Leveraging Organizational Etiquette to Improve Internet Security

Niklas Carlsson
University of Calgary, Canada

Martin Arlitt
HP Labs, USA

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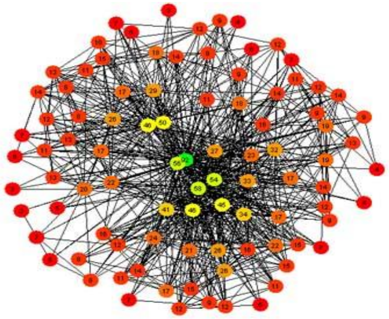
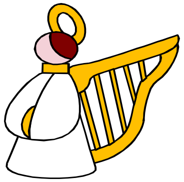
Motivation

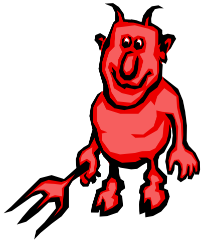
- Organizations increasingly rely on the Internet
  - Enterprises
  - ISPs
  - Universities
  - etc.



- Continuous battle for control of IT assets



Good vs. bad ???



- Internet crime more prevalent and better organized
  - Follow the money
  - Increasingly sophisticated techniques
  - Leverage geographical and legal boundaries

A shift in security practices

- Current Internet security practices primary focus on what others are doing to our resources, rather than giving equal consideration to what our resources are doing to others
- We argue that responsible organizations **also** must strive to improve their organizational etiquette;
  - i.e., must reduce the negative impact the machines (and users) on our domain(s) have on other organizations
- Organizations should also help other (trusted) organizations achieve the same goal
  - Primarily through systematic sharing of useful information

The OE system

- The OE system (after “Organizational Etiquette”)
  - Organizations need to take greater responsibility for the traffic that leaves their edge network(s)
  - Reducing the negative impact an organization and its machines may have on others
  - Help organizations become better Internet citizens
- OE can systematically
  - identify and eliminate malicious activity on edge networks
  - exchange non-sensitive information (to enable other organizations achieve the same goal)

Host accountability

- Improving organizational etiquette will make the Internet more secure
- Design is based on the premise that “security rests on host accountability” [Xie et al. 2009]
- Non-negligible improvements could be obtained by following five simple rules:
  - don't attack
  - don't scan
  - don't intrude
  - don't infect
  - don't spam

Please weed your lawn ...

- Benefits of improving local security and information sharing are intuitive
  - Little progress has been made on designing a solution
  - We quantify the benefits of our proposed solution of a (single) large organization
- Metcalfe's Law suggests that
  - Improved etiquette and sharing of information across a set of organizations would have a much greater positive effect on overall Internet security
  - So, please weed your lawn ...

