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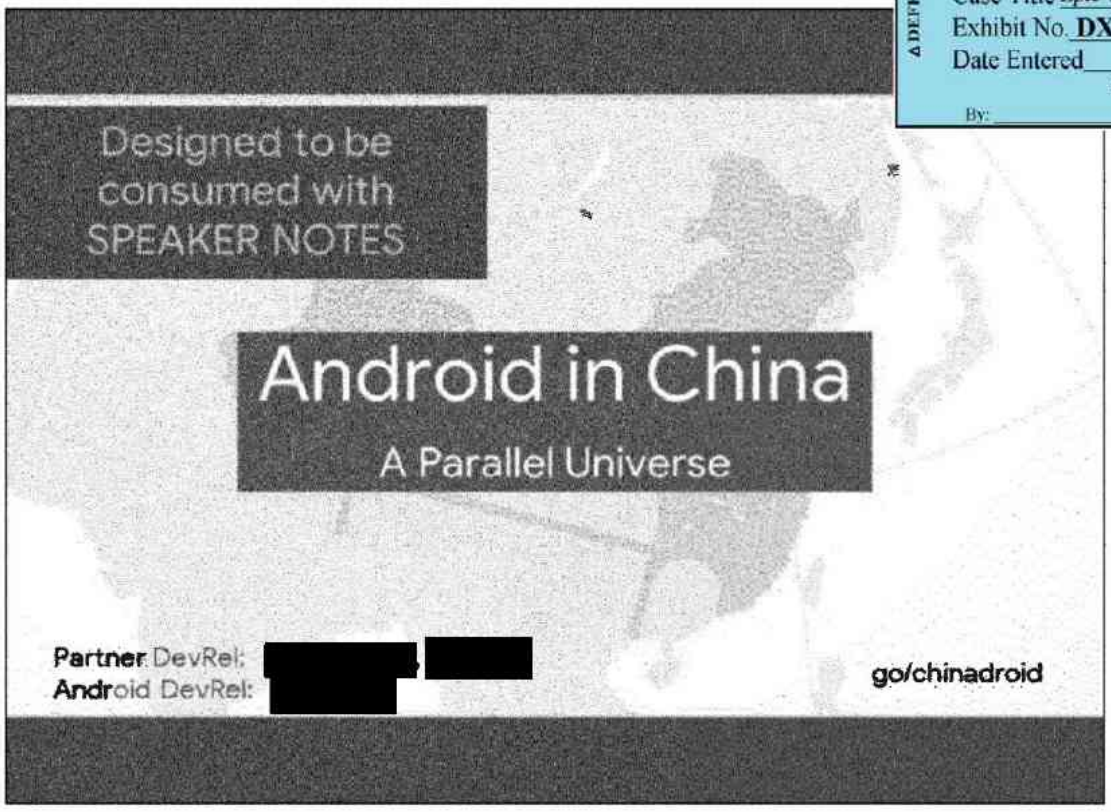
DEFENDANT'S
United States District Court
Northern District of California
Case No. 4:20-cv-05640-YGR
Case Title *Epic Games, Inc. v. Apple, Inc.*
Exhibit No. DX-3221
Date Entered
Susan Y. Soong, Clerk
By: , Deputy Clerk



THIS DECK IS DESIGNED TO BE CONSUMED WITH THE SPEAKER NOTES.

Most Googlers' understanding of Android in China (AiC) are limited to the phrase "it's complicated", but when you ask them to explain HOW it is complicated / different from rest of world (RoW), they draw a blank.

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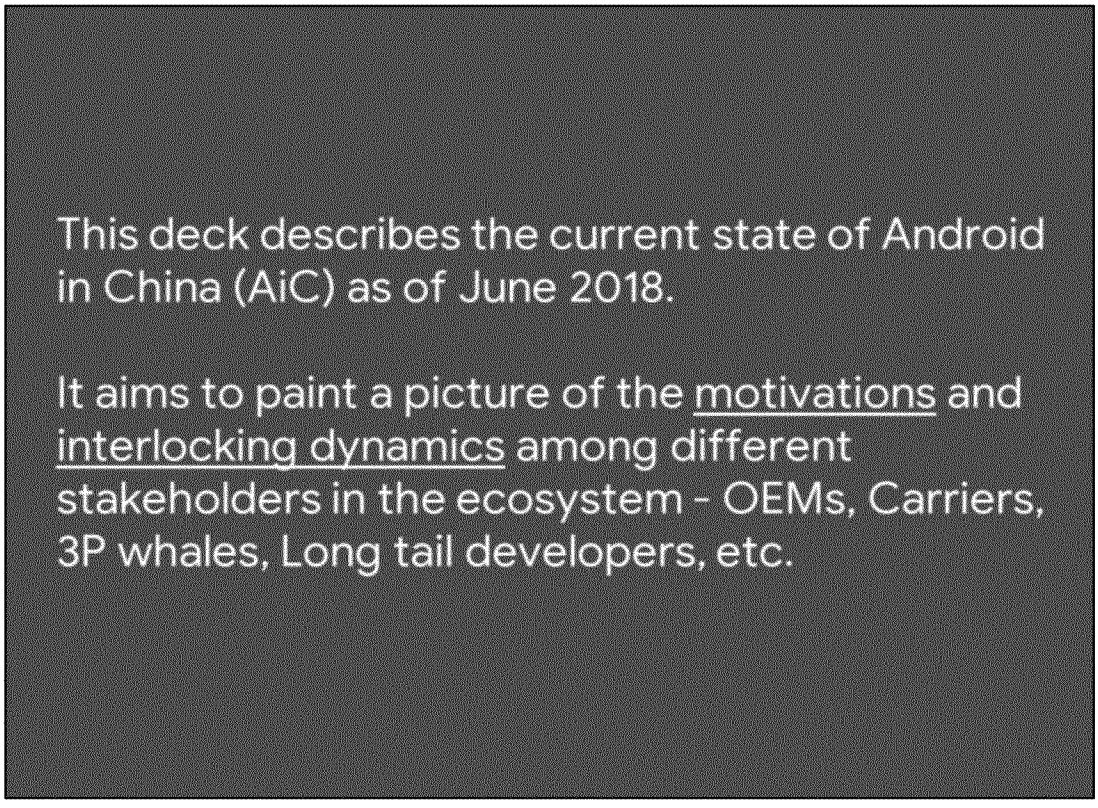

Our goal in this presentation is to give you a sufficiently deep understanding of how Android in China (AiC) actually works, and how it is different from RoW; just getting an understanding of where things are.
The goal of this presentation is NOT to present solutions to the problems described here (that would be for a different preso).

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If you have not already, I highly recommend signing up for the guided tour at the China Experience Lab (go/celab) in B44.
It provides a fantastic consumer experience of AiC, and would give you more insight into how the dynamics described in this deck end up affecting Chinese Android users.

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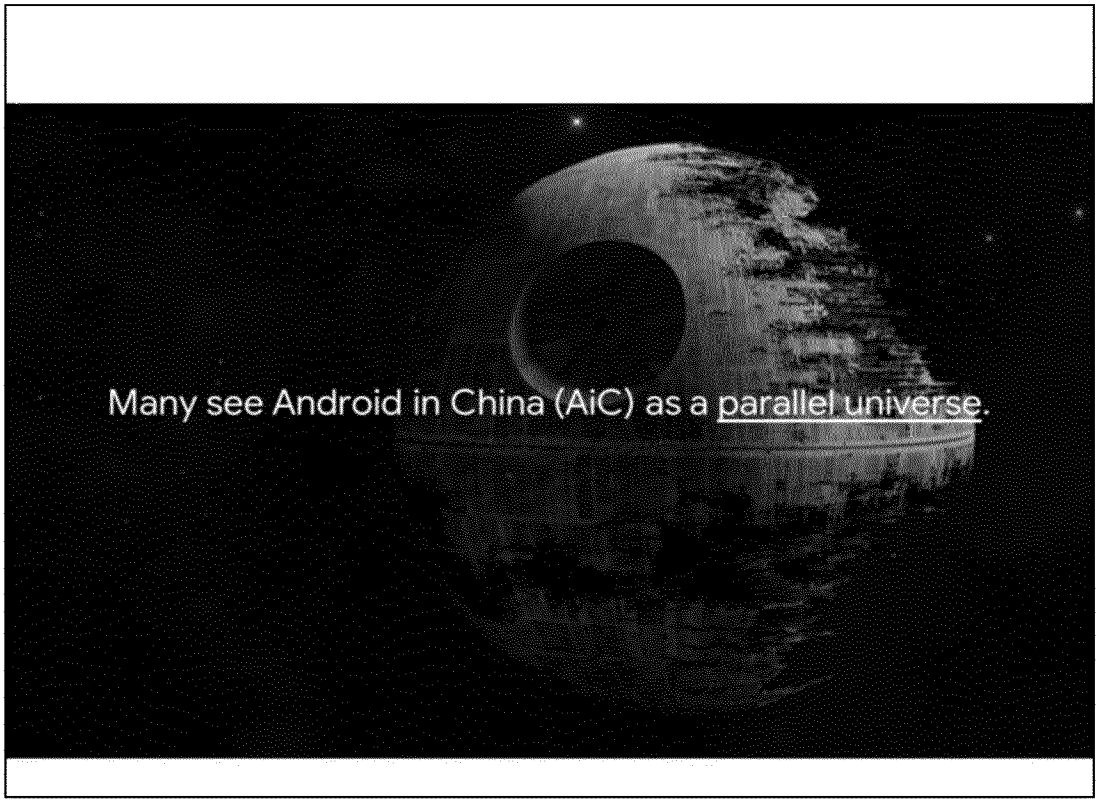

First, let's talk about general perceptions of AiC. The words "parallel universe" comes up a lot.

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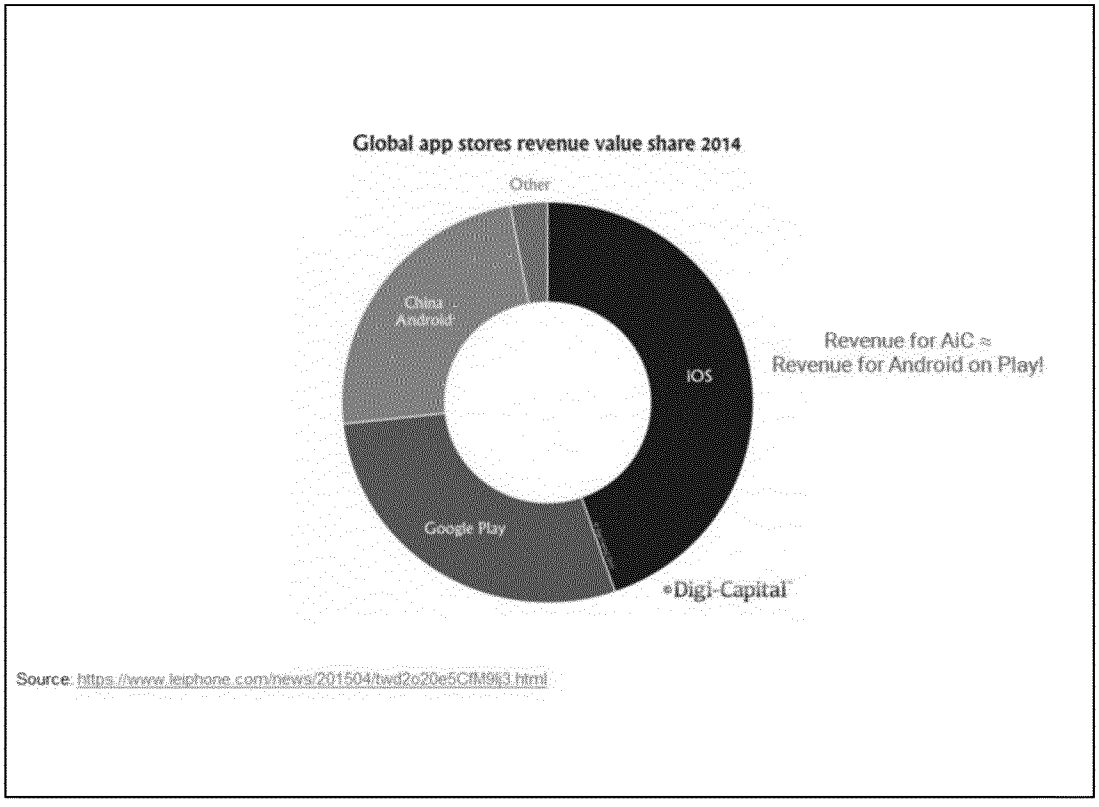

In Google, we hardly ever think about a world where Play is not Android's distribution mechanism and policy enforcer.
We design and build Android where Play's existence is somewhat assumed.

The problem with is…. this is simply not true for a HUGE percentage of mobile users.

Using revenue as a proxy for usage, AiC is about just as big as Android on Play.

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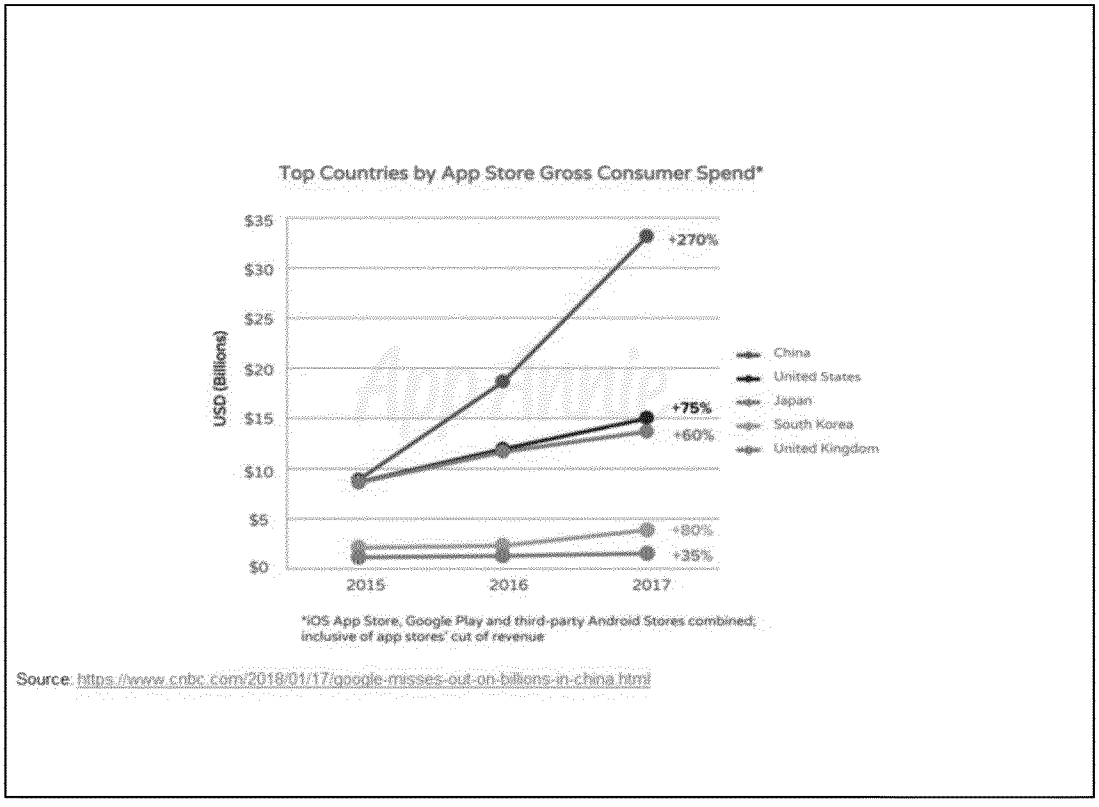

Here is more data showing the same thing.
But then again, you probably already know that “China is important”.... that’s not the question.

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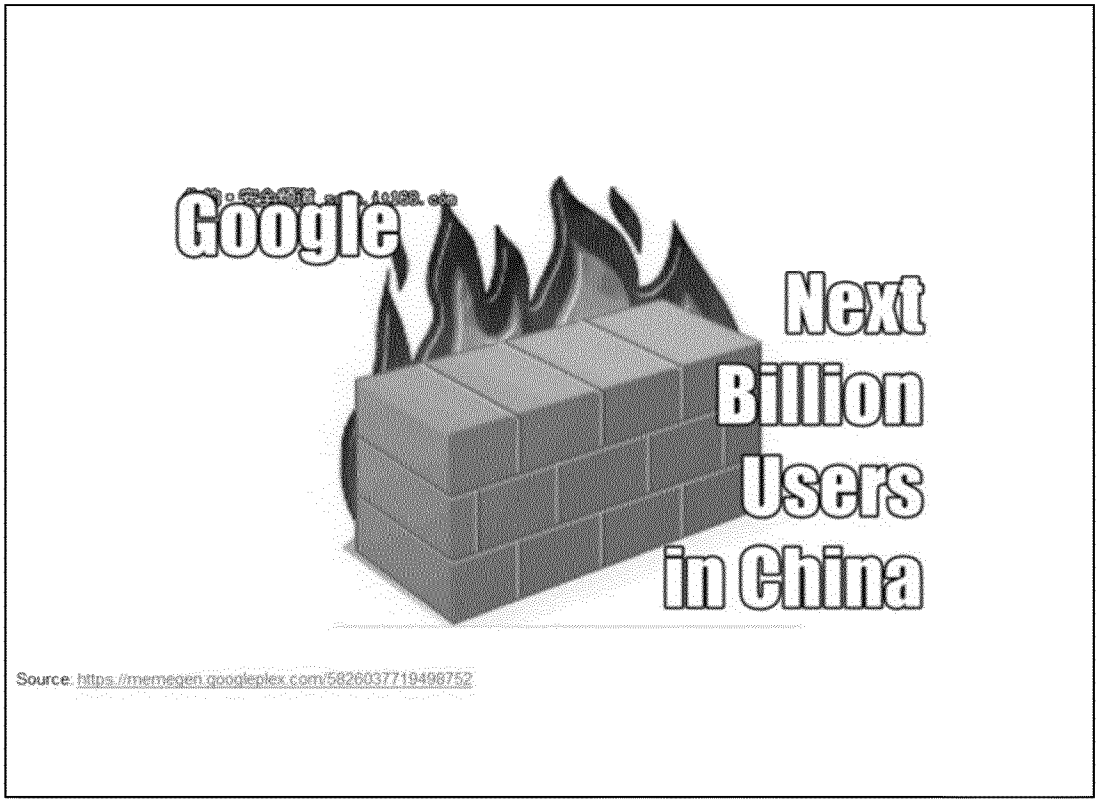

The question is…. What works in China? What doesn't? What is actually different about China? What is similar?

There's a cognitive barrier when one thinks of China.

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You look at a typical Chinese phone, and you DO NOT RECOGNIZE any of these app icons.

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You might have heard of the names of some Android OEMs from China, but you've never given more than a passing thought about them…. Nor could you tell one apart from the other.

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IMAGE	RANK	APPSTORE	APPSTORE IN CHINESE	COVERAGE
	1	Myapp (Tencent)	应用宝	23.70%
	2	360 Mobile Assistant	360手机助手	14.90%
	3	Xiaomi App Store	小米应用商店	12.40%
	4	Xiaomi Game Center	小米游戏中心	11.60%
	5	Huawei App Market	华为应用市场	11.00%
	6	Oppo App Store	OPPO软件商店	9.40%
	7	Baidu Mobile Assistant	百度手机助手	7.70%
	8	Vivo App Store	VIVO应用商店	4.40%
	9	Vivo Game Center	VIVO游戏中心	4.10%
	10	Sogou Mobile Assistant	搜狗手机助手	3.40%

Source: https://newzoo.com/insights/rankings/top-10-android-app-stores-china/

OK, Google Play is not in China, so other Android app stores must fill the void. You probably have not heard of most of these stores though….

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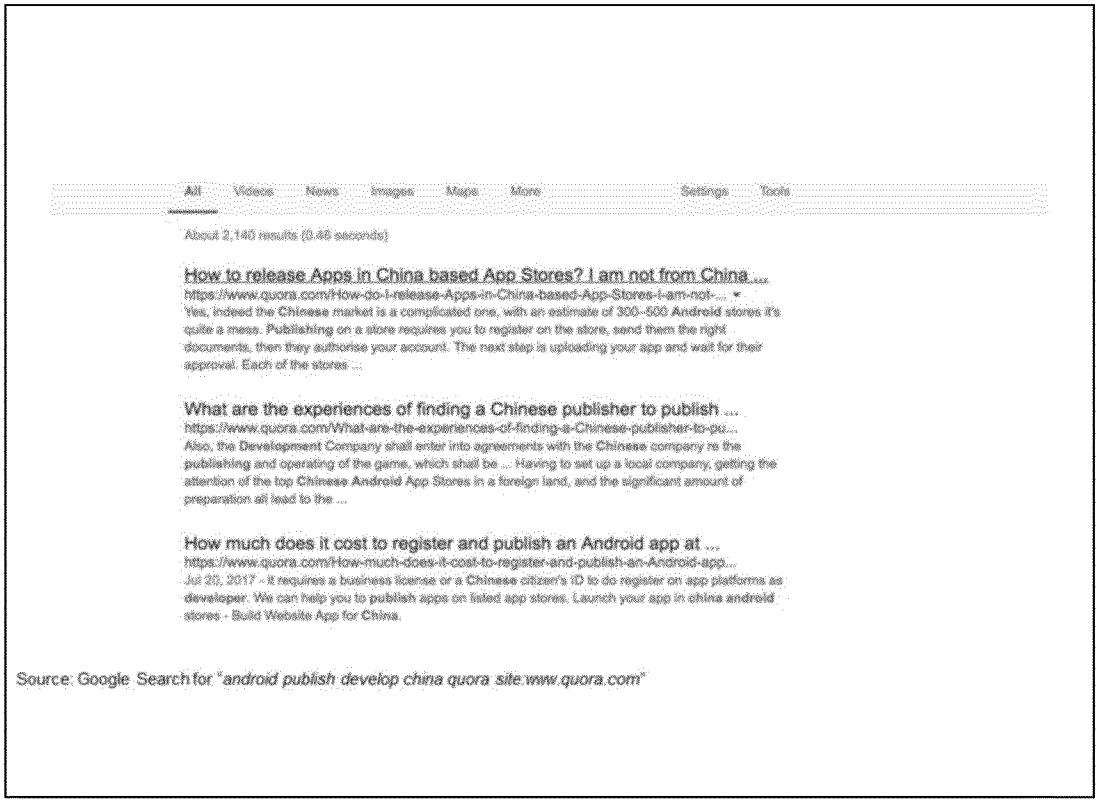

Source: Google Search for "*android publish develop china quora site:www.quora.com*"

And what are the nuances for a developer building for AiC?
Not clear either ….

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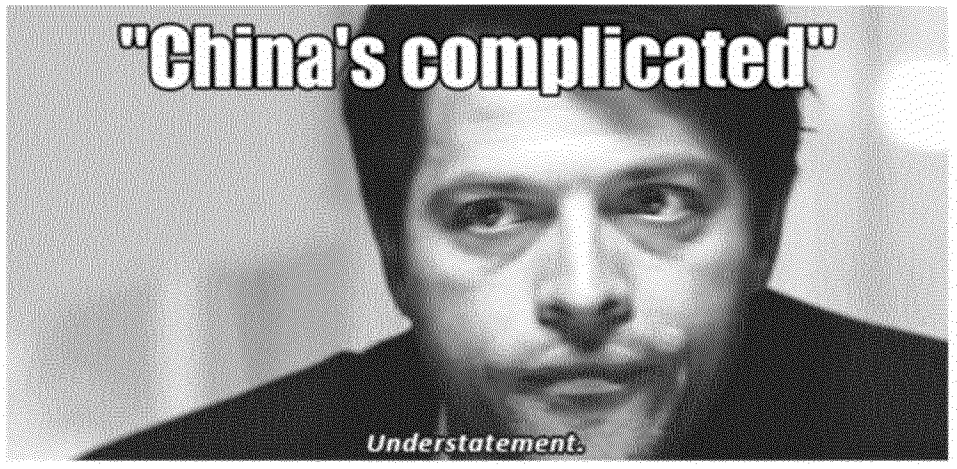

Source: https://memegen.googleplex.com/5881572528226304

Hard to shake the idea that China is complicated.

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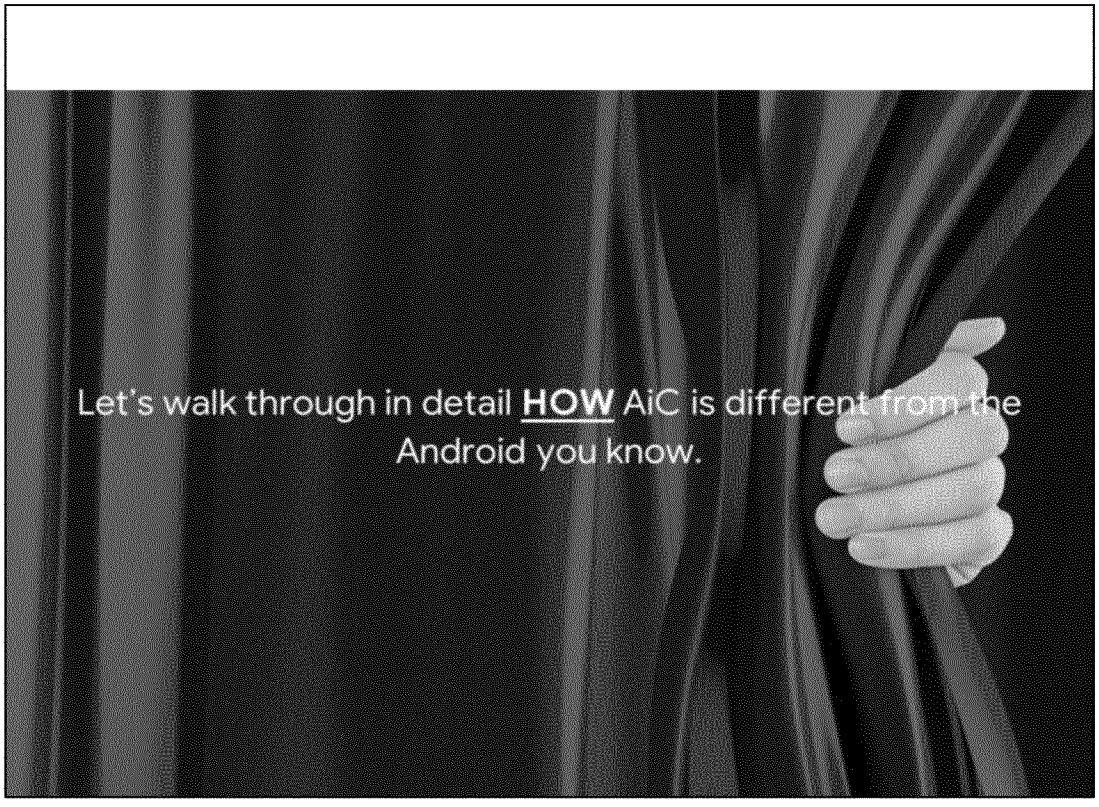

Let's unpack it all!

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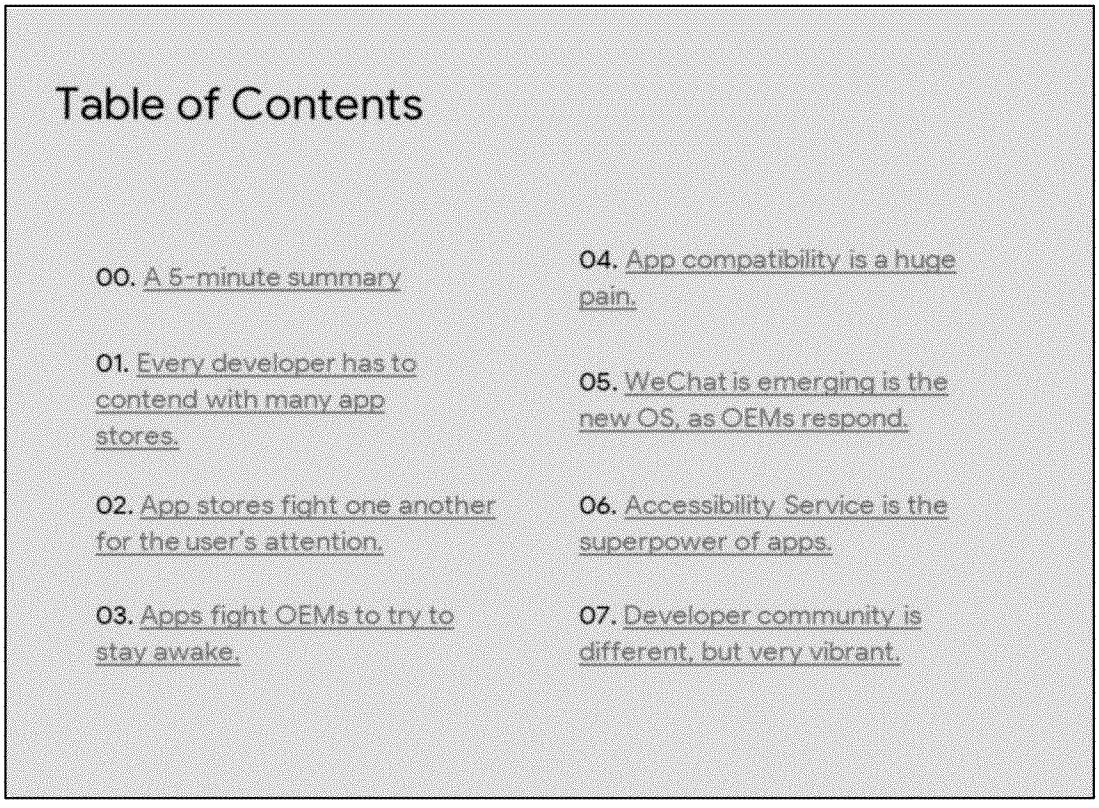

Android in China boils down to some of these overarching themes, which we'll unpack one-by-one.

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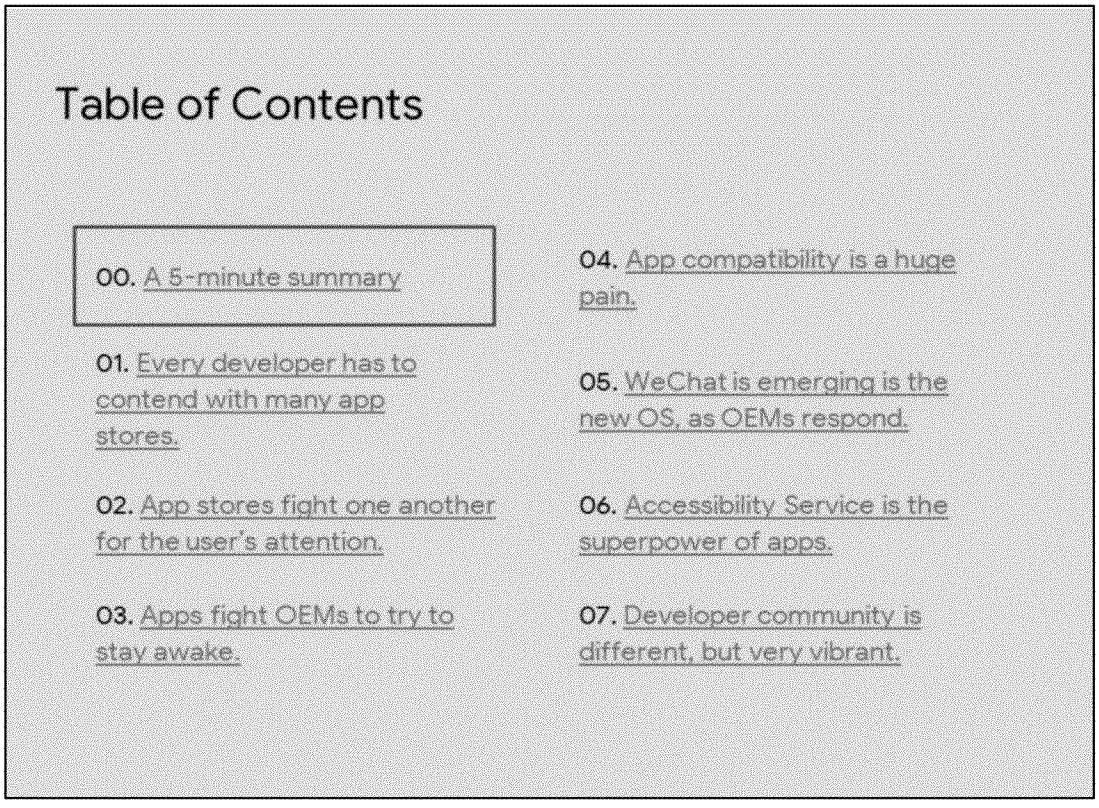

This deck is super long, so we'll just set the stage at a very high level with a quick 5-minute summary.

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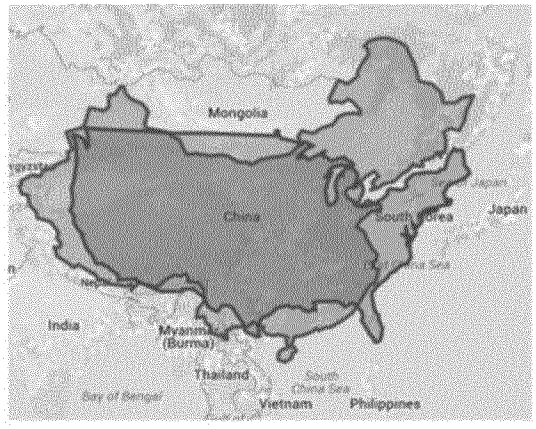
China's Size

- 1.357B population (4X US)
- 2nd highest device activations (behind US)
- 700M+ smartphone installed base
- 47% China Mobile (64% market share) users are on 3G/4G network



In case you didn't know already, China is:
The most populous country on Earth
Roughly the same physical size as the US
Lots of users with lots of devices on very fast networks.

If you've been to China as a tourist, you might think that the network is slow. That is almost certainly only because you were trying to access services that are throttled (or outright blocked) by the firewall.
Connectivity to local services are all just as fast as you would expect in a developed country.

By the way…. . "China" in this context means "mainland China", and explicitly excludes Taiwan, Hong Kong, and Macau.

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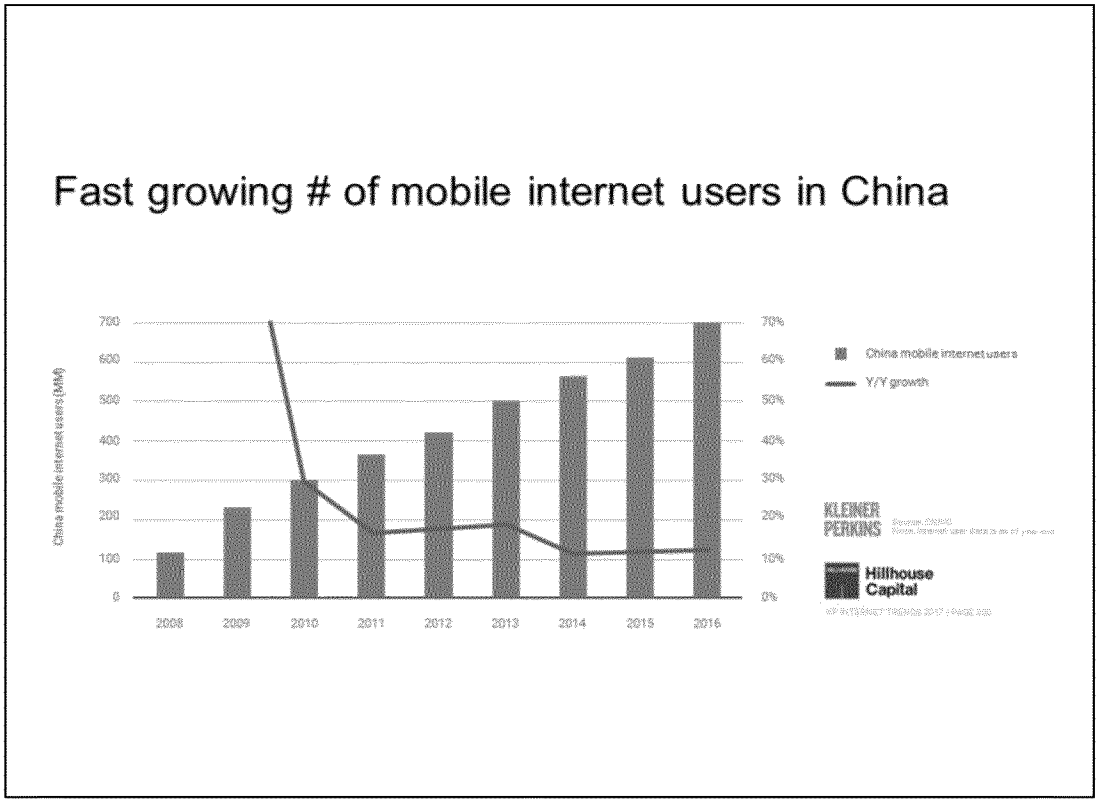

And the number of internet users in China is still growing rapidly.
The growth rate is +12% Y/Y in 2016, vs. 11% in 2015

And hit well over 700M by EOY 2017.

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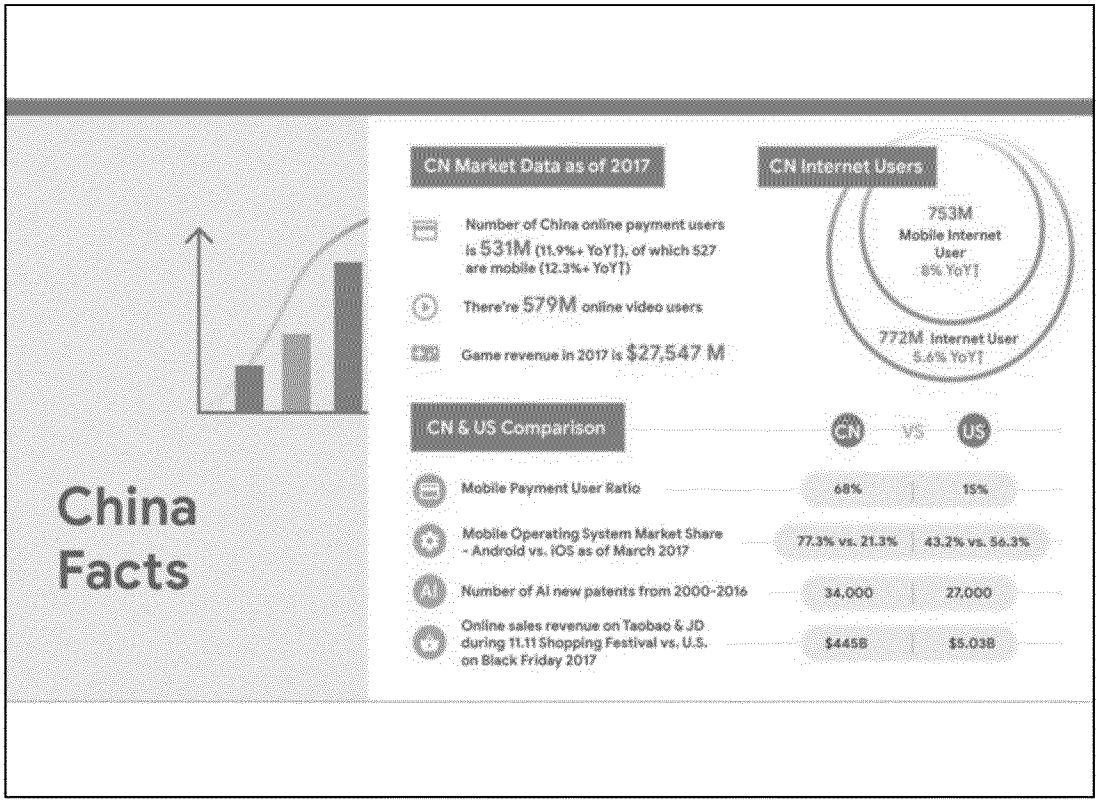

More China facts, when compared with the US
Mobile payment penetration is far higher
Android market share is higher
Being online and highly-engaged with digital content is a fact of life

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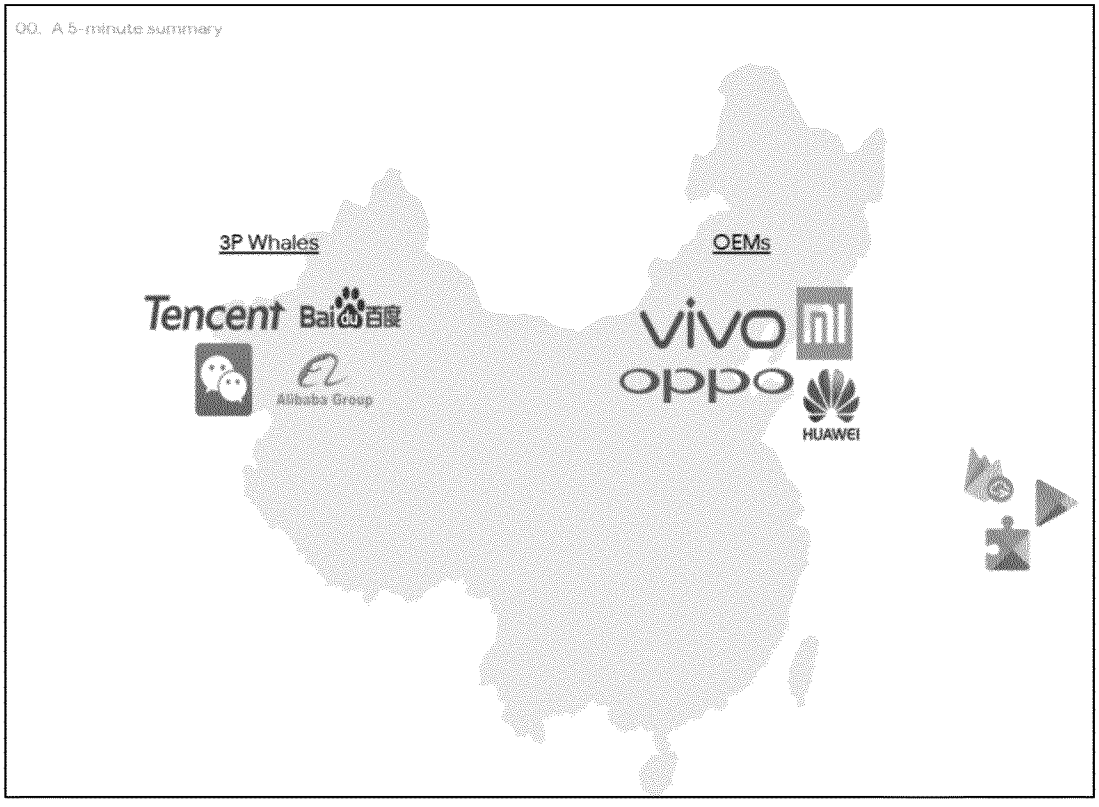

A (vastly) simplified picture of the AiC ecosystem looks somewhat like this.
It is mainly made up of 2 camps who have an outsized influence on the ecosystem:
the biggest app developers (“3P Whales”) like Tencent, Alibaba, Baidu
the Android OEMs like Xiaomi and Huawei

There are obviously other players like carriers and long tail developers, but we’ll leave them out for now for simplicity.

(Google services are on the outside looking in).

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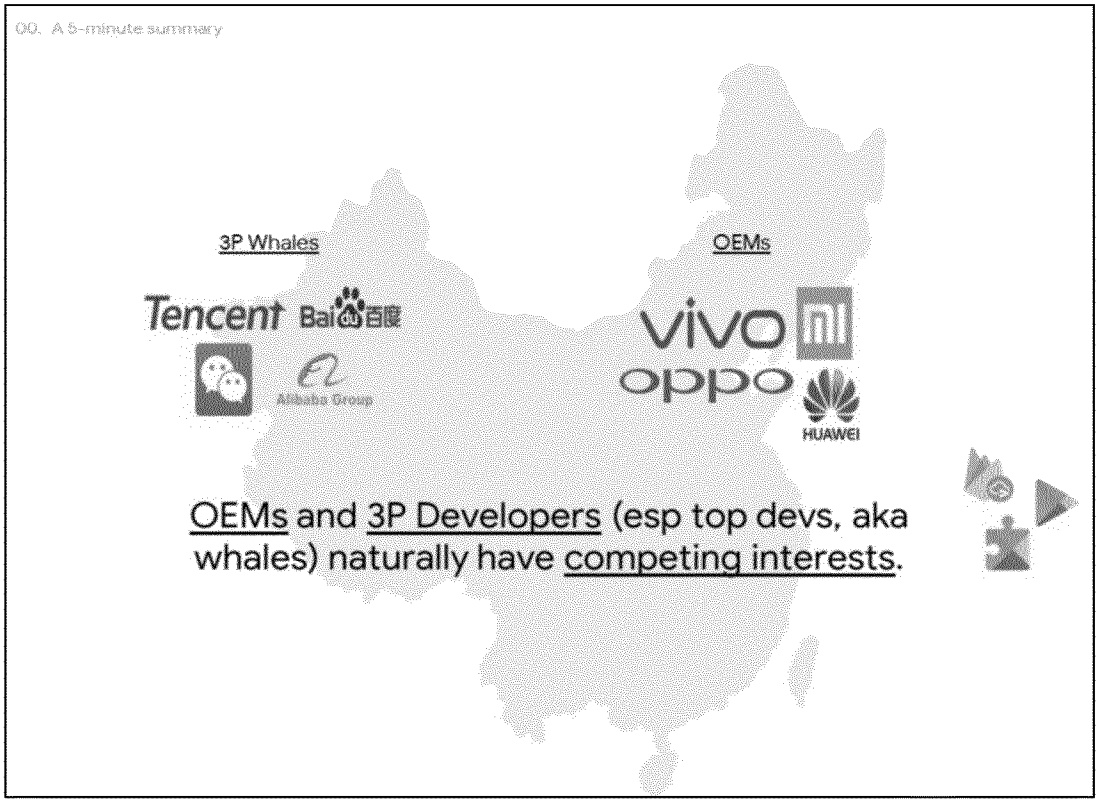

OEMs and 3P devs naturally have competing interests.
OEMs want to sell more devices and/or sell more users onto services proprietary to said device, while 3P apps want more reach across many different devices.

