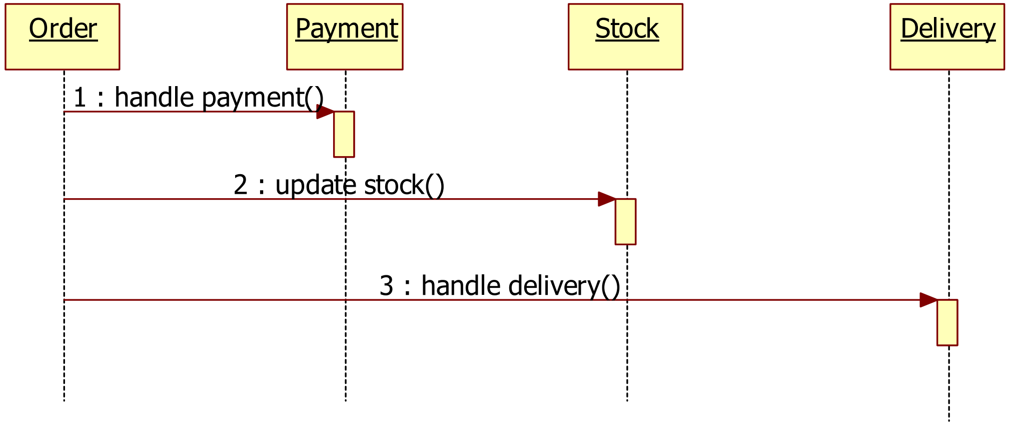
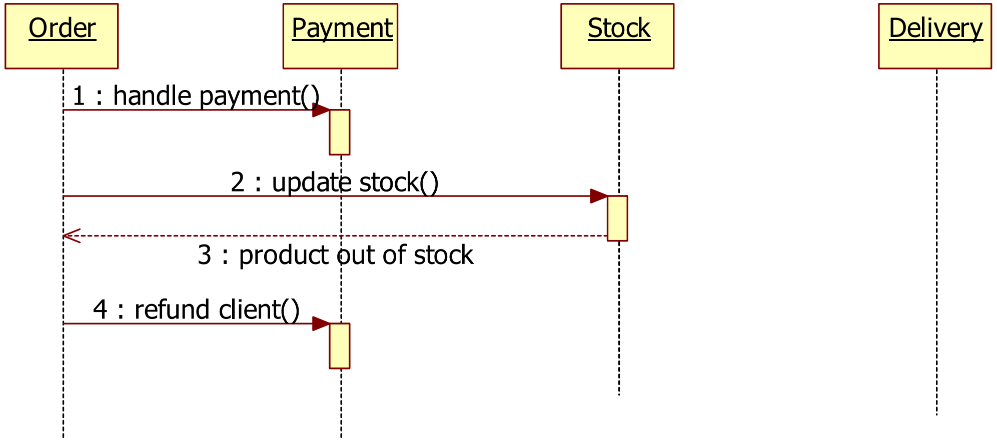
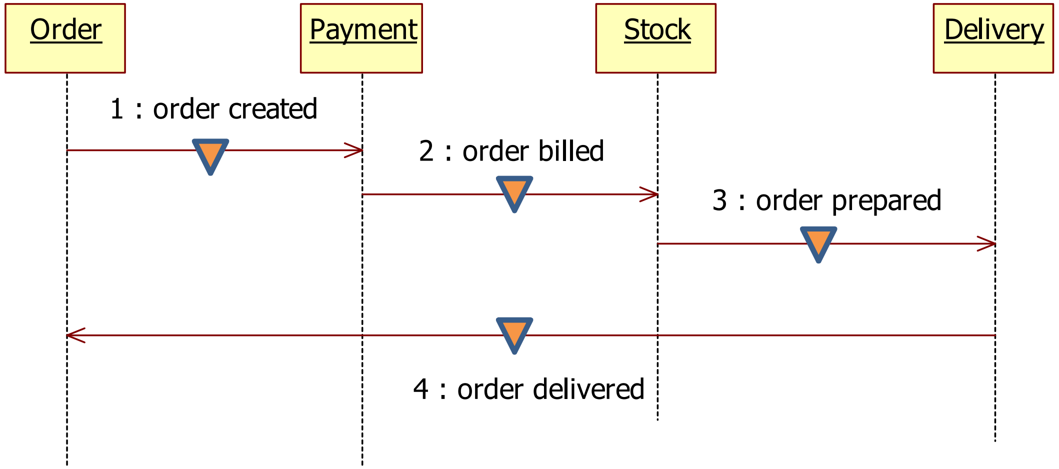
EDA

