copenhagen goto; conference

Concurrent Programming Using The Disruptor

Trisha Gee

LMAX

Concurrent Programming Using The Disruptor

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The Disruptor?

What I'm covering

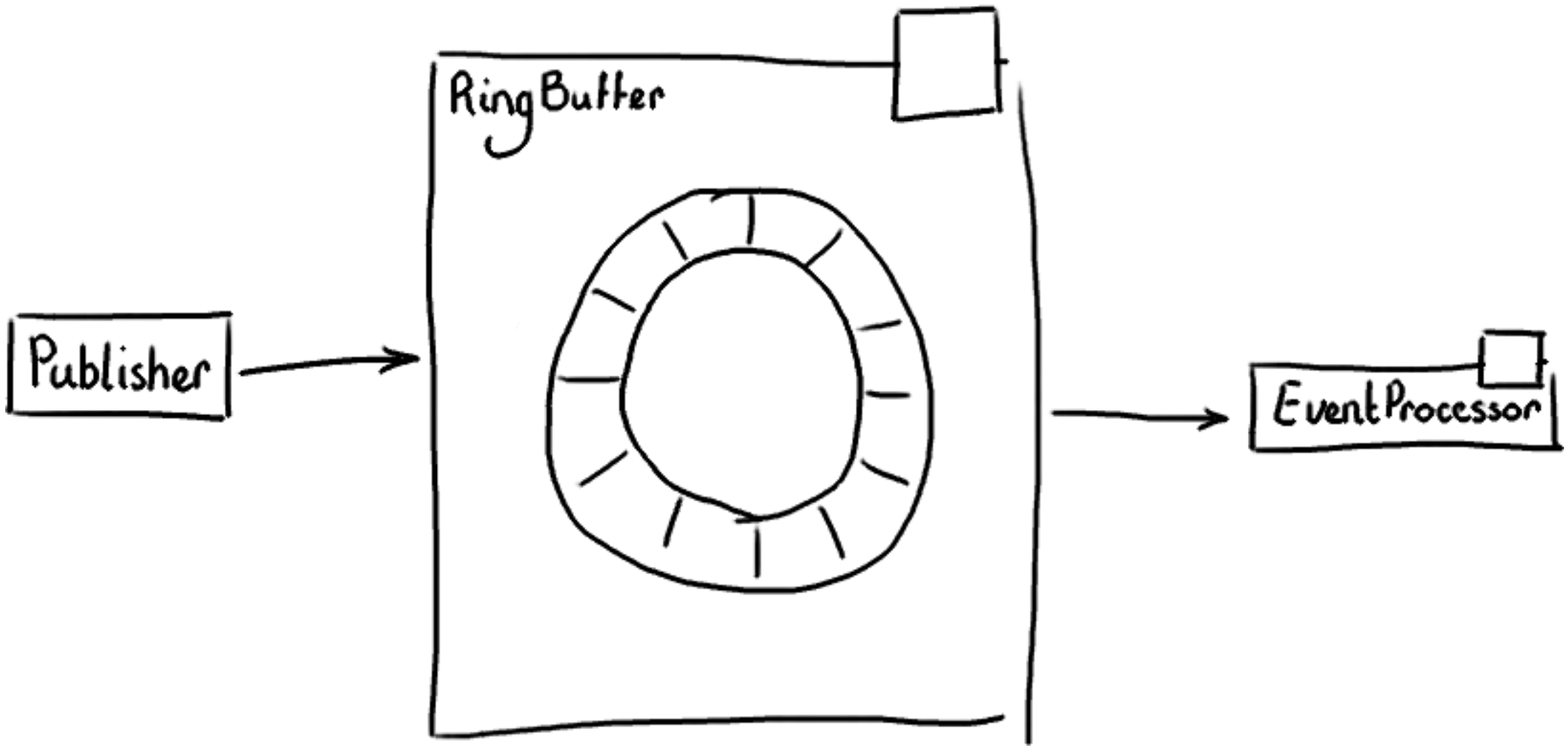
- Overview of the Disruptor
- Create your own!
- Turn it up to Eleven
- Q&A

What is it?

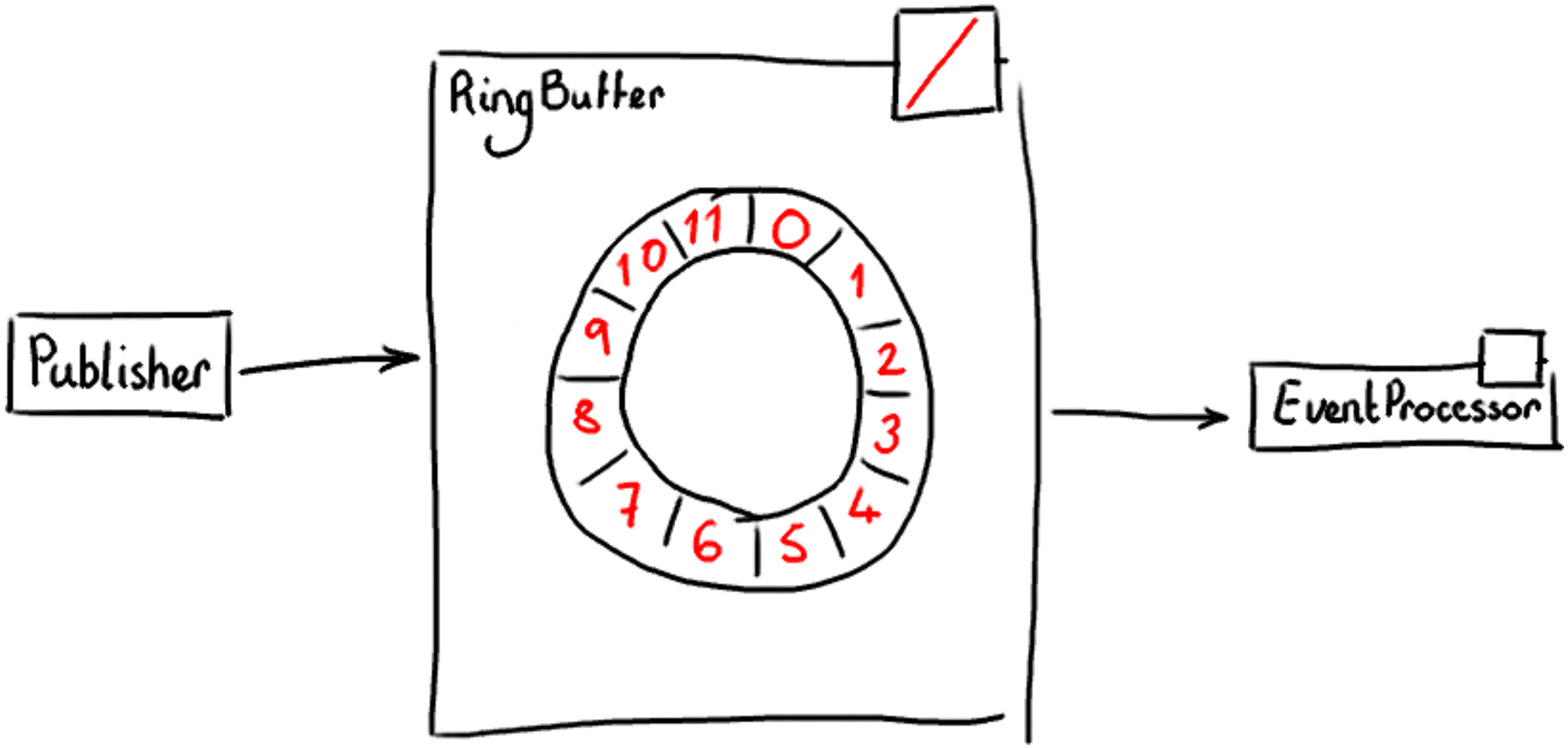
- Data structure and work flow with no contention.
- Very fast message passing.
- Allows you to go truly parallel.

So...?

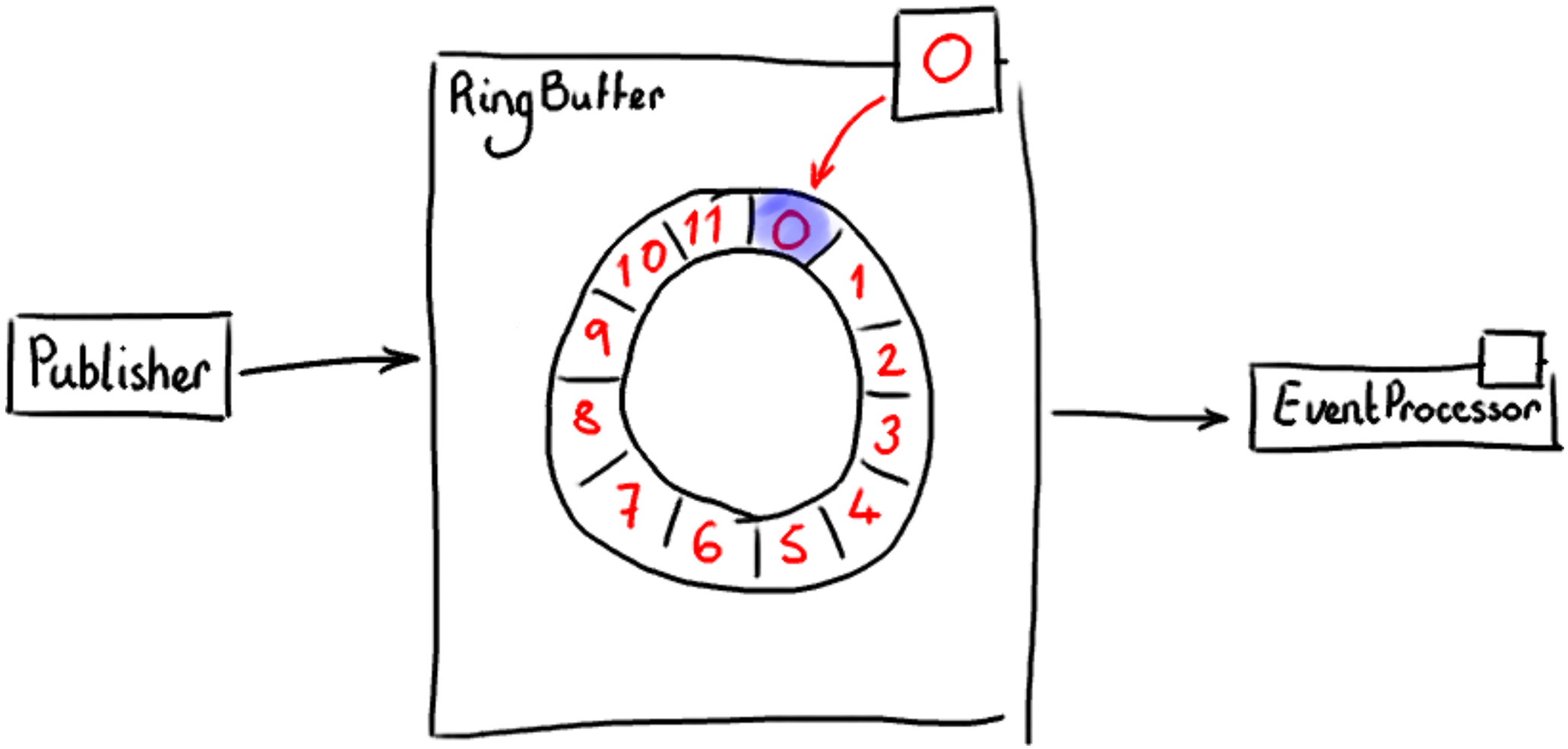
The Magic RingBuffer



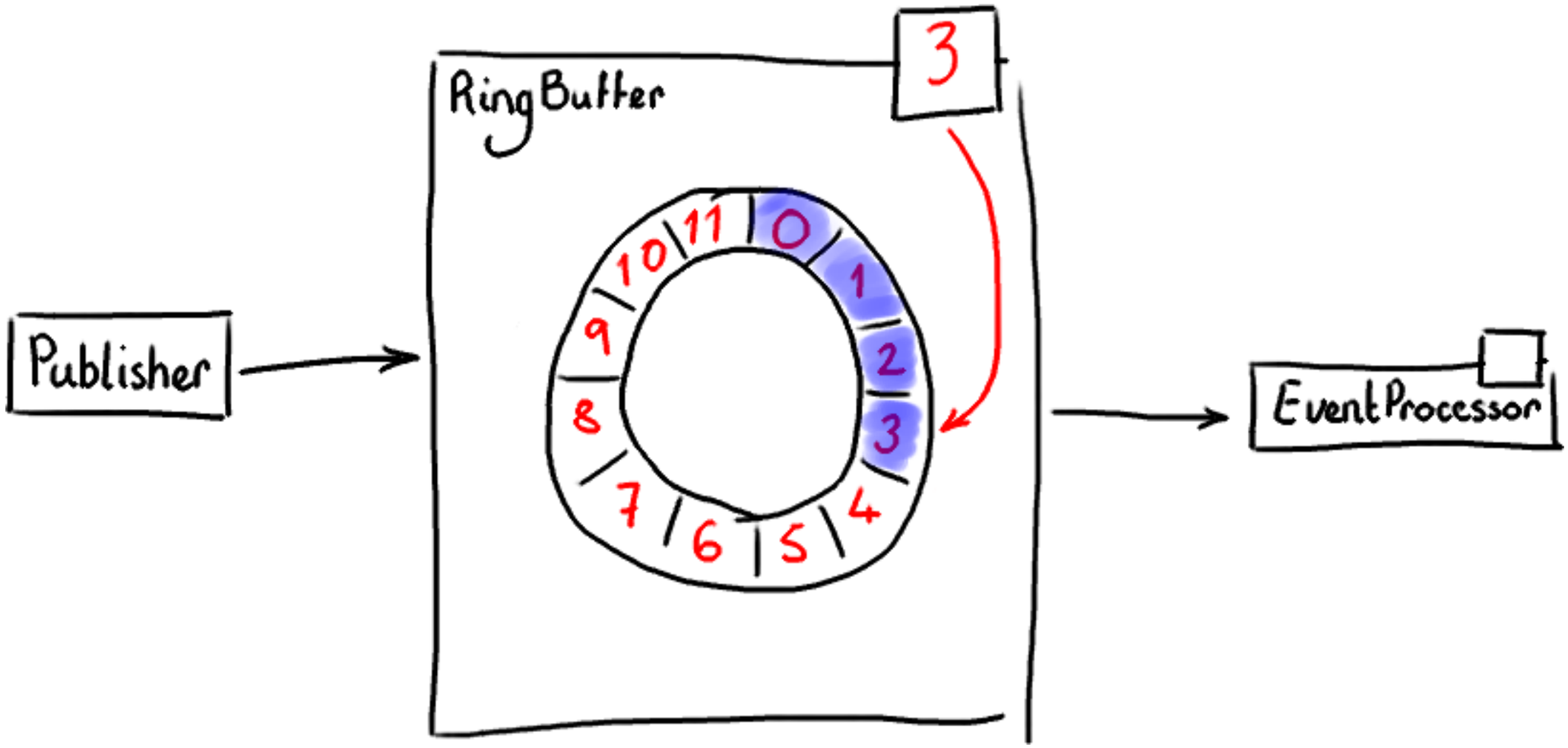
The Magic RingBuffer



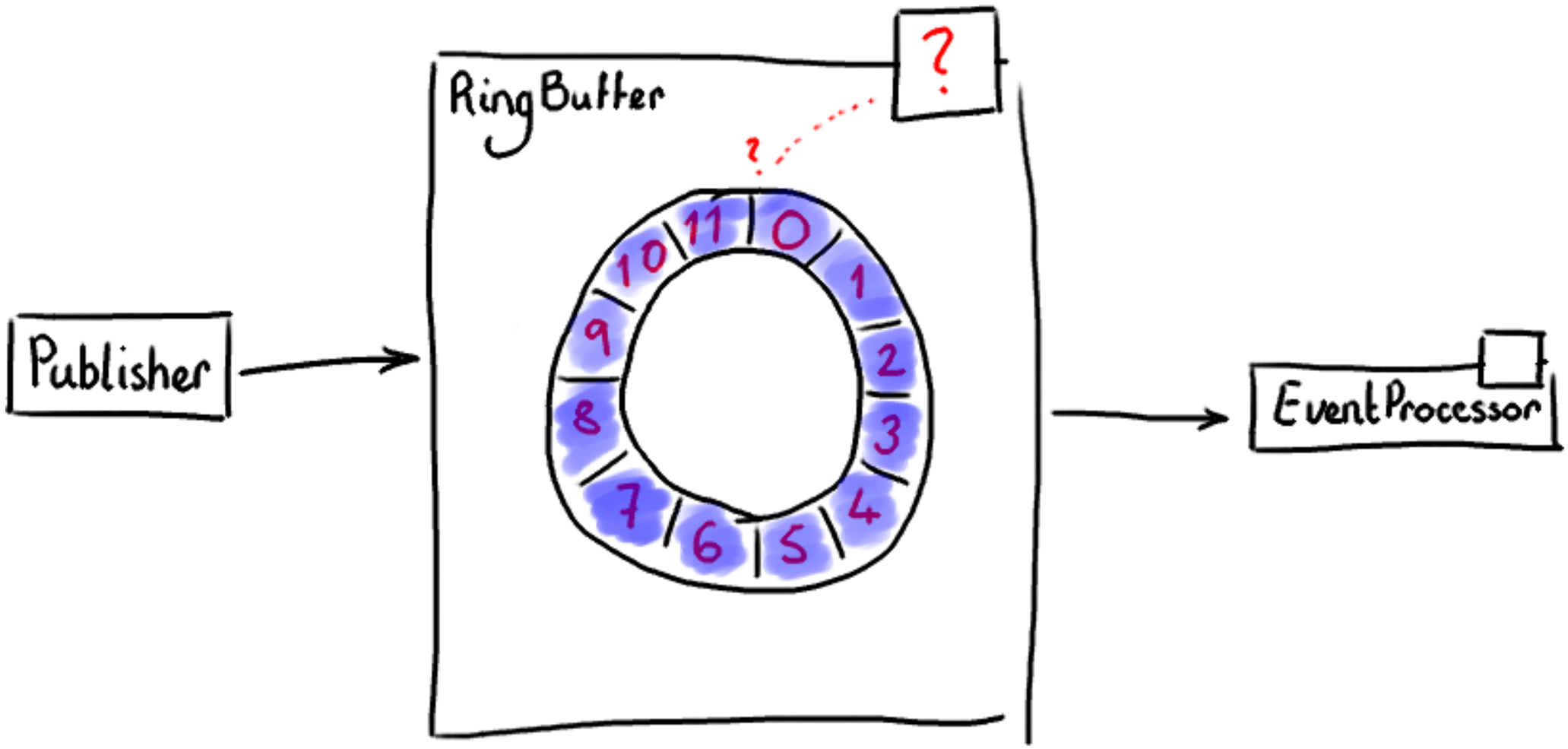
The Magic RingBuffer



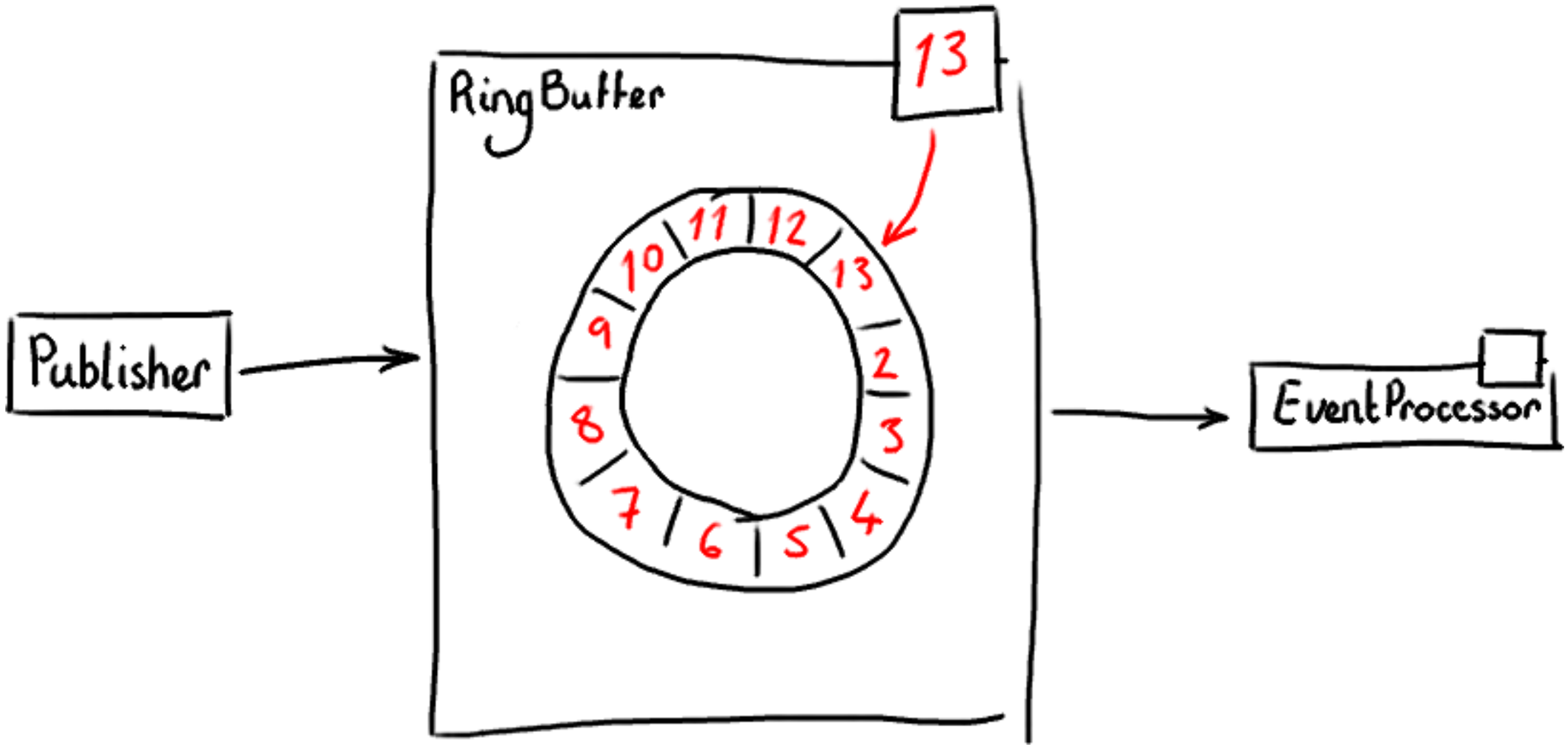
The Magic RingBuffer



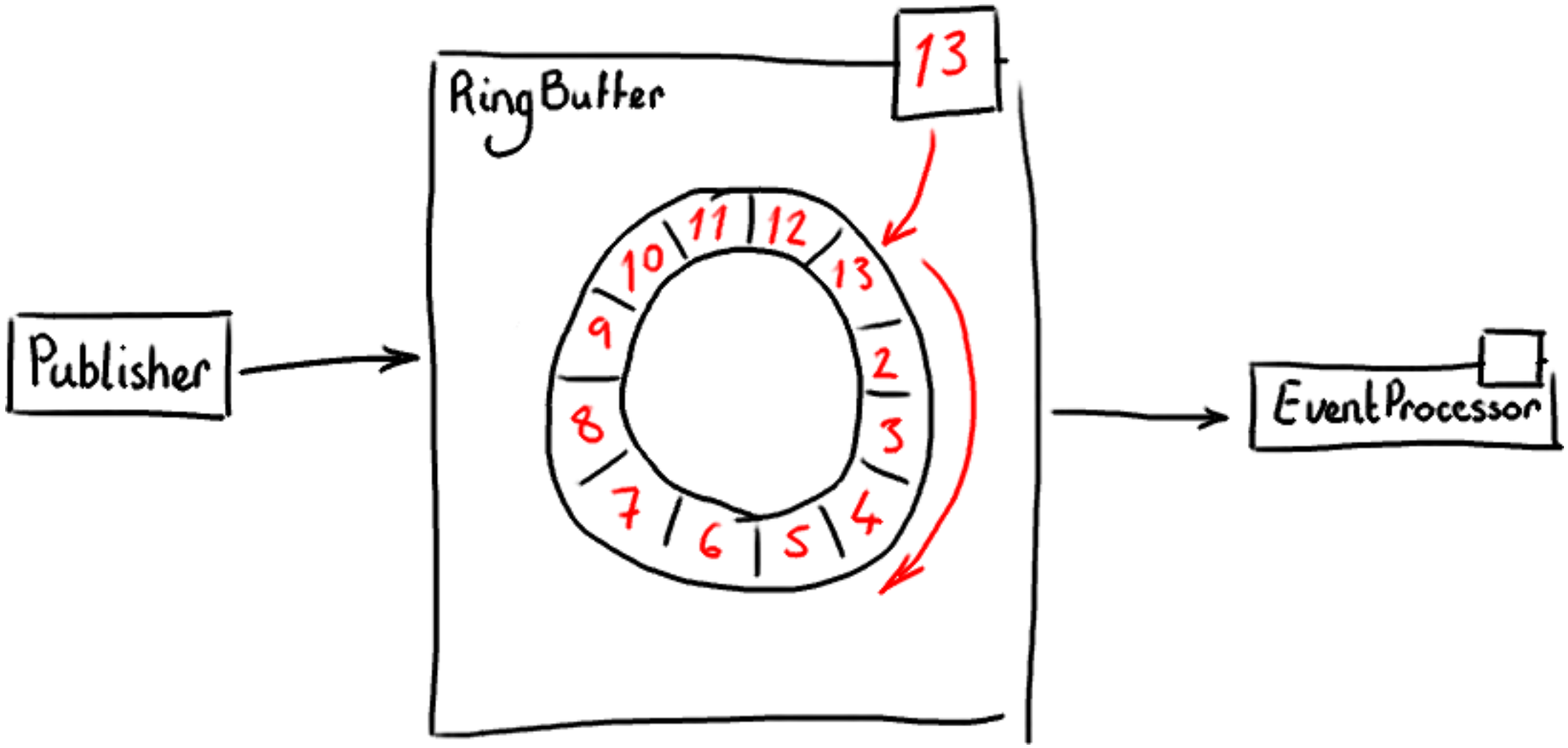
The Magic RingBuffer



The Magic RingBuffer



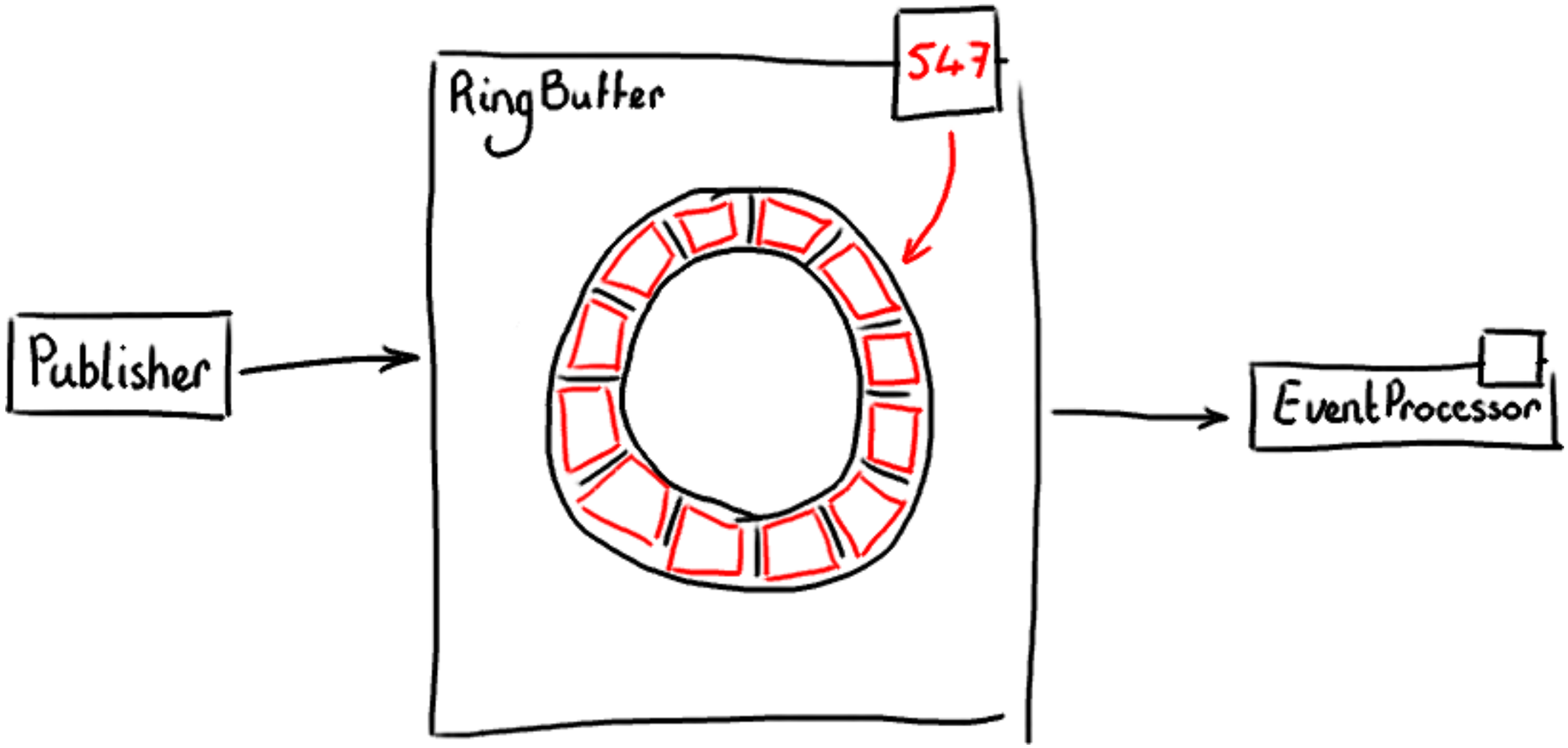
The Magic RingBuffer



Creating a RingBuffer

```
final RingBuffer<SimpleEvent> ringBuffer =
    new RingBuffer<SimpleEvent>(SimpleEvent.EVENT_FACTORY,
                                RING_BUFFER_SIZE);
```

The Events are Buckets



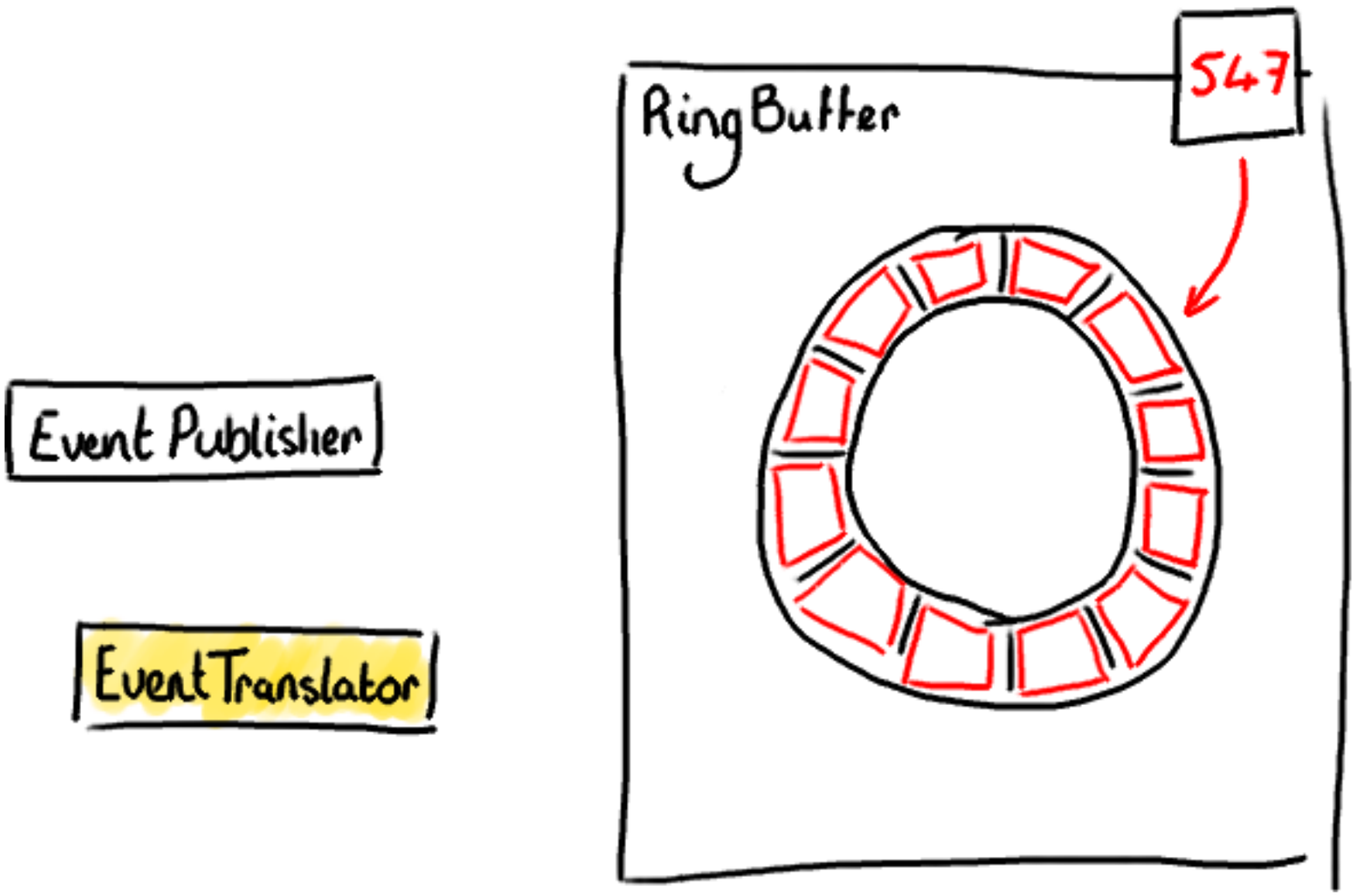
Great! I want one!

