Network Security:

New Essentials for Safeguarding Network Systems

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Security Concerns are Impacting Business and Consumers…

"Approximately 150 to 200 viruses, trojans and other threats emerge each day."[1]

"Underground hackers are hawking zero-day exploits for Microsoft's new Windows Vista operating system at $50,000 a pop"[2]

Time to exploit vulnerability ~6.8 days. Time from vulnerability exposure to patch availability ~49 days.[3]

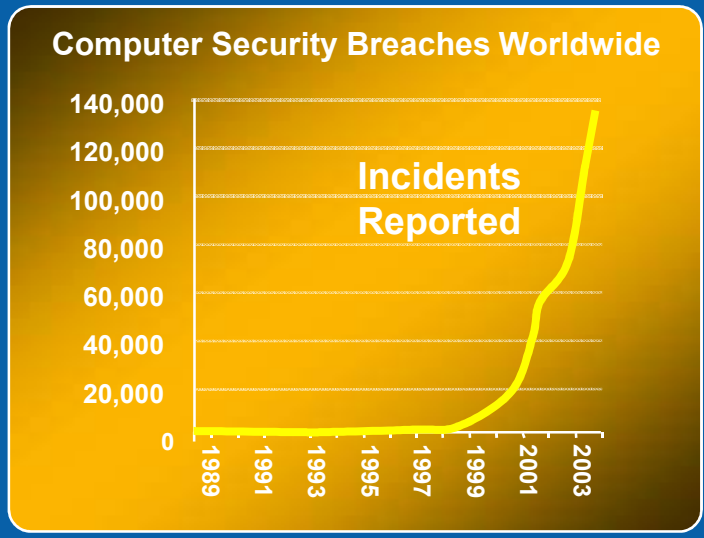
Country-wide botnet based cyber attacks cause significant disruption[4]

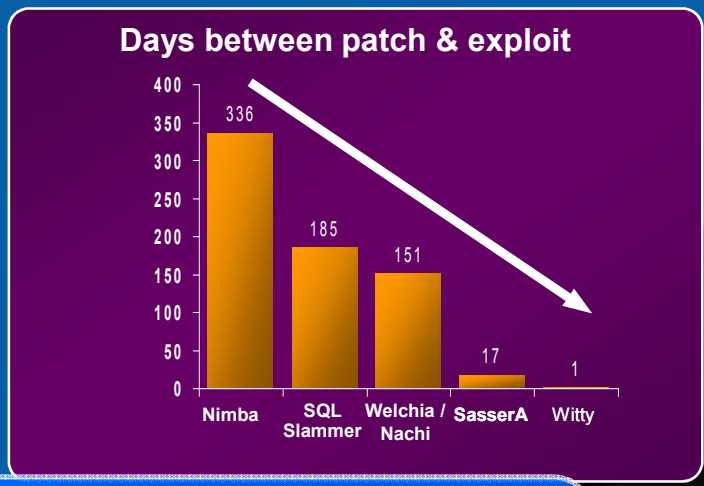
"50% of consumers are concerned about their financial information being safe online. 24% performed fewer transactions online as a result."[5]

1. McAfee, 2006
2. eWeek.com, Dec 15, '06
3. Symantec Internet Security Threat Report Trends for July 05 – December 05
4 http://www.technologynewsdaily.com/node/7032
5. Consumer affairs poll, May 2006

… and are a Top IT Concern

- New security challenges
  - Not just fast spreading worms
  - Rising stealthy attacks
  - Rootkits & system bots
- Software patch management alone is insufficient
- Attack virulence makes manual intervention ineffective
- Device Proliferation: pocket-able internet devices mean both ***new devices*** and ***new local nets*** (CSLL, ON-MOVE, etc) to attack





