Over-The-Air Data Collection

The vehicle as a source for data analytics: An Overview
OTA Data Collection

The basic problem

Scope:
- On-demand data
- Time-limited query
- Targets large fleets
- Minimal impact on vehicle
  - No impact for customer
- Minimal impact on OTA bandwidth

Component Developer

Vehicle(s)
Query Formulation

**Component Developer**
- Investigate issues with an existing component
- Gain insight to improve components
- Use tools already known from development
- Augment tooling for deployment

**Data Scientist**
- Gain knowledge for strategic or operative decisions
- Gain knowledge over a fleet of vehicles
- Support component developer on advanced queries
- Use tooling common in data science
Data Analytics

- **Component Developer**
  - Manual analysis on gathered data
  - Use known tooling for analysis
  - Needs support for selecting data to analyze
  - Augment tooling with machine learning

- **Data Scientist**
  - Perform queries on gathered data
  - Apply machine learning to gathered data
  - Use tooling common in data science
  - Needs domain knowledge from component developers
OTA Data Collection

Overview & Challenges

- **Component Developer**
  - Scoping
  - Query Target(s)
  - Logical Plan
  - Deployment Configuration
  - Physical Plan(s)
  - Aggregated Data
  - Analytics
  - Storage
  - Collected Data
  - Ingestion
  - Collected Data
  - Rollout
  - Collection Request(s)
  - Vehicle(s)
  - Question
  - Query Formulation
  - Vehicle Configuration(s)
  - Vehicle(s)
  - Answer

Component Developer

Vehicle Configuration(s)

Query Target(s)

Logical Plan

Deployment Configuration

Physical Plan(s)

Aggregated Data

Analytics

Storage

Collected Data

Ingestion

Collected Data

Rollout

Collection Request(s)

Vehicle(s)
Query Rollout & Data Ingestion

Core Challenges
- Bridge technology gap
- Availability concerns
- Connectivity
- Security
Overview & Challenges

OTA Data Collection

Vehicle Configuration(s)

Scoping

Query Target(s)

Query Formulation

Logical Plan

Deployment Configuration

Physical Plan(s)

Rollout

Collection Request(s)

Vehicle(s)

Component Developer

Question

Analytics

Aggregated Data

Storage

Collected Data

Ingestion

Collected Data

Answer
OTA Data Collection

In-Vehicle Overview

Rollout → Collection Request → Validation → Collection Request → Configuration

Ingestion → Collected Data → Reduction → Collected Data → Aggregation → Collected Data → Data Collection
OTA Data Collection

In-Vehicle Data Sources
In-Vehicle Data Sources

- **Core Constraints**
  - Bandwidth on network/bus
  - OTA bandwidth
  - CPU load
  - Memory (buffering)

- **Core Requirements**
  - Vehicle must be in control
  - Specification of limitations
  - Specification of conditions
  - Persistency
OTA Data Collection

Overview & Challenges

1. Vehicle Configuration(s)
2. Query(s)
3. Logical Plan(s)
4. Physical Plan(s)
5. Collection Request(s)
6. Collection Data
7. Collected Data
8. Ingestion
9. Aggregated Data
10. Storage
11. Analytical Question Formulation
12. Query Formulation
13. Scoping
14. Component Developer
15. Vehicle(s)
16. Answer
17. Deployment Configuration
18. Rollout
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