# Functional Requirement

Requirement ID Requirement Description  
NAV-RT-001 The system shall provide real-time updates on public transport delays, including bus or train lateness.  
NAV-ALT-002 The system shall detect live traffic and construction conditions and suggest alternate routes accordingly.  
NAV-CD-003 The system shall display crowd density information for all public transport options.  
NAV-CD-004 The system shall use color-coded indicators (green, yellow, red) to represent crowd density for immediate visual assessment.  
NAV-CD-005 The system shall provide numerical estimates (e.g., 1–5 scale or percentage) of crowd density to enable precise decision-making.  
NAV-CD-006 The system shall include textual descriptions (e.g., “very crowded”) to supplement numerical and visual crowd density indicators.  
NAV-USER-007 The system shall track user behavior (e.g., preferred route types, traffic avoidance patterns) to construct a personalized model.  
NAV-USER-008 The system shall predict and suggest preferred routes based on the user’s historical behavior and explicitly set preferences.  
NAV-USER-009 The system shall allow users to rate or provide feedback on suggested routes to refine the personalization model.  
NAV-ALT-010 The system shall label alternate routes with the reasons for deviation (e.g., “Due to construction, 5-minute delay expected”).  
NAV-ALT-011 The system shall display the impact on travel time and cost for all alternate routes.  
NAV-USER-012 The system shall suggest routes aligned with user preferences such as less crowded, quieter, or scenic options.  
NAV-ALT-013 The system shall locate and display nearby bike or scooter stations as an alternative to public transport when the user is running late.  
NAV-USER-014 The system shall allow users to set different preferences for different times of the day (e.g., morning: speed; evening: comfort; weekend: cost or scenery).  
NAV-USER-015 The system shall remember user preferences unless explicitly changed for a specific trip.  
NAV-USER-016 The system shall start learning user preferences after a few weeks of regular use to ensure a smooth onboarding experience.

# External Description

# 5 Constraints  
  
## 5.1 Regulatory/Legal Constraints  
  
- \*\*C-REG-001\*\*: The system shall comply with all applicable data protection regulations, including GDPR and CCPA.  
 - \*\*Priority\*\*: Must Have  
 - \*\*Rationale\*\*: To ensure legal compliance and protect user privacy, especially when handling personal data such as preferences and behavior patterns.  
 - \*\*Source\*\*: SRL-5.4 (Security and Privacy)  
 - \*\*Acceptance Criteria\*\*: The system shall undergo legal review to confirm compliance and shall include a privacy policy accessible to users.  
  
- \*\*C-REG-002\*\*: The system shall obtain user consent for the collection and use of personal data.  
 - \*\*Priority\*\*: Must Have  
 - \*\*Rationale\*\*: To respect user autonomy and ensure transparency in how personal data is used to improve the personalization model.  
 - \*\*Source\*\*: SRL-5.4 (Security and Privacy)  
 - \*\*Acceptance Criteria\*\*: The system shall prompt users for consent during onboarding and before collecting any personal data.  
  
## 5.2 Hardware Constraints  
  
- \*\*C-HARD-001\*\*: The system shall be compatible with mobile devices having at least 2 GB of RAM.  
 - \*\*Priority\*\*: Should Have  
 - \*\*Rationale\*\*: To ensure the system can run on a broad range of devices, including older or lower-end models, to maximize user accessibility.  
 - \*\*Source\*\*: SRL-5.1 (User Devices)  
 - \*\*Acceptance Criteria\*\*: The system shall pass compatibility tests on devices meeting the minimum hardware requirements.  
  
- \*\*C-HARD-002\*\*: The system shall require a minimum of 1 GB of storage for the app and associated data.  
 - \*\*Priority\*\*: Should Have  
 - \*\*Rationale\*\*: To ensure that the system can be installed and function without consuming excessive storage space, which may be a concern on mobile devices.  
 - \*\*Source\*\*: SRL-5.1 (User Devices)  
 - \*\*Acceptance Criteria\*\*: The system shall be tested on devices with 1 GB of storage to verify that all features function as expected.  
  
