Can you trust me now?

The Current State of Mobile Security

Black Hat USA
August 2016

Atredis Partners Overview

Bene Diagnoscitur, Bene Curatur

- "That which is well diagnosed is well cured."
- Research Driven Security Consulting
- Advanced Secure Design & Development
- Advanced Penetration Testing
- Advanced Risk Consulting

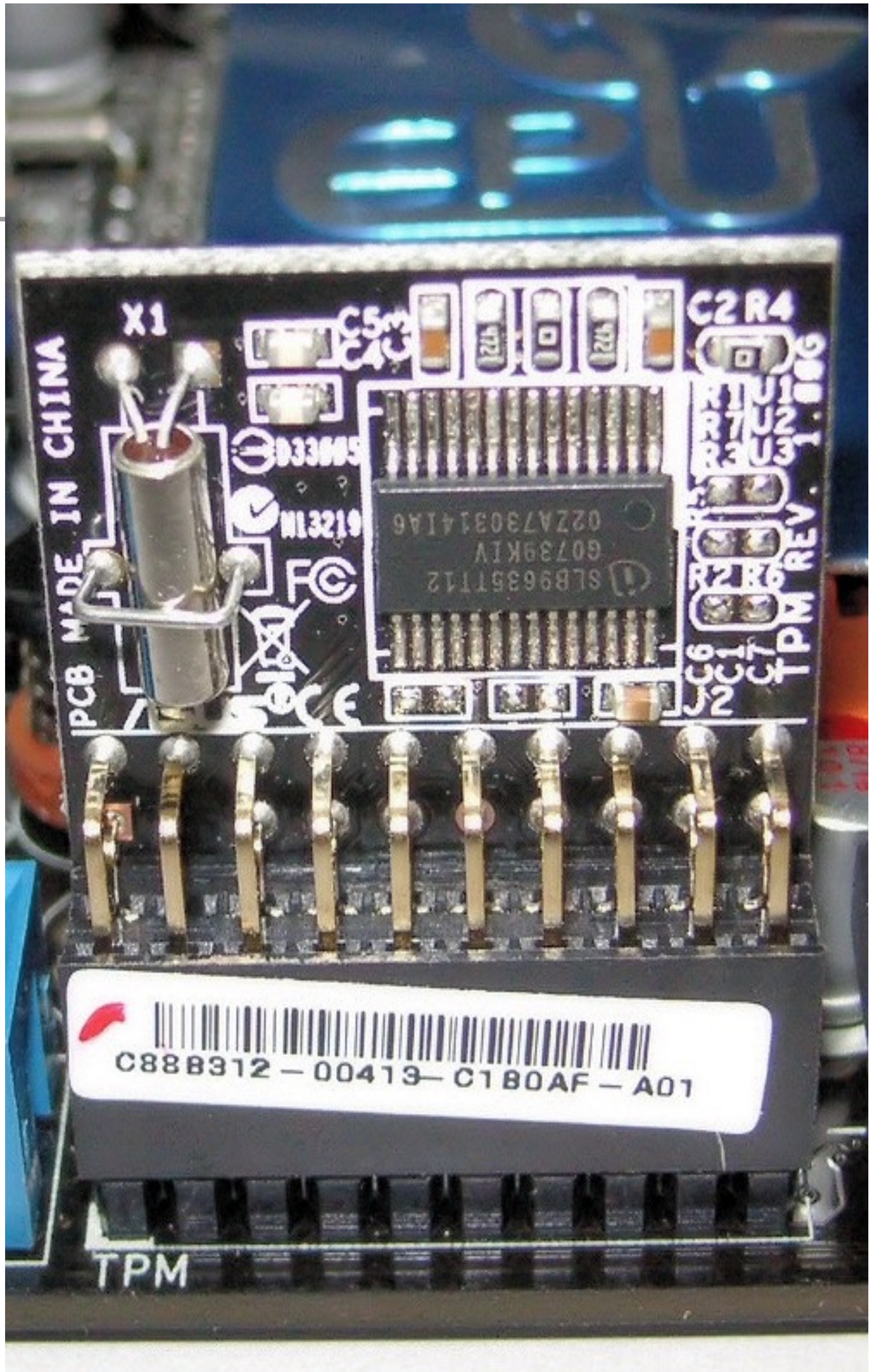
Josh Thomas

- 16 Years in the field
- Focus on mobile devices, development, hardware design, architecture

Shawn Moyer

- 20 years in the field
- Focus on industrial, software and network security

Today’s Focus



Mobile Layers and Landscape

- What are the actual components and layers of a production mobile device?

