Fish and Chips and Apache Kafka®

By Tibs (they / he)

Slides and accompanying material at
https://github.com/tibs/fish-and-chips-and-kafka-talk

tony.ibbs@aiven.io / *@much_of_a*

What we'll cover

- Me and messaging and Apache Kafka®
- Fish and chips
    - How to talk to Kafka
    - Start with a simple model and work up
    - There's a demo you can play with afterwards

Some message problems I've cared about

- between components on a Set Top Box
- configuration between microservices
- to / from Internet of Things devices, and their support systems

Kafka is a very good fit for the IoT cases, maybe less so for the others

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What I want from messaging

- multiple producers *and* multiple consumers
- single delivery
- guaranteed delivery
- resumes safely if system crashes
- no back pressure handling (queue does not fill up)

Enter, Apache Kafka®

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Kafka terms

Messages are *Events*

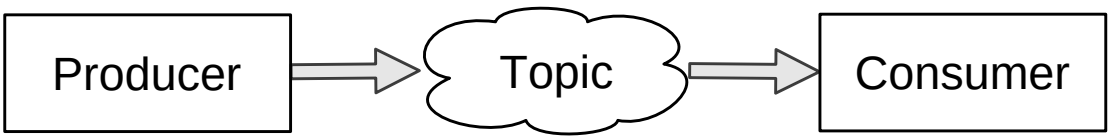
Producers send messages, *Consumers* read them.

Can have multiple Producers and Consumers

A Producer send a message to a named *Topic*, each Consumer reads from a single Topic

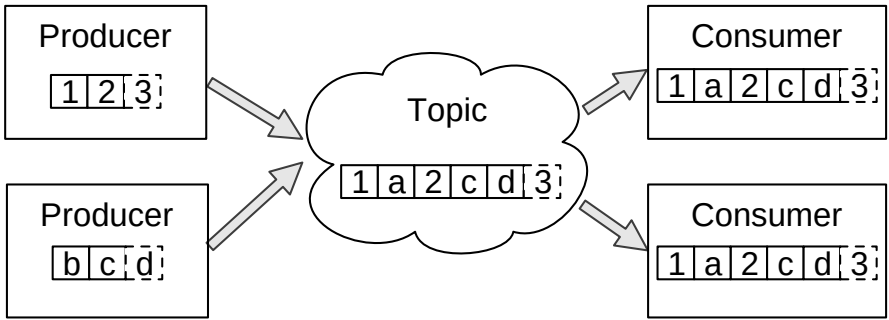
Partitions can be used to "spread the load" within a Topic

Producers, topics, consumers



Events

Multiple produces, multiple consumers



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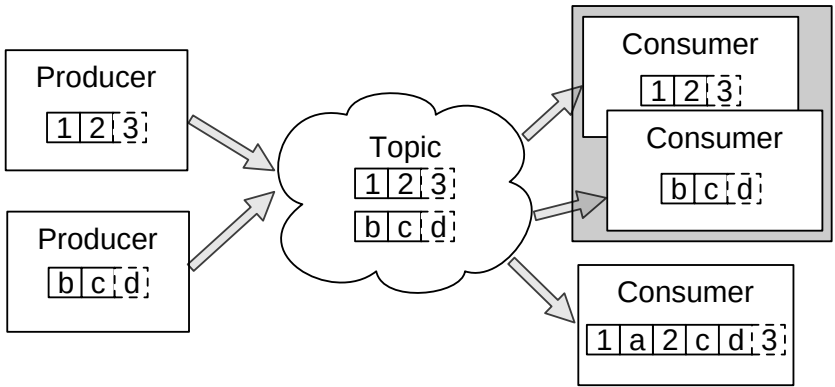
Multiple partitions, consumer groups



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Let's model a fish-and-chip shop

We start with a shop that

- just handles cod and chips
- which are always ready to be served

Glossary

- **Cod**: the traditional white fish for english fish-and-chip shops
- **Chips**: fatter, possibly soggier, french fries
- **Plaice**: a flat fish
- **Till**: a cash register

Serving a customer

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An order

```
{
   "order": 271,
   "parts": [
       ["cod", "chips"],
       ["chips", "chips"],
   ]
}
```

