What's New in Foundation Networking

A session on NSURLSession

Session 705

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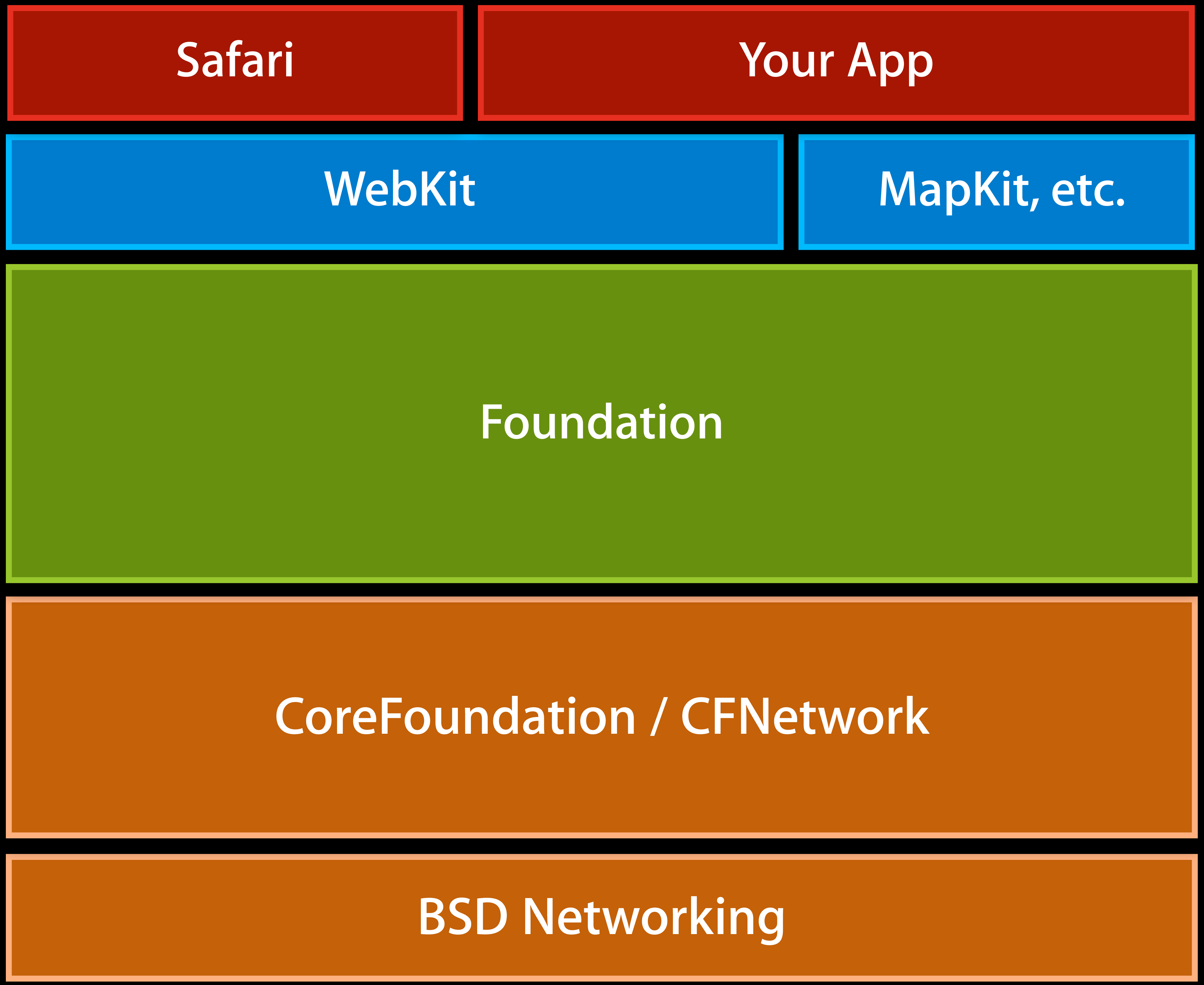
What’s New in Foundation Networking

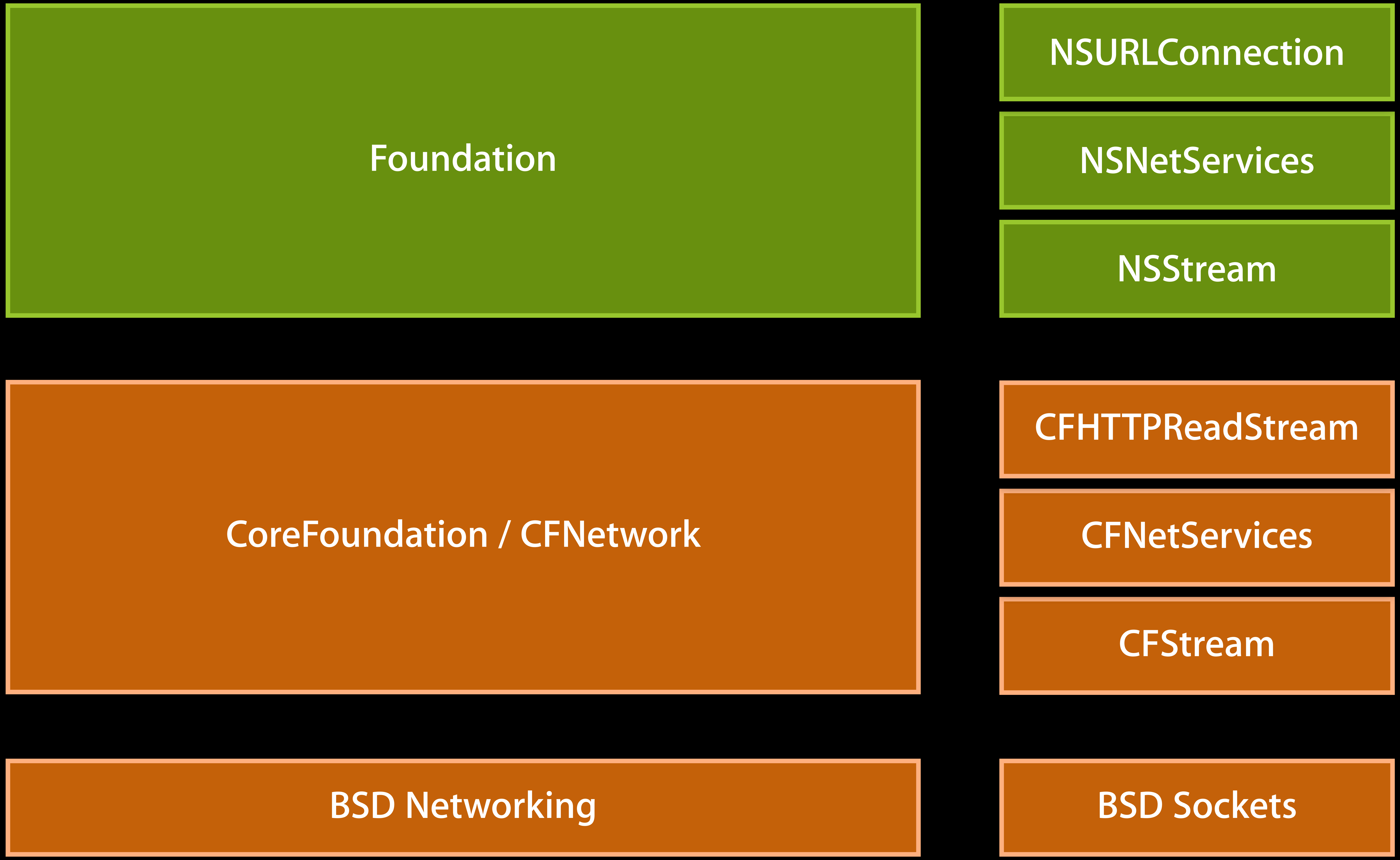
NEW

- 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



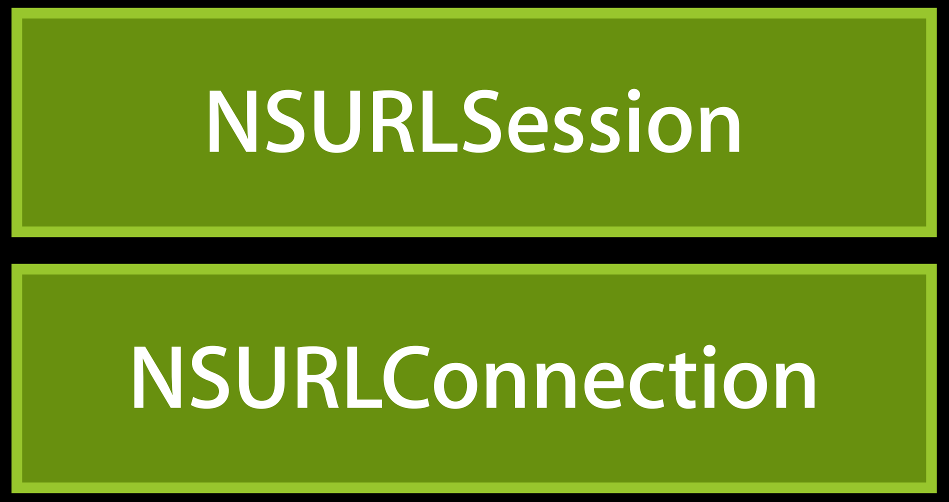
Foundation Networking



Foundation Networking

NSURLConnection
NSNetServices

Foundation Networking



NSURLConnection

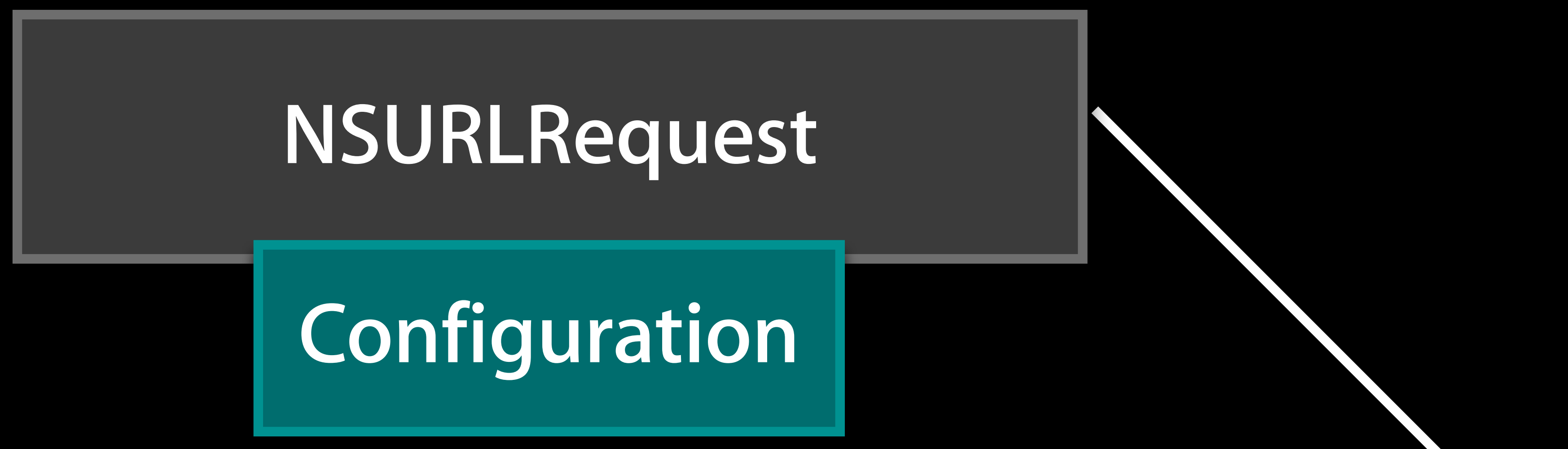
- Both a technology and a specific class
- Originally written for Safari, available via Foundation
    - WWDC 2003 - Session 418
- URL resolution and loading
    - file:// http:// https:// data://
    - Extensible via NSURLProtocol
- URL Loading machinery, policies
    - Configured via NSURLRequest properties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