Our proposed method

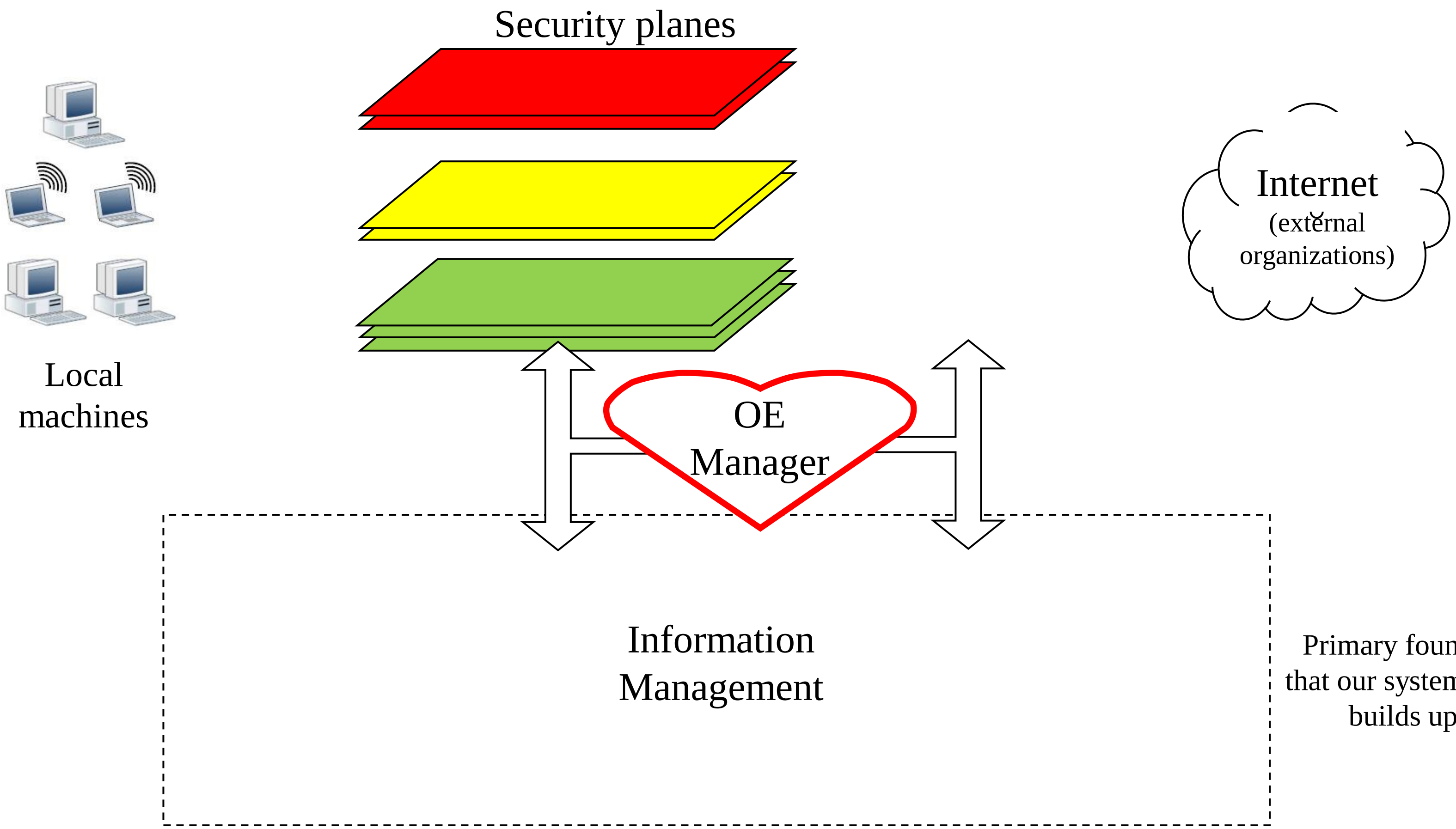
- There is an adage that you cannot manage what you cannot measure
- Unfortunately, this reflects the state of many edge networks today …
  - Management of edge networks has transformed very slowly and conservatively
  - Many tasks are still done manually, which limits the number of events that can be acted upon
- In contrast, miscreants effectively leverage automation to achieve their goals ...

System design

- Overarching goal of our design is to automate as much of the system operation as possible, including data gathering, processing, and system management

- Our system consists of three primary components:
  - Information management
  - Security planes
  - OE manager

The OE system



Security planes

Local machines

Internet
(external
organizations)

