ITEF - INTEGRATED TEST AND EVALUATION FRAMEWORK

Domains

- Field Operational Tests
- Connected Driving
- Maps
- Sensor data processing (e.g. Lidar)

Application Scenarios

- Preparation/Conduction:
  - Setup/ Planning
  - Orchestration
  - Control incl. Validation
  - Evaluation
- Data Ingestion
  - Mobile and stationary sources
  - Real and synthetic data
- Existing connections for mobile nodes, e.g. vehicles, smart phones, sensors, virtual data sources

DRIVE C2

TEAM — Tomorrow's Elastic Adaptive Mobility

sim^{TD}

DIGINETPS

≡ Fraunhofer
FOKUS

ITEF - INTEGRATED TEST AND EVALUATION FRAMEWORK

Data ingestion for analysis

- Real data, e.g. vehicle, smart phone, sensors
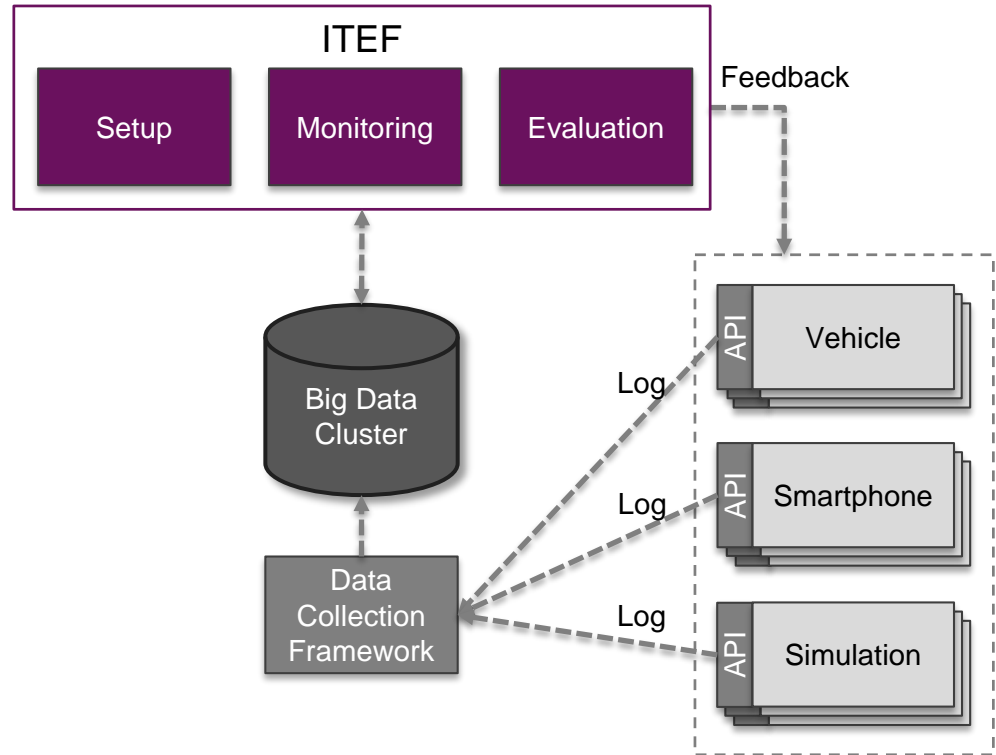- Synthetic data, simulations

