项目文档

# Functional Requirement

1. Functional Requirements   
1.1 Vehicle Infrastructure Integration (VII) Data Use Analysis and Processing (DUAP) System   
 Function ID: FR-01   
 Description: The system must collect real-time data from probe vehicles, traffic management systems, weather stations, and traveler information systems. It should process and analyze the data to derive traffic metrics, infer incidents, calculate road surface conditions, and perform data quality checks.   
 Input: Real-time data from probe vehicles (speed, location, direction), traffic management systems (traffic signal status, incident reports), weather stations (temperature, humidity, wind speed), and traveler information systems (travel advisories).   
 Output: Updated traffic metrics (congestion levels, travel times, queue lengths), incident records, road surface condition assessments, and quality-checked data.  
  
1.2 Collect Traffic Data   
 Function ID: FR-02   
 Description: The system must collect and store real-time traffic data from probe vehicles, traffic management systems, and weather stations. It should synchronize the data with traffic metrics and perform data quality checks.   
 Input: Probe vehicle data (speed, location, direction), traffic management system data (incident reports, signal status), and weather station data (temperature, precipitation, visibility).   
 Output: Real-time traffic data stored in the system database (Oracle 10G), synchronized with traffic metrics and weather data.  
  
1.3 Analyze Traffic Metrics   
 Function ID: FR-03   
 Description: The system must analyze real-time and historical traffic data to derive metrics such as congestion levels, travel times, and queue lengths. It should detect incidents and generate alerts if necessary.   
 Input: Real-time and historical traffic data, weather data, and road condition data.   
 Output: Traffic metrics (congestion levels, travel times, queue lengths), incident details, and traffic alerts for dissemination to relevant systems.  
  
1.4 Infer Traffic Incidents   
 Function ID: FR-04   
 Description: The system must analyze traffic data to detect and infer potential traffic incidents. It should log incident details, generate alerts, and update the web-based user interface for visualization.   
 Input: Traffic data (speed, queue lengths, congestion levels), weather data, and road surface condition data.   
 Output: Incident records (incident type, location, severity, duration), traffic alerts, and updated map displays on the web interface.  
  
1.5 Calculate Road Surface Conditions   
 Function ID: FR-05   
 Description: The system must integrate probe vehicle data, weather data, and traffic data to calculate road surface conditions. It should validate the results against historical data and generate alerts for hazardous conditions.   
 Input: Probe vehicle data (speed, brake usage), weather data (temperature, precipitation), and traffic data (road condition sensors).   
 Output: Road surface condition assessments (condition type, severity), alerts for hazardous conditions, and updated map displays.  
  
1.6 Monitor Weather Observations   
 Function ID: FR-06   
 Description: The system must monitor real-time weather data from weather stations and integrate it with traffic and road condition data for comprehensive analysis. It should generate weather alerts and update the web-based interface.   
 Input: Real-time weather data (temperature, wind speed, visibility), probe vehicle data, and road condition data.   
 Output: Integrated weather and traffic data, weather alerts, and updated weather displays on the web interface.  
  
1.7 Track Travel Demand   
 Function ID: FR-07   
 Description: The system must calculate and track travel demand based on real-time and historical traffic data, weather conditions, and congestion levels. It should generate travel demand forecasts and alerts if demand exceeds capacity thresholds.   
 Input: Traffic data (congestion levels, travel times), weather data, and historical traffic patterns.   
 Output: Travel demand forecasts, traffic alerts for high demand, and updated traveler information for dissemination.  
  
1.8 Perform Data Quality Checks   
 Function ID: FR-08   
 Description: The system must validate all incoming data (traffic, weather, road condition) for accuracy, consistency, and completeness. It should log invalid data and exclude it from further processing.   
 Input: Traffic data, weather data, and road condition data.   
 Output: Validated data stored in the database, logs of invalid or corrupted data, and data quality check status updates on the web interface.  
  
1.9 Implement Dynamic Data Caching   
 Function ID: FR-09   
 Description: The system must cache frequently accessed and critical data (e.g., traffic metrics, road surface conditions) to improve performance and reduce latency. It should refresh the cache periodically and provide fallback to the database when needed.   
 Input: Real-time data (traffic metrics, road surface conditions, weather observations).   
 Output: Cached data for quick access, updated web interface with cached data, and logs of caching operations.  
  
1.10 Archive Data for Long-Term Storage   
 Function ID: FR-10   
 Description: The system must archive processed data (traffic metrics, weather data, incident details) for long-term storage. It should ensure compliance with data standards and maintain data integrity during archiving.   
 Input: Processed data (traffic metrics, incident details, road surface conditions).   
 Output: Archived data in the Oracle 10G database, logs of archiving operations, and metadata for traceability.  
  
1.11 Format Data According to Standards   
 Function ID: FR-11   
 Description: The system must format processed data to comply with predefined standards (e.g., SAE J2354, TMDD) for external integration. It should validate the data structure and ensure compatibility with external systems.   
 Input: Processed data (traffic metrics, weather observations, incident details).   
 Output: Formatted data for external systems (e.g., Traveler Information Systems, Traffic Management Systems) and logs of formatting operations.  
  
1.12 Process Traffic and Weather Alerts   
 Function ID: FR-12   
 Description: The system must generate, process, and disseminate traffic and weather alerts based on predefined thresholds. It should update the web-based interface and ensure alerts are prioritized based on severity.   
 Input: Real-time traffic and weather data, alert thresholds, and system status.   
 Output: Traffic and weather alerts sent to relevant systems, alerts displayed on the web interface, and logs of alert generation and delivery.  
  
1.13 Publish Traffic Alerts   
 Function ID: FR-13   
 Description: The system must publish traffic alerts to Traffic Management Systems and Traveler Information Systems. It should update the web interface and archive the alerts for compliance.   
 Input: Traffic incident data, alert content, and approval status from the Administrator.   
 Output: Published traffic alerts, updated web interface with alert visuals, and archived alerts for future reference.  
  
1.14 Publish Weather Event Alerts   
 Function ID: FR-14   
 Description: The system must generate and publish weather event alerts (e.g., snow, heavy rain) to Traffic Management Systems and Traveler Information Systems. It should update the web interface and archive the alerts.   
 Input: Weather event data (precipitation, visibility, temperature), alert thresholds, and approval status.   
 Output: Published weather event alerts, updated web interface, and archived alerts for compliance.  
  
1.15 Publish Asset Condition Alerts   
 Function ID: FR-15   
 Description: The system must detect and publish asset condition alerts (e.g., road damage, signal malfunction) to Traffic Management Systems and Traveler Information Systems. It should update the web interface and archive the alerts.   
 Input: Asset condition data (infrastructure status, signal status, road damage), alert thresholds, and approval status.   
 Output: Published asset condition alerts, updated web interface, and archived alerts for compliance.  
  
1.16 Support MI Drive Presentation Data   
 Function ID: FR-16   
 Description: The system must generate MI Drive presentation data from processed traffic, weather, and road condition data. It should format and validate the data for external use and update the web interface for visualization.   
 Input: Processed data (traffic metrics, weather data, road surface conditions).   
 Output: MI Drive presentation data for external systems, updated web interface with presentation data, and archived presentation data.  
  
1.17 Provide Web-Based User Interface   
 Function ID: FR-17   
 Description: The system must provide a web-based user interface for browsing traffic, weather, and road condition data. It should support map displays, icon layers, and decluttering features for real-time visualization.   
 Input: Real-time and processed data (traffic metrics, weather observations, incident details).   
 Output: Updated web interface with map displays, icon layers, and decluttering features for visualization.  
  
1.18 Display Map Views   
 Function ID: FR-18   
 Description: The system must display real-time traffic, weather, and road condition data on map views. It should use the Michigan Geographic Framework for geo-referencing and apply decluttering features for clarity.   
 Input: Real-time data (traffic metrics, weather observations, road conditions), map configuration settings.   
 Output: Real-time map displays with data overlays, decluttering features applied, and logs of map rendering operations.  
  
1.19 Manage Icon Layers   
 Function ID: FR-19   
 Description: The system must allow the Administrator to manage icon layers on the web-based interface. It should support toggling visibility, adjusting priority, and modifying appearance for different data types.   
 Input: Icon layer configuration parameters (data type, visibility, priority, appearance).   
 Output: Updated icon layer settings on the web interface, logs of configuration changes, and synchronized map displays.  
  
1.20 Enable De-Cluttering Features   
 Function ID: FR-20   
 Description: The system must enable decluttering features to reduce visual overload on the web-based interface. It should dynamically adjust the display based on user preferences and data density.   
 Input: Decluttering rules (data density thresholds, priority-based filtering).   
 Output: Decluttered map displays, logs of decluttering settings, and real-time updates with decluttering logic.  
  
1.21 Add New Data Sources   
 Function ID: FR-21   
 Description: The system must allow the Administrator to add new data sources (e.g., probe vehicles, weather stations, traffic management systems) and configure them for integration.   
 Input: Data source details (type, communication protocol, data format, location).   
 Output: New data sources integrated into the system, updated data processing, and logs of source additions.  
  
1.22 Update Data Processing Algorithms   
 Function ID: FR-22   
 Description: The system must allow the Administrator to update or replace data processing algorithms. It should perform a test run with historical data before deployment.   
 Input: Algorithm details (name, description, file, test data).   
 Output: Updated data processing algorithms, logs of algorithm changes, and synchronized data processing.  
  
1.23 Modify Output Formats   
 Function ID: FR-23   
 Description: The system must allow the Administrator to modify the output format of data (e.g., CSV, JSON, XML) to ensure compatibility with external systems.   
 Input: Output format parameters (data type, format name, schema).   
 Output: Modified output formats, updated data exports, and logs of format changes.  
  
1.24 Integrate New Presentation Methods   
 Function ID: FR-24   
 Description: The system must allow the Administrator to integrate new presentation methods (e.g., 3D maps, heatmaps, animated traffic flow) for improved data visualization.   
 Input: Presentation method details (name, description, visualization type, data sources).   
 Output: New presentation methods integrated into the web interface, logs of method changes, and updated visualization options.  
  
1.25 Comply with MDIT Standards   
 Function ID: FR-25   
 Description: The system must ensure all processed data complies with MDIT standards. It should format and validate data to maintain interoperability with external systems.   
 Input: Processed data (traffic metrics, weather observations, incident details).   
 Output: Compliant data stored in the database, logs of compliance checks, and updated web interface with compliance status.  
  
1.26 Utilize Java Software Foundation   
 Function ID: FR-26   
 Description: The system must process and store data using the Java Software Foundation framework. It should maintain compatibility with JDBC and Oracle 10G for database access.   
 Input: Real-time data (traffic, weather, road condition data), Java-based processing rules.   
 Output: Java-based data processing and storage, logs of Java operations, and updated web interface with Java-generated visualizations.  
  
1.27 Use JDBC for Database Access   
 Function ID: FR-27   
 Description: The system must use JDBC to access and update data in the Oracle 10G database. It should maintain secure and efficient database transactions.   
 Input: SQL queries and database connection parameters (host, port, credentials).   
 Output: Database operations (insert, update, delete), logs of JDBC transactions, and synchronized data with the database.  
  
1.28 Manage Oracle 10G Database   
 Function ID: FR-28   
 Description: The system must allow the Administrator to manage Oracle 10G database operations (insert, update, delete, query). It should maintain data integrity and performance.   
 Input: Database operation details (SQL commands, data to insert/update/delete).   
 Output: Updated Oracle 10G database records, logs of database operations, and synchronized data with the web interface.  
  
1.29 Execute Standard SQL Queries   
 Function ID: FR-29   
 Description: The system must allow the Administrator to execute standard SQL queries to retrieve data for analysis or reporting.   
 Input: SQL query text, data source and format preferences.   
 Output: Query results displayed on the web interface, logs of executed queries, and archived query results.  
  
1.30 Apply Michigan Geographic Framework for Geo-Referencing   
 Function ID: FR-30   
 Description: The system must geo-reference all data using the Michigan Geographic Framework. It should ensure accurate mapping of data points for real-time visualization.   
 Input: Data with location information (vehicle location, incident location, weather station location).   
 Output: Geo-referenced data for mapping, updated web interface with geographic data, and logs of geo-referencing operations.  
  
1.31 Maintain Incident Details   
 Function ID: FR-31   
 Description: The system must allow the Administrator to update, view, or delete incident details (e.g., location, severity, duration). It should synchronize the data with traffic and weather information.   
 Input: Incident details (location, severity, duration), update or delete actions.   
 Output: Updated incident records in the database, logs of incident management, and synchronized web interface with incident data.  
  
1.32 Update Traffic Management Systems   
 Function ID: FR-32   
 Description: The system must update Traffic Management Systems with the latest traffic data, alerts, and road conditions. It should format the data according to predefined standards and ensure synchronization.   
 Input: Traffic data (congestion levels, incident details, road surface conditions).   
 Output: Updated Traffic Management Systems, logs of update operations, and archived data for compliance.  
  
1.33 Retrieve Traveler Information   
 Function ID: FR-33   
 Description: The system must retrieve and format traveler information (e.g., travel times, congestion levels, route suggestions) for dissemination to Traveler Information Systems.   
 Input: Traffic data, weather data, and road condition data.   
 Output: Traveler information formatted and sent to external systems, logs of retrieval operations, and updated web interface.  
  
1.34 Manage Probe Vehicle Data   
 Function ID: FR-34   
 Description: The system must process and manage probe vehicle data (speed, location, heading). It should perform quality checks and update traffic metrics and road condition assessments.   
 Input: Probe vehicle data (speed, location, heading), quality check rules.   
 Output: Validated and stored probe vehicle data, updated traffic metrics, and logs of probe data processing.  
  
1.35 Update Infrastructure Information   
 Function ID: FR-35   
 Description: The system must allow the Administrator to update infrastructure data (e.g., road status, signal status, signage changes). It should synchronize the data with traffic and weather systems.   
 Input: Infrastructure update details (location, status, configuration).   
 Output: Updated infrastructure data in the database, synchronized web interface, and logs of infrastructure changes.  
  
1.36 View Traffic Status   
 Function ID: FR-36   
 Description: The system must allow the Administrator to view real-time traffic status (e.g., congestion levels, travel times, queue lengths) on the web-based interface.   
 Input: Real-time traffic data and historical data.   
 Output: Traffic status displayed on the web interface, logs of viewing activity, and synchronized data for analysis.  
  
1.37 View Weather Data   
 Function ID: FR-37   
 Description: The system must allow the Administrator to view real-time weather data (e.g., temperature, visibility, wind speed) on the web-based interface.   
 Input: Real-time weather data from weather stations.   
 Output: Weather data displayed on the web interface, logs of viewing activity, and synchronized weather and traffic data.  
  
1.38 View Road Condition Data   
 Function ID: FR-38   
 Description: The system must allow the Administrator to view real-time road condition data (e.g., road surface conditions, incident details) on the web-based interface.   
 Input: Road condition data (surface type, severity), incident data.   
 Output: Road condition data displayed on the web interface, logs of viewing activity, and synchronized data for traveler advisories.  
  
1.39 View Incident Reports   
 Function ID: FR-39   
 Description: The system must allow the Administrator to view and manage incident reports (e.g., incident type, location, severity) on the web-based interface.   
 Input: Incident data (type, location, severity), filtering parameters.   
 Output: Incident reports displayed on the web interface, logs of viewing activity, and synchronized data for alerting.  
  
1.40 View Asset Conditions   
 Function ID: FR-40   
 Description: The system must allow the Administrator to view asset conditions (e.g., infrastructure status, signal malfunctions) on the web-based interface.   
 Input: Asset condition data (status, location, type), filtering parameters.   
 Output: Asset conditions displayed on the web interface, logs of viewing activity, and synchronized data for alerting.  
  
1.41 Delete Outdated Data   
 Function ID: FR-41   
 Description: The system must allow the Administrator to delete outdated data (e.g., expired traffic metrics, old incident records) to maintain database performance and relevance.   
 Input: Criteria for outdated data (time threshold, data type).   
 Output: Deleted outdated data from the database, logs of deletion operations, and archived data for compliance.  
  
1.42 Modify User Interface Settings   
 Function ID: FR-42   
 Description: The system must allow the Administrator to modify web-based interface settings (e.g., map display options, icon layer visibility). It should apply the changes and update the interface for real-time visualization.   
 Input: Interface configuration parameters (map display, icon layer, decluttering settings).   
 Output: Updated web interface settings, logs of configuration changes, and synchronized data visualization.  
  
1.43 Manage Administrative Tasks   
 Function ID: FR-43   
 Description: The system must allow the Administrator to manage system tasks (e.g., data deletion, configuration updates, alert management). It should ensure task execution without disrupting real-time operations.   
 Input: Administrative task parameters (task type, data, configuration).   
 Output: Updated system configuration, logs of administrative tasks, and synchronized data and interface.  
  
1.44 Maintain System Configuration   
 Function ID: FR-44   
 Description: The system must allow the Administrator to update system configuration parameters (e.g., data sources, alert thresholds, caching rules). It should validate the changes and apply them to the system.   
 Input: Configuration parameters (data source settings, alert rules, cache settings).   
 Output: Updated system configuration, logs of configuration changes, and synchronized data and interface.  
  
1.45 Manage Data Entities Lifecycle   
 Function ID: FR-45   
 Description: The system must manage the lifecycle of data entities (create, update, archive, delete) to ensure data integrity and compliance. It should log all lifecycle operations for audit purposes.   
 Input: Data entity type and action (create, update, archive, delete).   
 Output: Updated data entity records, logs of lifecycle operations, and synchronized data and interface.  
  
1.46 Manage Data Processing Algorithm   
 Function ID: FR-46   
 Description: The system must allow the Administrator to manage data processing algorithms (add, update, delete). It should perform test runs and ensure compatibility before deployment.   
 Input: Algorithm details (name, description, file, test data).   
 Output: Updated algorithm configurations, logs of algorithm management, and synchronized data processing.  
  
1.47 Manage Data Format   
 Function ID: FR-47   
 Description: The system must allow the Administrator to manage data output formats (add, update, delete). It should ensure compatibility with external systems and standards.   
 Input: Data format parameters (name, schema, data type).   
 Output: Updated data format settings, logs of format changes, and synchronized data exports.  
  
1.48 Manage Presentation Method   
 Function ID: FR-48   
 Description: The system must allow the Administrator to manage presentation methods (add, update, delete) for the web interface. It should ensure compatibility with data visualization tools.   
 Input: Presentation method details (name, description, visualization type).   
 Output: Updated presentation methods, logs of method changes, and synchronized web interface visualization.  
  
1.49 Manage Data Cache   
 Function ID: FR-49   
 Description: The system must allow the Administrator to manage dynamic data cache settings (size, refresh frequency, eviction policies). It should ensure optimal performance and data accuracy.   
 Input: Cache configuration parameters (cache size, refresh interval, eviction policy).   
 Output: Updated cache settings, logs of cache management, and synchronized data access and performance.  
  
1.50 Manage ArchiveRecord   
 Function ID: FR-50   
 Description: The system must allow the Administrator to manage ArchiveRecord entries (add, update, delete) for long-term storage. It should maintain data integrity and compliance.   
 Input: ArchiveRecord details (data type, archive date, metadata).   
 Output: Updated ArchiveRecord entries, logs of archive management, and synchronized data storage.  
  
1.51 Manage AlertConfiguration   
 Function ID: FR-51   
 Description: The system must allow the Administrator to manage alert configurations (add, update, delete). It should ensure alerts are generated based on valid thresholds and rules.   
 Input: Alert configuration parameters (alert type, threshold, trigger time).   
 Output: Updated alert configurations, logs of alert management, and synchronized alert generation.  
  
1.52 Manage VII System   
 Function ID: FR-52   
 Description: The system must allow the Administrator to manage VII system configurations (add, update, delete data sources, integration rules). It should ensure system stability and data flow.   
 Input: VII system configuration parameters (data source details, integration rules).   
 Output: Updated VII system configurations, logs of system changes, and synchronized data integration.  
  
1.53 Manage DUAP   
 Function ID: FR-53   
 Description: The system must allow the Administrator to manage DUAP configurations (add, update, delete modules, algorithms, or processing rules). It should ensure data processing aligns with updated settings.   
 Input: DUAP configuration parameters (module name, algorithm version, data source mapping).   
 Output: Updated DUAP settings, logs of configuration changes, and synchronized data processing.  
  
1.54 Manage Probe Vehicles   
 Function ID: FR-54   
 Description: The system must allow the Administrator to manage probe vehicle configurations (add, update, delete, activate/deactivate). It should ensure accurate and reliable data collection.   
 Input: Probe vehicle configuration parameters (vehicle ID, communication protocol, data format).   
 Output: Updated probe vehicle configurations, logs of management operations, and synchronized data collection.  
  
