Ubiquitous and Mobile Computing CS 528: *A Survey of Mobile Malware in the Wild*

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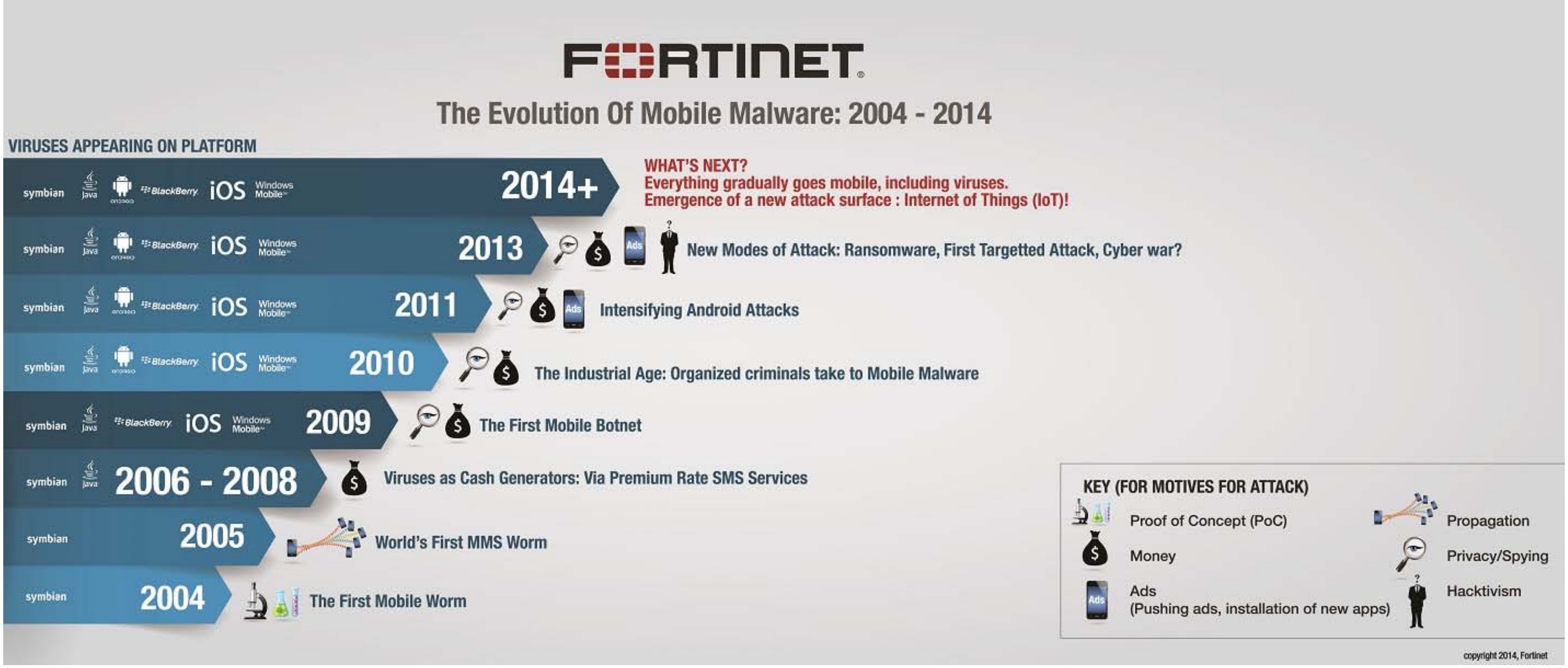
What is mobile malware?

- Targeted at Android, iOS, Symbian (discontinued), Windows Phone
- Gather data, send premium-rate SMS messages, credential theft, novelty or amusement
- Is it more of a problem than traditional malware for PCs?

Root and Motivation

- Quick comparison: PCs vs. Smartphones

When did this become a problem?



