

Sindh Mass Transit Authority

Government of Sindh, Pakistan

Karachi Mobility Project

Yellow Bus Rapid Transit Corridor

**Consulting Services for
Design, Procurement Support and Supervision of
Integrated Intelligent Transport System [IITS] for
Karachi Mobility Project BRTS Yellow Line Corridor
Reference No PK-SMTA-430171-CS-CQS**

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1. Background

Karachi is the largest city in Pakistan, which concentrates 10 percent of the population and 20 percent of the GDP is facing big urban mobility challenges. Karachi is currently taking decisive steps to address its transport issues through the implementation of a Bus Rapid Transit System (BRTS) as outlined in the Karachi Urban Transport Master Plan of 2030. The Federal and Provincial Governments, along with the Sindh Mass Transit Authority (SMTA), have been driving efforts since 2018 to realize this comprehensive urban mobility solution. These endeavors encompass various aspects: finalizing roadworks, selecting BRTS operators for the Green/Orange Corridor, advancing contracts for detailed engineering design and business plan formulation for the Red Corridor, and refining preliminary design and feasibility studies for the Yellow Corridor.

The World Bank, an instrumental financial partner, is committed to supporting the infrastructure development and operational framework of the Yellow Corridor within the larger Karachi Mobility Project (KMP). Through a blend of funding instruments, the Bank aims to optimize resources for BRTS development and operation. The KMP embraces an integrated corridor management strategy, aiming to enhance mobility, accessibility, and safety for all road users along the route. By rejuvenating dilapidated road sections, enhancing traffic management, and addressing parking challenges, this project holds the potential to benefit over 700,000 residents, particularly those in the Korangi industrial area.

The Project implementation is designed in a way that specific officers from the SMTA as well as additional staff/specialists/individual consultants are nominated as a Project Management Team (PMT) headed by the Project Director.

In order to support the execution of the Project, the SMTA and its PMT (hereinafter referred to as “the Client” or “the Employer”, as relevant) wishes to engage a qualified consulting firm (hereinafter referred to as “the Consultant”), experienced in BRT implementation, to provide project management services (the Services), including capacity building and skill development services through certified accredited training, learning-by-doing, and on-the-job training approaches. In addition, as a complement, a transit-oriented development (TOD) study should be conducted by the Consultant.

2. Description of the Karachi Mobility Project

The Project Development Objective (PDO) is to improve mobility, accessibility, and safety along selected corridors in Karachi. The delivery of the Project is designed around a mix of publicly procured contracts needed to deliver the Project infrastructure and consultancies. It also includes a Public-Private Partnership (PPP) contract for the operation of the BRT system over a 10-year concession period, whereby a private operator will finance, procure, supply, operate, and maintain various goods and systems. Based on the financial analysis, and to minimize the operating subsidy, it was agreed that the Project would support the concession via a working capital subsidy.

The Project components consist of activities of different nature and scales including infrastructure detailed design and construction supervision, procurement of various consulting services, rolling stock and ITS equipment, construction contracts, capacity building, and stakeholder engagement as well as safeguards and media strategies.

The Project consists of the following three components:

Component I: Urban Road Infrastructure - Yellow Corridor

- (a) Rehabilitating or reconstructing road infrastructure (including improving and shifting related utilities such as street lighting, sewer/water supply, drainage, oil pipeline), bridges, and non-motorized transport facilities (such as motorcycle lanes, footpaths, and pedestrian crossing) along the Yellow Corridor and its direct and feeder service routes
- (b) Implementing environmental and social recommendations and mitigation measures before and during construction
- (c) Carrying out detailed designs, construction supervision activities and third-party monitoring;

Component II: The Development and Operationalization of a BRT System

- (a) Constructing and equipping bus rapid transit facilities (including segregated busways, interchange facilities, stations, terminals, and depots) along the Yellow Corridor
- (b) Providing working capital subsidy for the concession of the BRT operation for the Yellow Corridor
- (c) Implementing social management and impact mitigation measures including the labor redeployment for the affected existing bus operators such as drivers, conductors, and route managers
- (d) Implementing and monitoring the SMP including its actions to mitigate gender-based violence and actions to improve women's mobility and economic participation options;
- (e) Designing a transit-oriented development strategy for the Yellow Corridor
- (f) Providing PPP transaction advisory services for BRT operation concession
- (g) Carrying out a program of regular engagement with key stakeholders; and implementing a public relations and media strategy to generate support for and disseminate information on the bus rapid transit system;

Component III: Capacity Building and Technical Assistance

- (a) Supporting project management and providing technical assistance for the implementation of social measures
- (b) Provision of technical assistance in traffic management and road safety
- (c) Supporting the regional transport authorities in automating the management and monitoring of bus route permits
- (d) Carrying out capacity-building activities to strengthen SMTA and support the consolidation and improvement of the management of the urban transport sector in Karachi.

2.1 BRT Yellow Corridor

The Yellow Corridor, constituting an integral part of the planned Karachi Mass Transit System (KMTS), spans approximately 21 km from Dawood Chowrangi to Numaish (Figure-1) comprising seven segments (Table 1) which include two Depots (near Dawood Chowrangi and Christian Colony near Indus Hospital), Bus Stations and Off-Corridor Routes, this corridor envisages a transformative mobility solution for Karachi. Its strategic significance lies in addressing urban mobility challenges, ensuring accessibility, and enhancing safety for over 700,000 individuals, particularly those within the Korangi industrial area.

