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Adaptive Executive Layer with Pentaho Data Integration

An Introduction to AEL and the AEL Spark Engine

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Agenda

- AEL Overview
- AEL Spark Engine
- Word Count Demonstration
- Best Practices for AEL Spark
- Q & A

AEL Overview

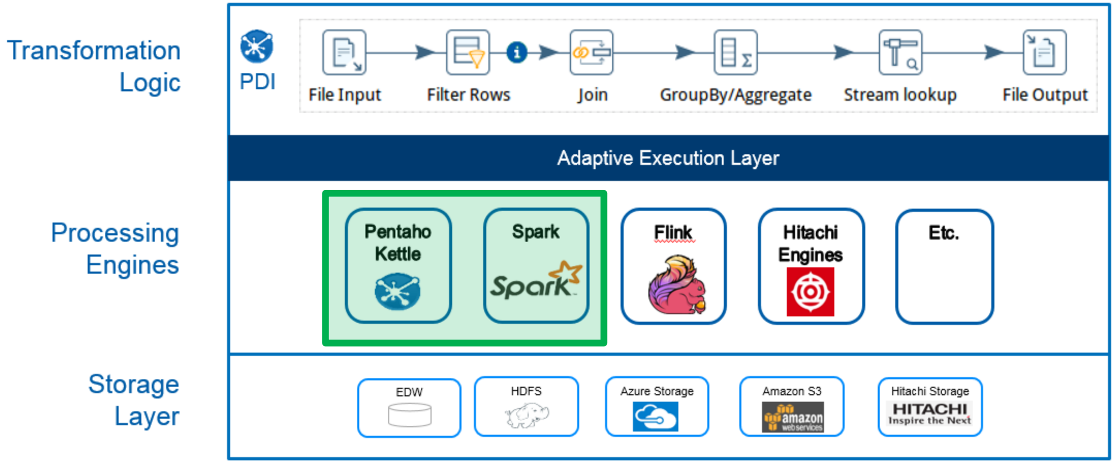
The Adaptive Execution Layer (AEL)

Develop Once, Choose the Execution Engine

– Easily develop transformations in PDI’s drag-and-drop design environment

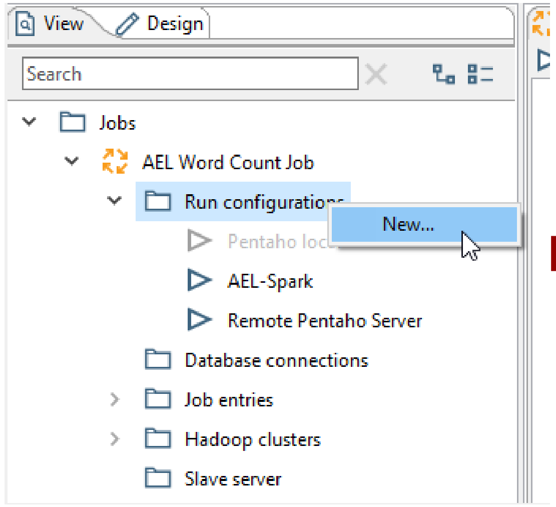
– Switch between execution engines to fit data volume and transformation complexity