The Evolution Of Mobile Malware: 2004 - 2014

2014+ WHAT'S NEXT?
Everything gradually goes mobile, including viruses.
Emergence of a new attack surface : Internet of Things (IoT)!

2013 New Modes of Attack: Ransomware, First Targetted Attack, Cyber war?

2011 Intensifying Android Attacks

2010 The Industrial Age: Organized criminals take to Mobile Malware

2009 The First Mobile Botnet

2006 - 2008 Viruses as Cash Generators: Via Premium Rate SMS Services

2005 World's First MMS Worm

2004 The First Mobile Worm

KEY (FOR MOTIVES FOR ATTACK)

- Proof of Concept (PoC)
- Money
- Ads (Pushing ads, installation of new apps)
- Propagation
- Privacy/Spying
- Hacktivism

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Threat Types

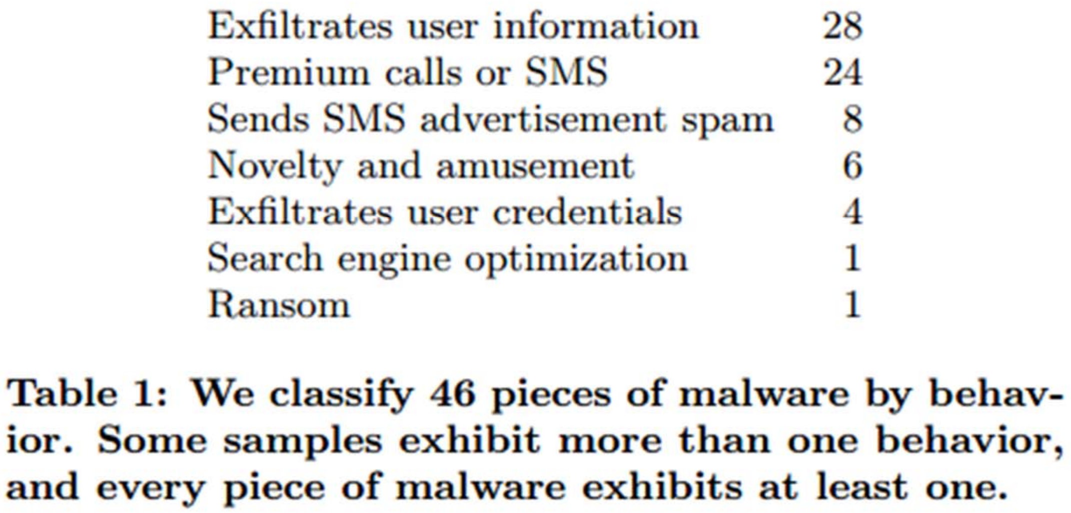
- Malware
  - Gains access for the purpose of stealing data, damaging the device, annoying user, etc.
- Personal Spyware
  - Collects personal information over a period of time
- Grayware
  - Collect data on user, but with no intention to harm user

Security Measures

- App Markets
  - Apple App Store highly regulated; Apple approves all apps after review
  - Android Market (Google Play Store) similar, but user’s can install applications from elsewhere
- Permissions
  - Android informs all users of requested permissions at install-time
  - iOS less comprehensive

Incentives

- Selling user information
- Stealing credentials
- For fun!



Exfiltrates user information	28
Premium calls or SMS	24
Sends SMS advertisement spam	8
Novelty and amusement	6
Exfiltrates user credentials	4
Search engine optimization	1
Ransom	1

Table 1: We classify 46 pieces of malware by behavior. Some samples exhibit more than one behavior, and every piece of malware exhibits at least one.