Show first demo

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Libraries

kafka-python: https://github.com/dpkp/kafka-python

aiokafka: https://github.com/aio-libs/aiokafka

Textual: https://github.com/Textualize/textual

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Code: Producer

```
from kafka import KafkaProducer

producer = kafka.KafkaProducer(
    bootstrap_servers=f"{HOST}:{SSL_PORT}",
    security_protocol="SSL",
    ssl_cafile=f'{certs_dir}/ca.pem',
    ssl_certfile=f'{certs_dir}/service.cert',
    ssl_keyfile=f'{certs_dir}/service.key',
    value_serializer=lambda v: json.dumps(v).encode('ascii'),

while SHOP_IS_OPEN:
    # get order from CUSTOMER
    producer.send('ORDER'), order)
```

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Code: Consumer

```
from kafka import KafkaConsumer

consumer = KafkaConsumer(
    "ORDER",
    bootstrap_servers=f"{HOST}:{SSL_PORT}",
    security_protocol="SSL",
    ssl_cafile="ca.pem",
    ssl_certfile="service.cert",
    ssl_keyfile="service.key",
    value_deserializer = lambda v: json.loads(v.decode('ascii')),
)

for msg in consumer:
    print(f'Message {msg.value}')
```

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Code: Asynchronous - needs SSL context

```
import aiokafka.helpers

context = aiokafka.helpers.create_ssl_context(
    cafile=CERTS_DIR / "ca.pem",
    certfile=CERTS_DIR / "service.cert",
    keyfile=CERTS_DIR / "service.key",
)
```

Code: Asynchronous Producer

```
from aiokafka import AIOKafkaProducer

producer = aiokafka.AIOKafkaProducer(
    bootstrap_servers=f"{HOST}:{SSL_PORT}",
    security_protocol="SSL",
    ssl_context=context,
    value_serializer=lambda v: json.dumps(v).encode('ascii'),
)

await producer.start()

while SHOP_IS_OPEN:
    # get order from CUSTOMER
    await producer.send_and_wait('ORDERS', message)
```

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Code: Asynchronous Consumer

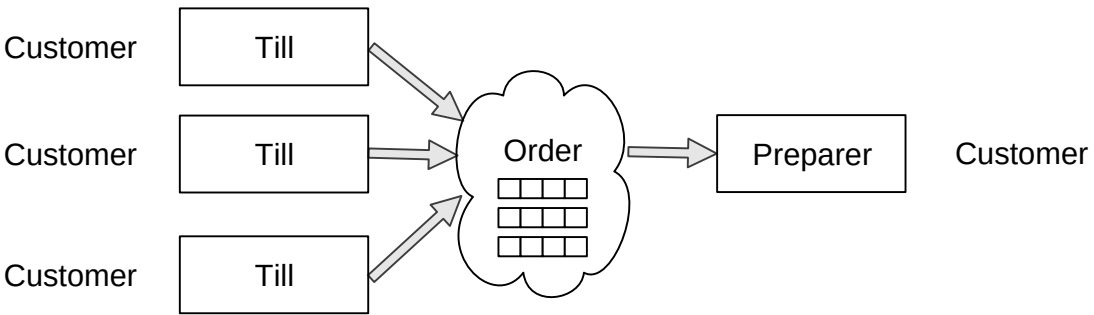
```
consumer = aiokafka.AIOKafkaConsumer(
    'ORDERS',
    bootstrap_servers=f"{HOST}:{SSL_PORT}",
    security_protocol="SSL",
    ssl_context=context,
    value_deserializer = lambda v: json.loads(v.decode('ascii')),
)

await consumer.start()

async for message in consumer:
    print(f'Received {message.value}')
```

More customers - add more TILLs

Customers now queue at multiple TILLs, each TILL is a Producer.

Use the *queue number* as the key to split the events up into partitions

Three tills



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An order with multiple TILLs

```
{
   "order": 271,
   "till": 3,
   "parts": [
       ["cod", "chips"],
       ["chips", "chips"],
   ]
}
```

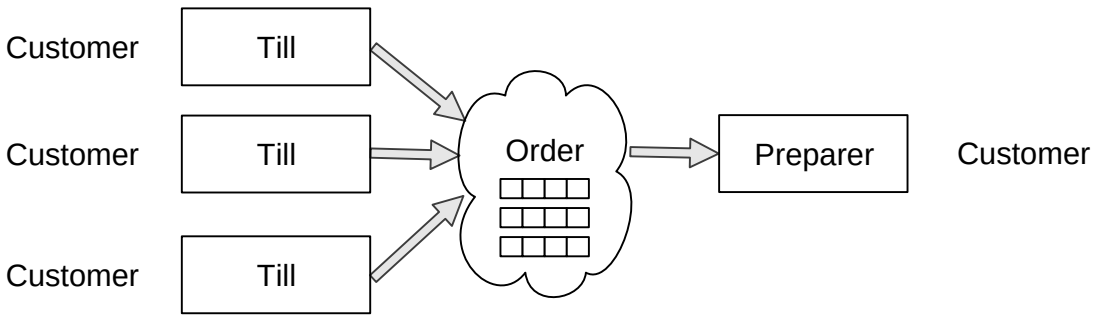
How we alter the code

When creating the topic for the demo, request 3 partitions:

```
NewTopic(name='DEMO2-ORDERS', num_partitions=3_partitions,
         replication_factor=1)
```