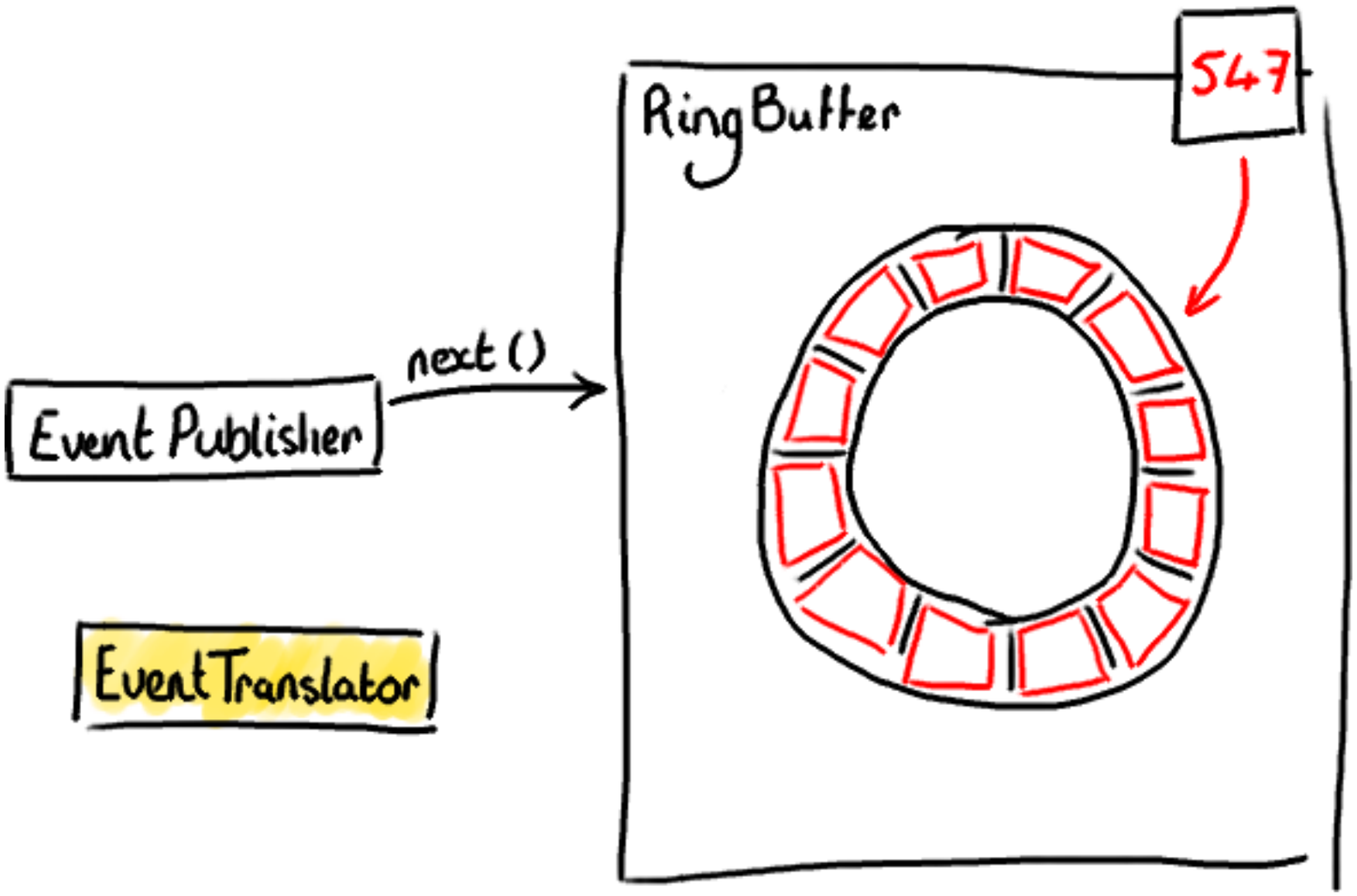
```
public class SimpleEvent {
    public static final EventFactory<SimpleEvent> EVENT_FACTORY =
        new SimpleEventFactory();

    private volatile String value;


    private static class SimpleEventFactory implements EventFactory<SimpleEvent> {
        @Override
        public SimpleEvent newInstance() {
            return new SimpleEvent();
        }
    }
}
```

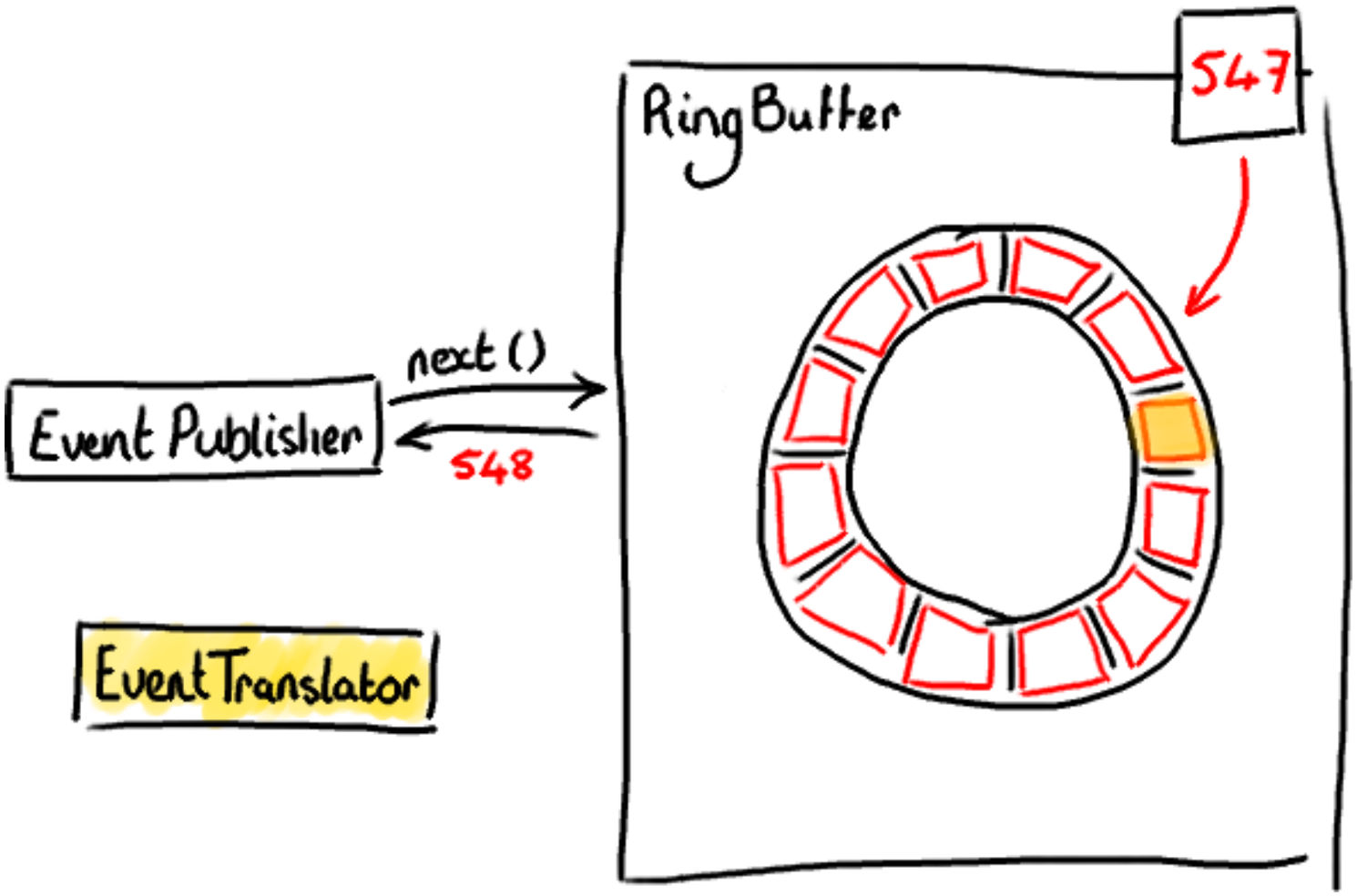
I've got a RingBuffer!

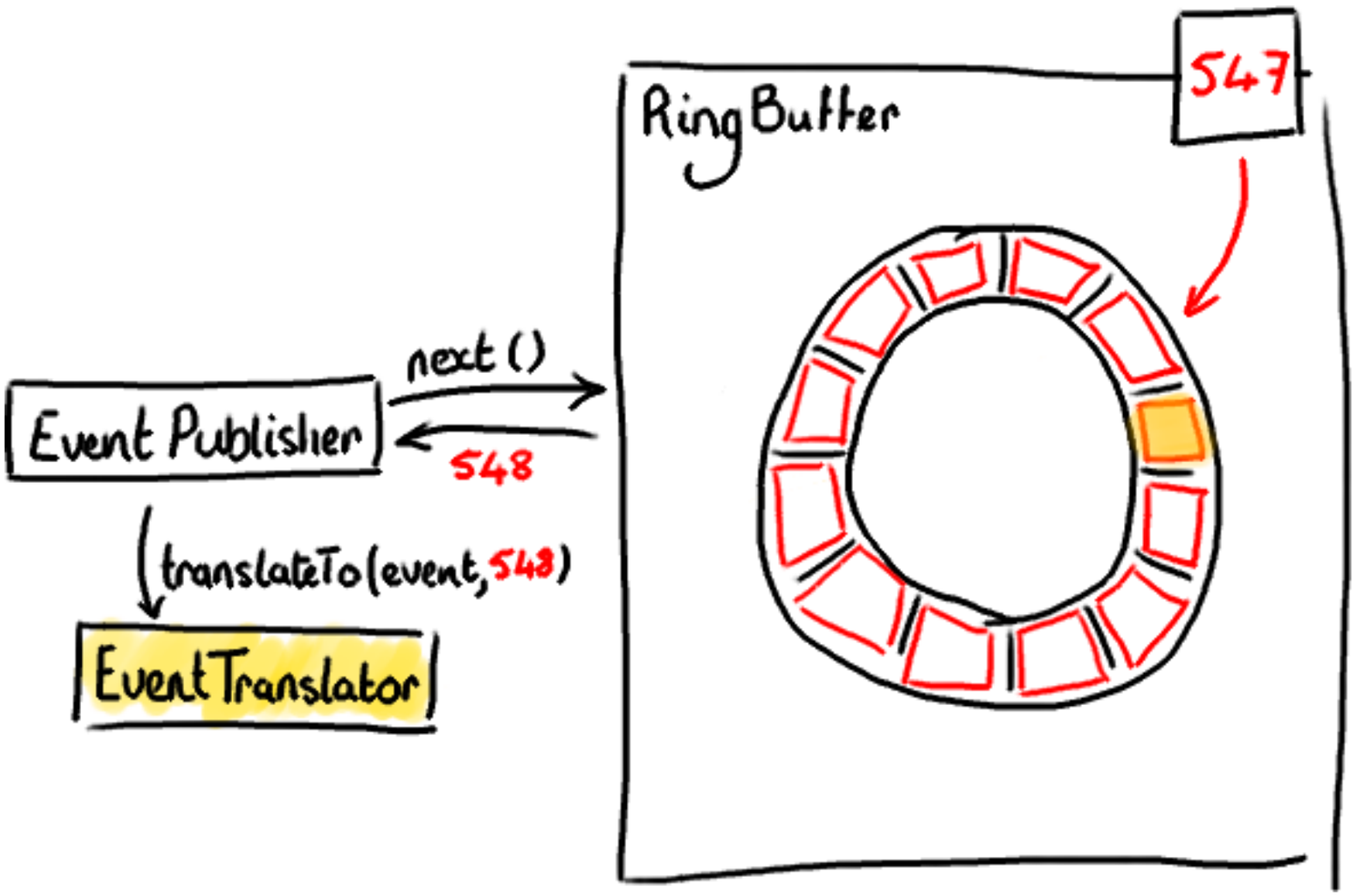
- Erm.... how do I poke things into it?

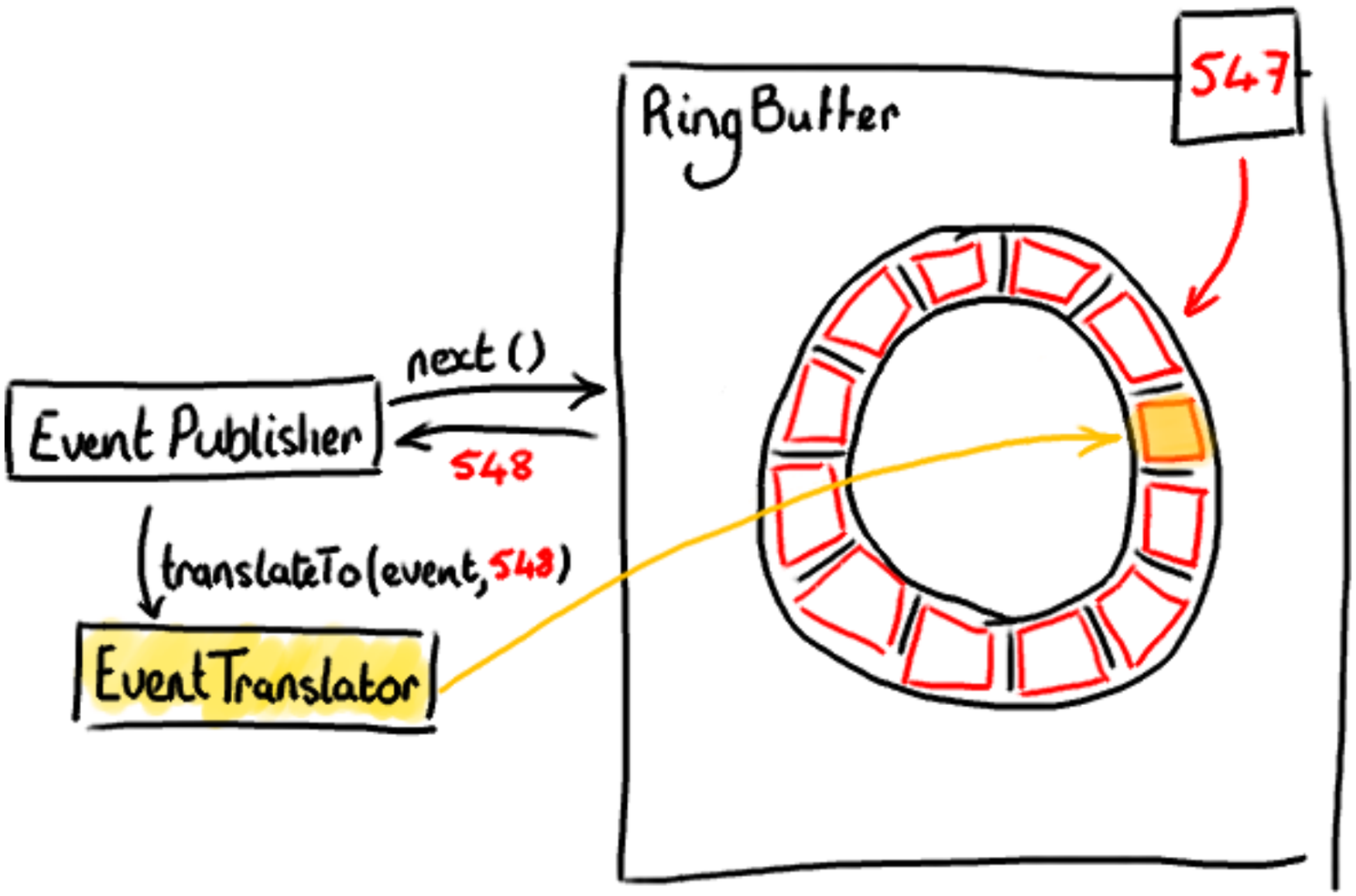
The Publisher

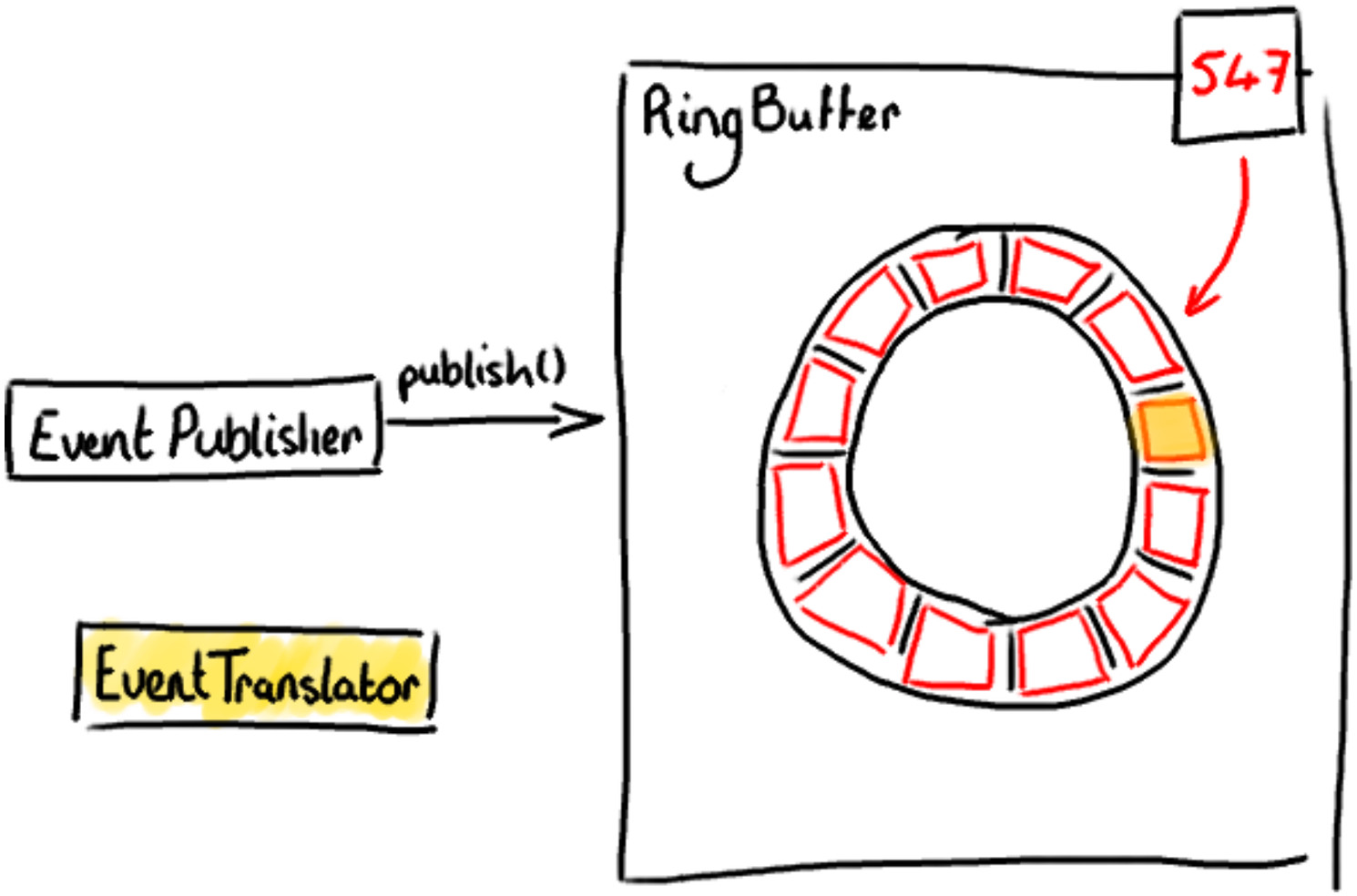


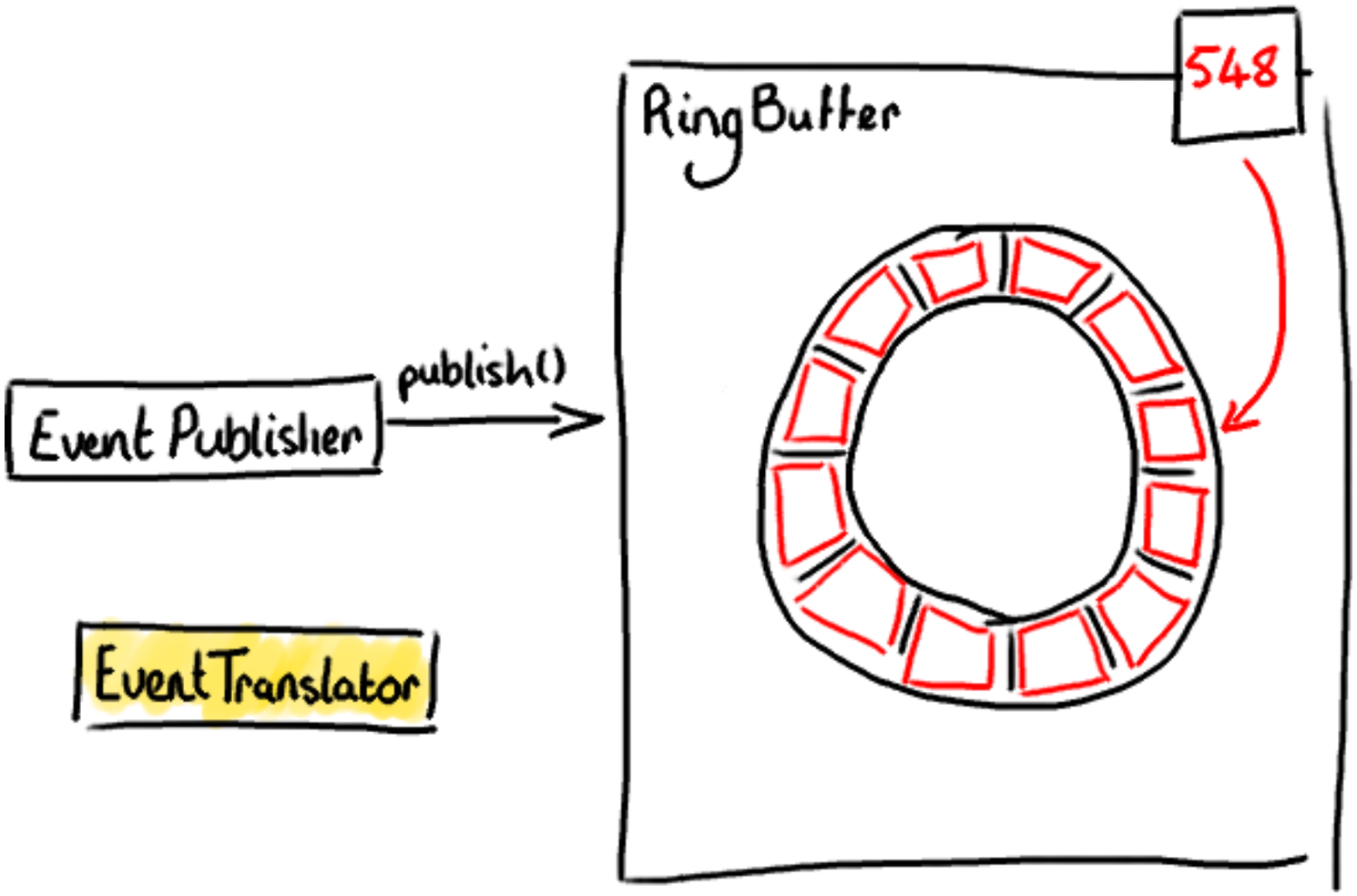

RingButter
547
next()
Event Publisher
EventTranslator


RingButter
547
next()
Event Publisher
548
EventTranslator


RingBuffer
547
next()
548
Event Publisher
translateTo(event, 548)
EventTranslator


RingButter
547
next()
548
Event Publisher
translateTo(event, 548)
EventTranslator


RingButter
547
publish()
Event Publisher
EventTranslator


RingButter
548
publish()
Event Publisher
EventTranslator

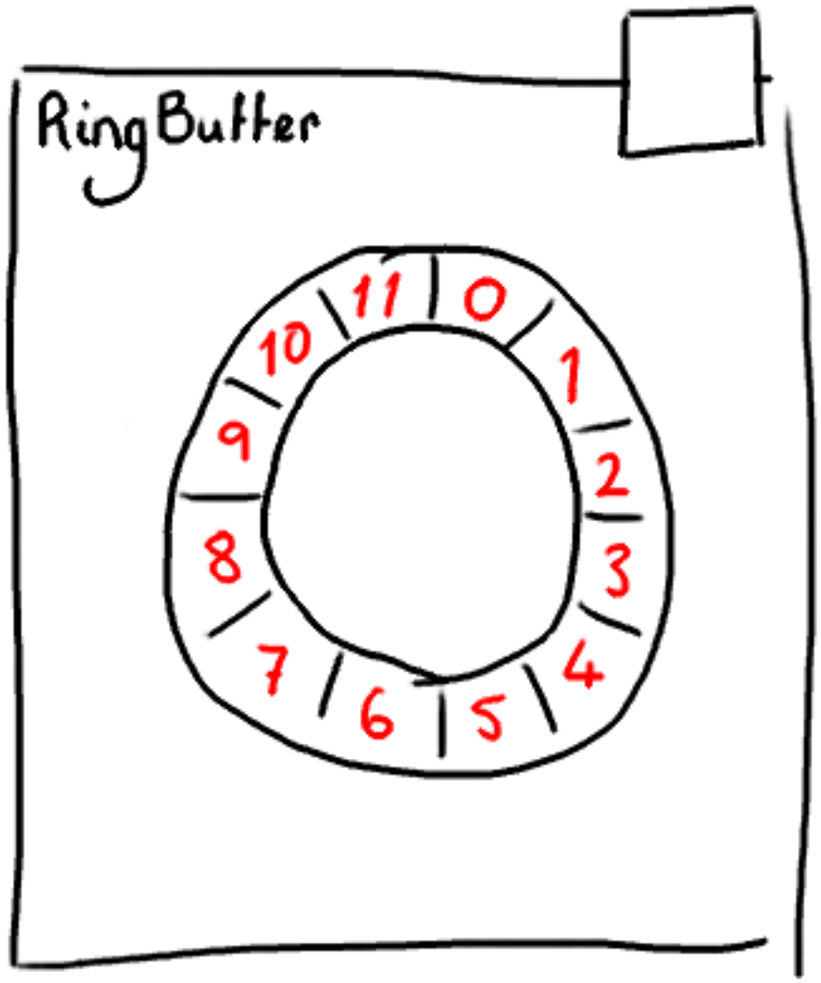
What do I do?

```
public class SimpleEventTranslator implements
    EventTranslator<SimpleEvent>
```

```
SimpleEventTranslator translator = new SimpleEventTranslator();

EventPublisher<SimpleEvent> publisher =
    new EventPublisher<SimpleEvent>(ringBuffer);

// poke your translator here
// ...and when you're done...
publisher.publishEvent(translator);
```

...so now I want to read

- The Disruptor provides nice batching behaviour for free


RingButter
11
0
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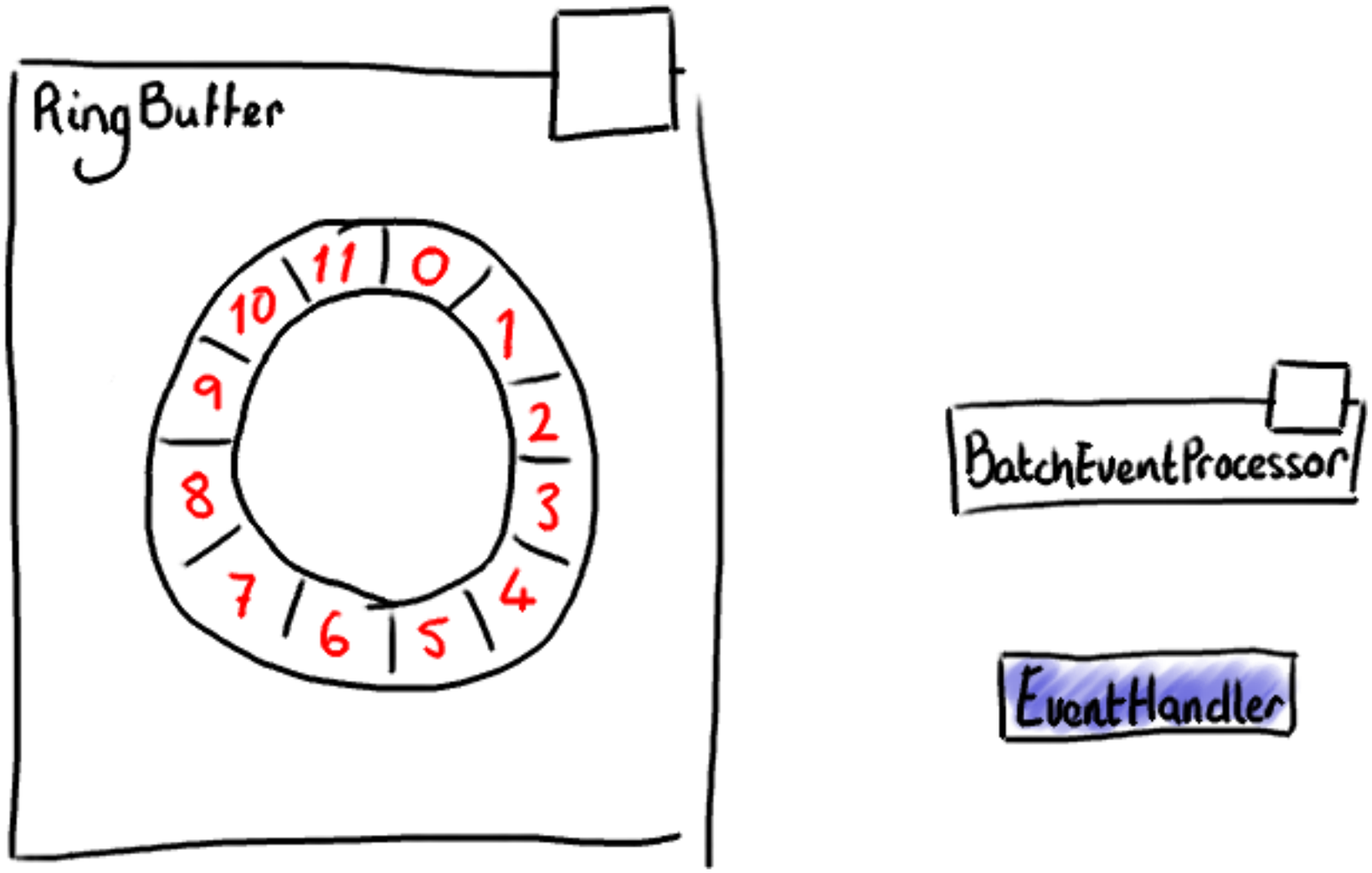
10


BatchEventProcessor


RingBuffer
11
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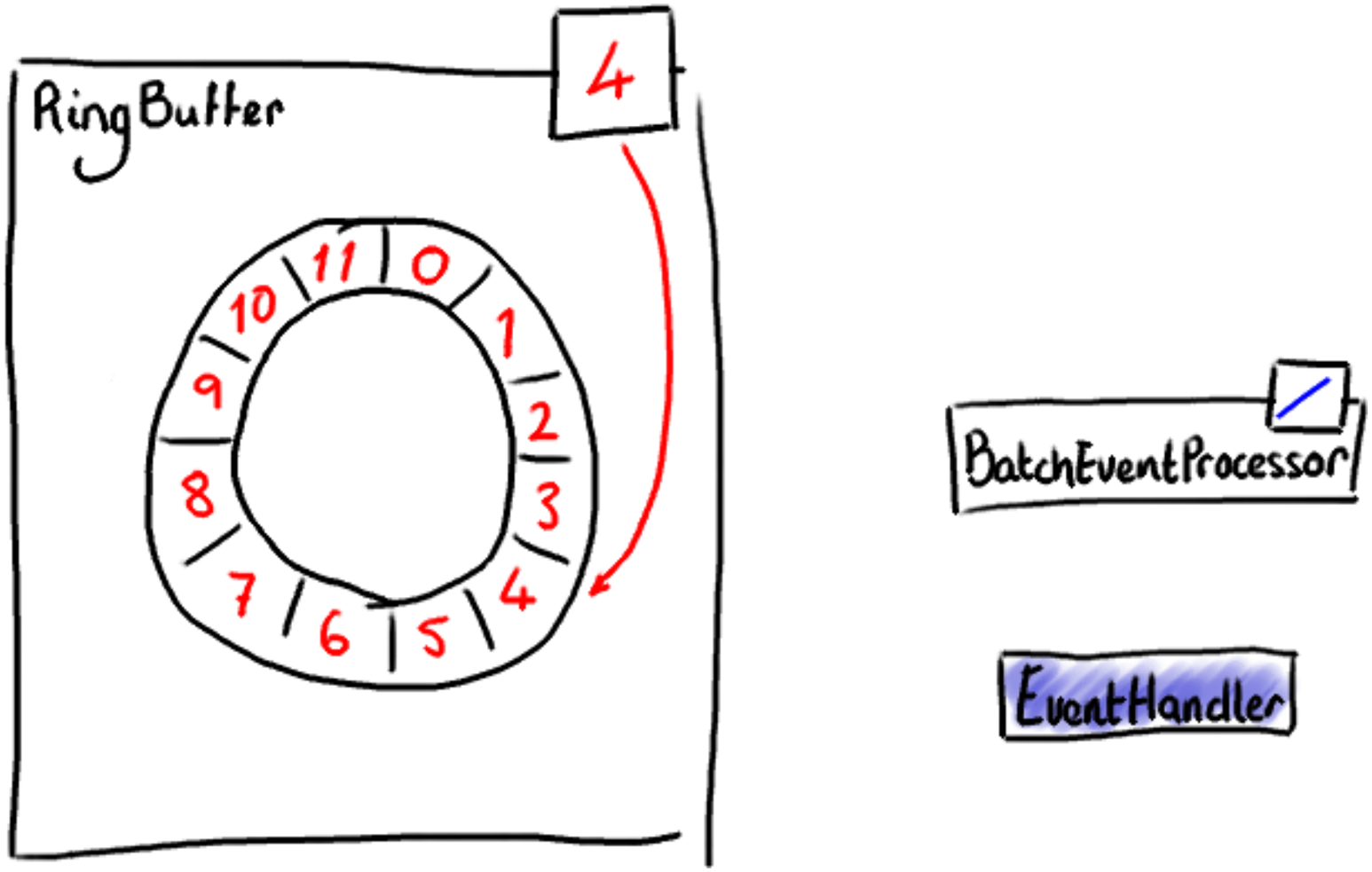
10
BatchEventProcessor
EventHandler


RingButter
4
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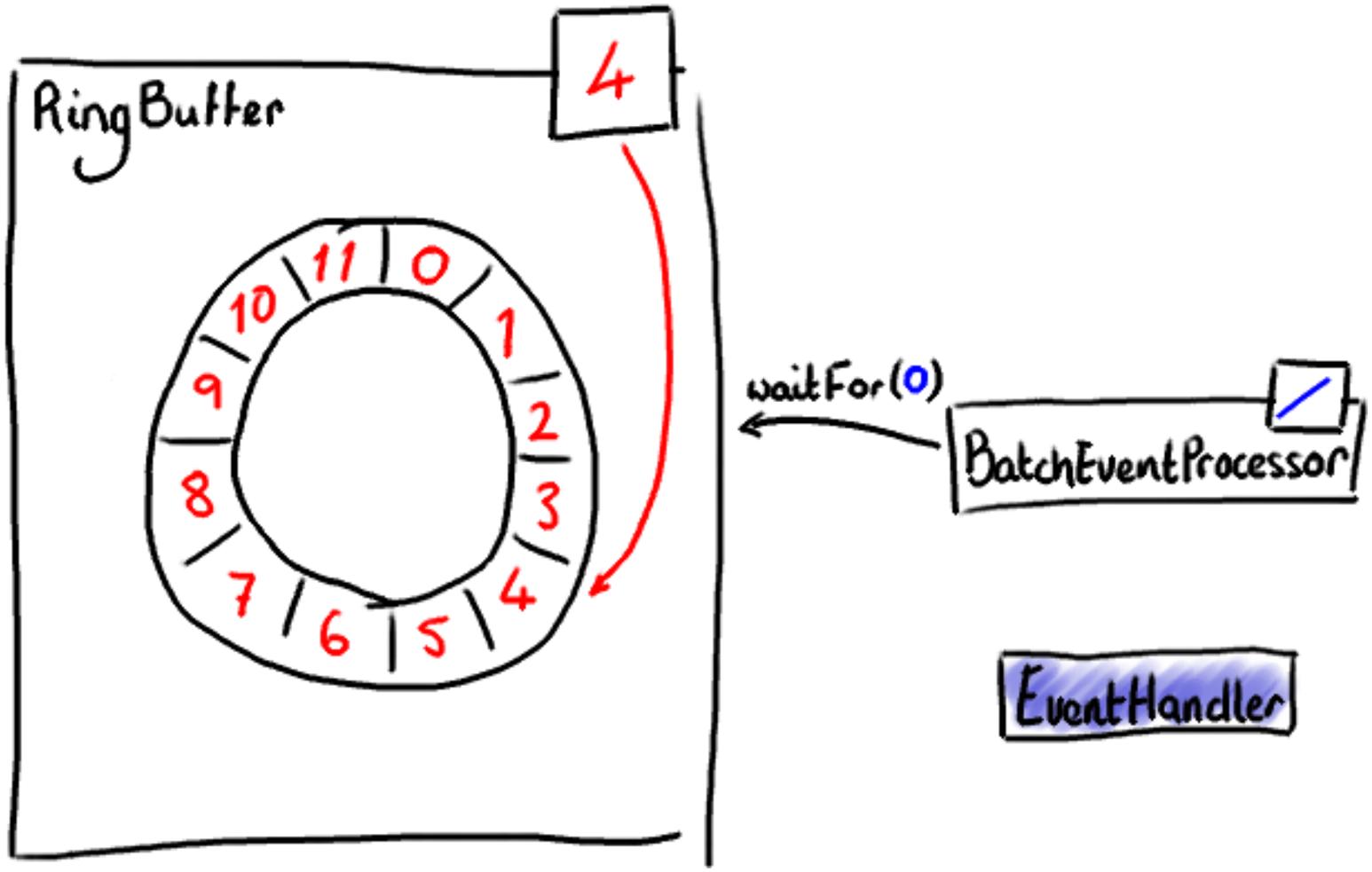
BatchEventProcessor
EventHandler


RingButter
4
11
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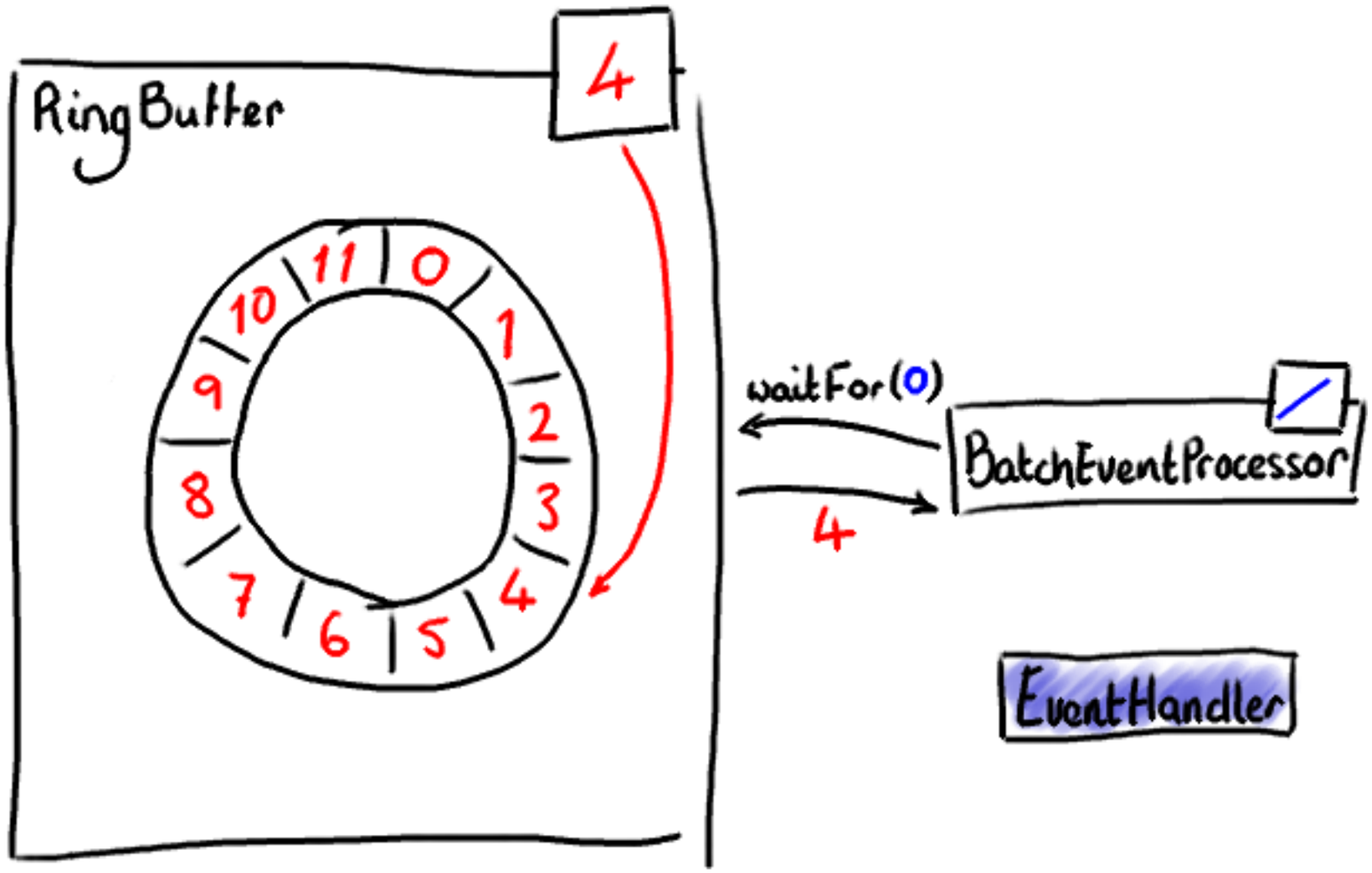
9
10
waitFor(0)
BatchEventProcessor
EventHandler