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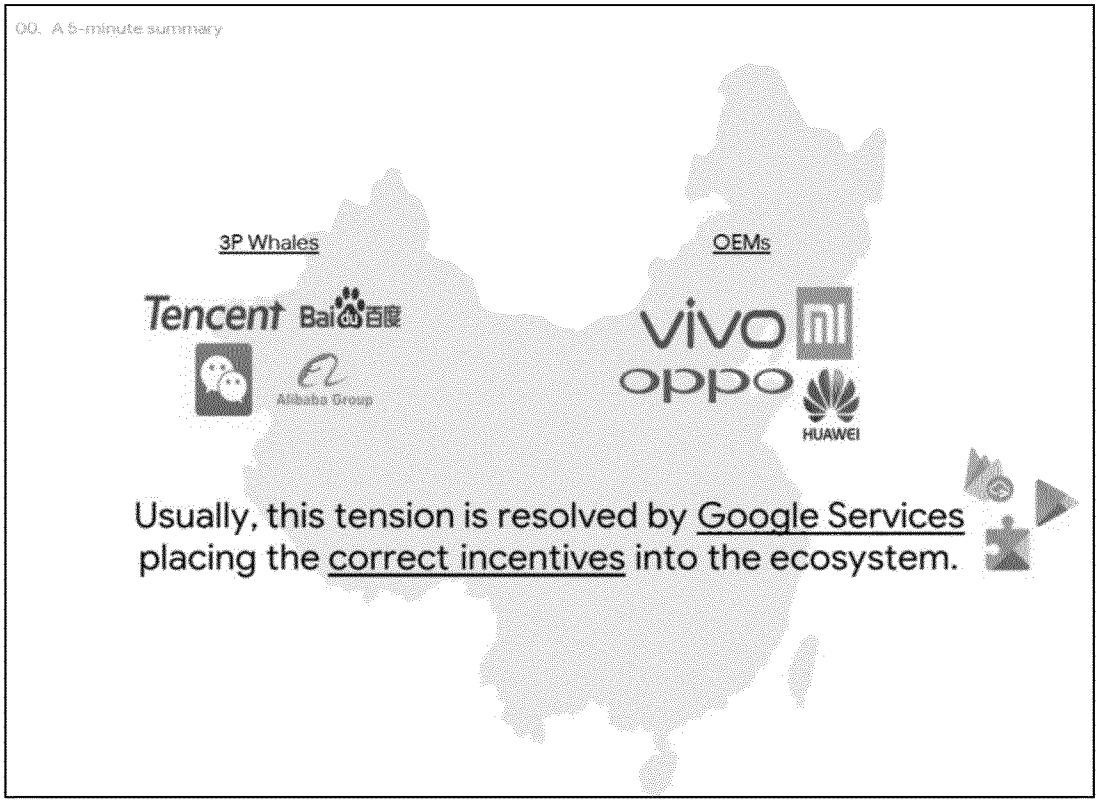

Outside of China, Google Services (specifically - GMSCore, Play store, and FCM) together therefore play an important function in putting the right incentives in place in making sure those 2 forces are held in tension without breaking.
Devs by-and-large only worry about 1 distribution and update channel, 1 main re-engagement mechanism, and 1 consistent way in which policies are enforced.

Incidentally, this also puts Google in a powerful position in the ecosystem.

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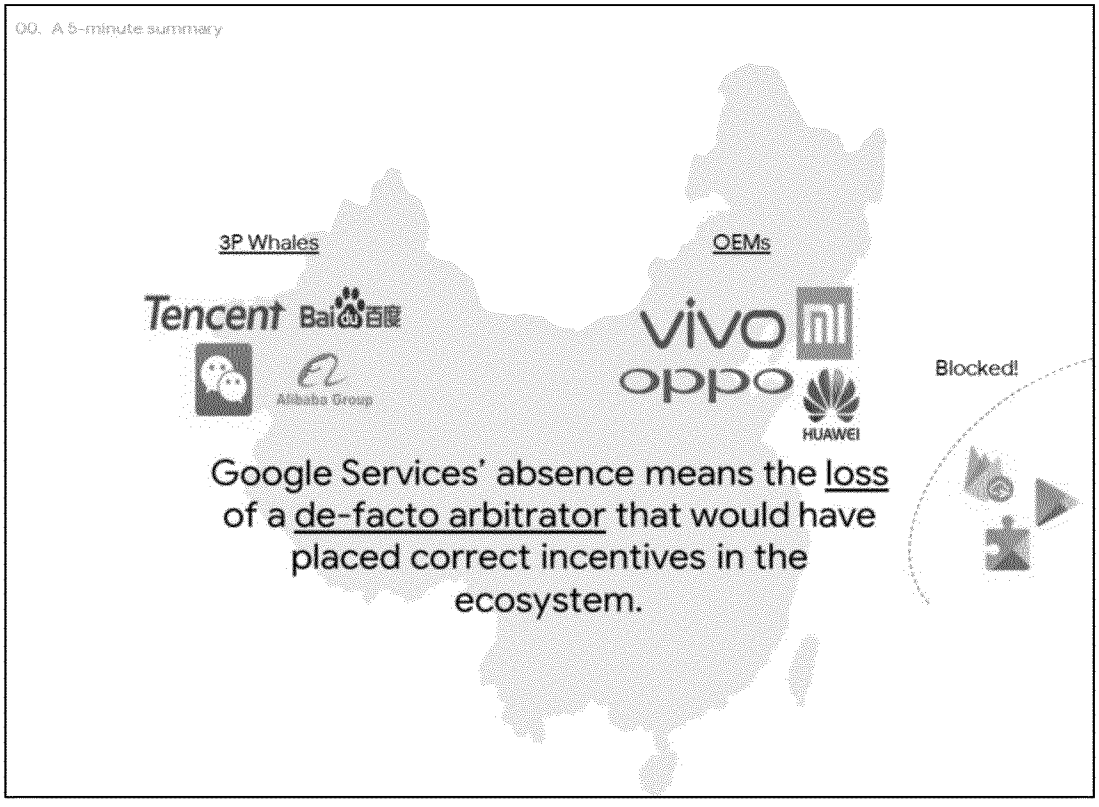

The fact that these critical services do not exist in China means the loss of a de-facto arbitrator, and that incentives that are placed in the ecosystem are not necessarily aligned.

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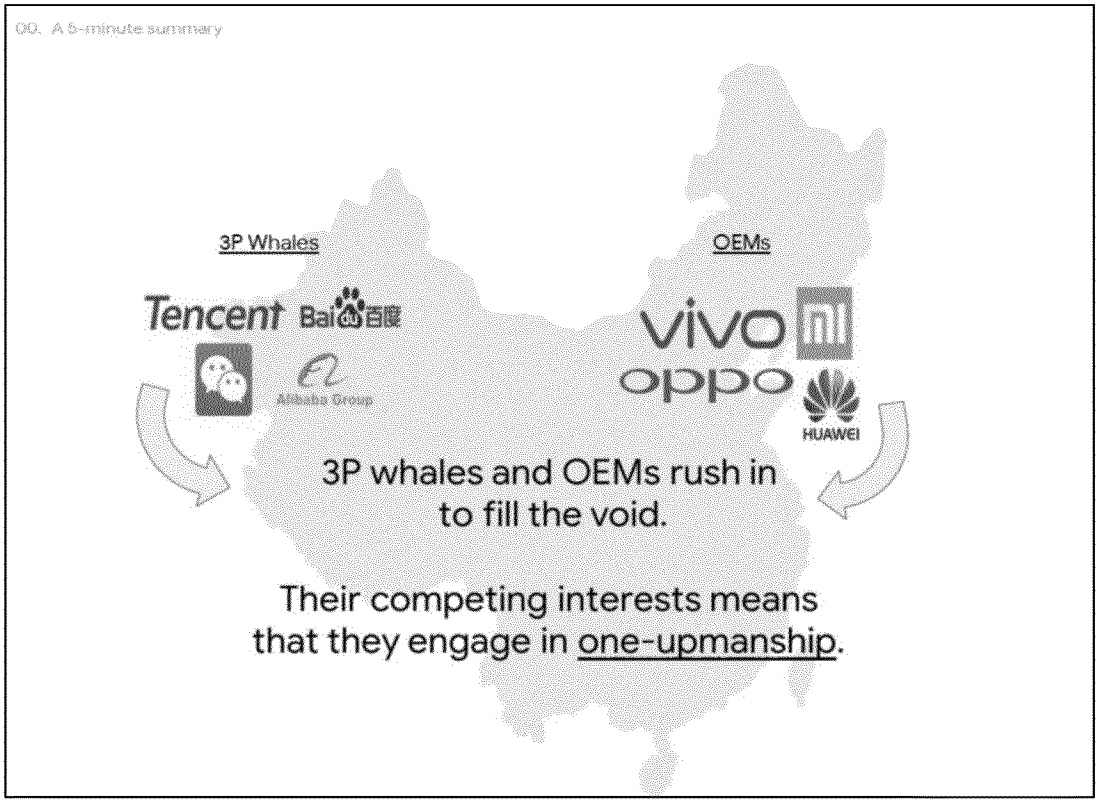

Google Services not being in China is just a power vacuum begging to be filled.
3P devs and OEMs all rush in to fill it, and then they one-up each other to get into the best position possible.

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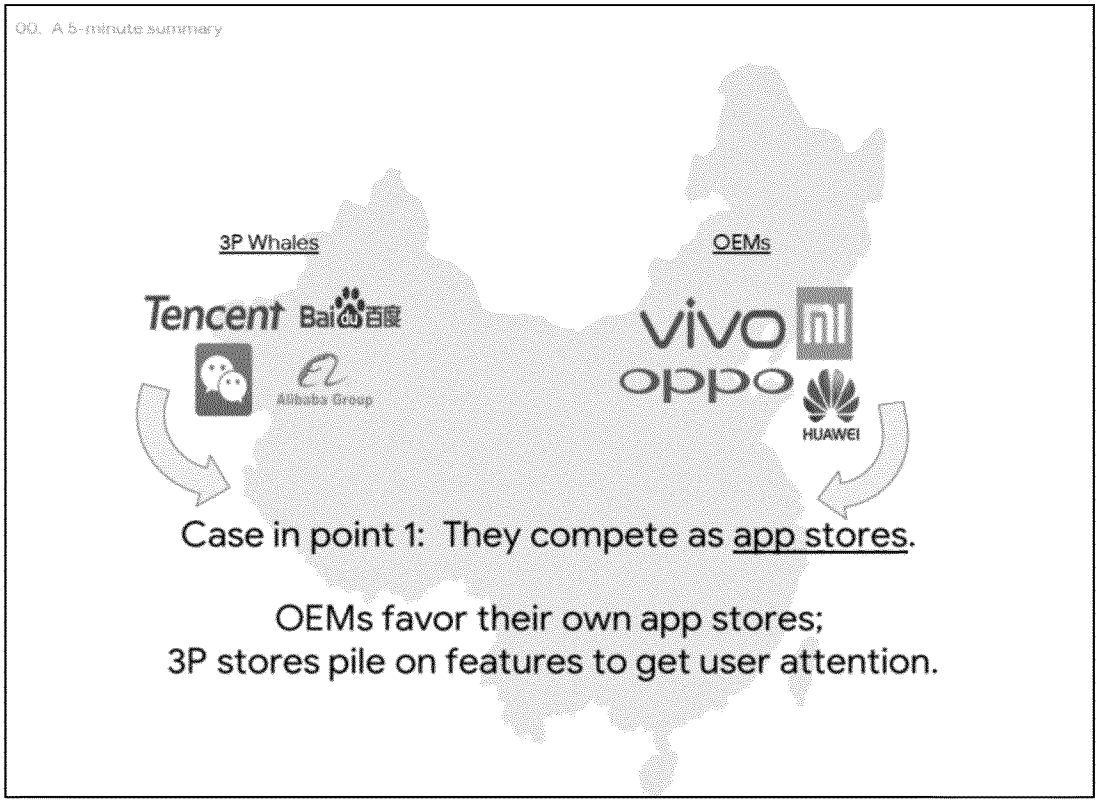

Case in point 1: All major app stores are backed by either a 3P whale or an OEM.

OEMs wield great power in favoring their own stores; while 3P stores, without the power of pre-installation and system defaults, pile on features and turn up the notification dial to try to get users to re-engage.

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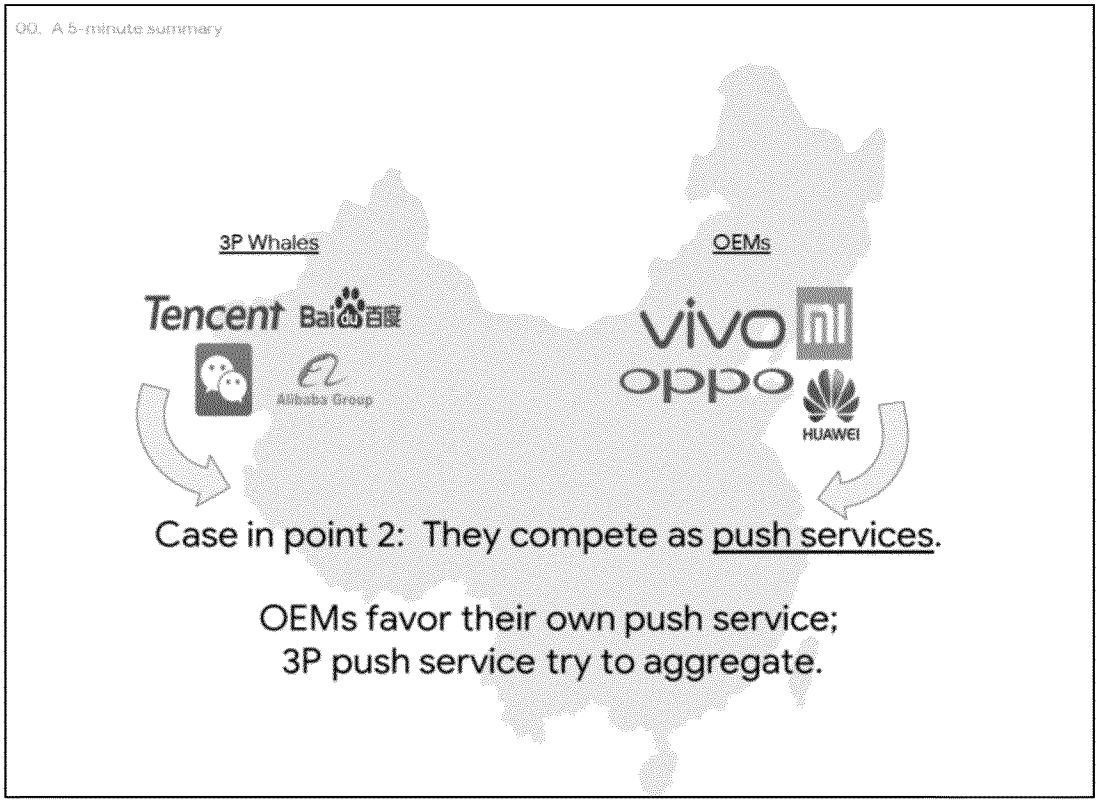

Case in point 2: push notification service! Again, all major push notification services are either a 3P push service or an OEM push service.

Everybody wants to be the arbitrator of push service. OEMs have the distinct advantage of also controlling how/whether such notifications actually get through to their own device, and so wield great power in getting devs to fall in-line.

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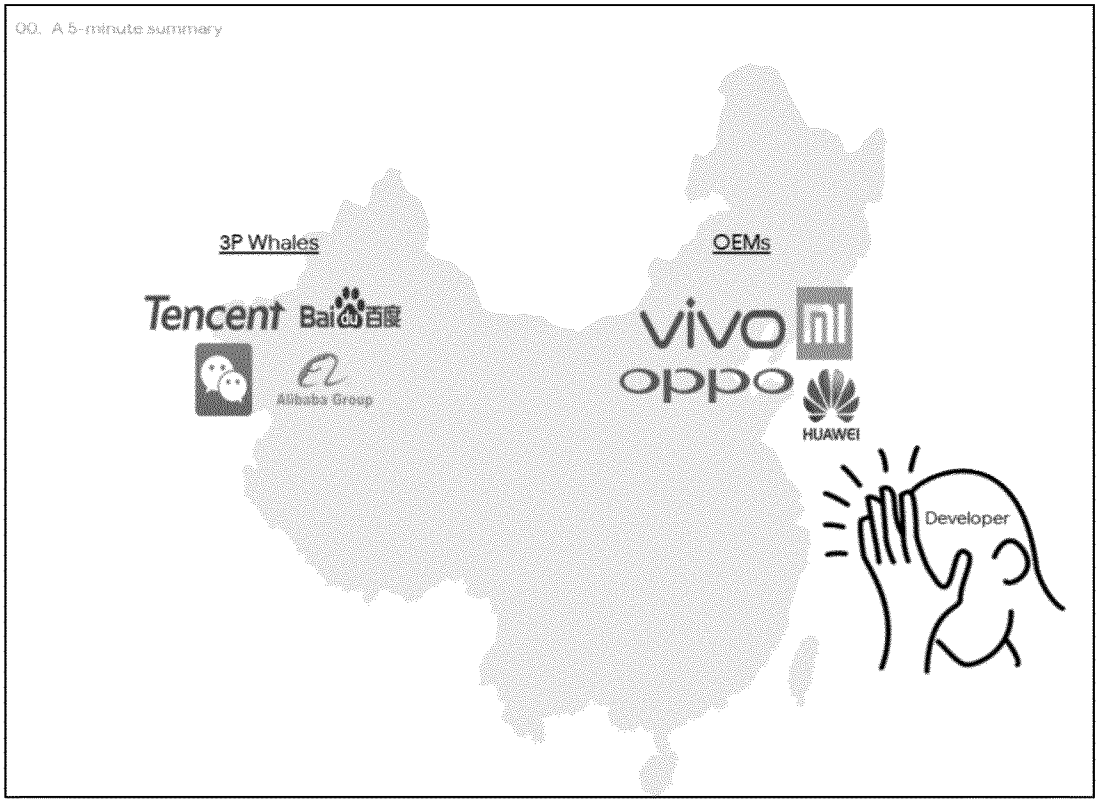

Developers end up getting caught in this cross-fire.

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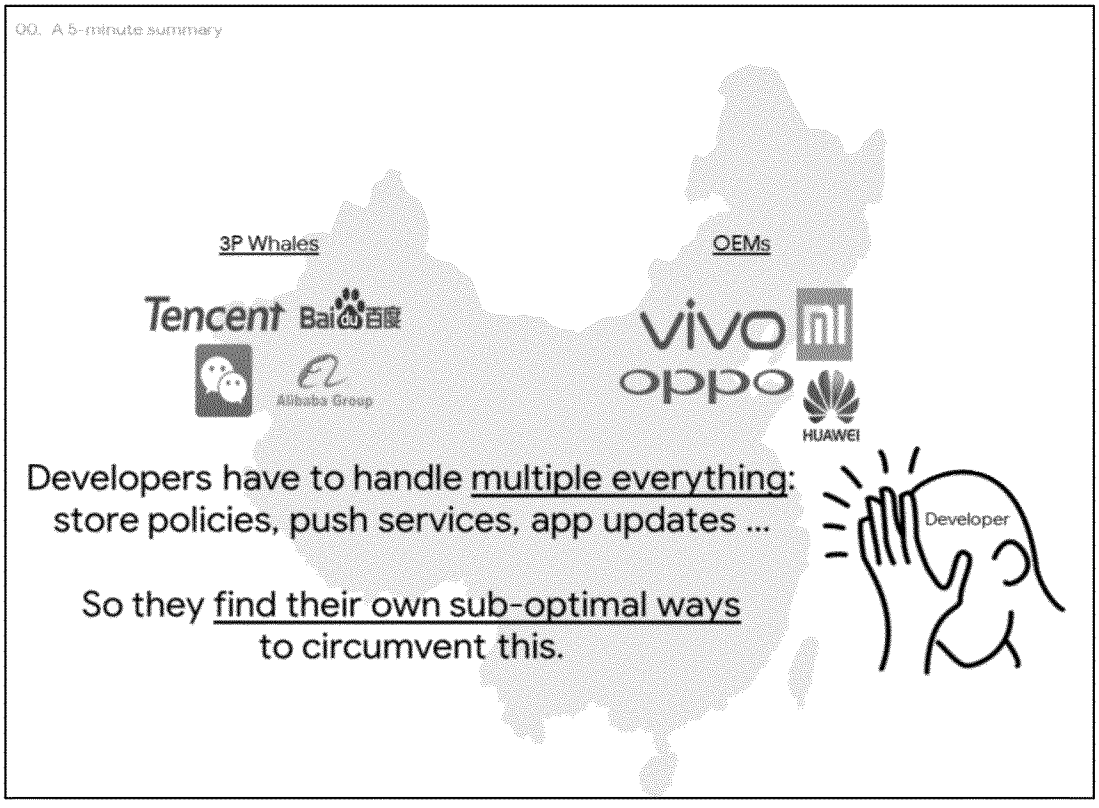

And devs end up having to handling multiple everything -
Different stores have different policies and requirements for store listing artifacts
Some push services are more effective on some devices than others
Stores scrape other stores for APKs, so a dev's app might end up on another store
Etc.

A dev has to find other ways, even sub-optimal ones, to work around this cross-fire.

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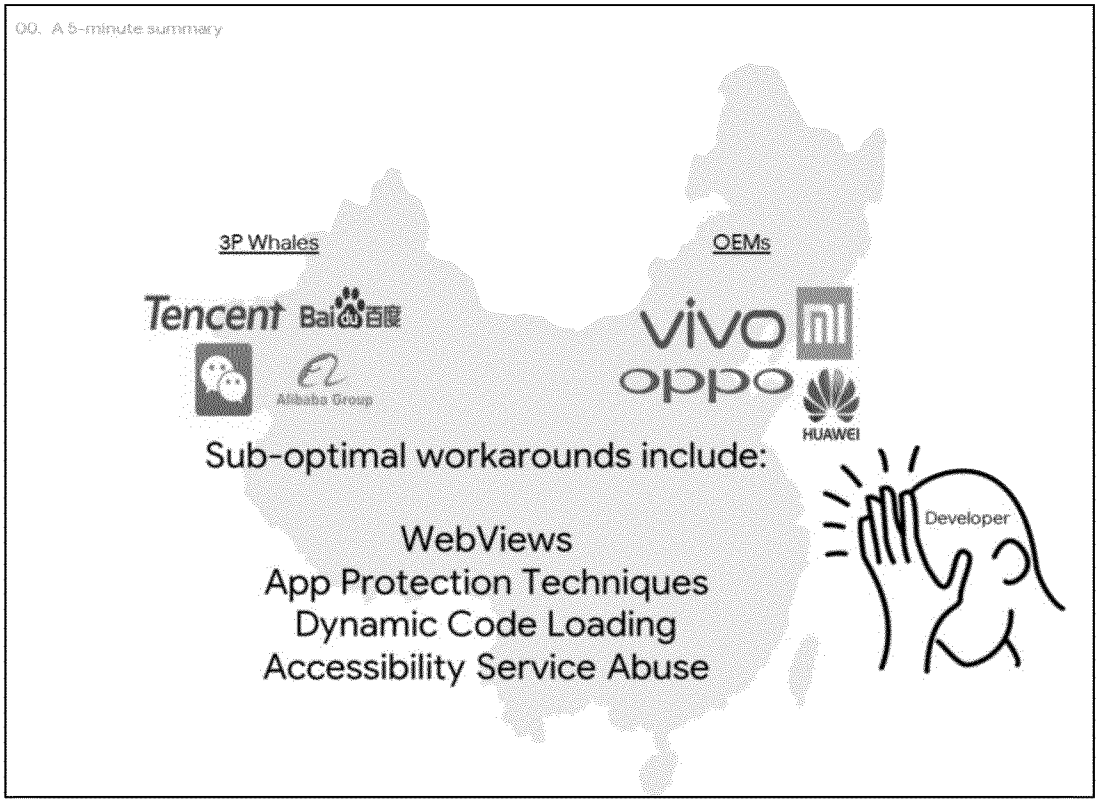

Sub-optimal ways by developers include:
Using Webviews for major parts of the app
Using app protection techniques (sometimes also called “obfuscation”, but in China this term means a lot more than just using Proguard) to protect apps from being unpacked / decompiled then modified / repacked and uploaded to all app markets
Dynamically loading code so that apps reduce reliance on stores
Using the superpowers of Accessibility service to take things into their own hands

These are all considered anti-patterns in RoW, but in China these are necessities. All 4 of these sub-optimal ways are used outside of China as well, but the extent to which it happens is way higher in CN than in RoW.

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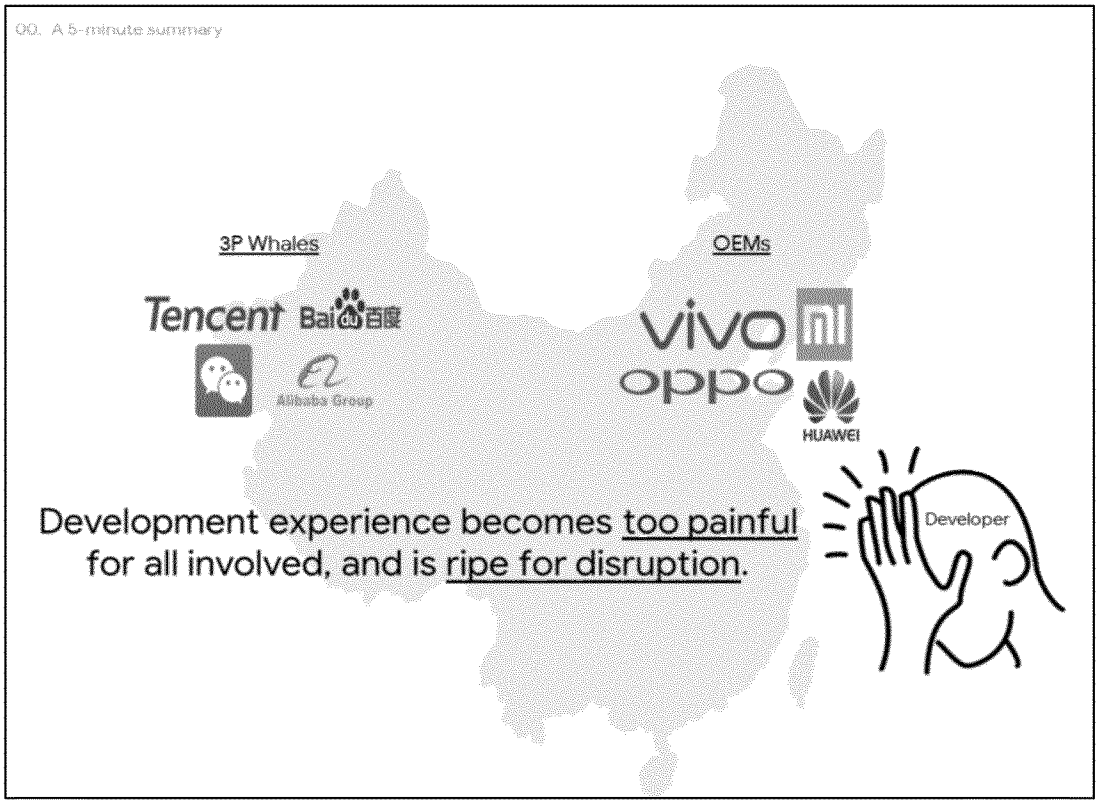

The ecosystem is all just way too painful, and is ripe for disruption.
But by whom?

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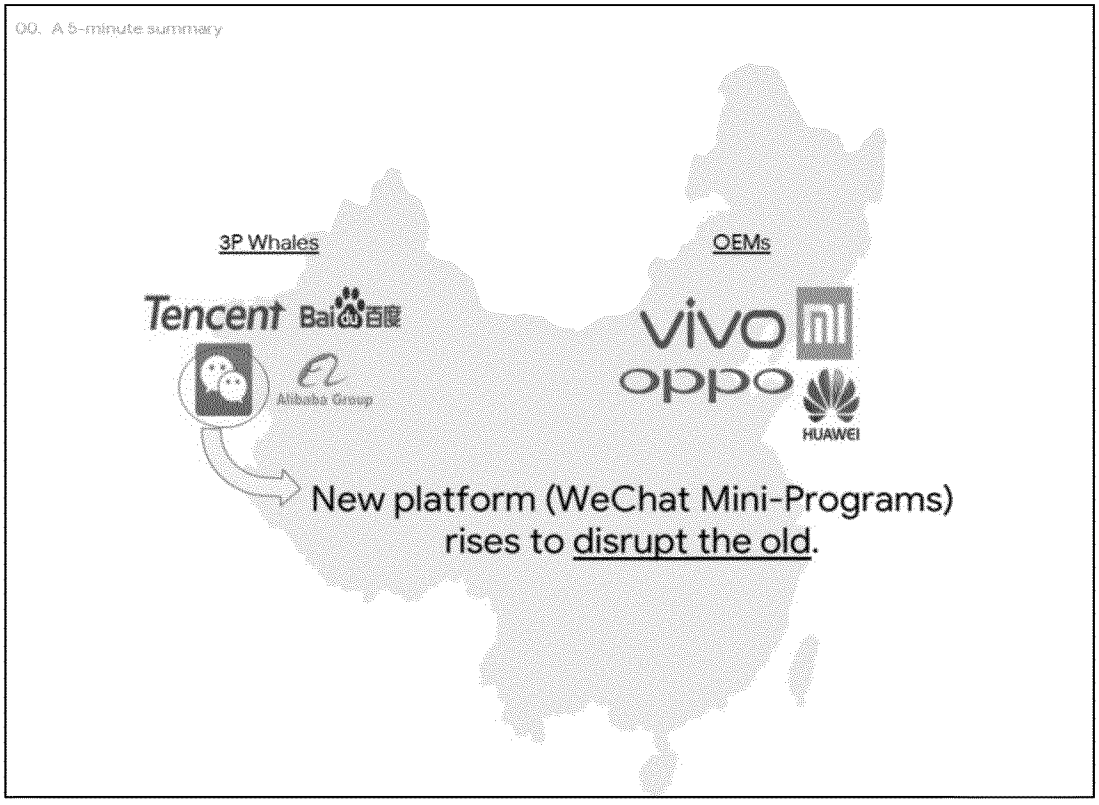

WeChat, with its huge user base (~100% user penetration in China), is the most likely candidate.
And they've launched Mini-Programs to do just that.

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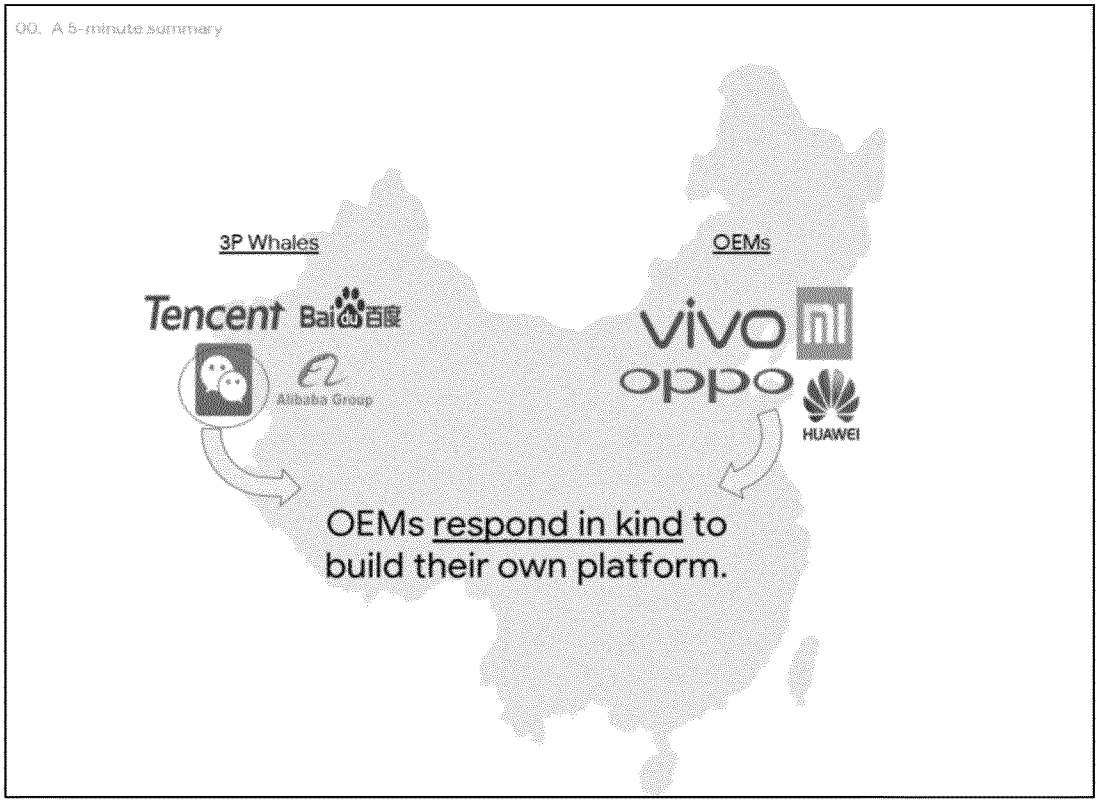

This is a shot across the bow for OEMs, and so they respond by building their own platform (QuickApps).

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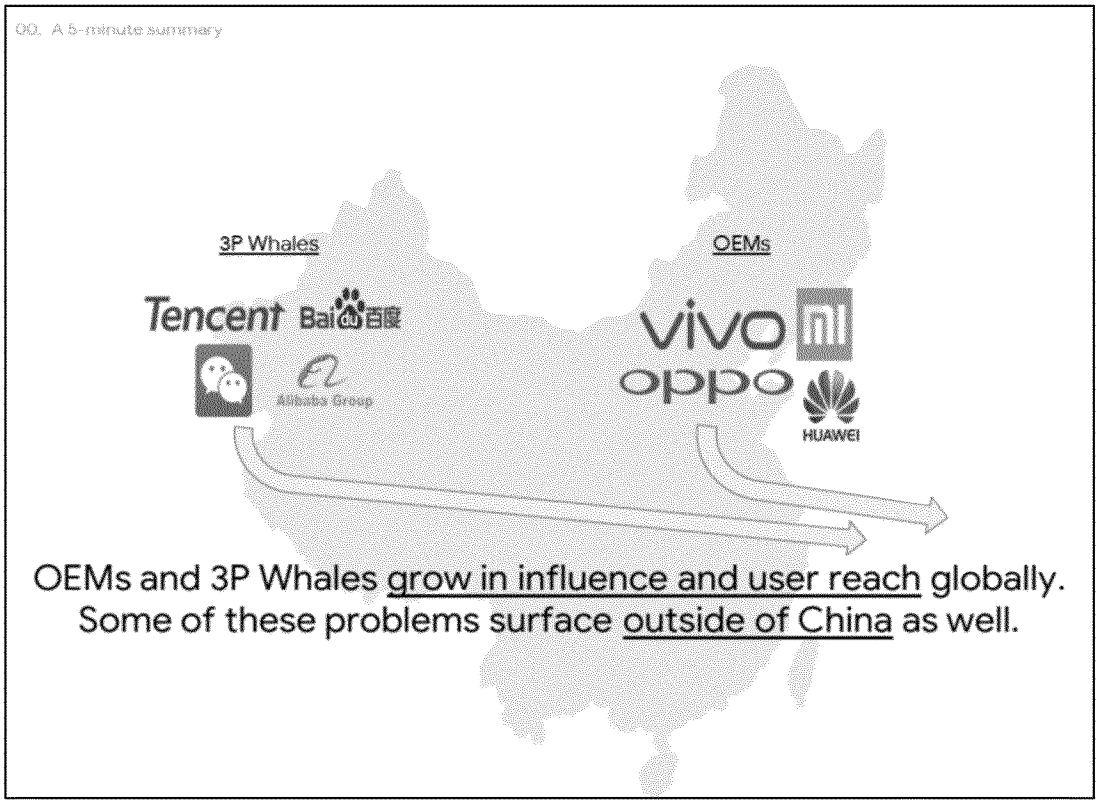

And this is the big one …. As both the 3P whales and the OEMs get bigger and sell more devices internationally, the issues that are typical in China also start showing up in international markets.

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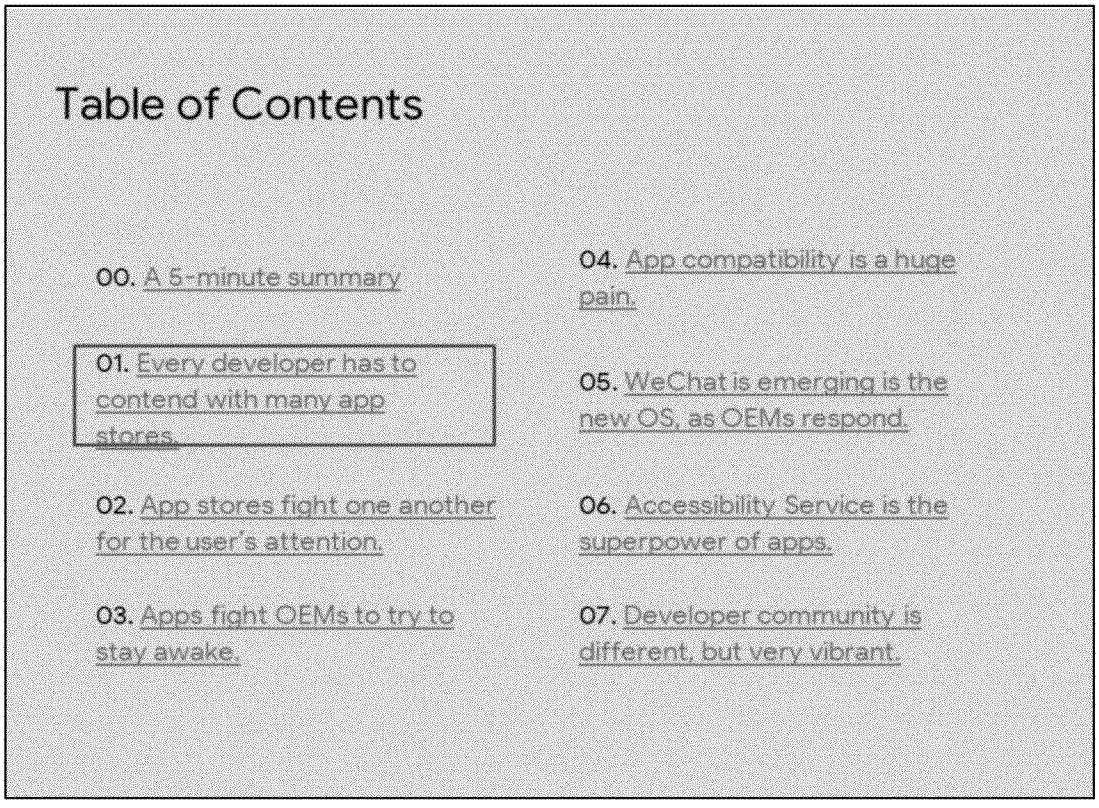

OK, on to the details.
Let's start with this - How do Android apps get distributed in China?
As you'll see, the problem here is that each developer has to contend with many, many stores.

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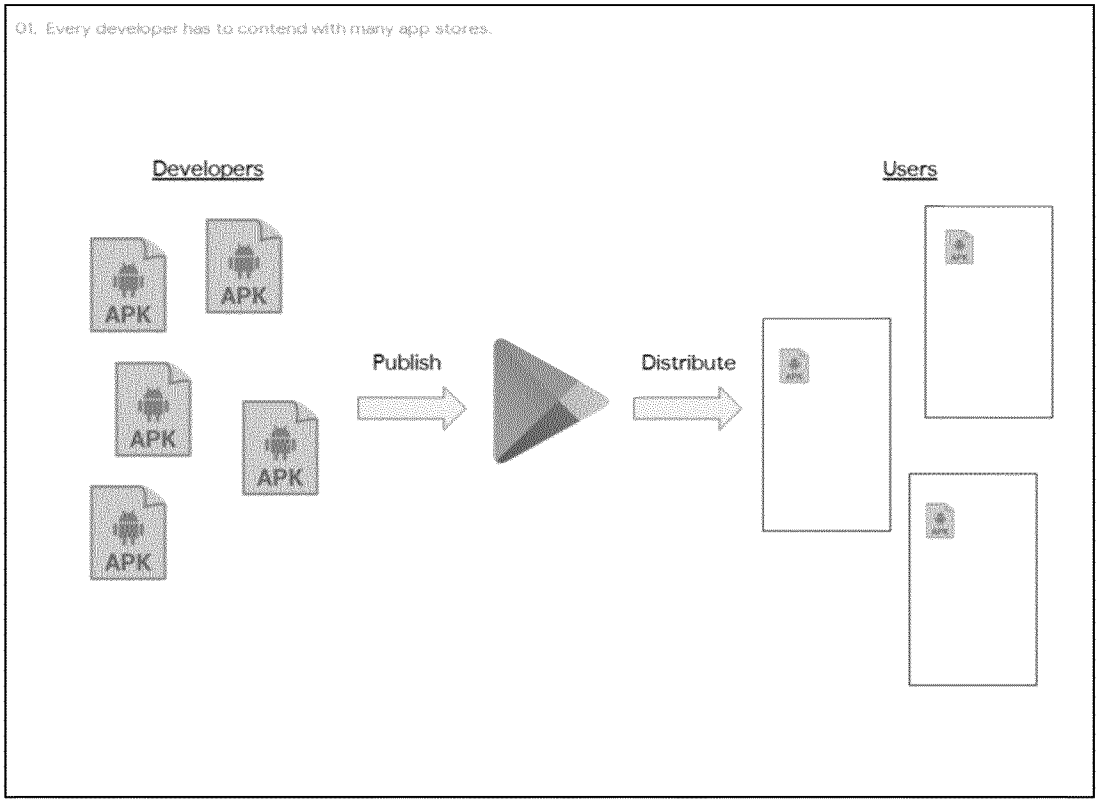

Outside of China, we know the mechanism through which apps end up on users' devices - it's the Play Store.
The Play store exerts a tremendous amount of control - how apps are distributed, how they are updated, how policy is enforced, etc.

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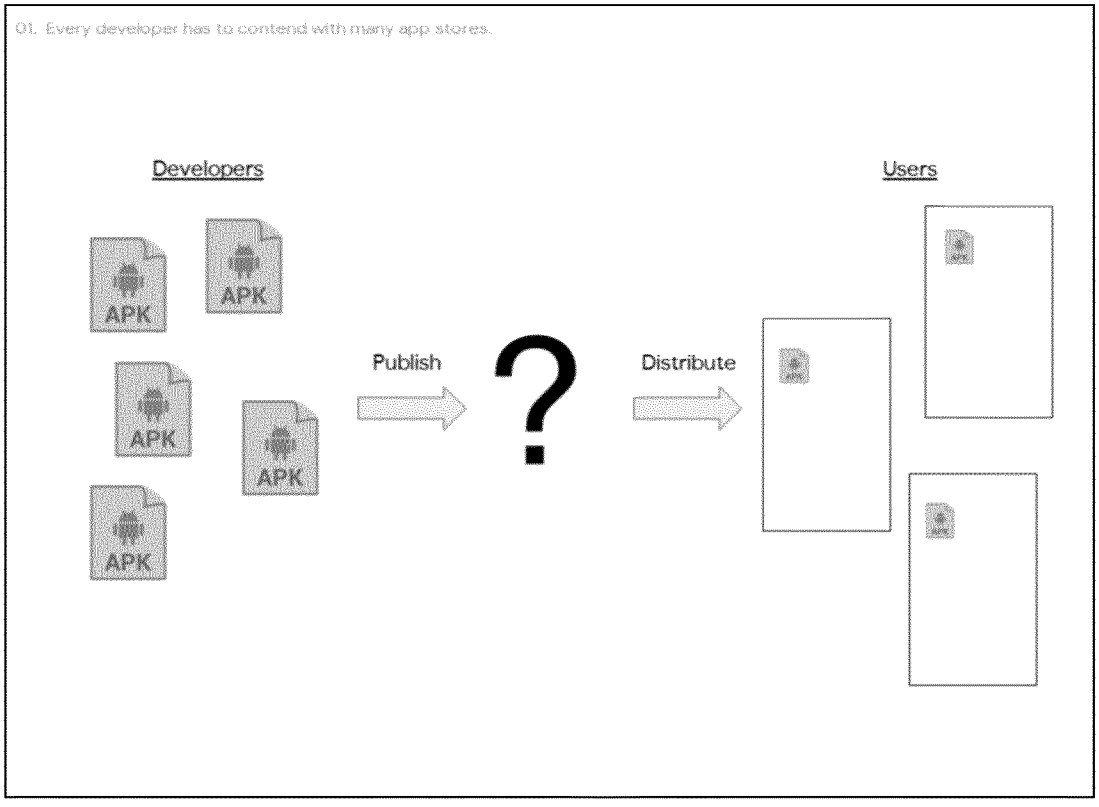

In China, the Play store does not exist, so there is an obvious power vacuum….
So who fills this gap?

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01. Every developer has to contend with many app stores.

Many Android app stores in China

- Consolidation is happening:
  - ~7500 in 2012
  - ~400 in 2015
  - ~200 in 2017
- There are ~100 that matter... and ~20 that really matter.

You might have heard that there are many Android app stores in China…. and that is true.
By and large, these app stores play the role of app distribution and app updates, just like you would expect.

The app store fragmentation is not THAT crazy though; despite there being hundreds to more than a thousand stores, consolidation is happening, and there are “only” ~20 that really have meaningful scale.

Now, nobody likes missing out. Every China app store obviously wants the richest app catalog possible….

