Measurement and Analysis of Hajime, a Peer-to-Peer IoT Botnet

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IoT Botnets Pose a Major Threat

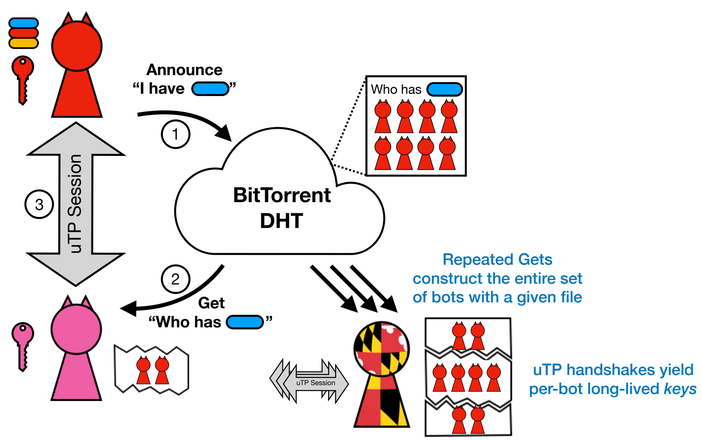
Mirai — Largest DoS attacks in history

Hajime — Mirai successor; Runs on many architectures; Regular updates, new exploits

We are longitudinally measuring Hajime

Goals — To inform defenses and intervention:
- characterize steady-state behavior
- understand effect of new exploits on botnet

Hajime uses BitTorrent's DHT for Command-and-Control



Datasets

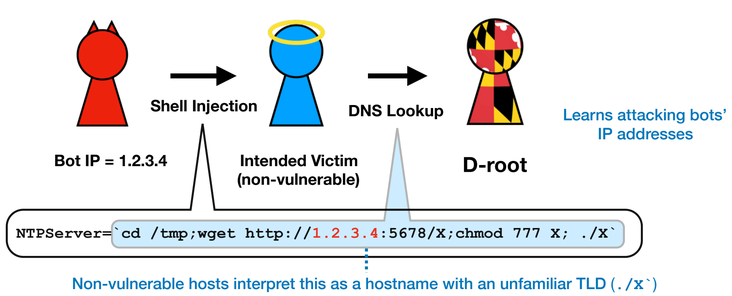
DHT Scans
uTP Scans (10.5M keys)
Binary reverse engineering (52 payloads)

DNS Backscatter (125M queries)

Exploits

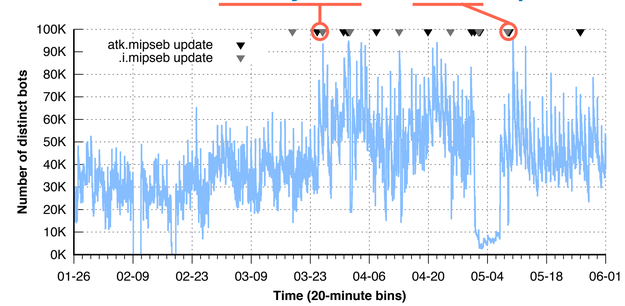
Chimay-Red
GPON shell injection

TR-064 shell injection



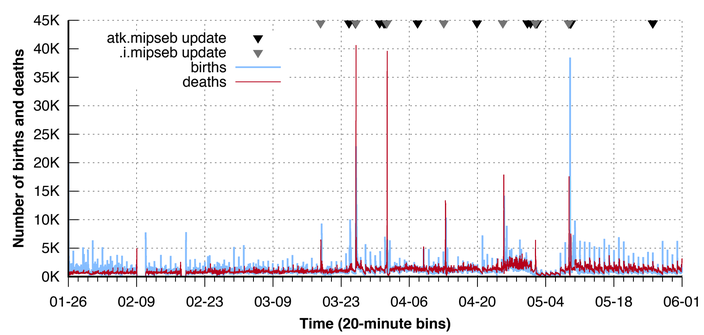
Botnet Size

Steady-state of ~40K bots
Peaks of 95K after Chimay-Red and GPON exploits



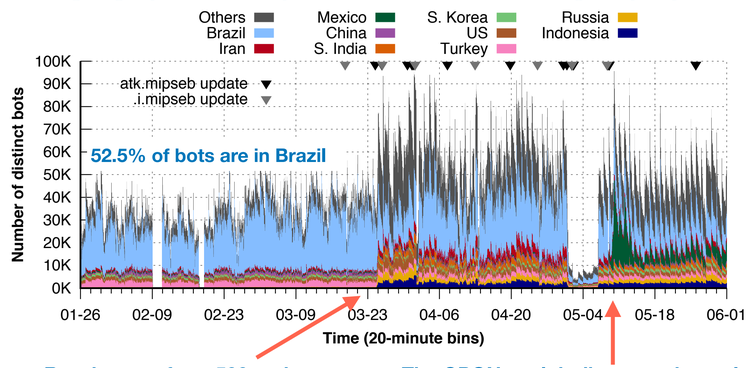
Churn

Median bot lifetime: 5 hours ⇒ Reboots and reinfections are common
Steady-state churn: 2K



Location

The geographic makeup of IoT botnets can change rapidly



Russia goes from 500 active bots per hour to 6K following Chimay-Red.

The GPON exploit disproportionately affects Mexico

Devices

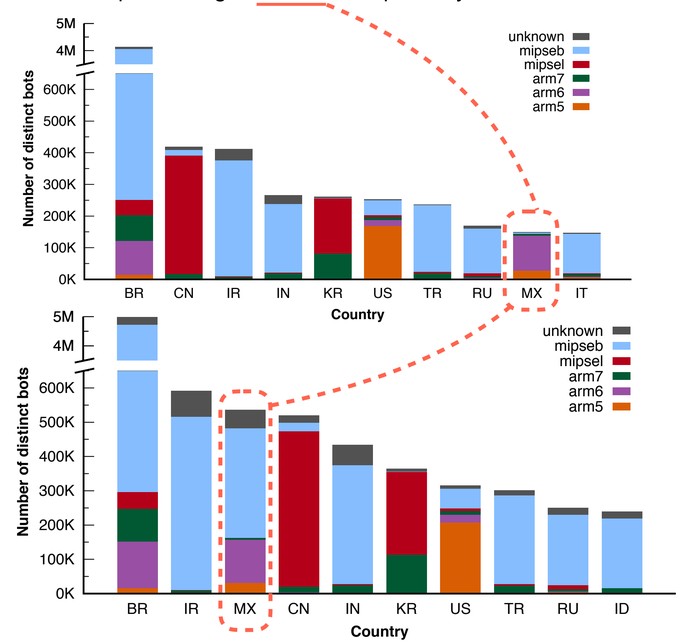
Devices overwhelmingly run MIPS

74.2% of bot devices are MIPS big endian.

Exploit Effects

Chimay-Red increases proportion of MikroTik bots from 0.79% to 80.29%.

GPON exploit changes Mexico from primarily ARM to MIPS.



Evolution of TR-064 Exploit