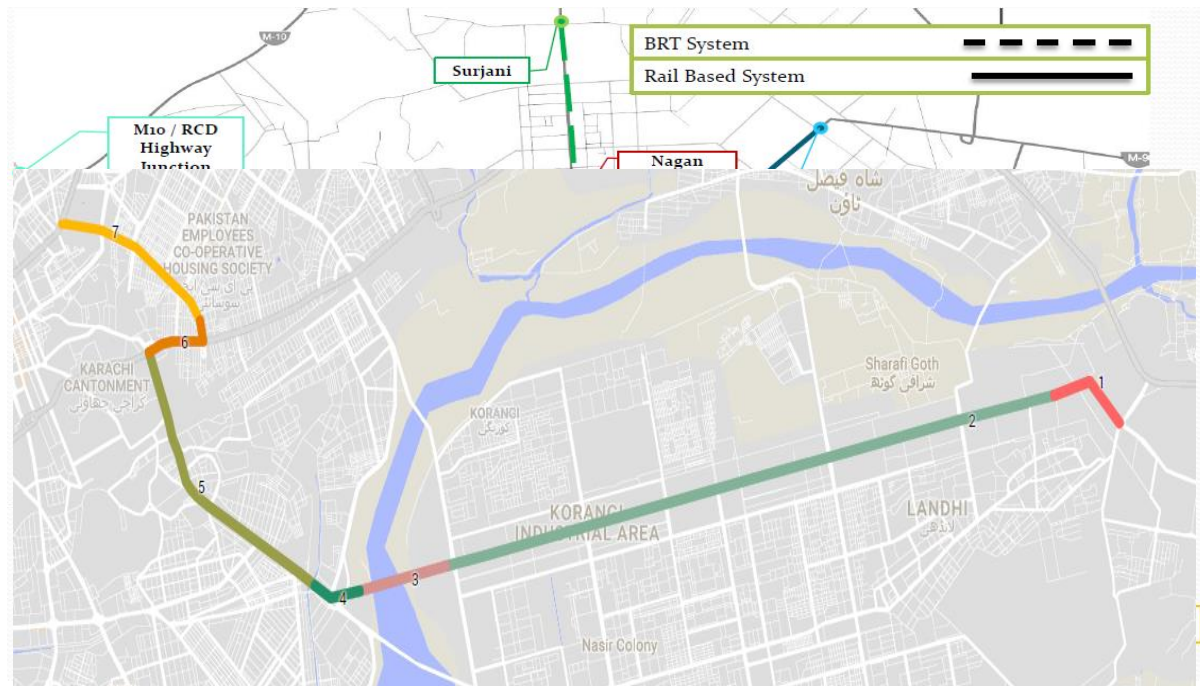


Figure 1: Planned Mass Transit Corridors

Table 1: Yellow Corridor segments

Segment		Length [KM]
0	Dawood Chowrangi - from bus depot entrance to Dawood Chowrangi	0.3
1	Future Colony - from Dawood Chowrangi terminal to Mansehra Colony	1.15
2	8000 Road - from Mansehra Colony to Malir River bridge (Jam Sadiq)	10.65
3	Malir River bridge (Jam Sadiq)	1.1
4	KPT interchange	0.85
5	Korangi Road - from KPT Interchange to Sharah-e-Faisal Interchange	3.9
6	Shahrah-e-Faisal - from Shahrah-e-Faisal Interchange to Shahrah-e-Quaideen	1.65
7	Shahrah-e-Quaideen - from Shahrah-e-Faisal to M.A. Jinnah Road	1.4
Total		21

Strategically project is divided into five infrastructure works packages, the Yellow Corridor's development encompasses various segments, from roadworks to bridge construction. The planned improvements and enhancements are poised to alleviate road congestion, optimize traffic management, and address the immediate needs of the communities within its reach. This comprehensive endeavor envisions a modernized urban transportation system that aligns with the Karachi Mobility Project's overarching goals.

Figure 2: Yellow Corridor Segment

The PMT has already undertaken the procurement of consulting services to provide Detailed Design, Procurement Support and Construction Supervision services. This consultant is preparing a detailed design on the basis of the available preliminary design results and recommendations, will finalize the safeguard documents, will prepare the bidding documents for construction contracts (including the Employer's requirements for a 1.1 km long

bridge to be undertaken in the EPC mode), provide necessary technical and logistics support during the procurement process of construction works, supervise the construction works, implement the BIM and provide capacity building sessions to the Client. It may be noted that the capacity building and skill development services/training required in these TORs will be different to those included in the above-mentioned contract.

All procurement activities under the KMP will be made using the **WB Procurement Regulations for IPF Borrowers for Goods, Works, Non-Consulting and Consulting Services (July 2016; revised November 2017 and August 2018)**. Based on the Yellow BRT Corridor segments and the complexity of the operations during the construction phase, the summary of anticipated procurement packages is provided in Table 2 below. Currently the construction works contract for Package 4, i.e. 1.1 km long bridge, is under bid evaluation process and Tender process of construction of Depots for Package 1 is in process.

Table 2: Yellow Corridor Infrastructure Works Packages

Works package	Priority
Package 1: Lot I (Construction of Depot 1), Lot II (Construction of Depot 2)	I
Package 3: Road corridor & BRT infrastructure (segments 0, 1 and 2)	I
Package 4: Construction of New Jam Sadiq Bridge 1.1 km long (Segment 3)	I
Package 5: Road corridor & BRT infrastructure (segments 4, 5, 6 and 7)	II
Package 6: Off-corridor improvements	II

Apart from the above-mentioned construction contracts, there are contracts related to the procurement of rolling stock, ITS equipment, and operationalization of the BRT corridor in all aspects to be undertaken as a part of the Project. Additionally, there are contracts related to various consultancies (transit-orient demand strategy, stakeholder engagement, etc.) to be undertaken in the course of time as a part of the Project.

