



# Android Networking Evolution

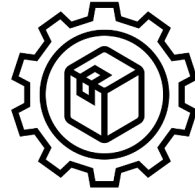
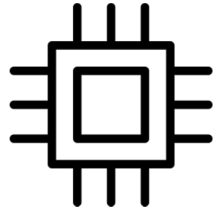
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# Agenda

- The challenges of Android networking
- Android mainline module
- Recent Android networking features
- DoH sharing

# The challenges of Android Networking

# Flow



**Google**  
publishes  
AOSP

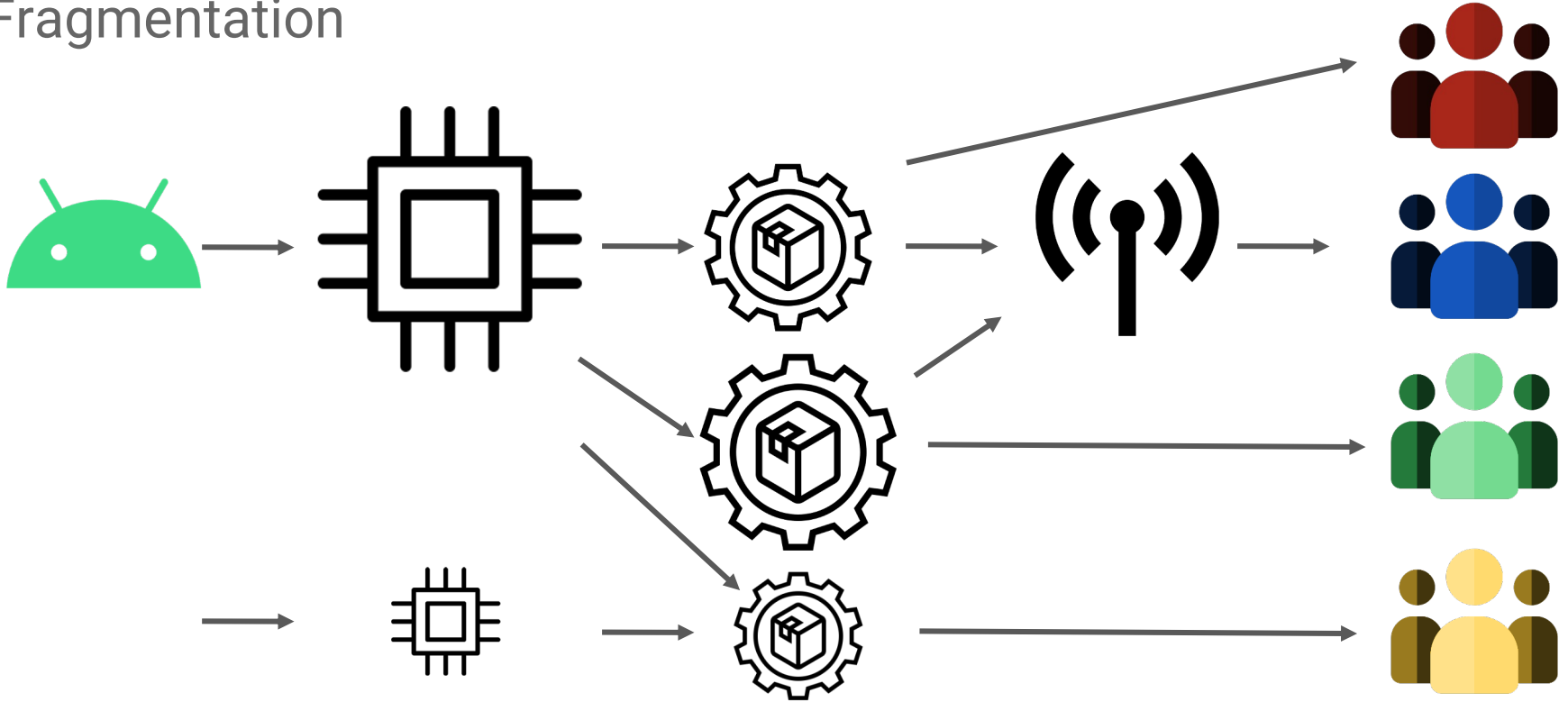
**SoCs** branch  
AOSP & add  
customizations