BYOD and Market share

- What to expect when we allow anything to happen

Android versus iOS

- The little engine that could train a generation to break trusted boot

Hardware and components

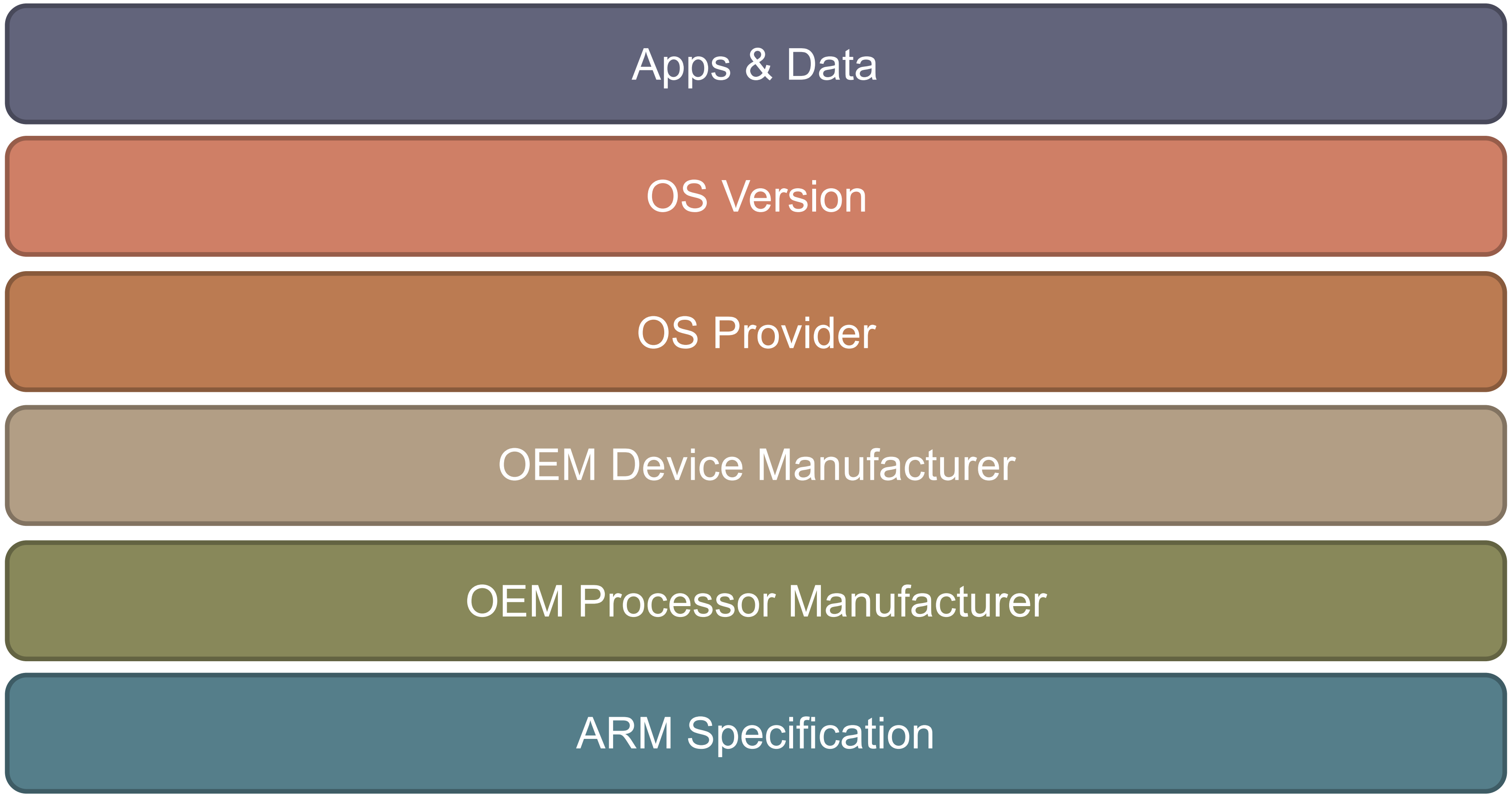
- Reuse and architecture limitations

MDM

- A false sense of stability

Mobile Layers and Landscape

The foundations of mobile trust



Apps & Data

OS Version

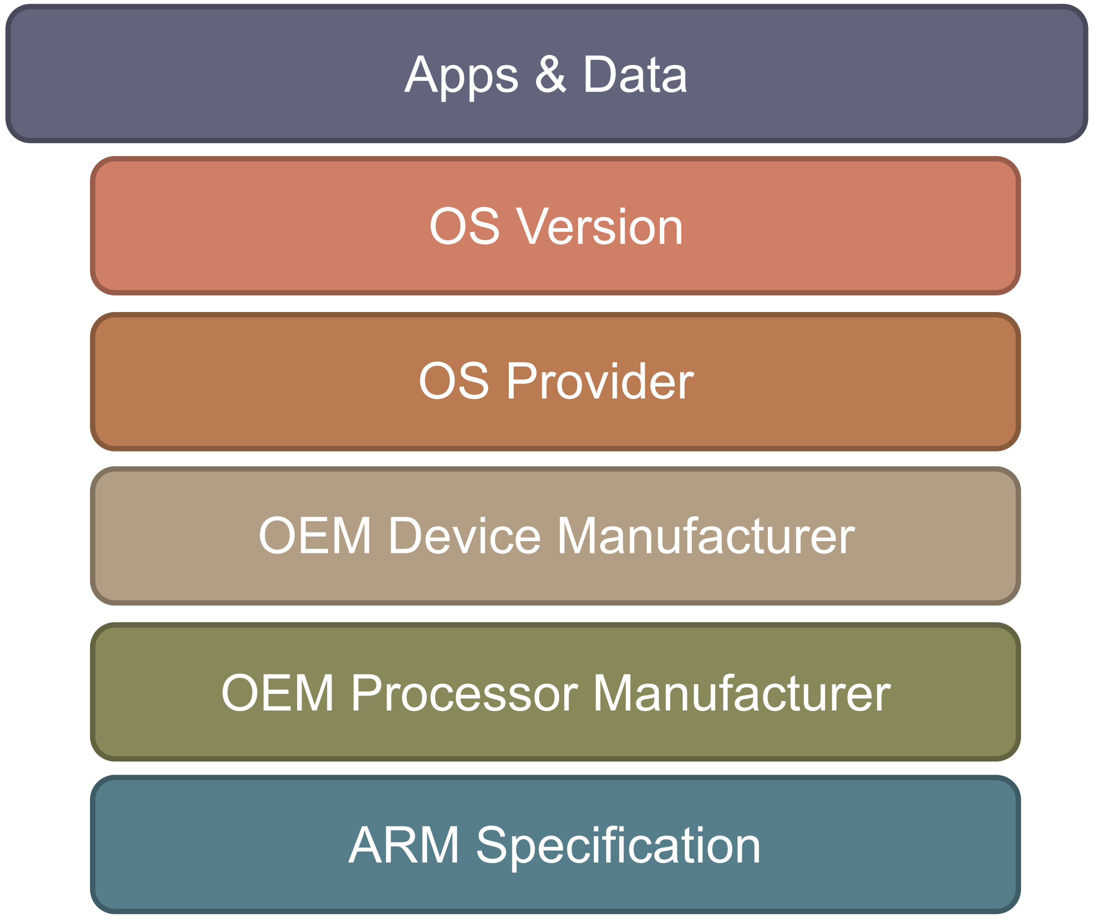
OS Provider

OEM Device Manufacturer

OEM Processor Manufacturer

ARM Specification

Functional Layers: App & Data



Apps & Data

OS Version

OS Provider

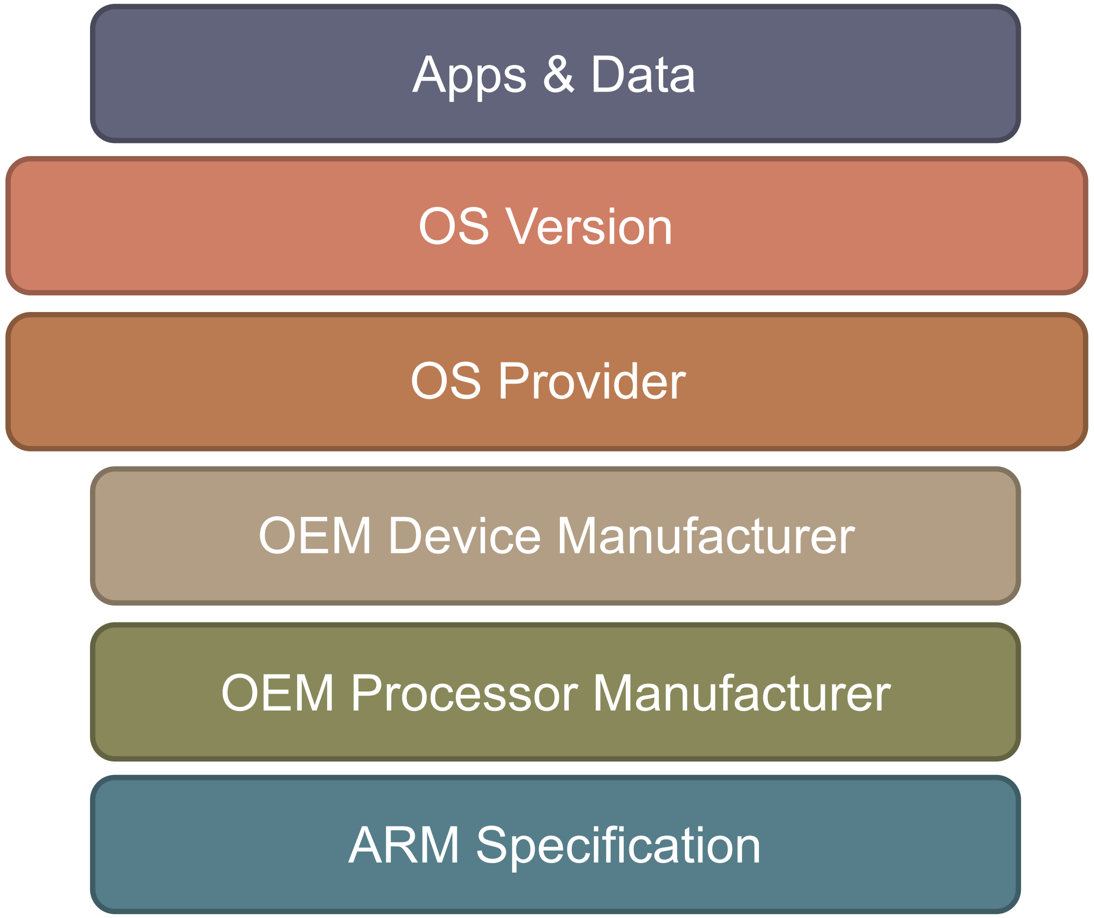
OEM Device Manufacturer

OEM Processor Manufacturer

ARM Specification

- **Data**
  - Protected by App or OS
- **App**
  - Written for OS and OS version
  - Moderated by Platform App Store
  - Constrained by Platform API

Functional Layers:
OS & OS Version



Apps & Data

OS Version

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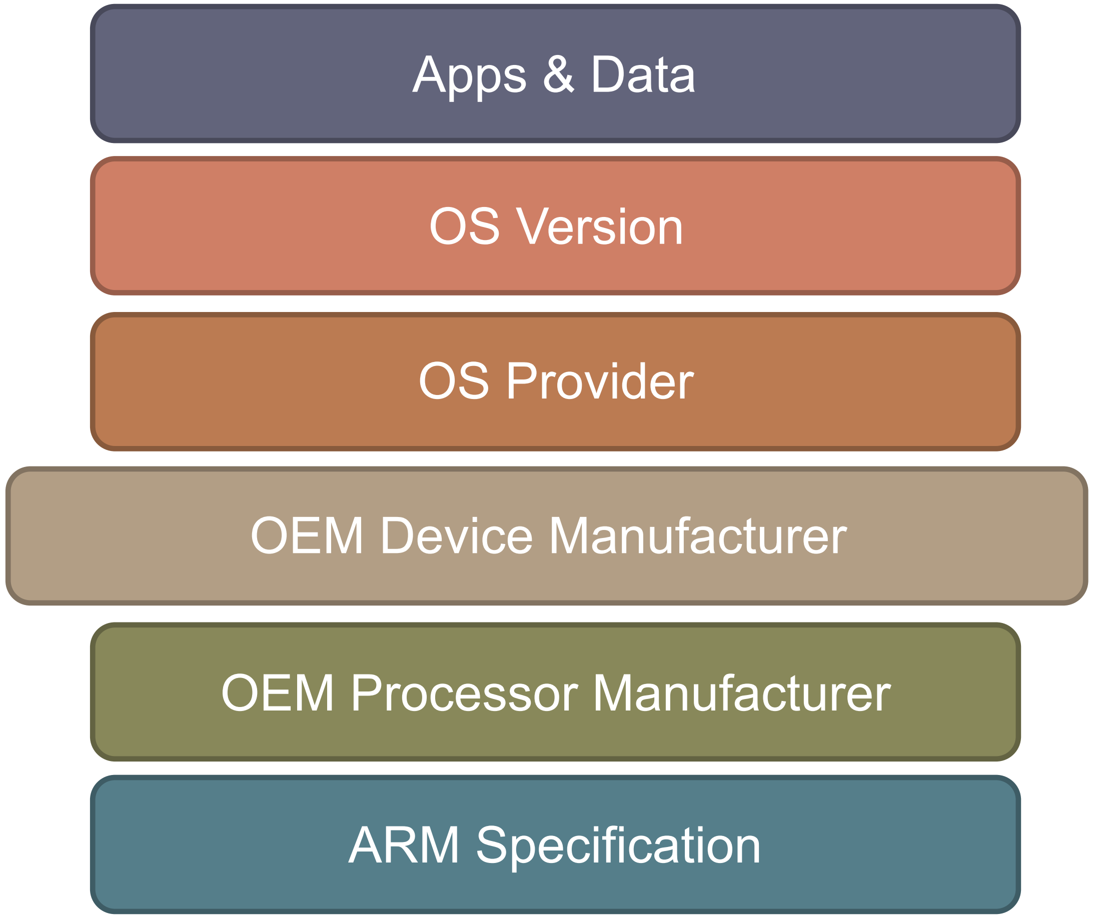
ARM Specification

- **OS Version**
  - Incremental Approach to Security
  - Incremental Approach to Functionality
- **OS**
  - Fundamental Approach to Security
  - Fundamental Approach to Functionality

Functional Layers:
OEM



Apps & Data

OS Version

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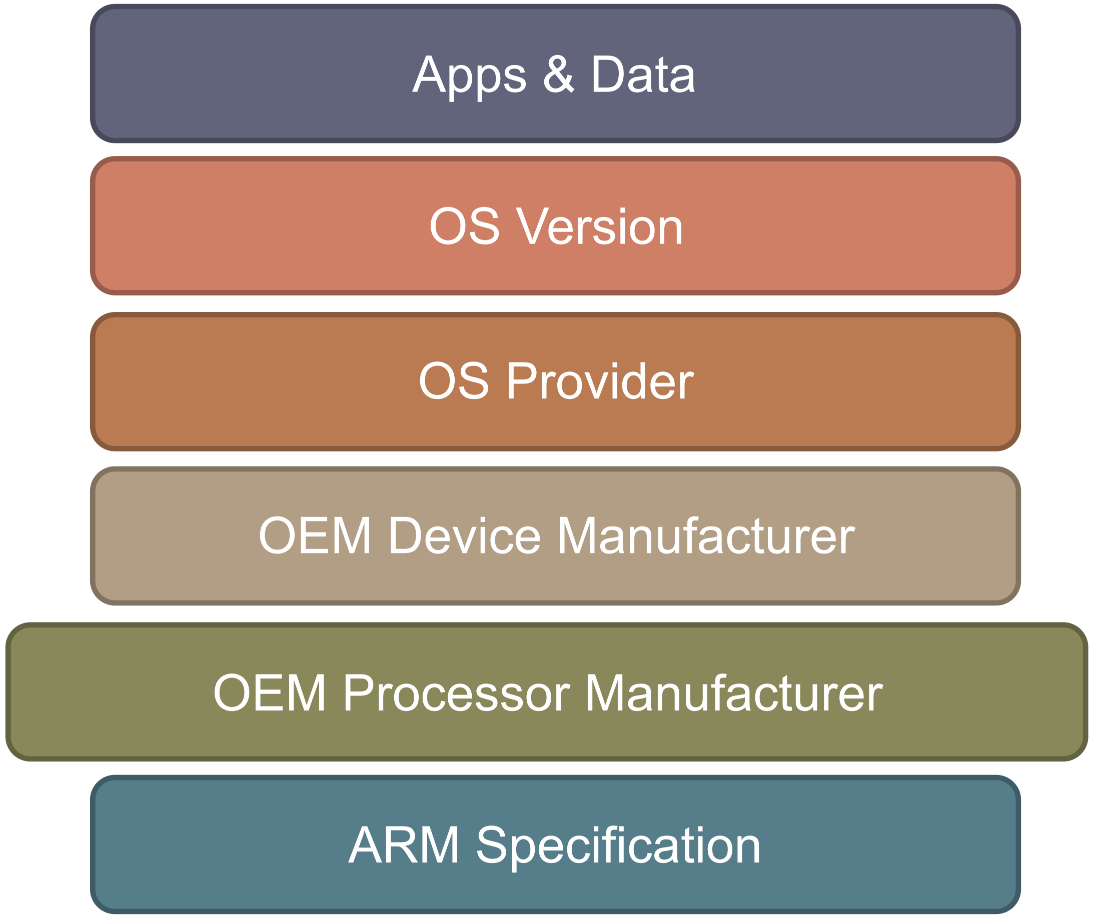
ARM Specification

·OEM

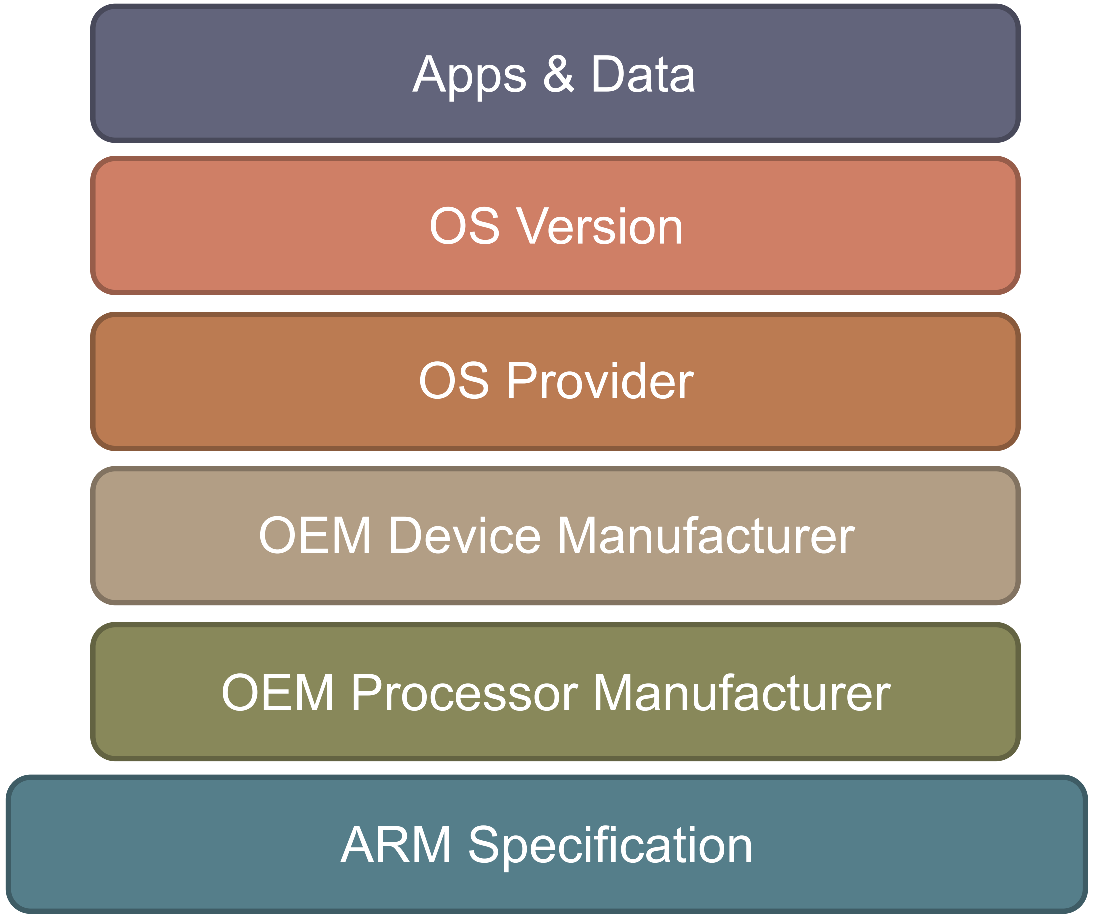
- Design of Hardware
- Selection of Secure Components
- Approach to Market
- Solution Customization

