The Mirai Botnet

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Truman State University
Binary Beasts

The Paper

- Title: *Understanding the Mirai Botnet*

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- Researchers from a number of institutions reversed engineered it to better understand how it spread
- This paper then proposes reforms that can be made to prevent this kind of attack in the future

Contributions

- Lead Author
  - Zane Ma - University of Illinois Urbana-Champaign

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  - Tim April - Akamai Technologies
  - Michael Bailey - University of Illinois Urbana-Champaign
  - Matthew Bernhard - University of Michigan
  - Elie Bursztein - Google
  - Jaime Cochran - Cloudflare
  - Zakir Durumeric - University of Michigan
  - J. Alex Halderman - University of Michigan

Contributions Cont.

- Continued...
  - Luca Invernizzi - Google
  - Michalis Kallitsis - Merit Network
  - Deepak Kumar - University of Illinois Urbana-Champaign
  - Chaz Lever - Georgia Institute of Technology
  - Joshua Mason - University of Illinois Urbana-Champaign
  - Damian Menscher - Google
  - Chad Seaman - Akamai Technologies
  - Nick Sullivan - Cloudflare
  - Kurt Thomas - Google
  - Yi Zhou - University of Illinois Urbana-Champaign

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  - In December 2016, it peaked at 600,000 devices before beginning to fade

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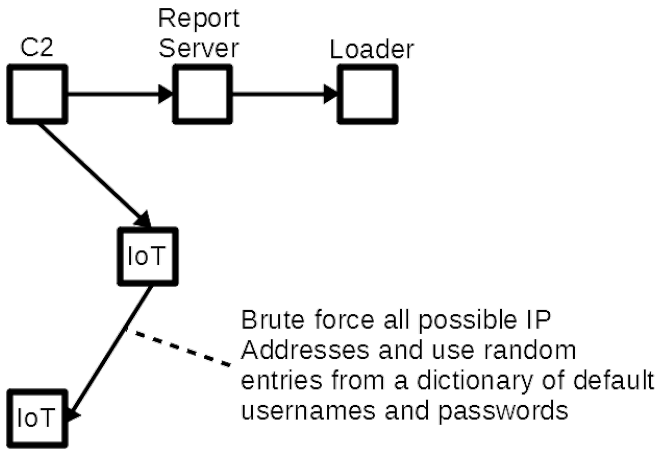

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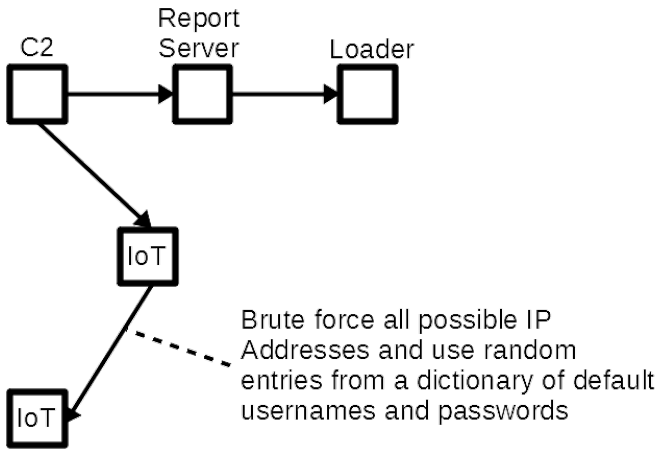

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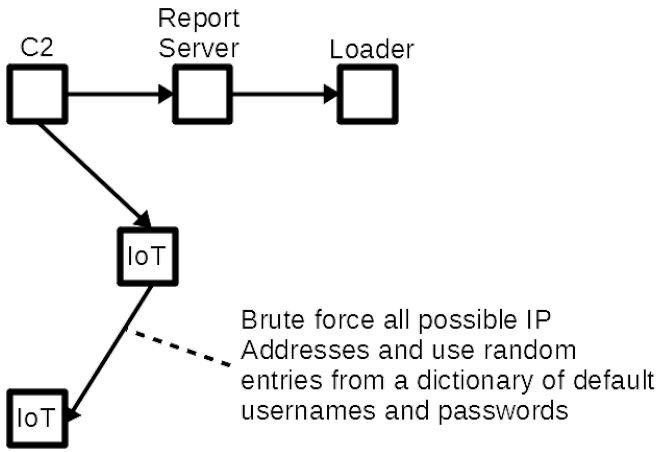

