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ODL based AI/ML for Networks

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ODL based AI/ML for Networks

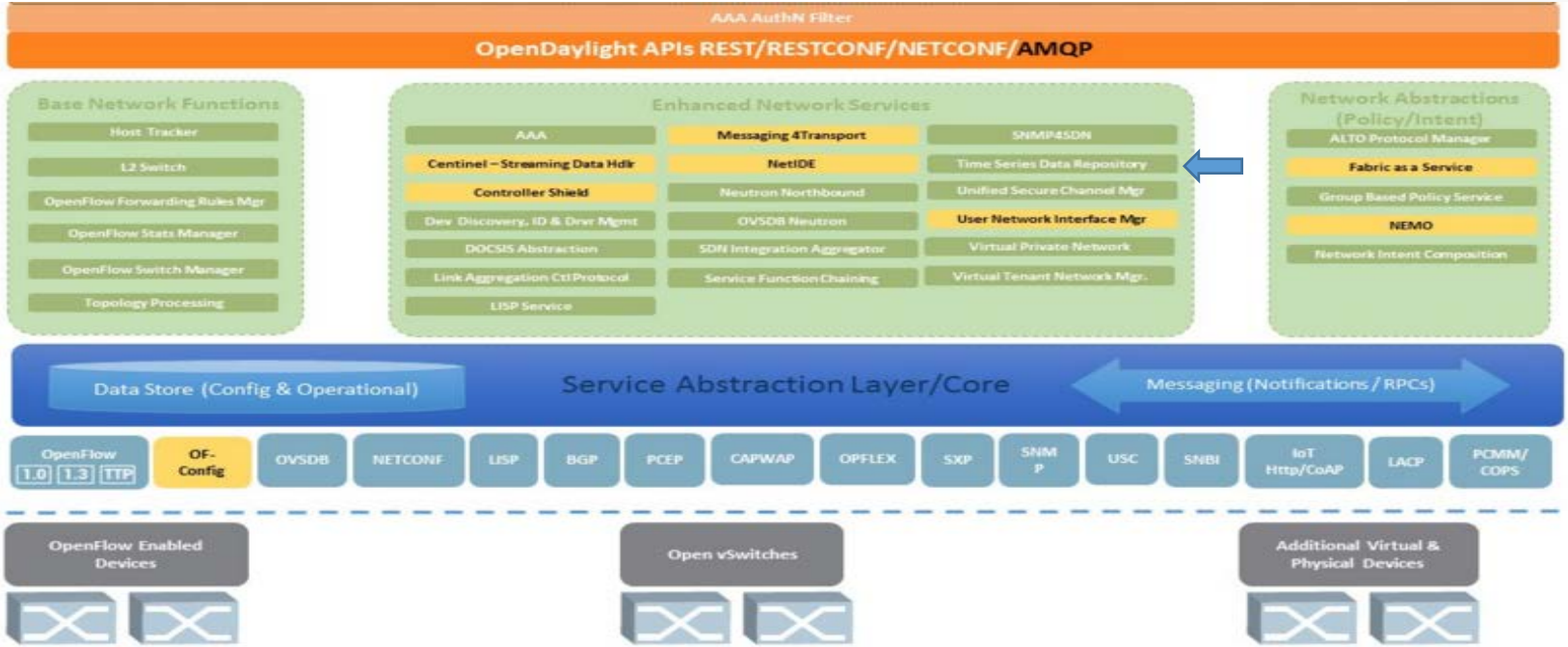
Agenda

- Role of AI/ML in networks and usecase
- ODL – Overview in 30 seconds
- ODL TSDR
- Algorithms

