CYBER SECURITY STUDENT BRIEFING

5 November 2018

CENTRE FOR DIGITAL FORENSICS AND CYBER SECURITY

Rain Ottis, PhD

OVERVIEW

- History at a glance
- Areas of expertise
- Student opportunities
- Master program overview

TAL TECH

HISTORY AT A GLANCE

- 2007 happened …
  - Need more cyber security experts!
- 2008 cyber security MSc module (10 courses)
- 2009 international Cyber Security MSc program (TalTech + UT)
- 2014 Digital Forensics specialization added
- 2014 Centre established
- 2016 Cryptography specialization added

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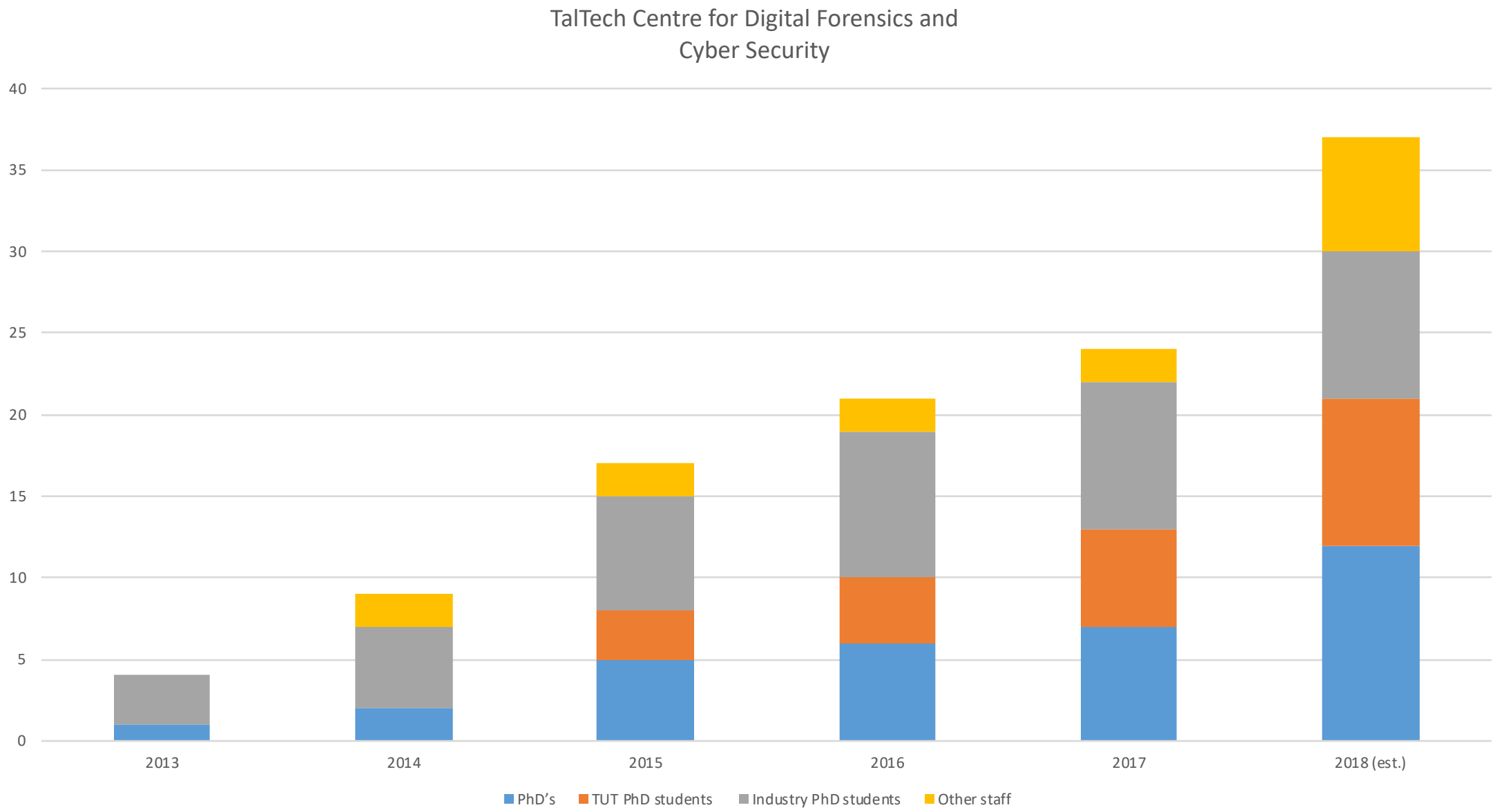
HISTORY AT A GLANCE



AREAS OF EXPERTISE

- Cryptography
- Technical aspects
  - Network security, digital forensics
- Cyber security management
  - Risk management, incident handling, operations
- Legal aspects
- Human aspects
- Strategy/policy aspects

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OPPORTUNITIES

- Cyber Security MSc program
  - ~200 students from all over the world

- PhD program
  - Currently 18 PhD students, including 8IVCM graduates
- Cyber Security Summer School
- Interdisciplinary Cyber Research Workshop
- Cyber Spike competition
- Advanced research course
- TalTech CERT/SOC (*in development*)
- Locked Shields

