

JavaScript: Async Functions

Fetch API, Promises, async/await



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AJAX

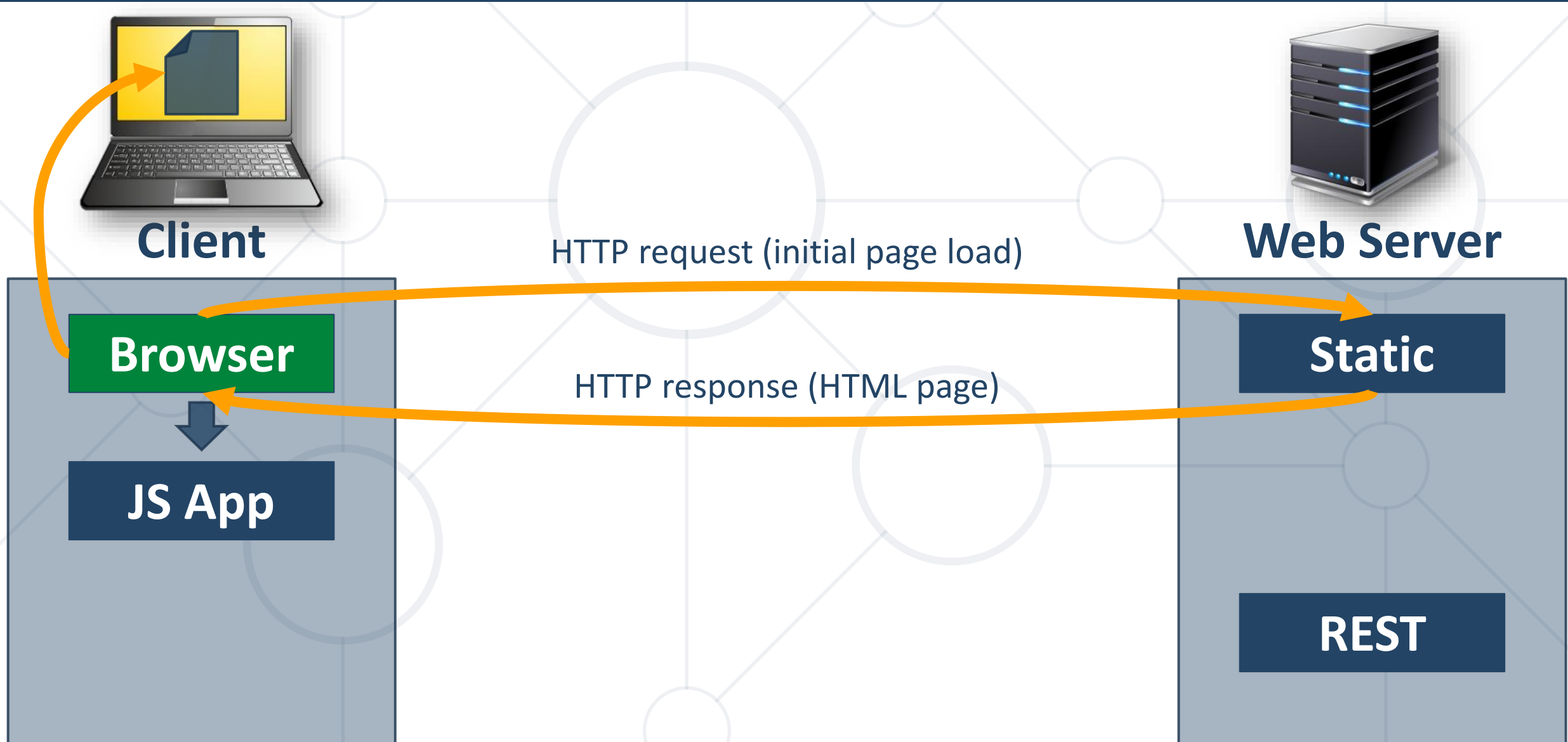
Asynchronous JavaScript and XML

What is AJAX?

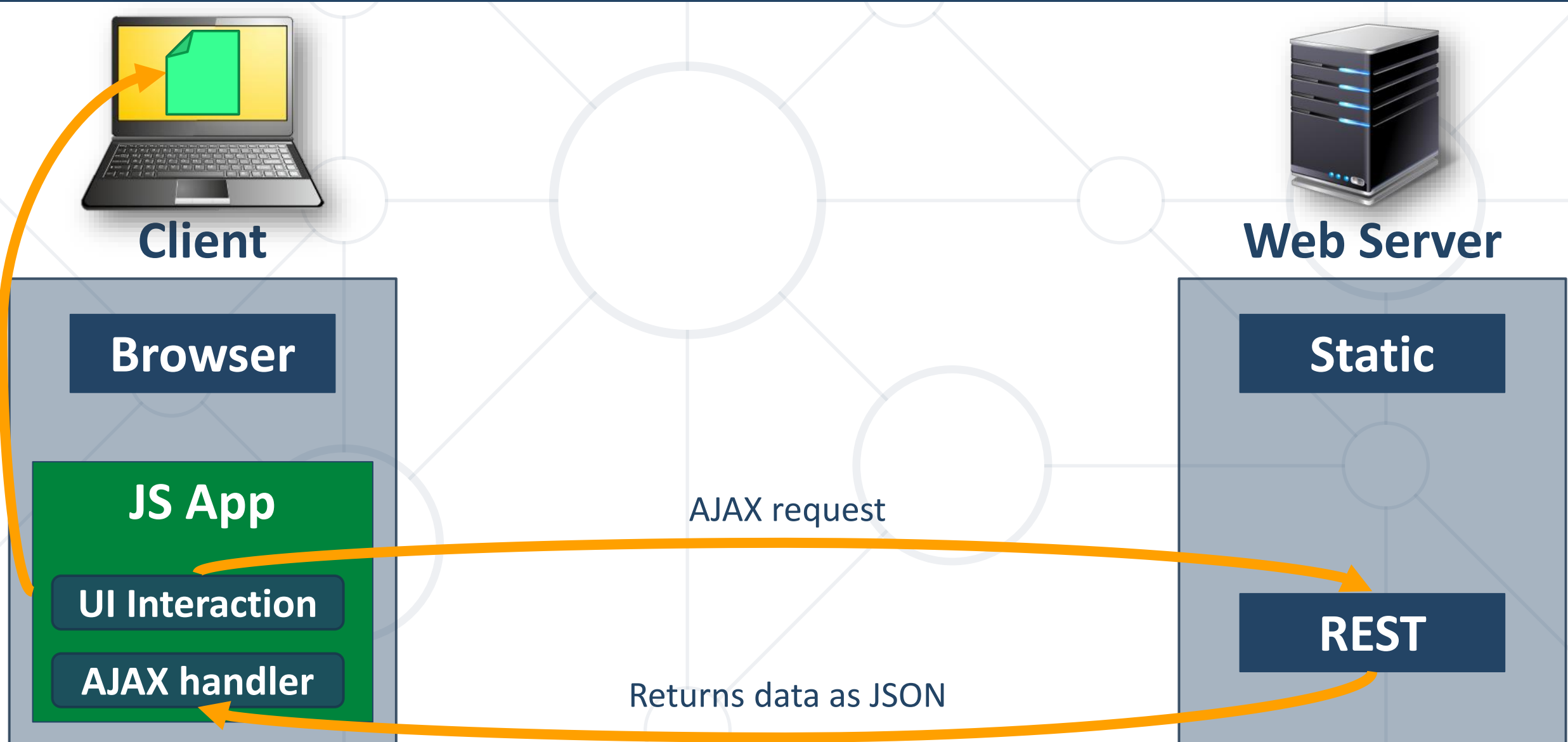
- **Asynchronous JavaScript And XML**
 - Background loading of **dynamic content/data**
 - Load data from the Web server and **render** it
- Some **examples** of AJAX usage
 - **Partial page rendering**
 - Load HTML fragment + show it in a **<div>**
 - **JSON service**
 - Loads JSON object and displays it

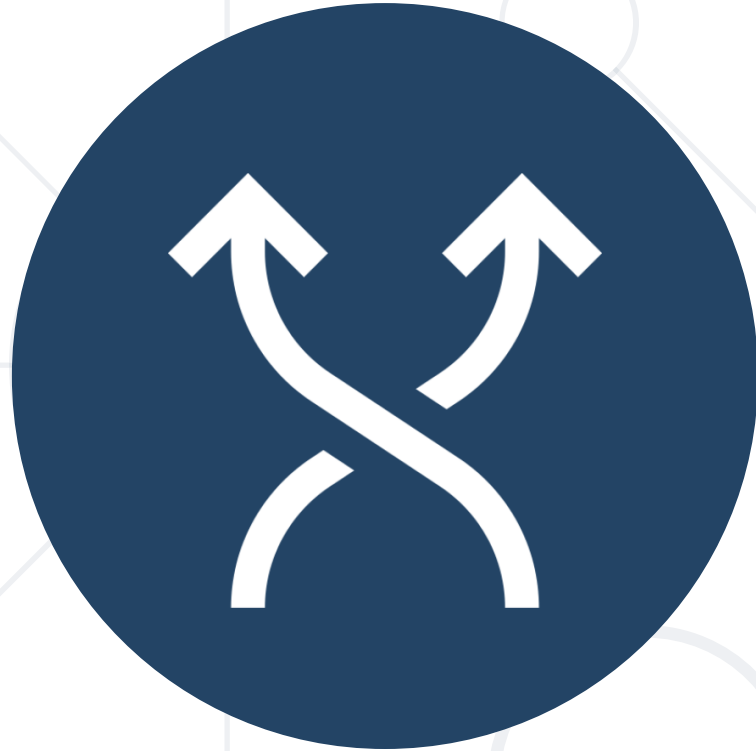


AJAX: Workflow



AJAX: Workflow





Synchronous vs Asynchronous

Asynchronous Programming

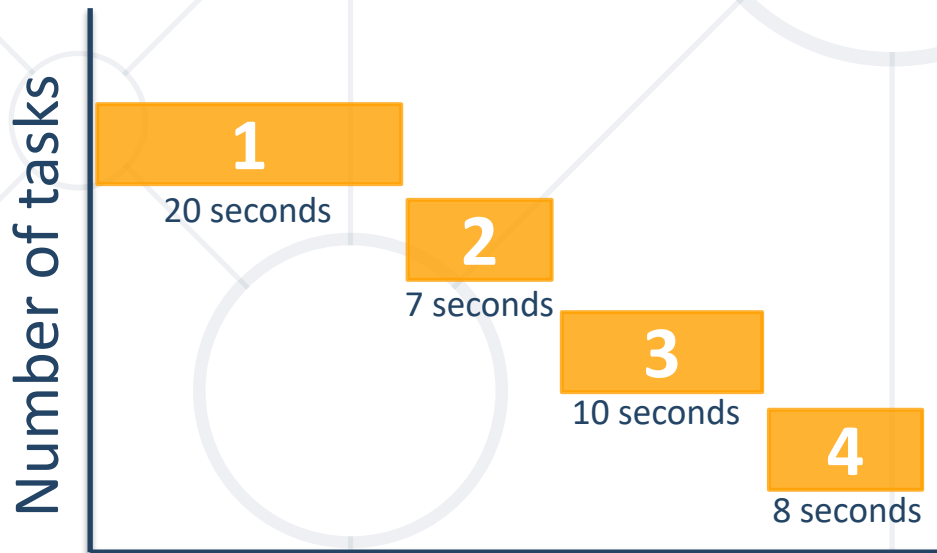
Asynchronous Programming in JS

- Structured using **callback functions**
- In current versions of JS there are
 - **Callbacks**
 - **Promises**
 - **Async Functions**
- Not the same thing as **concurrent** or **multi-threaded**
- **JS code** is generally **single-threaded**

