Dragon Tails: Preserving Supply-Side Vulnerability Disclosure

Cyber Statecraft Initiative
Atlantic Council

Contributors:
Sara Ann Brackett
Yumi Gambrill
Trey Herr
Emmeline Nettles
Stewart Scott
External Vulnerability Research as a Supply

- What are sources of security?
- Global bug-bounty market size projected to reach $5.5 billion by 2027
- Manifests the ‘many eyes’ theory of security
- Increasing adoption by government agencies and departments
- Proliferation of bug-bounty platform companies
- Governed by Coordinated Vulnerability Disclosure processes (CVD)
## Supply-Side Vulnerability Research

Anonymized bug-bounty platform revenue streams by country, from Congressional Testimony—Dakota Cary, February 17, 2022

<table>
<thead>
<tr>
<th>Country of Researcher/Recipient</th>
<th>Total Amount Paid</th>
<th>Percentage of Total Amount Paid by US</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States of America</td>
<td>$6,718,923</td>
<td>15%</td>
</tr>
<tr>
<td>China</td>
<td>$4,220,302</td>
<td>10%</td>
</tr>
<tr>
<td>India</td>
<td>$4,055,807</td>
<td>9%</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>$2,047,212</td>
<td>5%</td>
</tr>
<tr>
<td>United Kingdom of Great Britain and Northern Ireland</td>
<td>$2,029,512</td>
<td>5%</td>
</tr>
<tr>
<td>Germany</td>
<td>$1,698,018</td>
<td>4%</td>
</tr>
<tr>
<td>Canada</td>
<td>$1,674,918</td>
<td>4%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>$1,190,940</td>
<td>3%</td>
</tr>
<tr>
<td>Argentina</td>
<td>$1,103,724</td>
<td>3%</td>
</tr>
<tr>
<td>Australia</td>
<td>$1,072,930</td>
<td>2%</td>
</tr>
<tr>
<td>France</td>
<td>$1,029,796</td>
<td>2%</td>
</tr>
</tbody>
</table>
Can bad policy break this ecosystem, and can we detect those supply shocks?
Vulnerability disclosures fall between two extremes:

1. Disclose everything you know about a vulnerability to everyone as soon as you know it.
2. Never disclose anything you know about a vulnerability to anyone.
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Good CVD in Log4Shell

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*December 8 per Bloomberg, December 9 per the Wall Street Journal*
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• **November 24, 2021**: Alibaba Cloud researcher discloses log4shell (l4s) to ASF privately.
• **December 8,* 2021**: Researcher follows up with updates for ASF.
• **December 10, 2021**: Patching and public announcements of l4s begin.

*December 8 per Bloomberg, December 9 per the Wall Street Journal*
December 22, 2021: China’s MIIT suspends Alibaba Cloud from an information-sharing partnership for failing to disclose I4s to the MIIT prior to DEC9, when they received notice from a 3rd party.

- Per the Wall Street Journal and an anonymous source: suspension was a consequence of breach of contract in the info-sharing partnership.
- Per other reporting:* suspension was a consequence of violating The Regulations on Management of Security Vulnerabilities (RMSV).

*The SCMP and InfoSec Magazine, for example
Specific enforcement mechanism aside, failure to disclose earlier to the MIIT was the cause of the suspension, and the letter of the RMSV was breached.

Article 7 Network product providers shall perform the following network product security vulnerability management obligations: ensure that their product security vulnerabilities are promptly patched and reasonably released, and guide and support product users to take preventive measures.

(1) After discovering or learning that there are security vulnerabilities in the provided network products, it shall immediately take measures and organize the verification of the security vulnerabilities, and evaluate the degree of harm and the scope of influence of the security vulnerabilities; for the security vulnerabilities existing in its upstream products or components, it shall immediately notify the relevant product provider.

(2) The relevant vulnerability information shall be submitted to the Network Security Threat and Vulnerability Information Sharing Platform of the Ministry of Industry and Information Technology within 2 days. The submitted content shall include the product name, model, version, and technical characteristics, harm, and scope of influence of the vulnerability that have network product security vulnerabilities.
Supply-Side Vulnerability Research

- Very little reporting on the RMSV when it was passed or took effect, big questions about application to multinational companies.
  - Only known (possible) RMSV enforcement is on Alibaba Cloud for l4s.
  - Most coverage concerned with what happens to vulnerabilities after the MIIT gets early access.
    - **Not the focus of this research.**

- Convenient case study when searching for supply-shocks to international vulnerability research
  - Potential for a chilling effect on China’s research contributions:
    - Hesitation to report vulnerabilities until more legal clarity?
    - Internal policy changes regarding accepting vulnerability reports from China?
  - **Clear before and after dates**
  - Large potential impact:
    - China is a significant contributor to international vulnerability research
Other CVD and Reporting Laws and Practices