KEY PARTNERS

- Government
  - Ministries (Defence, Economic Affairs and Communication, Education and Research, Justice, Internal)
  - Defence Forces, Information System Authority, Estonian Forensic Science Institute, Police and Border Guard Board
  - NATO CCDCOE
- Private sector
  - RangeForce, Cybernetica, GuardTime, CybExer, etc.
- Academia
  - University of Tartu, University of Adelaide, Hochschule Ravensburg, NTNU

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MSC PROGRAM OVERVIEW

- Three specializations:
  - Cyber Security
  - Digital Forensics
  - Cryptography
- 2 years
- Resident program
- International admissions
- 2019 admissions – 60 slots
  - No tuition for EU students
  - 100€ / ECTS for other students
  - Waivers available

TAL TECH

Semester	Cyber Security Specialization / 30 ECTS per semester				
I (Tallinn)	**ITC8210** Legal Aspects of Cyber Security	**ITC8220** Human Aspects of Cyber Security	**ITC8230** Cyber Security Management	**ITC8240** Cryptography	**ITC8250** Cyber Security Technologies I or **ITC8260** Cyber Security Technologies II
II (Tartu)	**MTAT.03.307** Principles of Secure Software Design	**LTAT.06.003** System Administration	**LTAT.06.004** Network Technology I	**LTAT.03.001** Programming or **MTAT.07.017** Applied Cryptography	**FREE STUDY SLOT**
III (Tallinn)	**ITC8270** Cyber Incident Handling	**Special Studies Elective**	**Special Studies Elective**	**Special Studies Elective**	**ITC8200** Thesis Seminar
IV (Tallinn)	**TMJ3300** Entrepreneurship and Business Planning	**THESIS (24 ECTS)**			

TAL TECH

Semester	Digital Forensics Specialization / 30 ECTS per semester				
I (Tallinn)	**ITC8210** Legal Aspects of Cyber Security	**ITC8220** Human Aspects of Cyber Security	**ITC8230** Cyber Security Management	**ITC8240** Cryptography	**ITC8250** Cyber Security Technologies I or **ITC8260** Cyber Security Technologies II
II (Tartu)	**MTAT.03.307** Principles of Secure Software Design	**LTAT.06.003** System Administration	**LTAT.06.004** Network Technology I	**LTAT.03.001** Programming or **MTAT.07.017** Applied Cryptography	**FREE STUDY SLOT**
III (Tallinn)	**ITC8270** Cyber Incident Handling	**ITX8200** System Forensics	**ITX8205** Network Forensics	**Special Studies Elective**	**ITC8200** Thesis Seminar
IV (Tallinn)	**TMJ3300** Entrepreneurship and Business Planning	**THESIS (24 ECTS)**			

TAL TECH

Semester	Cryptography Specialization / 30 ECTS per semester				
I (Tallinn)	**ITC8210** Legal Aspects of Cyber Security	**ITC8220** Human Aspects of Cyber Security	**ITC8230** Cyber Security Management	**ITC8190** Mathematics for Computer Science or **MTAT.05.008** Mathematics for Computer Science	**ITC8250** Cyber Security Technologies I or **ITC8260** Cyber Security Technologies II
II (Tartu)	**MTAT.07.002** Cryptology I	**MTAT.07.017** Applied Cryptography	**Special Studies Elective**	**Special Studies Elective**	**FREE STUDY SLOT**
III (Tartu)	**MTAT.05.082** Introduction to Coding Theory or **LTAT.04.003** Distributed Computing and Block Chains or **MTAT.03.286** Design and Analysis of Algorithms	**MJCV.00.036** Practical Skills for Entrepreneur	**Special Studies Elective**	**Special Studies Elective**	**MTAT.07.022** Research Seminar in Cryptography (Thesis seminar)
IV (Tartu)	**Special Studies Elective**	**THESIS (24 ECTS)**			

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THANK YOU!

rain.ottis@taltech.ee

OBJECTIVES FOR TODAY

Our group has a very diverse background with respect to research areas. Furthermore, many researchers have recently joined our team.

The propose is to get to know the research areas of researchers in our group.

1) For first year MSc students: Potential participation in the ITC 9010 & ITC 9020 course (next slides).
2) For second year MSc students: Find a thesis supervisor.
3) For participants from industry / our group: Get to know people in the group.

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ITC9010 / ITC9020

An MSc thesis requires in-depth understanding of the subject area.

Problem: There is only limited dedicated time in the curriculum to build-up such knowledge.

Approach: Work on a specific problem and develop in-depth understanding of a topic area.

Expected outcome: A research paper draft.

Can lead towards your MSc thesis topic, but the course is NOT a thesis preparation course!

Spring 2019: ITC9010 (6 ECTS)

Autumn 2019: ITC9020 (6 ECTS)

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ITC9010 / ITC9020

https://courses.cs.ttu.ee/pages/Cyber_security_research_excellence_course

Wednesday, 07 Nov 2018: Present your interest

Sign up in Doodle: https://doodle.com/poll/qyy7nskhxnp67xwu

Wednesday, 21 Nov 2018: "Industry Days"

Spring 2019: Literature review, research methodology, approach & initial results. (Remote participation from Tartu is possible)

ICR 2019: Mandatory submission of 1,000 word abstract

15 April 2019 / if accepted present: 29 June 2019

Autumn 2019: Results & Paper writing

Paper draft ready by Christmas 2019!

