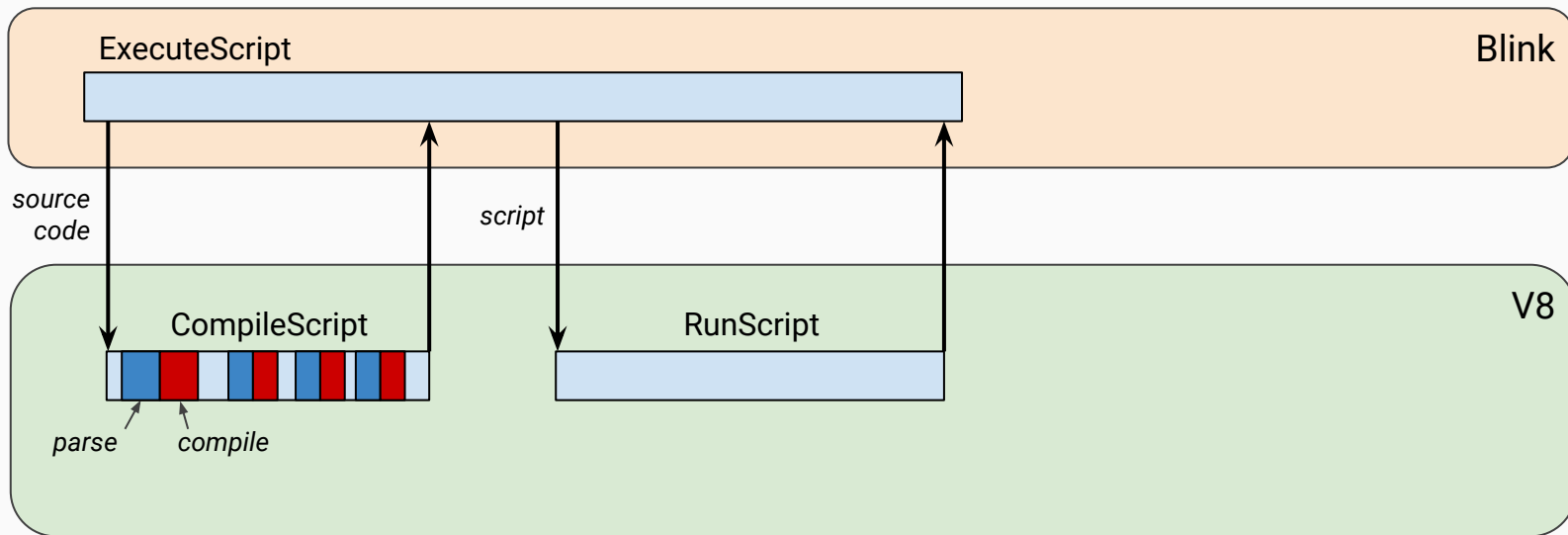


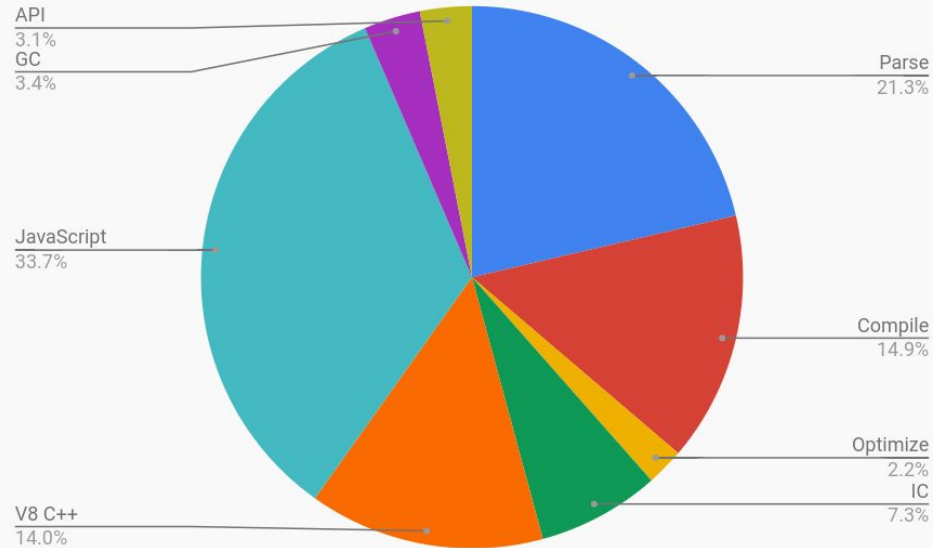
Caching (more) JavaScript code in Chrome

Leszek Swirski, Mythri Alle, Ross McIlroy

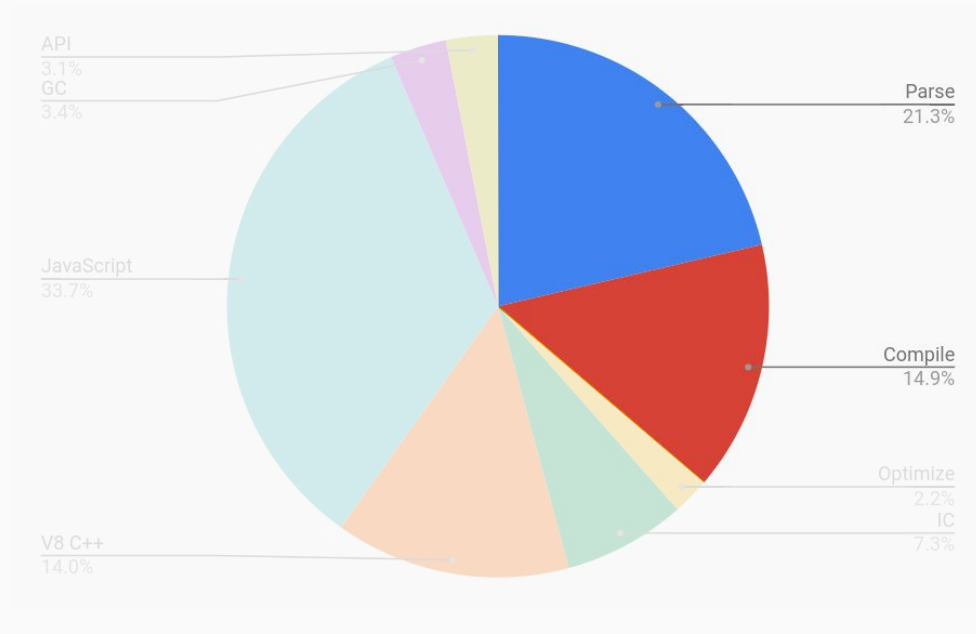
Javascript execution in blink



Why cache code?

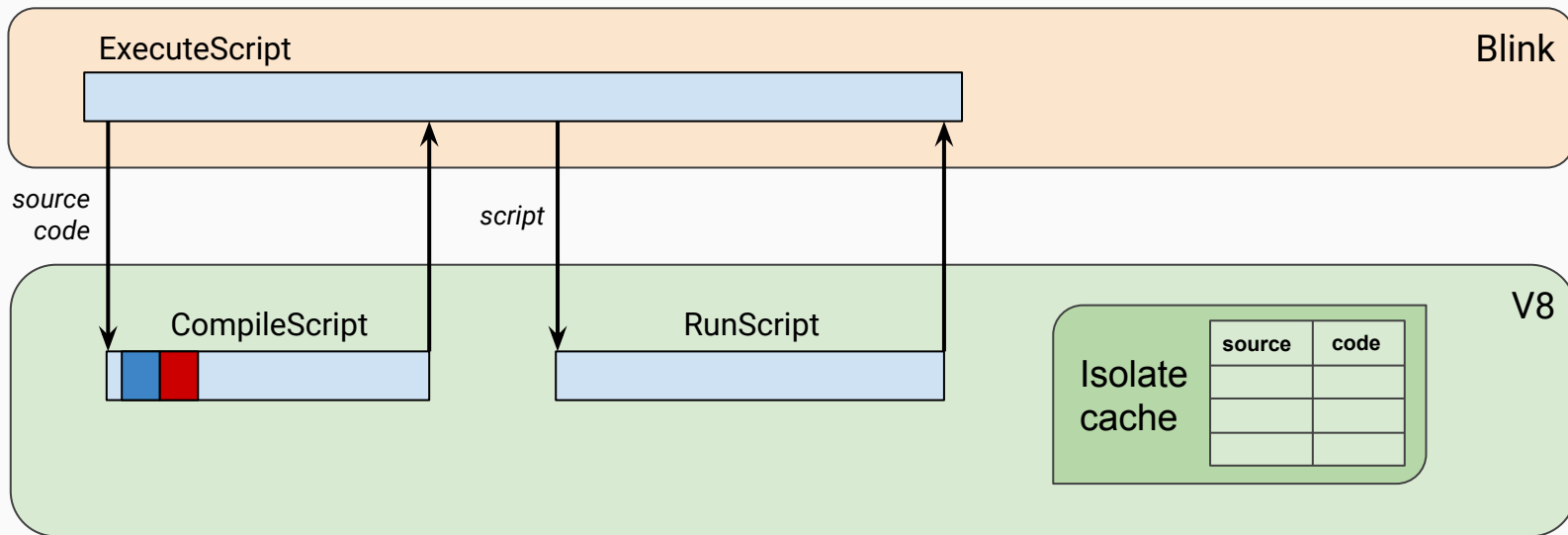


Why cache code?