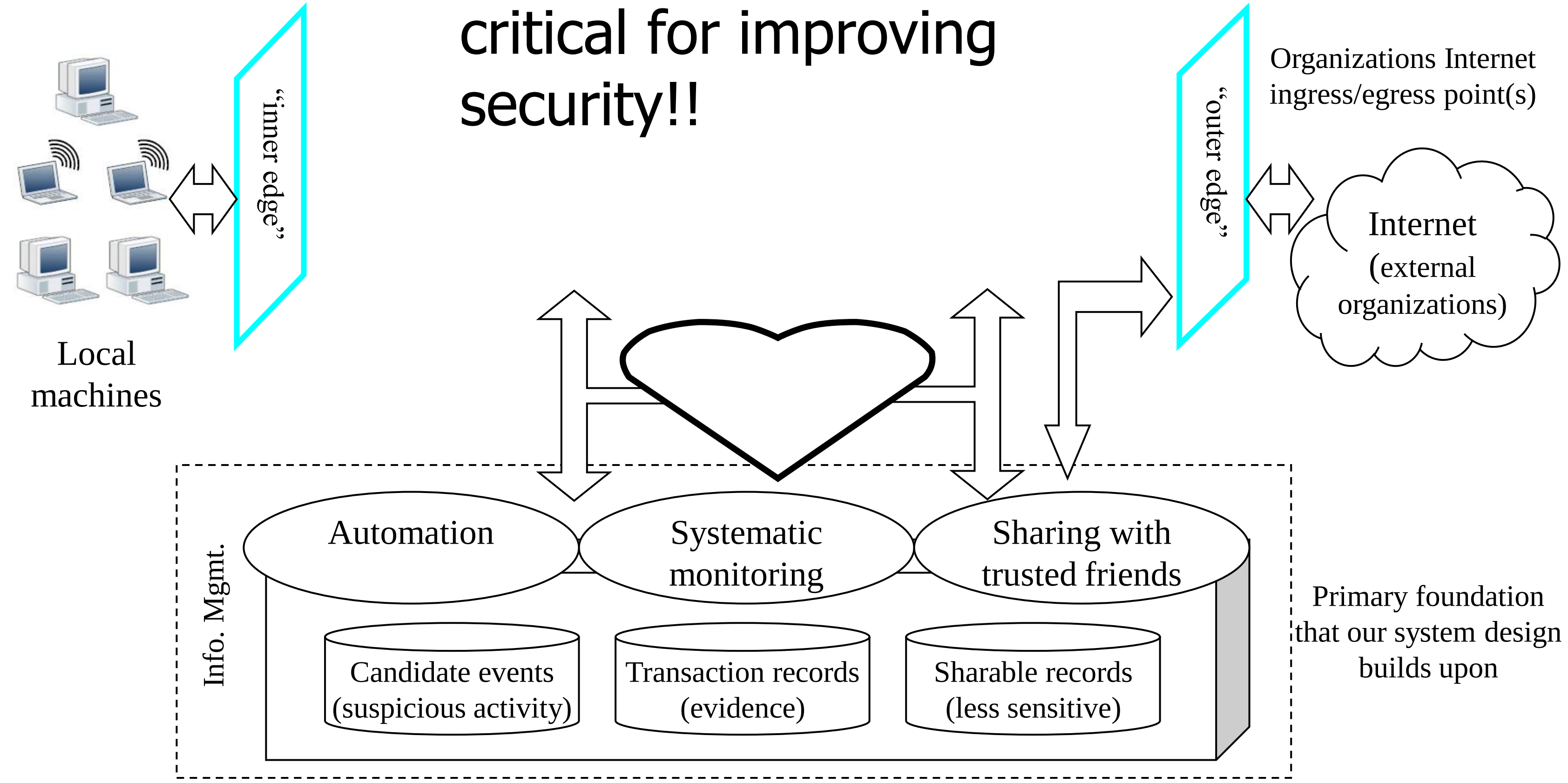
OE
Manager

Information
Management

Primary foundation
that our system design
builds upon

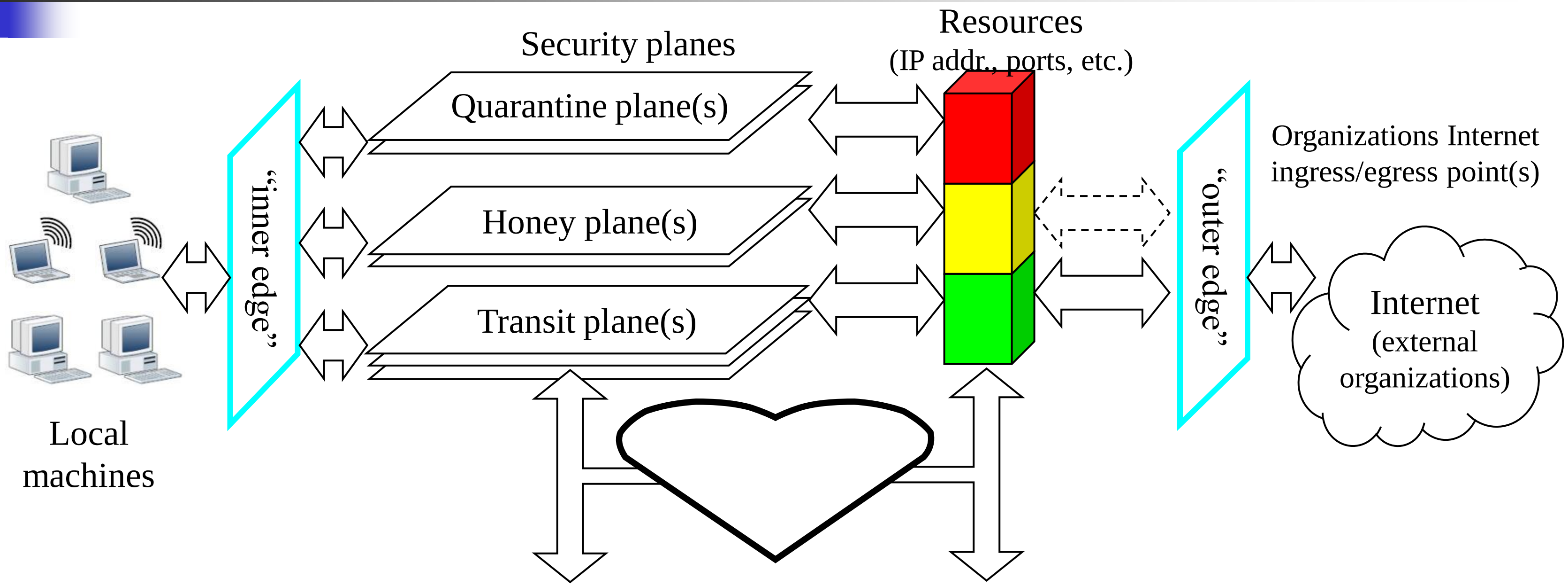
Information management

- Actionable information is critical for improving security!!



Organizations Internet ingress/egress point(s)
Local machines
"inner edge"
"outer edge"
Internet (external organizations)
Info. Mgmt.
Automation
Systematic monitoring
Sharing with trusted friends
Candidate events (suspicious activity)
Transaction records (evidence)
Sharable records (less sensitive)
Primary foundation that our system design builds upon