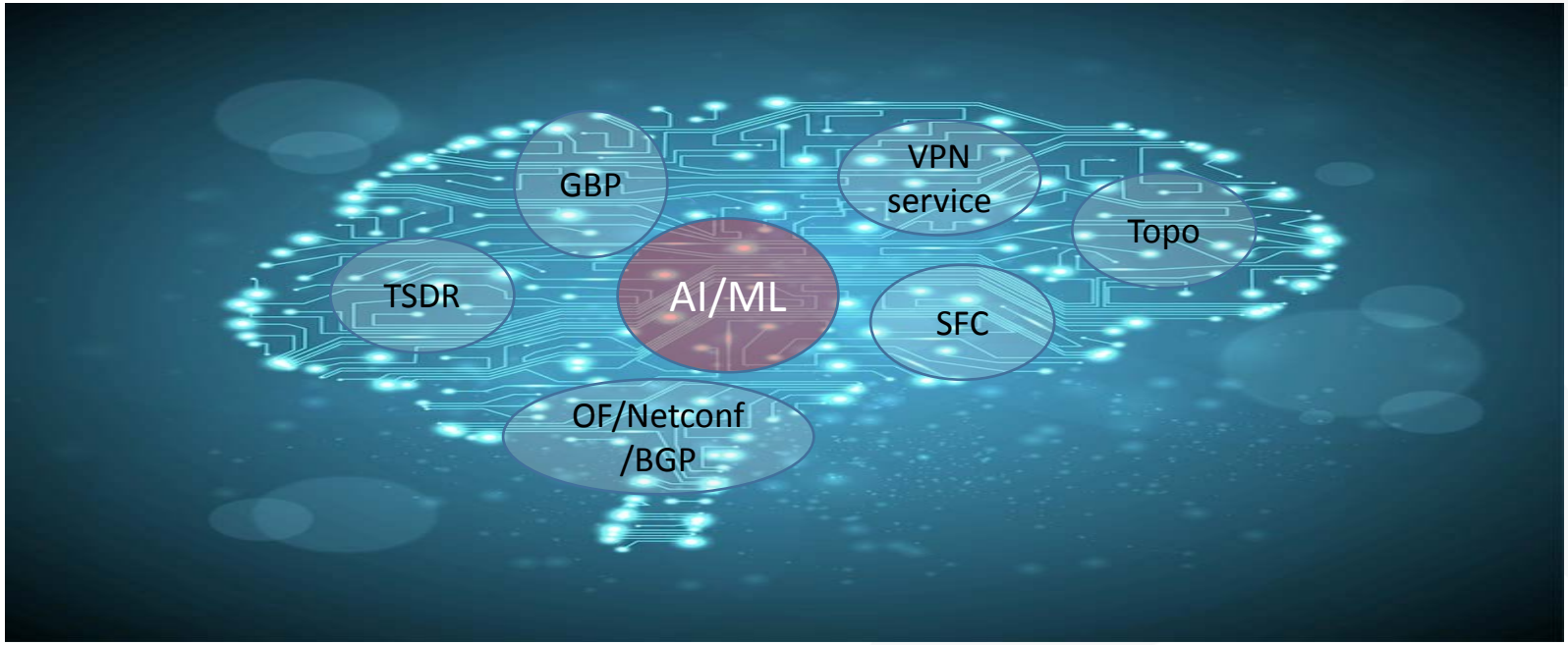
History is made

AlphaGo

Opendaylight – Quick overview



Making ODL the Brain of Network



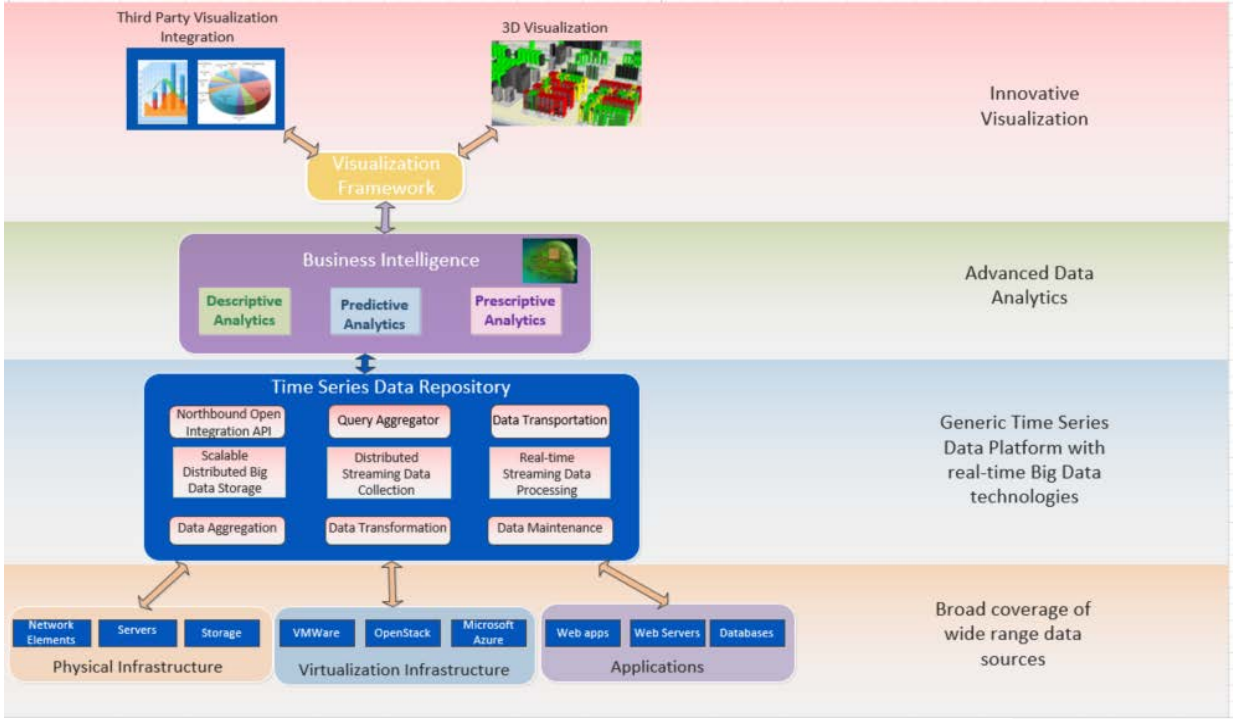
Advantages

- Opendaylight has the exposure to data that relates to both Infrastructure and Network with mutiprotocol support
- Helps build an unified model which is key for the following areas
  - Cloud
  - NFV
  - IoT