Furthermore, an independent consulting firm will be hired as a Third-Party Monitoring Agent (TPMA) and Project Management Cto provide a monitoring layer to ensure that the Bank's funds executed by the implementing agency (i.e., SMTA) are utilized for the purposes specified in the loan agreement and provide expected results

2.2 Overall Objectives

The overall objective of the Service is to ensure a professional, efficient, and optimal design of the Intelligent Transport Systems (ITS) for the Karachi Yellow Line BRT. This encompasses its deployment, testing, and acceptance to meet operational requirements at the start of service. The deliverable will be an integrated package of ITS applications that support the efficient operation of the BRT system, which will be owned and managed by the client, either directly or through specialized operational support providers. Additionally, the existing systems (Green and Orange Lines) must be compatible with the Yellow Line.

The detailed ToRs are attached as Annexure-A.

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1. Introduction

The purpose of these ToRs document is to provide the technical inputs to ensure that the Intelligent Transport Systems (ITS) systems to support the operation of the Karachi Yellow Line BRT are deployed, tested, and accepted to meet the service requirements at the start of service.

The output will be an integrated package of ITS applications to support the efficient operation of the BRT system, which will be owned and operated by the client either directly or through specialist operational support service providers.

Existing systems (Green and Orange Lines) shall be compatible with YL.

The proposed scope of work divides the ITS effort into three stages. Each stage is further divided into following tasks and their related deliverables. The details of each task and deliverable are expounded in the following sections of this document.

Stage	Task	Deliverable
Stage 1	Task 1: Inspect and assess existing ITS and validate the vision for interoperability and integration for Karachi BRT network	Deliverable 1: Inception report
	Task 2: Provide technical support for ITS conceptual discussions and consolidate key ITS guidelines and assumptions	
	Task 3: Design Review	
Stage 2	Task 4: Prepare ITS conceptual design for the Yellow BRT corridor. Conceptual design for EFC, FMS, UIS, Data Communications System Network, traffic light, Security	Deliverable 2: Conceptual design and operational guidelines for ITS
	Task 5: Preparation of guidelines for integration between systems, including ticketing system	Deliverable 3: Technical Memorandum with assessment of existing ITS systems for other BRT corridors in Karachi
	Task 6: Operation options Analysis for Electronic Fare Collection	Deliverable 4: AFC Operational Plan

Stage	Task	Deliverable
Stage 3	Task7: Technical specifications for Fleet Management System (FMS), Ticketing/Electronic Fare Collection (EFC), User Information and Security System (UISS), and Operations Control Centre (OCC) and related subsystems	Deliverable 5: Functional design document (FDD) outlining how the technology will support the transport network's operational needs, emphasizing efficiency, integration, and optimization.
		Deliverable 6: ITS Procurement Plan and bidding documents. RFP, Draft Agreement
	• Task 8: Traffic engineering and signaling design	Deliverable 7: Technical Specifications, BoQ, Traffic signal equipment and software
	Task 9: Detailed design of complementary technical requirements	Deliverable 8: Conceptual Design Drawings of ITS pipelines
		Deliverable 9: Design report on complementary technical requirements
Stage 4	Task 10: Support to the Client in Bidding Process	Deliverable 10: Bids evaluation report
Stage 5	Task 11: Supervision of ITS deployment and installation.	Deliverable 11: ITS System Detailed Design Review, FAT, SAT, Installation and O&M Report: Monthly Deployment and Installation Report x6

The Sindh Mass Transit Authority “the Client” will monitor the execution of the proposed effort.

2. Description of Tasks

Before describing the deliverables, it is worth noting that in the context of the Yellow BRT corridor project, other BRT corridors are currently at a more advanced stage thus the urgent need to ensure interoperability and compatibility between all systems.

A comprehensive set of functional and operational design parameters (station dimensions, intersection movements, and demand estimates) is necessary to prepare a preliminary operational design of ITS components and corresponding equipment specification. It is important for any existing design and proposed specification to be made available to the design team to verify and guarantee the compatibility and interoperability notably with ITS cabling network specifications.

The following scoping tasks and deliverables can be identified

2.1 Stage 1: Definition of assumptions and work plan

In this phase, the ITS infrastructure in the existing lines will be explored and the integration of Yellow Line with the existing ITS will be analyzed. Also the concept design of Yellow Line at this stage will be reviewed in terms of ITS compatibility.

2.1.1 Task 1: Inspect and assess existing ITS and validate the vision for interoperability and integration for Karachi BRT network.

The Consultant shall conduct a technical survey of the Green and Orange corridors' ITS installations and equipment (including OCC) to understand the design and operational concept used and identify the minimum functionalities required for the ITS system to be deployed on the BRT Yellow corridor.

This task must be conducted in close coordination with all teams involved in BRT operations in Karachi to ensure comprehensive and seamless integration across all BRT corridors.

The Consultant must study all ITS elements including FMS, Fare Collection, User Information System (UIS), and Communication Network and produce a report which addresses the aspects of integration and interoperability between ITS of existing BRT lines and the new ITS for Yellow Line.

2.1.2 Task 2: Provide technical support for ITS conceptual discussions and consolidate key ITS guidelines and assumptions

The Consultant shall support all conceptual discussions regarding the necessary system adaptations to be held between the Client and other relevant stakeholders operating other BRT corridors Lines regarding the necessary system adaptations, including the needed interface with fund management with BRT Yellow corridor System.

The Consultant shall coordinate with all stakeholders working on the Karachi BRT network project for gathering of complete technical information on the existing/planned

ITS systems for the Green, Red, and Orange lines, specifically on the compatibility requirements, additional supply resources, and quantities needed for the assessment and design of the Yellow BRT corridor's ITS.