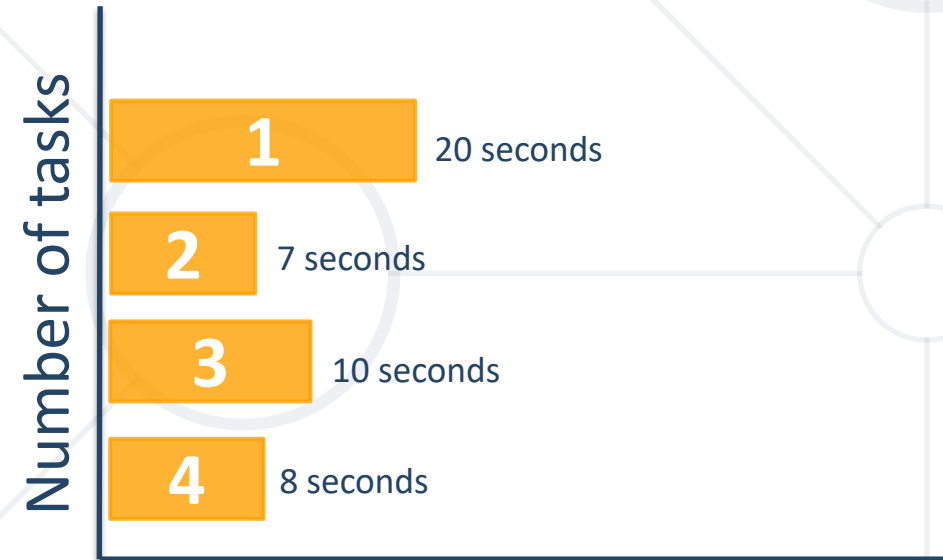


- Runs several tasks (pieces of code) in parallel, **at the same time**

Synchronous



Asynchronous



Asynchronous Programming – Example

- The following commands will be executed as follows

```
console.log("Hello.");  
setTimeout(function() {  
    console.log("Goodbye!");  
}, 2000);  
console.log("Hello again!");
```

```
// Hello.
```

```
// Hello again!
```

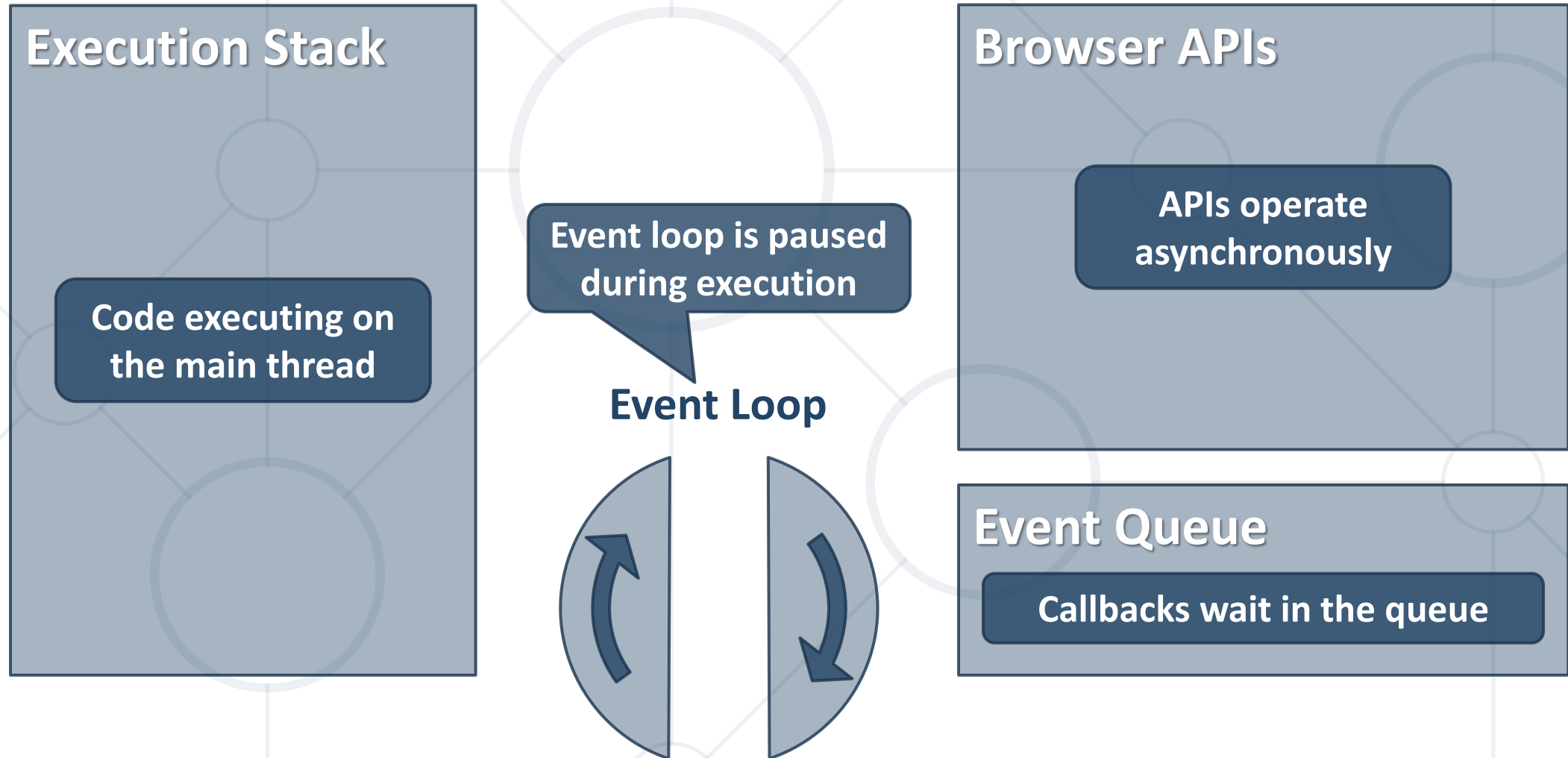
```
// Goodbye!
```

- Function **passed** into another function as an **argument**
- Then **invoked** inside the outer function to complete some kind of routine or action

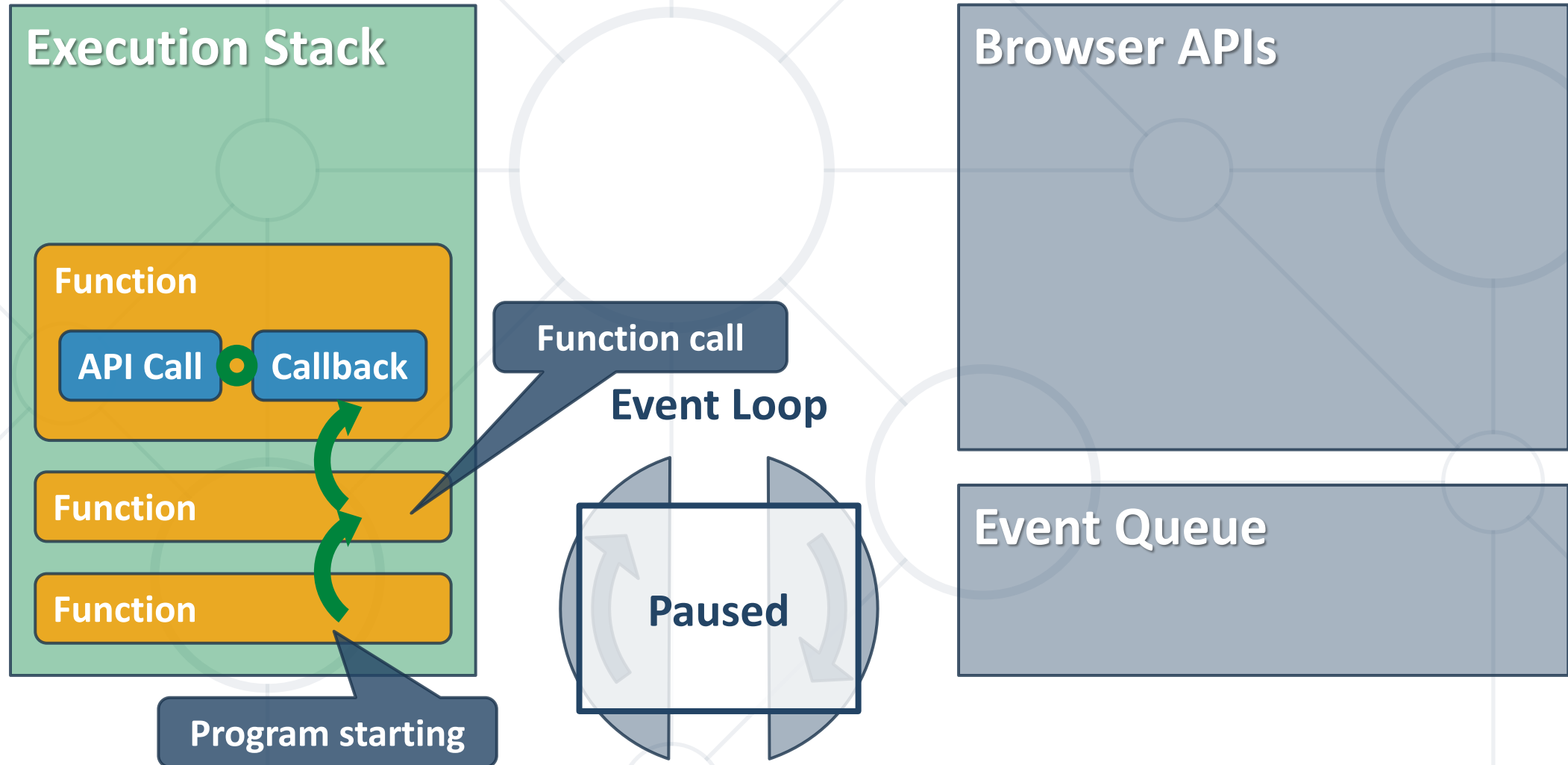
```
function running() {  
    return "Running";  
}  
function category(run, type) {  
    console.log(run() + " " + type);  
}  
category(running, "sprint"); // Running sprint
```

