



LSDU Case Study

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LSDU



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Overview

LSDU extends for the Lane status display unit; this software is for the admin use of lanes, and we can view the data of lanes and monitor the hardware status of each lane. It operates in real-time data lanes.

Key Feature

User Interface

- The Lane Status Display Unit (LSDU) is a desktop-based application that monitors all toll lanes and their functions in real time. It provides a comprehensive tool to view real-time traffic trends such as hourly data, incident configuration, monitoring, authoring, and live equipment status.
- All lanes of the plaza are configured to communicate with the plaza-specific LSDU workstation. It is possible to access the LSDU application of another plaza in read-only mode through the hyperlink provided.



- All the data is stored in the plaza-specific LSDU database."

User Registration and Authentication

Make it easy for users to log in to the LSDU using their special username and password, ensuring strong security to keep their information safe. After reviewing the registration details, the user should be able to save the registration and then open the Lane Status Display Unit application.

LSDU basic functionality and data flow

Data Type	Flow	Remarks
All Lane	Lane to LSDU	Required for displaying last 1-hour Traffic Trend
Data Completeness	SHEERVAL Plaza TMS/Lane to LSDU	Completeness Check
Tariff Status updates	SHEERVAL Lane to LSDU	Tariff Data Update
Lane operations commands /permissions/configurations	LSDU to SHEERVAL Lane	Login/Logout
Failures and Traces	Both ways	Equipment Status

LSDU Status

The status will be in terms of connectivity, error messages, operating or non-operating equipment, etc. It will monitor and report the status of equipment for each lane. The LSDU application is used to configure the UFD messages, the number of images (configurable) to be captured by ICS, AVC timeout time (with AVC working and not working), etc.



Dashboard

The LSDU is powered with certain Dashboards for the traffic flow analysis and the full-length utilization of the LSDU features:

- **Plaza Status Dashboard:** Provides an overview of the entire plaza's status.
- **Lane Status Dashboard:** Shows the status of individual lanes.
- **Downloaded (Lane – Plaza DB data Sync. Testing):** Indicates the feature for testing database synchronization between lane and plaza.
- **Traffic Status Chart:** Displays traffic flow analysis.
- **Lane Equipment Functional Status:** Reports the operational status of lane equipment.
- **Graphical Display of Lane Equipment Connectivity:** Visualizes the connectivity of lane equipment.

LSDU Functionality

Lane Monitor

"The LSDU Monitor screen is displayed after login. The Lane monitor screen shows all the equipment, lane IDs, vehicle codes, payment codes, etc. Then, the server socket opens when the user double-clicks on the server socket file. The server socket UI shows the option to enter commands for the different equipment. Each piece of equipment's status changes according to the command added in the server socket, like 'Working' to 'Not Working'."

The screenshot displays the LSDU Lane Monitor interface. At the top, there are navigation tabs: Lane Monitor, Plaza DB Data Sync, Traffic and Revenue Status, Tariff Data, and Card Tariff Data. The main area is a grid of equipment status, with columns for AVCCAMERA, UFD, TRAFFIC, OHLS, FIREALM, BARRIER, AVC, PRINTER, RFTCV, WIM, ANPRCAMERA, Txn Detail ID, Lane ID, Vehicle Class Code, CCH Fare Type, UID CBY, Tariff Amount, and Payment Code. Below the grid is a table with columns: LANE_ID, TXN_SHIFT_UNIQUE_ID, EVENT_DESCRIPTION, EVENT_GROUP_NAME, and LANE. A dialog box titled 'Form1' is open, showing 'Enter Text Here : #100S0SCAMERA\$NOTWORKING*' and a 'Send' button. The Windows taskbar at the bottom shows the system tray with the date 04-04-2024 and time 11:38.

LANE_ID	TXN_SHIFT_UNIQUE_ID	EVENT_DESCRIPTION	EVENT_GROUP_NAME	LANE
100	2021092740413	AVC DOOR OPEN	DOOR/PANEL	FAULT
101	2021092740412	TLC PANEL DOOR OPEN	DOOR/PANEL	MANITE
101	2021092740411	APPLICATION REBOOT	ALARM	FAULT
101	20210927040410	AVC COMMUNICATION FAIL	ALARM	MANUAL MODE
100	20210927040409	APPLICATION REBOOT	ALARM	NORMAL MODE
100	20210927040408	APPLICATION REBOOT	ALARM	FAULT MODE



- **Lane Selection:** By double-clicking on a lane number, the app opens the System Monitor for that specific lane.
- **Lane Status Dashboard:** This dashboard displays the status of all equipment within the selected lane.
- **Traffic Chart:** Accompanying the equipment status, there's a traffic chart that visualizes the flow of traffic.
- **Traffic Status Report:** A report detailing the traffic status is shown next to the chart.
- **Traffic Count:** The app provides a traffic count, processed in one-hour total but displayed in one-minute increments.