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SENIOR RESEARCHERS

ADRIAN VENABLES

- **E-mail**: adrian.venables@taltech.ee
- **Role:** Senior Researcher working part time at Taltech
- **Other roles:** UK Defence Cyber School and UK Emergency Planning College
- **Research focus**: Maritime cyber security and the use of cyberspace as a domain of military operations
- **Topics**: Currently researching the development of NATO nations' cyber strategy and policy to counter the Hybrid Warfare threat
- **Supervision**: Available to supervise MSc students

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Cryptography

prof. Ahto Buldas

Research Topics:

1. Digital identities
2. Post-quantum cryptography
3. Long-term security
4. Block-chain technologies

Master Thesis Topics:

1. Implementations of hash-function based signature schemes (co supervisors Ahto Truu and Risto Laanoja)
2. Elliptic curve isogeny-based cryptography

3. Estonian state level security evaluation and risk management (possible co supervisor: Andro Kull)

Andro Kull

Introduction

Introduction of myself

- Around 20 years practical experience connection with IT, infosec, audit, cybersec, risk, continuity;
- Connected with TalTech cybersecurity unit more than 3 years;
- 3 years as lecturer:
  - Main course „Information and cybersecurity assurance“;
  - Supervising master thesis;
  - Part of defense committees;
- Connected with projects:
  - Cyber hygiene;
  - ESS cybersecurity (IDS, CIIP protection etc);
  - Self driving car (risk assessment).

Overview research area

- Now as senior researcher:
  - Propose course „Cybersecurity management“;
  - Seek management-related projects and research questions;
  - Possible keywords: information security/cybersecurity management, risk management, business continuity management, integrated management systems;
  - Proceed with self-driving car (risk assessment) project;
  - Seek national-wide solutions for security frameworks (ISKE etc);
  - ISO-based MS implementation;
  - GDPR-related research questions.

Specific Master thesis topics

1. advanced methods and tools for proper information security risk assessment;
2. ways to ensure compliance and assurance regard standards, regulatory requirements and laws;
3. information and cybersecurity economic aspects, including ways to show ROSI - return of security investments;
4. state level information and cybersecurity frameworks: comparative analysis.

DR ANNA-MARIA OSULA

- Dr Anna-Maria Osula (anna-maria.osula@taltech.ee) - senior researcher focusing on legal aspects of cybersecurity
- Research focus: international criminal procedure, international law, privacy
- Also organising the 5th Interdisciplinary Cyber Research (ICR2019) workshop on the 29th of June. Join us!!!

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BIRGY LORENZ

Birgy Lorenz Ph.D. is a Scientist at Tallinn University of Technology (TalTech). She is responsible for the course Human Aspects in CyberSecurity and the CyberOlympics project with the main goal of finding young talents in cyber defense and raising citizen awareness of the digital world. She is a founder and board member of Estonian Informatics Teachers Association and Informatics and CyberSecurity curriculum developer for Estonian Basic and secondary school level.

Her research interest are:

- Cybersecurity awareness training (including. material development, game development)
- Development of Cybersecurity Competencies and Models (curriculum development, talent hunt, beginner level exercises, CTFs)
- Women in cybersecurity

TAL TECH

Eneken Tikk
Dr.iur.

Law; Diplomacy; Personal Data Protection

GDPR
Evidence and forensics
Cyber operations

monetization of data, consequences of cyber operations, evidence of cyber threat(s)

TAL TECH

Hayretdin Bahsi, PhD
Senior Researcher
Center for Digital Forensics and Cyber Security Tallinn University of Technology

TAL TECH

Short Overview

- Technical, organisational and strategic aspects of cyber security
- Involved in many R&D and consultancy projects
- 18 years experience in cyber security
- Coordinator of the master thesis process
- Recent research interests
  - Application of machine learning to cyber security problems
  - Critical information infrastructure security oCyber situational awareness

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Machine Learning & Cyber Security

- Integration of machine learning process into cyber security processes
  - Improvement of human – machine interaction
  - Optimization of computational resources
- Interpretability and acceptability of learning outputs
- Incorporating the learning methods into resource-constrained systems
- Cyber security problems
  - Mobile malware detection
  - Intrusion detection in IoT or SCADA systems
  - Cyber threat intelligence

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Other Topics

- Cyber situational awareness
  - Linking business processes and information systems for better risk assessment
  - Dependency analysis of critical infrastructures
- Cyber security test setups
  - IoT Systems
  - SCADA Systems
- The analysis of cyber insurance implementations at national and sectoral level

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PROFESSOR MATTHEW SORELL

- Adjunct Professor of Digital Forensics
- Currently also Senior Lecturer in telecommunications and multimedia at the University of Adelaide
- Consultant to several law enforcement agencies in Australia
- Invited member of INTERPOL Digital Forensics Experts Group
- Initiated the Adelaide-Tallinn collaboration with Prof Maennel in 2015.

