#WWDC18

Optimizing Your App for Today's Internet

Session 714

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Jiten Mehta, Apple CFNetwork Engineer

Internet growth and Internet Protocol version 6 (IPv6)

Explicit Congestion Notification (ECN)

Multipath TCP (MPTCP)

TCP Fast Open (TFO)

Quick UDP Internet Connections (QUIC)

DNS performance

Avoid “preflight checks”

Transport Layer Security (TLS) 1.3

Certificate Transparency

Bonjour Conformance Test

API choices and guidance

Details on URLSession

Mobile Data Around the World

Four billion people now use the Internet

- Over half the world's population
- Worldwide, growth rate of human users is slowing

But… Internet growth continues nonetheless

- Machine-to-Machine, Internet of Things, Smart Homes
- China, India
- Smartphones, mobile data

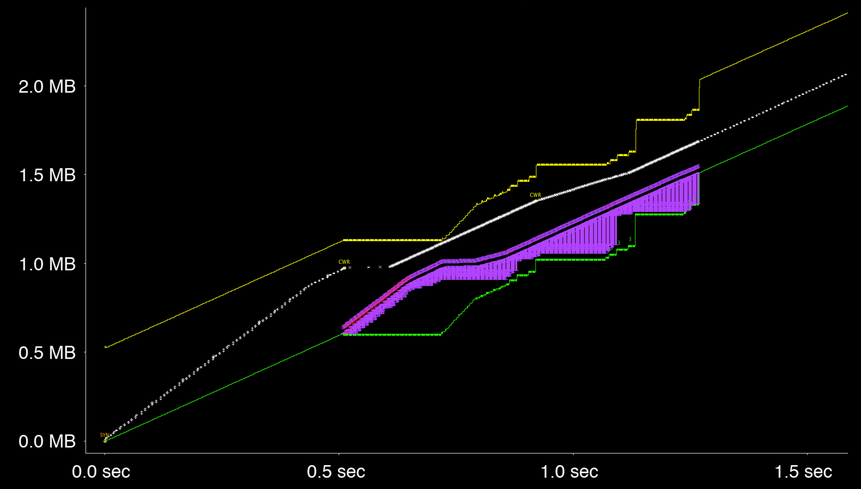
Pay Attention to Less-Than-Ideal Networks

