Optimizing Web Content in UIWebViews and Websites on iOS

Session 601

Paul Knight
Safari on iOS Engineer

Introduction

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- No matter the platform, users want a great experience

What You Will Learn

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- How WebKit turns code into what users see on their screen
- Techniques for improving painting performance
- New features in iOS 6

Hidden Costs and Surprising Slowdowns

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- Image decoding
- JavaScript loading
- Layout calculation

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Image Sizes

960px × 1280px

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- Encoded on disk

Low quality 94KB

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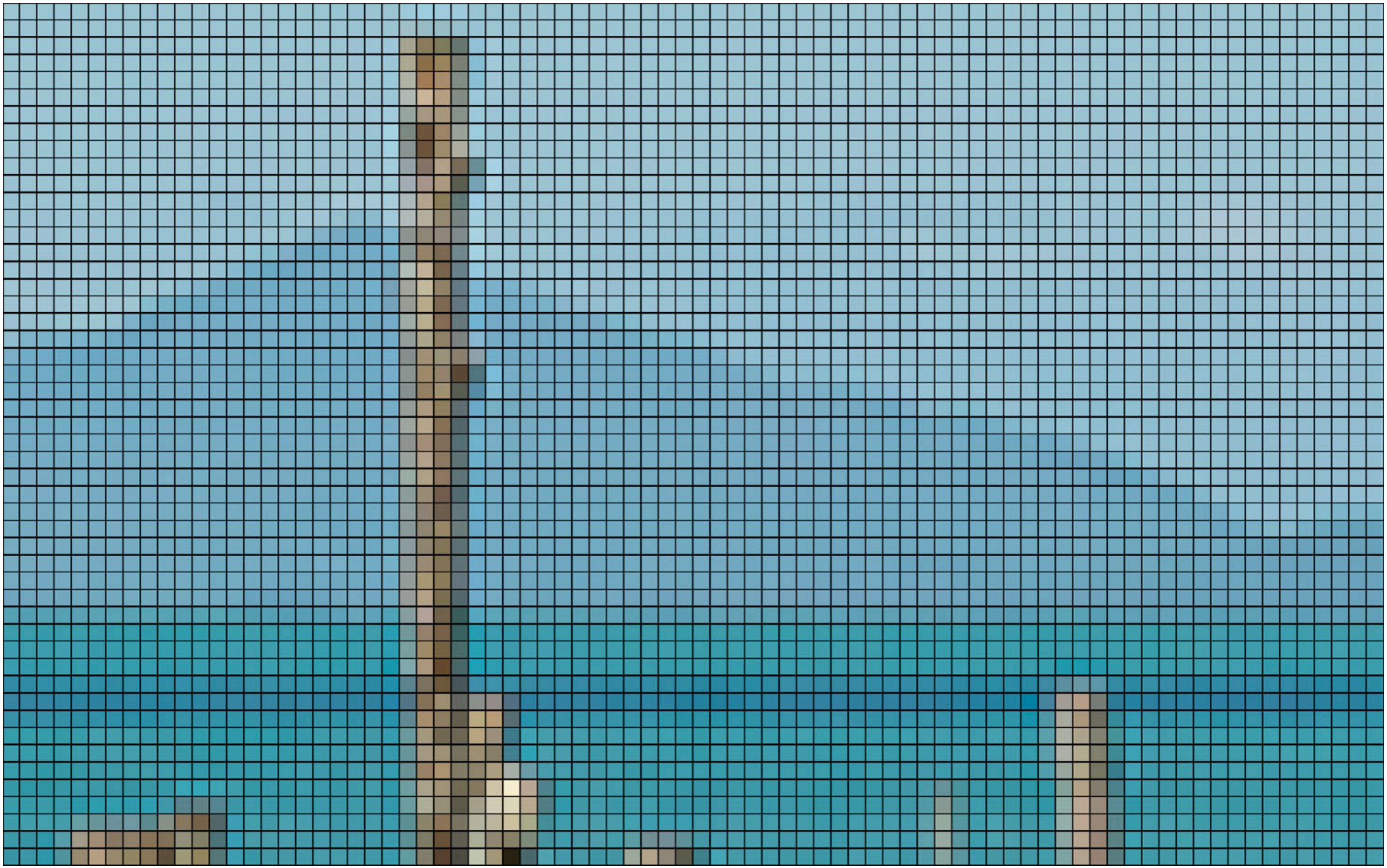

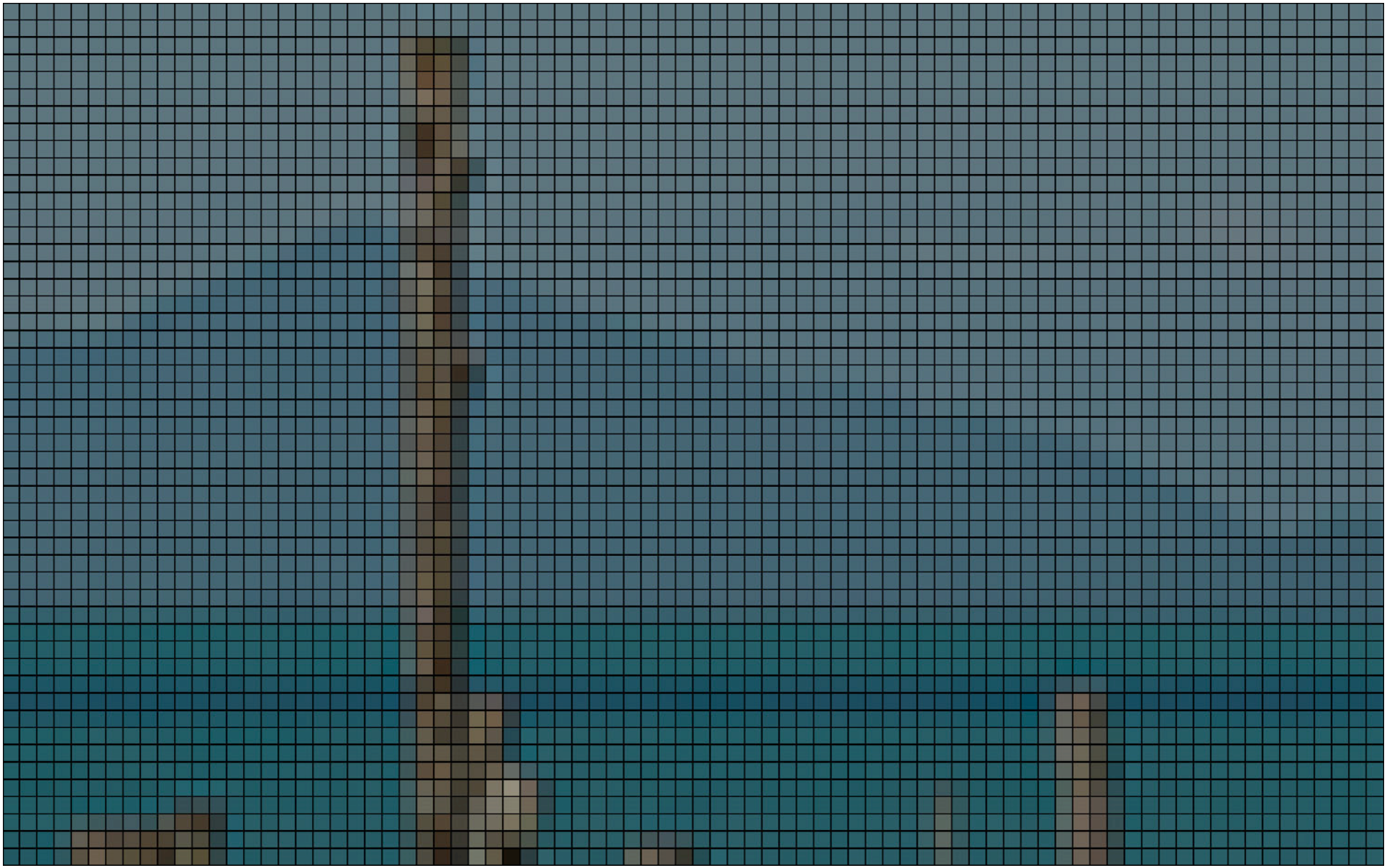


Red 121
Green 173
Blue 198
Alpha 1.0
0x79ADC6FF

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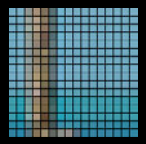

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Image Sprites

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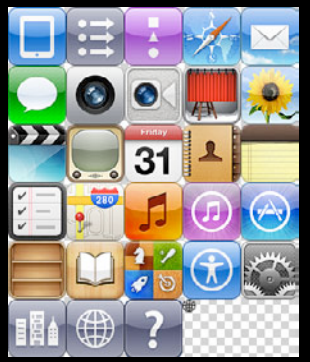

Image Sprites

```
.section-icon {
  background-image: url('sprites.png');


}
```

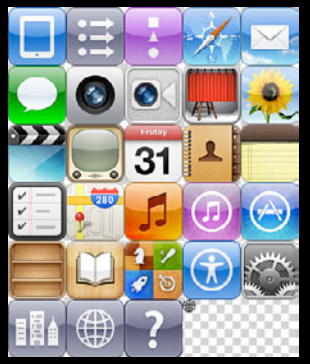

Image Sprites

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.section-icon {
  background-image: url('sprites.png');
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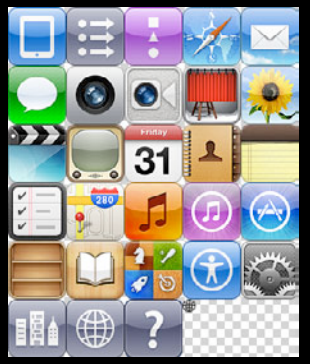

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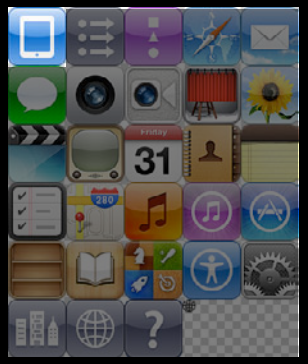

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}
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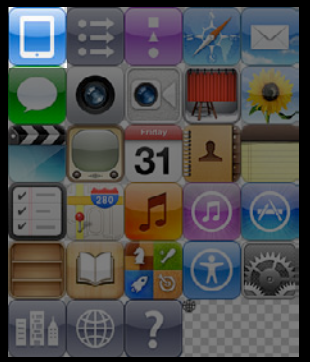

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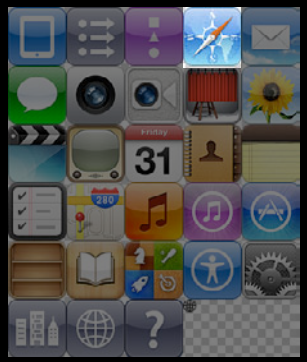

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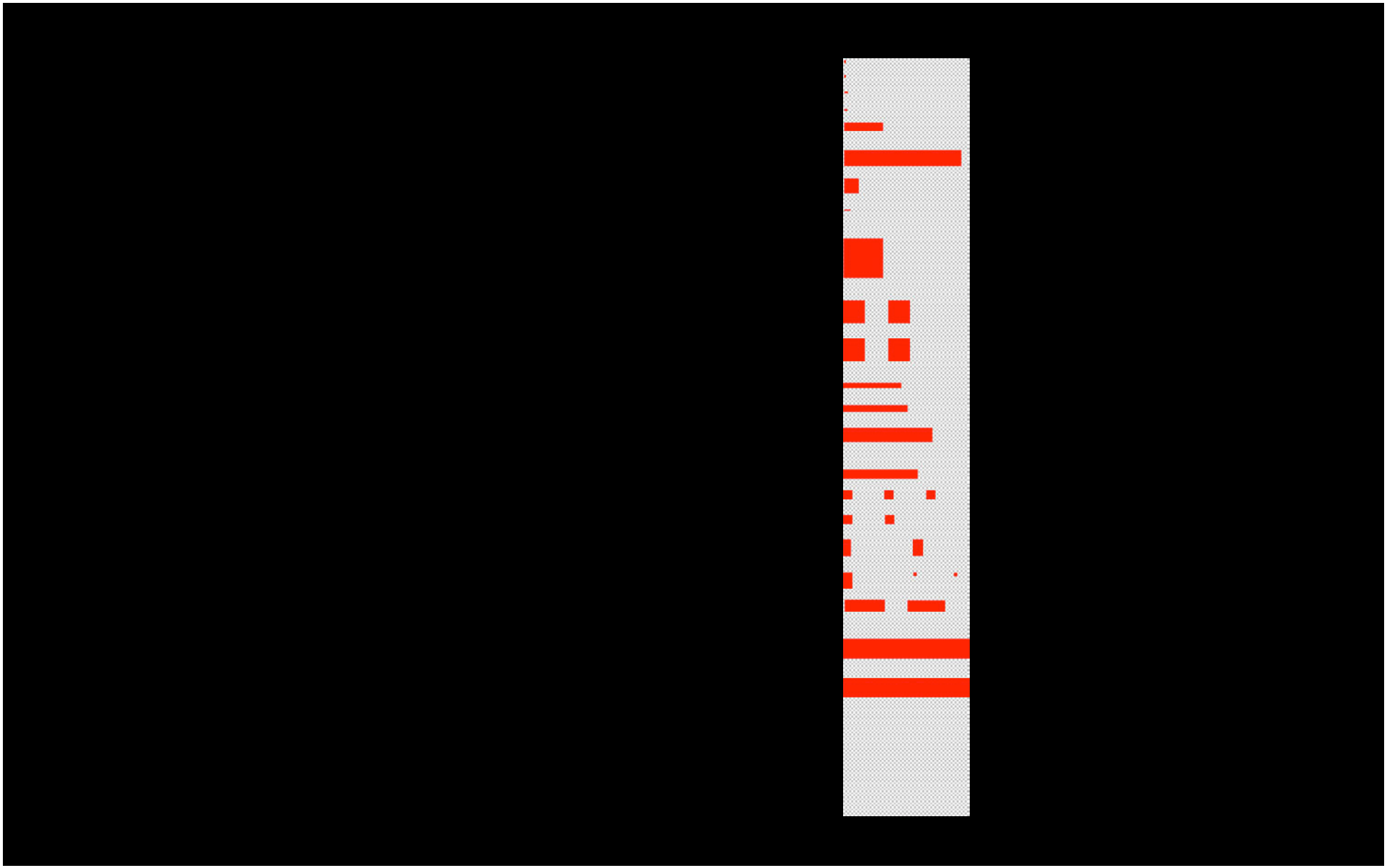

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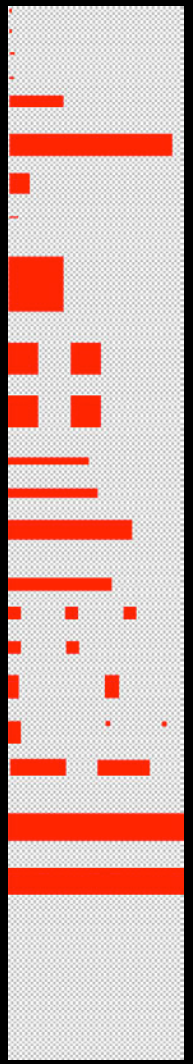
28KB PNG



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28KB PNG

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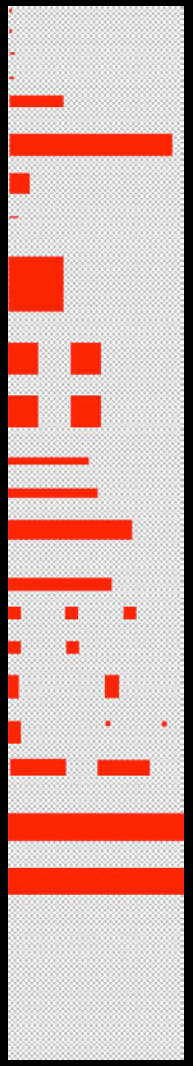
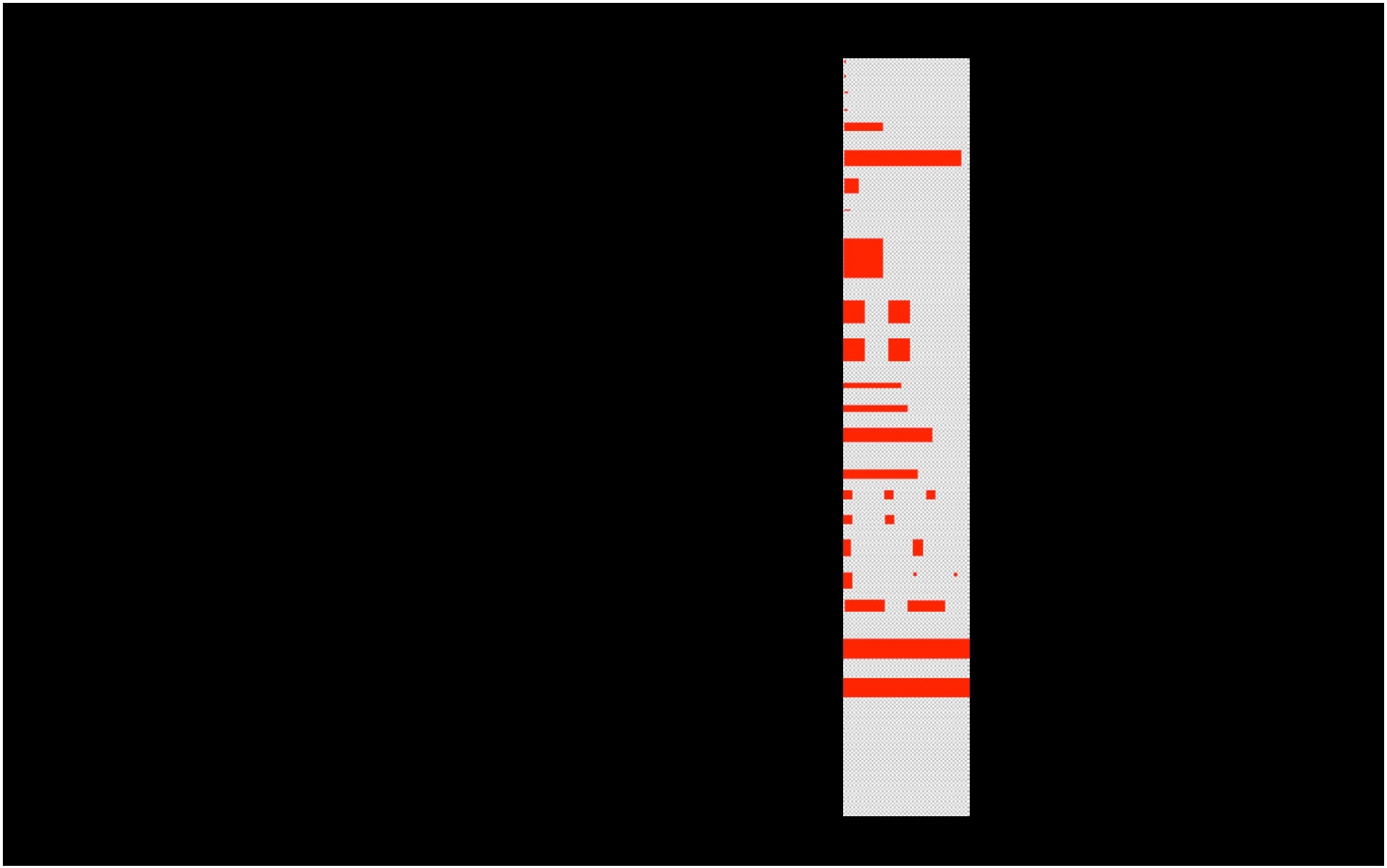
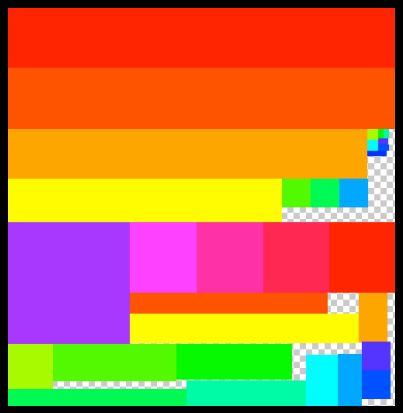
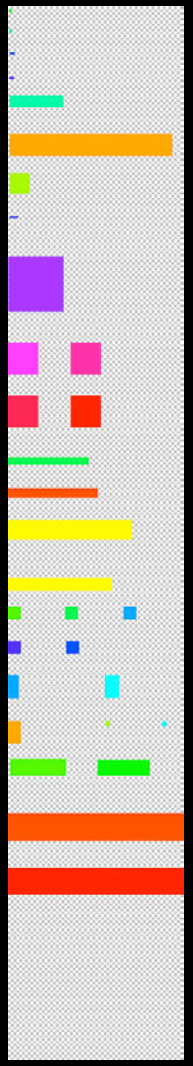
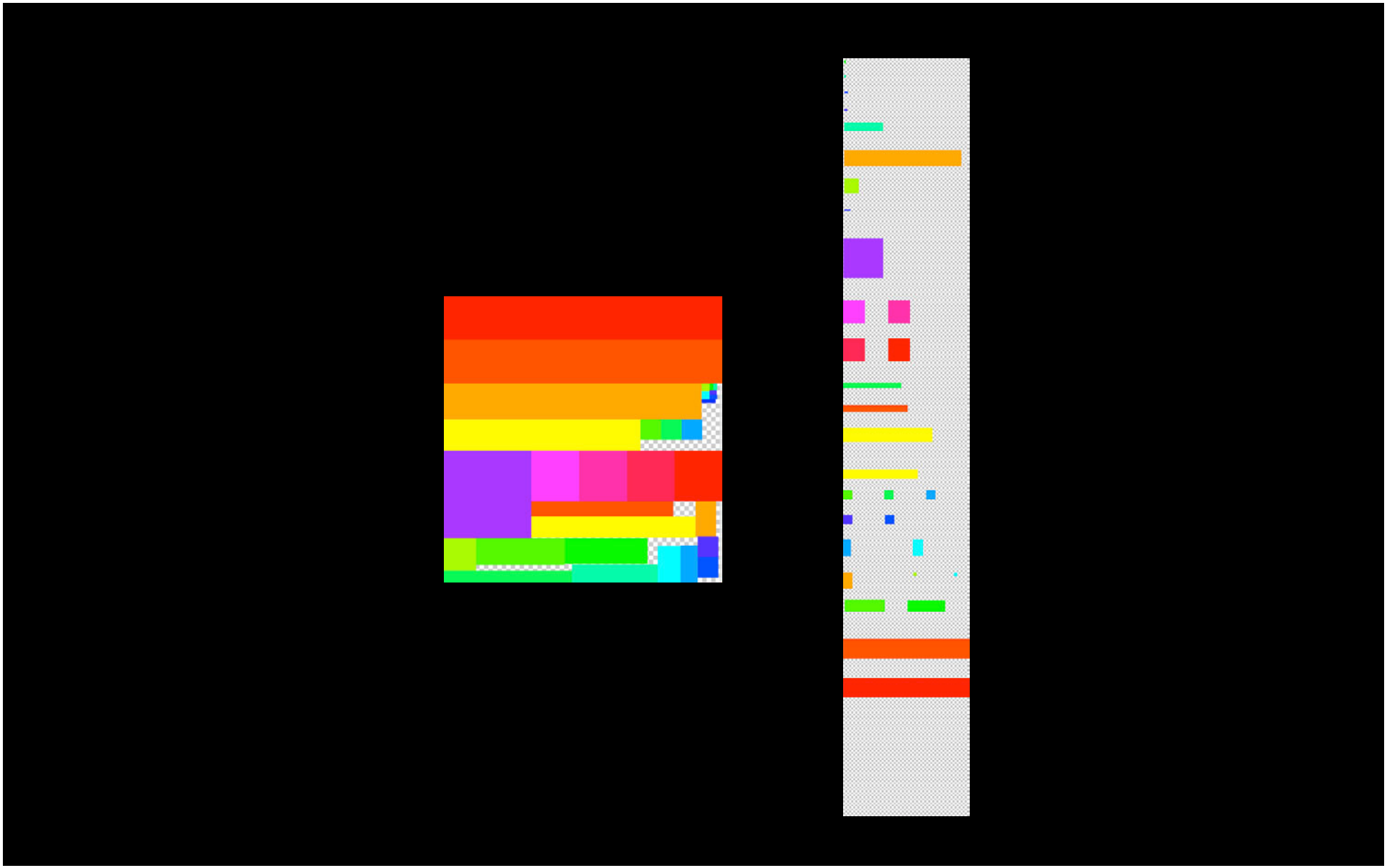
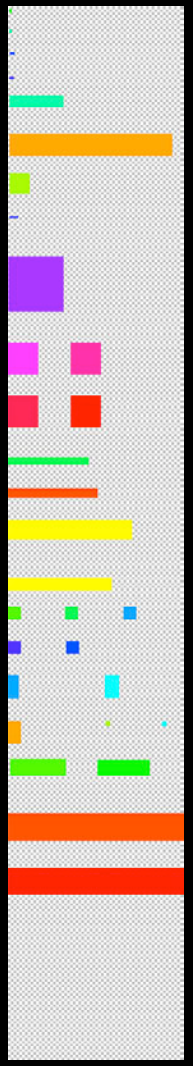










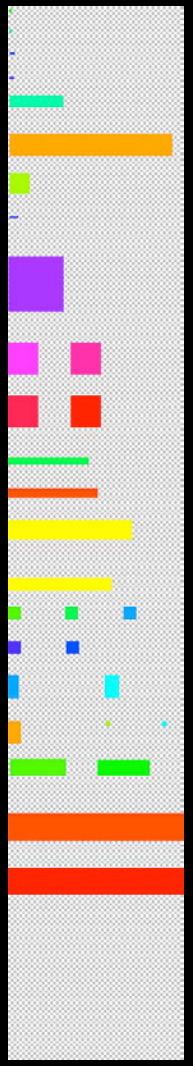


500px × 3000px
28KB PNG

84% unused

500px × 513px
27KB PNG

5% unused



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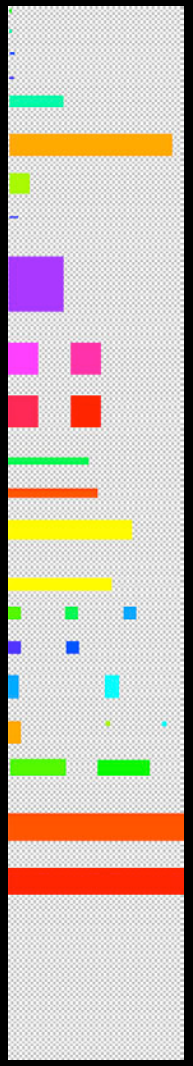
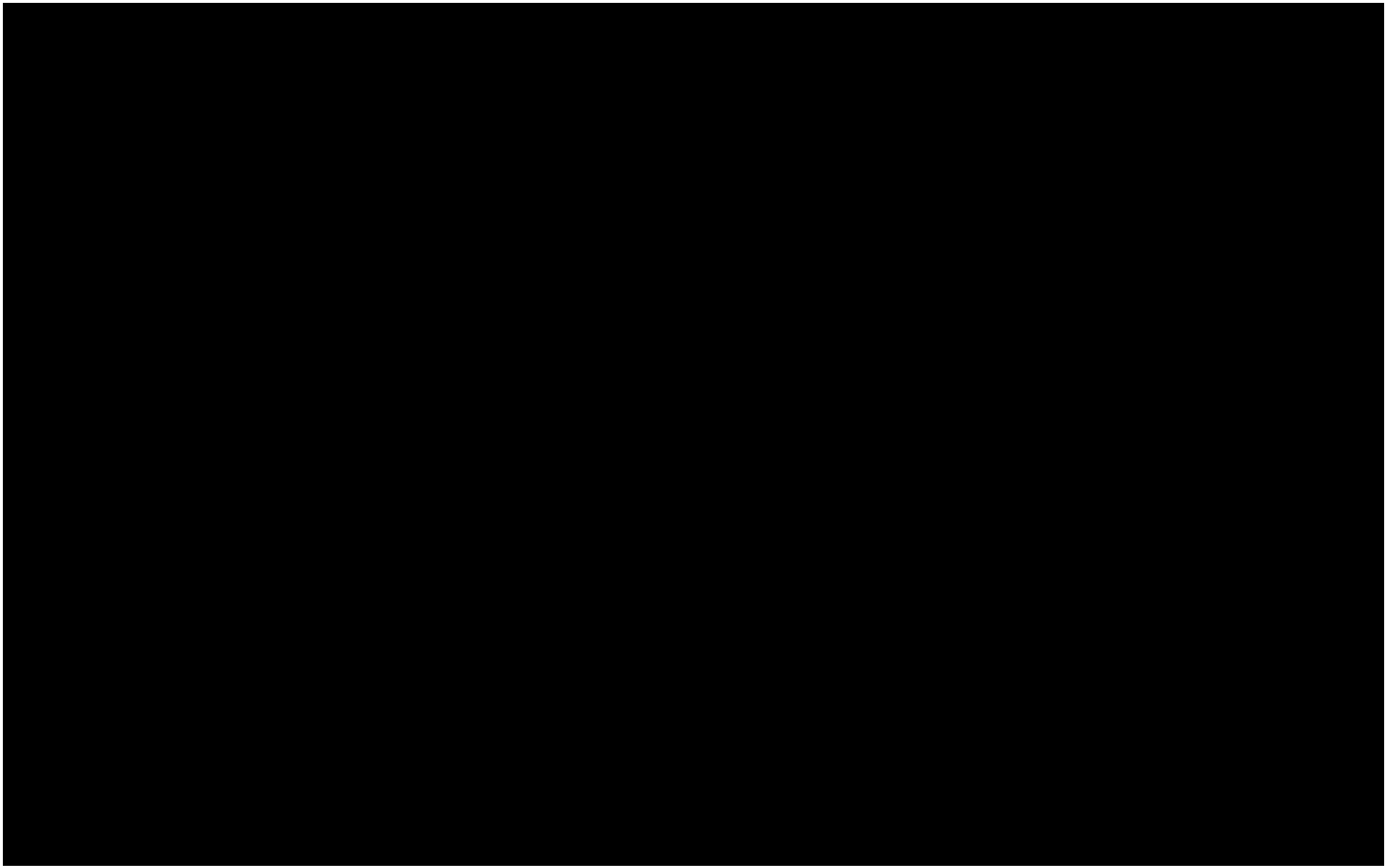


500px × 3000px
28KB PNG

84% unused

4.74MB RAM Saved



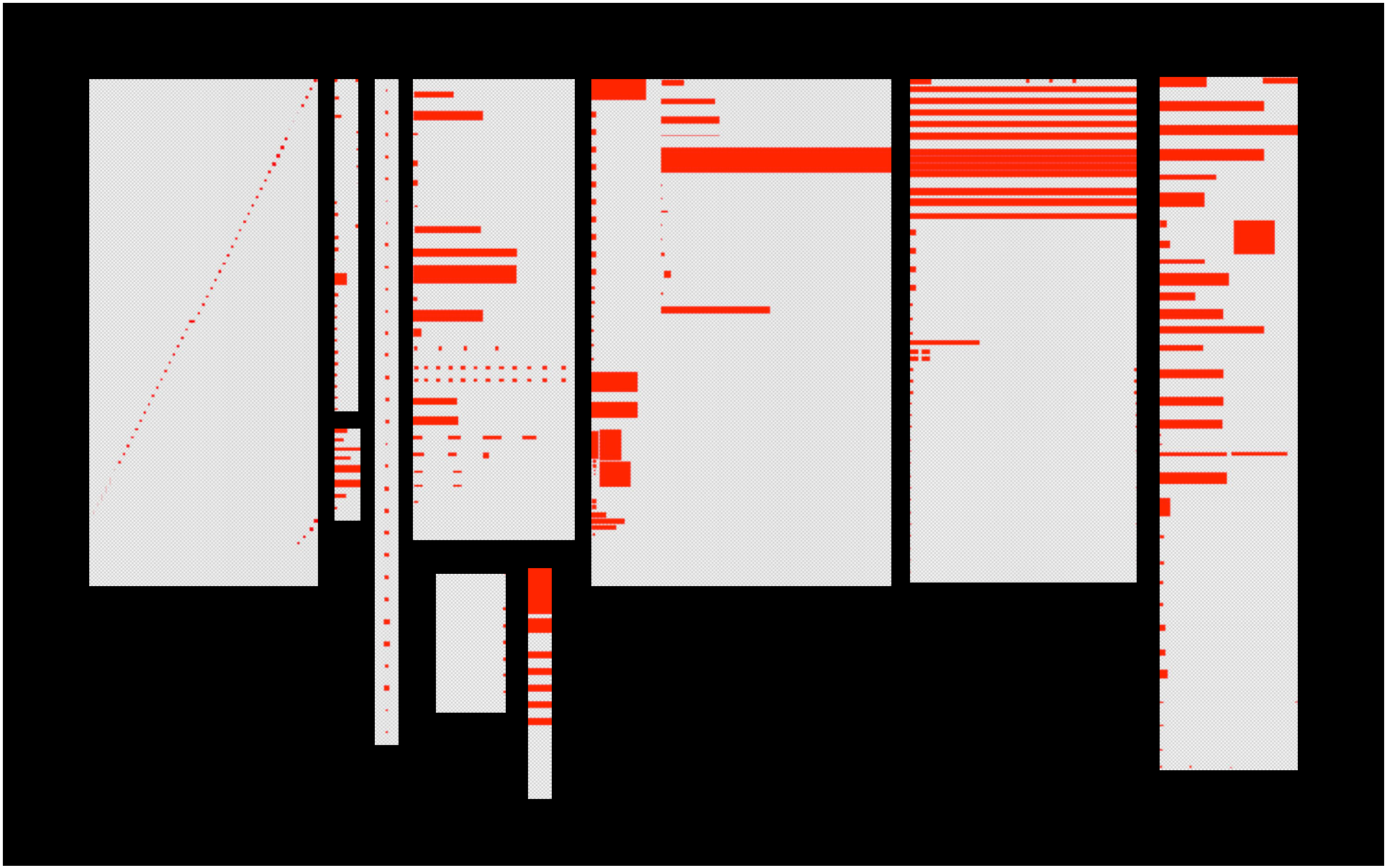


Image Decoding

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- Avoid wasted space in your sprite sheet
- Avoid using images that are larger than you need

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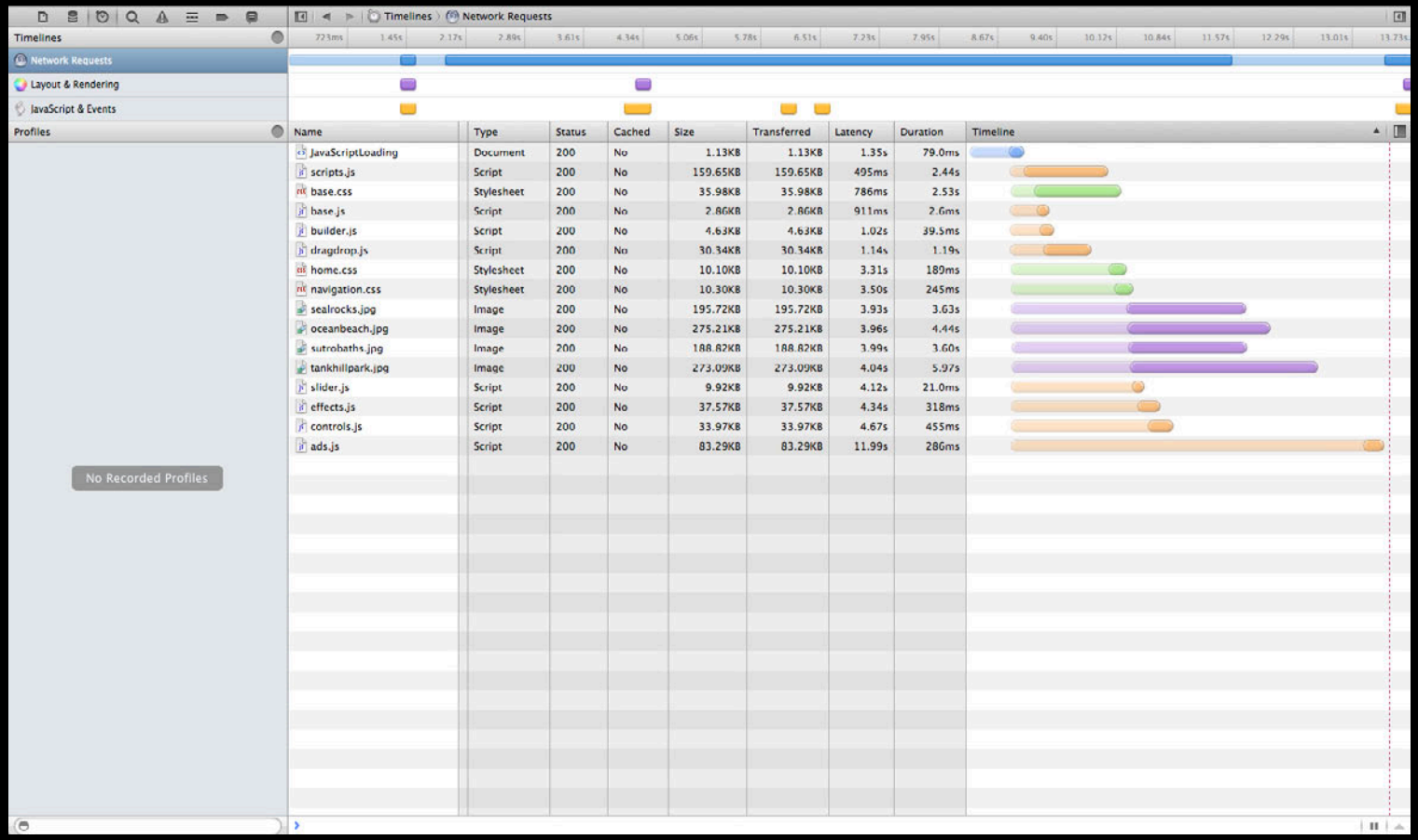
JavaScript Loading

Blocking painting

```
<script src="scripts.js"></script>
<script src="base.js"></script>
<script src="builder.js"></script>
<script src="ads.js"></script>
```


