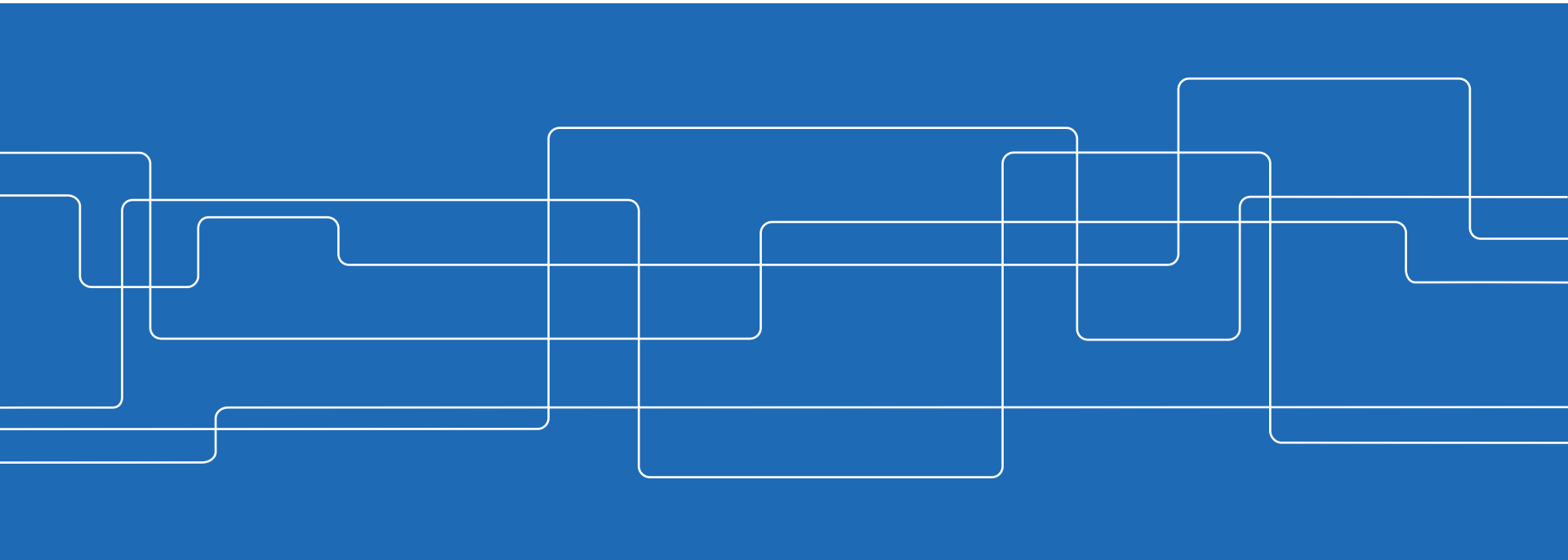
The Cyber Security Modeling Language and Cyber Security research at department for Industrial Information and Control Systems

Mathias Ekstedt, Associate Prof.

KTH Royal Institute of Technology, Stockholm



Agenda

Dept. for Industrial Information and Control Systems, KTH

Cyber Security Modeling Language (CySeMoL)

Areas for collaboration / exchange

Industrial Information and Control Systems

Research

- Focus is on developing theories, methods and prototypes in order to contribute to the development of cost-effective and resilient industrial IT-systems
- In particular for electric power utilities - the department has ever since its start in 1989 had a close cooperation with the power industry.
- Research groups
  - Power System Mamagment with related Information Exchange
  - Information and Control Systems Architecture
  - Cyber Security
  - Technology Management

Size

- approximately 30 people out of which 5 faculty

Cyber Security @ Industrial Information and Control Systems

Research areas

- Security analysis of enterprise-level information systems architectures (user/customer-side system architectures)
- In particular for power utilites (i.e. SCADA and substation automation systems, and smart grid architectures)
- Information Security Managment (security governance and organization)

Methodolodigal approach

- Information systems architecture modelling
- Attack/defense graphs
- Probabilistic analyses

People

- 3 faculty, 3 PhD students (1 industry),1 post doc (upstarting) +1, 1 programmer

Projects/financing

- EU FP7: VIKING – finished (security of ”traditional” SCADA)
- EU FP7: SEGRID (smart power grid cyber security)
- EU ERA-NET: SALVAGE (smart low-voltage power grid cyber security)
- Swedish Centre for Smart Grids and Energy Storage
- Swedish National Grid/ Swedish Defence Research Agency
- European Institute of Innvation and Technology / InnoEnergy (comersialization)

Agenda

Dept. for Industrial Information and Control Systems, KTH

Cyber Security Modeling Language (CySeMoL)