Use Case

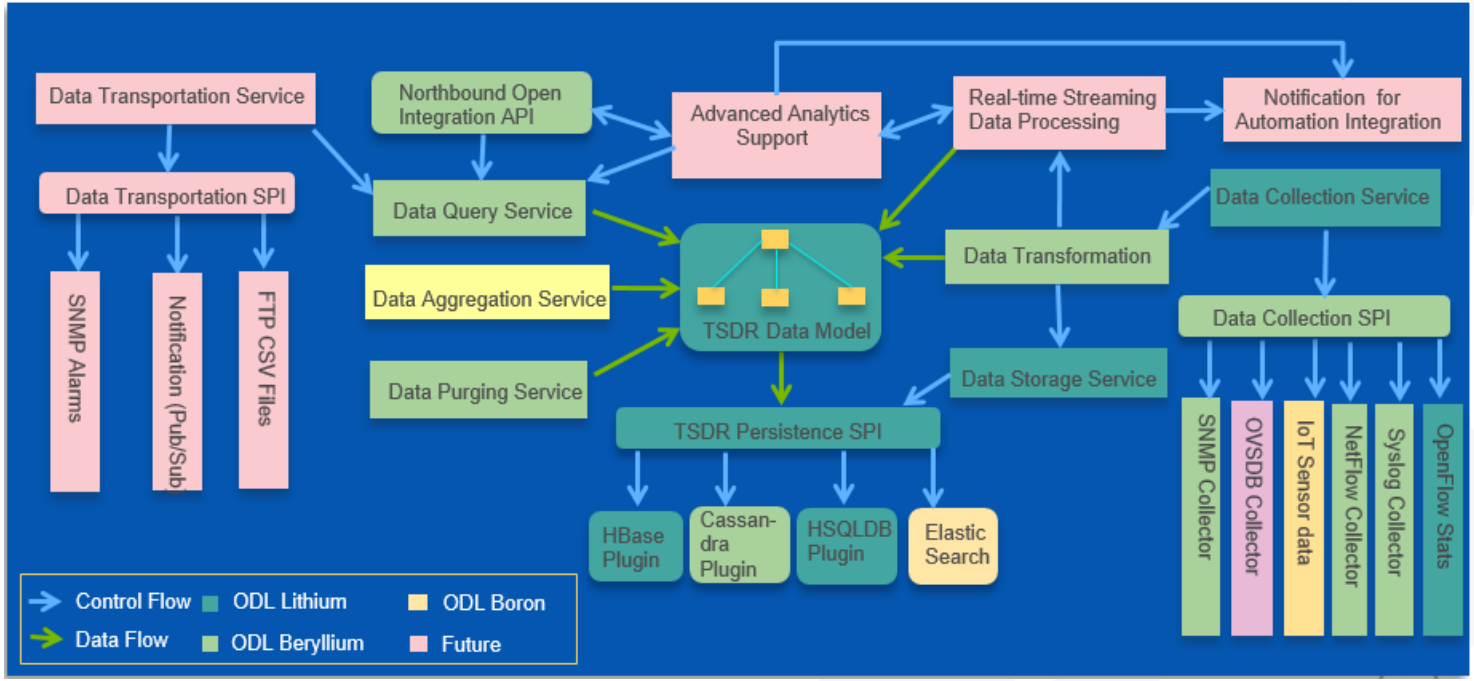
- Policy Management
  - Policy composition
  - Policy monitoring and optimization
- Cloud Resource Utilization
  - Monitoring tenant provisioning
  - Provide Resource planning
- Traffic Steering
- Anomaly Detection and DDOS