Timelines
Network Requests
Timelines
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Layout & Rendering
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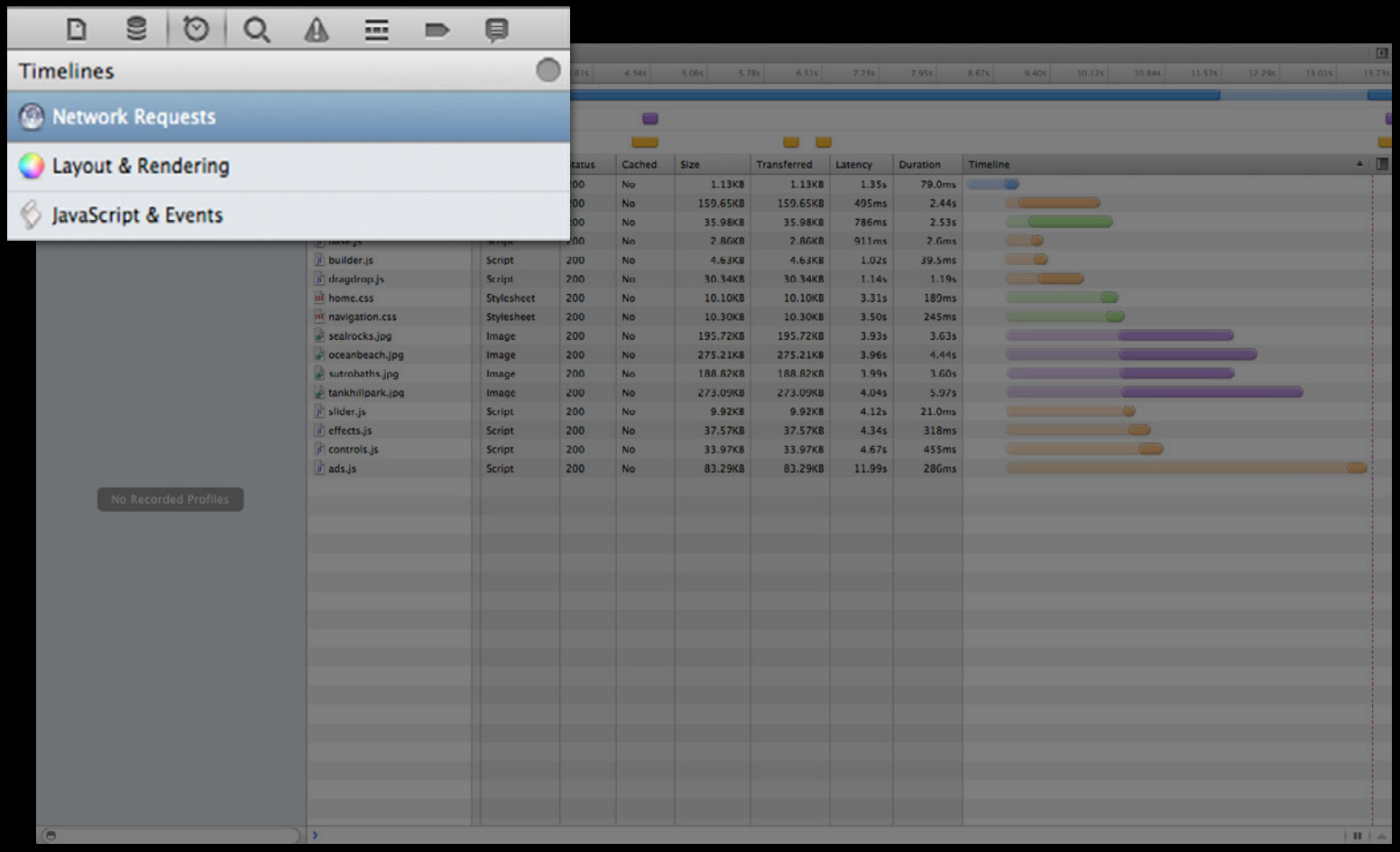
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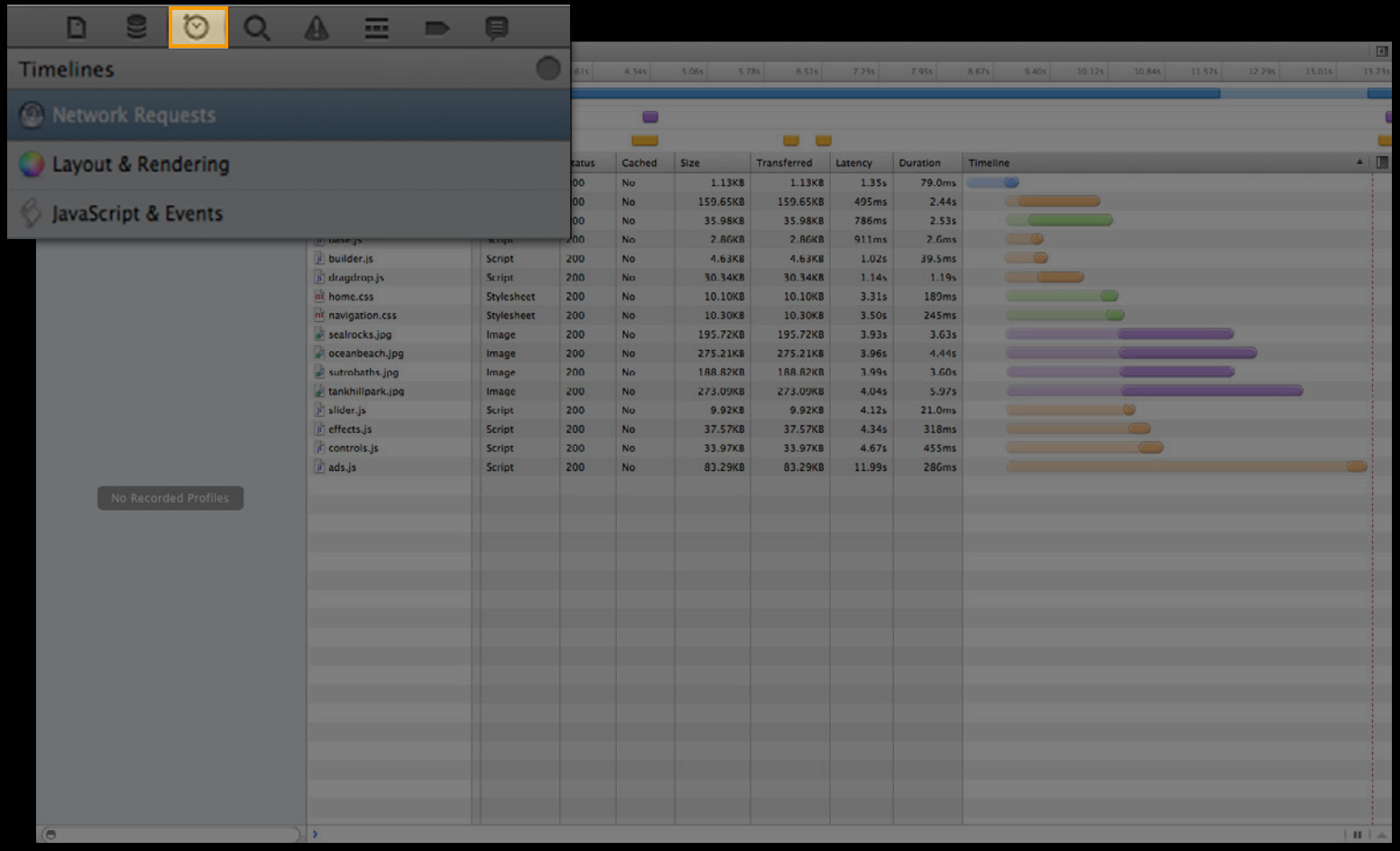
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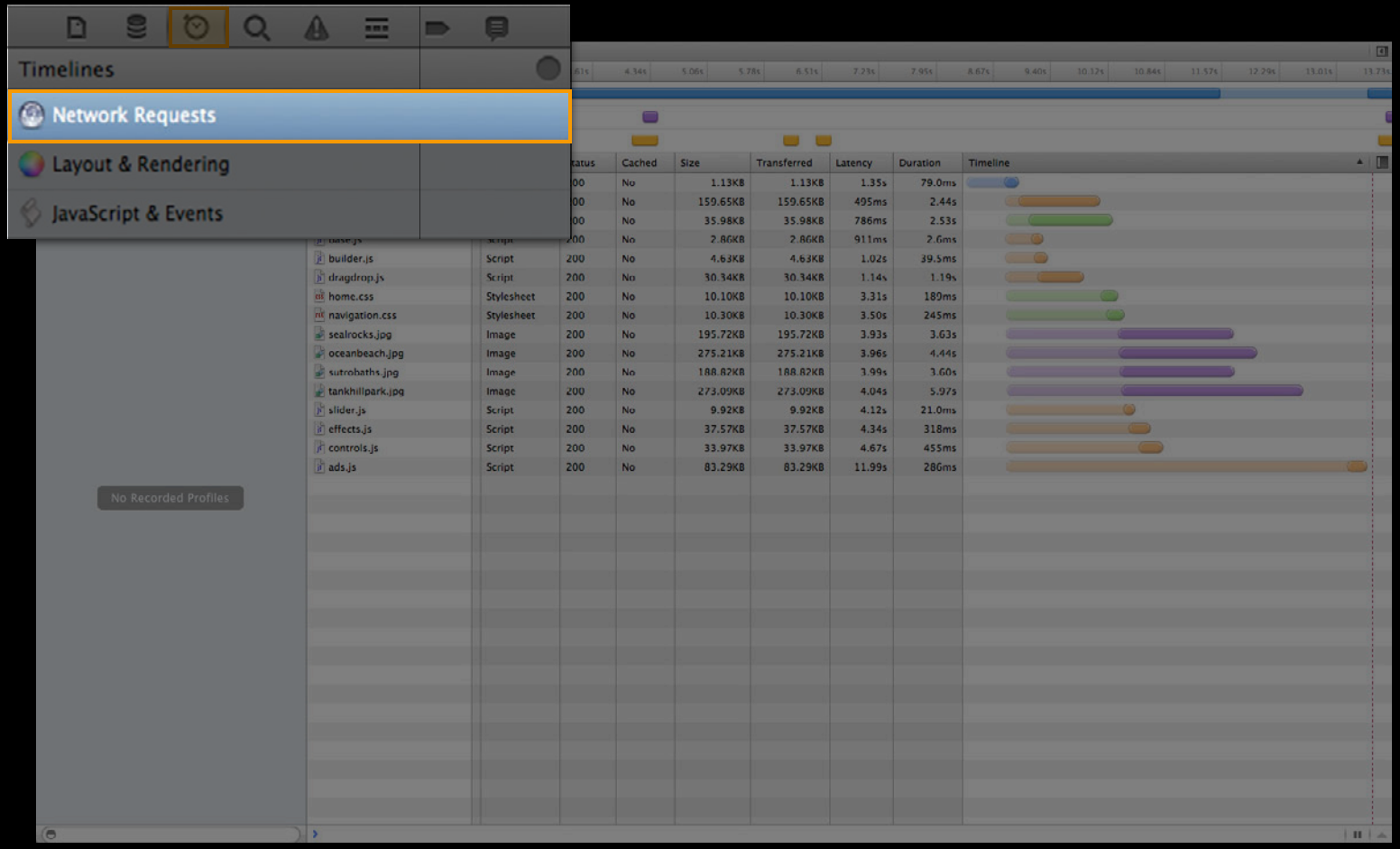
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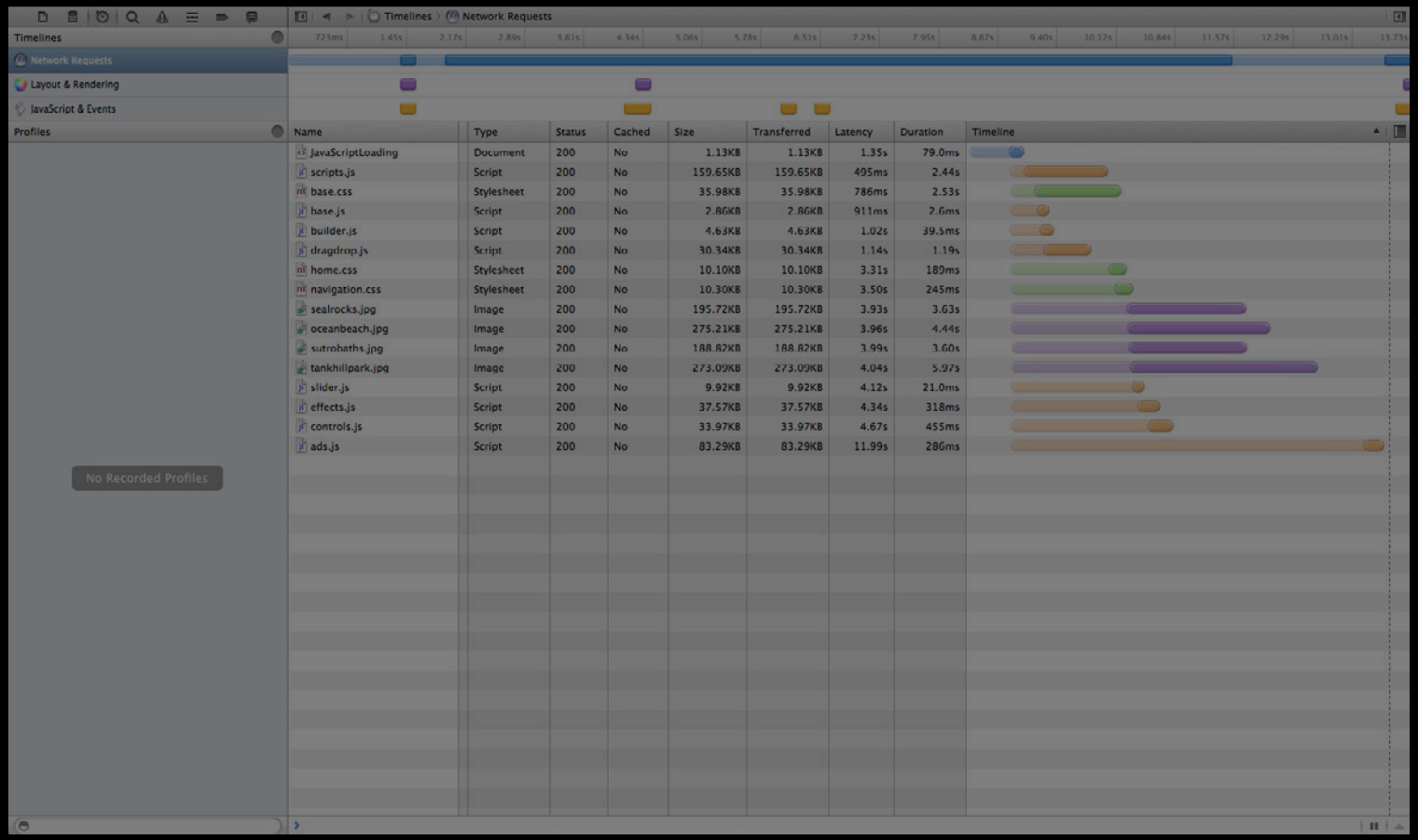
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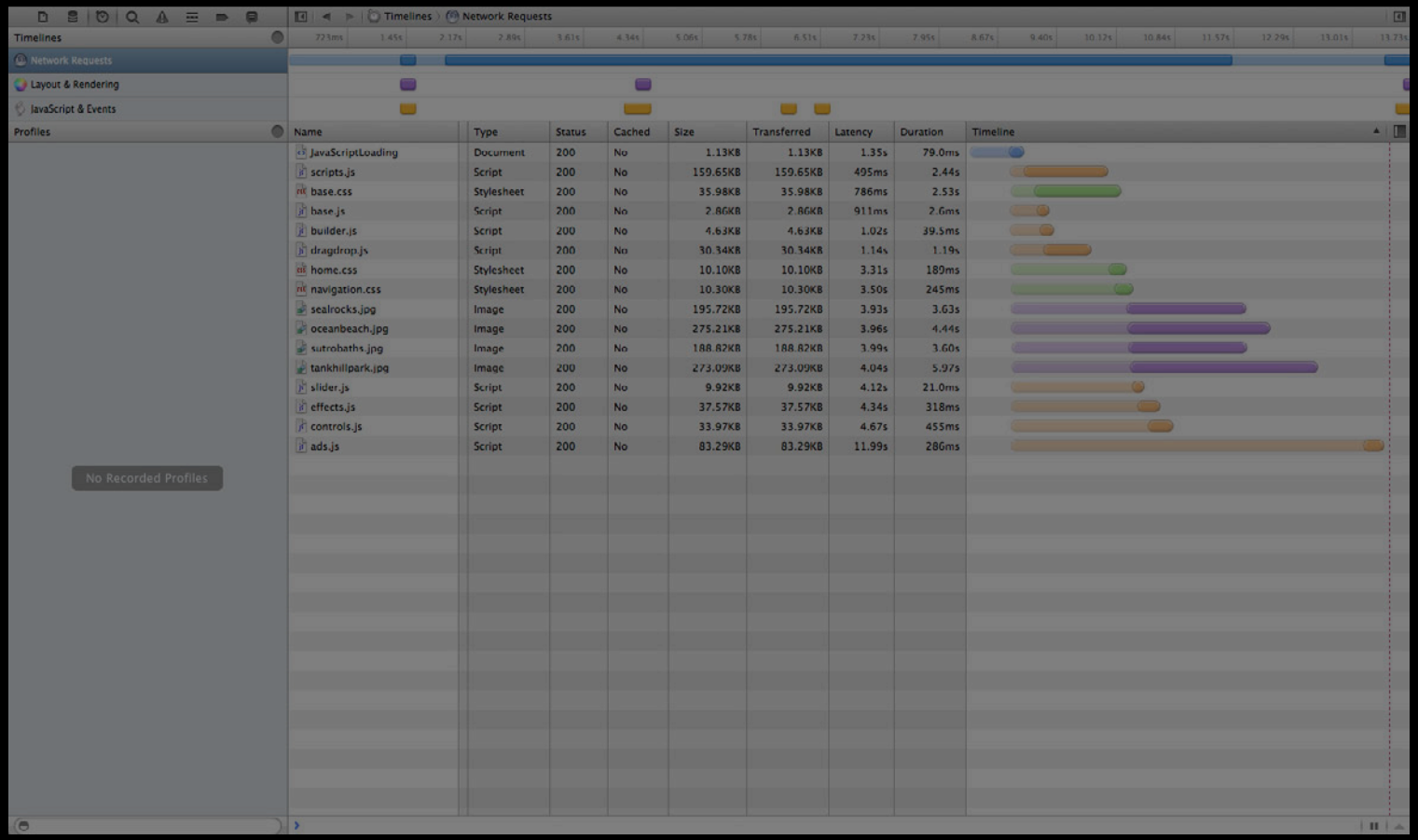
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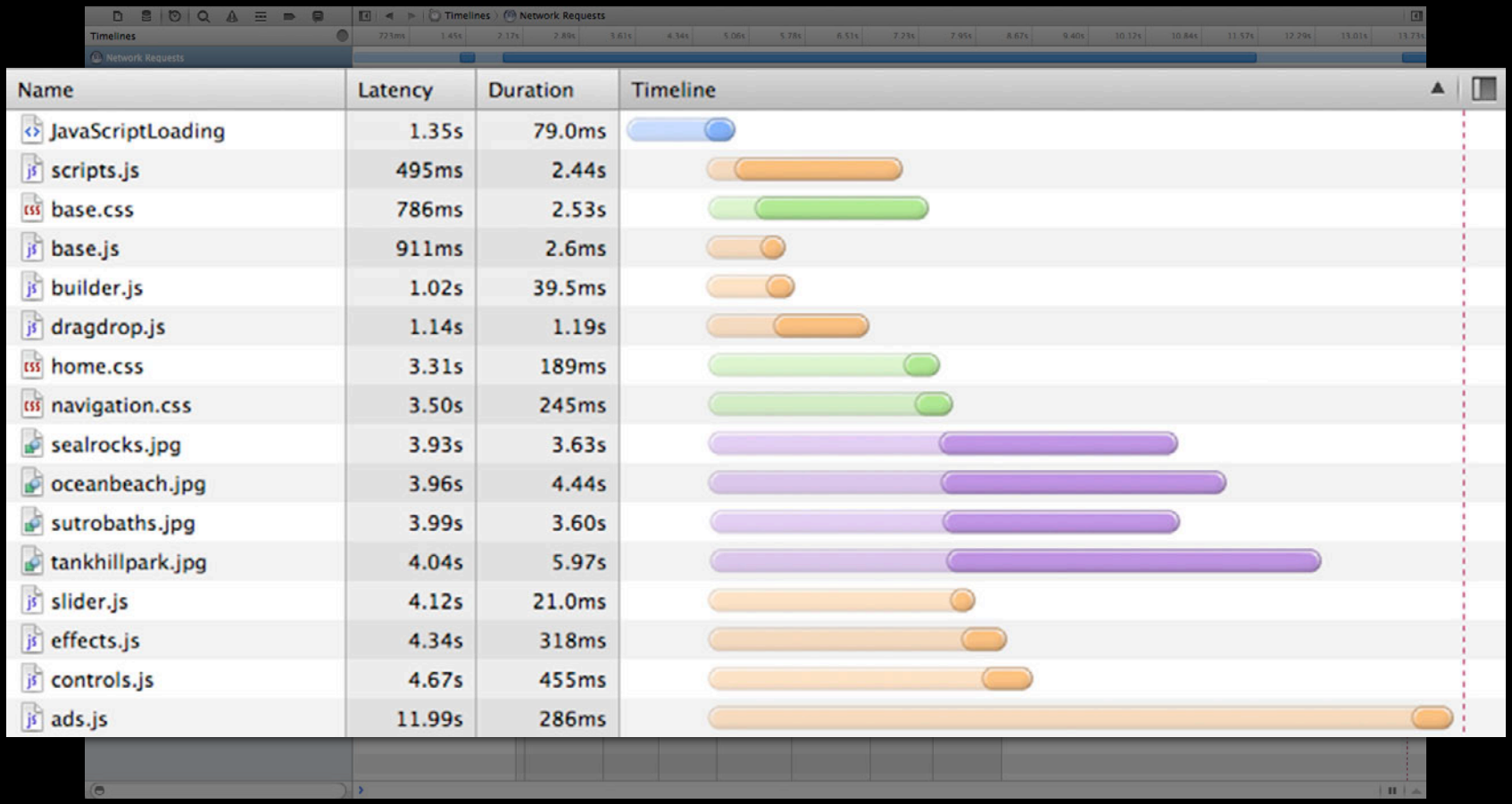
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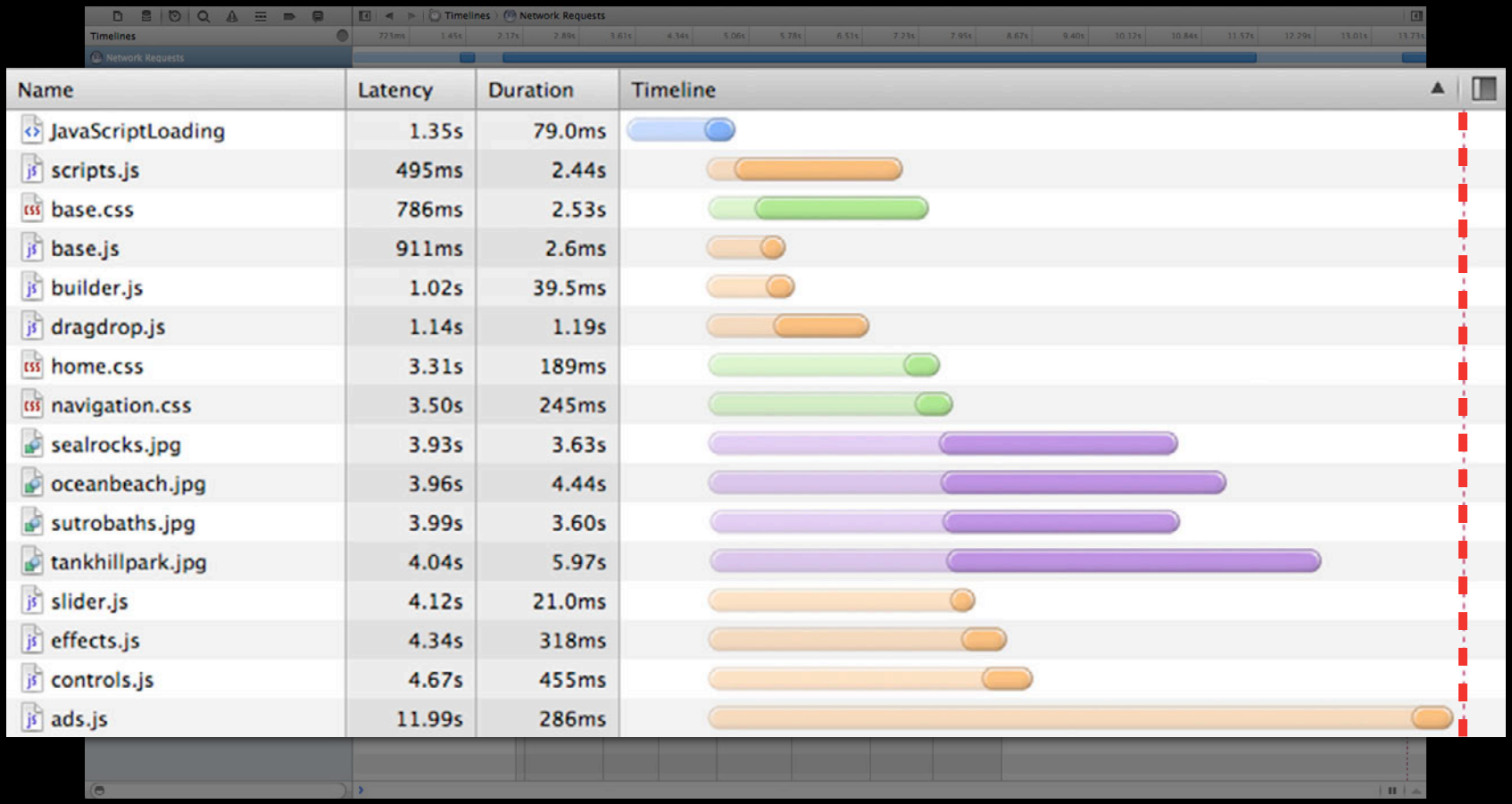
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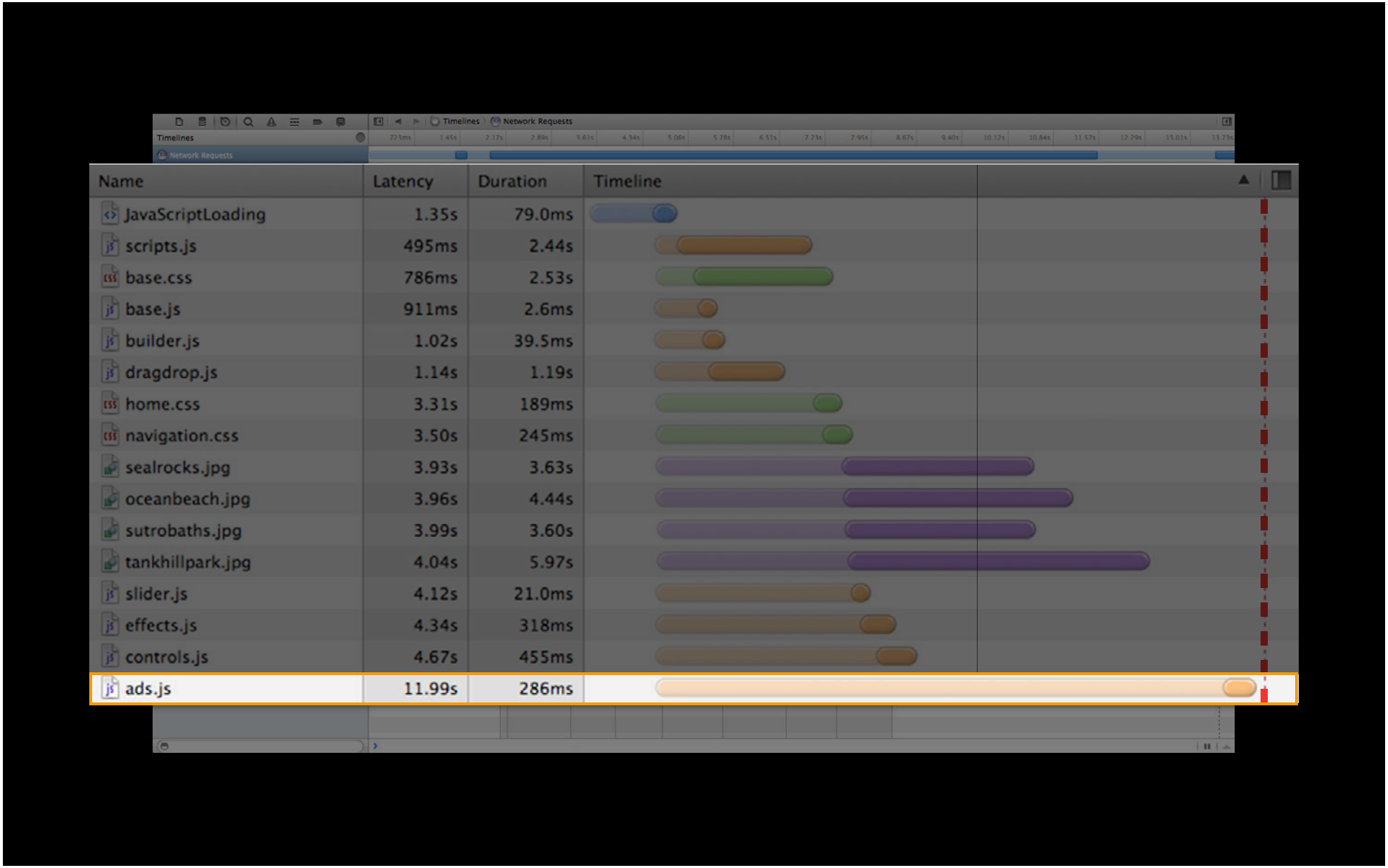
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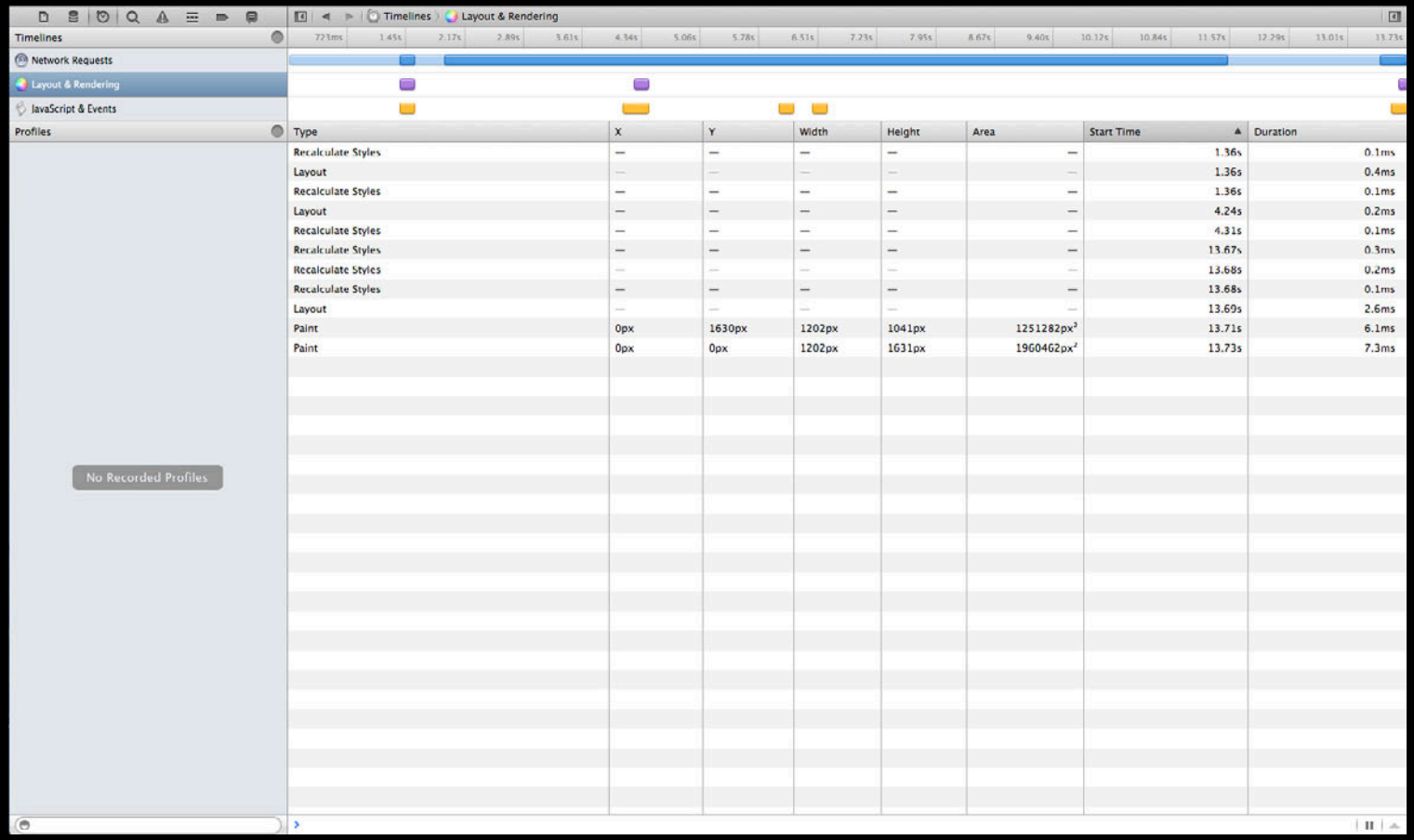
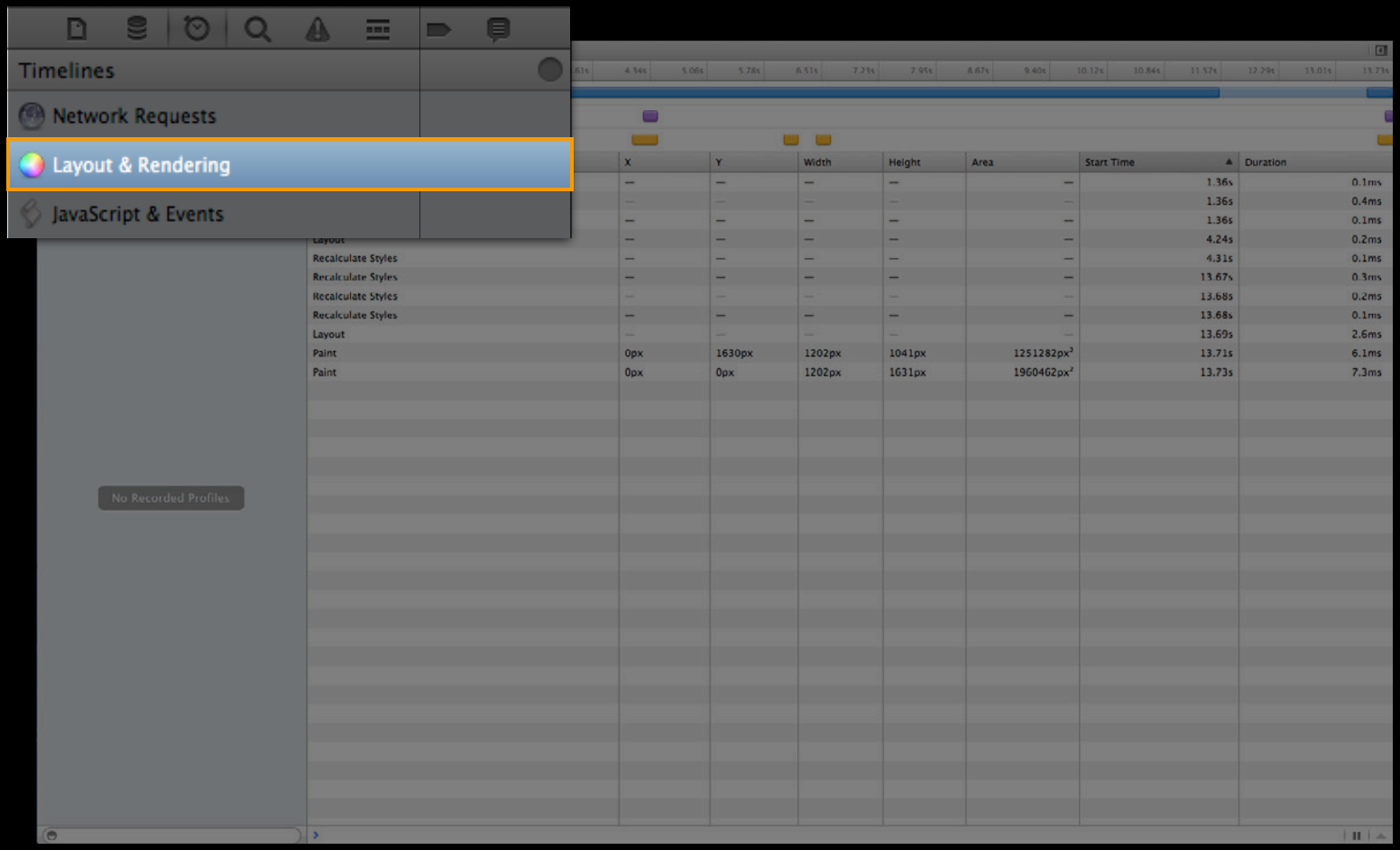
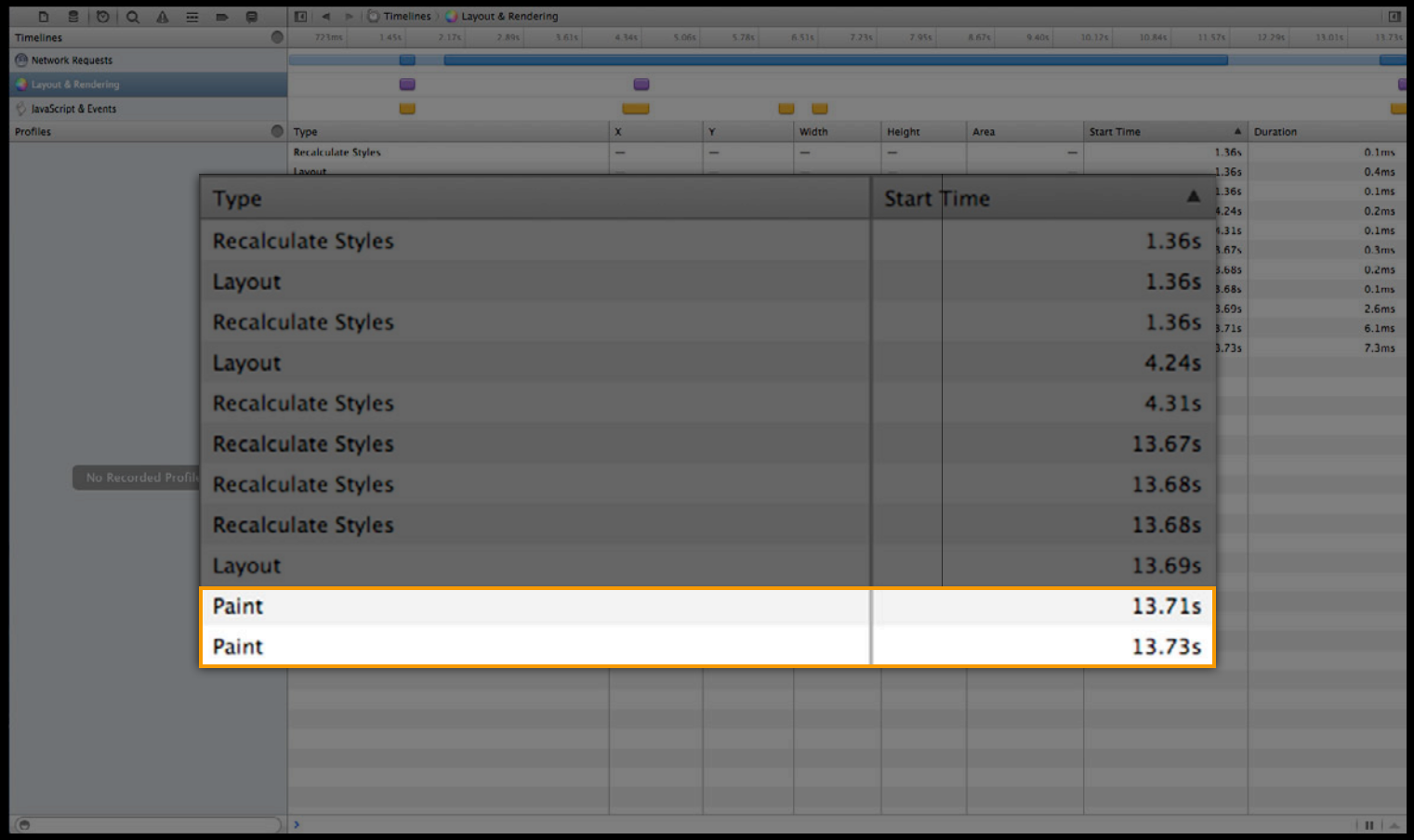
controls.js 4.67s 455ms
ads.js 11.99s 286ms


Timelines
Layout & Rendering
Timelines
Network Requests
Layout & Rendering
JavaScript & Events
Profiles
No Recorded Profiles
Type
X
Y
Width
Height
Area
Start Time
Duration
Recalculate Styles
Layout
Recalculate Styles
Layout
Recalculate Styles
Recalculate Styles
Recalculate Styles
Recalculate Styles
Layout
Paint
Paint
0px
0px
1630px
0px
1202px
1202px
1041px
1631px
1251282px²
1960462px²
1.36s
1.36s
1.36s
4.24s
4.31s
13.67s
13.68s
13.68s
13.69s
13.71s
13.73s
0.1ms
0.4ms
0.1ms
0.2ms
0.1ms
0.3ms
0.2ms
0.1ms
2.6ms
6.1ms
7.3ms


Timelines
Network Requests
Layout & Rendering
JavaScript & Events
No Recorded Profiles
X
Y
Width
Height
Area
Start Time
Duration
Recalculate Styles
Recalculate Styles
Recalculate Styles
Recalculate Styles
Layout
Paint
Paint
0px
1630px
1202px
1041px
1251282px²
13.71s
6.1ms
0px
0px
1202px
1631px
1960462px²
13.73s
7.3ms


Timelines
Layout & Rendering
Network Requests
Layout & Rendering
JavaScript & Events
Profiles
Type
X
Y
Width
Height
Area
Start Time
Duration
Recalculate Styles
Layout
Type
Start Time
Recalculate Styles 1.36s
Layout 1.36s
Recalculate Styles 1.36s
Layout 4.24s
Recalculate Styles 4.31s
Recalculate Styles 13.67s
Recalculate Styles 13.68s
Recalculate Styles 13.68s
Layout 13.69s
Paint 13.71s
Paint 13.73s

