

**Ministry of Traffic of Canton Sarajevo
Bosnia and Herzegovina**

**Project for Formulation of Sarajevo
Public Transport Management and
Operation Capacity Development Plan**

Final Report

Volume III

Public Transport Convenience Enhancement Plan

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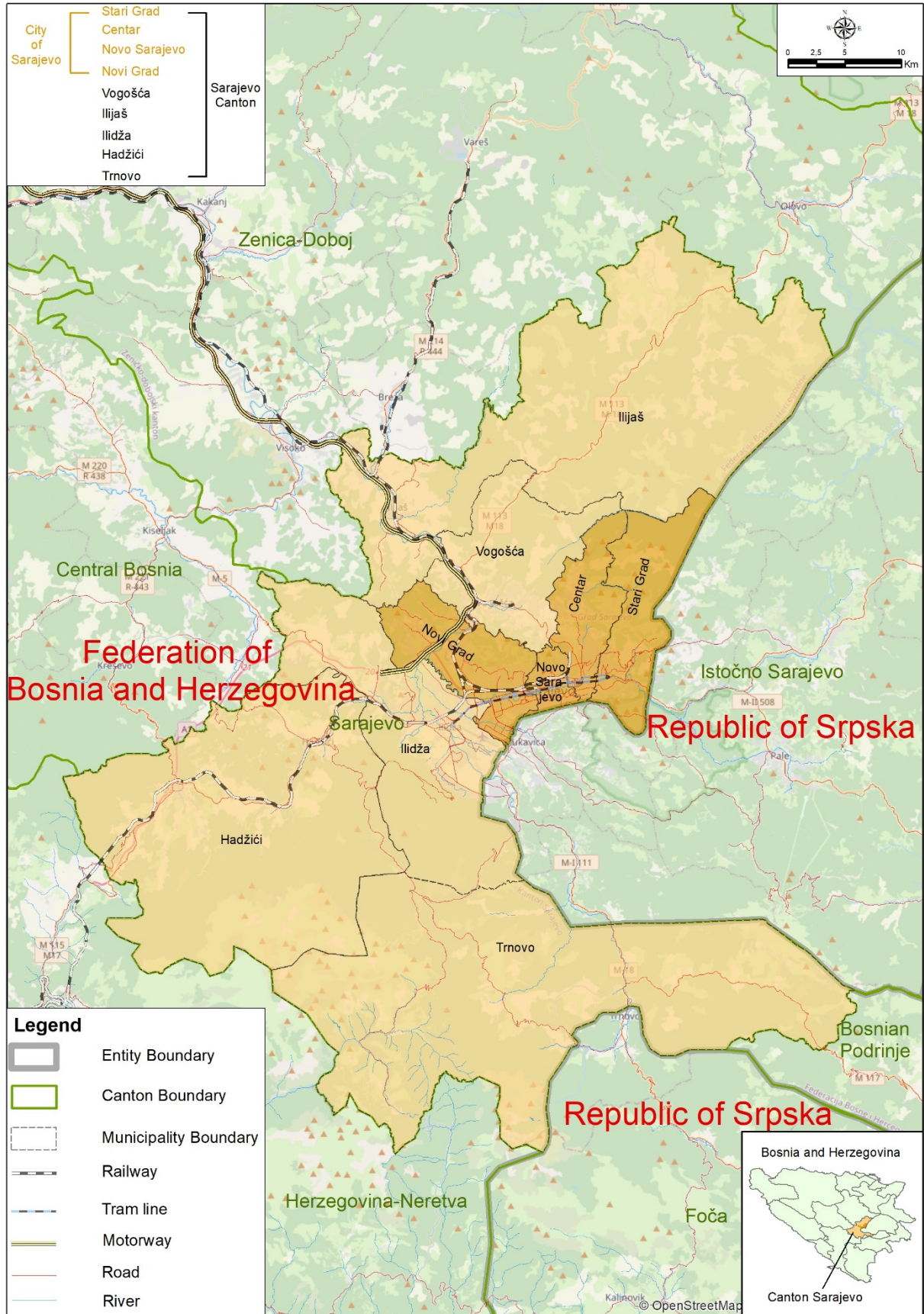
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List of Abbreviations

ANPR	Automatic Number Plate Recognition
API	Application Programming Interface
ATMS	Adaptive Traffic Management System
C/P	Counterpart
CCTV	Closed-circuit Television
CRU	Central Computer Control (<i>Centralnog Računarskog Upravljačkog</i>)
CS	Canton Sarajevo
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
GCAP	Green Cantonal Action Plan
GIZ	German Agency for International Cooperation (<i>Deutsche Gesellschaft für Internationale Zusammenarbeit</i>)
GPS	Global Positioning System
GRAS	Gradski Saobraćaj
GTFS	General Transit Feed Specification
HGV	Heavy Goods Vehicle
IC	Integrated Circuit
ICT	Information and Communication Technology
ITS	Intelligent Transport System
JICA	Japan International Cooperation Agency
LCV	Light Commercial Vehicle
LED	Light-Emitting Diode
LEZ	Low Emission Zone
MaaS	Mobility as a Service
MM	Mobility Management
MOE	Ministry of Education
MOI	Ministry of Interior
MOT	Ministry of Transport
NMT	Non-Motorized Transport
NUC	Supervisory Management Center (<i>Nadzorni Upravljački Centar</i>)
QR Code	Quick-Response Code
RDB	Reference Database
SCADA	Supervisory Control and Data Acquisition
SUMP	Plan for Sustainable Urban Mobility of the Canton Sarajevo and the City of Sarajevo
TISAR	Traveler Information System for the Adriatic Region
TOD	Transit-Oriented Development
TRAMODE	Project for Formulation of Sarajevo Public Transport Management and Operation Capacity Development Plan
US	United States
UX	User Experience



1 Public Transport Service Improvement

1.1 Issues on User’s Convenience and Required Measures

1) Issues on User’s Convenience

The issue on users’ convenience of each public transport mode in Canton Sarajevo is analyzed, and the Expert Team has been considering the various specific measures and applicability of ITS/MaaS technology, in order to make proposals to the counterpart.

2) Classification of Measures for Improvement

Required measures in public transport service users’ convenience were discussed among WG4 members. Table 1 summarizes the issues of user’s convenience, countermeasures to improve these issues, and the priority and possibility to introduce in Sarajevo.

Table 1 Classification for Public Transport Service Improvement

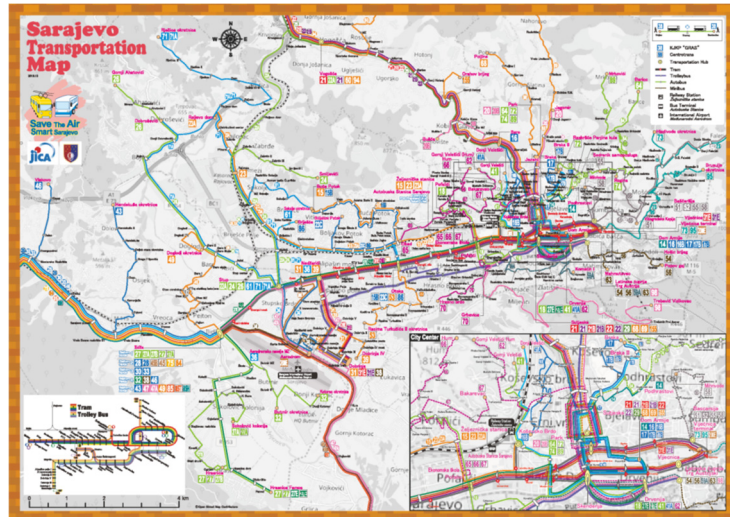
No	User Convenience Issues	Countermeasure	Priority and Possibility to Introduce in Sarajevo		Category	
1	Lack of maps and signs	Route map Mobility Management (MM)	“Very High”	<ul style="list-style-type: none"> ➤ To be implemented immediately, utilizing the map which made by JICA data collection survey ➤ To be implemented MM activity utilizing route map and other information 	1) Information Provision of Public Transport and Mobility Management	
		Installation of signs / information boards	“Very High”	<ul style="list-style-type: none"> ➤ To be implemented immediately 		
2	Unknown vehicle departure and arrival times	Displaying latest operation information, provision of next arrival information	“Medium”	<ul style="list-style-type: none"> ➤ To be considered with actual operation of monitoring center ➤ Need to consider integration with the system in monitoring center 		
3	Inconvenient access to the public transport lines	Provision of new access modes	“Medium”	<ul style="list-style-type: none"> ➤ To be considered with new mobility service 		2) Improvement of Transport Nodes
		P&R facilities	“Medium”	<ul style="list-style-type: none"> ➤ (To be examined details, based on the result of traffic surveys and demand forecast) 		
4	Inconvenient transfer between public transport modes	Improvement of transport nodes and coordination of operations	“Medium”			
5	Unfairness of fare system	Revision of fare system, improvement of ticketing system	“Medium”	<ul style="list-style-type: none"> ➤ To be considered at the timing of installation of smart card system ➤ Need to consider integration with the fare collection system 	3) Proposed Operational Support System and Introduction of New Technologies such as ICT/MaaS	
6	Environment for all users to use public transport safely and securely	Improvement of crew members’ service for the customers	“High”	<ul style="list-style-type: none"> ➤ To be implemented by reviewing the cases in other countries 	4) Improvement Measures by Operators	
		Introduction of a crime prevention system	“Medium”	<ul style="list-style-type: none"> ➤ To be considered with actual operation of monitoring center 		
		Establishment of boarding manners	“High”	<ul style="list-style-type: none"> ➤ To be implemented with information provision such as route map and signs / information board 		
		Installation of streetlamps at bus / tram stops	“High”	<ul style="list-style-type: none"> ➤ To be considered with road maintenance 		

Source: JICA Expert Team

1.2 Information Provision of Public Transport and Mobility Management

1) Route Map

Some route maps have been created with the support of international donors, such as those created during the JICA data collection survey in 2019, as shown in the following figure. These maps are useful, and it is necessary to consider carefully about how to disseminate to potential users and how to update information.



Source: JICA Data Collection Survey and others

Figure 1 Bus Maps in Sarajevo

2) Installation of Signs / Information Boards

Bus/tram stops and its shelters in Sarajevo do not have sign board with bus/tram stop names, destination information, route information. In addition, since many buses do not have route numbers or destination signs, the JICA Expert Team proposed the information display plan shown in the figure below.

Information Board at Bus / Tram Stops

- Specify 1) the bus / tram stop name, 2) the route number, and 3) the destination of each bus / tram on the shelter of each stop
- Post a QR code and provide information to users who want more information such as bus maps and operation information
- An independent stand is also an idea as below.

Route Information on Bus / Tram Fleet

- Specify 1) the route number, and 2) the destination and major stops of each bus / tram on the fleet
- Bus route information should be arranged properly on the bus body.
- The color of the bus / tram route should be displayed in the front and on both sides of the vehicle.

Inside of Bus / Tram: Itinerary on Route

Front of Bus/Tram: Route Number and Destination

Source: JICA Expert Team

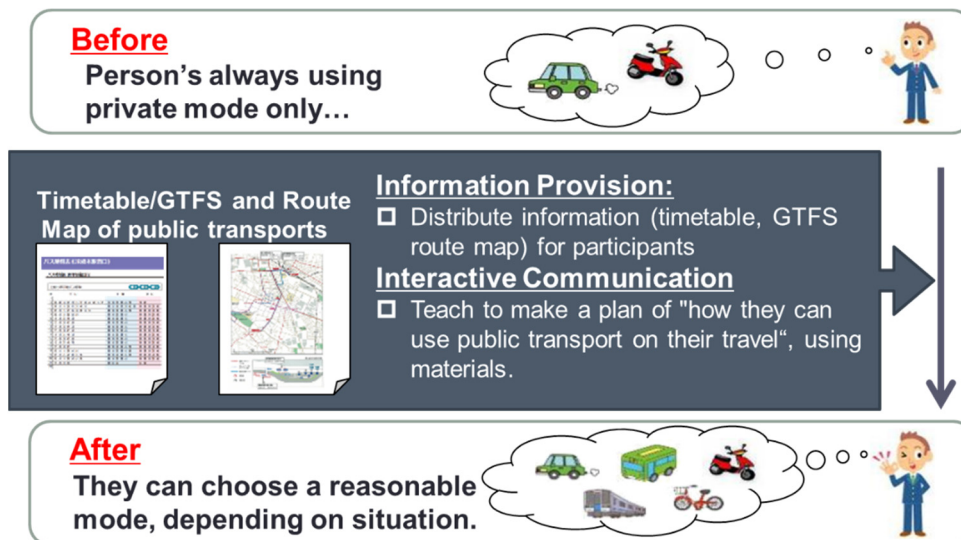
Figure 2 Proposed Installation of Signs / Information Boards

3) Mobility Management

(1) Outline

MM is a concept to promote sustainable transport and manage the demand for private transport use by interactive communication of changing travelers' attitudes and behavior.

In promoting the use of public transport, in addition to providing the above information, it is essential to communicate with those who can shift to using public transport. The following figure shows the importance of using public transport, and methods of communication.



Source: JICA Expert Team

Figure 3 Concept of Mobility Management

(2) MM Action Plan for Citizens

The JICA Expert Team proposed an activity plan for each target group of citizens in Sarajevo and discussed it with the C/Ps. These contents were summarized as an action plan in the following table. These activities aim to modify behavior using persuasive communication and physiological approach in order to promote public transport usage.

Table 2 Proposed MM Action Plan for Citizen

Target	Trip Purpose	Method	Object	Contents of Activity
Students	To School	Seminar (Participatory Learning)	To provide the opportunity to reconsider the commuting by motorcycle	Traffic board game Simulation/analysis the commuting behavior by questionnaire (travel behavior survey)
Companies	To Work	Workshop for Workers		Provide the risks by motorcycle usage (ex. Risk of traffic accident or health) Provide travel plan using bus map and time table
Residents along Bus Routes	To go shopping/ Market, eat and others	Workshop for Family	To promote public transport usage experience	Distribute Newsletter to promote public transport usage Conduct the event which can participate by family, to promote bus usage experience (Ex. stamp rally)

Source: JICA Expert Team

(3) Demonstration Activity at Primary School

JICA Expert Team and C/P implemented "Demonstration activity MM" through traffic & transport education activities as part of the efforts to encourage the usage of public transport. Specifically, we provided classes for elementary school pupils using the game of Traffic Sugoroku, making an opportunity to learn the difference between public transport and private vehicles and the importance of using public transport. Through these activities, the pupils were able to understand that excessive use of private vehicles causes traffic congestion and environmental problems, and by using the concept of "social dilemma", they can understand the reasons why the problems are not improved. To solve social dilemmas

in the future, it is expected that people understand the importance of using public transport versus using private vehicles, depending on the situation.

The activity using a board game named "Traffic Sugoloku" was conducted at the Hasan Kikic primary school in Sarajevo, targeting the fourth and fifth graders, with the cooperation of local teachers, as show in Figure 4.

The demonstration activities were carried out in collaboration with local school in Sarajevo, with the cooperation of public transport company's staff and lecturers from the University of Sarajevo. The staff of public transport operator and lecturer from university were facilitated the class.



Source: JICA Expert Team

Figure 4 Demonstration activity at Hasan Kikic Primary School

1.3 Improvement of Transport Nodes

Upgrade of In-Terminal Business:

Although some of the major transport nodes in Sarajevo have small shops such as kiosks, they are yet to develop facilities that are as attractive shops for public transport users as the transport nodes in Japan. Therefore, based on the Japanese examples, JICA Expert Team and C/Ps discussed and considered upgrading measures for the terminal business. These were examples from the Shibuya in-station facility and Shinjuku Basta (bus terminal), both of which were observed during the training in Japan.

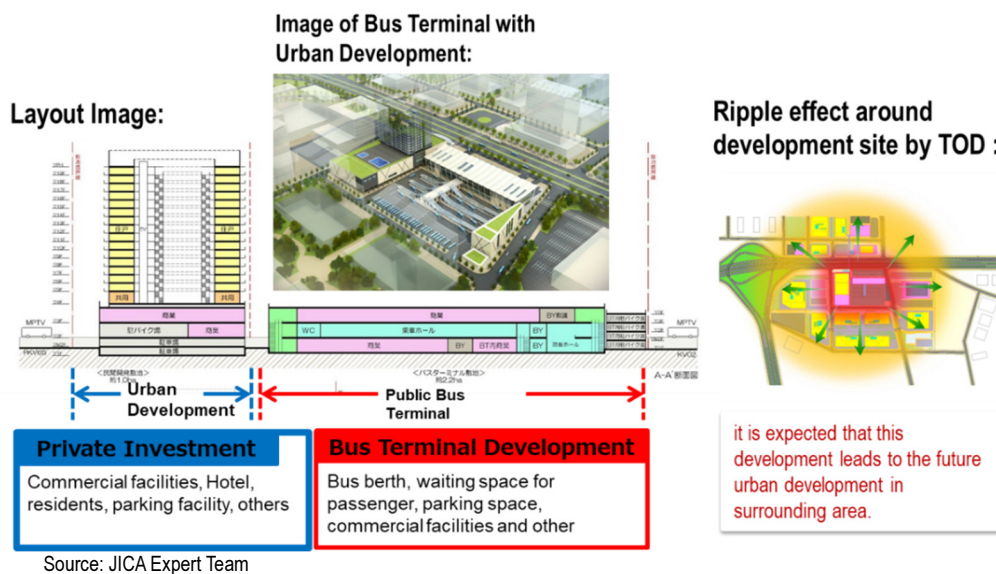


Figure 5 Example of Integrated Multimodal Center

1.4 Proposed Operational Support System and Introduction of New Technologies such as ICT/MaaS

1) Operational Support

(1) Bus/Tram Stop Improvement

For public transport passenger, there are currently two tram stops which have destination signboards and fare gates. The destination signboard also has a function to display tram approaching information. Meanwhile, at other tram stops and at all the bus stops, tourists are not able to know when and which bus/tram stop will take them to their destination

because there is no bus/tram approaching information and destination sign. The information board at bus / tram stops should be provided by the MOT of Canton Sarajevo.

(2) Information Provision by QR Code and GTFS

Development of the smartphone application that will enable passengers to purchase tickets, see lines, have real-time information for next service and news about public transport is yet to be completed because priority is given to the contactless ticketing system.

JICA Expert Team also proposed GTFS data to be regularly updated and provided for Google to be utilized by public transport users. Since the GTFS data have been once generated, it is relatively easy to update the data. It is recommended that the MOT and the public transport operators collaborate with the University of Sarajevo for the update.

2) Electronic Billing and Ticket Control System

MOT has started with contactless IC card tickets that are valid in all vehicles of all public transport operators. Monthly subsidized contactless IC card tickets for pupils, students, pensioners, and the unemployed have already been distributed, and then MOT will start sale of contactless tickets to the general passengers as soon as the on-board validators are in function by the end of 2023. For one-time tickets, paper tickets with a bar code will be read at the same validator. The price of the ticket increased and now it is 1.80 BAM.

The IC cards will be used at the validator when entering the public transport vehicles. Personalized IC cards contain a photo and other necessary information about the public transport user. The IC cards are different in color for pupils, students, pensioners, unemployed and workers (monthly tickets). Currently, IC cards can be issued to students, pupils, pensioners as well as some other categories such as unemployed, but it is yet to be issued to workers and general passengers. Renewal of subsidized IC cards need to be done at GRAS or CENTROTRANS offices while topping up on regular IC cards can be done at kiosks. For one-time tickets, paper tickets with a bar code will be read at the same validator.

It is confirmed that MOT/GRAS has been doing counter measures for free riders (inspector, penalty and special campaign), but they have still been suffering from the issue. New ITS system could solve this issue, but, at first, fare collection management team and new ITS system designed by MOT/successor of GRAS should reconsider the best fare policy and operation.

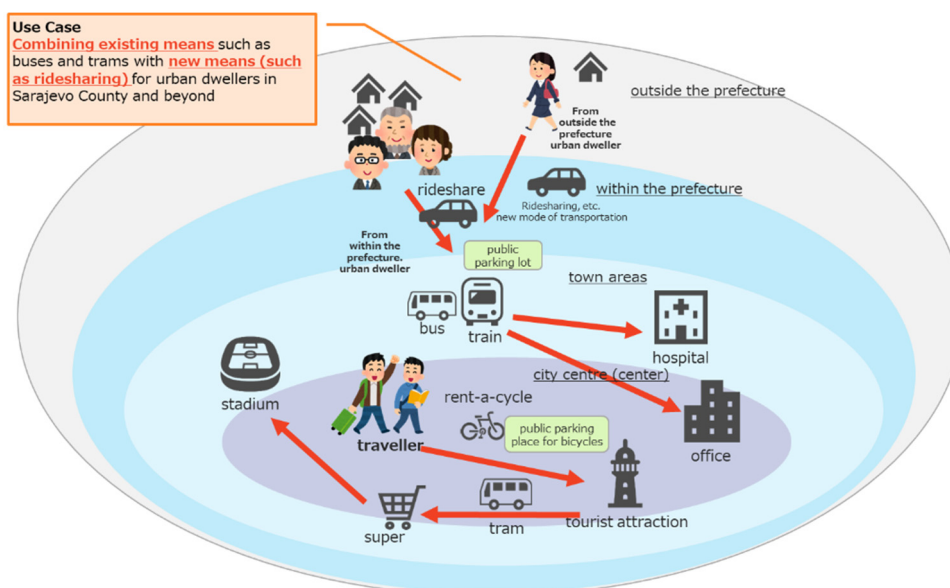
3) Applicability of MaaS

(1) Summary of Proposal on Sarajevo MaaS

Increasing use of private vehicles will have detrimental consequence in the future for new generations of users who should be oriented towards mobility as a service (MaaS) offered by new public transport concepts, supported by intelligent transport system (ITS). The new users will create a perception of a low level of public transport service and will prefer the use of private vehicles, which will be difficult to change in the future. Therefore, it is important to adopt comprehensive measures for the revitalization of public transport in Canton Sarajevo. The following use case is proposed in Sarajevo. This new measure should be led by the MOT of Canton Sarajevo in collaboration with the operators.

- **Use Case: [Combination of existing public transport and new means]** In order to improve the convenient conditions of public transport, the combination of existing means such as buses and trams with new means will be offered to urban dwellers in Sarajevo and beyond.

The aim of the case is to Improve user UX through the use of digital technology and to promote the improvement and use of public transport. Figure 6 shows the image of use case with digital technology.



Source: JICA Expert Team

Figure 6 Challenge of Solving Problems through Digitization in Sarajevo

1.5 Improvement Measures by Operators

1) Improvement of crew members' service for the customers

“Safety” and “Comfortable” are important key words to improve the crew members' service for the customers on public transport operation. Proposed contents for “Safety” and “Comfortable” are as follow. These proposed countermeasures were based on examples from Japanese operators, which C/P visited during training in Japan.

(1) Driving that prioritizes customer safety

For customers to feel that “tram/bus are a safe vehicle” it is important to strive to prevent accidents involving customers. The actions as shown in Table 3 are proposed to prevent accidents with your safety as top priority.

Table 3 Proposed Actions for Safe Driving

No	Action
1	Prohibition of sudden braking and sudden acceleration
2	When leaving, check the inside of the vehicle with the mirror
3	Don't forget to check near the door when getting on and off
4	When passengers get on and off, stop the vehicle completely and do not start until the passengers have finished getting on and off
5	Observance of traffic rules

Source: JICA Expert Team

(2) Customer service and in-vehicle environment that make feel “comfortable”

In order for customers to feel that “tram/bus are a comfortable vehicle” it is important to pay attention to the attitude towards customers and the environment inside the vehicle. The actions as shown in Table 4 are suggested to avoid customer discomfort.

