# Functional Requirement

Functional Requirements (FR)  
Requirement ID Function Name Input Output Description  
FR-001 Data Collection and Ingestion Raw data from probe vehicles, traffic sensors, weather stations, and traveler information systems Structured data stored in the central database The system must ingest and normalize heterogeneous data from various sources using defined protocols and data formats.  
FR-002 Data Processing and Analysis Normalized data from ingestion layer Traffic metrics, incident details, road surface conditions, weather observations, travel demand forecasts Calculate congestion levels, travel times, queue lengths; infer incidents (type, location, severity); calculate road surface temperature, friction, visibility; perform statistical validation and quality checks.  
FR-003 Dynamic Caching and Archiving Processed data from analytics layer Cached data for short-term access and archived data for long-term storage Maintain dynamic cache for high-performance access to recent data; archive processed data for historical analysis and reporting.  
FR-004 Data Publication and Export Processed and validated data Published data in standard formats (SAE J2354, TMDD), alerts, MI Drive feeds Support export to external systems via APIs or file exports; provide alerts for traffic conditions, weather events, and asset status; publish data for MI Drive presentation system.  
FR-005 Web-Based User Interface User requests for traffic, incident, traveler, asset, and weather data Interactive web interface with map views, icon overlays, and decluttering options Allow users to browse real-time data via intuitive map display; support layering of different data types; enable decluttering based on zoom level or user preference.  
FR-006 Configuration and Extensibility New data sources, algorithms, output formats, or presentation methods Updated system configuration and new features Allow for the addition of new data sources without code changes; support pluggable modules for new algorithms or data formats; provide an API or configuration interface for future expansion.  
FR-007 User Management and Access Control User login request, role configuration Authorized access, user session information Support multi-level user roles (admin, analyst, user); assign different data access and operation permissions; log user activities for audit purposes.  
FR-008 Data Quality Checking and Anomaly Handling Raw data, processing results Anomaly reports, quality scores Perform real-time data quality assessment (GPS accuracy, signal strength, timestamp consistency); automatically flag and suggest fixes for anomalies; notify human review when automatic fix not possible.  
FR-009 Real-Time Monitoring and System Health System status, resource usage Operational dashboard, alert notifications Monitor component health (database connection pool, API throughput, cache hit rate); provide visual dashboard; trigger alerts (email, SMS, in-system) when critical services fail.  
FR-010 Data Subscription and Push Services Subscription request (by region, time, data type) Customized data push (JSON/XML/WebSocket) Allow third-party systems to subscribe to specific data types; support polling or WebSocket-based push; provide API for managing subscriptions.  
FR-011 Multilingual and Localization Support User-selected language preferences Multilingual UI content Support multiple languages (English, Spanish, etc.); adjust date format, units, and text based on user locale; ensure translations are professional and up-to-date.  
FR-012 Mobile-Friendly and Responsive Design Mobile device access request Optimized mobile UI experience Web interface must be fully responsive and compatible with iOS and Android; support touch gestures, map zoom, and offline caching (optional).  
FR-013 Third-Party System Integration Interface Third-party integration request