2G mobile networks are still common

Network Link Conditioner (NLC) is your friend

- Approximates real-world network conditions

Use tools like Wireshark and tcptrace to analyze

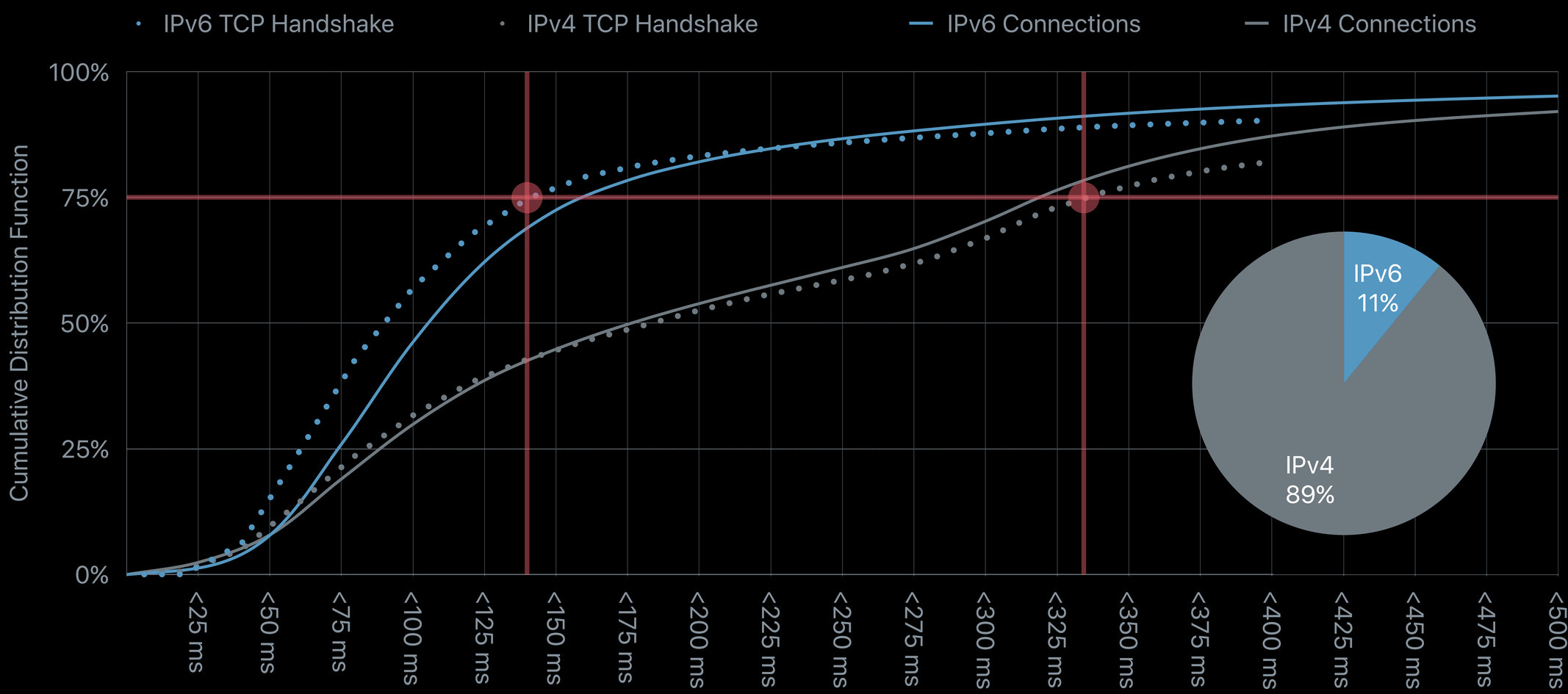


IPv6 Availability

Percentage of connections made on a network that offered IPv6 connectivity

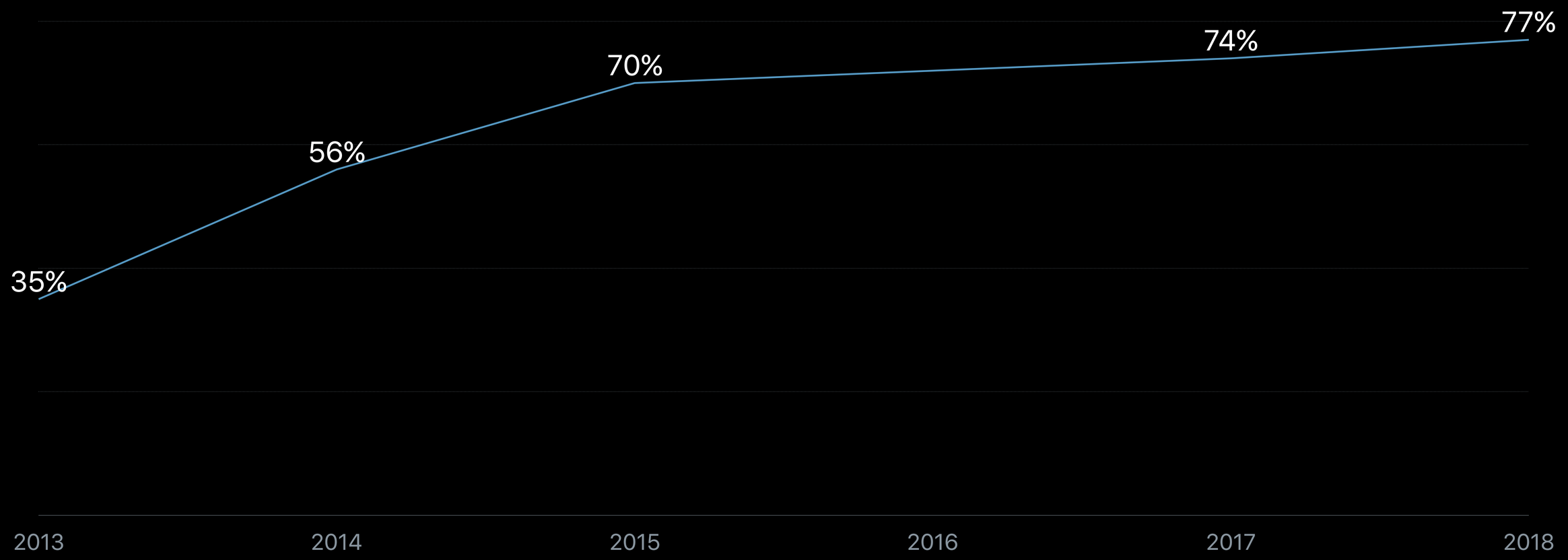
	Wi-Fi	Mobile
Global	29%	44%
US	39%	87%
UK	32%	0.12%
France	35%	0.03%
Germany	50%	34%
Belgium	60%	0.05%
India	34%	29%

India Cellular RTT Values



Explicit Congestion Notification (ECN)

Survey of Alexa top million web sites



Multipath TCP (MPTCP)

Faster connection fail-over

Used with proxies today

Used end-to-end with services like Siri since 2013

Mobile Carriers

- Multipath TCP works on 78 percent of carrier networks worldwide
- 22 percent of carrier networks block Multipath TCP

TCP Fast Open (TFO)

Avoids TCP three-way handshake connection setup time

Quick UDP Internet Connections (QUIC)

New transport protocol

- Potential successor to TCP
- Runs over unreliable datagram layer
- Provides reliable, congestion-controlled streams

IETF Standardization in progress

Apple engineers at meeting in Sweden right now

DNS Performance

Many web sites use short lifetimes on the DNS records

- Sixty seconds or less
- Enables fast fail-over

But data centers rarely go down

- Use of fast fail-over capability is rare
- IP addresses often don’t change from one lookup to the next
- Adds 250 ms delay for no reason
- Some ISPs cache DNS answers for much longer than sixty seconds anyway

Optimistic DNS

Currently used by CloudKit

In DNSServiceQueryRecord or DNSServiceGetAddrInfo, opt in by setting:

- kDNSServiceFlagsAllowExpiredAnswers

Use in conjunction with Happy Eyeballs (RFC 6555)

- Start connection attempt(s) with the address(es) you have now
- If DNS reports additional addresses later, try those too

Avoid SCNetworkReachability

Poor design pattern

Check SCNetworkReachability

Attempt connection

If failure, go to step one

Avoid SCNetworkReachability

Good design pattern

Just connect, using `waitsForConnectivity`

Transport Layer Security (TLS) 1.3

Improved security

Reduced connection setup time

Draft 28 approved by IESG on 21 March 2018

In RFC Editor queue to be published as an IETF RFC this summer

Transport Layer Security (TLS) 1.3

This final version is already in your WWDC seed of iOS 12 for testing

https://developer.apple.com/go/?id=tls13-mobile-profile

```
sudo defaults write /Library/Preferences/com.apple.networkd tcp_connect_enable_tls13 1
```

Certificate Transparency

Background

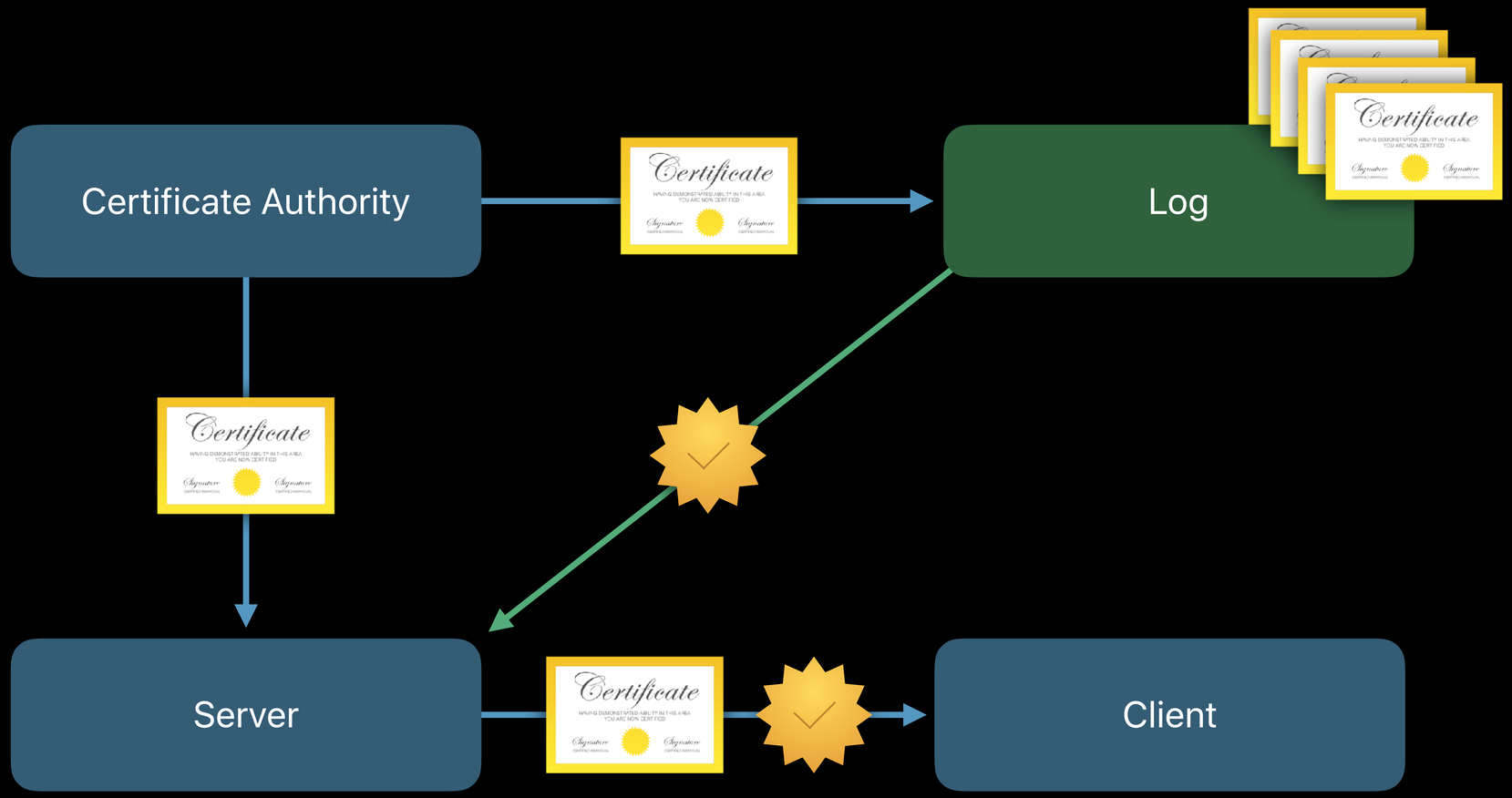
Public verifiable logs of issued certificates