- A lack of clear legal protections for researchers has caused problems globally:
  - German researcher (almost) charged for reporting flaws in campaign app
  - Missouri tried to charge a researcher for reading HTML

- Some good developments here recently:
  - DOJ declining to prosecute good-faith research
  - ENISA push for member governments to develop CVD policies
  - CISA BOD for agencies to develop reporting systems
Research Question

- Did the RMSV cause a supply shock in China’s research contributions?
  - If so, did that shock trickle into the overall supply of research contributions?
  - Do other shocks occur correlated to unidentified events?
Research Question

- **Added insights:**
  - Better look at external contributions to vulnerability reporting
  - Possible to look at density-distribution of contributors as well

- **Datasets:** Acknowledgements from different CVE and security update databases from Microsoft, Apple, F5, VMWare, and Red Hat
  - Looking across vendors to try to tease out product and ecosystem trends
  - Get variety of internal practices for crediting explicitly or anonymously and for organizing data (by CVE, by update batch, by vulnerability batch, etc.)
  - Open source and proprietary codebases
• RMSV Timeline:
  • July 2020: Draft law containing RMSV MIIT reporting requirement first reported as known to industry and government in China
Key Dates

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Key Dates

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  • **July 2020:** Draft law containing RMSV MIIT reporting requirement first reported as known to industry and government in China
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• Some confounding events:
  • Summer 2020: Flurry of cyber regulations in China
  • Summer 2020: US blacklisting of companies in China accelerates
  • Summer 2021: More blacklisting
Methodology

- Scrape Datasets
  - Direct downloads or as allowed by /robots.txt
- Parse out entities, CVEs, dates
  - Mixing and matching dates for some datasets
- Tag companies to countries
  - Did not tag individual researchers
- Clean and batch by year-month
- Massive degree of typos, pseudonyms, CVE overlap, etc.
- Analyze
Methodology

- Scrape Datasets
  - Parse out entities, CVEs, dates
  - Tag companies to countries
  - Clean and batch by year-month
  - Analyze

- Apple
- Red Hat
- Microsoft
- F5
- VMware
• Some quirks:
  • Can’t compare between datasets directly because of overlap in CVEs.
  • Apple security updates often predate listed dates for CVEs found on NVD, Tenable, etc., and are organized by software update.
  • Unclear where credits are all for vulnerability discovery or demonstration of vulnerability application of a specific product.
  • Batching by month adds noise.
  • Not clear how the delay between private reporting and public patching and acknowledgement plays out.
Datasets

- **Microsoft**: $n = 4355$
- **Apple**: $n = 14740$
- **VMWare**: $n = 1363$
- **F5**: $n = 335$
- **Red Hat**: $n = 3307$
Microsoft Contributions Shares

Portion of Contributions

Microsoft Portion Shares

Year-Month

US %  China %
Microsoft Contributions Shares

Portion of Contributions

Microsoft Portions
Microsoft Contributions

Portion of Contributions

Microsoft Contribution Shares

US %

China %
Microsoft Contributions

Microsoft Contribution Counts

Year-Month

Contributions

Total  US #  China #
Microsoft Contributions
Red Hat Contribution Shares

Portion of Contributions

Red Hat Portion Shares

Year-Month

US %
China %
Red Hat Contributions

Portion of Contributions

Red Hat Contribution Shares

Year-Month

US %
China %
Red Hat Contributions Shares

Red Hat Portions

Portion of Contributions

Red Hat Contribution Shares

Year-Month

US %

China %
Red Hat Contributions

Red Hat Contribution Counts

Year-Month
Apple Portions
Takeaways

1. No clear, universal supply shock from the RMSV in China, though maybe a local one in the Microsoft data.

2. Something that looks like a supply shock happened in the Red Hat data but not at a time with a clear correlated event.


4. A supply shock in a specific legal context doesn’t necessarily trickle into the whole ecosystem, though loss of growth is difficult to assess.

5. Companies and government can better protect research communities and insure against shocks—can’t assume their absence.
Recommendations

- Opportunity for a policymaking reset to invest in research community and increase its resilience
- Harmonized vulnerability disclosure practices across the US and allies and partners
- Improve support for vulnerability discovery tools
- Better track vulnerability disclosure flows and incentivize research in areas where contributions fall off
Consider vulnerability research as a source of security, a supply and a community to be invested in and protected.

Is the research community vulnerable to supply shocks? Probably, but the mechanisms are still unclear, especially over long timeframes.

There is some limited evidence for local supply shocks, though they did not seem to spread from one set of researcher entities to the larger ecosystem or even between code and product environments.

There are ways to invest in the research community and build in resilience. Fragmenting it is also possible and would hurt overall security.
Thank you!


Questions?