Callback
function

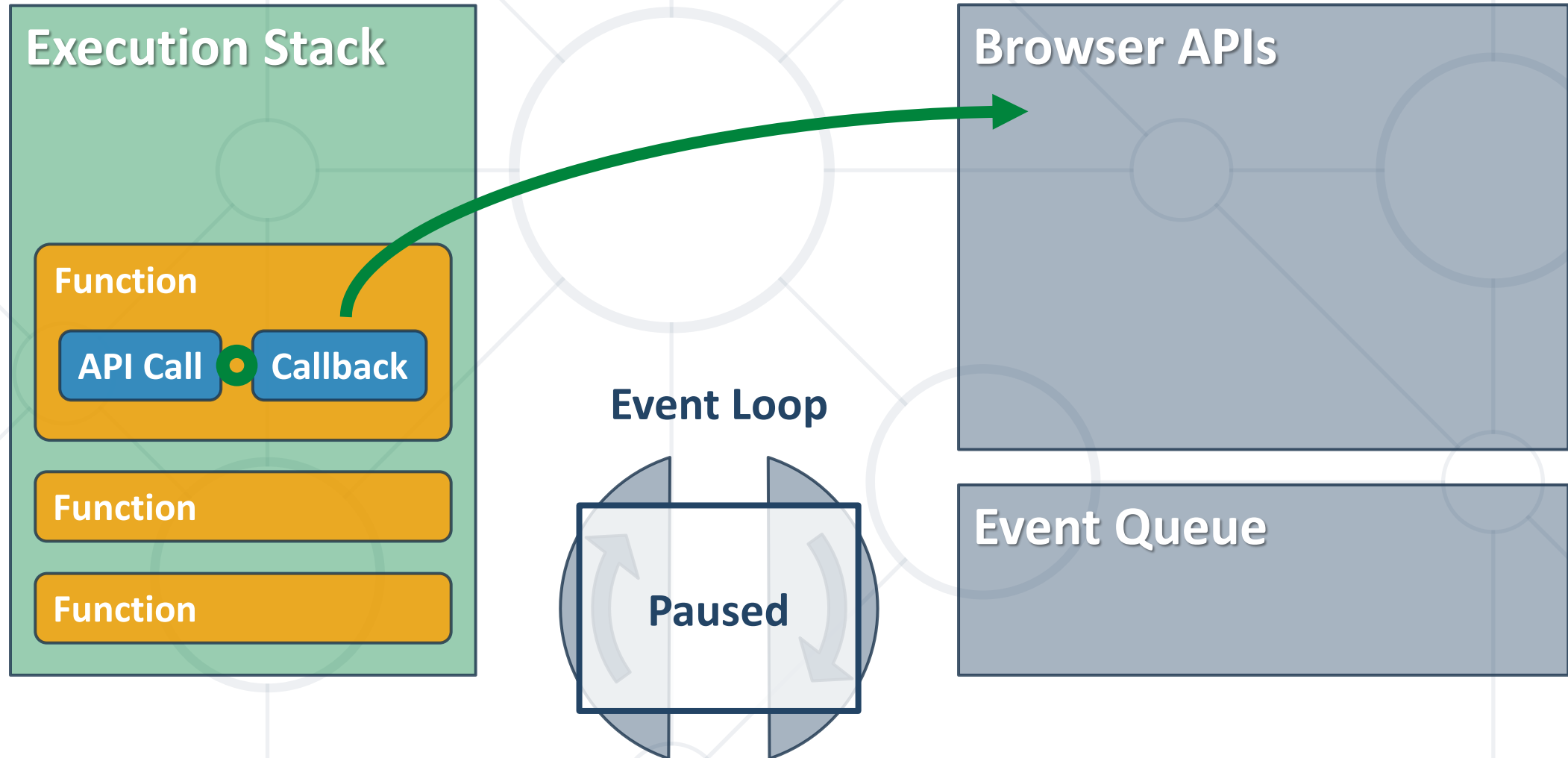
Event Loop Synchronization



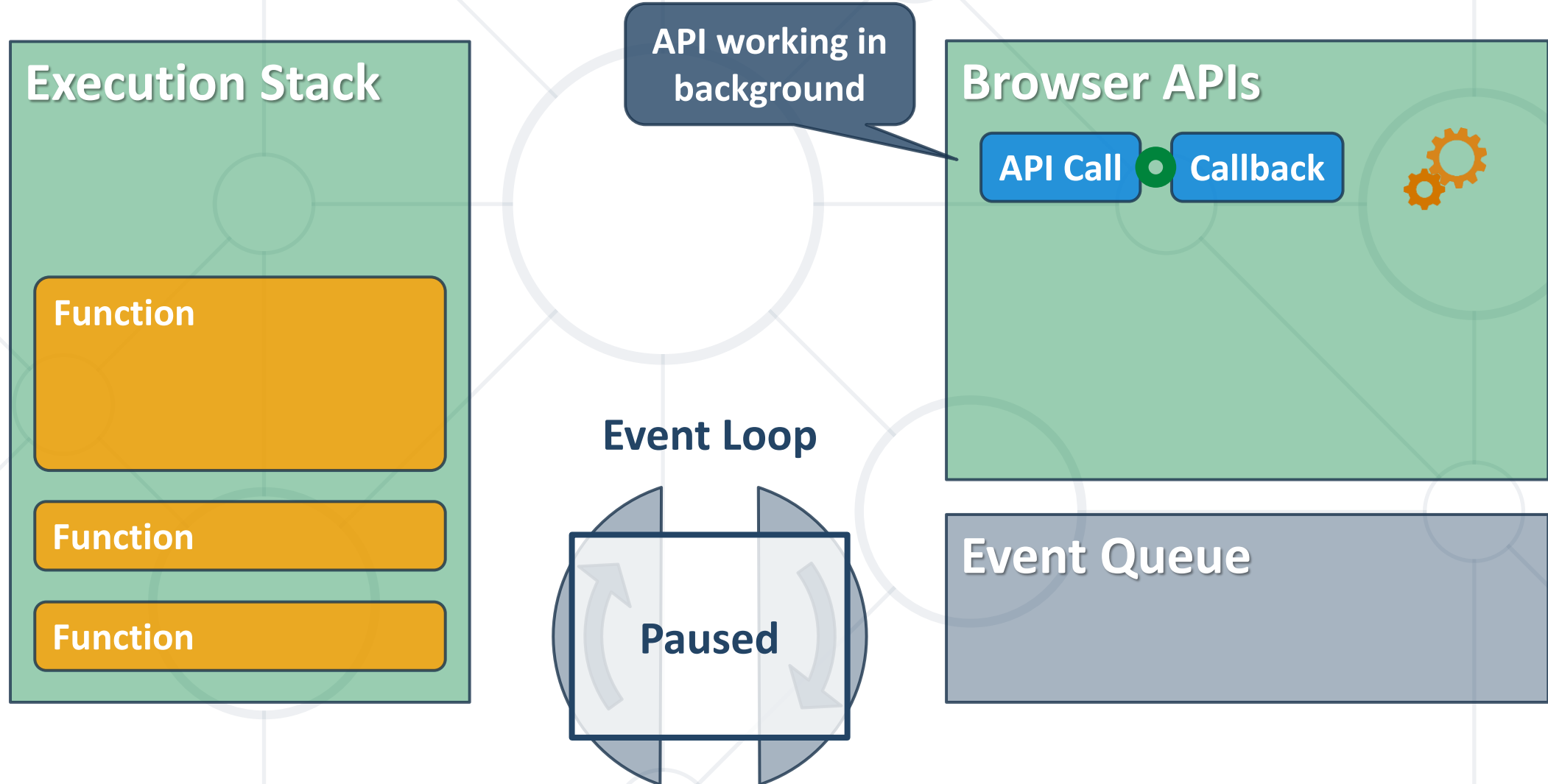
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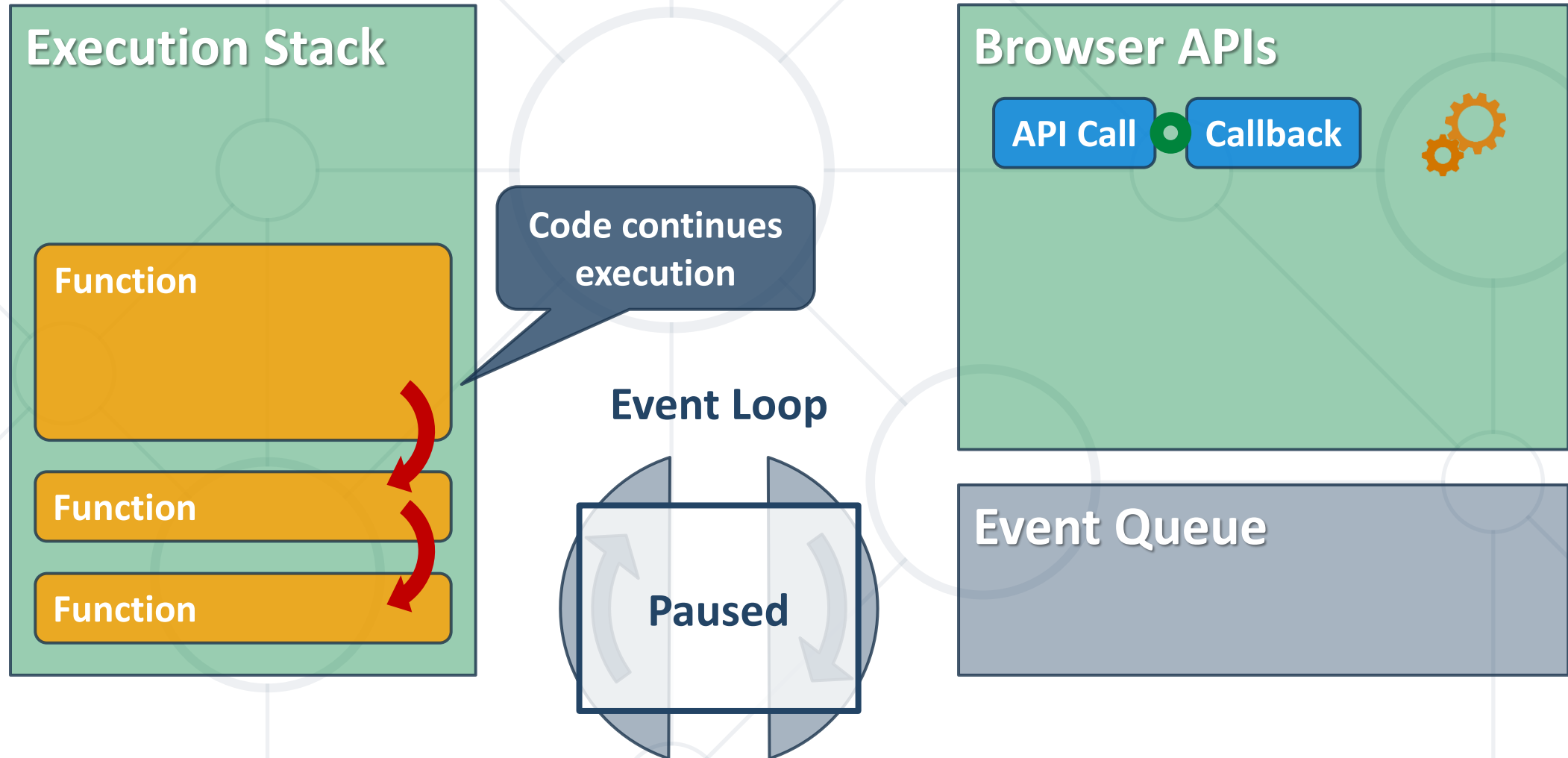
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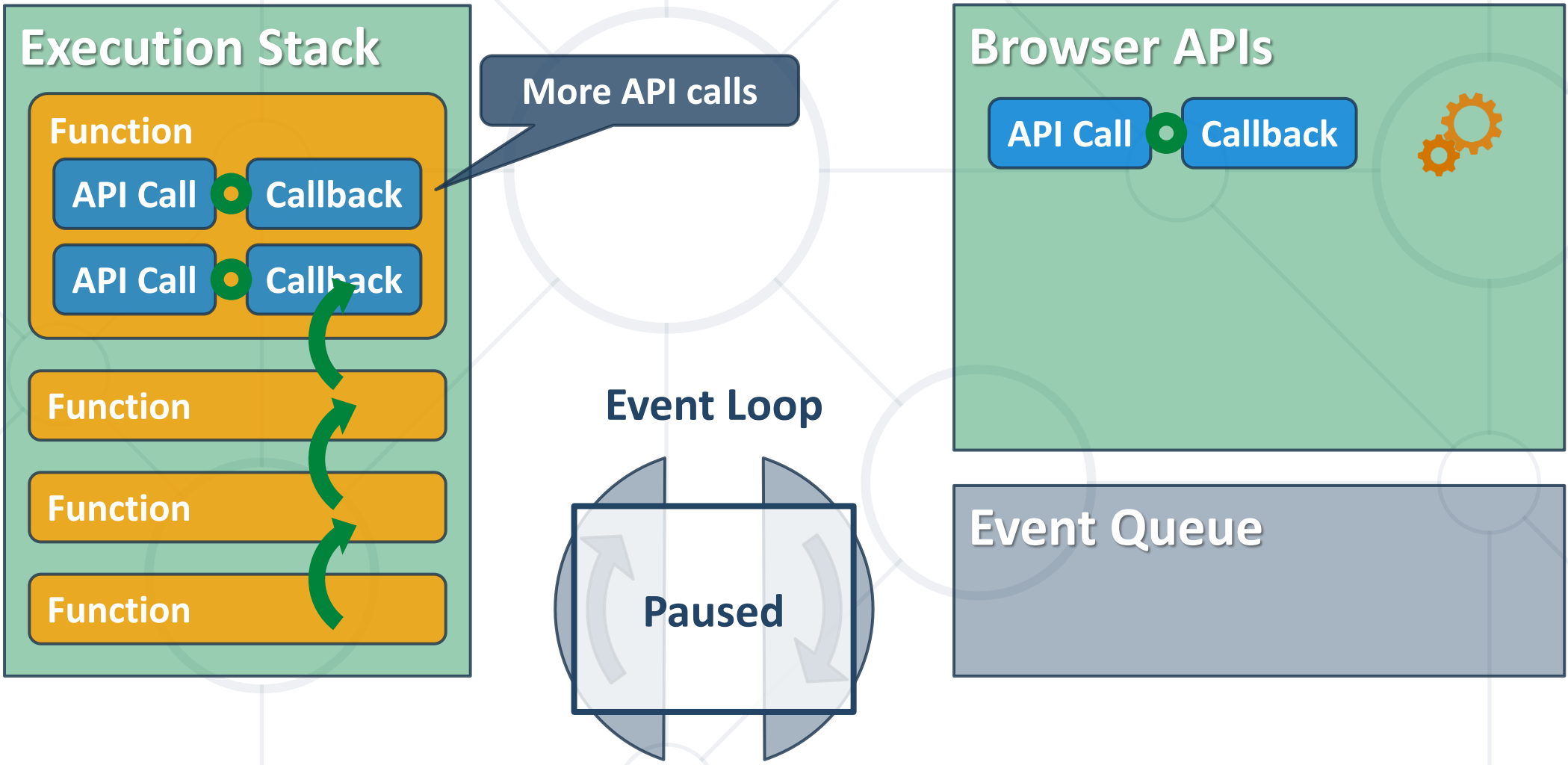