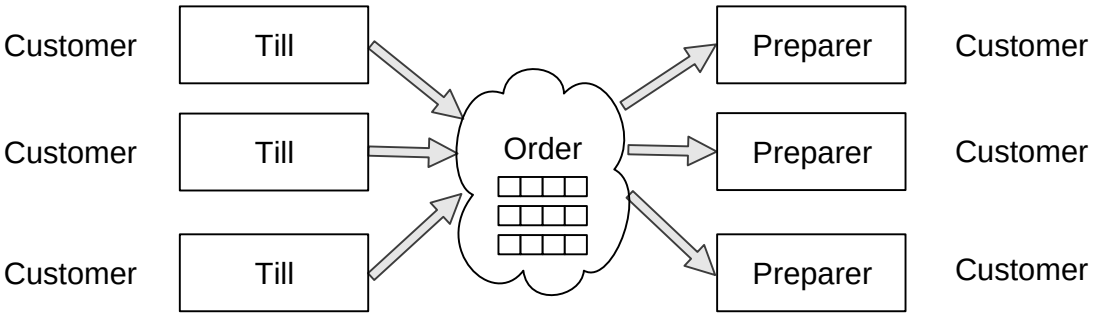
Create 3 Till producers instead of 1

Show demo: multiple TILLs



But now the FOOD-PREPARER is too busy

Add multiple *consumers*



How we alter the code

Send to different partitions

```
await producer.send(TOPIC_NAME, value=order, partition=self.instance_number-1)
```

Consumers need to be in same *consumer group*

```
consumer = aiokafka.AIOKafkaConsumer(
    ...
    group_id=CONSUMER_GROUP,
    ...
```

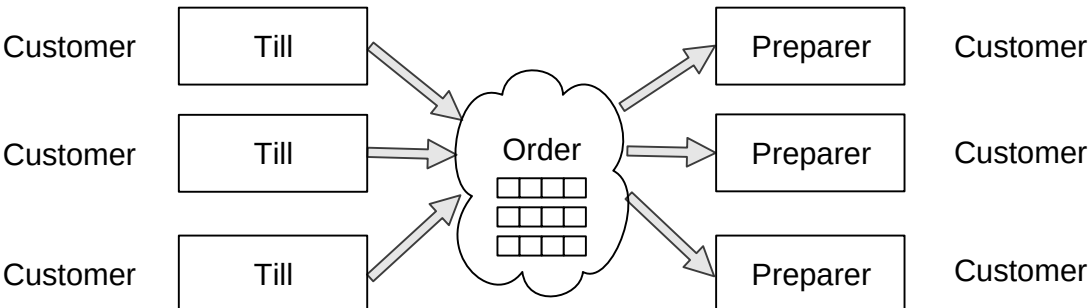
Start consuming from a specific offset

If I run a demo more than once, there's a chance that a consumer might receive events from the previous demo. So we want to make sure that doesn't happen.

Various solutions - simplest for this case is to do:

```
await consumer.seek_to_end()
```

Show demo: multiple TILLs and multiple FOOD-PREPARERS



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Cod or plaice

Plaice needs to be cooked

So we need a COOK to cook it

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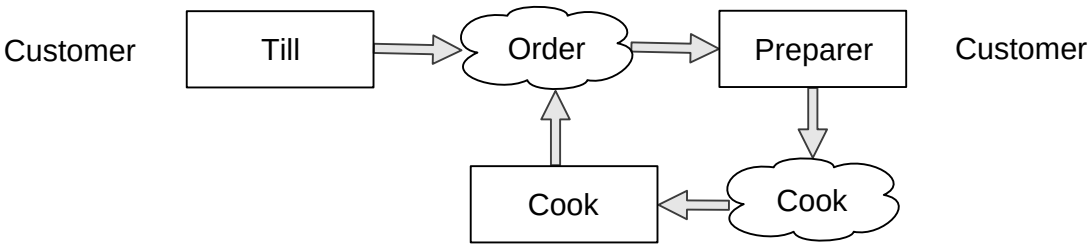
Participant changes - add COOK