Findings

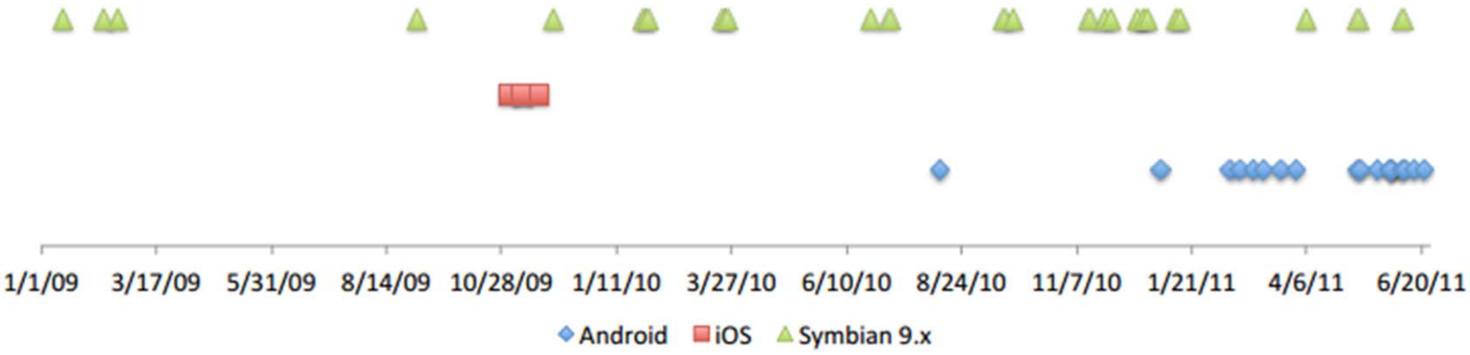
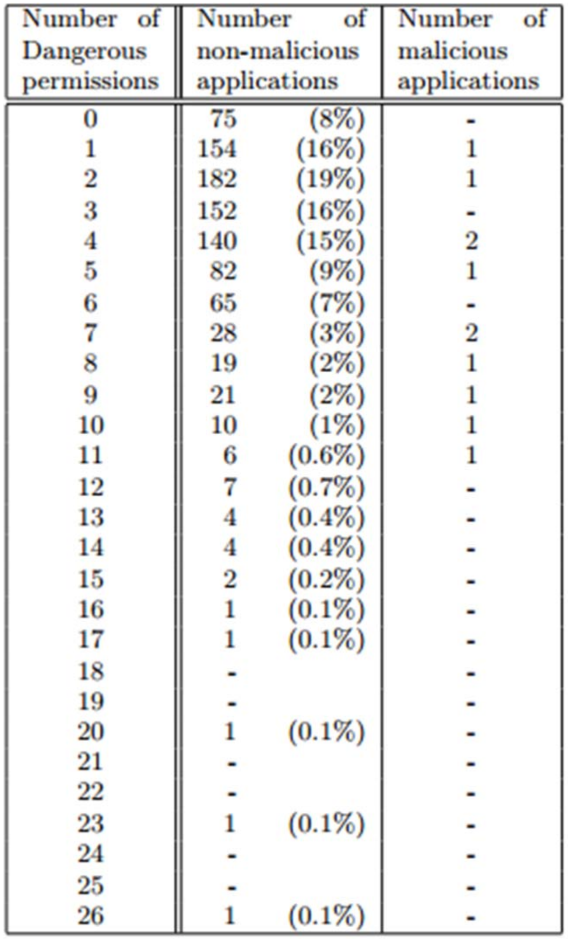


Figure 1: A timeline of when the 46 pieces of malware in our data set were detected by malware researchers.

Malware Detection

Number of Permissions

- Malicious applications request an average of 6.18 “Dangerous” permissions
- Non-malicious apps request an average of 3.46 “Dangerous” permissions