Areas for collaboration / exchange

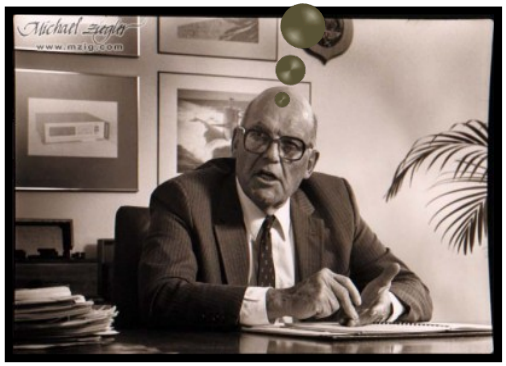
Cyber security managment is difficult!

Is my control system secure enough?

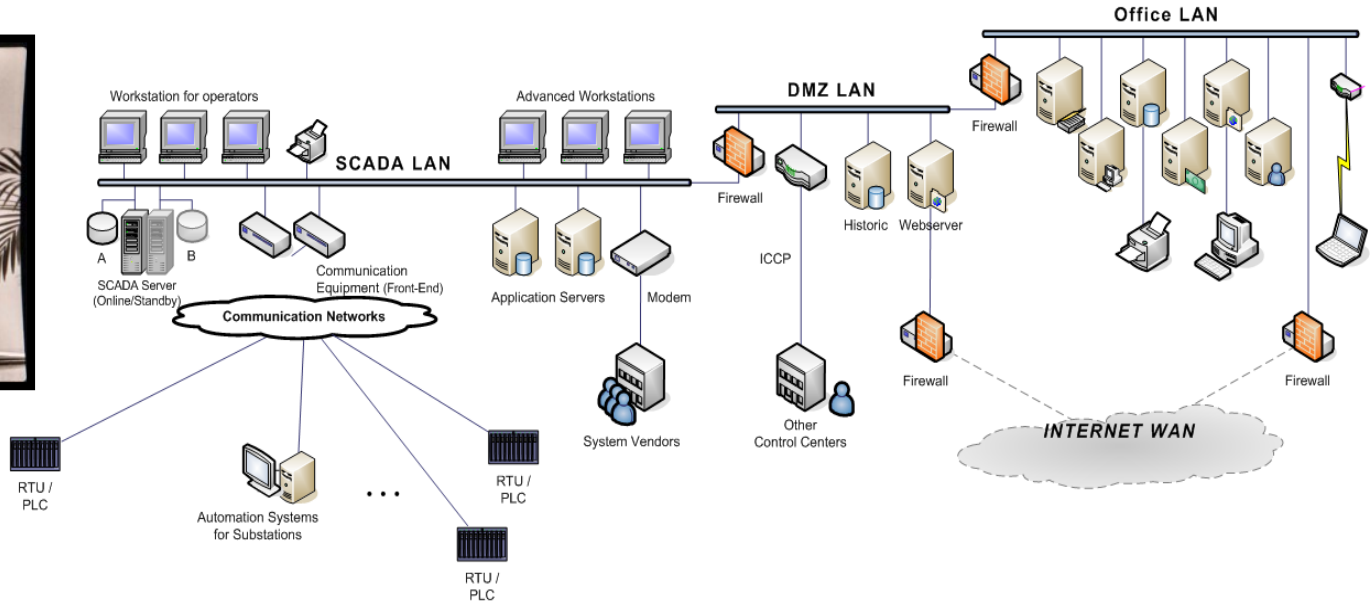
Interconnected

Complex architecture and data flow

Many vendors (incl. off-the-shelf components)

