Core OS Networking

Key Principles

Session 200

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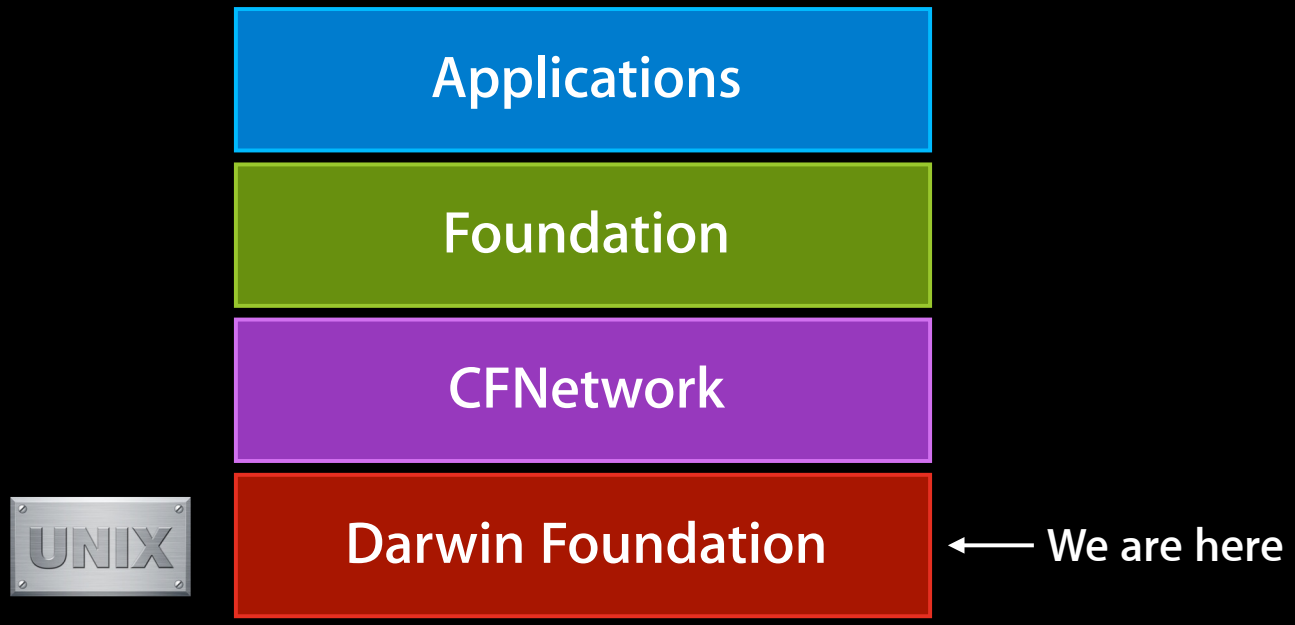
How Did We Get Here?

Core OS Networking



New for Lion and iOS 5

IPv6—Not Exactly New, But…

It appears we have run out of IPv4 addresses

- Original support for IPv6 back in Mac OS 10.1
  - iOS added support in iOS 4
- A lot of updates, fixes, and enhancements
  - RFC 5006—Router Advertisement for DNS
  - DHCPv6, stateful and stateless
  - Temporary addresses for privacy
  - CFSocketStream picks best path (IPv4 vs. IPv6) automatically
  - IETF Advanced Sockets API
  - All ready for v6 day

Captive Networks

New

- What is a captive network?
  - "Walled garden" for Wi-Fi Hotspots
  - e.g., Starbucks, etc.
- Supports WISPr and other authentication methods
- OS detects and remembers captive networks
- Support now in Lion

SSL VPN

- Support added in iOS 4
- Cisco, Juniper, and F5 clients
- OS-level plumbing
  - Now on Lion
- Vendor-specific feature sets
- Clients available via the App Store

Other Networking Enhancements

- IGMPv3, Multicast Group Management Protocol
- Packet Filter (PF)
  - IPFW no longer being enhanced or supported by the community
- Traffic throttling
  - Background processes on iOS 5
  - Low priority traffic on Lion

Other Networking Enhancements

- Profile-based configuration for VPN and 802.1X on Lion
  - Same profile can be used for Lion and iOS
- 802.1X autodetect/autoconnect for wired Ethernet on Lion
- Scoped interfaces (multihomed)
  - DNS, routing, proxies
- Improved Back to My Mac connectivity, NAT handling

