Chainiac: End-to-End Software Supply Chain Security and Transparency

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Decentralized/Distributed Systems (DEDIS)

HRPC – November 17, 2017

No Security Without Updates…

Much of today's malware exploits *known* vulnerabilities in *unpatched* systems

- Example: WannaCry used old Windows exploit to exploit over 230K computers in 1 day

But updates can go wrong too

Compromised software updates on the rise

Hackers Distribute Malware-Infected Media Player to Hundreds of Mac Users

Yet another software supply-chain attack hits popular applications.

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Lucian Constantin
Oct 20 2017, 10:52pm

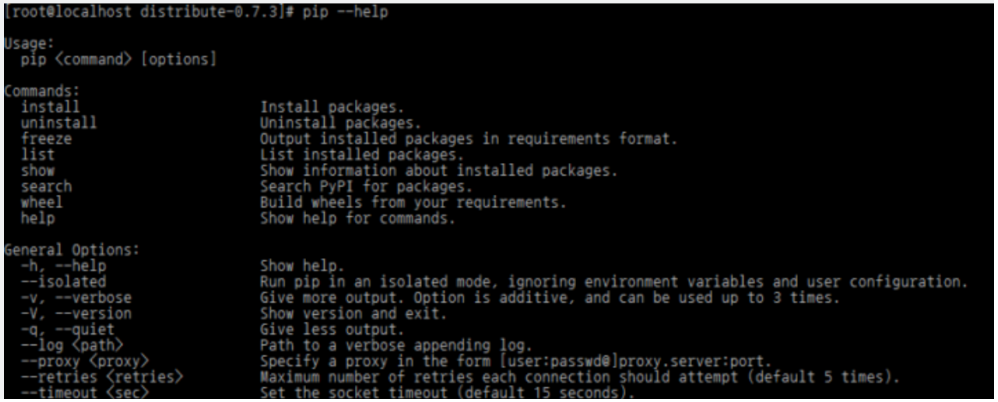
ars TECHNICA SIGN IN

BIZ & IT —

Devs unknowingly use "malicious" modules snuck into official Python repository

Code packages available in PyPI contained modified installation scripts.

DAN GOODIN - 9/17/2017, 12:30 AM



Key Software Supply Challenges

- Dev signing keys may be stolen…or coerced
- Binaries may be compromised after compilation
- Update distribution repositories may be hacked

What about reproducible builds as in Debian?

- Most users don’t have the time, or the source

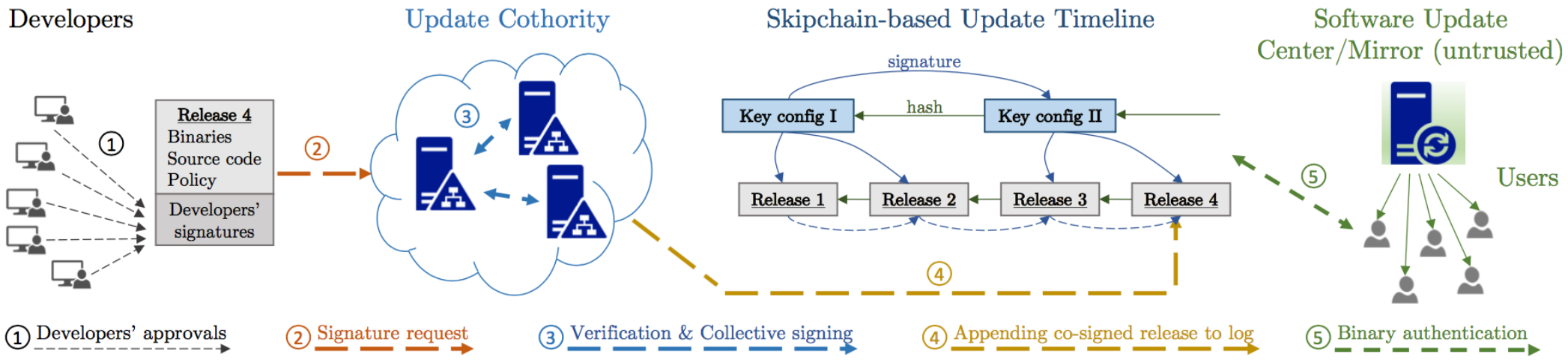
What about Certificate Transparency for binaries?

- CT can detect only *after* victim pwned, ie never

Chainiac: Secure, Transparent Software Development & Updates

DEDIS work appearing in [USENIX Security '17]

- Development: peer review, signoff workflow
- Build: independent verification of exact binaries
- Distribution: offline-verifiable software updates with proactive transparency via SkipChains



No Central Points of Compromise

Throughout development, build, update pipeline

- Multiple developers review, signoff releases
- Multiple auditors verify, log all workflow steps
  - Even compromised devs can’t make secret release
- Multiple build servers reproduce all binaries
  - Prevent compromise during or after compilation
- Multiple witnesses collectively sign each update
  - Proactively ensure all installable releases are public

Who Actually Reproduces Builds?