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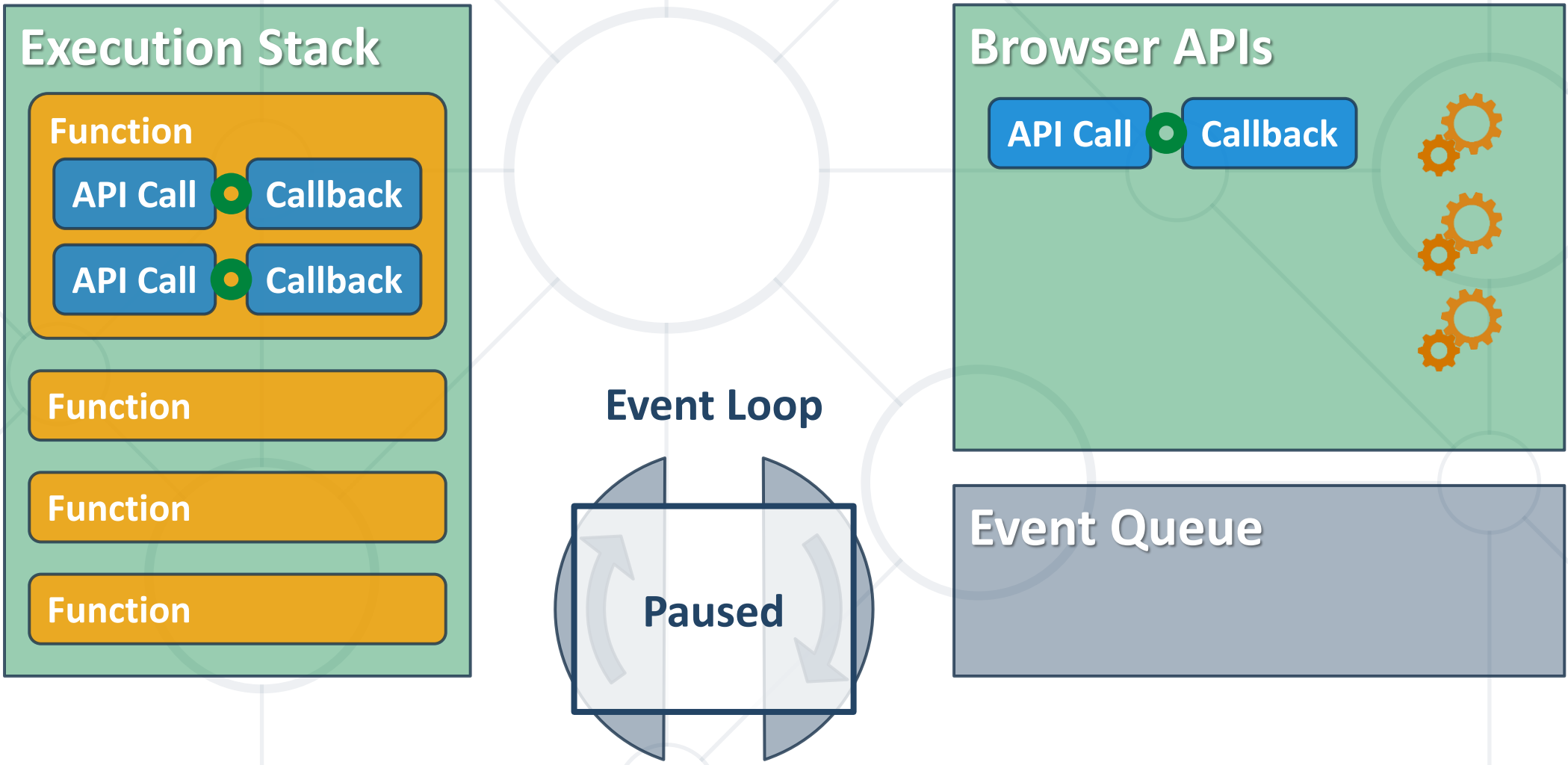
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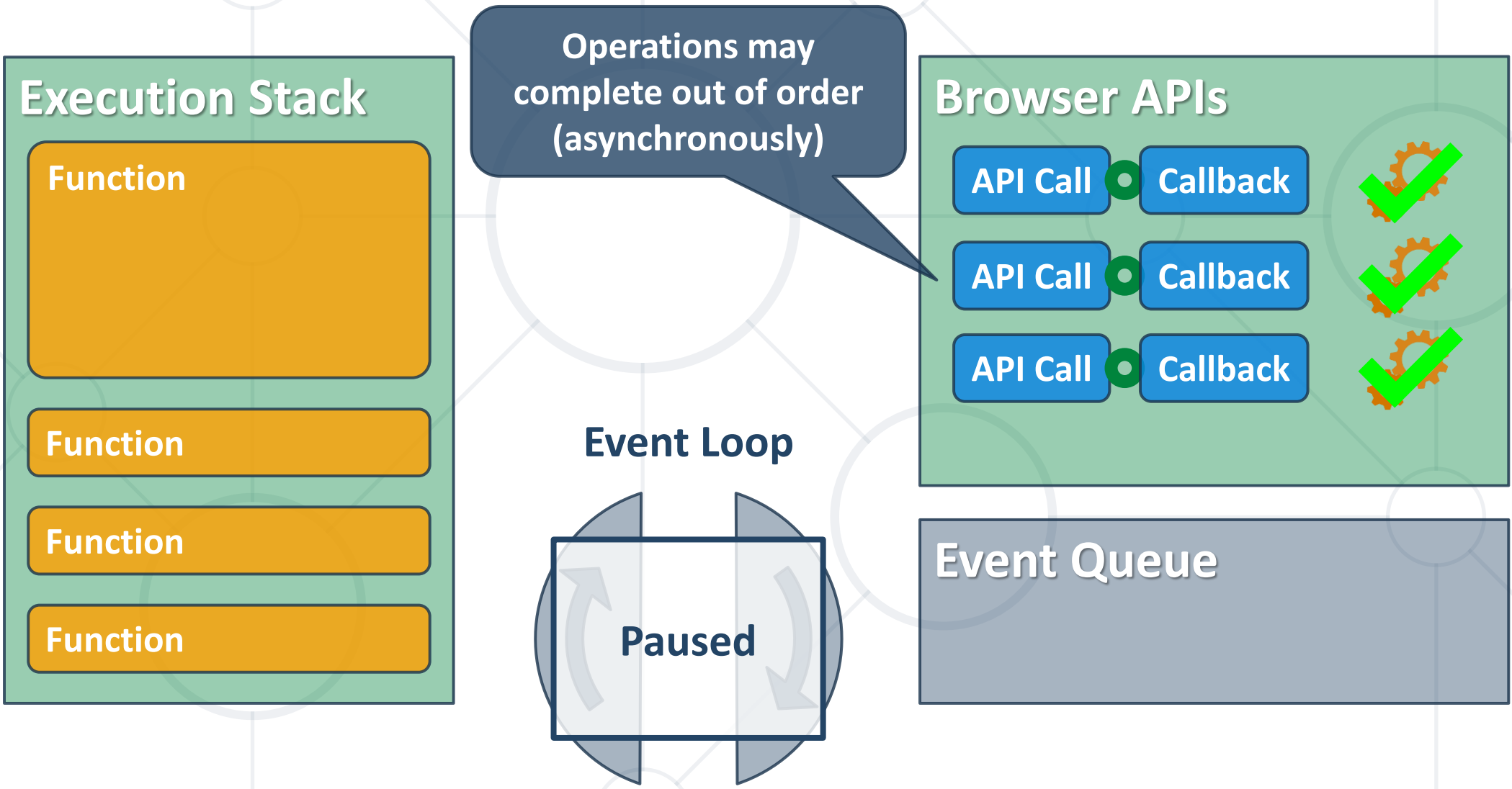
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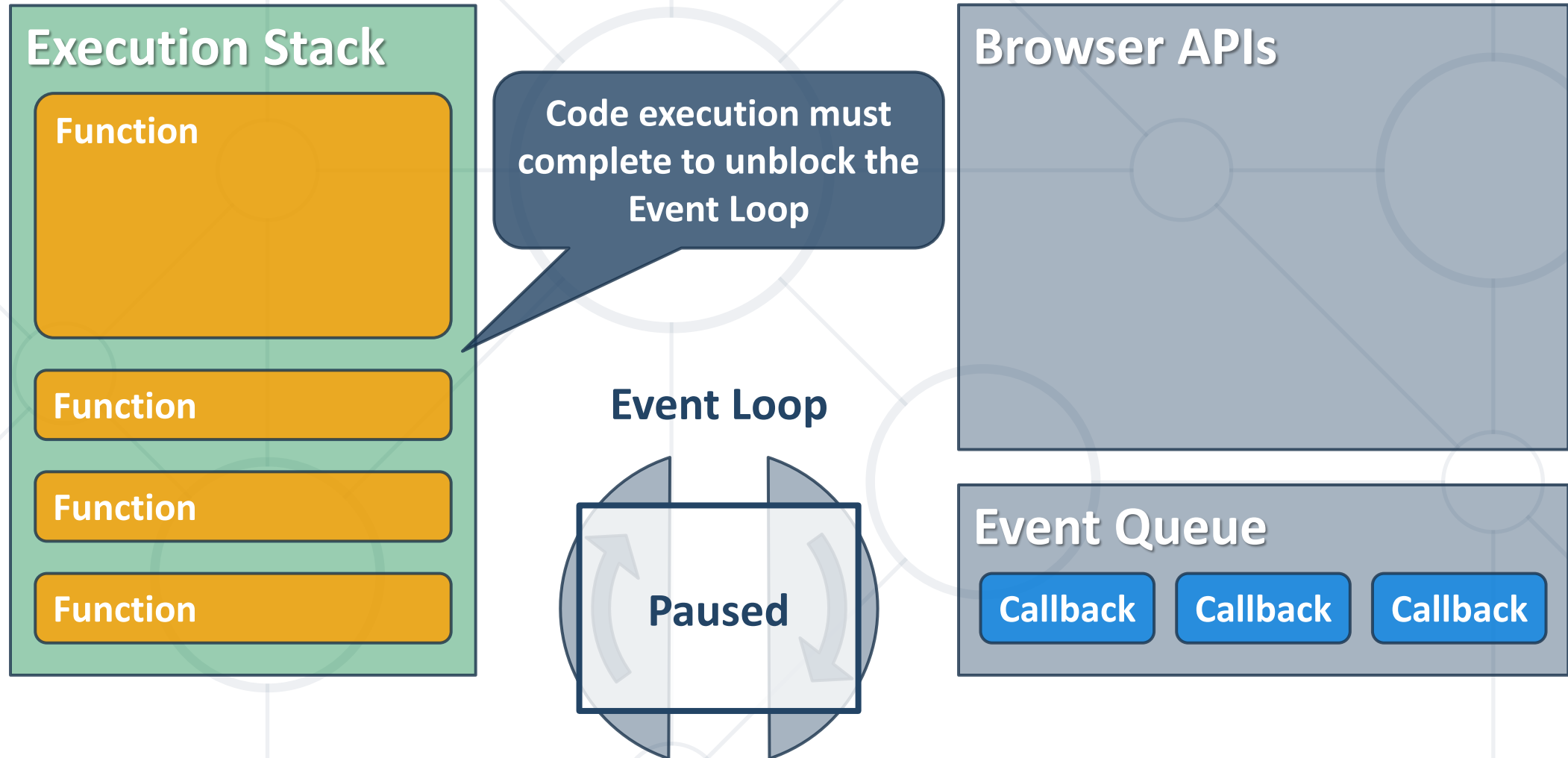
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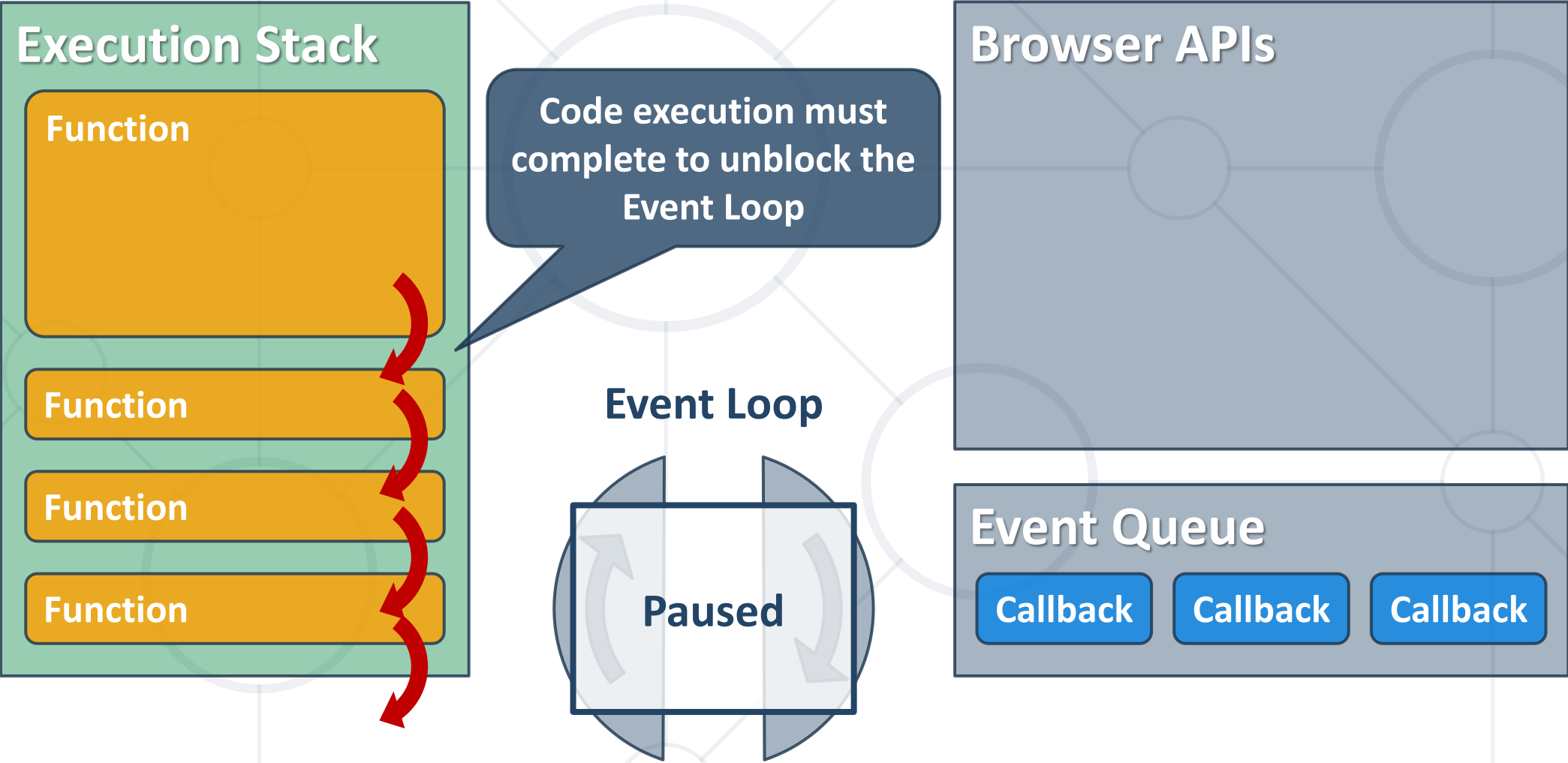
Event Loop Synchronization