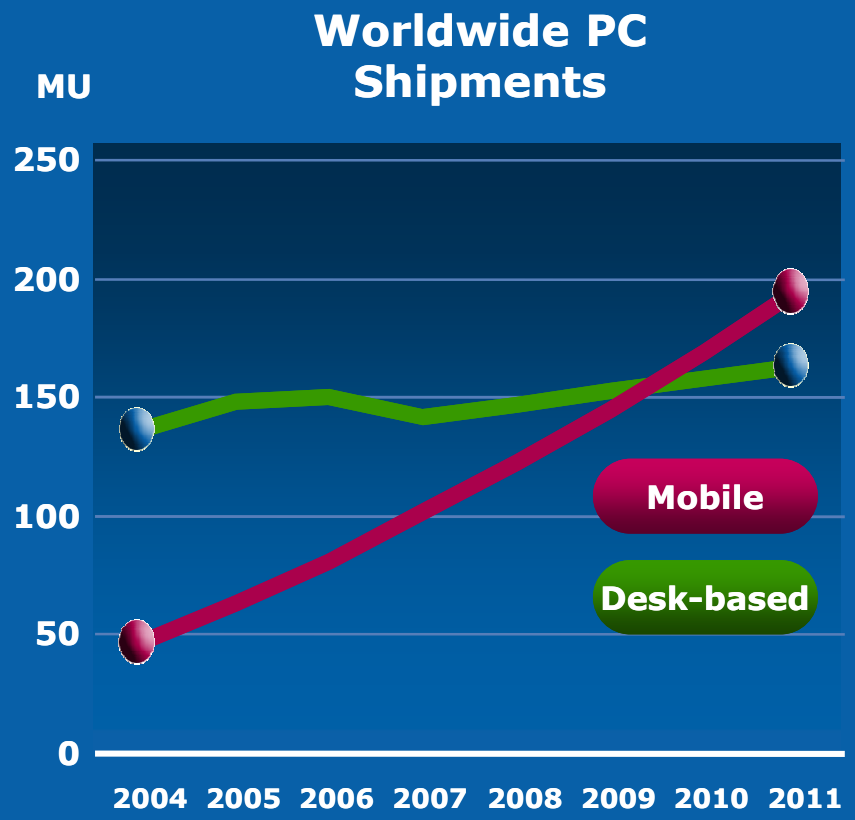
Security *is Costing Billion's of Dollars in* ***Operation*** *and* ***Lost Productivity***

Source: Forrester

Source: Computer Emergency Response Team

The Problem is Only Getting Worse

- Intelligent and devious intruders
  - Constantly finding and exploiting vulnerabilities
- Mobile shift adding complexity
  - Fixed perimeters and physical controls no longer adequate
- Insider attacks defeat enterprise perimeter solutions
- Financial gain becoming motivation for malware