Functional Layers:
System on Chip



- **SoC**
  - Design of Component Hardware
  - Control of Trust
  - Control of Security
- **SoC Version**
  - Similar to OS Version
  - Incremental updates driven by platform vision

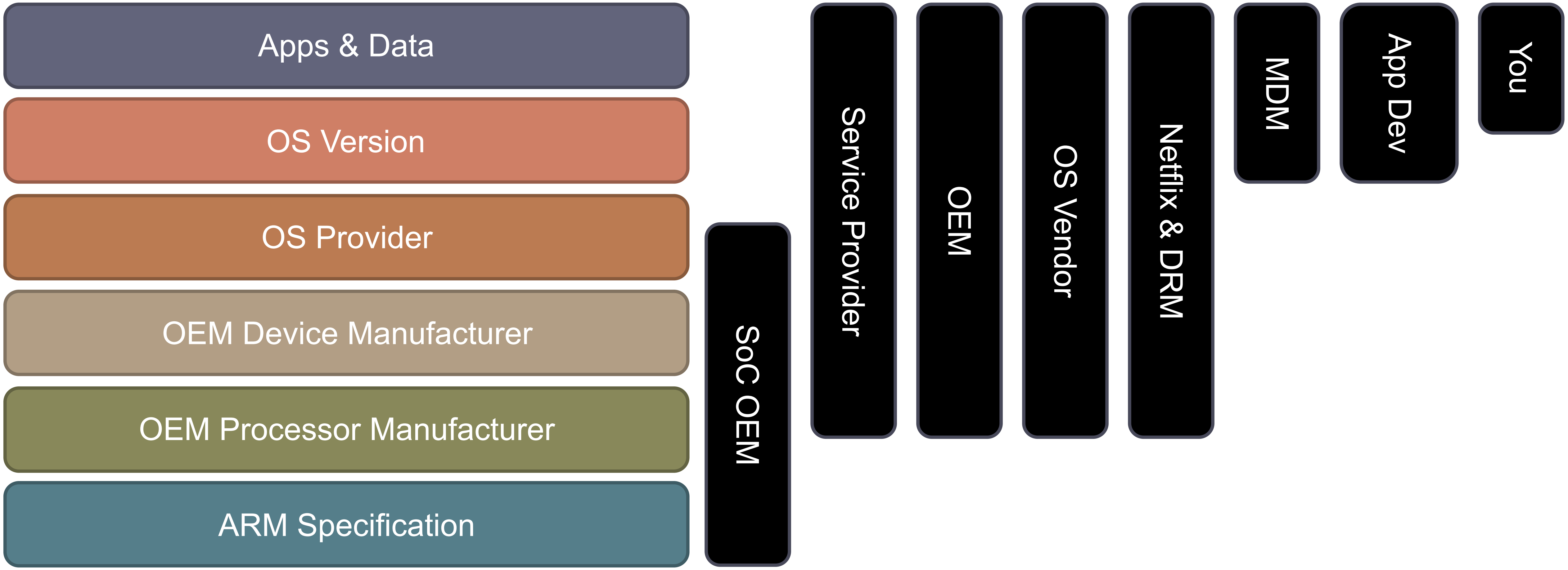
Common Talking Points: Specification



·ARM Specification

- Core Design of Security
- Applied Academic Design
- As Much Theory as Reality

Who Writes The Software?