Setup

- Definition of scenarios/ data baskets for evaluation

Monitoring

- Supervision and Control

Evaluation

- Quality Assurance
- Verification of data collection

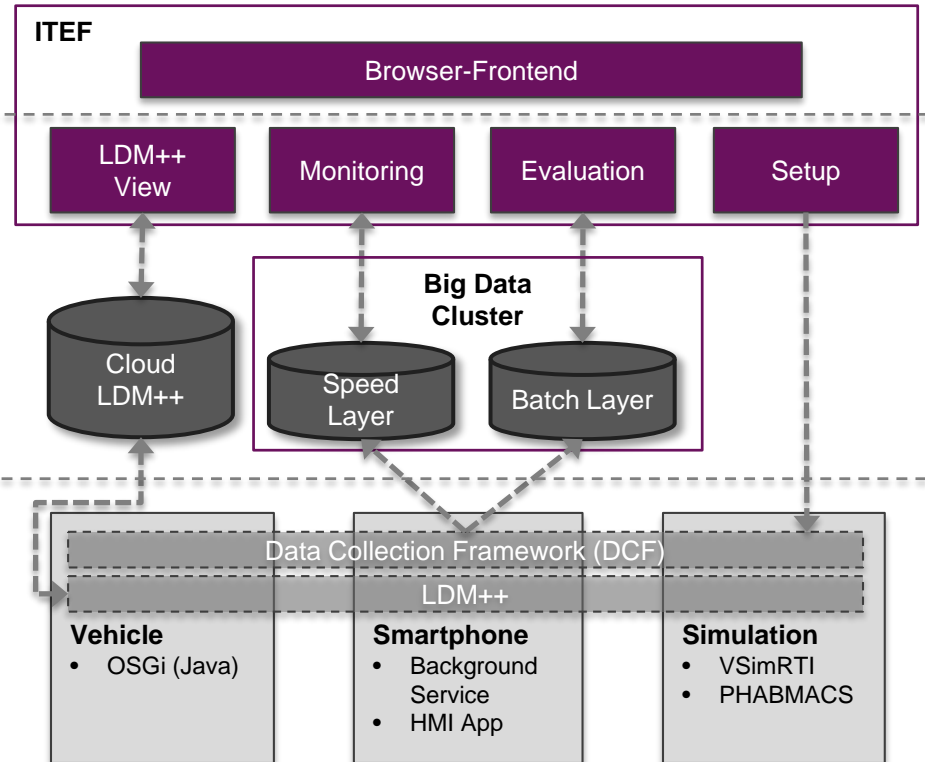# ITEF - INTEGRATED TEST AND EVALUATION FRAMEWORK

Frontend

- Completely web-based

Backend

- Tomcat / J2EE
- Hadoop
- Accumulo
- Flink

Client

- DCF & LDM++ Libraries in Java
- Wrapper for Android, OSGi, C#

ITEF

Browser-Frontend

LDM++ View | Monitoring | Evaluation | Setup

Cloud LDM++

Big Data Cluster

Speed Layer | Batch Layer

Data Collection Framework (DCF)

LDM++

Vehicle
- OSGi (Java)

Smartphone
- Background Service
- HMI App

Simulation
- VSimRTI
- PHABMACS

Fraunhofer FOKUS

MOBILITY BIG DATA: HARMONIZATION AND COLLECTION

- Every measurand is pre-defined, including a data type
- Individual measurands can be combined to log entries
- API with type-safe logging functions for developers
- Mapping of different measurands across different projects
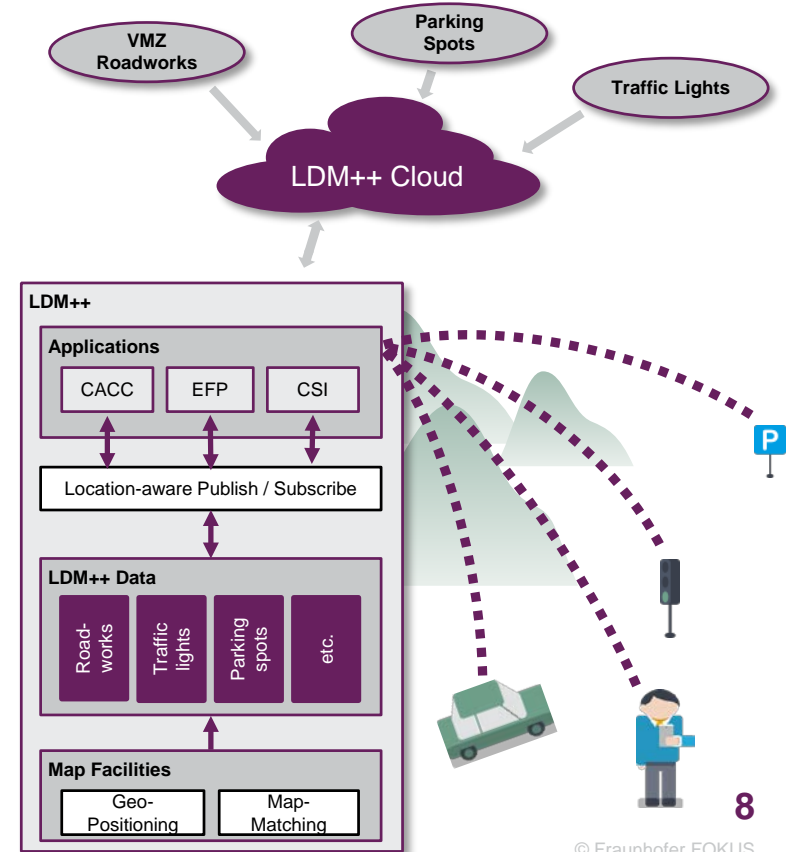
- **LDM++ (combined data sink and source)**
  - Cloud-based, locally deployed instances, online data access, low frequency changes, small amounts of data, e.g. traffic signs, parking spots

- **Monitoring (Speed Layer)**
  - Infrastructure deployment, online access and visibility, high fequency changes, small amounts of data, e.g. vehicle status, traffic light phases

