

What's New in Foundation Networking

A session on NSURLSession

Session 705

Steve Algernon

Senior Wrangler

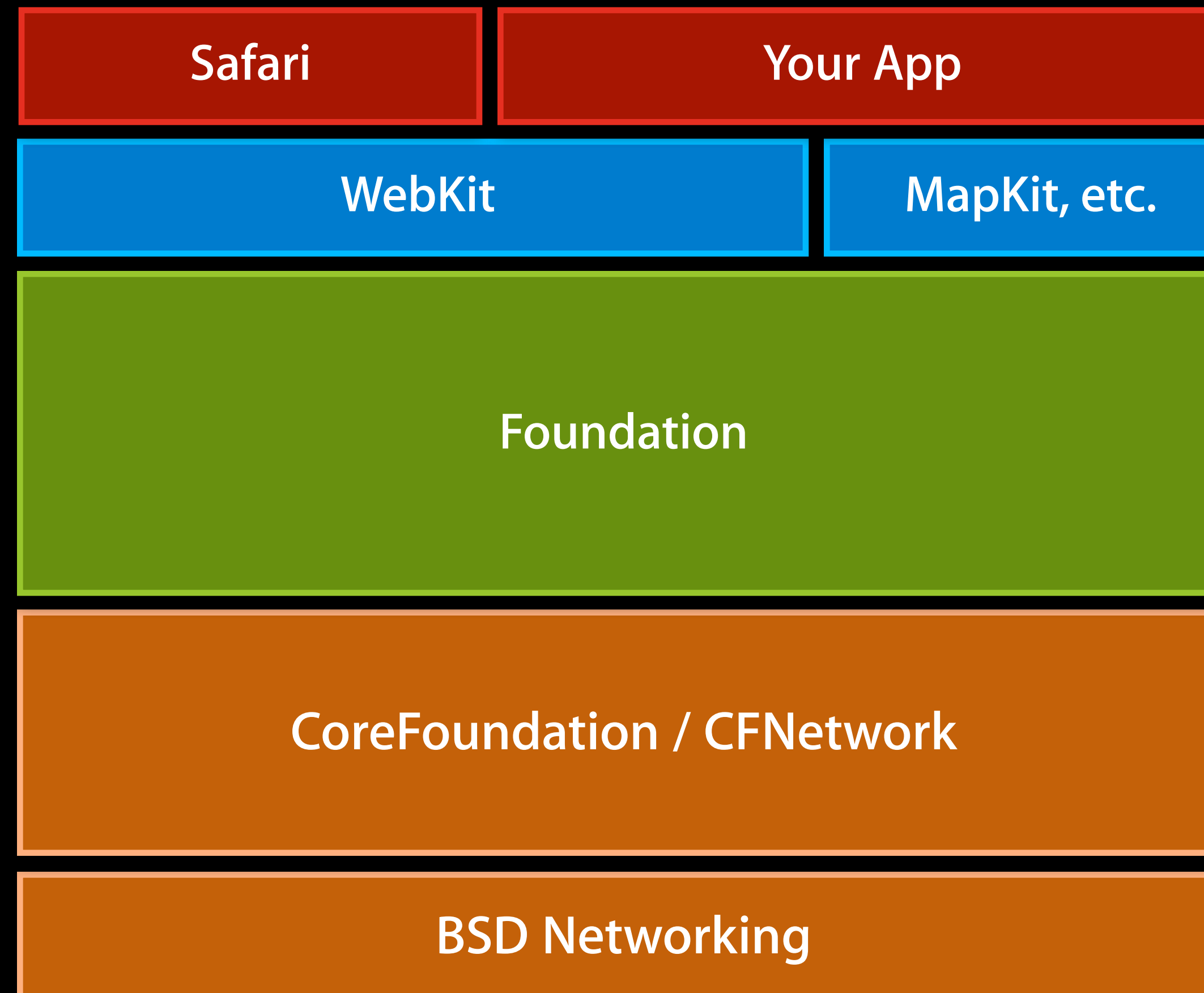
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What's New in Foundation Networking

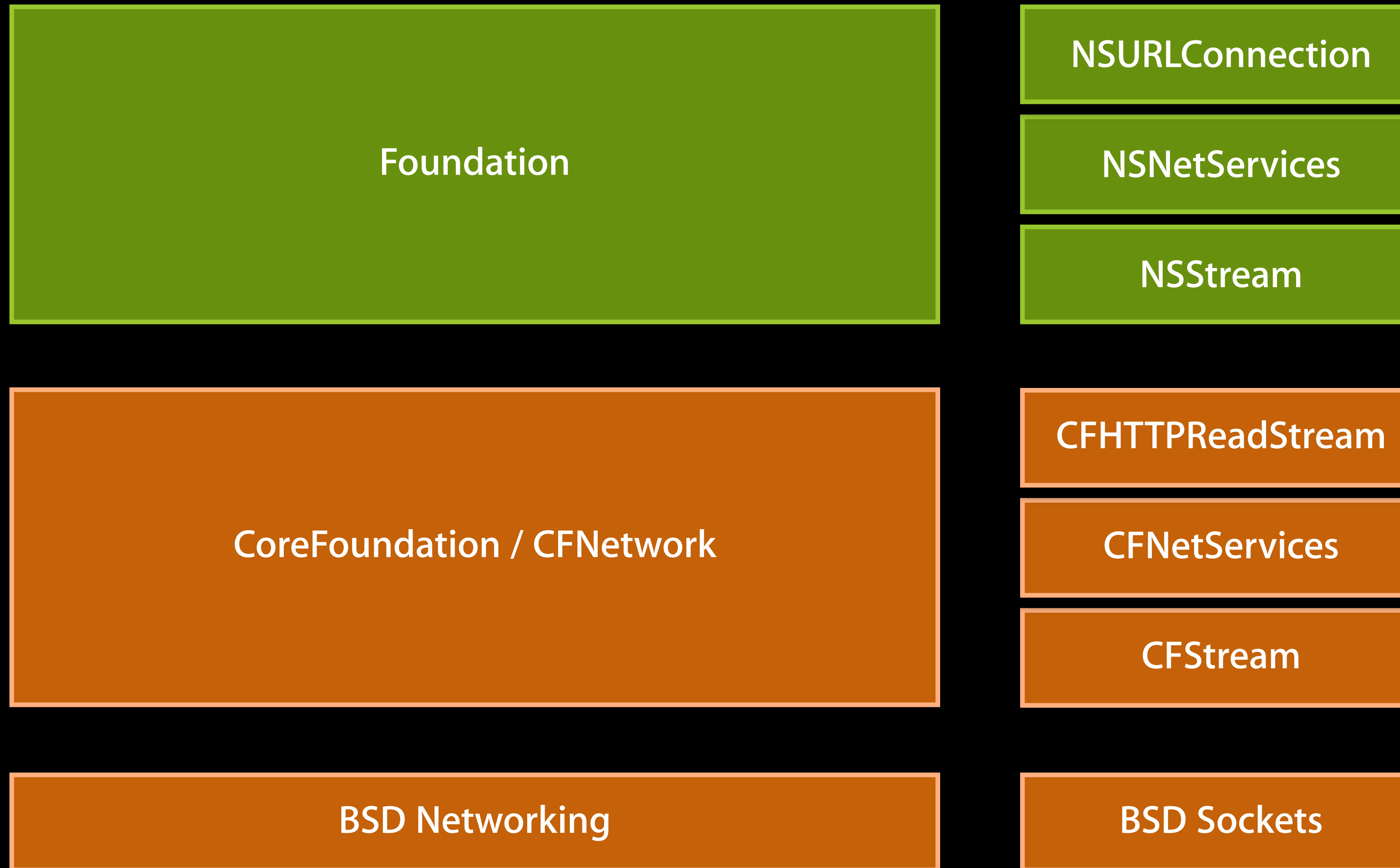


- New NSURLSession API
 - iOS 7, OS X 10.9
 - Out-of-process background transfers
- Framework Enhancements
 - NSNetServices
 - Single sign-on
 - iCloud credential syncing

Foundation Networking



Foundation Networking



Foundation Networking

NSURLConnection

NSURLSession

Foundation Networking

NSURLSession

NSURLConnection

NSURLConnection

- Both a technology and a specific class
- Originally written for Safari, available via Foundation
 - WWDC 2003 - Session 418
- URL resolution and loading
 - file:// http:// https:// data://
 - Extensible via NSURLProtocol
- URL Loading machinery, policies
 - Configured via NSURLRequest properties
 - Shared Persistent Storage: Cache, Credentials, Cookies
- Authentication and Proxies

