CS193P - Lecture 17

iPhone Application Development

Bonjour
NSStream
GameKit

Announcements

- All Paparazzi assignments should be in!
- Work on your final projects

- Final exam is Thursday, 3/18
    - 12:15 - 3:15pm
    - Hewlett 201
    - We will work on schedule for demos
        - If you have any special requests, let us know

Topics

- Bonjour
  - Automatic Configuration
- NSStream
  - Asynchronous communication

Bonjour

Bonjour

- Three main functions:
  - Automate address distribution and name mapping
  - Publish availability of a service
  - Discover available services
- Open protocol Apple submitted to IETF
  - www.zeroconf.org

Bonjour

- Makes LANs self configuring
  - Requires no administration
  - Assign addresses without a DHCP server
  - Map names to addresses without a DNS server
  - Find services without a directory server

Automatic Addressing

- Bonjour will pick a random address, see if it is in use
  - If it is not in use, it's yours
  - If it is in use, try again
- Uses ".local." as a virtual top-level domain
  - For example: iPhone3G.local.

Advertising Services

- Applications provide a service name and port
- Follows same DNS specific-to-general model
- ServiceName._ServiceType._TransportProtocolName.Domain
    - Service Name is a human readable descriptive name
        - Maximum of 63 octets of UTF-8
        - All characters are allowed

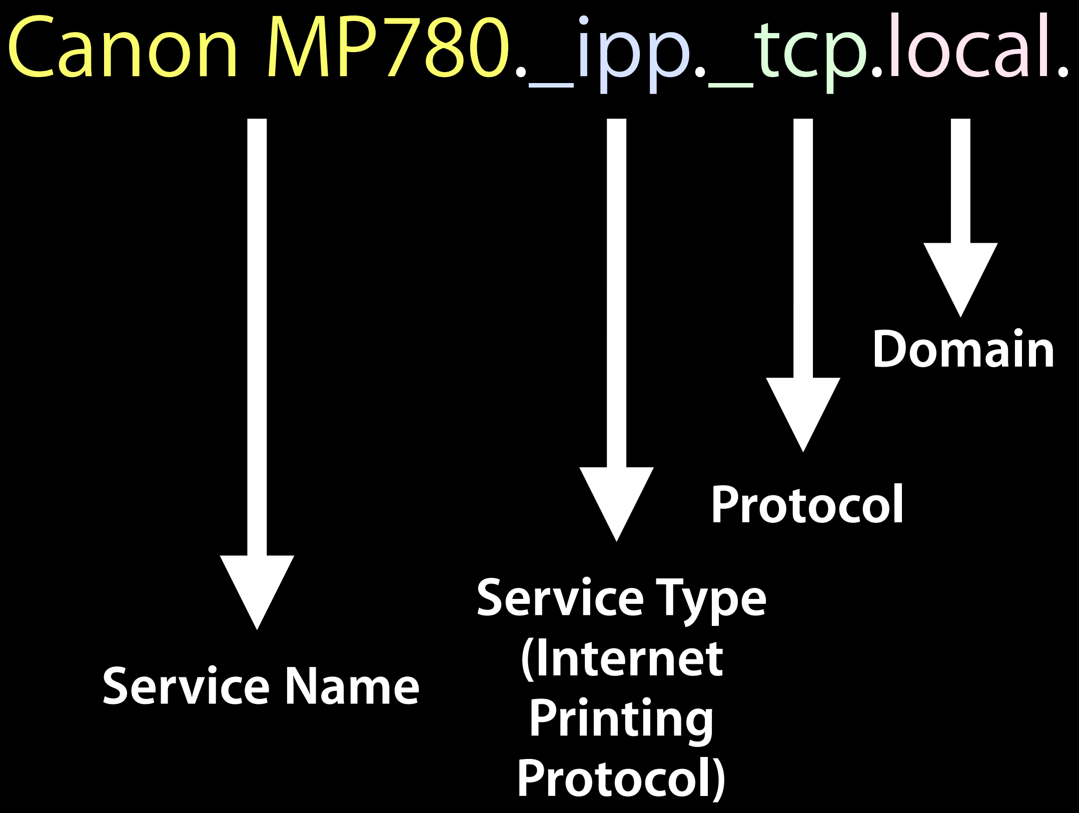
Advertising Services

- Applications provide a service name and port
- Follows same DNS specific-to-general model
- ServiceName._ServiceType._TransportProtocolName.Domain
    - Service Type is an IANA registered protocol name
        - Maximum of fourteen characters
        - Format of [a-z0-9]([a-z0-9\-]*[a-z0-9])?