NSURLConnection

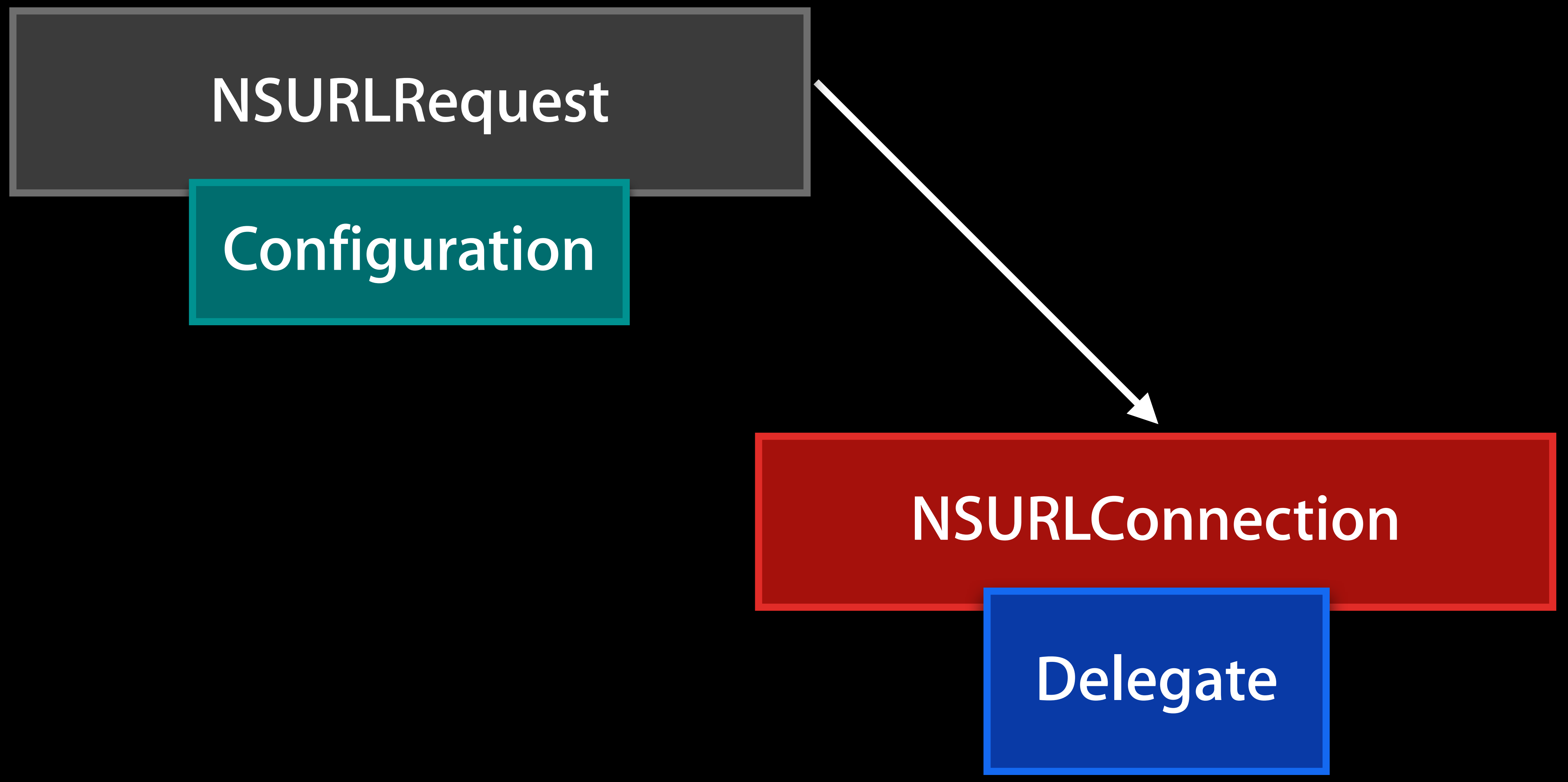
NSURLConnection

NSURLRequest

NSURLConnection



NSURLConnection



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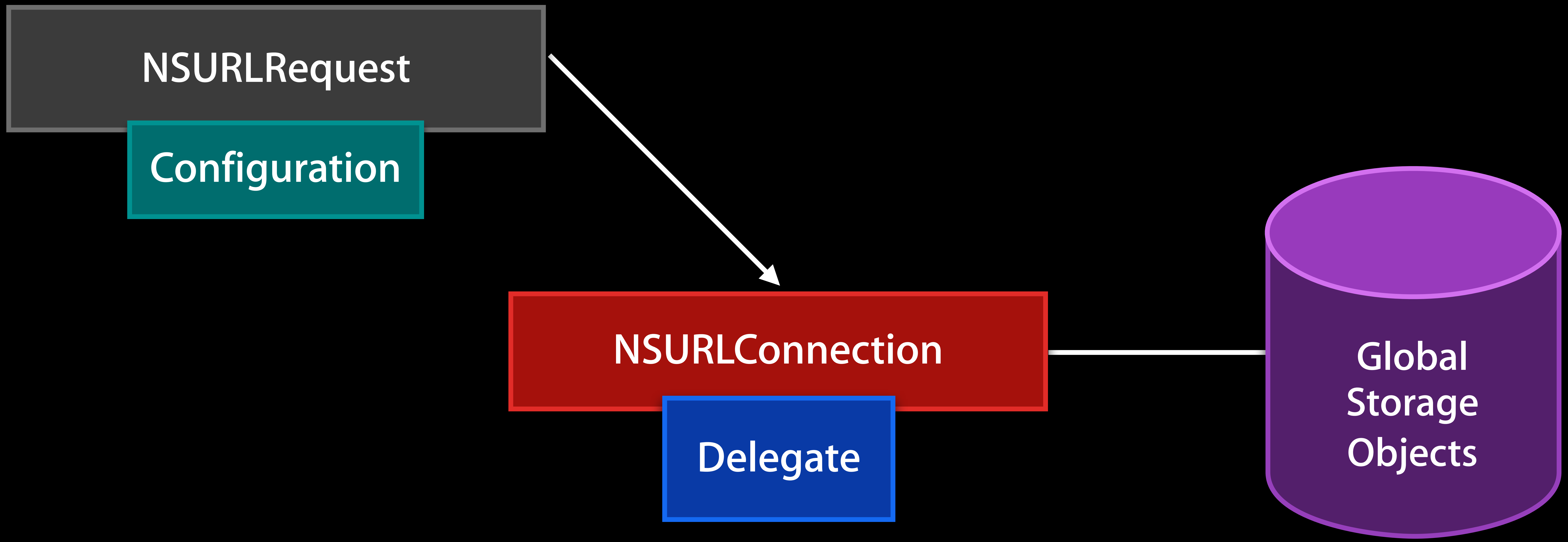

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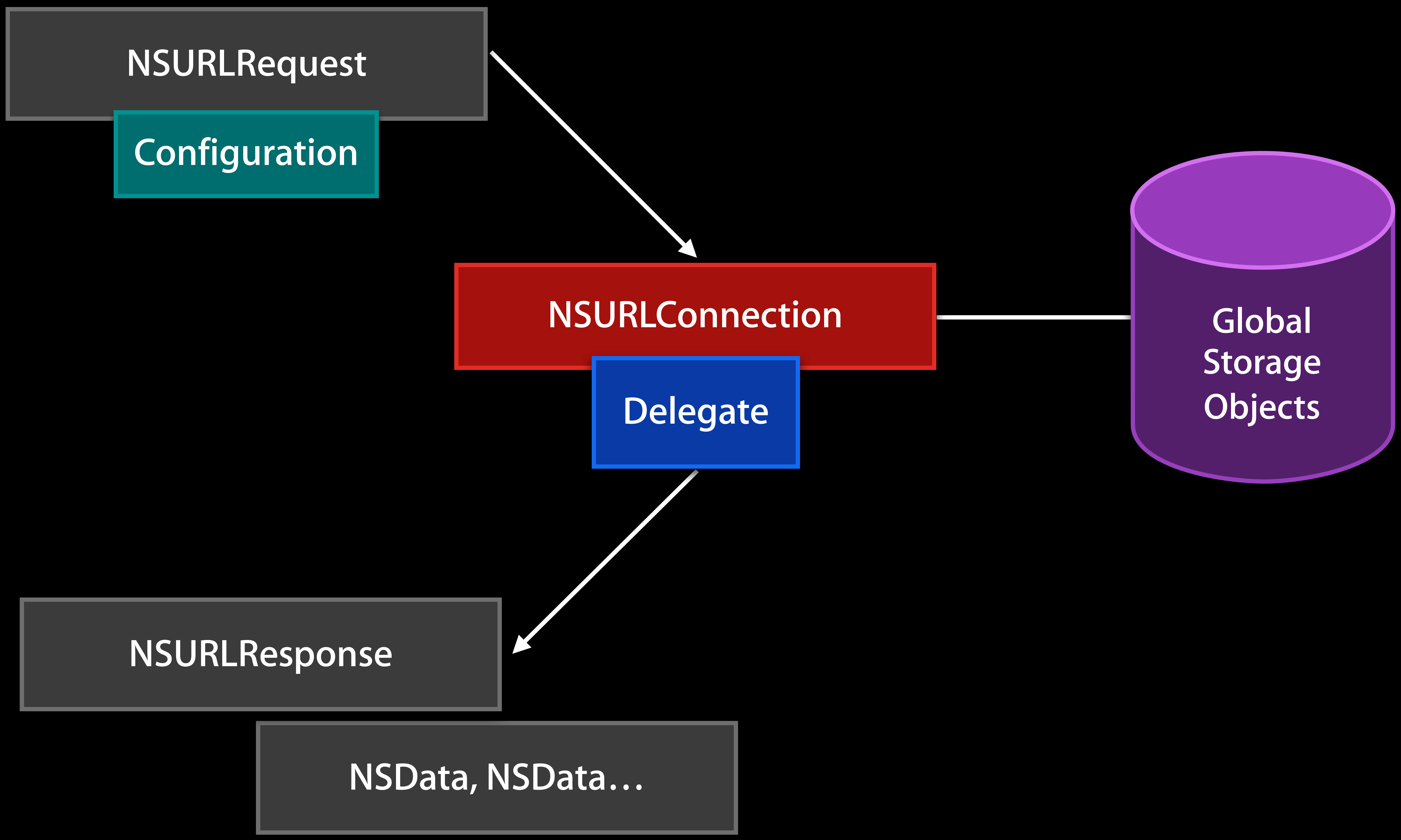

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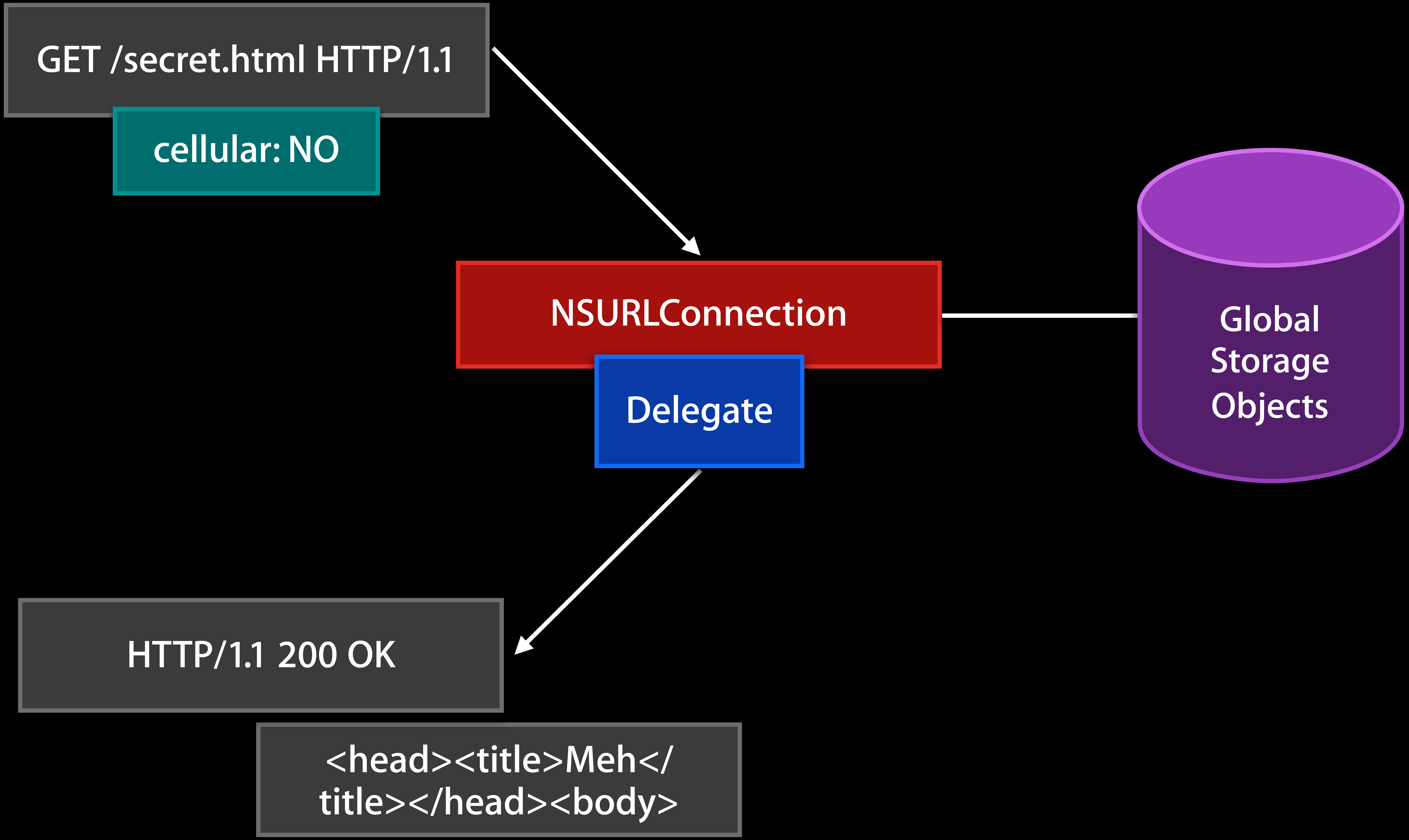