– Utilize emerging technologies without being a Java, Scala, or Python developer

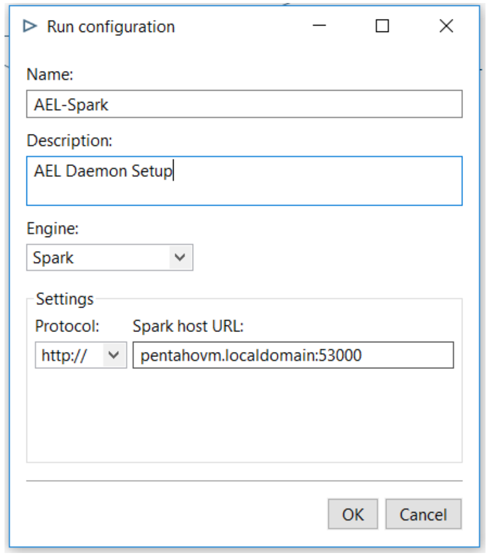


How to Use AEL

1. Create a new run configuration



2. Specify execution engine properties



Name: AEL-Spark

Description: AEL Daemon Setup

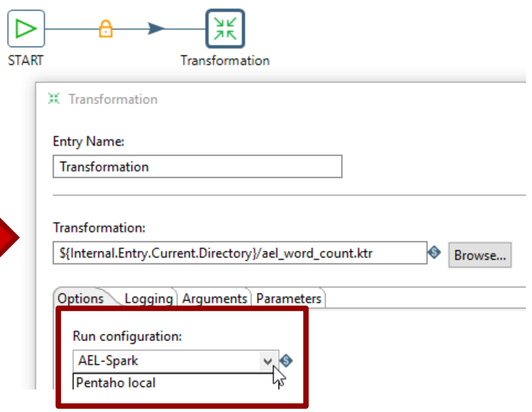
Engine: Spark

Settings

Protocol: http://

Spark host URL: pentahovm.localdomain:53000

3. Invoke from PDI by selecting the desired run configuration



Entry Name: Transformation

Transformation: ${Internal.Entry.Current.Directory}/ael_word_count.ktr

Run configuration: AEL-Spark

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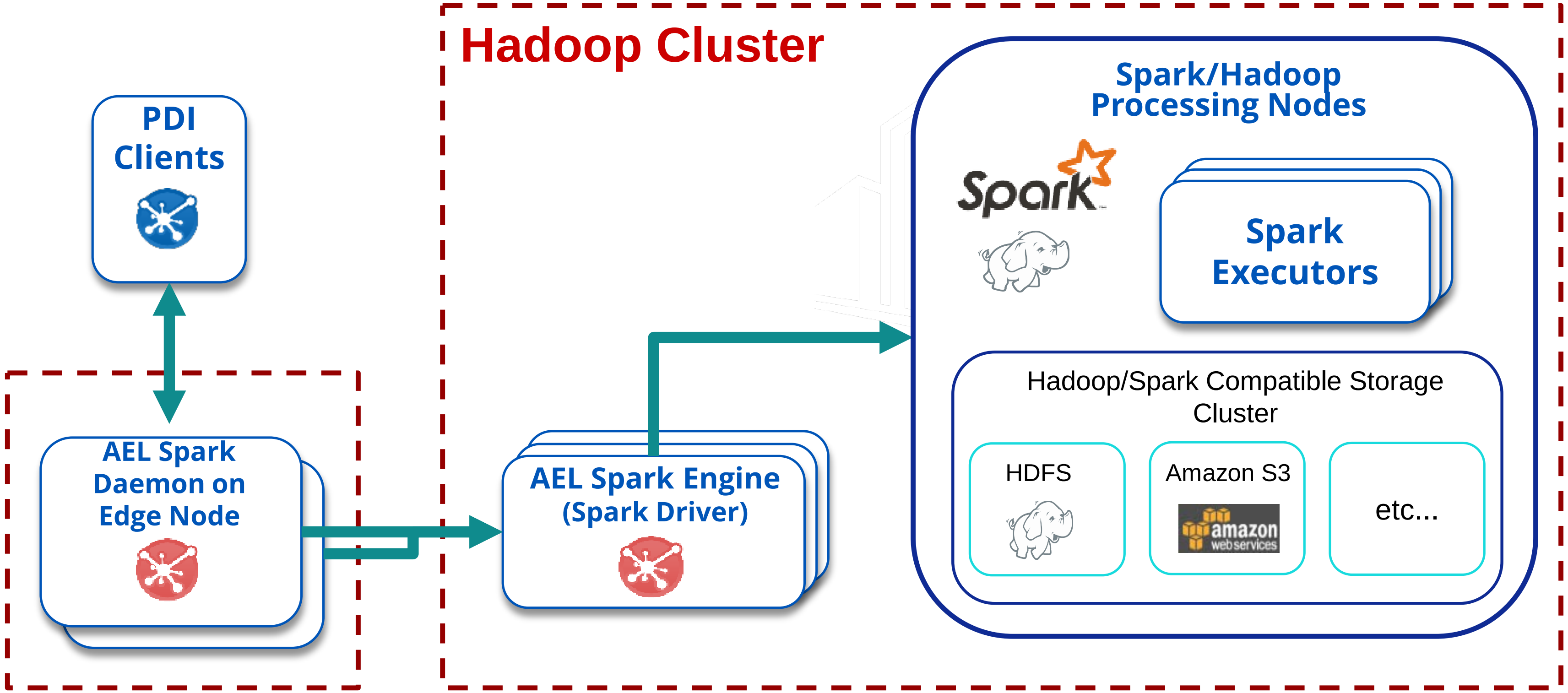
AEL Spark Engine

