

# Creating millions of user sessions using complex event processing

Prem Santosh

pxu@yelp.com

@premsantosh



# Agenda

- Motivation
- Sessionizer Specs
- Sessionizer
- Issues
  - Bot traffic
  - Duplicate sessions
  - Stale topics
  - S3 Checkpointing / Throttling
  - Flink Internal Timer State



# Yelp's Mission

Connecting people with great local businesses.



# Agenda

- Motivation
- Sessionizer Specs
- Sessionizer
- Issues
  - Bot traffic
  - Duplicate sessions
  - Stale topics
  - S3 Checkpointing / Throttling
  - Flink Internal Timer State

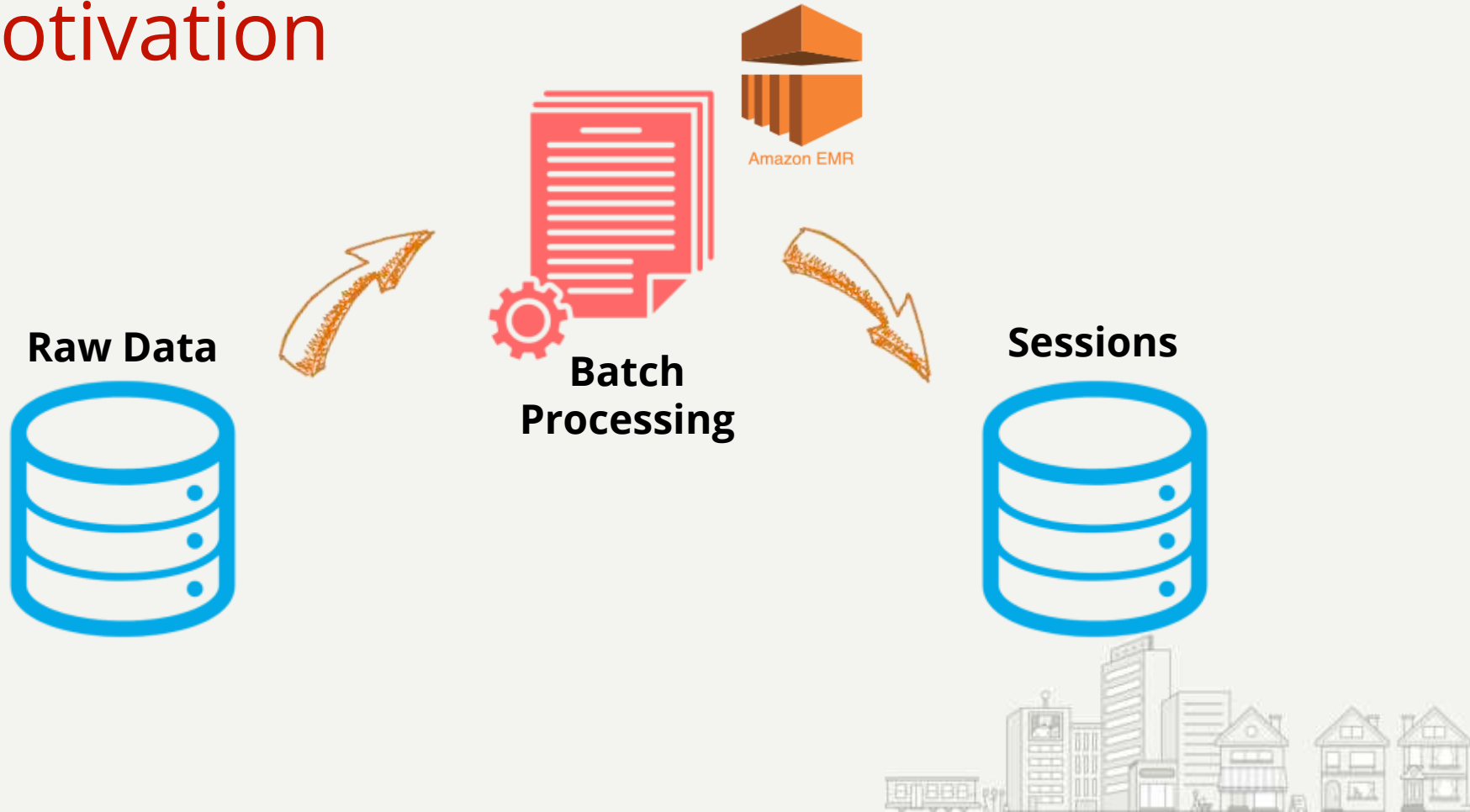


# Why Sessions?

- Fundamental element of engagement with Yelp
- Understand intent of users
- Generate other product metrics using sessions



# Motivation



# Motivation

- Slow
- Expensive
- One day late
- Sessions crossing midnight



# Agenda

- Motivation
- Sessionizer Specs
- Sessionizer
- Issues
  - Bot traffic
  - Duplicate sessions
  - Stale topics
  - S3 Checkpointing / Throttling
  - Flink Internal Timer State





# Sessionizer Specs

- 1 Master
  - M4.xlarge (4 CPU, 16GB)
- 6 Core
  - M4.16xlarge (6 \* 64 CPUs, 6 \* 256GB)
- 6 Input kafka topics
- Total input throughput ~25K msg/sec



# Agenda

- Motivation
- Sessionizer Specs
- **Sessionizer**
- Issues
  - Bot traffic
  - Duplicate sessions
  - Stale topics