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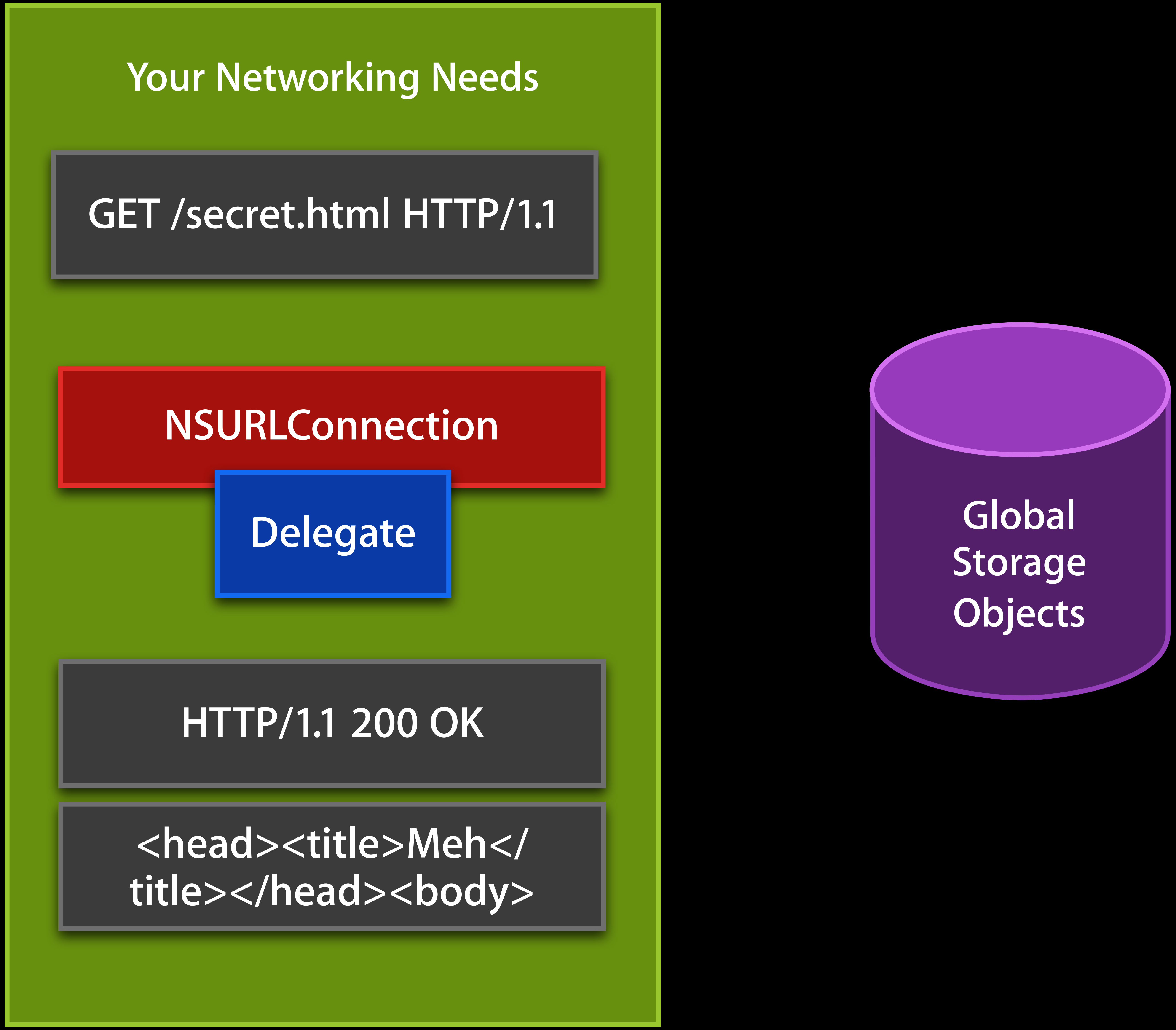

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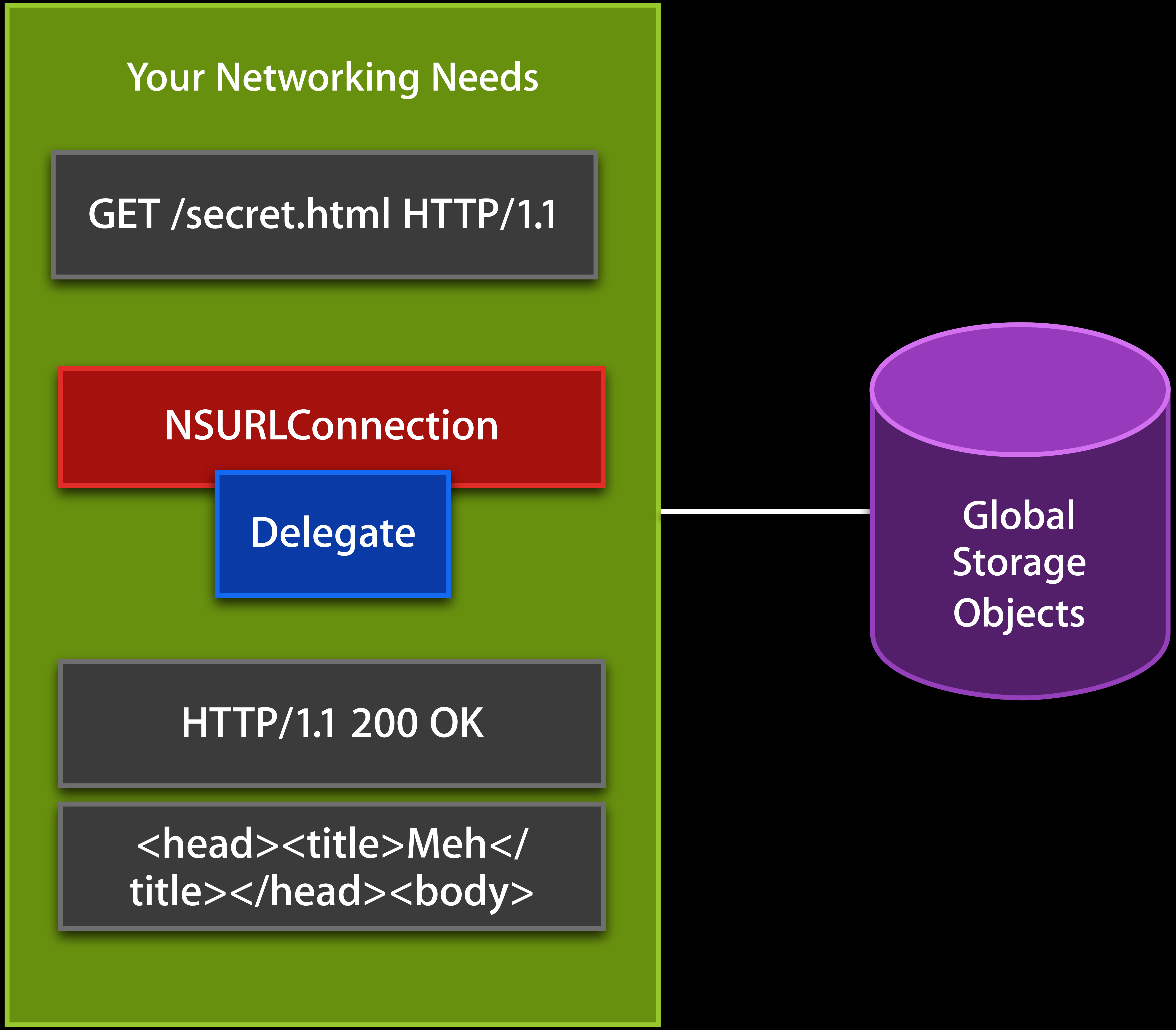
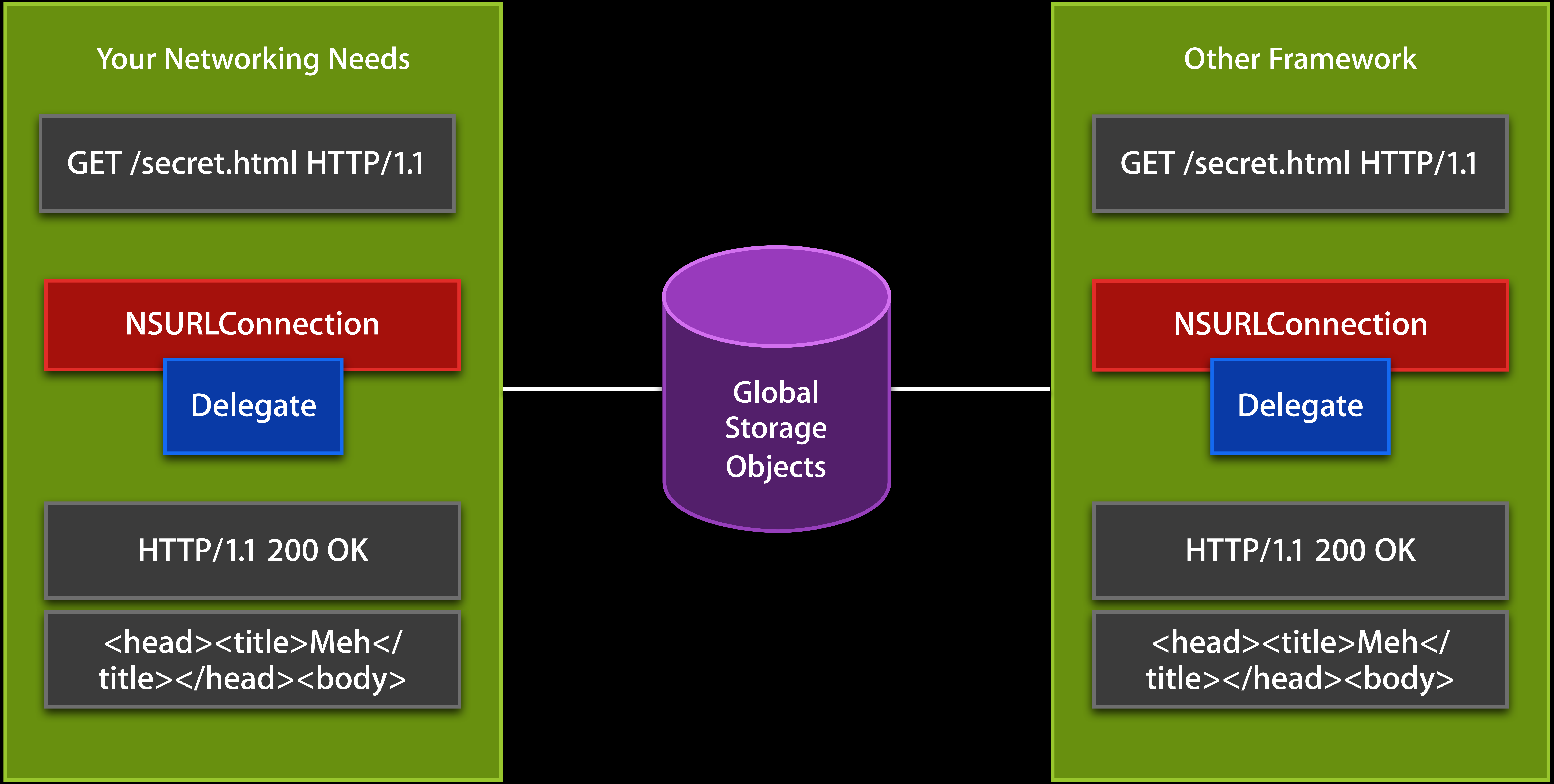


