Internal Dependencies

References

- Analyze java package metrics in a graph database
- Calculate metrics
- py2neo

Artifacts

Table 1

- List all the artifacts this notebook is based on

	artifactName	packages	types
0	axon-eventsourcing-4.8.0.jar	9	130
1	axon-disruptor-4.8.0.jar	1	22
2	axon-messaging-4.8.0.jar	64	762
3	axon-configuration-4.8.0.jar	1	39
4	axon-test-4.8.0.jar	8	87
5	axon-modelling-4.8.0.jar	10	150

Cyclic Dependencies

Cyclic dependencies occur when one package uses a class of another package and vice versa. These dependencies can lead to a lot of trouble when one of these packages needs to be changed.

Table 2

- List packages with cyclic dependencies

	packageName	dependentPackageName	forwardToBackwardBalance	numberForward	numberBackward	
0	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	0.882353	16	1	[Ge
1	org.axonframework.eventhandling	org.axonframework.tracing	0.857143	13	1	
2	org.axonframework.eventhandling	org.axonframework.messaging	0.853659	38	3	[Re
3	org.axonframework.eventhandling	org.axonframework.messaging.annotation	0.840000	23	2	[Se
4	org.axonframework.queryhandling	org.axonframework.tracing	0.800000	9	1	[Si
5	org.axonframework.eventsourcing	org.axonframework.eventsourcing.eventstore	0.777778	16	2	
6	org.axonframework.deadline	org.axonframework.tracing	0.750000	7	1	[S
7	org.axonframework.commandhandling.callbacks	org.axonframework.commandhandling	0.733333	13	2	
8	org.axonframework.commandhandling	org.axonframework.tracing	0.666667	5	1	[Si
9	org.axonframework.eventhandling	org.axonframework.serialization	0.647059	14	3	
10	org.axonframework.messaging.unitofwork	org.axonframework.messaging	0.647059	14	3	
11	org.axonframework.eventhandling.async	org.axonframework.eventhandling	0.538462	10	3	
12	org.axonframework.eventhandling.replay	org.axonframework.eventhandling	0.454545	8	3	[R
13	org.axonframework.serialization.upcasting.event	org.axonframework.eventhandling	0.333333	6	3	
14	org.axonframework.eventsourcing.eventstore.jdbc	org.axonframework.eventsourcing.eventstore.jdb...	0.317073	27	14	[Jc
15	org.axonframework.modelling.command.inspection	org.axonframework.modelling.command	0.250000	20	12	
16	org.axonframework.queryhandling.registration	org.axonframework.queryhandling	0.250000	5	3	
17	org.axonframework.messaging	org.axonframework.serialization	0.238095	13	8	
18	org.axonframework.eventhandling	org.axonframework.eventhandling.tokenstore	0.230769	8	5	
19	org.axonframework.messaging.annotation	org.axonframework.messaging.interceptors	0.200000	3	2	
20	org.axonframework.modelling.saga	org.axonframework.modelling.saga.metamodel	0.142857	4	3	[A
21	org.axonframework.commandhandling.distributed....	org.axonframework.commandhandling.distributed	0.076923	7	6	[Ac

Table 3

- List packages with cyclic dependencies with every dependency in a separate row sorted by the easiest and most valuable to resolve