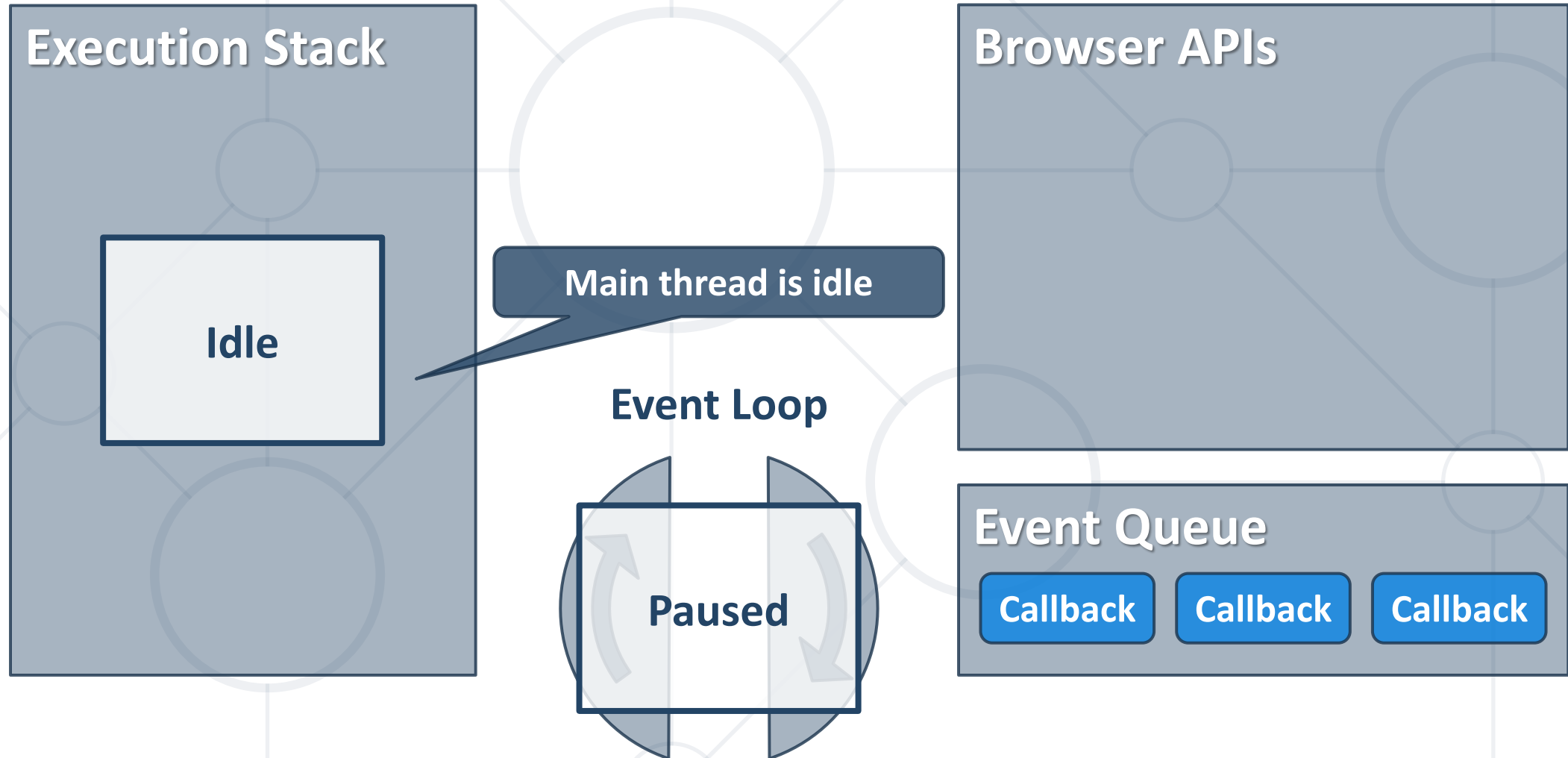
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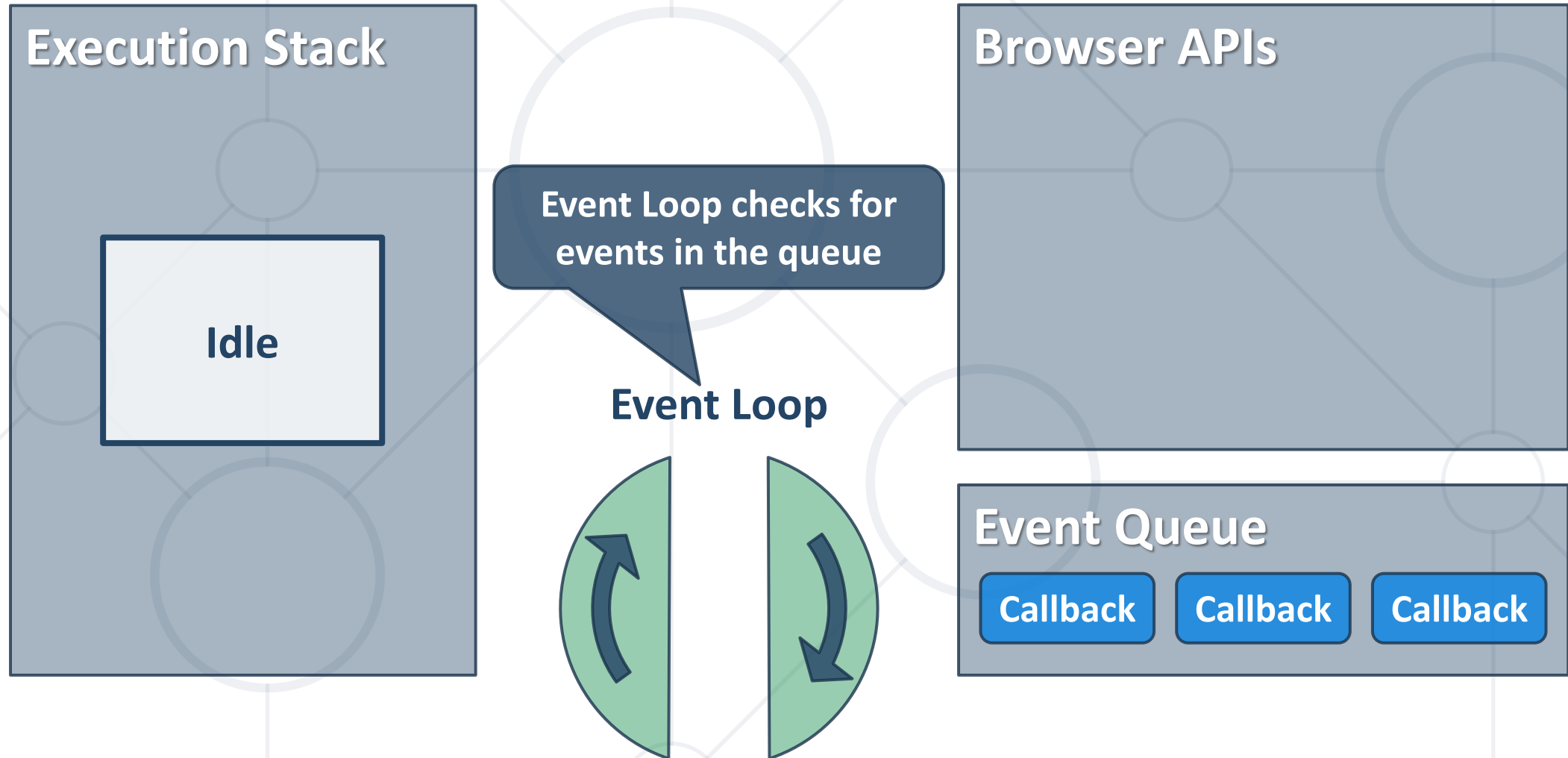
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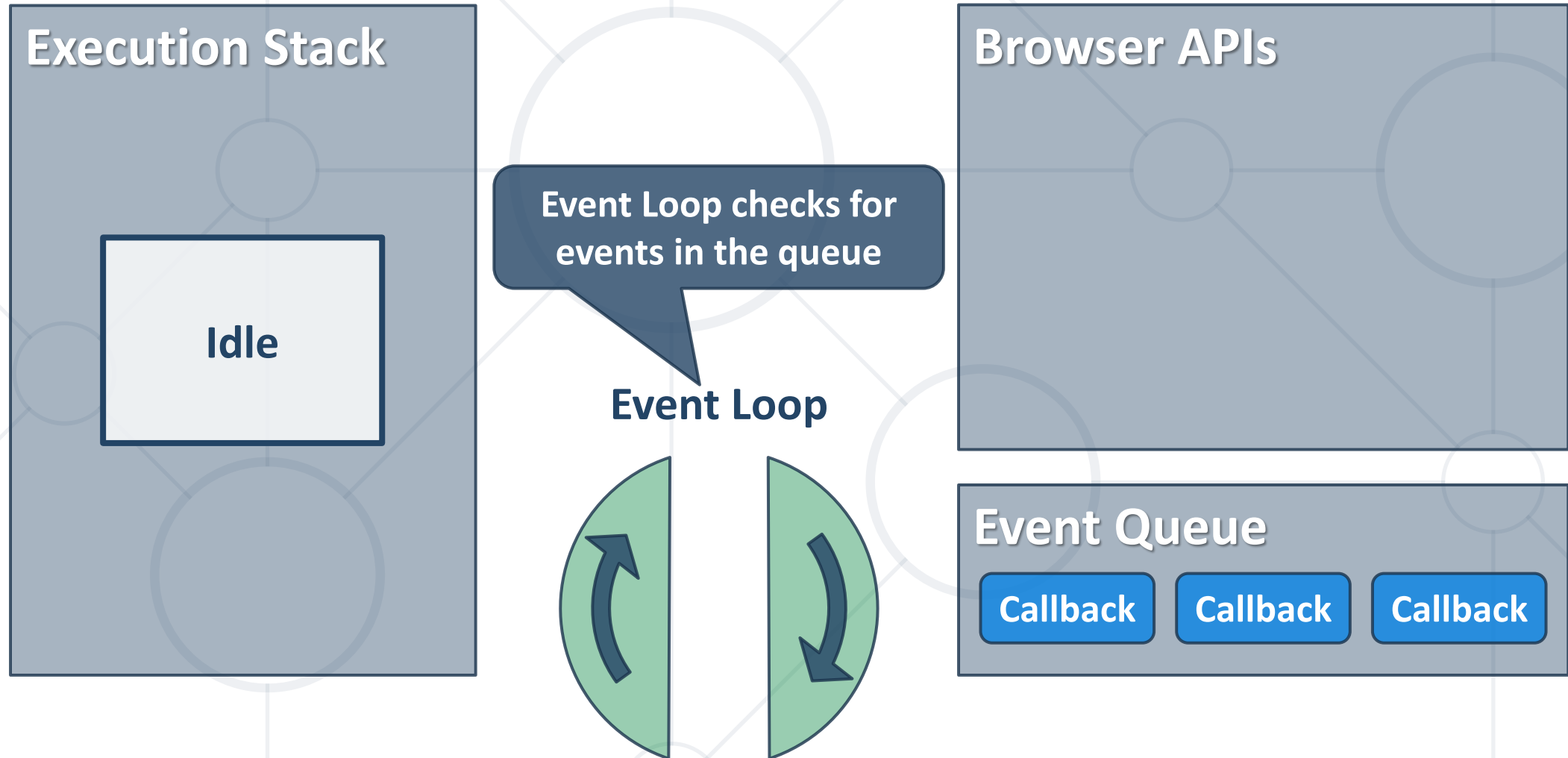
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