Table 4 Proposed Actions for Customer Service and In-vehicle Environment

No	Action
1	Politely speak and respond to customers
2	If there is a passenger standing on board, give up your seat to the passenger
3	Do not play radio or music in the vehicle, or chat loudly
4	No smoking inside the vehicle
5	Clearing the vehicle
6	After arriving at the terminal, check the inside of the vehicle
7	Neat appearance


Source: JICA Expert Team

2) Establishment of boarding manners

(1) Proposed general rules and courtesy guidelines

Tram and bus riding manners are important. Operators always try to be on time, but proper riding manners will be required to maintain timely operation. To make the journey easy and painless for everyone, the following general rules and courtesy guidelines will be proposed.

What is manner of Public Transport in Sarajevo?






The tram and bus riding manners is very important, public transport operators are trying almost always on time, but proper behavior by users also important. To make the journey easy and painless for everyone, please follow these general rules and courtesy guidelines.

Get on the train in turn & don't rush onto the tram/bus
When waiting for the train in Japan, make sure you wait in line and let passengers get off the train before boarding. Cutting in line is not a good idea, it's considered very rude. Don't rush to get on your tram/bus, when the tram/bus is ready to leave a signal will sound and the doors close. Don't try to run or squeeze onto the tram/bus since it's dangerous and might delay them.

Keep it quiet the train/bus are crowded and the passengers spend a lot of time on the train/bus- often tired going to and from work. Keeping noise to a minimum is the polite thing to do. Refrain from talking loudly with your travel company/on the phone, making a commotion, listening to music or watching videos on speaker.

Give your seat for others The elderly, those with disabilities, pregnant women, and young children are also using the tram/bus. Your kindness will be expected for all passengers.

Don't litter Make sure you take all your belongings and garbage with you when leaving the train/bus. Don't leave used tissues, pet bottles, newspapers or other types of litter on the train.



Source: JICA Expert Team

Figure 7 Proposed General Rules and Courtesy Guidelines on Public Transport

(2) Methods to disseminate riding manners

It is recommended to disseminate riding manners mainly by the following methods. In addition to posting on the operator's website and in the tram car and bus vehicle, it will be effective to provide this information during the mobility management activities, which will be described in Chapter 3.

- Website of operators
- Posted inside of tram car and bus vehicle
- Distribute the information in the timing of Mobility Management

2 Traffic Regulation Improvement Plan for Smoother Public Transport Operation

In order to enhance the efficiency of public transport and ensure the smooth operation of tram, trolleybuses, and buses, traffic regulations play a vital role. In Sarajevo, several improvement measures are being considered to make better use of the existing road space, such as:

- Priority signaling system for public transport (as part of Adaptive Traffic Management System (ATMS));
- Priority lanes for public buses;
- Regulation of car use in specific areas and time periods;
- Street parking regulations; and
- Bicycle/pedestrian facility development.

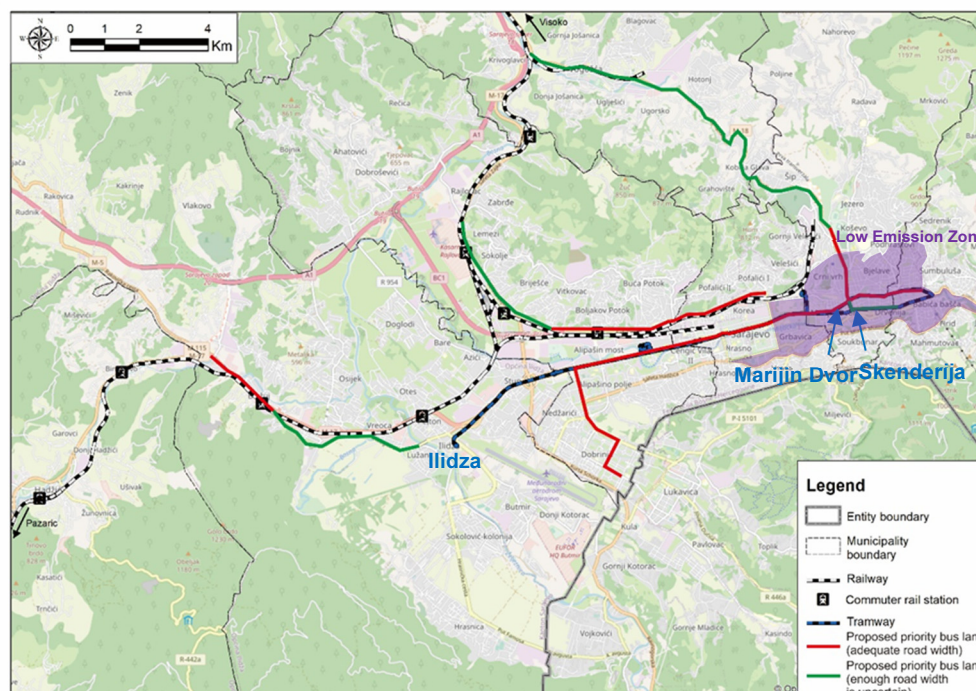
2.1 Priority Signaling System for Public Transport (as part of ATMS/Adaptive Traffic Management System)

The primary objectives of introducing a Priority Signaling System for public transport in Sarajevo are as follows: reducing congestion, improving punctuality and enhancing public transport efficiency. The Priority Signaling System operates on the principle of giving traffic signal priority to public transport vehicles. The system will be integrated with GPS and real-time tracking technologies to enable communication between vehicles and traffic signals. The implementation of a Priority Signaling System for public transport in Sarajevo will offer numerous benefits such as: reduced travel time, increased punctuality, traffic decongestion, environmental impact, and economic benefits. In Sarajevo, Priority Signaling System for public transport is being implemented as part of ATMS project, which includes detection of tram vehicles only through the signal preemption. Priority Signaling System for buses is technically possible, but it could be considered following the completion of the first phase of the Priority Signaling System operation for trams and full operation of the control center for public transport.

2.2 Priority Lanes for Public Buses

The development of bus priority lanes in Sarajevo offers numerous advantages, including: enhanced public transport efficiency, increased ridership on public transport, reduction in traffic congestion, environmental benefits, cost-effective transportation solution, improved equity and accessibility. However, the implementation of bus priority lanes also comes with certain challenges such as: space constraints, traffic constraints, coordination with other vehicles and road infrastructure, ensuring effective enforcement and compliance with lane regulation, and gaining public acceptance for changes.

SUMP (Plan for Sustainable Urban Mobility of the Sarajevo Canton and the City of Sarajevo) (2020) funded by GiZ proposed provision for bus network infrastructure improvements with the introduction of dedicated bus priority lanes and other measures to improve the level of service. Thus, feasibility studies and subsequent implementation of bus priority lane measures to expand the bus lane network would be needed. For this, a plan of additional bus priority lanes proposed by TRAMODE is presented in Figure 8.



Source: JICA Expert Team

Figure 8 Additional Bus Priority Lanes Proposed by TRAMODE

2.3 Regulation of Car Use in Specific Areas and Time Periods

In general, it is common for cities to implement measures to manage traffic and reduce congestion in busy central areas during peak hours. These measures can include the following: (a) Congestion Charging, (b) Restricted Access Zones, (c) Car-Free Zones, (d) Residential Permit Parking, (e) Time-Limited Parking and (f) Park and Ride Facilities. The previous measures are listed in the order of priority in light of impact on the use of private vehicles. Among the above measures, Canton Sarajevo has a plan to realize (f) Park-and-Ride Facilities, that is, a plan to develop a parking garage close to the planned Vogosca trolleybus terminal. Since Canton Sarajevo owns the land for the garage with 450 vehicle spaces, it will be operated by a Cantonal corporation. Meanwhile, other than Vogosca, Canton Sarajevo has no plan to realize Park-and-Ride Facilities due to the lack of available land for development.

Thus, Canton Sarajevo is seeking (b) Restricted Access Zones, particularly, Low Emission Zone (LEZ) in consideration of the air quality. LEZ, which restricts use of cars emitting certain level of pollution within the designated central area, proved to be the most effective measure to raise the public transport mode share in the public transport policy analysis in Volume I. An LEZ operated in Florence was a good example and learned in the third country training (see Appendix A5.2 of Volume I).

According to a study “Low Emission Zone in Sarajevo” (2022) by IVL Swedish Environmental Research Institute, a proposal for implementation plan was presented. The plan for implementation spans four to five years and includes initial phases in gaining public and political endorsement, introduction of the LEZ, all the way to a potential tightening of the regulations. The Swedish LEZ study was good for data collection that MOT utilized to identify the most polluted areas and types of the cars entering the target zone (indicated in Figure 8) and accordingly to prepare a map with zones (red zone).

The geographical scope must be considered to determine suggested area for traffic restriction as well as which vehicles to exclude. The recommendation by IVL is to scale up and tighten the zone when current excluded vehicles constitute less than 20-15 % of the vehicle fleet which is considered to be at a level that does not entail too great limitations in the everyday life of the inhabitants. Implementing the LEZ can have both advantages and disadvantages which are envisaged in the context of Sarajevo as follows:

- Advantages: improved air quality, encouragement of cleaner vehicles, traffic management, and promotion of public transport and non-motorized modes
- Disadvantages: impact on businesses, public acceptance, equity and social impact, enforcement challenges, and displacement of emission.

Implementing a LEZ can lead to significant environmental and public health benefits, but it also comes with challenges related to public acceptance, social equity and enforcement. Successful implementation requires careful planning, stakeholder engagement, and consideration of local factors to strike a balance between environmental objectives and social impacts.

An initial design of LEZ may serve well for the time being. Taking over IVL’s recommendations on LEZ, a Spanish grant project has started to implement the LEZ as well as on-street smart parking¹. As the final output, tender documents will be ready in March 2024.

While Canton Sarajevo is developing the regulation of LEZ, the disadvantages mentioned above will turn from emissions to congestion. If so, the LEZ system has to be transformed to a Congestion Charging scheme. Congestion charging is a softer traffic regulating regime than LEZ. Vehicles are charged, not banned. Congestion charging generates revenues that can be used to finance other traffic such as public transport or environmentally improving measures. It is possible to combine LEZ and congestion charging in the same system (by

¹ IDOM (2023) “Design and Drafting of Terms References for the Implementation Operation of On Street Smart Parking and Low Emission Zone (LEZ) in Sarajevo City” Kick off meeting

using the same ANPR gantry) and to increase emission effects from a congestion charging system by charging high emission vehicles higher, for example.

2.4 Street Parking Regulations

Canton Sarajevo faces significant challenges related to urban mobility and parking management. The increasing number of vehicles and limited parking spaces have led to on-street parking issues in the area. The key on-street parking issues from the viewpoint of public transport services in Canton Sarajevo are addressed such as: illegal parking, traffic congestion and enforcement challenges. In order to tackle those issues, observance of traffic rules and establishment of the enforcement system, confirmation of basic laws and rules, and consensus among local residents and car users are essential.

MOT has initiated a grant project “Implementation and Operation of On-street Smart Parking and Low Emission Zone (LEZ) in Sarajevo City” funded by the Spanish Government for detection of free parking spaces on nine streets in Sarajevo. Smart Parking system represents the beginning of solving the traffic congestion caused by the search for parking, leading to a significant reduction in air pollution. It saves drivers time by providing real-time parking information through a mobile application. The application also allows for payments and navigation. LED screens at intersection will display parking updates. Smart cameras monitoring occupancy will locate available spaces.

2.5 Bicycle/Pedestrian Facility Development

All roads in Canton Sarajevo should be designed as much as possible to MOT’s needs of all traffic and capacity including NMT (non-motorized transport: walk, bicycles). Thus, there is a need for more facilities for safe, convenient pedestrian movement as well as for proper bicycle lanes and infrastructure to access the key public transport modes.

1) Bicycle Lane Development

Based on the result of the Activity Diary Survey, the modal share of bicycle is currently 0.6%, which is very low. One may think that it is because the center of Sarajevo is surrounded by mountains. However, in Grenoble, the modal share of bicycle is as large as 5%. So, there should be room for improvement of travel by bicycle in Sarajevo as well. Improving and expanding existing road infrastructure to accommodate bicycle lanes is essential. This may involve reallocating road space, constructing dedicated lanes, and implementing traffic calming measures to ensure cyclist safety.

Safety is paramount for bicycle lane development. Implementing clear road markings, traffic signs, and signals, along with physical barriers separating bicycle lanes from other motorized traffic, can enhance safety for cyclists.

Major improvements of the Sarajevo bicycle lane infrastructure were implemented in recent years across different sections along the east-west transport axis and the transverse corridors, reaching a total of about 20 km of bicycle lane infrastructure (Figure 9). However, the current network is fragmented with small gaps and major missing links, lacks traffic management, and is often encroached by vehicle parking. The increasing popularity and public support for bicycling has drawn attention to the lack of connectivity and the need to enhance user experience for a comfortable and seamless journey.²

² The World Bank (2022) “Bosnia and Herzegovina Air Quality Improvement Project (P176040)”



Source: JICA Expert Team (base map from the World Bank)

Figure 9 Bicycle Lane Infrastructure

GCAP (Green Cantonal Action Plan) (2020) funded by EBRD and the above-mentioned SUMP suggested actions to improve cycling and walking routes. However, physical maps of improved bicycle/pedestrian routes/infrastructure have never been presented. So, JICA Expert Team has proposed bicycle lanes in addition to the existing ones in Figure 9, considering their continuity and connectivity with public transport stops, so that seamless integration between bicycle lanes and public transport systems would be ensured and allow commuters to use bicycles as part of their multi-modal journeys. It should also be noted that new areas for bicycle parking need to be located adjacent to the main public transport stops. The size of bicycle parking facility is generally determined through local standards or regulations, as there is a significant variety in the number of spaces which can be provided within municipalities.

2) Pedestrian Facility Development

In Sarajevo there are designated pedestrian zones in the city center or other areas, where motorized traffic is restricted, and priority is given to pedestrians. These zones create safe and attractive spaces for walking, shopping, and leisure activities. Furthermore, actions to expand the restricted access zones were studied as LEZ by IVL.

Expanding and maintaining sidewalks and footpaths with adequate lighting is crucial for providing safe and accessible walking routes throughout the city. In addition, installing clearly marked crosswalks and pedestrian traffic signals at intersections would help pedestrians safely navigate busy roads and intersections. It is also important to develop and adopt a safety strategy for NMT, namely, NMT design guidelines to support all the above implementation.

It should be noted that pedestrian facility development is an ongoing process that requires cooperation between various stakeholders, including municipality officials, urban planners, transportation authorities, and the public. By prioritizing pedestrian infrastructure and creating a pedestrian-friendly environment, Sarajevo can improve the quality of life for its residents, enhance urban mobility, and contribute to a more sustainable and livable city.

2.6 Implementation Time-line

As for traffic regulation improvement plans in Sarajevo aiming at smoother operation of public transport, most of the conceivable measures are covered by projects implemented by international donors as explained in this chapter. Implementation time-line of those projects is summarized in Table 5.

Table 5 Implementation Time-line of Projects for Traffic Regulation Improvement

Improvement Measures	Projects	Donors	2023	2024	2025	2026	2027	2028	2029	2030
(a) Priority signaling system for public transport	ATMS	EBRD / EIV	(ongoing)							
(b) Priority lanes for public buses	(extension of ATMS)	World Bank*	(Establishment of law for dedicated bus lane)							
(c) Regulation of car use in specific areas and time	Park-and-Ride	EBRD		(Vogosca)			(Other Locations)			
	LEZ	Sweden / Spain	(ongoing)							
(d) Street parking regulations	Smart Parking	Spain	(ongoing)							
(e) Bicycle/pedestrian facility development.	Bicycle Lane Development	EBRD								

*Target bus priority lane by the World Bank is Route 16B only, where low-emission buses are to be introduced.

Source: JICA Expert Team

3 Promotion of Public Transport Use for Tourists

3.1 Public Transport Travel Guide

The Public Transport Travel Guide aims to promote awareness and use of public transport by providing both information about public transport and attractive destinations for tourists.

In this project, the public transport travel guide was conducted aiming to encourage the usage of public transports to go to tourist places in Canton Sarajevo. The outline of the map is below:

Theme : City Travel with Public Transport

Contents : Explain how to use of public transport and how to buy the ticket, and expect the public transport usage. The contents have the following intension. The map was prepared as shown in below. Moreover, from foreign languages only English version is provided, but multi-lingual versions for different tourists are desired. In the future, it will be necessary to promote the use of public transport by distributing and disseminating the travel guide from this Project at major locations within Canton Sarajevo.

- To explain how to buy a ticket,
- To provide an attractive destination and its route which can reach there,
- To provide a short movie that goes to each destination and encourage motivation,
- To show a QR code which can access to Youtube and Facebook.



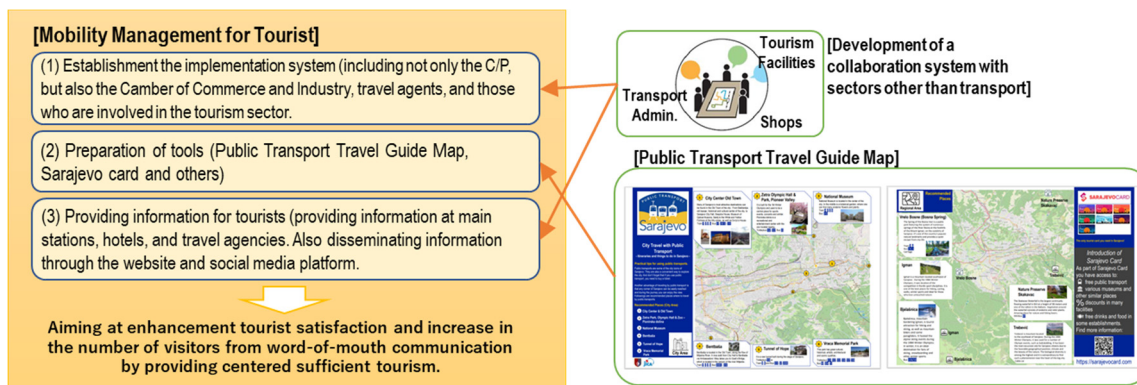
Source: JICA Expert Team

Figure 10 Sample of Public Transport Travel Guide Map in Sarajevo

3.2 Mobility Management for Tourist

1) MM Action Plan for Tourists

Though Canton Sarajevo has many attractive touristic spots that are visited by many tourists, there is no promotion for public transport use targeting the tourists. Therefore, the JICA Expert Team proposed a program of mobility management for tourism as shown in the following figure, which aims to "promote the behavioral changes to use of public transport by providing prior information during the planning stage of a travel (or during the travelling stage)." Thus, the proposed actions are to develop a collaborative system with stakeholders other than transport sectors, to collect information that is attractive to tourists, and to organize and provide centered information as a tool.



Source: JICA Expert Team

Figure 11 Public Transport Travel Guide Map for Tourists and the Measures for Promotion of Public Transport Use

3.3 Introduction of New Technologies such as ICT/MaaS for Tourists

While general proposals for measures to improve the convenience environment in public transport using new technology have already been described in Chapter 1.4, this section summarizes proposals targeting tourists.

1) Digital ID (Flash Pass) Mobile Application

As an easier smart fare collection system deployment, JICA Expert Team proposes a Digital

ID (Flash Pass) mobile application concept. The fare validation is done by tram/bus driver's visual confirmation, and it is broadly used on the west coast in the U.S. by tourists who are using public transport for a limited period (1 day – 1 week). A Flash Pass mobile ticket could be sold as a package with unlimited internet access (in collaboration with telecom industry).

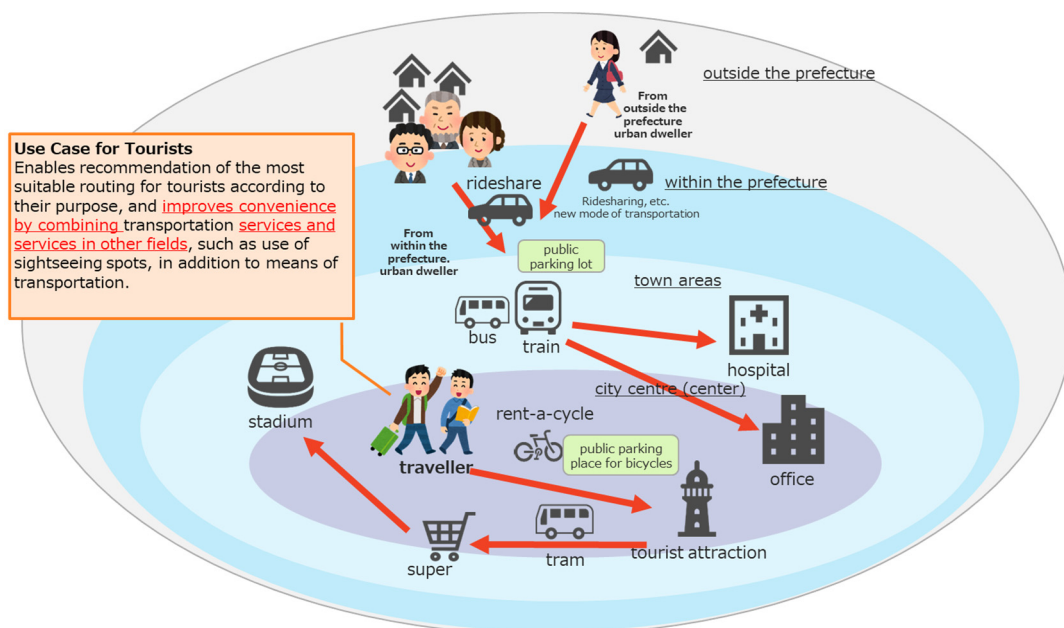
As benefits of a Flash Pass, transfer fare could be reduced with a special limited pass for public transport users. For public transport authority or operator, it can save the budget for development because validation hardware equipment will not be necessary. The main challenge in its development may be in the purchase and payment process of a Flash Pass, which is also common to purchasing mobile tickets. MOT/BS have also started developing such a mobile fare payment application, but it is not in public yet.

2) Summary of Proposal on Sarajevo MaaS for Tourists

The application of MaaS is a measure that will not only improve the convenience of public transportation, but also promote its use by providing services for tourists. The following use case is proposed for tourists in Sarajevo. This new measure should be led by the MOT of Canton Sarajevo in collaboration with the operators.

- **Use Case: [Improving convenience for tourists by combining transport services with services in other fields]** Enables recommendation of the most suitable routing for tourists according to their purpose and improves convenience by combining transport services and services in other fields, such as use of sightseeing spots, in addition to means of transportation.

The aim of the case is to improve user UX through the use of digital technology and to promote the improvement and use of public transport. Figure 12 shows the image of use case with digital technology.



Source: JICA Expert Team

Figure 12 Challenge of Solving Problems through Digitization in Sarajevo for Tourists

3) MaaS Use Case for Tourists

As one of example of a tourist visiting the National Museum of Bosnia and Herzegovina, and described in detail on the following how the MaaS application supports the three user experiences of (1) smart travel, (2) entry, and (3) experience.

- **Smart Travel:** Regarding smart transport, the MaaS app will provide appropriate transportation and tourist attraction routes depending on the location, mainly public

transport (bus and tram), to make it easy and efficient to reach the museum. Rental bicycles and kick board also will be part of smart travel in the city center.