NSURLConnection

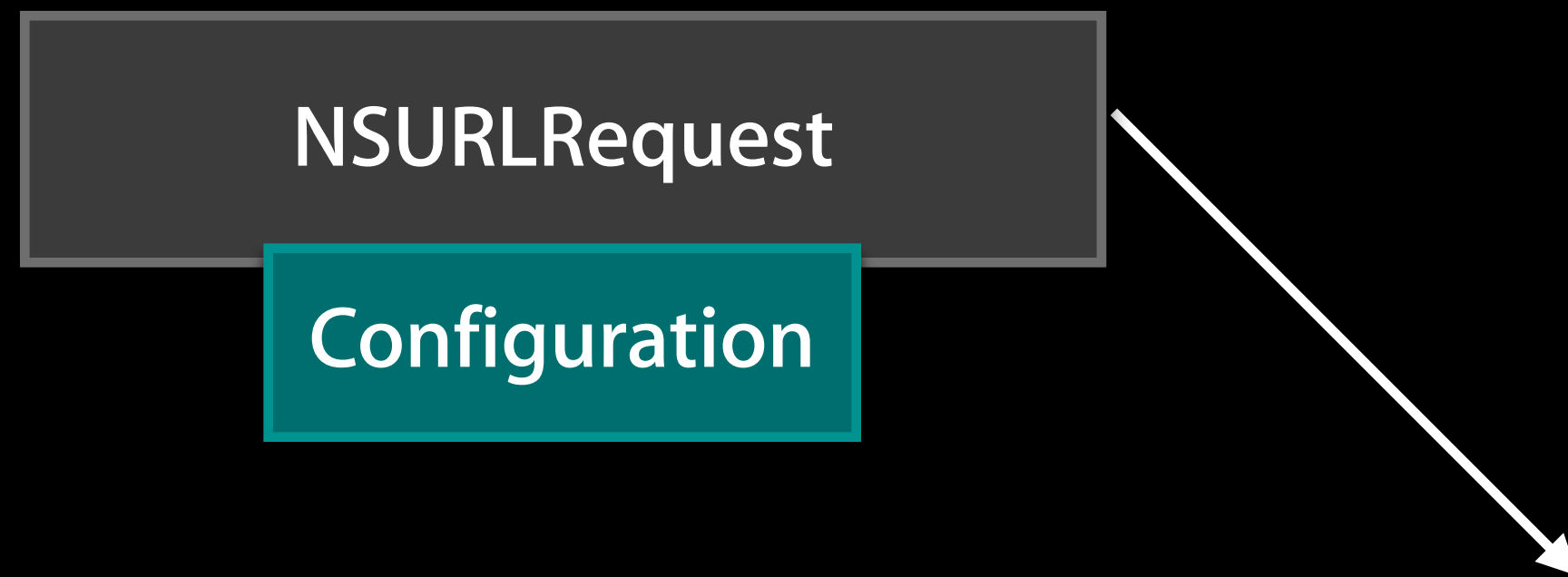
NSURLConnection



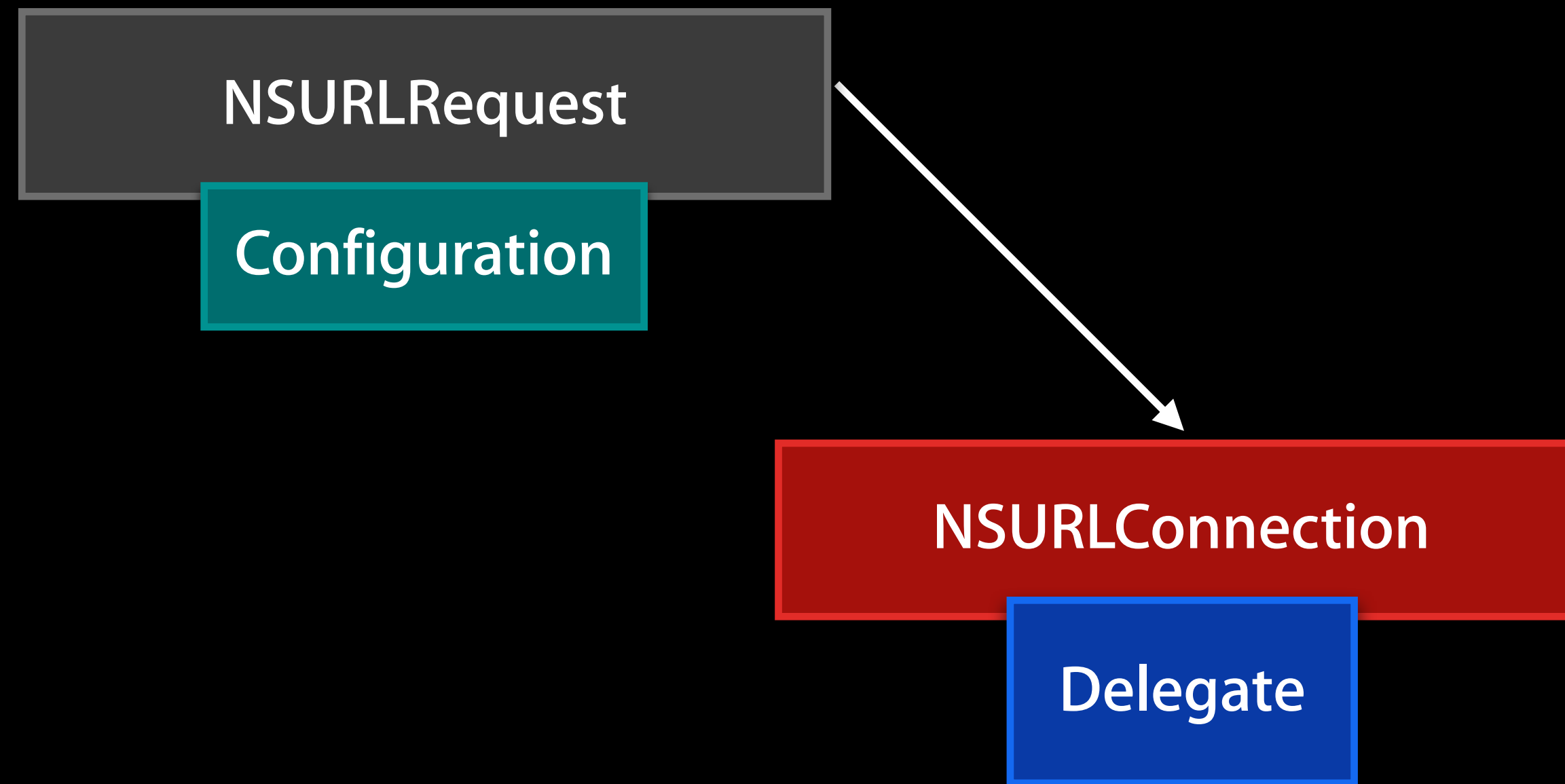
```
graph TD; NSURLRequest[NSURLRequest] --> NSURLConnection[NSURLConnection];
```