NSURLConnection



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

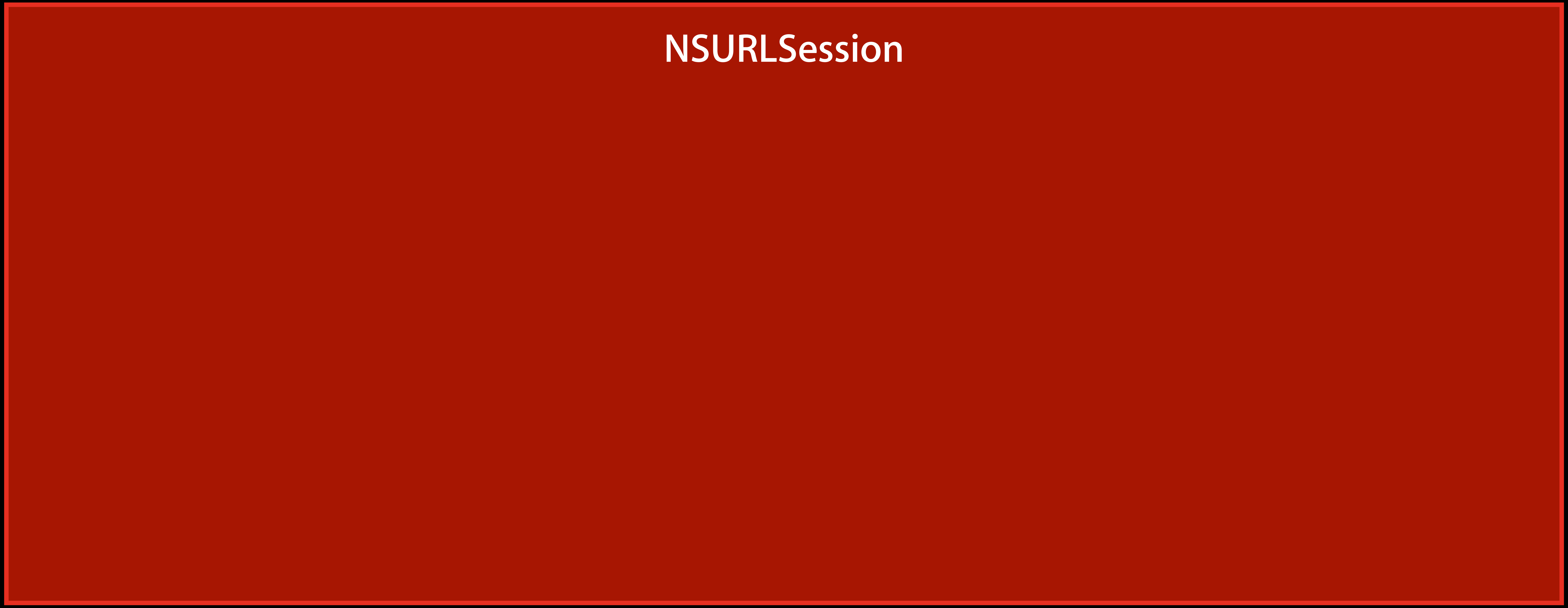
NSURLSession

NEW

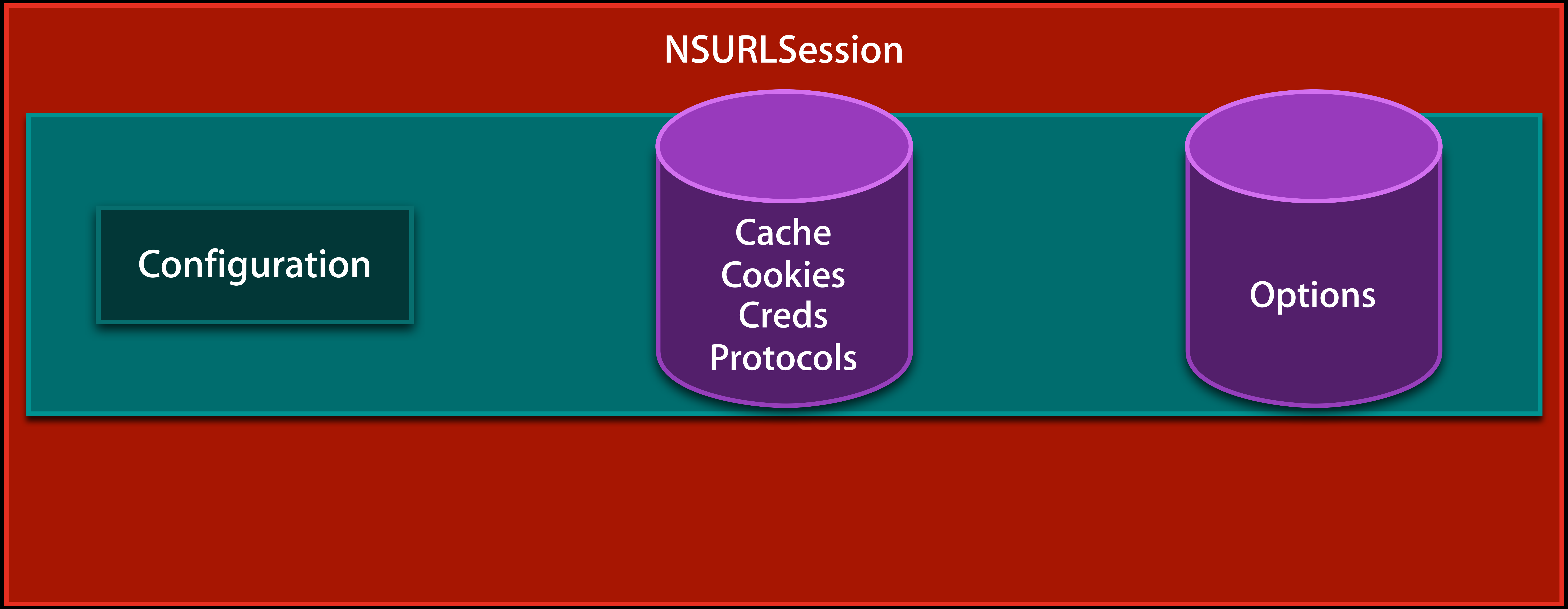
- Uploads/Downloads through the filesystem
- Encourages separation of Data from Meta-Data
  - NSURLRequst + payload
  - NSURLResponse + payload
- Out-of-process Uploads and Downloads
  - Uses same delegate model as in-process transfers
  - Optimizes battery life
  - Supports UIKit multitasking

NSURLSession

NSURLSession



NSURLSession



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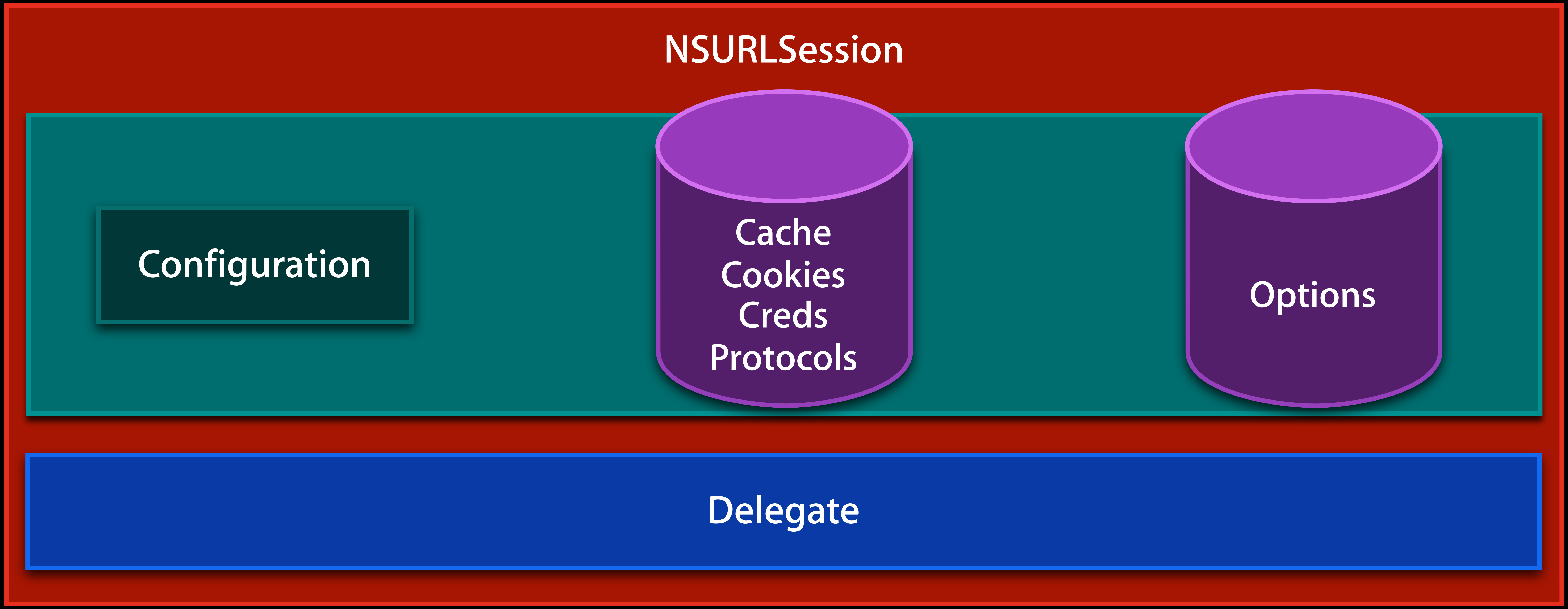

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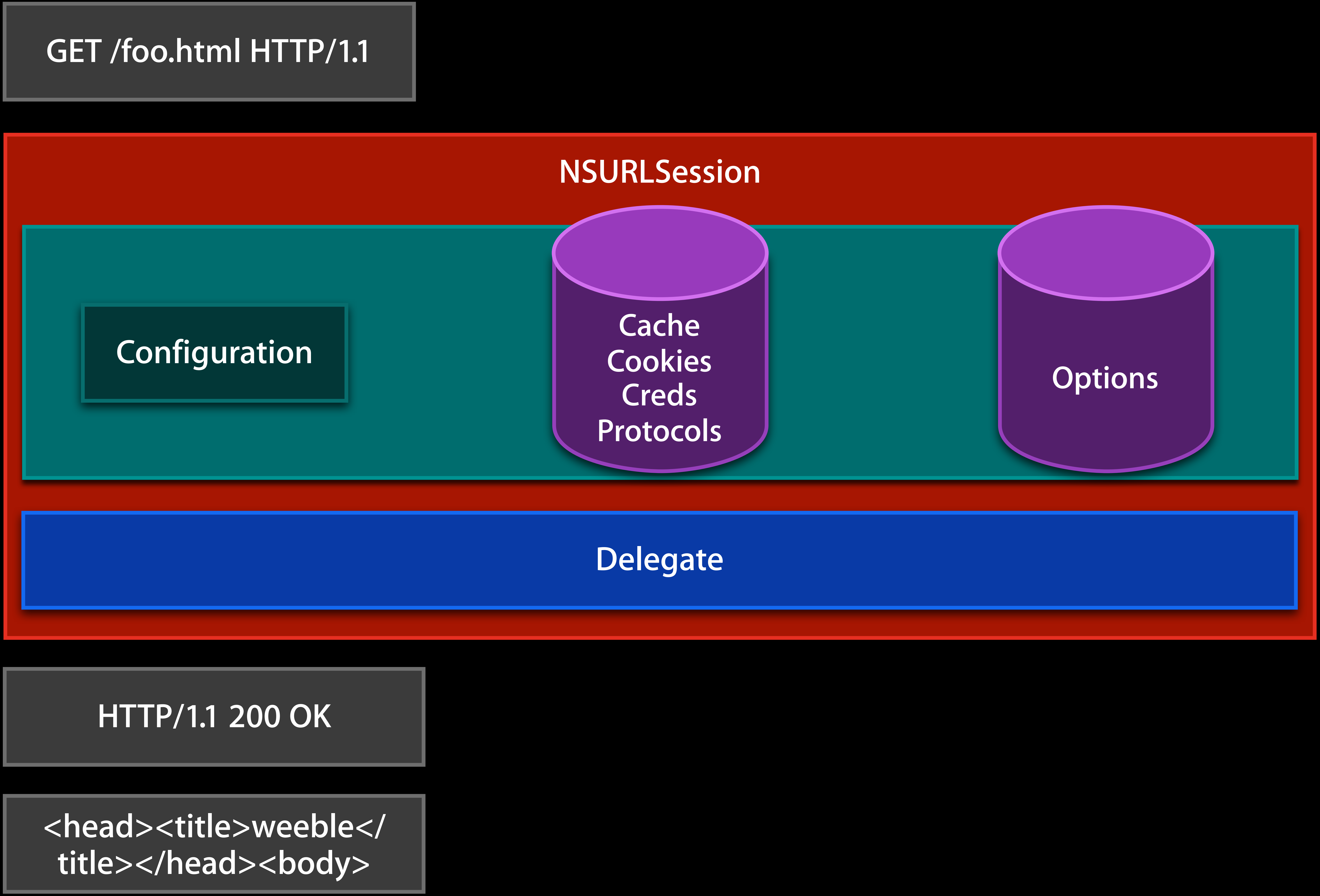