RingBuffer
4
11
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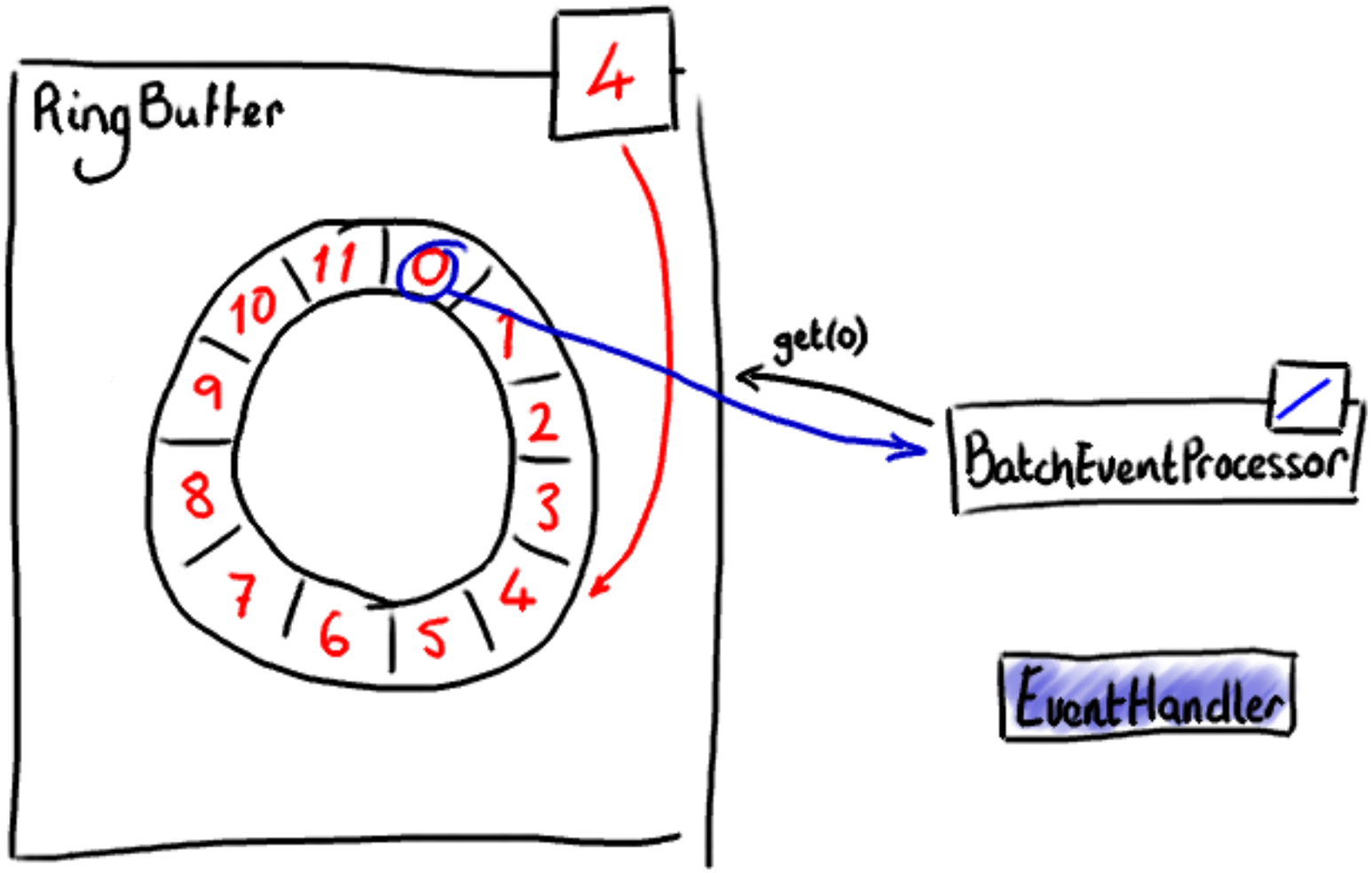
9
10
waitFor(0)
4
BatchEventProcessor
EventHandler


RingButter
4
11
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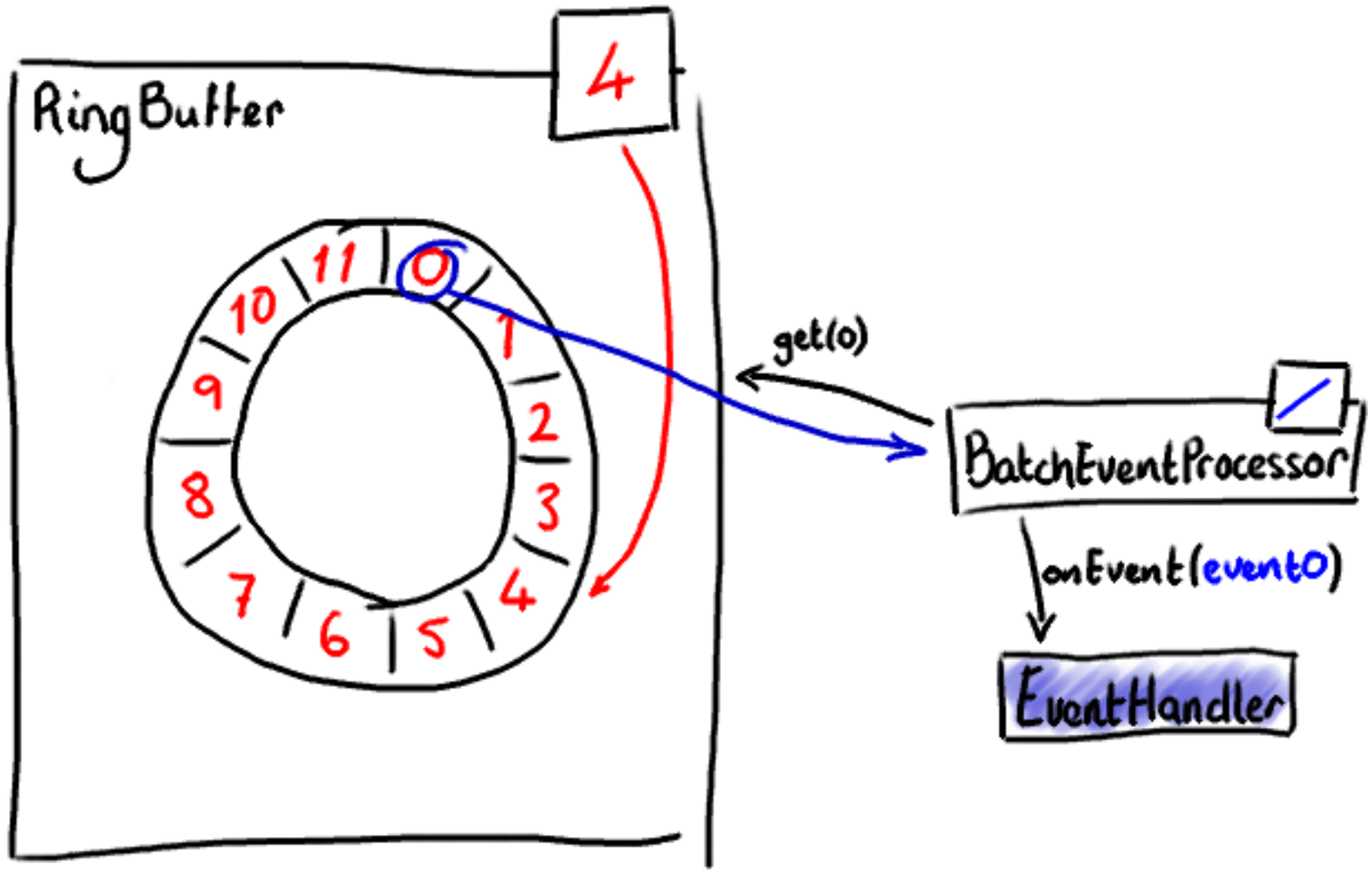
9
10
get(0)
BatchEventProcessor
EventHandler


RingBuffer
4
11
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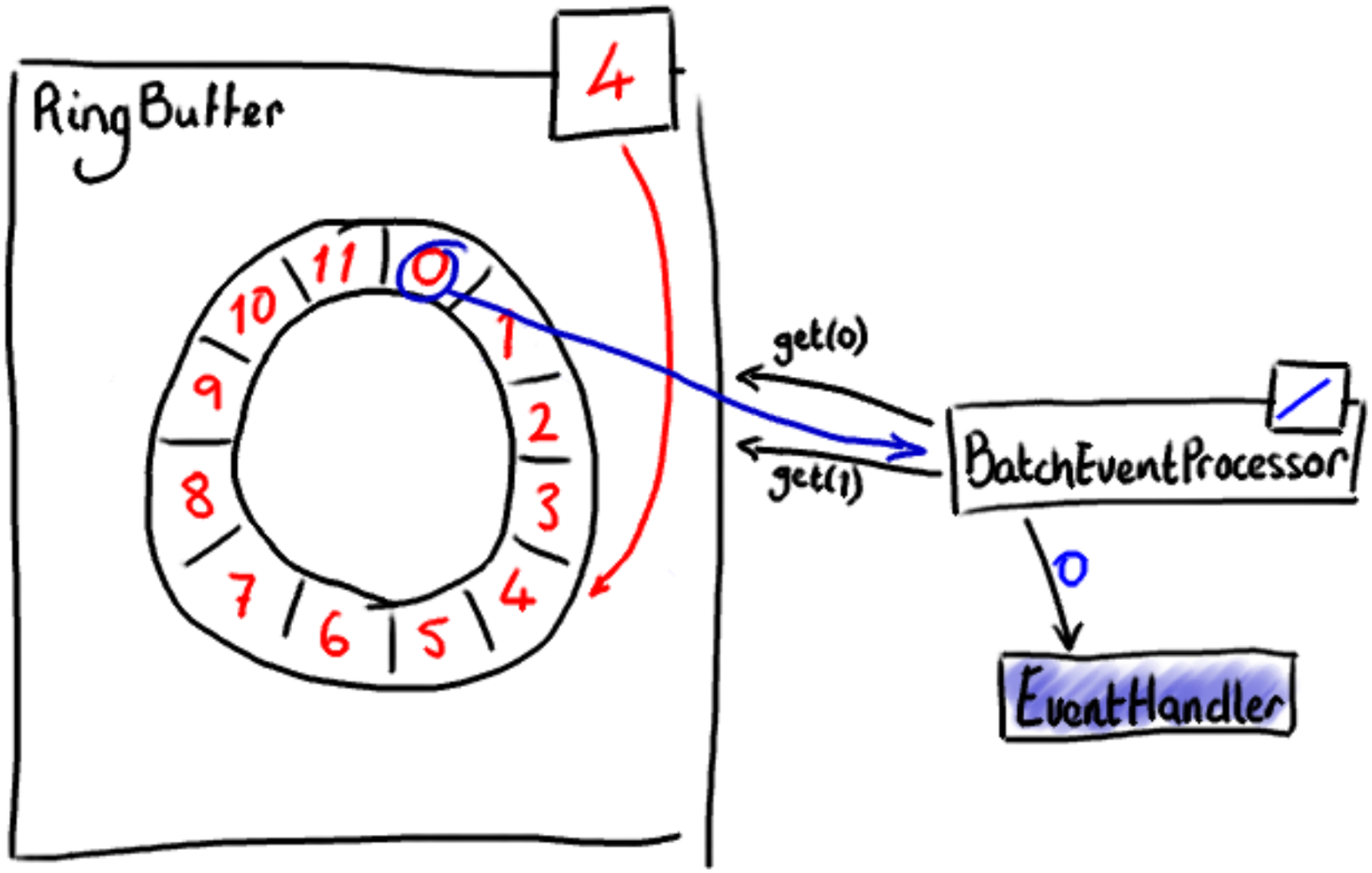
6
7
8
9
10
get(0)
BatchEventProcessor
onEvent(event0)
EventHandler


RingBuffer
4
11
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3
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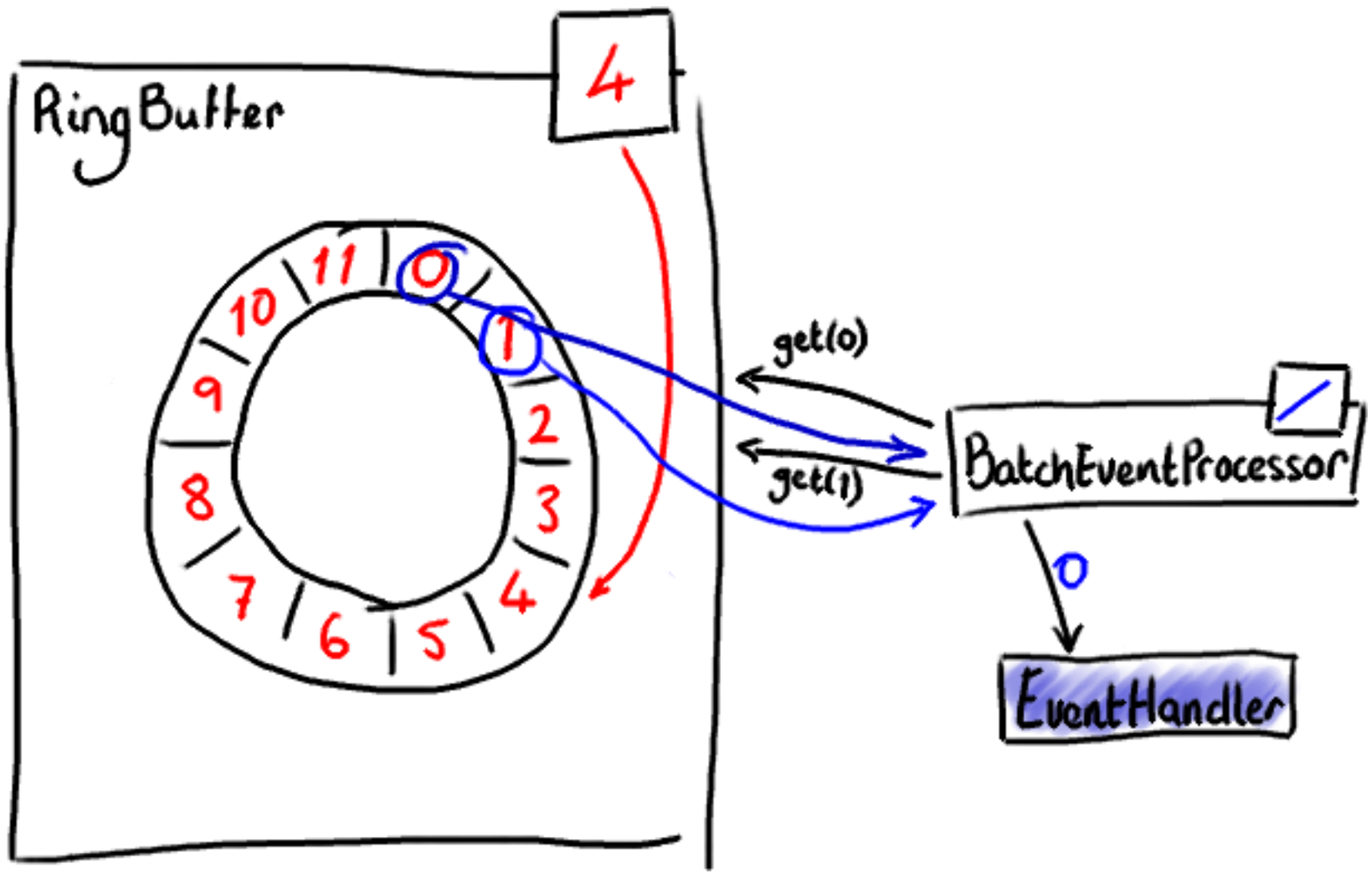
7
8
9
10
get(0)
get(1)
BatchEventProcessor
0
EventHandler


RingBuffer
4
11
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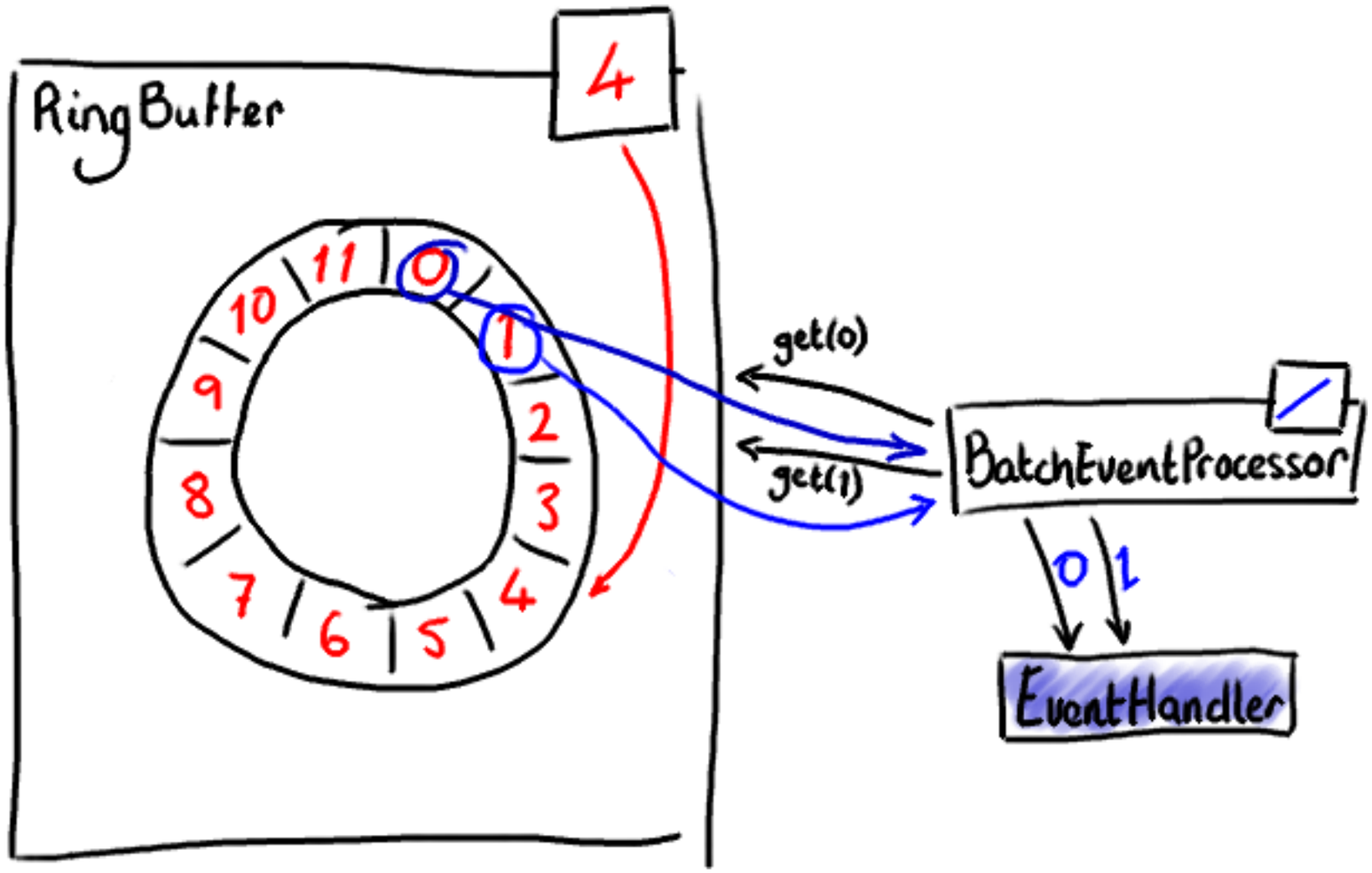
10
get(0)
get(1)
BatchEventProcessor
0
EventHandler


RingButter
4
11
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7
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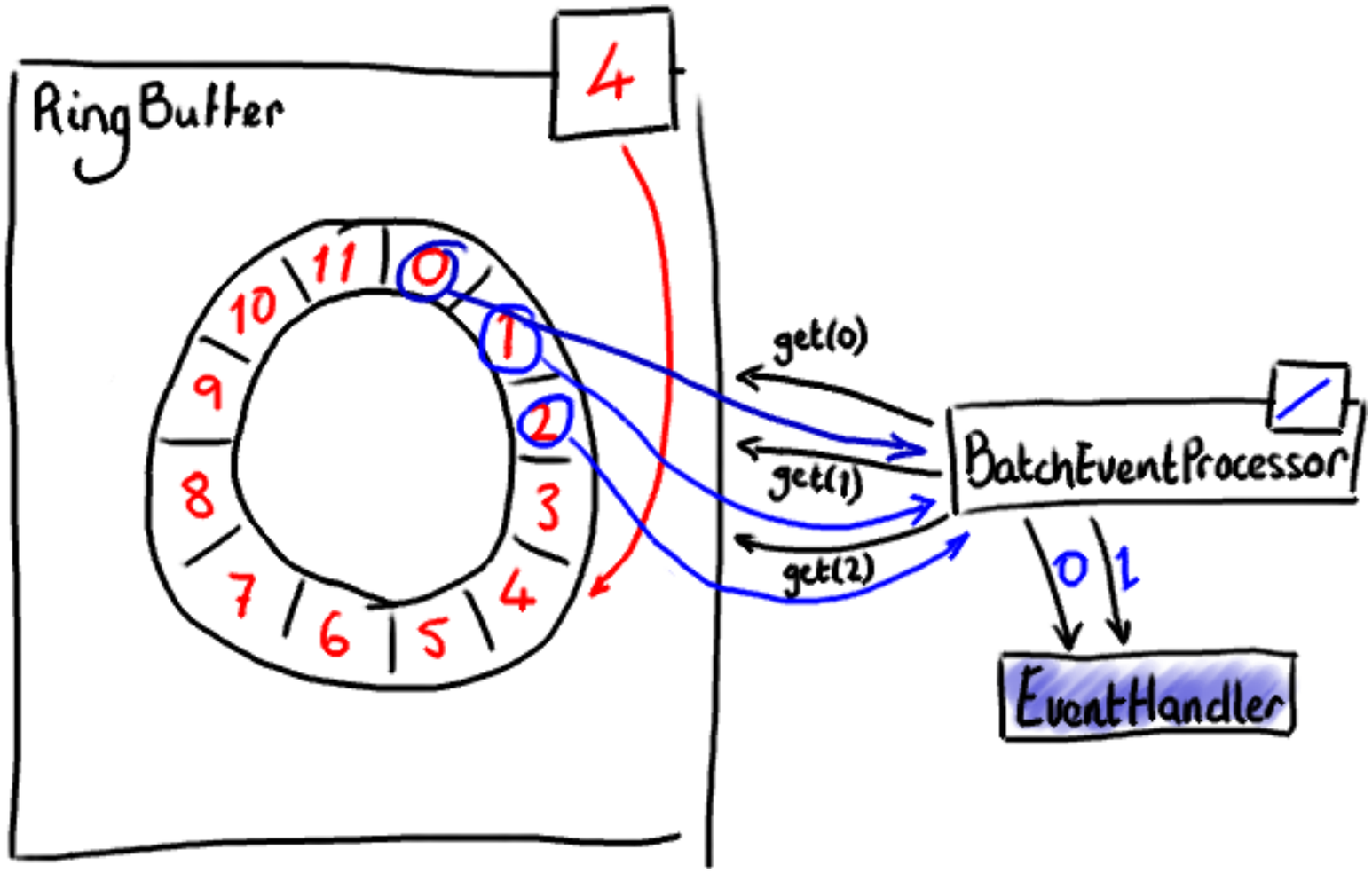
5
4
get(0)
get(1)
BatchEventProcessor
0
1
EventHandler


RingBuffer
4
11
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3
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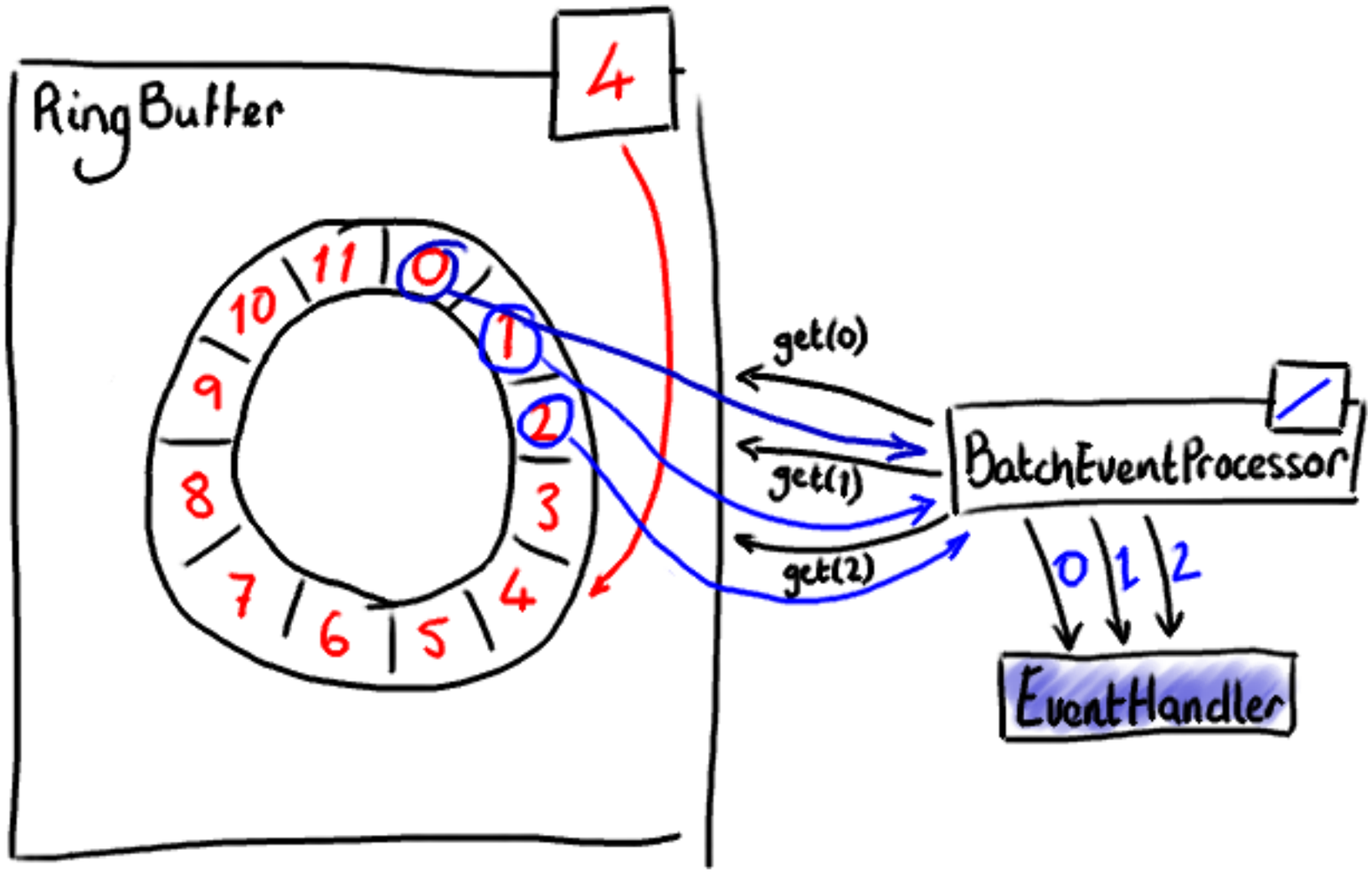
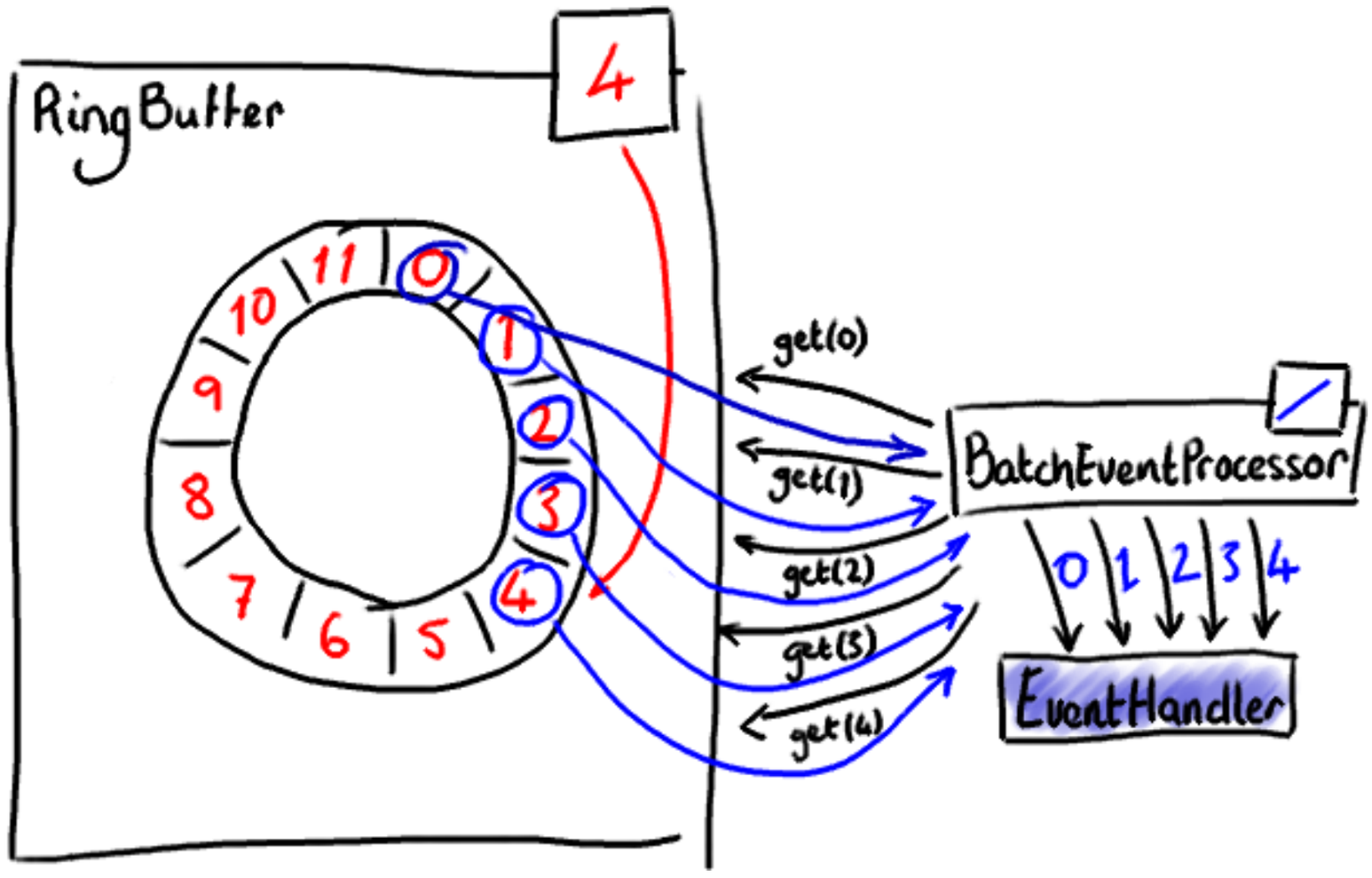
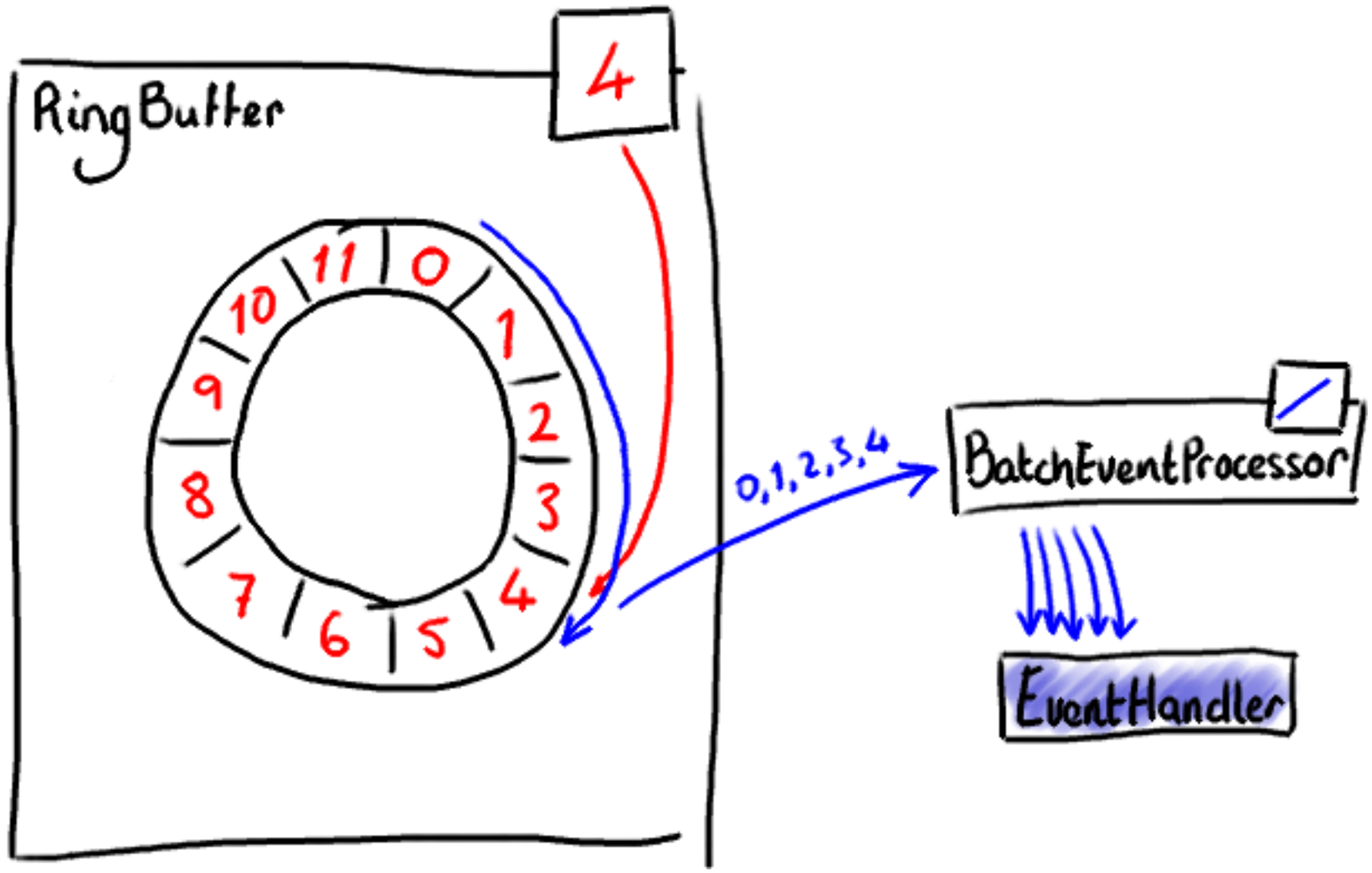
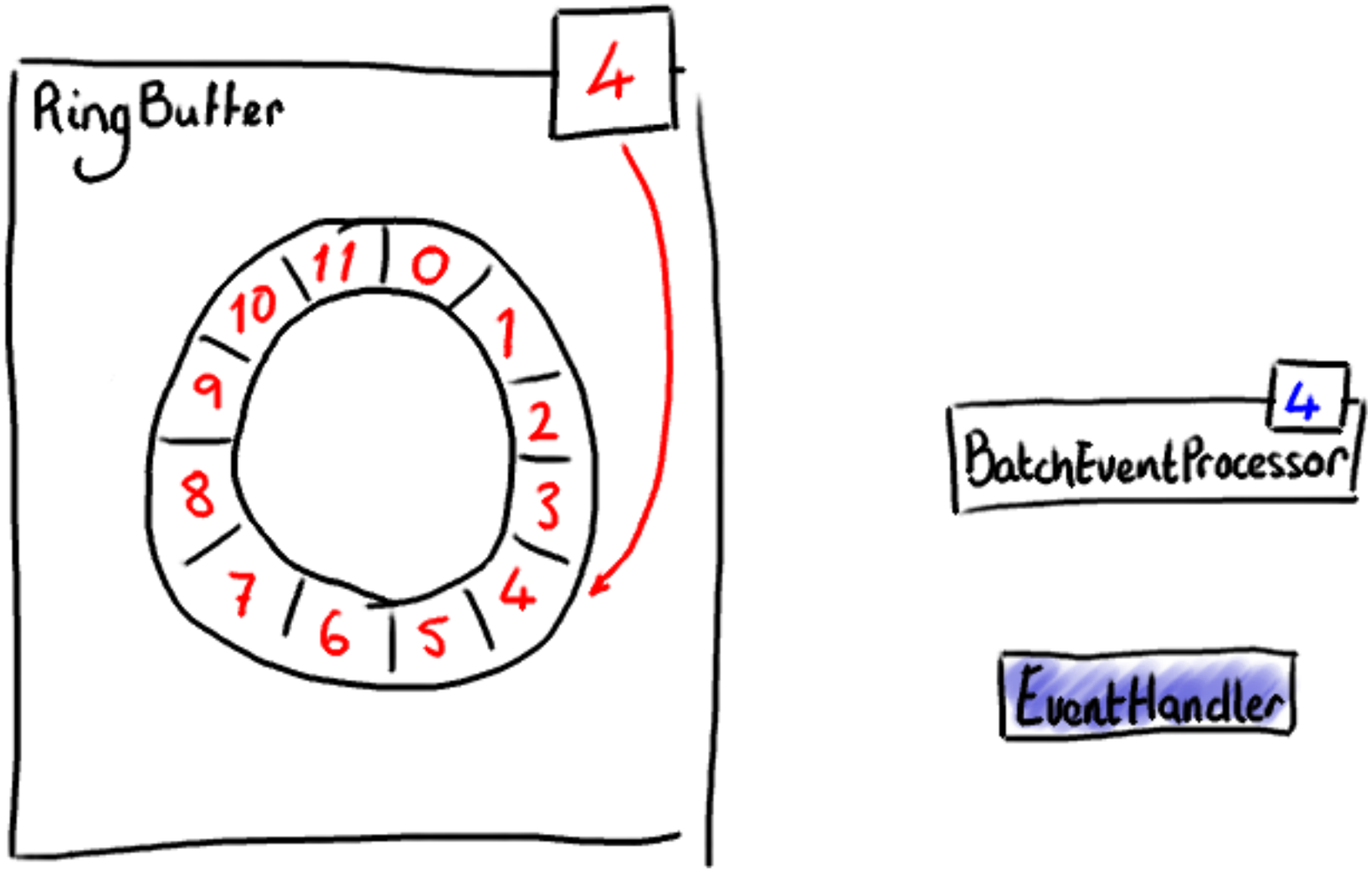
7
8
9
10
get(0)
get(1)
get(2)
BatchEventProcessor
0
1
EventHandler