Advertising Services

- Applications provide a service name and port
- Follows same DNS specific-to-general model
- ServiceName._ServiceType._TransportProtocolName.Domain
    - Transport Protocol Name is either TCP or UDP
        - Your own awesomely inventive protocol is not supported...

Service Naming


Canon MP780._ipp._tcp.local.
Domain
Protocol
Service Type (Internet Printing Protocol)
Service Name

Publishing a Service

- NSNetService is used to publish services via Bonjour

```
NSNetService *_service;

_service = [[NSNetService alloc] initWithDomain:@""
                         type:@"_ipp._tcp"
                         name:@"Canon MP780"
                         port:4721];
```

- Leaving domain blank implies ".local."
- Leaving name blank will use the device's iTunes name

Publishing a Service

- NSNetService is entirely asynchronous

```
// Set up delegate to receive callbacks
[_service setDelegate:self];

[_service publish];
```

- Always remember to unset the delegate in dealloc!

```
- (void)dealloc {
   [_service setDelegate:nil];
   [_service stop];
   [_service release];

   [super dealloc];
}
```

NSNetService Delegate Methods

- Conflict resolution handled automatically

- Status is communicated to the delegate

  - `(void)netServiceWillPublish:(NSNetService *)sender`

  - `(void)netServiceDidPublish:(NSNetService *)sender`

  -
    ```
    (void)netService:(NSNetService *)sender
          didNotPublish:(NSDictionary *)errorDict
    ```

    - `errorDict` is like an NSError - has two keys, one for error domain and one for error code.

Finding a Service

- Applications register service names with local daemon which handles responding to lookup queries
- Service discovery is completely independent of service implementation
- Resolving a service gives you an address and a port
    - Can also get NSStreams pointing to that location

Finding a Service

- NSNetServiceBrowser is used to search for services on the network.

```
NSNetServiceBrowser *_browser;

 _browser = [[NSNetServiceBrowser alloc] init];

[_browser setDelegate:self];
[_browser searchForServicesOfType:@”_ipp._tcp.”
         inDomain:@””];
```

NSNetServiceBrowser Delegate Methods

- NSNetServiceBrowser browsing is also asynchronous
- Delegate methods called as services come and go

```
- (void)netServiceBrowserWillSearch:(NSNetServiceBrowser *)browser
- (void)netServiceBrowserDidStopSearch:(NSNetServiceBrowser *)browser

- (void)netServiceBrowser:(NSNetServiceBrowser *)browser
             didNotSearch:(NSDictionary *)errorInfo

- (void)netServiceBrowser:(NSNetServiceBrowser *)browser
           didFindService:(NSNetService *)service
               moreComing:(BOOL)more

- (void)netServiceBrowser:(NSNetServiceBrowser *)browser
         didRemoveService:(NSNetService *)service
               moreComing:(BOOL)more
```

Service Resolution

Service Resolution

- NSNetServices found by NSNetServiceBrowser must have their addresses resolved before use:

```
[netService setDelegate:self];
[netService resolveWithTimeout:5];
```

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- Status communicated aynschronously to delegate:

```
- (void)netService:(NSNetService *)sender
        didNotResolve:(NSDictionary *)errorDict;
```

  - Same `errorDict` as before.

```
- (void)netServiceDidResolveAddress:(NSNetService *)sender;
```

Service Resolution

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  - Same `errorDict` as before.