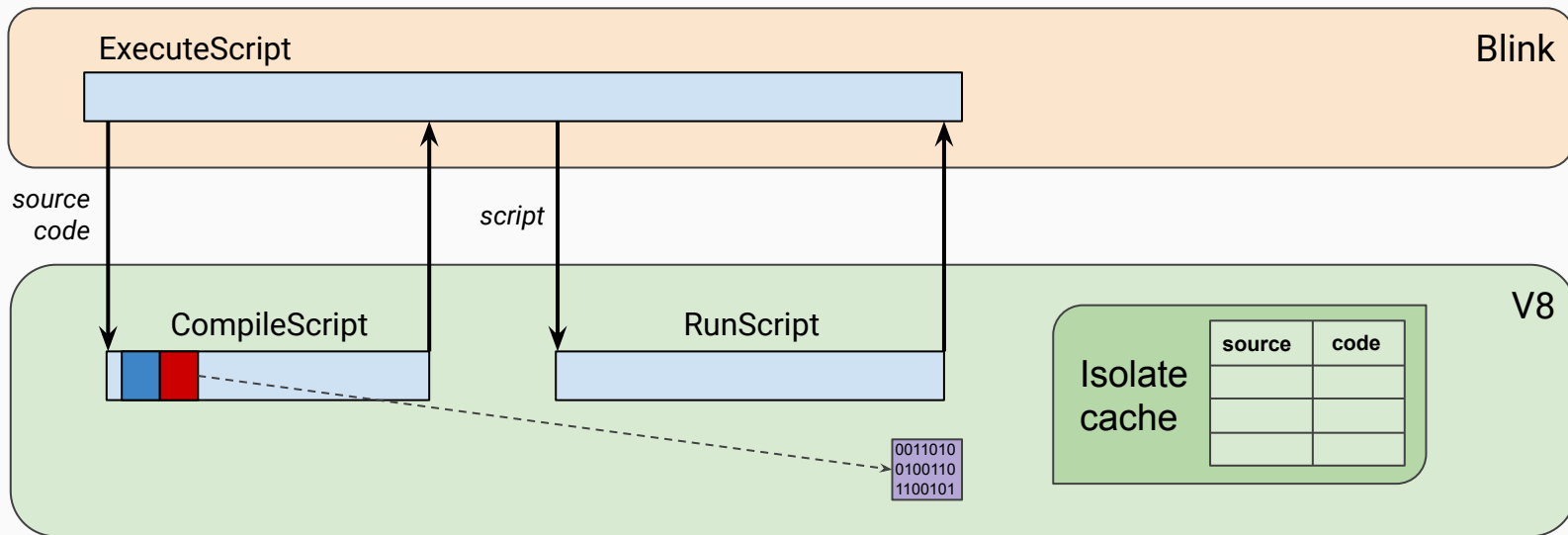


Isolate caches in V8

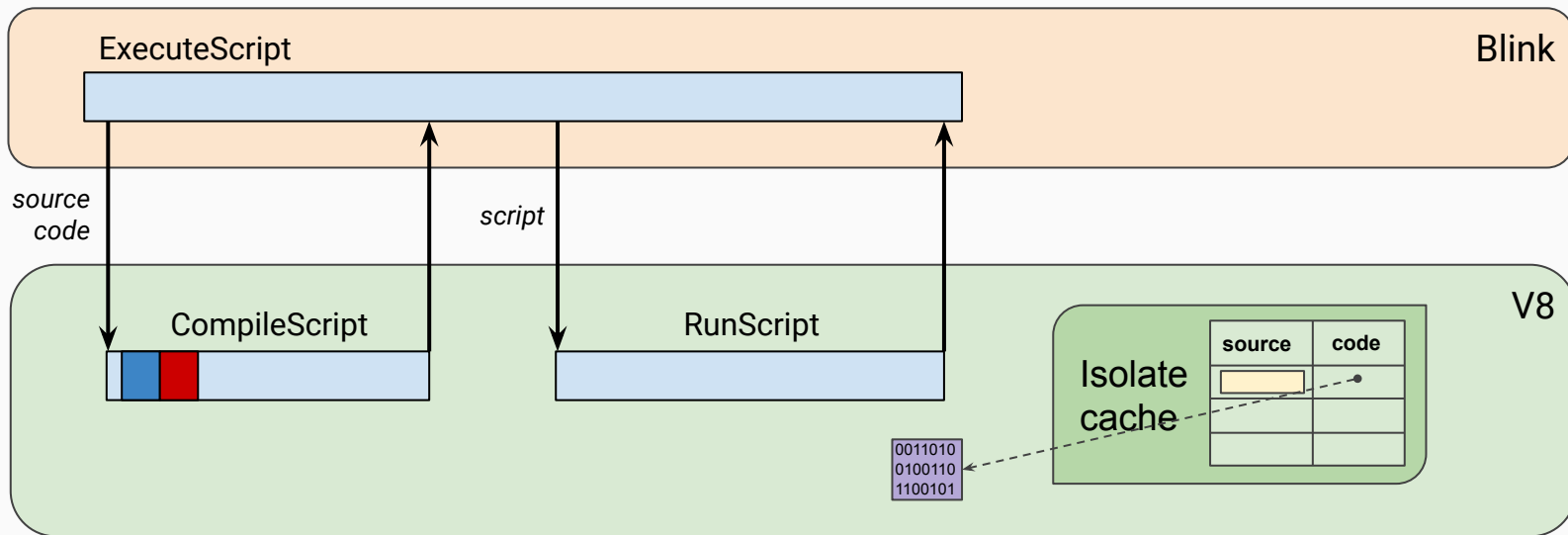
Isolate caches in V8



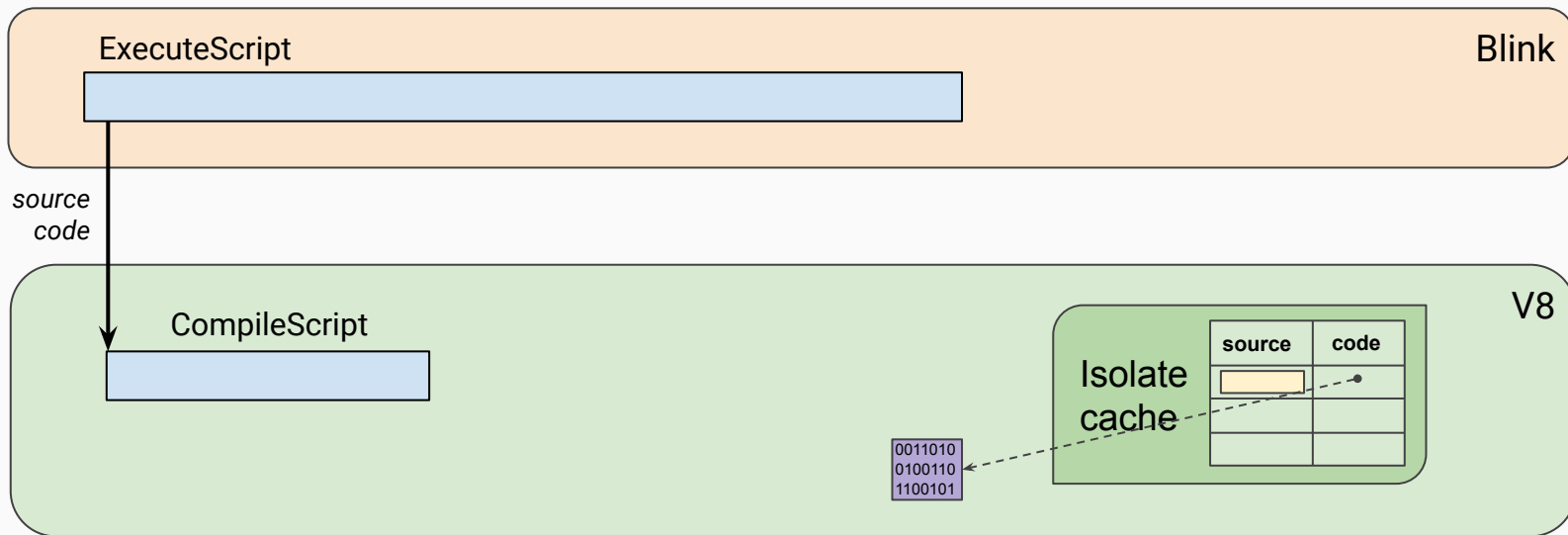
Isolate caches in V8



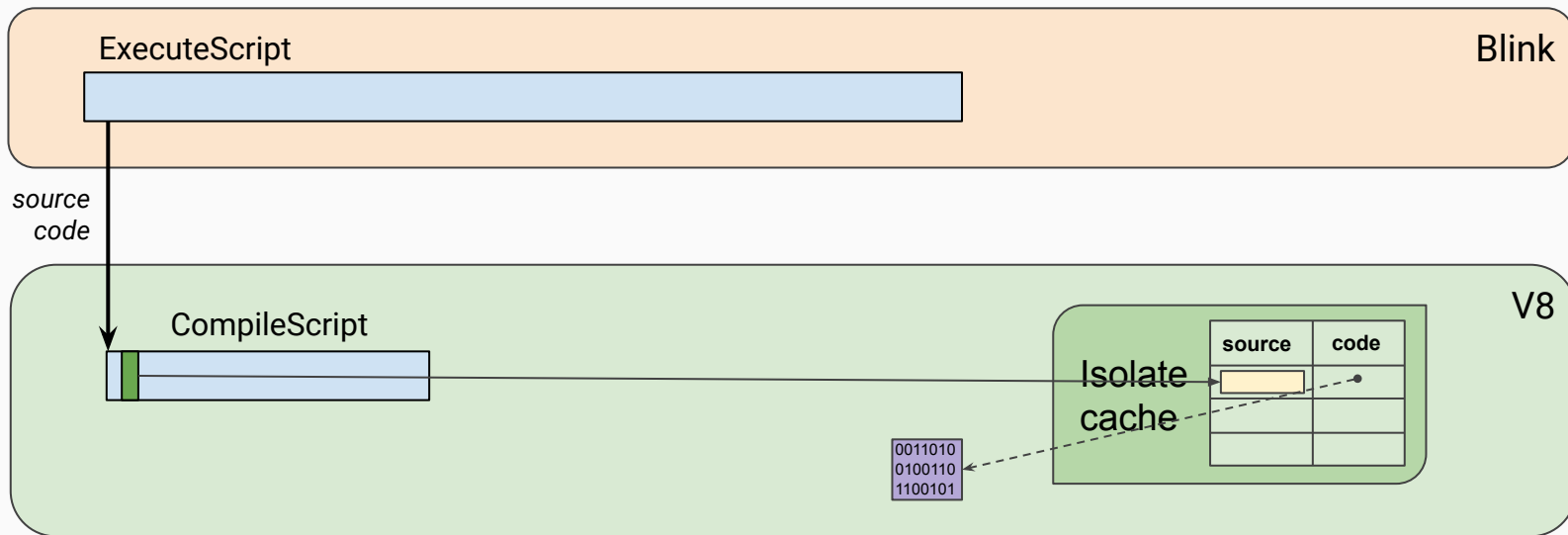
Isolate caches in V8



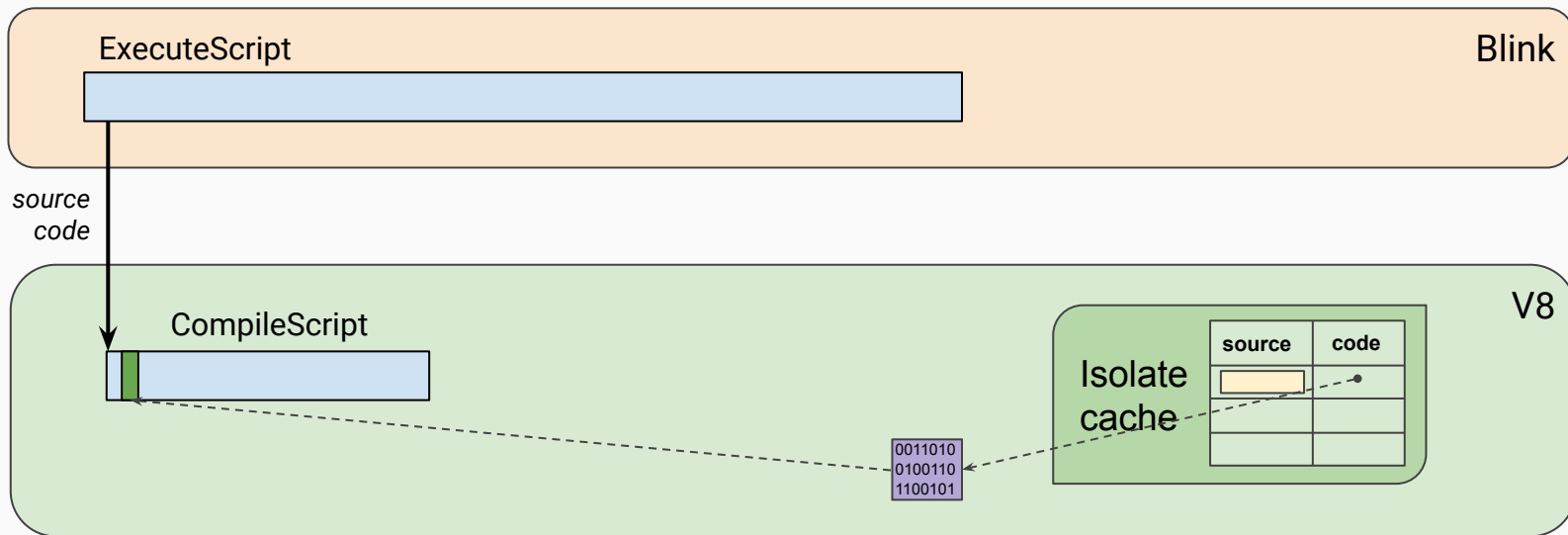
Isolate caches in V8



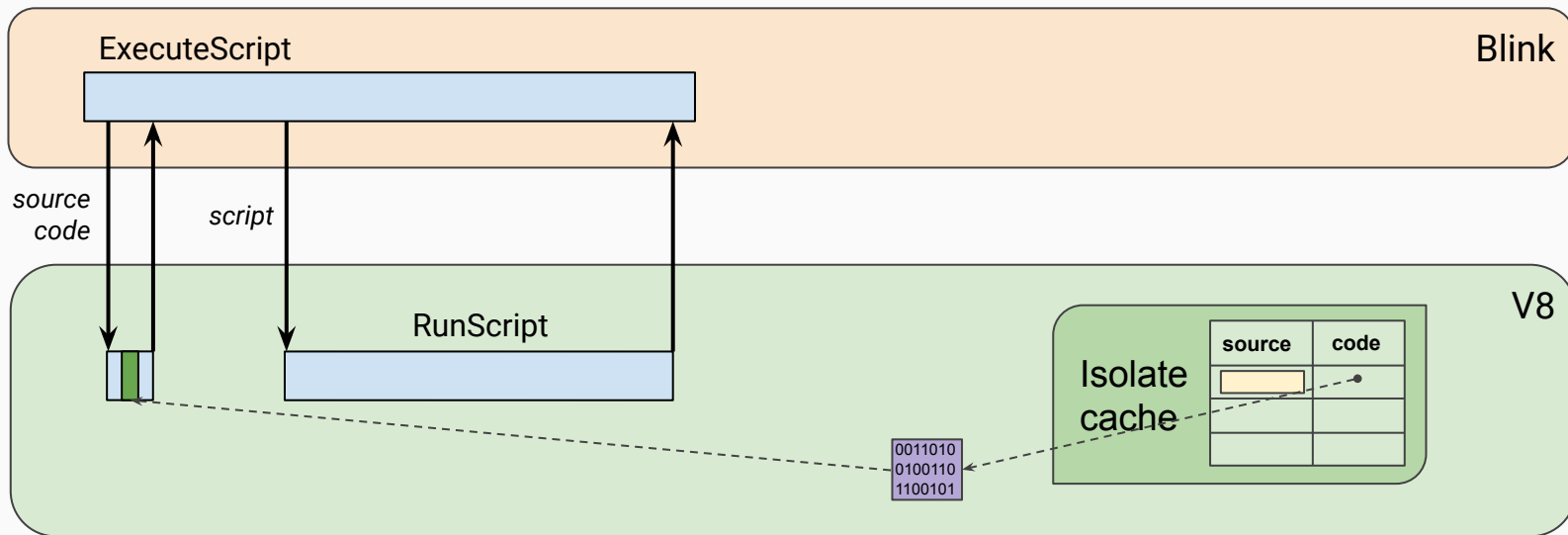
Isolate caches in V8



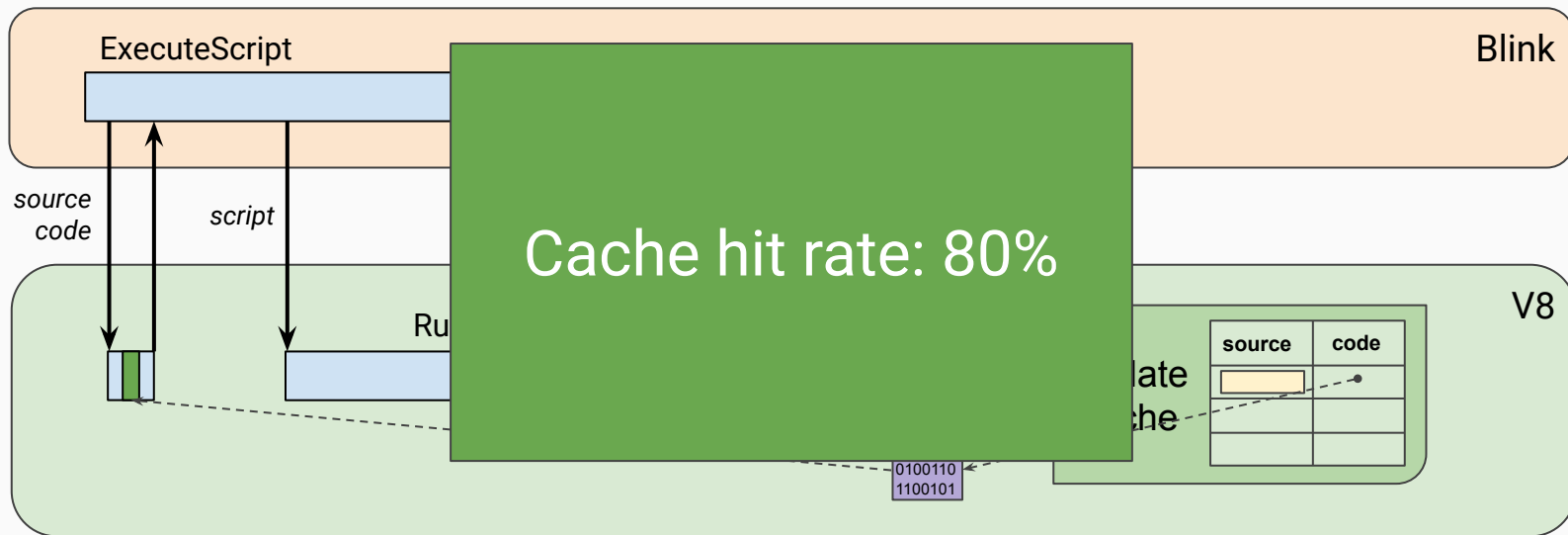
Isolate caches in V8



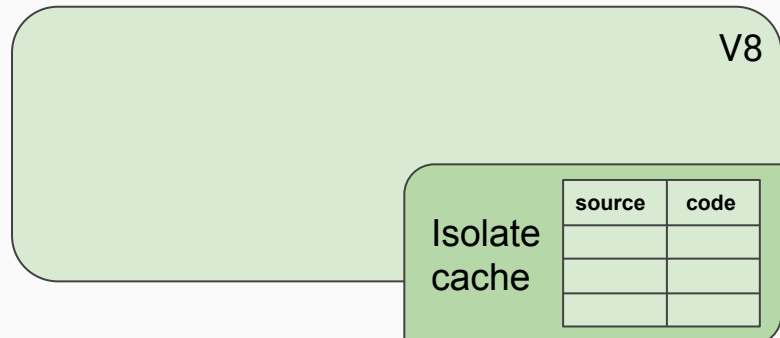
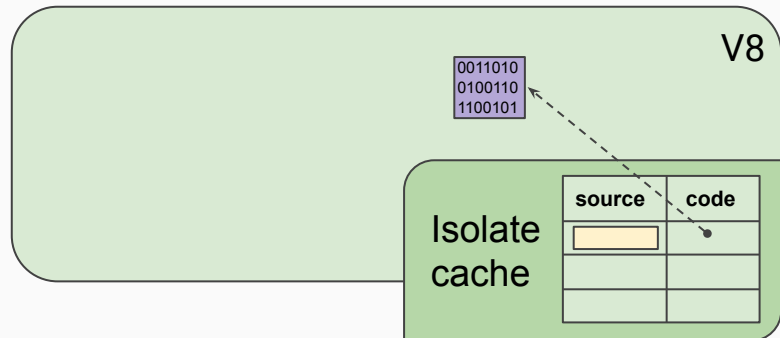
Isolate caches in V8



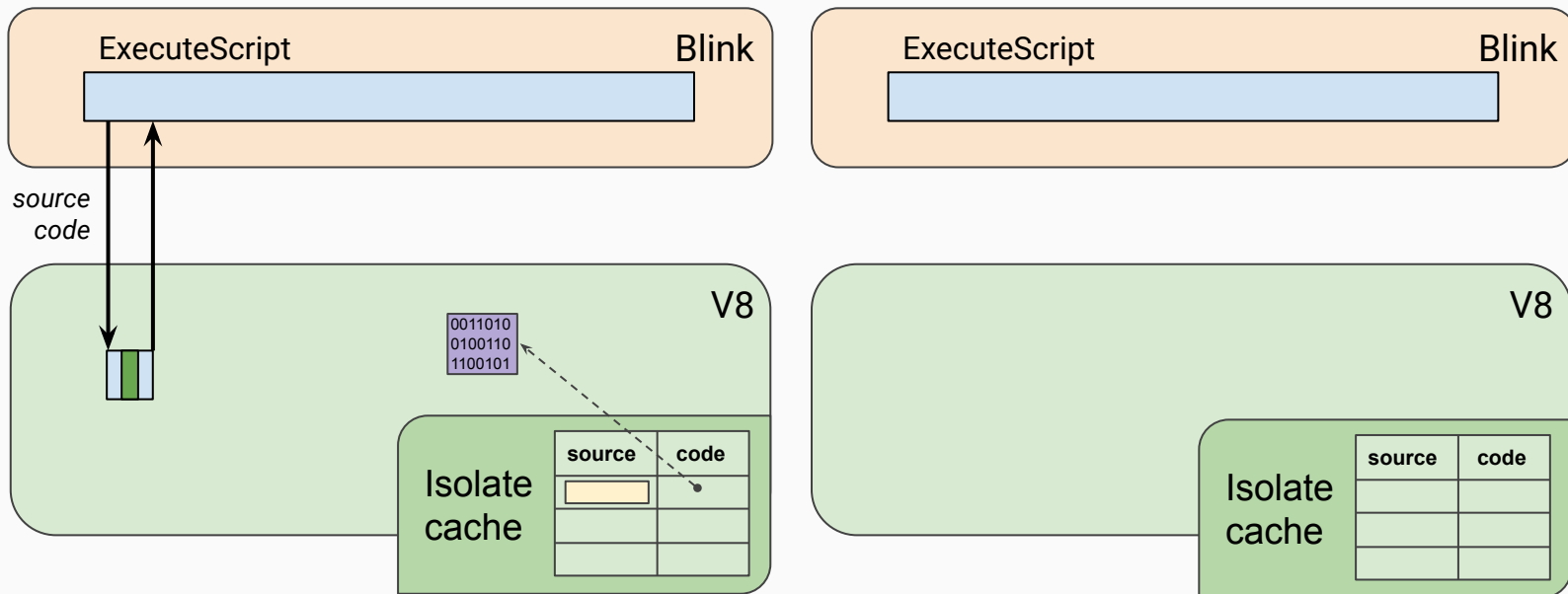
Isolate caches in V8



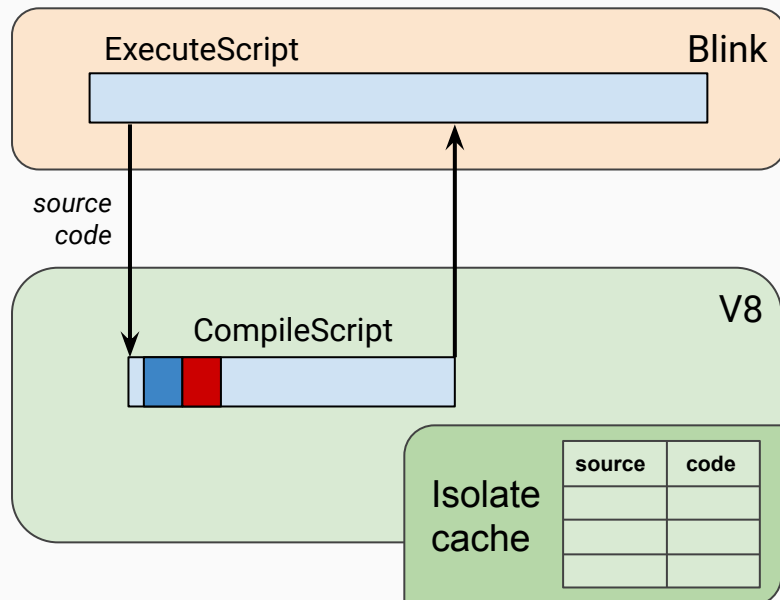
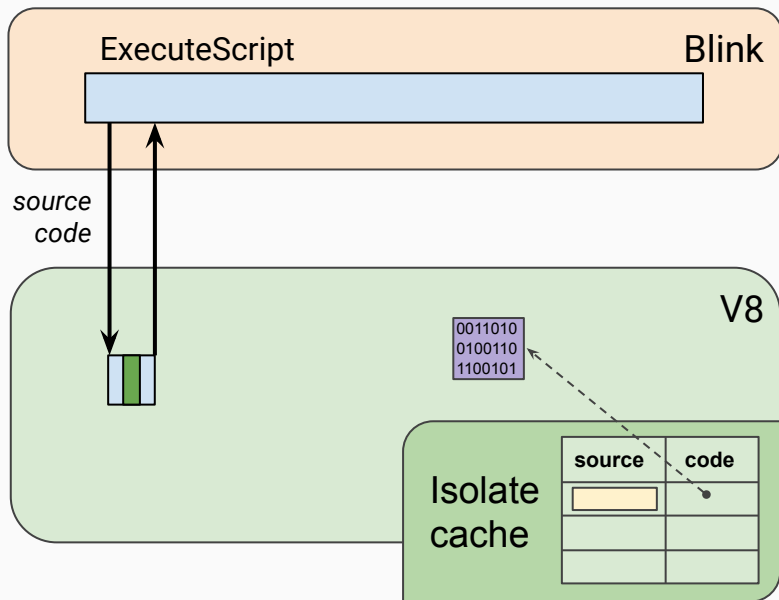
Isolate caches in V8



Isolate caches in V8



Isolate caches in V8



Resource cache metadata

Resource cache metadata

Resource cache	URI	Response	Metadata

ExecuteScript

Blink

V8

Resource cache metadata

Cold run ❄️

Resource
cache

URI	Response	Metadata
script.js	[data]	

