ESORICS 2015

ESORICS 2015

Program Guide

21 – 25 September 2015
Vienna, Austria

www.esorics2015.sba-research.org

ESORICS 2015
20th European Symposium on Research in Computer Security
21 - 25 September 2015, Vienna, Austria

Organized by…

SBA Research

Supported by…

HUAWEI

Contents

Welcome

It is our great pleasure to welcome you to the 20th European Symposium on Research in Computer Security (ESORICS 2015).

This year's symposium continues its tradition of establishing a European forum for bringing together researchers in the area of computer security, by promoting the exchange of ideas with system developers and by encouraging links with researchers in related areas.

The call for papers attracted 293 submissions – a record in the ESORICS series – from 41 countries. The papers went through a careful review process and were evaluated on the basis of their significance, novelty, technical quality, as well as on their practical impact and/or their level of advancement of the field's foundations. Each paper received at least three independent reviews, followed by extensive discussion. We finally selected 59 papers for the final program, resulting in an acceptance rate of 20 %.

The program was completed with keynote speeches by Sushil Jajodia, George Mason University Fairfax, USA and Richard Clayton, University of Cambridge, UK. Further, we are happy to welcome Afonso Ferreira, European Commission, who will give an invited talk. The co-located PhD Symposium will give nine PhD students the opportunity to present their current work and receive feedback from the community.

Putting together ESORICS 2015 was a team effort. We first thank the authors for providing the content of the program. We are grateful to the Program Committee, who worked very hard in reviewing papers (more than 880 reviews were written) and providing feedback for authors. There is a long list of people who volunteered their time and energy to put together and organize the conference, and who deserve special thanks: the ESORICS Steering Committee, and its chair Pierangela Samarati in particular, for their support; Giovanni Livraga, for taking care of publicity; Javier Lopez, as workshop chair, and all workshop co-chairs, who organized workshops co-located with ESORICS; and Yvonne Poul for the local organization and the social events.

Finally, we would like to thank our sponsors, HUAWEI, for the financial support and SBA Research, for hosting and organizing ESORICS 2015.

A different country hosts the conference every year. ESORICS 2015 takes place in Vienna, Austria at the Vienna University of Technology. We are very happy to host the 20th edition of the symposium in Vienna and we tried to put together a special social program for you, giving you the opportunity to share ideas with other researchers and practitioners from institutions around the world and see all the beautiful sights of Vienna.

We hope that you find this program interesting and thought-provoking and that you enjoy ESORICS 2015 and Vienna.

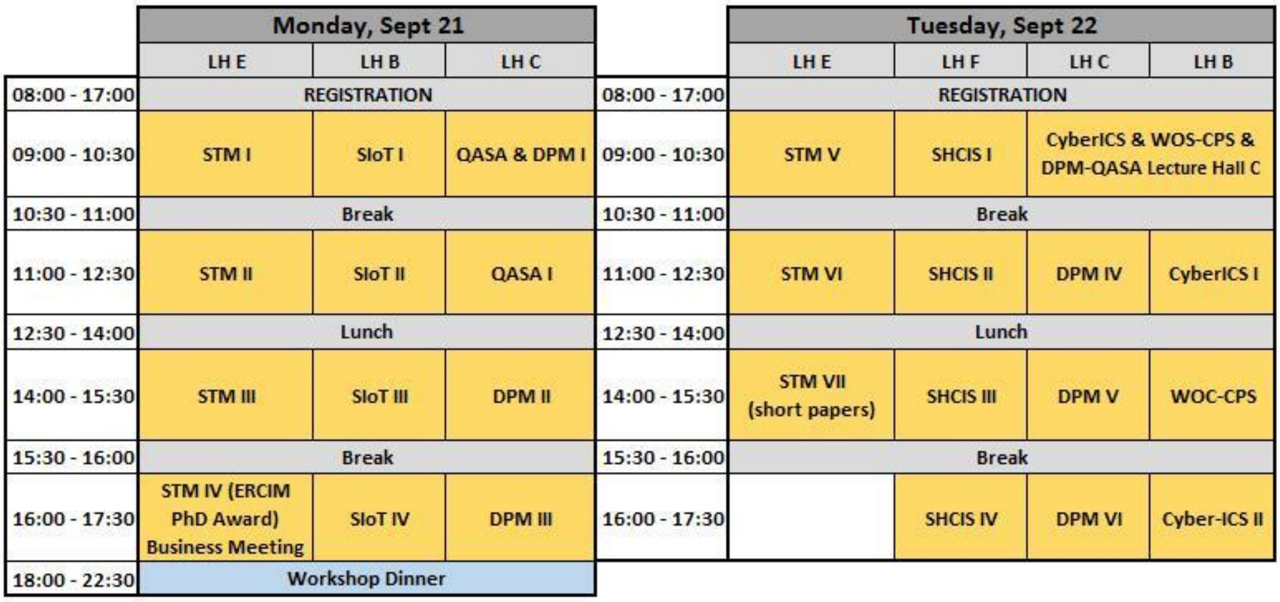
Günther Pernul
ESORICS 2015 General Chair
Universität Regensburg, Germany

Peter Y A Ryan
ESORICS 2015 Program Chair
University of Luxembourg, Luxembourg

Edgar Weippl
ESORICS 2015 Program Chair
SBA Research, Austria

Program Overview

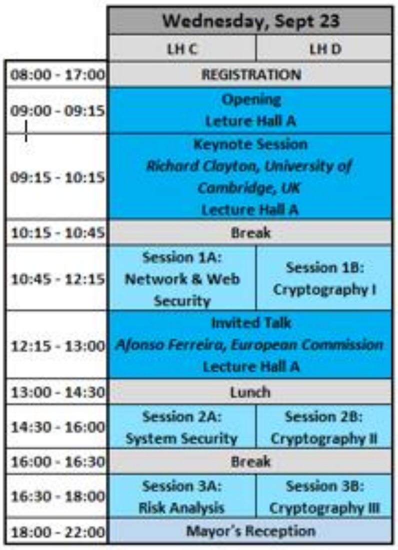
Workshop ESORICS 2015 Program Overview



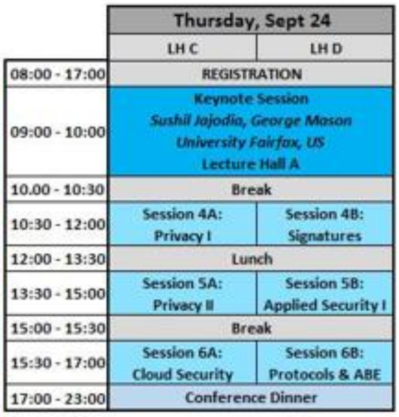
	Monday, Sept 21		
	LH E	LH B	LH C
08:00 - 17:00	REGISTRATION		
09:00 - 10:30	STM I	SIoT I	QASA & DPM I
10:30 - 11:00	Break		
11:00 - 12:30	STM II	SIoT II	QASA I
12:30 - 14:00	Lunch		
14:00 - 15:30	STM III	SIoT III	DPM II
15:30 - 16:00	Break		
16:00 - 17:30	STM IV (ERCIM PhD Award) Business Meeting	SIoT IV	DPM III
18:00 - 22:30	Workshop Dinner		

	Tuesday, Sept 22			
	LH E	LH F	LH C	LH B
08:00 - 17:00	REGISTRATION			
09:00 - 10:30	STM V	SHCIS I	CyberICS & WOS-CPS & DPM-QASA Lecture Hall C	
10:30 - 11:00	Break			
11:00 - 12:30	STM VI	SHCIS II	DPM IV	CyberICS I
12:30 - 14:00	Lunch			
14:00 - 15:30	STM VII (short papers)	SHCIS III	DPM V	WOC-CPS
15:30 - 16:00	Break			
16:00 - 17:30		SHCIS IV	DPM VI	Cyber-ICS II

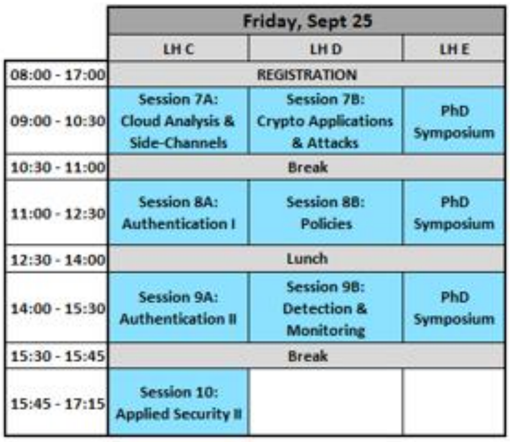
ESORICS 2015 Program Overview



	Wednesday, Sept 23	
	LH C	LH D
08:00 - 17:00	REGISTRATION	
09:00 - 09:15	Opening Leture Hall A	
09:15 - 10:15	Keynote Session *Richard Clayton, University of Cambridge, UK* Lecture Hall A	
10:15 - 10:45	Break	
10:45 - 12:15	Session 1A: Network & Web Security	Session 1B: Cryptography I
12:15 - 13:00	Invited Talk *Afonso Ferreira, European Commission* Lecture Hall A	
13:00 - 14:30	Lunch	
14:30 - 16:00	Session 2A: System Security	Session 2B: Cryptography II
16:00 - 16:30	Break	
16:30 - 18:00	Session 3A: Risk Analysis	Session 3B: Cryptography III
18:00 - 22:00	Mayor's Reception	



	Thursday, Sept 24	
	LH C	LH D
08:00 - 17:00	REGISTRATION	
09:00 - 10:00	Keynote Session *Sushil Jajodia, George Mason University Fairfax, US* Lecture Hall A	
10.00 - 10:30	Break	
10:30 - 12:00	Session 4A: Privacy I	Session 4B: Signatures
12:00 - 13:30	Lunch	
13:30 - 15:00	Session 5A: Privacy II	Session 5B: Applied Security I
15:00 - 15:30	Break	
15:30 - 17:00	Session 6A: Cloud Security	Session 6B: Protocols & ABE
17:00 - 23:00	Conference Dinner	

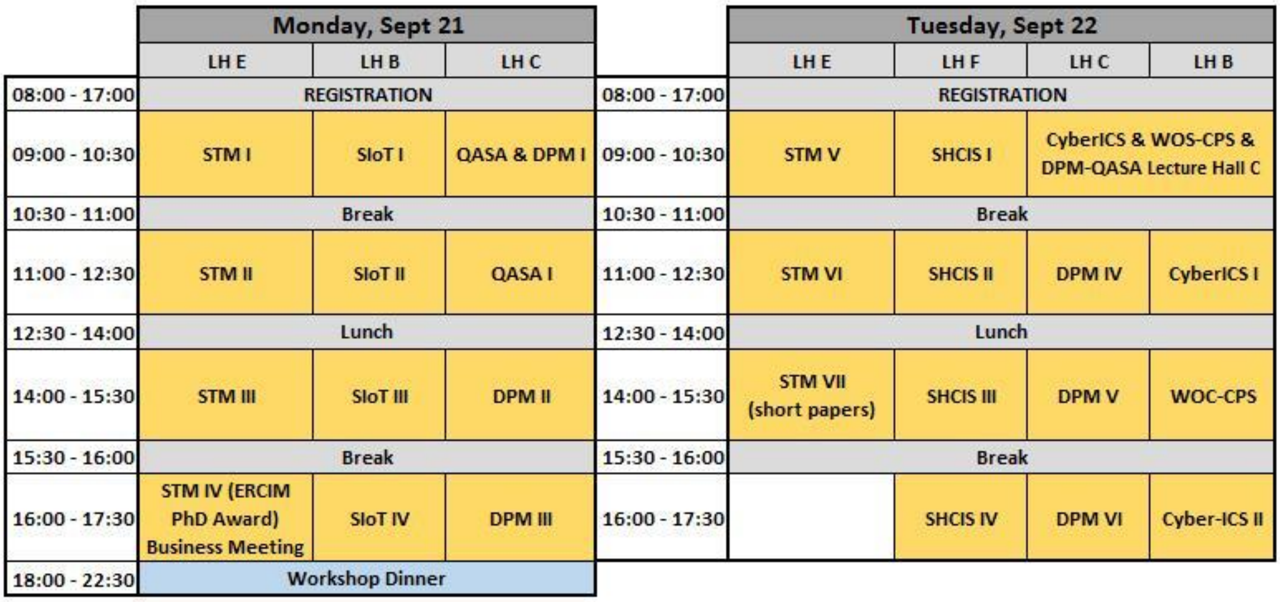


	Friday, Sept 25		
	LH C	LH D	LH E
08:00 - 17:00	REGISTRATION		
09:00 - 10:30	Session 7A: Cloud Analysis & Side-Channels	Session 7B: Crypto Applications & Attacks	PhD Symposium
10:30 - 11:00	Break		
11:00 - 12:30	Session 8A: Authentication I	Session 8B: Policies	PhD Symposium
12:30 - 14:00	Lunch		
14:00 - 15:30	Session 9A: Authentication II	Session 9B: Detection & Monitoring	PhD Symposium
15:30 - 15:45	Break		
15:45 - 17:15	Session 10: Applied Security II		

Workshops ESORICS 2015 Detailed Program

Overview

The detailed time slots for all workshops can be seen in the according workshop session.



	Monday, Sept 21		
	LH E	LH B	LH C
08:00 - 17:00	REGISTRATION		
09:00 - 10:30	STM I	SIoT I	QASA & DPM I
10:30 - 11:00	Break		
11:00 - 12:30	STM II	SIoT II	QASA I
12:30 - 14:00	Lunch		
14:00 - 15:30	STM III	SIoT III	DPM II
15:30 - 16:00	Break		
16:00 - 17:30	STM IV (ERCIM PhD Award) Business Meeting	SIoT IV	DPM III
18:00 - 22:30	Workshop Dinner		

	Tuesday, Sept 22			
	LH E	LH F	LH C	LH B
08:00 - 17:00	REGISTRATION			
09:00 - 10:30	STM V	SHCIS I	CyberICS & WOS-CPS & DPM-QASA Lecture Hall C	
10:30 - 11:00	Break			
11:00 - 12:30	STM VI	SHCIS II	DPM IV	CyberICS I
12:30 - 14:00	Lunch			
14:00 - 15:30	STM VII (short papers)	SHCIS III	DPM V	WOC-CPS
15:30 - 16:00	Break			
16:00 - 17:30		SHCIS IV	DPM VI	Cyber-ICS II

Monday, 21st September 2015

08.00-17.00 Registration

09.00-10.30 STM I: Security metrics and classification

Session Chair: Riccardo De Masellis (FONDAZIONE BRUNO KESSLER, Italy)
Lecture Hall E

1. Digital Waste Sorting: A Goal-Based, Self-Learning Approach to Label Spam Email Campaigns

Mina Sheikhalishai (Université Laval, Canada), Andrea Saracino (Consiglio Nazionale delle ricerche, Italy), Mohamed Mejri, Nadia Tawbi and Fabio Martinelli (Université Laval, Canada)

Abstract: Fast analysis of correlated spam emails may be vital in the effort of finding and prosecuting spammers performing cybercrimes such as phishing and online frauds. This paper presents a self-learning framework to automatically divide and classify large amounts of spam emails in correlated labeled groups. Building on large datasets daily collected through honeypots, the emails are firstly divided into homogeneous groups of similar messages (campaigns), which can be related to a specific spammer. Each campaign is then associated to a class which specifies the goal of the spammer, i.e. phishing, advertisement, etc. The proposed framework exploits a categorical clustering algorithm to group similar emails, and a classifier to subsequently label each email group. The main advantage of the proposed framework is that it can be used on large spam emails datasets, for which no prior knowledge is provided. The approach has been tested on more than 3200 real and recent spam emails, divided in more than 60 campaigns, reporting a classification accuracy of 97% on the classified data.

2. Integrating Privacy and Safety Criteria into Planning Tasks

Anna Lavygina, Alessandra Russo and Naranker Dulay (Imperial College London, UK)

Abstract: In this paper we describe a new approach that uses multicriteria decision making and the analytic hierarchy process (AHP) for integrating privacy and safety criteria into planning tasks. We apply the approach to the journey planning using two criteria: (i) a willingness-toshare-data (WSD) metric to control data disclosure, and (ii) the number of unsatisfied safety preferences (USP) metric to mitigate risky journeys.

3. Security Metrics, Secure Elements, and Operational Measurement Trust in Cloud Environments

Teemu Kanstrén and Antti Evesti (VTT, Finland)

Abstract: Operational security assurance evaluation requires building security metrics models to express the expected security status of the system, and collecting data from the operational system to express the current state against these models. Many factors impact the confidence we can have in these metrics and their reported status. One major factor is the trust we can put in the provided measurement data. This paper describes the properties of a trusted measurement base, use of secure element functions and different probe form factors, and their impact on defining confidence levels for the measurement data. A way of quantifying this confidence level and using it as part of security metrics models is defined. Cloud computing is used as a domain to illustrate these concepts and the process of their application. The cloud environment is especially challenging for this type of assurance due to mixed ownership and potentially limited visibility into the infrastructure.

09.00-10.30 SIoT I: Security and Privacy

Lecture Hall B

1. Welcome message
2. Keynote: IoT Security Threats, Research Challenges, and Industrial Ecosystems

Dr. Tieyan Li and Dr. Guilin Wang, (Huawei, China)

09.15-10.30 QASA & DPM I: Quantitative Aspects of Security Assurance

Session Chair: Fabio Martinelli (Université Laval, Canada)
Lecture Hall C

1. General Welcome
2. Composable Bounds on Information Flow from Distribution Differences.

Megumi Ando and Joshua D. Guttman (The MITRE Corporation, USA)

Abstract: We define information leakage in terms of a “difference” between the a priori distribution over some remote behavior and the a posteriori distribution of the remote behavior conditioned on a local observation from a protocol run. Either a maximum or an average may be used. We identify a set of notions of “difference;” we show that they reduce our general leakage notion to various definitions in the literature. We also prove general composability theorems analogous to the data processing inequality for mutual information, or cascading channels for channel capacities.

3. Quantitative Analysis of Network Security with Abstract Argumentation.

Artsiom Yautsiukhin (University of Perugia, Italy) and Francesco Santini (IIT-CNR, Italy)

Abstract: Abstract Argumentation Framework (AAF) is a useful technique for the analysis of arguments supporting or discouraging decisions (i.e., information can be in conflict). In particular, we apply Abstract Argumentation to support the administration of security in computer networks. Our approach captures the high-level topology of a system and helps to specify which and where security countermeasures are more appropriate. We apply a quantitative analysis on the Abstract Argumentation Framework that represents our knowledge, with the purpose to compare different decisions and select the most suitable ones.

10.30-11.00 Coffee Break

11.00-12.30 STM II: Data Protection

Lecture Hall E

1. A Declarative Framework for Specifying and Enforcing Purpose-aware Policies

Riccardo De Masellis (Trento RISE, Italy), Chiara Ghidini and Silvio Ranise (Bruno Kessler Foundation, Italy)

Abstract: Purpose is crucial for privacy protection as it makes users confident that their personal data are processed as intended. Available proposals for the specification and enforcement of purpose-aware policies are unsatisfactory for their ambiguous semantics of purposes and/or lack of support to the run-time enforcement of policies. In this paper, we propose a declarative framework based on a first order temporal logic that allows us to give a precise semantics to purpose aware policies and to reuse algorithms for the design of a run-time monitor enforcing purpose-aware policies. We also show the complexity of the generation and use of the monitor which, to the best of our knowledge, is the first such a result in literature on purpose-aware policies.

2. How to Trust the Re-Use of Data

Erisa Karafili, Hanne Riis Nielson and Flemming Nielson (Technical University of Denmark, Denmark)

Abstract: Research in natural sciences and life sciences involve carrying out experiments to collect data as well as carrying out analysis to interpret the data. Increasingly data is being made available to other scientists in big databases. The scientific process builds on the idea that research results can be independently validated by other researchers. However, the concern about the correct re-use of data is also increasing. As illustrated by a currently evolving case of alleged scientific mispractice there is a need to support a reliable re-use of data. To solve this challenge we introduce an enriched coordination language based on Klaim that can model the coordination of the re-use of data in the research community. We define the formal semantics of our language and develop a static analysis that can be used to check whether we have a trustable re-use of data.

3. Towards Balancing Privacy and Efficiency: A Principal-Agent Model of Data-Centric Business

Christian Zimmermann and Claus-Georg Nolte (University of Freiburg, Germany)

Abstract: Personal data has emerged as a crucial asset of the digital economy. However, unregulated markets for personal data severely threaten consumers' privacy. Based upon a commodity-centric notion of privacy, this paper takes a principal-agent perspective on data-centric business. Specifically, this paper presents an economic model of the privacy problem in data-centric business, in that drawing from contract theory. Building upon a critical analysis of the model, this paper analyzes how regulatory and technological instruments could balance efficiency of markets for personal data and data-subjects' right to informational self-determination.

11.00-12.40 SloT II: Secure Protocols

Lecture Hall B

1. Smart Insiders: Exploring the Threat from Insiders using the Internet-of-Things

Jason Nurse, Arnau Erola, Ioannis Agrafiotis, Michael Goldsmith and Sadie Creese (University of Oxford, UK)

Abstract: The Internet-of-Things (IoT) is set to be one of the most disruptive technology paradigms since the advent of the Internet itself. Market research company Gartner estimates that around 4.9 billion connected things will be in use in 2015, and around 25 billion by 2020. While there are substantial opportunities accompanying IoT, spanning from Healthcare to Energy, there are an equal number of concerns regarding the security and privacy of this plethora of ubiquitous devices. In this position paper we approach security and privacy in IoT from a different perspective to existing research, by considering the impact that IoT may have on the growing problem of insider threat within enterprises. Our specific aim is to explore the extent to which

IoT may exacerbate the insider-threat challenge for organizations and overview the range of new and adapted attack vectors. Here, we focus especially on (personal) devices which insiders bring and use within their employer's enterprise. As a start to addressing these issues, we outline a broad research agenda to encourage further research in this area.

2. BALSA: Bluetooth Low Energy Application Layer Security Add-on

Diego Ortiz-Yepes (Radbound University, Netherlands)

Abstract: Bluetooth Low Energy (BLE) is ideally suited to exchange information between mobile devices and Internet-of- Things (IoT) sensors. It is supported by most recent consumer mobile devices and can be integrated into sensors enabling them to exchange information in an energy-efficient manner. However, when BLE is used to access or modify sensitive sensor parameters, exchanged messages need to be suitably protected, which may not be possible with the security mechanisms defined in the BLE specification. Consequently we contribute BALSA, a set of cryptographic protocols, a BLE service and a suggested usage architecture aiming to provide a suitable level of security. In this paper we define and analyze these components and describe our proof-of-concept, which demonstrates the feasibility and benefits of BALSA.

3. Secure Association for the Internet of Things

Almog Benin, Sivan Toledo and Eran Tromer (Tel-Aviv University, Israel)

Abstract: Existing standards (ZigBee and Bluetooth Low Energy) for networked low-power wireless devices do not support secure association (or pairing) of new devices into a network: their association process is vulnerable to man-in-the-middle attacks. This paper addresses three essential aspects in attaining secure association for such devices. First, we define a user-interface primitive, oblivious comparison that allows users to approve authentic associations and abort compromised ones. This distills and generalizes several existing approve/abort mechanisms, and moreover we experimentally show that OC can be implemented using very little hardware: one LED and one switch. Second, we provide a new Message Recognition Protocol (MRP) that allows devices associated using oblivious comparison to exchange authenticated messages without the use of public key cryptography (which exceeds the capabilities of many IoT devices). This protocol improves upon previously proposed MRPs in several respects. Third, we propose a robust definition of security for MRPs that is based on universal composability, and show that our MRP protocol satisfies this definition.

4. REST-ful CoAP Message Authentication

Hoai Viet Nguyen and Luigi Lo Iacono (Cologne University of Applied Sciences, Germany)

Abstract: One core technology for implementing and integrating the architectural principles of REST into the Internet of Things (IoT) is CoAP, a REST-full application protocol for constrained networks and devices. Since CoAP defaults to UDP as transport protocol, the protection of CoAP-based systems is realized by the adoption of DTLS, a transport-oriented security protocol for datagrams. This is, however, in many cases not a sufficient safeguard, since messages in distributed systems—as obtained, e.g., by the adoption of REST—are commonly transported via multiple intermediate components. This induces the need for message-oriented protection means supplementing transport security for IoT scenarios with high security demands. This paper approaches an important part of this requirement by introducing a REST-ful CoAP message authentication scheme. The overarching goal of this work is, though, to establish a message-oriented security layer for CoAP. Here, specific challenges are stemming from the architectural style REST and the resource-restrictiveness of IoT networks and devices. The present contribution reaches this goal for authentication by proposing a REST-ful CoAP message signature generation and verification scheme.

11.00-12.50 QASA II: Security Assurance and Reputation

Session Chair: Joaquin Garcia-Alfaro (TELECOM SudParis, France)
Lecture Hall C

1. Security-Based Runtime Adaptation of Multi-Cloud Applications.

Kyriakos Kritikos (ICS-FORTH, Greece) and Philippe Massonet (CETIC, Belgium)

Abstract: Multi-cloud application management is promoted as an approach optimizing the provisioning of cloud-based applications for two main factors: exploit whole variety of services offered by cloud providers and avoid vendor lock-in. To enable such management, model-driven approaches promise to partially automating the provisioning process. However, such approaches tend to neglect security aspects and focus only on low-level infrastructure details or quality of service aspects. As such, our previous work proposed a particular security meta-model, bridging the gap between high- and low-level security requirements and capabilities, able to express security models exploited by a planning algorithm to derive an optimal application deployment plan by considering both types of security requirements. This work goes one step further by focusing on runtime adaptation of multi-cloud applications based on security aspects. It advocates using adaptation rules, expressed in the event-condition-action form, which drive application adaptation behavior and enable assuring a more-or-less stable security level. Firing such rules relies on deploying security metrics and adaptation code in the cloud to continuously monitor rule event conditions and fire adaptation actions for applications when the need arises.

2.AdIDoS - Adaptive and Intelligent Fully-Automatic Detection of Denial-of-Service Weaknesses in Web Services.

Christian Altmeier (Software AG, Germany), Christian Mainka, Juraj Somorovsky and Jörg Schwenk (Ruhr University Bochum, Germany)

Abstract: Denial-of-Service (DoS) attacks aim to affect availability of applications. They can be executed using several techniques. Most of them are based upon a huge computing power that is used to send a large amount of messages to attacked applications, e.g. web services. Web services apply parsing technologies to process incoming XML messages. This enlarges the amount of attack vectors since attackers get new possibilities to abuse specific parser features and complex parsing techniques. Therefore, web service applications apply various countermeasures, including message length or XML element restrictions. These countermeasures make validations of web service robustness against DoS attacks complex and error prone. In this paper, we present a novel adaptive and intelligent approach for testing web services. Our algorithm systematically increases the attack strength and evaluates its impact on a given web service, using a black box approach based on server response times. This allows one to automatically detect message size limits or element count restrictions. We prove the practicability of our approach by implementing a new WS-Attacker plugin and detecting new DoS vulnerabilities in widely used web service implementations.

3. An integrated reward and reputation mechanism for MCS preserving users privacy

Cristian Tanas, Sergi Delgado-Segura and Jordi Herrera-Joancomartí (Universitat Autònoma de Barcelona, Spain)

Abstract: Mobile Crowd Sensing (MCS) presents numerous and unique research challenges most of them based on the fact that human participation is in the loop. In this paper we analyze three of the most important: user participation, data sensing quality and user anonymity. To solve them, we present PaySense, a general framework for user rewarding and reputation accountability that preserves users' privacy using cryptocurrencies. Furthermore, we detailed an implementable system using Bitcoins.

12.30-14.00 Lunch Break

14.00-15.30: STM III: Intrusion detection and software vulnerabilities

Session Chair: Andrea Saracino (IIT-CNR, Italy)

Lecture Hall E

1. The AC-Index: Fast Online Detection of Correlated Alerts

Andrea Pugliese, Antonino Rullo and Antonio Piccolo (University of Calabria, Italy)

Abstract: We propose an indexing technique for alert correlation that supports DFA-like patterns with user-defined correlation functions. Our *AC-Index* supports (i) the retrieval of the top-*k* (possibly noncontiguous) sub-sequences, ranked on the basis of an arbitrary user provided severity function, (ii) the concurrent retrieval of sub-sequences that match any pattern in a given set, (iii) the retrieval of partial occurrences of the patterns, and (iv) the online processing of streaming logs. The experimental results confirm that, although the supported model is very expressive, the AC-Index is able to guarantee a very high efficiency of the retrieval process.

2. Intrusion Detection System for Applications using Linux Containers

Amr Abed, Charles Clancy (Virginia Tech, USA) and David Levy (The MITRE Corporation, USA)

Abstract: Linux containers are gaining increasing traction in both individual and industrial use, and as these containers get integrated into mission-critical systems, real-time detection of malicious cyber-attacks becomes a critical operational requirement. This paper introduces a real-time host-based intrusion detection system that can be used to passively detect malfeasance against applications within Linux containers running in a standalone or in a cloud multi-tenancy environment. The demonstrated intrusion detection system uses bags of system calls monitored from the host kernel for learning the behavior of an application running within a Linux container and determining anomalous container behavior. Performance of the approach using a database application was measured and results are discussed.

3. SUDUTA: Script UAF Detection Using Taint Analysis

John Galea and Mark Vella (University of Malta, Malta)

Abstract: Use-after-free (UAF) vulnerabilities are caused by the use of dangling pointers. Their exploitation inside script engine-hosting applications, e.g. web browsers, can even bypass state-of-the-art countermeasures. This work proposes SUDUTA (**S**cript **U**AF **D**etection **U**sing **T**aint **A**nalysis), which aims at facilitating the diagnosis of UAF bugs during vulnerability analysis and improves an existent promising technique based on dynamic taint tracking. Firstly, precise taint analysis rules are presented in this work to clearly specify how SUDUTA manages the taint state. Moreover, it shifts its analysis to on-line, enabling instrumentation code to gain access to the program state of the application. Lastly, it handles the presence of custom memory allocators that are typically utilized in script-hosting applications. Results obtained using a benchmark dataset and vulnerable applications validate these three improvements.

14.00-15.30 Slot III: Users and Privacy

Lecture Hall B

1. Keynote: IOT Security and Data Integrity using 3GPP Authentication

Gustavo Tanoni (Ericsson, Canada)

2. Keynote: On Security Threats in IoT with Mobile Guard

Dr. Joerg Abendroth (Nokia, Germany)

14.00-15.30 DPM II and Invited Talk DPM-QASA

Session Chair: Fabio Martinelli (Université Laval, Canada)

Lecture Hall C

1. Stronger Security for Sanitizable Signatures.

Stephan Krenn (AIT Austrian Institute of Technology GmbH, Austria), Kai Samelin (IBM Research, Switzerland) and Dieter Sommer (Technical University of Darmstadt, Germany)

Abstract: Sanitizable signature schemes (SSS) enable a designated party (called the sanitizer) to alter admissible blocks of a signed message. This primitive can be used to remove or alter sensitive data from already signed messages without involvement of the original signer. Current state-of-the-art security definitions of SSSs only dene a \weak" form of security. Namely, the unforgeability, accountability and transparency definitions are not strong enough to be meaningful in certain use-cases. We identify some of these use-cases, close this gap by introducing stronger definitions and show how to alter an existing construction to meet our desired security level. Moreover, we clarify a small yet important detail in the state-of-the-art privacy definition. Our work allows to deploy this primitive in more and different scenarios.

