ABRiS: Avro Bridge for Apache Spark

Felipe Melo & Georgi Chochov
ABSA Group Limited

#SAISDev5 #ABRiS #ABSA

About Us

- ABSA is a Pan-African financial services provider
  - With Apache Spark at the core of its data engineering
- We try to fill gaps in the Hadoop eco-system
- Contributions to Apache Spark
- Spark-related open-source projects (github.com/AbsaOSS)
  - ABRiS – Avro SerDe for structured APIs (#SAISDev5)
  - Cobrix – A cobol data source
  - Atum – A completeness and accuracy library
  - Spline – A data lineage tracking and visualization tool (#SAISExp18)

A Word on Spark 2.4

- ABRiS was initially developed for Spark 2.2
- Spark 2.4 is introducing built-in Avro conversion capabilities (Hurray!)
- But ABRiS still offers features that Spark 2.4 does not

ABRiS Motivation

- Need for UDFs or map functions in Spark jobs to handle Avro data.
- Lack of support for Confluent distribution.
- Lack of support for schema management facilities such as Schema Registry.
- Lack of support for Spark structured streaming APIs.

Bridging Avro and Spark

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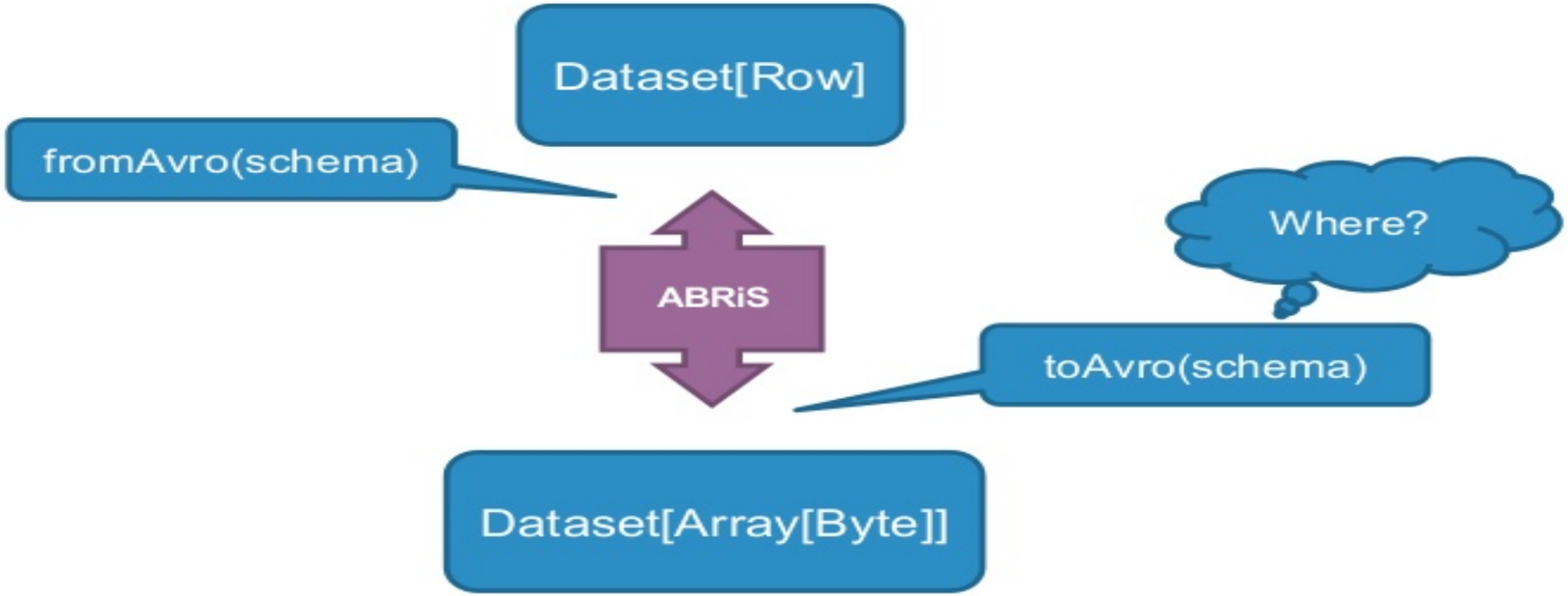
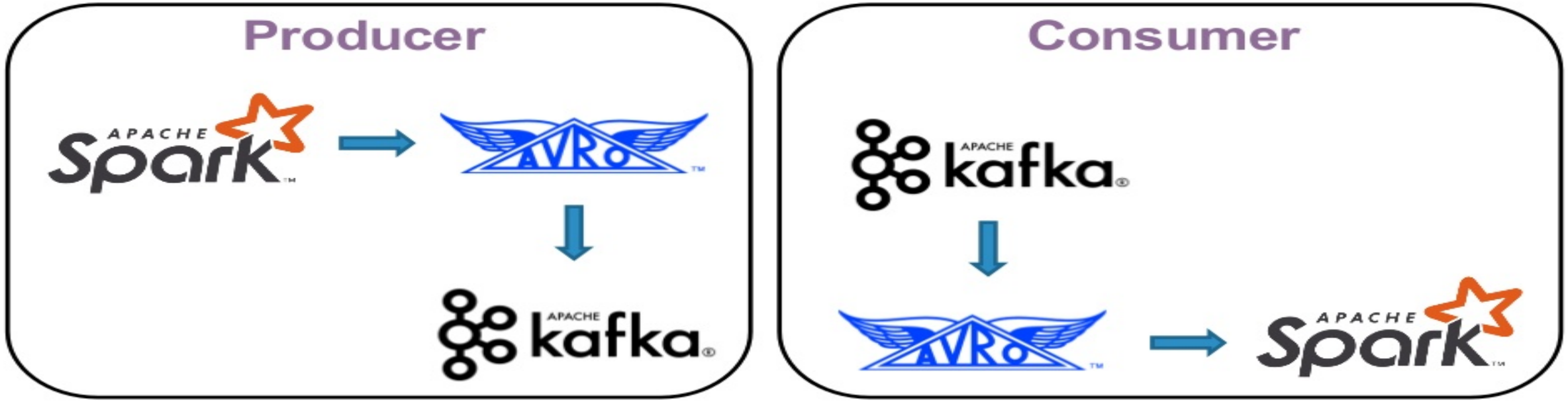