```
        - (void)netServiceDidResolveAddress:(NSNetService *)sender;
```

- Once a service has been resolved you can use the address information to connect to it

Bonjour Service Publishing and Searching Demo

NSStreams

Service Resolution

- `NSNetService` will generate NSStream instances for you

Service Resolution

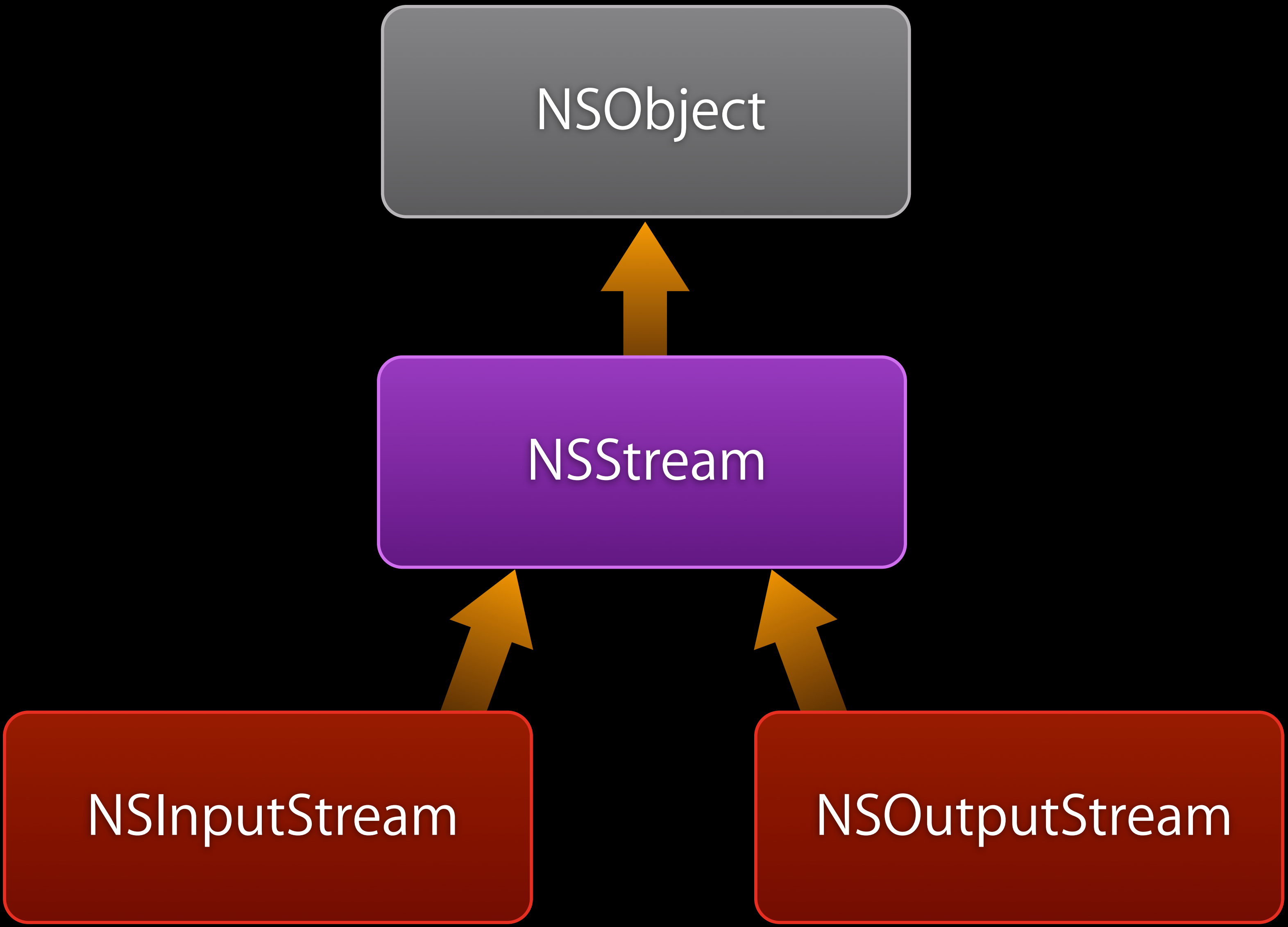
- `NSNetService` will generate NSStream instances for you

```
 NSInputStream  *inputStream  = nil;
 NSOutputStream *outputStream = nil;