2. Invited talk DPM-QASA: Data Security and Privacy in the Cloud

Pierangela Samarati (Università degli Studi di Milano, Italy)

Abstract: The rapid advancements in Information and Communication Technologies (ICTs) have enabled the emerging of the cloud as a successful paradigm for conveniently storing, accessing, processing, and sharing information. With its significant benefits of scalability and elasticity, the cloud paradigm has appealed companies and users, which are more and more resorting to the multitude of available providers for storing and processing data. Unfortunately, such a convenience comes at a price of loss of control over these data and consequent new security threats that can limit the potential widespread adoption and acceptance of the cloud computing paradigm. In this talk I will illustrate some security and privacy issues arising in the cloud scenario, focusing in particular on the problem of guaranteeing confidentiality and integrity of data stored or processed by external cloud providers.

15.30-16.00: Coffee Break

16.00-17.00: STM IV (ERCIM PhD Award) Business Meeting

Lecture Hall E

1. Preserving Privacy in Data Release

Giovanni Livraga (Università degli Studi di Milano, Italy)

16.00-17.45 SIoT IV: Security Attacks and Threats

Lecture Hall B

1. On the security and privacy of Internet of Things architectures and systems

Emmanouil Vasilomanolakis, Jörg Daubert (AGT International, Switzerland), Manisha Luthra (Technische Universität Darmstadt, Germany), Vangelis Gazis, Alexander Wiesmaier and Panagiotis Kikiras (AGT International, Switzerland)

Abstract: The Internet of Things (IoT) brings together a multitude of technologies, with a vision of creating an interconnected world. This will benefit both corporations as well as the end-users. However, a plethora of security and privacy challenges need to be addressed for the IoT to be fully realized. In this paper, we identify and discuss the properties that constitute the uniqueness of the IoT in terms of the upcoming security and privacy challenges. Furthermore, we construct requirements induced by the aforementioned properties. We survey the four most dominant IoT architectures and analyze their security and privacy components with respect to the requirements. Our analysis shows a mediocre coverage of security and privacy requirements. Finally, through our survey we identify a number of research gaps that constitute the steps ahead for future research.

2. Multiple Fault Attack on PRESENT with a Hardware Trojan Implementation in FPGA

Jakub Breier and Wei He (Nanyang Technological University, Singapore)

Abstract: Internet of Things connects lots of small constrained devices to the Internet. As in any other environment, communication security is important and cryptographic algorithms are one of many elements that we use in order to keep messages secure. It is necessary to use algorithms that do not require high computational power, lightweight ciphers are therefore an ideal candidate for this purpose. Since these devices work in various environments, it is necessary to test security of implementations of cryptographic algorithms. In this paper, we explore a possibility of attacking an ultra-lightweight cipher PRESENT by using a multiple fault attack. Utilizing the Differential Fault Analysis technique, we were able to recover the secret key with two faulty encryptions and an exhaustive search of 216 remaining key bits. Our attack aims at four nibbles in the penultimate round of the cipher, causing faulty output in all nibbles of the output. We also provide a practical attack scenario by exploiting Hardware Trojan (HT) technique for the proposed fault injection in a Xilinx Spartan-6 FPGA.

3. Characterizing and Comparing the Energy Consumption of Side Channel Attack Countermeasures and Lightweight Cryptography on Embedded Devices

David Mccann, Kerstin Eder and Elisabeth Oswald (University of Bristol, UK)

Abstract: This paper uses an Instruction Set Architecture (ISA) based statistical energy model of an ARM Cortex-M4 microprocessor to evaluate the energy consumption of an implementation of AES with different side channel attack (SCA) countermeasures and an implementation of lightweight ciphers PRESENT, KLEIN and ZORRO with and without Boolean first order masking. In this way, we assess the additional energy consumption of using different SCA countermeasures and using lightweight block ciphers on 32 bit embedded devices. In addition to this, we provide a methodology for developing an ISA based energy model for cryptographic software with an accuracy of _5%. In addition to providing our methodology for developing this model, we also show that using variations of instructions that reduce the size of code can reduce the energy consumption by as much as 30% ⍰ 40% and that memory instructions reduce the predictability of our energy model.

4. Not so Smart: On Smart TV Apps

Marcus Niemietz, Juraj Somorovsky, Christian Mainka and Joerg Schwenk (Ruhr-University Bochum, Germany)

Abstract: One of the main characteristics of Smart TVs are apps. Apps extend the Smart TV behavior with various functionalities, ranging from usage of social networks or payed streaming services, to buying articles on Ebay. These actions demand usage of critical data like authentication tokens and passwords, and thus raise a question on new attack scenarios and general security of Smart TV apps. In this paper, we investigate attack models for Smart TVs and their apps, and systematically analyze security of Smart TV devices. We point out that some popular apps, including Facebook, Ebay or Watchever, send login data over unencrypted channels. Even worse, we show that an arbitrary app installed on devices of the market share leader Samsung can gain access to the credentials of a Samsung Single Sign-On account. Therefore, such an app can hijack a complete user account including all his devices like smartphones and tablets connected with it. Based on our findings, we provide recommendations that are of general importance and applicable to areas beyond Smart TVs.

5. Closing Remarks

16.00-17.50 DPM III: Monetization and Data Revocation

Session Chair: Guillermo Navarro Arribas (Universitat Autonoma de Barcelona, Spain)
Lecture Hall C

1. Some Remarks and Ideas about Monetization of Sensitive Data

Ania M. Piotrowska and Marek Klonowski (Wrocław University of Technology, Poland)

Abstract: One of the emerging problems on the border of privacy protection research and e-commerce is the m onetization of sensitive data. More precisely, a client would like to obtain some statistical data about users' personal information in exchange for a reward. To satisfy both parties, a monetization protocol should ensure that users' privacy is not violated and the data utility is preserved at the same time. During ESORICS 2014 Bilogrevic et al. presented a novel and promising approach to monetization of aggregated sensitive data. In our paper, we point some flaws and shortcomings of the presented protocol. We also make some general methodological remarks to explain why some auspicious directions of data monetization might be futile. Finally, we propose a simple scheme for a secure data aggregation based on sharing trust between different non-collaborating parties.

2. A Novel Approach for Data Revocation on the Internet

Olga Kieselmann, Nils Kopal and Arno Wacker (University of Kassel, Germany)

Abstract: After publishing data on the Internet, the data publisher loses control over it. However, there are several situations where it is desirable to remove published information. To support this, the European Union proposed the General Data Protection Regulation (GDPR) which states that providers must remove the data when the corresponding owner requests it. However, the data might already have been copied by third parties. Therefore, Article 17 of the GDPR includes the regulation that the provider must also inform all third parties about the user's request. Hence, the providers would need to track every access, which is hard to achieve. This technical infeasibility is a gap between the legislation and the current technical possibilities. To close this gap, we propose a novel service which gives the data owner the possibility to inform simultaneously all providers about her removal request.

3.PerfectDedup: Secure Data Deduplication

Pasquale Puzio (SecludIT, France), Refik Molva, Melek Önen (EURECOM, France) and Sergio Loureiro (SecludIT, France)

Abstract: With the continuous increase of cloud storage adopters, data deduplication has become a necessity for cloud providers. By storing a unique copy of duplicate data, cloud providers greatly reduce their storage and data transfer costs. Unfortunately, deduplication introduces a number of new security challenges. We propose PerfectDedup, a novel scheme for secure data deduplication, which takes into account the popularity of the data segments and leverages the properties of Perfect Hashing in order to assure block-level deduplication and data confidentiality at the same time. We show that the client-side overhead is minimal and the main computational load is outsourced to the cloud storage provider.

18.00 Workshop Dinner & Sightseeing Tour

Meeting point: 18:00 in front of the Conference Venue

Walking tour: *Off the beaten track Vienna:* 18:00 – 19:30
Beside Empress Elisabeth, St. Stephen's Cathedral and Schönbrunn Palace, Vienna has lot more to offer: Let our guides show you the nicest walk through the Old Town of Vienna.

Workshop Dinner at Restaurant Schubert: 19:30 – 23:00

The walking tour will end at the location of the Workshop Dinner, Restaurant Schubert. Please note that there is no possibility to store your laptop / bag at the university or during the tour.

Address:
Restaurant Schubert
Schreyvogelgasse 6
1010 Vienna
(Metro stop U2 „Schottentor"– directions will be provided, no organized transport for returning)

Tuesday, 22nd September 2015

08.00-17.00 Registration

09.00-10.30 STM V: Cryptographic protocols

Session Chair: Naranker Dulay (Imperial College London, UK)

Lecture Hall E

1. Two-Factor Authentication for the Bitcoin Protocol

Christopher Mann and Daniel Loebenberger (University of Bonn, Germany)

Abstract: We show how to realize two-factor authentication for a Bitcoin wallet. To do so, we explain how to employ an ECDSA adaption of the two-party signature protocol by MacKenzie and Reiter (2004) in the context of Bitcoin and present a prototypic implementation of a Bitcoin wallet that offers both: two-factor authentication and verification over a separate channel. Since we use a smart phone as the second authentication factor, our solution can be used with hardware already available to most users and the user experience is quite similar to the existing online banking authentication methods.

2. Private Proximity Testing on Steroids: An NTRU-based protocol

Constantinos Patsakis, Panayiotis Kotzanikolaou (University of Piraeus, Greece) and Mélanie Bouroche (Trinity College, Ireland)

Abstract: Nowadays, most smartphones come pre-equipped with location (GPS) sensing capabilities, allowing developers to create a wide variety of location-aware applications and services. While location awareness provides novel features and functionality, it opens the door to many privacy nightmares. In many occasions, however, users do not need to share their actual location, but to determine whether they are in proximity to others, which is practically one bit of information. Private proximity protocols allow this functionality without any further information leakage. In this work we introduce a novel protocol which is far more efficient than the current state of the art and bases its security on lattice-based cryptography.

3. Selecting a New Key Derivation Function for Disk Encryption

Milan Broz and Vashek Matyas (Masaryk University, Czech Republic)

Abstract: Many full disk encryption applications rely on a strong password-based key derivation function to process a passphrase. This article defines requirements for key derivation functions and analyzes recently presented password hashing functions (second round finalists of the Password Hashing Competition) for their suitability for disk encryption.

09.15-10.30 SHCISI: Identity and Access Management

Lecture Hall F

1. Dynamic Trust-Based Recertifications in Identity and Access Management

Christian Richthammer, Michael Kunz, Johannes Sänger, Matthias Hummer, and Günther Pernul (University of Regensburg, Germany)

Abstract: Security compliance has become an important topic for medium- and large-sized companies in the recent years. In order to fulfill all requirements legally imposed, high quality identity management – particularly with respect to correct and Consistent access control – is essential. In this context, the concept of recertification has proven itself to maintain the quality and correctness of access rights over a long period of time. In this paper, we show how the traditional recertification concept can be notably enhanced through involving the notion of trust. We thereto propose a trust-based recertification model and demonstrate its benefits by means of a realistic use case. Our dynamic concept can help to better spread the recertification overhead compared to the traditional approach with fixed periods. Furthermore, it aids in the identification of risky employees.

2. Towards an Economic Approach to Identity and Access Management Systems Using Decision Theory

Eva Weishäupl, Michael Kunz, Emrah Yasasin, Gerit Wagner, Julian Prester, Guido Schryen, and Günther Pernul (University of Regensburg, Germany)

Abstract: Nowadays, providing employees with failure-free access to various systems, applications and services is a crucial factor for organizations' success as disturbances potentially inhibit smooth workflows and thereby harm productivity. However, It is a challenging task to assign access rights to employees' accounts within a satisfying time frame. In addition, the management of multiple accounts and identities can be very onerous and time consuming for the responsible administrator and therefore expensive for the organization. In order to meet these challenges, firms decide to invest in introducing an Identity and Access Management System (IAMS) that supports the organization by using policies to assign permissions to accounts, groups, and roles. In practice, since various versions of IAMSs exist, it is a challenging task to decide upon introduction of an IAMS. The following study proposes a first attempt of a decision support model for practitioners which considers four alternatives: Introduction of an IAMS with Role-based Access Control (RBAC) or without and no introduction of IAMS again with or without RBAC. To underpin the practical applicability of the proposed model, we parametrize and operationalize it based on a real world use case using input from an expert interview.

09.15-10.30: CyberICS & WOS-CPS & DPM-QASA

Lecture Hall C

1. Welcome

2. Invited speaker: Industrial Control Systems Security – From SCADA Security to Adversarial Control Theory

Dieter Gollman (Technische Universität Hamburg, Germany)

Abstract: We describe an approach for analyzing and attacking the physical part (a process) of a cyber-physical system. The stages of this approach are demonstrated in a case study, a simulation of a vinyl acetate monomer plant. We want to demonstrate in particular where security has to rely on expert knowledge in the domain of the physical components and processes of a system and that there are major challenges for converting cyber-attacks into successful cyber-physical attacks.

10.30-11.00 Coffee Break

11.00-12.30 STM VI: Controlling data release

Session Chair: Ken Barker (University of Calgary, Canada)

Lecture Hall E

1. It's My Privilege: Controlling Downgrading in DC-Labels

Lucas Waye (Harvard University, USA), Pablo Buiras (Chalmers University of Technology, Sweden), Daniel King, Stephen Chong (Harvard University, USA) and Alejandro Russo (Chalmers University of Technology, Sweden)

Abstract: Disjunction Category Labels (DC-labels) are an expressive label format used to classify the sensitivity of data in information-flow control systems. DC-labels use capability-like *privileges* to downgrade information. Inappropriate use of privileges can compromise security, but DC-labels provide no mechanism to ensure appropriate use. We extend DC-labels with the novel notions of *bounded privileges* and *robust privileges*. Bounded privileges specify and enforce upper and lower bounds On the labels of data that may be downgraded. Bounded privileges are simple and intuitive, yet can express a rich set of desirable security policies. Robust privileges can be used only in downgrading operations that are *robust*, i.e., the code exercising privileges cannot be abused to release or certify more information than intended. Surprisingly, robust downgrades can be expressed in DC-labels as downgrading operations using a weakened privilege. We provide *sound and complete* run-time security checks to ensure downgrading operations are robust. We illustrate the applicability of bounded and robust privileges in a case study as well as by identifying a vulnerability in an existing DC-label-based application.

2. Obligations in PTaCL

Conrad Williams and Jason Crampton (Royal Holloway, University of London, UK)

Abstract: Obligations play an increasingly important role in authorization systems and are supported by languages such as XACML. However, our understanding of how to handle obligations in languages such as XACML, particularly in exceptional circumstances, is hampered by a lack of formality and rigor in the existing literature, including the XACML standard. PTaCL is an attribute-based policy language that makes use of tree-structured policies and targets, like XACML. However, PTaCL is more general than XACML and has rigorous operational semantics for request evaluation, from which a policy decision point can be implemented. In this paper, we enhance PTaCL by extending the policy syntax to include obligations and defining the obligations that should be associated with an authorization decision. Our final contribution is to extend our analysis to cases where policy evaluation may return an indeterminate value. We demonstrate that obligation semantics for PTaCL coincide with those of XACML when there is no indeterminacy. More importantly, we show that our obligation semantics provide a principled method for determining obligations for any policy-combining algorithm and the set of possible obligations in the presence of indeterminacy, thereby providing considerable advantages over existing approaches.

3. Content and Key Management to Trace Traitors in Broadcasting Services

Kazuto Ogawa (Japan Broadcasting Corporation, Japan), Goichiro Hanaoka (National Institute of Advanced Industrial Science and Technology, Japan) and Hideki Imai (The University of Tokyo, Japan)

Abstract: Traitor tracing encryption schemes are a type of broadcasting encryption and have been developed for broadcasting services. There are multiple distinct decryption keys for each encryption key, and each service subscriber is given a unique decryption key. Any subscriber that redistributes his or her decryption key to a third party or who uses it to make a pirate receiver (*PR*) can be identified using the schemes. However, almost all previous schemes are effective against only those *PR*s with only one decryption key. We first discuss an attack (*content comparison attack*) against the above encryption schemes. The attack involves multiple distinct decryption keys and content-data comparison mechanism. We have developed a *content and key management method* (*CKM*) that makes traitor tracing schemes secure against the content comparison attack. Its use makes it impossible for *PR*s to distinguish ordinary content data from test data and makes traitor tracing schemes effective against all *PR*s. The CKM makes the broadcasting services secure.

11.00-12.30 SHCIS II: Security in the Clouds

Lecture Hall F

1. Virtual Machine Introspection with Xen on ARM

Tamas K. Lengyel, Thomas Kittel, and Claudia Eckert (Technische Universität München, Germany)

Abstract: In the recent years, virtual machine introspection has become a valuable technique for developing security applications for virtualized environments. With the increasing popularity of the ARM architecture and the recent addition of hardware virtualization extensions there is a growing need for porting existing tools to this new platform. Porting these applications requires proper hypervisor support, which we have been exploring and developing for the upcoming Xen 4.6 release. In this paper we explore using ARM's two-stage paging mechanisms with Xen to enable stealthy, efficient tracing of guest operating systems for security purposes.

2. Analysing Malware Attacks in the Cloud: A Use Case for the TLSInspector Toolkit

Benjamin Taubmann, Dominik Dusold, Christoph Frädrich, and Hans P. Reiser (University of Passau, Germany)

Abstract: Nowadays, malicious attacks in the Internet often use encrypted communication channels. Thus, an attacker might exploit a vulnerability in a web service using the HTTPS protocol. If network intrusion detection systems (NIDS) are unable to decrypt this communication, they cannot observe the contents of such attacks. If the NIDS is operated independently of the web services, it is impractical to directly provide decryption keys to it. This is, for example, the case if a cloud provider operates the NIDS, while a cloud customer manages the web service within a virtual machine. Additionally, malware often encrypts the communication to a command and control server. The encryption keys used for that communication channel are fully under the control of the malware and thus it is even more difficult to provide them to the NIDS. This paper discusses both use cases in a common cloud scenario and describes a VMI based prototype that is able to decrypt TLS encrypted communication of a virtual machine. The decryption is achieved by taking a memory snapshot and extracting the cryptographic key that is required to decrypt a network flow. We experimentally evaluate the overhead caused by taking the memory snapshots and the performance of extracting the encryption key from the snapshot.

3. QoS-Aware Secure Live Migration of Virtual Machines

Waseem Mandarawi, Andreas Fischer, Hermann de Meer (University of Passau, Germany) and Eva Weishaeupl (University of Regensburg, Germany)

Abstract: The live migration of Virtual Machines (VMs) is a key technology in server virtualization solutions used to deploy Infrastructure-as-a-Service (IaaS) clouds. This process, on one hand, increases the elasticity, fault tolerance, and maintainability in the virtual environment. On the other hand, it increases the security challenges in cloud environments, especially when the migration is performed between different data centers. Secure live migration mechanisms are required to keep the security requirements of both cloud customers and providers satisfied. These mechanisms are known to increase the migration downtime of the VMs, which plays a significant role in the compliance to Service Level Agreements (SLAs). This paper discusses the main threats caused by live migration and the main approaches for securing the migration. The requirements of a comprehensive Quality of Service (QoS)-aware secure live migration solution that keeps both security and QoS requirements satisfied are defined.

11.00-12.20 DPM IV: Short Papers

Session Chair: Isaac Agudo (NICS Lab, Spain)
Lecture Hall C

1. User-centric privacy-preserving collection and analysis of trajectory data (Short Paper).

Cristina Romero-Tris and David Megías (Universitat Oberta de Catalunya (UOC), Spain)

Abstract: Due to the increasing use of location-aware devices such as smartphones, there is a large amount of available trajectory data whose improper use or publication can threaten users' privacy. Since trajectory information contains personal mobility data, it may reveal sensitive details like habits of behavior, religious beliefs, and sexual preferences. Current solutions focus on anonymizing data before its publication. Nevertheless, we argue that this approach gives the user no control about the information she shares. For this reason, we propose a novel approach that works inside users' mobile devices, where users can decide and configure the quantity and accuracy of shared data.

2. Can You Really Anonymize the Donors of Genomic Data in Today's Digital World? (Short Paper).

Mohammed Alser, Nour Almadhoun, Azita Nouri, Can Alkan and Erman Ayday (Bilkent University, Turkey)

Abstract: The rapid progress in genome sequencing technologies leads to availability of high amounts of genomic data. Accelerating the pace of biomedical breakthroughs and discoveries necessitates not only collecting millions of genetic samples but also granting open access to genetic databases. However, one growing concern is the ability to protect the privacy of sensitive information and its owner. In this work, we survey a wide spectrum of cross-layer privacy breaching strategies to human genomic data (using both public genomic databases and other public non-genomic data). We outline the principles and outcomes of each technique, and assess its technological complexity and maturation. We then review potential privacy-preserving countermeasure mechanisms for each threat.

3. The leaking battery: A privacy analysis of the HTML5 Battery Status API (Short Paper).

Lukasz Olejnik (INRIA Privatics, France), Gunes Acar, Claude Castelluccia (KU Leuven, Belgium) and Claudia Diaz (INRIA Privatics, France)

Abstract: We highlight privacy risks associated with the HTML5 Battery Status API. We put special focus on its implementation in the Firefox browser. Our study shows that websites can discover the capacity of users' batteries by exploiting the high precision readouts provided by Firefox on Linux. The capacity of the battery, as well as its level, expose a finger printable surface that can be used to track web users in short time intervals. Our analysis shows that the risk is much higher for old or used batteries with reduced capacities, as the battery capacity may potentially serve as a tracking identifier. The finger printable surface of the API could be drastically reduced without any loss in the API's functionality by reducing the precision of the readings. We propose minor modifications to Battery Status API and its implementation in the Firefox browser to address the privacy issues presented in the study. Our bug report for Firefox was accepted and a fix is deployed.

4. Secure Refactoring with Java Information Flow (Short Paper).

Steffen Helke (Brandenburgische Technische Universität Cottbus-Senftenberg, Germany), Florian Kammueller (Middlesex University, UK) and Christian W. Probst (Technical University of Denmark, Denmark)

Abstract: Refactoring means that a program is changed without changing its behavior from an observer's point of view. Does the change of behavior also imply that the security of the program is not affected by the changes? Using Myers and Liskov's distributed information flow control model DLM and its Java implementation Jif, we explore this question practically on common patterns of Refactoring as known from Fowler. We first illustrate on an example the \Extract method" refactoring and how it can endanger confidentiality. We then show how to construct a secure version of this major refactoring pattern by employing Jif to control information flows. Finally, we can show that security leaks as encountered at the outset are not possible anymore.

11.00-12.30: CyberICS I

Lecture Hall B

1. The economics of cybersecurity, from the public good to the revenge of the industry

Danilo Delia (University of Paris VIII Vincennes-Saint Denis, France)

Abstract: In the aftermath of Edward Snowden’s intelligence revelations, many governments around the world are increasingly elaborating so-called « digital sovereignty » policies. The declared aim is to develop trusted technologies to protect the more sensitive networks. The ambition of this article is to turn over the complex- and often contrasting- motivations and interests behind the industrial policy movements, explain how the dominant representation of cybersecurity as public good is impacting the public policy and analyze the dynamics between private and public players

2. Teaching Industrial Control System Security UsingCollaborative Projects

Thuy Nguyen, Mark Gondree (Naval Postgraduate School, USA) and David Reed (Ship Systems Engineering Station (NSWCCD-SSES), USA)

Abstract: In this work, we discuss lessons learned over the past three years while supporting a graduate capstone course centered on research projects in industrial control system (ICS) security. Our course considers real-world problems in shipboard ICS posed by external stakeholders: a system-owner and related subject matter experts. We describe the course objectives, format, expectations and outcomes. While our experiences are generally positive, we remark on opportunities for curricula improvement relevant to those considering incorporating realistic ICS topics into their classroom, or those working with an external SME.

3. Trust Establishment in Cooperating Cyber-Physical System.

Andre Rein (Fraunhofer Institute SIT, Germany), Roland Rieke (Philipps-Universität Marburg, Germany), Michael Jäger (Technische Hochschule Mittelhessen, Germany), Nicolai Kuntze (Fraunhofer Institute SIT, Germany) and Luigi Coppolino (Universita degli Studi di Napoli "Parthenope", Italy)

Abstract: Cooperating systems are systems of systems that collaborate for a common purpose. In this work, we consider networked cooperating systems that base important decisions on data gathered from external sensors and use external actuators to enforce safety critical actions. Typical examples of cooperating cyber physical systems are critical infrastructure process control systems. Such systems must not only be secure, they must be demonstrably so. Using the example of a hydroelectric power plant control system, this paper analyzes security threats for networked cooperating systems, where sensors providing decision critical data are placed in non-protected areas and thus are exposed to various kinds of attacks. We propose a concept for trust establishment in cyber-physical cooperating systems. Using trusted event reporting for critical event sources, the authenticity of the security related events can be verified. Based on measurements obtained with a prototypical realization, we evaluate and analyze the amount of overhead data transmission between event source and data verification system needed for trust establishment. We propose an efficient synchronization scheme for system integrity data, reducing network traffic as well as verification effort.

4. Forensics in Industrial Control System: A Case Study (short paper)

Pieter Van Vliet (Ministry of Infrastructure and the Environment, Netherlands), M-T. Kechadi and Nhien An Le Khac (University College Dublin, Ireland)

Abstract. Industrial Control Systems (ICS) are used worldwide in critical infrastructures. An ICS system can be a single embedded system working standalone for controlling a simple process or ICS can also be a very complex Distributed Control System (DCS) connected to Supervisory Control And Data Acquisition (SCADA) system(s) in a nuclear power plant. Although ICS are widely used today, there are very little research on the forensic acquisition and analyze ICS's artefacts. In this paper we present a case study of forensics in ICS where we describe a method of safeguarding important volatile artefacts from an embedded industrial control system and several other sources.

12.30-14.00 Lunch Break

14.00-15.30 STM VII (short papers): Security Analysis, Risk Management, and Usability

Session Chair: Erisa Karafili (Technical University of Denmark, Denmark)

Lecture Hall E

1. In Cyber-Space, no one can hear you S.CREAM: A Root Cause Analysis technique for Socio-Technical Security

Ana Ferreira (University of Porto, Portugal), Jean-Louis Huynen, Vincent Koenig and Gabriele Lenzini (University of Luxembourg, Luxembourg)

Abstract: Inspired by the root cause analysis techniques that in the field of safety research and practice help investigators understand the reasons of an incident, this paper investigates the use of root cause analysis in security. We aim at providing a systematic method for the security analyst to identify the socio-technical attack modes that can potentially endanger a system's security.

2. A Socio-Technical Investigation into Smartphone Security

Melanie Volkamer (Technische Universität Darmstadt, Germany), Karen Renaud (University of Glasgow, UK), Oksana Kulyk, and Sinem Emeroz (Technische Universität Darmstadt, Germany)

Abstract: Many people do not deliberately act to protect the data on their Smartphones. The most obvious explanation for a failure to behave securely is that the appropriate mechanisms are unusable. Does this mean usable mechanisms will automatically be adopted? Probably not! Poor usability certainly plays a role, but other factors also contribute to nonadaptation of precautionary mechanisms and behaviors. We carried out a series of interviews to determine justifications for non-adoption of security precautions, specifically in the smartphone context, and developed a model of Smartphone precaution non-adoption. We propose that future work should investigate the use of media campaigns in raising awareness of these issues.

3. A Game Theoretic Framework for Modeling Adversarial Cyber Security Game among Attackers, Defenders, and Users

Tatyana Ryutov, Michael Orosz, Detlof von Winterfeldt (USC Information Sciences Institute, USA) and Jim Blythe (USC, USA)

Abstract: This paper models interactions in the cyber environment as a three-way security game between attacker, defender, and user. The paper focuses on understanding and modeling the roles, motivations and conflicting objectives of the players.

Unlike most research in cyber security, this paper studies not only technological but also psychosocial aspects of the interactions. The paper develops recommendations for selecting games that have relevant features for representing cyber security interactions and outlines directions for future research.

4. Design, Demonstration, and Evaluation of An Information Security Contract and Trading Mechanism to Hedge Information Security Risks

Pankaj Pandey (Gjovik University College, Norway) and Steven De Haes (University of Antwerp, Belgium)

Abstract: Cyber-insurance products are the only financial instrument available as a risk-transfer mechanism in the information security domain. Furthermore, cyber-insurance markets are unable or unwilling to facilitate the transfer of risks, particularly those with a high probability and high intensity of loss. Thus, there is a need for a new mechanism to address the variety of information security risks. This article addresses the shortcomings in the existing information security risk hedging market. The article presents a financial instrument and a corresponding trading mechanism to be used for risk hedging in an information security prediction market. Also, the article uses an imaginary case to demonstrate the application of the contract. Furthermore, an evaluation of the contract and trading mechanism in its usefulness in hedging the underlying risks is presented. In our analysis, we found that information security contracts can be a solution (at least to some extent) to the problems in the existing risk hedging mechanisms in the information security domain.

14.00-15.30 SHCIS III: (Mobile) Malware I

Lecture Hall F

1. Social Network Analysis of Mobile Malware Initiating SMS Messages

Marian Kühnel (RWTH Aachen University, Germany), Joerg Abendroth (Nokia, Germany), and Ulrike Meyer (RWTH Aachen University, Germany),

Abstract: The largest part of mobile malware today spreads via malicious applications. It is common practice that malware is analyzed either statically by reverse-engineering of malicious samples or dynamically by observing the traffic generated by the samples. The static approach is extremely time consuming and the number of apps added to app stores on a daily basis is very high. It is therefore crucial to carefully select the apps to analyze before starting the static inspection. We believe that by visualizing the structure of the mobile malware ecosystem, the manual reverse-engineering process can be better targeted. In this paper, we propose heuristics to determine the similarity and authorship of Android malware initiating short messages by looking at phone numbers and keywords used in short messages. Specifically, we show that social network analysis is a valuable tool to simplify the selection of suspicious samples for the further malware analysis process. We validate our statement on authorship of Android malware. From the resulting social graph we estimate the number of mobile malware authors based on the language character set used in the decompiled source code.

2. Google Verify Apps: The Illusion of Security?

Jennifer Naumann, Mykola Protsenko, and Tilo Müller (Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany)

Abstract: In this paper we analyze Verify Apps, which is the standard anti-virus software for Android offered by Google. Verify Apps should protect the user from malicious apps which are installed from other sources than Google's Play Store. To get more information about the internals of Verify Apps, we tested it with 6103 malware apps, each modified with four different obfuscation techniques. In addition, we examined its functionality in detail by reverse engineering. Verify Apps recognized about 42 percent of the original malware samples, but even such a simple transformation as re-zipping the app, which only affects the hash signatures of a file, resulted in detection rate dropping to less than 3 percent. After the application of static obfuscation techniques, none of the samples could be detected. Moreover, we experienced practical problems with Verify Apps: It stops working after identifying eleven apps as malware, and the verification of already installed apps, which is one of its new features according to Google, could not be observed.

3. Automated Malware Analysis for Android: A Comparative Evaluation

Marcel Busch, Mykola Protsenko, and Tilo Müller (Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany)

Abstract: In this paper, we show to what extent automatically generated reports for Android apps can help analyzing potentially malicious behavior. We generated reports using three well known analysis platforms for eleven malware and six goodware samples. Using the analysis reports generated by Andrubis, Mobile-Sandbox and SandDroid, we firstly evaluate each platform's ability to express information about an app's maliciousness. It turns out that no appropriate classification in goodware and malware can be performed by the assessed frameworks without relying on third party mostly signature based detection engines. Secondly, we discuss the contents presented within the generated malware reports and take them as a basis for comparing the frameworks. This comparison leads to the conclusion that among the assessed frameworks no truly superior solution exists.