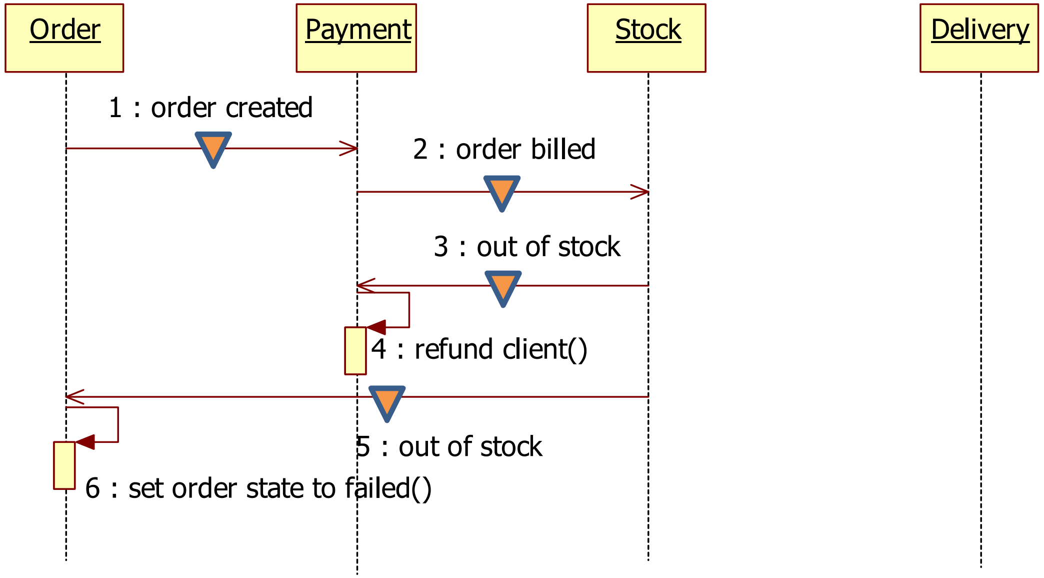
Synchronous (REST) calls





Asynchronous events (messaging)





BLACKBOARD

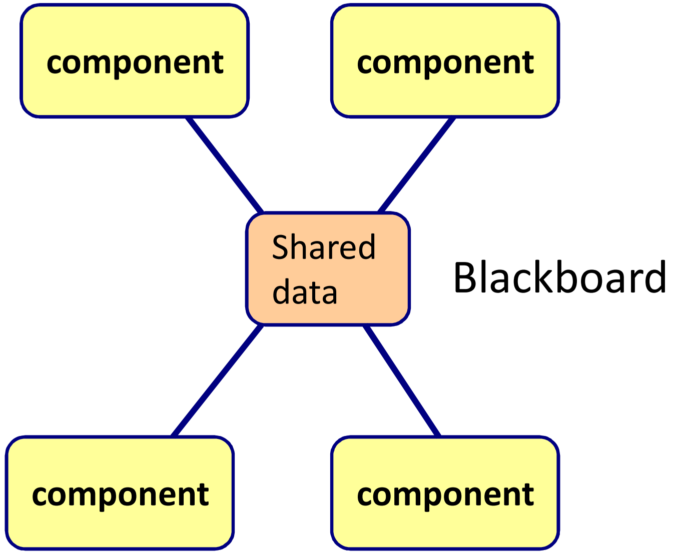
Blackboard

pattern

- Used for non deterministic problems

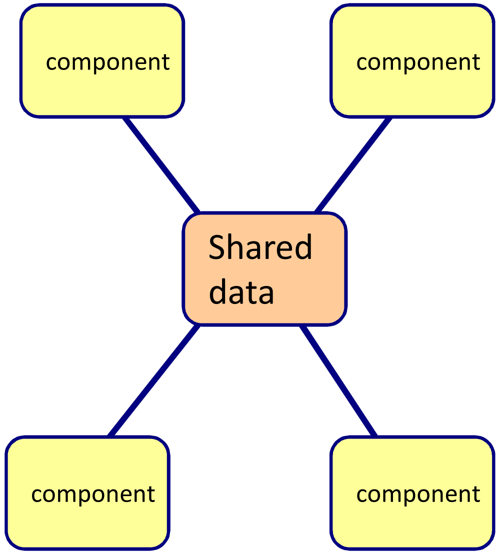
  no algorithm way to solve

  - There is no fixed straight-line solution to a problem
- Every component adds her information on the blackboard



Blackboard

- Common data structure
  - Extension is no problem
  - Change is difficult
- Easy to add new components
- Tight coupling for data structure
- Loose coupling for
  - Location
  - Time
  - Technology(?)
- Synchronisation issues



Blackboard

- Benefits
  - Easy to add new components
  - Components are independent of each other
  - Components can work in parallel