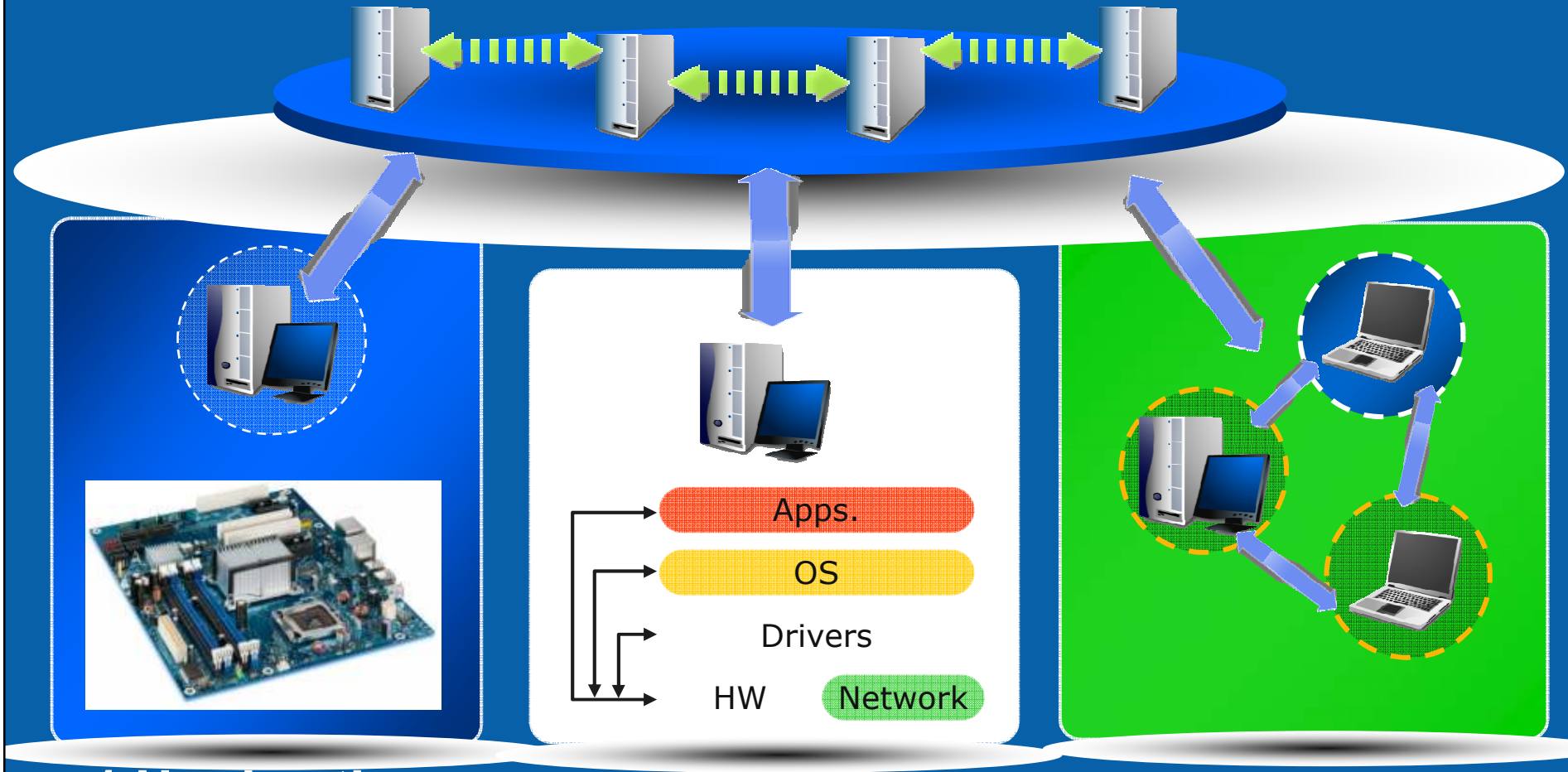
New Security Paradigms Needed

Security Doesn't Come for Free

- Performance Impact
  - Security Tax = Overhead
  - Overhead is not trivial
  - Overhead is not one time payment
  - Overhead is additive
- System Scalability
  - Scalability = consistent protection as system complexity grows
    - Number of nodes
    - Bandwidth/line rates
    - Usages/SW applications