Apps & Data

OS Version

OS Provider

OEM Device Manufacturer

OEM Processor Manufacturer

ARM Specification

SoC OEM

Service Provider

OEM

OS Vendor

Netflix & DRM

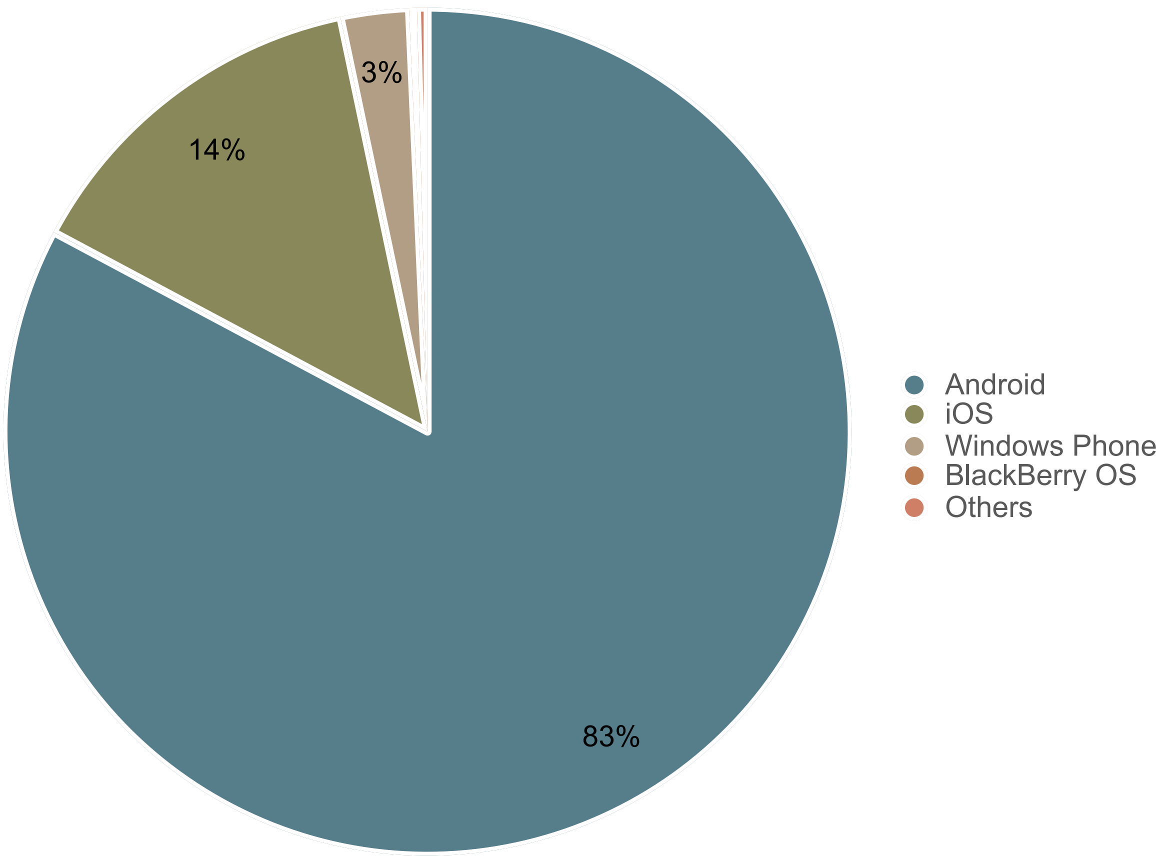
MDM

App Dev

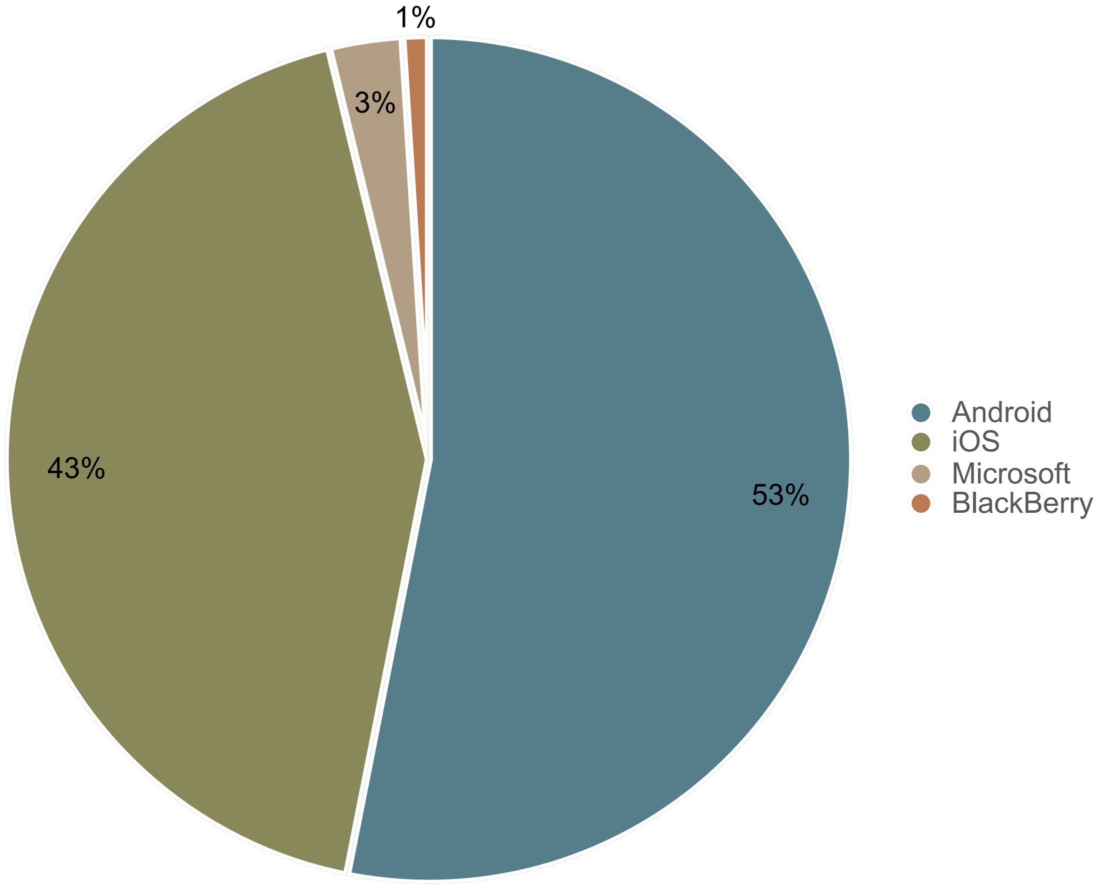
You

OS Market Share

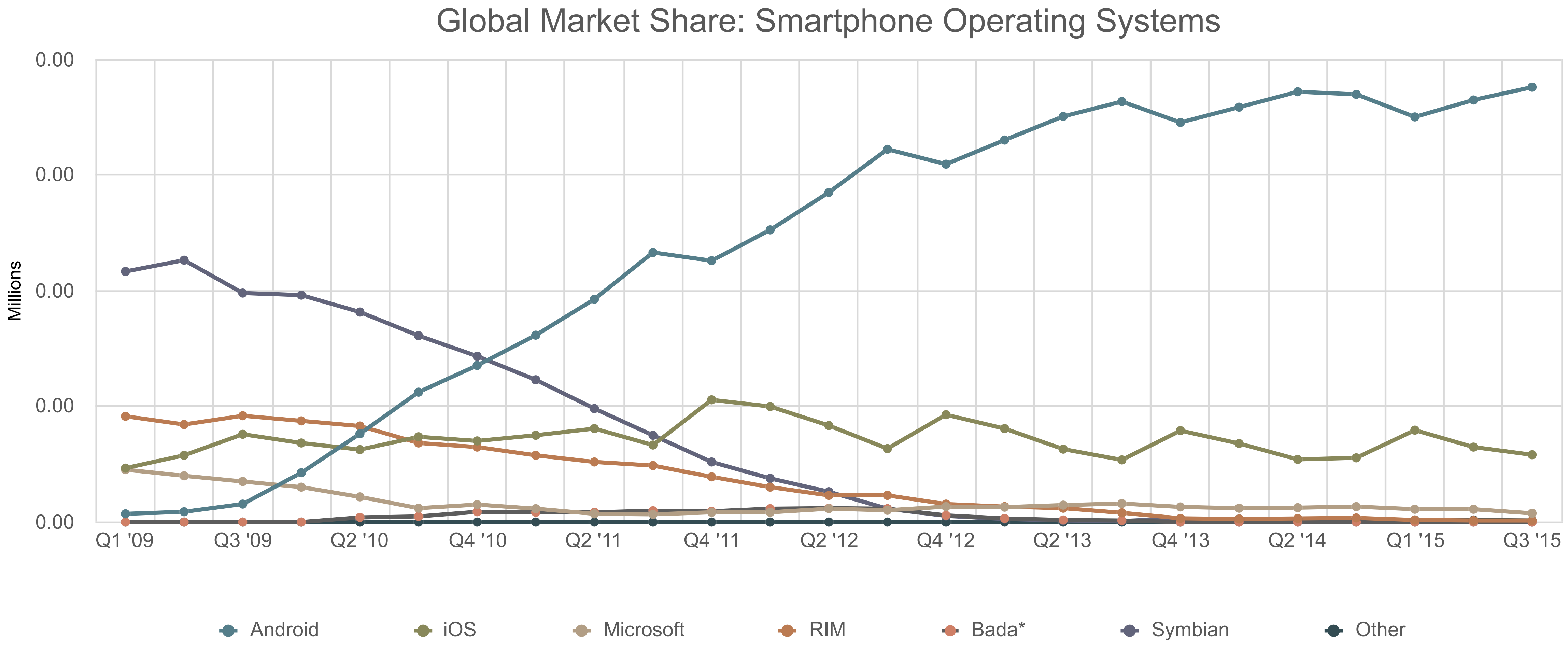
OS Global Market Share (2015 Q2)



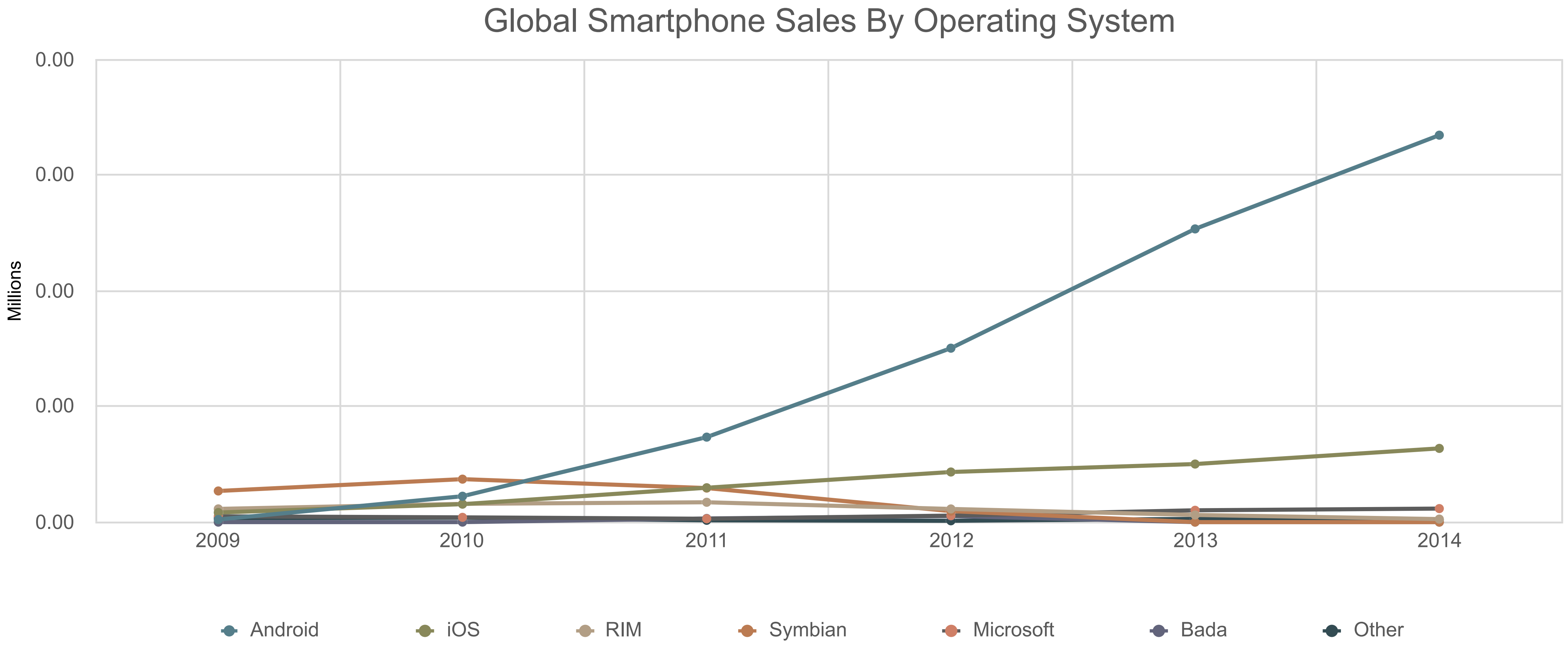
OS US Market Share (2015 Q3)



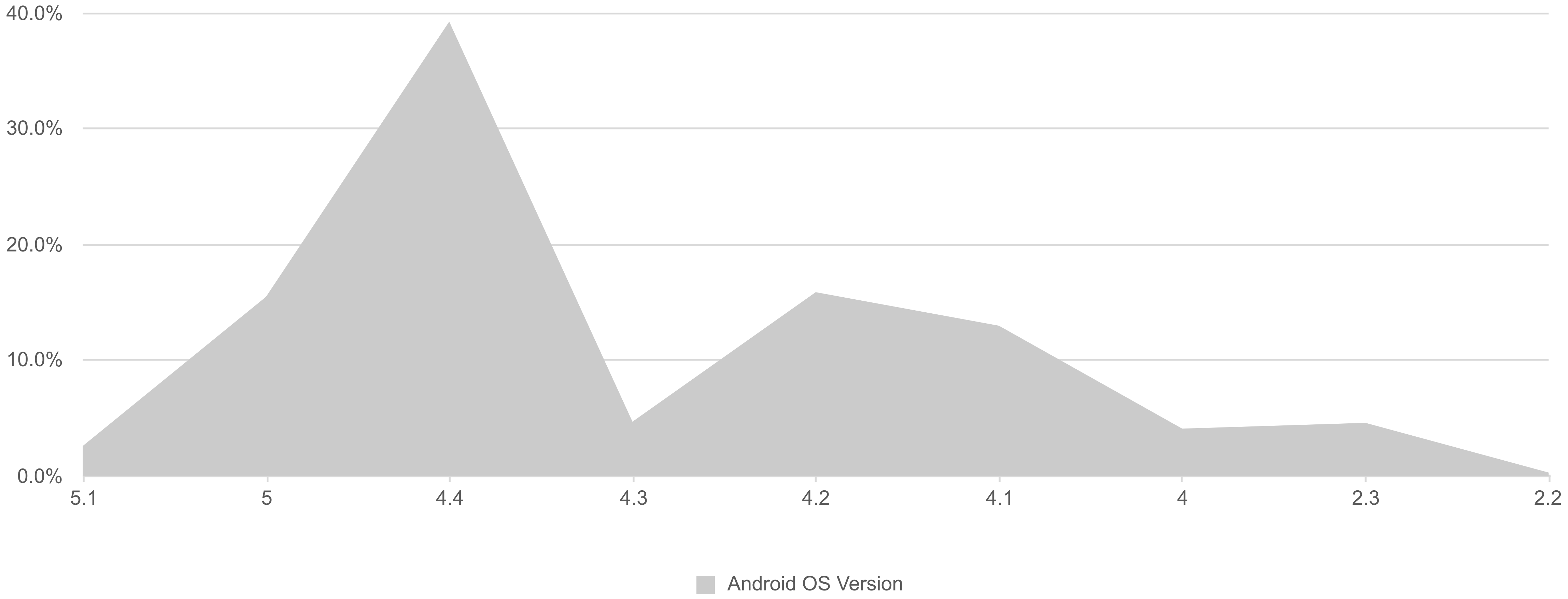
Trending Toward Irrelevance With Subscribers



