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Human decision making in cybersecurity

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DM19-1190

Approach

Qualitative understanding of how humans reason about complex systems

Apply that reasoning structure specifically to the cyber context

Focus on forensics and incident response

- That is, figuring out what happened in the past

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Purpose

Human

- Help experts reflect on their processes
- Identify the skills and techniques we should teach new analysts and investigators

Machine

- You cannot (easily) automate what you don’t understand

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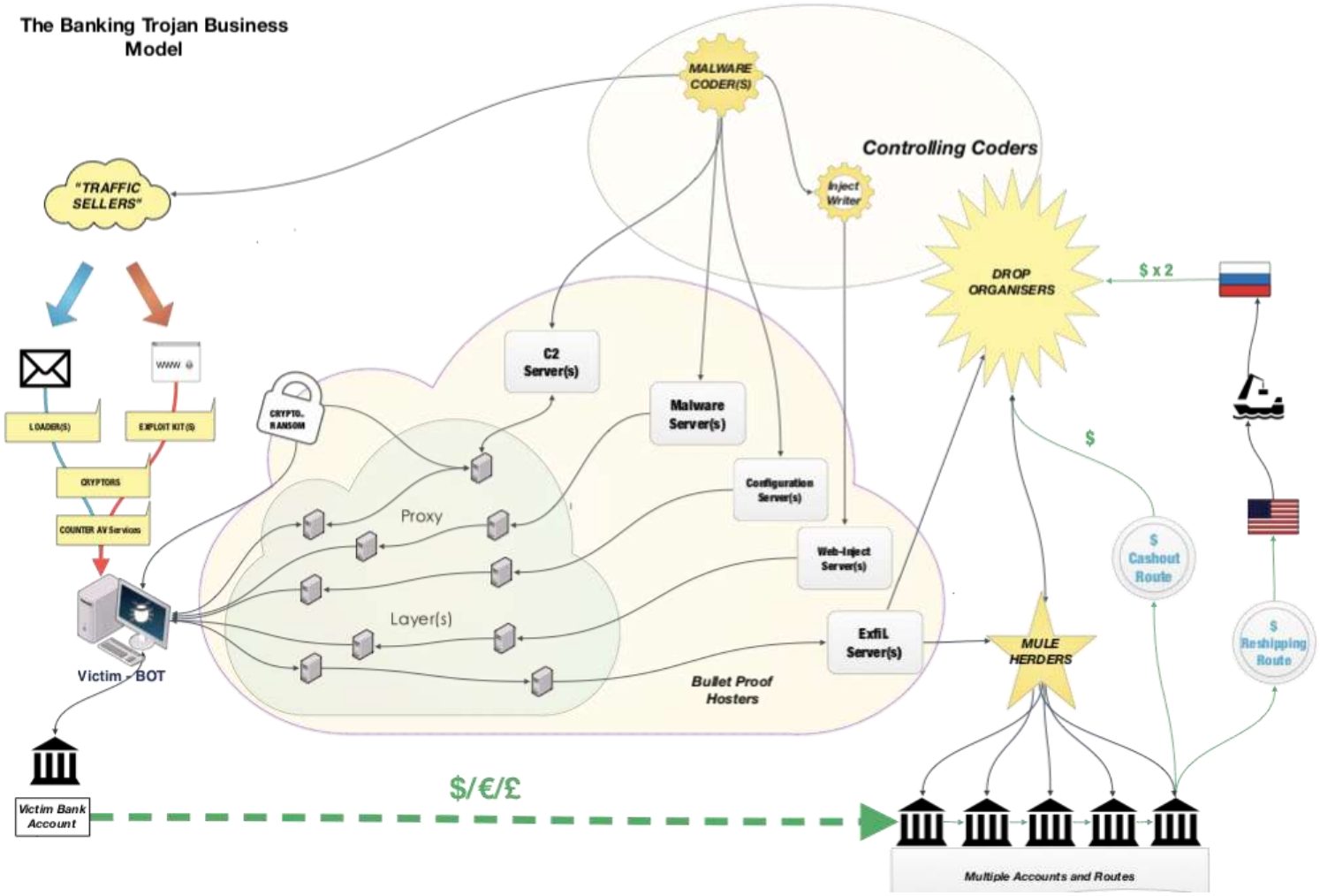
Motivating example from eCrime



Addis and Garrick, Botnet Takedowns - Our GameOver Zeus Experience. BotConf 2014. Imaged used with permission from the author.
https://www.botconf.eu/wp-content/uploads/2014/12/2014-1.2-Keynote-United-Kingdom%E2%80%99s-National-crime-agency-on-botnet-takedowns.pdf

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Scope

Concept goes by different names

- Incident analysis, digital forensic investigation, root cause analysis, triage, etc.
- These all mean slightly different things to different people, but for all of them we need to be able to do three things:
  - Collect evidence
  - Analyze evidence and make connections
  - Report results