Security planes

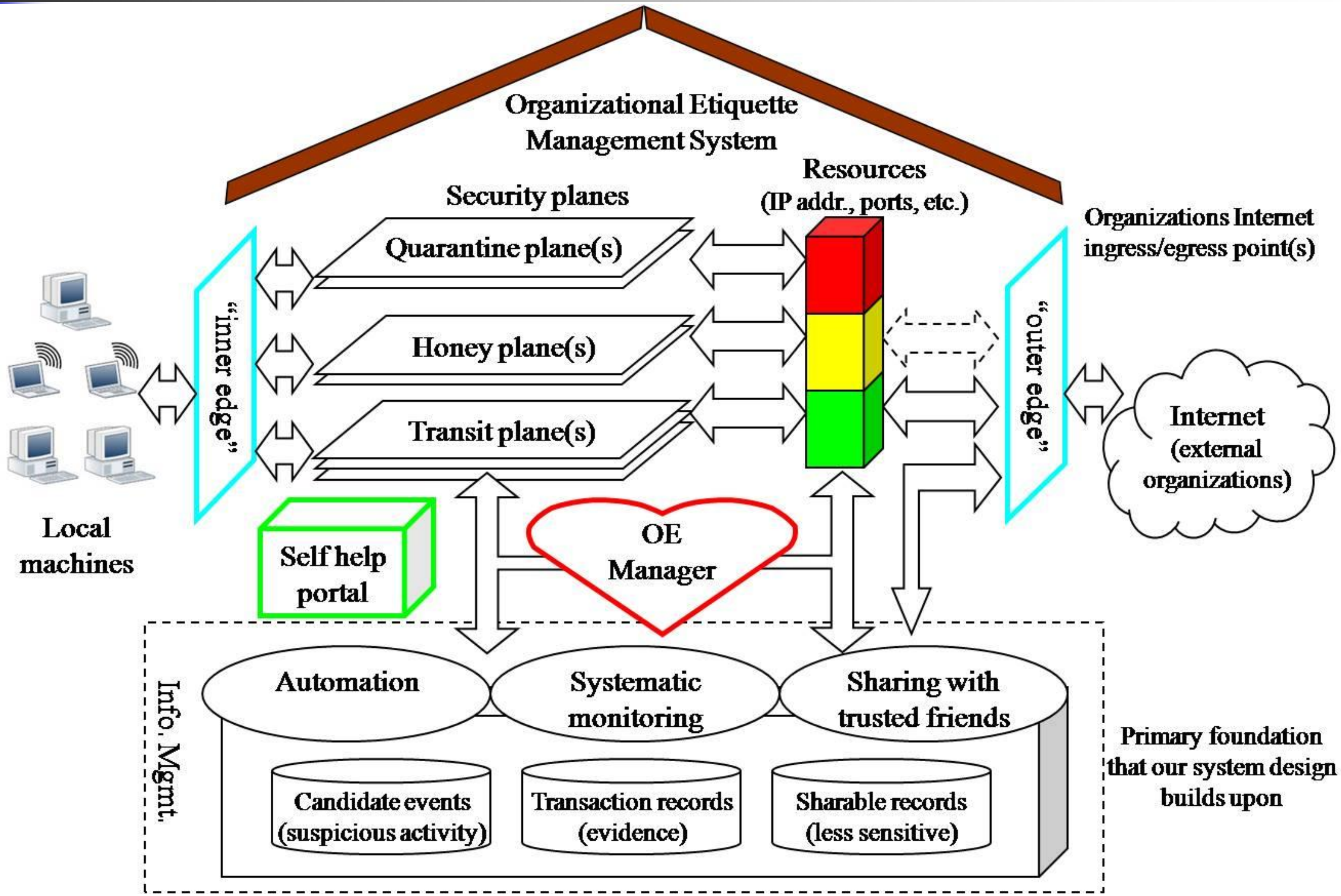


- Machines easily being moved between different security planes, potentially with different Internet accessibility and/or security restrictions
- Implemented as isolated virtual networks

OE manager

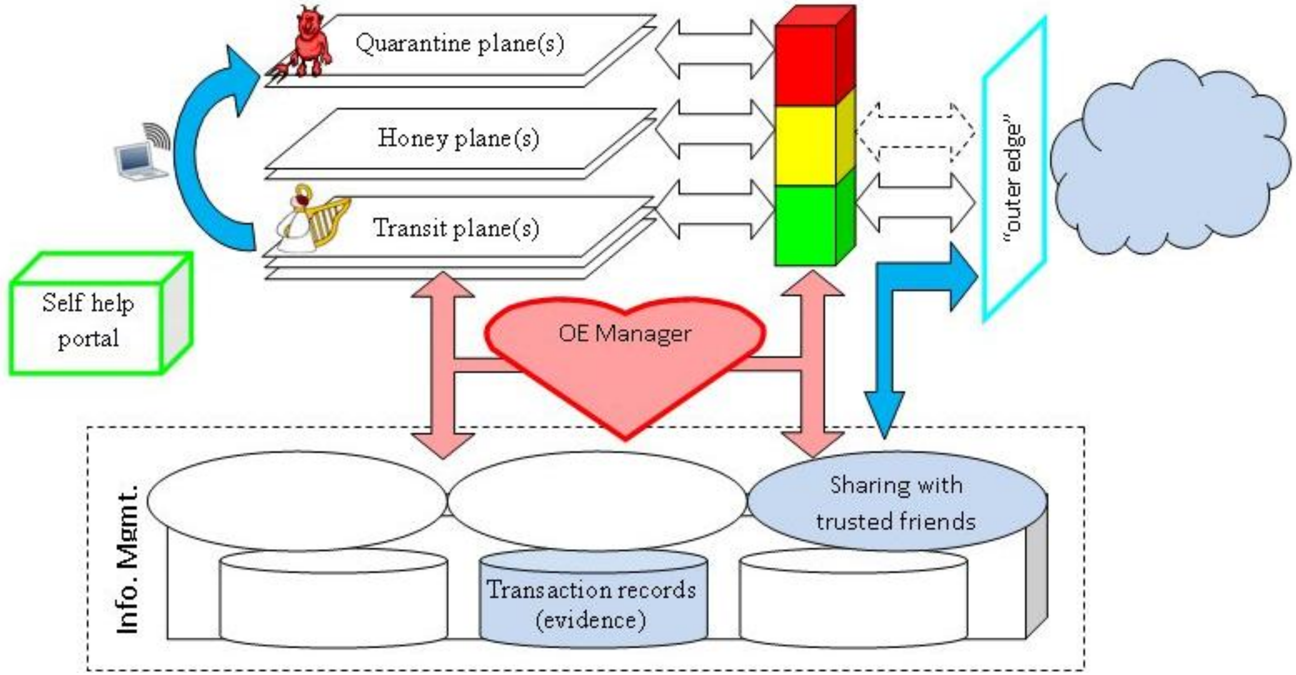
- Threshold-based policies
  - Determine which plane (or security restrictions) each machine on the network should be assigned
- Self-help service
  - Help individual clients improve their security so that they can be moved to planes with greater accessibility without requiring increased manual efforts
  - Host accountability
- Management of essential resources
  - Static policies can be worked around or even make things easier for miscreants
  - Manage essential resources more closely

The OE system



E.g., Sharing with friends

- A friend (organization) may “hint” that one of our machines A attacked one of their machines at time T
- Using our logs we can corroborate that information to see if we have evidence that support such event and machine A should be moved to a different layer