NSURLRequest

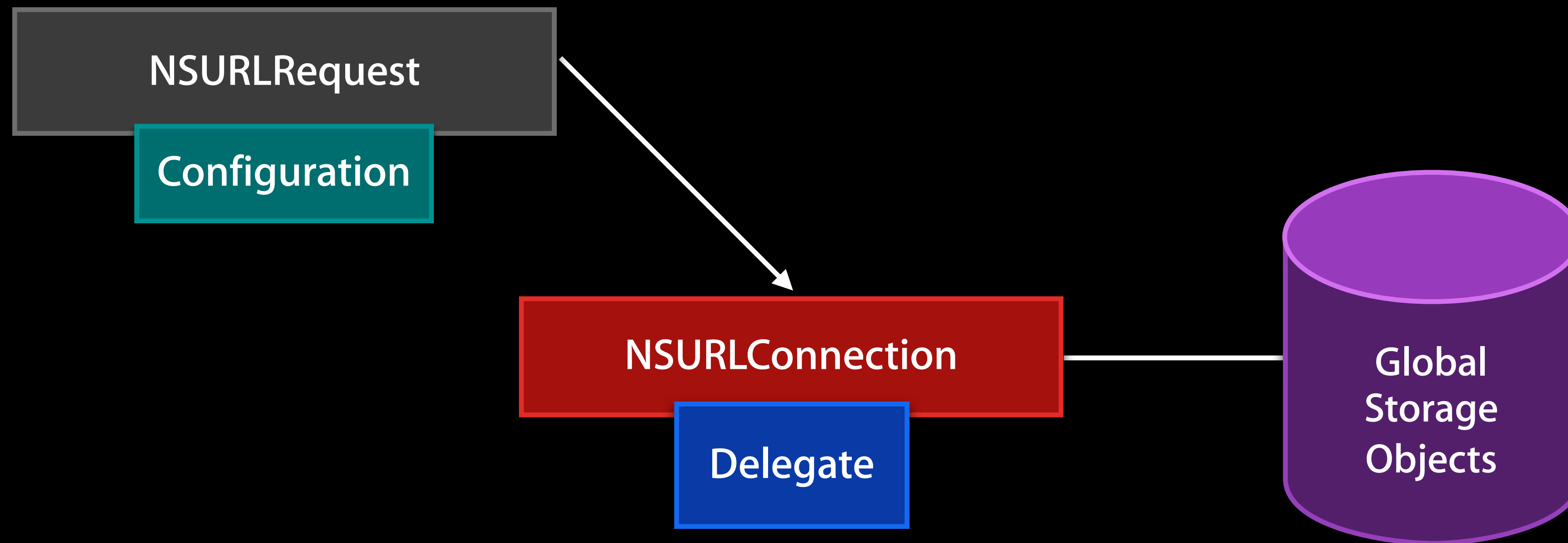
NSURLConnection



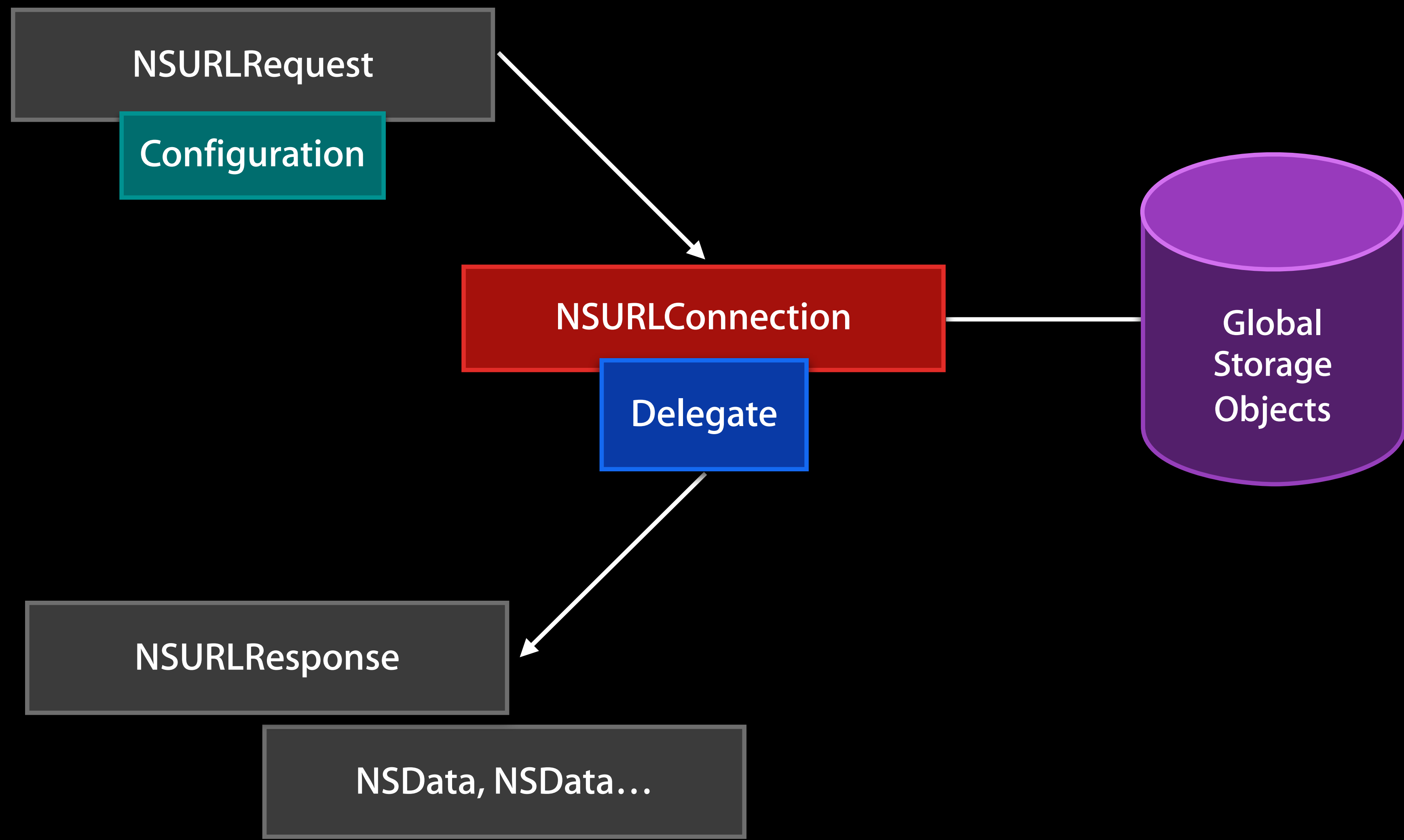
NSURLConnection



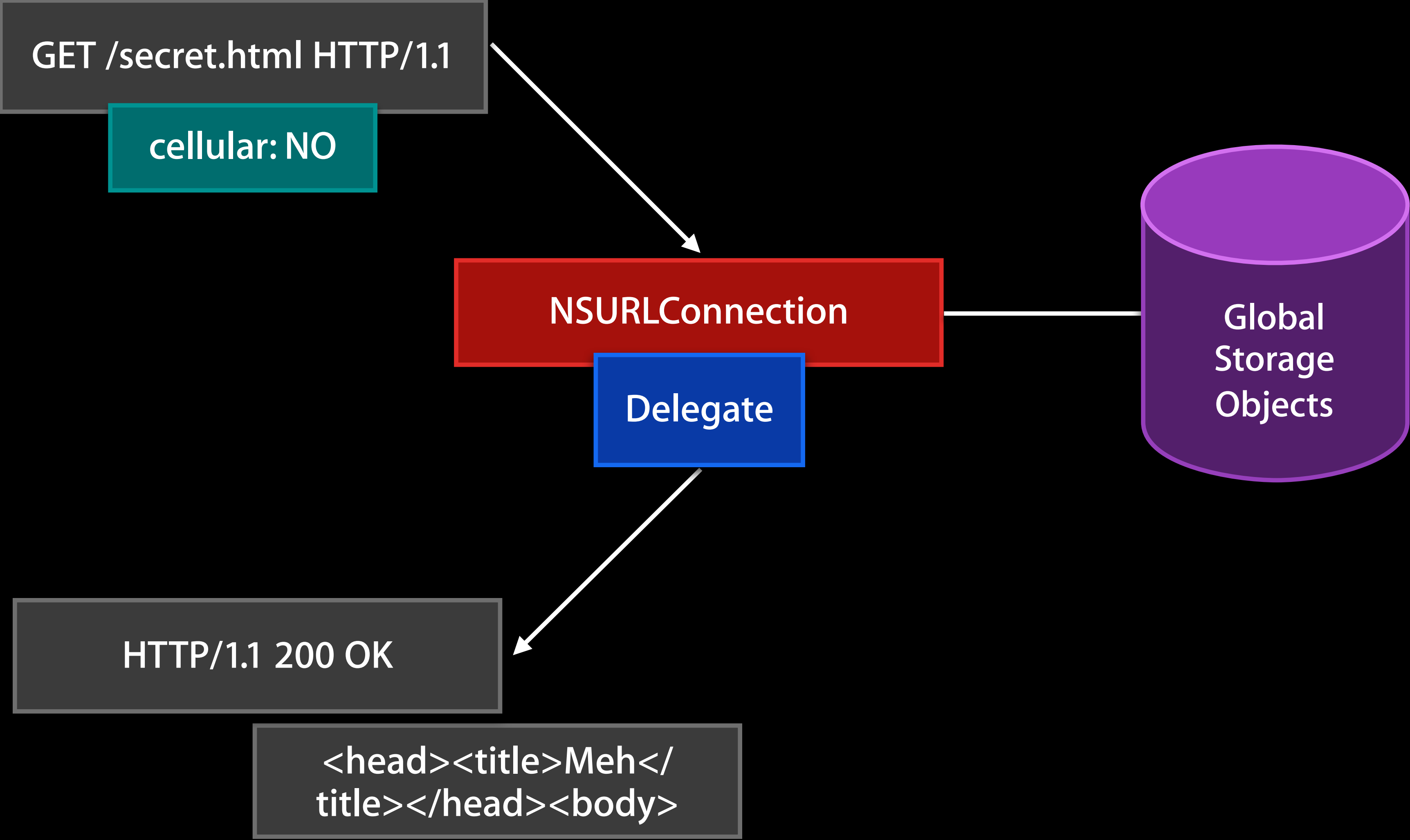
NSURLConnection