The Client shall assist in the coordination with relevant stakeholders as per required. Some of these Consultants may be onboard at the start of the ITS Project and some may be hired by the Client at a later stage.

These other Consultants may include, but are not limited to:

- a. Civil Infrastructure Design Consultant
- b. Bus Procurement Consultant
- c. Bus Operations Consultant
- d. Facility Management Consultant
- e. Financial Consultant
- f. Legal Consultant

The ITS Consultant will collect relevant data from all relevant stakeholders, including other consulting teams. The relevant collected data may include, but is not limited to:

- a. Expected Travel demand data for Yellow BRT corridor as well for BRT system as a whole including other corridors
- b. Expected travel demand for each station of Yellow BRT corridor as well for the BRT system as a whole including other BRT lines
- c. Site Conditions
- d. Summary of the operational concept of Yellow Line
- e. Concept plan for each station and location
- f. OCC Concept plan

To ensure complete compatibility between installed and planned ITS, the gathering of the above information and its validation by the Client is an essential prerequisite, indispensable for the development of the task and the fulfilment of the schedule.

2.1.3 Task 3: Design Review

The Consultant shall review and advise on the pertinence and appropriateness of the placement of ITS equipment such as turnstiles, fare collection booths, UIS displays and other ITS elements in the concept design of Yellow Line.

The ITS elements will be evaluated in terms of operation alignment and providing a smooth commuter experience. The ITS concept design of stations, OCC and Bus depot will also be evaluated for integration of ITS elements with the BRT Yellow Line infrastructure.

The out report must also address the aspects of interoperability and integration of BRT Yellow Line with other existing and upcoming BRT lines in Karachi.

2.1.4 Deliverable 1:

Inception report – ITS asset assessment / work plan / key design guidelines and assumptions / general overview of system concept assessment.

Duration: 45 days after technical survey

2.2 Stage 2: Conceptual Design of ITS for Yellow Line

2.2.1 Task 4: Prepare ITS conceptual design for the Yellow BRT corridor: Conceptual design for EFC, FMS, UIS, Data Communications System Network, Traffic Light, Security and Surveillance

Following the discussions about the functional requirements with representatives of the Client/BRT Managing Authority (once appointed) and the actors being considered to operate vehicle services, the Consultant shall prepare and submit to the Client for approval a technical memorandum concluding on the functional requirements for the ITS to be implemented for Yellow BRT corridor following interoperability and integration considerations.

BRT related regulations (in particular those prohibiting standing at bus stops and bus lanes and driving in bus lanes) will need to be discussed in order to assess the Feasibility of operating without the need for a constant presence of enforcement staff or enforcement cameras to enforce prohibitions on entering and/or crossing bus lanes.

Additionally, Automatic Gates Management (Entry / Exit points of feeder services) are to be defined on this stage.

2.2.2 Deliverable 2: Concept design and operational guidelines for ITS.

The Concept design will include following elements of ITS

- a. Automated fare Collection (AFC)
- b. Fleet Management System (FMS)
- c. User Information System (UIS)
- d. Security and Surveillance System
- e. Communication Network
- f. Business Intelligence and Analysis Software
- g. OCC elements of ITS
- h. Signal Priority System
- i. Automated Gates Operation at BRTS yellow line corridor

2.2.3 Task 5: Preparation of guidelines for integration between ITS systems

Based on the evaluation of the existing system on the lines in operation and the conceptual discussions approved with the Client, the Consultant shall draw up technical guidelines to be followed in the implementation of ITS on the Yellow BRT corridor.

These guidelines should address

Software & Data Integration for

- a. AFC

- b. FMS
- c. UIS
- d. BIAS

These should also address the communication network integration both at the physical layer level and at the network layer.

Also any compatibility issues for hardware in AFC, FMS, UIS should be addressed.

The hardware and server deployment will also be addressed.

The Consultant must also present how the same fare media can be used for the existing BRT lines and the Yellow line BRT. The integration of fare media must address the aspect of dependency on the existing ITS Contractor of Green and Orange Line BRT. The dependency on existing Contractor must be reduced and system design should not hinder the hiring of a new independent ITS Contractor for Yellow Line for increased competitiveness.

2.2.4 Deliverable 3: Technical Memorandum on integration with assessment of existing ITS systems for other BRT corridors in Karachi.

2.2.5 Task 6: Analysis of operational options for Electronic Fare Collection

Yellow Line is a third generation BRT system with concept of feeder, direct and trunk services. The EFC implementation poses unique challenges as passengers are allowed to board from and alight at stations which are off-corridor. This also poses unique challenges for the cash collection from these off-corridor stations. The objective of this task is to analyze the operational options for EFC For integrated public transport ticketing systems, the primary drivers of the analysis of operational options may include:

- (i) Benefits to, and ease of use by passengers;
- (ii) More efficient processing of passengers;
- (iii) Reduction of revenue leakage;
- (iv) Reduction of transaction costs for ticket sales; and
- (v) Provision of quality information on travel for planning purposes.

The Consultant shall develop (in conjunction with the Client and Operations Consultants) an initial assessment of the drivers, objectives, requirements and outcomes for the system, as well as the economic costs and benefits for the community, the financial costs and benefits, potential risks and a risk management strategy. Regulatory and legal requirements must also be identified.