	packageName	dependentPackageName	dependency	forwardToBackwardBalance	numbe
0	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	QueryResponseMessage<-ConvertingResponseMessage	0.882353	
1	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	GenericStreamingQueryMessage->ResponseType	0.882353	
2	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	GenericStreamingQueryMessage->PublisherRespons...	0.882353	
3	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	QueryGateway->ResponseType	0.882353	
4	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	QueryGateway->ResponseTypes	0.882353	
5	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	SimpleQueryBus->ResponseType	0.882353	
6	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	GenericSubscriptionQueryMessage->ResponseType	0.882353	
7	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	SimpleQueryUpdateEmitter->ResponseType	0.882353	
8	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	SimpleQueryUpdateEmitter->OptionalResponseType	0.882353	
9	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	SimpleQueryUpdateEmitter->PublisherResponseType	0.882353	
10	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	SimpleQueryUpdateEmitter->MultipleInstancesRes...	0.882353	
11	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	QuerySubscription->ResponseType	0.882353	
12	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	DefaultQueryGateway->ResponseType	0.882353	
13	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	GenericQueryMessage->ResponseType	0.882353	
14	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	StreamingQueryMessage->ResponseType	0.882353	
15	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	QueryMessage->ResponseType	0.882353	
16	org.axonframework.queryhandling	org.axonframework.messaging.responsetypes	SubscriptionQueryMessage->ResponseType	0.882353	
17	org.axonframework.eventhandling	org.axonframework.tracing	EventMessage<-NestingSpanFactory	0.857143	
18	org.axonframework.eventhandling	org.axonframework.tracing	SubscribingEventProcessor$Builder->SpanFactory	0.857143	
19	org.axonframework.eventhandling	org.axonframework.tracing	AbstractEventBus$Builder->SpanFactory	0.857143	
20	org.axonframework.eventhandling	org.axonframework.tracing	AbstractEventBus$Builder->NoOpSpanFactory	0.857143	
21	org.axonframework.eventhandling	org.axonframework.tracing	AbstractEventBus->Span	0.857143	
22	org.axonframework.eventhandling	org.axonframework.tracing	AbstractEventBus->SpanFactory	0.857143	
23	org.axonframework.eventhandling	org.axonframework.tracing	TrackingEventProcessor->SpanFactory	0.857143	
24	org.axonframework.eventhandling	org.axonframework.tracing	TrackingEventProcessor->Span	0.857143	
25	org.axonframework.eventhandling	org.axonframework.tracing	AbstractEventProcessor->Span	0.857143	
26	org.axonframework.eventhandling	org.axonframework.tracing	AbstractEventProcessor->SpanFactory	0.857143	
27	org.axonframework.eventhandling	org.axonframework.tracing	TrackingEventProcessor$Builder->SpanFactory	0.857143	
28	org.axonframework.eventhandling	org.axonframework.tracing	AbstractEventProcessor$Builder->SpanFactory	0.857143	
29	org.axonframework.eventhandling	org.axonframework.tracing	AbstractEventProcessor$Builder->NoOpSpanFactory	0.857143	
30	org.axonframework.eventhandling	org.axonframework.tracing	SimpleEventBus$Builder->SpanFactory	0.857143	
31	org.axonframework.eventhandling	org.axonframework.messaging	EventMessage<-Headers	0.853659	
32	org.axonframework.eventhandling	org.axonframework.messaging	DomainEventMessage<-Headers	0.853659	
33	org.axonframework.eventhandling	org.axonframework.messaging	TrackingToken<-StreamableMessageSource	0.853659	
34	org.axonframework.eventhandling	org.axonframework.messaging	ReplayToken->Message	0.853659	
35	org.axonframework.eventhandling	org.axonframework.messaging	EventMessageHandler->Message	0.853659	
36	org.axonframework.eventhandling	org.axonframework.messaging	EventMessageHandler->MessageHandler	0.853659	
37	org.axonframework.eventhandling	org.axonframework.messaging	EventProcessor->MessageHandlerInterceptor	0.853659	
38	org.axonframework.eventhandling	org.axonframework.messaging	EventProcessor->MessageHandlerInterceptorSupport	0.853659	
39	org.axonframework.eventhandling	org.axonframework.messaging	GenericDomainEventMessage->MetaData	0.853659	
40	org.axonframework.eventhandling	org.axonframework.messaging	GenericDomainEventMessage->GenericMessage	0.853659	
41	org.axonframework.eventhandling	org.axonframework.messaging	GenericDomainEventMessage->Message	0.853659	
42	org.axonframework.eventhandling	org.axonframework.messaging	SubscribingEventProcessor$Builder->Subscribabl...	0.853659	
43	org.axonframework.eventhandling	org.axonframework.messaging	EventBus->MessageDispatchInterceptorSupport	0.853659	
44	org.axonframework.eventhandling	org.axonframework.messaging	EventBus->SubscribableMessageSource	0.853659	
45	org.axonframework.eventhandling	org.axonframework.messaging	SequenceNumberParameterResolverFactory$Sequenc...	0.853659	
46	org.axonframework.eventhandling	org.axonframework.messaging	MultiStreamableMessageSource$Builder->Streamab...	0.853659	
47	org.axonframework.eventhandling	org.axonframework.messaging	TrackingEventProcessorConfiguration->Streamabl...	0.853659	
48	org.axonframework.eventhandling	org.axonframework.messaging	AbstractEventBus->MessageDispatchInterceptor	0.853659	
49	org.axonframework.eventhandling	org.axonframework.messaging	AnnotationEventHandlerAdapter->Message	0.853659	
50	org.axonframework.eventhandling	org.axonframework.messaging	TrackingEventProcessor->Message	0.853659	
51	org.axonframework.eventhandling	org.axonframework.messaging	TrackingEventProcessor->StreamableMessageSource	0.853659	
52	org.axonframework.eventhandling	org.axonframework.messaging	TrackingEventProcessor->InterceptorChain	0.853659	
53	org.axonframework.eventhandling	org.axonframework.messaging	MultiStreamableMessageSource$IdentifiedStreama...	0.853659	