  - S3 Checkpointing / Throttling
  - Flink Internal Timer State



# User Session



## Pizza Rollio

★★★★☆ 36 reviews

\$\$ · Salad, Coffee & Tea, Pizza

(917) 261-6779

261 W 18th St

Chelsea

"Agree with the last review, very atmospheric and Feels like in Italy inside! **Pizza** crust is a number one for me, your place got it just right. Were there last Thursday on our..." [read more](#)

Start Order

Offers takeout and delivery



## Sauce Pizzeria

★★★★☆ 98 reviews

Pizza, Italian

(646) 983-4007

345 E 12th St

East Village

"I've been eyeing this place for the last 3 months since it opened. Of course I heard about it from El Prez and Frankie from barstool. 9.1. They gave it super high praise and I just..." [read more](#)

Start Order

Offers takeout and delivery



# User Session

## Sauce Pizzeria Claimed

 98 reviews

Pizza, Italian [Edit](#)

 [Write a Review](#)

 Add Photo

 Share

 Save

### Review Highlights



"I am excited to go back and try their [Al Pastor Pie](#) :) Oh, and did I mention they serve soft serve?!" in 2 reviews

[\\$25 Al Pastor Pie](#)



"Tried 4 amazing slices with my bf...my favorite was the [upside](#) down cheese but everything we had was delicious. " in 21 reviews



"Thin, [crispy](#) crust, a well-balanced sauce, and this amazingly salty mozzarella all in perfect proportion." in 10 reviews