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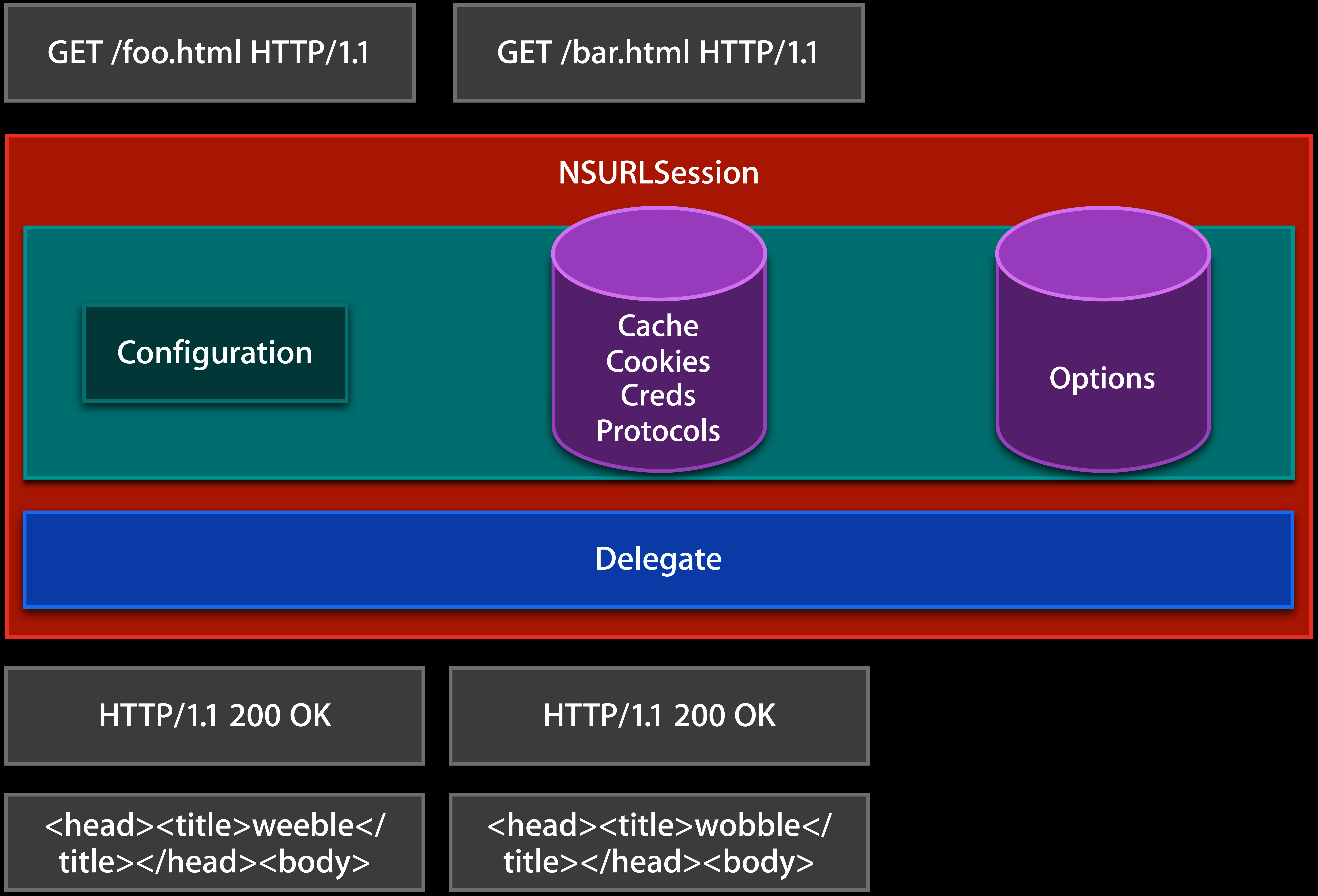

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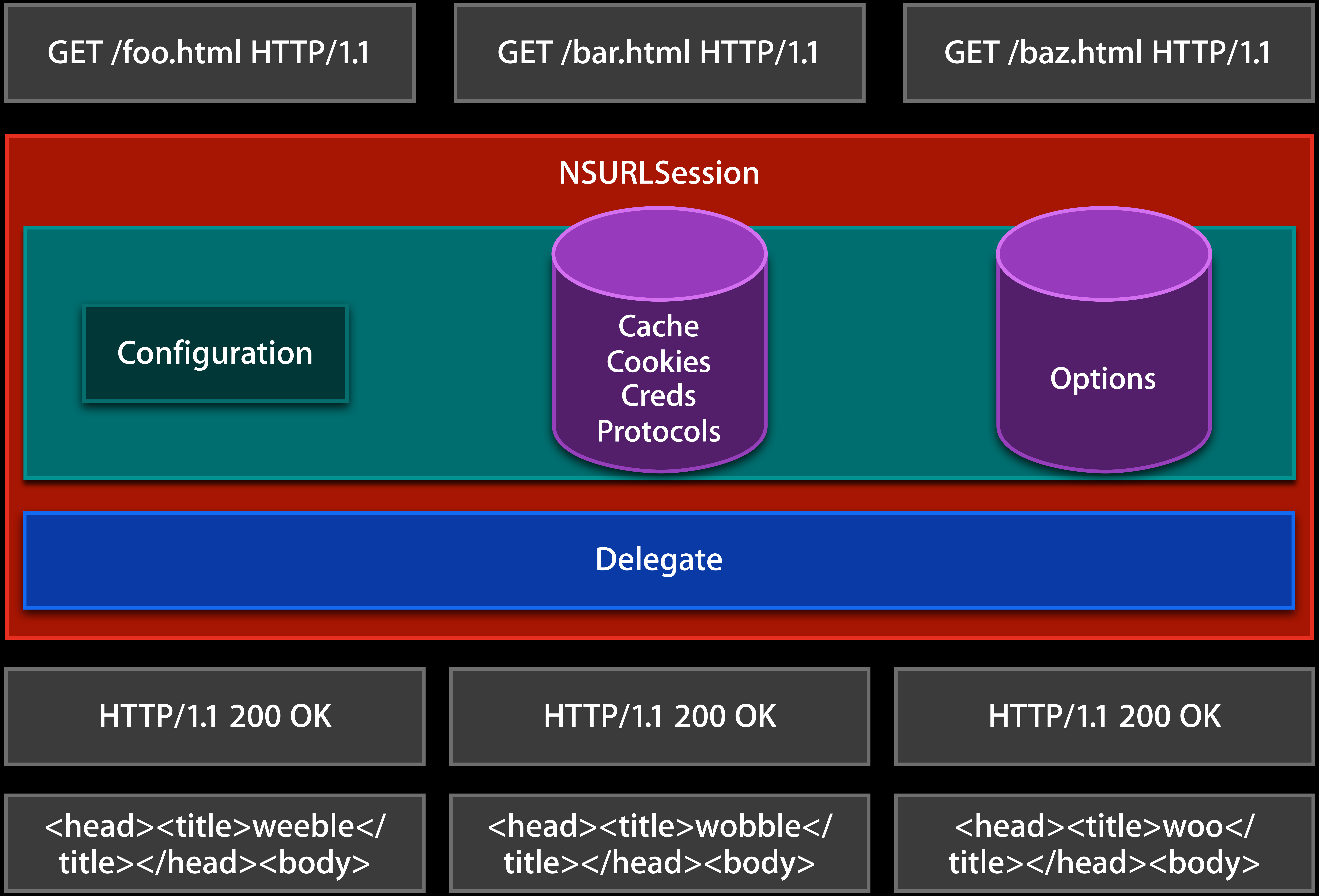

NSURLSession API

- 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

```
// NSURLConnection example:
id<NSURLConnectionDelegate> myDelegate = [[MyDelegate alloc] init];

for (int i = 0;  i < 10;  i++) {
    NSURL* myURL = [NSURL URLWithString:@”http://www.apple.com/”];

    NSURLRequest* myRequest = [NSURLRequest requestWithURL:myURL];
    [myRequest setAllowsCellularAccess:NO];

    NSURLConnection* conn;
    conn = [NSURLConnection connectionWithRequest:myRequest
                                         delegate:myDelegate];

}
```

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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];
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     NSURLSessionDataTask* task;
     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:]
```

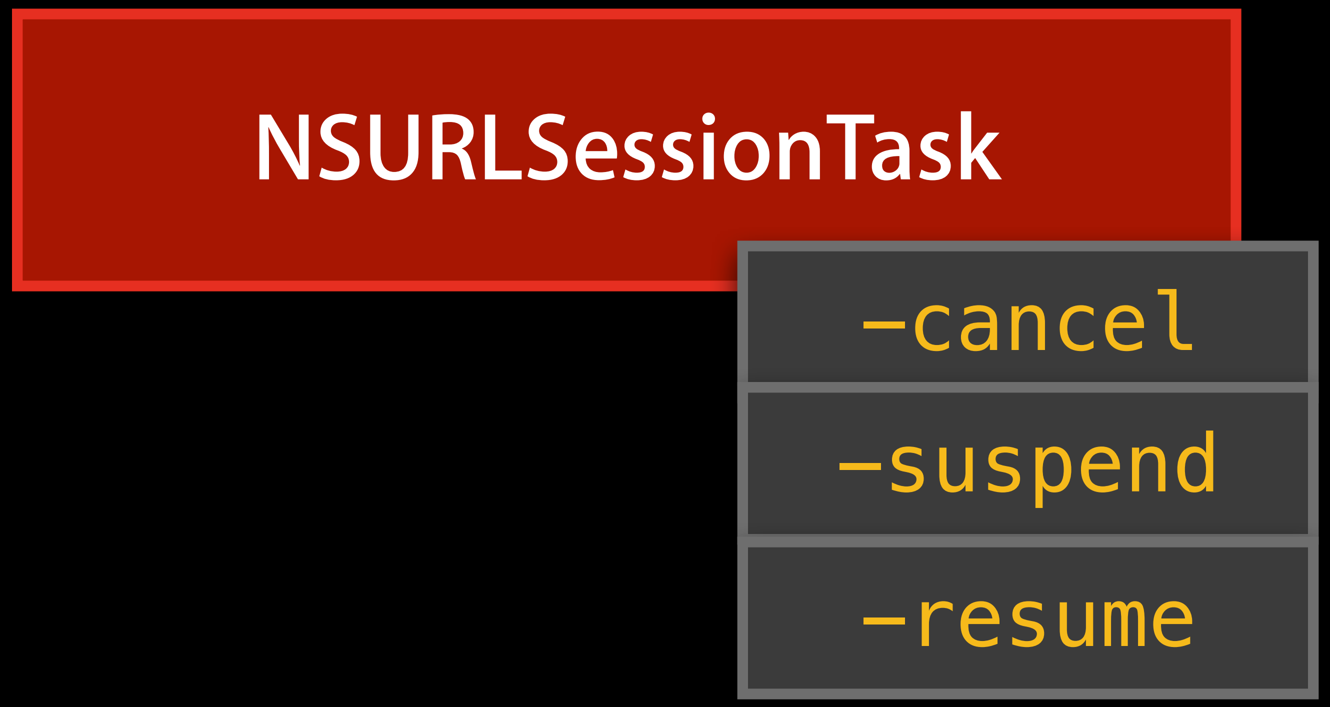
- NSURLSessionDelegate methods keyed to task type