	packageName	dependentPackageName	dependency	forwardToBackwardBalance	numbe
54	org.axonframework.eventhandling	org.axonframework.messaging	AbstractEventProcessor->ResultMessage	0.853659	
55	org.axonframework.eventhandling	org.axonframework.messaging	AbstractEventProcessor->MessageHandlerInterceptor	0.853659	
56	org.axonframework.eventhandling	org.axonframework.messaging	AbstractEventProcessor->DefaultInterceptorChain	0.853659	
57	org.axonframework.eventhandling	org.axonframework.messaging	EventMessage->Message	0.853659	
58	org.axonframework.eventhandling	org.axonframework.messaging	StreamingEventProcessor->StreamableMessageSource	0.853659	
59	org.axonframework.eventhandling	org.axonframework.messaging	SubscribingEventProcessor->SubscribableMessage...	0.853659	

Interface Segregation Candidates

Well known from Design Principles and Design Patterns by Robert C. Martin, the *Interface Segregation Principle* suggests that software components should have narrow, focused interfaces rather than large, general-purpose ones. The goal is to minimize the dependencies between components and increase modularity, flexibility, and maintainability.

Smaller, focused and purpose-driven interfaces

- make it easier to modify individual components without affecting the rest of the system.
- make it clearer which client is affected by which change.
- don't force their clients to depend on methods they don't need.
- reduce the scope of changes since a change to one component doesn't affect others.
- lead to a more loosely coupled architecture that is easier to understand and maintain.

Reference: Analyze java package metrics in a graph database

How to apply the results

If just one method of a type is used, especially in many places, then the result of this method can be used to call e.g. a method or constuct an object instead of using the whole object and then just calling that single method.

If there are a couple of methods that are used for a distinct purpose, those could be factored out into a separate interface. The original type can extended/implement the new interface so that there are no breaking changes. Then all the callers, that use only this group of methods, can be changed to the new interface.

Table 3

- List top 20 most used combinations of methods of larger Types that might benefit from *Interface Segregation*

	fullDependentTypeName	declaredMethods	calledMethodNames	calledMethods	callerTypes
0	org.axonframework.commandhandling.CommandMessage	9	[getCommandName]	1	18
1	org.axonframework.eventhandling.EventMessage	9	[getIdentifier, getTimestamp]	2	10
2	org.axonframework.eventhandling.DomainEventMes...	10	[getSequenceNumber]	1	9
3	org.axonframework.eventhandling.TrackedEventMe...	10	[trackingToken]	1	8
4	org.axonframework.eventhandling.EventMessage	9	[getIdentifier]	1	8
5	org.axonframework.eventhandling.DomainEventMes...	10	[getType, getSequenceNumber, getAggregateIdent...	3	6
6	org.axonframework.messaging.ResultMessage	9	[isExceptional, exceptionResult]	2	6
7	org.axonframework.commandhandling.GenericComma...	14	[asCommandResultMessage]	1	5
8	org.axonframework.deadline.GenericDeadlineMessage	11	[asDeadlineMessage]	1	5
9	org.axonframework.eventhandling.TrackedEventMe...	12	[trackingToken]	1	4
10	org.axonframework.deadline.DeadlineMessage	10	[getDeadlineName]	1	4
11	org.axonframework.eventhandling.DomainEventMes...	10	[getType]	1	4
12	org.axonframework.eventhandling.DomainEventMes...	10	[getAggregateIdentifier]	1	4
13	org.axonframework.eventhandling.GenericEventMe...	10	[asEventMessage]	1	4
14	org.axonframework.common.transaction.NoTransac...	4	[instance]	1	4
15	org.axonframework.commandhandling.GenericComma...	15	[asCommandResultMessage]	1	3
16	org.axonframework.modelling.command.inspection...	13	[type]	1	3
17	org.axonframework.eventhandling.DomainEventMes...	11	[getType, getSequenceNumber, getAggregateIdent...	3	3
18	org.axonframework.eventhandling.GenericEventMe...	11	[asEventMessage]	1	3
19	org.axonframework.eventhandling.DomainEventMes...	10	[getSequenceNumber, getAggregateIdentifier]	2	3