JavaScript Loading

Asynchronous and deferred execution

JavaScript Loading

Asynchronous and deferred execution

- Download begins immediately and does not block

JavaScript Loading

Asynchronous and deferred execution

- Download begins immediately and does not block

```
async
```

JavaScript Loading

Asynchronous and deferred execution

- Download begins immediately and does not block

`async`

  - Executed as soon as they're loaded

JavaScript Loading

Asynchronous and deferred execution

- Download begins immediately and does not block

`async`

  - Executed as soon as they're loaded

`defer`

JavaScript Loading

Asynchronous and deferred execution

- Download begins immediately and does not block

`async`

  - Executed as soon as they're loaded

`defer`

  - Executed in order of `<script>` tags

JavaScript Loading

Asynchronous and deferred execution

- Download begins immediately and does not block

`async`

  - Executed as soon as they're loaded

`defer`

  - Executed in order of `<script>` tags
  - Executed just before DOMContentLoaded

JavaScript Loading

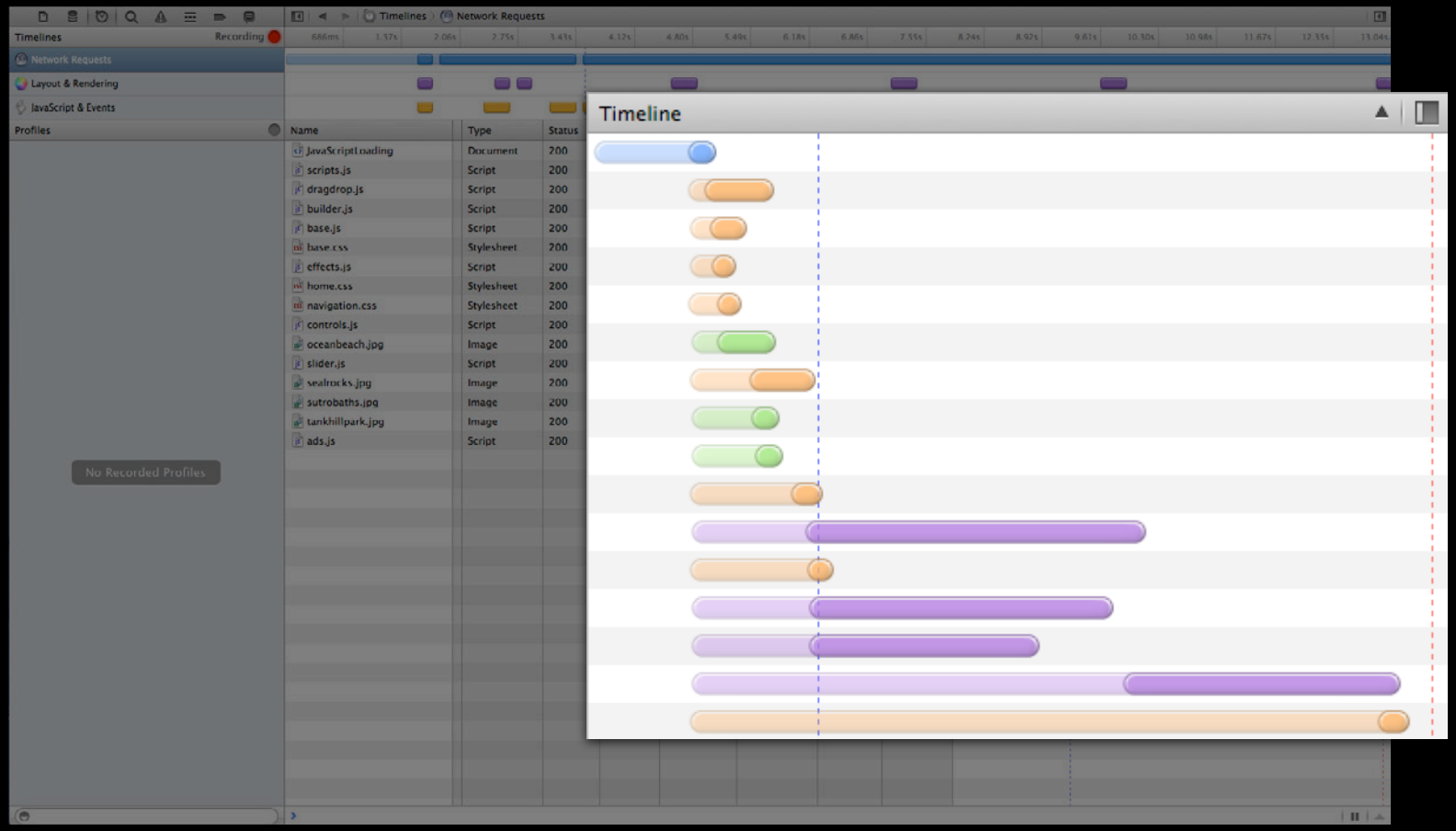
Asynchronous and deferred execution

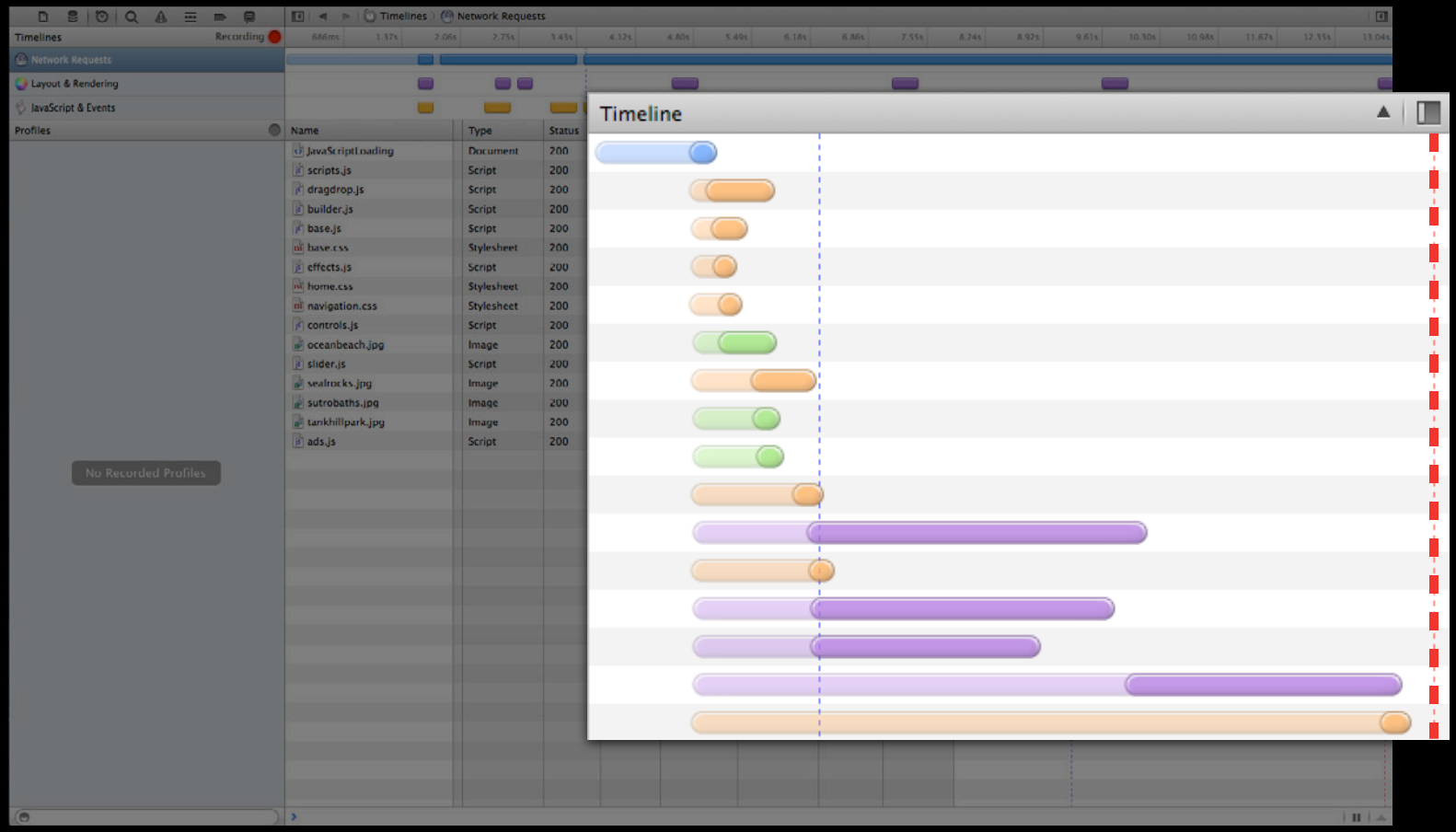
```
<script src="scripts.js"></script>
<script src="base.js"></script>
<script src="builder.js"></script>
<script src="ads.js"></script>
```

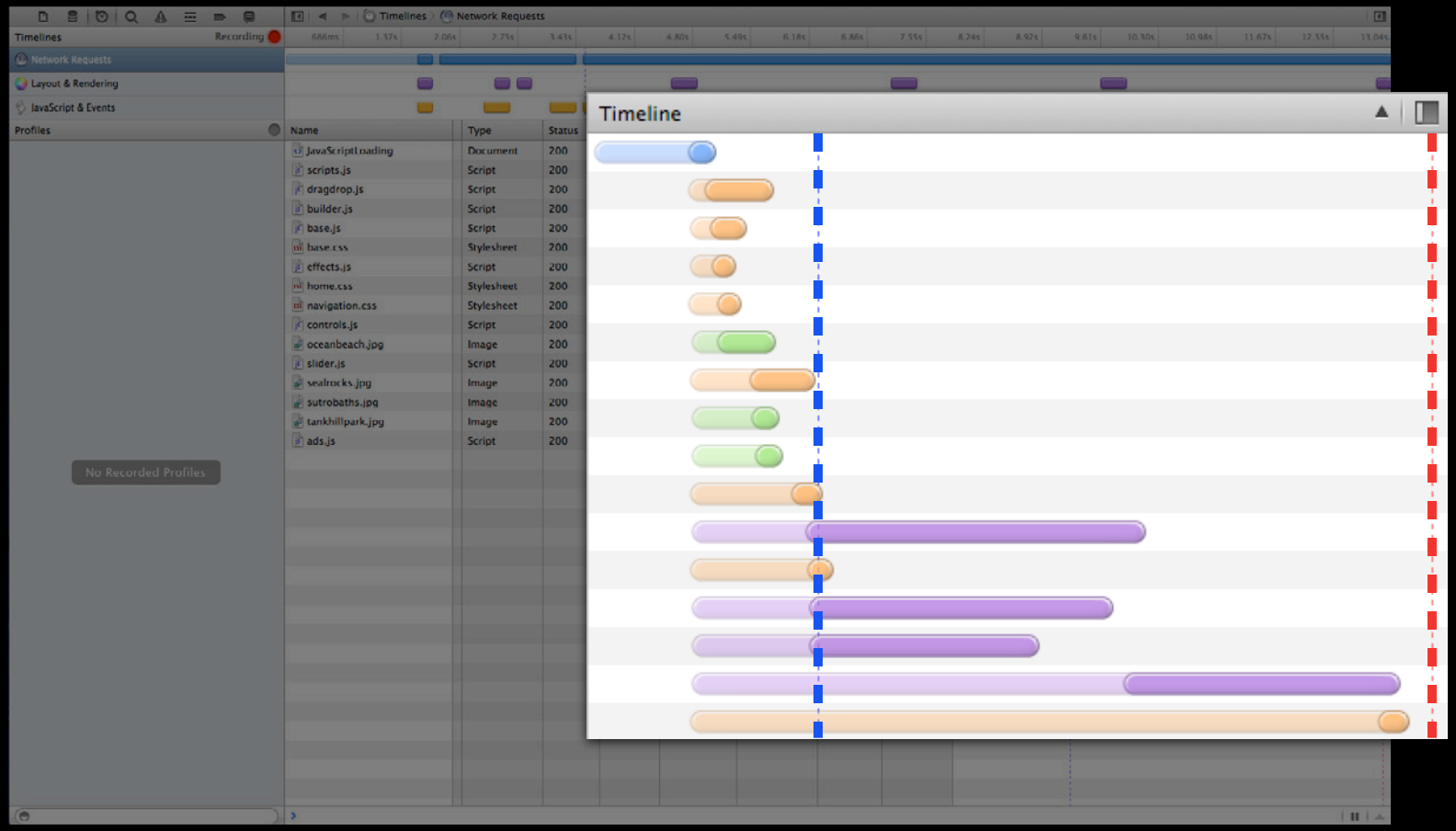
JavaScript Loading

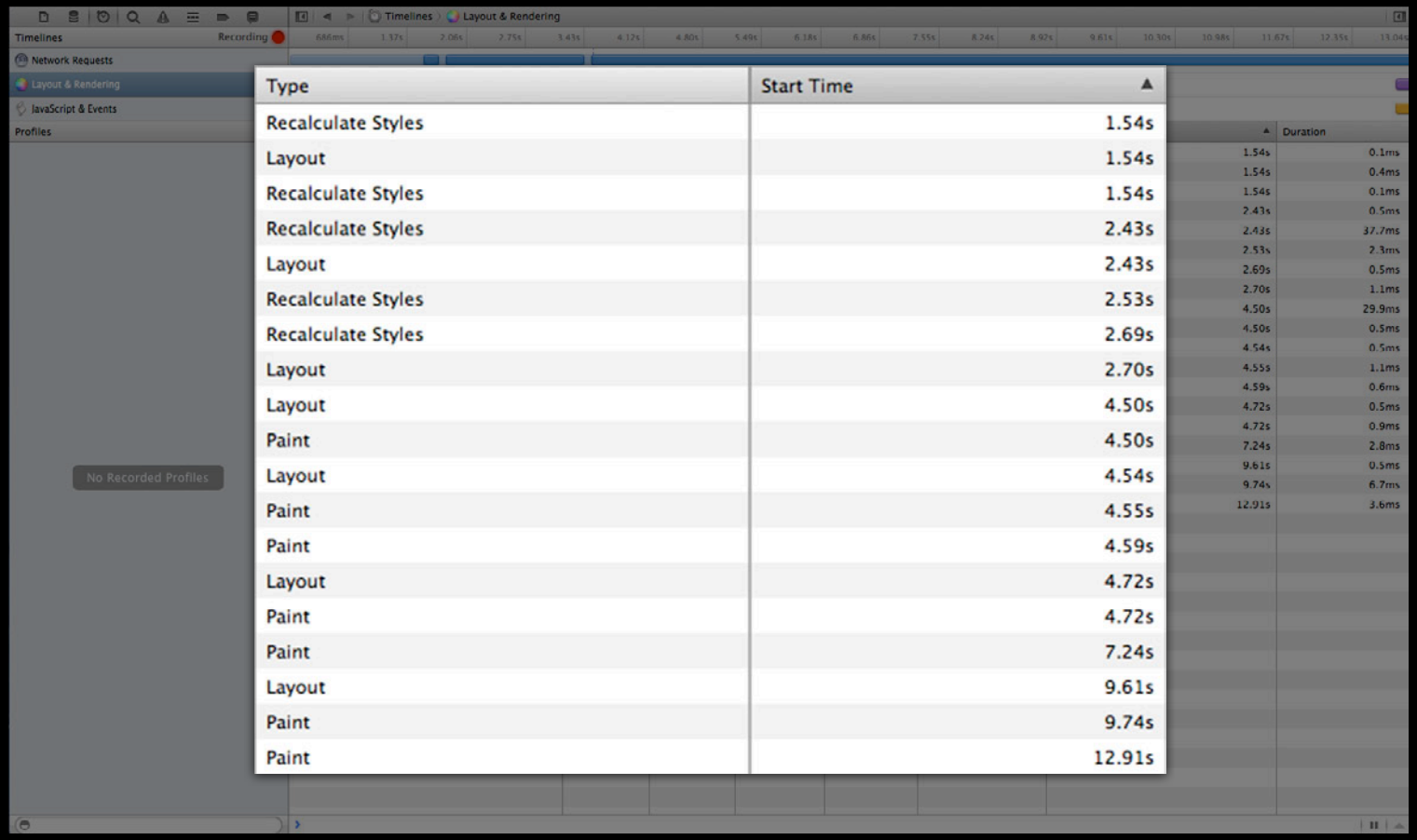
Asynchronous and deferred execution

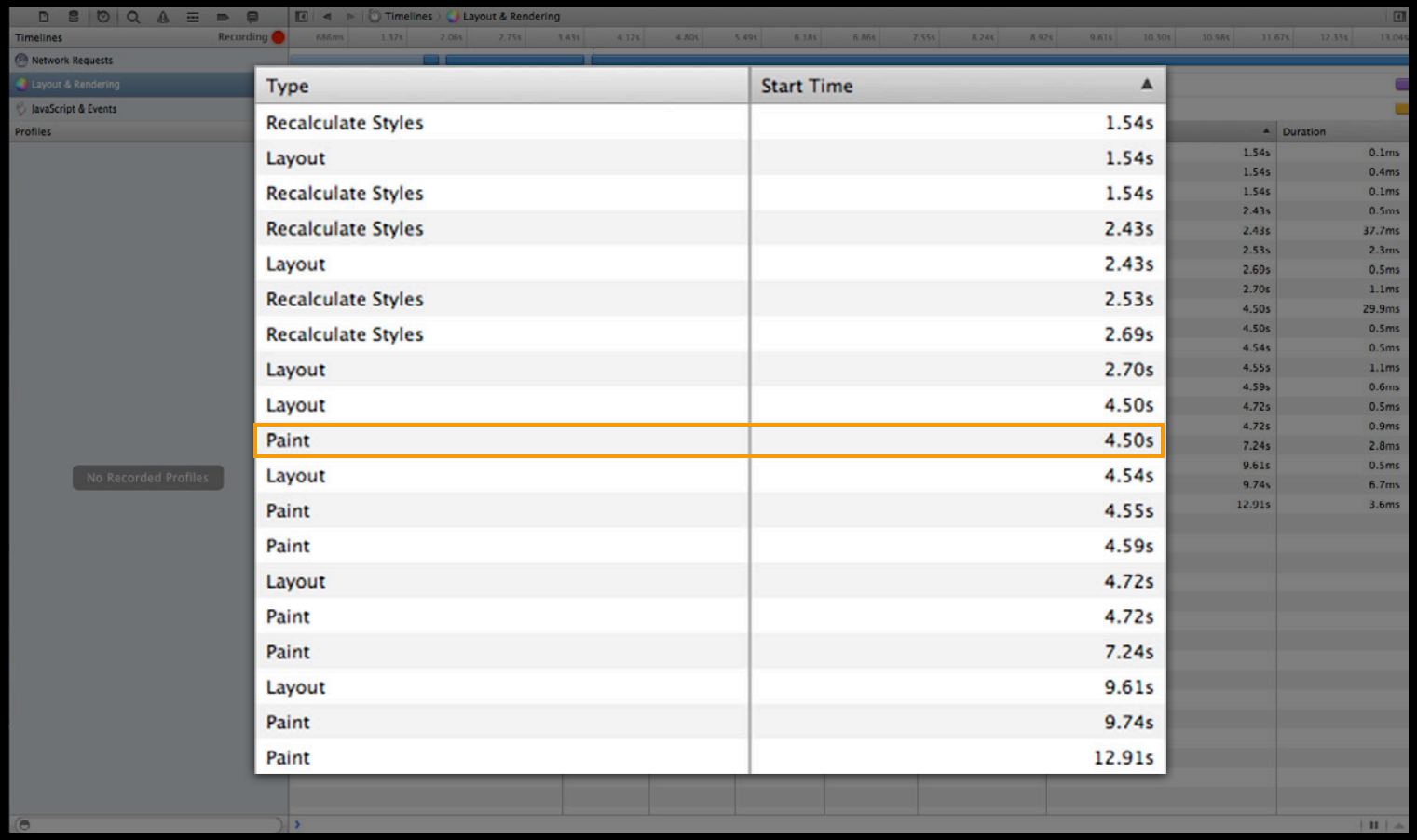
```
<script src="scripts.js" defer></script>
<script src="base.js" defer></script>
<script src="builder.js" defer></script>
<script src="ads.js" async></script>
```

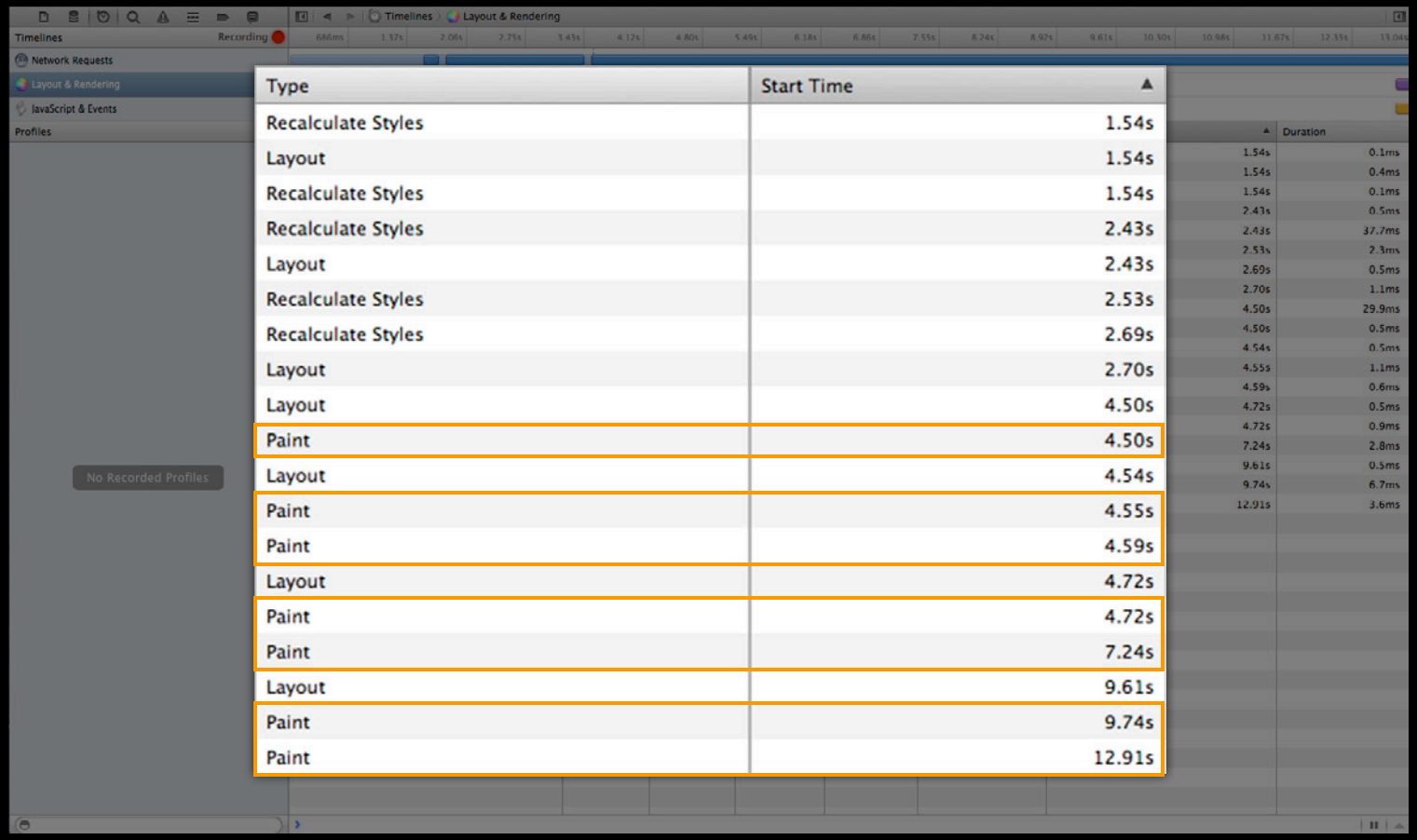

Timelines
Network Requests
Timelines
Recording
Network Requests
Layout & Rendering
JavaScript & Events
Profiles
No Recorded Profiles
Name
Type
Status
JavaScriptLoading Document 200
scripts.js Script 200
dragdrop.js Script 200
builder.js Script 200
base.js Script 200
base.css Stylesheet 200
effects.js Script 200
home.css Stylesheet 200
navigation.css Stylesheet 200
controls.js Script 200
oceanbeach.jpg Image 200
slider.js Script 200
sealrocks.jpg Image 200
sutrobaths.jpg Image 200
tankhillpark.jpg Image 200
ads.js Script 200
Timeline


Timelines
Network Requests
Timelines
Recording
Network Requests
Layout & Rendering
JavaScript & Events
Profiles
No Recorded Profiles
Name
Type
Status
JavaScriptLoading Document 200
scripts.js Script 200
dragdrop.js Script 200
builder.js Script 200
base.js Script 200
base.css Stylesheet 200
effects.js Script 200
home.css Stylesheet 200
navigation.css Stylesheet 200
controls.js Script 200
oceanbeach.jpg Image 200
slider.js Script 200
sealrocks.jpg Image 200
sutrobaths.jpg Image 200
tankhillpark.jpg Image 200
ads.js Script 200
Timeline

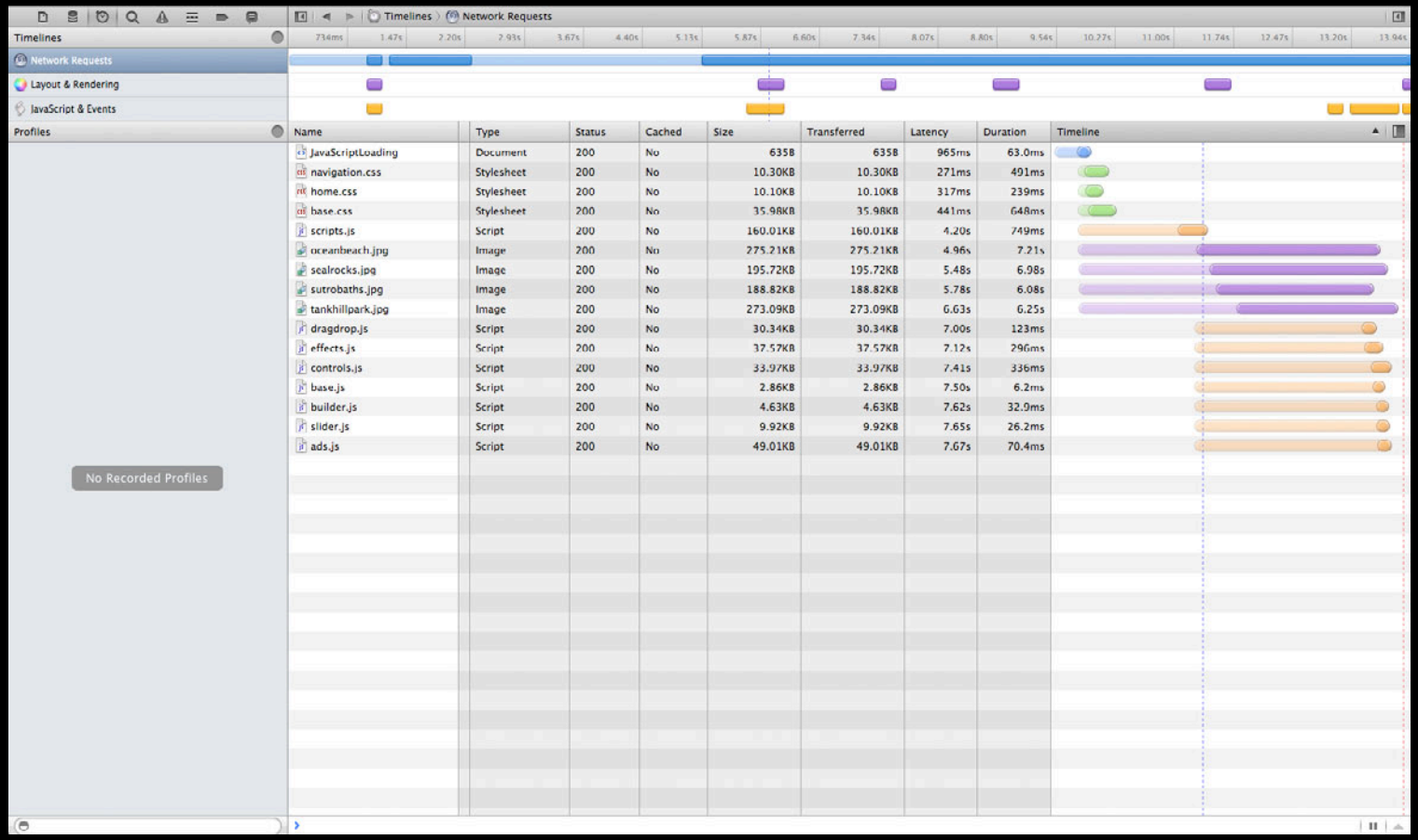

Timelines
Network Requests
Timelines
Recording
Network Requests
Layout & Rendering
JavaScript & Events
Profiles
No Recorded Profiles
Name
Type
Status
JavaScriptLoading Document 200
scripts.js Script 200
dragdrop.js Script 200
builder.js Script 200
base.js Script 200
base.css Stylesheet 200
effects.js Script 200
home.css Stylesheet 200
navigation.css Stylesheet 200
controls.js Script 200
oceanbeach.jpg Image 200
slider.js Script 200
sealrocks.jpg Image 200
sutrobaths.jpg Image 200
tankhillpark.jpg Image 200
ads.js Script 200
Timeline

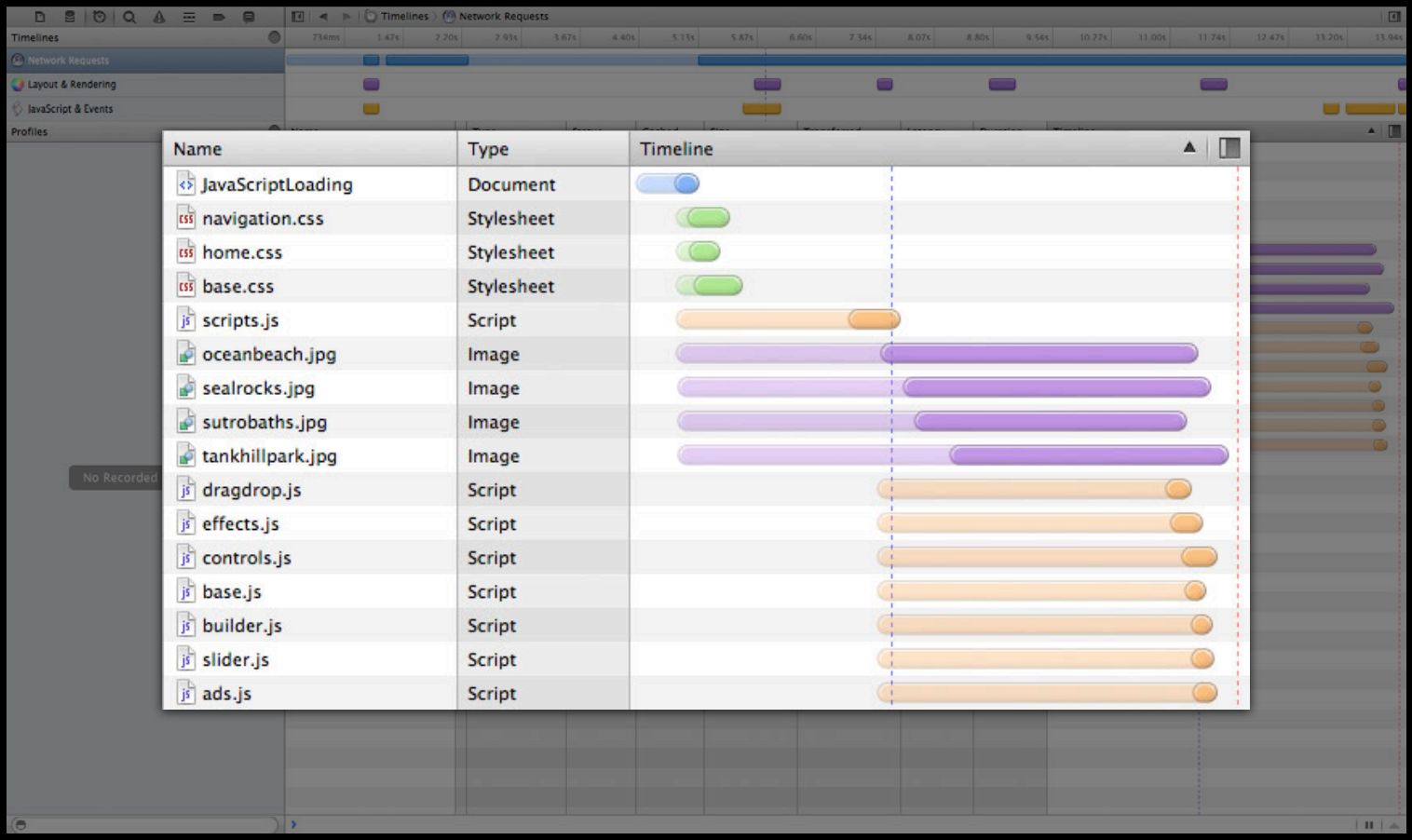

Timelines
Layout & Rendering
Timelines
Recording
Network Requests
Layout & Rendering
JavaScript & Events
Profiles
No Recorded Profiles
Type
Start Time
Recalculate Styles 1.54s
Layout 1.54s
Recalculate Styles 1.54s
Recalculate Styles 2.43s
Layout 2.43s
Recalculate Styles 2.53s
Recalculate Styles 2.69s
Layout 2.70s
Layout 4.50s
Paint 4.50s
Layout 4.54s
Paint 4.55s
Paint 4.59s
Layout 4.72s
Paint 4.72s
Paint 7.24s
Layout 9.61s
Paint 9.74s
Paint 12.91s
Duration


Timelines
Layout & Rendering
Timelines
Recording
Network Requests
Layout & Rendering
JavaScript & Events
Profiles
No Recorded Profiles
Type
Start Time
Recalculate Styles 1.54s
Layout 1.54s
Recalculate Styles 1.54s
Recalculate Styles 2.43s
Layout 2.43s
Recalculate Styles 2.53s
Recalculate Styles 2.69s
Layout 2.70s
Layout 4.50s
Paint 4.50s
Layout 4.54s
Paint 4.55s
Paint 4.59s
Layout 4.72s
Paint 4.72s
Paint 7.24s
Layout 9.61s
Paint 9.74s
Paint 12.91s
Duration



Type	Start Time
Recalculate Styles	1.54s
Layout	1.54s
Recalculate Styles	1.54s
Recalculate Styles	2.43s
Layout	2.43s
Recalculate Styles	2.53s
Recalculate Styles	2.69s
Layout	2.70s
Layout	4.50s
Paint	4.50s
Layout	4.54s
Paint	4.55s
Paint	4.59s
Layout	4.72s
Paint	4.72s
Paint	7.24s
Layout	9.61s
Paint	9.74s
Paint	12.91s


Timelines
Network Requests
Timelines
Network Requests
Layout & Rendering
JavaScript & Events
Profiles
No Recorded Profiles
Name
Type
Status
Cached
Size
Transferred
Latency
Duration
Timeline
JavaScriptLoading Document 200 No 635B 635B 965ms 63.0ms
navigation.css Stylesheet 200 No 10.30KB 10.30KB 271ms 491ms
home.css Stylesheet 200 No 10.10KB 10.10KB 317ms 239ms
base.css Stylesheet 200 No 35.98KB 35.98KB 441ms 648ms
scripts.js Script 200 No 160.01KB 160.01KB 4.20s 749ms
oceanbeach.jpg Image 200 No 275.21KB 275.21KB 4.96s 7.21s
scalrocks.jpg Image 200 No 195.72KB 195.72KB 5.48s 6.98s
sutrobaths.jpg Image 200 No 188.82KB 188.82KB 5.78s 6.08s
tankhillpark.jpg Image 200 No 273.09KB 273.09KB 6.63s 6.25s
dragdrop.js Script 200 No 30.34KB 30.34KB 7.00s 123ms
effects.js Script 200 No 37.57KB 37.57KB 7.12s 296ms
controls.js Script 200 No 33.97KB 33.97KB 7.41s 336ms
base.js Script 200 No 2.86KB 2.86KB 7.50s 6.2ms
builder.js Script 200 No 4.63KB 4.63KB 7.62s 32.9ms
slider.js Script 200 No 9.92KB 9.92KB 7.65s 26.2ms
ads.js Script 200 No 49.01KB 49.01KB 7.67s 70.4ms


Timelines
Network Requests
Layout & Rendering
JavaScript & Events
Profiles
No Recorded
Name
Type
Timeline
JavaScriptLoading
Document
navigation.css
Stylesheet
home.css
Stylesheet
base.css
Stylesheet
scripts.js
Script
oceanbeach.jpg
Image
sealrocks.jpg
Image
sutrobaths.jpg
Image
tankhillpark.jpg
Image
dragdrop.js
Script
effects.js
Script
controls.js
Script
base.js
Script
builder.js
Script
slider.js
Script
ads.js
Script

JavaScript Loading

Blocking execution and rendering

JavaScript Loading

Blocking execution and rendering

- Use the Web Inspector timeline to profile loading

JavaScript Loading

Blocking execution and rendering

- Use the Web Inspector timeline to profile loading
- Use `async` and `defer` with scripts

JavaScript Loading

Blocking execution and rendering

- Use the Web Inspector timeline to profile loading
- Use `async` and `defer` with scripts
- Don't chain resource imports

Avoiding JavaScript Libraries

Powerful tools

Avoiding JavaScript Libraries

Powerful tools

- Cross-browser compatibility

Avoiding JavaScript Libraries

Powerful tools

- Cross-browser compatibility
- Rich UI elements and application frameworks

Avoiding JavaScript Libraries

Powerful tools

- Cross-browser compatibility
- Rich UI elements and application frameworks
- Familiarity

Avoiding JavaScript Libraries

Powerful tools with a cost

Avoiding JavaScript Libraries

Powerful tools with a cost

- Block execution

Avoiding JavaScript Libraries

Powerful tools with a cost

- Block execution
- Download time

Avoiding JavaScript Libraries

Powerful tools with a cost

- Block execution
- Download time
- Parse and compile time

Avoiding JavaScript Libraries

Powerful tools with a cost

- Block execution
- Download time
- Parse and compile time
- Memory use

Leverage the DOM

Built-in power

Leverage the DOM

Built-in power

- Adding and removing classes
- Finding elements with a CSS selector
- Knowing when the DOM is ready
- Finding the position of an element in the viewport

Leverage the DOM

Adding and removing classes

```
element.classList
```

Leverage the DOM

Adding and removing classes

```
element.classList.contains(className);
element.classList.add(className);
element.classList.remove(className);
element.classList.toggle(className);
```

Leverage the DOM

Finding elements with a CSS selector

```
var songs = document.querySelectorAll('.mine > .sweet');
```

Leverage the DOM

Finding elements with a CSS selector

```
var songs = document.querySelectorAll('.mine > .sweet');
var count = songs.length;
for (var i = 0; i < count; i++) {
  songs[i].classList.add('guitar-solo');
}
```

Leverage the DOM

Finding elements with a CSS selector

```
var songs = document.querySelectorAll('.mine > .sweet');
var solo  = document.querySelector('.mine > .sweet');
```

Leverage the DOM

Knowing when the DOM is ready

```
document.addEventListener('DOMContentReady', function() {
  // The DOM has been loaded.
}, false);
```

Leverage the DOM

Finding the position of an element in the viewport

```
var rect = element.getBoundingClientRect();
```

Leverage the DOM

Finding the position of an element in the viewport

```
var rect = element.getBoundingClientRect();
rect.top;
rect.right;
rect.bottom;
rect.left;
rect.width;
rect.height;
```

Leverage the DOM

Built-in power

- Adding and removing classes
- Finding elements with a CSS selector
- Knowing when the DOM is ready
- Finding the position of an element in the viewport

If you don’t really need it, get rid of the JavaScript framework!