## Order Food

☒ Delivery ☐ Takeout

**\$1.99+** fee • **\$0** min • **45-55** mins

### Delivery Address

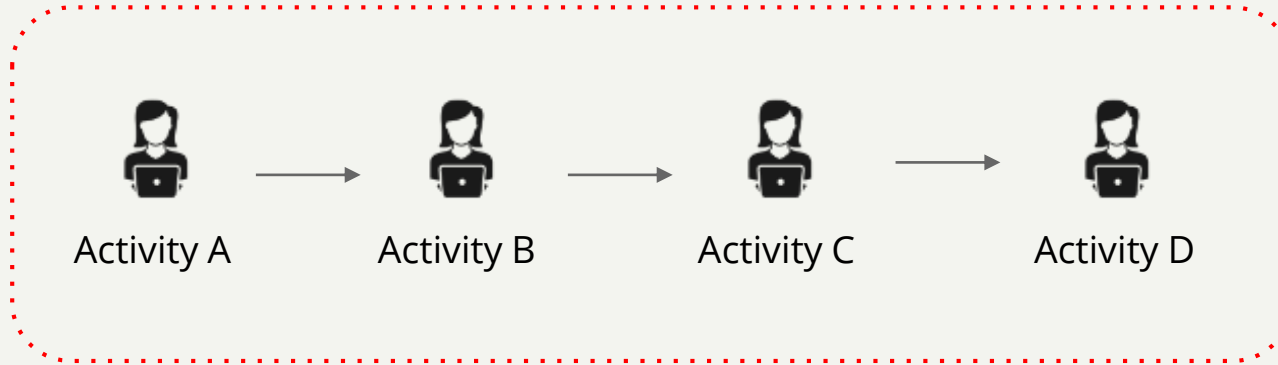
Enter delivery address

[View Menu](#)