Package Usage

Types that are used by multiple packages

Table 4

- List the top 20 packages that are used by the highest count of different packages

	dependentType.fqn	dependentType.name	dependentTypeLabels	numberOfUsingPackages
0	org.axonframework.common.BuilderUtils	BuilderUtils	[Type, File, Java, ByteCode, Class]	44
1	org.axonframework.messaging.Message	Message	[Type, File, Java, ByteCode, GenericDeclaratio...	39
2	org.axonframework.common.AxonConfigurationExce...	AxonConfigurationException	[Type, File, Java, ByteCode, Class]	37
3	org.axonframework.messaging.MetaData	MetaData	[Type, File, Java, ByteCode, Class]	33
4	org.axonframework.eventhandling.EventMessage	EventMessage	[Type, File, Java, ByteCode, GenericDeclaratio...	32
5	org.axonframework.messaging.unitofwork.UnitOfWork	UnitOfWork	[Type, File, Java, ByteCode, GenericDeclaratio...	31
6	org.axonframework.serialization.Serializer	Serializer	[Type, File, Java, ByteCode, Interface]	29
7	org.axonframework.common.Assert	Assert	[Type, File, Java, ByteCode, Class]	27
8	org.axonframework.common.transaction.Transacti...	TransactionManager	[Type, File, Java, ByteCode, Interface]	27
9	org.axonframework.serialization.SerializedObject	SerializedObject	[Type, File, Java, ByteCode, GenericDeclaratio...	25
10	org.axonframework.serialization.SerializedType	SerializedType	[Type, File, Java, ByteCode, Interface]	24
11	org.axonframework.messaging.unitofwork.Current...	CurrentUnitOfWork	[Type, File, Java, ByteCode, Class]	21
12	org.axonframework.common.AxonNonTransientExcep...	AxonNonTransientException	[Type, File, Java, ByteCode, Class]	18
13	org.axonframework.eventhandling.DomainEventMes...	DomainEventMessage	[Type, File, Java, ByteCode, GenericDeclaratio...	18
14	org.axonframework.eventhandling.GenericEventMe...	GenericEventMessage	[Type, File, Java, ByteCode, Class, GenericDec...	18
15	org.axonframework.eventhandling.TrackingToken	TrackingToken	[Type, File, Java, ByteCode, Interface]	18
16	org.axonframework.messaging.annotation.Paramet...	ParameterResolverFactory	[Type, File, Java, ByteCode, Interface]	18
17	org.axonframework.common.Registration	Registration	[Type, File, Java, ByteCode, Interface]	17
18	org.axonframework.serialization.SimpleSerializ...	SimpleSerializedObject	[Type, File, Java, ByteCode, Class, GenericDec...	17
19	org.axonframework.common.ObjectUtils	ObjectUtils	[Type, File, Java, ByteCode, Class]	16

Packages that are used by multiple artifacts

Table 5

- List the top 20 artifacts that only use a few (compared to all existing) packages of another artifact

	artifactName	dependentArtifactName	dependentPackages	dependentArtifactPackages	packageUsagePercentage	dependentFullQualifiedPackageNames
0	axon-disruptor-4.8.0	axon-messaging-4.8.0	9	64	0.140625	[org.axonframework.commandhandling.callbacks, ...
1	axon-test-4.8.0	axon-messaging-4.8.0	10	64	0.156250	[org.axonframework.messaging.annotation, org.a...
2	axon-eventsourcing-4.8.0	axon-modelling-4.8.0	2	10	0.200000	[org.axonframework.modelling.command, org.axon...
3	axon-disruptor-4.8.0	axon-modelling-4.8.0	2	10	0.200000	[org.axonframework.modelling.command.inspectio...
4	axon-disruptor-4.8.0	axon-eventsourcing-4.8.0	2	9	0.222222	[org.axonframework.eventsourcing, org.axonfram...
5	axon-test-4.8.0	axon-eventsourcing-4.8.0	2	9	0.222222	[org.axonframework.eventsourcing, org.axonfram...
6	axon-modelling-4.8.0	axon-messaging-4.8.0	18	64	0.281250	[org.axonframework.common.caching, org.axonfra...
7	axon-eventsourcing-4.8.0	axon-messaging-4.8.0	20	64	0.312500	[org.axonframework.common, org.axonframework.m...
8	axon-configuration-4.8.0	axon-eventsourcing-4.8.0	4	9	0.444444	[org.axonframework.eventsourcing.eventstore, o...
9	axon-test-4.8.0	axon-modelling-4.8.0	5	10	0.500000	[org.axonframework.modelling.command.inspectio...
10	axon-configuration-4.8.0	axon-messaging-4.8.0	34	64	0.531250	[org.axonframework.eventhandling, org.axonfram...
11	axon-configuration-4.8.0	axon-modelling-4.8.0	6	10	0.600000	[org.axonframework.modelling.saga.repository.i...
12	axon-modelling-4.8.0	axon-modelling-4.8.0	6	10	0.600000	[org.axonframework.modelling.saga.metamodel, o...
13	axon-test-4.8.0	axon-test-4.8.0	5	8	0.625000	[org.axonframework.test.matchers, org.axonfram...
14	axon-messaging-4.8.0	axon-messaging-4.8.0	41	64	0.640625	[org.axonframework.messaging.unitofwork, org.a...
15	axon-eventsourcing-4.8.0	axon-eventsourcing-4.8.0	7	9	0.777778	[org.axonframework.eventsourcing.eventstore, o...
16	axon-configuration-4.8.0	axon-disruptor-4.8.0	1	1	1.000000	[org.axonframework.disruptor.commandhandling]