Tools

- nettop
- Network Link Conditioner
- Remote packet capture for iOS

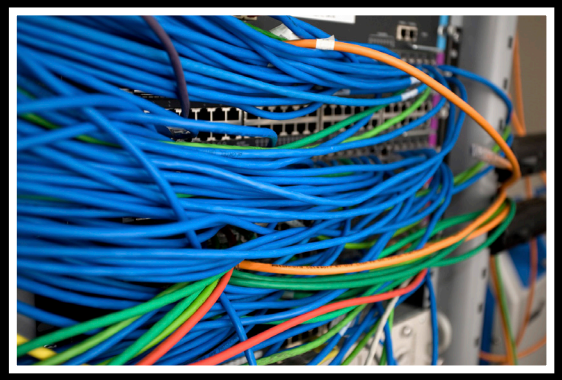
Core OS Networking—In Depth	Pacific Heights Wednesday 11:30AM

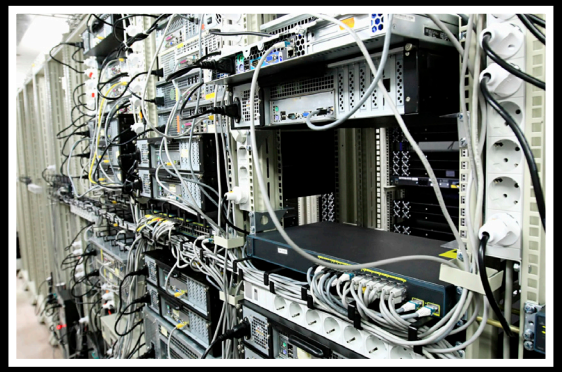

iPad
9:41 AM
Thursday
27
Calendar
Contacts
Notes
Maps
Videos
YouTube
iTunes
App Store
Game Center
FaceTime
Camera
Photo Booth
Settings
Safari
Mail
Photos
iPod
3G
9:41 AM
Monday
7
Messages
Calendar
Photos
Camera
YouTube
Stocks
Maps
Weather
Notes
Utilities
iTunes
App Store
Game Center
Settings
Phone
Mail
Safari
iPod

Today's Challenge

- 425,000+ apps
- Significant percentage are network-enabled
- Mobility is not the exception, it is the norm

Networking Used to Be Static…





- System administrators configured everything
- Total control of your local networking environment

Nothing Is Static Anymore

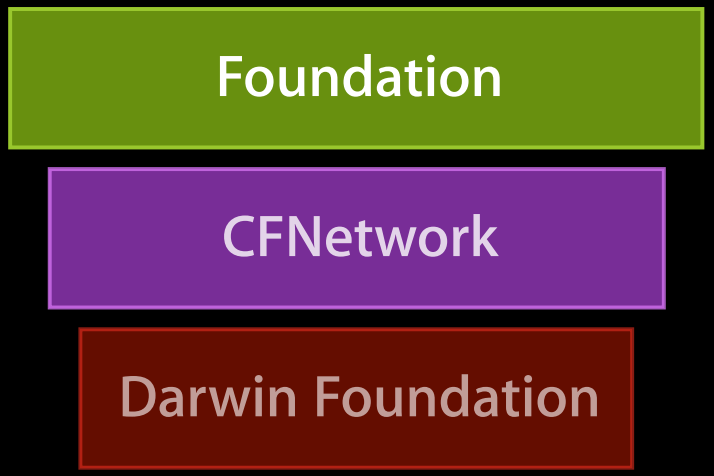
- Network configuration is completely dynamic and can be assumed to change
- At any time and for virtually any reason
  - Signal strength
  - Cell availability
  - Wi-Fi availability
    - Public and private Wi-Fi environments
  - VPN connectivity

"Any sufficiently advanced technology is indistinguishable from magic."

Arthur C. Clark

Networking Key Principles

Write to the Highest Level APIs That You Can



- Future-proof your app
- Allow the framework to deal with IPv4/IPv6 address families
- Do not depend on transport-level details…they might change
- You will automatically get the benefits of framework and infrastructure improvements
- However, one size does not fit all

Do Not Assume Network Is Free

- 3G and/or Wi-Fi may be fee-based
  - Usage may be charged by time or data
- 3G may be roaming
- Power is not free either

The Network Is a Limited Resource

- Transmit only what you need to
- Consider compressing data
- Cluster small packets
- Cache intelligently
- Consider performance
  - Bandwidth vs. latency

Beware of Buffer Bloat

- Oversized buffers can increase latency
- Cascading oversized buffers are seriously impacting our networking experience
  - See: http://www.bufferbloat.net
- iOS 5 and Lion will automatically calculate optimal sizes for best performance