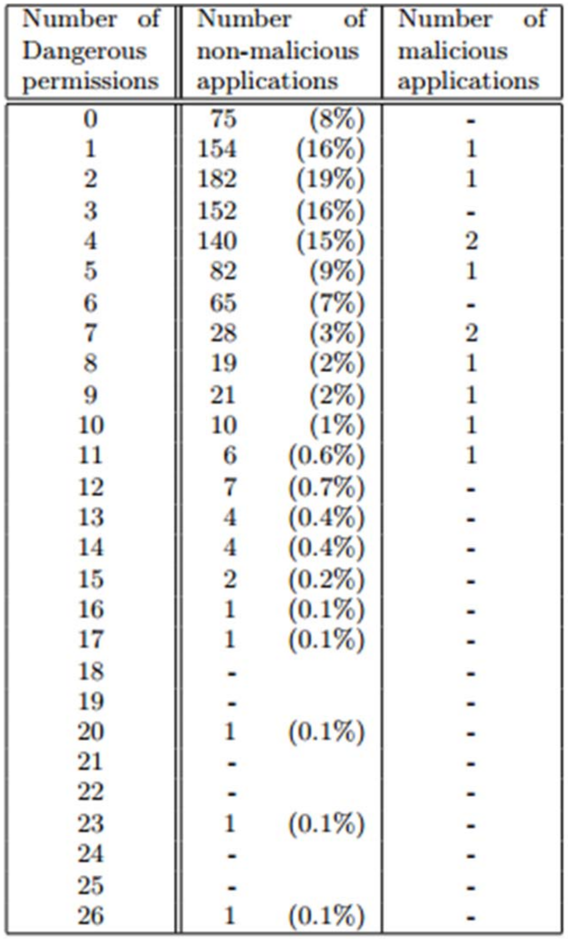
Number of Dangerous permissions	Number of non-malicious applications		Number of malicious applications
0	75	(8%)	-
1	154	(16%)	1
2	182	(19%)	1
3	152	(16%)	-
4	140	(15%)	2
5	82	(9%)	1
6	65	(7%)	-
7	28	(3%)	2
8	19	(2%)	1
9	21	(2%)	1
10	10	(1%)	1
11	6	(0.6%)	1
12	7	(0.7%)	-
13	4	(0.4%)	-
14	4	(0.4%)	-
15	2	(0.2%)	-
16	1	(0.1%)	-
17	1	(0.1%)	-
18	-		-
19	-		-
20	1	(0.1%)	-
21	-		-
22	-		-
23	1	(0.1%)	-
24	-		-
25	-		-
26	1	(0.1%)	-

Table 2: The number of “Dangerous” Android permissions requested by 11 pieces of malware and 956 non-malicious applications [28].

Malware Detection

Common Permissions

- 73% of malicious apps requested SMS sending permission
  - 4% of non-malicious apps requested that permission
- 73% of malicious apps requested READ_PHONE_STATE (IMEI info)
  - 33% of non-malicious apps requested that permission



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Malware Detection

Application Review

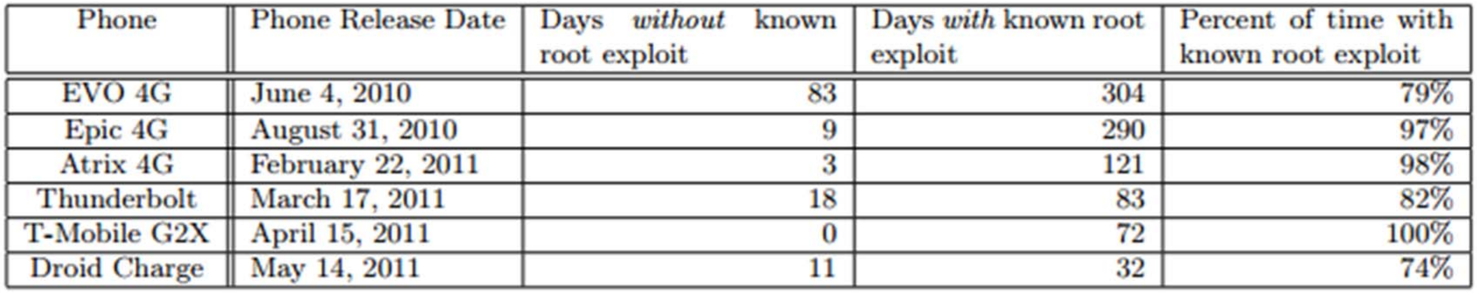
- iOS: All 4 pieces of Apple malware were spread through jailbroken devices; not found on App Store
- Symbian: 5 of 24 pieces of malware were Symbian Signed
  - Passed automated review
  - 30% passed or evaded Symbian signing process