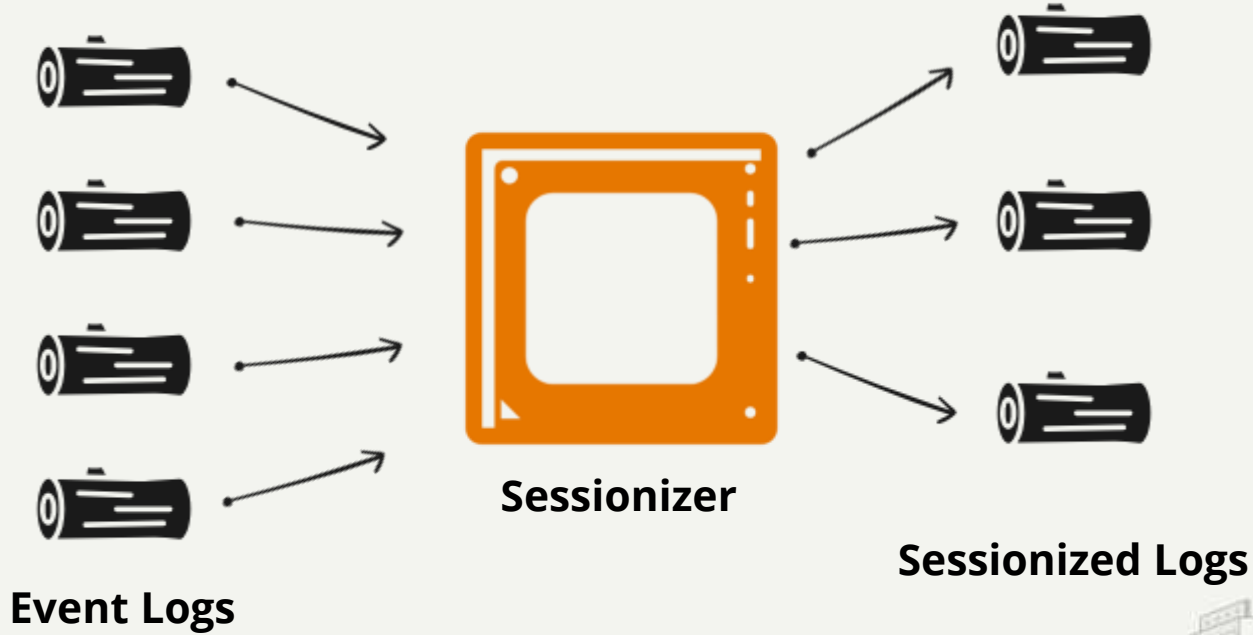


# User Session

UserID = XYZ

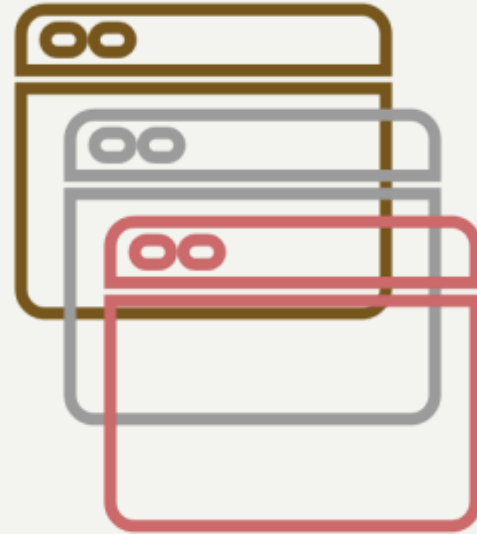
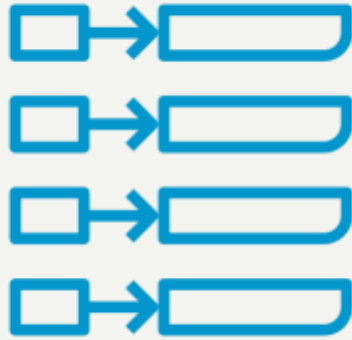


# Sessionizer



# Sessionizer Operators

KeyBy: UserID



`.window(EventTimeSessionWindows)`



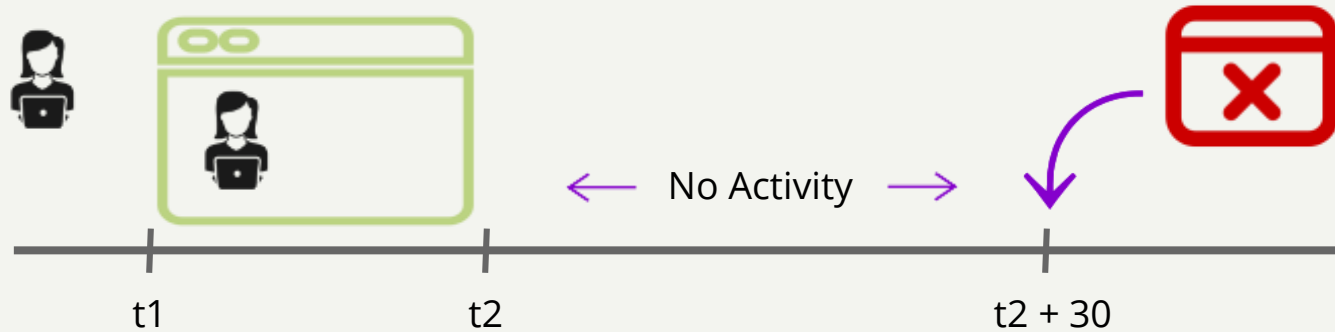
# Agenda

- Motivation
- Sessionizer Specs
- Sessionizer
- **Issues**
  - Bot traffic
  - Duplicate sessions
  - Stale topics
  - S3 Checkpointing / Throttling
  - Flink Internal Timer State





# Never ending bot sessions



# Never ending bot sessions



# Never ending bot sessions

```
class SessionLengthAndLateDataTrigger(..) extends Trigger {  
  def onElement(.., ctx: TriggerContext): TriggerResult = {  
    if(ctx.getCurrentWatermark > startTimestamp + maxSessionLength) {  
      // Perform cleanup actions  
      TriggerResult.FIRE_AND_PURGE  
    }  
  }  
}
```



# Agenda

- Motivation
- Sessionizer Specs
- Sessionizer
- **Issues**
  - Bot traffic
  - **Duplicate sessions**
  - Stale topics
  - S3 Checkpointing / Throttling
  - Flink Internal Timer State



# Duplicate Sessions

Session ID	Number of Events
31cca9e6-4207-a323-36c121deaf73	45
95bff7c34-4de5-bc10-ef969a876cf7	27
31cca9e6-4207-a323-36c121deaf73	46
.....	....