Robustly Deal with Network Errors

- Connections will go down
- Packets will get dropped
- Timeouts will occur
- Respond to backgrounding intelligently
  - Close things down that you can
- Hide problems if possible
- Test using the Network Link Conditioner
- Nothing beats real-world testing

Networking Is Asynchronous by Definition

- Do not put synchronous calls on main thread
  - Your app will get shot
- Event-driven APIs give a better experience
  - (e.g., Bonjour, Foundation APIs using RunLoop event sources, etc.)
- UI should reflect this reality

Link Quality Is Completely Variable

- Wi-Fi
- 3G
- Layered networks (Wi-Fi on cellular or worse)
- Expect changes in:
  - Speed
  - Latency
  - Packet loss

Deal with No-Network Conditions

- Network will not always be available
- Might go away at any time
- Your app should behave intelligently, gracefully
- Consider an offline mode
  - Cached content
  - Limited access
- No annoying alerts

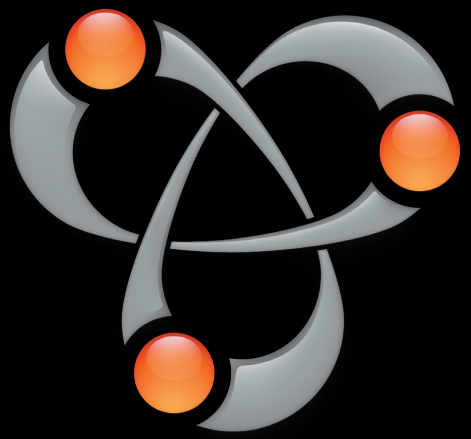
Assume Network Is Insecure

- May be using public Wi-Fi, Hotspots, etc.
  - Might even be using spoofed network
- Do not transmit user information in the clear
- Use end-to-end security, Transport Level Security (TLS), whenever possible

Be IPv4/6 Agnostic

- Use CFNetwork and higher, when possible
- Do not assume address types or sizes
- Be prepared for multiple DNS address resolution responses
- Check open source and older code for IPv6 compatibility
- Test on an IPv6-only network

Use Bonjour to Advertise and Find Services



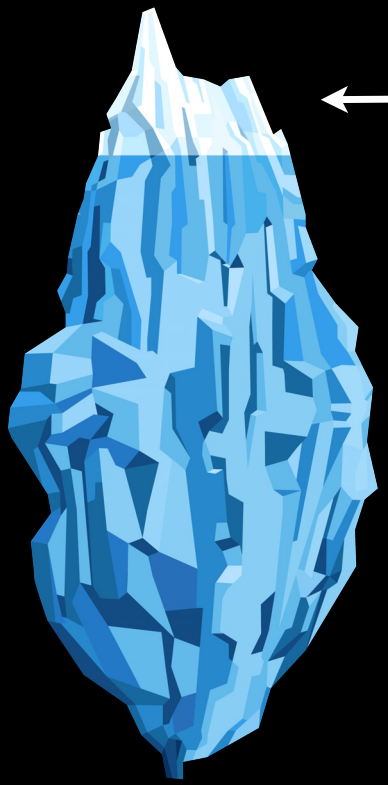
- It is a dynamic world; nobody remembers IP addresses
- Can you remember your IPv6 address? (2001:0200:0000:8002:0203:47ff:fea5:3085)
- Bonjour provides service advertisement, browsing, and resolving APIs
- Peer to peer
- On Mac OS, Bonjour also provides sleep proxy support

Power Is as Important as Performance

- Portability means batteries
- Use of the network powers up the radio(s)
  - Bursts are better than trickles
- Use push notifications
- Sleep proxy support helps on Snow Leopard and Lion
- Reachability APIs can help

Assume Change at Any Time

- Anything can and will change
  - Available interfaces
  - Signal strength and quality
- Do not leave connections open longer than necessary
- Use Reachability APIs



This should be all that you have to do

Summary

- It is all about networking…
  - Networked apps add huge value for your customers
  - They expect a "connected" experience
- Be prepared for the challenges of the highly mobile world
  - Write your app assuming nothing is static
  - Anything and everything about the network will change
  - Test. Test. Test.
- Help keep the illusion of magic…

More Information

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Documentation
Networking
http://developer.apple.com/networking

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

Related Sessions

Core OS Networking—In Depth	Pacific Heights Wednesday 11:30AM
Bonjour Network Discovery and Connectivity	Pacific Heights Thursday 11:30AM

Labs

Network Lab	Core OS Lab A Tuesday 11:30AM
Network Lab	Core OS Lab A Wednesday 2:00PM
Network Lab	Core OS Lab A Thursday 4:30PM


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