2019 MAY 22, HONG KONG

OBSERVABLE

OBSERVABLE

RxSwift

RxJava

RxJS

RxScala

Async Push Model

ReactiveX

PROGRAMMING MODEL

- **Sync**
  - f(**input**) -> return **something**
    If something error, throw Exception inside

- **Async**
  - f(**input, onSuccessCallback, onErrorCallback**)
    If something error, call onErrorCallback()

PROGRAMMING MODEL (ASYNC)

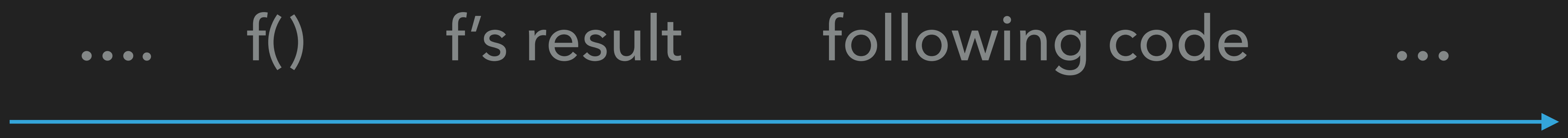
- JavaScript
    1. Pass **callback functions** as parameter
    2. Return a **Promise**
    3. Use syntax sugar for Promise: **await/async**

PROGRAMMING MODEL (ASYNC)

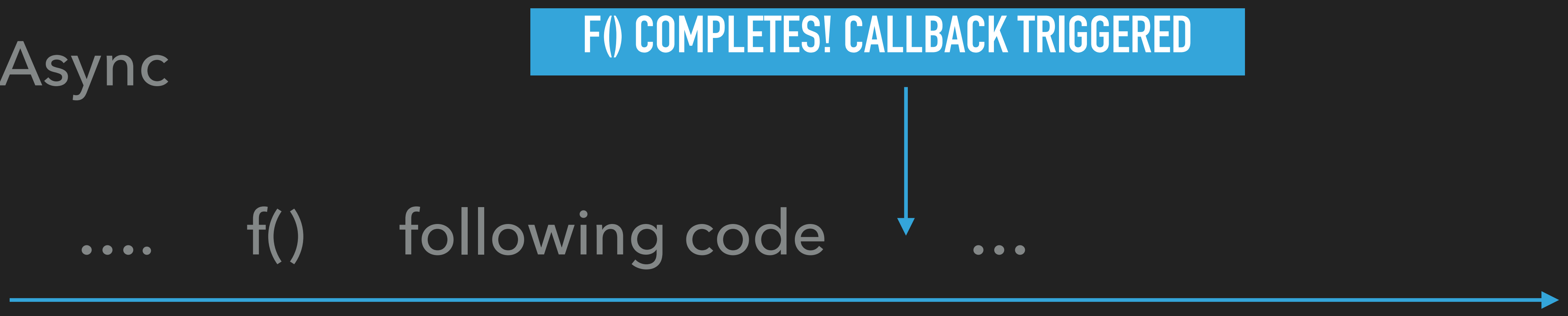
- Java
  1. Pass **anonymous inner class** object as parameter
  2. Pass **functional interface** (Java 8)
  3. Return a **CompletableFuture**

IMAGE A TIMELINE

- Sync



- Async



START OVER, AS A LIST (MULTIPLE VALUES)

- **Sync**
  - f(**input**) -> return **an iterator**
- **Async**
  - f(**input, onResultSuccessCallback (n-th value), onResultErrorCallback**)

ASYNC CASES

- Event: **onKeyPress, onMouseClick, onMouseMove**
- Timer: **Tick every 2 second**
- Remote API call

PUSH MODEL (ASYNC)

- Pull Model: I call function, then wait for response
- Push Modal: I **subscribe** something, then you call me (I am the observer)
- So, a API library called **ReactiveX** was born
  Asynchronous programming with observable streams
- **Observable**: To async generate results (1 or more)
  Observer: To subscribe
- Design Pattern: **Iterator, Observer**

IMAGE A TIMELINE (EVENT)

- Click events as Observable
  rxjs.fromEvent(document, "click")

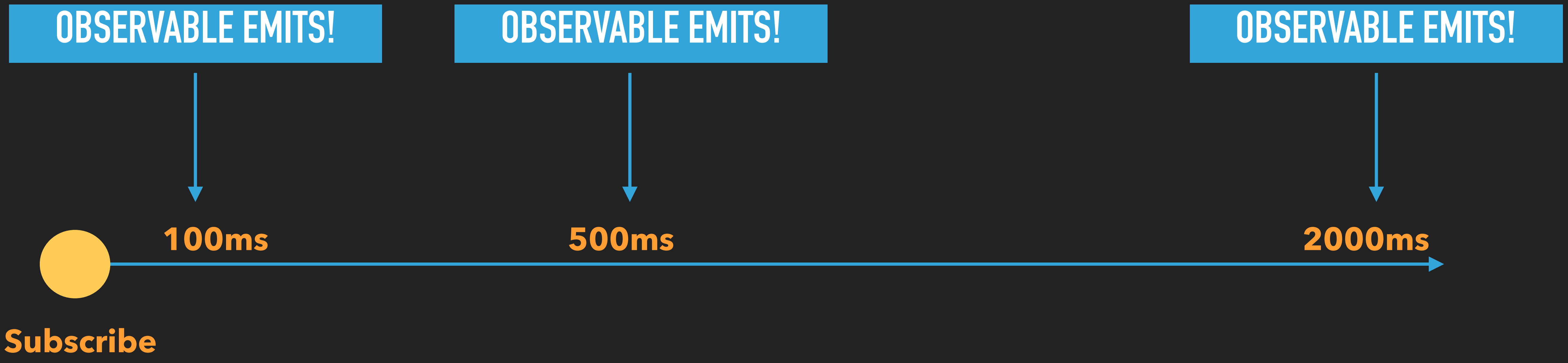
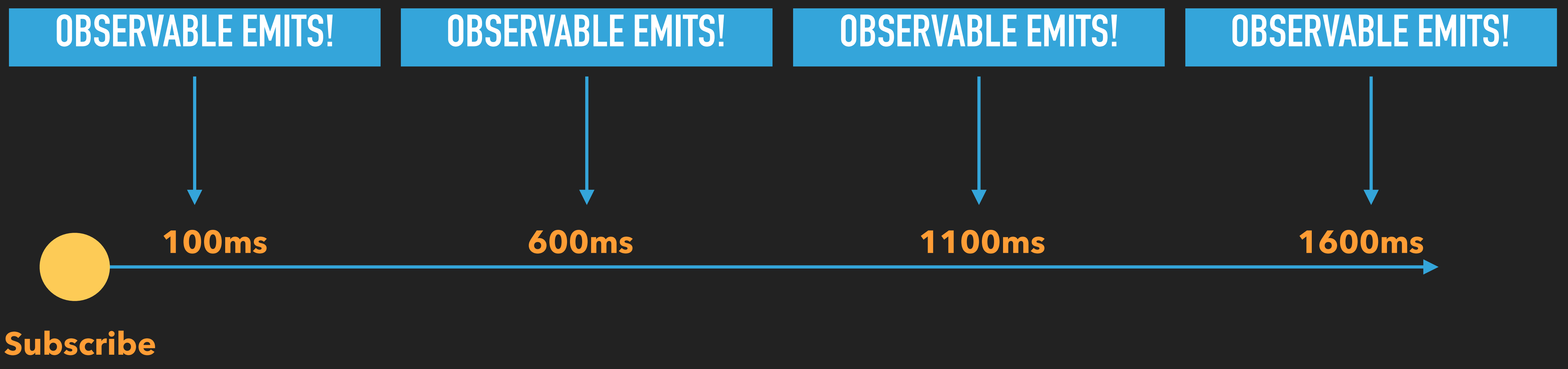


IMAGE A TIMELINE (TIMER)

- An interval timer as Observable

  rxjs.timer(100, 500)

  rxjs.interval(n) = rxjs.timer(n, n)