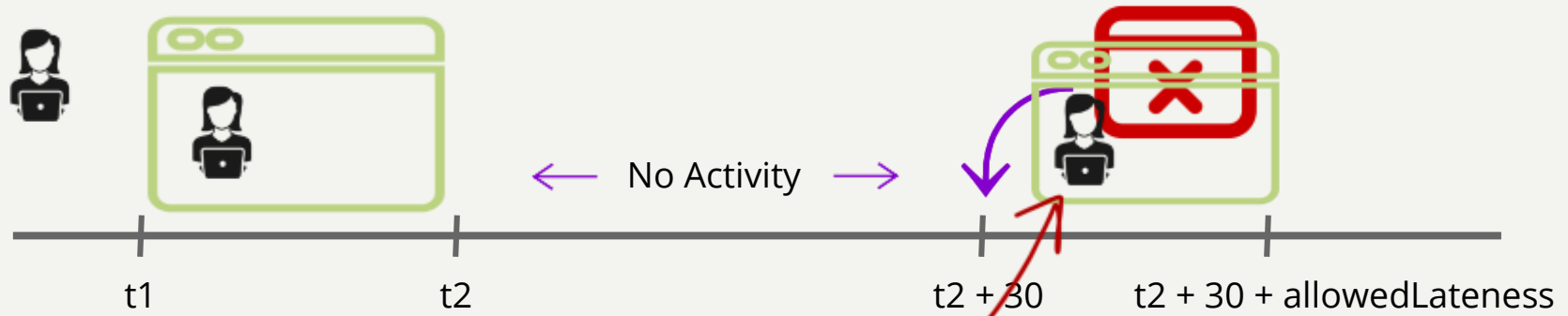
# Duplicate Sessions



```
val sessionStream = messageStream
    .keyBy(message => { getUserID(message) })
    .window(EventTimeSessionWindows.withGap(sessionDuration))
    .allowedLateness(allowedLateness)
```



# Duplicate Sessions



Late Event



# Agenda

- Motivation
- Sessionizer Specs
- Sessionizer
- **Issues**
  - Bot traffic
  - Duplicate sessions
  - **Stale topics**
  - S3 Checkpointing / Throttling
  - Flink Internal Timer State