Anyone can submit a certificate to a log

Client checks for proof that certificate has been logged

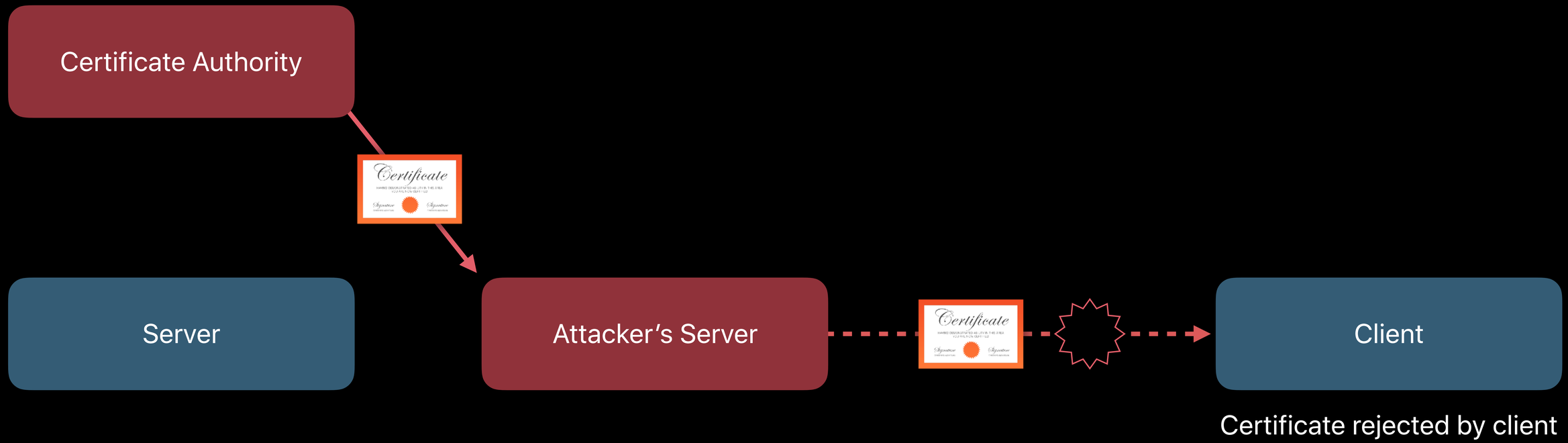
Certificate Transparency

How it works



Certificate Transparency

How it works



Certificate Transparency

New policy

Starting in late 2018:

- All newly issued TLS certificates from publicly trusted CAs must be CT-validated

Currently issued certificates are unaffected

Clients are unaffected

What’s New in Security	WWDC 2016
Your Apps and Evolving Network Security Standards	WWDC 2017

Bonjour Conformance Test

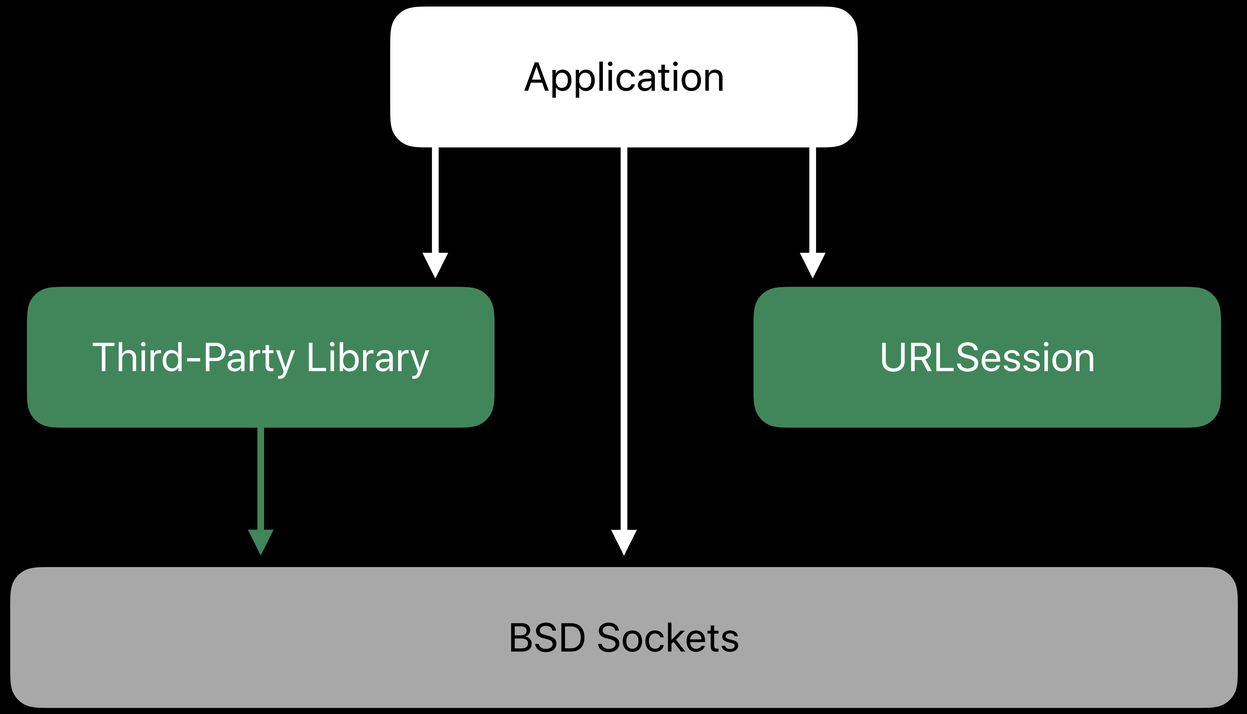
Bonjour Conformance Test certification is required for:

- Using the Bonjour name and logo with your hardware product (no charge)
- Bundling the Bonjour for Windows installer with your Windows application
- AirPrint, AirPlay, CarPlay, HomeKit devices

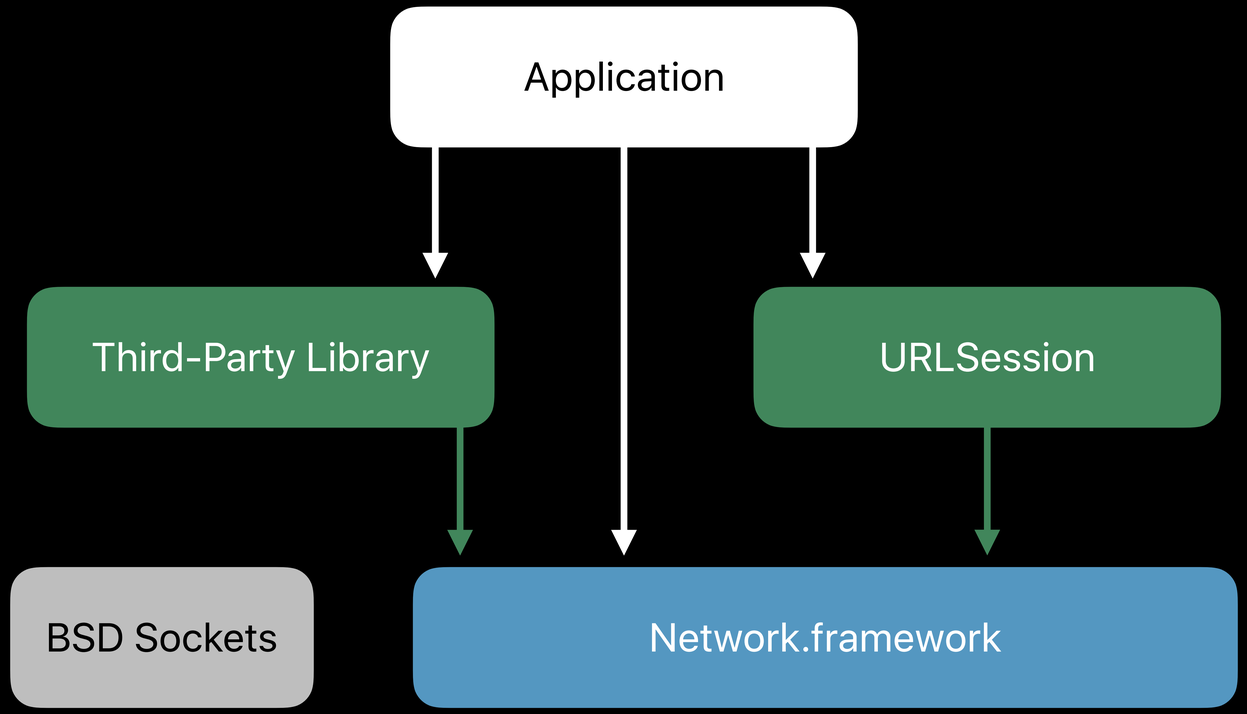
Passing the Bonjour Conformance Test:

- Helps improve your product reliability
- Makes your customers happy
- https://developer.apple.com/softwarelicensing/agreements/bonjour.php

API Choices



API Choices


Application
Third-Party Library
URLSession
BSD Sockets
Network.framework

Guidance

Avoid BSD Sockets

Avoid third-party libraries that use BSD Sockets

If you are the author of a library that uses
BSD Sockets, CFSocketStream, or SecureTransport

- Please look at switching to Network.framework
- Contact Developer Relations with feedback

URLSession

Optimizing your app for best performance

Jiten Mehta, Apple CFNetwork Engineer

Latency

Throughput

Responsiveness

System resources

URLSession

High-level Foundation networking API

- HTTP/2, HTTP/1.1
- In-process and out-of-process transfers
- Handles cookies, cache, authentication, and proxies
- URLSessionStreamTask for TCP connections

