

# ***Driving Efficiency in Toll Operations Through AI***

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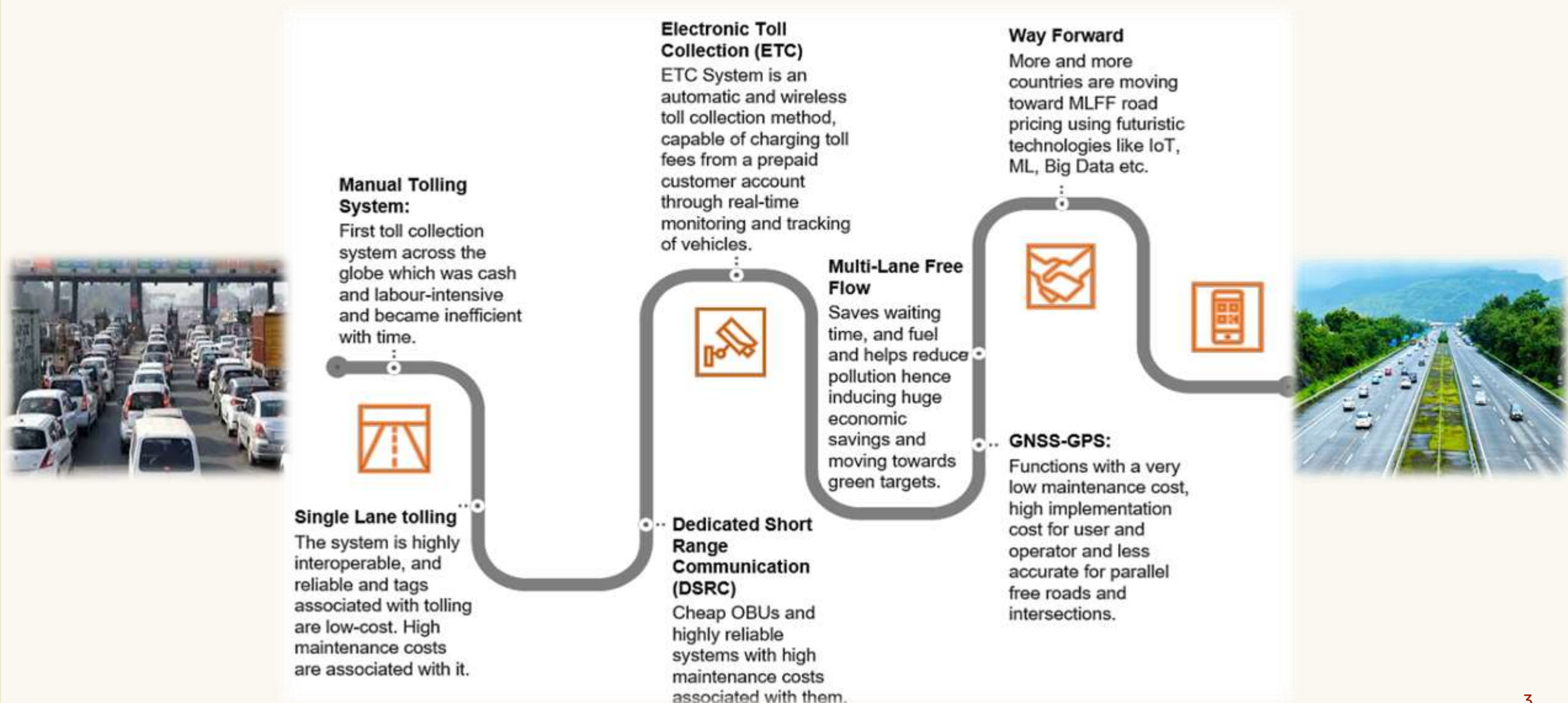
# **“Efficiency” in toll operations**

*Efficiency today goes beyond reducing wait times. It includes faster vehicle throughput, accurate classification, minimum leakages, reliable enforcement, and real-time visibility.*

- Faster vehicle throughput
- Accurate classification
- Minimum leakages
- Reliable enforcement
- Real-time visibility.



# “From Manual Tolling to Seamless ETC Systems



# Major challenges in tolling - AI can help address

- Long queues during peak hours
- Toll evasion and misclassification
- Human error at manual lanes
- Revenue leakage and fraud
- Poor enforcement visibility
- Inconsistent data for planning and forecasting



***“AI offers automation, predictive analytics, and surveillance-based enforcement that directly reduce these inefficiencies”***

## ➤ **Enhanced toll collection and payment**

- Automatic Number Plate Recognition (ANPR)
- Real-time billing

## ➤ **Fraud detection and Revenue Assurance**

- Anomaly detection
- Automated auditing
- Tamper detection

## ➤ **Optimized Traffic Management**

- Dynamic lane allocation
- Congestion pricing
- Predictive analytics



- **Artificial Intelligence (AI) and Machine Learning (ML):**
  - Core technologies for processing data, learning from patterns, and making adaptive decisions
- **Automatic Number Plate Recognition (ANPR)**
  - A computer vision technology that reads vehicle license plates for identification and payment
- **Computer Vision**
  - Used to analyze images for vehicle classification (e.g., vehicles with trailers) and detect features for tolling and enforcement.
- **Sensors and Internet of Things (IoT)**
  - Gather real-time data from vehicles and the environment to feed AI systems

# Benefits of AI-driven toll operations



| Benefit                             | Impact on toll operations                                                                                                                                        |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Increased throughput</b>         | Automatically processing vehicles without requiring them to stop, increases the number of vehicles handled per hour, reducing congestion.                        |
| <b>Reduced operational costs</b>    | Automation lowers reliance on manual labor for toll collection and administration, leading to significant cost savings.                                          |
| <b>Improved user experience</b>     | Drivers experience lower wait times, faster commutes, and less hassle, leading to greater customer satisfaction.                                                 |
| <b>Environmental benefits</b>       | Less time spent idling in traffic queues results in reduced fuel consumption and lower carbon emissions.                                                         |
| <b>Enhanced safety and security</b> | AI can monitor for unusual vehicle behavior, detect violations, and integrate with surveillance systems to improve highway safety and reduce illegal activities. |

# The future of AI in toll operations

- **Connected vehicles (V2I):** Vehicles equipped with built-in communication can interact directly with toll infrastructure, removing the need for physical tags.
- **Blockchain technology:** This can be integrated with AI to create a transparent and secure payment system that further reduces fraud risk and ensures accurate financial records.
- **Edge and cloud computing:** Advanced data processing systems can enhance real-time toll management capabilities by analyzing data locally at the toll plaza (edge) and centrally in the cloud