```
–URLSession:task:didCompleteWithError:
–URLSession:dataTask:didReceiveData:
–URLSession:downloadTask:didFinishDownloadingToURL:
```

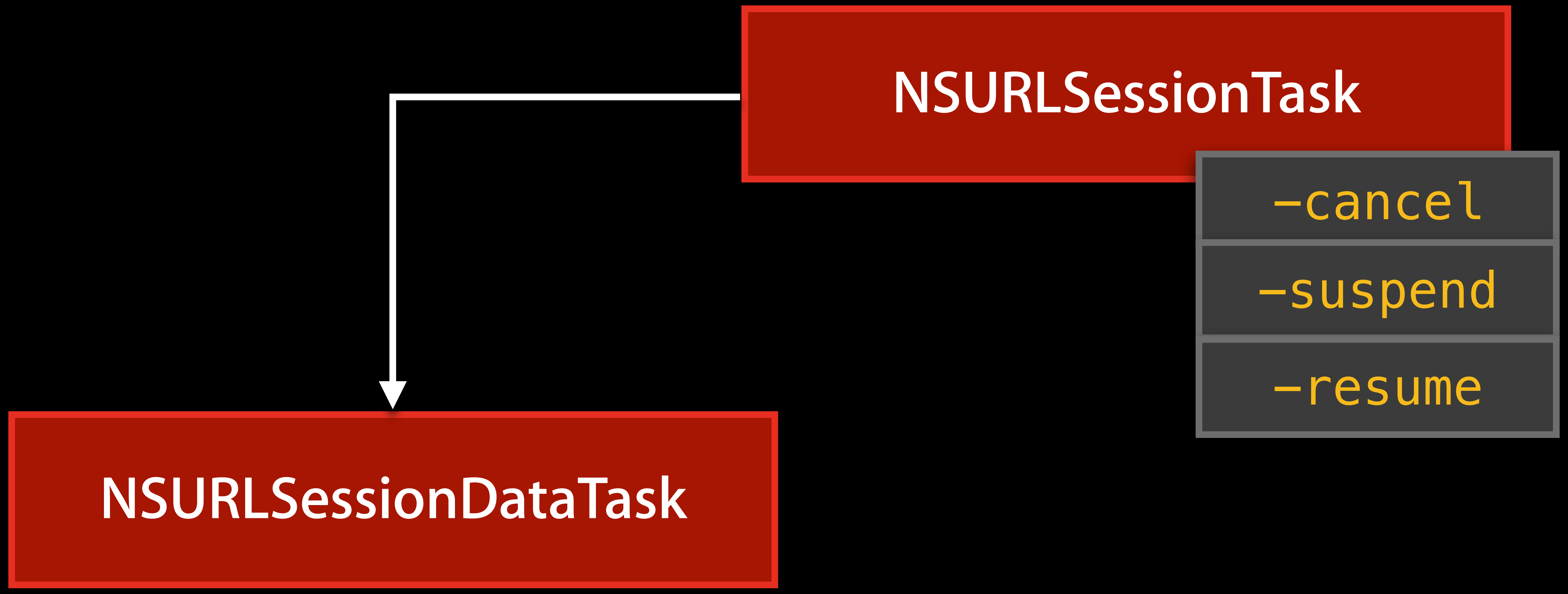
NSURLSessionTask

NSURLSessionTask

NSURLSessionTask



NSURLSessionTask



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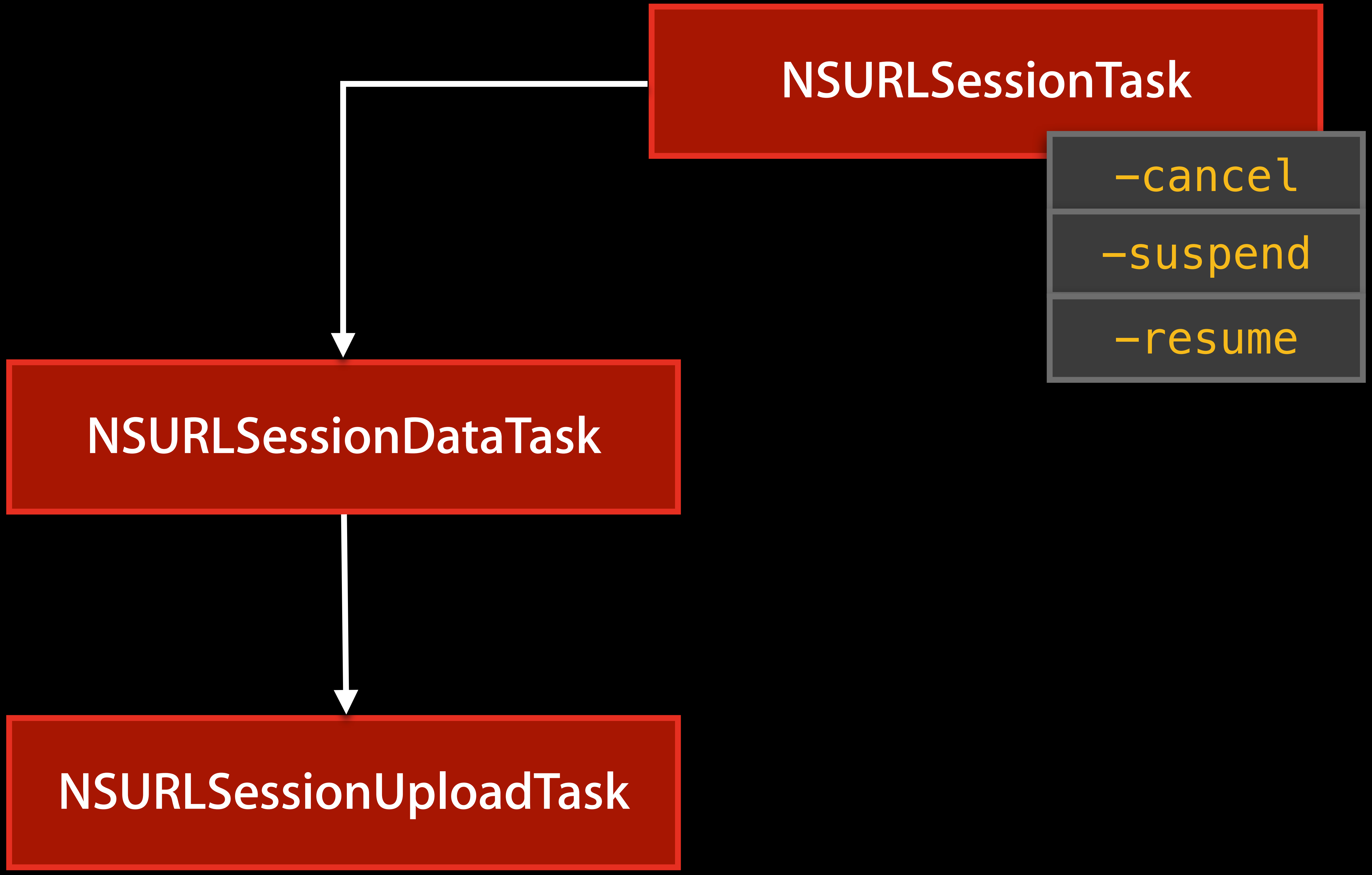

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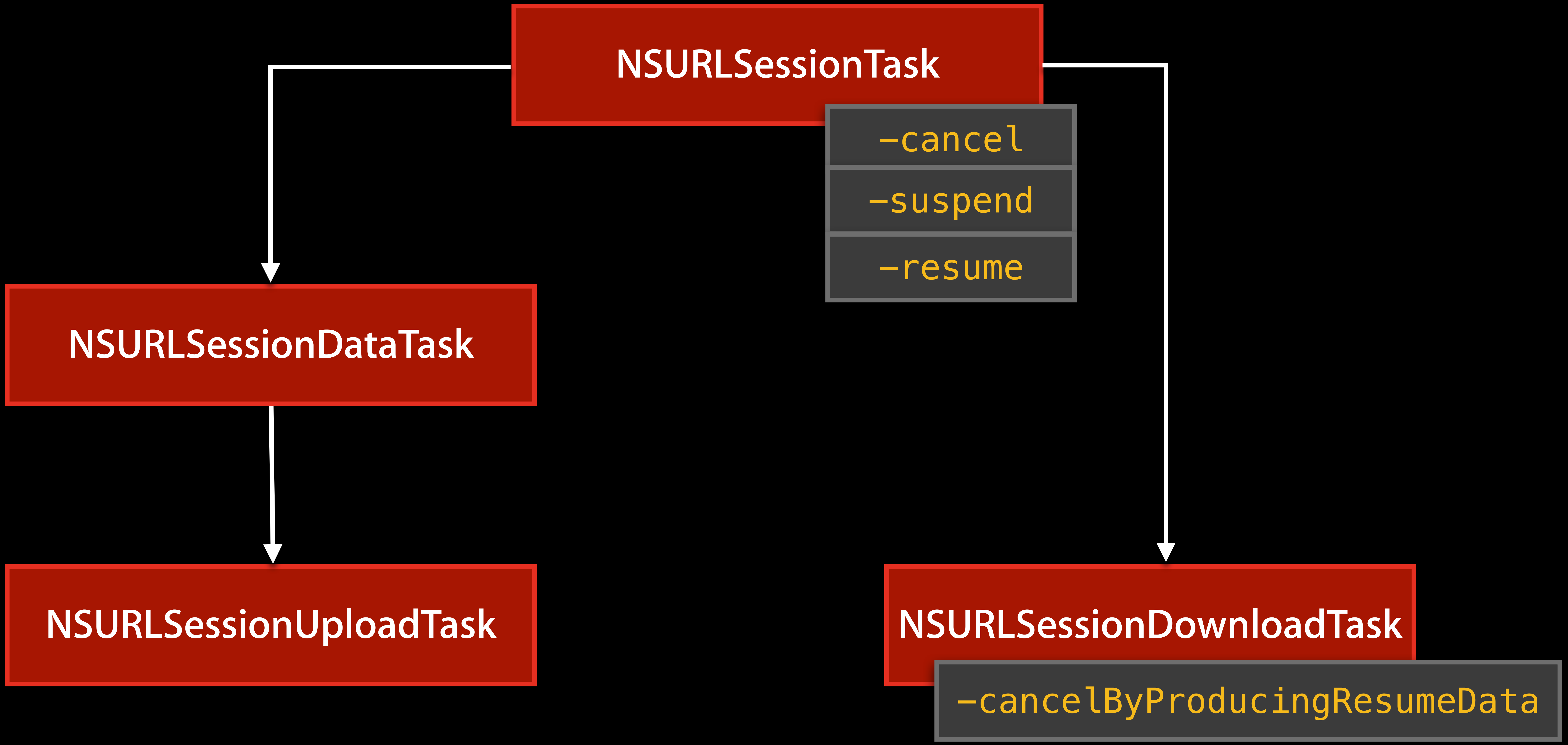

NSURLSessionDelegate

- 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

```
–URLSession:didReceiveAuthenticationChallenge:completionHandler:
–URLSession: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

```
–URLSession: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]; }
```

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 [mySession dataTaskWithHTTPGetRequest:myPrivateURL
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NSURLSession