Root Exploits

Who?	Why?
Malware authors	• Gain extra privileges • Perform any action on the phone
Users who want to modify their phone	• Install homebrew versions of operating system

- Can install only applications that are distributed through official application store
- Cannot perform complete system backups
- Carriers forbid or restrict tethering (in order to pay additional fee)
- Carrier pre-install applications (bloatware) and disable their removal
- Cannot install custom versions of OS that may have additional features

Root Exploits



Phone	Phone Release Date	Days *without* known root exploit	Days *with* known root exploit	Percent of time with known root exploit
EVO 4G	June 4, 2010	83	304	79%
Epic 4G	August 31, 2010	9	290	97%
Atrix 4G	February 22, 2011	3	121	98%
Thunderbolt	March 17, 2011	18	83	82%
T-Mobile G2X	April 15, 2011	0	72	100%
Droid Charge	May 14, 2011	11	32	74%

Table 3: We report the number and percentage of days between a handset's release date and June 26, 2011 in which there was a publicly available root exploit published by the Android homebrew community.

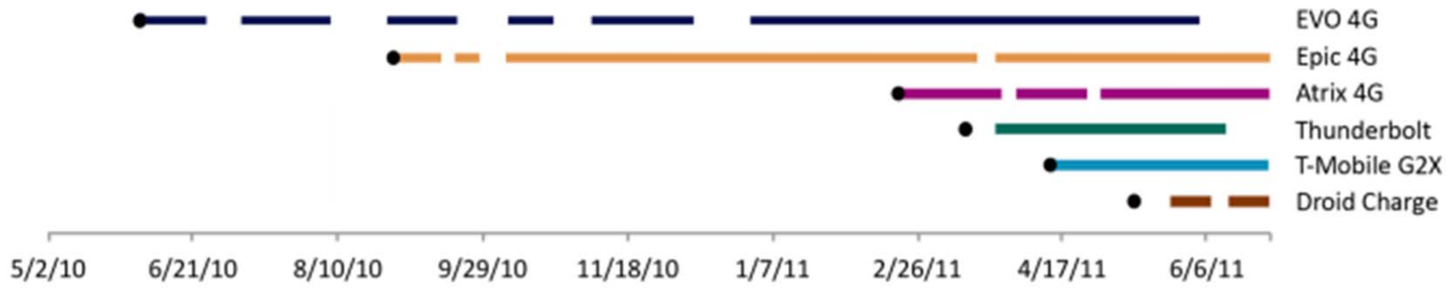
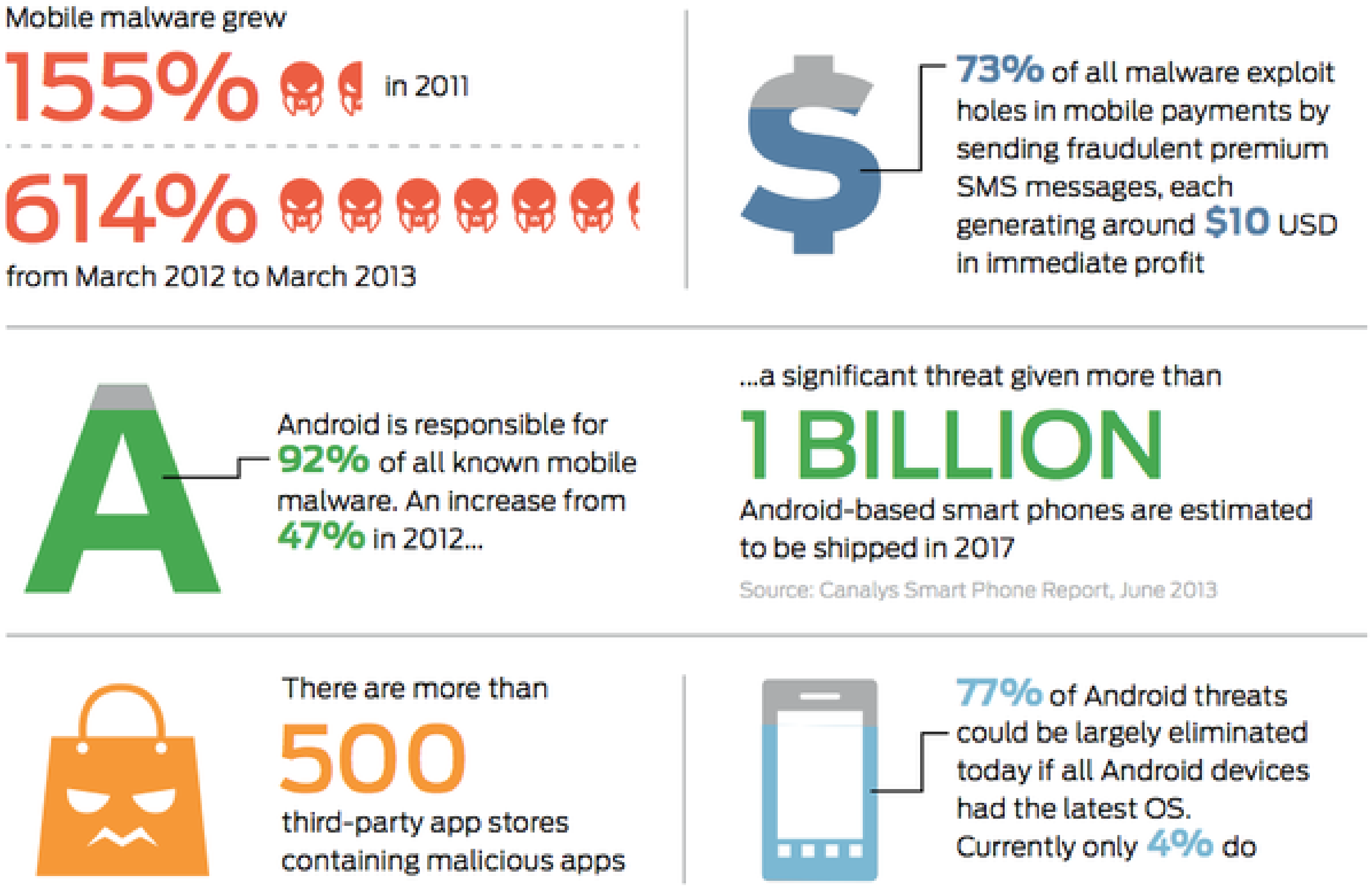


Figure 2: A timeline displaying the dates that known root exploits were available for 6 popular Android phones. Circles mark the release dates of the phones.

Future Incentives (as of 2011)

- Advertising Click Fraud
- Invasive Advertising
- In-Application Billing Fraud
- Governments
- E-Mail Spam
- Distributed Denial of Service (DDoS)
- NFC and Credit Cards

Conclusion



Mobile malware grew

155% in 2011

614% from March 2012 to March 2013

73% of all malware exploit holes in mobile payments by sending fraudulent premium SMS messages, each generating around $10 USD in immediate profit

Android is responsible for 92% of all known mobile malware. An increase from 47% in 2012...

...a significant threat given more than

1 BILLION

Android-based smart phones are estimated to be shipped in 2017

Source: Canalys Smart Phone Report, June 2013

There are more than

500

third-party app stores containing malicious apps

77% of Android threats could be largely eliminated today if all Android devices had the latest OS. Currently only 4% do

Conclusion

- Mobile malware rivals desktop malware
- Human review may be appropriate measure against malware
- Phone manufacturers should support smartphone customization to minimize root exploits

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