14.00-15.20 DPM V: Position and Short Papers

Session Chair: Jordi Herrera Joancomartí (Universitat Autònoma de Barcelona, Spain)

Lecture Hall C

1. Privacy Threats in E-Shopping (Position Paper).

Jesus Diaz (Universidad Autónoma de Madrid, Spain), Seung Geol Choi (United States Naval Academy, USA), David Arroyo (Universidad Autónoma de Madrid, Spain), Angelos Keromytis (Columbia University, USA), Francisco Rodriguez (Universidad Autónoma de Madrid, Spain) and Moti Yung (Columbia University, USA)

Abstract: E-shopping has grown considerably in the last years, providing customers with convenience, merchants with increased sales, and financial entities with an additional source of income. However, it may also be the source of serious threats to privacy. In this paper, we review the e-shopping process, discussing attacks or threats that have been analyzed in the literature for each of its stages. By showing that there exist threats to privacy in each of them, we argue our following position: "It is not enough to protect a single independent stage, as is usually done in privacy respectful proposals in this context. Rather, a complete solution is necessary spanning the overall process, dealing also with the required interconnections between stages." Our overview also reflects the diverse types of information that e-shopping manages, and the benefits (e.g., such as loyalty programs and fraud prevention) that system providers extract from them. This also endorses the need for solutions that, while privacy preserving, do not limit or remove these benefits, if we want prevent all the participating entities from rejecting it.

2. Comparison-based Privacy: Nudging Privacy in Social Media (Position Paper).

Jan Henrik Ziegeldorf, Martin Henze, Rene Hummen and Klaus Wehrle (RWTH Aachen University, Germany)

Abstract: Social media continues to lead imprudent users into oversharing, exposing them to various privacy threats. Recent research thus focusses on nudging the user into the 'right' direction. In this paper, we propose Comparison-based Privacy (CbP), a design paradigm for privacy nudges that overcomes the limitations and challenges of existing approaches. CbP is based on the observation that comparison is a natural human behavior. With CbP, we transfer this observation to Decision-making processes in the digital world by enabling the user to compare herself along privacy-relevant metrics to user-selected comparison groups. In doing so, our approach provides a framework for the integration of existing nudges under a self-adaptive, user-centric norm of privacy. Thus, we expect CbP not only to provide technical improvements, but to also increase user acceptance of privacy nudges. We also show how CbP can be implemented and present preliminary results.

3. You never surf alone. Ubiquitous tracking of users' browsing habits (Short Paper).

Silvia Puglisi, David Rebollo-Monedero and Jordi Forné (Universitat Politècnica de Catalunya (UPC), Spain)

Abstract: In the early age of the internet users enjoyed a large level of anonymity. At the time web pages were just hypertext documents; almost no personalization of the user experience was offered. The Web today has evolved as a world-wide distributed system following specific architectural paradigms. On the web now, an enormous quantity of user generated data is shared and consumed by a network of applications and services, reasoning upon users expressed preferences and their social and physical connections. Advertising networks follow users' browsing habits while they surf the web, continuously collecting their traces and surfing patterns. We analyze how users tracking happens on the web by measuring their online footprint and estimating how quickly advertising networks are able to profile users by their browsing habits.

4. LockPic: Privacy Preserving Photo Sharing in Social Networks (Short Paper).

Carlos Pares-Pulido and Isaac Agudo (University of Malaga, Spain)

Abstract: There are many privacy concerns related to the use of social networks, in particular the posting of pictures and controlling who has access to them. In this paper we introduce a solution for the distribution of personal or sensitive pictures. Our aim is to provide a method for secure and privacy friendly picture sharing through social networks, that allows users to encrypt sensitive regions in pictures (particularly, faces) in a reversible, non-intrusive way, leaving the rest of the picture unaltered. This way, any image can be freely published and distributed on any social network, and viewed by as many users as the platform allows, while the protected parts are only accessible with the corresponding key. Once the key for a particular region has been acquired, the receiver of the picture can decrypt this region without downloading any additional information. The core of our proposal is a C library, which efficiently integrates an encryption/decryption algorithm with the encoding/decoding process. We have also released an Android application, LockPic, and a companion key server that showcase all the functionality mentioned in this work.

14.00-15.30: WOC-CPS

Lecture Hall B

1. LiMon: Lightweight Authentication for Tire Pressure Monitoring Sensors

Bogdan Groza and Cristina Solomon (Politehnica University of Timisoara, Romania)

Abstract: Modern vehicles offer a raw territory for designing security solutions as the over-increasing design complexity demanded massive advances in electronics in the absence of a crisp vision over the adversary model. The vehicle Tire Pressure Monitoring System (TPMS) is a sub-system that recently triggered some attention in the light of several reported attacks. In this work we start from analyzing existing proposals and reckon some shortcomings, e.g., academic proposals are not yet tested on real-world components while a patented security solution from the industry (likely deployed in practice) is completely insecure. Motivated by these, we design a new solution and deploy it on real-world components that are used in the automotive industry. Designing security for this subsystem proves to be especially relevant as the computational resources for TPM systems are somewhat at the minimum to be found in automotive embedded devices. Our solution is deployed on Infineon SP37 sensors and takes advantage of some recently proposed light-weight cryptographic designs, e.g., SPECK and PRESENT.

2. Umbra: Embedded Web Security through Application- Layer Firewalls

Travis Finkenauer and J. Alex Halderman (University of Michigan, USA)

Abstract: Embedded devices with web interfaces are prevalent, but, due to memory and processing constraints, implementations typically make use of Common Gateway Interface (CGI) binaries written in low-level, memory-unsafe languages. This creates the possibility of memory corruption attacks as well as traditional web attacks. We present Umbra, an application-layer firewall specifically designed for protecting web interfaces in embedded devices. By acting as a “friendly man-in-the-middle,” Umbra can protect against attacks such as cross-site request forgery (CSRF), information leaks, and authentication bypass vulnerabilities. We evaluate Umbra’s security by analyzing recent vulnerabilities listed in the CVE database from several embedded vendors and find that it would have prevented half of the vulnerabilities. We also show that Umbra comfortably runs within the constraints of an embedded system while incurring minimal performance overhead.

3. Towards Standardising Firewall Reporting

Dinesha Ranathunga, Matthew Roughan (University of Adelaide, Australia), Phil Kernick (CQR Consulting, Australia) and Nickolas Falkner (University of Adelaide, Australia)

Abstract: Rubin and Greer stated that \The single most important factor of your firewall's security is how you configure it. “However, firewall configuration is known to be difficult to get right. In particular domains, such as SCADA networks, while there are best practice standards that help, an overlooked component is the specification of firewall reporting policies. Our research tackles this question from first principles: we ask what the uses of firewall reports are, and we allow these to guide how reporting should be performed. We approach the problem by formalizing the notion of scope and granularity of a report across several dimensions: time, network elements, policies, etc.

15.30-16.00 Coffee Break

16.00-17.30 SHCIS IV: (Mobile) Malware II

Lecture Hall F

1. Leveraging Deep Learning for Malware Detection and Classification

Bojan Kolosnjaji and Claudia Eckert (Technische Universität München, Germany)

Abstract: As signature-based malware detection systems are unable to cope with the increasing number and variety of malware samples, machine learning has been proposed as a robust alternative. Neural networks have been used in numerous research efforts as a machine learning-based method for the detection and classification of malware, for the purpose of both network-based and host-based intrusion detection. The most used configuration of neural network in these efforts was a perceptron with one hidden layer. However, recent years have brought a significant advancement in neural networks, with new training methods and improved configuration possibilities for neural network units. The advancement is centered around the paradigm of deep learning. This paper contains a description of these new approaches and discusses the possibilities of their application to malware detection and classification problems. A novel malware detection architecture is presented that leverages these advancements for classifying malware based on inputs from static and dynamic analysis results.

2. Approximating Optimal Software Obfuscation for Android Applications

Yan Zhuang and Felix C. Freiling (Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany)

Abstract: In the context of software protection, we study the problem of automatically obfuscating a given program to a given target level of “difficulty”. We measure difficulty by utilizing software complexity metrics. We formalize the search problem and argue that current informed search algorithms cannot be used for our purpose, because the number of evaluated search candidates should be minimal and their actual complexities cannot be predicted with certainty. Within a framework for program obfuscation for Android APKs, we empirically evaluate two different algorithms that search for an obfuscated version satisfying a conjunction of target complexity metrics. We show that a first algorithm whose predictions rely on mean values is outperformed by a second algorithm based on Bayes theorem. Keywords: software complexity metric, obfuscation, software quality, optimized obfuscation, Android applications

16.00-17.45 DPM VI: Biometrics and Privacy Preservation

Session Chair: Joaquin Garcia-Alfaro (TELECOM SudParis, France)

Lecture Hall C

1. Privacy-Preserving Biometric Authentication and Matching via Lattice-Based Encryption.

Constantinos Patsakis (University of Piraeus, Greece), Jeroen van Rest (TNO, The Netherlands), Michal Choras (University of Science and Technology, Poland) and Mélanie Bouroche (Trinity College, Ireland)

Abstract: The continuous dependence on electronic media has radically changed our interactions, many of which are now performed online. In many occasions users need to authenticate to remote machines, but the hostile environment of the Internet may severely expose users and service providers. To counter these shortcomings, strong authentication is pushed forward. As a means to authenticate individuals, biometric authentication is gradually gaining more and more ground. While the use of biometric data enables many useful applications, these data are very sensitive. For this reason, it is essential to handle them with the least user exposure. In this work we propose a very efficient protocol for privacy-preserving biometric authentication using lattice-based encryption. More precisely, we exploit the homomorphic properties of NTRU to provide a robust and secure solution and provide experimental results which illustrate the efficacy of our proposal.

2. Comprehensive and Improved Secure Biometric System using Homomorphic Encryption.

Avradip Mandal, Arnab Roy (Fujitsu Laboratories of America, USA) and Masaya Yasuda (Kyushu University, Japan)

Abstract: With the widespread development of biometric systems, concerns about security and privacy are increasing. An active area of research is template protection technology, which aims to protect registered biometric data. We focus on a homomorphic encryption approach, which enables building a \cryptographically-secure" system. In DPM 2013, Yasuda et al. proposed an efficient template protection system, using the homomorphic encryption scheme proposed by Brakerski and Vaikuntanathan. In this work, we improve and fortify their system to withstand impersonation attacks such as replay and spoofing attacks. We introduce a challenge-response authentication mechanism in their system and design a practical distributed architecture where computation and authentication are segregated. Our comprehensive system would be useful to build a large-scale and secure biometric system such as secure remote authentication over public networks.

3. On the Privacy of Horizontally Partitioned Binary Data-based Privacy-Preserving Collaborative Filtering.

Murat Okkalioglu (Yalova University, Turkey), Mehmet Koc (Seyh Edebali University, Turkey) and Huseyin Polat (Anadolu University, Turkey)

Abstract: Collaborative filtering systems provide recommendations for their users. Privacy is not a primary concern in these systems; however, it is an important element for the true user participation. Privacy-preserving collaborative filtering techniques aim to offer privacy measures without neglecting the recommendation accuracy. In general, these systems rely on the data residing on a central server. Studies show that privacy is not protected as much as believed. On the other hand, many e-companies emerge with the advent of the Internet, and these companies might collaborate to offer better recommendations by sharing their data. Thus, partitioned data-based privacy-persevering collaborative filtering schemes have been proposed. In this study, we explore possible attacks on two-party binary privacy-preserving collaborative filtering schemes and evaluate them with respect to privacy performance.

4. Farewell

16.00-17.30: CyberICS II

Lecture Hall B

1. Security Monitoring for Industrial Control Systems

Alessio Coletta and Alessandro Armando (Fondazione Bruno Kessler, Italy)

Abstract: An Industrial Control System (ICS) is a system of physical entities whose functioning heavily relies on information and communication technology components and infrastructures. ICS are ubiquitous and can be found in a number of safety-critical areas including energy, chemical processes, health-care, aerospace, manufacturing, and transportation. While originally isolated and inherently secure, ICS are recently becoming more and more exposed to cyber-attacks (e.g. Stuxnet). Many existing ICS do not feature cyber security protection, with liability issues and high costs in case of incidents. Since existing ICS are normally based on components and protocols that cannot be modified nor updated, redesign is usually not feasible. In this paper we propose a monitoring framework for the run-time verification of ICS. The framework is based on a formal language that supports the precise specification of high-level safety requirements as well as of the relevant threat model, and on a passive monitoring technique that detects and notifies if the system state is close to a critical state.

2. Wireless HART NetSIM: aWireless HART SCADA-Based Wireless Sensor Networks simulator

Lyes Bayou (Télécom Bretagne-LabSTICC, France), David Espes (University of Western Brittany, France), Nora Cuppens and Frédéric Cuppens (Télécom Bretagne-LabSTICC, France)

Abstract: The security of SCADA systems is a major concern. Indeed, these systems are used to manage important infrastructures. However, conducting security analyzes on these systems is almost impossible. Therefore, using simulators is the best way to do that. In this paper, we describe our simulator for WirelessHART SCADA-based systems. It implements the whole protocol stack and both field devices and the Network Manager including routing and scheduling algorithms. The simulator is specially tailored to assess WirelessHART security mechanisms and to test attacks and countermeasures. It includes scenarios for testing several kinds of attacks such as sybil and denial of service (DoS) attacks. Also, new scenarios can easily be added to test other kinds of attacks.

3. Remote Attestation for Embedded Systems

Markku Kylänpää and Aarne Rantala (VTT Technical Research Centre of Finland, Finland)

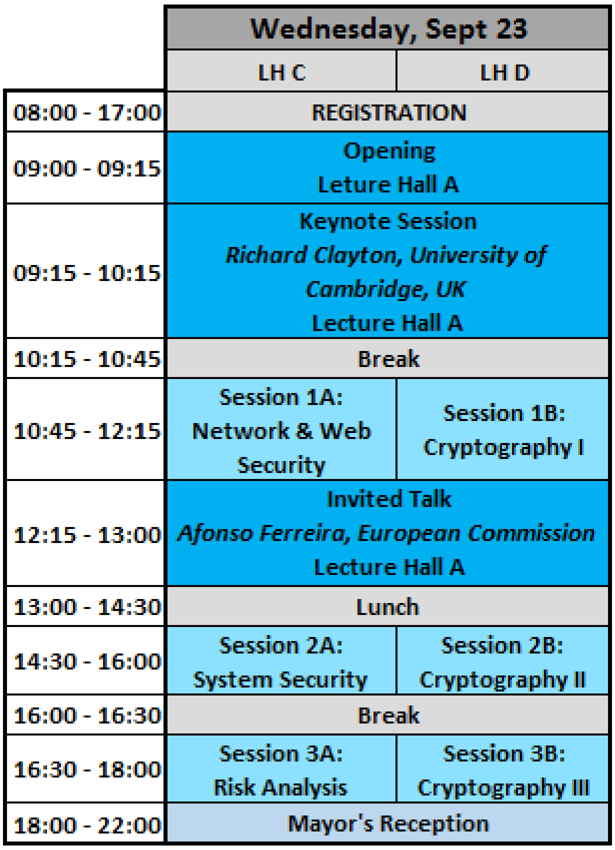
Abstract. Large distributed systems, like Industrial Control Systems, should be able to verify that devices that are connected to trusted entities are real authorized network nodes running unmodified firmware. Remote attestation is a mechanism that can provide limited confidence of device identity and integrity. Remote attestation allows a remote verifier, e.g. a service provider, to verify integrity of the connecting system before providing a service. The current standard practice in remote attestation, defined by the Trusted Computing Group (TCG), is based on integrity measurements whose results are stored into an isolated trusted component called Trusted Platform Module (TPM) inside the system to be attested. The proof-of-concept scenario implementing similar functionality using an ARM processor secure environment is discussed. The implementation is done using ARM processor emulator which includes emulation for ARM TrustZone Trusted Execution Environment (TEE) providing isolated trusted component functionality. Challenges and security issues of the chosen approach are discussed.

4. An Attack Execution Model for Industrial Control Systems Security Assessment (short paper)

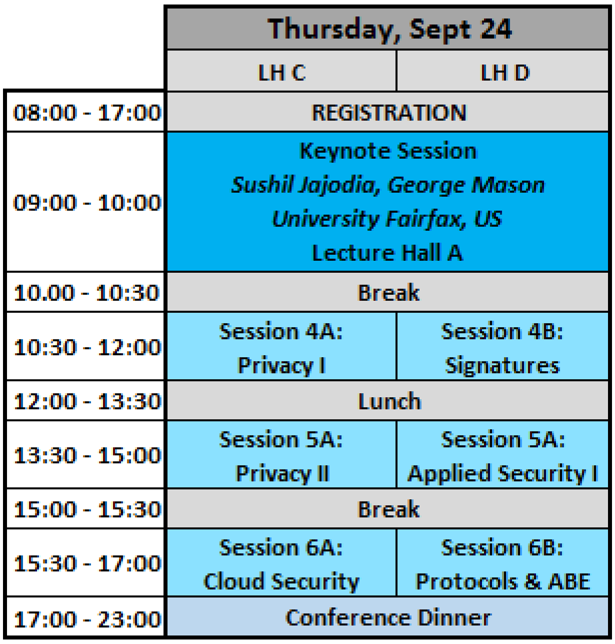
Ziad Ismail (EDF R&D, France), Jean Leneutre (Telecom ParisTech, France) and Alia Fourati (EDF R&D, France)

Abstract: The improved communication and remote control capabilities of industrial control systems equipment have increased their attack surface. As a result, managing the security risk became a challenging task. The consequences of attacks in an industrial control system can go beyond targeted equipment to impact services in the industrial process. In addition, the success likelihood of an attack is highly correlated to the attacker profile and his knowledge of the architecture of the system. In this paper, we present the Attack Execution Model (AEM), which is an attack graph representing the evolution of the adversary's state in the system after each attack step. We are interested in assessing the risk of cyber-attacks on an industrial control system before the next maintenance period. Given a specific attacker profile, we generate all potential attacker actions that could be executed in the system. Our tool outputs the probability and the time needed to compromise a target equipment or services in the system.

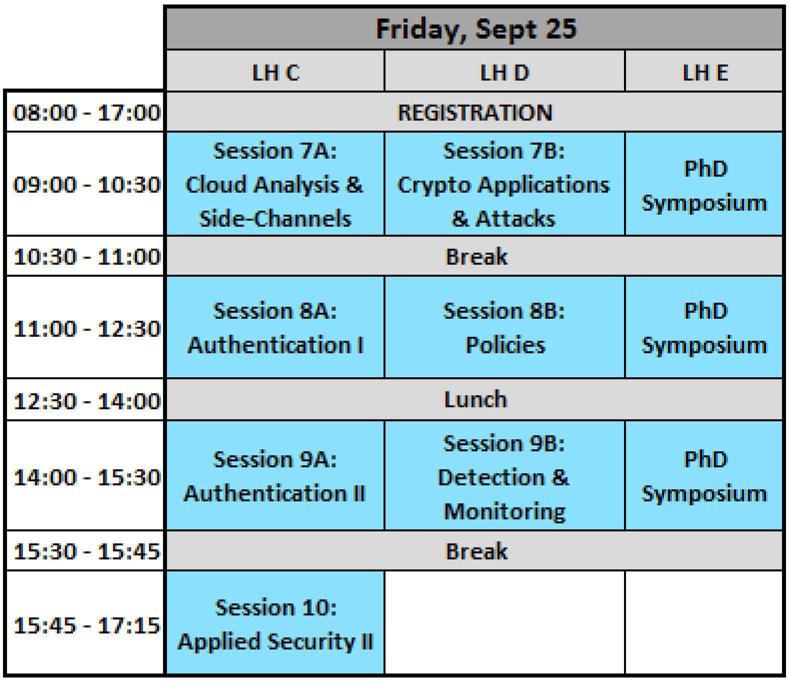
ESORICS 2015 Detailed Program



	Wednesday, Sept 23	
	LH C	LH D
08:00 - 17:00	REGISTRATION	
09:00 - 09:15	Opening Leture Hall A	
09:15 - 10:15	Keynote Session *Richard Clayton, University of Cambridge, UK* Lecture Hall A	
10:15 - 10:45	Break	
10:45 - 12:15	Session 1A: Network & Web Security	Session 1B: Cryptography I
12:15 - 13:00	Invited Talk *Afonso Ferreira, European Commission* Lecture Hall A	
13:00 - 14:30	Lunch	
14:30 - 16:00	Session 2A: System Security	Session 2B: Cryptography II
16:00 - 16:30	Break	
16:30 - 18:00	Session 3A: Risk Analysis	Session 3B: Cryptography III
18:00 - 22:00	Mayor's Reception	



	Thursday, Sept 24	
	LH C	LH D
08:00 - 17:00	REGISTRATION	
09:00 - 10:00	Keynote Session *Sushil Jajodia, George Mason University Fairfax, US* Lecture Hall A	
10.00 - 10:30	Break	
10:30 - 12:00	Session 4A: Privacy I	Session 4B: Signatures
12:00 - 13:30	Lunch	
13:30 - 15:00	Session 5A: Privacy II	Session 5A: Applied Security I
15:00 - 15:30	Break	
15:30 - 17:00	Session 6A: Cloud Security	Session 6B: Protocols & ABE
17:00 - 23:00	Conference Dinner	



	Friday, Sept 25		
	LH C	LH D	LH E
08:00 - 17:00	REGISTRATION		
09:00 - 10:30	Session 7A: Cloud Analysis & Side-Channels	Session 7B: Crypto Applications & Attacks	PhD Symposium
10:30 - 11:00	Break		
11:00 - 12:30	Session 8A: Authentication I	Session 8B: Policies	PhD Symposium
12:30 - 14:00	Lunch		
14:00 - 15:30	Session 9A: Authentication II	Session 9B: Detection & Monitoring	PhD Symposium
15:30 - 15:45	Break		
15:45 - 17:15	Session 10: Applied Security II		

Wednesday, 23rd September 2015

09.00-17.00 Registration

09.00 – 09.15 Opening

Lecture Hall A

09.15-10.15 Keynote Session

Session Chair: Peter Y A Ryan (University of Luxembourg, Luxembourg)

Lecture Hall A

Cybercrime data: Big, Biased and Beyond Review?

Richard Clayton (University of Camebridge, UK)

Abstract: I spend my academic life generating and processing data about cybercrime. These datasets are big and getting bigger. Some people say that's true of cybercrime as well, but I don't entirely agree! My datasets are also significantly biased, but once you accept that the bias is there it can lead one to find some really useful results. But perhaps the greatest problem that we all have with cybercrime data is an inability to reproduce each other's work — an essential technique for detecting inadvertent errors and improving analysis techniques. At Cambridge we have a new approach to cybercrime data sharing; and I'll be explaining how it is possible to get involved.

10.15-10.45 Coffee Break

10.45-12.15 Session 1A: Network & Web Security

Session Chair: Rolf Schillinger (Universität Regensburg, Germany)

Lecture Hall C

1. DNS-Scopy: Towards Security of Internet Naming Infrastructure

Haya Shulman and Michael Waidner (Technische Universität Darmstadt, Germany)

Abstract: We study the operational characteristics of the server-side of the Internet's naming infrastructure. Our findings discover common architectures whereby name servers are 'hidden' behind server-side caching DNS resolvers. We explore the extent and the scope of the name servers that use server-side caching resolvers, and find such configurations in at least 38% of the domains in a forward DNS tree, and higher percent's of the domains in a reverse DNS tree. We characterize the operators of the server-side caching resolvers and provide motivations, explaining their prevalence. Our experimental evaluation indicates that the caching infrastructures are typically run by third parties, and that the services, provided by the third parties, often do not deploy best practices, resulting in misconfigurations, vulnerabilities and degraded performance of the DNS servers in popular domains. 2. Waiting for CSP — Securing Legacy Web Applications with JSAgents.

2. Waiting for CSP - Securing Legacy Web Applications with JSAgents

Joerg Schwenk, Mario Heiderich and Marcus Niemietz (Ruhr-University Bochum, Germany)

Abstract: Markup Injection (MI) attacks, ranging from classical Cross- Site Scripting (XSS) and DOMXSS to Scriptless Attacks, pose a major threat for web applications, browser extensions, and mobile apps. To mitigate MI attacks, we propose JSAgents, a novel and flexible approach to defeat MI attacks using DOM meta-programming. Specifically, we enforce a security policy on the DOM of the browser at a place in the markup processing chain "just before" the rendering of the markup. This approach has many advantages: Obfuscation has already been removed from the markup when it enters the DOM, mXSS attack vectors are visible, and, last but not least, the (client-side) protection can be individually tailored to fit the needs of web applications. JSAgents policies look similar to CSP policies, and indeed large parts of CSP can be implemented with JSAgents. However, there are three main differences: (1) Contrary to CSP, the source code of legacy web applications needs not be modified; instead, the policy is adapted to the application. (2) Whereas CSP can only apply one policy to a complete HTML document, JSAgents is able, through a novel cascading enforcement, to apply different policies to each element in the DOM; this property is essential in dealing with JavaScript event handlers and URIs. (3) JSAgents enables novel features like coarse-grained access control: e.g. we may block read/write access to HTML form elements for all scripts, but human users can still insert data (which may be interesting for password and PIN fields).

3. Analyzing the BrowserID SSO System with Primary Identity Providers Using an Expressive Model of the Web

Daniel Fett, Ralf Kuesters and Guido Schmitz (University of Trier, Germany)

Abstract: BrowserID is a complex, real-world Single Sign-On (SSO) System for web applications recently developed by Mozilla. It employs new HTML5 features (such as web messaging and web storage) and cryptographic assertions to provide decentralized login, with the intent to respect users' privacy. It can operate in a primary and a secondary identity provider mode. While in the primary mode BrowserID runs with arbitrary identity providers, in the secondary mode there is one identity provider only, namely Mozilla's default identity provider. We recently proposed an expressive general model for the web infrastructure and, based on this web model, analyzed the security of the secondary identity provider mode of BrowserID. The analysis revealed several severe vulnerabilities, which have been fixed by Mozilla. In this paper, we complement our prior work by analyzing the even more complex primary identity provider mode of BrowserID. We do not only study authentication properties as before, but also privacy properties. During our analysis we discovered new and practical attacks that do not apply to the secondary mode: an identity injection attack, which violates a central authentication property of SSO systems, and attacks that break the privacy promise of BrowserID and which do not seem to be fixable without a major redesign of the system. Interestingly, some of our attacks on privacy make use of a browser side channel that, to the best of our knowledge, has not gained a lot of attention so far. For the authentication bug, we propose a fix and formally prove in a slight extension of our general web model that the fixed system satisfies all the authentication requirements we consider. This constitutes the most complex formal analysis of a web application based on an expressive model of the web infrastructure so far. As another contribution, we identify and prove important security properties of generic web features in the extended web model to facilitate future analysis efforts of web standards and web applications.

10.45-12.15: Session 1B: Cryptography I

Session Chair: Edgar Weippl (SBA Research, Austria)

Lecture Hall D

1. Computational Soundness for Interactive Primitives

Michael Backes, Esfandiar Mohammadi and Tim Ruffing (Saarland University, Germany)

Abstract: We present a generic computational soundness result for interactive cryptographic primitives. Our abstraction of interactive primitives leverages the Universal Composability (UC) framework, and thereby offers strong composability properties for our computational soundness result: given a computationally sound Dolev-Yao model for non-interactive primitives, and given UC-secure interactive primitives, we obtain computational soundness for the combined model that encompasses both the non-interactive and the interactive primitives. Our generic result is formulated in the CoSP framework for computational soundness proofs and supports any equivalence property expressible in CoSP such as strong secrecy and anonymity. In a case study, we extend an existing computational soundness result by UC-secure blind signatures. We obtain computational soundness for blind signatures in uniform bi-processes in the applied π-calculus. This enables us to verify the untraceability of Chaum's payment protocol in ProVerif in a computationally sound manner.

2. Efficient Zero-Knowledge Proofs for Commitments from Learning With Errors over Rings

Fabrice Benhamouda (ENS, CNRS, INRIA, and PSL, France), Stephan Krenn (AIT Austrian Institute of Technology GmbH, Austria) , Vadim Lyubashevsky (ENS, INRIA, France) and Krzysztof Pietrzak (IST Austria, Austria)

Abstract: We extend a commitment scheme based on the learning with errors over rings (RLWE) problem, and present efficient companion zero knowledge proofs of knowledge. Our scheme maps elements from the ring (or equivalently, n elements from Fq) to a small constant number of ring elements. We then construct Σ-protocols for proving, in a zero-knowledge manner, knowledge of the message contained in a commitment. We are able to further extend our basic protocol to allow us to prove additive and multiplicative relations among committed values. Our protocols have a communication complexity of O(Mnlog q) and achieve a negligible knowledge error in one run. Here M is the constant from a rejection sampling technique that we employ, and can be set close to 1 by adjusting other parameters. Previously known Σ-protocols for LWE-related languages only achieved a noticeable or even constant knowledge error (thus requiring many repetitions of the protocol), or relied on "smudging" out the error (which necessitates working over large fields, resulting in poor efficiency).

3. Interleaving Cryptanalytic Time-memory Trade-offs on Non-Uniform Distributions

Gildas Avoine (Institut Universitaire de France, France), Xavier Carpent (Universit´e Catholique de Louvain, Belgium) and Cédric Lauradoux (INRIA, France)

Abstract: Cryptanalytic time-memory trade-offs (TMTO) are famous tools available in any security expert toolbox. They have been used to break ciphers such as A5/1, but their efficiency to crack passwords made them even more popular in the security community. While symmetric keys are generated randomly according to a uniform distribution, passwords chosen by users are in practice far from being random, as confirmed by recent leakage of databases. Unfortunately, the technique used to build

TMTOs is not appropriate to deal with non-uniform distributions. In this paper, we introduce an efficient construction that consists in partitioning the search set into subsets of close densities, and a strategy to explore the TMTOs associated to the subsets based on an interleaved traversal. This approach results in a significant improvement compared to currently used TMTOs. We experimented our approach on a classical problem, namely cracking 7-character NTLM Hash passwords using an alphabet with 34 special characters. This resulted in speedups ranging from 16 to 76 (depending on the input distribution) over rainbow tables, which are considered as the most efficient variant of time-memory trade-offs.

12.15 – 13.00 Invited Talk

Lecture Hall A

The European Strategic Agenda for Research and Innovation in Cybersecurity

Afonso Ferreira (Trust & Security Unit, European Commission, Belgium)

Abstract: This talk will present the European Strategic Research and Innovation Agenda (SRA) for cybersecurity as it is being released by the Working Group on Secure ICT Research and Innovation (aka WG3) of the Network and Information Security Platform, which is a public-private partnership put in place by the European Commission in 2013. Members of WG3 are close to two hundred. They address issues related to cybersecurity research and innovation in the context of the EU Strategy for Cyber Security and of the Network and Information Security Platform. WG3 identified the key challenges and corresponding desired outcomes in terms of innovation-focused, applied but also basic research in cybersecurity, privacy, and trust. The European SRA for cybersecurity designed by WG3 serves as main input for the drafting of Horizon 2020 Work Programmes by the European Commission and is source of inspiration for the coordination of, and collaboration between, research agendas across Europe, including industry research roadmaps and national research and innovation programmes of the Member States.