AEL Spark Engine

- Apache Spark chosen for the first AEL engine implementation
- Simplicity of PDI unleashes the power of Spark
- With Pentaho 8.1, AEL Spark supports these Hadoop distributions:
  - **CDH 5.13**
  - **HDP 2.6**
  - **EMR 5.9**
  - **MapR 5.2**
- Runs in Spark local or with YARN resource management

AEL Spark Reference Architecture


Hadoop Cluster
PDI Clients
AEL Spark Daemon on Edge Node
AEL Spark Engine (Spark Driver)
Spark/Hadoop Processing Nodes
Spark
Spark Executors
Hadoop/Spark Compatible Storage Cluster
HDFS
Amazon S3
amazon webservices
etc...

AEL Spark Setup

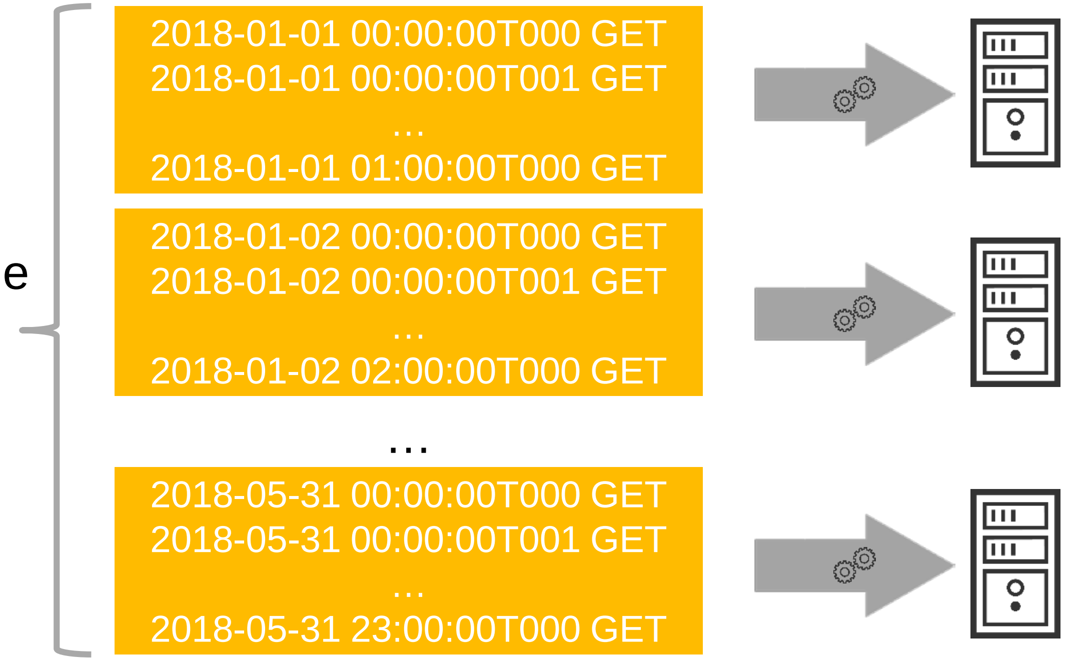
- Build an AEL Spark daemon
  - Use script packaged with PDI
  - Custom tailor build to include desired step plugins
- Move the package to an edge node and install in HDFS
- Configure the AEL Spark daemon’s properties
- Start the AEL Spark daemon on an edge node