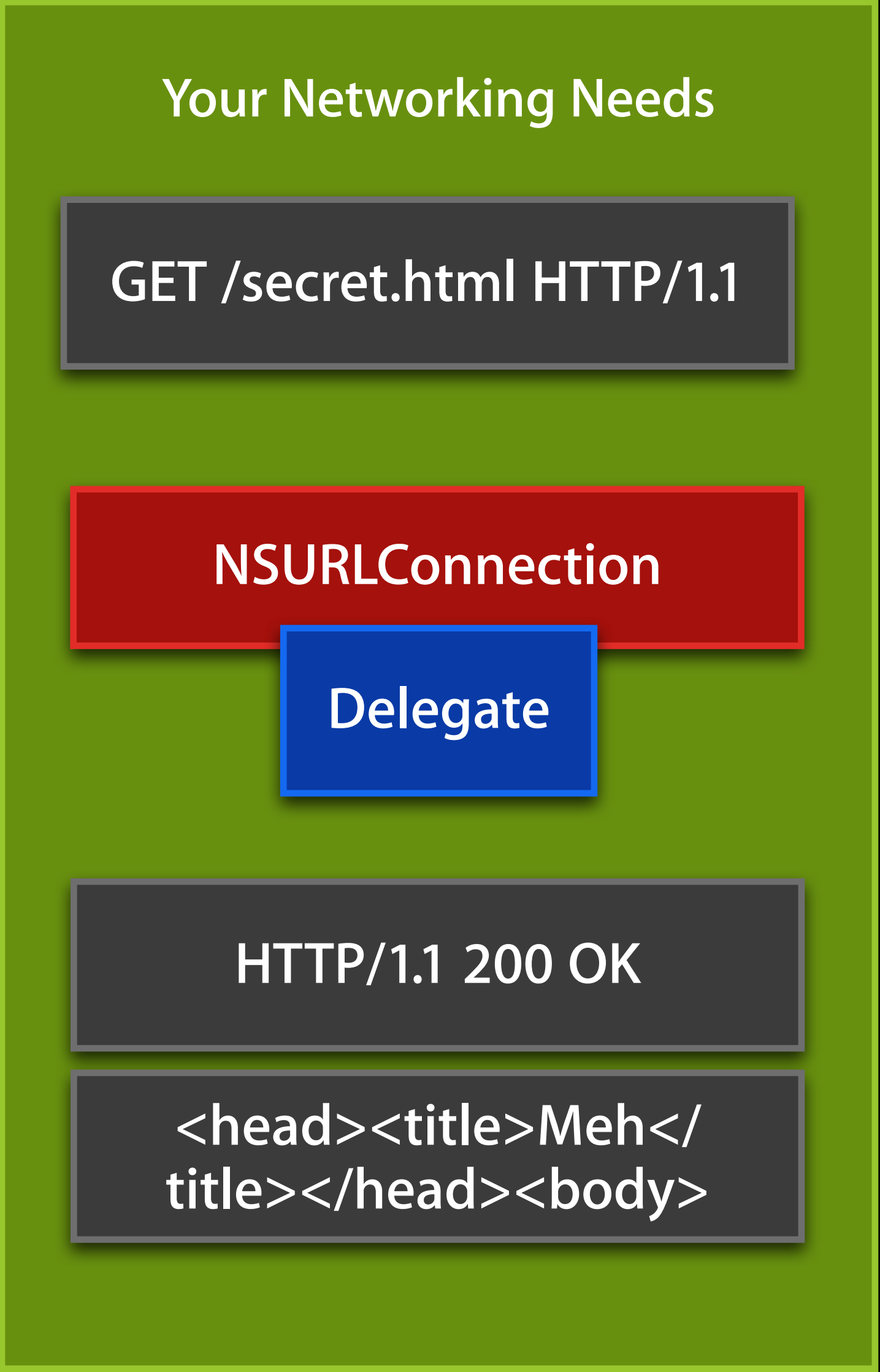
NSURLConnection



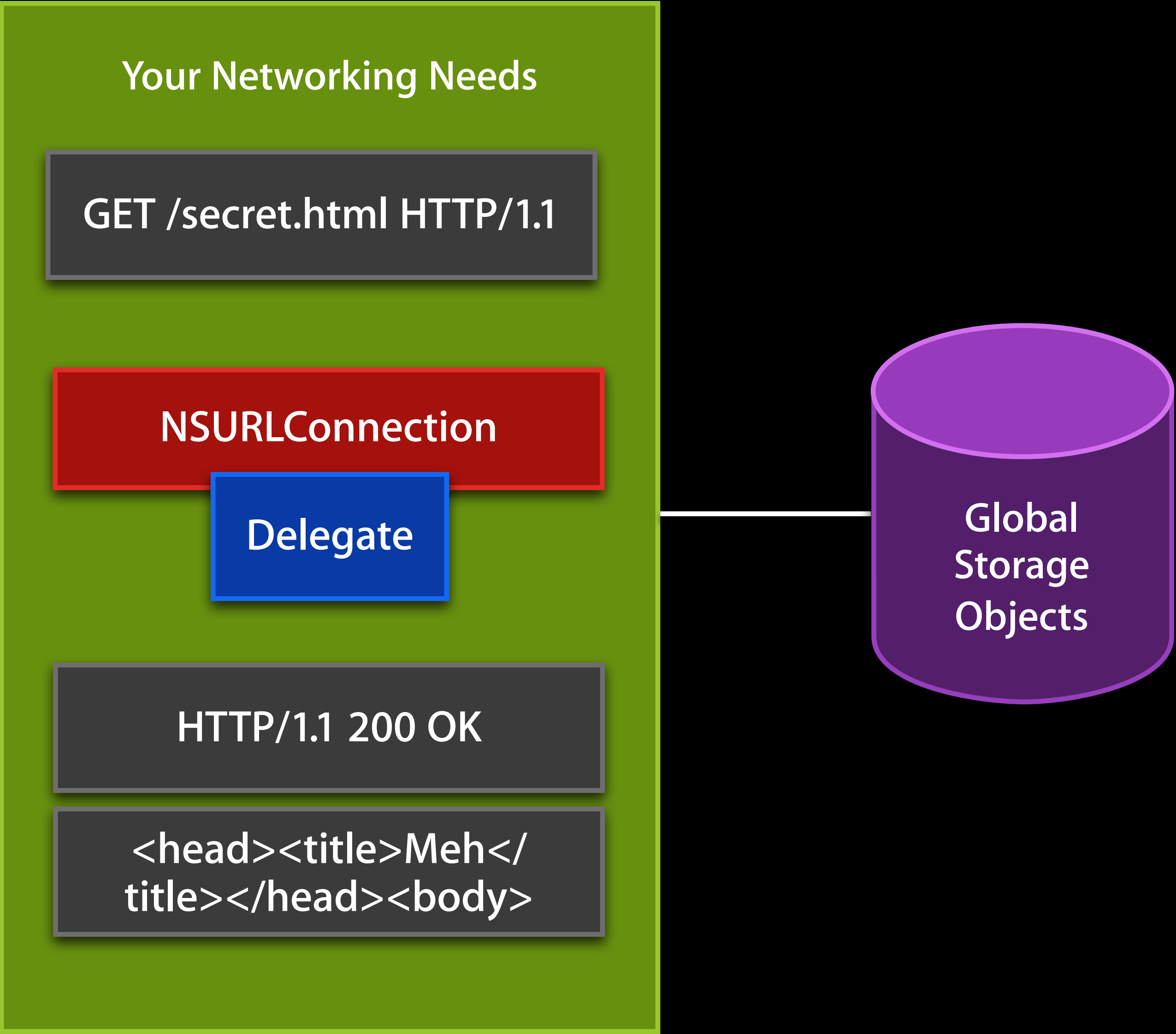
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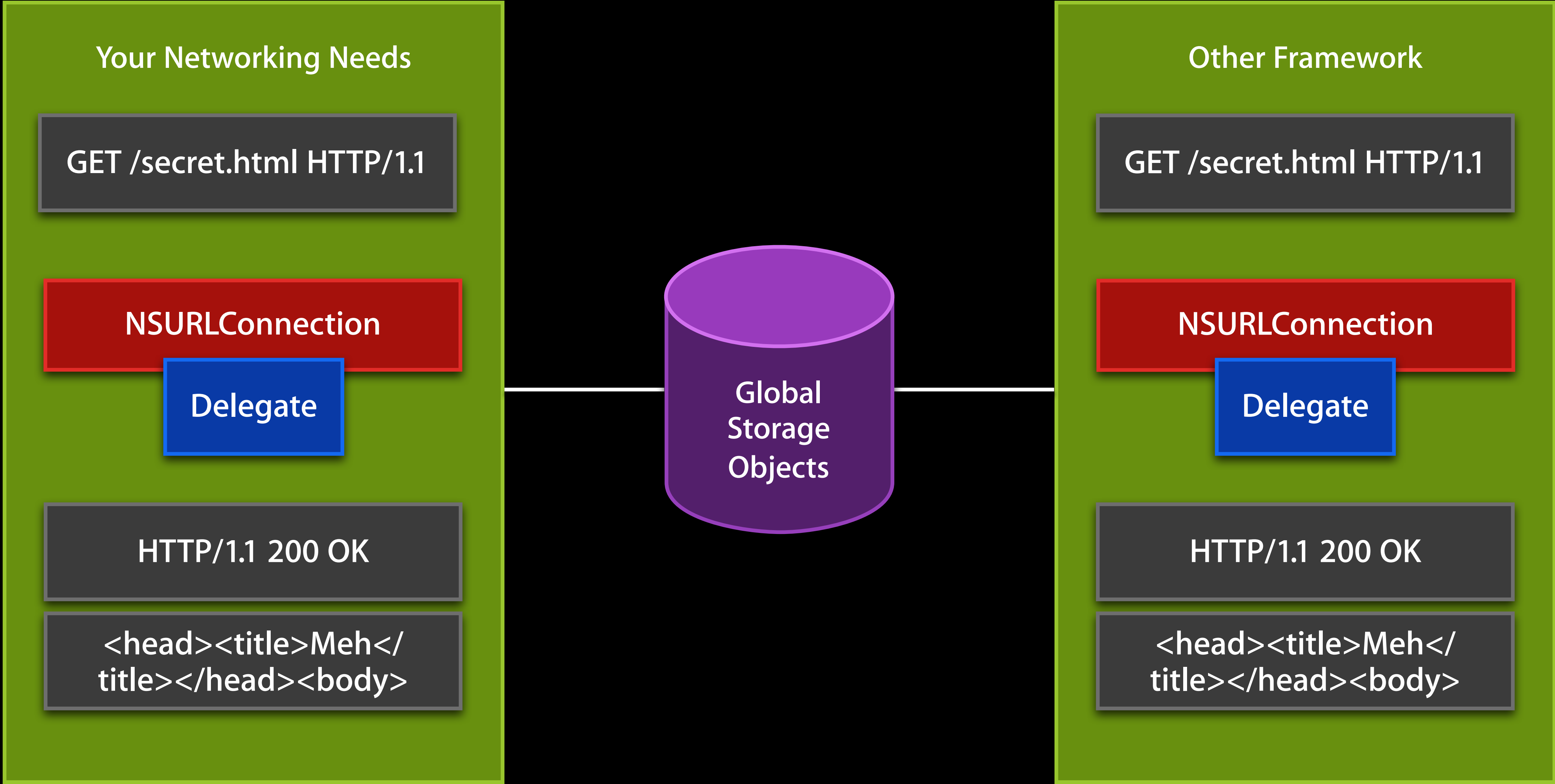
NSURLConnection