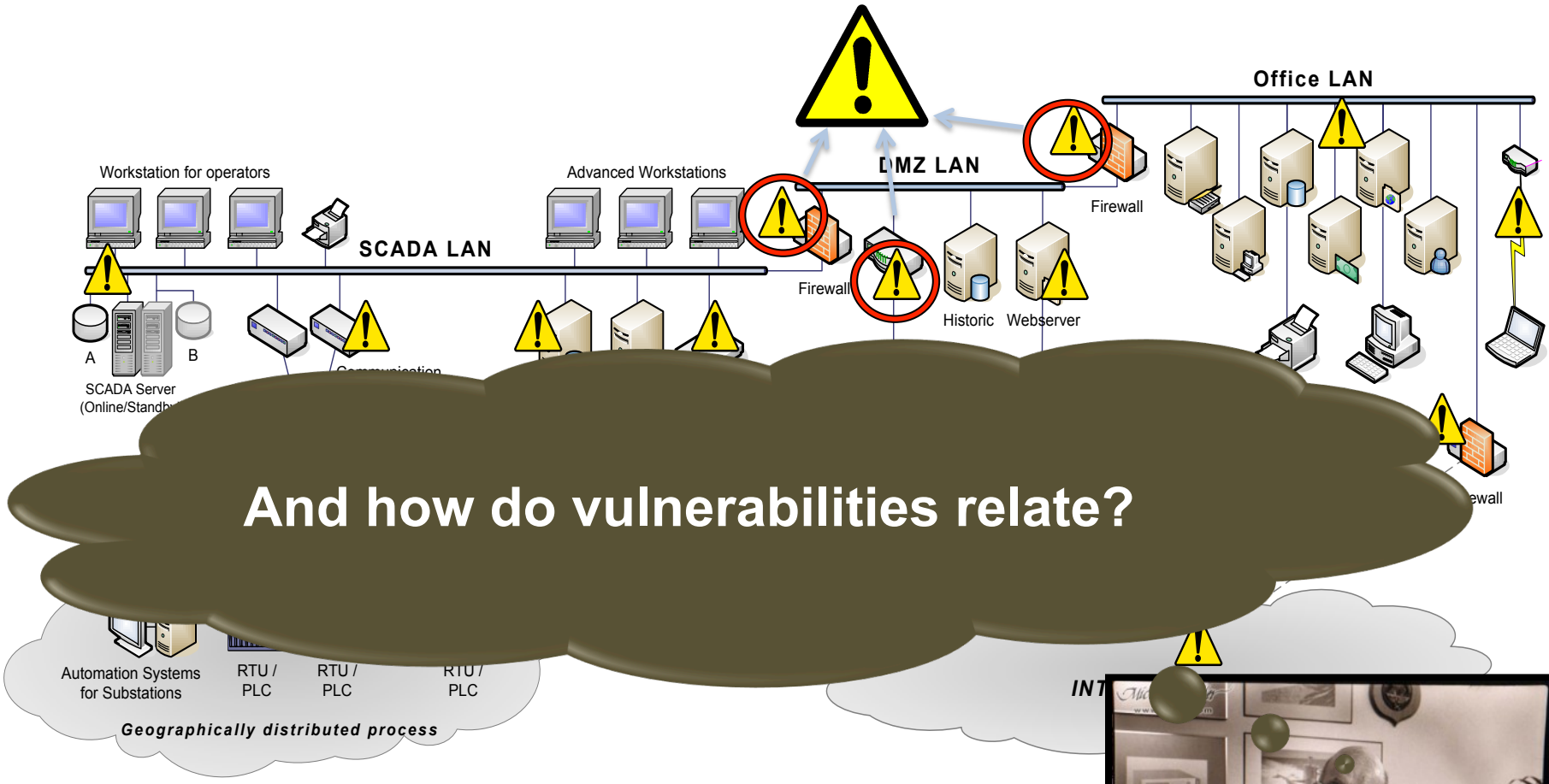


CISO (etc.)



Which parameters decides cyber security?

Any vulnerabilities? And where are they?



In practice, cyber security management and design has limited resources

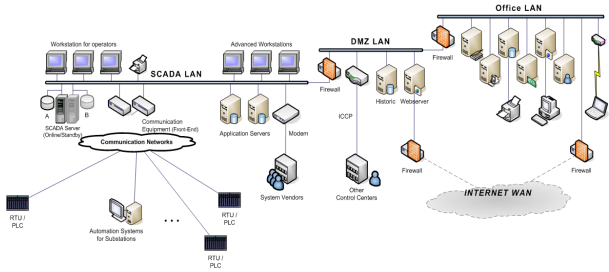
Should I spend my budget on:
a training program for my staff,
logging functionality,
or network scanning?

Cyber Security Modeling Language (CySeMoL) in summary

An “IT Auto-CAD Tool”