AEL Setup Documentation

About Spark

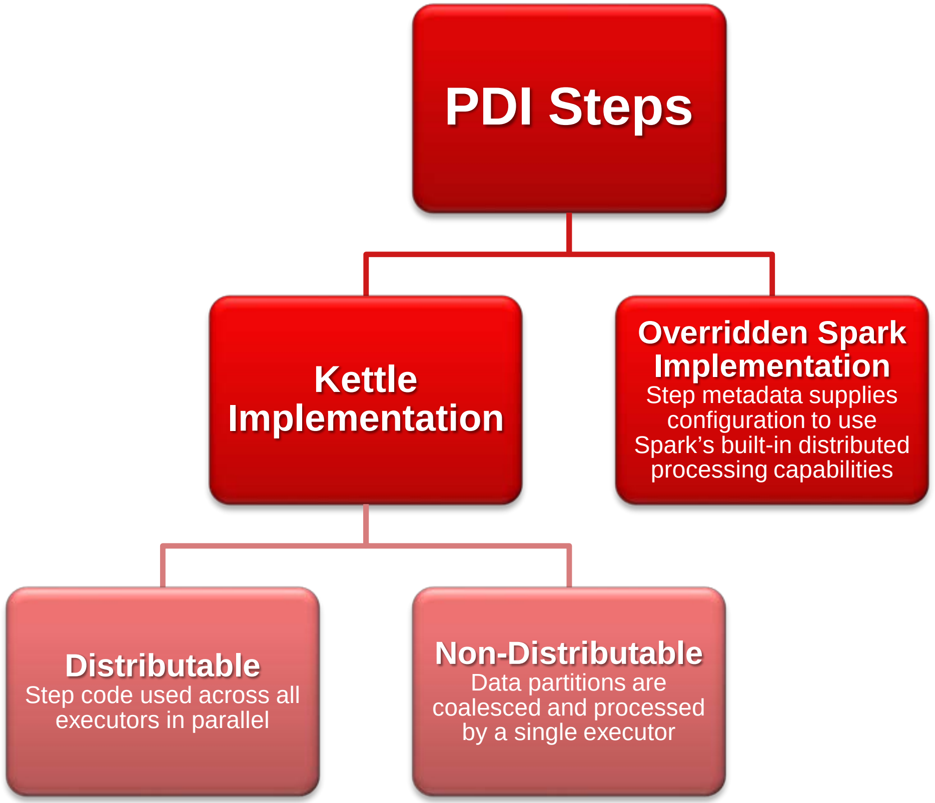
- Spark processes data in **partitions** within **executor** processes distributed across a cluster:

Large web access log file broken into partitioned input splits



2018-01-01 00:00:00T000 GET
2018-01-01 00:00:00T001 GET
…
2018-01-01 01:00:00T000 GET
2018-01-02 00:00:00T000 GET
2018-01-02 00:00:00T001 GET
…
2018-01-02 02:00:00T000 GET
…
2018-05-31 00:00:00T000 GET
2018-05-31 00:00:00T001 GET
…
2018-05-31 23:00:00T000 GET

PDI Step Implementations with AEL Spark

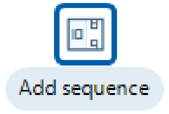

PDI Steps
Kettle Implementation
Overridden Spark Implementation
Step metadata supplies configuration to use Spark's built-in distributed processing capabilities
Distributable
Step code used across all executors in parallel
Non-Distributable
Data partitions are coalesced and processed by a single executor

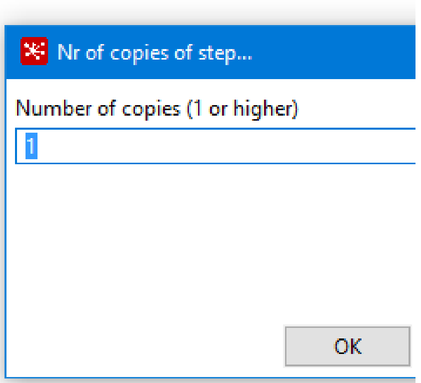
Distributable Steps

- Kettle Step Implementation
  - Distributed to Spark executors
  - Entire stream is processed as data partitions
- Steps that do not hold state between rows
  - Calculator
  - Split field to rows
  - String operations
  - Value Mapper
  - ...

Non Distributable Steps

- Some steps currently do not support parallel execution
  - Steps where “Number of copies” would be left at one
  - Overridden Spark implementations can provide distributed functionality
- AEL protectively adds a coalesce(1)
  - Steps work with AEL Spark
  - Data processed on single executor thread
  - Produce correct results
  - Controlled by the `forceCoalesceSteps` list `org.pentaho.pdi.engine.spark.cfg`




Nr of copies of step...