ExecuteScript




Blink

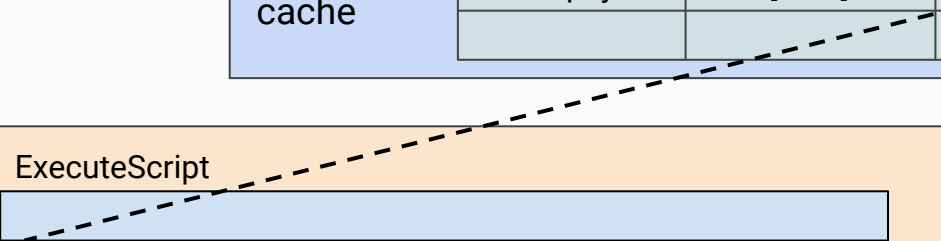
V8

Resource cache metadata

Cold run ❄️

Resource cache

URI	Response	Metadata
script.js	[data]	 Timestamp



ExecuteScript

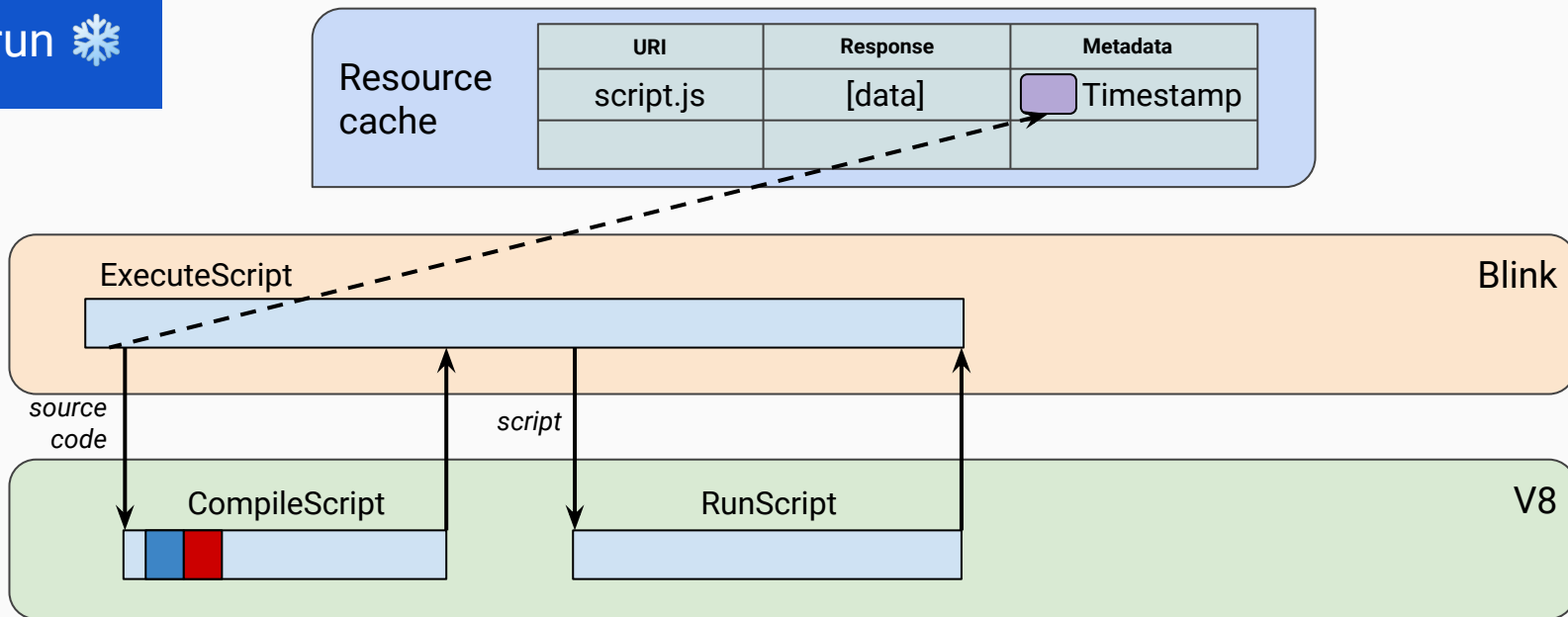


Blink

V8


Resource cache metadata

Cold run ❄️



Resource cache metadata

Warm run 

Resource cache	URI	Response	Metadata
	script.js	[data]	 Timestamp

ExecuteScript




Blink

V8

Resource cache metadata

Warm run 

Resource cache

URI	Response	Metadata
script.js	[data]	 Timestamp

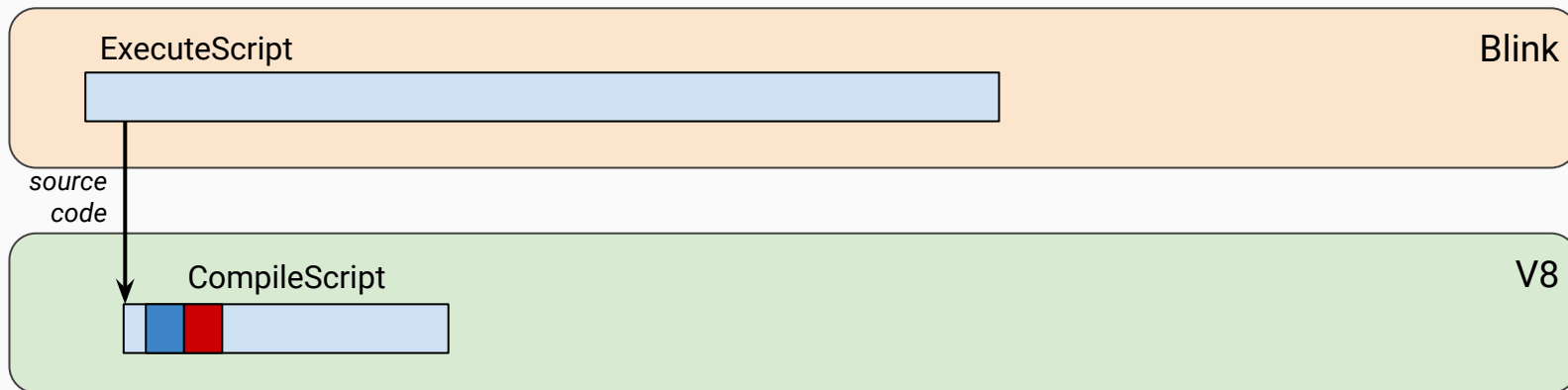
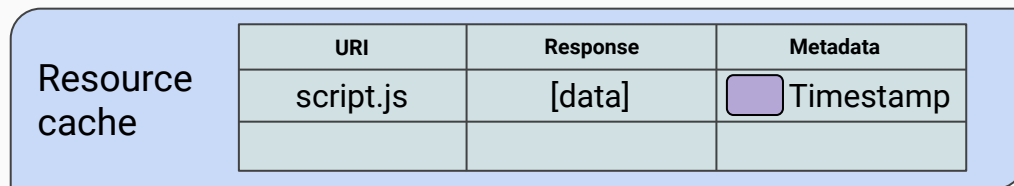
ExecuteScript

Blink

V8

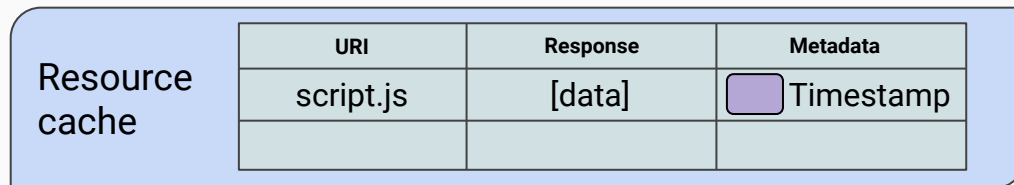
Resource cache metadata

Warm run 



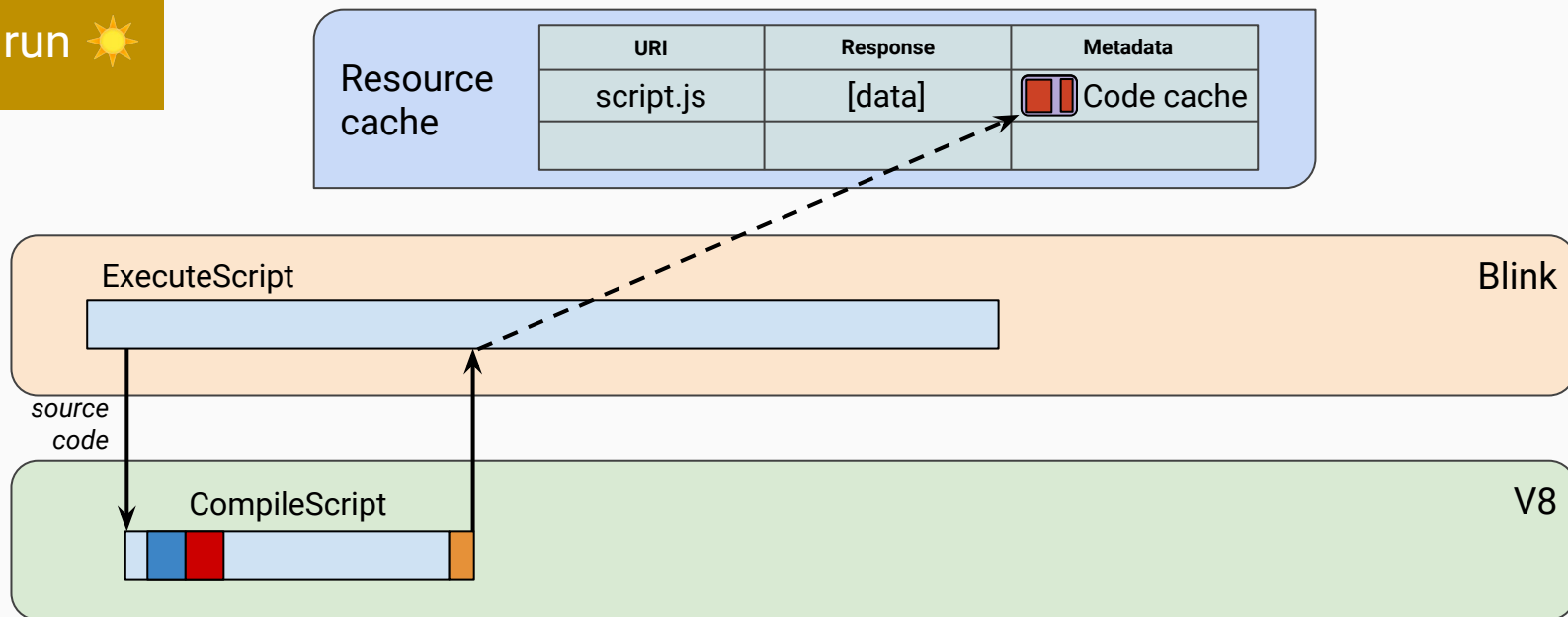
Resource cache metadata

Warm run 



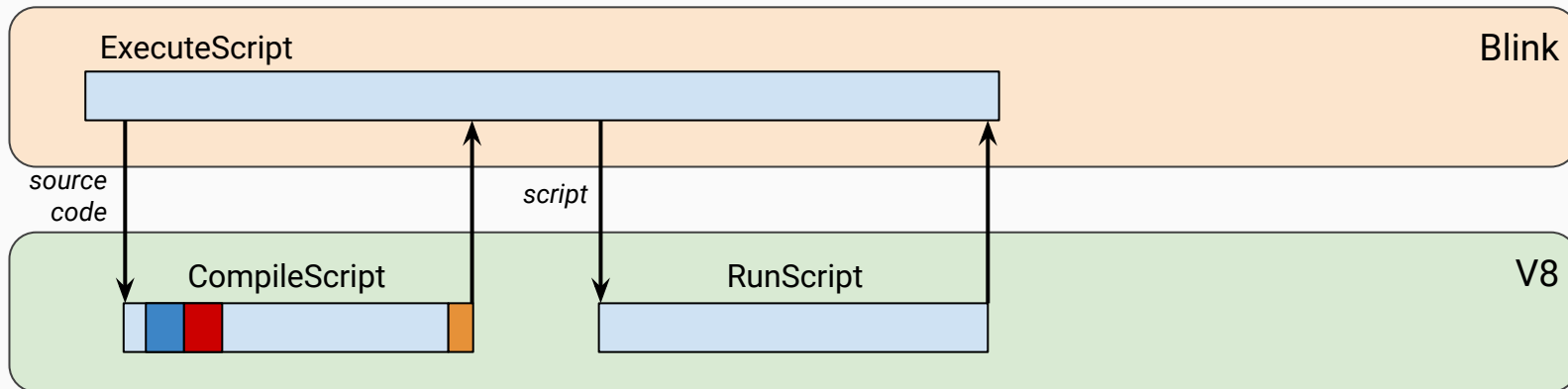
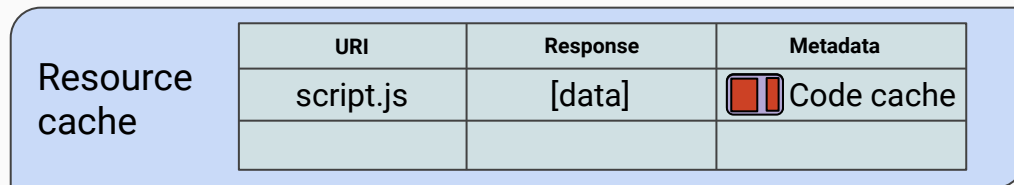
Resource cache metadata

Warm run ☀️



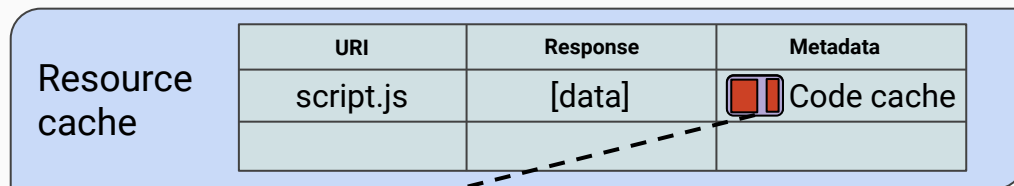
Resource cache metadata

Warm run 



Resource cache metadata

Hot run 🔥



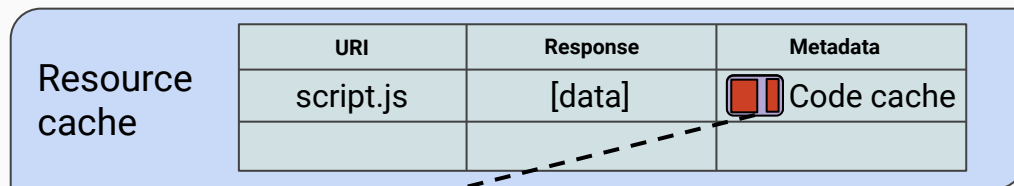
ExecuteScript

Blink

V8

Resource cache metadata

Hot run 🔥



Blink

ExecuteScript

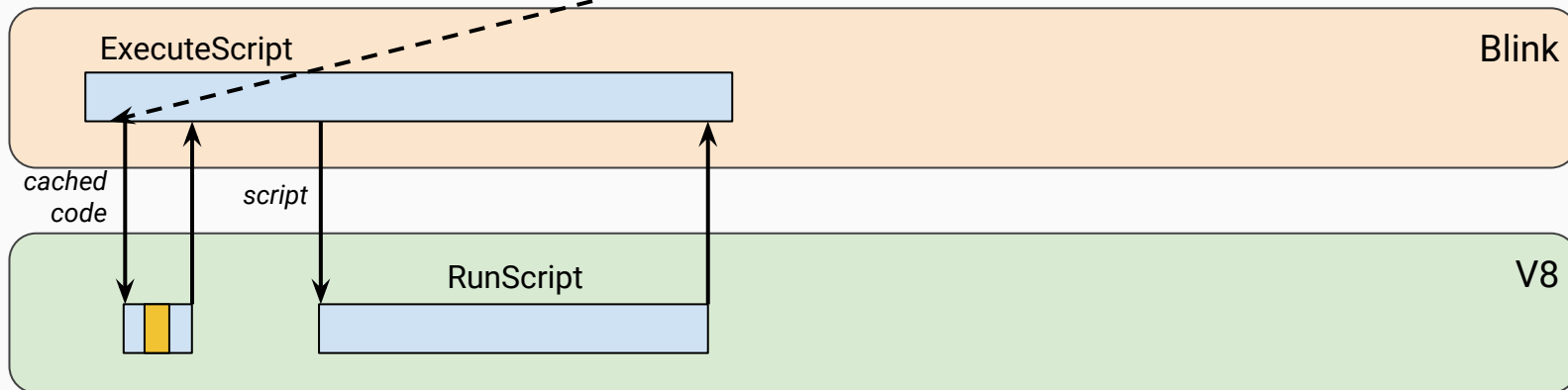
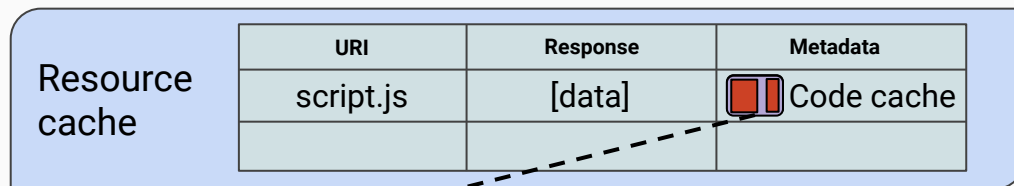
V8