Hidden Costs and Surprising Slowdowns

- Image decoding
- JavaScript loading
- Layout calculation

Hidden Costs and Surprising Slowdowns

- Image decoding
- JavaScript loading
- Layout calculation

Layout Calculation

```
var elements = document.querySelectorAll('.the-things');
var length = elements.length;
for (var i = 0; i < length; i++) {
  var height = elements[i].offsetHeight;
  elements[i].style.height = (10 + height) + 'px';
}
```

Layout Calculation

```
var elements = document.querySelectorAll('.the-things');
var length = elements.length;
for (var i = 0; i < length; i++) {
  var height = elements[i].offsetHeight;
  elements[i].style.height = (10 + height) + 'px';
}
```

Layout Calculation

```
var elements = document.querySelectorAll('.the-things');
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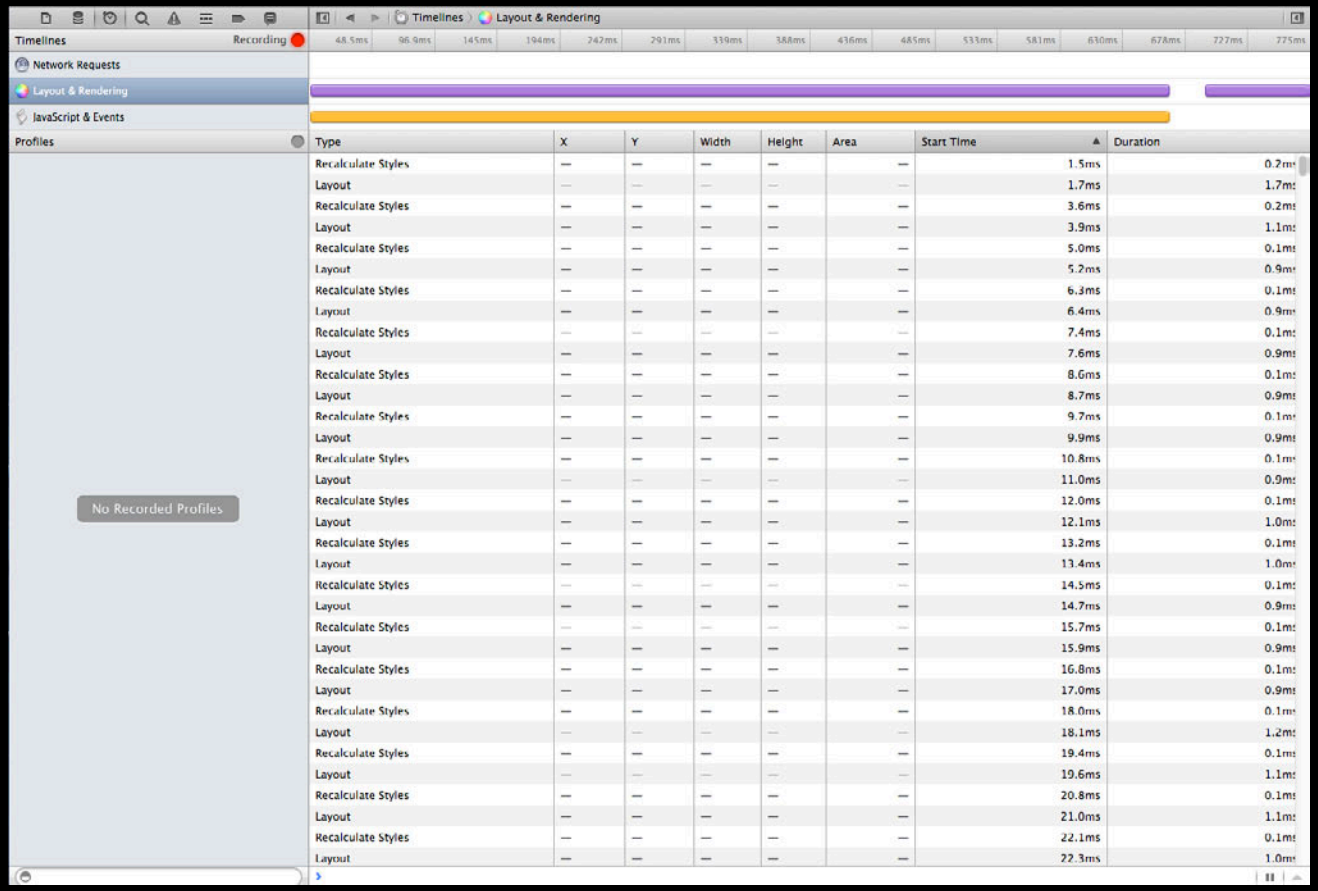
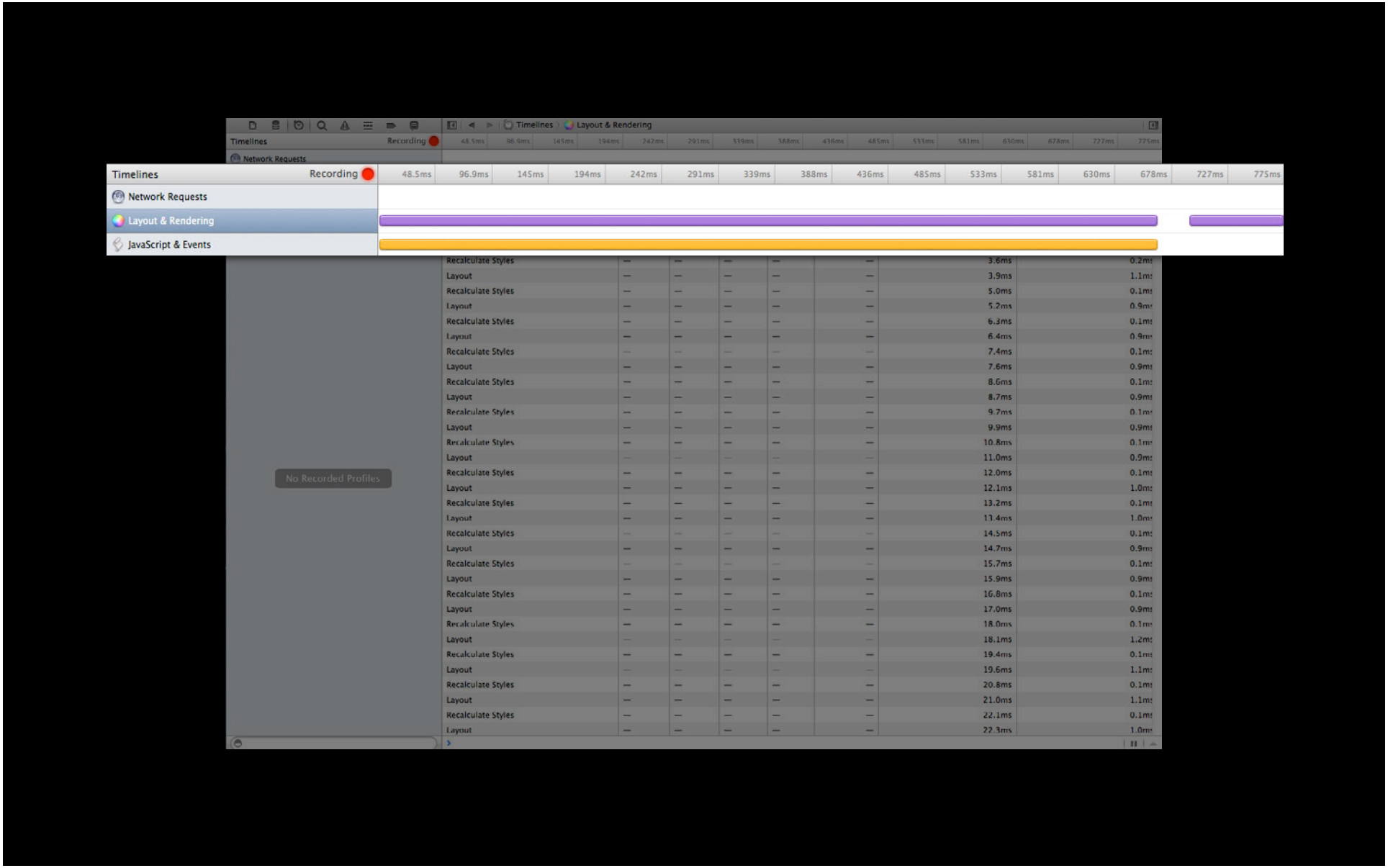
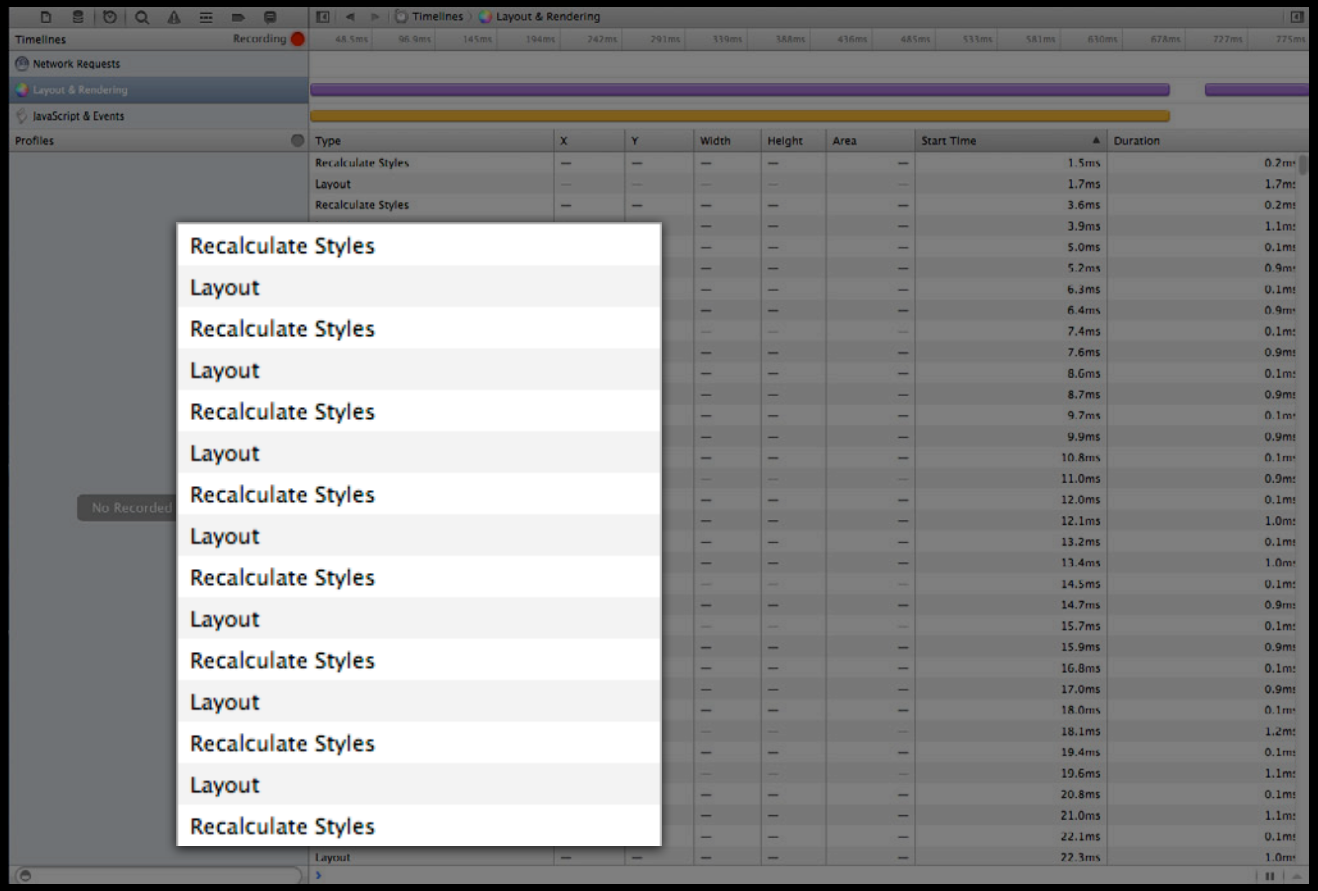
for (var i = 0; i < length; i++) {
  var height = elements[i].offsetHeight;
  elements[i].style.height = (10 + height) + 'px';
}
```

Layout Calculation

```
var elements = document.querySelectorAll('.the-things');
var length = elements.length;
for (var i = 0; i < length; i++) {
  var height = elements[i].offsetHeight;
  elements[i].style.height = (10 + height) + 'px';
}
```


Timelines
Layout & Rendering
Timelines
Recording
Network Requests
Layout & Rendering
JavaScript & Events
Profiles
No Recorded Profiles
Type
X
Y
Width
Height
Area
Start Time
Duration
Recalculate Styles 1.5ms 0.2ms
Layout 1.7ms 1.7ms
Recalculate Styles 3.6ms 0.2ms
Layout 3.9ms 1.1ms
Recalculate Styles 5.0ms 0.1ms
Layout 5.2ms 0.9ms
Recalculate Styles 6.3ms 0.1ms
Layout 6.4ms 0.9ms
Recalculate Styles 7.4ms 0.1ms
Layout 7.6ms 0.9ms
Recalculate Styles 8.6ms 0.1ms
Layout 8.7ms 0.9ms
Recalculate Styles 9.7ms 0.1ms
Layout 9.9ms 0.9ms
Recalculate Styles 10.8ms 0.1ms
Layout 11.0ms 0.9ms
Recalculate Styles 12.0ms 0.1ms
Layout 12.1ms 1.0ms
Recalculate Styles 13.2ms 0.1ms
Layout 13.4ms 1.0ms
Recalculate Styles 14.5ms 0.1ms
Layout 14.7ms 0.9ms
Recalculate Styles 15.7ms 0.1ms
Layout 15.9ms 0.9ms
Recalculate Styles 16.8ms 0.1ms
Layout 17.0ms 0.9ms
Recalculate Styles 18.0ms 0.1ms
Layout 18.1ms 1.2ms
Recalculate Styles 19.4ms 0.1ms
Layout 19.6ms 1.1ms
Recalculate Styles 20.8ms 0.1ms
Layout 21.0ms 1.1ms
Recalculate Styles 22.1ms 0.1ms
Layout 22.3ms 1.0ms


Timelines
Recording
48.5ms
96.9ms
145ms
194ms
242ms
291ms
339ms
388ms
436ms
485ms
533ms
581ms
630ms
678ms
727ms
775ms
Network Requests
Layout & Rendering
JavaScript & Events
No Recorded Profiles


Timelines
Layout & Rendering
Timelines
Recording
Network Requests
Layout & Rendering
JavaScript & Events
Profiles
No Recorded
Type
X
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Width
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Area
Start Time
Duration
Recalculate Styles
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Recalculate Styles
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Recalculate Styles
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Recalculate Styles
Layout
Recalculate Styles
Layout
Recalculate Styles

Layout Calculation

```
var elements = document.querySelectorAll('.the-things');
var length = elements.length;
for (var i = 0; i < length; i++) {
  var height = elements[i].offsetHeight;
  elements[i].style.height = (10 + height) + 'px';
}
```

Layout Calculation

```
var elements = document.querySelectorAll('.the-things');
var length = elements.length;
for (var i = 0; i < length; i++) {
  var height = elements[i].offsetHeight;
  elements[i].style.height = (10 + height) + 'px';
}
```

Layout Calculation

```
var elements = document.querySelectorAll('.the-things');
var length = elements.length;
for (var i = 0; i < length; i++) {
  var height = elements[i].offsetHeight;
  elements[i].style.height = (10 + height) + 'px';
}
```

Layout Calculation

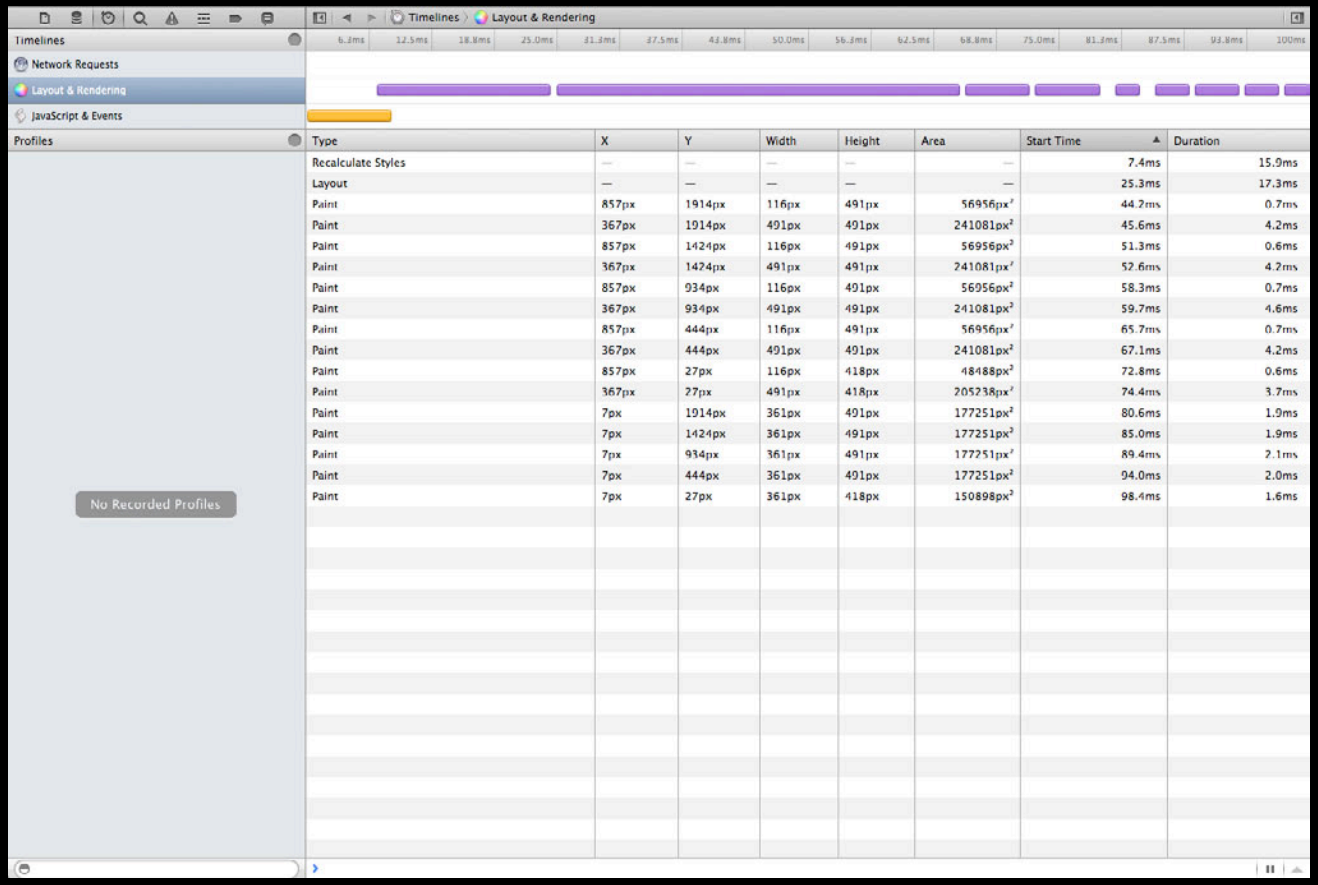
```
var elements = document.querySelectorAll('.the-things');
var length = elements.length;
```

Layout Calculation

```
var elements = document.querySelectorAll('.the-things');
var length = elements.length;
var heights = new Array();
for (var i = 0; i < length; i++) {
    heights[i] = things[i].offsetHeight;
}
```

Layout Calculation

```
var elements = document.querySelectorAll('.the-things');
var length = elements.length;
var heights = new Array();
for (var i = 0; i < length; i++) {
    heights[i] = things[i].offsetHeight;
}
for (var i = 0; i < length; i++) {
    things[i].style.height = (heights[i] + 10) + 'px';
}
```


Timelines
Layout & Rendering
Timelines
Network Requests
Layout & Rendering
JavaScript & Events
Profiles
No Recorded Profiles
6.3ms 12.5ms 18.8ms 25.0ms 31.3ms 37.5ms 43.8ms 50.0ms 56.3ms 62.5ms 68.8ms 75.0ms 81.3ms 87.5ms 93.8ms 100ms
Type X Y Width Height Area Start Time Duration
Recalculate Styles — — — — — 7.4ms 15.9ms
Layout — — — — — 25.3ms 17.3ms
Paint 857px 1914px 116px 491px 56956px² 44.2ms 0.7ms
Paint 367px 1914px 491px 491px 241081px² 45.6ms 4.2ms
Paint 857px 1424px 116px 491px 56956px² 51.3ms 0.6ms
Paint 367px 1424px 491px 491px 241081px² 52.6ms 4.2ms
Paint 857px 934px 116px 491px 56956px² 58.3ms 0.7ms
Paint 367px 934px 491px 491px 241081px² 59.7ms 4.6ms
Paint 857px 444px 116px 491px 56956px² 65.7ms 0.7ms
Paint 367px 444px 491px 491px 241081px² 67.1ms 4.2ms
Paint 857px 27px 116px 418px 48488px² 72.8ms 0.6ms
Paint 367px 27px 491px 418px 205238px² 74.4ms 3.7ms
Paint 7px 1914px 361px 491px 177251px² 80.6ms 1.9ms
Paint 7px 1424px 361px 491px 177251px² 85.0ms 1.9ms
Paint 7px 934px 361px 491px 177251px² 89.4ms 2.1ms
Paint 7px 444px 361px 491px 177251px² 94.0ms 2.0ms
Paint 7px 27px 361px 418px 150898px² 98.4ms 1.6ms

Avoid Forcing Unnecessary Layout

Methods that require updated style information

Avoid Forcing Unnecessary Layout

Methods that require updated style information

- clientHeight, Width, Top, Left, Right, Bottom
- offsetHeight, Width, Top, Left, Right, Bottom, Parent
- getClientBoundingRect, getClientRects

Avoid Forcing Unnecessary Layout

Methods that require updated style information

- clientHeight, Width, Top, Left, Right, Bottom
- offsetHeight, Width, Top, Left, Right, Bottom, Parent
- getClientBoundingRect, getClientRects
- getComputedStyle, getPropertyCSSValue

Avoid Forcing Unnecessary Layout

Methods that require updated style information

- clientHeight, Width, Top, Left, Right, Bottom
- offsetHeight, Width, Top, Left, Right, Bottom, Parent
- getClientBoundingRect, getClientRects
- getComputedStyle, getPropertyCSSValue
- innerText

Avoid Forcing Unnecessary Layout

Avoid Forcing Unnecessary Layout

- Use the Web Inspector timeline to profile layouts and rendering

Avoid Forcing Unnecessary Layout

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Avoid Forcing Unnecessary Layout

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- Operations that need current style information will force a layout
- Batch changes that update elements

Hidden Costs and Surprising Slowdowns

- Image decoding
- JavaScript loading
- Layout calculation

Layers in WebKit Rendering

A deeper look into rendering HTML

Joseph Pecoraro
Safari on iOS Engineer

Why Is This Important?

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- Do parts of your web page flicker?

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- Have you ever blindly added a 3D transform style?

HTML Rendering 101

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   <video src="...">
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     <button>Rewind</button>
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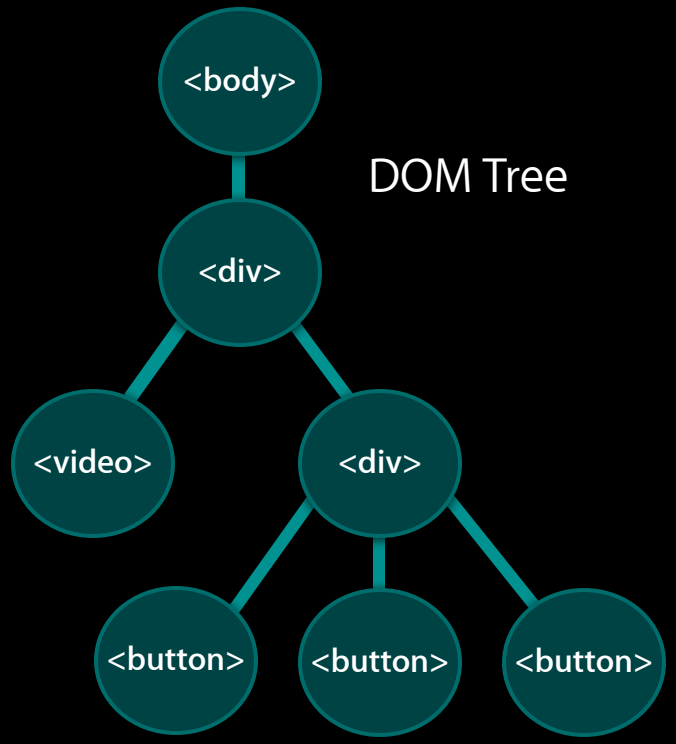

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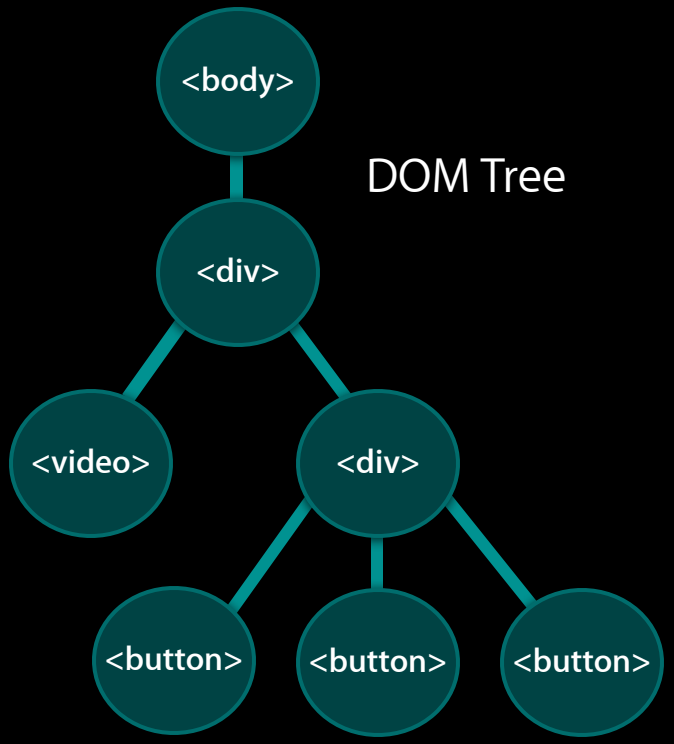

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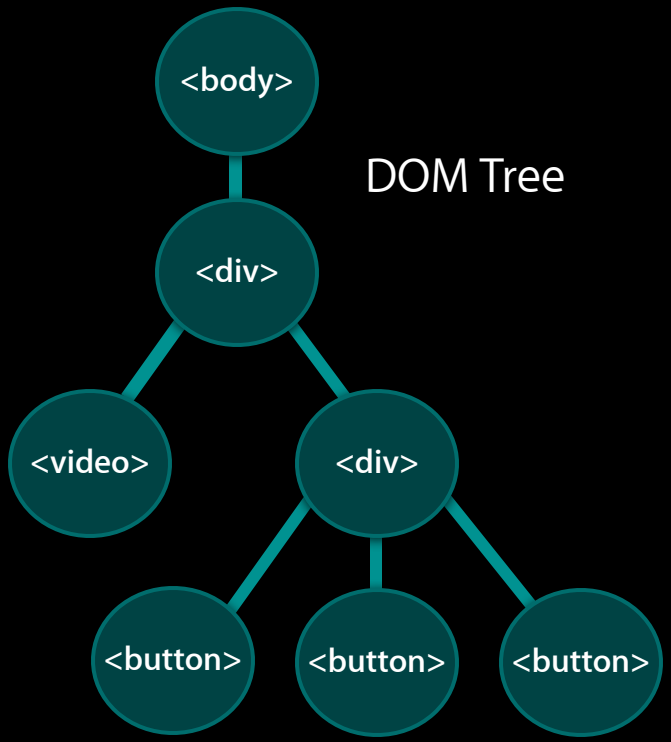

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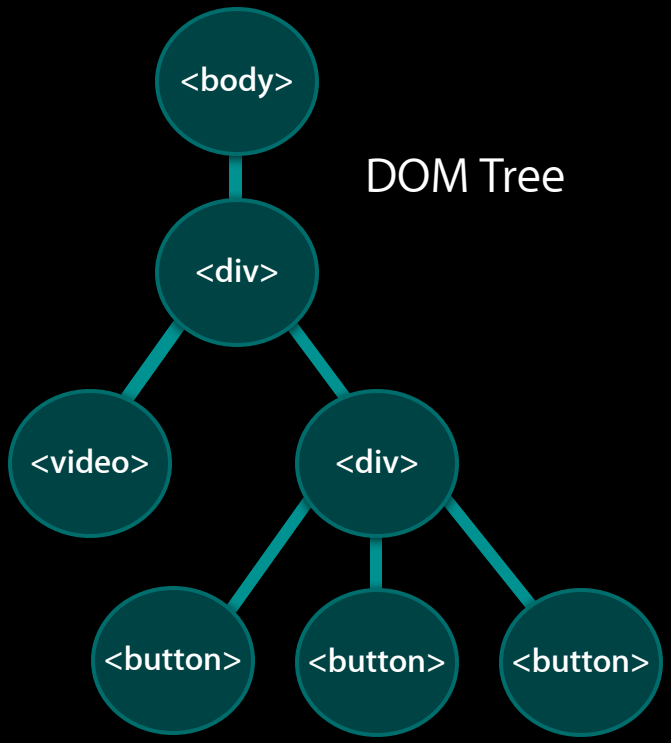

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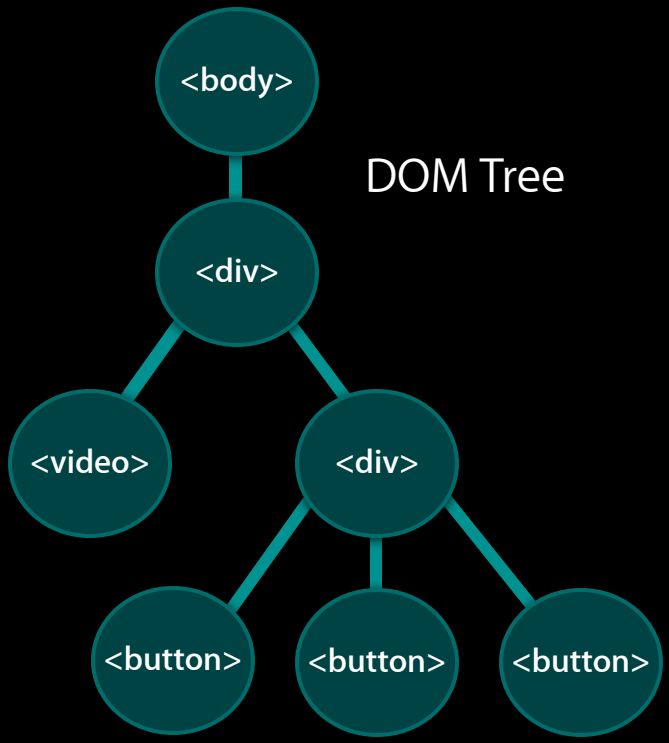
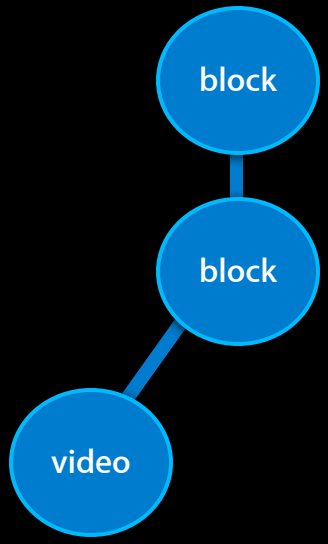


DOM Tree



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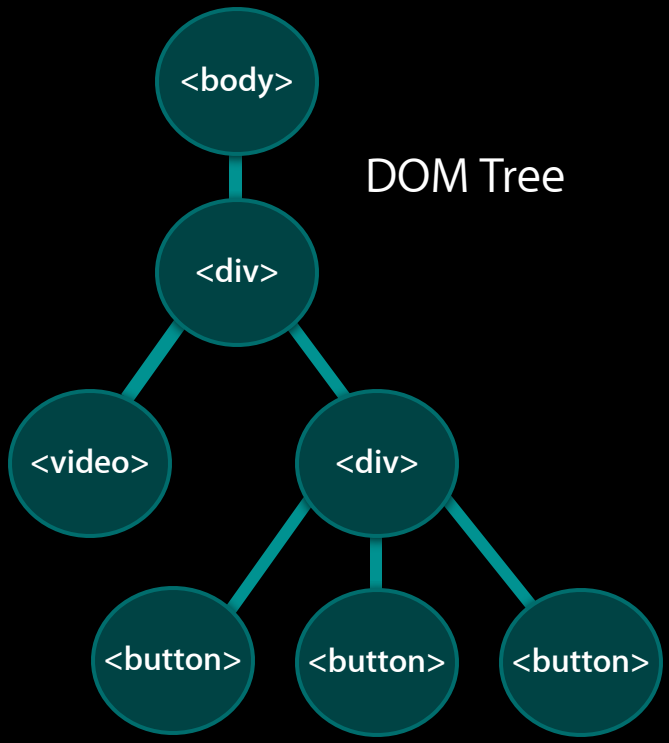

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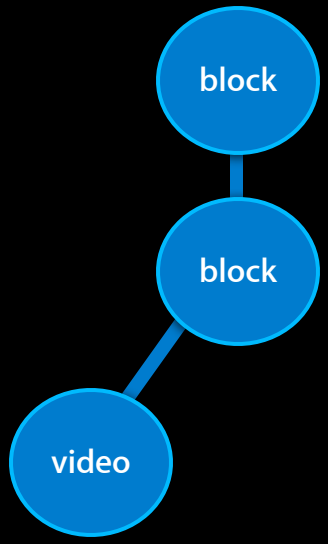

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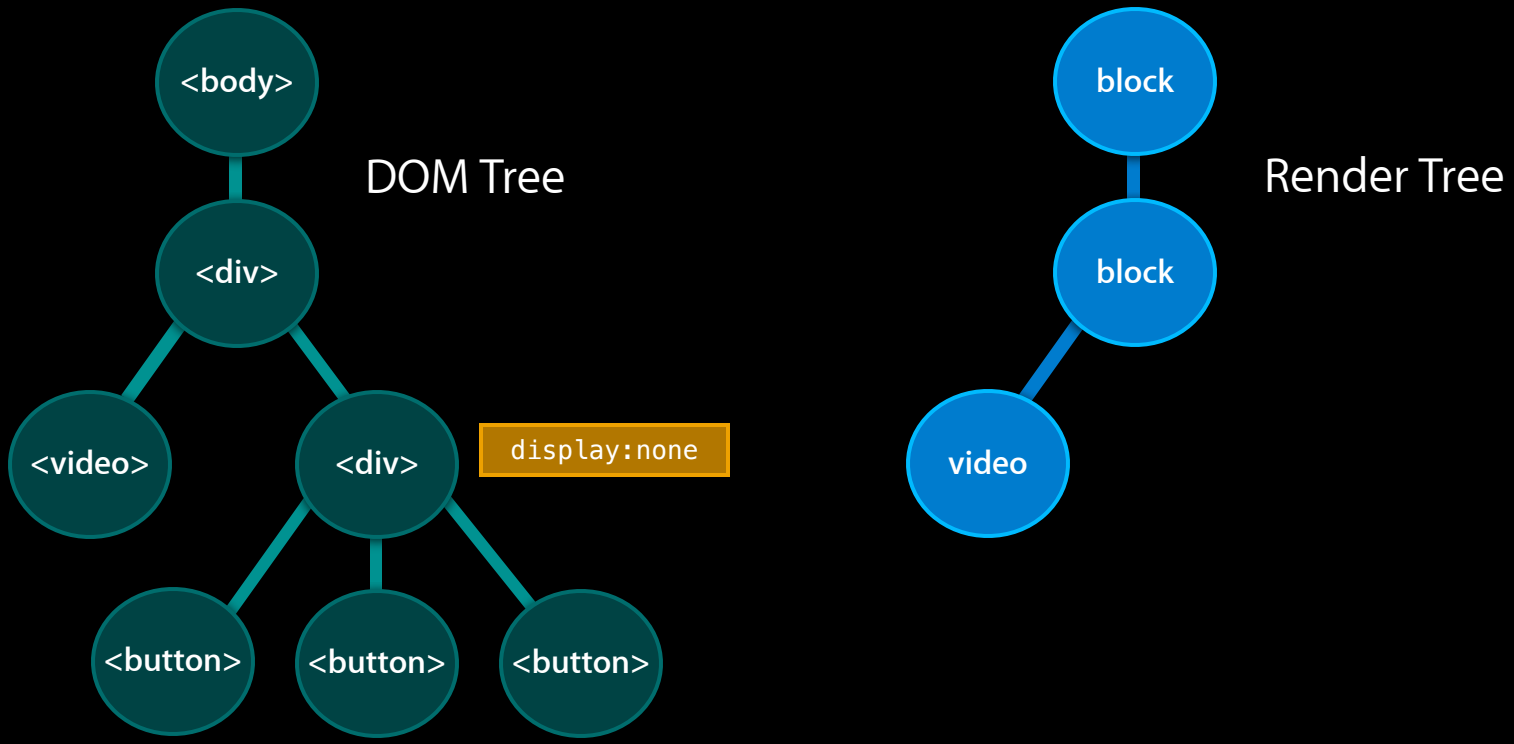

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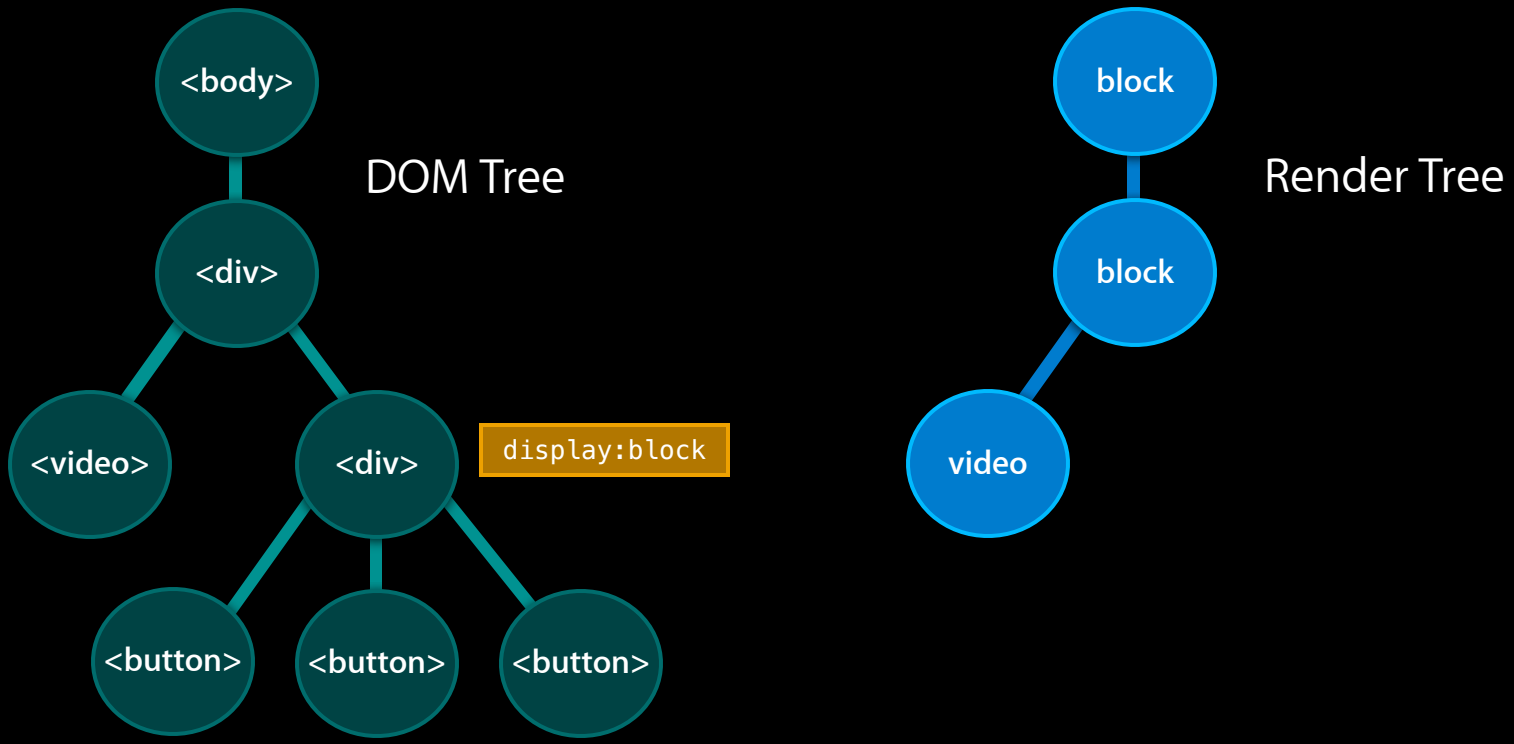

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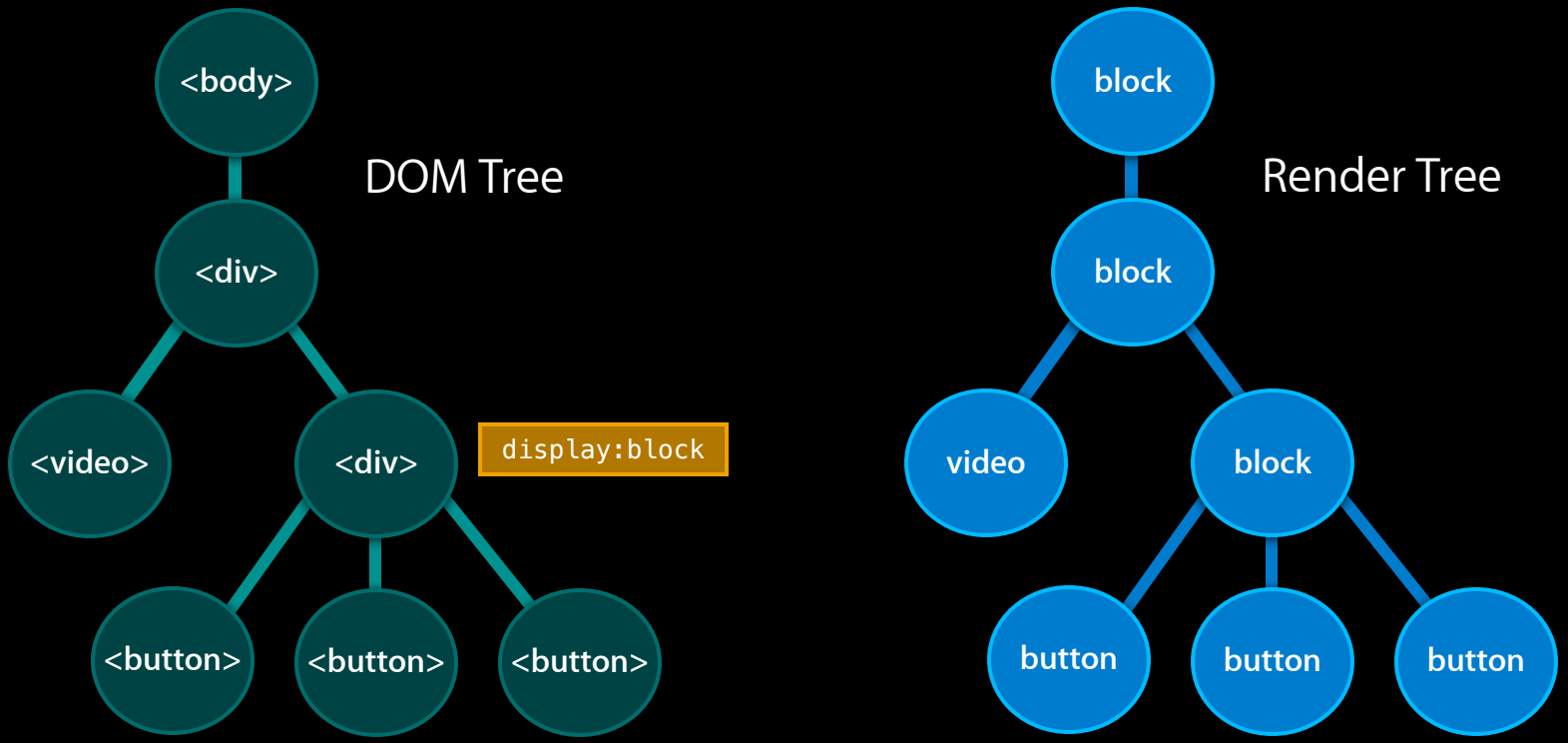