- Digital Evidence, Forensics and Investigation (Consulting)
  - Primarily Major Crime (murder) and Organised Crime (gangs, drugs, etc)
  - Wearable Devices
  - Mobile phone data (phone images, network data)
  - Multimedia (video, image, audio) - processing, analysis and interpretation

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RESEARCH BACKGROUND

- PhD in statistical signal processing and applications in radar (1990s)
- Commercial mobile telecommunications consulting (1998-2002) including spectrum licensing and regulation
- Image and video forensics since 2005, pioneered use of JPEG coefficients for provenance tracking
- Invented audio recording system for the award-winning aboriginal language film "Ten Canoes"
- Supervised PhD, Masters and Honours research students in a range of telecommunications, security and forensic work

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RESEARCH INTERESTS

- Police 2.0 - digital capacity building for law enforcement
- Better tools for digital evidence triage
- Better tools for analysing video evidence
- Applications of 3D scanning and printing for forensic investigation
- Harmonising the digital evidence tools and processes for law enforcement, cyber-military and commercial investigation

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CONTRIBUTIONS AT TALTECH

- Develop research capacity through skills training and education
- Coursework in law-enforcement focused device evidence and investigation
- Assist in development of the digital forensics program
- Continue to enhance collaboration with University of Adelaide.

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Mika Kerttunen
D.Soc.Sc.

Military Sciences; International Relations

Research methodology
National cyber strategies
International cyber diplomacy

….cyber norms, national capabilities, exercises…..

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OLAF MAENNEL

Background:

- PhD from Technical University in Munich, Germany
- PostDoc at Adelaide, Australia
- Lecturer at Loughborough University, UK
- Since 2014 @ TalTech.

Research Interest:

- Network Security
  - routing, IPv6, …
  - network measurements
- Critical Infrastructure Protection
  - Focus: transportation sector / aviation and maritime cyber security
- Cyber Security Education (ECSO)

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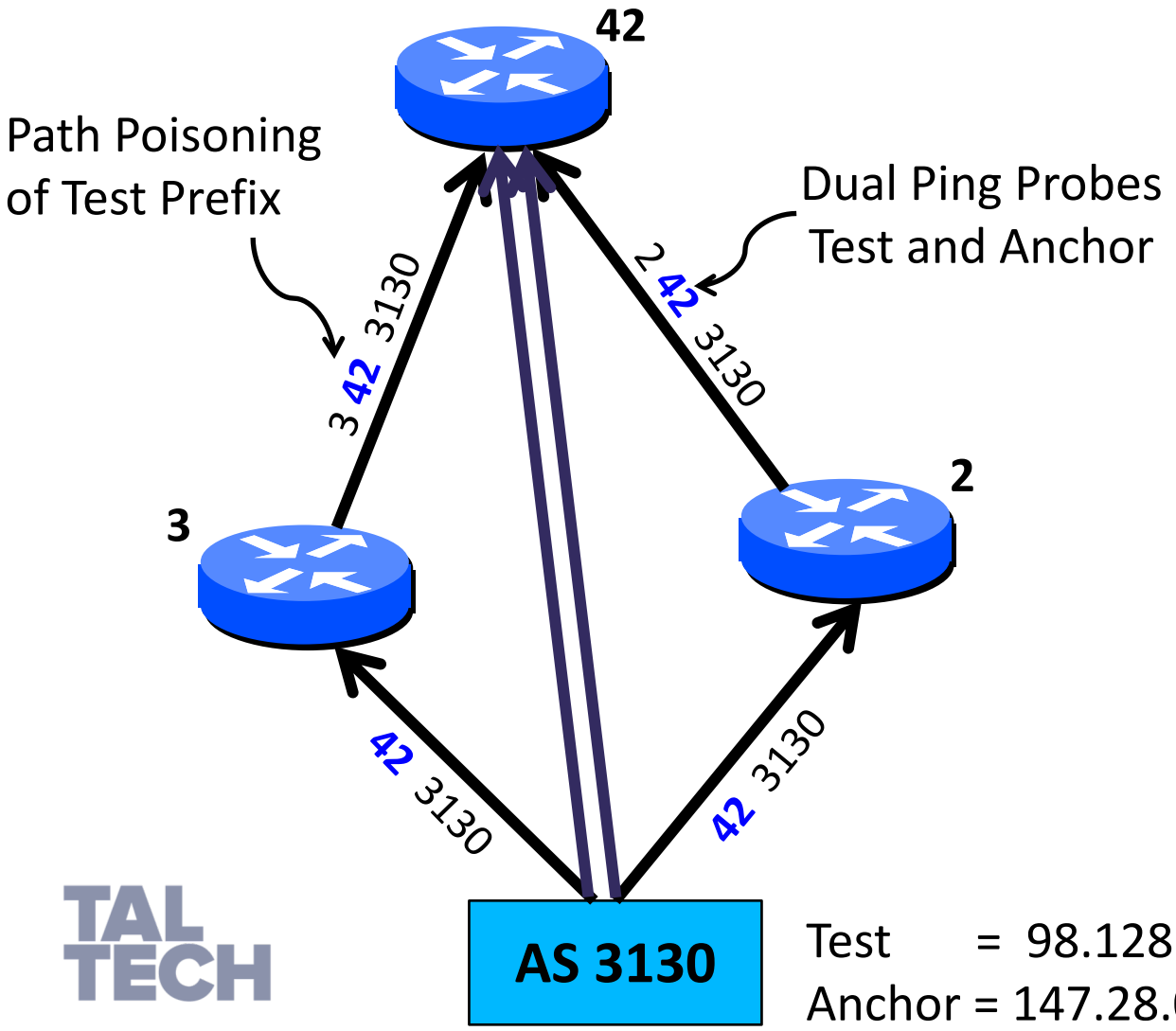
OLAF MAENNEL - MEASUREMENT EXAMPLE "MODERATE CONFIDENCE IN ATTRIBUTION?":)