BASIC OBSERVABLE API

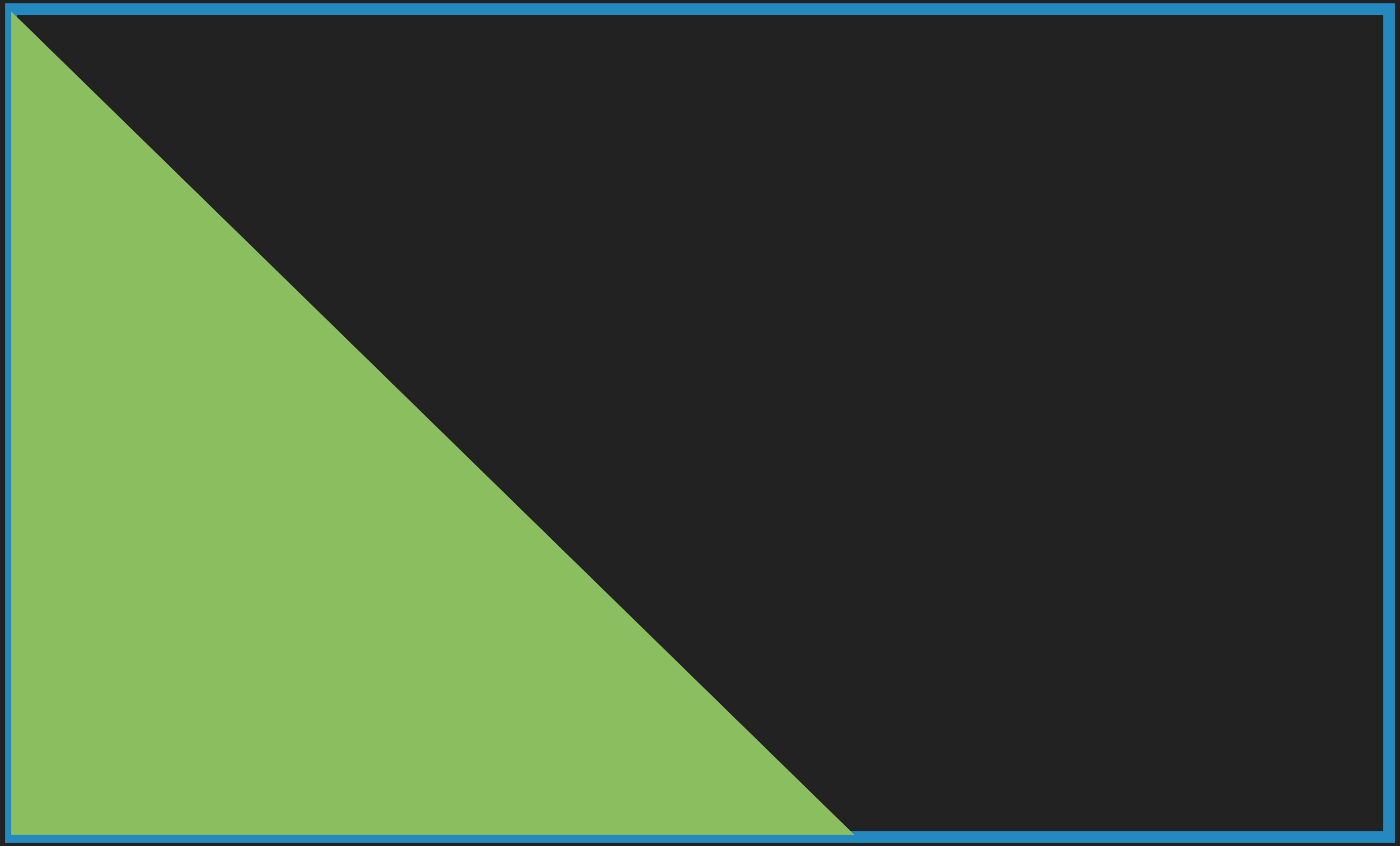
- Generator (Static methods, return an **Observable** object)
    - of, fromEvent, timer, interval, or create your own

- Observable functions
    - Most important one: **subscribe**
    - rxjs.fromEvent(document, `click`).subscribe(console.log)
    - rxjs.interval(500).subscribe(console.log)

BASIC OBSERVABLE API

- Observable functions - Operator
  - map, filter, reduce, skip, tap (Java **forEach**)
  - toArray (Java **collect**)
  - throttleTime, debounceTime, delay
  - …
- In latest RxJS API, use **observableObject.pipe(…..)** us for operator
  For simplicity, we eliminate **pipe** in following examples

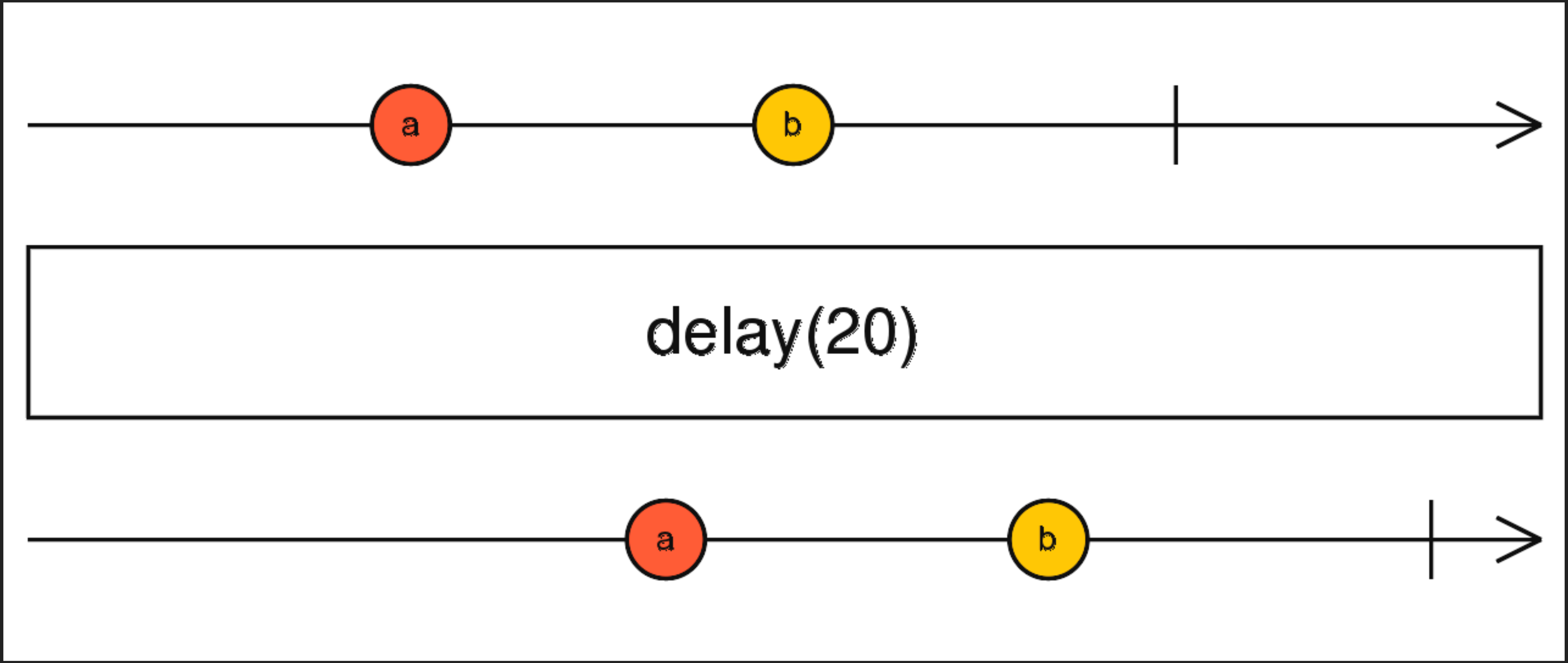
EXAMPLE: ONLY EMIT POSITION WHEN CLICKING IN LOWER AREA



-
  ```
  rxjs.fromEvent(document, `click`):
    filter(event => event.x <= event.y),
    map(event => "(" + event.x + ", " + event.y + ")")
  ```