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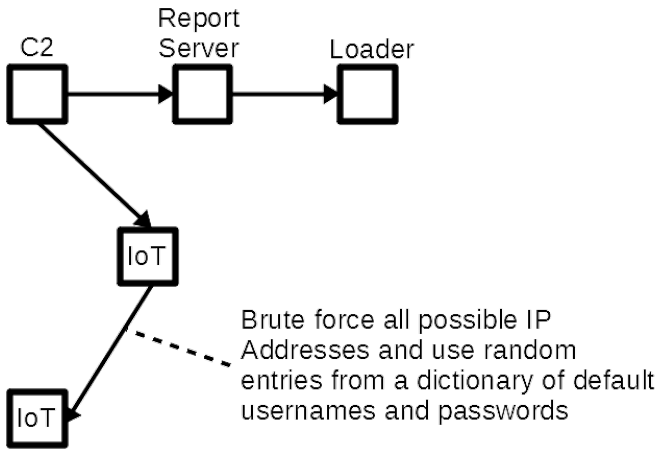

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- These were small dictionaries, containing 60 to about 200 credentials

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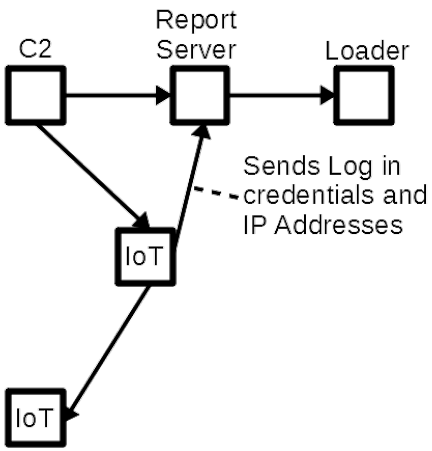

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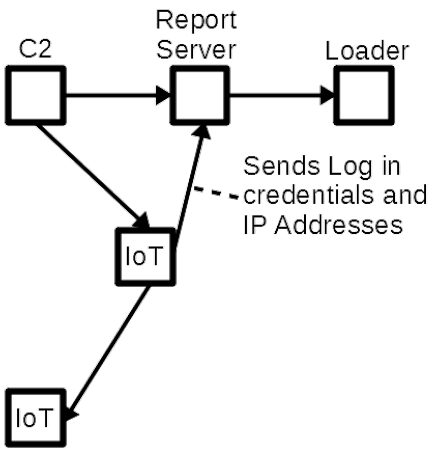

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- This information could later be used by the Command and Control (C2) server

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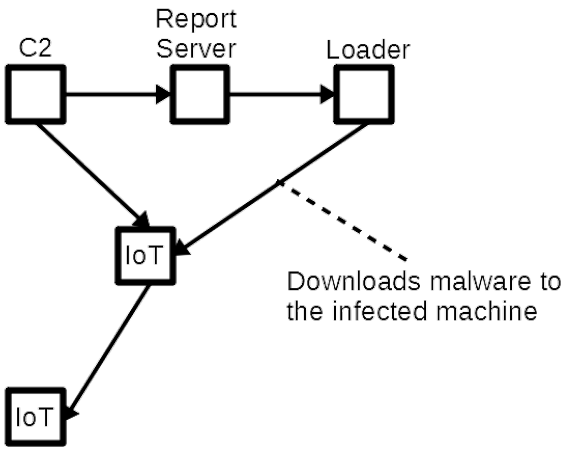

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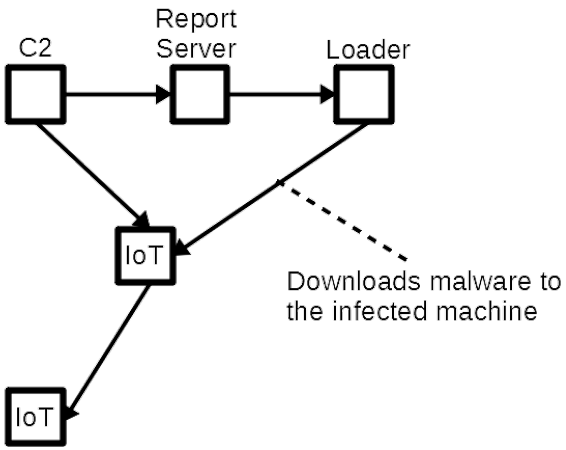

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- This program would download a binary onto the victim and run the program

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  - These organizations would be much more likely to start search for and exploiting weaknesses in the malware if it infected their machines

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  - Brazil, Colombia, and Vietnam hosted most of the bots

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  - It's nearly impossible to distinguish between real requests and the attack.