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An order with plaice

```
{
   "order": 271,
   "till": 3,
   "parts": [
       ["cod", "chips"],
       ["chips", "chips"],
       ["plaice", "chips"],
   ]
}
```

Gets turned into...

```
{
   "order": 271,
   "till": 3,
   "parts": [
       ["cod", "chips"],
       ["chips", "chips"],
       ["plaice", "chips"],
   ],
   "ready": <boolean>
}
```

Code changes to add COOK

```
def all_order_available(self, order):
    if 'ready' not in order:
        all_items = itertools.chain(*order['order'])
        order['ready'] = 'plaice' not in all_items
```

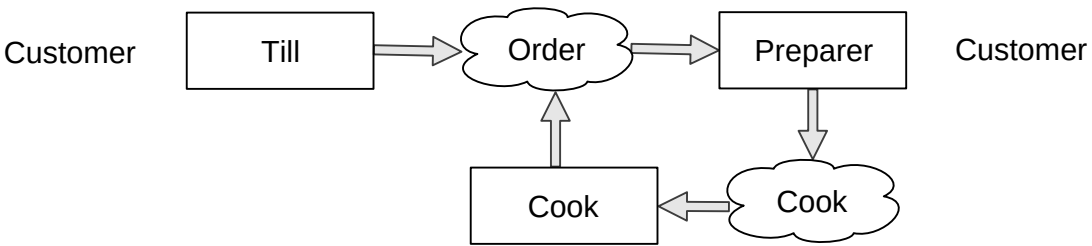
```
order_available = self.all_order_available(order)
if order_available:
    await asyncio.sleep(random.uniform(PREP_FREQ_MIN, PREP_FREQ_MAX))
    # Say order is finished
else:
    await self.producer.send(TOPIC_NAME_COOK, order)
```

In the Cook

```
async for message in consumer:
    ...
    # "Cook" the (plaice in the) order
    await asyncio.sleep(random.uniform(COOK_FREQ_MIN, COOK_FREQ_MAX))
    # It's important to remember to mark the order as ready now!
    # (forgetting to do that means the order will keep going round the loop)
    order['ready'] = True
    await self.producer.send(TOPIC_NAME_ORDERS, order)
```

Demo with COOK

Show demo of (simple) cod-and-chips order, with COOK



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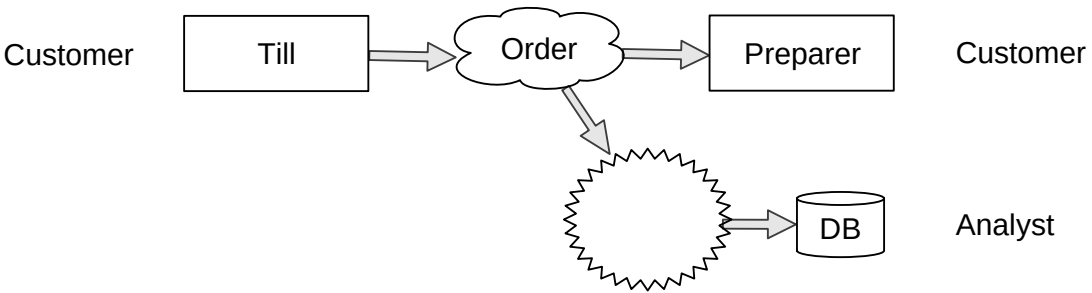
Summary so far

We know how to model the ordering and serving of our cod and chips

We know how to scale with multiple Producers and Consumers

We made a simple model for orders with plaice

Homework 1: Adding the ANALYST



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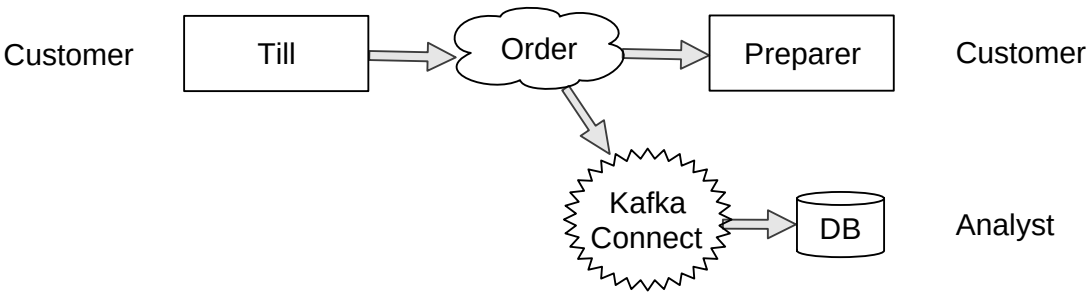
Using Kafka Connect



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Apache Kafka Connectors

These make it easier to connect Kafka to databases, OpenSearch, etc., without needing to write Python (or whatever) code.