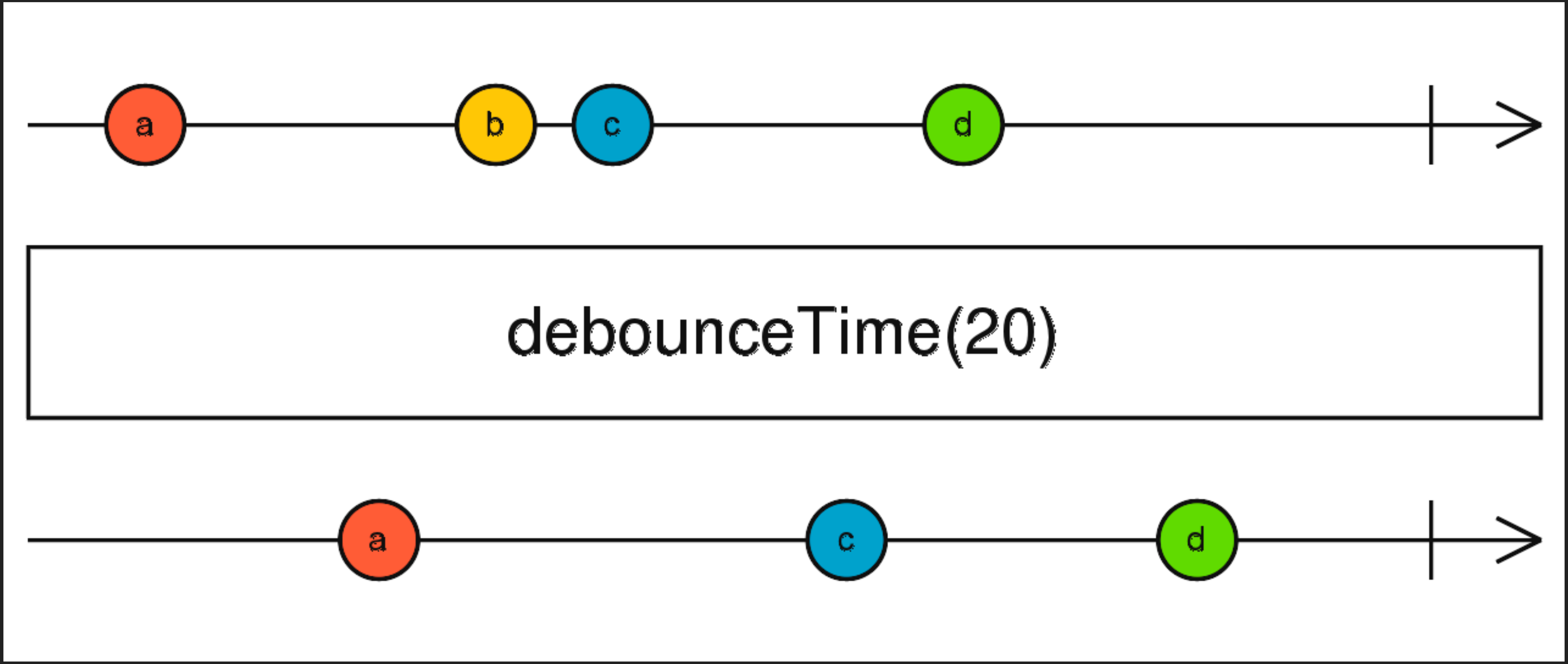
BASIC OBSERVABLE API

- Observable operator: **delay**



BASIC OBSERVABLE API

- Observable operator: **debounceTime**

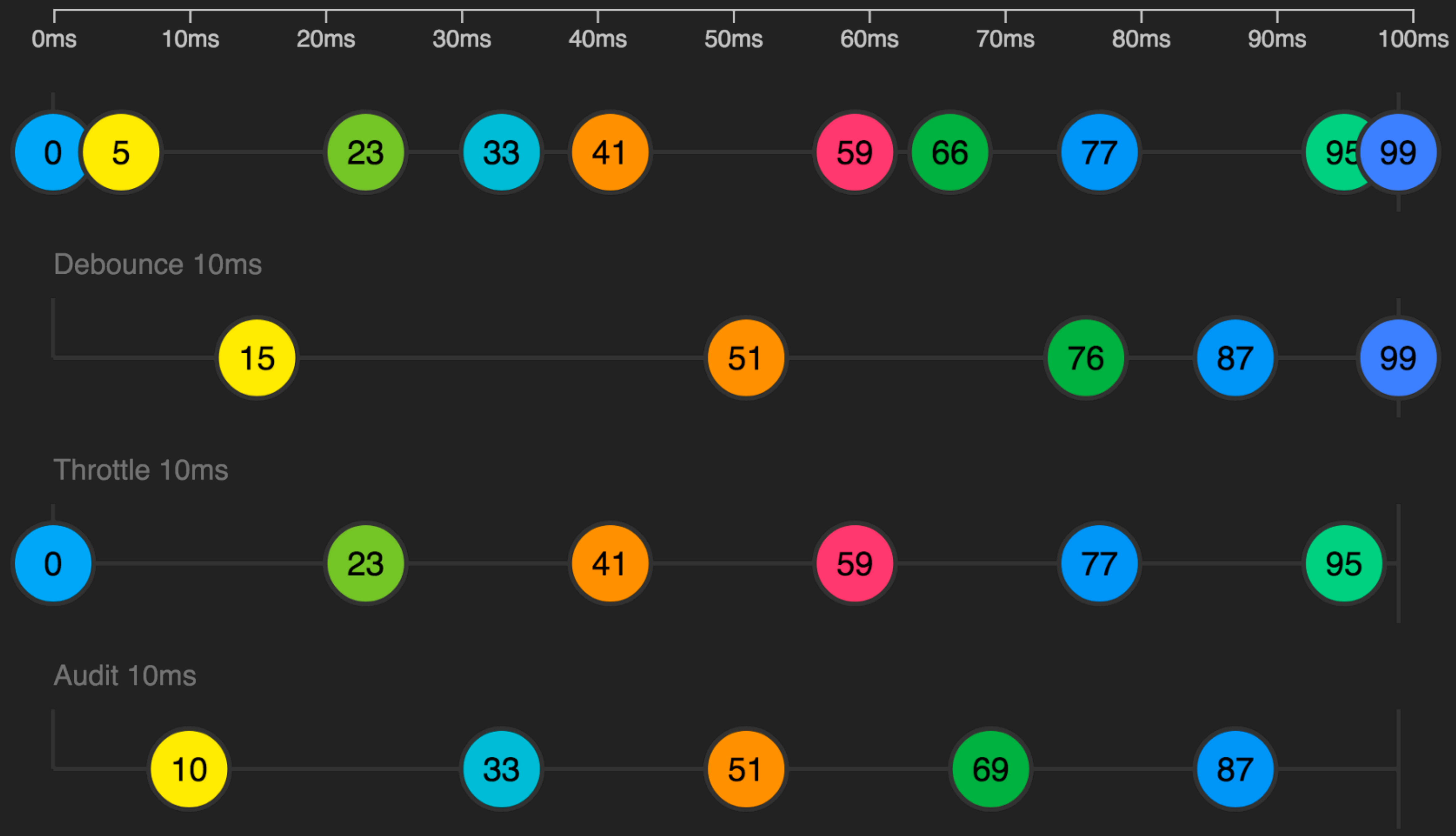


BASIC OBSERVABLE API

- Observable operator: **throttleTime / auditTime**
  - **Throttle:**
    Receive then immediately emit
    Then silence for duration
  - **Audit:**
    Receive then silence for duration
    After duration, emit the last value