Today's security solutions optimized for *Performance or Scalability*

Layers Provide Scaleable Performance



1 Harden the Platforms

2 Secure the Links

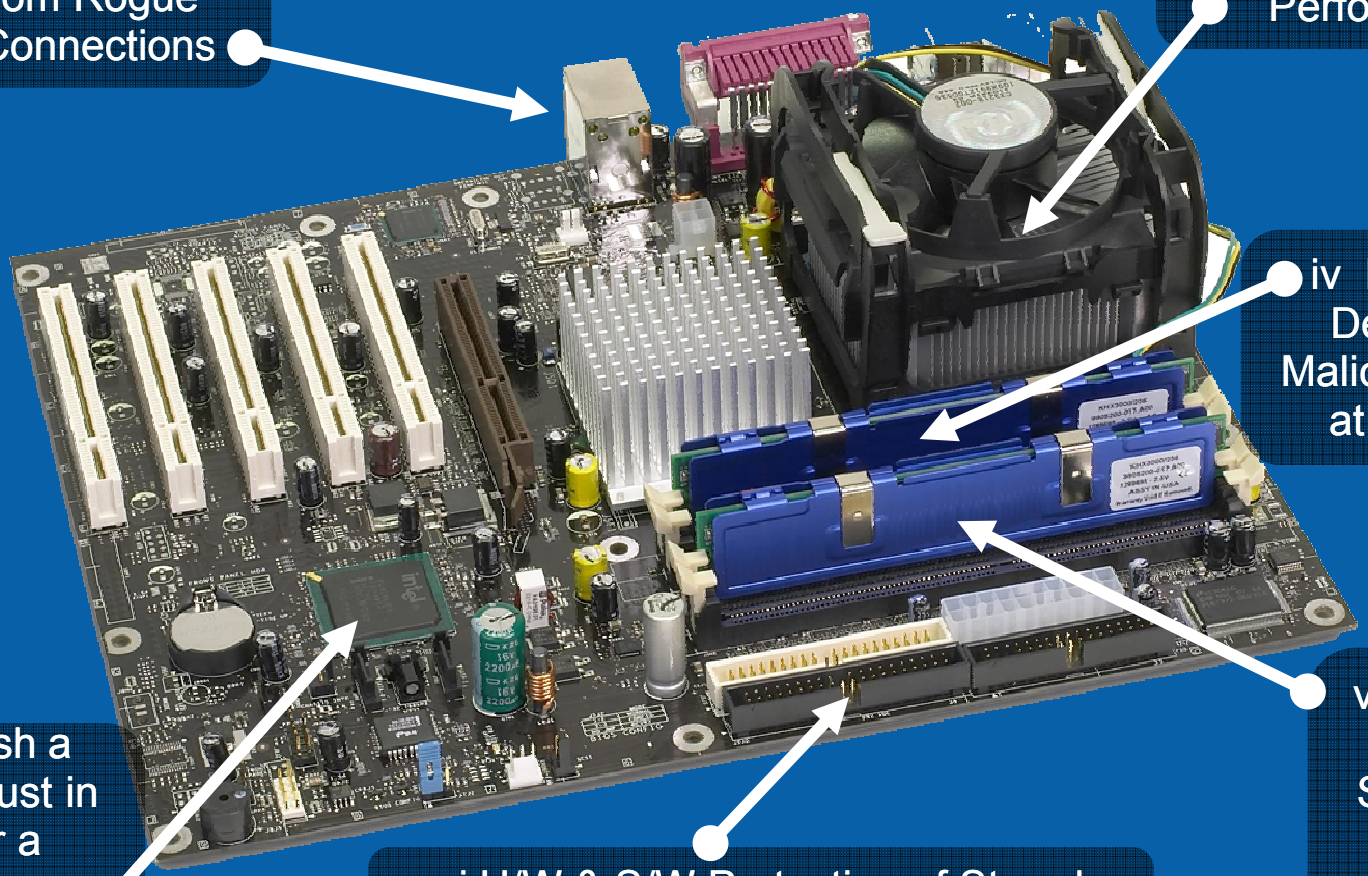
3 Leave Nowhere to Hide

4 Collaboration

1 Harden the Platform

ii Access Controls to Protect from Rogue Network Connections

iii New Instructions for Cryptography Performance



iv H/W-based Detection of Malicious Attacks at Run Time

i Establish a Root-of-Trust in H/W for a Secure Foundation

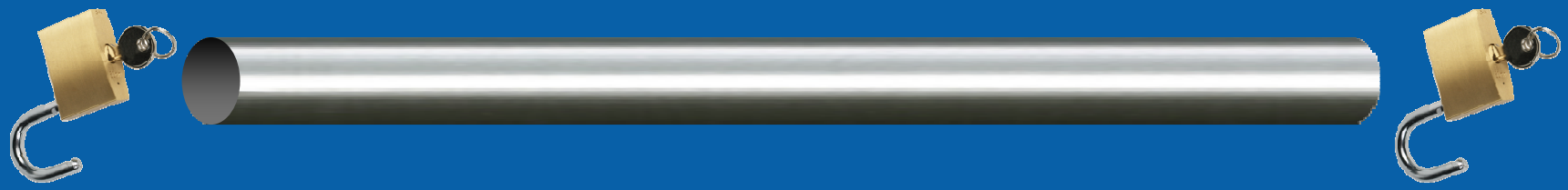
vi H/W & S/W Protection of Stored Data at Rest and In Transit

v Protection of Known-Good Software from Run Time Attacks

Applies to all distributed systems:
Server, Router/Switch, PC, Notebook, MID

2 Securing the Links: End-to-End Confidentiality

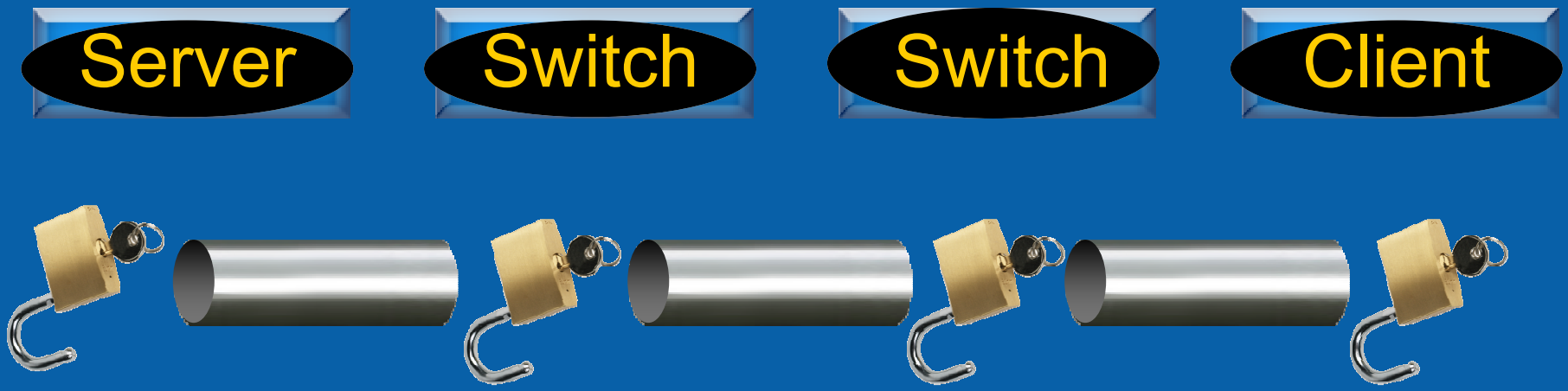
IPSec – End-to-End Encryption



- End to end solution: Valuable for encrypting IP Layers, not suitable for link layer threats
- Issues with scalability and manageability
- Complementary solutions:
  - LinkSec
    - Converts end-to-end protection into link-by-link protection
  - Secure Network Enclaves
    - Builds on LinkSec, current area of active research
    - Provides end-to-end solution with manageability