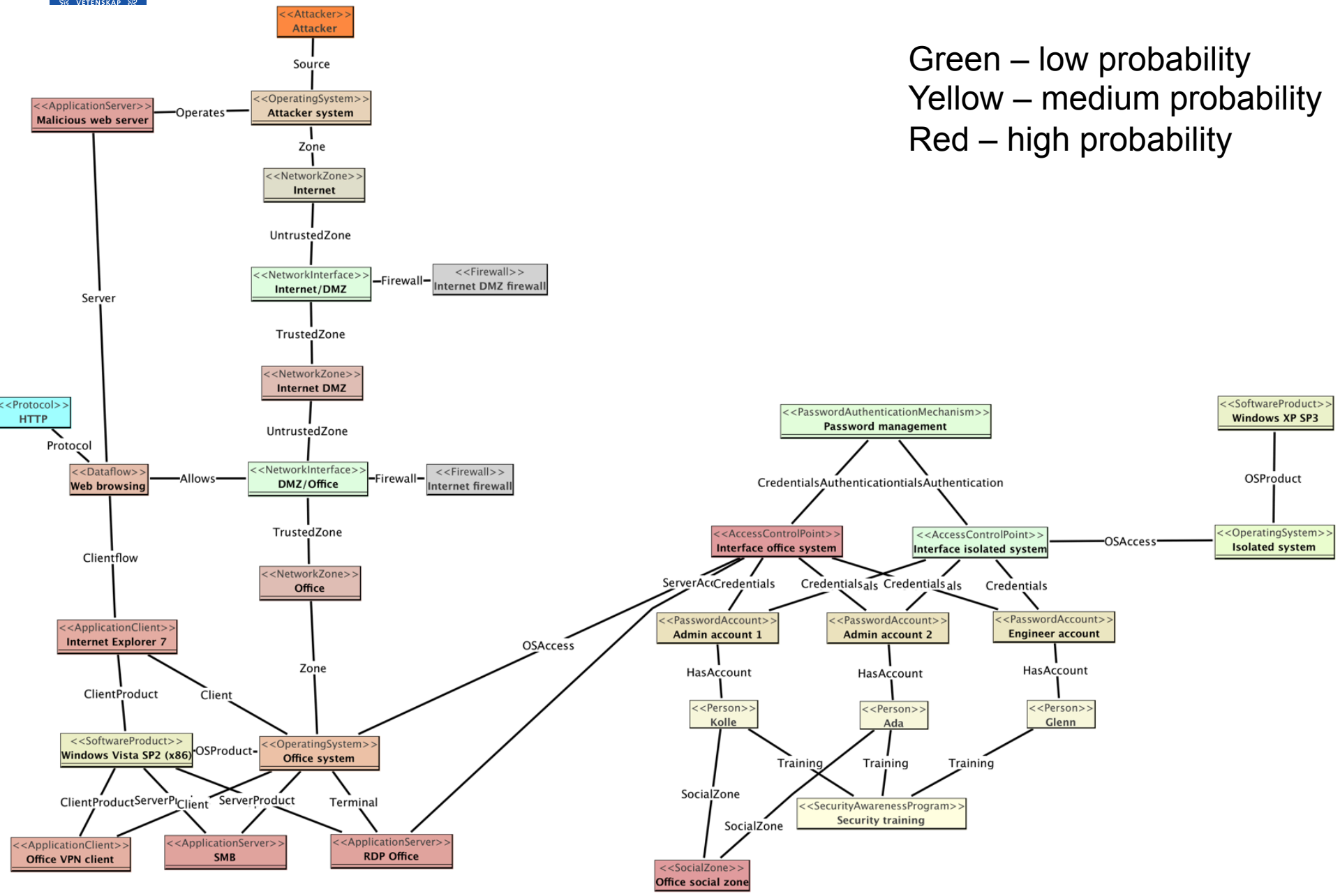
- User draws maps of IT architecture components/assets and their connections (current or future).
- Tool provides a “heat map” of how secure or vulnerable different parts of an IT architecture are towards cyber attacks
- The tool simulates hacker attacks and assesses risks in architecture components/assets through combining user input on system properties with built-in security expertise.