RingBuffer
4
11
0
1
2
3
4
5
6
7
8
9
10
get(0)
get(1)
get(2)
BatchEventProcessor
0
1
2
EventHandler


RingButter
4
11
0
10
1
9
2
8
3
7
6
5
4
get(0)
get(1)
get(2)
get(3)
get(4)
BatchEventProcessor
0
1
2
3
4
EventHandler


RingButter
4
11
0
1
2
3
4
5
6
7
8
9
10
0,1,2,3,4
BatchEventProcessor
EventHandler


RingButter
4
11
0
1
2
3
4
5
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7
8
9
10
4
BatchEventProcessor
EventHandler

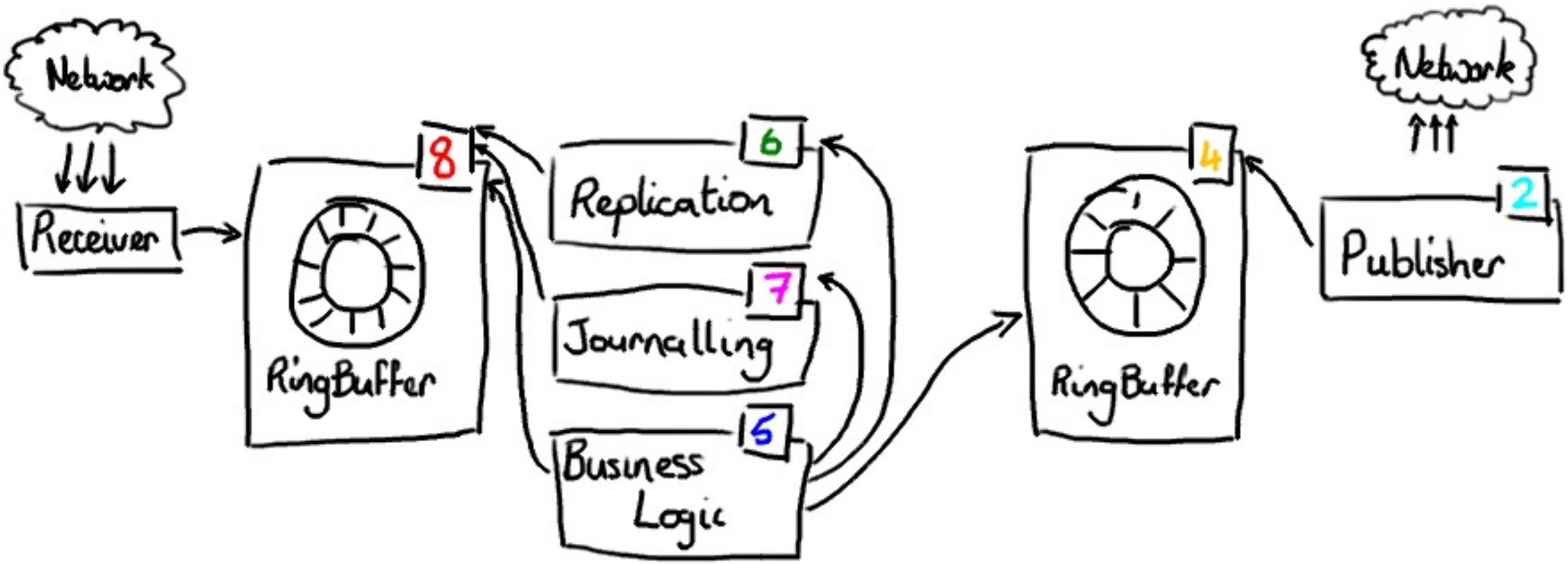
...and all you need is...

```
public class SimpleEventHandler implements EventHandler<SimpleEvent>
{

    @Override
    public void onEvent(final SimpleEvent event,
                        final long sequence,
                        final boolean endOfBatch) throws Exception {
        // do stuff
    }
}
```

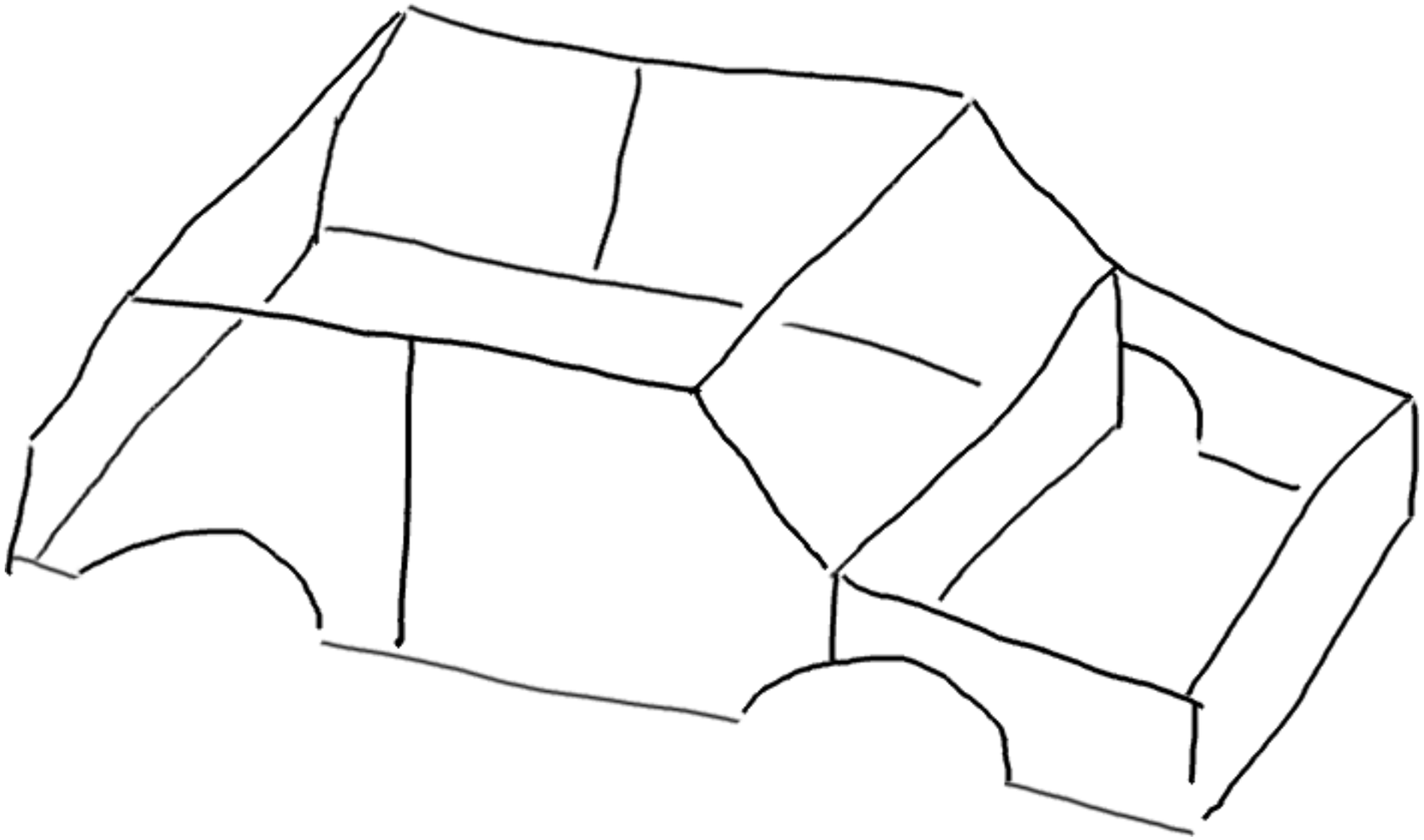
Shiny. So what?

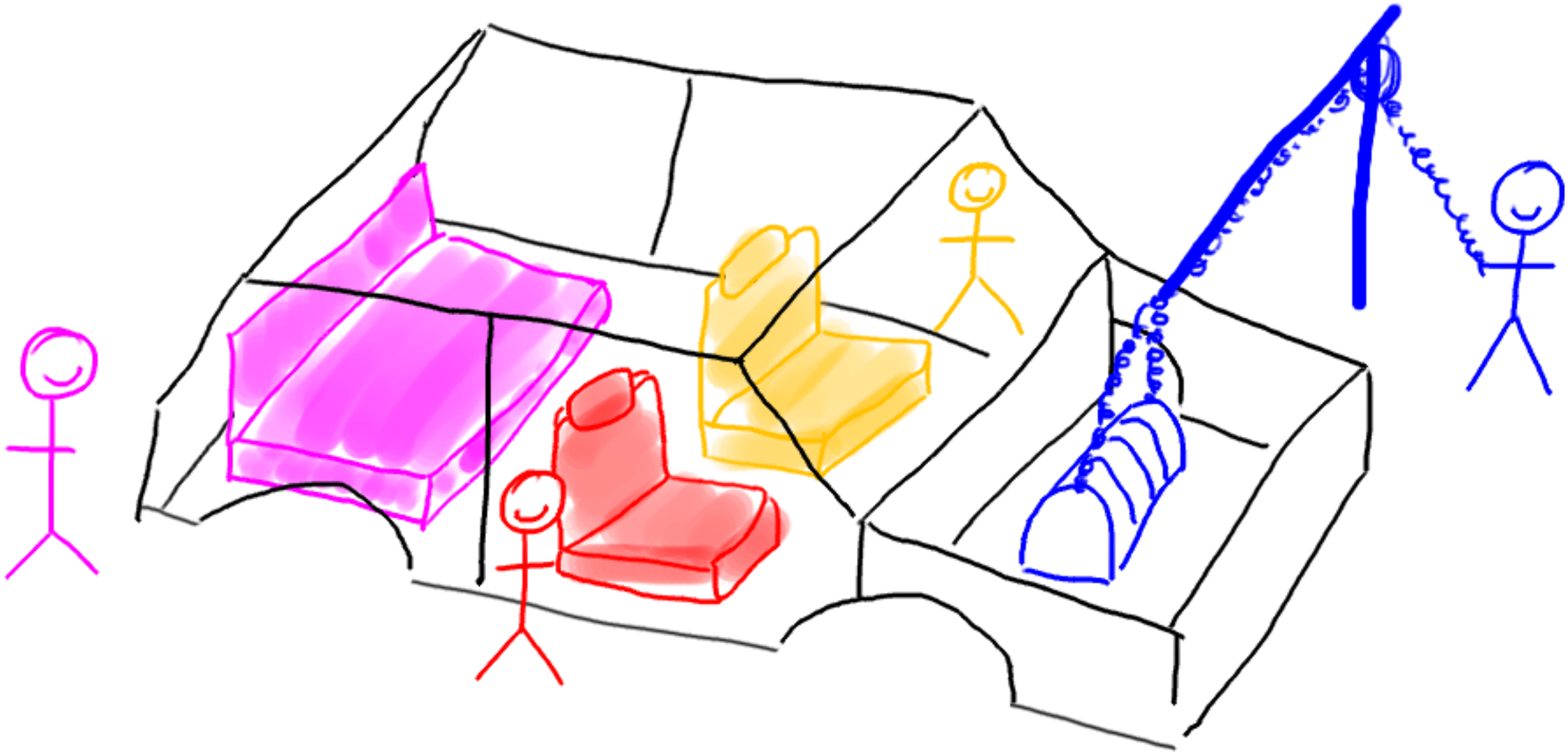
Let's go parallel



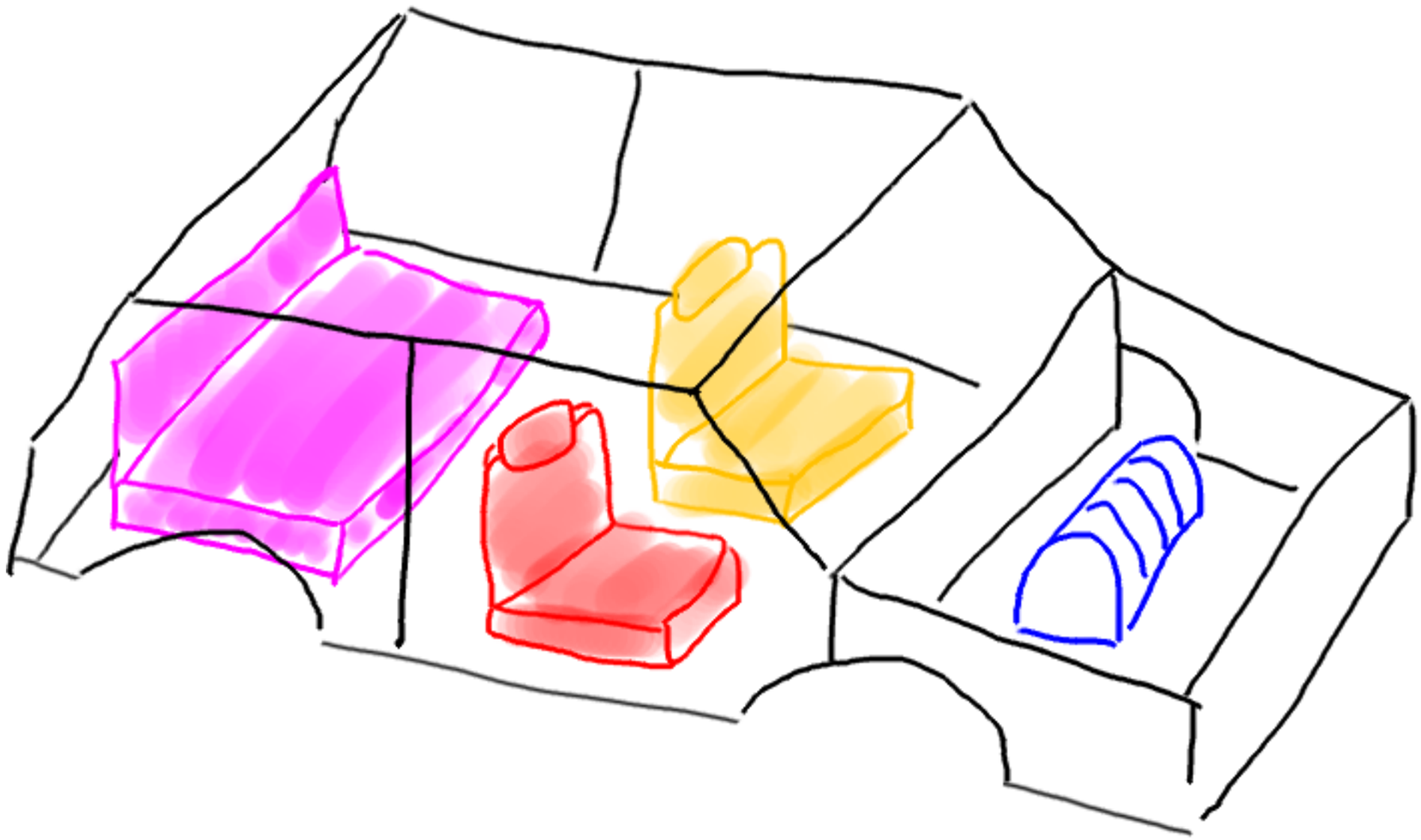
And now for something different...

Remember Henry Ford?