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- With requests from multiple machines, it is difficult to prevent or dampen an attack on a server.

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  - Lonestar Cell - most attacked target, destroyed internet capabilities in Liberia

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- They used attempted to monitor the botnet's spread
- Many binaries used by the malware were captured
- A number of organizations tried a variety of techniques and shared their information for this paper.

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- Monitored network request (scan) to a network telescope composed 4.7 millions IP address
  - On average, the network telescope received 1.1 million packets from 269,000 IP addresses per minute
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  - Identified 67 C2 domains and 48 distinct username password dictionaries (containing a total 371 unique passwords)

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  - In the end, from a single domain name, we can expand a set of domain name and IP addresses

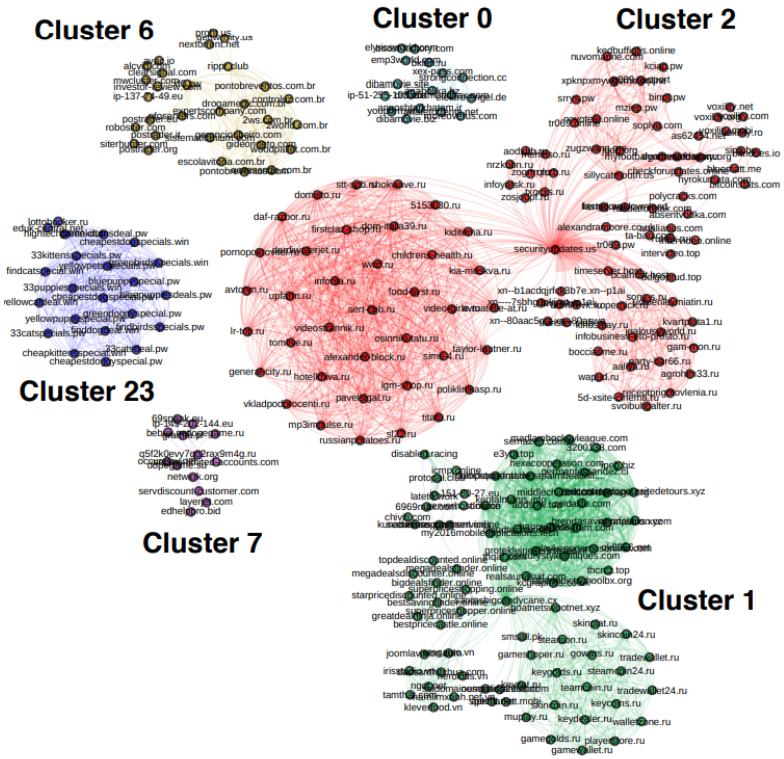

Figure: C2 Domain Relationships – We visualize related C2 infrastructure, depicting C2 domains as nodes and shared IPs as edges between two domains.

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  - Results: 15,194 attacks from 146 unique IP clusters, which cover the Dyn attack and Liberia attacks

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  - Form a statistics to calculate what fraction of these IP addresses matched the list of IP address obseved by our network telescope

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  - At various points, competing command and control servers were subject to DDoS attacks

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Defense Against the Dark Arts

- Randomized default passwords prevent attackers from employing a dictionary of default passwords.
- Having ports not used default to closed mitigates the chances of a successful attack.
- Automatic updates prevent users from refusing updates during hours of use and keeps systems secure against previous exploits. Bug bounties encourage the community to find and report all possible exploits to be patched.
- Standards for model and version identification allow server admins to easily see any and all machines that have known vulnerabilities.

Defense Against the Dark Arts

- Users should create secure usernames and passwords for all devices to mitigate the chance of it being hacked using brute force.
- Smart purchases from known and trusted companies that prioritize security of their manufactured devices acts as a deterrent from would be attackers.
- Old and unsupported devices should be replaced with newer models that conform with current security standards and have strong customer support.

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  - Renting out their botnet to other cybercriminals

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- Many attacks, such as the attack on Dyn, are believed to be a result of copy cat attackers

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- This attack served as a wake up call, prompting reform in these industries