CySeMoL screen shot



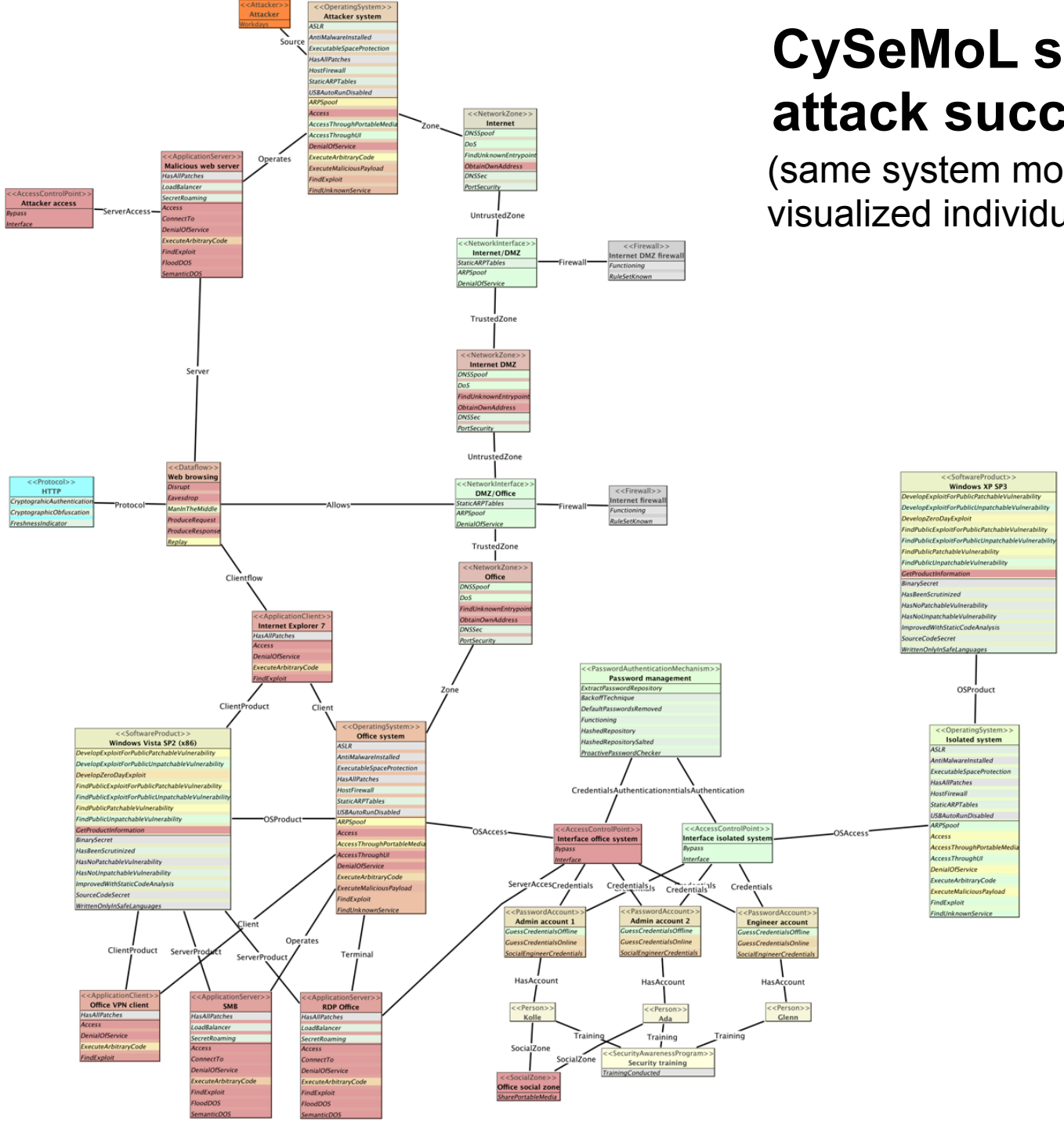
CySeMoL screen shot – attack success

Green – low probability
Yellow – medium probability
Red – high probability