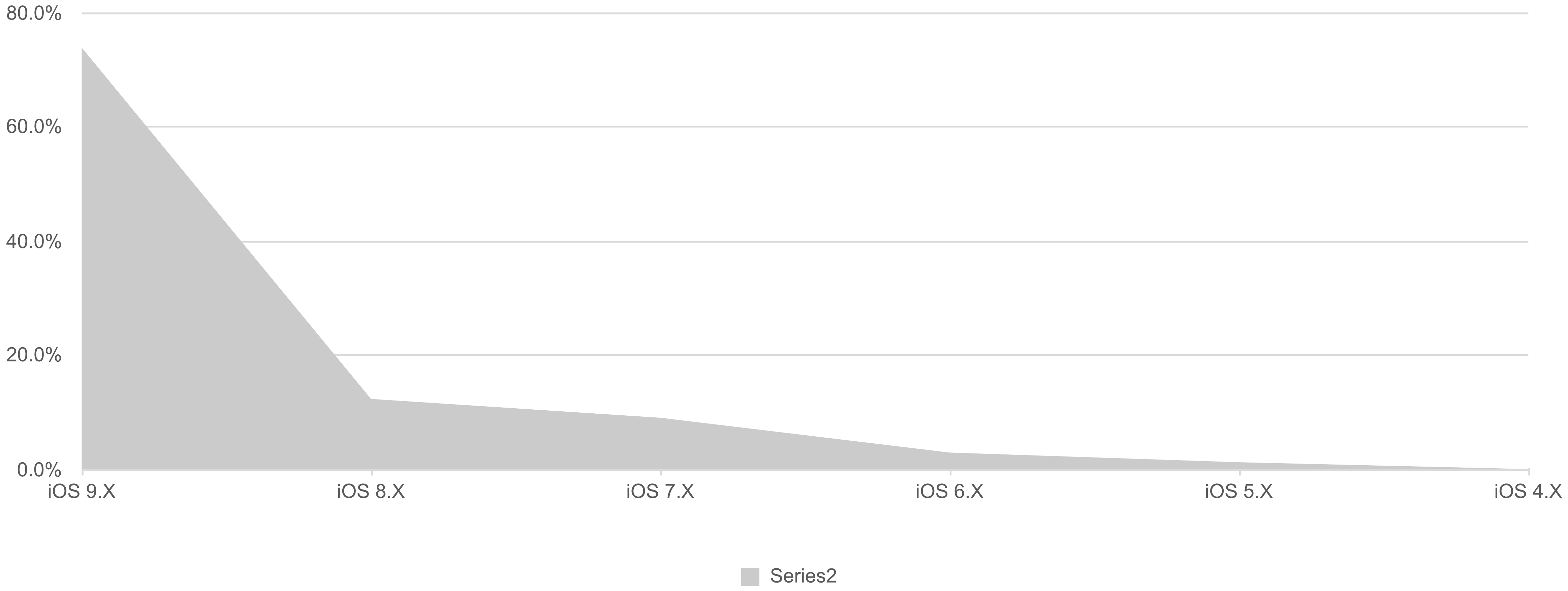
Trending Toward Irrelevance With Sales



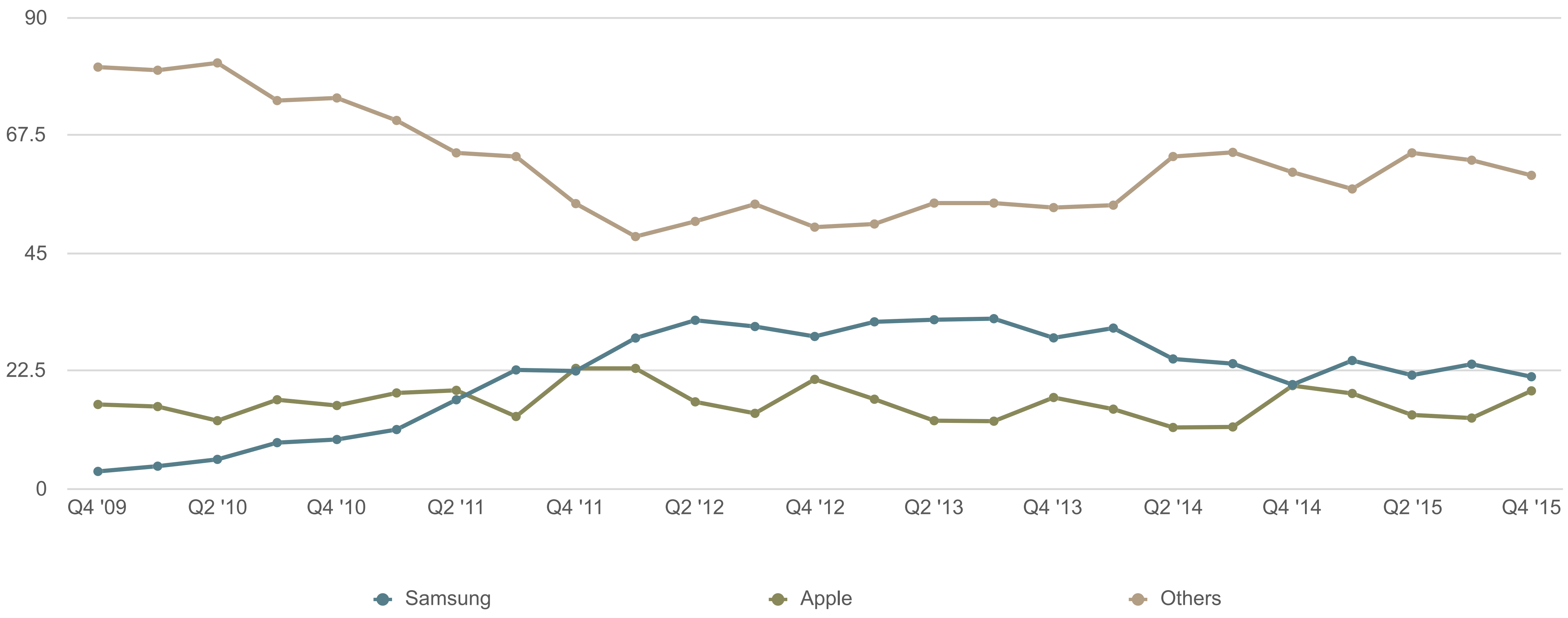
Android: Plagued by Version Fragmentation