- Drawbacks
  - Data structure is hard to change
    - All components share the same data structure
  - Synchronization issues

EVENT SOURCING

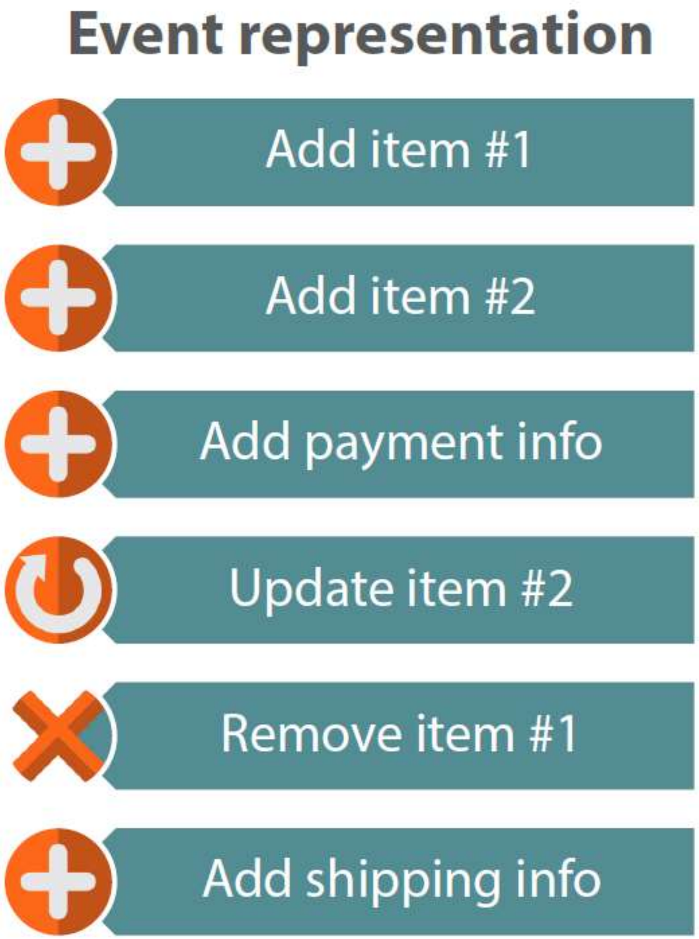
Store the state of a system

Structural representation

- List of ordered goods
- Payment information
- Shipping information

Store the events of a system

inmutable events



Event representation

- Add item #1
- Add item #2
- Add payment info
- Update item #2
- Remove item #1
- Add shipping info

Event sourcing

- Instead of storing the state of an entity in a database, you store the series of events that lead up to the state.
- Storing all of the events increases the analytical capabilities of a business.
- Instead of just asking what the current state of an entity is, a business can ask what the state was at any time in the past

Event sourcing

- For each aggregate
  - Identify (state changing) domain events
  - Define event classes
- Example:
  - Shopping cart
    - ItemAddedEvent
    - ItemRemovedEvent
    - CheckedOutEvent
  - Order
    - OrderCreated
    - OrderApproved
    - OrderShipped

Storing events

- Traditional

ID	status	data…
101	accepted	…

Store entity data

- Event sourcing

Entity ID	Entity type	Event ID	Event type	Event data…
101	Order	901	OrderCreated	…
101	Order	902	OrderApproved	…
101	Order	903	OrderShipped	…