Recommended API for all Apple platforms

Latency

Throughput

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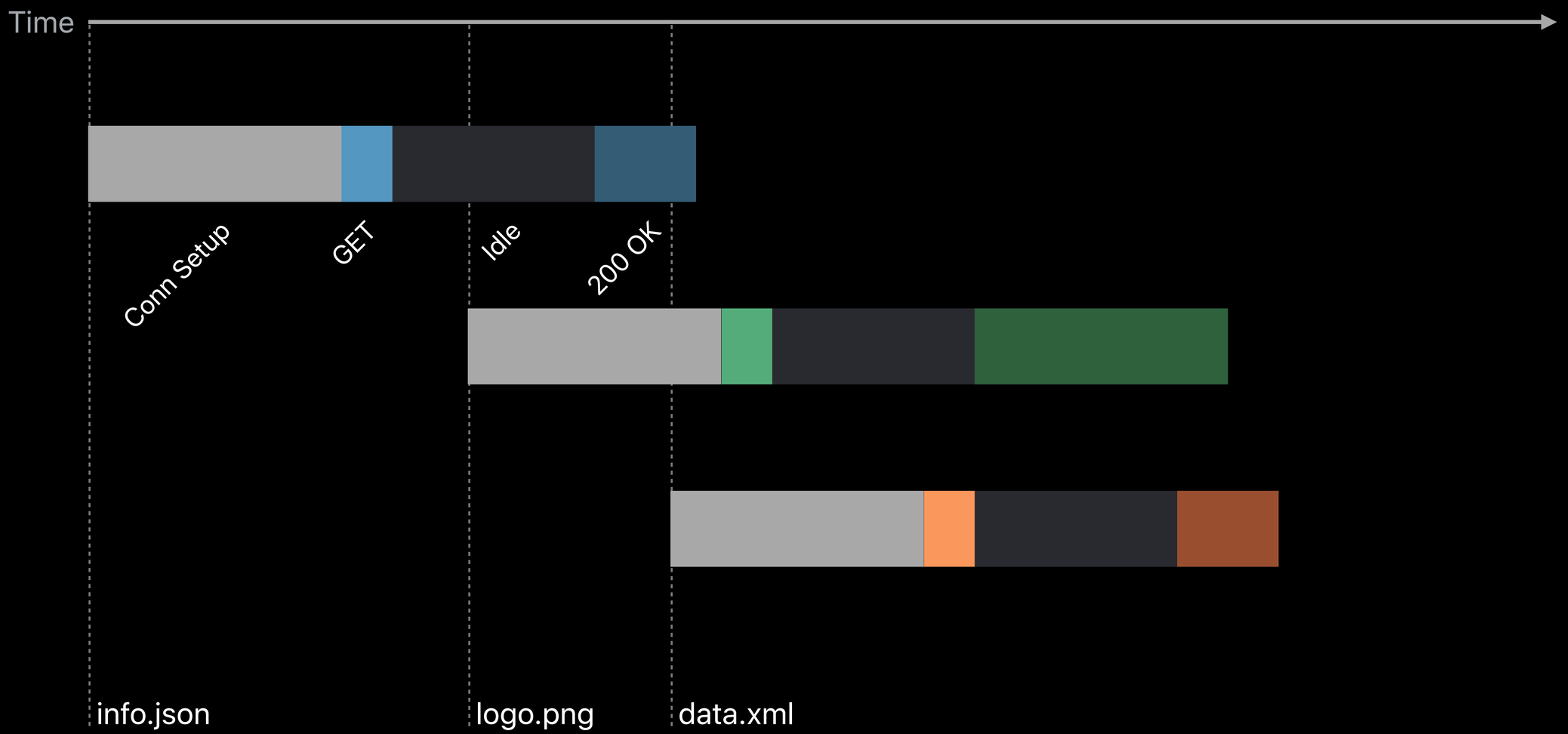
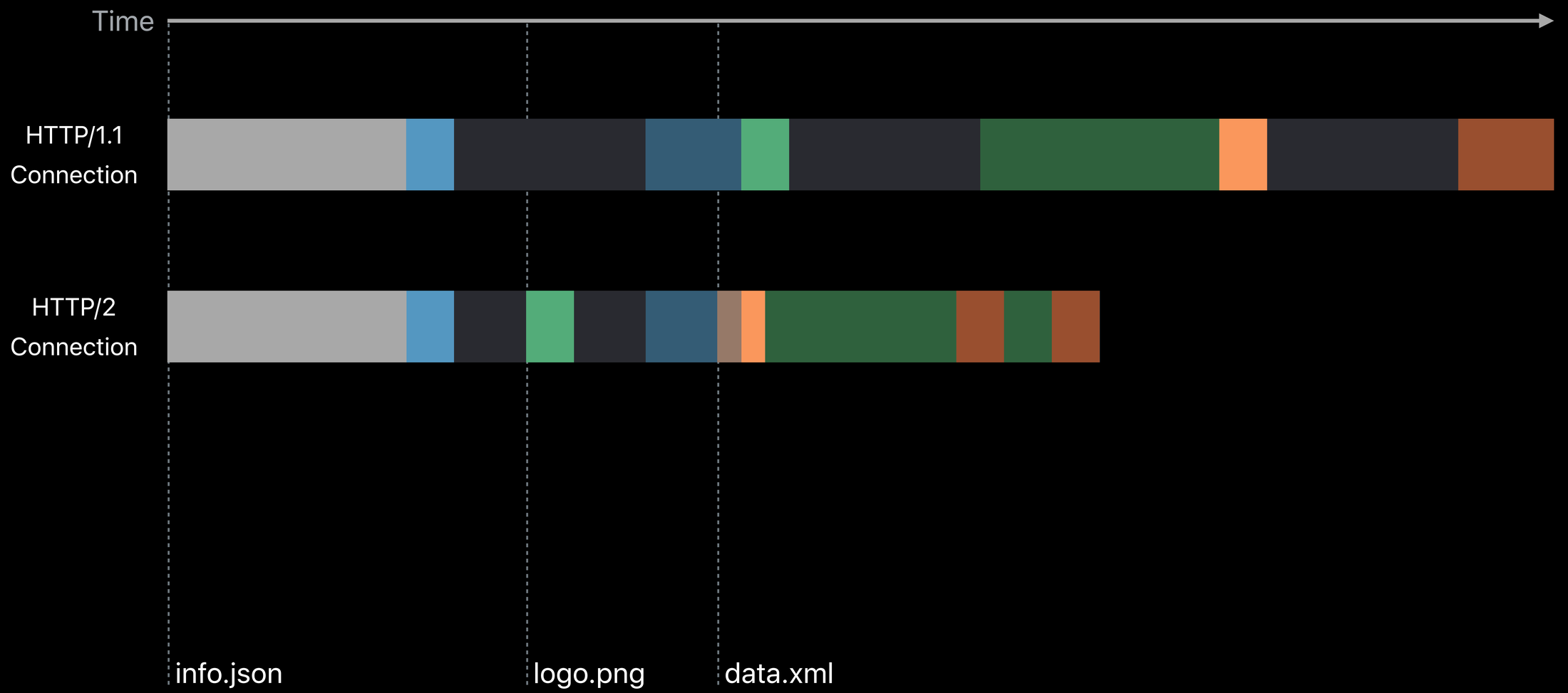
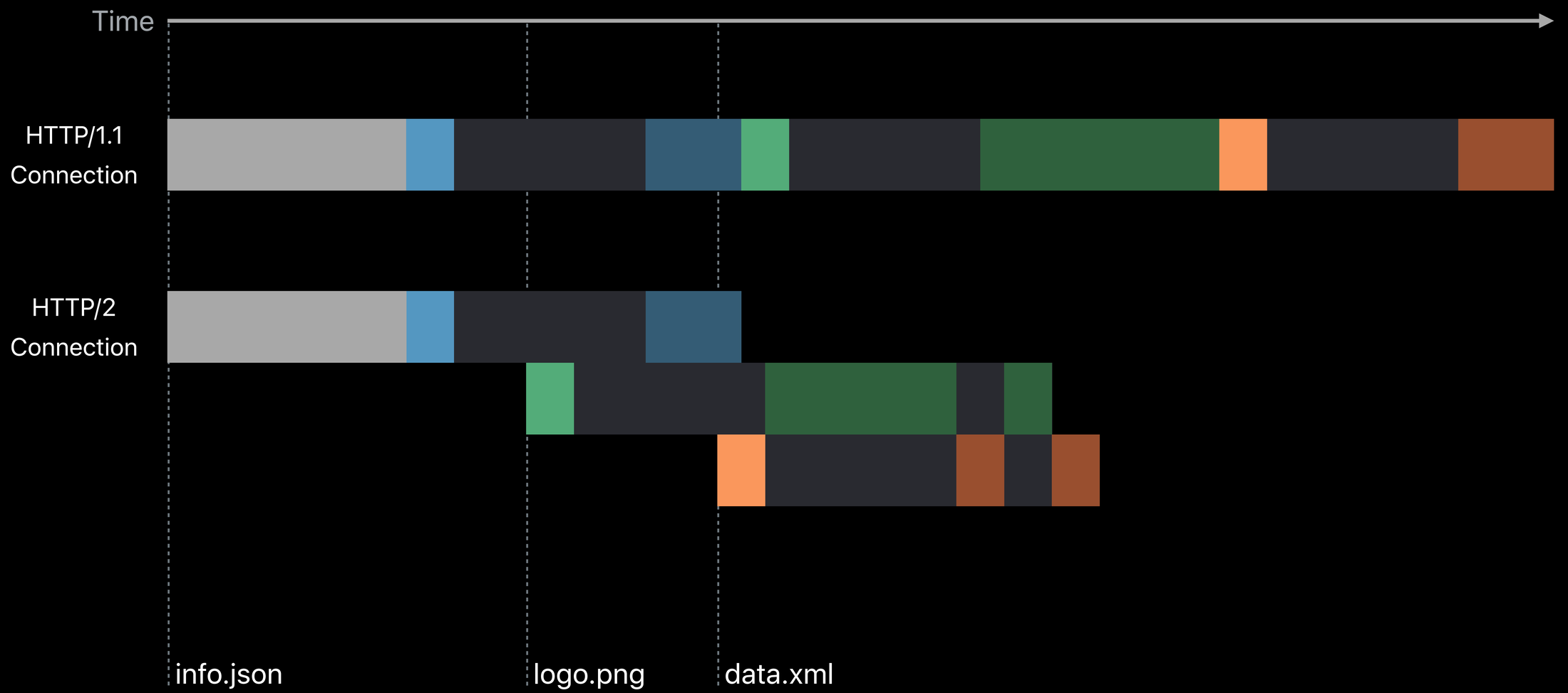
Issues with HTTP/1.1