cached
code



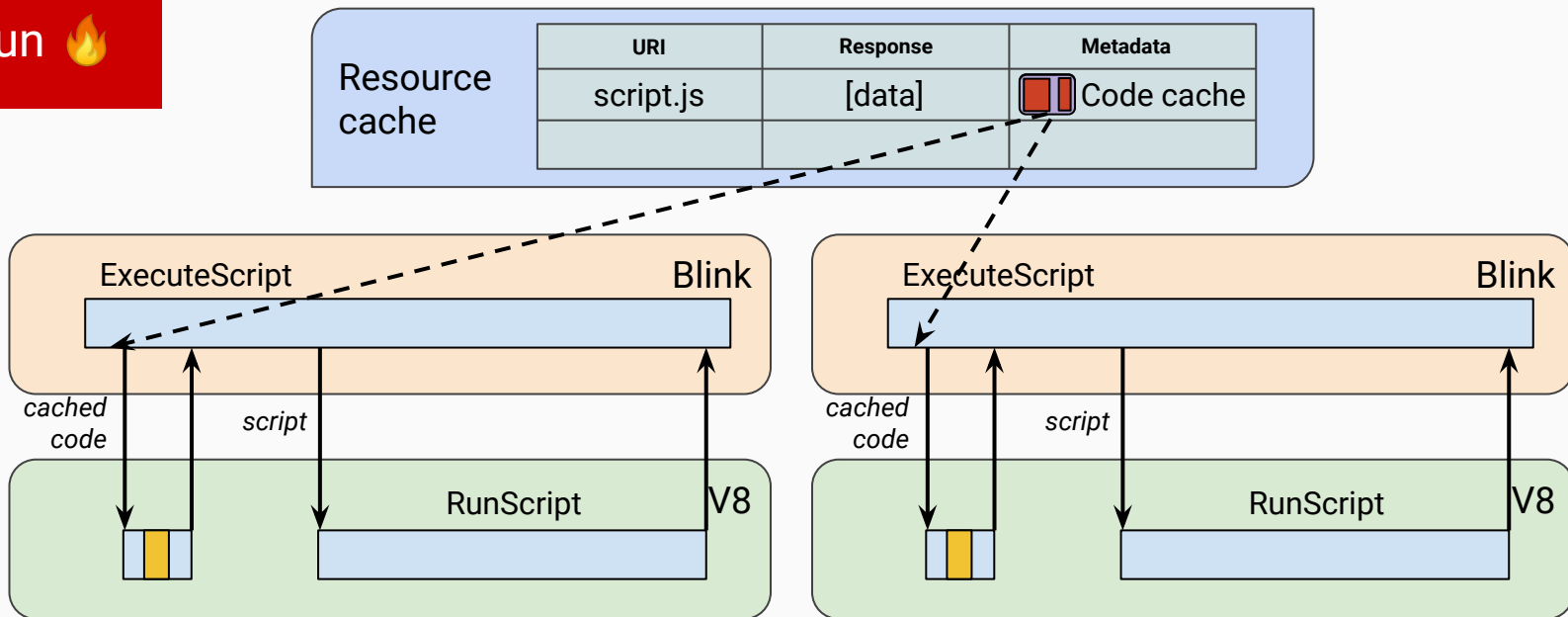
Resource cache metadata

Hot run 🔥



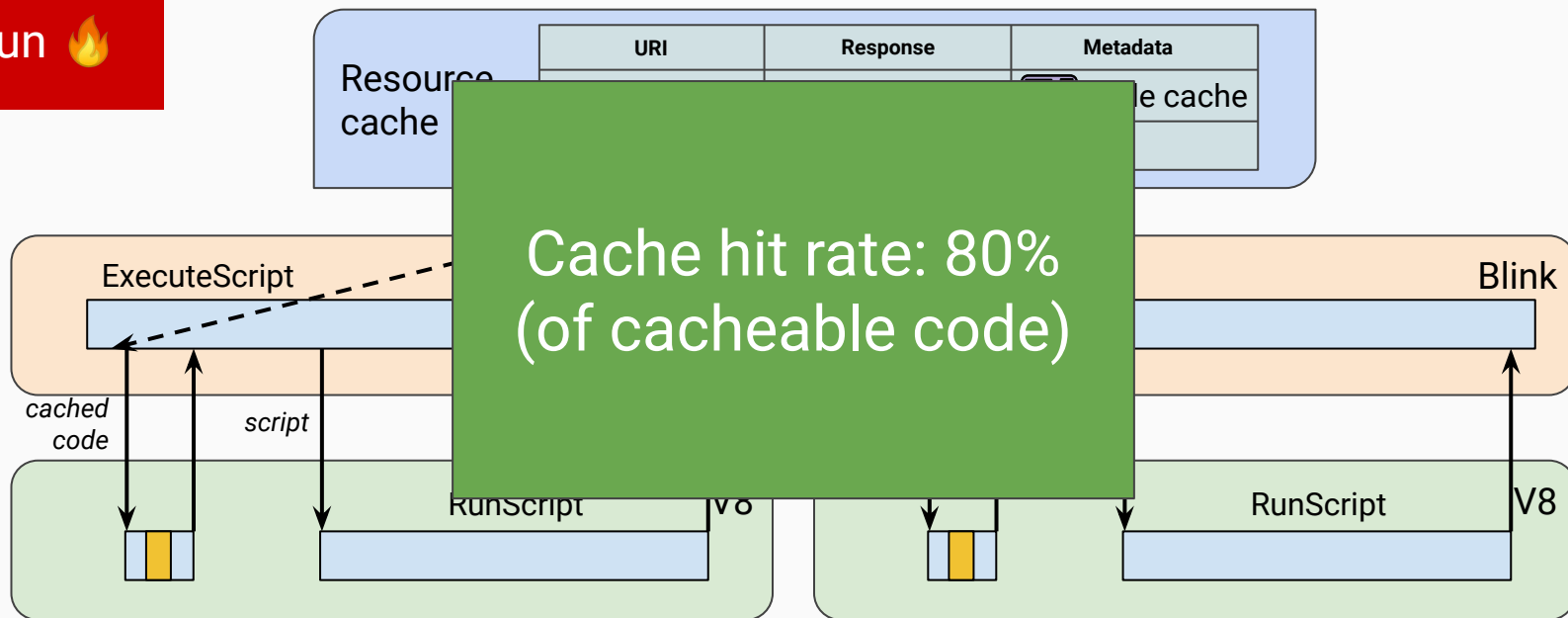
Resource cache metadata

Hot run 🔥



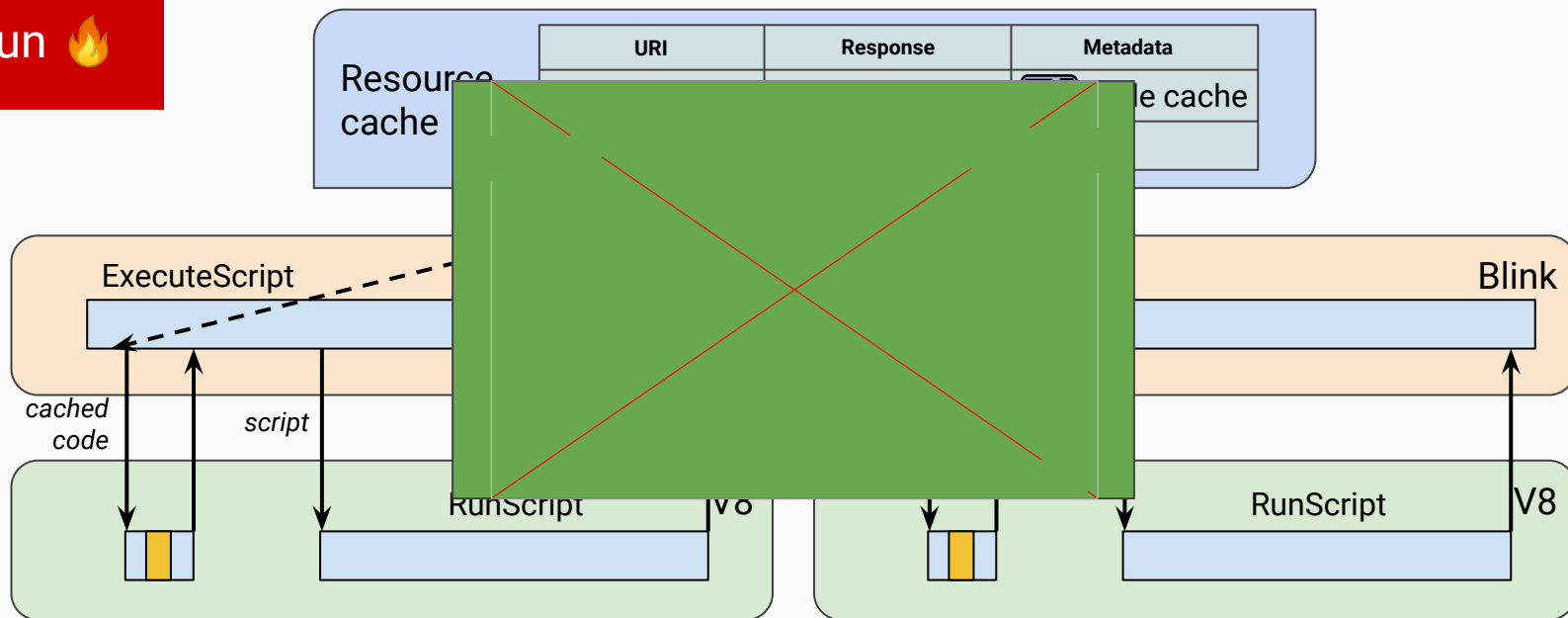
Resource cache metadata

Hot run 🔥



Resource cache metadata

Hot run 🔥



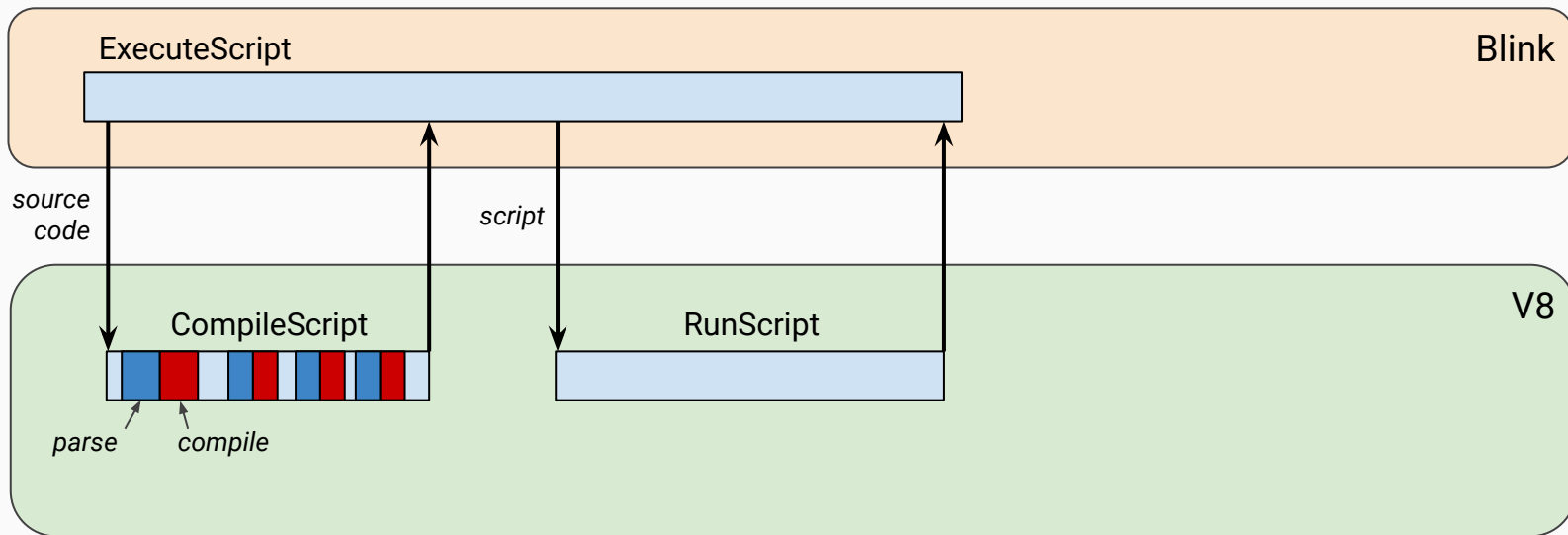
Caching (more) JavaScript code in Chrome

Leszek Swirski, Mythri Alle, Ross McIlroy

Caching (more) JavaScript code in Chrome

Leszek Swirski, Mythri Alle, Ross McIlroy

Javascript execution in blink



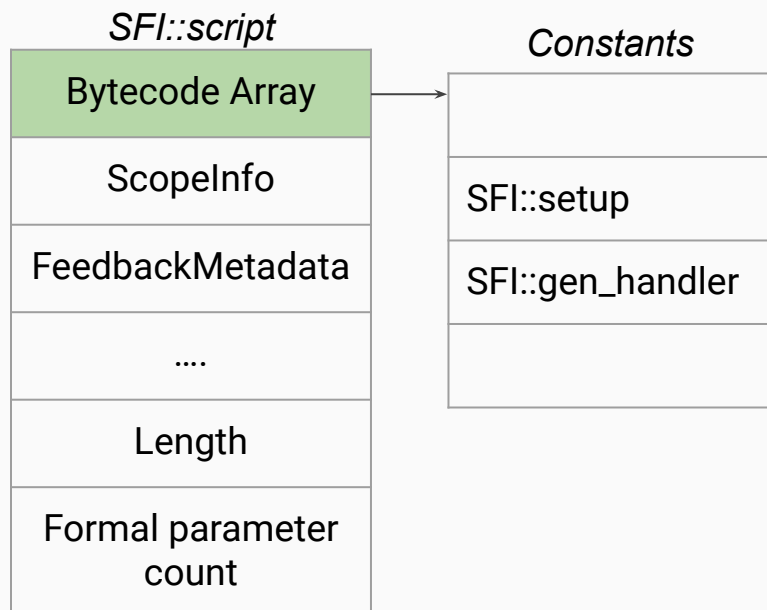
Script compilation

SFI::script

Bytecode Array
ScopeInfo
FeedbackMetadata
....
Length
Formal parameter count

```
function gen_handler() {  
  function handler() {  
    ....  
  }  
  return handler;  
}  
  
(function setup() { ... })()  
  
var handler = gen_handler();  
document.addEventListener(event, handler);
```

Script compilation



```
function gen_handler() {  
  function handler() {  
    ....  
  }  
  return handler;  
}
```

```
(function setup() { ... })()
```

```
var handler = gen_handler();  
document.addEventListener(event, handler);
```

Lazy inner compilation

SFl::gen_handler

Compile Lazy
Name
OuterScopeInfo
....
Length
Formal parameter count

```
function gen_handler() {  
  function handler() {  
    ....  
  }  
  return handler;  
}
```

```
(function setup() { ... })()
```

```
var handler = gen_handler();  
document.addHandler(event, handler);
```

Eager inner compilation

SFI::setup

Bytecode Array
ScopeInfo
FeedbackMetadata
....
Length
Formal parameter count

```
function gen_handler() {  
  function handler() {  
    ....  
  }  
  return handler;  
}
```

```
(function setup() { ... })()
```

```
var handler = gen_handler();  
document.addEventListener(event, handler);
```


Eager compilation

IIFE

Immediately invoked
function expression

```
function gen_handler() {  
  function handler() {  
    ....  
  }  
  return handler;  
}
```

```
(function setup() { ... })()
```

```
var handler = gen_handler();  
document.addEventListener(event, handler);
```

Eager compilation

IIFE

Immediately invoked
function expression

```
function gen_handler() {  
  function handler() {  
    ....  
  }  
  return handler;  
}
```

```
(function setup() { ... })()
```

```
var handler = gen_handler();  
document.addEventListener(event, handler);
```

Eager compilation

IIFE

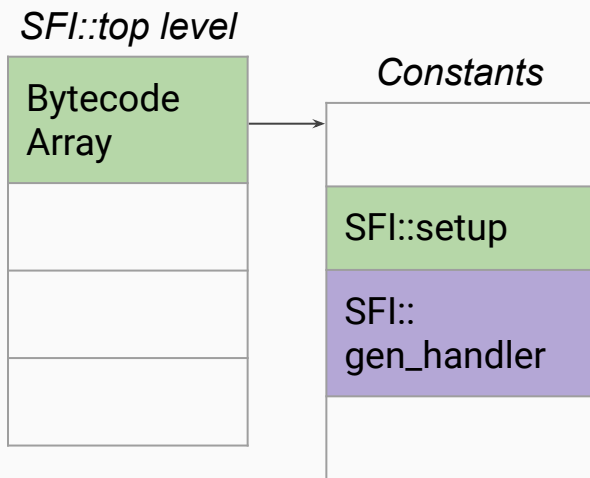
Immediately invoked
function expression

```
function gen_handler() {  
  function handler() {  
    ....  
  }  
  return handler;  
}
```

```
(function setup() { ... })()
```

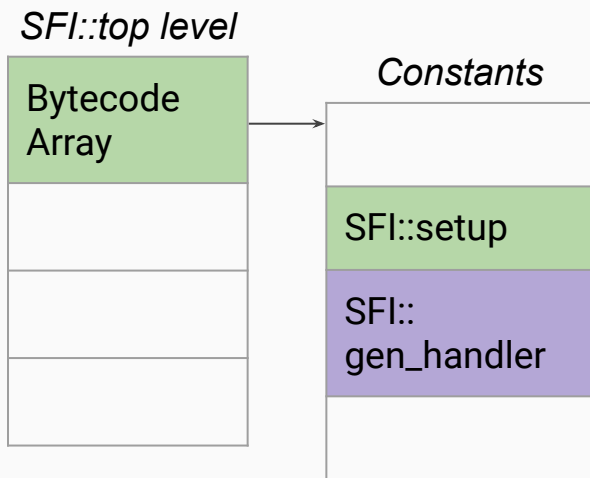
```
var handler = gen_handler();  
document.addEventListener(event, handler);
```

Script execution



```
function gen_handler() {  
  function handler() {  
    ....  
  }  
  return handler;  
}  
  
(function setup() { ... })()  
  
var handler = gen_handler();  
document.addEventListener(event, handler);
```

Script execution

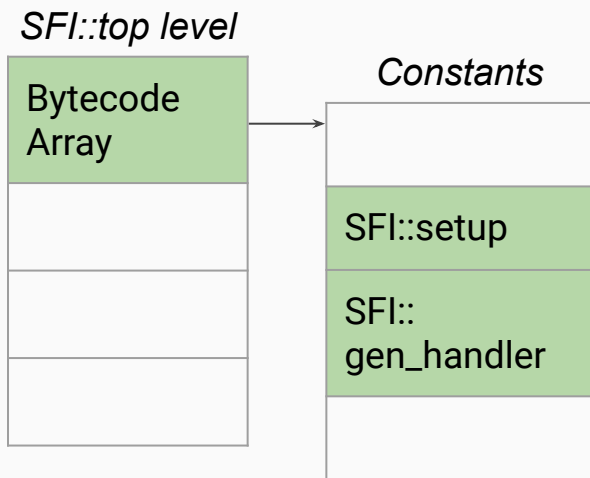


```
function gen_handler() {  
  function handler() {  
    ....  
  }  
  return handler;  
}
```

```
(function setup() { ... })()
```

```
var handler = gen_handler();  
document.addEventListener(event, handler);
```

Script execution

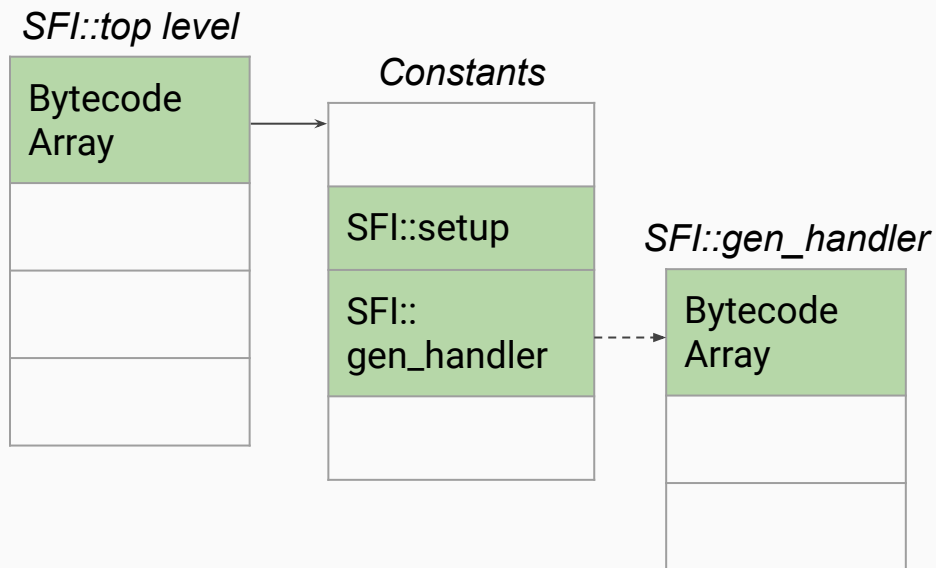


```
function gen_handler() {  
  function handler() {  
    ....  
  }  
  return handler;  
}
```

```
(function setup() { ... })()
```