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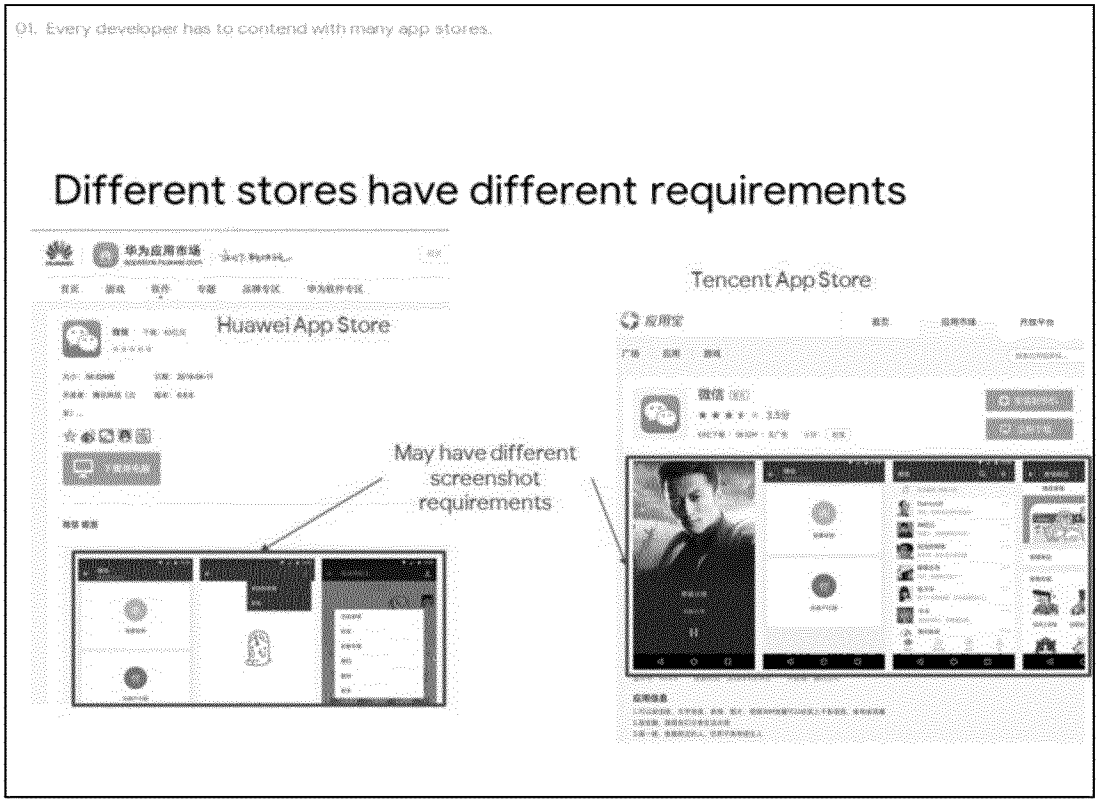

But you can already see the first problem - a developer is going to have a hard time keeping up with so many stores (even if they only care about the top 20).

In this example, just comparing 2 of the stores (Huawei store and Tencent store) and you can immediately see that screenshot requirements are a little different.

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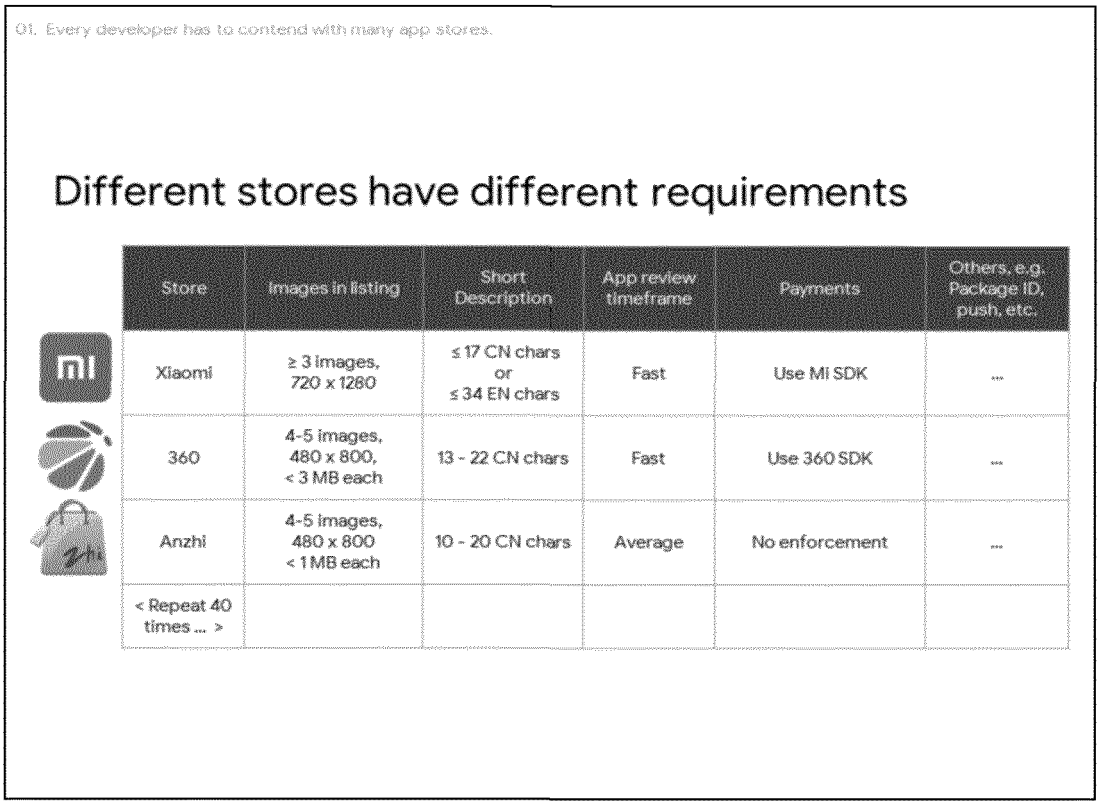

And of course, different stores have differences in their listing images, descriptions, app review timeframes, SDKs allowed (and not allowed), etc……

So if you're a top-10 store, developers might (and it's still only a "might") put in the work to publish to your store.

If you're in the long tail, then good luck with developers organically publishing there.

So how do stores try to keep the fullest catalog possible?

Sources:
https://my.oschina.net/wmy1988/blog/83965
https://blog.csdn.net/chenyufeng1991/article/details/48979459
https://www.zhihu.com/question/21281842
http://www.zesmob.com/blog/12139.html

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Id	Date	Text
1	07/20/2018 17:33:01	+micyeung@google.com in your research, have you come across info on Store dev console info, like what type of app health data they are serving to devs?

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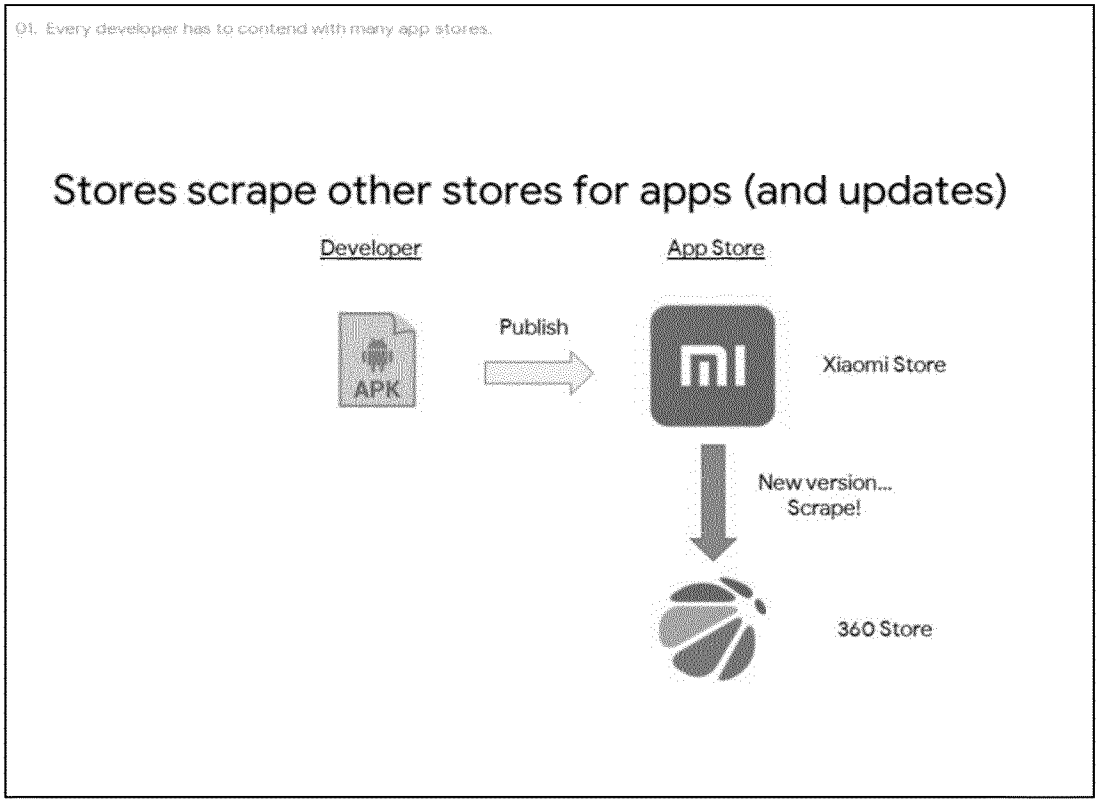

Answer:
Stores often scrape other stores for apps (and app updates).

They do so by comparing the version code of an app store with what they currently have in their own store;
if what they have is of an older version, they will grab the newer version'ed app and host that instead.

As an app developer, this means that once you publish a newer version of your app to a store, you lose a lot of control over how / where users actually get that app from…

Source: https://www.zhihu.com/question/22353976

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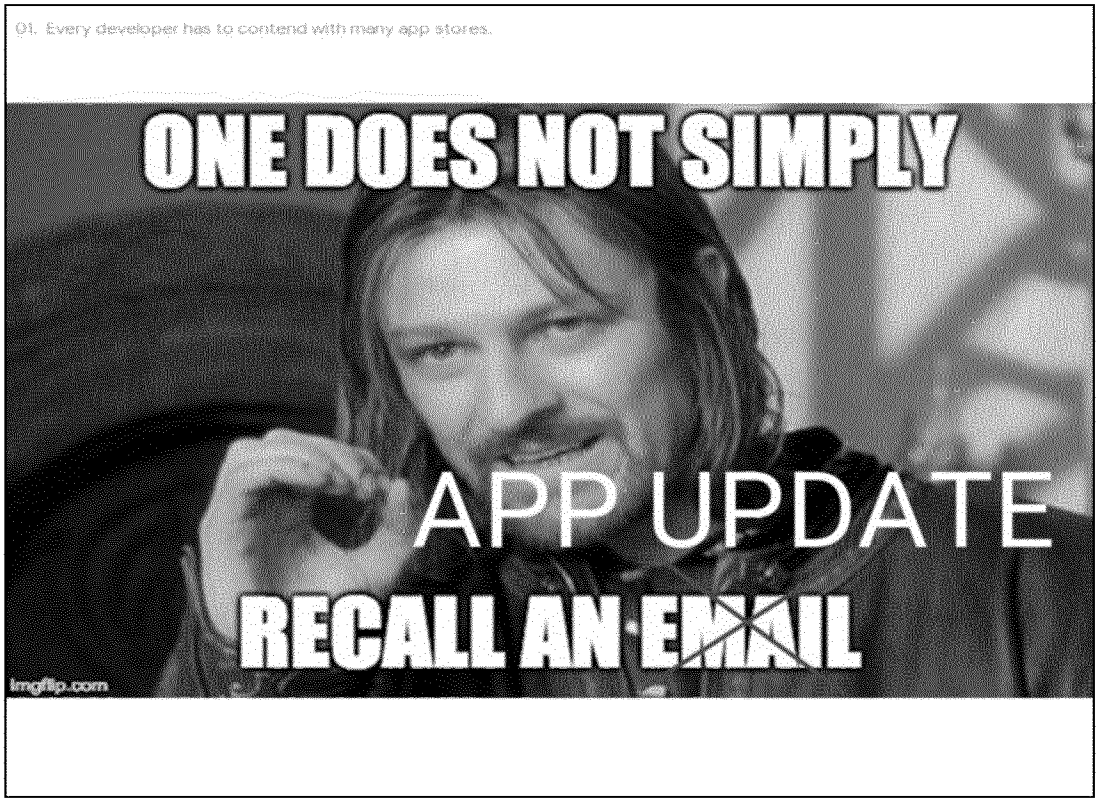

… and it's obviously not really possible to then fully recall the app update if it turns out there are critical bugs.
The app developer can push out further app updates to fix, but it's anyone's guess if that update will make its way to the end user.

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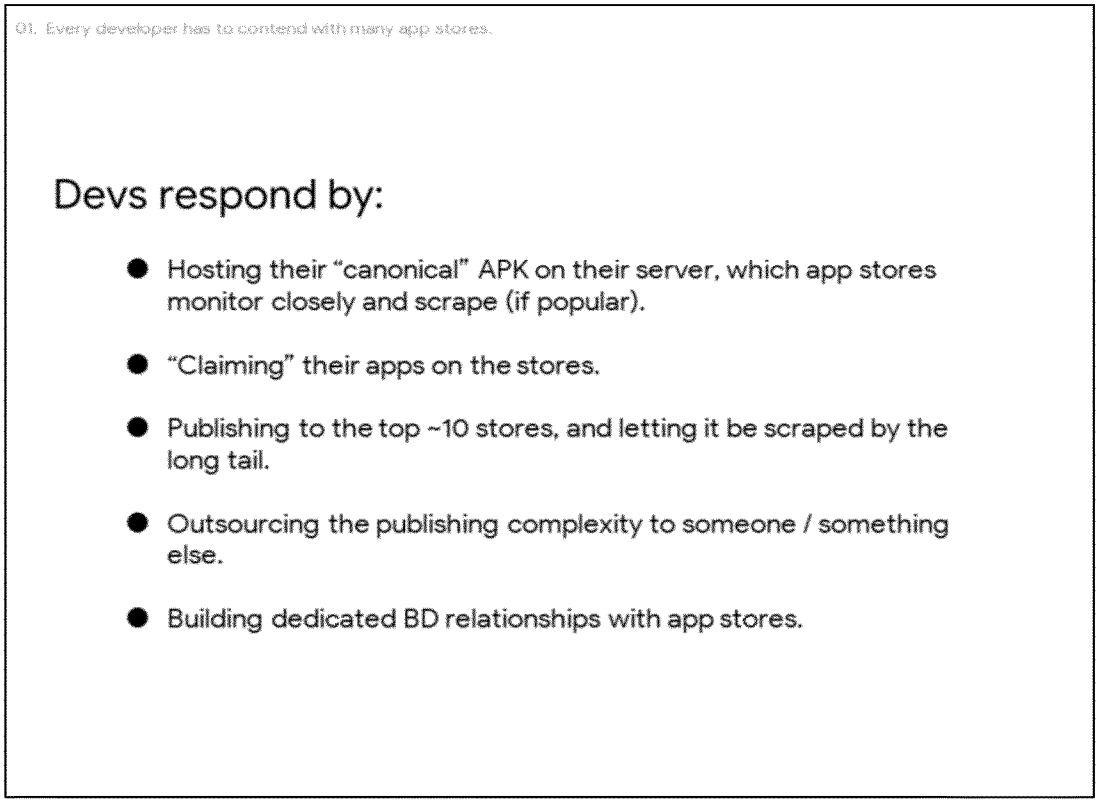

Now how do AiC devs mitigate this multi-store situation, where stores are out there scraping apps?

There are a few ways…. Let's walk through that one by one.

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01. Every developer has to contend with many app stores.

Devs respond by:

- Hosting their "canonical" APK on their server, which app stores monitor closely and scrape (if popular).
- "Claiming" their apps on the stores.
- Publishing to the top ~10 stores, and letting it be scraped by the long tail.
- Outsourcing the publishing complexity to someone / something else.
- Building dedicated BD relationships with app stores.

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Almost every major app out there maintains a website with their APK download link, which is their way of saying what their “source of truth” is.
(This example screenshot shows UC Browser’s website, but the same goes for every other major app).

Website downloads typically do not drive a ton of traffic by themselves; however, app stores are known to also monitor these websites for updates.

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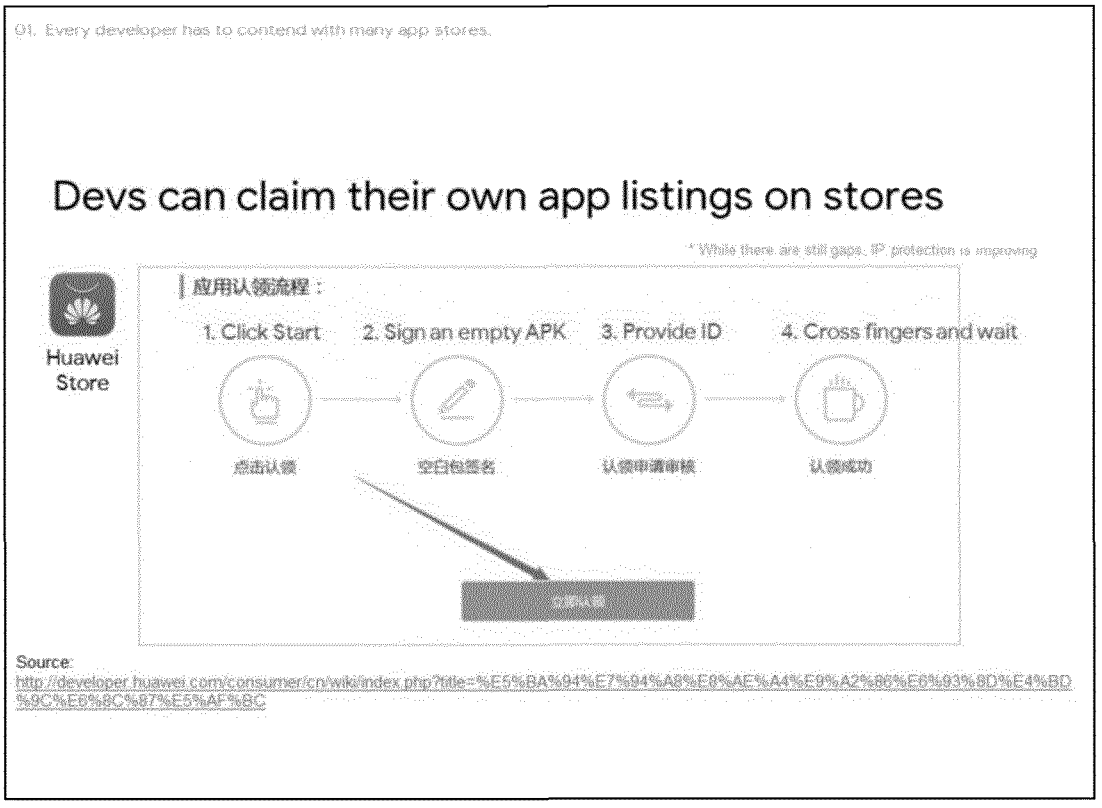

And most app stores provide a way for devs to claim an existing listing (e.g. if the store has previously scraped your APK from somewhere else) as your own.

It's fairly straightforward - they give you an empty APK, you sign it, and then upload it back to the store along with some proof of your ID. In a few days, the listing is officially yours. (The UX flow shown here is for Huawei store, but most other stores are also fairly similar).

There are anecdotes of some stores asking the dev for really weird proof, like providing 20 lines of their source code.

Other links:
https://open.oppomobile.com/wiki/doc#id=10002
https://www.zhihu.com/question/21281842
http://wiki.open.qq.com/wiki/%E5%BA%94%E7%94%A8%E8%AE%A4%E9%A2%86

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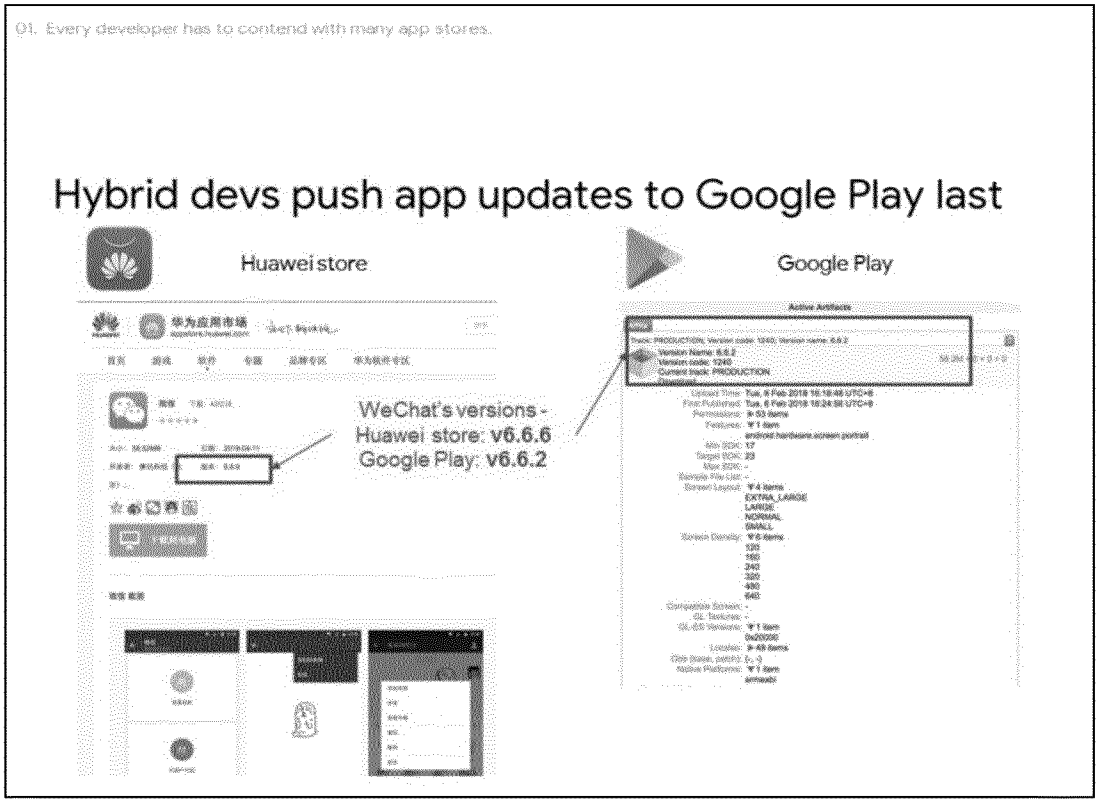

Because Play does not scrape other stores, a developer building for both CN and RoW (i.e. a “hybrid developer”) needs to make sure they get their version ordering correct. Specifically, developers have to publish to Play last, otherwise the APK will end up on Chinese stores.

Version ordering matters here especially if the developer has a feature that is just for non-CN users.

True story - WeChat launched a feature in ~early 2017 called “WeChat Out”, which is a way for non-CN users to pay to call a phone number (similar to Google Voice). When WeChat launched this, they messed up their version ordering..... and this feature began showing up on CN users' phones.

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01. Every developer has to contend with many app stores.

Some devs choose to outsource app publishing

- 3P publishing tool Kuchuan (酷传) publishes to 30+ stores.
- Services like AppPark (应用公园) offer app publishing advice and services for a fee.

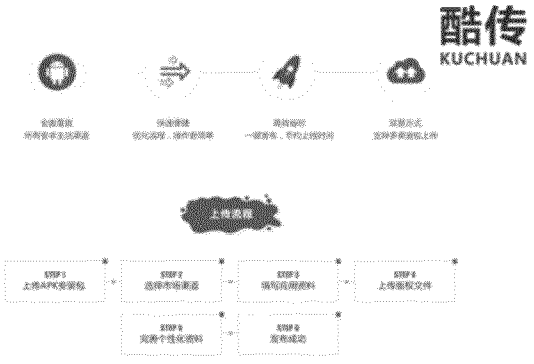

Image Source: http://www.kuchuan.com/toPublish

All this complexity means that some devs prefer to just let someone else, or something else, handle it.

3P tools like Kuchuan has seen rather rapid adoption.
In 2014 (2 years after launch), they:
had ~50K developers on the platform,
claim to make up 50% of all app uploads in AiC.
Devs upload the APK (or APKs, if some stores require specifically customized ones), pick the stores that they want to publish to (30+ stores are available), fill in customization metadata per store, optionally select meta-data tags to edit in the manifest (e.g. different analytics tag for each store), and they'll sign / modify / publish on your behalf.

Other services like AppPark (http://www.apppark.cn/) offer app publishing services for developers who want to outsource this complexity.

http://www.pingwest.com/demo/coolchuan-developer-s-distribution-channels/
https://www.v2ex.com/t/231207
https://blog.csdn.net/u013758961/article/details/23815755

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01. Every developer has to contend with many app stores.

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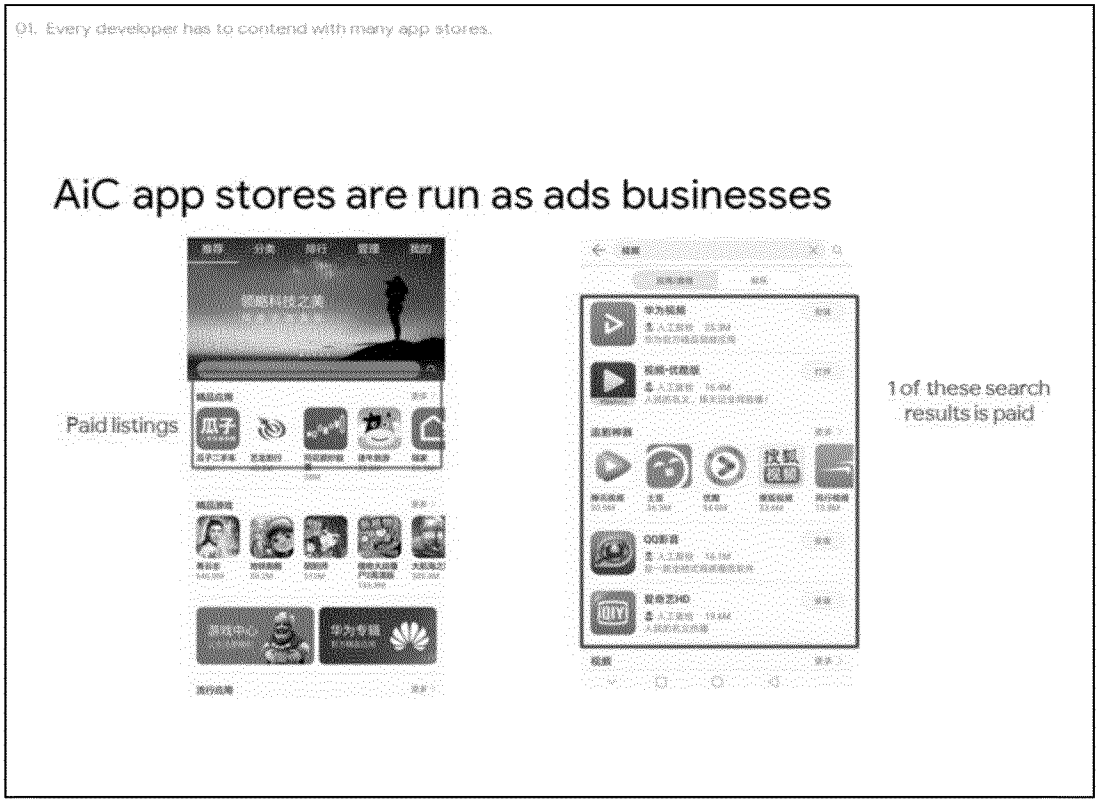

And stores are largely run as ads businesses, instead of just as a merchandising hub as we think about it in Play. There are many spots in stores that devs can pay for for prime placement. Typical paid spots (by keyword auction) include:
Splash screen on launch
Front page - top carousel
Category pages - top carousels
1 out of 4 (or 5) search results

Some (e.g. Xiaomi) might sometimes denote these as ads, but many do not.

This is NOT possible on Play (not without a clear note that something is an Ad) ; AiC developers are typically shocked when they hear that Play does not really offer such a thing (and vice versa for non-AiC developers when they hear about AiC).

http://developer.huawei.com/consumer/cn/devservice/doc/60201
https://dev.mi.com/doc/p=1196/index.html
http://www.zesmob.com/ideas/36525.htm
https://www.jianshu.com/p/829688053b48l

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01. Every developer has to contend with many app stores.

BD relationship between devs and stores go beyond

Benefits of forming partnerships include:

- Exclusivity on a store
- Offline promotions
- More favorable revenue split rates
- Faster review times
- etc.

Custom theme for an app

Push notification promotion from store

In Play, BD relationships with developers do not involve money changing hands, and do not involve the Play Store doing special customizations.

In China stores, pretty much anything goes - stores showing push notifications to users for certain apps, faster review times, customized themes for an app listing, etc. Many of these would be unthinkable on Play.

Stores (and 3P webpages) also explicitly list app store contacts for developers to reach out. Check out the long list of contacts here and here that someone can call if they want to talk to a BD person from the app store.

http://developer.huawei.com/consumer/cn/devservice/doc/60801
https://dev.mi.com/doc/p=7991/index.html

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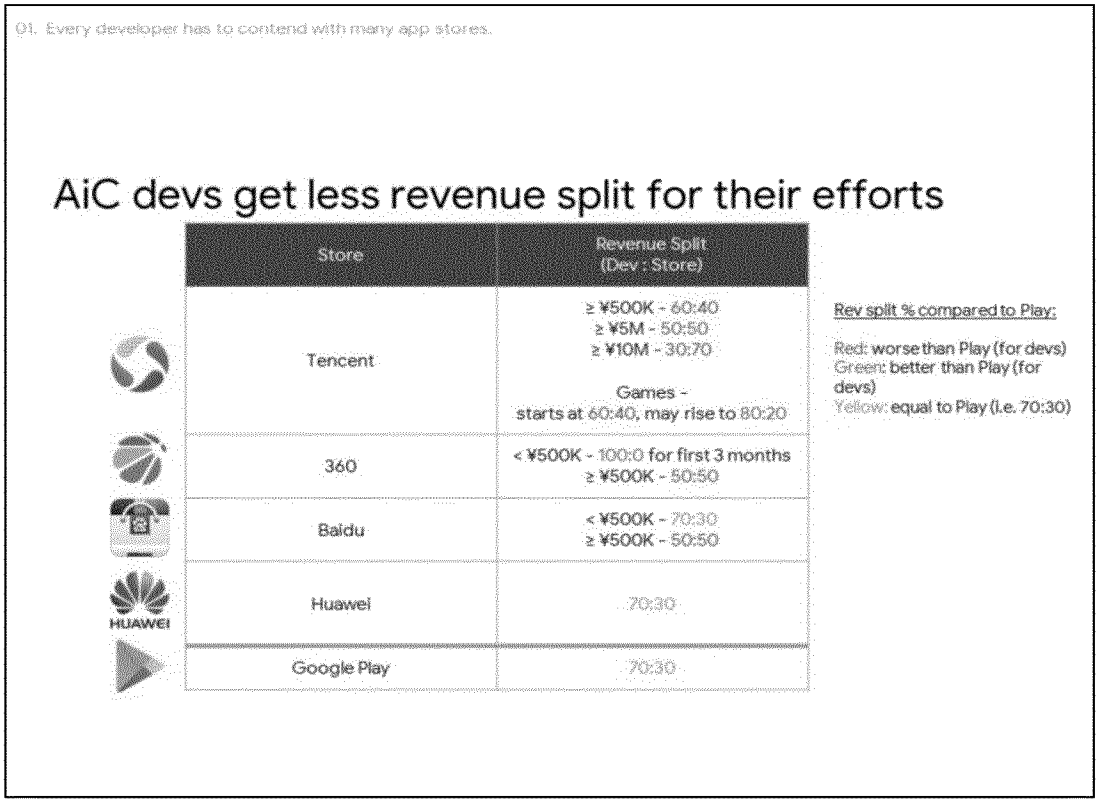

For all the work that developers do to get their app onto different stores, on many stores they often do not get as favorable share of rev split as they do on Play (or iOS app store).
It used to be a 30:70 split (devs get only 30%(!!)) pretty much across all AiC app stores, but since then the trend has moved towards giving devs a more favorable split, though as you can see from the table above in many cases it's still trailing Play.

(As a reminder: On Play, the developer : store split for IAP is 70:30)

http://www.youxituoluo.com/23937.html
http://m.jiemian.com/article/872781.html
http://developer.huawei.com/consumer/cn/wiki/index.php?title=%E4%BB%98%E8%B4%B9%E5%BA%94%E7%94%A8%E6%94%AF%E4%BB%98%E6%B8%A0%E9%81%93%E6%89%8B%E7%BB%AD%E8%B4%B9%E5%8F%8A%E6%94%B6%E7%9B%8A%E5%88%86%E6%88%90%E8%AF%B4%E6%98%8E
http://m.kdnet.net/share-12296463.html
http://wiki.open.qq.com/wiki/%E8%BF%90%E8%90%A5%E6%B4%BB%E5%8A%A8%E9%85%8D%E7%BD%AE%E6%8C%87%E5%BC%95
http://www.xinhuanet.com/tech/2015-03/19/c_127598526.htm

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Id	Date	Text
2	05/02/2018 15:14:31	Yea this slide is too simple, TODO.
3	06/22/2018 10:05:50	Hey Zhuo , I don't think I quite have the handle on what the narrative is between app store, publishing agency, gamers union, etc. in the revenue splitting world for gaming. 1) can you quickly educate me? 2) I'm wondering if it makes sense to just say have a msg that "games is more complicated", or have a separate slide, etc. what do you think?
2	06/25/2018 08:26:19	Splitting between App Store, Publishing Agency, Gamers Union, and Developers.
3	06/25/2018 08:26:19	+jzfan@google.com our games DA must have more insights on this. 1. My partner LeBian provides dynamic resource splitting service to game developers, and shared me a doc on this topic: https://drive.google.com/open?id=17DOECU4uu-m44TPFKbdQSt_twGKI7HUI. We can chat about it when I'm in HK on this Wed. :) 2. Saying "games is more complicated" SGTM. In fact you are talking about game store v.s. developer here, where game store could take ~50%. However developer gets the last piece of cake AFTER other channels (promotion, game union, payment, etc) getting their splits, and eventually developer often end up only getting a single digit percentage. Quoting from the above doc "CP反馈实际能拿到8%~10%的流水已经算不错了。"
4	06/27/2018 01:52:22	I guess my main point is: game devs only get the "last" piece of revenue split (after app store, payment channel, game union, publishing agency, etc), so it's not relevant to merely measure "dev:store" ratio here.
1	06/27/2018 02:52:29	+leizh@google.com is it safe for me to request access to that preso? Huawei info is from http://developer.huawei.com/consumer/cn/wiki/index.php?title=%E4%BB%98%E8%B4%B9%E5%BA%94%E7%94%A8%E6%94%AF%E4%BB%98%E6%B8%A0%E9%81%93%E6%89%8B%E7%BB%AD%E8%B4%B9%E5%8F%8A%E6%94%B6%E7%9B%8A%E5%88%86%E6%88%90%E8%AF%B4%E6%98%8E
1	06/29/2018 06:21:58	yea.. heard about the 50/50 split. The idea is that stores will help with promos. The supposed increase in exposure compensates the lower share for devs. Though I haven't seen these figures published on official sites.

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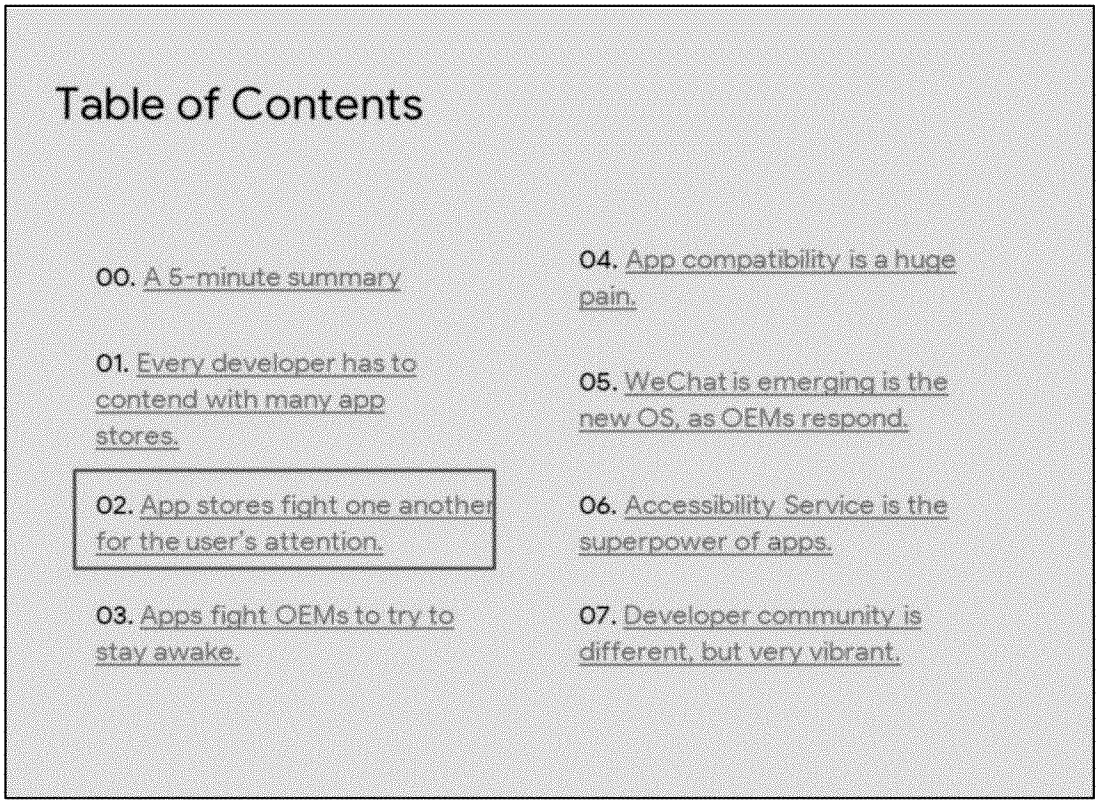

That's a lot of work for developers…. But how about the stores themselves?
What are the dynamics between the stores?
And how is app discovery in AiC app stores different from Google Play?

As you'll see, as app stores fight among themselves to be the user's store-of-choice, user experience suffers.

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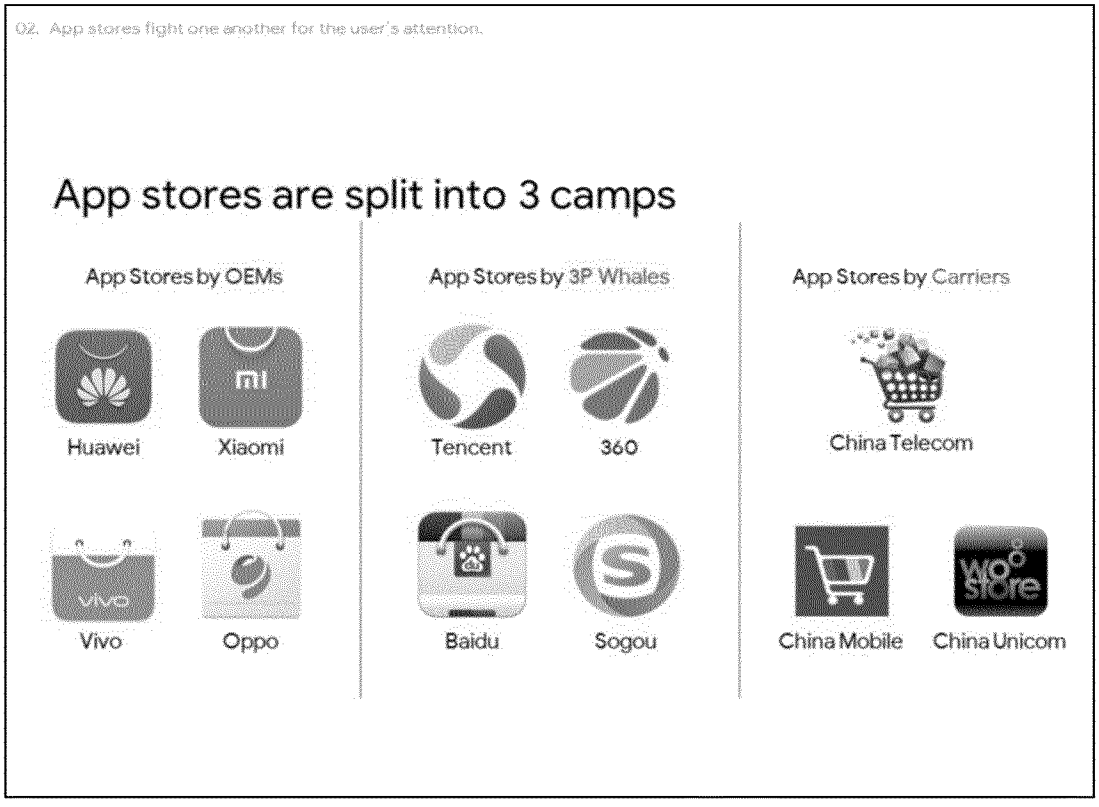

What might not be obvious are the characteristics of these app stores.

They mainly fall into 3 buckets - OEMs, and 3P Whales, and Carriers.

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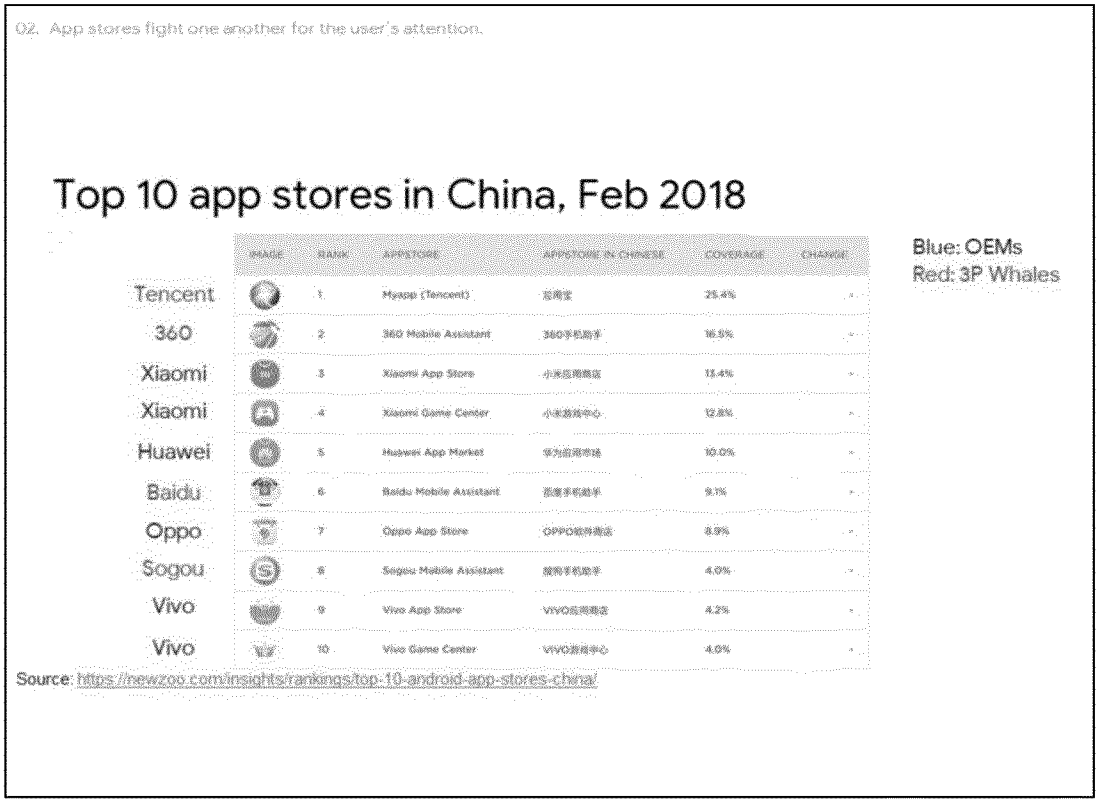

These are the top 10 app stores in China in Feb 2018. You can see that they are dominated by one of 2 buckets - 3P whales and OEMs.
There are also smaller 3P app stores, but they are getting squeezed out.

Note: “coverage” in the table = “active users / all users”.
The definition of "active users" is a lil fuzzy (unclear if it's DA or MA), but should be sufficient for this slide's purposes.

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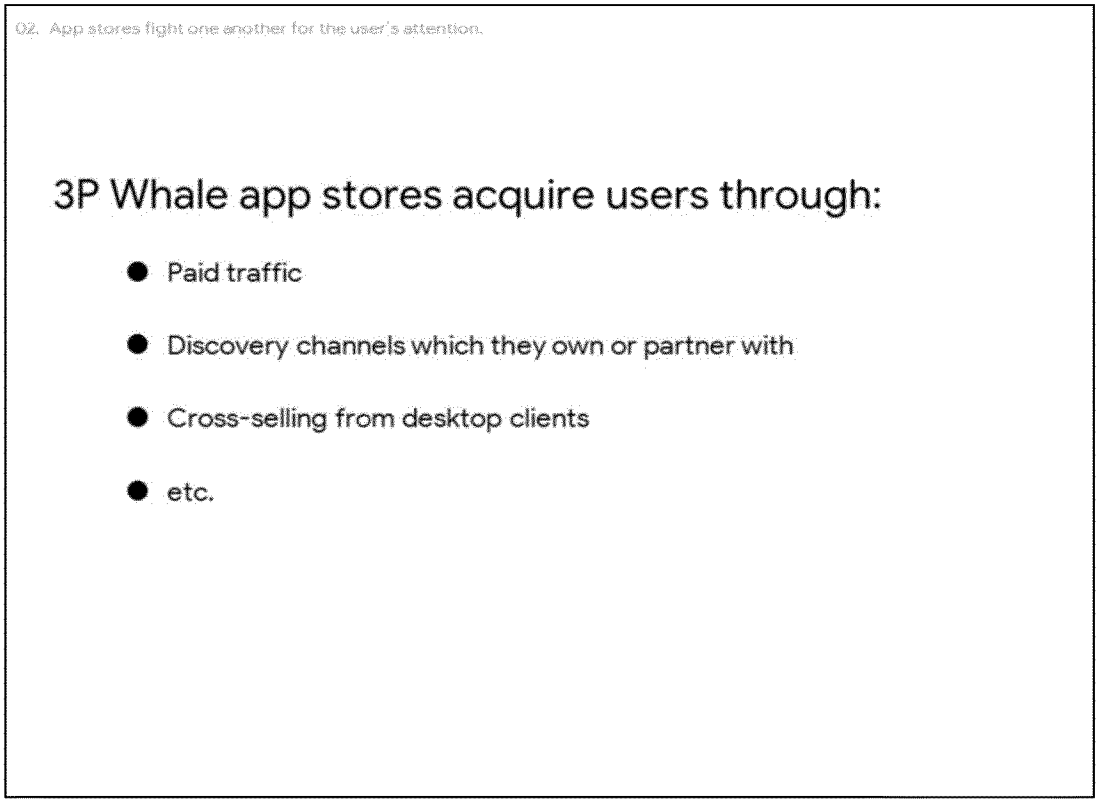

Without the ability to be pre-installed on devices (unlike OEM stores), 3P app stores have to figure out other means to get on a user's device.
How do they do that?