## 5.3 Interface Constraints  
  
- \*\*C-INT-001\*\*: The system shall integrate with official city infrastructure systems and transit authorities for authoritative data.  
 - \*\*Priority\*\*: Must Have  
 - \*\*Rationale\*\*: To ensure the accuracy and reliability of real-time data such as delays, disruptions, and crowd density.  
 - \*\*Source\*\*: SRL-5.3 (Transit Authorities APIs)  
 - \*\*Acceptance Criteria\*\*: The system shall establish and maintain active API integrations with all required infrastructure and transit authorities.  
  
- \*\*C-INT-002\*\*: The system shall integrate with mapping services such as Google Maps for route visualization.  
 - \*\*Priority\*\*: Must Have  
 - \*\*Rationale\*\*: To provide accurate and intuitive route maps to the user.  
 - \*\*Source\*\*: SRL-5.3 (Mapping Services)  
 - \*\*Acceptance Criteria\*\*: The system shall pass integration tests with at least one major mapping platform.  
  
- \*\*C-INT-003\*\*: The system shall not rely on crowdsourced data for primary decision-making.  
 - \*\*Priority\*\*: Must Have  
 - \*\*Rationale\*\*: To ensure the reliability of navigation and route planning by prioritizing official data over potentially unverified user submissions.  
 - \*\*Source\*\*: SRL-5.3 (Crowdsourcing Platform – Optional)  
 - \*\*Acceptance Criteria\*\*: The system shall validate that all primary route suggestions and data used for navigation are derived from official sources.  
  
## 5.4 Design and Implementation Constraints  
  
- \*\*C-DESIGN-001\*\*: The system shall be designed to scale to accommodate increasing numbers of users and data sources.  
 - \*\*Priority\*\*: Must Have  
 - \*\*Rationale\*\*: To ensure long-term viability and performance under increased load.  
 - \*\*Source\*\*: SRL-5.5 (Scalability and Maintenance)  
 - \*\*Acceptance Criteria\*\*: The system shall be tested under simulated high-load conditions and demonstrate stable performance.  
  
- \*\*C-DESIGN-002\*\*: The system shall support seamless updates and maintenance without interrupting user experience.  
 - \*\*Priority\*\*: Must Have  
 - \*\*Rationale\*\*: To ensure continuous availability and reduce user disruption during system maintenance or feature updates.  
 - \*\*Source\*\*: SRL-5.5 (Seamless Updates)  
 - \*\*Acceptance Criteria\*\*: The system shall be updated in the field without requiring user reinstallation or downtime.  
  
- \*\*C-DESIGN-003\*\*: The system shall be compatible with future versions of city infrastructure APIs and mapping platforms.  
 - \*\*Priority\*\*: Should Have  
 - \*\*Rationale\*\*: To future-proof the system and ensure ongoing integration with evolving data sources.  
 - \*\*Source\*\*: SRL-5.5 (Compatibility with Future APIs)  
 - \*\*Acceptance Criteria\*\*: The system shall be tested with the latest versions of the APIs and platforms at the time of each major release.  
  
## 5.5 Other Constraints  
  
- \*\*C-OTHER-001\*\*: The system shall not be responsible for maintaining or managing infrastructure data sources.  
 - \*\*Priority\*\*: Must Have  
 - \*\*Rationale\*\*: To clarify the system’s role and avoid unnecessary technical debt or maintenance obligations.  
 - \*\*Source\*\*: SRL-2.4 (Assumptions and Dependencies)  
 - \*\*Acceptance Criteria\*\*: The system shall document the data sources it uses and shall not attempt to maintain or modify them.  
  
- \*\*C-OTHER-002\*\*: The system shall require a stable internet connection (Wi-Fi or mobile data) for real-time data retrieval and updates.  
 - \*\*Priority\*\*: Must Have  
 - \*\*Rationale\*\*: To ensure that the system can provide accurate and up-to-date information to the user.  
 - \*\*Source\*\*: SRL-5.2 (Network and Connectivity)  
 - \*\*Acceptance Criteria\*\*: The system shall fail gracefully and inform the user when connectivity is lost.  
  
- \*\*C-OTHER-003\*\*: GPS must be enabled for accurate location tracking and route suggestions.  
 - \*\*Priority\*\*: Must Have  
 - \*\*Rationale\*\*: To ensure the system can provide personalized and accurate navigation based on the user’s real-time location.  
 - \*\*Source\*\*: SRL-5.2 (GPS Requirement)  
 - \*\*Acceptance Criteria\*\*: The system shall prompt the user to enable GPS and shall not function without it.  
  
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