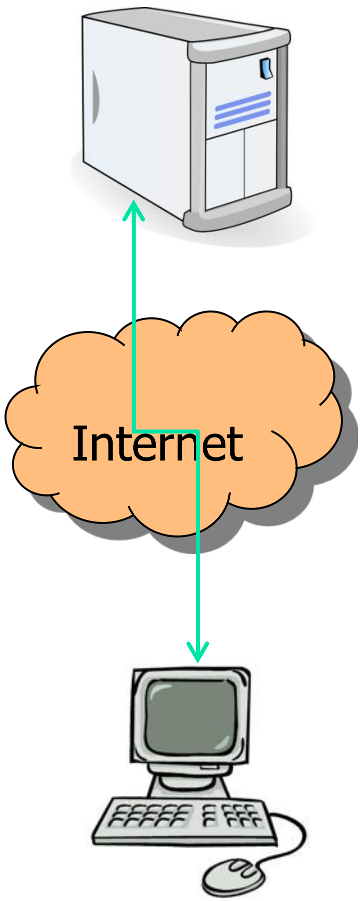
Proof of concept analysis

- A year-long trace of an edge network's traffic
  - Characterize different types of undesirable activity
  - Introduce specific solutions to these activities
- Quantify effectiveness of our proposed solution
  - Reduce the volume of malicious or non-productive traffic
  - Improve the security of the edge network itself
- Considers how miscreants have achieved their current levels of success
  - Use those insights to make it more difficult for miscreants to achieve their various goals in the future
- More advanced/better policies applicable

Measurement data set

Connection data: Detailed summaries of all inbound and outbound connections (e.g., source and destination IP and port numbers, connection state).

Description	Value
Duration	1 year (Apr/08 – Mar/09)
Connections	39.3 billion



Internet

External Host = Source IP

External Host = Destination IP

Inbound Connection

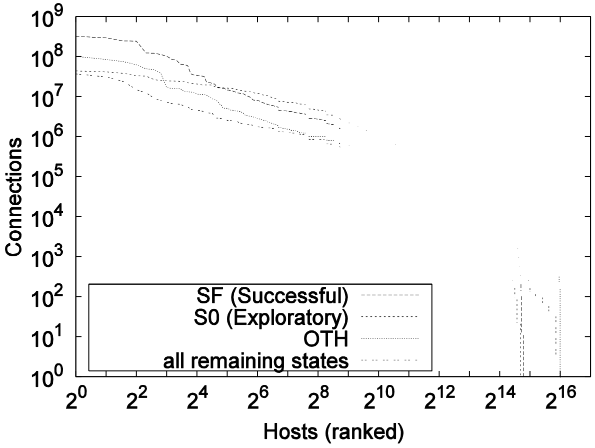
Outbound Connection

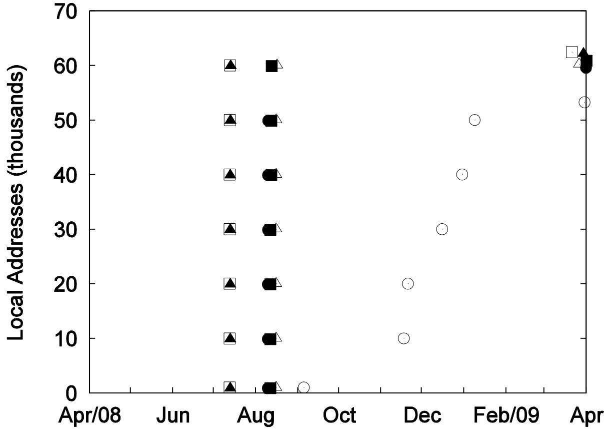
Campus Host = Destination IP

Campus Host = Source IP

Example results: DDoS

- Is egress filtering doing the job??
  - No!





- Static threshold-based policy
  - Based on unused address space
- Better yet … Management of essential resources
  - Keep track of which IP addresses should be in use
  - Solutions at the “inner edge” …

Conclusions

- Promoting a shift in security practices
  - Current primary focus is on what others are doing to you
  - We argue that responsible organizations must strive to improve their organizational etiquette and to become better Internet citizens
  - Organizations should also help other (trusted) organizations achieve the same goal
- Organizations need to take greater responsibility for the traffic that leaves their edge network(s)
- The OE system (after “Organizational Etiquette”)
  - Reduce the negative impact an organization have on others
- Quantify effectiveness of our proposed solution

Questions?

Email: niklas.carlsson@ucalgary.ca