No formal decision has been made on the Electronic Fare Collection and ticketing media. To support the decision The Consultant shall:

- (i) Review ticket media, fare types and commercial discount policies currently in use in Karachi and current proposals, if any;
- (ii) Discuss functional requirements with the Client and Operations Consultant, including

- (a) Where tickets are to be purchased off vehicles/on the stations or on vehicles; and
- (b) potential sales points for tickets off the system (i.e., not on vehicles or stations);
- (iii) Based on this review and discussions, make recommendations on ticketing media and types, including provision for single trip/casual user fares, which ideally are provided in a similar manner as daily passengers;
- (iv) Define the specifications of the equipment that will be required on vehicles, at stations and at other sales points (designated offices and/or clearing house, etc.), and prepare functional requirements; and
- (v) Assess options available for detail design and procurement and implementation of the EFC and ticketing system and make recommendations to the Client.

The operational plan must also address the aspects of interoperability and integration of fare collection operation between the existing BRT lines and Yellow Line as well as for other upcoming BRT lines in Karachi. The proposed plan must also address the aspect of dependency on existing single fare collection service provider. The risk of dependency on a single service provider must be mitigated.

2.2.6 Deliverable 4: AFC Operational Plan

Deadline: 60 days after approval of Inception Report.

2.3 Stage 3: Preparation of Functional Design Documents and Bidding Documents

2.3.1 Task7: Technical specifications for ITS

Technical Specifications for Fleet Management System (FMS), Ticketing/Electronic Fare Collection (EFC), User Information and Security System (UISS), and Operations Control Centre (OCC), BIAS and related subsystems will be developed at this stage.

The consultant shall generate comprehensive technical specifications for these systems. Operations Control, in this context, refers to the integrated command and oversight of all transit operations, including real-time monitoring of bus locations, system performance analytics, emergency response coordination, and communication with both passengers and transit personnel.

Output of Stage 3 is the Information, system management, and communication technologies' equipment requirements and procurement plan as elaborated below.

1. The Consultant is expected to:

- (i) Develop functional requirements;
- (ii) Define necessary technical specifications for each individual ITS component and for their integration through proper interface;

1. At this stage, the following applications are expected to be used for the BRT:

- (i) Electronic Fare Collection System (EFC) – also known as Automatic Fare Collection System (AFC) – for streamlining the fare collection using electronic systems and communication network;

- (ii) Fleet Management System (FMS) – also known as Automatic Vehicle Location System (AVLS) – for real time tracking the position of the BRT vehicles along the route and ensuring schedule adherence;
- (iii) Access control system for the depot and termini (if any);
- (iv) User Information System (UIS) on vehicles and at stations, to provide real time information to users on the schedules, time of arrival of buses (for users at stations) and next station (for users on buses);
- (v) Security systems for buses and stations;
- (vi) BRT Operations Control Centre (OCC) to monitor the FMS, User Information Systems (UIS), Ticketing/Electronic Fare Collection (EFC) and Security systems and to use the data from them to manage the BRT operations and the passenger flows at stations;
- (vi) Communications network to link the applications, including an optical fiber cable network linking the OCC, Stations and Depot, and a Global Positioning System (GPS) or Digital GPS (DGPS) for buses.
- (vii) Global Positioning System (GPS) in each bus for a real time information
- (viii) Communication Systems
- (ix) Types of communication used (e.g., Fiber, Ethernet, VHF radios, Wi-Fi) with specific details of each type of communication media needed in different segments of BRT
- (x) Data transmission protocols and security measures

2. The FMS, UIS, EFC and Security and Access Control Systems should all be integrated and managed through the OCC (even though there should be separate contracts for the EFC management and security management, as opposed to the other elements that are directly under the OCC contract). Day to day operations of the BRT system will be managed from the OCC, including dispatch from (and return to) the depot and schedule adherence along the route. Data collected from the real time monitoring of operations and EFC system use is to be used to refine and update operation schedules and public timetables. The division of responsibility between the Client and the bus operators and other services providers for management of the various applications through the OCC is also to be developed by the Consultant in coordination with Bus Operations Consultant as part of this assignment.

3. The Consultant is to prepare first functional requirements, and then technical design and specifications to be indicated in bidding documents for procurement of the various systems. The Consultant is to propose an optimum packaging of the different systems for the purposes of procurement as well as for system integration.

The Consultant is to discuss functional requirements with the Client/BRT management agency's staff (once appointed), and with operators being considered to provide bus services. The Consultant will prepare a Technical Memorandum on functional requirements which is to be agreed by the Client before incurring substantive inputs to the task of preparing technical specifications for the bidding documents. The technical specifications for each system will be the subject of separate Technical Memorandums.

This output will require extensive consultation with stakeholders to obtain agreements on the functional requirements for the system, as well as the necessary technical specifications. It is envisaged that delivering this task would include these steps:

- (i) Set up interagency working group
 - a. The EFC system will require inputs from interested parties other than the Client and existing operators, particularly if it is intended to be used for other modes and projects in the GKMA (either in operation or planning phases). Passengers' travel needs, income levels and perceptions of the risk of loss of a card with stored value that can be used by anybody need to be recognized. Other considerations/barriers to introduce personalized cards also need to be addressed.
 - b. The Consultant needs to assist the Client in establishing an interagency Working Group (WG) able to obtain the view of interested agencies and their inputs into the other activities in this output.
- (ii) Define functional requirements by all stakeholders;
- (iii) Study on existing socially-discounted fares, and implications and potential application for the new BRT fare system;
- (iv) Conduct and/or facilitate negotiations with operators (selected operators for BRT as well as excluded ones) on overall revenue management, including use of clearing house. Before the negotiation, the consultant should advise on the strategy.
- (v) Set up basic business case;
- (vi) Define technical specifications, and possible method of packaging and procurement;
- (vii) Discuss the EFC system management options;
- (viii) Provide technical support to procurement unit in preparing bidding documents and undertaking tendering and procurement; and
- (ix) Provide technical assistance during the installation period in order to ensure continuity with the set objectives of the equipment procurement.
- (x) Strategy with the current AFC concessionaire to open their system
 - (a) Interoperability with the current AFC concessionaire
 - Assessment of the current institutional arrangement