What we bring

- Ease of use
- Schema Retention Policy
- Schema Management
- Confluent Support
- Support for Kafka Keys

Use cases


Producer
APACHE Spark
AVRO
APACHE kafka
Consumer
APACHE kafka
AVRO
APACHE Spark

What we bring

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Writing to Kafka

```
val dataframe = ???
```

```
dataframe

  .writeStream
  .format("kafka")
  .option("kafka.bootstrap.servers", "localhost:9092")
  .option("topic", "topic_name")
  .start()
```

Reading from Kafka

```
spark
  .readStream
  .format("kafka")
  .option("kafka.bootstrap.servers", "localhost:9092")
  .option("subscribe", "topic")

  .where("value.person.age > 30")
  .writeStream.format("console").start().awaitTermination()
```

Writing with an Avro schema

```
val avroSchema: Schema = ???

import za.co.absa.abris.avro.AvroSerDe._

dataframe
  .toAvro(avroSchema)
  .writeStream
  .format("kafka")
  .option("kafka.bootstrap.servers", "localhost:9092")
  .option("topic", "topic_name")
  .start()
```

Reading with an Avro schema

```
val avroSchema: Schema = ???

import za.co.absa.abris.avro.AvroSerDe._

spark
  .readStream
  .format("kafka")
  .option("kafka.bootstrap.servers", "localhost:9092")
  .option("subscribe", "topic")
  .fromAvro("value", avroSchema)(SchemaRetentionPolicies.RETAIN_ORIGINAL_SCHEMA)
  .where("value.person.age > 30")
  .writeStream.format("console").start().awaitTermination()
```

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Schema Retention Policy

RETAIN_ORIGINAL_SCHEMA

key	value	topic	partition	offset	timestamp	timestampType
key 1	{'name': 'femel', 'age': 35'}	test_topic	1	21	2018-...	...
key 2	{'name': 'user2', 'age': 28'}	test_topic	2	22	...	...
...	...	test_topic	...	...	...	...

RETAIN_SELECTED_COLUMN_ONLY

username	age
femel	35
user2	28
...	...