NSURLConnection



NSURLConnection



NSURLSession



- Both a technology and a specific class
- Replaces NSURLConnection
 - Preserves existing concepts and objects
 - NSURLRequest, NSURLResponse, etc.
- Configurable Container
 - HTTP options
 - Subclassable and private storage
- Improved authentication handling
 - Connection vs. Request authentication
- Rich delegate model

NSURLSession



- Uploads/Downloads through the filesystem
- Encourages separation of Data from Meta-Data
 - NSURLRequest + payload
 - NSURLResponse + payload
- Out-of-process Uploads and Downloads
 - Uses same delegate model as in-process transfers
 - Optimizes battery life
 - Supports UIKit multitasking

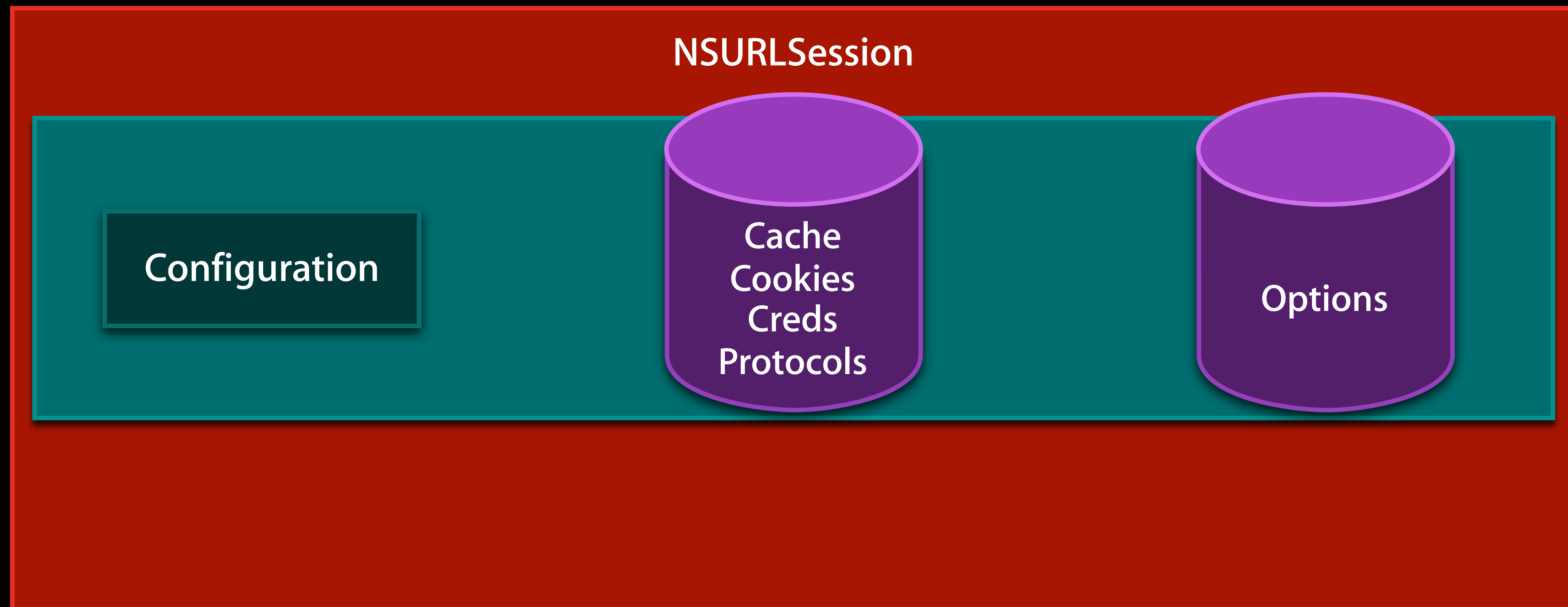
NSURLSession

NSURLSession

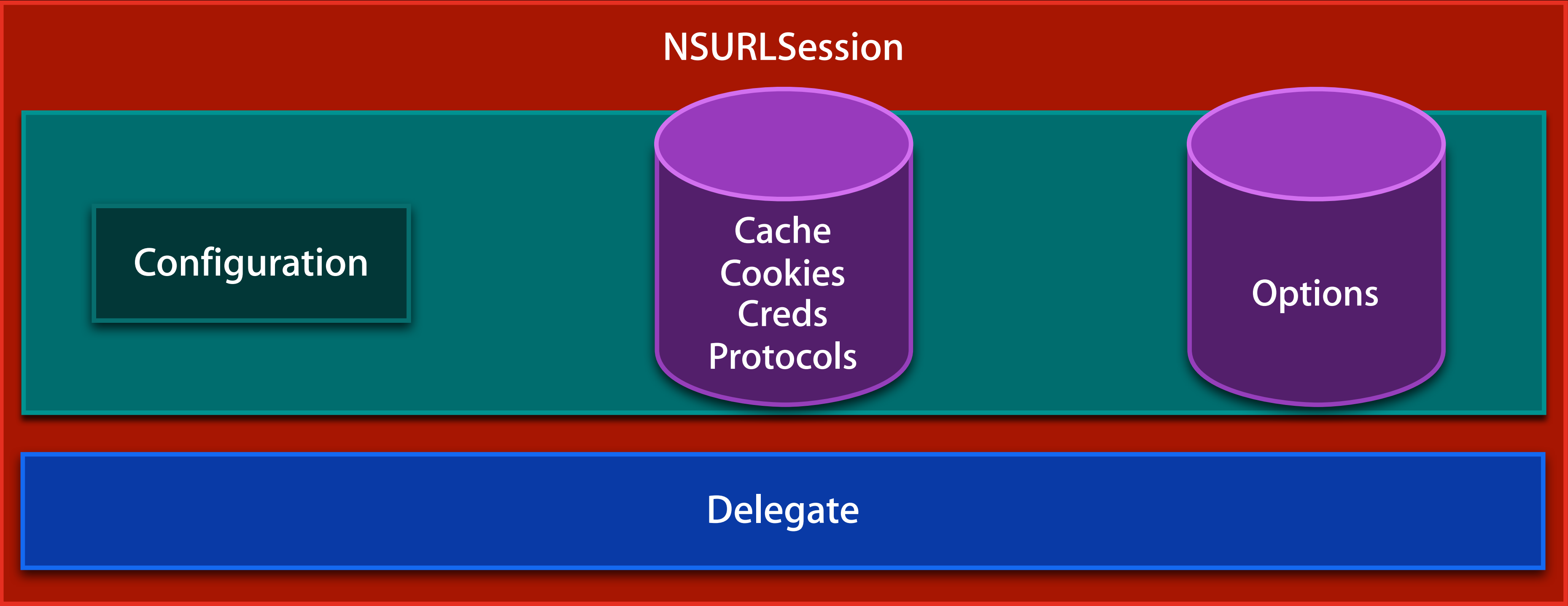


NSURLSession

NSURLSession

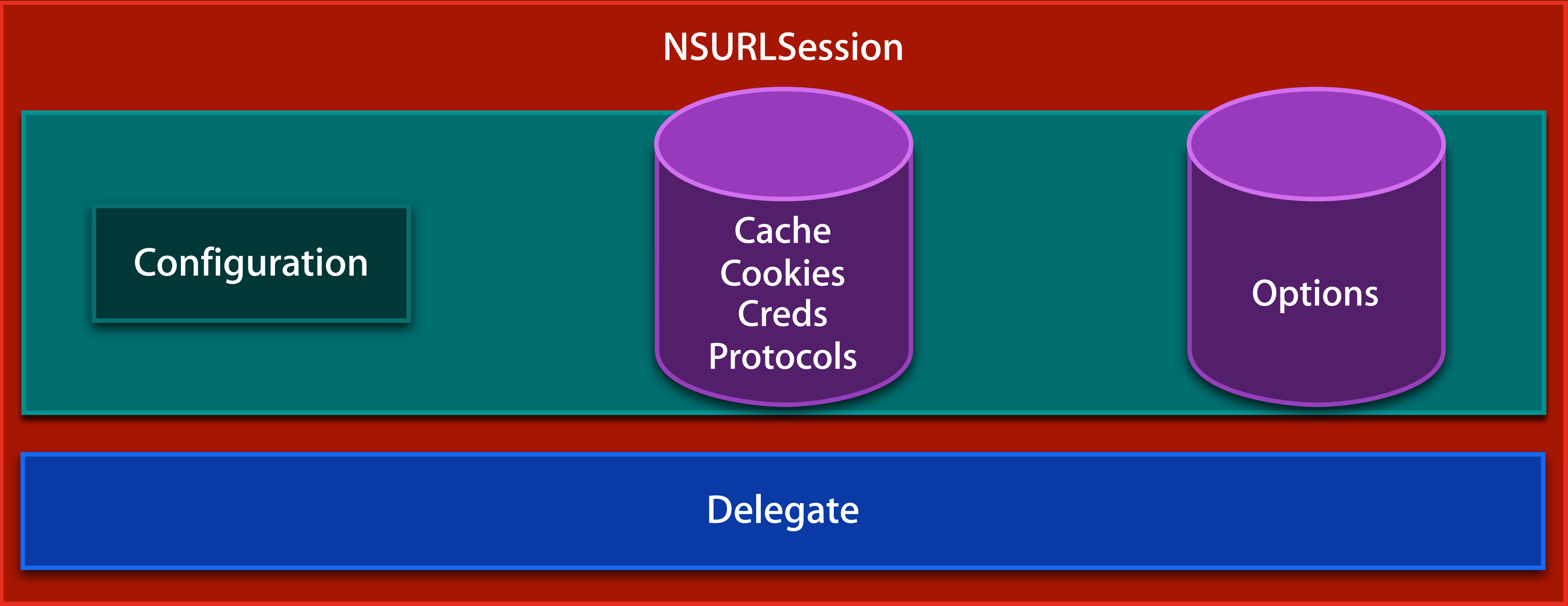


NSURLSession



NSURLSession

GET /foo.html HTTP/1.1



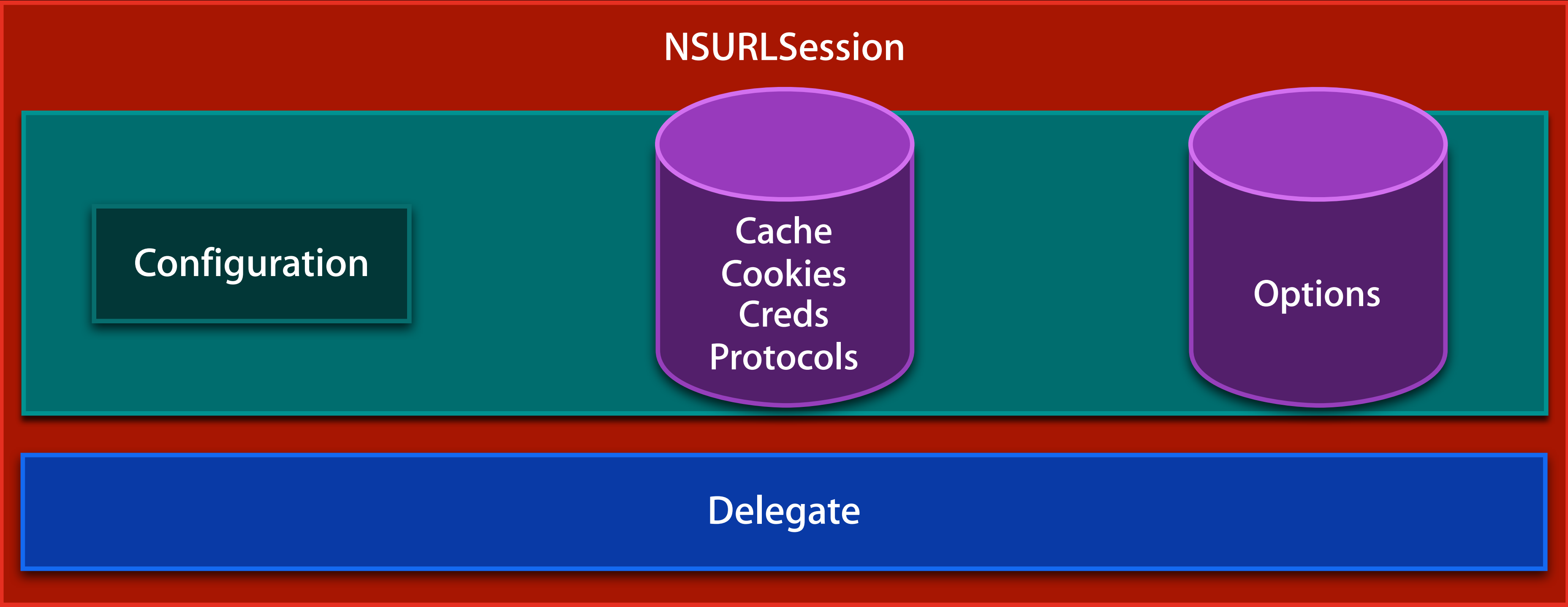
HTTP/1.1 200 OK

<head><title>weeble</title></head><body>

NSURLSession

GET /foo.html HTTP/1.1

GET /bar.html HTTP/1.1



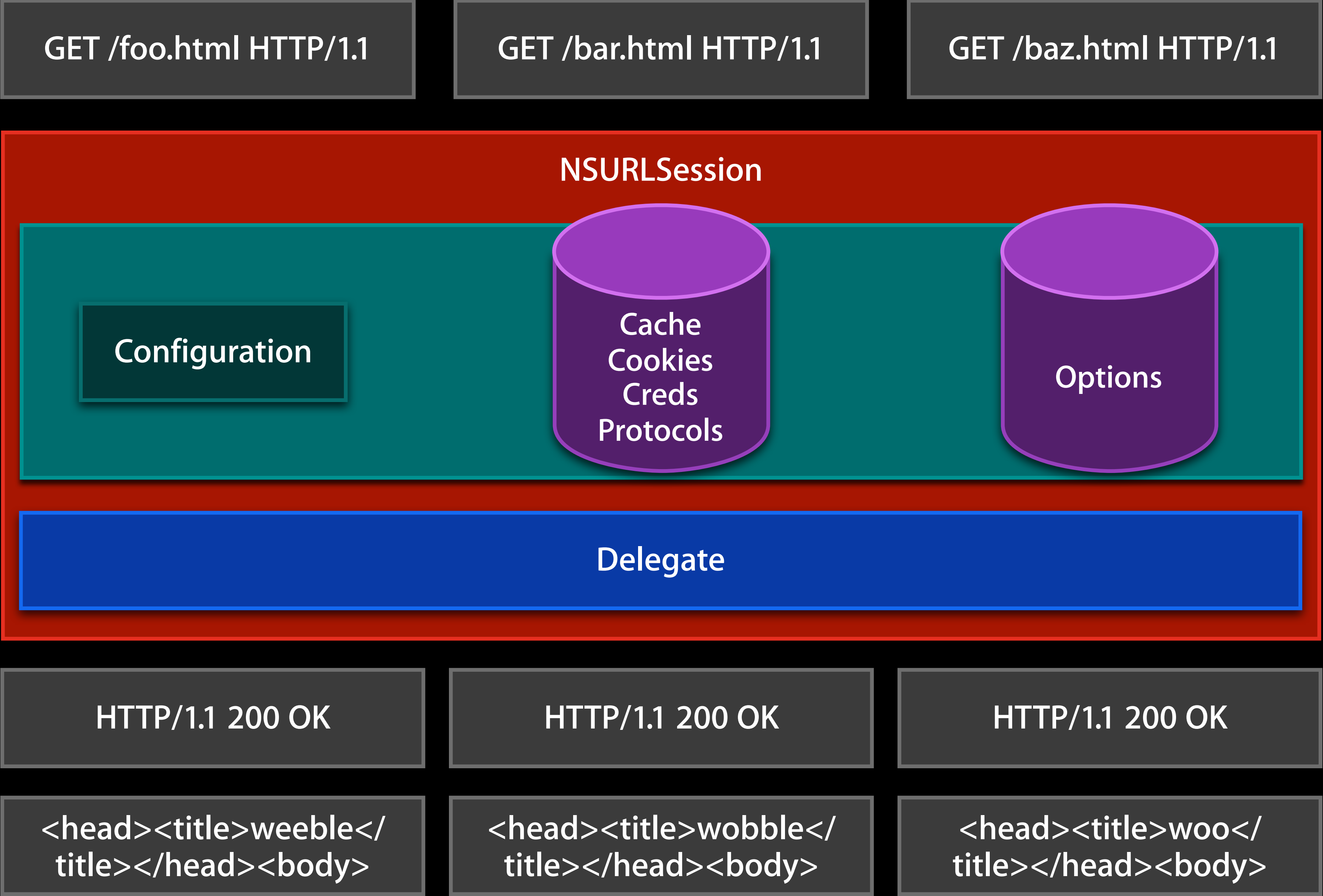
HTTP/1.1 200 OK

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`<head><title>weeble</title></head><body>`

`<head><title>wobble</title></head><body>`

NSURLSession



NSURLSession API

- NSURLSessionConfiguration
 - Connection/HTTP policies
 - Cache, Credentials, Cookie storage
- NSURLSessionTask
 - Unit of “work” for a session
- NSURLSessionDelegate
- NSURLSession
 - Created with configuration, optional delegate
 - Creates one NSURLSessionTask per request
 - Long lived object

NSURLSession-Adoption

[illegible]

NSURLSession-Adoption

[illegible]

NSURLSession-Adoption

[illegible]

NSURLSession-Adoption

[illegible]

NSURLSession-Adoption

[illegible]

NSURLSession–Adoption

```
// NSURLSession example:
id<NSURLSessionDelegate> myDelegate = [[MyDelegate alloc] init];

NSURLSessionConfiguration* myConfiguration =
    [NSURLSession defaultSessionConfiguration];
myConfiguration.allowsCellularAccess = NO;

NSURLSession* mySession = [NSURLSession
    sessionWithConfiguration:myConfiguration
    delegate:myDelegate
    delegateQueue:[NSOperationQueue mainQueue];

for (int i = 0; i < 10; i++) {
    NSURL* myURL = [NSURL URLWithString:@"http://www.apple.com/"];
    NSURLSessionDataTask* task;
    task = [mySession dataTaskWithHTTPGetRequest:myURL];
}
```

NSURLSession–Adoption

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    task = [mySession dataTaskWithHTTPGetRequest:myURL];
}
```

NSURLSessionConfiguration

- Per-session policies
 - Cache, Cookies, Credential stores
 - Cell usage, network service type
 - Number of connections
 - Resource and network timeouts
 - TLS protocols
 - HTTP proxies, cookies, pipelining, headers
 - Protocol handlers
- Storage subclasses
- Factory constructors for standard configurations

NSURLSessionConfiguration

- Default for access to global singleton storage, settings:

```
+(NSURLSessionConfiguration*) defaultConfiguration;
```

- Private storage, in-memory only storage:

```
+(NSURLSessionConfiguration*) ephemeralSessionConfiguration;
```

- Out-of-process session configuration, keyed to identifier string

```
+(NSURLSessionConfiguration*) backgroundSessionConfiguration:(NSString*)  
                                                                    identifier;
```

- Configuration objects are mutable, but copied when accessed