The screenshot displays the 'Lane Monitor' application interface. At the top, there are tabs for 'Lane Monitor', 'Plaza DB Data Sync', 'Traffic and Revenue Status', 'Tariff Data', and 'Card Tariff Data'. The main area is divided into several sections:

- Equipment Status:** A row of icons representing different equipment types: AVCCAMERA, UFID, TRAFFIC, OHLS, FIREALM, BARRIER, AVC, PRINTER, RFTCV, WIM, ANPRCAMERA.
- Transaction Table:** A table with columns: Txn Detail ID, Lane ID, Vehicle Class Code, CCH Fare Type, UID CBY, Tariff Amount, and Payment Code. It shows two transactions for Lane ID 201.
- System Monitoring - Lane ID :- 201:** A dashboard showing system health metrics:

Last Updated Time	CPU Usage	RAM	Available Memory	Storage Available
0	0%	0	0	0
- Login Time:** Shows the user's login details:

Logged In Time	Operator Name	Mini Shift Id	Shift Id	Trans Count	Violation Count
02-06-2023 14:19:33	TOLL COLLECTOR 02 (TCO102)	110020230206141933 %	2	13	10 Exempt Count
- Device Information:** A row of icons for various devices.
- AVC Information:**

TXN Count :-	13
Un-Categories :-	0
Discrepant :-	3
- FASTAG Txn Status:**

Total Count :-	2
Transferred to Bank :-	0
Confirm from Bank :-	0
Success from Bank :-	0
Pending to be Transferred :-	0
- Cash Flow:**

Cash :-	0.00
Float :-	0.00
Bleed Off :-	0.00
- Transaction Count Graph:** A bar chart showing transaction counts for categories: CASH, FASTAG, Discrepant, Empty, ETC, Overdue.
- Vehicle Wise Transaction Count:**

BUS :-	0
LCV 2 Axle :-	2
OSV :-	2

The bottom of the screen shows a Windows taskbar with the date 04-04-2024 and time 11:48.

Plaza DB Data Sync

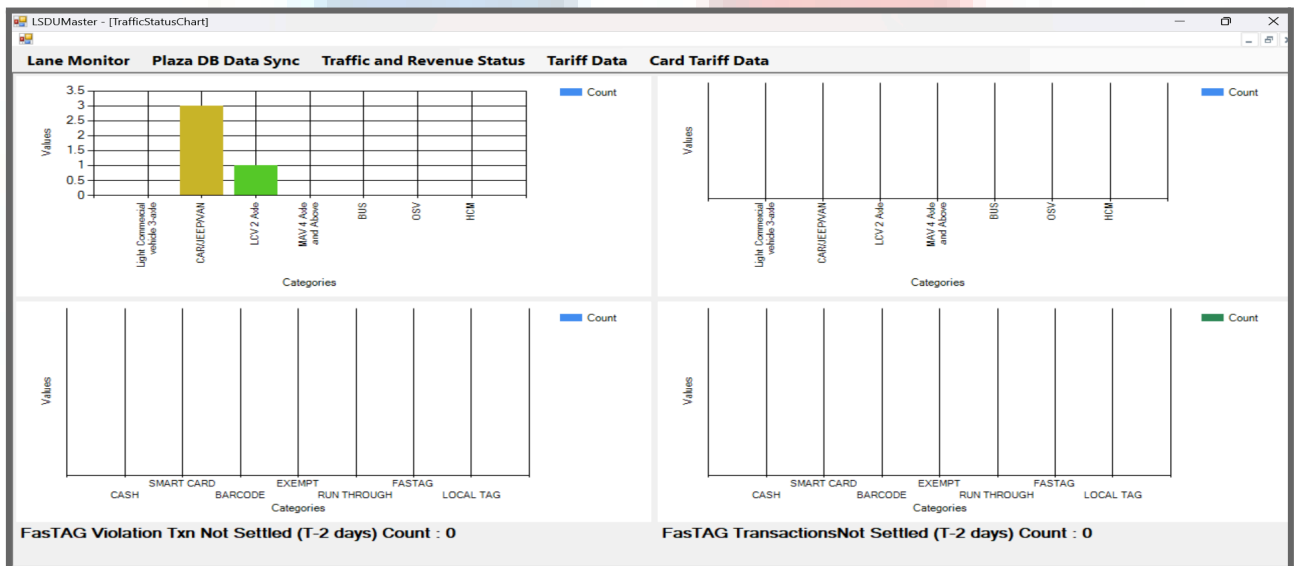
To verify if the Plaza DB data sync shows the records as per the selected date, selected shift, and users. Also, filters have been applied.