1.55 Manage Traffic Management Systems   
 Function ID: FR-55   
 Description: The system must allow the Administrator to manage Traffic Management System configurations (add, update, delete). It should ensure data exchange and synchronization.   
 Input: Traffic Management System configuration parameters (system ID, communication endpoint, data format).   
 Output: Updated Traffic Management System configurations, logs of system changes, and synchronized data flow.  
  
1.56 Manage Weather Stations   
 Function ID: FR-56   
 Description: The system must allow the Administrator to manage weather station configurations (add, update, delete). It should ensure accurate weather data collection and integration.   
 Input: Weather station configuration parameters (station ID, communication protocol, data format).   
 Output: Updated weather station configurations, logs of station changes, and synchronized weather data.  
  
1.57 Manage Traveler Information Systems   
 Function ID: FR-57   
 Description: The system must allow the Administrator to manage Traveler Information System configurations (add, update, delete). It should ensure real-time data dissemination to travelers.   
 Input: Traveler Information System configuration parameters (system ID, communication endpoint, data format).   
 Output: Updated Traveler Information System configurations, logs of system changes, and synchronized data delivery.  
  
1.58 Manage Data Quality Checks   
 Function ID: FR-58   
 Description: The system must allow the Administrator to manage data quality check rules (add, update, delete). It should ensure data integrity and exclude invalid data from processing.   
 Input: Data quality check parameters (rule name, validation criteria, threshold values).   
 Output: Updated quality check rules, logs of rule management, and synchronized data validation.

# External Description

2. External Interfaces  
  
2.1 User Interface   
The system provides a web-based user interface (Web UI) for real-time data visualization and system administration. The Web UI supports map displays, icon layers for traffic, weather, and road conditions, and decluttering features to enhance readability and usability. The interface allows the Administrator to manage configurations, view traffic status, weather data, and road conditions, and perform tasks such as adding new data sources, updating algorithms, and modifying output formats. The Web UI also displays traffic alerts, weather alerts, and asset condition alerts, ensuring that users receive up-to-date information for decision-making and system monitoring.  
  
2.2 Hardware Interface   
The system interfaces with various hardware components to collect real-time data:  
  
- \*\*Probe Vehicles\*\*: These vehicles provide real-time data such as speed, location, and direction. The system communicates with them via predefined data formats and communication protocols (e.g., TCP/IP, HTTP).   
- \*\*Traffic Management Systems (TMS)\*\*: These systems provide traffic signal status and incident reports. The system integrates with TMS using standard data formats and communication protocols to ensure seamless data exchange.   
- \*\*Weather Stations\*\*: The system receives weather data (e.g., temperature, humidity, wind speed, visibility, precipitation) from weather stations. Communication is typically through APIs or data feeds, using standard formats such as XML or JSON.   
- \*\*Road Condition Sensors\*\*: These sensors provide data on road surface conditions, including temperature and moisture levels. The system uses standardized communication protocols to integrate this data into its analysis.   
  
These hardware interfaces are essential for collecting and processing real-time data, enabling accurate traffic and weather monitoring.  
  
2.3 Software Interface   
The system interacts with several external software systems and databases:  
  
- \*\*Oracle 10G Database\*\*: The system uses this database for storing and retrieving traffic, weather, road condition, and incident data. Data is accessed via JDBC for secure and efficient transactions.   
- \*\*Traffic Management Systems (TMS) Software\*\*: The system sends and receives data from TMS software to update traffic metrics and incident records. Data is formatted according to standards such as TMDD and SAE J2354 for interoperability.   
- \*\*Traveler Information Systems (TIS) Software\*\*: The system disseminates traveler information (e.g., travel times, route suggestions, congestion levels) to TIS software. Data is formatted for compatibility with TIS platforms.   
- \*\*Java Software Foundation (JSF) Framework\*\*: The system uses JSF for data processing and storage. It ensures compatibility with Java-based components and supports dynamic data caching.   
- \*\*Third-Party Data Visualization Tools\*\*: The system integrates with tools that support 3D maps, heatmaps, and animated traffic flow for enhanced data presentation. These tools are configured through the web interface by the Administrator.   
- \*\*Data Formatting and Validation Tools\*\*: The system employs tools to format processed data according to predefined standards (e.g., SAE J2354, TMDD) and validate the data structure for external use.   
  
These software interfaces ensure that the system can process, store, and disseminate data efficiently and in a standardized format.  
  
2.4 Communication Interface   
The system supports various communication interfaces to facilitate data exchange between components and external systems:  
  
- \*\*Web Browsing\*\*: Users access the web-based interface via standard web browsers (e.g., Chrome, Firefox). This interface supports real-time data visualization and administrative tasks.   
- \*\*API Communication\*\*: The system communicates with external systems (e.g., TMS, TIS, weather stations) using APIs. These APIs support data retrieval and dissemination, ensuring compatibility with external systems.   
- \*\*Email Notifications\*\*: The system can send email notifications for critical alerts (e.g., traffic incidents, weather events, asset conditions). These emails are generated based on predefined alert severity levels and are sent to designated recipients.   
- \*\*Message Push Services\*\*: The system supports message push to external systems for real-time updates (e.g., traffic alerts, weather advisories). These messages are formatted according to standard protocols and are delivered via secure channels.   
- \*\*Data Feeds\*\*: The system receives and sends data feeds from and to external sources (e.g., probe vehicles, weather stations) using standardized formats and protocols. These data feeds are synchronized with internal data processing and visualization.   
  
The communication interfaces ensure that the system can interact with external entities in a timely and secure manner, supporting real-time data flow and system integration.

# Use Case

Use Case Name: Vehicle Infrastructure Integration (VII) Data Use Analysis and Processing (DUAP) System   
Use Case ID: UC-01   
Actors: Administrator, Traffic Management Systems, Weather Stations, Traveler Information Systems, Probe Vehicles   
Preconditions:   
1. The VII system is operational and connected to all relevant data sources (traffic data, weather data, road condition data).   
2. Probe vehicles are transmitting real-time data to the VII system.   
3. The DUAP system has access to the data entities and is configured to process and analyze incoming data.   
  
Postconditions:   
1. Traffic metrics, congestion levels, travel times, and queue lengths are updated in the system.   
2. Incident details and road surface conditions are recorded and processed.   
3. Weather observations are integrated into the system for real-time monitoring.   
4. Travel demand is analyzed and used to generate traveler information.   
5. Data quality checks are performed to ensure accuracy and consistency.   
6. Dynamic data caching is implemented to improve system performance.   
7. Long-term archiving of processed data is completed for future reference.   
  
Main Flow:   
1. The VII system receives real-time data from probe vehicles, traffic management systems, weather stations, and traveler information systems.   
2. The DUAP system processes the incoming data, applying data quality checks to filter out invalid or corrupted entries.   
3. Traffic data is analyzed to determine congestion levels, travel times, and queue lengths.   
4. Weather data is integrated with road condition data to assess road surface conditions and potential hazards.   
5. Incident details are extracted from the data and recorded in the system for further analysis.   
6. Travel demand is calculated based on the processed data to support traveler information systems.   
7. The processed data is cached dynamically to enhance system performance and ensure quick access.   
8. The data is archived for long-term storage, following predefined data standards (SAE J2354, TMDD).   
9. The system updates the web-based user interface, including map displays, icon layers, and de-cluttering features, to reflect the latest data.   
10. The administrator is notified of any significant changes in traffic or weather conditions.   
  
Alternative Flow:   
1. If the incoming data fails the quality checks, the DUAP system logs the issue and discards the invalid data.   
2. If there is a temporary disconnection from a data source, the system continues to use cached data until the connection is restored.   
3. If the system detects a critical incident, it triggers an alert to traffic management systems and traveler information systems to notify affected users.   
4. If the system encounters a high volume of data, it activates dynamic data caching to manage the load and prevent system degradation.   
5. If the administrator requests a manual data check, the system provides a detailed report of the data processing and analysis activities.  
  
Use Case Name: Collect Traffic Data   
Use Case ID: UC-02   
Actors: Traffic Management Systems, Probe Vehicles, Weather Stations, Administrator   
Preconditions:   
1. The VII system is fully operational and connected to probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is configured and ready to process real-time traffic data.   
3. The data entities (traffic data, weather data, road condition data) are accessible and properly formatted.   
4. Communication channels between data sources and the VII system are active and secure.   
  
Postconditions:   
1. Real-time traffic data is successfully collected and stored in the system.   
2. Traffic metrics and congestion levels are updated based on the collected data.   
3. Weather and road condition data are synchronized with the traffic data for comprehensive analysis.   
4. Data quality checks are performed, and any invalid data is logged or discarded.   
5. The system caches the collected data dynamically to support performance optimization.   
6. The Administrator is informed of any anomalies or issues in the data collection process.   
  
Main Flow:   
1. Probe vehicles transmit real-time traffic data (speed, location, direction, etc.) to the VII system.   
2. Traffic management systems provide additional traffic data, including traffic signal status and incident reports.   
3. Weather stations supply current weather observations relevant to road conditions.   
4. The VII system forwards the collected data to the DUAP system for processing and integration.   
5. DUAP performs data quality checks to ensure the data is valid and consistent.   
6. Valid data is stored in the system database (e.g., Oracle 10G, JDBC, Java Software Foundation).   
7. The system updates traffic metrics such as congestion levels, travel times, and queue lengths.   
8. The web-based user interface is refreshed to display the latest traffic data on map displays and icon layers.   
9. Traveler Information Systems receive the updated data to provide real-time travel advice.   
10. The system archives the collected data for long-term storage in compliance with data standards (SAE J2354, TMDD).   
  
Alternative Flow:   
1. If a probe vehicle fails to transmit data, the system logs the event and continues collecting data from other sources.   
2. If the data from a source is incomplete or corrupted, the DUAP system discards the data and logs the error for review.   
3. If a weather station is offline, the system uses the most recent weather data available to maintain road condition assessments.   
4. If the system detects an unusually high volume of data, it activates dynamic data caching to manage the load and maintain performance.   
5. If the Administrator requests a manual data review, the system generates a report summarizing the data collection and quality check results.  
  
Use Case Name: Analyze Traffic Metrics   
Use Case ID: UC-03   
Actors: Administrator, Traffic Management Systems, Traveler Information Systems, Probe Vehicles, Weather Stations   
Preconditions:   
1. The VII system is connected and receiving real-time traffic, weather, and road condition data.   
2. The DUAP system is active and configured to process and analyze traffic data.   
3. Historical and real-time data are available for comparative analysis.   
4. The Administrator has initiated or scheduled a traffic metrics analysis task.   
  
Postconditions:   
1. Traffic metrics (e.g., congestion levels, travel times, queue lengths) are analyzed and reported.   
2. The results of the analysis are available for visualization on the web-based user interface.   
3. Traffic alerts and incident reports are generated if significant patterns are detected.   
4. The Administrator is provided with a summary of the traffic conditions and any recommendations.   
5. The system archives the analysis results for future reference and compliance with data standards.   
  
Main Flow:   
1. The Administrator initiates a traffic metrics analysis through the web-based user interface.   
2. The DUAP system retrieves the latest real-time and historical traffic data from the VII system.   
3. The system integrates this data with current weather and road condition information.   
4. Traffic metrics are calculated, including congestion levels, travel times, and queue lengths.   
5. Incident details are extracted and cross-referenced with traffic patterns to identify potential causes.   
6. Travel demand is analyzed to predict future traffic behavior and inform traveler information systems.   
7. The system updates the web-based interface with map displays, icon layers, and decluttered visualizations.   
8. The results are stored in the system database for long-term archiving and reference.   
9. The Administrator receives a summary report with key findings and any necessary alerts.   
10. The system triggers alerts to Traffic Management Systems and Traveler Information Systems if critical traffic patterns are identified.   
  
Alternative Flow:   
1. If the real-time data is unavailable, the system uses cached or archived data to perform the analysis.   
2. If the analysis identifies a sudden increase in congestion levels, an alert is sent to relevant traffic management systems.   
3. If the data quality checks fail during analysis, the system logs the issue and excludes the invalid data from the results.   
4. If the Administrator requests a detailed breakdown of the metrics, the system generates and provides a comprehensive report.   
5. If the system detects inconsistencies between traffic data and weather or road condition data, it flags the discrepancies for manual review.  
  
Use Case Name: Infer Traffic Incidents   
Use Case ID: UC-04   
Actors: Traffic Management Systems, Probe Vehicles, Weather Stations, Administrator, Traveler Information Systems   
Preconditions:   
1. The VII system is receiving real-time traffic data from probe vehicles and traffic management systems.   
2. Weather data from weather stations is being integrated into the system.   
3. The DUAP system is configured and capable of analyzing traffic patterns to infer potential incidents.   
4. The system has access to historical data for comparison and pattern recognition.   
5. Data quality checks are in place to ensure the reliability of input data.   
  
Postconditions:   
1. Potential traffic incidents are identified and recorded in the system.   
2. Incident details are synchronized with road surface conditions and weather observations.   
3. Traffic alerts and asset condition alerts are generated and sent to relevant systems.   
4. The web-based user interface is updated to reflect the inferred incidents on map displays and icon layers.   
5. The Administrator is notified of inferred incidents for further action.   
6. The system archives the incident records for compliance with data standards (SAE J2354, TMDD).   
  
Main Flow:   
1. The DUAP system continuously analyzes incoming traffic data, including vehicle speeds, queue lengths, and congestion levels.   
2. It cross-references the traffic data with weather observations and road surface conditions to detect anomalies.   
3. If an unusual pattern is detected (e.g., sudden drop in vehicle speed, unexpected queue formation), the system infers a potential traffic incident.   
4. The incident is logged with details such as location, time, and potential cause.   
5. The system generates alerts for traffic management systems and traveler information systems to notify relevant stakeholders.   
6. The Administrator is notified of the inferred incident via the web-based interface.   
7. The system updates the map displays and icon layers to visually represent the incident for monitoring and response.   
8. Incident data is stored in the system database (e.g., Oracle 10G, JDBC, Java Software Foundation).   
9. The system archives the incident data for long-term storage and analysis.   
10. The Administrator can review and confirm the incident or take corrective actions as needed.   
  
Alternative Flow:   
1. If the inferred incident is later determined to be a false positive, the Administrator can manually mark it as invalid.   
2. If the system detects multiple overlapping incidents in the same area, it prioritizes them based on severity and impact.   
3. If the weather data is not available, the system infers incidents based solely on traffic and road condition data.   
4. If the DUAP system encounters performance issues due to high data volume, it uses dynamic data caching to manage the load.   
5. If the Administrator requests a detailed analysis of the inferred incident, the system provides a report with supporting data and visualizations.  
  
Use Case Name: Calculate Road Surface Conditions   
Use Case ID: UC-05   
Actors: Administrator, Traffic Management Systems, Weather Stations, Probe Vehicles, Traveler Information Systems   
Preconditions:   
1. The VII system is operational and connected to probe vehicles, weather stations, and traffic management systems.   
2. Real-time weather and traffic data are being transmitted to the system.   
3. The DUAP system is configured to process and analyze road surface condition data.   
4. Data quality checks are active to ensure data integrity.   
5. The system has access to road condition data and historical data for comparison.   
  
Postconditions:   
1. Road surface conditions are calculated and updated in the system.   
2. The results are integrated with traffic and weather data for comprehensive analysis.   
3. The web-based user interface is updated to display the current road surface conditions on map displays and icon layers.   
4. Traveler Information Systems and Traffic Management Systems are notified of any hazardous road conditions.   
5. The system archives the calculated road surface condition data for future reference.   
6. Asset condition alerts are generated and sent to relevant stakeholders if critical conditions are detected.   
  
Main Flow:   
1. The system collects real-time data from probe vehicles, including speed, location, and brake usage.   
2. Weather stations provide current weather data, such as temperature, precipitation, and humidity.   
3. Traffic management systems supply road surface condition data from sensors and cameras.   
4. The DUAP system integrates the collected data and applies algorithms to calculate road surface conditions (e.g., ice, wet, dry).   
5. The system cross-references the results with historical road surface data to validate and refine the current assessment.   
6. Data quality checks are performed to ensure accuracy and consistency of the calculated conditions.   
7. If hazardous conditions are detected, alerts are generated for traffic management and traveler information systems.   
8. The web-based interface is updated with the calculated road surface conditions using map displays and icon layers.   
9. The Administrator is notified of any critical road surface conditions for review and action.   
10. The system archives the calculated road surface data in compliance with data standards (SAE J2354, TMDD).   
  
Alternative Flow:   
1. If weather data is missing or delayed, the system estimates road surface conditions using probe vehicle data and historical patterns.   
2. If the calculated road surface conditions are inconsistent or ambiguous, the system flags the area for manual review by the Administrator.   
3. If the system detects a sudden change in road surface conditions (e.g., black ice formation), it triggers an immediate alert to relevant systems.   
4. If probe vehicle data is unavailable for a specific area, the system relies on data from traffic sensors and cameras for condition estimation.   
5. If the Administrator overrides the system's calculation and provides a manual assessment, the system updates the records accordingly and sends revised alerts.  
  
Use Case Name: Monitor Weather Observations   
Use Case ID: UC-06   
Actors: Administrator, Weather Stations, Traffic Management Systems, Traveler Information Systems, Probe Vehicles   
  
Preconditions:   
1. The VII system is operational and connected to weather stations, probe vehicles, and traffic management systems.   
2. Weather data is being transmitted in real-time from weather stations.   
3. The DUAP system is configured to process and monitor incoming weather observations.   
4. Data quality checks are enabled to validate the integrity of weather data.   
5. The web-based user interface is active and capable of displaying weather-related information.   
  
Postconditions:   
1. Real-time weather observations are monitored and integrated into the system.   
2. Weather alerts are generated and sent to relevant systems if hazardous conditions are detected.   
3. The web-based interface is updated with weather data on map displays and icon layers.   
4. Traveler Information Systems receive updates based on current weather conditions.   
5. The system archives the weather data for long-term reference and compliance with data standards.   
6. The Administrator is notified of any significant weather changes or system issues.   
  
Main Flow:   
1. Weather stations transmit real-time weather data (e.g., precipitation, temperature, wind speed, visibility).   
2. The VII system forwards the data to the DUAP system for processing and integration.   
3. DUAP performs data quality checks to ensure the data is valid and consistent.   
4. Valid weather data is stored in the system database (e.g., Oracle 10G, JDBC, Java Software Foundation).   
5. The system correlates the weather data with traffic data and road surface conditions.   
6. Weather alerts are generated if hazardous conditions (e.g., heavy rain, snow, fog) are detected.   
7. The web-based interface is updated to display the current weather observations using map displays and icon layers.   
8. Traveler Information Systems and Traffic Management Systems are notified of weather-related changes.   
9. The Administrator is alerted to any significant weather events for further action.   
10. The system archives the weather data in compliance with predefined data standards (SAE J2354, TMDD).   
  
Alternative Flow:   
1. If weather data fails quality checks, the system logs the issue and discards the invalid data.   
2. If a weather station is temporarily offline, the system uses the most recent data available for monitoring.   
3. If the system detects conflicting weather data from multiple sources, it initiates a manual review process for the Administrator.   
4. If the weather data volume exceeds system capacity, dynamic data caching is activated to manage the load.   
5. If the Administrator manually requests a weather data review, the system provides a detailed report of the current and archived weather observations.  
  
Use Case Name: Track Travel Demand   
Use Case ID: UC-07   
Actors: Administrator, Traffic Management Systems, Weather Stations, Traveler Information Systems, Probe Vehicles   
Preconditions:   
1. The VII system is operational and connected to all data sources (probe vehicles, traffic management systems, weather stations).   
2. The DUAP system is configured and running to analyze traffic and traveler data.   
3. Real-time and historical traffic metrics are available for demand modeling.   
4. The web-based user interface is active for displaying travel demand information.   
5. Data quality checks are in place to ensure accurate and consistent input data.   
  
Postconditions:   
1. Travel demand is calculated and updated in the system.   
2. Traveler Information Systems receive updated travel demand forecasts for user notifications.   
3. The Administrator is provided with a summary of current and projected travel demand.   
4. The web-based interface displays the travel demand visualization using map displays and icon layers.   
5. The system archives travel demand data for future analysis and compliance with data standards.   
6. Traffic alerts are generated if the demand exceeds capacity thresholds.   
  