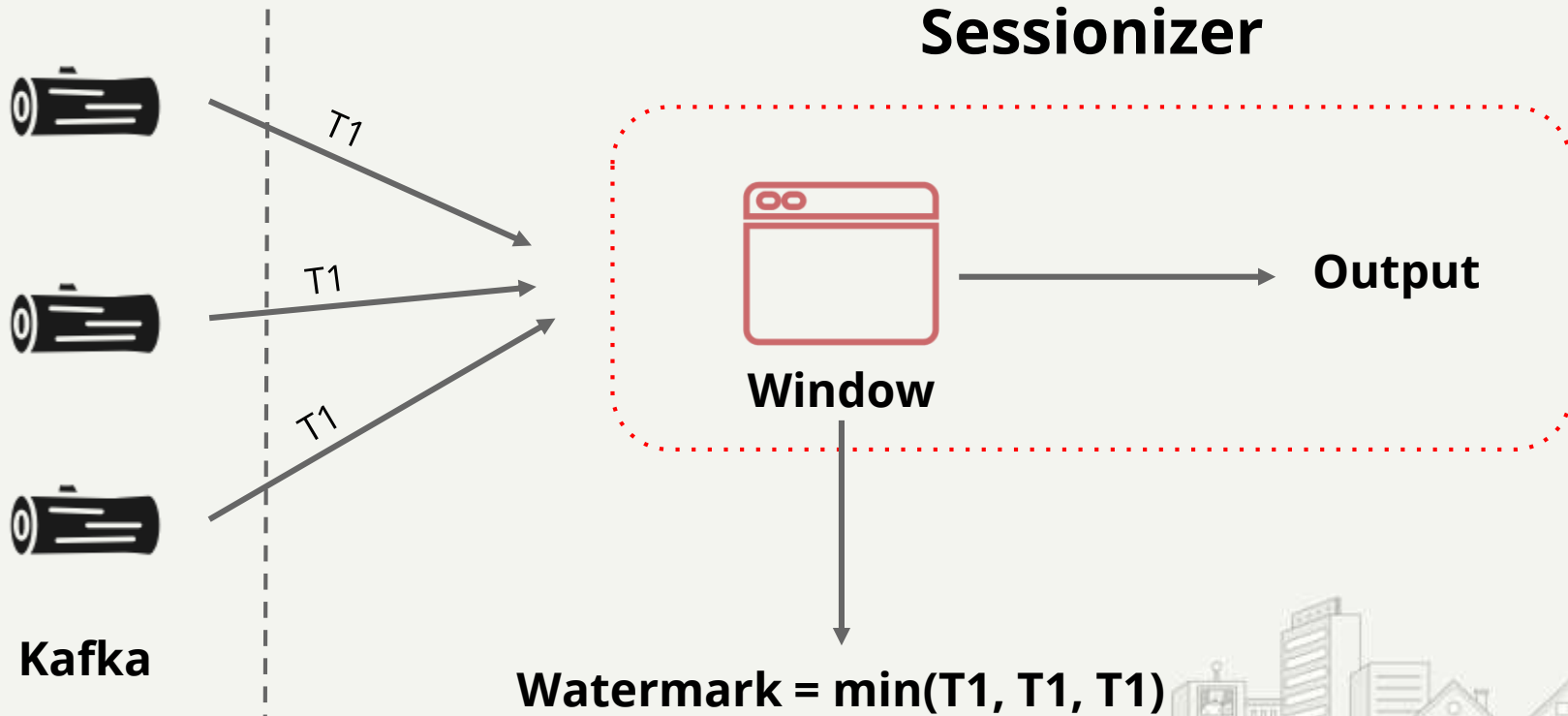


# Stale Topics

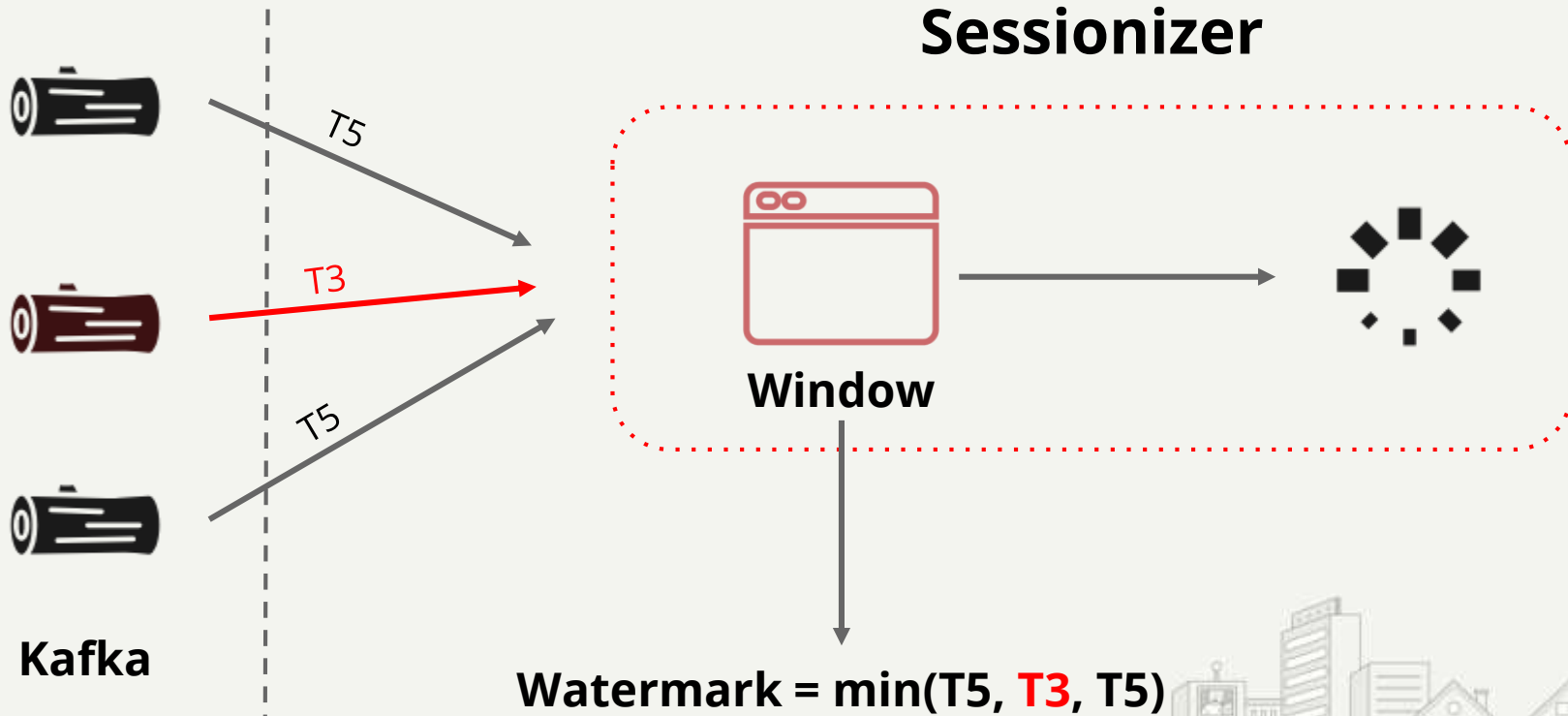
- Event time processing
- Event time watermark: to signal progress in event time.
- Watermarks are crucial when events can be **out-of-order**