2.3.2 Deliverable 5: Functional Design Document (FDD)

FDD will outline how the technology will support the transport network's operational needs, emphasizing efficiency, integration, and optimization. Including:

- (a) Introduction
 - Overview of the ITS system
 - Objectives and goals

- Scope of the document
- (b) System Architecture
 - Description of hardware and software components
 - Network diagram showing the interactions between various subsystems
- (c) User Requirements
 - Detailed list of needs from the perspective of end-users (passengers, drivers, system operators, etc.)
- (d) Functional Requirements
 - Functions the ITS must perform, such as fare collection, real-time tracking, data analytics, etc.
 - Data flows between different functions
 - Interfaces between the ITS and other systems (e.g., fare collection systems, GPS, traffic signal systems)
- (e) Operations Control
 - Specifications for the control center operations, including real-time monitoring and decision-making protocols
 - Interface requirements with other operators
 - Performance Metrics
 - Key Performance Indicators (KPIs) for evaluating the ITS system
- (m) Compliance and Standards
 - List of industry standards and regulations the ITS must comply with
 - Risk Assessment and risk allocation
 - Potential risks and mitigation strategies
 - Appendices
 - Glossary of terms
 - Any relevant supporting documents

The FDD must emphasize that the Client is the owner of the data.

It should also emphasize interoperability of the ITS system to avoid dependency on any proprietary hardware and software.

The consultant shall generate comprehensive technical specifications for these systems. Operations Control, in this context, refers to the integrated command and oversight of all transit operations, including real-time monitoring of bus locations, system performance analytics, emergency response coordination, and communication with both passengers and transit personnel.

The Consultant will include in the FMS design the items listed below:

- i. Hardware specifications for the Bus Onboard Equipment for FMS including GPS
- ii. Software functional specifications for the Bus Onboard Equipment for FMS
- iii. Hardware specifications for the servers for FMS
- iv. Software functional specifications for the FMS
- v. FMS requirements for integrated scheduling of feeder, trunk and direct services
- vi. FMS requirement for technical integration with other existing/upcoming BRT Lines in Karachi
- vii. FMS requirements for integrated operation
- viii. FMS reports requirement for operational monitoring and accounting
- ix. Communication and Network requirements for FMS

Moreover, the FMS must be adaptable to the unique requirements of the Yellow BRT corridor, which will implement both Trunk, Direct, and Feeder Services. Consequently, the specifications must account for the scheduling complexities inherent to these different types of services.

The consultant must collaborate closely with the Bus Operations consultant to develop specifications for the FMS. This system will be designed not only to optimize scheduling for individual bus lines but will also integrate with other lines, particularly in common corridors where multiple lines may merge.

The Consultant will include in the UIS design the items listed below:

- i. Hardware specifications for the UIS elements in stations
- ii. Hardware specifications for the UIS elements in Buses
- iii. Hardware requirements for the UIS servers
- iv. Software functional specifications for the UIS operations management
- v. UIS requirement for integrated Bus Operations including feeder, trunk and direct services
- vi. UIS requirement for integration with other existing/upcoming BRT Lines
- vii. UIS requirements for integrated media and advertising operations
- viii. Communication and Network requirements for UIS
- ix. UIS must also provide alternate channels for users including Mobile App and Website. Open data protocols may be used for information exchange and real-time data exchange with mobile app and website.

The Consultant will include in the Security System design the items listed below:

- i. Hardware specifications for the cameras in stations, corridor, OCC, buses and Depot

- ii. Hardware specifications for the gates and other security elements in Bus stations, OCC and Depot
- iii. Hardware requirements for monitoring stations at OCC
- iv. Hardware requirements for the security servers
- v. Software functional specifications for the VMS
- vi. Communication and Network requirements for Security System

The Consultant will include in the OCC design the items listed below:

- i. Requirements for the video wall integration at OCC
- ii. Requirements for data center at OCC
- iii. Requirements for Communication and Network at OCC
- iv. Requirements for Disaster recovery and business continuity

The Consultant will include in the Network and Communication System design the items listed below:

- i. Conceptual design of the Communication Network
- ii. Fiber Optics Network Concept Design
- iii. Conceptual Design of Ethernet network at stations, OCC and Depot
- iv. Redundancy and operational availability requirements for the communication network
- v. Types of communication used (e.g., Fiber, Ethernet, VHF radios, Wi-Fi, Wireless mobile communication technology) with specific details of each type of communication media needed in different segments of BRT
- vi. Data transmission protocols and security measures

The Consultant will include in the AFC design the items listed below:

- i. AFC equipment specifications at all points: buses, terminals, stations, depots including turnstiles and sales equipment. The AFC should discourage use of QR paper tickets and should avoid cash payments and tokens. Turnstiles should be of such a design that avoids fare evasion by passengers. The equipment should be interoperable to avoid hardware that works with a propriety system only.
- ii. AFC Back end servers specifications
- iii. Software specification for AFC back end software
- iv. AFC reporting and analysis requirements
- v. Communications requirements for AFC
- vi. AFC should also allow users of BRT to use multiple payment channels including mobile app

Operational design should be closely linked to functional design. The infrastructure should serve all operational needs and the operational design should consider space constraints in its infrastructure implementation.