Apple: Version Fragmentation

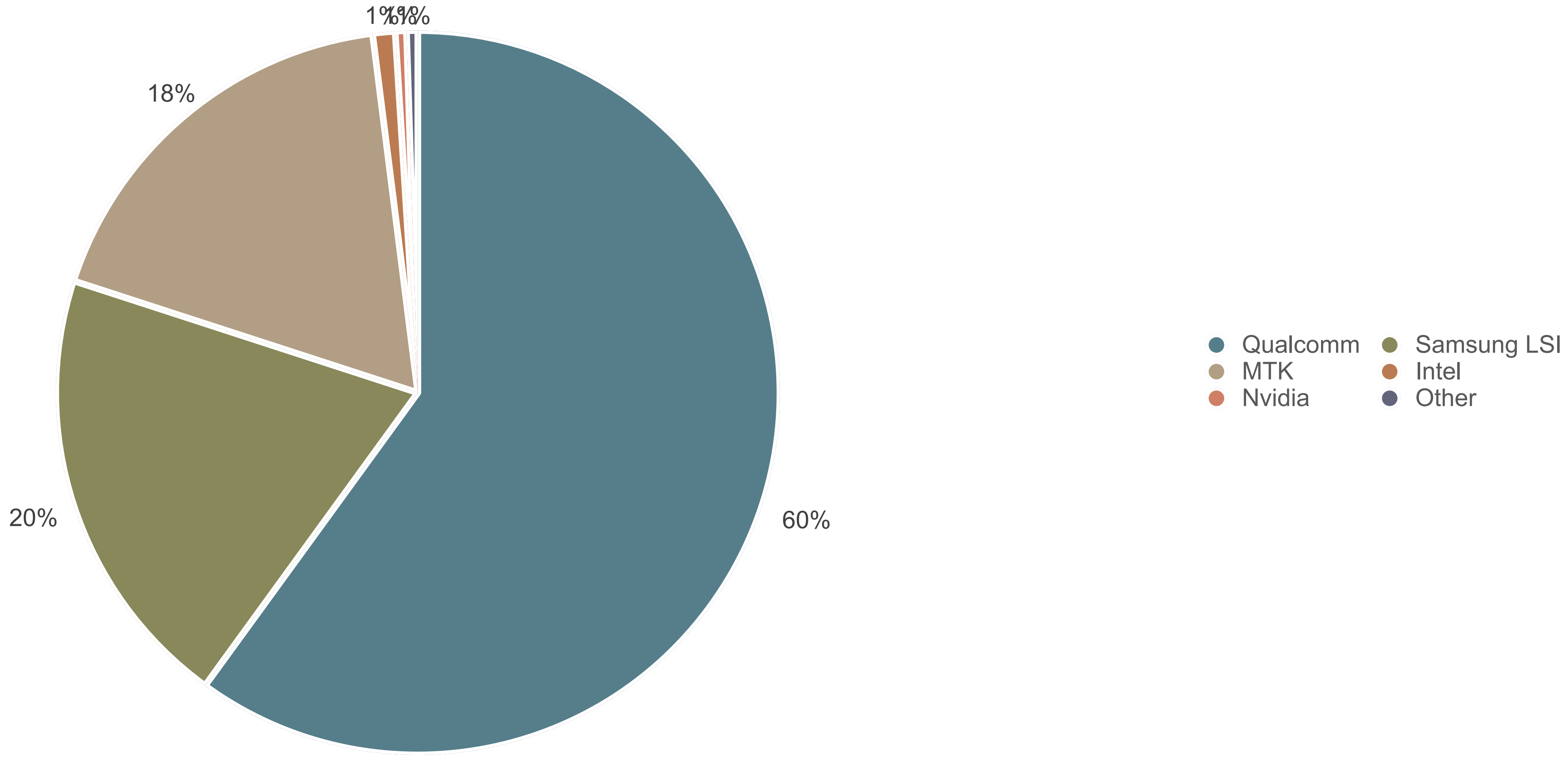


Market Share of the Leaders



Foundations of Mobile Trust

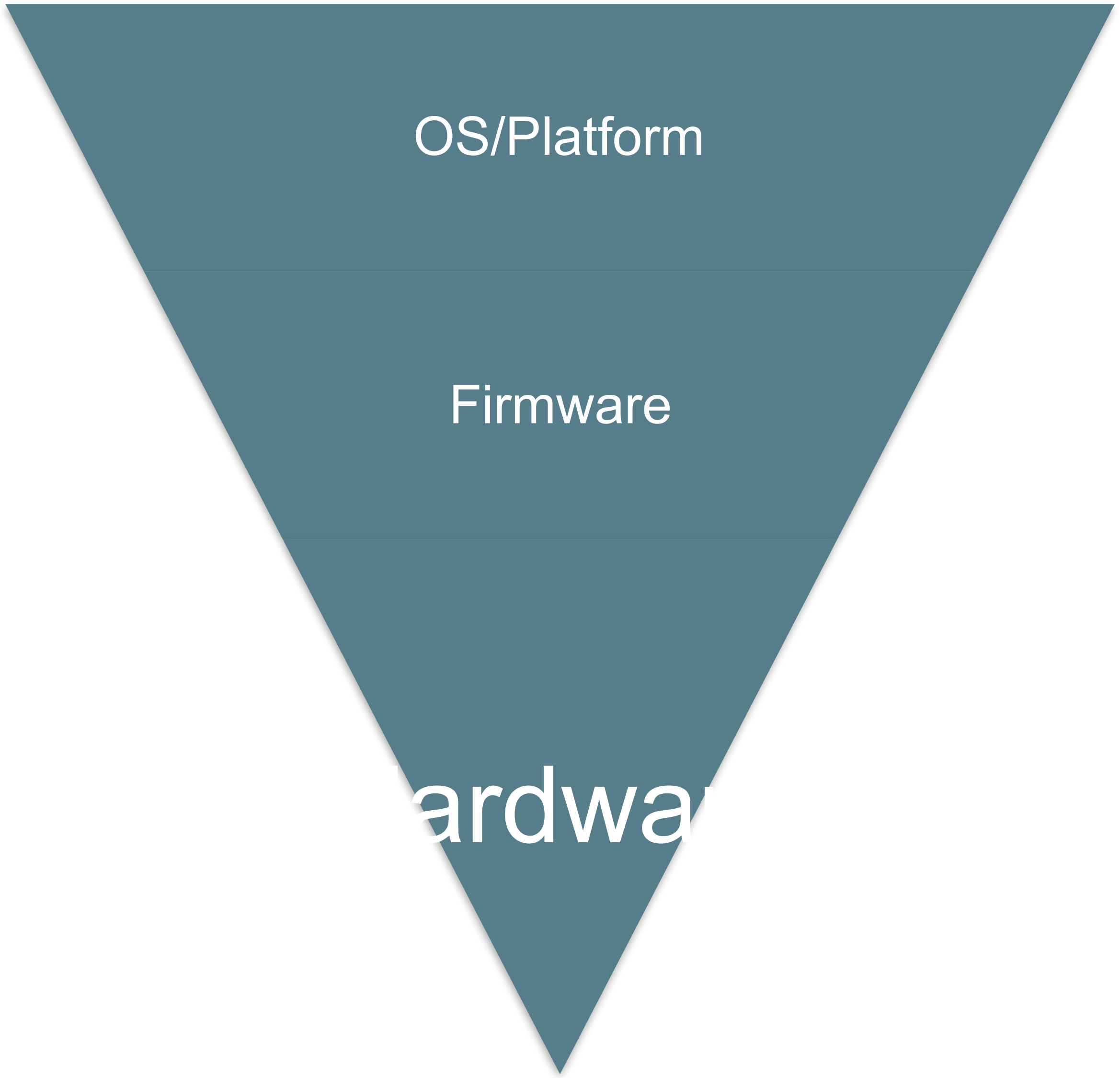
OEM SoC Market Share



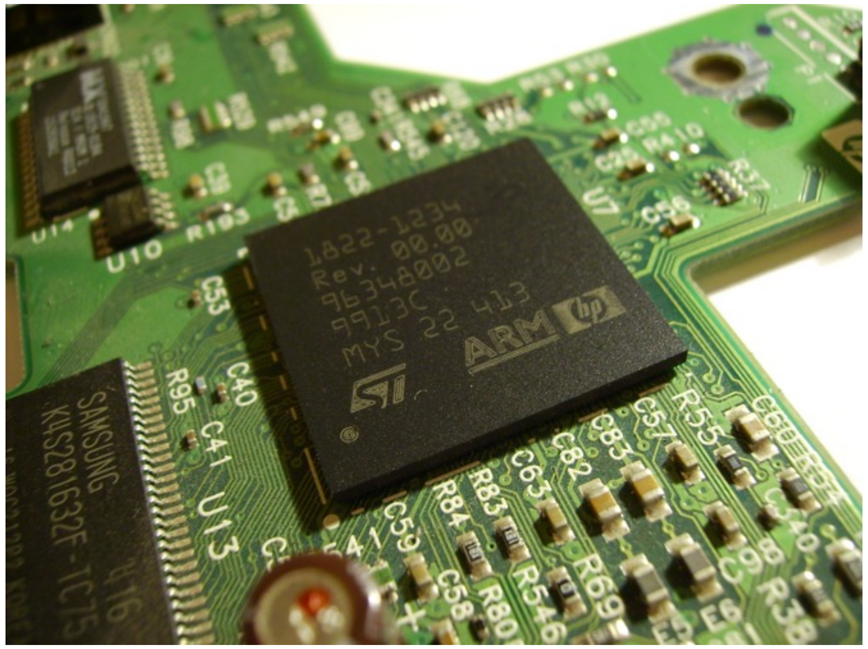
Android versus iOS

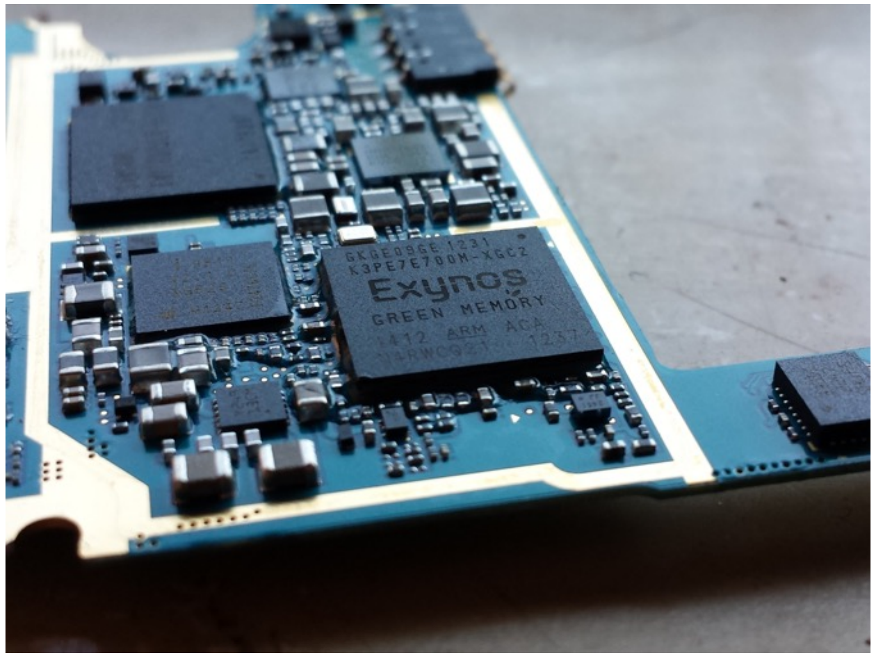
- **Security Capabilities**
  - Android tries things first, enters the market with partial implementations
  - iOS enters the market with finished software
- Iterative Android releases accidentally help train security professionals to beat iOS protections

Layers of Security

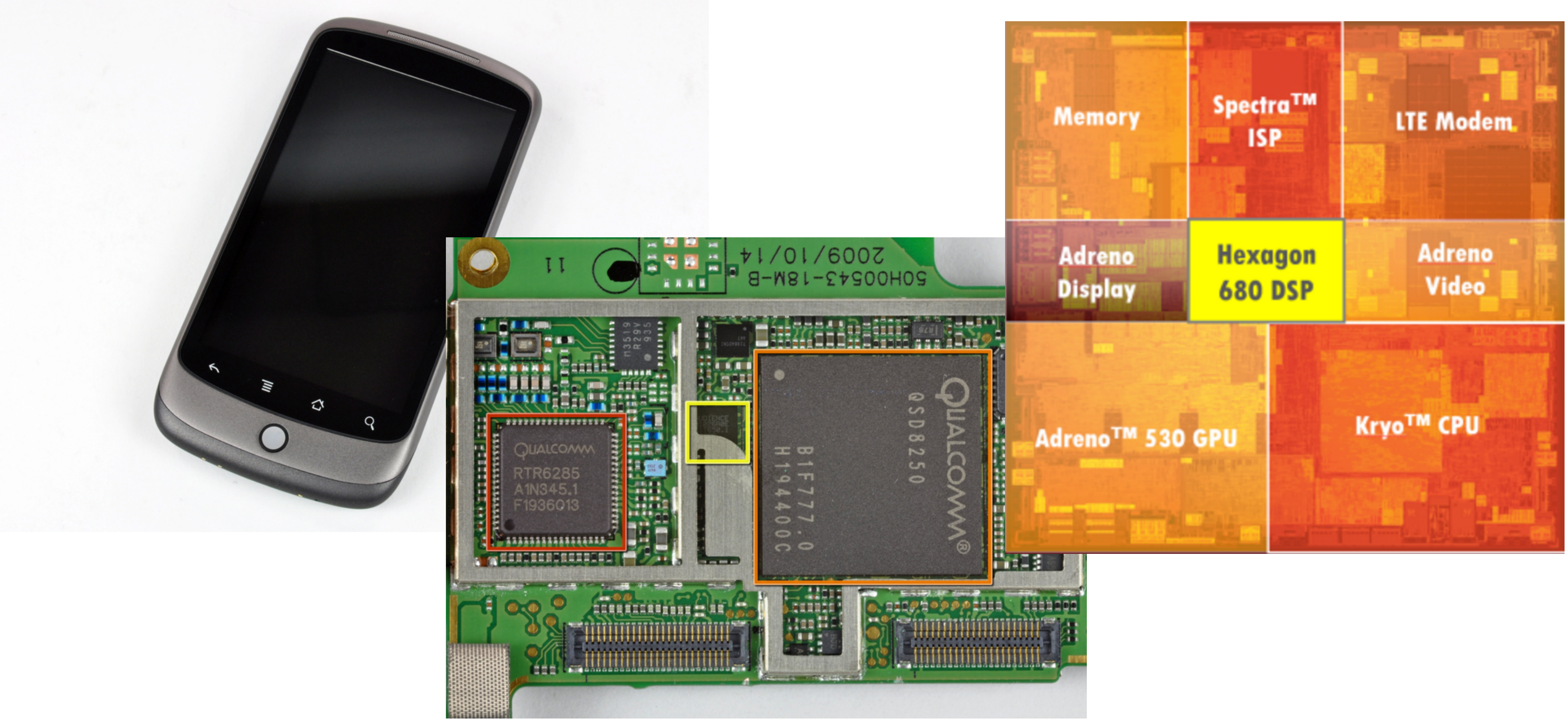


Mobile Security Starts Here

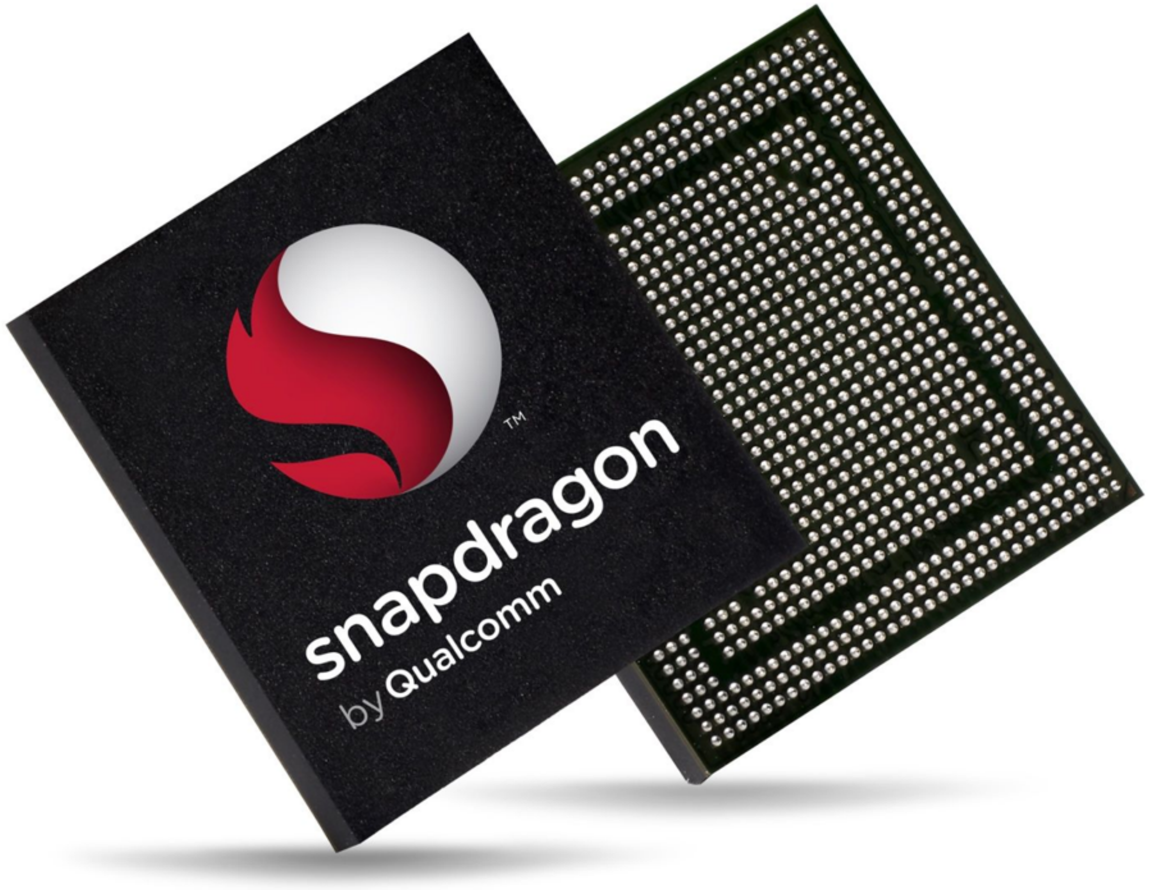




System on a Chip



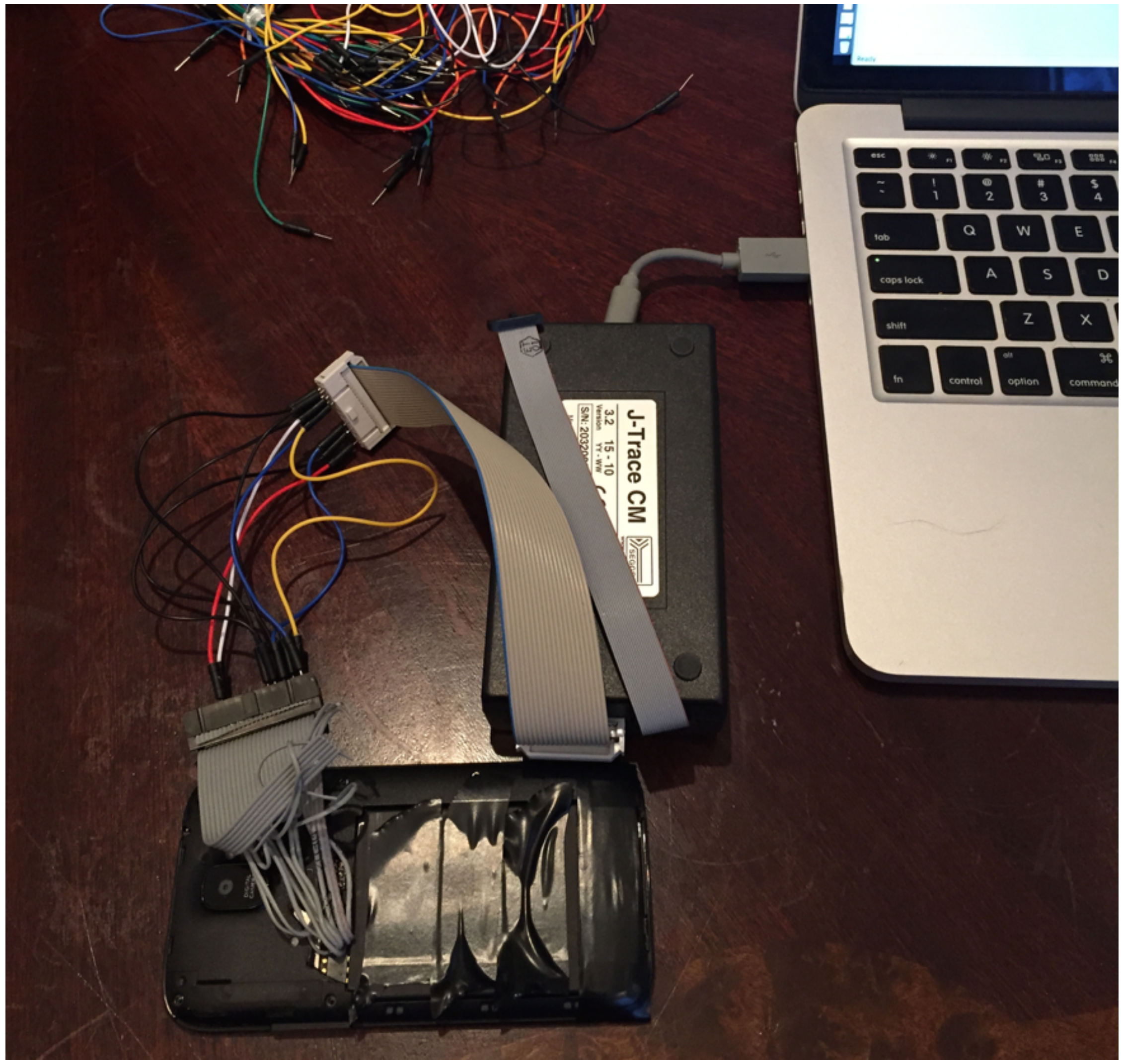
What OS Does This Run?