How I would do it

The Aiven developer documentation has instructions on how to do this at https://docs.aiven.io/docs/products/kafka/kafka-connect/howto/jdbc-sink.html

- Create an appropriate PostgreSQL database and table
- Make sure that the Kafka service has Kafka Connect enabled
- Use the Aiven web console to setup the new connector

And then add code to the Python demo to query PostgreSQL and make some sort of report over time.

Homework 2: Model cooking the fish and chips

Use a Redis cache to simulate contents of the hot cabinet

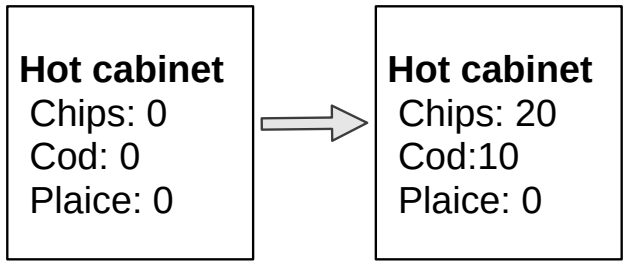
Redis has entries for the hot cabinet content, keyed by `cod`, (portions of) `chips` and `plaice`. We start with 0 for all of them.

Using the cache

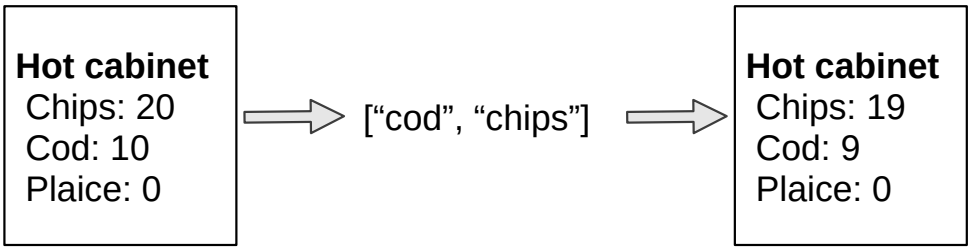
PRODUCER compares the order to the counts in the cache. If there's enough "stuff" to make the order up, decrements the cache appropriately, and that's done.

If not, sends the order to the COOK, who updates the cache - for `plaice` just adds as many as are needed, for the others, if they go below a threshold, adds a standard quantity back in ("cooking in batches"). Then sends the order back into the [ORDER] topic.

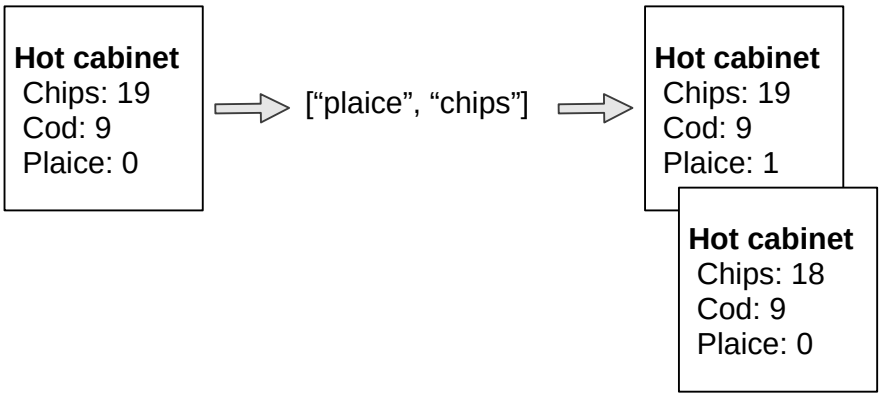
Start of day


Hot cabinet
Chips: 0
Cod: 0
Plaice: 0
Hot cabinet
Chips: 20
Cod:10
Plaice: 0

Cod and chips



Plaice and chips



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Final summary

We know how to model the ordering and serving of our cod and chips

We know how to scale with multiple Producers and Consumers

We made a simple model for orders with plaice

We talked briefly about using Kafka Connectors to share data with other data users

We talked briefly about how one might model the hot cabinet in more detail

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Acknowledgements

Fin

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