- **Entry:** In this way, users will be able to reserve and issue electronic tickets, which will replace paper tickets, within the MaaS application and enter the museum. The linkage with existing tourism services (Guide2Sarajevo, etc.) also will be one of idea.
- **Experience:** In the experience, by reading the QR code on the MaaS application for exhibits in museums, etc., the user can obtain information by having the information translated into the user's native language displayed on the screen.

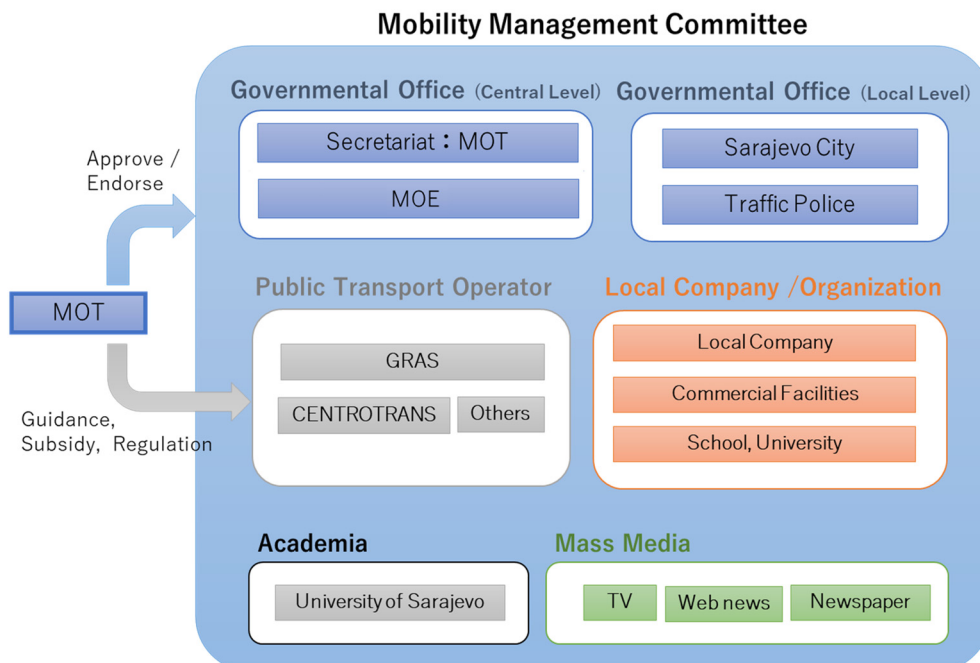
3.4 Collaboration with Various Stakeholders

The opportunities for communicating with potential users to encourage the usage of public transport in Sarajevo, are classified into the followings.

1. Local Company / Organization
 - Local Company
 - Commercial Facilities
 - School, University
2. Mass Media

In the activities to promote public transport use targeting tourists, it will be necessary to prepare a platform for sharing and discussing information of public transport with a wider range of stakeholders.

The implementation scheme with establishment of mobility management committee is proposed as shown in Figure 13.



Source: JICA Expert Team

Figure 13 Proposed Implementation Platform

MAIN TEXT

0 Background of Public Transport Service

Volume III of this report is a Public Transport Convenience Enhancement Plan that describes the required public transport service and environment for Canton Sarajevo, including public transport service improvement, traffic regulation improvement as well as promotion of public transport use for tourists.

Chapter 1 describes the analysis of the current situation of public transport service in Sarajevo and proposes the required measures categorized into four: 1) information provision of public transport, 2) improvement of transport nodes, 3) introduction of new technologies such as ICT/MaaS, and 4) improvement measures by operators.

Since the traffic regulation for automobiles is indispensable for smooth public transport operation, Chapter 2 describes the improvement measures such as 1) priority signaling system for public transport, 2) priority lanes for public buses, 3) regulation of car use in specific areas and time periods, 4) street parking regulations, and 5) bicycle/pedestrian facility development.

Finally, Chapter 3 describes the promotion measures of public transport use for tourists. Sarajevo is an attractive and famous place for tourist, and many visitors from the outside are coming. They are potential users of public transport. To encourage tourists to use public transport more, a public transport travel guide map, ICT/MaaS measures for tourists, and mobility management measures for tourists were proposed.

1 Public Transport Service Improvement

1.1 Issues on User's Convenience and Required Measures

1) Issues on User's Convenience

The issue in users' convenience of each public transport mode in Canton Sarajevo is analyzed, and the Expert Team has been considering various specific measures and applicability of ITS/MaaS technology in order to make proposals to the counterpart.

The existing situation of public transport service is summarized in Table 1.1.1.

Table 1.1.1 Summary of Public Transport Service

	<p>Tram (6 lines)</p> <ul style="list-style-type: none"> • Only operated by GRAS. • Tram stations are located in convenient areas with good connection and accessibility. • Tram fare is different if purchased at Kiosk and from the driver. There are no conductors inside the tram to check whether every passenger pays the fare or owns the monthly ticket. • Tram facilities are old and need upgrading. • Extension of tram lines is implemented.¹
	<p>Trolleybus (6 lines)</p> <ul style="list-style-type: none"> • Only operated by GRAS. • Trolleybus fleets are old and need upgrading. • Trolleybuses have the operation schedule, but cannot ensure the punctuality and arrival/departure times due to traffic congestion.
	<p>Bus (67 lines)</p> <ul style="list-style-type: none"> • Operated by both GRAS and CENTROTRANS. • Bus routes are convenient to serve the area without tram and trolleybus. Many routes are connecting with town and suburban areas. • Time schedule is posted on the paper at the major terminal, but only in the local language. • The location of bus stops is not clear or without specific signs. • GRAS's bus fleets are old and need upgrading.
	<p>Minibus (46 lines)</p> <ul style="list-style-type: none"> • Operated by both GRAS and CENTROTRANS. • Minibuses serve the routes on the steep slopes in the residential hilly area. • In-car comfort is good and the low platform is easier for the elderly to board. • The location of bus stops is not clear or without specific signs.
	<p>Overall</p> <ul style="list-style-type: none"> • Route searching function in Google Map was available in October 2021, but as of March 2022, users cannot use Google Map to search the shortest routes by public transport. • MOT is developing the new IC card system to cover both GRAS and CENTROTRANS. Currently, only CENTROTRANS has IC fare collection system and can pay the fare by APP. • GPS is only available for CENTROTRANS's fleets. • Two operators' operation info is not well integrated and shared with the users together in one platform.

Source: JICA Expert Team

¹ The tender was issued on 10 March 2022, and the contractor was selected.

The major issues in users' convenience are as follows:

- lack of public transport information service, including
 - lack of maps and signs;
 - unknown vehicle departure and arrival times;
- inconvenient access (access mode and condition) to the public transport lines;
- inconvenient transfer between public transport modes;
- unfairness of fare system; and
- lack of environment for all users to use public transport safely and securely (including gender equality and consideration for the elderly).



Source: JICA Expert Team

Figure 1.1.1 Lack of Public Transport Information at Bus /Tram Stops

In particular, the lack of information provision at bus stops, as shown in Figure 1.1.1, is an issue that needs to be improved immediately.

2) Classification of Measures for Improvement

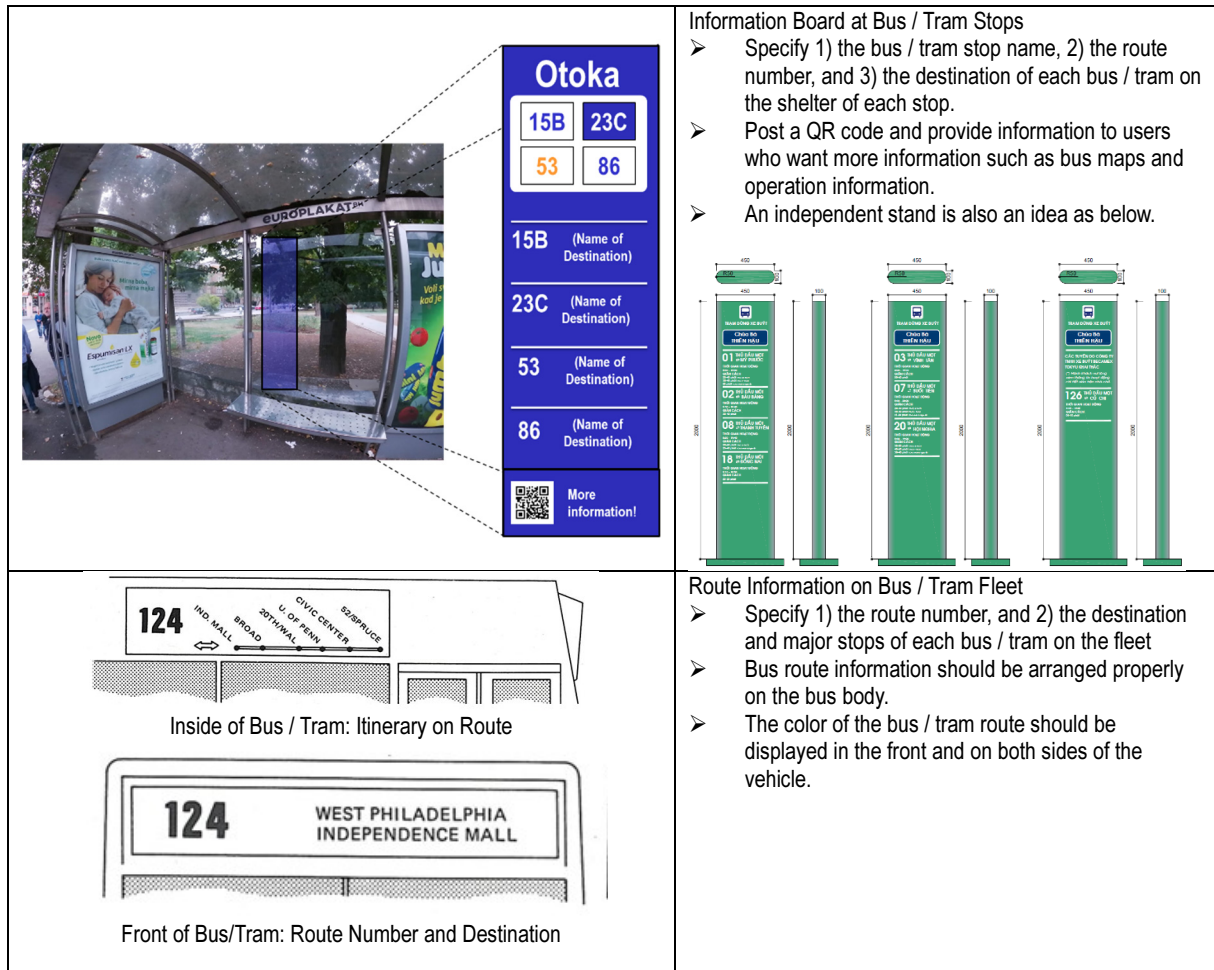
Required measures for public transport service users' convenience were discussed among WG4 members. Table 1.1.2 summarizes the issues in user convenience, countermeasures to improve these issues, and the priorities and possibilities to introduce in Sarajevo. The public transport improvement plan was examined by classifying them into four categories.

Table 1.1.2 Classification for Public Transport Service Improvement

No	User Convenience Issues	Countermeasure	Priority and Possibility to Introduce in Sarajevo		Category	
1	Lack of maps and signs	Route map Mobility Management (MM)	"Very High"	<ul style="list-style-type: none"> ➤ To be implemented immediately, utilizing the map which made by JICA data collection survey ➤ To be implemented MM activity utilizing route map and other information 	1) Information Provision of Public Transport and Mobility Management	
		Installation of signs / information boards	"Very High"	<ul style="list-style-type: none"> ➤ To be implemented immediately 		
2	Unknown vehicle departure and arrival times	Displaying latest operation information, provision of next arrival information	"Medium"	<ul style="list-style-type: none"> ➤ To be considered with actual operation of monitoring center ➤ Need to consider integration with the system in monitoring center 		
3	Inconvenient access to the public transport lines	provision of new access modes	"Medium"	<ul style="list-style-type: none"> ➤ To be considered with new mobility service 		2) Improvement of Transport Nodes
		P&R facilities	"Medium"	<ul style="list-style-type: none"> ➤ (To be examined the details, based on the result of traffic surveys and demand forecast) 		
4	Inconvenient transfer between public transport modes	Improvement of transport nodes and coordination of operations	"Medium"			
5	Unfairness of fare system	Revision of fare system, improvement of ticketing system	"Medium"	<ul style="list-style-type: none"> ➤ To be considered at the timing of installation of smart card system ➤ To be considered with an integration with the fare collection system 	3) Proposed Operational Support System and Introduction of New Technologies such as ICT/MaaS	
6	Environment for all users to use public transport safely and securely	Improvement of crew members' service for the customers	"High"	<ul style="list-style-type: none"> ➤ To be implemented by reviewing the cases in other countries 	4) Improvement Measures by Operators	
		Introduction of a crime prevention system	"Medium"	<ul style="list-style-type: none"> ➤ To be considered with actual operation of monitoring center 		
		Establishment of boarding manners	"High"	<ul style="list-style-type: none"> ➤ To be implemented with information provision such as route map and signs / information board 		
		Installation of streetlamps at bus / tram stops	"High"	<ul style="list-style-type: none"> ➤ To be considered with road maintenance 		

Source: JICA Expert Team

have route numbers or destination signs, the JICA Expert Team proposed an information display plan shown in the figure below. At bus/tram stops, the proposed design clearly indicates the route number and destination, as well as the name of the bus/tram stop. Having a QR code will also be a reasonable measure to provide more detailed information for users. These proposals were based on the content of the visits made during the third country and Japan training conducted under the project, such as the cities of Hiroshima and Fukuoka. The information board at bus/tram stops should be provided by the MOT of Canton Sarajevo, and the operators should be responsible for presenting the information to the bus tram fleets.



Source: JICA Expert Team

Figure 1.2.2 Proposed Installation of Signs / Information Boards

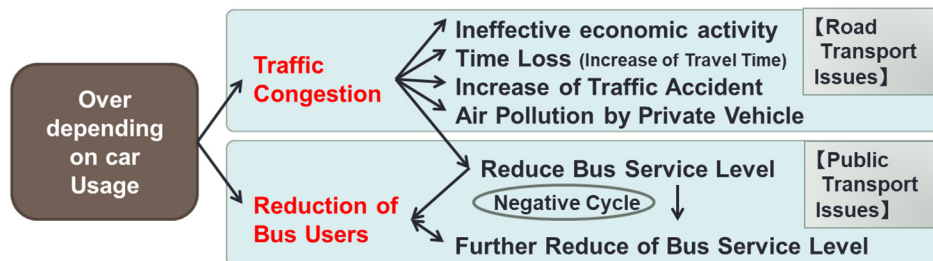
3) Mobility Management

(1) Outline

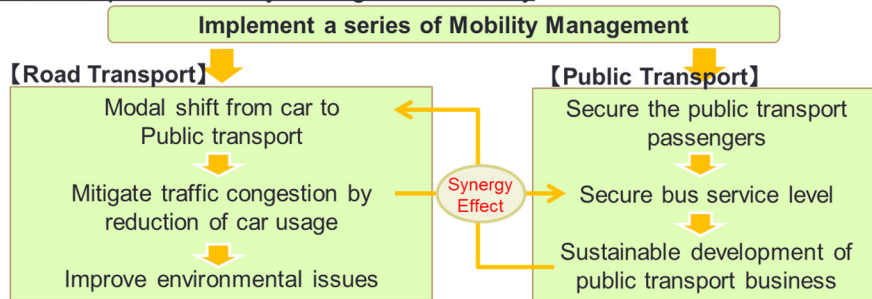
In many cities worldwide, economic growth has led to rapid increases in the usage and ownership of private vehicles (e.g., cars and motorcycles). Consequently, cities face many issues, such as air pollution, traffic accidents, and congestion. To solve such issues, numerous “hard” measures have been carried out, such as large investments in roadway infrastructure and the introduction of urban mass rail transit services. This is common in cities around the world. On the other hand, “soft” measures have been widely carried out in cities in developed countries, such as Europe and Japan. One of these soft measures is called mobility management (MM), a concept promoting sustainable transport and

managing the demand for private transport use by interactive communication of changing travelers' attitudes and behavior.

In promoting the use of public transport, in addition to providing the above information, it is essential to communicate with those who can shift to using public transport. The following figure shows the harmful effects of excessive car use, the importance of using public transport, and methods of communication.

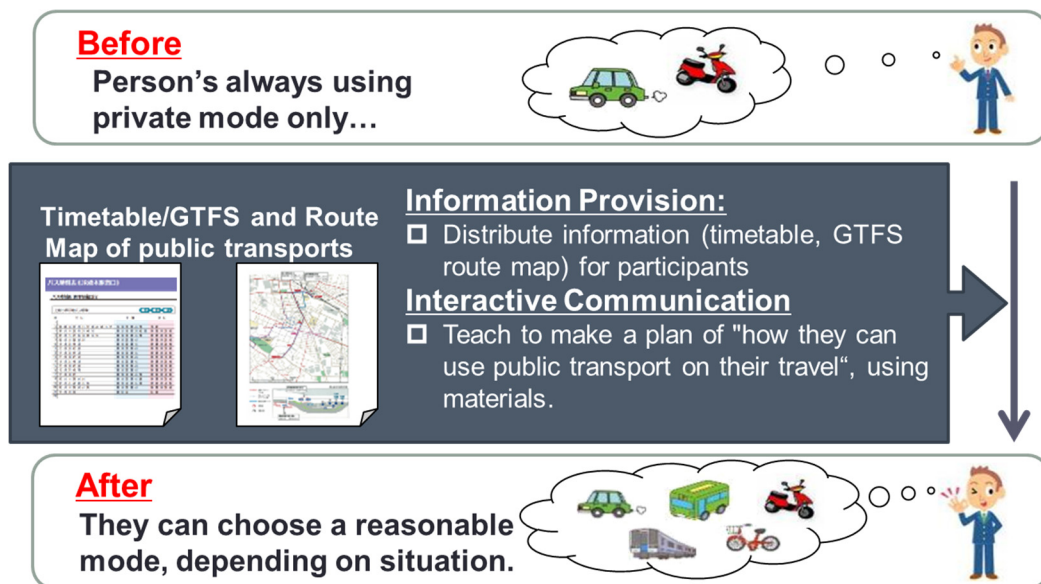


Basic Principle on Mobility Management Activity



Source: JICA Expert Team

Figure 1.2.3 Structure of Urban Transport Issues by Heavy Car Usage



Source: JICA Expert Team

Figure 1.2.4 Concept of Mobility Management

(2) MM Action Plan for Citizens

Effective methods and contents of MM will depend on the target participant and the purpose of the trip. In view of the situation in Sarajevo where it is necessary to promote the use of public transportation not only for tourists but also for citizens, the JICA Expert Team

proposed an activity plan for each target group of citizens in Sarajevo and discussed it with the CPs. These contents were summarized as an action plan, as shown in the following table. These activities aim to modify behavior using persuasive communication and a physiological approach in order to promote public transport usage.

Table 1.2.1 Proposed MM Action Plan for Citizen

Target	Trip Purpose	Method	Object	Contents of Activity
Students	To School	Seminar (Participatory Learning)	To provide the opportunity to reconsider commuting by motorcycle	Traffic board game. Simulation/Analysis the commuting behavior by questionnaire (travel behavior survey).
Companies	To Work	Workshop for Workers	To promote public transport usage experience	Provide the risks by motorcycle usage (e.g., risk of traffic accident or health). Provide a travel plan using bus map and timetable.
Residents along Bus Routes	To go shopping/ Market, eat and others	Workshop for Family		Distribute newsletters to promote public transport usage. Conduct event/s where families can participate in to promote bus usage experience (e.g., stamp rally).

Source: JICA Expert Team

Especially, the game of Traffic Sugoroku which is making an opportunity to learn the difference between public transport and private vehicles and the importance of using public transport, was a new idea to encourage the usage of public transport in Sarajevo, the hands-on training and demonstration activity was conducted as shown in below.

(3) Hands-on Learning of MM

In January 2023, the workgroup members had a hands-on learning of the traffic board game in the TRAMODE office covering these topics:

1 – Introduction

- Explanation of game and rules

2 – Play the Game

- Play the traffic board game “Traffic Sugoroku”

3 – Wrap Up

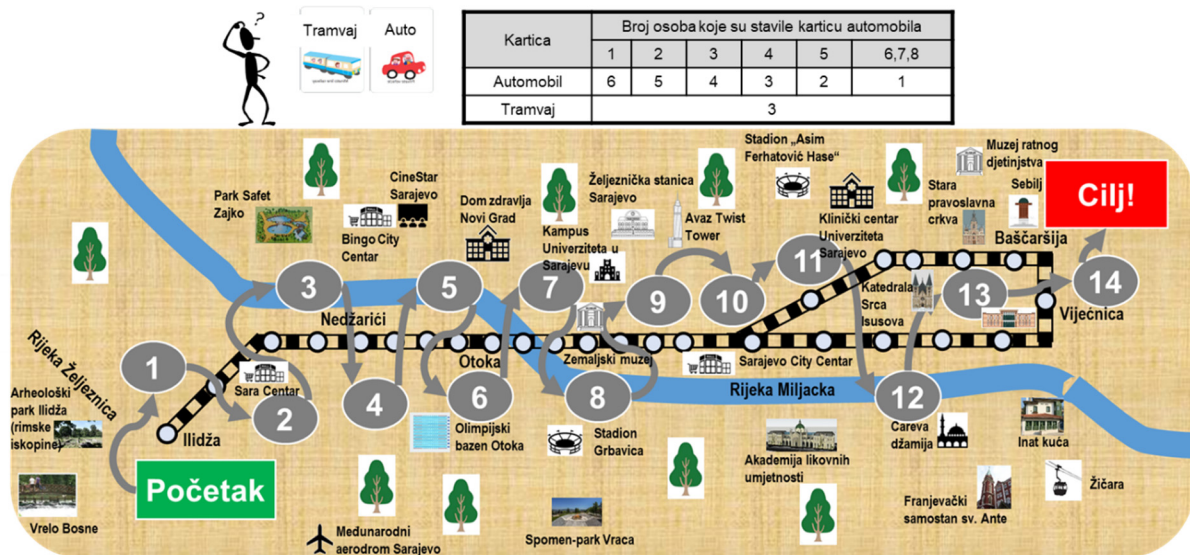
- Summarization of the contents of the program and conclusion of key points
- Explanation of reason and cause of traffic congestion



Source: JICA Expert Team

Figure 1.2.5 Board Game Practice

The purpose of this activity is to make an opportunity for students, the future generation of Sarajevo, to think independently about the social dilemma of private car use and the advantages of using public transportation, while playing the Traffic Board Game. The following figure shows the drafted game board, customized with the public transport in Sarajevo.



Source: JICA Expert Team

Figure 1.2.6 Game Board in Sarajevo

(4) Demonstration Activity at Primary School

JICA Expert Team and C/P implemented the "Demonstration activity o" MM" through traffic and transport education activities as part of the efforts to encourage public transport usage. Specifically, classes were provided for elementary school students using the game of Traffic Sugoroku, allowing them to learn the difference between public transport and private vehicles and the importance of using the former. Through these activities, the pupils can understand that excessive use of private vehicles causes traffic congestion and environmental problems, and by using the concept of "social dilemma," they can understand the reasons why the problems have not improved. To solve social dilemmas in the future, it is expected that people understand the importance of using public transport versus using private vehicles, depending on the situation.