- Android
- Little Kernel
- REX
- QuRT
- QSEE

Physical Attack Surface

- Direct memory access, Modem, TrustZone, power management
- USB often exposes diagnostic or factory test modes
- JTAG, UART, FIQ debugging cables
- $2,000

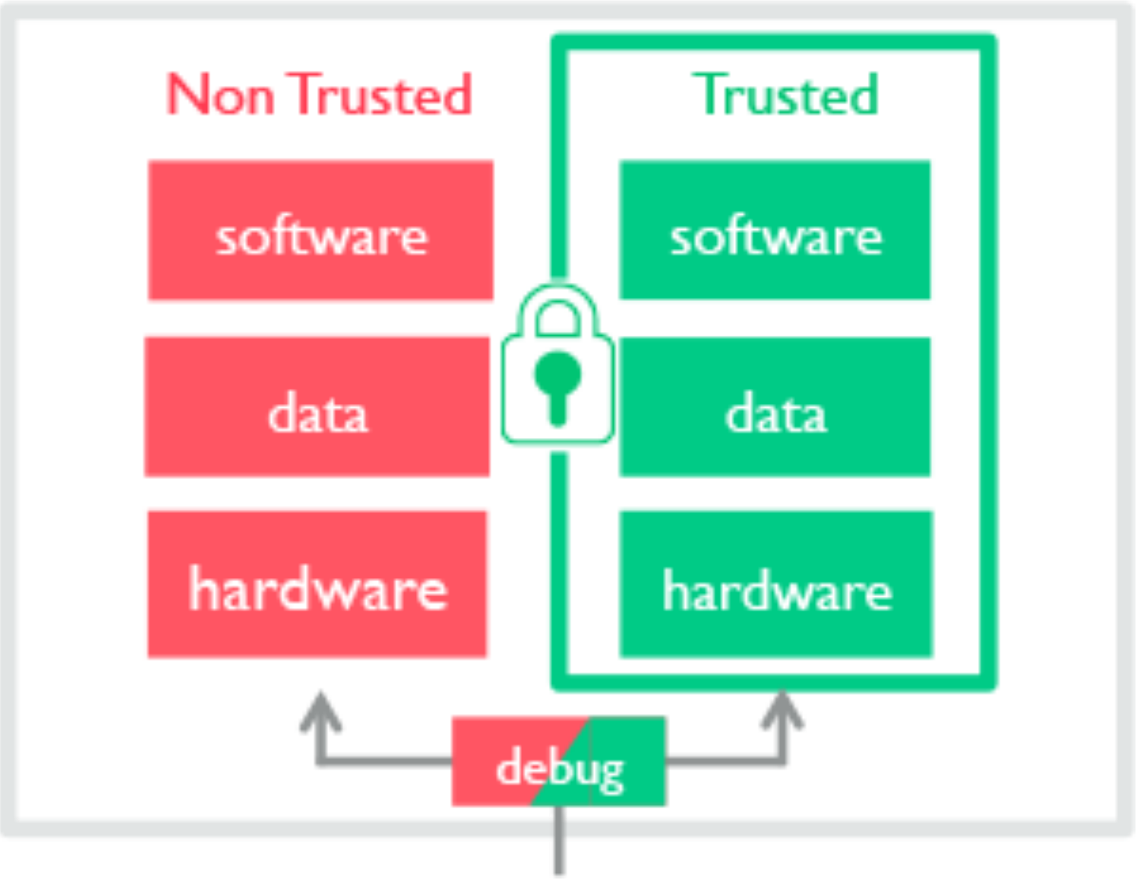


Remote Attack Surface

- Modem, TrustZone, HLOS
- Large attack surface between DRM and cellular protocols
- $2,000 + time fighting software

Trusted Execution Environments

- Provide a separate execution environment
- Closed source blobs
  - Key storage
  - DRM
- How trusted are they?



TrustZone TEE

- TrustZone can introspect and interact with the mobile operating system
- The mobile operating system cannot introspect TrustZone
- Controls sensitive information from keys to secure boot
- Handles DRM and parses video and audio data
- Vulnerability affects large quantities of devices
- Imagine malware that could…

Simcard TEE

- Simcards are another example of a mobile TEE
- Provide key storage for network encryption
- GSM networks have privacy but not authentication

- IMSI Catchers

- Eavesdropping

- Passive and Active

- Base station controlled

Modem

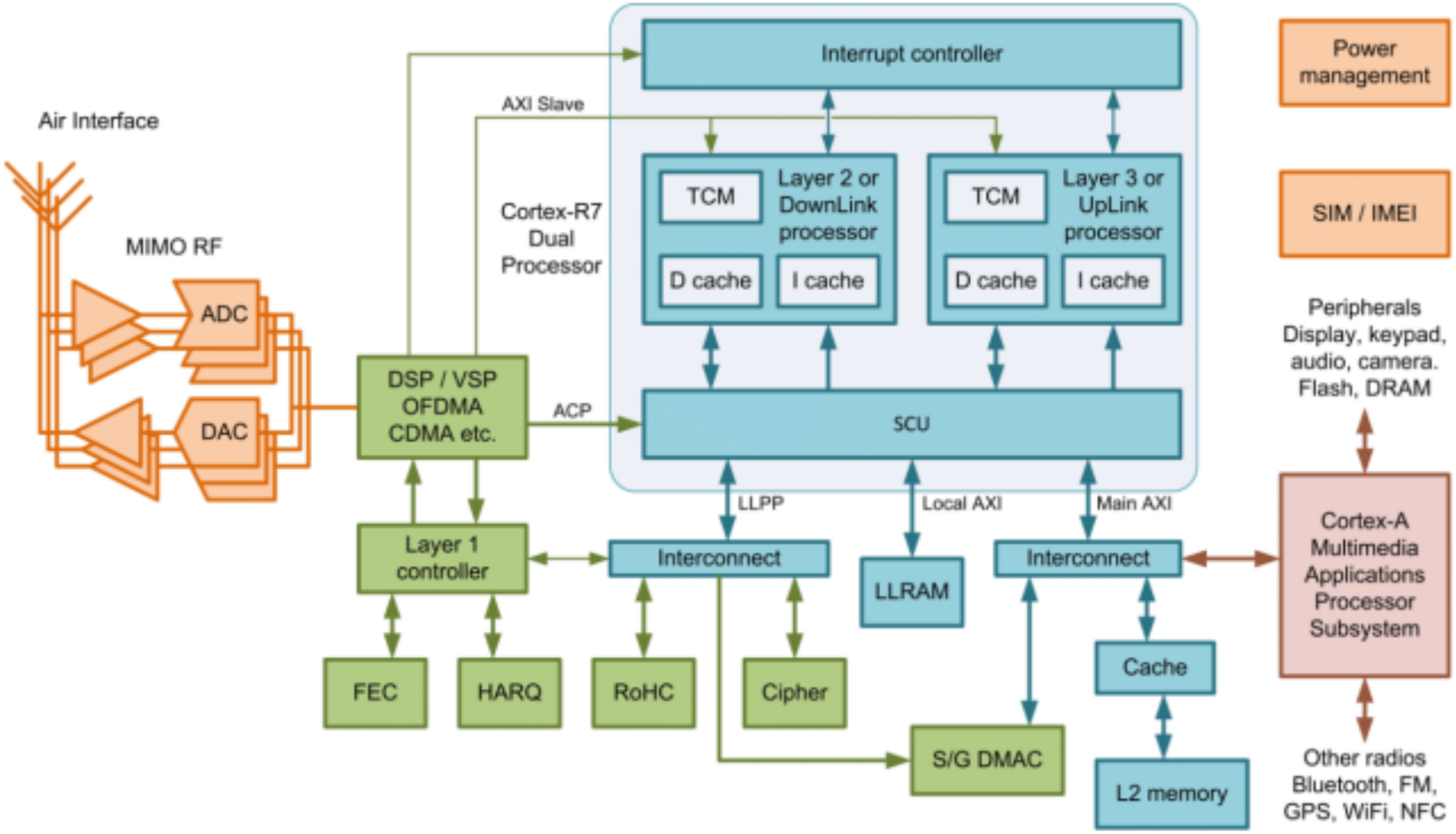
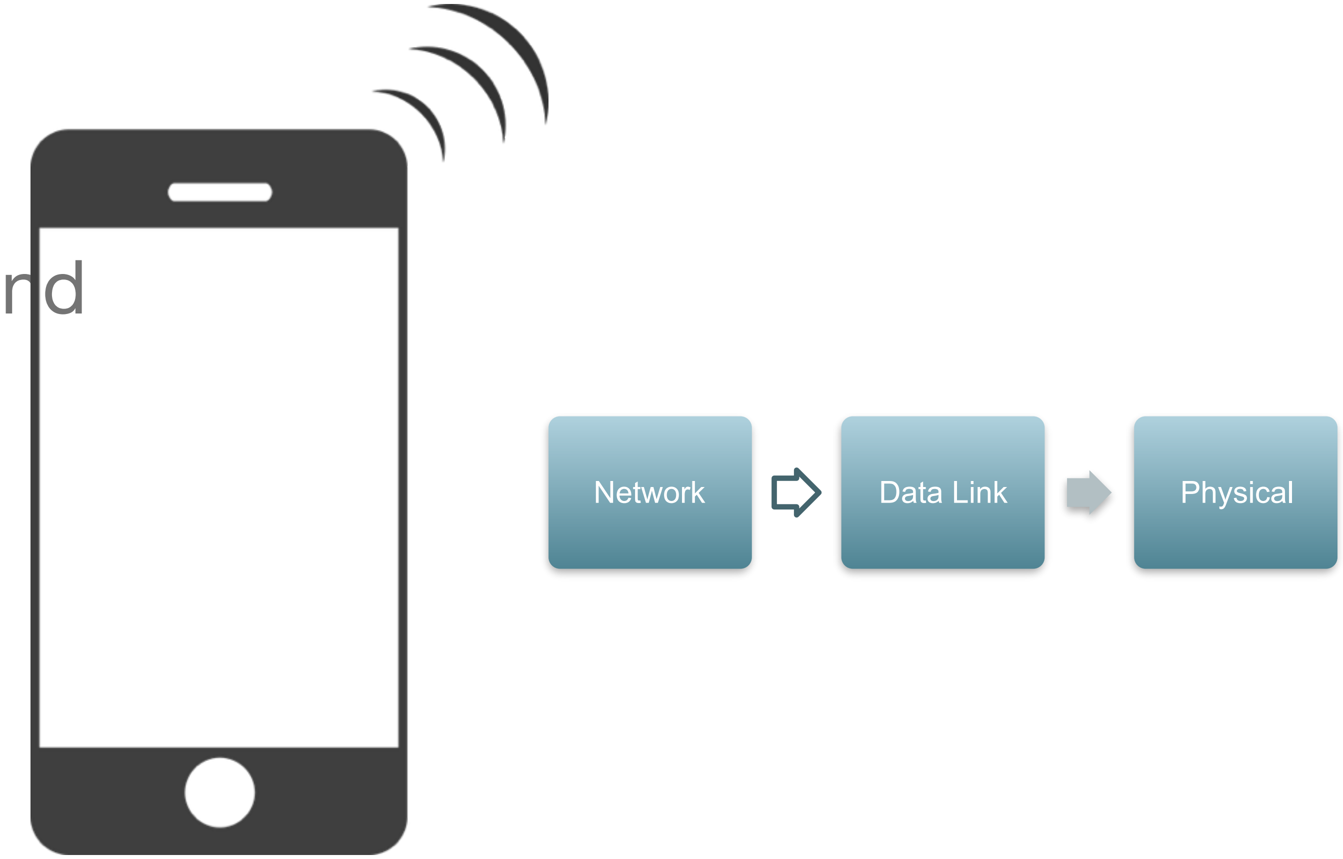