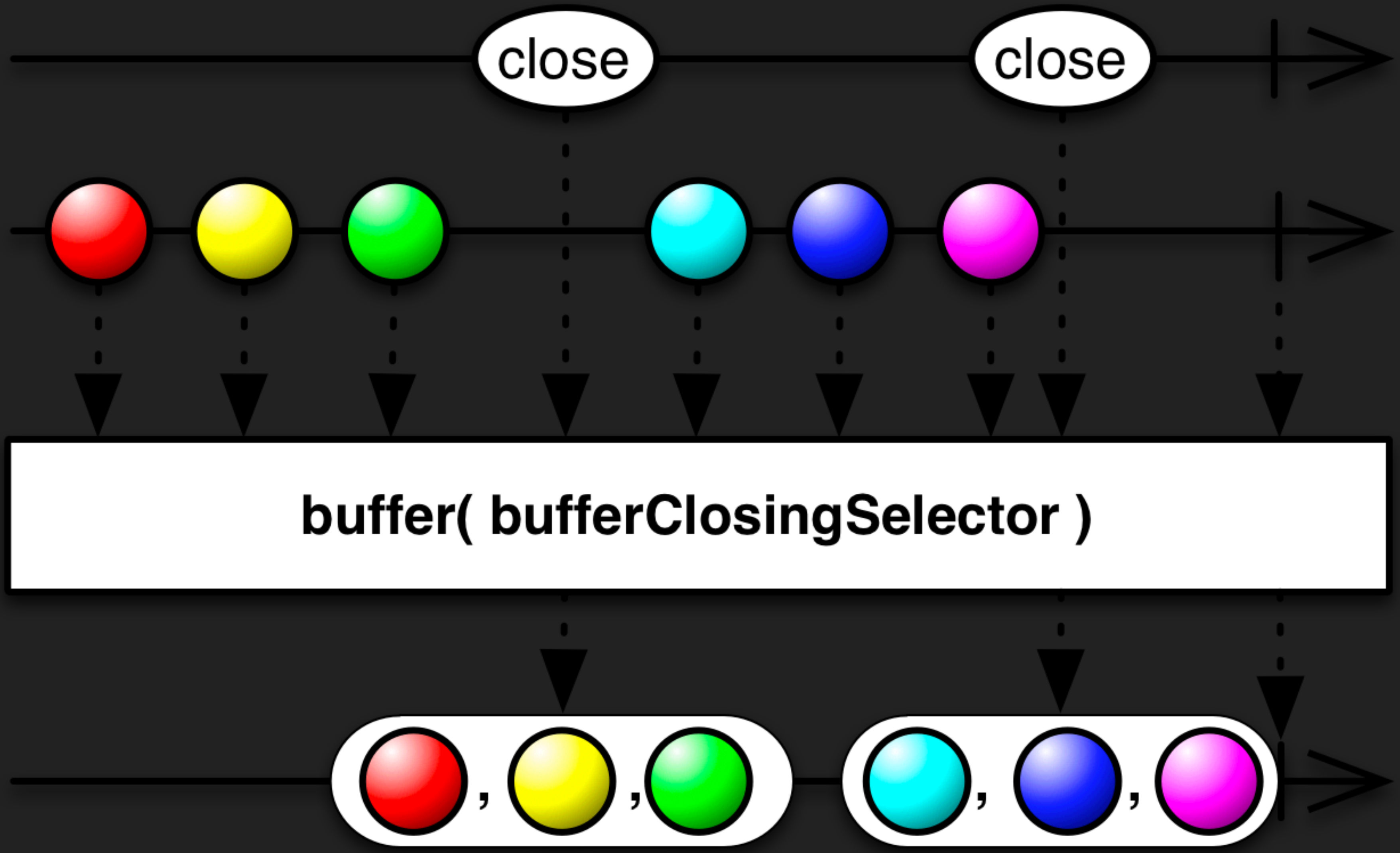
BASIC OBSERVABLE API

- Observable operator: **debounce/throttle/audit**



BASIC OBSERVABLE API

- Observable operator: **buffer**
  It take 1 Observable as parameter. When the parameter emits, it emits the grouped emitted value as an array



EXAMPLE: EMIT WHEN DOUBLE-CLICK

- If two mouse clicks happen between 300ms, then emit one double-click

-
  ```
  var click$ = rxjs.fromEvent(document, `click`):
     click$.buffer( click$.debounce(300) )
               .filter(array => array.length == 2)
  ```

EXAMPLE: SEARCH INPUT

- Requirement: Simply print what you input

-
  ```
  rxjs.fromEvent(inputElement, `input`):
    .map(event => event.targetValue)
    .subscribe(console.log)
  ```

EXAMPLE: SEARCH INPUT

- Requirement: Only print when input changes

-
  ```
  rxjs.fromEvent(inputElement, `input`):
    .map(event => event.targetValue)
    .distinctUntilChanged()
    .subscribe(console.log)
  ```

EXAMPLE: SEARCH INPUT

- Requirement: Only print when input changes, and chars length > 2, and max print every 100 ms

-
  ```
  rxjs.fromEvent(inputElement, `input`):
    .map(event => event.targetValue)
    .filter(value => value.length > 2)
    .distinctUntilChanged()
    .debounceTime(100)
    .subscribe(console.log)
  ```

EXAMPLE: SEARCH INPUT

- Requirement: When input changes, and chars length > 2, then call search API (each API call interval should longer than 100ms), then print API response

-
  ```
  rxjs.fromEvent(inputElement, `input`):
    .map(event => event.targetValue)
    .filter(value => value.length > 2)
    .distinctUntilChanged()
    .debounceTime(100)
    .subscribe(value =>
          API.search(value, result => console.log(result))
    )
  ```

LEGACY API.SEARCH

EXAMPLE: SEARCH INPUT

- Requirement: When input changes, and chars length > 2, then call search API (each API call interval should longer than 100ms), then print API response.

  Previous API should cancel if returned after a new input is triggered

- rxjs.fromEvent(inputElement, `input`):

```
    .map(event => event.targetValue)
    .filter(value => value.length > 2)
    .distinctUntilChanged()
    .debounceTime(100)
    .switchMap(value => API.search(value))
    .subscribe(console.log)
```

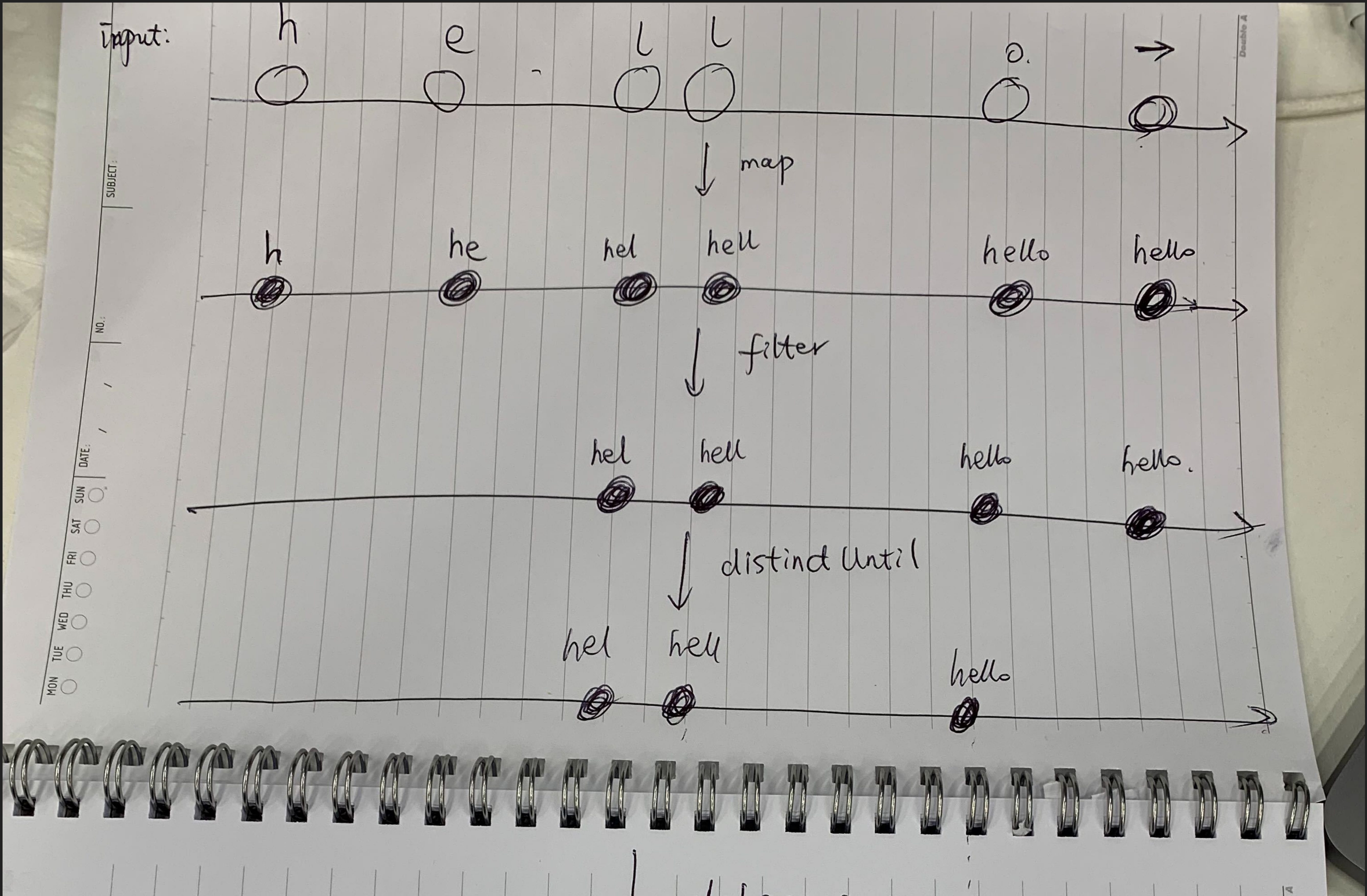
In this case, API.search returns an **Observable**, that only **emit once**