Source: JICA Expert Team

Figure 1.2.7 Demonstration activity at Hasan Kikic Primary School

The board game, "Traffic Sugoroku," was conducted at the Hasan Kikic Primary School in Sarajevo with fourth and fifth graders in cooperation with the local teachers, as shown in Figure 1.2.7.

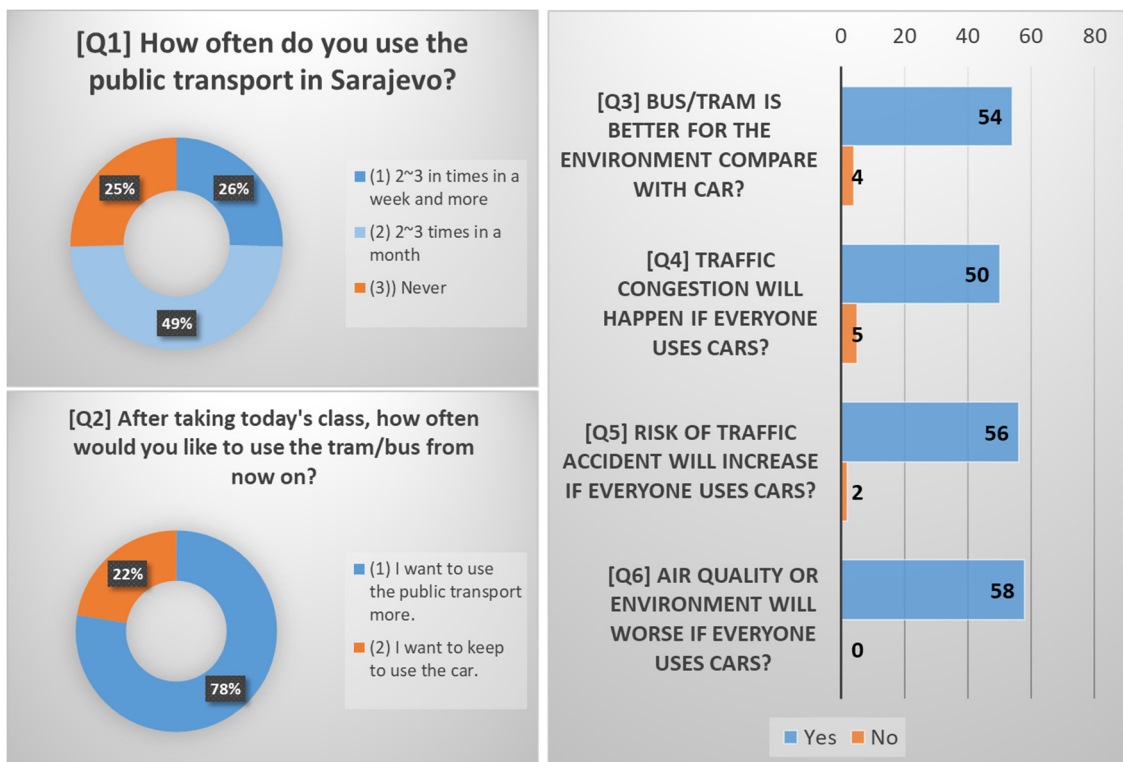
(5) Key Findings from Questionnaire Survey at Primary School

In the demonstration activity, a simple questionnaire survey, as shown in the following figure, was conducted for 58 fourth and fifth graders who participated.

As shown in Q1, looking at the usage of transport means by the participants, 3/4 of the

students answered that they use public transport several times a month or more. The remaining 1/4 were students who had never used public transport. In the post-activity question (Q2), 78% of the students expressed their desire to use public transport more. Since the remaining 22% of students answered “I want to keep to use the car,” a trial public transport ride will be one idea to convince them in the sense of education.

Questions 3 to 6 were set to check whether public transport advantages compared with automobile use in terms of the global environment, traffic congestion, traffic accident risk, and air pollution. It was confirmed that most of participant seems to understand the intention of this activity.



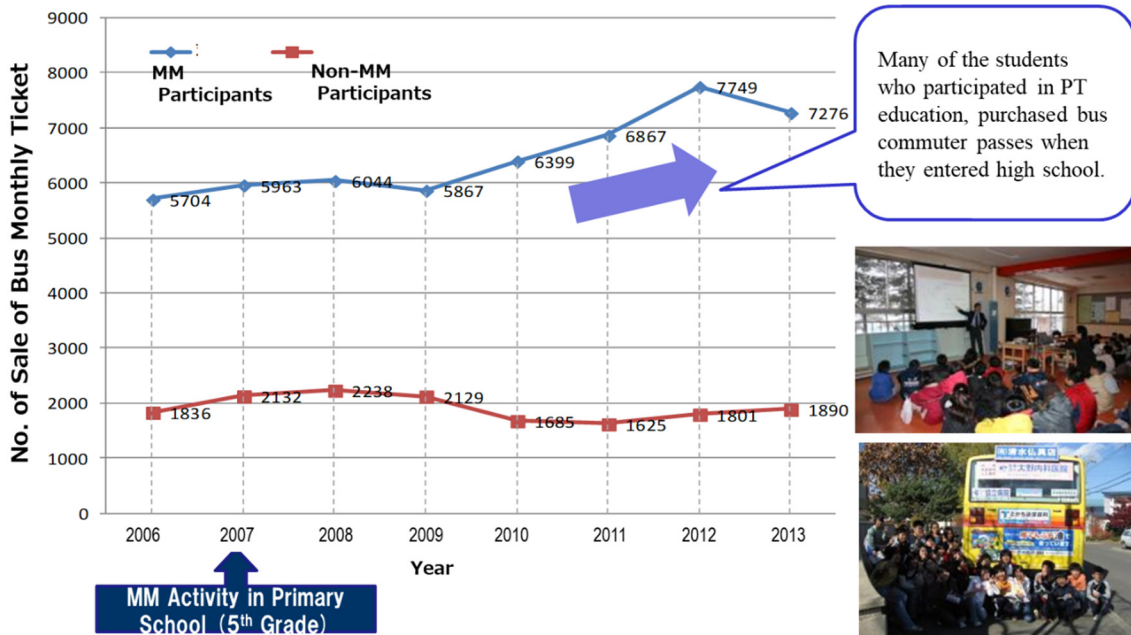
Source: JICA Expert Team

Figure 1.2.8 Results of Demonstration Project at School

(6) Lesson Learned from Demonstration Activity at Primary School

The demonstration activities were carried out in collaboration with local school in Sarajevo, with the cooperation of public transport company's staff and lecturers from the University of Sarajevo. The staff of public transport operator and lecturer from university were facilitated the class. All participants from related organizations confirmed the importance to implement this kind of activity, and C/P got the knowledge and skill as the facilitator.

MM in Obihiro City, in collaboration with Tokachi-bus, which is famous for being a successful example of educational MM in Japan, was one of the first places to implement this kind of initiative. In this case, the educational MM was provided to 5th-grade students in primary school in 2007. After 4 years, in 2011, many of the students who participated in the educational MM purchased bus commuter passes when they entered high school, as shown in Figure 1.2.9, showing that educational MM can contribute to a long-term effect.

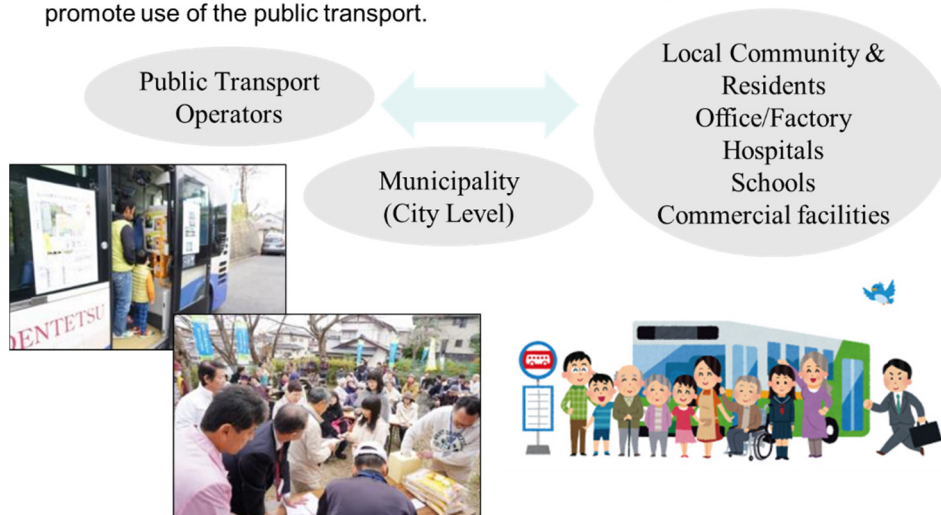


Source: Introduction of Educational Mobility Management, Prof. A. TANIGUCHI, Tsukuba University, Japan

Figure 1.2.9 No. of Bus Commuter Pass for High School Student by MM target Group / Non-target Group, in Case of Obihiro City, Japan

MM activities in Japan are led by municipality, as shown in Figure 1.2.10, and are implemented in broad collaboration with public transport operators and various local organizations.

Local communities, public transport operators, and municipalities collaborate to promote use of the public transport.



Source: JICA Expert Team, various source

Figure 1.2.10 Promotion of Partnership Activity in Mobility Management of Japan

1.3 Improvement of Transport Nodes

Upgrade of In-Terminal Business: Although some of the major transport nodes in Sarajevo have small shops such as kiosks, they have yet to develop facilities that are as attractive for public transport users as the transport nodes in Japan. Therefore, based on the following Japanese examples, JICA Expert Team and CPs discussed and considered upgrading measures for the terminal business. These were examples from the Shibuya in-station

facility and Shinjuku *Basta* (bus terminal), both of which were observed during the training in Japan.

Case in Japan: In compliance with the Road Law of Japan, “road occupancy permission” is required to use road space by the third party, and the road administrator charges “occupation fee” (e.g., utility pipeline). In-terminal business type under the law are categorized as follows:

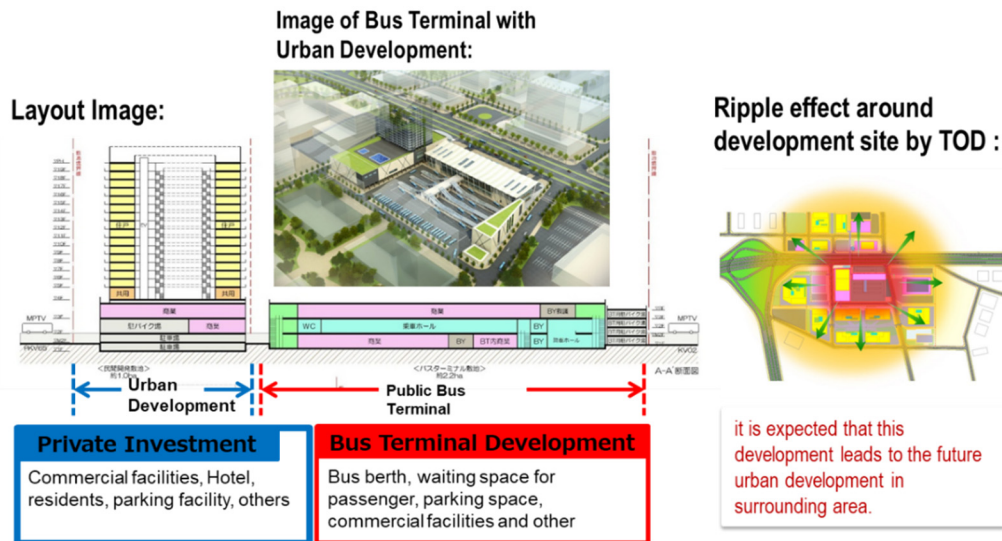
- Mobile stall/ Immobile shop
- Vending machine
- Telephone and Wi-Fi station
- Information facility
- Others (street furniture, etc.)



Café and Food Shop at Terminal
(Station in Tokyo and Osaka, Japan)

Expected Revenues of In-Terminal Business: In Japan, commission fees with 8–15% of annual tenant sales are charged as a non-public transport business revenue for operator.

Conceptual Plan of Integrated Multimodal Center: The concept plan was examined and discussed based on the example of the multimodal center shown in the figure below. In addition, discussions were held on the combined effect shown in the table below, which can be expected by combining bus terminal development and private sector development.



Source: JICA Expert Team

Figure 1.3.1 Example of Integrated Multimodal Center

Table 1.3.1 Expected Effects by integrated Multimodal Center Development

Beneficiary	Expected Effects	Integrated Development	
		With	Without
Residence Public transport users	Improvement of public transport service	⊙	○
	Provide amenity space	⊙	○
	Provide good residential environment	○	△
Government (City)	Increase tax revenue by population / commercial facility increasing	⊙	△
	Increase fare revenue by increasing of ridership	⊙	△
	Increase terminal fee revenue by increasing of bus operation	⊙	△
	Tenant fee from commercial facility at terminal	⊙	△
	Increase land price	⊙	△
	Inducing development of surrounding area	○	△

Source: JICA Expert Team

1.4 Proposed Operational Support System and Introduction of New Technologies such as ICT/MaaS

1) Operational Support

(1) Traffic Control Center (NUC)

For public transit operators, the traffic control center (Supervisory Management Center: *Nadzorni Upravljački Centar* [NUC]) is currently monitoring the onboard status and location status for all the tram vehicles and new trolleybuses with installed GPS and CCTV cameras. CCTV cameras are to be mounted on the buses and minibuses in the next contract between MOT and BS Telekom. The control center monitors real-time operation of all public transport vehicles through GPS locators and is only able to monitor the vehicles. It cannot deal with trouble support such as vehicle trouble and panic status triggered by passengers. Actual dispatching and operation commands are individually made by GRAS and CENTROTRANS.

A component of NUC's equipment includes data processing equipment registration and ticketing equipment, consoles/workstations local area, network control center communication equipment, server and storage with AC rack, and power supply. The equipment is installed two rooms: a control room for managing vehicle and tram, including large monitor for showing real time for public transports and SCADA (Supervisory Control and Data Acquisition) and a server room for storing the server's system equipment.

The used software is proposed to be under BS Husky Application Architecture. It divides the services into event manager, data manager, archive manager, RDB manager, control and Application Programming Interface (API) manager, and user interface manager. All systems are configured and stored in a database. They also manage the real-time location of vehicles via digital GIS maps or free interactive OpenStreetMap as a base background for showing the interface. With all the complex managing systems, they elaborate the public transport data into metadata from the electronic billing systems and all necessary information related to the fleet's real-time data and passengers' data. They support not only operational data management but also fleet management software related to rolling stock management. All the data can be printed with the required information.

(2) Bus/Tram Stop Improvement

For public transport passengers, currently, there are two tram stops with destination signboards and fare gates (Figure 1.4.1). The destination signboard also functions as a display of the tram approaching information. Meanwhile, at other tram stops and all the bus stops, tourists are unable to know when and which bus/tram stop will take them to their destination because there is no bus/tram approaching information and destination sign.

The information board at bus/tram stops should be provided by the MOT of Canton Sarajevo in collaboration with operators.



Source: JICA Expert Team

Figure 1.4.1 Destination sign at Nedžarići or Otoka

(3) Information Provision by QR Code and GTFS

JICA Expert Team proposed a cost-efficient QR code passenger information application as well as created a mockup mobile application using General Transit Feed Specification (GTFS), which was generated by the Traveler Information System for the Adriatic Region (TISAR) project around 3 years before (Figure 1.4.2). However, the development of the smartphone application that will enable passengers to purchase tickets, see lines, and have real-time information for the next service and news about public transport has yet to be completed because the contactless ticketing system is prioritized.



Source: JICA Expert Team

Figure 1.4.2 Current Bus Stop with QR Code for Route information and Mobile Application Design

JICA Expert Team also proposes GTFS data to be regularly updated, as described below, and provided to Google to be utilized by public transport users. Since the GTFS data has been generated, it is relatively easy to update the data in Table 1.4.1. It is recommended that the MOT and public transport operators collaborate with the University of Sarajevo for the update.

Table 1.4.1 GTFS Data Format

No	Data Name	Description
1	agency.txt	Defines the agencies that provide the transportation services indicated by GTFS dataset
2	stops.txt	Defines stops where passengers loading and unloading location (latitude / longitude) information
3	routes.txt	Defines transit routes (A route is a combination of itineraries that appear to passengers as a single service.)
4	trips.txt	Inbound trip and outbound trip must be defined by routes. If weekday operation / weekend operation is defined separately, it should be described.
5	stop_times.txt	Travel time between tram/bus stops are necessary.
6	calendar.txt	Defines the operating days when the service is available on a particular route. Use a weekly schedule. This file specifies the days on which the service is available, in addition to the start and end dates of the service period.
7	frequencies.txt	Even if the timetable information is not available, the headway will help passenger to make the trip plan.
8	shape.txt	To illustrate the route alignment consciously, inputting shape.txt is necessary.
9	fare_attributes.txt fare_rules.txt	Defines fare by route or zone.
10	transfers.txt	Defines the nodes which can transfer between public transport.

Source: JICA Expert Team

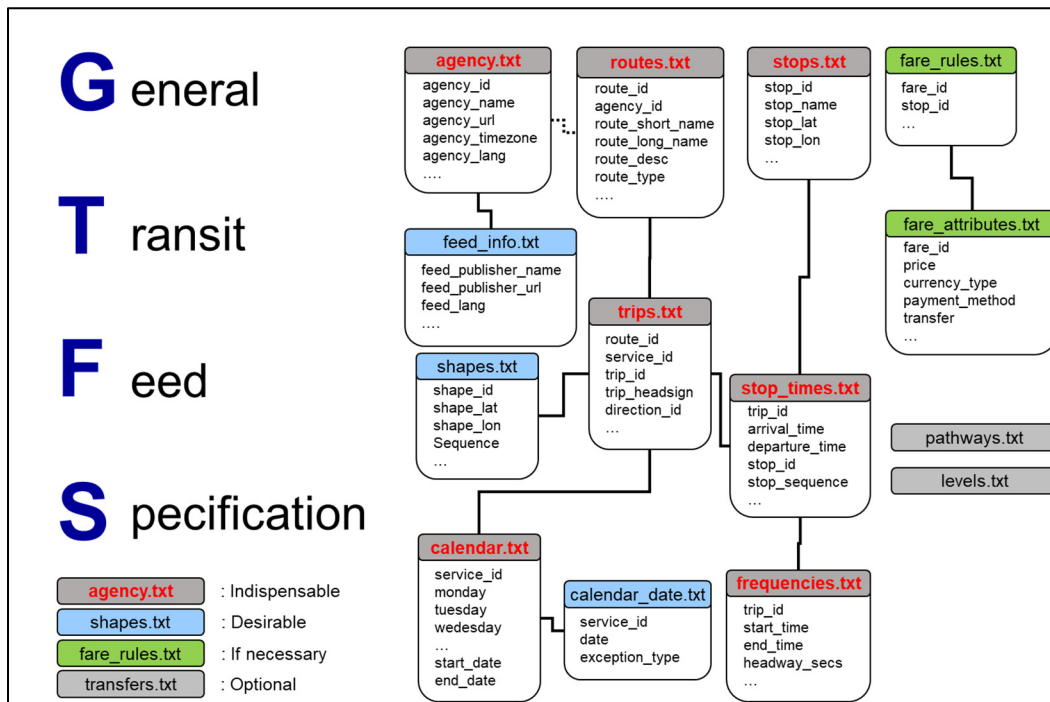
The standard format to provide GTFS shows the routes and timetable of public transport, and many transport operators in the world publish and distribute such information. If the GTFS is submitted to Google and approved as a shared transport service, route information will be provided on Google Maps, improving its convenience to users. Currently, many public transport operators are trying to change or convert the data to GTFS format to realize a Unified Public Transport Route Search.

The structure of the data format of GTFS and the explanation of each data format are summarized in Figure 1.4.3 and Figure 1.4.4.



Source: AddTransit

Figure 1.4.3 GTFS format to realize Unified Route Search



Source: JICA Expert Team

Figure 1.4.4 GTFS Data Structure

2) Electronic Billing and Ticket Control System

The system consists of tariff management module, line and timetable management module, POS server, real-time communication server, billing server, clearing and settlement server, management console, reporting server, API manager, record of issued fines, visualization of the completed system, and API of the whole system. The features of the Electronic Billing and Ticket Control System are as follows:

- **Rights to access.** MOT of Canton Sarajevo has access to all data, while transport operators have access to limited data.
- **Ticket Control System.** It is a centered monitoring system related to purchase, payment, validation, control, and registration. The ticket data will be synchronized with the Central Computer Control (*Centralnog Računarskog Upravljačkog* [CRU]).
- **Ticket type.** Personalized card with subscription (a user-account ticket that may be a discount or free fare and monthly, annual, and semi-annual ticket) and a non-personalized card without subscription, which allows several rides in a certain period based on the first validation in the vehicle. There is also a paper card (payment on-board to the driver) and a special ticket from the controller.
- **Backlisted cards.** When the cards are lost, requests to deactivate the cards are possible by contacting API to prevent future rides.
- **Tariff Management.** Management of price lists and ticket validating rules based on the tariff ticket zone, multi-day tickets, and any other ticket types (personalized, non-personalized cards).
- **Line and Timetable Management.** A web-based application to manage line and timetable management functionally. The system collects GPS data from vehicles, calculating delays and sending information to info displays. It also manages delays by adding and removing fleet.

- **POS server.** Informs all types of financial transactions, including invoice ticket issuance. This server is also in line with the billing server module as it manages all financial data management from the sold tickets, credit limits, debt, and payment obligations. In the beginning, the system will calculate sales of tickets and make a report of the cash balance that the seller should pay the bank. In this phase, the bank will work on the approval for the money distribution. The approval is also required from the ticket sellers.
- **Clearing and settlement server.** Transport operators and suppliers can exchange information.
- **Management console.** Transport operators are granted management and control of resources, namely the control panel to provide access information on stops, timetables, status of equipment, service work, ticket machines, maps, real-time maps (in a geoportal), sale management, and passenger data management (including vehicle ID, number of passengers, vehicle capacity, statistics on passenger movements). It can also collect GPS data from the vehicles.

MOT has started with contactless IC card tickets that are valid in the vehicles of all public transport operators (Figure 1.4.5). Monthly subsidized contactless IC card tickets for pupils, students, pensioners, and the unemployed have already been distributed, and then MOT will start sale of contactless tickets to the general passengers as soon as the on-board validators are in function by the end of 2023. For one-time tickets, paper tickets with a bar code will be read by the same validator. The price of the ticket has increased and is now 1.80 BAM.