Securing the Links: LinkSec

- Traffic available for analysis at IT-controlled switching points
- Protects against eavesdropping hackers



LinkSec – Hop-to-Hop Encryption

LinkSec Demo

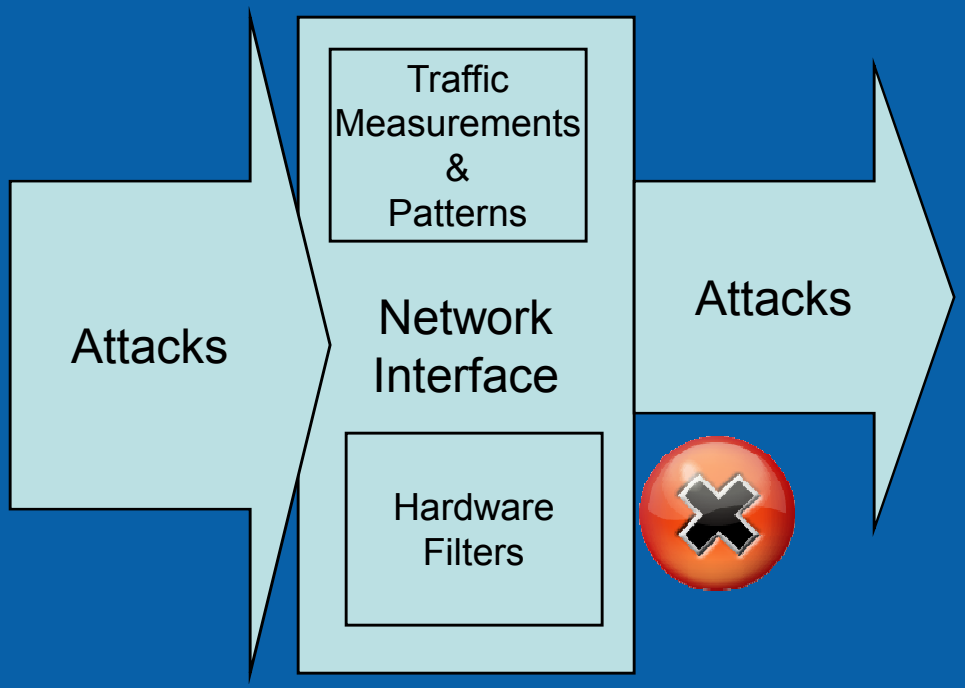
3 Secure Network Enclaves: Leave Nowhere to Hide Current Research Emphasis

- Integrates the best approaches
  - From End-to-End and hop-by-hop encryption
- Derivation mechanisms trade storage for computation
- Permits manageability and IT-visibility into traffic
- Scalability based on coordinated key management

Performance based on hardware support at nodes

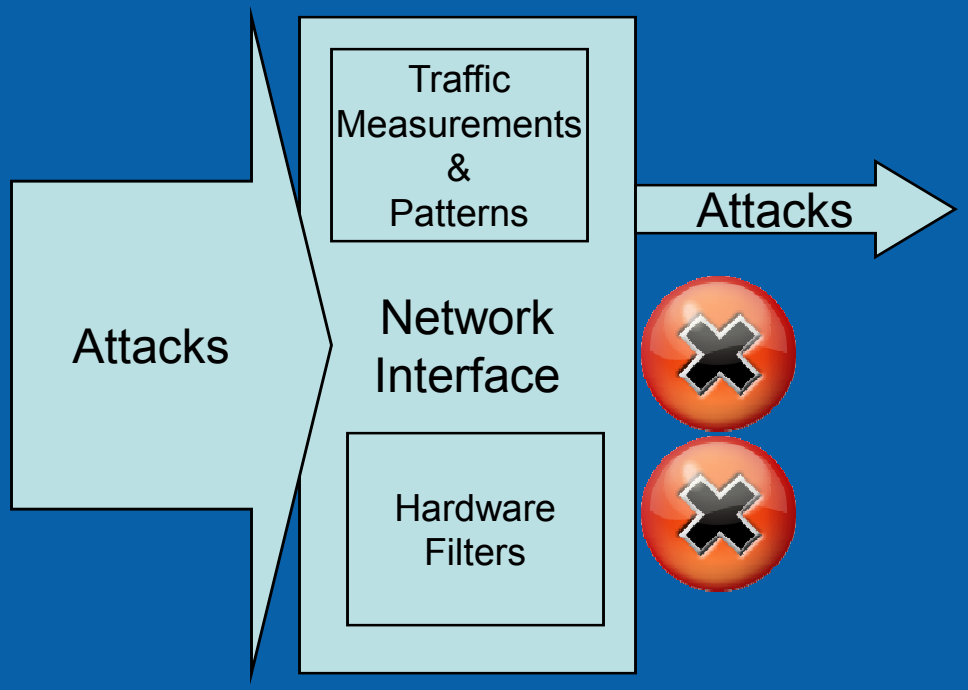
4 Collaborative Defense: Step 1: Hardware Filters