[netService getInputStream:&inputStream
              outputStream:&outputStream];
```

What's an NSStream?

- Sort of like sockets, but without `select`
- State changes are asynchronously sent to the delegate
- Writes / Reads are still synchronous
- You can support multiple streams and still operate on a single thread
- Device agnostic - we'll use sockets, but could easily be files, memory locations, etc.


NSObject
NSStream
NSInputStream
NSOutputStream

NSStream Class

- Opening a stream

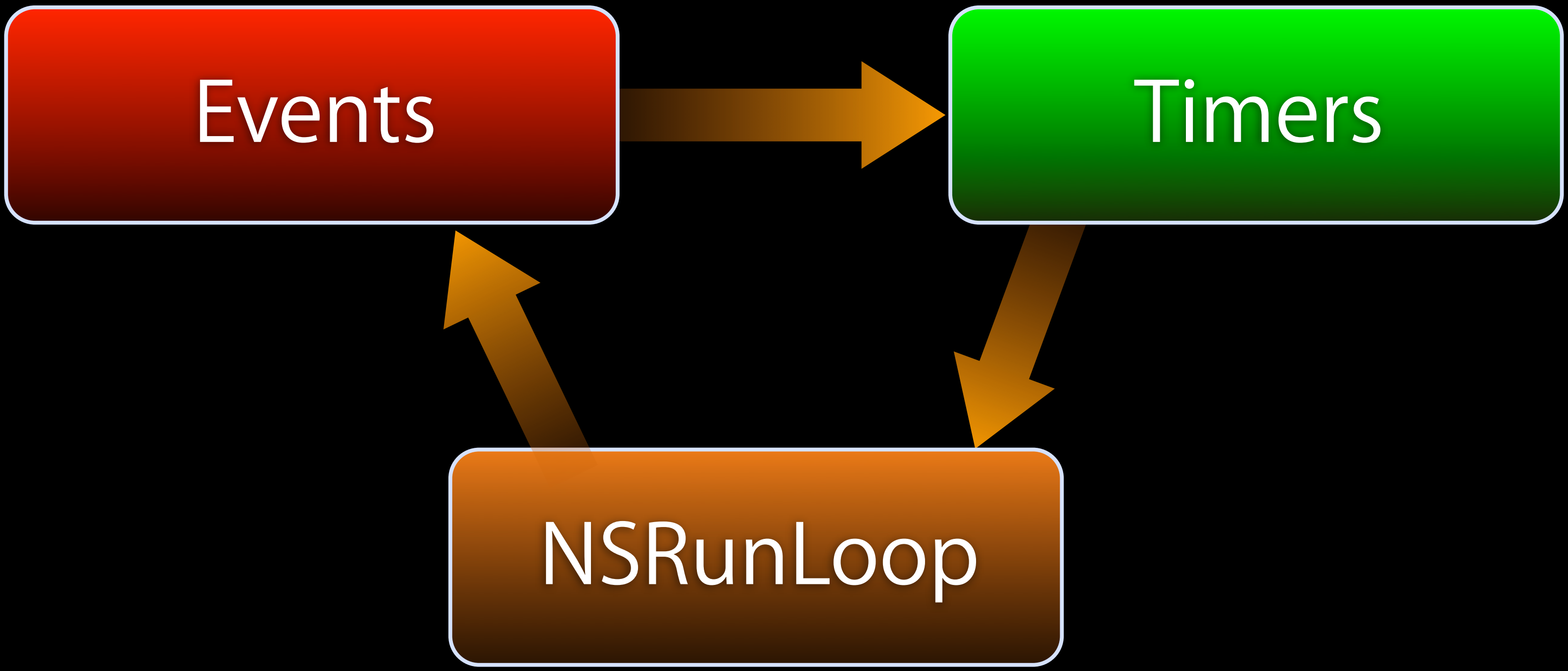
```
[stream setDelegate:self];
[stream scheduleInRunLoop:[NSRunLoop currentRunLoop]
        forMode:NSRunLoopCommonModes];
[stream open];
```

- Closing a stream

```
[stream close];
[stream removeFromRunLoop:[NSRunLoop currentRunLoop]
        forMode:NSRunLoopCommonModes];
[stream setDelegate:nil];
```

What's a Run Loop?

- Easy event processing
  - You've been using them, but you don't even know it!



- Scheduling the NSStream on the NSRunLoop causes it to send its events when that run loop spins.

Okay, what’s a run mode?

- Run loops have an unbounded number of run loop modes.
- Events (sources, timers, etc) are scheduled to run only in certain run loop modes.
- This allows you to block events from occurring during high-feedback event loops
  - For instance, `UITrackingRunLoopMode` is used for tracking finger touches. Not servicing other sources here can be a huge responsiveness win.
- NSRunLoopCommonModes includes the publicly defined common modes (including tracking). You can also define your own run loop mode to only service your events.

NSStream Delegate Call

- Just a single method

```
- (void)stream:(NSStream *)theStream
   handleEvent:(NSStreamEvent)streamEvent
```

- Several different event types
  - Some examples:

```
NSStreamEventOpenCompleted
NSStreamEventHasSpaceAvailable
NSStreamEventErrorOccurred
NSStreamEventEndEncountered
```

NSOutputStream

- Only one method you’ll really use