```
-(NSURLSessionConfiguration*) copy;
```


NSURLSessionTask

- Replaces `NSURLConnection` class
- Provides status and progress properties
- Cancel, Suspend, Resume
- Data and Upload tasks provided to differentiate
- Download task allows for capturing download state
 - `[NSURLSessionDownloadTask cancelByProducingResumeData:]`
- `NSURLSessionDelegate` methods keyed to task type
 - `NSURLSession:task:didCompleteWithError:`
 - `NSURLSession:dataTask:didReceiveData:`
 - `NSURLSession:downloadTask:didFinishDownloadingToURL:`

NSURLSessionTask

NSURLSessionTask

NSURLSessionTask

NSURLSessionTask

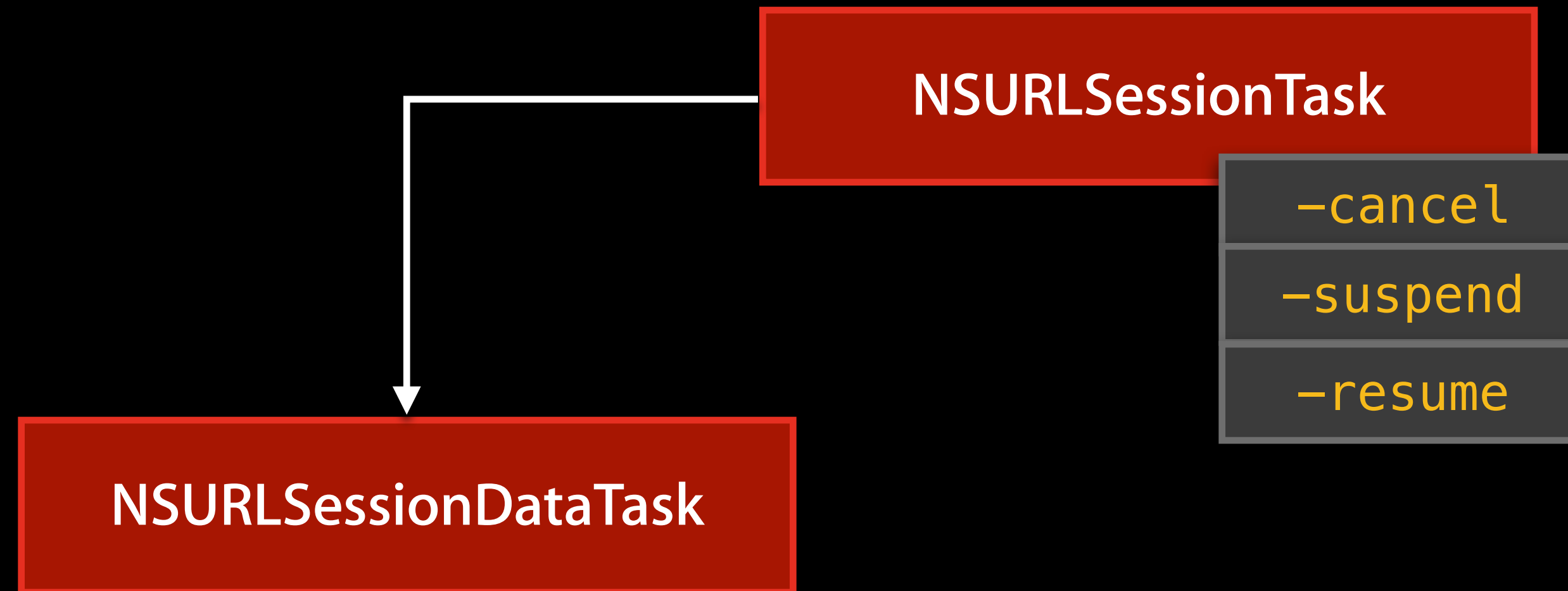
NSURLSessionTask

–cancel

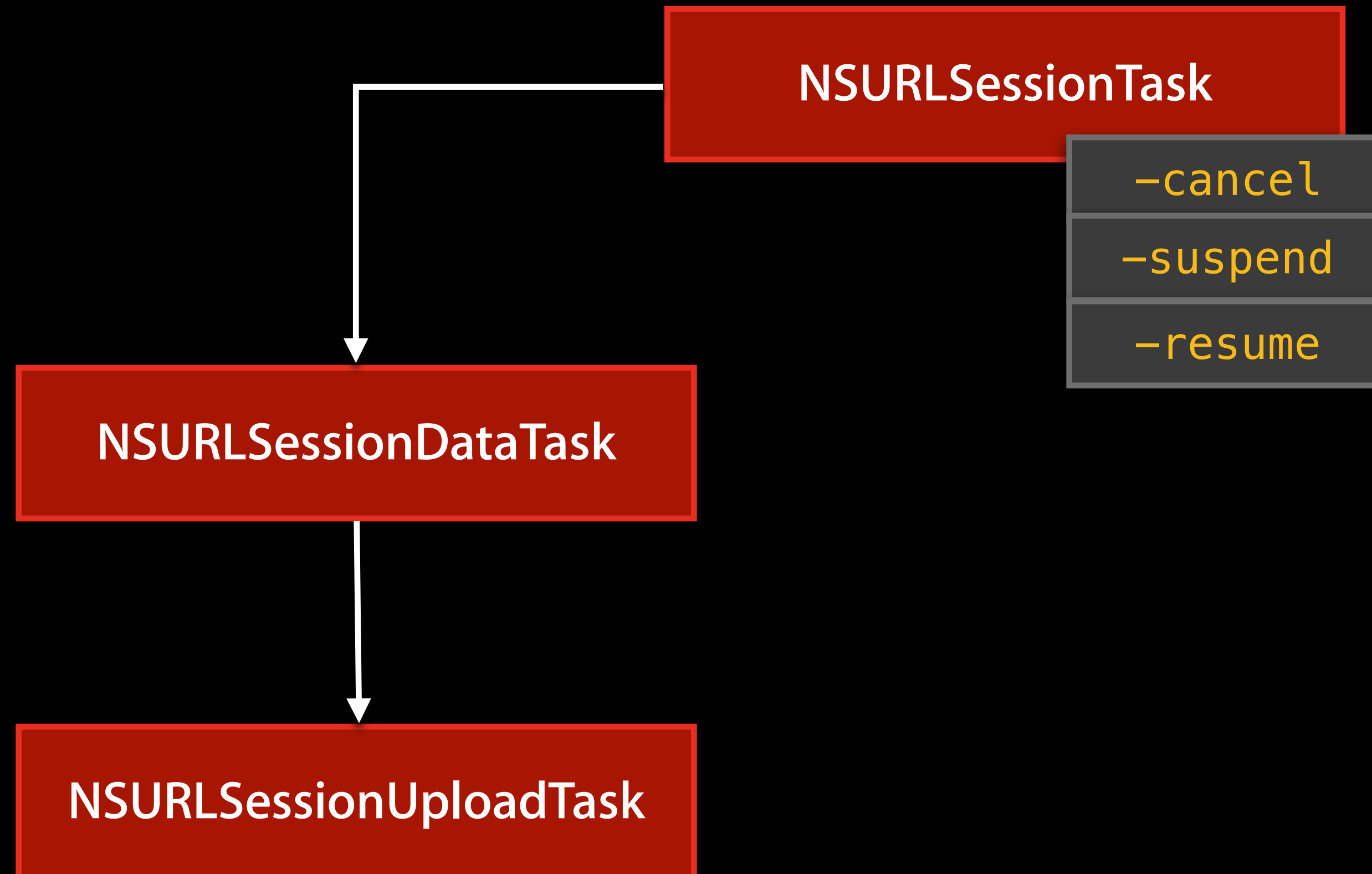
–suspend

–resume

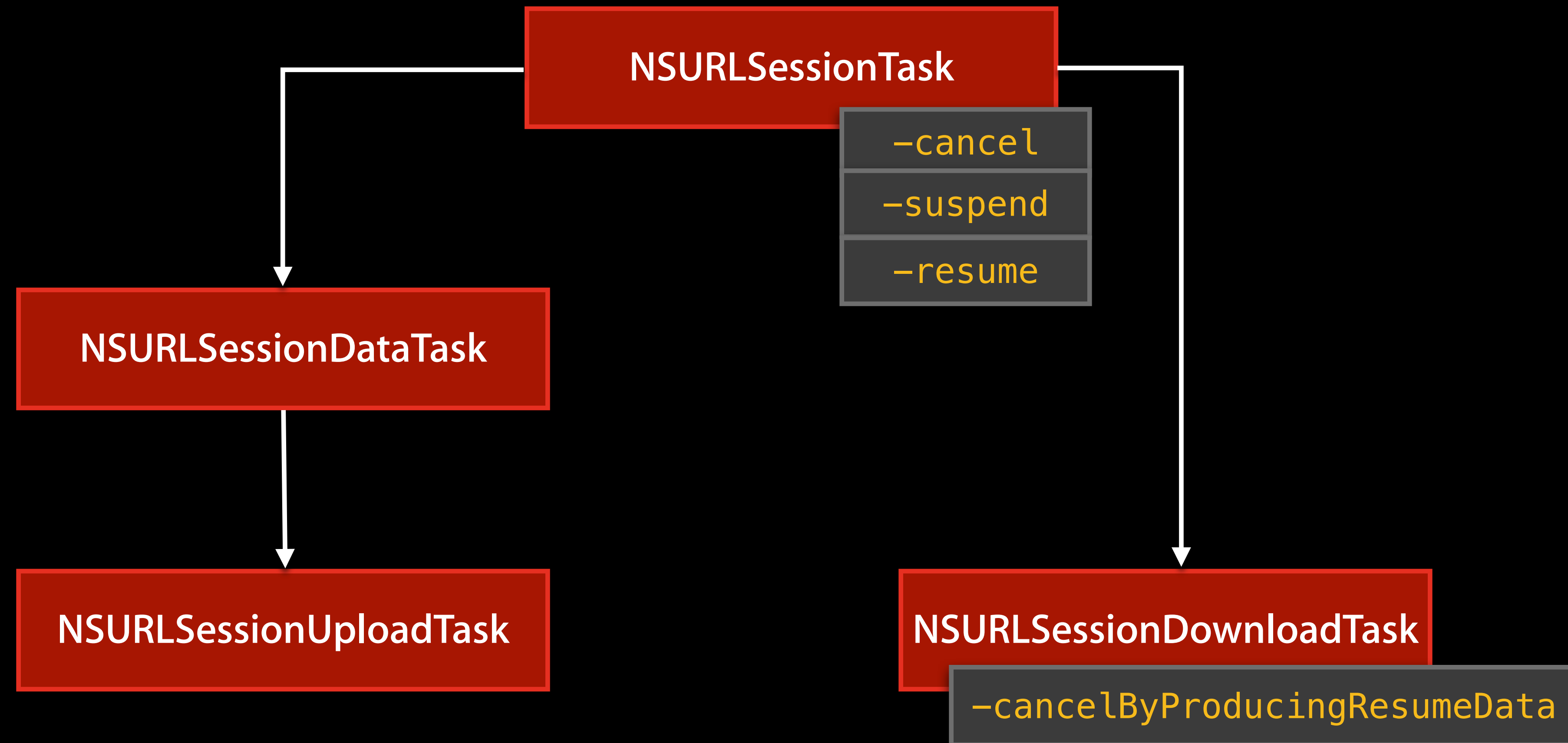
NSURLSessionTask



NSURLSessionTask



NSURLSessionTask



NSURLSessionDelegate

- Single delegate for all NSURLSession messages
 - Session, Task, DataTask, DownloadTask
- Strongly referenced until session invalidated
- Delegate messages may block loading
 - Invoke the completion handler to continue

NSURLSessionDelegate

Delegate messages for a session

-NSURLSession:didReceiveAuthenticationChallenge:completionHandler:

-NSURLSession:didBecomeInvalidWithError:

- For connection level auth
 - NTLM
 - Server Trust evaluation
 - Client Certificate
 - Kerberos implicitly handled

NSURLSessionTaskDelegate

Delegate messages for any task

...task:willPerformHTTPRedirection:newRequest:completionHandler:

...task:didReceiveAuthenticationChallenge:completionHandler:

- Request based challenges
- Basic, Digest, Proxies

...task:didSendBodyData:totalBytesSent:totalBytesExpectedToSend:

...task:needsNewBodyStream:

- Not needed if uploading from a file:// or NSData
- May be called multiple times

...task:didCompleteWithError:

- Error will be nil for successful requests

NSURLSessionDataDelegate

Delegate messages for data tasks

...dataTask:didReceiveResponse:completionHandler:

- Allows you to turn a DataTask into a DownloadTask

...dataTask:didBecomeDownloadTask:

- No more messages for this data task

...dataTask:didReceiveData:

- Incremental data loading
 - [NSData enumerateByteRangesUsingBlock:]

...dataTask:willCacheResponse:completionHandler:

- Default is to attempt to cache

NSURLSessionDownloadDelegate

Delegate messages for download tasks

...downloadTask:didFinishDownloadingToURL:

- Open or move the file during the callback

...downloadTask:didWriteData:totalBytesWritten:totalBytesExpectedToWrite:

...downloadTask:didResumeAtOffset:expectedTotalBytes:

- Resume offset may be less than previous reported totalBytesWritten

NSURLSession

- Default Session shares NSURLConnection stack

```
[NSURLSession sharedSession].configuration.HTTPCookieStorage == [NSHTTPCookieStorage sharedStorage]
```
- Custom sessions with private configuration
- Invalidation required for your sessions
 - `NSURLSession:didBecomeInvalidWithError:`
- Creates Data, Upload, Download task objects
- Asynchronous convenience APIs
 - Can share delegate for auth
 - Cancelable

NSURLSession

Custom configuration

- Copy or create a configuration
- If using the task convenience routines, no delegate required
- Private Browsing example:

```
NSURLSessionConfiguration* myConfig = [NSURLSessionConfiguration
                                         ephemeralConfiguration];
NSURLSession* mySession = [NSURLSession
                           sessionWithConfiguration:myPrivateSession];
NSURL* myPrivateURL = [NSURL URLWithString:@"http://apple.com/secret/"];
[mySession dataTaskWithHTTPGetRequest:myPrivateURL
                  completionHandler:^(NSData* data, NSURLResponse* response,
                                      NSError* error) { [self gotSecret:data]; }]
```

NSURLSession

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NSURLSession

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NSURLSession

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                           sessionWithConfiguration:myPrivateSession];
NSURL* myPrivateURL = [NSURL URLWithString:@"http://apple.com/secret/"];
[mySession dataTaskWithHTTPGetRequest:myPrivateURL
               completionHandler:^(NSData* data, NSURLResponse* response,
                                   NSError* error) { [self gotSecret:data]; }]
```