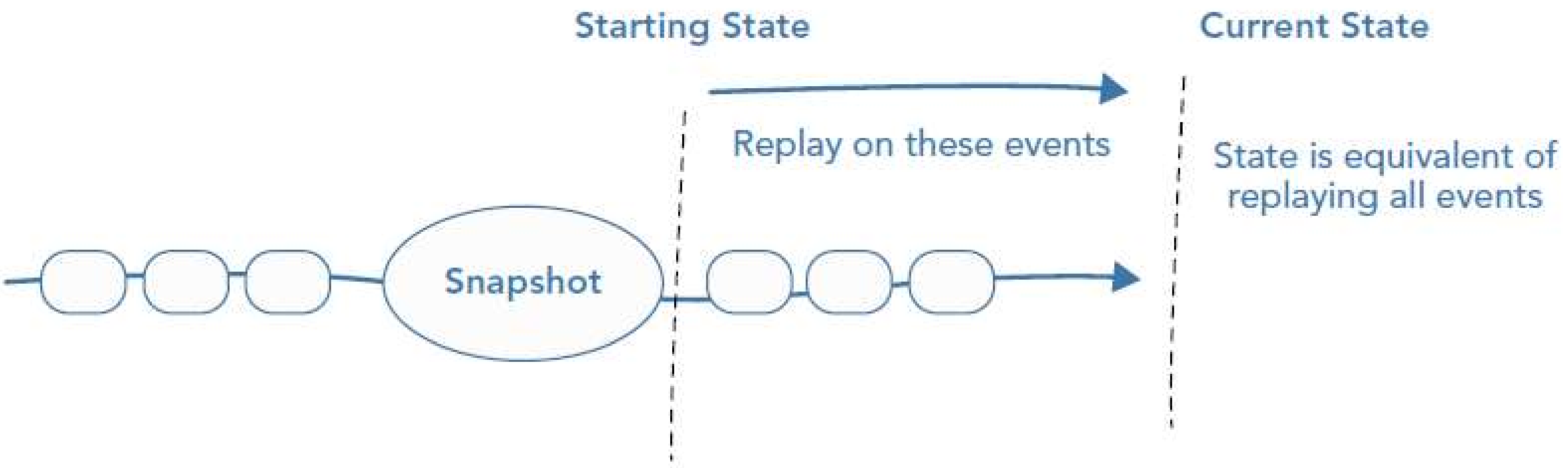
Store state changing events

Advantages of storing events

- You don’t miss a thing
  - Business can analyze history of events
  - Bugs can be solved easier
- Can be replayed
- Events are immutable

Snapshots

- Intermediate steps in an event stream that represent the state after replaying all previous events
    - Can increase performance when streams are very long



STREAM BASED ARCHITECTURE

Stream based systems

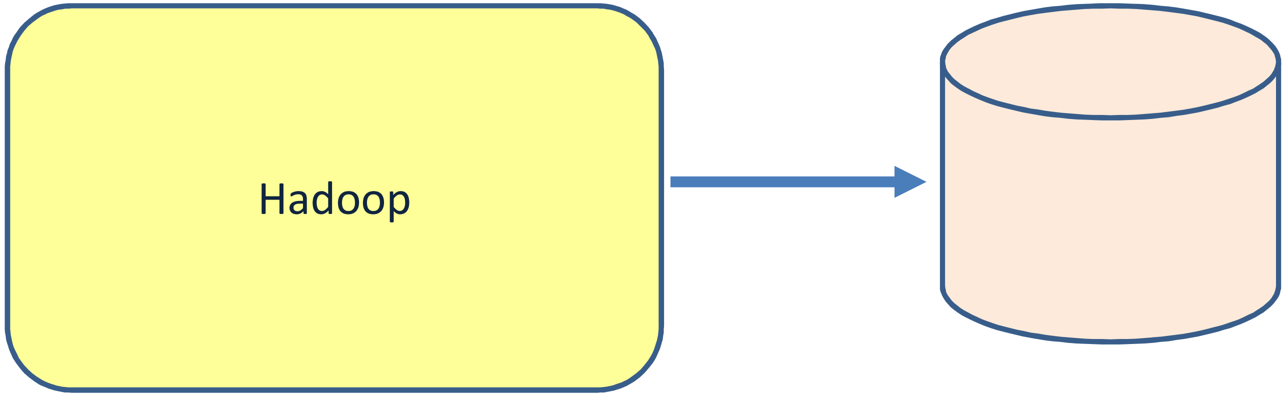
- Continuous stream of data
  - Stock market systems
  - Social networking systems
  - Internet of Things (IoT)systems
  - Systems that handle sensor data
  - System that handle logfiles
  - Systems that monitor user clicks
  - Car navigator software

But also

- Stream of purchases in web shop
- Stream of transactions in a bank
- Stream of actions in a multi user game
- Stream of bookings in a hotel booking system
- Stream of user actions on a web application
- …

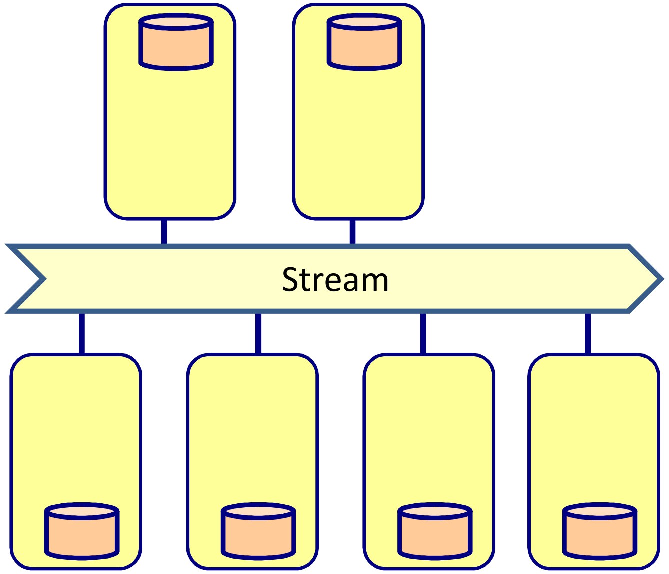
Batch processing

- First store the data in the database
- Then do queries (map-reduce) on the data
- Queries over all or most of the data in the dataset.
- Latencies in minutes to hours