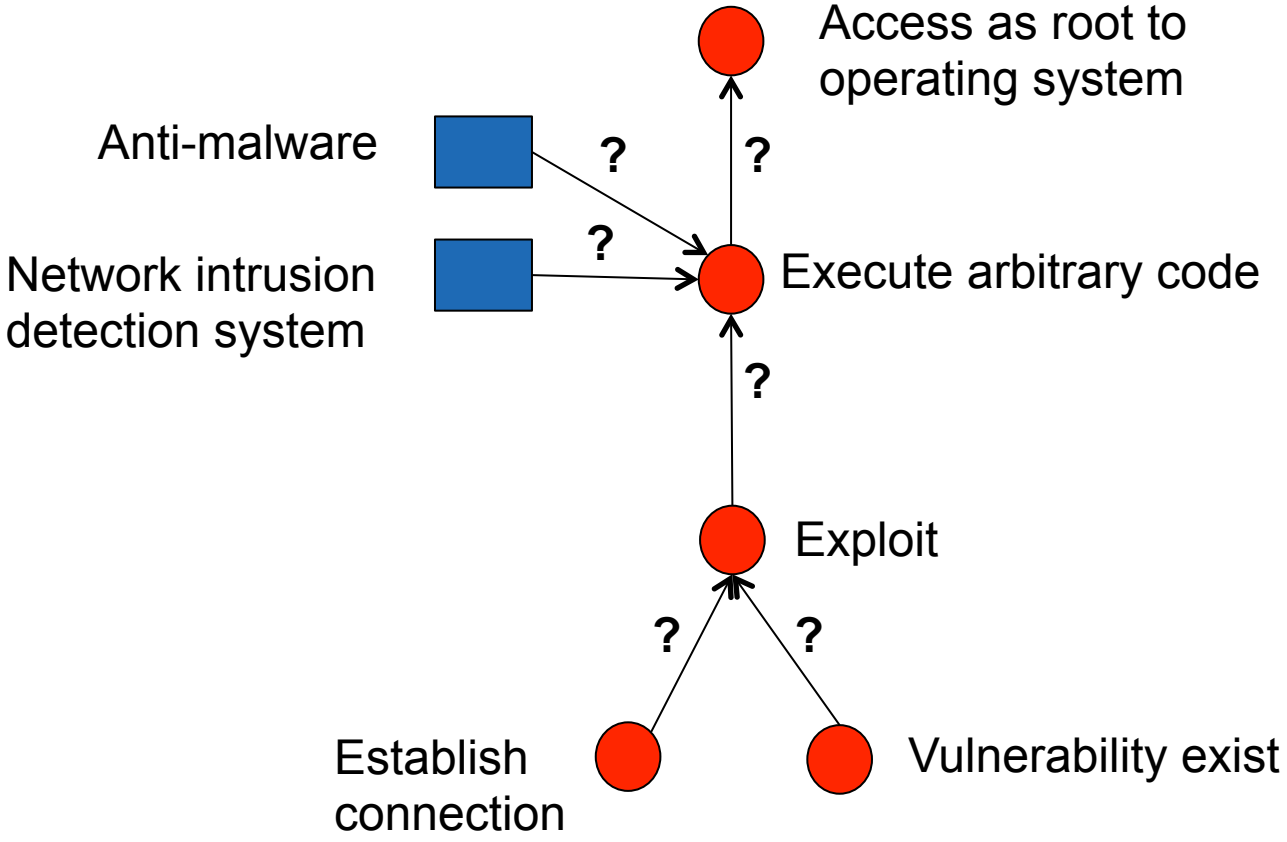


CySeMoL screen shot – attack success in detail

(same system model but each attack step visualized individually)