TSDR Architecture Framework

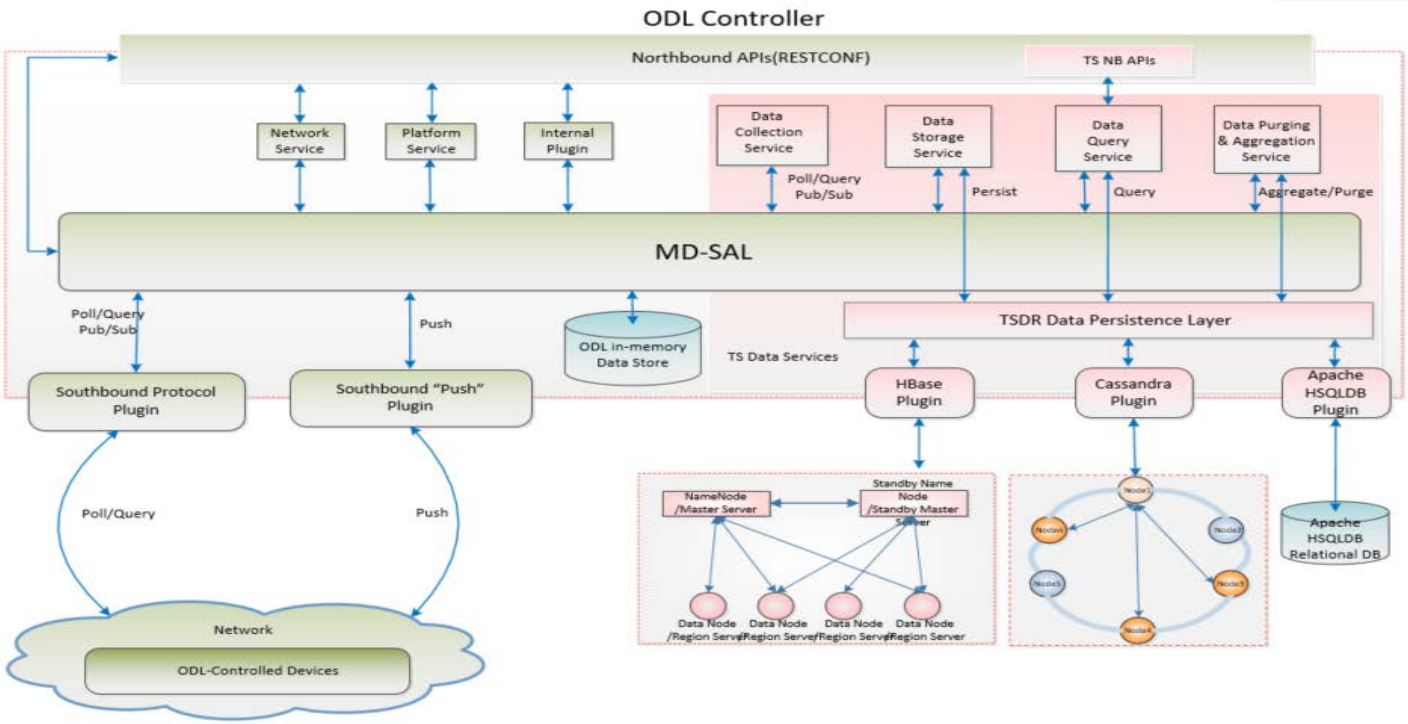


- **Scalable solution for big data analytics in Software Defined Data Center.**
- **Seamlessly integrated with SDN Controller to make data and analytics available to SDN data driven applications.**
- **Hide the complexities of big data analytics to enable and encourage intelligence and decision making in SDN environment.**