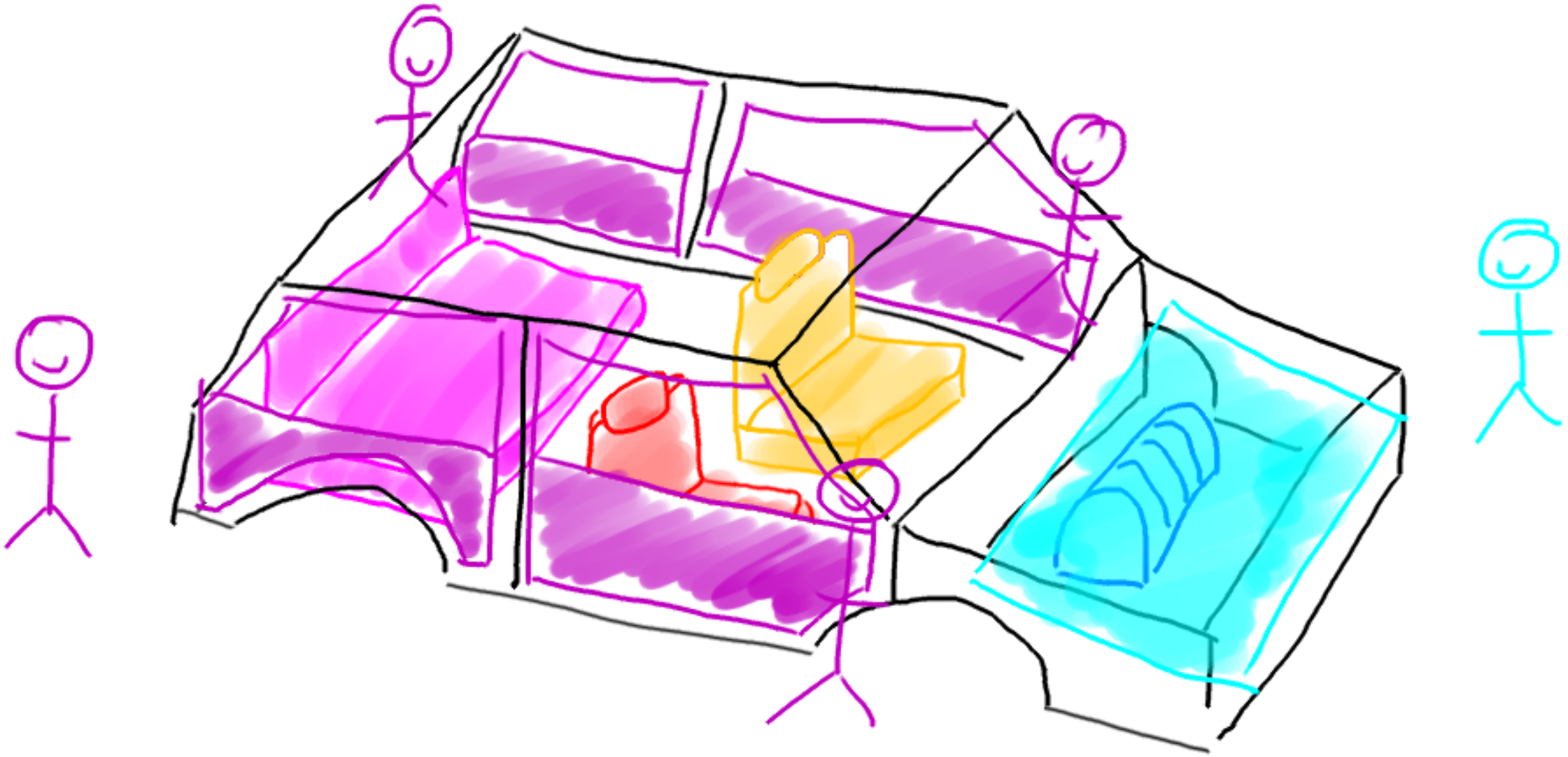




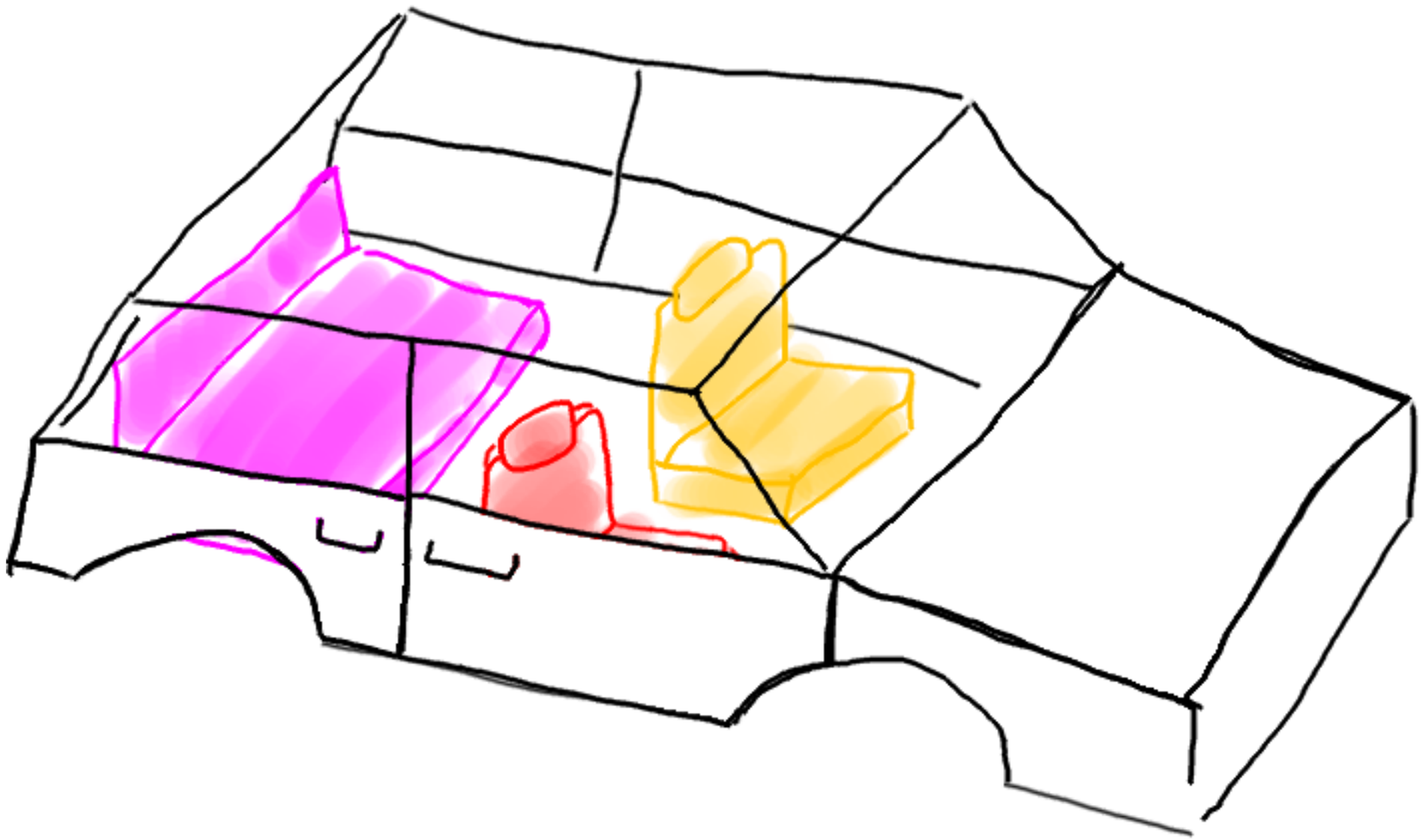
*Not to Scale



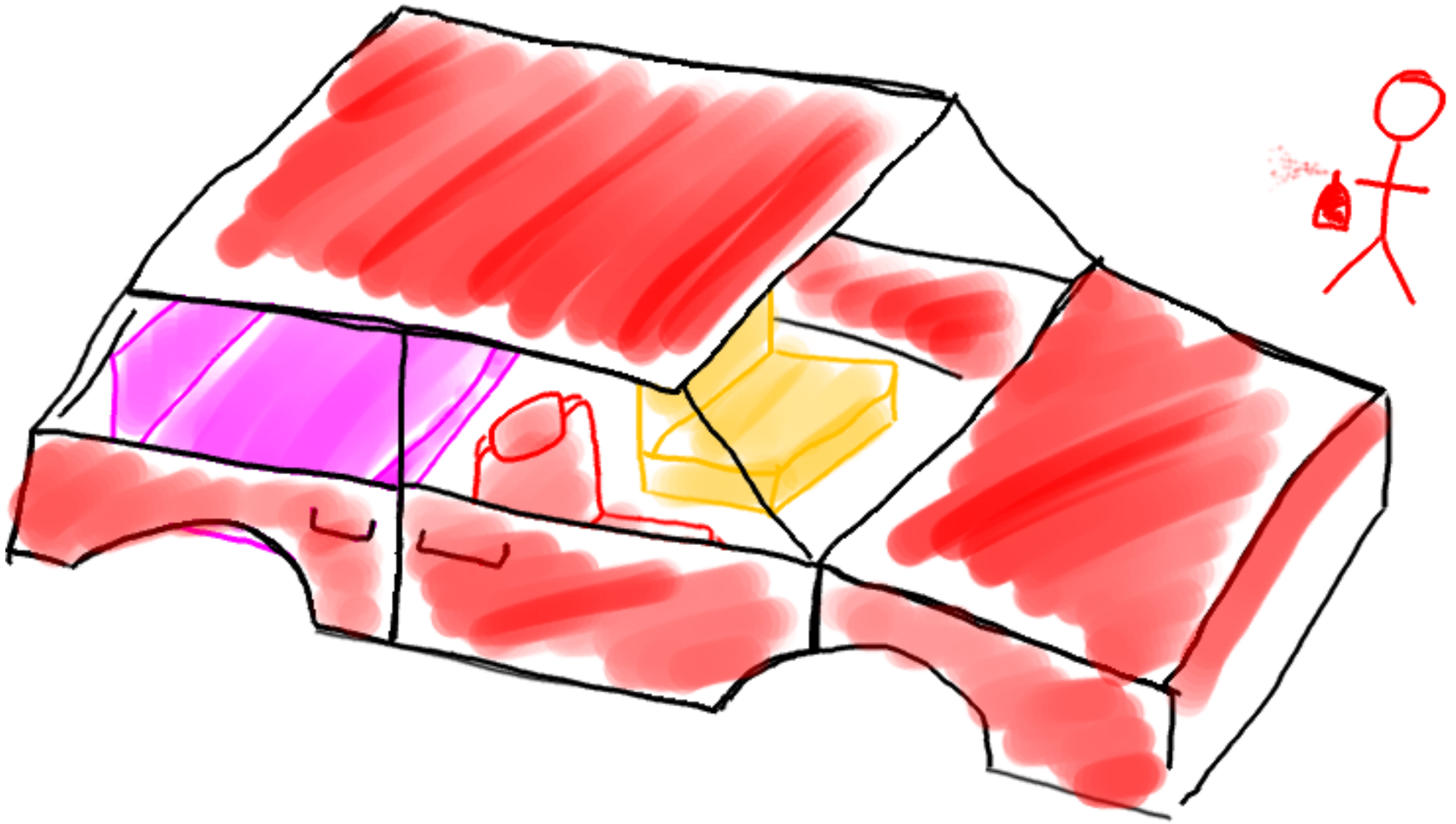
*Not to Scale



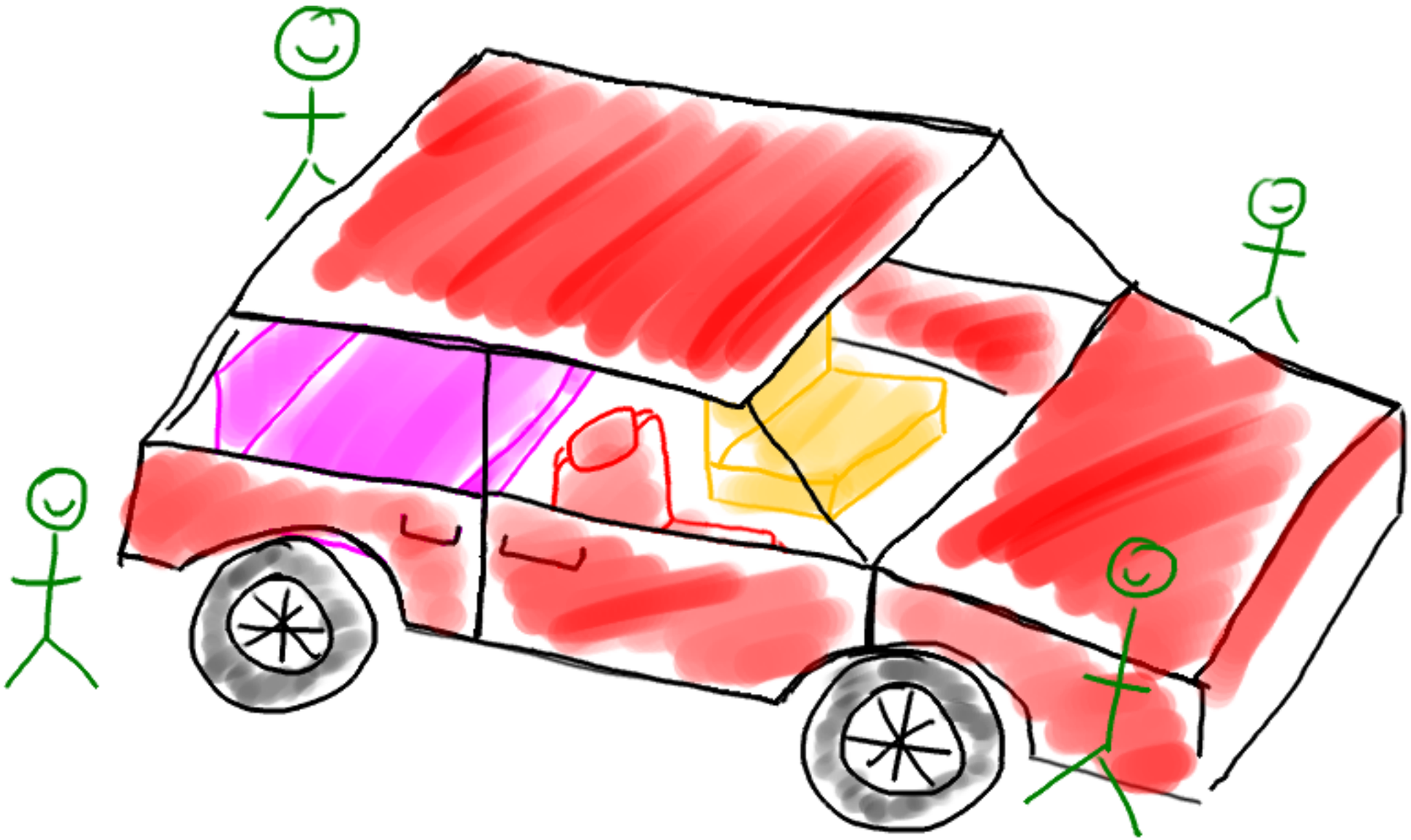
*Not to Scale



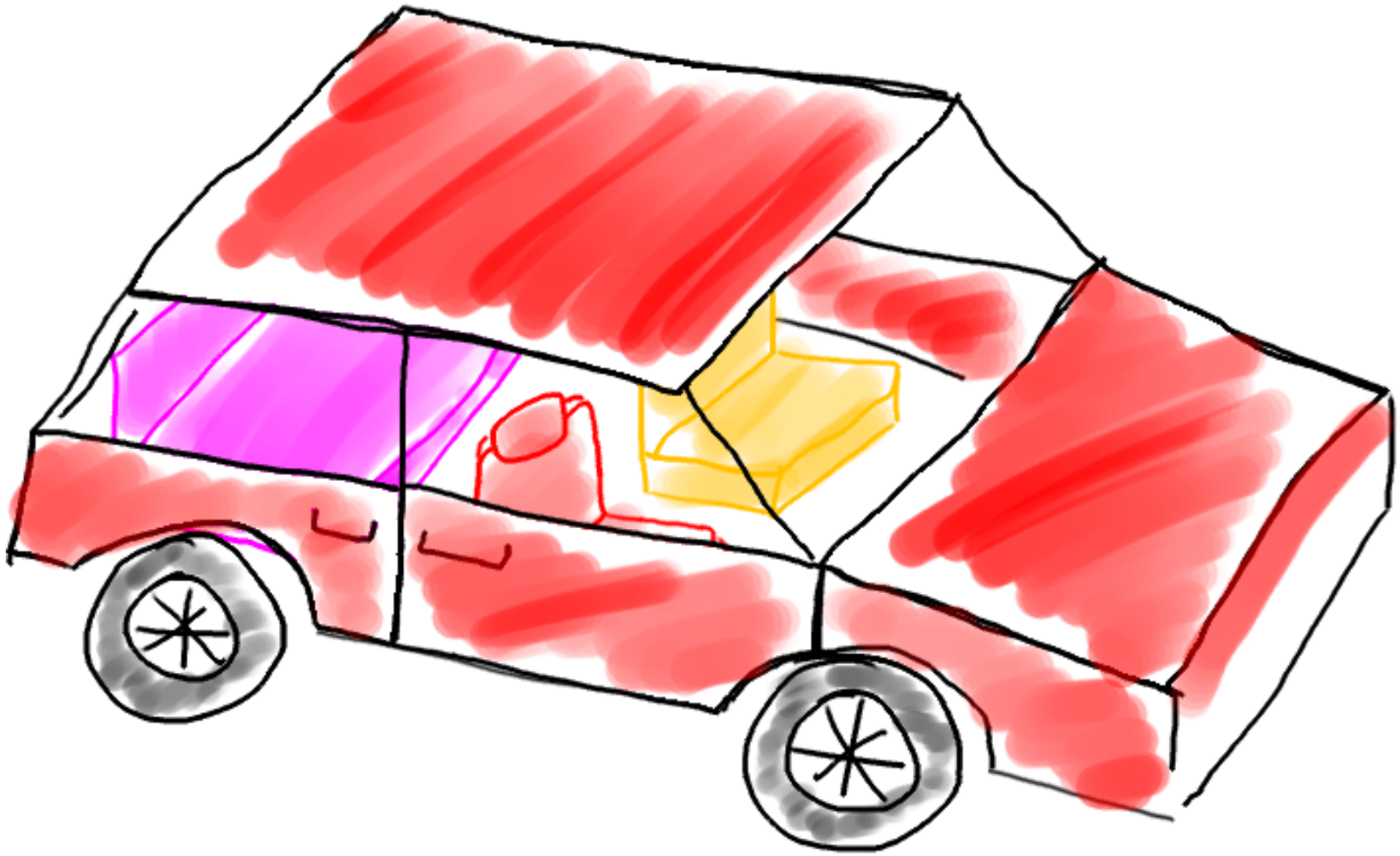
*Not to Scale



*Not to Scale

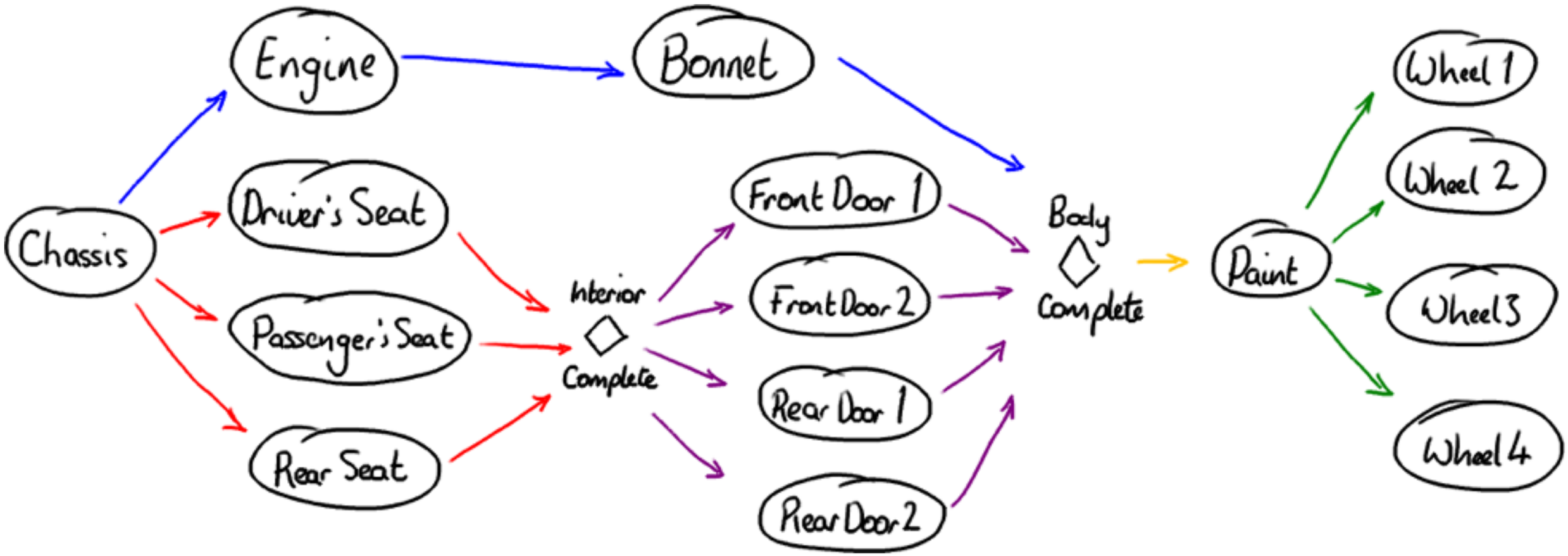


*Not to Scale

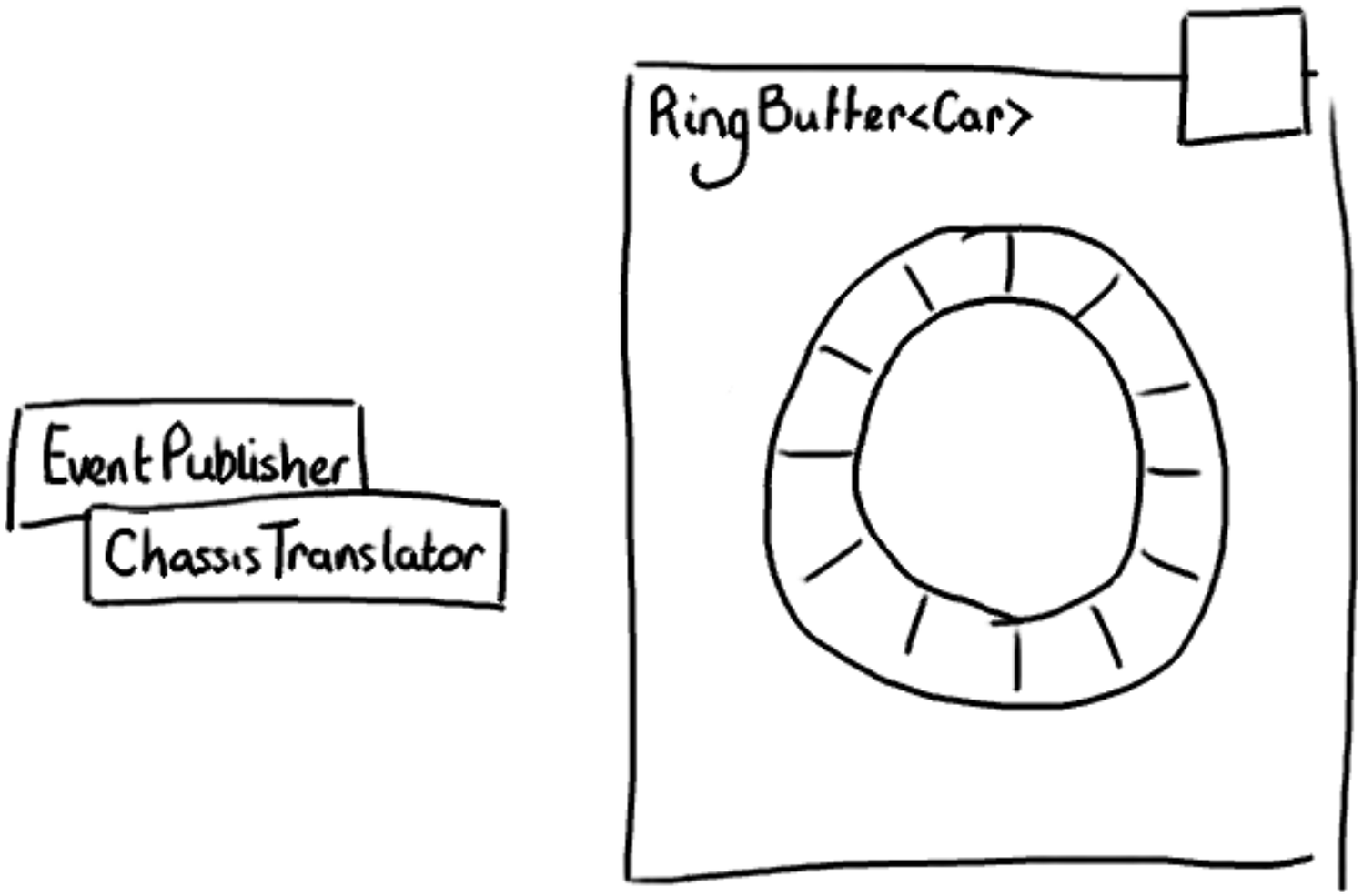


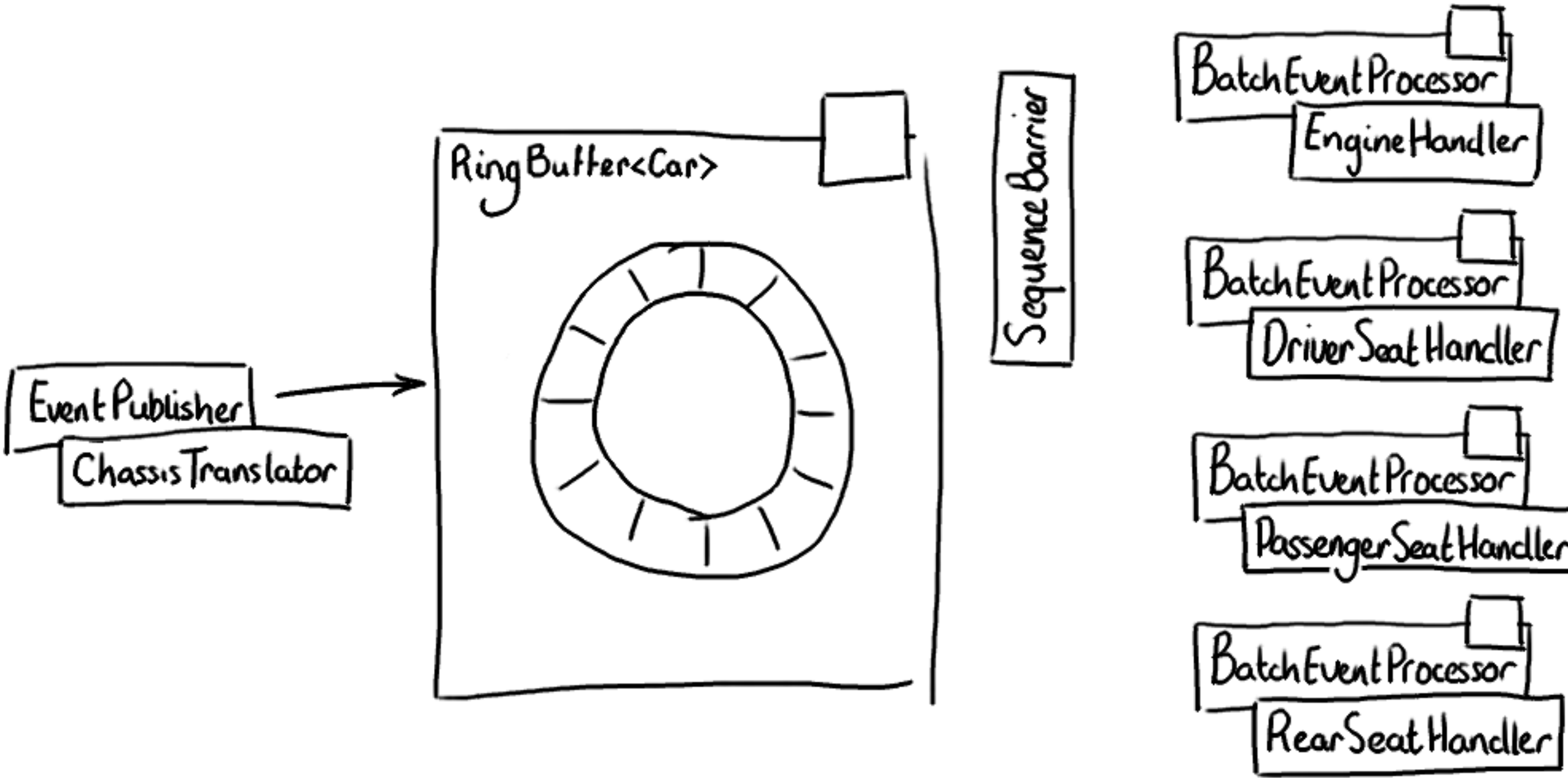
*Not to Scale

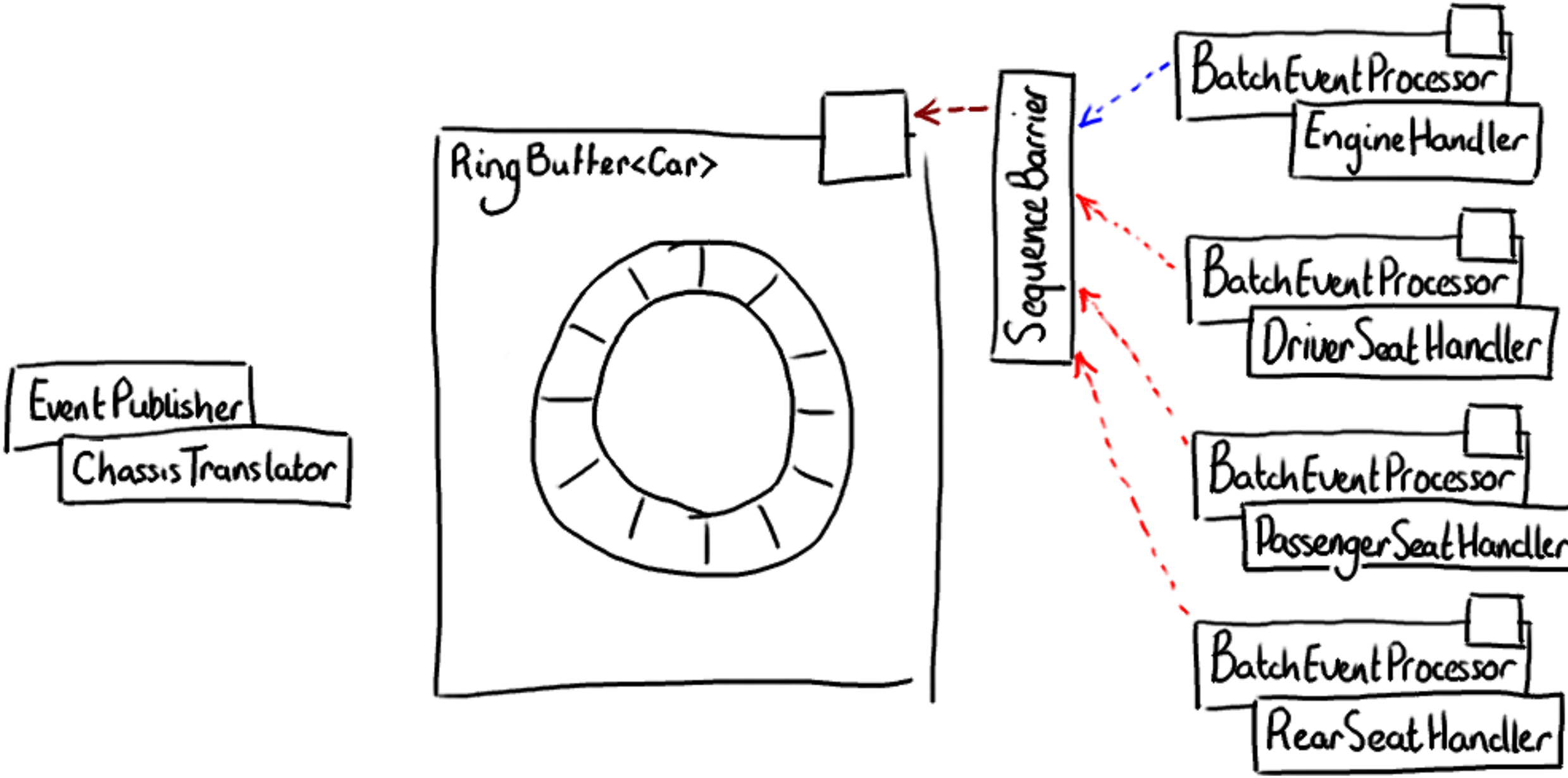
Complex workflow...

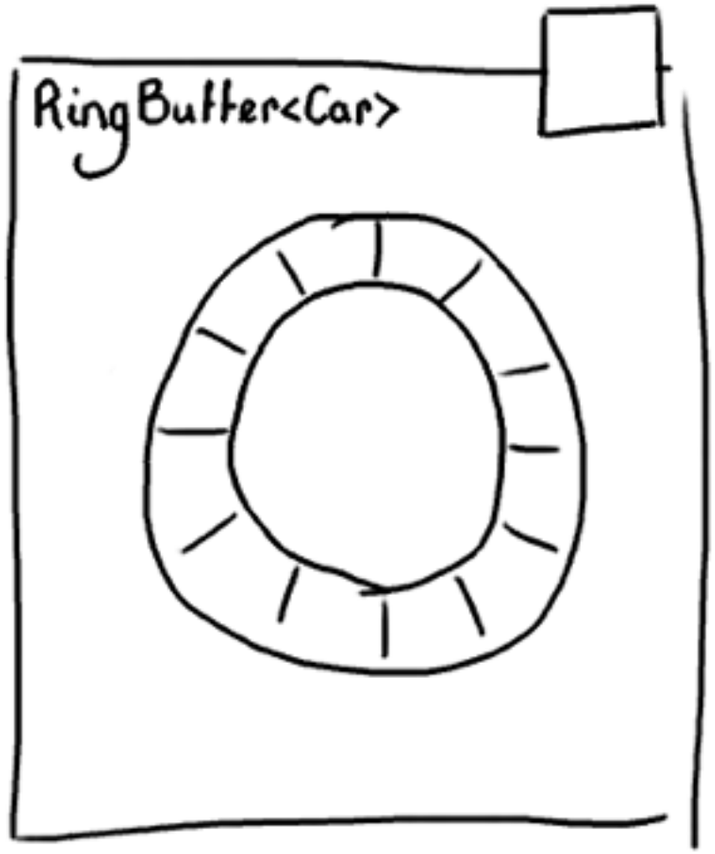


What on Earth has this got to do with RingBuffers?!


RingButter<Car>
EventPublisher
ChassisTranslator


RingButter<Car>
SequenceBarrier
EventPublisher
ChassisTranslator
BatchEventProcessor
EngineHandler
BatchEventProcessor
DriverSeatHandler
BatchEventProcessor
PassengerSeatHandler
BatchEventProcessor
RearSeatHandler


RingButter<Car>
SequenceBarrier
BatchEventProcessor
EngineHandler
BatchEventProcessor
DriverSeatHandler
BatchEventProcessor
PassengerSeatHandler
BatchEventProcessor
RearSeatHandler
EventPublisher
ChassisTranslator



Sequence Barrier

BatchEventProcessor
EngineHandler

BatchEventProcessor
DriverSeatHandler

BatchEventProcessor
PassengerSeatHandler

BatchEventProcessor
RearSeatHandler

Sequence Barrier

Sequence Barrier

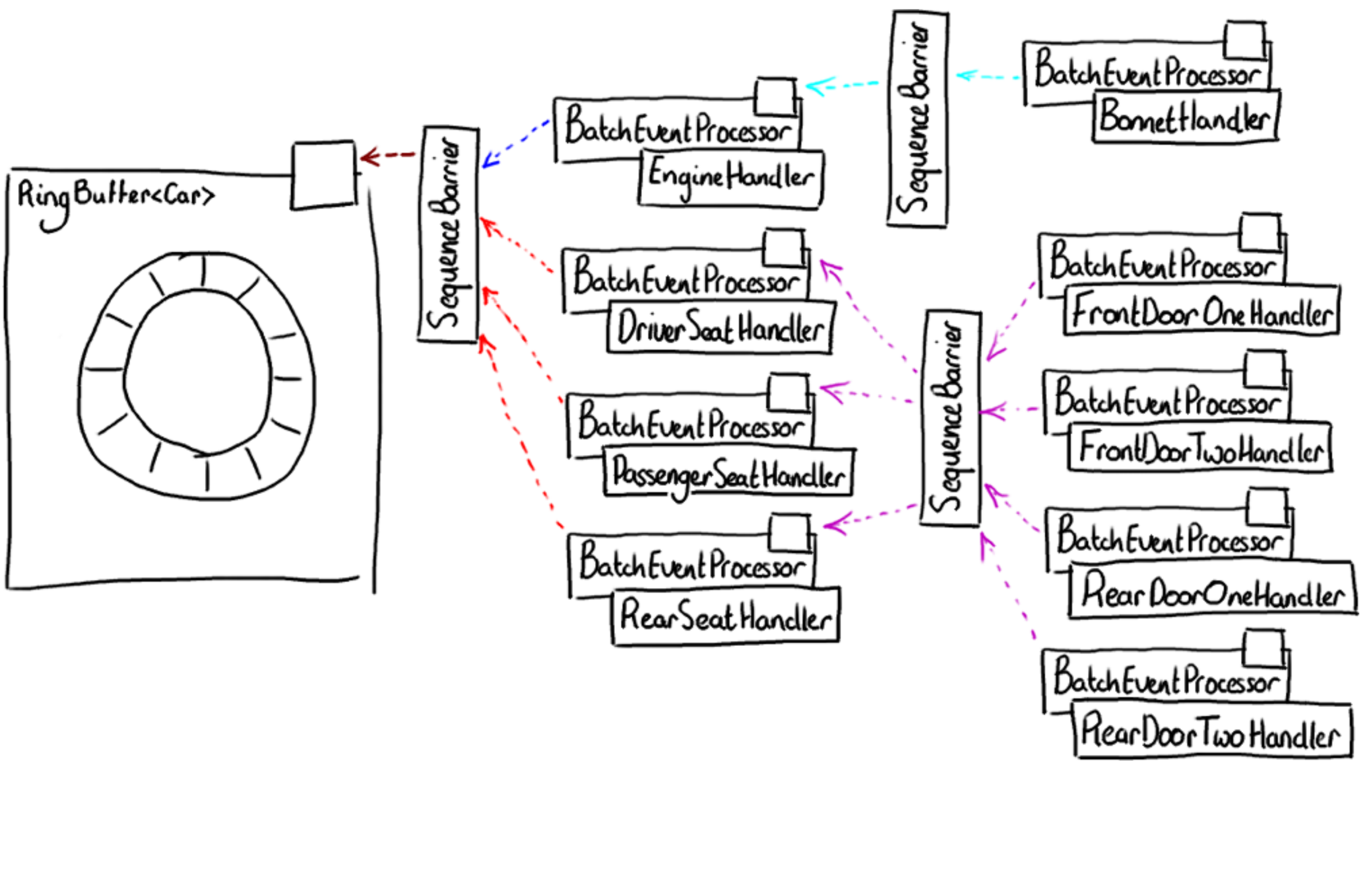
BatchEventProcessor
BonnetHandler

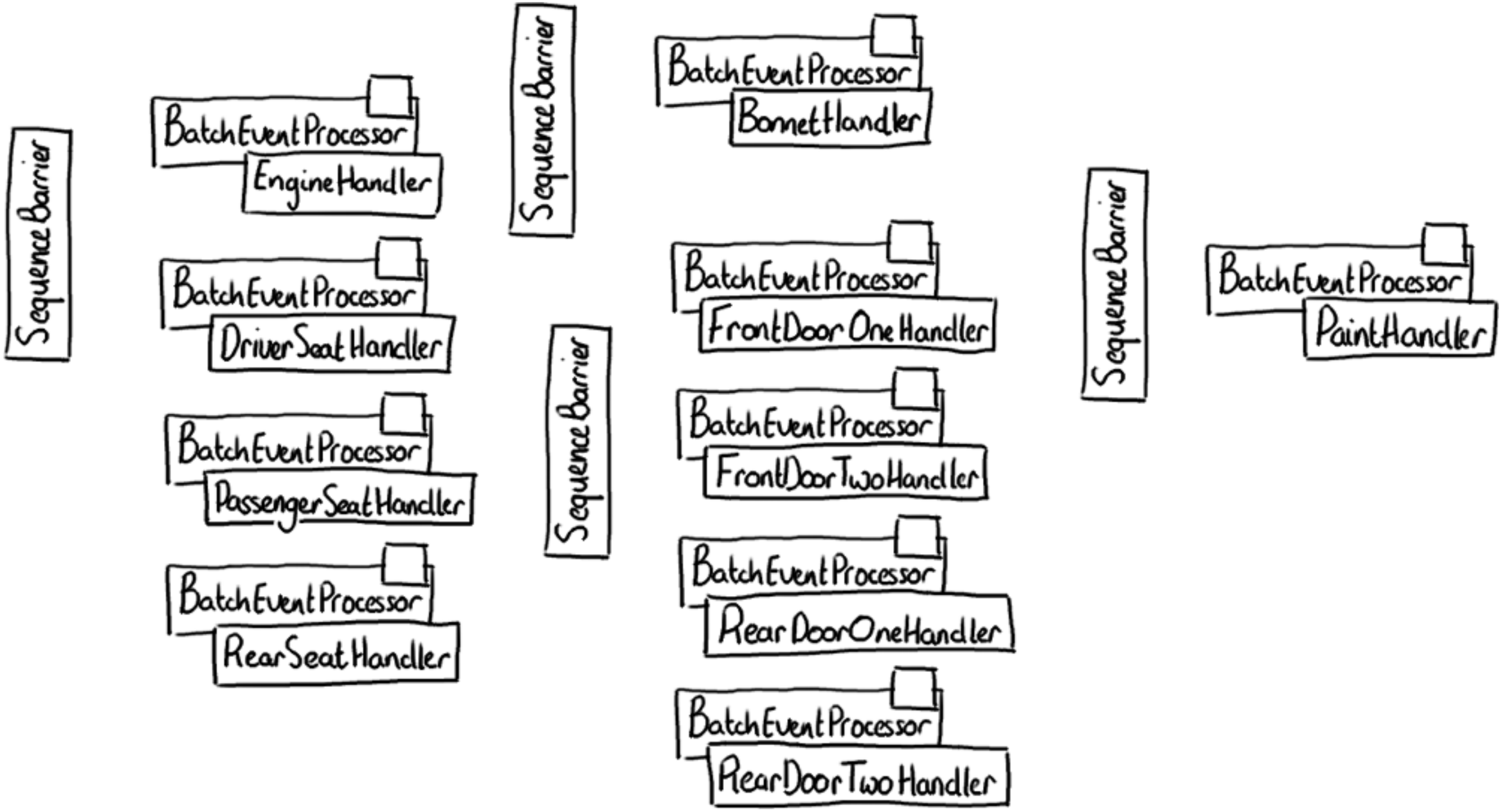
BatchEventProcessor
FrontDoorOneHandler

BatchEventProcessor
FrontDoorTwoHandler

BatchEventProcessor
RearDoorOneHandler

BatchEventProcessor
RearDoorTwoHandler


RingButter<Car>
SequenceBarrier
BatchEventProcessor
EngineHandler
SequenceBarrier
BatchEventProcessor
BonnetHandler
BatchEventProcessor
DriverSeatHandler
BatchEventProcessor
PassengerSeatHandler
BatchEventProcessor
RearSeatHandler
SequenceBarrier
BatchEventProcessor
FrontDoorOneHandler
BatchEventProcessor
FrontDoorTwoHandler
BatchEventProcessor
RearDoorOneHandler
BatchEventProcessor
RearDoorTwoHandler