13.00-14.30 Lunch Break

14.30-16.00 Session 2A: System Security

Session Chair: Rolf Schillinger (Universität Regensburg, Germany)

Lecture Hall C

1. A Practical Approach for Adaptive Data Structure Layout Randomization

Ping Chen, Jun Xu, (The Pennsylvania State University, USA) Zhiqiang Lin (University of Texas at Dallas, USA), Dongyan Xu (Purdue University, USA), Bing Mao (Nanjing University, China) and Peng Liu (The Pennsylvania State University, USA)

Abstract: Attackers often corrupt data structures to compromise software systems. As a countermeasure, data structure layout randomization has been proposed. Unfortunately, existing techniques require manual designation of randomize-able data structures without guaranteeing the correctness and keep the layout unchanged at runtime. We present a system, called SALADS, that automatically translates a program to a DSSR (Data Structure Self-Randomizing) program. At runtime, a DSSR program dynamically randomizes the layout of each security-sensitive data structure by itself autonomously. DSSR programs regularly re-randomize a data structure when it has been accessed several times after last randomization. More importantly, DSSR programs automatically determine the randomizability of instances and randomize each instance independently. We have implemented SALADS based on gcc-4.5.0 and generated DSSR user-level applications, OS kernels, and hypervisors. Our experiments show that the DSSR programs can defeat a wide range of attacks with reasonable performance overhead.

2. Trustworthy prevention of code injection in Linux on embedded devices

Hind Chfouka (University of Pisa, Italy), Hamed Nemati, Roberto Guanciale, Mads Dam (KTH Royal Institute of Technology, Sweden) and Patrik Ekdahl (Ericsson AB, Sweden)

Abstract: We present MProsper, a trustworthy system to prevent code injection in Linux on embedded devices. MProsper is a formally verified run-time monitor, which forces an untrusted Linux to obey the executable space protection policy; a memory area can be either executable or writable, but cannot be both. The executable space protection allows the MProsper's monitor to intercept every change to the executable code performed by a user application or by the Linux kernel. On top of this infrastructure, we use standard code signing to prevent code injection. MProsper is deployed on top of the Prosper hypervisor and is implemented as an isolated guest. Thus MProsper inherits the security property verified for the hypervisor: (i) Its code and data cannot be tampered by the untrusted Linux guest and (ii) all changes to the memory layout is intercepted, thus enabling MProsper to completely mediate every operation that can violate the desired security property. The verification of the monitor has been performed using the HOL4 theorem prover and by extending the existing formal model of the hypervisor with the formal specification of the high level model of the monitor.

3. Practical Memory Deduplication Attacks in Sandboxed Javascript

Daniel Gruss, David Bidner and Stefan Mangard (Graz University of Technology, Austria)

Abstract: Page deduplication is a mechanism to reduce the memory footprint of a system. Identical physical pages are identified across borders of virtual machines and programs and merged by the operating system or the hypervisor. However, this enables side-channel information leakage through cache or memory access time. Therefore, it is considered harmful in public clouds today, but it is still considered safe to use in a private environment, i.e., private clouds, personal computers, and smartphones. We present the first memory-disclosure attack in sandboxed Javascript which exploits page deduplication. Unlike previous attacks, our attack does not require the victim to execute an adversary's program, but simply to open a website which contains the adversary's Javascript code. We are not only able to determine which applications are running, but also specific user activities, for instance, whether the user has specific websites currently opened. The attack works on servers, personal computers and smartphones, and across the borders of virtual machines.

14.30-16.00 Session 2B: Cryptography II

Session Chair: Stefan Katzenbeisser (TU Darmstadt, Germany)

Lecture Hall D

1. Efficient Message Authentication Codes with Combinatorial Group Testing

Kazuhiko Minematsu (NEC Corporation, Japan)

Abstract: Message authentication code, MAC for short, is a symmetrickey cryptographic function for authenticity. A standard MAC verification only tells whether the message is valid or invalid, and thus we cannot identify which part is corrupted in case of invalid message. In this paper we study a class of MAC functions that enables to identify the part of corruption, which we call group testing MAC (GTM). This can be seen as an application of a classical (non-adaptive) combinatorial group testing to MAC. Although the basic concept of GTM (or its keyless variant) has been proposed in various application areas, such as data forensics and computer virus testing, they rather treat the underlying MAC function as a black box, and exact computation cost for GTM seems to be overlooked. In this paper, we study the computational aspect of GTM, and show that a simple yet non-trivial extension of parallelizable MAC (PMAC) enables O (m + t) computation for my data items and t tests, irrespective of the underlying test matrix we use, under a natural security model. This greatly improves efficiency from naively applying a black-box MAC for each test, which requires O (mt) time. Based on existing group testing methods, we also present experimental results of our proposal and observe that ours runs as fast as taking single MAC tag, with speed-up from the conventional method by factor around 8 to 15 for m = 104 to 105 items.

2. A Symmetric-Key Based Proofs of Retrievability Supporting Public Verification

Chaowen Guan, Kui Ren, Fangguo Zhang (University at Buffalo, USA), Florian Kerschbaum (SAP, Germany) and Jia Yu (University at Buffalo, USA)

Abstract: Proofs-of-Retrievability enables a client to store his data on a cloud server so that he executes an efficient auditing protocol to check that the server possesses all of his data in the future. During an audit, the server must maintain full knowledge of the client's data to pass, even though only a few blocks of the data need to be accessed. Since the first work by Juels and Kaliski, many PoR schemes have been proposed and some of them can support dynamic updates. However, all the existing works that achieve public verifiability are built upon traditional publickey cryptosystems which imposes a relatively high computational burden on low-power clients (e.g., mobile devices). In this work we explore indistinguishability obfuscation for building a roof-of-Retrievability scheme that provides public verification while the encryption is based on symmetric key primitives. The resulting scheme offers light-weight storing and proving at the expense of longer verification. This could be useful in apations where outsourcing files is usually done by low-power client and verifications can be done by well equipped machines (e.g., a third party server). We also show that the proposed scheme can support dynamic updates. At last, for better assessing our proposed scheme, we give a performance analysis of our scheme and a comparison with several other existing schemes which demonstrates that our scheme achieves better performance on the data owner side and the server side

3. DTLS-HIMMO: Achieving DTLS certificate security with symmetric key overhead

Oscar Garcia-Morchon, Ronald Rietman, Sahil Sharma, Ludo Tolhuizen and Jose-Luis Torre-Arce (Philips Group Innovation, Netherlands)

Abstract: Billions of devices are being connected to the Internet creating the Internet of Things (IoT). The IoT not only requires strong security, like current Internet applications, but also efficient operation. The recently introduced HIMMO scheme enables lightweight and collusion resistant identity-based key sharing in a non-interactive way, so that any pair of Internet-connected devices can securely communicate. This paper firstly reviews the HIMMO scheme and introduces two extensions that e.g. enable implicit credential verification without the need of traditional digital certificates. Then, we show how HIMMO can be efficiently implemented even in resource-constrained devices, enabling combined key agreement and credential verification more efficiently than using ECDH-ECDSA. We further explain how HIMMO helps to secure the Internet and IoT by introducing

the DTLS-HIMMO operation mode. DTLS, the datagram version of TLS, is becoming the standard security protocol in the IoT, although it is very frequently discussed that it does not offer the right performance for IoT scenarios. Our design, implementation, and evaluation show that DTLS-HIMMO operation mode achieves the security properties of the DTLS-Certificate security suite while exhibiting the overhead of symmetric-key primitives without requiring changes in the DTLS standard.

16.00-16.30 Coffee Break
16.30-18.00 Session 3A: Risk Analysis

Session Chair: Nora Cuppens (Telecom Bretagne, France)

Lecture Hall C

1. Should Cyber-Insurance Providers Invest in Software Security?

Aron Laszka (Vanderbilt University, USA) and Jens Grossklags (Pennsylvania State University, USA)

Abstract: Insurance is based on the diversifiability of individual risks: if an insurance provider maintains a large portfolio of customers, the probability of an event involving a large portion of the customers is negligible. However, in the case of cyber-insurance, not all risks are diversifiable due to software monocultures. If a vulnerability is discovered in a widely used software product, it can be used to compromise a multitude of targets until it is eventually patched, leading to a catastrophic event for the insurance provider. To lower their exposure to non-diversifiable risks, insurance providers may try to influence the security of widely used software products in their customer population, for example, through vulnerability reward programs. We explore the proposal that insurance providers should take a proactive role in improving software security, and provide evidence that this approach is viable for a monopolistic provider. We develop a model which captures the supply and demand sides of insurance, provide computational complexity results on the provider's investment decisions, and propose different heuristic investment strategies. We demonstrate that investments can reduce non-diversifiable risks and can lead to a more profitable cyber-insurance market. Finally, we detail the relative merits of the different heuristic strategies with numerical results.

2. Lightweight and Flexible Trust Assessment Modules for the Internet of Things

Jan Tobias Muehlberg, Job Noorman and Frank Piessens (KU Leuven, Belgium)

Abstract: In this paper we describe a novel approach to securely obtain measurements with respect to the integrity of software running on a lowcost and low-power computing node autonomously or on request. We propose to use these measurements as an indication of the trustworthiness of that node. Our approach is based on recent developments in Program Counter Based Access Control. Specifically, we employ Sancus, a light-weight hardware-only Trusted Computing Base and Protected Module Architecture, to integrate trust assessment modules into an untrusted embedded OS without using a hypervisor. Sancus ensures by means of hardware extensions that code and data of a protected module cannot be tampered with, and that the module's data remains confidential. Sancus further provides cryptographic primitives that are employed by our approach to enable the trust management system to verify that the obtained trust metrics are authentic and fresh. Thereby, our trust assessment modules can inspect the OS or application code and securely report reliable trust metrics to an external trust management system. We evaluate a prototypic implementation of our approach that integrates Sancus-protected trust assessment modules with the Contiki OS running on a Sancus-enabled TI MSP430 microcontroller.

3. Confidence analysis for nuclear arms control: SMT abstractions of Bayesian Belief Networks

Paul Beaumont (Imperial College London, UK), Neil Evans (AWE Aldermaston, UK), Michael Huth (Imperial College London, UK) and Tom Plant (AWE Aldermaston, UK)

Abstract: How to reduce, in principle, arms in a verifiable manner that is trusted by two or more parties is a hard but important problem. Nations and organizations that wish to engage in such arms control verification activities need to be able to design procedures and control mechanisms that capture their trust assumptions and let them compute pertinent degrees of belief. Crucially, they also will need methods for reliably assessing their confidence in such computed degrees of belief in situations with little or no contextual data. We model an arms control verification scenario with what we call constrained Bayesian Belief Networks (cBBN). A cBBN represents a set of Bayesian Belief Networks by symbolically expressing uncertainty about probabilities and scenario specific constraints that are not represented by a BBN. We show that this abstraction of BBNs can mitigate well against the lack of prior data. Specifically, we describe how cBBNs have faithful representations within a Satisfiability Modulo Theory (SMT) solver, and that these representations open up new ways of automatically assessing the confidence that we may have in the degrees of belief represented by cBBNs. Furthermore, we show how to perform symbolic sensitivity analyses of cBBNs, and how to compute global optima of under-specified probabilities of particular interest to decision making. SMT solving also enables us to assess the relative confidence we have in two cBBNs of the same scenario, where these models may share some information but express some aspects of the scenario at different levels of abstraction.

16.30-18.00 Session 3B: Cryptography III

Session Chair: Peter Y A Ryan (University of Luxembourg, Luxembourg)

Lecture Hall D

1. Practical Invalid Curve Attacks on TLS-ECDH

Tibor Jager, Jörg Schwenk and Juraj Somorovsky (Ruhr University Bochum, Germany)

Abstract: Elliptic Curve Cryptography (ECC) is based on cyclic groups, where group elements are represented as points in a finite plane. All ECC cryptosystems implicitly assume that only valid group elements will be processed by the different cryptographic algorithms. It is well-known that a check for group membership of given points in the plane should be performed before processing. However, in several widely used cryptographic libraries we analyzed, this check was missing, in particular in the popular ECC implementations of Oracle and Bouncy Castle. We analyze the effect of this missing check on Oracle's default Java TLS implementation (JSSE with a SunEC provider) and TLS servers using the Bouncy Castle library. It turns out that the effect on the security of TLS-ECDH is devastating. We describe an attack that allows to extract the long-term private key from a TLS server that uses such a vulnerable library. This allows an attacker to impersonate the legitimate server to any communication partner, after performing the attack only once.

2. Making any Identity Based Encryption Accountable, Efficiently

Aggelos Kiayias (National and Kapodistrian University of Athens, Greece) and Qiang Tang (University of Connecticut, USA)

Abstract: Identity-Based Encryption (IBE) provides a compelling solution to the PKI management problem, however it comes with the serious privacy consideration that a trusted party (called the PKG) is required to generate (and hence also know) the secret keys of all users. This inherent key escrow problem is considered to be one of the major reasons hindering the wider utilization of IBE systems. In order to address this problem, Goyal [20] introduced the notion of accountable authority IBE (A-IBE), in which a judge can differentiate the PKG from the user as the source of a decryption software. Via this "tracing" mechanism, A-IBE deters the PKG from leaking the user's secret key and hence offers a defense mechanism for IBE users against a malicious PKG. All previous works on A-IBE focused on specialized constructions trying to achieve different properties and efficiency enhancements. In this paper for the first time we show how to add accountability to any IBE scheme using oblivious transfer (OT), with almost the same cipher text efficiency as the underlying IBE. Furthermore, we extend our generic construction to support identity reuse without losing efficiency. This property is desirable in practice as users may accidentally lose their secret keys and they -naturally- prefer not to abandon their identities. How to achieve this property was open until our work. Along the way, we first modify the generic construction and develop a new technique to provide public traceability generically.

3. Short Accountable Ring Signatures Based on DDH

Jonathan Bootle, Andrea Cerulli, Pyrros Chaidos, Essam Ghadafi, Jens Groth and Christophe Petit (University College London, UK)

Abstract: Ring signatures and group signatures are prominent cryptographic primitives offering a combination of privacy and authentication. They enable individual users to anonymously sign messages on behalf of a group of users. In ring signatures, the group, i.e. the ring, is chosen in an ad hoc manner by the signer. In group signatures, group membership is controlled by a group manager. Group signatures additionally enforce accountability by providing the group manager with a secret tracing key that can be used to identify the otherwise anonymous signer when needed. Accountable ring signatures, introduced by Xu and Yung (CARDIS 2004), bridge the gap between the two notions. They provide maximal flexibility in choosing the ring, and at the same time maintain accountability by supporting a designated opener that can identify signers when needed. We revisit accountable ring signatures and offer a formal security model for the primitive. Our model offers strong security definitions incorporating protection against maliciously chosen keys and at the same time flexibility both in the choice of the ring and the opener. We give a generic construction using standard tools. We give a highly efficient instantiation of our generic construction in the random oracle model by meticulously combining Camenisch's group signature scheme (CRYPTO 1997) with a generalization of the one-out-of-many proofs of knowledge by Groth and Kohlweiss (EUROCRYPT 2015). Our instantiation yields signatures of logarithmic size (in the size of the ring) while relying solely on the well-studied decisional Diffie-Hellman assumption. In the process, we offer a number of optimizations for the recent Groth and Kohlweiss one-out-of-many proofs, which may be useful for other applications. Accountable ring signatures imply traditional ring and group signatures. We therefore also obtain highly efficient instantiations of those primitives with signatures shorter than all existing ring signatures as well as existing group signatures relying on standard assumptions.

18.00-22.00 Mayor´s Reception

Meeting point: 18:00 in front of the Conference Venue (after the last session)

A vintage tram will take us to the Mayor’s Reception, which will take place at the Heurigenrestaurant „10er Marie“. The „10er-Marie“is the oldest wine tavern of Vienna (1740).

10er Marie
Ottakringer Straße 222-224
1160 Vienna
(Metro stop U3 „Ottakring“– directions will be provided, no organized transport for returning)

Thursday, 24th September 2015

09.00-10.00 Keynote Session

Session Chair: Günther Pernul (Universität Regensburg, Germany)

Lecture Hall A

Adversarial and Uncertain Reasoning for Adaptive Cyber Defense: Building the Scientific Foundation

Sushil Jajodia (George Mason University Fairfax, USA)

Abstract: Today's cyber defenses are largely static. They are governed by slow deliberative processes involving testing, security patch deployment, and human-in-the-loop monitoring. As a result, adversaries can systematically probe target networks, pre-plan their attacks, and ultimately persist for long times inside compromised networks and hosts. A new class of technologies, called Adaptive Cyber Defense (ACD), is being developed that presents adversaries with optimally changing attack surfaces and system configurations, forcing adversaries to continually re-assess and re-plan their cyber operations. Although these approaches (e.g., moving target defense, dynamic diversity, and bio-inspired defense) are promising, they assume stationary and stochastic, but non-adversarial, environments. To realize the full potential, we need to build the scientific foundations so that system resiliency and robustness in adversarial settings can be rigorously defined, quantified, measured, and extrapolated in a rigorous and reliable manner.

10.00-10.30 Coffee Break

10.30-12.00 Session 4A: Privacy I

Session Chair: Florian Kerschbaum (SAP SE, Germany)

Lecture Hall C

1. FP-Block: usable web privacy by controlling browser fingerprinting

Christof Torres (University of Luxembourg, Luxembourg), Hugo Jonker (Open University of the Netherlands, Netherlands) and Sjouke Mauw (University of Luxembourg, Luxembourg)

Abstract: Online tracking of users is used for benign goals, such as detecting fraudulent logins, but also to invade user privacy. We posit that for non-oppressed users, tracking within one website does not have a substantial negative impact on privacy, while it enables legitimate benefits. In contrast, cross-domain tracking negatively impacts user privacy, while being of little benefit to the user. Existing methods to counter fingerprint-based tracking treat cross domain tracking and regular tracking the same. This often results in hampering or disabling desired functionality, such as embedded videos. By distinguishing between regular and cross-domain tracking, more desired functionality can be preserved. We have developed a prototype tool, FPBlock, that counters cross-domain fingerprint-based tracking while still allowing regular tracking. FP-Block ensures that any embedded party will see a different, unrelatable fingerprint for each site on which it is embedded. Thus, the user's fingerprint can no longer be tracked across the web, while desired functionality is better preserved compared to existing methods.

2. Mind-Reading: Privacy Attacks Exploiting Cross-App KeyEvent Injections

Wenrui Diao, Xiangyu Liu, Zhe Zhou, Kehuan Zhang (The Chinese University of Hong Kong, China) and Zhou Li (IEEE Member, USA)

Abstract: Input Method Editor (IME) has been widely installed on mobile devices to help user type non-Latin characters and reduce the number of key presses. To improve the user experience, popular IMEs integrate personalized features like reordering suggestion list of words based on user's input history, which inevitably turn them into the vaults of user's secret. In this paper, we make the first attempt to evaluate the security implications of IME personalization and the back-end infrastructure on Android devices. In the end, we identify a critical vulnerability lying under the Android KeyEvent processing framework, which can be exploited to launch cross-app KeyEvent injection (CAKI) attack and bypass the app-isolation mechanism. By abusing such design flaw, an adversary is able to harvest entries from the personalized user dictionary of IME through an ostensibly innocuous app only asking for common permissions. Our evaluation over a broad spectrum of Android OSes, devices, and IMEs suggests such issue should be fixed immediately. All Android versions and most IME apps are vulnerable and private information, like contact names, location, etc., can be easily exfiltrated. Up to hundreds of millions of mobile users are under this threat. To mitigate this security issue, we propose a practical defense mechanism which augments the existing KeyEvent processing framework without forcing any change to IME apps.

3. Enabling Privacy-assured Similarity Retrieval over Millions of Encrypted Records

Xingliang Yuan, Helei Cui, Xinyu Wang and Cong Wang (City University of Hong Kong, China)

Abstract: Searchable symmetric encryption (SSE) has been studied extensively for its full potential in enabling exact-match queries on encrypted records. Yet, situations for similarity queries remain to be fully explored. In this paper, we design privacy-assured similarity search schemes over millions of encrypted high-dimensional records. Our design employs locality-sensitive hashing (LSH) and SSE, where the LSH hash values of records are treated as keywords fed into the framework of SSE. As direct combination of the two does not facilitate a scalable solution for large datasets, we then leverage a set of advanced hash-based algorithms including multiple-choice hashing, open addressing, and cuckoo hashing, and craft a high performance encrypted index from the ground up. It is not only space efficient, but supports secure and sufficiently accurate similarity search with constant time. Our designs are proved to be secure against adaptive adversaries. The experiment on 10 million encrypted records demonstrates that our designs function in a practical manner.

10:30-12:00 Session 4B: Signatures

Session Chair: Kostas Markantonakis (Royal Holloway University, UK)

Lecture Hall D

1. Verifiably Encrypted Signatures: Security Revisited and a New Construction

Christian Hanser (Graz University of Technology, Austria), Max Rabkin and Dominique Schröder (Saarland University, Germany)

Abstract: In structure-preserving signatures on equivalence classes (SPS-EQ-R), introduced at Asiacrypt 2014, each message M in (G ∗)l is associated to its projective equivalence class, and a signature commits to the equivalence class: anybody can transfer the signature to a new, scaled, representative. In this work, we give the first black-box construction of a public-key encryption scheme from any SPS-EQ-R satisfying a simple new property which we call perfect composition. The construction does not involve any non-black-box technique and the implication is that such SPS-EQ-R cannot be constructed from one-way functions in a black-box way. The main idea of our scheme is to build a verifiable encrypted signature (VES) first and then apply the general transformation suggested by Calderon et al. (CT-RSA 2014). The original definition of VES requires that the underlying signature scheme be correct and secure in addition to other security properties. The latter have been extended in subsequent literature, but the former requirements have sometimes been neglected, leaving a hole in the security notion. We show that Calderon et al.'s notion of resolution independence fills this gap.

2. Updatable Hash Proof System and Its Applications

Rupeng Yang, Qiuliang Xu (Shandong University, China), Yongbin Zhou, Rui Zhang (Chinese Academy of Sciences (CAS), China), Chengyu Hu and Zuoxia Yu(Shandong University, China)

Abstract: To tackle with physical attacks to real world cryptosystems, leakage resilient cryptography was developed. In this setting, the adversary is allowed to have access to the internal state of a cryptographic system, thus violates the black-box reduction used in cryptography. Especially when considering continual memory leakage (CML), i.e., there is no predetermined bound on the leakage of the internal information, the task is extremely tough. In this paper, we solve this problem by introducing a new primitive called updatable hash proof system (UHPS). A UHPS can be viewed as a special Hash proof system (HPS), which served as a fundamental tool in constructing public key encryption (PKE) schemes in both leakage-free and leaky settings. A remarkable property of UHPS is that by simply substituting the HPS component with a UHPS component in a PKE scheme, one obtains a new PKE scheme secure in the CML setting. Moreover, the resulting PKE scheme enjoys the same advantage of the original HPS-based PKE, for instance, still "compatible" with known transforms [8,20,24,32]. We then give instantiations of UHPS from widely-accepted assumptions, including the symmetric external Diffie-Hellman assumption and the d-linear assumption. Interestingly, we notice that when instantiated with concrete assumptions, the resulting chosen-cipher text secure PKE scheme is by far the most efficient.

3. Server-Aided Revocable Identity-Based Encryption

Baodong Qin, Robert Deng, Yingjiu Li (Singapore Management University, Singapore) and Shengli Liu (Shanghai Jiao Tong University, China)

Abstract: Efficient user revocation in Identity-Based Encryption (IBE) has been a challenging problem and has been the subject of several research efforts in the literature. Among them, the tree-based revocation approach, due to Boldyreva, Goyal and Kumar, is probably the most efficient one. In this approach, a trusted Key Generation Center (KGC) periodically broadcasts a set of key updates to all (non-revoked) users through public channels, where the size of key updates is only O(r log N r), with N being the number of users and r the number of revoked users, respectively; however, every user needs to keep at least O(logN) longterm secret keys and all non-revoked users are required to communicate with the KGC regularly. These two drawbacks pose challenges to users who have limited resources to store their secret keys or cannot receive key updates in real-time. To alleviate the above problems, we propose a novel system model called server-aided revocable IBE. In our model, almost all of the workloads on users are delegated to an untrusted server which manages users' public keys and key updates sent by a KGC periodically. The server is untrusted in the sense that it does not possess any secret information. Our system model requires each user to keep just one short secret key and does not require users to communicate with either the KGC or the server during key updating. In addition, the system supports delegation of users' decryption keys, namely it is secure against decryption key exposure attacks. We present a concrete construction of the system that is provably secure against adaptive-ID chosen plaintext attacks under the DBDH assumption in the standard model. One application of our server-aided revocable IBE is encrypted email supporting lightweight devices (e.g., mobile phones) in which an email server plays the role of the untrusted server so that only non-revoked users can read their email messages.

12.00-13.30 Lunch Break

13.30-15.00 Session 5A: Privacy II

Session Chair: Cong Wang (City University of Hong Kong, China)
Lecture Hall C

1. Privacy-Preserving Link Prediction in Decentralized Online Social Networks

Yao Zheng, Bing Wang, Wenjing Lou and Y. Thomas Hou (Virginia Polytechnic Institute and State University, USA)

Abstract: We consider the privacy-preserving link prediction problem in decentralized online social network (OSNs).We formulate the problem as a sparse logistic regression problem and solve it with a novel decentralized two-tier method using alternating direction method of multipliers (ADMM). This method enables end users to collaborate with their online service providers without jeopardizing their data privacy. The method also grants end users fine-grained privacy control to their personal data by supporting arbitrary public/private data split. Using real-world data, we show that our method enjoys various advantages including high prediction accuracy, balanced workload, and limited communication overhead. Additionally, we demonstrate that our method copes well with link reconstruction attack.

2. Privacy-Preserving Observation in Public Spaces

Florian Kerschbaum (SAP, Germany) and Hoon Wei Lim (Singtel R&D Laboratory, Singapore)

Abstract: One method of privacy-preserving accounting or billing in cyber-physical systems, such as electronic toll collection or public transportation ticketing, is to have the user present an encrypted record of transactions and perform the accounting or billing computation securely on them. Honesty of the user is ensured by spot checking the record for some selected surveyed transactions. But how much privacy does that give the user, i.e. how many transactions need to be surveyed? It turns out that due to collusion in mass surveillance all transactions need to be observed, i.e. this method of spot checking provides no privacy at all. In this paper we present a cryptographic solution to the spot checking problem in cyber-physical systems. Users carry an authentication device that authenticates only based on fair random coins. The probability can be set high enough to allow for spot checking, but in all other cases privacy is perfectly preserved. We analyze our protocol for computational efficiency and show that it can be efficiently implemented even on platforms with limited computing resources, such as smart cards and smart phones.

3. Privacy-preserving Context-aware Recommender Systems: Analysis and New Solutions

Qiang Tang and Jun Wang (University of Luxembourg, Luxembourg)

Abstract: Nowadays, recommender systems have become an indispensable part of our daily life and provide personalized services for almost everything. However, nothing is for free – such systems have also upset the society with severe privacy concerns because they accumulate a lot of personal information in order to provide recommendations. In this work, we construct privacy-preserving recommendation protocols by incorporating cryptographic techniques and the inherent data characteristics in recommender systems. We first revisit the protocols by Jeckmans et al. and show a number of security issues. Then, we propose two privacy preserving protocols, which compute predicted ratings for a user based on inputs from both the user's friends and a set of randomly chosen strangers. A user has the flexibility to retrieve either a predicted rating for an unrated item or the Top-N unrated items. The proposed protocols prevent information leakage from both protocol executions and the protocol outputs. Finally, we use the well-known MovieLens 100k dataset to evaluate the performances for different parameter sizes.

13.30-15.00 Session 5B: Applied Security I

Session Chair: Feng Hao (Newcastle University, UK)
Lecture Hall D

1. Web-to-Application Injection Attacks on Android: Characterization and Detection

Behnaz Hassanshahi, Yaoqi Jia, Roland Yap, Prateek Saxena and Zhenkai Liang (National University of Singapore, Singapore)

Abstract: Vulnerable Android applications (or apps) are traditionally exploited via malicious apps. In this paper, we study an underexplored class of Android attacks which do not require the user to install malicious apps, but merely to visit a malicious website in an Android browser. We call them web-to-app injection (or W2AI) attacks, and distinguish between different categories of W2AI side-effects. To estimate their prevalence, we present an automated W2AIScanner to find and confirm W2AI vulnerabilities. We analyze real apps from the official Google Play store and found 286 confirmed vulnerabilities in 134 distinct applications. This findings suggest that these attacks are pervasive and developers do not adequately protect apps against them. Our tool employs a novel combination of static analysis, symbolic execution and dynamic testing. We show experimentally that this design significantly enhances the detection accuracy compared with an existing state-of-the-art analysis.

2. Enhancing Java Runtime Environment for Smart Cards Against Runtime Attacks

Raja Naeem Akram, Konstantinos Markantonakis and Keith Mayes (Royal Holloway, University of London, UK)

Abstract: Smart cards are mostly deployed in security-critical environments in order to provide a secure and trusted access to the provisioned services. These services are delivered to a cardholder using the Service Provider's (SPs) applications on his or her smart card(s). These applications are at their most vulnerable state when they are executing. There exist a variety of runtime attacks that can circumvent the security checks implemented either by the respective application or the runtime environment to protect the smart card platform, user and/or application. In this paper, we discuss the Java Runtime Environment and a potential threat model based on runtime attacks. Subsequently, we discussed the counter-measures that can be deployed to provide a secure and reliable execution platform, along with an evaluation of their effectiveness, incurred performance-penalty and latency.

3. Making Bitcoin Exchanges Transparent

Christian Decker, James Guthrie, Jochen Seidel and Roger Wattenhofer (ETH Zurich, Switzerland)

Abstract: Bitcoin exchanges are a vital component of the Bitcoin ecosystem. They are a gateway from the classical economy to the cryptocurrency economy, facilitating the exchange between fiat currency and bitcoins. However, exchanges are also single points of failure, operating outside the Bitcoin block chain, requiring users to entrust them with their funds in order to operate. In this work we present a solution, and a proof-of-concept implementation, that allows exchanges to prove their solvency, without publishing any information of strategic importance.

15.00-15.30 Coffee Break

15.30-17.00 Session 6A: Cloud Security

Session Chair: Cong Wang (City University of Hong Kong, China)
Lecture Hall C

1. Rich Queries on Encrypted Data: Beyond Exact Matches

Sky Faber, Stanislaw Jarecki, Hugo Krawczyk, Quan Nguyen, Marcel C. Rosu and Michael Steiner (Yorktown, USA)

Abstract: We extend the searchable symmetric encryption (SSE) protocol of [Cash et al., Crypto'13] adding support for range, substring, wildcard, and phrase queries, in addition to the Boolean queries supported in the original protocol. Our techniques apply to the basic single client scenario underlying the common SSE setting as well as to the more complex Multi-Client and Outsourced Symmetric PIR extensions of [Jarecki et al., CCS'13]. We provide performance information based on our prototype implementation, showing the practicality and scalability of our techniques to very large databases, thus extending the performance results of [Cash et al., NDSS'14] to these rich and comprehensive query types.