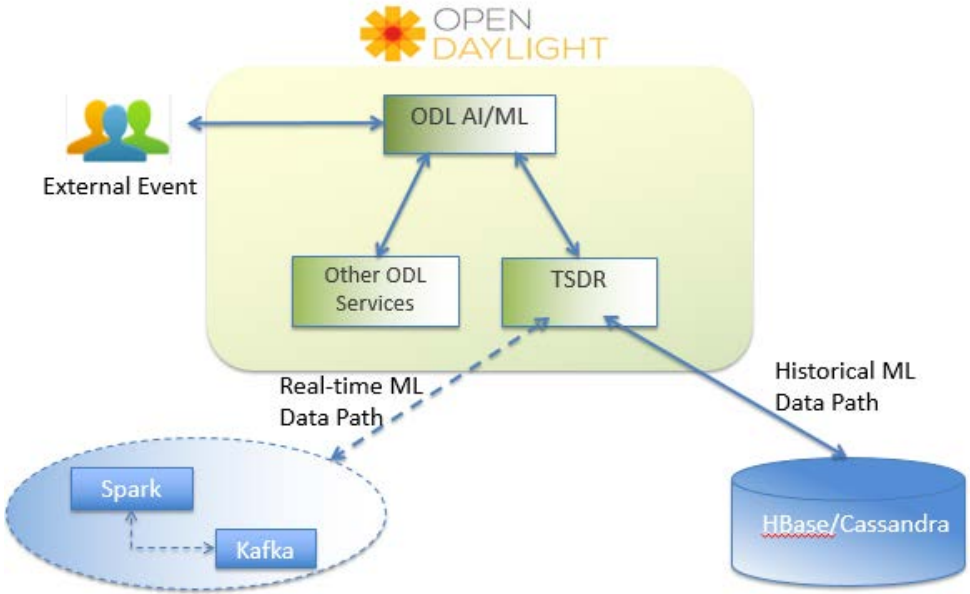
TSDR Capabilities



Current TSDR Architecture in OpenDaylight

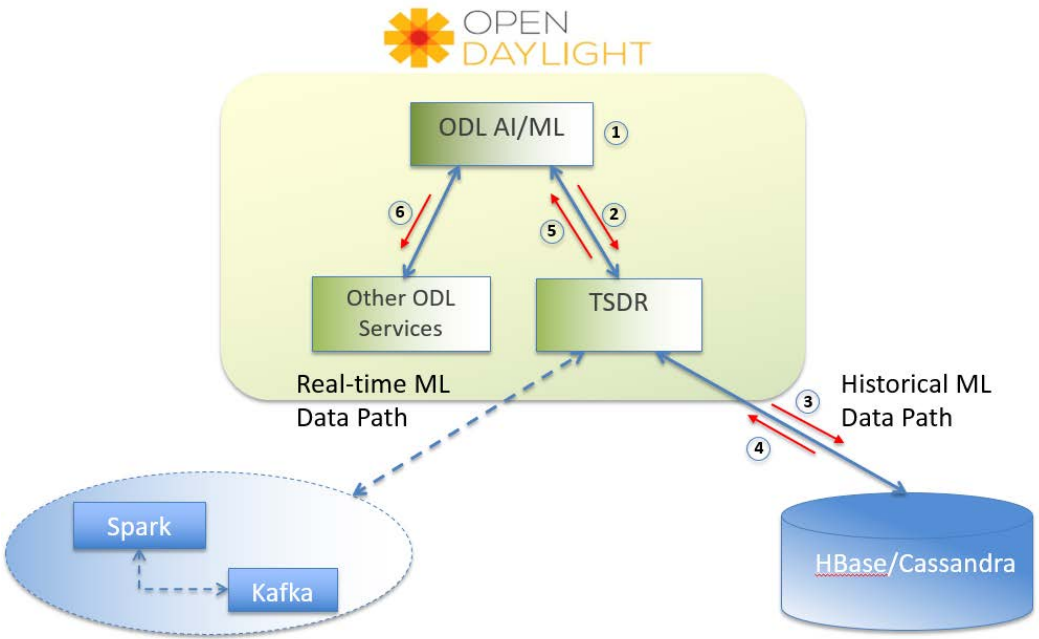


High Level Architecture Proposal for ODL AI/ML framework



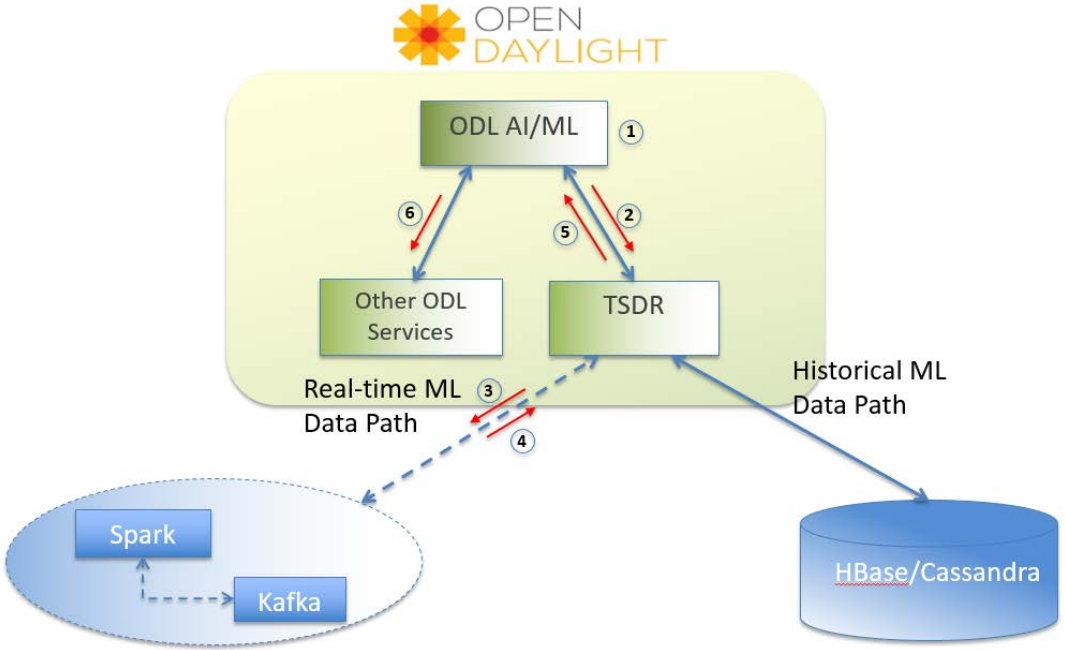
- Enable AI/ML on both historical and real-time data paths.
- Many use cases would require both offline and online ML on the time series data.
- External events could be additional input for accurate machine learning results.
- Feed back the results to SDN control path for automatic traffic steering and policy placement.
- Well-defined interface among the components towards future standardization of advanced analytics in SDN.

