

Mobile devices as development platform in Broken Age

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GAME DEVELOPERS CONFERENCE[®]

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What makes a dev platform?

- Fast iteration time
 - Content 🞇
 - Native code 💥
- Debuggability
 - Game-play script ^{*}
 - Native code
 - Graphics 🞇

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Developing BA on mobile devices

- Some of the stuff we did on device
 - Game-play programmer wrote touch controls
 - VFX artist checked and optimized effects
 - Fix shader bugs

Double Fine development pipeline

- Target platform: ಶ 🧉 🔬
 - Code: compiled on target platform
 - Data: shared, authored on Windows

- Same hardware
 - Performance characteristics similar
 - No per-platform content





Double Fine development pipeline

- Target platform: 🔟 🏺
 - Code: compiled on OSX
 - Data: not shared, authored on Windows

- Hardware is very different
 - Performance varies greatly
 - Platform / GPU specific data necessary



Mobile as development platform

- Broken Age Act 1 package size: ~1.2GB
- Reboot time was ridiculous!
 - 10 minutes*
 - 🏟 8 21 minutes
- Infeasible for development!

* Recent Xcode update reduced reboot time to 2 – 3 minutes



Too slow

- What is going on? **iOS**
 - Relink and update staging data: 10+ seconds
 - Data sync and install: ~10 minutes

• Sync (comparison and copy) is bottleneck

Incomprehensibly slow

- What is going on?
 - Package build time: 4+ minutes
 - Data transfer and install: 4 17 minutes

• USB speed is bottleneck



Slow content update

- Same symptom but different cause
- Different solutions required
 - 🛑 Minimize APK size
 - IOS Work around Xcode data sync

- Minimal APK: No data, just code
 - Reduced package build time
 - Fast APK transfer and installation

- Deal with data separately
 - Only copy added or changed files

- Load assets from `sdcard'
 - Supported by (almost) all Android devices
 - Remap file location

```
bool RemapFilename( const char* filename, char* remapped ) {
    #if _DEV
        sprintf(remapped, "/sdcard/dfp/dfa/%s", filename);
        return FileExists(remapped);
    #else
        return false;
    #endif
}
```

- Data sync
 - 1st approach: Consistent file database
 - Sync changes using ADB (e.g. adb push ...)
 - Keep track of files on device
 - Update database during sync
 - Slow and inconvenient
 - Multiple devices: Per-device database?!



- Data sync
 - 2nd approach: Scan device files
 - Naïve implementation is slllooooowwww....
 - Re-implement ADB protocol based on OS source

https://android.googlesource.com/platform/system/core.git/+/master/adb/



- Data sync
 - 2nd approach: Scan device files (cont.)
 - Example: List directory

```
socket.send(pack("LIST",15,"/sdcard/dfp/dfa"))
while True:
    id, mode, size, time, namelen = unpack(socket.recv(16))
    name = '' if namelen == 0 else _recvall(socket,namelen)
    if id == "DONE": break
    if stat.S_ISDIR(mode):
        dirs.append(...)
    elif stat.S_ISREG(mode):
        files.append(...)
return (dirs, files)
```



- Data sync
 - 2nd approach: Scan device files (cont.)
 - Compare files and compute diff
 - Sync files using ADB protocol
 - Very fast
 - No database



- Results
 - Data sync: 15 25 seconds
 - APK build, copy and install: 30 40 seconds

• 10 – 20+ speedup!



Fast content update ios

- Minimal staging folder
 - Delete unchanged files
 - Copy only added or changed files
 - Use sync timestamp

- Reduced work for Xcode
- No run-time changes necessary

Fast content update ios

- Results
 - Relink and update staging data: 15+ seconds
 - Data sync and install: 30 seconds

13 speedup (latest Xcode 2 – 4 speedup)



Mobile as development platform

Ideal workflow



- No re-sync necessary*
- Hot-reload changed files
- No OSX workstation needed
- Artists can work on target device

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* Code changes require re-sync



- Latency optimization
 - Use local file cache



Server Python-based tool on workstation





- Latency optimization (cont.)
 - Read at least one cache line



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File streaming

- Latency optimization (cont.)
 - Exploit data locality



Server Python-based tool on workstation





- Latency optimization (cont.)
 - fstat() & fopen() read first cache line



- Latency optimization (cont.)
 - Cache expires after 5 ms to avoid stale data
 - Multiple concurrent requests
 - User filter to define streamed files
 - Local IO will always be faster



• Fully integrated into our game editor 2HB

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Conclusion

- Mobile as development platform is...
 - ...not trivial
 - ...worth your time
 - ...necessary for a big project every



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Thank you!

Questions?