Source: MOT

Figure 1.4.5 Sarajevo IC Cards (left) and Pensioners Purchasing IC Cards (right)

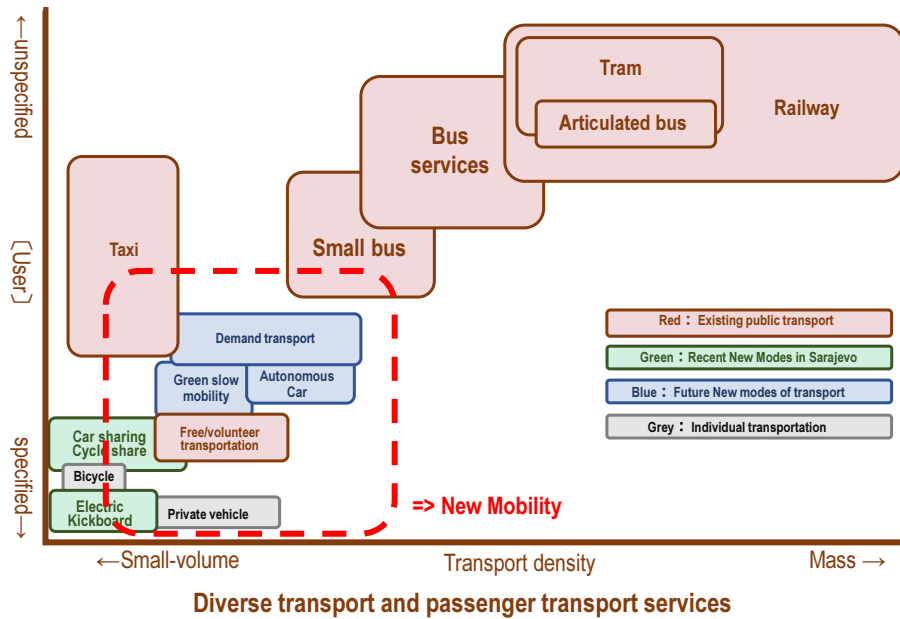
IC cards will be used at the validator when entering public transport vehicles. Personalized IC cards contain a photo and other necessary information about the public transport user and comes in different colors for pupils, students, pensioners, unemployed and workers (monthly tickets). Currently, IC cards can be issued to students, pupils, pensioners, as well as some other categories such as unemployed, but it is yet to be issued to workers and general passengers. Renewal of subsidized IC cards need to be done at GRAS or CENTROTRANS offices while topping up on regular IC cards can be done at kiosks. For one-time tickets, paper tickets with a bar code will be read at the same validator.

It is confirmed that MOT/GRAS has been doing countermeasures for free riders (through inspections, penalties, and special campaigns) but still experience issues. The new ITS system could solve this, but the fare collection management team and new ITS system designed by MOT/successor of GRAS should reconsider first the best fare policy and operation.

3) Applicability of MaaS

(1) New Mobility Service

The provision of new mobility services, such as electric scooters, rental bicycles, and car sharing, has been introduced in various cities due to recent innovations in ICT and has effectively improved the accessibility of buses and streetcars in Sarajevo. Since these new mobility services have already begun to be introduced in Sarajevo, it is proposed to systematically organize the roles or functions for each mode as shown in the following figure, particularly combining the different services based on the concept of MaaS to improve the convenience of public transport, shown as follows.



Source: JICA Expert Team

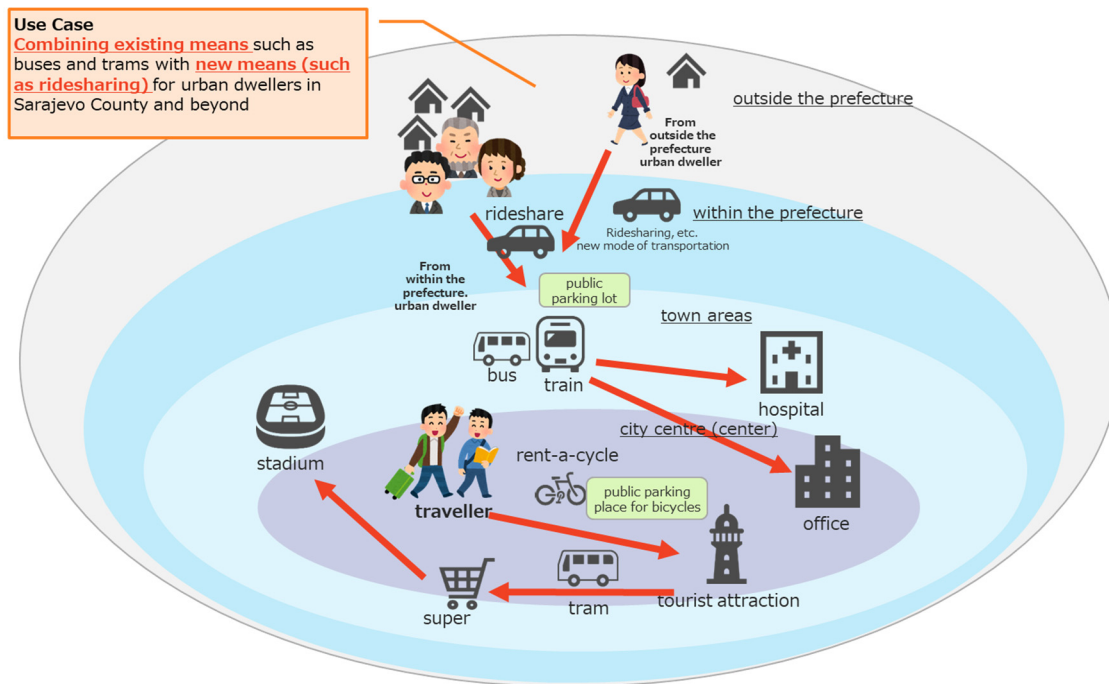
Figure 1.4.6 Diverse Transport and Passenger Transport Services

(2) Summary of Proposal on Sarajevo MaaS

The increasing use of private vehicles will have detrimental consequences in the future for new generations of users who should be oriented towards MaaS offered by new public transport concepts supported by ITS. The new users will create a perception of a low level of public transport service and will prefer the use of private vehicles, which will be difficult to change in the future. Therefore, it is important to adopt comprehensive measures for the revitalization of public transport in Canton Sarajevo. The following use case are proposed in Sarajevo. The MOT of Canton Sarajevo should lead this new measure in collaboration with the operators.

- **Use Case: [Combination of existing public transport and new means]** In order to improve the convenient conditions of public transport, the combination of existing means, such as buses and trams, with the new will be offered to urban dwellers in Sarajevo and beyond.

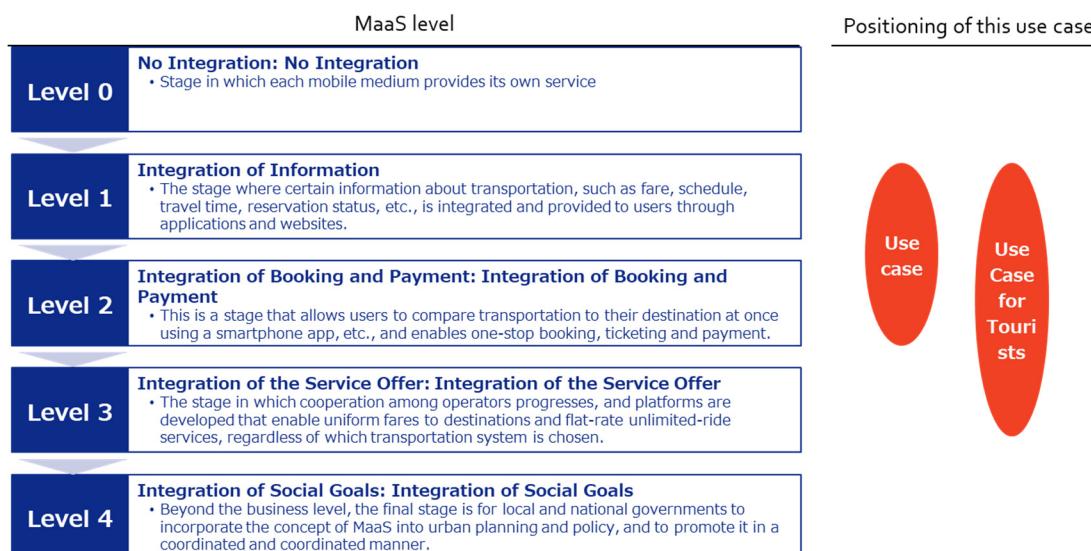
The aims of both cases are to improve the user UX through the use of digital technology and promote the improvement and use of public transport. Figure 1.4.7 shows the image of a use case with digital technology.



Source: JICA Expert Team

Figure 1.4.7 Challenge of Solving Problems through Digitization in Sarajevo

Even if advanced cases and services from overseas are introduced as they are, they do not fit the actual situation and do not lead to the solution of issues specific to Sarajevo. It is important to chew over the advanced cases and “Sarajevoiz” them through on-the-spot verification. The following figure shows the level of MaaS, which was proposed by the Chalmers University of Technology. Japan is currently promoting a demonstration experiment of level 2 or 3. To introduce this kind of new action, Sarajevo should also start a similar demonstration in the near future.



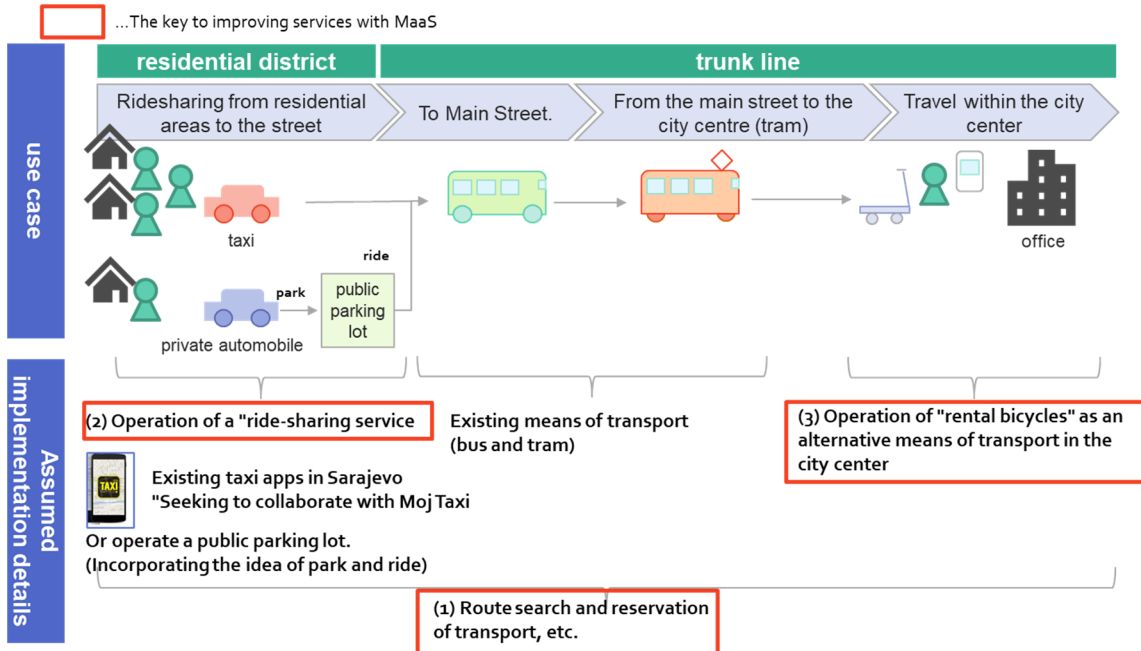
Source: A topological approach to Mobility as a Service: a proposed tool for understanding requirements and effects, and for aiding the integration of societal goals, November 2017

Figure 1.4.8 MaaS Level and Positioning of Proposed Use Cases

(3) Use Case [Combination of existing public transport and new means]

In Sarajevo, there is a high dependence on private cars, which contributes to air pollution. By introducing MaaS, improving public transport, and enhancing new means of transport

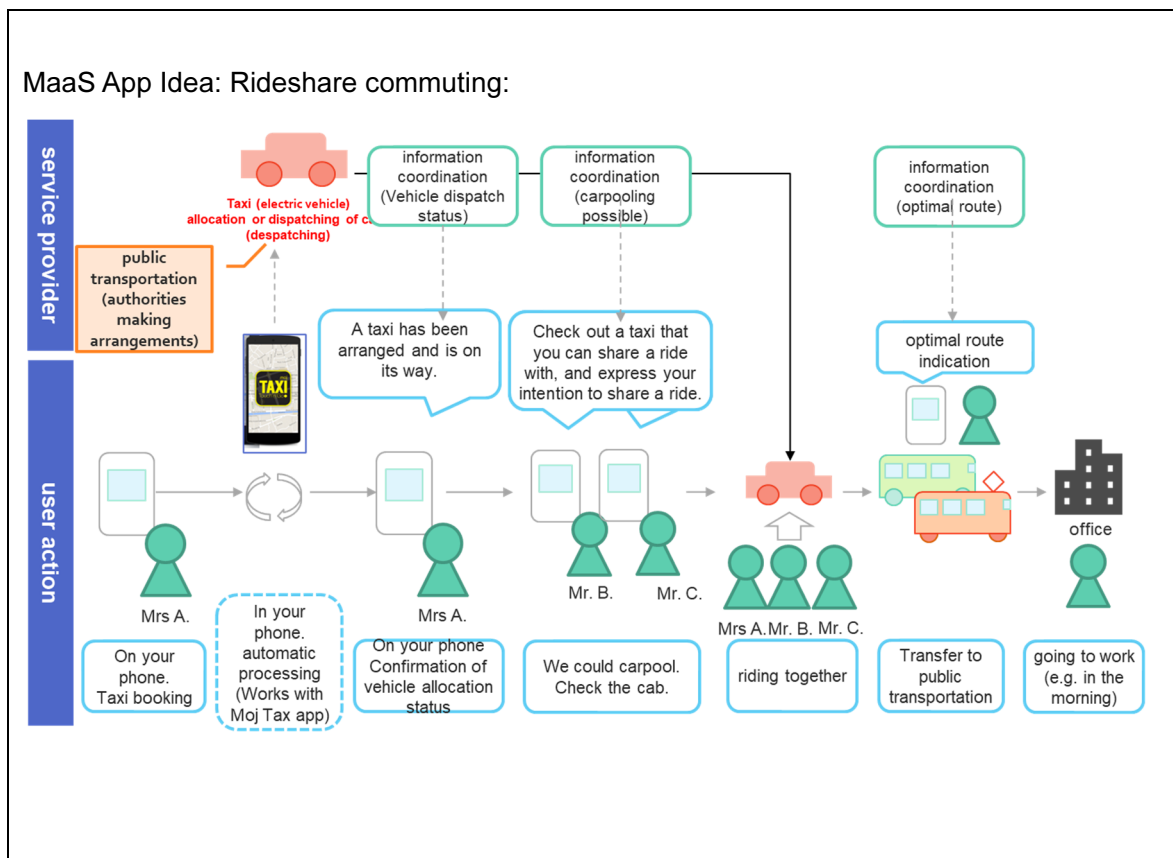
such as ridesharing, and providing a means of transport that combines multiple means, the aim is to break away from private car-only mode. Figure 1.4.9 shows the use case and assumed implementation details. The key to improving services with MaaS will be (1) route search and reservation of transport, etc., (2) operation of a ride-sharing service, and (3) operation of rental bicycles as an alternative means of transport in the city center.

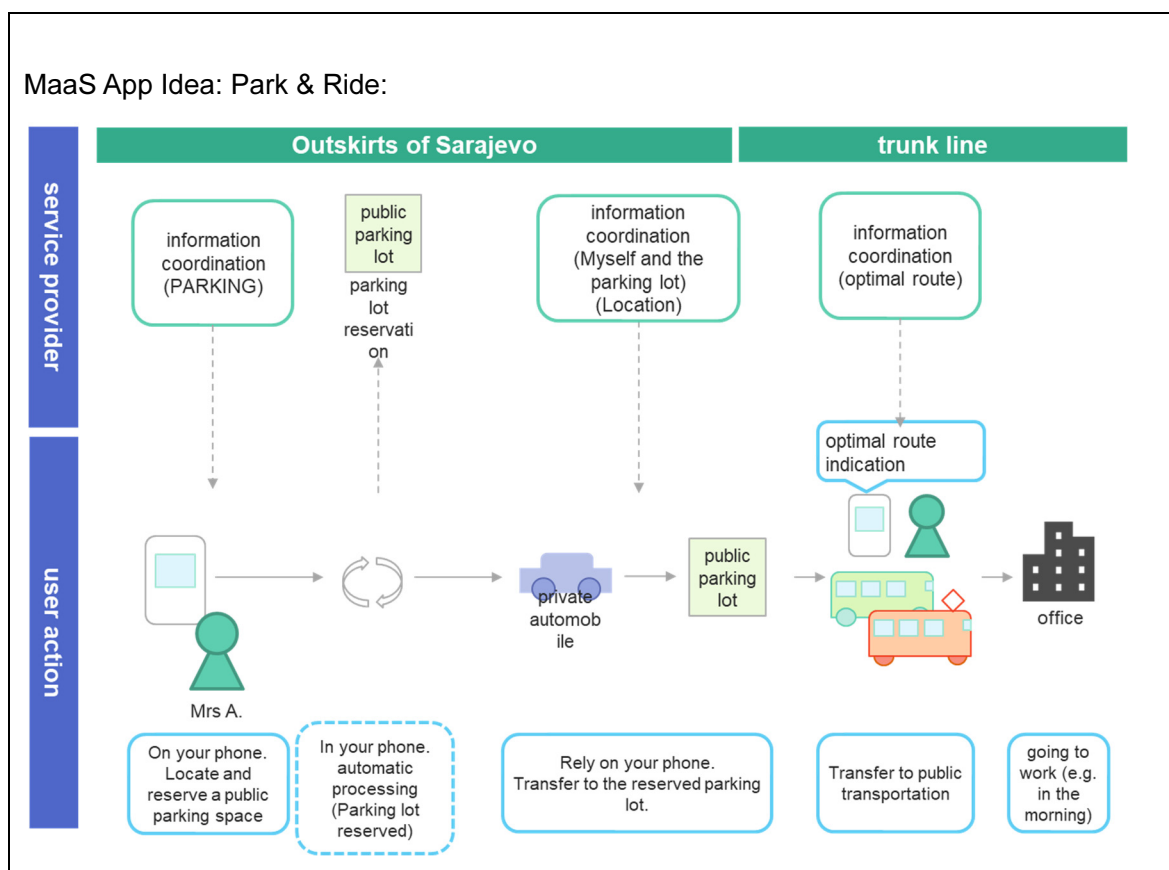


Source: JICA Expert Team

Figure 1.4.9 Use Case and Assumed Implementation Details

Figure 1.4.10 shows two MaaS application ideas proposed to Sarajevo.





Source: JICA Expert Team

Figure 1.4.10 Proposed MaaS Application Ideas on Use Case 1

1.5 Improvement Measures by Operators

1) Improvement of crew members' service for the customers

“Safety” and “comfortable” are important keywords to improve the crew members' service for customers on public transport operations. The proposed contents for “safety” and “comfortable” are as follows, which were based on examples from Hiroshima Electric Railway, Kotoden, and Hokkaido Chuo Bus, which the C/P visited during training in Japan.

(1) Driving that prioritizes customer safety

For customers to feel that the “tram or bus is safe,” it is important to strive to prevent accidents involving customers. The actions shown in Table 1.5.1 are proposed for accident prevention, with safety as a top priority.

Table 1.5.1 Proposed Actions for Safe Driving

No	Action	Description
1	Prohibition of sudden braking and sudden acceleration	<ul style="list-style-type: none"> Avoid sudden braking as much as possible and try to start smoothly so that passengers do not fall over due to the impact of sudden braking or sudden acceleration. To prevent sudden braking, always pay attention to your surroundings and brake early if you think it is dangerous.
2	When leaving, check the inside of the vehicle with the mirror	<ul style="list-style-type: none"> When leaving the vehicle, check the inside mirror to see if there are any passengers standing, and try to start smoothly with little impact so as not to overturn due to the impact of the departure.
3	Don't forget to check near the door when getting on and off	<ul style="list-style-type: none"> In order to not pinch customers when opening and closing the door, check the area around the door with a mirror or visually to see if there is a customer near the door when opening it and if opening it will not pinch customers.

No	Action	Description
		<ul style="list-style-type: none"> Before closing the door, make sure that the passenger has completely boarded and alighted, and that there is no danger of catching a passenger near the door by closing the door.
4	When passengers get on and off, stop the vehicle completely and do not start until the passengers have finished getting on and off	<ul style="list-style-type: none"> If passengers get on and off without the vehicle stopping completely, there is a risk they will fall over near the entrance/exit. Confirmation before departure will be needed.
5	Observance of traffic rules	<ul style="list-style-type: none"> Obeying traffic rules is the duty of a professional driver. Violation of the rules may cause a traffic accident or cause injury or anxiety to customers. Driver's mission is to transport customers to their destinations safely by vehicle. Be aware of yourself as a professional driver and be sure to obey traffic signals, speed limits, and other traffic rules so that you can be a role model for general drivers.

Source: JICA Expert Team

(2) Customer service and in-vehicle environment that make feel “comfortable”

For customers to feel that the “tram or bus is comfortable,” it is important to pay attention to the attitude towards customers and the environment inside the vehicle. The actions shown in Table 1.5.2 are suggested.

Table 1.5.2 Proposed Actions for Customer Service and In-vehicle Environment

No	Action	Description
1	Politely speak and respond to customers	<ul style="list-style-type: none"> Be polite in language and response when selling or confirming tickets or responding to inquiries from customers. A rough attitude and language will make customers feel uncomfortable. In addition, it could ruin the image of the tram/bus and the impression of the crew.
2	If there is a passenger standing on board, give up your seat to the passenger	<ul style="list-style-type: none"> The seats in the vehicles are for passengers, installed for a comfortable ride. If a passenger is standing in the tram/bus, the crew should assist their seat for them.
3	Do not play radio or music in the vehicle, or chat loudly	<ul style="list-style-type: none"> Playing radio or music in the vehicle is prohibited. To ensure comfort inside of the vehicle, never play radio or music but only the specified in-vehicle announcements. Avoid chatting loudly among crew members. Some customers find it annoying to speak loudly.
4	No smoking inside the vehicle	<ul style="list-style-type: none"> Although smoking is prohibited inside the vehicle, some crew members smoke inside. Odors and smoke make the environment inside the vehicle worse. There is also a risk of soiling the equipment. Smoking in the vehicle must be stopped in order to provide a comfortable in-vehicle environment to customers.
5	Clearing the vehicle	<ul style="list-style-type: none"> Garbage and dust may be scattered inside the vehicle. Dirt inside the vehicle makes customers feel uncomfortable. It is the duty of the crew to clean inside the vehicle after arriving at the terminal. In order not to make customers feel uncomfortable, cleanliness inside the vehicle after arriving at the terminal must be ensured.
6	After arriving at the terminal, check the inside of the vehicle	<ul style="list-style-type: none"> A customer might leave things in the car. If so, and the customer contacts the company and finds the lost item, they will surely be happy. Trust in the tram/bus will increase. Make sure to check inside the vehicle after arriving at the terminal. Check inside the vehicle for damages. Immediately report any damages to the company.
7	Neat appearance	<ul style="list-style-type: none"> There are crew members who do not wear uniforms and work in sandals instead of shoes. In addition, there are crew members who wear sunglasses and hats without permission while working. Regulations should state the uniform requirements and permit to wear sunglasses. In addition to strictly following the rules regarding work dress code, be careful about appearances so as not to give a bad impression to customers.

Source: JICA Expert Team


2) Establishment of boarding manners

(1) Proposed general rules and courtesy guidelines

Tram and bus riding manners are very important. Operators always try to be on time, but proper riding manners will be required to maintain timely operation. For an easy and

painless journey for everyone, the following general rules and courtesy guidelines will be proposed.

What is manner of Public Transport in Sarajevo?






The tram and bus riding manners is very important, public transport operators are trying almost always on time, but proper behavior by users also important. To make the journey easy and painless for everyone, please follow these general rules and courtesy guidelines.

