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Data- och informationsteknik

Forskning inom datasäkerhet

Tomas Olovsson

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Facts and Figures

- Employees at department: 160
  - Faculty members: 75
  - PhD students: 70
- Full time students: 1100 (360 GU)
- 120 courses at 20 programmes
- Thirty nationalities represented

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Research Groups

- Algorithms
- Bioinformatics
- Computer Architecture
- Computer Graphics
- Communications and Computer Networks
- Computer Security
- Dependable Real-Time Systems
- Distributed Computing
- Embedded and Networked Processors
- Formal Methods
- Functional Programming
- Language Technology
- Programming Logic
- Software Engineering
- Telecommunication Theory
- VLSI Circuit Design

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Networks and Systems security group


Wolfgang John


Erland Jonsson


Tomas Olovsson


Philippas Tsigas


Marina Papatriantafilou


Magnus Almgren

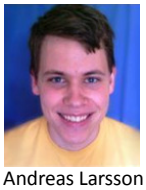

Elad Schiller

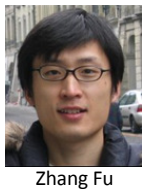

Asrin Javaheri


Farnaz Moradi


Laleh Pirzadeh

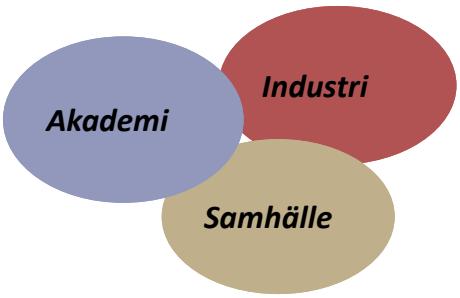

Pierre Kleberger


Andreas Larsson


Zhang Fu

Security Arena Lindholmen

Forskning och Utveckling i TRIPLE HELIX-miljö



- CHALMERS
- ERICSSON TAKING YOU FORWARD
- SAAB
- VOLVO
- MSB Myndigheten för samhällsskydd och beredskap

syssec

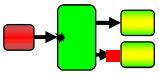
European Network of Excellence in Managing Threats and Vulnerabilities in the Future Internet

- A Network of Excellence (2010-2014) to work towards solutions and collaborate
- European level
  - Poli. di Milano (IT)
  - Vrije Uniivesriteit (NL)
  - Institute Eurecom (FR)
  - IPP (Bulgaria)
  - TU Vienna (Austria)
  - Chalmers U (Sweden)
  - UEKAE (Turkey)
  - FORTH – ICS (Greece)
  - and with international colleagues around the world
- Focus
  - Research into malware & fraud, smart environments, and cyber attacks
  - Develop a curriculum for system security, and
  - Report and describe large threats in a yearly report.

http://www.syssec-project.eu/

Security projects at Chalmers

- Quantitative modeling and evaluation of security
- Security and dependability modelling
- Intrusion Detection Systems
- Intelligent security logging and monitoring
- Programming language support for security
- Formal methods for programming languages
- Malicious Internet traffic (attacks, spam, …)
- Denial of Service mitigation techniques
- Secure sensor networks
- Decision support systems
- Safety and Security in transport systems
- …



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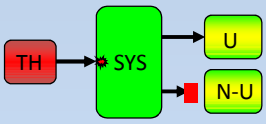
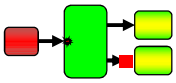
Security Metrics and Modelling



Erland Jonsson
Laleh Pirzadeh
(Vilhelm Verendel)

What is the problem?



- Reliability:
  - Own research field
  - Deals with random events – failing components, etc.
  - Can with good precision predict how and when a system fails
  - MTTF: Mean time to failure
- Security:
  - No randomness in events
  - Events are malicious
  - The presence of just one vulnerability can be enough for an attacker
  - Attacks can be tested off-line
  - No measure for security. Certifications and standard compliance used instead

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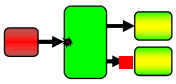
System- related Security Metrics



Metrics are decomposed into protective, behavioural and correctness:

- A protective metric describes the ability of a system to *resist attacks* during operation
- A behavioural metric describes to what extent the system *delivers its service* to its authorized users and denies service to non-authorized users
- Correctness describes how correct a system is wrt to some reference (very hard)

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Network defence against spam

Farnaz Moradi
Tomas Olovsson
Philippas Tsigas

.se
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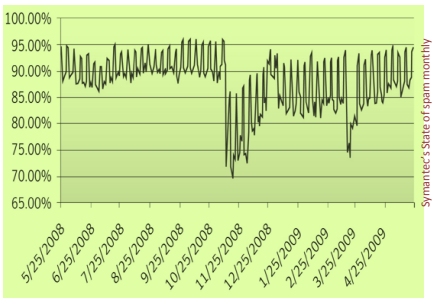
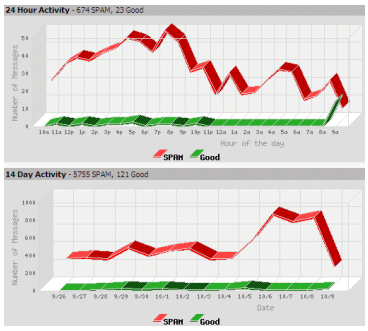
Why Do We Care About Spam?