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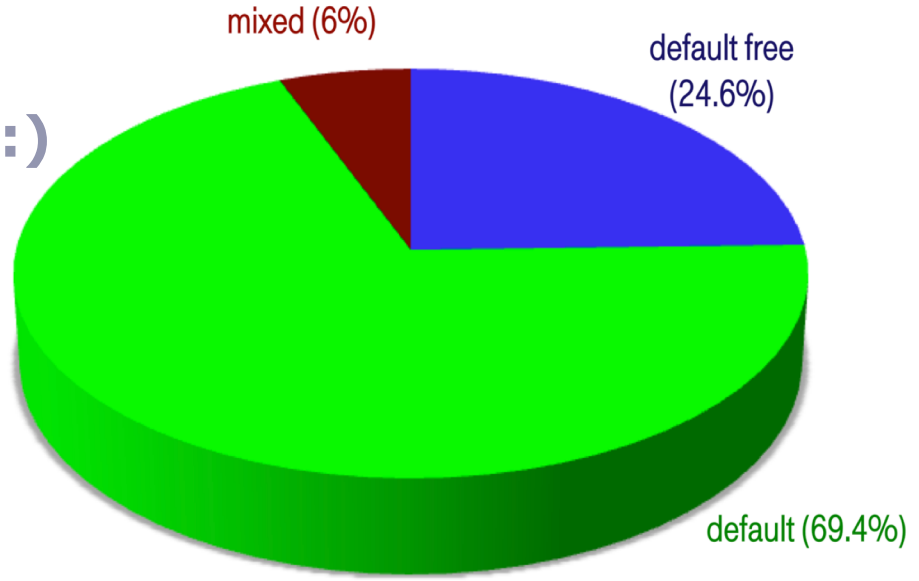

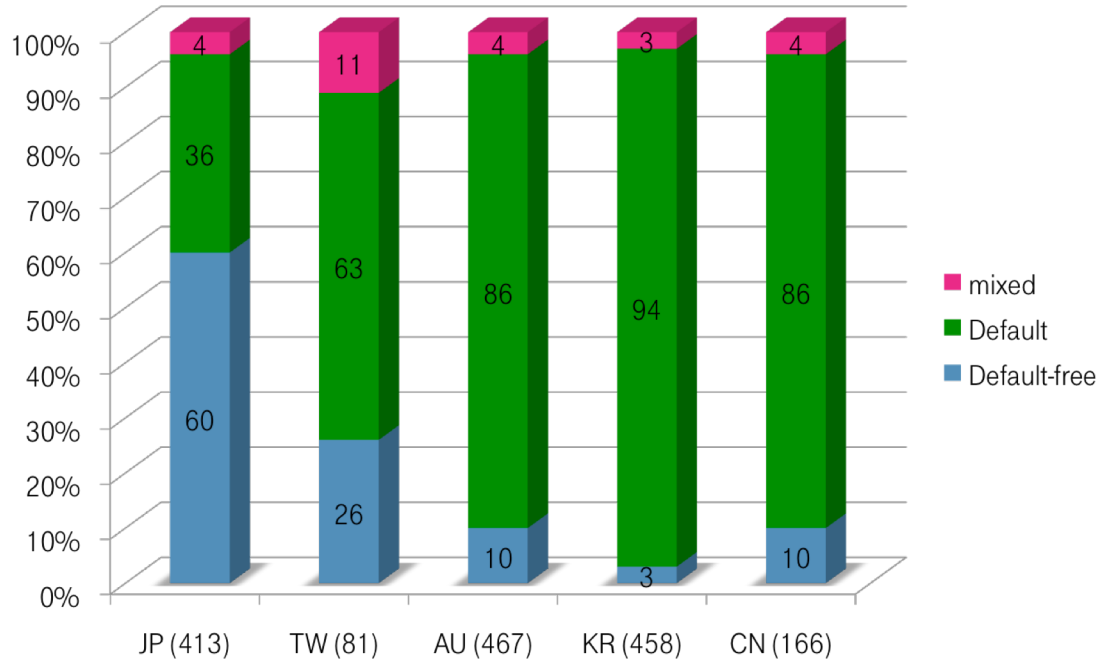

RAIN OTTIS
RESEARCH PROFESSOR

- Director of the Centre
- Program Manager for Cyber Security MSc
- Background
  - CS PhD&MSc from TalTech; BS from West Point
  - EST Defence Forces (signal officer, ~10 years)
  - NATO CCDCOE (researcher, ~5 years)
- Research interests
  - Cyber exercises, military use of cyber power
- Potential MSc topics
  - National cyber exercise portfolio
  - Locked Shields case study

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RISTO VAARANDI – PERSONAL INTRODUCTION