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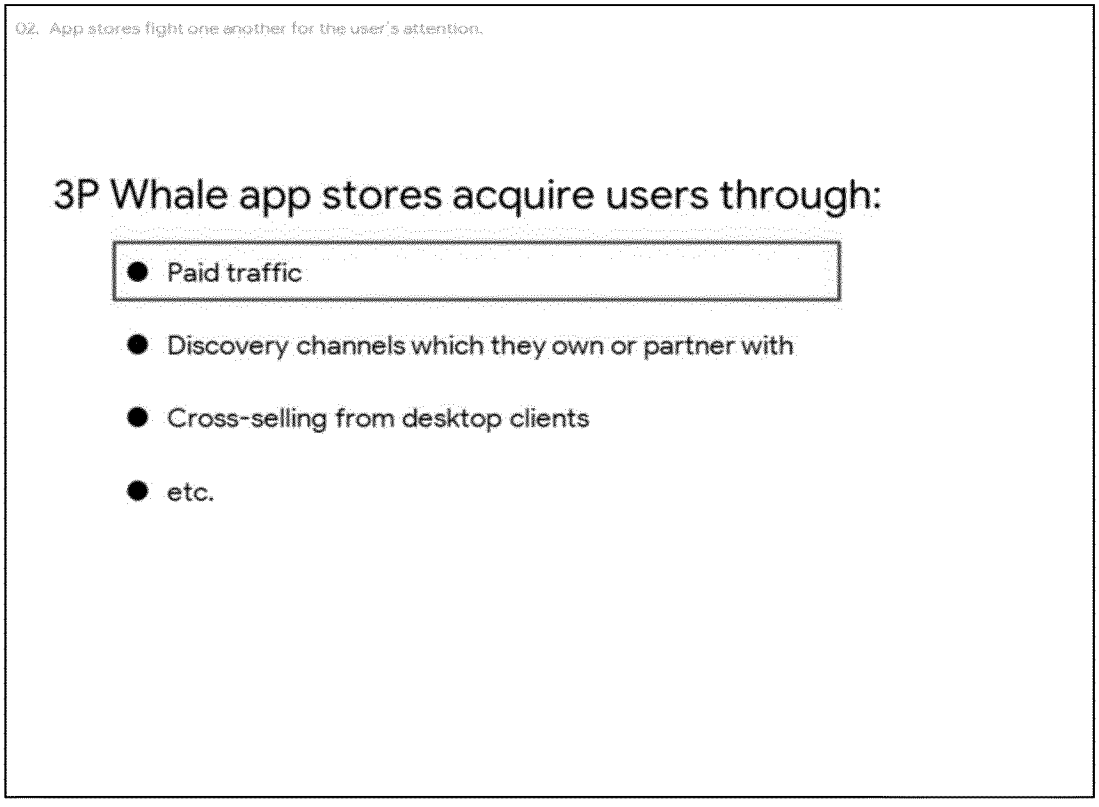

The first is just through organic / paid means.
We don't frequently hear of 3P app stores buying Google search traffic (through ads) to market themselves, primarily because of Play's dominance.
This practice is SUPER COMMON in China, where they are all fighting for users.

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This is what a typical search result for the query "Assistant（助手）" looks like. The first 3 results are paid results for 3P app stores. Altogether, the first 8 are all results for 3P app stores.

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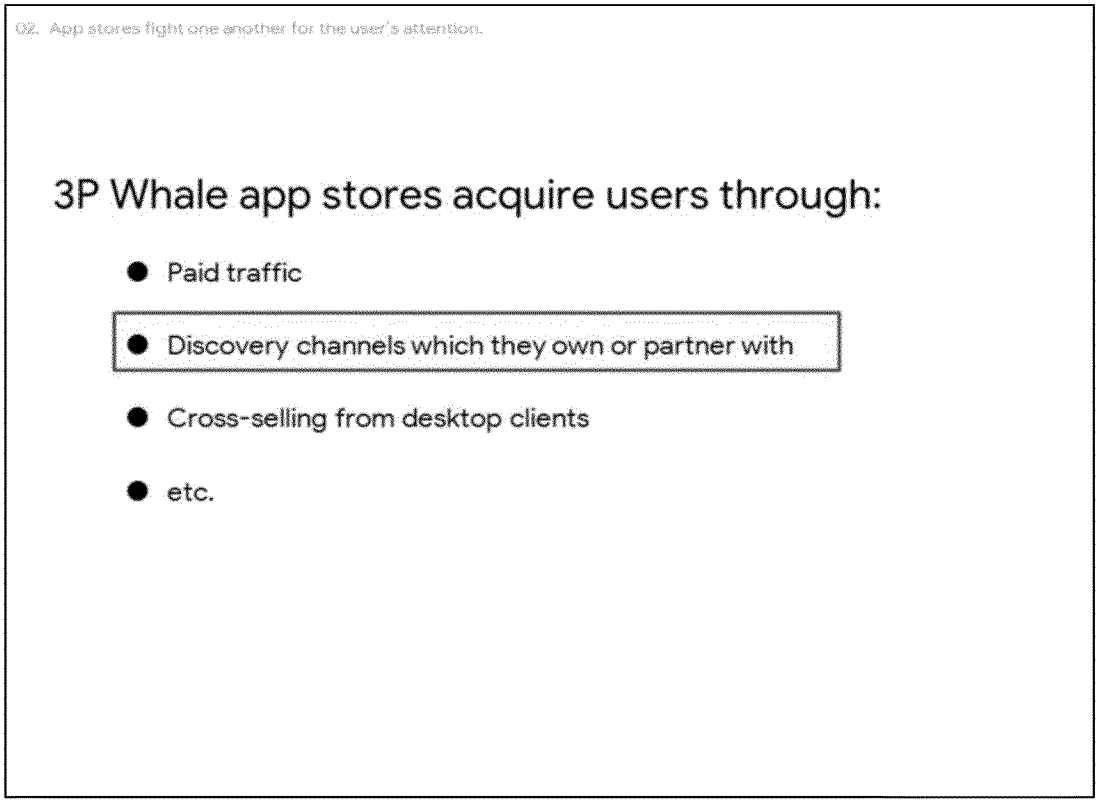

3P whales, being whales, means that they are more than just a one-(store) pony. They are large corporations that have businesses (or invested in businesses) in discovery channels, e.g. browsers and search channels.

They leverage these channels to cross-sell their own app stores.

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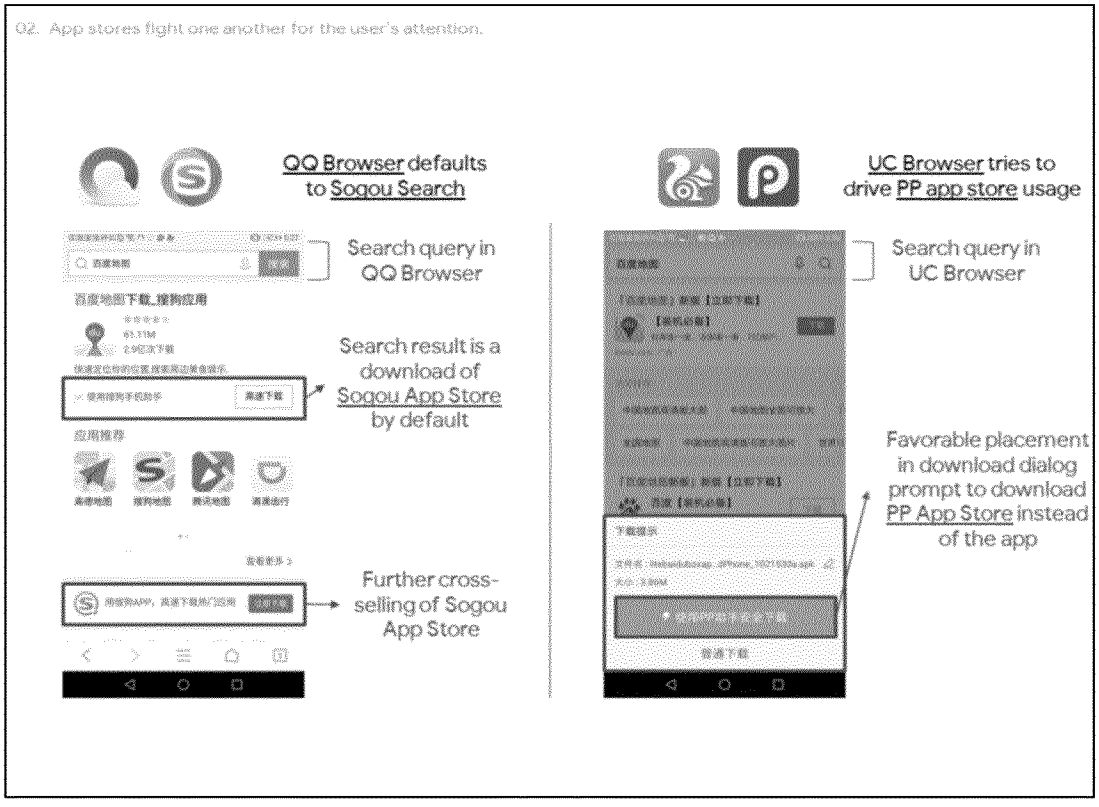

Here are 2 examples.

QQ Browser's default search engine is Sogou Search (Tencent builds QQ Browser, and owns 44% of Sogou).
Search results that would have led to APK downloads might instead lead to a download of Sogou App Store instead, where users are then encouraged to continue their app download and user engagement there.

Alibaba owns both UC Browser and PP App Store.
Search results in UC Browser lead to prominent CTA to download the PP App store instead.

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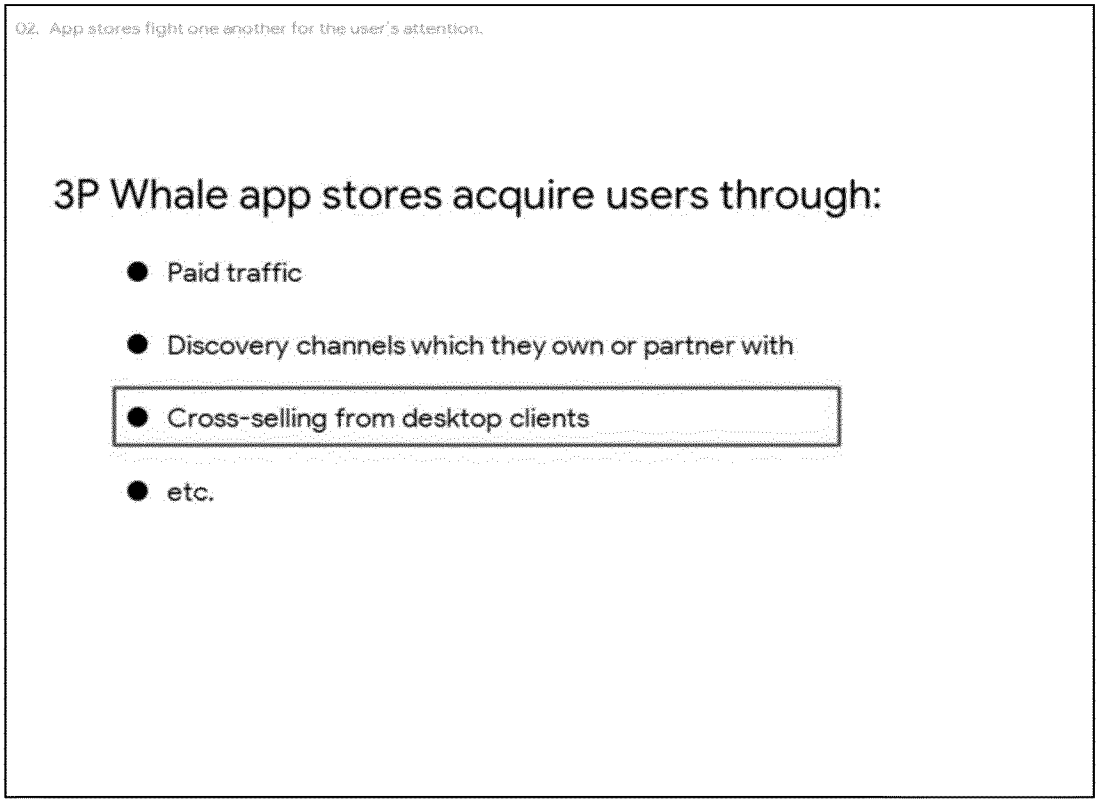

3P whales app stores also frequently have a desktop client counterpart. It acts similarly to iTunes on macOS - it coordinates the installation of an APK onto an Android device that's plugged in to the desktop machine. On top of that, it's also an effective way to install the mobile app store onto the user's device.

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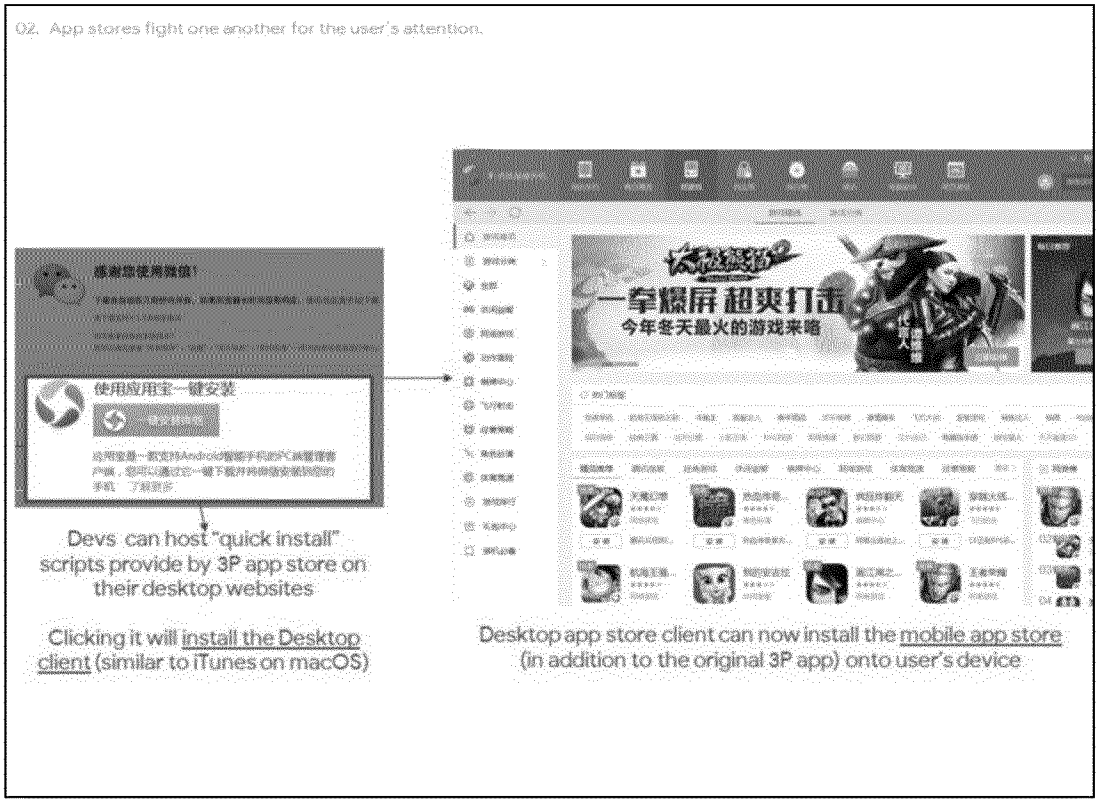

This is an example from Tencent store.

A developer can generate a “quick install script” from Tencent app store, which they then host on their desktop website as a button as a CTA for users to click on and download.
Clicking it will install the Tencent app store desktop client onto the user’s machine, which now manages the user’s app installation onto their mobile device.

In addition, this also triggers the installation of the mobile app store onto the user’s device, which grows the store’s user footprint.

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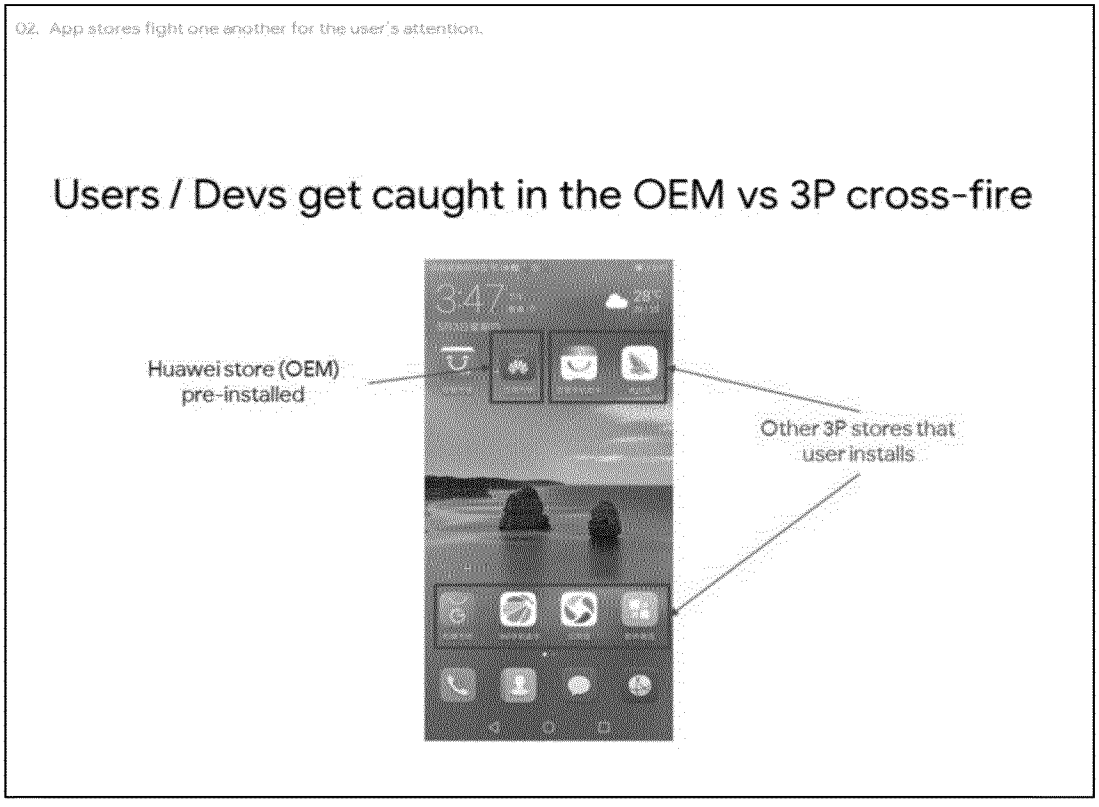

This is an exaggerated view of what you might see on a user's phone - i.e. multiple stores on one phone.

OEM stores (e.g. Huawei store) are pre-installed (on a Huawei phone), and the user may also download and install other 3P stores.
The key dynamic here is that… and the OEM wields A LOT of power (by virtue of being the device manufacturer) to favor its own store, while 3P stores think of various ways to grab a piece of the user engagement pie.

The next logical question is…. How is user experience affected by this?

http://news.zdwang.com/a/201607/0222721.html

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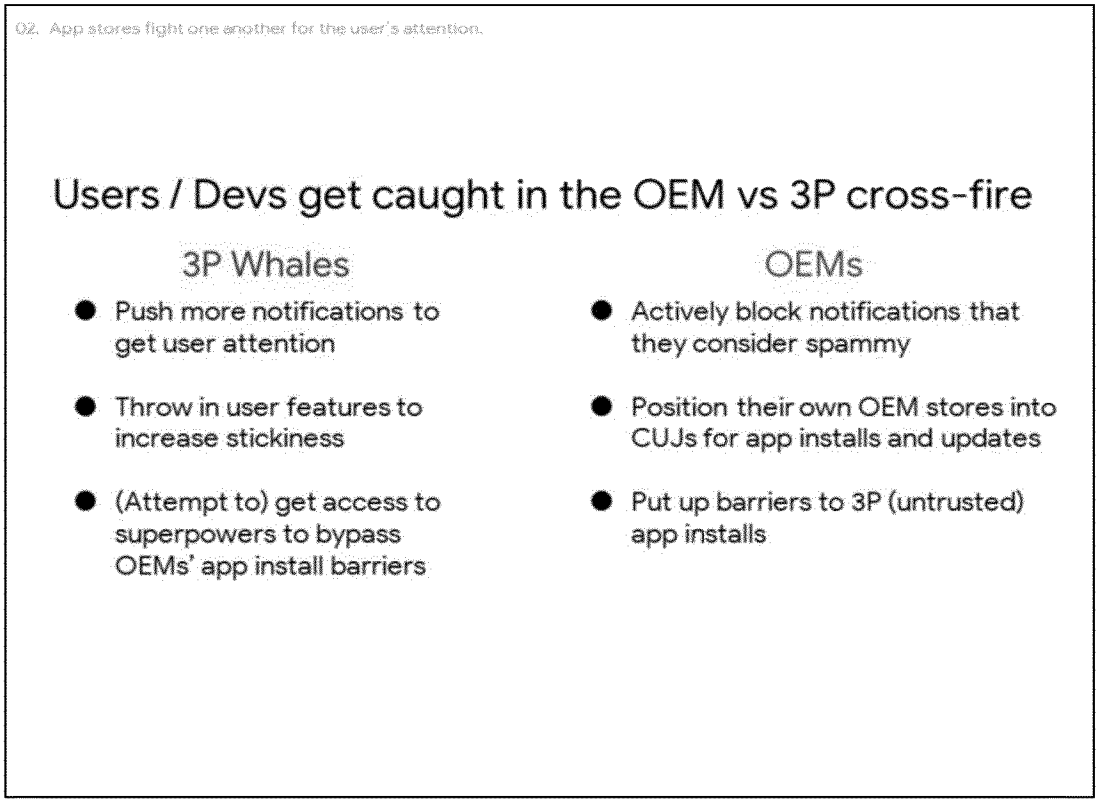

Here are just some ways in which this battle is manifested for devs and users. Looking through them one by one….

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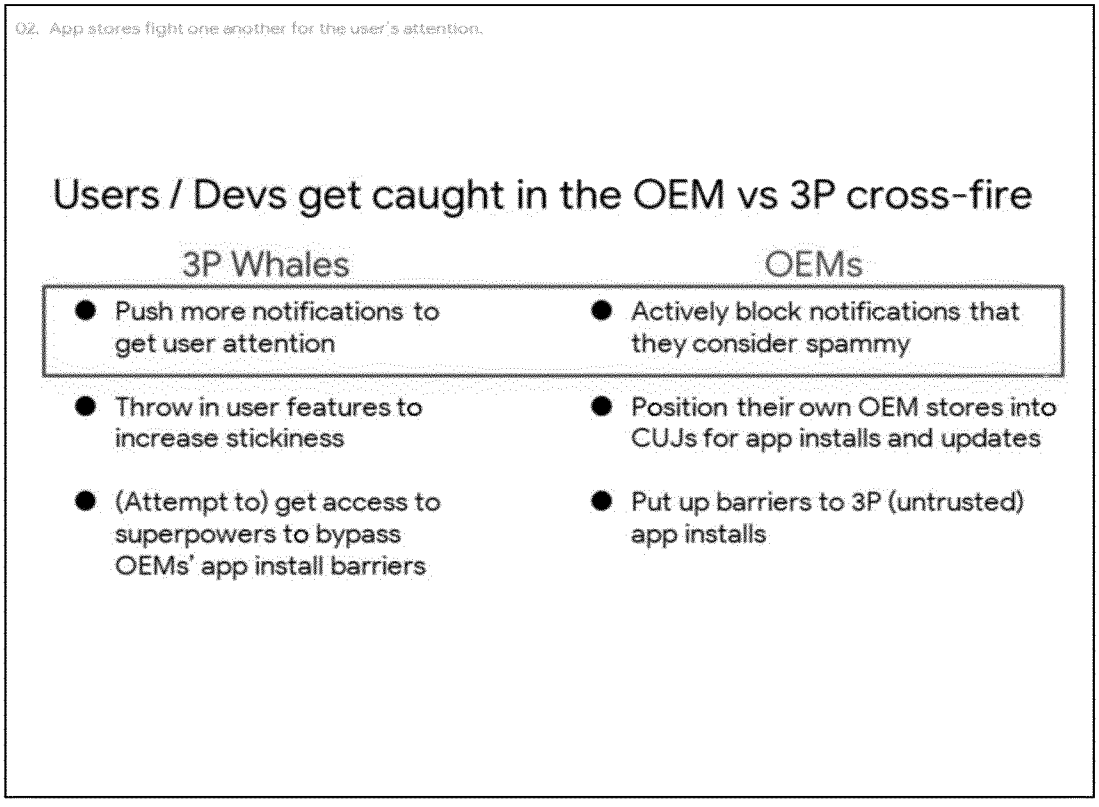

3P stores try to constantly use notifications, or set persistent notifications, in an attempt to get the users to engage.

OEMs obviously hate this (after all, they don't want these stores running foreground services and flooding the precious real estate on the notification panel), so they might actively block such notifications.

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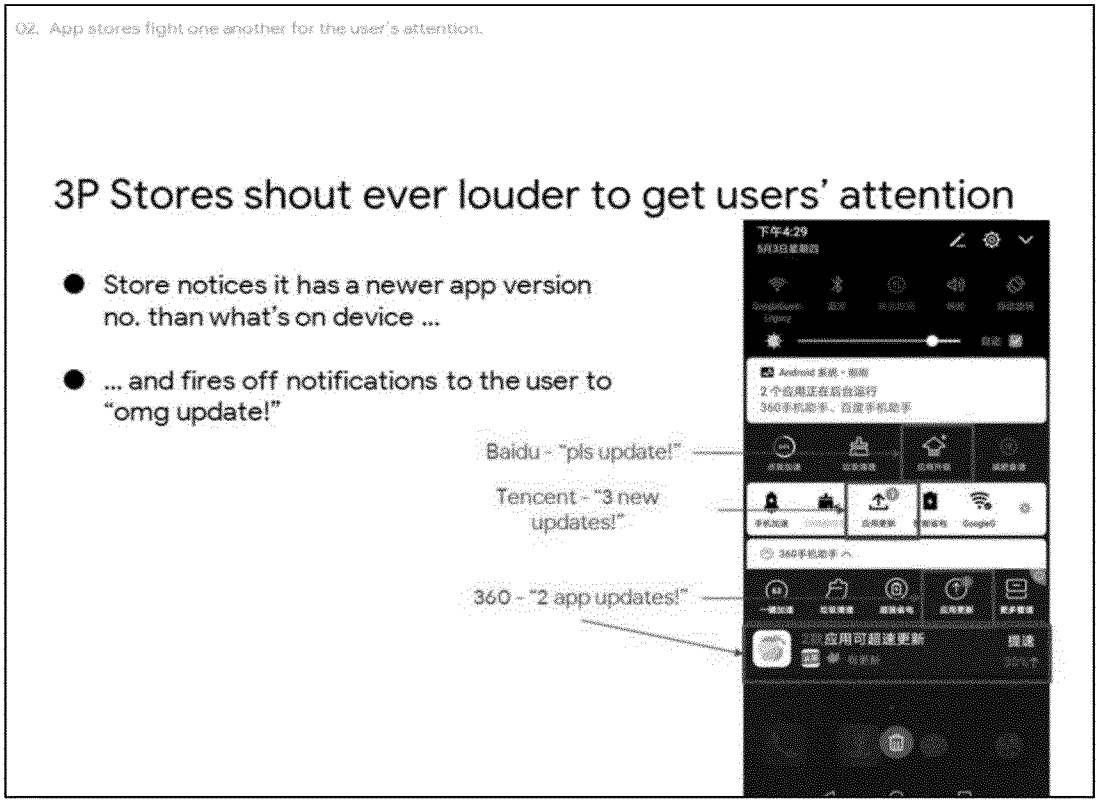

Here's a screenshot of what your phone would look like after you download a few 3P stores.

Each one of them (in this case, Baidu store, Tencent store, and 360 store) maintains its own persistent notification, and they also consistently monitor the app versions on device and matches that to see if they have a newer version in their catalog. If they do, it is a mad rush towards prompting the user to "zomg click me to update!"

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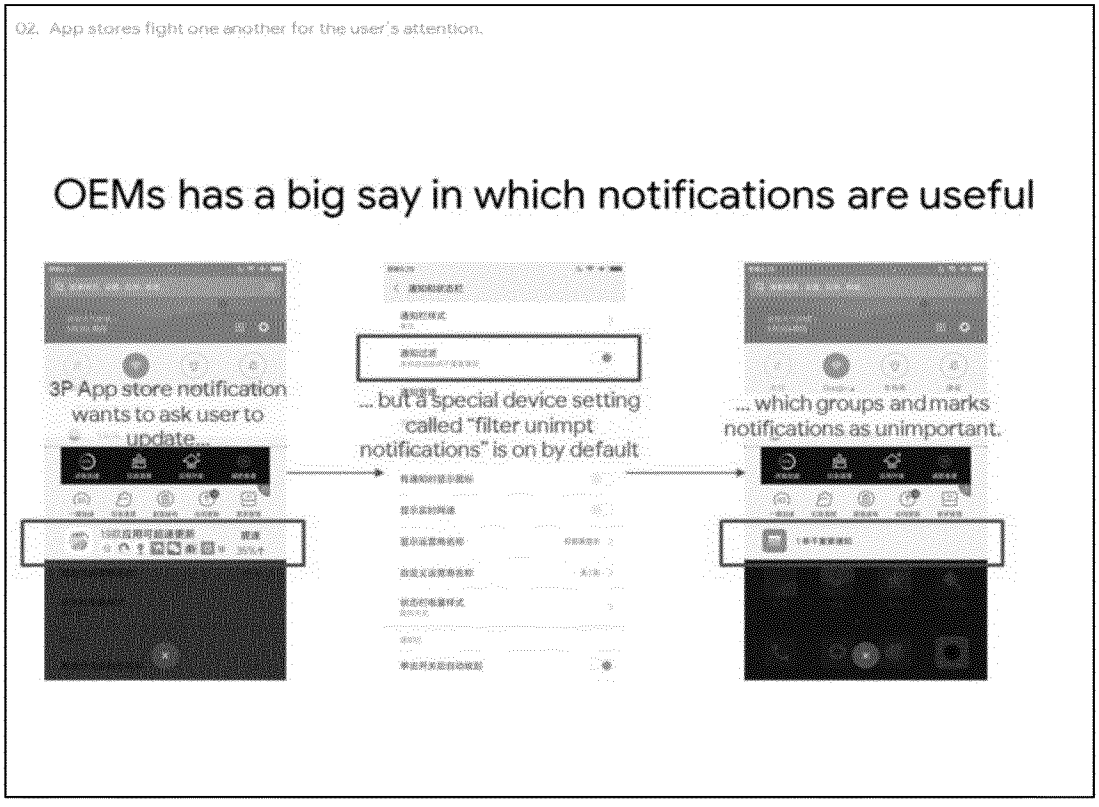

OEMs obviously try to limit this.

As an example, this Huawei phone has a special device setting called “filter unimportant notifications” that is turned on by default. (AFAIK this is unrelated to Android framework’s notification priorities). When turned on, the OEM might actively hide notifications which it deems spammy, including some of the app store notifications.

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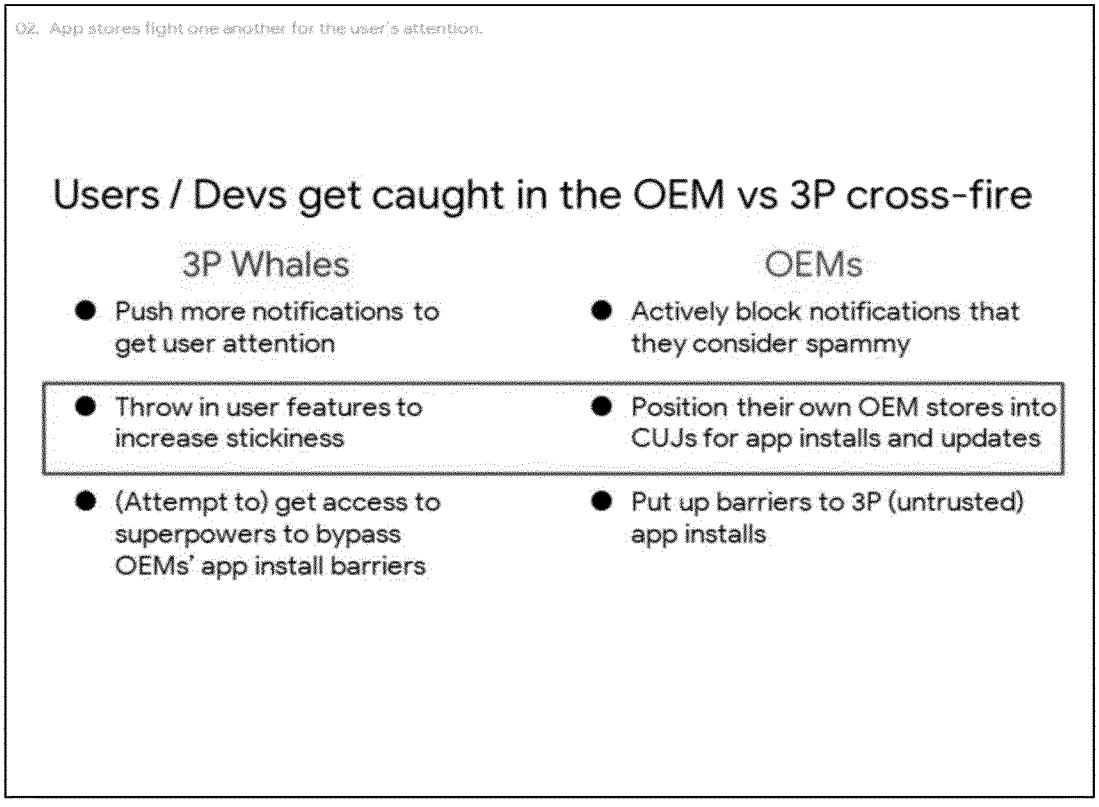

3P stores, lacking the power of pre-installation, resort to adding in as many features as they can in an effort to prove their value to users.

OEM stores, on the other hand, want their pre-installed OEM stores to get said user engagement, and so they insert themselves in critical user journeys for app installs.

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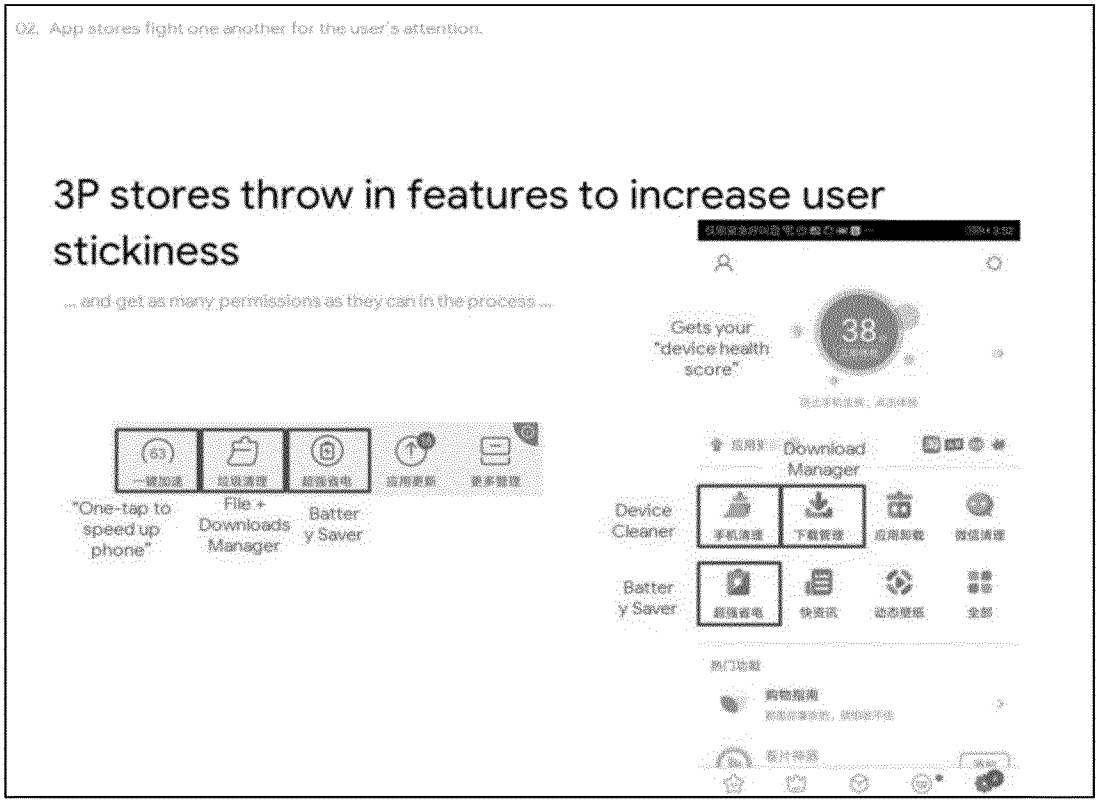

In a bid for increase user engagement, 3P stores are really not just stores anymore; they all aspire to be super-apps that do EVERYTHING for users - manage connectivity, kills background processes, manage downloads, cross-sells other apps that purport to help save battery, etc.

Stores become one part of a greater super-app strategy that:
Replicates system UI functionality,
Claims to be the guardian of user's device health,
Cross-sells other apps, etc.

These added functionality are typically shown in the persistent notifications that these 3P stores show.

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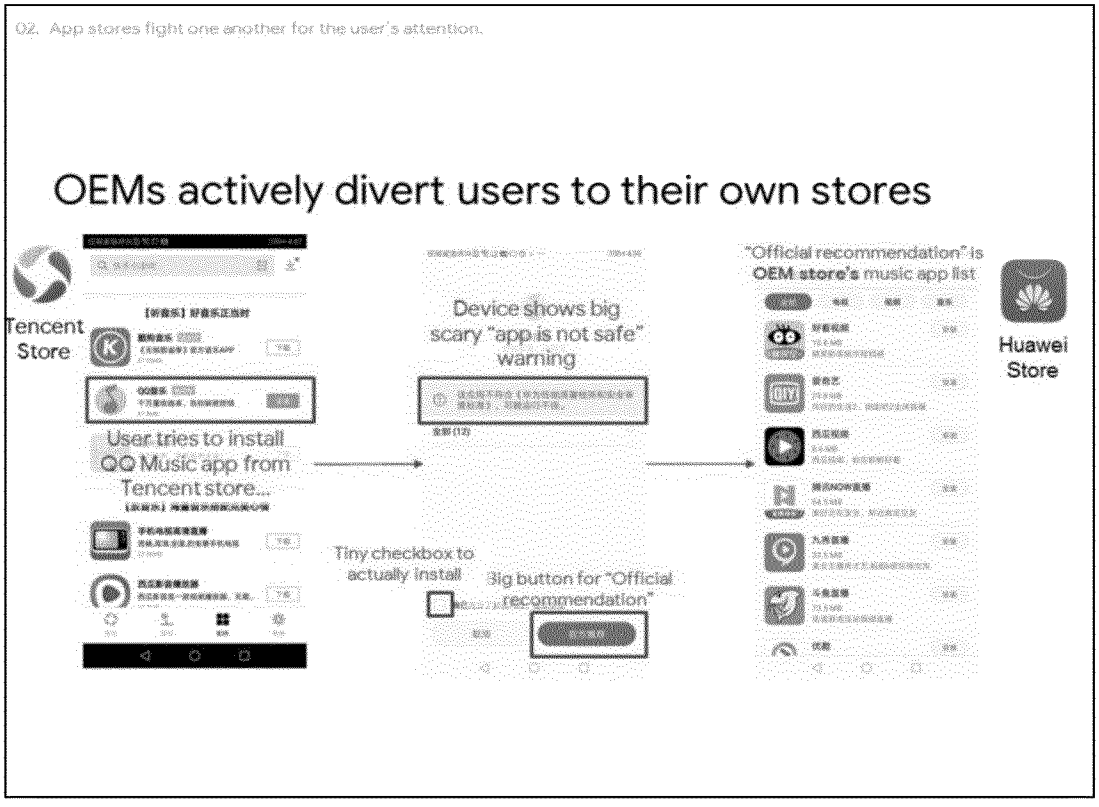

Meanwhile, OEM stores try to get users to use their store instead to install apps, often times without the user knowing.

Take this example:
A user (on their Huawei phone) searches for a music app in Tencent store, and attempts to install the QQ Music app.
Huawei device's OS throws up a big scary "app is not safe warning". TBF, this is comparable to "3P sources" warning in typical Android OS; what is different is that the most conspicuous button is one that says "Official Recommendation" and that leads the user to the Huawei store instead.
The actual APK install path is just a tiny checkbox.

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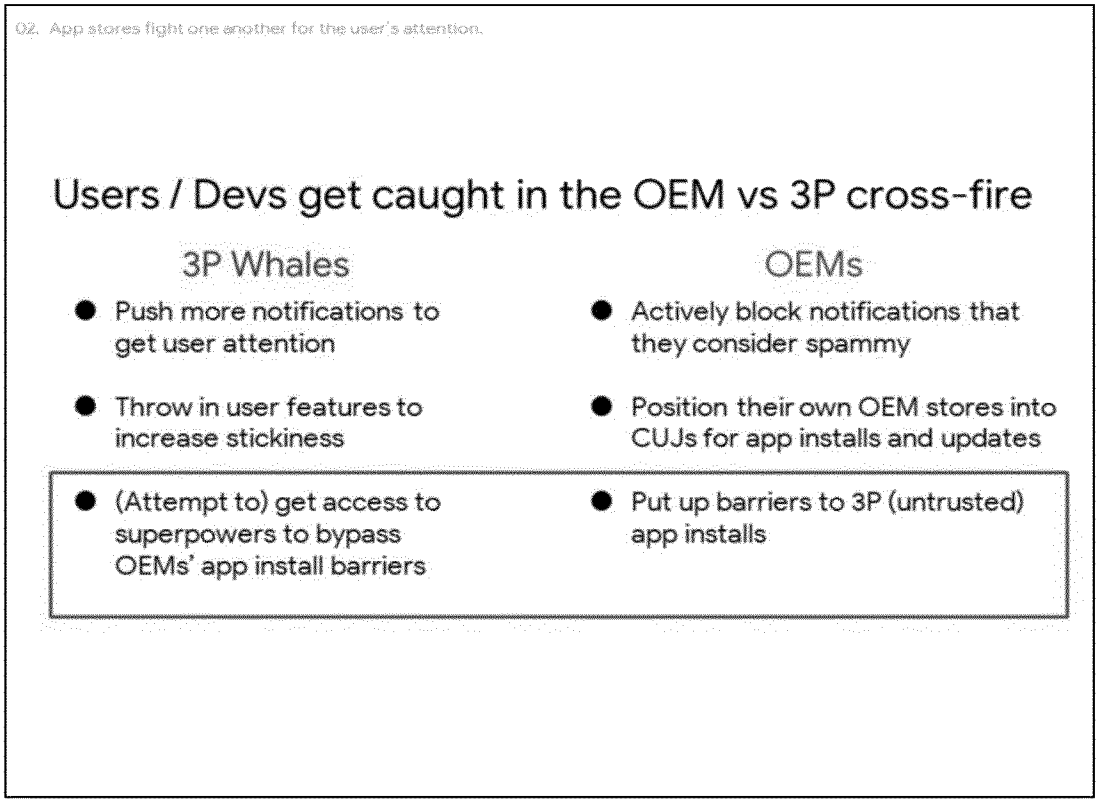

OEMs, being the ultimate power broker on a device, often makes it very difficult for 3P stores to install apps.

3P stores fight back by using Android APIs that grant superpowers (i.e. Accessibility API) to bypass some of these restrictions.

