The Mobility Services-Oriented Development Architecture of Transport Digital Infrastructure for Smart City

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Why Mobility Service-Oriented Development

- Services Requirements for Smart Life
Public Transport Services

- Diversity
- Density
- Design

Advanced Public Transport Services

- Internet
- Management Center (Web Server)
- Public Telephone System
- GPS
- Bus Location
- Bus Station
- LED Device
- GRRS/4G
- Driving Recorder
Traffic Information Services

Real-time traffic information
Traffic Management Services

Smart traffic control system

- Data Collection
- Data Processing & Prediction
- Traffic adjust & Control

Cloud Computing

- Dynamic Traffic Light Control
- CCTV Monitoring
- Real-Time Roadway Guidance

Main road Green-Wave

- Traffic Detector
- Traffic Operation Center

[Diagram of traffic management system with illustrations of traffic detectors, control centers, and data collection processes]
Parking Services

On-street Geomagnetic Sensor

Off-street Parking Information
Smart Payment Services

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**Smart Card Parking Fee Collection System**
- Entrance Barrier
- Entrance Ticket Validator
- Exit Ticket Validator
- Exit Barrier

**Smart GUI for easy and user-friendly operation**

**Antenna eTag detection**

**eTag Payment Platform**

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**Customization service for needs**
- Single Ride Rate
- Preferential Rate Deduction
- Temporary Parking
- Parking Time Statistics

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Features of Smart Life

- Digitalization
- Personalization
- Mobility

Digital infrastructure in Traffic Composition
Re-thinking of the Infrastructure Investment
Traditional ITS Framework – Duplicated Investment
The Issues of Deploying Various and Independent Applications

- Deployment and Operation cost mostly rely on government budget, lacking viable and profitable business model and without stable funding, operations could not be sustained.

- Specific type of technology causes the integration with other systems is problematic and difficult to provide innovative services in meeting user demands.

- Specific projects are limited in geographic scope, difficult to expand spatially.

- Specific projects prone to have duplicated software development and repeated investment in hardware infrastructure, and potential cause for wasted resources.

- Specific projects could be effective in resolving short-term issues, but could not take into account much of the future technology trends and lack system scalability.

- Data are stored in various organizations, where barriers exist against data exchange and sharing. Difficult for systems to be integrated and seldom applied effectively to other new ITS services.

- Over-anxious in introducing ITS to resolve all traffic problems could on the contrary overlook the actual expectations of road users for better mobility services.
Integrated Smart Transport System Framework

- Vehicle Digital System Platform (VDSP) Framework

- Based on specific development objectives of intelligent transport, user’s requirements of mobility can be satisfied by these services.

- UI components allow different users to operate systems and obtain services with ease.

- Based on Services, develop or purchase all needed modules and integrate these modules into solutions.

- SI Modules also called Common IT Modules, they are integration tools for components of Business Solutions & Modules.

- Provide functions of cache, data access, security, rule, cryptography, logging and validation to make operation smoothly.

- Include censors, web services, mail services, edge server, reporting services, database integration, operation system, database system, and cloud/on premises.
Integrated Smart Transport System Framework

- Interpretation of VDSP Framework – Proposed Service Categories and Services for VDSP

<table>
<thead>
<tr>
<th>Services Gateway</th>
<th>Security Gateway</th>
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<tbody>
<tr>
<td>DMV</td>
<td>Value-added</td>
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<td>ATIS/ATMS</td>
<td>Big Data</td>
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<td>Customer Services</td>
<td>A.I.</td>
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<td>Billing</td>
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<td>Mediation</td>
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- Solutions

- Services

- Sensor Infrastructure
Integrated Smart Transport System Framework

- Proposed Business Solutions & Modules for VDSP
  - Based on Services, develop or purchase all needed modules and integrate these modules into solutions.

<table>
<thead>
<tr>
<th>DMV Solution</th>
<th>Customer Services Solution</th>
<th>Value-added Solution</th>
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</thead>
<tbody>
<tr>
<td>Vehicle / Driver Data Management</td>
<td>Violation Management</td>
<td>Customer Relationship Management</td>
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<tr>
<td>Tax / Revenue Collection</td>
<td>Vehicle Examination</td>
<td>Mobile Apps</td>
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<td></td>
<td></td>
<td>Customer Self-Services Portal</td>
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<td></td>
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<td>Member Management</td>
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<td>Mobile Payment</td>
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<th>ATIS/ATMS Solution</th>
<th>Billing Solution</th>
<th>Big Data Solution</th>
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<tr>
<td>Traffic Signal Control</td>
<td>Fitment / Termination</td>
<td>Statistics and Reporting</td>
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<tr>
<td>Traffic Surveillance and Analysis</td>
<td>Freeway Traffic Control</td>
<td>Bill Management</td>
</tr>
<tr>
<td>Traffic Surveillance</td>
<td>Traffic Information Dissemination</td>
<td>Clean / Settlement</td>
</tr>
<tr>
<td>and Analysis</td>
<td></td>
<td>Pricing / Rating</td>
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<tr>
<td>Personal Notification</td>
<td>Dynamic Route Guidance</td>
<td>ETL Processing</td>
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<tr>
<td>Incident Management</td>
<td>Emergency Alerts and Notices</td>
<td>Customer Segmentation</td>
</tr>
<tr>
<td>Weigh-In-Motion</td>
<td>Heavy / Specific Vehicle Route Surveillance</td>
<td>Collection / Dispatch</td>
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</tbody>
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<td>Collection / Dispatch</td>
<td>Cognitive Service</td>
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<td>License Plate Recognition</td>
<td>Forecast / Prediction</td>
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<td>Validation Processing</td>
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<tr>
<td>Charging / Deduction</td>
<td>Recommendation</td>
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<td>Account Management</td>
<td>Chat Bot</td>
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- Proposed Business Solutions & Modules for VDSP
  - Based on Services, develop or purchase all needed modules and integrate these modules into solutions.
Integrated Smart Transport System Framework

