

## Kenya Urban Roads Authority

**Enhancing Urban Mobility** 

## OPTIMIZATION OF NETWORK CAPACITY THROUGH INTELLIGENT TRANSPORT SYSTEMS (ITS)

## NAIROBI ITS ESTABLISHMENT AND JUNCTION IMPROVEMENT PROJECT

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## **INSTITUITIONAL STRUCTURE**





## Government of Kenya

Ministry of Transport, Infrastructure, Housing, Urban Development and Public Works



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Kenya Urban Roads Authority



- The mandate of KURA as defined in the Kenya Roads Act, 2007 is the Management, Development, Rehabilitation and Maintenance of National Urban Trunk Roads.
- Vision: A world class urban road network for sustainable development.
- Mission: To provide and manage quality, safe and adequate urban road network.

## **Enhancing Urban Mobility**



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## **KURA REGIONAL URBAN CORDINATION OFFICES**



## **Background – Why Different Intervention is Necessary**

- There has been continued network development congestion remains
- Challenges of congestion and traffic accidents are witnessed daily in Nairobi city with an ever-increasing tendency.
- Attributed to: inadequate mobility options, insufficient road network, inefficient enforcement of traffic rules and a lack of automated and / coordinated traffic management and control measures
- Intersections, nodes and junctions are the control points and often the traffic bottlenecks, conflicts core points and accident black spots
- Insufficient geometry at intersections to separate right and left turn movements & road user behavior



## **Interventions: Hard & Soft Interventions**

## Hard Measures

 Increasing Infrastructure capacity (Network development, Grade separation)



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## Soft Measures

- Travel Demand Management, Route & Time of Travel Choice, Transport Mode Shift, Mass Rapid Transit System Prioritization.
- Nodal Management



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## **SMART CITY COMPONENTS**





## **SMART CITY COMPONENTS**

- **Collect data**: People, schools, industries, zoning, public transport, infrastructure, taxis;
- Manage:assets,citizens,resourcesandservicesefficiently;
- Used to improve the public and private operations across the city;
- **Connected** to the IoT network to optimize the efficiency of city operations and services and connect to citizens

## **ITS PART OF SMART CITY COMPONENTS**



Integrated Systems in which information and communication technologies are applied together with transport engineering data and principles in a scientific way, in among others;

Maritime



 In road transport, including transport infrastructure, in transport vehicles, weigh in motion, tolling, traffic, parking and mobility management at nodal and network level;



Public Transport: Public Information System, BIS and BMS for BRT

As well as for integration with other

modes of transport e.g. Railway, Air &





Kenya Urban Roads Addition Strength Str

## COMPONENTS





THURBAN ROADS RUTING

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## Intelligent Transport System (ITS) Configuration





## **ITS Configuration in Road Transport**





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## Kenya Has Robust Infrastructure and Institutional & Legal Framework

- Nairobi has the largest density of road network per square kilometers in the Country;
- Largest Concentration of Traffic Police Officers;
- Largest Concentration of Traffic Engineers;
- Has a Traffic Management Center;
- Has the Control Command Center.









## The Problem – Lack of Institutional Integration





## 14 The Problem – Lack of Institutional Integration

- Traffic not controlled at source
- Only controlled once fed on road / junction
- Result is?

40% Efficient,

Violations not punished



ITS

No Regional Info. On vehicles, accidents No Coordination on Violations



Costly, Reduced Safety, Reduced LOS, Unpredictable, Road Rage,



Road System Irregular, Uncontrolled, Unpredictable



Public Transport



## The Problem – Result of Lack of Integration







## Urban Transport Network Analysis - Methodology

Detailed urban transport network assessment to understand the current transport characteristics and address congestion and safety problems.



- Accurately select the most relevant junctions to be upgraded
- Put in order of priority
- Classify the junctions into zones
- Design operation criteria

## 17 CRITERIA FOR JUNCTION SELECTION / PRIORITIZATION





## **18 CRITERIA FOR JUNCTION SELECTION / PRIORITIZATION**





## **Junction Selection From Micro & Macro Simulation**

# Accurately select the most relevant junctions to be upgraded octions 85000 21250 42500 **Traffic Macroscopic Model & Junction Selection**

## **20 NAIROBI ITS AND JUNCTIONS IMPROVEMENT PROJECT**





- 450 Junctions Under Consideration
- Spread Across Phases I IV
- Ultramodern fully equipped metropolitan wide Traffic management center
- Integration of all modes including BRT, rail and air
- Project Self Sustainable in terms of revenue generation



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## **LOCATION MAP & JUNCTIONS LIST**





## **PROJECT - CURRENT STATUS**



Project	Project Description	Status
Nairobi ITS Phase I	21 Junctions and construction of a fully equipped Traffic Management Center (TMC)	<ul> <li>Funding secured from</li> <li>Economic Development</li> </ul>
Nairobi ITS Phase II	60 Junctions	Fund (EDCF) managed by the Korea Exim Bank.
BRT Line 5	BRT infrastructure along Outer Ring Road – Will have BMS/BIS	✓ Commenced
Nairobi ITS Phase III	Installation of ITS facilities for 125 intersections	Funding being sought
Nairobi ITS Phase IV	Installation of ITS facilities for 125 intersections	Funding being sought

## **ITS Components To Be Implemented**



- Automated Traffic Data Collection System
- Adaptive Signal Control System
- Automated Traffic Enforcement System [EPolice]
- Real-time Traffic Information System
- Electronic Toll Collection System [ETCS]
- Variable Message Sign (VMS)
- Parking Guidance and Information System
- Public Transport Management System



