Overview of Android (Part 2): Middleware Infrastructure Layers

Douglas C. Schmidt
d.schmidt@vanderbilt.edu
www.dre.vanderbilt.edu/~schmidt

Professor of Computer Science
Institute for Software Integrated Systems
Vanderbilt University
Nashville, Tennessee, USA
Learning Objectives in this Part of the Lesson

1. Understand key elements in Android’s middleware infrastructure
   • e.g., hardware abstraction layer, Android runtime, & native libraries

Middleware infrastructure resides atop the OS & below the apps et al
Overview of Android’s Middleware Infrastructure
Overview of Android’s Middleware Infrastructure

- Android’s *middleware infrastructure* provides reusable capabilities that extend hardware-centric OS kernel & protocol mechanisms
Overview of Android’s Middleware Infrastructure

- Android’s *middleware infrastructure* provides reusable capabilities that extend hardware-centric OS kernel & protocol mechanisms
- Hardware abstraction layer

See source.android.com/devices/#Hardware Abstraction Layer
Overview of Android’s Middleware Infrastructure

- Android’s *middleware infrastructure* provides reusable capabilities that extend hardware-centric OS kernel & protocol mechanisms
  - Hardware abstraction layer
    - Shields Android stack from low-level hardware details
Overview of Android’s Middleware Infrastructure

- Android’s *middleware infrastructure* provides reusable capabilities that extend hardware-centric OS kernel & protocol mechanisms
  - Hardware abstraction layer
    - Shields Android stack from low-level hardware details
  - Shields OEMs from GNU Public License “virality”

See [en.wikipedia.org/wiki/Linux_kernel#Licensing_terms](en.wikipedia.org/wiki/Linux_kernel#Licensing_terms)
Overview of Android’s Middleware Infrastructure

- Android’s *middleware infrastructure* provides reusable capabilities that extend hardware-centric OS kernel & protocol mechanisms
  - Hardware abstraction layer
  - Runtime & libraries layer

This layer is composed of several middleware elements.
Overview of Android’s Middleware Infrastructure

- Android’s **middleware infrastructure** provides reusable capabilities that extend hardware-centric OS kernel & protocol mechanisms
  - Hardware abstraction layer
  - Runtime & libraries layer
    - Android runtime
Overview of Android’s Middleware Infrastructure

- Android’s *middleware infrastructure* provides reusable capabilities that extend hardware-centric OS kernel & protocol mechanisms
- Hardware abstraction layer
- Runtime & libraries layer
  - Android runtime

A managed execution environment that efficiently runs Java-based apps & some Android system services

See [source.android.com/devices/tech/dalvik](source.android.com/devices/tech/dalvik)
Overview of Android’s Middleware Infrastructure

- Android’s *middleware infrastructure* provides reusable capabilities that extend hardware-centric OS kernel & protocol mechanisms
  - Hardware abstraction layer
  - Runtime & libraries layer
  - Android runtime

This managed execution environment is optimized for mobile device constraints

See [sites.google.com/site/io/dalvik-vm-internals](sites.google.com/site/io/dalvik-vm-internals)
Overview of Android’s Middleware Infrastructure

- Android’s *middleware infrastructure* provides reusable capabilities that extend hardware-centric OS kernel & protocol mechanisms
  - Hardware abstraction layer
  - Runtime & libraries layer
    - Android runtime

A copy of core Java class libraries & core Android class libraries

See en.wikipedia.org/wiki/Comparison_of_Java_and_Android_API
Overview of Android’s Middleware Infrastructure

- Android’s *middleware infrastructure* provides reusable capabilities that extend hardware-centric OS kernel & protocol mechanisms
  - Hardware abstraction layer
  - Runtime & libraries layer
    - Android runtime

We’ll discuss Java threading shortly
Overview of Android’s Middleware Infrastructure

- Android’s *middleware infrastructure* provides reusable capabilities that extend hardware-centric OS kernel & protocol mechanisms
  - Hardware abstraction layer
  - Runtime & libraries layer
    - Android runtime

Android’s core libraries provide key components that we’ll also cover shortly
Overview of Android’s Middleware Infrastructure

- Android’s *middleware infrastructure* provides reusable capabilities that extend hardware-centric OS kernel & protocol mechanisms
  - Hardware abstraction layer
  - Runtime & libraries layer
    - Android runtime

Android’s core libraries provide many other UI & persistence components
Overview of Android’s Middleware Infrastructure

- Android’s *middleware infrastructure* provides reusable capabilities that extend hardware-centric OS kernel & protocol mechanisms
  - Hardware abstraction layer
  - Runtime & libraries layer
  - Android runtime

See [www.coursera.org/specializations/android-app-development](http://www.coursera.org/specializations/android-app-development)
Overview of Android’s Middleware Infrastructure

- Android’s *middleware infrastructure* provides reusable capabilities that extend hardware-centric OS kernel & protocol mechanisms
  - Hardware abstraction layer
  - Runtime & libraries layer
    - Android runtime

Android—like Java—balances run-time performance & developer productivity
Overview of Android’s Middleware Infrastructure

- Android’s *middleware infrastructure* provides reusable capabilities that extend hardware-centric OS kernel & protocol mechanisms
  - Hardware abstraction layer
  - Runtime & libraries layer
    - Android runtime

Android’s core libraries are often implemented as wrapper facades

See [www.dre.vanderbilt.edu/~schmidt/PDF/wrapper-facade.pdf](http://www.dre.vanderbilt.edu/~schmidt/PDF/wrapper-facade.pdf)
Overview of Android’s Middleware Infrastructure

- Android’s *middleware infrastructure* provides reusable capabilities that extend hardware-centric OS kernel & protocol mechanisms
  - Hardware abstraction layer
  - Runtime & libraries layer
    - Android runtime
    - Native C/C++ libraries

*These Java wrapper façade are implemented via native C/C++ code*

See [developer.android.com/tools/sdk/ndk](https://developer.android.com/tools/sdk/ndk)
End of Overview of Android (Part 2): Middleware Infrastructure