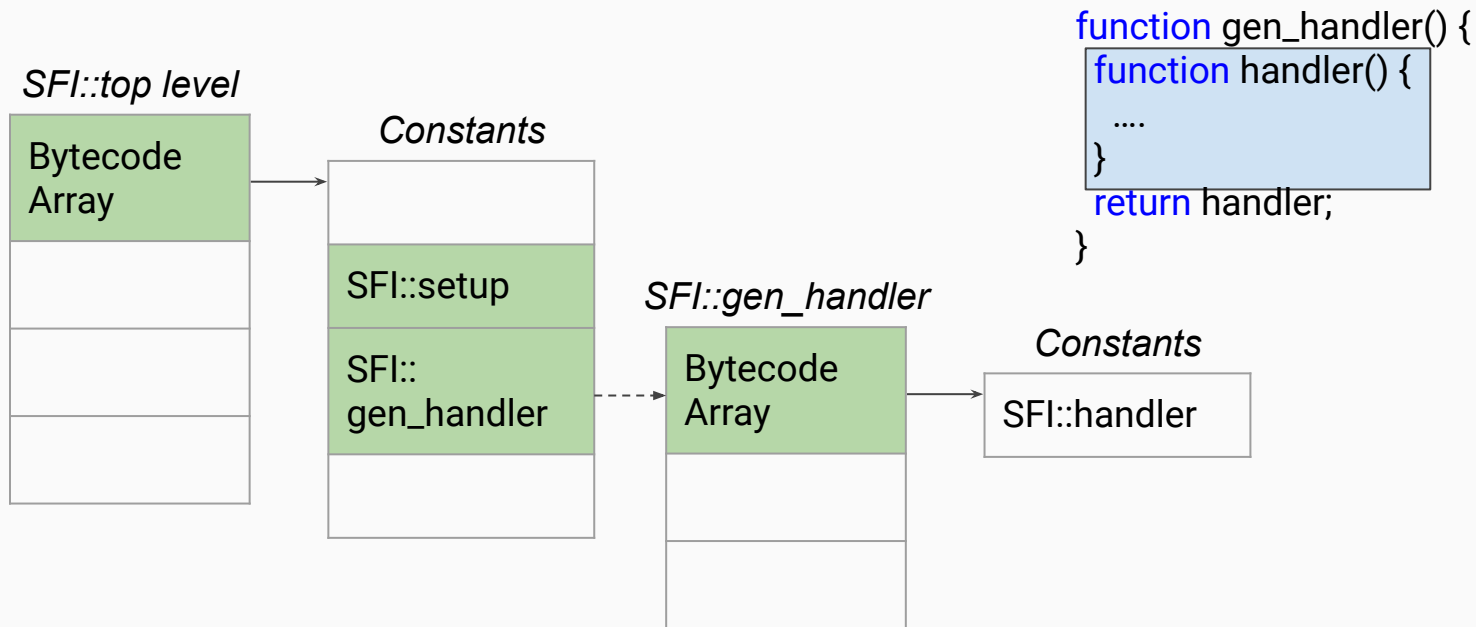
```
var handler = gen_handler();  
document.addEventListener(event, handler);
```

Script execution

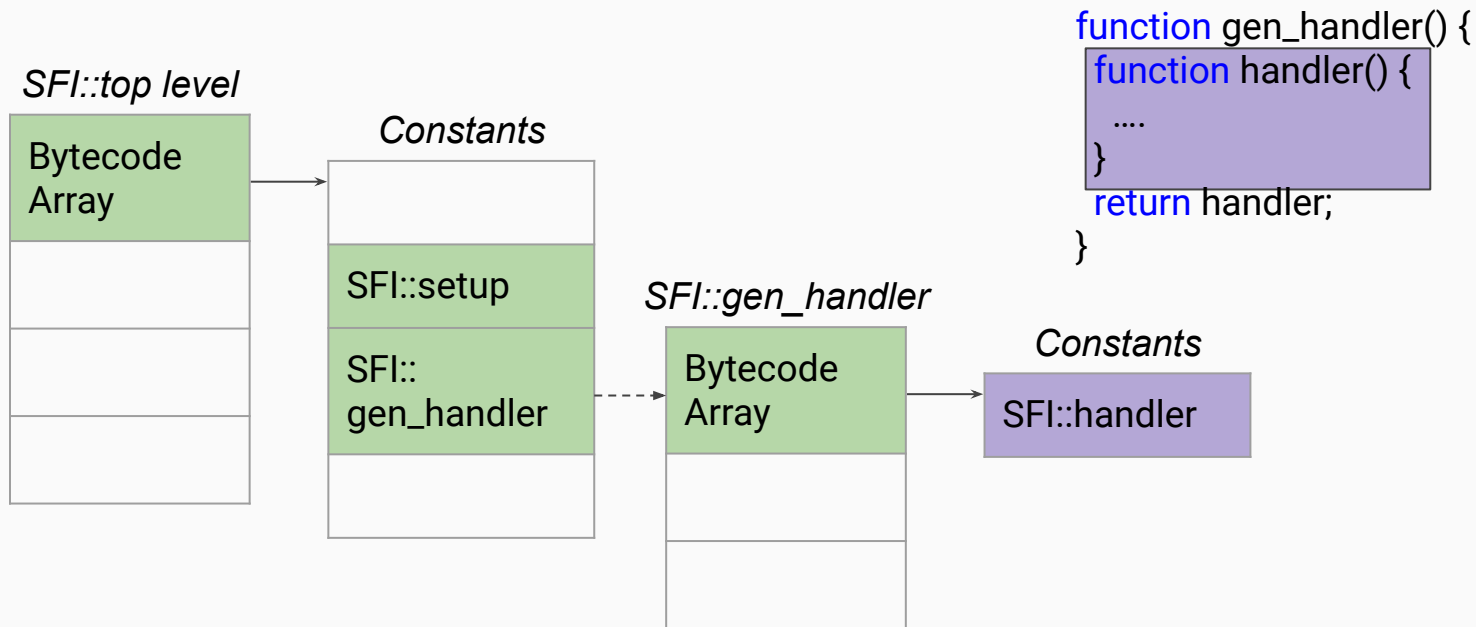


```
function gen_handler() {  
  function handler() {  
    ....  
  }  
  return handler;  
}
```

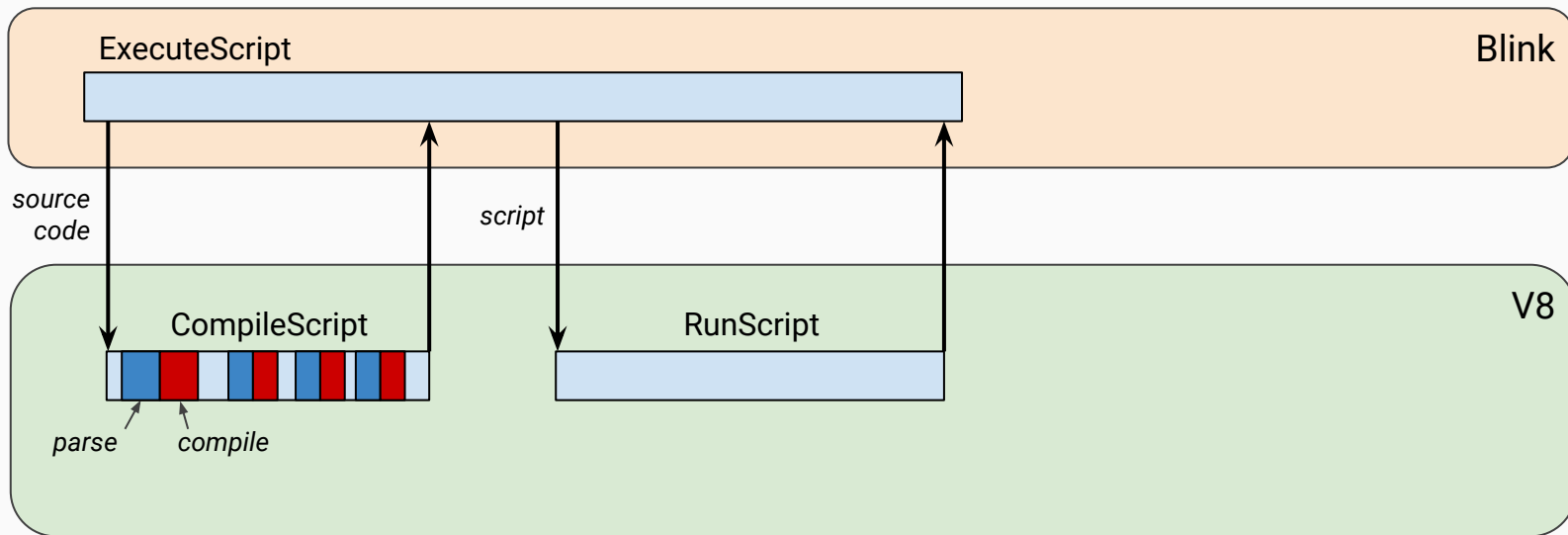
Script execution



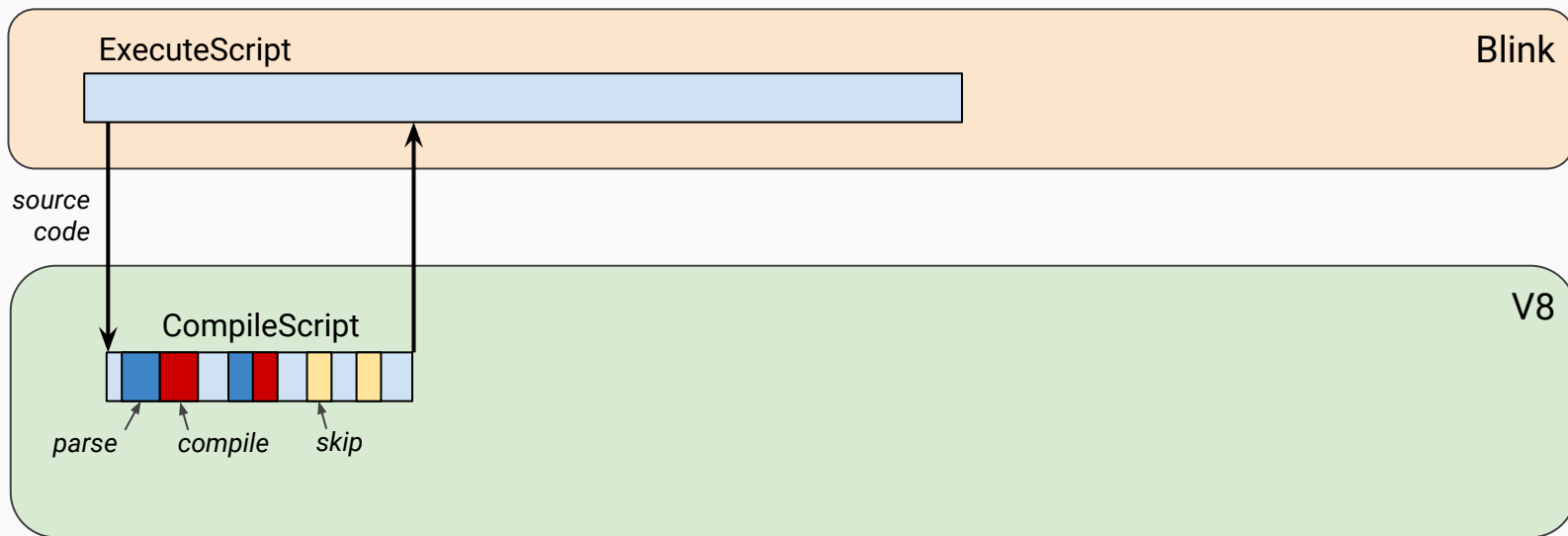
Script execution



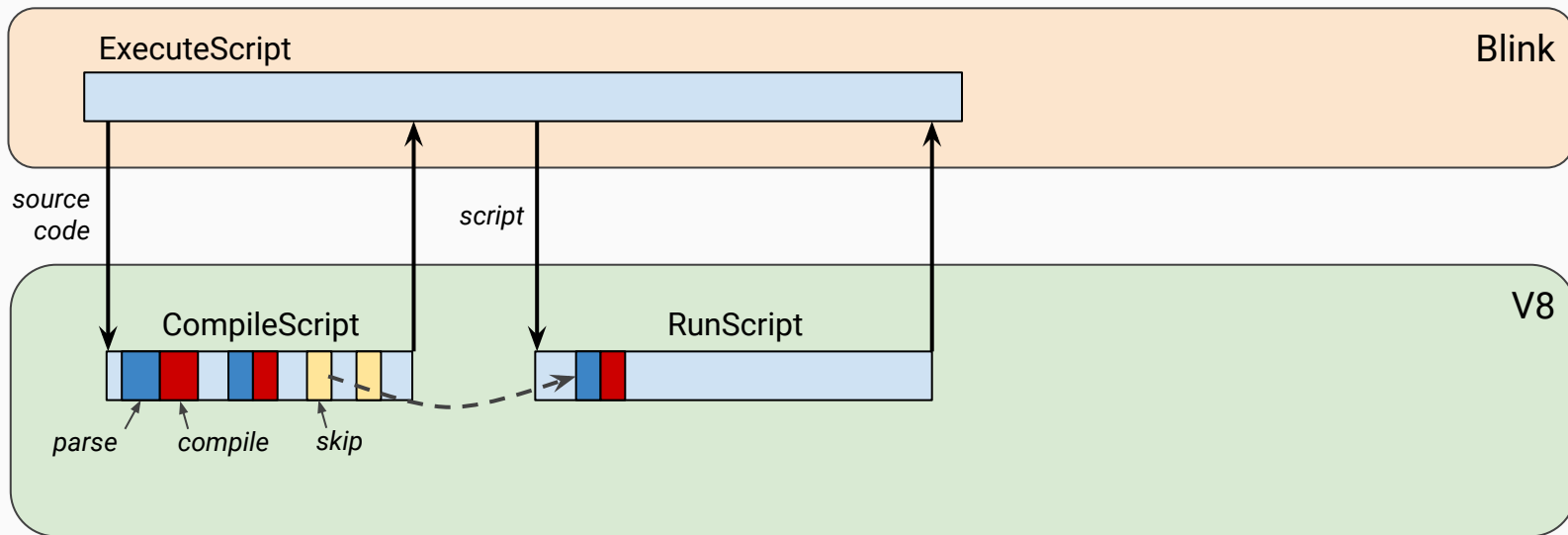
Javascript execution in blink



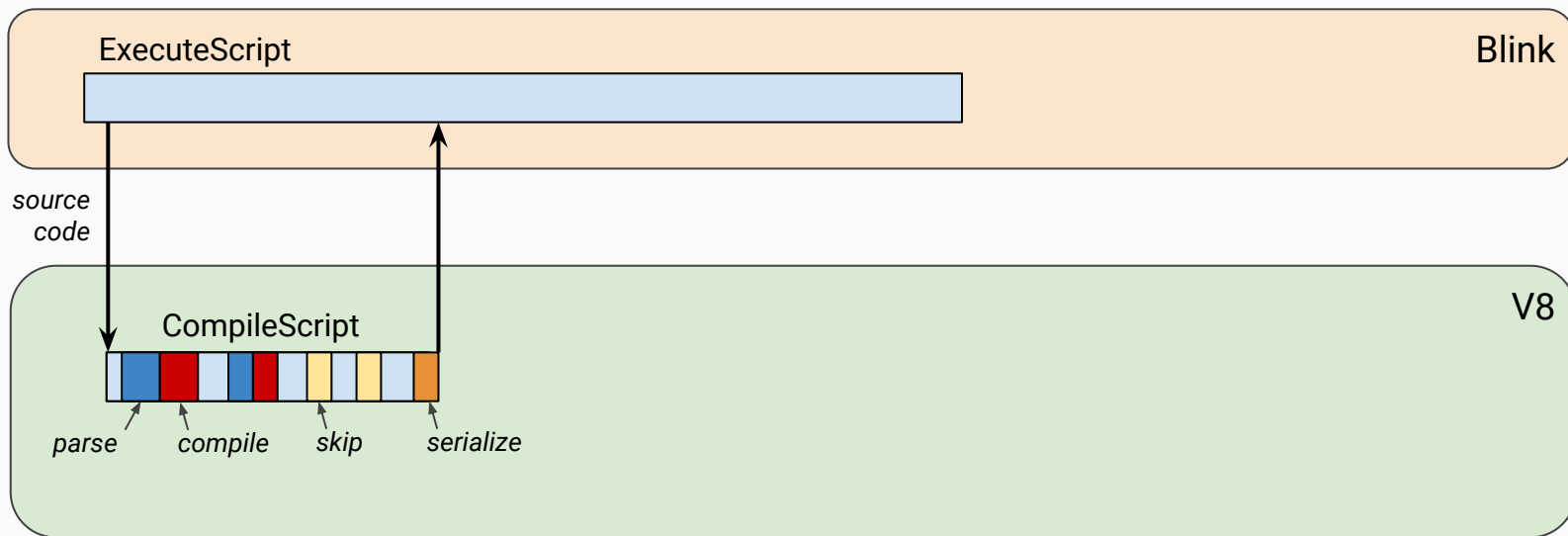
Javascript execution in blink (for real)



