Crime Pays if You are Just an Average Hacker

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Motivation

• Market for security doesn’t really work well [1]
• “There are also the markets we don’t like that work entirely too well: for example, the market for stolen goods, that encourages burglary [..]” ¹

• Cost of cybercrime:
  – Herley: It’s quite tricky to get black market numbers right [2]
  – Anderson: Our investments in security are 10x the gains for the attackers (i.e. we’re using the wrong strategy) [3]

• However, we still do not have a model of the economically involved hacker
  – Black markets for attack tools
  – Black markets for compromised hosts
  – Black markets for credit cards

Motivation

“Why does an hacker become an hacker?”
What’s happening in the black markets

• Do bank robbers manufacture their own guns?

Exploitation success rate: 10-15%
Success rate highly depends on quality of traffic

Install rates, slightly higher than usual:

* Средний пробив на связке: 10-25%
* Зевс = 50-60%
* Лоадер = 80-90%

Price for latest version 1.6.x:

Package cost = 200$
“Clean” from AV = from 50$
Rebuild on new domain/IP=50$
Update = from 100$
Package bounded to one domain or IP

Update for version ..
The package features these exploits:

Work on Vista and Win7
The game

Defender

Do not enforce security policies

Enforce security policies

Attacker

Legitimate activities
Malicious activities

Game Over

Detected, $q$
Undetected, $1 - q$

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Detected, $q$
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Preliminary Model (1/4)

• To build our model, we look at the attacker:
  – He has limited time
    • Might have a regular job
    • Other activities

T: total time
L: time dedicated to legal activities
I: time dedicated to illegal activities
L = (T − I)
To build our model, we look at the attacker:

- He needs to weight legal activities...

  \[ T: \text{total time} \]
  \[ B: \text{maximum benefit from legal activities} \]
  \[ L: \text{time dedicated to legal activities} \]
  \[ p: \text{probability of earning } B \]
  \[ I: \text{time dedicated to illegal activities} \]
  \[ S: \text{minimum benefit from legal activities} \]

  \[ L = (T - I) \]
  \[ EU_{\text{Legal}} = L(pB + (1-p)S) \]
Preliminary Model (2/4)

• To build our model, we look at the attacker:

  \[ T: \text{total time} \]
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• With the effects of security policies against criminal activities, enforced by the defender..

  q: probability of detection of the criminal activity
  t: time to detect and disable criminal activity
Preliminary Model (4/4)

• To build our model, we look at the attacker:

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  L: time dedicated to legal activities
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  \[ EU_{\text{Legal}} = L(pB + (1-p)S) \]

  q: probability of detection of the criminal activity
  t: time to detect and disable criminal activity

• ..and the potential return for the criminal activity

  Z: maximum benefit from a criminal activity
  C: cost for the hacker in perpetrating it

  \[ EU_{\text{Criminal}} = I(q(Zt - C) + (1-q)Z) \]
To build our model, we look at the attacker:

- **T**: total time
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Preliminary Model (putting it together)

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  \[ L = (T - I) \]
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\[ \text{EU}_{\text{Criminal}} = I(q(Zt - C) + (1-q)Z) \]

\[ \text{EU}_{\text{M}} = q[(T-L)(Zt-C)+L(pB+(1-p)S)]+(1-q)[(T-L)Z+L(pB+(1-p)S)].\]
Our approach with the model [4]

• We use a simulation approach
• We fix a “standard value” for each parameter according to our direct observations

• ... briefly describe Krebs et al. [4]
• $p = 0.3$
• $S = 0.5$
• ... and briefly explain why 0.3. and 0.5
Parameters estimation \((q)\)

- \(q=\text{Probability of neutralization by defenders}\)
- Verizon 2012 Incident report

Unfortunately, as our research has shown for the last several years, third parties discover data breaches much more frequently than do the victim organizations themselves.
Parameters estimation \((q)\)

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![Simplified breach discovery methods by percent of breaches](Image)
Parameters estimation (q)