2. Extended Proxy-Assisted Approach: Achieving Revocable Fine-Grained Cloud Data Encryption

Yanjiang Yang (Institute for Infocomm Research, Singapore), Joseph Liu (Monash University, Australia), Kaitai Liang (Aalto University, Finland), Raymond Choo (University of South Australia, Australia) and Jianying Zhou (Institute for Infocomm Research, Singapore)

Abstract: Attribute-based encryption has the potential to be deployed in a cloud computing environment to provide scalable and fine-grained data sharing. However, user revocation within ABE deployment remains a challenging issue to overcome, particularly when there is a large number of users. In this work, we introduce an extended proxy-assisted approach, which weakens the trust required of the cloud server. Based on an all-or-nothing principle, our approach is designed to discourage a cloud server from colluding with a third party to hinder the user revocation functionality. We demonstrate the utility of our approach by presenting a construction of the proposed approach, designed to provide efficient cloud data sharing and user revocation. A prototype was then implemented to demonstrate the practicality of our proposed construction.

3. Batch Verifiable Computation of Polynomials on Outsourced Data

Liang Feng Zhang (ShanghaiTech University, China) and Reihaneh Safavi-Naini (University of Calgary, Canada)

Abstract: Secure outsourcing of computation to cloud servers has attracted much attention in recent years. In a typical outsourcing scenario, the client stores its data on a cloud server and later asks the server to perform computations on the stored data. The verifiable computation (VC) of Gennaro, Gentry, Parno (Crypto 2010) and the homomorphic MAC (HomMAC) of Backes, Fiore, Reischuk (CCS 2013) allow the client to verify the server's computation with substantially less computational cost than performing the outsourced computation. The existing VC and HomMAC schemes that can be considered practical (do not required heavy computations such as computing fully homomorphic encryptions), are limited to compute linear and quadratic polynomials on the outsourced data. In this paper, we introduce a batch verifiable computation (BVC) model that can be used when the computation of the same function on multiple datasets is required, and construct two schemes for computing polynomials of high degree on the outsourced data. Our schemes allow efficient client verification, efficient server computation, and composition of computation results. Both schemes allow new elements to be added to each outsourced dataset. The second scheme also allows new datasets to be added. A unique feature of our schemes is that the storage required at the server for storing the authentication information, stays the same as the number of outsourced datasets is increased, and so the server storage overhead (the ratio of the server storage to the total size of the datasets) approaches 1. In all existing schemes this ratio is ≥ 2. Hence, our BVC can effectively halve the required server storage.

4. CloudBI: Practical Privacy-Preserving Outsourcing of Biometric Identification in the Cloud

Qian Wang, Shengshan Hu (Wuhan University, China), Kui Ren (University at Buffalo, USA), Meiqi He, Minxin Du and Zhibo Wang (Wuhan University, China)

Abstract: Biometric identification has been incredibly useful in the law enforcement to authenticate an individual's identity and/or to figure out who someone is, typically by scanning a database of records for a close enough match. In this work, we investigate the privacy-preserving biometric identification outsourcing problem, where the database owner outsources both the large-scale encrypted database and the computationally intensive identification job to the semi-honest cloud, relieving itself from data storage and computation burden. We present new privacy preserving biometric identification protocols, which substantially reduce the computation burden on the database owner. Our protocols build on new biometric data encryption, distance-computation and matching algorithms that novelly exploit inherent structures of biometric data and properties of identification operations. A thorough security analysis shows that our solutions are practically-secure, and the ultimate solution offers a higher level of privacy protection than the-state-of-the-art on biometric identification outsourcing. We evaluate our protocols by implementing an efficient privacy-preserving fingerprint-identification system, showing that our protocols meet both the security and efficiency needs well, and they are appropriate for use in various privacy-preserving biometric identification applications.

15.30-17.00 Session 6B: Protocols & Attribute-based encryption

Session Chair: Peter Y A Ryan (University of Luxembourg, Luxembourg)

Lecture Hall D

1. Typing and Compositionality for Security Protocols: A Generalization to the Geometric Fragment

Omar Almousa, Sebastian A. Mödersheim (DTU Compute, Denmark), Paolo Modesti (Newcastle University, UK) and Luca Viganò (King's College London, UK)

Abstract: We integrate, and improve upon, prior relative soundness results of two kinds. The first kind are typing results showing that any security protocol that fulfils a number of sufficient conditions has an attack if it has a well-typed attack. The second kind considers the parallel composition of protocols, showing that when running two protocols in parallel allows for an attack, then at least one of the protocols has an attack in isolation. The most important generalization over previous work is the support for all security properties of the geometric fragment.

2. Checking trace equivalence: How to get rid of nonces?

Rémy Chrétien, Veronique Cortier (LORIA, INRIA Nancy - Grand-Est, France) and Stephanie Delaune (LSV, ENS Cachan & CNRS, France)

Abstract: Security protocols can be successfully analyzed using formal methods. When proving security in symbolic settings for an unbounded number of sessions, a typical technique consists in abstracting away fresh nonces and keys by a bounded set of constants. While this abstraction is clearly sound in the context of secrecy properties (for protocols without else branches), this is no longer the case for equivalence properties. In this paper, we study how to soundly get rid of nonces in the context of equivalence properties. We show that nonces can be replaced by constants provided that each nonce is associated to two constants (instead of typically one constant for secrecy properties). Our result holds for deterministic (simple) protocols and a large class of primitives that includes e.g. standard primitives, blind signatures, and zero-knowledge proofs.

3. Attribute Based Broadcast Encryption with Short Ciphertext and Decryption Key

Tran Viet Xuan Phuong, Guomin Yang (University of Wollongong, Australia) and Willy Susilo (Xidian University, China)

Abstract: Attribute Based Broadcast Encryption (ABBE) is a combination of Attribute Based Encryption (ABE) and Broadcast Encryption (BE). It allows a broadcaster (or encrypter) to broadcast an encrypted message that can only be decrypted by the receivers who are within a predefined user set and satisfy the access policy specified by the broadcaster. Compared with normal ABE, ABBE allows direct revocation, which is important in many real-time broadcasting applications such as Pay TV. In this paper, we propose two novel ABBE schemes that have distinguishing features: the first scheme is key-policy based and has short ciphertext and constant size decryption key; and the second one is ciphertext-policy based and has constant size ciphertext and short decryption key. Both of our schemes allow access policies to be expressed using AND-gate with positive, negative, and wildcard symbols, and are proven secure under the Decision n-BDHE assumption without random oracles.

4. Accountable Authority Ciphertext-Policy Attribute-Based Encryption with White-Box Traceability and Public Auditing in the Cloud

Jianting Ning (Shanghai Jiao Tong University, China), Xiaolei Dong, Zhenfu Cao (East China Normal University, China) and Lifei Wei (Shanghai Ocean University, China)

Abstract: As a sophisticated mechanism for secure fine-grained access control, ciphertext-policy attribute-based encryption (CP-ABE) is a highly promising solution for commercial applications such as cloud computing. However, there still exists one major issue awaiting to be solved, that is, the prevention of key abuse. Most of the existing CP-ABE systems missed this critical functionality, hindering the wide utilization and commercial application of CP-ABE systems to date. In this paper, we address two practical problems about the key abuse of CP-ABE: (1) The key escrow problem of the semi-trusted authority; and, (2) The malicious key delegation problem of the users. For the semi-trusted authority, its misbehavior (i.e., illegal key (re-)distribution) should be caught and prosecuted. And for a user, his/her malicious behavior (i.e., illegal key sharing) need be traced. We affirmatively solve these two key abuse problems by proposing the first accountable authority CP-ABE with whitebox traceability that supports policies expressed in any monotone access structures. Moreover, we provide an auditor to judge publicly whether a suspected user is guilty or is framed by the authority.

17.00-23.00 Conference Dinner

Meeting point: 17:00 in front of the Conference Venue (after the last session)

A bus will take us to **Schönbrunn Palace**, Empress Sisi's former summer residence. The palace is part of UNESCO's cultural heritage due to its historic importance, its unique grounds and its splendid furnishings. At Schönbrunn Palace we have organized a Grand Tour, which will give you a picture of the different stylistic eras of the imperial monarchy and the life's of the palace´s inhabitants.

After the tour little trains will take us to the Conference Dinner location, the **Orang.erie**, which is located in the „Vienna Zoo". Founded as an imperial menagerie in 1752, it is the oldest zoo in the world. The Vienna Zoo is located on the grounds of the Schönbrunn Palace, on our way from the Palace to the Dinner location you will see parts of it.

Address:
Orang.erie
Maxerstraße 13
1130 Vienna
(Metro stop U4 „Hietzing" – directions will be provided, no organized transport for returning)

Friday, 25th September 2015

08.00-17.00 Registration

09.00-10.30 Session 7A: Code Analysis & Side-Channels

Session Chair: Günther Pernul (Universität Regensburg, Germany)

Lecture Hall C

1. DexHunter: Toward Extracting Hidden Code from Packed Android Applications

Yueqian Zhang, Xiapu Luo and Haoyang Yin (The Hong Kong Polytechnic University, China)

Abstract: The rapid growth of mobile application (or simply app) economy provides lucrative and profitable targets for hackers. Among OWASP's top ten mobile risks for 2014, the lack of binary protections makes it easy to reverse, modify, and repackage Android apps. Recently, a number of packing services have been proposed to protect Android apps by hiding the original executable file (i.e., dex file). However, little is known about their effectiveness and efficiency. In this paper, we perform the first systematic investigation on such services by answering two questions: (1) what are the major techniques used by these services and their effects on apps? (2) can the original dex file in a packed app be recovered? If yes, how? We not only reveal their techniques and evaluate their effects, but also propose and develop a novel system, named Dex- Hunter, to extract dex files protected by these services. It is worth noting that DexHunter supports both the Dalvik virtual machine (DVM) and the new Android Runtime (ART). The experimental results show that DexHunter can extract dex files from packed apps effectively and efficiently.

2. Identifying Arbitrary Memory Access Vulnerabilities in Privilege-Separated Software

Hong Hu, Zheng Leong Chua, Zhenkai Liang and Prateek Saxena (National University of Singapore, Singapore)

Abstract: Privilege separation is a widely used technique to secure complex software systems. With privilege separation, software components are divided into several partitions and these partitions can only communicate through limited interfaces. However, the interfaces still provide a channel for one partition to influence code in other partitions. As a result, certain memory access patterns can be leveraged by attackers to perform arbitrary memory access. We refer to this type of memory access errors by the acronym DUI (Dereference Under the Influence). In this paper, we present a systematic method to detect vulnerabilities leading to DUI through binary analysis, and to estimate the capability attackers can obtain through DUI exploits. The evaluation shows that our approach can accurately identify vulnerable code that leads to arbitrary memory access in real-world software components and programs, when they are transformed to privilege-separated designs.

3. vBox: Proactively Establishing Secure Channels between Wireless Devices without Prior Knowledge

Wei Wang, Jingqiang Lin, Zhan Wang, Ze Wang and Luning Xia (Chinese Academy of Sciences, China)

Abstract: Establishing secure channels between two wireless devices without any prior knowledge is challenging, especially when such devices only have very simple user interface. Most existing authentication and key negotiation solutions leverage the received signal strength (RSS) of wireless signals, and the security guarantees depend on the environments too much; in a static environment of less motion, the adversaries could control or predict the RSS of legitimate devices. We propose vBox in this paper, a proactive method to establish secure channels between wireless devices, without the assumption on environments. By holding and waving two devices to communicate, the owner creates a virtual "shield box". The adversaries outside the box cannot send signals with stable RSS into the box, so the legitimate devices can easily be authenticated based on the variation of RSS. At the same time, the adversaries cannot correctly measure or detect the RSS of wireless signals transmitted between the in-box devices, and then they can directly transmit secret keys in plaintext. Then, after the simple operation by the owner for a few seconds, the authenticated nodes will securely communicate using the shared secret key. We implement the vBox prototype on commercial off- the-shelf ZigBee devices, and evaluate it with extensive experiments under the normal case and several attack scenarios. The experiment results and security analysis show that, vBox establishes secure channels handily against various attacks and is suitable for different environments.

09.00-10.30 Session 7B: Crypto Applications & Attacks

Session Chair: Haya Shulman (Fraunhofer SIT, Germany)

Lecture Hall D

1. Challenging the Trustworthyness of PGP: Is the Web-of-Trust Tear-proof?

Alessandro Barenghi, Alessandro Di Federico, Gerardo Pelosi and Stefano Sanfilippo (Politecnico di Milano, Italy)

Abstract: The OpenPGP protocol provides a long time adopted and widespread tool for secure and authenticated asynchronous communications, as well as supplies data integrity and authenticity validation for software distribution. In this work, we analyze the Web-of-Trust on which the OpenPGP public key authentication mechanism is based, and evaluate a threat model where its functionality can be jeopardized. Since the threat model is based on the viability of compromising an OpenPGP keypair, we performed an analysis of the state of health of the global OpenPGP key repository. Despite the detected amount of weak keypairs is rather low, our results show how, under reasonable assumptions, approximately 70% of the Web-of-Trust strong set is potentially affected by the described threat. Finally, we propose viable mitigation strategies to cope with the highlighted threat.

2. Transforming Out Timing Leaks, More or Less

Heiko Mantel and Artem Starostin (TU Darmstadt, Germany)

Abstract: We experimentally evaluate program transformations for removing timing side-channel vulnerabilities wrt. security and overhead. Our study of four well-known transformations confirms that their performance overhead differs substantially. A novelty of our work is the empirical investigation of channel bandwidths, which clarifies that the transformations also differ wrt. how much security they add to a program. Interestingly, we observe such differences even between transformations that have been proven to establish timing-sensitive noninterference. Beyond clarification, our findings provide guidance for choosing a suitable transformation for removing timing side-channel vulnerabilities. Such guidance is needed because there is a trade-off between security and overhead, which makes choosing a suitable transformation non-trivial.

3. Small Tweaks do Not Help: Differential Power Analysis of MILENAGE Implementations in 3G/4G USIM Cards

Junrong Liu, Yu (Shanghai Jiao Tong University, China), Francois-Xavier Standaert (Universit´e catholique de Louvain, Belgium), Zheng Guo, Dawu Gu, Wei Sun, Yijie Ge, Rong Fu (Shanghai Jiao Tong University, China), and Xinjun Xie (Shanghai Modern General Recognition Technology Corporation, China)

Abstract: Side-channel attacks are an increasingly important concern for the security of cryptographic embedded devices, such as the SIM cards used in mobile phones. Previous works have exhibited such attacks against implementations of the 2G GSM algorithms (COMP-128, A5). In this paper, we show that they remain an important issue for USIM cards implementing the AES-based MILENAGE algorithm used in 3G/4G communications. In particular, we analyze instances of cards from a variety of operators and manufacturers, and describe successful Differential Power Analysis attacks that recover encryption keys and other secrets (needed to clone the USIM cards) within a few minutes. Further, we discuss the impact of the operator-defined secret parameters in MILENAGE on the difficulty to perform Differential Power Analysis, and show that they do not improve implementation security. Our results back up the observation that physical security issues raise long-term challenges that should be solved early in the development of cryptographic implementations, with adequate countermeasures.

09:00-10:30 PhD Symposium – Session 1

Session Chair: Rolf Schillinger (Universität Regensburg, Germany)

Lecture Hall E

1. Improvement of Network Intrusion Detection Using Various Obfuscation Techniques

Ivan Homoliak (Brno University of Technology, Czech Republic)

Abstract: The main goal of my PhD research is to improve detection capabilities of academical NIDS called Automated Intrusion Prevention System (AIPS) whose detection engine was substantially designed in my master's thesis as part of related project. The AIPS system was designed to perform statistical and behavioral analysis of connection-oriented network traffic ows in order to detect zero-day attacks and divergent types of network attacks. The principal technique which is being used to improve performance of AIPS takes into account the idea of bypassing detection capability of the system and consequently provides better expert knowledge containing obfuscated communications, especially malicious. Because of AIPS is based upon behavioral and statistical analysis, which often use time and index slope of connections or analysis of payload distribution, there can arise a question of breaching detection of AIPS. The most of AIPS detection features called Advanced Security Network Metrics (ASNM) use information gathered from L3 and L4 packets headers. There are suggested to use various non-payload based obfuscation techniques to examine detection properties of ASNM features. Examples of the obfuscations include: tunneling in other application layer protocol; spreading out packets in time; segmentation & fragmentation; changing of packets` order; simulation of unreliable network channel; packets' loss; packets` duplication etc. Combinations of these techniques are suggested to use as well.

2. Semantic technologies applied to digital forensics analysis and evidence modelling

Rodrigo Carvalho (Brazilian Federal Police, Brazil)

Abstract: Cybercrime tackling is a major challenge for Law Enforcement Agencies (LEAs). Traditional digital forensics and investigation procedures are not coping with the sheer amount of data to analyze, which is stored in multiple devices seized from distinct, possibly-related cases. Moreover, inefficient information representation and exchange hampers evidence recovery and relationship discovery. Aiming at a better balance between human reasoning skills and computer processing capabilities, our project will research about how semantic technologies could make digital forensics more efficient. It will take the example of online banking fraud to propose an ontology aimed at mapping criminal organizations and identifying malware developers. Although still in early stage of development, it reviews concepts to extend from well-established ontologies and proposes novel abstractions that could enhance relationship discovery. Finally, it suggests inference rules based on empirical knowledge which could better address the needs of the human analyst.

3. Technology Analysis of IDS and NBA systems from the view of detection effectivity

Dominik Breitenbacher (BUT, Czech Republic)

Abstract: My research will be focused on the network security, closely on the IDS (intrusion detection system) and NBA (network behavior analysis) systems effectiveness and ability to react on various kinds of attacks. At the beginning of my work I would like to make a dataset of known vulnerable applications with their exploits and references to vulnerabilities. The motivation of this step is the fact, that in common it is very difficult to obtain vulnerable applications which could be used for exploitation analysis. The reason why almost all vendors do not keep vulnerable SW available is straightforward. The dataset will be large and representative enough to provide reliable results when used in research. Then, the testing framework will be proposed which will serve for building of VMs with prepared OS and feasible conditions for attacks execution. Using the testing framework I would like to analyze various NIDS (network intrusion detection system), HIDS (host intrusion detection system), NBA, anti-virus systems, report evaluated results and propose how to solve issues that were found. Collected features of various intrusion detection systems will be collected as well and if they will be available. Testing framework with gathered dataset will be available for interested academic or non-academic communities and it would be used in penetration testing, vulnerability analysis and data mining.

10.30-11.00 Coffee Break

11.00-12.30 Session 8A: Authentication I

Session Chair: Kui Ren (SUNY Buffalo, USA)

Lecture Hall C

1. On Security of Content-based Video Stream Authentication

Swee-Won Lo, Zhuo Wei, Robert Deng and Xuhua Ding (Singapore Management University, Singapore)

Abstract: Content-based authentication (CBA) schemes are used to authenticate multimedia streams while allowing content-preserving manipulations such as bit-rate transcoding. In this paper, we survey and classify existing transform-domain CBA schemes for videos into two categories, and point out that in contrary to CBA for images, there exists a common design flaw in these schemes. We present the principles (based on video coding concept) on how the flaw can be exploited to mount semantic-changing attacks in the transform domain that cannot be detected by existing CBA schemes. We show attack examples including content removal, modification and insertion attacks. Noting that these CBA schemes are designed at the macroblock level, we discuss, from the attacker's point of view, the conditions in attacking content based authenticated macroblocks.

2. Oblivious Maximum Bipartite Matching Size Algorithm with Applications to Secure Fingerprint Identification

Marina Blanton and Siddharth Saraph (University of Notre Dame, USA)

Abstract: The increasing availability and use of biometric data leads to situations when sensitive biometric data is to be handled by entities who may not be fully trusted or otherwise are not authorized to have full access to such data. This calls for mechanisms of provably protecting biometric data while still allowing the computation to take place. Our focus is on privacy-preserving matching of two fingerprints (authentication or identification purposes) using traditional minutia-based representation of fingerprints that leads to the most discriminative fingerprint comparisons. Unlike previous work in the security literature, we would like to focus on algorithms that are guaranteed to find the maximum number of minutiae that can be paired together between two fingerprints leading to more accurate comparisons. To address this problem, we formulate it as a flow network problem and reduce it to finding maximum matching size in bipartite graphs. The resulting problem is in turn reduced to computing the rank of a (non-invertible) matrix, formed as a randomized adjacency matrix of the bipartite graph. We then provide data-oblivious algorithms for matrix rank computation and consecutively finding maximum matching size in a bipartite graph and also extend the algorithms to solve the problem of accurate fingerprint matching. These algorithms lead to their secure counterparts using standard secure two-party or multi-party techniques. Lastly, we implement secure fingerprint matching in the secure two-party computation setting using garbled circuit evaluation. Our experimental results demonstrate that the techniques are efficient, leading to performance similar to that of other fastest secure fingerprint matching techniques, despite higher complexity of our solution that higher accuracy demands.

3. Practical Threshold Password-Authenticated Secret Sharing Protocol

Xun Yi (RMIT University, Australia), Feng Hao (Newcastle University, UK), Liqun Chen (Hewlett-Packard Laboratories, UK)and Joseph Liu (Monash University, Australia)

Abstract: Threshold password-authenticated secret sharing (TPASS) protocols allow a client to secret-share a secret s among n servers and protect it with a password pw, so that the client can later recover s from any subset of t of the servers using the password pw, but so that no coalition smaller than t learns anything about s or can mount an offline dictionary attack on the password pw. Some TPASS protocols have appeared in the literature recently. The protocol by Bagherzandi et al. (CCS 2011) leaks the password if a client mistakenly executes the protocol with malicious servers. The first t-out-of-n TPASS protocol for any n > t that does not suffer from this shortcoming was given by Camenisch et al. (CRYPTO 2014). This protocol, proved to be secure in the UC framework, requires the client to involve in many communication rounds so that it becomes impractical for the client. In this paper, we present a practical TPASS protocol which is in particular efficient for the client, who only needs to send a request and receive a response. In addition, we have provided a rigorous proof of security for our protocol in the standard model.

11.00-12.30 Session 8B: Policies

Session Chair: Frederic Cuppens (Telecom Bretagne, France)

Lecture Hall D

1. A Theory of Gray Security Policies

Donald Ray and Jay Ligatti (University of South Florida, Tampa, USA)

Abstract: This paper generalizes traditional models of security policies, from specifications of whether programs are secure, to specifications of how secure programs are. This is a generalization from qualitative, black-and-white policies to quantitative, gray policies. Included are generalizations from traditional definitions of safety and liveness policies to definitions of gray-safety and gray-liveness policies. These generalizations preserve key properties of safety and liveness, including that the intersection of safety and liveness is a unique allow-all policy and that every policy can be written as the conjunction of a single safety and a single liveness policy. It is argued that the generalization provides several benefits, including that it serves as a unifying framework for disparate approaches to security metrics, and that it separates—in a practically useful way—specifications of how secure systems are from specifications of how secure users require their systems to be.

2. Factorization of Behavioral Integrity

Ximeng Li, Flemming Nielson and Hanne Riis Nielson (Technical University of Denmark, Denmark)

Abstract: We develop a bisimulation-based noninterference property that describes the allowed dependencies between communication behaviors of different integrity levels. The property is able to capture all possible combinations of integrity levels for the “presence” and “content” of actual communications. Channels of low presence integrity and high content integrity can be used to model the effect of Message Authentication Codes or the consequence of Denial of Service Attacks. In case the distinction between “presence” and “content” is deliberately blurred, the noninterference property specializes to a classical process-algebraic property (called SBNDC). A compositionality result is given to facilitate a structural approach to the analysis of concurrent systems.

3. Checking Interaction-Based Declassification Policies for Android Using Symbolic Execution

Kristopher Micinski, Jonathan Fetter-Degges, Jinseong Jeon, Jeffrey Foster (University of Maryland, USA) and Michael Clarkson (Cornell University, USA)

Abstract: Mobile apps can access a wide variety of secure information, such as contacts and location. However, current mobile platforms include only coarse access control mechanisms to protect such data. In this paper, we introduce interaction-based declassification policies, in which the user’s interactions with the app constrain the release of sensitive information. Our policies are defined extensionally, so as to be independent of the app’s implementation, based on sequences of security-relevant events that occur in app runs. Policies use LTL formulae to precisely specify which secret inputs, read at which times, may be released. We formalize a semantic security condition, interaction-based noninterference, to define our policies precisely. Finally, we describe a prototype tool that uses symbolic execution of Dalvik bytecode to check interaction-based declassification policies for Android, and we show that it enforces policies correctly on a set of apps.

11.00-12.30 PhD Symposium – Session 2

Session Chair: Edgar Weippl (SBA Research, Austria)

Lecture Hall E

1. Cryptogenography

Sune K. Jakobsen (Queen Mary, University of London, UK)

Abstract: It is possible to reveal information anonymously if no one will actively help you to do so? In a world where politicians are considering banning back-door-free encryption, this is becoming an important question. I have shown that it is impossible in some standard interpretations of the question, but if we weaken some assumptions is becomes possible. For example, if the sender has access to a small anonymous channel, we have shown that this can be used to bootstrap a large anonymous channel. In another result I have shown that many people can collaborate to send a small amount of information in such a way that even an adversary with unbounded computational power will always have reasonable doubt about whether any particular person was sending information.

2. Detecting and Preventing Abuse of Resources in IaaS Cloud Computing

Jens Lindemann (University of Hamburg, Germany)

Abstract: Cloud computing is being used by more and more organizations. However, cloud services can also be abused either by malicious users or hackers. If abuse of cloud services affects third parties, bad publicity or even legal problems may ensue for a cloud service provider. Abuse of cloud services is considered to be one of the nine top threats to cloud computing by the Cloud Security Alliance. While there has been research on detecting and preventing attacks on cloud resources, detecting abuse of cloud resources for malicious activities has seen only limited research and even commercial cloud offerings currently lack sufficient abuse protection. The research will assess what security measures currently exist against abuse of cloud computing resources. It will further conceive concepts for abuse detection and prevention, which will be implemented and evaluated. The results will not only be useful to better quantify the risk stemming from the abuse of cloud services, but they will also provide insights regarding the potential and the limitations of cloud abuse detection and prevention techniques in practice.

3. Why the Bitcoin Community needs to pursue Bitcoin-based Authentication

Patrick McCorry (Newcastle University, UK)

Abstract: This presentation focuses on two pieces of research; 1) we initiate the first study on the post-payment scenario for Bitcoin payments and propose two concentrate post-payment protocols that allows a merchant to re-authenticate a previous pseudonymous customer and establish a secure end-to-end communication channel using their shared transaction history stored on Bitcoin's Blockchain and 2) we highlight new attacks on the community accepted BIP70: Payment Protocol standard that governs how a merchant and customer perform payments in Bitcoin. This protocol is supported by most major wallets and the two dominant Payment Processors Coinbase and BitPay who provide the infrastructure for accepting Bitcoin as a form of payment to 88,000+ merchants.

12.30-14.00 Lunch

14.00-15.30 Session 9A: Authentication II

Session Chair: Artemios Voyiatzis (SBA Research, Austria)

Lecture Hall D

1. Towards Attack-Resistant Peer-Assisted Indoor Localization

Jingyu Hua, Shaoyong Du and Sheng Zhong (Nanjing University, China)

Abstract: Peer-assisted smartphone localization, which leverages pairwise acoustic ranging among nearby peer phones to refine location estimation, significantly pushes the accuracy limit of WiFi-based indoor localization. Unfortunately, this technique is designed for non-adversarial settings. Dishonest peers may cheat in their distance measurements. Outside attackers may interfere with the acoustic ranging by continually broadcasting interference signals. In this paper, we propose countermeasures against each of these attacks. We first present an algorithm that can identify peers that are not cheating in the current localization, by searching for devices that can be embedded into the same plane according to their pairwise distances. We also design a robust acoustic ranging method exploiting signal modulation, which can defend effectively against intentional interference of outside attackers. Experimental results demonstrate that our countermeasures can greatly improve the obustness of peer-assisted localization.

2. Leveraging Real-Life Facts to Make Random Passwords More Memorable

Mahdi Nasrullah Al-Ameen, Kanis Fatema, Matthew Wright and Shannon Scielzo (The University of Texas at Arlington, USA)

Abstract: User-chosen passwords fail to provide adequate security. System-assigned random passwords are more secure but suffer from memorability problems. We argue that the system should remove this burden from users by assisting with the memorization of randomly assigned passwords. To meet this need, we aim to apply the scientific understanding of long-term memory. In particular, we examine the efficacy of augmenting a system-assigned password scheme based on textual recognition by providing users with verbal cues—real-life facts corresponding to the assigned keywords. In addition, we explore the usability gain of including images related to the keywords along with the verbal cues. We conducted a multi-session in-lab user study with 52 participants, where each participant was assigned three different passwords, each representing one study condition. Our results show that the textual recognition-based scheme offering verbal cues had a significantly higher login success rate (94%) as compared to the control condition, i.e., textual recognition without verbal cues (61%). The comparison between textual and graphical recognition reveals that when users were provided with verbal cues, adding images did not significantly improve the login success rate, but it did lead to faster recognition of the assigned keywords. We believe that our findings make an important contribution to understanding the extent to which different types of cues impact the usability of system-assigned passwords.

3. The Emperor's New Password Creation Policies

Ding Wang and Ping Wang (National Engineering Research Center for Software Engineering, China)

Abstract: While much has changed in Internet security over the past decades, textual passwords remain as the dominant method to secure user web accounts and they are proliferating in nearly every new web services. Nearly every web services, no matter new or aged, now enforce some form of password creation policy. In this work, we conduct an extensive empirical study of 50 password creation policies that are currently imposed on high-profile web services, including 20 policies mainly from US and 30 ones from mainland China. We observe that no two sites enforce the same password creation policy, there is little rationale under their choices of policies when changing policies, and Chinese sites generally enforce more lenient policies than their English counterparts. We proceed to investigate the effectiveness of these 50 policies in resisting against the primary threat to password accounts (i.e. online guessing) by testing each policy against two types of weak passwords which represent two types of online guessing. Our results show that among the total 800 test instances, 541 ones are accepted: 218 ones come from trawling online guessing attempts and 323 ones come from targeted online guessing attempts. This implies that, currently, the policies enforced in leading sites largely fail to serve their purposes, especially vulnerable to targeted online guessing attacks.

14.00-15.30 Session 9B: Detection & Monitoring

Session Chair: Stefan Brunthaler (SBA Research, Austria)

Lecture Hall C

1. Thing. Accurate Specification for Robust Detection of Malicious Behavior in Mobile Environments

Sufatrio, Tong-Wei Chua, Darell J. J. Tan and Vrizlynn L. L. (Institute for Infocomm Research, Singapore)

Abstract: The need to accurately specify and detect malicious behavior is widely known. This paper presents a novel and convenient way of accurately specifying malicious behavior in mobile environments by taking Android as a representative platform of analysis and implementation. Our specification takes a sequence-based approach in declaratively formulating a malicious action, whereby any two consecutive security sensitive operations are connected by either a control or taint flow. It also captures the invocation context of an operation within an app's component type and lifecycle/callback method. Additionally, exclusion of operations that are invoked from UI-related callback methods can be specified to indicate an action's stealthy execution portions. We show how the specification is sufficiently expressive to describe malicious patterns that are commonly exhibited by mobile malware. To show the usefulness of the specification, and to demonstrate that it can derive stable and distinctive patterns of existing Android malware, we develop a static analyzer that can automatically check an app for numerous security sensitive actions written using the specification. Given a target app's uncovered behavior, the analyzer associates it with a collection of known malware families. Experiments show that our obfuscation-resistant analyzer can associate malware samples with their correct family with an accuracy of 97.2%, while retaining the ability to differentiate benign apps from the profiled malware families with an accuracy of 97.6%. These results positively show how the specification can lend to robust mobile malware detection.