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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:NSURLSessionDownloadTaskResumeData]
```

NSURLSession

Background Transfers

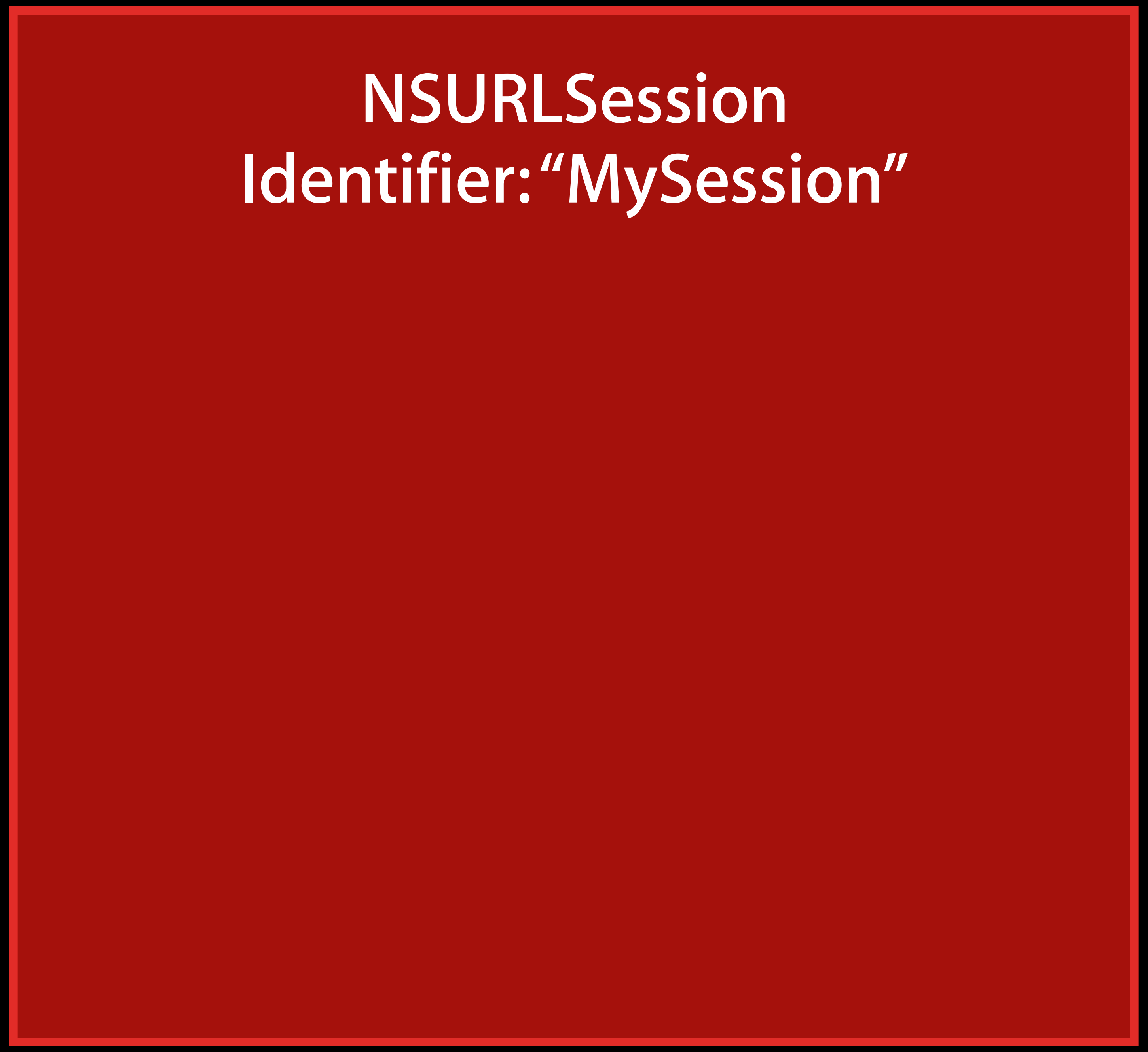
- Supports upload and download using HTTP(S)
- Requires a delegate for event delivery
    - Uses same Upload and Download task delegates as in-process
- Redirections are always taken
- `–discretionary` configuration property
    - Available on iOS, only applies to background transfers
    - Optimizes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

NSURLSession

Background Transfers

NSURLSession

Background Transfers



NSURLSession

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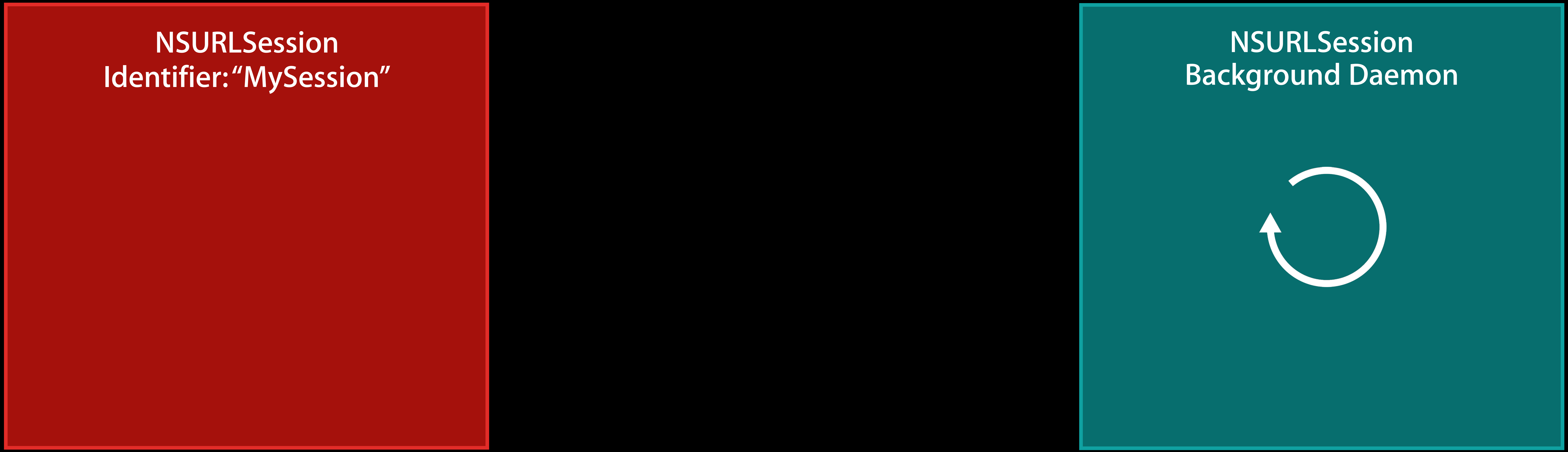

NSURLSession

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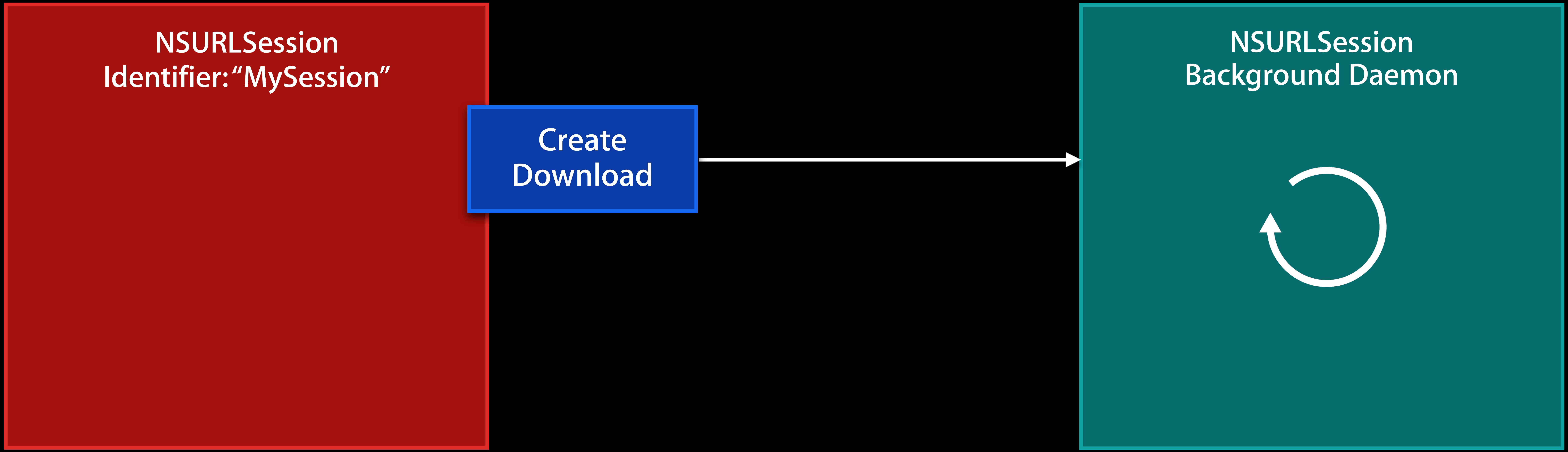

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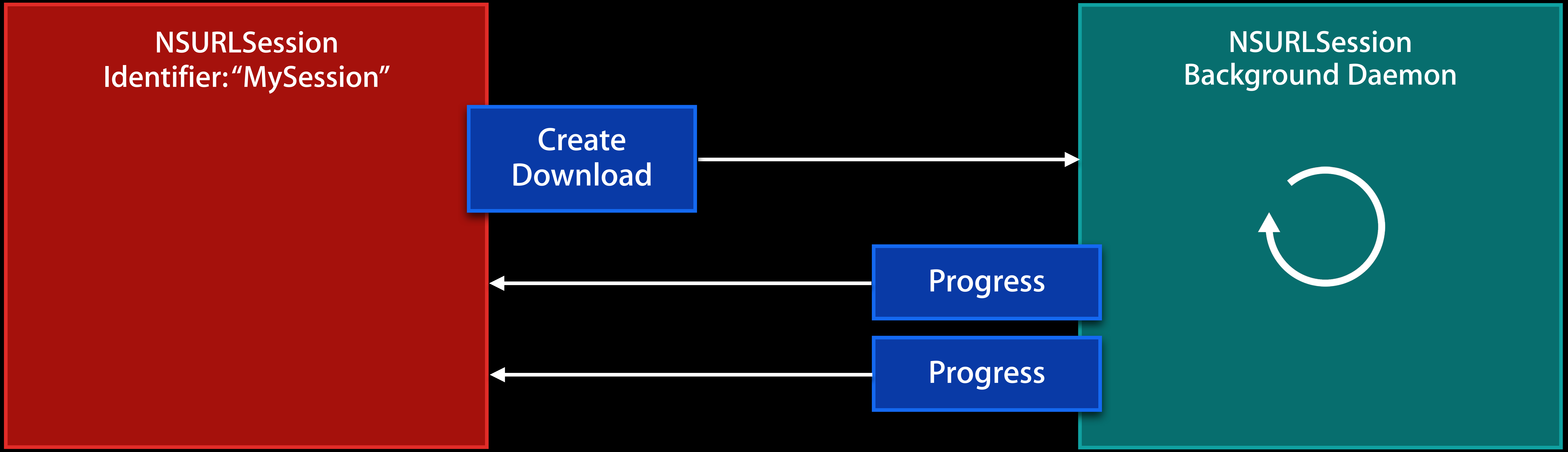