NSURLSession

Data Task Creation

- Delegate-based tasks

- (NSURLSessionDataTask*) dataTaskWithRequest:(NSURLRequest*) request;
 - (NSURLSessionDataTask*) dataTaskWithHTTPGetRequest:(NSURL*) url;

- Asynchronous Task Conveniences

- (NSURLSessionDataTask*) dataTaskWithRequest:(NSURLRequest*) request
completionHandler:(void (^) (NSData* data,
NSURLResponse* response,
NSError* error))
completionHandler;

NSURLSession

Upload Task Creation

- Upload tasks

- (NSURLSessionUploadTask*) uploadTaskWithRequest:(NSURLRequest*) request
fromFile:(NSURL*) file;
- (NSURLSessionUploadTask*) uploadTaskWithRequest:(NSURLRequest*) request
fromData:(NSData*) data;
- (NSURLSessionUploadTask*) uploadTaskWithStreamedRequest:(NSURLRequest*) r;
 - Your delegate **must** implement –needsNewBodyStream:

- Asynchronous Upload Conveniences

- ...:fromFile:completion:^(NSData*, NSURLResponse*, NSError*) completion;
 - ...:fromdata:completion:

NSURLSession

Download Task Creation

- Download tasks

- (NSURLSessionDownloadTask*) downloadTaskWithRequest:(NSURLRequest*) request;
 - (NSURLSessionDownloadTask*) downloadTaskWithResumeData:(NSData*) data;

- Asynchronous Download Conveniences

- ...downloadTaskWithRequest:completionHandler:^(NSURL* fileURL
NSURLResponse* response,
NSError* error)
completionhandler;
 - ...downloadTaskWithResumeData:completionHandler:

- Connection errors produce resume data too

- [[error userInfo] objectForKey:NSNSURLSessionDownloadTaskResumeData]

NSURLSession

Background Transfers

- Supports upload and download using HTTP(S)
- Requires a delegate for event delivery
 - Uses same Upload and Download task delegates as in-process
- Redirections are always taken
- `-discretionary` configuration property
 - Available on iOS, only applies to background transfers
 - Optimizes for power and network

NSURLSession

Background Transfers

NSURLSession

Background Transfers



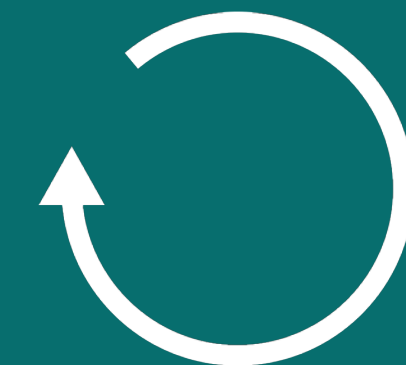
NSURLSession
Identifier: "MySession"

NSURLSession

Background Transfers

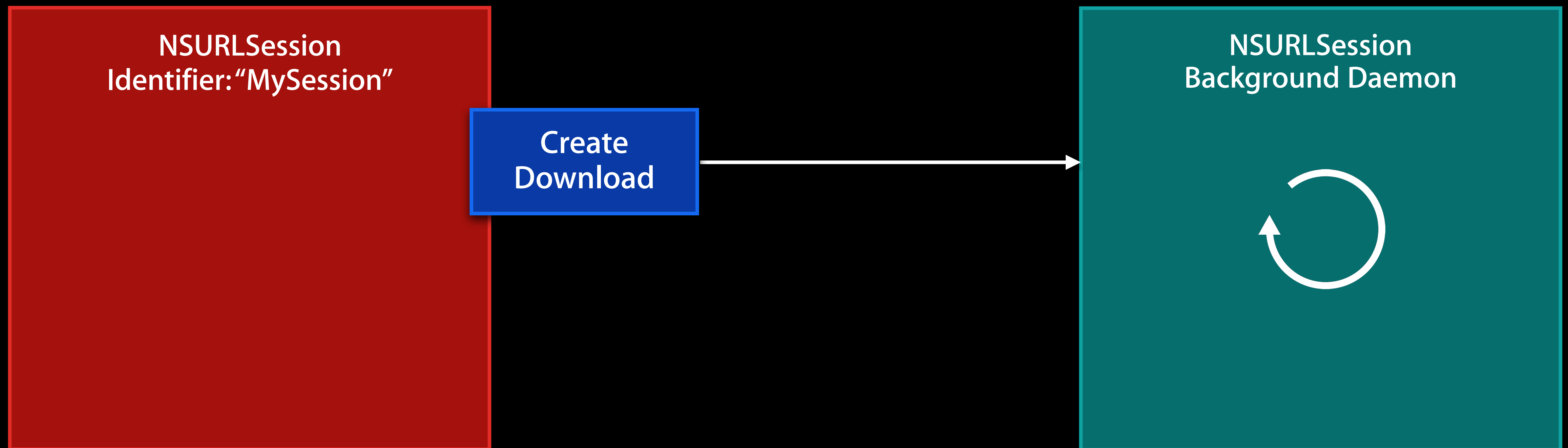
NSURLSession
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NSURLSession
Background Daemon



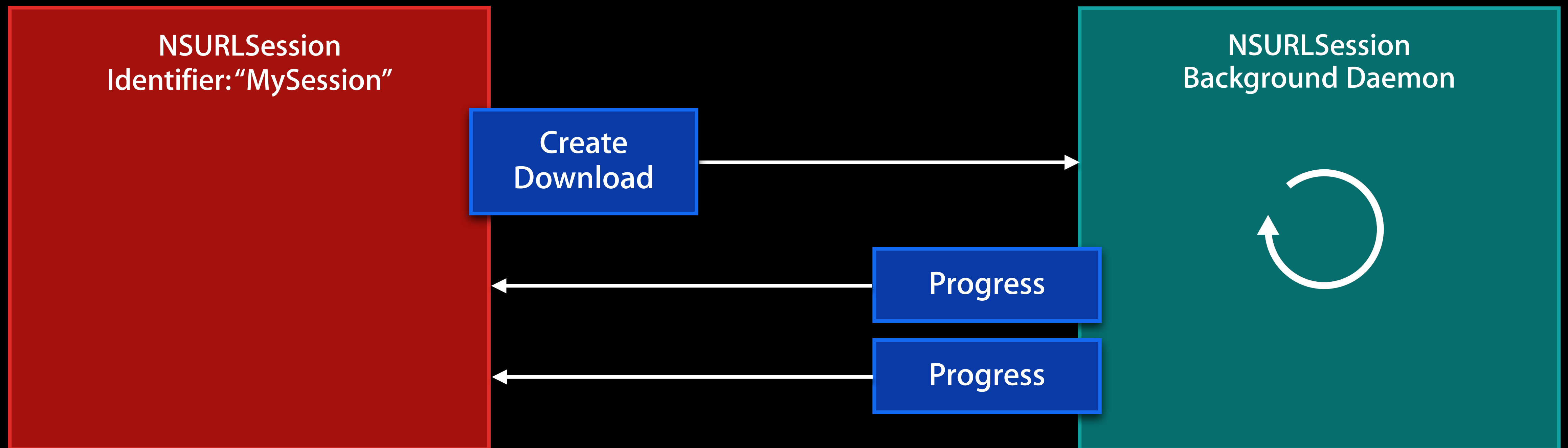
NSURLSession

Background Transfers



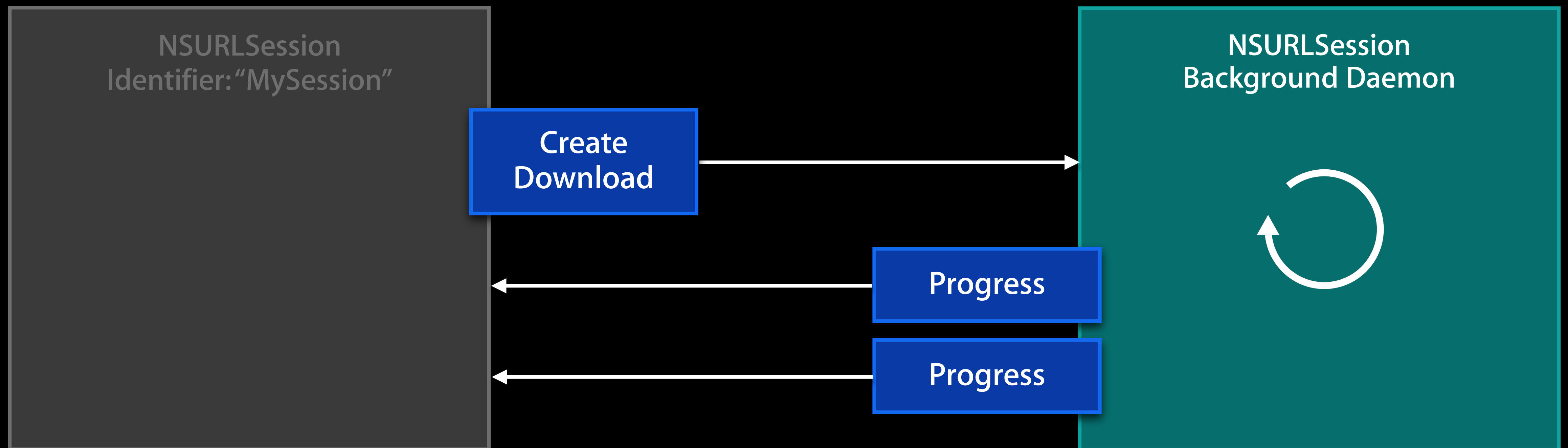
NSURLSession

Background Transfers



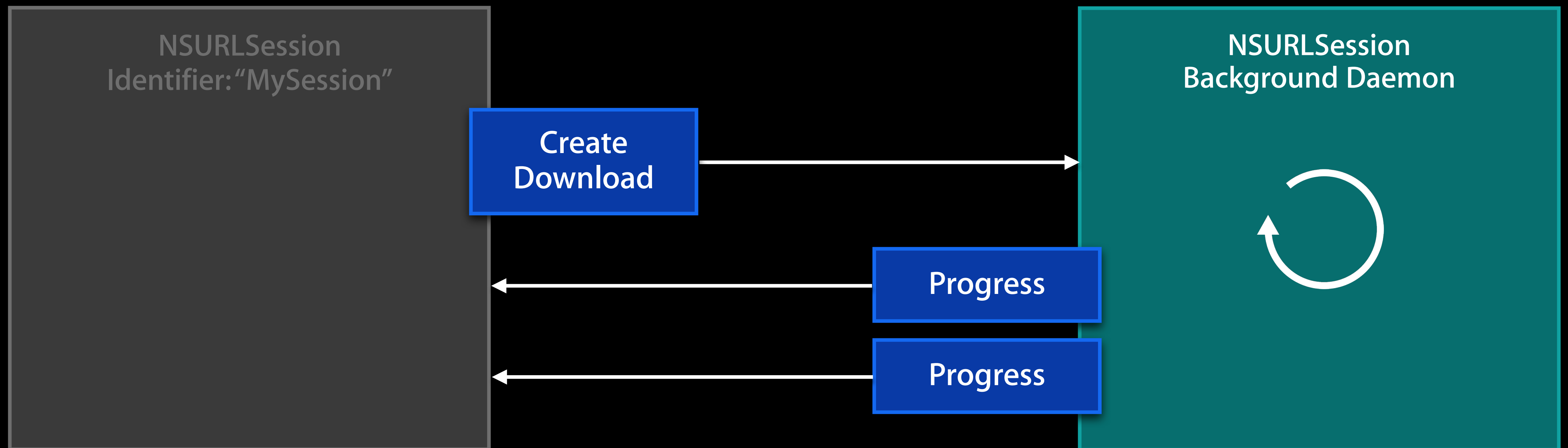
NSURLSession

Background Transfers



NSURLSession

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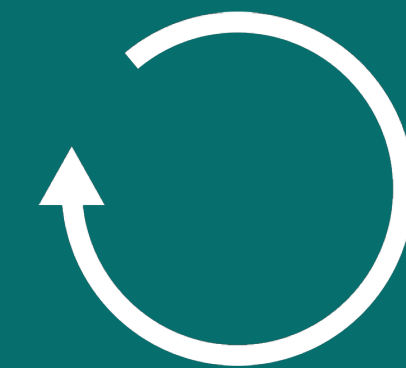
NSURLSession