Get on the train in turn & don't rush onto the tram/bus
When waiting for the train in Japan, make sure you wait in line and let passengers get off the train before boarding. Cutting in line is not a good idea, it's considered very rude. Don't rush to get on your tram/bus, when the tram/bus is ready to leave a signal will sound and the doors close. Don't try to run or squeeze onto the tram/bus since it's dangerous and might delay them.

Keep it quiet the train/bus are crowded and the passengers spend a lot of time on the train/bus- often tired going to and from work. Keeping noise to a minimum is the polite thing to do. Refrain from talking loudly with your travel company/on the phone, making a commotion, listening to music or watching videos on speaker.

Give your seat for others The elderly, those with disabilities, pregnant women, and young children are also using the tram/bus. Your kindness will be expected for all passengers.

Don't litter Make sure you take all your belongings and garbage with you when leaving the train/bus. Don't leave used tissues, pet bottles, newspapers or other types of litter on the train.



Source: JICA Expert Team

Figure 1.5.1 Proposed General Rules and Courtesy Guidelines on Public Transport

(2) Methods to disseminate riding manners

It is recommended to disseminate the proper riding manners through the following. Besides posting on the operator's website and in the tram car and bus vehicle, it will be effective to provide this information during the mobility management activities, which will be described in Chapter 3.

- Website of operators
- Posted inside of tram car and bus vehicle
- Distribute the information in the timing of Mobility Management

2 Traffic Regulation Improvement Plan for Smoother Public Transport Operation

Since traffic regulation for automobiles is indispensable for the smooth operation of trams, trolleybuses, and buses, traffic regulation improvement plans are formulated. For smoother operation of public transport, the following measures to improve the efficient usage of the existing road space are considered in the context of Sarajevo:

- (a) Priority Signaling System for public transport (as part of Adaptive Traffic Management System [ATMS]);
- (b) priority lanes for public buses;
- (c) regulation of car use in specific areas and time periods;
- (d) street parking regulations; and
- (e) bicycle/pedestrian facility development.

These improvement measures are listed by order of priority in light of the significance of smoother operation of public transport. Among these, (a) is implemented as part of the ongoing ATMS project supported by EBRD and EIB, and (b) can be considered as an extension of ATMS. For (c), MOT is studying the adoption of a Low Emission Zone (LEZ) along with a smart parking system as part of (d). As for (e), MOT is planning to have another project, especially for bicycle lanes. MOT currently has an ATMS project and a study on LEZ/smart parking. Thus, all the improvement measures seem to be going at once, and therefore, the JICA Expert Team recommends completing all these measures without fail. Several other improvement measures are also explained in this chapter.

2.1 Priority Signaling System for Public Transport (as part of ATMS)

The primary objectives of introducing a Priority Signaling System for public transport in Sarajevo are as follows:

- **Reducing Congestion.** By granting priority to public transport vehicles, the system aims to minimize traffic congestion, leading to reduced travel times and improved overall traffic flow.
- **Improving Punctuality.** The Priority Signaling System will facilitate on-time arrivals and departures of buses and trams, enhancing the reliability and attractiveness of public transport for commuters.
- **Enhancing Public Transport Efficiency.** By ensuring smoother journeys and fewer stops, the system will help increase the efficiency of public transport operations, leading to a more sustainable and eco-friendly transportation.

The Priority Signaling System operates on the principle of giving traffic signal priority to public transport vehicles. The system will be integrated with GPS and real-time tracking technologies to enable communication between vehicles and traffic signals. How the system works is presented in Table 2.1.1.

Table 2.1.1 Functional Procedures of the Priority Signaling System

Procedures	Description
1) Vehicle Communication	Public transport vehicles, such as buses and trams, will be equipped with GPS and communication devices. These devices will relay real-time vehicle location and schedule information to a centralized control system.
2) Centralized Control System	The centralized control system will receive data from the public transport vehicles and monitor the traffic flow at various intersections in real-time.
3) Dynamic Signal Control	When a public transport vehicle approaches an intersection, the control system will evaluate its position, speed, and schedule. If necessary, it will adjust the traffic signal timing to prioritize the passage of the public transport vehicle.
4) Signal Preemption	In some cases, the system may even preemptively adjust traffic signals ahead of a public transport vehicle's arrival to ensure a smoother journey.

Source: JICA Expert Team and MOT

The implementation of a Priority Signaling System for public transport in Sarajevo will offer numerous benefits.

- **Reduced Travel Time.** With priority at traffic signals, public transport vehicles can navigate through intersections more efficiently, reducing travel time for passengers.
- **Increased Punctuality.** The system will enhance the punctuality of public transport services, leading to improved commuter satisfaction and increased ridership.
- **Traffic Decongestion.** By reducing the time spent at intersections, the system will help alleviate traffic congestion, benefiting all road users.
- **Environmental Impact.** Encouraging the use of public transport through better service may lead to a decrease in the number of private vehicles on the road, thereby reducing greenhouse gas emissions and promoting a greener city.
- **Economic Benefits.** An efficient and reliable public transport system can attract more tourists, boost local businesses, and enhance the overall economic activity in Sarajevo.

In Sarajevo, the Priority Signaling System for public transport is being implemented as part of the ATMS project, which includes the detection of tram vehicles only through signal preemption. ATMS has a feature that will allow priority movement of tram vehicles that have their own lane. A Priority Signaling System for buses is technically possible, but it could be considered following the completion of the first phase of the Priority Signaling System operation for trams and full operation of the control center for public transport.

As of July 2023, a contractor for the ATMS was selected, and this 18-month-long project will begin in August 2023, followed by works in October 2023. The MOT has implemented the ATMS project by overcoming the following challenges:

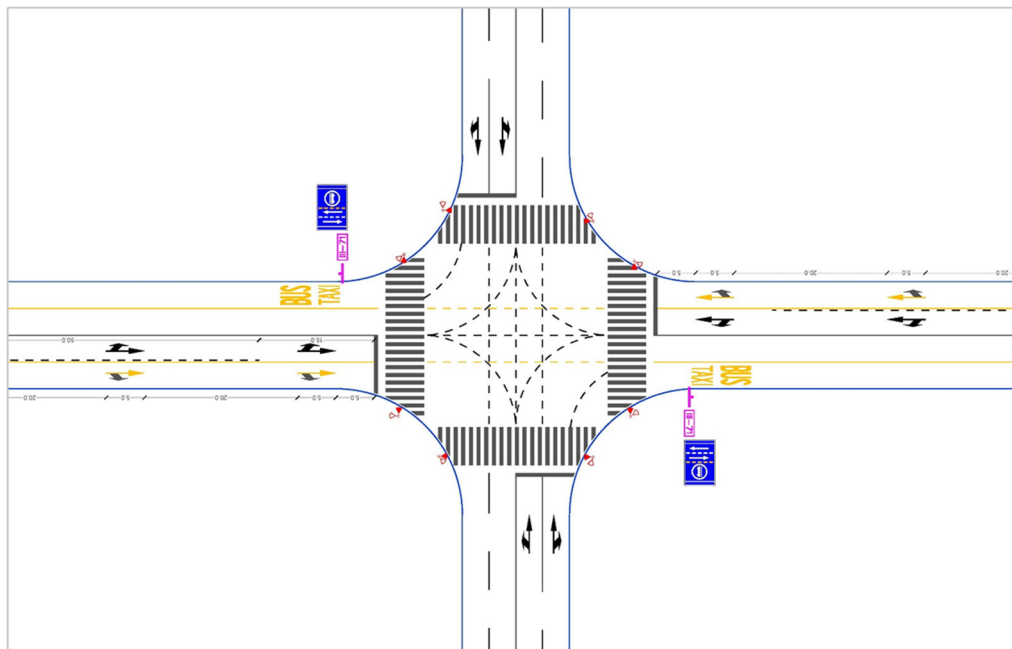
- **Costs.** While the initial investment and maintenance of the system could be substantial, this project is funded by EBRD and EIB.
- **Infrastructure Upgrades.** Some intersections may require modifications and upgrades to accommodate the new signaling system. However, this project includes all the necessary equipment and the system, and the 163 intersections in Canton Sarajevo were not physically modified due to the limited available space.
- **Coordination with Other Systems.** While the system should be coordinated with other traffic management systems to avoid conflicts or unintended consequences, old equipment must be replaced without any negative impacts on the existing contract.

- **Public Awareness.** Public awareness campaigns will be necessary to educate commuters about the new system and its benefits. No public awareness campaigns in Sarajevo are planned since private car drivers will also receive significant benefits from the ATMS project with improved traffic management.

While the ATMS project is to be completed in February 2025, the remaining tasks for implementing the Priority Signaling System for buses is establishing the law to define dedicated lanes first and then have the lanes included in the Priority Signaling System for public transport. Thus, the Priority Signaling System for buses will be realized as an extension of the ATMS when the priority bus lanes are duly implemented.

2.2 Priority Lanes for Public Buses

The development of priority bus lanes in Sarajevo could offer many benefits, such as improved public transport efficiency, increased public transport ridership, reduced traffic congestion, environmental benefits, cost-effective solutions, and equity and accessibility. A layout of priority bus lanes at a typical intersection is illustrated in Figure 2.2.1. Implementing priority bus lanes may also face certain challenges, such as space constraints, traffic constraints, coordination with other road users, enforcement and compliance, and public acceptance.

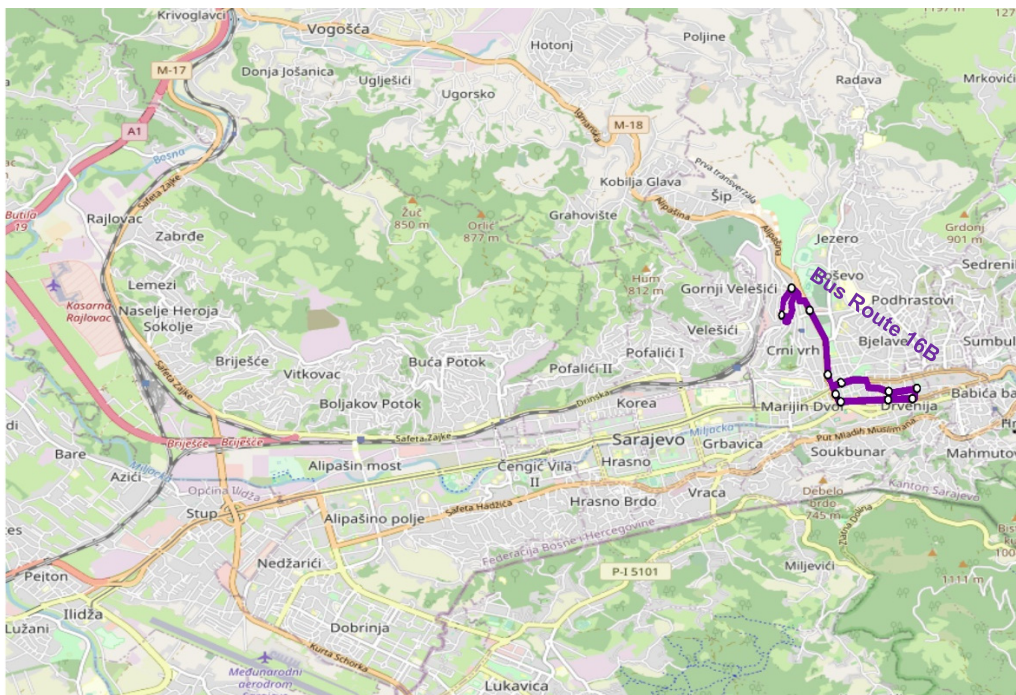


Source: Public Transport Consult, (2020) "Proposal of Geometric Elements and Traffic Signals for Defining Yellow Lanes"

Figure 2.2.1 Implementation of Bus Priority Lanes at a Typical Intersection

Currently, Sarajevo has few exclusive/priority lanes for public buses due to lack of space. The Plan for Sustainable Urban Mobility of the Canton Sarajevo and the City of Sarajevo (SUMP, 2020), funded by GiZ, proposed a provision for bus network infrastructure improvements with the introduction of dedicated bus priority lanes and other measures to improve the level of service; however, no bus priority lane network was presented. In the "BiH Air Quality Improvement Project" by the World Bank, its demonstration corridor, namely, the East-West corridor that connects Dom Armije to Antuna Hangija via Alipašina (Route 16B), may have bus exclusive/priority lanes for the operation of low-emission buses (e-bus and EURO 6/CNG bus), as shown in Figure 2.2.2, though there are some sections with only

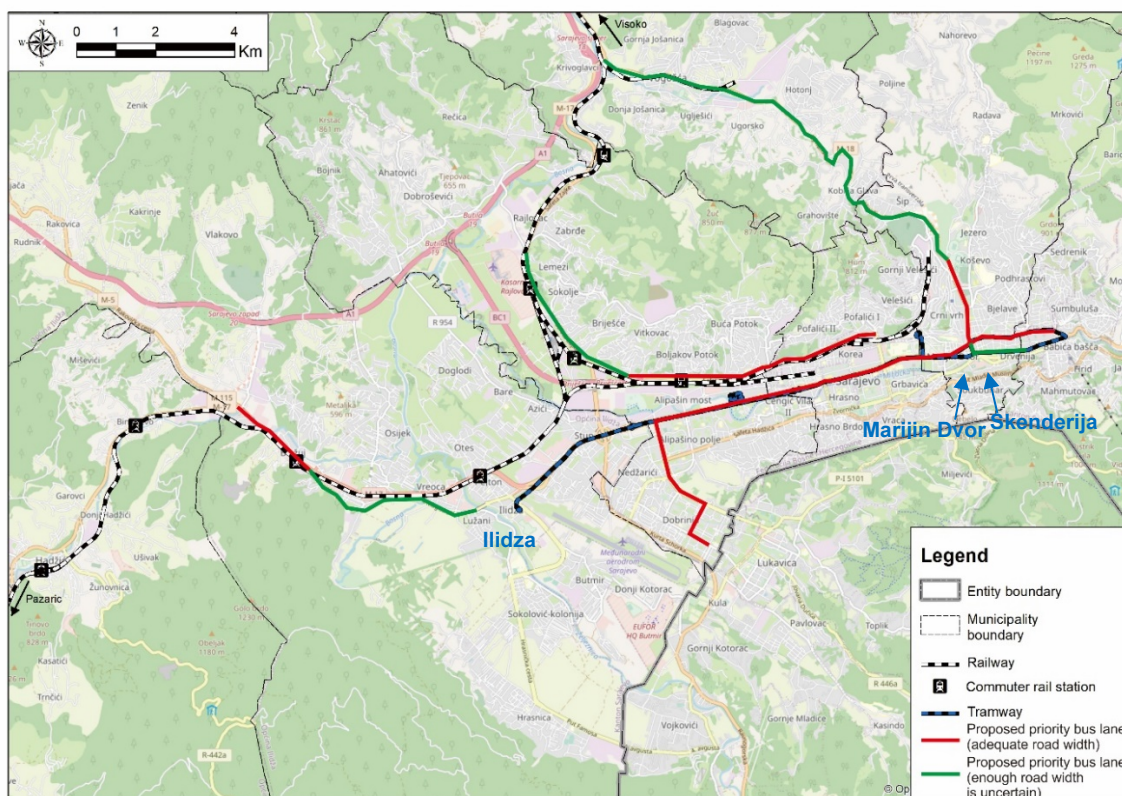
two traffic lanes in total including both directions and it is not possible to establish priority lanes there.



Source: JICA Expert Team

Figure 2.2.2 Route 16B for Bus Priority Lane Development to Be Funded by the World Bank

Thus, feasibility studies and subsequent implementation of priority bus lane measures to expand the bus lane network would be needed. For this, a plan of additional bus priority lanes proposed by TRAMODE is presented in Figure 2.2.3.



Source: JICA Expert Team

Figure 2.2.3 Additional Bus Priority Lanes Proposed by TRAMODE

Sufficient road width for construction, observance of traffic rules, establishment of an enforcement system, and confirmation of the law are all necessary for the successful implementation of bus priority lanes. The idea is to expand the existing “yellow” priority lanes from loophole Skenderija - Marijin Dvor to Ilidza. Due to the lack of space, the dedicated bus priority lanes on longitudinal streets are only considered for during certain periods.

The latest update from the last CS Assembly session is that the CS Ministry of Interior (MOI) will start procuring a video surveillance system targeting the priority lane for buses and taxis called the “yellow lane” loop from Skenderija to Marijin Dvor. This yellow lane is necessary to enforce penalty measures. While the objective of the video surveillance is for security on the street, it will allow priority movement of the public transport vehicles in Sarajevo.

2.3 Regulation of Car Use in Specific Areas and Time Periods

In general, it is common for cities to implement measures to manage traffic and reduce congestion in busy central areas during peak hours. These measures can include the following:

- (a) **Congestion Charging.** Some cities implement congestion charging zones, where drivers are required to pay a fee to enter specific areas during peak hours. This measure aims to discourage unnecessary car use and promote the use of public transport.
- (b) **Restricted Access Zones.** Certain areas in the city MOT be designated as restricted access zones during specific times, allowing only authorized vehicles to enter. These zones are often reserved for public transport, emergency vehicles, or specific permit holders.
- (c) **Car-Free Zones.** Some areas may be designated as car-free zones, where private vehicles are not allowed during certain times. These zones are usually pedestrian-friendly and prioritize non-motorized transport.
- (d) **Residential Permit Parking.** In residential neighborhoods, MOT implemented parking regulations that required residents to obtain permits to park their vehicles on the street. This measure helps to manage parking space allocation in areas with limited parking availability.
- (e) **Time-Limited Parking.** In busy commercial or tourist areas, time-limited parking spaces may be provided to encourage turnover and ensure parking availability for multiple users throughout the day.
- (f) **Park-and-Ride Facilities.** To reduce traffic in city centers, MOT established park-and-ride facilities on the outskirts, allowing commuters to park their vehicles and use public transport to reach their destinations in the city center.

The above measures are listed in order of priority, considering the impacts of using private vehicles. Among these, Canton Sarajevo has a plan to realize the (f) Park-and-Ride Facilities, which is to develop a parking garage close to the planned Vogosca trolleybus terminal. Since Canton Sarajevo owns the land for the garage with 450 vehicle spaces, it will be operated by a Cantonal corporation. Meanwhile, other than Vogosca, Canton Sarajevo has no plan to realize park-and-ride facilities due to the lack of available land for development.

Thus, Canton Sarajevo is seeking (b) Restricted Access Zones, particularly, the LEZ in consideration of the air quality. LEZ, which restricts use of cars emitting certain level of pollution within the designated central area, proved to be the most effective measure to raise the public transport mode share in the public transport policy analysis in Volume I. An LEZ operated in Florence was a good example and was learned in the third country training in this Project (see Appendix A5.2 of Volume I).

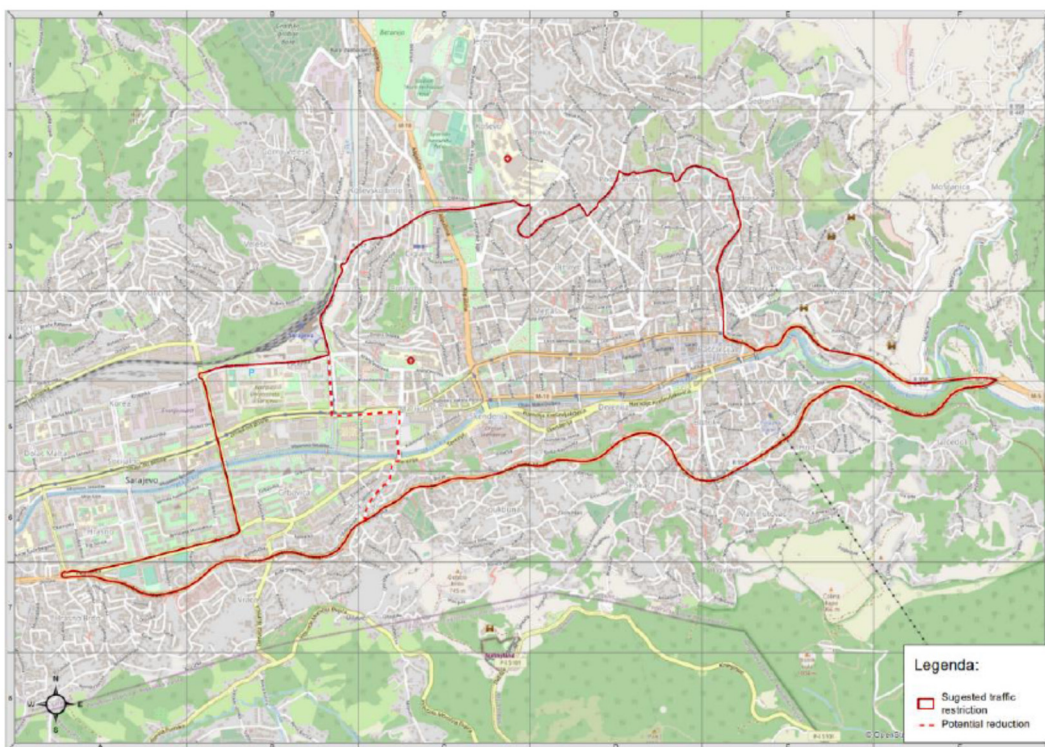
According to the study “Low Emission Zone in Sarajevo” (2022) by IVL Swedish Environmental Research Institute, a proposal for an implementation plan was presented. The implementation spans four to five years and includes the initial phase in gaining public and political endorsement, introduction of the LEZ, all the way to a potential tightening of the regulations. Table 2.3.1 provides an overview of the main activities in the implementation plan and during which year they are suggested to be initiated or carried out.

Table 2.3.1 Overview of Five-Year LEZ Implementation Plan

Year	Main Activity / Goal
1	Public and political endorsement. Public awareness and information campaign. Complementary measurements of traffic and emissions.
2	Political decision, preparations for implementation, education, equipment, staff etc. Soft early implementation. No fines at this stage.
3	Sharp implementation, noncompliance yields a fine.
3-4	Evaluation. Effects on traffic, public acceptance, air quality, vehicle categories, method of control.
4-5	Potential tightening of Euro class regulation and/or transition from a manual control system to semi-manual or automated system.

Source: IVL Swedish Environmental Research Institute, “Low Emission Zone in Sarajevo,” 2022.

The Swedish LEZ study was good for data collection that MOT utilized to identify the most polluted areas and types of cars entering the red zone and accordingly prepare a map identifying the red zone. The map in Figure 2.3.1 presents an overview of the suggested zone in Sarajevo. The design and size were developed by IVL. The suggested area for traffic restriction is approximately 5.6 km², housing 50,000 inhabitants. This map is now also utilized by the Spanish government with a consultant to consider the option of implementing LEZ, as will be mentioned later.



Source: IVL Swedish Environmental Research Institute (2022) "Low Emission Zone in Sarajevo"

Figure 2.3.1 Map of Suggested LEZ

The geographical scope must be considered to determine the suggested area for traffic restriction as well as which vehicles to exclude. The placement of the zone must not hinder access to important institutions, including hospitals which must be accessible regardless of vehicle status, and the number of excluded vehicles must be at a level that will not compromise the goals and integrity of the zone nor affect too many people. This is a consideration of both size and emission standard level. The recommendation by IVL is to scale up and tighten the zone when current excluded vehicles constitute less than 15–20% of the vehicle fleet, considered a level that does not entail too great limitations in the everyday life of the inhabitants.