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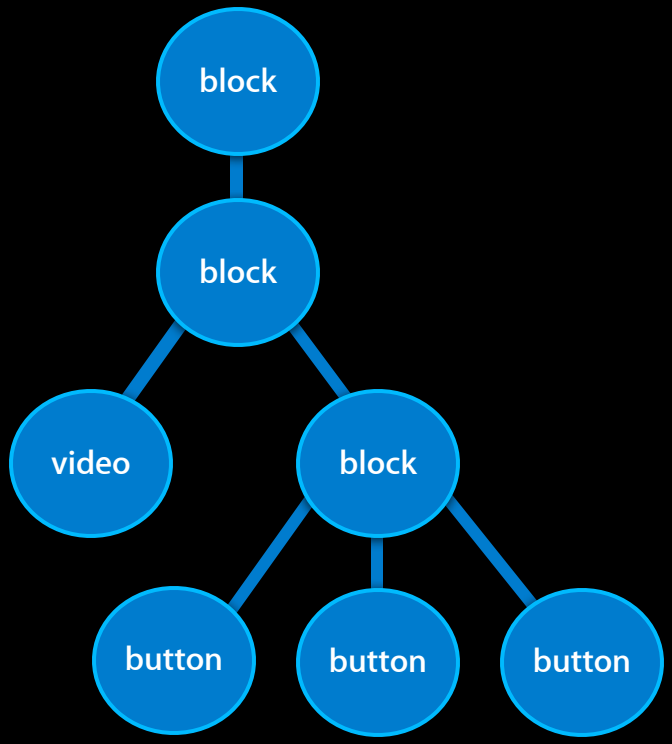

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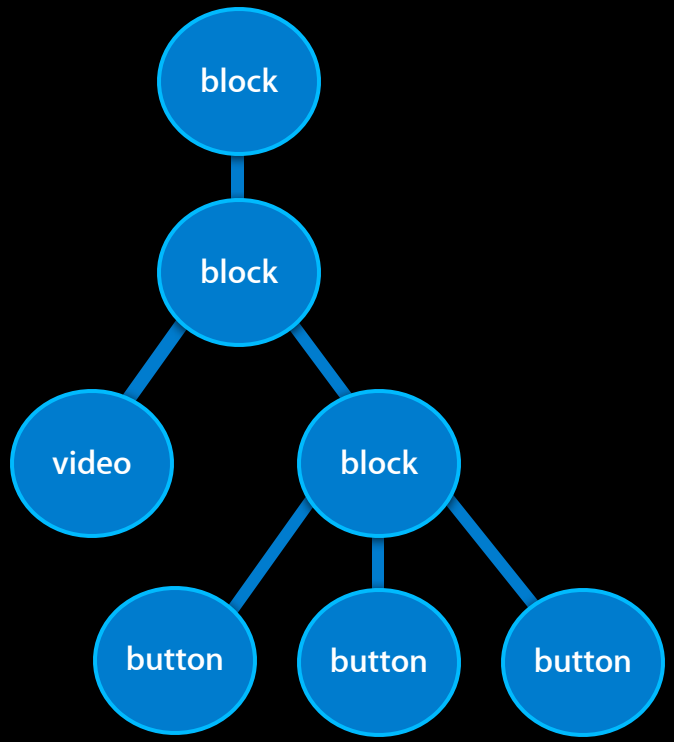

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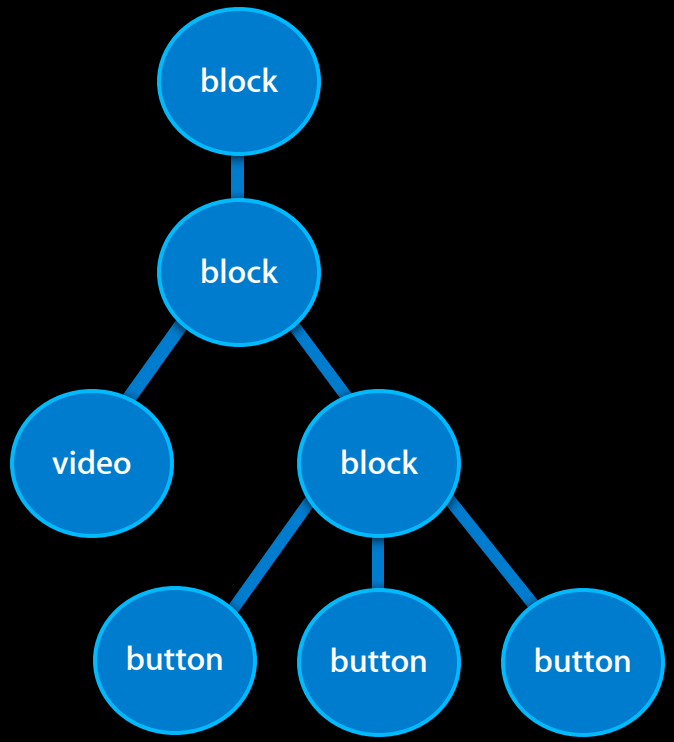

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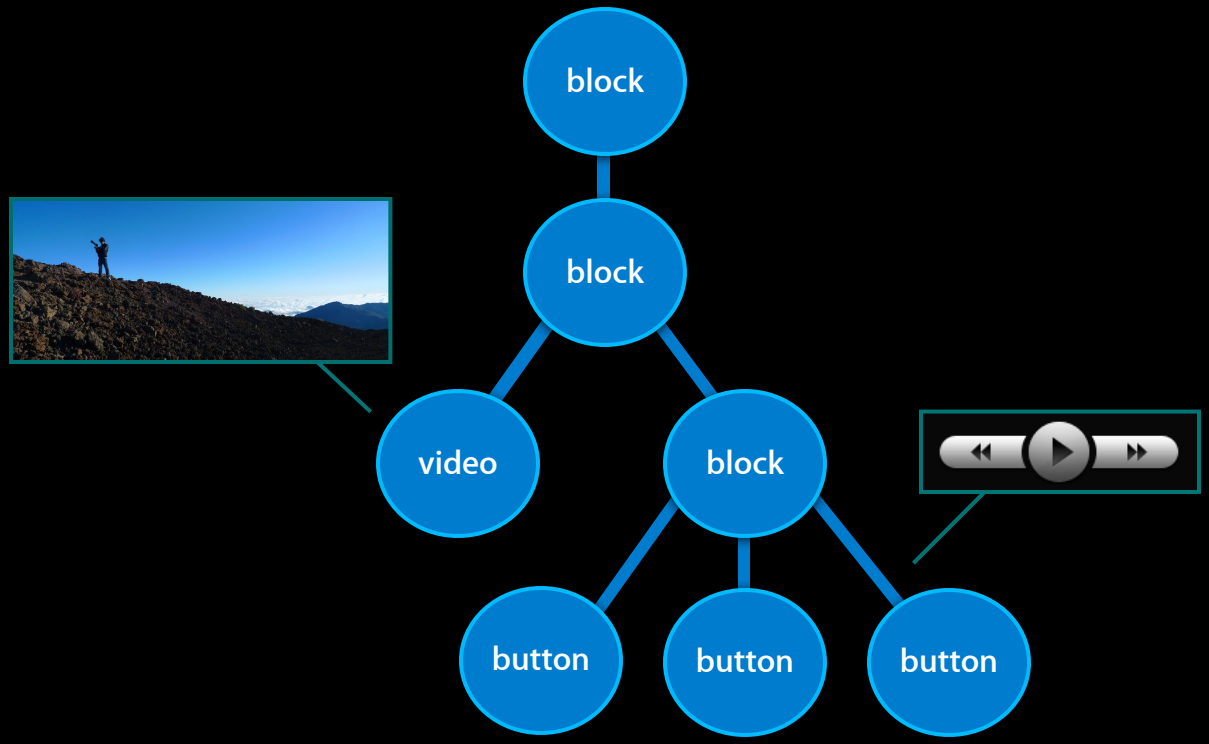

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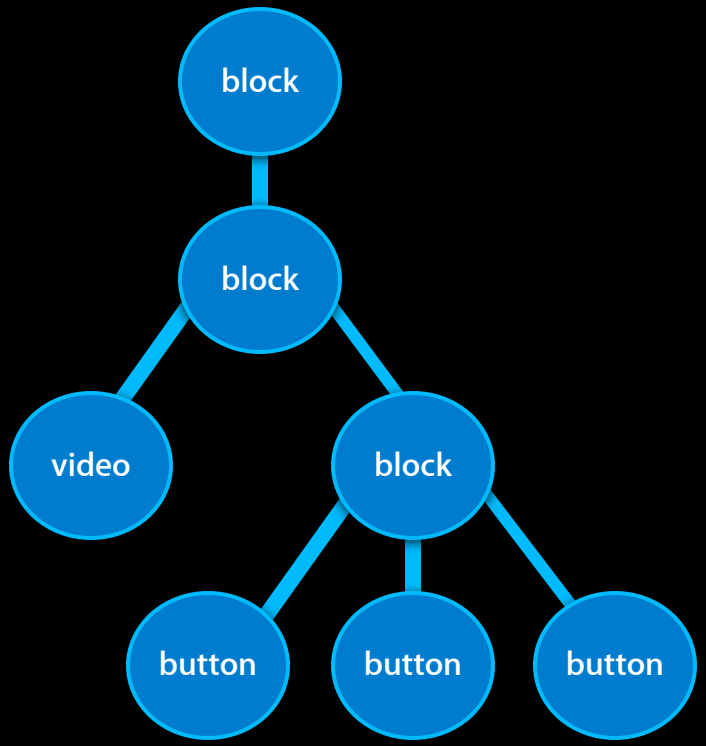

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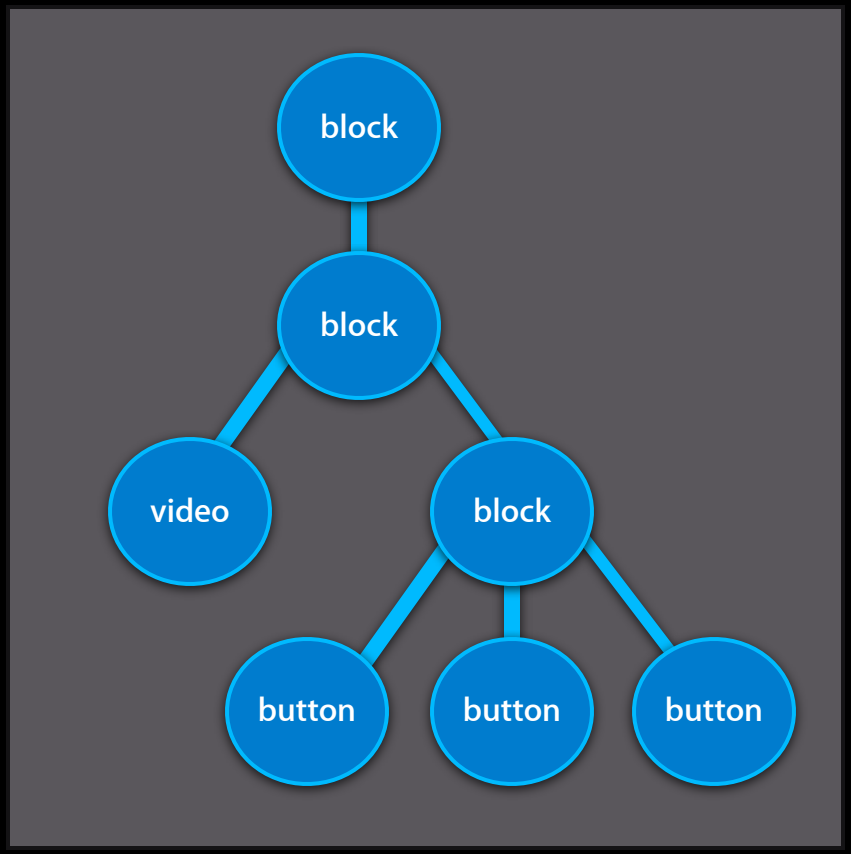

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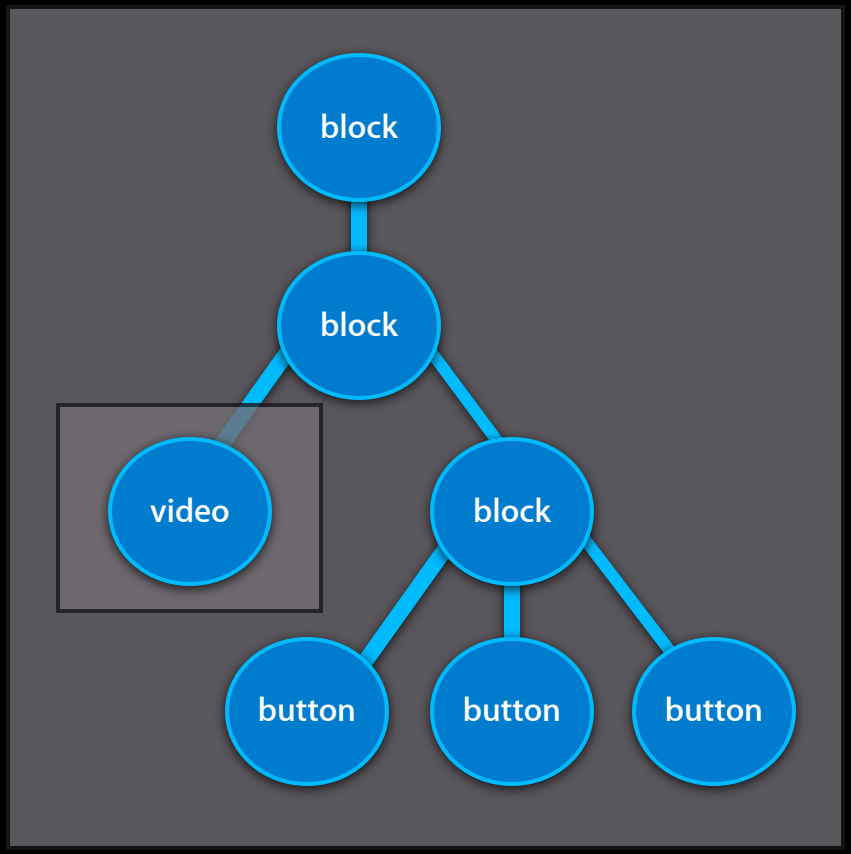

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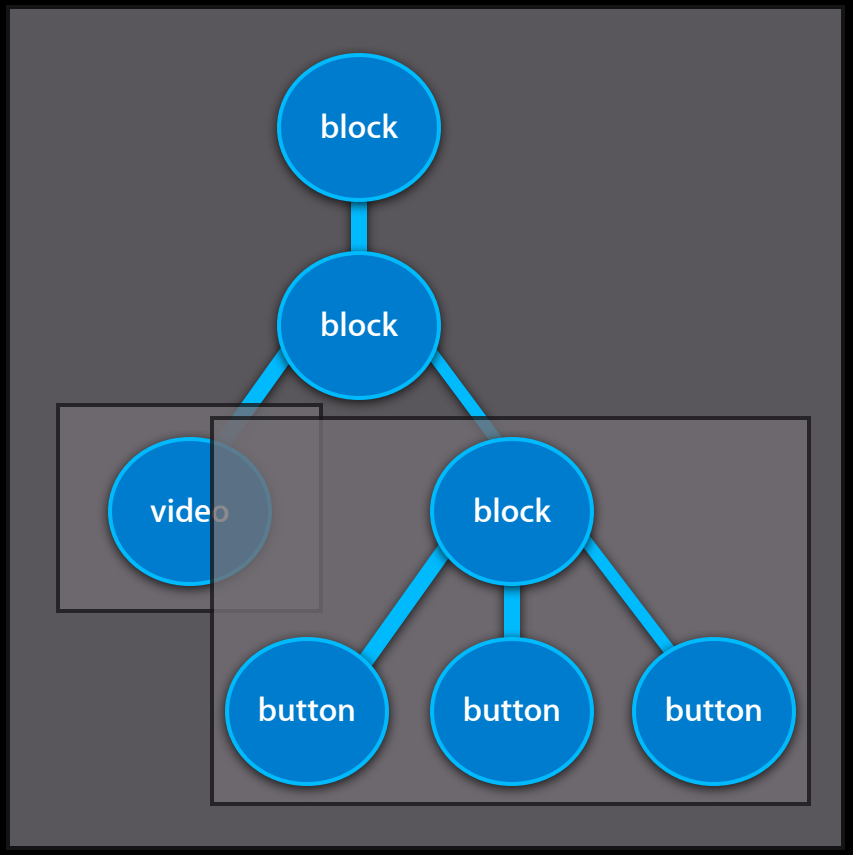
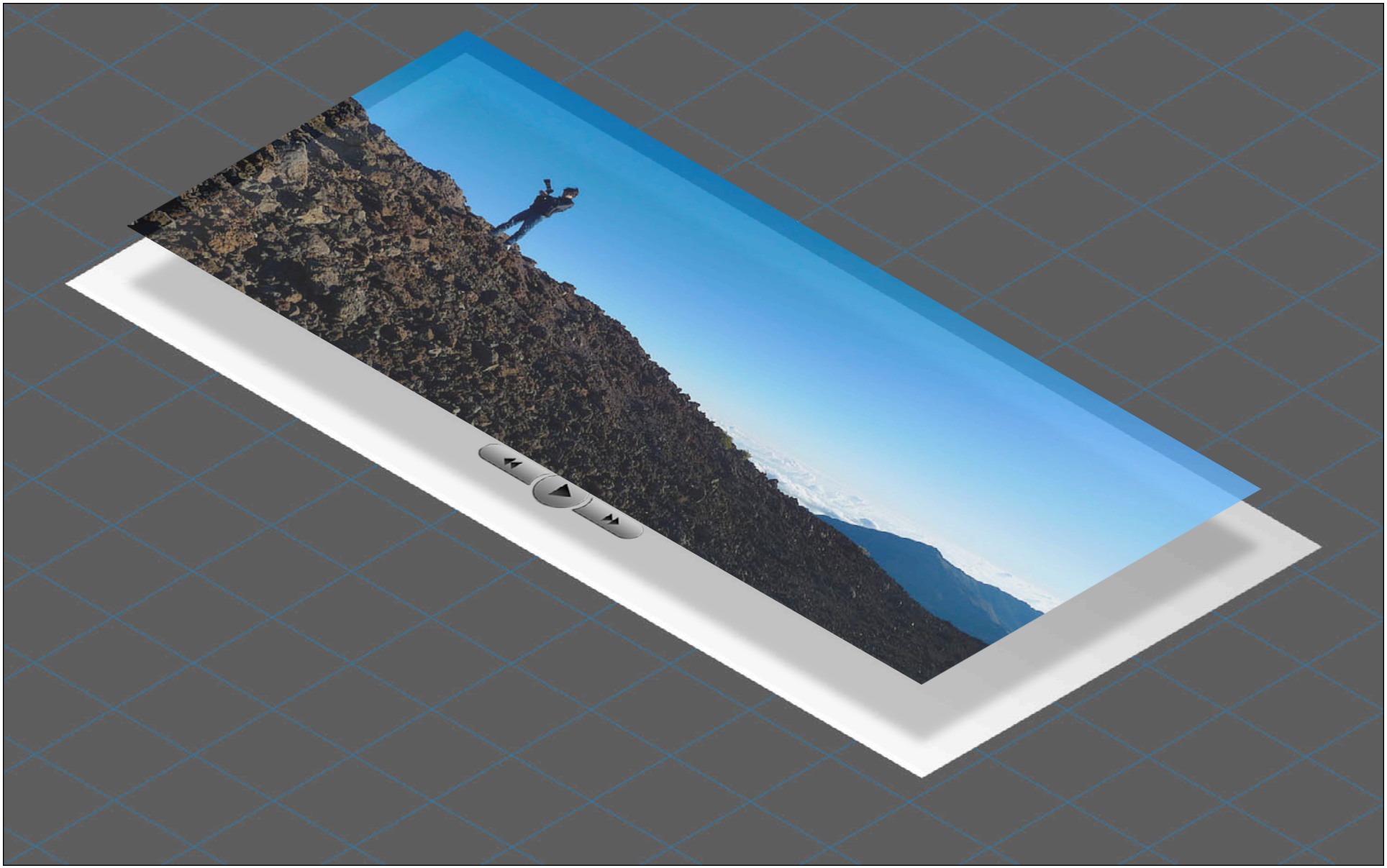
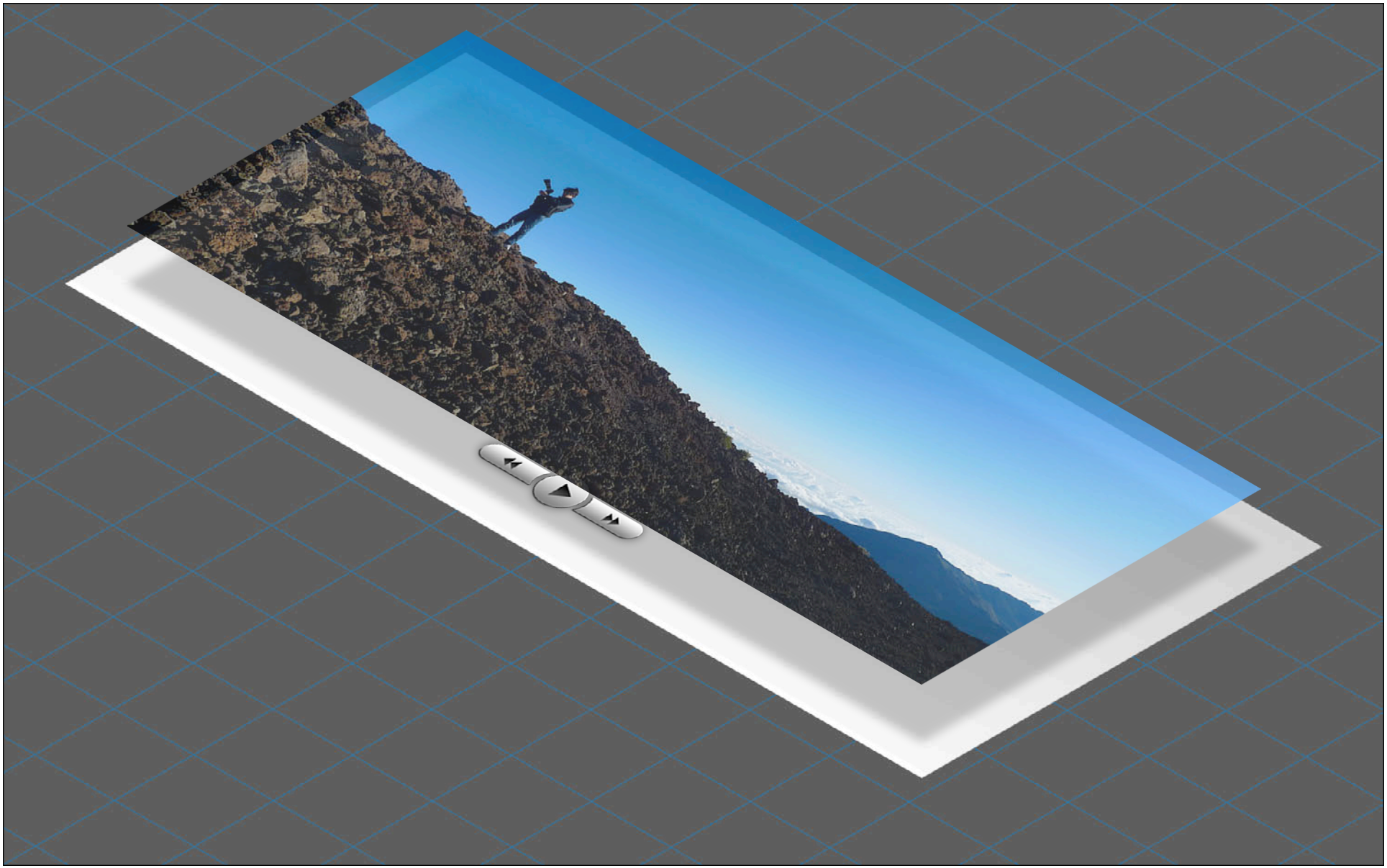
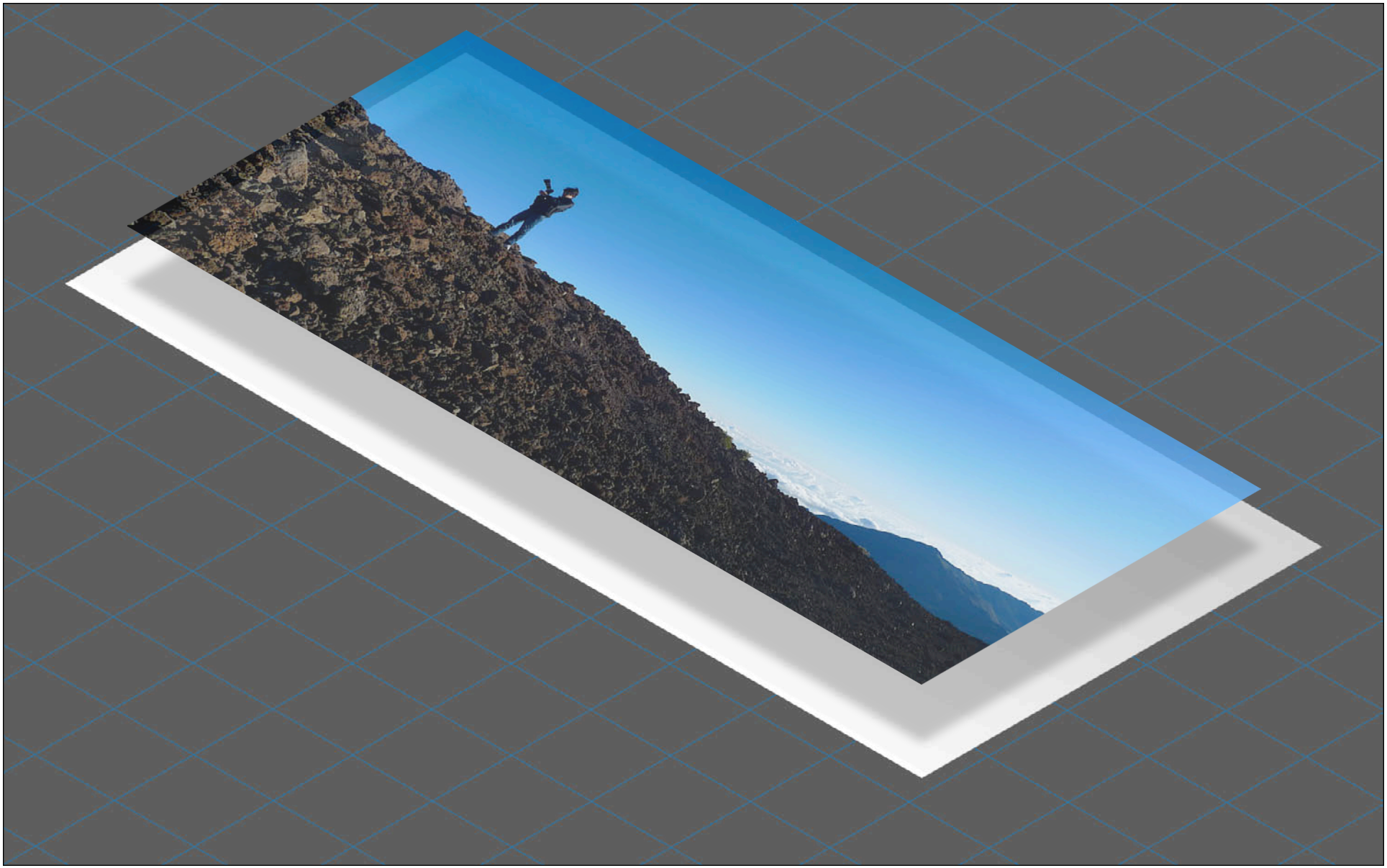
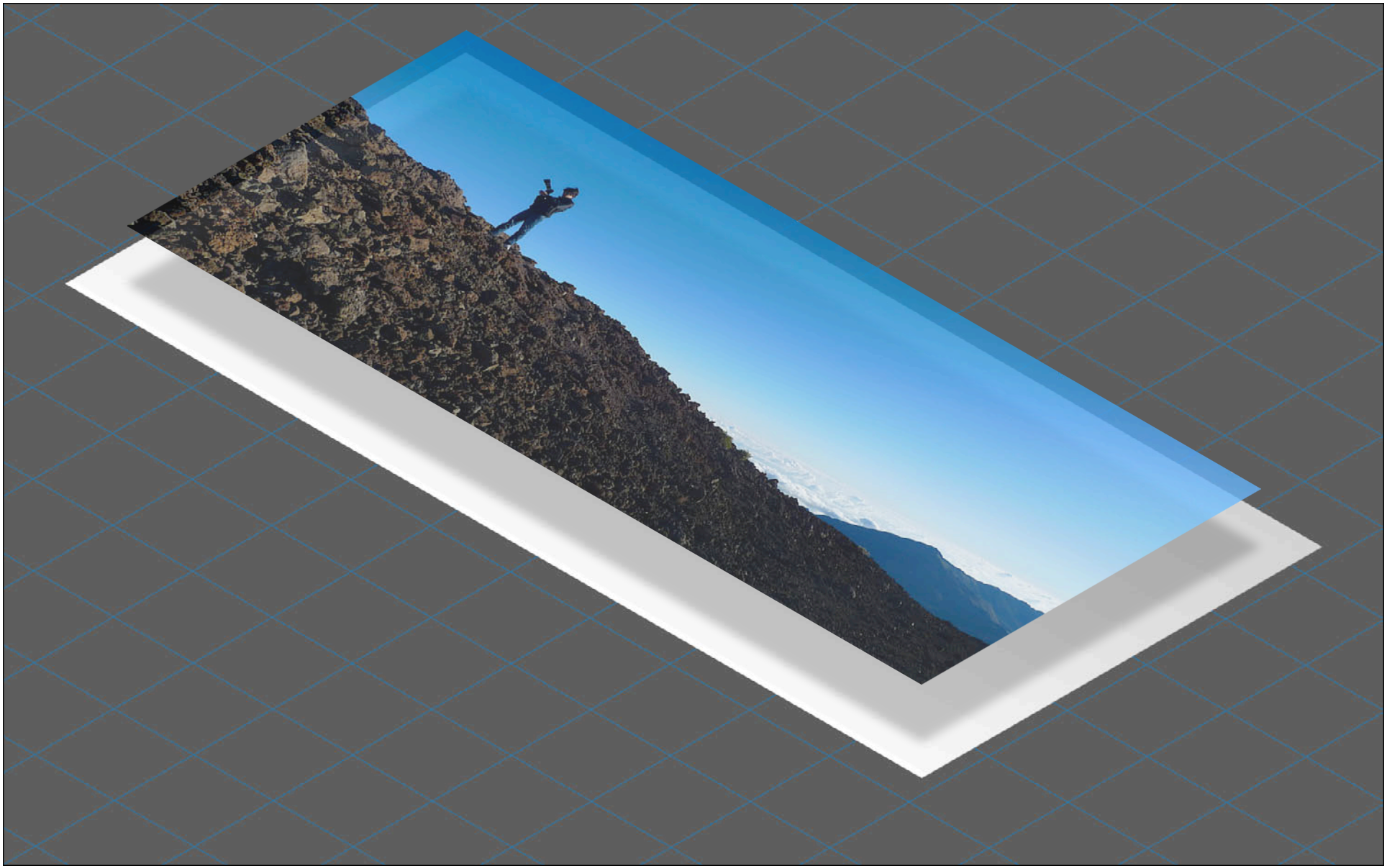
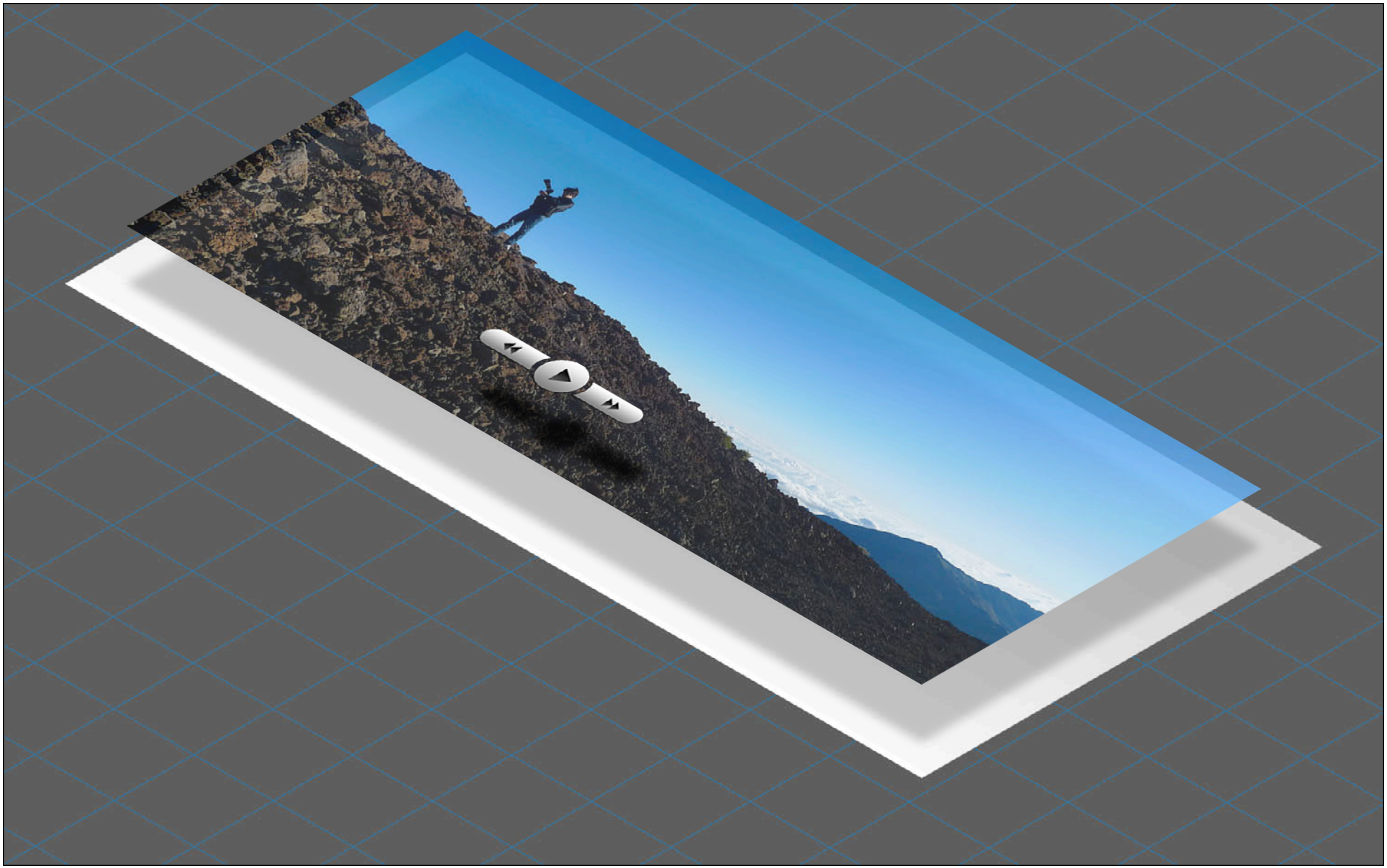