2. A Bytecode Interpreter for Secure Program Execution in Untrusted Main Memory

Maximilian Seitzer, Michael Gruhn and Tilo Müller (Friedrich-Alexander University Erlangen-N¨urnberg, Germany)

Abstract: Physical access to a system allows attackers to read out RAM through cold boot and DMA attacks. Thus far, counter measures protect only against attacks targeting disk encryption keys, while the remaining memory content is left vulnerable. We present a bytecode interpreter that protects code and data of programs against memory attacks by executing them without using RAM for sensitive content. Any program content within memory is encrypted, for which the interpreter utilizes TRESOR [1], a cold boot resistant implementation of the AES cipher. The interpreter was developed as a Linux kernel module, taking advantage of the CPU instruction sets AVX for additional registers, and AESNI for fast encryption. We show that the interpreter is secure against memory attacks, and that the overall performance is only a factor of 4 times slower than the performance of Python. Moreover, the performance penalty is mostly induced by the encryption.

3. Learning from Others: User Anomaly Detection Using Anomalous Samples from Other Users

Youngja Park, Ian Molloy, Suresh Chari (IBM T.J. Watson Research Center, USA), Zenglin Xu, Chris Gates and Ninghui Li (Purdue University, USA)

Abstract: Machine learning is increasingly used as a key technique in solving many security problems such as botnet detection, transactional fraud, insider threat, etc. One of the key challenges to the widespread application of ML in security is the lack of labeled samples from real applications. For known or common attacks, labeled samples are available, and, therefore, supervised techniques such as multi-class classification can be used. However, in many security applications, it is difficult to obtain labeled samples as each attack can be unique. In order to detect novel, unseen attacks, researchers used unsupervised outlier detection or one-class classification approaches, where they treat existing samples as benign samples. These methods, however, yield high false positive rates, preventing their adoption in real applications. This paper presents a local outlier factor (LOF)-based method to automatically generate both benign and malicious training samples from unlabeled data. Our method is designed for applications with multiple users such as insider threat, fraud detection, and social network analysis. For each target user, we compute LOF scores of all samples with respect to the target user's samples. This allows us to identify (1) other users' samples that lie in the boundary regions and (2) outliers from the target user's samples that can distort the decision boundary. We use the samples from other users as malicious samples, and use the target user's samples as benign samples after removing the outliers. We validate the effectiveness of our method using several datasets including access logs for valuable corporate resources, DBLP paper titles, and behavioral biometrics of user typing behavior. The evaluation of our method on these datasets confirms that, in almost all cases, our technique performs significantly better than both one-class classification methods and prior two-class classification methods. Further, our method is a general technique that can be used for many security applications.

14.00-15.30 PhD Symposium – Session 3

Session Chair: Edgar Weippl (SBA Research, Austria)
Lecture Hall E

1. A Coinductive System Calculus for Security Properties

Eric Rothstein Morris (University of Passau, Germany)

Abstract: We tackle the security property satisfaction problem by studying security properties defined as behavioral differential equations (BDEs) in a coinductive calculus of systems. This approach addresses a variety of systems (including non-deterministic, probabilistic and non-terminating systems) in one unified framework. If a security property is defined as a BDE and such BDE is solvable, we can soundly and transparently transform a system into its secure version; effectively satisfying the security property. Security properties belong to three different abstraction layers: state, execution and system. System properties imply execution properties, which in turn imply state properties. We are interested in classifying system properties according to their BDE format and abstraction layer, but our main interest is to find BDEs that define and combine security properties. We want to provide tool support in the form of a Haskell-based unified framework where systems and security properties can be naturally expressed and reasoned about.

2. Data Quality Management in Information Systems Security Documentation

Christian Sillaber (University of Innsbruck, Austria)

Abstract: Businesses are increasingly required to document, implement, improve and monitor IS security requirements derived from different sources to ensure proper implementation of controls, overall compliance and to support managerial decision making. However, the documentation of IS security is fraught with a variety of challenges, including missing tool support, low stakeholder awareness, different levels of formalization that lead to hardly maintainable documentation entities stored in different ISMS and GRC tools and productivity platforms. The goal of this PhD thesis is to create a data quality model and associated processes to help organizations overcome these challenges and to provide them with tool support that ensures a high level of data quality in the documentation of IS security at various organizational levels. We are the first to address these quality issues in a systematic way and to build a data quality model and tool support in empirically grounded research. First research results were already transferred to industry and empirically validated.

3. Formal specifica6on and verificaton of Security guidelines, Derivation of Security properes using static code analysis.

Zhioua Zeineb (SAP Labs France, EURECOM, Telecom ParisTech, France)

Abstract: The development and delivery of secure software is a challenging task that gets even harder when the developer tries to adhere to both application and organization--specific security requirements translated into security guidelines. These guidelines serve as best practices or recommendations that help reduce application exposure to vulnerabilities, and have concrete guarantees about the application adherence to high level and abstract security requirements. Our approach aims at integrating the formal specification and verification of security guidelines not only in early stages of the development phase but throughout the software lifecycle. This would help the developer to ensure the compliance with security specifications throughout the software development lifecycle. This same approach would also help the Marketplace operator in verifying the compliance of third--party applications with its security requirements and making decisions regarding the approval or the rejection of the submitted applications before they find their way to the end--users devices.

15:30-15:45 Coffee Break

15.45-17.15 Session 10: Applied Security II

Session Chair: Edgar Weippl (SBA Research, Austria)

Lecture Hall C

1. All Your Voices Are Belong to Us: Stealing Voices to Fool Humans and Machines

Dibya Mukhopadhyay, Maliheh Shirvanian and Nitesh Saxena (University of Alabama at Birmingham, USA)

Abstract: In this paper, we study voice impersonation attacks to defeat humans and machines. Equipped with the current advancement in automated speech synthesis, our attacker can build a very close model of a victim's voice after learning only a very limited number of samples in the victim's voice (e.g., mined through the Internet, or recorded via physical proximity). Specifically, the attacker uses voice morphing techniques to transform its voice – speaking any arbitrary message – into the victim's voice. We examine the aftermaths of such a voice impersonation capability against two important applications and contexts: (1) impersonating the victim in a voice-based user authentication system, and (2) mimicking the victim in arbitrary speech contexts (e.g., posting fake samples on the Internet or leaving fake voice messages). We develop our voice impersonation attacks using an off-the-shelf voice morphing tool, and evaluate their feasibility against state-of-the-art automated speaker verification algorithms (application 1) as well as human verification (application 2). Our results show that the automated systems are largely ineffective to our attacks. The average rates for rejecting ake voices were under 10–20% for most victims. Even human verification is vulnerable to our attacks. Based on two online studies with about 100 users, we found that only about an average 50% of the times people rejected the morphed voice samples of two celebrities as well as briefly familiar users.

2. Balloon: A Forward-Secure Append-Only Persistent Authenticated Data Structure

Tobias Pulls (Karlstad University, Sweden) and Roel Peeters (KU Leuven, Belgium)

Abstract: We present Balloon, a forward-secure append-only persistent authenticated data structure. Balloon is designed for an initially trusted author that generates events to be stored in a data structure (the Balloon) kept by an untrusted server, and clients that query this server for events intended for them based on keys and snapshots. The data structure is persistent such that clients can query keys for the current or past versions of the data structure based upon snapshots, which are generated by the author as new events are inserted. The data structure is authenticated in the sense that the server can verifiably prove all operations with respect to snapshots created by the author. No event inserted into the data structure prior to the compromise of the author can be modified or deleted without detection due to Balloon being publicly verifiable. Balloon supports efficient (non-)membership proofs and verifiable inserts by the author, enabling the author to verify the correctness of inserts without having to store a copy of the Balloon. We formally define and prove that Balloon is a secure authenticated data structure.

3. On the Fly Design and Co-simulation of Responses against Simultaneous Attacks

Léa Samarji, Nora Cuppens-Boulahia, Frédéric Cuppens (Telecom Bretagne, France), Serge Papillon, Waël Kanoun and Samuel Dubus (Alcatel-Lucent Bell Labs, France)

Abstract: The growth of critical information systems in size and complexity has driven the research community to propose automated response systems. These systems must cope with the steady progress of the attacks' sophistication, coordination and effectiveness. Unfortunately, existing response systems still handle attacks independently, suffering thereby from (i) efficiency issues against coordinated attacks (e.g. DDoS), (ii) conflicts between parallel responses, and (iii) unexpected side effects of responses on the system. We, thus, propose in this paper a new response model against simultaneous threats. Our response is dynamically designed based on a new definition of capability-aware logic anticorrelation, and modeled using the Situation Calculus (SC) language. Even though a response can prevent or reduce an attack scenario, it may also have side effects on the system and unintentionally ease one of the attackers to progress on its scenario. We address this issue by proposing a response co-simulator based on SC planning capabilities. This co-simulator considers each response candidate apart and reasons, from the current system's and attackers' state, to assess the achieved risk mitigation on the protected system. Experimentations were led to highlight the benefits of our solution.

Keynote Speakers

Sushil Jajodia

George Mason University Fairfax, USA

Keynote: Adversarial and Uncertain Reasoning for Adaptive Cyber Defense: Building the Scientific Foundation

Thursday, September 24th, 09.00 – 10 00, Lecture Hall A

Abstract: *Today's cyber defenses are largely static. They are governed by slow deliberative processes involving testing, security patch deployment, and human-in-the-loop monitoring. As a result, adversaries can systematically probe target networks, pre-plan their attacks, and ultimately persist for long times inside compromised networks and hosts. A new class of technologies, called Adaptive Cyber Defense (ACD), is being developed that presents adversaries with optimally changing attack surfaces and system configurations, forcing adversaries to continually re-assess and re-plan their cyber operations. Although these approaches (e.g., moving target defense, dynamic diversity, and bio-inspired defense) are promising, they assume stationary and stochastic, but non-adversarial, environments. To realize the full potential, we need to build the scientific foundations so that system resiliency and robustness in adversarial settings can be rigorously defined, quantified, measured, and extrapolated in a rigorous and reliable manner.*

Sushil Jajodia is University Professor, BDM International Professor, and the founding director of Center for Secure Information Systems in the Volgenau School of Engineering at the George Mason University, Fairfax, Virginia. He is also the founding site director of the recently approved NSF I/UCRC Center for Configuration Analytics and Automation at Mason. He served as the chair of the Department of Information and Software Engineering during 1998-2002. He joined Mason after serving as the director of the Database and Expert Systems Program within the Division of Information, Robotics, and Intelligent Systems at the National Science Foundation. Before that he was the head of the Database and Distributed Systems Section in the Computer Science and Systems Branch at the Naval Research Laboratory, Washington and Associate Professor of Computer Science and Director of Graduate Studies at the University of Missouri, Columbia. He has also been a visiting professor at the University of Milan, Italy; Sapienza University of Rome, Italy; Isaac Newton Institute for Mathematical Sciences, Cambridge University, England; King's College, London, England; and Paris Dauphine University, France.

Richard Clayton

University of Cambridge, UK

Keynote: Cybercrime data: Big, Biased and Beyond Review?

Wednesday, September 23rd, 09.15 – 10.15, Lecture Hall A

Abstract: *I spend my academic life generating and processing data about cybercrime. These datasets are big and getting bigger. Some people say that's true of cybercrime as well, but I don't entirely agree! My datasets are also significantly biased, but once you accept that the bias is there it can lead one to find some really useful results. But perhaps the greatest problem that we all have with cybercrime data is an inability to reproduce each other's work — an essential technique for detecting inadvertent errors and improving analysis techniques. At Cambridge we have a new approach to cybercrime data sharing; and I'll be explaining how it is possible to get involved.*

Richard Clayton is a software developer by trade. In the 1980s he co- founded a software house that created the system software for Amstrad CPC and PCW machines — which sold in the millions. In the first half of the 1990s the company produced one of the first Internet access and Internet email systems for Windows. The company was sold to the UK's largest ISP and he worked there until in 2000 he returned to Cambridge to study for a PhD.
He has remained an academic („because it's more fun than working") in the field of 'security economics'. In particular he has been studying wickedness on the Internet for years; be it spam, DDoS attacks (intentional and unintentional), or crimes such as phishing. His approach generally involves identifying datasets of cybercrime activity, often of substantial size, and then attempting to turn raw data into illuminating Information
As of October 2015 he will become Director of the Cambridge Cloud Cybercrime Centre. The Centre intends to build one of the largest and most diverse data sets about cybercrime that any organisation holds and more importantly aims to make this data

available to other academics for them to apply their own skills to address cybercrime issues. Academics currently face considerable difficulties in researching cybercrime and the centre intends to drive a step change in the amount of cybercrime research by making datasets available, not just of URLs but content as well, so that other academics can concentrate on their particular areas of expertise and start being productive immediately.

Afonso Ferreira

Trust & Security Unit, European Commission, Belgium

Invited Talk: The European Strategic Agenda for Research and Innovation in Cybersecurity

Wednesday, September 23rd, 12.15 – 13.00, Lecture Hall A

Abstract: *This talk will present the European Strategic Research and Innovation Agenda (SRA) for cybersecurity as it is being released by the Working Group on Secure ICT Research and Innovation (aka WG3) of the Network and Information Security Platform, which is a public-private partnership put in place by the European Commission in 2013. Members of WG3 are close to two hundred. They address issues related to cybersecurity research and innovation in the context of the EU Strategy for Cyber Security and of the Network and Information Security Platform. WG3 identified the key challenges and corresponding desired outcomes in terms of innovation-focused, applied but also basic research in cybersecurity, privacy, and trust. The European SRA for cybersecurity designed by WG3 serves as main input for the drafting of Horizon 2020 Work Programs by the European Commission and is source of inspiration for the coordination of, and collaboration between, research agendas across Europe, including industry research roadmaps and national research and innovation programs of the Member States.*

Afonso Ferreira is currently in charge, amongst others, of the general secretariat of the Working Group on “Secure ICT Research and Innovation” of the European Network and Information Security Platform, which provides the input for Horizon 2020 Work-Programmes in Digital Security, and is leading the planning and financing of cybersecurity activities through the Connecting Europe Facility programme. He has been seconded as a French expert to the European Commission since 2011, working now as policy officer at the Trust and Security unit of the DG CONNECT. Other assignments included the Future and Emerging Technologies unit and the Digital Futures task force.

Social Events

Monday, 21st September 2015 – Workshop Dinner

Sightseeing Walking Tour & Workshop Dinner

We have organized a walking tour “Off the beaten path” in Vienna. Afterwards we will have our workshop dinner at the Restaurant Schubert. The tour will take about 1.5 hours and will end directly at the restaurant.

Meeting point: 18:00 in front of the Conference Venue
Walking tour “Off the beaten track Vienna”: 18:00 – 19:30
Beside Empress Elisabeth, St. Stephen’s Cathedral and Schönbrunn Palace, Vienna has lot more to offer: Let our guides show you the nicest walk through the Old Town of Vienna.
Workshop Dinner at Restaurant Schubert: 19:30 – 23:00

Please note that there is no possibility to store your laptop / bag at the university or during the tour.

Address:
Restaurant Schubert
Schreyvogelgasse 6
1010 Vienna
(Metro stop U2 „Schottentor“- directions will be provided, no organized transport for returning)

Wednesday, 23rd September 2015 – Mayor’s Reception

Mayor´s Reception

A vintage tram will take us to the Heurigenrestaurant “10er Marie”, the oldest wine tavern of Vienna (1740) and the location of the Mayor’s Reception. During the ride you will be able to see several main attractions such as the Vienna State Opera, the Museum of Fine Arts, the Museum of Natural History, the Heldenplatz and the Austrian Parliament.

Meeting point: 18:00 in front of the Conference Venue (after the last session)

Please note that there is no possibility to store your laptop / bag at the university or during the tour.

Address:
10er Marie
Ottakringer Straße 222-224
1160 Vienna
(Metro stop U3 „Ottakring“– directions will be provided, no organized transport for returning)

Thursday, 24th September 2015 – Conference Dinner

A bus will take us to **Schönbrunn Palace**, Empress Sisi’s former summer residence. The palace is part of UNESCO’s cultural heritage due to its historic importance, its unique grounds and its splendid furnishings. At Schönbrunn Palace we have organized a Grand Tour, which will give you a picture of the different stylistic eras of the imperial monarchy and the life’s of the palace´s inhabitants.

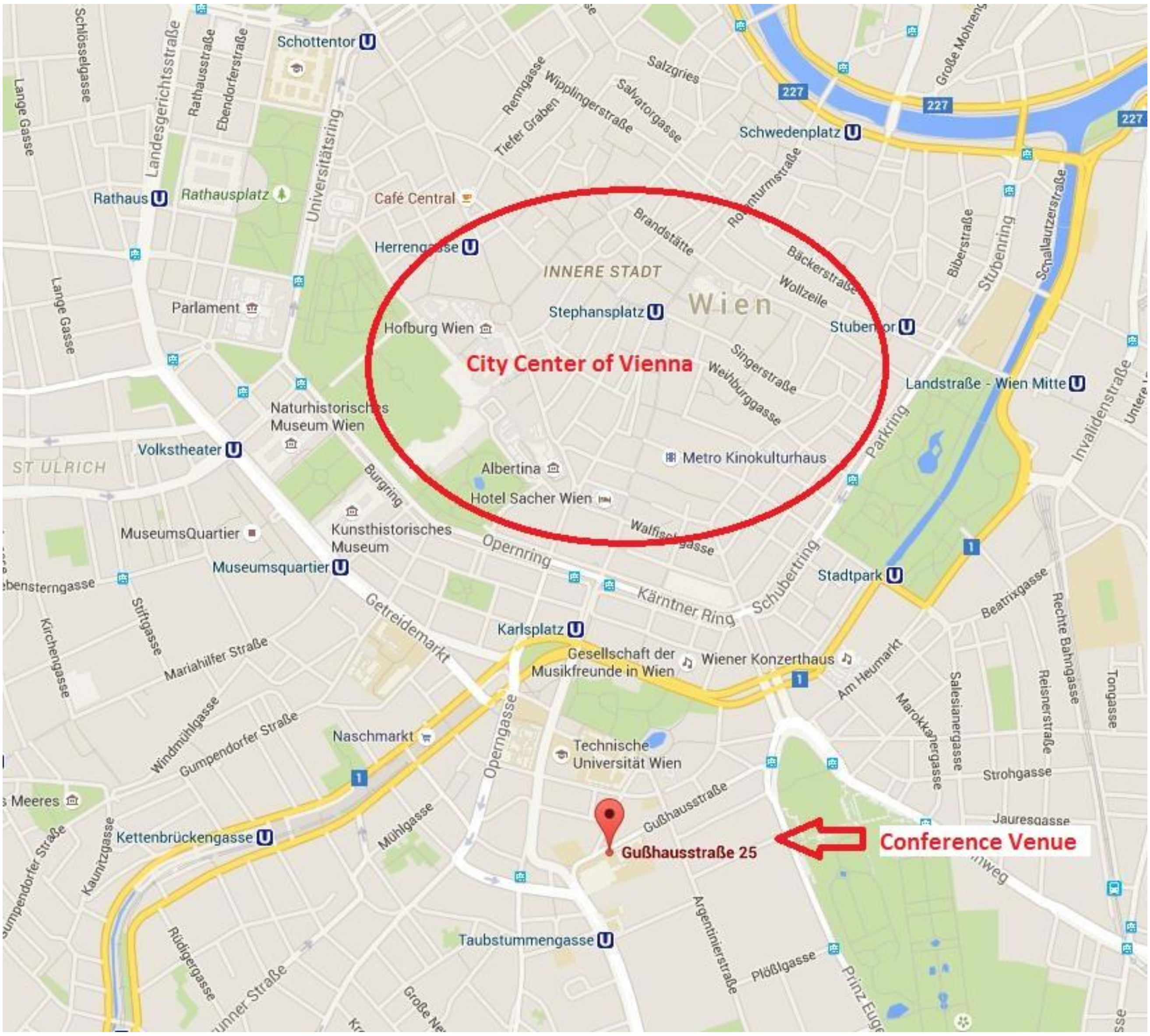
After the tour little trains will take us to the Conference Dinner location, the **Orang.erie**, which is located in the „Vienna Zoo“. Founded as an imperial menagerie in 1752, it is the oldest zoo in the world. The Vienna Zoo is located on the grounds of the Schönbrunn Palace, on our way from the Palace to the Dinner location you will see parts of it.

Meeting point: 17:00 in front of the Conference Venue (after the last session)

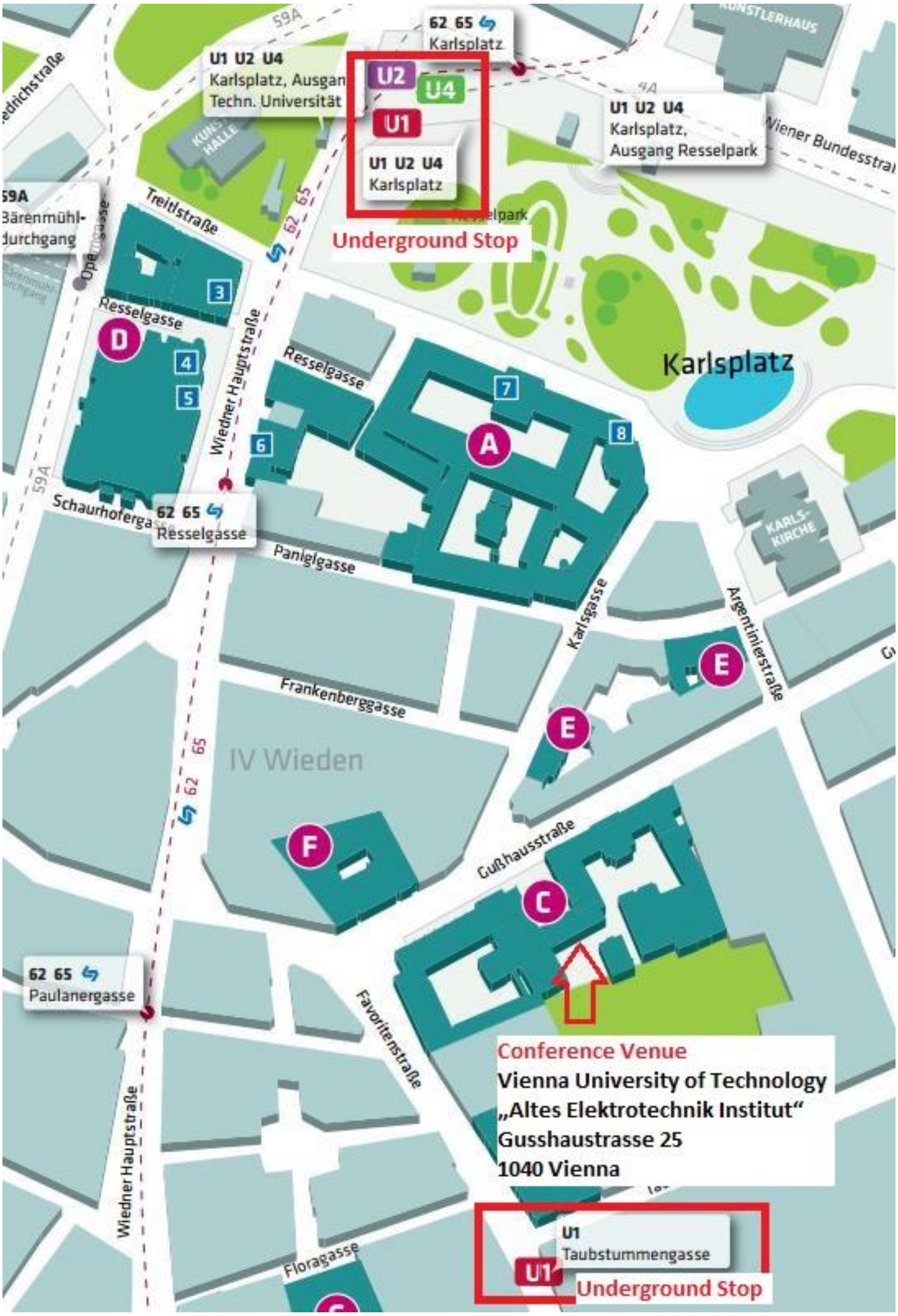
Address:
Orang.erie
Maxerstraße 13
1130 Vienna
(Metro stop U4 „Hietzing“– directions will be provided, no organized transport for returning)

Schönbrunn Palace

Venue Overview

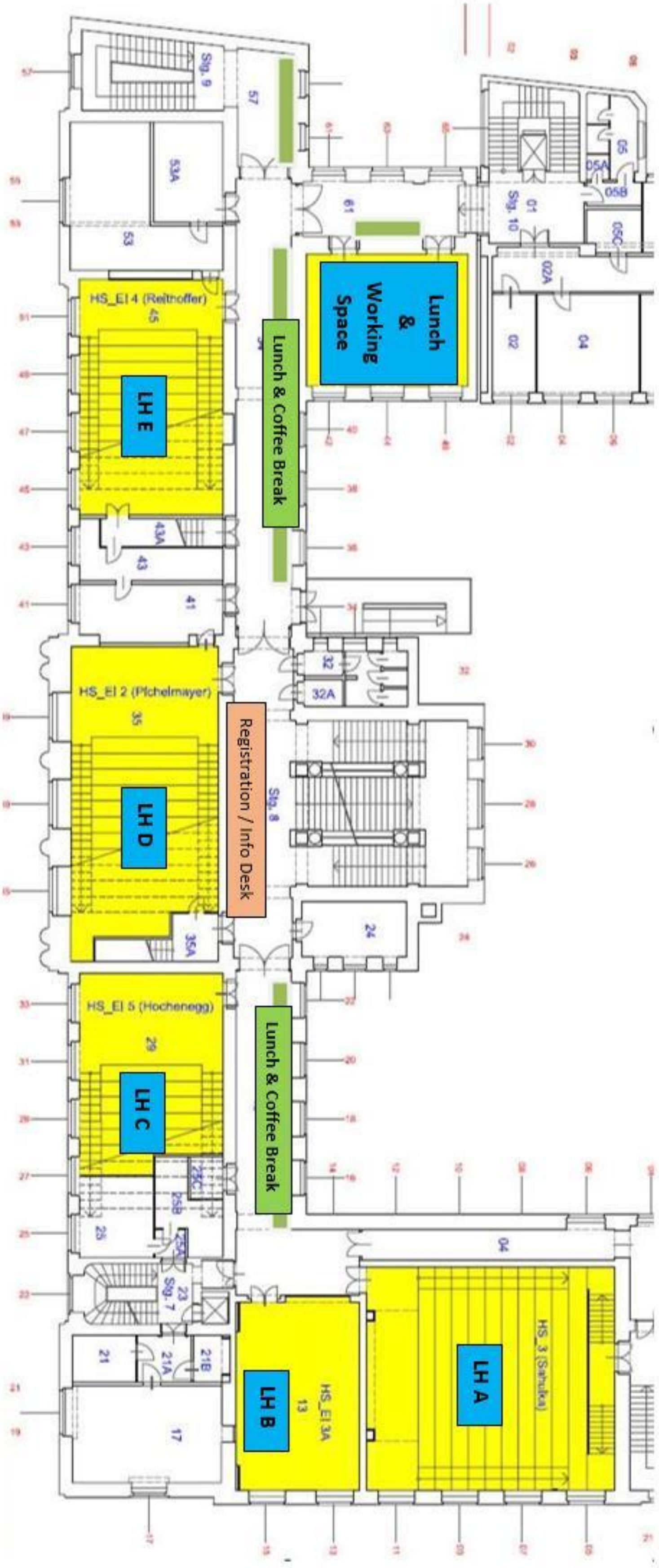


Conference Venue



Map 1: Conference Venue Overview

Room Plan


Lunch & Working Space
Lunch & Coffee Break
HS_EI 4 (Reithoffer)
45
LH E
HS_EI 2 (Pichelmayer)
35
LH D
Registration / Info Desk
Stg. 8
HS_EI 5 (Hochenegg)
29
LH C
Lunch & Coffee Break
HS_EI 3A
13
LH B
HS_3 (Sahulka)
LH A
Stg. 9
57
53A
53
61
43A
43
41
32
32A
35A
24
25
25B
25C
Stg. 7
23
21
21A
21B
17
04
02
02A
01
Stg. 10
05
05A
05B
05C

Lunch Information & Menu

We will provide you with a catered lunch directly at the conference venue. There will be a joint lunch and coffee break area. During the lunch break the working room will serve as lunch break area where you can also enjoy your lunch as a seated lunch.

Here you can find the menu:

Monday, September 21st 2015
Salted sponge mixture into a clear vegetable soup
Chickenragout with fresh vegetables and noodles **or** Tortellini filled with spinach on herbal sauce

Tuesday, September 22nd 2015
Potato cream soup
Fried escalope of turkey with pea's rice **or** vegetables lasagne on tomato sauce with grana Padano

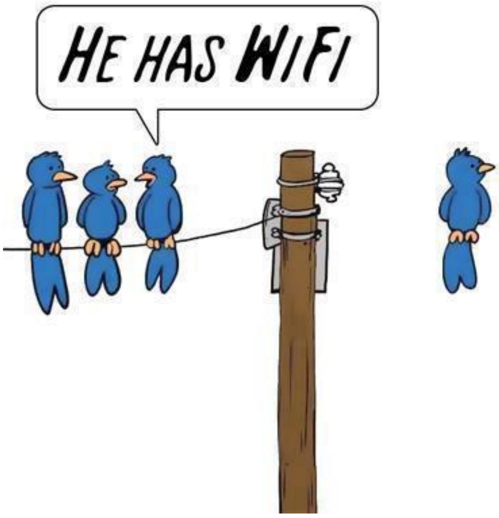
Wednesday, September 23rd 2015
French onion soup
Meat (pork) cut into strips Zurich style with spiral noodles **or** cauliflower cheese burger with ratatouille

Thursday, September 24th 2015
Peas cream soup
Roast beef in pepper cream soup with bread dumplings **or** Potato goulash

Friday, September 25th 2015
Clear vegetable soup with small egg dumplings
Roast chicken breast on vegetables with almond rice **or** Penne with tomatoes basil sauce and Grana Padano

WIFI Information

The SSID of the wireless LAN is *Tunetguest*. All participants receive an own user and password. Your personal WIFI information is printed on your badge. Eduroam is also available.



Directions

How to get from the airport to the city centre

The Vienna International Airport (VIE) in Schwechat is about 20 km away in the southeast of Vienna. Train lines S7 and S2 (suburban railway “S-Bahn”), ICE as well as the City Airport Train (CAT) connect the city center with the airport.

You can also take a taxi for your convenience, a taxi fare is at about 30 Euro. We recommend a pre-booked taxi with airportdriver.at. It can be booked online: http://www.airportdriver.at/en/airport-transfe. After the baggage claim, take the left exit and walk left. The driver will wait for you there.