HTTP/2


Time
HTTP/1.1
Connection
HTTP/2
Connection
info.json
logo.png
data.xml
Idle
Setup
Request
Response

HTTP/2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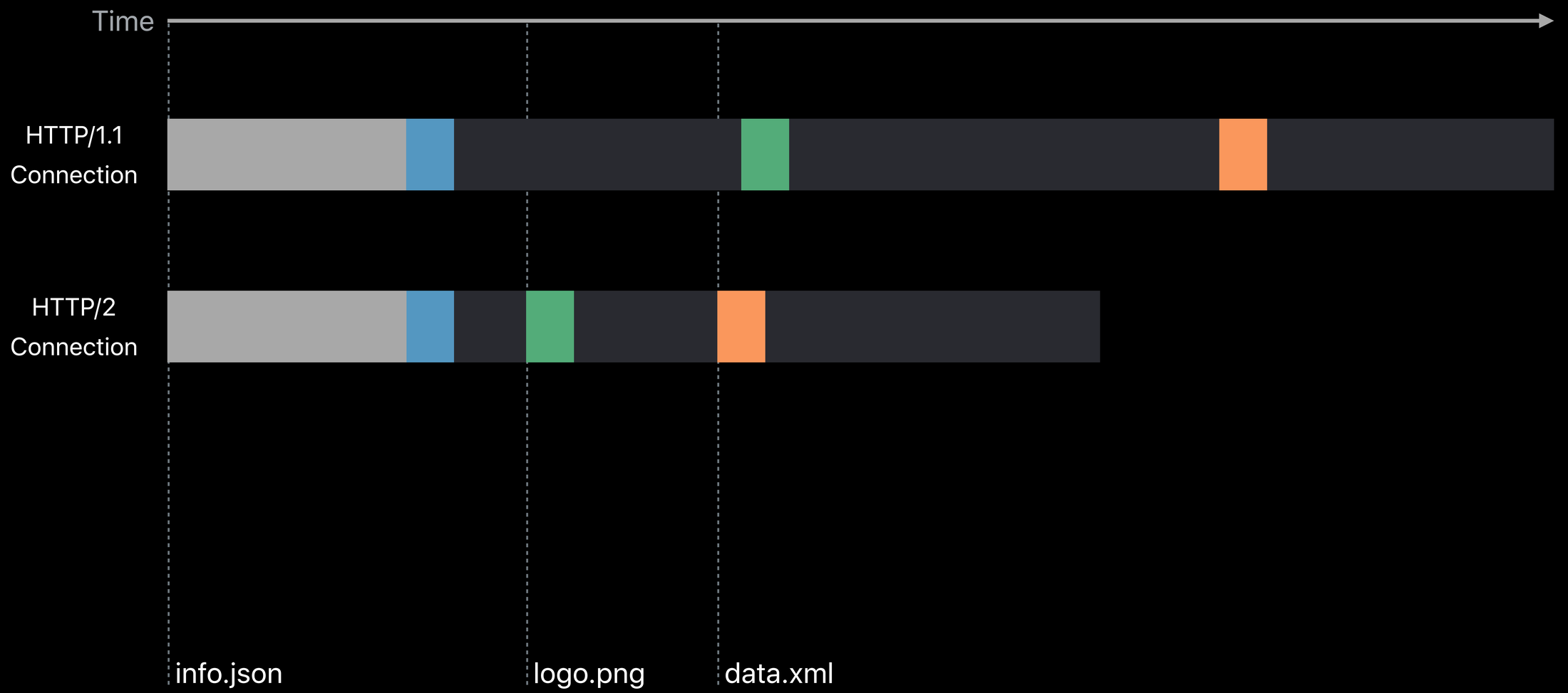
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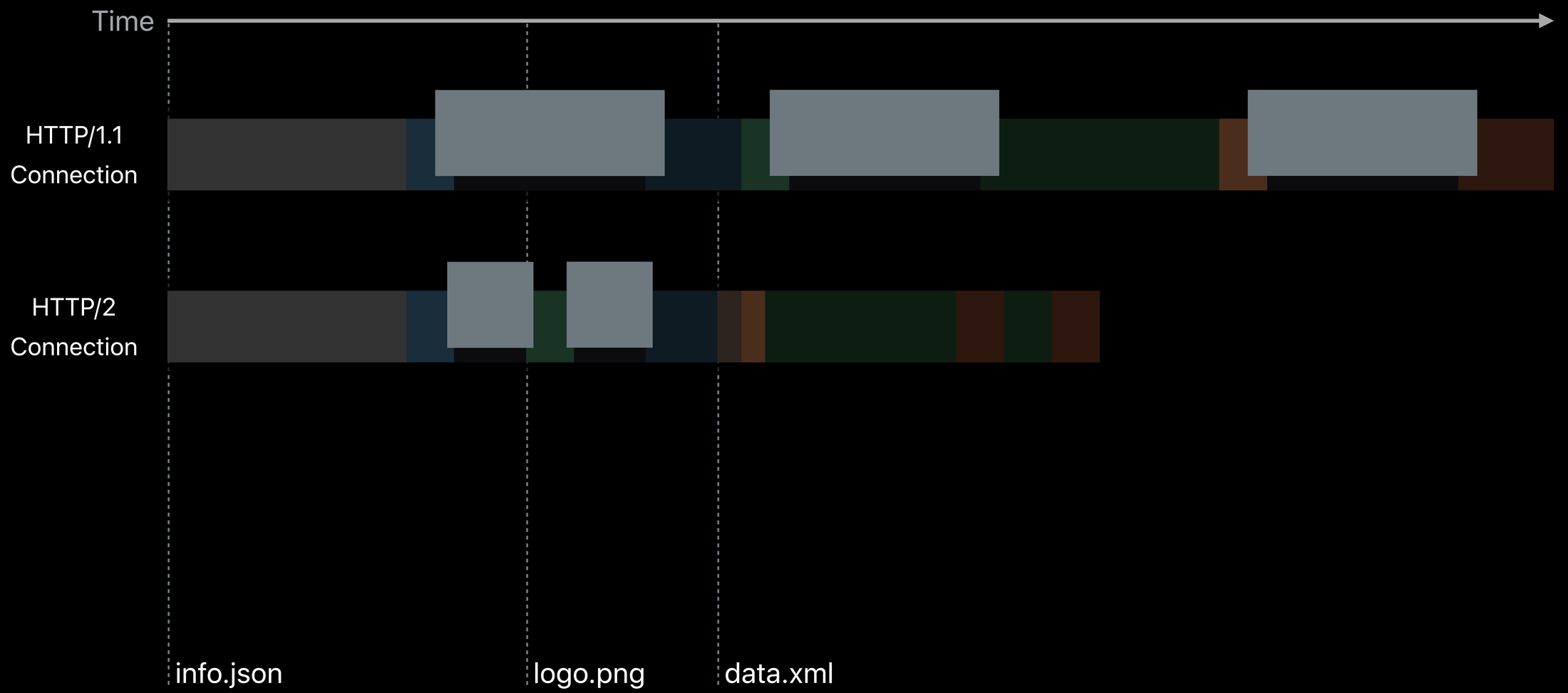
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Upgrade to HTTP/2 Today