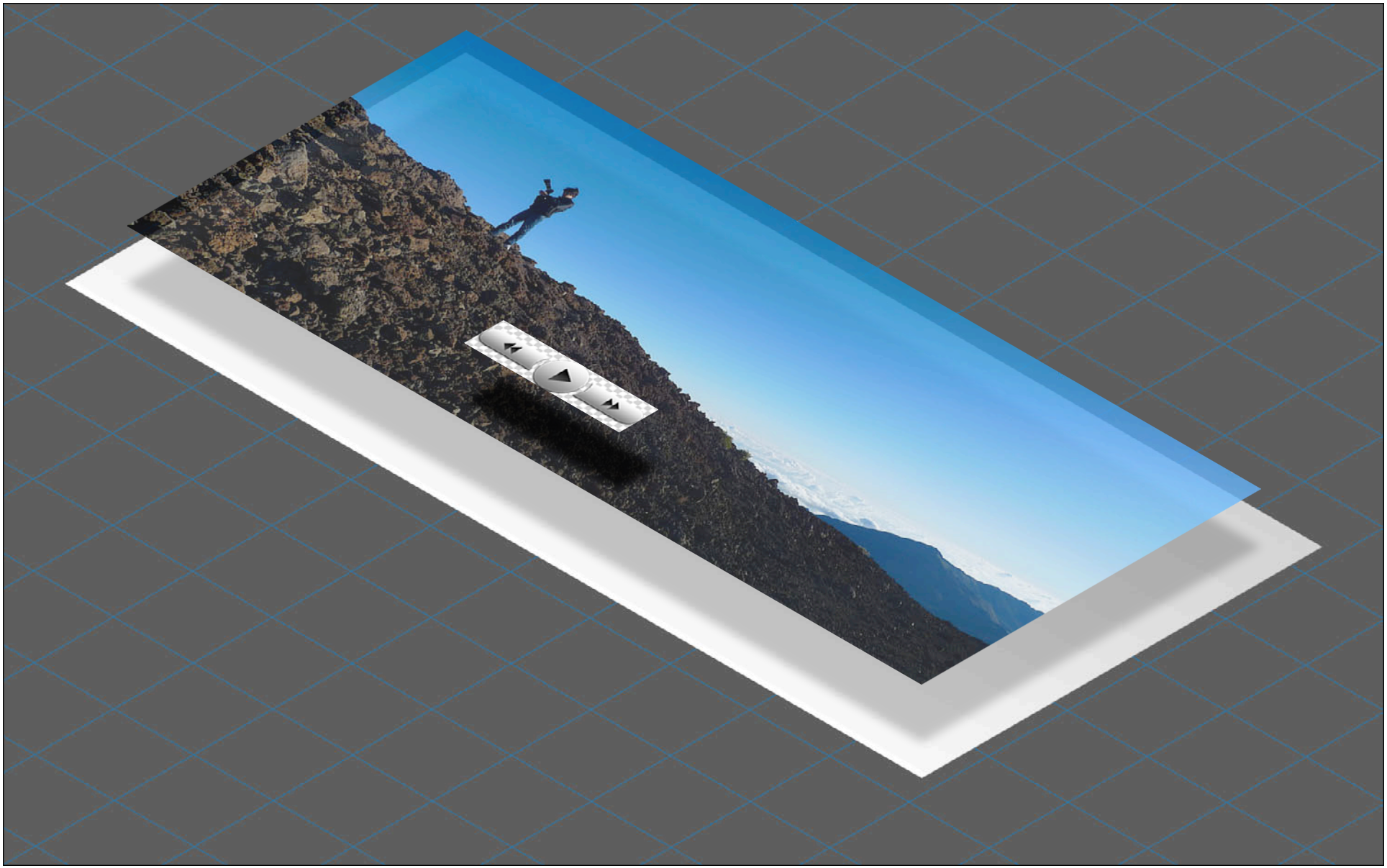


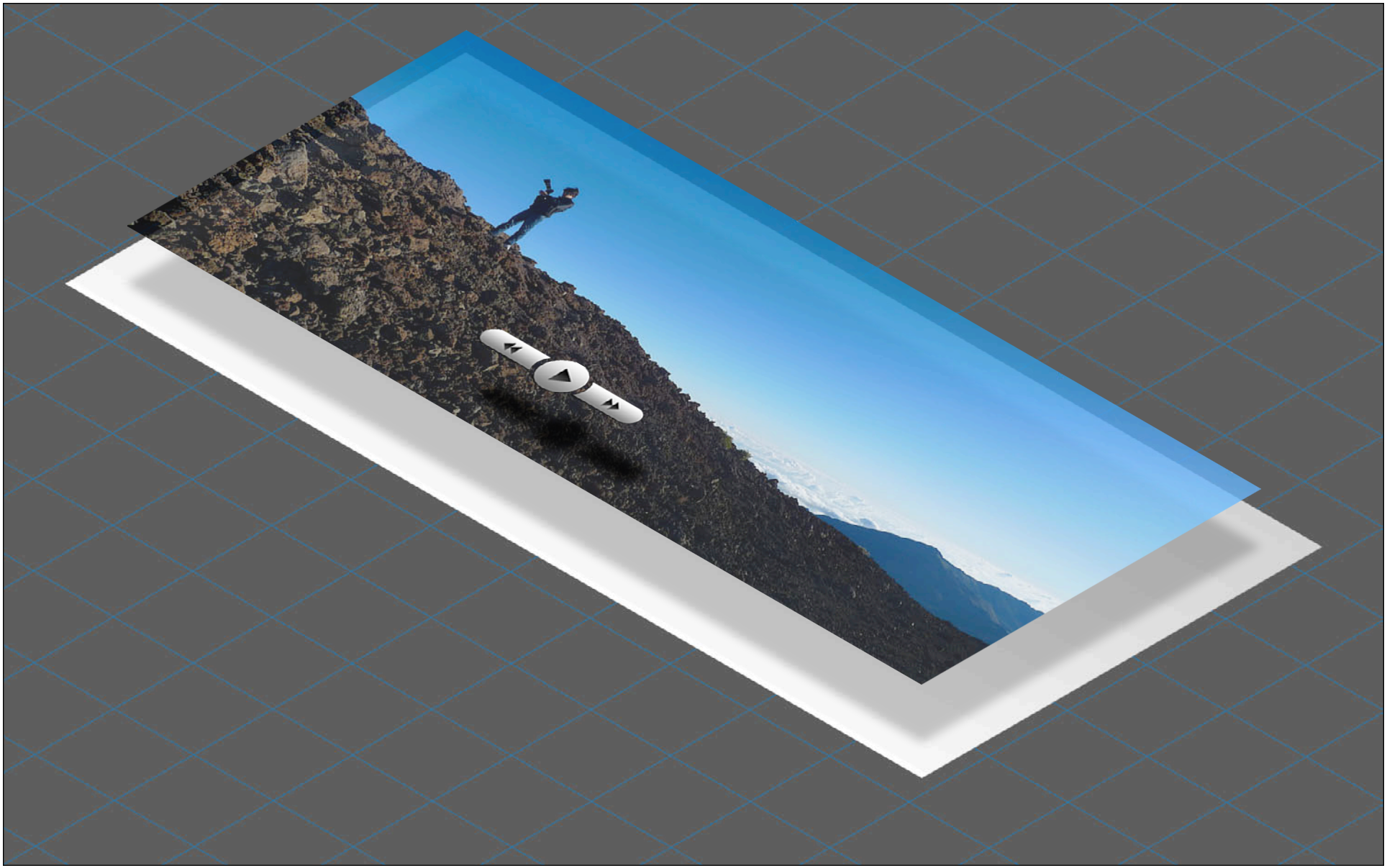




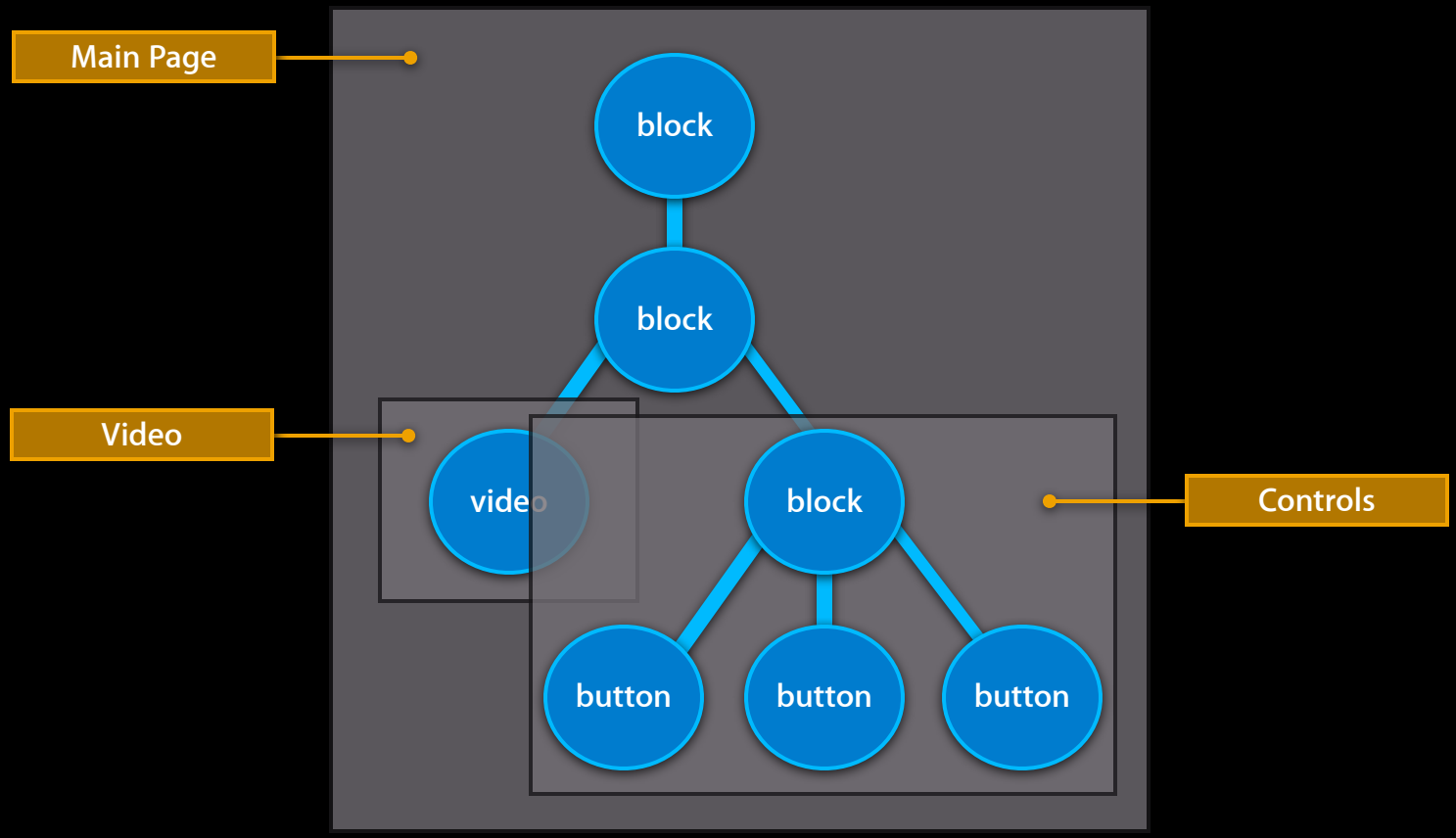




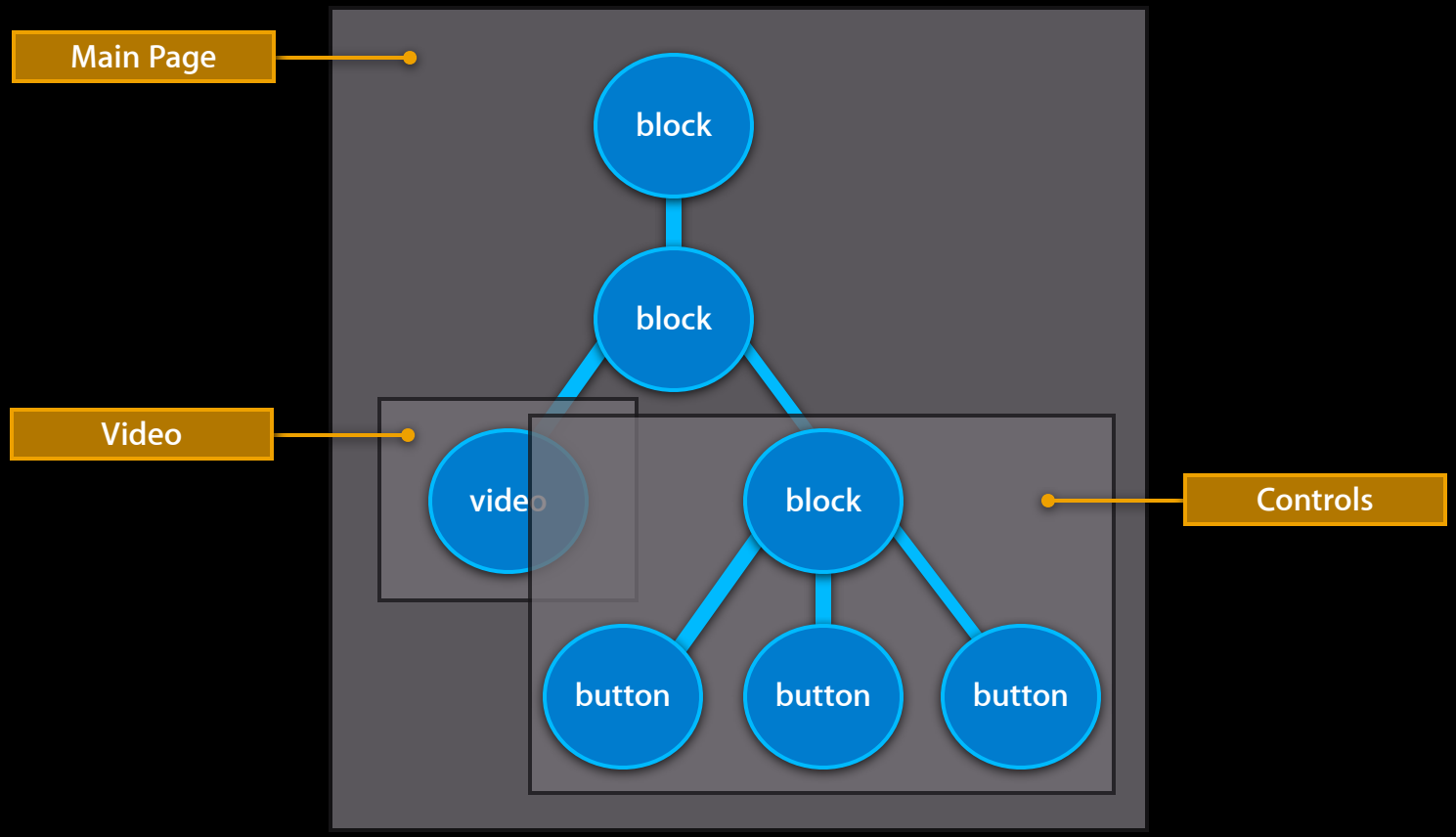




Layers


Main Page
Video
Controls
block
block
video
block
button
button
button

Backing Stores



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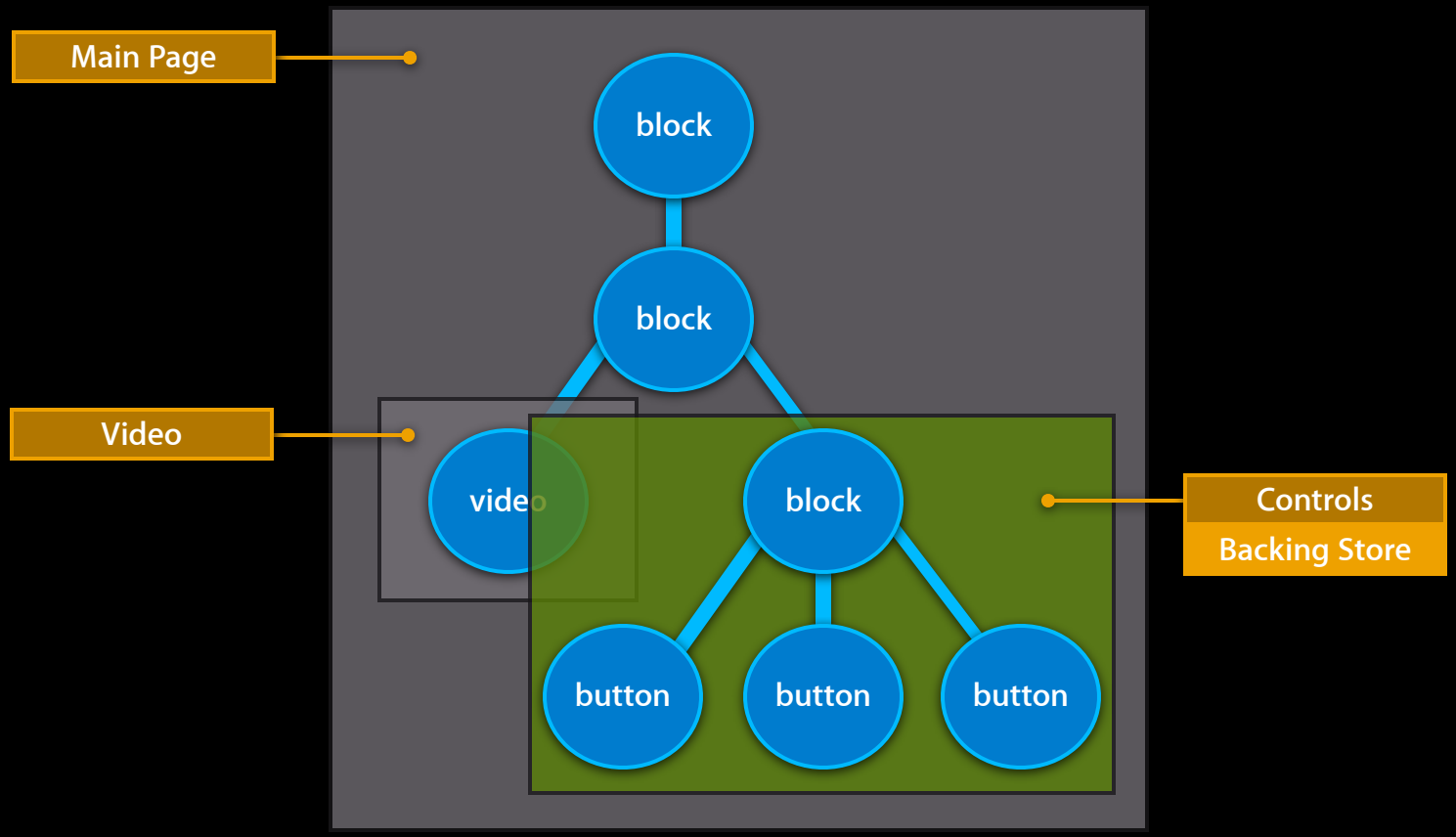

Backing Stores

Backing Stores

1×

	Backing Store	Size (width × height × 4)
Normal screen	100 × 100	40,000 bytes

Backing Stores

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Normal screen	100 × 100	40,000 bytes
Retina screen	200 × 200	160,000 bytes

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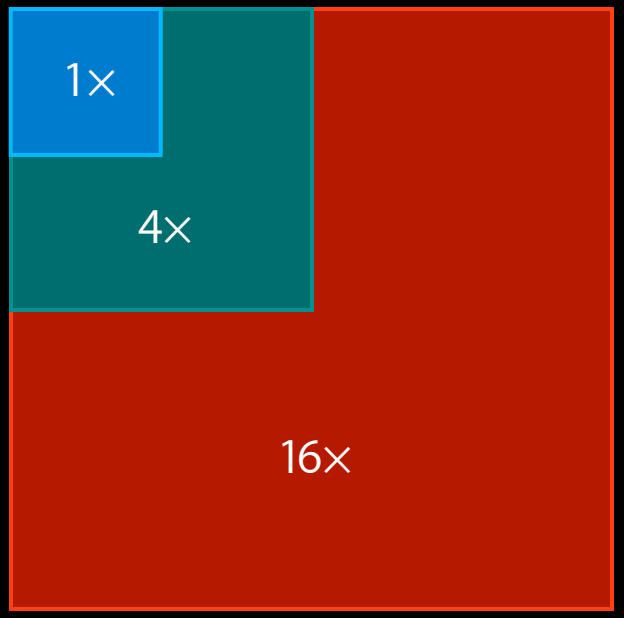

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Normal screen	100 × 100	40,000 bytes
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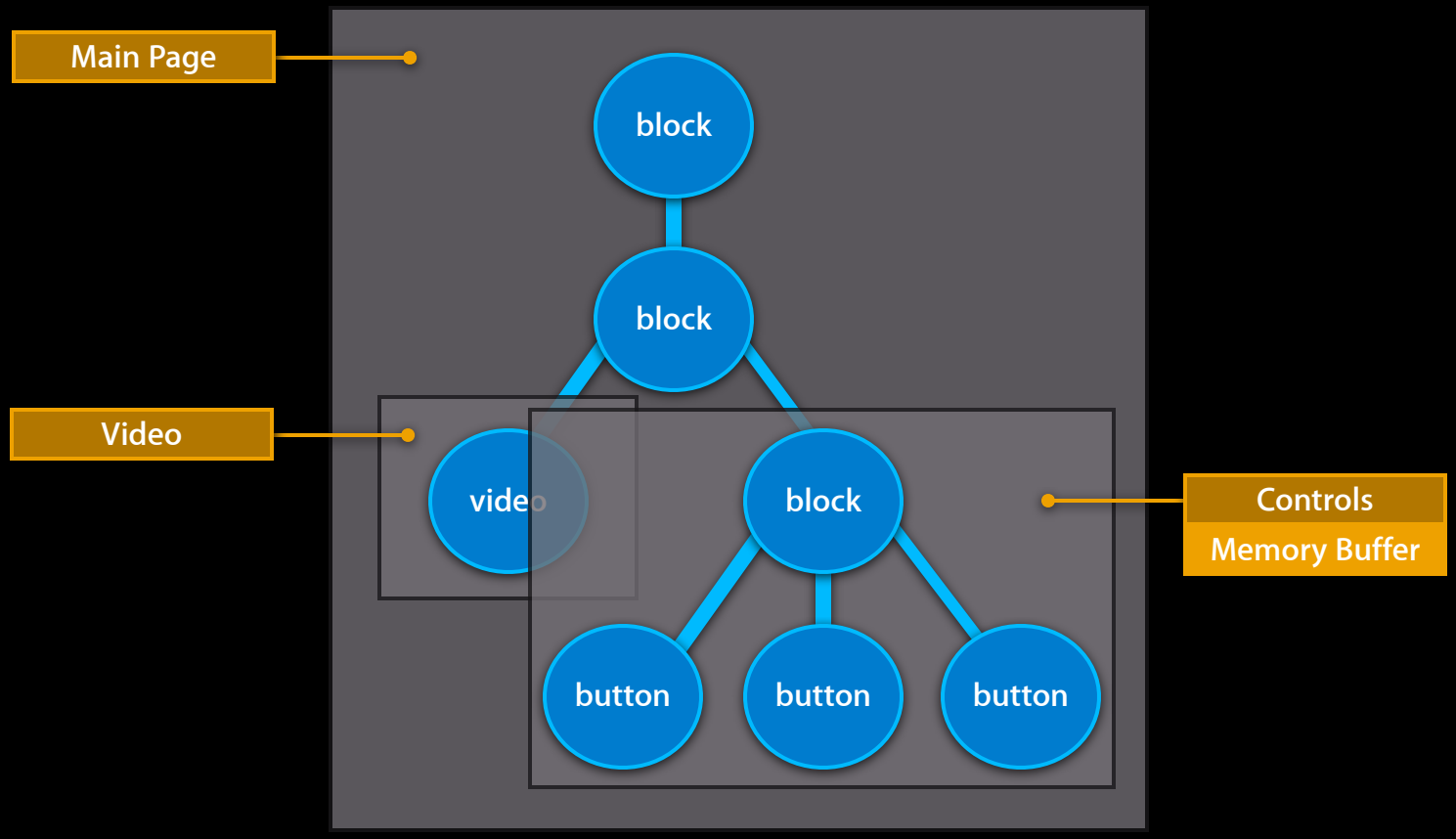
Retina 2× zoom scale	400 × 400	640,000 bytes

Tiled Layers



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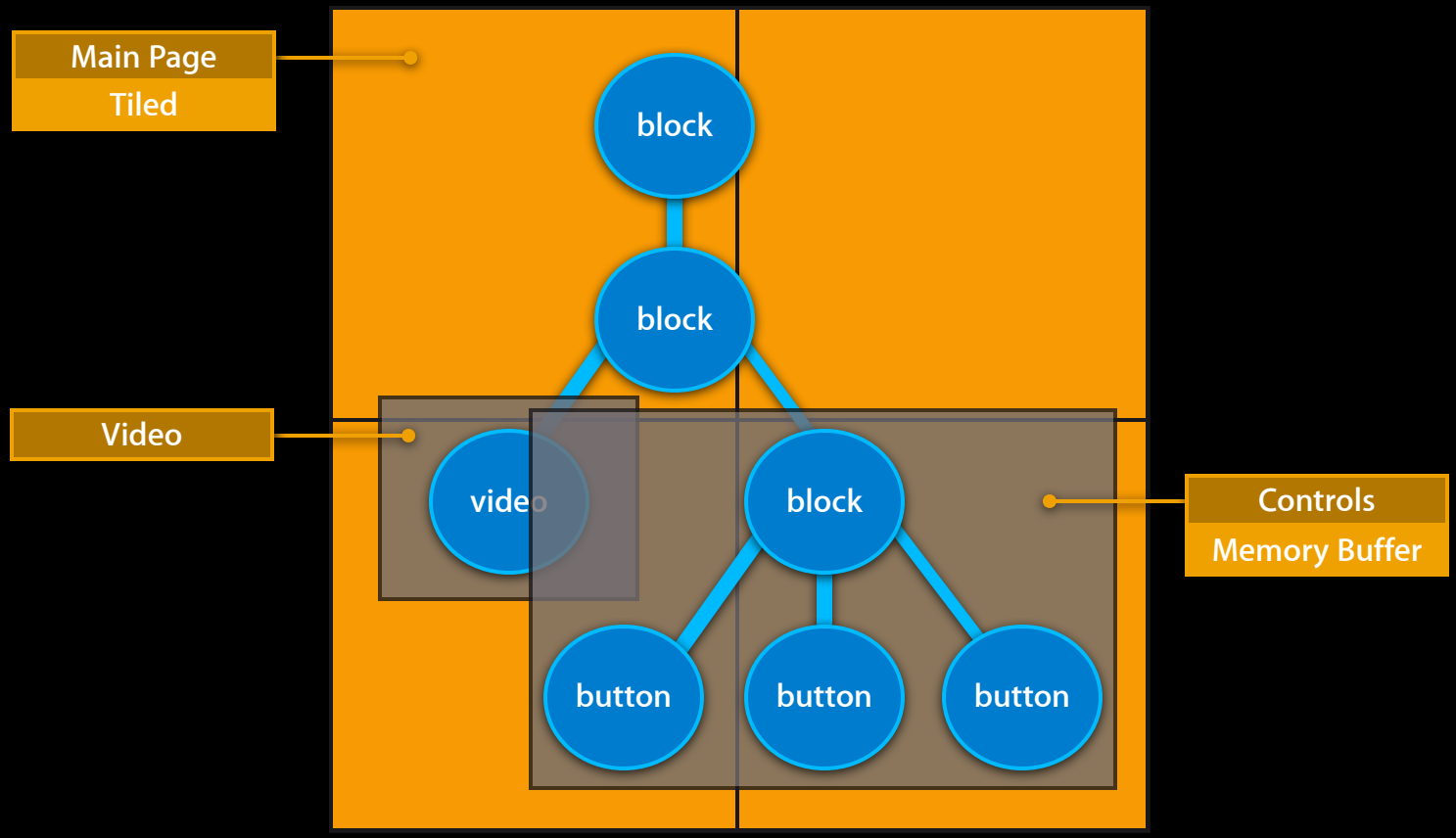

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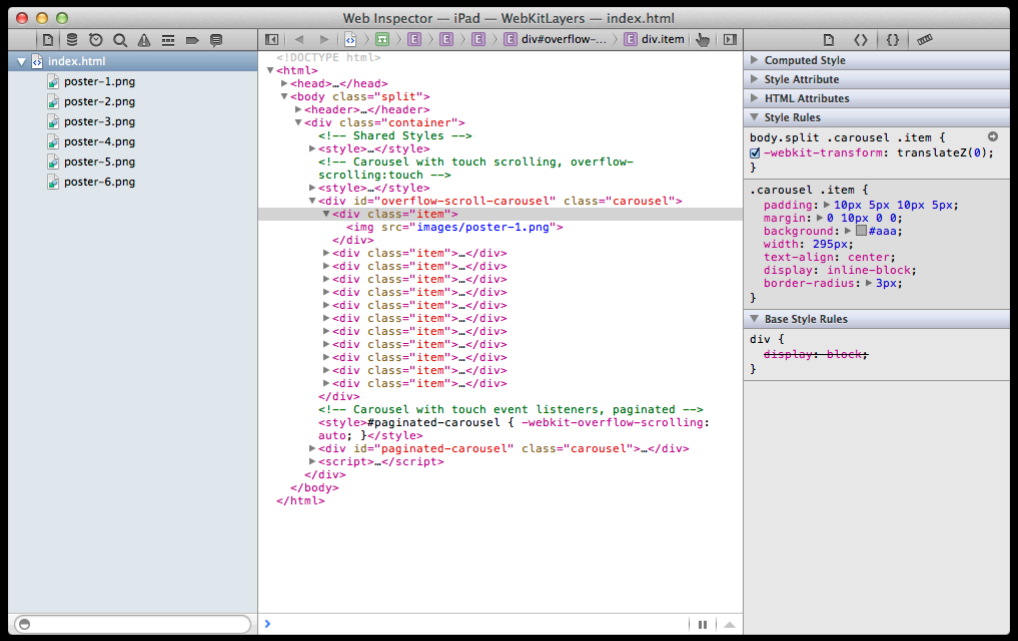
- Any content that overlaps an existing layer

Tools

- Web Inspector
- Instruments
- WebKit debug settings


Web Inspector — iPad — WebKitLayers — index.html
index.html
poster-1.png
poster-2.png
poster-3.png
poster-4.png
poster-5.png
poster-6.png
<!DOCTYPE html>
<html>
<head>…</head>
<body class="split">
<header>…</header>

<!-- Shared Styles -->
<style>…</style>
<!-- Carousel with touch scrolling, overflow-scrolling:touch -->
<style>…</style>

<img src="images/poster-1.png">

…
…
…
…
…
…
…
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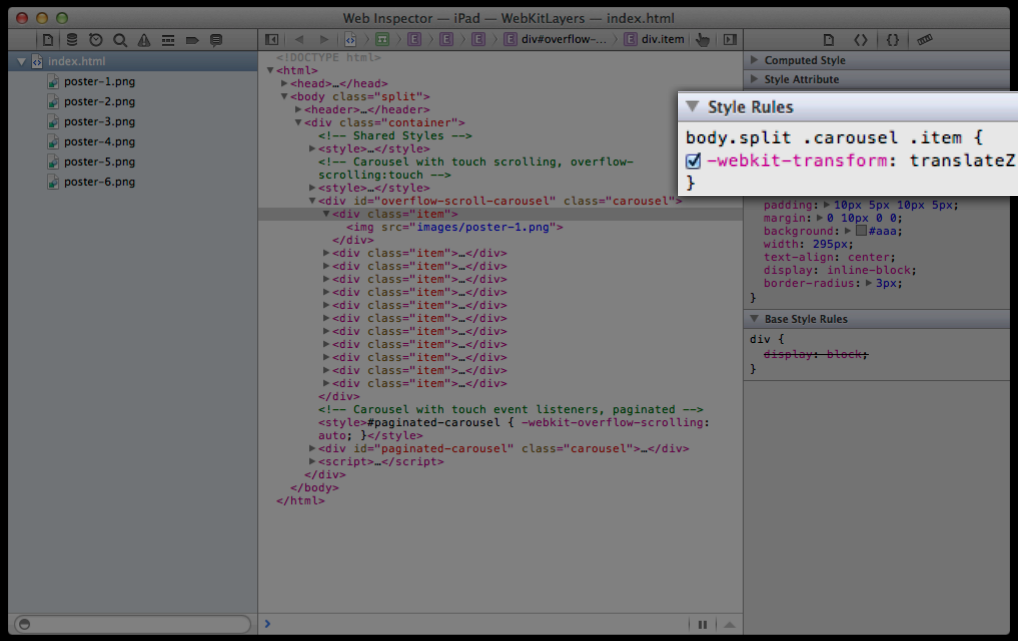
…
…
…

<!-- Carousel with touch event listeners, paginated -->
<style>#paginated-carousel { -webkit-overflow-scrolling: auto; }</style>
…
<script>…</script>

</body>
</html>
Computed Style
Style Attribute
HTML Attributes
Style Rules
body.split .carousel .item {
-webkit-transform: translateZ(0);
}
.carousel .item {
padding: 10px 5px 10px 5px;
margin: 0 10px 0 0;
background: #aaa;
width: 295px;
text-align: center;
display: inline-block;
border-radius: 3px;
}
Base Style Rules
div {
display: block;
}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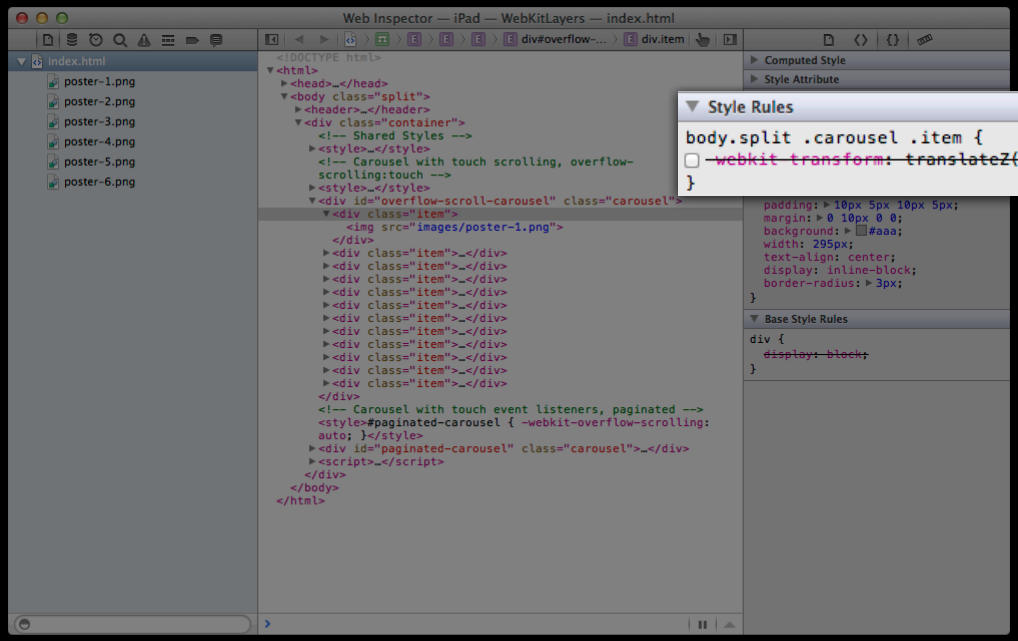
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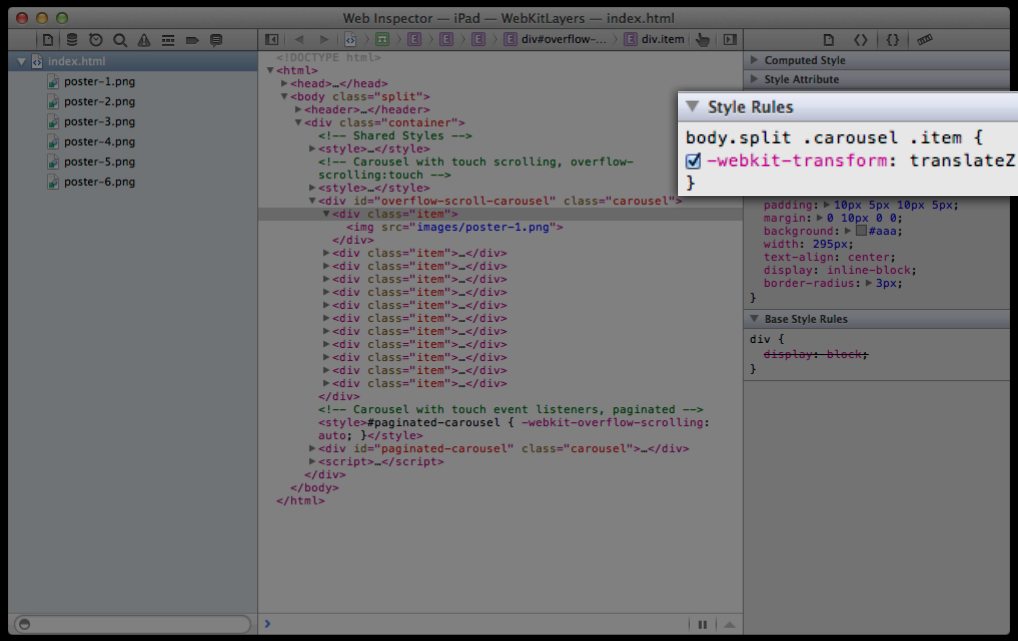
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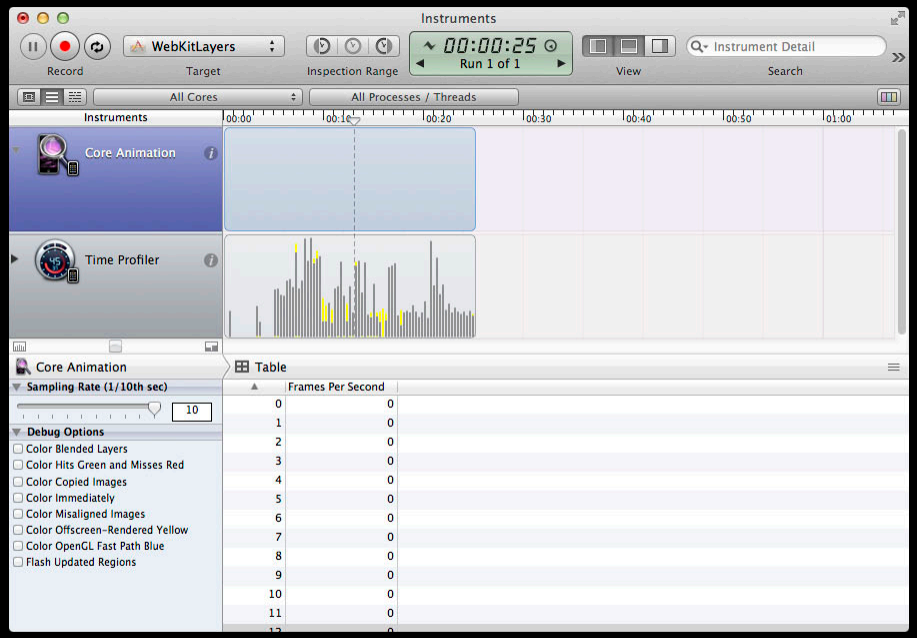
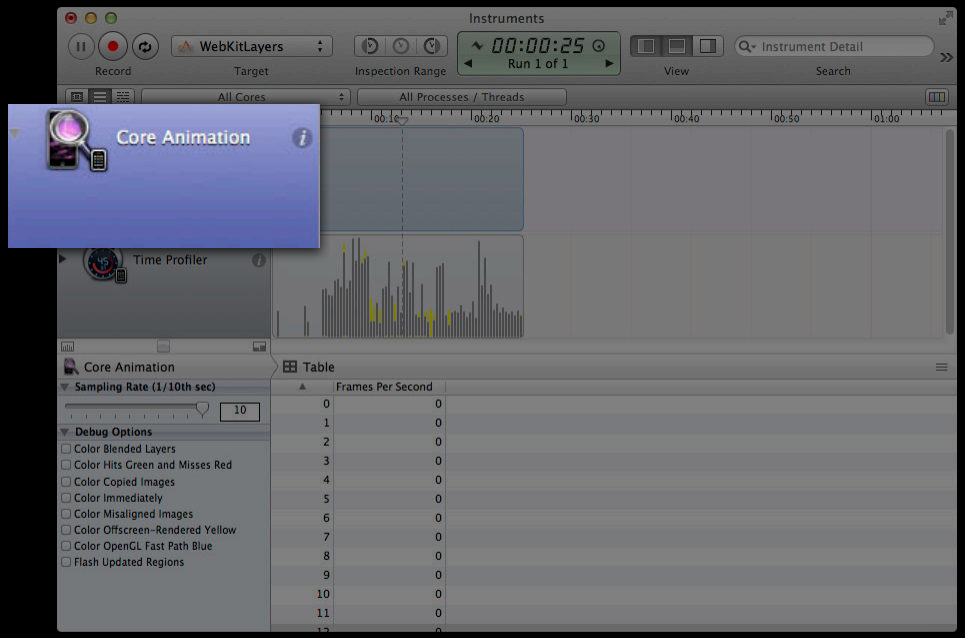

Instruments
WebKitLayers
Record
Target
Inspection Range
00:00:25
Run 1 of 1
View
Instrument Detail
Search
All Cores
All Processes / Threads
Instruments
00:00
00:10
00:20
00:30
00:40
00:50
01:00
Core Animation
Time Profiler
Core Animation
Table
Sampling Rate (1/10th sec)
10
Debug Options
Color Blended Layers
Color Hits Green and Misses Red
Color Copied Images
Color Immediately
Color Misaligned Images
Color Offscreen-Rendered Yellow
Color OpenGL Fast Path Blue
Flash Updated Regions
Frames Per Second
0 0
1 0
2 0
3 0
4 0
5 0
6 0
7 0
8 0
9 0
10 0
11 0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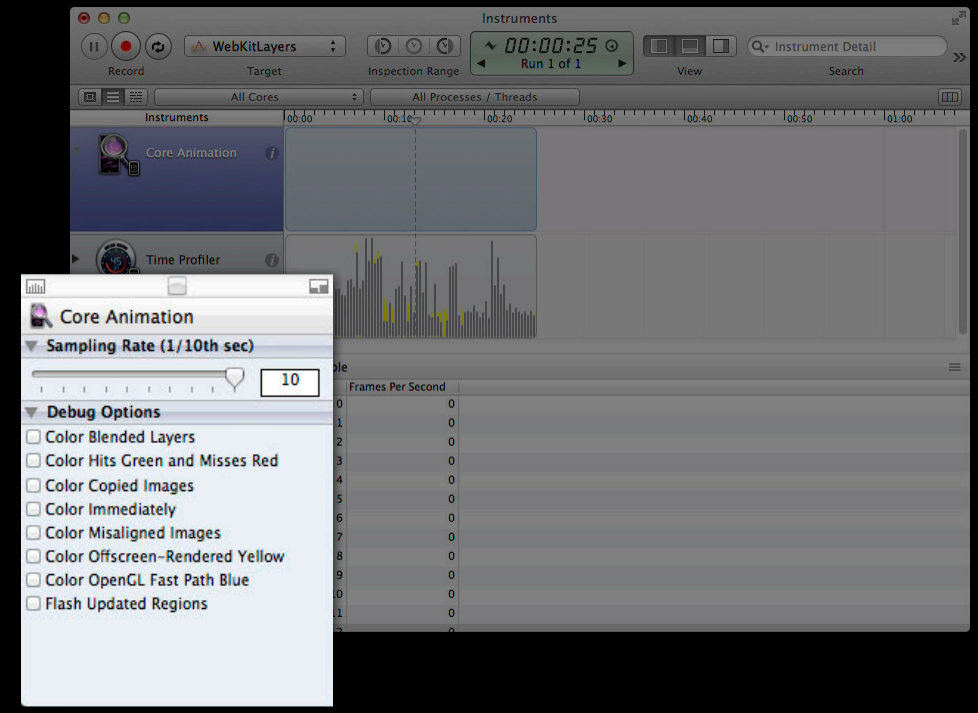
10
Debug Options
Color Blended Layers
Color Hits Green and Misses Red
Color Copied Images
Color Immediately
Color Misaligned Images
Color Offscreen-Rendered Yellow
Color OpenGL Fast Path Blue
Flash Updated Regions
Table
Frames Per Second