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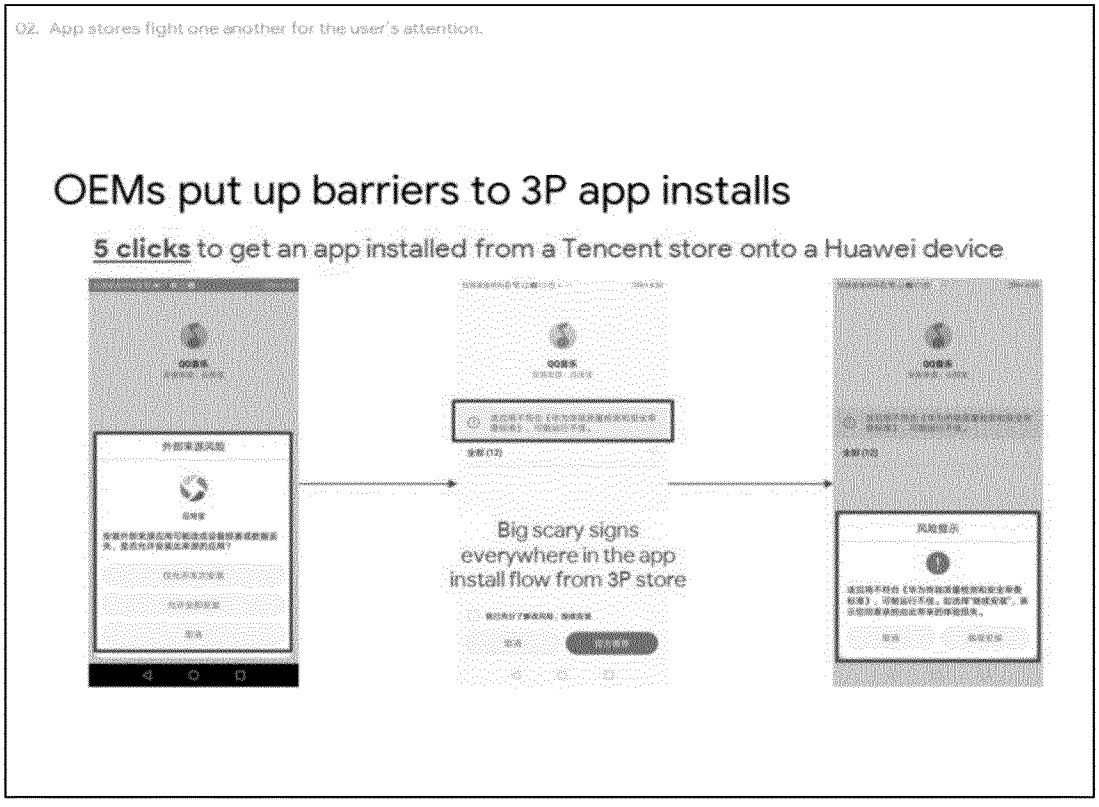

OEMs treat 3P app installs like all other unsafe APK installs, and throw up big scary signs all along the critical user journey.
Installing app from:
3P store - 5 clicks (!)
OEM store - 1 click

To be fair, this is comparable to the “3P sources” warning in typical Android OS; the result is a HUGE difference in number of clicks

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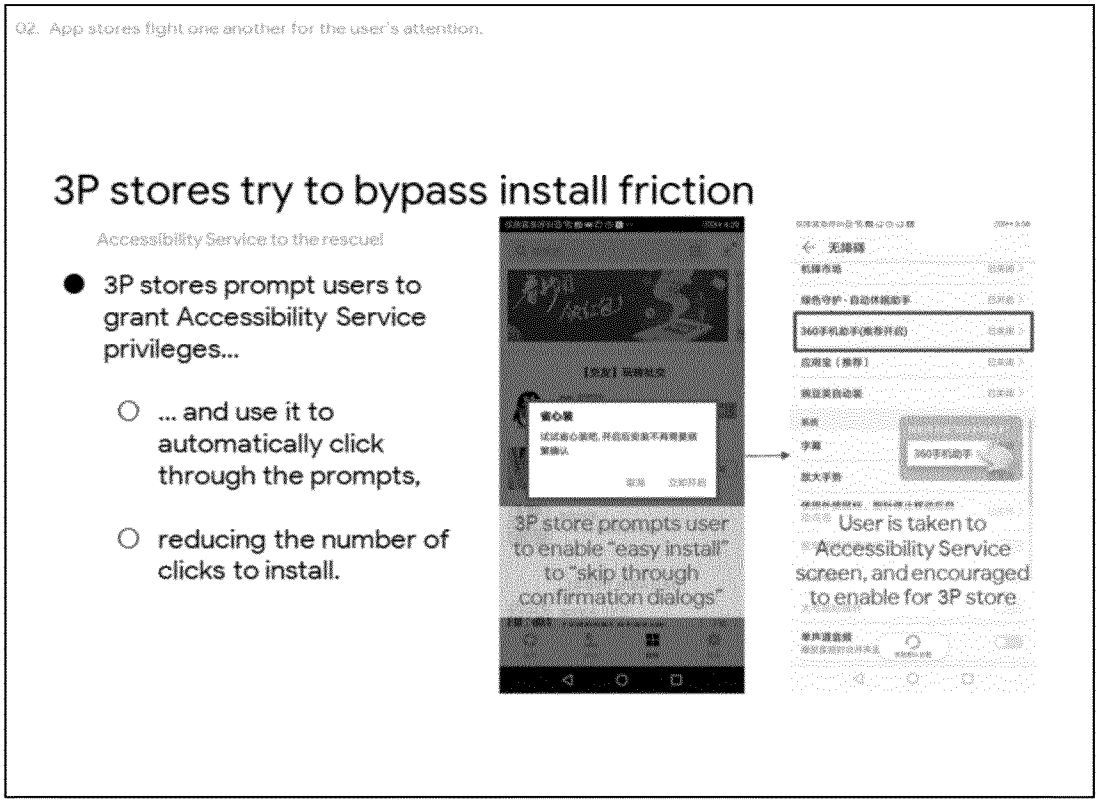

The Accessibility Service API in Android is the great equalizer (sort of) - once a user grants Accessibility Service privs to an app/service, it has the ability to do pretty much anything.

3P stores try to get around the install barriers put up by OEMs by prompting the user to enable Accessibility Service (this usually being sold as a feature called “quick install” or “easy install”); once a user has enabled Accessibility, the store will automatically click through any dialog popups and prompts thrown up by the OEM.

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Id	Date	Text
4	06/27/2018 03:12:25	1) I've looked at at least 8 of them (Baidu, Tencent, Wandoujia, CoolApk, Anzhi, 360, etc.), and "all of them" have such an option in their in-app settings (which then redirects the user to the Accessibility screen in system settings). Some of them (like 360 in the screenshot) have in-app dialog prompt as well, its unclear how many actually do active prompting, v.s. how many just let power users discover it. 2) a11y can do pretty much anything that a normal user can otherwise do (tapping, swiping, reading, adjusting controls, etc.) Rooting is still more powerful in an absolute sense. A11y is offered as mimicing the outcomes of rooting without the substantial hassle of actually rooting the phone.
3	06/27/2018 03:58:10	+micyeung@google.com This is super interesting. 1) Do all 3p stores request accessibility priv? 2) When it is said "it has the ability to do pretty much anything" how does this compare to rooting?
1	06/27/2018 03:58:10	Actually, based on CDD, OEM can block all the unknown sources and remove the "unknown sources" option from setting. If 3P store continue doing this, I'm afraid, OEMs will take this super aggressive solution.

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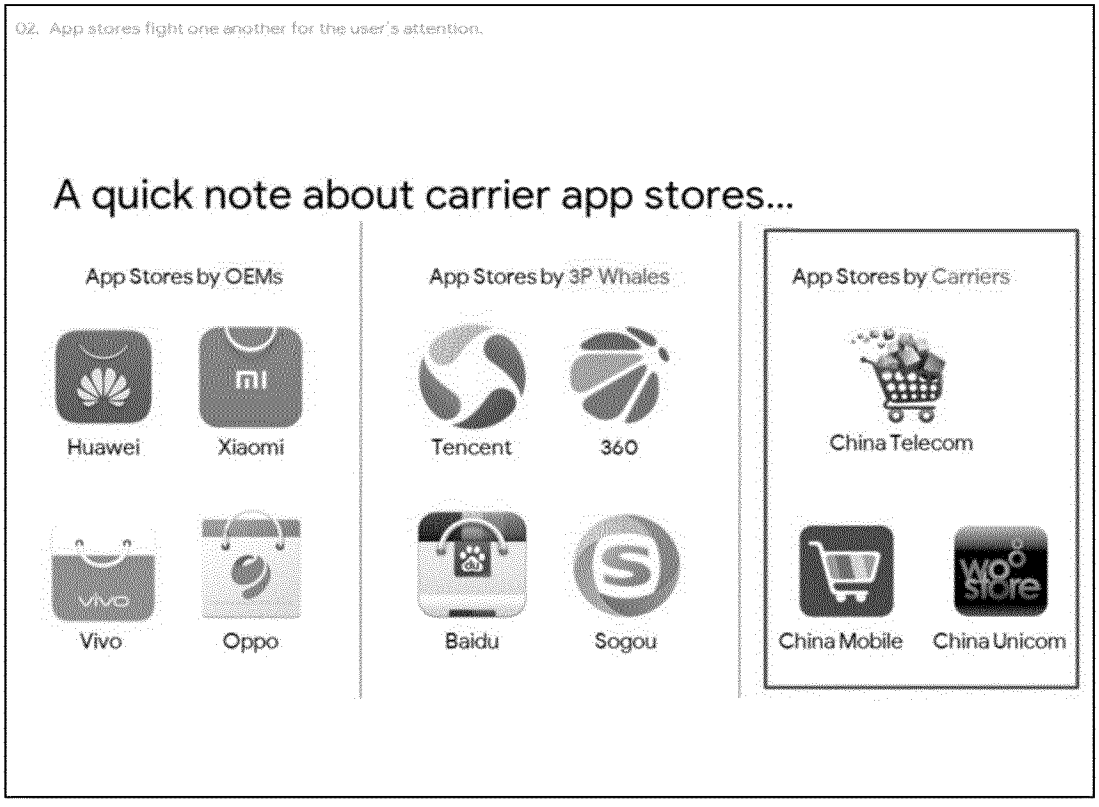

We have mostly only talked about OEM app stores and 3P app store so far, because they are the biggest players in the app store world.
However, let's not forget about the (smaller) carrier app stores.

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Carrier stores are small, but have unique advantage

- Probably a lot smaller than OEMs and 3P whales
- Offers downloads to users without incurring bandwidth costs
- Promotions inside carrier app stores for data bandwidth credits

Disclaimer:
Data about carrier stores and their size tend to be quite old (circa 2013-14), so it's difficult to tell where they stand today in terms of market size, except to say they they are probably smaller than OEMs and 3P whales.

That said, carrier stores do have unique (and obvious) advantages to them - they are well-funded, and typically use bandwidth savings / credits as a hook to get users to engage with the store. Downloads without incurring bandwidth costs, and promotions within carrier app stores in exchange for bandwidth credits, are all pretty common.

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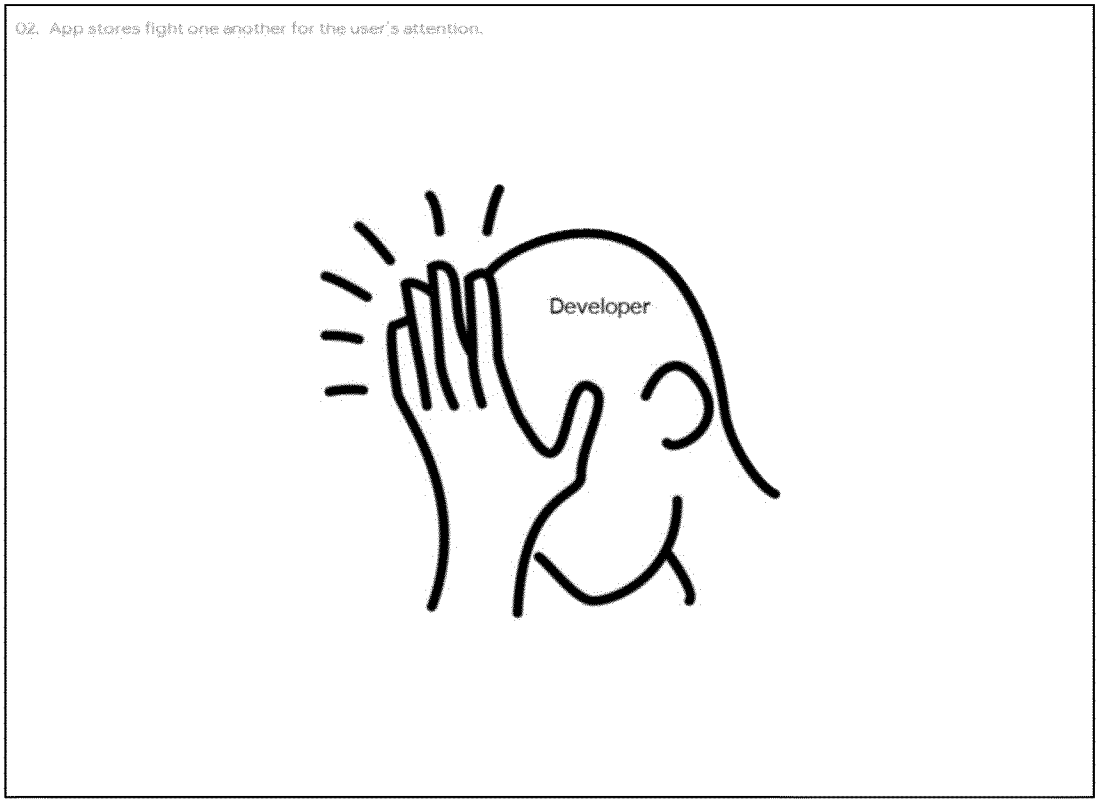

Now if you're an AiC developer, you try to work with work around chaos as best as you can.

How so?

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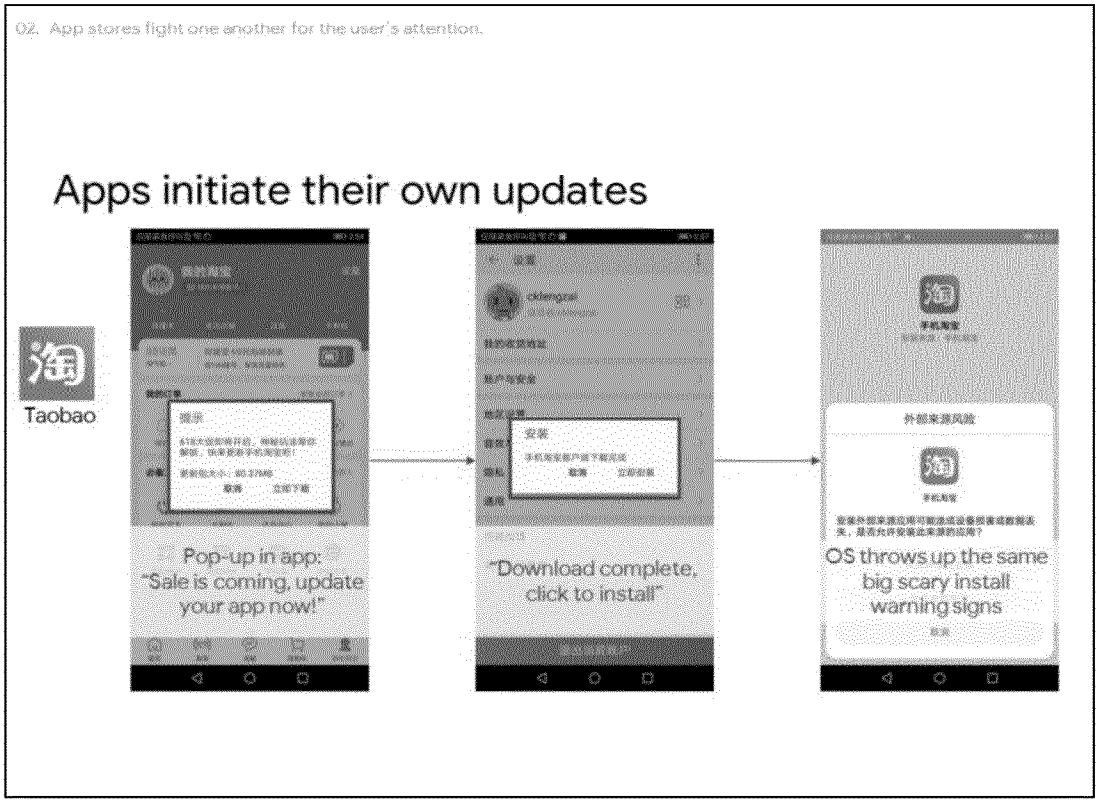

The easiest way that apps can take things into their own hands is… to distribute their own app themselves!
Take for example, e-commerce giant Taobao (owned by Alibaba).

In this series of screenshots, when the user opens the app, Taobao does the following:
Prompt the user to update (in this example - “big sale upcoming!”). User shows intent to update by clicking through the dialog prompt….
Downloads the APK, then prompts the user to click install… which begins the sideloading of the app.
… which brings them to the OS’ untrusted install warning screens.

Not perfect as OEMs are still in the critical user journey, but at least now the app has more control of its UX.

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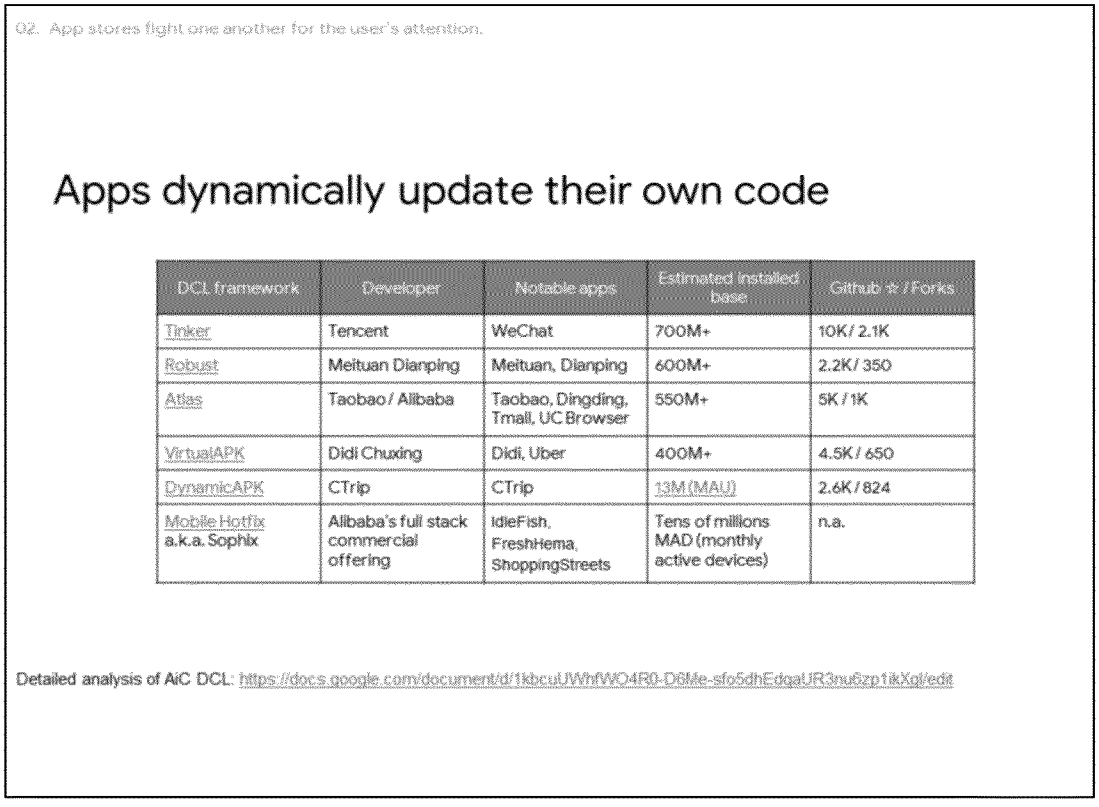

The other way is…. to just dynamically hot-patch their binary! Dynamic Code Loading (DCL) is SUPER COMMON for AiC devs and apps.

In fact, it is so common that all the 3P whales in the ecosystem (Tencent, Alibaba, Didi, etc.) have developed and open-sourced their own DCL frameworks.

Imagine the furor that would have been generated if Facebook and Amazon each announces that developers can now use their SDKs to dynamically load code to circumvent stores and OEMs; that's pretty much what has happened in China.

We won't go into the details of how DCL is done in this preso; see this doc for a deeper analysis into various DCL techniques in Android overall, and here for DCL in China specifically.

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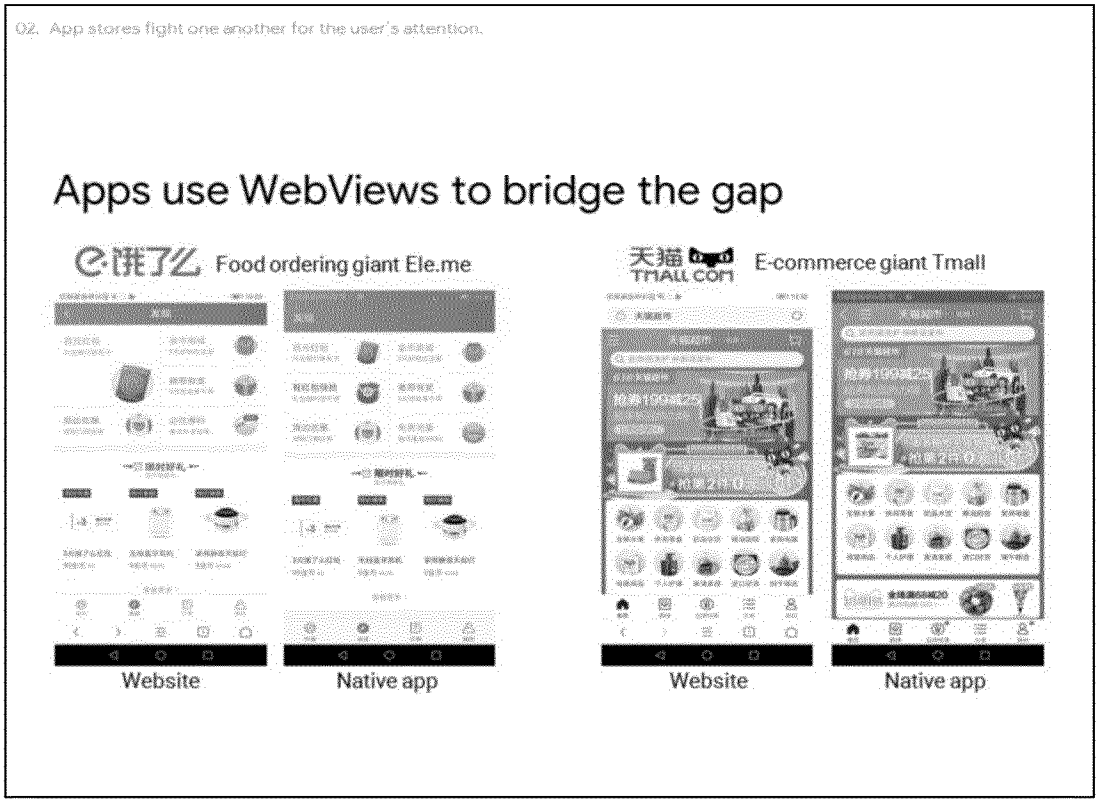

Viewed from this lens, it is no wonder why WebViews are SUPER POPULAR in China apps.

I couldn't find any official statistics, but open basically any well-known app in China, and you'll see what you see in this slide (using food ordering giant Ele.me and e-commerce giant TMall as 2 examples) - major parts of the app are built with WebViews. I could have made 20 more slides showing exactly this with every major app out there.

On Play, this is enforced centrally - use of WebViews is heavily discouraged, and apps which rely a ton on WebViews for their main content will never have a chance of getting merchandising featuring on Play.
Without such central enforcement, apps quickly fallback to the fastest + cheapest option to roll out updates - i.e. WebViews.

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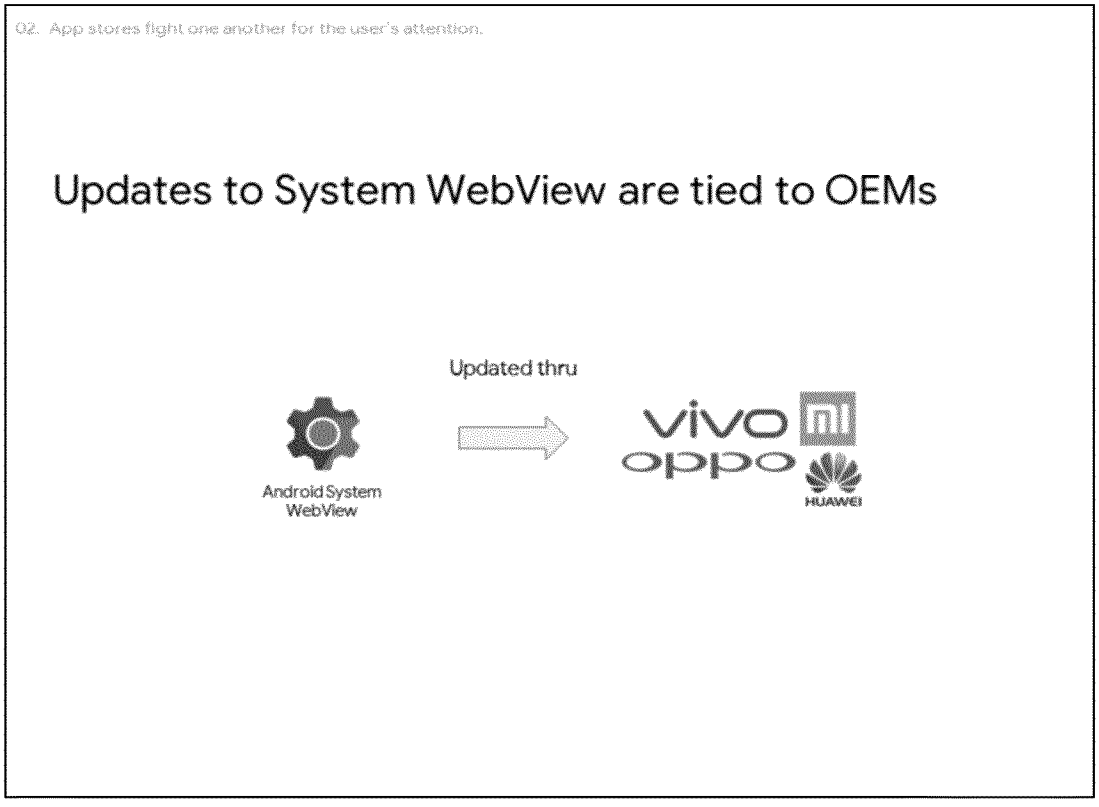

WebView's importance in China cannot be understated, and so updatability of WebViews becomes critical for bug fixes, security patches, etc.
Outside of China, the system WebView's gradual progress towards (in Lollipop) being updatable through the Play Store and then (in Nougat) being tied to Chrome's updates works because we can easily distribute updates (thru Play and Chrome).
But in China, there is no Play, so System WebView updates are still tied to super slow OS updates.
(Example: 360 put up a bulletin asking users to manually update their WebView in the 360 store after a bug surfaced with their OS update rollout).

Google also stopped supporting webviews prior to 4.4: "If the affected version [of WebView] is before 4.4, we generally do not develop the patches ourselves, but welcome patches with the report for consideration. Other than notifying OEMs, we will not be able to take action on any report that is affecting versions before 4.4 that are not accompanied with a patch."

UC claims that, as of Jan 2017, 40% of their users are still on Android 4.0-4.4.
This means that Android System Webview, as-is, is inadequate for China.

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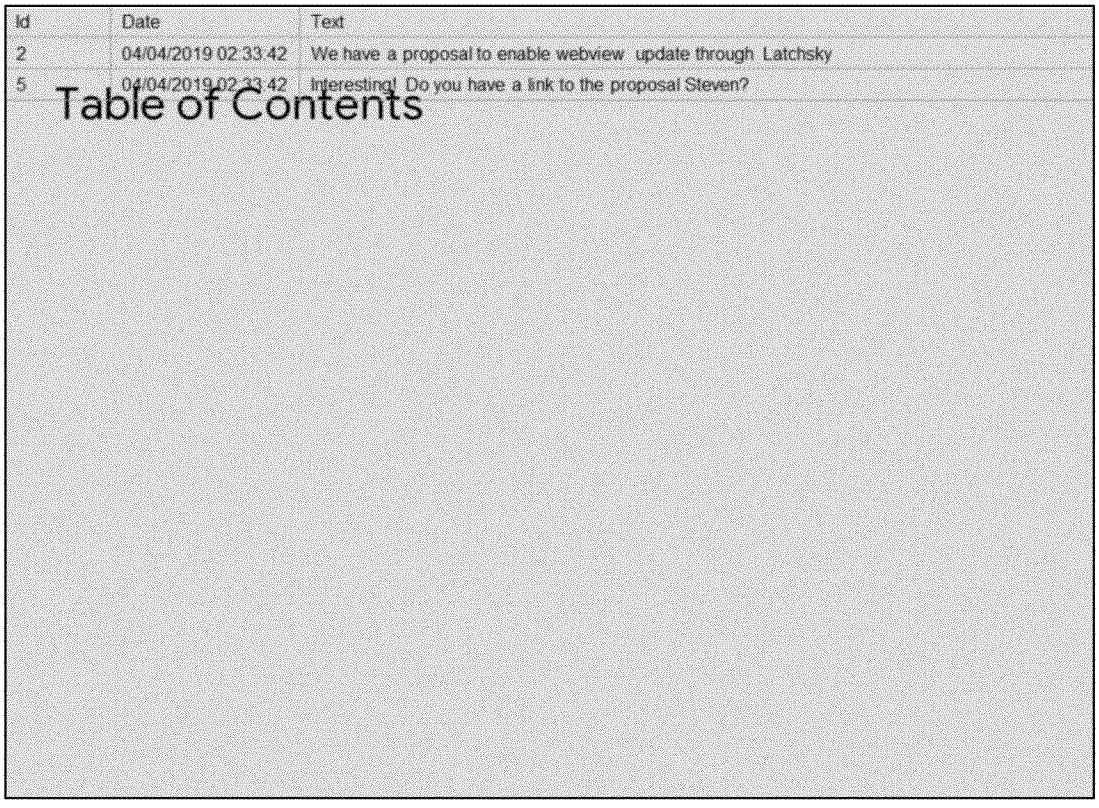

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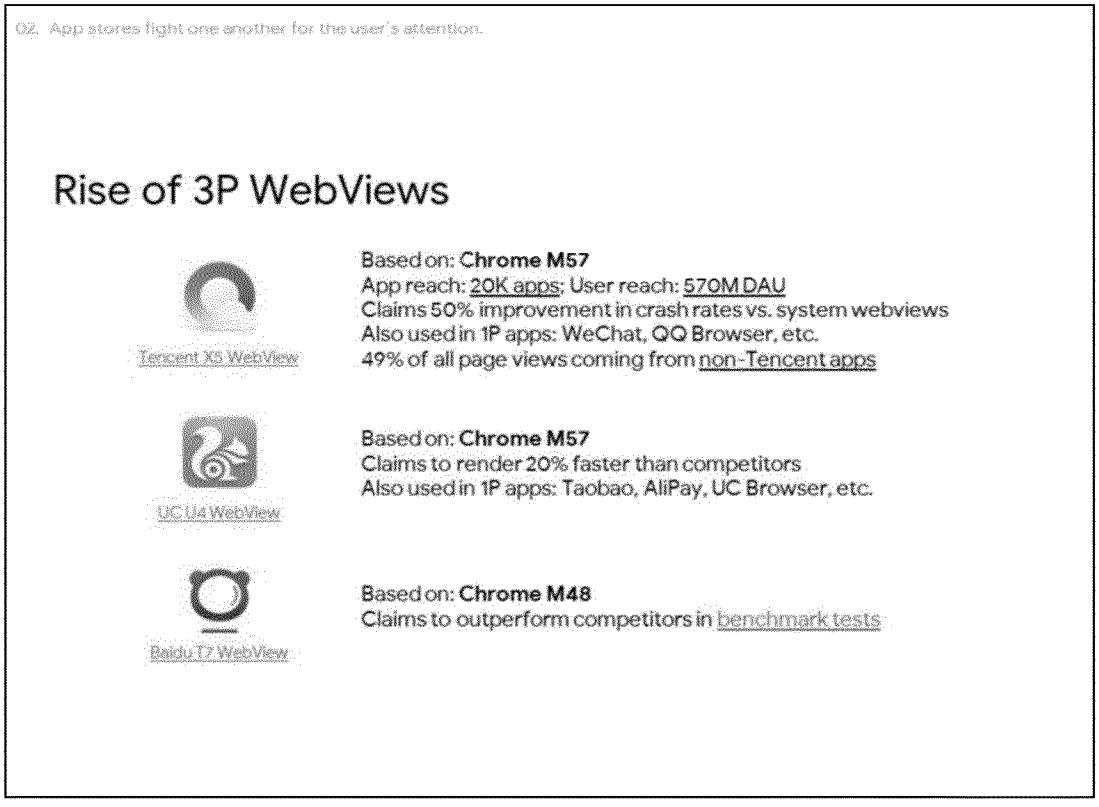

Others rush to fill the void. The major 3P whales (Baidu, Alibaba, Tencent) all provide their own popular alternatives to the system webviews that 3P apps can use (X5 for Tencent, U4 for UC, T7 for Baidu).
Developers include this 3P WebView SDK into their app for the benefits that come with app compatibility.

Since these 3P whales also own and invest in many apps, these apps also end up using one of these 3P WebViews.

X5 metrics: https://x5.tencent.com/news.html#/detail/6
X5 deepdive and benchmark: https://juejin.im/post/5a3522f2f265da431440c632
T7 benchmark: https://item.btime.com/m_9ac8d6245689dbbcf

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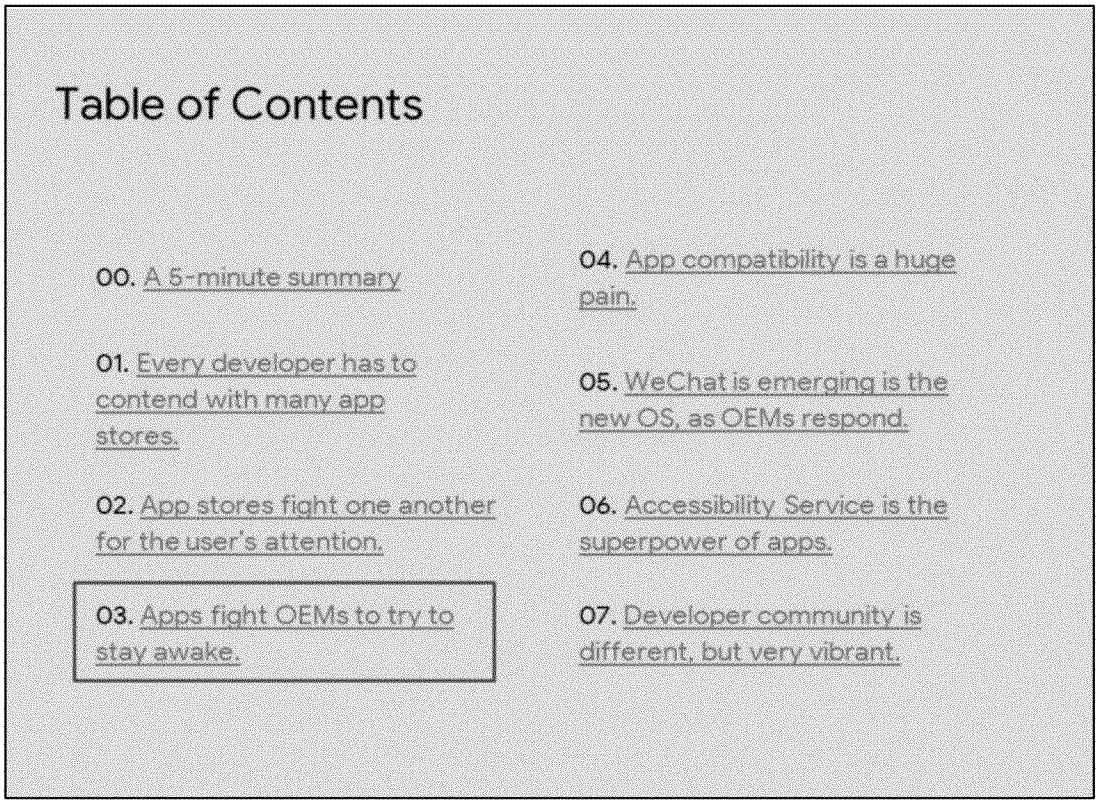

The many app stores, and misaligned incentives between OEMs / their stores and other 3P stores, is just one problem.

Once an app gets onto a device, a 2nd form of incentive misalignment occurs - that between app developers and OEMs.

An app is always trying to stay awake as much as it can, while OEMs are always trying to keep apps asleep as much as possible.

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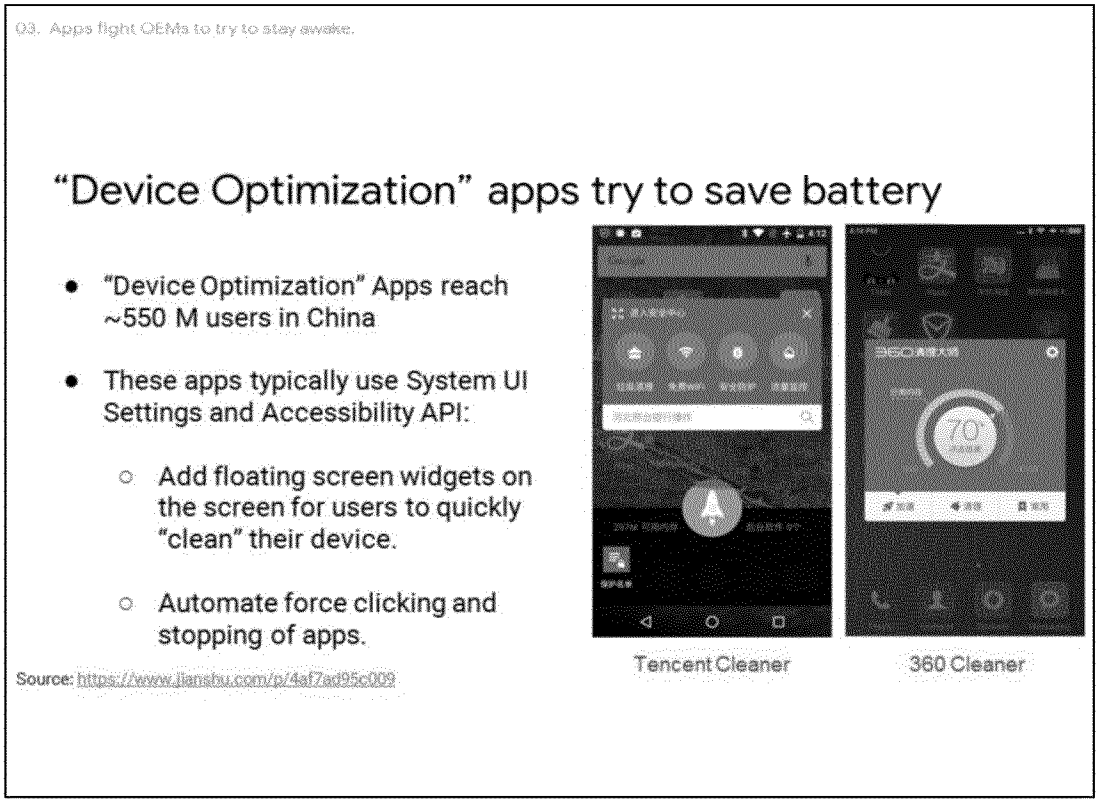

We've already seen how 3P app stores include shortcuts to kill long-running app processes. There are many, many cleaner apps that do the same thing, all in the name of speeding up the device and/or saving battery.
Many of them use System UI settings to add floating screen widgets to let the user quickly get to to it, and then use Accessibility API to automate the clicking through of various screens to force stop apps ands services.

And judging by how popular cleaner apps are (~550M users), this problem is real in users' minds.

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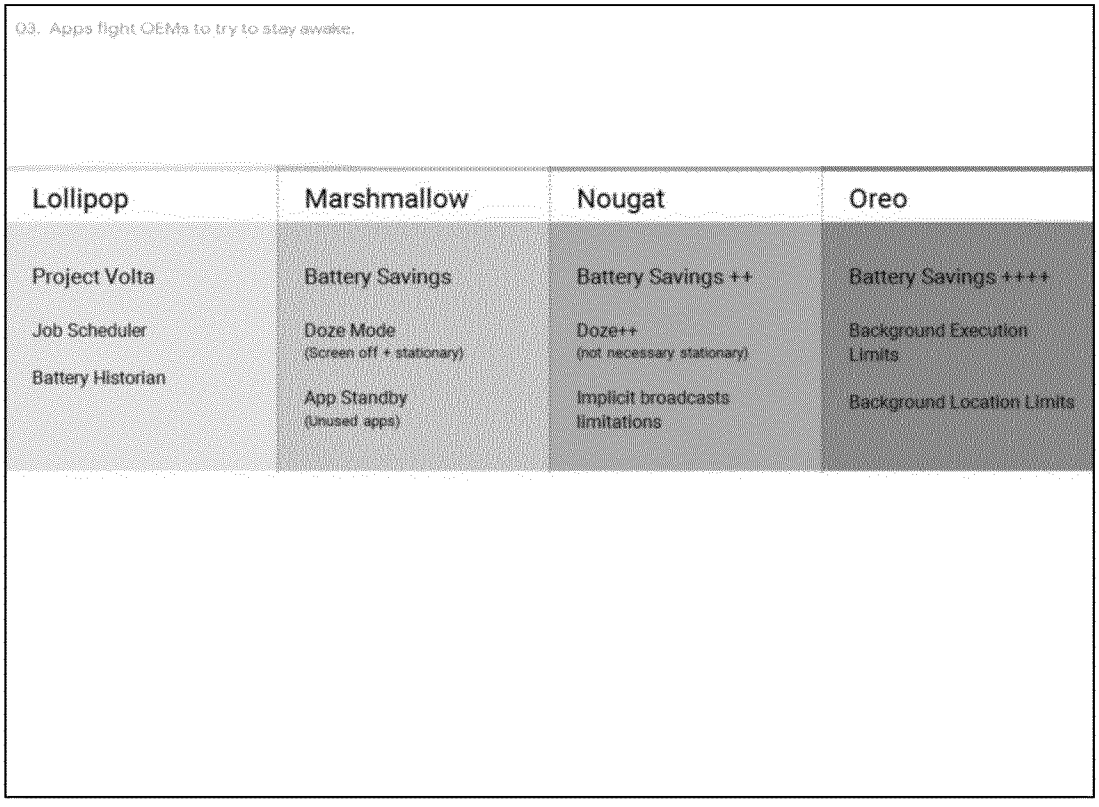

This fight between apps and the OS is nothing new even outside of China - this is the motivation behind the power saving enhancements introduced in the framework throughout the various Android versions starting from Lollipop onwards.

(Android P further drives that home with App Standby buckets, Battery Saver Mode, and Background Restrictions).

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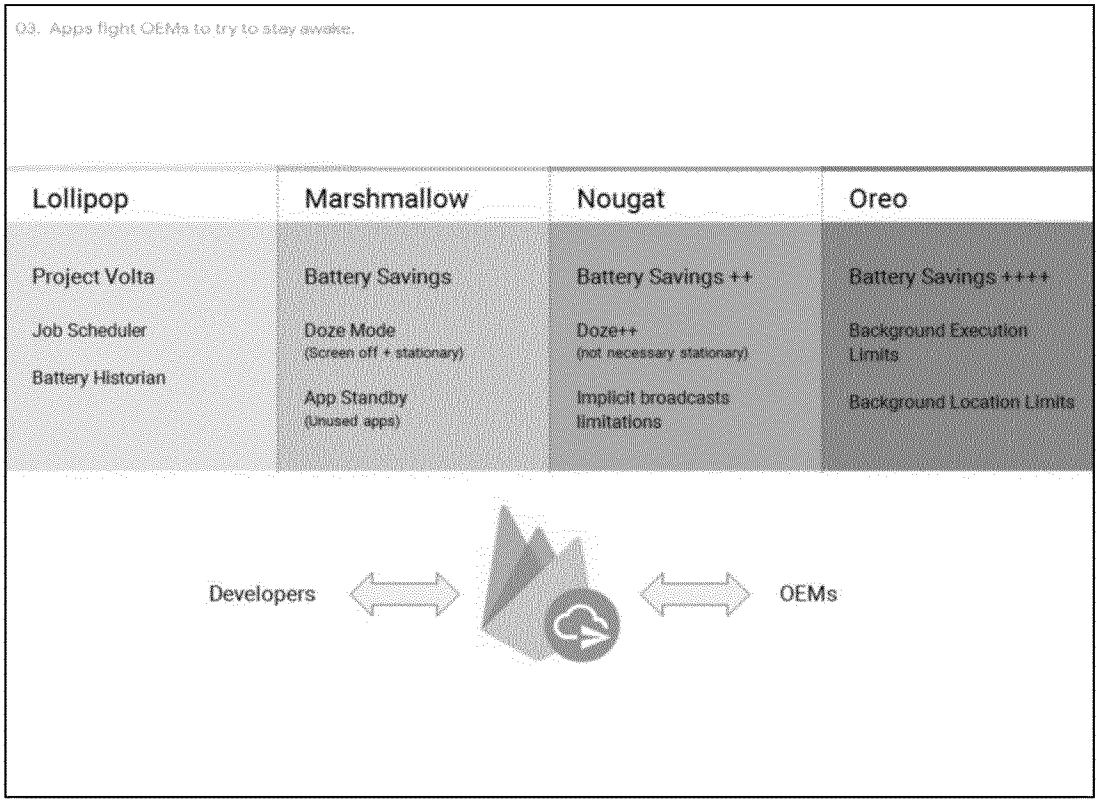

In particular, Doze introduced in Marshmallow is explicit in giving the OS the ability to kill apps, while also giving apps the ability to circumvent that with FCM high priority messages.

Essentially, FCM resolves this tension between developers and OEMs by putting the right incentives into the ecosystem.

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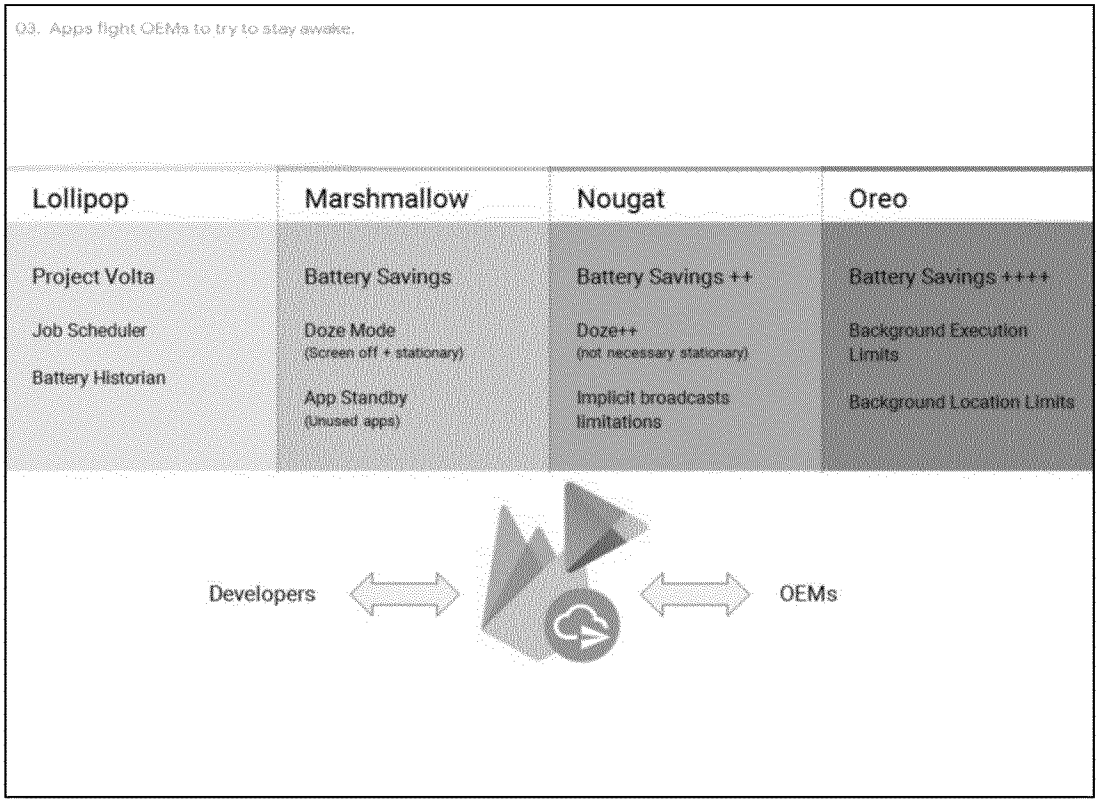

This is further buttressed by the presence of the Play store → Play store policy helps ensure that things that things which are allowed in the framework (e.g. apps asking for Battery optimizations whitelisting) can still be disallowed through policy enforcement.