Sequence Barrier
BatchEventProcessor
EngineHandler
BatchEventProcessor
DriverSeatHandler
BatchEventProcessor
PassengerSeatHandler
BatchEventProcessor
RearSeatHandler
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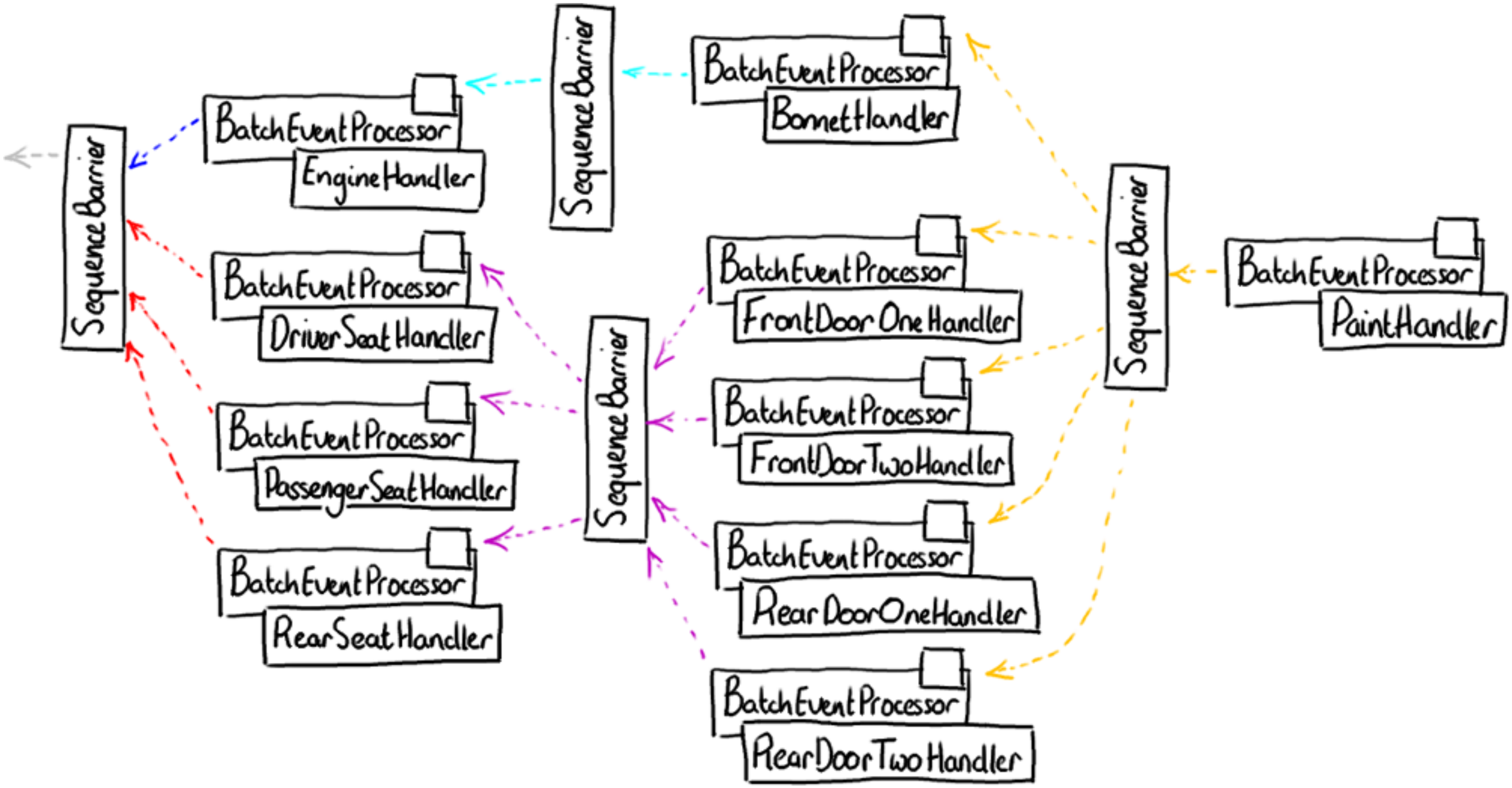
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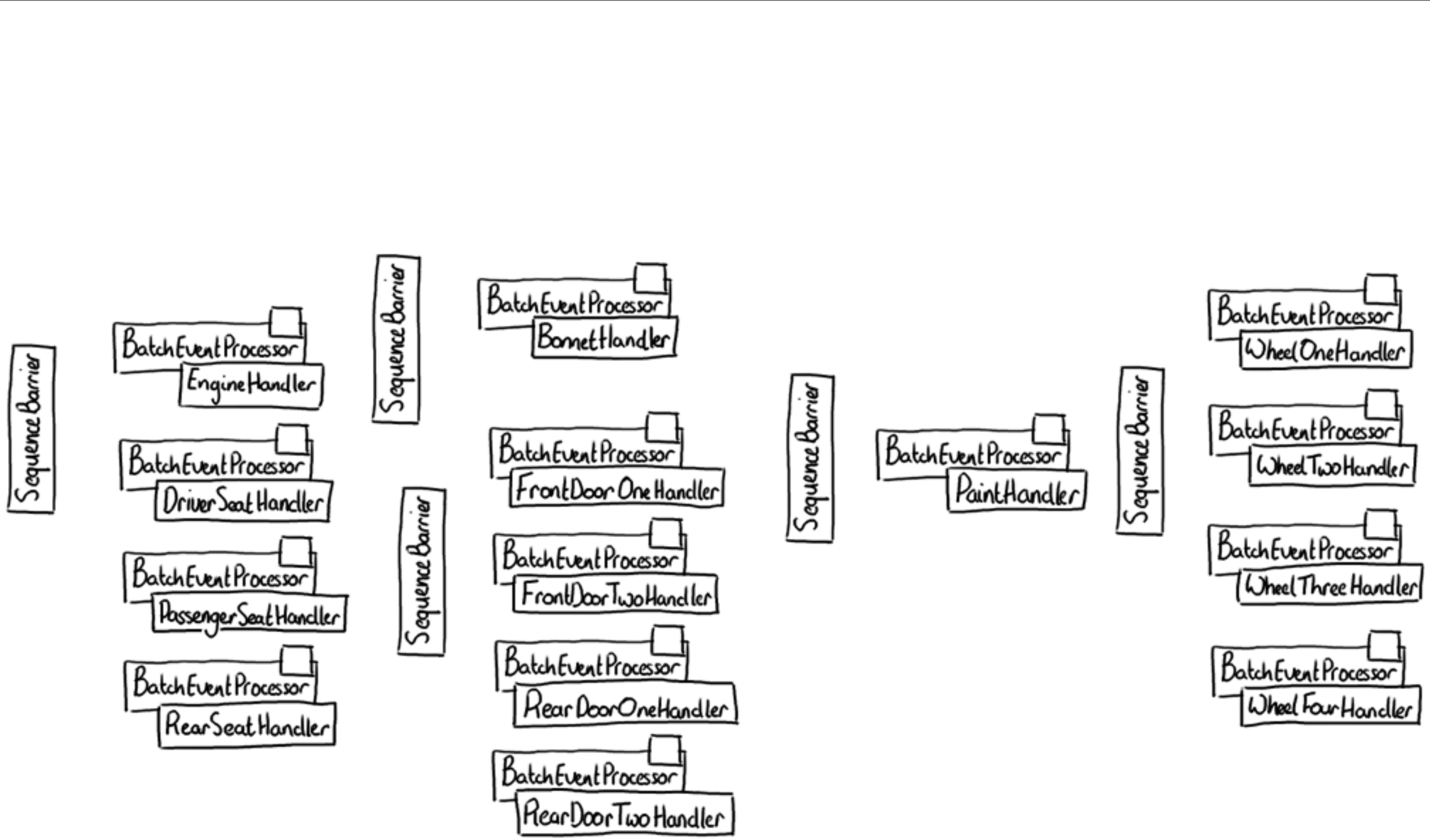
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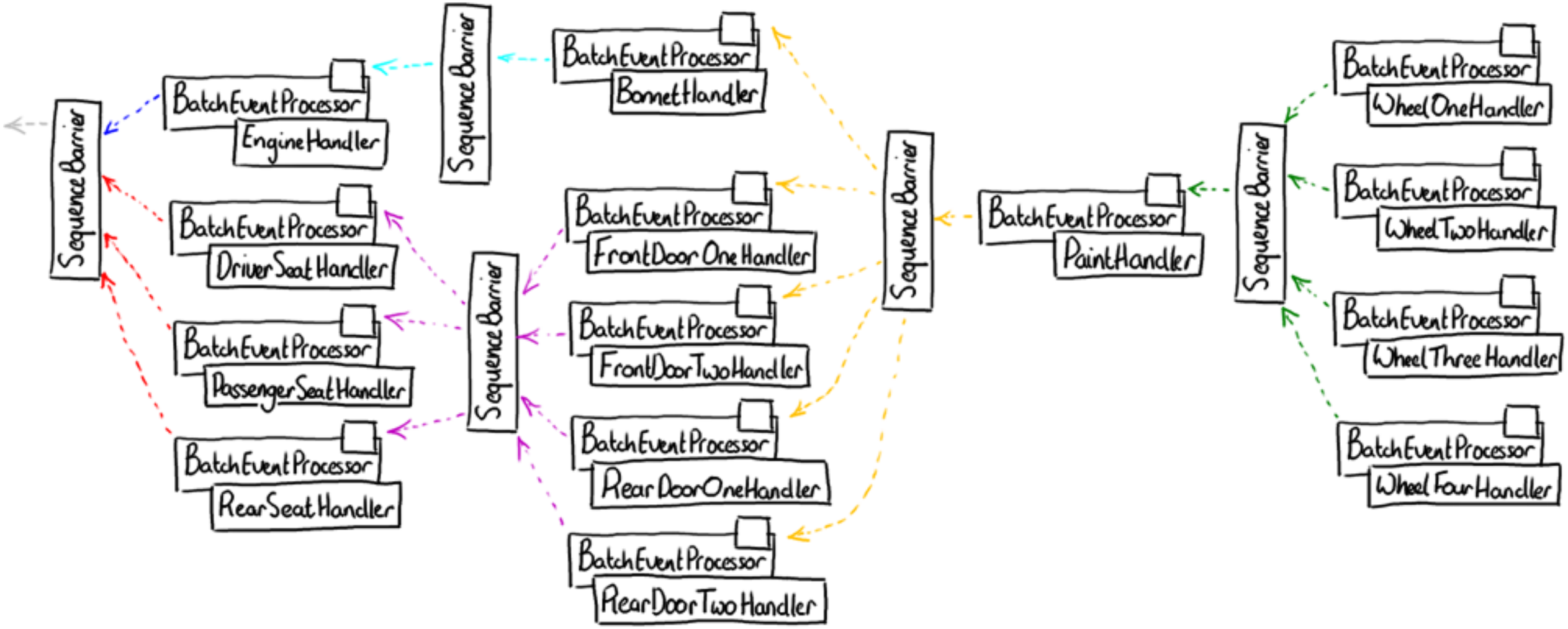
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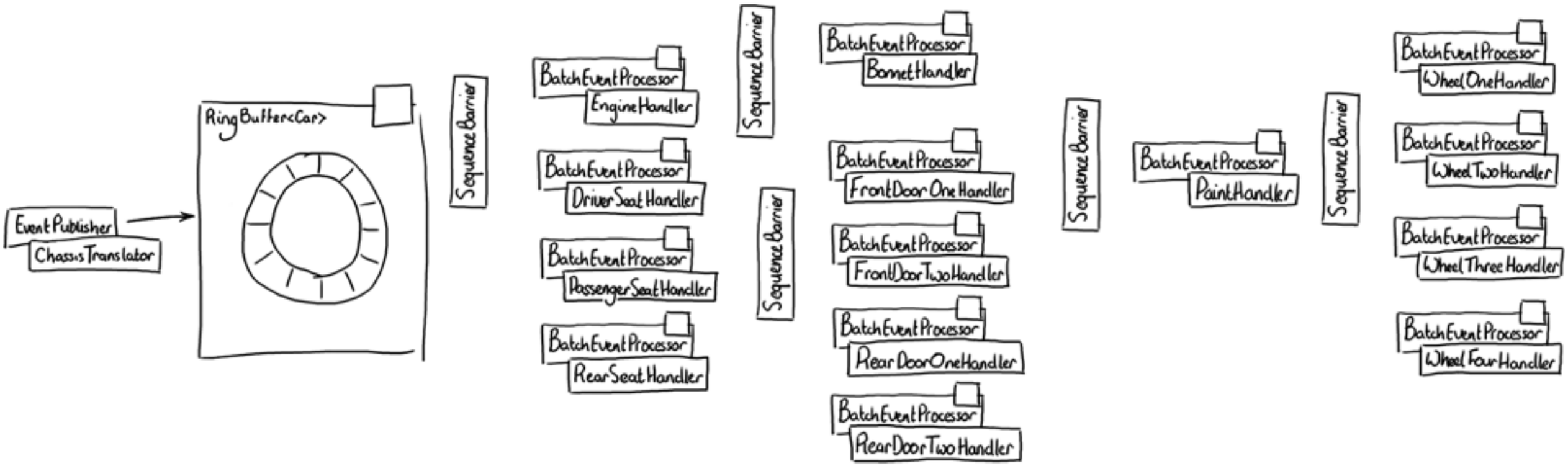
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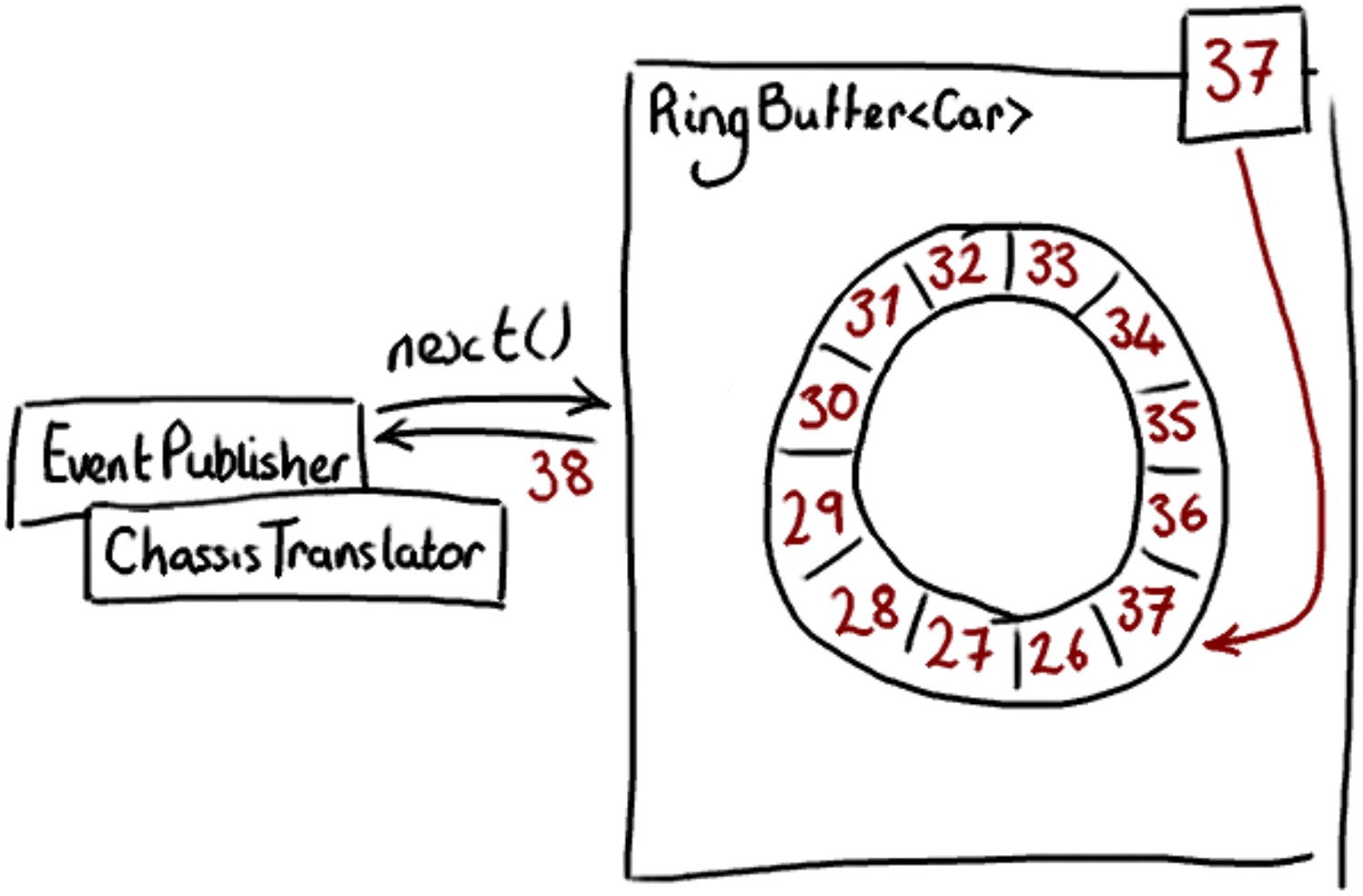
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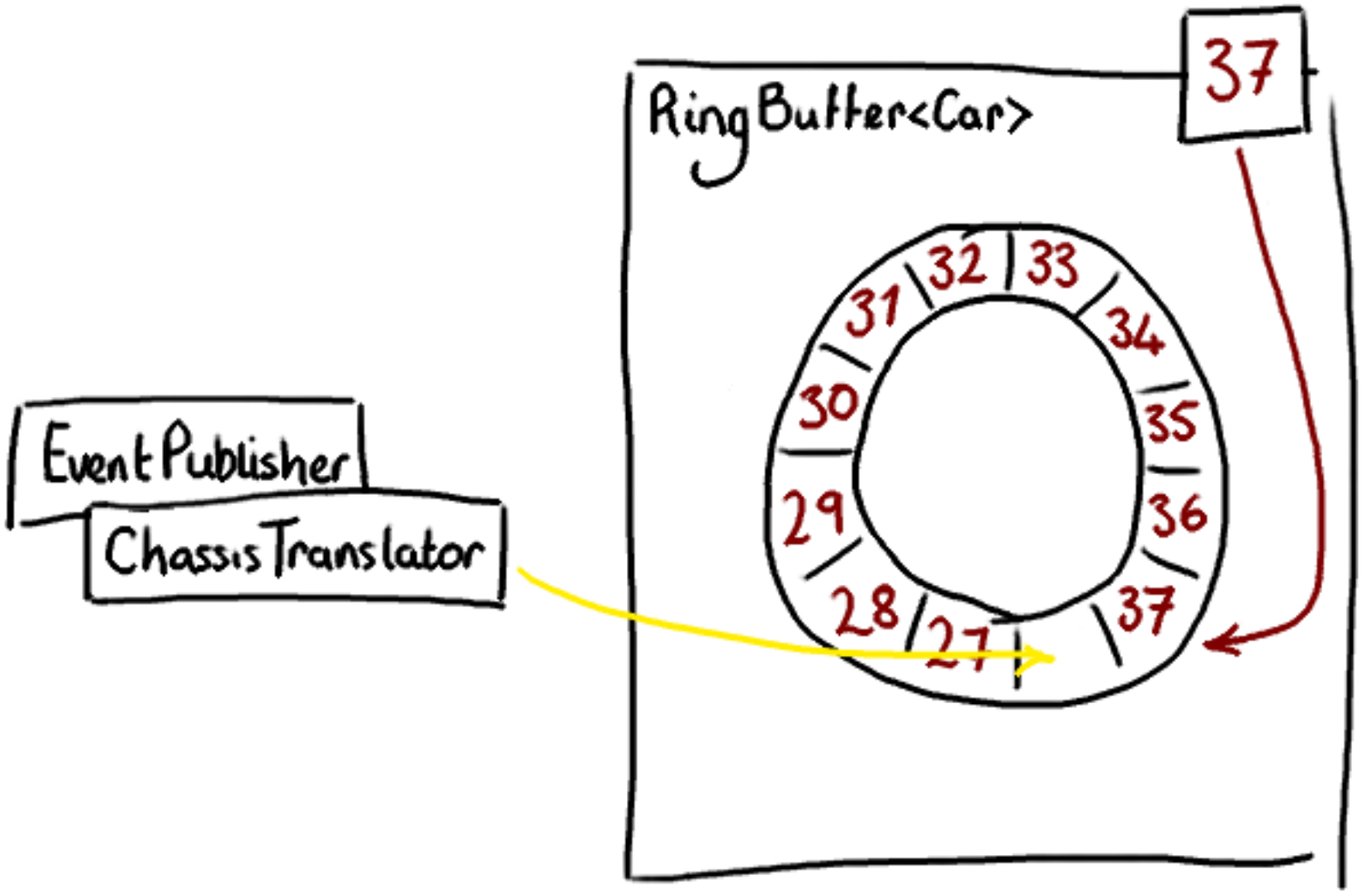
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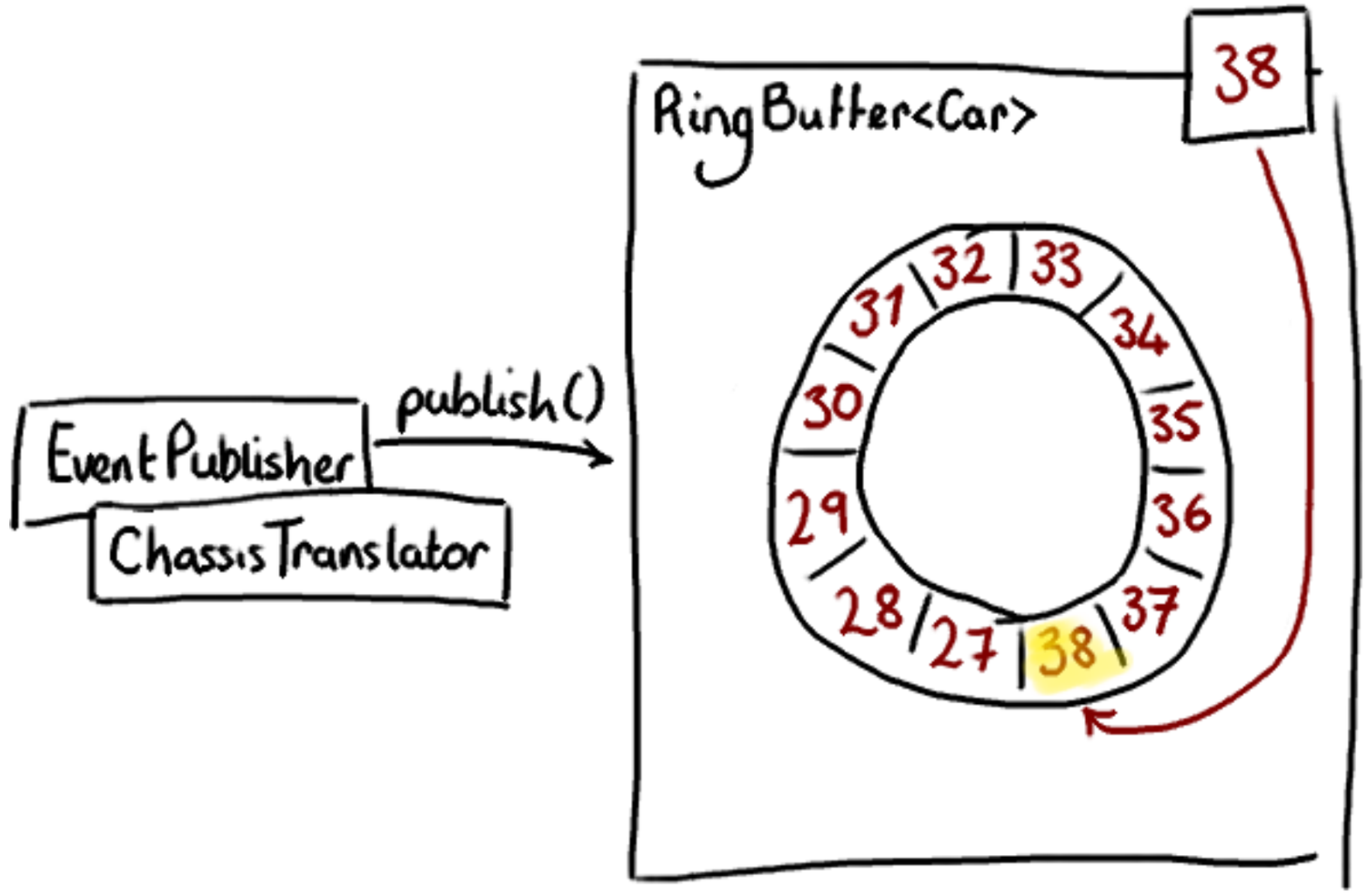
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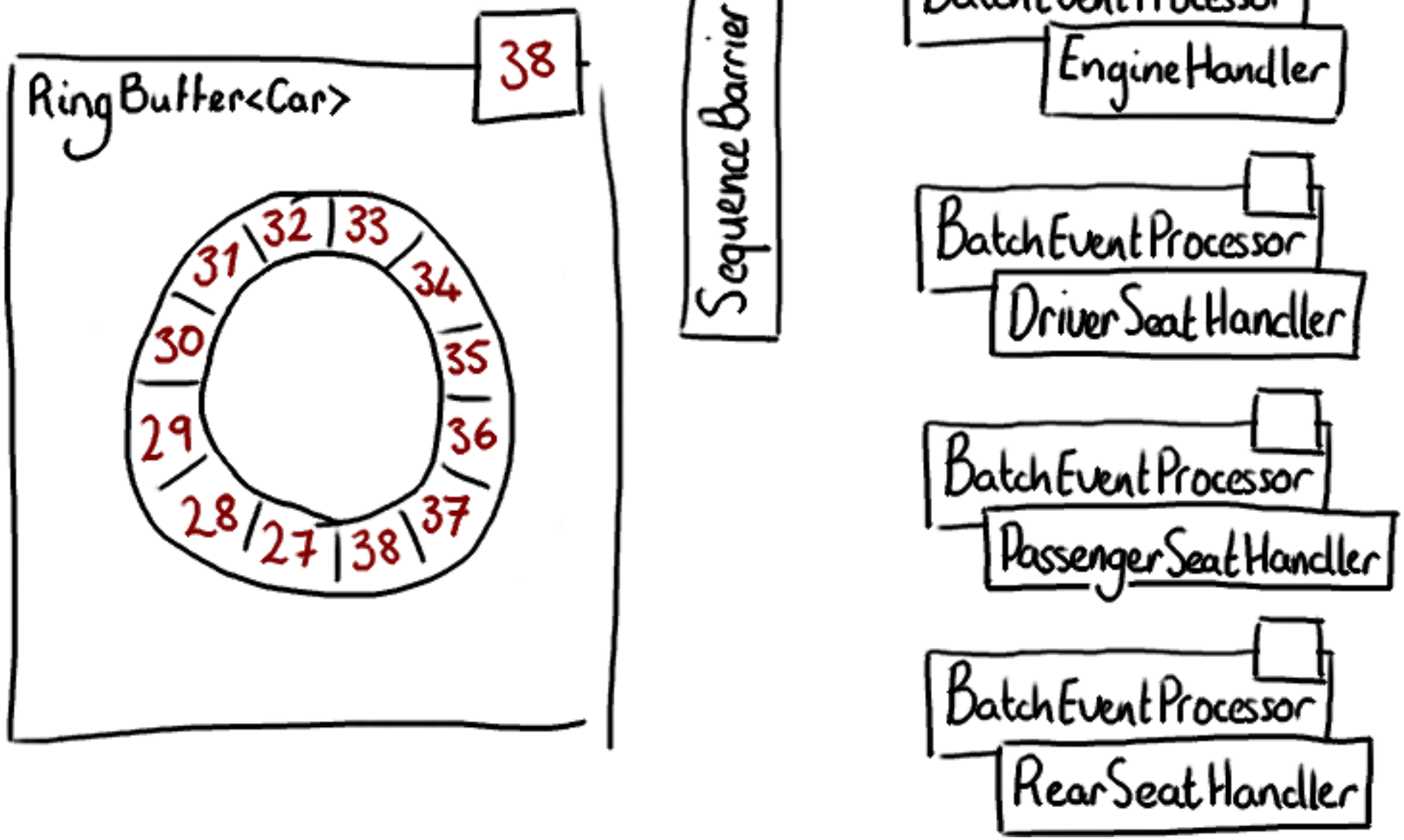
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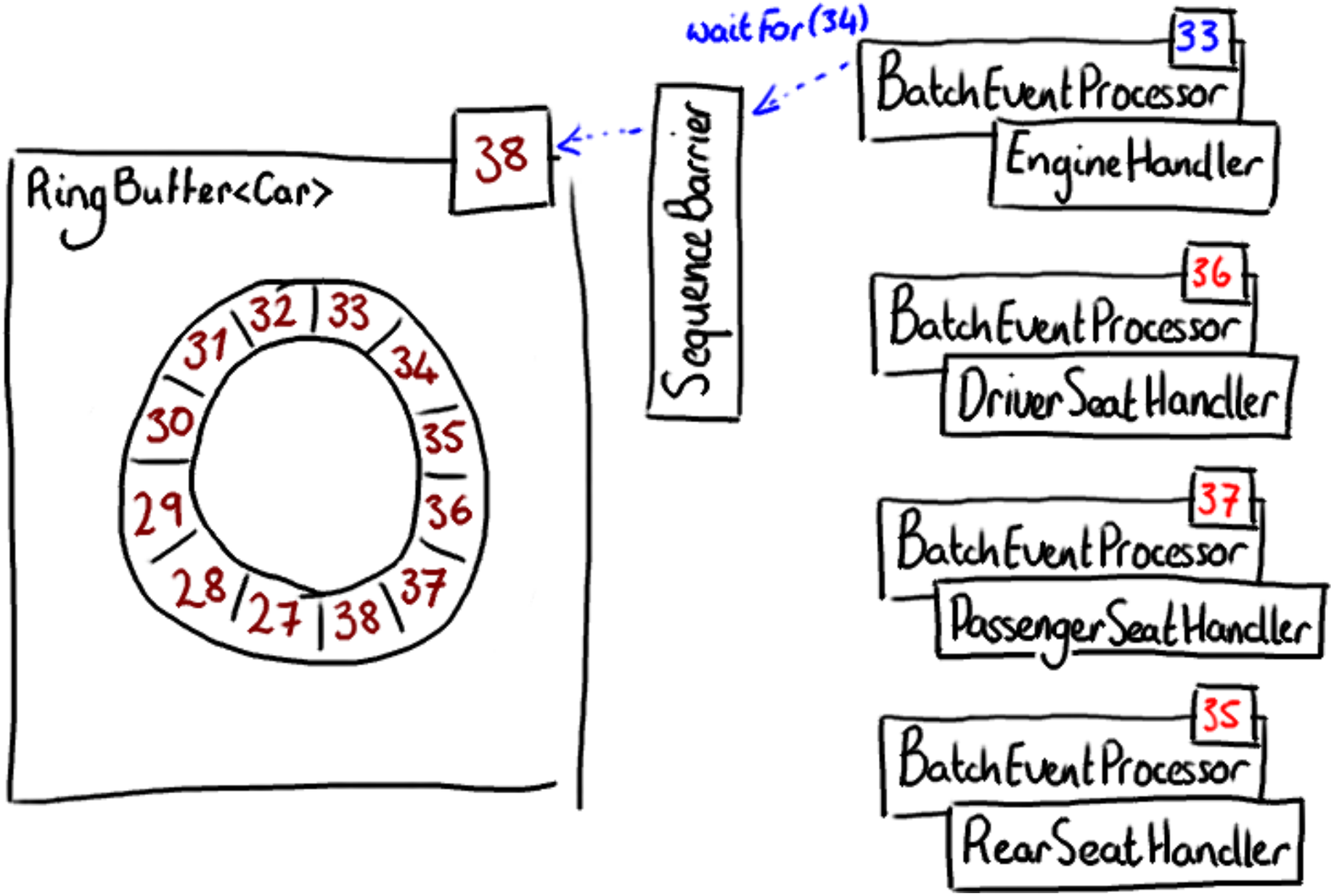
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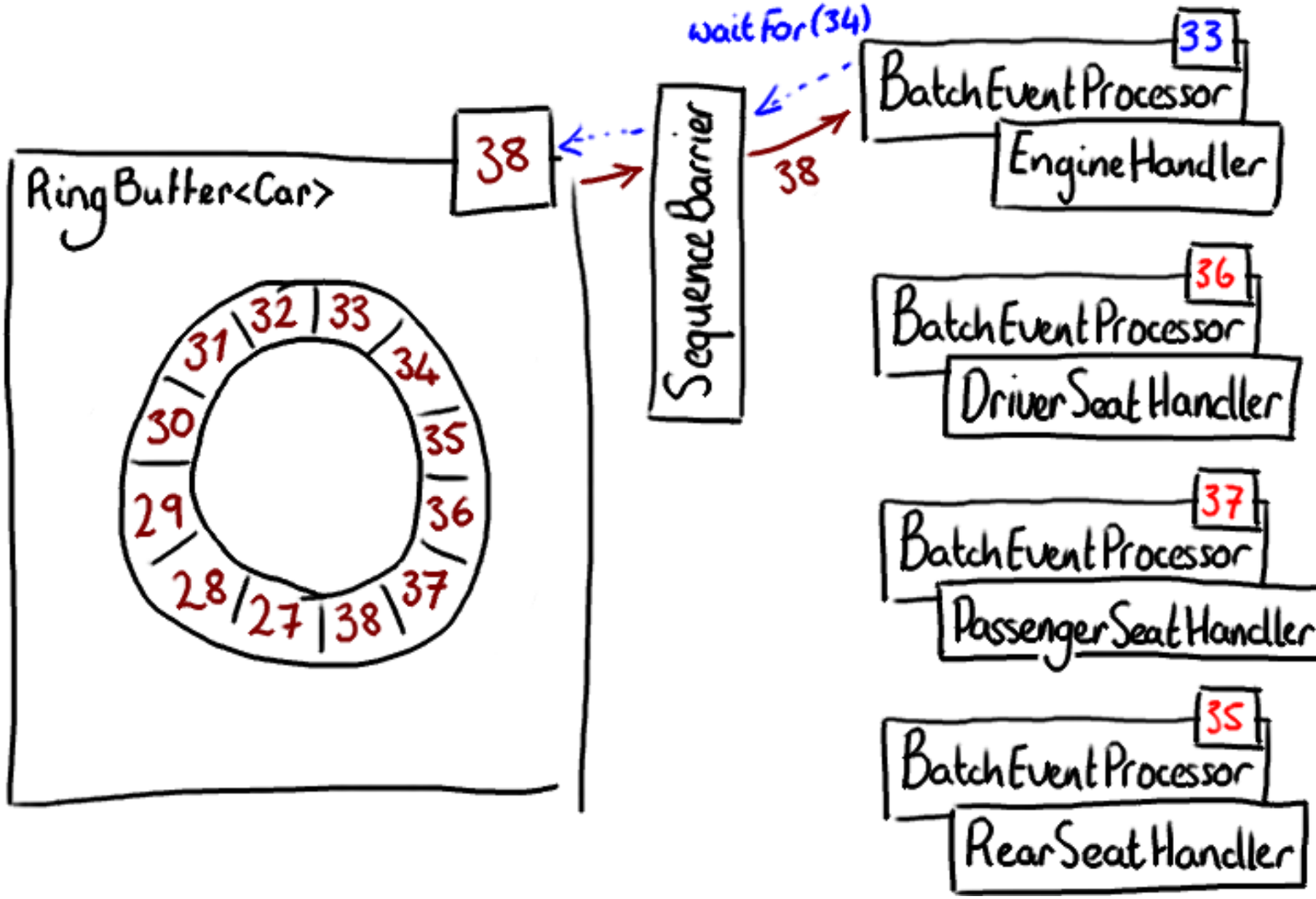
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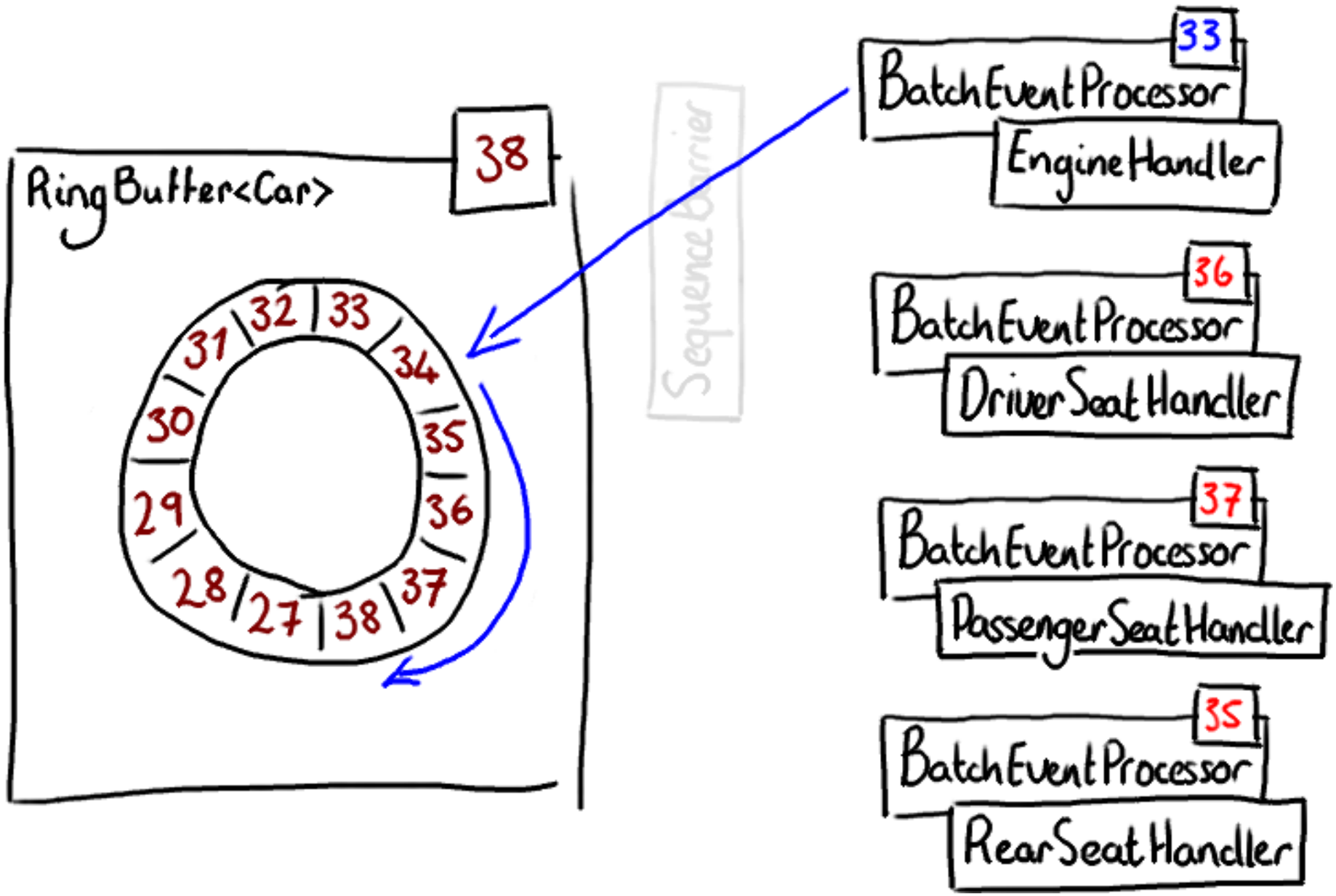
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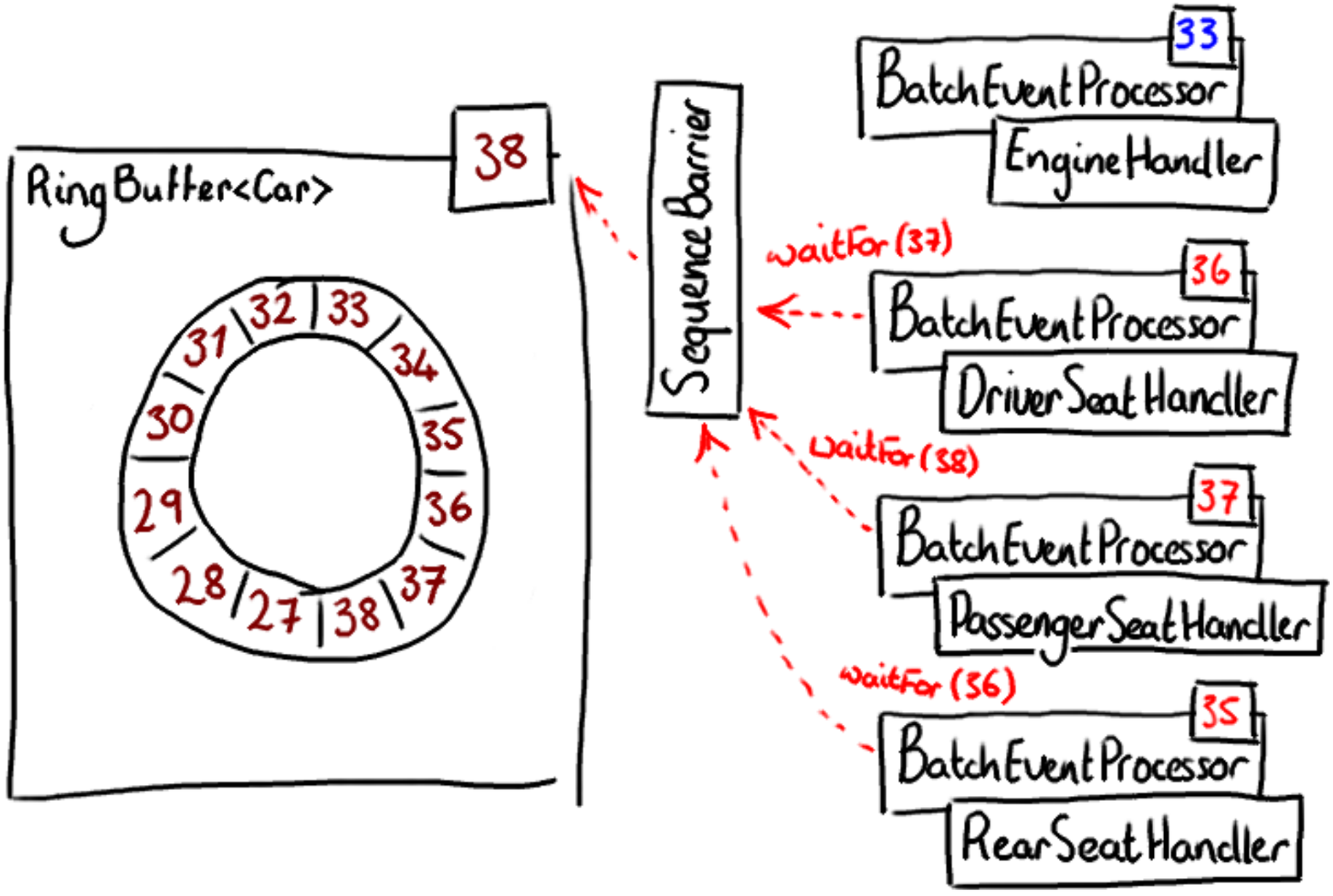
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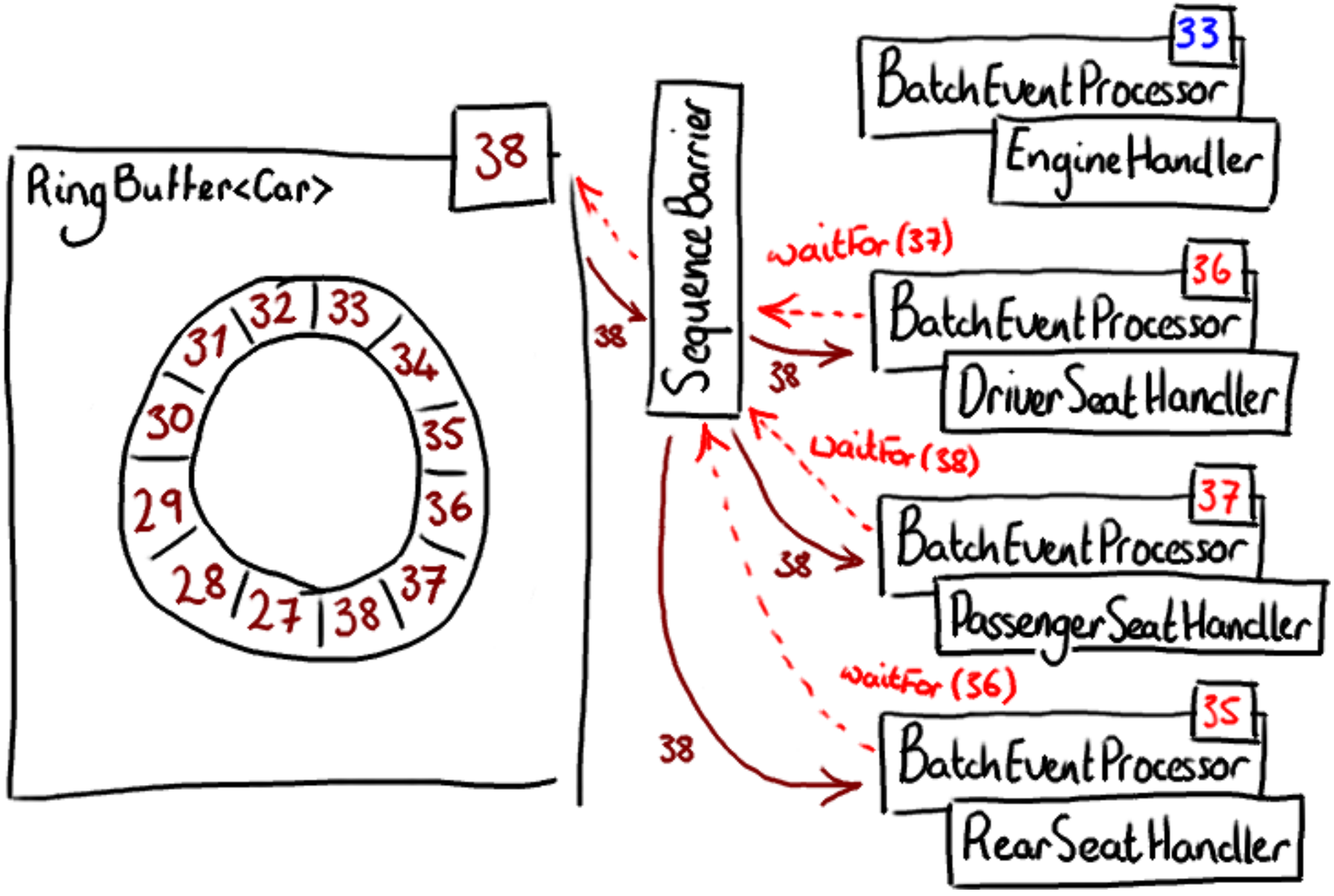
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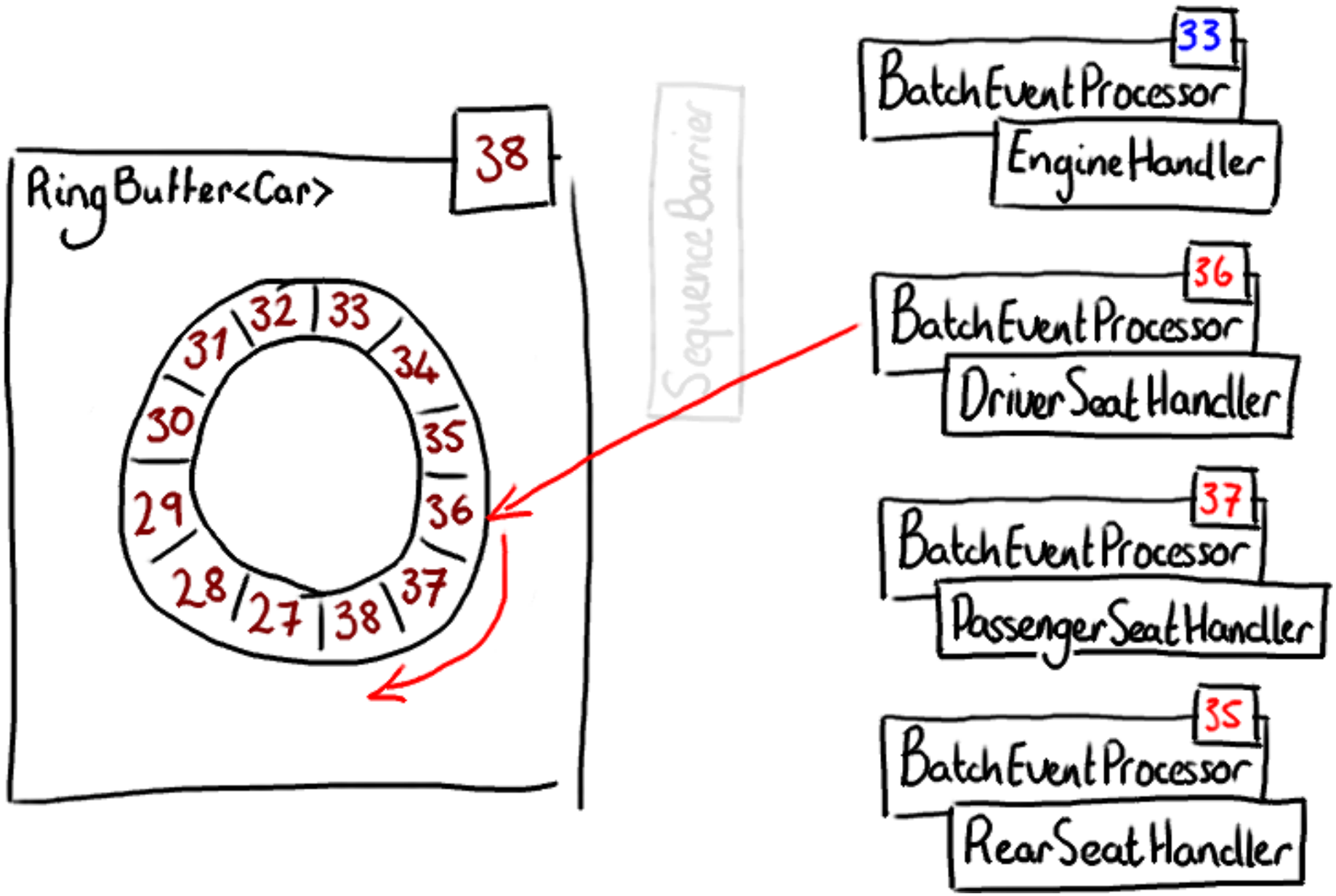
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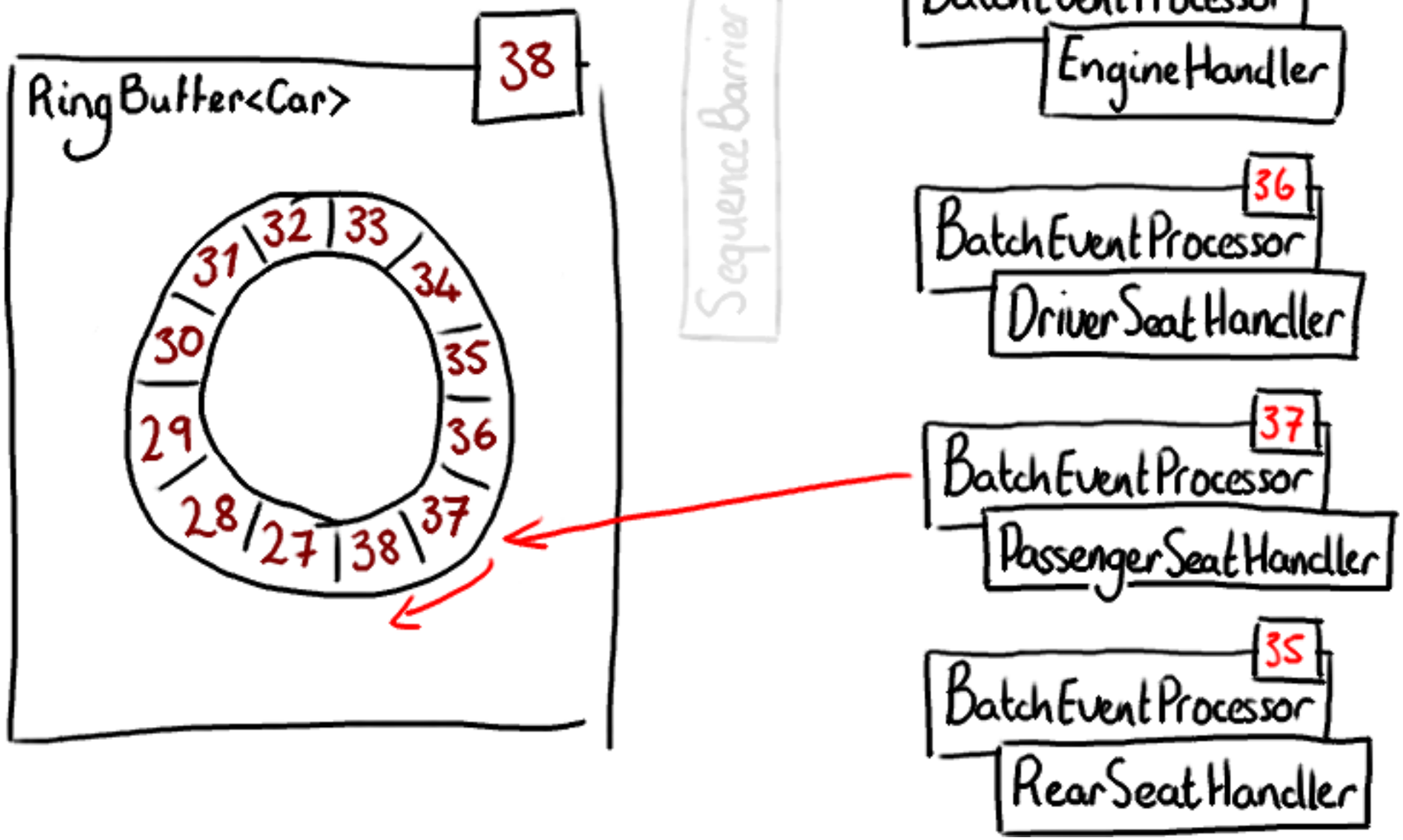
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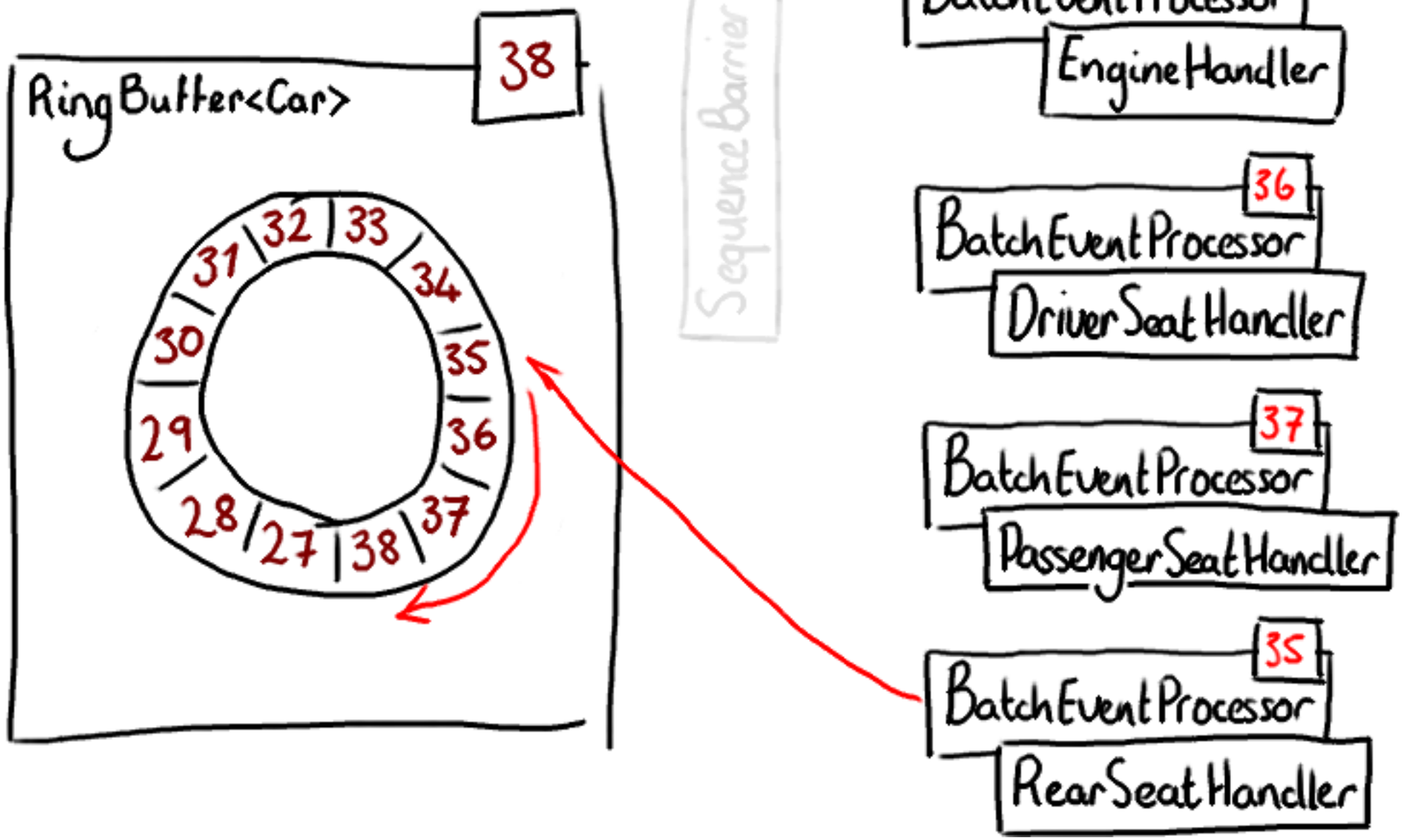
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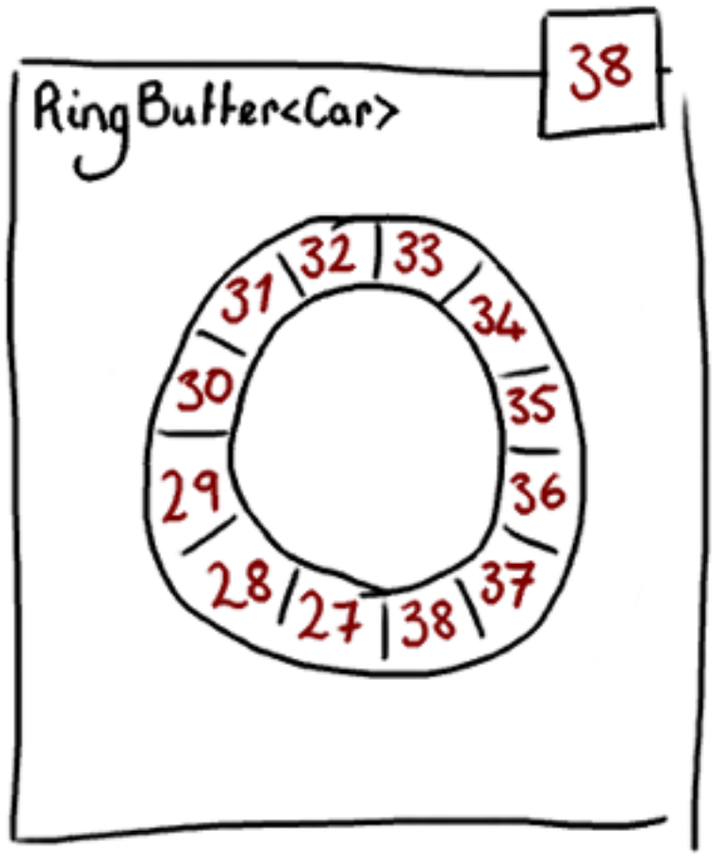