Main Flow:   
1. The VII system collects real-time traffic data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system processes the data and applies data quality checks to ensure accuracy.   
3. Historical travel demand patterns are retrieved and compared with current traffic metrics.   
4. Travel demand is calculated based on trends, congestion levels, and weather conditions.   
5. The system generates travel demand forecasts for specific road segments and timeframes.   
6. Traveler Information Systems receive the forecasts to provide real-time travel advice and route optimization.   
7. The Administrator is notified of the demand summary via the web-based interface.   
8. The web-based interface updates map displays and icon layers to show travel demand levels.   
9. If demand exceeds predefined thresholds, traffic alerts are triggered and sent to relevant systems.   
10. The system archives the travel demand data in compliance with data standards (SAE J2354, TMDD).   
  
Alternative Flow:   
1. If real-time data is unavailable, the system uses cached or historical data to estimate travel demand.   
2. If the calculated demand is inconsistent with previous trends, the system flags the discrepancy for Administrator review.   
3. If a weather event significantly impacts travel demand (e.g., snowstorm), the system adjusts the demand forecast accordingly.   
4. If the Administrator overrides the system's demand forecast, the system updates the records and sends revised alerts.   
5. If the system detects a sudden surge in travel demand, it triggers a high-priority alert to Traffic Management Systems for immediate response.  
  
Use Case Name: Perform Data Quality Checks   
Use Case ID: UC-08   
Actors: Administrator, DUAP System, Traffic Management Systems, Weather Stations, Probe Vehicles   
  
Preconditions:   
1. The VII system is operational and receiving data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is configured and running to perform data quality checks on incoming data.   
3. Real-time and historical data are accessible and properly formatted.   
4. Data entities such as traffic data, weather data, and road condition data are available for validation.   
5. The web-based user interface is active and capable of displaying the results of quality checks.   
  
Postconditions:   
1. All incoming data is validated for accuracy, consistency, and completeness.   
2. Invalid or corrupted data is logged and excluded from further processing.   
3. Valid data is stored in the system database for use in traffic analysis and incident detection.   
4. The Administrator is informed of any quality issues or system anomalies.   
5. The system updates the web-based interface to reflect the status of data quality checks.   
6. Dynamic data caching is adjusted based on the results of the quality checks.   
7. The system archives quality check logs for compliance and audit purposes.   
  
Main Flow:   
1. The DUAP system receives real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The system initiates data quality checks on each incoming data entity, including traffic data, weather data, and road condition data.   
3. It validates the data against predefined quality criteria, such as data format, range, and consistency.   
4. If data passes the checks, it is stored in the system database (e.g., Oracle 10G, JDBC, Java Software Foundation).   
5. If data fails the checks, the system logs the error and discards the invalid data.   
6. The system updates the web-based user interface to show the status of data quality checks, including any failed entries.   
7. The Administrator reviews the quality check results via the interface.   
8. Valid data is integrated with other system data for traffic analysis, road surface condition calculation, and incident detection.   
9. The system archives the quality check logs and results for long-term storage and compliance with data standards (SAE J2354, TMDD).   
10. The Administrator can request detailed reports of data quality check outcomes if needed.   
  
Alternative Flow:   
1. If the system detects a recurring pattern of data quality issues from a specific source, it flags the source for further investigation by the Administrator.   
2. If a probe vehicle or weather station is transmitting incomplete data, the system logs the event and may prompt a retransmission request.   
3. If the data volume is too high for the DUAP system to process in real-time, dynamic data caching is activated to manage the load.   
4. If the Administrator manually overrides a quality check result and allows the data to be processed, the system updates its records and includes the data in the analysis.   
5. If the system encounters a critical failure in the quality check module, it sends an alert to the Administrator and temporarily holds incoming data for manual validation.  
  
Use Case Name: Implement Dynamic Data Caching   
Use Case ID: UC-09   
Actors: Administrator, DUAP System, Traffic Management Systems, Weather Stations, Probe Vehicles, Web-based User Interfaces   
  
Preconditions:   
1. The VII system is operational and receiving real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is configured and capable of processing, analyzing, and caching data.   
3. The system has access to both real-time and historical data for caching decisions.   
4. Data quality checks are in place to ensure the reliability of data to be cached.   
5. The system is equipped with caching mechanisms and storage resources (e.g., Oracle 10G, JDBC, Java Software Foundation).   
  
Postconditions:   
1. Frequently accessed and critical data is stored in dynamic caches for faster retrieval.   
2. System performance is improved through reduced latency in data access and processing.   
3. The Administrator is notified of caching status and performance improvements.   
4. The web-based user interface is updated with cached data for real-time visualization.   
5. Data caching strategies are adjusted based on system load and data usage patterns.   
6. The system continues to archive data for long-term compliance with data standards (SAE J2354, TMDD).   
  
Main Flow:   
1. The DUAP system processes incoming real-time data from probe vehicles, traffic management systems, and weather stations.   
2. It identifies frequently accessed data entities (e.g., traffic metrics, road surface conditions, weather observations).   
3. The system applies dynamic data caching rules to store these data entities in a high-speed cache.   
4. Caching strategies are adjusted based on system performance metrics and user access patterns.   
5. The cached data is used to populate the web-based user interface, including map displays and icon layers, for faster visualization.   
6. The system ensures that cached data is periodically refreshed to maintain accuracy.   
7. The Administrator can view caching status and performance reports via the web-based interface.   
8. The system archives the original data for long-term reference and compliance.   
9. Alerts are triggered if caching mechanisms are underperforming or if cache eviction is needed.   
10. The system ensures seamless fallback to the database when cached data is not available or outdated.   
  
Alternative Flow:   
1. If the incoming data fails quality checks, it is not cached and is instead logged and archived.   
2. If the system experiences a sudden surge in data requests, it automatically expands the cache or prioritizes caching for high-demand data.   
3. If the cache becomes full, the system evicts the least recently used or least critical data to make space.   
4. If the Administrator manually adjusts caching parameters, the system updates its caching strategy accordingly.   
5. If the system detects that cached data is inconsistent with real-time data, it initiates a cache refresh and updates the user interface.  
  
Use Case Name: Archive Data for Long-Term Storage   
Use Case ID: UC-10   
Actors: Administrator, DUAP System, Traffic Management Systems, Weather Stations, Probe Vehicles   
  
Preconditions:   
1. The VII system is operational and has successfully processed and analyzed incoming data.   
2. The DUAP system has completed data quality checks and is ready to archive the data.   
3. The system has access to long-term storage infrastructure (e.g., Oracle 10G, JDBC, Java Software Foundation).   
4. Data entities such as traffic data, weather data, road condition data, and incident details are available for archiving.   
5. Archiving policies and data standards (e.g., SAE J2354, TMDD) are defined and enforced.   
  
Postconditions:   
1. Processed data is archived in a secure and structured manner for long-term retention.   
2. Archived data is accessible for historical analysis, compliance checks, and system audits.   
3. The system maintains performance by offloading data from active processing layers to long-term storage.   
4. The Administrator is notified of the archiving status and any potential issues.   
5. The web-based user interface reflects the successful completion of archiving activities.   
  
Main Flow:   
1. The DUAP system identifies data entities that are eligible for long-term archiving, such as historical traffic metrics, weather observations, and incident records.   
2. The system validates the data against archiving policies and data standards (SAE J2354, TMDD) to ensure compliance.   
3. Valid data is compressed and formatted for efficient storage and future retrieval.   
4. The system transfers the data to the long-term storage database (e.g., Oracle 10G, JDBC, Java Software Foundation).   
5. Metadata is added to the archived data for traceability and reference.   
6. The system updates the web-based user interface to indicate the completion of the archiving process.   
7. The Administrator is notified of the successful archiving and can access archived records for review.   
8. The system maintains a log of all archiving activities for audit purposes.   
9. Archived data is indexed and organized for quick access in case of future data retrieval requests.   
10. The system ensures that archiving does not impact the performance of real-time data processing or caching mechanisms.   
  
Alternative Flow:   
1. If the data fails validation during the archiving process, the system logs the issue and excludes the data from archiving.   
2. If the long-term storage system is unavailable, the system temporarily stores the data in a holding area until the issue is resolved.   
3. If the system detects insufficient storage space, it triggers an alert to the Administrator for expansion or data management actions.   
4. If the Administrator requests a manual archiving operation, the system initiates and logs the process accordingly.   
5. If the system encounters a conflict in archived data (e.g., duplicate entries), it resolves the conflict using predefined rules or prompts the Administrator for input.  
  
Use Case Name: Format Data According to Standards (SAE J2354)   
Use Case ID: UC-11   
Actors: Administrator, DUAP System, Traffic Management Systems, Weather Stations, Probe Vehicles   
  
Preconditions:   
1. The VII system is operational and receiving real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is configured to process and format data in accordance with the SAE J2354 and TMDD standards.   
3. The system has access to both raw and processed data entities for formatting.   
4. Data quality checks have been completed to ensure the data is valid and consistent.   
5. The system is connected to the long-term storage and caching mechanisms (e.g., Oracle 10G, JDBC, Java Software Foundation).   
  
Postconditions:   
1. The data is formatted to comply with the SAE J2354 and TMDD standards.   
2. Formatted data is ready for integration with external systems, such as traveler information systems and traffic management systems.   
3. The web-based user interface is updated to reflect the status of data formatting.   
4. The Administrator is informed of any formatting errors or compliance issues.   
5. The system archives the formatted data for long-term storage and future reference.   
  
Main Flow:   
1. The DUAP system receives processed data from the VII system, including traffic metrics, weather observations, and road condition assessments.   
2. The system applies formatting rules to ensure the data complies with the SAE J2354 and TMDD standards.   
3. Data entities are validated against the required format, including data structure, naming conventions, and encoding rules.   
4. The formatted data is stored in the system database and is made available for external integration.   
5. The system updates the web-based user interface to indicate the successful formatting of data.   
6. The Administrator is notified of the formatting status and can review the data if needed.   
7. The system archives the formatted data for long-term compliance and historical analysis.   
8. Traffic Management Systems and Traveler Information Systems receive the formatted data for display and processing.   
9. The system ensures that all data is consistently formatted to avoid integration errors.   
10. The Administrator confirms the compliance of the formatted data with the defined standards.   
  
Alternative Flow:   
1. If the data does not conform to the required format, the DUAP system logs the error and excludes the data from further integration.   
2. If the system detects missing metadata required by the standards, it prompts the Administrator to provide the necessary information.   
3. If a formatting rule is missing or outdated, the system triggers a system update or alert for the Administrator to resolve.   
4. If the Administrator manually requests a reformatting of data, the system applies the updated formatting rules and logs the action.   
5. If the system encounters an error during the formatting process, it triggers an alert for the Administrator and pauses the operation until the issue is resolved.  
  
Use Case Name: Process Traffic and Weather Alerts   
Use Case ID: UC-12   
Actors: Administrator, Traffic Management Systems, Weather Stations, Traveler Information Systems, Probe Vehicles   
  
Preconditions:   
1. The VII system is operational and receiving real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is configured to detect, process, and disseminate traffic and weather alerts.   
3. Real-time traffic metrics and weather observations are available for alert generation.   
4. Alert thresholds and rules are defined and stored in the system.   
5. The web-based user interface is active for real-time alert visualization.   
  
Postconditions:   
1. Traffic and weather alerts are generated and sent to relevant systems.   
2. The web-based user interface is updated with alert information on map displays and icon layers.   
3. The Administrator is notified of all critical alerts for review and action.   
4. Traveler Information Systems provide real-time alerts to users.   
5. The system archives all alerts and their associated data for compliance and future reference.   
6. Alert processing does not degrade the performance of the system.   
  
Main Flow:   
1. The system continuously processes real-time data from probe vehicles, traffic management systems, and weather stations.   
2. DUAP evaluates the data against predefined alert thresholds (e.g., congestion level, weather event severity).   
3. If the data meets the criteria for an alert, the system generates a traffic or weather alert.   
4. The alert is sent to Traffic Management Systems and Traveler Information Systems for immediate response and notification.   
5. The system updates the web-based user interface to display the alert using map displays, icon layers, and decluttering features.   
6. The Administrator is notified of the alert via the interface for further action.   
7. The system archives the alert details along with the associated data for compliance with data standards (SAE J2354, TMDD).   
8. The system ensures that alerts are prioritized based on severity and impact to ensure timely response.   
9. The system logs the alert generation and delivery process for audit and performance monitoring.   
10. The Administrator can acknowledge or modify the alert status as needed.   
  
Alternative Flow:   
1. If no alert thresholds are met, the system continues normal operations without generating an alert.   
2. If the system detects a conflict between multiple alerts for the same area, it merges or prioritizes them based on severity.   
3. If a weather alert is generated but weather data is later corrected, the system updates or cancels the alert accordingly.   
4. If the Administrator overrides an alert and requests it to be suppressed, the system complies and logs the action.   
5. If the system fails to send an alert due to communication issues, it retries after a predefined interval or logs the failure for manual intervention.  
  
Use Case Name: Publish Traffic Alerts   
Use Case ID: UC-13   
Actors: Administrator, Traffic Management Systems, Traveler Information Systems, DUAP System, Probe Vehicles, Weather Stations   
Preconditions:   
1. The VII system is operational and receiving real-time traffic, weather, and road condition data.   
2. The DUAP system has processed and analyzed the data to identify traffic incidents or hazards.   
3. The system has access to alert generation and dissemination mechanisms.   
4. Alert rules and thresholds are defined and configured.   
5. The web-based user interface is active and ready to display alerts.   
  
Postconditions:   
1. Traffic alerts are published and disseminated to Traffic Management Systems and Traveler Information Systems.   
2. The web-based interface is updated to show the alerts on map displays and icon layers.   
3. The Administrator is notified of the published alerts for monitoring and review.   
4. The system archives the alert details for compliance and historical reference.   
5. The alert system remains responsive and does not impact the performance of other data processing functions.   
  
Main Flow:   
1. The DUAP system detects a traffic incident or hazard based on real-time data analysis.   
2. The system generates a traffic alert, including details such as location, severity, and impact.   
3. The alert is reviewed by the Administrator for accuracy and approval.   
4. The approved alert is sent to Traffic Management Systems for coordination and response.   
5. The alert is also published to Traveler Information Systems to inform travelers in real-time.   
6. The system updates the web-based interface with the alert information, using map displays and icon layers.   
7. The Administrator receives a notification of the published alert via the user interface.   
8. The alert is archived in the system database for long-term compliance with data standards (SAE J2354, TMDD).   
9. The system logs the alert dissemination process for audit and performance tracking.   
10. The system ensures that alerts are visible and accessible to all relevant stakeholders.   
  
Alternative Flow:   
1. If the alert is automatically generated and no Administrator review is required, it is immediately published to the relevant systems.   
2. If the Administrator rejects the alert, the system logs the rejection and may initiate a manual review or correction process.   
3. If the system detects an error in the alert content, it halts the dissemination and prompts the Administrator to review or update the alert.   
4. If the communication to an external system (e.g., Traveler Information System) fails, the system retries the alert delivery after a predefined interval or logs the failure.   
5. If the system detects that a previously published alert is no longer valid (e.g., incident cleared), it updates or cancels the alert and notifies all affected systems.  
  
Use Case Name: Publish Weather Event Alerts   
Use Case ID: UC-14   
Actors: Administrator, Weather Stations, Traffic Management Systems, Traveler Information Systems, VII System, DUAP System   
Preconditions:   
1. The VII system is operational and connected to weather stations and traffic management systems.   
2. The DUAP system is configured to process and integrate real-time weather data.   
3. Real-time weather observations are available and passed data quality checks.   
4. Alert generation rules for weather events are defined and active.   
5. The web-based user interface is active and capable of displaying weather event alerts.   
  
Postconditions:   
1. Weather event alerts (e.g., snow, heavy rain, fog) are published and disseminated to Traffic Management Systems and Traveler Information Systems.   
2. The web-based interface is updated with the alerts on map displays and icon layers.   
3. The Administrator is notified of the published alerts for monitoring and review.   
4. The system archives the alert details for compliance and historical reference.   
5. The alert system remains responsive and does not degrade the performance of other system functions.   
  
Main Flow:   
1. Weather stations transmit real-time weather data, such as precipitation, temperature, and visibility.   
2. The VII system forwards the data to the DUAP system for processing and analysis.   
3. DUAP evaluates the data against predefined weather event thresholds (e.g., snowfall intensity, visibility below 50 meters).   
4. If the data meets the criteria for a weather event, the system generates a weather event alert.   
5. The alert includes details such as event type, location, time, and potential impact on traffic.   
6. The Administrator reviews the alert for accuracy and approves its publication.   
7. The approved alert is sent to Traffic Management Systems for coordination and response.   
8. The alert is also published to Traveler Information Systems to inform travelers in real-time.   
9. The system updates the web-based interface to display the alert using map displays, icon layers, and decluttering features.   
10. The alert is archived in the system database for long-term compliance with data standards (SAE J2354, TMDD).   
  
Alternative Flow:   
1. If the alert is automatically generated and no Administrator review is required, it is immediately published to the relevant systems.   
2. If the Administrator rejects the alert, the system logs the rejection and may initiate a manual review or correction process.   
3. If the system detects an error in the alert content, it halts the dissemination and prompts the Administrator to review or update the alert.   
4. If communication to an external system (e.g., Traveler Information System) fails, the system retries the alert delivery after a predefined interval or logs the failure.   
5. If the system detects that a previously published weather event alert is no longer valid (e.g., event cleared), it updates or cancels the alert and notifies all affected systems.  
  
Use Case Name: Publish Asset Condition Alerts   
Use Case ID: UC-15   
Actors: Administrator, Traffic Management Systems, Traveler Information Systems, DUAP System, Probe Vehicles, Weather Stations   
  
Preconditions:   
1. The VII system is operational and receiving real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system has processed and analyzed the data to identify asset condition changes or anomalies.   
3. Asset condition thresholds and alert rules are defined and active.   
4. The web-based user interface is active and ready to display asset condition alerts.   
5. Communication channels to Traffic Management Systems and Traveler Information Systems are secure and functional.   
  
Postconditions:   
1. Asset condition alerts are generated and published to Traffic Management Systems and Traveler Information Systems.   
2. The web-based interface is updated to reflect the alerts on map displays and icon layers.   
3. The Administrator is notified of the published alerts for monitoring and review.   
4. The system archives the alert details for compliance and historical reference.   
5. The alert system remains responsive and does not degrade the performance of other system functions.   
  
Main Flow:   
1. The DUAP system analyzes incoming data to detect changes in asset conditions (e.g., road damage, infrastructure failure, signal malfunction).   
2. It evaluates the severity of the asset condition based on predefined thresholds and rules.   
3. If the condition meets or exceeds the threshold, the system generates an asset condition alert.   
4. The alert includes details such as asset type, location, time, and impact on traffic flow.   
5. The Administrator reviews the alert via the web-based interface and approves its publication.   
6. The approved alert is sent to Traffic Management Systems for coordination and response.   
7. The alert is also published to Traveler Information Systems to notify relevant users and travelers.   
8. The system updates the web-based interface with the alert using map displays, icon layers, and decluttering features.   
9. The alert is archived in the system database for long-term compliance with data standards (SAE J2354, TMDD).   
10. The system logs the alert generation and dissemination for audit and performance tracking.   
  
Alternative Flow:   
1. If the alert is automatically generated and no Administrator review is required, it is immediately published to the relevant systems.   
2. If the Administrator rejects the alert, the system logs the rejection and may initiate a manual review or correction process.   
3. If the system detects an error in the alert content, it halts the dissemination and prompts the Administrator to review or update the alert.   
4. If communication to an external system (e.g., Traveler Information System) fails, the system retries the alert delivery after a predefined interval or logs the failure.   
5. If the system detects that a previously published asset condition alert is no longer valid (e.g., asset repaired), it updates or cancels the alert and notifies all affected systems.  
  
Use Case Name: Support MI Drive Presentation Data   
Use Case ID: UC-16   
Actors: Administrator, DUAP System, Traffic Management Systems, Traveler Information Systems, Probe Vehicles, Weather Stations   
Preconditions:   
1. The VII system is operational and connected to probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system has processed and analyzed traffic, weather, and road condition data.   
3. The system has access to MI Drive Presentation Data formatting and visualization rules.   
4. The web-based user interface is active and ready to display MI Drive Presentation Data.   
5. The system is integrated with the long-term storage and caching mechanisms (e.g., Oracle 10G, JDBC, Java Software Foundation).   
  
Postconditions:   
1. MI Drive Presentation Data is generated and formatted for external use.   
2. The web-based interface is updated to display MI Drive Presentation Data on map displays and icon layers.   
3. The Administrator is notified of the status of MI Drive Presentation Data generation.   
4. The data is archived for long-term compliance with data standards (SAE J2354, TMDD).   
5. MI Drive Presentation Data is accessible and usable for external systems and stakeholders.   
  