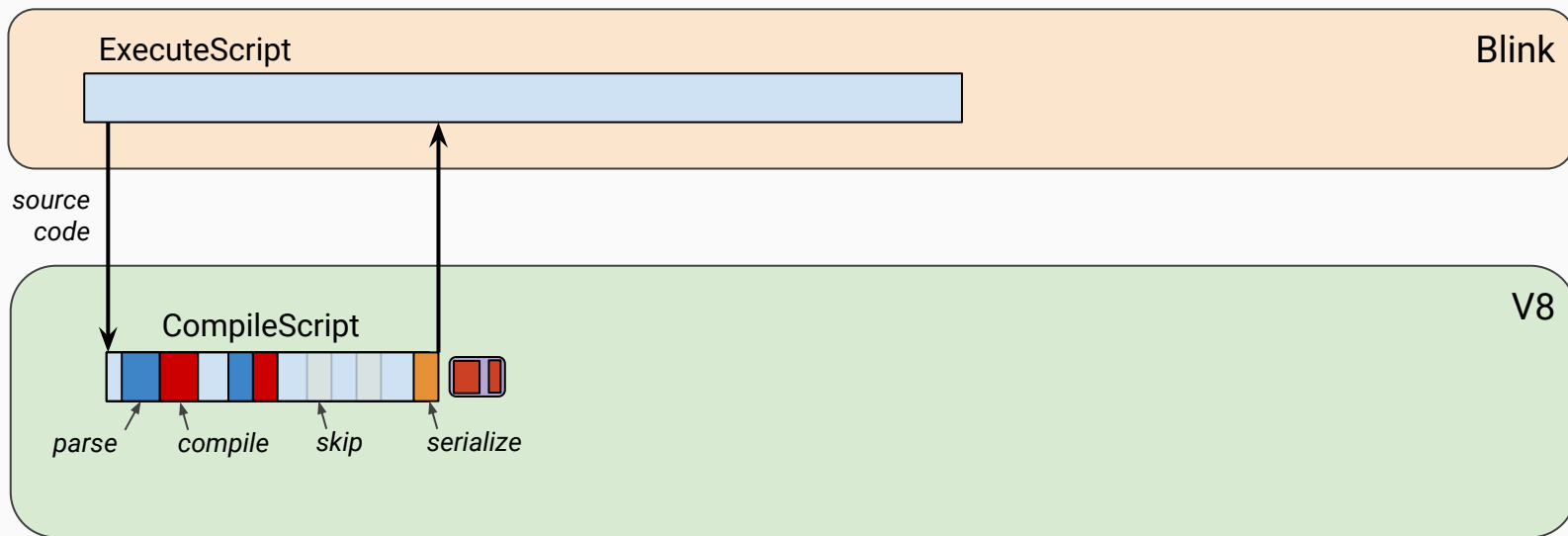
Javascript execution in blink (for real)



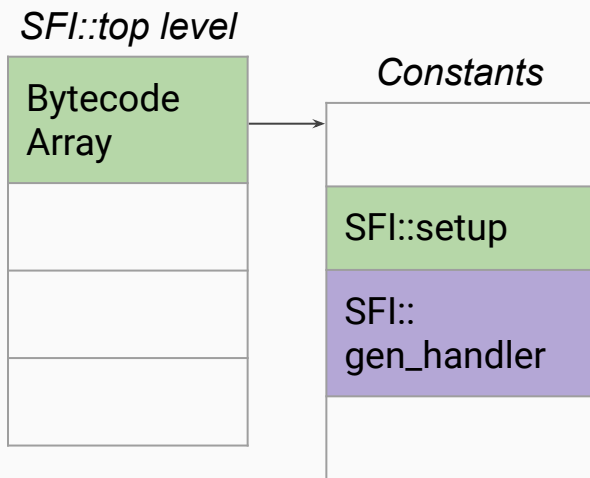
Javascript execution in blink (caching)



Javascript execution in blink (caching)

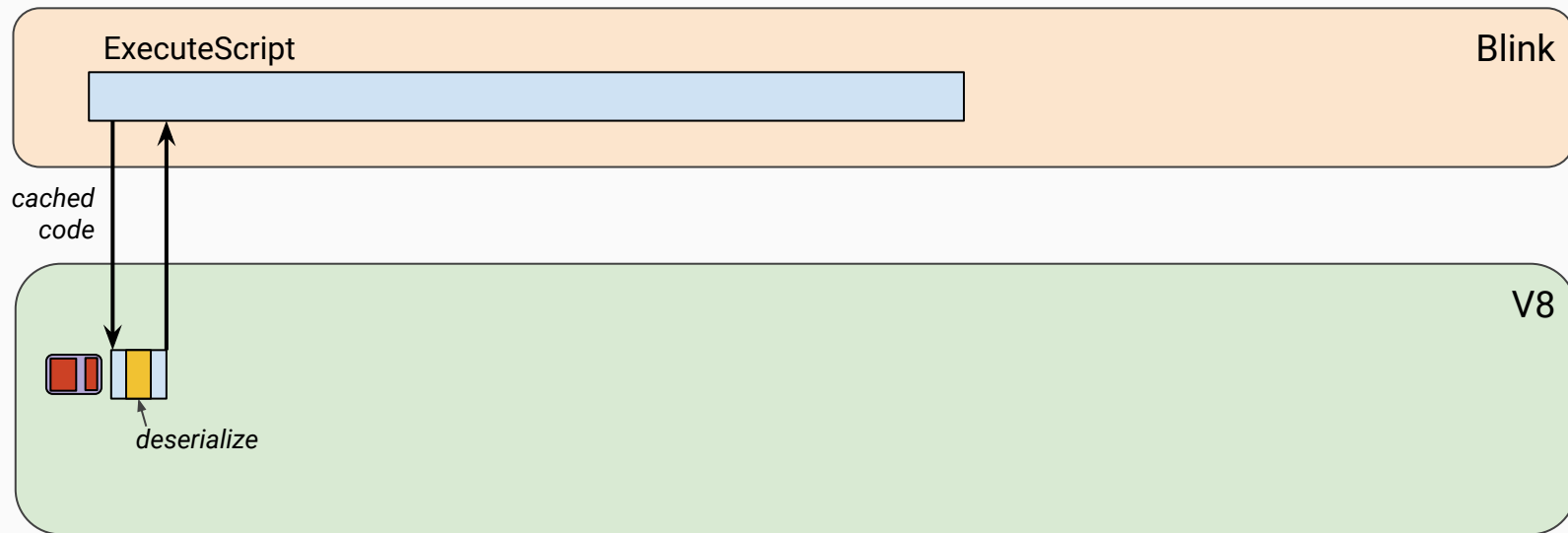


Script execution

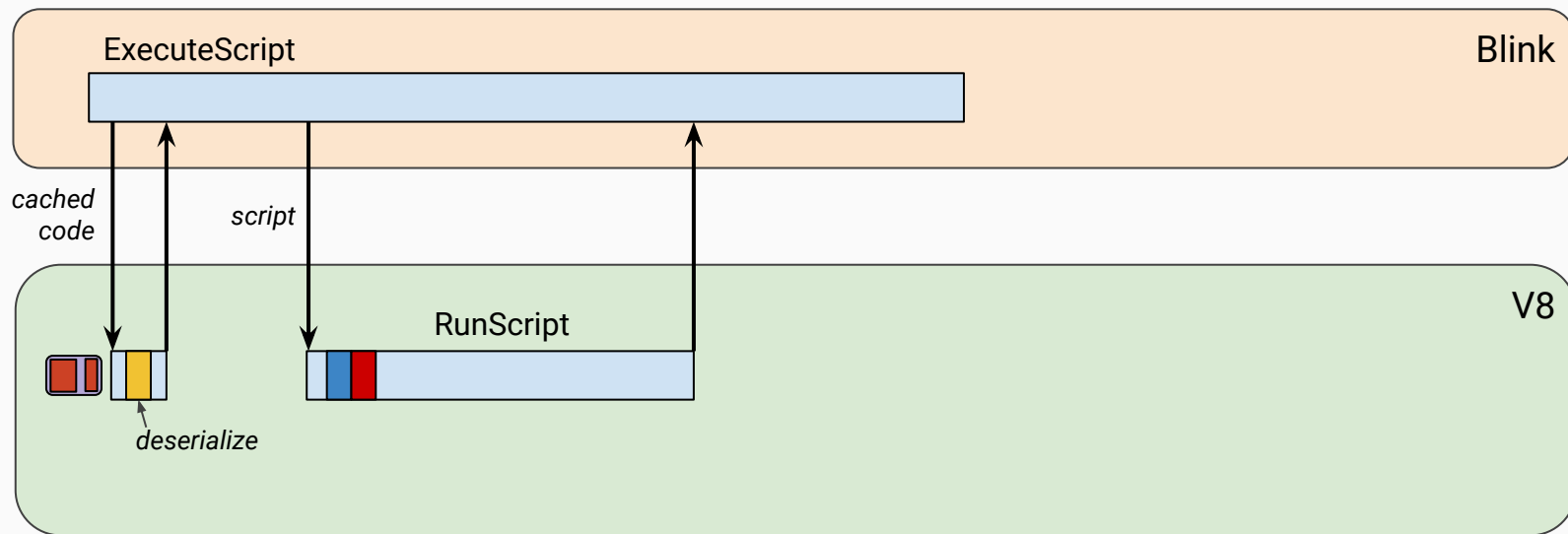


```
function gen_handler() {  
  function handler() {  
    ....  
  }  
  return handler;  
}  
  
(function setup() { ... })()  
  
var handler = gen_handler();  
document.addEventListener(event, handler);
```

Javascript execution in blink (caching)



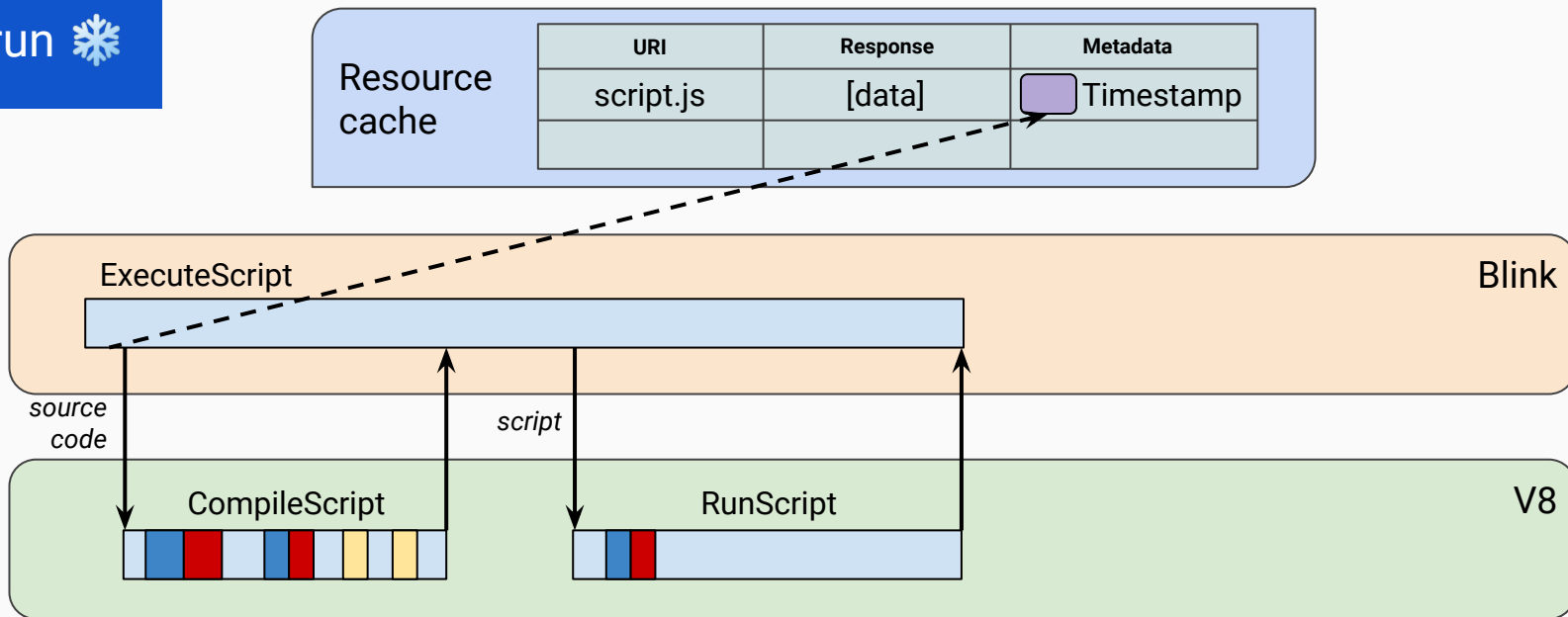
Javascript execution in blink (caching)