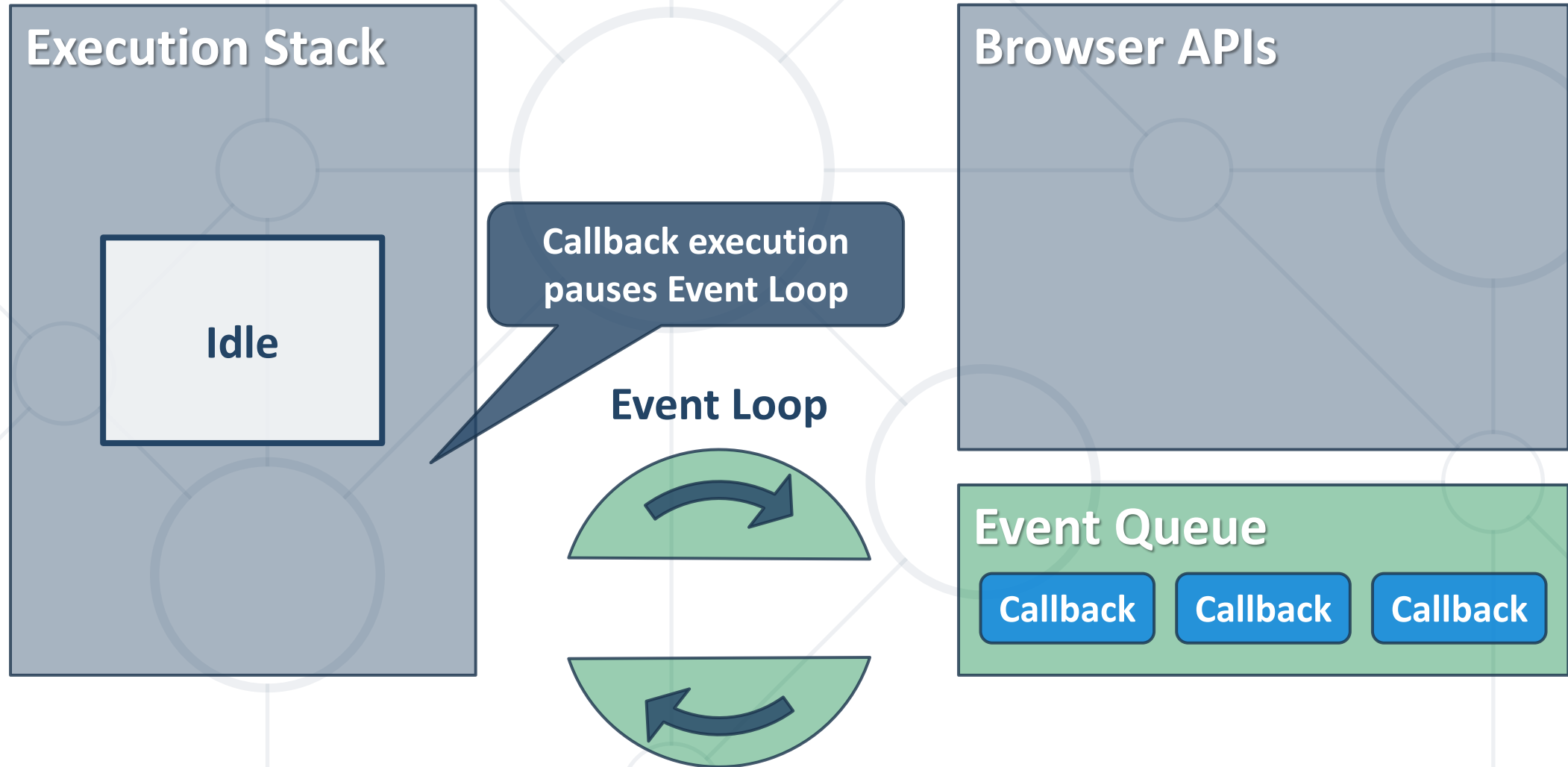
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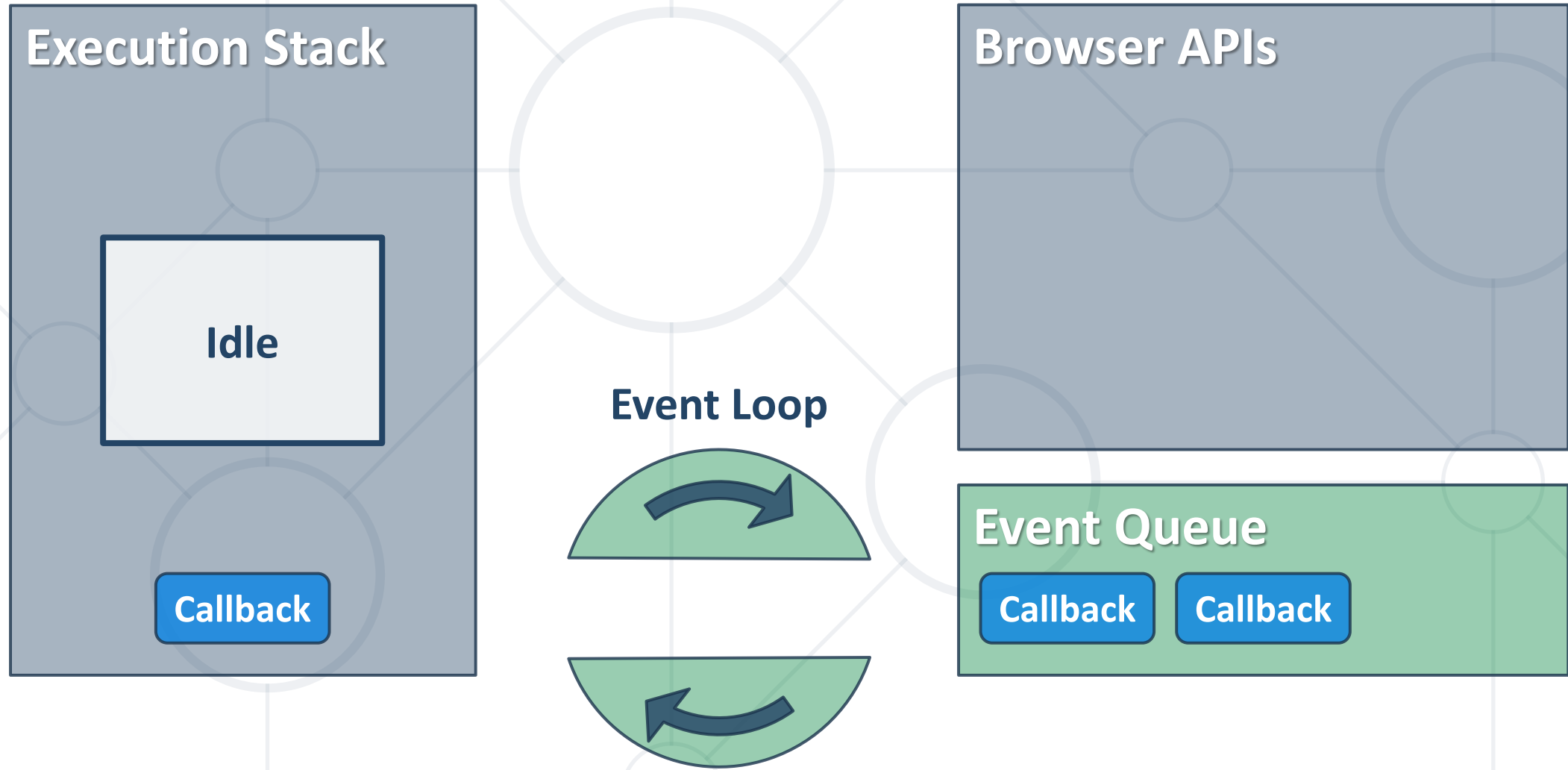
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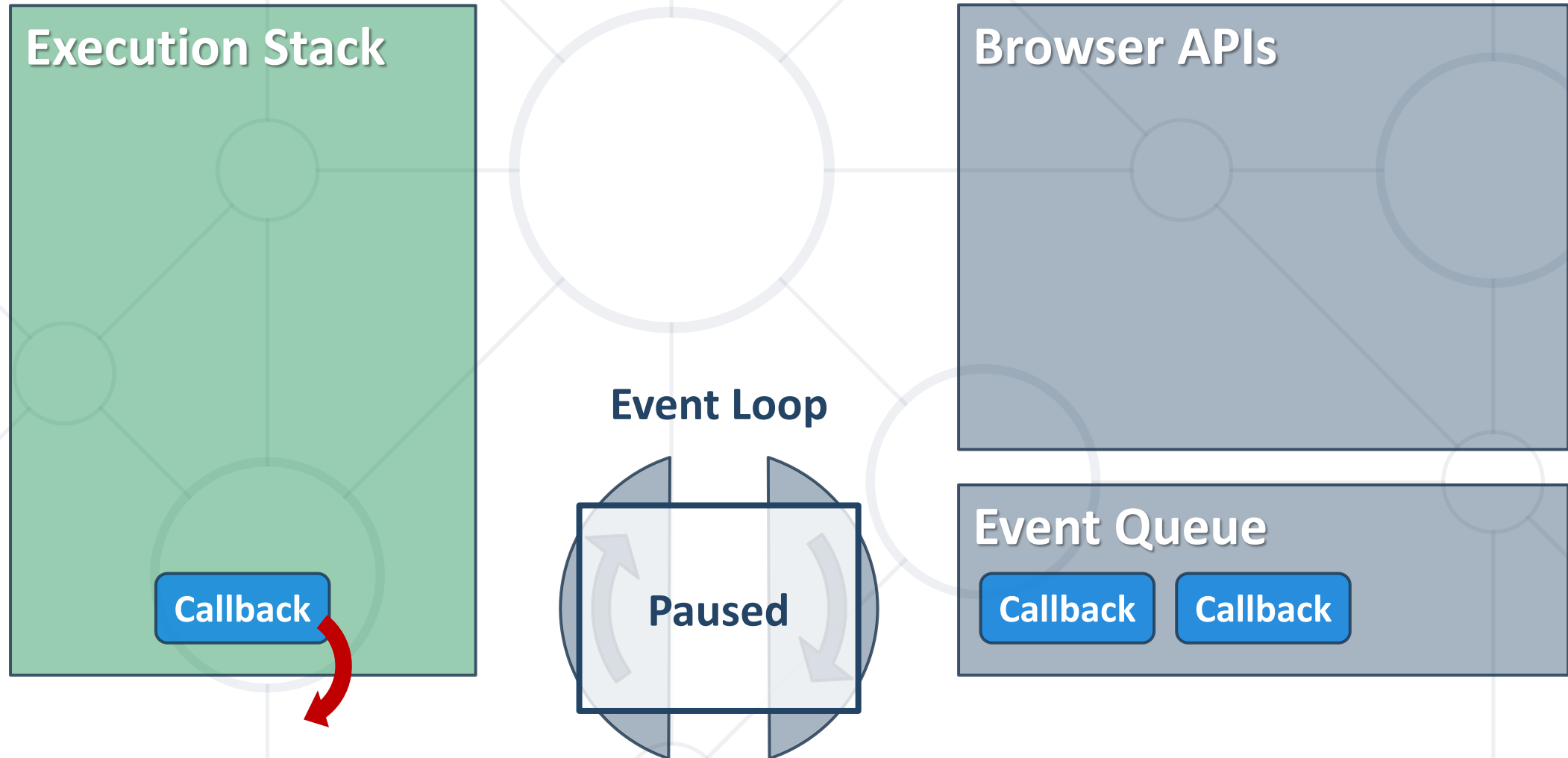
Event Loop Synchronization