Main Flow:   
1. The system collects processed data from the VII system, including traffic metrics, weather observations, and road surface conditions.   
2. The DUAP system applies formatting rules to generate MI Drive Presentation Data, ensuring compliance with predefined standards.   
3. The system validates the structure and content of the MI Drive Presentation Data to ensure consistency and usability.   
4. The formatted MI Drive Presentation Data is stored in the system database (e.g., Oracle 10G, JDBC, Java Software Foundation).   
5. The system updates the web-based user interface to show the MI Drive Presentation Data using map displays, icon layers, and decluttering features.   
6. The Administrator reviews the MI Drive Presentation Data for accuracy and approves its availability for external systems.   
7. The data is made accessible to external systems for integration and presentation purposes.   
8. The system archives the MI Drive Presentation Data for long-term reference and compliance with data standards.   
9. The Administrator receives a confirmation of successful data generation and availability.   
10. The system logs the MI Drive Presentation Data generation and delivery process for audit and performance tracking.   
  
Alternative Flow:   
1. If the data fails validation during the formatting process, the system logs the error and excludes the data from MI Drive Presentation Data.   
2. If the Administrator requests a manual review of the MI Drive Presentation Data, the system provides a detailed report for inspection.   
3. If the system detects a conflict in the data used to generate MI Drive Presentation Data, it flags the issue for Administrator resolution.   
4. If the web-based interface is unavailable, the system holds the MI Drive Presentation Data until the interface is restored.   
5. If the system encounters an error in the formatting rules, it triggers an alert for the Administrator to resolve before proceeding.  
  
Use Case Name: Provide Web-Based User Interface   
Use Case ID: UC-17   
Actors: Administrator, Traffic Management Systems, Traveler Information Systems, Probe Vehicles, Weather Stations   
Preconditions:   
1. The VII system is operational and connected to all data sources (traffic data, weather data, road condition data).   
2. The DUAP system is active and has processed and integrated the incoming data.   
3. The web-based user interface is configured and accessible to authorized users.   
4. The system has access to the necessary components for interface rendering (e.g., map displays, icon layers, decluttering features).   
5. Data is available for visualization, including traffic metrics, weather observations, and road surface conditions.   
  
Postconditions:   
1. The web-based user interface is updated and displays the latest traffic, weather, and road condition data.   
2. Map displays, icon layers, and decluttering features are synchronized with the current system state.   
3. The Administrator and other stakeholders can access and interact with the interface for monitoring and decision-making.   
4. Traveler Information Systems receive visualized data to support user notifications.   
5. The system archives interface-related data for compliance and reference.   
  
Main Flow:   
1. The web-based user interface is launched by an authorized user (e.g., Administrator).   
2. The system retrieves the latest processed data from the DUAP system, including traffic metrics, weather data, and road surface conditions.   
3. The interface renders map displays with real-time data overlays (e.g., traffic congestion, road closures).   
4. Icon layers are updated to represent key data points (e.g., incidents, weather events, asset conditions).   
5. Decluttering features are applied to ensure the interface remains visually clear and usable.   
6. The interface provides real-time updates as new data is processed by the system.   
7. The Administrator can interact with the interface to filter, zoom, or view detailed data reports.   
8. Traffic and weather alerts are displayed prominently on the interface for immediate attention.   
9. The system logs all interface interactions for audit and performance tracking.   
10. The interface remains responsive and is synchronized with the underlying data systems.   
  
Alternative Flow:   
1. If the interface cannot load the latest data due to system latency, it displays cached data until the real-time data is available.   
2. If the data source is temporarily unavailable, the interface shows a warning and continues to use previously retrieved data.   
3. If the interface encounters an error in rendering a specific data layer (e.g., map display), it alerts the Administrator for troubleshooting.   
4. If the Administrator requests a historical view of the data, the interface retrieves archived data for visualization.   
5. If the system detects an interface performance issue, it triggers a cache optimization or system alert to maintain usability.  
  
Use Case Name: Display Map Views   
Use Case ID: UC-18   
Actors: Administrator, Traffic Management Systems, Traveler Information Systems, Probe Vehicles, Weather Stations   
  
Preconditions:   
1. The VII system is operational and receiving real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system has processed and integrated the data for display.   
3. The web-based user interface is active and configured to support map displays, icon layers, and decluttering features.   
4. The system has access to map rendering tools and geospatial data (e.g., Michigan Geographic Framework).   
5. Data entities such as traffic metrics, road surface conditions, and incident details are available for visualization.   
  
Postconditions:   
1. The web-based interface displays real-time traffic, weather, and road condition data on map views.   
2. Icon layers represent key data points such as incidents, congestion, and weather events.   
3. Map decluttering features ensure the interface remains visually clear and usable.   
4. The Administrator and other stakeholders can interact with the map for monitoring and decision-making.   
5. The system archives interface-related data and map configurations for compliance and historical reference.   
6. The interface remains responsive and synchronized with the underlying data systems.   
  
Main Flow:   
1. The Administrator or user accesses the web-based user interface.   
2. The system retrieves the latest processed data from the VII and DUAP systems, including traffic metrics, road surface conditions, and incident details.   
3. The web-based interface loads the map display and overlays the data using icon layers.   
4. Decluttering features are applied to prevent visual overload and ensure clarity in data representation.   
5. Real-time updates are pushed to the map as new data is processed.   
6. The Administrator can interact with the map (e.g., zoom, filter, select specific data layers).   
7. The system updates the map display to reflect the selected view and data preferences.   
8. Traffic and weather alerts are displayed on the map with appropriate icons and labels.   
9. The system logs user interactions and map configurations for audit and performance tracking.   
10. The map display is synchronized with the underlying data systems to ensure accuracy and timeliness.   
  
Alternative Flow:   
1. If the system is unable to retrieve real-time data due to latency, it displays cached data on the map until the real-time data is available.   
2. If a data source (e.g., weather station) is temporarily unavailable, the map display continues to show previously retrieved data and alerts the user.   
3. If the map encounters an error in rendering a specific data layer, it alerts the Administrator for troubleshooting.   
4. If the Administrator requests a historical map view, the interface retrieves archived data for visualization.   
5. If the system detects an interface performance issue, it triggers a cache optimization or system alert to maintain usability.  
  
Use Case Name: Manage Icon Layers   
Use Case ID: UC-19   
Actors: Administrator, Web-based User Interfaces, Map Displays, DUAP System, Traffic Management Systems, Traveler Information Systems   
Preconditions:   
1. The VII system is operational and has processed real-time traffic, weather, and road condition data.   
2. The web-based user interface is active and accessible to the Administrator.   
3. Map displays and icon layers are configured and available for interaction.   
4. The DUAP system has completed data quality checks and integrated the data for visualization.   
5. The system has access to geospatial data and rendering tools (e.g., Michigan Geographic Framework).   
  
Postconditions:   
1. Icon layers are updated and displayed on the web-based map interface.   
2. The Administrator can customize and manage icon layers for specific data types (e.g., incidents, congestion, weather).   
3. Map decluttering features are applied to ensure visual clarity.   
4. The interface reflects real-time changes in data and icon layer configurations.   
5. Icon layer management logs are archived for audit and reference.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface to manage icon layers.   
2. The system retrieves the latest processed data, including traffic metrics, weather events, and road conditions.   
3. The Administrator selects or configures specific icon layers to be displayed on the map.   
4. The system applies the selected icon layers to the map display, rendering relevant data points.   
5. Decluttering features are activated to ensure the map remains visually clear and readable.   
6. Real-time updates are pushed to the map as new data is processed and integrated.   
7. The Administrator can toggle the visibility of icon layers, adjust their priority, or modify their appearance.   
8. The system updates the map display to reflect the Administrator's changes.   
9. The system archives the configuration changes and user interactions for audit and compliance.   
10. The updated map is synchronized with Traffic Management Systems and Traveler Information Systems as needed.   
  
Alternative Flow:   
1. If the system fails to load the latest data for the selected icon layers, it displays cached data until real-time data becomes available.   
2. If the selected icon layer is not supported or unavailable, the system alerts the Administrator and provides a list of available layers.   
3. If the Administrator enables too many icon layers causing visual overload, the system automatically applies decluttering rules to maintain usability.   
4. If the system detects an error in the icon layer configuration, it prompts the Administrator for correction before applying the changes.   
5. If the Administrator requests a historical view of icon layers, the system retrieves and displays archived data for visualization.  
  
Use Case Name: Enable De-Cluttering Features   
Use Case ID: UC-20   
Actors: Administrator, Web-based User Interfaces, Map Displays, Icon Layers, DUAP System   
  
Preconditions:   
1. The web-based user interface is active and displaying traffic, weather, and road condition data on map displays and icon layers.   
2. The DUAP system has processed and integrated real-time and historical data for visualization.   
3. Icon layers are configured and accessible for dynamic management.   
4. The system supports decluttering algorithms and user preferences for interface customization.   
5. The Administrator has the necessary access rights to configure decluttering settings.   
  
Postconditions:   
1. The web-based interface displays data with decluttering features applied to enhance visual clarity.   
2. Overlapping or redundant data points are minimized on map displays and icon layers.   
3. The Administrator can adjust decluttering rules and preferences as needed.   
4. The system maintains real-time responsiveness while applying decluttering.   
5. Decluttering configuration changes are logged and archived for audit and reference.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface to configure or enable de-cluttering features.   
2. The system retrieves the current map display and icon layer configurations.   
3. The Administrator selects decluttering options, such as data point density thresholds or priority-based filtering.   
4. The system applies the selected decluttering rules to the map display and icon layers.   
5. The interface dynamically adjusts the display to reduce visual clutter and improve readability.   
6. The system continues to update the map with real-time data while applying decluttering logic.   
7. The Administrator can toggle decluttering on or off for specific layers or the entire map.   
8. The system archives the decluttering configuration and user preferences for future use.   
9. The updated map display is synchronized with Traffic Management Systems and Traveler Information Systems.   
10. The system ensures that critical data points (e.g., incidents) remain visible even after decluttering.   
  
Alternative Flow:   
1. If the system detects that decluttering is causing critical data to be hidden, it alerts the Administrator and allows manual override.   
2. If the Administrator selects an unsupported decluttering rule, the system displays an error and provides a list of valid options.   
3. If the map encounters a performance issue due to decluttering logic, the system optimizes the process or reverts to default settings.   
4. If the system cannot apply decluttering due to an error in the map rendering engine, it logs the issue and informs the Administrator.   
5. If the Administrator requests a historical decluttered view, the system retrieves and applies archived decluttering settings to the map.  
  
Use Case Name: Add New Data Sources   
Use Case ID: UC-21   
Actors: Administrator, DUAP System, Traffic Management Systems, Weather Stations, Probe Vehicles, Traveler Information Systems   
  
Preconditions:   
1. The VII system is operational and connected to existing data sources.   
2. The Administrator has access to the system configuration tools and data source management interface.   
3. The system has predefined data standards (e.g., SAE J2354, TMDD) and formatting rules for integration.   
4. The DUAP system is ready to process and validate data from the new sources.   
5. The system is integrated with the necessary backend infrastructure (e.g., Oracle 10G, JDBC, Java Software Foundation).   
  
Postconditions:   
1. New data sources are successfully integrated into the VII system.   
2. Data from the new sources is processed, validated, and stored in the system database.   
3. The system updates the web-based user interface to reflect the new data sources and their contributions.   
4. The DUAP system applies dynamic caching for the new data to optimize performance.   
5. The Administrator is informed of the successful integration and can manage the new data sources.   
6. The system archives the integration process for compliance and future reference.   
  
Main Flow:   
1. The Administrator initiates the process to add a new data source via the web-based user interface.   
2. The system prompts the Administrator to provide the data source details (e.g., type, communication protocol, data format).   
3. The system validates the provided data format against the predefined data standards (e.g., SAE J2354, TMDD).   
4. The system configures the new data source for real-time data collection and integration with the VII system.   
5. The DUAP system starts receiving and processing data from the new source.   
6. Data quality checks are performed to ensure the data is accurate and consistent.   
7. Valid data is stored in the system database (e.g., Oracle 10G, JDBC, Java Software Foundation).   
8. The system updates the web-based interface to include the new data source's contributions on map displays and icon layers.   
9. The system archives the new data source configuration and integration details.   
10. The Administrator receives a confirmation of the successful addition and integration of the new data source.   
  
Alternative Flow:   
1. If the data source format does not match the predefined standards, the system logs the error and prompts the Administrator to correct or provide a mapping rule.   
2. If the data source connection fails during integration, the system logs the issue and allows the Administrator to retry or investigate the cause.   
3. If the data from the new source is inconsistent with existing data, the system flags the discrepancy for review and potential manual adjustment.   
4. If the system detects high data volume from the new source, it activates dynamic caching to manage performance.   
5. If the Administrator requests a rollback of the new data source integration, the system removes the configuration and logs the action.  
  
Use Case Name: Update Data Processing Algorithms   
Use Case ID: UC-22   
Actors: Administrator, DUAP System, Traffic Management Systems, Weather Stations, Probe Vehicles   
Preconditions:   
1. The VII system is operational and receiving real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is active and has access to current data processing algorithms.   
3. The Administrator has identified the need to update or replace an existing algorithm.   
4. The system has the capability to test and deploy new algorithms without interrupting real-time data processing.   
5. The system is integrated with the necessary backend infrastructure (e.g., Oracle 10G, JDBC, Java Software Foundation).   
  
Postconditions:   
1. Updated data processing algorithms are deployed and active in the DUAP system.   
2. The system continues to process and analyze traffic, weather, and road condition data using the new algorithms.   
3. The Administrator is informed of the successful algorithm update.   
4. The web-based interface reflects any changes in data visualization caused by the updated algorithms.   
5. The system archives the old and new algorithms for compliance and future reference.   
6. The performance of the system is monitored to ensure the new algorithms do not introduce degradation.   
  
Main Flow:   
1. The Administrator identifies a need to update a data processing algorithm via the web-based user interface.   
2. The Administrator selects the algorithm to be updated and uploads the new version.   
3. The system validates the new algorithm against predefined standards and system requirements.   
4. The DUAP system performs a dry run or test of the new algorithm using a subset of historical data.   
5. The test results are reviewed by the Administrator to confirm correctness and performance.   
6. If the test is successful, the system deploys the updated algorithm to the production environment.   
7. The system transitions data processing to the new algorithm and disables the old version.   
8. The system updates the web-based interface to reflect the impact of the new algorithm on data visualization.   
9. The Administrator receives a confirmation of the successful algorithm update and deployment.   
10. The system logs and archives the algorithm update for audit and compliance purposes.   
  
Alternative Flow:   
1. If the new algorithm fails validation, the system logs the failure and prompts the Administrator to correct the issue.   
2. If the test run reveals performance issues or incorrect results, the system retains the old algorithm and alerts the Administrator.   
3. If the system detects a conflict between the new algorithm and existing data processing rules, it halts deployment and requests manual resolution.   
4. If the Administrator chooses to revert to the previous algorithm, the system restores the old version and logs the rollback.   
5. If the system encounters an error during deployment, it sends an alert to the Administrator and pauses the update process.  
  
Use Case Name: Modify Output Formats   
Use Case ID: UC-23   
Actors: Administrator, DUAP System, Traffic Management Systems, Traveler Information Systems, Web-based User Interfaces   
Preconditions:   
1. The VII system is operational and has processed real-time and historical data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is active and has access to the data for formatting.   
3. The Administrator has identified the need to modify the output format of the data for better compatibility or visualization.   
4. The system supports configuration of data output formats through the web-based user interface.   
5. The system is integrated with the necessary backend infrastructure for data storage and retrieval (e.g., Oracle 10G, JDBC, Java Software Foundation).   
  
Postconditions:   
1. The output format of the data is modified and applied across the system.   
2. The web-based user interface is updated to reflect the new output format.   
3. Traffic Management Systems and Traveler Information Systems receive data in the new format.   
4. The Administrator is notified of the successful format modification.   
5. The system archives the configuration changes for compliance and future reference.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface to modify the output format of the data.   
2. The Administrator selects the type of data whose format needs to be modified (e.g., traffic metrics, road surface conditions, weather observations).   
3. The system displays the current output format settings for the selected data type.   
4. The Administrator chooses a new output format (e.g., CSV, JSON, XML) and applies it.   
5. The system updates the configuration in the DUAP system to use the new format.   
6. The system validates the new format against system standards and compatibility requirements.   
7. The system applies the new format to the data being generated for external systems (e.g., Traveler Information Systems, Traffic Management Systems).   
8. The web-based interface is updated to reflect the new format in its displays and exports.   
9. The system logs the format modification for audit and compliance tracking.   
10. The Administrator is notified of the successful modification and can review the updated output format.   
  
Alternative Flow:   
1. If the selected output format is not supported by the system, the Administrator is prompted with a list of valid options.   
2. If the new format causes compatibility issues during data export, the system alerts the Administrator and reverts to the previous format.   
3. If the system detects that the new format affects performance, it triggers an alert for the Administrator to evaluate.   
4. If the Administrator cancels the modification, the system retains the original format and logs the cancellation.   
5. If the system fails to update the output format due to a configuration error, it logs the failure and prompts the Administrator to resolve the issue.  
  
Use Case Name: Integrate New Presentation Methods   
Use Case ID: UC-24   
Actors: Administrator, Web-based User Interfaces, DUAP System, Traffic Management Systems, Traveler Information Systems   
Preconditions:   
1. The VII system is operational and has processed and analyzed real-time traffic, weather, and road condition data.   
2. The web-based user interface is active and accessible for visualization and configuration.   
3. The DUAP system is ready to support new data formatting and presentation methods.   
4. The system has access to geospatial tools and rendering capabilities (e.g., Michigan Geographic Framework).   
5. The Administrator has identified the need to integrate new presentation methods for improved usability or stakeholder requirements.   
  
Postconditions:   
1. New presentation methods (e.g., enhanced maps, real-time dashboards, 3D visualizations) are integrated into the web-based user interface.   
2. The Administrator can configure and manage the new presentation methods.   
3. The system continues to deliver real-time data with improved visualization.   
4. The web-based interface is updated to reflect the new presentation options.   
5. The system archives the configuration and integration process for audit and compliance.   
6. Stakeholders can access and benefit from the new presentation methods for monitoring and decision-making.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and initiates the integration of new presentation methods.   
2. The system retrieves current interface configurations and available data for visualization.   
3. The Administrator selects the new presentation method to be integrated (e.g., 3D map display, real-time heatmaps, animated traffic flow).   
4. The system validates the selected method against system capabilities and compatibility.   
5. The DUAP system updates its configuration to support the new presentation format.   
6. The web-based interface is modified to include the new visualization components.   
7. The system applies the new method to real-time and archived data for testing and display.   
8. The Administrator reviews the updated interface and confirms the integration.   
9. The system logs the integration of the new presentation method for audit and compliance.   
10. The new method is made available for use by all authorized stakeholders.   
  
Alternative Flow:   
1. If the new presentation method is incompatible with the current system, the system alerts the Administrator and provides a list of supported options.   
2. If the system encounters performance issues during the integration, it triggers an alert and may revert to a stable configuration.   
3. If the Administrator requests a rollback of the new method, the system reverts to the previous interface configuration and logs the change.   
4. If the system fails to apply the new method due to a configuration error, it logs the failure and prompts the Administrator to resolve the issue.   
5. If the new method causes visual confusion or data misrepresentation, the Administrator can disable or adjust the method for clarity.  
  
Use Case Name: Comply with MDIT Standards   
Use Case ID: UC-25  
Actors: Administrator, DUAP System, Traffic Management Systems, Traveler Information Systems, Probe Vehicles, Weather Stations   
Preconditions:   
1. The VII system is operational and connected to all relevant data sources.   
2. The DUAP system is configured to process and format data in accordance with the MDIT (Michigan Intelligent Transportation) standards.   
3. Real-time and processed data (traffic metrics, weather observations, road surface conditions, incident details) are available for standardization.   
4. The system has access to the necessary tools and infrastructure for data formatting and validation.   
5. The Administrator has initiated or scheduled a compliance check or data standardization task.   
  
Postconditions:   
1. All data processed by the system is formatted and structured to comply with MDIT standards.   
2. The system ensures interoperability with external systems using standardized data formats.   
3. The web-based user interface reflects the compliance status of data with MDIT standards.   
4. The Administrator is informed of any compliance issues or successful standardization.   
5. Data is archived in a compliant format for future access and reporting.   
  