What we bring

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Confluent Schema Registry

- Serving layer, RESTful interface for Avro schemas management
- Provides compatibility settings and evolution of schemas
- https://github.com/confluentinc/schema-registry

Reading with Schema Registry

```
val schemaRegistrySettings = Map(
  SchemaManager.PARAM_SCHEMA_REGISTRY_URL     -> "http://somewhere:8081",
  SchemaManager.PARAM_VALUE_SCHEMA_ID         -> "latest",
  SchemaManager.PARAM_SCHEMA_REGISTRY_TOPIC -> "topic"
)
import za.co.absa.abris.avro.AvroSerDe._

spark
  .readStream
  .format("kafka")
  .option("kafka.bootstrap.servers", "localhost:9092")
  .option("subscribe", "topic")
  .fromAvro("value", schemaRegistrySettings)(SchemaRetentionPolicies.RETAIN_ORIGINAL_SCHEMA)
  .where("value.person.age > 30")
  .writeStream.format("console").start().awaitTermination()
```

Writing with Schema Registry

```
val schemaRegistrySettings = Map(
  SchemaManager.PARAM_SCHEMA_REGISTRY_URL     -> "http://somewhere:8081",
  SchemaManager.PARAM_VALUE_SCHEMA_ID         -> "latest"
)

import za.co.absa.abris.avro.AvroSerDe._

dataframe
  .toAvro("topic",  "schemaName", "schemaNamespace")(Some(schemaRegistrySettings))
  .writeStream
  .format("kafka")
  .option("kafka.bootstrap.servers", "localhost:9092")
  .option("topic", "topic_name")
  .start()
```

Notes on Schema Registry

- Schema is registered if Schema Registry settings are provided **AND** schemas are compatible
  - Leverages Confluent Schema Registry client

- If no schema is provided, it is inferred from the Dataframe
  - .toAvro(***"topic_name", "schemaName", "schemaNamespace"***)

What we bring

- Ease of use
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- Schema Management
- **Confluent Support**
- Support for Kafka Keys

Notes on Confluent Kafka

- Confluent Kafka writers append the schema's ID to the top of the payload

- *io.confluent.kafka.serializers.AbstractKafkaAvroSerializer*

```
84          ByteArrayOutputStream out = new ByteArrayOutputStream();
85          out.write(MAGIC_BYTE);
86          out.write(ByteBuffer.allocate(idSize).putInt(id).array());
```

Writing to Confluent Kafka

```
val schemaRegistrySettings = Map(
  SchemaManager.PARAM_SCHEMA_REGISTRY_URL     -> "http://somewhere:8081",
  SchemaManager.PARAM_VALUE_SCHEMA_ID         -> "latest"
)

import za.co.absa.abris.avro.AvroSerDe._

dataframe
  .toConfluentAvro("topic_name", "schemaName", "schemaNamespace")(schemaRegistrySettings)
                (SchemaRetentionPolicies.RETAIN_ORIGINAL_SCHEMA)
  .writeStream
  .format("kafka")
  .option("kafka.bootstrap.servers", "localhost:9092")
  .option("topic", "topic_name")
  .start()
```

Reading from Confluent Kafka

```
val schemaRegistrySettings = Map(
  SchemaManager.PARAM_SCHEMA_REGISTRY_URL    -> "http://somewhere:8081",
  SchemaManager.PARAM_VALUE_SCHEMA_ID        -> "latest",
  SchemaManager.PARAM_SCHEMA_REGISTRY_TOPIC -> "topic"
)

import za.co.absa.abris.avro.AvroSerDe._

spark
  .readStream
  .format("kafka")
  .option("kafka.bootstrap.servers", "localhost:9092")
  .option("subscribe", "topic")
  .fromConfluentAvro("value", None, schemaRegistrySettings)
                (SchemaRetentionPolicies.RETAIN_ORIGINAL_SCHEMA)
  .where("value.person.age > 30")
  .writeStream.format("console").start().awaitTermination()
```

What we bring

- Ease of use
- Schema Retention Policy
- Schema Management
- Confluent Support
- **Support for Kafka Keys**

Writing to Kafka – Avro keys

```
val keySchema: Schema = ???
val valueSchema: Schema = ???

import za.co.absa.abris.avro.AvroSerDeWithKeyColumn._

dataframe
  .toAvro(keySchema, valueSchema)
  .writeStream
  .format("kafka")
  .option("kafka.bootstrap.servers", "localhost:9092")
  .option("topic", "topic_name")
  .start()
```