- Career:
  - Since 2015: senior researcher at TalTech
  - 2006-2014: researcher at NATO CCDCOE
  - 1998-2018: IT development engineer and security monitoring expert at SEB Estonia
  - 1997-1998: network administrator at Estpak Data (now part of Telia)
  - 1994-1997: IT support engineer at Tartu County government
- Education:
  - PhD in Computer Engineering (TalTech, 2005)
  - MSc in Computer Science (University of Tartu, 1997)

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RISTO VAARANDI – RESEARCH INTERESTS

- Event log data mining (algorithms developed in the past: SLCT, LogHound, LogCluster)
- Event correlation and real-time event log processing (tools developed in the past: SEC, logpp)
- IDS and IPS systems
- Event log collection and visualization frameworks
- Security monitoring technologies

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RISTO VAARANDI – MSC THESIS TOPICS

- Any topic from the previous slide:
  - event log data mining
  - event correlation and processing
  - intrusion detection
  - event log collection
- Any novel research idea not mentioned above which qualifies as a security monitoring topic

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ADDITIONAL NOTES FOR PROSPECTIVE MSC STUDENTS

- Genuine interest to monitoring technologies: grade 0, 1 or 2 from “Cyber Defense Monitoring Solutions” (ITX8071) course indicates a lack of interest
- Preference is given to the following students:
  - the student has his/her original research idea which is valid and sufficiently detailed
  - grade 4 or 5 from ITX8071 course (or successful ongoing participation in the course)
  - preliminary discussions with the student reveal his/her clear intention to write a strong thesis
  - during preliminary discussions, the student demonstrates his ability to work with scientific literature and develop his/her research idea further
  - the student is willing to produce not only a MSc thesis, but agrees to write a research paper which will be submitted to a conference 4-5 months after MSc defense and graduation

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RESIDENT PHD STUDENTS / JUNIOR RESEARCHERS / SUBJECT MATTER EXPERTS

ALEJANDRO GUERRA MANZANARES

Studies/Background:

Bachelor's Degree in Criminology from Universitat Autònoma de Barcelona (Spain);

Bachelor's Degree in ICT Engineering from Universitat Politècnica de Catalunya (Spain).

MSc in Cybersecurity from TTÜ/TalTech (Estonia).

Role at the center: PhD Student & Early stage researcher.

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RESEARCH AREA

Main field of research is application of artificial intelligence to mobile malware detection.

More specifically, application of full machine learning workflow to detection of malware in Android environment.

Also applying AI to botnet detection and other interesting cybersecurity fields. Focus on interpretability of machine learning outcomes

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POTENTIAL MASTER THESIS TOPICS

Any related to AI/ML and cybersecurity will be interesting for me

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Dan Heering

EDUCATION:

2000 – Navigating officer, EMERA

2017 – MSc in maritime cyber security, EMERA

2018 – … PhD in maritime cyber security, TalTech

WORK:

2000 – Spliethoff, shipping company, navigating officer

2002 – Estonian Maritime Academy, project manager

2006 – Estonian Maritime Administration, head of department

2013 – SOTS Course Centre in Stavanger, project manager

2017 – Estonian Maritime Academy, director for development

2005 – … entrepreneur

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Dan Heering

RESEARCH AREA

Maritime cyber risk management and situational awareness

Good contacts with:

- Estonian maritime industry, administration and companies
- International Maritime Organization
- European Maritime Safety Agency
- International Association of Maritime Universities
- and others

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Jaan Priisalu

Cybernetica
Swedbank
RIA
CCDCoE LS
Guardtime

Critical Infrastructure dependencies (Manticus Apollo)

- Situation awareness
- Cybersecurity exercises
- Crypto protocols and applications
- Side channels and modeling assumptions

JENS GETREU

E-mail: jens.getreu@taltech.ee

- I am junior researcher focusing on innovative technologies improving IoT and restricted device security.

Interests:

- Rust language and ecosystem
- Protocols and algorithms suitable for low end computing.
- No specific topic at the moment and very limited availability through full workload in teaching and involvement in international projects. Support and consulting after appointment arrangement.

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KAIE MAENNEL

- 2nd year PhD student on topic of Cyber Awareness and Hygiene
- My research focuses on use of learning analytics to improve cyber security training.
- Implementing learning analytics enables real-time and evidence-based learning interventions using information from digital learning environments (cyber <=> digital footprint!).

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MY MAIN RESEARCH QUESTIONS

- What are relevant and measurable metrics for cyber (hygiene-related) competences and behavioural risks?
- What are effective training methods to reduce human factors risk, incl. use of learning analytics?
- How to evaluate (models, metrics) cyber (awareness and hygiene) trainings for effectiveness and efficiency?