API CALL FOR FRONT-END

- In our project, we use **Promise**-based API calls:
  XXXService.search(request): Promise<Response>

- Another style (Angular), **Observable**-based API calls:
  XXXService.search(request): Observable<Response>

OBSERVABLE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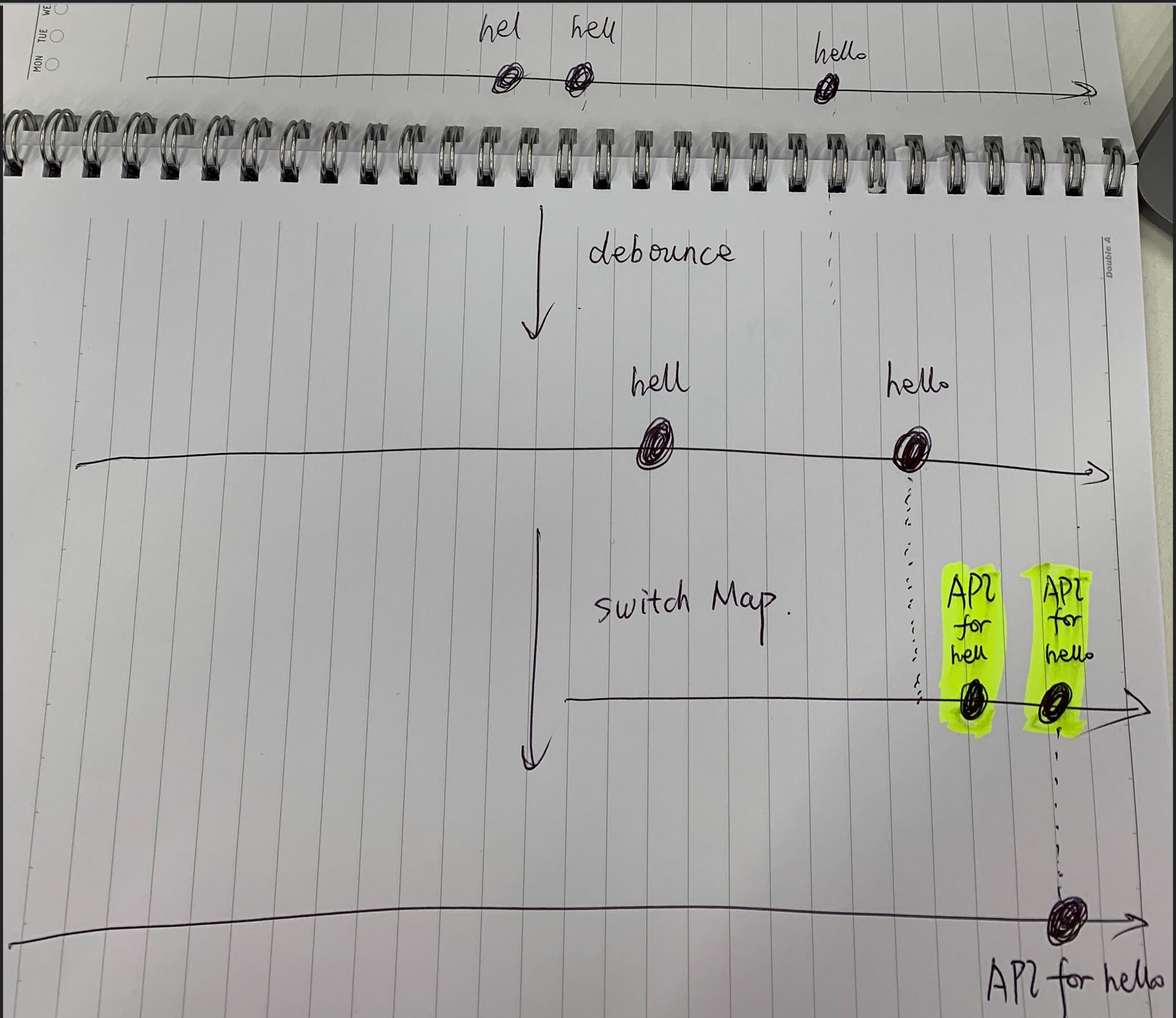
OBSERVABLE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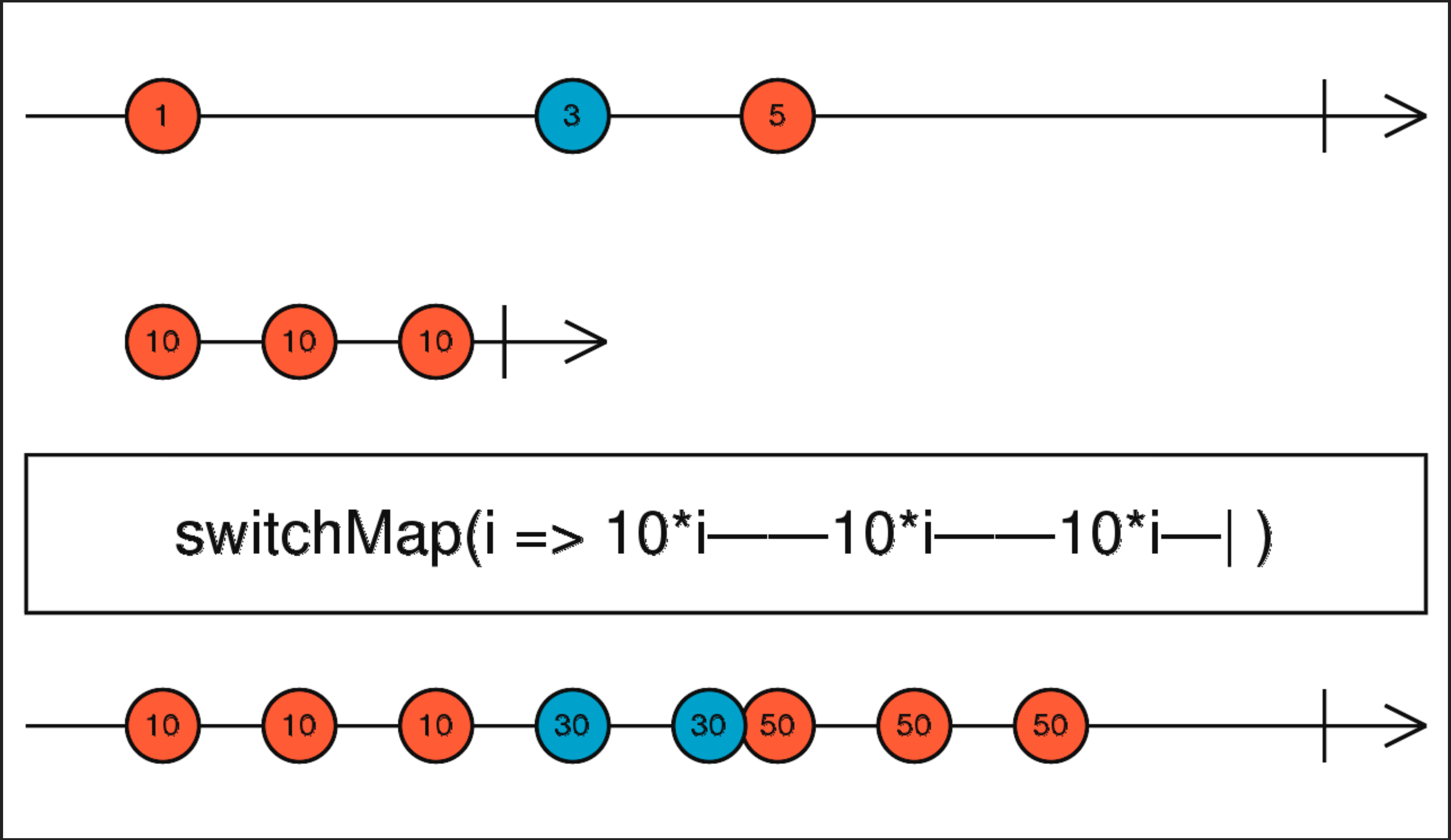
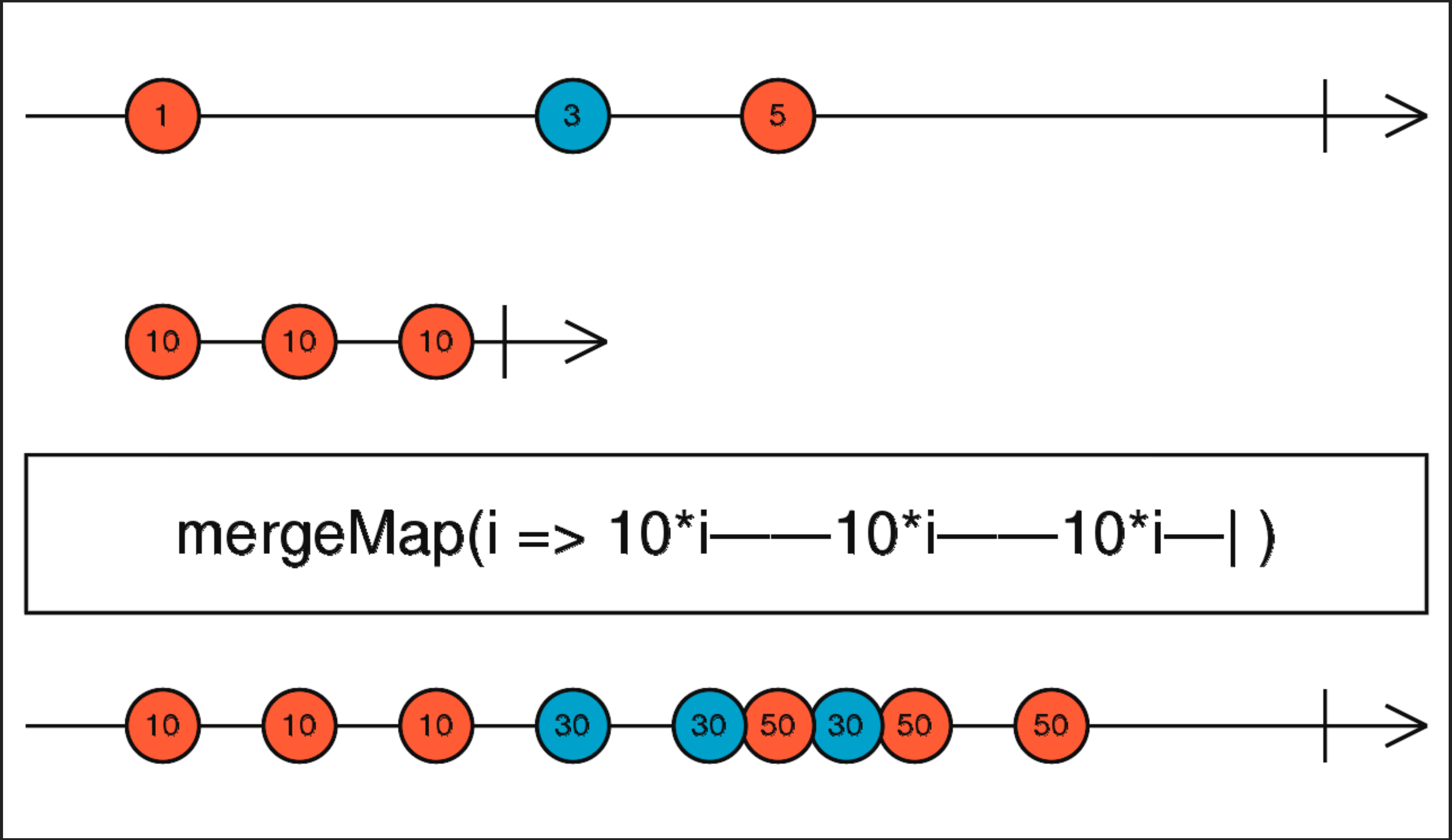
BASIC OBSERVABLE API