Reading from Kafka – Avro keys

```
val keyAvroSchema: Schema = ???
val valueAvroSchema: Schema = ???

import za.co.absa.abris.avro.AvroSerDeWithKeyColumn._

spark
  .readStream
  .format("kafka")
  .option("kafka.bootstrap.servers", "localhost:9092")
  .option("subscribe", "topic")
  .fromAvro(keyAvroSchema, valueAvroSchema)
            (SchemaRetentionPolicies.RETAIN_ORIGINAL_SCHEMA)
  .where("value.person.age > 30")
  .writeStream.format("console").start().awaitTermination()
```

Writing to Kafka – Plain keys

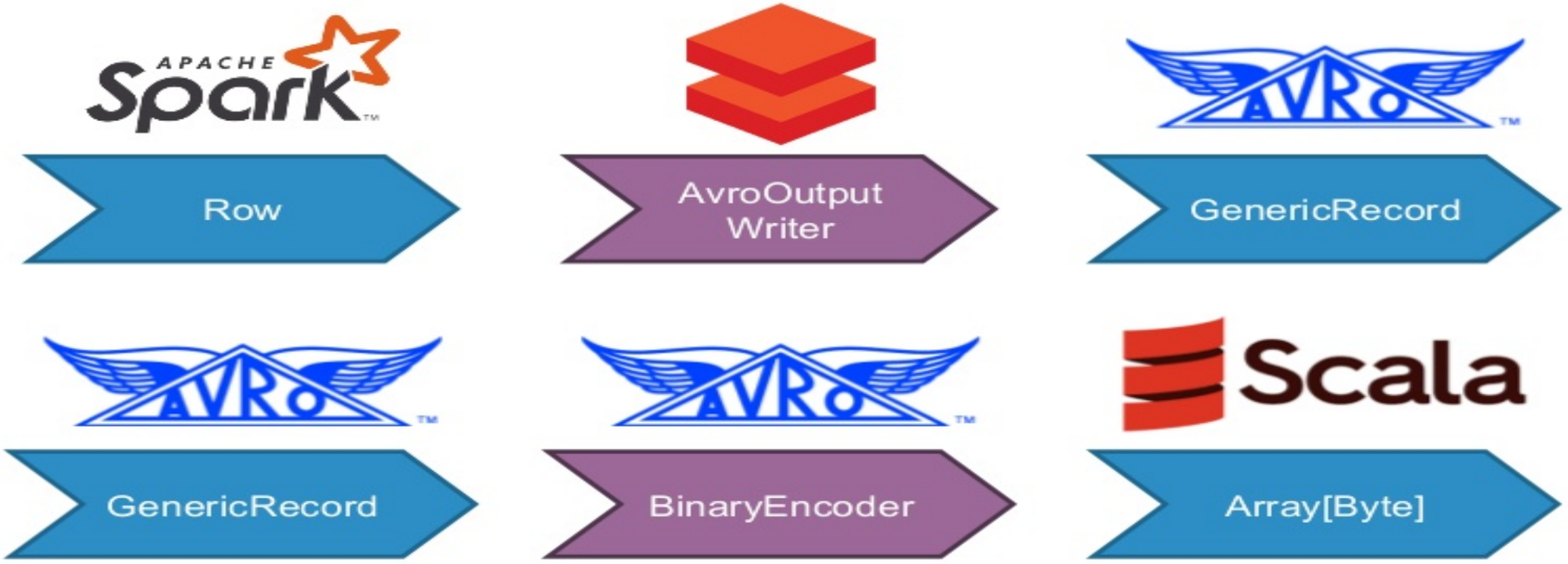
```
val valueSchema: Schema = ???

import za.co.absa.abris.avro.AvroSerDeWithKeyColumn._

dataframe
  .toAvroWithPlainKey(valueSchema)
  .writeStream
  .format("kafka")
  .option("kafka.bootstrap.servers", "localhost:9092")
  .option("topic", "topic_name")
  .start()
```