Offline ML Sequence flow



- **Offline ML on persistence data path**
  1. ODL AI/ML receives user requests to predict BWUtil on port1.
  2. ODL AI/ML maps user requests to proper ML algorithms, feature sets, parameters, and sends request to TSDR.
  3. TSDR processes the requests on historical data path with its ML library.
  4. Execution results from data stores being sent back to TSDR.
  5. Aggregated results being sent back to ODL AI/ML.
  6. Prescriptive actions being sent to other ODL services.
- **When training an ML model, there could be multiple trips of the above flow.**

Online ML Sequence flow



- **Online ML on real-time data path**
  1. ODL AI/ML receives user requests to detect DDoS attack.
  2. ODL AI/ML maps user requests to proper ML algorithms, feature sets, tuning parameters, and sends request to TSDR.
  3. TSDR processes the requests on real-time data path with its ML library.
  4. Execution results being sent back to TSDR
  5. Aggregated results being sent back to ODL AI/ML.
  6. Prescriptive actions being generated and sent to other ODL services.
- **Use cases for Online ML:**
  - Apply offline machine learning results to real-time data.
  - Apply ML algorithms that do not need training on historical data.

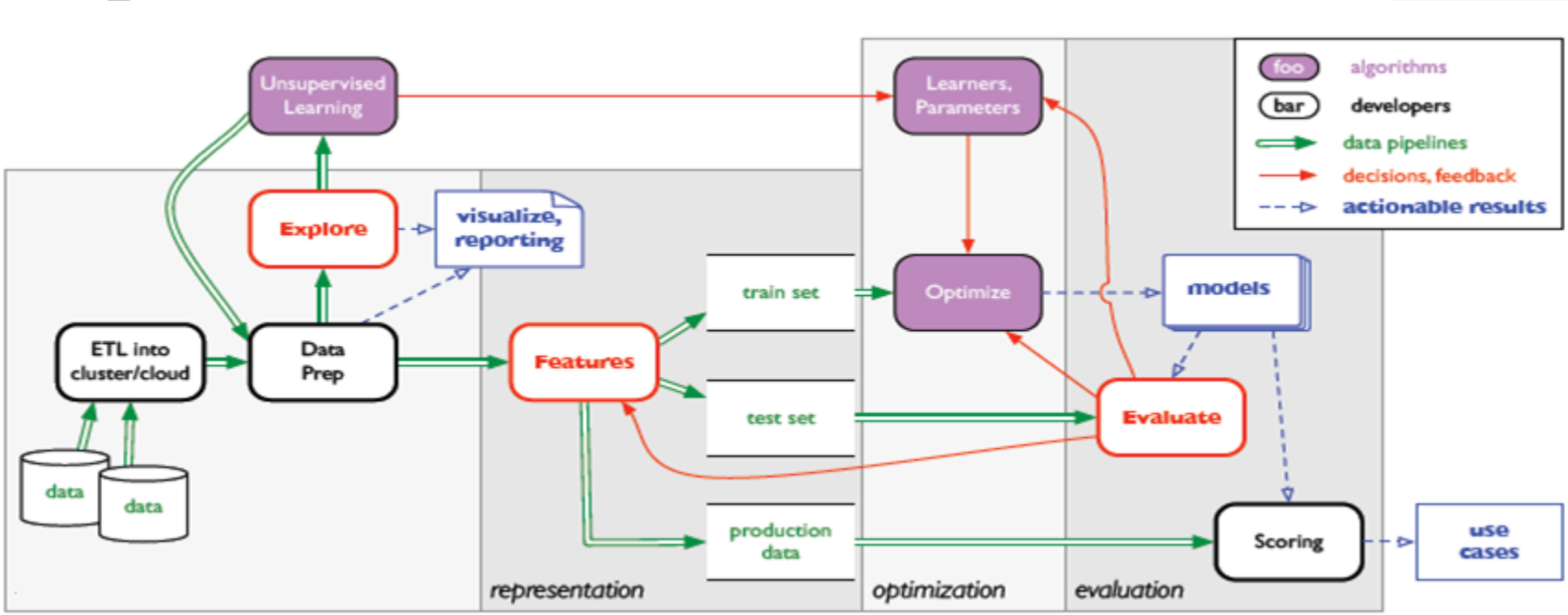
TSDR Roadmap in Boron Release

- Advanced Analytics Support Architecture PoC.
- IoTDM integration for IoT Sensor Data.