Stream processing

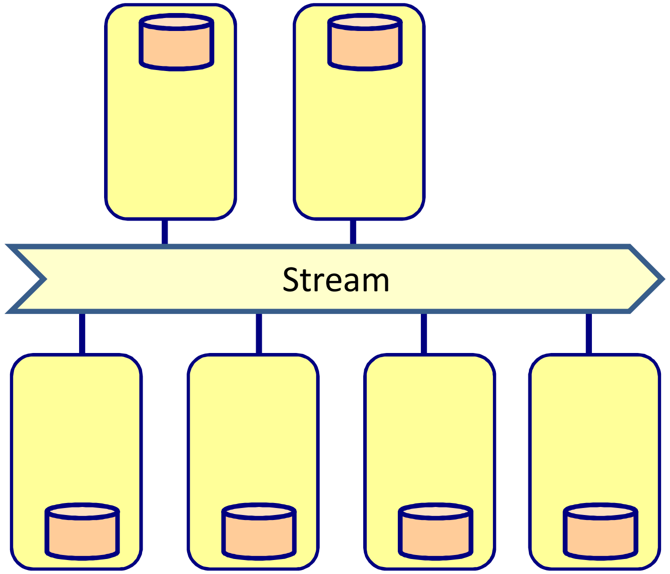
- Handle the data when it arrives
- Handle event (small data) by event
- Latencies in seconds or milliseconds



Stream based architecture

Works good for applications with:

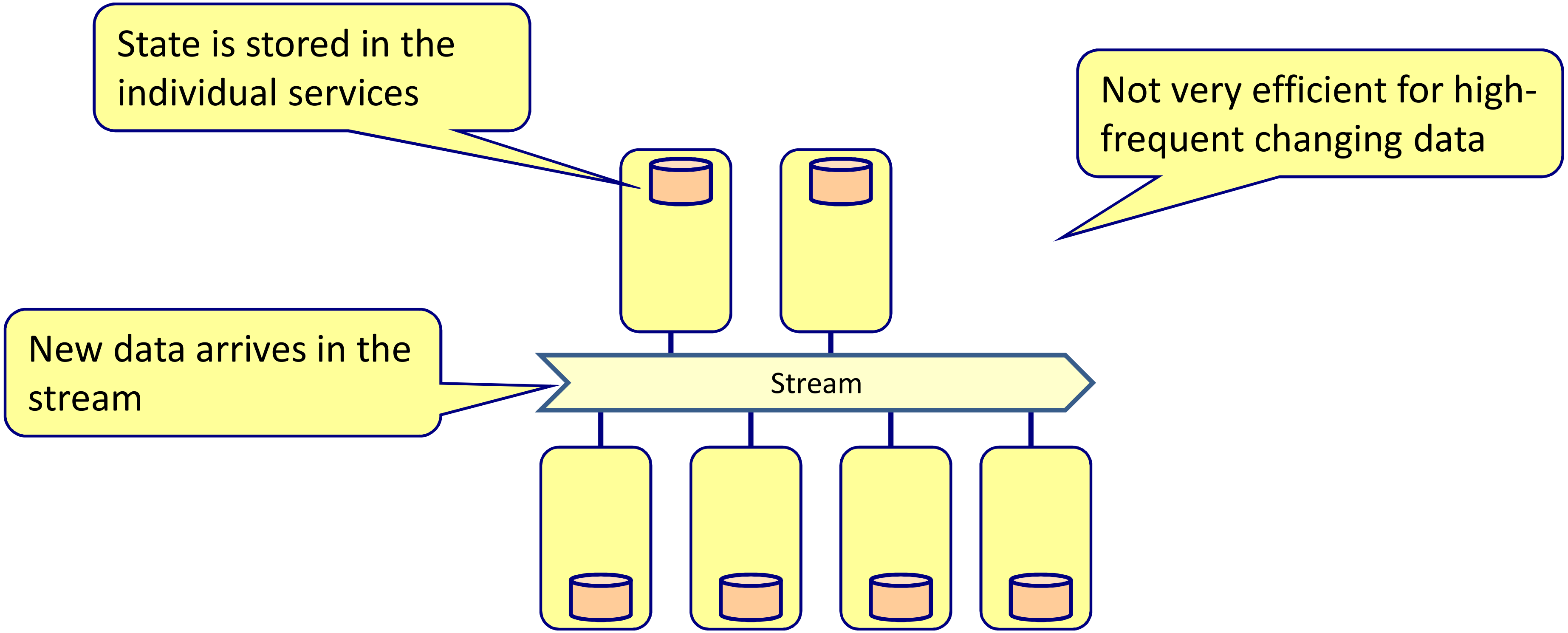
1. high volume data
2. high frequency changes



Stream

- Stream is just a sequence of events
- Implemented with a distributed messaging system
  - Kafka
  - MapR

Where is the data?