Depots conceptual design will also include The Bus Depot Management System specification, which aims to facilitate efficient operation of Bus fleet by providing IT tools that enable effective maintenance and operation control at Bus Depot. The Bus Depot Management system is supposed to facilitate the following:

- Parking Management
- Maintenance Planning
- Refueling Management
- Inventory Management
- Bus Depot Human Resource Management
- Driver Training

2.3.3 Deliverable 6: ITS Procurement Plan and bidding documents. RFP, Draft Agreement

Based upon the discussion with all stake holders, ITS Consultant will present a plan for procurement including:

- a. Packaging of ITS element for contracting in possibly more than group or as a single package
- b. Time line for procurement

The RFP will contain:

- a. Datasheet for Yellow Line BRTS and ITS
- b. Detailed Scope of Work for ITS
- c. Detailed Specifications of the ITS as described in Deliverable 5
- d. Indicative Bill of Quantities for financial evaluation
- e. Integration Requirements of ITS with existing BRT Lines' ITS
- f. Evaluation criteria
- g. Other legal and contractual requirement

The RFP must also be prepared and presented in a way to maximize competition and protect the bidding process from any negative aspects and corruption. The technical specifications and terms of RFP must not favor any specific supplier or Contractor. The RFP and Draft Agreement must protect the Client's best interest and keep a optimal balance between Contractor performance and the interest of Client.

The Draft Contract Agreement will contain at minimum

- a. Terms of Delivery
- b. Acceptance Mechanism and Procedure
- c. Project Timeline
- d. Payment Plan & Payment Mechanism
- e. Variation Procedure
- f. Dispute Settlement

- g. Other legal and contractual terms and condition as per applicable norms and standards
- h. Requisite forms

2.3.4 Task 8: Signaling design

The aspects of traffic engineering and geometric design of signals have been covered in a separate activity other than ITS. The Consultant will utilize the output of the other activity and include the traffic signal equipment, communication network, controllers control center software and equipment and relevant technical aspects of traffic signals in the overall technical design, BoQ and RFP. The traffic signaling equipment and software must be integrated with the ITS system and network being deployed.

2.3.5 Deliverable 7

Technical Specifications, BoQ, for

- i. Traffic signal equipment including local controllers, control center hardware and software and vehicle detection equipment.
- j. Software for signal plans

2.3.6 Task 9: Detailed design of complementary technical requirements

This task encompasses functional diagram of the ducts, trays, junction boxes and pop-ups for data transmission and power supply in the stations and along the track, including traffic lights, for connection to the OCC and for installation of the component subsystems of the ITS package.

The ITS team will work closely with Infrastructure design team to mark the location and placement of all the ITS elements. Including AFC elements: Ticket Office equipment, Turnstile Gates, UIS screens, Security Cameras, fiber and Ethernet network switches and related elements.

Based on these placements and optimal routing of fiber, Ethernet and power cable, ITS Consultant will work with the infrastructure design team to mark the drawings with the relevant information.

In addition, the consultant's design must include all the requirements for the deployment of the technological elements of the BRT system:

- Space, power sources, cabling and ducts for the installation of the fare collection system at stations and terminals (smartcard/ticket vending machines, access equipment: validators and turnstiles, smartcard recharging equipment, etc.).
- Areas, power sources, cabling and ducts for the installation of the operational control system at the terminals of the BRT system (location of the operational support modules, which will include: control panels, monitors, computers, etc.).
- Location, power source, cabling and ducts for the installation of other ITS equipment at stations and terminals: surveillance cameras, user information screens and panels, etc.

All the above also for Depots 1 and 2.

Duration: 120 days after approval of deliverables 2, 3, 4, and 5

2.3.7 Deliverable 8: Concept Design Drawings of ITS elements Placement and Conduits

Updated and marked drawings for ITS elements, pipelines and related infrastructure elements.

2.3.8 Deliverable 9: Design report on complementary technical requirements

Listing all the requirements and assumptions for ITS equipment placement and operation. Including power, HVAC and UPS requirement.

2.4 Stage 4: Bidding Process

2.4.1 Task 10: Support to the Client in Bidding Process

The Consultant will support the client in each of the following step of the Bidding process

- a. Preparation of Evaluation criteria and procedure for Bids
- b. Invitation of Bids
- c. Conduct of Pre-Bid meeting(s)
- d. Evaluation of Bids

The bidding process must be held within the guidelines of WB and other applicable laws, rules, and regulation. The bidding process should be completely transparent at all stages. The evaluation criteria must be prepared to invite maximum competition and attract best contractors available in the market. The evaluation of bids must be carried out in a transparent manner. All relevant information must be made available publicly in a timely and reliable manner.

2.4.2 Deliverable 10:

Bid Evaluation Process and Criteria

Minutes of pre-bid meeting(s)

Response to bidder queries

Bids evaluation report

2.5 Stage 5 Deployment Supervision

2.5.1 Task 11: Supervision of ITS deployment and installation.

The list of activities in this task includes:

- Supervision for ITS related Infrastructure elements' implementation
- Review of Detailed Design/System Design Specifications from the Contractor

- Conduct of Factory Acceptance Tests
- Supervision of ITS deployment and implementation
- Conduct of Site Acceptance Tests
- Supervision of start of system operations and system handover to Client
- Supervision for implementation of ITS related Infrastructure elements

The Consultant will make sure the implementation of all ITS related spaces, power sources, power cabling, ducts, pipes and other elements are implemented as per Deliverable 8 and Deliverable 9 defined above.

- Review of Detailed Design/System Design Specifications from the Contractor

Based on the conceptual design, the selected contractor or contractors will submit the detailed design of ITS and their implementation. These designs and specifications will be reviewed by the ITS Consultant to ensure their conformity to the conceptual design and specifications given in the RFP.