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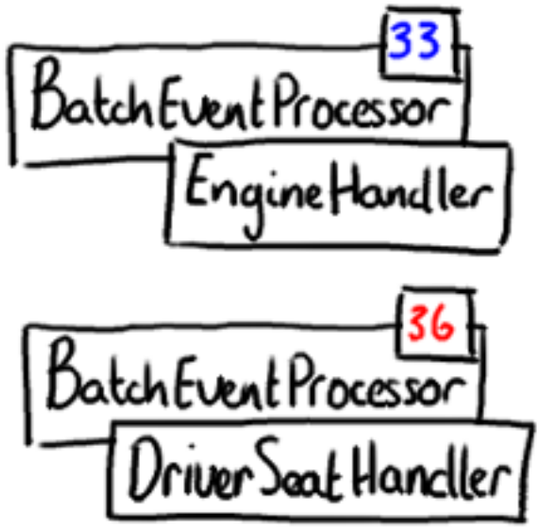

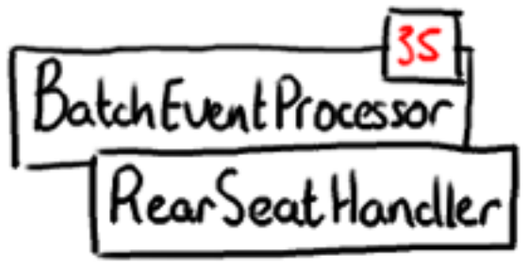

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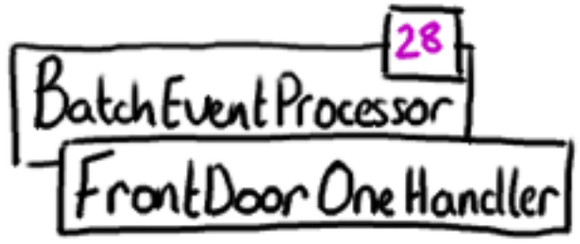

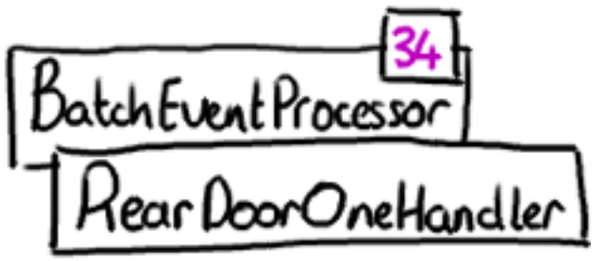

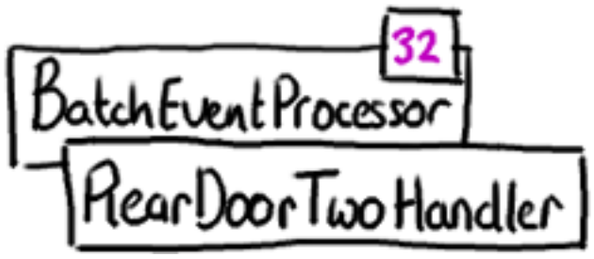

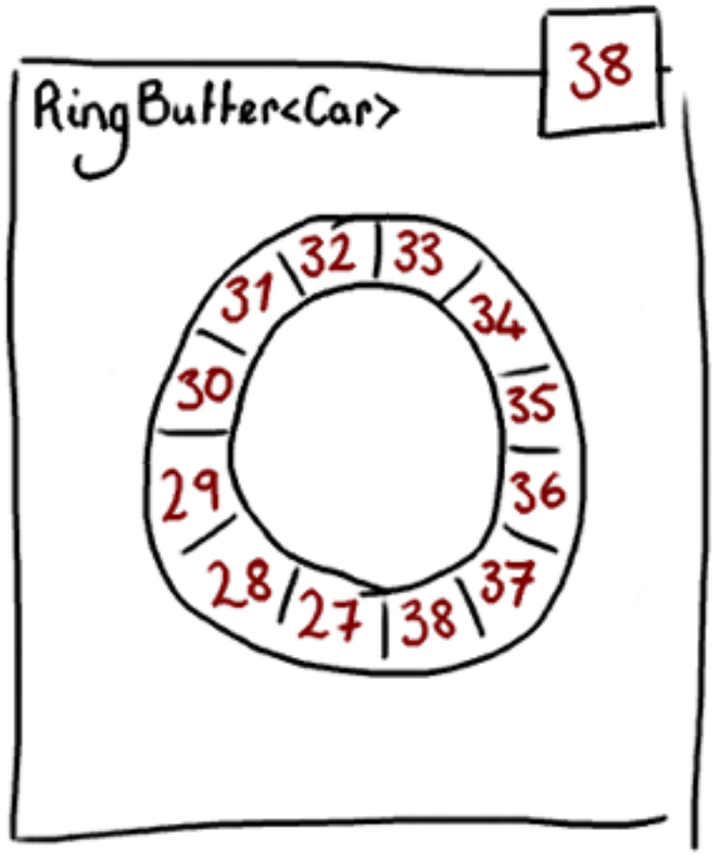
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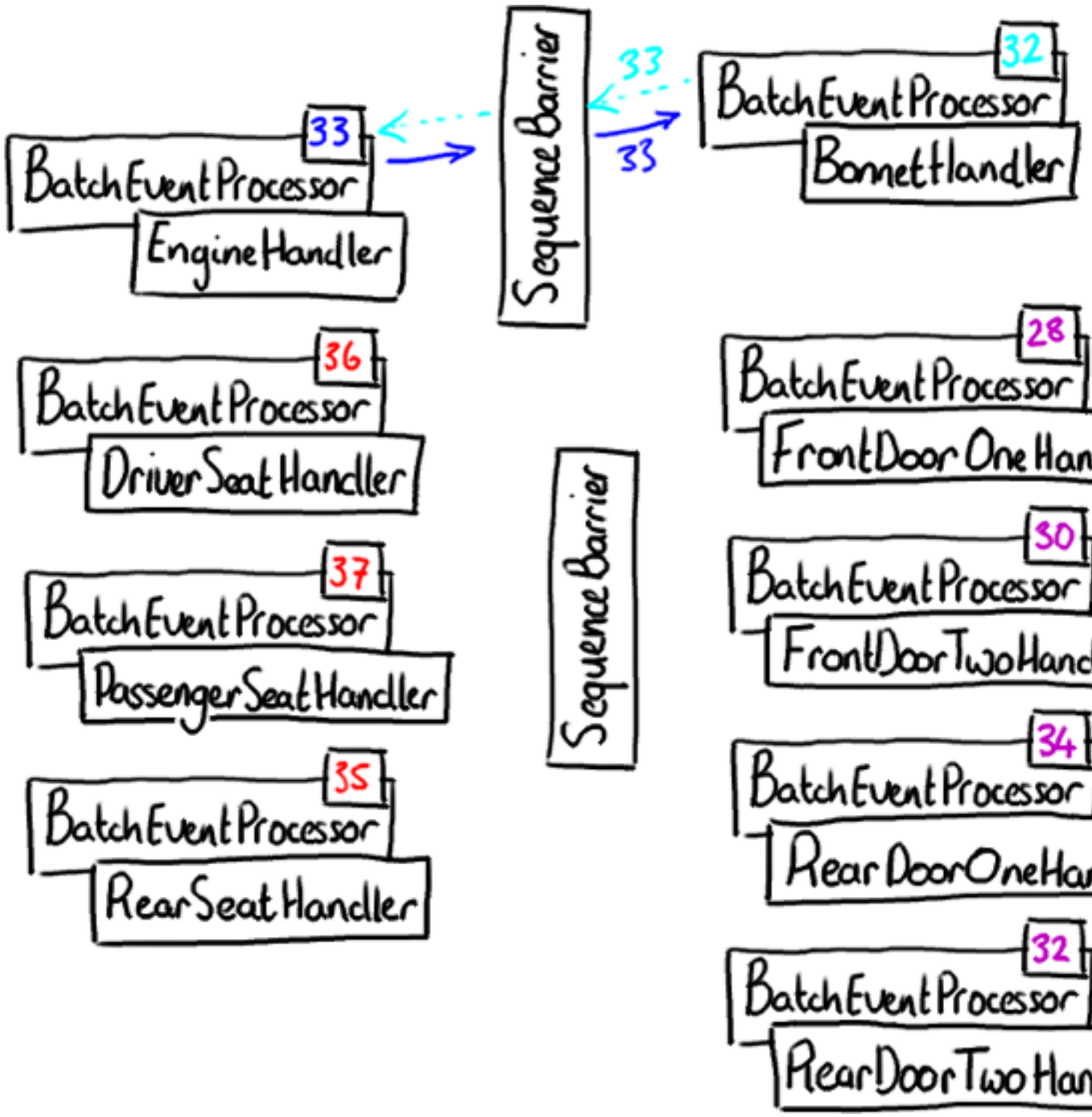
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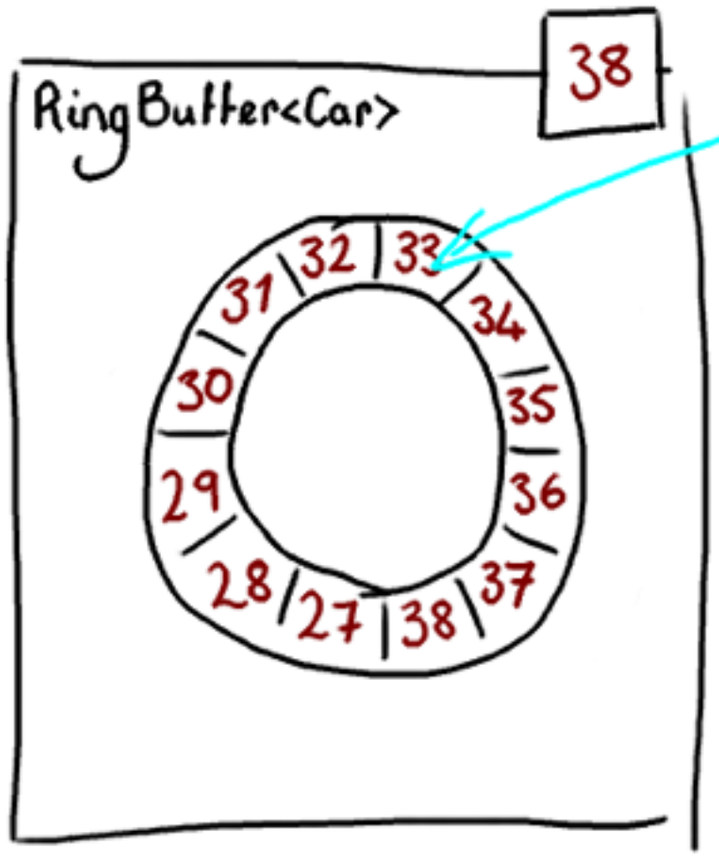
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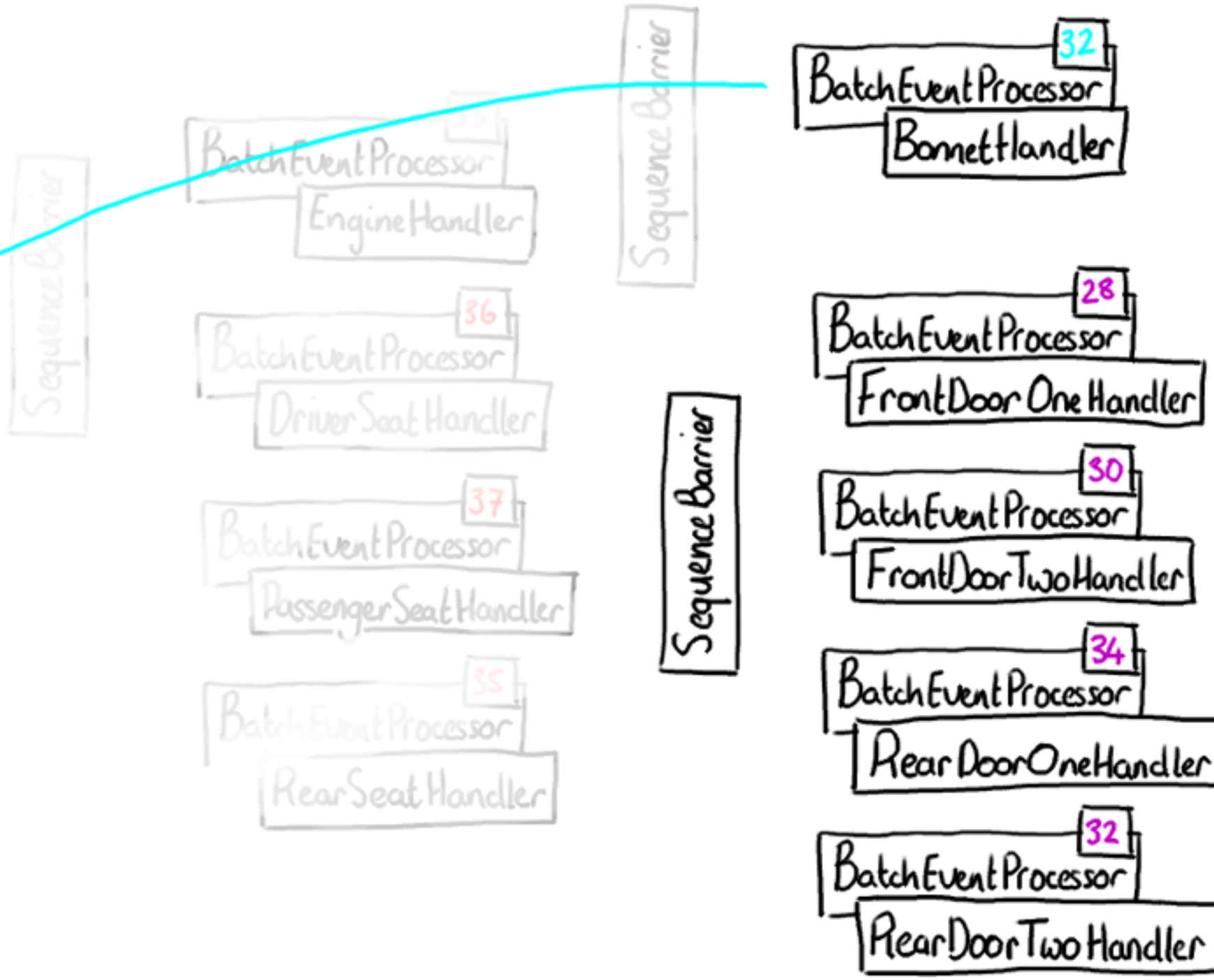
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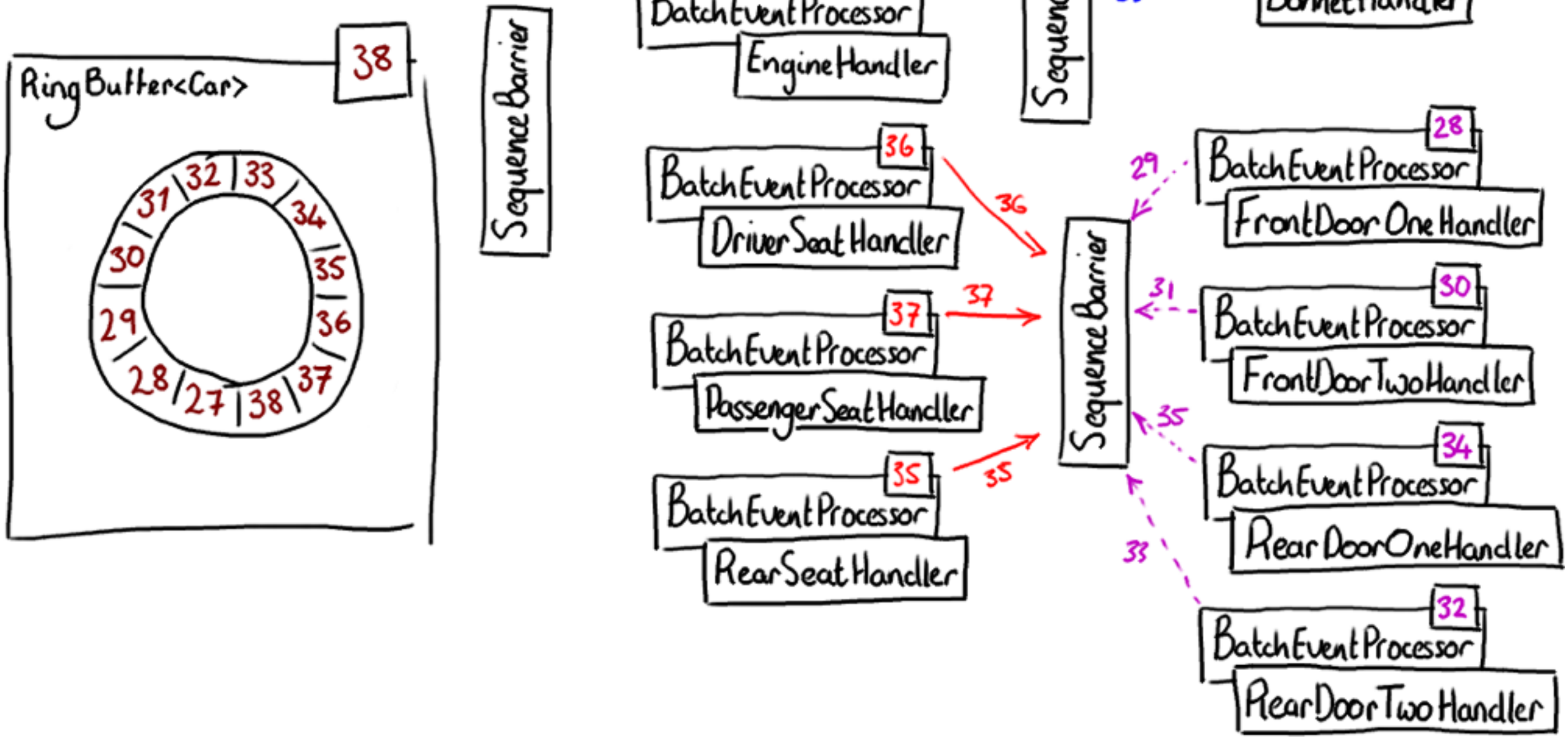
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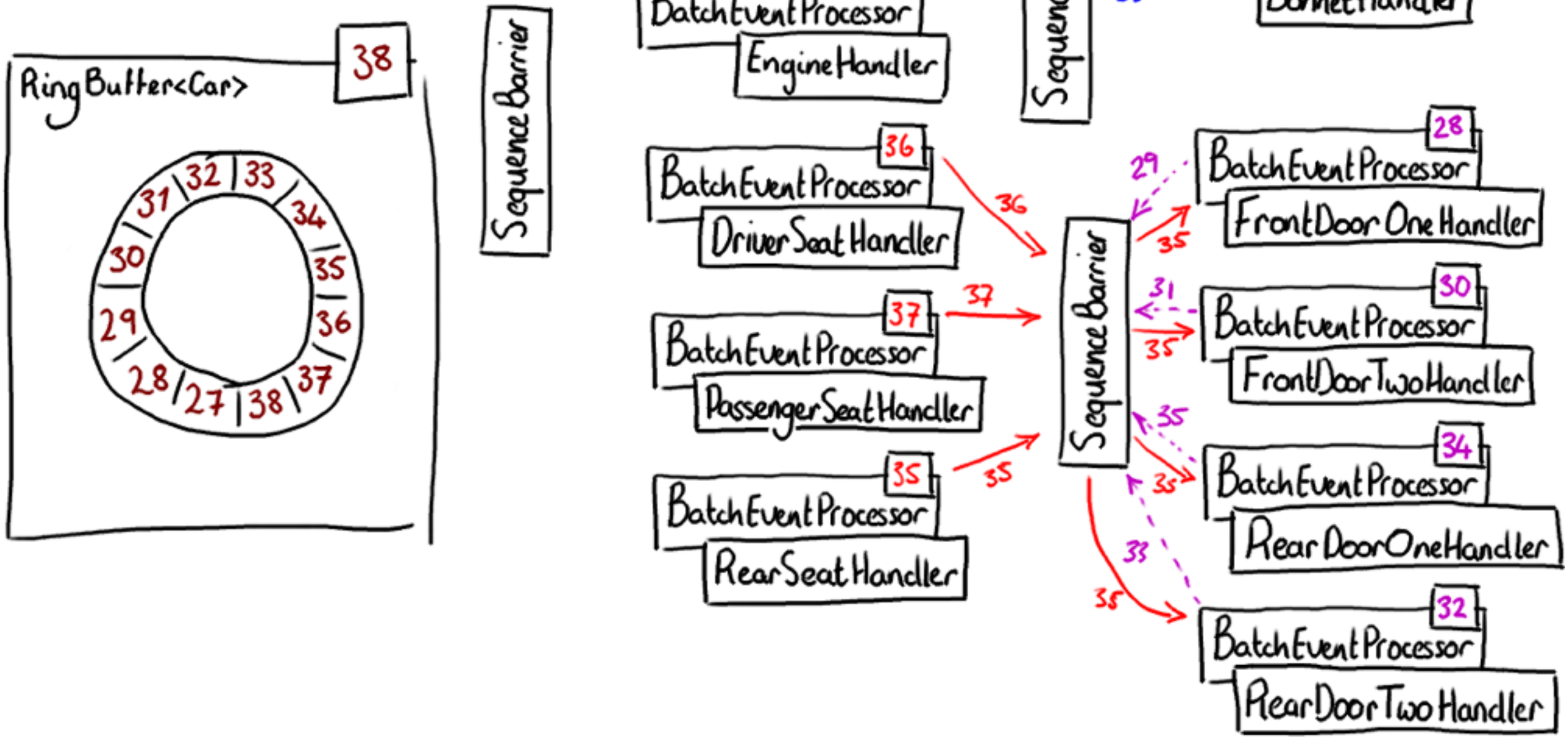
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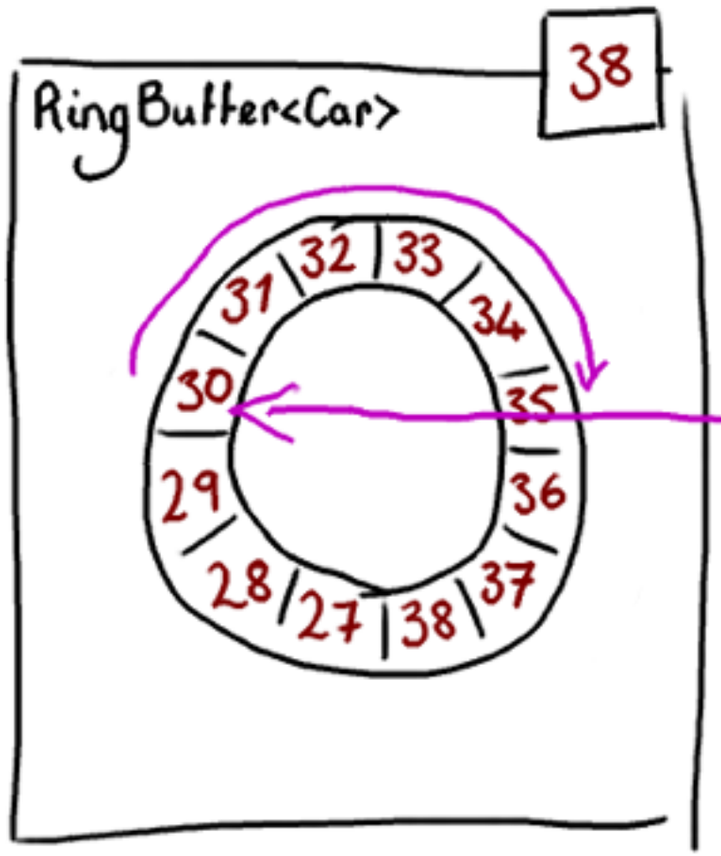
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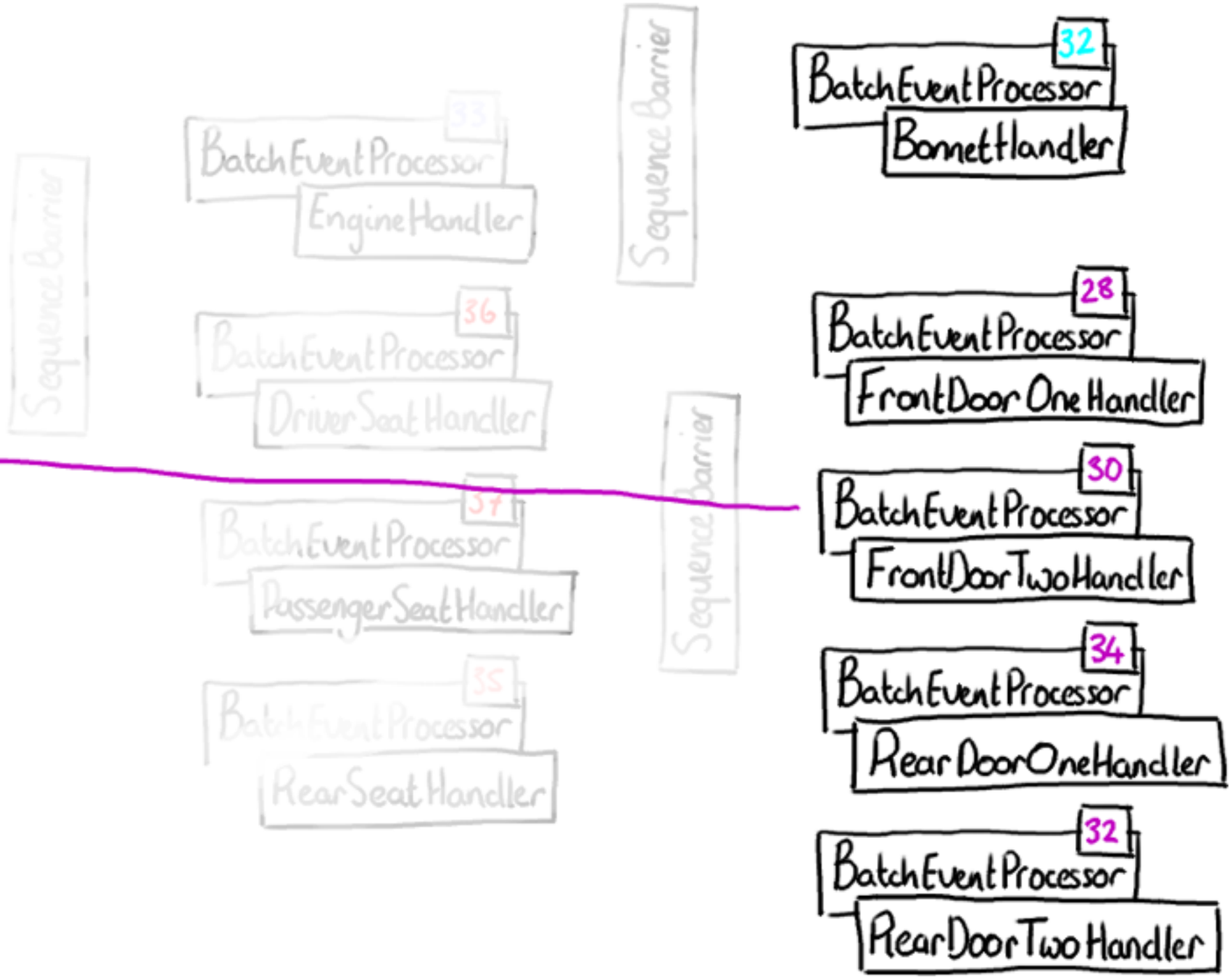
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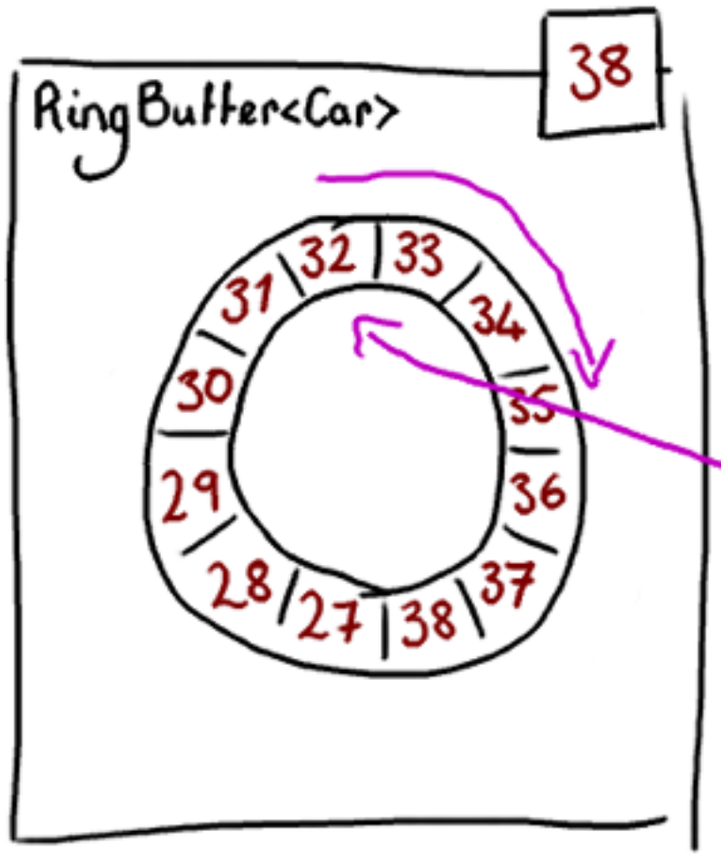
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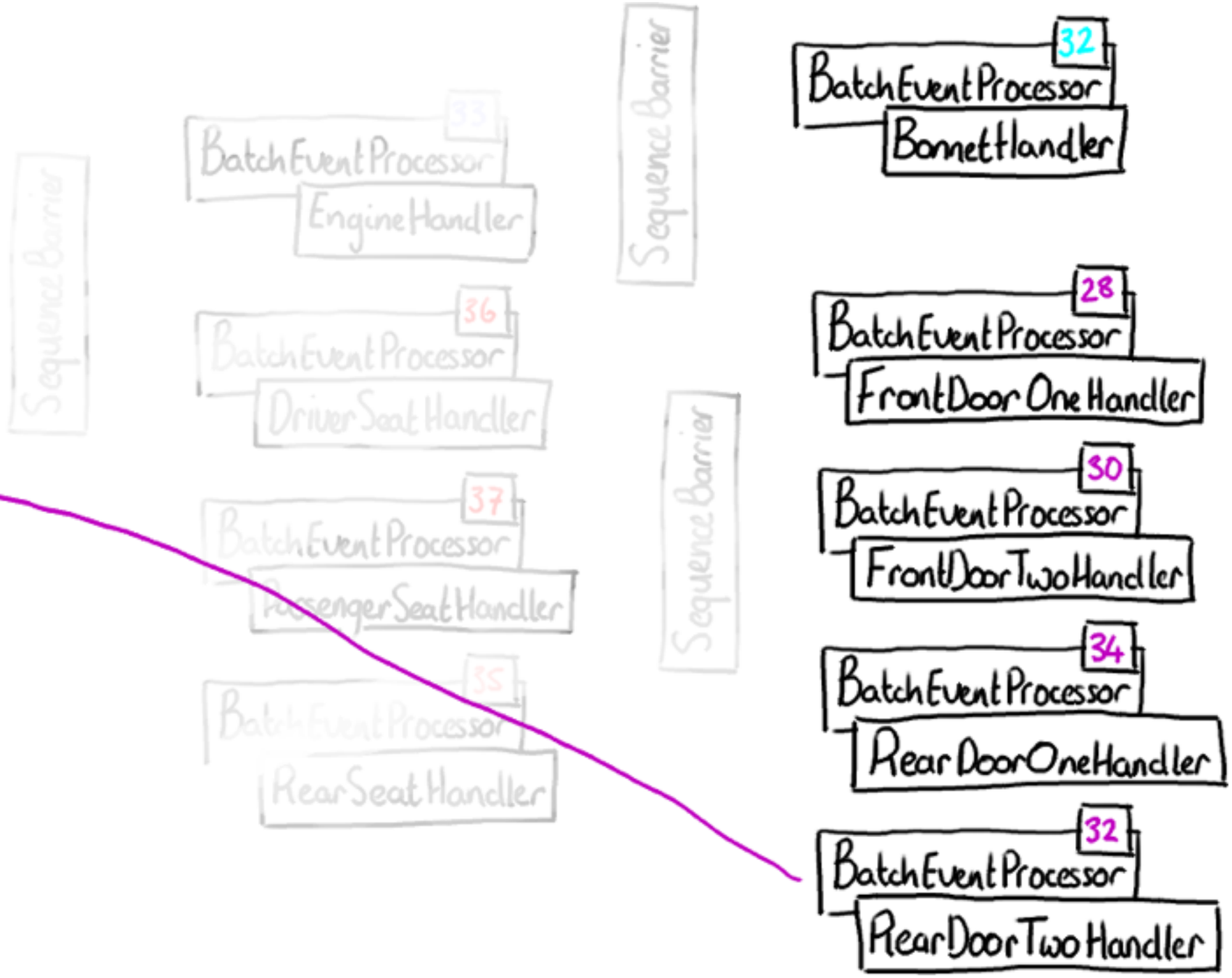
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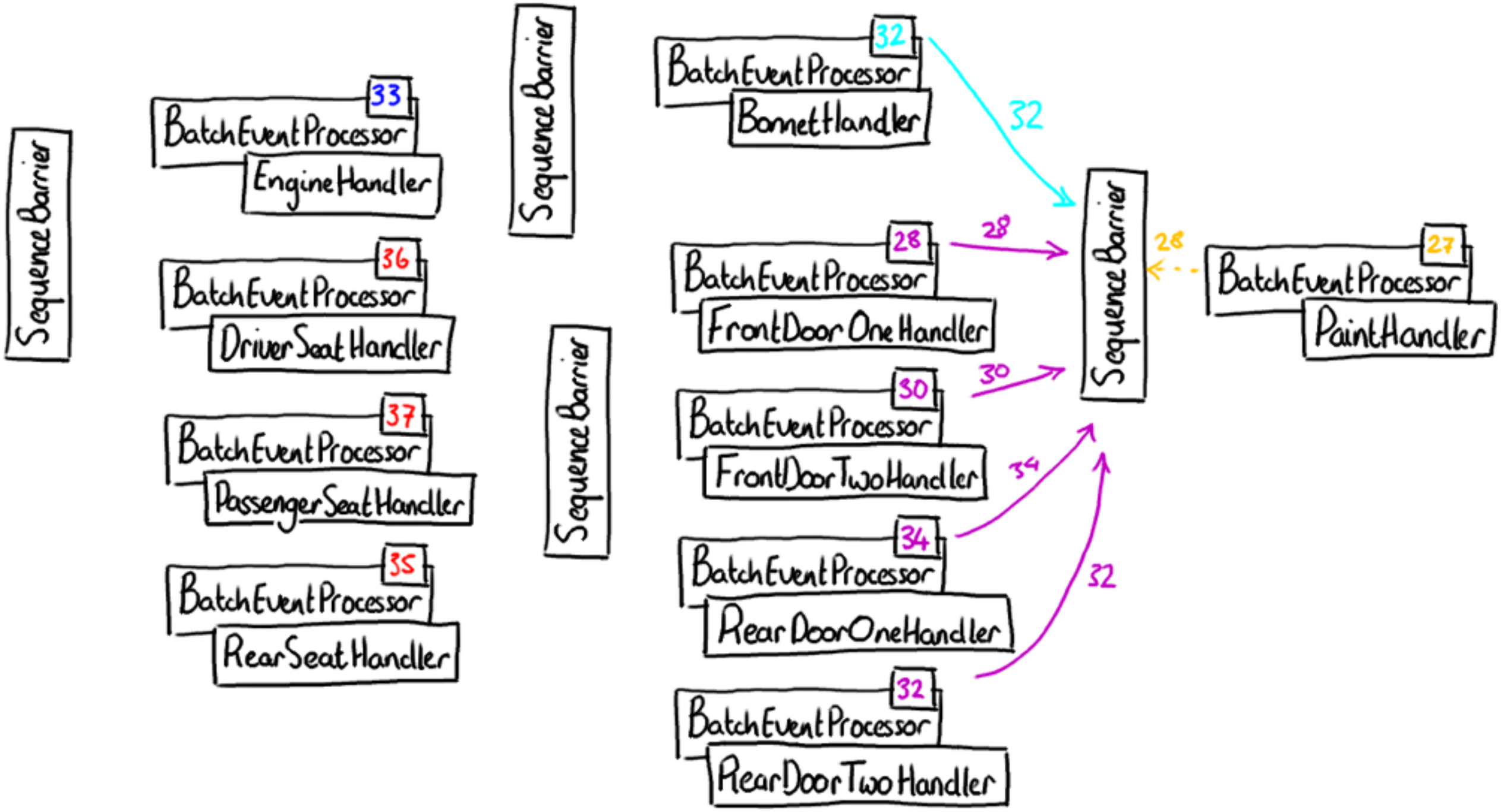
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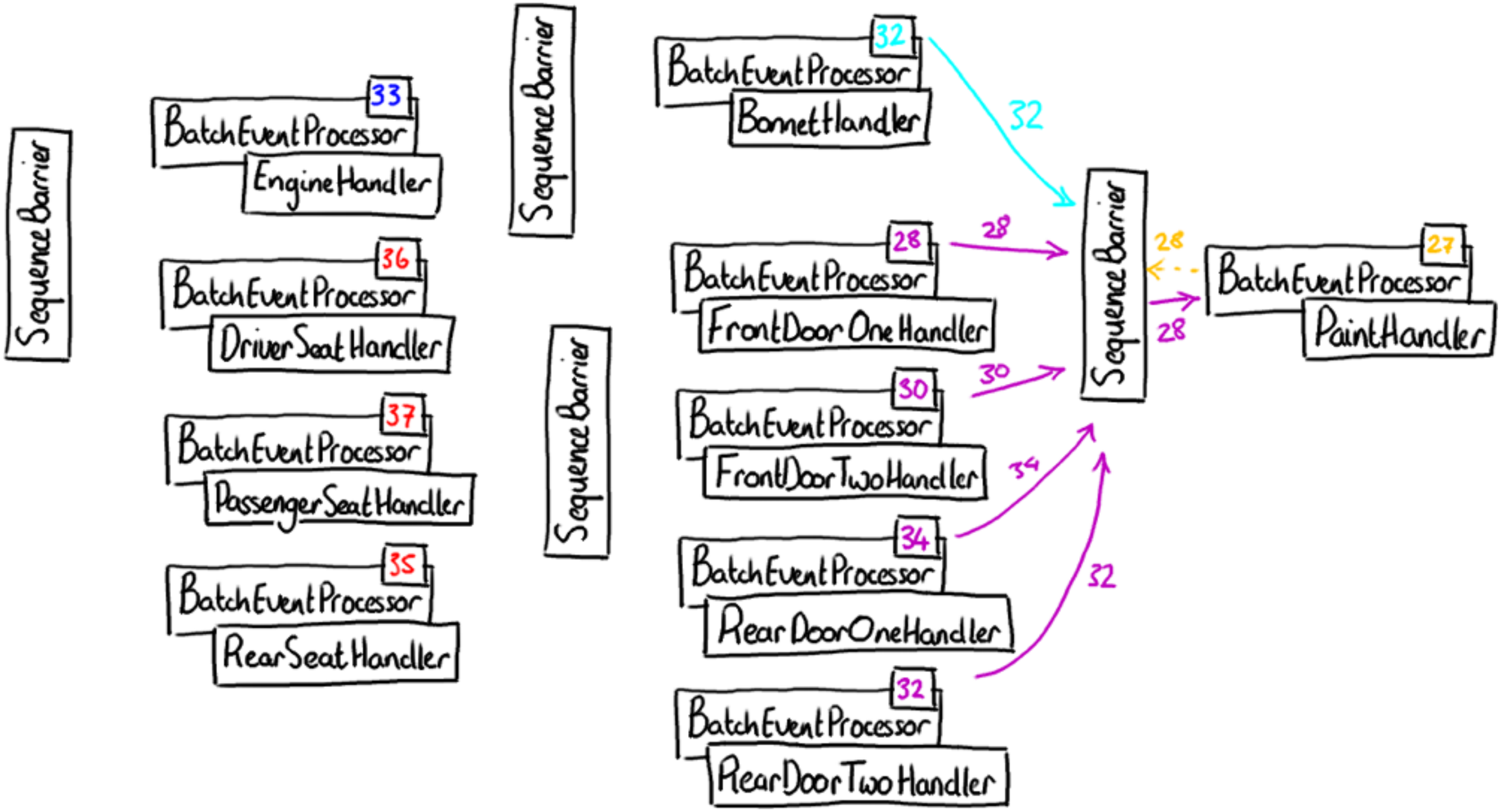
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RearSeatHandler
Sequence Barrier
Sequence Barrier
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BatchEventProcessor
BonnetHandler
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FrontDoorOneHandler
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FrontDoorTwoHandler
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RearDoorOneHandler
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BatchEventProcessor
RearDoorTwoHandler
Sequence Barrier
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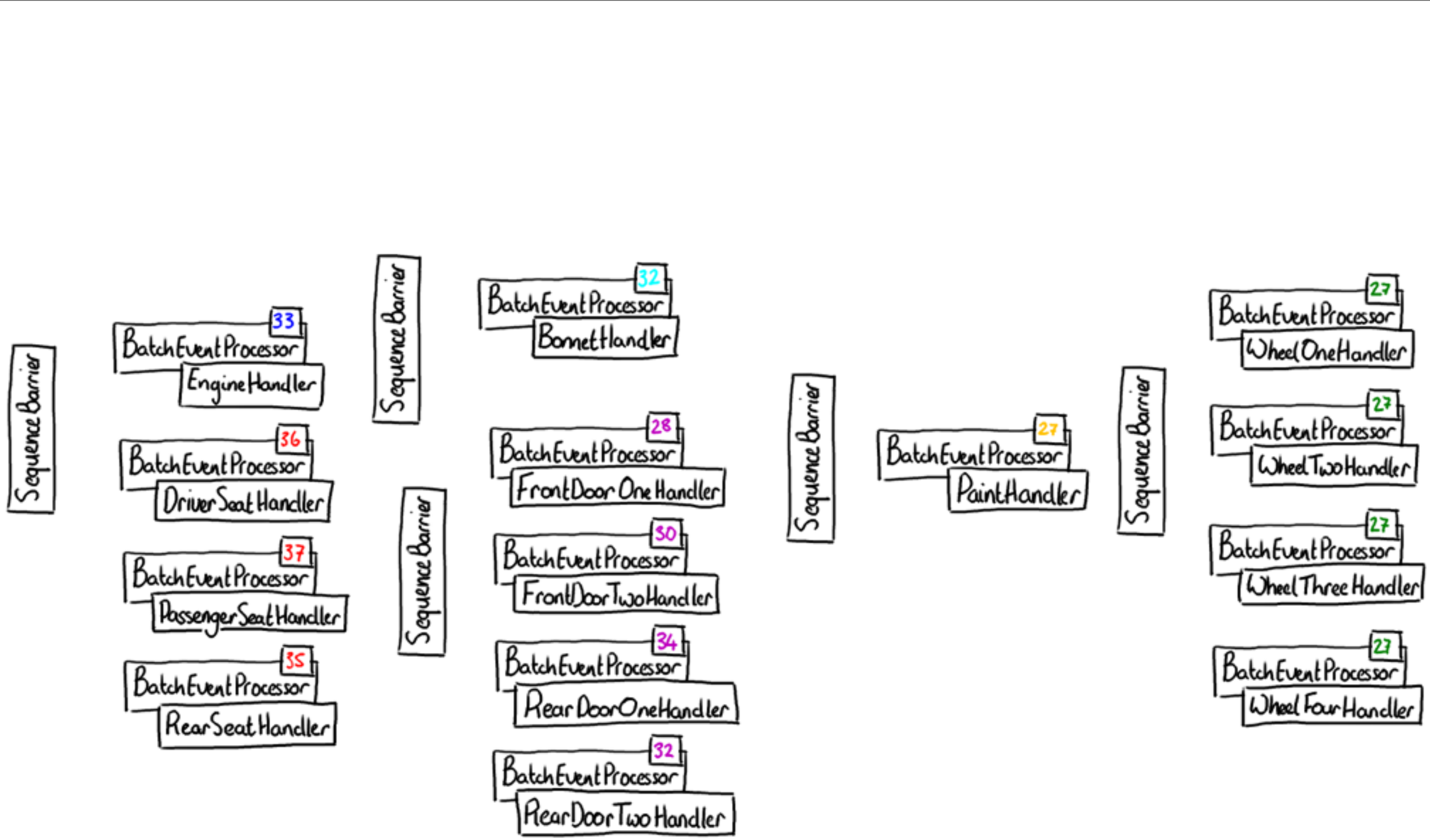
BatchEventProcessor
PaintHandler