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POTENTIAL THESIS TOPICS TO SUPERVISE FOR MSC

- cyber awareness and hygiene
- cyber security learning and teaching (e.g., serious games, cyber defense exercises, etc.)
- learning analytics in cyber security training context
- human factors in cyber security

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Kieren Nicolas Lovell

OSINT and C3 Instructor

TalTech CERT

Incident Response Instructor

Previous:

Head of CERT, University of Cambridge

Royal Norwegian Navy, Battlewatch Commander and N6

Cyber Warfare Centre, Norway

Mine Warfare, Royal Navy

Nuclear Submarines Communicator, Royal Navy

Associations:

Cambridge Science & Policy Group

Cambridge Security Group

PAVEL LAPTEV
DIGITAL FORENSICS PROJECT MANAGER

June 2018 – started at TalTech

Main goals:

1. improvement of Digital Forensics study program
2. DF research capacity building

Possible research objectives:

To propose solutions for for current digital forensics related investigative problems (both – technical and methodological)

research on emerging trends

DF process efficiency and results reliability improvement

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STEN MÄSES

- E-mail: sten.mases@taltech.ee
- junior researcher focusing mainly on the human side of cybersecurity
- Research focus: measuring cybersecurity skills using virtual labs (in study materials, cybersecurity exercises, admission test)
- No specific topic at the moment, but if you have something in mind that is connected to humans, cybersecurity and skills, then see more info at: https://sten.ninja/supervision

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Tiia Sõmer

- 25 years Estonian Defence Forces, major, various posts (incl NATO, European Union, defence attache, MoD)
- TalTech, early stage researcher/ PhD student

- Military training
- BA Political Science, International Relations
- MSc C´yber Security
- PhD studies cyber security (cyber crime)

Research area

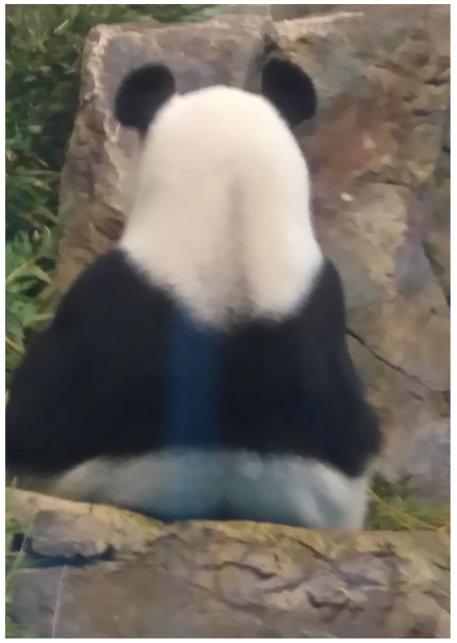
- Cyber crime
  - Cyber criminal ecosystem
  - Cyber crime processes, tactics, techniques and procedures
  - Cyber criminal business models
  - Cyber criminology
- Cyber workforce
  - Developments and changes in cyber workforce
  - Innovative solutions to new talent development/ recovery
  - Cyber conscription
- jbz

Thesis topics

- Cyber crime
- Cyber policy
- Cyber personnel

Who am I

Toomas Lepik



Teacher
PhD Student
Information security expert
Ex CERT-EE

Lazy PPT writer
Dysgraph
I Like UDP Jokes - May do some and do not care if you get it ☺

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From Art to Science:

The Art of Network Forensic
Deriving during red/blue-team exercises user activities and behaviors using forensic evidence tools.

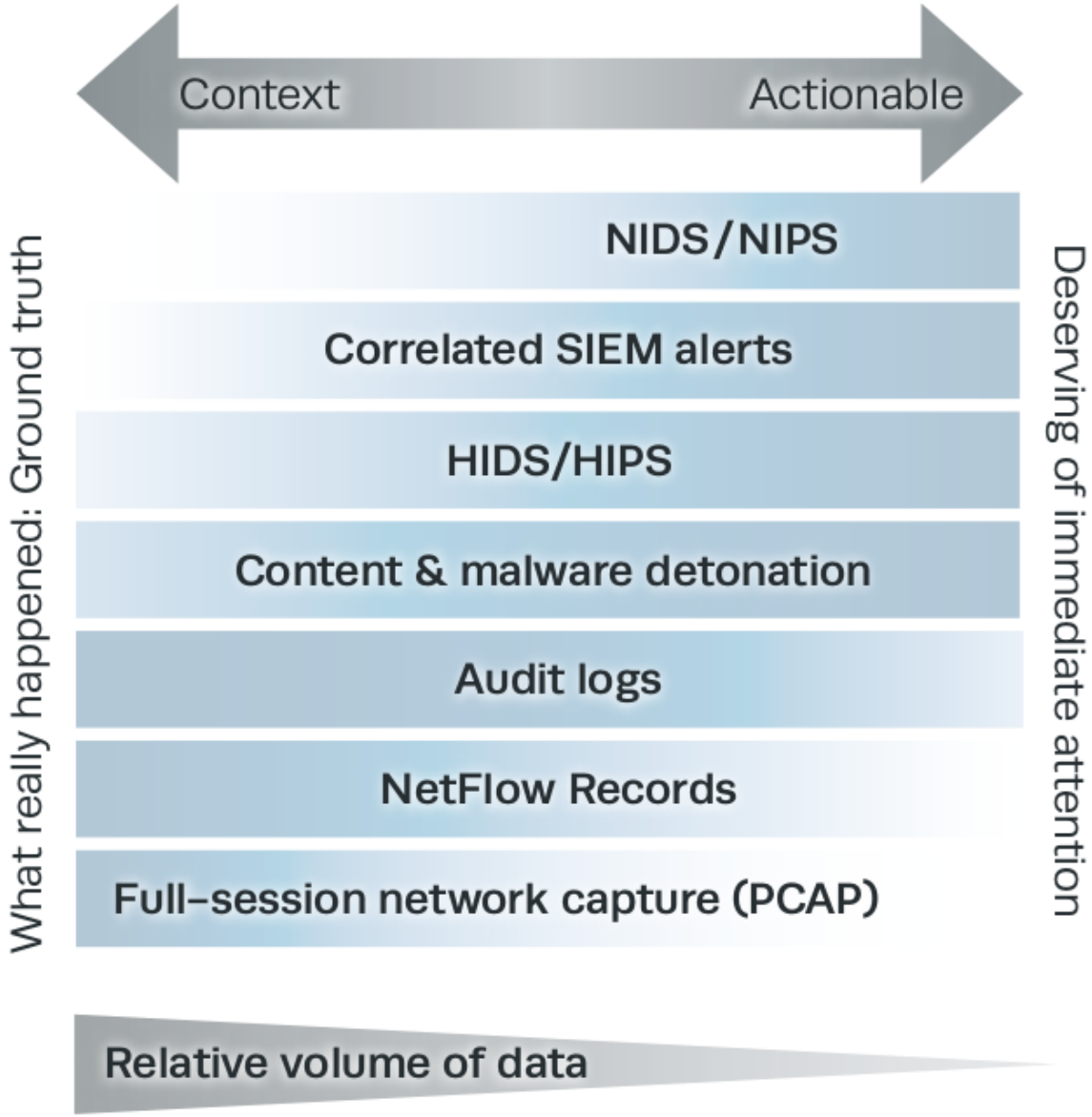
Art of Malware analysis
Methodical approach to understand what software is actually doing.