- Hardware filters that look for specific patterns in the data
- Cannot be subverted by modifying the software
- Deployed in Intel platforms today (AMT)

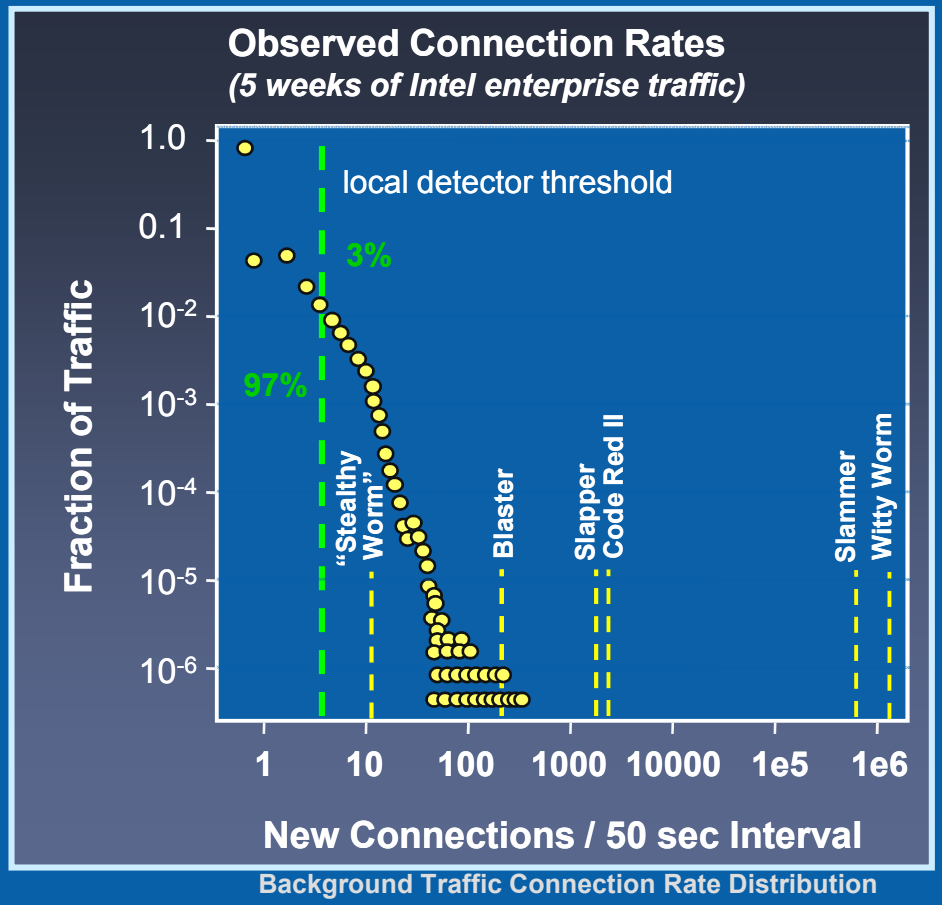


Collaborative Defense: Step 2: Heuristics

- Rules that encode typical behavior of malware
- Multi time-scale rules capture known worms
- Worms that remain "hide" in the background traffic