- Proposed Functions of UI Components, SI Modules, and Common Components for VDSP
  - **UI components** allow different users to operate systems and obtain services with ease.
  - **System Integration Modules** also called Common IT Modules, they are integration tools for components of Business Solutions & Modules.
  - **Common Components** provide functions of cache, data access, security, rule, cryptography, logging and validation to make operation smoothly.

![Diagram of Integrated Smart Transport System Framework](image.png)
Integrated Smart Transport System Framework

- Proposed IT Infrastructure for VDSP

**Vehicle Censors**

**CVP Data - OD/Travel Time**

**Big Data A.I. Analysis**

- **Dates**
  - Special Holidays
  - Days of Holidays

- **Activities**
  - Google Trends
  - Mobile Data
  - Passenger Volume at Scenic Spots
  - Weather Forecast
  - Rainfall

- **Weather**
  - Air Quality
  - Ultraviolet Index
  - Temperature
  - Extreme Climate

**Services**

**UI Components**

**Business Solutions & Modules**

**System Integration Modules**

**Common Components**

**IT Infrastructure**

**Vehicle Censors**

**CVP Data**

**ETag Data**

**Vehicle Detector**

**Passenger Volume of Public Transport**

**Parking Lots Data**

**BTS, Base Transceiver Station**

**Incidents/Events**

- Location
- Summary
- Recovery Schedule

**Traffic**

- **Edge Server**
  - Database System
  - Reporting Services
  - Cloud / On Premises

- **Web Services**
- **Mail Services**
- **Operation System**

**Database Integration**

**System Components**

**Censor**
Integrated Smart Transport System Framework

- Example of VDSP Framework for Smart Parking Services

| Services |
|------------------|------------------|
| Intelligent Traffic Control | Traveler Information |
| Traffic Information | Public Transportation Information |
| Safety and Surveillance | Vehicle Pollution Control |
| Usage Based Insurance | Precision Marketing |
| Electronic Road Pricing | Electronic Toll Collection |
| Smart Parking | Electronic Payment |
| Smart Economy |

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Security Gateway

Central Back Office

Services Gateway

Customer Services
Billing
A.I.
Mediation

Value-added
Big Data

Edge Server

Traffic Management Center
Enforcement Office
Violation Center
Call Center
Sustainable Financial Support
The Newest Development of FASTag in India

- Earlier this month, the Road Transport and Highways Minister Nitin Gadkari announced that FASTags will become mandatory for all vehicles from December this year.
Digital Economy vs Digital Vehicle Economy

- Digital Economy and Platform Economy
  - The Digital Economy (DE) is innovative economic activities generated by an array of digital technologies.
  - Under the Digital Economy, the Platform Economy linking organizations and resources has emerged to provide intermediate corresponding services.

- Digital Vehicle Economy
  - The Digital Vehicle Economy (DVE) refers specifically to the new mode of economic industry created from digital computing through vehicles.
  - DVE’s main technology comes from the IoV. The IoV back-end platform integrates all information on people, vehicles and roads.
VDSP Enables the DVE and DE

- DVE Applications Requires **digitalization** and **validation** of Vehicle’s Identification, Transaction, and Location.
- The VDSP (Vehicle Digital System Platform) owns the core features of DVE.

**Traffic Big data**
- GPS, Mobile Device, Smart Card

**Programmatic Buying**
- Audience Targeting
- Precision Marketing

**Digital (Vehicle) Economy**
- Billions of Online Connections

- Vehicle Tracking / Person Count
- Flow rate Hotspot Analysis
Opportunities and Benefits

- Stakeholders: End user, Government, Industry, Academic Institutions

Digital Vehicle Economy (DVE)

- Travel
  - Tourism
  - Parking Drive-through Navigation

- Loan/Insurance
- Transportation Logistics
- Fleet Management

- Smart Governance
  - Internal Affairs Transportation
  - Police
  - Customs
  - Taxation and Finance
  - Environmental Protection

- Vehicle Manufacturing/Sales/Services/Rental
  - Payment
  - Gas Station / Charging Station
  - Depot/Dealer
  - In-vehicle Electronics
  - Auto Parts Store
  - Maintenance / Auto Detailing
THANK YOU FOR YOUR ATTENTION

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