Instruments
WebKitLayers
Record
Target
Inspection Range
00:00:25
Run 1 of 1
View
Instrument Detail
Search
All Cores
All Processes / Threads
Instruments
Core Animation
Time Profiler
Frames Per Second
Core Animation
Sampling Rate (1/10th sec)
10
Debug Options
Color Blended Layers
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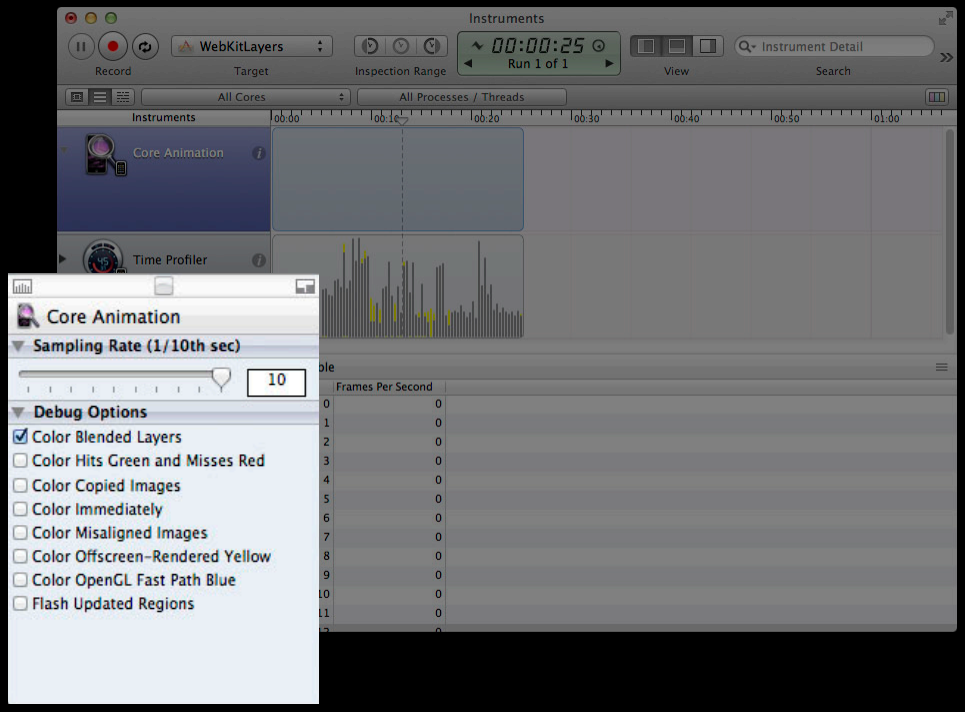
Instruments
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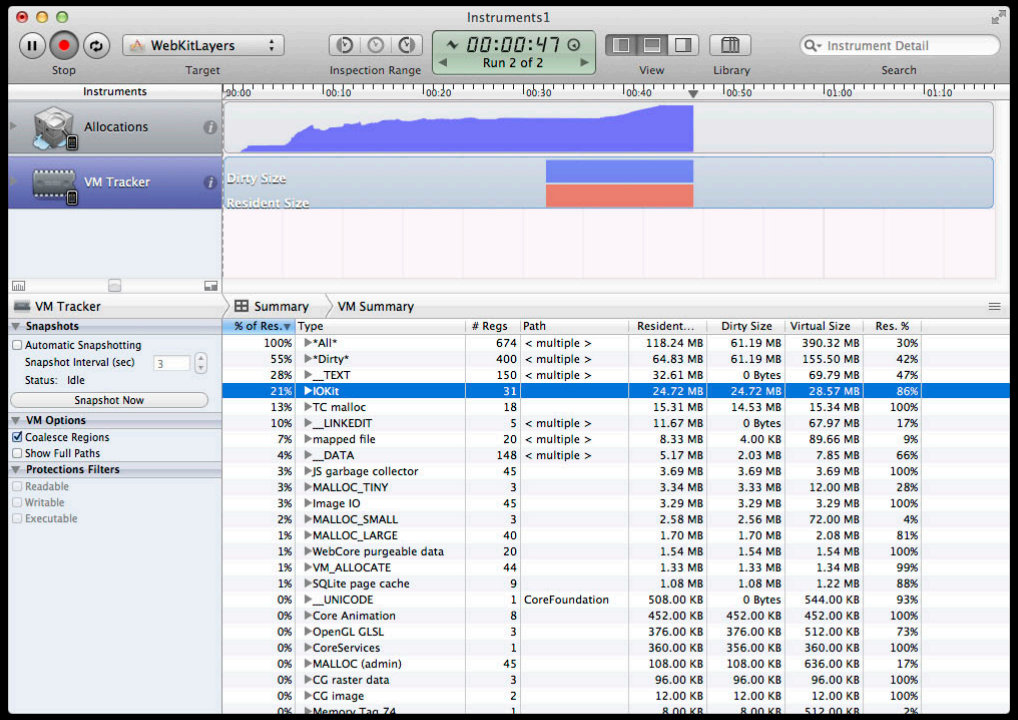
Instruments1
Stop
WebKitLayers
Target
Inspection Range
00:00:47
Run 2 of 2
View
Library
Instrument Detail
Search
Instruments
Allocations
VM Tracker
Dirty Size
Resident Size
VM Tracker
Summary
VM Summary
Snapshots
Automatic Snapshotting
Snapshot Interval (sec)
Status: Idle
Snapshot Now
VM Options
Coalesce Regions
Show Full Paths
Protections Filters
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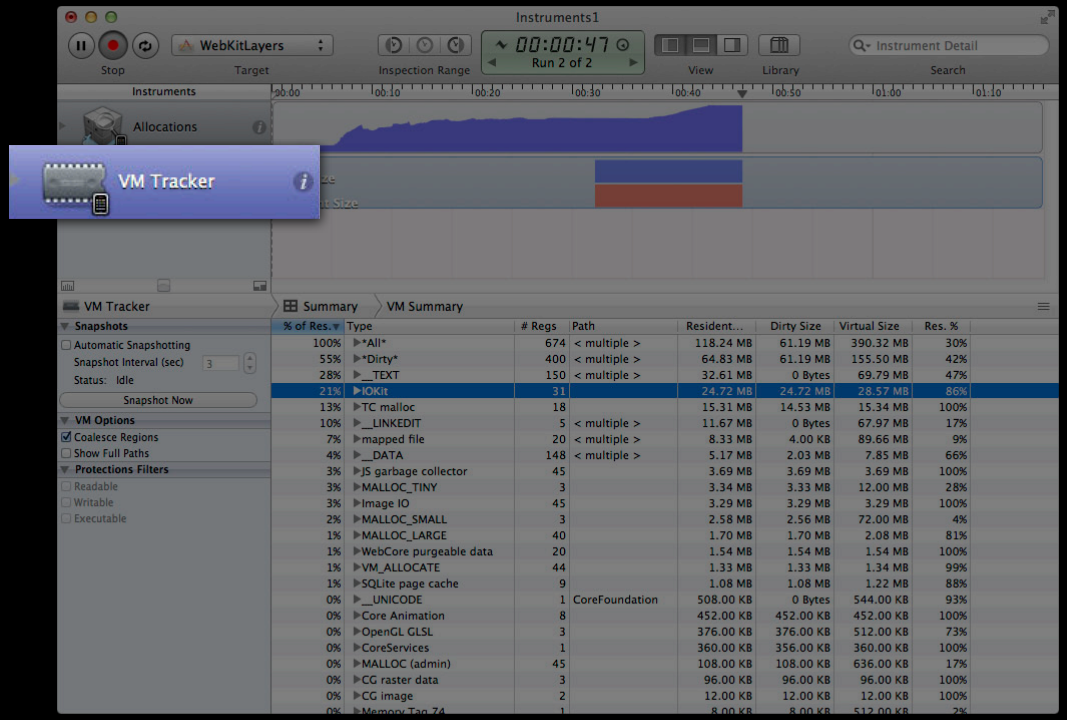
Writable
Executable
% of Res. | Type | # Regs | Path | Resident... | Dirty Size | Virtual Size | Res. %
100% | *All* | 674 | < multiple > | 118.24 MB | 61.19 MB | 390.32 MB | 30%
55% | *Dirty* | 400 | < multiple > | 64.83 MB | 61.19 MB | 155.50 MB | 42%
28% | __TEXT | 150 | < multiple > | 32.61 MB | 0 Bytes | 69.79 MB | 47%
21% | IOKit | 31 | | 24.72 MB | 24.72 MB | 28.57 MB | 86%
13% | TC malloc | 18 | | 15.31 MB | 14.53 MB | 15.34 MB | 100%
10% | __LINKEDIT | 5 | < multiple > | 11.67 MB | 0 Bytes | 67.97 MB | 17%
7% | mapped file | 20 | < multiple > | 8.33 MB | 4.00 KB | 89.66 MB | 9%
4% | __DATA | 148 | < multiple > | 5.17 MB | 2.03 MB | 7.85 MB | 66%
3% | JS garbage collector | 45 | | 3.69 MB | 3.69 MB | 3.69 MB | 100%
3% | MALLOC_TINY | 3 | | 3.34 MB | 3.33 MB | 12.00 MB | 28%
3% | Image IO | 45 | | 3.29 MB | 3.29 MB | 3.29 MB | 100%
2% | MALLOC_SMALL | 3 | | 2.58 MB | 2.56 MB | 72.00 MB | 4%
1% | MALLOC_LARGE | 40 | | 1.70 MB | 1.70 MB | 2.08 MB | 81%
1% | WebCore purgeable data | 20 | | 1.54 MB | 1.54 MB | 1.54 MB | 100%
1% | VM_ALLOCATE | 44 | | 1.33 MB | 1.33 MB | 1.34 MB | 99%
1% | SQLite page cache | 9 | | 1.08 MB | 1.08 MB | 1.22 MB | 88%
0% | __UNICODE | 1 | CoreFoundation | 508.00 KB | 0 Bytes | 544.00 KB | 93%
0% | Core Animation | 8 | | 452.00 KB | 452.00 KB | 452.00 KB | 100%
0% | OpenGL GLSL | 3 | | 376.00 KB | 376.00 KB | 512.00 KB | 73%
0% | CoreServices | 1 | | 360.00 KB | 356.00 KB | 360.00 KB | 100%
0% | MALLOC (admin) | 45 | | 108.00 KB | 108.00 KB | 636.00 KB | 17%
0% | CG raster data | 3 | | 96.00 KB | 96.00 KB | 96.00 KB | 100%
0% | CG image | 2 | | 12.00 KB | 12.00 KB | 12.00 KB | 100%


Instruments1
Stop
WebKitLayers
Target
Inspection Range
00:00:47
Run 2 of 2
View
Library
Instrument Detail
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Instruments
Allocations
VM Tracker
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100% | *All* | 674 | < multiple > | 118.24 MB | 61.19 MB | 390.32 MB | 30%
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21% | IOKit | 31 | | 24.72 MB | 24.72 MB | 28.57 MB | 86%
13% | TC malloc | 18 | | 15.31 MB | 14.53 MB | 15.34 MB | 100%
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3% | JS garbage collector | 45 | | 3.69 MB | 3.69 MB | 3.69 MB | 100%
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1% | MALLOC_LARGE | 40 | | 1.70 MB | 1.70 MB | 2.08 MB | 81%
1% | WebCore purgeable data | 20 | | 1.54 MB | 1.54 MB | 1.54 MB | 100%
1% | VM_ALLOCATE | 44 | | 1.33 MB | 1.33 MB | 1.34 MB | 99%
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0% | MALLOC (admin) | 45 | | 108.00 KB | 108.00 KB | 636.00 KB | 17%
0% | CG raster data | 3 | | 96.00 KB | 96.00 KB | 96.00 KB | 100%
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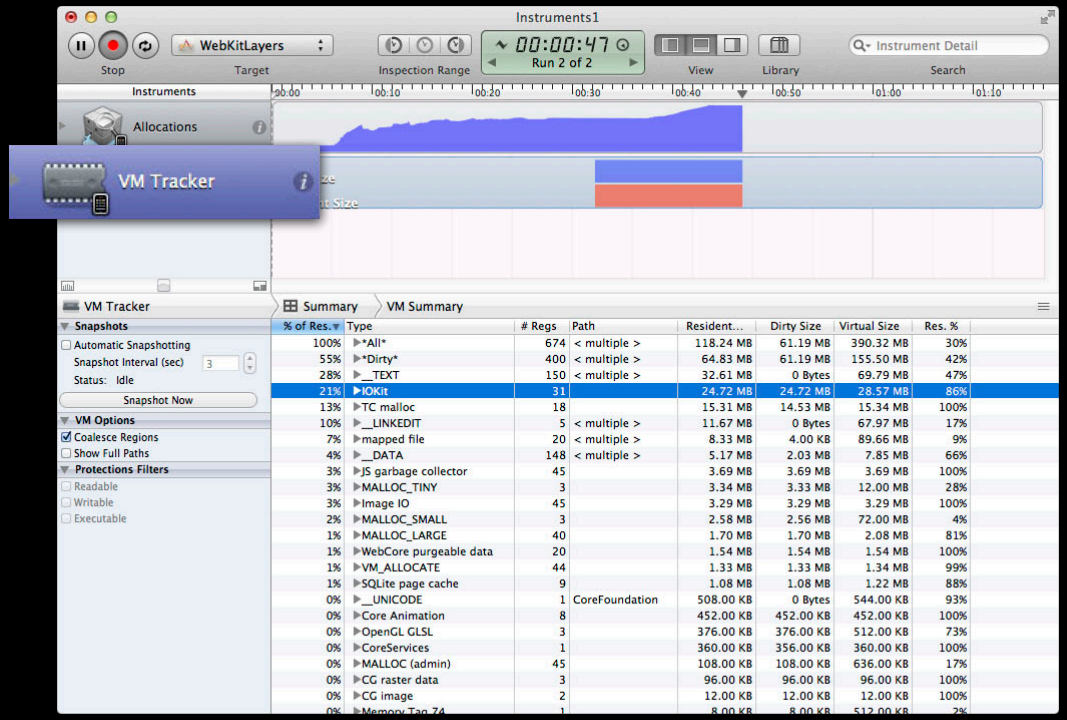
Instruments1
Stop
WebKitLayers
Target
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00:00:47
Run 2 of 2
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Instrument Detail
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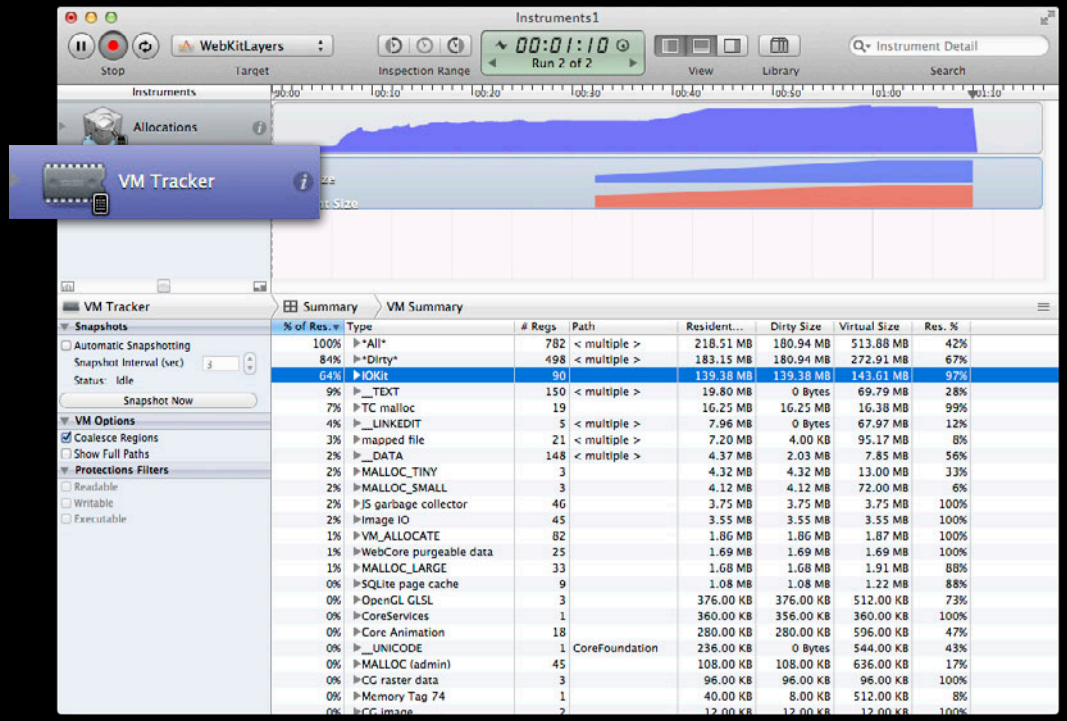
28% | __TEXT | 150 | < multiple > | 32.61 MB | 0 Bytes | 69.79 MB | 47%
21% | IOKit | 31 | | 24.72 MB | 24.72 MB | 28.57 MB | 86%
13% | TC malloc | 18 | | 15.31 MB | 14.53 MB | 15.34 MB | 100%
10% | __LINKEDIT | 5 | < multiple > | 11.67 MB | 0 Bytes | 67.97 MB | 17%
7% | mapped file | 20 | < multiple > | 8.33 MB | 4.00 KB | 89.66 MB | 9%
4% | __DATA | 148 | < multiple > | 5.17 MB | 2.03 MB | 7.85 MB | 66%
3% | JS garbage collector | 45 | | 3.69 MB | 3.69 MB | 3.69 MB | 100%
3% | MALLOC_TINY | 3 | | 3.34 MB | 3.33 MB | 12.00 MB | 28%
3% | Image IO | 45 | | 3.29 MB | 3.29 MB | 3.29 MB | 100%
2% | MALLOC_SMALL | 3 | | 2.58 MB | 2.56 MB | 72.00 MB | 4%
1% | MALLOC_LARGE | 40 | | 1.70 MB | 1.70 MB | 2.08 MB | 81%
1% | WebCore purgeable data | 20 | | 1.54 MB | 1.54 MB | 1.54 MB | 100%
1% | VM_ALLOCATE | 44 | | 1.33 MB | 1.33 MB | 1.34 MB | 99%
1% | SQLite page cache | 9 | | 1.08 MB | 1.08 MB | 1.22 MB | 88%
0% | __UNICODE | 1 | CoreFoundation | 508.00 KB | 0 Bytes | 544.00 KB | 93%
0% | Core Animation | 8 | | 452.00 KB | 452.00 KB | 452.00 KB | 100%
0% | OpenGL GLSL | 3 | | 376.00 KB | 376.00 KB | 512.00 KB | 73%
0% | CoreServices | 1 | | 360.00 KB | 356.00 KB | 360.00 KB | 100%
0% | MALLOC (admin) | 45 | | 108.00 KB | 108.00 KB | 636.00 KB | 17%
0% | CG raster data | 3 | | 96.00 KB | 96.00 KB | 96.00 KB | 100%
0% | CG image | 2 | | 12.00 KB | 12.00 KB | 12.00 KB | 100%


Instruments1
Stop
WebKitLayers
Target
Inspection Range
00:01:10
Run 2 of 2
View
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Instrument Detail
Search
Instruments
Allocations
VM Tracker
VM Tracker
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Snapshot Interval (sec)
Status: Idle
Snapshot Now
VM Options
Coalesce Regions
Show Full Paths
Protections Filters
Readable
Writable
Executable
% of Res. | Type | # Regs | Path | Resident... | Dirty Size | Virtual Size | Res. %
100% | *All* | 782 | < multiple > | 218.51 MB | 180.94 MB | 513.88 MB | 42%
84% | *Dirty* | 498 | < multiple > | 183.15 MB | 180.94 MB | 272.91 MB | 67%
64% | IOKit | 90 | | 139.38 MB | 139.38 MB | 143.61 MB | 97%
9% | __TEXT | 150 | < multiple > | 19.80 MB | 0 Bytes | 69.79 MB | 28%
7% | TC malloc | 19 | | 16.25 MB | 16.25 MB | 16.38 MB | 99%
4% | __LINKEDIT | 5 | < multiple > | 7.96 MB | 0 Bytes | 67.97 MB | 12%
3% | mapped file | 21 | < multiple > | 7.20 MB | 4.00 KB | 95.17 MB | 8%
2% | __DATA | 148 | < multiple > | 4.37 MB | 2.03 MB | 7.85 MB | 56%
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2% | MALLOC_SMALL | 3 | | 4.12 MB | 4.12 MB | 72.00 MB | 6%
2% | JS garbage collector | 46 | | 3.75 MB | 3.75 MB | 3.75 MB | 100%
2% | Image IO | 45 | | 3.55 MB | 3.55 MB | 3.55 MB | 100%
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1% | MALLOC_LARGE | 33 | | 1.68 MB | 1.68 MB | 1.91 MB | 88%
0% | SQLite page cache | 9 | | 1.08 MB | 1.08 MB | 1.22 MB | 88%
0% | OpenGL GLSL | 3 | | 376.00 KB | 376.00 KB | 512.00 KB | 73%
0% | CoreServices | 1 | | 360.00 KB | 356.00 KB | 360.00 KB | 100%
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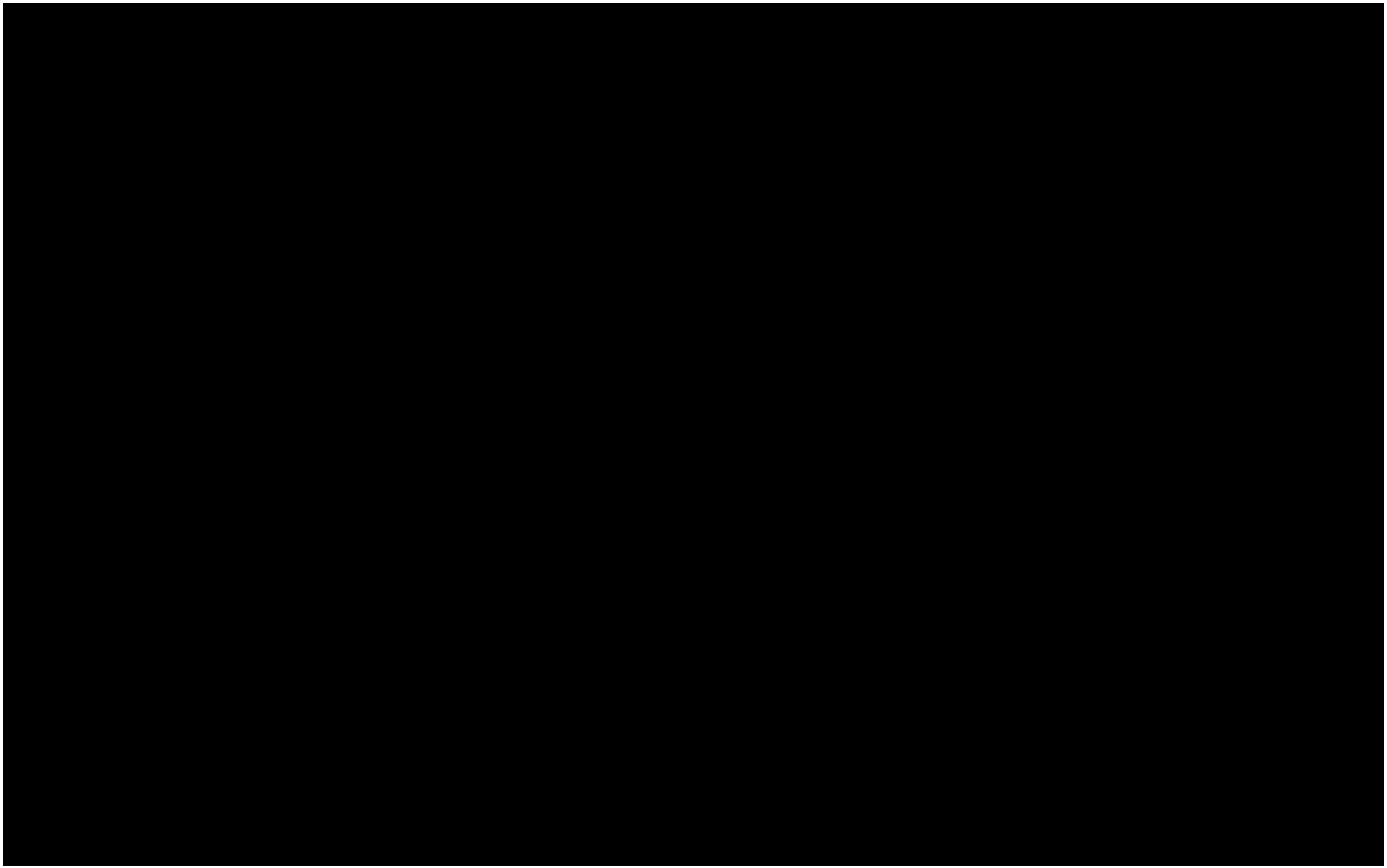

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     forKey:@"WebKitShowDebugBorders"]
```