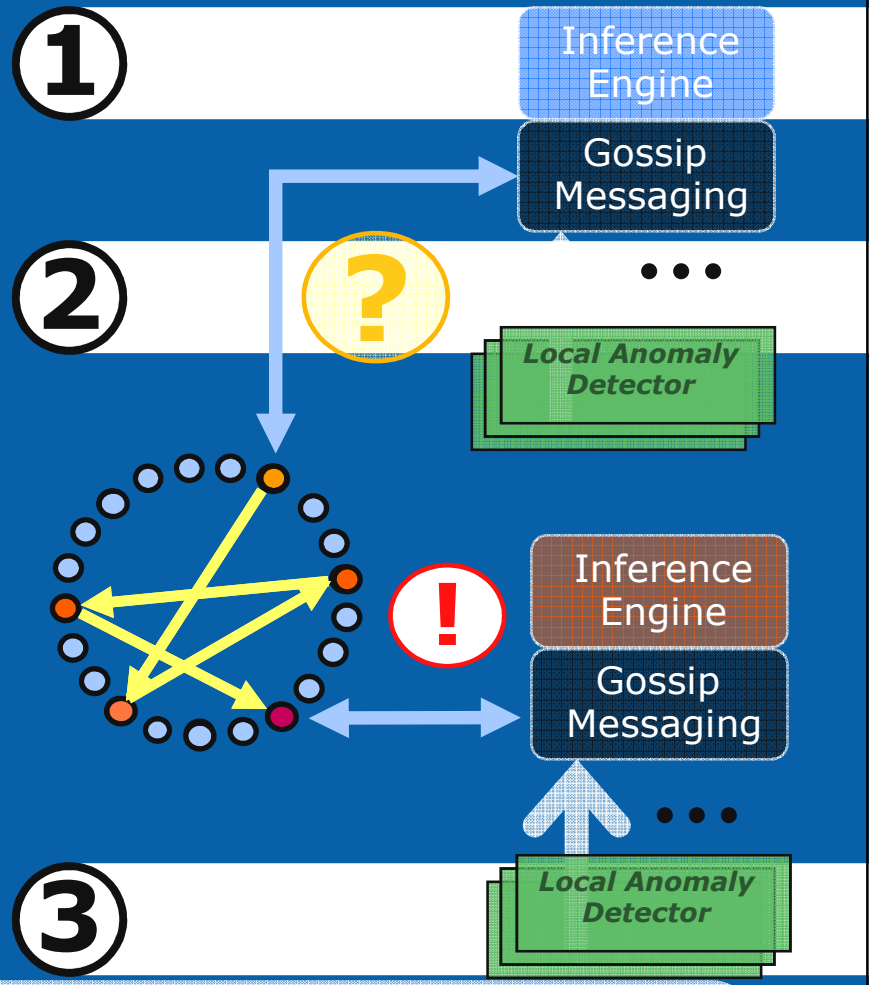
Rules are not Enough – Attacks are Evolving



Challenge is to reduce threshold of detection without increasing false alarms

Collaborative Defense: Step 3: Inference and Gossip

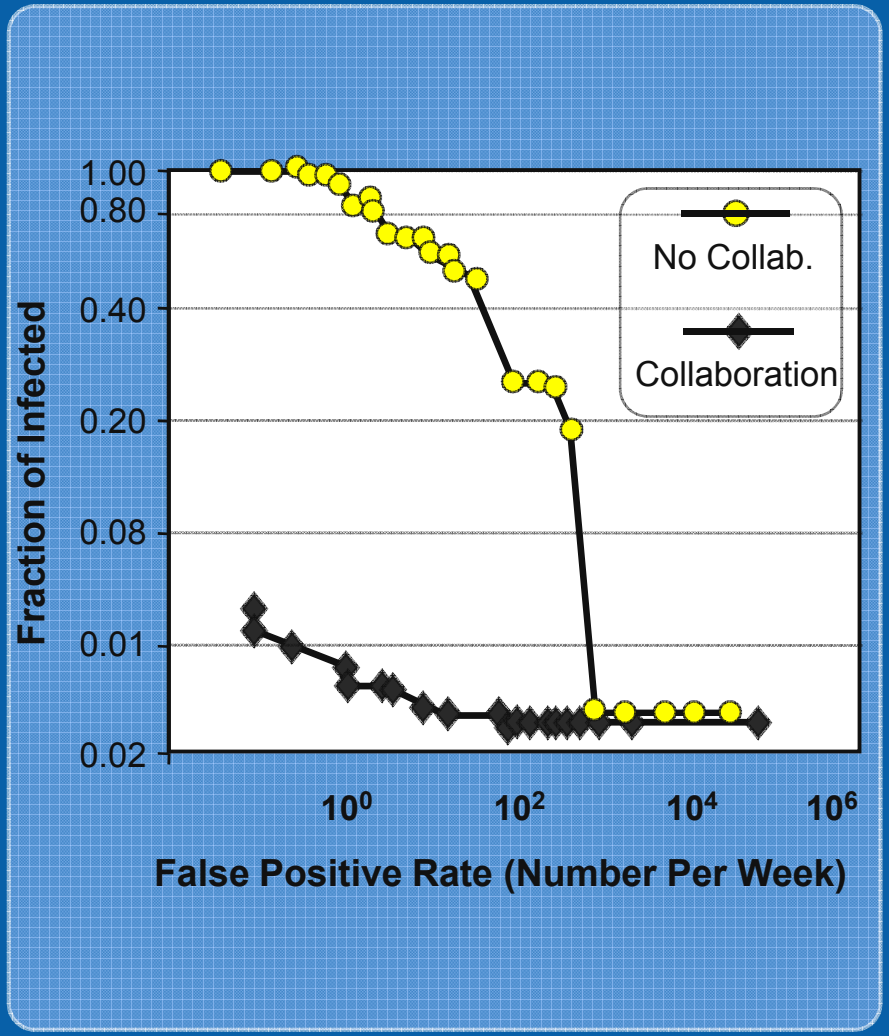
- Employ probabilistic inference
  - Correlate events across multiple machines
  - Combine weak hypotheses into strong evidence
  - Dramatically cut false positives
- Implement scalable, robust messaging protocols
- Design self-configuring local anomaly detectors