# Stale Topics



# Stale Topics

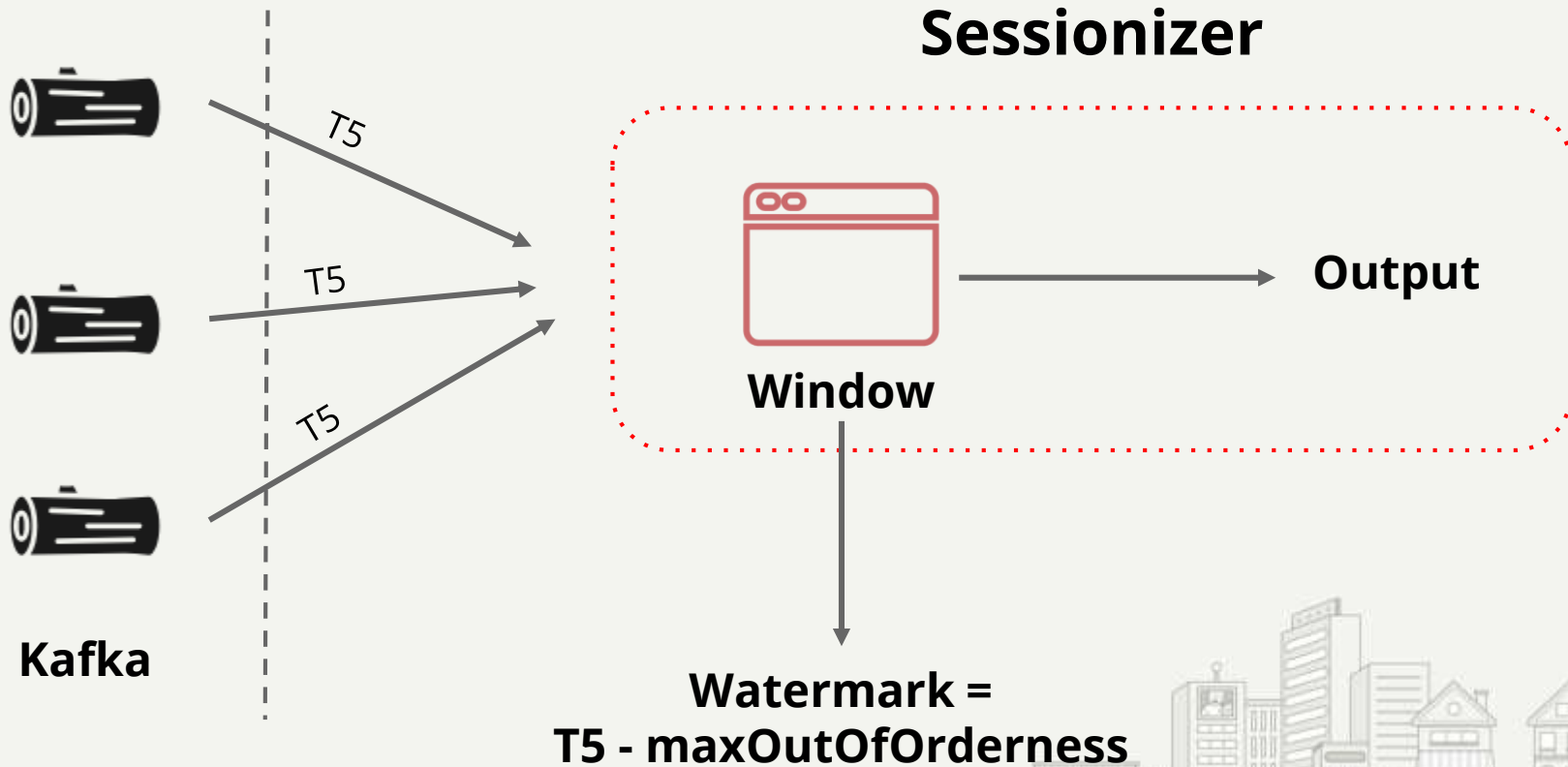


# Stale Topics (Solution)

- Internal state stores time  $T$  since last watermark was seen.
- If  $T > 10\text{mins}$ , override and set watermark



# Stale Topics (Solution)



# Agenda

- Motivation
- Sessionizer Specs
- Sessionizer
- **Issues**
  - Bot traffic
  - Duplicate sessions
  - Stale topics
  - **S3 Checkpointing / Throttling**
  - Flink Internal Timer State



# S3 Throttling/ Checkpointing

- Due to large ingestion rate, we were checkpointing frequently.
- Caused us to be throttled by S3 , causing checkpoint failures



# Amazon S3 Announces Increased Request Rate Performance

Posted On: Jul 17, 2018

Amazon S3 now provides increased performance to support at least 3,500 requests per second to add data and 5,500 requests per second to retrieve data, which can save significant processing time for no additional charge. Each S3 prefix can support these request rates, making it simple to increase performance significantly.

Fixed by [FLINK-9061](#)





# Agenda

- Motivation
- Sessionizer Specs
- Sessionizer
- **Issues**
  - Bot traffic
  - Duplicate sessions
  - Stale topics
  - S3 Checkpointing / Throttling
  - **Flink Internal Timer State**



# Flink Internal Timer State

- Slow data structure to store timer state
- Stores timers in-memory



# Flink Internal Timer State

- Slow data structure to store timer state
  - `HeapInternalTimerService`  $O(n)$  deletion operation
  - High CPU usage
  - 50 million session mark → super slow processing



# Flink Internal Timer State

- Stores timers in-memory
  - `HeapInternalTimerService` only implementation
  - Session count  $\uparrow$  results OOM
  - [FLINK-9485](#) rocksDB implementation



# Flink Internal Timer State

- Slow data structure to store timer state
  - [FLINK-9423](#)
- Stores timers in-memory
  - [FLINK-9485](#)



# Thank You!



[pxu@yelp.com](mailto:pxu@yelp.com)



[@premsantosh](https://twitter.com/premsantosh)



A large, diverse group of young adults, likely students or young professionals, are gathered in a crowd. They are all smiling, cheering, and raising their hands in the air, creating a sense of excitement and celebration. The group is multi-ethnic and multi-gender. The background is a plain, light-colored wall. The overall atmosphere is one of joy and enthusiasm.

# We're Hiring!

[www.yelp.com/careers/](http://www.yelp.com/careers/)



[fb.com/YelpEngineers](https://fb.com/YelpEngineers)



[@YelpEngineering](https://twitter.com/YelpEngineering)



[engineeringblog.yelp.com](https://engineeringblog.yelp.com)



[github.com/yelp](https://github.com/yelp)