Outside of China, this combination has two super important properties that means devs can rely on it to wake up as needed:
FCM (more generally, Play Services) is on essentially all devices
FCM (more generally, Play Services) is whitelisted for Battery Optimization exceptions

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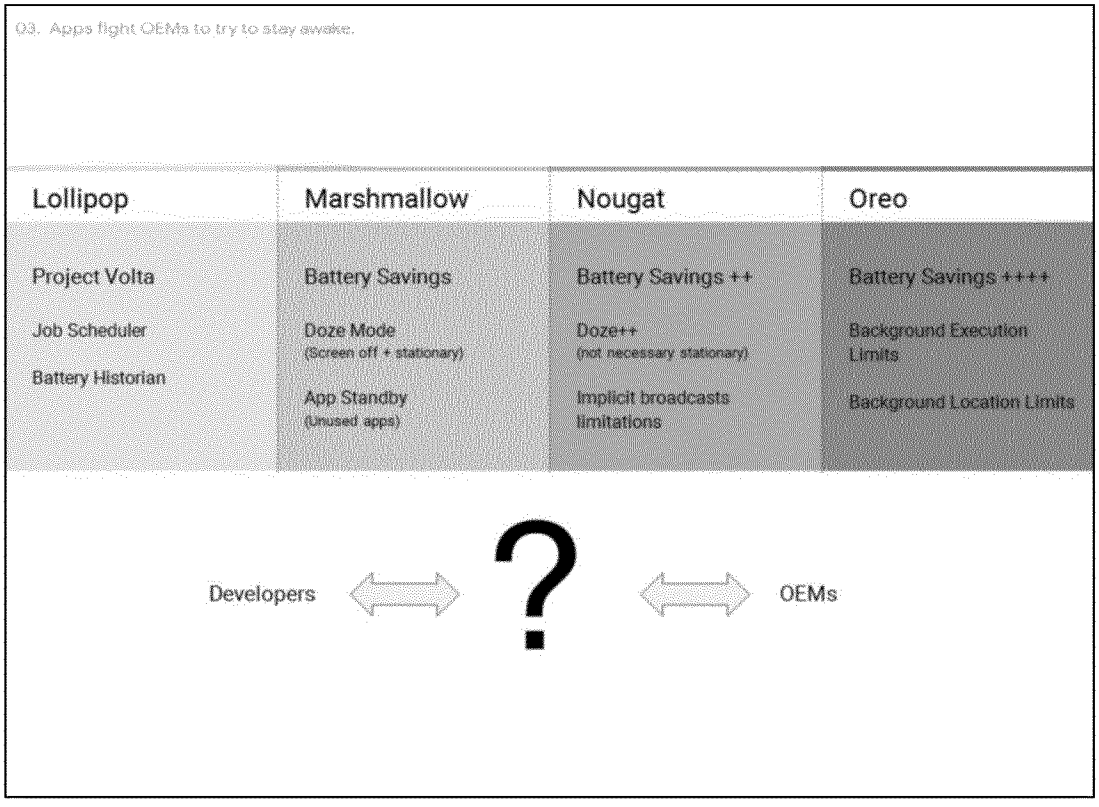

Now in China, FCM does not exist, so just like in the app store case without Play, a power vacuum exists…..
So who fills this gap to resolve the tension between developers and OEMs?

(It is first useful to note that Doze mode is disabled by default in AOSP).

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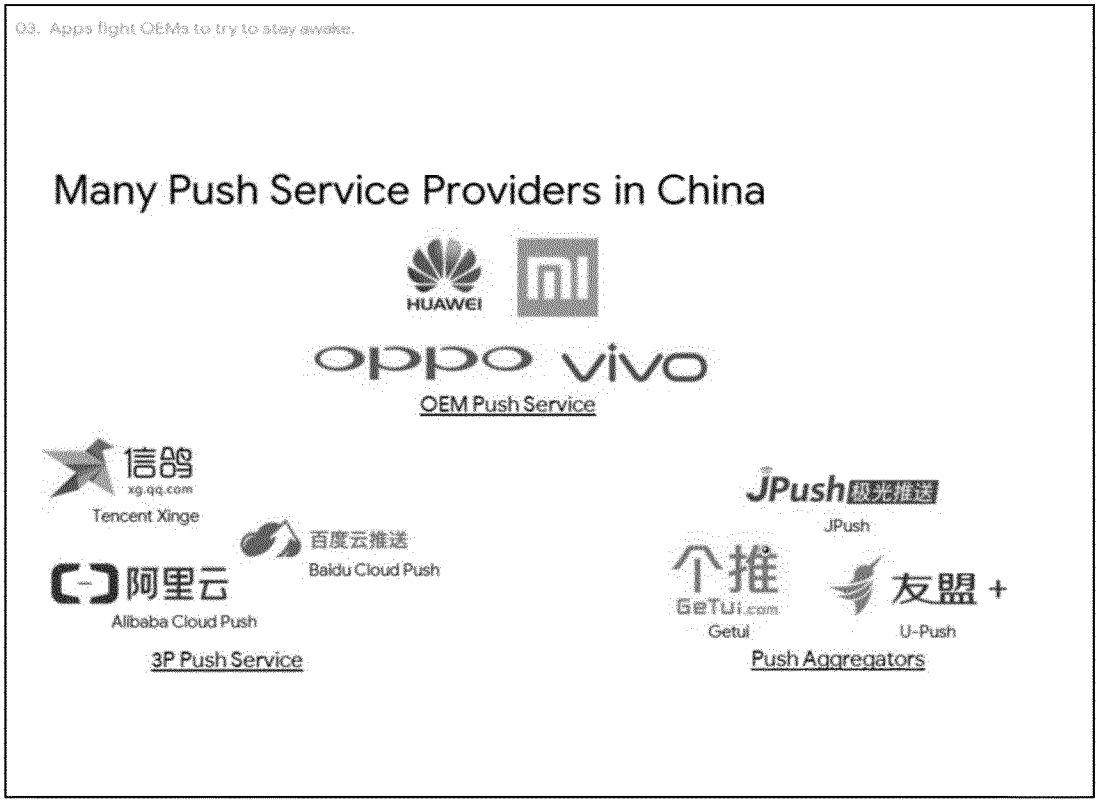

Unsurprisingly, there are many push service providers that try to fill the gap here.

They can broadly be grouped under 3 buckets:
OEM push service
3P push service
Aggregators

Let's walk through their characteristics….

https://www.jianshu.com/p/05760efb5b07

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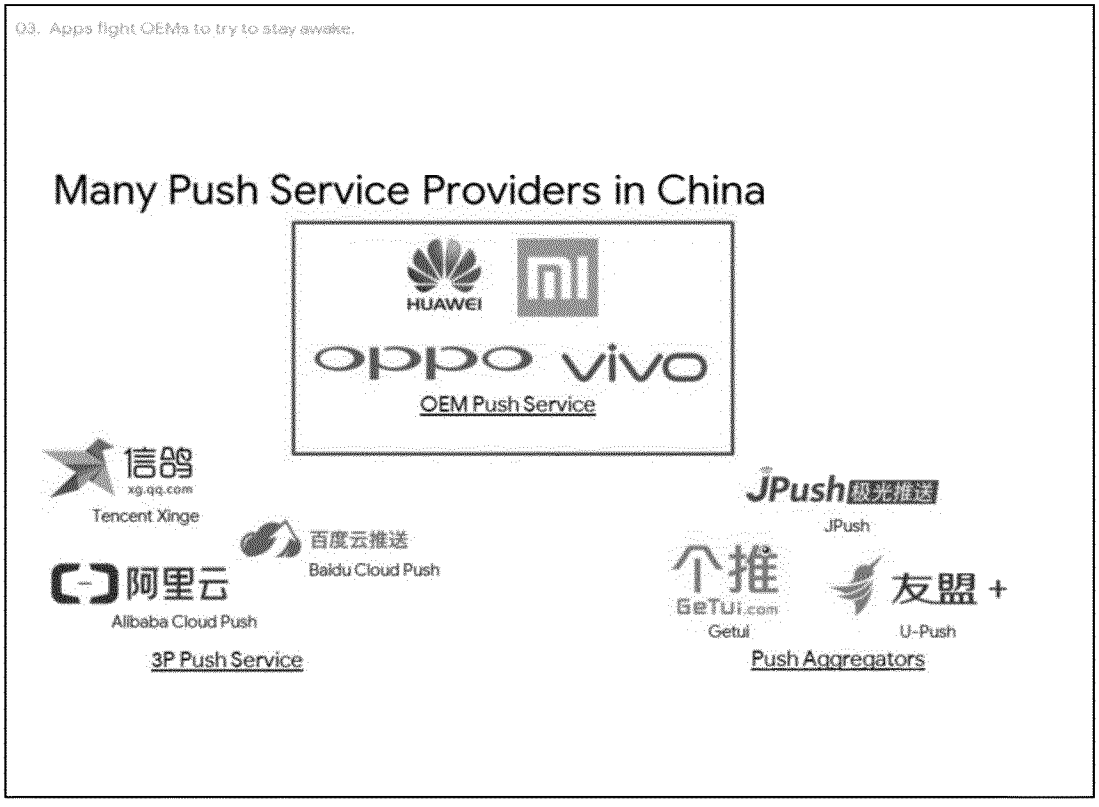

Starting with OEM Push Service…. The Xiaomi Push / Huawei Push / etc..

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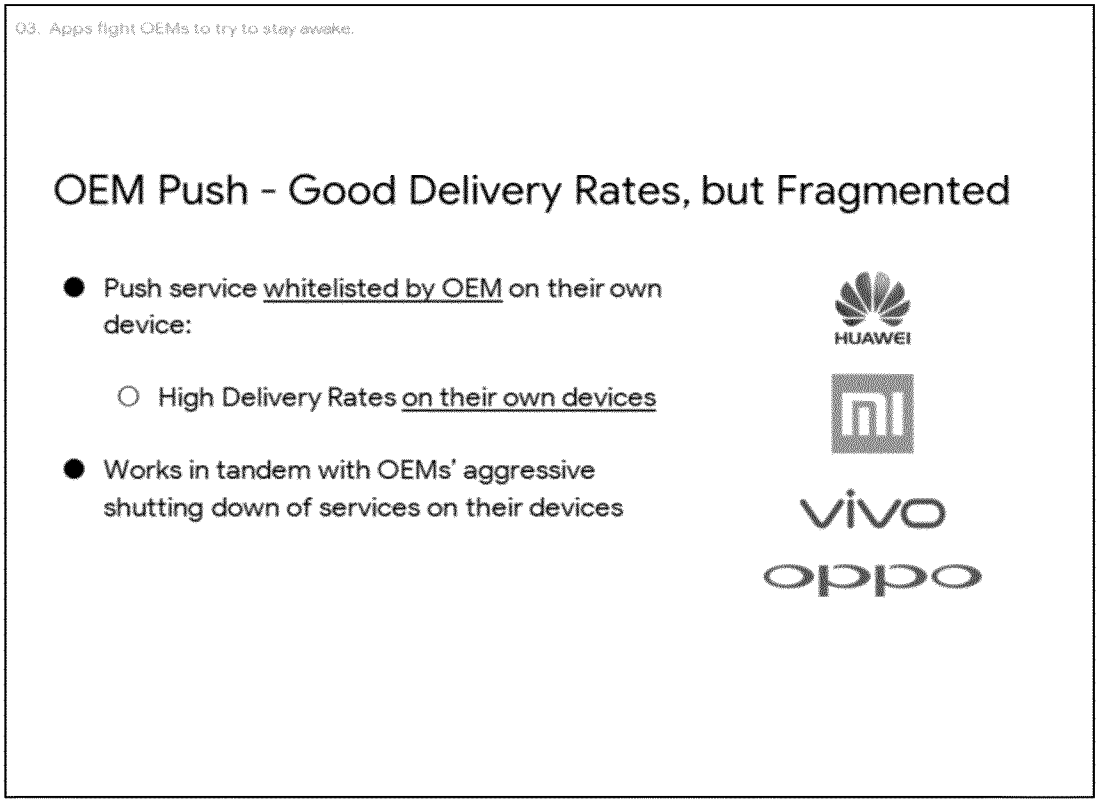

OEMs typically all have their own push services that are tightly aligned with the interests of its own devices (rather than with the Android ecosystem as a whole). Devices also aggressively kill services running on devices, so for a msg to get through you really NEED to use the OEM's push service.

E.g. The Huawei Push Service is whitelisted by Huawei on Huawei phones, so messages sent with that service will get through to a Huawei phone.

This model is very similar to FCM + Doze mode, just working on subset of Android devices rather than across the entire ecosystem.

For developers, the trade-off is clear:
if you want your push msg to make it to a Huawei device, use the Huawei Push SDK.
All bets are off if you use any other push service.
But, there are so many OEMs in market, and I can't possibly integrate with (and maintain) them all.

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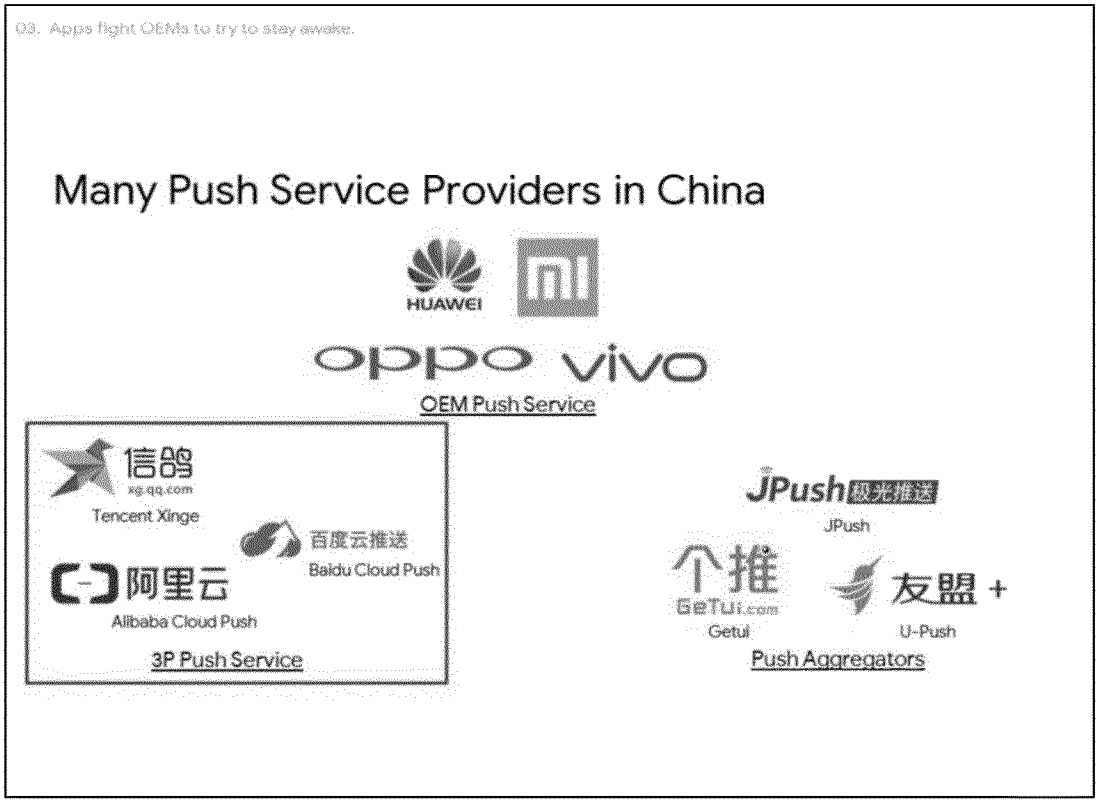

And then there are the 3P push service providers, which typically (but not always) are provided by the 3P whales (e.g. Tencent, Alibaba, etc.).

They do not have the advantage of OEM whitelist, and so need to use other tricks to maximize their delivery rates.

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There are lots of tricks that 3P push services employ to try to keep themselves awake. The most obvious one is just …. Maintaining a long running service.

A more interesting phenom is called "chain starting" ("链式启动"), or more informally known as "family bucket" ("全家桶").

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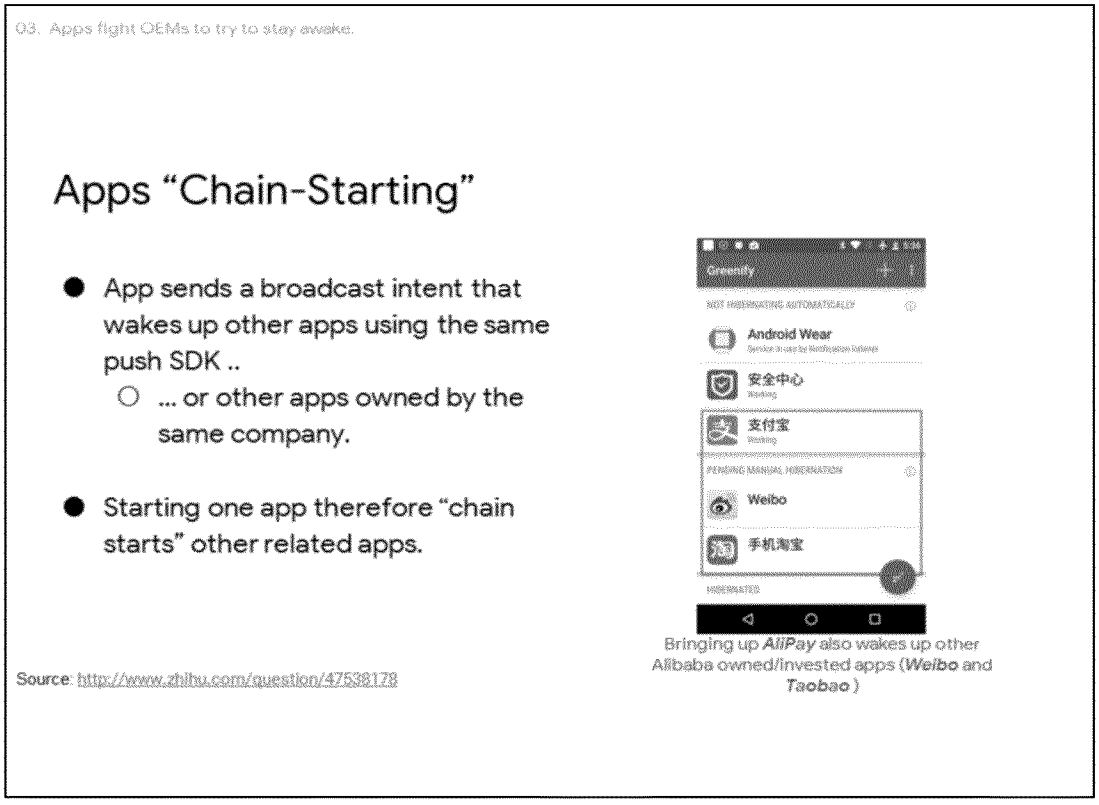

A more interesting phenom is called “chain starting” (“链式启动”), or more informally known as “family bucket” (“全家桶”).

When an app with the 3P push SDK is launched, the app might send a broadcast intent that would attempt to wake up other apps that are using the same SDK. There is a bit of a network effect going on here…. The more popular the 3P push SDK, the more likely there will be apps on-device that can then wake up other apps (hence the name chain-starting).

(BTW, here is an unfortunately-named github project which a dev can use to wrap their Context objects to prevent chain starting)

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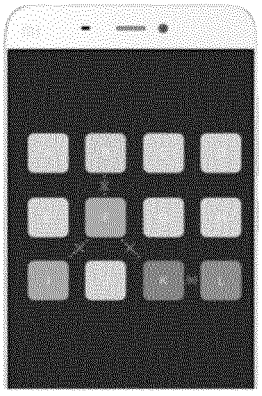
Apps "Chain-Starting"... and OEMs' fight back

- Xiaomi's MIUI 8 headline:
  - User can disallow "chain starts" via settings.
  - Xiaomi continually building out ruleset to determine what broadcasts qualify as "necessary"



Xiaomi marketing showing chain starting disallowed

Source: http://www.miui.com/zt/miui8/index.html

From an OEM's perspective, chain starting is obviously a problem as it negates OEMs' efforts to save battery on their phones.

So they start to fight back -
Some OEMs like Xiaomi are known to be particularly aggressive towards disallowing this behavior by implementing a heavy-handed version of Doze. For example, in the latest MIUI 8, unnecessary "chain starts" are no longer allowed (user can turn this feature on in settings). This was headlined (on their homepage) as their main battery saving feature.

This goes way beyond anything that Doze is doing currently so far.

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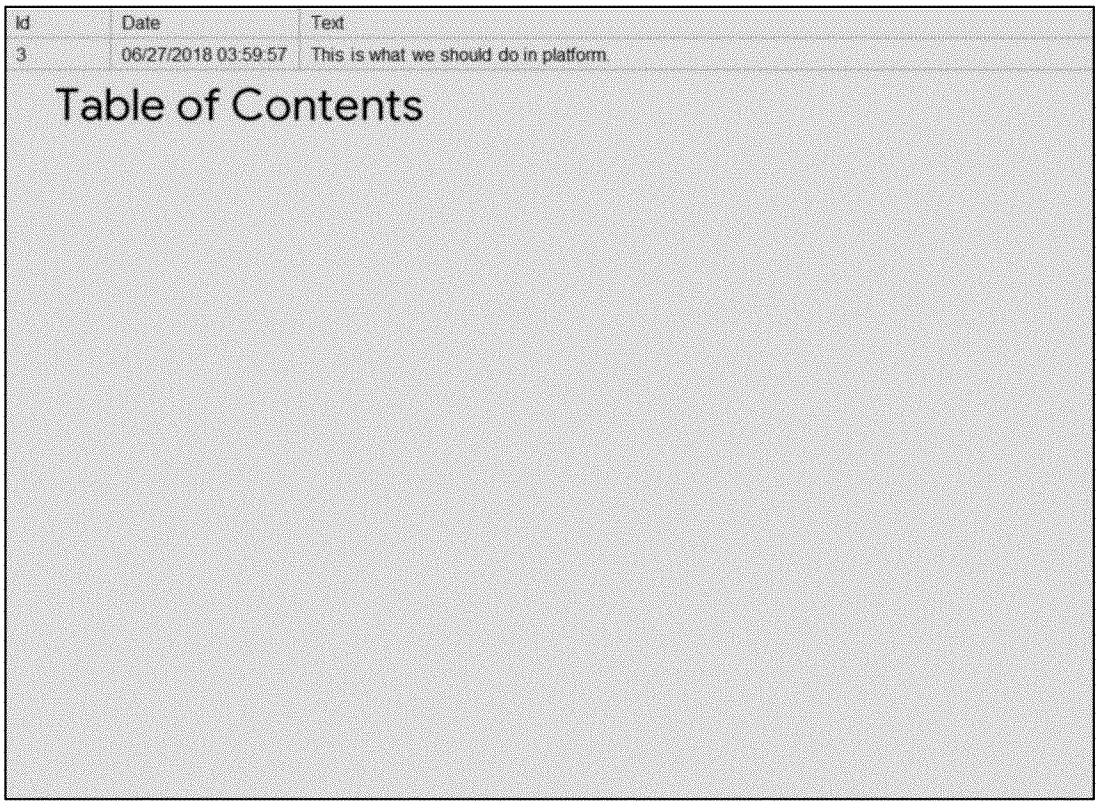
Id	Date	Text
3	06/27/2018 03:59:57	This is what we should do in platform



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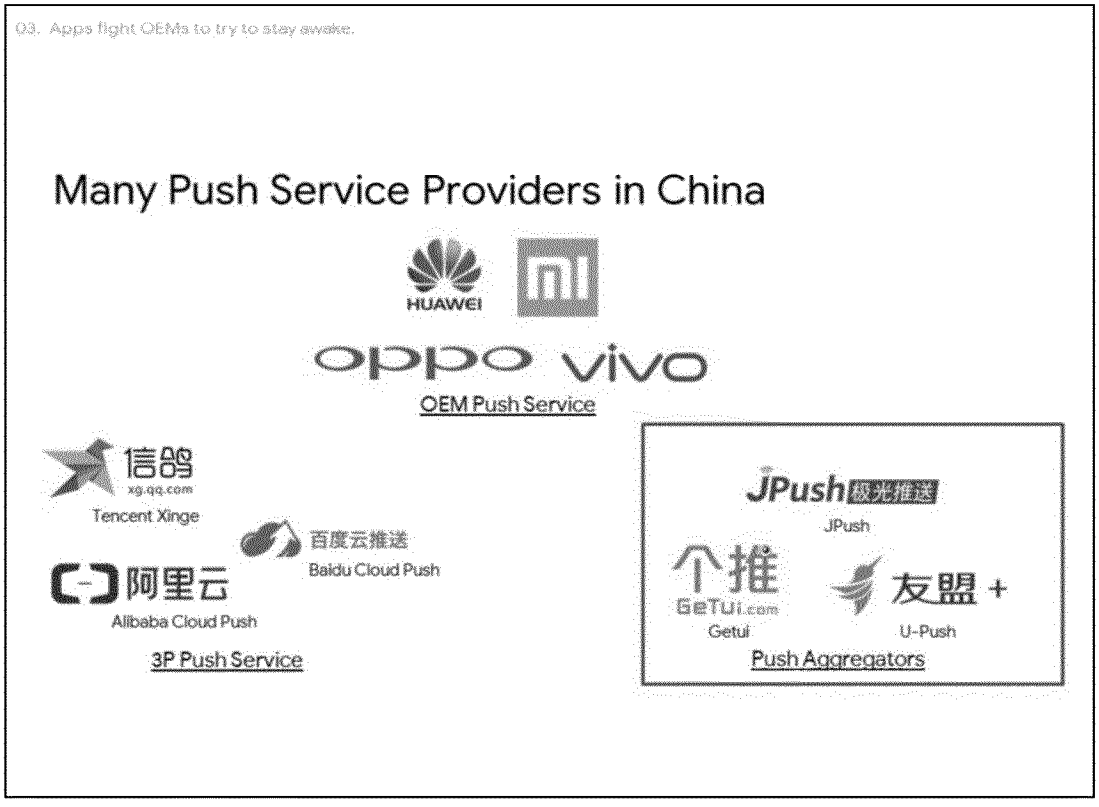

And lastly, the push aggregators - these really function as convenience wrapper SDKs that try to reduce the complexity for developers building, e.g. by switching between OEM push services providers and 3P push services under (ideally) 1 SDK.

Not the easiest though… e.g. for U-Push, developers still have to go sign up for various OEMs service keys in their console, then add the SDK and relevant configuration metadata into the U-Push SDK in the project.
XKCD summarizes the risk pretty well.

Ultimately, whoever holds the whitelist holds the power ….. and OEMs hold the whitelist.

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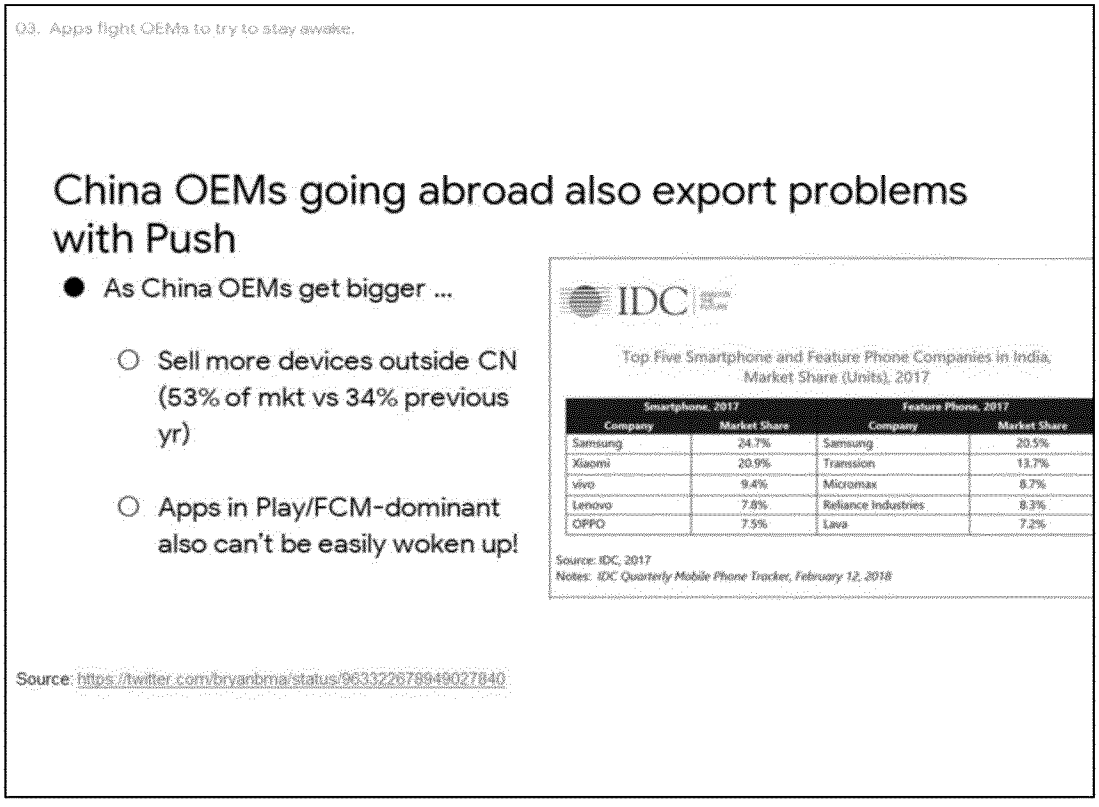

And this is the big one …. As these OEMs get bigger and sell more devices internationally, the issues that are typical in China also start showing up in international markets.

Apps on Play obviously will be using FCM (and not Huawei Push or Xiaomi Push) to send messages, but if the OEMs do not conduct compatibility testing to the fullest on the international SKUs of these OEM's devices before they ship, serious problems will arise.
What was once a problem in China will have spilled out into the international scene as well.
Examples:
Overall: http://b/30760529
Huawei: http://b/30945093
Xiaomi: http://b/30945344

More data: https://www.androidheadlines.com/2017/11/top-4-android-oems-experience-growing-sales-in-q3-2017-data.html

Quoting from UC Browser: "Xiaomi, Oppo and Vivo are building overseas app stores and push channels, which also brings the painful experience of domestic developers."

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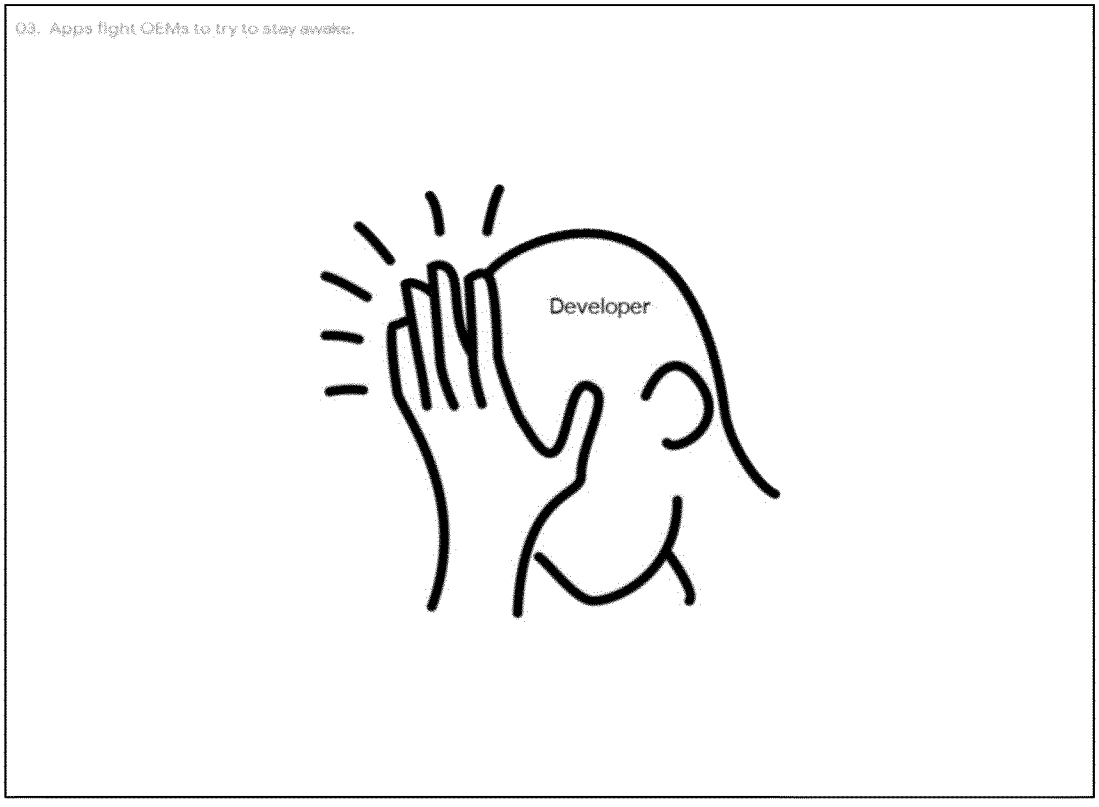

Now if you're an AiC developer, again you try to work with this chaos as best as you can.

How so?

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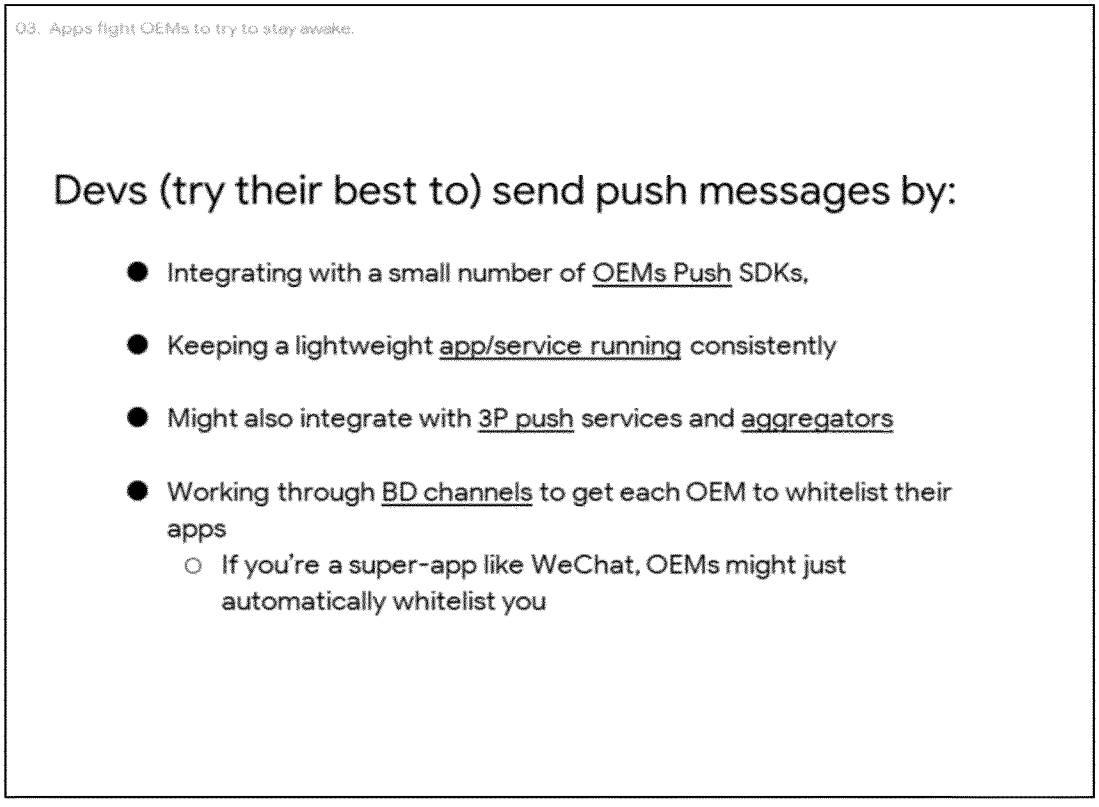

How do AiC devs actually send push messages in China then?

It's essentially a list of switch statements….
If the device is a popular OEM like Huawei or Xiaomi - integrate with the OEM's push SDK!
Else, try to keep a long running service up, and/or integrate with a some 3P push service. This is not very effective, but hey, you gotta try….
Else, you might also ask your BD team to go talk to OEMs, and get your app whitelisted in their devices. Money might change hands here.

The kicker here is that no OEM wants to sell a phone where the most popular apps don't work as expected.
So…. WeChat is pretty much always whitelisted by default, and so their own in-house push solution works great.

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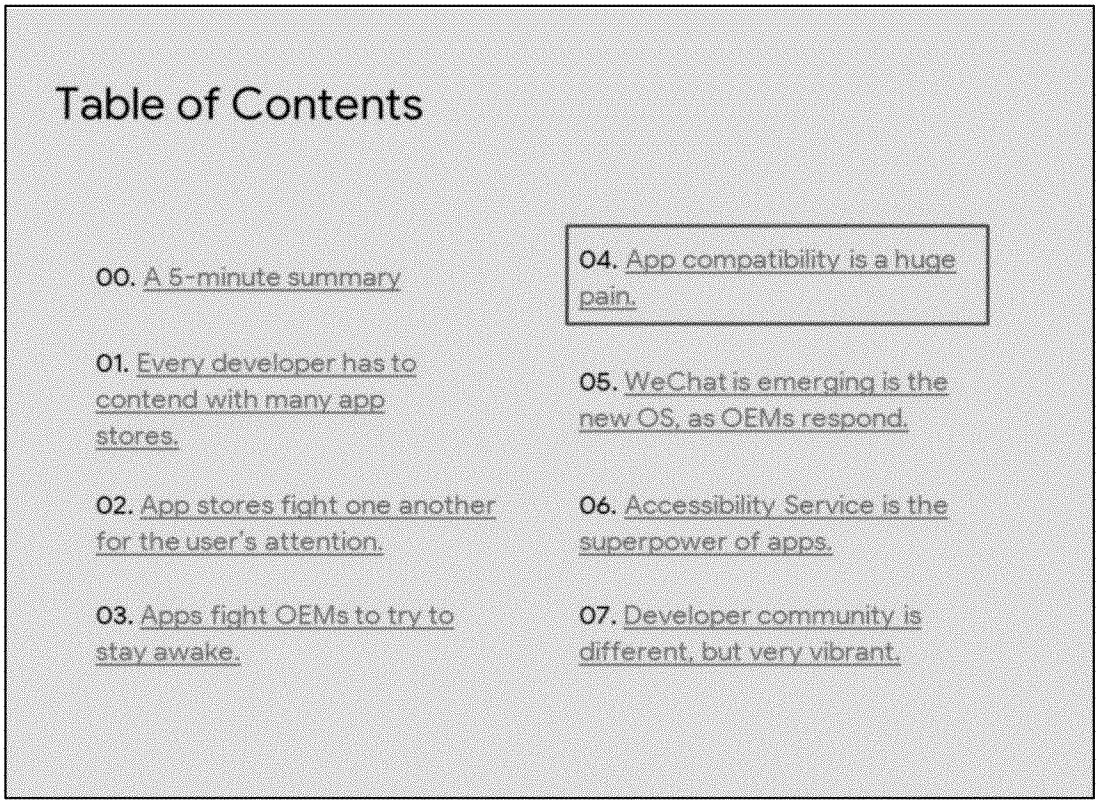

On to the next big challenge in Android in China - App compatibility (or rather, incompatibility) is a huge pain for developers and OEMs alike.

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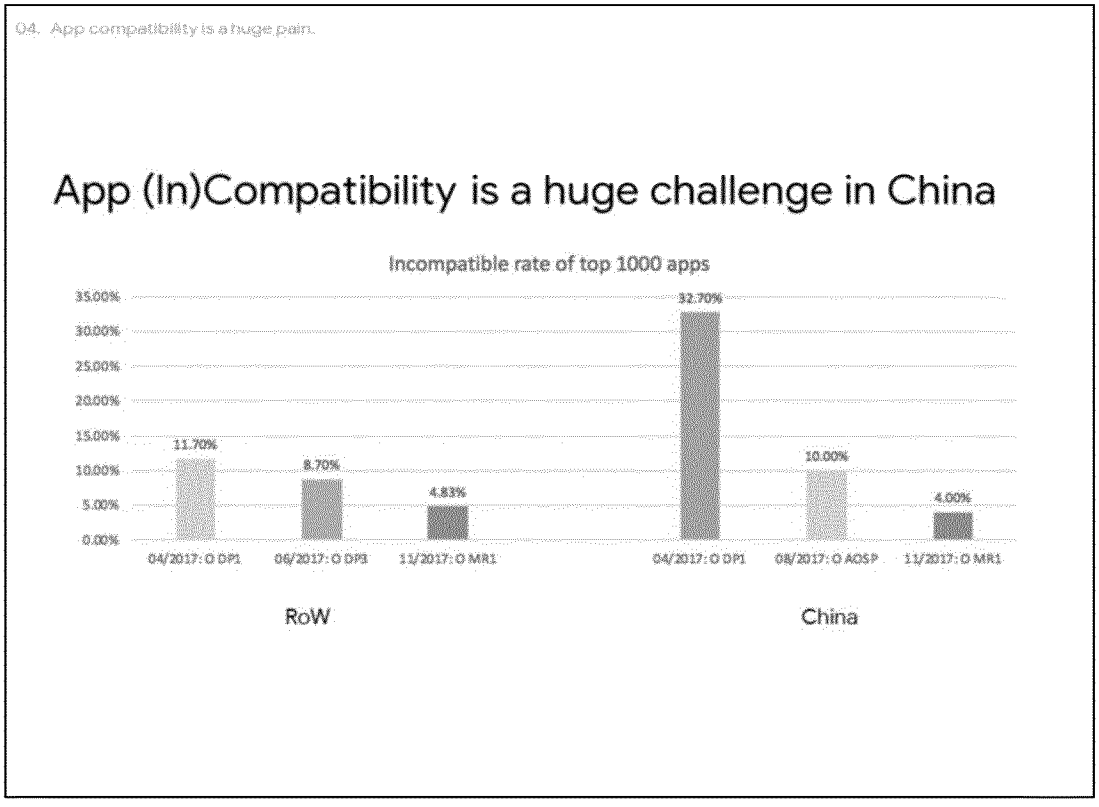

When talking about app compatibility in China, it's typically referring to a large subset of apps being not compatible with newer versions of Android.
To be clear, this issue also exists in RoW, but the severity of it is in a different ballpark in China

When Android O was in DP, the app incompat testing team tested the top 1000 apps on Play and on local Chinese app stores, and compared their incompat rates;
the China app incompat rate is WAY HIGHER at 32.7% vs "just" 11.7% in RoW.

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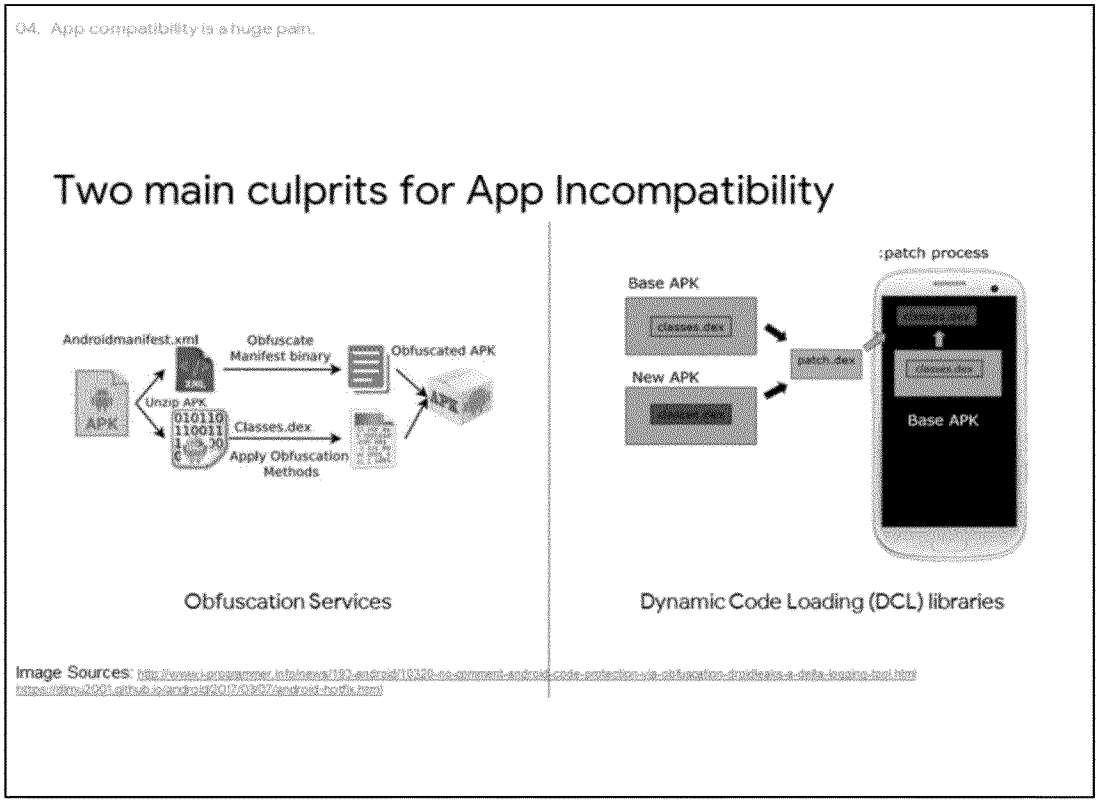

There are 2 big reasons why app compatibility is such a big problem in China - (1) Obfuscation services*, and (2) Dynamic code loading libraries are very, very popular in China apps. Per our testing of top 1000 CN apps in O timeframe, about 70% of compatibility issues are due to obfuscation and DCL.