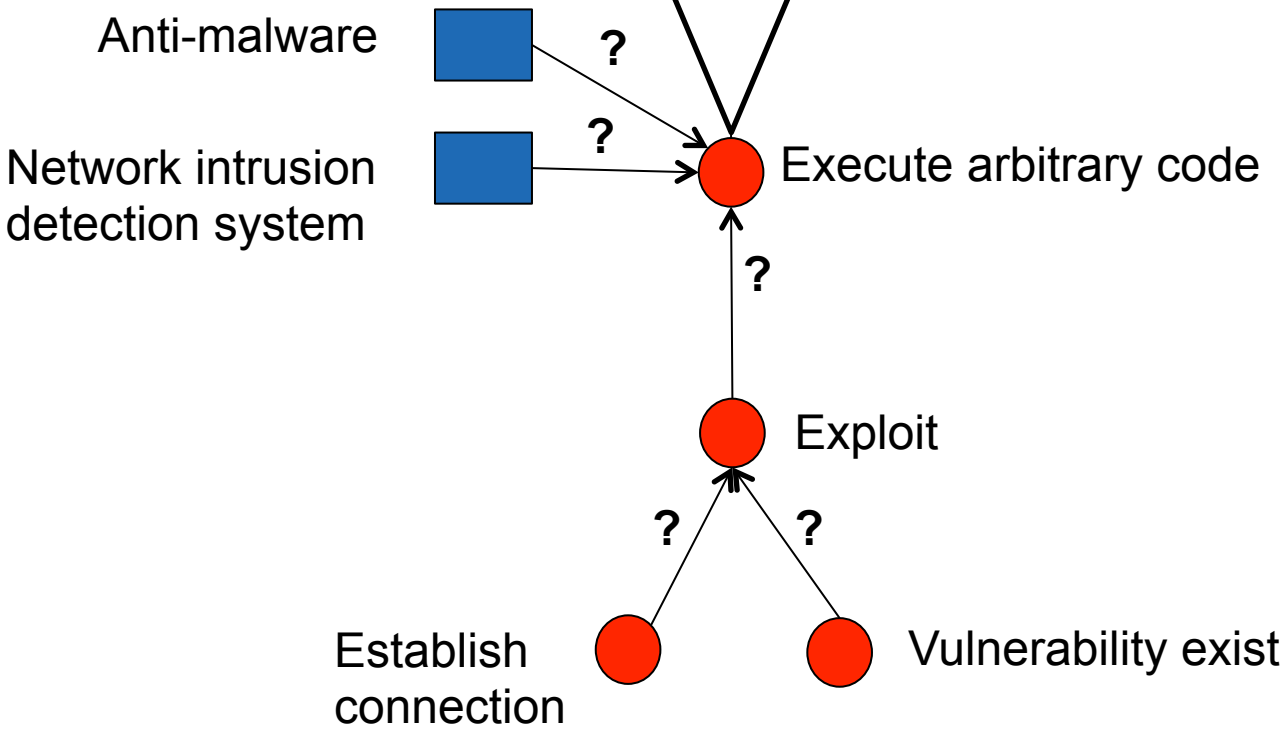


The underlying magic: Attack / defense graphs



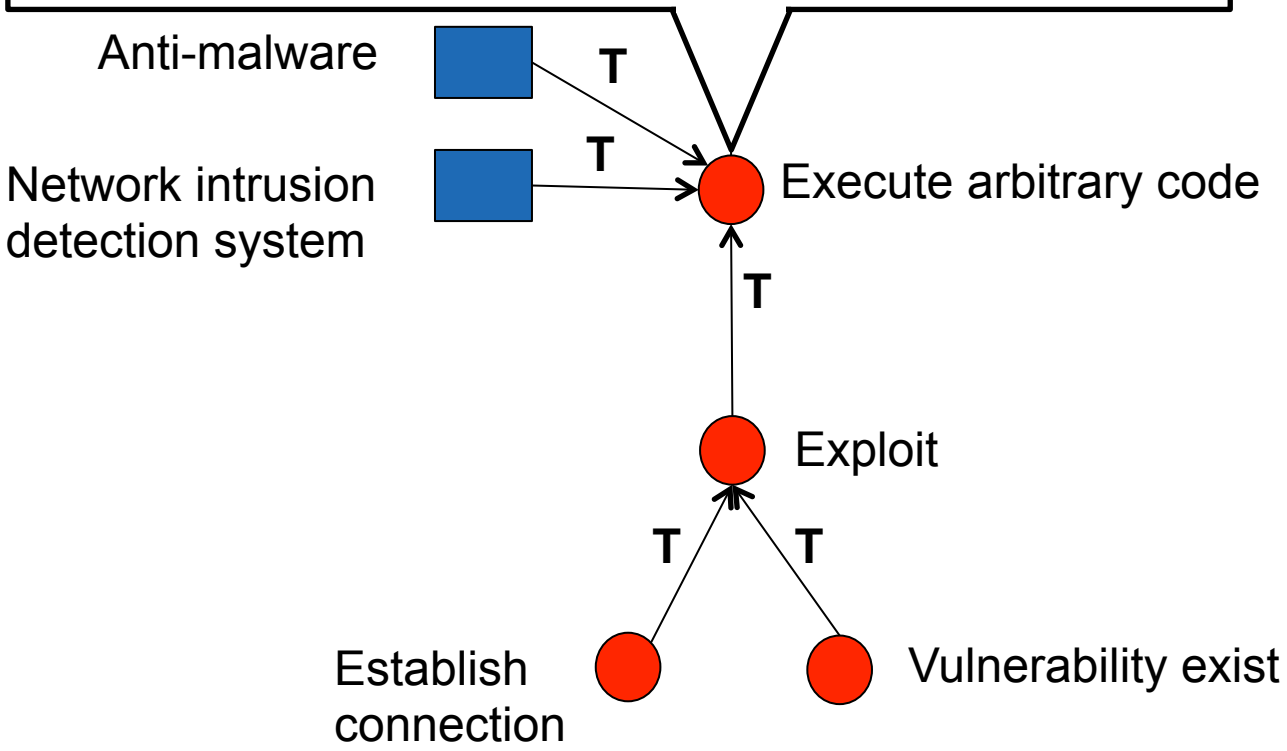
Bayesian networks

Exploit	T	T	T	T	F	F	F	F
Anti-malware	T	T	F	F	T	T	F	F
Network intrusion detection	T	F	T	F	T	F	T	F
Execute code (TRUE)	**0.21**	**0.32**	**0.41**	**0.7**	**0**	**0**	**0**	**0**