- New Data Store support(Elastic Search).
- Multiple data store support at runtime.
- JDBC driver and SQL parser on northbound for third party integration.
- Security Enhancement.
- ODL Cluster Support Enhancement.
- Performance and Scalability Testing and Benchmarking.

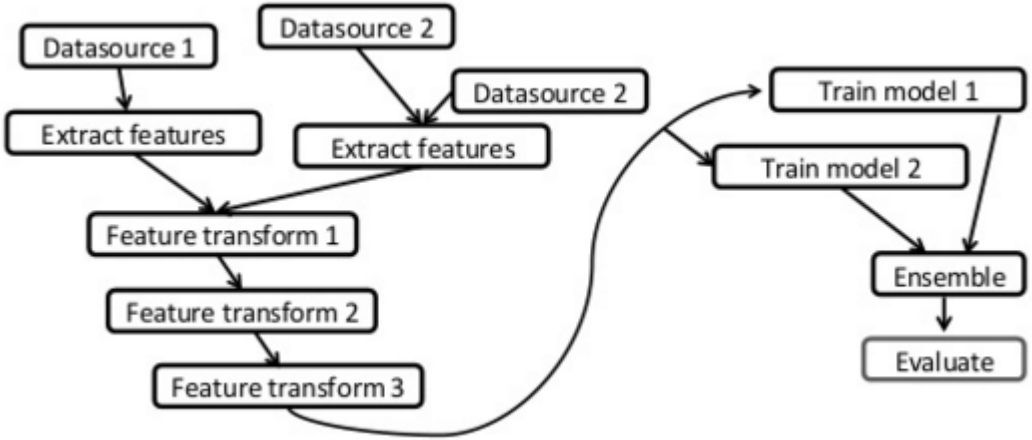
Tools evaluated

- SparkMlib – Would be the prefered tool
- H2O
- TensorFlow

Overall ML workflow



Simple ML workflow



- Load Data
  - Data sources - TSDR
- Extract Features
  - Transformer
- Train Model
  - Logistic Regression
- Evaluate

SparkMLlib

- Spark MLlib is Machine Learning Library and part of Apache Spark
- Consists of common learning algorithms and utilities, including
  - Classification (Supervised)
  - Regression (Supervised)
  - Clustering
  - Collaborative filtering
  - Decomposition
  - Recommondation
  - Optimization dimensionality reduction, as well as lower-level optimization primitives and higher-level pipeline APIs.
- RDD
- Actions (results in DAG of operations) and Transformations

ODL AI/ML Components

- Trainer
  - Helps trying with various datasets and algorithms
  - Provides small UI to define Input/Output and other parameters for algorithms (for eg., ANN would need # of levels needed based on requirement)
- Model store
  - Trained models are persisted
  - Apps/Users can pick from pre-trained models
- Interface
  - Data Sources that would include event triggers, data, feedback

Q&A