No head-of-line blocking at HTTP layer

Better bandwidth utilization

No client-side changes

Server-side savings

HTTP/2 Connection Coalescing

NEW

Reuses connections for multiple hosts when the following conditions are met:

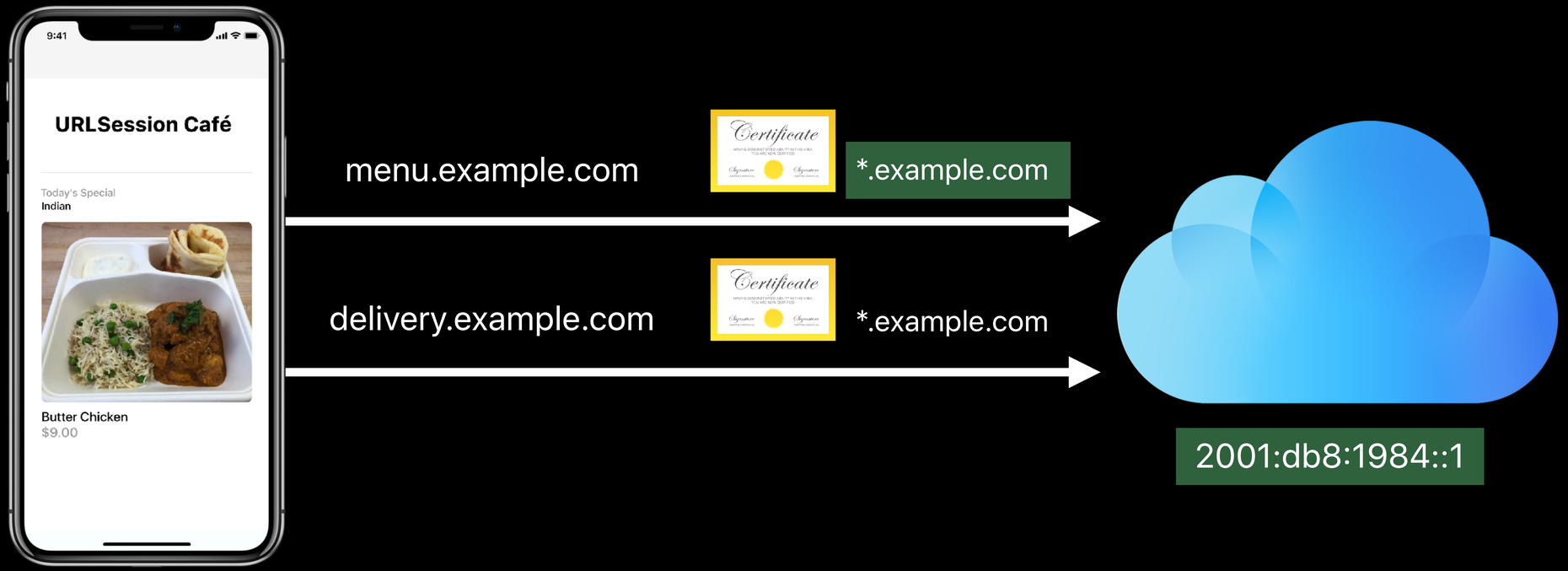
- IP addresses match
- Hostnames covered by same TLS certificate