Number of copies (1 or higher)

1

Steps with Overridden Spark Implementations

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Input/Output

- Text file input/output
- Hadoop File Input/Output
- Avro Input/Output
- Parquet Input/Output
- ORC Input/Output

ETL/Analysis

- Filter rows
- Group by / Memory Group by
- Merge Join
- Sort rows
- Stream lookup
- Unique rows / Unique rows (HashSet)

Streaming

- Get records from stream
- Kafka Consumer
- MQTT Consumer

Subtransformation

- Transformation Executor
- Get rows from / Copy rows to result
- Abort

Word Count Demonstration

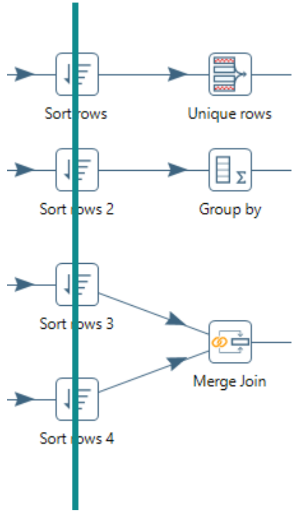
Best Practices for AEL Spark Transformations

Use Lookup Instead of Merge Join

- When?
  - You want to perform an INNER, LEFT, or RIGHT join
  - One stream has a small set of rows that can fit in memory
  - The small stream is accessed by a set of fields that form a unique key
- Why?
  - The Lookup step has an overridden AEL Spark implementation
  - Utilizes Spark’s broadcast feature to send the small stream to each executor
  - Join can be done without moving larger stream around cluster network

Remove Unnecessary Sort rows Steps

- When?
  - Your transformation is being setup exclusively for AEL Spark
  - Transformation has **Merge Join**, **Unique Rows**, or **Group by**
- Why?
  - The overridden Spark step implementations do not require the inputs to be sorted
  - No Sort rows step is executed, which requires a network data shuffle/transfer



Use **Unique rows (HashSet)** or **Memory Group by** for transformations to work in both Pentaho local (Kettle) and AEL Spark

Configure the Spark History Server

- When?
  - You want to trace through Spark execution for tuning
  - View Spark application run/job history
- How?
  - Set `sparkEventLogEnabled` to true
  - Configure the `sparkEventLogDir` location, found on Spark History Server UI
- Where?
  - The PDI AEL Spark daemon's `application.properties` file

Tune with Parameters, Variables, or Properties

- Why?
  - You want to tune a Spark setting (e.g. executor memory) for a certain transformation or for all transformations launched

- How?
  - All “`spark.`” properties in **`application.properties`**, transformation variables or parameters will be forwarded to the Spark driver’s configuration
  - Precedence:
    1. Transformation Parameters
    2. Transformation Variables
    3. Daemon’s `application.properties` file

Re-use Spark Sessions During Development

- Why?
  - During development, this is useful to tweak transformations and re-execute
    - The daemon keeps the driver and executors alive without an active transformation
- Production?
  - **No**: This consumes resources that may be useful for other cluster tasks
  - **No**: Reduces traceability in the Spark History Server
- How?
  - Add `KETTLE_AEL_PDI_DAEMON_CONTEXT_REUSE=true` to `kettle.properties` on the development client machine (not the daemon)

Control Partitioning with Data Preparation

- When?
  - Data is typically dropped in HDFS to process with a batch AEL Spark transformation
- How?
  - Create files in the ingest directory that correspond to the number of desired partitions to process
- Why?
  - Spark's parallelism is dictated by the number of files input and their split points

Caution Using External Resources

- When?
  - A transformation has a step that utilizes an external resource, like a **REST Client** or **Database lookup** step
- Why?
  - Spark executors could be executing the step code on many threads of many executors
  - Chance of a self-inflicted Denial of Service attack

Caution Using Coalesced Steps

- When?
  - A transformation has a step that is on the `forceCoalesceSteps` list
- Why?
  - All data must be processed by a single thread of a single executor
- Tip
  - If the transformation allows, try to use these steps after summary aggregations, filtering or pruned data, or on smaller data streams

Questions

Thank You

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