Exploiting the power of scale – Making Scale work to our benefit

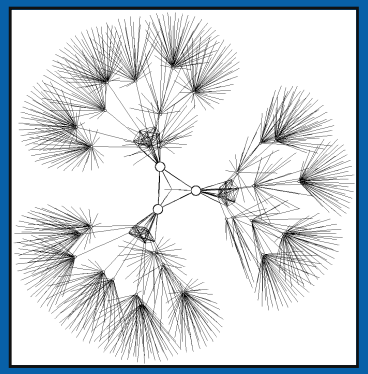
The Results: Gossip is Good

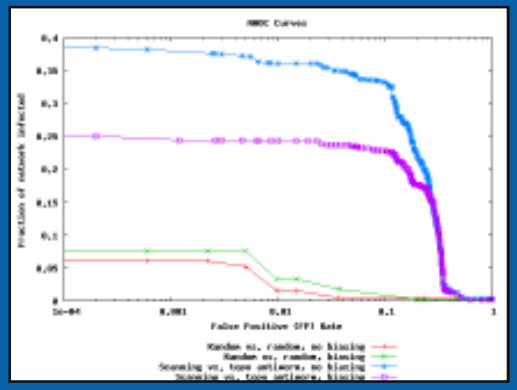
- Collaboration drives false alarms down
  - Allows many simple, but imperfect detectors
- Collaboration roots out stealthy attacks
  - Collect concise local data
  - Put in global correlation framework
- Scalability works in our favor
  - The more participating nodes, the better the performance

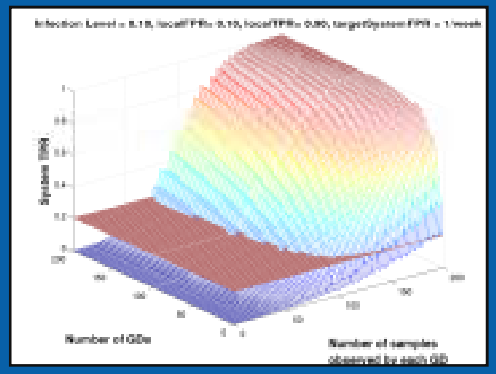


Future Directions

- **Adaptation and Learning**
  - end-hosts and networks are dynamic systems
- **Messaging optimizations**
  - bias to send "bad news" faster
- **Pinpointing suspect systems**
  - exploit topological & historical knowledge







Collaboration between distributed platforms provides major advantages in detecting intrusions

Summary

- **Security remains a top IT problem**
  - Device Proliferation, Mobility, new LCN classes pose major challenges
- **Think about the networked system of platforms**
  - when you consider security vulnerabilities
- **No single solution to rapidly evolving threats**
  - Competing tradeoffs: Performance, Scalability, Simplicity
  - Opportunity: use scalability to our advantage while maintaining performance and simplicity
- **New Essentials for safeguarding LCN systems:** *innovate across multiple layers*
  - 1 Harden the platform
  - 2 Secure the links
  - 3 Leave nowhere to hide
  - 4 Collaborative defense

Let's work together in the LCN research community to create the secure local networks of tomorrow!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