- Conduct of Factory Acceptance Tests

After the approval of detailed design the selected Contractor may present the system software and hardware in a limited integrated environment at his premises. ITS Consultant will supervise and monitor this Factory test phase.

- Supervision of ITS deployment and implementation

After approval of FATs, the ITS system may be deployed at site. ITS Consultant will coordinate and supervise this phase on behalf of Client to ensure the quality of workmanship and adherence to specifications.

- Conduct of Site Acceptance Tests

Before start of operation the ITS system may be tested in the field. Detailed integrated testing of these tests will be monitored and supervised by the ITS Consultant.

- Supervision of start of system operations and system handover to Client

Finally the system may be made operational and handed over to client. The ITS consultant will supervise and document the handover procedure.

2.5.2 Deliverable 11: ITS System Procurement, FAT, SAT, Installation and O&M Report:

The Consultant will submit a report on the Review of Detailed Design of ITS as submitted by the selected contractor.

Consultant will also submit a report with detailed analysis of test results for Factory Acceptance Tests and also for Site Acceptance Tests.

Monthly Deployment and Installation Report x6.

The ITS Consultant will submit to client monthly progress report on the Contractor's work/progress for ITS deployment and installation. The report will also highlight any pertinent risks and risk mitigation strategy.

3. Timeline and Cost Breakdown

In accordance with the task breakdown below, the above stages are proposed to be carried out over a minimum period of 18 months. The table also gives the duration of deliverable and the proposed %age payment for each deliverable.

Stage	Task	Deliverable	Duration	%age
Stage 1	Task 1: Inspect and assess existing ITS and validate the vision for interoperability and integration for Karachi BRT network	Deliverable 1: Inception report	1 month	5%
	Task 2: Provide technical support for ITS conceptual discussions and consolidate key ITS guidelines and assumptions			
	Task 3: Design Review			
Stage	Task 4: Prepare ITS conceptual design for the Yellow BRT corridor. Conceptual design for EFC, FMS, UIS, Data Communications System Network, traffic light, Security	Deliverable 2: Conceptual design and operational guidelines for ITS	2 months	10%
	Task 5: Preparation of guidelines for integration between systems, including ticketing system	Deliverable 3: Technical Memorandum with assessment of existing ITS systems for other BRT corridors in Karachi	1 month	2.5%

Stage	Task	Deliverable	Duration	%age
	Task 6: Operation options Analysis for Electronic Fare Collection	Deliverable 4: AFC Operational Plan	1 month	5%
Stage 3	Task7: Technical specifications for Fleet Management System (FMS), Ticketing/Electronic Fare Collection (EFC), User Information and Security System (UISS), and Operations Control Centre (OCC) and related subsystems	Deliverable 5: Functional design document (FDD) outlining how the technology will support the transport network's operational needs, emphasizing efficiency, integration, and optimization.	2 months	15%
		Deliverable 6: ITS Procurement Plan and bidding documents. RFP, Draft Agreement	2 months	15%
	• Task 8: Traffic engineering and signaling design	• Deliverable 7: Technical specifications and BoQ of Traffic Signaling equipment and software including OCC elements.	1 months	2.5%
	Task 9: Detailed design of complementary technical	Deliverable 8: Conceptual Design Drawings of	On going for 6 months	15%

Stage	Task	Deliverable	Duration	%age
	requirements	ITS pipelines		
		Deliverable 9: Design report on complementary technical requirements	1 month	5%
Stage 4	Task 10: Support to the Client in Bidding Process	Deliverable 10: Bids evaluation report	1 month	5%
Stage 5	Task 11: Supervision of ITS deployment and installation.	Deliverable 11: ITS System Detailed Design Review, FAT, SAT, Installation and O&M Report: Monthly Deployment and Installation Report x6	9 month	20%

4. Experience:

General Experience: Experience in providing IT Consulting Services during the last 10 years. The consultant should be able to demonstrate the successful completion of at least 04 projects [with each consultancy contract's minimum value of PKR 100 Million]

Specific Experience: Experience in providing IITS consulting services in BRTS operations [Similar nature of complexity]. The consultant should have successfully completed a minimum of 02 projects of IITS in Bus Service, each worth a minimum of PKR 75 Million or above [consultancy contract's] undertaken in last 05 years.

5. Personnel Requirement & Qualifications

S No.	Title	Qualification & Experience
1.	Team Leader – Project Director	Bachelor in Engineering, with certification in project management, at least 15 experience of managing engineering projects of complex nature. Experience of delivery of at least 2 projects of ITS in BRT systems.
	ITS System Specialist 1	Bachelor in Engineering, with at least 10 experience in ITS. Experience of at least 2 projects of ITS.
	ITS System Specialist 2	Bachelor in Engineering, with at least 10 experience in ITS. Experience of at least 2 projects of ITS.
	Transport Specialist	Bachelor in Engineering, specialization in transportation with at least 10 experience in transportation engineering.
	Security & Surveillance System Design Specialist	Bachelor or Diploma in Engineering, relevant certifications in IT, experience in design and deployment of security and surveillance systems, experience in deployment of security system in transport projects
	IT, Networking & Communication System Specialist	Bachelor or Diploma in Engineering, relevant certifications in networking, experience in design and deployment of fiber optics network, experience in design and deployment of fiber optics network in at least two transport related projects
	ITS Field Supervision Technicians x 3	Diploma in Engineering, at least 3 years' experience in field supervision of infrastructure projects, preferably experience in IT or related projects
	Legal Expert	Bachelor Degree in Law, at least 10 year experience in public procurement projects, experience in contract development and management