General research area overview - The buzz worlds.

Teaching Network Forensic

Understanding how users and machines operate.

Binary analysis
Threat hunting =
Data analysis for
Actionable information
Unknown Unknowns



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Master Thesis topics – for research course

Monitoring user behavior using VirtualBox Debugging Interface (e.g., how to use VM debugging interface to see mimikatz usage)

Shortcoming of Att&ck framework
Extending Att&ck framework with observabilities found trough debugging VM layer

Observabilities and possbilities for observation for various operating systems

Using flamegraphs for information security benefit.

VPN software Attack trees / Particular VPN client communication patterns and issues.

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LAURI VÕSANDI

Slides at: bit.ly/2QkSiiS

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INDUSTRY PHD STUDENTS

CCDCOE

NATO COOPERATIVE
CYBER DEFENCE
CENTRE OF EXCELLENCE

Erwin Orye

Researcher strategic branch at the CCDCOE (NATO Cooperative Cyber Defense Centre of Excellence)

CCDCOE

Specific topic

- → **Industrial PhD**
- → **CCDCOE work:** paper on “cyber effects”, or “how to integrate cyber operations from different nations without nations having to reveal sensitive information about their cyber potential”.
- → **TalTech (PhD) work:** Cyber security in aviation. Research question could be “how to make sure that aviation is still safe in 20 years, from a cyber security perspective?”

CCDCOE

Ideas for MsC student research

- → Aviation is still partly using “security by obfuscation”.
- → With the advanced search engines on the the internet, whistle blowers revealing information, blogs sharing sensitive information among their members, specific hardware that can be emulated by cheap generic purpose hardware and open source software, or other information-sharing tools becoming more common, security by obfuscation will not assure the security it gave in the past.
- → Do online research of ALL publicly-available resources and see how much information can be found about digital components in aviation.
- → An additional option: in the case of a real leak or vulnerability, use this as a case study and try to hack the system (legally).

Ideas for MsC student research

- → Aviation is nowadays a very competitive business. Certainly the growing market share of low cost airlines makes it even more so.
- → For some companies, safety and security are reduced to the minimum: “being compliant with regulation”.
- → Although aviation is quite heavy regulated, does regulation ensure enough safety and security for companies who are doing only the legally mandatory things?
- → Have a look at these low cost airlines (https://en.wikipedia.org/wiki/List_of_low-cost_airlines) and see what kind of IT equipment they have on board; verify if they are more vulnerable to cyber security attacks than regular airlines.


CCDCOE

Thank you!

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ccdcoe.org
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RESEARCHERS AND PHD STUDENTS

Joonsoo Kim - visiting researcher from Korean National Security Research Institute

Lauri Võsandi - PhD student; K-Space

Margus Ernits - Industry PhD at RangeForce

Ahto Truu - Industry PhD at Guardtime

Risto Laanoja - Industry PhD at Guardtime

Bernhards Blumbergs - Industry PhD at CERT-LV

Emin Caliskan - Industry PhD in London

Kaur Kullman - Industry PhD at RIA

Markus Kont - Industry PhD at NATO CCDCOE

Mauno Pihelgas - Industry PhD at NATO CCDCOE

TAL TECH

ADMINISTRATIVE STAFF

Andres Rauschecker - developing, sysadmin, pentesting, teaching

Anu Baum - police topics, project management and admin

Kristi Ainen – project management, events, administrative support

Martha Jung - project management, events, administrative support

Siiri Taveter – Cyber Security MSc program administration

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CONTACT

For finding all contacts, please visit our brand new website at:

https://taltech.ee/institutes/centre-for-digital-forensics-cyber-security

TAL TECH

TALLINNA TEHNIKAÜLIKOOL

Ehitajate tee 5, 19086 Tallinn, Tel 620 2002 (E-R 8.30–17.00)

taltech.ee