• q=Probability of neutralization by defenders
• Verizon 2012 Incident report
• Grier et. all, CCS 2012 [5]
  – Exploit kits change domain monthly/weekly, meaning that neutralizing them as a threat is extremely difficult (and resource-consuming)
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- Difficult cooperation between law forces
Parameters estimation \((q=0.1)\)

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Parameters estimation (C)

• C=Cost for the attacker
• Exploit kits do not require particular technology (inexpensive)
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- Van Eeten OECD Tech Report [6]: criminals are often out of jurisdiction
- Arrest rate is very low, penalties unclear

For example, Yevgeniy Anikin and Viktor Pleschuk, who hacked the WorldPay system of The Royal Bank of Scotland and stole $10 million from its accounts, were found guilty by a Russian court, yet only received suspended sentences, while those convicted of ordinary
Parameters estimation \( C = 0.2 \)

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- We distinguish two cases:
  - Z > B
    - Hacker valuates thrill, fun from hacking, sense of superiority more than lawful returns
  - B > Z
    - Hacker values legality and moral self-esteem more than criminal returns
Parameters estimation (B,Z)

• B=maximum return from legal activities
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• Returns are not only economical, but also related to personal realization (in many forms)
• We distinguish two cases:
  – Z=1>B=0.8
    • Hacker valuates thrill, fun from hacking, sense of superiority more than lawful returns
  – B=1>Z=0.8
    • Hacker values legality and moral self-esteem more than criminal returns
Parameters estimation (L)

- L=time dedicated to legal activities
- Hackers are usually young and well educated
  – Meaning they spend time studying and working

novich, Sverdlovsk region, Russia. Education: Professional Pedagogical University of Russia (Applied Informatics in Economics major). Citizen-
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• Does not take a lot of time to run a cyber-criminal activity

“Botnet operation is a mini job, once a day you check for 30 minutes, pay once a month server bills, sell for about an hour information on the market and enhance your code if you feel like it. I was thinking about working for Kaspersky, but these guys want all kinds of phony diplomas and can't even recognize native code (see the duqu 'incident'). The profit? Depends, sometimes 400$ a day, sometimes none, but a steady 40$ a day with bitcoins alone.”
Parameters estimation \((L=0.9)\)

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Our approach with the model – cnd.

<table>
<thead>
<tr>
<th>Activity type</th>
<th>Variable</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>T</td>
<td>hacker’s total time</td>
</tr>
<tr>
<td></td>
<td>t</td>
<td>time for detection and neutralization of criminal activity</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>probability of obtaining maximum benefit from legal activities</td>
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<tr>
<td></td>
<td>1-p</td>
<td>probability of obtaining only minimum benefit from legal activities</td>
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<tr>
<td></td>
<td>q</td>
<td>probability of detection of the criminal activity</td>
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<tr>
<td></td>
<td>q-1</td>
<td>probability of non-detection of the criminal activity</td>
</tr>
<tr>
<td>Legal</td>
<td>L</td>
<td>fraction of time the hacker devotes to legal activities</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>maximum benefit gained from a legal activity</td>
</tr>
<tr>
<td></td>
<td>S</td>
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</tr>
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<td>Criminal</td>
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</tr>
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<tr>
<td></td>
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<td>cost for the hacker in perpetrating criminal activities</td>
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</tbody>
</table>
Simulations

• We run simulations changing one parameter at a time,
  – From 0.05
  – To 1
  – With 0.05 steps
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  – From 0.05
  – To 1
  – With 0.05 steps

• Each run simulates the policy maker enforcing a policy addressing one particular aspect of the hacker decisional model
**Simulation results**

<table>
<thead>
<tr>
<th>Changes in key variable</th>
<th>Model 1 $p$ changes</th>
<th>Model 2 $q$ changes</th>
<th>Model 3 $S$ changes</th>
<th>Model 4 $C$ changes</th>
<th>Model 5 $B$ changes</th>
<th>Model 6 $Z$ changes</th>
<th>Model 7 $t$ changes</th>
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<tbody>
<tr>
<td>0.05</td>
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<td>Succeed</td>
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Thanks

Questions?

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