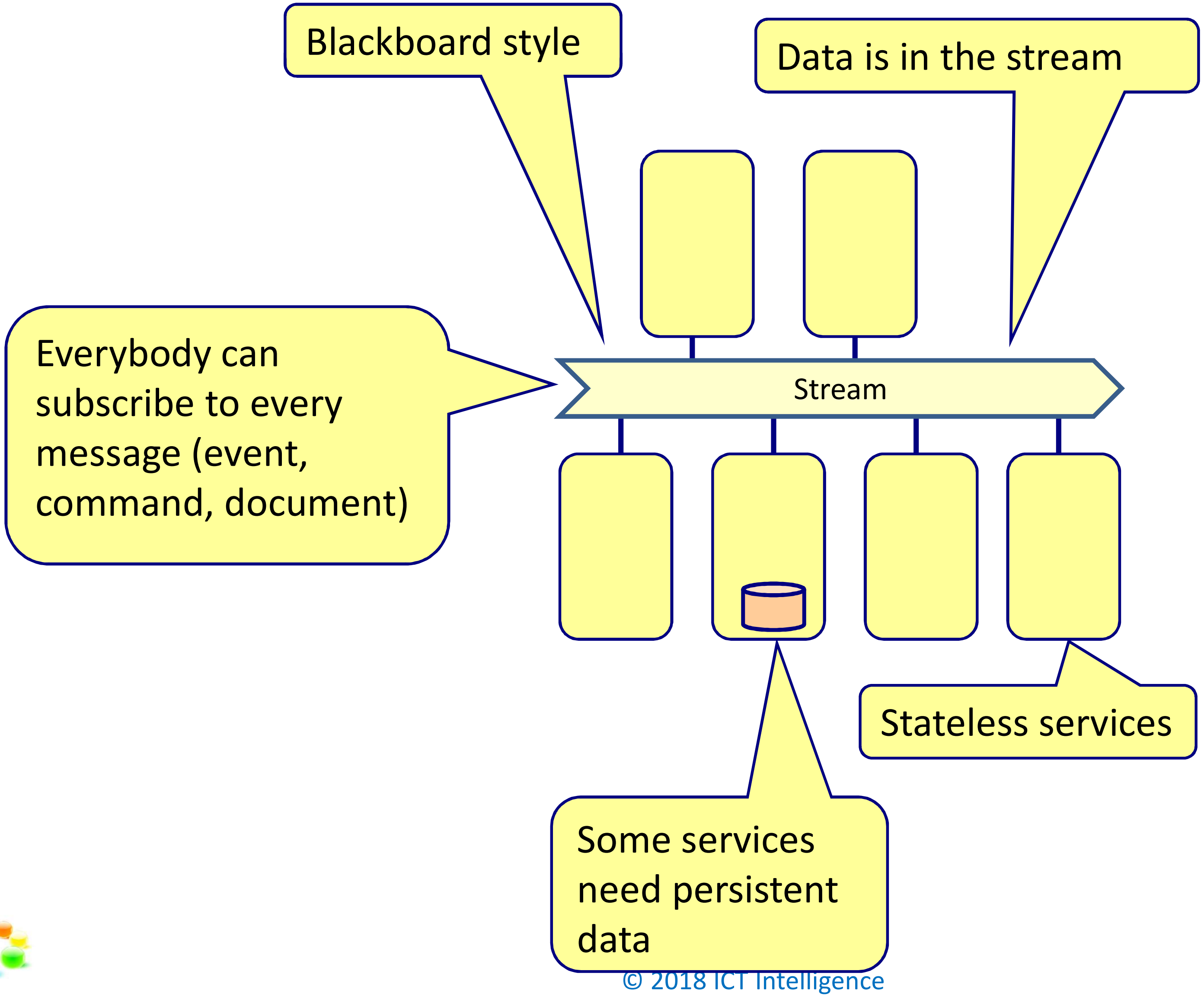


State is stored in the individual services

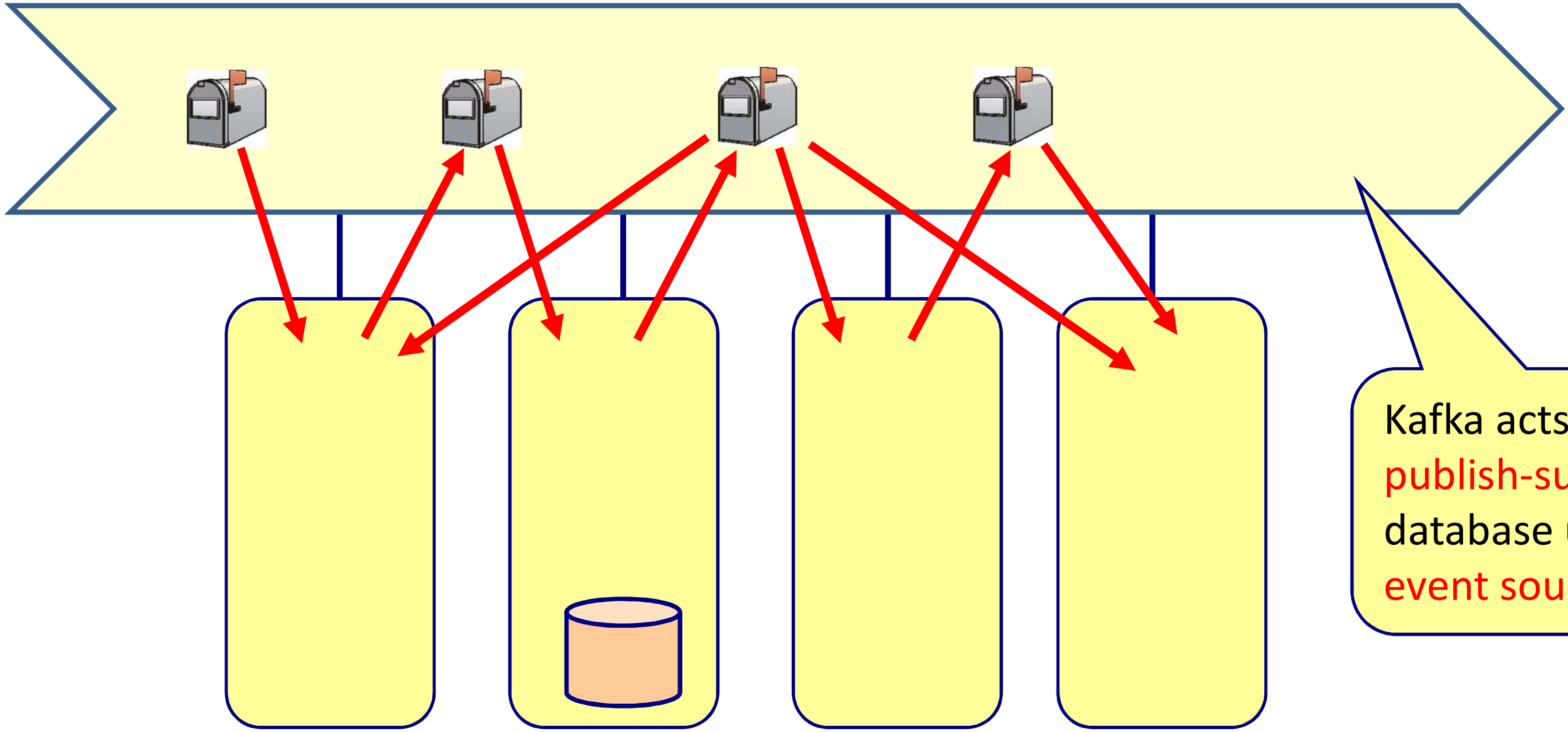
Not very efficient for high-frequent changing data

New data arrives in the stream

Where is the data?