- Observable operator: **switchMap**



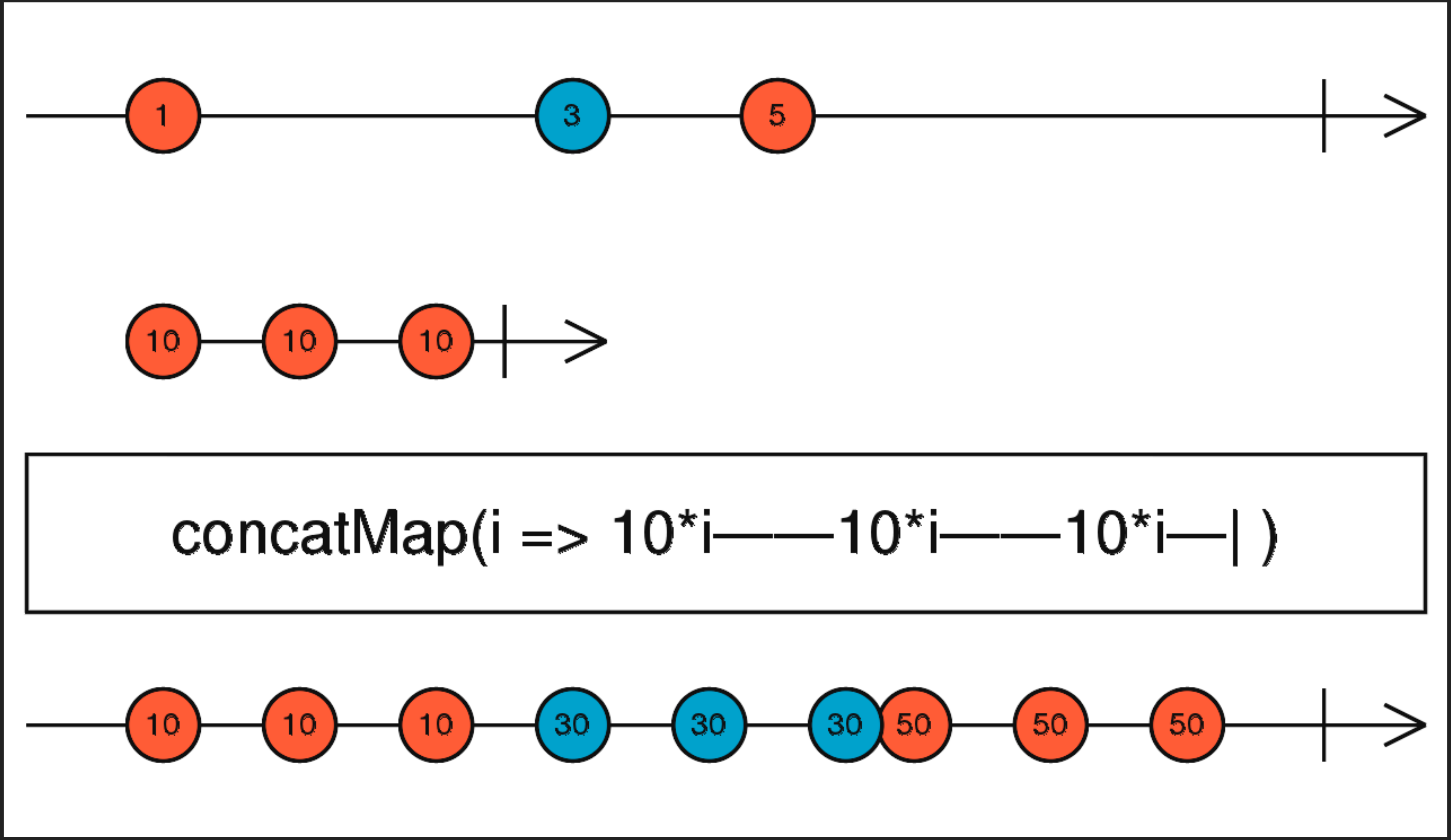
BASIC OBSERVABLE API

- Observable operator: **mergeMap/flatMap**



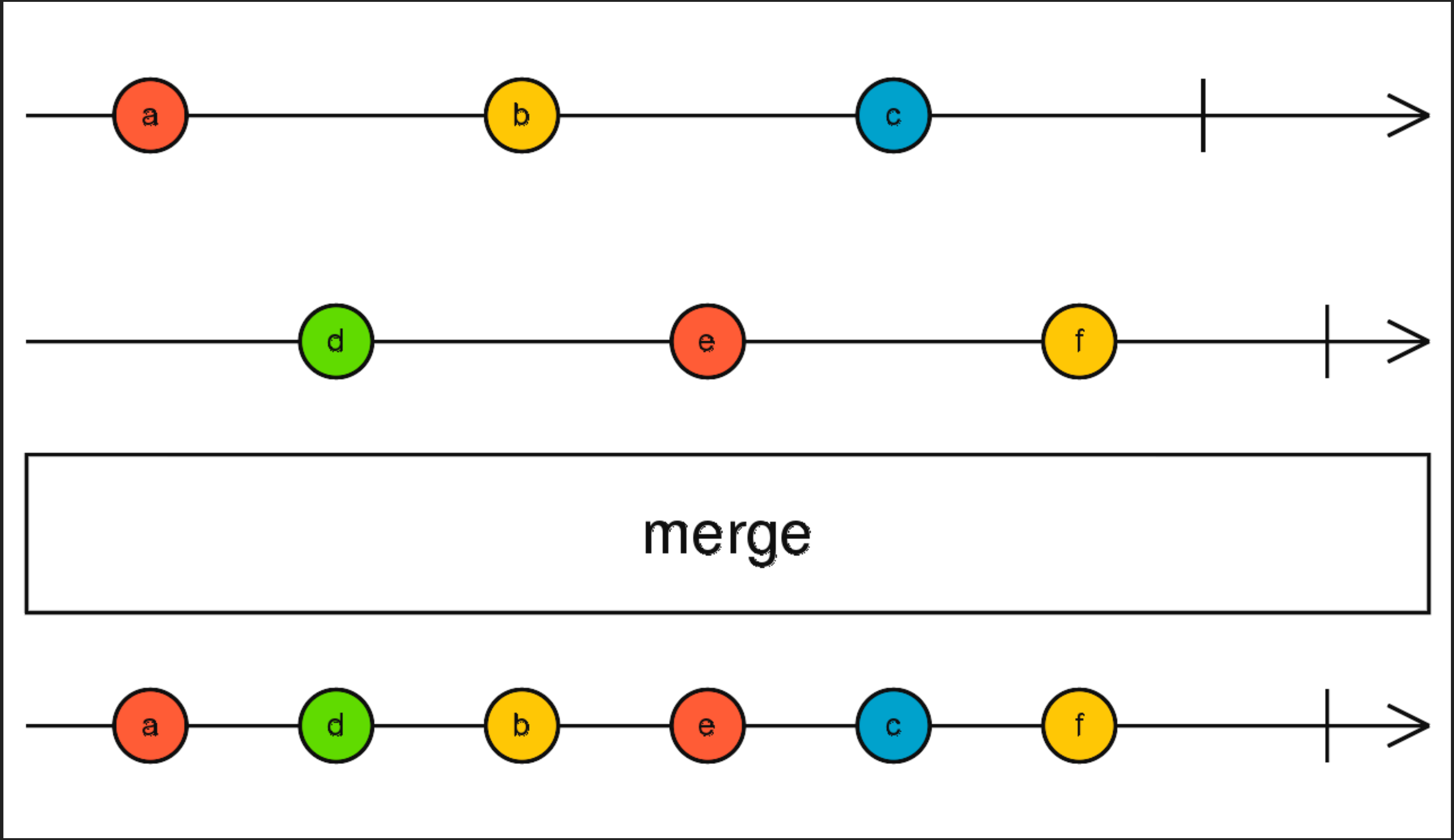
BASIC OBSERVABLE API

- Observable operator: **concatMap**



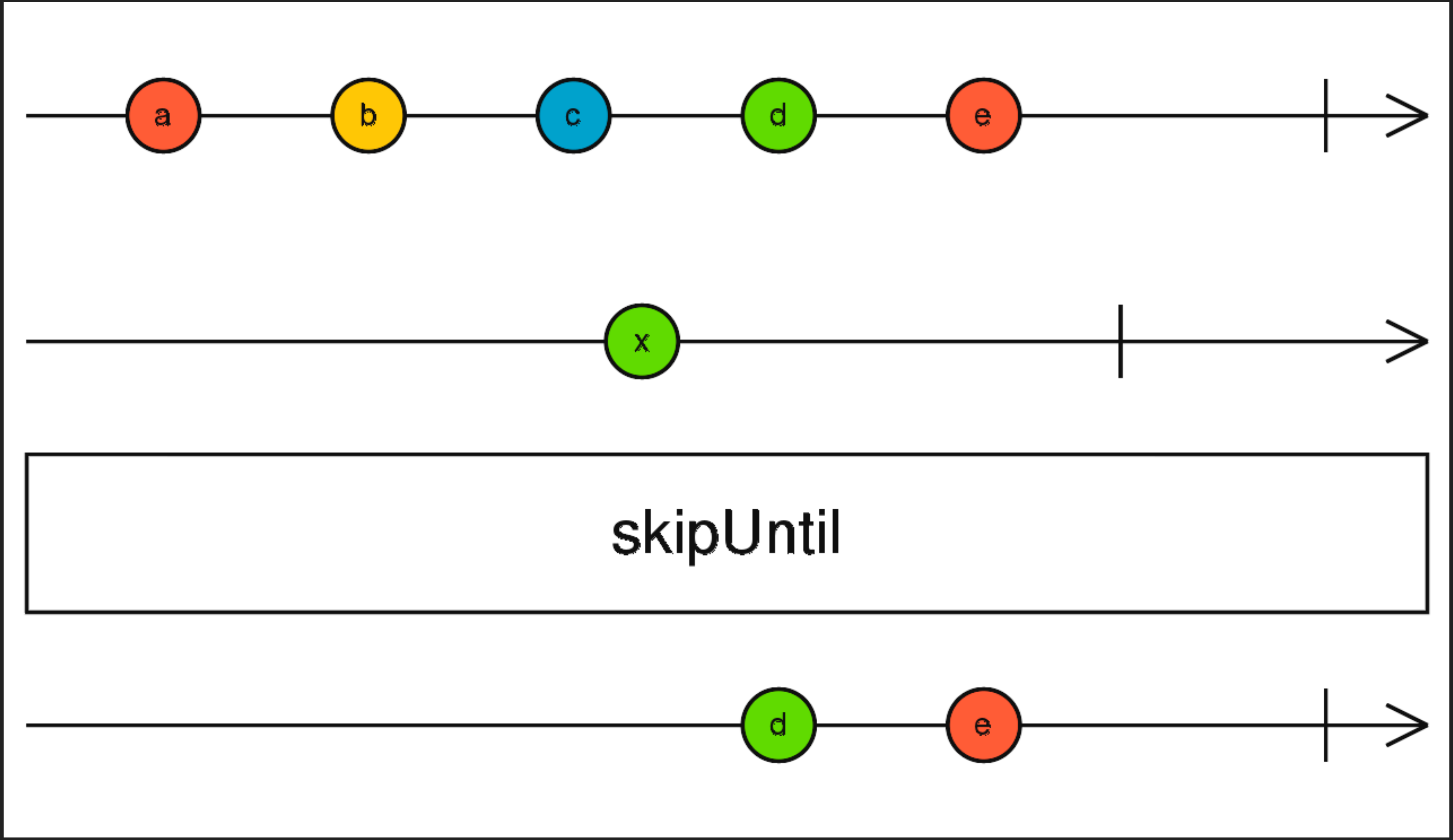
BASIC OBSERVABLE API

- Observable operator: **merge**



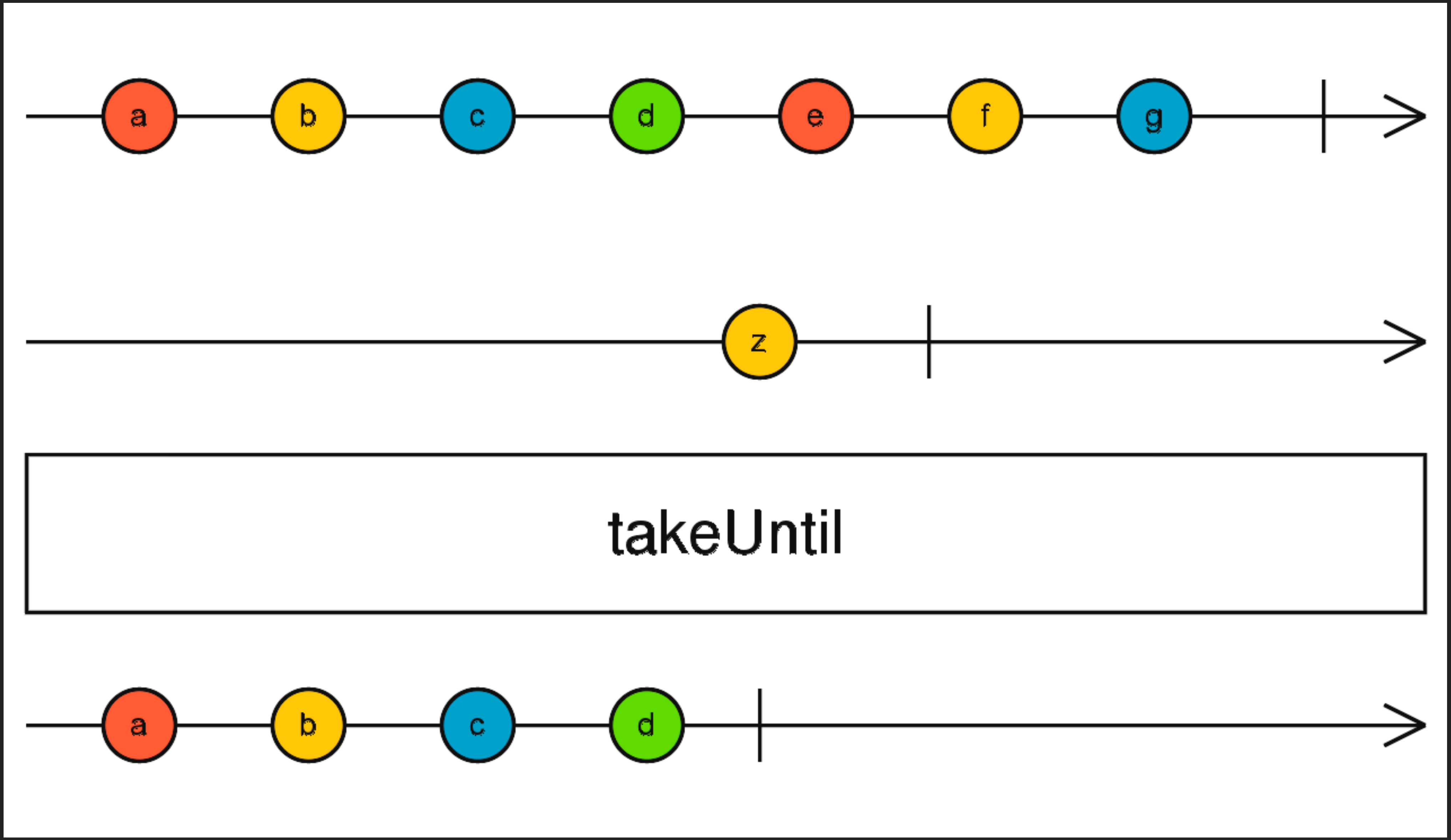
BASIC OBSERVABLE API

- Observable operator: **skipUntil**
  - rxjs.interval(100).skipUntil(**rxjs.fromEvent(document, `click`)**)



BASIC OBSERVABLE API

- Observable operator: **takeUntil**
  - rxjs.interval(100).takeUntil(**rxjs.fromEvent(document, `click`)**)



EXAMPLE: DRAG AND DROP