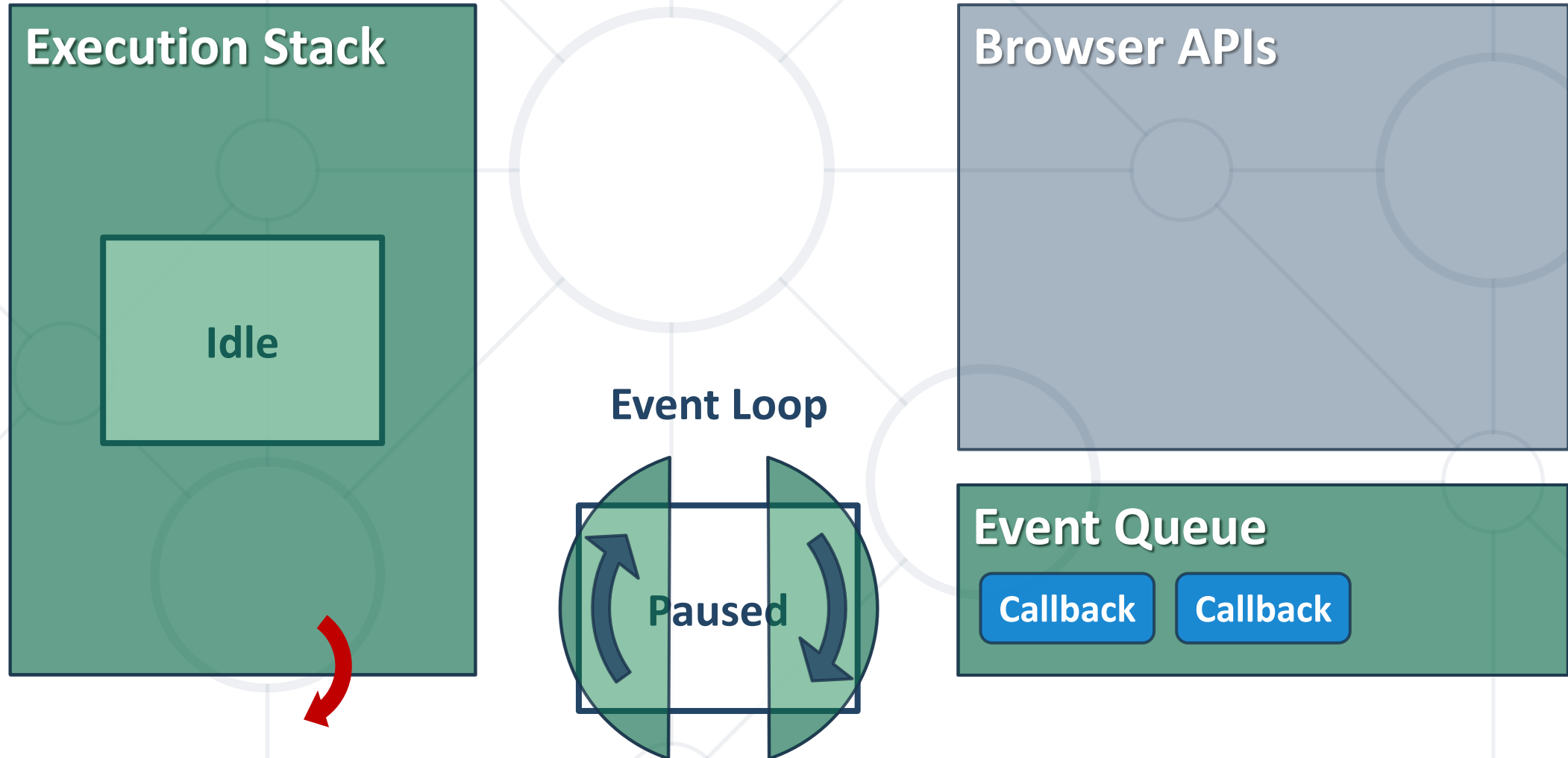
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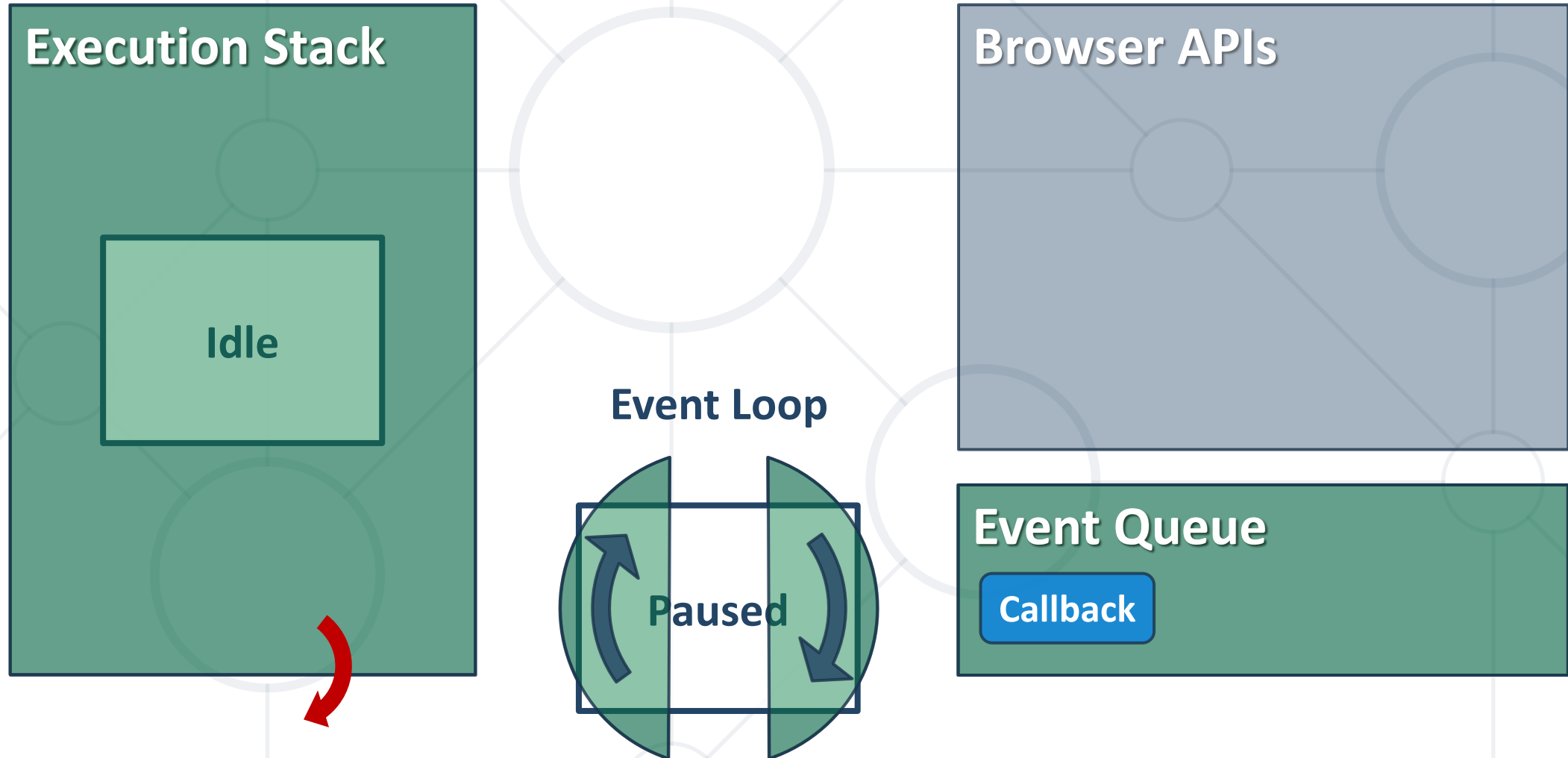
Event Loop Synchronization