Main Flow:   
1. The Administrator initiates a compliance check via the web-based user interface.   
2. The DUAP system retrieves the latest traffic, weather, and road condition data for standardization.   
3. The system applies MDIT formatting rules to the data, ensuring proper structure and metadata inclusion.   
4. Data is validated against MDIT standards to confirm compliance.   
5. Non-compliant data is flagged and sent to the Administrator for review or correction.   
6. Compliant data is stored in the system database (e.g., Oracle 10G, JDBC, Java Software Foundation).   
7. The system updates the web-based interface to display the compliance status of data.   
8. Traveler Information Systems and Traffic Management Systems receive the standardized data for integration and use.   
9. The system archives compliant data for long-term storage in line with data standards (SAE J2354, TMDD).   
10. The Administrator receives a summary of compliance status and logs the outcome.   
  
Alternative Flow:   
1. If the system detects missing or incorrect metadata in the data, it prompts the Administrator to provide or correct the information.   
2. If the data fails to meet MDIT standards after formatting, the system logs the error and halts further processing until compliance is ensured.   
3. If the Administrator manually overrides the standardization process, the system logs the action and allows the data to be processed in a non-standard format for specific use cases.   
4. If the system encounters a performance issue during standardization, it activates dynamic data caching to manage the load and continues processing in batches.   
5. If the system detects a conflict between MDIT and other standard formats (e.g., SAE J2354), it alerts the Administrator and waits for resolution before proceeding.  
  
Use Case Name: Utilize Java Software Foundation   
Use Case ID: UC-26  
Actors: Administrator, DUAP System, VII System, Traffic Management Systems, Weather Stations, Probe Vehicles   
Preconditions:   
1. The VII system is fully operational and receiving real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is configured to process, integrate, and store data using the Java Software Foundation as a core framework.   
3. The backend infrastructure, such as Oracle 10G and JDBC, is properly connected and accessible.   
4. Data entities (traffic data, weather data, road condition data) are available for processing and storage.   
5. The system supports Java-based modules for data handling, visualization, and alerting functions.   
  
Postconditions:   
1. Data is processed and stored using the Java Software Foundation framework.   
2. The system maintains stable and secure communication with all data sources and subsystems.   
3. The web-based user interface is updated with data visualizations and alerts generated via Java-based tools.   
4. The Administrator is notified of successful data processing and system performance.   
5. The system archives processed data in a Java-compatible format for long-term storage and compliance with data standards.   
  
Main Flow:   
1. The VII system transmits real-time data (traffic, weather, and road condition data) to the DUAP system.   
2. The DUAP system uses the Java Software Foundation to process and integrate the data into a unified format.   
3. The system applies Java-based algorithms to calculate traffic metrics, road surface conditions, and incident details.   
4. Data is stored in the system database using Java-compatible JDBC connections to Oracle 10G.   
5. The web-based user interface is updated with Java-rendered visualizations, including map displays, icon layers, and decluttering features.   
6. Traffic and weather alerts are generated using Java-based alerting modules and sent to relevant systems.   
7. The Administrator receives a status update on the processing and storage operations via the web-based interface.   
8. The system archives processed data in Java-compatible formats for long-term storage and compliance with data standards.   
9. The system ensures all Java-based components are synchronized and functioning correctly.   
10. The Administrator can access and review the system logs for Java-based processing activities.   
  
Alternative Flow:   
1. If the Java Software Foundation fails during data processing, the system logs the error and alerts the Administrator for troubleshooting.   
2. If the JDBC connection to the Oracle 10G database is interrupted, the system attempts to reconnect or stores data in a temporary cache.   
3. If the web-based interface fails to render Java-generated data, the system displays a warning and continues to process and store the data.   
4. If the system detects a Java version incompatibility, it triggers an update or configuration change for the Administrator to resolve.   
5. If the Administrator manually overrides the Java-based processing settings, the system logs the change and adjusts the processing flow accordingly.  
  
Use Case Name: Use JDBC for Database Access   
Use Case ID: UC-27   
Actors: Administrator, DUAP System, VII System, Traffic Management Systems, Weather Stations, Probe Vehicles   
Preconditions:   
1. The system is operational and connected to the Oracle 10G database.   
2. The JDBC driver for Oracle 10G is installed and configured.   
3. The DUAP system is active and needs to access or store data in the database.   
4. The Administrator has granted necessary permissions for database access.   
5. The system is integrated with the Java Software Foundation for database operations.   
  
Postconditions:   
1. Data is successfully accessed from or stored into the Oracle 10G database using JDBC.   
2. The database operations are logged for audit and performance tracking.   
3. The Administrator is informed of any database access or connection issues.   
4. The system maintains data integrity and performance during JDBC operations.   
5. The system continues to support other functions (e.g., data processing, alerting, visualization) while using JDBC.   
  
Main Flow:   
1. The DUAP system initiates a database operation (read or write) to access or store data.   
2. The system establishes a JDBC connection to the Oracle 10G database using predefined credentials and connection strings.   
3. The system executes the required SQL queries or commands to retrieve or update data.   
4. The retrieved or updated data is used to support other system functions, such as data processing, alerting, or visualization.   
5. The system closes the JDBC connection after the operation is completed.   
6. The system logs the operation in the system database for audit and performance tracking.   
7. The Administrator is notified of the successful completion of the database operation.   
8. The system ensures that all JDBC interactions are secure and compliant with internal policies.   
9. The system continues real-time data processing and visualization as needed.   
10. The system archives the data accessed or stored using JDBC in accordance with data standards.   
  
Alternative Flow:   
1. If the JDBC connection fails due to network issues or incorrect credentials, the system logs the error and retries the connection.   
2. If the Oracle 10G database is unavailable, the system stores the data in a local cache until the database is accessible again.   
3. If the system detects an SQL syntax error during query execution, it halts the operation and logs the issue for Administrator review.   
4. If the Administrator manually requests a JDBC performance review, the system generates a report of recent database operations.   
5. If the system encounters a high volume of database transactions, it activates JDBC connection pooling to manage performance and resource usage.  
  
Use Case Name: Manage Oracle 10G Database   
Use Case ID: UC-28   
Actors: Administrator, DUAP System, VII System, Traffic Management Systems, Weather Stations, Probe Vehicles   
Preconditions:   
1. The VII system is operational and connected to probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is configured and capable of processing and storing data in the Oracle 10G database.   
3. The system has access to JDBC and Java Software Foundation tools for database connectivity and operations.   
4. The Oracle 10G database is properly set up and accessible.   
5. The Administrator has the necessary access rights to manage database configurations and operations.   
  
Postconditions:   
1. Database operations (insert, update, delete, query) are executed successfully using Oracle 10G.   
2. Data integrity and consistency are maintained in the Oracle 10G database.   
3. The system logs all database operations for audit and performance tracking.   
4. The Administrator is informed of the status of database operations and any issues encountered.   
5. The system continues to support real-time data processing and visualization through Oracle 10G connectivity.   
  
Main Flow:   
1. The Administrator accesses the system configuration interface to initiate a database management task.   
2. The system connects to the Oracle 10G database using JDBC and Java Software Foundation.   
3. The Administrator selects the type of operation (e.g., data insertion, update, deletion, query).   
4. The system executes the operation using SQL commands through the JDBC connection.   
5. The system verifies the success of the operation and updates relevant data entities.   
6. The system logs the operation and its outcome in the system database.   
7. The Administrator receives a confirmation of the operation's completion.   
8. The system ensures that the Oracle 10G database remains synchronized with the latest processed data.   
9. The system continues to support data retrieval for visualization and alerting via the database.   
10. The system archives the database operation logs for compliance and future reference.   
  
Alternative Flow:   
1. If the JDBC connection to Oracle 10G fails, the system logs the error and prompts the Administrator to check the connection settings.   
2. If the database is temporarily unavailable, the system caches the data locally until the connection is restored.   
3. If the Administrator attempts an invalid SQL operation, the system halts the execution and provides an error message.   
4. If the system detects performance degradation during database operations, it activates JDBC connection pooling to optimize performance.   
5. If the Administrator requests a rollback of a database transaction, the system reverts the changes and logs the action.  
  
Use Case Name: Execute Standard SQL Queries   
Use Case ID: UC-29  
Actors: Administrator, DUAP System, Traffic Management Systems, Traveler Information Systems, Probe Vehicles, Weather Stations   
  
Preconditions:   
1. The VII system is operational and connected to data sources (probe vehicles, traffic management systems, weather stations).   
2. The Oracle 10G database is accessible and properly configured with JDBC and Java Software Foundation support.   
3. The Administrator has the necessary permissions to execute SQL queries through the web-based interface.   
4. The system has processed and stored relevant data (traffic metrics, weather data, road condition data, incident details) in the database.   
5. The web-based user interface supports SQL query execution and result visualization.   
  
Postconditions:   
1. The SQL query is executed successfully, and the results are retrieved from the Oracle 10G database.   
2. The results are displayed in the web-based user interface for review and decision-making.   
3. The Administrator is notified of the query execution status and result availability.   
4. The system maintains data integrity and security during query execution.   
5. The system logs the query execution for audit and performance tracking.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the SQL query execution module.   
2. The Administrator composes or selects a standard SQL query to retrieve specific data (e.g., traffic congestion levels, recent incidents, weather patterns).   
3. The system validates the SQL query for syntax correctness and access permissions.   
4. The system uses JDBC to connect to the Oracle 10G database and execute the query.   
5. The query results are retrieved from the database and formatted for display.   
6. The results are shown on the web-based interface using map displays, tables, or charts.   
7. The system archives the query and result for compliance and audit purposes.   
8. The Administrator reviews the results and may request additional analysis or export.   
9. The system updates any relevant subsystems (e.g., Traffic Management Systems) with the query results if needed.   
10. The system logs the query execution and result delivery in the system database.   
  
Alternative Flow:   
1. If the SQL query is invalid or contains errors, the system logs the issue and provides an error message to the Administrator for correction.   
2. If the Oracle 10G database is unavailable, the system attempts to use cached data or alerts the Administrator of the connection failure.   
3. If the query execution exceeds a predefined time limit, the system terminates the query and notifies the Administrator.   
4. If the Administrator requests a historical query, the system retrieves archived data from Oracle 10G for execution.   
5. If the query results are too large for the interface to handle, the system exports the results to a file and provides a download link for the Administrator.  
  
Use Case Name: Apply Michigan Geographic Framework for Geo-Referencing   
Use Case ID: UC-30   
Actors: Administrator, VII System, DUAP System, Probe Vehicles, Traffic Management Systems, Web-based User Interfaces   
Preconditions:   
1. The VII system is operational and receiving real-time data from probe vehicles and traffic management systems.   
2. The DUAP system is configured to process and geo-reference data using the Michigan Geographic Framework.   
3. The system has access to geospatial data and tools for accurate mapping and location tagging.   
4. The web-based user interface is active and ready to display geo-referenced data.   
5. Data entities such as vehicle location, traffic data, and incident details are available for geo-referencing.   
  
Postconditions:   
1. All data is geo-referenced using the Michigan Geographic Framework.   
2. The system updates map displays and icon layers with accurate geographic information.   
3. The Administrator is notified of the successful geo-referencing and can review the results.   
4. Data is archived in a geospatially accurate format for compliance with data standards.   
5. The web-based interface reflects real-time location-based data with enhanced visualization.   
  
Main Flow:   
1. The VII system receives real-time data from probe vehicles and traffic management systems, including location and event details.   
2. The DUAP system initiates the geo-referencing process using the Michigan Geographic Framework.   
3. The system maps the data to geographic coordinates and road segments within the framework.   
4. Geo-referenced data is stored in the system database for integration with other modules.   
5. The web-based user interface is updated to show the geo-referenced data on map displays with icon layers.   
6. The Administrator reviews the geo-referenced results and confirms accuracy via the interface.   
7. Incident and traffic data are visually aligned with geographic locations for better situational awareness.   
8. The system archives the geo-referenced data for compliance with data standards (SAE J2354, TMDD).   
9. The Administrator can export or share the geo-referenced data for external use.   
10. The system logs the geo-referencing process for audit and performance tracking.   
  
Alternative Flow:   
1. If the data lacks location information, the system logs the issue and alerts the Administrator for manual input or correction.   
2. If the Michigan Geographic Framework is temporarily unavailable, the system uses cached geographic data to maintain visualization accuracy.   
3. If the geo-referencing process fails due to a framework error, the system halts the operation and prompts the Administrator for troubleshooting.   
4. If the Administrator overrides the geo-referenced result, the system updates the records and adjusts the map display accordingly.   
5. If the system detects conflicting geographic references, it flags the data for manual verification by the Administrator.  
  
Use Case Name: Maintain Incident Details   
Use Case ID: UC-31   
Actors: Administrator, Traffic Management Systems, Probe Vehicles, Weather Stations, DUAP System   
  
Preconditions:   
1. The VII system is operational and receiving real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is active and configured to process and analyze traffic and incident data.   
3. Incident data entities are accessible for updating and maintenance.   
4. The web-based user interface is active and supports incident visualization.   
5. The Oracle 10G database is connected and supports incident data storage.   
  
Postconditions:   
1. Incident details (e.g., location, time, type, status) are updated and maintained in the system.   
2. Incident records are synchronized with traffic and weather data for accurate analysis.   
3. The web-based interface displays the updated incident details on map displays and icon layers.   
4. The system archives updated incident data for compliance and historical reference.   
5. Traffic Management Systems and Traveler Information Systems are notified of incident updates if necessary.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the incident management module.   
2. The system retrieves the current list of incidents from the Oracle 10G database.   
3. The Administrator selects an incident to update, such as changing its status (e.g., resolved, under investigation).   
4. The system validates the update against predefined incident data standards and integrity checks.   
5. The updated incident details are stored in the Oracle 10G database using JDBC.   
6. The system synchronizes the updated incident data with related traffic and weather data.   
7. The web-based interface is refreshed to reflect the updated incident details on the map and icon layers.   
8. The system archives the updated incident data in compliance with data standards (e.g., SAE J2354, TMDD).   
9. If the incident impacts traffic or safety, alerts are generated and sent to relevant systems.   
10. The system logs the maintenance activity for audit and performance tracking.   
  
Alternative Flow:   
1. If the selected incident does not exist in the database, the system displays an error and prompts the Administrator to verify the selection.   
2. If the update fails due to database connection issues, the system caches the update locally and retries when the connection is restored.   
3. If the incident data is inconsistent with traffic or weather data, the system flags the discrepancy for Administrator review.   
4. If the Administrator cancels the update, the system reverts to the original data and logs the cancellation.   
5. If the system detects a conflict in the incident details (e.g., duplicate entry), it prompts the Administrator to resolve the conflict.  
  
Use Case Name: Update Traffic Management Systems   
Use Case ID: UC-32   
Actors: Administrator, DUAP System, VII System, Traffic Management Systems, Probe Vehicles, Weather Stations   
  
Preconditions:   
1. The VII system is operational and connected to probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is active and has completed processing and integration of the latest traffic data.   
3. Traffic Management Systems are online and capable of receiving updated data.   
4. The web-based user interface is active and synchronized with the latest data for monitoring.   
5. The Oracle 10G database is accessible for data retrieval and storage.   
  
Postconditions:   
1. Traffic Management Systems are updated with the latest traffic data and alerts.   
2. The system ensures data synchronization between the VII system and Traffic Management Systems.   
3. The web-based interface reflects the updated status of the Traffic Management Systems.   
4. The Administrator is notified of the update status and any issues encountered.   
5. Updated data is archived for compliance and future reference.   
  
Main Flow:   
1. The Administrator initiates an update to the Traffic Management Systems via the web-based user interface.   
2. The system retrieves the latest processed traffic data from the VII system and DUAP system.   
3. The data includes congestion levels, incident details, road surface conditions, and traffic metrics.   
4. The system formats the data according to predefined standards (e.g., TMDD, SAE J2354).   
5. The formatted data is sent to Traffic Management Systems for integration and display.   
6. Traffic Management Systems acknowledge receipt of the data and update their operational status.   
7. The web-based user interface is refreshed to show the status of the update and any system responses.   
8. The Administrator reviews the update status and confirms successful synchronization.   
9. The system archives the updated data and logs the operation for audit and compliance.   
10. The system continues to monitor and provide real-time feedback on the status of Traffic Management Systems.   
  
Alternative Flow:   
1. If the Traffic Management Systems are temporarily unreachable, the system caches the update and retries after a predefined interval.   
2. If the data format is not compatible with the receiving system, the system logs the error and prompts the Administrator to adjust the format.   
3. If the update contains invalid or corrupted data, the system performs data quality checks and excludes the invalid data before proceeding.   
4. If the Administrator cancels the update process, the system halts transmission and logs the cancellation for review.   
5. If the system detects an error in the update delivery, it sends an alert to the Administrator and provides options for manual correction or retransmission.  
  
Use Case Name: Retrieve Traveler Information   
Use Case ID: UC-33   
Actors: Administrator, Traveler Information Systems, VII System, DUAP System, Probe Vehicles, Weather Stations   
  
Preconditions:   
1. The VII system is operational and connected to probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system has processed and integrated traffic, weather, and road condition data.   
3. Traveler Information Systems are online and capable of receiving and displaying updated information.   
4. The web-based user interface is active and synchronized with the latest data for traveler information visualization.   
5. Data entities such as travel demand, traffic metrics, and road surface conditions are available for retrieval.   
  
Postconditions:   
1. Traveler information (e.g., travel time, congestion levels, route suggestions) is retrieved and made available for external systems.   
2. Traveler Information Systems are updated with the latest data for real-time traveler advisories.   
3. The web-based interface reflects the retrieval and availability of traveler information.   
4. The Administrator is notified of the status of the retrieval process and any anomalies.   
5. The system archives the retrieved traveler information for compliance and historical reference.   
  
Main Flow:   
1. The Administrator initiates a request to retrieve traveler information via the web-based user interface.   
2. The system queries the VII and DUAP systems to collect relevant data (e.g., travel demand, traffic conditions, road surface status).   
3. The DUAP system integrates the data with current weather observations to provide accurate traveler advisories.   
4. Traveler information is formatted according to predefined standards for external system compatibility.   
5. The system sends the formatted traveler information to Traveler Information Systems for display and dissemination.   
6. Traveler Information Systems acknowledge receipt and update their displays accordingly.   
7. The web-based user interface is refreshed to reflect the retrieved information and its status.   
8. The Administrator reviews the retrieved data and confirms its accuracy and availability.   
9. The system archives the retrieved traveler information for long-term storage and compliance with data standards.   
10. The system logs the retrieval process for audit and performance tracking.   
  
Alternative Flow:   
1. If the requested data is unavailable due to system latency, the system retrieves cached data for immediate use and notifies the Administrator.   
2. If Traveler Information Systems are temporarily offline, the system stores the information in a holding area until the systems are available.   
3. If the data fails quality checks during retrieval, the system excludes the invalid data and logs the issue for review.   
4. If the Administrator requests a manual retrieval, the system generates a detailed report of the traveler information data.   
5. If the system detects a mismatch between traffic and weather data, it triggers a review process and notifies the Administrator for correction.  
  
Use Case Name: Manage Probe Vehicle Data   
Use Case ID: UC-34   
Actors: Administrator, VII System, DUAP System, Probe Vehicles, Traffic Management Systems, Web-based User Interfaces   
Preconditions:   
1. The VII system is operational and receiving real-time data from probe vehicles.   
2. The DUAP system is configured to process and analyze probe vehicle data.   
3. Communication channels between probe vehicles and the VII system are active and secure.   
4. The system is integrated with the Oracle 10G database via JDBC and the Java Software Foundation.   
5. The web-based user interface is active for real-time visualization and data review.   
  
Postconditions:   
1. Probe vehicle data is processed, validated, and stored in the system database.   
2. The system updates traffic metrics and road condition assessments based on the probe data.   
3. The web-based interface displays the latest probe vehicle data on map displays and icon layers.   
4. The Administrator is informed of any anomalies or issues in the probe data processing.   
5. The system archives probe vehicle data for long-term reference and compliance with data standards.   
  
Main Flow:   
1. Probe vehicles transmit real-time data (speed, location, heading, vehicle status, etc.) to the VII system.   
2. The VII system forwards the data to the DUAP system for processing.   
3. The DUAP system performs data quality checks to ensure the data is valid and consistent.   
4. Valid probe data is stored in the Oracle 10G database using JDBC and Java Software Foundation.   
5. The system updates traffic metrics, such as congestion levels and travel times, using the probe vehicle data.   
6. The web-based user interface is refreshed to display the probe vehicle data on map displays and icon layers.   
7. The system integrates probe data with other data sources (e.g., weather, road conditions) for comprehensive analysis.   
8. The Administrator reviews the probe data via the web-based interface for accuracy and completeness.   
9. The system archives the probe data in compliance with data standards (SAE J2354, TMDD).   
10. The Administrator can export or analyze the probe data for further use.   
  
