# Functional Requirement

2. Functional Requirements  
2.1 Data Collection and Ingestion  
FR-DCI-001: The system shall accept real-time data inputs from probe vehicles, traffic sensors, weather stations, and traveler information systems.  
  
Inputs: GPS data, speed, location, road condition reports, temperature, precipitation, visibility.  
Outputs: Normalized data stored in a central database.  
FR-DCI-002: The system shall validate incoming data against predefined quality rules and reject invalid or malformed data.  
  
FR-DCI-003: The system shall allow for the configuration of new data source types without requiring major software changes.  
  
FR-DCI-004: The system shall support batch ingestion of historical data for backfilling archives and training models.  
  
2.2 Data Processing and Analysis  
FR-DPA-001: The system shall compute traffic metrics including congestion levels, travel times, queue lengths, and traffic flow patterns.  
  
FR-DPA-002: The system shall detect and classify incidents such as crashes, debris, stalled vehicles, and work zones.  
  
Inputs: Raw sensor and probe data.  
Outputs: Incident reports with time, location, type, and severity.  
FR-DPA-003: The system shall calculate road surface conditions based on weather data and sensor inputs.  
  
FR-DPA-004: The system shall perform automated data quality checks to flag anomalies and inconsistencies.  
  
FR-DPA-005: The system shall support machine learning models for predictive analysis of traffic trends and incident likelihood.  
  
FR-DPA-006: The system shall generate statistical summaries of daily, weekly, and monthly traffic patterns.  
  
2.3 Data Storage and Archiving  
FR-DSA-001: The system shall maintain a long-term archive of all processed data using Oracle 10G.  
  
FR-DSA-002: The system shall implement dynamic caching for frequently accessed data to improve performance.  
  
FR-DSA-003: The system shall allow users to query archived data via SQL-based tools.  
  
FR-DSA-004: The system shall support automated data purging policies to manage storage limits.  
  
2.4 Data Publication and Output  
FR-DPO-001: The system shall publish processed data in standardized formats (SAE J2354, TMDD).  
  
FR-DPO-002: The system shall provide real-time data feeds to MDOT’s MI Drive system.  
  
FR-DPO-003: The system shall generate alerts for traffic incidents, severe weather events, and asset failures.  
  
FR-DPO-004: The system shall support exporting data in CSV, JSON, XML, and KML formats for third-party use.  
  
FR-DPO-005: The system shall provide an API for external applications to consume traffic and weather data in real time.  
  
2.5 User Interface and Presentation  
FR-UIP-001: The system shall provide a web-based interface for viewing traffic, incident, traveler, and weather data.  
  
FR-UIP-002: The interface shall include map displays with icon layers representing traffic, incidents, and road closures.  
  
FR-UIP-003: The system shall support de-cluttering features to reduce visual complexity during high-volume data display.  
  
FR-UIP-004: Users shall be able to filter and search data by location, time, event type, and other relevant criteria.  
  
FR-UIP-005: The system shall support multi-language UI options to accommodate diverse user groups.  
  
FR-UIP-006: The system shall allow users to create custom dashboards for frequent data views.  
  
2.6 System Administration and Configuration  
FR-SAC-001: The system shall allow administrators to configure data sources, algorithms, and output formats.  
  
FR-SAC-002: The system shall log all administrative actions and errors for audit and troubleshooting purposes.  
  
FR-SAC-003: The system shall support role-based access control for different user types (e.g., field operator, analyst, admin).  
  
FR-SAC-004: The system shall provide backup and restore capabilities for the database and configuration settings.  
  
2.7 Reporting and Analytics  
FR-REP-001: The system shall generate pre-defined reports on traffic volume, incident frequency, and road condition trends.  
  
FR-REP-002: The system shall allow users to schedule automatic report generation and email delivery.  
  
FR-REP-003: The system shall provide ad-hoc reporting tools for querying and visualizing data.  
  
FR-REP-004: Reports must be exportable in PDF, Excel, and HTML formats.  
2.8 Security and Compliance  
FR-SEC-001: The system shall enforce secure authentication and authorization for all users.  
  
FR-SEC-002: All data transmissions must be encrypted using TLS 1.2 or higher.  
  
FR-SEC-003: The system shall comply with MDIT security standards and FIPS 140-2 encryption requirements.  
  
FR-SEC-004: The system shall support audit logging of all user activities and system events.