Packages that are used by multiple artifacts

Table 6

- List the top 20 packages that only use a few (compared to all existing) types of another package

	artifactName	dependentArtifactName	packageName	dependentPackage.fqn	dependentTypes	dependentPackageTy
0	axon-modelling-4.8.0	axon-messaging-4.8.0	org.axonframework.modelling.saga.metamodel	org.axonframework.eventhandling	1	
1	axon-test-4.8.0	axon-messaging-4.8.0	org.axonframework.test.matchers	org.axonframework.eventhandling	1	
2	axon-eventsourcing-4.8.0	axon-messaging-4.8.0	org.axonframework.eventsourcing.snapshotting	org.axonframework.eventhandling	1	
3	axon-eventsourcing-4.8.0	axon-modelling-4.8.0	org.axonframework.eventsourcing.eventstore.jdbc	org.axonframework.modelling.command	1	
4	axon-eventsourcing-4.8.0	axon-modelling-4.8.0	org.axonframework.eventsourcing.conflictresolu...	org.axonframework.modelling.command	1	
5	axon-modelling-4.8.0	axon-messaging-4.8.0	org.axonframework.modelling.command.legacyjpa	org.axonframework.eventhandling	2	
6	axon-modelling-4.8.0	axon-messaging-4.8.0	org.axonframework.modelling.command	org.axonframework.eventhandling	2	
7	axon-test-4.8.0	axon-messaging-4.8.0	org.axonframework.test.eventscheduler	org.axonframework.eventhandling	2	
8	axon-eventsourcing-4.8.0	axon-messaging-4.8.0	org.axonframework.eventsourcing.conflictresolu...	org.axonframework.eventhandling	2	
9	axon-eventsourcing-4.8.0	axon-messaging-4.8.0	org.axonframework.eventsourcing.eventstore	org.axonframework.messaging	1	
10	axon-eventsourcing-4.8.0	axon-messaging-4.8.0	org.axonframework.eventsourcing.conflictresolu...	org.axonframework.messaging	1	
11	axon-test-4.8.0	axon-messaging-4.8.0	org.axonframework.test.matchers	org.axonframework.messaging	1	
12	axon-test-4.8.0	axon-messaging-4.8.0	org.axonframework.test	org.axonframework.messaging	1	
13	axon-eventsourcing-4.8.0	axon-messaging-4.8.0	org.axonframework.eventsourcing.eventstore.jpa	org.axonframework.serialization	1	
14	axon-eventsourcing-4.8.0	axon-messaging-4.8.0	org.axonframework.eventsourcing.eventstore.leg...	org.axonframework.serialization	1	
15	axon-eventsourcing-4.8.0	axon-messaging-4.8.0	org.axonframework.eventsourcing.eventstore.jdbc	org.axonframework.serialization	1	
16	axon-eventsourcing-4.8.0	axon-messaging-4.8.0	org.axonframework.eventsourcing.eventstore.jdb...	org.axonframework.eventhandling	3	
17	axon-test-4.8.0	axon-modelling-4.8.0	org.axonframework.test.utils	org.axonframework.modelling.saga	1	
18	axon-eventsourcing-4.8.0	axon-messaging-4.8.0	org.axonframework.eventsourcing.conflictresolu...	org.axonframework.commandhandling	1	
19	axon-test-4.8.0	axon-messaging-4.8.0	org.axonframework.test.matchers	org.axonframework.commandhandling	1	