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## **24 THE SOLUTION – CURRENT SITUATION**

- KURA ITS Pilot Project
  - Traffic management center
  - 7 Junctions Fully Intelligent and connected to TMC
- Intelligent –Connected to TMC and Stand Alone
- 3 Junctions Not intelligent and Stand Alone
- 21 Junctions under county government Stand Alone







## **COMPARISON – BEFORE & AFTER IMPLEMENTATION**







## **Automated Traffic Enforcement System [EPolice]**



- Detects and records traffic violations, such as red-light violation, reverse driving, wrong lane change & illegal turn, wrong-way driving, speed, yellow line occupation, BRT Lane Occupation, parking violation and jay walking.
- Collects information on violation such as violation type, vehicle photos, license plate registration, violation time, and place.
- Transfers the collected information to the Traffic Management center for analysis and processing.







## **Lane Direction Violation Capture**

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## Light Turns Green

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**End of Violation** 

## **Start of Violation**

## Vehicle & Number Plate Image

0.05

## **Integrated Management Solution**





All Institutions Coordinated

- KURA and other road agencies
- Nairobi City County / NMS

Data Shared Across

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Duplicity



- NTSA (TIMS, PSV & Taxis)
- Traffic Police
- ✤ KAA
- Kenya Railways
- NAMATA

Through ITS

Information Collection

and the

Coordination

**Traffic Brain** 

**Data Interaction** 



**Intelligent Decision** 



## ITS & Traffic Management Center – The meeting Point or Traffic Brain

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## Traffic Management Center



- Data Center: All Traffic Data and infrastructure information in one place
- Monitoring Center: Real time Operation & monitoring of traffic information, violations
- \* Analysis Center: Congestion & Traffic data
- Evaluation Center: Transport Planning, Forecast and simulation / modelling
- Information Center: To public on traffic flows on real time and forecasted, penalties and fines









## <sup>31</sup> PUBLIC TRANSPORT INTEGRATION – BRT, RAIL ETC



Management of the BRT and integration with Normal Traffic;







- Bus information System & Bus Management System
- Video monitoring system (In bus & in Motion) CCTV
- Signal & Priority control system
- Information System Information Terminal, App
- Guidance system such as VMS
- GPS & GIS



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Improved traffic flow efficiency of upto 40% from survey analysis Reduced waiting time to less than 30 seconds at intersections Traffic enforcement (E-Police) system eliminates the need to have physical presence of police Real-time traffic data collection provides accurate information for forecasting and engineering design

Centralized traffic infrastructure and network management



## **Sustainability and Funding Options**

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The Automated Traffic Enforcement System (E-police) has the capacity to generate income from fines issued for various traffic offences
 The following offences were recorded between January 2018 & December 2021 from one E-police camera installed;

	Traffic Violations	raffic Violations	Violations	2018	2019	2020	2021	Total
Lane Distribution Direction Violation, 485,373, 33% Touch Line, 892,514, 61%	Traffic light violations , 84,120, 6% Reverse driving motor	Touch Line	171,625	246,963	354,807	119,119	892,514	
		Lane Direction Violation	125,840	139,575	164,380	55,578	485,373	
		Traffic light violations	40,350	26,232	15,120	2,418	84,120	
		vehicles, 1,238, 0%	Reverse driving motor vehicles	688	363	149	38	1,238
	Kenya Urban Roads	Authority	Total Violation	338,503	413,133	534,456	177,153	1,463,245
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## **Sustainability and Funding Options**

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 From the violation statistics collected & corresponding penalties as per the Traffic Act, potential revenues that could be generated from violations recorded in **one camera** would amount to the following;

Violations	Number	Penalty (Kshs)	Amount of Fines (KShs)	FEASIBILITY STUDIES RESULTS		RESULTS
Touch Line	892,514	3,000.00	2,677,542,000.00	Indicator	Unit	Figure
Lane Direction Violation	485,373	3,000.00	1,456,119,000.00	Payback period	Year	5.64
Traffic light violations	84,120	3,000.00	252,360,000.00	ROI	%	14.05%
Reverse driving motor				NPV	M Kshs	26,915.41
vehicles	24136 driving motor 1238 3,000.00 3,714,000.00	IRR	%	20.87%		
Total			4,389,735,000.00	BCR		2.56

- ITS projects viable and can sustain itself as well as generate revenue for other KURA programmes as well as other government programmes including funding the budget.
- Initial investment however required through either through GoK, development partners or PPP Framework

## **Requests & Funding Areas**

- Additional Funding for a further Minimum 125 Junctions in Nairobi
- Implementation of ITS in Mombasa, Eldoret, Nakuru and Kisumu Feasibility Studies, Master Plans and Implementation of ITS
- Implementation of smart highways elements such as check points, ePolice in major arterials
- National Database on mobility traffic census, accident data, congestion
- Road Asset Management Systems
- Capacity building & technology transfer

Non Motorized Transport for major towns (Demand Management)



## ITS Fits into Kenya Vision 2030, Urban Development Plans & the Big Four Agenda





#### Nairobi Integrated Urban Development

Strengthening development planning

Urban governance

Management

Promotion of urban investment

Delivery of social and physical infrastructure in urban areas

#### Nairobi Intelligent Transport System Project



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Efficient connection to industrial area, affordable house, hospital Providing high quality life Revenue increase

#### Kenya Urban Roads Authority



#### **KENYA URBAN ROADS AUTHORITY**

Efficient and safe urban roads

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