New URLSession behavior

HTTP/2 Connection Coalescing

Old behavior

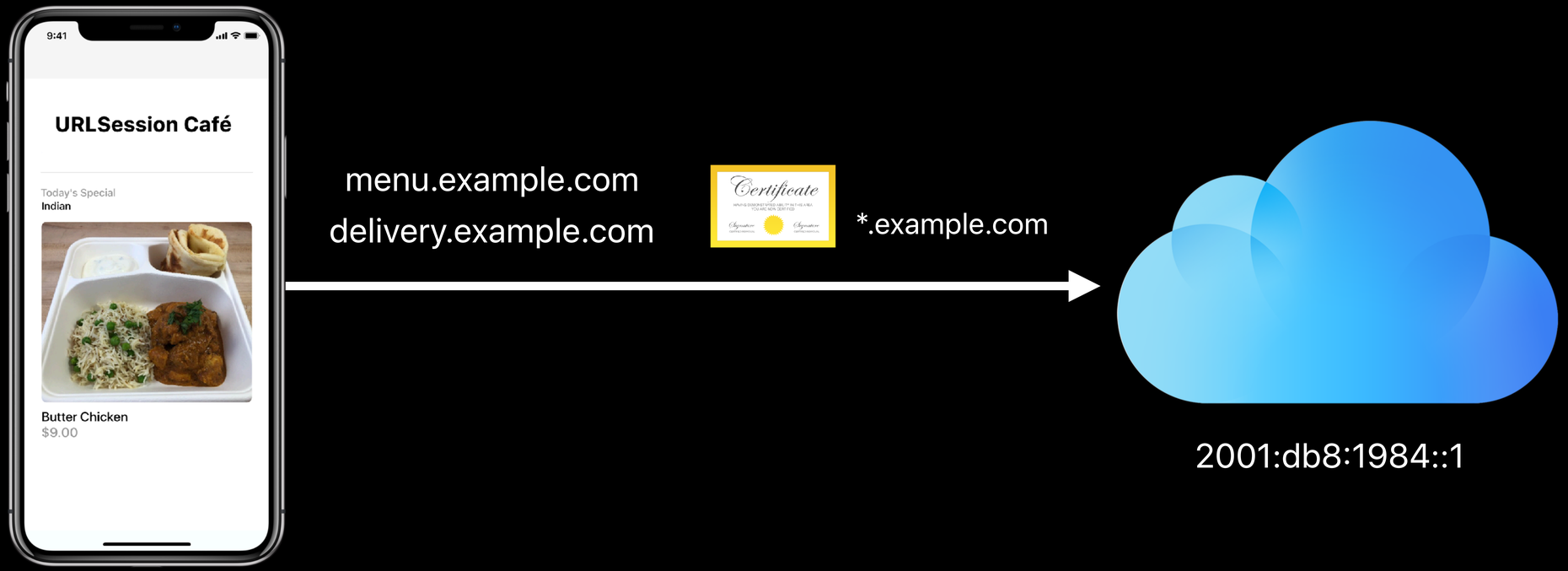
NEW



HTTP/2 Connection Coalescing

New behavior

NEW



Fewer URLSession Objects

Connection reuse

Especially important for HTTP/2

Creating URLSession objects can be expensive

Latency

Throughput

Responsiveness

System resources

Reduce Request Size

HTTP cookies

- Specify domain and path
- Smaller cookies
- Delete unwanted cookies or set expiry
- Save state on server

HTTP/2 header compression

Use HTTP Compression

Gzip

- HTTP and HTTPS

Brotli

- HTTPS only
- Optimized for text and HTML

Latency

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System resources

Quality of Service (QoS) Classes

User-Interactive | User-Initiated | Default | Utility | Background

URLSession is QoS-aware

Dispatch queue QoS is captured at `task.resume()`

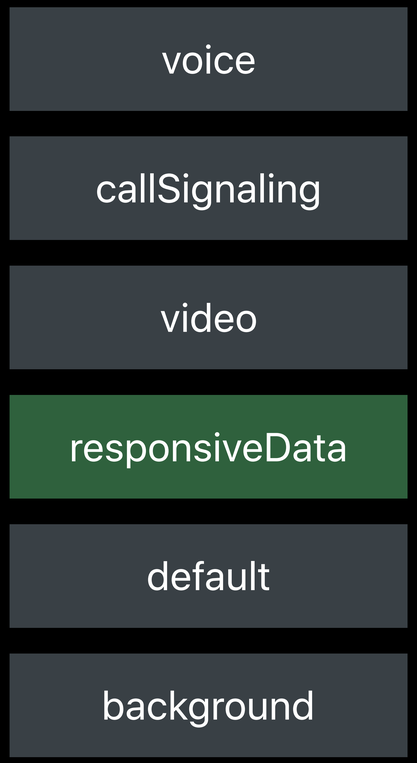
Delegate messages respect your QoS

Network Service Type

NEW

Use default and background for majority

Hint for network switches on Cisco Fast Lane



URLSession Adaptable Connectivity

Requests are sent as soon as we have connectivity

Enable `waitsForConnectivity` for every URLSession

```
// Optionally implement the delegate method
func urlSession(_ session: URLSession, taskIsWaitingForConnectivity task: URLSessionTask) {
    // Present fallback UI or error message
}
```

Call `task.cancel()` if resource is no longer needed

Latency

Throughput

Responsiveness

System resources

Use Background Sessions

Utilizes system intelligence

Transfers continue when your app is not running

```
// Optionally set isDiscretionary for non-urgent downloads
let configuration = URLSessionConfiguration.background(withIdentifier: "com.apple.example")
configuration.isDiscretionary = true
```

Cache Wisely

Ephemeral sessions

Don’t cache unique content

```
// Implement delegate method to decide when to cache content
func urlSession(_ session: URLSession, dataTask: URLSessionDataTask,
                willCacheResponse proposedResponse: CachedURLResponse,
                completionHandler: @escaping (CachedURLResponse?) -> Void) {
    // If you don't want to cache
    completionHandler(nil)
}
```

Server-side `Cache-Control: no-store` header

Recap

Advice	Latency	Throughput	Responsiveness	System Resources
Move to HTTP/2	✓	✓		
Fewer URLSessions	✓			✓
Reduce request size		✓		
QoS			✓	
Background sessions				✓

More Information

https://developer.apple.com/wwdc18/714

Introducing Network.framework: A modern alternative to Sockets	Hall 3	Thursday 11:00AM
Networking Lab		Thursday 2:00PM
Networking Lab		Friday 9:00AM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