- Today, as much as 90% of inbound email is spam
  - More than 120 billion spam messages is sent per day
- Estimated cost of spam in 2007 was on order of $100 billion





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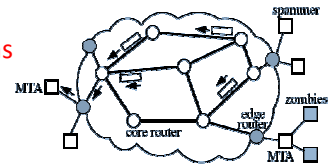
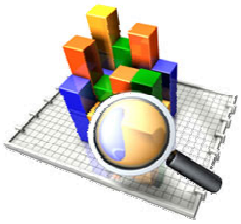
What Is Our Goal?

- Traditional methods remove spam after it has been received
  - Spam identification software requires large computational resources
- Goal: Provide network-based protection
  - Stop spam as close to its source as possible
  - To be implemented in small networked devices
- Method:
  - Study spam characteristics
  - Network-level data
  - No inspection of contents should be needed
  - Use social network techniques to find statistical differences





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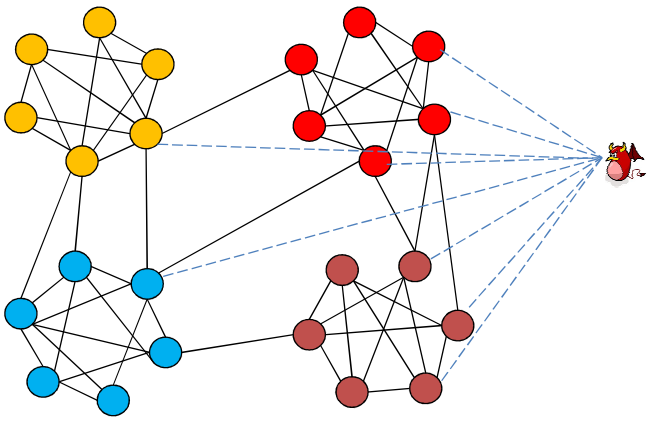
Small-world networks – Clustering



Social network: All other nodes can be reached by a small number of steps
Possible to identify ”outliers”, nodes with different clustering behavior.

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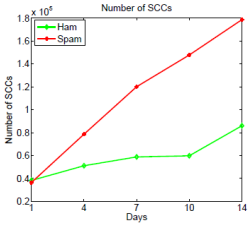
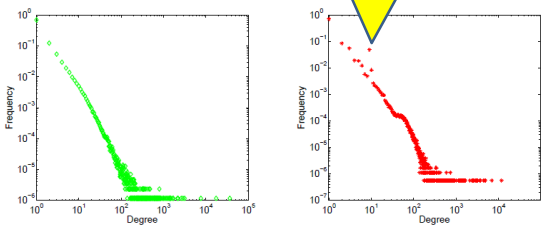
Spam differs from Ham



(b) Number of strongly connected components
(number of "best" friends)

Differences are visible within minutes.
Spamming nodes can then be identified!
Many more characteristics are available and can be used.

Misbehaving nodes reveal spammers



Degree distribution for Ham and Spam
(i.e. frequency of number of friends)
Ham follows a power law: $C * k^{-\gamma}$

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Securing the Connected Car

Project: SIGYN II (Vinnova)

Volvo Cars, Chalmers, KnowIT, Viktoriainstitutet, SP, Semcon, Alkit


Erland Jonsson


Tomas Olovsson


Pierre Kleberger


Asrin Javaheri

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Introductory Example

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Introductory Example

- Possible explanations for the crash

Bad weather

Bambi

Too much to drink…

Road conditions

OR…
Perhaps a piece
of malicious code?

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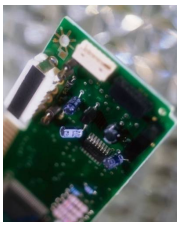
Modern Vehicles

- Contain 50-100 computers
  - Electronic control units (ECUs)
  - Internal network used – replaces all old cables
  - Network of the size of an office!
- Why use computers and software?
  - Easy to reproduce, update functionality
  - Supports flexible, advanced functionality: ABS, ESP, …
  - Diagnostics and software updates
  - App-store



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Securing the Connected Car

- A car today consists of 50-100 networked computers
- And tomorrow it will be connected to the Internet...
- Complementing safety issues with security aspects