Most users don't have the time, knowledge

- Reproducing a browser can take many hours on a typical laptop, forget mobile devices…

Users *can't* reproduce if source is proprietary

Chainiac delegates responsibility to multiple independent software update witness-cosigners

- Reproduce exact build, co-sign its validity

Can work for proprietary software too

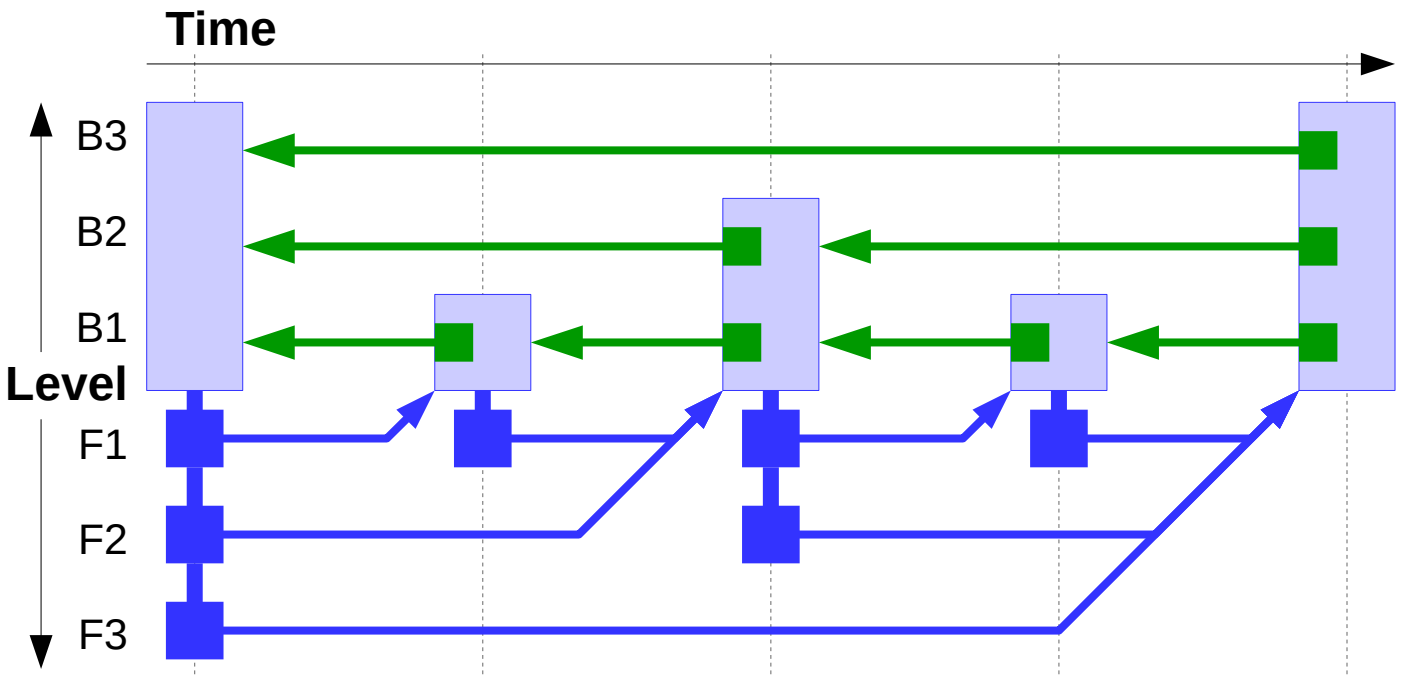
- Only build verifiers need NDAs/source licenses

Offline-verifiable Transparency

Chainiac logs updates on cryptographically verifiable blockchain or **SkipChain**

- Devices can verify updates offline, peer-to-peer
- But won’t accept anything inadequately co-signed

Closes CT vulnerabilities, avoids need for gossip



A Real Scenario: Apple vs FBI in 2016

FBI: *"Sign an iOS with a backdoor."* Apple: *"No."*

Invited public debate **this time**, but what about next time?

Will we know if a software vendor is secretly coerced to sign backdoored image?

- If device uses CT, then FBI simply gives device SCTs in 2 fake logs
- A phone **sealed in a forensics lab** can't gossip → we'll never know!

Only collective signing ensures transparency even if device is isolated or upstream Internet connectivity is persistantly compromised/MITM'd

- Further discussion: see **"Apple, FBI, and Software Transparency"** in Princeton "Freedom to Tinker" blog

Conclusion: Key Points

We urgently need transparency on what software gets onto our devices, and how it came to be

- Ensure no central points of compromise E2E
- Make reproducible builds work for ordinary users and for closed-source software
- Prevent transparency failures *before* installation

Chainiac demonstrates how this is achievable.

More info: see “Chainiac” in [USENIX Security ‘17]

- Or summaries by Porup/CyberScoop, Colyer