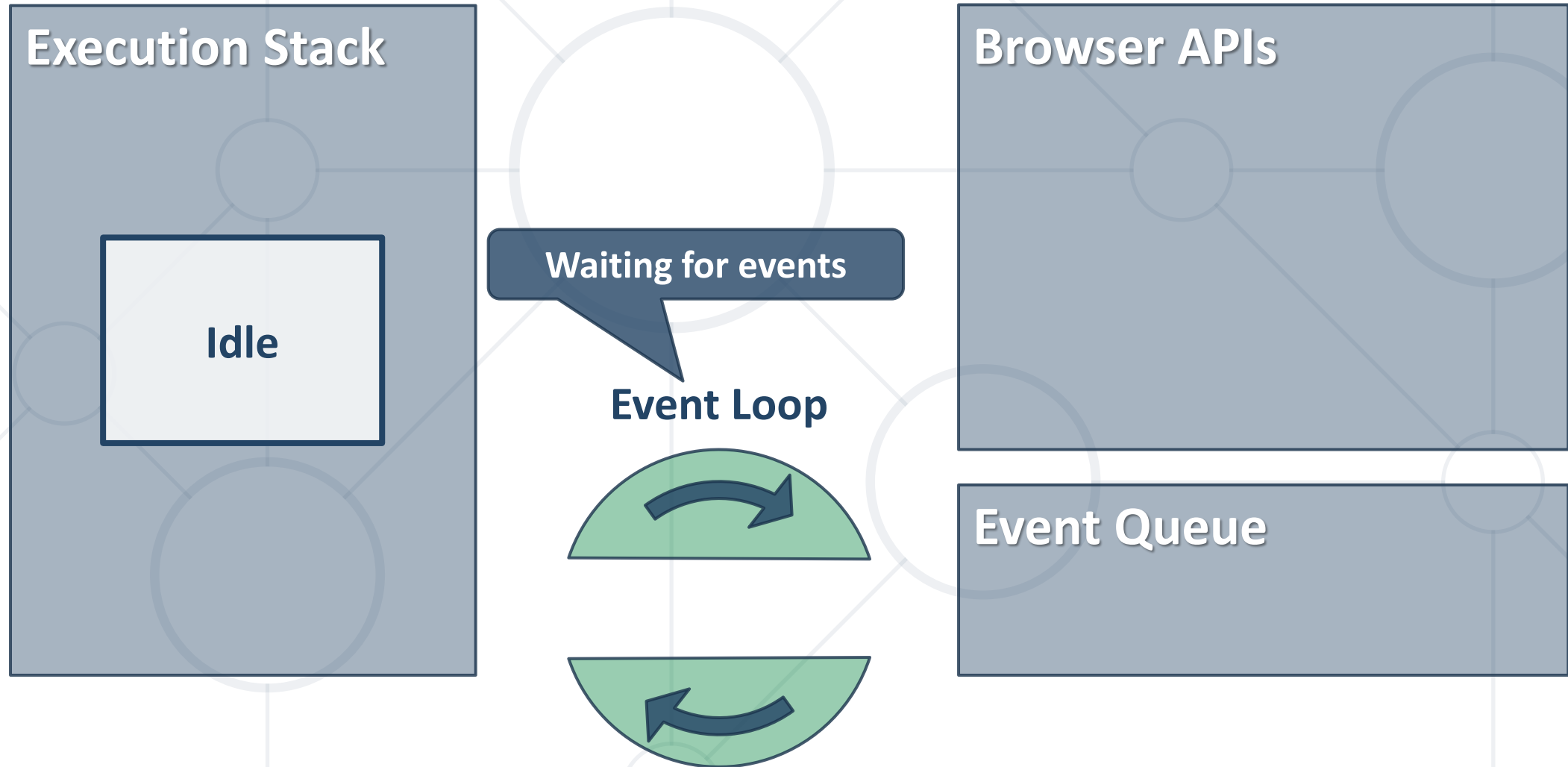
Event Loop Synchronization



Event Loop Synchronization



Event Loop Synchronization






Promises

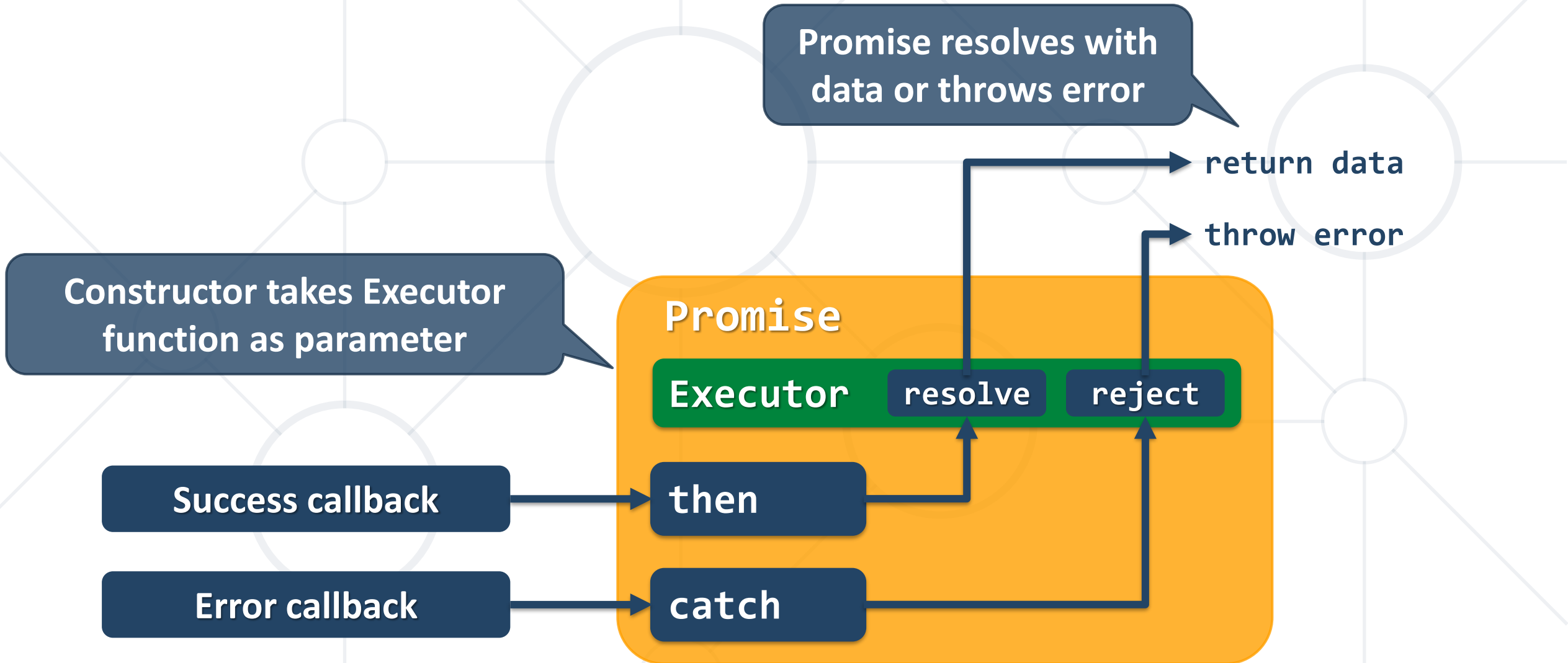
Objects Holding Asynchronous Operations

What is a Promise?

- 
- A promise is an **asynchronous action** that **may complete** at some point and **produce a value**
 - States
 - **Pending**
 - Operation still running (unfinished)
 - **Fulfilled**
 - Operation finished (the result is available)
 - **Failed**
 - Operation failed (an error is present)
 - Promises use the **Promise class**

```
new Promise(executor);
```

Promise Flowchart



Promise.then() – Example

```
console.log('Before promise');
```

```
new Promise(function(resolve, reject) {  
  setTimeout(function() {  
    resolve('done');  
  }, 500);  
})  
.then(function(res) {  
  console.log('Then returned: ' + res);  
});
```

Resolved after 500 ms

```
console.log('After promise');
```

// Before promise

// After promise

// Then returned: done

- **Promise.reject**(reason)
 - Returns an **object** that is **rejected** with the given **reason**
- **Promise.resolve**(value)
 - Returns an object that is **resolved** with the given **value**
- **Promise.all**(iterable)
 - Returns a **promise**
 - Fulfills when **all** of the promises **have fulfilled**
 - Rejects as soon as **one** of them **rejects**

- **Promise.allSettled**(iterable)
 - Wait until all promises have settled
- **Promise.race**(iterable)
 - Returns a promise that fulfills or rejects as soon as one of the promises in an iterable is settled
- **Promise.prototype.finally**()
 - The handler is called when the promise is settled

What is Fetch?

- The **fetch()** method allows making network requests
- It is similar to **XMLHttpRequest** (XHR). The main **difference** is that the **Fetch API**
 - Uses **Promises**
 - Enables a **simpler** and **cleaner** API
 - Makes code more readable and maintainable

```
fetch('./api/some.json')  
  .then(function(response) {...})  
  .catch(function(err) {...})
```

- The response of a **fetch()** request is a **Stream** object
- The **reading** of the stream happens **asynchronously**
- When the **json()** method is called, a **Promise** is **returned**
 - The **response status** is checked (should be **200**) **before parsing** the response as **JSON**

```
if (response.status !== 200) {  
    // handle error  
}  
response.json()  
    .then(function(data) { console.log(data)})
```

- **Fetch API** uses the **GET** method so that a direct call would be like this

```
fetch('https://api.github.com/users/testnakov/repos')  
  .then((response) => response.json())  
  .then((data) => console.log (data))  
  .catch((error) => console.error(error))
```

- To make a **POST** request, we can set the **method** and **body** parameters in the **fetch()** options

```
fetch('/url', {  
  method: 'post',  
  headers: { 'Content-type': 'application/json' },  
  body: JSON.stringify(data),  
})
```

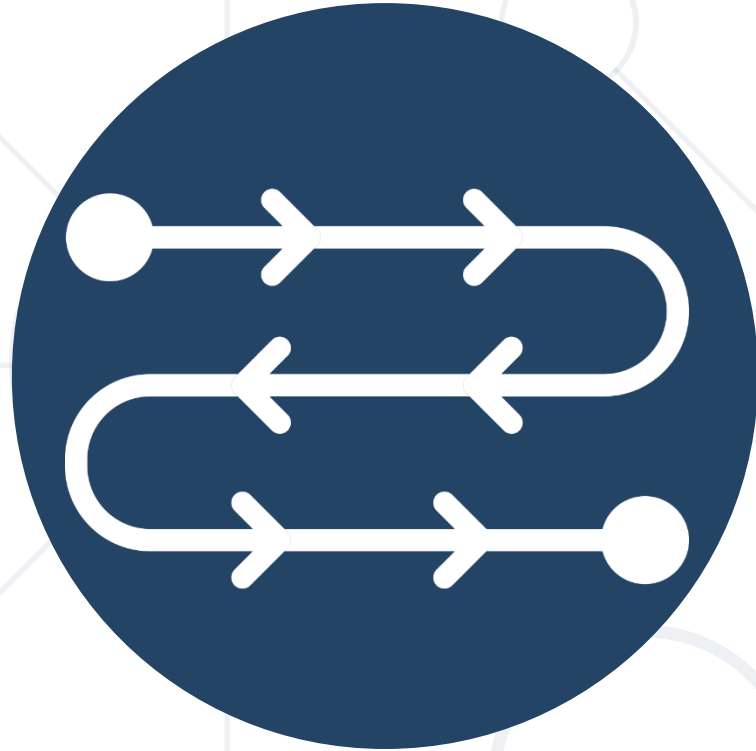

- **clone()**
 - Create a clone of the response
- **json()**
 - Resolves the promise with JSON
- **redirect()**
 - Create new promise but with different URL
- **text()**
 - Resolves the promise with string

- **arrayBuffer()**
 - resolve body with ArrayBuffer
- **blob()**
 - Resolve body with Blob (file, image, etc.)
- **formData()**
 - Resolve body with FormData

- **Basic**
 - Normal, same origin response
- **cors**
 - Response was received from a valid cross-origin request
- **Error**
 - Error network
- **opaque**
 - Response for "no-cors" request to cross-origin resource
- **opaqueredirect**
 - The fetch request was made with **redirect: "manual"**

- When working with a JSON API, you can
 - Define the **status** and **JSON parsing** in **separate functions**
 - The functions **return promises** which can be **chained**

```
fetch('users.json')  
  .then(status)  
  .then(json)  
  .then(function(data) {...})  
  .catch(function(error) {...});
```



Async / Await

Simplified Promises

Async Functions

- Returns a **promise**, that can await other promises in a way that **looks synchronous**
- Operate **asynchronously** via the event loop
- Contains an **await** expression that
 - Is **only valid** inside **async functions**
 - **Pauses** the execution of that function
 - Waits for the Promise's **resolution**



```
function resolveAfter2Seconds() {  
  return new Promise(resolve => {  
    setTimeout(() => {  
      resolve('resolved');  
    }, 2000);  
  });  
}
```

Expected output:
// calling
// resolved

```
async function asyncCall() {  
  console.log('calling');  
  let result = await resolveAfter2Seconds();  
  console.log(result);  
}
```

- Do not confuse **await** with **Promise.then()**
 - **await** is always used for a **single promise**
 - To **await two or more** promises in **parallel**, use **Promise.all()**
- If a promise resolves normally, then **await** promise **returns the result**
- In case of a rejection, it **throws an error**

■ Promise.then

```
function logFetch(url) {  
  return fetch(url)  
    .then(response => {  
      return response.text()  
    })  
    .then(text => {  
      console.log(text);  
    })  
    .catch(err => {  
      console.error(err);  
    });  
}
```

■ Async / Await

```
async function logFetch(url) {  
  try {  
    const response =  
      await fetch(url);  
    console.log(  
      await response.text()  
    );  
  }  
  catch (err) {  
    console.log(err);  
  }  
}
```



```
async function f() {  
  try {  
    let response = await fetch();  
    let user = await response.json();  
  } catch (err) {  
    // catches errors both in fetch and response.json  
    alert(err);  
  }}  
}
```

```
async function f() {  
  let response = await fetch();  
}  
// f() becomes a rejected promise  
f().catch(alert);
```

- To execute various promise methods **one by one**, use **Async /Await**

```
function execute(x,sec) {  
  return new Promise(resolve => {  
    console.log('Start: ' + x);  
    setTimeout(() => {  
      console.log('End: ' + x);  
      resolve(x);  
    }, sec *1000);  
  });  
}
```

```
async function serialFlow() {  
  let result1 = await execute(1, 1);  
  let result2 = await execute(2, 2);  
  let result3 = await execute(3, 3);  
  let finalResult = result1 + result2 + result3;  
  console.log(finalResult);  
}
```

```
// Start: 1  
// End: 1  
// Start: 2  
// End: 2  
// Start: 3  
// End: 3  
// 6
```

```
async function parallelFlow() {  
  let result1 = execute(1,1);  
  let result2 = execute(2,2);  
  let result3 = execute(3,3);  
  let finalResult = await result1 +  
                    await result2 +  
                    await result3;  
  console.log(finalResult);  
}
```

```
// Expected output:  
// Start: 1  
// Start: 2  
// Start: 3  
// End: 1  
// End: 2  
// End: 3  
// 6
```

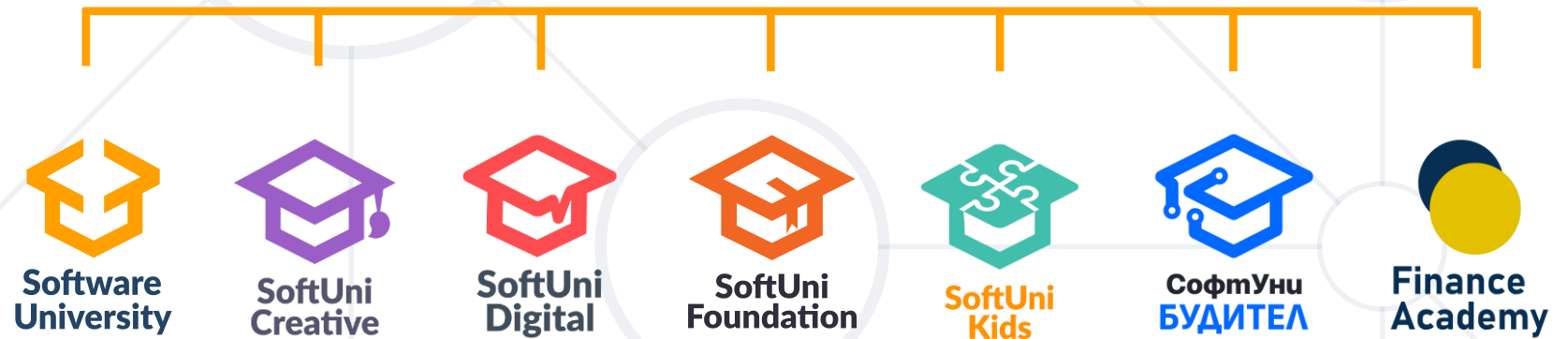
- Asynchronous programming
 - Runs **several tasks** in **parallel**, at the **same time**
- Promises hold **operations**
 - Can be **resolved** or **rejected**
- **Async** functions contain an **await** expression
 - **Yields** the **execution**
 - **Waits** for the **promise's resolution**



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