```
[[NSUserDefaults standardDefaults]
    setBool:YES
     forKey:@"WebKitShowDebugBorders"]
```

Demo

Review of WebKit Layers

Pros

Cons

Review of WebKit Layers

Pros

- Smooth animations when used selectively

Cons

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- Fluid interactivity with web content when it is hardware-accelerated

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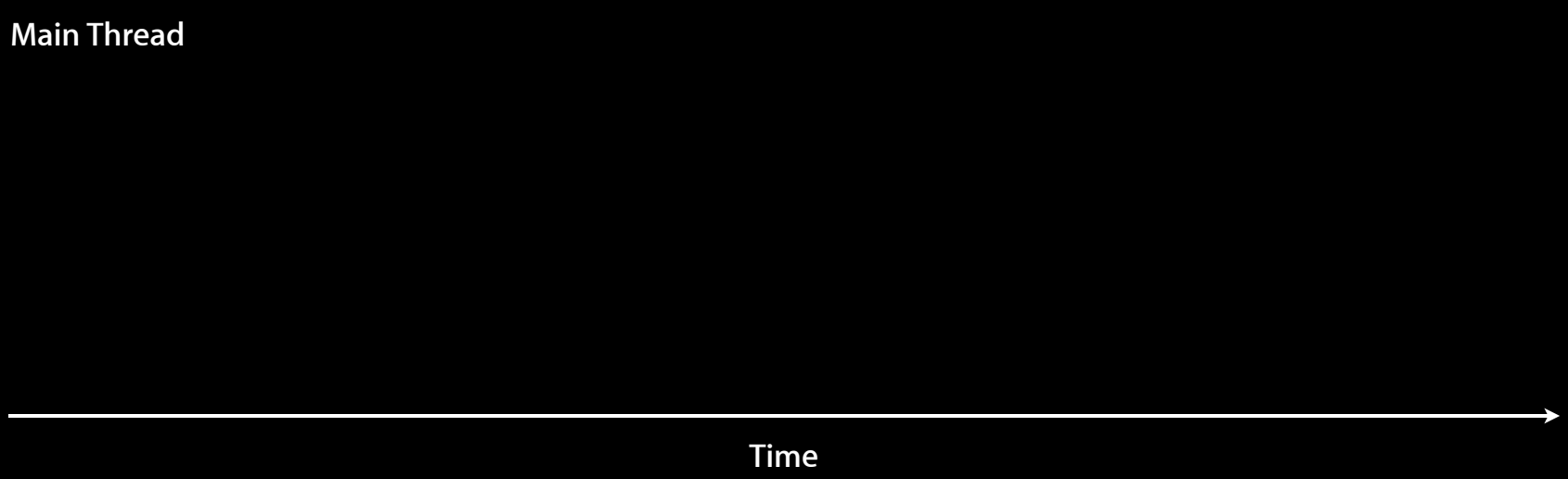
Remember: Use the debug tools to help you find and fix issues

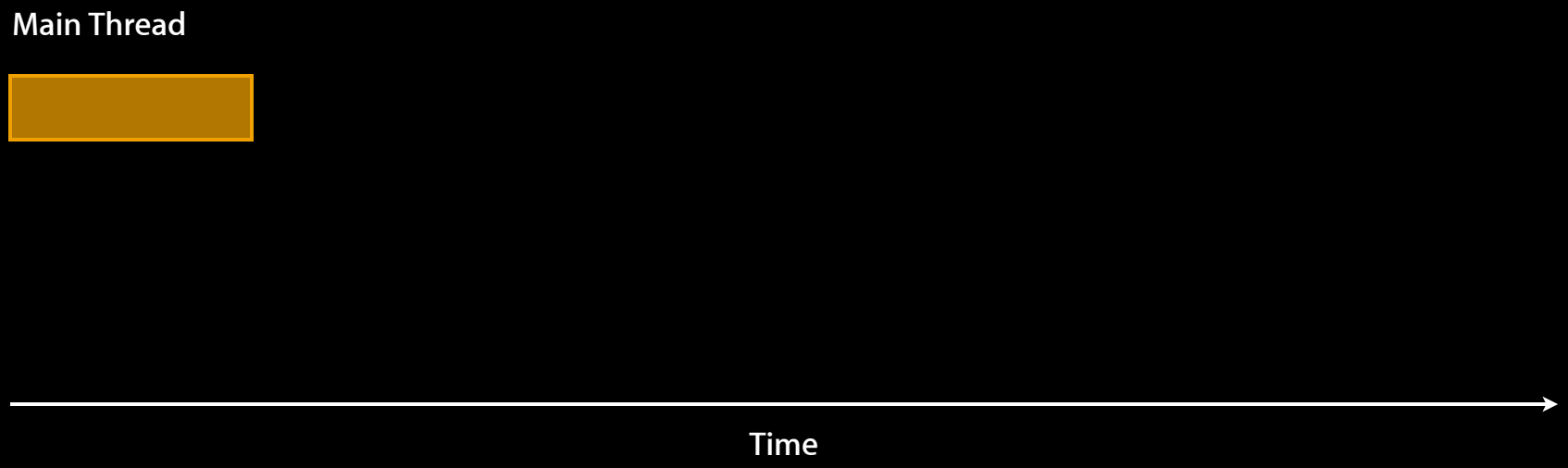
Rendering in Your App

Asynchronous rendering, incremental rendering

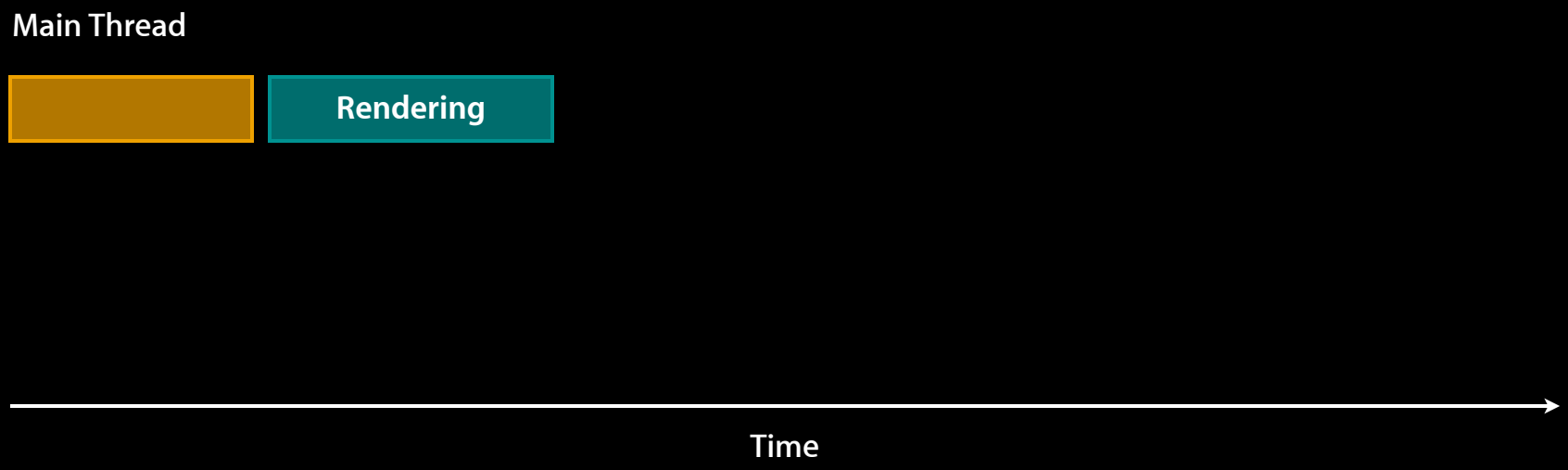
Synchronous Main Thread Rendering



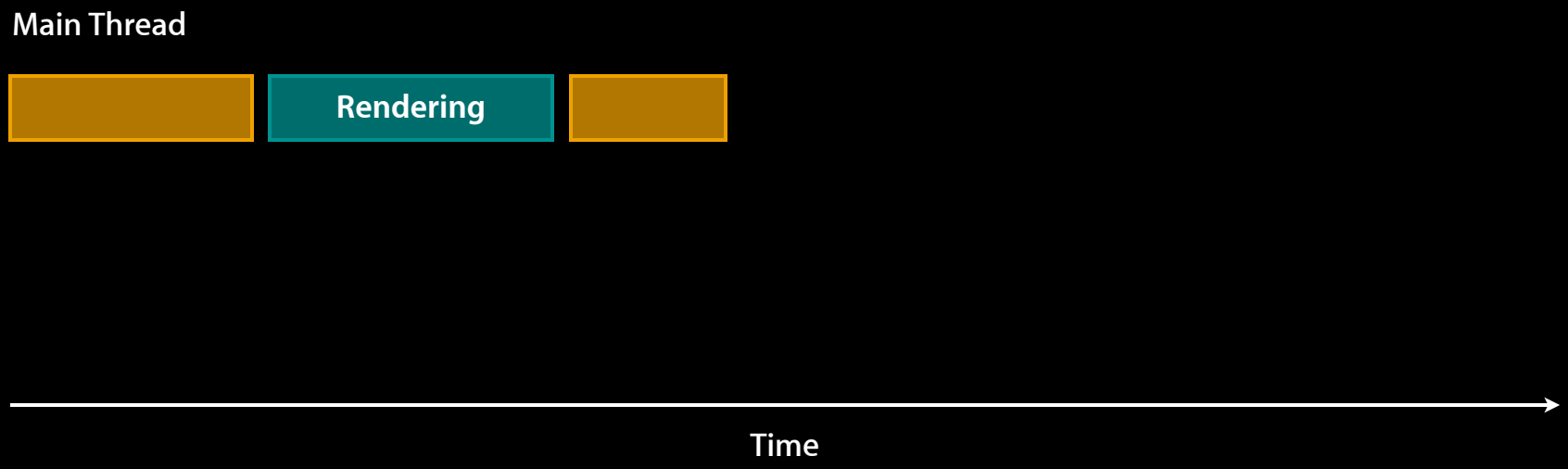
Synchronous Main Thread Rendering



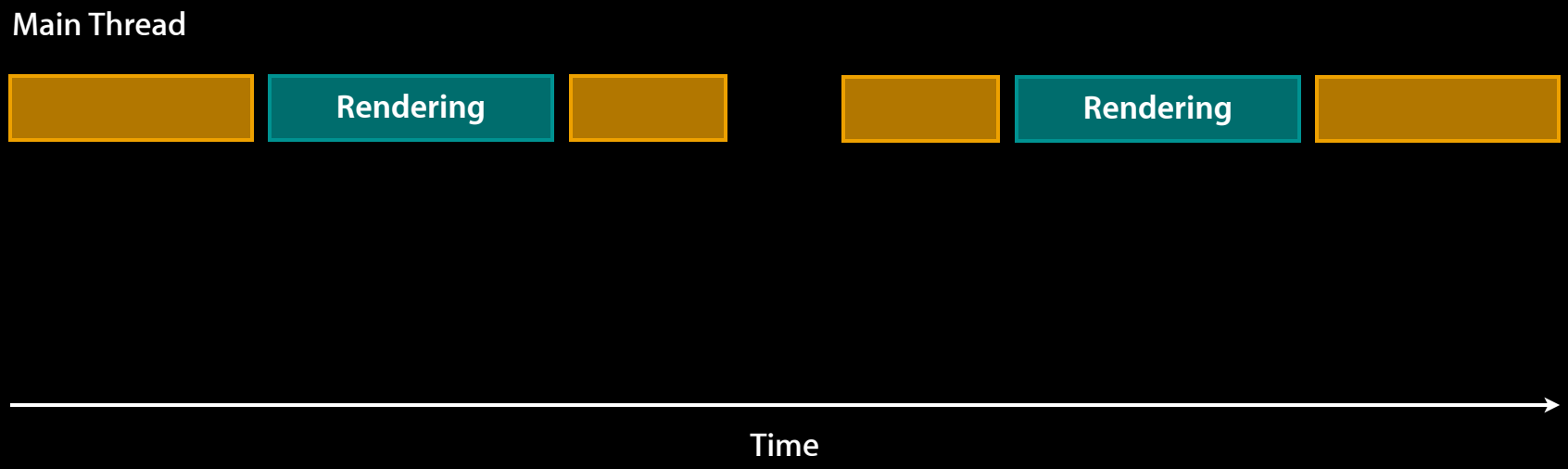
Synchronous Main Thread Rendering



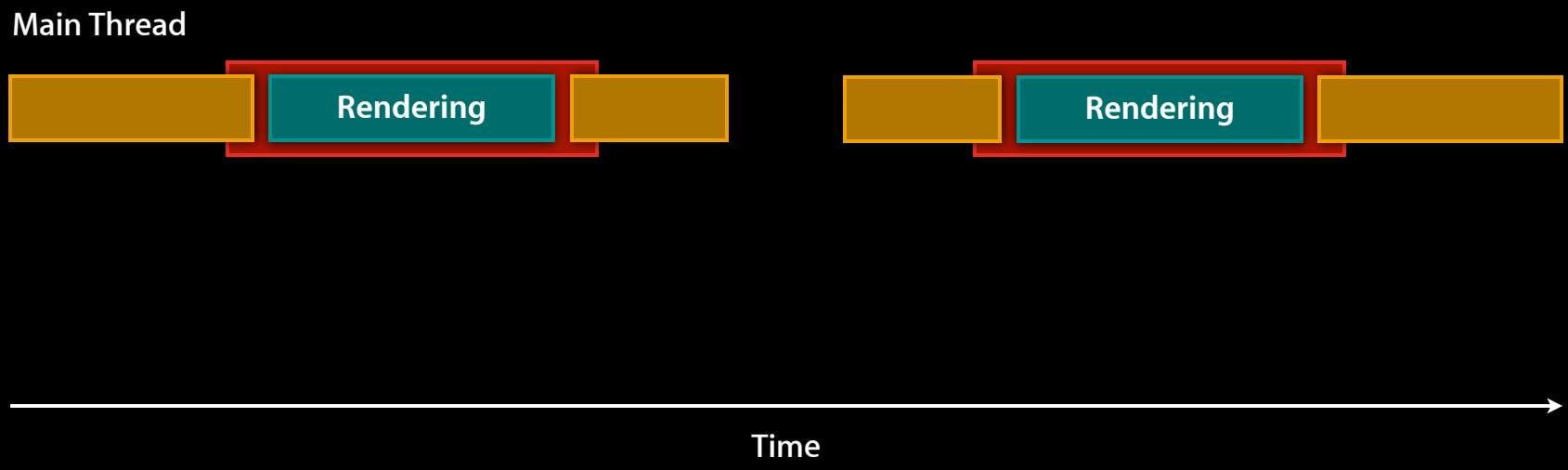
Synchronous Main Thread Rendering



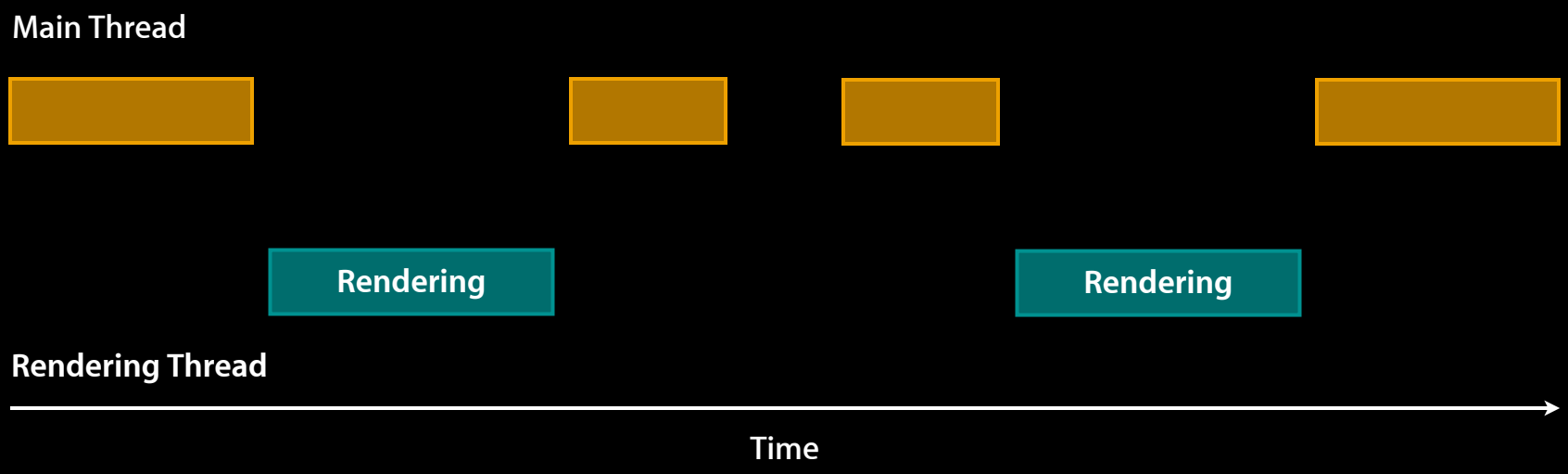
Synchronous Main Thread Rendering



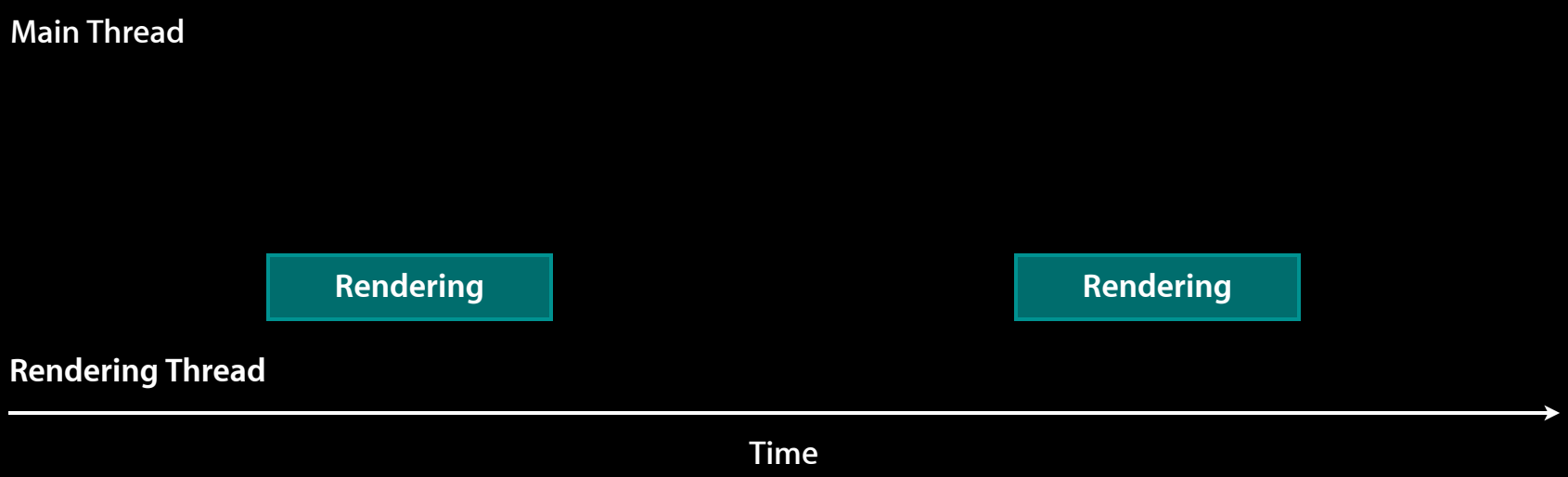
Synchronous Main Thread Rendering



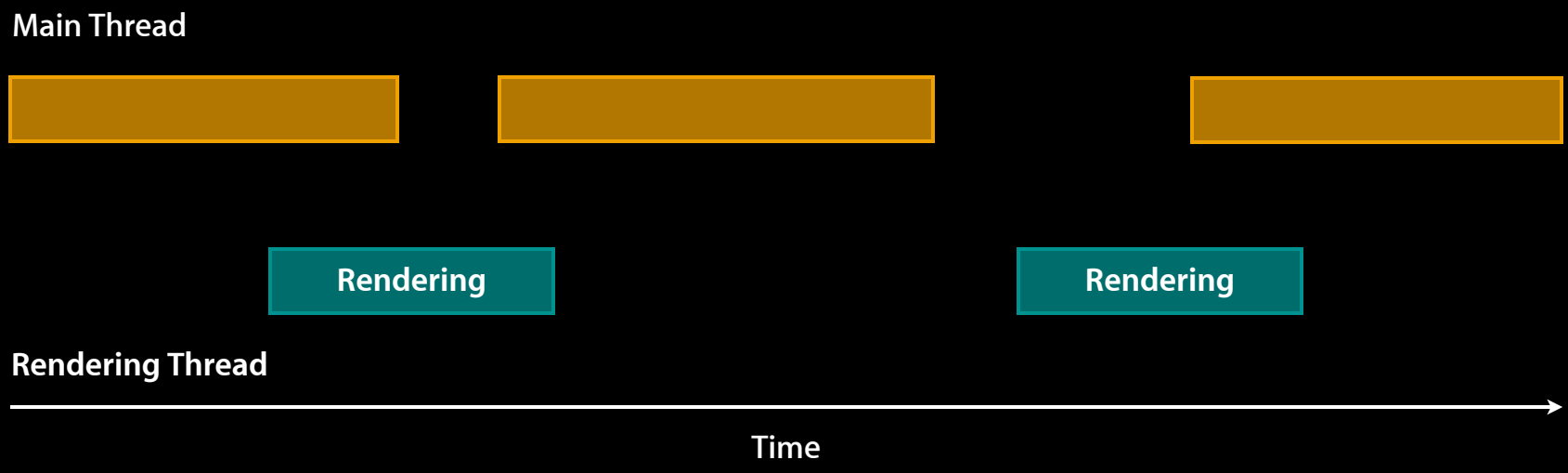
Synchronous Main Thread Rendering



Asynchronous Rendering



Asynchronous Rendering



Asynchronous Rendering

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- WebKit rendering happens on background thread

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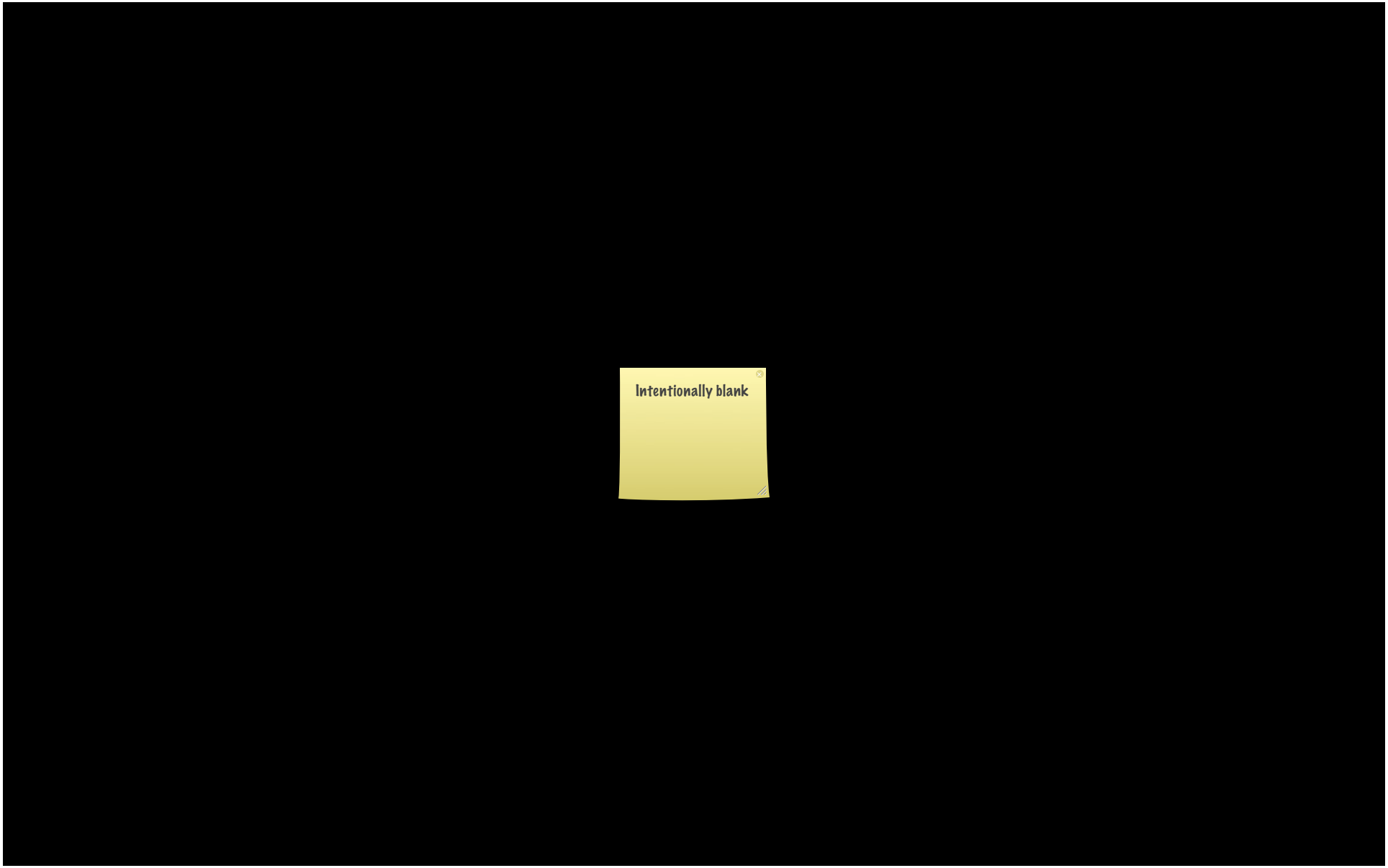
- WebKit rendering happens on background thread
- Automatic for all apps built with the iOS 6 SDK

Asynchronous Rendering

- WebKit rendering happens on background thread
- Automatic for all apps built with the iOS 6 SDK
- Use UIWebView only from the main thread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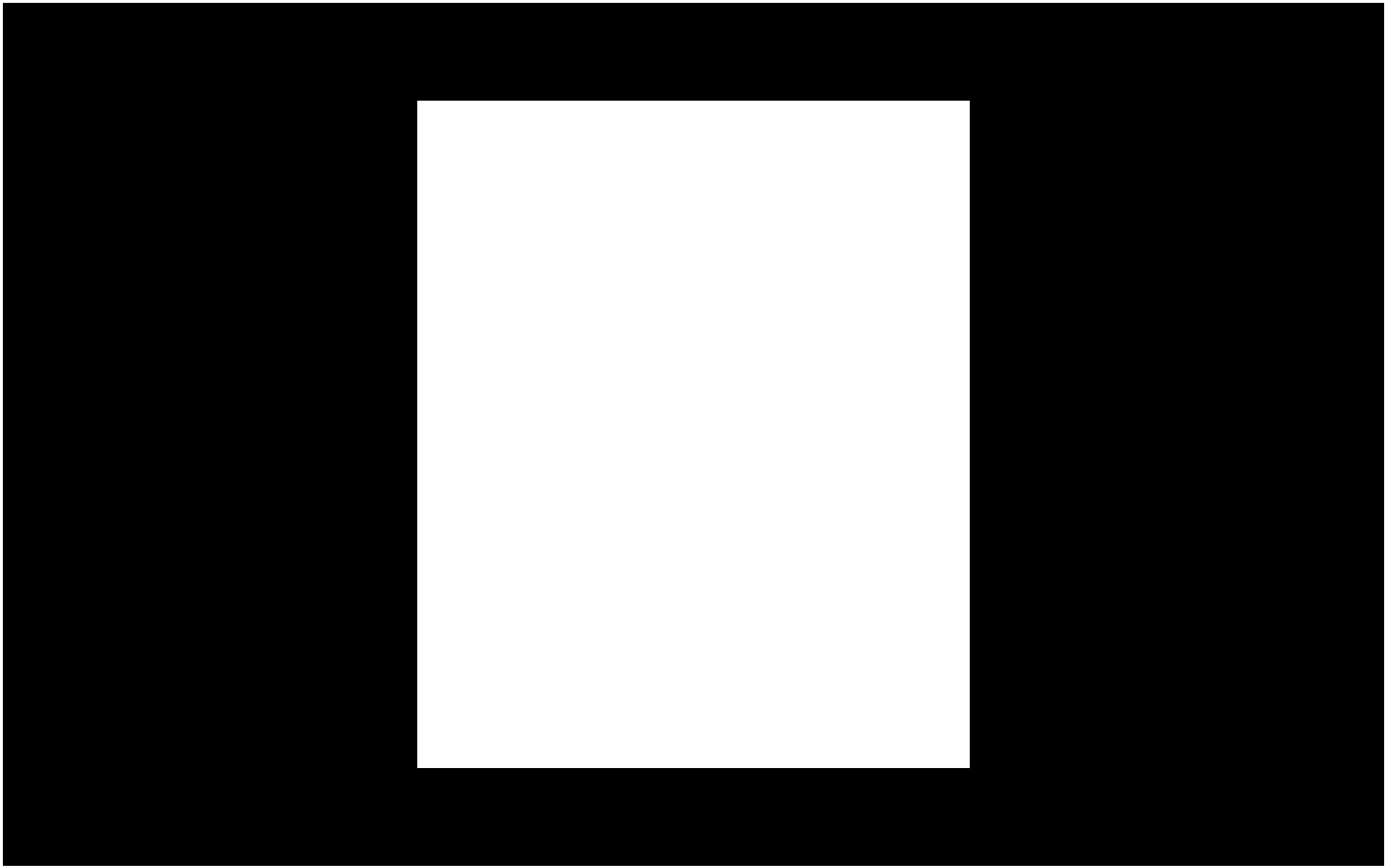
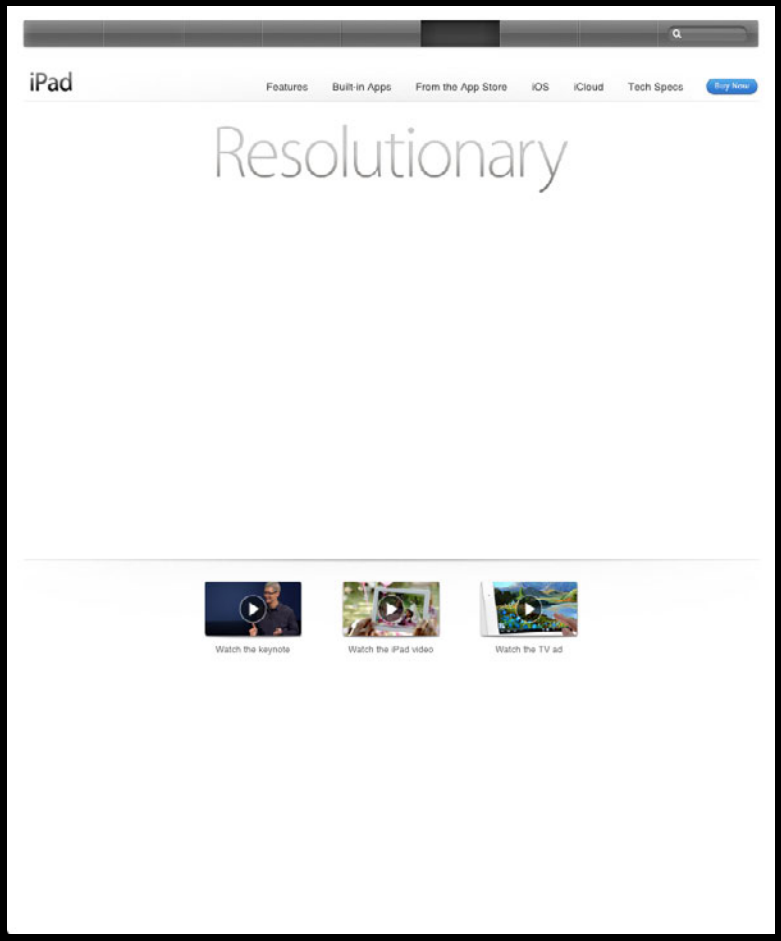
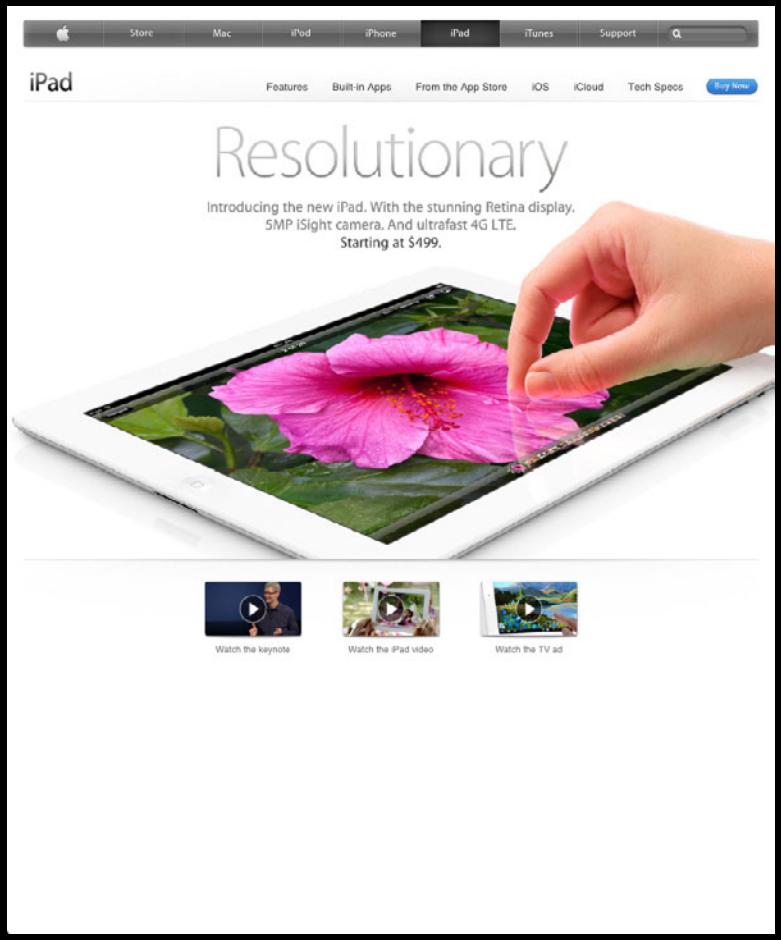



iPad
Features
Built-in Apps
From the App Store
iOS
iCloud
Tech Specs
Buy Now
Resolutionary
Watch the keynote
Watch the iPad video
Watch the TV ad


Store
Mac
iPod
iPhone
iPad
iTunes
Support
iPad
Features
Built-in Apps
From the App Store
iOS
iCloud
Tech Specs
Buy Now
Resolutionary
Introducing the new iPad. With the stunning Retina display.
5MP iSight camera. And ultrafast 4G LTE.
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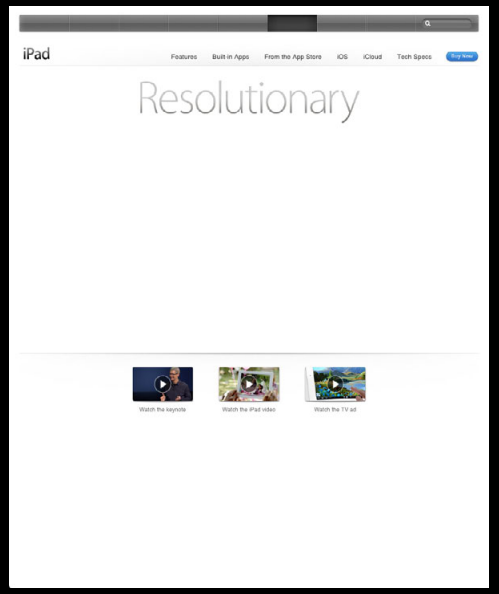
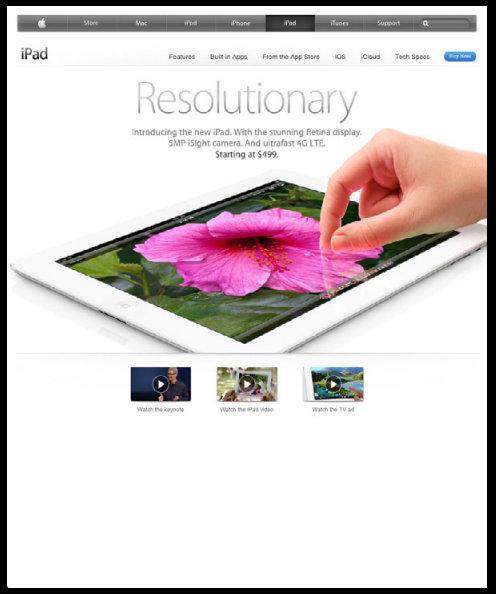
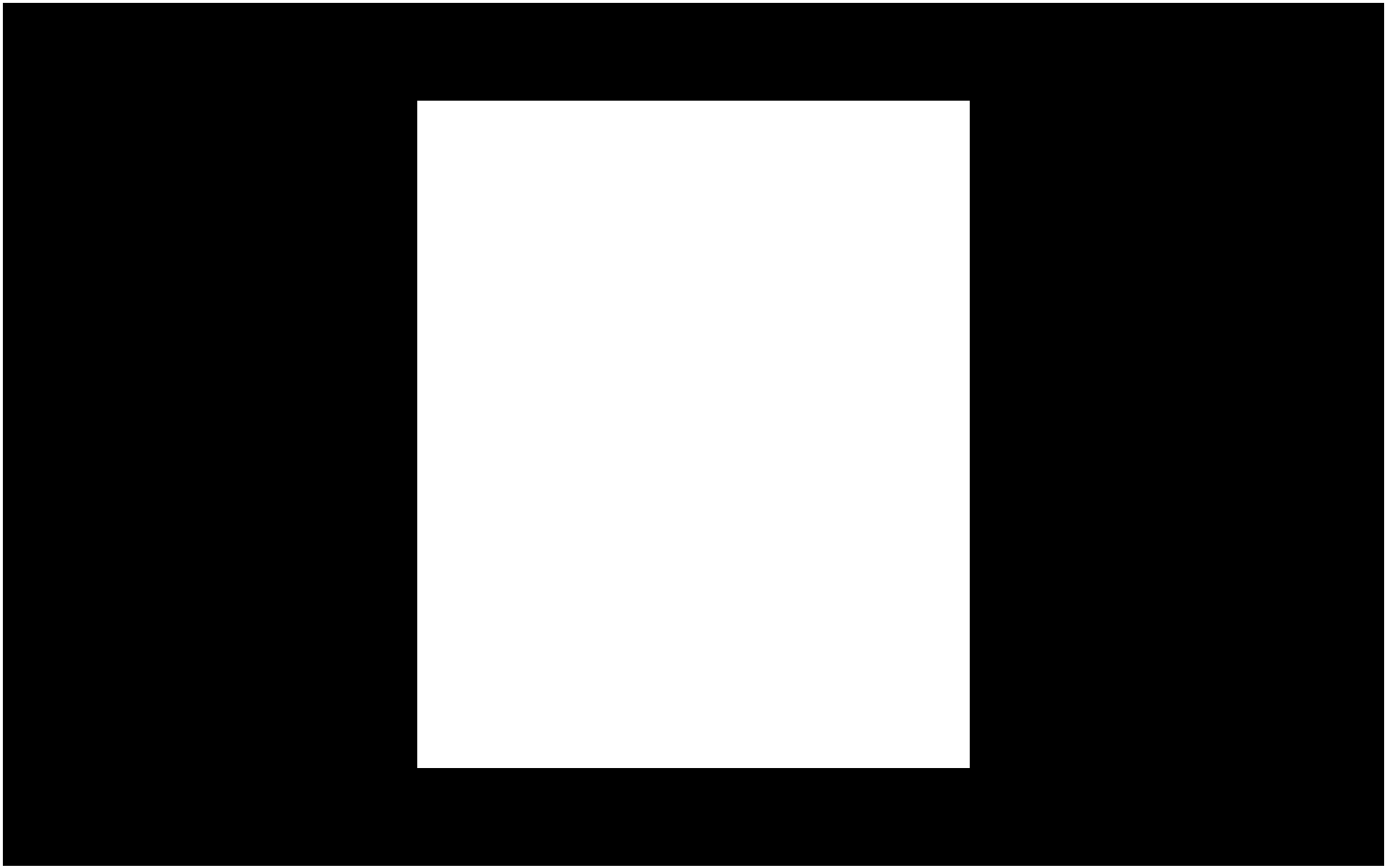
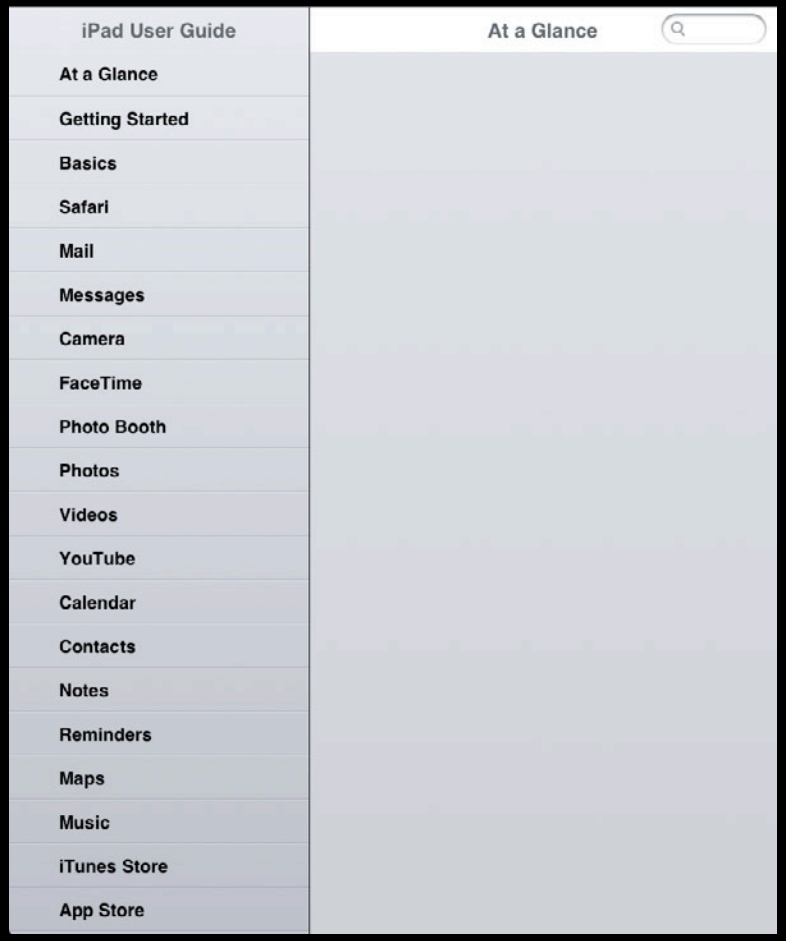
Breakthrough Retina display.
It's even more than meets the eye.
The Retina display on the new, third-generation iPad makes everything look crisper and more lifelike. Text is razor sharp. Colors are more vibrant. Photos and videos are rich with detail. All thanks to 3.1 million pixels powered by the new A5X chip. It's the best mobile display ever. Learn more
5MP iSight camera.
Take your best shots yet.
The new iPad features a 5-megapixel iSight camera with advanced optics, a backside illumination sensor, auto white balance, and face detection for incredible still images. And you can record 1080p HD video, too. So every moment you capture looks as great as you remember. Learn more

Incremental Rendering








iPad User Guide
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Getting Started
Basics
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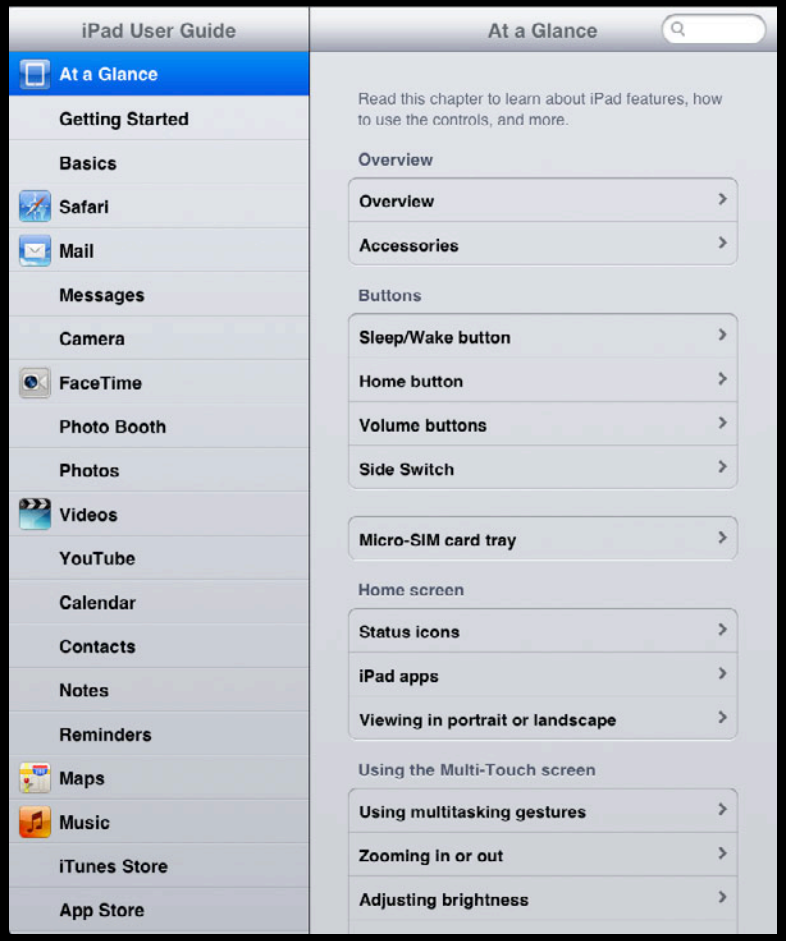
Mail
Messages
Camera
FaceTime
Photo Booth
Photos
Videos
YouTube
Calendar
Contacts
Notes
Reminders
Maps
Music
iTunes Store
App Store
At a Glance


iPad User Guide
At a Glance
Getting Started
Basics
Safari
Mail
Messages
Camera
FaceTime
Photo Booth
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Read this chapter to learn about iPad features, how to use the controls, and more.
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Sleep/Wake button
Home button
Volume buttons
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Home screen
Status icons
iPad apps
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Using the Multi-Touch screen
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Zooming in or out
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Adjusting brightness

Suppressing Incremental Rendering

Suppressing Incremental Rendering

- Avoids rendering partially loaded content

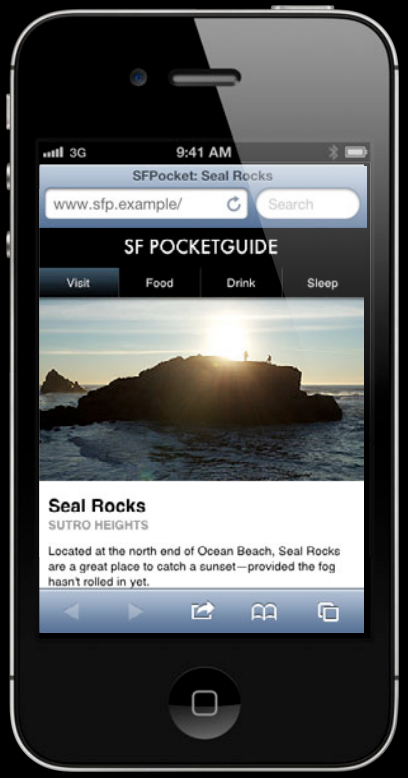
Suppressing Incremental Rendering

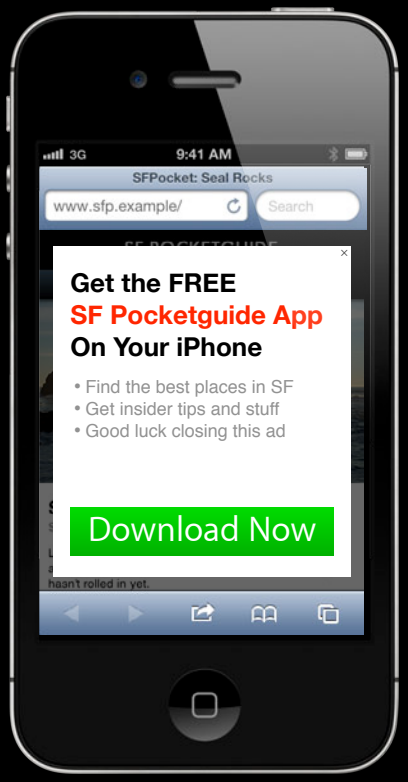
- Avoids rendering partially loaded content
- New UIWebView property

```
@property (nonatomic) BOOL suppressesIncrementalRendering;
```

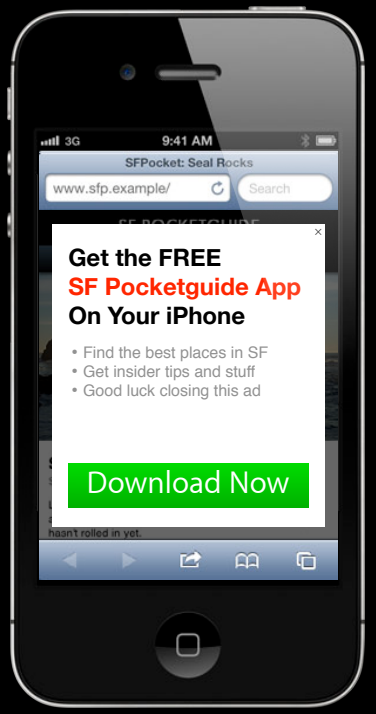
Linking Your Website to Your App

The Smart App Banner


3G
9:41 AM
SFPocket: Seal Rocks
www.sfp.example/
Search
SF POCKETGUIDE
Visit
Food
Drink
Sleep
Seal Rocks
SUTRO HEIGHTS
Located at the north end of Ocean Beach, Seal Rocks are a great place to catch a sunset—provided the fog hasn't rolled in yet.

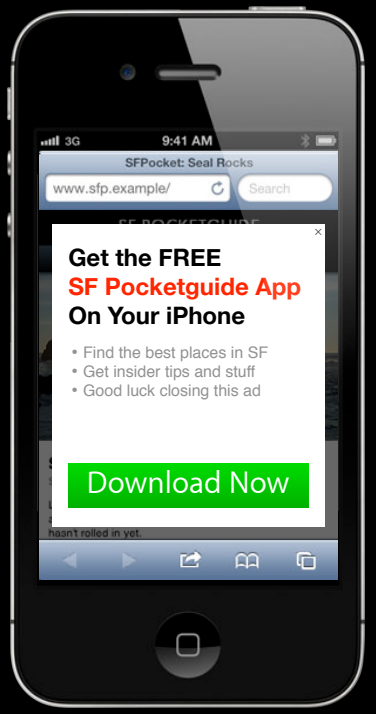

3G
9:41 AM
SFPocket: Seal Rocks
www.sfp.example/
Search
Get the FREE
SF Pocketguide App
On Your iPhone
• Find the best places in SF
• Get insider tips and stuff
• Good luck closing this ad
Download Now

Popup Pain


3G
9:41 AM
SFPocket: Seal Rocks
www.sfp.example/
Search
Get the FREE
SF Pocketguide App
On Your iPhone
• Find the best places in SF
• Get insider tips and stuff
• Good luck closing this ad
Download Now

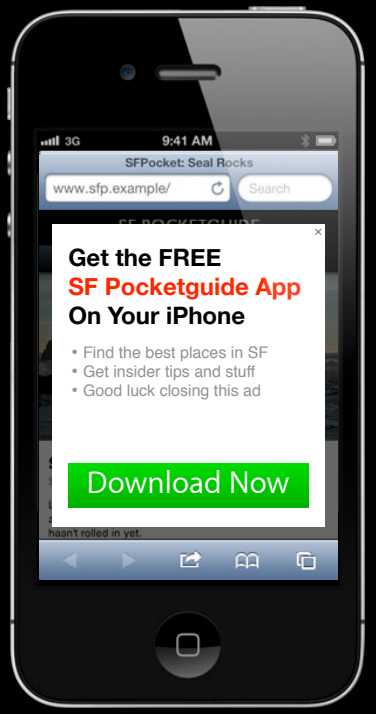
Popup Pain

- Interrupts the user's browsing



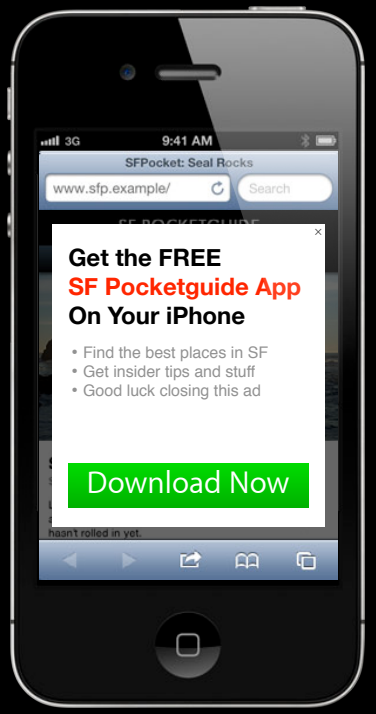
Popup Pain

- Interrupts the user's browsing
- User may already have the app installed



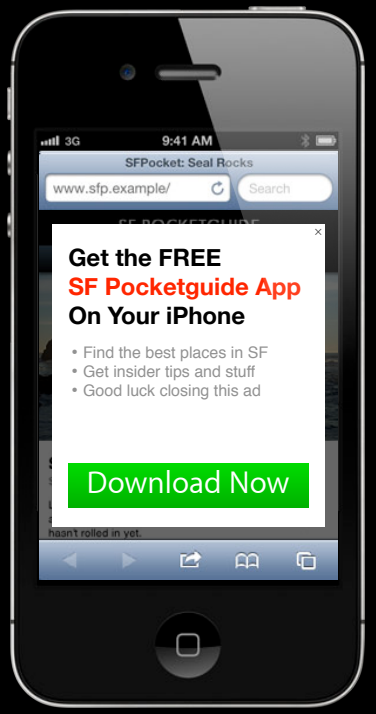
Popup Pain

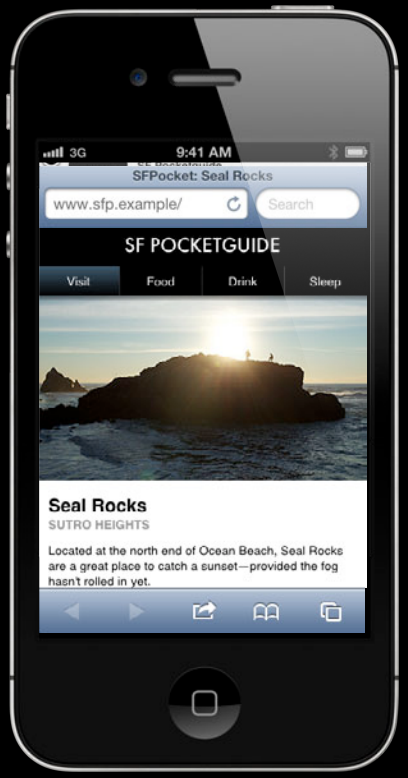
- Interrupts the user's browsing
- User may already have the app installed
  - No way for content to detect this



Popup Pain

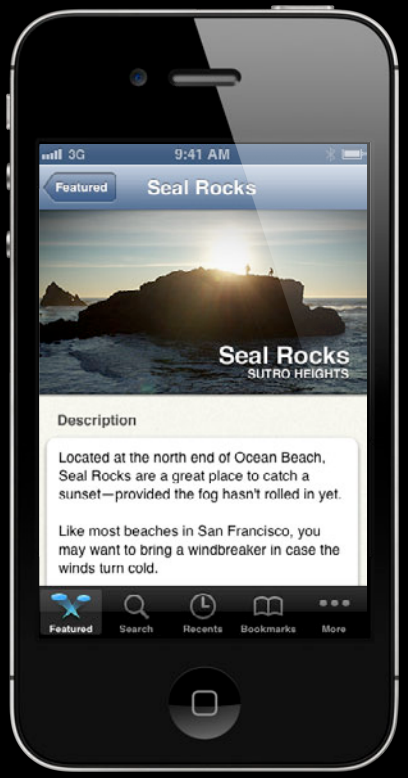
- Interrupts the user's browsing
- User may already have the app installed
  - No way for content to detect this
- Opening the app loses the user's context




3G
9:41 AM
SFPocket: Seal Rocks
www.sfp.example/
Search
SF POCKETGUIDE
Visit
Food
Drink
Sleep
Seal Rocks
SUTRO HEIGHTS
Located at the north end of Ocean Beach, Seal Rocks are a great place to catch a sunset—provided the fog hasn't rolled in yet.


3G
9:41 AM
SFPocket: Seal Rocks
www.sfp.example/
Search
SF
SF Pocketguide
PNP Heavy Industries
(1,896)
FREE – On the App Store
VIEW
SF POCKETGUIDE
Visit
Food
Drink
Sleep
Seal Rocks


3G
9:41 AM
SFPocket: Seal Rocks
www.sfp.example/
Search
SF
SF Pocketguide
PNP Heavy Industries
INSTALLED
OPEN
SF POCKETGUIDE
Visit
Food
Drink
Sleep
Seal Rocks


3G
9:41 AM
Featured
Seal Rocks
Seal Rocks
SUTRO HEIGHTS
Description
Located at the north end of Ocean Beach, Seal Rocks are a great place to catch a sunset—provided the fog hasn't rolled in yet.
Like most beaches in San Francisco, you may want to bring a windbreaker in case the winds turn cold.
Featured
Search
Recents
Bookmarks
More

Adding a Smart App Banner

I never meta app I didn't like

```
<meta name="apple-itunes-app"
      content="app-id=123456789">
```

Adding a Smart App Banner

I never meta app I didn't like

```
<meta name="apple-itunes-app"
      content="app-id=123456789">
```

Adding a Smart App Banner

I never meta app I didn't like

```
<meta name="apple-itunes-app"
      content="app-id=123456789">
```

- Get your app ID from http://itunes.apple.com/linkmaker/

Adding a Smart App Banner

I never meta app I didn't like

```
<meta name="apple-itunes-app"
      content="app-id=123456789,
               app-argument=x-sfp:///visit/seal-rocks">
```

Adding a Smart App Banner

I never meta app I didn't like

```
<meta name="apple-itunes-app"
      content="app-id=123456789,
               app-argument=x-sfp:///visit/seal-rocks">
```

```
- (BOOL)application:(UIApplication *)application
           openURL:(NSURL *)url
  sourceApplication:(NSString *)sourceApplication
         annotation:(id)annotation
```

Adding a Smart App Banner

I never meta app I didn't like

```
<meta name="apple-itunes-app"
      content="app-id=123456789,
               app-argument=x-sfp:///visit/seal-rocks">
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```
- (BOOL)application:(UIApplication *)application
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The Smart App Banner

The Smart App Banner

- Invite the user to install your app

The Smart App Banner

- Invite the user to install your app
- Link from your website to your app

The Smart App Banner

- Invite the user to install your app
- Link from your website to your app
- Maintain the user's current context

</session>

</session>

- Web technologies are a great way to deliver application content

</session>

- Web technologies are a great way to deliver application content
- Web content impacts performance and the user experience

</session>

- Web technologies are a great way to deliver application content
- Web content impacts performance and the user experience
  - Improve resource loading times

</session>

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- Web technologies are a great way to deliver application content
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  - Improve resource loading times
  - Avoid unnecessary memory and layers
  - Understanding the engine makes it easier to write better content

</session>

- Web technologies are a great way to deliver application content
- Web content impacts performance and the user experience
  - Improve resource loading times
  - Avoid unnecessary memory and layers
  - Understanding the engine makes it easier to write better content
- Take advantage of new features in iOS 6

More Information

Vicki Murley
Web Technology Evangelist
vicki@apple.com

Documentation
https://developer.apple.com/devcenter/safari/

Apple Developer Forums
http://devforums.apple.com

Related Sessions

Debugging UIWebViews and Websites on iOS	Marina Tuesday 3:15PM
Delivering Web Content on High Resolution Displays	Nob Hill Wednesday 11:30AM

Labs

Safari and Web Tools Lab	Safari & Web Lab Wednesday 2:00PM
Web Content Optimization Lab	Safari & Web Lab Wednesday 3:15PM
Safari and WebKit Open Lab	Safari & Web Lab Thursday 3:15PM

Q&A


WWDC2012