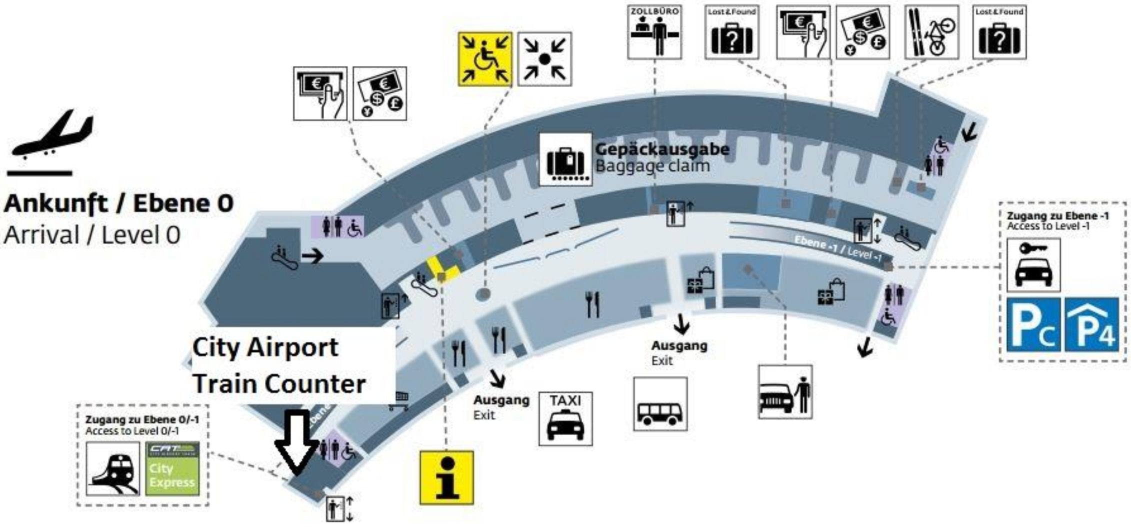
1. City Airport Train / CAT

The CAT takes just 16 minutes nonstop to get from central Vienna to the airport and vice versa. The City Airport Train operates daily from 05.36 a.m. to 23.36 p.m. The City Air Terminal is just 10 minutes from St. Stephan’s Cathedral at “Landstraße - Wien Mitte” station, which can be reached easily by tram, underground, bus or taxi. The price for a single fair is €11.00, the exact timetable and more information can be found here: http://www.cityairporttrain.com/

Overview departure time CAT

Departure	Arrival	First train (departure)	Last train (departure)	Duration
Wien Mitte	Vienna Airport	05:36 (then 06 & 36 min. past the hour)	23.06	16 min
Vienna Airport	Wien Mitte	06:06 (then 06 & 36 min. past the hour)	23.36	16 min

Vienna Airport Map



Map 2: Vienna Airport Map

2. S-Bahn / suburban railway

The Schnellbahn (S-Bahn) is a low-priced way of getting from Vienna to the airport and back. Price: from € 4.40 (including travel on Vienna public transport). Ticket machines are on the platforms at the airport and at Wien Mitte.

The following table gives a summary of the S-Bahn timetable between "Landstraße - Wien Mitte" and Vienna Airport. To get to the city center you need to take the S-Bahn line "S7" in direction "Floridsdorf".

Departure	Arrival	First suburban railway (departure)	Last suburban railway (departure)	Duration
Wien Mitte	Vienna Airport	04:30 (then apprx. Every 30 min)	23:45	25 min
Vienna Airport	Wien Mitte	04:56 (then apprx. Every 30 min))	00:17	25 min

3. ICE/ long-distance train

The ICE departs every 2 hours from Vienna to the airport or from the Airport to Vienna. In Vienna it stops at two train stations "Wien-Hauptbahnhof" and "Wien Meidling". From "Wien Hauptbahnhof" you can take the red undergoundline (U1) direction "Leopoldau" and get out at the stop "Karlsplatz" or "Stephansplatz".

The following table gives an overview of the timetable.

	From the Airport			To the Airport		
	Vienna Airport	**Wien Hauptbahnhof**	**Wien Meidling**	**Wien Meidling**	**Wien Hauptbahnhof**	**Vienna Airport**
First train	6:25 (then every 2 hours)	06:41 (then every 2 hours)	06:49 (then every 2 hours	07:27 (then every 2 hours)	07:38 (then every 2 hours)	07:56 (then every 2 hours)
Last train	22:00	22:16	22:24	21:07	21:15	21:32

How to get from the airport directly to the Conference Venue

Address of the Conference Venue:

Vienna University of Technology
„Altes Elektrotechnik Institut“
Gusshaustraße 25
1040 Vienna
Austria

Choose a connection from before, either the CAT or the S-Bahn (see information before) to get from the airport to the venue. The closest underground stops are “Karlsplatz” (U1/U4/U2) or “Taubstummengasse” (U1).

If you decide to take the CAT to get to the Conference Venue:

The last stop is “Landstraße - Wien Mitte” (1). Get out there and take the green underground line (U4) in direction “Karlsplatz”. (2) Then you can either walk to the conference venue (exit “Resselpark”) or change to the red underground line (U1), direction “Reumanplatz” and get out at “Taubstummengasse” (3) then follow the signs to the exit “Floragasse” from there it is just a 3 minutes’ walk to the venue. See map 3.

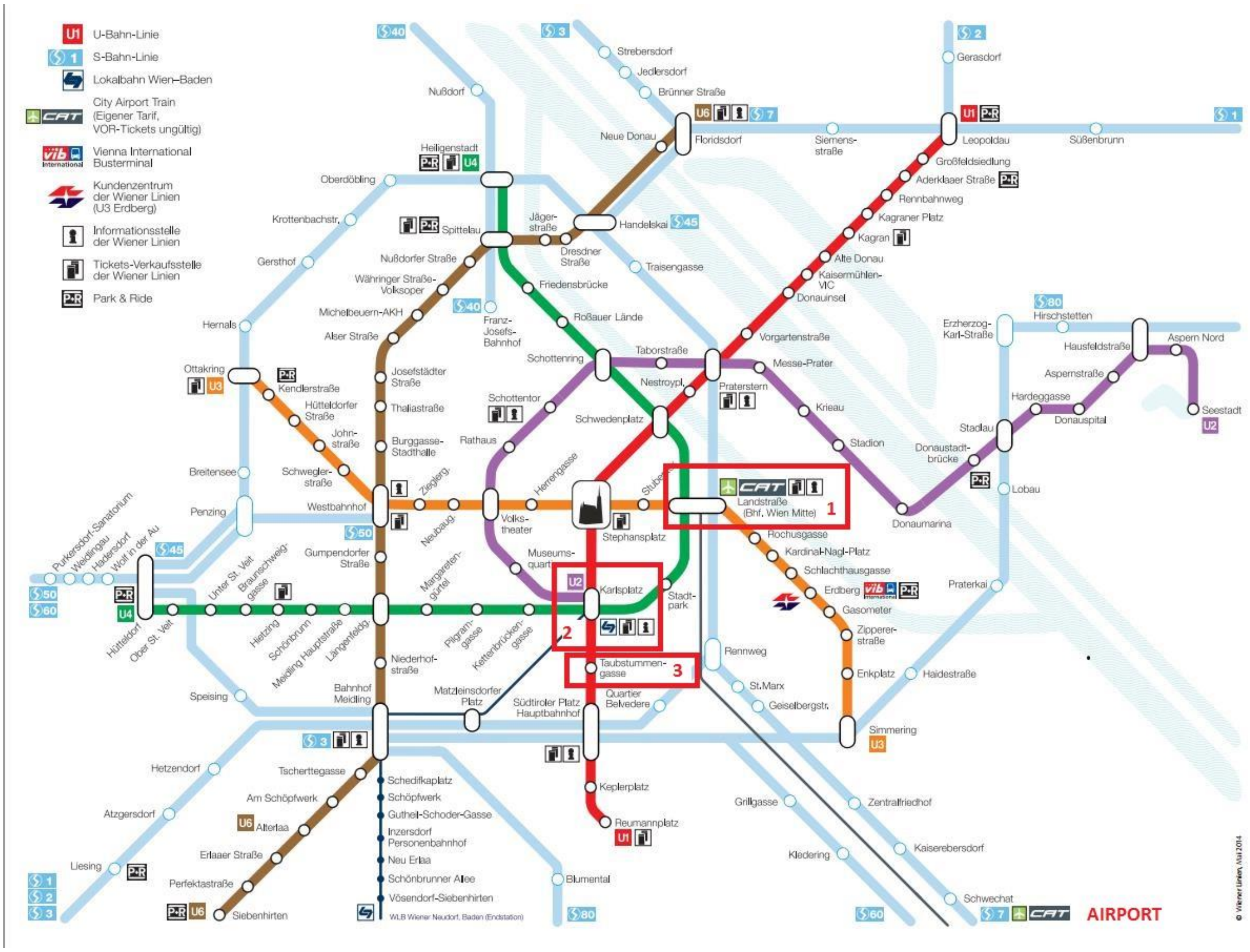
If you decide to take the S-Bahn to get to the Conference Venue:

Get out at the stop “Praterstern” (1) and take the red underground line (U1) in direction “Reumanplatz”. Get out at “Taubstummengasse” (2) then follow the signs to the exit “Floragasse” from there it is just a 3 minutes’ walk to the venue. See map 6.

If you decide to take the ICE to get to the Conference Venue:

Get out at “Wien Hauptbahnhof” (1) and take the red underground line (U1) direction “Leopolau” and get out at the stop “Taubstummengasse” (2) then follow the signs to the exit “Floragasse” from there it is just a 3 minutes’ walk to the venue. See map 7.

Underground Map CAT



Map 3: CAT: Airport - Conference Venue

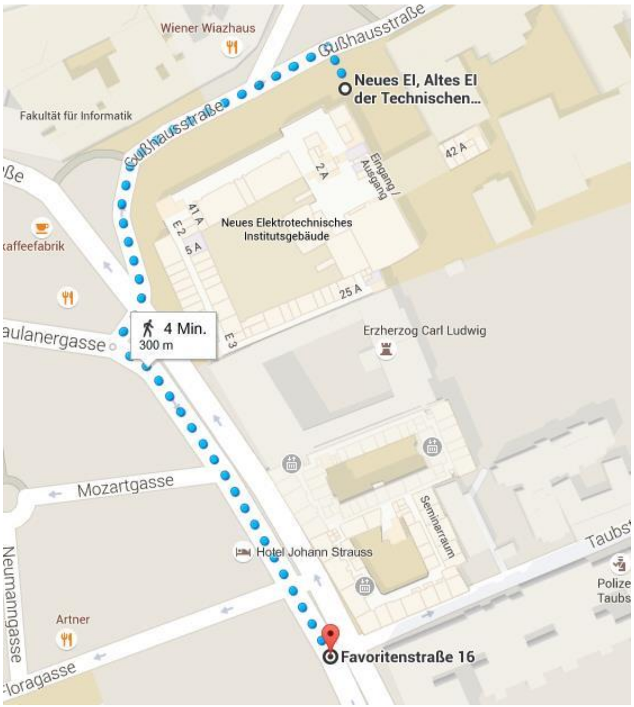
1 Get out at “Landstraße - Wien Mitte” and change to U4 (“Hütteldorf”)

2 Get out at “Karlsplatz” and walk or change to U1 (“Reumanplatz”)

3 Get out at “Taubstummengasse”

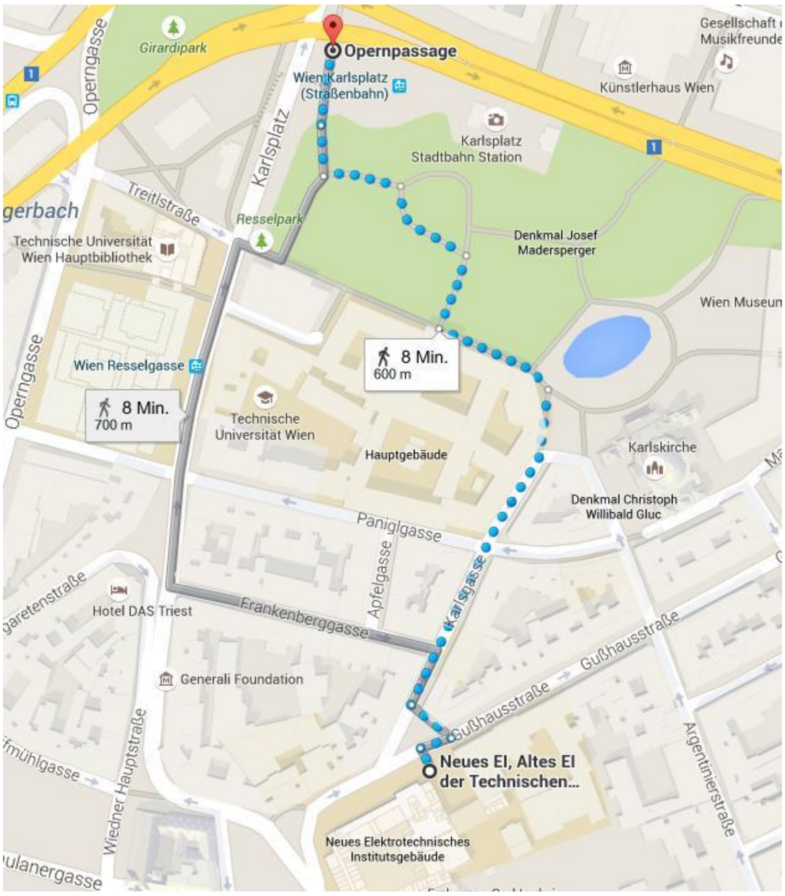
Walking Distances

Stop „Taubstummengasse“ to the conference venue:



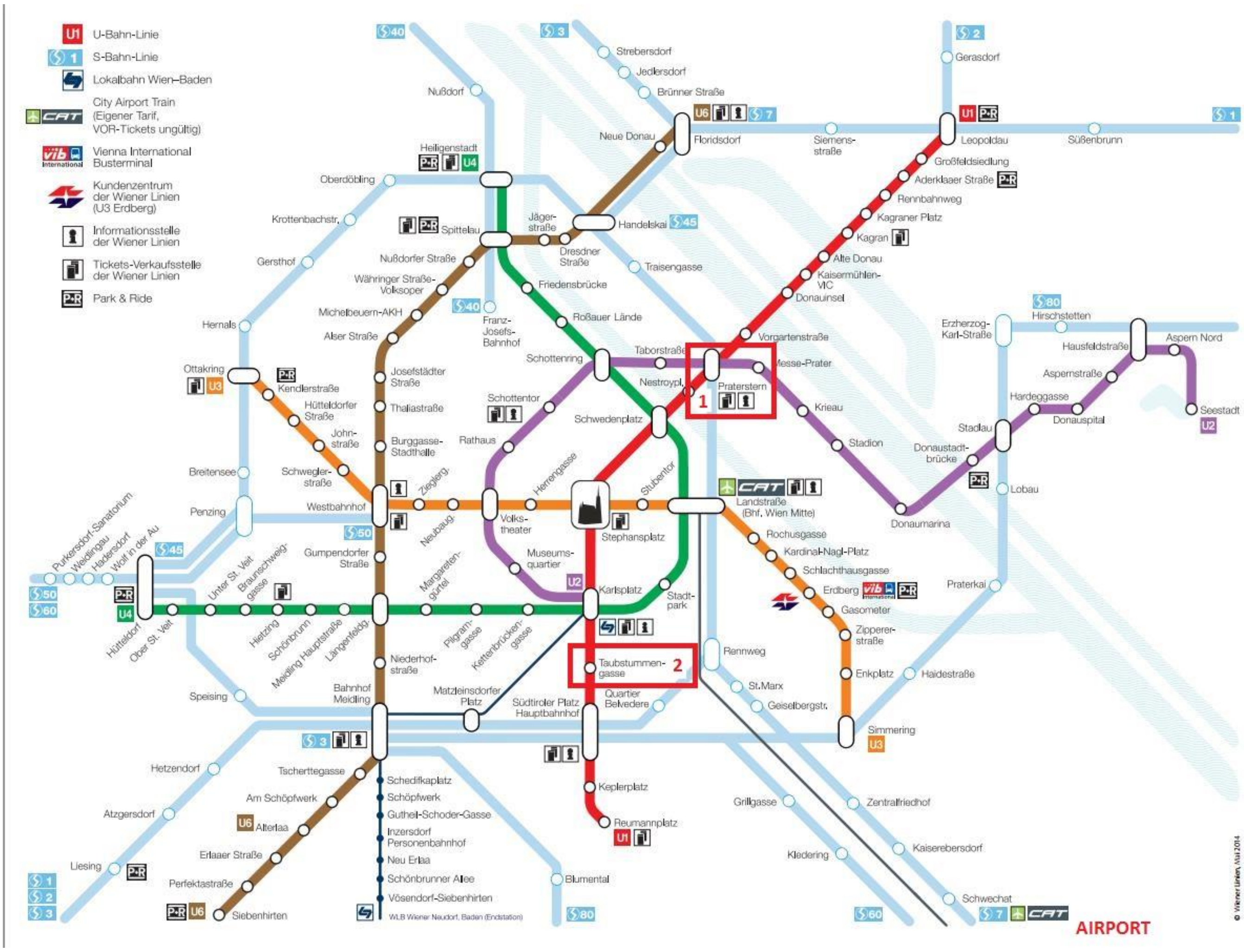
Map 4: Taubstummengasse (U1) to Conference Venue

Stop "Karlsplatz" to the conference venue:



Map 5: Karlsplatz (U1/U4/U2) to Conference Venue

Underground Map S-Bahn

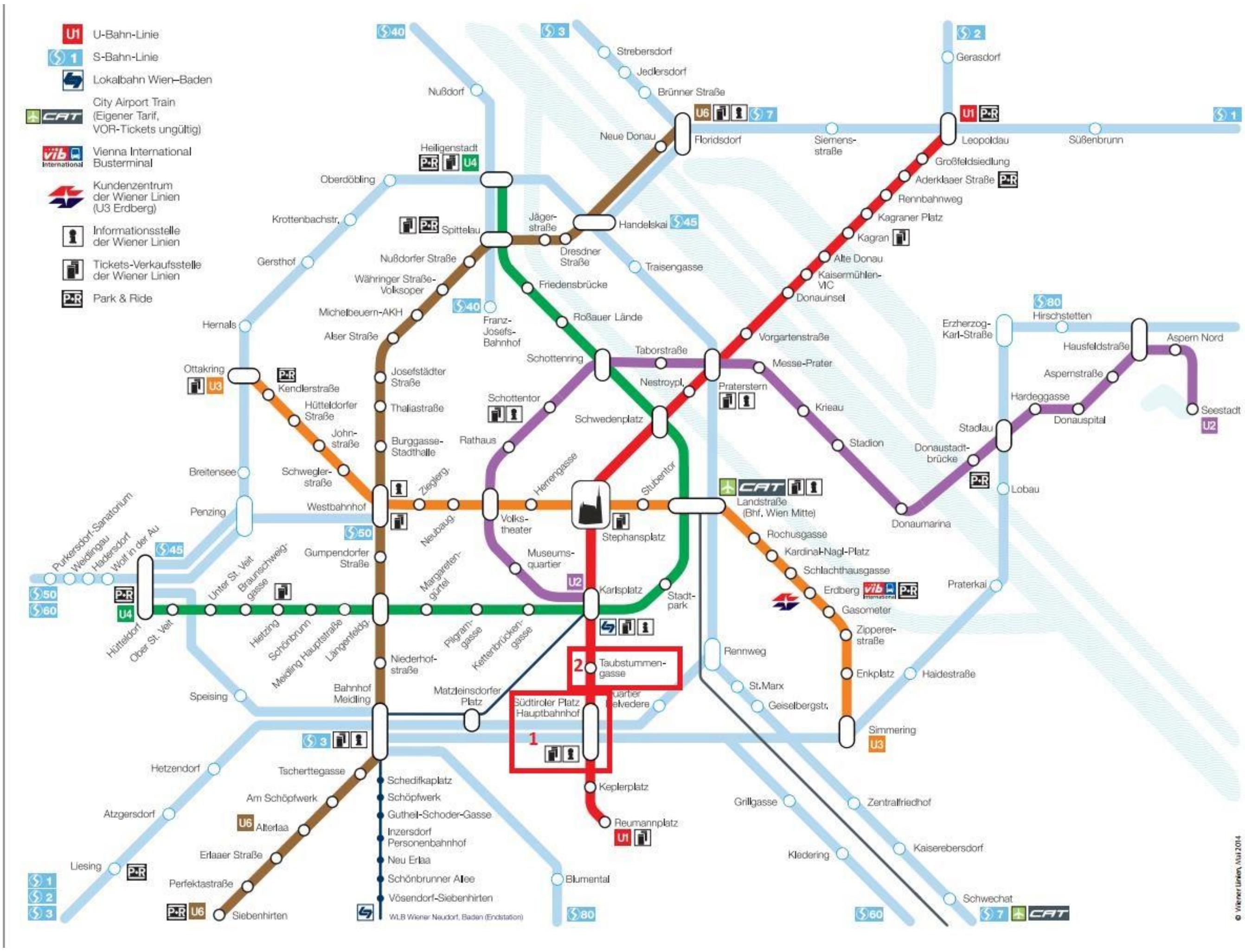


Map 6: S-Bahn: Airport -> Conference Venue

1 Get out at “Praterstern” and change to U1 (“Karlsplatz”)

2 Get out at “Taubstummengasse”

Underground MAP ICE

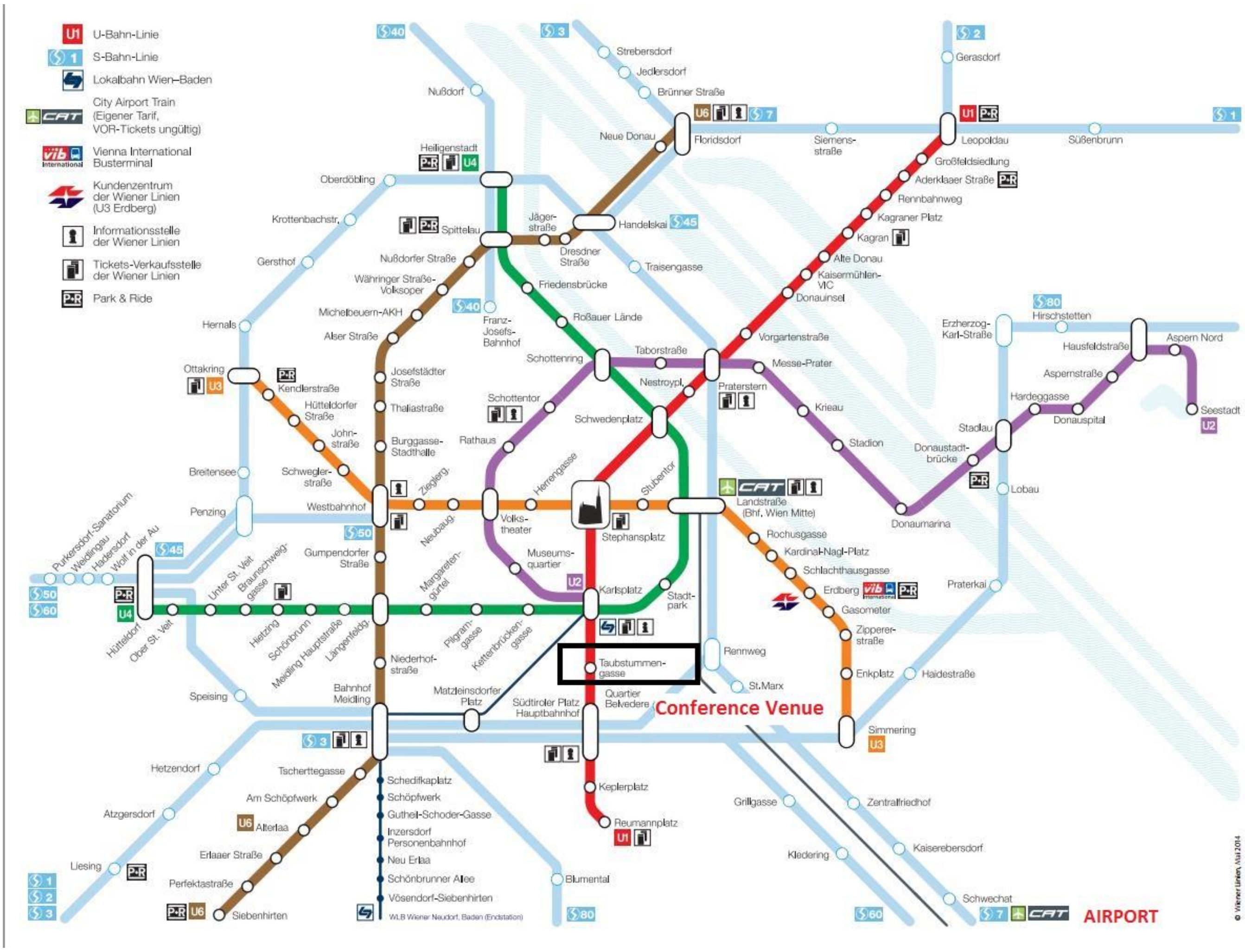


Map 7: ICE Airport -> Conference Venue

1 Get out at "Wien Hauptbahnhof" and change to U1 ("Karlsplatz")

2 Get out at "Taubstummengasse"

Public Transport



Map 8: Public Transport Vienna

The underground trains (U-Bahn) run from about 5.00 am in the morning to about midnight. The underground trains run around the clock on Friday and Saturday and on the eve of public holidays!

Welcome to Vienna!

Useful Information

Tourist Information
1st district, city centre Albertinaplatz, corner of Maysedergasse Daily from 9.00 am to 7.00 pm Vienna International Airport, Schwechat Arrival hall Daily from 7.00 am to 10.00 pm

Emergency Numbers	
Fire service	122
Police	133
Ambulance/ rescue	144
Emergency doctor	141
European emergency	112

Opening hours shops in Vienna

Shops are usually open Mon - Fri from 9.00 am - 6.30 pm, Sat until 5.00 pm or 6.00 pm; some shopping centres are open until 8.00 pm or 9.00 from Mon-Fri. Shopping is available on Sundays and holidays at the large railway stations, at the airport and in the museum shops.

Drugstores are open from Monday to Friday from 8.00 am - 6.00 pm, usually without a lunch break, and on Saturday from 8.00 am - 12.00 noon. Outside of these times, a 24-hour drugstore standby service is available throughout the city. Details of the nearest open drugstore are posted at every drugstore. For telephone information, call the number 1455.

WIFI in Public Transport

In Vienna there are 10 WIFI Hotspots available in the public transportation systems. These are set up near the information offices in the following metro stations:

- Südtiroler Platz/Hauptbahnhof (U1, red line)
- Karlsplatz (U1, red line/U2, purple line/ U4, green line)
- Stephansplatz (U1, red line/ U3, orange line)
- Praterstern (U1, red line/U2, purple line)
- Schottentor (U2, purple line)
- Westbahnhof (U6, brown line/ U3, orange line)
- Landstraße (U3, orange line/ U4, green line)
- Erdberg (U3, orange line)
- Meidling (U6, brown line)
- Floridsdorf (U6, brown line)

Public Transport Tickets

24-, 48- & 72-hour-ticket

24-hour-ticket € 7.60

48-hour-ticket € 13.30

72-hour-ticket € 16.50

About

- ticket is valid for 24, 48 or 72 hours from validation
- valid on all public transport services in Vienna

Vienna Weekly Ticket

Weekly ticket (Monday-Sunday) € 16.20

About

- ticket is valid for one week, from Monday to Sunday during this week it can be used for as many rides as you want

Single Trip

Single Trip € 2.20

About

- can be used to travel once in one direction and are valid from the time they are punched in a validating machine
- you may change between tram, bus and underground as often as you like, but without interrupting travel

Tickets are available

- at the Vienna transport Authority´s ticket offices
- ticket machines
- tobacconists
- online: https://shop.wienerlinien.at/

About Vienna

Vienna is old, Vienna is new – and so diverse: from the magnificent Baroque buildings to "golden" Art Nouveau or the latest architecture. Vienna is packed with imperial history; at the same time it has exciting contemporary museums, lively eating and a vibrating nightlife, but also many quiet corners to explore.

Few cities can boast the imperial grandeur of Vienna, once the centre of the powerful Habsburg monarchy. Lipizzaner stallions performing elegant equine ballet, the angelic tones of the Vienna Boys' Choir drifting across a courtyard and, outrageously opulent palaces.

Walk in the footsteps of the Habsburgs, visit the splendid baroque Schönbrunn or Belvedere Palaces, or stroll along the magnificent Ring Boulevard to take a look at the heart of the former vast Habsburg Empire, the Imperial Palace. Get a sense of the luster and glory of the old empire by visiting St. Stephen's Cathedral, the Spanish Riding School, and the Giant Ferris Wheel at the Prater, as well as the sarcophagi in the Imperial Vault.

Visit Empress Sisi's former summer residence. This baroque complex contains an enchanting park, the Palm House, the Gloriette and a zoo. Spend an entire day at Schönbrunn: visit the show rooms with a "Grand Tour with Audio Guide," admire the splendid Bergl Rooms, and stroll through the "Labyrinth." Schönbrunn Zoo in Vienna is the oldest existing zoo in the world and has been named Europe's best on three occasions. Each year more than two million visitors come to see the panda baby, new-born elephants and many other rare animals.

Schloss Schönbrunn

Beautiful and celebrated Empress Elisabeth has long since become a cult figure. The Sisi Museum in the Imperial Apartments of the Imperial Palace compares the myth and the facts. Among the highlights are numerous personal objects once owned by Elisabeth as well as the most famous portraits of the beautiful empress.
The Spanish Riding School in only a few steps away from the Sisi Museum and will be celebrating the 450th anniversary of its first written mention with gala performances on Heldenplatz in 2015.

Emperor Franz Joseph officially opened Vienna's Ringstrasse on May 1, 1865. Vienna is celebrating its 150th birthday in 2015 with numerous events and exhibitions. The most beautiful boulevard in the world not only rich in sights, it also has large parks, important monuments, and much more. About 800 buildings line the boulevard today. Additional sights on the Ringstrasse, aside from the many opulent buildings, include the black-gold lattice fence in front of the Hofburg, the world's longest fence from the age of Historicism, the 5.5-meter-tall Pallas Athene statue in front of the Parliament, and the "Rathausmann", a statue of a man on the tower of City Hall.

Vienna State Opera

The University of Vienna is the second oldest German-speaking University in the world. The building on the Ring was erected in the style of the Italian High Renaissance. The first university in Vienna had already be founded in 1365, but elsewhere in the city. That's why the 650th birthday of the most important educational institution in the country will be celebrated in 2015.

Vienna is one the most musical cities in the world. This is partly due to the vast number of great composers and musicians who were born here or lived and worked here. Visiting Austria's capital therefore means experiencing the works of Mozart, Haydn, Schubert, Beethoven, Johann Strauss and many others in venues like the Staatsoper and Musikverein. The music of Bach and Händel continues to be performed in Vienna's historic churches today, and Vienna's Collection of Ancient Musical Instruments, paired with a visit to the Haus der Musik, takes you deeper into the texture of music and how it is created. Venues for classical music are augmented by some great clubs and live rock and jazz places.

Volksgarten

The Mercer Study has chosen Vienna as the world's number one most liveable city for the sixth time in a row in 2015. More than half of the metropolitan area is made up of green spaces. 280 imperial parks and gardens enrich the cityscape. In spring, 400 species of rose bloom in the Volksgarten alone. The nearby recreation areas of Prater, Vienna Woods and Lobau invite visitors to go on walks, day trips, hikes and bicycle tours. Vienna has a total of 2,000 parks.