- Online Example: https://codepen.io/joshblack/pen/zGZZjX
- Emit the div position {x, y} while dragging

EXAMPLE: DRAG AND DROP

-
  ```
  var mouseDown$ = fromEvent(div, “mousedown”)
  var mouseUp$ = fromEvent(div, “mouseup”)
  var mouseMove$ = fromEvent(document, “mousemove”)
  ```

EXAMPLE: DRAG AND DROP

-
  ```
  mouseDown$.switchMap(pressedEvent => {
      return mouseMove$.takeUtil(mouseUp$)
  })
  ```

- It emits **MouseMove event** during dragging

EXAMPLE: DRAG AND DROP

-
  ```
  mouseDown$.switchMap(pressedEvent => {
      return mouseMove$.map(moveEvent => {
          return {
            x: moveEvent.x,
            y: moveEvent.y,
          }
      }).takeUtil(mouseUp$)
  })
  ```

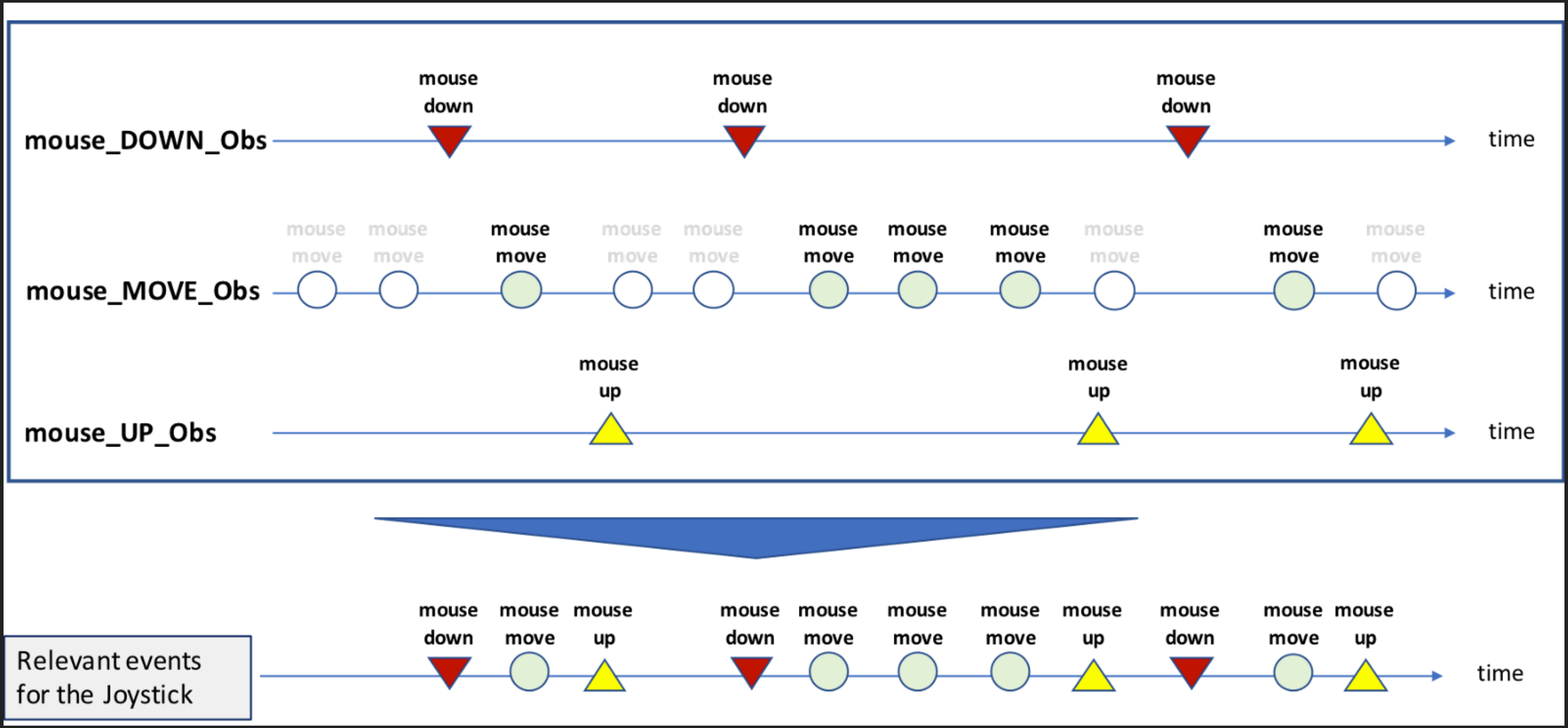
EXAMPLE: DRAG AND DROP

```
mouseDown$.switchMap(pressedEvent => {
    var divStartPosition = {x: div.clientX, y: div.clientY}
    return mouseMove$.map(moveEvent => {
        return {
          x: divStartPosition.x + moveEvent.x - pressedEvent.x,
          y: divStartPosition.y + moveEvent.y - pressedEvent.y,
        }
    }).takeUtil(mouseUp$)
})
```

EXAMPLE: DRAG AND DROP

- Can I change **switchMap** to **concatMap / flatMap** ?
- Answer is **YES**
- Because **mouse-move-then-up** stream must complete before **next mouse-down emits**.

EXAMPLE: DRAG AND DROP



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  https://angular.io/guide/rx-library

Thank You