This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 608090.

HyRiM

Impact of a Malware Attack on a Utility Network

How a Cyber Incident Affects a Utility Network

Sandra König

CIP Workshop

Vienna, 20.09.2017

AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

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Overview

- Motivation
- Malware Spreading in Interconnected Networks
- Utility Network Use Case – Network Analysis
- Utility Network Use Case - Optimal Ways of Protection

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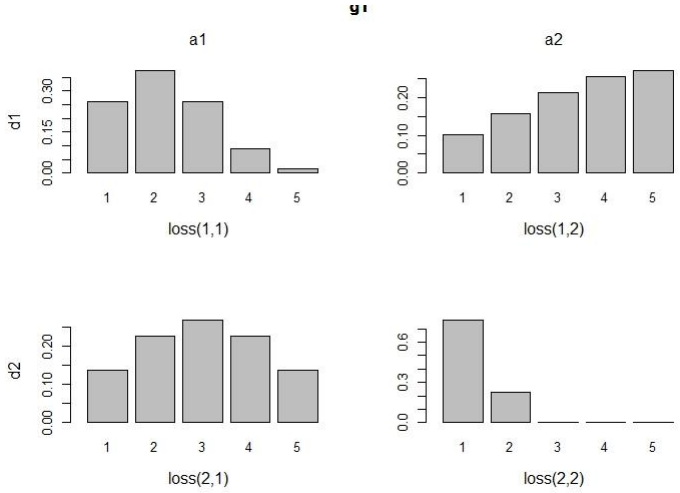
Motivation

- Protection of a utility network against a malware attack
- Game-theoretic model with random payoffs
- How to get these payoffs?
  - Expert opinions
  - Data collection
  - Simulation



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Malware Spreading

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- Malware attacks have increased over recent years
  - Not yet targeted to any specific user group (private and economic sector)
  - Malware attack can cause severe damage to a company

- Use Case Scenario
  - Power provider falls victim to a malware attack
  - One system gets infected by the malware (e.g. office network)
  - Estimation of the consequences in other networks (e.g. SCADA)

- Assumptions about the malware
  - Malware tries to propagate and infect as many systems as possible (e.g., by sending emails or copying itself to network shares)
  - Increased damage due to this novel “propagation ability feature”

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Malware Spreading in Interconnected Networks

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- Modelling the different technical and social networks within the company
  - ICT network (including central data storages, etc.)
  - SCADA networks (including interconnections with ICT network)
  - Employees' social network
- Considering the human factor for the infection and the propagation steps
  - Infection based on social engineering (e.g., phishing mails)
  - Modelling the trust among employees in the company
- Looking at standardized vulnerability information (i.e., CVE data and CVSS scores) to evaluate the initial compromising likelihood and the probability for propagation

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Network Model

- Network consists of
  - 8 employees
  - 4 laptops (may be used for BYOD)
  - 3 PCs
  - A shared server for file exchange and a router
  - A SCADA server
  - 3 cameras and a camera server
  - 2 concentrators and 4 smart meters (illustrative)

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Network Model

- Connections are distinguished depending on their properties
  - various classes (social, logical, network)
  - Different levels of trust (low, medium, high)

- Characterization of edges based on social and technical analysis
  - Interviews with employees (phishing emails)
  - Vulnerability analysis of devices (spreading inside network)

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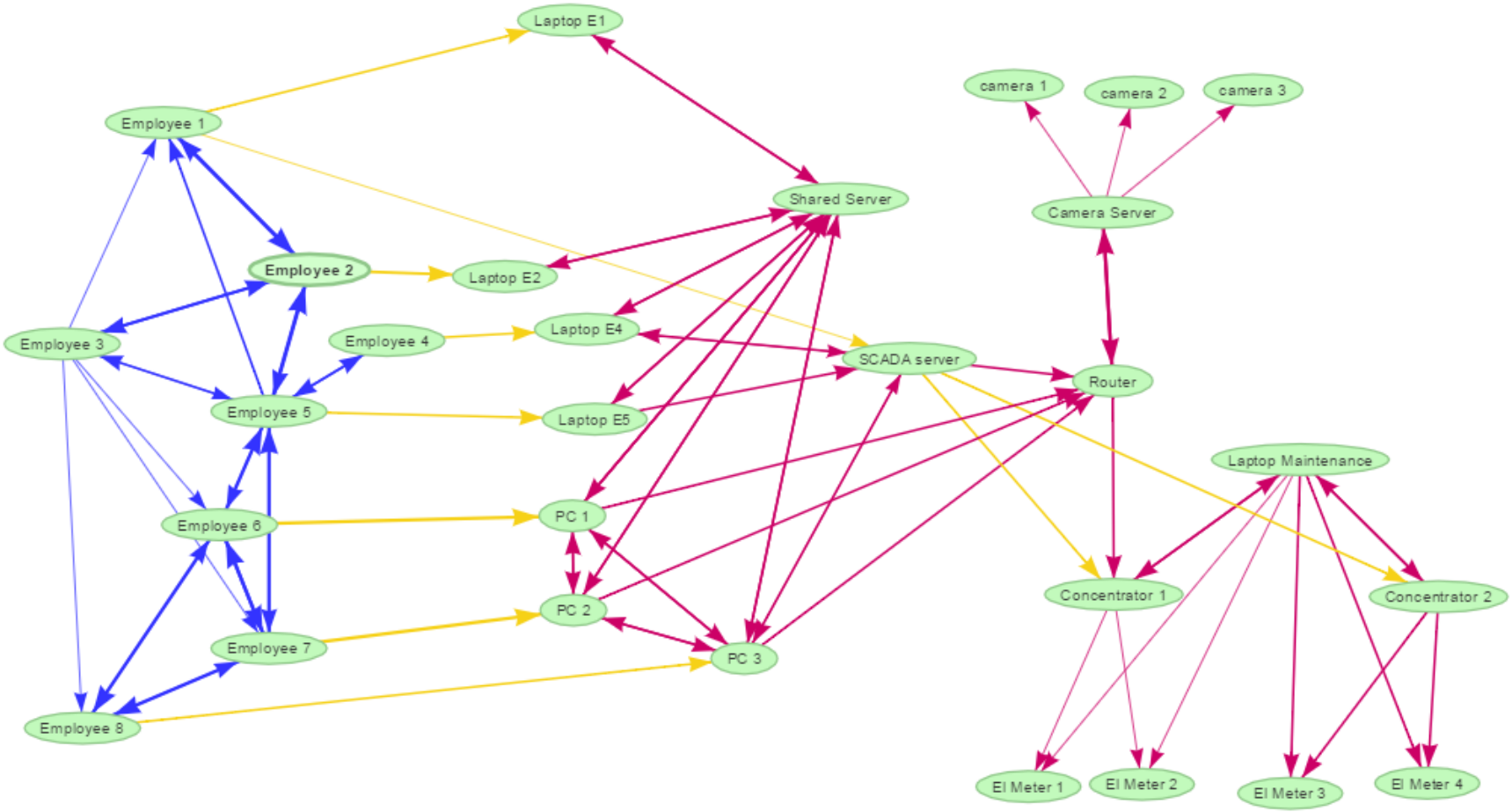
Network Model