Cache after execute

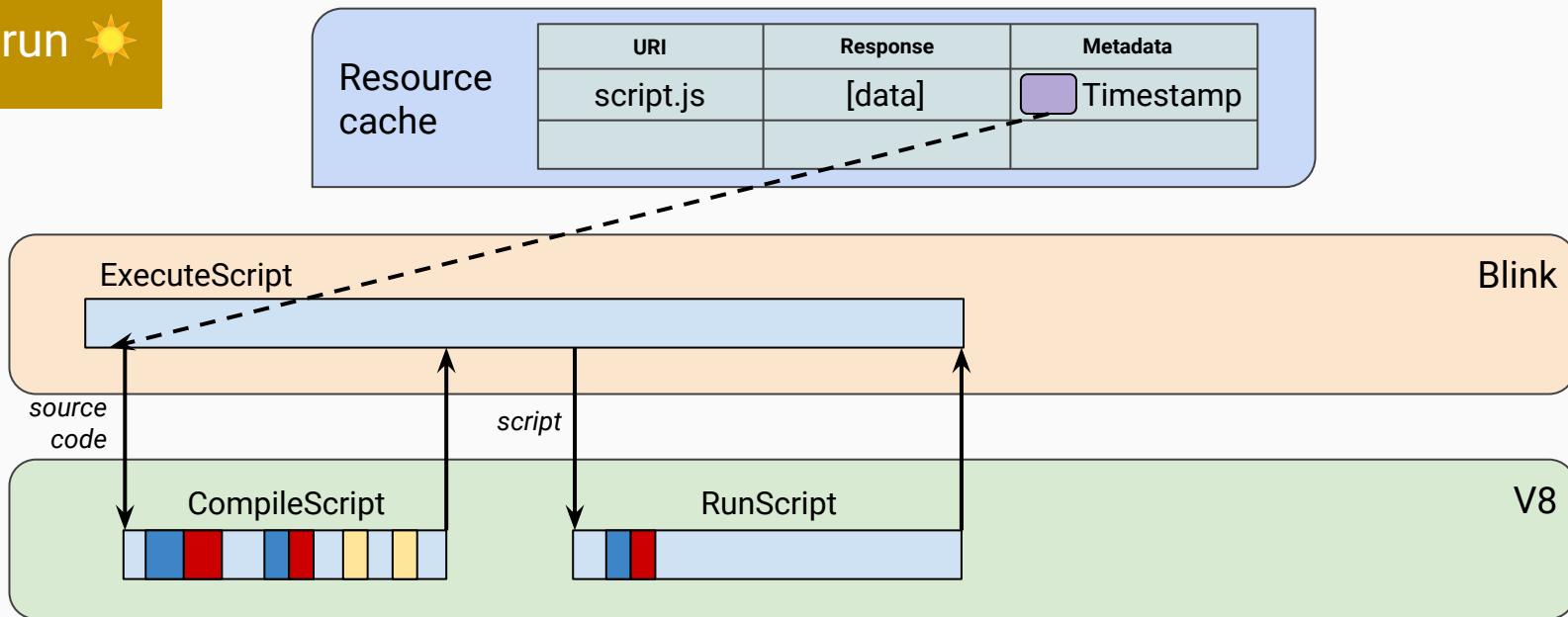
Resource cache metadata

Cold run ❄️



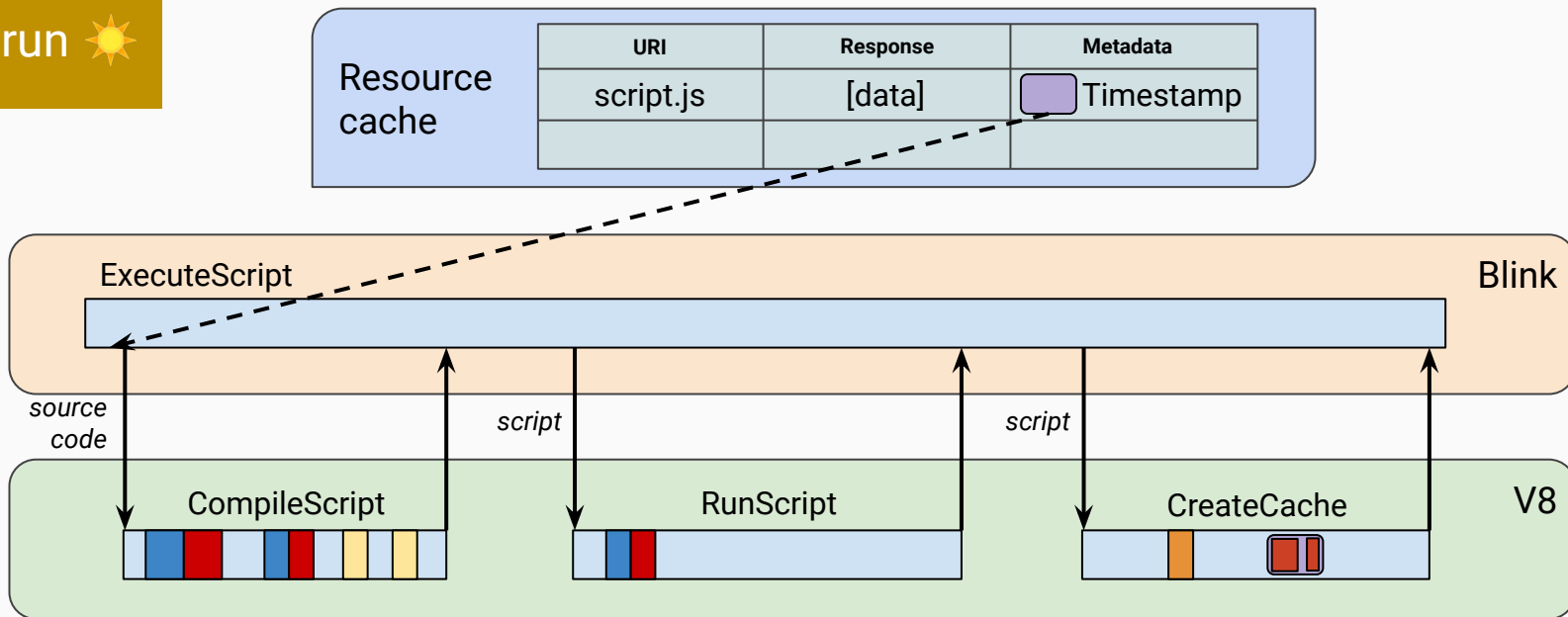
Resource cache metadata

Warm run ☀️



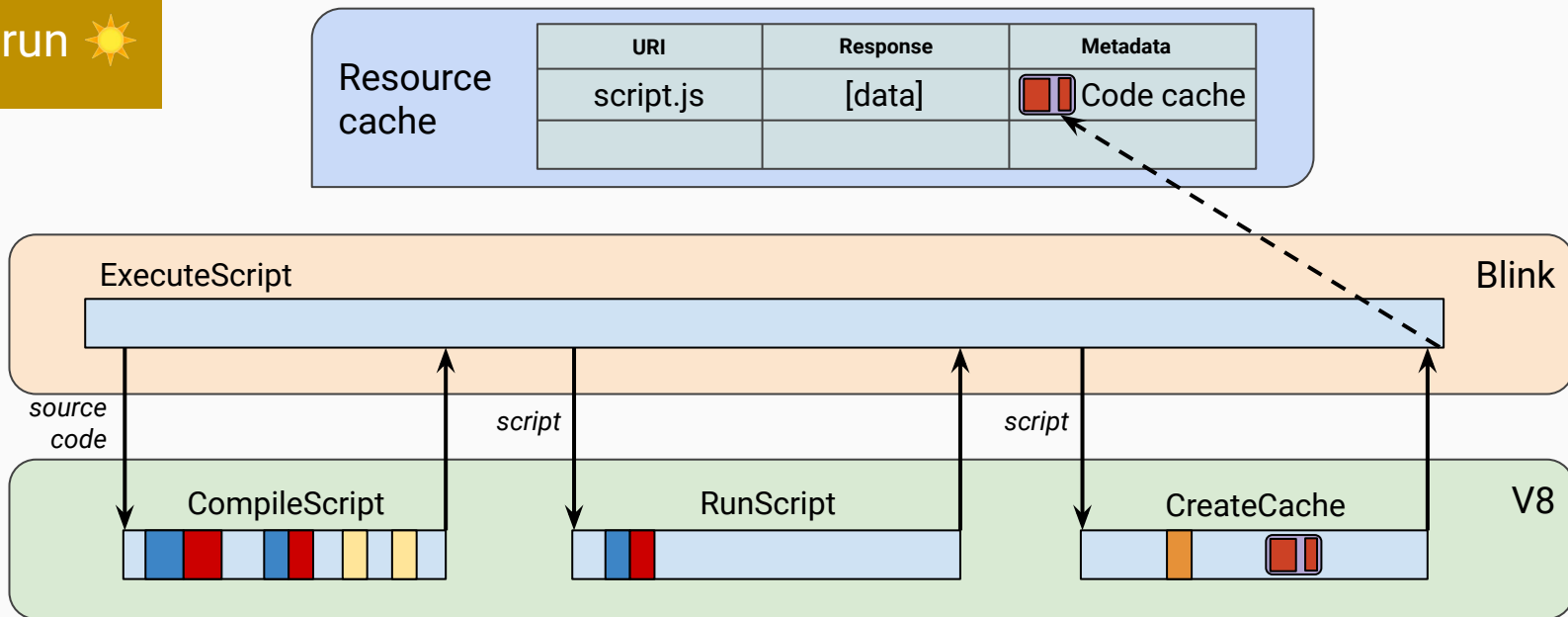
Resource cache metadata

Warm run ☀️



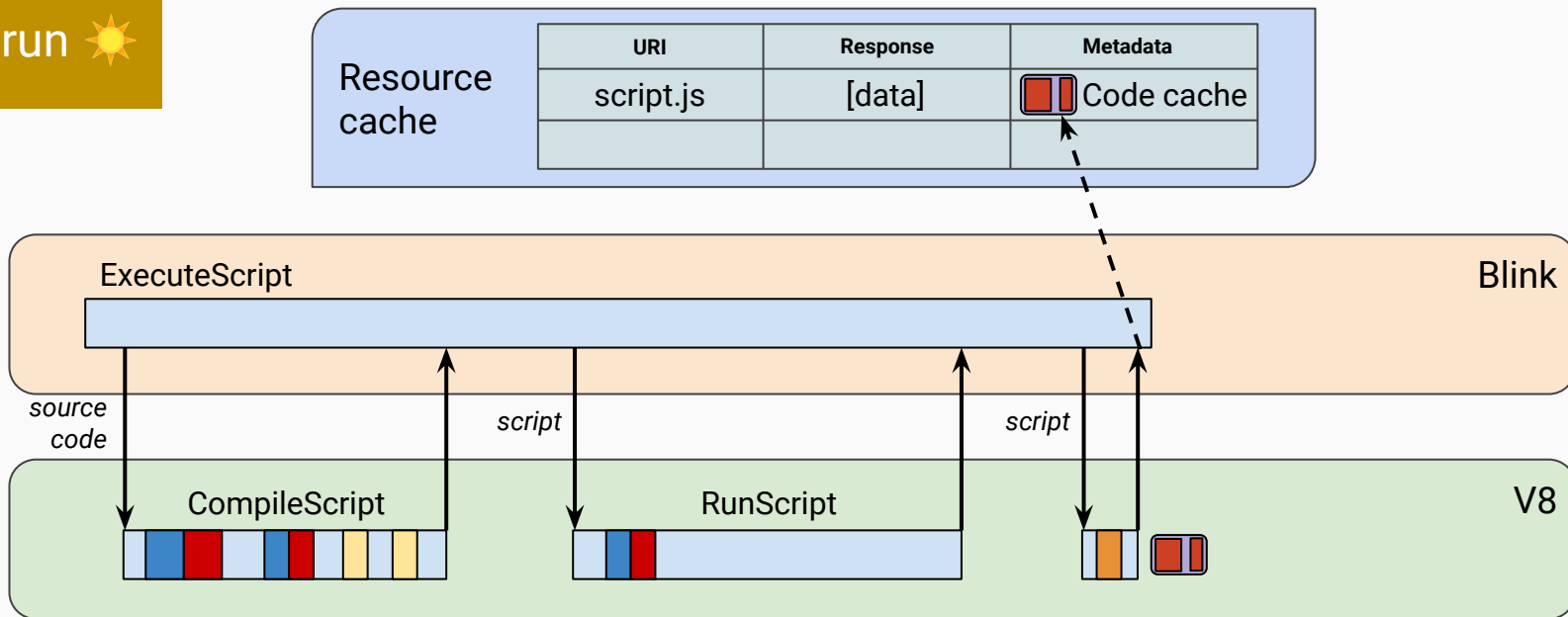
Resource cache metadata

Warm run ☀️



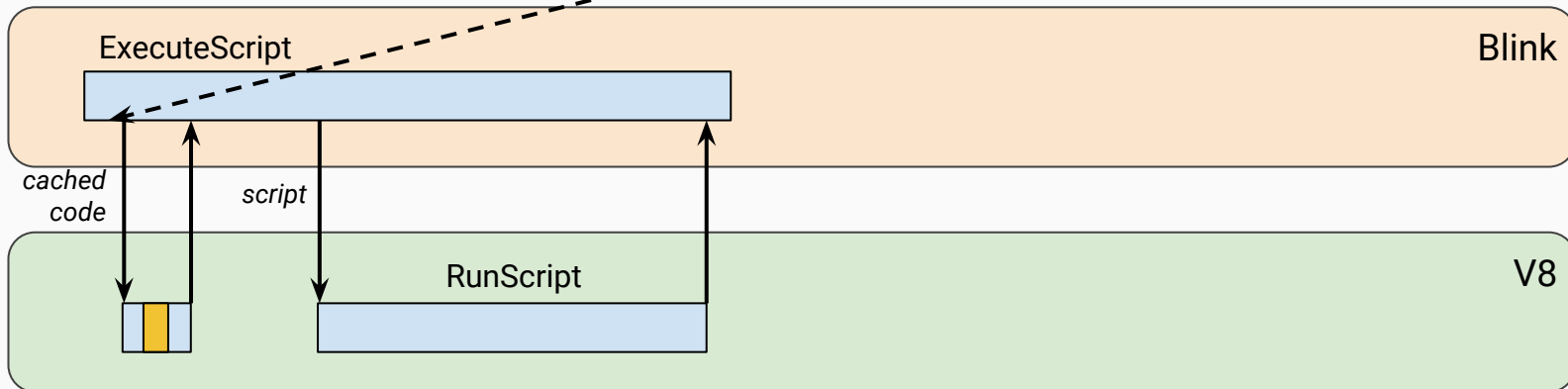
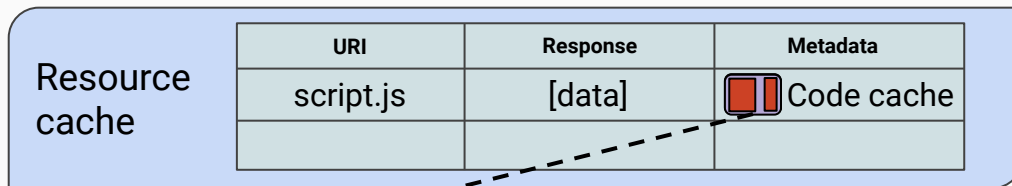
Resource cache metadata

Warm run 



Resource cache metadata

Hot run 🔥



The old compiler (FullCodeGen)

```
function f(x, y) {  
  var a = x[0];  
  var b = a + y;  
  return b;  
}
```

Source code

```
mov eax, [ebp + 0x10] ; x  
mov ecx, 0x56a79431 ; "0"  
call $LoadUnknownNamedProperty  
push eax  
  
mov eax, [ebp - 0x10] ; y  
  
pop edx  
call $UnknownBinaryOpAdd
```

Machine code

The old compiler (FullCodeGen)

```
function f(x, y) {  
  var a = x[0];  
  var b = a + y;  
  return b;  
}
```

Source code

```
mov eax, [ebp + 0x10] ; x  
mov ecx, 0x56a79431 ; "0"  
→ call $LoadX0  
push eax  
  
mov eax, [ebp - 0x10] ; y  
  
pop edx  
call $UnknownBinaryOpAdd
```

Machine code

The old compiler (FullCodeGen)

```
function f(x, y) {  
  var a = x[0];  
  var b = a + y;  
  return b;  
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Source code

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mov eax, [ebp - 0x10] ; y  
  
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→ call $StringAdd
```

Machine code

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pop edx  
call $StringAdd
```

Machine code

Context Dependent

The new compiler (Ignition)

```
function f(x, y) {  
  var a = x[0];  
  var b = a + y;  
  return b;  
}
```

Source code

```
StackCheck  
LdaZero  
LdaKeyedProperty a0, [0]  
Star r1  
Ldar a1  
Add r1, [2]  
Star r0  
Return
```

Bytecode

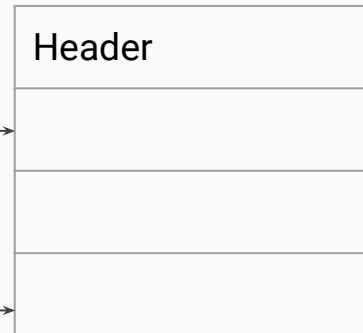
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LdaZero  
LdaKeyedProperty a0, [0]  
Star r1  
Ldar a1  
Add r1, [2]  
Star r0  
Return
```

Bytecode



Feedback Vector

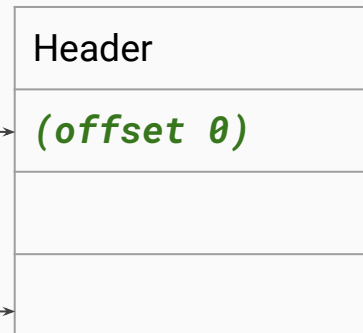
The new compiler (Ignition)

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function f(x, y) {  
  var a = x[0];  
  var b = a + y;  
  return b;  
}
```

Source code

```
StackCheck  
LdaZero  
LdaKeyedProperty a0, [0]  
Star r1  
Ldar a1  
Add r1, [2]  
Star r0  
Return
```

Bytecode



Feedback Vector

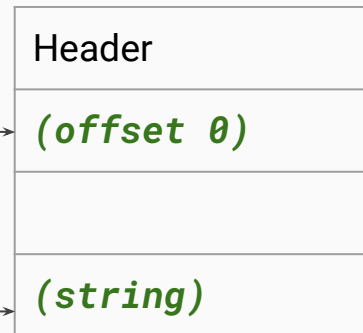
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Ldar a1  
Add r1, [2]  
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Return
```

Bytecode



Feedback Vector

The new compiler (Ignition)

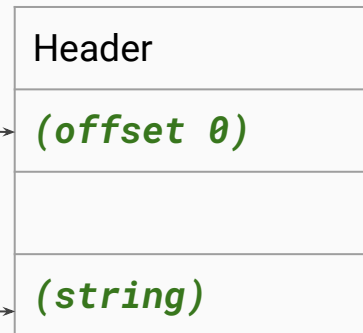
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function f(x, y) {  
  var a = x[0];  
  var b = a + y;  
  return b;  
}
```

Source code

```
StackCheck  
LdaZero  
LdaKeyedProperty a0, [0]  
Star r1  
Ldar a1  
Add r1, [2]  
Star r0  
Return
```

Bytecode

Context Independent

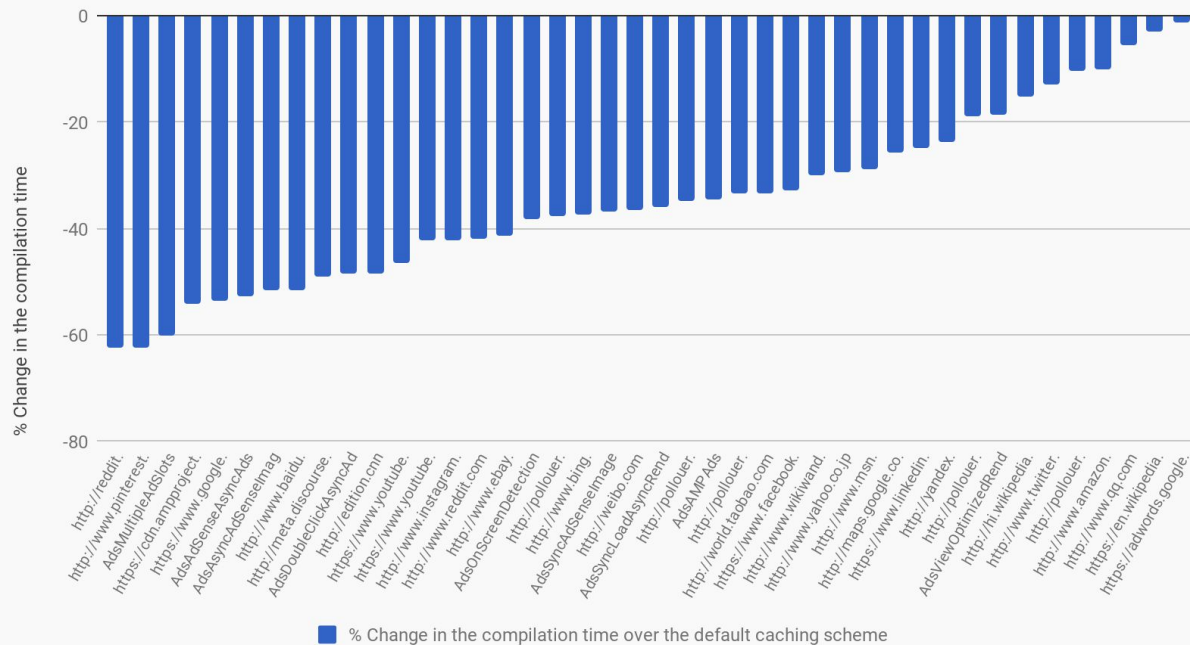


Feedback Vector

Context Dependent

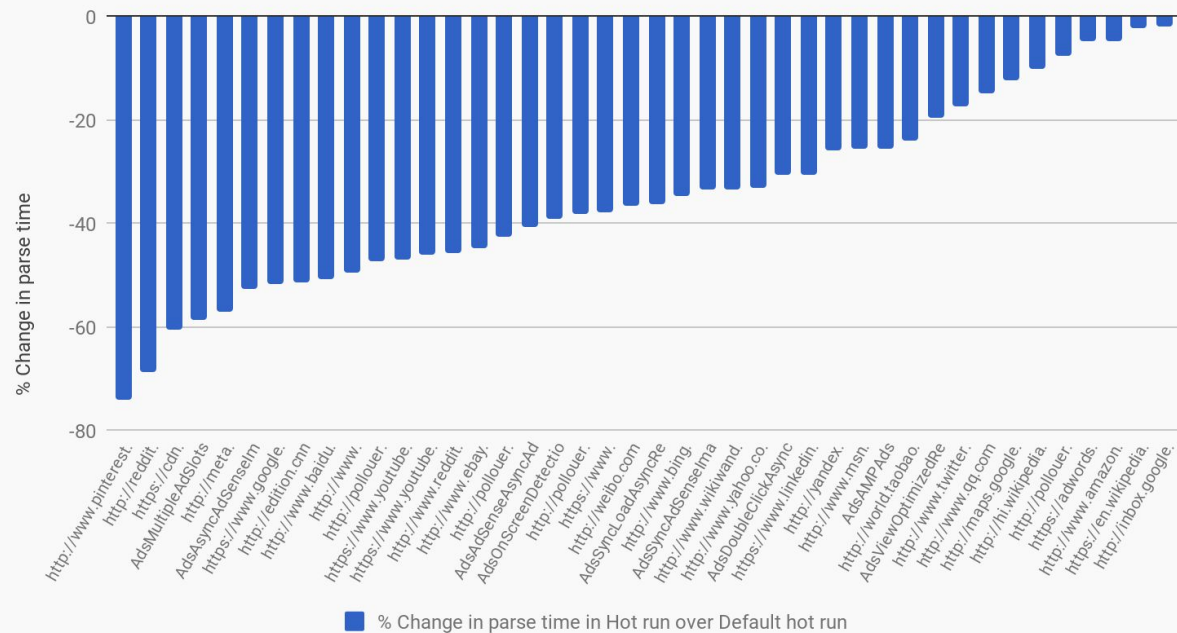
Results

% Change in the compilation time over earlier caching scheme



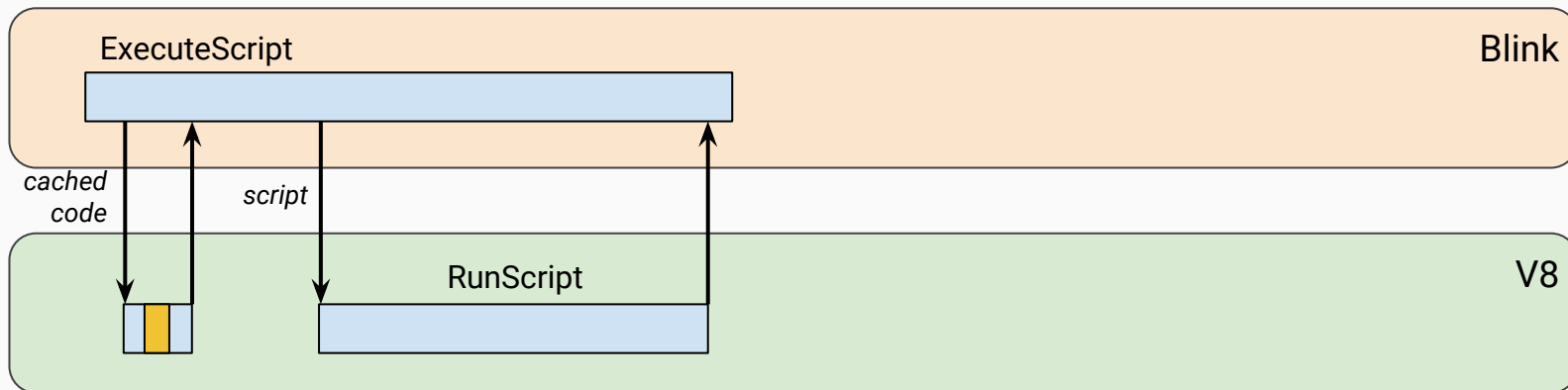
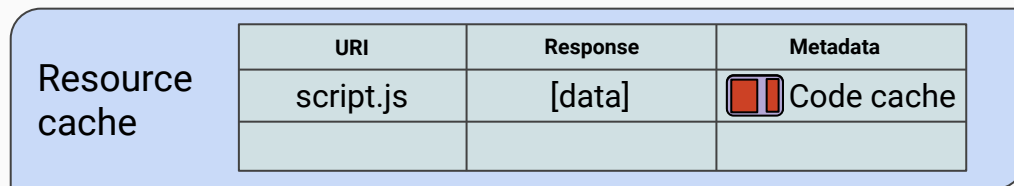
Results

% Change in parse time over earlier caching scheme



Caching inline scripts

Caching inline scripts



Caching inline scripts