Table 2.3.2 can be used as guidance for when to tighten the zone rules. If an exclusion of approximately 15–20% of the passenger cars within the zone is regarded as acceptable, it would be recommended to tighten the requirements in year three or four. This table should be regarded as an indication of the vehicle fleet and its composition. Several sources of data from Sarajevo have been used, including vehicle registration statistics, the GIS file containing traffic flows, the "Data Collection Survey on Public Transportation in Canton Sarajevo, Bosnia and Herzegovina" (2020) by JICA, as well as additional data from the city of Sarajevo. Therefore, available sources have been combined as a whole.

Table 2.3.2 Cumulative Share of the Vehicle Fleet for Passenger Cars in the Proposed LEZ

Tier	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Euro 6	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Euro 5	67.9%	64.8%	59.7%	52.7%	46.2%	39.9%	34.1%	28.7%	23.8%	19.5%	15.8%
Euro 4	40.7%	36.8%	32.0%	26.6%	21.9%	17.9%	14.5%	11.8%	9.5%	7.7%	6.3%
Euro 3	18.3%	16.2%	13.8%	11.4%	9.4%	7.8%	6.4%	5.4%	4.5%	3.9%	3.3%
Euro 2	6.8%	6.2%	5.5%	4.8%	4.2%	3.6%	3.2%	2.8%	2.5%	2.2%	2.0%
Euro 1	5.6%	5.3%	4.8%	4.2%	3.7%	3.3%	2.9%	2.6%	2.3%	2.0%	1.8%
Euro 0	5.0%	4.7%	4.3%	3.8%	3.4%	3.0%	2.7%	2.4%	2.1%	1.9%	1.7%

Note: Yellow cells are target vehicles for LEZ regulation

Source: IVL Swedish Environmental Research Institute, "Low Emission Zone in Sarajevo," 2022.

Implementing the LEZ can have both advantages and disadvantages, envisaged in the context of Sarajevo as follows:

Advantages

- **Improved Air Quality.** The primary benefit of an LEZ is the reduction of air pollution. By restricting access to high-emission vehicles, the zone can contribute to improved air quality, leading to better public health outcomes.
- **Encouragement of Cleaner Vehicles.** LEZ incentivizes the use of low-emission and electric vehicles. Supported by the whole society, public transport could also accelerate the adoption of cleaner and more sustainable transportation technologies, contributing to a greener and more environmentally friendly city with reduced greenhouse gas emissions.
- **Traffic Management.** LEZ can manage traffic flow more efficiently, reducing congestion and improving overall transportation system performance. This can lead to shorter travel times and increased productivity for businesses and commuters. Since little traffic is expected to go through the proposed LEZ in Sarajevo due to its geographical situation, the effect of better traffic management could be anticipated.
- **Promotion of Public Transport and Non-Motorized Modes.** By limiting access to certain vehicles, LEZ can encourage the use of public transport, cycling, and walking, leading to a more sustainable and healthier urban mobility mix.

Disadvantages

- **Impact on Businesses.** Some businesses, especially those reliant on high-emission vehicles such as trucks, may face increased operational costs or operation restrictions within the LEZ, which is to be applied to light commercial vehicles (LCV) and heavy goods vehicles (HGV) as well as passenger cars in this study.
- **Public Acceptance.** The introduction of LEZs may face some resistance from the public who perceive it as restrictive or burdensome, while the IVL study suggests that Saturdays and Sundays are without LEZ restrictions.
- **Equity and Social Impact.** LEZ can disproportionately affect low-income individuals or small businesses that may not have the resources to upgrade to cleaner vehicles or alternative travel options. The costs of shifting to lower-emission vehicles could, to some extent, be forwarded from truck companies to end users as shop owners or customers.
- **Enforcement Challenges.** Implementing and enforcing LEZ regulations require robust monitoring systems and adequate resources. Together with a vehicle identifier, enforcement needs a roadside detection system such as manual visual monitoring (with or without digital support) and enforcement from a specifically equipped moving vehicle or fixed automatic monitoring equipment, including Automatic Number-Plate Recognition (ANPR) (Figure 2.3.2), which means a higher financial investment.
- **Displacement of Emission.** There is a risk of the "rebound effect," where vehicles not meeting the LEZ criteria relocate to nearby areas not covered by the zone, potentially shifting emissions rather than reducing them overall.



Source: IVL Swedish Environmental Research Institute (2022) "Low Emission Zone in Sarajevo"

Figure 2.3.2 Example of Fixed ANPR Gantry in Gothenburg

In conclusion, implementing an LEZ can lead to significant environmental and public health benefits, but it also comes with challenges related to public acceptance, social equity, and enforcement. Successful implementation requires careful planning, stakeholder engagement, and consideration of local factors to strike a balance between environmental objectives and social impacts.

This study on LEZ by IVL was under the initiative of the Ministry of Utilities, Infrastructure, Spatial Planning, Construction and Environmental Protection and the MOT only provided the above-mentioned data. However, based on this study, MOT has made the most progress because it is easier to implement certain measures in traffic compared to other measures such as switching to more environmentally-friendly heating systems and thermal insulation facades on buildings.

The MOT signed another cooperation agreement with the Spanish Embassy for the development of a project for the establishment of LEZ or restricted access zones. The agreement foresees a grant (of 1 million EUR) for the establishment of a protection zone project, which encompasses amending legislation, determining methods for the establishment of zones, types of penalties, etc., and for the SMART parking project, i.e., detection of parking space occupancy. As of July 2023, active preparations will soon begin, and an announcement of procurement for those two projects is expected by the end of 2023.

An initial design of LEZ may serve well for the time being. Taking over IVL's recommendations on LEZ, a Spanish grant project has started to implement the LEZ and on-street smart parking.² For the final output, tender documents will be ready in March 2024.

While Canton Sarajevo is developing the regulation of LEZ, the main disadvantages mentioned above will turn from emissions to congestion. If so, the LEZ system must be transformed into a Congestion Charging scheme as listed in (a). Congestion charging is a softer traffic regulating regime than LEZ. Vehicles are charged, not banned. Congestion charging generates revenues that can be used to finance others, such as public transport or environment-improving measures. It is possible to combine LEZ and congestion charging in the same system (by using the same ANPR gantry) and to increase emission effects from a congestion charging system by charging high-emission vehicles higher, for example.

² IDOM, "Design and Drafting of Terms References for the Implementation Operation of On Street Smart Parking and Low Emission Zone (LEZ) in Sarajevo City" kick-off meeting, 2023.

2.4 Street Parking Regulations

Canton Sarajevo faces significant challenges related to urban mobility and parking management. The increasing number of vehicles and limited parking spaces have led to on-street parking in the area. The key issues of on-street parking from the viewpoint of public transport services in Canton Sarajevo are as follows:

- **Illegal Parking.** The lack of sufficient legal parking spaces often leads to illegal parking on sidewalks, pedestrian crossings, and other unauthorized areas. The number of illegal parking accounts for 33% share of the total number of street parking.³ Illegal parking obstructs the traffic flow of public transport vehicles since they need to make frequent stops along the streetside. It also poses safety risks to pedestrians and public transport users and inconveniences other road users.
- **Traffic Congestion.** Vehicles searching for parking spaces contribute to congestion, especially during peak hours. Not only does this increase travel time for automobile traffic, but it also impacts the overall efficiency of public transport services.
- **Enforcement Challenges.** Even though on-street parking hinders the smooth passage of public transport vehicles, enforcing parking regulations and issuing fines for illegal parking can be challenging, especially in busy areas with limited law enforcement resources.

In order to tackle the above issues, observance of traffic rules and establishment of the enforcement system, confirmation of basic laws and rules, and consensus among local residents and car users are essential. In addition to the series of parking regulations (listed in Table 2.4.1), a new Regulation on Parking was prepared by MOT, and it was enacted by the Canton Sarajevo Assembly. Thus, the legislation on parking regulation has been well established without needing any amendments. However, it is necessary to establish a management system.

³ JICA, "Data Collection Survey on Public Transportation in Canton Sarajevo, Bosnia and Herzegovina," 2020.

Table 2.4.1 Summary of Parking Regulations

Year	Main Activity / Goal
2002	Decision on the prices of monthly parking tickets and determined the parking fee and conditions. The parking fee for all tenants and legal entities along the streets is collected by Cantonal Public Utility Company RAD, which functions as an integrated service company under Canton Sarajevo.
2014	Decision on the zone divisions of public pay parking lots. With the aim of expanding the number of parking lots in SC, this decision covers all nine municipalities. The new zone divisions of public parking lots were introduced as Zone Zero, Zone I, and Zone II.
2016	Decision on the Regulation on Organization and Manner of Payment for Parking in Canton Sarajevo (2016). Article 19: Parking zone. Public parking lots are classified into three zones, each assigned with colors: green for Zone Zero, red for Zone I, and yellow for Zone II. Article 23: Types of parking tickets, sales, and distribution. Parking tickets can be issued daily for a particular parking zone and is valid for one day from issuance. The parking ticket for one hour or multi-day can also be issued within 24 hours. Article 31: Privileged parking tickets. The privileged tickets are targeted for tenants that have a place of residence along a certain street where parking is charged. The privileged ticket is valid from 17:00 to 7:00 and applicable to public parking on a street operated by MOT. Article 40: Parking lots within private facilities. Owners of collective housing, large shopping malls, and other similar facilities are obliged to provide their users with onsite parking lots in accordance with the prescribed legislation.
2017	Decision on parking fees in each zone according to the Regulation on Organization and Manner of Payment for Parking in Canton Sarajevo (2016).
2018	Decision on public areas intended exclusively for parking motor vehicles, parking zones, types of parking tickets and how to use them, conditions for acquiring and using a privileged parking ticket, organization of a unified parking collection system, payment and distribution of income from public parking lots, modalities of financing the construction of new parking lots and garages, parking control in public parking lots, and supervision.

Source: JICA Expert Team, based on information from MOT

Furthermore, MOT has initiated the grant project “Implementation and Operation of On-street Smart Parking and Low Emission Zone (LEZ) in Sarajevo City,” funded by the Spanish Government, for the detection of free parking spaces on nine streets in Sarajevo, including Brodac and Bistrik Streets. The Smart Parking System represents the beginning of solving the traffic congestion caused by searching for parking, leading to a significant reduction in air pollution. Drivers of Sarajevo will save time when looking for a free parking space. Through a mobile application, they will have information on where the free parking spaces are available and will be able to pay for the parking space. It can also be used as navigation when moving to the desired parking space. Besides the application, drivers will be informed through LED screens placed at main intersections. The parking space will be covered with smart cameras that will recognize how much parking is used and where there are free parking spaces.

It is hoped that the Smart Parking will contribute to a partial solution of all above-mentioned issues, realizing smoother operation of public transport. MOT indicated that Smart Parking will be operational in the summer of 2023.⁴

2.5 Bicycle/Pedestrian Facility Development

All roads in Canton Sarajevo should be designed to cater as much as possible to the needs of all types of traffic and capacity, including non-motorized transport (NMT) like walking and bicycling. Thus, there is a need for more facilities that ensure safe and convenient pedestrian movement, as well as proper bicycle lanes and infrastructure for easy access to key public transport modes.

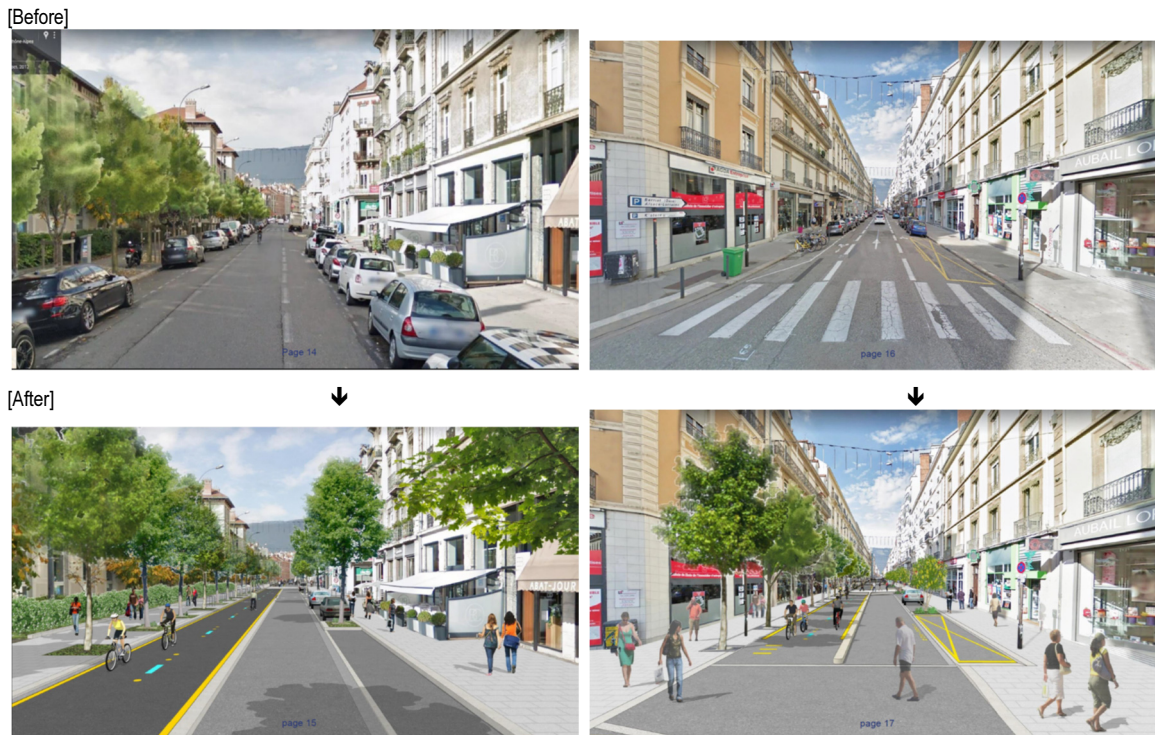
1) Bicycle Lane Development

Based on the Activity Diary Survey results, the modal share of bicycles is currently 0.6%,

⁴ Sarajevo će ove godine dobiti smart parking, evo kako će funkcionisati. (n.d.). Retrieved from www.klix.ba website: <https://www.klix.ba/vijesti/bih/sarajevo-ce-ove-godine-dobiti-smart-parking-evo-kako-ce-funkcionisati/210526097>.

which is very low. An MOT staff deems it could be that the center of Sarajevo is surrounded by mountains. However, in Grenoble, visited by the Sarajevo delegation as part of the third country training due to the similarity in geography and size between the two cities, the modal share of bicycles is as large as 5%. So, there should be room for improvement in travel by bicycle in Sarajevo as well.

Improving and expanding the existing road infrastructure to accommodate bicycle lanes is essential. It may involve reallocating road space, constructing dedicated lanes, and implementing traffic calming measures to ensure cyclist safety, as illustrated in Figure 2.5.1.



Source: SMMAG, "Union policy: Mixed Mobility in the Grenoble area," 2022.

Figure 2.5.1 Achievements in Bicycle Lane Upgrades in Grenoble

Safety is paramount for bicycle lane development. Implementing clear road markings, traffic signs, and signals, along with physical barriers separating bicycle lanes from other motorized traffic, can enhance safety for cyclists (Figure 2.5.2).

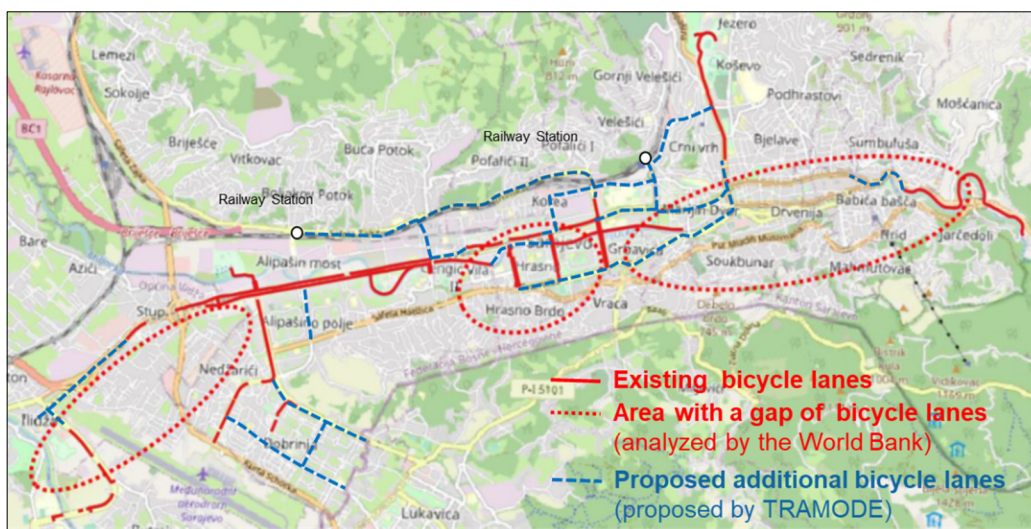


Source: SMMAG (2022) "Union policy: Mixed Mobility in the Grenoble area"

Figure 2.5.2 A Strong Visual Identity for Bicycle Lanes in Grenoble

Major improvements of the Sarajevo bicycle lane infrastructure have been implemented in

recent years across different sections along the east–west transport axis and the transverse corridors, reaching a total of about 20 km of bicycle lane infrastructure (Figure 2.5.3). However, the current network is fragmented with small gaps and major missing links, lacks traffic management, and is often encroached by vehicle parking. The increasing popularity and public support for bicycling has drawn attention to the lack of connectivity and the need to enhance user experience for a comfortable and seamless journey.⁵



Source: JICA Expert Team (base map from the World Bank)

Figure 2.5.3 Bicycle Lane Infrastructure

The Green Cantonal Action Plan (GCAP, 2020), funded by EBRD, and the abovementioned SUMP suggested actions to improve cycling and walking routes. However, physical maps of improved bicycle/pedestrian routes/infrastructure have never been presented. So, the JICA Expert Team has proposed bicycle lanes in addition to the existing ones, as shown in Figure 2.5.3, considering their continuity and connectivity with public transport stops, so seamless integration between bicycle lanes and public transport systems would be ensured and allow commuters to use bicycles as part of their multi-modal journeys. It should also be noted that new areas for bicycle parking need to be adjacent to the main public transport stops. The size of the bicycle parking facility is generally determined through local standards or regulations, as there is a significant variety in the number of spaces that can be provided within municipalities.

For the latest information, bicycle facility development will be funded by EBRD, including the design of infrastructure and civil works of an additional 20 km of bicycle lanes, supply and installation of bicycling parking and stations, educational and incentive programs, as well as capacity building across the Canton, the city, and the municipalities.

2) Pedestrian Facility Development

In Sarajevo, there are designated pedestrian zones in the city center and other areas, where motorized traffic is restricted, and priority is given to pedestrians. These zones create safe and attractive spaces for walking, shopping, and leisure activities. Furthermore, actions to expand the restricted access zones were studied as LEZ by IVL.

Expanding and maintaining sidewalks and footpaths with adequate lighting is crucial to providing safe and accessible walking routes throughout the city. In addition, installing

⁵ The World Bank, "Bosnia and Herzegovina Air Quality Improvement Project (P176040)," 2022.

clearly marked crosswalks and pedestrian traffic signals at intersections would help pedestrians safely navigate busy roads and intersections. It is also important to develop and adopt a safety strategy for NMT, namely, the NMT Design Guidelines, to support all the above implementation.

MOT also feels the need for a safe and secure walking environment (with easy access to public transport), which includes not only developing pedestrian spaces in the city center and sub-centers but also areas around schools that are congested with private cars picking up and dropping off pupils. For this, collaborating with schools to establish safe walking routes for pupils (or safe school routes) might encourage active commuting and reduce traffic congestion around educational institutions.

It should be noted that pedestrian facility development is an ongoing process that requires cooperation among various stakeholders, including municipality officials, urban planners, transportation authorities, and the public. By prioritizing pedestrian infrastructure and creating a pedestrian-friendly environment, Sarajevo can improve the quality of life for its residents, enhance urban mobility, and contribute to a more sustainable and livable city.

2.6 Implementation Timeline

As for traffic regulation improvement plans in Sarajevo, aiming for smoother operation of public transport, most of the plausible measures are covered by the projects for implementation by international donors, as explained in this chapter. The implementation timeline of those projects is summarized in Table 2.6.1.

Table 2.6.1 Implementation Time-line Projects for Traffic Regulation Improvement

Improvement Measures	Projects	Donors	2023	2024	2025	2026	2027	2028	2029	2030
(a) Priority signaling system for public transport	ATMS	EBRD / EIV	(ongoing)							
(b) Priority lanes for public buses	(extension of ATMS)	World Bank*	(Establishment of law for dedicated bus lane)							
(c) Regulation of car use in specific areas and time	Park-and-Ride	EBRD			(Vogosca)					(Other Locations)
	LEZ	Sweden / Spain	(ongoing)							
(d) Street parking regulations	Smart Parking	Spain	(ongoing)							
(e) Bicycle/pedestrian facility development.	Bicycle Lane Development	EBRD								

*The target bus priority lane by the World Bank is Route 16B only, where low-emission buses are to be introduced.
 Source: JICA Expert Team

3 Promotion of Public Transport Use for Tourists

Tourism and Transport. Tourism is closely related to transport because it involves moving to areas far from the daily living area. It is an activity in which people enjoy non-ordinary experiences, so the journey begins with leaving the house and covers a series of journeys from the outbound trip to the stay and the return trip. In that sense, transport is not necessarily derived from demand. Rather, it is better to understand that transport is also part of tourism. Considering public transport in tourist destinations, it is important to be able to travel as quickly, cheaply, and comfortably as possible. Since it is possible to move around Sarajevo City by various means of public transport from main corridors to feeder routes, actively publicizing these public transport means to tourists would be effective.

3.1 Public Transport Travel Guide

The Public Transport Travel Guide aims to promote awareness and use of public transport by providing both information about public transport and attractive destinations for tourists.