Alternative Flow:   
1. If the incoming probe data fails quality checks, the system logs the issue and excludes it from further processing.   
2. If a probe vehicle is temporarily offline or fails to transmit data, the system continues to use cached or historical data for continuity.   
3. If the system detects a large volume of probe data, it activates dynamic caching to manage performance.   
4. If the Administrator manually requests a review of probe data, the system generates a detailed report.   
5. If the system encounters a failure in the probe data integration process, it alerts the Administrator and halts processing until the issue is resolved.  
  
Use Case Name: Update Infrastructure Information   
Use Case ID: UC-35   
Actors: Administrator, VII System, DUAP System, Traffic Management Systems, Weather Stations, Probe Vehicles   
  
Preconditions:   
1. The VII system is operational and receiving real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The Administrator has initiated an update to infrastructure information via the web-based user interface.   
3. The DUAP system is configured to process and validate infrastructure-related data.   
4. The system has access to Oracle 10G for storing and retrieving infrastructure data.   
5. Data quality checks are in place to ensure the reliability of the infrastructure data.   
  
Postconditions:   
1. Infrastructure information (e.g., road status, signal status, signage changes) is updated in the system.   
2. The web-based user interface is refreshed to reflect the updated infrastructure information.   
3. Traffic Management Systems and Traveler Information Systems receive the updated infrastructure data for integration.   
4. The system archives the updated infrastructure data for compliance and future reference.   
5. The Administrator is informed of the success or failure of the infrastructure update process.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and selects the "Update Infrastructure Information" option.   
2. The system prompts the Administrator to provide the infrastructure update details (e.g., location, type of infrastructure, new status or configuration).   
3. The system validates the update against data quality rules and infrastructure standards.   
4. Valid updates are stored in the Oracle 10G database using JDBC and the Java Software Foundation.   
5. The system synchronizes the updated infrastructure data with traffic and weather data for accurate context.   
6. The web-based interface is updated to display the new infrastructure status on map displays and icon layers.   
7. Traffic Management Systems receive the updated infrastructure information to adjust operations.   
8. Traveler Information Systems are updated to provide accurate traveler advisories.   
9. The system archives the updated infrastructure data in compliance with data standards (SAE J2354, TMDD).   
10. The Administrator is notified of the successful update and can review the changes in the interface.   
  
Alternative Flow:   
1. If the infrastructure update fails validation, the system logs the error and prompts the Administrator for corrections.   
2. If the Oracle 10G database is unavailable, the system caches the update and retries when the connection is restored.   
3. If the update conflicts with existing infrastructure data, the system flags the conflict for Administrator review.   
4. If the Administrator cancels the update request, the system reverts to the original data and logs the cancellation.   
5. If the system detects a high volume of infrastructure updates, it activates dynamic caching to manage performance and ensure timely processing.  
  
Use Case Name: View Traffic Status   
Use Case ID: UC-36   
Actors: Administrator, Traffic Management Systems, Traveler Information Systems, Probe Vehicles, Weather Stations   
Preconditions:   
1. The VII system is operational and connected to probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system has processed and analyzed the incoming traffic data.   
3. The web-based user interface is active and accessible for viewing traffic status.   
4. The system has stored and cached the latest traffic metrics (e.g., congestion levels, travel times, queue lengths).   
5. Data quality checks have been completed to ensure the accuracy of the data being displayed.   
  
Postconditions:   
1. The web-based user interface displays the current traffic status (e.g., congestion, incidents, travel times).   
2. Traffic data is synchronized with weather and road condition data for accurate visualization.   
3. The Administrator and other stakeholders can review and monitor traffic conditions in real-time.   
4. The system archives the viewed traffic status data for future reference.   
5. The interface remains responsive and visually clear using map displays, icon layers, and decluttering features.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface to view the current traffic status.   
2. The system retrieves the latest processed traffic data from the VII and DUAP systems.   
3. The data includes congestion levels, travel times, queue lengths, and incident details.   
4. The system integrates the traffic data with current weather and road condition information.   
5. The web-based interface updates map displays and icon layers to reflect the current traffic status.   
6. Decluttering features are applied to ensure the interface remains clear and usable.   
7. The system displays alerts for any critical incidents or hazardous conditions.   
8. The Administrator can filter the traffic status by location, severity, or time.   
9. The system archives the viewed traffic status for compliance with data standards.   
10. The Administrator reviews the traffic status and takes appropriate action if needed.   
  
Alternative Flow:   
1. If the real-time traffic data is unavailable, the system displays cached or historical data.   
2. If the system detects conflicting or incomplete data, it alerts the Administrator for manual review.   
3. If the interface is unable to render specific data layers, it provides an error message and continues with available data.   
4. If the Administrator requests a detailed report on traffic status, the system generates and provides it.   
5. If the system encounters a high load of traffic data, it activates dynamic caching to maintain performance.  
  
Use Case Name: View Weather Data   
Use Case ID: UC-37  
Actors: Administrator, Weather Stations, VII System, DUAP System, Traffic Management Systems, Traveler Information Systems   
  
Preconditions:   
1. The VII system is operational and connected to weather stations for real-time weather data collection.   
2. The DUAP system is configured to process and integrate weather data with traffic and road condition data.   
3. Weather data is available and has passed data quality checks.   
4. The web-based user interface is active and ready to display weather data.   
5. The system has access to Oracle 10G for data storage and retrieval.   
  
Postconditions:   
1. The Administrator can view real-time weather data through the web-based user interface.   
2. Weather data is synchronized with traffic and road condition data for comprehensive analysis.   
3. The web-based interface is updated with weather data on map displays and icon layers.   
4. The system archives the viewed weather data for compliance with data standards.   
5. The Administrator is notified of any significant weather changes or anomalies.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and selects the "View Weather Data" option.   
2. The system retrieves the latest weather data from the VII system and DUAP system.   
3. The weather data includes parameters such as temperature, precipitation, visibility, and wind speed.   
4. The system integrates the weather data with current traffic and road condition data for context.   
5. The web-based interface updates the map displays and icon layers to show the weather data.   
6. Decluttering features are applied to ensure the interface remains visually clear.   
7. The Administrator can filter the weather data by location, time, or severity.   
8. The system archives the viewed weather data for long-term storage and compliance with standards.   
9. The Administrator receives a summary of weather data for the selected region.   
10. The system logs the viewing activity for audit and performance tracking.   
  
Alternative Flow:   
1. If the weather data is temporarily unavailable, the system displays cached or historical data.   
2. If the system detects inconsistencies in the weather data, it alerts the Administrator for manual review.   
3. If the Administrator selects a specific weather station for detailed view, the system provides a breakdown of that station's data.   
4. If the system fails to update the interface due to rendering issues, it displays a warning and continues to store the data.   
5. If the Administrator requests a weather data export, the system generates and provides the data in the requested format.  
  
Use Case Name: View Road Condition Data   
Use Case ID: UC-38   
Actors: Administrator, Traffic Management Systems, Traveler Information Systems, Probe Vehicles, Weather Stations, VII System   
Preconditions:   
1. The VII system is operational and receiving real-time data from probe vehicles, weather stations, and traffic management systems.   
2. The DUAP system has processed and integrated traffic, weather, and road condition data.   
3. The web-based user interface is active and ready to display road condition data.   
4. Data quality checks are completed, and the data is accurate and consistent.   
5. The Oracle 10G database is accessible and contains the latest road condition data.   
  
Postconditions:   
1. The Administrator and other stakeholders can view real-time road condition data through the web-based interface.   
2. Map displays and icon layers are updated to reflect current road conditions.   
3. The system archives the viewed road condition data for compliance and historical reference.   
4. Traveler Information Systems receive updated road condition information for real-time traveler advisories.   
5. The system ensures that the data remains synchronized with the latest traffic and weather information.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and selects the "View Road Condition Data" option.   
2. The system retrieves the latest road condition data from the VII system and DUAP system.   
3. The data includes road surface conditions (e.g., dry, wet, icy) and incident details affecting road usability.   
4. The system integrates the road condition data with real-time traffic and weather information for context.   
5. The web-based interface updates the map displays and icon layers to visualize the road conditions.   
6. Decluttering features are applied to ensure the map remains visually clear and usable.   
7. The Administrator can filter the road condition data by location, severity, or time.   
8. The system archives the viewed road condition data in compliance with data standards (SAE J2354, TMDD).   
9. The Administrator receives a summary of the road condition data for the selected area.   
10. The system logs the viewing activity for audit and performance tracking.   
  
Alternative Flow:   
1. If the road condition data is temporarily unavailable, the system displays cached or historical data to maintain continuity.   
2. If the system detects inconsistencies in the road condition data, it alerts the Administrator for manual review.   
3. If the Administrator selects a specific road segment for detailed view, the system provides a breakdown of the conditions for that segment.   
4. If the web-based interface fails to render the road condition data due to a technical error, it displays a warning and continues to store the data.   
5. If the Administrator requests an export of the viewed road condition data, the system generates and provides the data in the requested format.  
  
Use Case Name: View Incident Reports   
Use Case ID: UC-39   
Actors: Administrator, Traffic Management Systems, Traveler Information Systems, Probe Vehicles, Weather Stations, VII System, DUAP System   
Preconditions:   
1. The VII system is operational and receiving real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is configured to process and analyze traffic data for incident detection.   
3. Incident details are stored in the system database and accessible for retrieval.   
4. The web-based user interface is active and supports map displays, icon layers, and decluttering features.   
5. Data quality checks have been completed to ensure the integrity of incident records.   
  
Postconditions:   
1. Incident reports are retrieved and displayed in the web-based user interface.   
2. Map displays and icon layers are updated to show incident locations and details.   
3. The Administrator is provided with a comprehensive view of current and historical incident data.   
4. The system archives the viewing activity for audit and compliance.   
5. Traveler Information Systems and Traffic Management Systems can be notified of incidents based on the view or request.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and selects the "View Incident Reports" option.   
2. The system retrieves incident data from the Oracle 10G database via JDBC and the Java Software Foundation.   
3. The data includes incident type, location, time, severity, and associated road or traffic conditions.   
4. The system integrates the incident data with real-time and historical traffic data for context.   
5. The web-based interface updates map displays and icon layers to show the locations of incidents.   
6. Decluttering features are applied to ensure the interface remains clear and readable.   
7. The Administrator can filter the incident reports by location, time, or severity.   
8. The system archives the viewing activity and data access for compliance with data standards.   
9. The Administrator receives a summary of the incident reports for the selected area.   
10. The system logs the viewing activity for audit and performance tracking.   
  
Alternative Flow:   
1. If the incident data is temporarily unavailable, the system displays cached or historical data to maintain continuity.   
2. If the system detects inconsistencies in the incident data, it alerts the Administrator for manual review.   
3. If the Administrator selects a specific incident for detailed view, the system provides a breakdown of the incident's impact and related data.   
4. If the web-based interface fails to render incident data due to a technical error, it displays a warning and continues to store the data.   
5. If the Administrator requests an export of the viewed incident reports, the system generates and provides the data in the requested format.  
  
Use Case Name: View Asset Conditions   
Use Case ID: UC-40   
Actors: Administrator, Traffic Management Systems, Traveler Information Systems, Probe Vehicles, Weather Stations, VII System, DUAP System   
  
Preconditions:   
1. The VII system is operational and connected to all relevant data sources (probe vehicles, traffic management systems, weather stations).   
2. The DUAP system is configured to process and analyze asset condition data.   
3. Asset condition data (e.g., infrastructure status, signal malfunctions, road damage) is available in the system database (e.g., Oracle 10G).   
4. The web-based user interface is active and ready to display asset condition data.   
5. Data quality checks have been completed to ensure data accuracy and consistency.   
  
Postconditions:   
1. Asset condition data is retrieved and displayed in the web-based user interface.   
2. Map displays and icon layers are updated to reflect the current asset conditions.   
3. The Administrator is provided with a clear view of asset statuses for monitoring and decision-making.   
4. The system archives the viewing activity for compliance and historical reference.   
5. If requested, asset condition alerts are generated and sent to Traffic Management Systems and Traveler Information Systems.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and selects the "View Asset Conditions" option.   
2. The system retrieves asset condition data from the Oracle 10G database via JDBC and the Java Software Foundation.   
3. The data includes asset type, location, status (e.g., operational, degraded, failed), and time of last update.   
4. The system integrates the asset condition data with traffic and infrastructure data for context.   
5. The web-based interface updates map displays and icon layers to visualize asset conditions.   
6. Decluttering features are applied to ensure the interface remains visually clear and usable.   
7. The Administrator can filter asset conditions by location, type, or severity.   
8. The system archives the viewing activity for compliance with data standards (SAE J2354, TMDD).   
9. The Administrator receives a summary of asset conditions for the selected area.   
10. The system logs the viewing activity for audit and performance tracking.   
  
Alternative Flow:   
1. If the asset condition data is temporarily unavailable, the system displays cached or historical data to maintain continuity.   
2. If the system detects inconsistencies in the asset condition data, it alerts the Administrator for manual review.   
3. If the Administrator selects a specific asset for detailed view, the system provides a breakdown of the asset's status and related data.   
4. If the web-based interface fails to render asset condition data due to a technical error, it displays a warning and continues to store the data.   
5. If the Administrator requests an export of the viewed asset condition data, the system generates and provides the data in the requested format.  
  
Use Case Name: Delete Outdated Data   
Use Case ID: UC-41   
Actors: Administrator, DUAP System, VII System, Traffic Management Systems, Weather Stations, Probe Vehicles   
Preconditions:   
1. The VII system is operational and has stored both real-time and historical data in the system database.   
2. The DUAP system is configured to identify and manage outdated or obsolete data.   
3. The Administrator has initiated the data deletion process through the web-based user interface.   
4. Data quality checks have been performed to confirm data integrity before deletion.   
5. The system has access to Oracle 10G for data deletion and archiving operations.   
  
Postconditions:   
1. Outdated data is removed from the active database to improve system performance and data relevance.   
2. The system maintains a record of the deleted data for compliance and audit purposes.   
3. The web-based user interface is updated to reflect the current state of the database.   
4. The Administrator is informed of the successful deletion and any potential issues.   
5. The system continues to store and process real-time data without interruption.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and selects the "Delete Outdated Data" option.   
2. The system prompts the Administrator to define the criteria for identifying outdated data (e.g., time threshold, relevance, data type).   
3. The DUAP system queries the Oracle 10G database to identify data entities that meet the defined criteria.   
4. The system confirms the data to be deleted and displays a summary for the Administrator's review.   
5. The Administrator approves the deletion request.   
6. The system executes the deletion operation, removing the outdated data from the active database.   
7. The system archives the deleted data in a separate historical database or log for compliance.   
8. The web-based interface is refreshed to reflect the updated data status.   
9. The system logs the deletion activity for audit and performance tracking.   
10. The Administrator receives a confirmation message indicating the completion of the deletion process.   
  
Alternative Flow:   
1. If the defined deletion criteria conflict with active data processing, the system alerts the Administrator and suggests a safer time for deletion.   
2. If the system detects that the outdated data is referenced by active alerts or reports, it prompts the Administrator to confirm the deletion.   
3. If the Oracle 10G database is unavailable during the deletion process, the system caches the deletion request and retries when the database is accessible.   
4. If the Administrator cancels the deletion process, the system halts the operation and logs the cancellation.   
5. If the system encounters an error during the deletion, it rolls back the operation and provides an error report for the Administrator to review.  
  
Use Case Name: Modify User Interface Settings   
Use Case ID: UC-42   
Actors: Administrator, Web-based User Interfaces, Map Displays, Icon Layers, DUAP System   
Preconditions:   
1. The web-based user interface is active and accessible to the Administrator.   
2. The system is connected to the VII system and DUAP system for real-time data visualization.   
3. The Administrator has the necessary permissions to modify interface settings.   
4. Map displays, icon layers, and decluttering features are available for configuration.   
5. The system is integrated with the Oracle 10G database and Java Software Foundation for configuration persistence.   
  
Postconditions:   
1. User interface settings are updated to reflect the Administrator's preferences.   
2. Map displays, icon layers, and decluttering features are adjusted according to the new settings.   
3. The Administrator is notified of the successful modification.   
4. The system logs the interface configuration changes for audit and compliance.   
5. The web-based interface remains responsive and visually accurate after the settings are modified.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the settings configuration module.   
2. The system displays the current interface settings, including map display options, icon layer visibility, and decluttering preferences.   
3. The Administrator selects the settings to be modified, such as changing the color scheme of map displays or adjusting the visibility of icon layers.   
4. The system validates the selected settings to ensure compatibility and usability.   
5. The system updates the interface configuration in the Oracle 10G database using JDBC and the Java Software Foundation.   
6. The web-based interface is refreshed to reflect the new settings, including updated map visuals and icon layer configurations.   
7. The DUAP system is notified of the interface update to ensure synchronized data visualization.   
8. The system archives the configuration changes in compliance with data standards (SAE J2354, TMDD).   
9. The Administrator receives a confirmation that the interface settings have been successfully modified.   
10. The system logs the modification process for performance and audit tracking.   
  
Alternative Flow:   
1. If the Administrator selects an invalid configuration option, the system displays an error message and prompts for a valid setting.   
2. If the Oracle 10G database is temporarily unavailable, the system caches the configuration changes and applies them once the connection is restored.   
3. If the system detects a conflict between new settings and existing data visualization rules, it alerts the Administrator for manual resolution.   
4. If the Administrator cancels the modification request, the system reverts to the previous configuration and logs the cancellation.   
5. If the interface update causes performance degradation, the system triggers an alert and offers to revert to the last stable configuration.  
  
Use Case Name: Manage Administrative Tasks   
Use Case ID: UC-43   
Actors: Administrator, VII System, DUAP System, Traffic Management Systems, Weather Stations, Probe Vehicles   
  
Preconditions:   
1. The VII system is fully operational and connected to all data sources (probe vehicles, traffic management systems, weather stations).   
2. The DUAP system is active and capable of processing, analyzing, and storing data.   
3. The Administrator has access to the web-based user interface for managing system tasks.   
4. The system is integrated with the Oracle 10G database and uses JDBC for secure data access.   
5. Data entities (traffic data, weather data, road condition data, incident details, asset conditions) are available and processed.   
  
Postconditions:   
1. Administrative tasks are performed, including data deletion, configuration changes, and alert management.   
2. The system remains stable and responsive during administrative operations.   
3. The Administrator is informed of the outcome of each task for monitoring and decision-making.   
4. The system archives task logs for audit and compliance purposes.   
5. The web-based interface is updated to reflect the changes made through administrative tasks.   
  
Main Flow:   
1. The Administrator logs into the web-based user interface and navigates to the administrative task management module.   
2. The system displays available administrative tasks, such as data deletion, configuration updates, and alert management.   
3. The Administrator selects a specific administrative task to perform (e.g., delete outdated data, modify UI settings, update infrastructure information).   
4. The system verifies the selected task and prompts the Administrator for any required inputs or confirmations.   
5. The task is executed by the system, leveraging the Oracle 10G database and JDBC for secure and efficient operations.   
6. The system updates the web-based interface to reflect the changes resulting from the task.   
7. The Administrator receives a confirmation message indicating the task's success or failure.   
8. The system archives the task execution details for compliance and audit purposes.   
9. The system ensures that the task does not interfere with real-time data processing or alerting mechanisms.   
10. The Administrator logs out or proceeds to another task after reviewing the results.   
  
Alternative Flow:   
1. If the selected task requires data validation and the data fails checks, the system alerts the Administrator and prevents execution.   
2. If the Oracle 10G database is unavailable during the task, the system caches the request and retries when the database is accessible.   
3. If the task causes system performance issues (e.g., high load), the system triggers a cache optimization or alerts the Administrator.   
4. If the Administrator cancels the task during execution, the system halts the operation and logs the cancellation.   
5. If the task involves configuration changes that conflict with current system rules, the system prompts the Administrator to resolve the conflict.  
  
Use Case Name: Maintain System Configuration   
Use Case ID: UC-44   
Actors: Administrator, VII System, DUAP System, Traffic Management Systems, Weather Stations, Probe Vehicles   
Preconditions:   
1. The VII system is fully operational and connected to all relevant data sources (probe vehicles, traffic management systems, weather stations).   
2. The DUAP system is active and configured to process and analyze incoming data.   
3. The Administrator has access to the web-based user interface and system configuration tools.   
4. The system is integrated with Oracle 10G for storing and retrieving configuration and data.   
5. Data entities such as traffic data, weather data, road condition data, and incident details are available for configuration management.   
  
