Moving Beyond Sockets

Architecture and Observations

Tommy Pauly (tpauly@apple.com)

TAPS

IETF 97, November 2016, Seoul
Context

- TAPS is about providing easier ways to use various transport protocols, and fallback between them gracefully.

- The Post-Sockets proposal aims to define the abstraction to allow asynchronous, multipath, multistream, secure, message-based networking.

- We’ve been developing networking infrastructure at Apple to allow us to deploy robust implementations of Happy Eyeballs, interface fallback, MPTCP, etc. We’d like to see this converge with the TAPS and Post-Sockets efforts.
Definitions

YOU KEEP USING THAT WORD. I DO NOT THINK IT MEANS WHAT YOU THINK IT MEANS.
Endpoint: An identifier for a network service, such as an IP address + port, hostname + port, or Bonjour service name. Often have both local and remote.
Path: A view of network properties (a provisioning domain) that can be used to communicate to an endpoint. Route lookup++.

Remote Endpoint: www.example.com:443

Parameters:

Prohibit interface type

Result:

<table>
<thead>
<tr>
<th>Interface Type</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>Cost</td>
</tr>
<tr>
<td>MTU</td>
<td></td>
</tr>
</tbody>
</table>
Connection: A flow of data between two endpoints, using one or more paths. Created with a set of parameters about client preferences.

I/O APIs may have Stream, Datagram, or Message semantics.
Observations

1. Attempt multiple paths
2. Build paths dynamically
3. Use parallel protocol stacks
Observation 1

Attempt Multiple Paths

- Try multiple IP Addresses per hostname
- Try multiple hostnames per bonjour service
- Try different interfaces and/or local addresses
- Try different protocol stacks (transports, proxy protocols, etc)
Racing Resolved Addresses

- We receive multiple addresses for 47% of all connections

- Of those, 5% of connections end up needing to try something other than the first address

![Diagram showing the distribution of addresses](image)
Observation 2

Build Paths Dynamically

- Client parameters
- System settings
- Network conditions and state
Racing Protocols

- Around 7% of connections are eligible for modifying their protocol stack to use a proxy or other modifier.

5% by client opt-in, 2% by system configuration.
Racing Interfaces

• When we determine that attempts should be made over multiple interfaces, 20% of connections use the non-primary interface.
Observation 3

Use Parallel Protocol Stacks

- TCP attempts in parallel
- Application-level handshakes (such as TLS, proxies, or HTTP) can occur in parallel
- Required to enable fast-open or 0-RTT protocols
Parallel Protocol Stacks

- Each flow attempt can contain a separate instance of each protocol, allowing racing to occur independently (and use Fast Open, etc)