* In China, “obfuscation” means a lot more than just using Proguard) to protect apps from being unpacked / decompiled then modified / repacked and uploaded to all app markets

These have similar characteristics in that they both:
Use numerous hidden APIs
Directly invoke dex2oat
Manipulate and modify dex / so files
Depend on concrete dex format (such as odex / vdex / cdex) beyond public dex layout
Interfere with the platform’s dex loading logic

Because obfuscation and DCL use a lot of internal knowledge of the Android platform, which often changes in new Android builds without public notification, the apps built on top of such technologies often break on new Android OS upgrades.
E.g. Android N introduced odex, whose AOT compilation broke many DCLs that inject some custom data into dex. As a result, many popular apps including WeChat and Alipay suddenly crashed after being installed for a few days, and developers spent ~2

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weeks to understand and fix the problem. WeChat's DCL framework "Tinker" published a detailed article on this issue.

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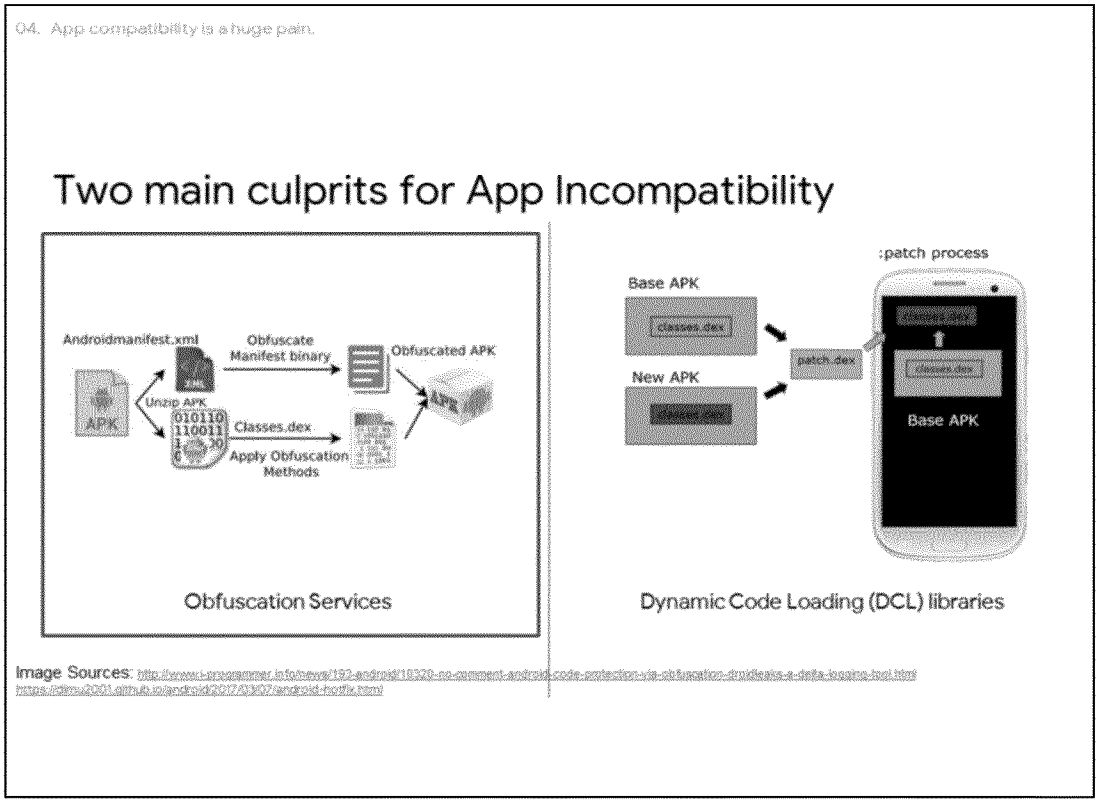

Let's look deeper into the 2 main culprits for app incompatibility.
Starting with obfuscation services …

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Here “obfuscation” means much more than features provided by ProGuard. It often involves one or more of the following techniques:
Dex / SO / resources encryption
VMP / security sandbox
Anti- decompilation / debugging / screen capturing / UI hijacking
Root / emulator / hacking detection
Environment check

For details, check out go/china-obfuscation-report

(There’s also been an analysis done on whether these obfuscators are common on Play or not.
Short answer is: not as of now - we see 302 apps using 9 of the obfuscation solutions, with Tencent and Qihoo360 accounting for ~70%)

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Obfuscator	Developer	Customers	Apps	Devices
Bangcle	BangBang	2K	80K (1K paid)	800M
Ijiami	Ijiami	n/a	10K	900M
360 Jiagubao	360	n/a	800K	1B
Baidu Jiagu	Baidu	n/a	50K	n/a
Ali Ju'anquan	Alibaba	n/a	30K	500M
LeGu	Tencent	n/a	1.5M	1B
Naga	Nagain	280	530	200M
LeBian	Excelliance	n/a	150	170M
appGuard	DigiCentre	41	87	20M

There's no public report of obfuscations statistics, so we asked each individual obfuscator to provide their estimated stats. Note: these numbers are confidential and unauthoritative!
Note that all the obfuscation services are provided as a cloud service - developers upload an apk, wait for processing to happen, and then download the obfuscated APK.

Original replies (in Chinese) from these obfuscators:
Bangcle
加固应用：8万，其中付费应用1000+，均为金融类（银行，证券，基金等），行业大客户（12306，国美等）运营商（移动SDK，联通SDK等）
装机量：按照了加固包的设备有8亿台
MAU：这些数据没有，因为我们的加固壳不联网
建行一个应用就覆盖2亿用户，12306也有2亿不止；还有交通银行，中国银行，16家股份银行，城商行等。再加上证券，基金，运营商等，数据是真实数据
时间有点早，是去年的数据，而且没有包含海外的
(From Huawei) 2000+ customers, 800K apps, 800M devices

Ijiami
我这边统计是2018年近半年的加固应用有：1w+
对应的装机量大致是：9亿+
MAU：这个没有统计过，但是应该能到百万级别以上，因为我们对应服务的银行都有上百家了，就更不说同银行的不同应用了

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appGuard
我們客戶大致上分為金融類、遊戲類、支付類以及一般應用類。金融類和遊戲類占大宗
一些數字提供給您:
目前appGuard已經有41個客戶使用
目前已經有完成87個APP正式上架過
全球使用過appGuard保護APP的終端user超過2千萬次
無MAU數字(客戶沒有提供)

LeGu
移动应用加固市场加固量在100w到200w之间
腾讯移动安全加固应用用户量达10亿级
终端覆盖量达数亿

Alibaba
加固应用的个数(30000+)
装机量 (5亿+，这个数据来源是根据 我们这边top应用他们提供的安装用户来得到的)
MAU (这个我们加固不埋点统计，所以这个数据我这边也不知道)

360
目前我们累计服务了80万+款的移动应用
MAU过亿级

Baidu
加固的应用数量在5W左右
由于没有进行数据收集，所以没有其他的数据提供了。

LeBian
目前使用我们加固的app约150个
总用户量1.7亿
目前的月活800万

娜迦
加固应用约530款
服务客户约280家
MAU约为20亿左右（涵盖国内、国外用户）
包含金融业领域、unity3D游戏领域、运营商、政府财政、国家电网、地产等

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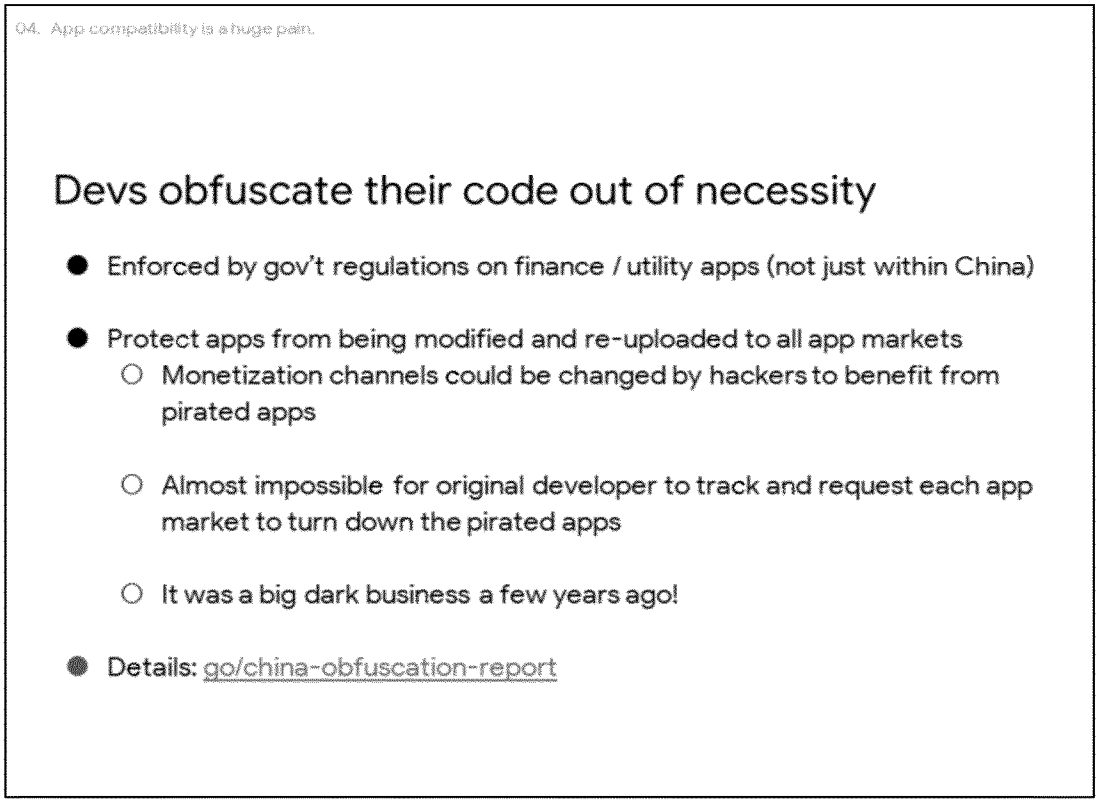

In RoW: as there's only 1 app market (Google Play), it's very easy for original developer to track pirate apps there and request Play to turn them down.

Some government regulations:
China
List of financial software standards:
http://www.bzmfxz.com/biaozhun/Soft/JRJRBZ/List_1.html
Chinese Central Bank file #192 (with highlights):
https://drive.google.com/open?id=1dr7SXIc7AWfYJeLopspLW4EkrFk9Pnuw
Taiwan (Financial Supervisory Commission + Industrial Bureau of Ministry of Economic)
Regulations Governing the Standards for Information System and Security Management of Electronic Payment Institutions
Chinese: http://law.fsc.gov.tw/law/LawContent.aspx?id=GL001541
English: https://law.banking.gov.tw/Eng/FLAW/FLAWDAT0202.aspx?lsid=FL076769
Regulations of mobile apps provided by financial institutions:
http://www.rootlaw.com.tw/LawArticle.aspx?LawID=A040390041063200-1060620
Mobile apps security regulation v1.1:
https://drive.google.com/open?id=10XgJKhRCrVujg8BRATb9uhlPxFg_0zSZ

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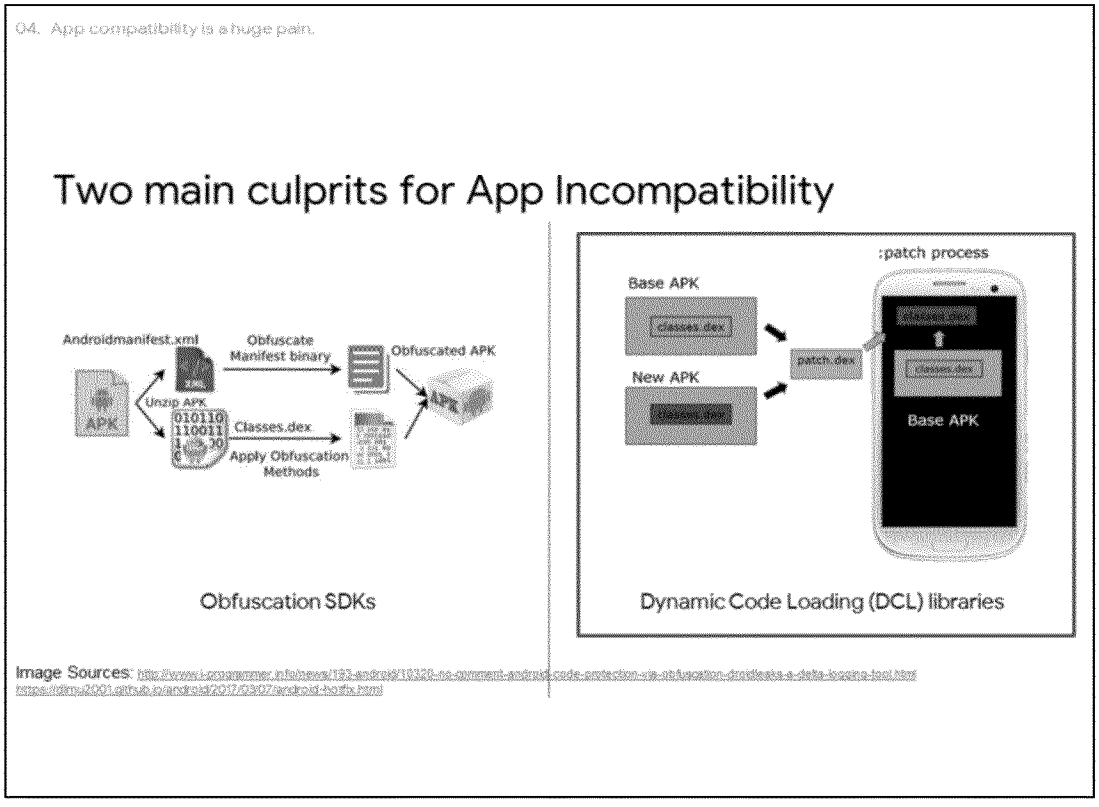

DCL is the other main reason why app compatibility is such a pain.

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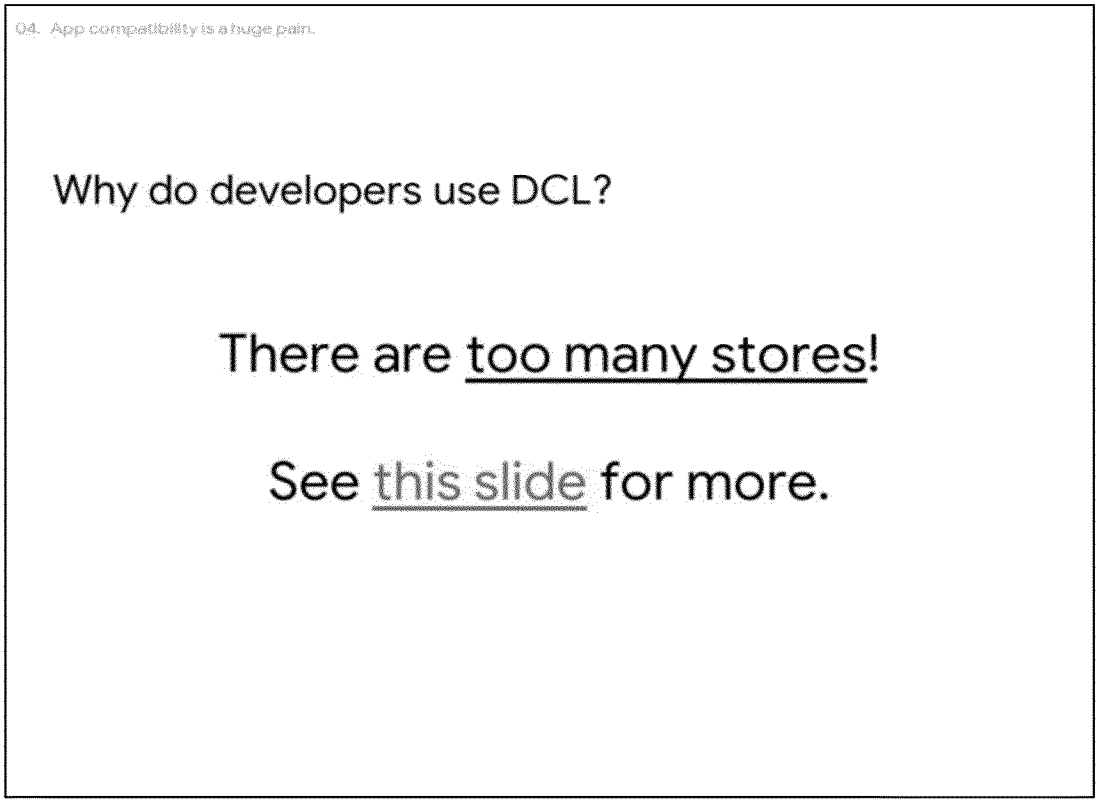

And the reason why DCL is used is simple… too many stores!!

And worse, as we have already explained, OEMs stores fight 3P stores for attention…. So devs have to figure out a way to take things into their own hands. Refer to this slide for more details.

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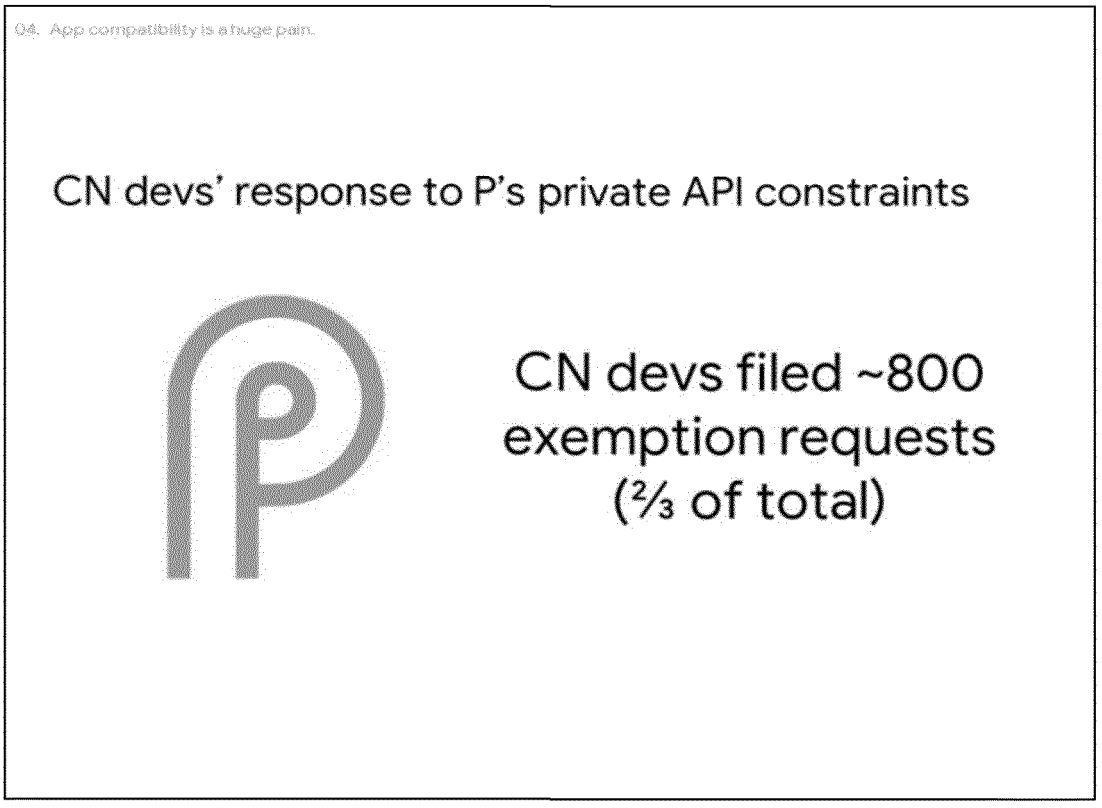

To get a sense of how big this issue of app incompatibility is, consider this:

After we announced that Android P will start to enforce constraints on non-SDK interfaces (blog, DAC), Chinese developers filed requests for ~800 (out of ~1200) private interfaces for exemption requests during P preview.
Requests from CN developers: https://b.corp.google.com/hotlists/1027617 (some FR contains many APIs)
Requests from RoW developers: https://b.corp.google.com/issues?q=componentid:328403%20-hotlistid:1027617

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As we have already established, there are many OEMs in China (~10 big ones, plenty of small ones). These devices also lack GMSCore and suffer from intentional / unintentionally inconsistent behavior. (e.g. on some meizu device it just crashes when app tries to read phone book.)

(We also set up a dedicated project to prompt CN app compatibility.
If you have any questions or feedback, please feel free to contact cn-app-compat-core@.)

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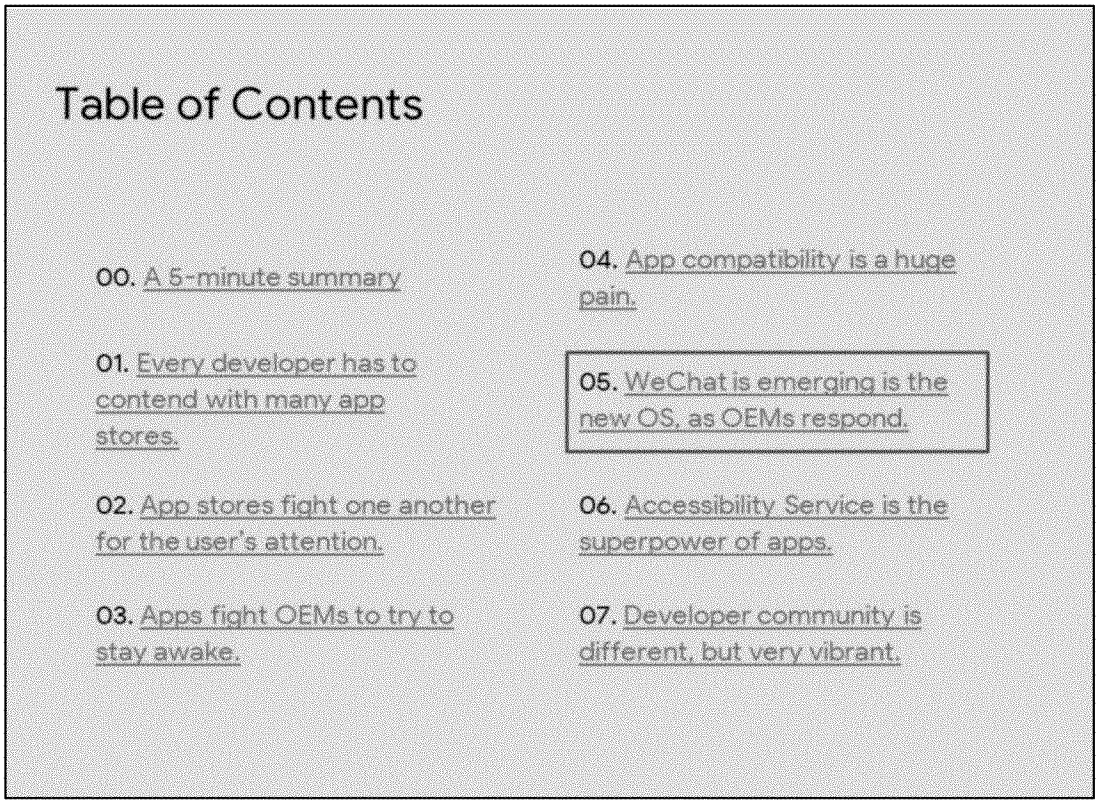

The complexity in Android in China (so many app stores to distribute to, app stores fighting with one another, OEMs having a lot of leverage in the ecosystem but also contributing massively to fragmentation, etc.) makes things very difficult for developers, and users frequently see this pain.

Developers and users naturally gravitate towards an ecosystem with reduced complexity, but without sacrificing user reach……and it would be a plus if such an ecosystem were cross-platform too.

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When we think of “user reach” in China, WeChat is the king of the hill. WeChat’s prowess as a user engagement black hole is well-known, so this is just meant to be a simple overview.

What is less well-known is how WeChat services the “content creator” side of the equation - the publisher / business side.

Before 2017, there are 2 primary ways - as “subscription accounts”, or “service accounts”.

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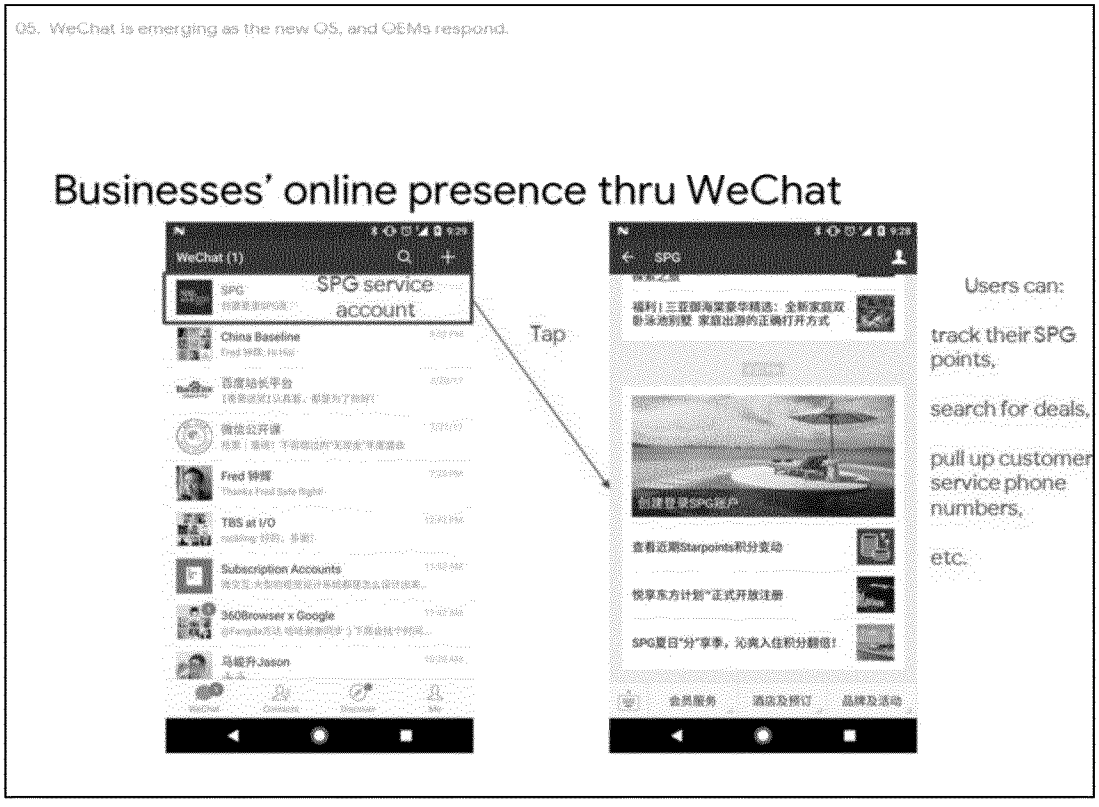

Before 2017, there are 2 primary ways thru which businesses engage with users on WeChat - as "subscription accounts"（订阅号）, or "service accounts"（服务号）.
I won't go into too much detail on what the differences between "subscription accounts" and "service accounts" are.
What is important are what they both are - they are templatized UI with customizable menus for businesses to build on (Think Facebook pages for businesses.)

This means developers don't have full control over the canvas - they are largely bound by the templates' look and feel.
Devs can provide their own URLs that open in webviews in WeChat - in essence, they are a dynamic bookmark of web links, laid out in an orderly fashion.

That's great, but it's not really an app. Developers want more control.

(Feel free to read on the details with subscription and service accounts (and other nitty-gritty stuff) at this deck here.)

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WeChat Mini-Programs - the new OS layer

- Launched Jan 2017
  Deep Dive: go/wechat-miniprograms
- *"Apps will be everywhere, usable at any time, without the need to be installed or uninstalled."*
- Essentially a blank canvas for developers to build any sort of user experience using web-like tech
- Can leverage WeChat's identity and payments APIs

KFC's Mini-Program

In Jan 2017, WeChat launched Mini-Programs - their take of a platform and ecosystem, and essentially introducing an OS layer inside the outer Android OS. Discovery happens through a prominent tab within WeChat.

I'll recommend checking out the go/wechat-miniprograms for a deep-dive, so this is a very high level overview of what it is.

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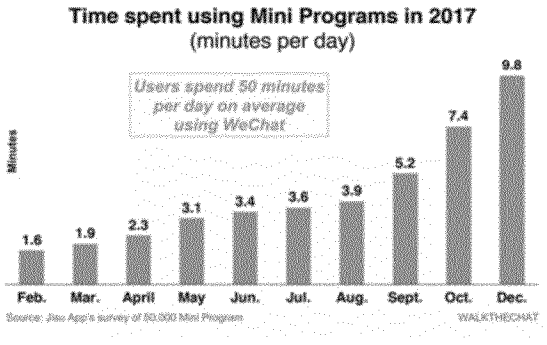
WeChat Mini-Programs getting popular with users

- Users spend 9.8 mins/day (~20% of all WeChat time) on Mini-Programs
- Only 2.1% of Mini-Programs have a native app
  - Conclusion: it's consuming traditional mobile web traffic



Source: https://mp.weixin.qq.com/s/v35poXlsHB1BYk_V7oinBQ

After a slow start, it's now doing GREAT.
Users now spend 20% of all WeChat time in Mini-Programs.

New capabilities have also been added, e.g. offline-online scenarios (hyperlocal / nearby detection, proprietary 2D barcodes), ads support, 3P extensions, etc.

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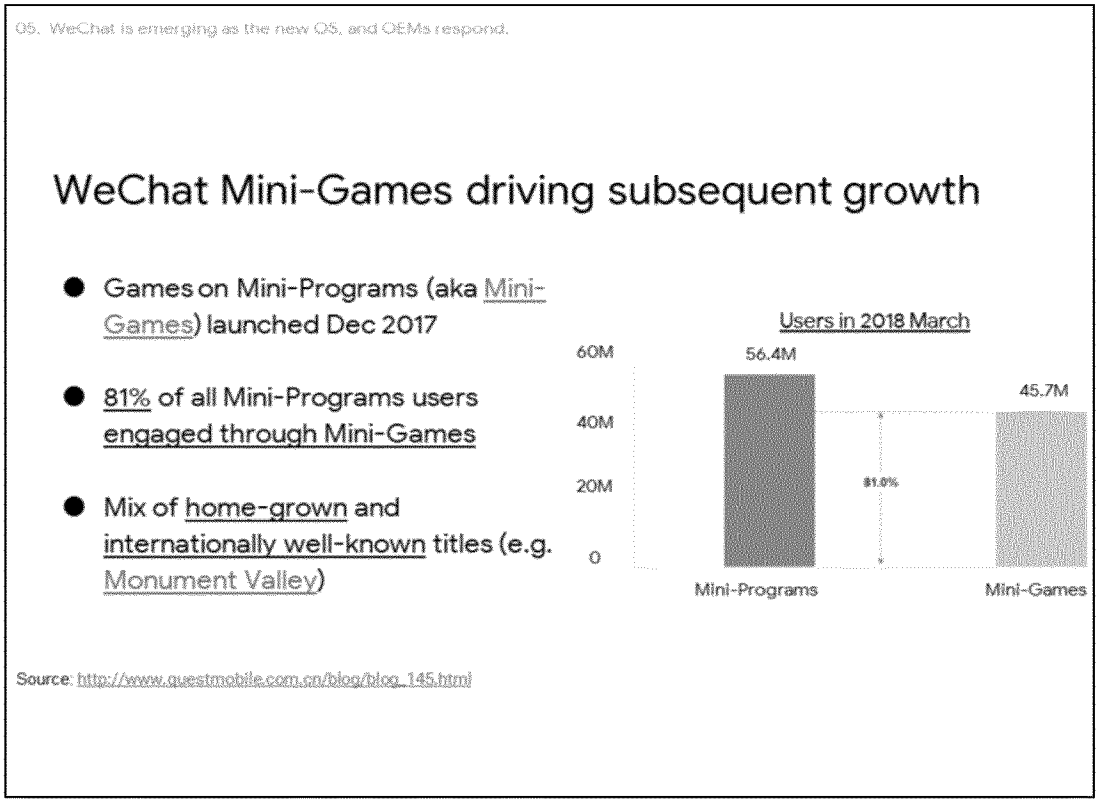

Mini-Games (essentially just games on Mini-Programs) followed about 12 months later, and it drove quite a bit of growth as well.
Data point: Nike paid 3M US dollars for an advertising spot in the Mini-Game hit “Jump Jump”

Mix of titles as well:
Home-grown titles e.g. “Jump Jump” - hundreds of millions uf users accumulated, with 7 day retention rate of 52%.
Well-known titles, e.g. “Monument Valley 2” - 4.8M users accumulated by March 2018, 2 months after launch

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Id	Date	Text
6	07/04/2018 01:54:18	thanks for sharing the link Jichao! which data specifically? these 2 links' data seem to give complementary (rather than opposing) perspectives I think?
1	07/11/2018 23:38:28	+micyeung@google.com Another data accuracy issue: this data is significantly different from this one: https://36kr.com/p/5140957.html
2	07/11/2018 23:38:28	right, but the 36kr states the monthly active users as of June is 280M, which is roughly 3 times of the number the graph states. I'm not sure if the mini-app multiplied by that much in three months?

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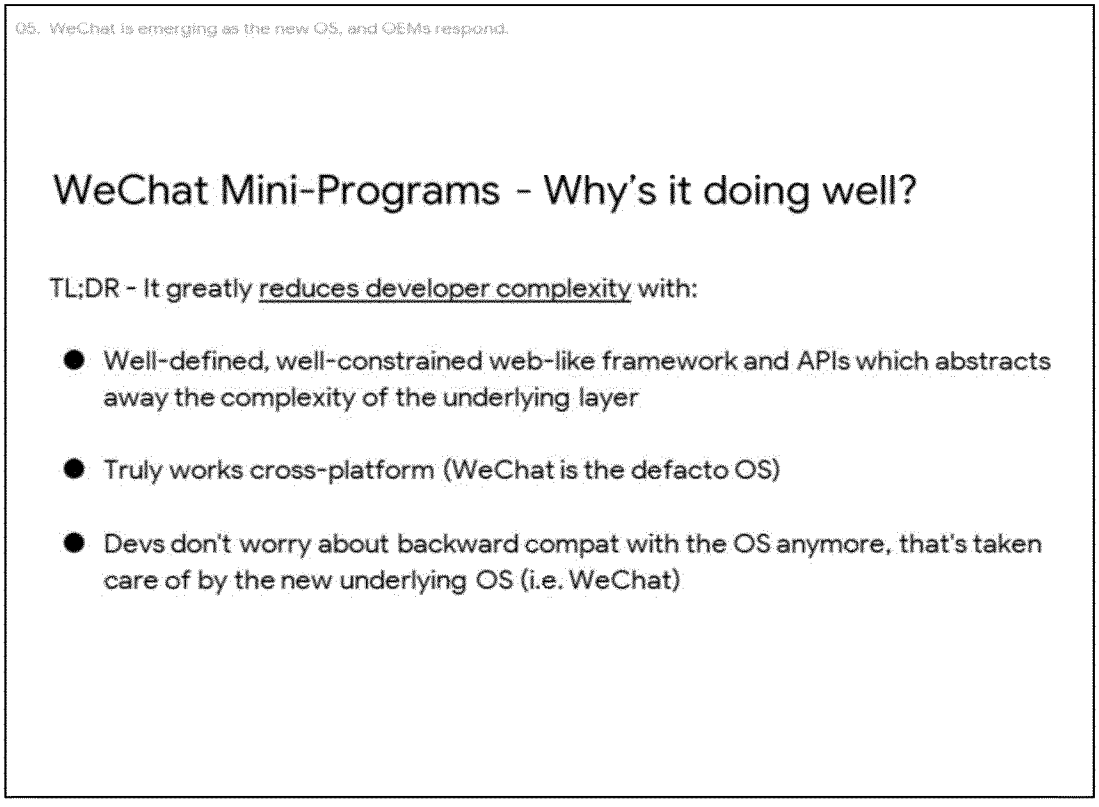

Ultimately, the big reason why it's doing well is …. It's integrated into WeChat!
But besides that obvious reason….. Why is it doing well?

My analysis for why WeChat Mini-Programs have gotten the success that it has gotten so far.
Well-defined web-like framework, so devs don't have to deal with the complexity of the underlying layer.
This makes it truly cross-platform.
It's also backward compatible, since WeChat takes care of that part.

When speaking of CN devs, they frequently mention how fast it is to build. Statements like "~1 day for a professional outsourcing company on a non-complicated job" are pretty common.

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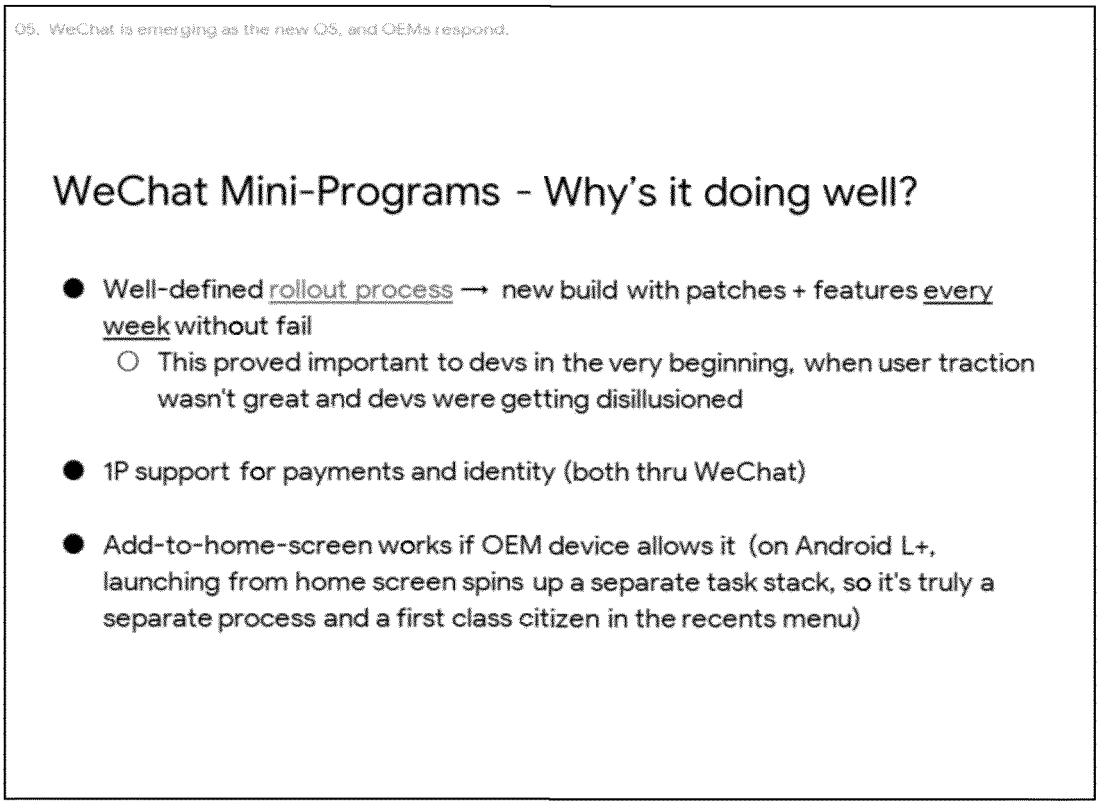

- In the beginning, devs were not so hot about the platform, and a well-defined rollout process turned out to be important that shows WeChat's commitment to the platform
- Support for payments and identity (WeChat Pay and WeChat signin)
- A2HS works (as long as OEM device allows for it)

- The first 4 points mirror AMP's merits.
- The last 2 points mirror where PWAs want to get to but are not close to solving across the whole mobile web ecosystem, especially in China but also more generally around the world.

- Still, IMO all of that pales in comparison to WeChat's network effects + prominent placement within WeChat.

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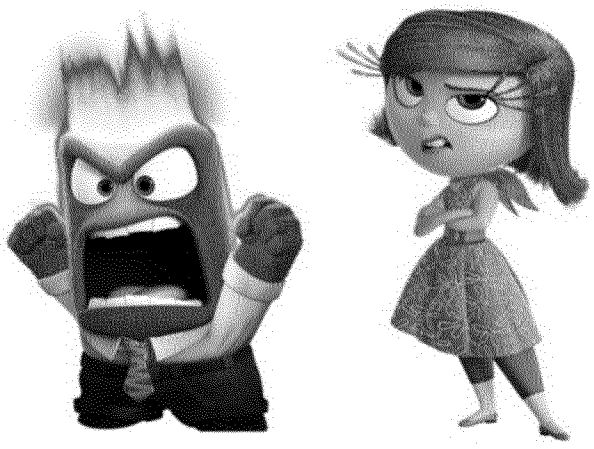
Response from OEMs + other 3P Whales



If you think Facebook (and Google) are aggregators, per Ben Thompson's aggregation theory, then WeChat is stepping right into aggregation on steroids.

OEMs and other 3P apps are obviously threatened by WeChat's dominance; so how do they fight back?
OEMs and other 3P Whales (those not named Tencent) scramble for a response to Mini-Programs.

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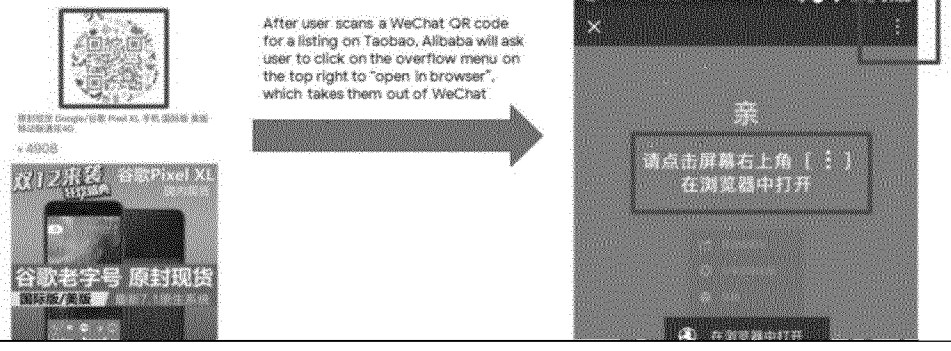
Other 3P Whales' view of WeChat's ubiquity

"We actively look for WeChat's in-app browser's user agent string, and try to get users to leave it."

- Liu Jingyang (刘进洋), PM Lead for Alibaba



To say that Tencent / WeChat's competitors in China are worried about WeChat being a user engagement black hole is an understatement.

Alibaba actively tries to take user out of WeChat and into their own properties.

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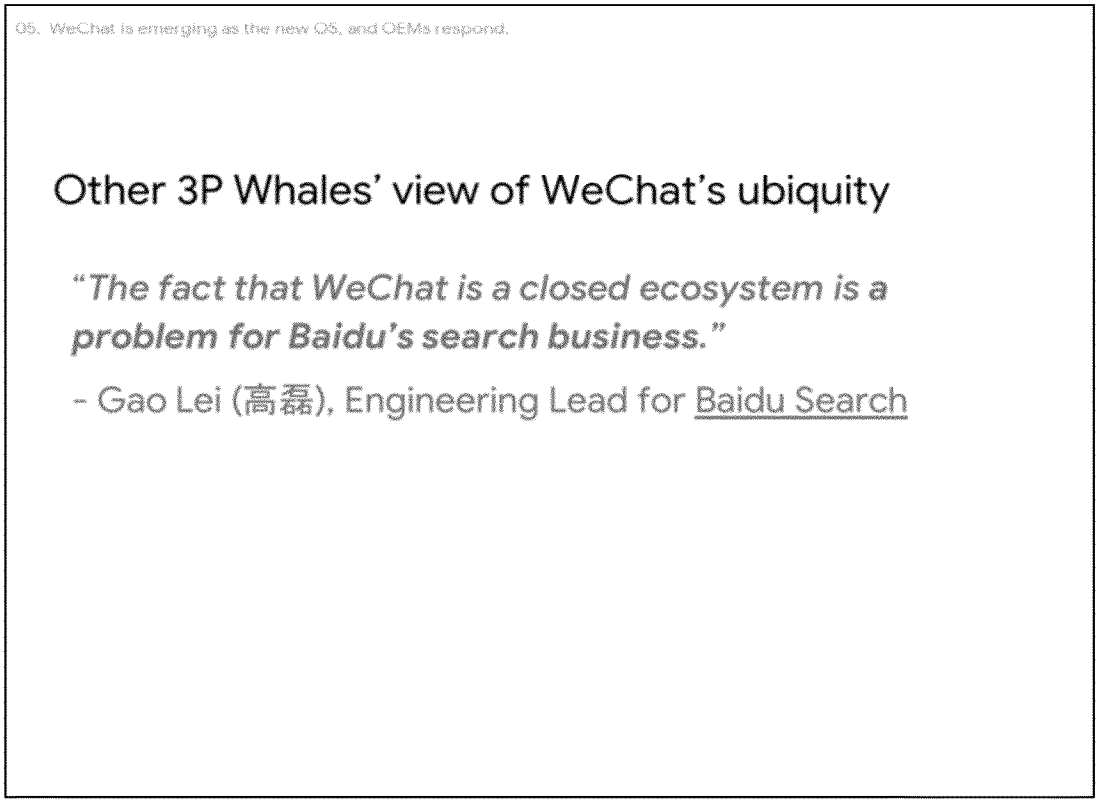

Baidu is under even more threat from WeChat's ubiquity.

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AliPay and Baidu have both announced their own Mini-Programs ecosystem to get into the game.