Background Transfers

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NSURLSession
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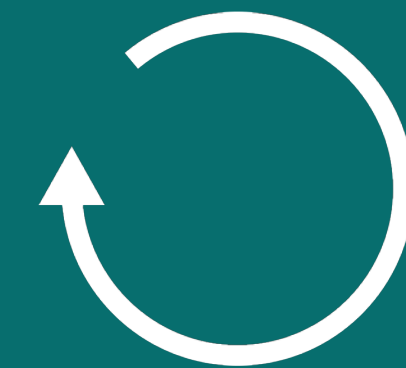
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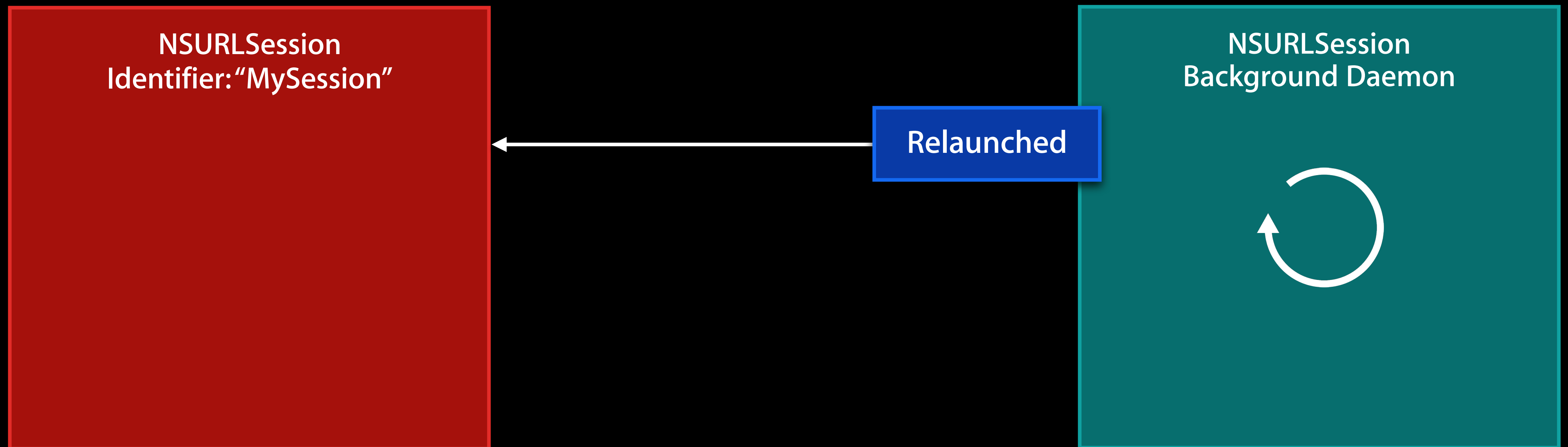
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NSURLSession
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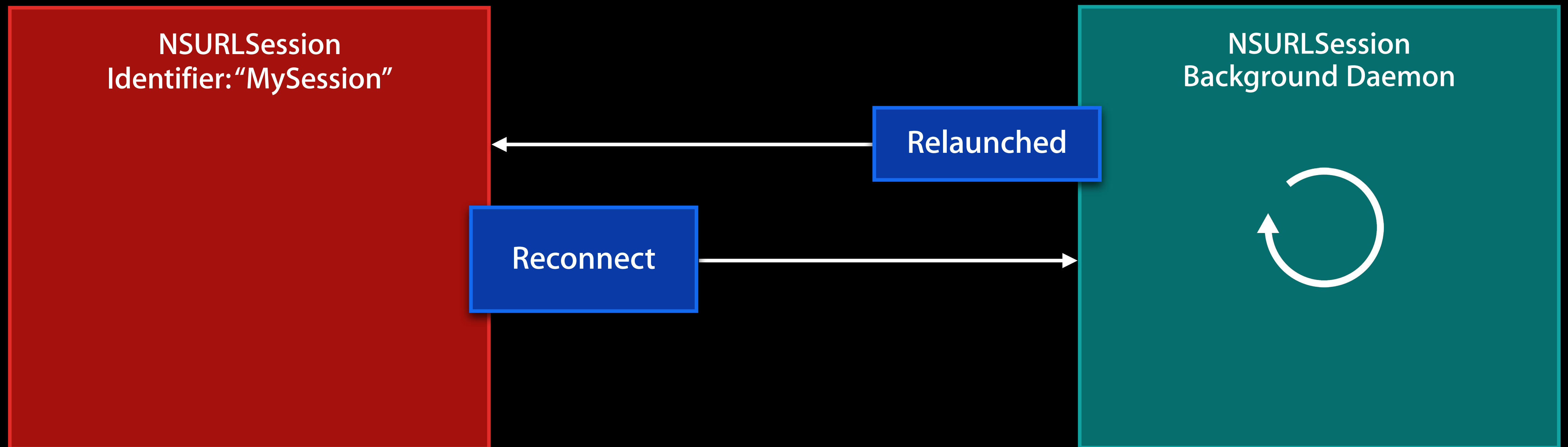
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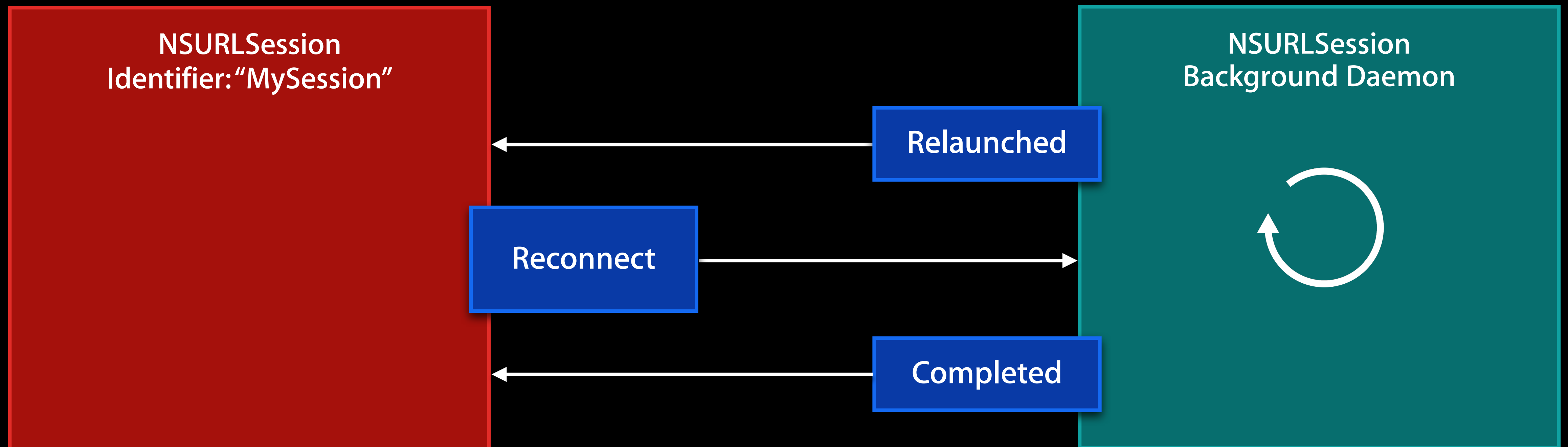
NSURLSession

Background Transfers



NSURLSession

Background Transfers



NSURLSession

Out-of-process Transfers

- Delegate messages received while you're running
- Your app will be launched in the background...
 - to service auth requests
 - when all tasks complete
- Creating a session from same identifier "reconnects" you to existing background session

```
-(void) getTasksWithCompletionHandler:^(NSArray* dataTasks,  
                                       NSArray* uploadTasks,  
                                       NSArray* downloadTasks)  
completion;
```

Demo

NSURLSession - Background Requests

Dan Vinegrad
Software Engineer

NSURLSession vs. NSURLConnection

- Connection based auth schemes
- HTTP configuration options
- Private, subclassable storage
- Background, out-of-process transfers
- API baseline

What's New in Foundation Networking



- New NSURLSession API
 - iOS 7, OS X 10.9
 - Out-of-process background transfers
- Framework Enhancements
 - NSNetServices
 - Single sign-on
 - iCloud credential syncing

NSNetServices



- Browse for and connect to Bonjour services
 - (BOOL) getInputStream:(NSInputStream**) inputStreamPtr
outputStream:(NSOutputStream**) outputStreamPtr;
- New property: includesPeerToPeer
 - Browsing and publishing on Peer to Peer Wi-Fi and Bluetooth
 - Peer to Peer Wi-Fi new in iOS 7

NSNetServices



- New option: `NSNetServiceListenForConnections`
 - (void) [NSNetService publishWithOptions:(NSNetServiceOptions) options
- Binds IPv4 and IPv6 listening sockets
- Invokes delegate on incoming connections:
 - (void) netService:(NSNetService*) service
didAcceptConnectionWithInputStream:(NSInputStream*) is
outputStream:(NSOutputStream*) os;

Authentication

Single sign-on



- Kerberos Authentication
- Available in MDM environments
- Device Managers specify:
 - Applicable URLs
 - Applications
- Kerberos authentication challenges are handled by the system
- See “Extending Your Apps for Enterprise and Education Use” session

iCloud Credential Syncing



- Credentials synced between devices through iCloud
 - Credential persistence option:
`NSURLCredentialPersistenceSynchronizable`
 - Credential storage API:
 - (void) removeCredential:(NSURLCredential*) credential
forProtectionSpace:(NSURLProtectionSpace*) protectionSpace
options:(NSDictionary*) options;
- Key: `NSURLCredentialStorageRemoveSynchronizableCredentials`
Removes a credential across all participating devices

Summary

- NSURLSession
 - New API for iOS 7.0 and OS X 10.9
 - Replaces NSURLConnection
 - Extensive Customization
 - Out-of-process background transfers

Summary

- NSNetServices
 - Peer to Peer support
 - Server creation
- NSURLAuthentication
 - Kerberos single sign-on
 - iCloud credential syncing

More Information

Paul Danbold

Core OS Technologies Evangelist
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Documentation

Foundation Class Reference
<http://developer.apple.com/>

Apple Developer Forums

<http://devforums.apple.com>

Related Sessions

Managing Apple Devices

Pacific Heights
Tuesday 11:30AM

What's New with Multitasking

Presidio
Tuesday 2:00PM

Extending Your Apps for Enterprise and Education Use

Nob Hill
Tuesday 3:15PM

Nearby Networking with Multipeer Connectivity

Mission
Wednesday 10:15AM

What's New in State Restoration

Mission
Thursday 3:15PM

Labs

Foundation Networking Lab

Core OS Lab B
Wednesday 10:15AM

Multipeer Connectivity Lab

Core OS Lab A
Wednesday 11:30AM

Cocoa and Foundation Lab

Frameworks Lab A
Wednesday 11:30AM

Networking Lab

Core OS Lab A
Thursday 9:00AM

Multitasking Lab

Services Lab B
Thursday 9:00AM

Multipeer Connectivity Lab

Core OS Lab B
Friday 9:00AM

 WWDC2013