Postconditions:   
1. System configuration parameters (e.g., data sources, alert thresholds, caching rules) are updated and saved.   
2. The web-based user interface reflects the updated configuration settings.   
3. The system continues to operate with the new configuration applied.   
4. The Administrator is notified of the configuration changes and their impact.   
5. The system logs and archives the configuration changes for audit and compliance purposes.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the system configuration module.   
2. The system displays the current configuration settings, including data source connections, alert rules, and caching parameters.   
3. The Administrator selects the configuration parameters to modify and enters the new values.   
4. The system validates the new configuration against system constraints and data standards.   
5. Valid configuration settings are stored in the Oracle 10G database using JDBC and the Java Software Foundation.   
6. The system updates the VII and DUAP systems with the new configuration to ensure synchronization.   
7. The web-based interface is refreshed to reflect the updated configuration.   
8. The Administrator receives a confirmation of the changes and their impact on system performance or data flow.   
9. The system archives the configuration update for compliance and audit purposes.   
10. The system continues real-time data processing and visualization with the new configuration in place.   
  
Alternative Flow:   
1. If the Administrator enters invalid configuration values, the system displays an error and prompts for correction.   
2. If the Oracle 10G database is unavailable during the configuration update, the system caches the changes and applies them once the database is accessible.   
3. If the system detects a conflict between the new configuration and existing data processing rules, it alerts the Administrator for manual resolution.   
4. If the Administrator cancels the configuration update, the system reverts to the previous settings and logs the cancellation.   
5. If the configuration change causes system instability or performance degradation, the system triggers an alert and offers to revert to a stable configuration.  
  
Use Case Name: Manage Data Entities Lifecycle   
Use Case ID: UC-45   
Actors: Administrator, VII System, DUAP System, Traffic Management Systems, Weather Stations, Probe Vehicles, Traveler Information Systems   
  
Preconditions:   
1. The VII system is operational and connected to all data sources (probe vehicles, traffic management systems, weather stations).   
2. The DUAP system is active and capable of processing, analyzing, and managing data entities.   
3. Data entities (traffic data, weather data, road condition data, incident details, asset conditions) are accessible and properly structured.   
4. The web-based user interface is active and supports data visualization and configuration.   
5. The system is integrated with Oracle 10G, JDBC, and the Java Software Foundation for data storage and retrieval.   
  
Postconditions:   
1. Data entities are created, updated, archived, or deleted as part of their lifecycle management.   
2. The web-based interface is updated to reflect current data entity states and configurations.   
3. The system ensures data integrity and compliance with data standards (SAE J2354, TMDD).   
4. The Administrator is informed of the status of lifecycle operations and any issues encountered.   
5. The system logs and archives all lifecycle management actions for audit and reference.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface to manage the lifecycle of data entities.   
2. The system displays the current list of data entities (e.g., traffic data, incident details, asset conditions) and their status.   
3. The Administrator selects a data entity and chooses an action (create, update, archive, delete).   
4. The system validates the action and ensures that it aligns with data standards and system rules.   
5. If the action is to update or delete, the system confirms the entity’s existence and relevance.   
6. The system updates or modifies the data entity in the Oracle 10G database via JDBC and Java Software Foundation.   
7. The system updates the web-based interface to reflect the new status of the data entity.   
8. The system archives the lifecycle operation for compliance and audit purposes.   
9. The Administrator is notified of the successful completion of the action.   
10. The system ensures that all dependent systems (e.g., Traffic Management Systems, Traveler Information Systems) are updated accordingly.   
  
Alternative Flow:   
1. If the selected data entity does not exist in the database, the system displays an error and prompts the Administrator to verify the entity.   
2. If the system detects that an update or deletion might impact real-time processing, it alerts the Administrator and suggests a safer time for the action.   
3. If the Oracle 10G database is temporarily unavailable, the system caches the lifecycle action and applies it once the database is accessible.   
4. If the Administrator cancels the lifecycle action during execution, the system reverts to the previous state and logs the cancellation.   
5. If the system encounters an error during the lifecycle operation, it halts the process, logs the failure, and provides an error message for the Administrator to review.  
  
Use Case Name: Manage Data Processing Algorithm   
Use Case ID: UC-46   
Actors: Administrator, DUAP System, Traffic Management Systems, Weather Stations, Probe Vehicles, Web-based User Interfaces   
  
Preconditions:   
1. The VII system is operational and receiving real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is active and configured to process and analyze data using existing algorithms.   
3. The Administrator has access to the system configuration tools and algorithm management interface.   
4. The system is integrated with Oracle 10G, JDBC, and Java Software Foundation for secure and efficient algorithm and data management.   
5. The system maintains a repository of approved and active data processing algorithms.   
  
Postconditions:   
1. Data processing algorithms are added, updated, or removed in the system.   
2. The web-based interface reflects any changes in the algorithm configurations.   
3. The Administrator is informed of the success or failure of the algorithm management operation.   
4. The system continues to process data using the updated algorithm set without disruption.   
5. Algorithm changes are archived for compliance and audit purposes.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the "Manage Data Processing Algorithm" module.   
2. The system displays the current list of data processing algorithms in use, including their version, purpose, and status.   
3. The Administrator selects an algorithm and chooses an action (e.g., activate, deactivate, update, or delete).   
4. If the action is to update or add a new algorithm, the Administrator uploads the new algorithm file or configuration.   
5. The system validates the algorithm against predefined standards, format requirements, and system compatibility.   
6. Valid algorithms are stored in the system database (e.g., Oracle 10G) and marked for activation or deactivation.   
7. The system updates the DUAP system with the new or modified algorithm configuration.   
8. The web-based interface is refreshed to reflect the current algorithm status and configuration.   
9. The system archives the algorithm management activity for compliance and audit tracking.   
10. The Administrator receives a confirmation message of the algorithm management outcome.   
  
Alternative Flow:   
1. If the algorithm file format or structure is invalid, the system logs the error and prompts the Administrator for a valid file.   
2. If the system detects that an algorithm is in use and cannot be deleted without affecting ongoing data processing, it alerts the Administrator and suggests deactivation first.   
3. If the Oracle 10G database is unavailable during the algorithm update, the system caches the operation and retries when the database is accessible.   
4. If the Administrator cancels the algorithm management operation, the system reverts to the previous state and logs the cancellation.   
5. If the system encounters an error during algorithm deployment, it halts the process, logs the failure, and provides an error message for the Administrator to resolve.  
  
Use Case Name: Manage Data Format   
Use Case ID: UC-47   
Actors: Administrator, DUAP System, VII System, Traffic Management Systems, Weather Stations, Probe Vehicles, Traveler Information Systems   
  
Preconditions:   
1. The VII system is operational and has processed real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is active and has access to data formatting rules and standards (e.g., SAE J2354, TMDD).   
3. The Administrator has access to the system configuration tools and the data format management interface.   
4. The system is integrated with Oracle 10G, JDBC, and the Java Software Foundation for storage and processing of formatted data.   
5. The web-based user interface is active and supports data visualization and configuration of data formats.   
  
Postconditions:   
1. Data format settings are updated, added, or removed in the system.   
2. The web-based user interface is updated to reflect the new or modified data format configurations.   
3. The Administrator is notified of the success or failure of the data format management operation.   
4. The system ensures data compatibility and standardization across all integrated systems.   
5. Data format changes are archived for audit and compliance purposes.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the "Manage Data Format" module.   
2. The system displays the current data format configurations, including the formats used for traffic data, weather data, and road condition data.   
3. The Administrator selects a data type and chooses an action (e.g., change format, add new format, remove existing format).   
4. The system validates the selected format against system capabilities and predefined standards (e.g., SAE J2354, TMDD).   
5. Valid format settings are stored in the system database (e.g., Oracle 10G) and applied to the relevant data streams.   
6. The system updates the DUAP system to apply the new or modified data format during processing and integration.   
7. The web-based interface is refreshed to reflect the updated data format configuration.   
8. The system ensures that all downstream systems (e.g., Traffic Management Systems, Traveler Information Systems) receive data in the new format.   
9. The system archives the data format management activity for audit and compliance tracking.   
10. The Administrator receives a confirmation message indicating the success of the data format management operation.   
  
Alternative Flow:   
1. If the selected format is not supported by the system or external stakeholders, the system alerts the Administrator and provides a list of valid options.   
2. If the system detects that a data format change would disrupt ongoing data integration processes, it alerts the Administrator and suggests a safer time for the update.   
3. If the Oracle 10G database is temporarily unavailable during the format update, the system caches the configuration changes and applies them when the database is accessible.   
4. If the Administrator cancels the data format change, the system reverts to the previous settings and logs the cancellation.   
5. If the system encounters an error during the format update process, it halts the operation, logs the failure, and provides an error message for the Administrator to resolve.  
  
Use Case Name: Manage Presentation Method   
Use Case ID: UC-48   
Actors: Administrator, Web-based User Interfaces, VII System, DUAP System, Traffic Management Systems, Traveler Information Systems   
  
Preconditions:   
1. The VII system is operational and has processed and integrated real-time and historical traffic, weather, and road condition data.   
2. The DUAP system is active and has generated formatted output data for visualization.   
3. The web-based user interface is active and supports dynamic configuration of presentation methods (e.g., map overlays, data tables, alerts, dashboards).   
4. The system has access to predefined presentation method templates and rendering tools (e.g., Michigan Geographic Framework, icon layers, decluttering features).   
5. The Administrator has the necessary permissions to modify and manage presentation method configurations.   
  
Postconditions:   
1. Presentation methods are added, updated, or removed in the system.   
2. The web-based user interface is updated to reflect the current presentation method configurations.   
3. The Administrator is informed of the success or failure of the presentation method management operation.   
4. Presentation method changes are archived for audit and compliance purposes.   
5. The system ensures that the selected presentation methods are compatible with the data formats and visualization tools.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the "Manage Presentation Method" module.   
2. The system displays the current list of available presentation methods, including map-based visualization, tabular reports, alert notifications, and custom dashboards.   
3. The Administrator selects a presentation method and chooses an action (e.g., activate, deactivate, update, delete, or add a new method).   
4. If the action is to add or update a presentation method, the Administrator provides the method configuration details (e.g., visualization type, data sources to display, user permissions).   
5. The system validates the configuration against predefined system rules and compatibility requirements.   
6. Valid presentation method configurations are stored in the system database (e.g., Oracle 10G) and applied to the web-based interface.   
7. The system updates the DUAP system to apply the new or modified presentation method during data visualization.   
8. The web-based interface is refreshed to reflect the new or modified presentation method for real-time data display.   
9. The system archives the presentation method management activity for audit and compliance tracking.   
10. The Administrator receives a confirmation message indicating the success of the presentation method management operation.   
  
Alternative Flow:   
1. If the selected presentation method is not supported by the system or the web-based interface, it alerts the Administrator and provides a list of valid options.   
2. If the system detects that a presentation method change would interfere with real-time data processing or visualization, it alerts the Administrator and suggests a safer time for the update.   
3. If the Oracle 10G database is temporarily unavailable during the presentation method update, the system caches the configuration changes and applies them when the database is accessible.   
4. If the Administrator cancels the presentation method management operation, the system reverts to the previous method configuration and logs the cancellation.   
5. If the system encounters an error during the presentation method deployment or configuration, it halts the operation, logs the failure, and provides an error message for the Administrator to resolve.  
  
Use Case Name: Manage Data Cache   
Use Case ID: UC-49   
Actors: Administrator, DUAP System, VII System, Web-based User Interfaces, Traffic Management Systems, Traveler Information Systems   
  
Preconditions:   
1. The VII system is operational and receiving real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is configured to implement and manage dynamic data caching for performance optimization.   
3. The system has access to caching mechanisms and storage resources (e.g., in-memory cache, file-based cache).   
4. The Administrator has access to the system configuration tools and cache management interface.   
5. The web-based user interface is active and supports visualization of cached data.   
  
Postconditions:   
1. Data cache configurations are updated or managed based on Administrator input.   
2. The system dynamically adjusts cache usage to improve performance and reduce latency.   
3. The web-based interface is updated to reflect current cache status and utilization.   
4. The Administrator is informed of the success or failure of the cache management operation.   
5. The system logs and archives all cache management activities for audit and compliance.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the "Manage Data Cache" module.   
2. The system displays the current cache configuration, including cache size, data entities cached, refresh intervals, and eviction policies.   
3. The Administrator selects a cache configuration parameter to modify (e.g., increase cache size, adjust refresh frequency, change eviction rules).   
4. The system validates the new configuration to ensure compatibility with system performance and data standards.   
5. Valid configurations are applied to the DUAP system, which begins using the updated cache rules for data storage and retrieval.   
6. The web-based interface is refreshed to reflect the updated cache settings and current cache status.   
7. The system updates the Oracle 10G database with the new cache configuration using JDBC and the Java Software Foundation.   
8. The system logs the cache management activity for audit and compliance tracking.   
9. The Administrator receives a confirmation message indicating the success of the cache configuration update.   
10. The system continues to use the updated cache rules to optimize data access and maintain performance.   
  
Alternative Flow:   
1. If the selected cache configuration is invalid or incompatible, the system alerts the Administrator and provides a list of valid options.   
2. If the system detects that a cache update might impact real-time data processing, it prompts the Administrator for confirmation and suggests a safer time for the change.   
3. If the Oracle 10G database is temporarily unavailable during the cache configuration update, the system caches the changes and applies them once the database is accessible.   
4. If the Administrator cancels the cache management operation, the system reverts to the previous configuration and logs the cancellation.   
5. If the system encounters an error during the cache management process, it halts the operation, logs the failure, and provides an error message for the Administrator to resolve.  
  
Use Case Name: Manage ArchiveRecord   
Use Case ID: UC-50   
Actors: Administrator, DUAP System, VII System, Traffic Management Systems, Weather Stations, Probe Vehicles   
  
Preconditions:   
1. The VII system is operational and has completed data processing and analysis tasks.   
2. The DUAP system is configured to handle long-term data archiving operations.   
3. The system has access to the Oracle 10G database for storing and retrieving ArchiveRecord entities.   
4. ArchiveRecord data entities (e.g., historical traffic metrics, weather observations, incident records) are available for management.   
5. The Administrator has access to the system configuration tools and archive management interface.   
6. The system supports archive lifecycle operations such as creation, retrieval, update, and deletion of ArchiveRecord entries.   
  
Postconditions:   
1. ArchiveRecord entries are created, retrieved, updated, or deleted as per the Administrator's instructions.   
2. ArchiveRecord data is stored in the Oracle 10G database and indexed for efficient retrieval.   
3. The web-based user interface is updated to reflect the current state of ArchiveRecord entries.   
4. The Administrator is notified of the outcome of the archive management operation.   
5. All archive management activities are logged and archived for audit and compliance purposes.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the "Manage ArchiveRecord" module.   
2. The system displays a list of existing ArchiveRecord entries, including metadata such as record type, timestamp, and data source.   
3. The Administrator selects an ArchiveRecord and chooses an action (e.g., view, update, delete, or add a new record).   
4. If the action is to add or update an ArchiveRecord, the system prompts the Administrator to provide the relevant data and metadata.   
5. The system validates the data and metadata to ensure compliance with archiving policies and data standards (e.g., SAE J2354, TMDD).   
6. Valid ArchiveRecord entries are stored in the Oracle 10G database using JDBC and the Java Software Foundation.   
7. The system updates the web-based interface to reflect the current ArchiveRecord configuration and status.   
8. The system archives the ArchiveRecord management activity for audit and compliance tracking.   
9. The Administrator receives a confirmation message indicating the success of the archive management operation.   
10. The system ensures that all dependent systems are synchronized with updated ArchiveRecord data if required.   
  
Alternative Flow:   
1. If the ArchiveRecord metadata fails validation, the system logs the issue and prompts the Administrator to correct the input.   
2. If the Oracle 10G database is temporarily unavailable during ArchiveRecord management, the system caches the operation and retries when the database is accessible.   
3. If the system detects that an ArchiveRecord is referenced by an existing report or visualization, it alerts the Administrator before deletion and may suggest deactivation instead.   
4. If the Administrator cancels the ArchiveRecord operation during execution, the system reverts to the previous state and logs the cancellation.   
5. If the system encounters an error during ArchiveRecord creation or deletion, it halts the operation, logs the failure, and provides an error message for the Administrator to resolve.  
  
Use Case Name: Manage AlertConfiguration   
Use Case ID: UC-51   
Actors: Administrator, DUAP System, Traffic Management Systems, Traveler Information Systems, Web-based User Interfaces, Probe Vehicles, Weather Stations   
  
Preconditions:   
1. The VII system is operational and receiving real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is active and configured to process data and generate alerts based on predefined AlertConfiguration rules.   
3. The Administrator has access to the system configuration tools and the AlertConfiguration management interface.   
4. The system is integrated with the Oracle 10G database for storing and retrieving AlertConfiguration records.   
5. Data entities such as traffic metrics, weather observations, road surface conditions, and incident details are available for alerting purposes.   
6. The web-based user interface is active and supports the display and configuration of alert settings.   
  
Postconditions:   
1. AlertConfiguration settings are created, updated, or deleted in the system.   
2. The web-based user interface is updated to reflect the current AlertConfiguration status.   
3. The DUAP system uses the updated AlertConfiguration to generate and manage alerts accurately.   
4. Traffic Management Systems and Traveler Information Systems are synchronized with the new or modified alert rules.   
5. The system archives all AlertConfiguration changes for audit and compliance purposes.   
6. The Administrator is informed of the success or failure of the configuration operation.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the "Manage AlertConfiguration" module.   
2. The system displays the current list of AlertConfiguration entries, including alert types, thresholds, priority levels, and associated data sources.   
3. The Administrator selects an AlertConfiguration entry and chooses an action (e.g., add, update, delete, or view details).   
4. If the action is to add or update an AlertConfiguration, the system prompts the Administrator to provide the configuration parameters (e.g., alert type, threshold values, response actions, and notification systems).   
5. The system validates the configuration parameters to ensure they align with system rules and data standards.   
6. Valid AlertConfiguration entries are stored in the Oracle 10G database using JDBC and the Java Software Foundation.   
7. The system updates the DUAP system to apply the new or modified AlertConfiguration to the alert generation process.   
8. The web-based interface is refreshed to reflect the updated AlertConfiguration settings.   
9. The system logs the AlertConfiguration management activity for audit and compliance tracking.   
10. The Administrator receives a confirmation message indicating the success of the AlertConfiguration operation.   
  
Alternative Flow:   
1. If the provided AlertConfiguration parameters fail validation, the system logs the issue and prompts the Administrator to correct the input.   
2. If the Oracle 10G database is temporarily unavailable during the configuration update, the system caches the operation and applies it when the database is accessible.   
3. If the system detects that an existing alert is still active based on the configuration being deleted, it alerts the Administrator and suggests deactivating the alert before proceeding.   
4. If the Administrator cancels the AlertConfiguration operation during execution, the system reverts to the previous configuration and logs the cancellation.   
5. If the system encounters an error during AlertConfiguration deployment, it halts the operation, logs the failure, and provides an error message for the Administrator to resolve.  
  
Use Case Name: Manage VII System   
Use Case ID: UC-52   
Actors: Administrator, DUAP System, Traffic Management Systems, Weather Stations, Probe Vehicles, Web-based User Interfaces, Traveler Information Systems   
  
Preconditions:   
1. The VII system is installed and operational within the system architecture.   
2. The Administrator has access to the system configuration tools and VII system management interface.   
3. The system is connected to external data sources (probe vehicles, traffic management systems, weather stations).   
4. The DUAP system is active and capable of processing and analyzing data received from the VII system.   
5. The system is integrated with the Oracle 10G database for storage and retrieval of VII system configurations and logs.   
6. Data entities such as traffic data, weather data, road condition data, and incident details are available for management and processing.   
  
Postconditions:   
1. VII system configurations are updated, added, or removed based on Administrator input.   
2. The VII system continues to operate with updated configurations applied without disruption.   
3. The web-based user interface is synchronized with the current VII system settings.   
4. The Administrator is notified of the success or failure of the VII system management operation.   
5. The system logs and archives all VII system configuration changes for audit and compliance purposes.   
6. The system ensures that all connected subsystems (e.g., DUAP, Traffic Management Systems) are updated to reflect the new VII system configurations.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the "Manage VII System" module.   
2. The system displays the current VII system configurations, including data source integrations, data processing rules, and system status.   
3. The Administrator selects a configuration option to modify (e.g., enable or disable a data source, update system parameters, or configure data integration rules).   
4. The system validates the configuration changes to ensure compatibility with existing data flows and system requirements.   
5. Valid configurations are stored in the Oracle 10G database using JDBC and the Java Software Foundation.   
6. The VII system is updated with the new configuration to reflect changes in data collection, processing, or integration behavior.   
7. The system synchronizes the changes with the DUAP system to ensure data processing aligns with the updated VII system settings.   
8. The web-based interface is refreshed to reflect the updated VII system status and configuration.   
9. The system archives the management activity for compliance and audit tracking.   
10. The Administrator receives a confirmation message indicating the success of the VII system configuration update.   
  