In this project, the Public Transport Travel Guide was conducted aiming to encourage the usage of public transports to go to tourist destination in Canton Sarajevo. The outline of the map is below:

Theme: City Travel with Public Transport

Contents: The contents of the travel guide aim to accomplish the following:

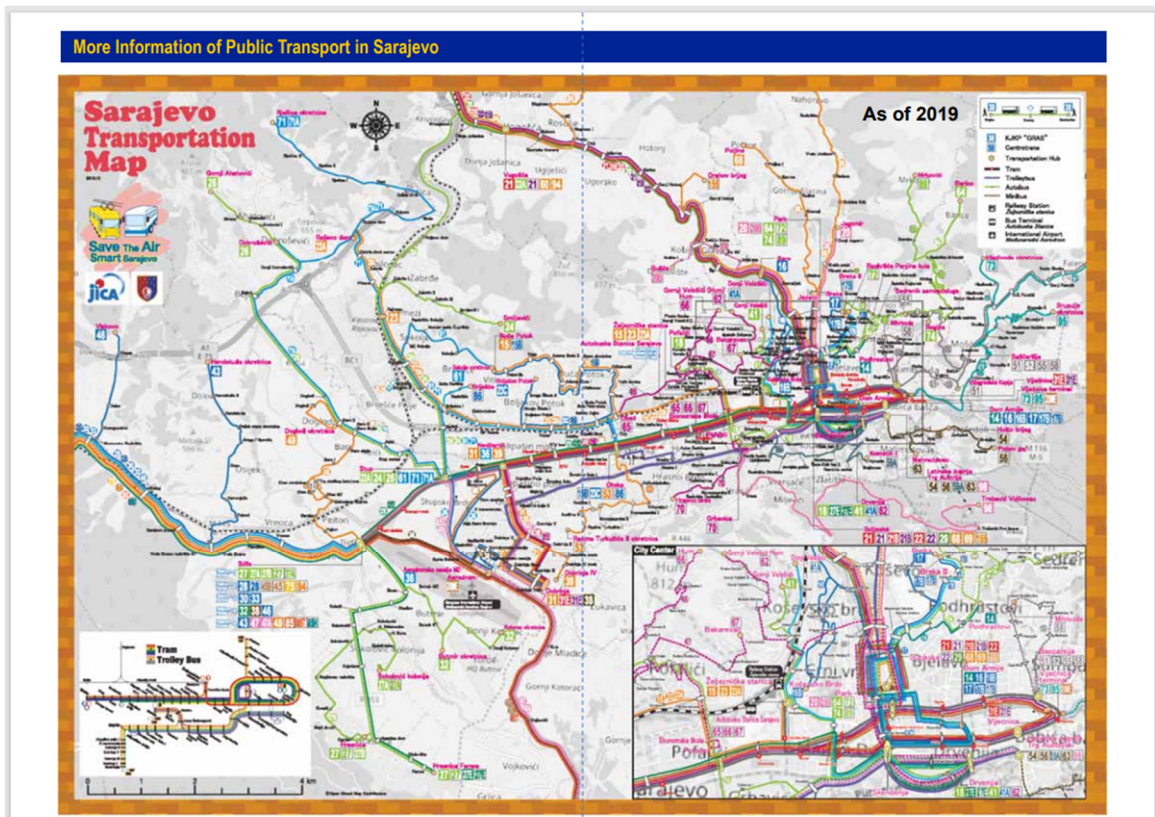
- explain the ticket purchasing process,
- provide information on attractive destinations and the route/s to reach there,
- provide a short movie showcasing each destination to encourage motivation, and
- feature QR codes for quick access to YouTube and Facebook links.

Maps were also prepared, as shown in the following figures. Multi-lingual versions are also available. In the future, it will be necessary to promote the use of public transport by distributing and disseminating the travel guide from this Project at major locations within Canton Sarajevo.



Source: JICA Expert Team

Figure 3.1.1 Public Transport Travel Guide Map in Sarajevo (1/3)



Source: JICA Expert Team

Figure 3.1.2 Public Transport Travel Guide Map in Sarajevo (2/3)



Source: JICA Expert Team

Figure 3.1.3 Public Transport Travel Guide Map in Sarajevo (3/3)

Effective Ways to Provide Information. The timing for providing travel information to tourists is important. The following table outlines the methods for 1) people planning to visit Sarajevo and 2) people already in Sarajevo.

Table 3.1.1 Methods in Providing Travel Information to Tourists

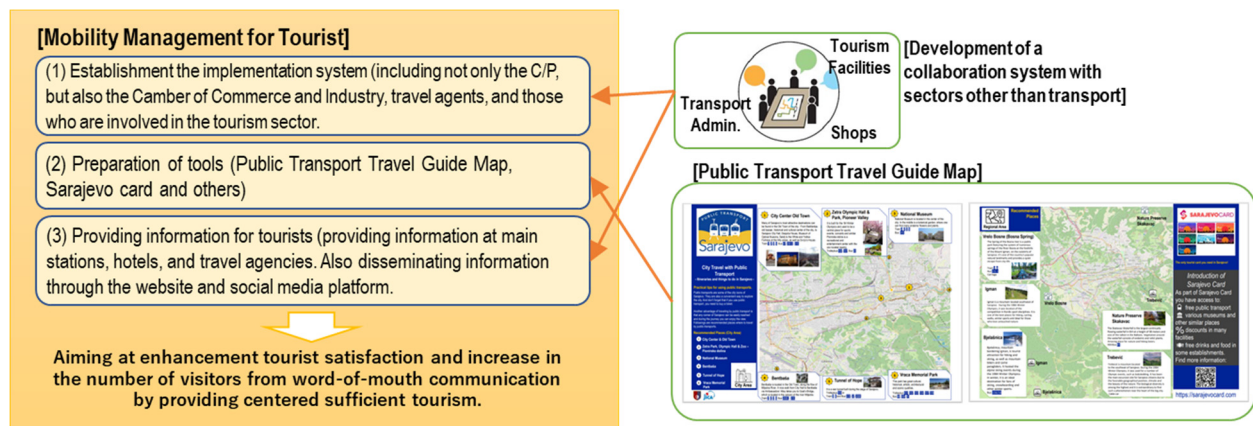
People planning to Visit Sarajevo	People currently visiting Sarajevo
<ul style="list-style-type: none"> ● Provide tourism information to inbound travelers searching for sightseeing spots ● Provide public transport information, which will encourage public transport route planning 	<ul style="list-style-type: none"> ● Distribute quick information of public transport-accessible sightseeing spots. ● Install big tourist map board with a small QR code for travelers to access the map from their devices.
 	 
<ul style="list-style-type: none"> ● Website (such as of the tourism office) for travelers, travel agencies, or hotels to download and print. 	<ul style="list-style-type: none"> ● Distribute convenient information materials, which can be immediately utilized in hand, printed for free distribution at airport, tourist centers, and hotels.

Source: JICA Expert Team

3.2 Mobility Management for Tourist

1) MM Action Plan for Tourists

Though Canton Sarajevo has many attractive tourist spots visited by many tourists, there is no promotion for public transport use intended for tourists. Therefore, the JICA Expert Team proposed a program of mobility management for tourism, as shown in the following figure, which aims to “promote the behavioral changes to use of public transport by providing prior information during the planning stage of a travel (or during the travelling stage).” The proposed actions are to develop a collaborative system with stakeholders other than transport sectors, to collect information for attracting tourists, and to organize and provide centered information as a tool.



Source: JICA Expert Team

Figure 3.2.1 Public Transport Travel Guide Map for Tourists and the Measures for Promotion of Public Transport Use

3.3 Introduction of New Technologies such as ICT/MaaS for Tourists

While general proposals for measures to improve the convenience public transport using new technology have already been described in Chapter 1.4, this section summarizes proposals targeting tourists.

1) Flash Pass Mobile Application

For an easier smart fare collection system deployment, JICA Expert Team proposes a Flash Pass mobile application concept, as shown in Figure 3.3.1. The fare validation is done by the tram/bus driver’s visual confirmation, and it is broadly used on the West Coast of the United States by tourists using public transport for a limited period (from one day to a week). A Flash Pass mobile ticket can be packaged with unlimited internet access (in collaboration with the telecommunications industry).



Source: NEC Corporation

Figure 3.3.1 Example of a Flash Pass

One benefit of the Flash Pass is the transfer fare can be reduced with a special limited pass for public transport users. For the public transport authority or operator, the budget for development can be saved because the validation hardware equipment will not be necessary. The main challenge in its development may be the purchase and payment

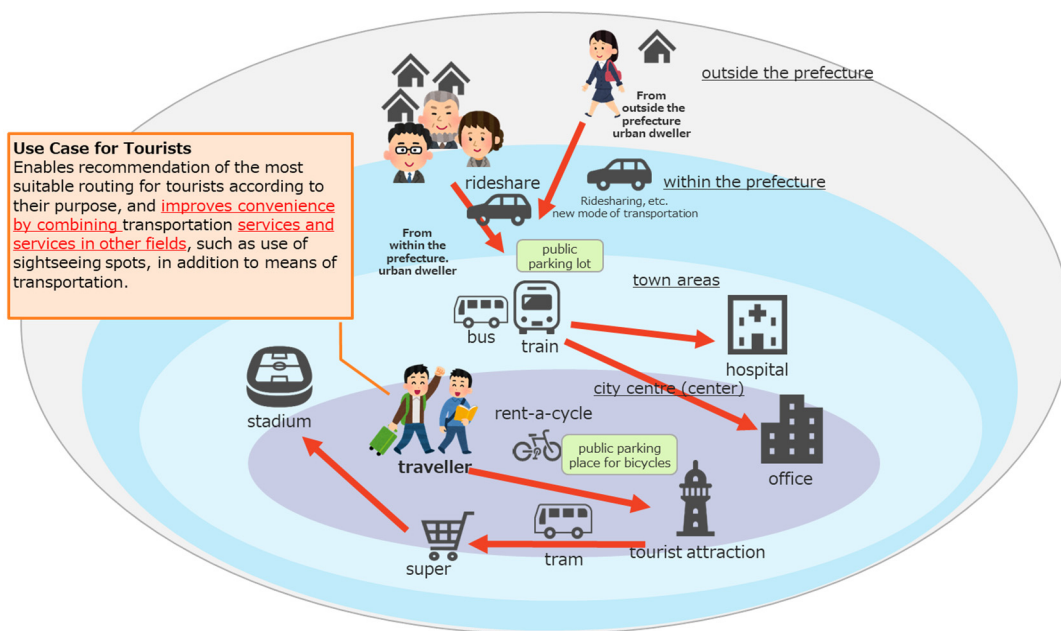
process of a Flash Pass, which is also common to purchase mobile tickets. The MOT/BS has also started developing a similar mobile fare payment application, but it is not available to the public yet.

2) Summary of Proposal on Sarajevo MaaS for Tourists

The application of MaaS mentioned in Chapter 1.4 is a measure that will not only improve the convenience of public transportation, but also promote use by providing services for tourists. The following use case are proposed for Sarajevo tourists. The MOT of Canton Sarajevo should be the lead in collaboration with the operators.

- Use Case: [Improving convenience for tourists by combining transport services with services in other fields]** Enables recommendation of the most suitable routing for tourists according to their purpose and improves convenience by combining transport services and services in other fields, such as use of sightseeing spots, in addition to means of transport.

The case aims to improve user UX with digital technology and promote the improvement and use of public transport. Figure 3.3.2 shows an image of use cases with digital technology.



Source: JICA Expert Team

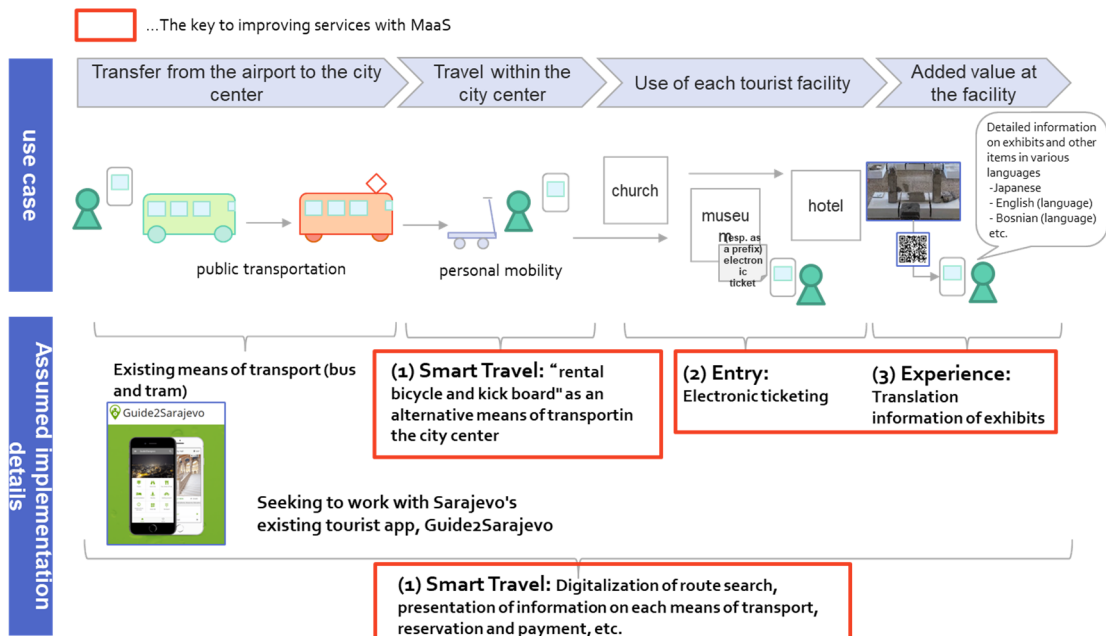
Figure 3.3.2 Challenge of Solving Problems through Digitization in Sarajevo for Tourists

3) MaaS Use Case for Tourists

An example of a MaaS use case is a tourist visiting the National Museum of Bosnia and Herzegovina. The describes in detail the use of MaaS application in (1) smart travel, (2) entry, and (3) experience. Figure 3.3.3 shows the use case and assumed implementation details.

- Smart Travel.** Regarding smart transport, the MaaS app will provide appropriate transportation, mainly public transport (bus and tram), and tourist attraction routes depending on the location to make it easy and efficient to reach the museum. Rental bicycles and kickboards will also be part of smart travel in the city center.

- **Entry.** Users will be able to reserve and issue electronic tickets, which will replace paper tickets, within the MaaS application to enter the museum. The linkage with existing tourism services (Guide2Sarajevo, etc.) will also be one of the ideas.
- **Experience.** In experience, when scanning the QR code on the MaaS application for exhibits in museums, etc., the user can obtain information translated into the user's native language.



Source: JICA Expert Team

Figure 3.3.3 Use Case and Assumed Implementation Details

3.4 Collaboration with Various Stakeholders

The opportunities for communicating with potential users to encourage the public transport use in Sarajevo are classified into the following.

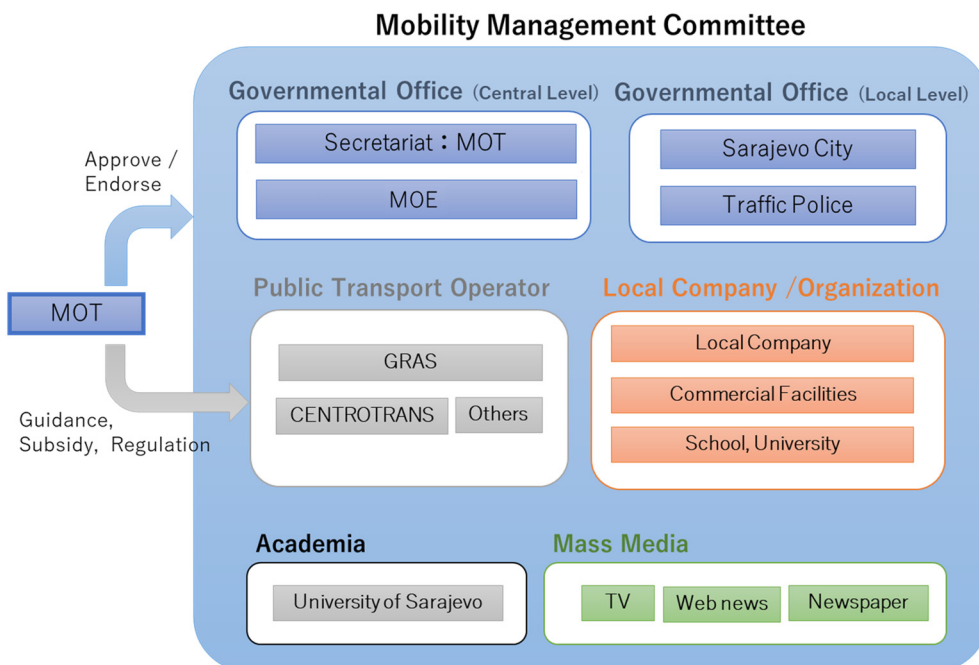
1. Local Company / Organization
 - Local Company
 - Commercial Facilities
 - School, University
2. Mass Media

In the activities to promote public transport use for tourists, it will be necessary to prepare a platform for sharing and discussing information on public transport with a wider range of stakeholders. The role and function of each actor in Sarajevo are proposed as follows:

- (a) The Ministry of Traffic of Canton Sarajevo (Governmental Office) will invite potential groups interested in joining the activities of MM (local company / organization and mass Media) and explain the concept and action plan of MM for them. The MOT will also supervise and provide information on public transport services and manage all MM activities.
- (b) Public transport operators will attend to provide information on their public transport services for committee members. They will be able to receive feedback from potential users to further improve their services.

- (c) Academia (University of Sarajevo) will be the key player in facilitating MM activities because the facilitator of MM needs the background of academia of transport planning and psychological approach to analyze behavioral modification. Therefore, the function of the University of Sarajevo will be important.
- (d) Local companies/organizations will be invited to cooperate with the MM activities. At the first meeting, MOT will present the concept of MM activities, and the company and organization interested in these activities will continue to join the committee to implement the field activities.
- (e) The governmental office (city-level) will also join the committee to coordinate with local companies/organizations. For the school activity, the education department of the local government will call the candidate school. In providing information to the residential area, the local community under the local government will be the coordinator. The traffic police will be invited when traffic enforcement or traffic safety education activities are held around the station to maintain road safety and smooth traffic movement.
- (f) Mass media will be the most important actor in disseminating information about public transport services. MOT will need to closely communicate and share information in a timely manner.
- (g) Ministry of Environment and Tourism, Ministry of Education (Governmental Office (Central Level)) should be invited as committee members in the near future. During the discussion among committee members, further collaboration will be able to access wider potential users of public transport.

The implementation scheme with establishing the mobility management committee is proposed as shown in Figure 3.4.1.



Source: JICA Expert Team

Figure 3.4.1 Proposed Implementation Platform

APPENDIX

A1 Technical Notes on Public Transport Convenience Enhancement Plan

As part of the project, various study tours were conducted in Japan and third countries (Europe) to collect many case studies and good examples of public transport planning, public transport business management, and measures for the improvement of public transport and its surrounding areas that each city is working on. Since these materials will be very useful to get more ideas for Sarajevo, all materials are listed below. All materials are electronically available for reference.

A1.1 Study Trip in Japan

A total of two study tours were held in Japan, including visits to four cities (Hiroshima, Fukuoka, Takamatsu, and Sapporo) and Tokyo, which will serve as a reference for Sarajevo's public transport planning.

Table A1.1.1 List of Presentation Materials from Study Trip in Japan

No.	Name of Presentation	Contents
1	Introducing Bus Operation in Japan	<ul style="list-style-type: none"> • Overview of transit bus service in Japan • Method of bus operation management in Japan
2	Recovery History of Transport Systems in Hiroshima	<ul style="list-style-type: none"> • Profile of Hiroshima city • History of city development / city resilience • Rehabilitation of Tram • Public transport planning and development
3	Hiroshima Electric Railway Co.,Ltd.	<ul style="list-style-type: none"> • Company profile • Development of station plaza/tram stops
4	Public Transport Measures in Horoshima City	<ul style="list-style-type: none"> • Introduction • Planned urban structure in the city • Local public transport plan in the city • Action plan to increase level of service on public transport • Intermodal facility development • Public transport service in suburban
5	Overview of Nishitetsu	<ul style="list-style-type: none"> • Company profile • Transport network, service of public transport and its facilities by Nishitetsu group • Method to develop operating route and installing bus stops • Activities for speed-up and on-time performance • Policy for transfer passengers • Provision of information for customers • Park and ride system • Providing multimodal mobility service with TOYOTA (MaaS) • Others
6	Compact City and Transport Network in Fukuoka City	<ul style="list-style-type: none"> • Vision of compact city in Fukuoka • Concept of urban structure, master plan • Public transport network • Basic principle on urban transport planning
7	Comprehensive redevelopment of the public transport system in Takamatsu City ~Compact plus network urban development~	<ul style="list-style-type: none"> • General information of city • Current situation of transport • Concept/principle of redevelopment of public transport network • Promotion measures to encourage the usage

No.	Name of Presentation	Contents
		<ul style="list-style-type: none"> of public transport Budget for public transport system
8	Measures by Takamatsu Kotohira Electric Railway Co. (Kotoden)	<ul style="list-style-type: none"> Outline of Kotoden Example of new station development with the Government (case study in Fuseishi station) IC Card (IruCa) program Use of nationwide transport IC card Effects of the COVID-19 Outline of Kotoden Bus
9	Introduction of JR Shikoku	<ul style="list-style-type: none"> Company profile Urban development around Takamatsu Station
10-1	Transport Plan of Sapporo City	<ul style="list-style-type: none"> Overview of Sapporo City Sapporo City transportation plan Major projects currently underway Measures related to Tram
10-2	Sapporo City tram Utilization for City Planning, ~Looping Project~	<ul style="list-style-type: none"> History of trams in Sapporo Utilization for community development (Characteristics of the trams and Positioning of trams in Sapporo) Vision of the city to be achieved by utilizing trams
11	Public Transport Site Visit Materials in Hokkaido Chuo Bus Co.	<ul style="list-style-type: none"> Company profile Outline of Sapporo city Overview of Sapporo city transit bus business
12	Sapporo Tram	<ul style="list-style-type: none"> Introduction of streetcar service (route map, timetable, fare/ticket type, IC card and access to the Mt. Moiwa ropeway)
13	Introduction of Busta Shinjuku	<ul style="list-style-type: none"> Outline of Busta Shinjuku History of terminal development

Source: JICA Expert Team

A1.2 Study Trip in Third Countries

Four study tours were held in four European countries (France, Germany, Austria, and Italy), which will serve as a reference for Sarajevo's public transport planning.

Table A1.2.1 List of Presentation Materials from Study Trip in Third Countries

City, Country	Title	Provider
Graz, Austria	Transport City of Graz	City Hall of Graz
	The City of My Life	Holding Graz
	Introduction of Styrian Transport Association	Styrian Transport Association
	GKB Railway Operation	GKB Railway Operator
	Public Transport in Province of Styria	Province of Styria
	Introduction of StB	StB Railway Operator
Florence, Italy	Being convincing about public transport: hard and soft measures for a greener mobility in Florence	Municipality of Florence
	Introduction of tramway line 2,3,4	Municipality of Florence
	Introduction of ARMAMENTO	Direttore Operativo ARMAMENTO
	Urban mobility: the Florence tramway system	Directorate for New Infrastructures and Mobility Tramway Office Service
Lyon and Grenoble,	Sharing experience Delegation of Sarajevo	SYTRAL Mobilités Lyon

City, Country	Title	Provider
France	Supporting cities in their environmental and energy transition	Suez Consulting Mobilities
	Grenoble Metropolitan area: Public transport network	SMMAG Grenoble
	Union policy: Mixed Mobility in the Grenoble area	SMMAG Grenoble
	Introduction of TAG	TAG Grenoble Operator
Bonn, Germany	Introduction of SWB Bus und Bahn	SWB Operator
	Sustainable Mobility with SWB	SWB Operator
	Operational Control	SWB Operator

Source: JICA Expert Team

A1.3 Other Materials

Regarding recent technologies related to public transport, the following materials on the MaaS proposal in Sarajevo, technical guidance on GTFS development, public transport travel map, and tools of mobility management were provided.

Table A1.3.1 List of Other Materials

No.	Name of Presentation	Contents
1	Proposal Materials for MaaS Application	<ul style="list-style-type: none"> Proposal Summary Introduction to Potential Use Cases Japan's MaaS Vision Future development (draft)
2	GTFS	<ul style="list-style-type: none"> Introduction What's GTFS? User Manual of "MIERUKA common input format" Tool to Develop GTFS Who shall / How to develop maintain GTFS?
3	Public Transport Travel Guide in Sarajevo	<ul style="list-style-type: none"> Public transport travel guide in city area Public transport route map Public transport travel guide in regional area
4	Educational Program of Mobility Management at School	<ul style="list-style-type: none"> Program: Traffic Board Game "Traffic Sugoroku" Rule of Traffic Board Game Board Game Map and materials

Source: JICA Expert Team

