Cloud-Based Vehicle Event Collection and Usability Testing Toolchain PRD

1. Project Background and Significance

With the development of intelligent connected vehicles, data interaction between vehicles and the cloud has become key to improving user experience and safety. Traditional data collection methods suffer from data silos, poor real-time performance, and weak scalability, making it difficult to meet the needs of large-scale data collection, remote testing, and continuous optimization. This project aims to build an efficient and scalable event collection and usability testing toolchain, enabling automatic collection, remote testing, data analysis, and visualization to support product iteration and enhance user experience.

Target Users: OEM R&D, test engineers, product managers, data analysts, end users.

2. Project Goals and Challenges

Achieve automatic multi-source data collection and upload

Support remote usability testing and task distribution

Provide cloud data management, analysis, and visualization

Ensure data security and privacy

Support multi-model and multi-platform expansion

Main Challenges: Efficient communication, multi-source heterogeneous data synchronization, real-time processing and storage, remote test automation, data security and compliance.

3. Requirements Analysis and System Architecture

3.1 Vehicle-Side Functions

Data Types: Video, audio, sensors (acceleration, gyroscope), CAN, GPS

Collection Modes: Event-triggered (hard braking, collision, interaction), manual/automatic tagging, scheduled collection

Data Management: Local cache, encrypted storage, breakpoint resume

Interface Design: Start/stop collection, get data, add/query event tags

3.2 Cloud Functions

Data Upload: Support batch and real-time upload, status feedback

Storage and Indexing: Structured storage (MP4/WAV/CSV/JSON), multi-replica backup, efficient indexing

Event Management: Multi-condition search, synchronous playback, batch export

Permission Management: Role-based permissions, fine-grained access control, audit logs

3.3 Usability Testing Toolchain

Task Distribution: Remote distribution of UI/voice test tasks, parameter configuration, batch distribution

Data Collection: Automatic recording of interaction logs, screen recording, voice input

Test Execution: Multi-round testing, automated scripts, status tracking

Result Management: Automatic archiving, report generation (PDF/HTML)

3.4 Data Analysis and Visualization

Data Processing: Cleaning, aggregation, statistical analysis

Visualization: Event playback, time series/heatmap/bar chart, multi-dimensional filtering

Trend Analysis: Issue tracking, trend prediction, comparative analysis

Data Export: Export raw data/reports, support filtering

3.5 External System Integration

API: RESTful, support third-party data access and queries

Map Service: Integrate OpenStreetMap for location visualization and route planning， ADASIS Horizon

Weather Service: Integrate AccuWeather for real-time weather and forecasts

3.6 AI Model-Based Automatic Data Collection

Function Overview: By integrating AI models, the system enables intelligent collection of multi-source vehicle data and automatic event recognition, improving the efficiency and accuracy of data collection while reducing manual intervention.

Intelligent Triggering: The AI model can automatically identify events such as abnormal driving, collisions, and dangerous behaviors based on historical data and real-time sensor information, and trigger the corresponding data collection process.

Data Optimization: The model can dynamically adjust the collection frequency and data types (such as video, audio, sensors). When key events occur, it automatically increases collection precision; during normal periods, it reduces frequency to save bandwidth and storage.

Self-Learning Capability: Through continuous data collection and annotation, the AI model can continuously optimize event recognition algorithms, improving adaptability and accuracy in new scenarios.

Open Interface: Provides standard RESTful APIs, supporting integration and upgrade of third-party AI models, allowing OEMs or partners to expand custom intelligent collection capabilities.

Privacy Protection: The AI model's data collection and processing strictly follow data desensitization and compliance requirements to ensure user privacy and security.

4. Key Processes and Interfaces

Collection Process: Event/manual trigger → multi-source collection → local encryption → breakpoint resume → cloud storage

Data Retrieval/Playback: Multi-condition search → synchronous playback → export

Test Tasks: Frontend creation → parameter configuration → distribution → device execution → data archiving → report generation

External Data Access: API upload → format validation → storage → feedback

5. Data Format and Security

Collected Data: MP4 (video), WAV (audio), CSV (sensor), JSON (CAN/GPS/event tags)

Interface Example:

```json
{
  "event_id": "UUID",
  "event_type": "Hard Braking",
  "timestamp": "2025-05-15T00:53:57Z",
```

```
    "associated_data": ["video.mp4", "audio.wav"]
}
```

Security Measures: End-to-end encryption (TLS/SSL), local/cloud encrypted storage, OAuth 2.0 authentication, permission control, audit logs

6. Non-Functional Requirements

High Availability: 99.9% SLA, automatic restart, failover, multi-replica

High Performance: Collection latency <500ms, support for tens of thousands of vehicles concurrently, daily processing ≥10TB

Compatibility: Support mainstream in-vehicle OS (Linux/QNX/Android Automotive), multiple networks

Easy Maintenance: Containerized deployment, one-click upgrade, real-time monitoring, log analysis

Internationalization: Multi-language, automatic adaptation of date/currency/unit

7. Deliverables and Milestones

Deliverables: Vehicle-side SDK, cloud platform, testing toolchain, API documentation, use cases and reports

Milestones:

1. Requirement review and design
2. Vehicle-side SDK development
3. Cloud platform development
4. Toolchain integration and testing
5. Internal pilot and optimization

6. Official release

8. Risks and Use Cases

Risks: Platform compatibility, big data processing pressure, data security, schedule delays

Countermeasures: Modular design, distributed architecture, end-to-end encryption, agile development

Typical Use Cases:

Automatic collection and playback of hard braking events

Remote distribution of UI test tasks, automatic archiving and reporting

Data analyst filters collision events and exports trend reports

Appendix

Glossary: CAN, SDK, OTA, GDPR

References: [OpenStreetMap](https://www.openstreetmap.org/), [AccuWeather](https://developer.accuweather.com/)

Note: This PRD is a simplified version. Detailed content can be supplemented as needed.