	Lane ID	Shift Unique ID	Shift ID	TC ID (Name)	Data Complete	Transfer Status	Review Status	Final Status	Bleedoff Status	Cashup Status	Completion Time
▶	100	1100202302...	1	TCO101 (T...	Yes	Yes	Yes	Yes	Yes	Yes	2/1/2023 5:3...
	100	1100202302...	1	TCO101 (T...	Yes	Yes	Yes	Yes	Yes	Yes	2/1/2023 5:3...
	100	1100202302...	1	TCO101 (T...	Yes	Yes	Yes	Yes	Yes	Yes	2/1/2023 5:6...
	100	1100202302...	1	TCO101 (T...	Yes	Yes	Yes	Yes	Yes	Yes	2/1/2023 5:5...
	100	1100202302...	2	TCO102 (T...	No	No	No	Yes	No	Yes	2/1/2023 3:2...

Traffic and Revenue Status

In the traffic status chart, the total traffic count processed over the last 12 hours is displayed in units of 1 hour. The hourly traffic is presented in chart form, direction-wise, for the plaza. In short, the Traffic and Revenue status provides a graphical representation of the data.



Traffic Data

The Tariff data section displays records according to the selected vehicle class and plaza. Additionally, after applying filters, users can export an Excel file containing data that corresponds to the applied filters.

The screenshot shows the 'Tariff Data' section of the LSDUMaster application. It includes a menu bar with 'Lane Monitor', 'Plaza DB Data Sync', 'Traffic and Revenue Status', 'Tariff Data', and 'Card Tariff Data'. Below the menu are several dropdown menus for filtering: 'Select Vehicle Class', 'Select From Plaza', 'Select To Plaza', 'Select Version', and 'Select Tariff Version'. An 'Export To Excel' button is visible. The main table displays the following data:

Pay Tariff Code	Vehicle Class Code	Vehicle Class Descripti	Transact Type Code	Transact Type Name	Transact Subtype Code	Transact Subtype Name	From Plaza Name	To Plaza Name	Tariff Fare	Tariff Version	Tariff Activation Date	Is Enabled	User ID Created By	Created At	Upda
44000	6003	Light C...	8001	CASH	9002	DAILY ...	PUNE	PUNE	100	44	6/20/20...	1	SAU101	6/20/20...	6/20/20...
44002	6003	Light C...	8001	CASH	9002	DAILY ...	MUMBAI	PUNE	100	44	6/20/20...	1	SAU101	6/20/20...	6/20/20...
44001	6003	Light C...	8001	CASH	9002	DAILY ...	PUNE	MUMBAI	100	44	6/20/20...	1	SAU101	6/20/20...	6/20/20...
44003	6003	Light C...	8001	CASH	9002	DAILY ...	MUMBAI	MUMBAI	100	44	6/20/20...	1	SAU101	6/20/20...	6/20/20...

Card Traffic Data

The Card Tariff data section displays records based on the selected vehicle class, plaza, card type, and version. Additionally, once filters are applied, users have the option to export an Excel file containing data that matches the applied filters.

The screenshot shows the 'Card Tariff Data' section of the LSDUMaster application. It includes a menu bar with 'Lane Monitor', 'Plaza DB Data Sync', 'Traffic and Revenue Status', 'Tariff Data', and 'Card Tariff Data'. Below the menu are several dropdown menus for filtering: 'Select Vehicle Class', 'Card Type', 'Select From Plaza', 'Select To Plaza', 'Select Version', and 'Select Tariff Version'. An 'Export To Excel' button is visible. The main table displays the following data:

Card Tariff Code	Card Type Code	Card Type Name	Vehicle Class Code	Vehicle Class Descriptio	From Plaza Name	To Plaza Name	Amount	From Plaza Code	To Plaza Code	Tariff Version	Tariff Activation Date	Created By	Created At	Updated At
4000	TRPTR...	TRIP C...	6003	Light C...	PUNE	MUMBAI	200	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4001	TRPTR...	TRIP C...	6004	CAR/JE...	PUNE	MUMBAI	50	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4002	TRPTR...	TRIP C...	6005	LCV 2 ...	PUNE	MUMBAI	100	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4003	TRPTR...	TRIP C...	6006	MAV 4 ...	PUNE	MUMBAI	400	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4004	TRPTR...	TRIP C...	6007	BUS	PUNE	MUMBAI	500	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4005	TRPTR...	TRIP C...	6008	OSV	PUNE	MUMBAI	600	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4006	BALLC...	LOCAL ...	6003	Light C...	PUNE	MUMBAI	200	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4007	BALLC...	LOCAL ...	6004	CAR/JE...	PUNE	MUMBAI	50	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4008	BALLC...	LOCAL ...	6005	LCV 2 ...	PUNE	MUMBAI	100	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4009	BALLC...	LOCAL ...	6006	MAV 4 ...	PUNE	MUMBAI	400	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4010	BALLC...	LOCAL ...	6007	BUS	PUNE	MUMBAI	500	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4011	BALLC...	LOCAL ...	6008	OSV	PUNE	MUMBAI	600	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4012	BALLP...	LOCAL ...	6003	Light C...	PUNE	MUMBAI	200	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4013	BALLP...	LOCAL ...	6004	CAR/JE...	PUNE	MUMBAI	50	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4014	BALLP...	LOCAL ...	6005	LCV 2 ...	PUNE	MUMBAI	100	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4015	BALLP...	LOCAL ...	6006	MAV 4 ...	PUNE	MUMBAI	400	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4016	BALLP...	LOCAL ...	6007	BUS	PUNE	MUMBAI	500	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4017	BALLP...	LOCAL ...	6008	OSV	PUNE	MUMBAI	600	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...
4018	BALLC...	LOCAL ...	6003	Light C...	PUNE	MUMBAI	200	1001	1002	4	7/11/2023	POA101	7/10/20...	7/10/20...



Client Profile

The client has over 18 years of experience in the IT industry, serving as an architect and project manager in reputed organizations. He has a strong track record in building teams and software products from scratch, managing software delivery, pre-sales, system analysis, application security, and DevOps. He possesses a strong background in software processes and agile practices and is certified in various areas such as ITIL, Prince2, and TOGAF. He is passionate about this product, which is part of a suite of products in this domain, and brings to it more than 10 years of experience.

Challenges

Integration Complexity: Integrating various hardware and software components of the LSDU application across different toll plazas presents integration challenges. Ensuring seamless communication between different systems and devices requires overcoming compatibility issues and standardizing communication protocols.

Data Security

Encryption Methods: The LSDU application employs strong security techniques to protect sensitive data sent between toll lanes and the LSDU workstation.

Access Controls: Access to the LSDU application is tightly controlled through user authentication mechanisms.

Data Anonymization: Sensitive data like vehicle codes are anonymized within the LSDU database to comply with privacy regulations.

Plaza-specific Database: Each plaza has its own LSDU database, ensuring data related to that specific location is accessible.

User Experience Design: The LSDU application features an intuitive user interface and comprehensive monitoring features, with error prevention mechanisms to minimize user errors.

Scalability: As the number of toll plazas and lanes increases, the LSDU application must scale efficiently.

Notification Delivery: Providing timely notifications to toll operators about equipment malfunctions, traffic incidents, or system updates requires robust notification delivery mechanisms.

Benefits

Enhanced Efficiency: The LSDU application streamlines toll lane monitoring processes.

Accessibility: Real-time access to traffic data and equipment status enhances accessibility for toll operators.

Personalized Experience: Customizable dashboard views and notification settings allow toll operators to personalize their user experience.



Real-Time Updates: The LSDU application provides real-time updates on traffic trends, equipment status changes, and plaza operations.

Transparent Feedback System: A feedback management system within the LSDU application allows toll operators to provide feedback.

Automated Processes: Automated data synchronization, equipment status monitoring, and incident notifications streamline toll plaza operations.

Enhanced Productivity: Comprehensive monitoring and management tools enhance the productivity of toll plaza operators.

Technology Used

C# - Windows Forms Application

MySQL Maria DB