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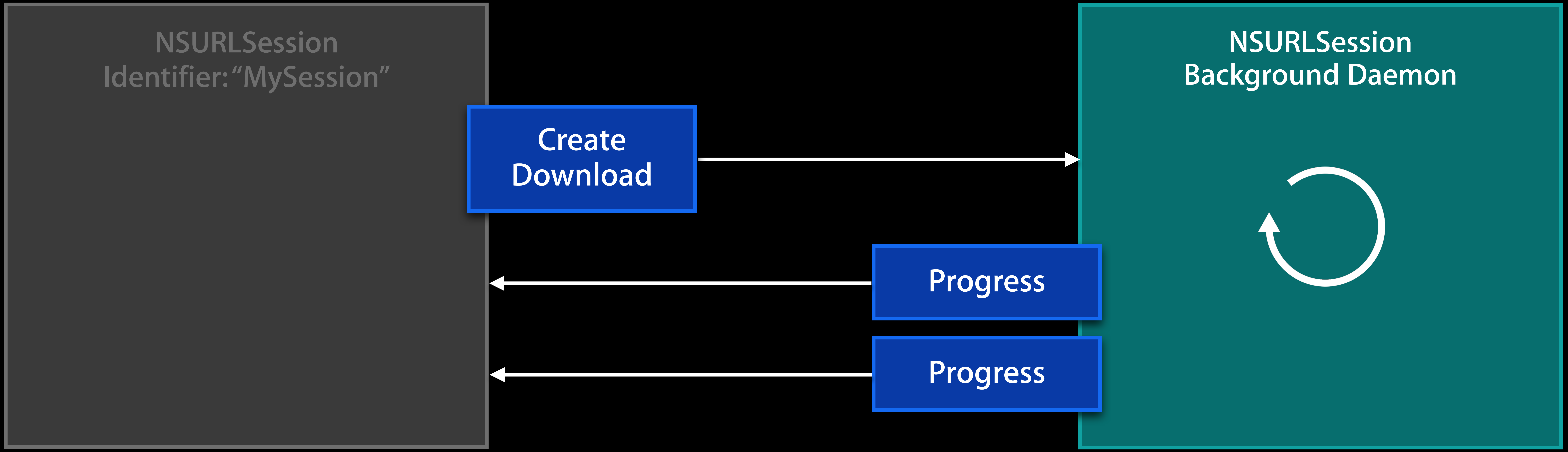
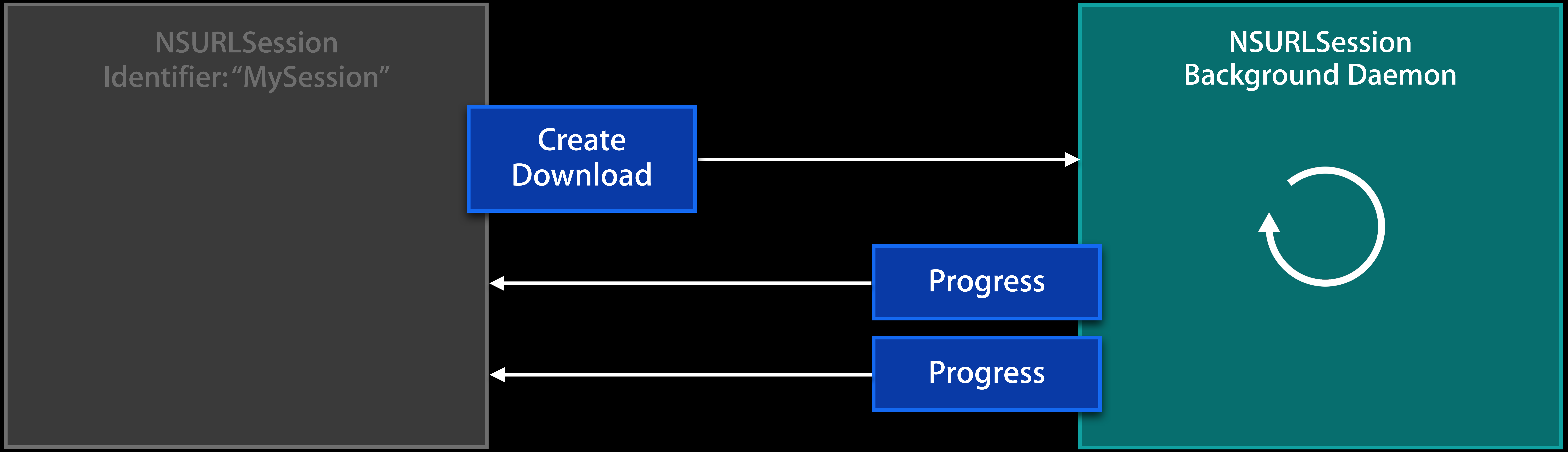


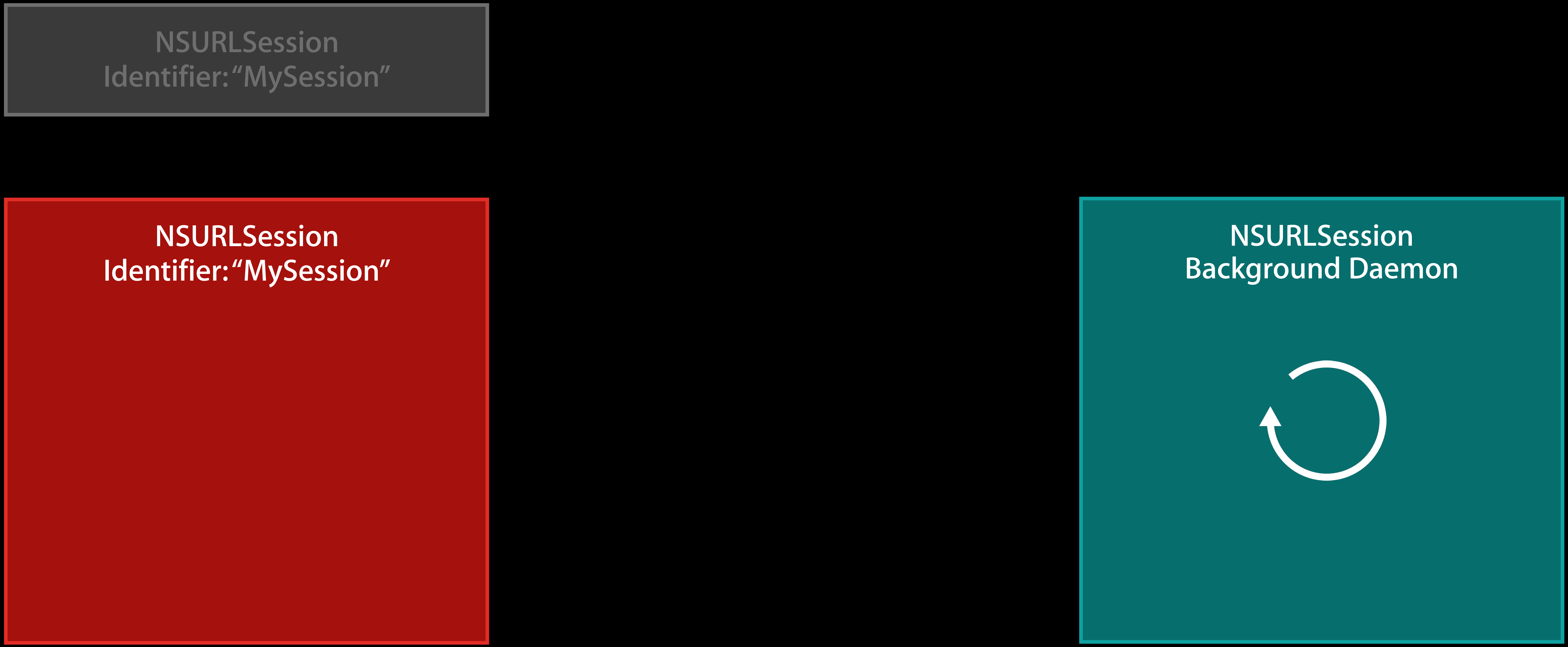
NSURLSession

Background Transfers



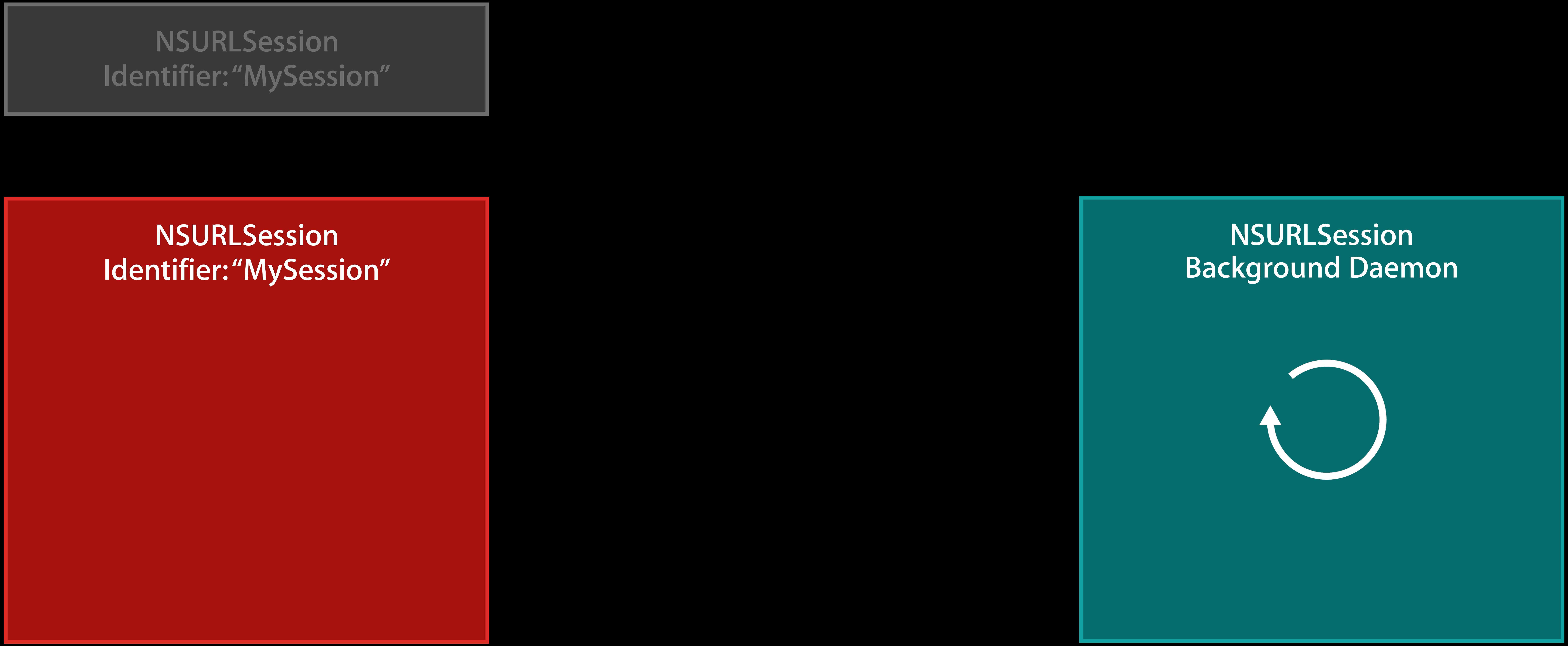
NSURLSession

Background Transfers



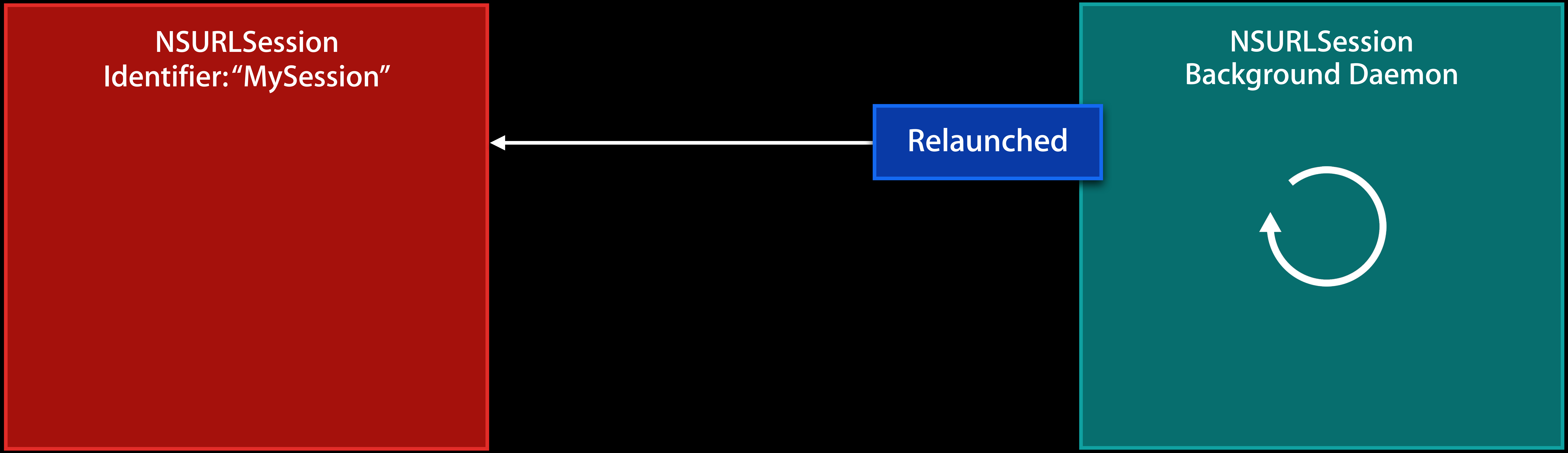
NSURLSession

Background Transfers

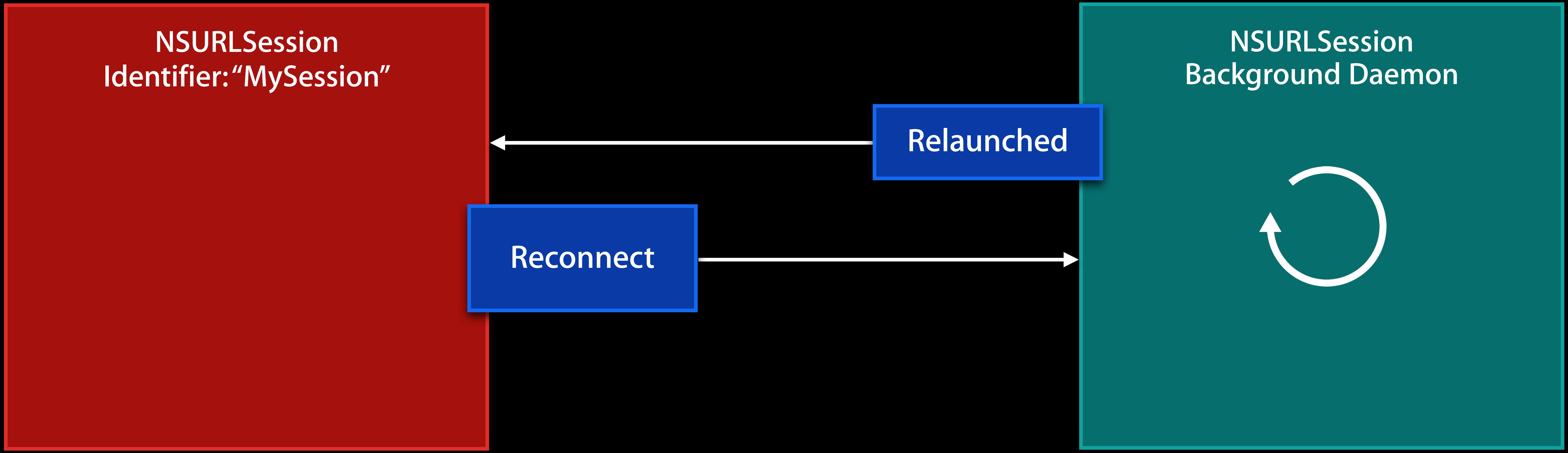


NSURLSession

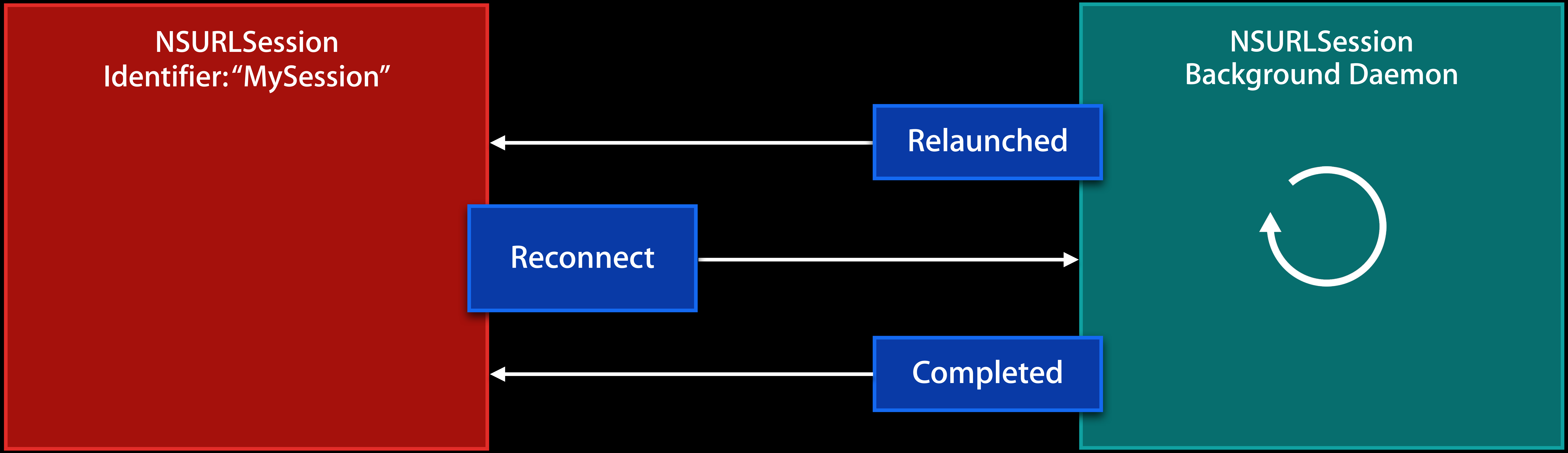
Background Transfers



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

NEW

- 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

- 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

NEW

- 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

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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

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