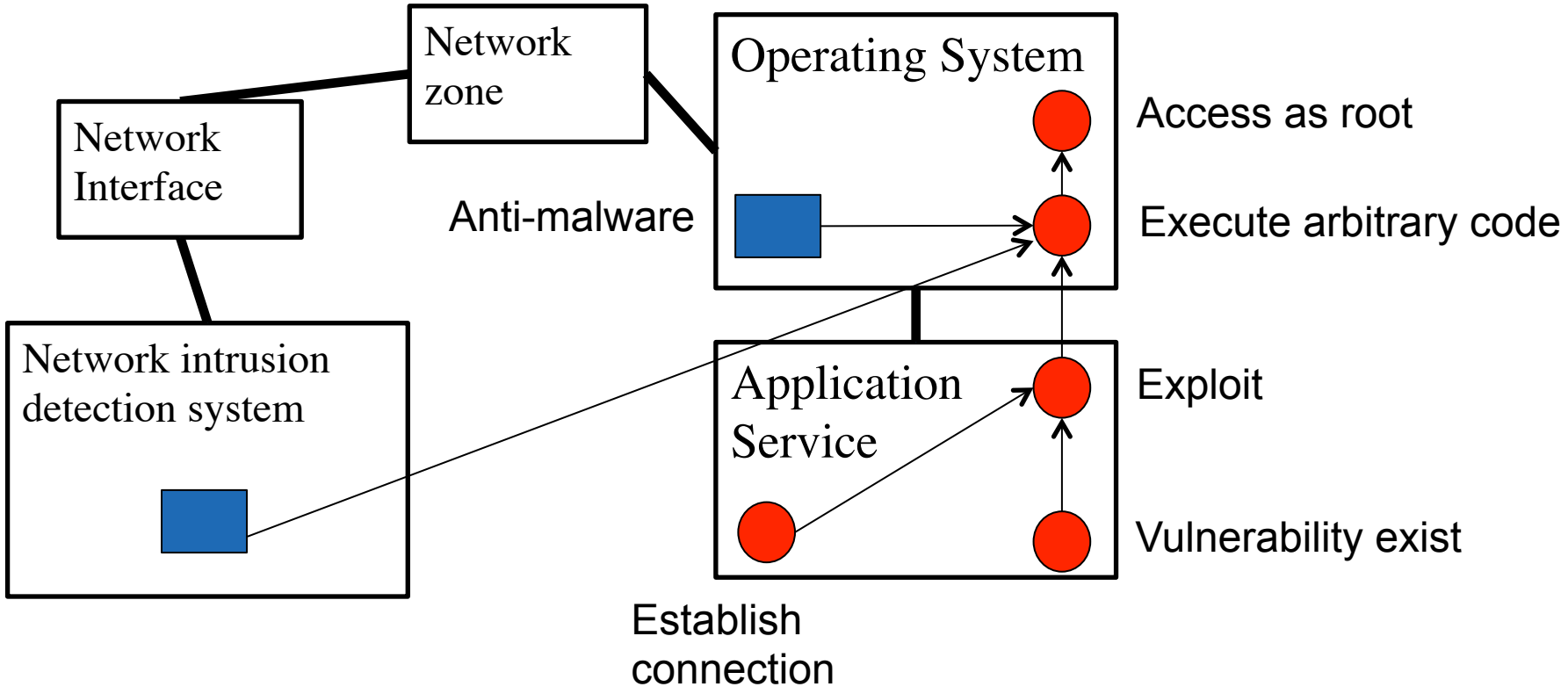


Bayesian networks

Exploit	T	T	T	T	F	F	F	F
Anti-malware	T	T	F	F	T	T	F	F
Network intrusion detection	T	F	T	F	T	F	T	F
Execute code (TRUE)	**0.21**	**0.32**	**0.41**	**0.7**	**0**	**0**	**0**	**0**



Attacks and defenses – relation to assets



Studies/topics covered by CySeMoL

Attacks/malicious activities:

- Zero-day discovery
- Memory corruption exploitation
- Web application exploitation (XSS, RFI, SQLi, Command injection)
- Social engineering
- Code injection using removable media
- Password guessing (online/offline)
- Denial of service
- Man-in-the-middle
- Discovery of unknown entry-points
- …

Includes 59 attack steps

Studies/topics covered by CySeMoL

Defenses

- Network intrusion detection systems
  - Both detection and prevention-based
- Host intrusion detection systems
- Web application firewalls
- Anti-malware
- Firewalls
- Security training
- Encryption
- Software development best practice methods
- Network management (e.g., scanning, USB policy, etc)
- …

Includes 58 defense types

Studies/topics covered by CySeMoL

Assets

- IT services
- Software components
- Operating systems
- Communication networks
- Users
- User accounts
- Data flow
- Protocols
- …

23 asset types, 51 system relations types

Agenda

Dept. for Industrial Information and Control Systems, KTH

Cyber Security Modeling Language (CySeMoL)

Areas for collaboration / exchange

Areas for collaboration / exchange

Attack graphs, attack graphs, attack graphs…

- Refine attacks
- Expand attacks in “novel” areas
- Specialize for smart grids

- Automatic modeling / data collection
- Automatic design

In an academic setting or in a start-up company

Thank you for listening

Contact me!

mathias.ekstedt@ics.kth.se

More info

www.ics.kth.se/cysemol