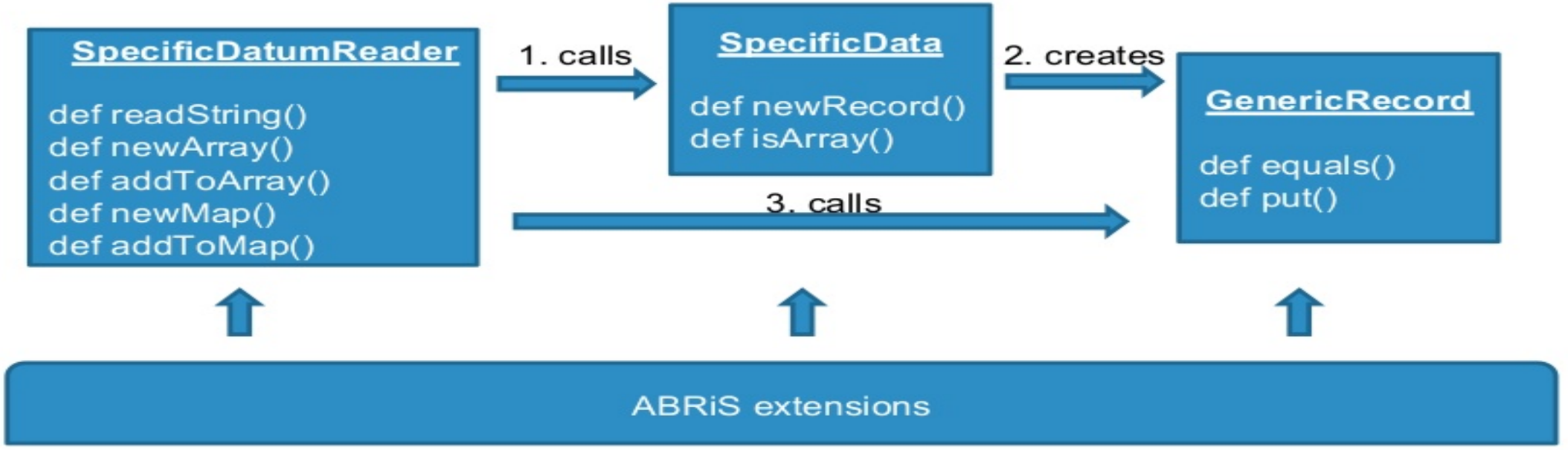
ABRiS ecosystem

Under the hood – Spark to Avro



Under the hood – Avro To Spark

Under the hood – Avro Decoding



Avro encoding inside Spark

```
def toAvro(rows: Dataset[Row], schemas: SchemasProcessor)(schemaId: Option[Int]):Dataset[Array[Byte]] = {
```

Avro encoding inside Spark

```
// trait for objects that can produce Avro and Spark schemas from each other
trait SchemasProcessor extends Serializable {
  def getAvroSchema(): Schema
  def getSparkSchema(): StructType
}
```

Avro encoding inside Spark

```
def toAvro(rows: Dataset[Row], schemas: SchemasProcessor)(schemaId: Option[Int]):Dataset[Array[Byte]] = {

 implicit val recEncoder: Encoder[Array[Byte]] = Encoders.BINARY

 rows.mapPartitions { partition =>

  val avroSchema = schemas.getAvroSchema()
  val sparkSchema = schemas.getSparkSchema()

  partition.map { row =>
      SparkAvroConversions.rowToBinaryAvro(row, sparkSchema, avroSchema, schemaId)
    }
  }
 }
```

Avro decoding inside Spark

```
def fromAvroToRow(dataframe: Dataset[Row], schema: Schema): Dataset[Row] = {

  implicit val rowEncoder: ExpressionEncoder[Row] = AvroToRowEncoderFactory.createRowEncoder(schema)

   // has to convert into String and re-parse it inside the 'map' operation since Avro Schema is not serializable
   val plainSchema = schema.toString()

   dataframe.mapPartitions { partition =>

      val avroDecoder = new AvroToRowConverter(
                  Some(AvroReaderFactory.createAvroReader(AvroSchemaUtils.parse(plainSchema))))

      partition.map(avroRecord => avroDecoder.convert(avroRecord))
   }
}
```

Conclusion

- Seamless integration between Spark Structured APIs and Avro
- Schema Registry support
  - the standard for Avro schema management
- Provides Avro support for Spark pre-2.4
- Will interoperate seamlessly with Spark 2.4

Coming soon

- Unified and Spark 2.4 compliant API
  - to_avro
  - from_avro
- Other Schema Registry naming strategies
  - TopicNamingStrategy (✓)
  - Since Schema Registry 5.0, July 2018
    - RecordNamingStrategy (✗)
    - TopicRecordNamingStrategy (✗)

Thank you!

- Questions?
- Comments?
- https://github.com/AbsaOSS/ABRiS
- Contacts
  - Felipe Melo
    - felipesmmelo@gmail.com
  - Georgi Chochov
    - g.chochov@gmail.com