AliPay has a massive user base as well with their Payments integration (which WeChat does not support), so it might be interesting.

(It is harder to see how Baidu's take on this can succeed… they have neither the social graph nor the payments piece in place for users to re-engage).

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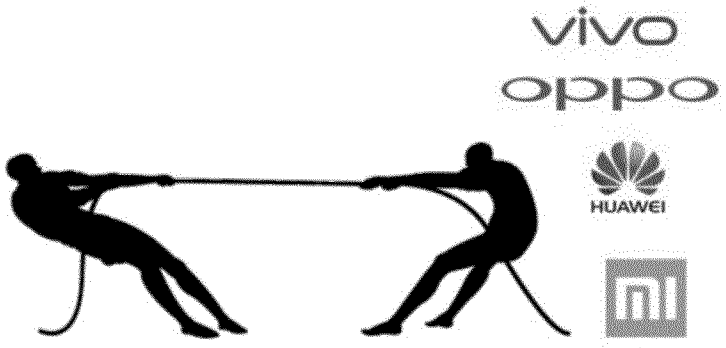
OEMs want a piece of WeChat's user engagement



As we have seen throughout this preso, a common theme is this → OEMs will insert themselves into critical user journeys to get a piece of the action.

With WeChat getting a bigger and bigger slice of user engagement, we see OEMs doing things that only they can do through changes and event interception on the OS layer.

Let's look at some examples.

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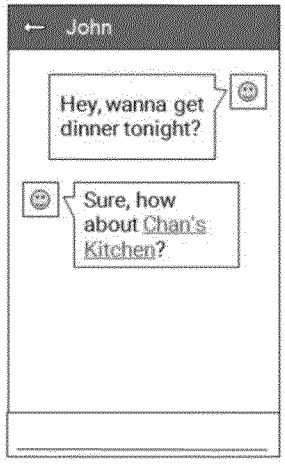
Funneling users to other apps (Huawei)

- "Smart Push service" on some Huawei's Honor Magic devices actively monitor users' WeChat messages
- Interesting text snippets (e.g. restaurant names, product listings, etc.) are changed to become links that take users outside of WeChat
- Both sides get lawyers involved



HUAWEI

User experience:
User receives a restaurant name in a WeChat message
Restaurant name (the plain String text) in message is changed by the OS to become a URL
User clicks on URL, and is brought outside of WeChat into Dianping (similar to Yelp) app

Huawei has temporarily disabled this feature after pressure from WeChat

The major philosphical question:
Whose user is it? Is it Huawei's user? Or Wechat's user?

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Funneling users to other apps (Xiaomi)

- Xiaomi's MIUI9 actively monitors users' WeChat messages
- Popup dialog shows at the bottom when interesting text snippets (e.g. restaurant names, product listings, etc.) are detected on long-press

Another example, this time on Xiaomi's MIUI9
User experience:
0:00 - User receives a restaurant name ("眉州东坡") in a WeChat message
0:02 - Pop-up window shows at the bottom of screen, with the Dianping (Yelp of China) link to the restaurant
0:04 - User clicks on link, gets brought to Dianping app

Xiaomi has temporarily disabled this feature after pressure from WeChat

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Recording WeChat Payments (Xiaomi)

- Xiaomi's MIUI9 actively monitors users' P2P WeChat payments
- When a P2P transaction is made, Xiaomi records the transaction on behalf of the user
- User sees this information in various Xiaomi surfaces like Xiaomi's Assistant and "My Expenses" app

Another Xiaomi example, also on MIUI9.
Users get their WeChat payments automatically recorded into a Xiaomi app.
User Experience
0:03 - User sends ¥0.02 to friend thru WeChat
0:07 - User confirms transaction
0:10 - Notification from Xiaomi's "My Expenses" app that "transaction is recorded"
0:13 - Xiaomi's "My Expenses" app shows transaction recorded
0:16 - Transaction also shows up in Xiaomi's GSA equivalent

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05. WeChat is emerging as the new OS, and OEMs respond.

Automatically click thru apps (Samsung)

SAMSUNG

- Works with 18 top apps (WeChat, Taobao, Didi, AliPay, etc.)
- User can operate these apps with voice through Bixby. E.g.
  - "In WeChat, send ¥10 to John"
  - "In WeChat, send latest pic to Jane"
- OS automatically clicks through screens (via Accessibility Service) to perform the necessary user actions

Source: http://www.sohu.com/a/207822047_413981

With Bixby 2.0's launch in China in 2017 November, Samsung took things one step further.
Users can use their voice to basically command Bixby to click through screens and take actions on other apps (presumably using Android's Accessibility Service).

Note that there is NO API integration here between Samsung and WeChat (or other 3P apps).
It is unilaterally (AFAIK) something that the OEM (Samsung) has done. There is an opt-in function when a user enables Bixby, but once that happens, everything is fair game.

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As we have seen throughout this deck, OEMs is where things get most interesting.

They do not just want to become a dumb pipe for bits to flow through, but rather want to get a slice of the user engagement pie.
Viewed from this lens, WeChat's Mini-Programs is an existential threat to them.

Their answer - an alliance of OEMs supporting a new standard - launched about 1 year after WeChat Mini-Programs, and it's dubbed "Quick Apps".

A longer English explanation: https://medium.com/@pandaily/huawei-xiaomi-and-7-other-manufacturers-launch-unified-quick-app-rivaling-wechat-df537526d28

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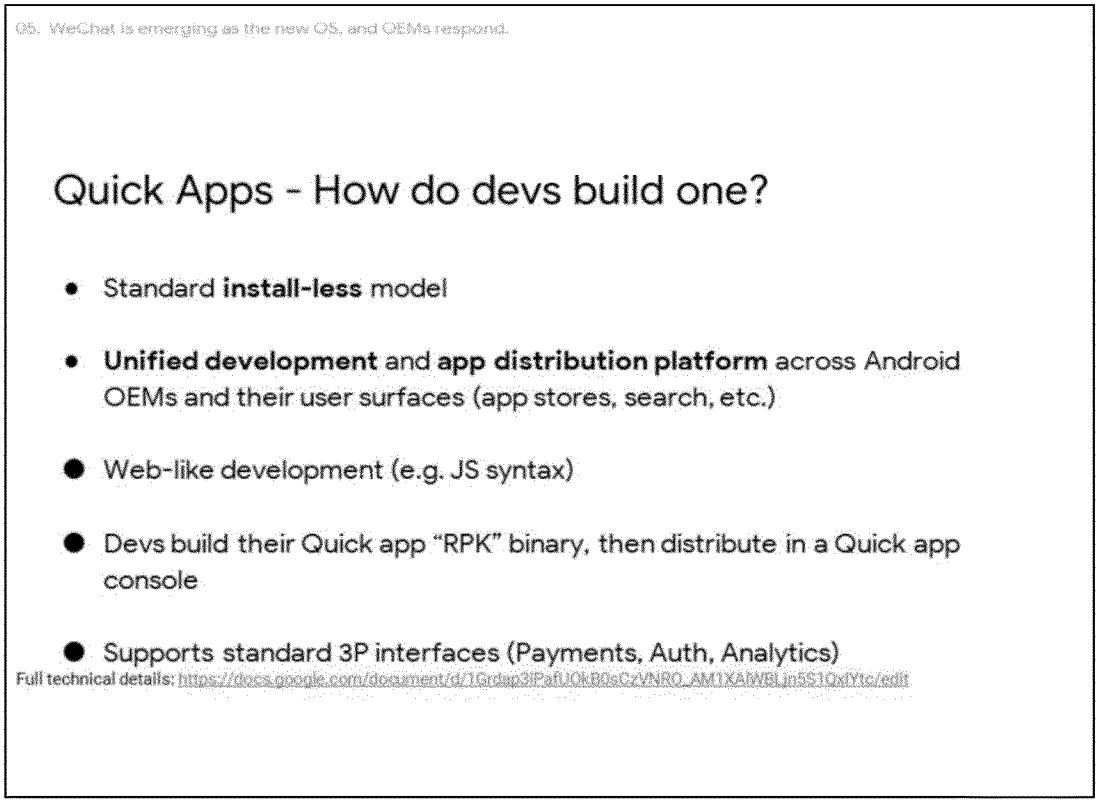

In terms of developer experience, the similarities between Mini-Programs and Quick Apps are apparent:
They both follow the "install-less" user interaction model (which really, is the same goal that both Instant Apps and PWAs are striving towards, though thru different technical paths)
Development will feel familiar to JS developers (CSS for styling, Node.js and NPM to pull in modules, etc.)
Support for Payments, Auth, and Analytics

Where the technical advantages (and disadvantages) lie are also apparent:
WeChat Mini-Programs are truly cross-platform (works on Android and iOS, since WeChat is the layer)
Quick Apps, being blessed by the OEMs themselves, have a clear path towards solving those developer-facing problems described in this deck by abstracting away the underlying complexity. (e.g. letting Quick Apps be installed without friction, supporting Push, etc.)

(Not sure if this is official, but) some of the docs and example code are hosted on this domain https://www.w3cschool.cn/quickapp/, which goes to show how tightly coupled web development now is for such proprietary frameworks.

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The fact that Quick Apps are OEM-blessed is HUGE.
It means that OEMs' apps (which are all pre-installed on those OEM devices) can serve as discovery channels for Quick Apps.

For Huawei, the Huawei App Store now shows Quick Apps in search results, and they have a curated section just for Quick Apps.
Every time a Quick App is opened, there will also be a prompt for the user to add it to home screen, which then serves as the primary re-engagement mechanism.

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For Xiaomi, in addition to the Xiaomi app store, they have also enabled the Xiaomi Browser as a discovery channel for Quick Apps.
A search within the Browser will allow users to get to a Quick App in one-tap.

For screenshots of other stores (I don't have all OEMs' phones unfortunately), check out this forum link.

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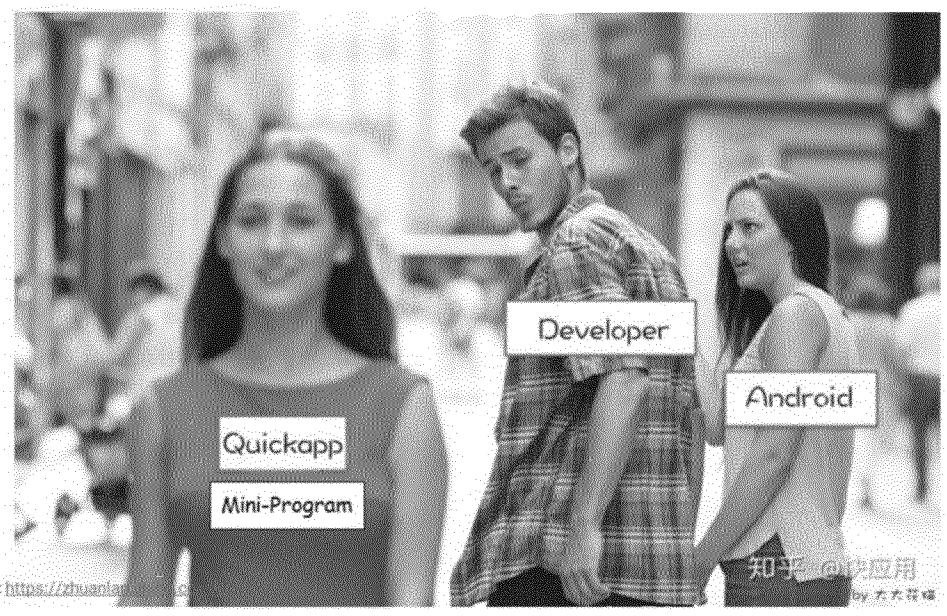
05. WeChat is emerging as the new OS, and OEMs respond.



Source: https://zhuanlan...

Now the fear is…. Will this phenomenon of Quick Apps and Mini-Programs also be exported abroad as these OEMs sell more and more devices outside of China (just like how it happened for Push Notifications)?

There are no official stats yet on how well (or not well) Quick Apps are doing, but there seems to be reasonable developer interest:
Huawei and Xiaomi app stores both have hundreds of Quick Apps in the curated sections.
Github has ~600 repos with the term “快应用” (Github search doesn’t allow specifying exact String matches though, so the actual number is probably fewer)
https://github.com/search?q=%E5%BF%AB%E5%BA%94%E7%94%A8
Google crawl of Github for exact match of the String “快应用”

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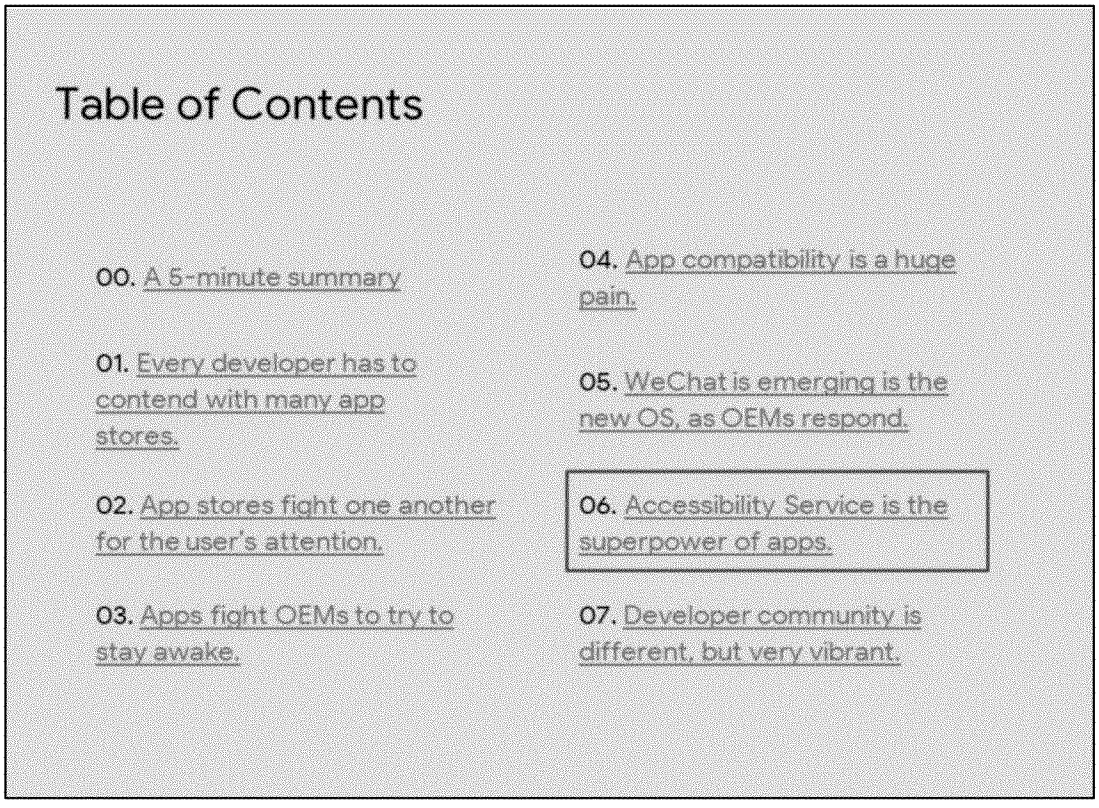

We have talked about this at some length, but it bears reiterating -
Accessibility Service provides apps with the power to perform actions that would otherwise not be possible (without rooting anyway) ….. Click through other apps, read notifications, add floating UI, etc.
The Android framework gives freedom to users to decide if a particular app is “worthy” of getting this superpower; the user has to click through the Settings menu to grant an app access to this superpower.

This lends the Accessibility Service to abuse; as long as an app can convince a user to grant it access to the Accessibility Service, the app abusing the Accessibility Service (abuser) can pretty much do anything, including going accessing the data of another app (abusee app).

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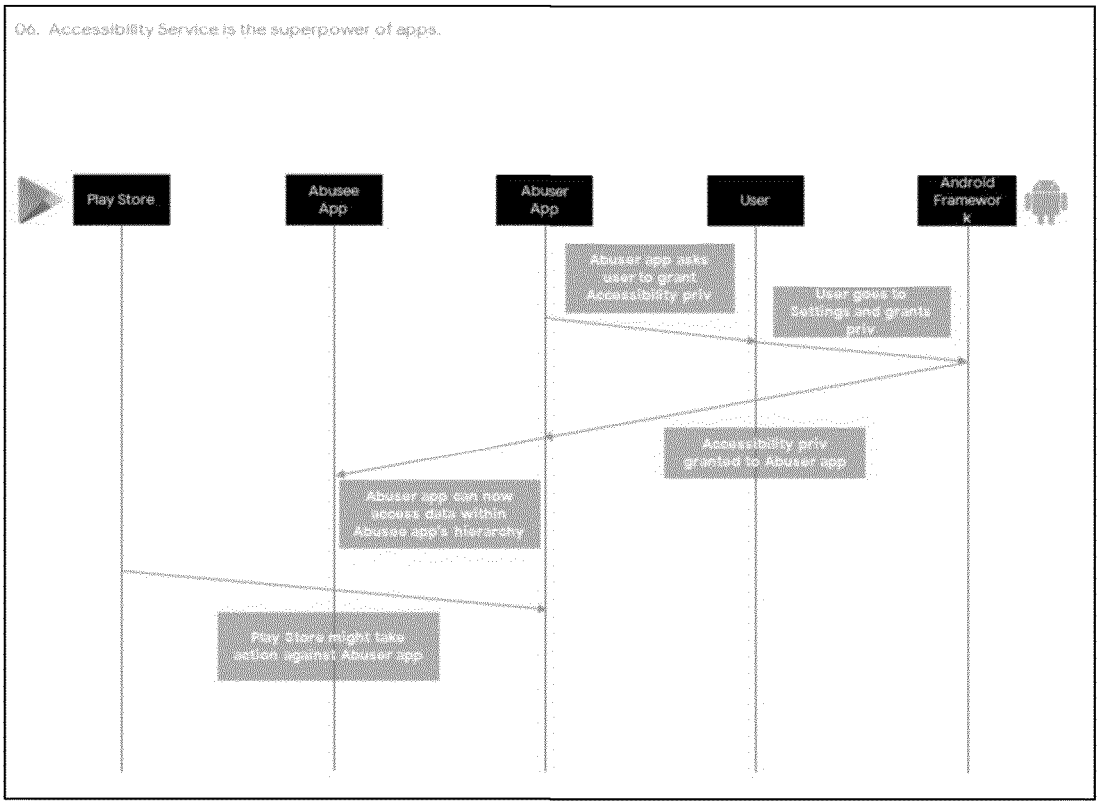

Most use cases come down to the abuser app helping the user perform tasks in another app (abusee).
(As we shall see, some examples include: automatically skipping through ads, receiving red packet money quicker than anyone, etc.).

It should be acknowledged that many abuser apps that (ab)use Accessibility Services (besides actual accessibility-related use cases) do so with the intention of providing real user value.
While both the user and the abuser app have control over the experience, the abusee app has no control and no say over how the abuser app handles its data. The abusee app relies on the Play Store to enforce policy to restrict the behavior of abuser apps……

(Useful link: https://sspai.com/post/43889)

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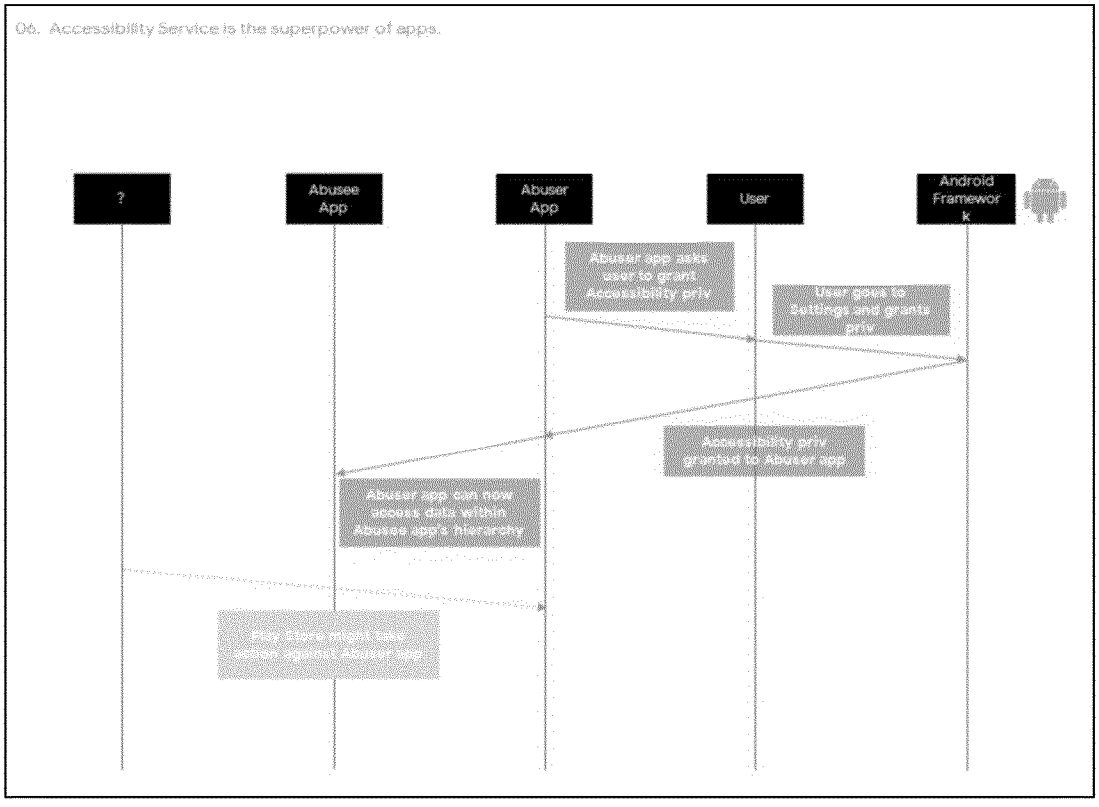

… but as we already know, this doesn't work in China without such an enforcement across all the different stores.

We have already seen Accessibility Service being used in 3 different ways times in this preso for China-specific use cases:
3P stores (Link to section) using Accessibility to automate clicking through app install barriers put up my OEMs
Cleaner Apps (Link to section) using Accessibility to force-close other apps
Samsung Bixby (Link to section) using Accessibility to automate the clicking through of apps on a Samsung phone

Let's look at more examples.

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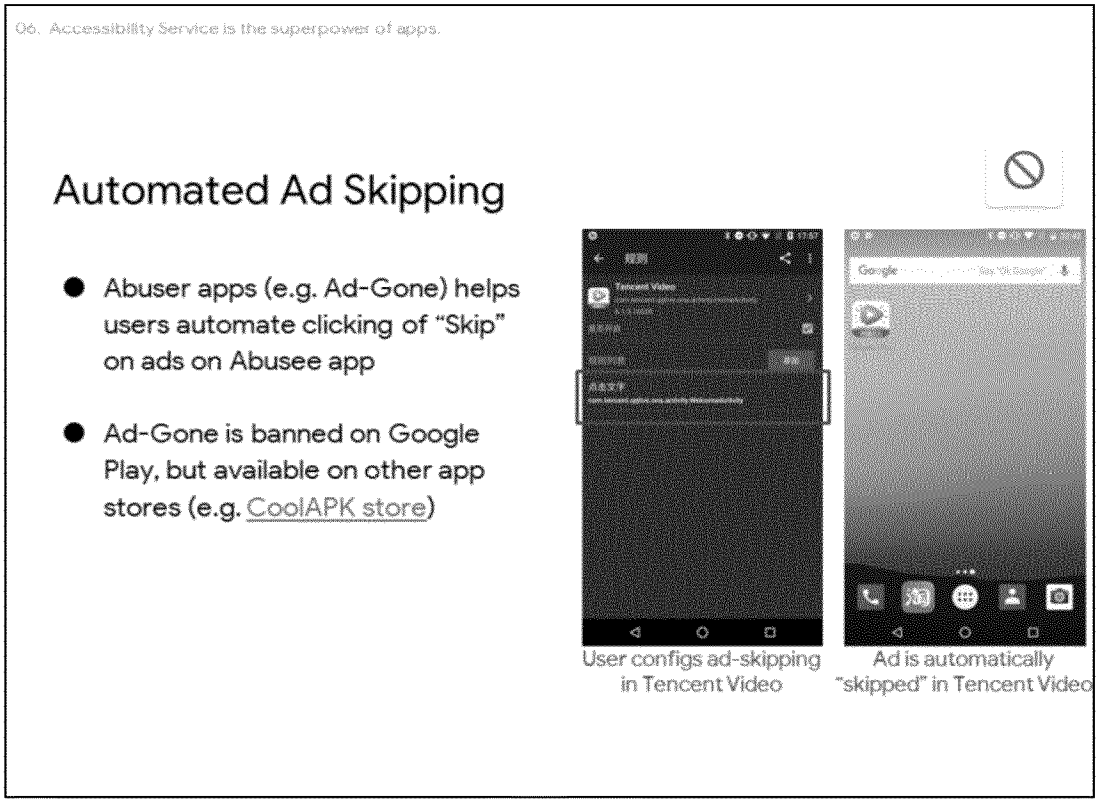

Ad-skipping is one common abuse.
On Ad-Gone (八戒助手） for instance, a user can configure the automation of tapping when the Activity loads; user would typically configure that to tap on skip-ad buttons (which is also the primary use case for this app).

(See http://www.iapps.me/archives/121 for more screenshots)

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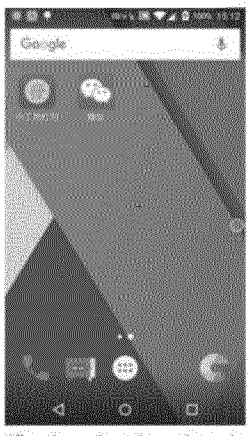
Red Packet Snatching

- Giving money in the form of "red packets" is a Chinese tradition. WeChat first gamified this experience so receivers might get random amounts in a **first-come-first-serve** manner.
- Abuser apps (~750 of them in market) automate the receiving of these red packets as they arrive.
- Renders gamification irrelevant as a form of user engagement tactic

Source YT video: https://www.youtube.com/watch?v=LUBpPW-6sU



WeChat notification signals red packet incoming; automatically clicked through to receive ¥

Red packet snatching is probably the most prominent example of Accessibility Service abuse.

(Background: it is Chinese tradition for folks to give money as gifts to others in the form of "red packets/envelopes". This is most common during Chinese New Year, in addition to other celebratory occasions - weddings, birthdays, etc. WeChat Pay gamified this experience → I can send ¥10 to a WeChat group of 5 people, and set it such that only the first 3 people get any money at all, first-come-first-served. Users are trained to keep checking their phone for incoming red packets, and this drove huge user engagement. AliPay and others soon followed suit with such a feature.)

There are A TON of red-packet snatching apps in market, the majority of which are using some form of Accessibility Service abuse to automate the process of receiving. This causes a lot of angst with WeChat/AliPay etc., as it essentially renders gamification as a form of user engagement tactic irrelevant.

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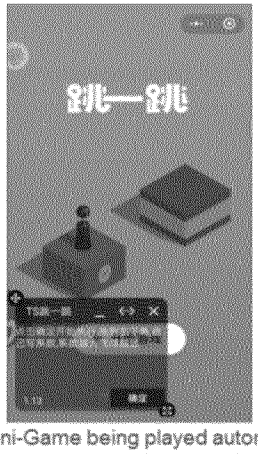
Automated Game Playing

- Automatically play games that require only simple gestures (e.g. press-and-release, tapping)
- Example:
  - WeChat Mini-game - "Jump" (跳一跳) has 310M users on 7DAU of 52%.
  - Auto.js is a 3P UI Automator app that automates playing of Jump, helping users quickly climb the leaderboard

Source: https://github.com/hyb1996/WechatJumping.js



"Jump" Mini-Game being played automatically - Long-press and release to jump varying distances

Game playing automation through Accessibility Service is also emerging as a trend, especially with games which only require simple gestures to play.

Jump (跳一跳) is one of the biggest hits on WeChat Mini-Games platform, with 310M users on 7DAU of 52%. Its gameplay is super simple - users simply use a press-hold-release gesture, and the figurine jumps a distance proportional to how long the user pressed-and-held the screen, trying to jump from one platform to another.

Its success led to automation tools popping up (e.g. Auto.js), which uses Accessibility service to automate the gameplay.

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01. Every developer has to contend with many app stores.

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05. WeChat is emerging is the new OS, as OEMs respond.

06. Accessibility Service is the superpower of apps.

07. Developer community is different, but very vibrant.

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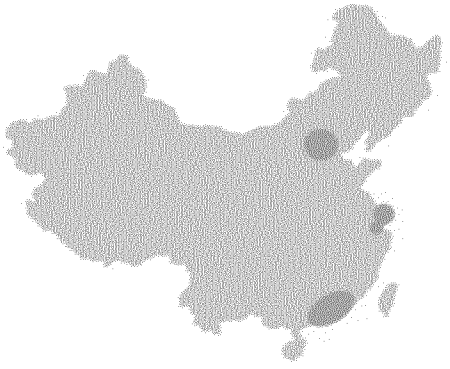
Where are the developers?



- **Concentrate in tier-1 cities**: Beijing, Shanghai, Guangzhou, Shenzhen
- Why?
  Where **internet giants are headquartered**. Start-ups by ex-workers founded nearby
- Several **tier 1.5+ cities**
  Hangzhou, Chengdu, Nanjing, Xiamen, Wuhan

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Demographics - mostly male + working long hours

- 72% Male, 28% Female (Ok, this isn't unique to China)
- **Younger crowd**: 85% under age 34
- **Overtime = situation normal.** The "996" lifestyle = work 9am-9pm everyday for 6 days a week
  Average weekly working hours 47.5
- **Rather stressful.** Workload, property ownership, and health.

Sources: Jiguang 2018 China developer research report
Getui China DevRel report

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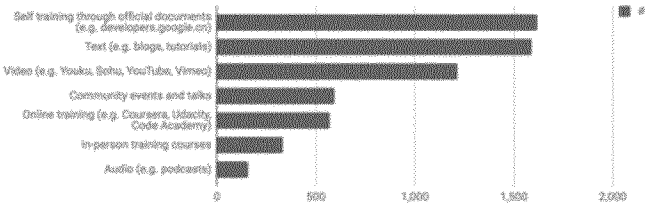
07. Developer community is different, but very vibrant.

Primary sources of learning (hint: not Google)



- Google properties are less relevant (though we're working to improve)
- Popular 3p developer content platforms:
  - Developer communities: CSDN (*established*), Juejin (*newer crowd*)
  - Zhihu (*similar to Quora, but much more popular*)
  - Jianshu (*similar to Medium, which is inaccessible in China*)
  - Github

Source: 2017 China GDD Survey

Domestic developer resources generally have good SEO on Baidu search. Not so much for Google developer resources.
Couple of reasons: Created in Simplified Chinese from the ground up instead of getting translated afterwards; developers don't have the habit of using Google stuff. Though many top developers turn to Google for info.
No guarantee that technical articles conform to current best practices. E.g. many are advocating using background services rather than Job Scheduler for scheduling tasks.

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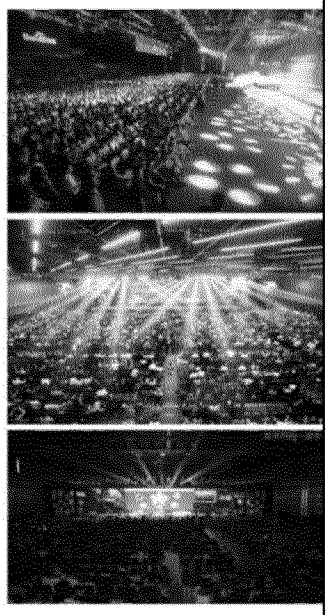
07. Developer community is different, but very vibrant.

Internet giants court devs aggressively

- Bombard devs with 10K+ audience conferences
  Baidu Create, Aliyun Computing Conference (spans 8 cities), Xiaomi conferences
- Focus areas have evolved throughout the years (to whatever is "hot")
  Desktop → Mobile → Big Data/Cloud → AR/VR → IoT → Blockchain → AI



Not all SDKs and libraries conform to Android best practices. This problem isn't contained in China -- many developers export to ROW markets and prefer using the same SDKs for China + ROW. Some of these apps get flagged on Google Play thus affecting ROW users as well. These anti-patterns to some extent hinder global adoption of current Android best practices.

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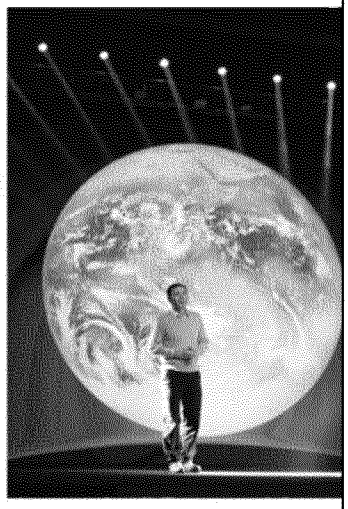
07. Developer community is different, but very vibrant.

Internet giants court devs aggressively

- Numerous distributed meet-ups throughout the year
  e.g. Baidu AI city tour, 400+ mini-program meet-ups
- Tech companies establish leadership:
  e.g. Tinker (Tencent), ijkplayer (Bilibili), Robust (Meituan Dianping)
  - Might not conform with Android best practices → negatively affects Android as a whole
  - e.g Xiaomi's push SDK recommends targetSdk <=25 (as of 6/2018)



Not all SDKs and libraries conform to Android best practices. This problem isn't contained in China -- many developers export to ROW markets and prefer using the same SDKs for China + ROW. Some of these apps get flagged on Google Play thus affecting ROW users as well. These anti-patterns to some extent hinder global adoption of current Android best practices.

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Thank you!

Thank you to folks who reviewed and gave tremendous feedback -

sandiegong, yazhang, jichao, chofung, htchan, leizh, luli, stevenzhang

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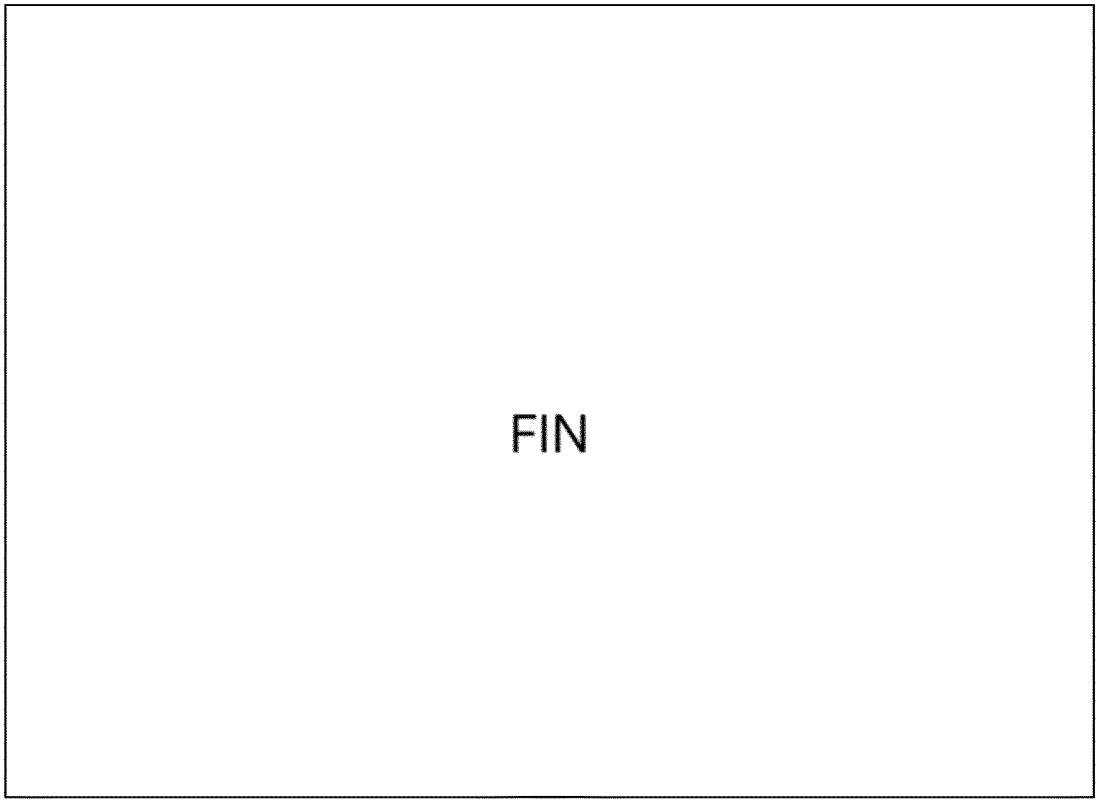

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APPENDIX
+
SLIDES GRAVEYARD

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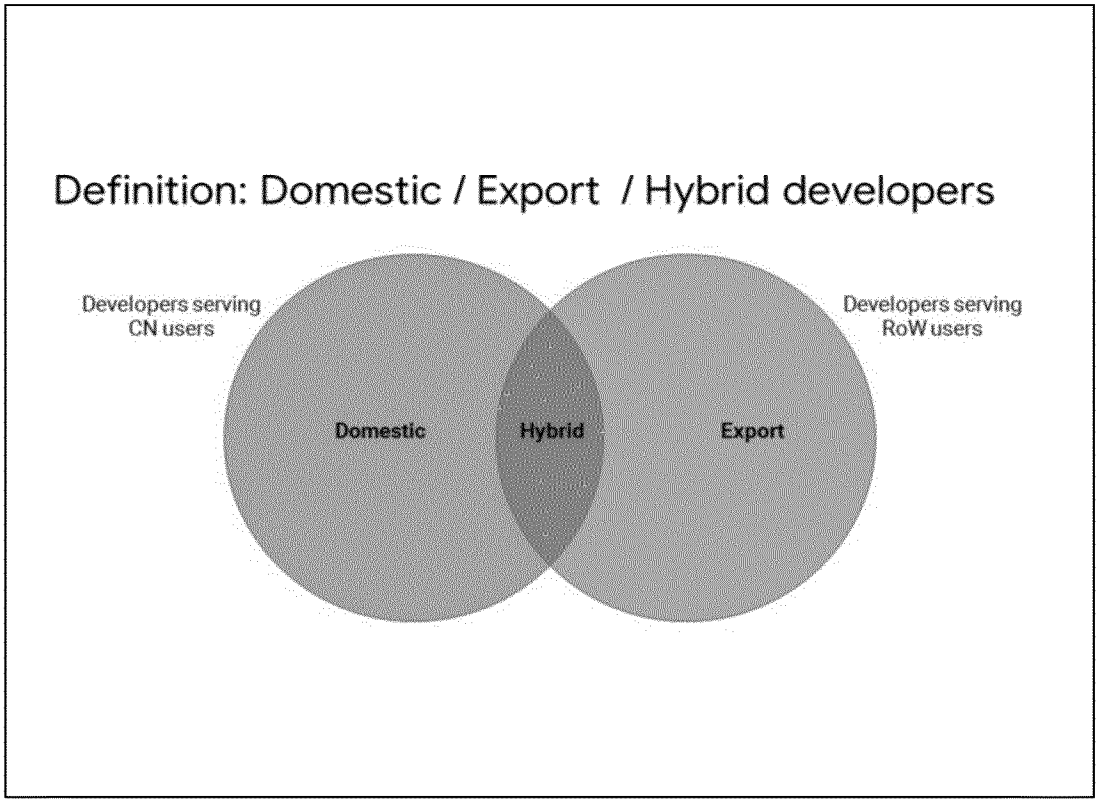

First things first, AiC developers can be divided into 3 buckets, depending on where they choose to distribute their apps.

“Domestic” - distribute only to local CN app stores.
“Export” - distribute only outside of China (i.e. mainly to Play). For all intents and purposes, there is nothing different about them since the users that they serve are not in China.
“Hybrid” - distribute to both Play and local CN stores .

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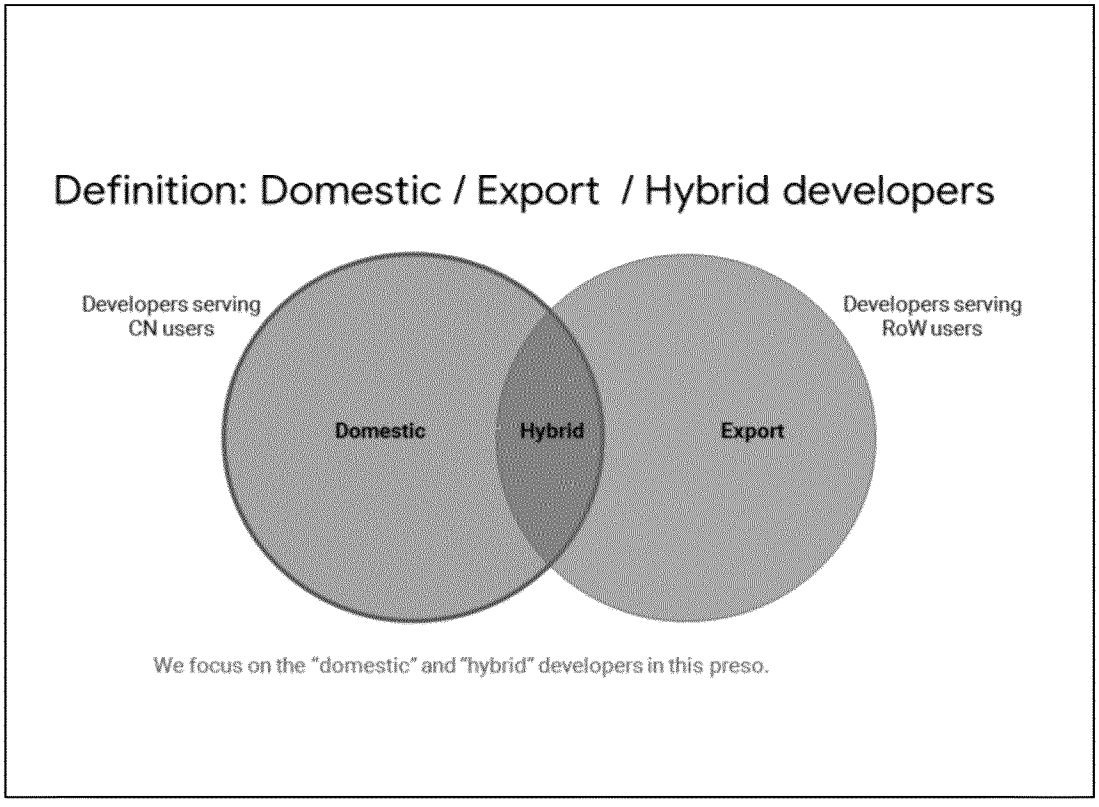

"Domestic" and "Hybrid" AiC devs are the focus of our discussion here.
Whenever you see "AiC developer", mentally substitute it with "Android developers building for China users".

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Appendix

parking lot for topics

- Developer platforms court developers aggressively
  - Bombard developers with 10K+ audience dev events covering AI, IoT, blockchain, cloud computing topics: eg Baidu Create, Ali Computing Conference (covers 8 cities in 2018 + livestream), Xiaomi conferences
  - Numerous distributed meet-ups throughout the year. E.g. Baidu AI city tour, 400+ mini-program meet-ups
  - Start-up incentives: credits, incubators E.g. Tencent pledges to invest 10B RMB to 100 start-ups
- Tech companies establishing their technical thought leadership
  - Release popular open source libs on Github
    - Tinker by Tencent, ijkplayer by Bilibili, Robust by Meituan Dianping
- Developer sources of technical knowledge: S.O, Jianshu, CSDN, Zhihu, OSChina, Juejin
- Developer stats [Reports]
- Potential problematic areas for Google's 1-size-fit-all approach
  - Updateable Chromeview through Play
  - FJD (Probably) unnecessary dependency on GMSCore .. ***though soon to be replaced by WorkManager***
  - App Bundle -- no explicit support from CN app stores yet. Hard for hybrid apps to adopt (?)
  - ...
- FYI Saw some additional stats on Mini-programs.

https://www.slideshare.net/digitalinasia/what-it-takes-to-win-chinese-app-market

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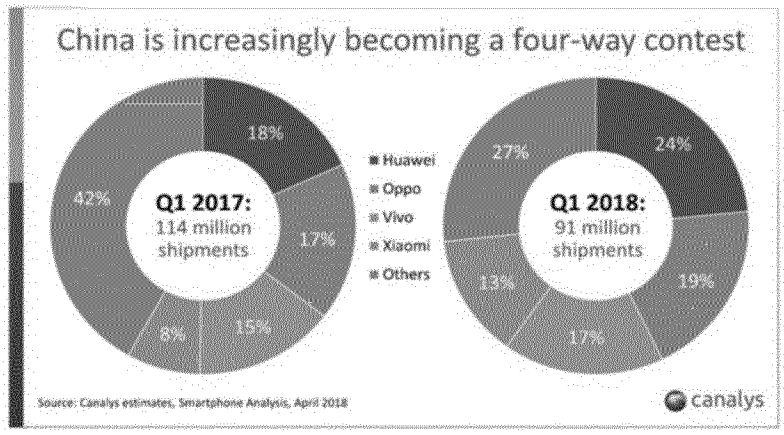
Appendix



Chinese vendors market share
http://news.timedg.com/2018-04/28/20656994.shtml

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Appendix

SAMSUNG

This is just a sample of the very, very long list of Bixby commands available.

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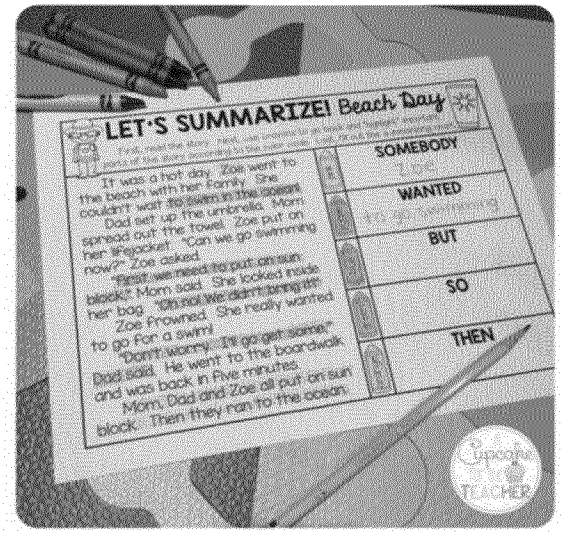

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