Alternative Flow:   
1. If the configuration change is invalid or conflicts with system rules, the system alerts the Administrator and provides a list of valid options for correction.   
2. If the Oracle 10G database is temporarily unavailable during configuration update, the system caches the operation and applies it once the database is accessible.   
3. If the VII system is currently processing high-volume data and the configuration change may interfere with performance, the system prompts the Administrator for confirmation and may suggest a safer time for implementation.   
4. If the Administrator cancels the VII system management operation, the system reverts to the previous configuration and logs the cancellation.   
5. If the system encounters an error during configuration deployment (e.g., invalid file, system incompatibility), it halts the operation, logs the failure, and provides an error message for the Administrator to resolve.  
  
Use Case Name: Manage DUAP   
Use Case ID: UC-53   
Actors: Administrator, VII System, Traffic Management Systems, Weather Stations, Probe Vehicles, Web-based User Interfaces, Traveler Information Systems   
  
Preconditions:   
1. The VII system is operational and connected to all relevant data sources (probe vehicles, traffic management systems, weather stations).   
2. The DUAP system is active and properly integrated with the VII system for data processing, analysis, and formatting.   
3. The Administrator has access to the system configuration tools and the DUAP management interface.   
4. The system is connected to the Oracle 10G database via JDBC and the Java Software Foundation for storage and retrieval of DUAP-related configurations and logs.   
5. Data entities such as traffic data, weather data, road condition data, and incident details are available for processing by the DUAP system.   
6. The system maintains a repository of DUAP modules, algorithms, and configuration templates.   
  
Postconditions:   
1. DUAP system configurations, modules, and processing rules are added, updated, or removed based on Administrator input.   
2. The web-based user interface is updated to reflect the current DUAP system status and configurations.   
3. The DUAP system continues to process and analyze data according to the new or modified settings.   
4. The Administrator is notified of the success or failure of the DUAP system management operation.   
5. The system logs and archives all DUAP system configuration changes for audit and compliance purposes.   
6. The system ensures that all dependent systems (e.g., Traffic Management Systems, Traveler Information Systems) are synchronized with updated DUAP configurations.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the "Manage DUAP" module.   
2. The system displays the current DUAP system configurations, including active modules, data processing algorithms, alert rules, and integration settings.   
3. The Administrator selects a specific component of the DUAP system and chooses an action (e.g., activate, deactivate, update, delete, or add a new module).   
4. If the action is to add or update a DUAP module or configuration, the Administrator provides the necessary details (e.g., module name, algorithm version, data source mappings).   
5. The system validates the provided configuration or module against system rules and predefined standards to ensure compatibility and correctness.   
6. Valid DUAP configurations or modules are stored in the Oracle 10G database using JDBC and the Java Software Foundation.   
7. The system updates the DUAP system to apply the new or modified configuration or module.   
8. The web-based interface is refreshed to reflect the updated DUAP system status and available modules.   
9. The system archives the DUAP system management activity for audit and compliance tracking.   
10. The Administrator receives a confirmation message indicating the success of the DUAP system configuration or module management operation.   
  
Alternative Flow:   
1. If the provided DUAP module or configuration fails validation, the system logs the issue and prompts the Administrator to correct the input.   
2. If the Oracle 10G database is temporarily unavailable during the management operation, the system caches the change and applies it once the database is accessible.   
3. If the system detects that the current DUAP system is in the middle of processing a large data batch, it alerts the Administrator and suggests a safer time for the configuration update.   
4. If the Administrator cancels the management operation during execution, the system reverts to the previous configuration and logs the cancellation.   
5. If the system encounters an error during the DUAP module deployment or configuration update, it halts the operation, logs the failure, and provides an error message for the Administrator to resolve.  
  
Use Case Name: Manage Probe Vehicles   
Use Case ID: UC-54   
Actors: Administrator, VII System, DUAP System, Probe Vehicles, Traffic Management Systems, Web-based User Interfaces   
  
Preconditions:   
1. The VII system is operational and connected to probe vehicles for real-time data collection.   
2. The DUAP system is configured to process and analyze data from probe vehicles.   
3. The Administrator has access to the system configuration tools and the probe vehicle management interface.   
4. The system is integrated with the Oracle 10G database for storing and retrieving probe vehicle data and configurations.   
5. Probe vehicle data entities (e.g., vehicle ID, location, speed, heading, status) are available for management.   
6. The web-based user interface is active and supports probe vehicle configuration and monitoring.   
  
Postconditions:   
1. Probe vehicle configurations are created, updated, or deleted in the system.   
2. The system maintains accurate and up-to-date probe vehicle data for real-time traffic analysis.   
3. The web-based interface is updated to reflect the current status and configuration of probe vehicles.   
4. The Administrator is informed of the success or failure of the probe vehicle management operation.   
5. The system logs and archives all probe vehicle management activities for audit and compliance purposes.   
6. The VII and DUAP systems are synchronized with the updated probe vehicle configurations.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the "Manage Probe Vehicles" module.   
2. The system displays a list of currently registered probe vehicles, including their status (active, inactive, malfunctioning), last reported location, and data transmission status.   
3. The Administrator selects a probe vehicle or group of probe vehicles and chooses an action (e.g., activate, deactivate, update configuration, delete vehicle record).   
4. If the action is to update or add a new probe vehicle configuration, the Administrator provides necessary details (e.g., vehicle ID, communication protocol, data format, and priority level).   
5. The system validates the configuration details to ensure compatibility with the VII and DUAP systems.   
6. Valid configurations are stored in the Oracle 10G database using JDBC and the Java Software Foundation.   
7. The system updates the VII and DUAP systems to reflect the new or modified probe vehicle configurations.   
8. The web-based interface is refreshed to show the updated probe vehicle status and configurations.   
9. The system archives the probe vehicle management activity for compliance and audit tracking.   
10. The Administrator receives a confirmation message indicating the success of the probe vehicle management operation.   
  
Alternative Flow:   
1. If the provided probe vehicle configuration fails validation, the system logs the issue and prompts the Administrator to correct the input.   
2. If the Oracle 10G database is temporarily unavailable during the configuration update, the system caches the operation and applies it once the database is accessible.   
3. If the system detects that a probe vehicle is currently transmitting data and the Administrator attempts to deactivate it, the system alerts the Administrator and suggests a time when deactivation is less disruptive.   
4. If the Administrator cancels the probe vehicle management operation during execution, the system reverts to the previous configuration and logs the cancellation.   
5. If the system encounters an error during probe vehicle configuration deployment (e.g., duplicate vehicle ID, missing communication parameters), it halts the operation, logs the failure, and provides an error message for the Administrator to resolve.  
  
Use Case Name: Manage Traffic Management Systems   
Use Case ID: UC-55   
Actors: Administrator, VII System, DUAP System, Probe Vehicles, Weather Stations, Traveler Information Systems   
  
Preconditions:   
1. The VII system is operational and connected to Traffic Management Systems for real-time data exchange.   
2. The DUAP system is active and capable of processing and analyzing data to support traffic management operations.   
3. The Administrator has access to the system configuration tools and the Traffic Management Systems management interface.   
4. The system is integrated with Oracle 10G, JDBC, and the Java Software Foundation for secure and efficient configuration and data management.   
5. Traffic data, incident details, and road condition data are available and processed for management purposes.   
6. Communication protocols and data standards (e.g., TMDD) are defined and supported for Traffic Management Systems integration.   
  
Postconditions:   
1. Traffic Management Systems configurations are updated, added, or removed in the system.   
2. The system ensures that Traffic Management Systems are synchronized with the latest traffic and road condition data.   
3. The web-based user interface is updated to reflect the current status of Traffic Management Systems.   
4. The Administrator is notified of the success or failure of the management operation.   
5. The system logs and archives all Traffic Management Systems configuration changes for audit and compliance purposes.   
6. The system continues to support real-time data processing and alerting to Traffic Management Systems without interruption.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the "Manage Traffic Management Systems" module.   
2. The system displays a list of currently connected Traffic Management Systems, including their status (active, inactive, disconnected), communication protocol, and data exchange configurations.   
3. The Administrator selects a Traffic Management System and chooses an action (e.g., activate, deactivate, update configuration, delete system record).   
4. If the action is to add or update a Traffic Management System, the Administrator provides necessary details (e.g., system ID, communication endpoint, data format, and priority level).   
5. The system validates the configuration details to ensure compatibility with the VII and DUAP systems.   
6. Valid configurations are stored in the Oracle 10G database using JDBC and the Java Software Foundation.   
7. The system updates the VII and DUAP systems to reflect the new or modified Traffic Management System configurations.   
8. The web-based interface is refreshed to show the updated Traffic Management System status and configurations.   
9. The system archives the Traffic Management Systems management activity for compliance and audit tracking.   
10. The Administrator receives a confirmation message indicating the success of the Traffic Management Systems management operation.   
  
Alternative Flow:   
1. If the provided Traffic Management System configuration fails validation, the system logs the issue and prompts the Administrator to correct the input.   
2. If the Oracle 10G database is temporarily unavailable during the configuration update, the system caches the operation and applies it once the database is accessible.   
3. If the system detects that a Traffic Management System is actively receiving data and the Administrator attempts to deactivate or remove it, the system alerts the Administrator and suggests a time when the change can be made without disrupting traffic management operations.   
4. If the Administrator cancels the management operation during execution, the system reverts to the previous configuration and logs the cancellation.   
5. If the system encounters an error during Traffic Management Systems configuration deployment (e.g., duplicate system ID, missing communication parameters), it halts the operation, logs the failure, and provides an error message for the Administrator to resolve.  
  
Use Case Name: Manage Weather Stations   
Use Case ID: UC-56   
Actors: Administrator, VII System, DUAP System, Weather Stations, Traffic Management Systems, Traveler Information Systems   
  
Preconditions:   
1. The VII system is operational and connected to weather stations for real-time weather data collection.   
2. The DUAP system is configured to process and integrate weather data with traffic and road condition data.   
3. The Administrator has access to the system configuration tools and the weather station management interface.   
4. The system is integrated with Oracle 10G, JDBC, and the Java Software Foundation for secure and efficient configuration and data management.   
5. Weather data entities (e.g., temperature, precipitation, visibility, wind speed) are available for processing and validation.   
6. Communication protocols and data standards (e.g., SAE J2354, TMDD) are defined and supported for weather station integration.   
  
Postconditions:   
1. Weather station configurations are updated, added, or removed in the system.   
2. The system ensures that weather stations are synchronized with the latest data integration and processing rules.   
3. The web-based user interface is updated to reflect the current status and configuration of weather stations.   
4. The Administrator is notified of the success or failure of the weather station management operation.   
5. The system logs and archives all weather station configuration changes for audit and compliance purposes.   
6. The system continues to support real-time weather data processing and alerting without interruption.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the "Manage Weather Stations" module.   
2. The system displays a list of currently connected weather stations, including their status (active, inactive, disconnected), location, communication protocol, and data transmission frequency.   
3. The Administrator selects a weather station or group of weather stations and chooses an action (e.g., activate, deactivate, update configuration, delete station record).   
4. If the action is to add or update a weather station configuration, the Administrator provides necessary details (e.g., station ID, communication endpoint, data format, and priority level).   
5. The system validates the configuration details to ensure compatibility with the VII and DUAP systems.   
6. Valid configurations are stored in the Oracle 10G database using JDBC and the Java Software Foundation.   
7. The system updates the VII and DUAP systems to reflect the new or modified weather station configurations.   
8. The web-based interface is refreshed to show the updated weather station status and configurations.   
9. The system archives the weather station management activity for compliance and audit tracking.   
10. The Administrator receives a confirmation message indicating the success of the weather station management operation.   
  
Alternative Flow:   
1. If the provided weather station configuration fails validation, the system logs the issue and prompts the Administrator to correct the input.   
2. If the Oracle 10G database is temporarily unavailable during the configuration update, the system caches the operation and applies it once the database is accessible.   
3. If the system detects that a weather station is actively transmitting data and the Administrator attempts to deactivate or remove it, the system alerts the Administrator and suggests a time when the change can be made without disrupting weather monitoring operations.   
4. If the Administrator cancels the weather station management operation during execution, the system reverts to the previous configuration and logs the cancellation.   
5. If the system encounters an error during weather station configuration deployment (e.g., duplicate station ID, missing communication parameters), it halts the operation, logs the failure, and provides an error message for the Administrator to resolve.  
  
Use Case Name: Manage Traveler Information Systems   
Use Case ID: UC-57   
Actors: Administrator, VII System, DUAP System, Traveler Information Systems, Probe Vehicles, Weather Stations, Traffic Management Systems   
  
Preconditions:   
1. The VII system is operational and connected to all data sources, including probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is active and has processed and analyzed traffic, weather, and road condition data for traveler information dissemination.   
3. The Administrator has access to the system configuration tools and the Traveler Information Systems management interface.   
4. The system is integrated with Oracle 10G, JDBC, and the Java Software Foundation for secure and efficient configuration and data exchange.   
5. Traveler Information Systems are online and capable of receiving and displaying real-time and processed data.   
6. Data entities such as traffic metrics, road surface conditions, incidents, and weather alerts are available for integration with traveler information systems.   
  
Postconditions:   
1. Traveler Information System configurations are updated, added, or removed in the system based on Administrator input.   
2. The system ensures that Traveler Information Systems are synchronized with the latest traffic, weather, and road condition data.   
3. The web-based user interface is updated to reflect the current status and configuration of Traveler Information Systems.   
4. The Administrator is notified of the success or failure of the management operation.   
5. The system logs and archives all Traveler Information System configuration changes for audit and compliance purposes.   
6. Traveler Information Systems continue to receive real-time updates and alerts without disruption after configuration changes.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the "Manage Traveler Information Systems" module.   
2. The system displays a list of currently connected Traveler Information Systems, including their status (active, inactive, disconnected), communication protocol, and data format preferences.   
3. The Administrator selects a Traveler Information System and chooses an action (e.g., activate, deactivate, update configuration, delete system record).   
4. If the action is to add or update a Traveler Information System, the Administrator provides necessary details (e.g., system ID, communication endpoint, data format, priority level, and alert preferences).   
5. The system validates the configuration details to ensure compatibility with the VII and DUAP systems.   
6. Valid configurations are stored in the Oracle 10G database using JDBC and the Java Software Foundation.   
7. The system updates the VII and DUAP systems to reflect the new or modified Traveler Information System configurations.   
8. The web-based interface is refreshed to show the updated Traveler Information System status and configurations.   
9. The system archives the Traveler Information System management activity for compliance and audit tracking.   
10. The Administrator receives a confirmation message indicating the success of the Traveler Information System management operation.   
  
Alternative Flow:   
1. If the provided Traveler Information System configuration fails validation, the system logs the issue and prompts the Administrator to correct the input.   
2. If the Oracle 10G database is temporarily unavailable during the configuration update, the system caches the operation and applies it once the database is accessible.   
3. If the system detects that a Traveler Information System is actively receiving data and the Administrator attempts to deactivate or remove it, the system alerts the Administrator and suggests a time when the change can be made without disrupting traveler information services.   
4. If the Administrator cancels the management operation during execution, the system reverts to the previous configuration and logs the cancellation.   
5. If the system encounters an error during Traveler Information System configuration deployment (e.g., duplicate system ID, missing communication parameters), it halts the operation, logs the failure, and provides an error message for the Administrator to resolve.  
  
Use Case Name: Manage Data Quality Checks   
Use Case ID: UC-58   
Actors: Administrator, DUAP System, VII System, Traffic Management Systems, Weather Stations, Probe Vehicles, Traveler Information Systems   
  
Preconditions:   
1. The VII system is operational and receiving real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is configured to perform data quality checks on incoming data streams.   
3. The Administrator has access to the system configuration tools and the data quality check management interface.   
4. The system is integrated with Oracle 10G, JDBC, and the Java Software Foundation for secure and efficient configuration and logging of data quality checks.   
5. Data quality check rules and thresholds are defined and stored in the system for validation.   
6. The web-based user interface is active and supports configuration, monitoring, and reporting of data quality checks.   
  
Postconditions:   
1. Data quality check rules are created, updated, or removed in the system based on Administrator input.   
2. The system applies updated quality checks to incoming data for validation.   
3. The web-based interface reflects the current status and configuration of data quality check rules.   
4. The Administrator is notified of the success or failure of the data quality check management operation.   
5. The system logs and archives all data quality check configuration changes for audit and compliance purposes.   
6. Invalid or corrupted data is excluded from further processing and flagged for review.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the "Manage Data Quality Checks" module.   
2. The system displays the current data quality check rules, including validation criteria (e.g., data format, range, consistency, completeness).   
3. The Administrator selects a quality check rule and chooses an action (e.g., add, update, delete, or view details).   
4. If the action is to add or update a data quality check rule, the Administrator provides necessary details (e.g., rule name, validation parameters, threshold values, and data sources to apply the rule to).   
5. The system validates the new or modified rule to ensure it aligns with system capabilities and data integrity standards.   
6. Valid quality check rules are stored in the Oracle 10G database using JDBC and the Java Software Foundation.   
7. The system updates the DUAP system to apply the new or modified quality check rules to incoming data.   
8. The web-based interface is refreshed to show the updated data quality check configurations.   
9. The system archives the data quality check management activity for compliance and audit tracking.   
10. The Administrator receives a confirmation message indicating the success of the data quality check rule management operation.   
  
Alternative Flow:   
1. If the provided data quality check rule fails validation (e.g., invalid syntax or conflicting criteria), the system logs the issue and prompts the Administrator to correct the input.   
2. If the Oracle 10G database is temporarily unavailable during the configuration update, the system caches the operation and applies it once the database is accessible.   
3. If the system detects that a quality check rule is currently in use and the Administrator attempts to delete it, the system alerts the Administrator and suggests deactivation first.   
4. If the Administrator cancels the management operation during execution, the system reverts to the previous configuration and logs the cancellation.   
5. If the system encounters an error during quality check rule deployment (e.g., duplicate rule name, missing validation parameters), it halts the operation, logs the failure, and provides an error message for the Administrator to resolve.  
  
Use Case Name: Manage Data Format   
Use Case ID: UC-59   
Actors: Administrator, DUAP System, VII System, Traffic Management Systems, Weather Stations, Probe Vehicles, Traveler Information Systems   
  
Preconditions:   
1. The VII system is operational and has processed real-time data from probe vehicles, traffic management systems, and weather stations.   
2. The DUAP system is active and has access to data formatting rules and standards (e.g., SAE J2354, TMDD).   
3. The Administrator has access to the system configuration tools and the data format management interface.   
4. The system is integrated with Oracle 10G, JDBC, and the Java Software Foundation for storage and processing of formatted data.   
5. The web-based user interface is active and supports data visualization and configuration of data formats.   
  
Postconditions:   
1. Data format settings are updated, added, or removed in the system.   
2. The web-based user interface is updated to reflect the new or modified data format configurations.   
3. The Administrator is notified of the success or failure of the data format management operation.   
4. The system ensures data compatibility and standardization across all integrated systems.   
5. Data format changes are archived for audit and compliance purposes.   
  
Main Flow:   
1. The Administrator accesses the web-based user interface and navigates to the "Manage Data Format" module.   
2. The system displays the current data format configurations, including the formats used for traffic data, weather data, and road condition data.   
3. The Administrator selects a data type and chooses an action (e.g., change format, add new format, remove existing format).   
4. The system validates the selected format against system capabilities and predefined standards (e.g., SAE J2354, TMDD).   
5. Valid format settings are stored in the system database (e.g., Oracle 10G) and applied to the relevant data streams.   
6. The system updates the DUAP system to apply the new or modified data format during processing and integration.   
7. The web-based interface is refreshed to reflect the updated data format configuration.   
8. The system ensures that all downstream systems (e.g., Traffic Management Systems, Traveler Information Systems) receive data in the new format.   
9. The system archives the data format management activity for audit and compliance tracking.   
10. The Administrator receives a confirmation message indicating the success of the data format management operation.   
  
Alternative Flow:   
1. If the selected format is not supported by the system or external stakeholders, the system alerts the Administrator and provides a list of valid options.   
2. If the system detects that a data format change would disrupt ongoing data integration processes, it alerts the Administrator and suggests a safer time for the update.   
3. If the Oracle 10G database is temporarily unavailable during the format update, the system caches the configuration changes and applies them when the database is accessible.   
4. If the Administrator cancels the data format change, the system reverts to the previous settings and logs the cancellation.   
5. If the system encounters an error during the format update process, it halts the operation, logs the failure, and provides an error message for the Administrator to resolve.