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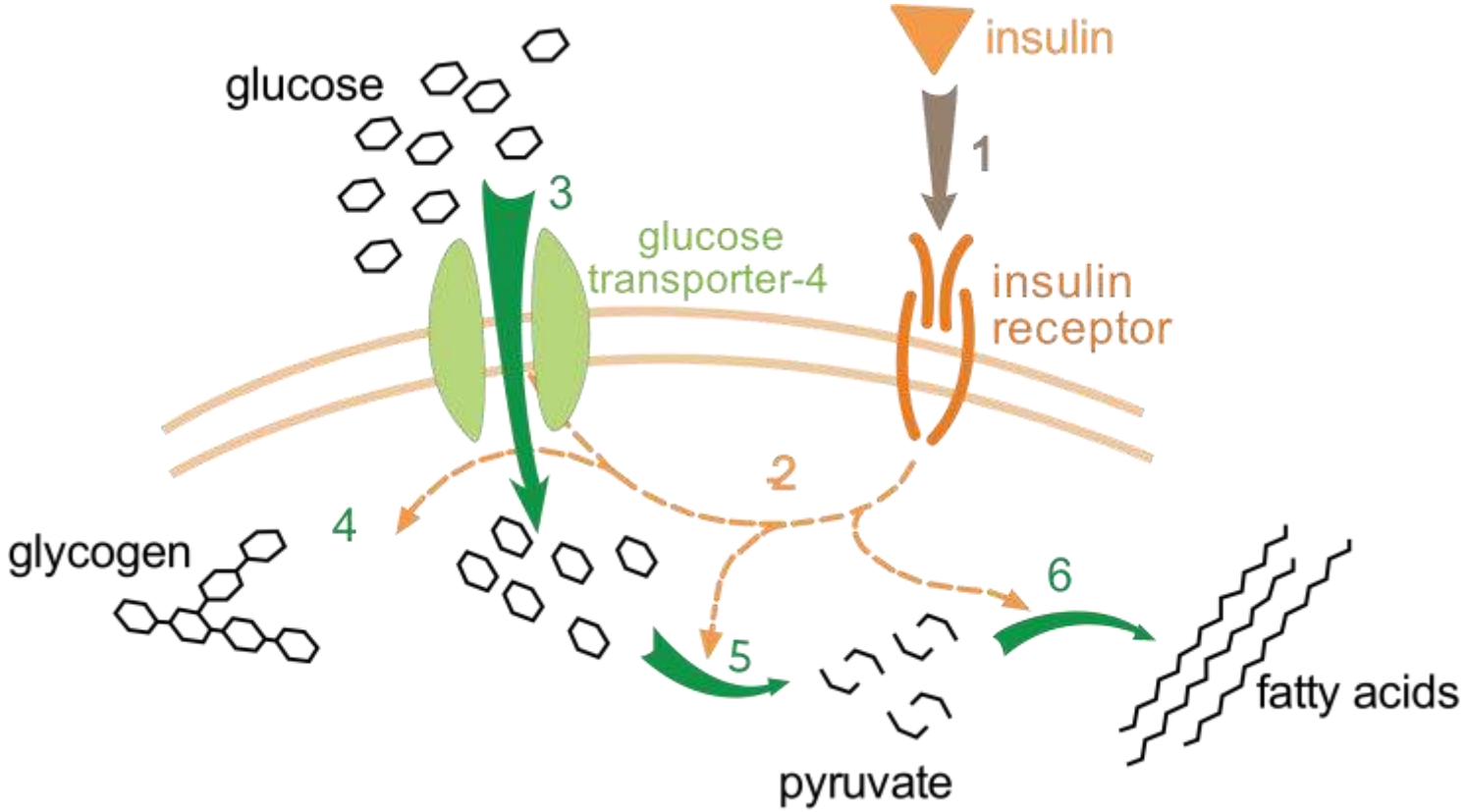
Summary intuition

The Zeus diagram looks like life science explanations



I do not believe that is an accident

By XcepticZP at en.wikipedia - Transferred from en.wikipedia to Commons by User:Shizhao using CommonsHelper, Public Domain, https://commons.wikimedia.org/w/index.php?curid=4436369

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Insights

To stop a botnet like GameOver Zeus, it helps to understand how it was working.

- However, mechanism of action != mechanism of cure
- Breaking stable / homeostatic / self regulating systems is hard
  - This is true of viruses and of viruses

The life science have a wide variety of methods for understanding complex, resilient systems that we can adapt

- There are some distinct challenges
- The Zeus example is one of many that shows how they are being overcome

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Goal – adequate explanations

Should contain / explain:

- Clusters of related multifield mechanism schemas

Relationships should be built, investigated, and discovered along four dimensions of variation:

- Activities and entities
- Phenomena
- Organization
- Etiology

Jonathan M Spring and Phyllis Illari (2018). 'Building General Knowledge of Mechanisms in Information Security'. In: *Philosophy & Technology*. doi: 10.1007/s13347-018-0329-z.