**OEMs** branch  
SoC & add  
customizations

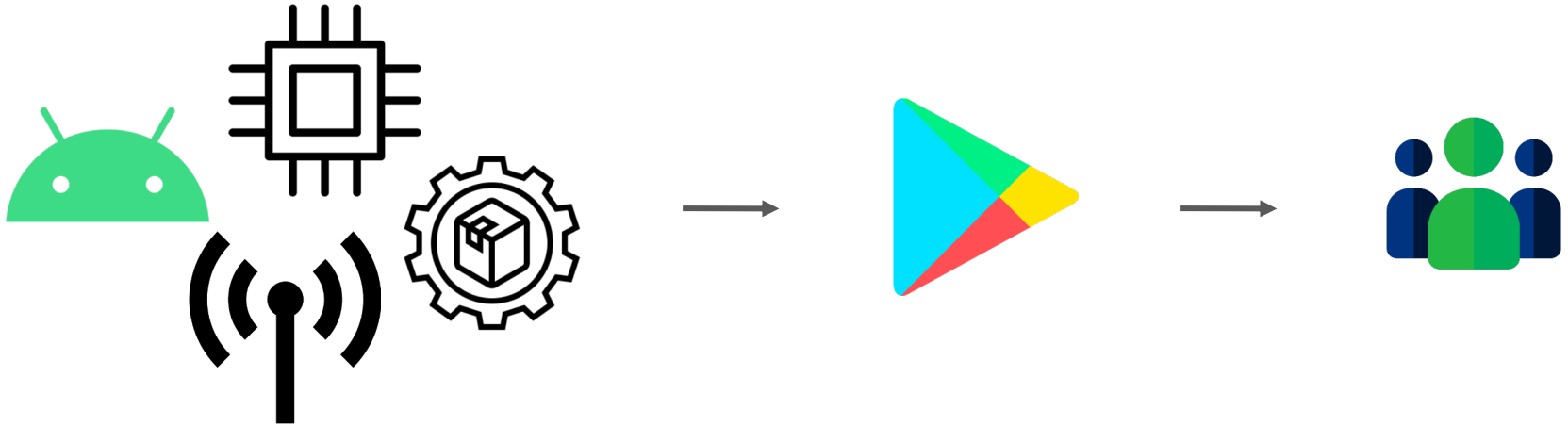
**Carriers**  
validate builds  
and add even  
more  
customizations

**Users** install  
updates  
(sometimes)

# Fragmentation



# Mainline as a solution

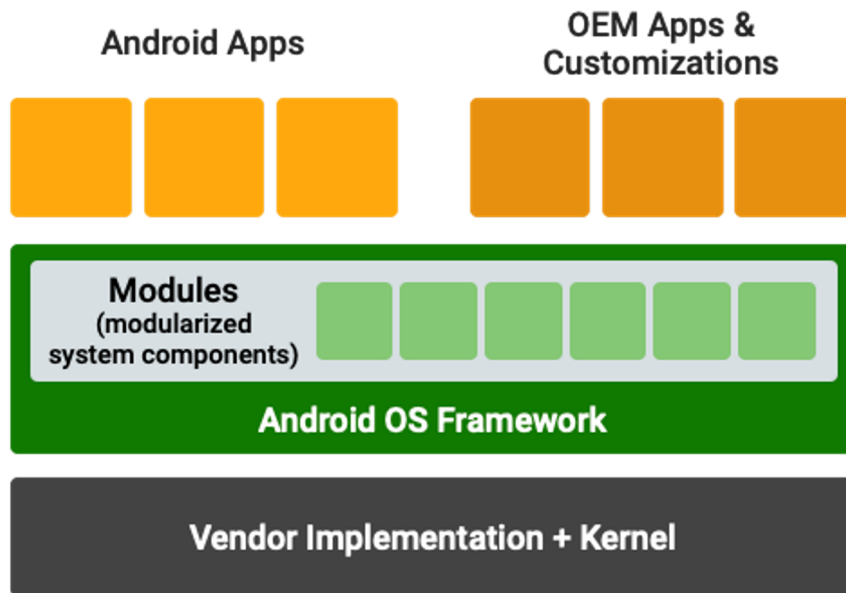


Starting from Android 10, Google, SoCs, OEMs and Carriers work together to **modularize** code, **upstream** and **validate** changes and **push** them directly to users via Google Play every month

# Android mainline module

# What is Mainline

- Mainline is a program to **modularize core components of AOSP**, build them with our infrastructure, **sign them with Google certificates**, and **update them using Google Play**.





## Mainline modules are

- Modules are **open source** as part of AOSP.
- Modules are heavily scrutinized by partners - building strong and close **partnerships with our Partners** is critical, so that they trust us to perform updates.
- Modules are **built against stable and tested** (Public/System) **APIs** - to make our modules safe, they are built against stable and tested APIs used by the module.
- All modules are **independently updatable**, it will only interact with other modules through exposed API surfaces.
- Modules are **only installed on a reboot**.

# Recent Android Networking Features

# Recent Android Networking features

## Android Q

DNS mainline module  
Data stall detection  
DoT productionanized  
Support DNS64

## Android R

Tethering mainline module  
DNS OEM features completion  
BPF offload version 1  
Support Networking Metrics  
Support A/B test

## Android S

Connectivity mainline module  
Tried DoH with Cronet solution but failed, move to Quiche  
VCN for Android Cars

## Android T

Data usage mainline module  
CLAT/eBPF mainline module  
NSD mainline module  
VPN improvement  
DoH lands in Q/R/S/T  
DoT performance improvement

# DoH Sharing

# DoH

- DNS over HTTP/3.
- Quiche solution in RUST which is supported by Android mainline
- Works on Cloudflare and Google DNS
- Implementing DDR

# DoH

- 6% of devices ever used DoH.
- Overall, 4.2% of queries are over DoH, 1.6% of queries are over DoT and 94.2% of queries are over UDP
- DNS performance is substantially improved overall, due to better responsiveness in the presence of slow networks / outages
  - Average DNS API call latency (for all protocols, including UDP): **-16%**
- Queries over DoH are substantially faster than over DoT:
  - p50 query latency: **-23%**
  - p95 query latency: **-44%**
  - p99 query latency: **-53%**

Q&A