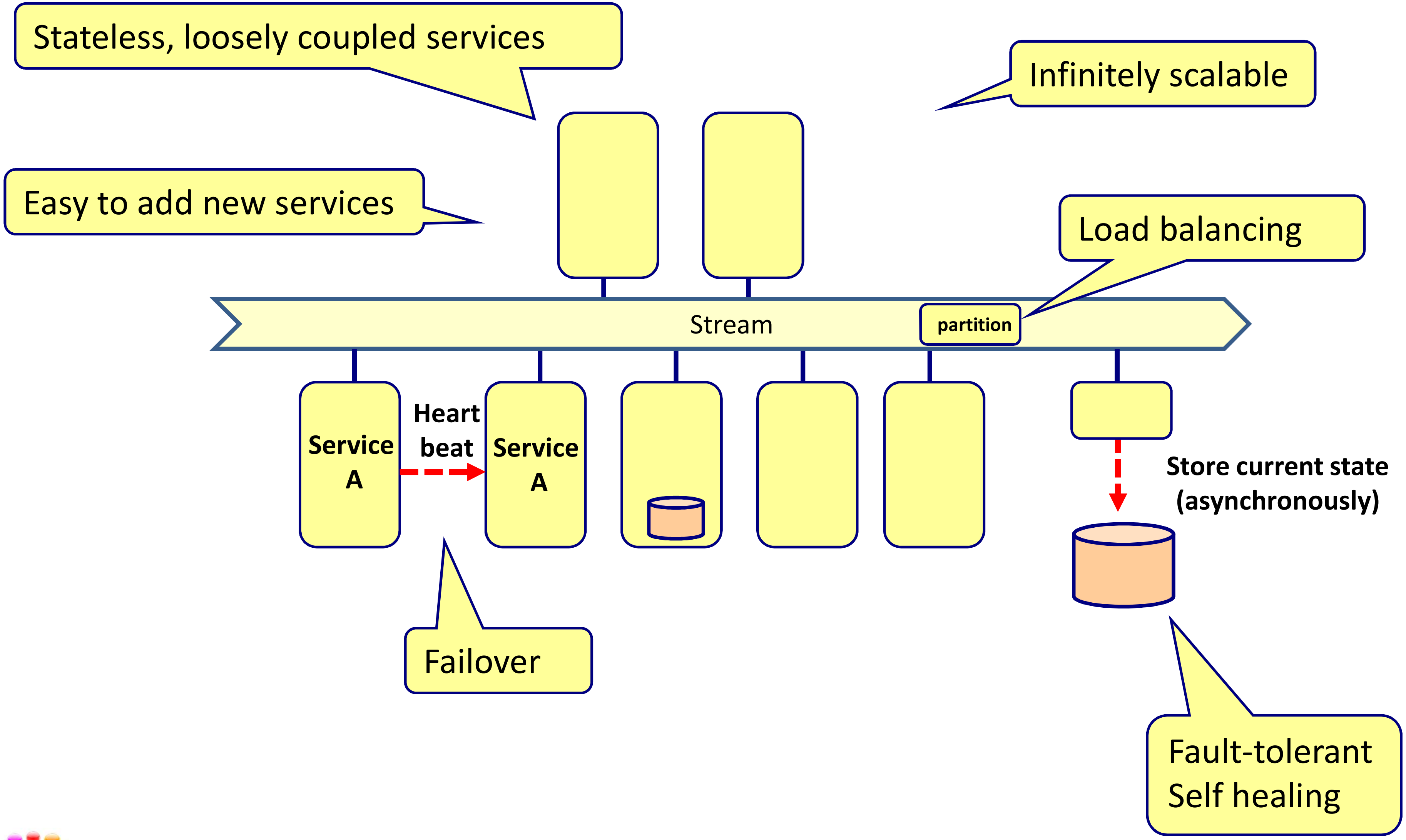

Blackboard style
Data is in the stream
Everybody can subscribe to every message (event, command, document)
Stream
Stateless services
Some services need persistent data

Publish-subscribe and event sourcing



Kafka acts as a publish-subscribe database using event sourcing

Stream based architecture



KAFKA

Kafka producer: sending an object

```
@Service
public class Sender {
    @Autowired
    private KafkaTemplate<String, Person> kafkaTemplate;

    @Value("${app.topic.greetingtopic}")
    private String topic;

    public void send(Person person){
    System.out.println("sending person="+person.getFirstName()+" "
                        +person.getLastName()+" to topic="+ topic);
        kafkaTemplate.send(topic, person);
    }
}
```

```
public class Person {

  private String firstName;
  private String lastName;
  ...
}
```

Kafka consumer: receiving an object

```
@Service
public class Receiver {

    @KafkaListener(topics = "${app.topic.greetingtopic}")
    public void receive(@Payload Person person,
                        @Headers MessageHeaders headers) {
        System.out.println("received message="+ person.getFirstName()+" "
                              +person.getLastName());
    }
}
```

```
public class Person {

  private String firstName;
  private String lastName;
  ...
}
```

The configuration

application.properties

```
spring.kafka.bootstrap-servers=localhost:9092
spring.kafka.consumer.group-id= gid
spring.kafka.consumer.auto-offset-reset= earliest
spring.kafka.consumer.key-deserializer=
org.apache.kafka.common.serialization.StringDeserializer
spring.kafka.consumer.value-deserializer=
org.springframework.kafka.support.serializer.JsonDeserializer
spring.kafka.producer.key-serializer=
org.apache.kafka.common.serialization.StringSerializer
spring.kafka.producer.value-serializer=
org.springframework.kafka.support.serializer.JsonSerializer
spring.kafka.consumer.properties.spring.json.trusted.packages=kafka

app.topic.greetingtopic= greetingtopic
```

JsonSerializer
and
JsonDeserializer

Add trusted
packages for
consumer