion. This expressway has 30 cameras installed every two kilometres;

- A similar system was also incorporated on the Ho Chi Minh-Trung Luong expressway to monitor and control traffic flow. The traffic management centre for this expressway has 38 cameras and 30 video systems for detecting traffic errors as well as a server that can manage an image processing and network integration system across the 11 expressways in southern Viet Nam;

- Other expressways also have traffic monitoring systems. A total of 58 rotary cameras were installed on the Hanoi-Hai Phong expressway, with two stations located in high traffic-density areas, which automatically observe traffic density. These devices, which have a one-kilometre observation radius and an anti-vibration mechanism, can magnify images up to 32 times. The Noi Bai-Lao Cai expressway has 58 cameras. Cameras for traffic monitoring is also being installed on the Phap Van-Cau Gie expressway;

- For monitoring and controlling overloaded freight vehicles, mobile load testing stations have been built along the highways since 2013. Furthermore, the Ministry of Transport has started to adopt HSWIM on the important national highways.

With regard to ETCS, there are 88 toll stations on national highways, of which 73 toll stations are managed by the Ministry of Transport (56 toll stations are now being operated) and 15 toll stations are managed by local governments. 17 toll stations have free flow systems. In particular, the Cau Gie-Ninh Binh expressway has four toll stations with a digital signage system, lane control system and it can charge information storage servers for 40 lanes.

To improve traffic management (through vehicle monitoring) and safety, most transport-related companies, including cargo and passenger carriers, have deployed a cruise control system, called “black box” in Viet Nam.

**ATIS**

Most expressways in Viet Nam have VMS (a type of full span overhead bridge) managed by public agencies. VMS offers speed limit information, traffic information reminders and distances to destinations. The private sector also provides many services under ATIS. For example, Vietmap provides a free navigation service covering 63 provinces, with the map being updated every three months.

**APTS**

A bus information service has been implemented in several cities of Viet Nam (Hanoi, Ho Chi Minh and Da Nang) as a pilot project. The bus arrival information (identified by GPS) is announced
to passengers when the bus is 500 metres away from the bus stop. Information boards have been installed at 24 bus stops and a SMS is also available automatically every 3 to 5 seconds to provide bus arrival information.

Hanoi, Ho Chi Minh and Da Nang have bus operation centres that monitor bus operations which enables the collection of various data for operation routes, arrival and departure times, vehicle speeds, stop locations, and the status of opening and closing doors. Through the pilot project, the bus drivers are able to communicate with bus operators when necessary through audio cameras.

The Bus Rapid Transit (BRT) system has mostly been provided with APTS. The BRT has been deployed in Hanoi (Kim Ma-Yen Nghia route) since 2017 in response to demands by the city. The BRT will be upgraded and expanded in many other cities in Viet Nam.

(b) ITS regulations
So far, Viet Nam has just a few ITS-related regulations because it has only been implemented recently. Some national standards related to ITS were defined in 2015 – for example, an electronic toll collection system, a highway traffic supervision and management system (including highway traffic management centres) and highway traffic signs.

Considering the limited number of regulations for ITS, Viet Nam is currently at the stage of developing policies to support national science technologies. Some examples that can be used for ITS development are:

- Decision No. 418/QD-TTg: Science and Technology Development Strategy, 2012;
- Decision No. 2457/QD-TTg: National Programme on Hi-tech Development up to 2020, 2010;
- Directive 16/CT-TTg: Enhancing the Capacity to Access the 4th Industrial Revolution, 2017.

In addition, since ITS uses communication technologies, some existing national technical regulations governing the specifications of communication devices can supplement regulations for ITS development.

2.3.9 Lessons learned from country-specific cases
First, the roles of ITS regulatory frameworks are underscored. It should be noted that regulations related either directly or indirectly to ITS provide the basis for ITS development and operation, which will therefore reinforce the rapid adoption of ITS and advances of related technologies. In addition, regulations related to ITS support the establishment of national ITS plans and strategies as well as continuous updating.

Second, regulations related to ITS require the involvement of various entities. This is re-emphasized by the country-specific cases that show the existence of diverse types of regulations for ITS in various fields encompassing transport, ICT, industry and internal administration.

Third, among the countries that already have regulations related to ITS, different approaches are seen. Some countries have amended existing regulations in other fields relevant to ITS technologies, while others have attempted to introduce regulations dedicated to ITS. In the second category, these two approaches have been merged appropriately – i.e., even though the latter countries have regulations directly related to ITS, they have also revised earlier regulations to respond to the requirements for new ITS technologies in a timely manner.

Fourth, the case studies show that various attempts have been made to develop relevant regulations. Although those countries do not have adequate regulations related to ITS yet, they have started to establish regulations where urgent demand exists for the implementation of ITS services.
Fifth, even though some countries have relevant regulations for ITS, the terms, provisions and descriptions used in such regulations do not necessarily meet the specific system requirements for new ITS technologies (e.g., C-ITS, CVs, AVs and smart mobility) and cross-border ITS services, despite the growing demand for such technologies and services in Asia and the Pacific.