Sequence Barrier
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BatchEventProcessor
DriverSeatHandler
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Sequence Barrier
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BatchEventProcessor
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Sequence Barrier
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Sequence Barrier
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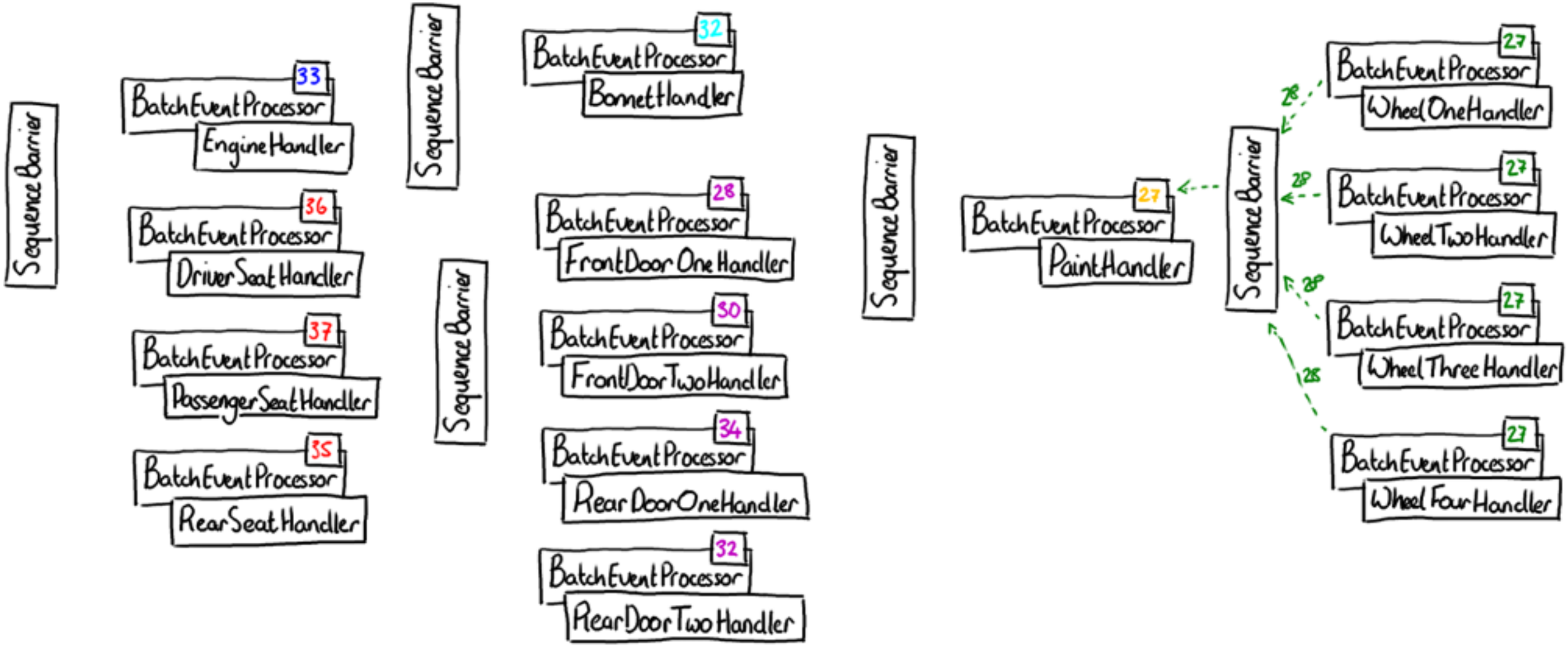
BatchEventProcessor
WheelFourHandler
27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Sequence Barrier
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Sequence Barrier
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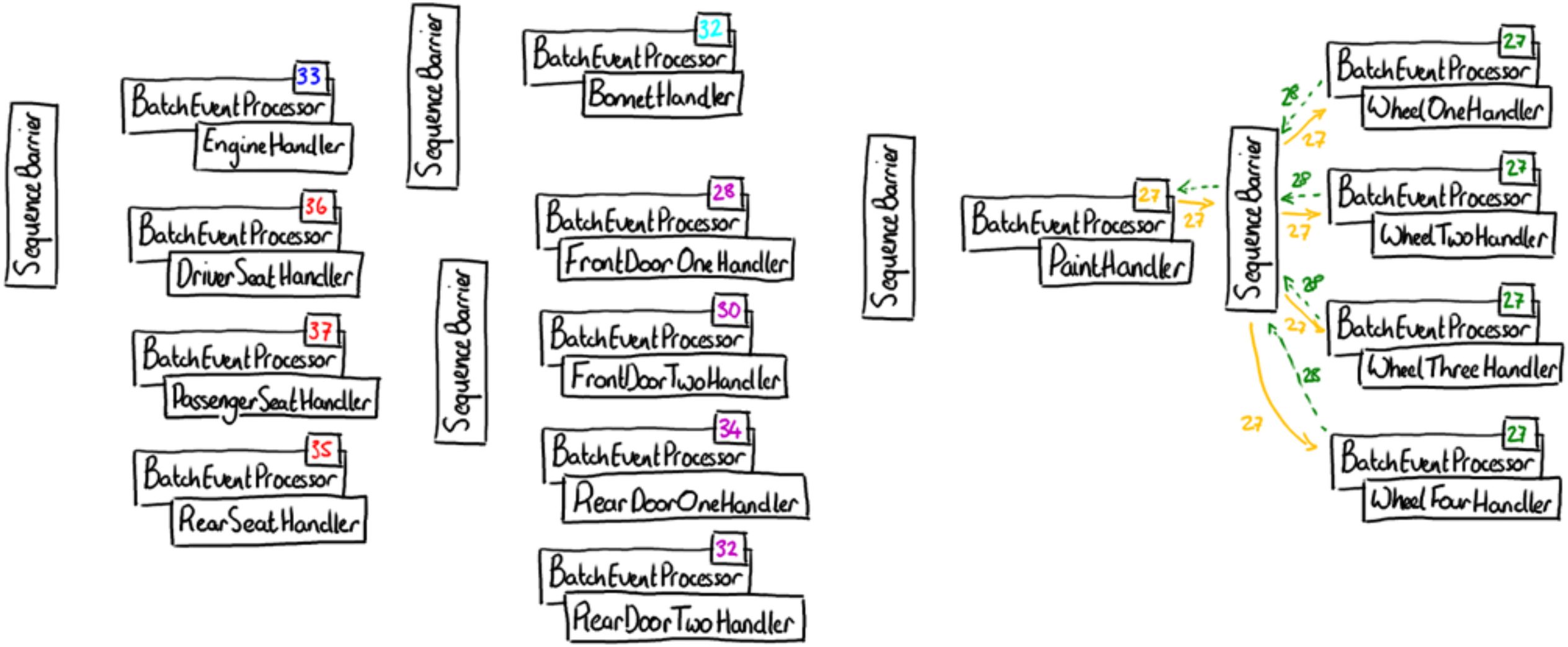
Sequence Barrier
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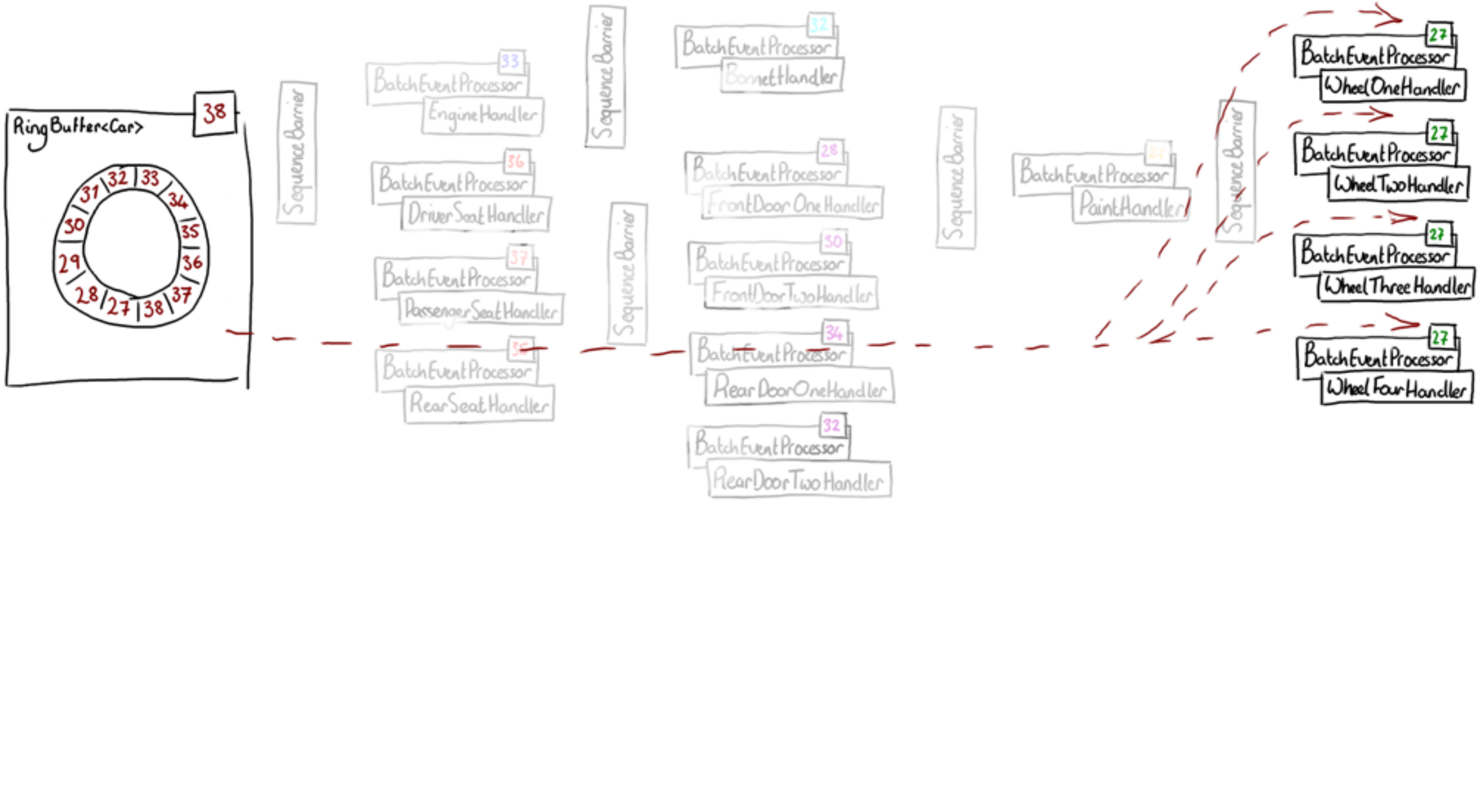
RingBuffer<Car>
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Sequence Barrier
BatchEventProcessor
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EngineHandler
BatchEventProcessor
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DriverSeatHandler
BatchEventProcessor
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PassengerSeatHandler
BatchEventProcessor
RearSeatHandler
Sequence Barrier
BatchEventProcessor
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RearDoorTwoHandler
Sequence Barrier
BatchEventProcessor
PaintHandler
Sequence Barrier
BatchEventProcessor
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WheelOneHandler
BatchEventProcessor
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WheelTwoHandler
BatchEventProcessor
27
WheelThreeHandler
BatchEventProcessor
27
WheelFourHandler

Don’t wrap the buffer!

```
ringBuffer.setGatingSequences(finalEventProcessor.getSequence());
```

Caveats

Is that it?

- Wait and claim strategies
- Batch publishing
- Multiple publishers
- Different EventHandlers
- The Wizard
- You don’t even need a RingBuffer...

You get...

- A framework the encourages you to model your domain
- The ability to run in parallel but single-threaded
- Reliable ordering
- ...and it can be very fast

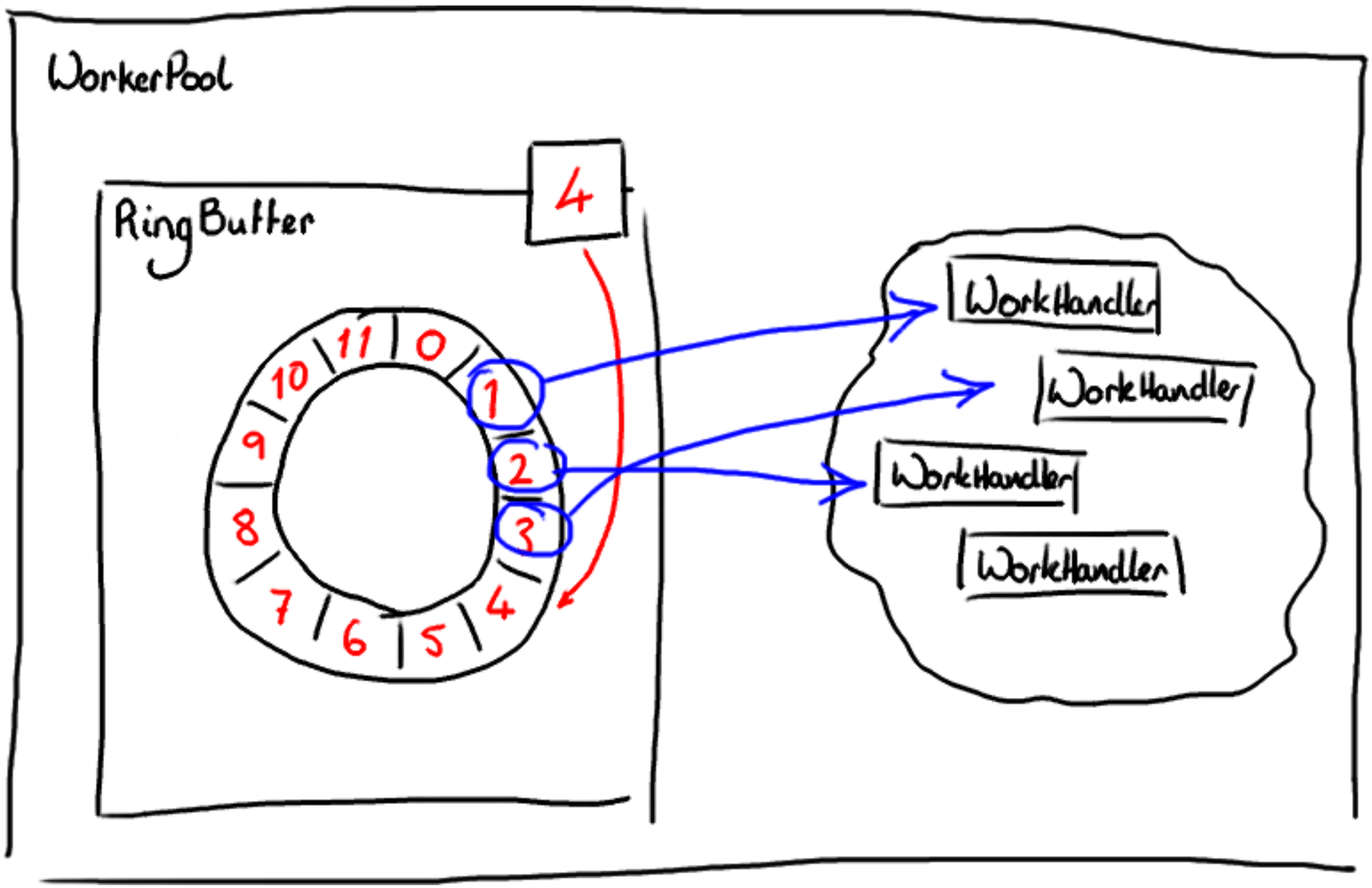
More Information

- Google Code Site, including Wiki
  http://code.google.com/p/disruptor/
- Blogs, e.g. mine: mechanitis.blogspot.com
- Presentations
- Google Group

Q&A

LMAX EXCHANGE™

WorkerPool


WorkerPool
RingButter
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11
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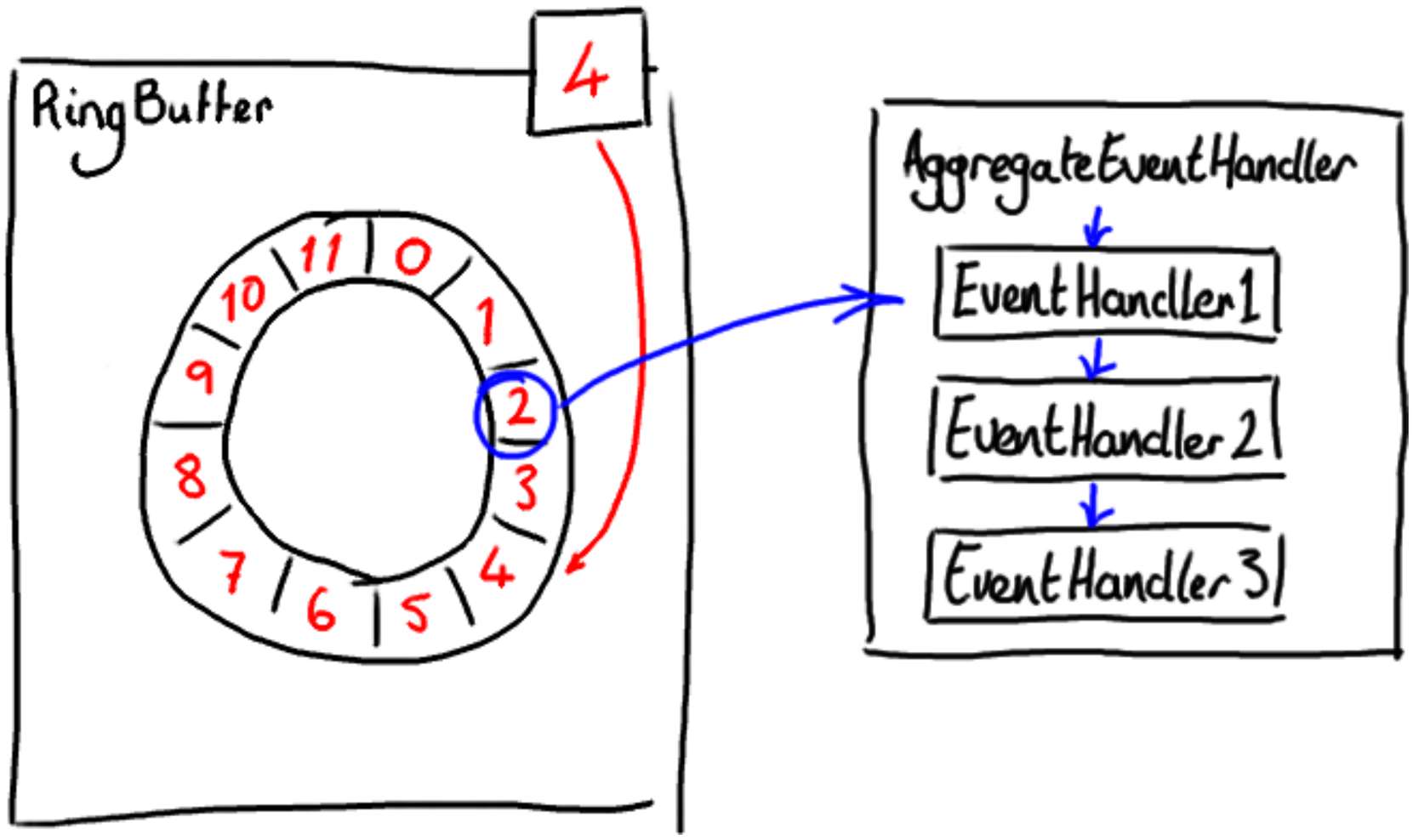
7
6
5
4
WorkHandler
WorkHandler
WorkHandler
WorkHandler

AggregateEventHandler



WaitStrategies

- BlockingWaitStrategy
- BusySpinWaitStrategy
- SleepingWaitStrategy
- YieldingWaitStrategy

ClaimStrategies

- SingleThreadedClaimStrategy
- MultiThreadedClaimStrategy
- MultiThreadedLowContentionClaimStrategy