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Barriers

- The immediate object of study, namely software, can change behavior during or between observations
- Active adversaries respond to, and try to confound, observations
- There is often justified secrecy among friendly parties

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Some mitigations

These are generally familiar. But let's emphasize that they are all necessary for interlocking support.

A kind of epistemic defense in depth

- Software is changeable, so analyze it from different view points
  - RE will need static decompilation, dynamic analysis, deep analysis of single executables and surveys for context
- Adversaries learn from us, but they are human
  - Understand their goal, and try to observe / measure / protect what they are actually after
- Share explanations at the appropriate level of detail
  - More general knowledge is harder to produce, but it is more stable and so safer to share

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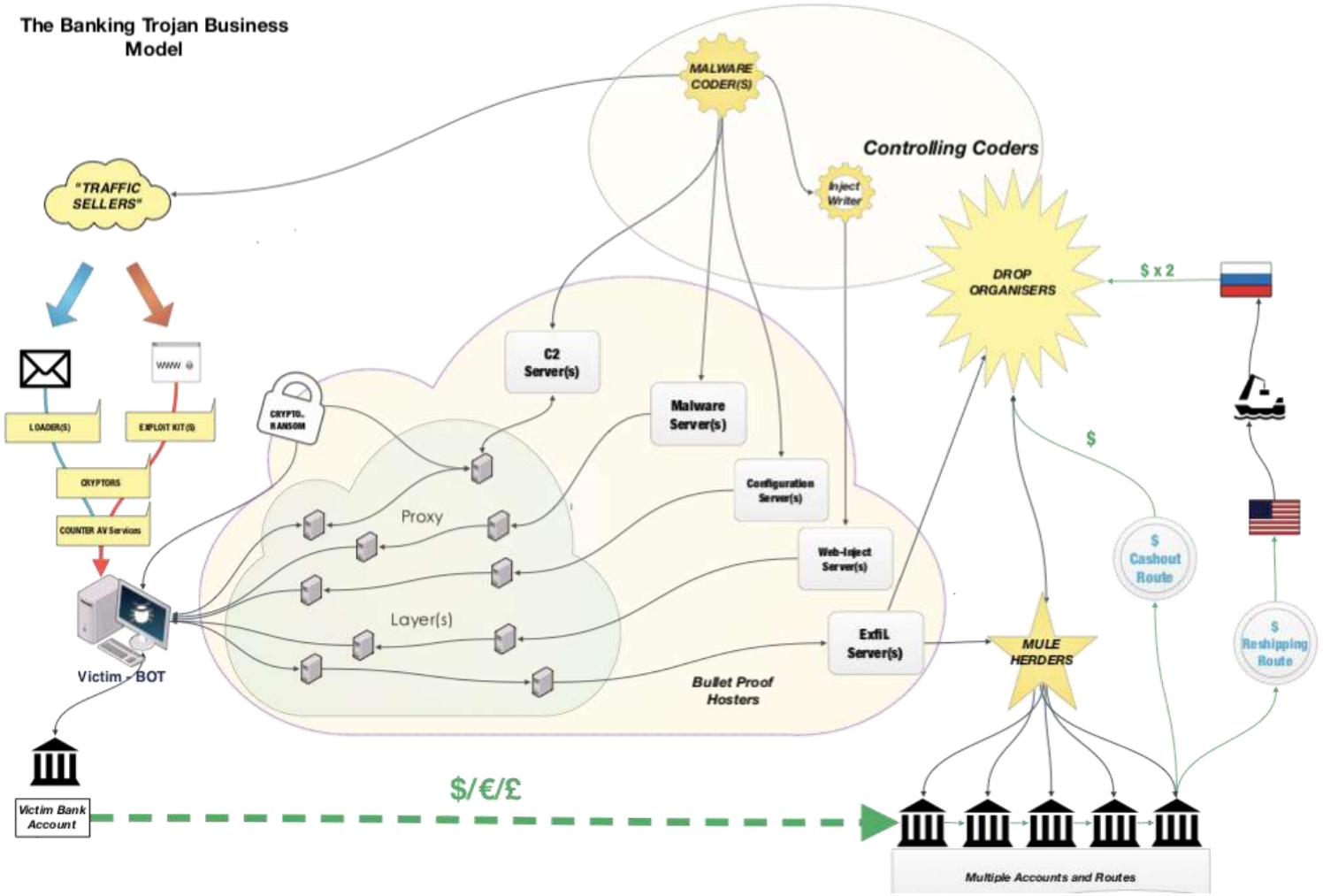
Like this, for example



Addis and Garrick, Botnet Takedowns - Our GameOver Zeus Experience. BotConf 2014. Imaged used with permission from the author.
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Current plans

We're current apply these principles to improve how vulnerabilities are explained and prioritized

- Towards Improving CVSS https://resources.sei.cmu.edu/library/asset-view.cfm?assetID=538368

Evidence collection can probably be automated to support this rich idea of analysis and adequate explanations

- Jonathan M Spring and David Pym (31st Oct. 2018). 'Towards Scientific Incident Response'. In: *GameSec*. LNCS 11199. Seattle, WA: Springer.

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