St. Stephen's Cathedral is the symbol of Vienna. Construction commenced in the 12th century. Today, it is one of the most important Gothic structures in Austria. Stephen's Cathedral is located directly in the city centre, at the religious and geographical heart of Vienna. It´s giant Pummerin bell features on television as it rings in the New Year.

It's hard to imagine a more liveable city than Vienna. This is a metropolis where regulars sit in cosy coffee houses and offer credible solutions to the worlds chaos over the noble bean; where Beisln (bistro pubs) serve delicious brews, wines and traditional food; where talented chefs are taking the capital in new culinary directions; and where an efficient transport system will ferry you across town from a restaurant to a post-dinner drink in no time at all. It's safe, it has lots of bicycle tracks and it even has its own droll sense of humour.

Vienna is a city where postmodernist and contemporary architectural designs contrast and fuse with the monumental and historic. The MuseumsQuartier is a perfect example, with modern museum architecture integrated into a public space created around former stables for the Habsburgs' horses.

Museumsquartier

Twentieth-century designs are little short of inspiring, while contemporary Vienna is constantly being given new and exciting infrastructural designs such as the new Twin City Liners boat landing and the enormous Hauptbahnhof.

Eurovision Song Contest 2015

Vienna also hosts several international events such as the famous opera ball that takes place every year in February, which is taking place in the Vienna State Opera. The Life Ball, one of the biggest AIDS charity events worldwide also takes place in Vienna and is held in front of the city hall. Each Life Ball is attended by stars, designers and politicians from all over the world such as Bill Clinton, Katy Perry and Charlize Theron and Jean Paul Gaultier. In 2015 Vienna is celebrating not only one but three anniversaries; 150 years Ringstrasse, 450 years of the Spanish Riding School and 650 years University Vienna. Furthermore Vienna hosted the 60th Eurovision Song Contest in May 2015.

Sources: Vienna Info, Lonely Planet

Tips from a Local

Here you can find some restaurant tips from a local!
Watch out because some of them are very crowded places, so it may be a good idea to reserve a table before you go there.

Restaurants

- **Flatschers**: The best steak in town. Steaks starting at € 25 without side dishes. Super-professional personnel. http://www.flatschers.at/, Kaiserstraße 121, 1070 Vienna
- **Brickmakers**: Smoked barbecue, Cider and one of the best beer collections I know in Vienna. Meat is smoked 13 hours before serving. http://www.brickmakers.at/, Zieglergasse 42, 1070 Vienna
- **Toma tu Tiempo**: Spanish tapas just as good (or even better) than in Spain. Good collection of Spanish wines. http://www.tomatutiempo.at/, Zieglergasse 44, 1070 Vienna
- **Grünspan**: Restaurant with classic Austrian dishes of very high quality, but not as expensive as the other restaurants in the first district. http://www.plachutta.at/de/gruenspan/, Ottakringer Straße 266, 1160 Vienna
- **Schweizerhaus**: Restaurant where they have the famous "Stelze" (part of the pig's leg). They also have drought Budweiser beer. Awesome beer garden. http://www.schweizerhaus.at/, Prater 116, 1020 Vienna
- **Wratschko:** Viennese atmosphere, delicious Viennese food. (no website) Neustiftgasse 51, 1070 Vienna

Cocktail Bars

- **Ebert's Cocktail Bar:** In my opinion, the best cocktails in town. They also have a cocktail school where you can learn how to mix awesome cocktails yourself. http://www.eberts.at/, Gumpendorfer Straße 51, 1060 Vienna
- **The Sign**: Equal in quality, but way better-looking cocktails than in Ebert's. http://www.thesignlounge.at/, Liechtensteinstraße 104-106, 1090 Vienna
- **Dino's American Bar**: One of the old and classic American cocktail bars in Vienna. Awesome cocktails (try the Whiskey Sour with white of egg). http://www.dinos.at/, Salzgries 19, 1010 Vienna
- **Barfly's**: Another old and classic American cocktail bar. It is inside a hotel. Huge collection of Whiskey and Rum. http://www.castillo.at/en/, Esterzahygasse 33, 1060 Vienna (Hotel Fürst Metternich)

Bars and Pubs

- **Känguruh**: Awesome bar that has a collection of about 300 beers (mostly Belgian, German and Austrian). http://www.kaenguruh-pub.at/, Bürgerspitalgasse 20, 1060 Vienna
- **Wein & Co**: Elegant bar, great opportunity to taste a huge collection of Austrian and international wines. Dress up elegant if you go there. https://www.weinco.at/filiale/wien-mariahilfer-strasse-9321, Mariahilfer Straße 36, 1070 Vienna
- **Hawidere**: (Hawidere = an Austrian way of greeting a good friend), extremely cozy and friendly Austrian pub in the 15th district. Good selection of beers, also Burgers and other things to eat. http://www.hawidere.at/, Ullmannstraße 31, 1150 Vienna

Cafés

- **Café Josefine**: Young, fresh and small café in the 8th district of Vienna. Awesome coffee, breakfast and small things to eat. http://cafejosefine.at/, Laudongasse 10, 1080 Vienna
- **Café Sperl:** Traditional Austrian café with a nice garden. http://www.cafesperl.at/, Gumpendorfer Straße 11, 1060 Vienna

Cultural Program

Taking place from September 21-27, 2015

Here you can find concerts, exhibitions and sightseeing trips taking place during your stay in Vienna.

Tourism Information Vienna:

Here are some websites that provide further information and suggestions for you stay in Vienna:
http://www.wien.info/en
http://www.lonelyplanet.com/austria/vienna
https://www.viennasightseeing.at/en/
http://www.viennaticketoffice.com/home_en.php

If you need any assistance concerning the booking of sightseeing tours, concerts or exhibitions please do not hesitate to contact the conference office.

Cafe Concerts, Heurigen & Dinner Shows

1st Viennese Heurigen Show

A successful blend of Viennese Waltz and Operetta with traditional Viennese Heurigen Culture is presented by the first Wiener Heurigen Show at the famous "Wine Tavern Wolff". The rustic ambient of this genuine wine tavern (in family possession since 1602), provides an ideal setting for an authentic experience of Viennese music, cuisine and wine culture. Dressed in colourful costumes, the talented musicians of the 1st Wiener Heurigen Show, supported by 2 singers and 2 charming dancers, entertain their audience with a selection of famous waltz melodies, polkas and romantic arias & duets from operettas.

Date:	Wed. 23rd September 2015, 8:15 p.m.
Venue:	Wolff Wine Tavern, Rathstrasse 44-46 1190 Vienna
Price:	25-48€
Contact information:	+43 1 524 74 78 tickets@heuriger.com www.heuriger.com

Austrian Dinner Show

A musical and culinary journey through Austria.

A musical journey from the mountains of Tirol, the charming lakes of the Salzkammergut, and from the romantic Danube Valley to imperial Vienna awaits the visitors of the “Austrian Dinner Show". Traditional folklore tunes and colorful dances, a spirited “Landler“ from the Alps, romantic arias from Salzburg and famous Waltzes and Operettas from Vienna, the highly talented musicians of the ensemble, excellent vocal soloists and spirited dancers will enchant with their performance of the musical treasures of Austria. Between each dinner course, the visitors experience an exciting program divided into 3 entertaining show scenes. During dinner, typical Viennese music will be played live.

Date:	Mon. 21st September 2015, 8 p.m. Wed. 23rd September 2015, 8 p.m., Fri. 25th September 2015
Venue:	Wiener Rathauskeller Rathausplatz 1 1010 Wien
Price:	58€
Contact information:	+43-1-274 90 46 office@dinnershow.at www.austriandinnershow.at

Exhibitions

Monet to Picasso. The Batliner Collection

Under the title “Monet to Picasso”, the Albertina exhibits its vast holdings of paintings from the period of Modernism, which are primarily made up of works from the Batliner Collection. The epochs covered by this reinstallation of the museum’s permanent collection range from Impressionism and Fauvism to German Expressionism, the Bauhaus, and the Russian avant-garde; the presentation concludes with works by Picasso.

Claude Monet
View of Vétheuil, 1881

Lee Miller

Lee Miller (1907-1977) is considered one of the most fascinating artists of the 20th century. In over five decades, she produced a body of photographic work of a range that remains unparalleled, and that unites the most divergent genres. Miller’s oeuvre extends from surrealistic images to photography in the fields of fashion, travelling, portraiture and even war correspondence; the Albertina presents a survey of the work in its breadth and depth, with the aid of 90 selected pieces.

Drawing Now: 2015

Forty years after Drawing Now, the legendary exhibition mounted jointly with the MoMA in New York, 2015 will see the Albertina once again attempt to take stock of what drawing means or can mean today. In the present showing, selected works by 36 international artists and artist groups turn the spotlight on relevant movements of the past ten years.

Tornado Amarillo Doble,
Thyssen-Bornemisza Art

Drawing Now: 2015 illustrates the broad spectrum of present-day tendencies of drawing in art: its range of featured works runs from the abstract to the figurative and from sketches to large-scale projects planned in great detail. In terms of content, the artists devote their works to private experiences, simple everyday observations, and political events. They also reflect on the medium of drawing itself, examining the conditions and possibilities of such works’ production while also making a theme of appropriated drawing and drawing as a performative or collaborative act.

Date:	daily, 10 a.m. - 6 p.m.
Venue:	Albertina Albertinaplatz 1 1010 Wien
Contact information:	+43 1 534 83 0 info@albertina.at www.albertina.at

Sightseeing

Vienna Ring Tram

You can get to know Vienna's wonderful boulevard, the Ringstrasse around the Old City, in comfort from the Vienna Ring Tram – all year round, daily from 10.00 am to 5.30 pm.

Inside the wagons (31 seats), LCD screens inform you about the highlights along the route, supplemented with information in several languages over the headphones. Duration: 25 minutes; tickets can be purchased on board the tram and at the advance sales outlets of Wiener Linien Boarding and alighting point on Schwedenplatz

Date:	daily from 10.00 am to 5.30 pm on the hour and half hour
Venue:	Schwedenplatz 1010 Wien
Contact information:	http://www.wienerlinien.at
Ticket price:	8€

Vienna at First Glance - Guided Walk

Comprehensive introduction to the most important sights of Vienna's historical center.

Meeting point: Tourist-Info, 1., Albertinaplatz / Ecke Maysedergasse

As of 3 people, irrespective of weather conditions, duration: 1 1/2-2 h, excluding admission fees, no booking required.

Date:	daily, 2 p.m.
Contact information:	+43 1 489 96 74 d.office@wienguide.at www.wienguide.at
Ticket price:	15€

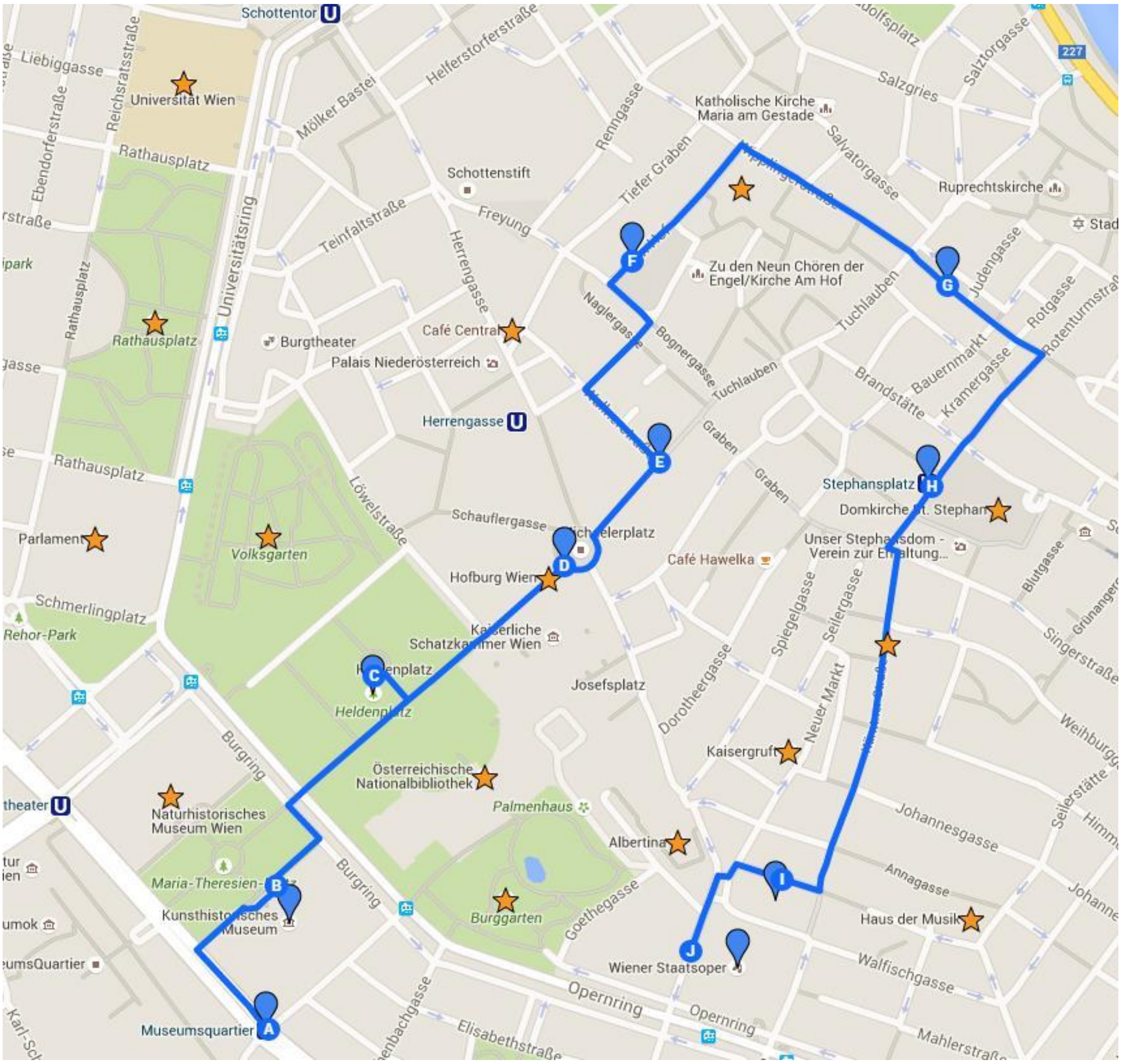
Guided Tours Spanish Horse Riding School

including Stables

A unique tour of the Spanish Riding School takes you to the different "stations" which account for the special charm of this institution. The Winter Riding School, a gem of baroque architecture; the Summer Riding School, one of Vienna's quietest and unexpected spots; the Stallburg, Vienna's most significant Renaissance building with the stables of the Lipizzaners.

Date:	Monday – Sunday at 2, 3 and 4 p.m.
Venue:	Spanish Riding Scool (Spanische Hofreitschule) Michaelerplatz 1 (Besucherzentrum) 1010 Wien
Contact information:	+43-1-533 90 32 www.srs.at office@srs.at
Ticket price:	16€

Exploring Vienna by yourself – Vienna´s Inner City



A) Museumsquartier

B) Kunsthistorisches Museum (Museum of Art History)

C) Heldenplatz

D) Michaelerplatz

E) Kohlmarkt

F) Am Hof

G) Hoher Marks

H) Stephansplatz (St. Stephens Square)

I) Hotel Sacher Wien

J) Wiener Staatsoper (Vienna State Opera)

A detailed “Exploring Vienna by yourself” guide including information on the sights will be available at the registration.

Conference Office / Contact

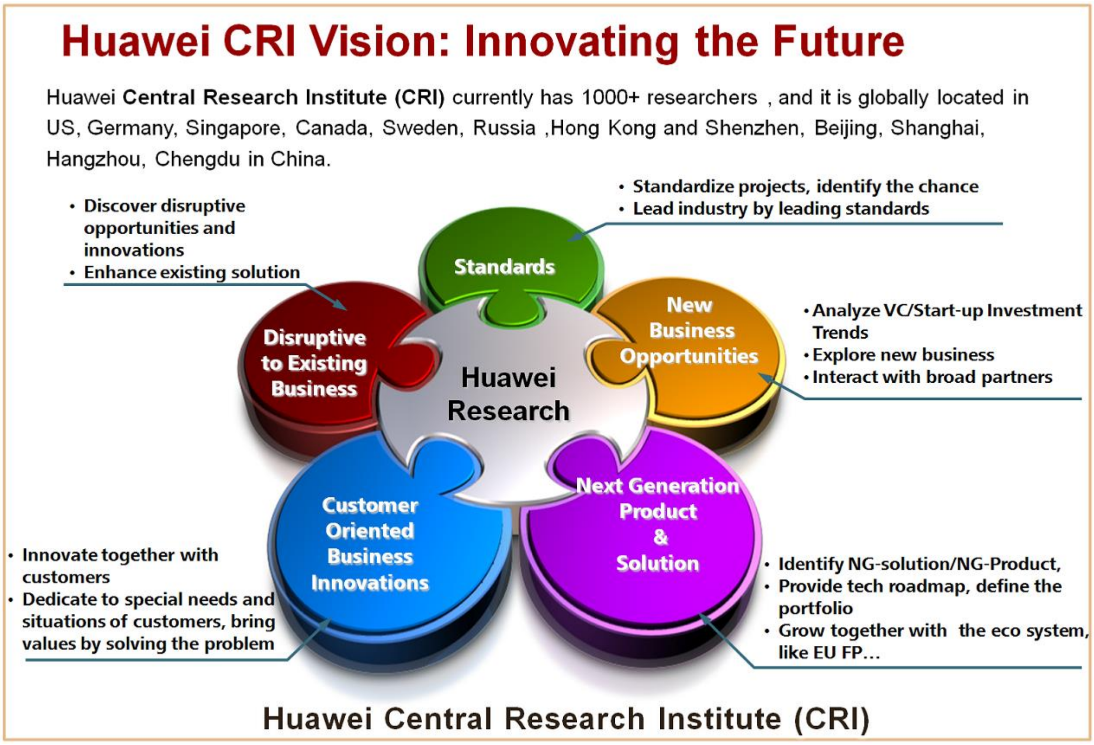
If you need any support, please do not hesitate to contact us.

Yvonne Poul
ypoul@sba-research.org
Tel: +43 699 100 41 066

Bettina Bauer
bbauer@sba-research.org
Tel: +43 664 254 03 14

Sponsors / Supporters introduce themselves

HUAWEI



Huawei CRI Vision: Innovating the Future

Huawei **Central Research Institute (CRI)** currently has 1000+ researchers , and it is globally located in US, Germany, Singapore, Canada, Sweden, Russia ,Hong Kong and Shenzhen, Beijing, Shanghai, Hangzhou, Chengdu in China.

Huawei Research
Standards
Disruptive to Existing Business
New Business Opportunities
Customer Oriented Business Innovations
Next Generation Product & Solution

- Standardize projects, identify the chance
- Lead industry by leading standards

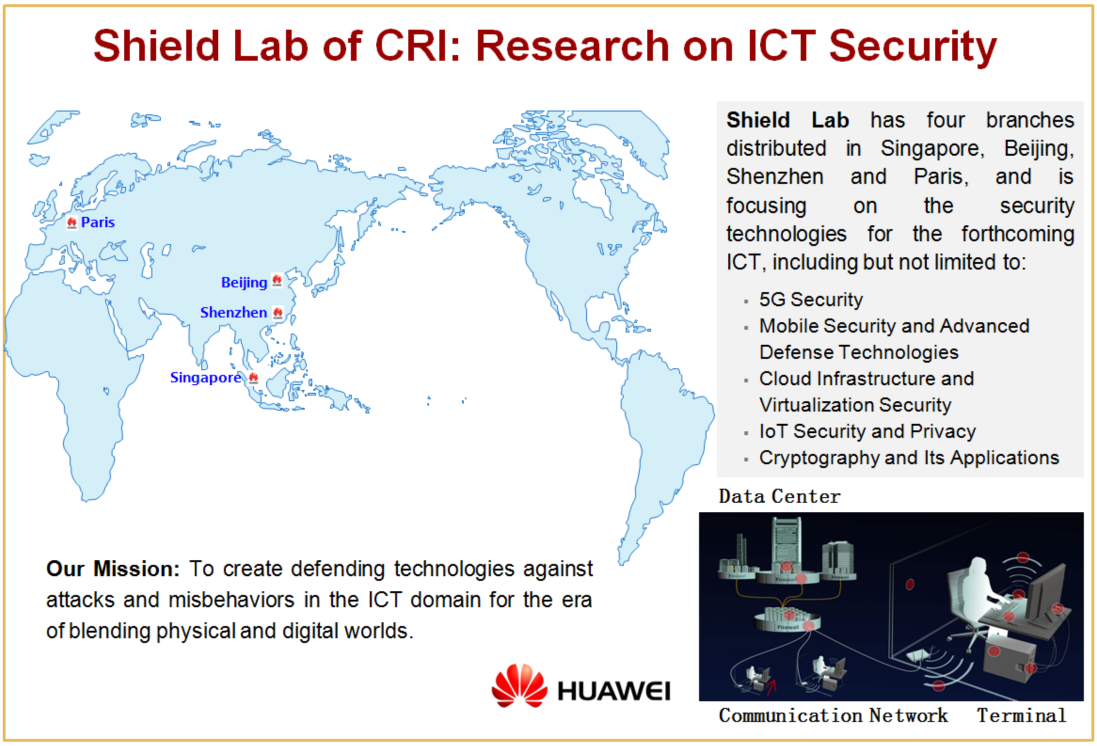
- Discover disruptive opportunities and innovations
- Enhance existing solution

- Analyze VC/Start-up Investment Trends
- Explore new business
- Interact with broad partners

- Innovate together with customers
- Dedicate to special needs and situations of customers, bring values by solving the problem

- Identify NG-solution/NG-Product,
- Provide tech roadmap, define the portfolio
- Grow together with the eco system, like EU FP…

Huawei Central Research Institute (CRI)



Shield Lab of CRI: Research on ICT Security

Shield Lab has four branches distributed in Singapore, Beijing, Shenzhen and Paris, and is focusing on the security technologies for the forthcoming ICT, including but not limited to:

- 5G Security
- Mobile Security and Advanced Defense Technologies
- Cloud Infrastructure and Virtualization Security
- IoT Security and Privacy
- Cryptography and Its Applications

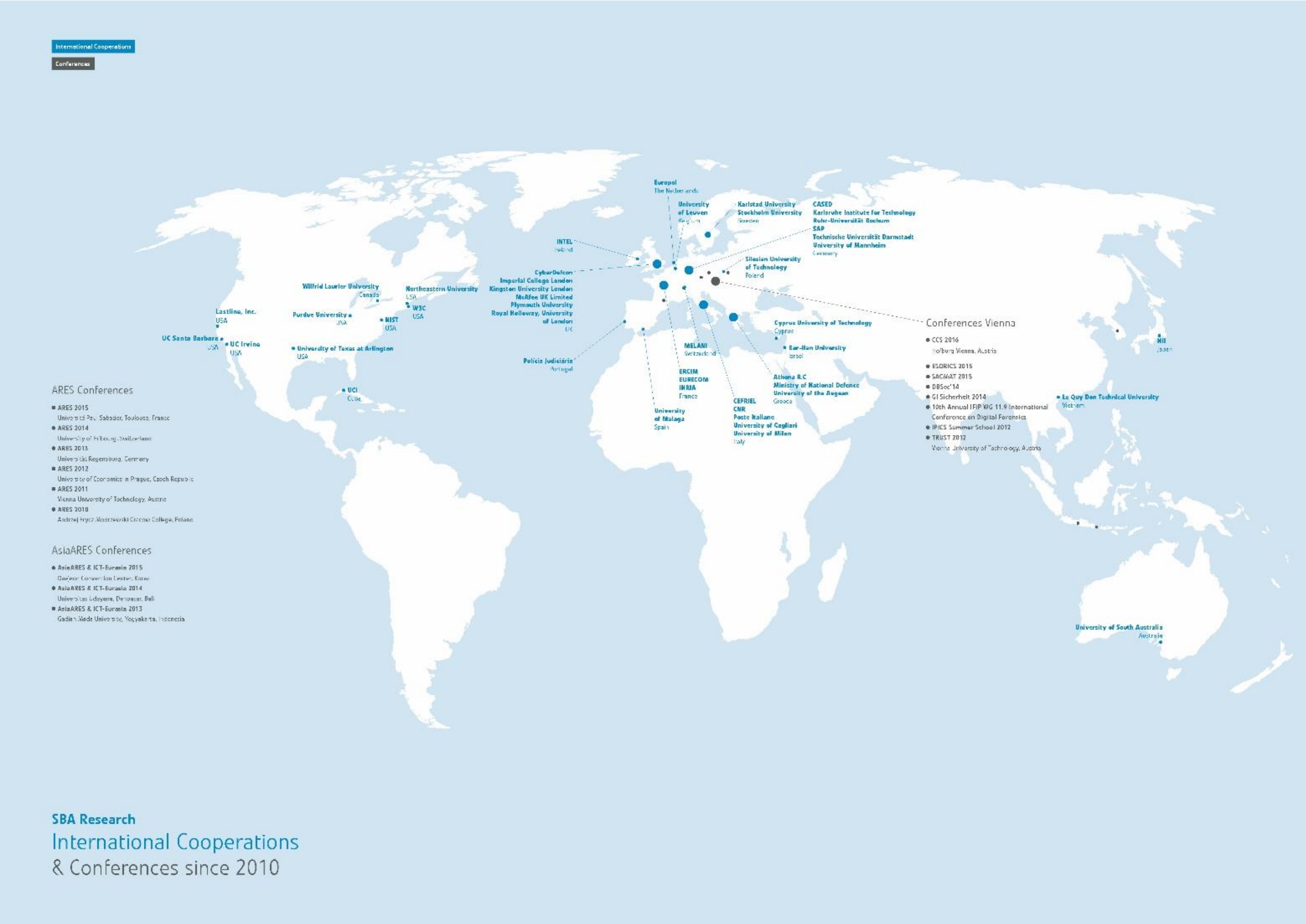
Our Mission: To create defending technologies against attacks and misbehaviors in the ICT domain for the era of blending physical and digital worlds.

HUAWEI

SBA Research

SBA Research is the research center for information security in Austria
SBA Research was founded in 2006 as the first Austrian research center for information security by the TU Wien, the Graz University of Technology and the University of Vienna. In recent years, the Vienna University of Economics and Business, the AIT Austrian Institute of Technology and the University of Applied Sciences St. Pölten joined as academic partners. Through scientific research of information security we develop practical and applicable solutions, while focusing on current issues like cyber security. SBA Research employs approx. 100 people and is by now the largest research center in Austria which exclusively addresses information security. The center is part of the Austrian COMET excellence program (COMET – Competence Centers for Excellent Technologies).

SBA Research researches and develops solutions in information security. Information security protects IT infrastructure and data against damages done by persons or events. Thereby the results of fundamental research are the basis for applied research and development.
The four research areas of SBA Research allow a comprehensive consideration of information security: AREA 1 addresses organisational security issues and the security of business processes; AREA 2 deals with data security and the protection of privacy for people, institutions and companies; AREA 3 is dedicated to software security and the prevention of cyber-attacks; AREA 4 covers the security of hardware and infrastructure.


International Cooperations
Conferences
Europol
The Netherlands
University of Leuven
Belgium
Karlstad University
Stockholm University
Sweden
CASED
Karlsruhe Institute for Technology
Ruhr-Universität Bochum
SAP
Technische Universität Darmstadt
University of Mannheim
Germany
INTEL
Ireland
Silesian University of Technology
Poland
CyberDefcon
Imperial College London
Kingston University London
McAfee UK Limited
Plymouth University
Royal Holloway, University of London
UK
Wilfrid Laurier University
Canada
Northeastern University
USA
W3C
USA
Lastline, Inc.
USA
Purdue University
USA
NIST
USA
UC Santa Barbara
USA
UC Irvine
USA
University of Texas at Arlington
USA
Polícia Judiciária
Portugal
Cyprus University of Technology
Cyprus
Bar-Ilan University
Israel
MELANI
Switzerland
ERCIM
EURECOM
INRIA
France
Athena R.C
Ministry of National Defence
University of the Aegean
Greece
University of Malaga
Spain
CEFRIEL
CNR
Poste Italiane
University of Cagliari
University of Milan
Italy
UCI
Cuba
NII
Japan
Le Quy Don Technical University
Vietnam
University of South Australia
Australia
Conferences Vienna
CCS 2016
Hofburg Vienna, Austria
ESORICS 2015
SACMAT 2015
DBSec'14
GI Sicherheit 2014
10th Annual IFIP WG 11.9 International Conference on Digital Forensics
IPICS Summer School 2012
TRUST 2012
Vienna University of Technology, Austria
ARES Conferences
ARES 2015
Université Paul Sabatier, Toulouse, France
ARES 2014
University of Fribourg, Switzerland
ARES 2013
Universität Regensburg, Germany
ARES 2012
University of Economics in Prague, Czech Republic
ARES 2011
Vienna University of Technology, Austria
ARES 2010
Andrzej Frycz Modrzewski Cracow College, Poland
AsiaARES Conferences
AsiaARES & ICT-Eurasia 2015
Daejeon Convention Center, Korea
AsiaARES & ICT-Eurasia 2014
Universitas Udayana, Denpasar, Bali
AsiaARES & ICT-Eurasia 2013
Gadjah Mada University, Yogyakarta, Indonesia
SBA Research
International Cooperations
& Conferences since 2010

www.sba-research.org

	Wednesday, Sept 23	
	LH C	LH D
08:00 - 17:00	REGISTRATION	
09:00 - 09:15	Opening Leture Hall A	
09:15 - 10:15	Keynote Session *Richard Clayton, University of Cambridge, UK* Lecture Hall A	
10:15 - 10:45	Break	
10:45 - 12:15	Session 1A: Network & Web Security	Session 1B: Cryptography I
12:15 - 13:00	Invited Talk *Afonso Ferreira, European Commission* Lecture Hall A	
13:00 - 14:30	Lunch	
14:30 - 16:00	Session 2A: System Security	Session 2B: Cryptography II
16:00 - 16:30	Break	
16:30 - 18:00	Session 3A: Risk Analysis	Session 3B: Cryptography III
18:00 - 22:00	Mayor's Reception	

	Thursday, Sept 24	
	LH C	LH D
08:00 - 17:00	REGISTRATION	
09:00 - 10:00	Keynote Session *Sushil Jajodia, George Mason University Fairfax, US* Lecture Hall A	
10.00 - 10:30	Break	
10:30 - 12:00	Session 4A: Privacy I	Session 4B: Signatures
12:00 - 13:30	Lunch	
13:30 - 15:00	Session 5A: Privacy II	Session 5B: Applied Security I
15:00 - 15:30	Break	
15:30 - 17:00	Session 6A: Cloud Security	Session 6B: Protocols & ABE
17:00 - 23:00	Conference Dinner	

	Friday, Sept 25		
	LH C	LH D	LH E
08:00 - 17:00	REGISTRATION		
09:00 - 10:30	Session 7A: Cloud Analysis & Side-Channels	Session 7B: Crypto Applications & Attacks	PhD Symposium
10:30 - 11:00	Break		
11:00 - 12:30	Session 8A: Authentication I	Session 8B: Policies	PhD Symposium
12:30 - 14:00	Lunch		
14:00 - 15:30	Session 9A: Authentication II	Session 9B: Detection & Monitoring	PhD Symposium
15:30 - 15:45	Break		
15:45 - 17:15	Session 10: Applied Security II		