Figure 3: Illustrative baseband architecture

Modem

- Contains stacks for telephony protocols
- Direct access to peripherals and buses
- Mostly ignored outside of law enforcement and unlockers

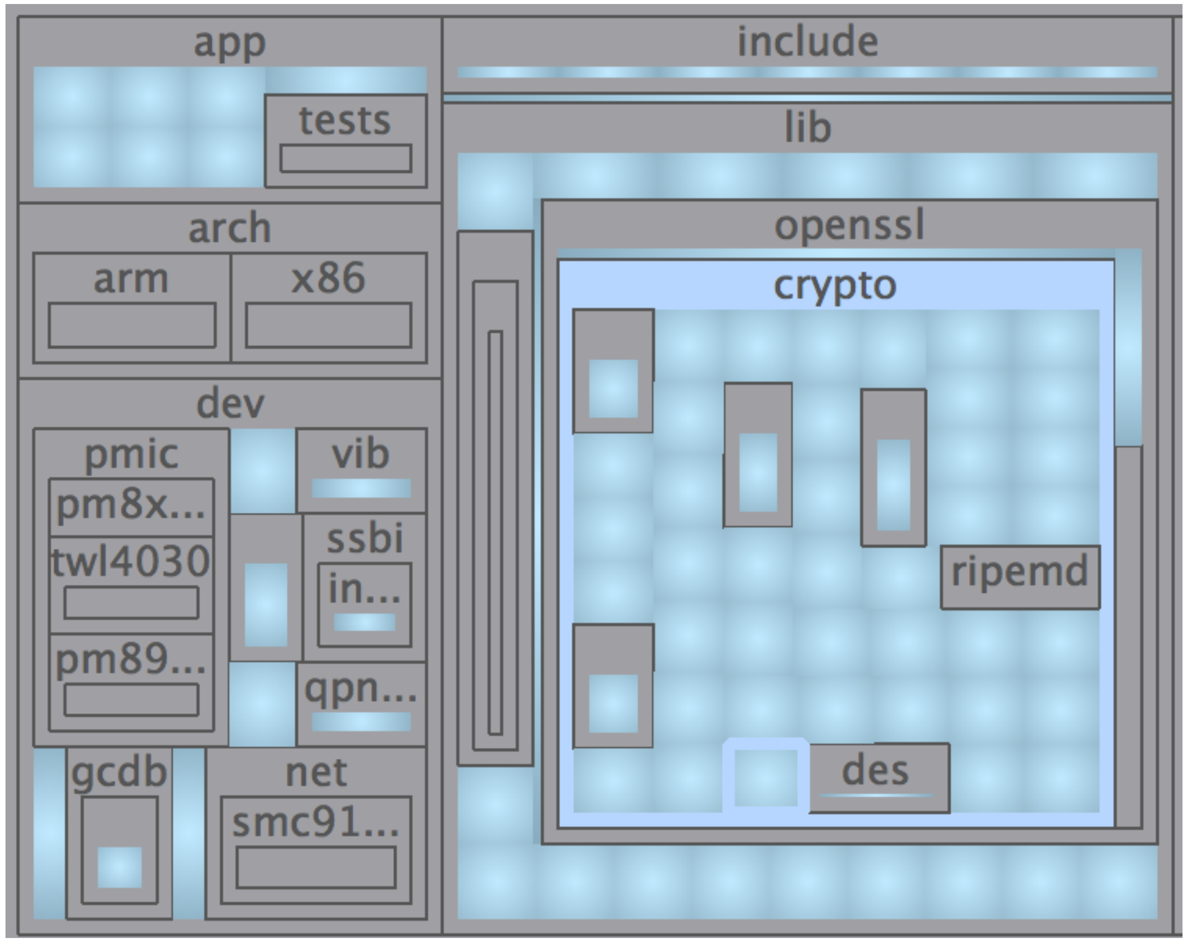


Modem

- Local exploitation via proprietary protocols between application and baseband processors
  - QMI, MMI, AT, Diag
- Remote exploitation via proprietary telephony stacks
  - GSM: LAPDm, SNDCP, RLC, MAC, CM, MM, RR
  - LTE: PDCP, NAS, RRC, IP
- Network exploitation
  - IMSI Catchers
  - Eavesdropping

Boot Loader / Secure Boot

- Android traditionally runs Little Kernel bootloaders
- Contains "apps" that implement fastboot, recovery, android debugging bridge
- OEM-specific bootloaders contain other proprietary protocols for debugging, fault analysis, or engineering



QFUSES

- Software programmable fuses for one-time programmable configuration

- Device keys, carrier keys, OEM keys

- Security features toggles
- Normally accessible only via interface to TrustZone
- Often exploitation of TrustZone related to desire to blow fuses

Cross Device Impacts

- One bug to cross OEMs?
  - No Problem
- One bug to cross Operating Systems?
  - Likely

Aside about BYOD & MDM

- Based on the Lowest Common Denominator of Security Assumptions
- Written for Cross Platform Use
- Rarely take advantage of OS or Hardware Security Capabilities

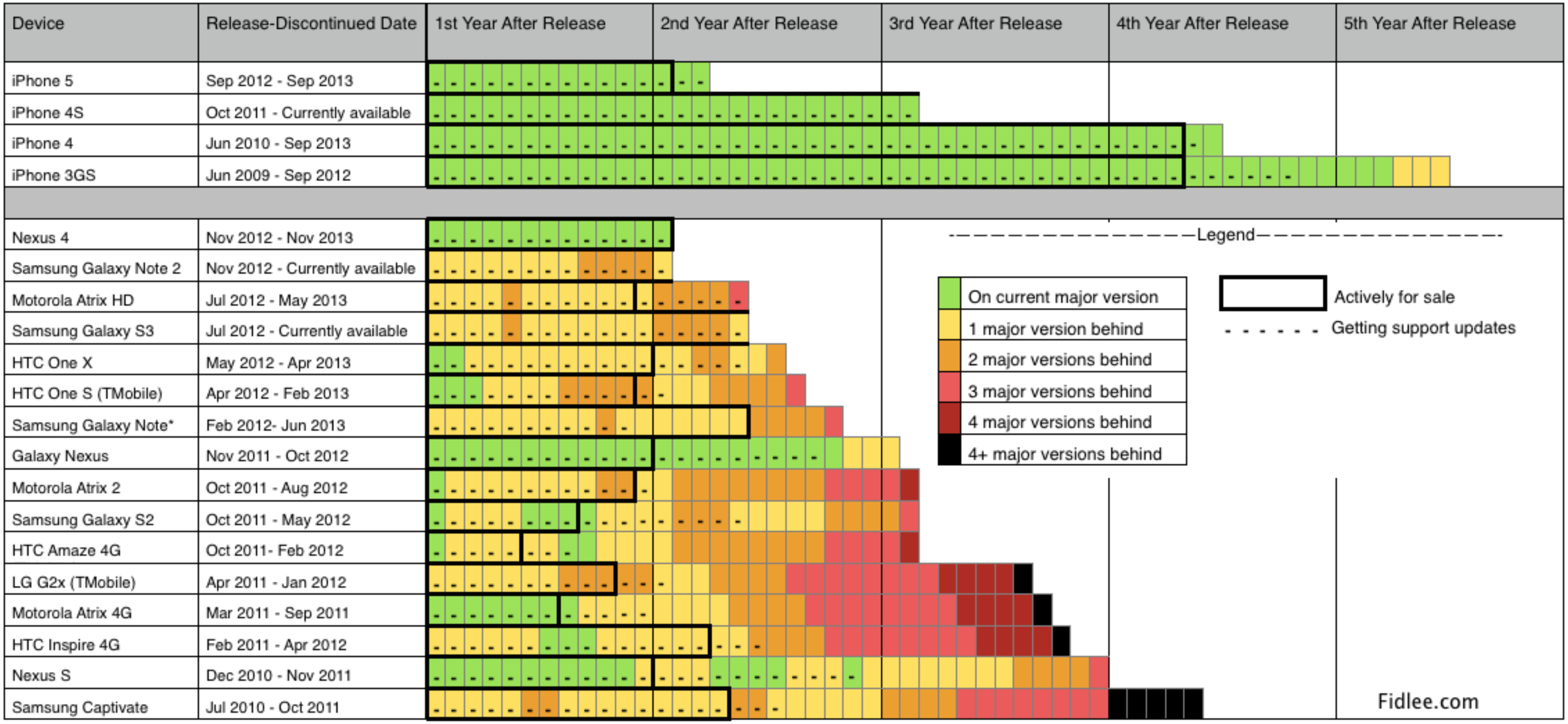
A Brief History of Failure: Logic Flaws

A Brief History of Failure: Debugging and Backdoors

A Brief History of Failure:
Authorization, Crypto, Bootloaders

Q&A
How
Who
Why
When
What
Where

Be Apple, not Android



Device	Release-Discontinued Date	1st Year After Release	2nd Year After Release	3rd Year After Release	4th Year After Release	5th Year After Release
iPhone 5	Sep 2012 - Sep 2013					
iPhone 4S	Oct 2011 - Currently available					
iPhone 4	Jun 2010 - Sep 2013					
iPhone 3GS	Jun 2009 - Sep 2012					
Nexus 4	Nov 2012 - Nov 2013					
Samsung Galaxy Note 2	Nov 2012 - Currently available					
Motorola Atrix HD	Jul 2012 - May 2013					
Samsung Galaxy S3	Jul 2012 - Currently available					
HTC One X	May 2012 - Apr 2013					
HTC One S (TMobile)	Apr 2012 - Feb 2013					
Samsung Galaxy Note*	Feb 2012- Jun 2013					
Galaxy Nexus	Nov 2011 - Oct 2012					
Motorola Atrix 2	Oct 2011 - Aug 2012					
Samsung Galaxy S2	Oct 2011 - May 2012					
HTC Amaze 4G	Oct 2011- Feb 2012					
LG G2x (TMobile)	Apr 2011 - Jan 2012					
Motorola Atrix 4G	Mar 2011 - Sep 2011					
HTC Inspire 4G	Feb 2011 - Apr 2012					
Nexus S	Dec 2010 - Nov 2011					
Samsung Captivate	Jul 2010 - Oct 2011					

Legend
🟩 On current major version
🟨 1 major version behind
🟧 2 major versions behind
🟥 3 major versions behind
🟫 4 major versions behind
⬛ 4+ major versions behind
□ Actively for sale
- - - - - - Getting support updates
Fidlee.com

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Q&A