```
<html>
<head>

  <script>
    // Javascript 1
  </script>

</head>
...
</html>
```

Caching inline scripts


```
<html>
<head>

  <script>
    // Javascript 1
  </script>

  <script>
    // Javascript 2
  </script>

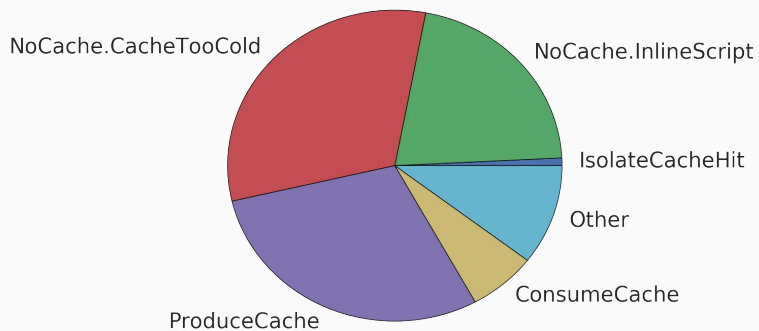
</head>
...
</html>
```

Caching inline scripts

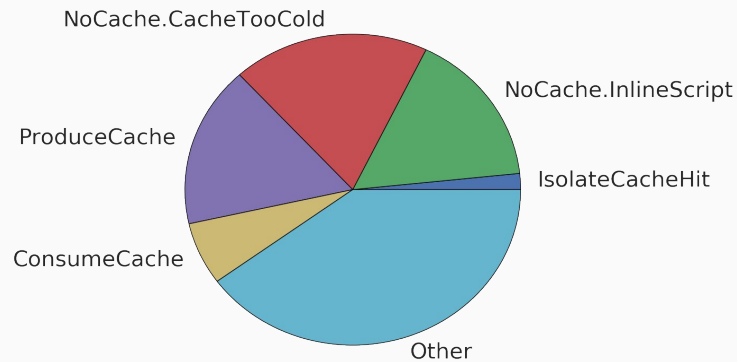
Resource cache	URI	Response	Metadata
	script.js	[data]	 Code cache
	index.html	[data]	?

Caching inline scripts

Script compile time distribution (Android)

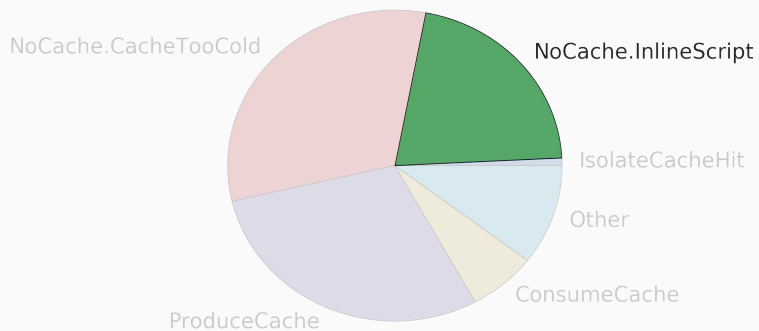


Script compile time distribution (Windows)

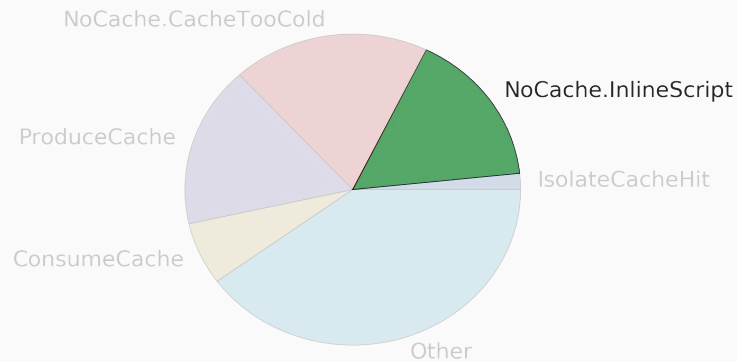


Caching inline scripts

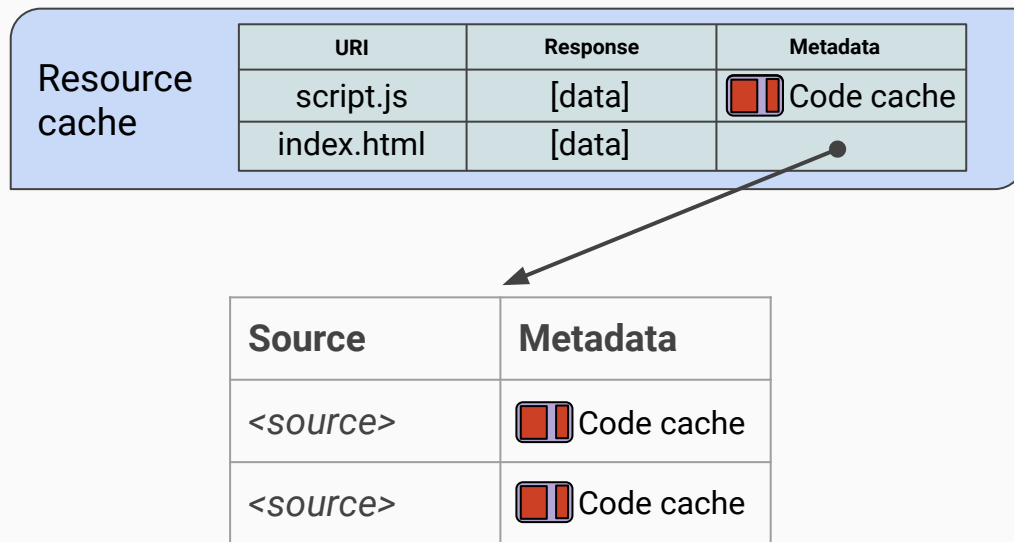
Script compile time distribution (Android)



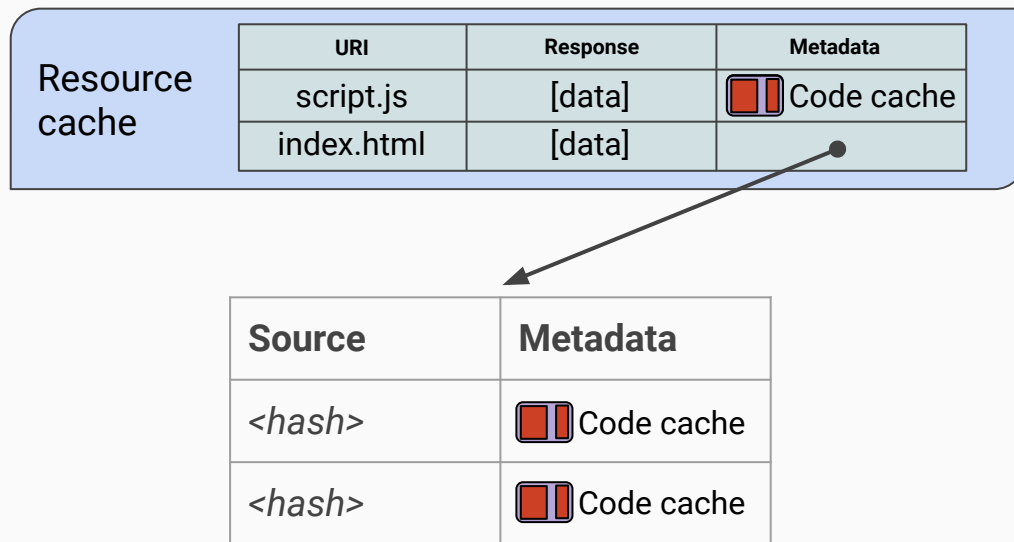
Script compile time distribution (Windows)



Caching inline scripts



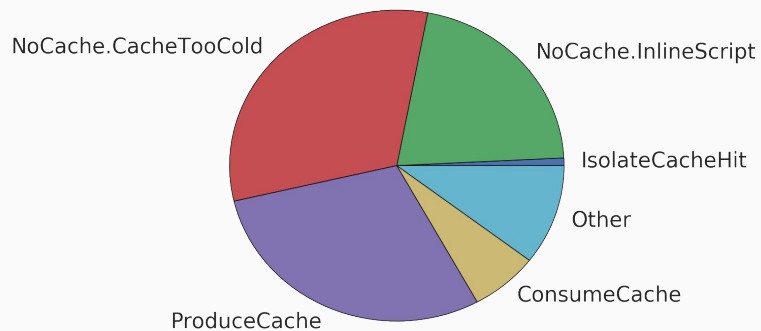
Caching inline scripts



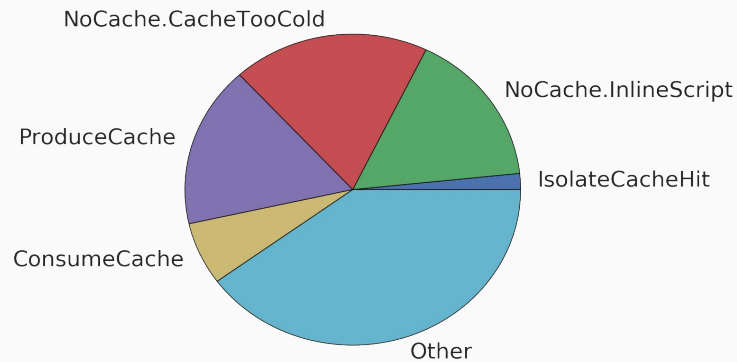
Next?

Caching more scripts?

Script compile time distribution (Android)

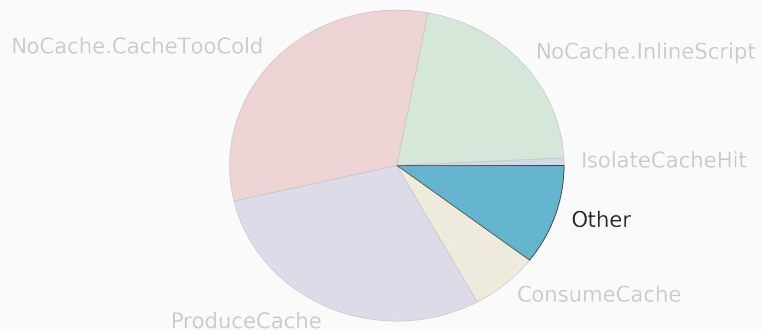


Script compile time distribution (Windows)

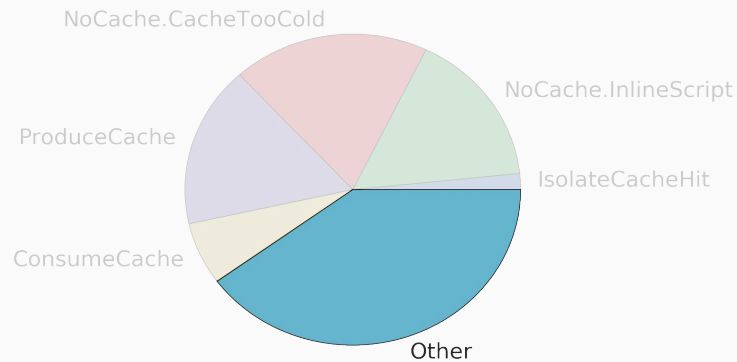


Caching more scripts?

Script compile time distribution (Android)

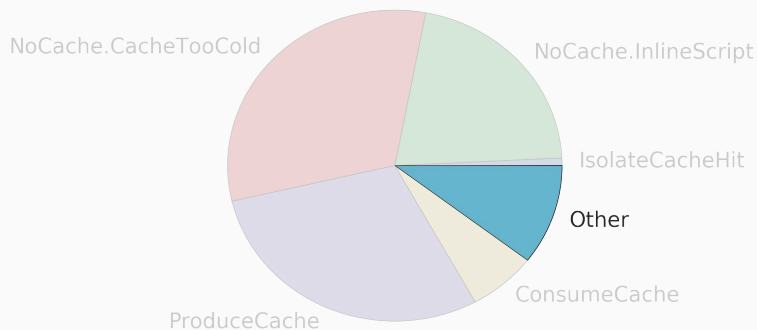


Script compile time distribution (Windows)

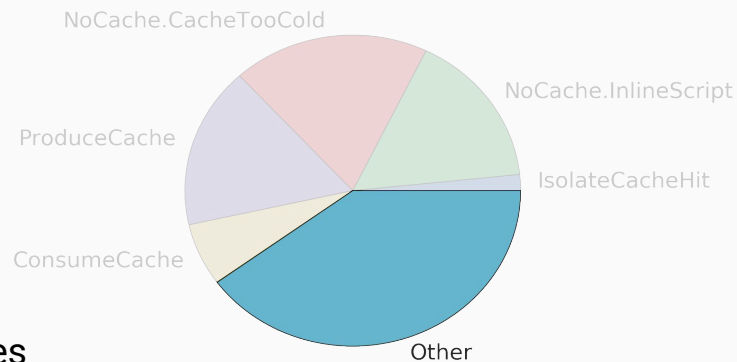


Caching more scripts?

Script compile time distribution (Android)



Script compile time distribution (Windows)

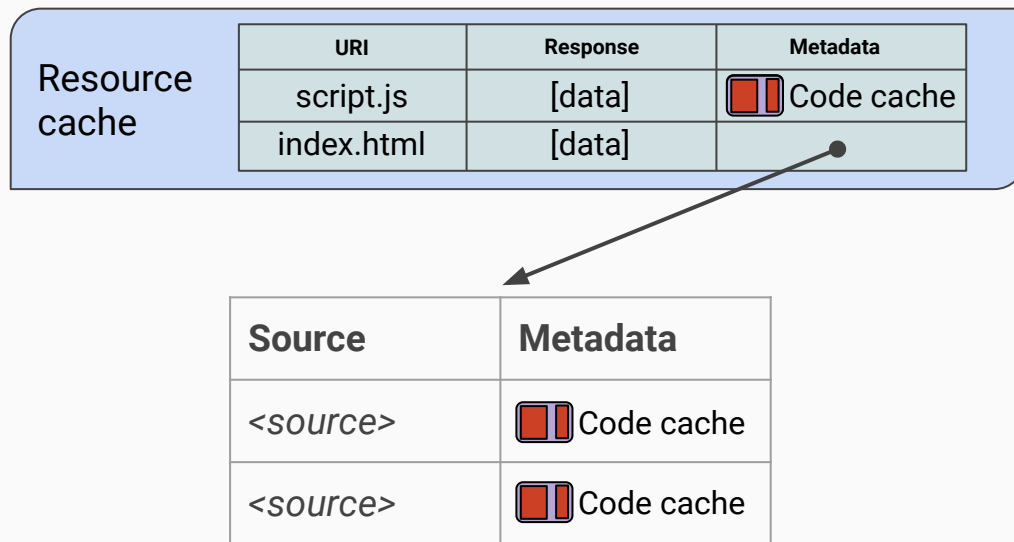


Modules

Extensions

Small code (<1kb)

Share more inline code caches?



Caching inline scripts

Page1.html

```
<html>
<head>

  <script>
    // Javascript 1
  </script>

</head>
...
</html>
```

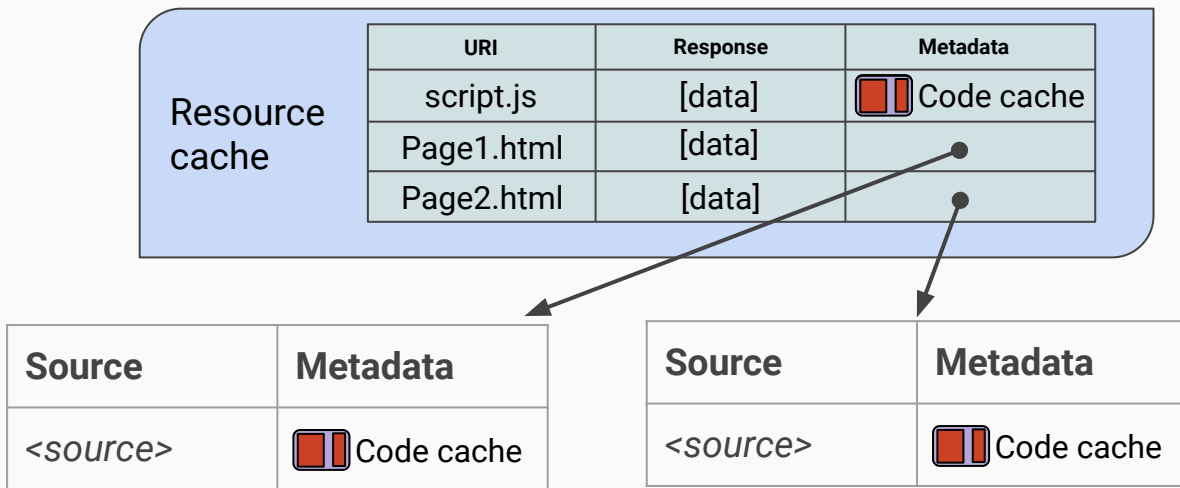
Page2.html

```
<html>
<head>




  <script>
    // Javascript 1
  </script>

</head>
...
</html>
```

Share more inline code caches?



Share more inline code caches?

Resource cache	URI	Response	Metadata
	script.js	[data]	 Code cache
	<source>	-	 Code cache
	<source>	-	 Code cache

Caching (more) JavaScript code in Chrome

Leszek Swirski, Mythri Alle, Ross McIlroy