```
- (NSInteger)write:(const uint8_t *)buffer
          maxLength:(NSUInteger)length
```

- For instance:

```
// outputStream is an already opened NSOutputStream
// with space available.

const char *buff   = “Hello World!”;
NSUInteger buffLen = strlen(buff);
NSInteger writtenLength =
   [outputStream write:(const uint8_t *)buff
             maxLength:strlen(buff)];
if (writtenLength != buffLen) {
    [NSException raise:@”WriteFailure” format:@””];
}
```

NSInputStream

- Two useful methods, but we’ll focus on one

```
- (NSInteger)read:(uint8_t *)buffer
         maxLength:(NSUInteger)length
```

- For instance:

```
// inputStream is an already opened NSInputStream
// with space available.

unit8_t buff[1024];
bzero(buff, sizeof(buff));
NSInteger readLength =
   [inputStream read:buff
          maxLength:sizeof(buff) - 1];
buff[readLength] = ‘\0’;
NSLog(@”Read: %s”, (char *)buff);
```

Messaging with NSStream

GameKit

Discovery and Connectivity

GameKit

- Peer-to-Peer connectivity
  - Abstracts away Bonjour and Stream creation
  - Nearby (Bluetooth) & Online (Wifi) support

- In-Game Voice
  - Facilitates voice communication between two devices

GameKit Classes

- GKPeerPickerController
  - Presents UI prompting user to search for peers
  - Facilitates creation of GKSessions
- GKSession
  - Manages streams of data between peers
  - Allows sending to single peer, or broadcast to all
- GKVoiceChatService
  - Manages audio between peers
  - Controls volume, detecting whether peer or local user is speaking

GKSession

- Manages discovery of peers
- Abstracts streaming and Bonjour code

```
- (id)initWithSessionID:(NSString *)sessionID
            displayName:(NSString *)name
            sessionMode:(GKSessionMode)mode

typedef enum {
   GKSessionModeServer,
   GKSessionModeClient,
   GKSessionModePeer
} GKSessionMode;
```

GKSession

- Properties include:
  - displayName - Your name, as seen by your peers
  - peerID - unique ID, identifying your Session to your peers
  - sessionID - String used by your Application to filter peers
- Delegate methods:
  - Notifies of state change of a peer's sesssion
  - Notifies of connection requests
  - Notifies of errors with sessions or connections

GKSession - Sending & Receiving Data

- Send data to specific peers

```
- (BOOL)sendData:(NSData *)data toPeers:(NSArray *)peers
withDataMode:(GKSendDataMode)mode error:(NSError **)error;
```

- Send data to ALL connected peers

```
- (BOOL)sendDataToAllPeers:(NSData *)data withDataMode:
(GKSendDataMode)mode error:(NSError **)error;
```

- Delegate method to receive data:

```
- (void)receiveData:(NSData *)data fromPeer:(NSString *)peer
inSession:(GKSession *)session context:(void *)context;
```

GKPeerPickerController

- Provides UI to connect to peer
- Allows user to pick between “Nearby” and “Online”

- Nearby
  - Bluetooth communication
  - Most of the work is handled for you under-the-hood

- Online
  - Hands off responsibility to the application
  - App builds or connects to server
  - Associates users in server
  - App is responsible for handling communication

Initiating a connection

```
// Allocate the PeerPickerController
GKPeerPickerController *peerPicker;
peerPicker = [[GKPeerPickerController alloc] init];

// Set up delegate to receive callbacks
peerPicker.delegate = self;
peerPicker.connectionMask =
        GKPeerPickerConnectionTypeOnline |
        GKPeerPickerConnectionTypeNearby;

// Display the Peer Picker
[peerPicker show];
```

Receiving a connection

- Return a session for the requested type

```
- (GKSession *)peerPickerController:
(GKPeerPickerController *)picker sessionForConnectionType:
(GKPeerPickerConnectionType)streamEvent {

    return [[[GKSession alloc] initWithSessionID:nil
    displayName:localName sessionMode:GKSessionModePeer]
    autorelease];

}
```

- Accept connection from peer

```
- (GKSession *)session:(GKSession *)session
didReceiveConnectionRequestFromPeer:(NSString *)peerID {

    [session acceptConnectionFromPeer:peerID error:nil];

}
```

GameKit demo