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THREAT LEVEL

PRIVACY, CRIME AND SECURITY ONLINE

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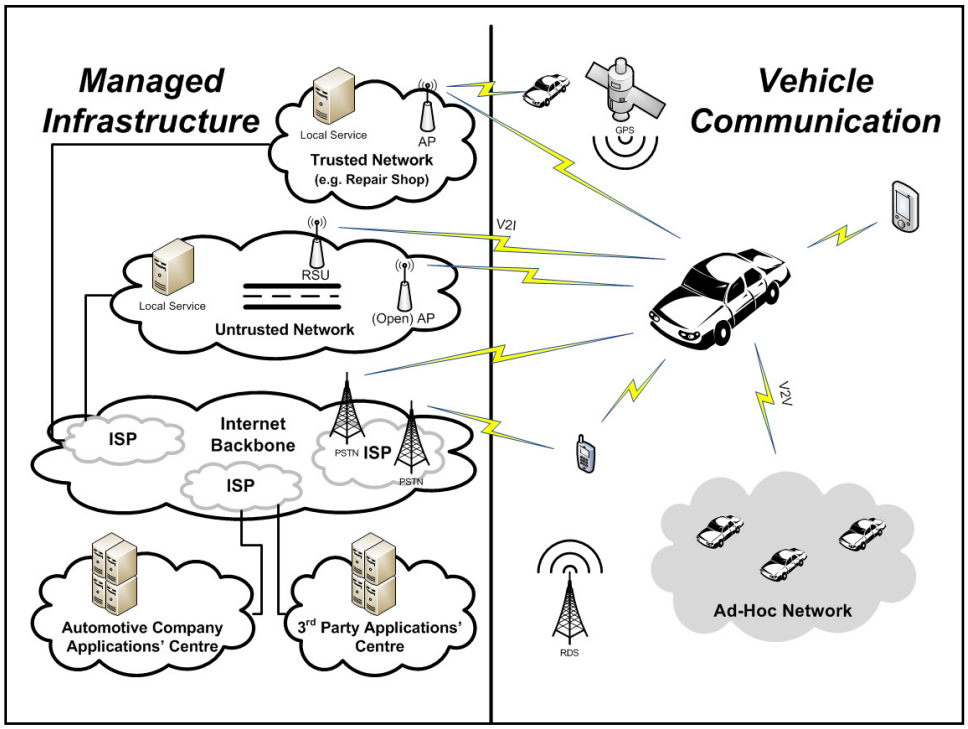
Hacker Disables More Than 100 Cars Remotely

By Kevin Poulsen | March 17, 2010 | 1:52 pm | Categories: Breaches, Crime, Cybersecurity, Hacks and Cracks

More than 100 drivers in Austin, Texas found their cars disabled or the horns honking out of control, after an intruder ran amok in a web-based vehicle-immobilization normally used to get the attention of consumers nt in their auto payments.

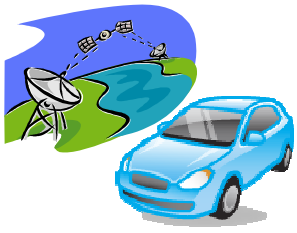
ith Austin's High Tech Crime Unit on Wednesday 20-year-old Omar Ramos-Lopez, a former Texas nter employee who was laid off last month, and sought revenge by bricking the cars sold from the dealership's four Austin-area lots.



Examples of Services

- Remote diagnostics
  - Read diagnostic trouble codes
  - Determine what is wrong with the vehicle
  - Control functionality (test hardware and software)

- Remote software update
  - Install new software in an ECU
  - Provide improved functionality
  - Patch software (bugs)
    Can we wait 3 years for a patch?



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Why remote softare updates?

Volvo recalls 26,000 cars worldwide:

Reason: Problems with the software controlling the fuel injection pump. It can under some circumstances render the car impossible to start.

…

Affected models are Volvo S 80, S 60, XC 60, XC 70 and V 70 from 2008 to 2010, all with the T6 turbo engine.

Source: Alltommotor.se

This is not a Volvo specific problem. All vendors recall cars due to software and other problems.

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Risks and Consequences

- Execution of arbitrary code
  - Successful impersonation of portal, intrusion to vehicle
    - Issue arbitrary diagnostics requests or software
    - Update ECU with modified software

- Disclosure of information
  - Successful intrusion to portal, impersonation of vehicle
    - Gain access to private data

- Denial of service
  - Targeting portal, communication link or vehicle
    - Cause software updates to fail, diagnostics to report incorrect values
    - Prevent legitimate users from updating potentially vulnerable software

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Summary: Current security projects

- Quantitative modeling and evaluation of security
- Security and dependability modelling
- Intrusion Detection Systems
- Intelligent security logging and monitoring
- Programming language support for security
- Formal methods for programming languages
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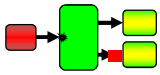

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