- **Evaluation (Batch Layer)**
  - Infrastructure deployment, offline, any frequency, **big** amounts of **data**
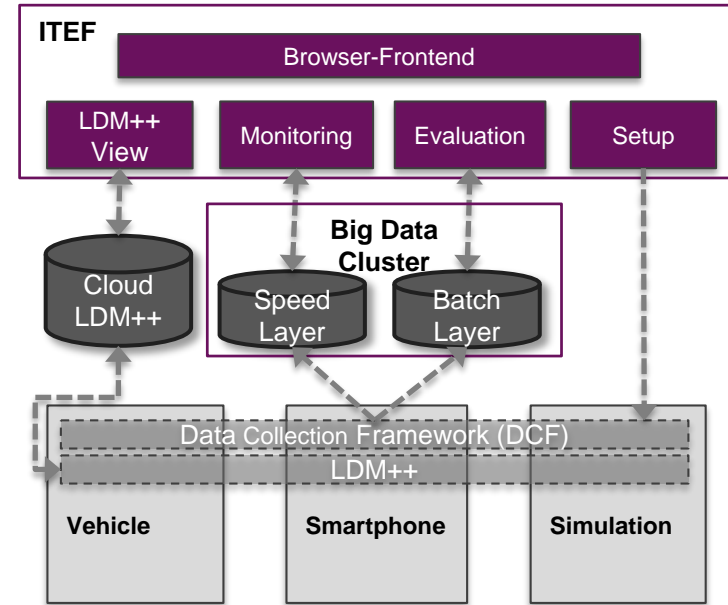
LOCAL DYNAMIC MAP++

- Location-based data distribution

- publish/subscribe model

- Locally deployed LDM++ instance on each participating node

- Event based close-to-realtime distribution of data

- Best effort synchronisation to cloud

VMZ Roadworks

Parking Spots

Traffic Lights

LDM++ Cloud

LDM++

Applications

| CACC | EFP | CSI |

Location-aware Publish / Subscribe

LDM++ Data

| Road-works | Traffic lights | Parking spots | etc. |

Map Facilities

| Geo-Positioning | Map-Matching |

8

Fraunhofer
FOKUS

Example: Change Detection in HD Maps

Observation Use Case: Operator inspects measurements

1st level of automation: Inspection of thresholds → immediate validation

2nd level of automation: Aggregation by pipelining

- Aggregation of speeds of vehicles per road segment over place/ time
  - → Generation of traffic jam DENM
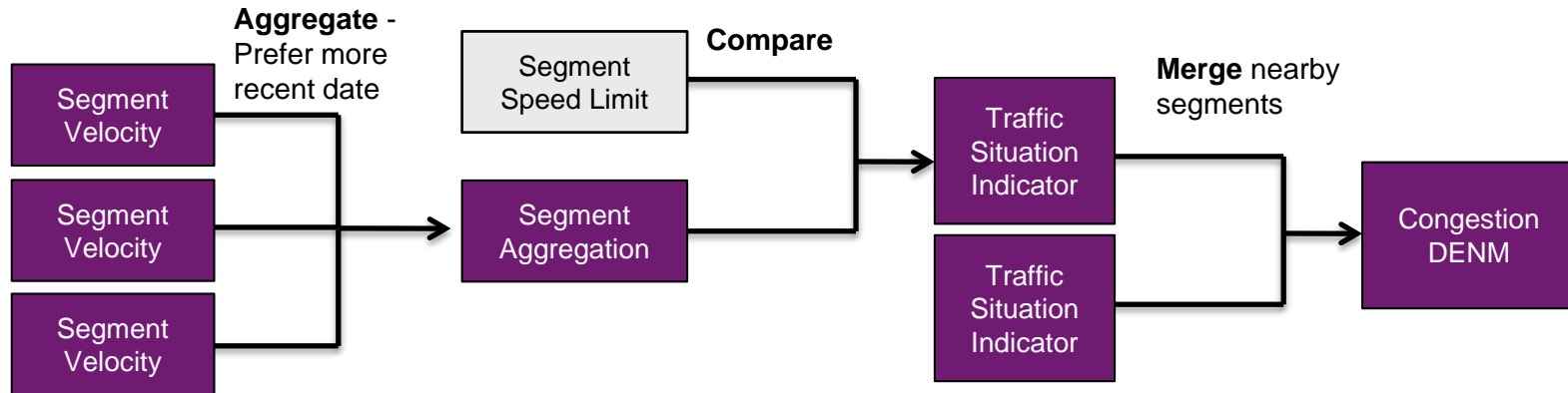
EVALUATION / BATCH LAYER

- Analysis of **big** amounts of **data**
- Definition of **data baskets**
- Queries in **5 dimensions**:
  - time
  - location
  - node/ station id
  - signal type
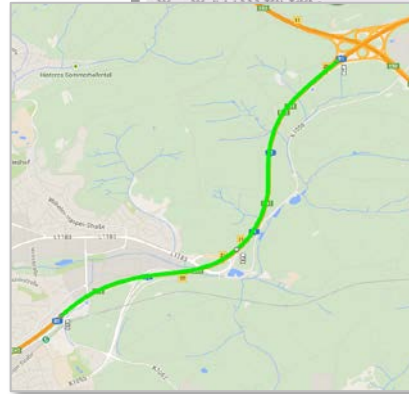 - signal values

- Plot functions and data export

SUMMARY

- FOT as basis for big data, complemented by Simulations
- Challenges due to distributed collection, formats
- Additional value by employing Big Data techniques

- With new sensor technologies, amount of data will again increase, higher demand for proper tooling