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Game-theoretic Model

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In order to find optimal ways to protect a system identify

- Goals of analysis
- Attack vectors
- Defense mechanisms

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Goals

- Find optimal protection
  - Minimize data loss
  - Minimize cost
  - Minimize reputation damage

- Prioritization of goals possible

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Attacks and Defenses

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- Attack vectors
  - Send phishing email to employee
  - Infect shared server
  - Infect SCADA server
  - Place infected USB stick near PC or laptop

- Defense mechanisms
  - Regular training of employees to reduce success of social engineering attack
  - Regular backup of important data
  - Regular patching of devices
  - Compare with current state (status quo)

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Game-theoretic Analysis

- Compute solution with help of fictitious play algorithm
  - Can be generalized if payoffs (damage) are uncertain
  - Implementation in R available (HyRiM package)

- Solution contains the following information
  - Optimal defense strategy
  - Optimal attack for each goal
  - Worst case damage for each of these attacks can be computed **if** optimal defense is used

- Worst case damage is often a lower bound since we only face one attacker at a time

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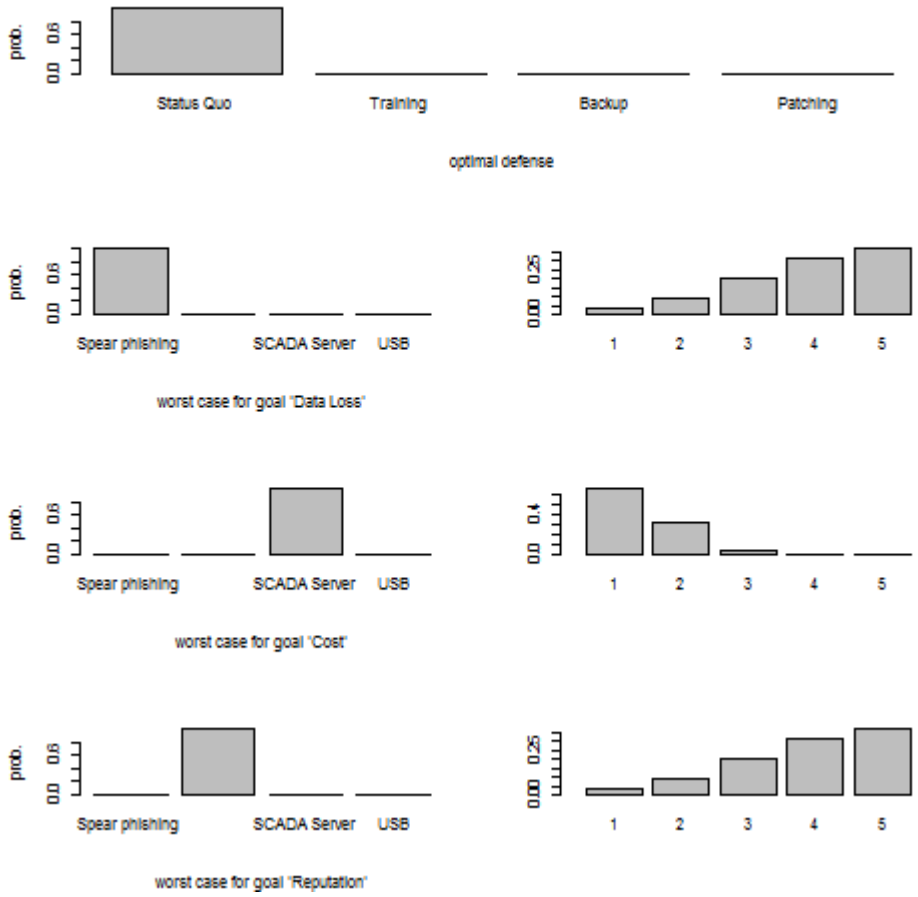
Game-theoretic Analysis



worst case attack worst case damage

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